Interagency Flood Risk Management (InFRM)

Watershed Hydrology Assessment for the Nueces River Basin

Appendix B:

HEC-HMS Model Development and Uniform Rainfall Frequency Results

March 2025

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1 Rainfall-Runoff Modeling in HEC-HMS

Rainfall-runoff watershed modeling is used to simulate the physical processes that occur during storm events that move water across the land surface and through the streams and rivers. While the statistical analyses of the gage records from Appendix A are a valuable means of estimating the magnitude of flood frequency flows at the gages, watershed rainfall-runoff modeling is often used to estimate the rare frequency events whose return periods exceed the gaged period of record as well as to account for non-stationary watershed conditions such as urban development, reservoir storage and regulation, and climate variability. Rainfall-runoff modeling also provides a means of estimating flood frequency flows at other locations throughout the watershed that do not coincide with a streamflow gage.

In this phase of the multi-layered hydrologic analysis, a rainfall-runoff model was developed for the Nueces River Basin with input parameters that represented the physical characteristics of the watershed. The rainfall-runoff model for the basin was completed using the basin-wide Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) model developed for USACE's 2020 Nueces Basin Corps Water Management System (CWMS) Implementation as a starting point (USACE, 2020). This model was further refined by adding additional detailed data, updating the land use, and calibrating the model to multiple recent flood events. Through calibration, the updated HEC-HMS model was verified to accurately reproduce the response of the watershed to multiple recent observed storm events, including those similar in magnitude to a 1% annual chance (100-yr) storm. Finally, frequency storms were built using the depth area analysis in HEC-HMS and the latest published frequency rainfall depths from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (NOAA, 2018). These frequency storms were run through the calibrated model, yielding consistent estimates of the 1% annual chance (100-yr) and other frequency peak flows at various locations throughout the basin.

In addition to the uniform rainfall frequency storm results presented in this appendix, the InFRM team also developed elliptical frequency storms for stream reaches with drainage areas greater than 400 square miles in the Nueces River Basin. The results from the elliptical frequency storms in HEC-HMS are presented in Appendix C: Elliptical Frequency Storms in HEC-HMS.

1.1 EXISTING HEC-HMS MODELS

The existing HEC-HMS model from the Nueces CWMS Implementation was used as the starting point for the current study. The CWMS model contained 100 subbasins in the Nueces River Basin with an average size of 165 square miles. The watershed drains into the Gulf of Mexico in Corpus Christi, Texas and totals approximately 16,675 square miles. The subbasins were delineated using the HEC-GeoHMS program and utilized terrain data in the form of a Digital Elevation Model (DEM) with a 15-meter grid cell size. The 15-meter DEM was derived from a combination of 10-meter seamless USGS National Elevation Data (NED) and limited high resolution LiDAR data where available. The vertical elevation units of the DEM was converted from meters to feet and the projection was converted to the standard USACE CWMS projection of Albers equal area. .

The Nueces CWMS HEC-HMS model used the following methods:

- Losses –Deficit and Constant
- Transform – ModClark
- Baseflow – Recession
- Routing – Modified Puls and Muskingum

• Computation Interval – 60 minutes

A map of the Nueces CWMS subbasins is shown in Figure B.1. More information on the CWMS model development is given in the final CWMS implementation report for the Nueces River Basin (USACE, 2020).

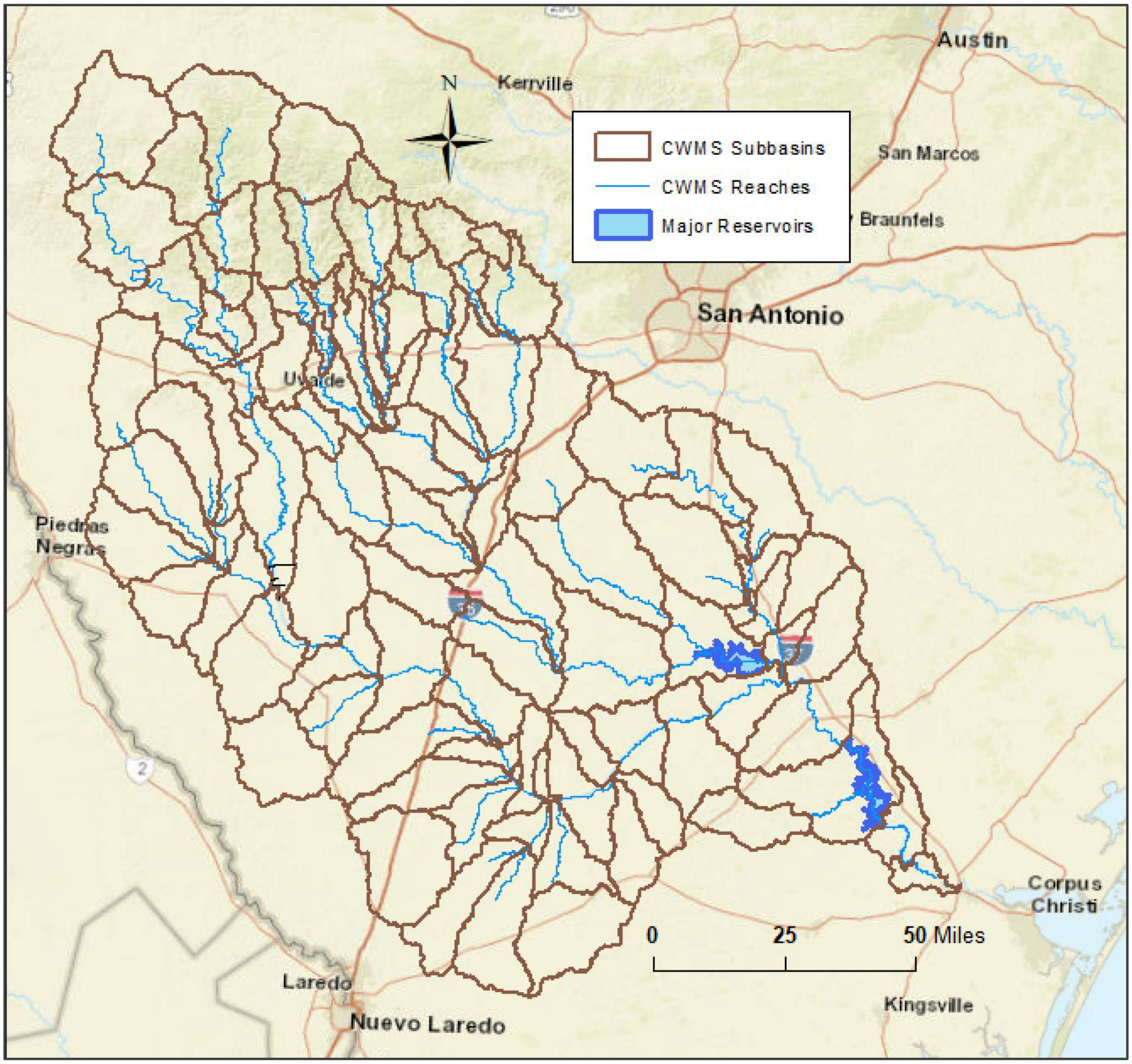


Figure B.1: Existing CWMS Subbasins for the Nueces River Basin

1.2 UPDATES TO THE HEC-HMS MODEL

To better define the hydrology of the Nueces River Basin, additional subbasin breaks were added to the original CWMS delineation in order to have better definition of the flow change locations. The number of subbasins in the basin was increased from 100 to 199, with break points primarily at major tributaries, major roads and stream gages. Figure B.2 shows the final HEC-HMS subbasin delineation for the InFRM Watershed Hydrology Assessment for the Nueces River basin. The subbasin sizes in the final HEC-HMS model varied from 2 to 282 square miles, with a mean subbasin size of 84 square miles.

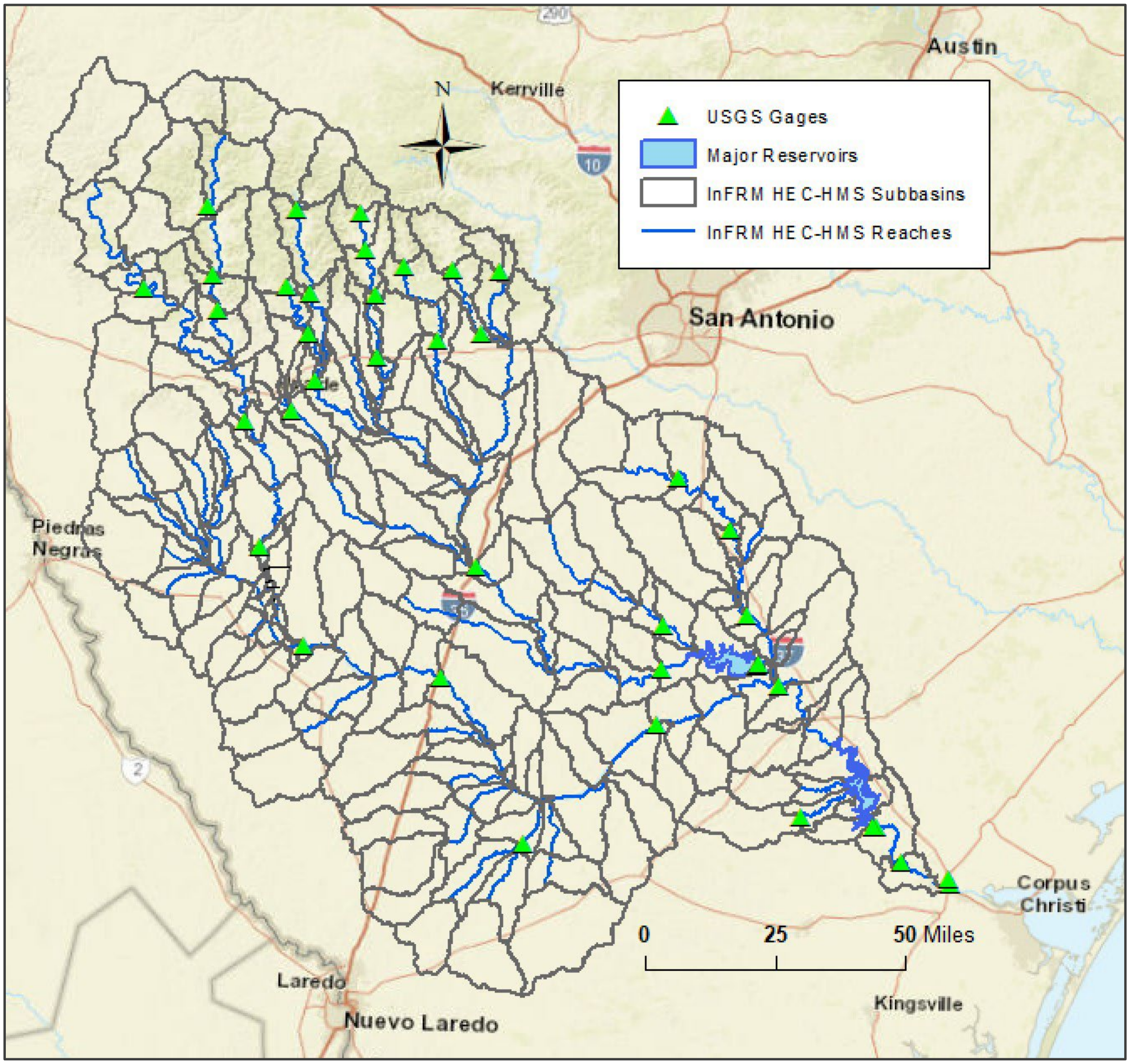


Figure B.2: Final InFRM Subbasins for the Nueces River Basin

After breaking out the additional subbasins, detailed routing data was added to the HEC-HMS model for the associated new river reaches. New detailed Modified Puls routing data was developed for portions of the basin using high resolution LiDAR elevation data and FEMA's Base Level Engineering (BLE) data, where available. The Modified-Puls routing method calculates the change in flow through the reach based on the volume of floodplain storage through that reach. The new detailed Modified Puls routing data was used to replace the existing Muskingum routing data.

During the CWMS implementation, the CWMS team noted that they were unable to correctly delineate or calibrate a split flow area on the Nueces River near Crystal City, Texas. In this area, the Nueces River at Crystal City splits into two rivers: the Nueces River and Espantosa Slough. Espantosa Slough merges with Turkey Creek to form Soldier Slough. Soldier Slough reconnects with the Nueces River approximately 20 miles downstream near Asherton, Texas. In addition, there are several small irrigation dams and irrigation diversion channel located along these split flow reaches. Therefore, special attention was paid to this area in the development of the InFRM HEC-HMS model. First, the terrain was reconditioned during the HEC-GeoHMS process to correctly delineate both flow paths and their associated subbasins. Second, a new 2D HEC-RAS model of the split flow area was developed from the BLE LiDAR terrain data. The new 2D HEC-RAS model was used to calculate an inflow-diversion curve at the split flow location, which was input into HEC-HMS as a Diversion element, as well as to calculate the Modified Puls storage-discharge relationships along each reach of the split flow paths. The diversion and split flow reaches were then calibrated to the observed hydrographs at Asherton, as will be described in a later section of this appendix.

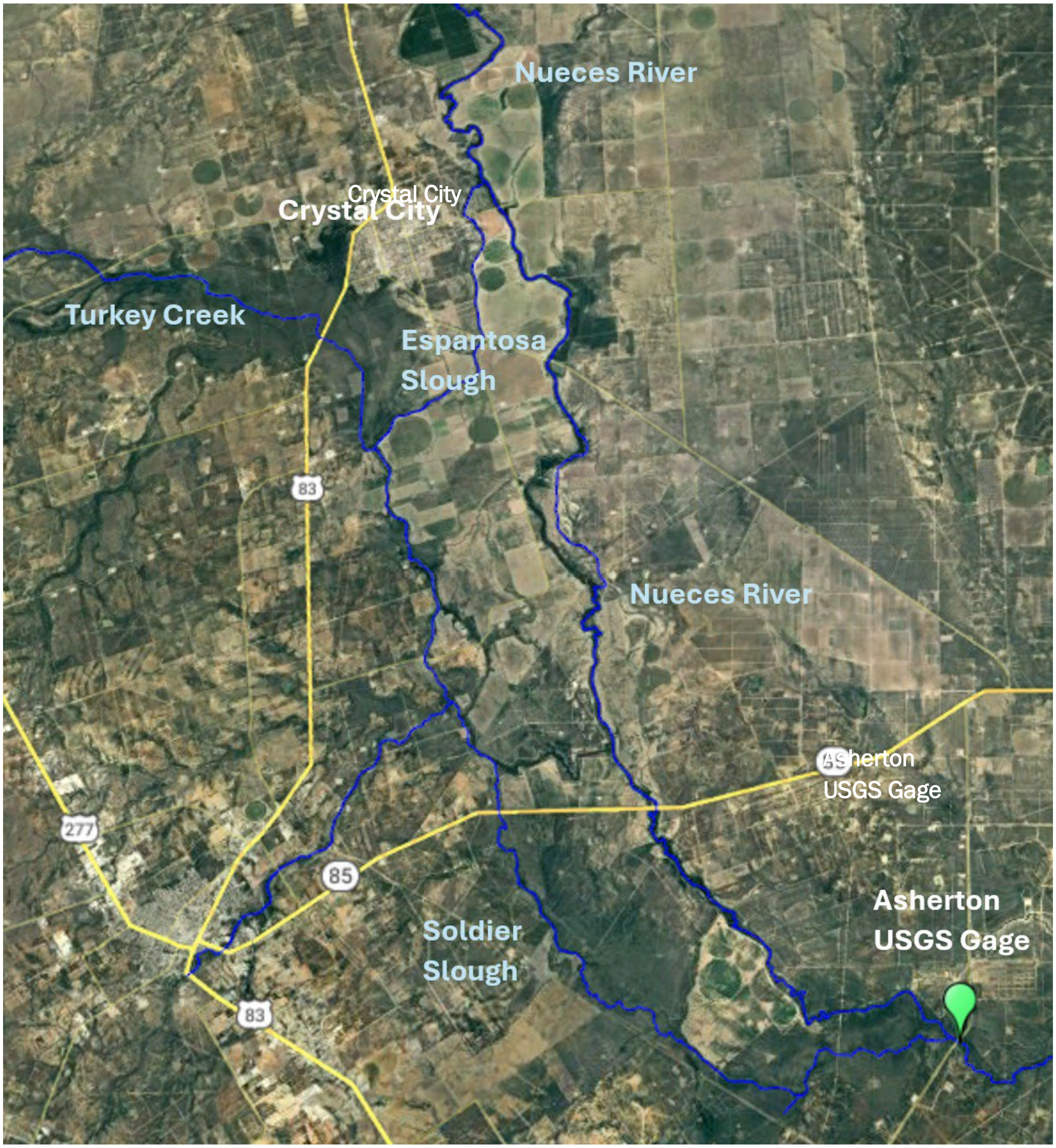


Figure B.3: Split Flow Area on the Nueces River between Crystal City and Asherton, TX

Thirdly, the channel loss data was updated for the HEC-HMS reaches in areas where the reaches cross the aquifer outcrops and where routing losses have been observed in the USGS stream gage data. There are several major aquifers within this watershed that divert flow from surface water to groundwater. Part of the flow of the Nueces River and its headwater tributaries enters the Carrizo and Edwards aquifers and their associated limestones in the Balcones Fault Zone. After entering these aquifers, water moves slowly toward lower lying places and eventually is discharged from the aquifer from springs, seeps into streams, or is withdrawn from the ground by wells. A map of the major aquifers in the Nueces River Basin is shown in Figure B.4. For these reaches, the constant channel loss method was applied in HEC-HMS which diverts a constant baseflow into the ground as well as a fraction of the overall inflow hydrograph. More information on the development and calibration of these channel losses is included in later sections of this appendix.

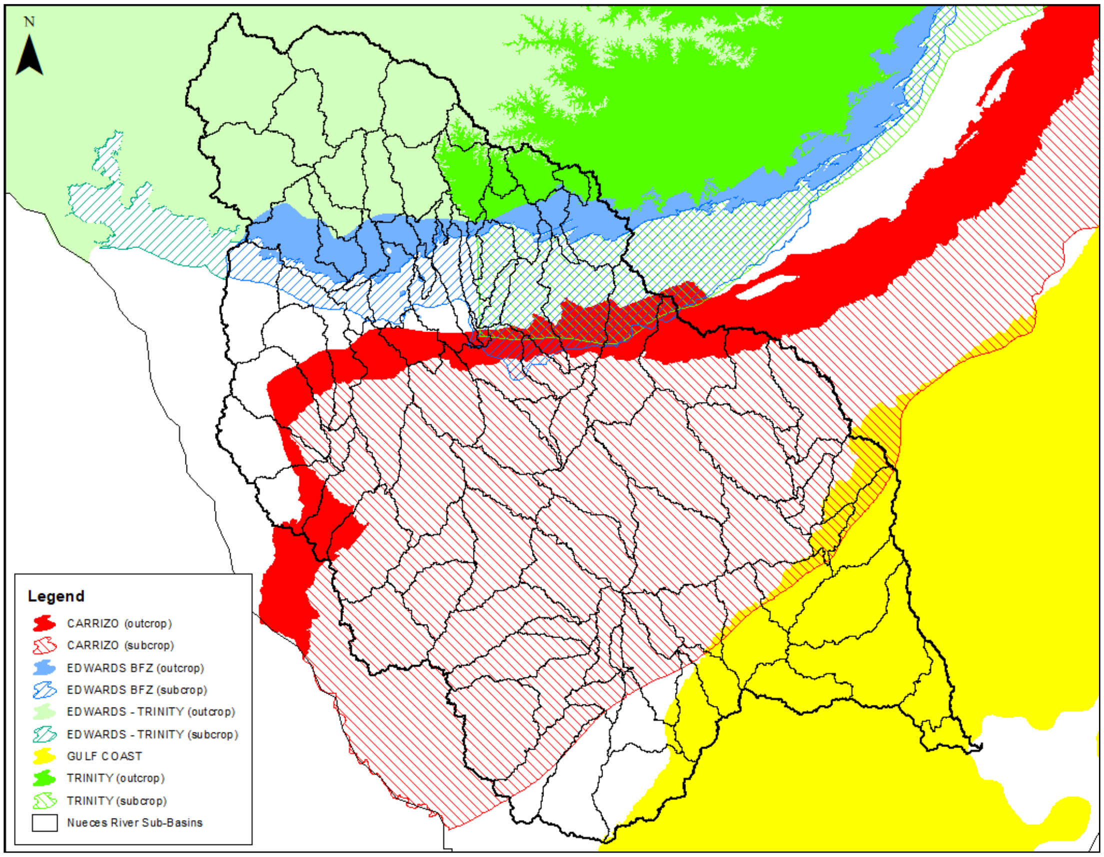


Figure B.4: Major Aquifers in the Nueces River Watershed.

Finally, after adding all of the above detailed data, the loss method was updated from deficit constant to initial and constant, since the focus of this study is on single storm events, whereas the original CWMS model was used for multi-storm event real-time forecasting. Both of these methods have been found to adequately capture the range of observed losses experienced in Texas from extreme drought to 100% saturated soil conditions and are also simple to adjust for real-time forecasting purposes.

The computation interval of the model was also decreased from 60 to 15 minutes to show more refinement of the hydrographs on the smaller tributaries. The final Nueces HEC-HMS model was run in HEC-HMS version 4.6.1 and used the following methods:

- Losses – Initial and Constant
- Transform – Snyder
- Baseflow – Recession
- Routing – Modified Puls and Muskingum
- Computation Interval – 15 minutes

The Nueces HEC-HMS model also includes two significant reservoirs, which were modeled as reservoir elements in HEC-HMS. These reservoirs are Choke Canyon Reservoir and Lake Corpus Christi. While the National Inventory of Dams (NID) shows that over 400 small dams exist within Nueces River basin, these two reservoirs were selected to be modeled in detail due to their sizable flood storage and their noticeable influence on discharges in the major rivers downstream.

1.3 HEC-HMS MODEL INITIAL PARAMETERS

1.3.1 Subbasin and Routing Initial Parameters

The Nueces River HEC-HMS model contains 199 subbasins totaling about 16,675 square miles on the Nueces River. The subbasins were delineated using the HEC-GeoHMS program and utilized 15-meter DEM terrain data. The Nueces River HEC-HMS model used initial and constant losses, Snyder transform, recession baseflows, and Modified Puls / Muskingum routing. The sources of the initial estimates for these parameters are described below.

- **Initial Loss and Constant Loss Rate** – For calibration, the initial and constant losses were initially set to a moderate loss of 2 inches of initial loss, and the constant losses were calculated from the SSURGO soils data based on their Hydrologic Soil Group and the guidance included in the HEC-HMS technical reference manual. The initial and constant losses were then adjusted according to the antecedent conditions of particular storm events during calibration. The calibrated initial and constant losses varied for each calibration event based on the soil moisture condition. For the frequency storms, the initial and constant loss rates were calculated based on the SSURGO soil type, according to the Fort Worth District Loss Rate equations, which vary the loss rates by frequency.

- **Percent Impervious** – The percent impervious values were developed based on the 2016 National Land Cover Database (NLCD) percent developed impervious dataset, which was the latest dataset that was available at be beginning of this study and was adjusted to account for Open Water surface in the river basin.

- **Snyder's Transform Parameters** – Transform parameters were initially developed from regional equations for the Snyder's unit hydrograph method based on watershed characteristics such as length of longest flow path and stream slope that were extracted from ArcGIS. From this data, two regional equations were used to develop initial estimates of lag time for the Snyder unit hydrographs.

The regional equations that were used to develop initial estimates of lag time for the Snyder unit hydrograph was from the U.S. Army Corps of Engineers (USACE) Fort Worth District San Antonio Steep-Area (Upper Salado) and San Antonio Rolling – and Flatter-Area (Lower Salado) urban studies (Nelson, 1979) (Rodman, 1977). These equations estimate subbasin lag time based on the length and slope of the watershed, and the percent urban values taken from land cover data. The San Antonio Steep-Area equation was used for subbasins with mean percent rise in slope greater than 6 percent. The remaining subbasins used the San Antonio Rolling–and Flatter-Area equation.

The following San Antonio Steep-Area regional equation was used to calculate subbasin lag times for steep subbasins:

$$\log(Top) = .36\log(L*Lca/(S \wedge .5)) + \log(.29) - (BW*PercentUrban./100)$$

where: Tp = Snyder's lag time (hours)

L = longest flow path within the subbasin (miles)

Lca = distance along the stream from the subbasin centroid to outlet (miles)

S = stream slope over reach between 0% and 100% of L (feet per feet)

BW = log(tp) bandwidth between 0% and 100% urbanization = 0.30 (log hours)

Urban. = percentage urbanization factor

The following San Antonio Rolling-and Flatter-Area regional equation was used to calculate subbasin lag times for flatter subbasins:

log (Tp) = .367log (L*Lca/(S ^ .5))+log(.51)-(BW*PercentUrban./100)

where: Tp = Snyder's lag time (hours)

L = longest flow path within the subbasin (miles)

Lca = distance along the stream from the subbasin centroid to outlet (miles)

S = stream slope over reach between 0% and 100% of L (feet per feet)

BW = log(tp) bandwidth between 0% and 100% urbanization = 0.32 (log hours)

Urban. = percentage urbanization factor

The Snyder's peaking coefficients for steep subbasins were set to a value of 0.86 for subbasins with mean percent rise in slope greater than 15 percent and a value of 0.78 for subbasins with mean percent rise in slope greater than 6 percent but less than 15 percent. The Snyder's peaking coefficients for flatter subbasins were set to a value of 0.70 for subbasins with mean percent rise in slope less than 6 percent.

- **Baseflow Parameters** – Initial baseflow parameters were taken from the existing USACE Nueces CWMS HEC-HMS model. For the entire watershed, the recession baseflows were set at 0.1 cfs/square mile of initial baseflow, 0.7 for the recession constant, and 0.1 for the ratio to peak. These values were later adjusted during calibration.

- **Routing Parameters (Modified Puls)** – Storage-discharge curves for the Modified Puls routing were extracted from new or existing 1D and 2D hydraulic routing models in HEC-RAS, which were developed from the available LiDAR data. The existing 1D HEC-RAS models that were available for the basin included the CWMS HEC-RAS model and FEMA's BLE HEC-RAS models. New 2D HEC-RAS models were also developed from the LiDAR data for key locations in watershed, including the split flow area above Asherton and the reaches of the Nueces and Frio Rivers where the stream reaches suddenly transition from steep hilly reaches to wide irrigated floodplains. Initial subreach values were estimated based on the reach length and an average travel time through the reach.

- **Routing Parameters (Muskingum)** – Muskingum routing parameters were calculated from basin geometry and adjusted to fall within the feasible range described by the HEC-HMS Technical Reference Manual. Muskingum K was estimated, as recommended by EM 1110-2-1417, by dividing the flood wave velocity from the length of the reach. The flood wave velocity was estimated to be 1.5 times the average velocity, which was 1 mph for the entire basin. Muskingum X values range between 0.0 and 0.5 and was estimated to be equivalent to the slope. Number of subreaches was initially set to equal the Muskingum K in hours. Parameters were adjusted during calibration to best represent attenuation while remaining in a feasible range of values.

The initial subbasin and routing parameters that were entered into the HEC-HMS model are shown in Tables B.1 through B.4. Some of these parameters were adjusted during calibration.

Table B.1: Subbasin Area, Percent Impervious and Initial Loss Rates

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
Atascosa_S010	154.495	1.05	2	0.34
Atascosa_S011	160.626	1.39	2	0.24
Atascosa_S020	136.19	3.01	2	0.3
Atascosa_S030	59.56	1.33	2	0.18
Atascosa_S031	25.0916	1.92	2	0.23
Atascosa_S040	142.92	0.8	2	0.2
Atascosa_S041	78.267	1.28	2	0.11
Atascosa_S050	56.02	1.72	2	0.15
Atascosa_S060	21.1962	1.47	2	0.11
Atascosa_S070	79.506	2.36	2	0.12
Atascosa_S071	139.128	2.45	2	0.09
Atascosa_S080	31.2048	1.98	2	0.17
ChokeCanyon_S010	116.197	21.33	2	0.13
CorpusChristi_S010	56	28.19	2	0.21
CorpusChristi_S011	48.286	7.19	2	0.25
FrioRv_D_S010	124.545	0.18	2	0.11
FrioRv_D_S020	51.552	0.13	2	0.14
FrioRv_D_S030	11.0757	0.74	2	0.26
FrioRv_Sab_S060	12.629	0.1	2	0.23
FrioRv_S010	138.379	0.26	2	0.12
FrioRv_S011	96.676	0.22	2	0.11
FrioRv_S020	154.584	0.43	2	0.16
FrioRv_S030	51.927	0.36	2	0.18
FrioRv_S040	4.317	0.7	2	0.32
FrioRv_S051	112.761	0.57	2	0.23
FrioRv_S070	72.383	0.38	2	0.24
FrioRv_S071	88.665	0.21	2	0.22
FrioRv_S072	14.5773	0.22	2	0.26
FrioRv_S080	54.201	0.14	2	0.2
FrioRv_S090	102.39	2.72	2	0.24
FrioRv_S100	53.124	0.51	2	0.26
FrioRv_S101	152.661	0.91	2	0.24
FrioRv_S102	44.61	0.63	2	0.21
FrioRv_S110	56.479	1.29	2	0.23
FrioRv_S111	98.73	1.35	2	0.13

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
FrioRv_S112	89.603	1.2	2	0.07
FrioRv_S113	58.525	1.97	2	0.1
FrioRv_S114	66.56	2.19	2	0.11
FrioRv_S120	56.649	2.55	2	0.14
FrioRv_S130	5.907	1.65	2	0.18
FrioRv_S140	19.1402	3.83	2	0.17
F_BlancoCk_S010	64.51	0.11	2	0.15
F_BlancoCk_S020	69.081	0.16	2	0.2
F_CiboloCk_S010	83.213	0.24	2	0.24
F_CiboloCk_S011	91.201	0.35	2	0.26
F_CiboloCk_S020	220.341	1.12	2	0.17
F_HondoCk_S010	96.07	0.33	2	0.12
F_HondoCk_S020	60.375	0.1	2	0.14
F_HondoCk_S021	4.3104	0.37	2	0.29
F_HondoCk_S030	142.008	1.23	2	0.19
F_HondoCk_S031	144.232	0.27	2	0.21
F_HondoCk_S040	86.865	0.2	2	0.22
F_LeonaRv_S010	49.668	2.21	2	0.16
F_LeonaRv_S011	18.9453	3.61	2	0.17
F_LeonaRv_S012	34.0071	2.91	2	0.14
F_LeonaRv_S020	28.5272	2.25	2	0.2
F_LeonaRv_S021	64.888	0.27	2	0.21
F_LeonaRv_S022	37.9824	0.61	2	0.18
F_LeonaRv_S023	6.9691	0.17	2	0.24
F_LeonaRv_S030	139.421	0.47	2	0.22
F_LeonaRv_S031	80.332	0.15	2	0.19
F_LeonaRv_S040	124.479	0.2	2	0.19
F_LeonaRv_S041	75.525	0.24	2	0.24
F_LeonaRv_S042	9.3313	0.08	2	0.25
F_MVerdeCk_S010	38.9	0.2	2	0.14
F_MVerdeCk_S011	18.6383	0.17	2	0.1
F_MVerdeCk_S020	75.923	0.15	2	0.14
F_MVerdeCk_S021	85.587	0.23	2	0.1
F_SabinalRv_S010	55.749	0.22	2	0.1
F_SabinalRv_S020	73.788	0.26	2	0.15

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
F_SabinalRv_S021	76.386	0.27	2	0.14
F_SabinalRv_S030	34.6353	0.47	2	0.2
F_SabinalRv_S040	13.7927	0.34	2	0.26
F_SabinalRv_S041	79.641	0.24	2	0.14
F_SabinalRv_S050	64.479	0.16	2	0.18
F_SabinalRv_S055	48.108	1.51	2	0.21
F_SanMigCk_S010	221.572	1.53	2	0.19
F_SanMigCk_S011	126.962	0.72	2	0.2
F_SanMigCk_S020	168.24	0.4	2	0.24
F_SanMigCk_S021	166.839	0.68	2	0.17
F_SanMigCk_S022	57.823	1.1	2	0.12
F_SanMigCk_S023	40.714	1.74	2	0.17
F_SanMigCk_S024	72.649	1.71	2	0.19
F_SecoCk_S010	45.047	0.12	2	0.09
F_SecoCk_S020	86.896	0.08	2	0.12
F_SecoCk_S021	33.2067	0.15	2	0.16
F_SecoCk_S030	102.093	0.88	2	0.18
F_SecoCk_S031	86.703	0.75	2	0.18
La_ParitaCk_S010	211.677	1.49	2	0.13
La_ParitaCk_S020	79.719	1.16	2	0.13
La_ParitaCk_S030	20.0074	1.71	2	0.13
NuecesRv_S010	96.228	0.26	2	0.1
NuecesRv_S011	103.703	0.25	2	0.11
NuecesRv_S012	154.406	0.35	2	0.16
NuecesRv_S020	175.487	0.28	2	0.13
NuecesRv_S030	129.8	0.6	2	0.17
NuecesRv_S040	56.938	0.4	2	0.16
NuecesRv_S041	19.6128	0.27	2	0.11
NuecesRv_S050	79.761	0.44	2	0.18
NuecesRv_S060	2.34194	0.33	2	0.32
NuecesRv_S061	65.495	0.09	2	0.16
NuecesRv_S070	35.9836	0.37	2	0.23
NuecesRv_S071	23.4125	0.82	2	0.26
NuecesRv_S080	24.0005	0.88	2	0.26
NuecesRv_S081	95.661	0.49	2	0.25

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
NuecesRv_S082	121.367	1.15	2	0.25
NuecesRv_S083	20.2831	0.46	2	0.27
NuecesRv_S084	42.483	0.64	2	0.27
NuecesRv_S090	12.3846	0.71	2	0.25
NuecesRv_S100	188.819	0.59	2	0.21
NuecesRv_S101	119.53	0.5	2	0.21
NuecesRv_S110	78.151	1.76	2	0.15
NuecesRv_S111	77.263	0.62	2	0.22
NuecesRv_S120	82.182	0.19	2	0.26
NuecesRv_S121	98.564	0.3	2	0.26
NuecesRv_S122	87.776	0.73	2	0.25
NuecesRv_S130	194.005	1.32	2	0.18
NuecesRv_S140	66.703	0.69	2	0.15
NuecesRv_S150	7.4468	0.68	2	0.15
NuecesRv_S151	52.433	0.52	2	0.07
NuecesRv_S160	65.912	1.13	2	0.11
NuecesRv_S161	25.4901	0.55	2	0.05
NuecesRv_S170	25.1723	2.97	2	0.12
NuecesRv_S180	179.939	0.85	2	0.15
NuecesRv_S185	143.406	1.13	2	0.25
NuecesRv_S190	103.259	0.54	2	0.27
NuecesRv_S200	85.371	1.35	2	0.08
NuecesRv_S210	162.75	0.86	2	0.14
NuecesRv_S220	77.07	1.03	2	0.27
NuecesRv_S221	92.931	1.69	2	0.19
NuecesRv_S222	78.217	0.43	2	0.26
NuecesRv_S230	110.912	0.82	2	0.23
NuecesRv_S231	54.452	1.23	2	0.25
NuecesRv_S240	188.576	1.58	2	0.22
NuecesRv_S250	95.95	1.53	2	0.27
NuecesRv_S260	17.9619	3.66	2	0.25
NuecesRv_S261	100.564	0.92	2	0.27
NuecesRv_S270	88.081	1.52	2	0.26
NuecesRv_S290	154.676	6.03	2	0.24
NuecesRv_S300	115.499	1.6	2	0.18

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
NuecesRv_S310	57.703	3.98	2	0.23
NuecesRv_W_S010	254.418	0.22	2	0.11
NuecesRv_W_S011	119.074	0.14	2	0.1
NuecesRv_W_S020	162.46	0.17	2	0.1
NuecesRv_W_S021	110.452	0.06	2	0.08
NuecesRv_W_S022	47.537	0.38	2	0.13
NuecesRv_W_S030	73.973	0.21	2	0.14
NuecesRv_W_S031	52.309	0.34	2	0.12
NuecesRv_W_S032	98.062	0.1	2	0.2
N_BlackCk_S010	282.58	0.51	2	0.24
N_BlackCk_S020	91.263	1	2	0.21
N_BlackCk_S021	49.626	0.76	2	0.21
N_CalmanCk_S010	115.031	0.65	2	0.24
N_CalmanCk_S011	70.487	0.64	2	0.13
N_ChaconCk_S010	254.901	0.49	2	0.2
N_ChaconCk_S020	82.649	0.64	2	0.18
N_ChaconCk_S021	69.981	0.69	2	0.17
N_ChaconCk_S022	61.552	0.58	2	0.19
N_ChaconCk_S023	51.255	0.24	2	0.21
N_ChapCk_S010	132.773	0.52	2	0.2
N_ChapCk_S011	71.773	0.33	2	0.22
N_LagartoCk_S010	155.279	0.48	2	0.27
N_LagartoCk_S020	46.587	1.48	2	0.27
N_LaRaicesCk_S010	175.31	0.39	2	0.25
N_LaRaicesCk_S011	96.811	0.67	2	0.22
N_LosOlmosCk_S010	94.39	0.42	2	0.26
N_LosOlmosCk_S011	137.479	0.44	2	0.22
N_LosOlmosCk_S012	90.699	0.53	2	0.12
N_LosOlmosCk_S020	80.525	0.36	2	0.08
N_PicosaCk_S010	190.279	0.75	2	0.12
N_PicosaCk_S011	34.143	0.27	2	0.2
N_PicosaCk_S020	78.178	0.57	2	0.21
N_PicosaCk_S021	94.572	0.36	2	0.22
N_SanCasCk_S010	170.001	1.39	2	0.19
N_SanCasCk_S011	95.027	1.12	2	0.08

HEC-HMS Subbasin Name	Subbasin Area	Percent Impervious	Initial Loss	Constant Loss
	(sq mi)	%	(in)	(in/hr)
N_SanCasCk_S020	105.24	0.67	2	0.08
N_SanCasCk_S021	97.383	0.44	2	0.08
N_SanCasCk_S030	69.684	0.43	2	0.09
N_SanRoqCk_S010	158.545	0.77	2	0.08
N_SanRoqCk_S011	97.224	1.01	2	0.1
N_SanRoqCk_S020	78.143	0.84	2	0.13
N_SanRoqCk_S021	81.564	1.18	2	0.14
N_TurkeyCk_S010	111.927	0.51	2	0.17
N_TurkeyCk_S011	58.587	0.33	2	0.25
N_TurkeyCk_S012	39.529	0.53	2	0.23
N_TurkeyCk_S020	44.514	0.43	2	0.19
N_TurkeyCk_S030	89.425	1.86	2	0.17
N_TurkeyCk_S031	88.946	0.35	2	0.18
N_TurkeyCk_S040	8.5707	7.83	2	0.22
N_TurkeyCk_S050	12.6267	1.63	2	0.27
N_TurkeyCk_S060	49.734	0.48	2	0.17
N_TurkeyCk_S061	31.5129	5.02	2	0.21
N_TurkeyCk_S070	25.1063	1.15	2	0.25
N_TurkeyCk_S080	30.4028	1.13	2	0.19
N_TurkeyCk_S081	117.854	1.4	2	0.12
N_TurkeyCk_S090	10.9672	0.55	2	0.19
RamirenaCk_S010	81.016	0.72	2	0.27
RamirenaCk_S020	38.582	0.65	2	0.25
TurkeyCk_S041	5.2757	1.92	2	0.27

Table B.2: Initial Estimates of Subbasin Transform Parameters

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
Atascosa_S010	31.165	15.629	0.0020	1.03	2.48	15.31	0.7
Atascosa_S011	28.118	11.015	0.0019	1.24	2.30	13.1	0.7
Atascosa_S020	25.989	9.507	0.0033	3.05	2.35	10.72	0.7
Atascosa_S030	19.885	10.754	0.0022	0.97	2.32	11.19	0.7
Atascosa_S031	14.544	7.491	0.0024	1.78	2.08	8.54	0.7
Atascosa_S040	30.169	14.924	0.0020	0.56	1.80	14.91	0.7
Atascosa_S041	22.364	11.034	0.0022	0.87	2.08	11.81	0.7
Atascosa_S050	24.114	11.662	0.0027	1.31	2.54	11.88	0.7
Atascosa_S060	8.720	3.898	0.0053	1.22	3.56	4.82	0.7
Atascosa_S070	25.250	12.042	0.0025	2.03	2.33	12.3	0.7
Atascosa_S071	30.716	18.128	0.0024	1.98	2.13	15.52	0.7
Atascosa_S080	15.517	6.897	0.0030	1.91	2.43	8.13	0.7
ChokeCanyon_S010	23.226	10.498	0.0021	0.89	2.06	11.8	0.7
CorpusChristi_S010	16.091	6.021	0.0016	2.55	1.92	8.71	0.7
CorpusChristi_S011	23.045	11.611	0.0025	1.00	2.56	11.82	0.7
FrioRv_D_S010	37.131	15.717	0.0052	0.04	20.00	7.39	0.86
FrioRv_D_S020	20.827	12.975	0.0068	0.09	13.24	5.34	0.78
FrioRv_D_S030	11.720	5.585	0.0040	0.48	2.88	6.5	0.7
FrioRv_Sab_S060	12.470	5.690	0.0039	0.05	4.22	6.75	0.7
FrioRv_S010	29.636	14.647	0.0055	0.19	18.72	6.59	0.86
FrioRv_S011	25.233	11.204	0.0062	0.15	19.95	5.52	0.86
FrioRv_S020	33.112	18.199	0.0062	0.40	21.94	7.23	0.86
FrioRv_S030	30.956	17.057	0.0066	0.32	11.82	6.83	0.78
FrioRv_S040	6.241	2.309	0.0048	0.20	3.08	3.62	0.7
FrioRv_S051	40.905	21.390	0.0021	0.52	2.03	18.91	0.7
FrioRv_S070	29.920	17.239	0.0020	0.12	2.54	15.78	0.7
FrioRv_S071	26.738	12.836	0.0024	0.15	1.99	13.14	0.7
FrioRv_S072	10.878	4.471	0.0031	0.37	1.27	6.1	0.7
FrioRv_S080	24.919	15.415	0.0025	0.06	2.41	13.55	0.7
FrioRv_S090	34.210	16.117	0.0019	2.85	1.39	15.92	0.7
FrioRv_S100	13.916	5.166	0.0042	0.57	2.10	6.66	0.7
FrioRv_S101	29.568	13.201	0.0018	0.95	1.55	14.39	0.7
FrioRv_S102	23.764	13.281	0.0018	0.58	1.42	13.38	0.7
FrioRv_S110	15.386	7.590	0.0014	1.17	1.07	9.74	0.7

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
FrioRv_S111	26.153	13.291	0.0020	0.85	1.16	13.59	0.7
FrioRv_S112	21.909	8.548	0.0021	0.74	1.61	10.74	0.7
FrioRv_S113	23.354	10.994	0.0013	1.53	1.80	13	0.7
FrioRv_S114	19.637	9.510	0.0025	1.13	2.06	10.38	0.7
FrioRv_S120	15.854	7.208	0.0026	1.84	2.46	8.52	0.7
FrioRv_S130	7.648	3.972	0.0051	1.28	3.60	4.67	0.7
FrioRv_S140	16.677	9.567	0.0026	3.80	1.96	9.5	0.7
F_BlancoCk_S010	30.402	13.402	0.0074	0.18	10.60	6.09	0.78
F_BlancoCk_S020	33.074	18.043	0.0030	0.23	1.47	15.42	0.7
F_CiboloCk_S010	19.487	8.826	0.0023	0.09	1.00	10.29	0.7
F_CiboloCk_S011	16.816	6.053	0.0021	0.40	1.15	8.57	0.7
F_CiboloCk_S020	33.514	13.959	0.0017	1.02	1.29	15.54	0.7
F_HondoCk_S010	19.624	7.979	0.0102	0.15	16.99	4.08	0.86
F_HondoCk_S020	27.512	15.552	0.0055	0.17	7.19	6.54	0.78
F_HondoCk_S021	6.303	3.285	0.0048	0.51	2.14	4.12	0.7
F_HondoCk_S030	31.533	11.320	0.0027	1.32	2.04	12.93	0.7
F_HondoCk_S031	25.506	10.789	0.0030	0.27	2.42	11.59	0.7
F_HondoCk_S040	21.888	7.945	0.0026	0.31	1.82	10.08	0.7
F_LeonaRv_S010	25.256	13.590	0.0064	2.34	4.48	10.79	0.7
F_LeonaRv_S011	16.012	8.807	0.0029	4.05	1.67	8.88	0.7
F_LeonaRv_S012	16.925	8.699	0.0033	3.02	1.67	8.91	0.7
F_LeonaRv_S020	12.727	6.081	0.0018	2.46	1.21	7.85	0.7
F_LeonaRv_S021	22.342	11.460	0.0022	0.28	2.03	12.01	0.7
F_LeonaRv_S022	22.012	11.380	0.0020	0.42	1.51	12.06	0.7
F_LeonaRv_S023	7.880	3.788	0.0048	0.13	1.61	4.71	0.7
F_LeonaRv_S030	30.873	14.832	0.0022	0.31	1.21	14.76	0.7
F_LeonaRv_S031	28.874	15.777	0.0020	0.07	1.80	15.09	0.7
F_LeonaRv_S040	34.461	20.714	0.0021	0.16	2.25	17.55	0.7
F_LeonaRv_S041	18.674	9.135	0.0025	0.23	1.40	10.08	0.7
F_LeonaRv_S042	5.688	2.280	0.0016	0.10	2.04	4.24	0.7
F_MVerdeCk_S010	15.185	8.214	0.0098	0.09	14.56	3.79	0.78
F_MVerdeCk_S011	12.594	5.542	0.0116	0.17	11.56	2.98	0.78
F_MVerdeCk_S020	26.601	14.515	0.0062	0.22	5.27	11.53	0.7
F_MVerdeCk_S021	20.653	9.410	0.0065	0.24	4.33	8.86	0.7
F_SabinalRv_S010	15.097	5.583	0.0100	0.20	28.03	3.27	0.86

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
F_SabinalRv_S020	18.841	7.876	0.0096	0.24	17.58	4.04	0.86
F_SabinalRv_S021	26.409	11.525	0.0082	0.34	13.63	5.38	0.78
F_SabinalRv_S030	23.985	12.812	0.0077	0.52	5.59	10.15	0.7
F_SabinalRv_S040	7.238	2.512	0.0039	0.39	1.99	4.09	0.7
F_SabinalRv_S041	22.902	12.995	0.0029	0.31	2.52	12.03	0.7
F_SabinalRv_S050	38.951	19.831	0.0058	0.25	5.63	15.02	0.7
F_SabinalRv_S055	24.926	11.067	0.0027	0.20	2.07	11.86	0.7
F_SanMigCk_S010	50.557	26.804	0.0021	1.47	2.24	21.99	0.7
F_SanMigCk_S011	37.975	14.561	0.0025	0.67	2.31	15.49	0.7
F_SanMigCk_S020	30.238	12.782	0.0023	0.31	2.60	13.83	0.7
F_SanMigCk_S021	36.116	19.568	0.0017	0.52	1.81	18.12	0.7
F_SanMigCk_S022	16.195	7.922	0.0035	0.50	2.62	8.54	0.7
F_SanMigCk_S023	15.626	5.965	0.0026	0.93	2.23	7.97	0.7
F_SanMigCk_S024	24.649	13.644	0.0017	0.90	1.71	13.84	0.7
F_SecoCk_S010	16.523	8.818	0.0110	0.07	21.61	3.92	0.86
F_SecoCk_S020	19.949	9.255	0.0096	0.06	10.36	4.38	0.78
F_SecoCk_S021	13.670	8.101	0.0039	0.16	2.47	7.94	0.7
F_SecoCk_S030	44.458	22.181	0.0027	0.40	3.52	18.91	0.7
F_SecoCk_S031	40.197	17.761	0.0023	0.23	2.81	17.27	0.7
La_ParitaCk_S010	39.470	23.059	0.0020	0.97	1.74	19.26	0.7
La_ParitaCk_S020	28.515	16.100	0.0018	0.51	1.96	15.34	0.7
La_ParitaCk_S030	10.600	6.306	0.0036	0.60	2.52	6.67	0.7
NuecesRv_S010	22.348	11.015	0.0056	0.26	13.19	5.33	0.78
NuecesRv_S011	17.029	8.947	0.0074	0.08	14.30	4.28	0.78
NuecesRv_S012	35.164	18.320	0.0048	0.16	20.99	7.76	0.86
NuecesRv_S020	35.397	15.697	0.0052	0.21	19.15	7.27	0.86
NuecesRv_S030	27.634	10.289	0.0075	0.32	17.30	5.33	0.86
NuecesRv_S040	15.106	6.645	0.0095	0.20	19.18	3.52	0.86
NuecesRv_S041	15.530	7.407	0.0106	0.10	19.54	3.63	0.86
NuecesRv_S050	25.202	9.170	0.0065	0.26	9.12	5.08	0.78
NuecesRv_S060	3.130	1.476	0.0091	0.00	3.43	2.12	0.7
NuecesRv_S061	28.667	14.292	0.0062	0.05	11.08	6.31	0.78
NuecesRv_S070	13.448	4.996	0.0039	0.37	2.51	6.58	0.7
NuecesRv_S071	12.053	6.101	0.0028	0.34	2.73	7.22	0.7
NuecesRv_S080	11.152	5.249	0.0045	0.36	2.35	6.1	0.7

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
NuecesRv_S081	23.942	10.526	0.0023	0.23	1.54	11.77	0.7
NuecesRv_S082	30.253	21.425	0.0013	0.64	1.39	18.51	0.7
NuecesRv_S083	15.876	8.183	0.0016	0.44	1.33	9.85	0.7
NuecesRv_S084	21.543	12.050	0.0017	0.36	0.67	12.65	0.7
NuecesRv_S090	9.904	9.316	0.0032	0.28	2.05	7.7	0.7
NuecesRv_S100	39.860	18.653	0.0016	0.25	1.02	18.82	0.7
NuecesRv_S101	27.831	13.478	0.0024	0.25	1.41	13.6	0.7
NuecesRv_S110	22.630	10.286	0.0022	0.58	1.30	11.52	0.7
NuecesRv_S111	21.407	9.156	0.0019	0.35	1.09	11.13	0.7
NuecesRv_S120	20.353	8.075	0.0028	0.18	2.02	9.77	0.7
NuecesRv_S121	21.759	10.299	0.0025	0.21	1.48	11.14	0.7
NuecesRv_S122	15.950	4.675	0.0028	0.65	2.26	7.27	0.7
NuecesRv_S130	33.800	16.914	0.0016	1.12	1.75	16.85	0.7
NuecesRv_S140	24.394	12.068	0.0022	0.41	1.11	12.62	0.7
NuecesRv_S150	7.643	3.713	0.0027	0.33	1.29	5.15	0.7
NuecesRv_S151	15.478	7.478	0.0022	0.27	1.12	8.95	0.7
NuecesRv_S160	23.819	12.937	0.0018	0.50	1.47	13.31	0.7
NuecesRv_S161	13.314	8.943	0.0024	0.20	1.44	8.89	0.7
NuecesRv_S170	16.111	8.826	0.0023	0.20	0.86	9.6	0.7
NuecesRv_S180	29.470	9.111	0.0021	0.30	1.23	12.25	0.7
NuecesRv_S185	32.774	17.213	0.0031	1.11	2.18	14.89	0.7
NuecesRv_S190	26.193	14.550	0.0031	0.53	1.85	12.99	0.7
NuecesRv_S200	23.997	9.338	0.0022	0.58	1.48	11.34	0.7
NuecesRv_S210	26.055	10.014	0.0017	0.51	2.09	12.63	0.7
NuecesRv_S220	28.345	15.624	0.0036	0.63	2.14	13.32	0.7
NuecesRv_S221	19.551	10.644	0.0030	1.14	1.92	10.41	0.7
NuecesRv_S222	24.491	16.006	0.0029	0.29	2.53	13.33	0.7
NuecesRv_S230	22.360	9.805	0.0031	0.57	2.27	10.6	0.7
NuecesRv_S231	20.333	11.604	0.0016	1.15	2.68	12.24	0.7
NuecesRv_S240	36.641	16.384	0.0025	1.49	2.30	15.88	0.7
NuecesRv_S250	23.848	4.414	0.0031	1.38	2.85	8.05	0.7
NuecesRv_S260	10.693	0.970	0.0037	3.50	2.03	3.27	0.7
NuecesRv_S261	27.165	15.173	0.0030	0.85	3.46	13.42	0.7
NuecesRv_S270	28.366	12.903	0.0025	1.05	2.91	13.22	0.7
NuecesRv_S290	31.288	9.591	0.0019	0.88	3.15	12.99	0.7

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
NuecesRv_S300	33.968	15.644	0.0013	1.37	1.50	17.19	0.7
NuecesRv_S310	25.236	13.301	0.0008	2.56	1.61	15.68	0.7
NuecesRv_W_S010	31.370	13.143	0.0038	0.14	9.07	6.89	0.78
NuecesRv_W_S011	27.066	14.038	0.0045	0.03	9.33	6.51	0.78
NuecesRv_W_S020	32.782	15.690	0.0048	0.08	12.02	7.18	0.78
NuecesRv_W_S021	33.735	16.925	0.0047	0.00	9.93	7.48	0.78
NuecesRv_W_S022	17.182	6.643	0.0068	0.00	11.10	3.92	0.78
NuecesRv_W_S030	18.160	7.069	0.0066	0.12	9.98	4.11	0.78
NuecesRv_W_S031	21.920	11.414	0.0072	0.01	16.58	5.14	0.86
NuecesRv_W_S032	35.751	18.055	0.0047	0.06	6.78	7.81	0.78
N_BlackCk_S010	29.402	4.049	0.0036	0.33	2.06	8.25	0.7
N_BlackCk_S020	19.432	4.614	0.0041	0.16	1.56	7.26	0.7
N_BlackCk_S021	16.702	9.256	0.0024	0.59	1.14	9.77	0.7
N_CalmanCk_S010	28.305	13.382	0.0030	0.43	1.43	13.02	0.7
N_CalmanCk_S011	24.679	12.460	0.0024	0.34	1.26	12.56	0.7
N_ChaconCk_S010	42.211	19.419	0.0035	0.35	2.96	16.88	0.7
N_ChaconCk_S020	18.598	11.776	0.0024	0.16	1.21	11.1	0.7
N_ChaconCk_S021	18.027	9.188	0.0027	0.29	0.86	9.84	0.7
N_ChaconCk_S022	30.049	15.715	0.0018	0.22	1.36	15.49	0.7
N_ChaconCk_S023	21.505	11.597	0.0013	0.12	0.98	13.08	0.7
N_ChapCk_S010	28.551	10.782	0.0053	0.17	3.62	10.91	0.7
N_ChapCk_S011	25.201	13.759	0.0019	0.12	1.24	13.7	0.7
N_LagartoCk_S010	38.135	19.681	0.0026	0.48	2.95	17.2	0.7
N_LagartoCk_S020	25.741	12.047	0.0021	0.53	2.68	12.98	0.7
N_LaRaicesCk_S010	30.263	15.813	0.0025	0.23	1.97	14.7	0.7
N_LaRaicesCk_S011	28.908	16.606	0.0020	0.47	1.43	15.35	0.7
N_LosOlmosCk_S010	29.809	18.145	0.0031	0.35	1.66	14.82	0.7
N_LosOlmosCk_S011	28.641	9.982	0.0029	0.29	1.57	11.85	0.7
N_LosOlmosCk_S012	33.157	20.129	0.0021	0.42	1.43	17.12	0.7
N_LosOlmosCk_S020	17.367	6.907	0.0022	0.18	1.05	9.07	0.7
N_PicosaCk_S010	23.869	9.727	0.0022	0.20	1.55	11.53	0.7
N_PicosaCk_S011	13.265	7.524	0.0026	0.05	1.37	8.22	0.7
N_PicosaCk_S020	13.327	4.035	0.0023	0.20	1.37	6.71	0.7
N_PicosaCk_S021	22.367	12.634	0.0021	0.16	1.32	12.57	0.7
N_SanCasCk_S010	27.474	14.726	0.0026	0.61	1.78	13.73	0.7

HEC-HMS Subbasin Name	L	Lca	Sst	Percent Urban	Mean Percent Rise in Slope	Snyder's Tp	Snyder's Peaking Coeff
	(mi)	(mi)	(ft/ft)	%	%	(hrs)	
N_SanCasCk_S011	25.270	12.745	0.0023	0.31	1.62	12.96	0.7
N_SanCasCk_S020	20.909	9.481	0.0028	0.57	1.43	10.43	0.7
N_SanCasCk_S021	30.953	16.132	0.0014	0.16	1.53	16.72	0.7
N_SanCasCk_S030	22.251	11.051	0.0018	0.19	1.73	12.24	0.7
N_SanRoqCk_S010	22.985	10.188	0.0023	0.55	1.36	11.44	0.7
N_SanRoqCk_S011	20.323	9.509	0.0033	0.63	1.71	10	0.7
N_SanRoqCk_S020	12.098	3.477	0.0034	0.33	1.50	5.71	0.7
N_SanRoqCk_S021	20.140	9.187	0.0019	0.79	1.42	10.84	0.7
N_TurkeyCk_S010	28.298	12.989	0.0035	0.17	3.40	12.55	0.7
N_TurkeyCk_S011	20.629	9.422	0.0025	0.05	1.37	10.58	0.7
N_TurkeyCk_S012	21.231	9.522	0.0022	0.10	1.32	10.97	0.7
N_TurkeyCk_S020	16.438	8.134	0.0022	0.22	1.34	9.41	0.7
N_TurkeyCk_S030	19.961	5.766	0.0021	1.14	1.29	8.93	0.7
N_TurkeyCk_S031	29.438	16.104	0.0021	0.25	1.88	15.13	0.7
N_TurkeyCk_S040	6.585	1.941	0.0022	8.23	0.78	3.77	0.7
N_TurkeyCk_S050	7.821	3.539	0.0012	0.92	0.82	5.92	0.7
N_TurkeyCk_S060	15.444	7.961	0.0031	0.42	2.05	8.57	0.7
N_TurkeyCk_S061	11.139	5.184	0.0038	5.31	1.65	6.05	0.7
N_TurkeyCk_S070	12.165	4.412	0.0010	0.98	0.85	7.8	0.7
N_TurkeyCk_S080	15.330	8.221	0.0033	0.99	1.38	8.51	0.7
N_TurkeyCk_S081	25.672	12.184	0.0025	0.78	1.63	12.58	0.7
N_TurkeyCk_S090	6.382	2.597	0.0038	0.28	1.60	3.97	0.7
RamirenaCk_S010	21.061	10.330	0.0030	0.66	3.40	10.63	0.7
RamirenaCk_S020	17.403	9.366	0.0029	0.60	3.66	9.62	0.7
TurkeyCk_S041	8.387	3.901	0.0019	1.78	1.62	5.73	0.7

Table B.3: Initial Modified Puls Routing Data

Reach Name	Length	Storage-Discharge Curve Name	Subreaches
	(mi)		
NuecesRv_R080	6.192	NuecesRv_R080	1
NuecesRv_R090	14.853	NuecesRv_R090	1
NuecesRv_R100	22.606	NuecesRv_R0100	1
NuecesRv_R110	9.284	NuecesRv_R110	1
NuecesRv_R120	6.586	NuecesRv_R120	1
NuecesRv_R130	14.716	NuecesRv_R130	1
Nueces_TurkeyCk_R010	6.250	Nueces_TurkeyCk_R010	1
TurkeyCk_R060	5.029	TurkeyCk_R060	1
TurkeyCk_R070	7.209	TurkeyCk_R070	1
TurkeyCk_R080	2.515	TurkeyCk_R080	1
TurkeyCk_R090	2.634	TurkeyCk_R090	1
FrioRv_R050	29.075	FrioRv_R050	19
FrioRv_R070	22.541	FrioRv_R070	15
FrioRv_R080	5.996	FrioRv_R080	3
FrioRv_R090	22.080	FrioRv_R090	14
FrioRv_R110	8.062	FrioRv_R110	5
FrioRv_R120	15.417	FrioRv_R120	10
FrioRv_R130	16.729	FrioRv_R130	11
CiboloCk_R010	13.874	CiboloCk_R010	9
CiboloCk_R020	28.715	CiboloCk_R020	19
FrioRv_R140	13.379	FrioRv_R140	9
FrioRv_R150	6.058	FrioRv_R150	4
FrioRv_R160	14.854	FrioRv_R160	10
FrioRv_R170	10.680	FrioRv_R170	7
SanMiguelCk_R010	19.662	SanMiguelCk_R010	13
SanMiguelCk_R020	13.647	SanMiguelCk_R020	9
SanMiguelCk_R030	8.028	SanMiguelCk_R030	5
SanMiguelCk_R040	13.084	SanMiguelCk_R040	9
FrioRv_R180	4.175	FrioRv_R180	3
FrioRv_R190	0.173	FrioRv_R190	1
AtascosaRv_R010	16.517	AtascosaRv_R010	11
AtascosaRv_R020	10.507	AtascosaRv_R020	7
AtascosaRv_R030	16.222	AtascosaRv_R030	11
AtascosaRv_R040	11.400	AtascosaRv_R040	8
BorregoCk_R010	11.447	BorregoCk_R010	8
AtascosaRv_R050	10.477	AtascosaRv_R050	7
La_ParitaCk_R010	3.979	LaParitaCk_R010	3

Reach Name	Length	Storage-Discharge Curve Name	Subreaches
	(mi)		
AtascosaRv_R060	4.479	AtascosaRv_R060	3
AtascosaRv_R070	8.640	AtascosaRv_R070	6
AtascosaRv_R080	6.408	AtascosaRv_R080	4
AtascosaRv_R085	0.116	AtascosaRv_R085	1
AtascosaRv_R090	7.165	AtascosaRv_R090	5
NuecesRv_R310	7.578	NuecesRv_R310	5
NuecesRv_R320	10.924	NuecesRv_R320	7
NuecesRv_R330	1.774	NuecesRv_R330	1
NuecesRv_R340	11.957	NuecesRv_R340	8
NuecesRv_R350	9.388	NuecesRv_R350	6
LagartoCk_R010	19.818	LagartoCk_R010	13
RamirenaCk_R010	13.230	RamirenaCk_R010	9
NuecesRv_R360	22.117	NuecesRv_R360rev	15
NuecesRv_R370	18.451	NuecesRv_R370rev	12

Table B.4: Initial Muskingum Routing Data

Reach Name	Length	Muskingum K	Muskingum X	Subreaches
	(mi)	(hr)		
W_NuecesRv_R010	28.798	19.20	0.2	19
W_NuecesRv_R020	11.901	7.93	0.2	7
W_NuecesRv_R030	13.551	9.03	0.2	9
W_NuecesRv_R040	30.606	20.40	0.2	20
NuecesRv_R010	22.495	15.00	0.3	14
NuecesRv_R020	14.844	9.90	0.2	9
NuecesRv_R030	9.507	6.34	0.2	6
NuecesRv_R040	15.901	10.60	0.2	10
NuecesRv_R050	2.129	1.42	0.2	1
NuecesRv_R060	8.535	5.69	0.2	5
NuecesRv_R070	8.688	5.79	0.2	5
NuecesRv_R135	0.168	0.25	0.1	1
ChaconCk_R010	14.983	9.99	0.1	9
ChaconCk_R020	17.505	11.67	0.1	11
Palo_BlancoCk_R010	16.618	11.08	0.1	11
Palo_BlancoCk_R020	2.771	1.85	0.1	1
PicosaCk_R010	11.545	7.70	0.1	7
Palo_BlancoCk_R030	2.672	1.78	0.1	1
ComancheCk_R010	14.547	9.70	0.1	9
ComancheCk_R020	1.925	1.28	0.1	1
TurkeyCk_R010	16.404	10.94	0.1	10
TurkeyCk_R020	11.063	7.38	0.2	7
ChaparrosaCk_R010	18.707	12.47	0.1	12
TurkeyCk_R030	12.131	8.09	0.1	8
TurkeyCk_R040	7.460	4.97	0.1	4
TurkeyCk_R050	2.694	1.80	0.1	1
CarrizoCk_R010	6.203	4.14	0.2	4
El_MoroCk_R010	0.372	0.25	0.1	1
TurkeyCk_R100	0.320	0.25	0.1	1
NuecesRv_R140	9.835	6.56	0.1	6
Arroyo_Negro_R010	1.314	0.88	0.1	1
NuecesRv_R150	3.840	2.56	0.1	2
NuecesRv_R160	9.442	6.29	0.1	6
San_RoqueCk_R010	7.467	4.98	0.1	4
San_RoqueCk_R020	14.086	9.39	0.1	9

Reach Name	Length	Muskingum K	Muskingum X	Subreaches
	(mi)	(hr)		
NuecesRv_R170	6.193	4.13	0.1	4
NuecesRv_R180	11.795	7.86	0.1	7
NuecesRv_R190	25.440	16.96	0.1	16
La_RaicesCk_R010	17.793	11.86	0.1	11
NuecesRv_R200	8.505	5.67	0.1	5
CalmanCk_R010	14.204	9.47	0.1	9
NuecesRv_R210	3.263	2.18	0.1	2
Los_OlmosCk_R010	0.622	0.41	0.1	1
Los_OlmosCk_R020	11.416	7.61	0.1	7
Los_OlmosCk_R030	11.810	7.87	0.1	7
NuecesRv_R220	3.384	2.26	0.1	2
NuecesRv_R225	3.328	2.22	0.1	2
SaladoCk_R010	17.559	11.71	0.1	11
BecerraCk_R010	25.108	16.74	0.1	16
San_CasimiroCk_R010	12.473	8.32	0.1	8
NuecesRv_R230	2.332	1.55	0.1	1
BlackCk_R010	7.062	4.71	0.1	4
BlackCk_R020	13.727	9.15	0.1	9
NuecesRv_R240	14.920	9.95	0.1	9
NuecesRv_R250	1.869	1.25	0.1	1
NuecesRv_R260	2.247	1.50	0.1	1
NuecesRv_R270	16.285	10.86	0.1	10
NuecesRv_R280	5.259	3.51	0.1	3
NuecesRv_R285	9.111	6.07	0.1	6
OldRv_R010	1.535	1.02	0.2	1
NuecesRv_R290	13.541	9.03	0.1	9
NuecesRv_R300	16.224	10.82	0.1	10
FrioRv_R010	2.022	1.35	0.2	1
FrioRv_R020	24.273	16.18	0.3	16
FrioRv_R030	24.198	16.13	0.2	16
Dry_FrioRv_R010	18.403	12.27	0.3	12
Dry_FrioRv_R020	9.863	6.58	0.2	6
FrioRv_R040	6.022	4.01	0.2	4
BlancoCk_R010	22.810	15.21	0.2	15
FrioRv_R060	0.954	0.64	0.1	1

Reach Name	Length	Muskingum K	Muskingum X	Subreaches
	(mi)	(hr)		
SabinalRv_R010	9.811	6.54	0.4	6
SabinalRv_R020	13.722	9.15	0.3	9
SabinalRv_R030	19.936	13.29	0.2	13
SabinalRv_R040	6.661	4.44	0.2	4
RancherosCk_R010	5.742	3.83	0.2	3
SabinalRv_R050	9.438	6.29	0.2	6
SabinalRv_R060	7.365	4.91	0.2	4
FrioRv_R085	0.260	0.25	0.1	1
HondoCk_R010	22.821	15.21	0.3	15
HondoCk_R020	5.349	3.57	0.3	3
VerdeCk_R010	3.935	2.62	0.4	2
VerdeCk_R020	20.925	13.95	0.3	13
VerdeCk_R025	0.637	0.42	0.3	1
HondoCk_R030	13.094	8.73	0.1	8
HondoCk_R040	19.594	13.06	0.1	13
SecoCk_R010	14.862	9.91	0.3	9
SecoCk_R020	9.511	6.34	0.2	6
SecoCk_R030	34.541	23.03	0.2	23
SecoCk_R040	4.640	3.09	0.2	3
HondoCk_R050	8.060	5.37	0.1	5
LeonaRv_R010	1.930	1.29	0.1	1
Cooks_Slough_R010	1.819	1.21	0.2	1
LeonaRv_R015	2.254	1.50	0.2	1
LeonaRv_R020	16.822	11.21	0.1	11
LeonaRv_R030	4.673	3.12	0.1	3
LeonaRv_R040	22.135	14.76	0.1	14
LeonaRv_R050	23.732	15.82	0.1	15
LeonaRv_R060	5.150	3.43	0.1	3
FrioRv_R100	0.686	0.46	0.1	1
NuecesRv_R305	1.115	0.74	0.1	1

Table B.5: Initial Channel Loss Data

Reach Name	Flow Rate (cfs)	Fraction
W_NuecesRv_R030	3	0.25
W_NuecesRv_R040	6	0.25
NuecesRv_R040	20	0.25
NuecesRv_R050	3	0.25
NuecesRv_R060	11	0.25
NuecesRv_R070	11	0.25
NuecesRv_R080	5	0.25
NuecesRv_R090	13	0.25
NuecesRv_R100	20	0.25
NuecesRv_R110	8	0.25
NuecesRv_R120	6	0.25
FrioRv_R010	1	0.25
FrioRv_R020	11	0.25
FrioRv_R030	171	0.25
Dry_FrioRv_R010	318	0.25
Dry_FrioRv_R020	85	0.25
FrioRv_R040	42	0.25
FrioRv_R050	205	0.25
SabinalRv_R010	45	0.25
SabinalRv_R020	62	0.25
SabinalRv_R030	91	0.25
HondoCk_R010	191	0.25
HondoCk_R020	45	0.25
VerdeCk_R010	28	0.25
VerdeCk_R020	147	0.25
VerdeCk_R025	4	0.25
SecoCk_R010	107	0.25
SecoCk_R020	69	0.25
SecoCk_R030	92	0.25
SecoCk_R040	12	0.25
NuecesRv_R350	0	0
NuecesRv_R360	147	0.25
NuecesRv_R370	122	0.25

1.3.2 Initial Reservoir Data

According to the National Inventory of Dams (NID), over 400 dams exist within Nueces River basin, most of which are NRCS structures, irrigation dams, or other small dams. Of these, reservoir elements were used in the HEC-HMS rainfall-runoff model for two reservoirs in the Nueces basin. These dams were selected to be modeled in detail due to their sizable flood storage and their noticeable influence on discharges in the major rivers downstream. Table B.6 summarizes the reservoir data obtained for these dams and their corresponding data sources, and Figure B.5 illustrates their locations within the basin.

Two reservoirs, Choke Canyon Dam and Lake Corpus Christi, were included in the model. The dams were modeled as reservoir elements in HEC-HMS.

The elevation-storage and elevation-discharge curves for Choke Canyon Dam were taken from the CWMS model. Both curves were based on data provided by the Bureau of Reclamation (USBR) to 233.0 ft. Values were estimated above 233.0 ft. The curve input in HEC-HMS is in vertical datum NAVD88.

The elevation-storage and elevation-discharge curves for Lake Corpus Christi were taken from the CWMS model. The storage-elevation curve data was derived from the Texas Water Development Board (TWDB) survey from 2016.

The smaller dams were scattered throughout the rural areas of the basin. These dams were not modeled in detail but were accounted for in the model through adjustments to the subbasins' initial losses, peaking coefficients, and routing data. Data for these dams was obtained from the National Inventory of Dams (USACE, 2016).

Table B.6: Reservoir Data and Sources for Dams Modeled in HEC-HMS

Reservoir Name	Data	Source(s)
Choke Canyon	Elevation-Storage, Elevation-Discharge rating	Bureau of Reclamation (USBR)
Lake Corpus Christi	Elevation-Storage, Elevation-Discharge rating	Texas Water Development Board (TWDB)

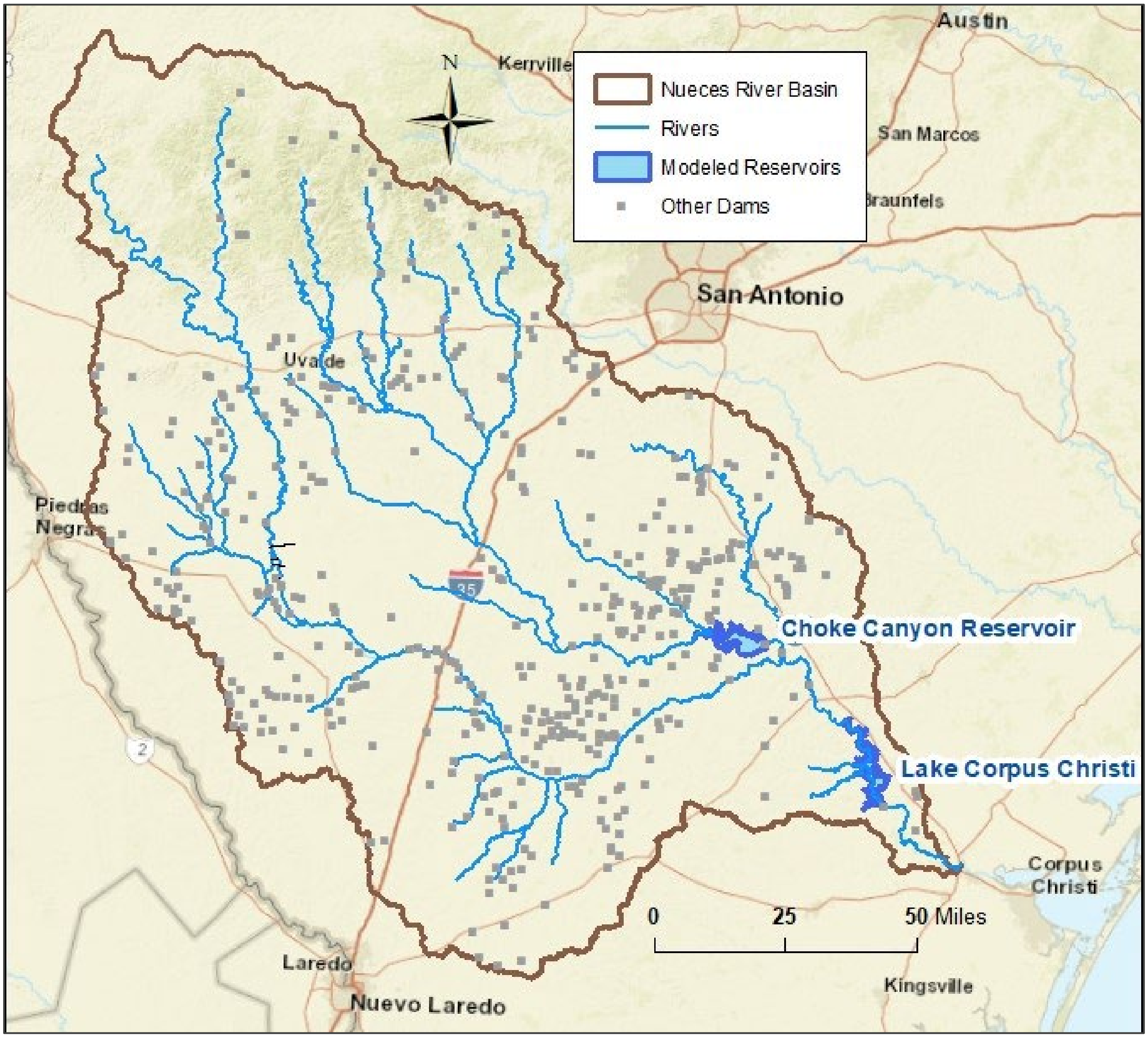


Figure B.5: Locations of Reservoirs Modeled in HEC-HMS

1.4 HEC-HMS MODEL CALIBRATION

After building the more detailed HEC-HMS model with its initial parameters, the model was calibrated to ensure that it would accurately simulate the response of the watershed to a range of observed flood events, including large events similar to a 1% annual chance (100-yr) flood. The goal of calibration is to accurately simulate the response of the watershed to a given storm by reproducing the timing, shape, and magnitudes of the observed flows at the stream gages. A total of sixteen recent storm events were used throughout different parts of the watershed to calibrate the model. For these storms, the National Weather Service (NWS) hourly rainfall radar data allowed the team to fine tune the rainfall runoff model through detailed calibration. This radar rainfall data is a gridded product with a spatial resolution of approximately 4 km x 4 km cell sizes, and the rainfall depths are calibrated by the NWS to on-the-ground observations at rainfall gages. Prior to the late 1990s, the NWS radar data was not available for use during earlier modeling efforts. The model calibration and verification process undertaken during this study exceeds the standards of a typical FEMA floodplain study.

1.4.1 Calibration Storms

Table B.7 lists the storms that were used to calibrate the Nueces HEC-HMS model, and Figures B.6 through B.21 illustrate the total depth of rain for the major calibration storms and how that rain was distributed spatially throughout the Nueces River watershed. These plots were extracted from the HEC-MetVue meteorological program for visualizing and processing rainfall data. These storms were selected as the largest available storms during the time that NWS radar data was available. Since the rain fell on different parts of the basin from one historic storm event to another, the calibration of each storm was focused on those areas of the basin that received the greatest and most intense rainfall. Calibration was also only performed when the USGS stream gages were recording and experienced a significant peak flow for that event. Table B.8 shows which storms were calibrated for each USGS stream and reservoir gage location.

Table B.7: Storm Events Used for Model Calibration

Historic Storm Event	Simulation Period
Oct 1996	October 27 - November 9
Jun 1997	June 20 - July 6
Aug 1998	August 20 - September 2
Nov 2001	November 13 - November 21
Jul 2002	June 29 - July 13
Sep 2002 TS Fay	September 6 - September 29
Jun 2007	June 19 - July 19
Jul 2007 (short)	July 17 - July 23
Jul 2007 (late)	July 23 - August 5
Jul 2007 (long)	July 17 - August 12
May 2015 middle	May 11 - May 22
May 2015	May 20 - May 27
Sep 2016	September 24 - October 9
Oct 2018 (early)	October 7 - October 13
Oct 2018 middle	October 14 - October 20
Oct 2018 entire	October 7 - November 24

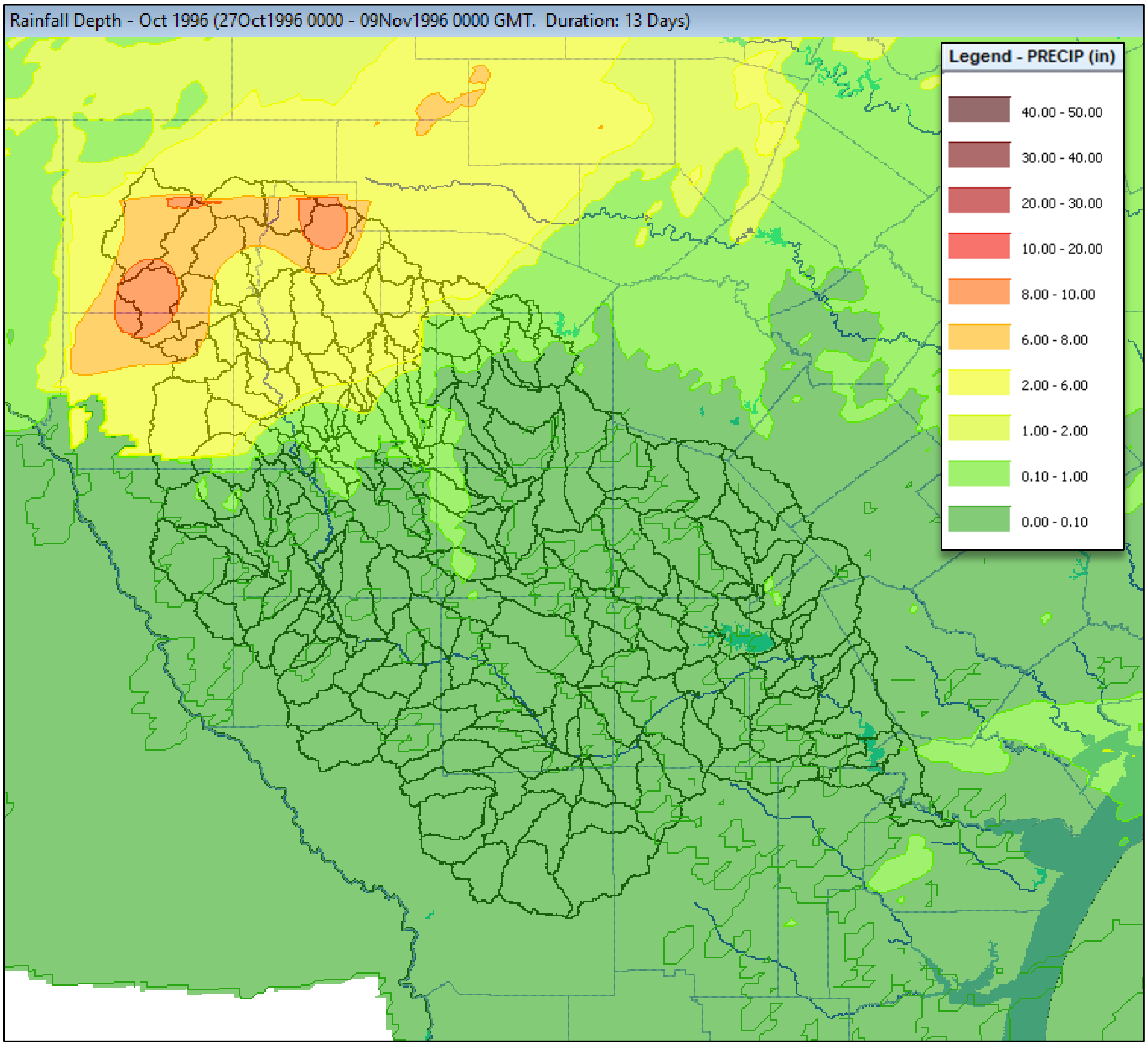


Figure B.6: Total Rainfall Depths (inches) for the October 1996 Calibration Storm

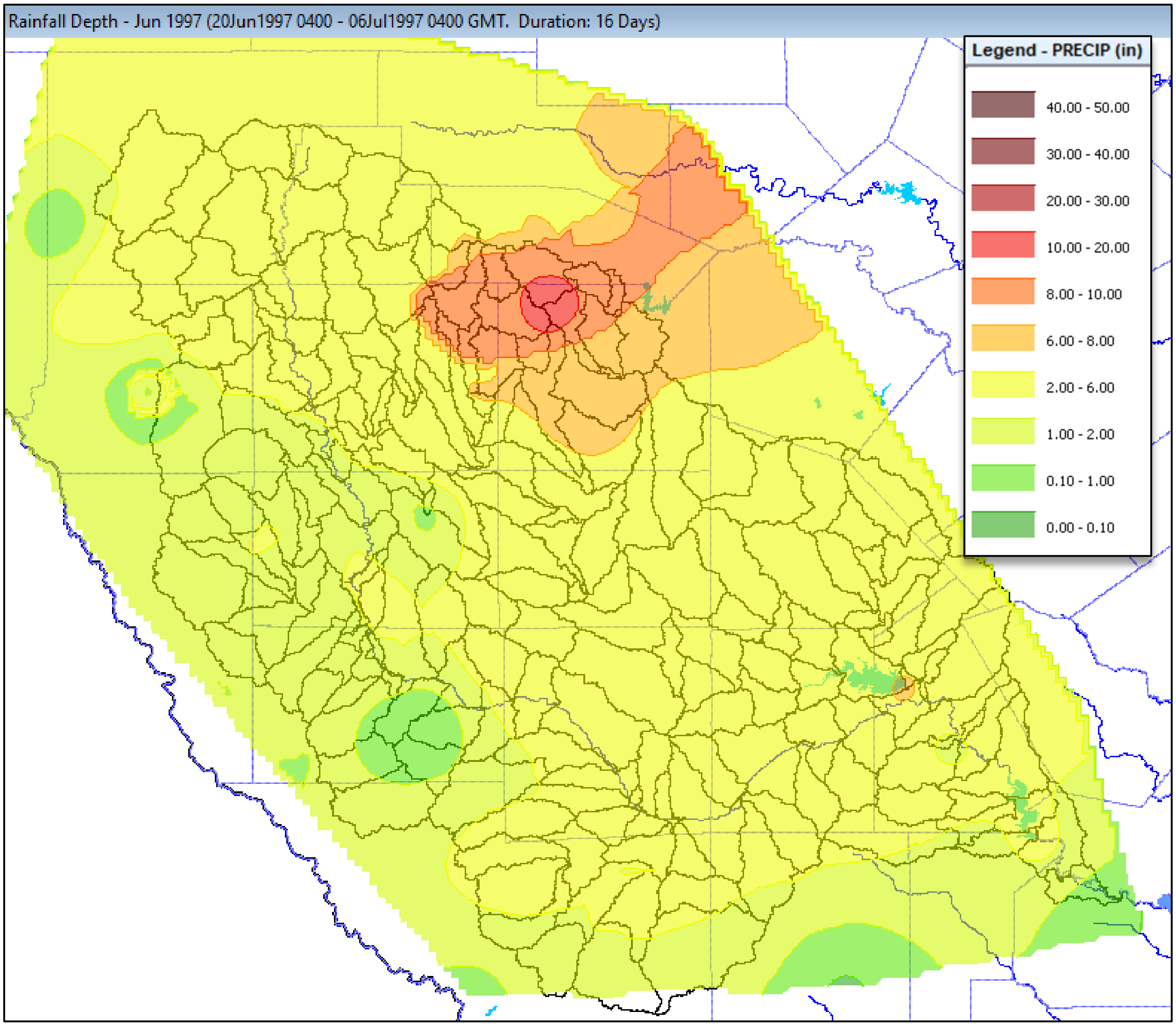


Figure B.7: Total Rainfall Depths (inches) for the June 1997 Calibration Storm

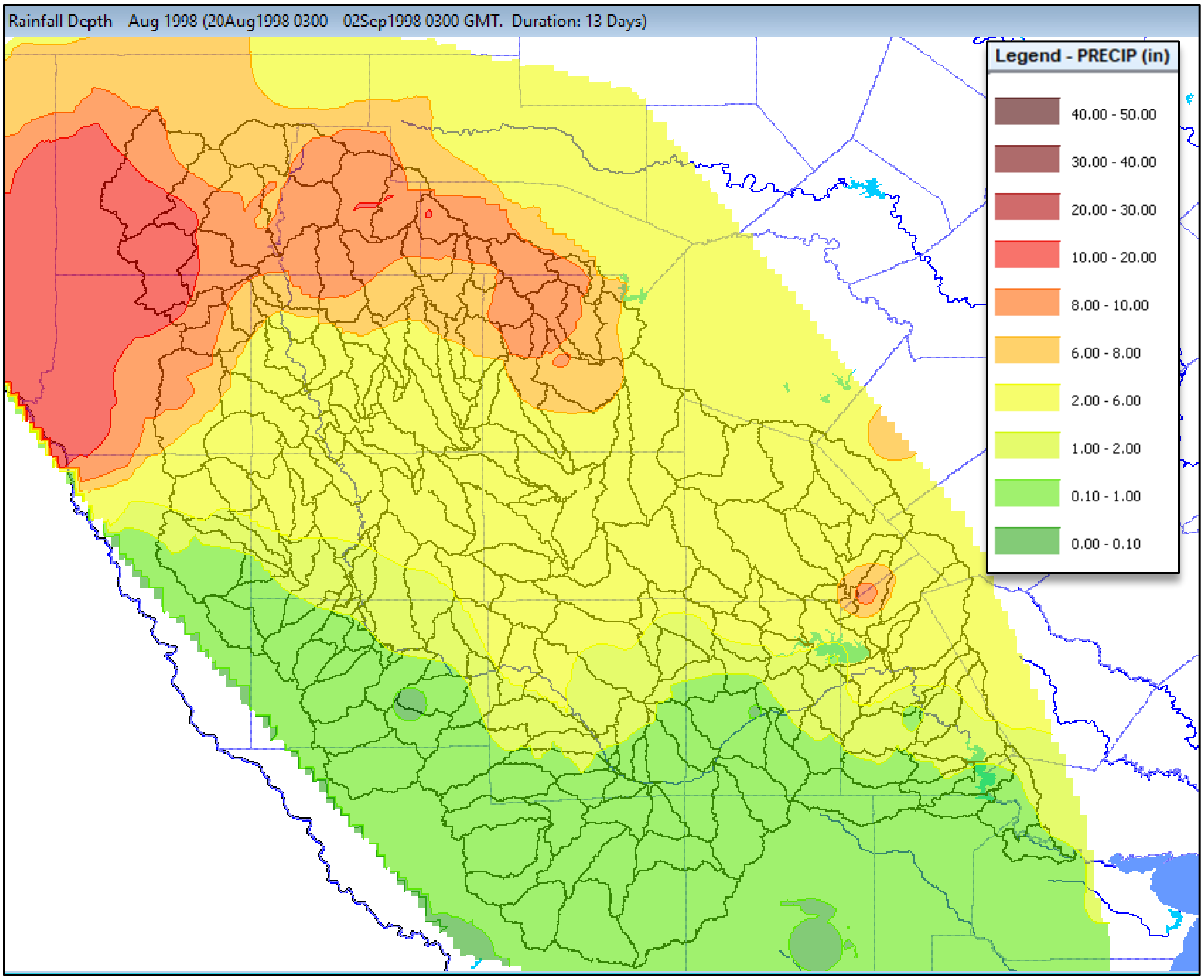


Figure B.8: Total Rainfall Depths (inches) for the August 1998 Calibration Storm

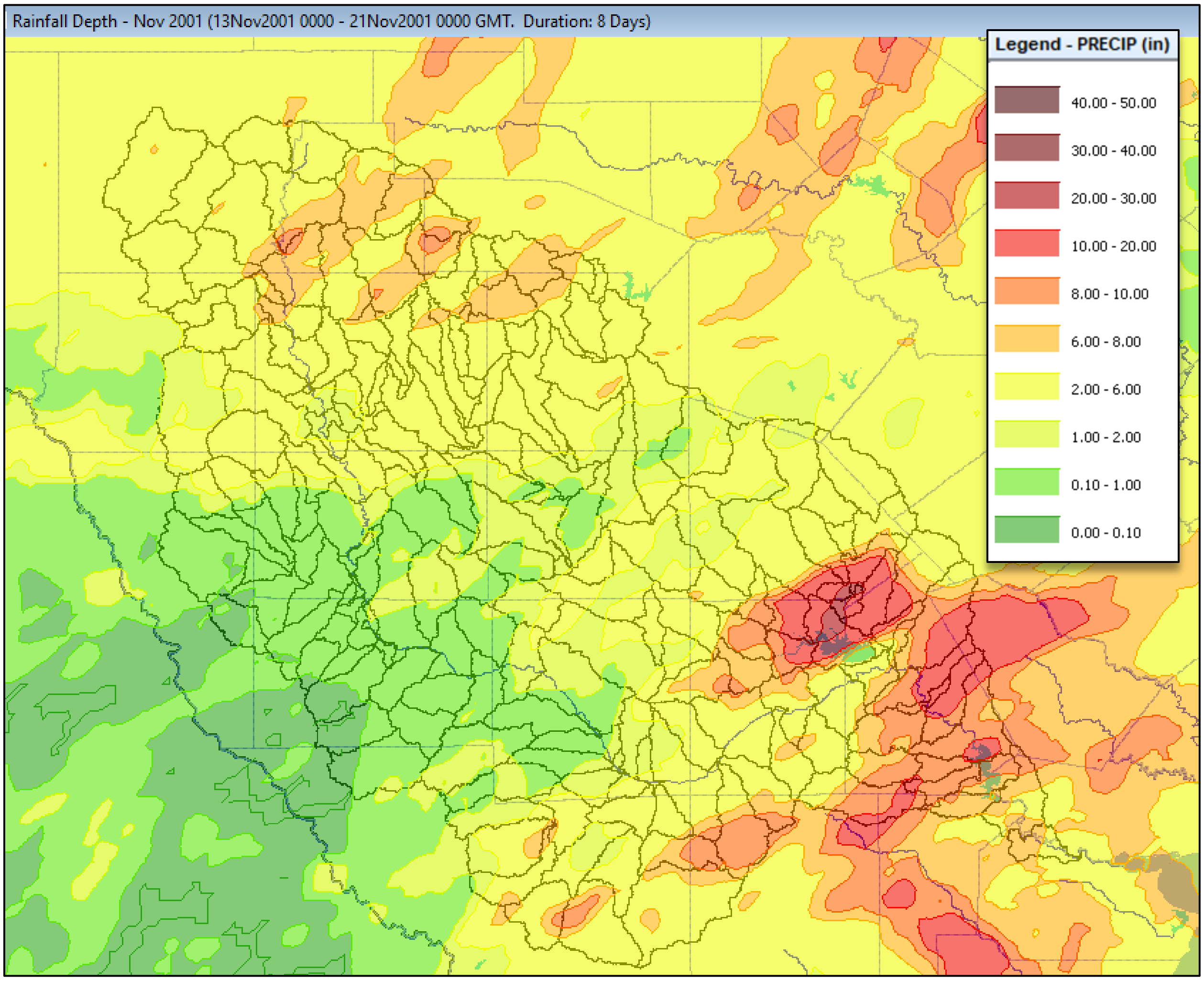


Figure B.9: Total Rainfall Depths (inches) for the November 2001 Calibration Storm

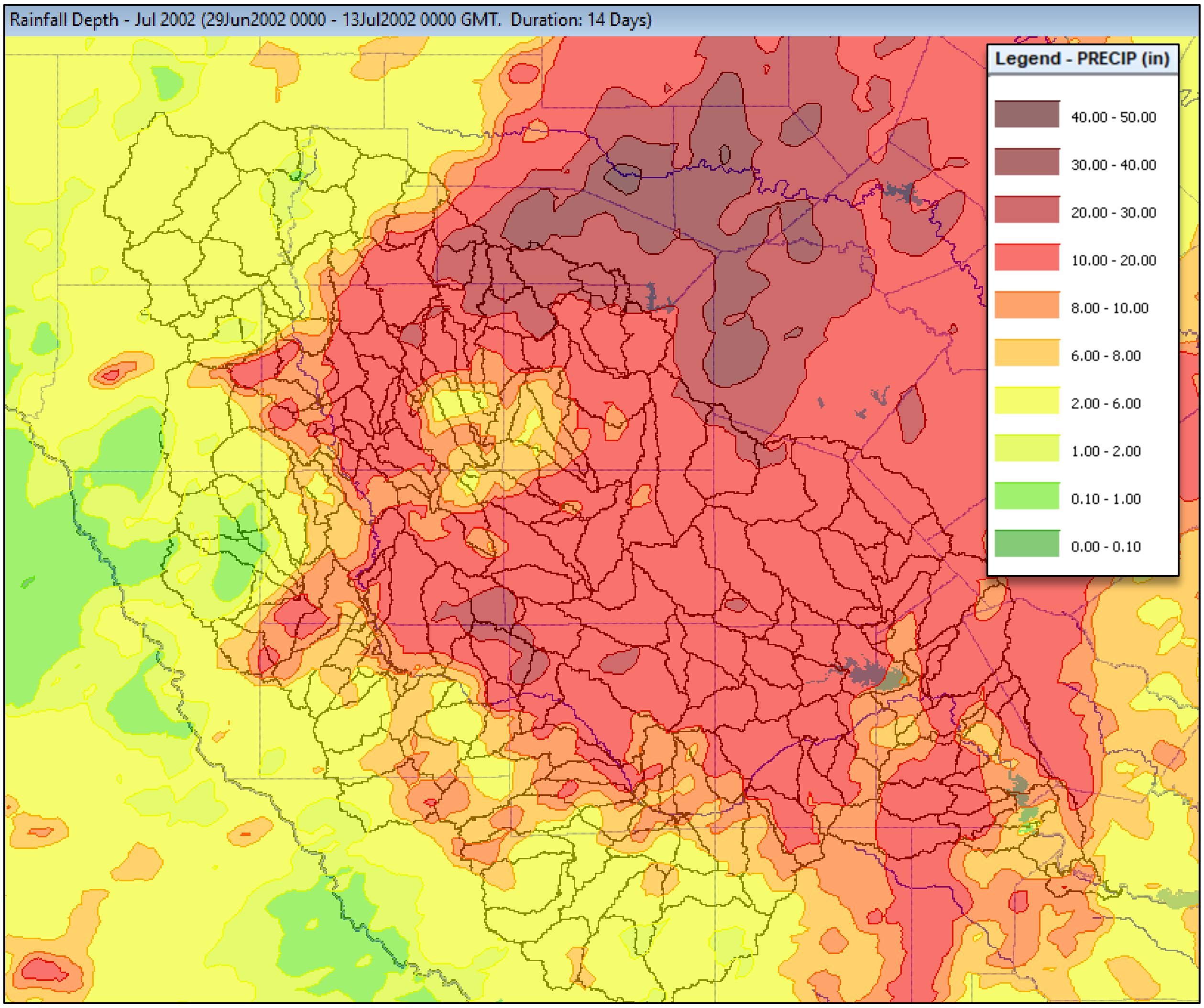


Figure B.10: Total Rainfall Depths (inches) for the July 2002 Calibration Storm

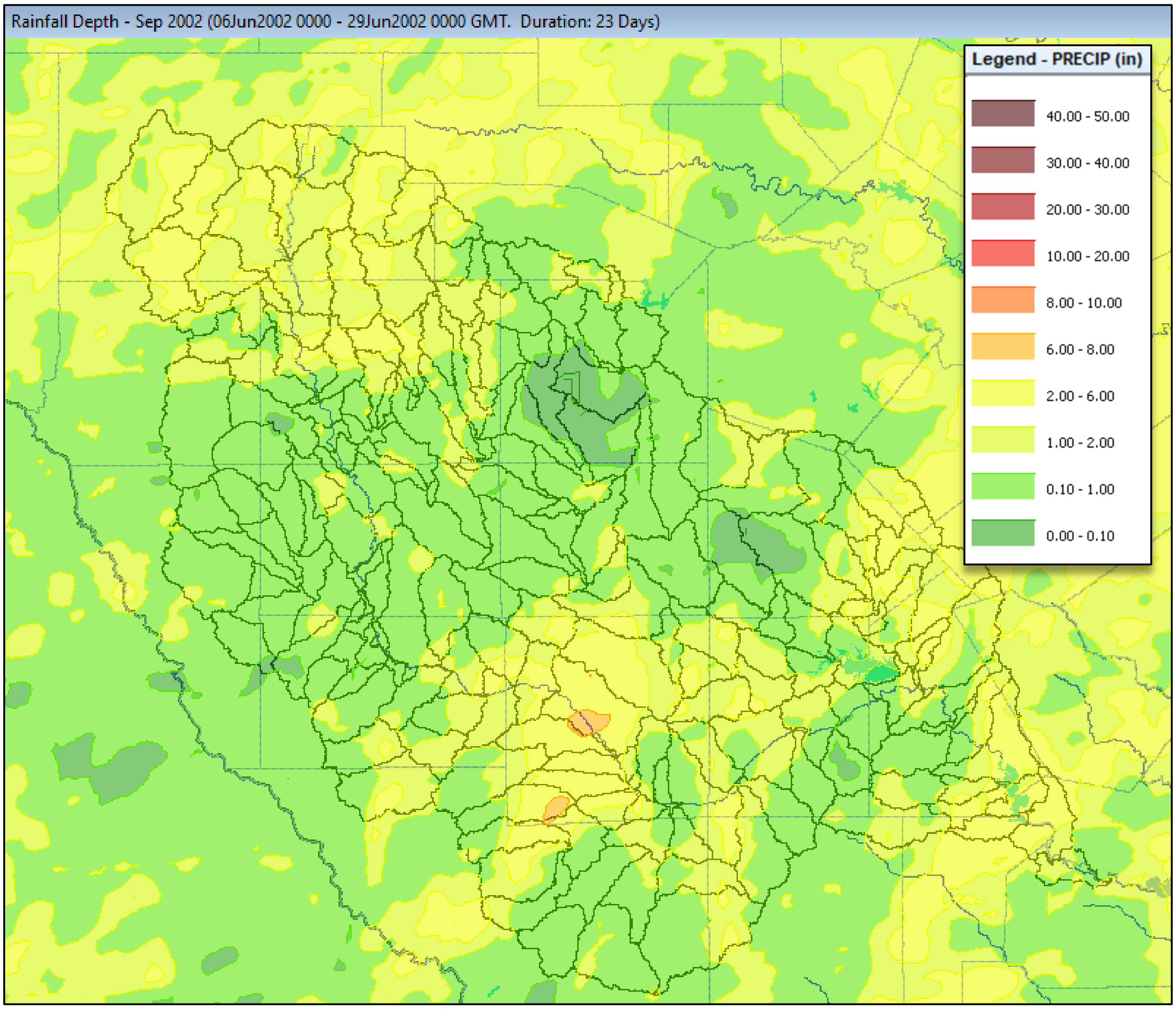


Figure B.11: Total Rainfall Depths (inches) for the September 2002 TS Fay Calibration Storm

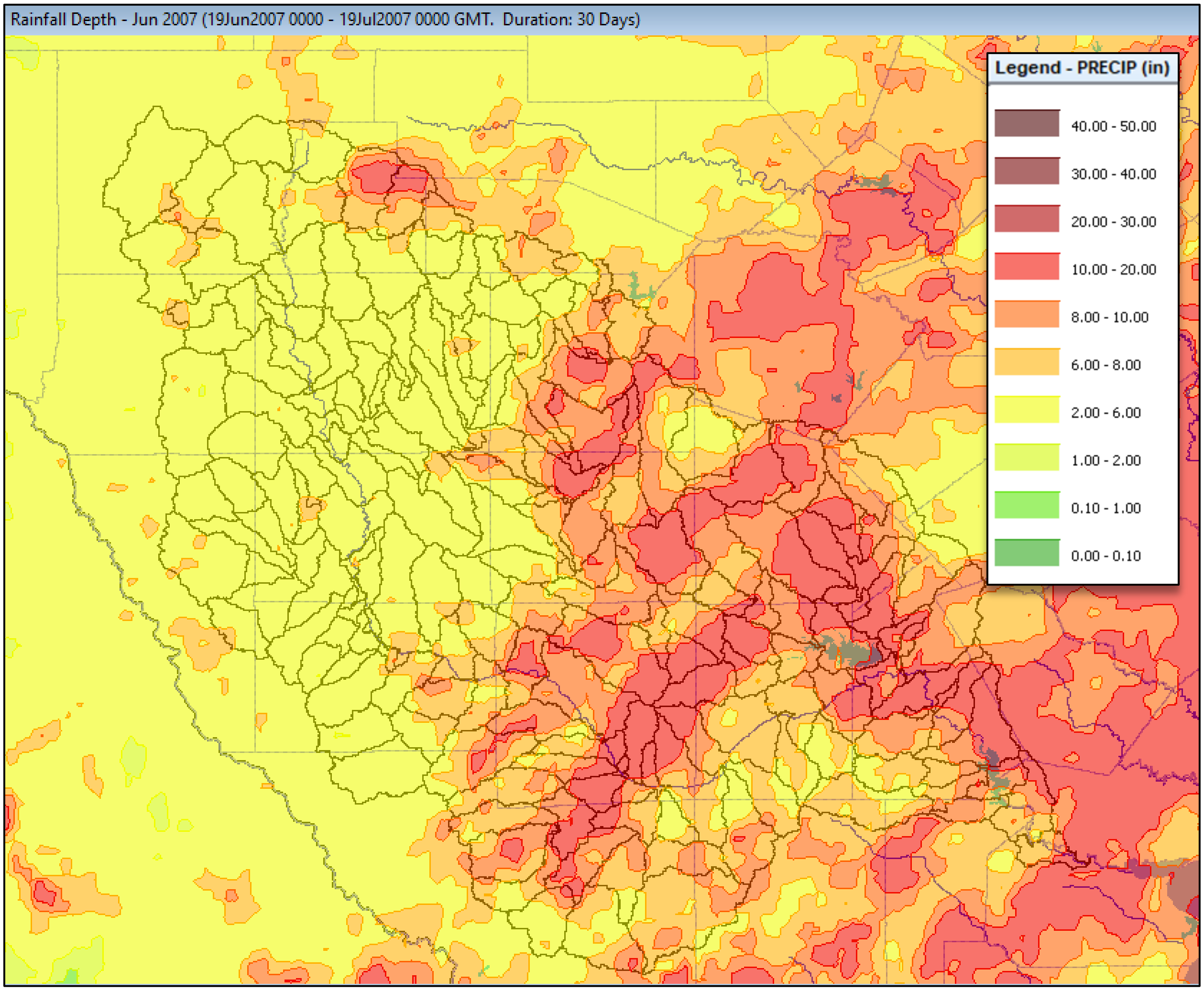


Figure B.12: Total Rainfall Depths (inches) for the June 2007 Calibration Storm

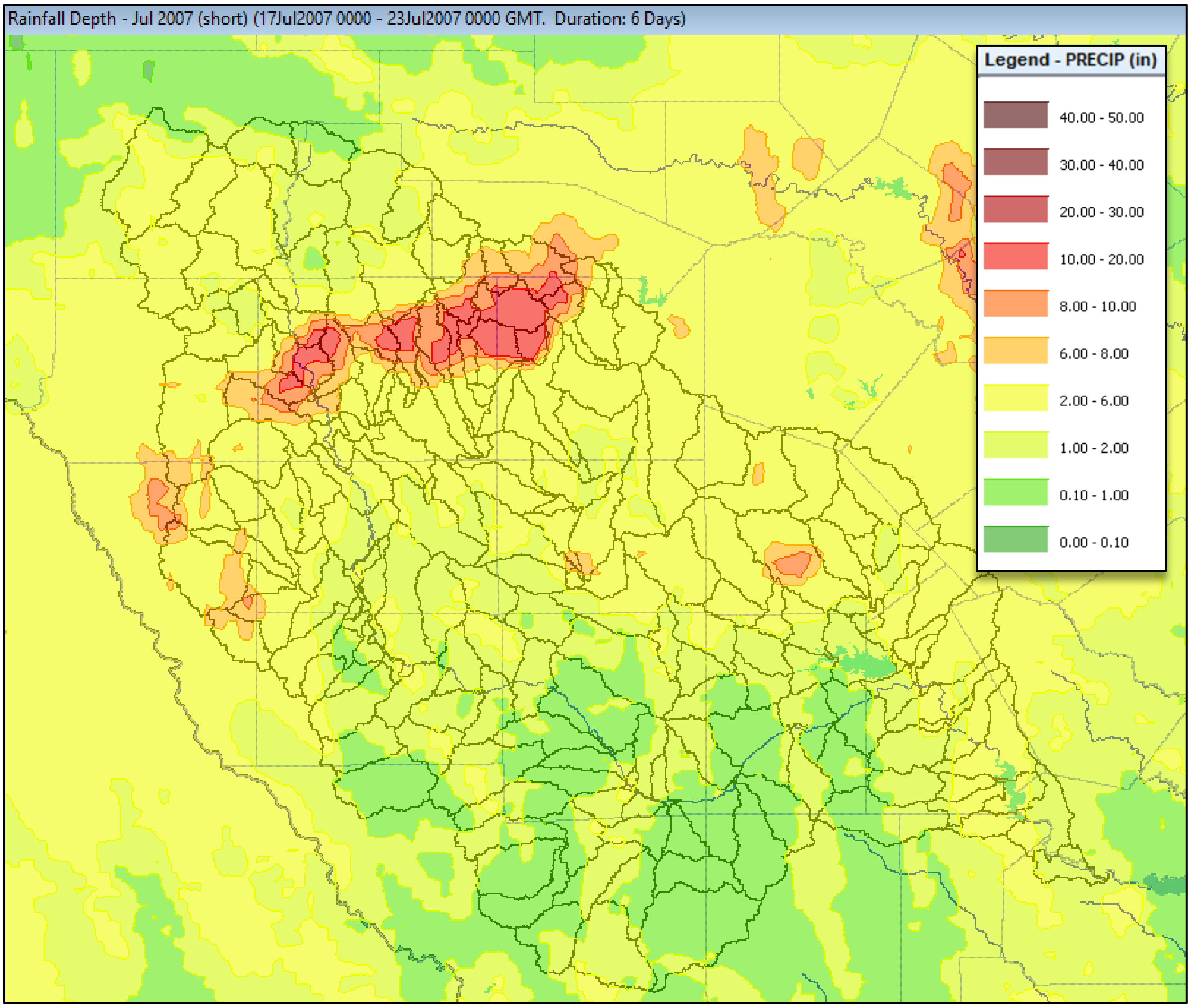


Figure B.13: Total Rainfall Depths (inches) for the July 2007 (short) Calibration Storm

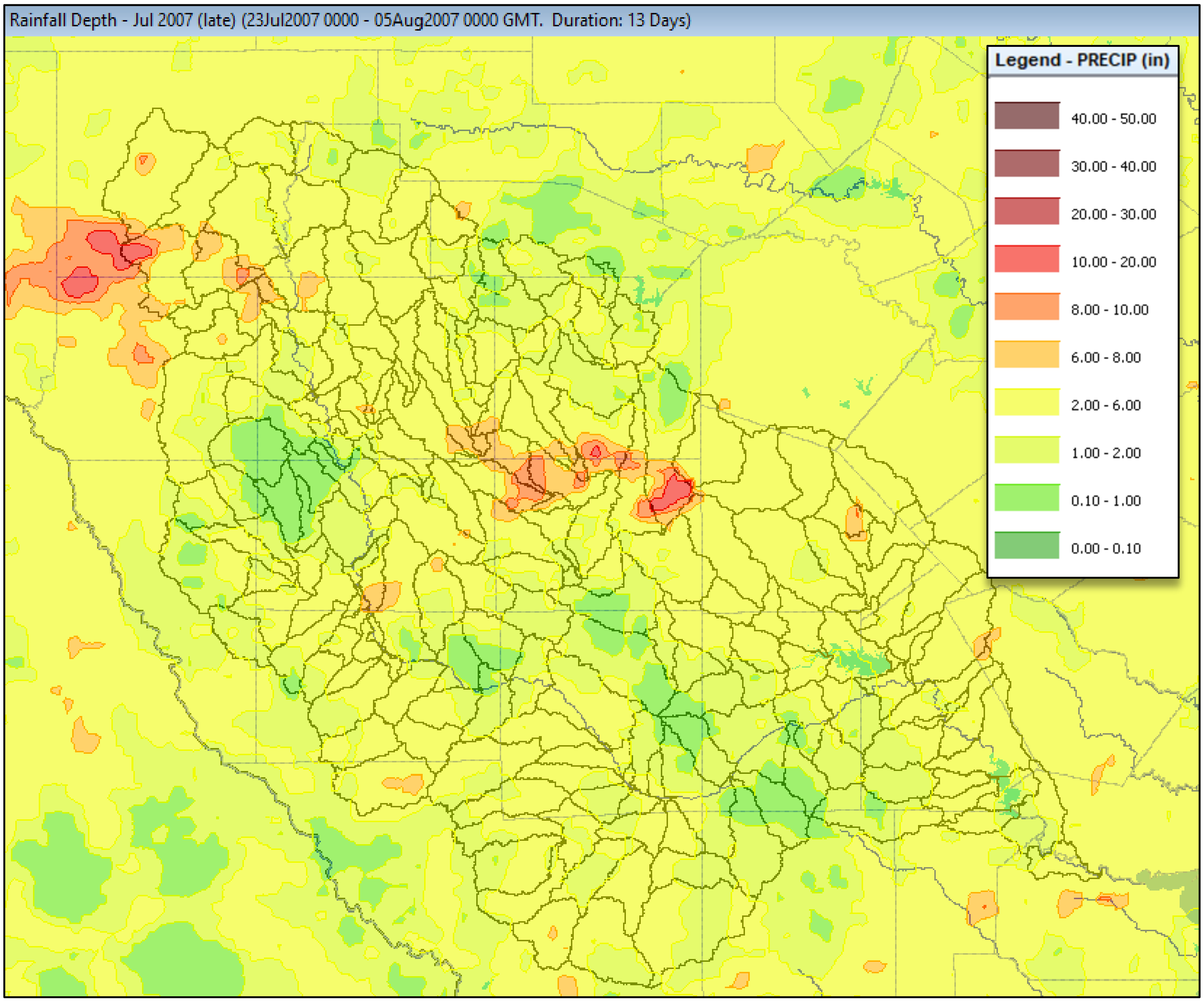


Figure B.14: Total Rainfall Depths (inches) for the July 2007 (late) Calibration Storm

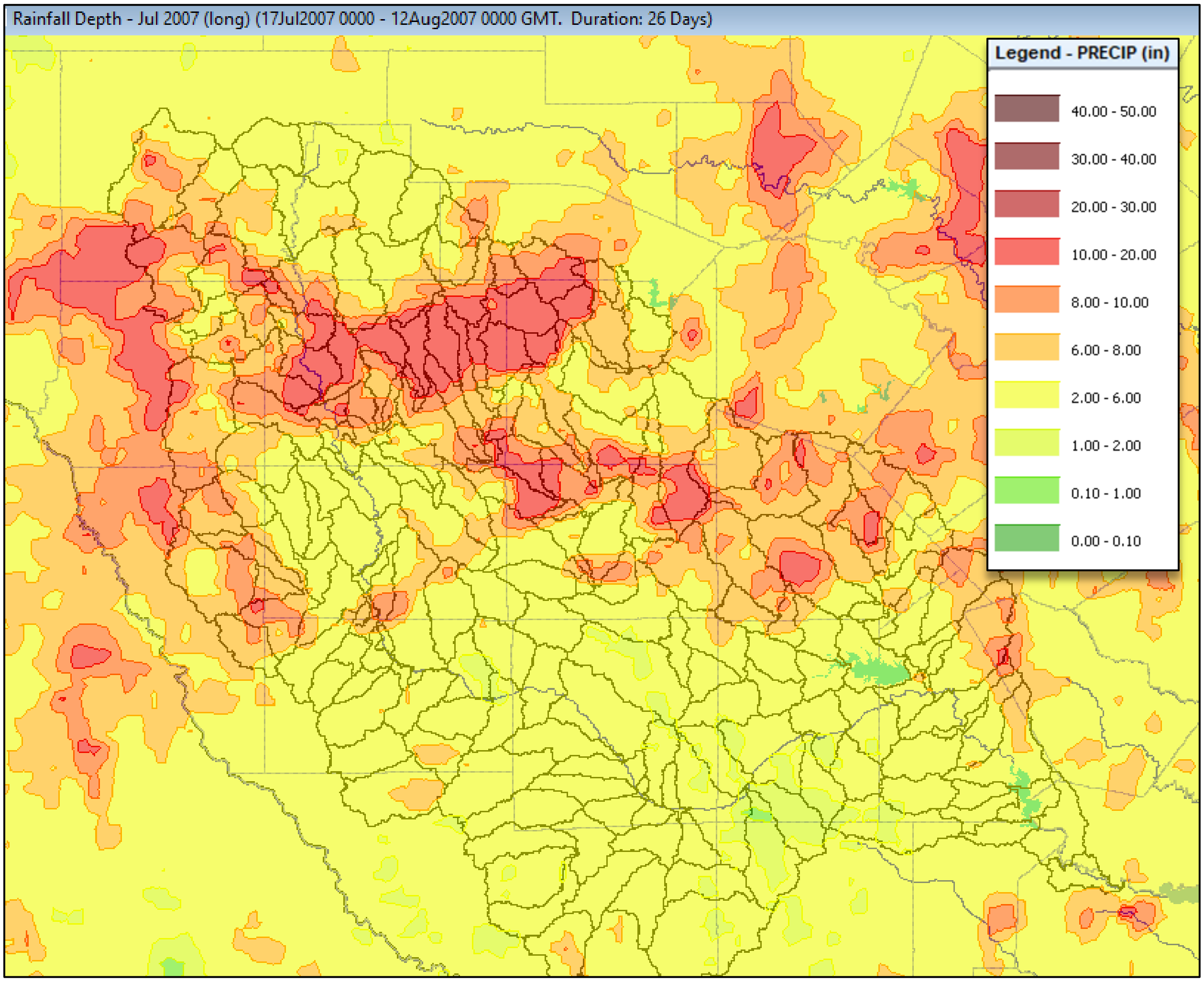


Figure B.15: Total Rainfall Depths (inches) for the July 2007 (long) Calibration Storm

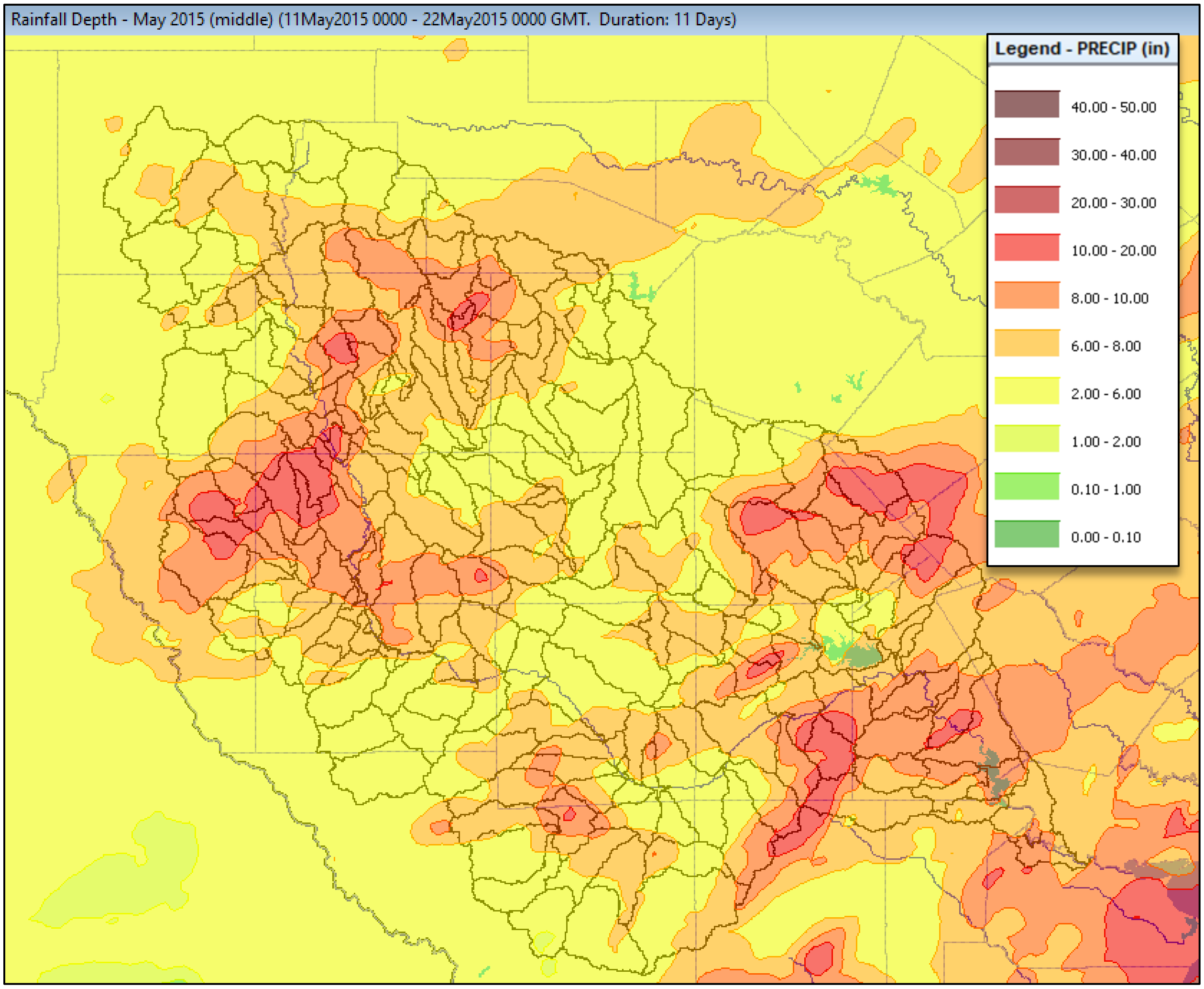


Figure B.16: Total Rainfall Depths (inches) for the May 2015 middle Calibration Storm

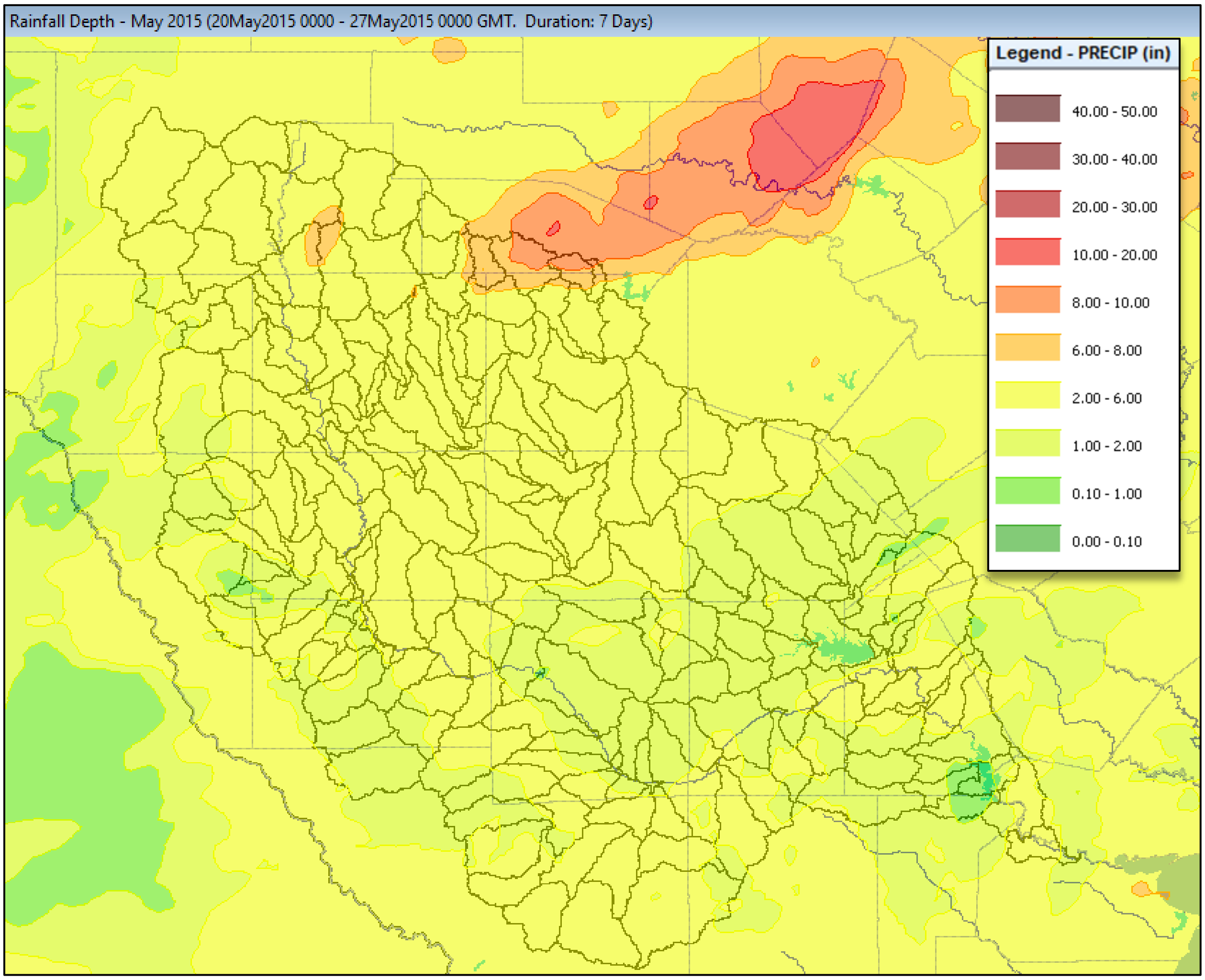


Figure B.17: Total Rainfall Depths (inches) for the May 2015 Calibration Storm

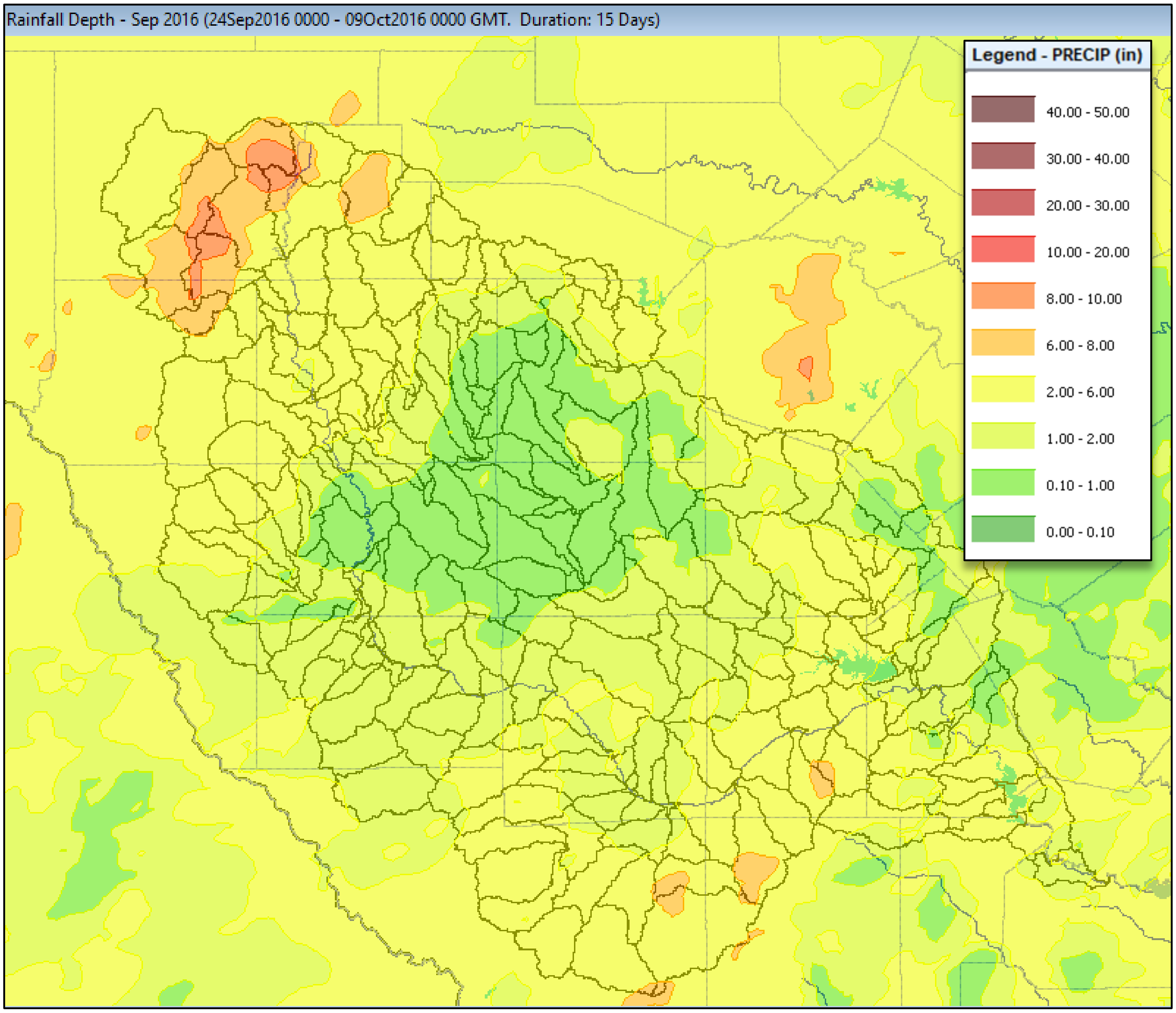


Figure B.18: Total Rainfall Depths (inches) for the September 2016 Calibration Storm

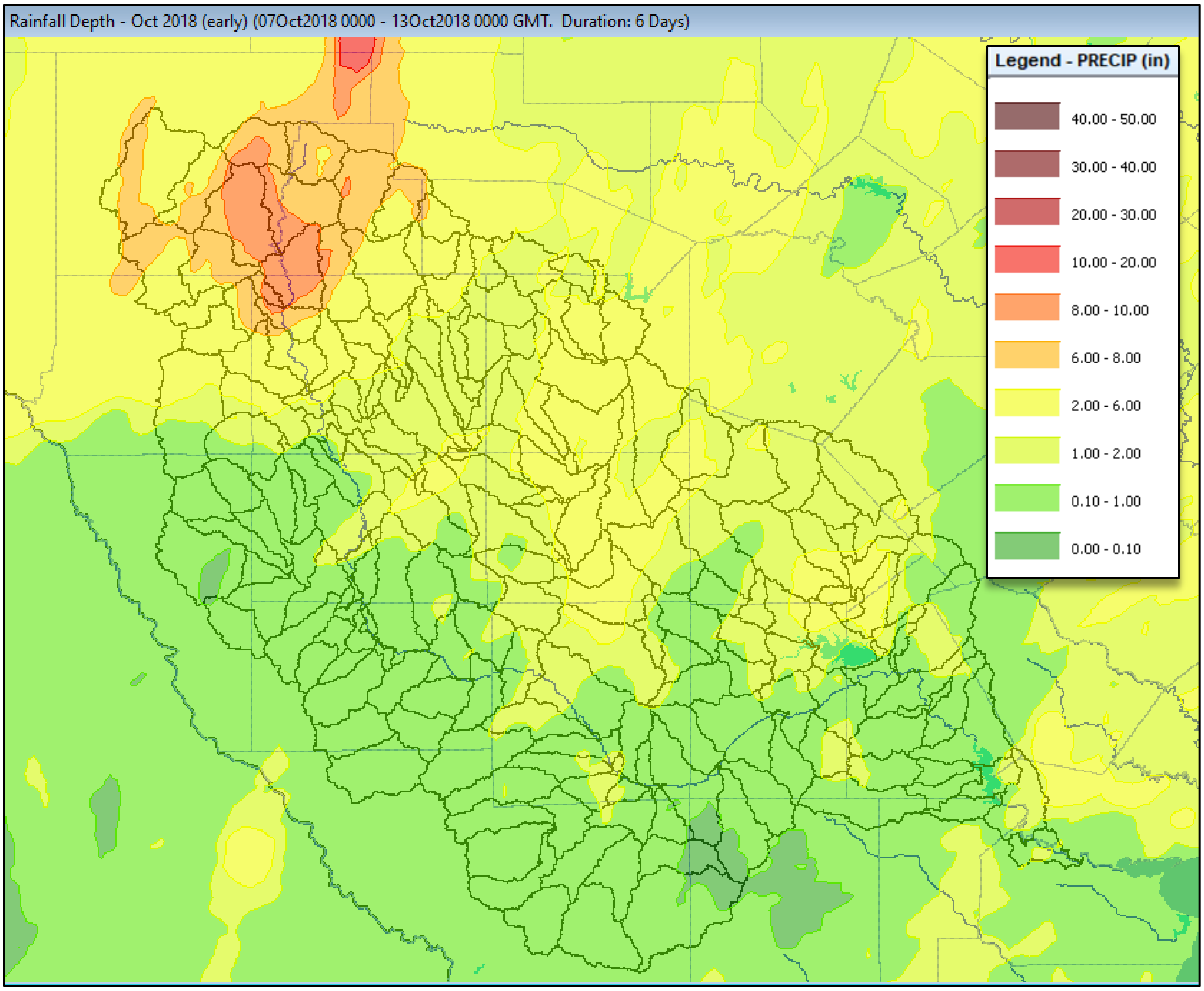


Figure B.19: Total Rainfall Depths (inches) for the October 2018 (early) Calibration Storm

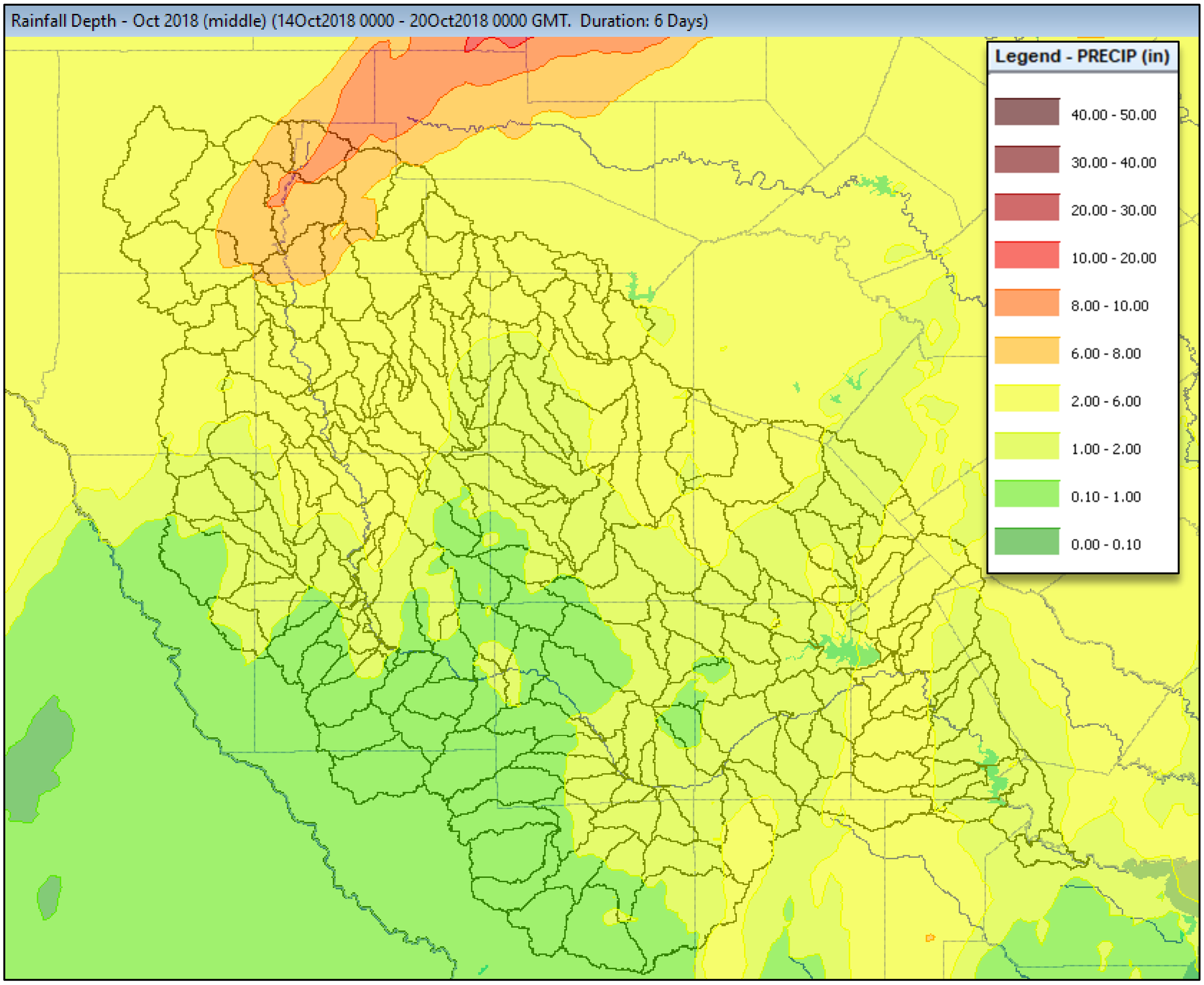


Figure B.20: Total Rainfall Depths (inches) for the October 2018 middle Calibration Storm

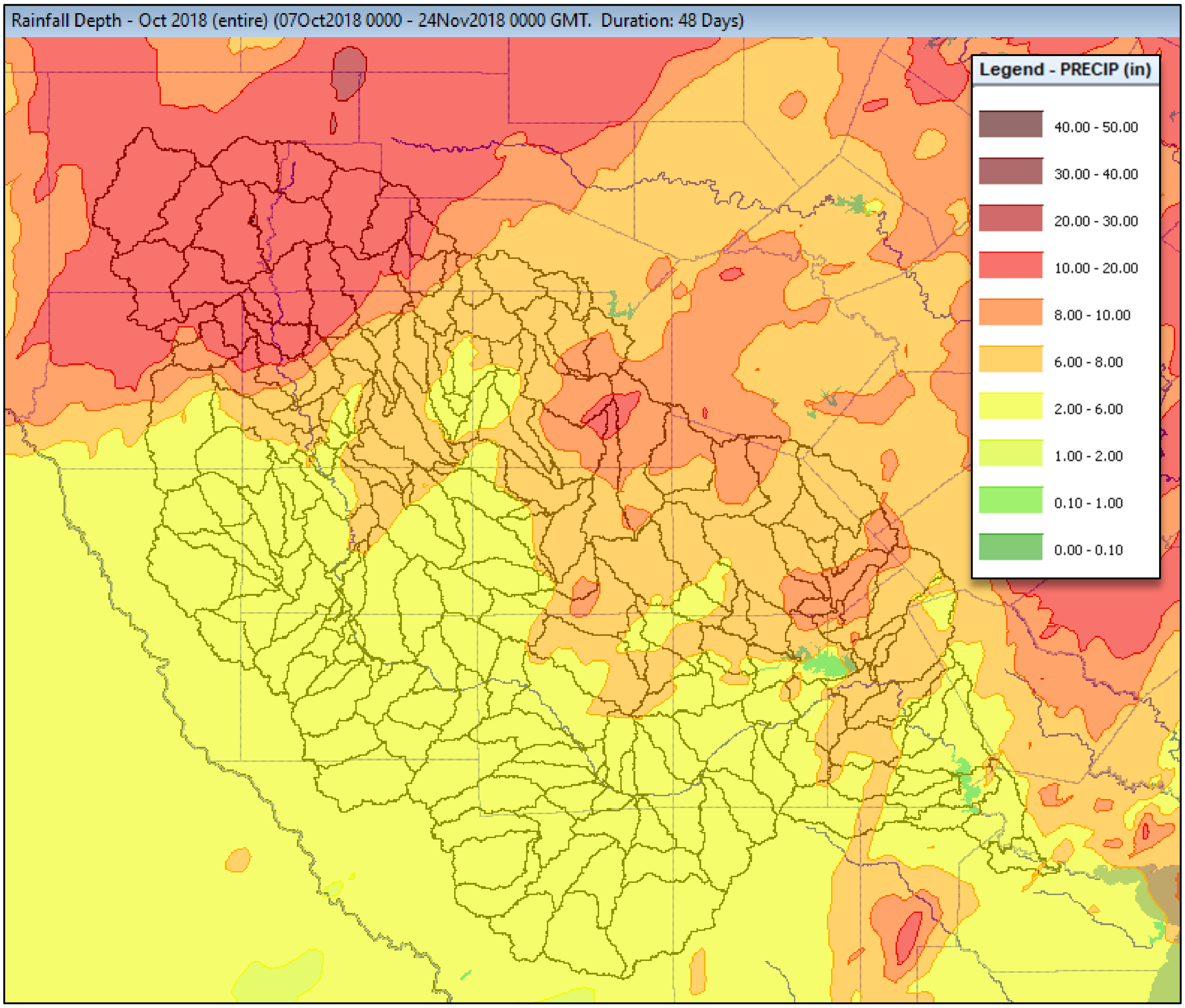


Figure B.21: Total Rainfall Depths (inches) for the October 2018 entire Calibration Storm

Table B.8: Calibrated Storm Events for Specific Gage Locations

USGS Gage Location	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007 Short
Nueces Rv at Laguna TX	142,000	139,000	82,000	69,600	13,200			26,500
W Nueces Rv nr Brackettville TX	230,000	72,300	46,400	43,600				
Nueces Rv bl Uvalde TX	201,000	102,000	83,200	63,500	21,700			80,100
Nueces Rv nr Asherton TX					12,600			
Nueces Rv at Cotulla TX					18,100			
San Casimiro Ck nr Freer TX				12,000	15,600	9,380	6,990	
Nueces Rv nr Tilden TX					31,500			
Frio Rv at Concan TX	47,500	56,200	59,900		42,100		36,400	
Dry Frio Rv nr Reagan Wells TX	55,000	31,900	25,500		97,900			12,000
Dry Frio Rv at FM 2690 nr Knippa TX								
Frio Rv bl Dry Frio Rv nr Uvalde TX	66,800	100,000	81,200		189,000			74,100
Sabinal Rv bl Mill Ck nr Vaderpool TX								
Sabinal Rv nr Sabinal TX		52,500	18,500		108,000			19,600
Sabinal Rv at Sabinal TX	5,910	93,500	19,700		119,000			42,000
Hondo Ck nr Tarpley TX		76,900	16,400		24,000			51,100
Hondo Ck at SH 173 nr Hondo TX		63,600	12,600		31,600			60,400
Middle Verde Ck at SH 173 nr Bandera TX								2,240
Seco Ck at Miller Rh nr Utopia TX		64,900	13,000		36,500			
Seco Ck at Rowe Rh nr D'Hanis TX		51,400	19,200		15,300			52,200
Leona Rv nr Uvalde TX								
Frio Rv nr Derby TX		56,400			44,300			
Frio Rv at Tilden TX		20,800			33,000	30,800		
San Miguel Ck nr Tilden TX					16,800	29,500		4,200
Choke Canyon Res nr Three Rivers, TX					221.33	223.59	222.42	
Choke Canyon Res OWC nr Three Rivers TX								
Atascosa Rv nr McCoy TX						5,060	2,600	2,340
Atascosa Rv at Whitsett TX				18,200	10,600	13,200	12,700	9,360
Nueces Rv nr Three Rivers TX					39,800	48,500	19,900	
Lagarto Ck nr George West TX								
Lk Corpus Christi nr Mathis TX					94.55	94.36	94.42	
Nueces Rv nr Mathis TX								
Nueces Rv at Bluntzer TX								
Nueces Rv at Calallen TX					38,500	47,800	25,300	

USGS Gage Location	Jul 2007 Late	Jul 2007 Long	May 2015 middle	May 2015	Sep 2016	Oct 2018 early	Oct 2018 middle	Oct 2018 entire
Nueces Rv at Laguna TX				16,400	42,200	71,500	71,300	
W Nueces Rv nr Brackettville TX	8,460				46,500	35,300	8,400	
Nueces Rv bl Uvalde TX				11,200	70,400	105,000	102,000	
Nueces Rv nr Asherton TX		6,100			7,650	11,800		
Nueces Rv at Cotulla TX		7,550						13,200
San Casimiro Ck nr Freer TX		2,090			1,130			
Nueces Rv nr Tilden TX								10,600
Frio Rv at Concan TX				20,600	14,000	23,300		
Dry Frio Rv nr Reagan Wells TX				10,600		13,000		
Dry Frio Rv at FM 2690 nr Knippa TX								
Frio Rv bl Dry Frio Rv nr Uvalde TX				28,900		11,000		
Sabinal Rv bl Mill Ck nr Vaderpool TX						5,630		
Sabinal Rv nr Sabinal TX				14,700		8,980		
Sabinal Rv at Sabinal TX				15,800		7,890		
Hondo Ck nr Tarpley TX				42,000				
Hondo Ck at SH 173 nr Hondo TX				29,100				
Middle Verde Ck at SH 173 nr Bandera TX				11,700				
Seco Ck at Miller Rh nr Utopia TX				12,900				
Seco Ck at Rowe Rh nr D'Hanis TX				19,500				
Leona Rv nr Uvalde TX	19,400		N/A					
Frio Rv nr Derby TX		38,600		16,400				
Frio Rv at Tilden TX		15,200						
San Miguel Ck nr Tilden TX	6,670			5,350				
Choke Canyon Res nr Three Rivers, TX		221.78		200.38				
Choke Canyon Res OWC nr Three Rivers TX								
Atascosa Rv nr McCoy TX	4,890		6,330					
Atascosa Rv at Whitsett TX			16,800					
Nueces Rv nr Three Rivers TX		14,700	15,000					9,940
Lagarto Ck nr George West TX								
Lk Corpus Christi nr Mathis TX		94.15	94.45					94.23
Nueces Rv nr Mathis TX								
Nueces Rv at Bluntzer TX			7,820					6,890
Nueces Rv at Calallen TX		16,700	9,730					7,680

1.4.2 Calibration Methodology

Following the initial parameter estimates, calibration simulations were made using observed hourly Next-Generation Radar (NEXRAD) Stage IV gridded precipitation data obtained from the West Gulf River Forecast Center (WGRFC). For each storm event, the model's calculated flow hydrographs were compared to the observed USGS stream flow data at the gages. The model's parameters were then adjusted to improve the match between the simulated and observed hydrographs for the observed events. Calibration was performed for the 16 storm events previously listed in Table B.6. Subbasin parameters that were adjusted during calibration included the subbasins' initial and constant loss rates, Snyder lag and peaking coefficients, and baseflow parameters. For the routing reaches, the Modified Puls number of subreaches and Muskingum routing parameters were adjusted as needed.

Calibration was generally performed from upstream to downstream, with all subbasins upstream of a specific gage receiving uniform adjustments, unless specific rainfall or observed flow patterns necessitated adjusting subbasin parameters on an individual basis. Generally, subbasin parameters were adjusted in a consistent order: first baseflow parameters, then subbasin loss rates and channel losses, and then Snyder lag and peaking coefficients. Modified Puls Routing subreaches and Muskingum routing parameters were the last to be adjusted. The methods of adjustment for each parameter are summarized in Table B.9.

To the extent possible, effort was made to calibrate the model's results to the volume, timing, peak magnitude, and shape of the observed flow hydrograph. However, imperfections in the observed rainfall data and streamflow data did not always allow for a perfect match. For example, the gridded NEXRAD rainfall data from the National Weather Service was only available on an hourly basis. This meant that intense bursts of rain that occurred in 15-min or 30-min timespans might not be adequately represented in the hourly rainfall data. It also meant that even though the model was being run on a 15-min time step, the timing of the hydrographs could only be calibrated to the nearest hour. Likewise, the observed flow values at the gages are calculated indirectly from the observed stage and a limited number of flow measurements. While abundant flow measurements were usually available in the low flow range, the number and quality of USGS flow measurements were often very limited in the high flow range, leading to uncertainty in some of the observed flow hydrographs. In cases where all aspects of the observed flow hydrograph could not be matched simultaneously, priority was given to matching the peak flow magnitude first, followed by the peak timing, which are the aspects of model calibration that are most relevant to the final frequency flow estimation.

Table B.9: HEC-HMS Calibration Approach

Parameter	Calibration Approach
Baseflow Parameters	First, the baseflow parameters were adjusted to match the observed flow rates at the start and end of each model simulation period. The initial discharges for the subbasins upstream of a certain gage were adjusted uniformly up or down to match the initial observed discharge at that gage. Similarly, the recession constant was adjusted to match the slope of the recession limb of the observed hydrograph, and the ratio to peak was adjusted to match the observed discharge at the end of the calibration event. All baseflow parameters were adjusted uniformly for all subbasins upstream of a given gage
Initial Loss (in)	After adjusting the baseflow parameters, the initial and constant losses were adjusted to calibrate the total volume of the flood hydrograph. The initial loss was adjusted according to the antecedent soil moisture conditions at the beginning of each observed storm event. The initial loss was increased or decreased until the timing and volume of the initial runoff generally matched the observed arrival of the flow hydrograph at the nearest downstream gage. All subbasins that were upstream of each gage were generally adjusted uniformly, unless specific rainfall and observed flow patterns necessitated adjusting the subbasin initial losses on an individual basis.
Constant Loss Rate (in/hr)	After adjusting the baseflow and initial loss parameters, the constant losses were adjusted to calibrate the total volume of the flood hydrograph. The subbasins' constant loss rates were increased or decreased until the volume and magnitude of the simulated hydrographs generally matched the observed volume of the flow hydrograph at the nearest downstream gage. The combination of the adjusted baseflow and loss rate parameters led to the total calibrated volume of runoff at the gage.
Channel Loss (cfs) and Fraction	After adjusting the subbasin loss rates, the channel losses were adjusted as needed to calibrate the total volume of the flood hydrograph at the downstream gage. In general, channel losses were adjusted to account for the loss in observed stream flow volume in acre-feet from one upstream gage to the next downstream gage. The channel losses were adjusted uniformly for all reaches above a given stream gage.
Snyder Lag (hours)	After adjusting the loss rates, the Snyder Lags (T_p) were the next parameters to be adjusted upstream of an individual gage. The Snyder Lags were adjusted to match the timing of the observed peak flow at the gage. Normally, all of the subbasin T_p's upstream of an individual gage were adjusted uniformly and proportionally to their initial values, unless the magnitude or shape of the observed hydrograph necessitated making individual adjustments. Efforts were also made to ensure that the adjusted T_p's still fell within a reasonable range, using the equivalent Snyder's lag times from the Fort Worth District Fort Worth District San Antonio Steep-Area (Upper Salado) and San Antonio Rolling – and Flatter-Area (Lower Salado) urban studies as a guide.
Snyder Peaking Coefficient	Snyder Peaking Coefficients (Cp) were adjusted to match the general shape of the observed flow hydrograph as higher peaking coefficients produce steeper, narrower flood hydrographs, and lower peaking coefficients produce flatter, wider flood hydrographs. An attempt was made to use the same peaking coefficient for all subbasins with similar watershed characteristics. For example, steep, hilly subbasins were given a higher peaking coefficient, whereas flatter subbasins, such as those near the coast, were given lower peaking coefficients. Efforts were also made to ensure that the adjusted peaking coefficients fell within the typical range of 0.4 to 0.8. In most cases, peaking coefficients were adjusted once and left alone between subsequent events.

Parameter	Calibration Approach
Modified Puls Routing Subreaches	The number of subreaches in the Modified Puls routing reaches were the final parameters to be adjusted when necessary. Calibration of routing parameters focused on storms that fell near the upstream end of the watershed and were routed downstream with little intervening subbasin flow. Adjustments to the number of subreaches in a given routing reach were made in order to match the amount of attenuation in the peak flow that occurred from the upstream end of a reach to the downstream gage. In a very few cases, where an adjustment to the subreaches was not sufficient to match the observed downstream hydrograph, a factor was also applied to the reach's storage volume in the storage-discharge curve.
Muskingum Routing Parameters	For areas of the model that included Muskingum routing, the Muskingum k, X and subreach values were adjusted as needed. Calibration of the routing parameters focused on storms that fell near the upstream end of the watershed and were routed downstream with little intervening local flow. The Muskingum k values were adjusted to match the timing of the observed peak flow at the gage, while the Muskingum X values were adjusted to match the relative flatness or steepness of the hydrograph. Finally, adjustments to the number of subreaches were made in order to match the amount of attenuation in the peak flow that occurred from the upstream end of a reach to the downstream gage.

In addition to the calibration methods described above, some non-conventional calibration methods were needed to calibrate portions of the Nueces River basin. As discussed in section 6.2, a split flow area is located on the Nueces River between Crystal City and Asherton. A 2D HEC-RAS analysis was developed to calculate an inflow-diversion curve at the split flow location as well as to calculate the Modified Puls storage-discharge relationships for the routing reaches along each reach of the split flow paths. This more detailed modeling of the split flow area helped to better calibrate the downstream gage at Asherton.

A 2D HEC-RAS analysis was also performed on the ungaged Turkey Creek watershed above Asherton. Turkey Creek is an ungaged portion of the Nueces River basin that encompasses approximately 2,000 square miles of drainage area. With no observed data available to help calibrate this portion of the HEC-HMS model, it was a prime candidate for a 2D runoff analysis. In addition, no existing hydraulic models were available within the Turkey Creek watershed to develop Modified Puls routing data for HEC-HMS. Therefore, a 2D HEC-RAS model was developed for the Turkey Creek watershed upstream of Highway 83, and the model was used to estimate Modified Puls routing parameters and to calibrate the Snyder's subbasin transform parameters. For more information on the 2D HEC-RAS analysis for Turkey Creek, see Appendix F.

Another issue that needed special attention was the calibration of channel losses in the HEC-HMS model. A unique aspect of the hydrology of the Nueces River basin is that peak flows have been observed to decrease dramatically from upstream to downstream along certain stream reaches. Figure B.22 illustrates one example of this decrease in streamflow by comparing the observed streamflow at the Nueces River USGS gages at Uvalde and Asherton during the 1996 flood event. Asherton is located approximately 60 miles downstream of Uvalde, and as one can see from this figure, the 201,000 cfs observed peak flow at Uvalde was reduced to only 12,900 cfs by the time the flood reached the Asherton gage. In addition, 84% of the total volume of water that passed the upstream gage never reached the gage at Asherton. This phenomenon is observed for multiple events at multiple locations throughout the Nueces River basin, primarily at the locations where the streams cross the aquifer outcrops and where the streams abruptly transition from steep, narrow hill country watersheds to wide, irrigated floodplains. These dramatic decreases in streamflow are likely due to a combination of factors including aquifer recharge, irrigation withdrawals and floodplain attenuation. For these reaches, part of the model calibration process involved calibrating the channel losses along the losing reaches of the rivers. The constant loss method was used in HEC-HMS for these reaches, and the constant flow rate along with the fraction of inflow to be lost were adjusted through calibration to multiple flood events. After calibrating those channel loss parameters, the watershed model results matched the observed data at the downstream gages very well. More information on the results of those calibrations is included in section 1.4.4 of this appendix.

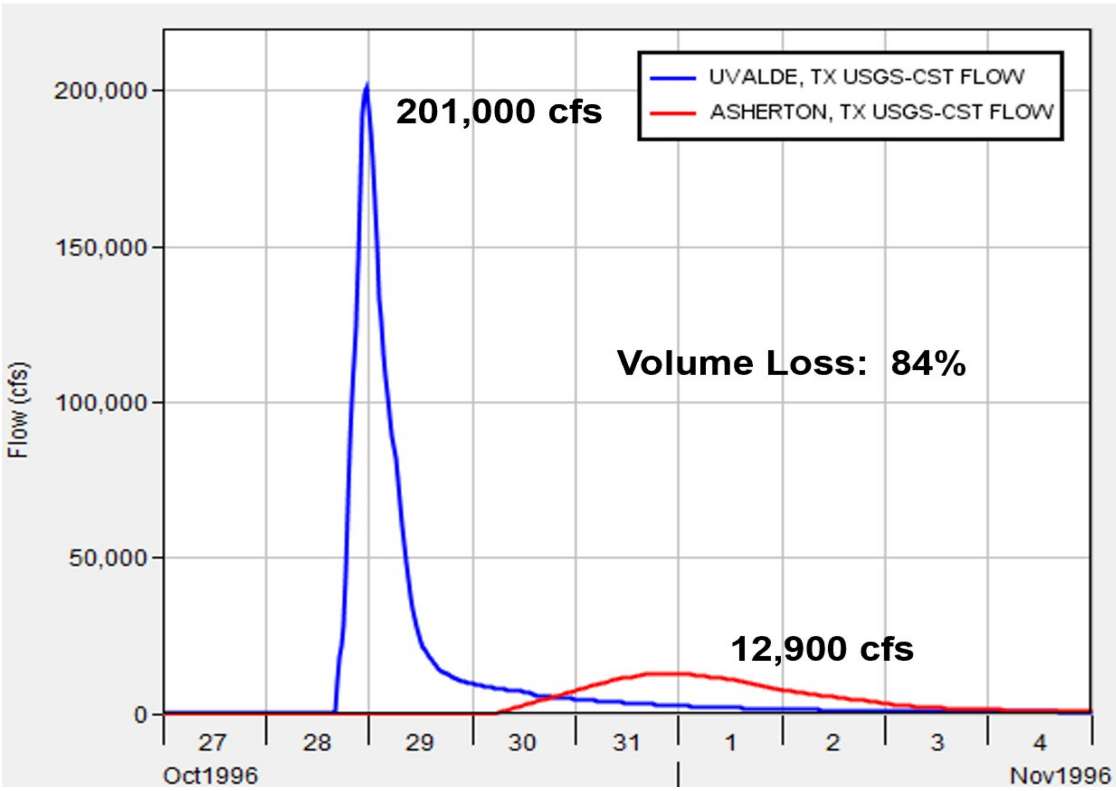


Figure B.22: Decreasing Streamflow on the Nueces River between Uvalde and Asherton.

1.4.3 Calibrated Parameters

The resulting calibrated subbasin and routing reach parameters that were adjusted for each storm event are shown in Tables B.10 through B.22.

Table B.10: Calibrated Initial Losses (inches)

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0.5	0.1	1.1	2.7	4.5			2	2.85		3.2	3	4.39	1.7	4.39
NuecesRv_W_S011	0.5	0.1	1.1	2.7	6			2	2.85		3.2	3	4.39	1.7	4.39
NuecesRv_W_S020	0.5	0.1	1.1	2.7	4.5			2	3		3.2	3	4.39	1.65	4.39
NuecesRv_W_S021	1.5	0.1	1.1	2.7	6			2	2.3		3.2	3	4.39	1.65	4.39
NuecesRv_W_S022	2	2	5.3	2.7	4.5			2	2.85		2	3	3.5	1.7	3.5
NuecesRv_W_S030	4	2	4	2	0.5			3			2.5	3.5	1.2	2	1.2
NuecesRv_W_S031	4	2	4	2	0.5			3			3.5	3.5	2	2	2
NuecesRv_W_S032	4	2	4.5	2	2.5			4.5			3	3.5	2	2	2
NuecesRv_S011	3.1	0.1	1	2	3			1.9			3	3.3	2.5	1.95	2.5
NuecesRv_S010	3.1	0.1	1	2	3			1.9			3	3.3	2.5	1.95	2.5
NuecesRv_S012	3.1	0.1	1.5	2	3			1.9			1.5	3.3	2.5	1.9	2.5
NuecesRv_S020	3.1	0.1	1.5	2	3			1.9			2	3.3	2.8	1.9	2.8
NuecesRv_S030	3.1	0.5	2.9	2.3	3			1.9			1.9	1	4.5	2	4.5
NuecesRv_S041	2.75	0.5	1.6	2.3	3			1.9			2	2	3	2	3
NuecesRv_S040	2.75	2	2.5	1.5	2.9			1.9			2	2	3.7	2	3.7
NuecesRv_S050	4	2	2.5	2	4.5			3.2			4	2	2	2	2
NuecesRv_S061	4	2	2	2	3.5			3.2			3.5	2	1	2	1
NuecesRv_S060	0.3	2	0.3	0.3	2.9			3.5			4	2	1	2	1
NuecesRv_S070	0.1	2	0.1	0.1	5.5			3.5			4	2	1	2	1
NuecesRv_S071	0	2	0	0	2			3			4	2	1	2	1

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	2	2			3.5			2				2	0.5		0.5
NuecesRv_S081	2	2			3.5			2				2	0.5		0.5
NuecesRv_S082	2	2			3.5			2				2	0.5		0.5
NuecesRv_S083	2	2			3.5			2				2	0.5		0.5
NuecesRv_S084	2	2			3.5			2				2	0.5		0.5
NuecesRv_S090	2	2			3.5			2				2	0.5		0.5
N_ChaconCk_S010	0.9	2			4.5			4				3.6	4		4
N_ChaconCk_S020	2	2			4.5			4				3.6	4		4
N_ChaconCk_S021	2	2			4.5			4				3.6	4		4
N_ChaconCk_S023	2	2			4.5			4				3.6	4		4
N_ChaconCk_S022	2	2			4.5			4				3.6	4		4
N_PicosaCk_S010	2	2			4.5			4				3.6	4		4
N_PicosaCk_S011	2	2			4.5			4				3.6	4		4
N_PicosaCk_S020	2	2			4.9			4				3.6	4		4
N_TurkeyCk_S010	2	2			4.5			4				3.6	4		4
N_TurkeyCk_S011	2	2			4.5			4				3.6	4		4
N_TurkeyCk_S012	2	2			4.5			4				3.6	4		4
N_ChapCk_S010	2	2			4.5			4				3.6	4		4
N_ChapCk_S011	2	2			4.5			4				3.6	4		4
N_TurkeyCk_S020	2	2			4.5			4				3.6	0.05		0.05
N_PicosaCk_S021	2	2			4.9			4				3.6	4		4
N_TurkeyCk_S030	2	2			4.9			4				3.6	0.5		0.5
N_TurkeyCk_S031	2	2			4.5			4				3.6	4		4

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	2	2			4.2			2				3	0.5		0.5
TurkeyCk_S041	2	2			4.2			2				3	1		1
N_TurkeyCk_S050	2	2			4.2			2				3	1		1
N_TurkeyCk_S060	2	2			4.2			2				3	1		1
N_TurkeyCk_S061	2	2			4.2			2				3	1		1
N_TurkeyCk_S070	2	2			4.2			2				3	1		1
N_TurkeyCk_S080	2	2			4.2			2				3	1		1
N_TurkeyCk_S081	2	2			4.2			2				3	1		1
N_TurkeyCk_S090	2	2			4.2			2				3	1		1
NuecesRv_S100					6			2							2
NuecesRv_S101					7			2							2
NuecesRv_S110					4			3							2
NuecesRv_S111					4			1							2
N_SanRoqCk_S010					3			3.5							2
N_SanRoqCk_S011					3			3.5							2
N_SanRoqCk_S020					3			4.5							2
N_SanRoqCk_S021					3			1							2
NuecesRv_S121					9.5			1							2
NuecesRv_S120					3.5			1							2
NuecesRv_S122					0.5			2.1							2.5
NuecesRv_S130					7	4		4							2
N_LaRaicesCk_S010					7	3		3							2
N_LaRaicesCk_S011					7	3		3							2

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					7	3		3							2
N_CalmanCk_S010					7	3		3							2
N_CalmanCk_S011					7	3		3							2
NuecesRv_S150					7	3		3							2
N_LosOlmosCk_S012					7	4		2							2
N_LosOlmosCk_S011					7	3		3							2
N_LosOlmosCk_S010					7	3.5		3							2
N_LosOlmosCk_S020					7	5.5		3							2
NuecesRv_S151					7	3		3							2
NuecesRv_S160					7	3		3							2
NuecesRv_S161					7	3		3							2
N_SanCasCk_S010				1.8	2.5	4.4	2	2				2.5			2
N_SanCasCk_S020				1.8	3.6	4.4	1.8	1.3				2			2
N_SanCasCk_S021				1	2.5	2.5	3.3	1				2			2
N_SanCasCk_S011				3	1.8	2.5	2.5	2				3.5			2
N_SanCasCk_S030					5	3		2							2
NuecesRv_S170					6	3		3							2
N_BlackCk_S010					4.8	3		2							2
N_BlackCk_S020					5.5	3		2							2
N_BlackCk_S021					5.5	3		2							2
NuecesRv_S180					7	2		1.3							2
NuecesRv_S185					7	2		1.3							2
NuecesRv_S190					7	2		1.3							2

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					7	2		1.3							2
NuecesRv_S210					4.5	5		1.85							2
NuecesRv_S220					5.5	3	4	4		5.5					2
NuecesRv_S221					5.5	3	5	5		5.5					2
NuecesRv_S222					5	3	4	4		5.5					2
NuecesRv_S230					5	3	5	5		5.5					2
NuecesRv_S231					4	4	5	5		5.5					3
FrioRv_S011	3.3	1	2.6		2		0.5	0.5			2	3	1		1.0
FrioRv_S010	3.3	1	2.6		2		0.5	0.5			2	3.4	1		1.0
FrioRv_S020	3	0.9	2.6		2		0.5	0.5			2.3	1.7	0.5		0.5
FrioRv_S030	0.3	2	0		10			3			1.5		1.5		1.5
FrioRv_D_S010	1.25	0.05	0.5		1			1.35			0.7		1.5		1.5
FrioRv_D_S020	0.5	2	0		10			2			1.5		1.5		1.5
FrioRv_D_S030	0.3	2	0		10			2			1.5		1.3		1.3
FrioRv_S040	0.3	2	0		10			2			2		1		1
FrioRv_S051		3			10			3			10				
F_BlancoCk_S010		4			10			7			10				
F_BlancoCk_S020		3			10			6			10				
F_SabinalRv_S010	3.02	1.2	4.8		7.6			2.2			2.5		1.35		1.2
F_SabinalRv_S020	3.02	1.1	4.8		7.6			2.2			3.2		1.2		1.2
F_SabinalRv_S021	3.02	1.1	2.9		7.6			2.15			2.3		1.7		1.7
F_SabinalRv_S030	1.5	1.5	3.5		3			3.5			2.3		1.8		1.8
F_SabinalRv_S041		4			10			7			10				

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		4			10			5			10				
F_SabinalRv_S050		4			10			6			10				
F_SabinalRv_S055		4			10			5			10				
FrioRv_Sab_S060		3			10			5			10				
FrioRv_S070		3			10			5			10				
FrioRv_S071		3			10			5			10				
FrioRv_S072		3			10			5			10				
F_HondoCk_S010		0.5	6.8		8.2			2.5			2.5				
F_HondoCk_S020		5.4	7.7		10			4.5			3.3				
F_HondoCk_S021		4			10			4			10				
F_MVerdeCk_S010		5.5			6.5			2.3			4.75				
F_MVerdeCk_S011		5.5			10			4			10				
F_MVerdeCk_S021		5.5			10			4			10				
F_MVerdeCk_S020		5.5			10			4			10				
F_HondoCk_S030		5.5			10			4			10				
F_HondoCk_S031		5.5			10			5			10				
F_SecoCk_S010	1.61	0.1	5		6.5			6.43			2.88				
F_SecoCk_S020		2	4.5		5.3			4.5			2				
F_SecoCk_S021		2	4		5			4			2				
F_SecoCk_S030		5.5			10			5			10				
F_SecoCk_S031		4			10			5			10				
F_HondoCk_S040		4			10			5			10				
FrioRv_S080		4			4			2			10				

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		3			10			6	1	3	0.5				
F_LeonaRv_S011		3			10			4	1	2.5	0.5				
F_LeonaRv_S012		3			10			5	1	3	0.5				
F_LeonaRv_S020		3			10			3	1	2.5	1				
F_LeonaRv_S021		3			10			2			10				
F_LeonaRv_S022		3			10			2			10				
F_LeonaRv_S023		3			10			2			10				
F_LeonaRv_S030		3			10			2			10				
F_LeonaRv_S031		3			10			2			10				
F_LeonaRv_S040		3			10			2			10				
F_LeonaRv_S041		3			12			2			10				
F_LeonaRv_S042		3			4			2			10				
FrioRv_S090		4			4.2			2.2			10				
FrioRv_S100		3			5	3.5		3			10				
FrioRv_S101		3			5	3		2			10				
FrioRv_S102		3			5	1		2			10				
F_CiboloCk_S010		3			5	3.5		2			10				
F_CiboloCk_S011		3			5	3.5		2			10				
F_CiboloCk_S020		3			5	1		2			10				
FrioRv_S110		3			5.2	1		2			10				
FrioRv_S111		3			5.2	1		2			10				
FrioRv_S112		3			5.2	1		2			10				
FrioRv_S113		3			5	3		2			10				

	Calibrated Initial Loss (inches)													
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		2			5.5	3		2			10				
FrioRv_S120					10	7	7	7			10				
F_SanMigCk_S010					4	2.2		2.8	1.5		2.5				
F_SanMigCk_S011					4	2.2		2.5	1.5		2.5				
F_SanMigCk_S020					5	2.2		2	0.4		2.5				
F_SanMigCk_S022					2	2		2	0.3		2.5				
F_SanMigCk_S021					3	2		2	0.3		2.5				
F_SanMigCk_S023					5.5	3		3	1		2.5				
F_SanMigCk_S024					10	7	7	7			10				
ChokeCanyon_S010					10	9	9	9			10				
FrioRv_S130					3	4	4	4		5.5					10
Atascosa_S010				2	6.5	3	3	1.3	1.3	4					3
Atascosa_S011				2	5	3	4	2	1.3	2.4					3
Atascosa_S020				2	6.5	4	4	1.9	1.3	1.9					3
Atascosa_S030				2	6.5	5.68	4.2	2.85	0.6	3.4					3
Atascosa_S031				0.8	6.1	4	1.5	1	0.5	1.5					3
Atascosa_S040				0.8	6.1	3.8	2	0.8	0.5	1					3
Atascosa_S041				0.8	6.1	3.8	1.5	0.8	0.5	1.5					3
Atascosa_S050				2.2	6.2	4.5	1.5	1	2.2	3					3
La_ParitaCk_S010				0.8	5	4.4	1.5	2	1.5	3					3
La_ParitaCk_S020				0.8	5.5	4.4	1.5	2	1.5	3					3
La_ParitaCk_S030				4	5.5	4	1.5	2	1.5	3					3
Atascosa_S060				7	6	3	1.9	1	1.5	1.5					3

	Calibrated Initial Loss (inches)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					5	5	7	4.5		4.5					3
Atascosa_S071					5	5	6	4.5		0.5					3
Atascosa_S080					3	4	6	4.5		5.5					3
FrioRv_S140					3	4	4	4		5.5					3
NuecesRv_S240					5	1.8	3	1		7					2.4
NuecesRv_S250					5	1.8	3	1		8					2.4
NuecesRv_S260					2.5	1.8	3	1		8					2.4
NuecesRv_S261					2.5	1.8	3	1		8					2.4
NuecesRv_S270					2.5	1.8	2	1		8					2.4
NuecesRv_S290					2.5	1.5	2	1		2.9					2.6
N_LagartoCk_S010					3	1.5	5.5	2		4					3
N_LagartoCk_S020					2.5	1.5	5.8	1		2.2					3
RamirenaCk_S010					2.5	1.5	5.8	1		2.9					3
RamirenaCk_S020					2.5	1.5	5.8	1		2.9					3
CorpusChristi_S010					2.5	1.5	5.8	1		2.2					2.6
CorpusChristi_S011					2.5	1.5	5.8	1		2.2					2.6
NuecesRv_S300					3	0.5	3	0.5		2					2
NuecesRv_S310					1.8	0.5	3	0.5		3					2

Table B.11: Calibrated Constant Losses (inches per hour)

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0.06	0.02	0.22	0.26	0.5			0.25	0.34		0.4	0.22	0.3	0.14	0.3
NuecesRv_W_S011	0.06	0.02	0.22	0.26	0.5			0.25	0.34		0.5	0.22	0.3	0.14	0.3
NuecesRv_W_S020	0.05	0.02	0.22	0.26	0.5			0.25	0.29		0.4	0.22	0.3	0.16	0.3
NuecesRv_W_S021	0.08	0.02	0.22	0.26	0.6			0.25	0.4		0.4	0.22	0.3	0.16	0.3
NuecesRv_W_S022	0.15	0.1	0.3	0.26	0.5			0.25	0.29		0.25	0.22	0.3	0.08	0.3
NuecesRv_W_S030	0.22	0.02	0.02	0.05	0.3			0.3			0.45	0.1	0.05	0.05	0.05
NuecesRv_W_S031	0.22	0.02	0.02	0.05	0.3			0.3			0.45	0.1	0.05	0.05	0.05
NuecesRv_W_S032	0.22	0.02	0.02	0.05	0.55			0.4			0.45	0.1	0.05	0.05	0.05
NuecesRv_S011	0.13	0.02	0.08	0.1	0.5			0.3			0.45	0.3	0.28	0.1	0.28
NuecesRv_S010	0.13	0.02	0.08	0.1	0.5			0.3			0.45	0.3	0.28	0.1	0.28
NuecesRv_S012	0.13	0.02	0.12	0.12	0.4			0.3			0.4	0.3	0.28	0.1	0.28
NuecesRv_S020	0.13	0.02	0.12	0.12	0.5			0.3			0.41	0.3	0.28	0.1	0.28
NuecesRv_S030	0.13	0.02	0.25	0.14	0.5			0.3			0.41	0.1	0.28	0.15	0.28
NuecesRv_S041	0.13	0.02	0.1	0.14	0.4			0.3			0.2	0.2	0.28	0.13	0.28
NuecesRv_S040	0.16	0.1	0.2	0.18	0.35			0.4			0.14	0.2	0.28	0.13	0.28
NuecesRv_S050	0.22	0.1	0.02	0.05	0.55			0.15			0.5	0.1	0.05	0.05	0.05
NuecesRv_S061	0.22	0.1	0.02	0.05	0.3			0.16			0.5	0.1	0.05	0.05	0.05
NuecesRv_S060	0.05	0.1	0.02	0.05	0.5			0.28			0.5	0.1	0.05	0.05	0.05
NuecesRv_S070	0.02	0.1	0.02	0.02	0.5			0.28			0.5	0.1	0.05	0.05	0.05
NuecesRv_S071	0.01	0.1	0.01	0.01	0.5			0.28			0.45	0.1	0.05	0.05	0.05

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	0.26	0.26			0.21			0.1				0.1	0.05		0.05
NuecesRv_S081	0.25	0.25			0.21			0.1				0.1	0.05		0.05
NuecesRv_S082	0.25	0.25			0.21			0.1				0.1	0.05		0.05
NuecesRv_S083	0.27	0.27			0.22			0.18				0.1	0.05		0.05
NuecesRv_S084	0.27	0.27			0.22			0.18				0.1	0.05		0.05
NuecesRv_S090	0.25	0.25			0.22			0.18				0.1	0.05		0.05
N_ChaconCk_S010	0.4	0.2			0.21			0.23				0.12	0.1		0.1
N_ChaconCk_S020	0.18	0.18			0.21			0.23				0.12	0.1		0.1
N_ChaconCk_S021	0.17	0.17			0.21			0.23				0.12	0.1		0.1
N_ChaconCk_S023	0.21	0.21			0.21			0.23				0.12	0.1		0.1
N_ChaconCk_S022	0.19	0.19			0.21			0.23				0.12	0.1		0.1
N_PicosaCk_S010	0.12	0.12			0.21			0.23				0.12	0.1		0.1
N_PicosaCk_S011	0.2	0.2			0.21			0.23				0.12	0.1		0.1
N_PicosaCk_S020	0.21	0.21			0.21			0.23				0.12	0.1		0.1
N_TurkeyCk_S010	0.17	0.17			0.21			0.23				0.12	0.1		0.1
N_TurkeyCk_S011	0.25	0.25			0.21			0.23				0.12	0.1		0.1
N_TurkeyCk_S012	0.23	0.23			0.21			0.23				0.12	0.1		0.1
N_ChapCk_S010	0.2	0.2			0.21			0.23				0.12	0.1		0.1
N_ChapCk_S011	0.22	0.22			0.21			0.23				0.12	0.1		0.1
N_TurkeyCk_S020	0.19	0.19			0.21			0.23				0.12	0.05		0.05
N_PicosaCk_S021	0.22	0.22			0.21			0.23				0.12	0.1		0.1
N_TurkeyCk_S030	0.17	0.17			0.21			0.23				0.12	0.05		0.05
N_TurkeyCk_S031	0.18	0.18			0.21			0.23				0.12	0.1		0.1

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	0.22	0.22			0.22			0.18				0.12	0.05		0.05
TurkeyCk_S041	0.27	0.27			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S050	0.27	0.27			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S060	0.17	0.17			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S061	0.21	0.21			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S070	0.25	0.25			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S080	0.19	0.19			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S081	0.12	0.12			0.22			0.18				0.12	0.1		0.1
N_TurkeyCk_S090	0.19	0.19			0.22			0.18				0.12	0.1		0.1
NuecesRv_S100					0.45			0.25							0.25
NuecesRv_S101					0.45			0.25							0.25
NuecesRv_S110					0.45			0.3							0.25
NuecesRv_S111					0.45			0.15							0.25
N_SanRoqCk_S010					0.3			0.35							0.35
N_SanRoqCk_S011					0.3			0.35							0.35
N_SanRoqCk_S020					0.3			0.45							0.35
N_SanRoqCk_S021					0.3			0.1							0.35
NuecesRv_S121					0.45			0.1							0.25
NuecesRv_S120					0.4			0.1							0.25
NuecesRv_S122					0.2			0.25							0.3
NuecesRv_S130					0.45	0.2		0.25							0.25
N_LaRaicesCk_S010					0.25	0.2		0.25							0.25
N_LaRaicesCk_S011					0.25	0.2		0.25							0.25

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					0.25	0.2		0.25							0.25
N_CalmanCk_S010					0.25	0.2		0.22							0.25
N_CalmanCk_S011					0.25	0.2		0.22							0.25
NuecesRv_S150					0.25	0.2		0.22							0.25
N_LosOlmosCk_S012					0.25	0.15		0.25							0.25
N_LosOlmosCk_S011					0.25	0.15		0.25							0.25
N_LosOlmosCk_S010					0.25	0.15		0.25							0.25
N_LosOlmosCk_S020					0.25	0.15		0.25							0.25
NuecesRv_S151					0.25	0.05		0.25							0.25
NuecesRv_S160					0.25	0.05		0.25							0.25
NuecesRv_S161					0.25	0.05		0.2							0.25
N_SanCasCk_S010				0.2	0.3	0.4	0.4	0.35				0.24			0.25
N_SanCasCk_S020				0.2	0.3	0.35	0.04	0.25				0.25			0.25
N_SanCasCk_S021				0.2	0.3	0.09	0.04	0.16				0.25			0.25
N_SanCasCk_S011				0.2	0.24	0.09	0.45	0.22				0.25			0.25
N_SanCasCk_S030					0.24	0.05		0.2							0.25
NuecesRv_S170					0.28	0.05		0.25							0.25
N_BlackCk_S010					0.24	0.05		0.1							0.25
N_BlackCk_S020					0.24	0.05		0.1							0.25
N_BlackCk_S021					0.24	0.05		0.1							0.25
NuecesRv_S180					0.29	0.2		0.25							0.25
NuecesRv_S185					0.29	0.2		0.2							0.25
NuecesRv_S190					0.29	0.2		0.25							0.25

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					0.29	0.2		0.25							0.25
NuecesRv_S210					0.36	0.2		0.2							0.25
NuecesRv_S220					0.5	0.4	0.35	0.35		0.5					0.25
NuecesRv_S221					0.5	0.4	0.35	0.35		0.5					0.25
NuecesRv_S222					0.5	0.4	0.35	0.35		0.5					0.25
NuecesRv_S230					0.5	0.4	0.35	0.35		0.5					0.25
NuecesRv_S231					0.5	0.4	0.35	0.35		0.5					0.2
FrioRv_S011	0.13	0.2	0.3		0.01		0.05	0.1			0.28	0.3	0.22		0.22
FrioRv_S010	0.13	0.2	0.3		0.01		0.05	0.1			0.28	0.18	0.22		0.22
FrioRv_S020	0.13	0.02	0.3		0.01		0.05	0.2			0.18	0.35	0.15		0.15
FrioRv_S030	0.01	0.02	0.01		0.5			0.14			0.18		0.2		0.2
FrioRv_D_S010	0.01	0.02	0.12		0.01			0.2			0.1		0.46		0.46
FrioRv_D_S020	0.01	0.02	0.01		0.5			0.14			0.3		0.2		0.2
FrioRv_D_S030	0.01	0.02	0.01		0.5			0.2			0.3		0.2		0.2
FrioRv_S040	0.01	0.02	0.01		0.5			0.2			0.2		0.2		0.2
FrioRv_S051		0.3			0.5			0.4			0.5				
F_BlancoCk_S010		0.3			0.5			0.4			0.5				
F_BlancoCk_S020		0.3			0.5			0.4			0.5				
F_SabinalRv_S010	0.19	0.33	0.3		0.3			0.3			0.32		0.33		0.33
F_SabinalRv_S020	0.19	0.32	0.3		0.3			0.3			0.32		0.24		0.24
F_SabinalRv_S021	0.19	0.32	0.3		0.3			0.4			0.18		0.24		0.24
F_SabinalRv_S030	0.1	0.05	0.38		0.01			0.05			0.1		0.3		0.3
F_SabinalRv_S041		0.3			0.14			0.4			0.14				

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		0.3			0.5			0.4			0.5				
F_SabinalRv_S050		0.3			0.5			0.4			0.5				
F_SabinalRv_S055		0.3			0.5			0.4			0.5				
FrioRv_Sab_S060		0.3			0.5			0.4			0.5				
FrioRv_S070		0.3			0.5			0.4			0.5				
FrioRv_S071		0.3			0.5			0.4			0.5				
FrioRv_S072		0.3			0.5			0.4			0.5				
F_HondoCk_S010		0.05	0.5		0.3			0.35			0.3				
F_HondoCk_S020		0.45	0.57		0.5			0.24			0.32				
F_HondoCk_S021		0.3			0.5			0.4			0.5				
F_MVerdeCk_S010		0.3			0.3			0.68			0.45				
F_MVerdeCk_S011		0.3			0.5			0.4			0.5				
F_MVerdeCk_S021		0.3			0.5			0.4			0.5				
F_MVerdeCk_S020		0.3			0.5			0.4			0.5				
F_HondoCk_S030		0.3			0.5			0.4			0.5				
F_HondoCk_S031		0.3			0.5			0.4			0.5				
F_SecoCk_S010	0.06	0.05	0.4		0.45			0.45			0.5				
F_SecoCk_S020		0.29	0.55		0.55			0.5			0.32				
F_SecoCk_S021		0.29	0.55		0.5			0.15			0.35				
F_SecoCk_S030		0.3			0.5			0.4			0.5				
F_SecoCk_S031		0.3			0.5			0.4			0.5				
F_HondoCk_S040		0.3			0.5			0.4			0.5				
FrioRv_S080		0.3			0.2			0.4			0.5				

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		0.3			0.5			0.2	0.2	0.2	0.2				
F_LeonaRv_S011		0.3			0.5			0.1	0.1	0.05	0.2				
F_LeonaRv_S012		0.3			0.5			0.2	0.2	0.1	0.2				
F_LeonaRv_S020		0.3			0.5			0.1	0.1	0.05	0.2				
F_LeonaRv_S021		0.3			0.5			0.3			0.5				
F_LeonaRv_S022		0.3			0.5			0.3			0.5				
F_LeonaRv_S023		0.3			0.5			0.3			0.5				
F_LeonaRv_S030		0.3			0.5			0.3			0.5				
F_LeonaRv_S031		0.3			0.5			0.3			0.5				
F_LeonaRv_S040		0.3			0.5			0.3			0.5				
F_LeonaRv_S041		0.3			0.5			0.3			0.5				
F_LeonaRv_S042		0.3			0.2			0.3			0.5				
FrioRv_S090		0.3			0.2			0.4			0.5				
FrioRv_S100		0.4			0.45	0.4		0.3			0.5				
FrioRv_S101		0.4			0.45	0.4		0.3			0.5				
FrioRv_S102		0.4			0.45	0.15		0.3			0.5				
F_CiboloCk_S010		0.3			0.45	0.4		0.3			0.5				
F_CiboloCk_S011		0.3			0.45	0.4		0.3			0.5				
F_CiboloCk_S020		0.3			0.45	0.15		0.3			0.5				
FrioRv_S110		0.3			0.25	0.15		0.3			0.5				
FrioRv_S111		0.3			0.25	0.15		0.2			0.5				
FrioRv_S112		0.3			0.25	0.3		0.3			0.5				
FrioRv_S113		0.3			0.25	0.4		0.3			0.5				

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		0.11			0.25	0.4		0.3			0.5				
FrioRv_S120					0.5	0.45	0.45	0.45			0.5				
F_SanMigCk_S010					0.4	0.28		0.3	0.2		0.25				
F_SanMigCk_S011					0.4	0.28		0.3	0.2		0.25				
F_SanMigCk_S020					0.55	0.32		0.2	0.2		0.25				
F_SanMigCk_S022					0.4	0.32		0.2	0.2		0.25				
F_SanMigCk_S021					0.32	0.32		0.2	0.2		0.25				
F_SanMigCk_S023					0.45	0.3		0.2	0.2		0.25				
F_SanMigCk_S024					0.5	0.45	0.45	0.45			0.5				
ChokeCanyon_S010					0.5	0.45	0.45	0.45			0.5				
FrioRv_S130					0.3	0.4	0.35	0.35		0.5					0.5
Atascosa_S010				0.2	0.45	0.38	0.25	0.3	0.15	0.28					0.65
Atascosa_S011				0.2	0.45	0.38	0.35	0.3	0.2	0.32					0.56
Atascosa_S020				0.2	0.45	0.5	0.35	0.3	0.2	0.22					0.55
Atascosa_S030				0.2	0.45	0.45	0.35	0.2	0.2	0.15					0.45
Atascosa_S031				0.19	0.4	0.35	0.15	0.2	0.12	0.4					0.35
Atascosa_S040				0.2	0.4	0.2	0.1	0.1	0.08	0.4					0.35
Atascosa_S041				0.2	0.4	0.2	0.15	0.1	0.12	0.4					0.35
Atascosa_S050				0.2	0.4	0.35	0.15	0.3	0.3	0.4					0.35
La_ParitaCk_S010				0.2	0.3	0.35	0.2	0.3	0.3	0.1					0.35
La_ParitaCk_S020				0.2	0.35	0.35	0.32	0.3	0.3	0.1					0.35
La_ParitaCk_S030				0.2	0.35	0.35	0.32	0.3	0.3	0.1					0.35
Atascosa_S060				0.2	0.3	0.5	0.4	0.3	0.3	0.1					0.35

	Calibrated Constant Losses (inches per hour)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					0.5	0.4	0.35	0.35		0.5					0.2
Atascosa_S071					0.5	0.4	0.35	0.35		0.45					0.2
Atascosa_S080					0.3	0.4	0.35	0.35		0.5					0.2
FrioRv_S140					0.3	0.4	0.35	0.35		0.5					0.2
NuecesRv_S240					0.5	0.3	0.3	0.35		0.4					0.18
NuecesRv_S250					0.5	0.3	0.3	0.35		0.4					0.125
NuecesRv_S260					0.45	0.3	0.3	0.35		0.4					0.25
NuecesRv_S261					0.45	0.25	0.3	0.35		0.4					0.25
NuecesRv_S270					0.45	0.25	0.2	0.3		0.4					0.25
NuecesRv_S290					0.45	0.25	0.2	0.25		0.34					0.03
N_LagartoCk_S010					0.4	0.25	0.25	0.3		0.4					0.3
N_LagartoCk_S020					0.45	0.25	0.35	0.2		0.24					0.03
RamirenaCk_S010					0.45	0.25	0.35	0.2		0.29					0.03
RamirenaCk_S020					0.45	0.25	0.35	0.2		0.29					0.03
CorpusChristi_S010					0.45	0.25	0.35	0.2		0.25					0.03
CorpusChristi_S011					0.45	0.25	0.35	0.2		0.25					0.03
NuecesRv_S300					0.3	0.05	0.25	0.05		0.35					0.25
NuecesRv_S310					0.2	0.05	0.2	0.05		0.5					0.15

Table B.12: Calibrated Snyder's Lag (hours)

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	5.89	6.89	6.89	4.89	5.89			6.89	6.89		6.89	6.89	6.89	6.89	6.89
NuecesRv_W_S011	5.51	6.51	6.51	4.51	5.51			6.51	6.51		6.51	6.51	6.51	6.51	6.51
NuecesRv_W_S020	6.18	7.18	7.18	5.18	6.18			7.18	9.2		7.18	7.18	7.18	7.18	7.18
NuecesRv_W_S021	6.48	7.48	7.48	5.48	6.48			7.48	5.48		7.48	7.48	7.48	7.48	7.48
NuecesRv_W_S022	2.92	3.92	3.92	2.92	2.92			3.92	3.92		3.92	3.92	5	3.92	3.92
NuecesRv_W_S030	3.11	4.11	3.11	3.11	3.11			3.11			3.11	4.11	3.11	3.11	3.11
NuecesRv_W_S031	4.14	5.14	4.14	4.14	4.14			4.14			4.14	5.14	4.14	4.14	4.14
NuecesRv_W_S032	6.81	7.81	6.81	6.81	6.81			6.81			6.81	7.81	6.81	6.81	6.81
NuecesRv_S011	3.28	4.28	4.28	3.28	3.28			4.28			4.28	3.28	3.28	3.28	3.28
NuecesRv_S010	4.33	5.33	5.33	4.33	4.33			5.33			5.33	4.33	4.33	4.33	4.33
NuecesRv_S012	6.76	7.76	7.76	6.76	6.76			7.76			7.76	6.76	6.76	6.76	6.76
NuecesRv_S020	6.27	7.27	7.27	6.27	6.27			7.27			7.27	6.27	6.27	6.27	6.27
NuecesRv_S030	4.33	5.33	5.33	4.33	4.33			5.33			5.33	4.33	4.33	4.33	4.33
NuecesRv_S041	3.63	3.63	3.63	3.63	3.63			2.63			2.63	2.63	2.63	2.63	2.63
NuecesRv_S040	2.52	3.52	3.52	2.52	1.52			1.52			2.52	2.52	3.7	2.52	2.52
NuecesRv_S050	4.08	5.08	4.08	4.08	4.08			3.81			4.08	5.08	4.08	4.08	4.08
NuecesRv_S061	5.31	6.31	5.31	5.31	4.81			4.81			5.31	6.31	5.31	5.31	5.31
NuecesRv_S060	1.12	2.12	1.12	1.12	1.12			1.12			1.12	2.12	1.12	1.12	1.12
NuecesRv_S070	5.58	6.58	5.58	5.58	5.58			5.58			5.58	7.58	5.58	5.58	5.58
NuecesRv_S071	6.22	7.22	6.22	6.22	6.22			6.22			6.22	7.22	6.22	6.22	6.22

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	6.1	6.1			7.1			7.1				7.1	7.1		7.1
NuecesRv_S081	11.77	11.77			12.77			12.77				12.77	12.77		12.77
NuecesRv_S082	18.51	18.51			19.51			19.51				19.51	19.51		19.51
NuecesRv_S083	9.85	9.85			10.85			10.85				10.85	10.85		10.85
NuecesRv_S084	12.65	12.65			13.65			13.65				13.65	13.65		13.65
NuecesRv_S090	7.7	7.7			8.8			8.8				8.8	8.8		8.8
N_ChaconCk_S010	16.88	16.88			17.88			17.88				17.88	17.88		17.88
N_ChaconCk_S020	11.1	11.1			12.1			12.1				12.1	12.1		12.1
N_ChaconCk_S021	9.84	9.84			10.84			10.84				10.84	10.84		10.84
N_ChaconCk_S023	13.08	13.08			14.08			14.08				14.08	14.08		14.08
N_ChaconCk_S022	15.49	15.49			16.49			16.49				16.49	16.49		16.49
N_PicosaCk_S010	11.53	11.53			12.53			12.53				12.53	12.53		12.53
N_PicosaCk_S011	8.22	8.22			9.22			9.22				9.22	9.22		9.22
N_PicosaCk_S020	6.71	6.71			7.71			7.71				7.71	7.71		7.71
N_TurkeyCk_S010	12.55	12.55			13.55			13.55				13.55	13.55		13.55
N_TurkeyCk_S011	10.58	10.58			11.58			11.58				11.58	11.58		11.58
N_TurkeyCk_S012	10.97	10.97			11.97			11.97				11.97	11.97		11.97
N_ChapCk_S010	10.91	10.91			11.91			11.91				11.91	11.91		11.91
N_ChapCk_S011	13.7	13.7			14.7			14.7				14.7	14.7		14.7
N_TurkeyCk_S020	9.41	9.41			10.41			10.41				10.41	10.41		10.41
N_PicosaCk_S021	12.57	12.57			13.57			13.57				13.57	13.57		13.57
N_TurkeyCk_S030	8.93	8.93			9.93			9.93				9.93	9.93		9.93
N_TurkeyCk_S031	15.13	15.13			16.13			16.13				16.13	16.13		16.13

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	3.77	3.77			4.77			4.77				4.77	4.77		4.77
TurkeyCk_S041	5.73	5.73			6.73			6.73				6.73	6.73		6.73
N_TurkeyCk_S050	5.92	5.92			6.92			6.92				6.92	6.92		6.92
N_TurkeyCk_S060	8.57	8.57			9.57			9.57				9.57	9.57		9.57
N_TurkeyCk_S061	6.05	6.05			7.05			7.05				7.05	7.05		7.05
N_TurkeyCk_S070	7.8	7.8			8.8			8.8				8.8	8.8		8.8
N_TurkeyCk_S080	8.51	8.51			9.51			9.51				9.51	9.51		9.51
N_TurkeyCk_S081	12.58	12.58			13.58			13.58				13.58	13.58		13.58
N_TurkeyCk_S090	3.97	3.97			4.97			4.97				4.97	4.97		4.97
NuecesRv_S100					18.82			28.2							18.82
NuecesRv_S101					13.6			20.4							13.6
NuecesRv_S110					11.52			17.3							11.52
NuecesRv_S111					11.13			16.7							11.13
N_SanRoqCk_S010					11.44			17.2							11.44
N_SanRoqCk_S011					10			15.0							10
N_SanRoqCk_S020					5.71			8.6							5.71
N_SanRoqCk_S021					10.84			16.3							10.84
NuecesRv_S121					10.14			16.7							11.14
NuecesRv_S120					9.77			14.7							9.77
NuecesRv_S122					12.27			10.9							7.27
NuecesRv_S130					16.85	16.85		16.85							16.85
N_LaRaicesCk_S010					14.7	14.7		14.7							14.7
N_LaRaicesCk_S011					15.35	15.35		15.35							15.35

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					12.62	12.62		12.62							12.62
N_CalmanCk_S010					13.02	13.02		13.02							13.02
N_CalmanCk_S011					12.56	12.56		12.56							12.56
NuecesRv_S150					5.15	5.15		5.15							5.15
N_LosOlmosCk_S012					17.12	17.12		17.12							17.12
N_LosOlmosCk_S011					11.85	11.85		11.85							11.85
N_LosOlmosCk_S010					14.82	14.82		14.82							14.82
N_LosOlmosCk_S020					9.07	9.07		9.07							9.07
NuecesRv_S151					8.95	8.95		8.95							8.95
NuecesRv_S160					13.31	13.31		13.31							13.31
NuecesRv_S161					8.89	8.89		8.89							8.89
N_SanCasCk_S010				13.73	13.73	13.73	13.73	13.73				13.73			13.73
N_SanCasCk_S020				10.43	10.43	10.43	10.43	10.43				10.43			10.43
N_SanCasCk_S021				16.72	20.1	20.1	20.72	20.72				16.72			16.72
N_SanCasCk_S011				12.96	15.6	17.0	15.96	15.96				12.96			12.96
N_SanCasCk_S030					12.24	12.24		12.24							12.24
NuecesRv_S170					9.6	9.6		9.6							9.6
N_BlackCk_S010					8.25	8.25		8.25							8.25
N_BlackCk_S020					7.26	7.26		7.26							7.26
N_BlackCk_S021					9.77	9.77		9.77							9.77
NuecesRv_S180					9.2	12.25		12.25							12.25
NuecesRv_S185					14.9	14.89		14.89							14.89
NuecesRv_S190					13.0	12.99		12.99							12.99

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					11.3	11.34		11.34							11.34
NuecesRv_S210					12.63	12.63		12.63							12.63
NuecesRv_S220					13.32	13.32	13.32	13.32		13.32					13.32
NuecesRv_S221					10.41	10.41	10.41	10.41		10.41					10.41
NuecesRv_S222					13.33	13.33	13.33	13.33		13.33					13.33
NuecesRv_S230					10.6	10.6	10.6	10.6		10.6					10.6
NuecesRv_S231					12.24	12.24	12.24	12.24		12.24					12.24
FrioRv_S011	4.52	5.52	5.52		4.52		5.52	5.52			5.52	5.52	4.52		4.52
FrioRv_S010	5.59	6.59	6.59		5.59		6.59	6.59			6.59	4.59	5.59		5.59
FrioRv_S020	6.23	6.23	7.23		6.23		3.75	5.42			3.75	7.23	6.23		6.23
FrioRv_S030	5.83	6.83	5.83		6.83			4.10			6.83		6.83		6.83
FrioRv_D_S010	3.39	4.39	7.39		5.39			5.39			7.39		3.39		3.39
FrioRv_D_S020	4.34	5.34	4.34		5.34			2.94			5.34		5.34		5.34
FrioRv_D_S030	5.5	6.50	5.5		6.5			3.58			6.5		6.5		6.5
FrioRv_S040	2.62	3.62	2.62		3.62			2.72			3.62		3.62		3.62
FrioRv_S051		18.91			18.91			18.91			18.91				
F_BlancoCk_S010		6.09			6.09			6.09			6.09				
F_BlancoCk_S020		15.42			15.42			15.42			15.42				
F_SabinalRv_S010	2.27	2.27	3.27		2.27			3.27			3.27		3.27		3.27
F_SabinalRv_S020	3.04	3.04	4.04		3.04			4.04			4.04		4.04		4.04
F_SabinalRv_S021	4.38	5.38	4.38		4.38			4			3.38		5.38		5.38
F_SabinalRv_S030	10.15	5.45	4.95		4.45			4.45			5.45		4.45		4.45
F_SabinalRv_S041		12.03			12.03			12.03			12.03				

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		4.09			4.09			4.09			4.09				
F_SabinalRv_S050		15.02			15.02			15.02			15.02				
F_SabinalRv_S055		11.86			11.86			11.86			11.86				
FrioRv_Sab_S060		6.75			6.75			6.75			6.75				
FrioRv_S070		15.78			15.78			15.78			15.78				
FrioRv_S071		13.14			13.14			13.14			13.14				
FrioRv_S072		6.1			6.1			6.1			6.1				
F_HondoCk_S010		3.08	3.08		2.08			2.45			2.45				
F_HondoCk_S020		5.54	5.54		6.54			3.92			5.54				
F_HondoCk_S021		4.12			4.12			4.12			4.12				
F_MVerdeCk_S010		3.79			3.79			3.25			2.25				
F_MVerdeCk_S011		2.98			2.98			2.98			2.98				
F_MVerdeCk_S021		8.86			8.86			8.86			8.86				
F_MVerdeCk_S020		11.53			11.53			11.53			11.53				
F_HondoCk_S030		12.93			12.93			12.93			12.93				
F_HondoCk_S031		11.59			11.59			11.59			11.59				
F_SecoCk_S010	2.92	1.92	1.92		1.92			1.5			1.5				
F_SecoCk_S020		4.38	2.38		4.38			2.88			4.38				
F_SecoCk_S021		6.94	3.97		6.94			2.00			4.28				
F_SecoCk_S030		18.91			18.91			18.91			18.91				
F_SecoCk_S031		17.27			17.27			17.27			17.27				
F_HondoCk_S040		10.08			10.08			10.08			10.08				
FrioRv_S080		13.55			13.55			13.55			13.55				

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		10.79			10.79			10.79	10.79	10.79	10.79				
F_LeonaRv_S011		8.88			8.88			8.88	8.88	8.88	8.88				
F_LeonaRv_S012		8.91			8.91			8.91	8.91	8.91	8.91				
F_LeonaRv_S020		7.85			7.85			7.85	7.85	7.85	7.85				
F_LeonaRv_S021		12.01			12.01			12.01			12.01				
F_LeonaRv_S022		12.06			12.06			12.06			12.06				
F_LeonaRv_S023		4.71			4.71			4.71			4.71				
F_LeonaRv_S030		14.76			14.76			14.76			14.76				
F_LeonaRv_S031		15.09			15.09			15.09			15.09				
F_LeonaRv_S040		17.55			17.55			17.55			17.55				
F_LeonaRv_S041		10.08			10.08			10.08			10.08				
F_LeonaRv_S042		4.24			4.24			4.24			4.24				
FrioRv_S090		15.92			15.92			15.92			15.92				
FrioRv_S100		6.66			6.66	6.66		6.66			6.66				
FrioRv_S101		14.39			14.39	14.39		14.39			14.39				
FrioRv_S102		13.38			13.38	13.38		13.38			13.38				
F_CiboloCk_S010		10.29			10.29	10.29		10.29			10.29				
F_CiboloCk_S011		8.57			8.57	8.57		8.57			8.57				
F_CiboloCk_S020		15.54			15.54	15.54		15.54			15.54				
FrioRv_S110		9.74			9.74	9.74		9.74			9.74				
FrioRv_S111		13.59			13.59	13.59		13.59			13.59				
FrioRv_S112		10.74			10.74	10.74		10.74			10.74				
FrioRv_S113		13			13	13		13			13				

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		10.38			10.38	10.38		10.38			10.38				
FrioRv_S120					8.52	8.52	8.52	8.52			8.52				
F_SanMigCk_S010					21.99	20.99		20.99	21.99		21.99				
F_SanMigCk_S011					15.49	14.49		14.49	15.49		15.49				
F_SanMigCk_S020					12.83	12.83		12.83	13.83		12.83				
F_SanMigCk_S022					11.1	7.54		7.54	8.54		7.54				
F_SanMigCk_S021					15	17.12		17.12	18.12		17.12				
F_SanMigCk_S023					6.97	6.97		6.97	7.97		6.97				
F_SanMigCk_S024					13.84	13.84	13.84	13.84			13.84				
ChokeCanyon_S010					11.8	11.8	11.8	11.8			11.8				
FrioRv_S130					4.67	4.67	4.67	4.67		4.67					4.67
Atascosa_S010				15.31	15.31	15.31	15.31	12.2	15.31	15.31					15.31
Atascosa_S011				13.1	13.1	13.1	13.1	10.5	13.1	13.1					13.1
Atascosa_S020				10.72	10.72	10.72	10.72	8.6	10.72	10.72					10.72
Atascosa_S030				11.19	11.19	10.19	10.19	13.4	11.19	11.19					11.19
Atascosa_S031				8.54	8.54	8.54	8.54	8.54	8.54	8.54					8.54
Atascosa_S040				14.91	14.91	14.91	14.91	14.91	19.4	19.4					14.91
Atascosa_S041				11.81	11.81	11.81	11.81	11.81	11.81	11.81					11.81
Atascosa_S050				11.88	11.88	11.88	11.88	11.88	11.88	11.88					11.88
La_ParitaCk_S010				19.26	25.0	19.26	25.0	19.26	19.26	25.0					19.26
La_ParitaCk_S020				15.34	15.34	15.34	20.0	15.34	15.34	20.0					15.34
La_ParitaCk_S030				6.67	6.67	6.67	8.7	6.67	6.67	8.7					6.67
Atascosa_S060				4.82	4.82	4.82	4.82	4.82	4.82	4.82					4.82

	Calibrated Snyder's Lag (hours)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					12.3	12.3	12.3	12.3		16					12.3
Atascosa_S071					15.52	15.52	15.52	15.52		26					15.52
Atascosa_S080					8.13	8.13	8.13	8.13		10.6					8.13
FrioRv_S140					9.5	9.5	9.5	9.5		9.5					9.5
NuecesRv_S240					15.88	15.88	15.88	15.88		15.88					15.88
NuecesRv_S250					8.05	8.05	8.05	8.05		8.05					8.05
NuecesRv_S260					3.27	3.27	3.27	3.27		3.27					3.27
NuecesRv_S261					13.42	13.42	13.42	13.42		13.42					13.42
NuecesRv_S270					13.22	13.22	13.22	13.22		13.22					13.22
NuecesRv_S290					12.99	12.99	12.99	12.99		12.99					12.99
N_LagartoCk_S010					17.2	17.2	9.15	9.15		17.2					17.2
N_LagartoCk_S020					12.98	12.98	12.98	12.98		12.98					12.98
RamirenaCk_S010					10.63	10.63	10.63	10.63		10.63					10.63
RamirenaCk_S020					9.62	9.62	9.62	9.62		9.62					9.62
CorpusChristi_S010					8.71	8.71	8.71	8.71		8.71					8.71
CorpusChristi_S011					11.82	11.82	11.82	11.82		11.82					11.82
NuecesRv_S300					17.19	17.19	17.19	17.19		22.3					17.19
NuecesRv_S310					15.68	15.68	15.68	15.68		20.4					15.68

Table B.13: Calibrated Snyder's Peaking Coefficient

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0.78	0.78	0.78	0.78	0.78			0.78	0.78		0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S011	0.78	0.78	0.78	0.78	0.78			0.78	0.78		0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S020	0.78	0.78	0.78	0.78	0.78			0.78	0.78		0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S021	0.78	0.78	0.78	0.78	0.78			0.78	0.78		0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S022	0.78	0.78	0.78	0.78	0.78			0.78	0.78		0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S030	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S031	0.78	0.86	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_W_S032	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S011	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S010	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S012	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S020	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S030	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S041	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S040	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.70	0.78	0.78
NuecesRv_S050	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S061	0.78	0.78	0.78	0.78	0.78			0.78			0.78	0.78	0.78	0.78	0.78
NuecesRv_S060	0.70	0.70	0.70	0.7	0.70			0.70			0.7	0.70	0.70	0.70	0.7
NuecesRv_S070	0.70	0.70	0.70	0.7	0.70			0.70			0.7	0.70	0.70	0.70	0.7
NuecesRv_S071	0.70	0.70	0.70	0.7	0.70			0.70			0.7	0.70	0.70	0.70	0.7

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S081	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S082	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S083	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S084	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S090	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChaconCk_S010	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChaconCk_S020	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChaconCk_S021	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChaconCk_S023	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChaconCk_S022	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_PicosaCk_S010	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_PicosaCk_S011	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_PicosaCk_S020	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S010	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S011	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S012	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChapCk_S010	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_ChapCk_S011	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S020	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_PicosaCk_S021	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S030	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S031	0.70	0.70			0.70			0.70				0.70	0.70		0.7

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	0.70	0.70			0.70			0.70				0.70	0.70		0.7
TurkeyCk_S041	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S050	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S060	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S061	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S070	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S080	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S081	0.70	0.70			0.70			0.70				0.70	0.70		0.7
N_TurkeyCk_S090	0.70	0.70			0.70			0.70				0.70	0.70		0.7
NuecesRv_S100					0.60			0.60							0.7
NuecesRv_S101					0.60			0.60							0.7
NuecesRv_S110					0.60			0.60							0.7
NuecesRv_S111					0.60			0.60							0.7
N_SanRoqCk_S010					0.60			0.60							0.7
N_SanRoqCk_S011					0.60			0.60							0.7
N_SanRoqCk_S020					0.60			0.60							0.7
N_SanRoqCk_S021					0.60			0.60							0.7
NuecesRv_S121					0.60			0.60							0.7
NuecesRv_S120					0.60			0.60							0.7
NuecesRv_S122					0.60			0.60							0.7
NuecesRv_S130					0.70	0.70		0.70							0.7
N_LaRaicesCk_S010					0.70	0.70		0.70							0.7
N_LaRaicesCk_S011					0.70	0.70		0.70							0.7

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					0.70	0.70		0.70							0.7
N_CalmanCk_S010					0.70	0.70		0.70							0.7
N_CalmanCk_S011					0.70	0.70		0.70							0.7
NuecesRv_S150					0.70	0.70		0.70							0.7
N_LosOlmosCk_S012					0.70	0.70		0.70							0.7
N_LosOlmosCk_S011					0.70	0.70		0.70							0.7
N_LosOlmosCk_S010					0.70	0.70		0.70							0.7
N_LosOlmosCk_S020					0.70	0.70		0.70							0.7
NuecesRv_S151					0.70	0.70		0.70							0.7
NuecesRv_S160					0.70	0.70		0.70							0.7
NuecesRv_S161					0.70	0.70		0.70							0.7
N_SanCasCk_S010				0.70	0.50	0.50	0.70	0.70				0.70			0.7
N_SanCasCk_S020				0.70	0.70	0.70	0.70	0.70				0.70			0.7
N_SanCasCk_S021				0.70	0.70	0.70	0.70	0.70				0.70			0.7
N_SanCasCk_S011				0.70	0.50	0.50	0.70	0.70				0.70			0.7
N_SanCasCk_S030					0.70	0.70		0.70							0.7
NuecesRv_S170					0.70	0.70		0.70							0.7
N_BlackCk_S010					0.70	0.70		0.70							0.7
N_BlackCk_S020					0.70	0.70		0.70							0.7
N_BlackCk_S021					0.70	0.70		0.70							0.7
NuecesRv_S180					0.70	0.70		0.70							0.7
NuecesRv_S185					0.70	0.70		0.70							0.7
NuecesRv_S190					0.70	0.70		0.70							0.7

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					0.70	0.70		0.70							0.7
NuecesRv_S210					0.70	0.70		0.70							0.7
NuecesRv_S220					0.70	0.70	0.70	0.70		0.7					0.7
NuecesRv_S221					0.70	0.70	0.70	0.70		0.7					0.7
NuecesRv_S222					0.70	0.70	0.70	0.70		0.7					0.7
NuecesRv_S230					0.70	0.70	0.70	0.70		0.7					0.7
NuecesRv_S231					0.70	0.70	0.70	0.70		0.7					0.7
FrioRv_S011	0.78	0.78	0.78		0.78		0.78	0.78			0.78	0.78	0.78		0.78
FrioRv_S010	0.78	0.78	0.78		0.78		0.78	0.78			0.78	0.78	0.78		0.78
FrioRv_S020	0.78	0.78	0.78		0.78		0.78	0.78			0.78	0.78	0.78		0.78
FrioRv_S030	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
FrioRv_D_S010	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
FrioRv_D_S020	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
FrioRv_D_S030	0.7	0.70	0.70		0.70			0.70			0.7		0.70		0.7
FrioRv_S040	0.7	0.70	0.70		0.70			0.70			0.7		0.70		0.7
FrioRv_S051		0.70			0.70			0.70			0.7				
F_BlancoCk_S010		0.78			0.78			0.78			0.78				
F_BlancoCk_S020		0.70			0.70			0.70			0.7				
F_SabinalRv_S010	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
F_SabinalRv_S020	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
F_SabinalRv_S021	0.78	0.78	0.78		0.78			0.78			0.78		0.78		0.78
F_SabinalRv_S030	0.7	0.78	0.78		0.70			0.78			0.78		0.70		0.7
F_SabinalRv_S041		0.70			0.70			0.70			0.7				

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		0.70			0.70			0.70			0.7				
F_SabinalRv_S050		0.70			0.70			0.70			0.7				
F_SabinalRv_S055		0.70			0.70			0.70			0.7				
FrioRv_Sab_S060		0.70			0.70			0.70			0.7				
FrioRv_S070		0.70			0.70			0.70			0.7				
FrioRv_S071		0.70			0.70			0.70			0.7				
FrioRv_S072		0.70			0.70			0.70			0.7				
F_HondoCk_S010		0.78	0.78		0.78			0.78			0.78				
F_HondoCk_S020		0.78	0.78		0.78			0.78			0.78				
F_HondoCk_S021		0.70			0.70			0.70			0.7				
F_MVerdeCk_S010		0.78			0.78			0.78			0.78				
F_MVerdeCk_S011		0.78			0.78			0.78			0.78				
F_MVerdeCk_S021		0.70			0.70			0.70			0.7				
F_MVerdeCk_S020		0.70			0.70			0.70			0.7				
F_HondoCk_S030		0.70			0.70			0.70			0.7				
F_HondoCk_S031		0.70			0.70			0.70			0.7				
F_SecoCk_S010	0.78	0.78	0.78		0.78			0.78			0.78				
F_SecoCk_S020		0.78	0.78		0.78			0.78			0.78				
F_SecoCk_S021		0.70	0.78		0.70			0.78			0.78				
F_SecoCk_S030		0.70			0.70			0.70			0.7				
F_SecoCk_S031		0.70			0.70			0.70			0.7				
F_HondoCk_S040		0.70			0.70			0.70			0.7				
FrioRv_S080		0.70			0.70			0.70			0.7				

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		0.70			0.70			0.70	0.70	0.70	0.7				
F_LeonaRv_S011		0.70			0.70			0.70	0.70	0.70	0.7				
F_LeonaRv_S012		0.70			0.70			0.70	0.70	0.70	0.7				
F_LeonaRv_S020		0.70			0.70			0.70	0.70	0.70	0.7				
F_LeonaRv_S021		0.70			0.70			0.70			0.7				
F_LeonaRv_S022		0.70			0.70			0.70			0.7				
F_LeonaRv_S023		0.70			0.70			0.70			0.7				
F_LeonaRv_S030		0.70			0.70			0.70			0.7				
F_LeonaRv_S031		0.70			0.70			0.70			0.7				
F_LeonaRv_S040		0.70			0.70			0.70			0.7				
F_LeonaRv_S041		0.70			0.70			0.70			0.7				
F_LeonaRv_S042		0.70			0.70			0.70			0.7				
FrioRv_S090		0.70			0.70			0.70			0.7				
FrioRv_S100		0.70			0.70	0.70		0.70			0.7				
FrioRv_S101		0.70			0.70	0.70		0.70			0.7				
FrioRv_S102		0.70			0.70	0.70		0.70			0.7				
F_CiboloCk_S010		0.70			0.70	0.70		0.70			0.7				
F_CiboloCk_S011		0.70			0.70	0.70		0.70			0.7				
F_CiboloCk_S020		0.70			0.70	0.70		0.70			0.7				
FrioRv_S110		0.70			0.70	0.70		0.70			0.7				
FrioRv_S111		0.70			0.70	0.70		0.70			0.7				
FrioRv_S112		0.70			0.70	0.70		0.70			0.7				
FrioRv_S113		0.70			0.70	0.70		0.70			0.7				

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		0.70			0.70	0.70		0.70			0.7				
FrioRv_S120					0.70	0.70	0.70	0.70			0.7				
F_SanMigCk_S010					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S011					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S020					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S022					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S021					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S023					0.70	0.70		0.70	0.70		0.7				
F_SanMigCk_S024					0.70	0.70	0.70	0.70			0.7				
ChokeCanyon_S010					0.70	0.70	0.70	0.70			0.7				
FrioRv_S130					0.70	0.70	0.70	0.70		0.70					0.7
Atascosa_S010				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S011				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S020				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S030				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S031				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S040				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S041				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S050				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
La_ParitaCk_S010				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
La_ParitaCk_S020				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
La_ParitaCk_S030				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7
Atascosa_S060				0.70	0.70	0.70	0.70	0.70	0.70	0.70					0.7

	Calibrated Snyder's Peaking Coefficient														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					0.70	0.70	0.70	0.70		0.70					0.7
Atascosa_S071					0.70	0.70	0.70	0.70		0.70					0.7
Atascosa_S080					0.70	0.70	0.70	0.70		0.70					0.7
FrioRv_S140					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S240					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S250					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S260					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S261					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S270					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S290					0.70	0.70	0.70	0.70		0.70					0.7
N_LagartoCk_S010					0.70	0.70	0.70	0.70		0.70					0.7
N_LagartoCk_S020					0.70	0.70	0.70	0.70		0.70					0.7
RamirenaCk_S010					0.70	0.70	0.70	0.70		0.70					0.7
RamirenaCk_S020					0.70	0.70	0.70	0.70		0.70					0.7
CorpusChristi_S010					0.70	0.70	0.70	0.70		0.70					0.7
CorpusChristi_S011					0.70	0.70	0.70	0.70		0.70					0.7
NuecesRv_S300					0.70	0.70	0.70	0.70		0.60					0.7
NuecesRv_S310					0.70	0.70	0.70	0.70		0.60					0.7

Table B.14: Calibrated Initial Baseflow (cfs/sq mi)

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0	0.013	0.15	0.001	0.0006			0.12	0.33		0.35	0.001	0.08	0.43	0.08
NuecesRv_W_S011	0	0.013	0.15	0.001	0.0006			0.12	0.33		0.35	0.001	0.08	0.43	0.08
NuecesRv_W_S020	0	0.013	0.15	0.001	0.0006			0.12	0.33		0.35	0.001	0.08	0.43	0.08
NuecesRv_W_S021	0	0.013	0.15	0.001	0.0006			0.12	0.33		0.35	0.001	0.08	0.43	0.08
NuecesRv_W_S022	0	0.013	0.15	0.001	0.0006			0.12	0.33		0.35	0.001	0.08	0.43	0.08
NuecesRv_W_S030	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_W_S031	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_W_S032	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_S011	0.08	0.61	0.62	0.07	0.06			0.62			0.12	0.09	0.25	3.37	0.25
NuecesRv_S010	0.08	0.61	0.62	0.07	0.06			0.62			0.12	0.09	0.25	3.37	0.25
NuecesRv_S012	0.08	0.61	0.62	0.07	0.06			0.62			0.12	0.09	0.25	3.37	0.25
NuecesRv_S020	0.08	0.61	0.62	0.07	0.06			0.62			0.92	0.09	0.25	3.37	0.25
NuecesRv_S030	0.08	0.61	0.62	0.07	0.06			0.62			0.92	0.02	1.77	3.37	1.77
NuecesRv_S041	0.08	0.61	0.62	0.07	0.06			0.62			5	0.02	0.06	3.37	0.06
NuecesRv_S040	0.08	0.61	0.62	0.07	0.06			0.62			5	2.2	2	3.37	2
NuecesRv_S050	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_S061	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_S060	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_S070	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001
NuecesRv_S071	0.06	0.3	0.06	0.06	0.08			0.001			0.001	0.001	0.001	0.001	0.001

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S081	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S082	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S083	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S084	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S090	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChaconCk_S010	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChaconCk_S020	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChaconCk_S021	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChaconCk_S023	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChaconCk_S022	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_PicosaCk_S010	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_PicosaCk_S011	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_PicosaCk_S020	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S010	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S011	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S012	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChapCk_S010	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_ChapCk_S011	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S020	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_PicosaCk_S021	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S030	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S031	0.001	0.3			0.001			0.09				0.001	0.16		0.16

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	0.001	0.3			0.001			0.09				0.001	0.16		0.16
TurkeyCk_S041	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S050	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S060	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S061	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S070	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S080	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S081	0.001	0.3			0.001			0.09				0.001	0.16		0.16
N_TurkeyCk_S090	0.001	0.3			0.001			0.09				0.001	0.16		0.16
NuecesRv_S100					0.001			0.08							0.08
NuecesRv_S101					0.001			0.08							0.08
NuecesRv_S110					0.001			0.08							0.08
NuecesRv_S111					0.001			0.08							0.08
N_SanRoqCk_S010					0.001			0.08							0.08
N_SanRoqCk_S011					0.001			0.08							0.08
N_SanRoqCk_S020					0.001			0.08							0.08
N_SanRoqCk_S021					0.001			0.08							0.08
NuecesRv_S121					0.001			0.08							0.08
NuecesRv_S120					0.001			0.08							0.08
NuecesRv_S122					0.001			0.08							0.08
NuecesRv_S130					0.001	0.001		0.001							0.1
N_LaRaicesCk_S010					0.001	0.001		0.001							0.1
N_LaRaicesCk_S011					0.001	0.001		0.001							0.1

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					0.001	0.001		0.001							0.1
N_CalmanCk_S010					0.001	0.001		0.001							0.1
N_CalmanCk_S011					0.001	0.001		0.001							0.1
NuecesRv_S150					0.001	0.001		0.001							0.1
N_LosOlmosCk_S012					0.001	0.001		0.001							0.1
N_LosOlmosCk_S011					0.001	0.001		0.001							0.1
N_LosOlmosCk_S010					0.001	0.001		0.001							0.1
N_LosOlmosCk_S020					0.001	0.001		0.001							0.1
NuecesRv_S151					0.001	0.001		0.001							0.1
NuecesRv_S160					0.001	0.001		0.001							0.1
NuecesRv_S161					0.001	0.001		0.001							0.1
N_SanCasCk_S010				0.001	0.001	0.001	0.04	0.01				0.001			0.1
N_SanCasCk_S020				0.001	0.001	0.001	0.04	0.01				0.001			0.1
N_SanCasCk_S021				0.001	0.001	0.001	0.04	0.01				0.001			0.1
N_SanCasCk_S011				0.001	0.001	0.001	0.04	0.01				0.001			0.1
N_SanCasCk_S030					0.001	0.001		0.001							0.1
NuecesRv_S170					0.001	0.001		0.001							0.1
N_BlackCk_S010					0.001	0.001		0.001							0.1
N_BlackCk_S020					0.001	0.001		0.001							0.1
N_BlackCk_S021					0.001	0.001		0.001							0.1
NuecesRv_S180					0.001	0.001		0.001							0.1
NuecesRv_S185					0.001	0.001		0.001							0.1
NuecesRv_S190					0.001	0.001		0.001							0.1

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					0.001	0.001		0.001							0.1
NuecesRv_S210					0.001	0.001		0.001							0.1
NuecesRv_S220					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S221					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S222					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S230					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S231					0.001	0.001	0.001	0.001		0.1					0.1
FrioRv_S011	0.14	0.8	0.2		0.06		0.54	1.18			0.95	0.4	0.83		0.83
FrioRv_S010	0.14	0.8	0.2		0.06		0.54	1.18			0.95	0.4	0.83		0.83
FrioRv_S020	0.14	0.8	0.2		0.06		0.54	1.18			0.95	0.4	0.83		0.83
FrioRv_S030	0.01	0.001	0.001		0.01			0.001			0.001		0.01		0.01
FrioRv_D_S010	0.1	0.1	0.21		0.002			0.36			1.9		0.84		0.84
FrioRv_D_S020	0.01	0.001	0.001		0.01			0.001			0.001		0.01		0.01
FrioRv_D_S030	0.01	0.001	0.001		0.01			0.001			0.001		0.01		0.01
FrioRv_S040	0.1	0.001	0.001		0.01			0.001			0.001		0.01		0.01
FrioRv_S051		0.15			0.1			0.01			0.1				
F_BlancoCk_S010		0.15			0.1			0.01			0.1				
F_BlancoCk_S020		0.15			0.1			0.01			0.1				
F_SabinalRv_S010	0.03	0.5	0.04		0.1			0.9			1.2		0.73		0.73
F_SabinalRv_S020	0.03	0.5	0.04		0.1			0.9			1.2		2.1		2.1
F_SabinalRv_S021	0.03	0.5	0.04		0.1			0.9			1.2		2.1		2.1
F_SabinalRv_S030	0.02	0.001	0.02		0.02			0.01			0.001		0.001		0.001
F_SabinalRv_S041		0.15			0.1			0.1			0.1				

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		0.15			0.1			0.01			0.1				
F_SabinalRv_S050		0.15			0.1			0.01			0.1				
F_SabinalRv_S055		0.15			0.1			0.01			0.1				
FrioRv_Sab_S060		0.15			0.1			0.01			0.1				
FrioRv_S070		0.15			0.1			0.01			0.1				
FrioRv_S071		0.15			0.1			0.01			0.1				
FrioRv_S072		0.15			0.1			0.01			0.1				
F_HondoCk_S010		0.55	0.05		0.008			0.82			4.4				
F_HondoCk_S020		0.01	0.001		0.1			0.01			0.01				
F_HondoCk_S021		0.15			0.1			0.01			0.1				
F_MVerdeCk_S010		0.15			0.1			0.74			1.5				
F_MVerdeCk_S011		0.15			0.1			0.01			0.1				
F_MVerdeCk_S021		0.15			0.1			0.01			0.1				
F_MVerdeCk_S020		0.15			0.1			0.01			0.1				
F_HondoCk_S030		0.15			0.1			0.01			0.1				
F_HondoCk_S031		0.15			0.1			0.01			0.1				
F_SecoCk_S010	0.01	0.53	0.06		0.01			0.001			3.4				
F_SecoCk_S020		0.001	0		0			0.001			0.001				
F_SecoCk_S021		0.001	0		0			0.001			0.001				
F_SecoCk_S030		0.15			0.1			0.001			0.1				
F_SecoCk_S031		0.15			0.1			0.001			0.1				
F_HondoCk_S040		0.15			0.1			0.01			0.1				
FrioRv_S080		0.15			0.1			0.01			0.1				

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		0.15			0.1			0.17	1.3	0.01	0.02				
F_LeonaRv_S011		0.15			0.1			0.17	1.3	0.01	0.02				
F_LeonaRv_S012		0.15			0.1			0.17	1.3	0.01	0.02				
F_LeonaRv_S020		0.15			0.1			0.17	1.3	0.01	0.02				
F_LeonaRv_S021		0.15			0.1			0.01			0.1				
F_LeonaRv_S022		0.15			0.1			0.01			0.1				
F_LeonaRv_S023		0.15			0.1			0.01			0.1				
F_LeonaRv_S030		0.15			0.1			0.01			0.1				
F_LeonaRv_S031		0.15			0.1			0.01			0.1				
F_LeonaRv_S040		0.15			0.1			0.01			0.1				
F_LeonaRv_S041		0.15			0.1			0.01			0.1				
F_LeonaRv_S042		0.15			0.1			0.01			0.1				
FrioRv_S090		0.15			0.1			0.01			0.1				
FrioRv_S100		0.001			0.1	0.001		0.01			0.1				
FrioRv_S101		0.001			0.1	0.001		0.01			0.1				
FrioRv_S102		0.001			0.1	0.001		0.01			0.1				
F_CiboloCk_S010		0.001			0.1	0.001		0.01			0.1				
F_CiboloCk_S011		0.001			0.1	0.001		0.01			0.1				
F_CiboloCk_S020		0.001			0.1	0.001		0.01			0.1				
FrioRv_S110		0.001			0.1	0.001		0.01			0.1				
FrioRv_S111		0.001			0.1	0.001		0.01			0.1				
FrioRv_S112		0.001			0.1	0.001		0.01			0.1				
FrioRv_S113		0.001			0.1	0.001		0.01			0.1				

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		0.001			0.1	0.001		0.01			0.1				
FrioRv_S120					0.12	0.001	0.001	0.01			0.1				
F_SanMigCk_S010					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S011					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S020					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S022					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S021					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S023					0.001	0.001		0.05	0.7		0.001				
F_SanMigCk_S024					0.12	0.001	0.001	0.01			0.1				
ChokeCanyon_S010					0.12	0.001	0.001	0.01			0.1				
FrioRv_S130					0.001	0.001	0.1	0.1		0.1					0.1
Atascosa_S010				0.001	0.001	0.02	0.27	0.057	0.55	0.01					0.02
Atascosa_S011				0.001	0.001	0.02	0.27	0.057	0.55	0.01					0.02
Atascosa_S020				0.001	0.001	0.02	0.27	0.057	1	0.01					0.02
Atascosa_S030				0.001	0.001	0.02	0.27	0.057	1	0.01					0.02
Atascosa_S031				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
Atascosa_S040				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
Atascosa_S041				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
Atascosa_S050				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
La_ParitaCk_S010				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
La_ParitaCk_S020				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
La_ParitaCk_S030				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02
Atascosa_S060				0.001	0.001	0.001	0.001	0.3	0.3	0.02					0.02

	Calibrated Initial Baseflow (cfs/sq mi)														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					0.001	0.001	0.001	0.001		0.02					0.02
Atascosa_S071					0.001	0.001	0.001	0.001		0.02					0.02
Atascosa_S080					0.001	0.001	0.001	0.001		0.02					0.02
FrioRv_S140					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S240					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S250					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S260					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S261					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S270					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S290					0.001	0.001	0.001	0.001		0.1					0.1
N_LagartoCk_S010					0.001	0.001	0.001	0.001		0.001					0.001
N_LagartoCk_S020					0.001	0.001	0.001	0.001		0.1					0.1
RamirenaCk_S010					0.001	0.001	0.001	0.001		0.1					0.1
RamirenaCk_S020					0.001	0.001	0.001	0.001		0.1					0.1
CorpusChristi_S010					0.001	0.001	0.001	0.001		0.1					0.1
CorpusChristi_S011					0.001	0.001	0.001	0.001		0.1					0.1
NuecesRv_S300					0.24	0.1	0.001	3		0.1					0.1
NuecesRv_S310					0.28	0.1	0.001	3		0.1					0.1

Table B.15: Calibrated Baseflow Recession Constant

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0.6	0.7	0.6	0.6	0.6			0.8	0.8		0.7	0.6	0.6	0.6	0.6
NuecesRv_W_S011	0.6	0.7	0.6	0.6	0.6			0.8	0.8		0.7	0.6	0.6	0.6	0.6
NuecesRv_W_S020	0.6	0.7	0.6	0.6	0.6			0.8	0.8		0.7	0.6	0.6	0.6	0.6
NuecesRv_W_S021	0.6	0.7	0.6	0.6	0.6			0.8	0.8		0.7	0.6	0.6	0.6	0.6
NuecesRv_W_S022	0.6	0.7	0.6	0.6	0.6			0.8	0.8		0.7	0.6	0.6	0.6	0.6
NuecesRv_W_S030	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_W_S031	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_W_S032	0.6	0.7	0.6	0.6	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_S011	0.6	0.7	0.7	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S010	0.6	0.7	0.7	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S012	0.6	0.7	0.7	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S020	0.6	0.7	0.7	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S030	0.6	0.7	0.7	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S041	0.6	0.7	0.6	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S040	0.6	0.7	0.6	0.7	0.7			0.8			0.8	0.8	0.7	0.7	0.7
NuecesRv_S050	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_S061	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_S060	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_S070	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6
NuecesRv_S071	0.7	0.7	0.7	0.7	0.6			0.6			0.7	0.7	0.6	0.6	0.6

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S081	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S082	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S083	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S084	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S090	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChaconCk_S010	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChaconCk_S020	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChaconCk_S021	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChaconCk_S023	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChaconCk_S022	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_PicosaCk_S010	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_PicosaCk_S011	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_PicosaCk_S020	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S010	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S011	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S012	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChapCk_S010	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_ChapCk_S011	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S020	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_PicosaCk_S021	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S030	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S031	0.7	0.7			0.7			0.7				0.7	0.7		0.7

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	0.7	0.7			0.7			0.7				0.7	0.7		0.7
TurkeyCk_S041	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S050	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S060	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S061	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S070	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S080	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S081	0.7	0.7			0.7			0.7				0.7	0.7		0.7
N_TurkeyCk_S090	0.7	0.7			0.7			0.7				0.7	0.7		0.7
NuecesRv_S100					0.7			0.7							0.7
NuecesRv_S101					0.7			0.7							0.7
NuecesRv_S110					0.7			0.7							0.7
NuecesRv_S111					0.7			0.7							0.7
N_SanRoqCk_S010					0.7			0.7							0.7
N_SanRoqCk_S011					0.7			0.7							0.7
N_SanRoqCk_S020					0.7			0.7							0.7
N_SanRoqCk_S021					0.7			0.7							0.7
NuecesRv_S121					0.7			0.7							0.7
NuecesRv_S120					0.7			0.7							0.7
NuecesRv_S122					0.7			0.7							0.7
NuecesRv_S130					0.7	0.7		0.7							0.7
N_LaRaicesCk_S010					0.7	0.7		0.7							0.7
N_LaRaicesCk_S011					0.7	0.7		0.7							0.7

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					0.7	0.7		0.7							0.7
N_CalmanCk_S010					0.7	0.7		0.7							0.7
N_CalmanCk_S011					0.7	0.7		0.7							0.7
NuecesRv_S150					0.7	0.7		0.7							0.7
N_LosOlmosCk_S012					0.7	0.7		0.7							0.7
N_LosOlmosCk_S011					0.7	0.7		0.7							0.7
N_LosOlmosCk_S010					0.7	0.7		0.7							0.7
N_LosOlmosCk_S020					0.7	0.7		0.7							0.7
NuecesRv_S151					0.7	0.7		0.7							0.7
NuecesRv_S160					0.7	0.7		0.7							0.7
NuecesRv_S161					0.7	0.7		0.7							0.7
N_SanCasCk_S010				0.7	0.7	0.7	0.7	0.7				0.7			0.7
N_SanCasCk_S020				0.7	0.7	0.7	0.7	0.7				0.7			0.7
N_SanCasCk_S021				0.7	0.7	0.7	0.7	0.7				0.7			0.7
N_SanCasCk_S011				0.7	0.7	0.7	0.7	0.7				0.7			0.7
N_SanCasCk_S030					0.7	0.7		0.7							0.7
NuecesRv_S170					0.7	0.7		0.7							0.7
N_BlackCk_S010					0.7	0.7		0.7							0.7
N_BlackCk_S020					0.7	0.7		0.7							0.7
N_BlackCk_S021					0.7	0.7		0.7							0.7
NuecesRv_S180					0.7	0.7		0.7							0.7
NuecesRv_S185					0.7	0.7		0.7							0.7
NuecesRv_S190					0.7	0.7		0.7							0.7

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					0.7	0.7		0.7							0.7
NuecesRv_S210					0.7	0.7		0.7							0.7
NuecesRv_S220					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S221					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S222					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S230					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S231					0.7	0.7	0.7	0.7		0.7					0.7
FrioRv_S011	0.6	0.75	0.7		0.6		0.7	0.7			0.7	0.9	0.7		0.7
FrioRv_S010	0.6	0.75	0.7		0.6		0.7	0.7			0.7	0.9	0.7		0.7
FrioRv_S020	0.6	0.75	0.7		0.6		0.7	0.7			0.7	0.9	0.7		0.7
FrioRv_S030	0.6	0.7	0.6		0.6			0.7			0.7		0.6		0.6
FrioRv_D_S010	0.6	0.7	0.7		0.6			0.8			0.8		0.8		0.8
FrioRv_D_S020	0.6	0.7	0.6		0.6			0.7			0.7		0.6		0.6
FrioRv_D_S030	0.6	0.7	0.6		0.6			0.7			0.7		0.6		0.6
FrioRv_S040	0.6	0.7	0.6		0.6			0.7			0.7		0.6		0.6
FrioRv_S051		0.7			0.7			0.7			0.7				
F_BlancoCk_S010		0.7			0.7			0.7			0.7				
F_BlancoCk_S020		0.7			0.7			0.7			0.7				
F_SabinalRv_S010	0.65	0.8	0.7		0.7			0.7			0.72		0.7		0.7
F_SabinalRv_S020	0.65	0.8	0.7		0.7			0.7			0.72		0.75		0.75
F_SabinalRv_S021	0.65	0.8	0.7		0.7			0.7			0.72		0.75		0.75
F_SabinalRv_S030	0.65	0.65	0.65		0.65			0.7			0.7		0.65		0.65
F_SabinalRv_S041		0.7			0.7			0.7			0.7				

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		0.7			0.7			0.7			0.7				
F_SabinalRv_S050		0.7			0.7			0.7			0.7				
F_SabinalRv_S055		0.7			0.7			0.7			0.7				
FrioRv_Sab_S060		0.7			0.7			0.7			0.7				
FrioRv_S070		0.7			0.7			0.7			0.7				
FrioRv_S071		0.7			0.7			0.7			0.7				
FrioRv_S072		0.7			0.7			0.7			0.7				
F_HondoCk_S010		0.7	0.7		0.7			0.7			0.7				
F_HondoCk_S020		0.7	0.7		0.7			0.7			0.7				
F_HondoCk_S021		0.7			0.7			0.7			0.7				
F_MVerdeCk_S010		0.7			0.7			0.75			0.7				
F_MVerdeCk_S011		0.7			0.7			0.7			0.7				
F_MVerdeCk_S021		0.7			0.7			0.7			0.7				
F_MVerdeCk_S020		0.7			0.7			0.7			0.7				
F_HondoCk_S030		0.7			0.7			0.7			0.7				
F_HondoCk_S031		0.7			0.7			0.7			0.7				
F_SecoCk_S010	0.6	0.7	0.6		0.6			0.7			0.7				
F_SecoCk_S020		0.6	0.6		0.6			0.6			0.6				
F_SecoCk_S021		0.6	0.7		0.6			0.6			0.6				
F_SecoCk_S030		0.7			0.7			0.7			0.7				
F_SecoCk_S031		0.7			0.7			0.7			0.7				
F_HondoCk_S040		0.7			0.7			0.7			0.7				
FrioRv_S080		0.7			0.7			0.7			0.7				

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		0.7			0.7			0.6	0.6	0.6	0.6				
F_LeonaRv_S011		0.7			0.7			0.6	0.6	0.6	0.6				
F_LeonaRv_S012		0.7			0.7			0.6	0.6	0.6	0.6				
F_LeonaRv_S020		0.7			0.7			0.6	0.6	0.6	0.6				
F_LeonaRv_S021		0.7			0.7			0.7			0.7				
F_LeonaRv_S022		0.7			0.7			0.7			0.7				
F_LeonaRv_S023		0.7			0.7			0.7			0.7				
F_LeonaRv_S030		0.7			0.7			0.7			0.7				
F_LeonaRv_S031		0.7			0.7			0.7			0.7				
F_LeonaRv_S040		0.7			0.7			0.7			0.7				
F_LeonaRv_S041		0.7			0.7			0.7			0.7				
F_LeonaRv_S042		0.7			0.7			0.7			0.7				
FrioRv_S090		0.7			0.7			0.7			0.7				
FrioRv_S100		0.7			0.7	0.7		0.7			0.7				
FrioRv_S101		0.7			0.7	0.7		0.7			0.7				
FrioRv_S102		0.7			0.7	0.7		0.7			0.7				
F_CiboloCk_S010		0.7			0.7	0.7		0.7			0.7				
F_CiboloCk_S011		0.7			0.7	0.7		0.7			0.7				
F_CiboloCk_S020		0.7			0.7	0.7		0.7			0.7				
FrioRv_S110		0.7			0.7	0.7		0.7			0.7				
FrioRv_S111		0.7			0.7	0.7		0.7			0.7				
FrioRv_S112		0.7			0.7	0.7		0.7			0.7				
FrioRv_S113		0.7			0.7	0.7		0.7			0.7				

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		0.7			0.7	0.7		0.7			0.7				
FrioRv_S120					0.7	0.6	0.6	0.6			0.7				
F_SanMigCk_S010					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S011					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S020					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S022					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S021					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S023					0.7	0.7		0.7	0.7		0.7				
F_SanMigCk_S024					0.7	0.6	0.6	0.6			0.7				
ChokeCanyon_S010					0.7	0.6	0.6	0.6			0.7				
FrioRv_S130					0.7	0.7	0.7	0.7		0.7					0.7
Atascosa_S010				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S011				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S020				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S030				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S031				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S040				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S041				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S050				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
La_ParitaCk_S010				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
La_ParitaCk_S020				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
La_ParitaCk_S030				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7
Atascosa_S060				0.7	0.7	0.7	0.7	0.7	0.7	0.7					0.7

	Calibrated Baseflow Recession Constant														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					0.7	0.7	0.7	0.7		0.7					0.7
Atascosa_S071					0.7	0.7	0.7	0.7		0.7					0.7
Atascosa_S080					0.7	0.7	0.7	0.7		0.7					0.7
FrioRv_S140					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S240					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S250					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S260					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S261					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S270					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S290					0.7	0.7	0.7	0.7		0.7					0.7
N_LagartoCk_S010					0.7	0.7	0.7	0.7		0.7					0.7
N_LagartoCk_S020					0.7	0.7	0.7	0.7		0.7					0.7
RamirenaCk_S010					0.7	0.7	0.7	0.7		0.7					0.7
RamirenaCk_S020					0.7	0.7	0.7	0.7		0.7					0.7
CorpusChristi_S010					0.7	0.7	0.7	0.7		0.7					0.7
CorpusChristi_S011					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S300					0.7	0.7	0.7	0.7		0.7					0.7
NuecesRv_S310					0.7	0.7	0.7	0.7		0.7					0.7

Table B.16: Calibrated Baseflow Ratio to Peak

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_W_S010	0.01	0.015	0.01	0.001	0.01			0.10	0.08		0.1	0.02	0.03	0.07	0.03
NuecesRv_W_S011	0.01	0.015	0.01	0.001	0.01			0.10	0.08		0.1	0.02	0.03	0.07	0.03
NuecesRv_W_S020	0.01	0.015	0.01	0.001	0.01			0.10	0.08		0.1	0.02	0.03	0.07	0.03
NuecesRv_W_S021	0.01	0.015	0.01	0.001	0.01			0.10	0.08		0.1	0.03	0.03	0.07	0.03
NuecesRv_W_S022	0.01	0.015	0.01	0.001	0.01			0.10	0.08		0.1	0.02	0.03	0.07	0.03
NuecesRv_W_S030	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.06	0.01	0.01	0.01
NuecesRv_W_S031	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.06	0.01	0.01	0.01
NuecesRv_W_S032	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.06	0.01	0.01	0.01
NuecesRv_S011	0.02	0.03	0.02	0.05	0.02			0.05			0.06	0.03	0.065	0.09	0.065
NuecesRv_S010	0.02	0.03	0.02	0.05	0.02			0.05			0.06	0.03	0.065	0.09	0.065
NuecesRv_S012	0.02	0.03	0.02	0.05	0.02			0.05			0.06	0.03	0.065	0.09	0.065
NuecesRv_S020	0.02	0.03	0.02	0.05	0.02			0.05			0.1	0.03	0.065	0.09	0.065
NuecesRv_S030	0.02	0.03	0.02	0.05	0.02			0.05			0.1	0.03	0.065	0.09	0.065
NuecesRv_S041	0.02	0.03	0.02	0.05	0.02			0.05			0.08	0.03	0.065	0.09	0.065
NuecesRv_S040	0.02	0.03	0.02	0.05	0.02			0.05			0.08	0.03	0.065	0.09	0.065
NuecesRv_S050	0.08	0.1	0.08	0.08	0.012			0.001			0.1	0.03	0.01	0.01	0.01
NuecesRv_S061	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.03	0.01	0.01	0.01
NuecesRv_S060	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.03	0.01	0.01	0.01
NuecesRv_S070	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.03	0.01	0.01	0.01
NuecesRv_S071	0.08	0.1	0.08	0.08	0.02			0.001			0.1	0.03	0.01	0.01	0.01

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S080	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S081	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S082	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S083	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S084	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S090	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_ChaconCk_S010	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChaconCk_S020	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChaconCk_S021	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChaconCk_S023	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChaconCk_S022	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_PicosaCk_S010	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_PicosaCk_S011	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_PicosaCk_S020	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S010	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S011	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S012	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChapCk_S010	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_ChapCk_S011	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S020	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_PicosaCk_S021	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S030	0.03	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S031	0.03	0.1			0.01			0.05				0.05	0.05		0.05

	Calibrated Baseflow Ratio to Peak													
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
N_TurkeyCk_S040	0.02	0.1			0.01			0.05				0.05	0.05		0.05
TurkeyCk_S041	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S050	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S060	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S061	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S070	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S080	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S081	0.02	0.1			0.01			0.05				0.05	0.05		0.05
N_TurkeyCk_S090	0.02	0.1			0.01			0.05				0.05	0.05		0.05
NuecesRv_S100					0.05			0.10							0.1
NuecesRv_S101					0.05			0.10							0.1
NuecesRv_S110					0.05			0.10							0.1
NuecesRv_S111					0.05			0.10							0.1
N_SanRoqCk_S010					0.05			0.10							0.1
N_SanRoqCk_S011					0.05			0.10							0.1
N_SanRoqCk_S020					0.05			0.10							0.1
N_SanRoqCk_S021					0.05			0.10							0.1
NuecesRv_S121					0.05			0.10							0.1
NuecesRv_S120					0.05			0.10							0.1
NuecesRv_S122					0.05			0.10							0.1
NuecesRv_S130					0.01	0.01		0.01							0.1
N_LaRaicesCk_S010					0.01	0.01		0.01							0.1
N_LaRaicesCk_S011					0.01	0.01		0.01							0.1

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S140					0.01	0.01		0.01							0.1
N_CalmanCk_S010					0.01	0.01		0.01							0.1
N_CalmanCk_S011					0.01	0.01		0.01							0.1
NuecesRv_S150					0.01	0.01		0.01							0.1
N_LosOlmosCk_S012					0.01	0.01		0.01							0.1
N_LosOlmosCk_S011					0.01	0.01		0.01							0.1
N_LosOlmosCk_S010					0.01	0.01		0.01							0.1
N_LosOlmosCk_S020					0.01	0.01		0.01							0.1
NuecesRv_S151					0.01	0.01		0.01							0.1
NuecesRv_S160					0.01	0.01		0.01							0.1
NuecesRv_S161					0.01	0.01		0.01							0.1
N_SanCasCk_S010				0.05	0.01	0.01	0.05	0.05				0.05			0.1
N_SanCasCk_S020				0.05	0.01	0.01	0.01	0.01				0.05			0.1
N_SanCasCk_S021				0.05	0.01	0.01	0.01	0.01				0.05			0.1
N_SanCasCk_S011				0.05	0.01	0.01	0.05	0.05				0.05			0.1
N_SanCasCk_S030					0.01	0.01		0.01							0.1
NuecesRv_S170					0.01	0.01		0.01							0.1
N_BlackCk_S010					0.01	0.01		0.01							0.1
N_BlackCk_S020					0.01	0.01		0.01							0.1
N_BlackCk_S021					0.01	0.01		0.01							0.1
NuecesRv_S180					0.01	0.01		0.01							0.1
NuecesRv_S185					0.01	0.01		0.01							0.1
NuecesRv_S190					0.01	0.01		0.01							0.1

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_S200					0.01	0.01		0.01							0.1
NuecesRv_S210					0.01	0.01		0.01							0.1
NuecesRv_S220					0.05	0.01	0.01	0.01		0.05					0.1
NuecesRv_S221					0.05	0.01	0.01	0.01		0.05					0.1
NuecesRv_S222					0.05	0.01	0.01	0.01		0.05					0.1
NuecesRv_S230					0.05	0.01	0.01	0.01		0.05					0.1
NuecesRv_S231					0.05	0.01	0.01	0.01		0.05					0.1
FrioRv_S011	0.025	0.035	0.03		0.024		0.06	0.07			0.08	0.03	0.06		0.1
FrioRv_S010	0.025	0.035	0.03		0.024		0.06	0.07			0.08	0.03	0.06		0.1
FrioRv_S020	0.025	0.035	0.03		0.024		0.06	0.01			0.08	0.03	0.06		0.1
FrioRv_S030	0.02	0.1	0.02		0.02			0.001			0.001		0.02		0.02
FrioRv_D_S010	0.02	0.02	0.03		0.01			0.13			0.1		0.07		0.07
FrioRv_D_S020	0.02	0.1	0.02		0.02			0.001			0.001		0.02		0.02
FrioRv_D_S030	0.02	0.1	0.02		0.02			0.001			0.001		0.02		0.02
FrioRv_S040	0.02	0.1	0.02		0.02			0.001			0.001		0.02		0.02
FrioRv_S051		0.05			0.1			0.02			0.1				
F_BlancoCk_S010		0.05			0.1			0.02			0.1				
F_BlancoCk_S020		0.05			0.1			0.02			0.1				
F_SabinalRv_S010	0.02	0.035	0.015		0.035			0.05			0.06		0.05		0.05
F_SabinalRv_S020	0.02	0.035	0.015		0.035			0.05			0.06		0.1		0.1
F_SabinalRv_S021	0.02	0.035	0.015		0.035			0.05			0.06		0.1		0.1
F_SabinalRv_S030	0.01	0.03	0.01		0.01			0.01			0.01		0.01		0.01
F_SabinalRv_S041		0.05			0.1			0.05			0.1				

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_SabinalRv_S040		0.05			0.1			0.05			0.1				
F_SabinalRv_S050		0.05			0.1			0.05			0.1				
F_SabinalRv_S055		0.05			0.1			0.05			0.1				
FrioRv_Sab_S060		0.05			0.1			0.02			0.1				
FrioRv_S070		0.05			0.1			0.02			0.1				
FrioRv_S071		0.05			0.1			0.02			0.1				
FrioRv_S072		0.05			0.1			0.02			0.1				
F_HondoCk_S010		0.005	0.02		0.03			0.03			0.03				
F_HondoCk_S020		0.005	0.01		0.1			0.001			0.1				
F_HondoCk_S021		0.05			0.1			0.02			0.1				
F_MVerdeCk_S010		0.05			0.1			0.17			0.04				
F_MVerdeCk_S011		0.05			0.1			0.02			0.1				
F_MVerdeCk_S021		0.05			0.1			0.02			0.1				
F_MVerdeCk_S020		0.05			0.1			0.02			0.1				
F_HondoCk_S030		0.05			0.1			0.02			0.1				
F_HondoCk_S031		0.05			0.1			0.02			0.1				
F_SecoCk_S010	0.04	0.015	0.02		0.03			0.01			0.025				
F_SecoCk_S020		0.001	0.005		0.02			0.01			0.01				
F_SecoCk_S021		0.001	0.005		0.02			0.01			0.01				
F_SecoCk_S030		0.05			0.1			0.02			0.1				
F_SecoCk_S031		0.05			0.1			0.02			0.1				
F_HondoCk_S040		0.05			0.1			0.02			0.1				
FrioRv_S080		0.05			0.1			0.02			0.1				

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
F_LeonaRv_S010		0.05			0.1			0.02	0.015	0.01	0.015				
F_LeonaRv_S011		0.05			0.1			0.02	0.015	0.01	0.015				
F_LeonaRv_S012		0.05			0.1			0.02	0.015	0.01	0.015				
F_LeonaRv_S020		0.05			0.1			0.02	0.015	0.01	0.015				
F_LeonaRv_S021		0.05			0.1			0.10			0.1				
F_LeonaRv_S022		0.05			0.1			0.10			0.1				
F_LeonaRv_S023		0.05			0.1			0.10			0.1				
F_LeonaRv_S030		0.05			0.1			0.10			0.1				
F_LeonaRv_S031		0.05			0.1			0.10			0.1				
F_LeonaRv_S040		0.05			0.1			0.10			0.1				
F_LeonaRv_S041		0.05			0.1			0.10			0.1				
F_LeonaRv_S042		0.05			0.1			0.10			0.1				
FrioRv_S090		0.05			0.1			0.02			0.1				
FrioRv_S100		0.1			0.001	0.01		0.001			0.1				
FrioRv_S101		0.1			0.001	0.01		0.001			0.1				
FrioRv_S102		0.1			0.001	0.01		0.001			0.1				
F_CiboloCk_S010		0.1			0.001	0.01		0.001			0.1				
F_CiboloCk_S011		0.1			0.001	0.01		0.001			0.1				
F_CiboloCk_S020		0.1			0.001	0.01		0.001			0.1				
FrioRv_S110		0.1			0.001	0.01		0.001			0.1				
FrioRv_S111		0.1			0.001	0.01		0.001			0.1				
FrioRv_S112		0.1			0.001	0.01		0.001			0.1				
FrioRv_S113		0.1			0.001	0.01		0.001			0.1				

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_S114		0.1			0.001	0.01		0.001			0.1				
FrioRv_S120					0.01	0.01	0.01	0.01			0.1				
F_SanMigCk_S010					0.01	0.01		0.03	0.02		0.01				
F_SanMigCk_S011					0.01	0.01		0.03	0.02		0.01				
F_SanMigCk_S020					0.01	0.01		0.03	0.02		0.01				
F_SanMigCk_S022					0.01	0.01		0.03	0.02		0.01				
F_SanMigCk_S021					0.01	0.01		0.03	0.02		0.01				
F_SanMigCk_S023					0.01	0.01		0.01	0.01		0.01				
F_SanMigCk_S024					0.01	0.01	0.01	0.01			0.1				
ChokeCanyon_S010					0.01	0.01	0.01	0.01			0.1				
FrioRv_S130					0.01	0.01	0.01	0.01		0.05					0.1
Atascosa_S010				0.01	0.01	0.01	0.03	0.03	0.03	0.01					0.05
Atascosa_S011				0.01	0.01	0.01	0.03	0.03	0.03	0.01					0.05
Atascosa_S020				0.01	0.01	0.01	0.03	0.03	0.03	0.01					0.05
Atascosa_S030				0.01	0.01	0.01	0.03	0.03	0.03	0.01					0.05
Atascosa_S031				0.01	0.02	0.05	0.06	0.06	0.06	0.05					0.05
Atascosa_S040				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05
Atascosa_S041				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05
Atascosa_S050				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05
La_ParitaCk_S010				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05
La_ParitaCk_S020				0.01	0.01	0.05	0.05	0.05	0.05	0.05					0.05
La_ParitaCk_S030				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05
Atascosa_S060				0.01	0.01	0.05	0.06	0.06	0.06	0.05					0.05

	Calibrated Baseflow Ratio to Peak														
Subbasin Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Atascosa_S070					0.01	0.03	0.03	0.03		0.05					0.05
Atascosa_S071					0.01	0.03	0.03	0.03		0.05					0.05
Atascosa_S080					0.01	0.03	0.03	0.03		0.05					0.05
FrioRv_S140					0.01	0.01	0.01	0.01		0.05					0.1
NuecesRv_S240					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S250					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S260					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S261					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S270					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S290					0.001	0.01	0.01	0.01		0.01					0.1
N_LagartoCk_S010					0.001	0.01	0.01	0.01		0.01					0.1
N_LagartoCk_S020					0.001	0.01	0.01	0.01		0.01					0.1
RamirenaCk_S010					0.001	0.01	0.01	0.01		0.01					0.1
RamirenaCk_S020					0.001	0.01	0.01	0.01		0.01					0.1
CorpusChristi_S010					0.001	0.01	0.01	0.01		0.01					0.1
CorpusChristi_S011					0.001	0.01	0.01	0.01		0.01					0.1
NuecesRv_S300					0.1	0.01	0.01	0.10		0.01					0.1
NuecesRv_S310					0.1	0.1	0.01	0.10		0.01					0.1

Table B.17: Calibrated Muskingum K (hours)

	Calibrated Muskingum K (hours)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
W_NuecesRv_R010	5	6	6	4	3			11	19.2		11	4	4.5	8	4.5
W_NuecesRv_R020	2	4	4	2	2			6	6		6	2	2	4	2
W_NuecesRv_R030	2	3	2.5	3	3			3			6	4	3	3	3
W_NuecesRv_R040	4.5	6	5	6	6			6			12	6	6	6	6
NuecesRv_R010	3	5	4.5	4	4			6			4	4	4	3.25	4
NuecesRv_R020	2	3	4	3	3			7			3.5	3	3	2.25	3
NuecesRv_R030	2	2	3	2	2			6			2.5	2	2	1.5	2
NuecesRv_R040	3	1.5	3	3	4			3			2.5	3	3	3	3
NuecesRv_R050	1	1	0.5	1	0.5			1			0.5	1	1	1	1
NuecesRv_R060	2	2	1.5	2	2			2			2.5	3	2	2	2
NuecesRv_R070	2	2	1.5	2	2			2			2.5	3	2	2	2
NuecesRv_R135	0.25	0.25			0.25			0.25				0.25	0.25		0.25
ChaconCk_R010	9.99	9.99			14			11				11	9.99		9.99
ChaconCk_R020	11.67	11.67			16			13				13	11.67		11.67
Palo_BlancoCk_R010	11.08	11.08			12			12				11.08	11.08		11.08
Palo_BlancoCk_R020	1.85	1.85			1.85			1.85				1.85	1.85		1.85
PicosaCk_R010	7.7	7.7			12			7.7				7.7	7.7		7.7
Palo_BlancoCk_R030	1.78	1.78			1.78			1.78				1.78	1.78		1.78
ComancheCk_R010	9.7	9.7			12			9.7				9.7	9.7		9.7
ComancheCk_R020	1.28	1.28			2			1.28				1.28	1.28		1.28

	Calibrated Muskingum K (hours)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
TurkeyCk_R010	10.94	10.94			15			12				12	10.94		10.94
TurkeyCk_R020	7.38	7.38			11			8				8	7.38		7.38
ChaparrosaCk_R010	12.47	12.47			17			14				14	12.47		12.47
TurkeyCk_R030	8.09	8.09			12			9				9	8.09		8.09
TurkeyCk_R040	4.97	4.97			9			6				6	4.97		4.97
TurkeyCk_R050	1.8	1.8			2			1.8				1.8	1.8		1.8
CarrizoCk_R010	4.14	4.14			6			4.14				4.14	4.14		4.14
El_MoroCk_R010	0.25	0.25			0.25			0.25				0.25	0.25		0.25
TurkeyCk_R100	0.25	0.25			0.25			0.25				0.25	0.25		0.25
NuecesRv_R140					18			28							18
Arroyo_Negro_R010					0.88			0.9							0.88
NuecesRv_R150					8			12							8
NuecesRv_R160					18			28							18
San_RoqueCk_R010					7			7							4.98
San_RoqueCk_R020					14			14							9.39
NuecesRv_R170					12			20							12
NuecesRv_R180					19.7			34							22
NuecesRv_R190					17	17		62							41
La_RaicesCk_R010					11.86	11.86		18							11.86
NuecesRv_R200					14	14		21							14
CalmanCk_R010					9.47	9.47		14							9.47
NuecesRv_R210					5.5	5.5		8							6
Los_OlmosCk_R010					0.41	0.41		1							0.41

	Calibrated Muskingum K (hours)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Los_OlmosCk_R020					7.61	7.61		11							7.61
Los_OlmosCk_R030					7.87	7.87		12							7.87
NuecesRv_R220					5.7	5.7		8							6
NuecesRv_R225					5.6	5.6		8							6
SaladoCk_R010				22	13	35	30	31				11.71			11.71
BecerraCk_R010				28	18	40	35	36				16.74			16.74
San_CasimiroCk_R010					10.4	10.4		12							8.32
NuecesRv_R230					4	4		6							4
BlackCk_R010					7.1	7.1		7							4.71
BlackCk_R020					13.7	13.7		14							9.15
NuecesRv_R240					35	24		38							24
NuecesRv_R250					3.1	3.1		5							3
NuecesRv_R260					3.8	3.8		6							4
NuecesRv_R270					15.2	19		40							26
NuecesRv_R280					5.3	8	8	8		8					9
NuecesRv_R285					9.1	12	12	12		12					15
OldRv_R010					1.5	1.02	1.02	1.02		1.02					1.02
NuecesRv_R290					13.5	19	19	19		19					24
NuecesRv_R300					16.2	22	22	22		22					28
FrioRv_R010	0.75	1.35	1.35		1.35		1.35	1.35			1.35	1.35	1.35		1.35
FrioRv_R020	3.5	4	3		3		3	4			5	4.5	4		4
FrioRv_R030	5	5.25	11		5			4			5		5		5
Dry_FrioRv_R010	4	4	8		4			3.5			3		4		4

	Calibrated Muskingum K (hours)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Dry_FrioRv_R020	4	2	6		2			2			2		2		2
FrioRv_R040	2	1	4		1			1.5			1		1		1
BlancoCk_R010		22			22			22			22				
FrioRv_R060		1			1			1			1				
SabinalRv_R010	2	2	3.5		2			3			3		3		3
SabinalRv_R020	3	3	4.5		3			4			4		4		4
SabinalRv_R030	6	4	4.25		2			3			4		5		5
SabinalRv_R040		7			7			7			7				
RancherosCk_R010		6			6			6			6				
SabinalRv_R050		10			10			10			10				
SabinalRv_R060		8			8			8			8				
FrioRv_R085		0.25			0.25			0.25			0.25				
HondoCk_R010		2.5	2.75		15.21			3.75			3.75				
HondoCk_R020		3.57			3.57			3.57			3.57				
VerdeCk_R010		2.62			2.62			2.62			2.62				
VerdeCk_R020		21			13.95			21			21				
VerdeCk_R025		0.42			0.42			0.42			0.42				
HondoCk_R030		13			8.73			13			13				
HondoCk_R040		20			13.06			21			21				
SecoCk_R010		5	2		3			2.5			2.75				
SecoCk_R020		4	1.5		2			1.5			2				
SecoCk_R030		34			23.03			34			34				
SecoCk_R040		5			3.09			5			5				

	Calibrated Muskingum K (hours)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
HondoCk_R050		7.75			5.37			7.75			7.75				
LeonaRv_R010		1.29			1.29			2	2	2	2				
Cooks_Slough_R010		1.21			1.21			2	2	2	2				
LeonaRv_R015		1.5			1.5			2	2	2	2				
LeonaRv_R020		11.21			11.21			14			11.21				
LeonaRv_R030		3.12			3.12			3			3.12				
LeonaRv_R040		14.76			14.76			18			14.76				
LeonaRv_R050		15.82			15.82			19			15.82				
LeonaRv_R060		3.43			3.43			4			3.43				
FrioRv_R100		0.46			0.46			0.46			0.46				
NuecesRv_R305					1.5	2	2	2		1					1

Table B.18: Calibrated Muskingum X

Reach Name	Calibrated Muskingum X														
	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
W_NuecesRv_R010	0.2	0.2	0.2	0.4	0.2			0.2	0.2		0.2	0.2	0.2	0.2	0.2
W_NuecesRv_R020	0.2	0.2	0.2	0.4	0.2			0.2	0.2		0.2	0.2	0.2	0.2	0.2
W_NuecesRv_R030	0.4	0.2	0.4	0.4	0.4			0.4			0.2	0.25	0.4	0.2	0.4
W_NuecesRv_R040	0.4	0.2	0.4	0.4	0.4			0.4			0.2	0.25	0.4	0.2	0.4
NuecesRv_R010	0.4	0.2	0.4	0.2	0.2			0.2			0.2	0.3	0.2	0.2	0.2
NuecesRv_R020	0.4	0.2	0.4	0.2	0.2			0.2			0.2	0.3	0.2	0.2	0.2
NuecesRv_R030	0.4	0.2	0.4	0.2	0.2			0.2			0.2	0.3	0.2	0.2	0.2
NuecesRv_R040	0.4	0.2	0.4	0.4	0.4			0.4			0.4	0.25	0.4	0.2	0.4
NuecesRv_R050	0.4	0.2	0.4	0.4	0.4			0.4			0.4	0.25	0.4	0.2	0.4
NuecesRv_R060	0.4	0.2	0.4	0.4	0.4			0.4			0.4	0.25	0.4	0.2	0.4
NuecesRv_R070	0.4	0.2	0.4	0.4	0.4			0.4			0.4	0.25	0.4	0.2	0.4
NuecesRv_R135	0.1	0.1			0.1			0.1				0.1	0.1		0.1
ChaconCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
ChaconCk_R020	0.1	0.1			0.1			0.1				0.1	0.1		0.1
Palo_BlancoCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
Palo_BlancoCk_R020	0.1	0.1			0.1			0.1				0.1	0.1		0.1
PicosaCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
Palo_BlancoCk_R030	0.1	0.1			0.1			0.1				0.1	0.1		0.1
ComancheCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
ComancheCk_R020	0.1	0.1			0.1			0.1				0.1	0.1		0.1

	Calibrated Muskingum X														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
TurkeyCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
TurkeyCk_R020	0.2	0.2			0.2			0.1				0.2	0.2		0.2
ChaparrosaCk_R010	0.1	0.1			0.1			0.1				0.1	0.1		0.1
TurkeyCk_R030	0.1	0.1			0.1			0.1				0.1	0.1		0.1
TurkeyCk_R040	0.1	0.1			0.1			0.1				0.1	0.1		0.1
TurkeyCk_R050	0.1	0.1			0.1			0.1				0.1	0.1		0.1
CarrizoCk_R010	0.1	0.2			0.2			0.1				0.2	0.2		0.2
El_MoroCk_R010	0.2	0.1			0.1			0.1				0.1	0.1		0.1
TurkeyCk_R100	0.1	0.1			0.1			0.1				0.1	0.1		0.1
NuecesRv_R140					0.1			0.1							0.1
Arroyo_Negro_R010					0.1			0.1							0.1
NuecesRv_R150					0.1			0.1							0.1
NuecesRv_R160					0.1			0.1							0.1
San_RoqueCk_R010					0.1			0.1							0.1
San_RoqueCk_R020					0.1			0.1							0.1
NuecesRv_R170					0.1			0.1							0.1
NuecesRv_R180					0.1			0.1							0.1
NuecesRv_R190					0.1	0.1		0.1							0.1
La_RaicesCk_R010					0.1	0.1		0.1							0.1
NuecesRv_R200					0.1	0.1		0.1							0.1
CalmanCk_R010					0.1	0.1		0.1							0.1
NuecesRv_R210					0.1	0.1		0.1							0.1
Los_OlmosCk_R010					0.1	0.1		0.1							0.1

	Calibrated Muskingum X														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Los_OlmosCk_R020					0.1	0.1		0.1							0.1
Los_OlmosCk_R030					0.1	0.1		0.1							0.1
NuecesRv_R220					0.1	0.1		0.1							0.1
NuecesRv_R225					0.1	0.1		0.1							0.1
SaladoCk_R010				0.2	0.1	0.1	0.1	0.1				0.1			0.1
BecerraCk_R010				0.2	0.1	0.1	0.1	0.1				0.1			0.1
San_CasimiroCk_R010					0.1	0.1		0.1							0.1
NuecesRv_R230					0.1	0.1		0.1							0.1
BlackCk_R010					0.1	0.1		0.1							0.1
BlackCk_R020					0.1	0.1		0.1							0.1
NuecesRv_R240					0.1	0.1		0.1							0.1
NuecesRv_R250					0.1	0.1		0.1							0.1
NuecesRv_R260					0.1	0.1		0.1							0.1
NuecesRv_R270					0.1	0.1		0.1							0.1
NuecesRv_R280					0.1	0.1	0	0		0.1					0.1
NuecesRv_R285					0.1	0.1	0	0		0.1					0.1
OldRv_R010					0.2	0.2	0.2	0.2		0.2					0.2
NuecesRv_R290					0.1	0.1	0	0		0.1					0.1
NuecesRv_R300					0.1	0.1	0	0		0.1					0.1
FrioRv_R010	0.2	0.2	0.2		0.2		0.2	0.2			0.2	0.4	0.4		0.4
FrioRv_R020	0.2	0.2	0.2		0.2		0.2	0.4			0.2	0.4	0.4		0.4
FrioRv_R030	0.2	0.4	0.4		0.2			0.4			0.4		0.2		0.2
Dry_FrioRv_R010	0.2	0.4	0.4		0.2			0.4			0.4		0.2		0.2

	Calibrated Muskingum X														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Dry_FrioRv_R020	0.2	0.4	0.4		0.2			0.4			0.4		0.2		0.2
FrioRv_R040	0.2	0.4	0.4		0.2			0.4			0.4		0.2		0.2
BlancoCk_R010		0.2			0.2			0.2			0.2				
FrioRv_R060		0.1			0.1			0.1			0.1				
SabinalRv_R010	0.2	0.4	0.4		0.2			0.2			0.2		0.2		0.2
SabinalRv_R020	0.2	0.4	0.4		0.2			0.2			0.2		0.2		0.2
SabinalRv_R030	0.35	0.4	0.4		0.2			0.4			0.4		0.4		0.4
SabinalRv_R040		0.2			0.2			0.2			0.1				
RancherosCk_R010		0.2			0.2			0.2			0.2				
SabinalRv_R050		0.2			0.2			0.2			0.1				
SabinalRv_R060		0.2			0.2			0.2			0.1				
FrioRv_R085		0.1			0.1			0.1			0.1				
HondoCk_R010		0.4	0.2		0.3			0.4			0.3				
HondoCk_R020		0.3			0.3			0.3			0.1				
VerdeCk_R010		0.4			0.4			0.4			0.2				
VerdeCk_R020		0.3			0.3			0.3			0.2				
VerdeCk_R025		0.3			0.3			0.3			0.2				
HondoCk_R030		0.1			0.1			0.1			0.1				
HondoCk_R040		0.1			0.1			0.1			0.1				
SecoCk_R010		0.4	0.4		0.2			0.4			0.2				
SecoCk_R020		0.4	0.4		0.2			0.4			0.2				
SecoCk_R030		0.2			0.2			0.2			0.1				
SecoCk_R040		0.2			0.2			0.2			0.1				

	Calibrated Muskingum X														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
HondoCk_R050		0.1			0.1			0.1			0.1				
LeonaRv_R010		0.1			0.1			0.1	0.1	0.1	0.1				
Cooks_Slough_R010		0.2			0.2			0.2	0.2	0.2	0.2				
LeonaRv_R015		0.2			0.2			0.2	0.2	0.2	0.2				
LeonaRv_R020		0.1			0.1			0.1			0.1				
LeonaRv_R030		0.1			0.1			0.1			0.1				
LeonaRv_R040		0.1			0.1			0.1			0.1				
LeonaRv_R050		0.1			0.1			0.1			0.1				
LeonaRv_R060		0.1			0.1			0.1			0.1				
FrioRv_R100		0.1			0.1			0.1			0.1				
NuecesRv_R305					0.1	0.1	0.1	0.1		0.1					0.1

Table B.19: Calibrated Muskingum Subreaches

	Calibrated Muskingum Subreaches														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
W_NuecesRv_R010	15	12	14	8	8			22	19		22	8	8	16	8
W_NuecesRv_R020	6	8	8	6	6			12	6		12	4	4	8	4
W_NuecesRv_R030	6	8	6	6	6			6			6	8	8	8	8
W_NuecesRv_R040	12	14	12	12	12			12			12	14	14	12	14
NuecesRv_R010	12	10	10	8	8			12			8	6	8	6	8
NuecesRv_R020	8	6	8	6	6			14			3	6	6	4	6
NuecesRv_R030	8	4	6	4	4			12			2	4	4	2	4
NuecesRv_R040	6	3	12	6	8			9			3	8	8	8	8
NuecesRv_R050	1	2	1	1	2			3			1	2	2	2	2
NuecesRv_R060	4	6	6	4	4			6			3	6	6	6	6
NuecesRv_R070	4	6	6	4	4			6			3	6	6	4	6
NuecesRv_R135	1	1			1			1				1	1		1
ChaconCk_R010	9	9			12			16				16	9		9
ChaconCk_R020	11	11			15			13				13	11		11
Palo_BlancoCk_R010	11	11			12			12				11	11		11
Palo_BlancoCk_R020	1	1			2			1				1	1		1
PicosaCk_R010	7	7			10			11				11	7		7
Palo_BlancoCk_R030	1	1			2			1				1	1		1
ComancheCk_R010	9	9			11			15				15	9		9
ComancheCk_R020	1	1			2			2				2	2		2

	Calibrated Muskingum Subreaches														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
TurkeyCk_R010	10	10			14			12				12	10		10
TurkeyCk_R020	7	7			21			16				16	14		14
ChaparrosaCk_R010	12	12			16			14				14	12		12
TurkeyCk_R030	8	8			11			9				9	8		8
TurkeyCk_R040	4	4			8			6				6	4		4
TurkeyCk_R050	1	1			2			2				2	2		2
CarrizoCk_R010	4	4			12			8				8	8		8
El_MoroCk_R010	1	1			1			1				1	1		1
TurkeyCk_R100	1	1			1			1				1	1		1
NuecesRv_R140					18			28							7
Arroyo_Negro_R010					1			1							1
NuecesRv_R150					8			3							3
NuecesRv_R160					18			7							6
San_RoqueCk_R010					7			2							4
San_RoqueCk_R020					14			3							18
NuecesRv_R170					12			5							4
NuecesRv_R180					20			6							7
NuecesRv_R190					3	3		62							2
La_RaicesCk_R010					12	6		16							11
NuecesRv_R200					2	2		21							1
CalmanCk_R010					9	3		12							9
NuecesRv_R210					1	1		8							1
Los_OlmosCk_R010					1	1		1							1

	Calibrated Muskingum Subreaches														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Los_OlmosCk_R020					8	2		9							7
Los_OlmosCk_R030					8	2		10							7
NuecesRv_R220					1	1		8							1
NuecesRv_R225					1	1		8							1
SaladoCk_R010				22	13	35	30	31				11			11
BecerraCk_R010				28	18	40	35	36				16			16
San_CasimiroCk_R010					10	5		10							8
NuecesRv_R230					1	1		6							1
BlackCk_R010					7	3		6							4
BlackCk_R020					14	7		12							9
NuecesRv_R240					18	1		38							1
NuecesRv_R250					1	1		5							1
NuecesRv_R260					1	1		6							1
NuecesRv_R270					15	6		40							1
NuecesRv_R280					1	1	8	8		1					2
NuecesRv_R285					1	1	12	12		1					3
OldRv_R010					1	1	1	1		1					1
NuecesRv_R290					1	1	19	19		1					5
NuecesRv_R300					1	1	22	22		1					6
FrioRv_R010	3	3	3		3		3	3			3	3	3		3
FrioRv_R020	10	8	6		6		6	8			10	9	8		8
FrioRv_R030	10	10	22		10			8			10		10		10
Dry_FrioRv_R010	8	8	18		8			7			6		8		8

	Calibrated Muskingum Subreaches														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
Dry_FrioRv_R020	8	4	14		4			6			4		4		4
FrioRv_R040	4	2	8		2			3			2		2		2
BlancoCk_R010		15			36			36			5				
FrioRv_R060		1			1			1			1				
SabinalRv_R010	6	8	8		4			6			6		6		6
SabinalRv_R020	10	10	10		6			8			8		8		8
SabinalRv_R030	12	10	8		4			9			10		10		10
SabinalRv_R040		12			12			12			2				
RancherosCk_R010		12			12			12			2				
SabinalRv_R050		20			20			20			3				
SabinalRv_R060		16			16			16			2				
FrioRv_R085		1			1			1			1				
HondoCk_R010		10	6		40			15			15				
HondoCk_R020		3			10			10			1				
VerdeCk_R010		2			10			10			1				
VerdeCk_R020		55			35			55			5				
VerdeCk_R025		1			2			2			1				
HondoCk_R030		20			8			20			3				
HondoCk_R040		25			13			30			5				
SecoCk_R010		10	4		6			5			6				
SecoCk_R020		8	3		4			3			4				
SecoCk_R030		60			46			60			7				
SecoCk_R040		10			6			10			1				

Reach Name	Calibrated Muskingum Subreaches														
	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
HondoCk_R050		10			5			12			2				
LeonaRv_R010		1			2			3	3	3	2				
Cooks_Slough_R010		1			2			4	4	4	2				
LeonaRv_R015		1			3			4	4	4	2				
LeonaRv_R020		11			11			14			11				
LeonaRv_R030		3			3			3			3				
LeonaRv_R040		14			14			18			8				
LeonaRv_R050		15			15			19			8				
LeonaRv_R060		3			3			4			2				
FrioRv_R100		1			1			1			1				
NuecesRv_R305					1	1	2	2		1					1

Table B.20: Calibrated Modified Puls Subreaches

		Calibrated Modified Puls Subreaches														
Reach Name	Calibrated Storage Discharge Curve Name	Oct-96	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
NuecesRv_R080	NuecesRv_R080	1	1			1			1				1	1		1
NuecesRv_R090	NuecesRv_R090	2	1			2			1				1	1		1
NuecesRv_R100	NuecesRv_R0100	4	1			4			1				1	1		1
NuecesRv_R110	NuecesRv_R110	2	1			2			1				1	1		1
NuecesRv_R120	NuecesRv_R120	1	1			1			1				1	1		1
NuecesRv_R130	NuecesRv_R130	1	1			1			1				1	1		1
Nueces_TurkeyCk_R010	Nueces_TurkeyCk_R010	2	1			2			1				1	1		1
TurkeyCk_R060	TurkeyCk_R060	1	1			1			1				1	1		1
TurkeyCk_R070	TurkeyCk_R070	1	1			1			1				1	1		1
TurkeyCk_R080	TurkeyCk_R080	1	1			1			1				1	1		1
TurkeyCk_R090	TurkeyCk_R090	1	1			1			1				1	1		1
FrioRv_R050	FrioRv_R050		9			13			13			1				
FrioRv_R070	FrioRv_R070		5			9			9			1				
FrioRv_R080	FrioRv_R080		1			2			2			1				
FrioRv_R090	FrioRv_R090		5			9			9			1				
FrioRv_R110	FrioRv_R110		2			2	2		2			2				
FrioRv_R120	FrioRv_R120		3			4	7		3			3				
FrioRv_R130	FrioRv_R130		3			4	8		3			4				
CiboloCk_R010	CiboloCk_R010		5			5	5		9			5				
CiboloCk_R020	CiboloCk_R020		10			19	19		19			10				

		Calibrated Modified Puls Subreaches														
Reach Name	Calibrated Storage Discharge Curve Name	Oct-96	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
FrioRv_R140	FrioRv_R140		2			3	6		2			3				
FrioRv_R150	FrioRv_R150		1			1	2		1			1				
FrioRv_R160	FrioRv_R160		2			4	6		3			3				
FrioRv_R170	FrioRv_R170					7	7	7	7			7				
SanMiguelCk_R010	SanMiguelCk_R010					13	13		13	13		13				
SanMiguelCk_R020	SanMiguelCk_R020					9	9		9	9		9				
SanMiguelCk_R030	SanMiguelCk_R030					6	3		6	5		5				
SanMiguelCk_R040	SanMiguelCk_R040					9	9	9	9			9				
FrioRv_R180	FrioRv_R180					1	3	3	3		1					3
FrioRv_R190	FrioRv_R190					1	1	1	1		1					1
AtascosaRv_R010	AtascosaRv_R010				11	11	11	11	11	11	11					11
AtascosaRv_R020	AtascosaRv_R020				7	7	7	7	7	7	7					7
AtascosaRv_R030	AtascosaRv_R030				11	11	8	11	11	4	11					11
AtascosaRv_R040	AtascosaRv_R040				8	8	10	8	10	10	16					8
BorregoCk_R010	BorregoCk_R010				8	8	12	8	12	12	16					8
AtascosaRv_R050	AtascosaRv_R050				7	7	9	7	9	9	14					7
La_ParitaCk_R010	LaParitaCk_R010				3	3	3	1	3	3	6					3
AtascosaRv_R060	AtascosaRv_R060				3	3	3	1	3	3	6					3
AtascosaRv_R070	AtascosaRv_R070					3	3	6	6		1					6
AtascosaRv_R080	AtascosaRv_R080					2	2	4	4		1					4

		Calibrated Modified Puls Subreaches														
Reach Name	Calibrated Storage Discharge Curve Name	Oct-96	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
AtascosaRv_R085	AtascosaRv_R085					1	1	1	1		1					1
AtascosaRv_R090	AtascosaRv_R090					2	5	5	5		1					5
NuecesRv_R310	NuecesRv_R310					1	5	5	5		5					5
NuecesRv_R320	NuecesRv_R320					1	7	7	7		7					7
NuecesRv_R330	NuecesRv_R330					1	1	1	1		1					1
NuecesRv_R340	NuecesRv_R340					1	8	8	8		8					8
NuecesRv_R350	NuecesRv_R350					1	6	6	6		6					6
LagartoCk_R010	LagartoCk_R010					13	13	13	13		13					13
RamirenaCk_R010	RamirenaCk_R010					9	9	9	9		9					9
NuecesRv_R360	NuecesRv_R360					4	15	10	15		4					8
NuecesRv_R370	NuecesRv_R370					3	12	8	12		6					12

Table B.21: Calibrated Channel Loss Flow Rate (cfs)

	Calibrated Channel Loss Flow Rate (cfs)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
W_NuecesRv_R030	3	0	3	3	3			3			3	3	3	3	3
W_NuecesRv_R040	6	0	6	6	6			6			6	6	6	6	6
NuecesRv_R040	20	0	20	20	20			50			200	50	20	20	20
NuecesRv_R050	3	0	3	3	3			13			25	10	3	3	3
NuecesRv_R060	11	0	11	11	11			20			100	31	11	11	11
NuecesRv_R070	11	0	11	11	11			20			100	31	11	11	11
NuecesRv_R080	5	5	5		5			5				5	5		5
NuecesRv_R090	13	13	13		13			13				13	13		13
NuecesRv_R100	20	20	20		20			20				20	20		20
NuecesRv_R110	8	8	8		8			8				8	8		8
NuecesRv_R120	0	0	6		0			0				0	0		0
FrioRv_R010	1	1	1		1		1	1			1	1	1		1
FrioRv_R020	11	11	1		1		11	11			11	11	1		1
FrioRv_R030	171	211	60		171			350			350		171		171
Dry_FrioRv_R010	318	0	20		318			318			318		318		318
Dry_FrioRv_R020	85	0	0		85			85			85		85		85
FrioRv_R040	42	92	0		42			162			92		42		42
FrioRv_R050		205			205			205			205				
SabinalRv_R010	45	0	0		0			0			0		45		45
SabinalRv_R020	62	0	0		0			0			0		62		62

	Calibrated Channel Loss Flow Rate (cfs)														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
SabinalRv_R030	40	85	95		1			125			101		141		141
HondoCk_R010		0	191		191			78			375				
HondoCk_R020		45			45			45			45				
VerdeCk_R010		28			28			28			28				
VerdeCk_R020		147			147			147			147				
VerdeCk_R025		4			4			4			4				
SecoCk_R010		107	107		0			0			70				
SecoCk_R020		69	69		0			0			50				
SecoCk_R030		92			92			92			92				
SecoCk_R040		12			12			12			12				
NuecesRv_R350					50	0	50								
NuecesRv_R360					0	147	0	147		0					0
NuecesRv_R370					122	122	65	122		122					122

Table B.22: Calibrated Channel Loss Fraction

	Calibrated Channel Loss Fraction														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
W_NuecesRv_R030	0.10	0	0.01	0.05	0.20			0.1			0.08	0.01	0.03	0.03	0.03
W_NuecesRv_R040	0.10	0	0.01	0.05	0.20			0.1			0.08	0.01	0.03	0.03	0.03
NuecesRv_R040	0.10	0.05	0.01	0.05	0.25			0.1			0.08	0.01	0.03	0.03	0.03
NuecesRv_R050	0.10	0.03	0.01	0.05	0.25			0.02			0.02	0.01	0.03	0.03	0.03
NuecesRv_R060	0.10	0.03	0.01	0.05	0.25			0.06			0.08	0.01	0.03	0.03	0.03
NuecesRv_R070	0.10	0.03	0.01	0.05	0.25			0.06			0.08	0.01	0.03	0.03	0.03
NuecesRv_R080	0.30	0.13	0.25		0.15			0.13				0.15	0.15		0.15
NuecesRv_R090	0.30	0.13	0.25		0.15			0.13				0.15	0.15		0.15
NuecesRv_R100	0.30	0.13	0.25		0.15			0.13				0.15	0.15		0.15
NuecesRv_R110	0.30	0.13	0.25		0.15			0.13				0.15	0.15		0.15
NuecesRv_R120	0	0	0.25		0			0				0	0		0
FrioRv_R010	0.25	0.01	0.25		0.01		0.01	0.01			0.01	0.01	0.28		0.28
FrioRv_R020	0.25	0.01	0.25		0.01		0.01	0.01			0.01	0.05	0.28		0.28
FrioRv_R030	0.12	0.01	0		0.01			0.12			0.07		0.25		0.25
Dry_FrioRv_R010	0.12	0.01	0		0.01			0.06			0.07		0.25		0.25
Dry_FrioRv_R020	0.12	0.01	0		0.01			0.06			0.07		0.25		0.25
FrioRv_R040	0.12	0.01	0		0.01			0.06			0.07		0.25		0.25
FrioRv_R050		0.5			0.25			0.25			0.5				
SabinalRv_R010	0.25	0.05	0.25		0.01			0.25			0.2		0.25		0.25
SabinalRv_R020	0.25	0.05	0.25		0.01			0.25			0.2		0.25		0.25

	Calibrated Channel Loss Fraction														
Reach Name	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007	Jul 2007 (late)	May 2015 middle	May 2015	Sep 2016	Oct 2018 (early)	Oct 2018 middle	Oct 2018 entire
SabinalRv_R030	0.5	0.01	0.05		0.01			0.1			0.05		0.05		0.05
HondoCk_R010		0.25	0.25		0.25			0.05			0.2				
HondoCk_R020		0.25			0.25			0.25			0.45				
VerdeCk_R010		0.25			0.25			0.25			0.45				
VerdeCk_R020		0.25			0.25			0.25			0.45				
VerdeCk_R025		0.25			0.25			0.25			0.45				
SecoCk_R010		0.25	0.38		0.25			0.30			0.25				
SecoCk_R020		0.25	0.38		0.25			0.30			0.25				
SecoCk_R030		0.25			0.25			0.25			0.45				
SecoCk_R040		0.25			0.25			0.25			0.45				
NuecesRv_R350					0.10	0	0.13								
NuecesRv_R360					0.01	0.02	0.01	0.01		0.15					0.01
NuecesRv_R370					0.01	0.1	0.01	0.01		0.12					0.12

1.4.4 Calibration Results

The final calibration results showed that the HEC-HMS model was able to accurately simulate the response of the watershed, as it reproduced the volume, timing, shape, and peak magnitudes of most observed floods very well. The resulting hydrograph comparisons can be seen in the following figures of this section. The figures show the HEC-HMS computed versus the USGS observed flow hydrographs at each stream gage location. For each reservoir, the figures show the HEC-HMS computed pool elevation versus the USGS observed pool elevation. Calibration figures are only shown for the locations where the USGS stream gages were recording for that event and where the magnitude of the flow was significant enough to warrant calibration.

In addition to graphical comparisons of simulated to observed flow hydrographs, statistical tests were also employed in evaluating model performance. The statistical metrics used to evaluate the HEC-HMS model performance included the Nash-Sutcliffe Efficiency (NSE), the Root Mean Square Error – Observed Standard Deviation Ratio (RSR), and the Percent Bias (PBIAS). For the purposes of this study, the performance metrics were evaluated using the performance ratings shown in Table B.23. These performance ratings are consistent with standard practices in watershed modeling (Moriasi, 2007) (Moriasi, 2012). In cases where each metric had a different performance rating, the overall performance rating for that calibration was assigned as the lowest of the three ratings, which is the strictest method of assigning performance ratings.

Table B.23: HEC-HMS Model Calibration Evaluation Metrics

Performance Rating	NSE	RSR	PBIAS
Very Good	$0.80 \le NSE < 1.00$	$0 \le RSR \le 0.50$	$0 \le PBIAS \le \pm5$
Good	$0.70 \le NSE < 0.80$	$0.50 < RSR \le 0.60$	$\pm5 < PBIAS < \pm10$
Satisfactory	$0.50 \le NSE < 0.70$	$0.60 < RSR \le 0.70$	$\pm10 \le PBIAS \le \pm25$
Unsatisfactory	$NSE < 0.50$	$RSR > 0.70$	$PBIAS > \pm25$

Table B.24 lists a summary of the model performance ratings for all the HEC-HMS calibrations performed for this study. The statistical metrics used to assign these performance ratings are shown on the following figures for each individual calibration.

As shown in Table B.19, over 51% of the all of the HEC-HMS model calibrations were rated as Good or Very Good. These ratings indicate that the HEC-HMS model performed very well in all three metrics when compared to observed data. For the other calibrations, the lower ratings were often due to missing observed data or inaccuracies in the rainfall data. Therefore, in most cases, the lower rating was not an accurate representation of the quality of the calibration. More discussion on each individual calibration is included with the plots.

Table B.24: Summary of HEC-HMS Model Calibration Performance Rating

USGS Gage Location	Oct 1996	Jun 1997	Aug 1998	Nov 2001	Jul 2002	Sep 2002 TS Fay	Jun 2007	Jul 2007 Short
Nueces Rv at Laguna TX	Very Good	Good	Satisfactory	Satisfactory	Very Good			Good
W Nueces Rv nr Brackettville TX	Very Good	Satisfactory	Unsatisfactory	Satisfactory				
Nueces Rv bl Uvalde TX	Very Good		Very Good	Unsatisfactory	Satisfactory			Good
Nueces Rv nr Asherton TX					Very Good			
Nueces Rv at Cotulla TX					Very Good			
San Casimiro Ck nr Freer TX				Satisfactory	Very Good	Very Good	Very Good	
Nueces Rv nr Tilden TX					Very Good			
Frio Rv at Concan TX	Very Good	Very Good	Satisfactory		Unsatisfactory		Unsatisfactory	Unsatisfactory
Dry Frio Rv nr Reagan Wells TX	Unsatisfactory	Unsatisfactory	Unsatisfactory		Unsatisfactory			Unsatisfactory
Dry Frio Rv at FM 2690 nr Knippa TX								
Frio Rv bl Dry Frio Rv nr Uvalde TX	Very Good	Satisfactory	Unsatisfactory		N/A			Satisfactory
Sabinal Rv bl Mill Ck nr Vaderpool TX								
Sabinal Rv nr Sabinal TX		Good	Very Good		Satisfactory			Very Good
Sabinal Rv at Sabinal TX	Satisfactory	Good	Satisfactory		Unsatisfactory			Good
Hondo Ck nr Tarpley TX		Unsatisfactory	Unsatisfactory		Satisfactory			Very Good
Hondo Ck at SH 173 nr Hondo TX		Satisfactory	Good		Unsatisfactory			Very Good
Middle Verde Ck at SH 173 nr Bandera TX								Satisfactory
Seco Ck at Miller Rh nr Utopia TX		Unsatisfactory	Unsatisfactory		Satisfactory			
Seco Ck at Rowe Rh nr D'Hanis TX		Unsatisfactory	Satisfactory		Very Good			Good
Leona Rv nr Uvalde TX								
Frio Rv nr Derby TX		Very Good			Unsatisfactory			
Frio Rv at Tilden TX		Satisfactory			Very Good	Very Good		
San Miguel Ck nr Tilden TX					Good	Very Good		Very Good
Choke Canyon Res nr Three Rivers, TX					Very Good	Unsatisfactory	Very Good	
Choke Canyon Res OWC nr Three Rivers TX								
Atascosa Rv nr McCoy TX						Very Good	Satisfactory	Very Good
Atascosa Rv at Whitsett TX				Very Good	Satisfactory	Satisfactory	Good	Unsatisfactory
Nueces Rv nr Three Rivers TX					Very Good	Satisfactory	Satisfactory	
Lagarto Ck nr George West TX								
Lk Corpus Christi nr Mathis TX					Very Good	Unsatisfactory	Unsatisfactory	
Nueces Rv nr Mathis TX								
Nueces Rv at Bluntzer TX								
Nueces Rv at Calallen TX					Good	Satisfactory	Satisfactory	

USGS Gage Location	Jul 2007 Late	Jul 2007 Long	May 2015 middle	May 2015	Sep 2016	Oct 2018 early	Oct 2018 middle	Oct 2018 entire
Nueces Rv at Laguna TX				Very Good	Very Good	Very Good	Very Good	
W Nueces Rv nr Brackettville TX	Good				Very Good	Good	Very Good	
Nueces Rv bl Uvalde TX				Very Good	Very Good	Good	Very Good	
Nueces Rv nr Asherton TX		Unsatisfactory			Very Good	Very Good		
Nueces Rv at Cotulla TX		Very Good						Very Good
San Casimiro Ck nr Freer TX		Unsatisfactory			Unsatisfactory			
Nueces Rv nr Tilden TX								Good
Frio Rv at Concan TX				Very Good	Very Good	Good		
Dry Frio Rv nr Reagan Wells TX				Unsatisfactory		Satisfactory		
Dry Frio Rv at FM 2690 nr Knippa TX								
Frio Rv bl Dry Frio Rv nr Uvalde TX				Good		Good		
Sabinal Rv bl Mill Ck nr Vaderpool TX						Satisfactory		
Sabinal Rv nr Sabinal TX				Good		Very Good		
Sabinal Rv at Sabinal TX				Satisfactory		Good		
Hondo Ck nr Tarpley TX				Satisfactory				
Hondo Ck at SH 173 nr Hondo TX				Very Good				
Middle Verde Ck at SH 173 nr Bandera TX				Satisfactory				
Seco Ck at Miller Rh nr Utopia TX				Very Good				
Seco Ck at Rowe Rh nr D'Hanis TX				Unsatisfactory				
Leona Rv nr Uvalde TX	Satisfactory		Unsatisfactory					
Frio Rv nr Derby TX		Good		Very Good				
Frio Rv at Tilden TX		Satisfactory						
San Miguel Ck nr Tilden TX	Unsatisfactory			Unsatisfactory				
Choke Canyon Res nr Three Rivers, TX		Unsatisfactory		Good				
Choke Canyon Res OWC nr Three Rivers TX								
Atascosa Rv nr McCoy TX	Very Good		Very Good					
Atascosa Rv at Whitsett TX			Satisfactory					
Nueces Rv nr Three Rivers TX		Very Good	Satisfactory					Satisfactory
Lagarto Ck nr George West TX								
Lk Corpus Christi nr Mathis TX		Unsatisfactory	Very Good					Unsatisfactory
Nueces Rv nr Mathis TX								
Nueces Rv at Bluntzer TX			Satisfactory					Good
Nueces Rv at Calallen TX		Satisfactory	Satisfactory					Very Good

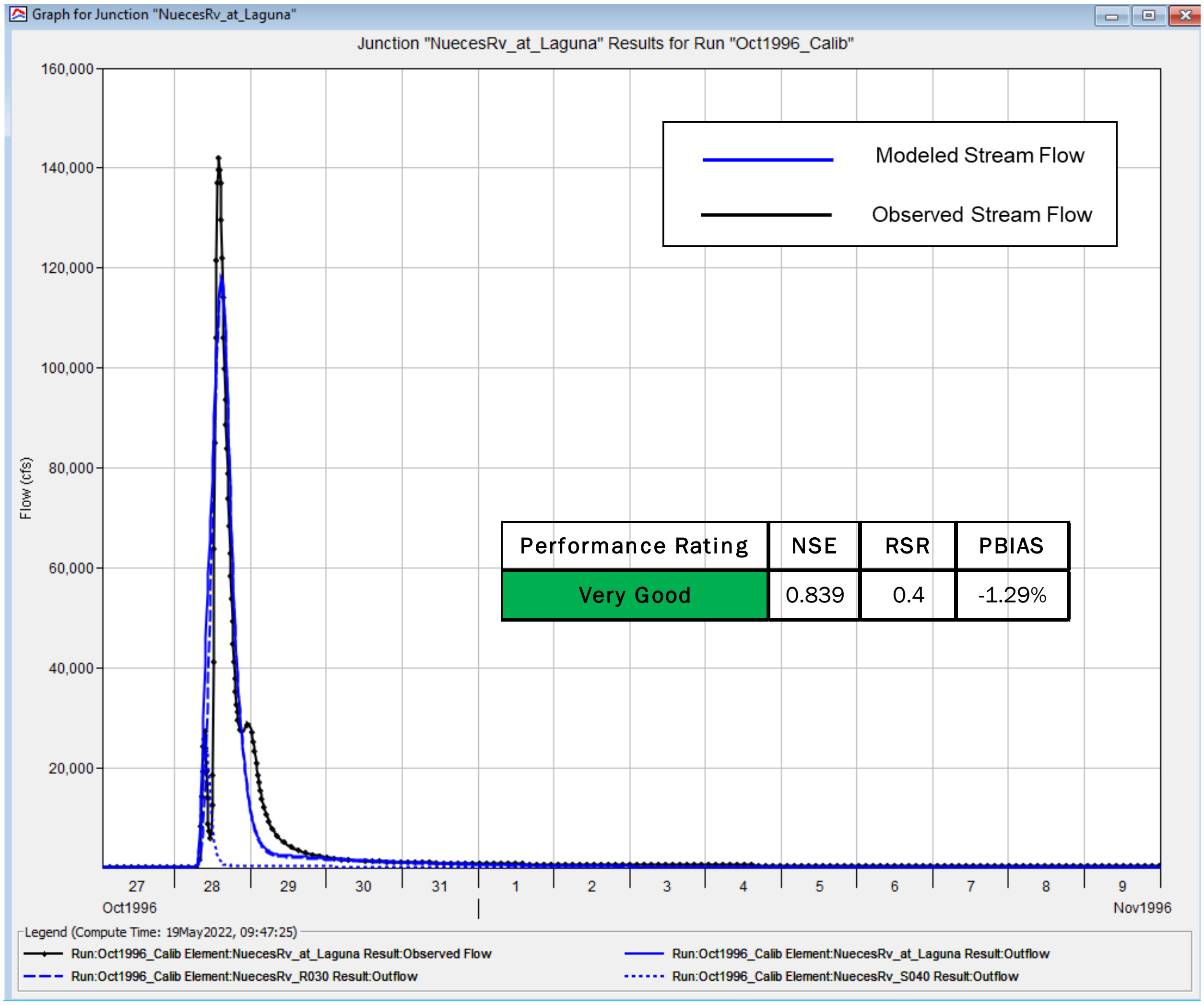
There are two types of calibration figures which are shown in this section of the report: reservoirs and streamflow gages. In the reservoir calibration figures, the observed pool elevation at the reservoir gage is compared to the modeled pool elevation in the top half of the figure. The other lines on these plots show reservoir storage, inflow and outflow, but are not relevant to the comparison with the observed pool elevations.

In the streamflow calibration figures, the solid blue line represents the total modeled streamflow at the gage, while the black line represents the observed streamflow that was recorded by the gage. The other dotted blue lines on these figures represent the runoff from individual model components, and they should be ignored as they are not relevant to the gage comparison.

1.4.4.1 October-November 1996 Event

The October-November 1996 event was an upper Nueces River and Frio River Basin flood. Calibration on the Nueces River, Frio River and Sabinal River ended at the Nueces River below Uvalde gage, Frio River below Dry Frio near Uvalde gage and Sabinal River at Sabinal gage, respectively. For this flood event, the HEC-HMS model simulation period was October 27 thru November 9. The original NEXRAD precipitation was underestimated for this storm event. The original NEXRAD gridded precipitation was adjusted by ground-truthing to observed National Weather Service (NWS) daily and hourly precipitation gages using HEC-MetVue. The calibrations were improved with this ground-truthing, but precipitation and or intensity was still too low above the Nueces River at Laguna gage, Dry Frio River near Reagan Wells, and Frio River below Dry Frio near Uvalde gage.

The Southern Texas Palmer Drought Severity Index (PDSI) was moderate drought (-2.00 to -2.99) in September 1996. Southern Texas Palmer Z-index was midrange (-1.24 to +0.99) in September 1996.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.839	0.4	-1.29%

Figure B.22: October 1996 Calibration Results for Nueces River at Laguna USGS Gage

The HEC-HMS model achieved a “Very Good” performance rating at the Nueces River at Laguna gage. However, the model still could not match the observed peak flow because of the rainfall data underestimating the rainfall intensity. The Nueces River at Laguna plot is shown above.

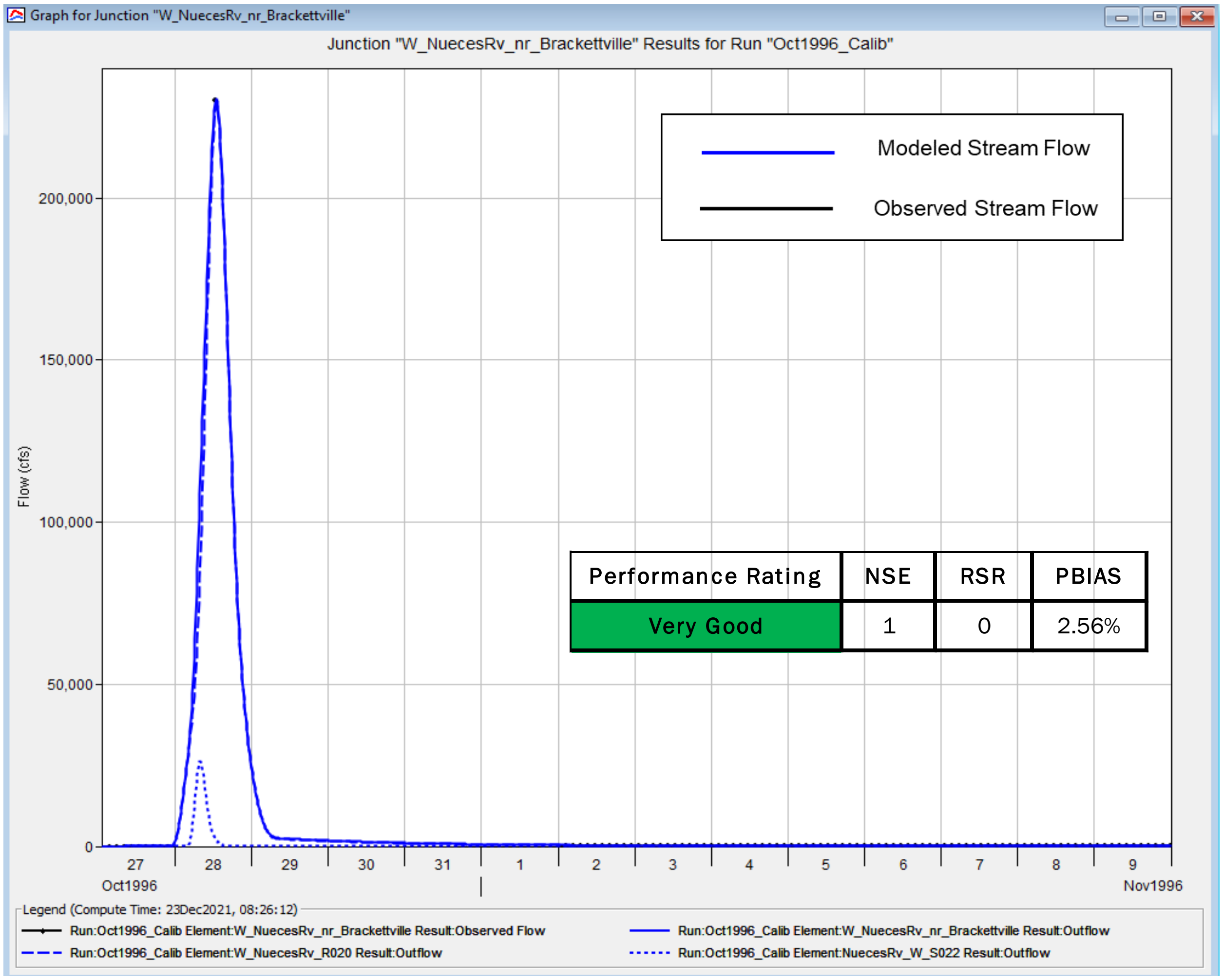
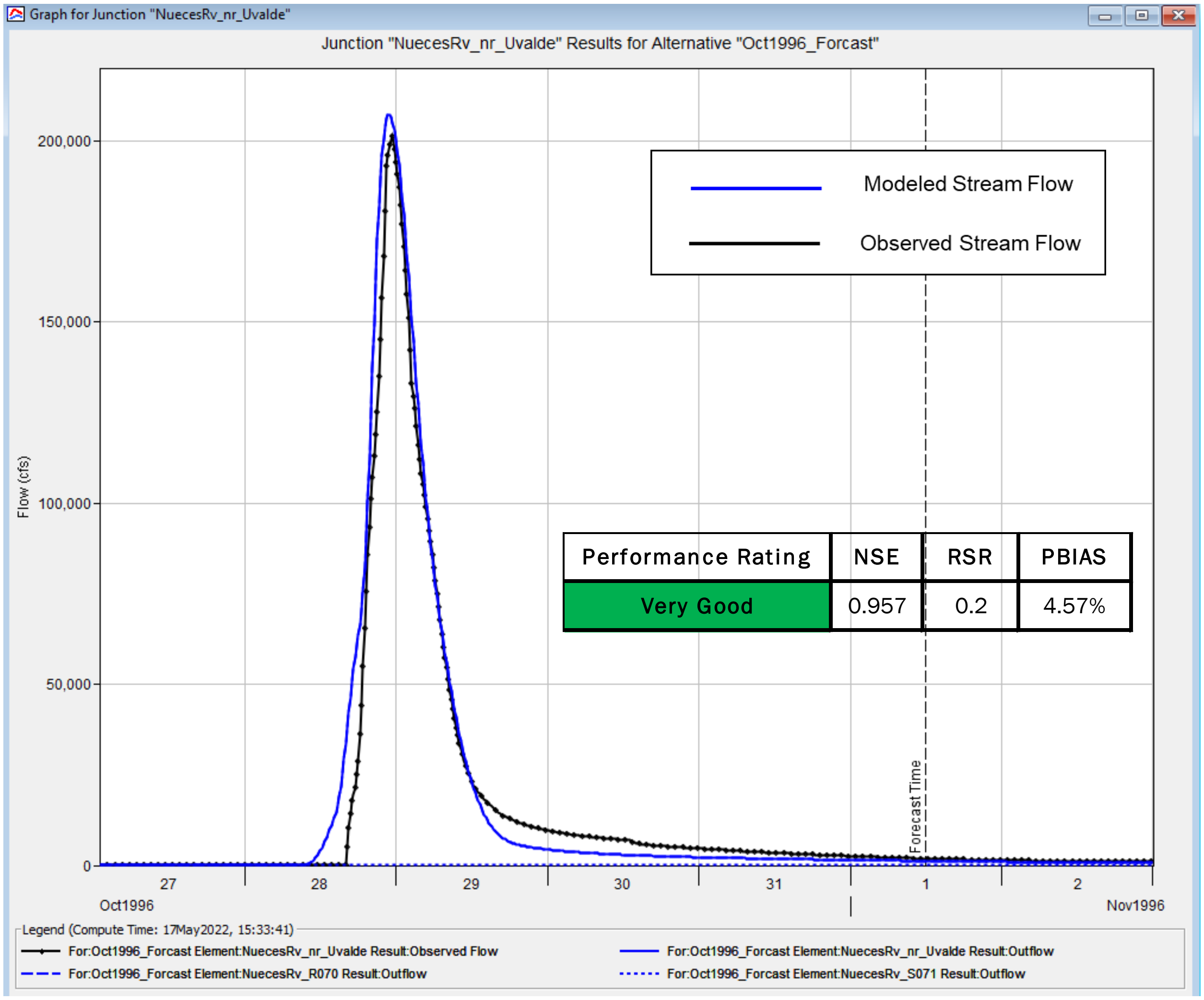


Figure B.23: October 1996 Calibration Results for Nueces near Brackettville USGS Gage

The West Nueces River near Brackettville observed hydrograph was missing. Only the peak discharge and time of peak was available, so the model was adjusted to match the peak flow. The West Nueces River near Brackettville plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.957	0.2	4.57%

Figure B.24: October 1996 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde calibration achieved a “Very Good” performance rating. Muskingum routing, channel loss and initial losses were adjusted to achieve the calibration. The Nueces River below Uvalde plot is shown above.

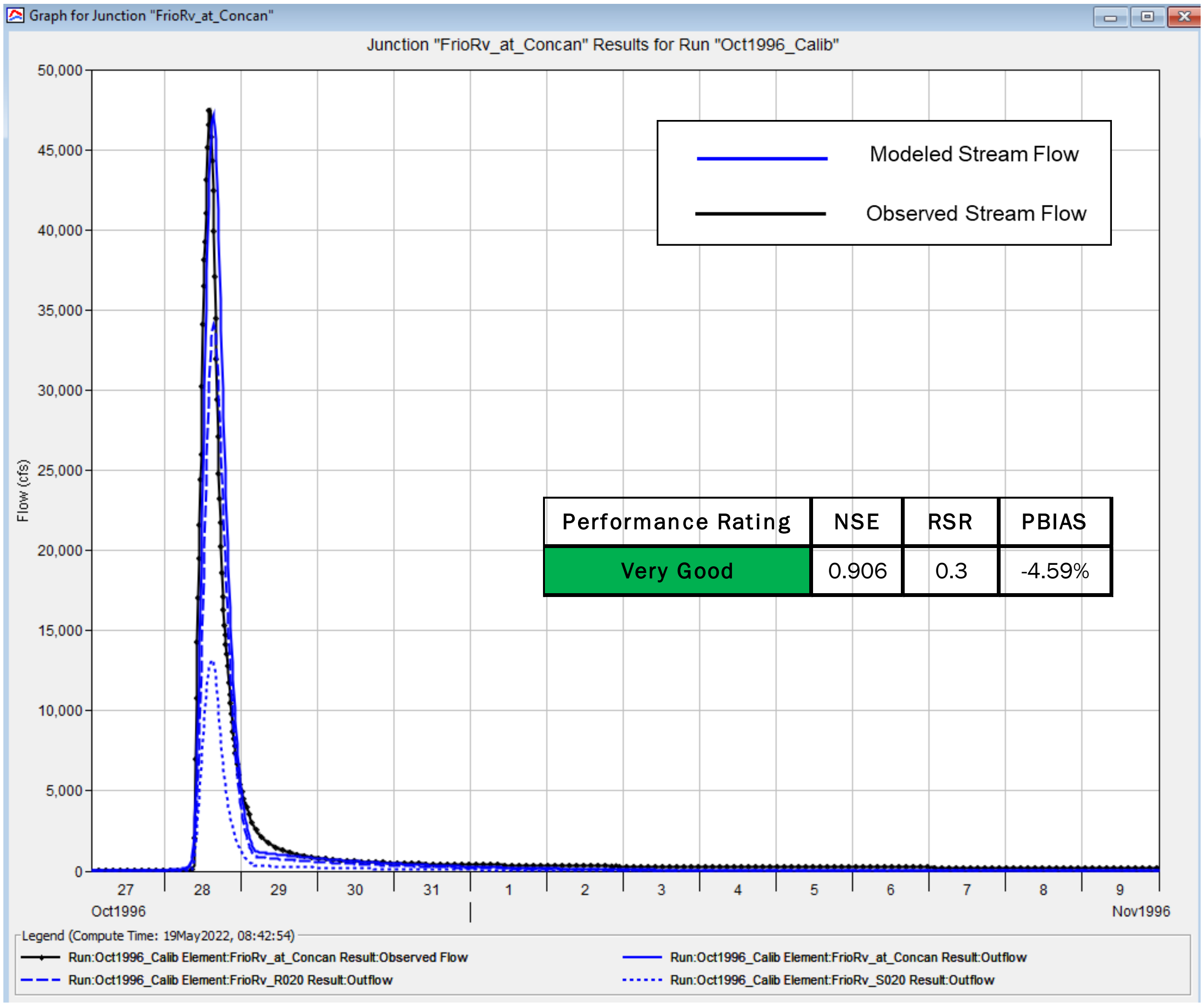


Figure B.25: October 1996 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan calibration achieved a “Very Good” performance rating. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well. The Frio River at Concan plot is shown above.

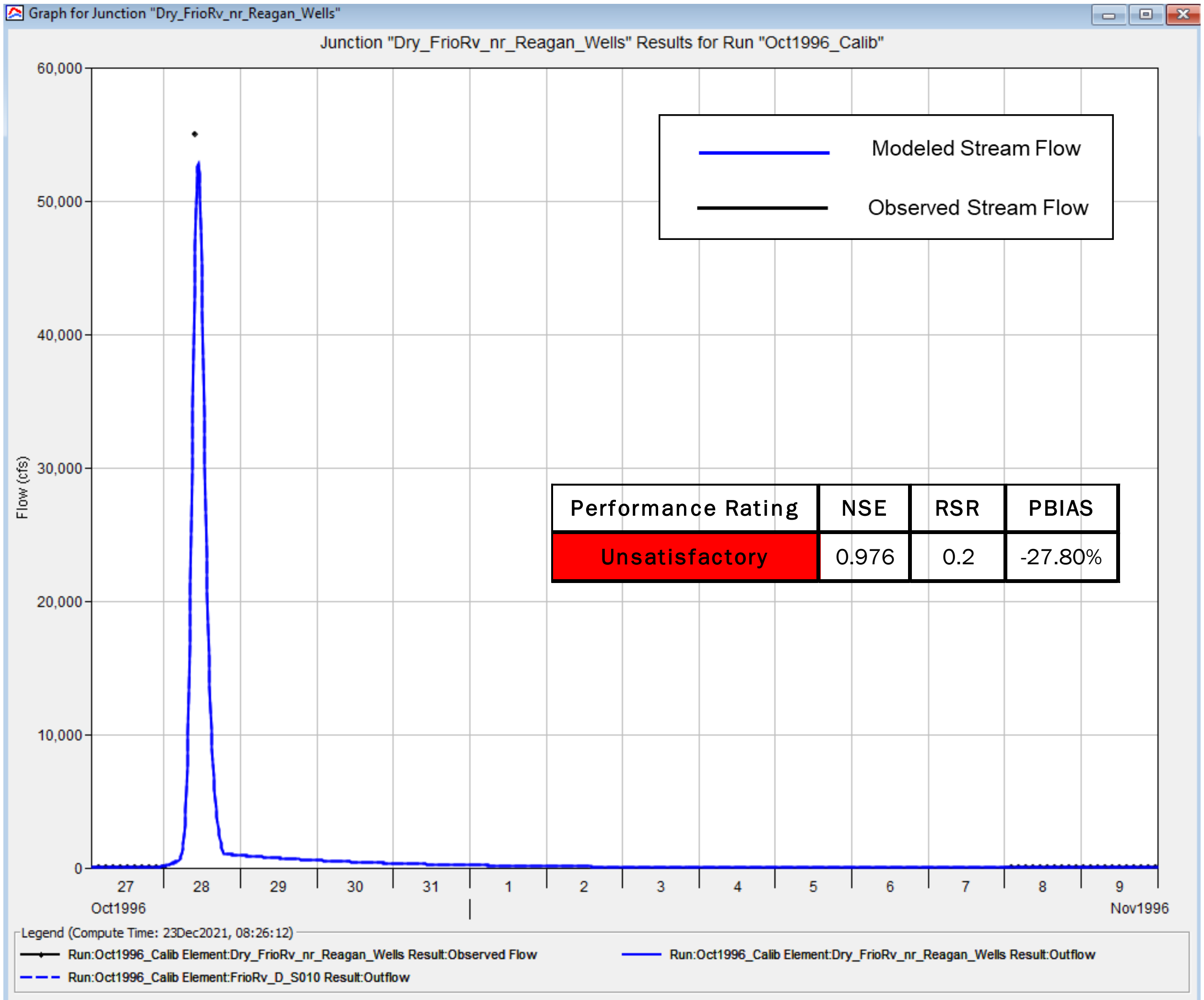


Figure B.26: October 1996 Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Dry Frio River near Reagan Wells observed hydrograph was missing. Only the peak discharge and time of peak was available. The Dry Frio River near Reagan Wells plot is shown above. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the calibration quality.

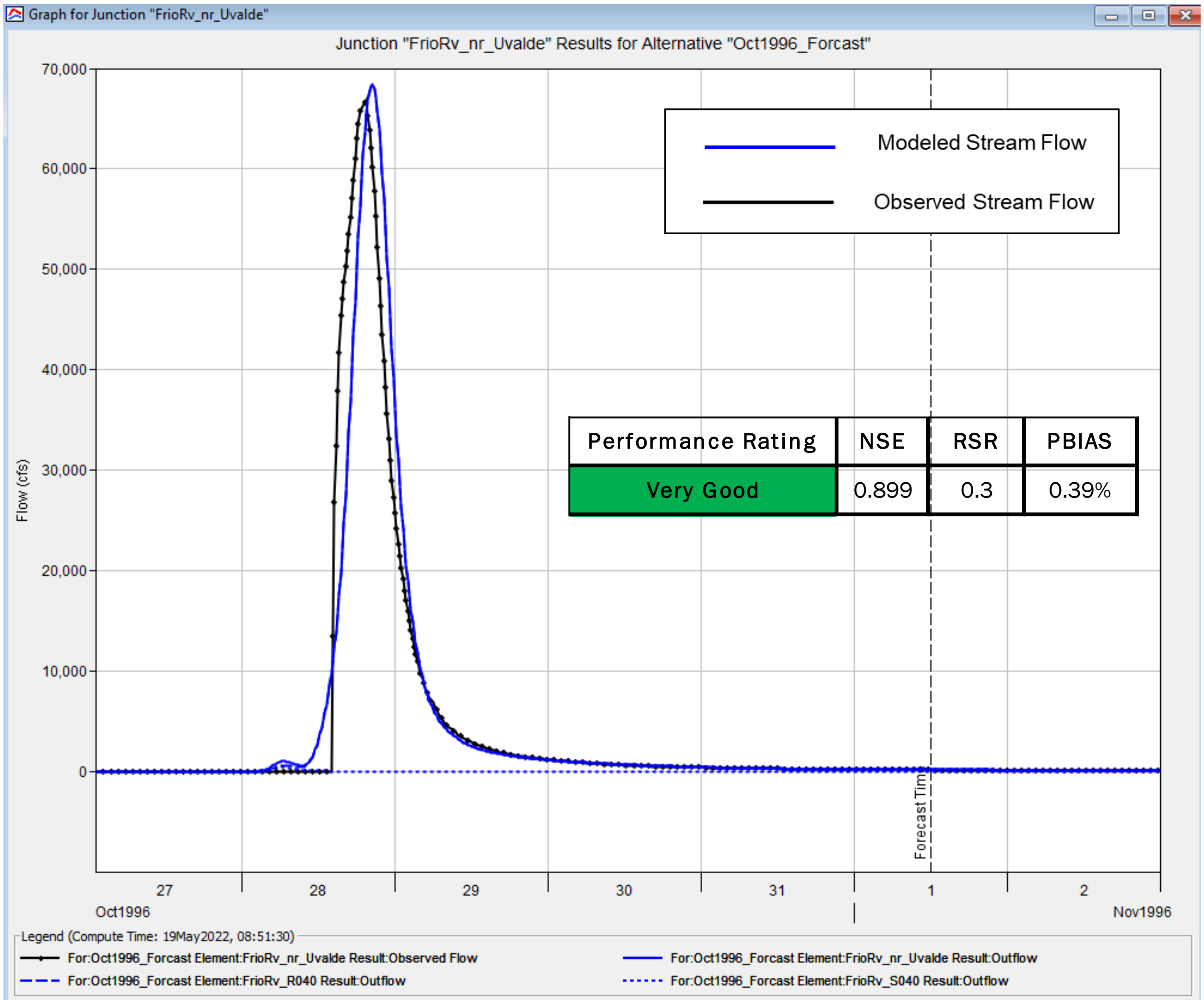
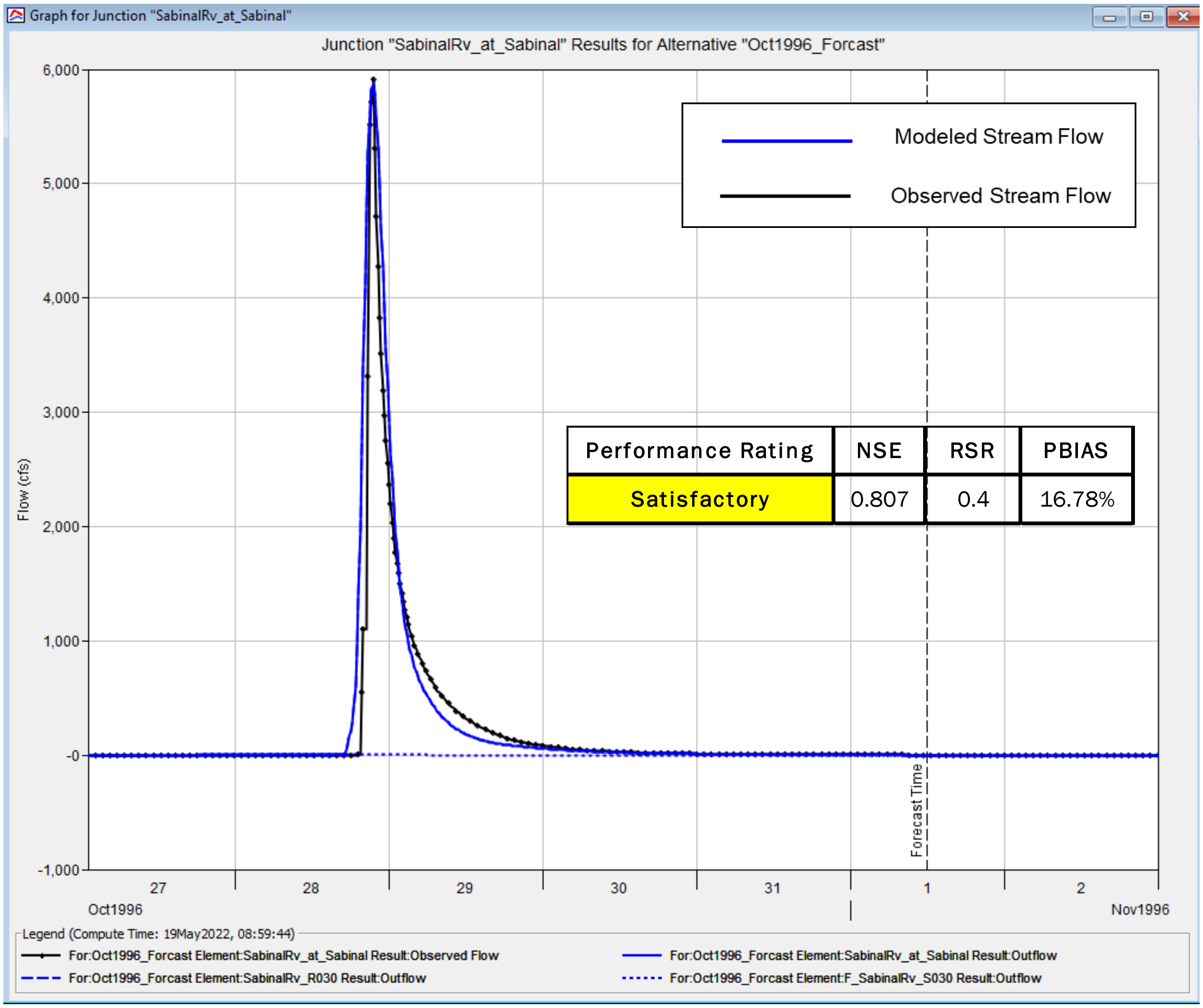


Figure B.27: October 1996 Calibration Results for Frio near Uvalde USGS Gage

The Frio near Uvalde calibration achieved a “Very Good” performance rating. The HEC-HMS model matched the shape, magnitude and volume of the observed hydrograph very well. The revised Frio River below Dry Frio near Uvalde plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Satisfactory	0.807	0.4	16.78%

Figure B.28: October 1996 Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River at Sabinal calibration achieved a “Satisfactory” performance rating. The HEC-HMS model matched the shape, shape and magnitude of the observed hydrograph very well, but the volume was a bit high, as reflected in the percent bias. The Sabinal River at Sabinal plot is shown above.

1.4.4.2 June 1997 Event

The June 1997 event was an upper Nueces River and Frio River Basin flood. For this flood event, the HEC-HMS model simulation period was June 20 thru July 10. The original NEXRAD precipitation was underestimated for this storm event. The original NEXRAD gridded precipitation was adjusted by ground-truthing to observed National Weather Service (NWS) daily and hourly precipitation gages using HEC-MetVue. The calibrations were improved with this ground-truthing, but precipitation and or intensity was still too low above several of the gages. The Southern Texas Palmer Drought Severity Index (PDSI) was moderately moist +2.00 to +2.99) in May 1997. Southern Texas Palmer Z-index was moderately moist (+1.00 to +2.49) in May 1997.

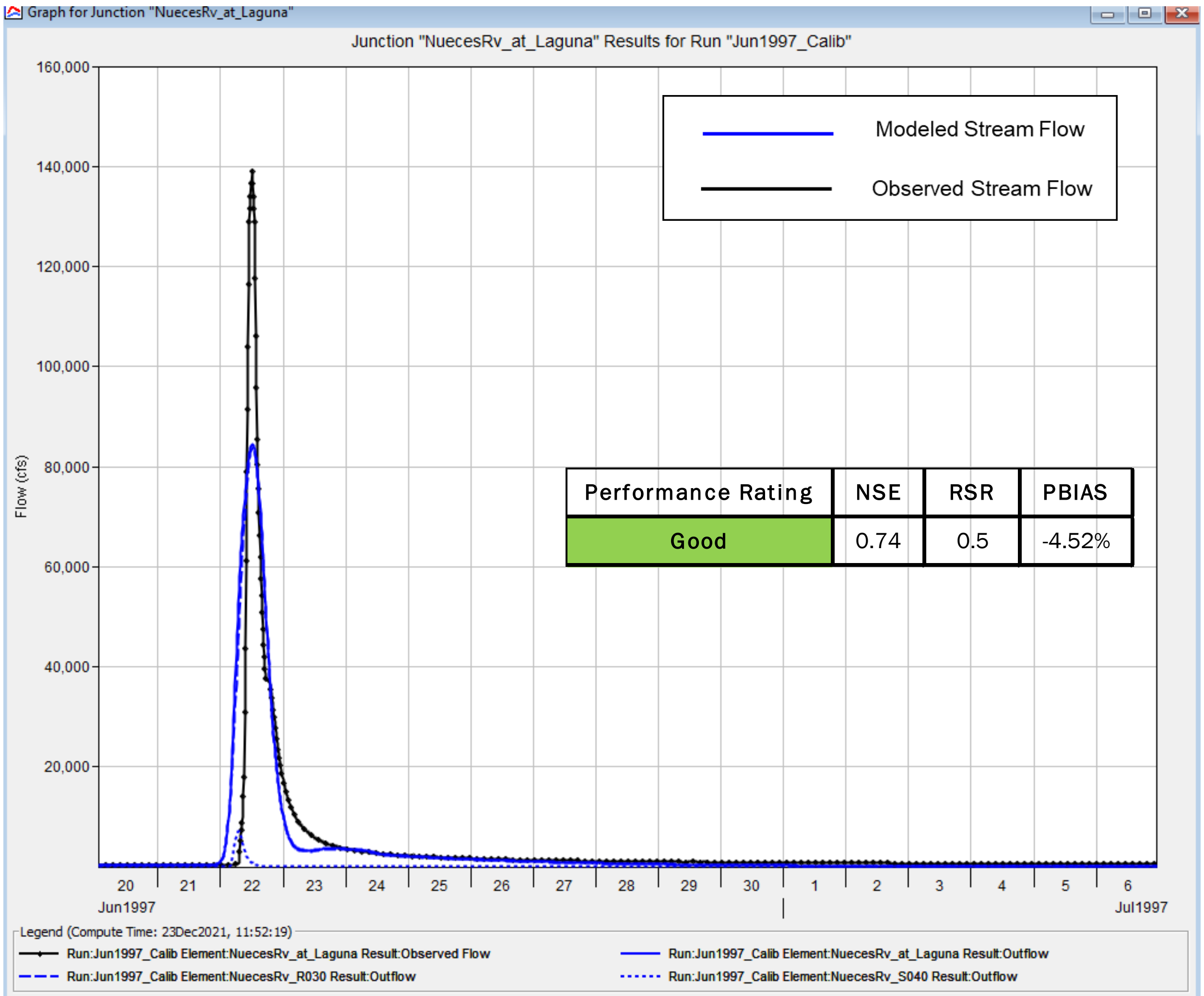


Figure B.29: June 1997 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna achieved a “Good” performance rating for the 1997 event. However, the model could not match the observed peak flow because of a lack of intensity in the rainfall data. The Nueces River at Laguna plot is shown above.

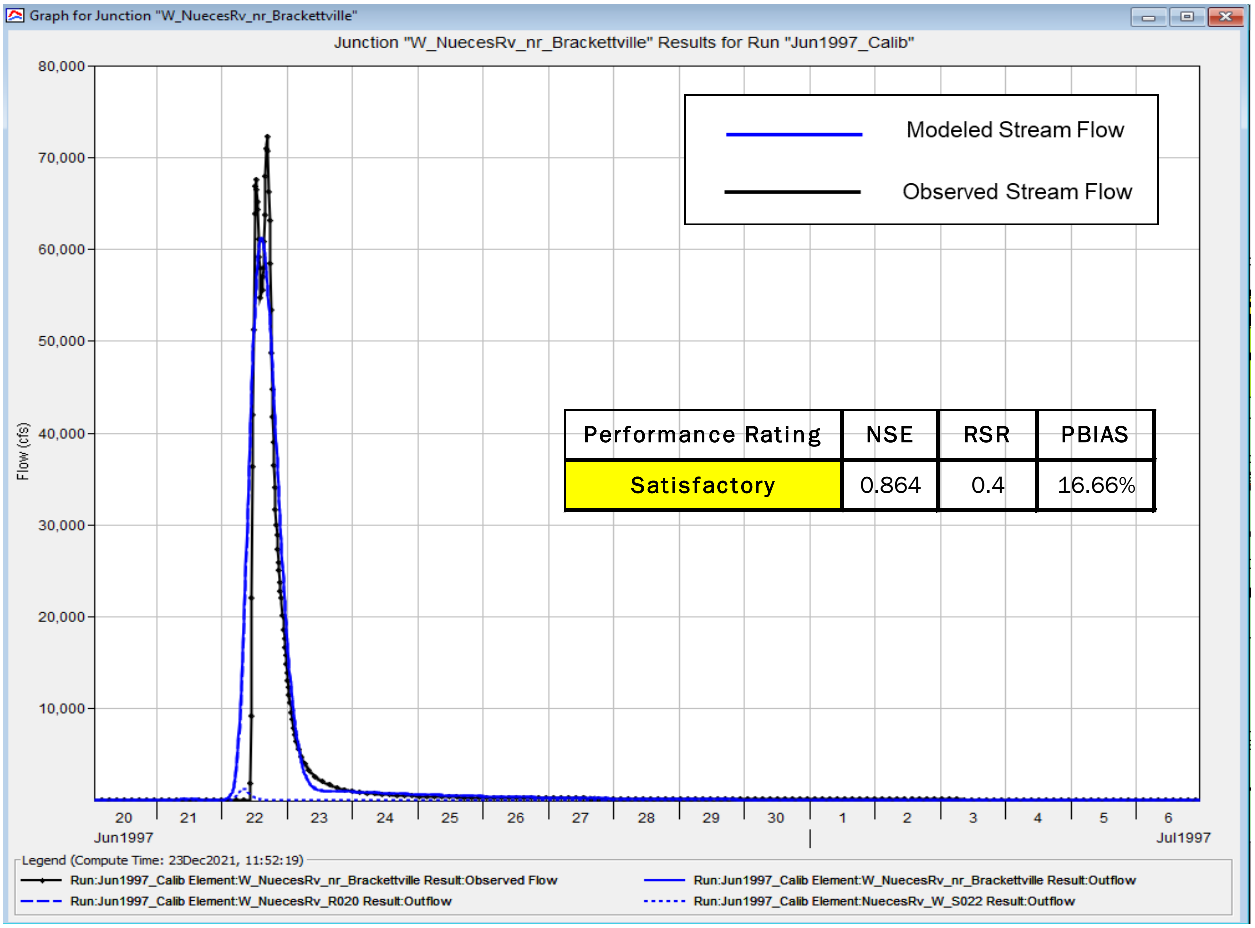
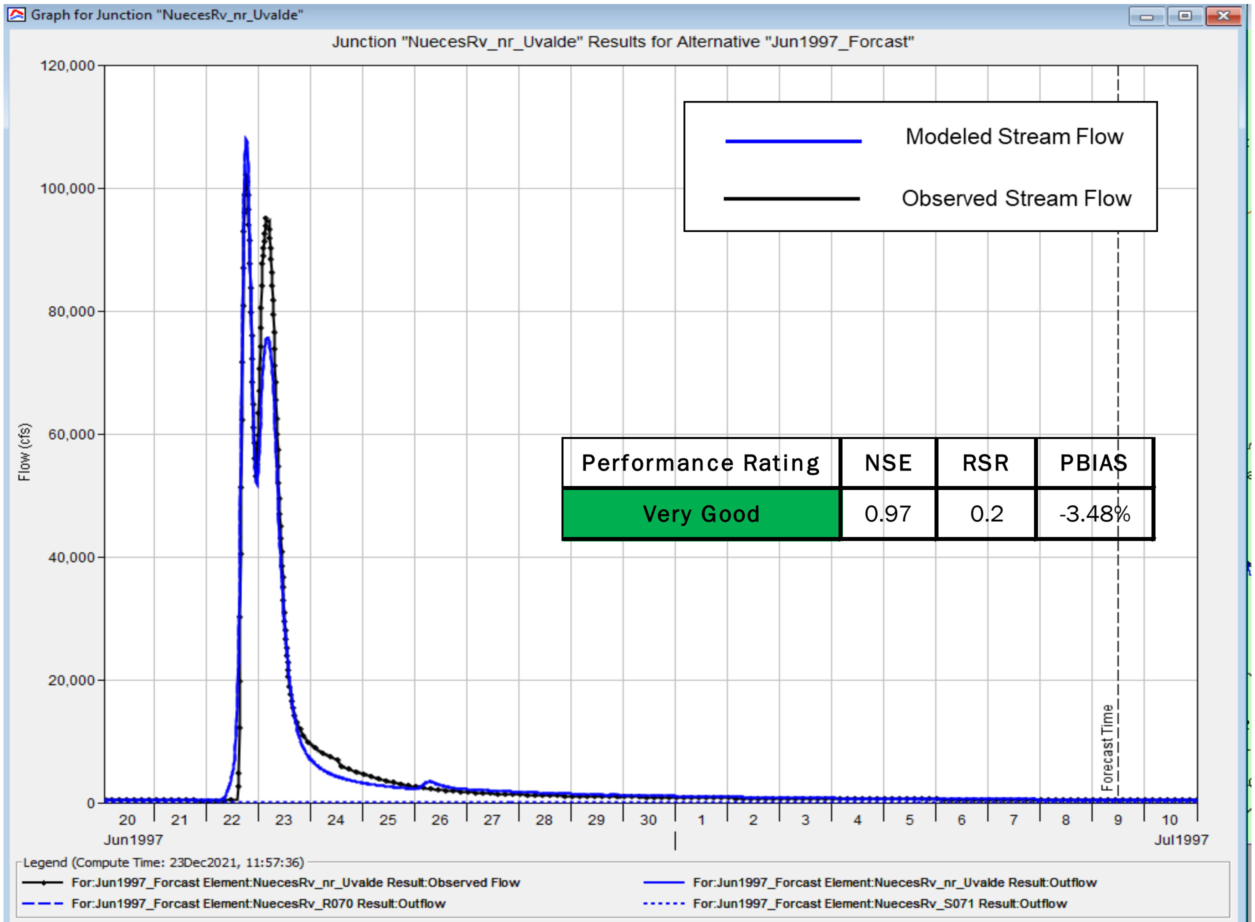


Figure B.30: June 1997 Calibration Results for West Nueces River near Brackettville USGS Gage

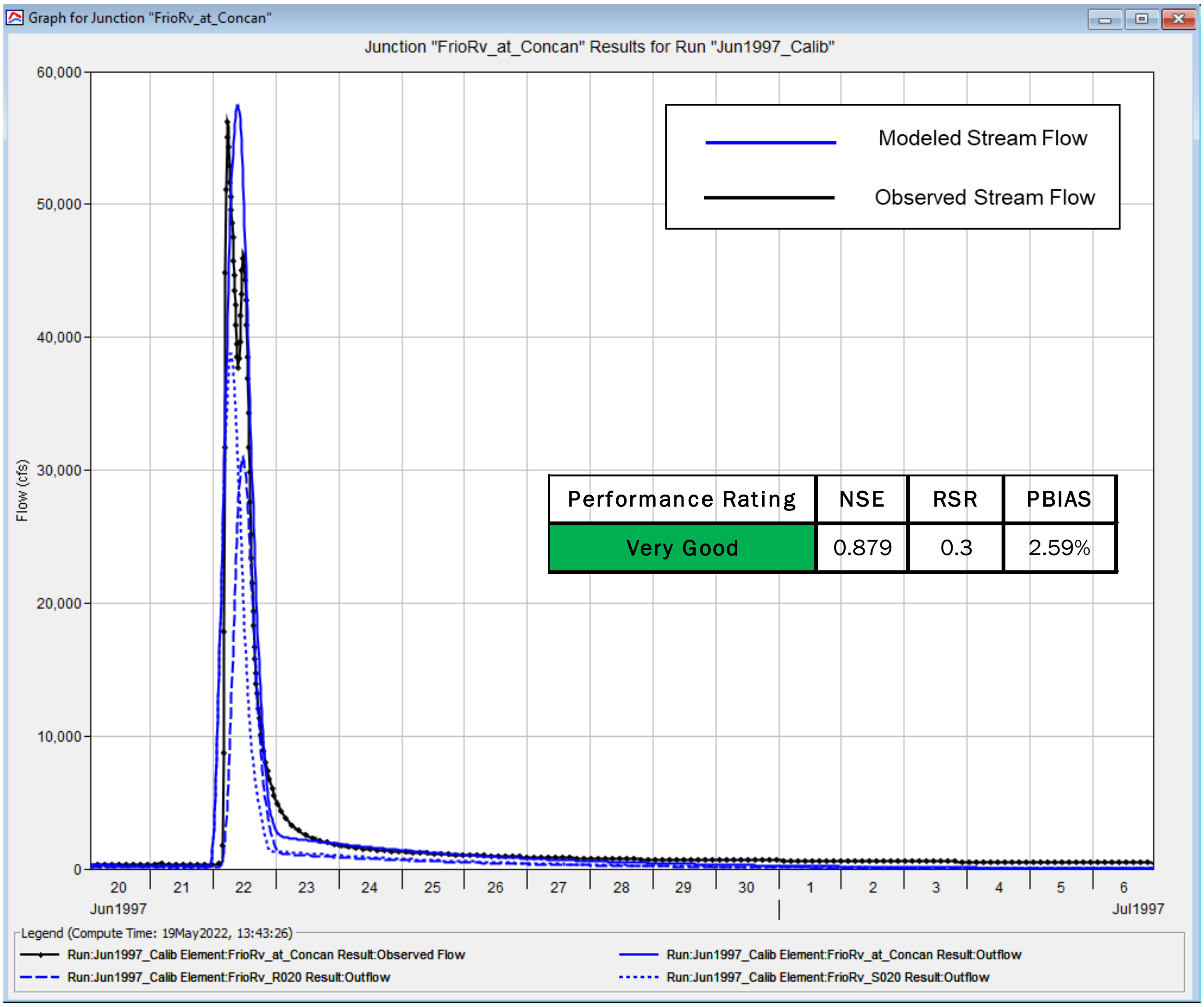
The West Nueces River near Brackettville achieved a "Satisfactory" performance rating for the 1997 event. HEC-HMS matched the timing and shape of the observed hydrograph very well, but the runoff volume was a bit high, resulting in the lower performance rating. The West Nueces River near Brackettville plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.97	0.2	-3.48%

Figure B.31: June 1997 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde achieved a “Very Good” performance rating for the 1997 event. HEC-HMS matched the timing and magnitude of the observed hydrograph very well. The Nueces River below Uvalde plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.879	0.3	2.59%

Figure B.32: June 1997 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan achieved a “Very Good” performance rating for the 1997 event. HEC-HMS matched the timing and magnitude of the observed hydrograph very well. HEC-HMS result could not match the shape of the double peak in the observed hydrograph most likely due to precipitation intensity and or distribution. The Frio River at Concan plot is shown above.

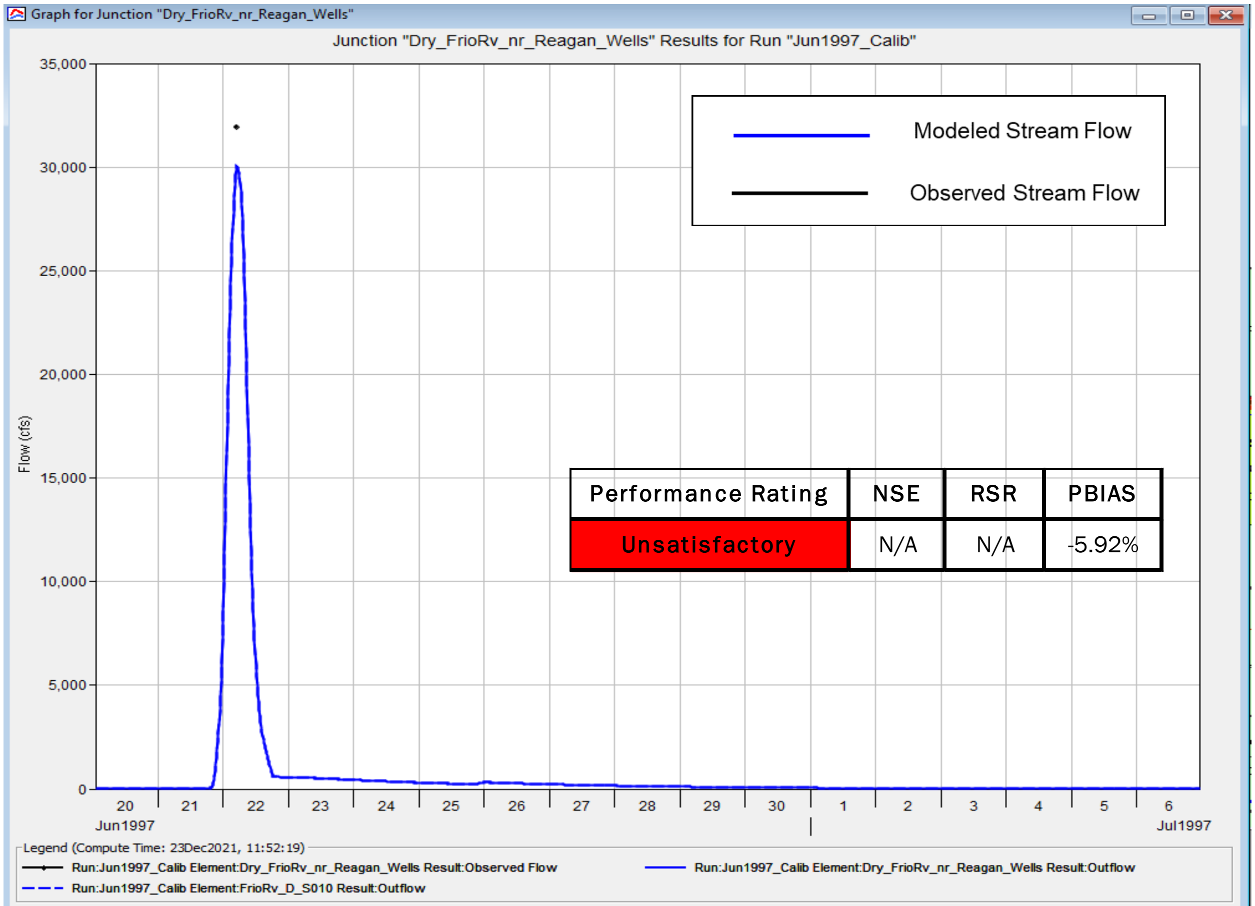


Figure B.33: June 1997 Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Dry Frio River near Reagan Wells achieved an “Unsatisfactory” performance rating. However, the observed hydrograph was missing, and only the peak discharge and time of peak was available. The Dry Frio River near Reagan Wells plot is shown above. The HEC-HMS model matched the timing of the peak very well, but slightly underestimated the peak. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

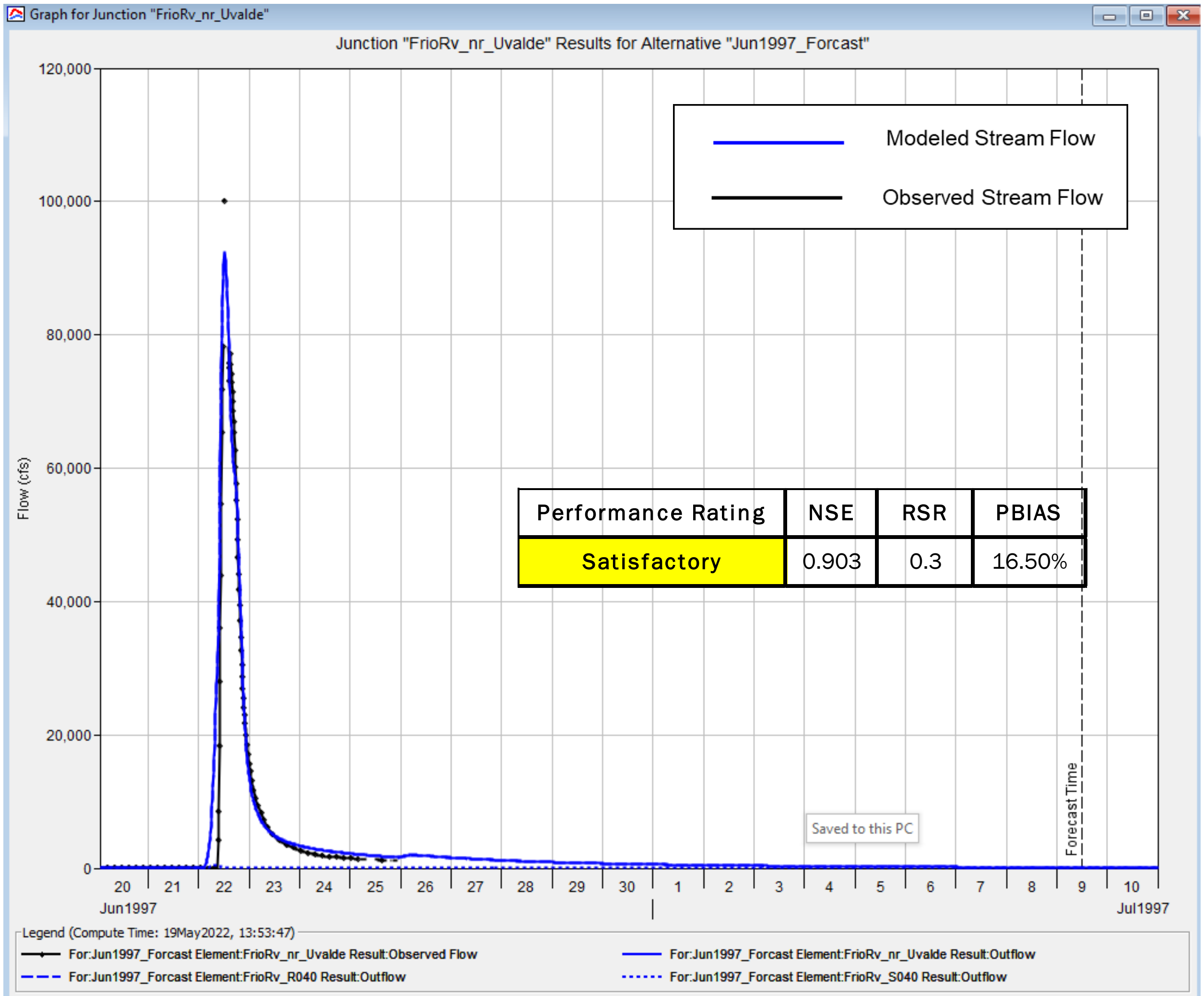
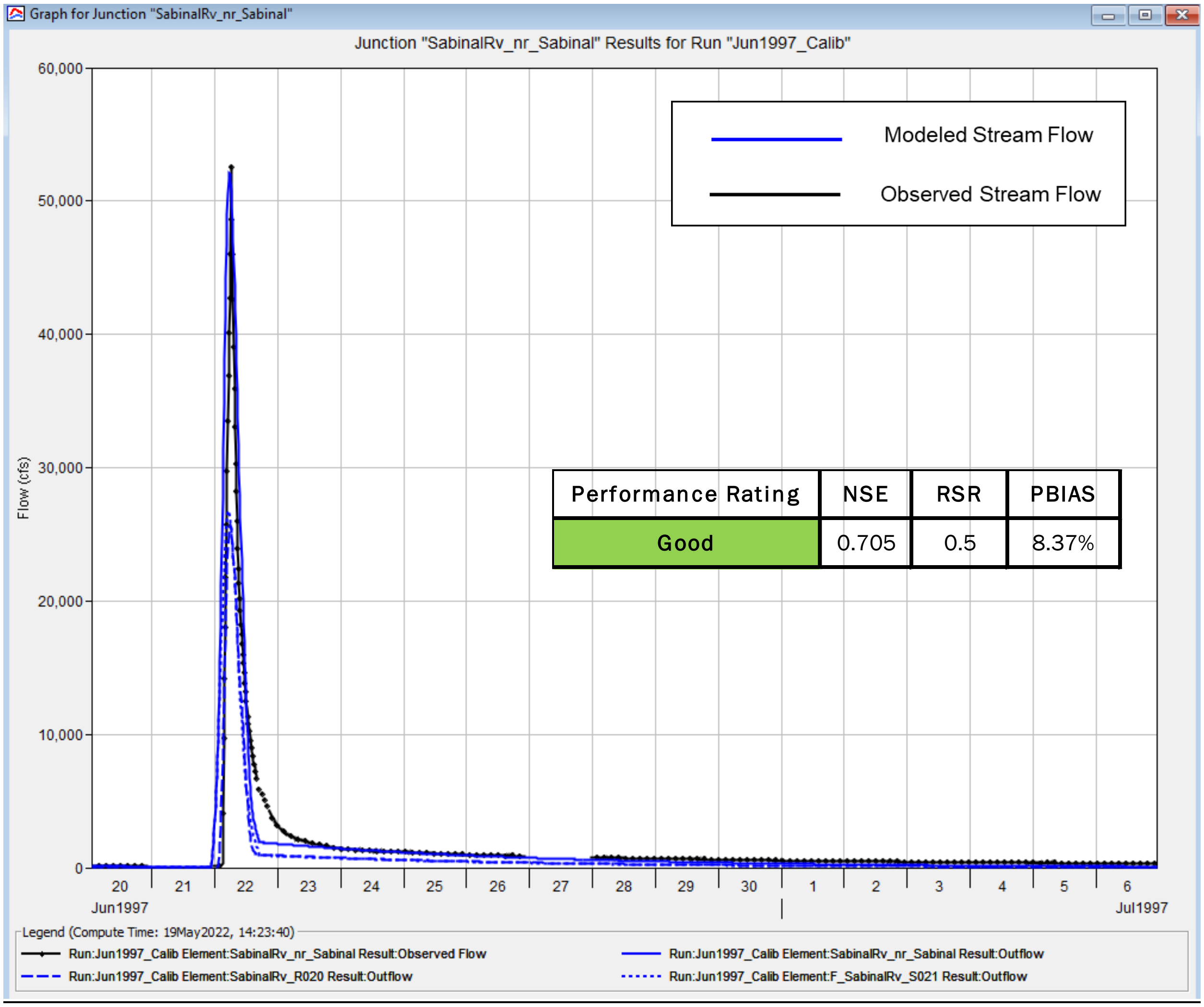


Figure B.34: June 1997 Calibration Results for Frio River below Dry Frio near Uvalde USGS Gage

The Dry Frio River near Uvalde achieved an “Satisfactory” performance rating. HEC-HMS matched the observed timing and shape of the hydrograph very well but could not quite reach the observed peak magnitude, likely due to too low precipitation and or intensity. The final Frio River below Dry Frio near Uvalde plot is shown above. The satisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.



Performance Rating	NSE	RSR	PBIAS
Good	0.705	0.5	8.37%

Figure B.35: June 1997 Calibration Results for Sabinal River near Sabinal USGS Gage

The Sabinal River near Sabinal achieved an “Good” performance rating. HEC-HMS matched the timing, shape and peak magnitude of the observed data very well. The baseflow volume was a bit high, resulting in a “Good” rating rather than “Very Good.” The final Sabinal River near Sabinal plot is shown above.

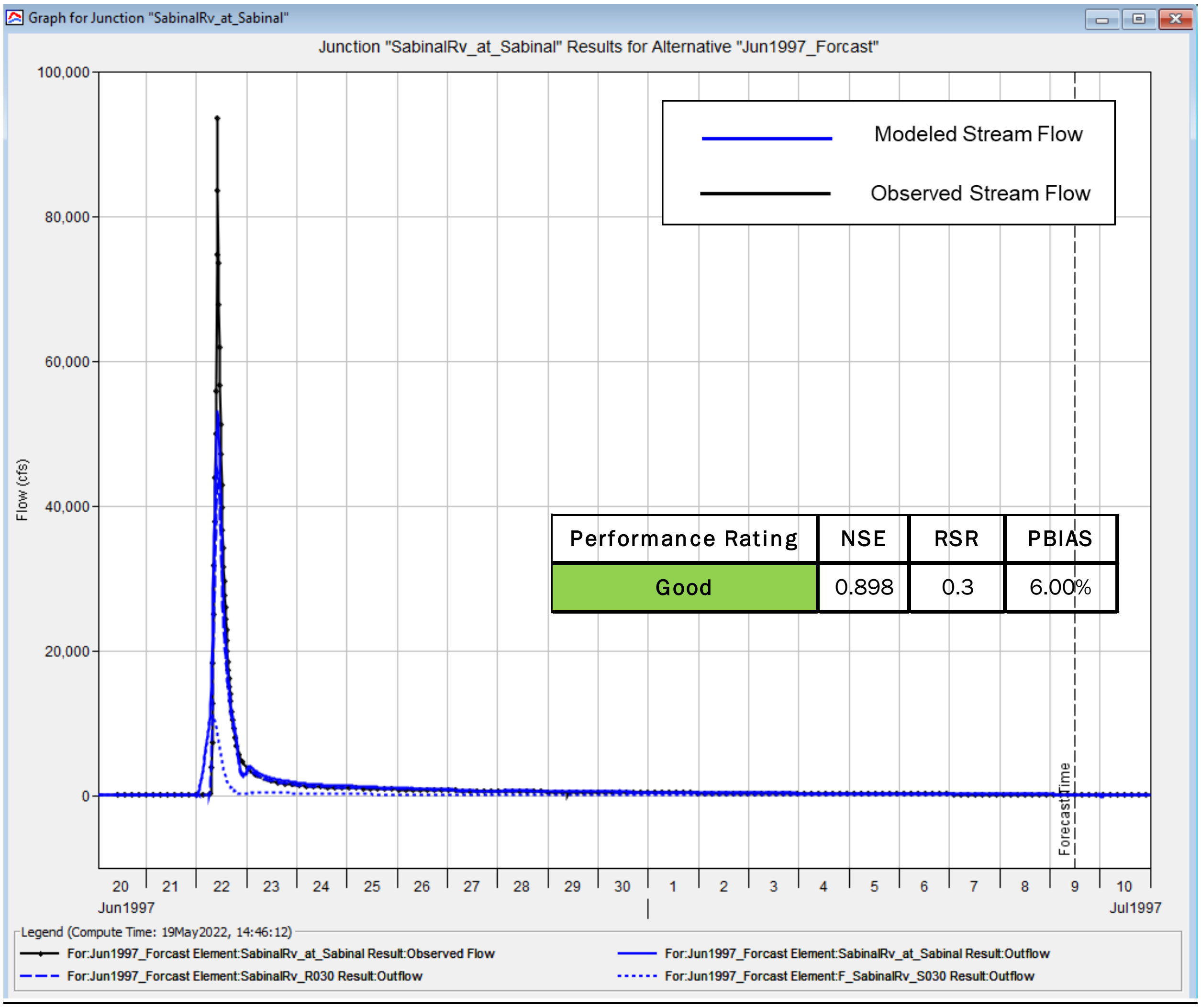


Figure B.36: June 1997 Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River at Sabinal achieved an “Good” performance rating. HEC-HMS matched the timing, volume and shape of the observed data very well. However, HEC-HMS could not match the observed peak magnitude, possibly due to too low precipitation volume and or intensity. The final Sabinal River at Sabinal plot is shown above.

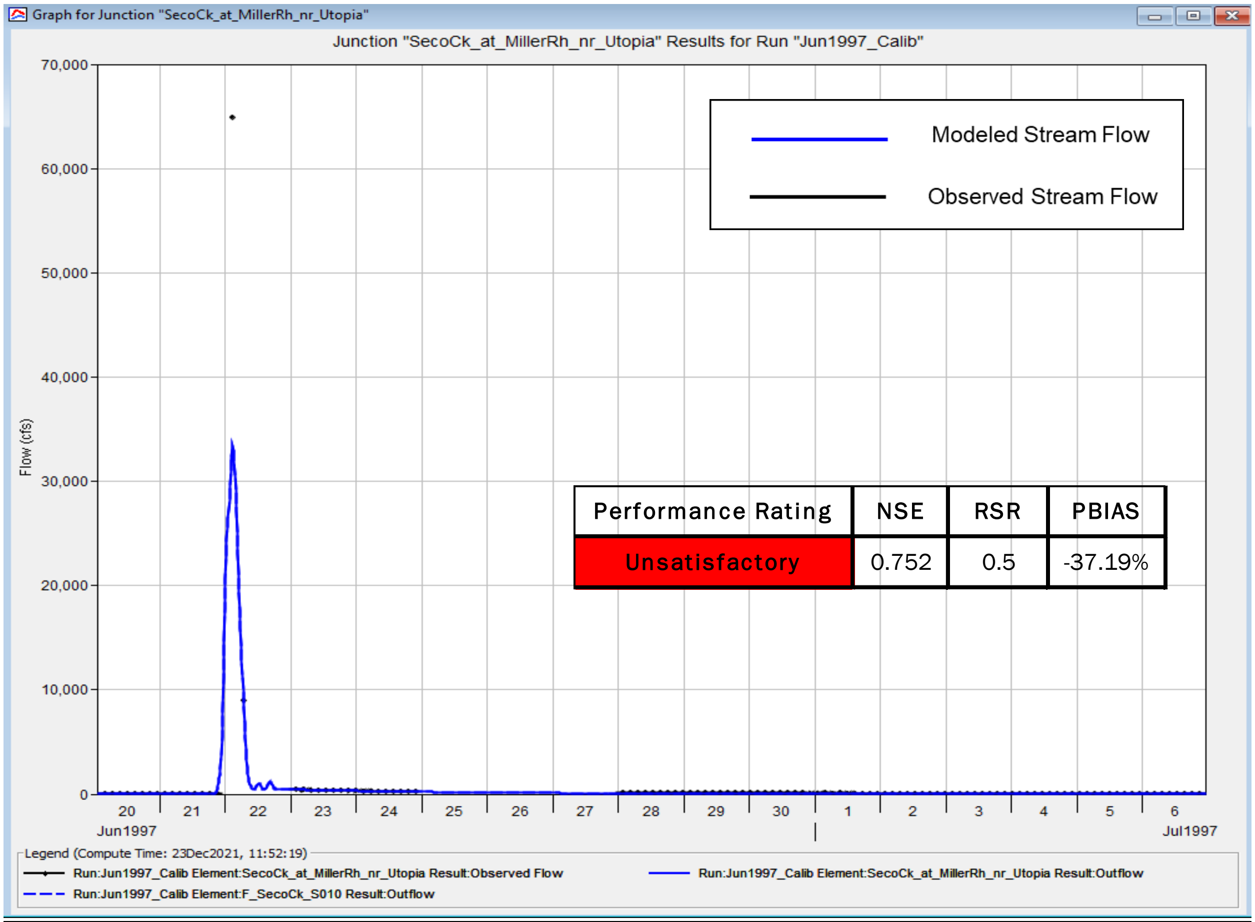


Figure B.37: June 1997 Calibration Results for Seco Creek at Miller Ranch near Utopia USGS Gage

The Seco Creek at Miller Ranch near Utopia observed hydrograph was missing. Only the peak discharge and time of peak was available. HEC-HMS could not match observed hydrograph peak magnitude because of too low precipitation and or intensity. The Seco Creek at Miller Ranch near Utopia plot is shown above. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

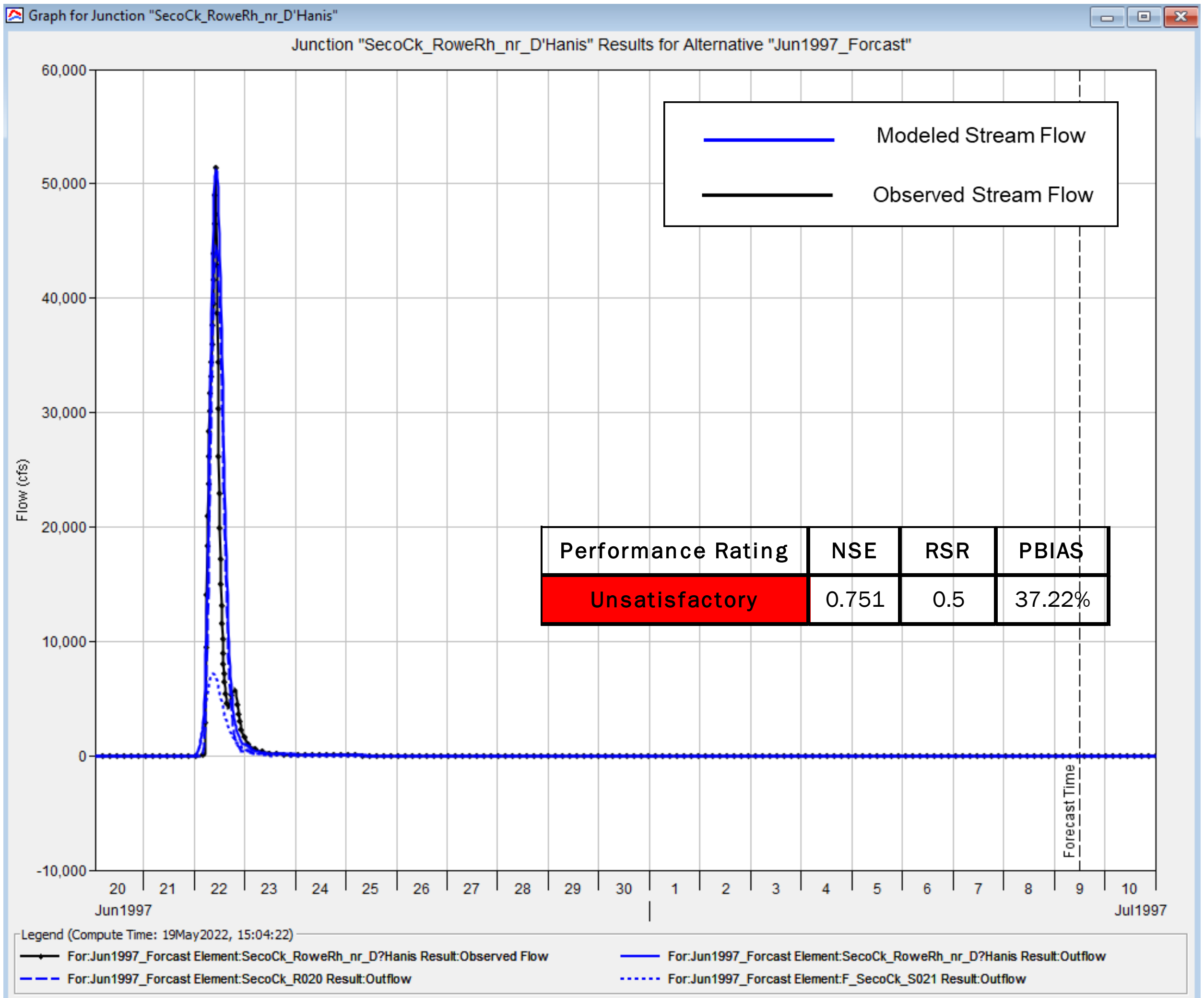


Figure B.38: June 1997 Calibration Results for Seco Creek at Rowe Ranch near D'Hanis USGS Gage

The Seco Creek at Rowe Ranch near D'Hanis achieved an "Unsatisfactory" performance rating due to a higher overall hydrograph volume reflected in the percent bias. However, HEC-HMS matched the timing, magnitude and shape of the observed data very well. Therefore, the unsatisfactory performance rating does not accurately reflect the quality of the calibration. The Seco Creek at Rowe Ranch near D'Hanis plot is shown above.

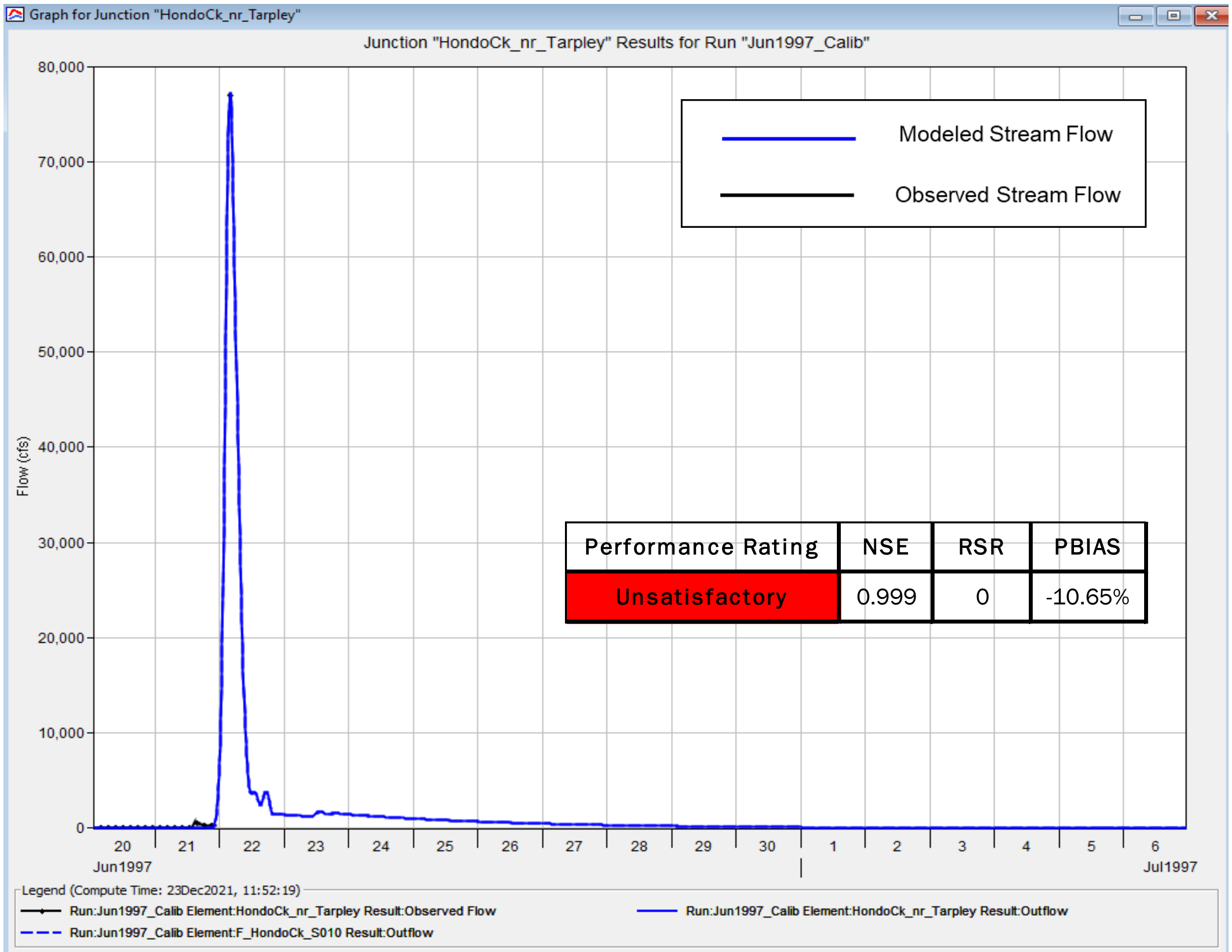


Figure B.39: June 1997 Calibration Results for Hondo Creek near Tarpley USGS Gage

The Hondo Creek near Tarpley observed hydrograph was missing. Only the peak discharge and time of peak was available, and the HEC-HMS model matched the peak magnitude and timing very well. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration. The Hondo Creek near Tarpley plot is shown above.

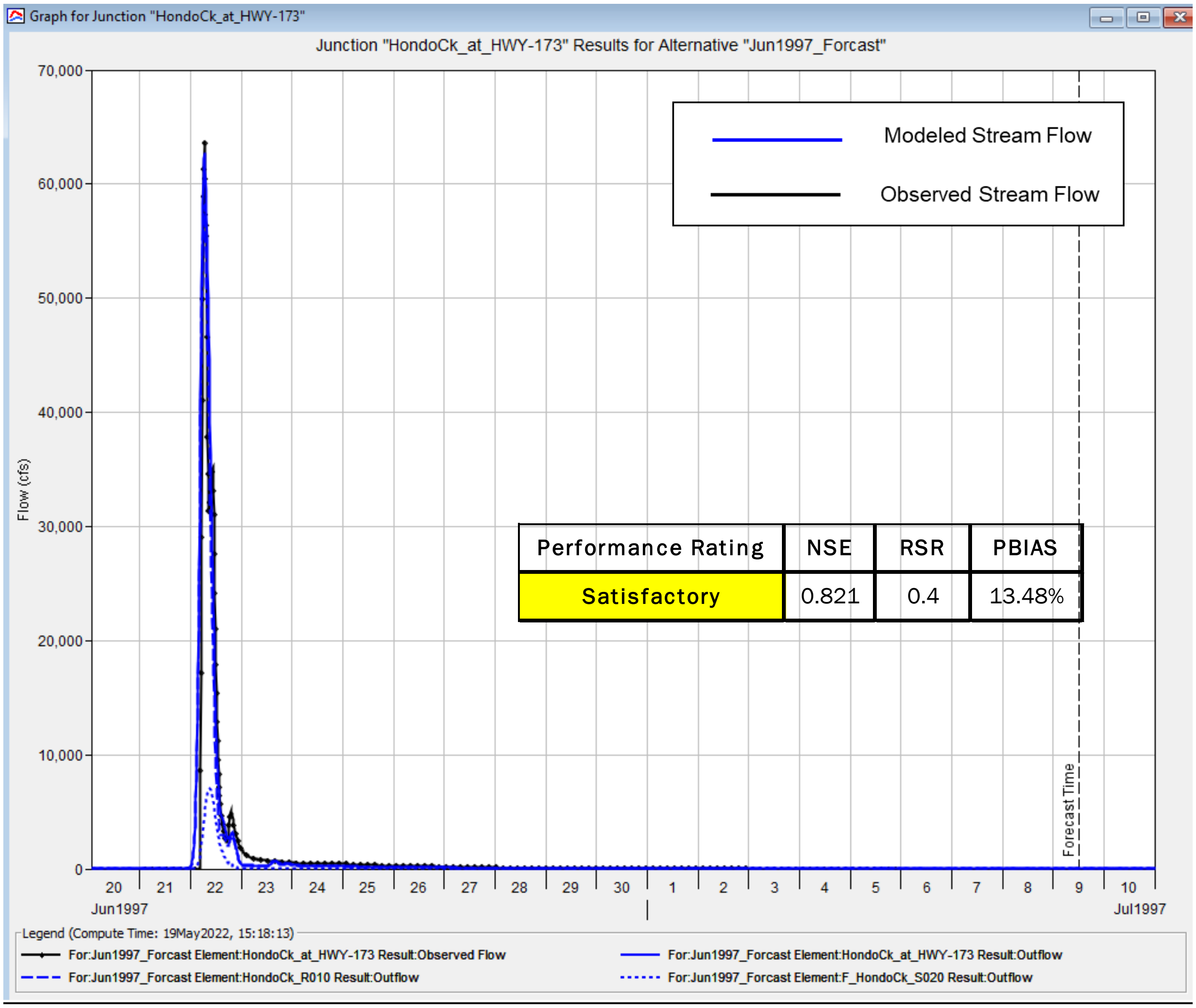
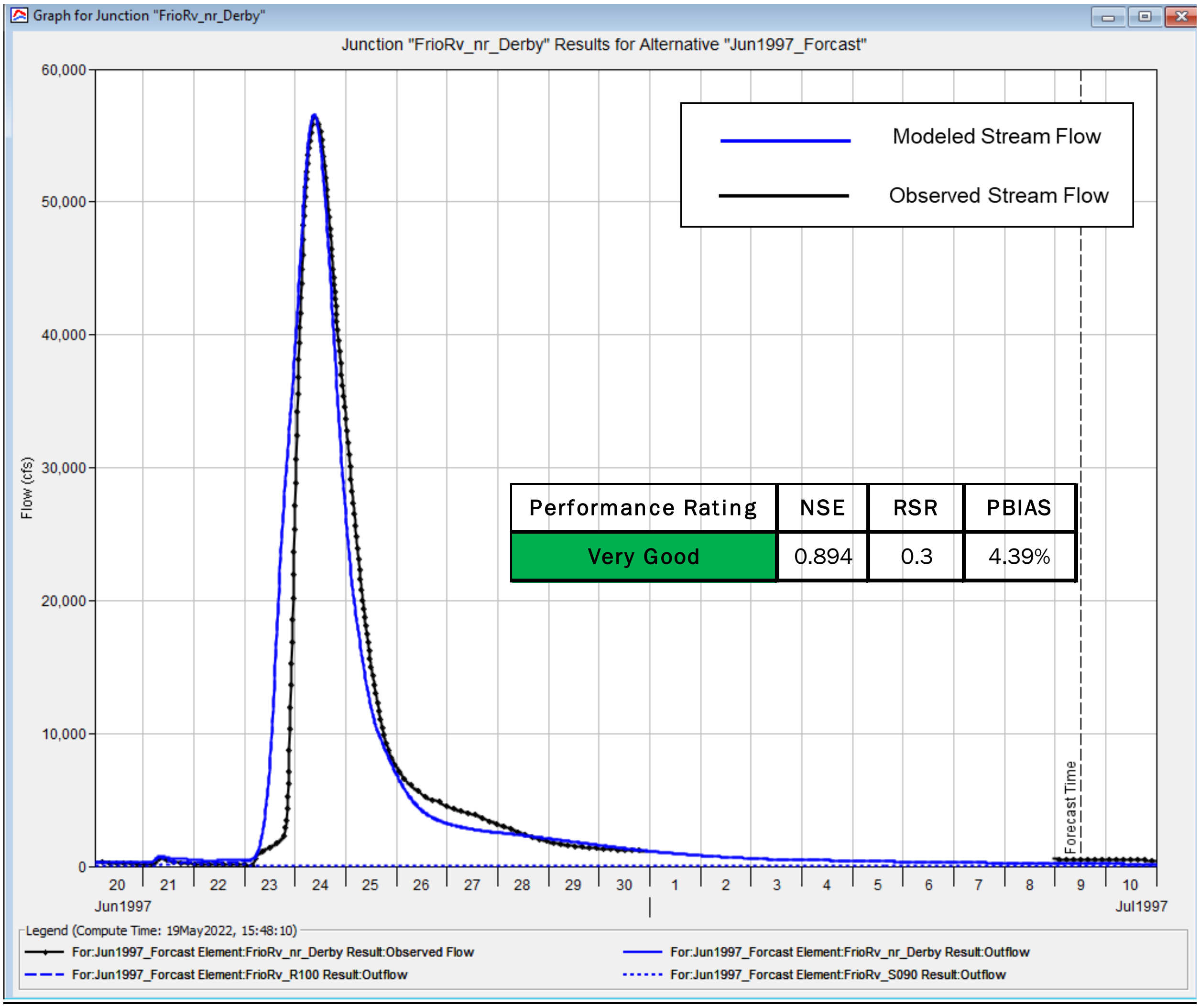


Figure B.40: June 1997 Calibration Results for Hondo Creek at SH 173 near Hondo USGS Gage

The older Hondo Creek at King Waterhole near Hondo gage is approximately 2.6 miles upstream of Hondo Creek at SH 173 near Hondo gage. The Hondo Creek near Hondo gage achieved a “Satisfactory” performance rating, primarily due to the runoff volume being a bit high, as reflected in the percent bias. HEC-HMS still matched the .timing, magnitude and shape of the observed hydrograph very well, so the performance rating is not an accurate representation of the quality of the calibration. The final Hondo Creek near Hondo plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.894	0.3	4.39%

Figure B.41: June 1997 Calibration Results for Frio River near Derby USGS Gage

The Frio River near Derby gage achieved a “Very Good” performance rating. HEC-HMS matched the timing, magnitude, shape and volume of the observed hydrograph very well. The final Frio River near Derby plot is shown above.

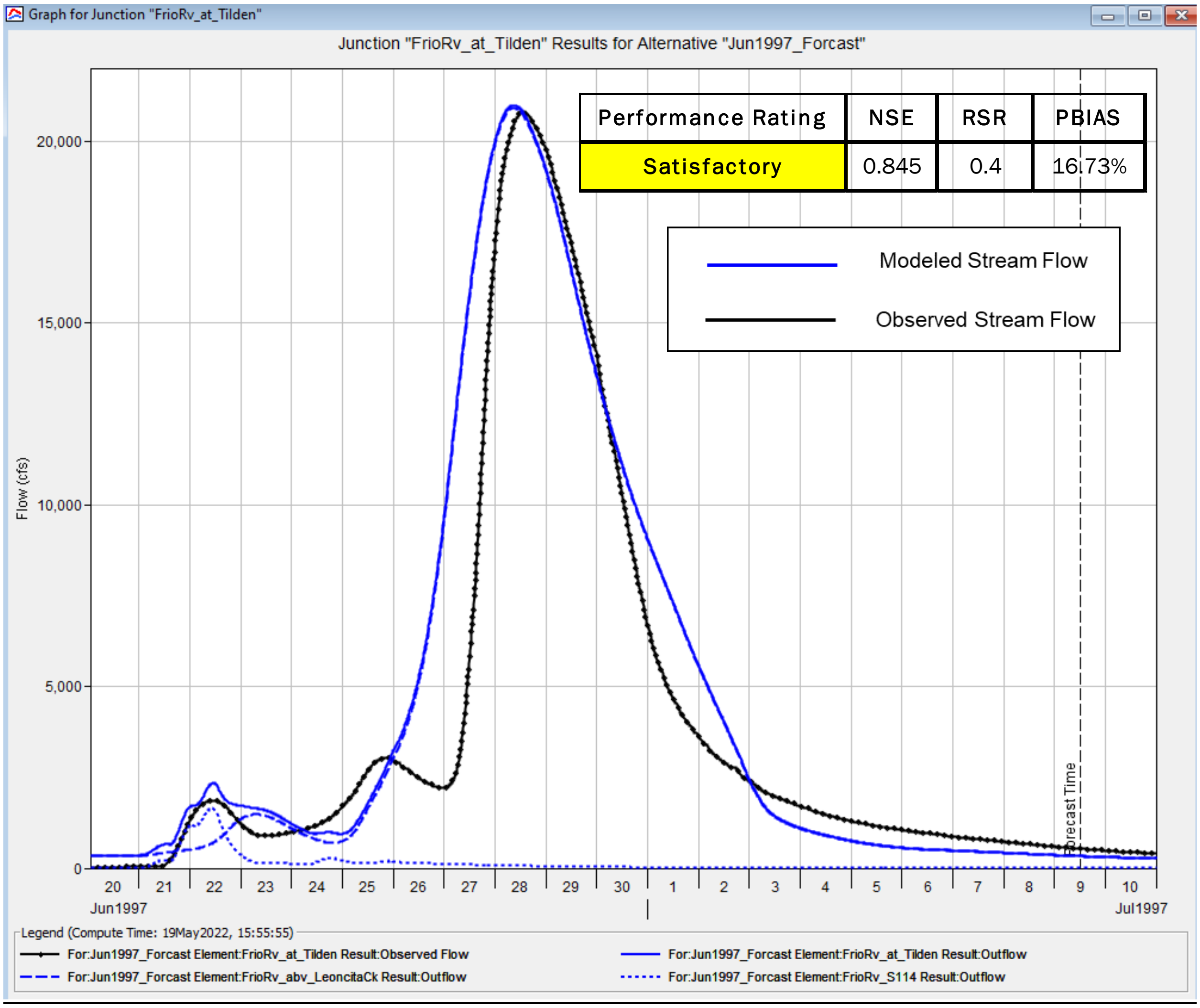


Figure B.42: June 1997 Calibration Results for Frio River at Tilden USGS Gage

The Frio River at Tilden gage achieved a “Very Good” performance rating. HEC-HMS matched the timing, magnitude, and shape of the observed hydrograph very well. The satisfactory performance rating was due to a higher overall hydrograph volume reflected in the percent bias. Revisions were made to model parameters to improve calibration at the Frio River at Tilden gage. The final Frio River at Tilden plot is shown above.

1.4.4.3 August 1998 Event

The August 1998 event was an upper Nueces River and Frio River Basin flood. For this flood event, the HEC-HMS model simulation period was August 20 thru September 2. The original NEXRAD precipitation was underestimated for this storm event. The original NEXRAD gridded precipitation was adjusted by ground-truthing to observed National Weather Service (NWS) daily and hourly precipitation gages using HEC-MetVue. The calibrations were improved with this ground-truthing, but precipitation and or intensity was still too low above several gages. NEXRAD hourly precipitation data also seemed to be off in its timing on Seco Creek and Hondo Creek watershed. For the Seco Creek at Miller Ranch near Utopia gage, the peak rainfall occurred at the same time as the peak discharge at the gage.

The Southern Texas Palmer Drought Severity Index (PDSI) was severe drought (-3.00 to -3.99) in July 1998. Southern Texas Palmer Z-index was severe drought (-2.00 to -2.74) in July 1998.

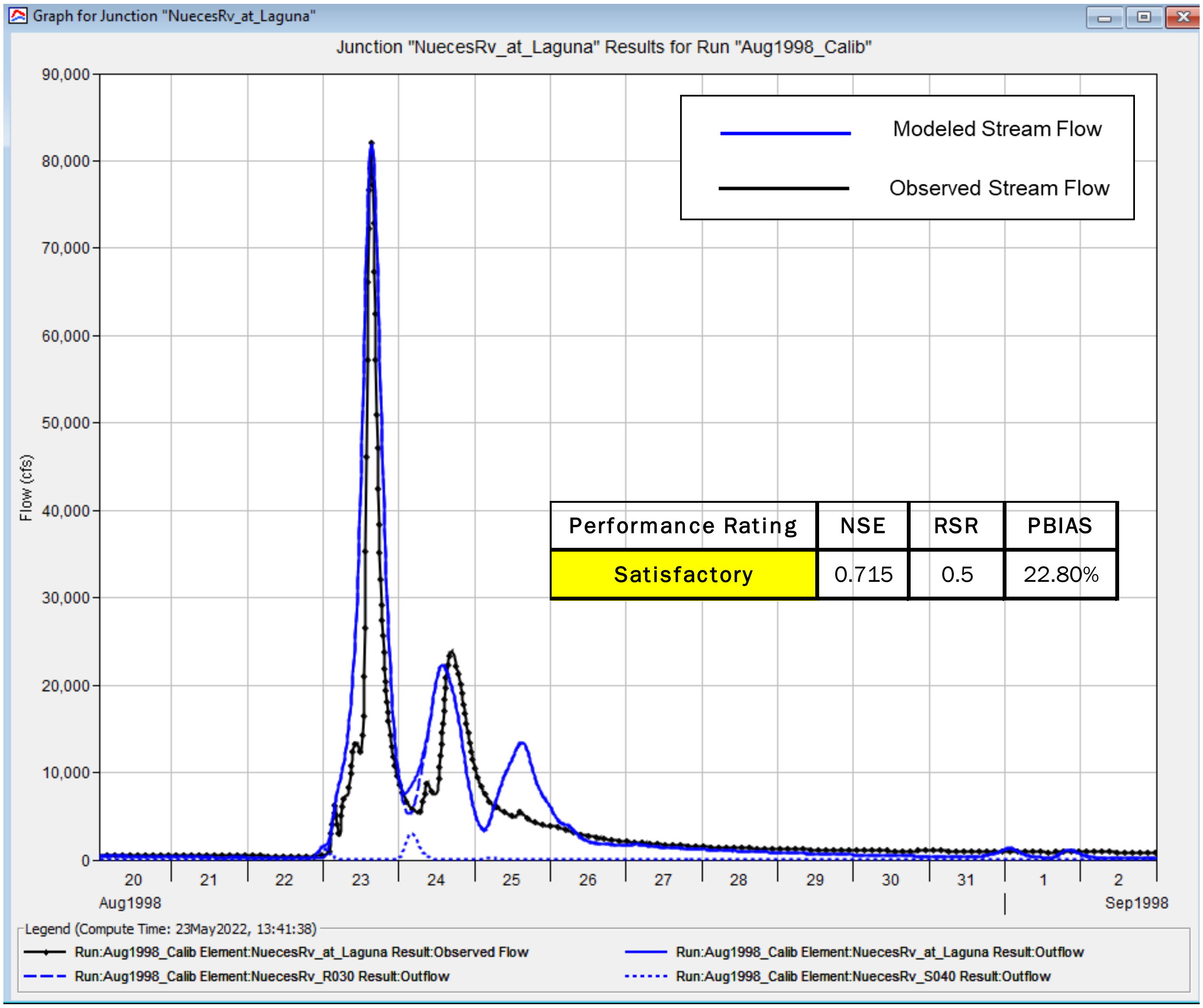


Figure B.43: August 1998 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna gage achieved a “Satisfactory” performance rating. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well, but the overall volume of the hydrograph was a bit high, as reflected in the percent bias. The Nueces River at Laguna plot is shown above.

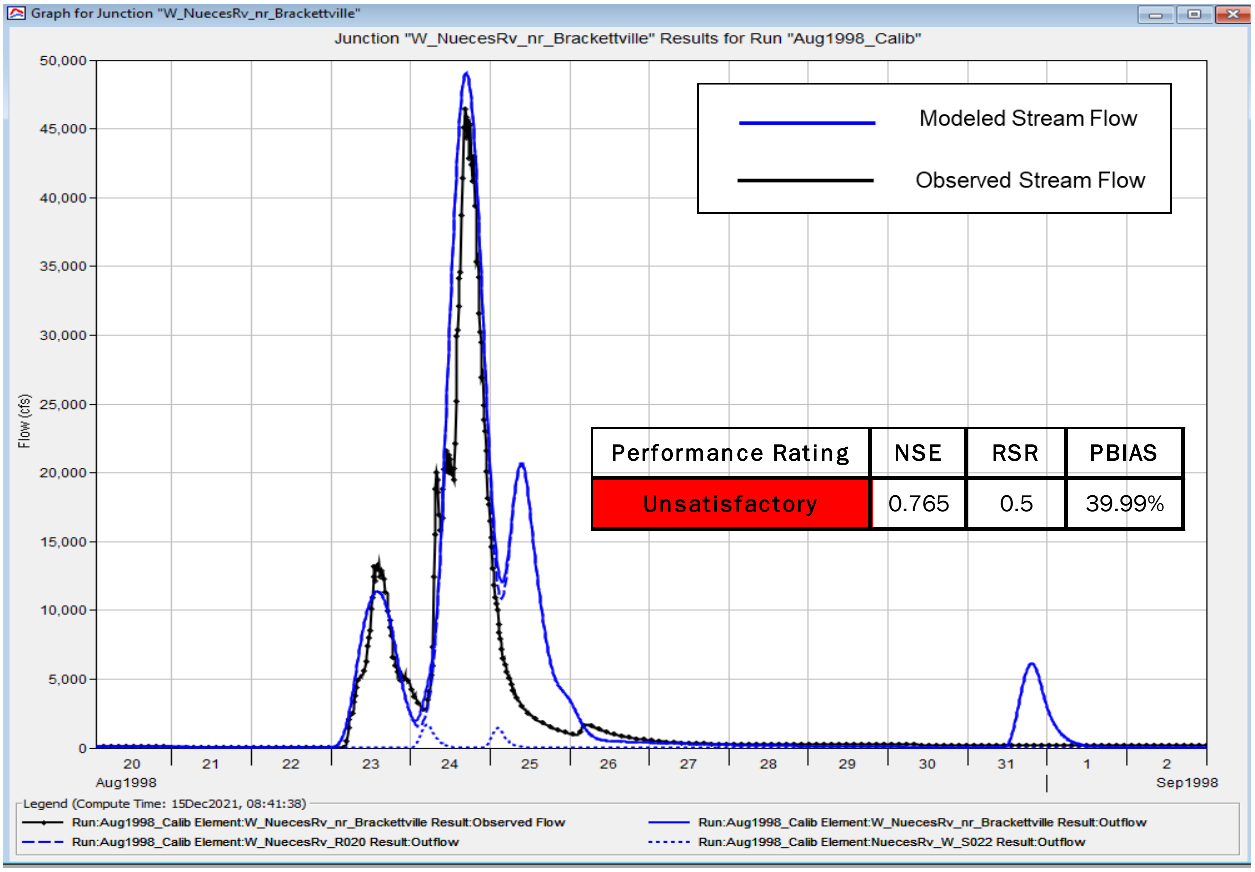
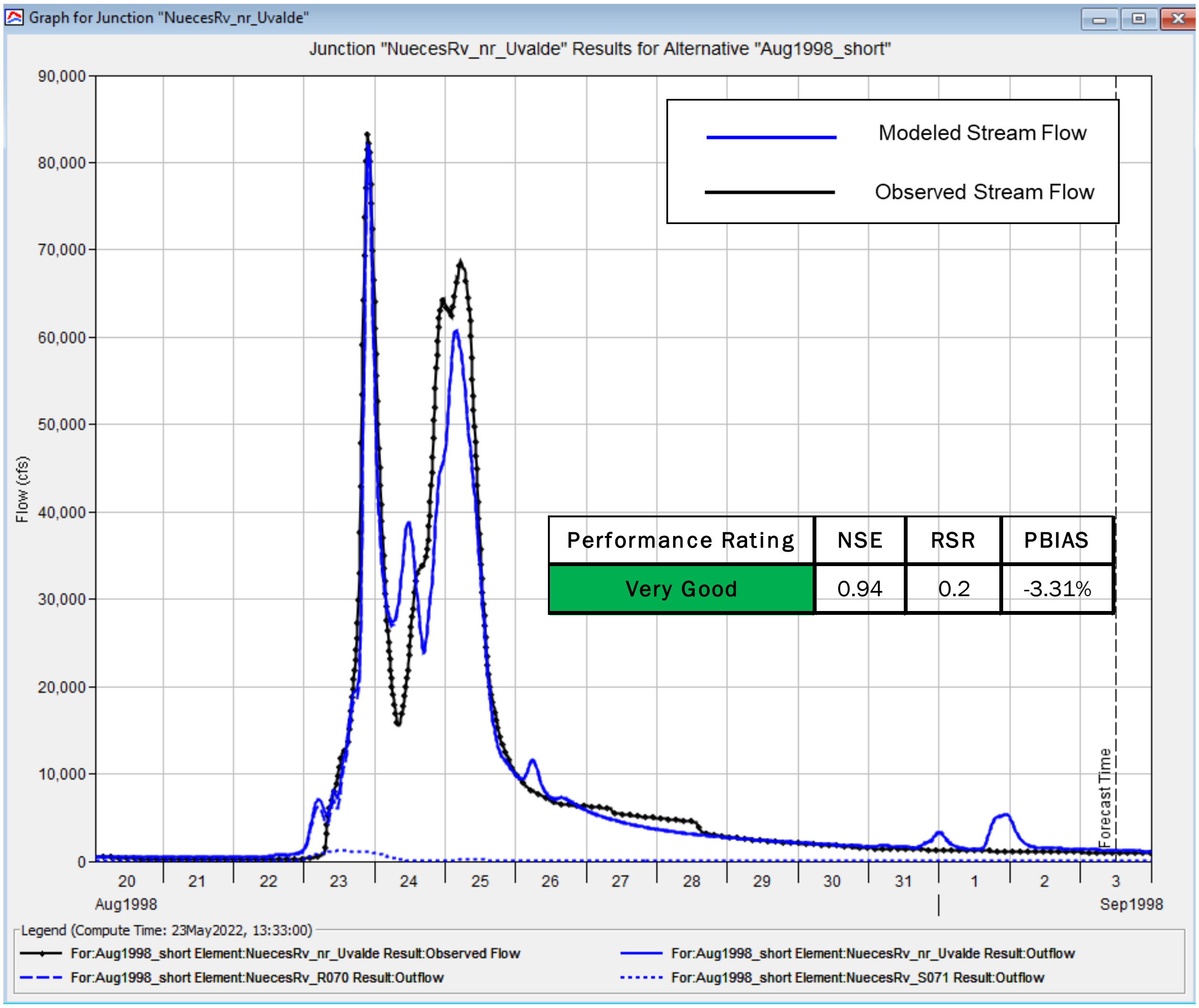


Figure B.44: August 1998 Calibration Results for West Nueces River near Brackettville USGS Gage

The West Nueces River near Brackettville gage achieved an “Unsatisfactory” performance rating. The HEC-HMS model matched the timing, magnitude, and shape of the main peak in the observed hydrograph very well. The unsatisfactory rating was due to the overall volume of the hydrograph being high, as reflected in the percent bias. There appears to be an overestimation of precipitation on August 25 and 31 causing additional peaks on the modeled hydrograph. Therefore, the rating is not an accurate representation of the quality of the calibration. The West Nueces River near Brackettville plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.94	0.2	-3.31%

Figure B.45: August 1998 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde gage achieved a “Very Good” performance rating for the Aug 1998 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The Nueces River below Uvalde plot is shown above.

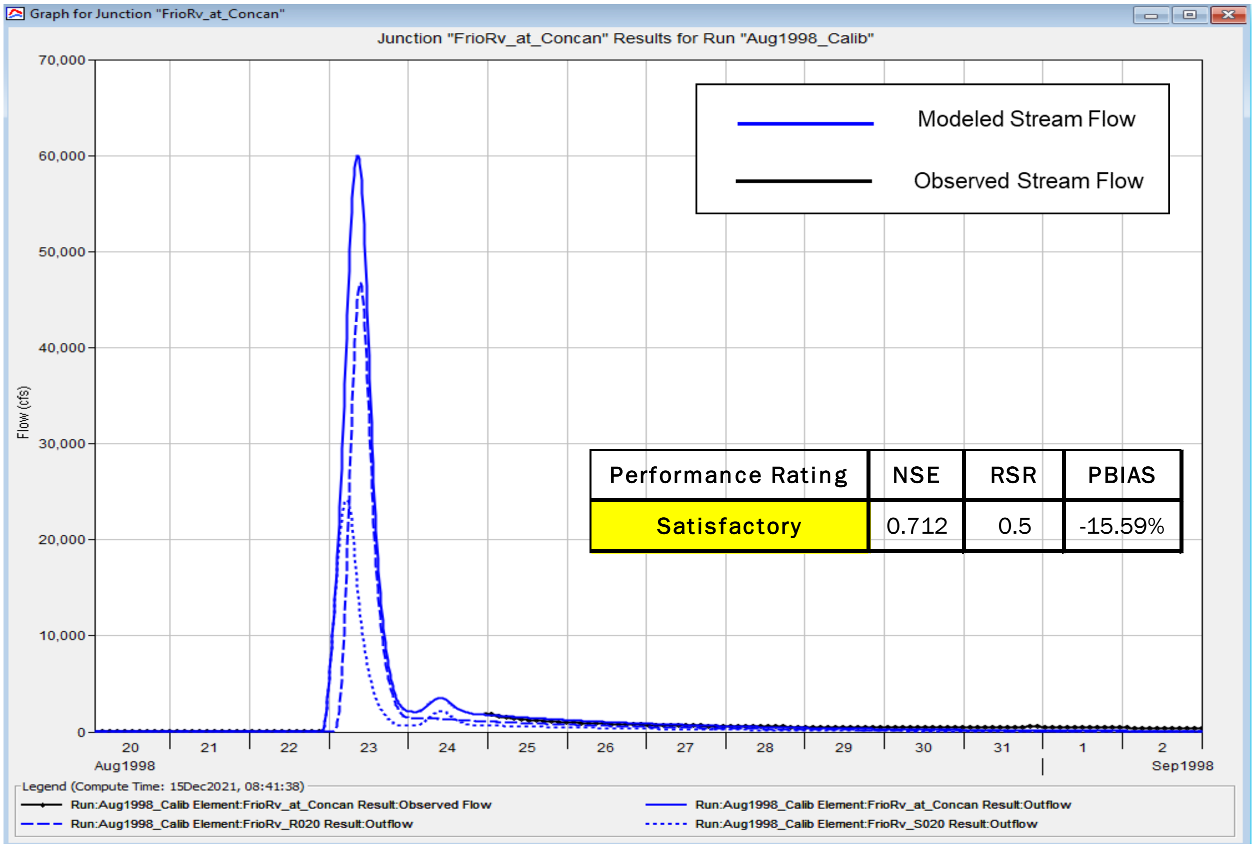


Figure B.46: August 1998 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan observed hydrograph was missing. Only the peak discharge was available. The Frio River at Concan gage peaked on August 23, 1998, at 59,900 cfs with time of peak unknown. The model was only adjusted to match the peak magnitude since the rest of the observed data is unknown. The Frio River at Concan plot is shown above. The satisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

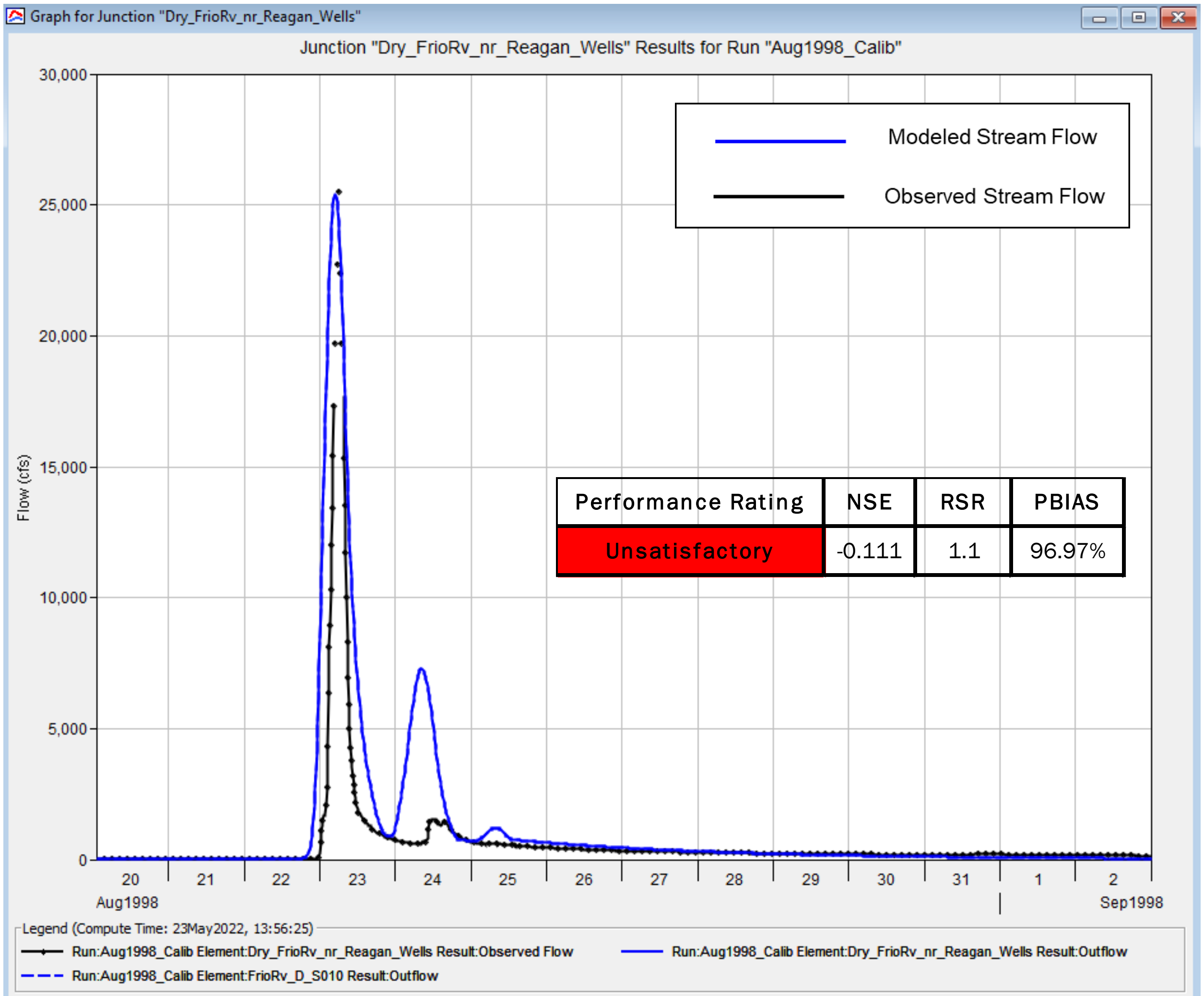


Figure B.47: August 1998 Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Nueces River below Uvalde gage achieved an “Unsatisfactory” performance rating for the Aug 1998 event. The HEC-HMS model matched the timing and magnitude of the observed hydrograph well, but there were substantial portions of missing data. There also appears to be an overestimation of precipitation on August 24 and 25 causing extra peaks on the computed hydrograph. The Dry Frio River near Reagan Wells plot is shown above. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

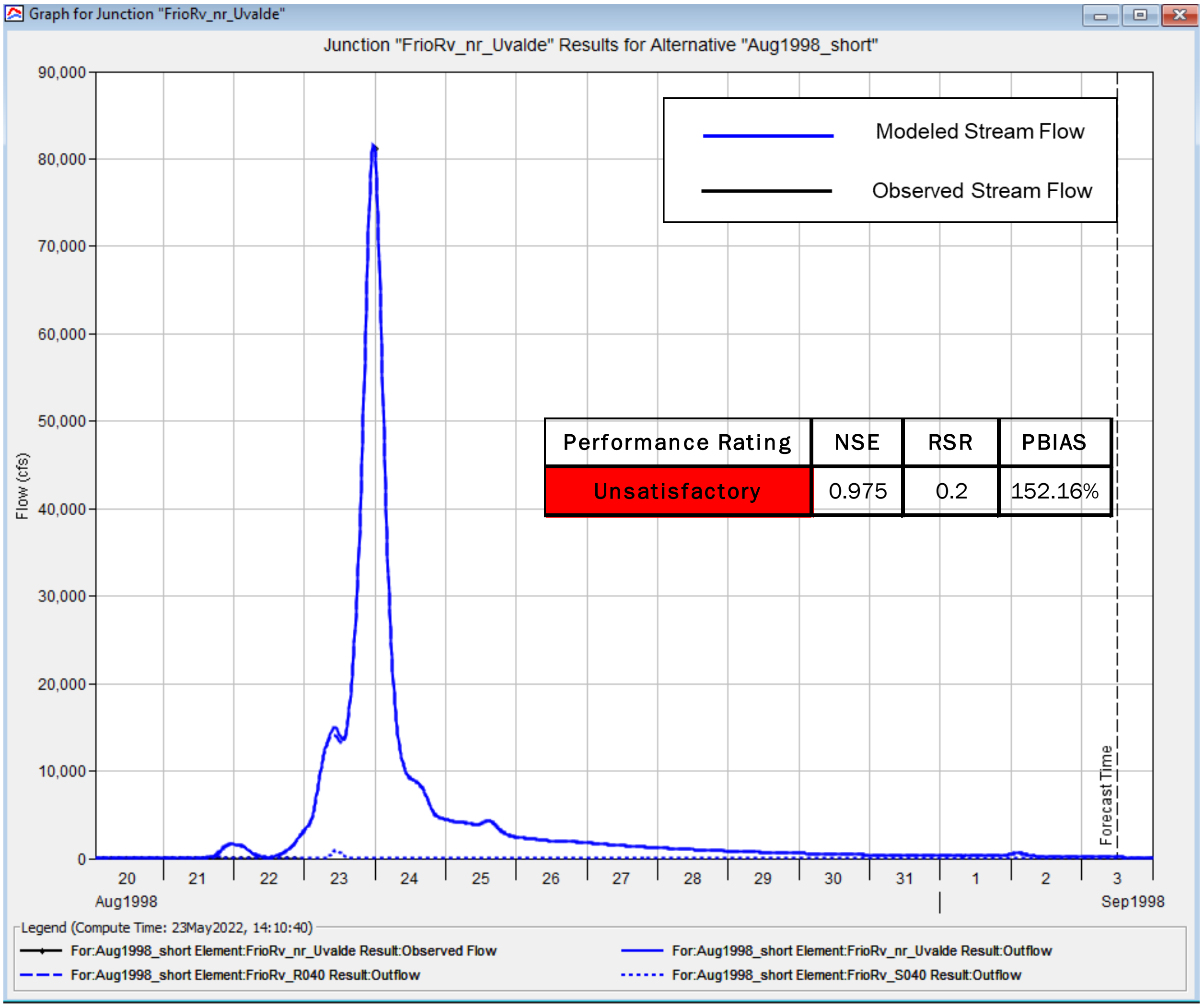


Figure B.48: August 1998 Calibration Results for Frio River below Dry Frio near Uvalde USGS Gage

The Frio River below Dry Frio near Uvalde observed hydrograph was missing. Only the peak discharge and time of peak was available. The HEC-HMS model was able to match the timing and magnitude of the observed peak very well. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration. The Frio River below Dry Frio near Uvalde plot is shown above.

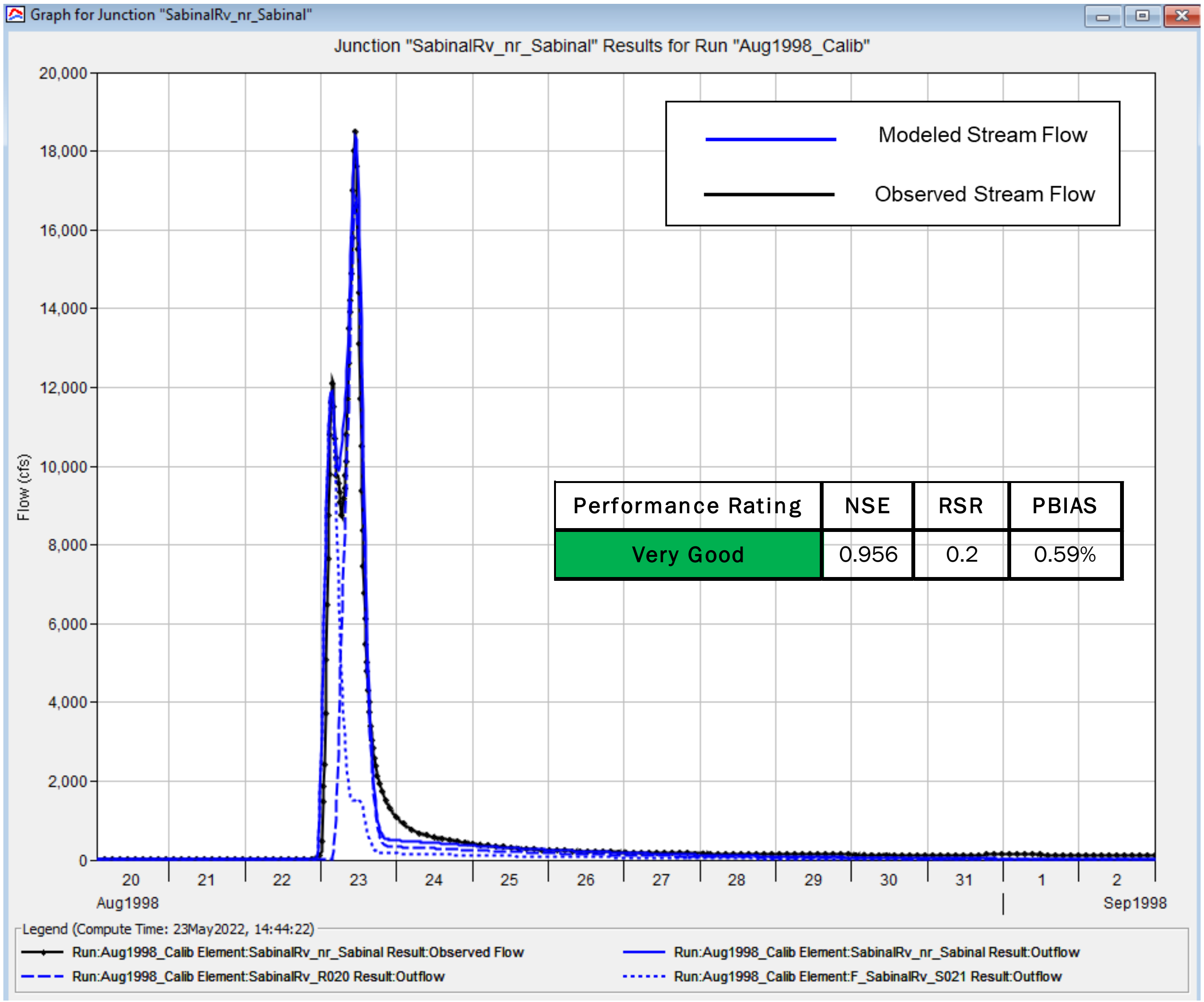


Figure B.49: August 1998 Calibration Results for Sabinal River near Sabinal USGS Gage

The Sabinal River near Sabinal gage achieved a “Very Good” performance rating for the Aug 1998 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. Revisions were made to model parameters to improve the calibration. The Sabinal River near Sabinal plot is shown above.

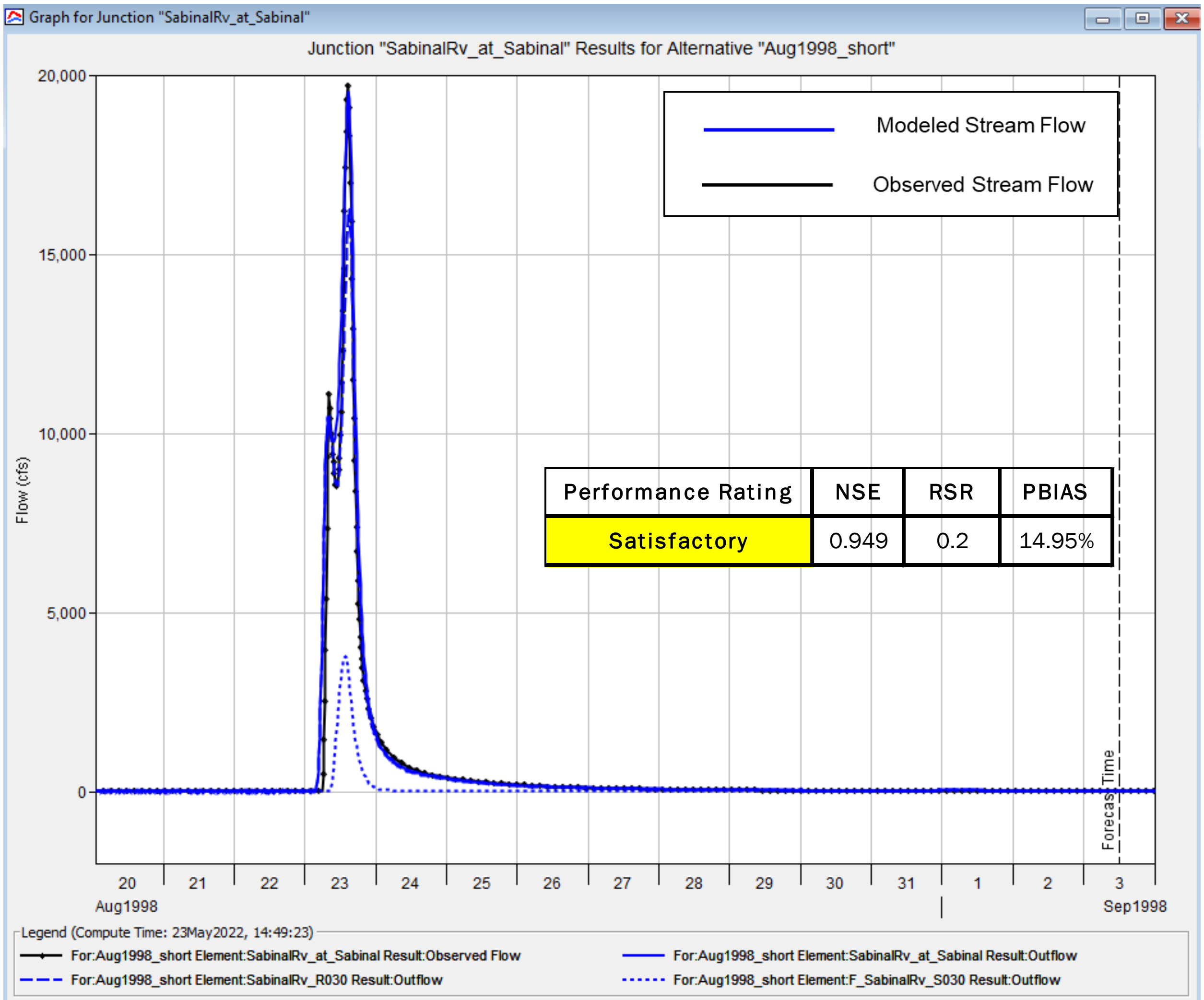
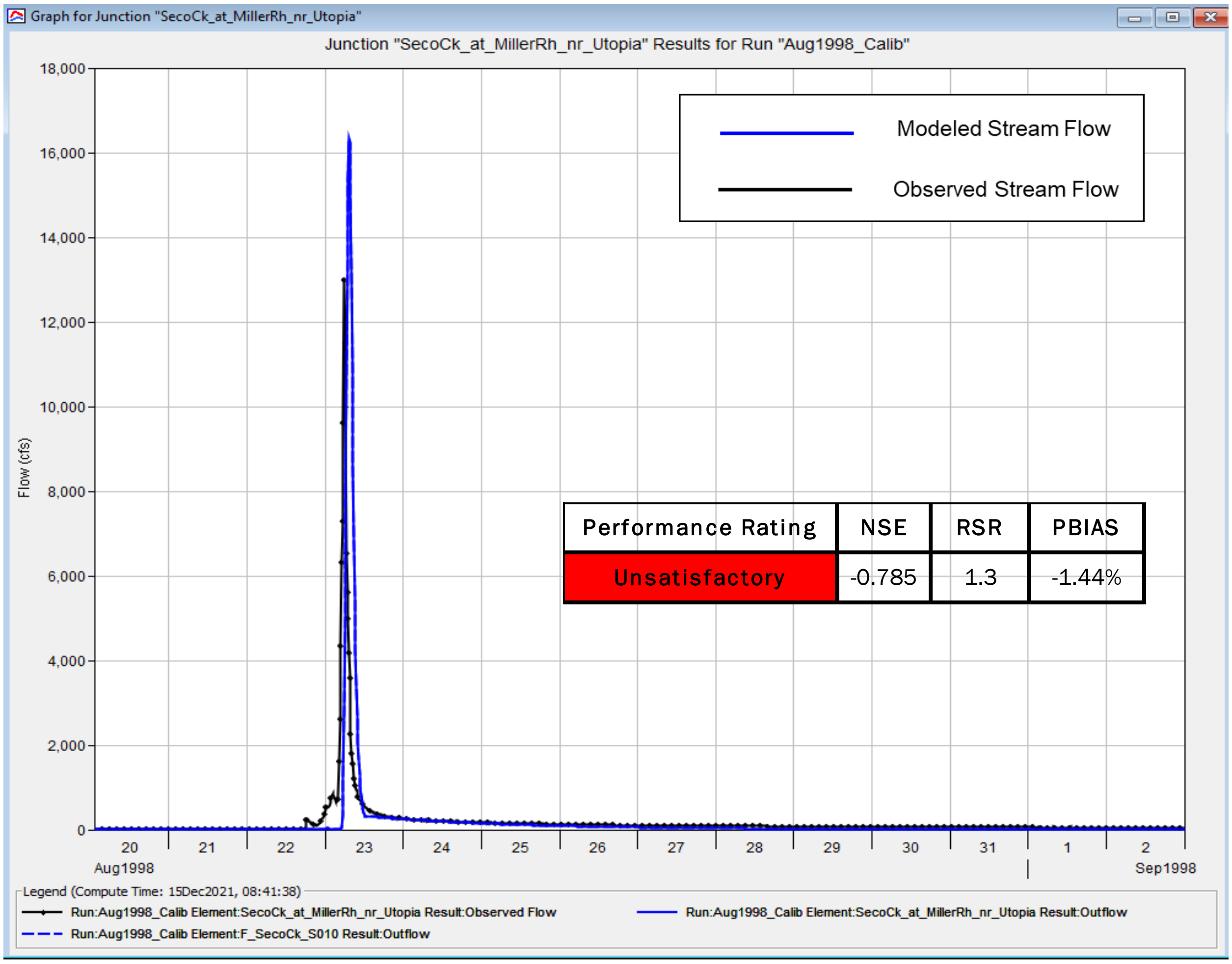


Figure B.50: August 1998 Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River at Sabinal gage achieved a "Satisfactory" performance rating for the Aug 1998 event. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well. The satisfactory rating was due to the overall volume being a bit high, as reflected in the percent bias. Revisions were made to model parameters to improve the calibration. The Sabinal River at Sabinal plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Unsatisfactory	-0.785	1.3	-1.44%

Figure B.51: August 1998 Calibration Results for Seco Creek at Miller Ranch near Utopia USGS Gage

The Seco Creek at Miller Ranch near Utopia gage achieved an “Unsatisfactory” performance rating for the Aug 1998 event. The HEC-HMS model matched the shape and volume of the observed hydrograph very well, but the timing was off. This is most likely due to errors in the timing of the NEXRAD hourly precipitation data. An examination of the data showed that the peak rainfall occurred at the same time as the peak discharge at the gage, which is not physically possible. The Seco Creek at Miller Ranch near Utopia plot is shown above.

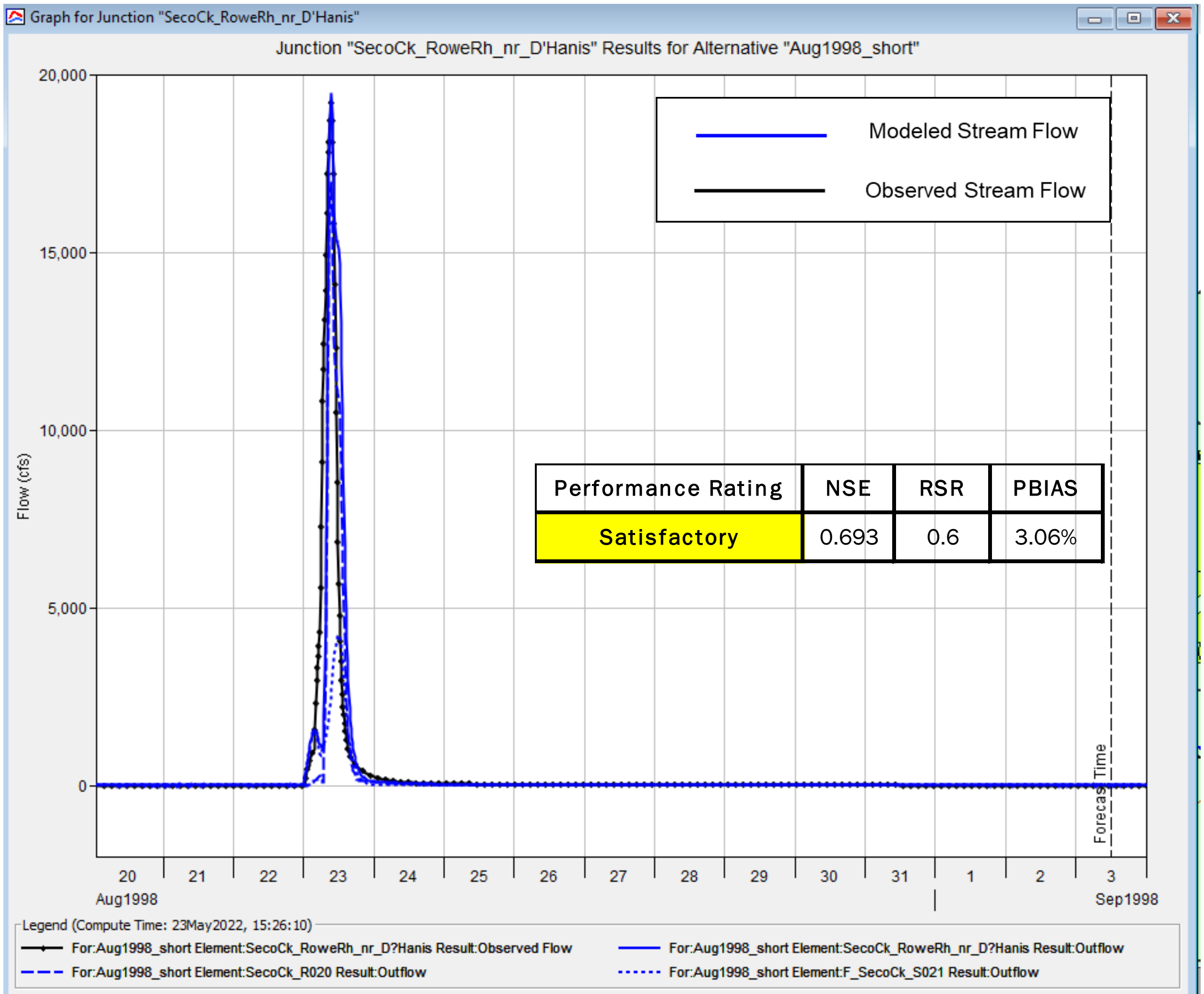
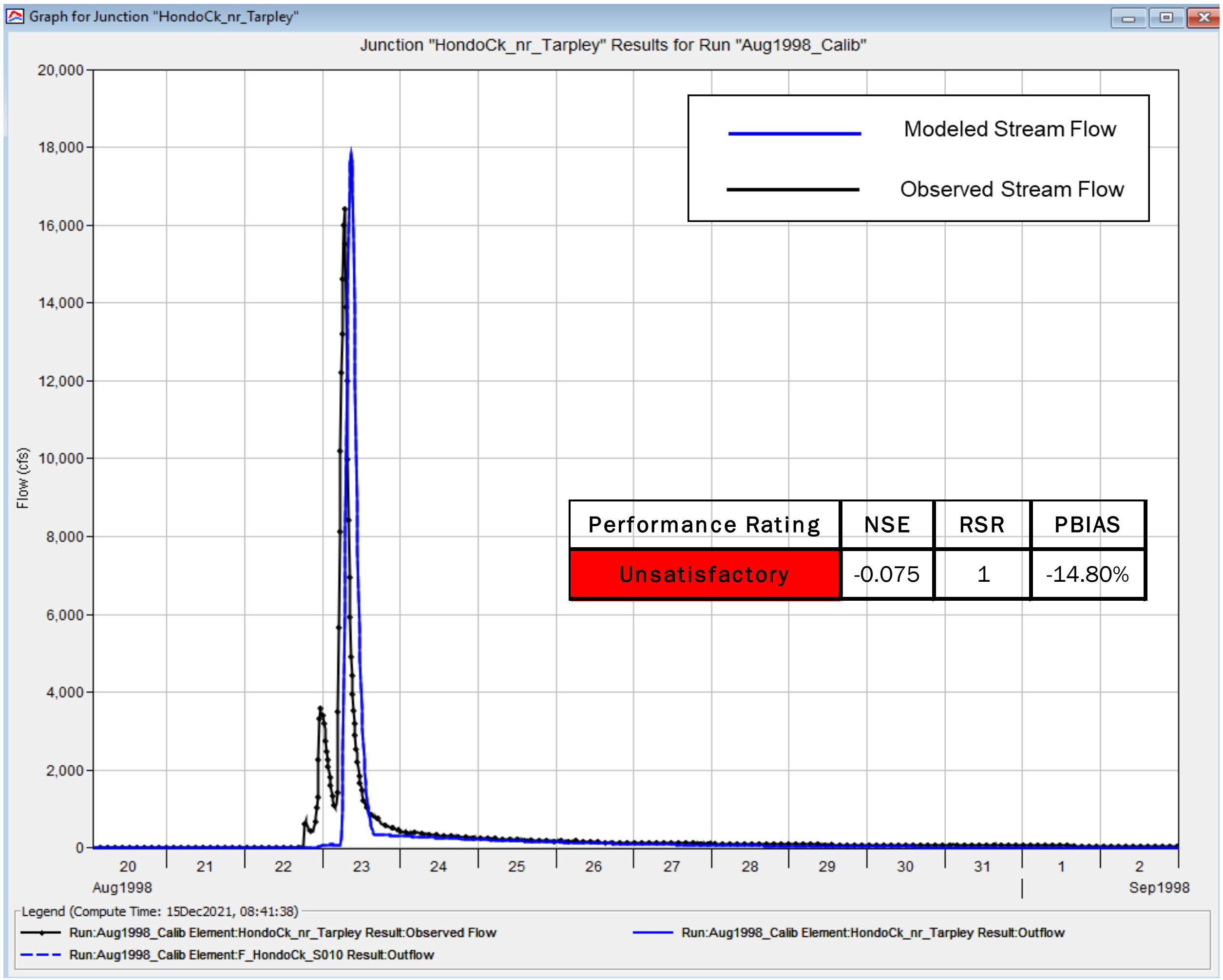


Figure B.52: August 1998 Calibration Results for Seco Creek at Rowe Ranch near D'Hanis USGS Gage

The Seco Creek at Rowe Ranch near D'Hanis gage achieved a "Satisfactory" performance rating for the Aug 1998 event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph very well, but the timing was off. This is most likely due to errors in the timing of the NEXRAD hourly precipitation data, similar to the previous gage. The Seco Creek at Rowe Ranch near D'Hanis plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Unsatisfactory	-0.075	1	-14.80%

Figure B.53: August 1998 Calibration Results for Hondo Creek near Tarpley USGS Gage

The Hondo Creek near Tarpley gage achieved an "Unsatisfactory" performance rating for the Aug 1998 event. The HEC-HMS model matched the shape and magnitude of the observed hydrograph relatively well, but the timing was off. This is most likely due to errors in the timing of the NEXRAD hourly precipitation data, similar to the Seco Creek gages. The Hondo Creek near Tarpley plot is shown above.

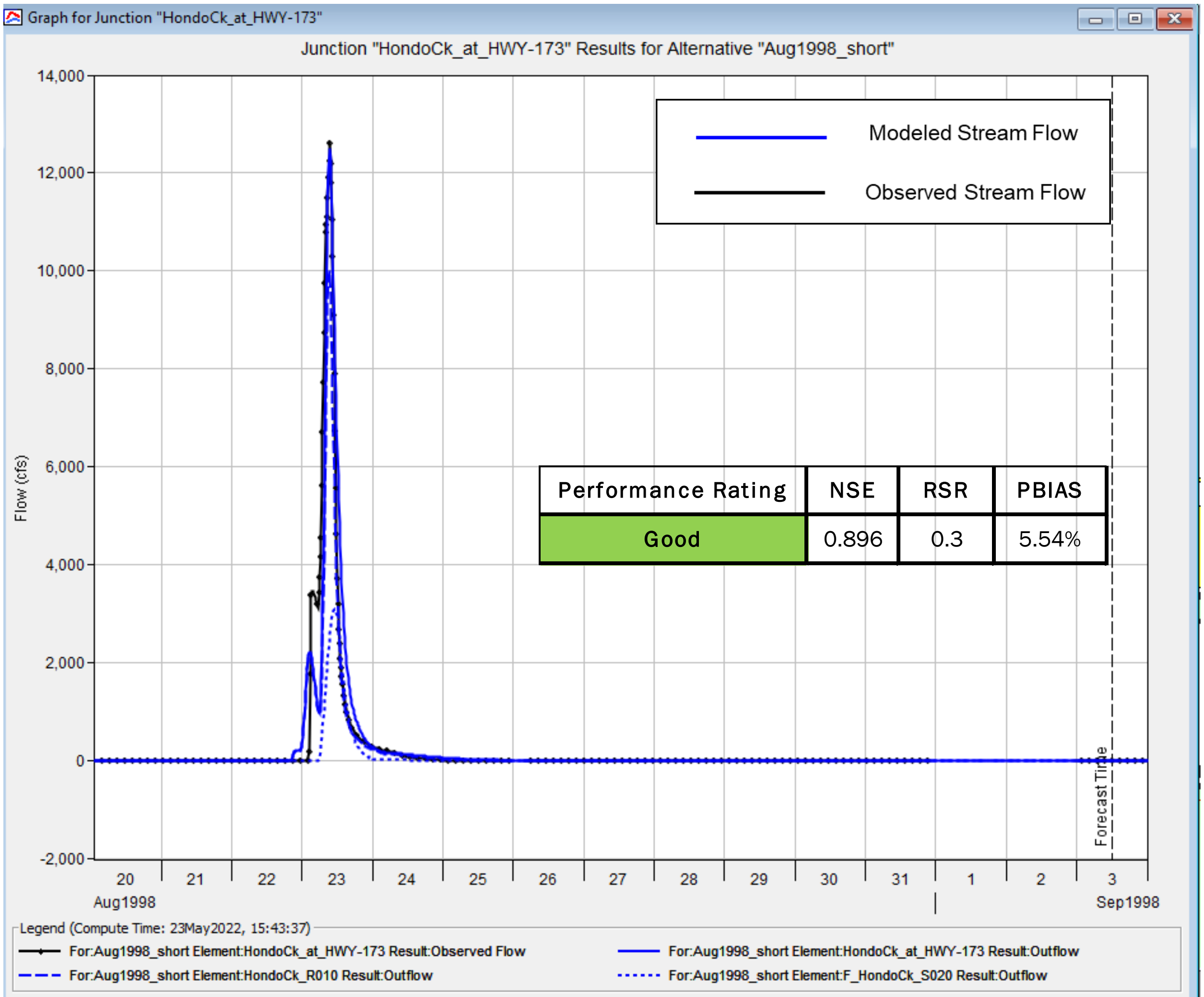


Figure B.54: August 1998 Calibration Results for Hondo Creek at King Waterhole near Hondo USGS Gage

The Hondo Creek at King Waterhole near Hondo gage achieved a “Good” performance rating for the Aug 1998 event. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well. The overall runoff volume was just slightly beyond the threshold of a “Very Good” rating, as shown in the percent bias. To prevent the upstream model errors from propagating downstream, forecast blending was used on the observed data at the upstream gage. The Hondo Creek at King Waterhole near Hondo plot is shown above.

1.4.4.4 November 2001 Event

The November 2001 event was an upper Nueces River, San Casimiro Creek, and Atascosa River Basin flood. For this flood event, the HEC-HMS model simulation period was November 13 thru November 21. Prior to this event, the Southern Texas Palmer Drought Severity Index (PDSI) was moderate drought (-2.00 to -2.99) in October 2001. Southern Texas Palmer Z-index was severe drought (-2.00 to -2.74) in October 2001.

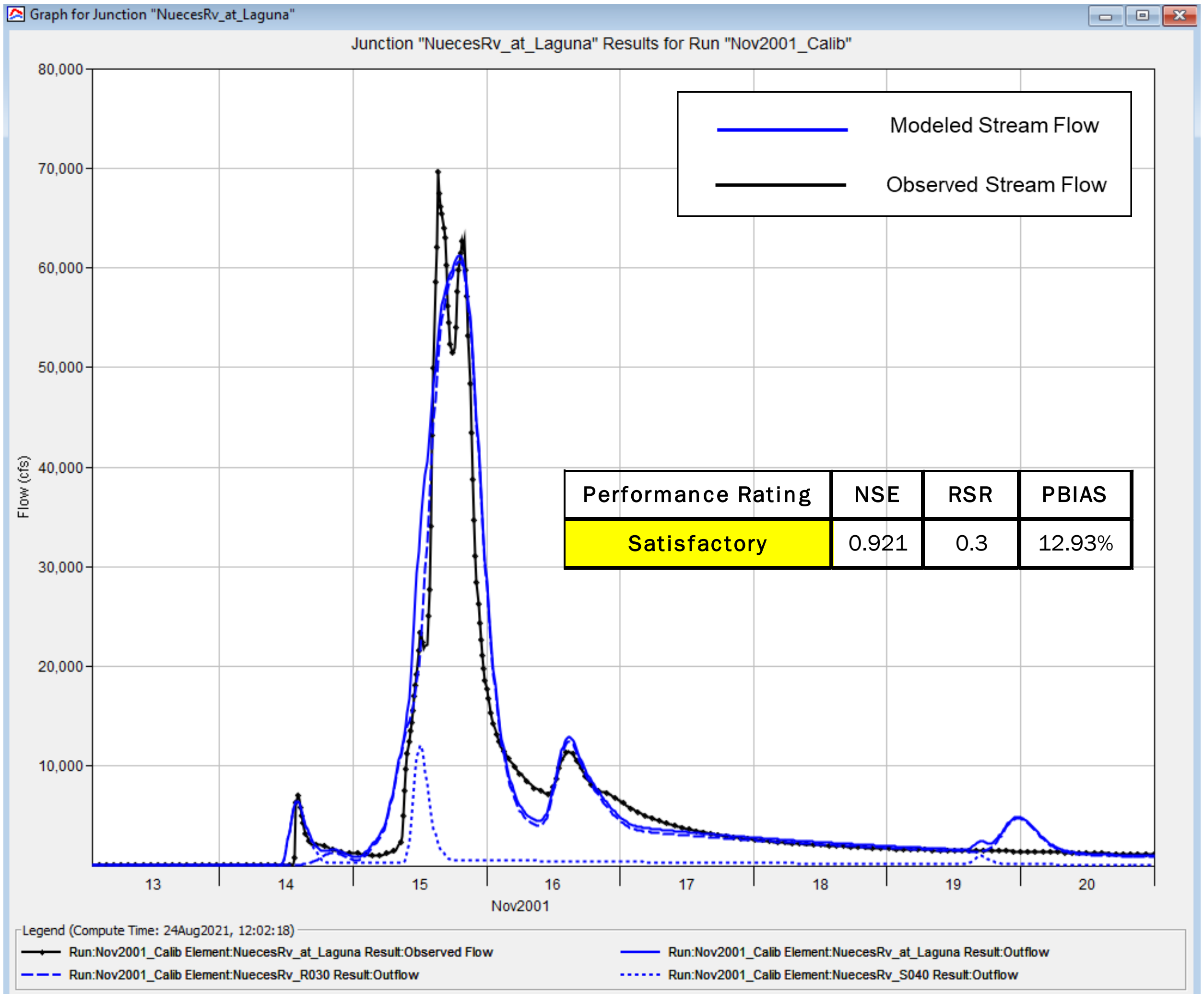


Figure B.55: November 2001 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna gage achieved a "Satisfactory" performance rating for the November 2001 event. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well. The overall runoff volume was just a bit high, as shown in the percent bias, resulting in the satisfactory rating. The model results were also a bit low on first observed peak of 69,600 cfs on November 15, but they did match the second observed peak of 62,800 cfs on November 15. There appears to be a rainfall data issue on the area immediately upstream of Laguna gage. National Weather Service (NWS) daily precipitation gage at nearby Camp Wood reported 8.37 inches on November 15 at 0700 hr whereas the gridded NEXRAD precipitation only showed 4.04 inches by that time. The Nueces River at Laguna plot is shown above,

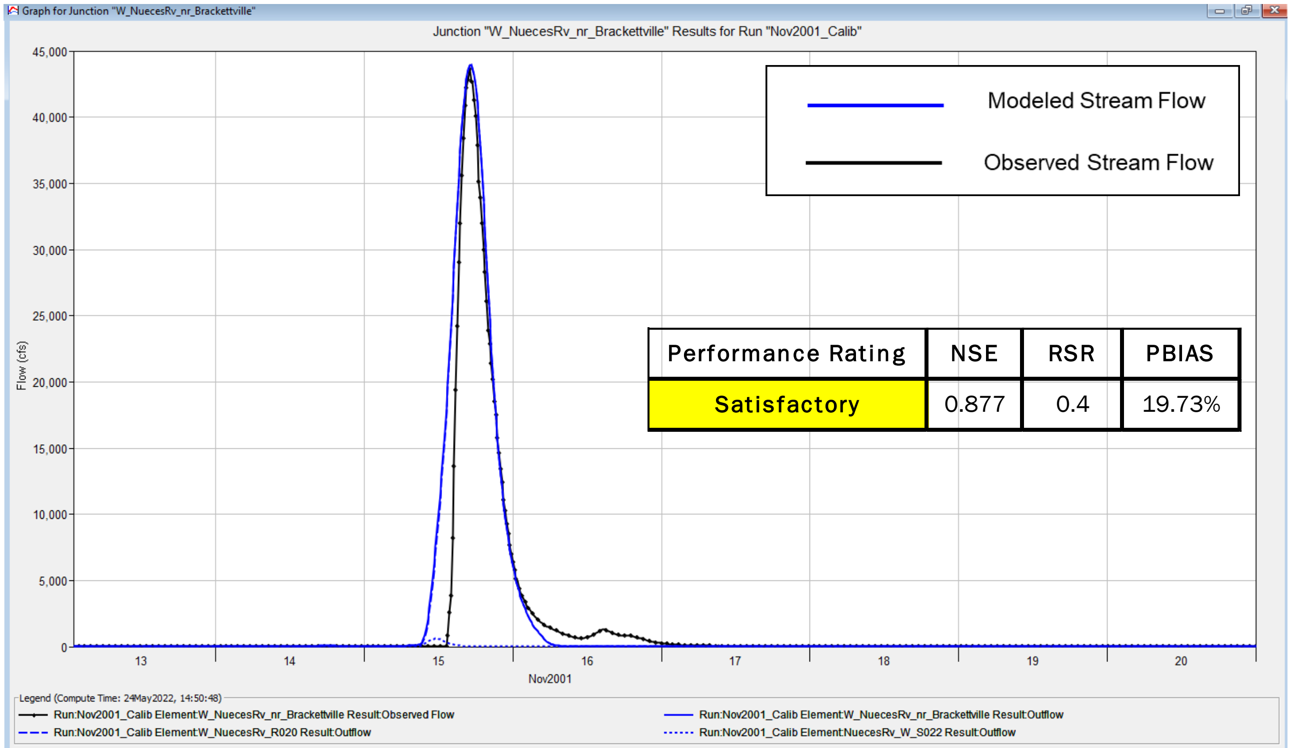


Figure B.56: November 2001 Calibration Results for West Nueces River near Brackettville USGS Gage

The West Nueces River near Brackettville gage achieved a “Satisfactory” performance rating for the November 2001 event. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well. The overall runoff volume was just a bit high, as shown in the percent bias, so the performance rating is not an accurate measure of the quality of the calibration. The final West Nueces River near Brackettville plot is shown above.

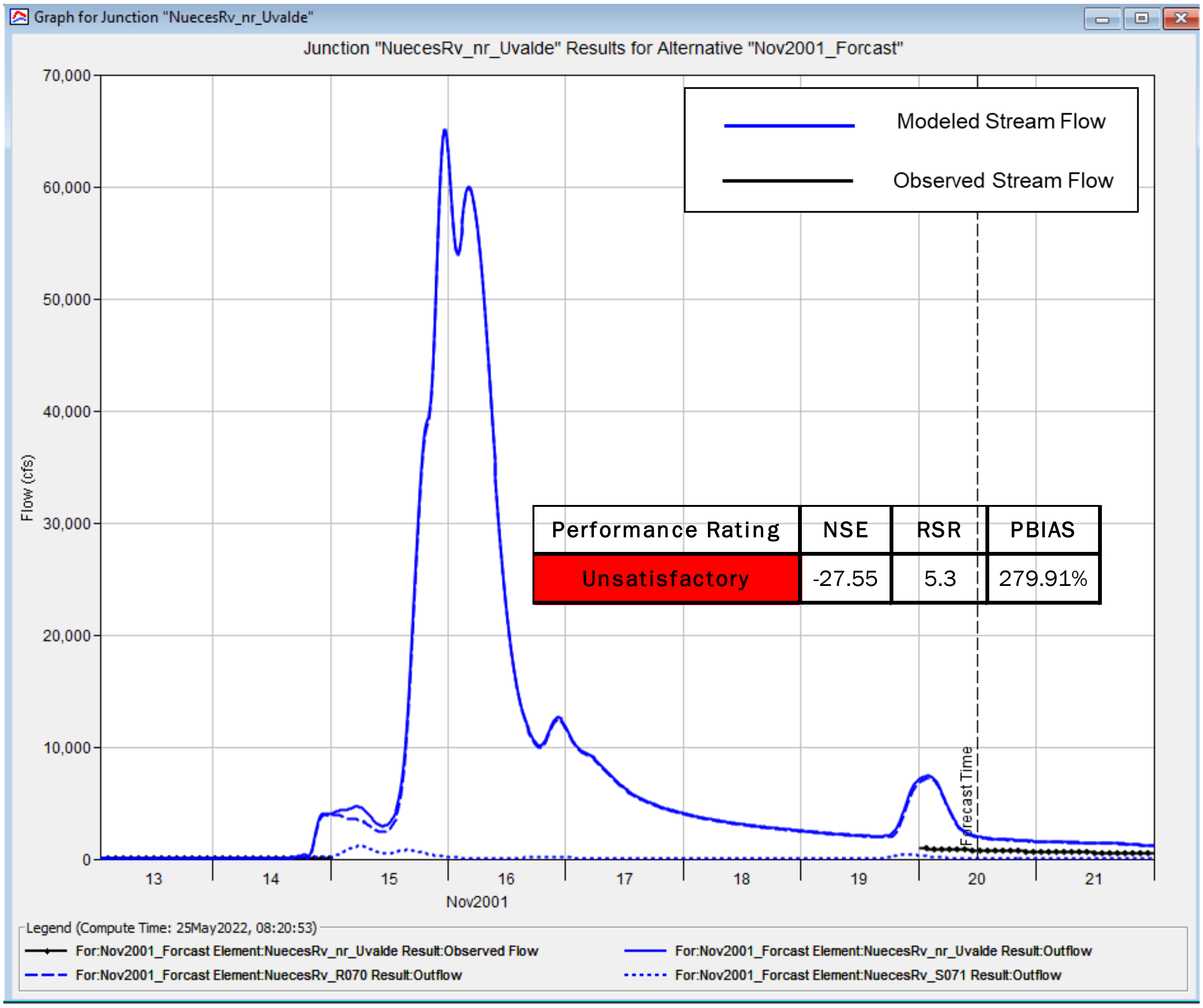


Figure B.57: November 2001 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde observed hydrograph was missing. Only the peak discharge was available. The Nueces River below Uvalde gage peaked on November 15, 2001, at 65,300 cfs with time of peak unknown. The HEC-HMS model matched the observed peak magnitude well. The Nueces River below Uvalde gage achieved an “Unsatisfactory” performance rating due to the missing observed data, so it is not an accurate representation of calibration quality. The Nueces River below Uvalde plot is shown above.

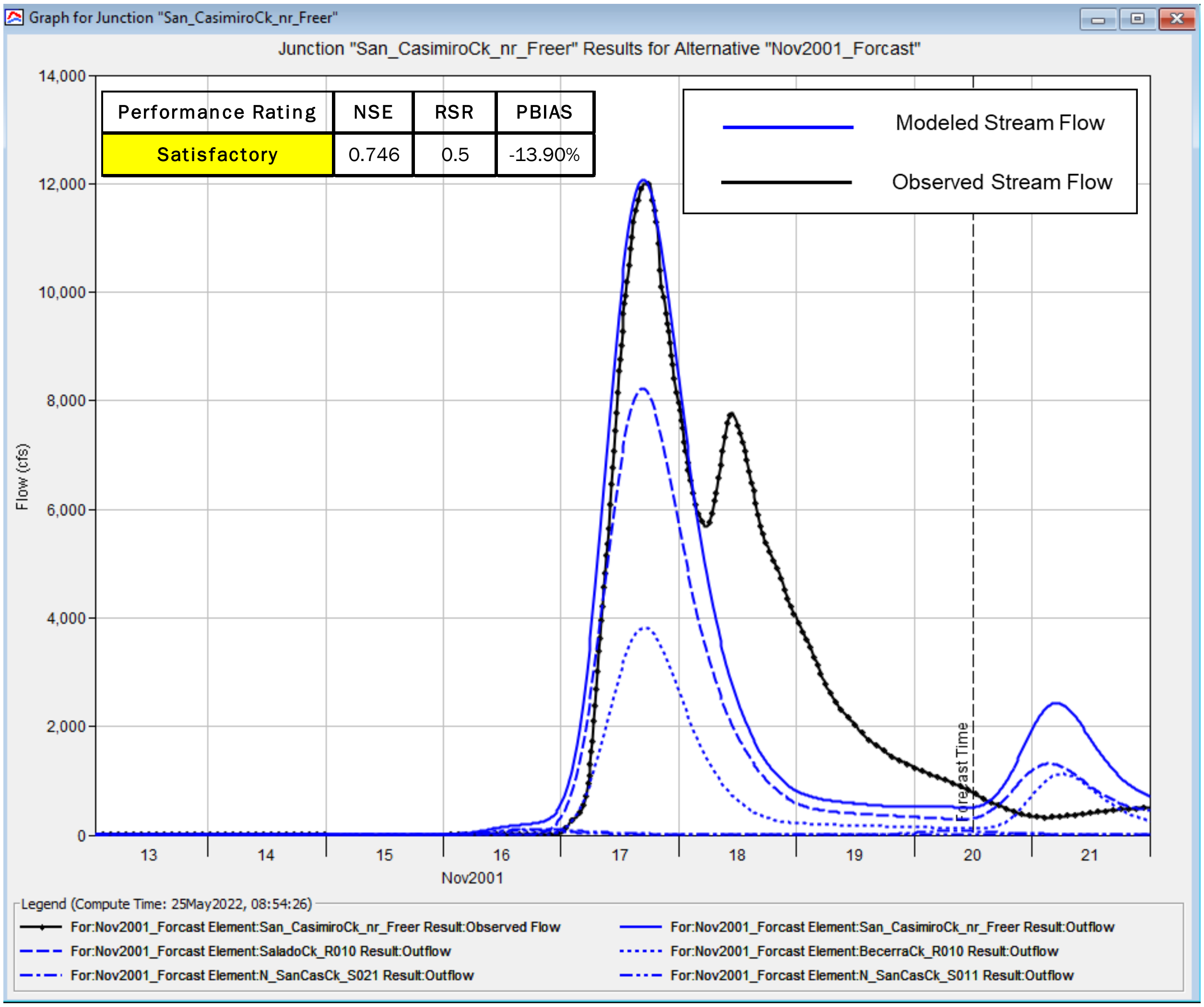


Figure B.58: November 2001 Calibration Results for San Casimiro Creek near Freer USGS Gage

At the San Casimiro Creek near Freer gage, HEC-HMS matched the observed hydrograph on for the first peak on November 17th, but not the second peak on November 18th. Overall, this resulted in a "Satisfactory" performance rating. Majority of the subarea precipitation occurred between November 15 at 2000 hr. thru November 16 at 1300 hr. A check of the NWS daily precipitation gages showed no precipitation on November 18th. There are multiple dams upstream of the Freer gage on Salado Creek, Caliche Creek, and Alamita Creek in subareas N_SanCasCk_S010 and N_SanCasCk_S011, which were not modeled in HEC-HMS. Delayed releases from these dams could be causing the second peak on November 18th. The San Casimiro Creek near Freer plot is shown above.

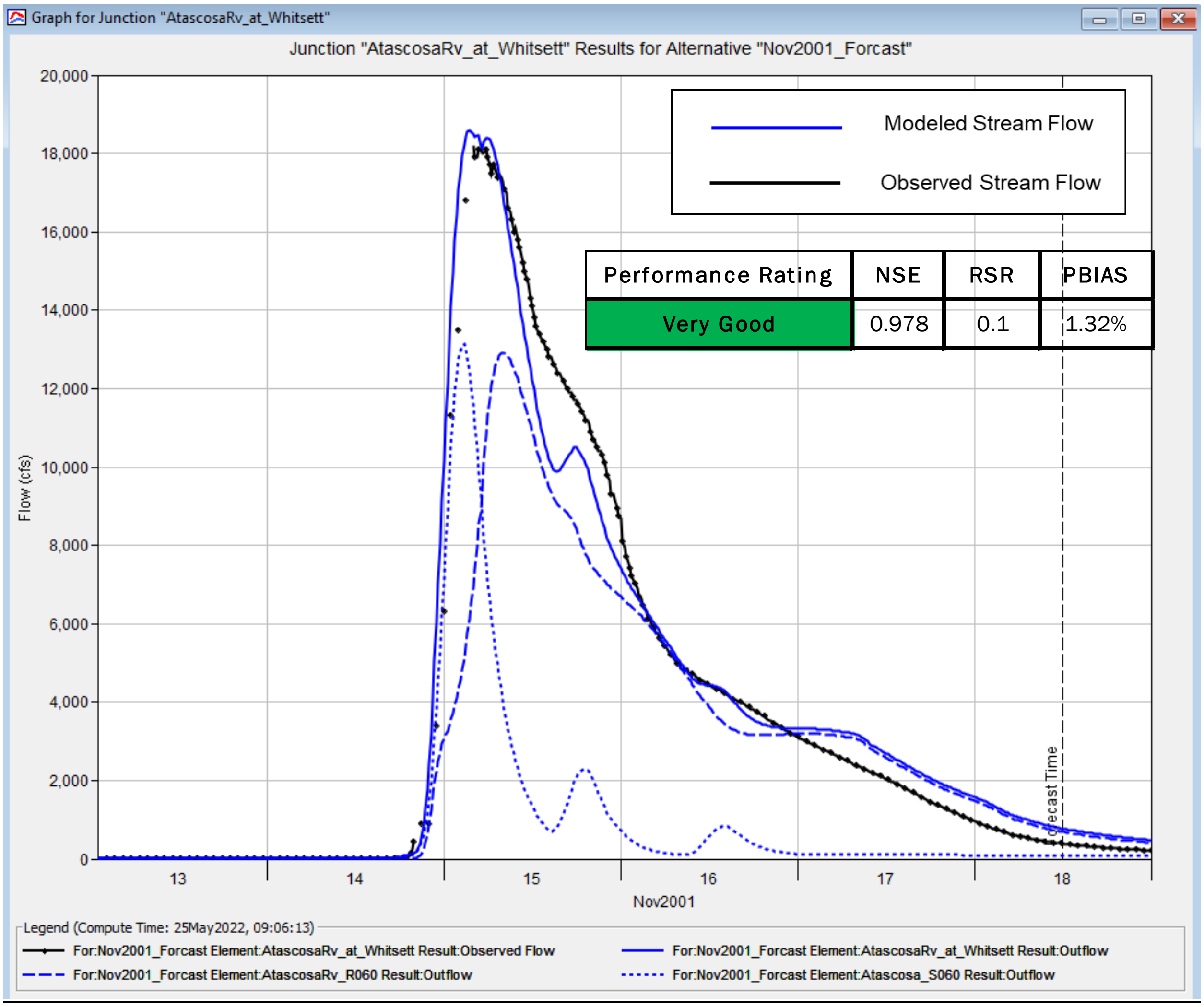


Figure B.59: November 2001 Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage achieved a “Very Good” performance rating for the November 2001 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The Atascosa River at Whitsett plot is shown above.

1.4.4.5 July 2002 Event

The July 2002 event was an entire Nueces River Basin flood. Calibration on the Nueces River ended at the Nueces River near Callen gage. For this flood event, the HEC-HMS model simulation period was June 29 thru August 10. This event has multiple individual storms occurring over several days.

The Southern Texas Palmer Drought Severity Index (PDSI) was severe drought (-3.00 to -3.99) in June 2002. Southern Texas Palmer Z-index was moderate drought (-1.25 to -1.99) in June 2002.

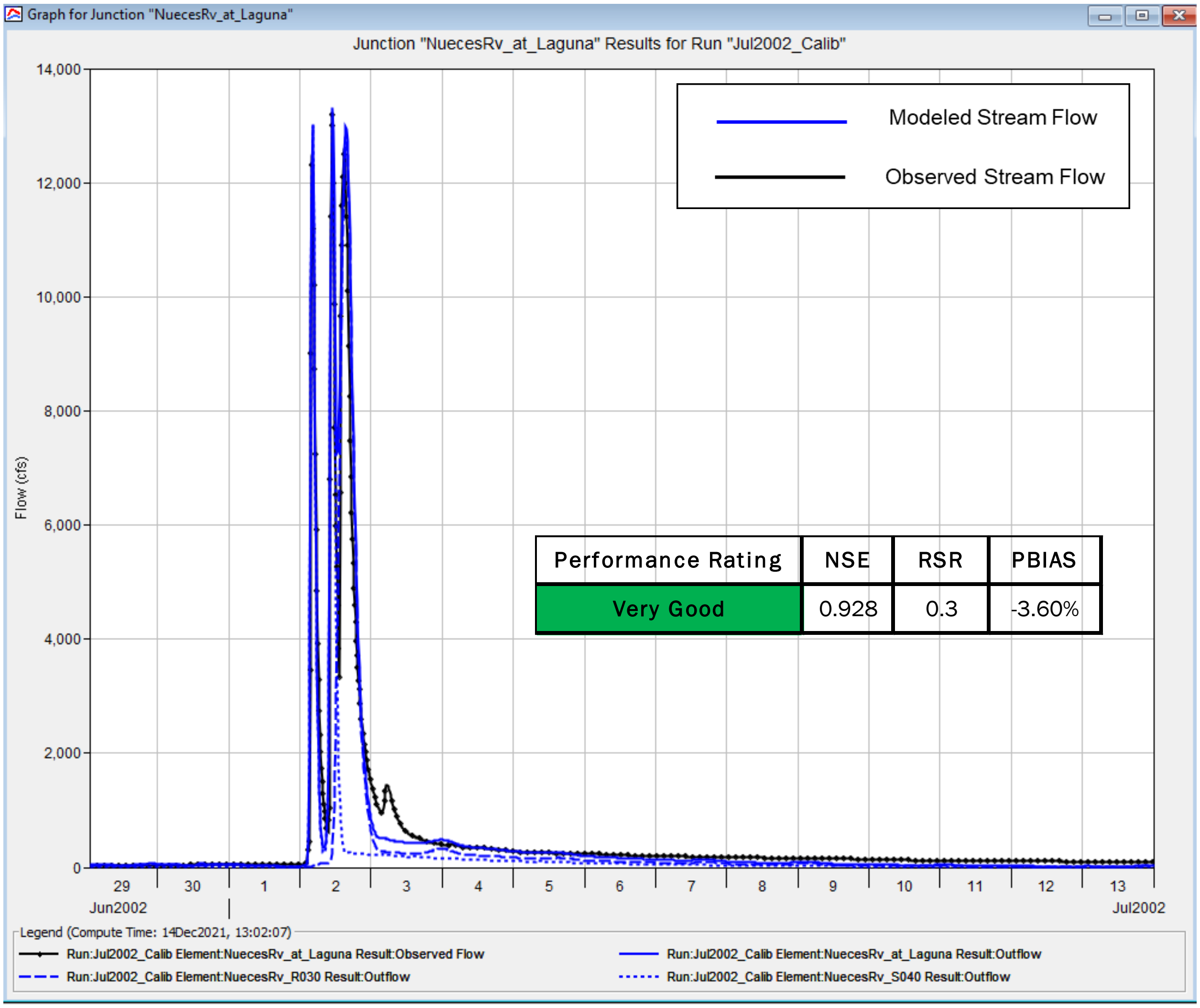


Figure B.60: July 2002 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The Nueces River at Laguna plot is shown above.

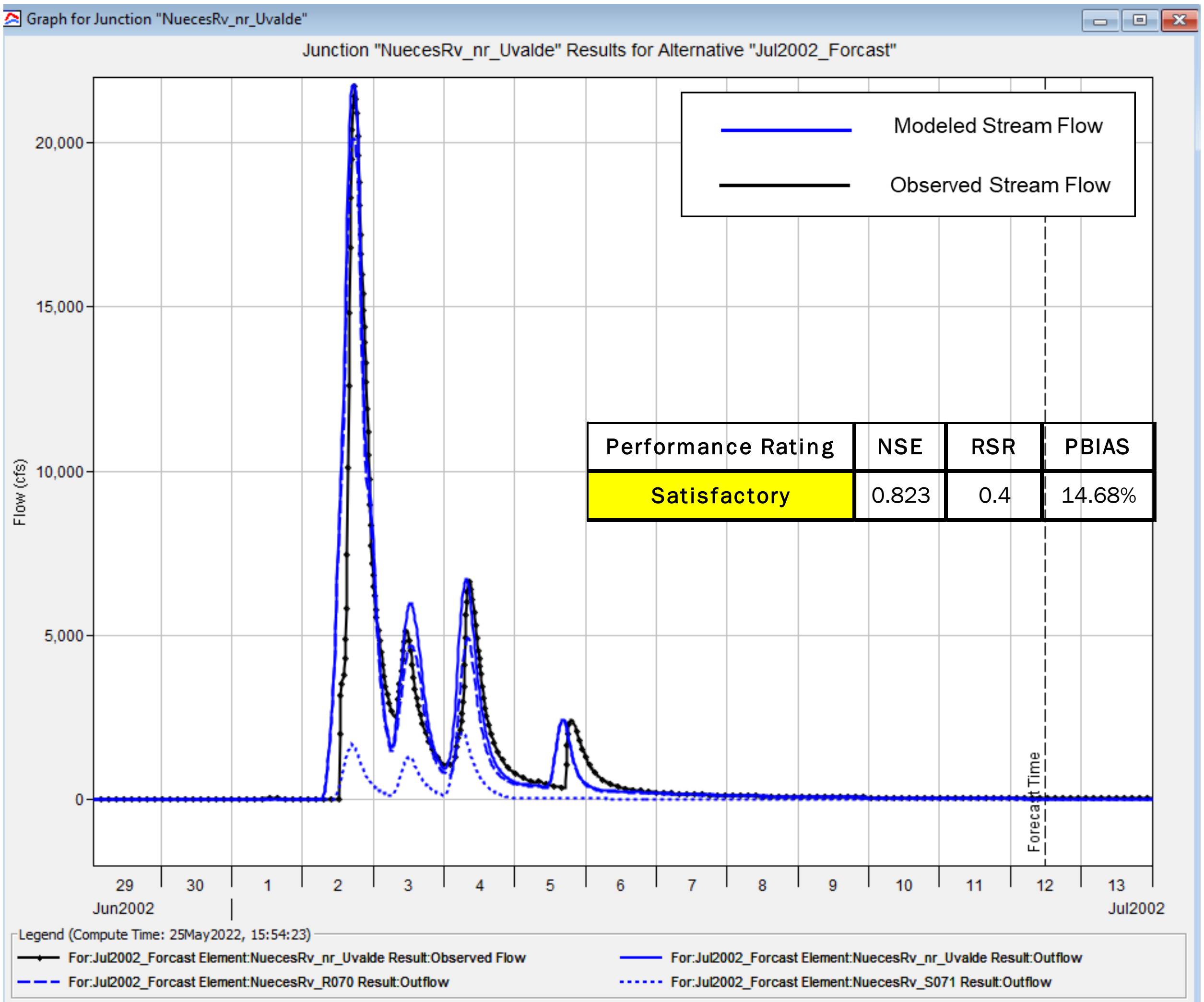


Figure B.61: July 2002 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde gage achieved a "Satisfactory" performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph very well. The overall runoff volume was just a bit high, as reflected in the percent bias. The Nueces River below Uvalde plot is shown above.

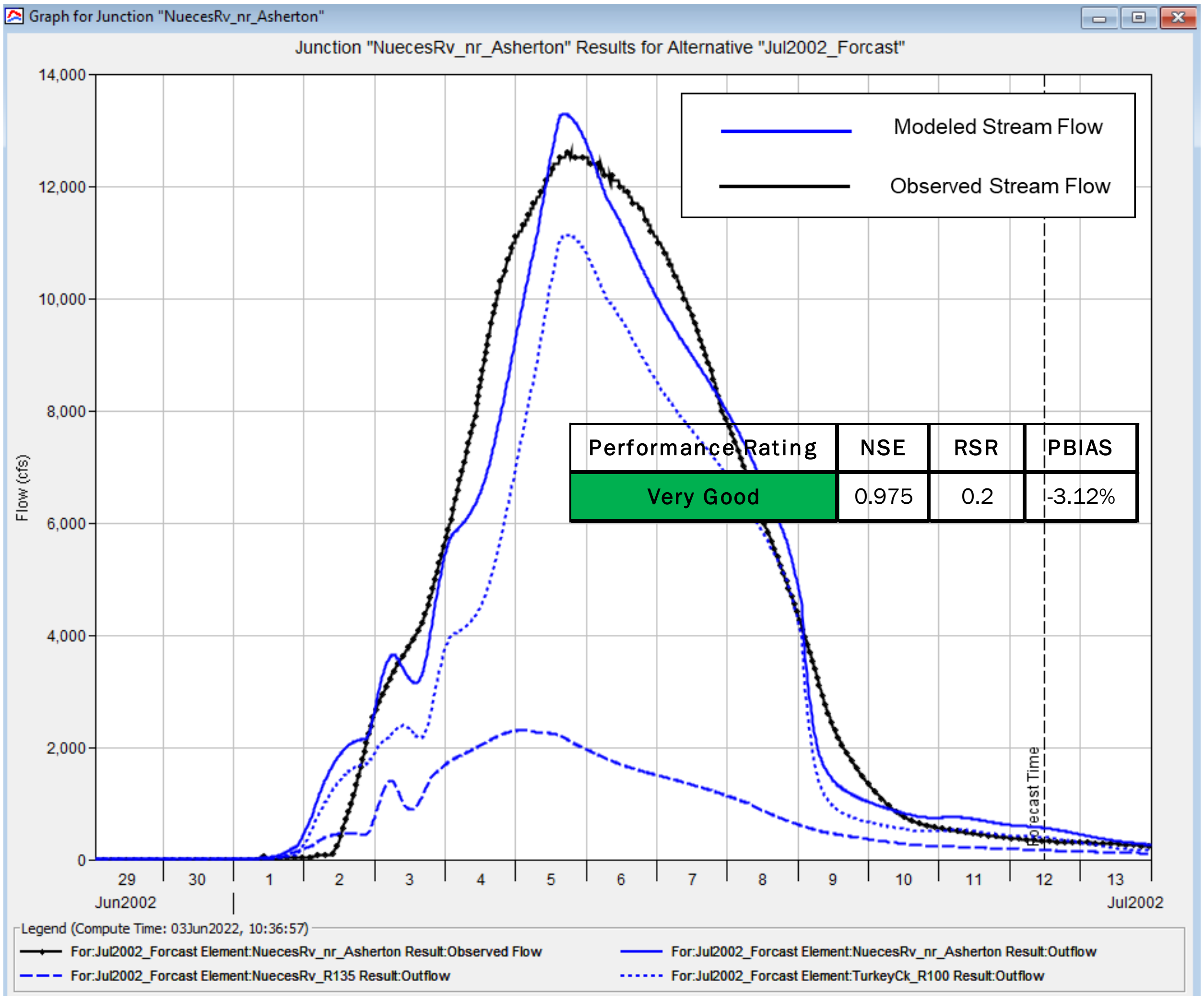
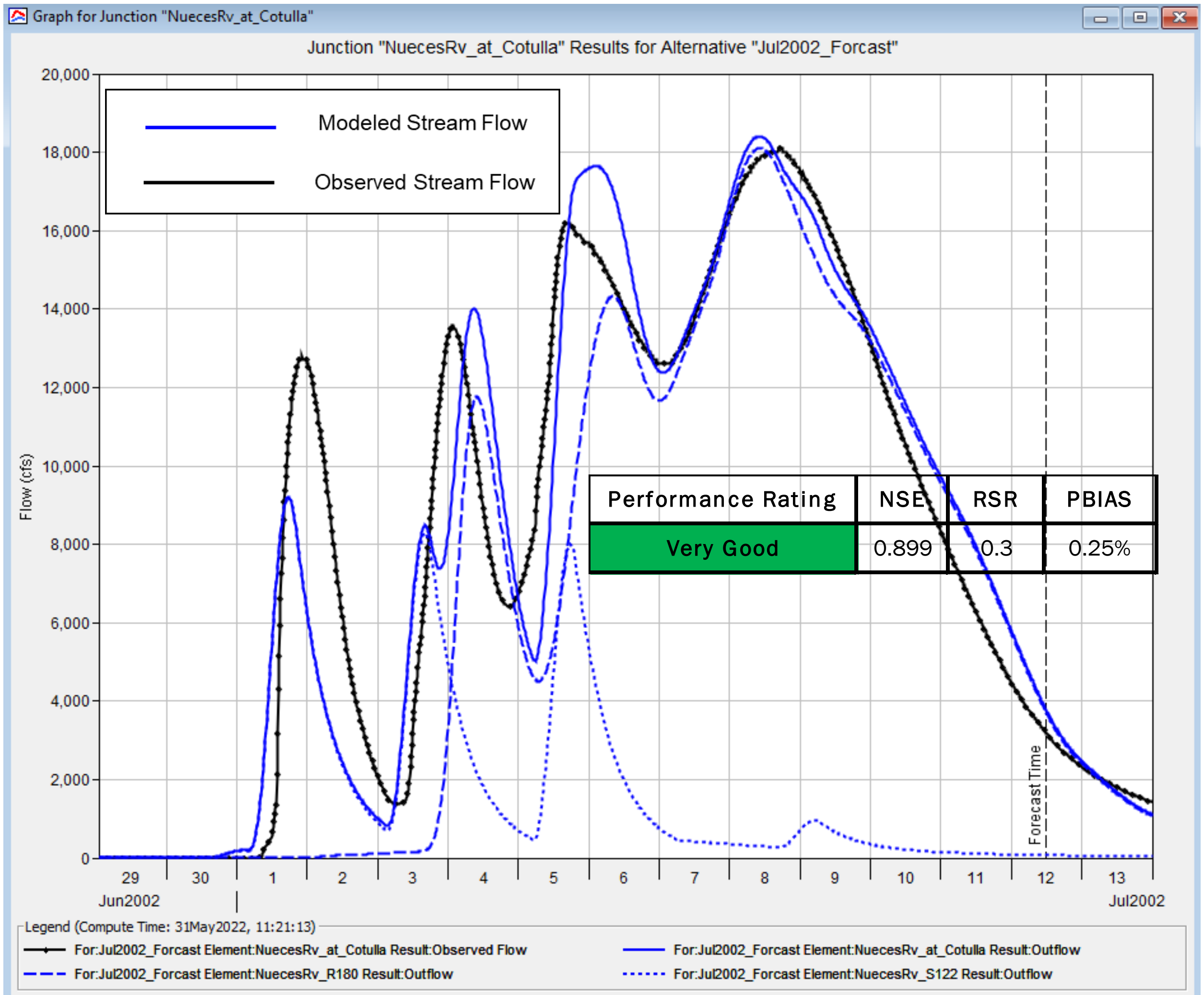


Figure B.62: July 2002 Calibration Results for Nueces River near Asherton USGS Gage

The Nueces River near Asherton gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The split flow between the Nueces River and Espantosa Slough/Soldier Slough starting near the town of Crystal City to just upstream of the Nueces River near Asherton gage (State Hwy 190) was calibrated using a diversion element with an Inflow-Diversion Function that was estimated with 2D HEC-RAS. Modified Puls routing data was also developed from the 2D HEC-RAS model for the Nueces River and Espantosa Slough/Soldier Slough reaches. The channel loss fractions were increased to match the observed flow volume at Asherton. The final Nueces River near Asherton plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.899	0.3	0.25%

Figure B.63: July 2002 Calibration Results for Nueces River at Cotulla USGS Gage

The Nueces River at Cotulla gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph fairly well. The July 2002 event has multiple individual storms occurring over several days. Since it was difficult to match all the peaks with a single set of loss rates, the calibration focused on the largest peak in the event. The Nueces River at Cotulla plot is shown above.

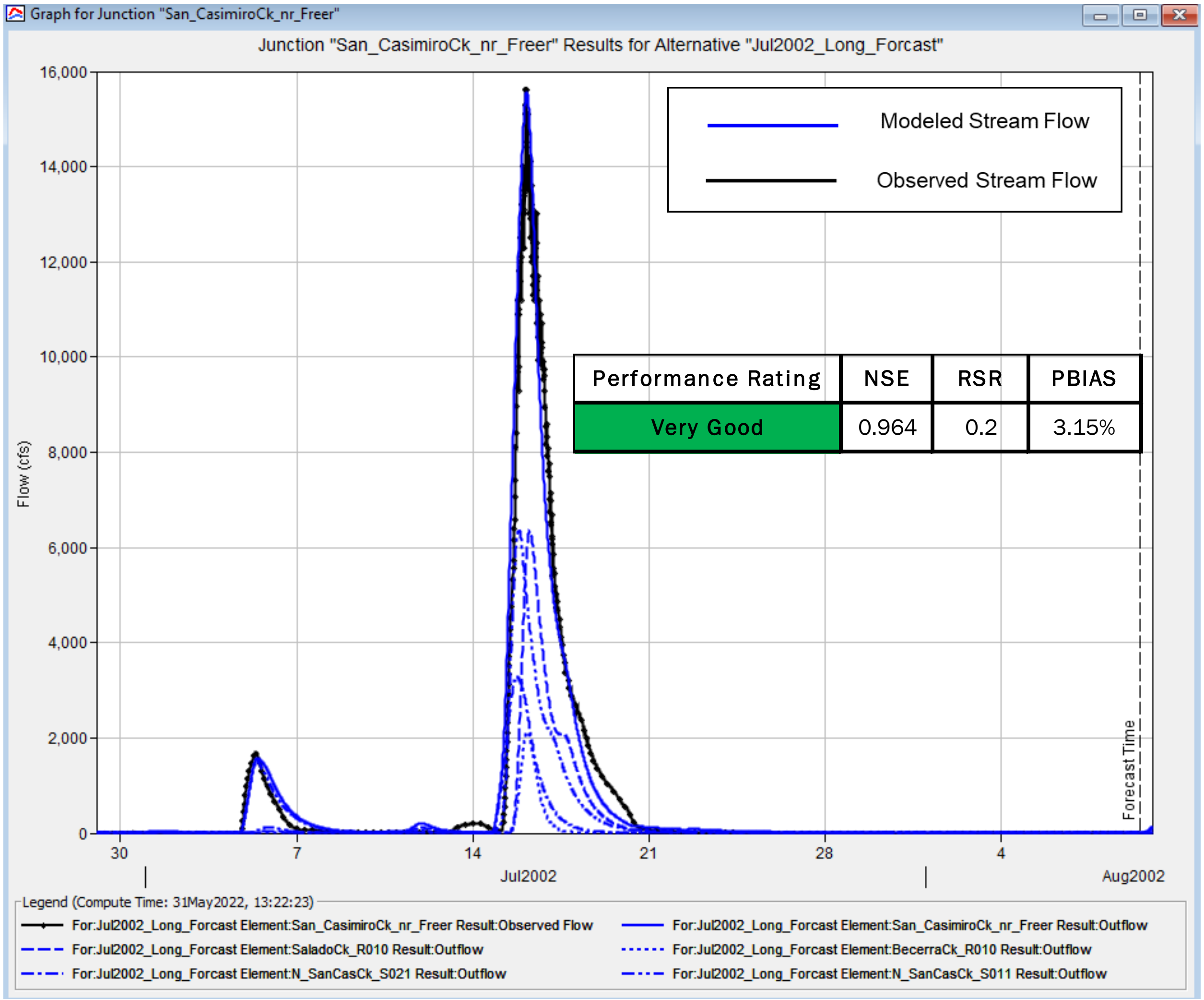


Figure B.64: July 2002 Calibration Results for San Casimiro Creek near Freer USGS Gage

The San Casimiro Creek near Freer gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. Unlike the previous calibration event at this gage, there is no late second peak in the observed data, which indicates that the multiple dams upstream of the Freer gage likely did not spill for this event. The San Casimiro Creek near Freer plot is shown above.

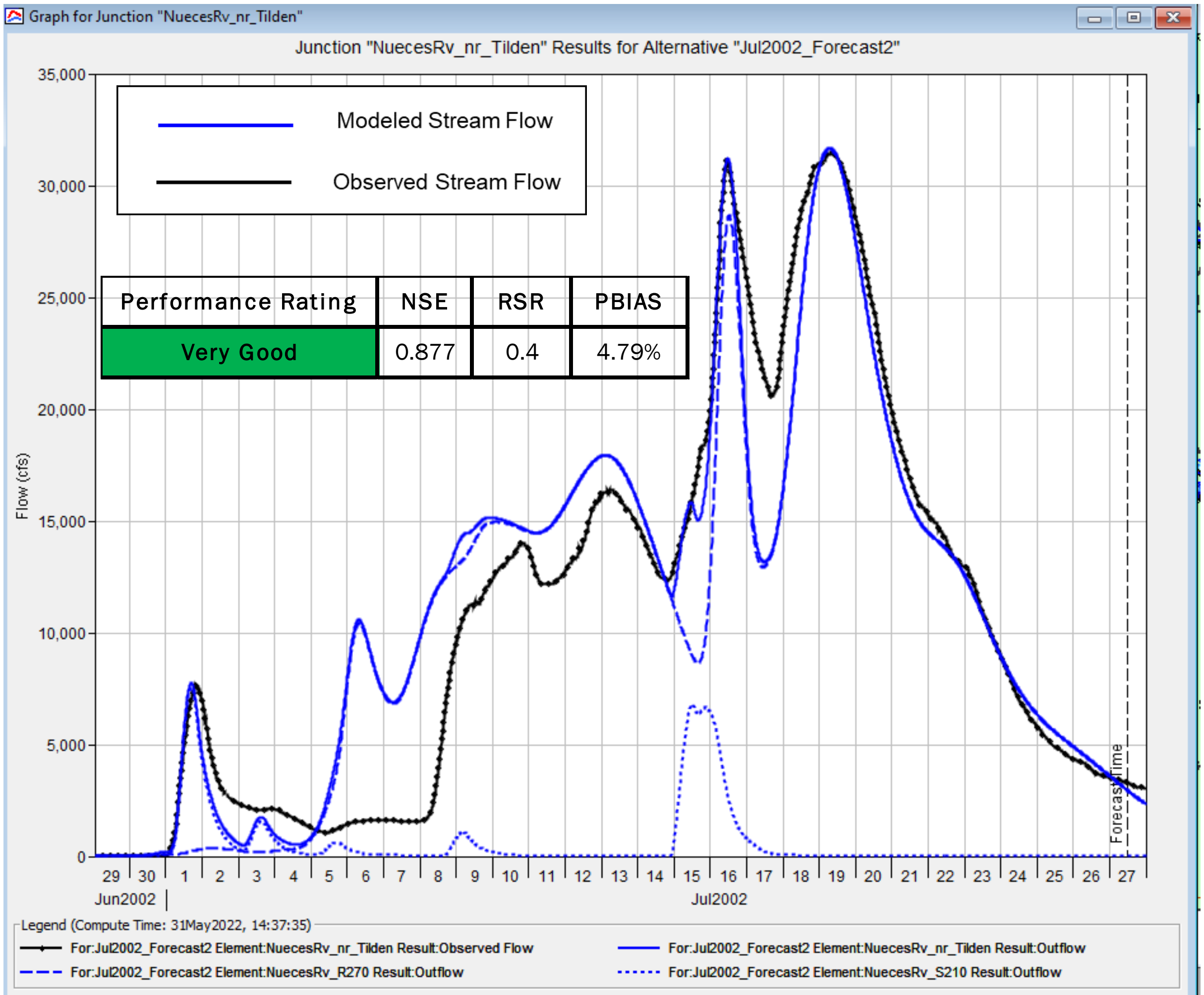
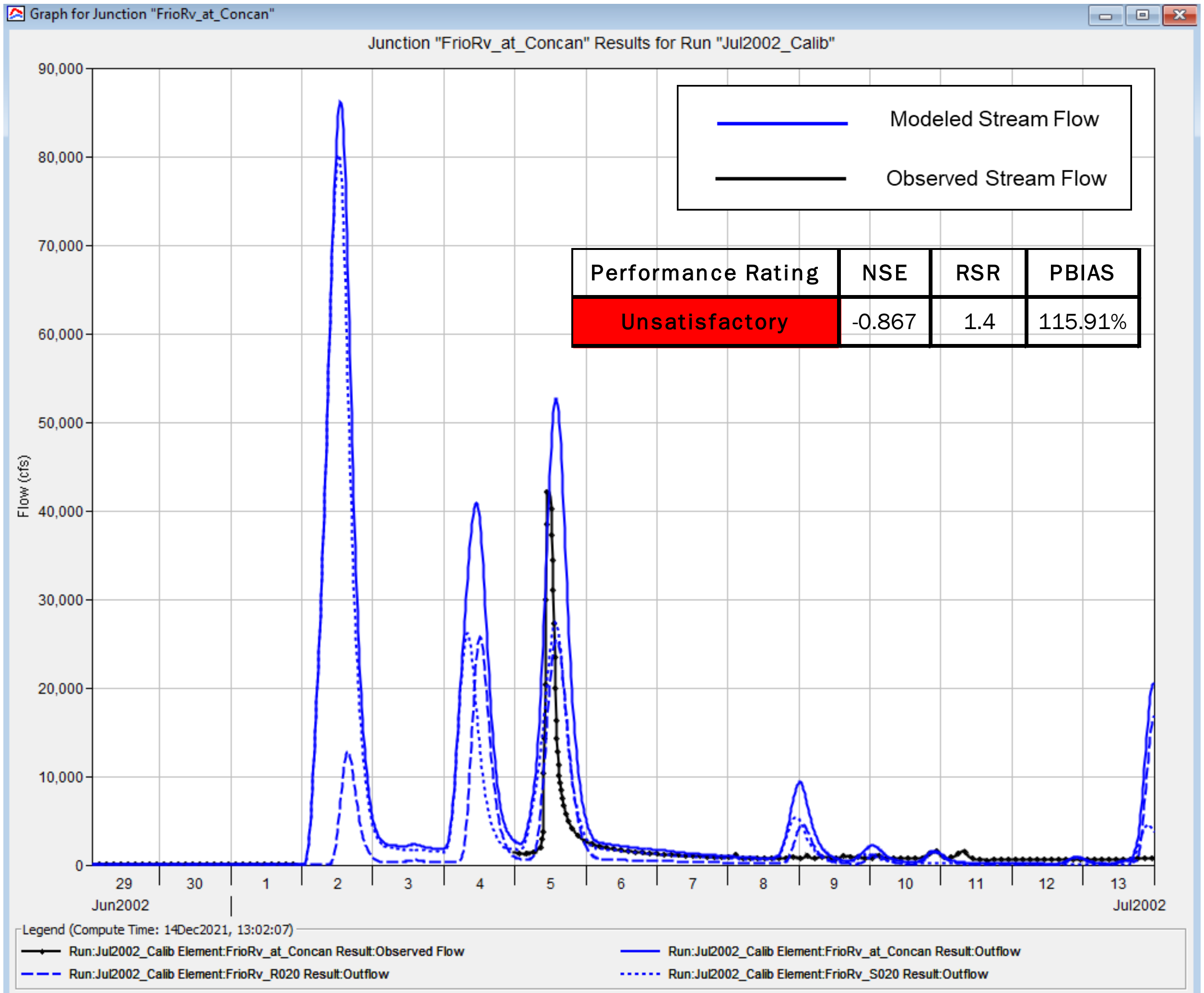


Figure B.65: July 2002 Calibration Results for Nueces River near Tilden USGS Gage

The Nueces River near Tilden gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the largest peaks in the observed hydrograph very well. The July 2002 event has multiple individual storms occurring over several days. Since it is extremely difficult to match all peaks with a single set of loss rates, the calibration focused on the largest peaks in the event. The Nueces River near Tilden plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Unsatisfactory	-0.867	1.4	115.91%

Figure B.66: July 2002 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan gage achieved an “Unsatisfactory” performance rating for the July 2002 event. The HEC-HMS model matched the timing and shape of the partial observed hydrograph fairly well, but the observed hydrograph was missing for a major portion of this event. The Frio River at Concan gage peaked on July 2, 2002, at 119,000 cfs with time of peak unknown. The HEC-HMS model could not match observed peak magnitude because of too low precipitation and or intensity. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

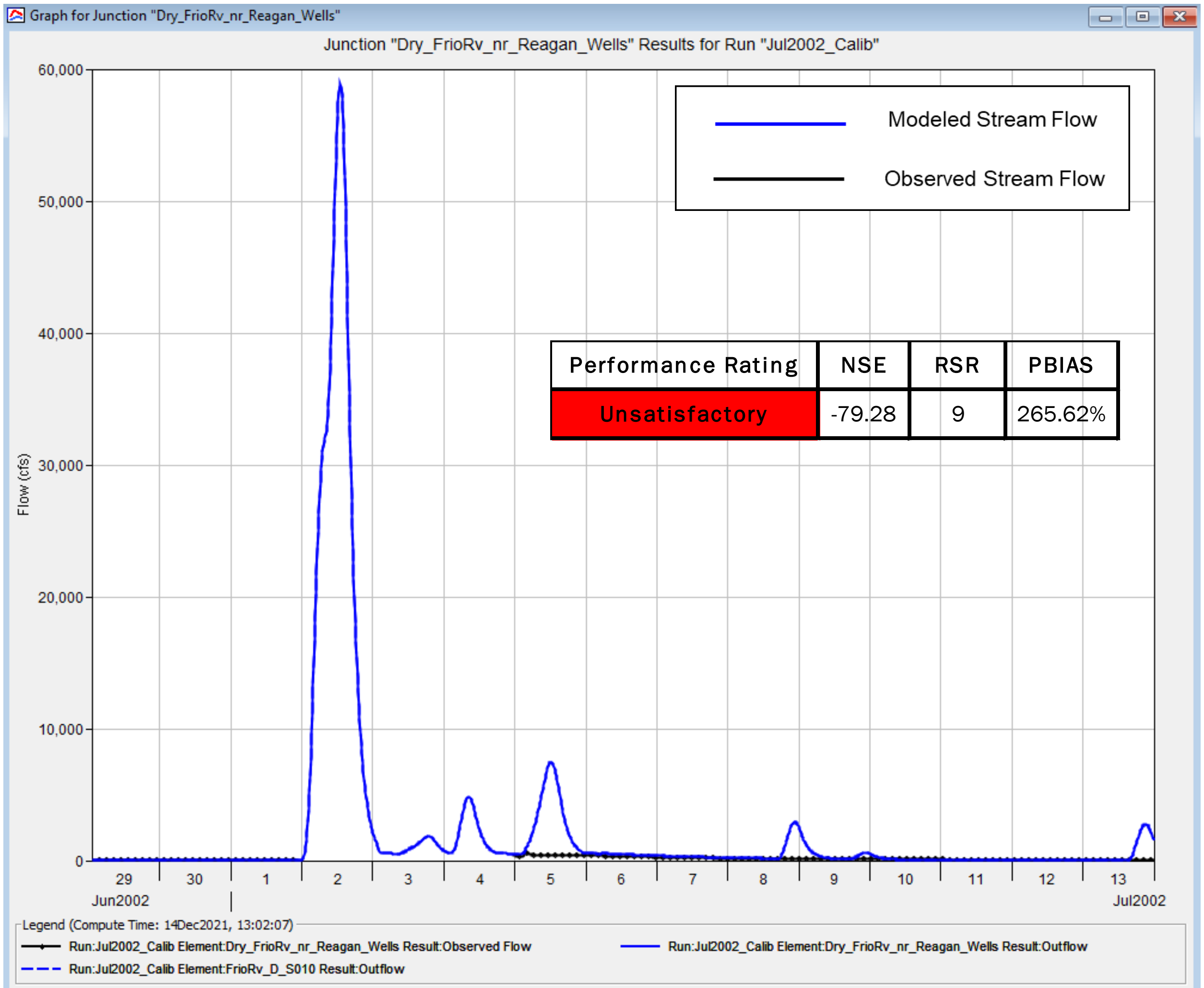


Figure B.67: July 2002 Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Dry Frio River near Reagan Wells observed hydrograph was missing. Only the peak discharge was available. From a high water mark, the USGS estimated that the Dry Frio River near Reagan Wells gage peaked on July 2, 2002, at 97,900 cfs with time of peak unknown. The HEC-HMS model could not match observed peak because of too low precipitation and or intensity. The Dry Frio River near Reagan Wells plot is shown above. The unsatisfactory performance rating was largely due to missing observed data and does not accurately reflect the quality of the calibration.

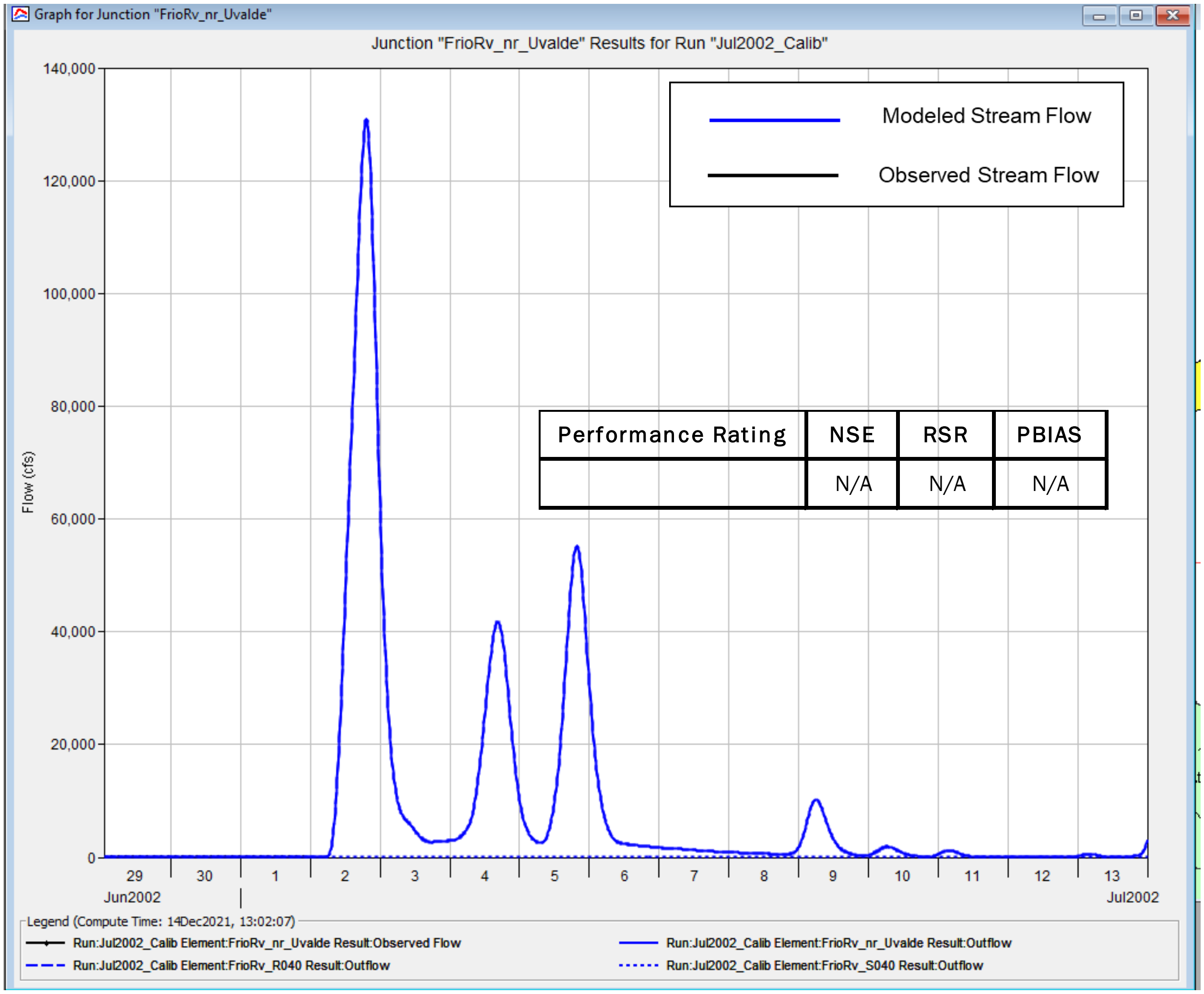


Figure B.68: July 2002 Calibration Results for Frio River below Dry Frio near Uvalde USGS Gage

The Frio River below Dry Frio near Uvalde observed hydrograph was missing. Only the peak discharge was available. From a high water mark, the USGS estimated that the Frio River below Dry Frio near Uvalde gage peaked on July 2, 2002, at 189,000 cfs with the time of peak unknown. The HEC-HMS model could not match the observed peak magnitude because of too low precipitation and or intensity above the upstream gages. The Frio River below Dry Frio near Uvalde plot is shown above. The unsatisfactory performance rating was due to missing observed data and does not accurately reflect the quality of the calibration.

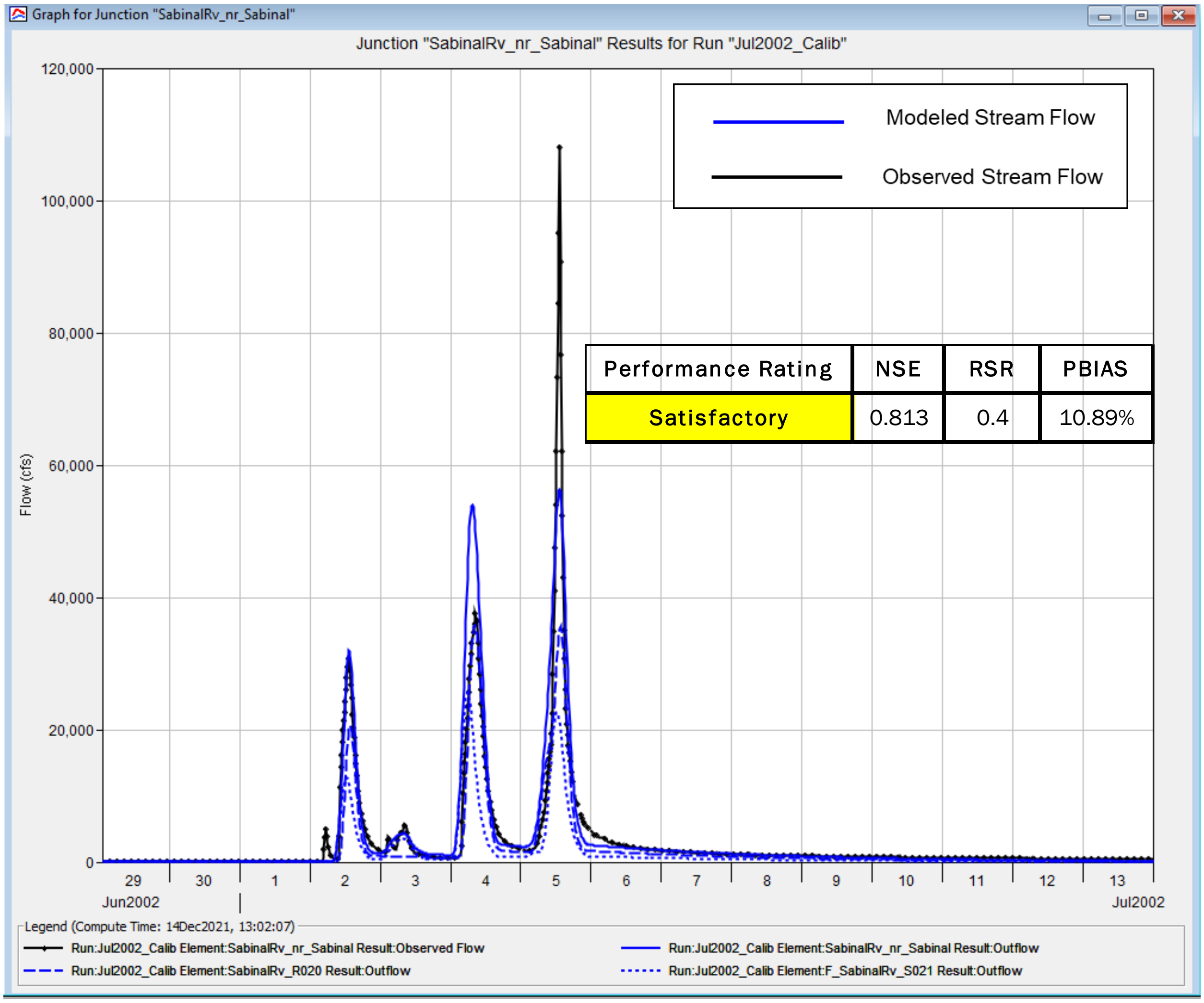
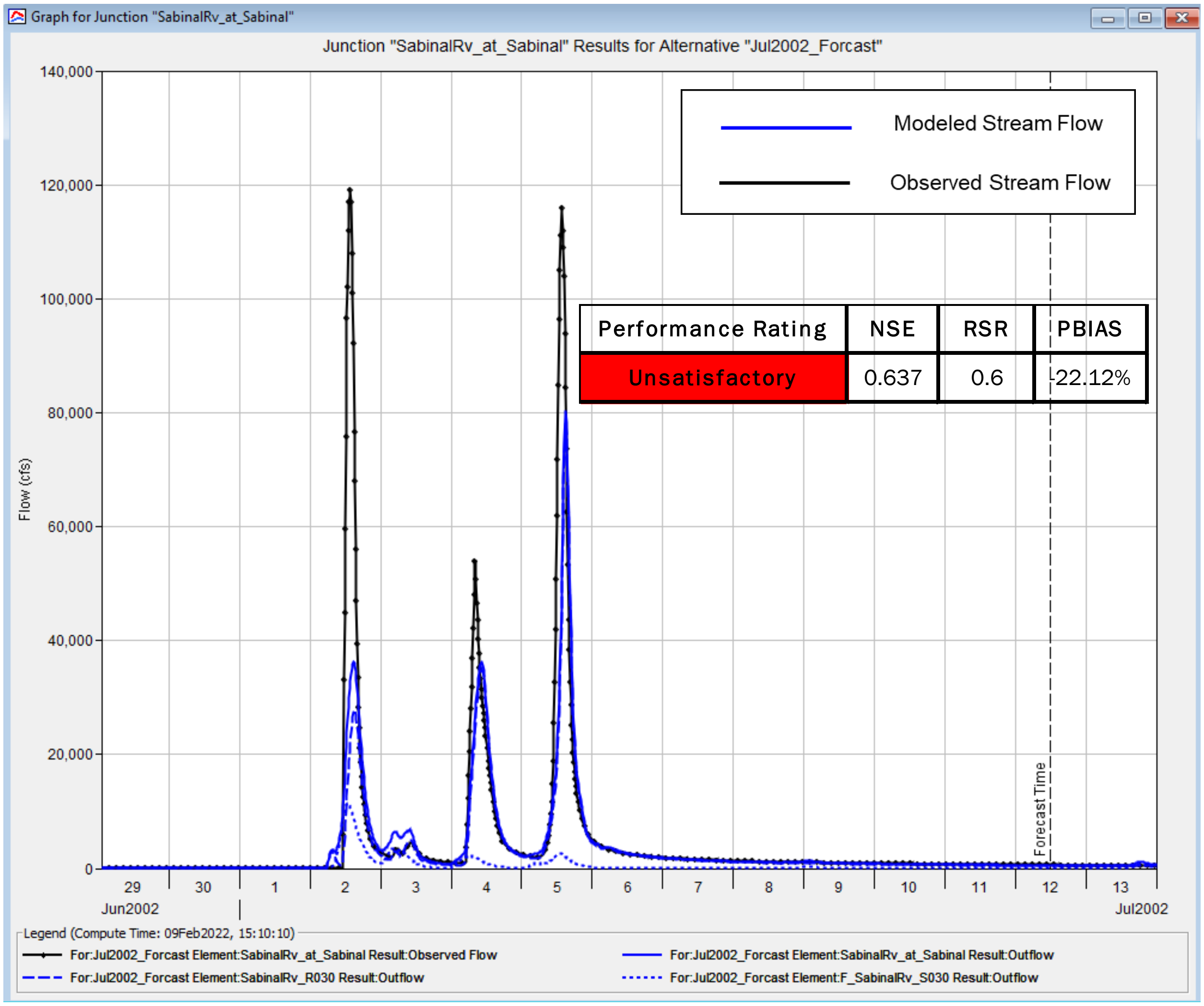


Figure B.69: July 2002 Calibration Results for Sabinal River near Sabinal USGS Gage

The Sabinal River near Sabinal gage achieved a "Satisfactory" performance rating for the July 2002 event. The HEC-HMS model matched the timing and shape of the some of the peaks in the observed hydrograph fairly well, but the overall flow volume was a bit high, as reflected in the percent bias. The HEC-HMS model could not match the peak on July 5th even if the constant loss rate was set to zero. Most likely the precipitation and or intensity was too low on July 5, 2002. The Sabinal River near Sabinal plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Unsatisfactory	0.637	0.6	-22.12%

Figure B.70: July 2002 Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River at Sabinal gage achieved an “Unsatisfactory” performance rating for the July 2002 event. The HEC-HMS model matched the timing and shape of the observed hydrograph fairly well, but the peak magnitudes and overall flow volume were too low. The Sabinal River at Sabinal gage peaked on July 2, 2002, at 119,000 cfs at stage 39.0 ft. The peak discharge was estimated by extending the rating curve above an indirect measurement of 71,000 cfs. The HEC-HMS model could not match the peak on July 2th even if the loss rates were set to zero. Most likely the precipitation data and/or intensity was too low on July 2, 2002. The Sabinal River at Sabinal plot is shown above.

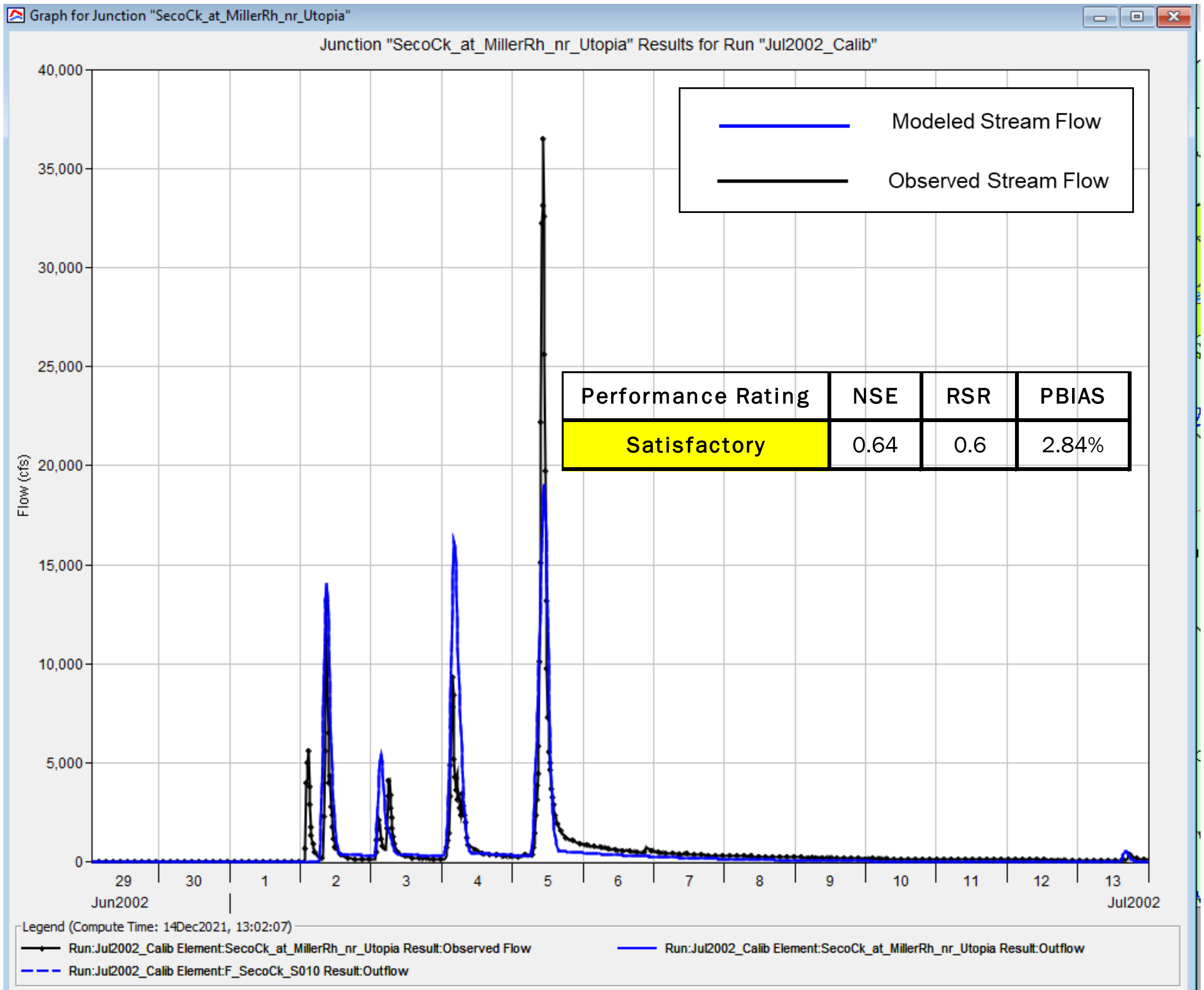


Figure B.71: July 2002 Calibration Results for Seco Creek at Miller Ranch near Utopia USGS Gage

The Seco Creek at Miller Ranch near Utopia gage achieved a “Satisfactory” performance rating for the July 2002 event. The HEC-HMS model matched the timing and shape of the observed hydrograph fairly well, but the peak magnitude was too low. The HEC-HMS model could not match the observed peak on July 5, 2002 even if the loss rates were set to zero, because of the precipitation data being too low in depth and/or intensity. The Seco Creek at Miller Ranch near Utopia plot is shown above.

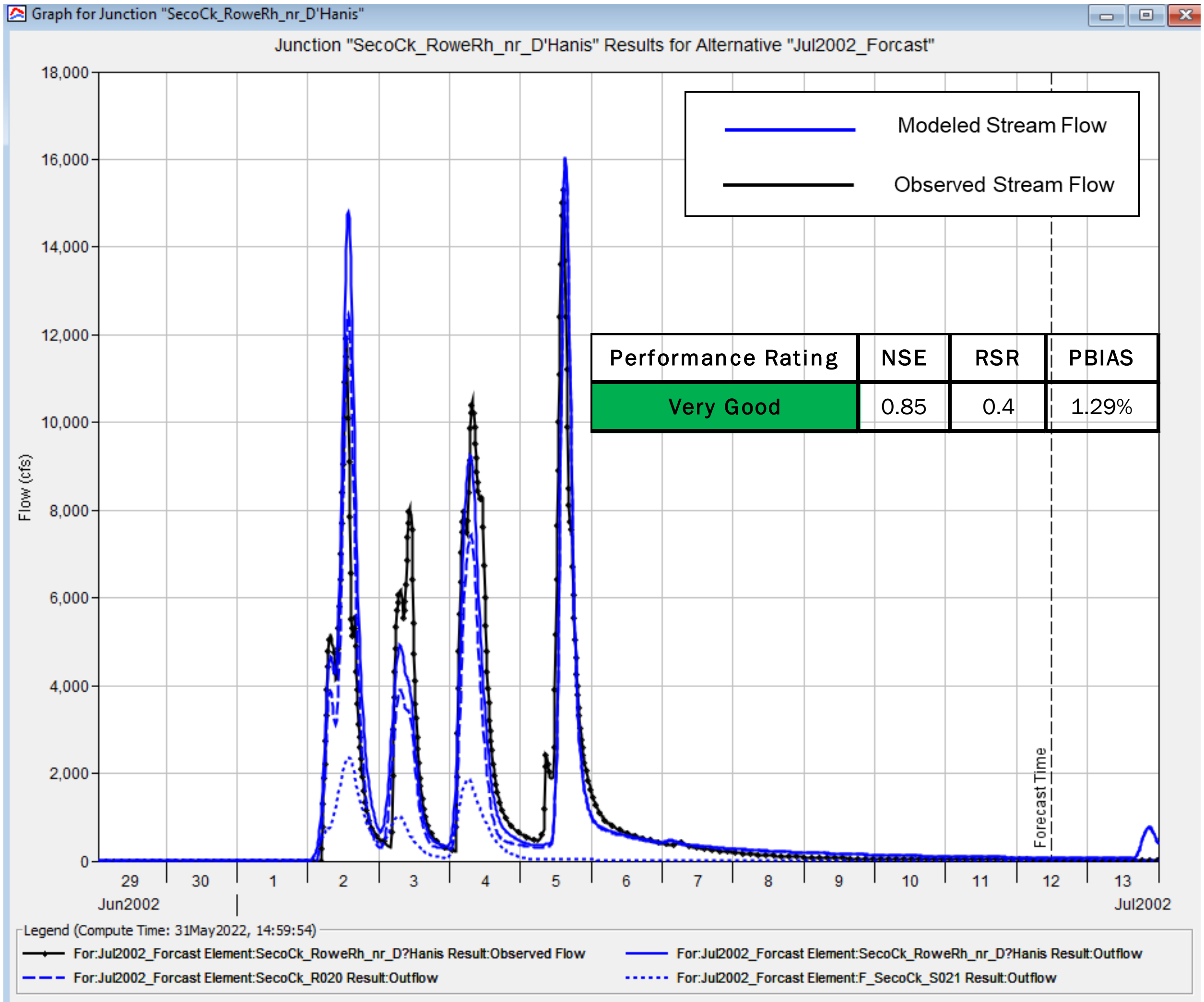


Figure B.72: July 2002 Calibration Results for Seco Creek at Rowe Ranch near D'Hanis USGS Gage

The Seco Creek at Rowe Ranch near D'Hanis gage achieved a "Very Good" performance rating for the July 2002 event. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph fairly well. Forecast blending of the observed data at the upstream gage was used to prevent upstream errors from propagating downstream. The Seco Creek at Rowe Ranch near D'Hanis plot is shown above.

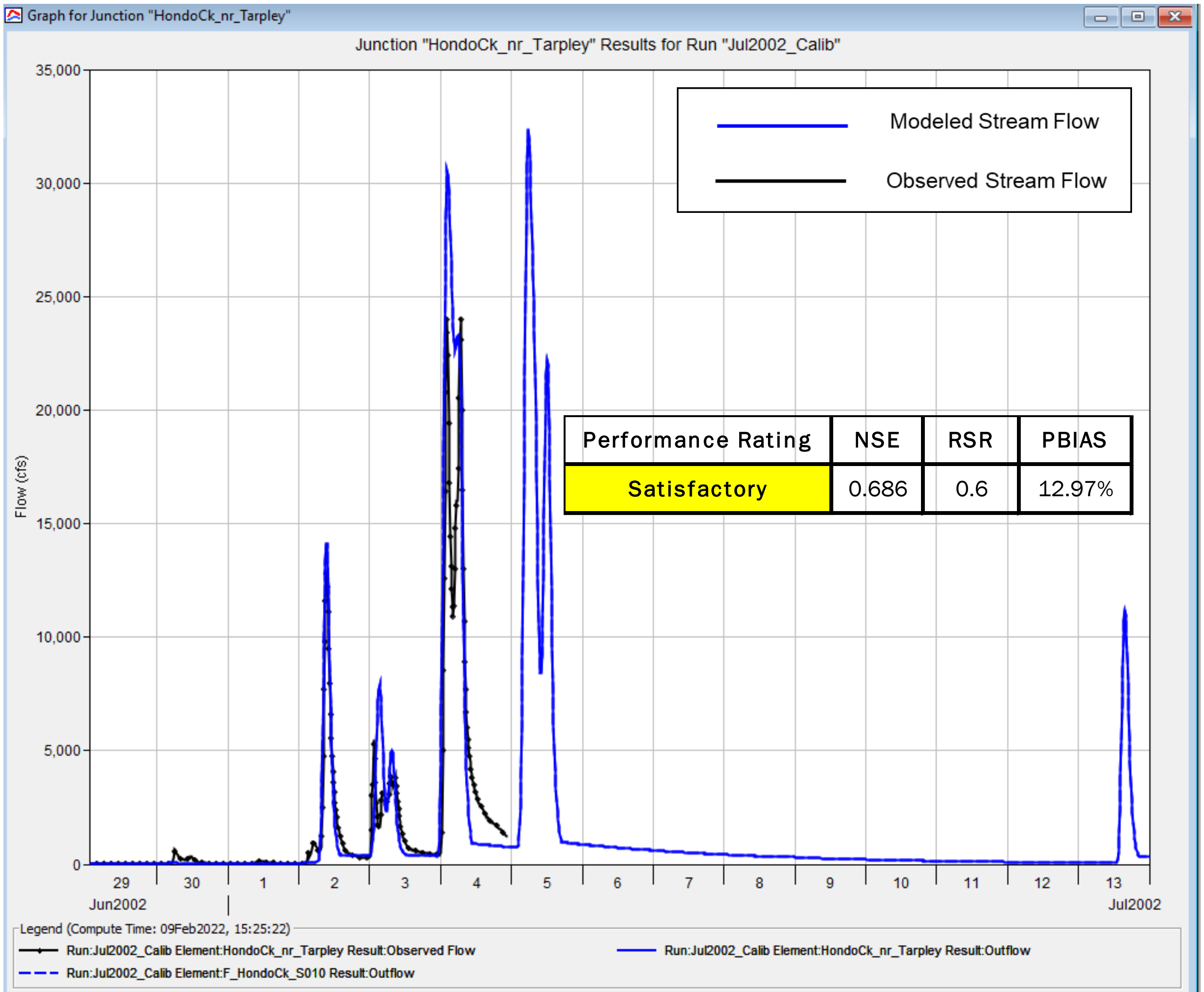


Figure B.73: July 2002 Calibration Results for Hondo Creek near Tarpley USGS Gage

The Hondo Creek near Tarpley gage achieved a “Satisfactory” performance rating for the July 2002 event. The HEC-HMS model matched the timing and shape of the observed hydrograph fairly well, but the observed hydrograph was missing after July 4, 2002. From a high water mark, the USGS estimated that the gage peaked on July 5, 2002, at 55,300 cfs at stage of 25.30 ft with a time of peak unknown. The HEC-HMS model could not match the peak on July 5, 2002 even if the loss rates were set to zero. This indicates that the precipitation data is too low in depth and/or intensity. The Hondo Creek near Tarpley plot is shown above.

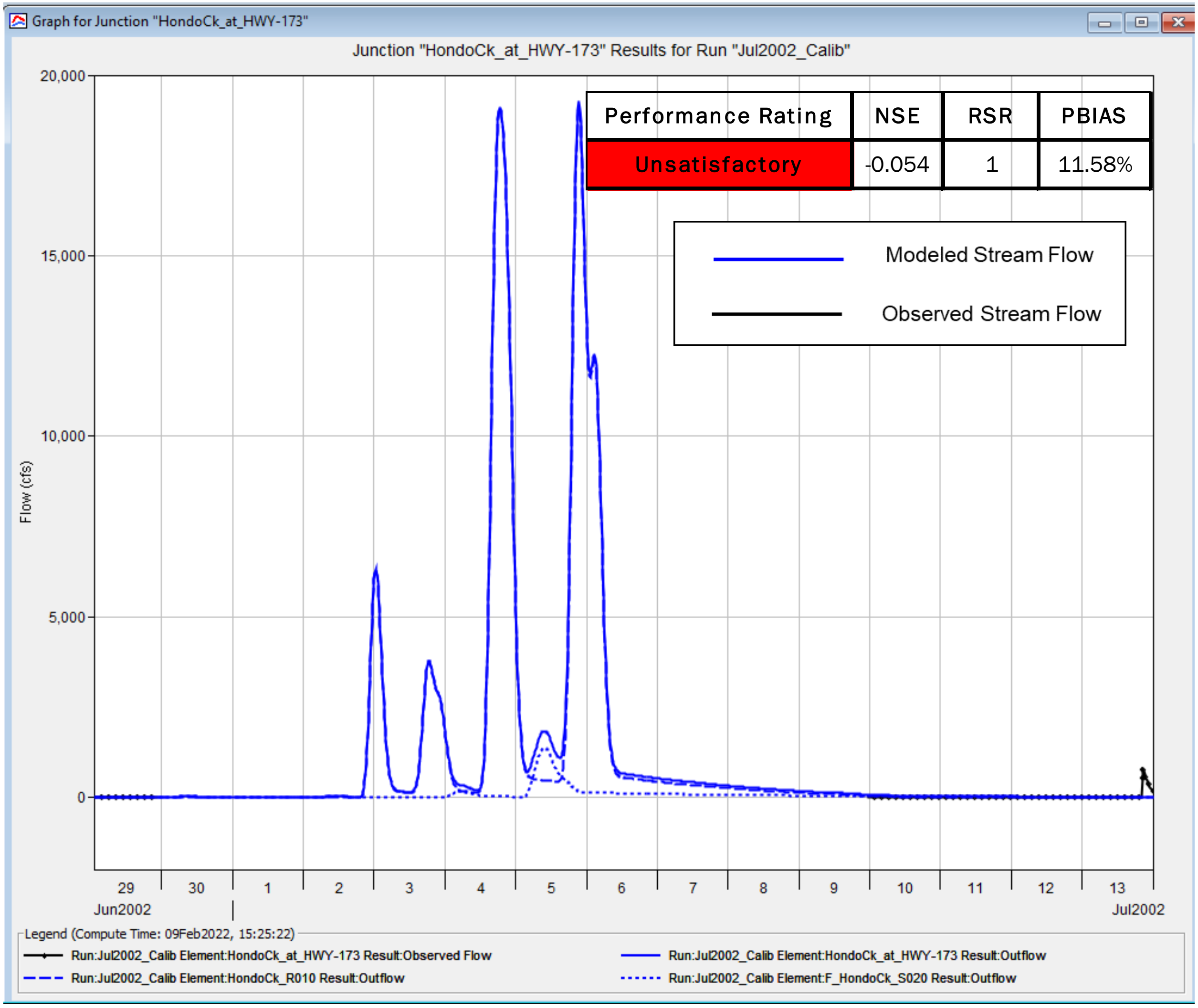


Figure B.74: July 2002 Calibration Results for Hondo Creek at King Waterhole near Hondo USGS Gage

The Hondo Creek at King Waterhole near Hondo gage achieved an "Unsatisfactory" performance rating for the July 2002 event. Only the peak discharge was available. The Hondo Creek at King Waterhole near Hondo gage peaked on July 5, 2002, at an estimated 31,600 cfs based on a high water mark with the time of peak unknown. The HEC-HMS model could not match the observed peak magnitude due to too low precipitation and or intensity above the Hondo Creek near Tarpley gage. The Hondo Creek at King Waterhole near Hondo plot is shown above.

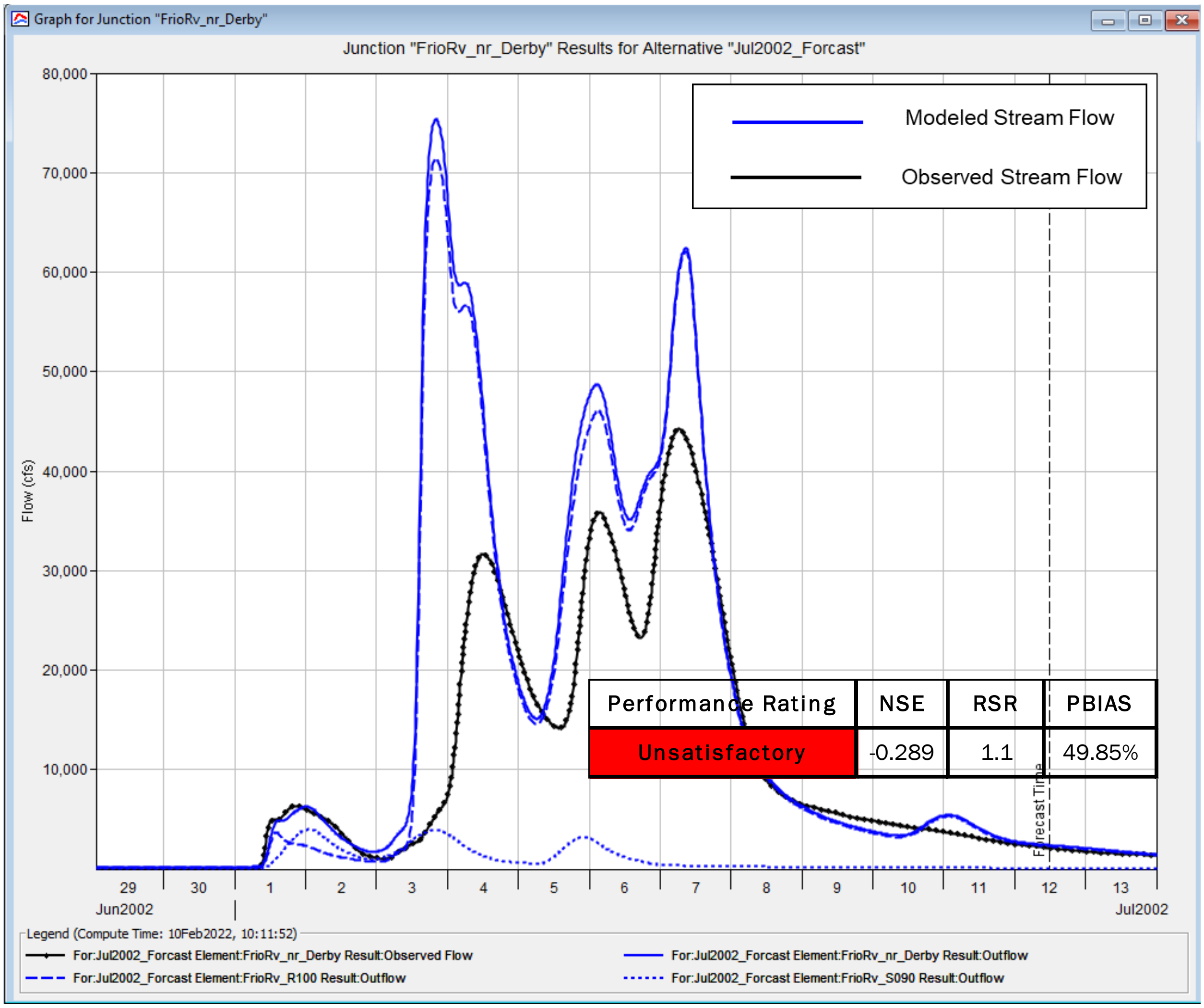


Figure B.75: July 2002 Calibration Results for Frio River near Derby USGS Gage

The Frio River near Derby gage achieved an "Unsatisfactory" performance rating for the July 2002 event. The HEC-HMS model had too much inflow volume in the central portions of the hydrograph. One major issue that contributed to this was that the observed hydrographs were missing for several upstream gages including the Frio River at Concan, Dry Frio River near Reagan Wells, Frio River below Dry Frio near Uvalde, Hondo Creek near Tarpley, and Hondo Creek at King Waterhole near Hondo. However, the model results matched the observed hydrograph well on the first early peak and on the recession limb starting on July 8th. The Frio River near Derby plot is shown above.

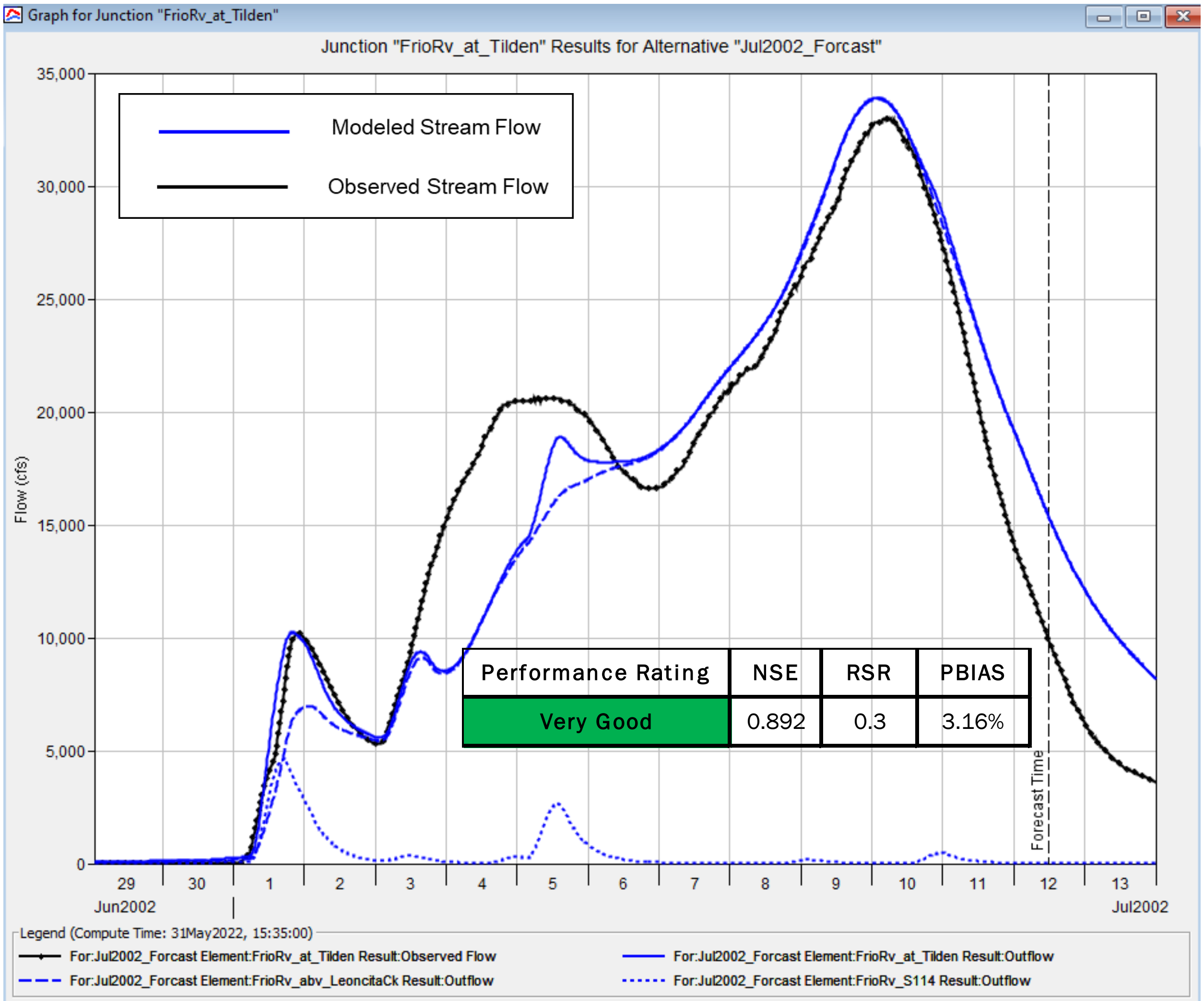


Figure B.76: July 2002 Calibration Results for Frio River at Tilden USGS Gage

The Frio River at Tilden gage achieved a "Very Good" performance rating for the July 2002 event. The HEC-HMS model matched the timing, shape, volume and magnitude of the observed hydrograph very well, particularly for the first and highest peaks. The observed data was blended in forecast mode at the upstream Frio River near Derby gage to keep the errors from propagating further downstream. The Frio River at Tilden plot is shown above.

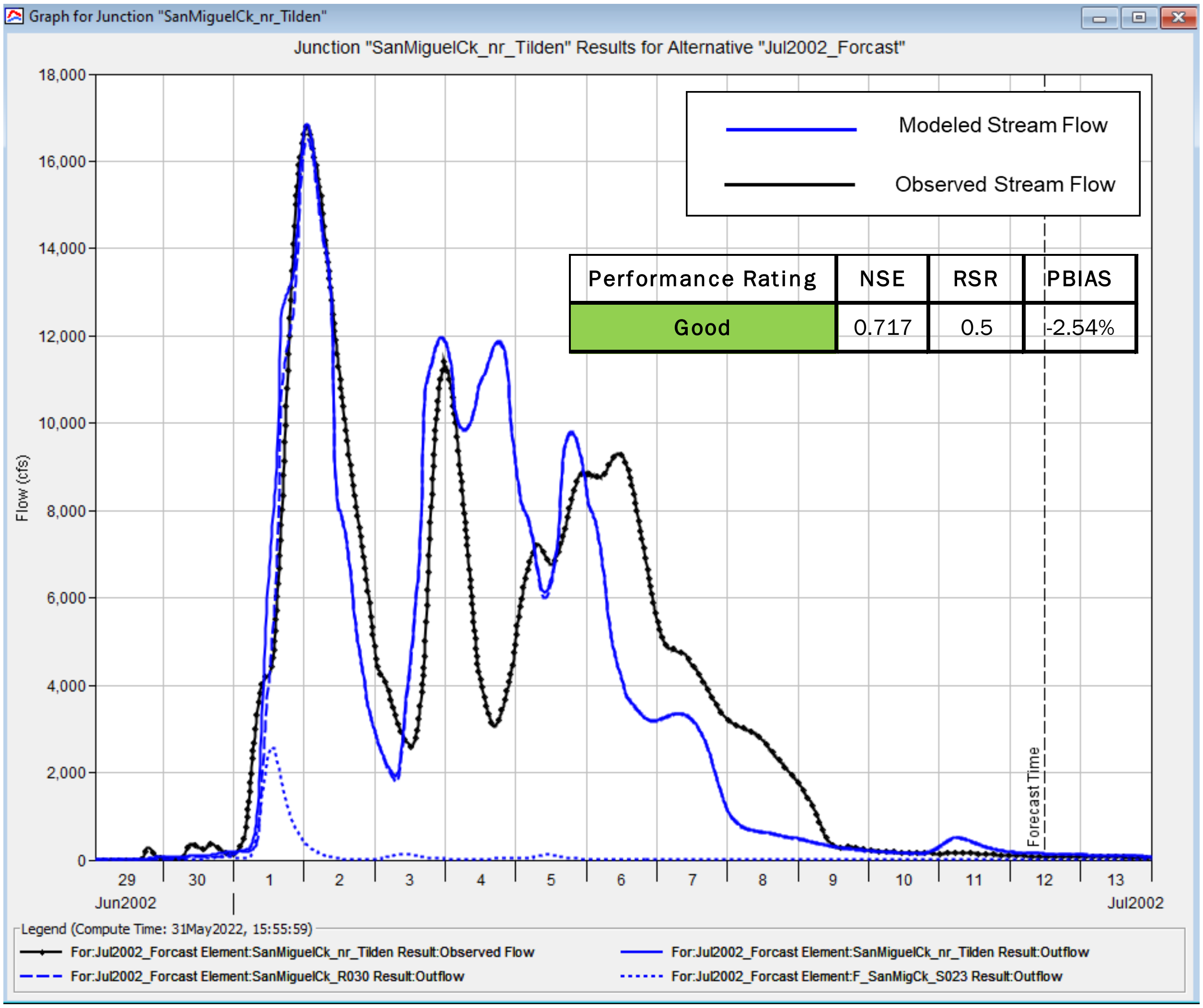


Figure B.77: July 2002 Calibration Results for San Miguel River near Tilden USGS Gage

The San Miguel River near Tilden gage achieved a "Good" performance rating for the July 2002 event. The HEC-HMS model matched the timing, shape, volume and magnitude of the observed hydrograph very well for the first peak, but the shape of the hydrograph was a bit off for the second and third peaks. The July 2002 event had multiple individual storms occurring over several days, and it is extremely difficult to match all the peaks with a single set of loss rates. The San Miguel River near Tilden plot is shown above.

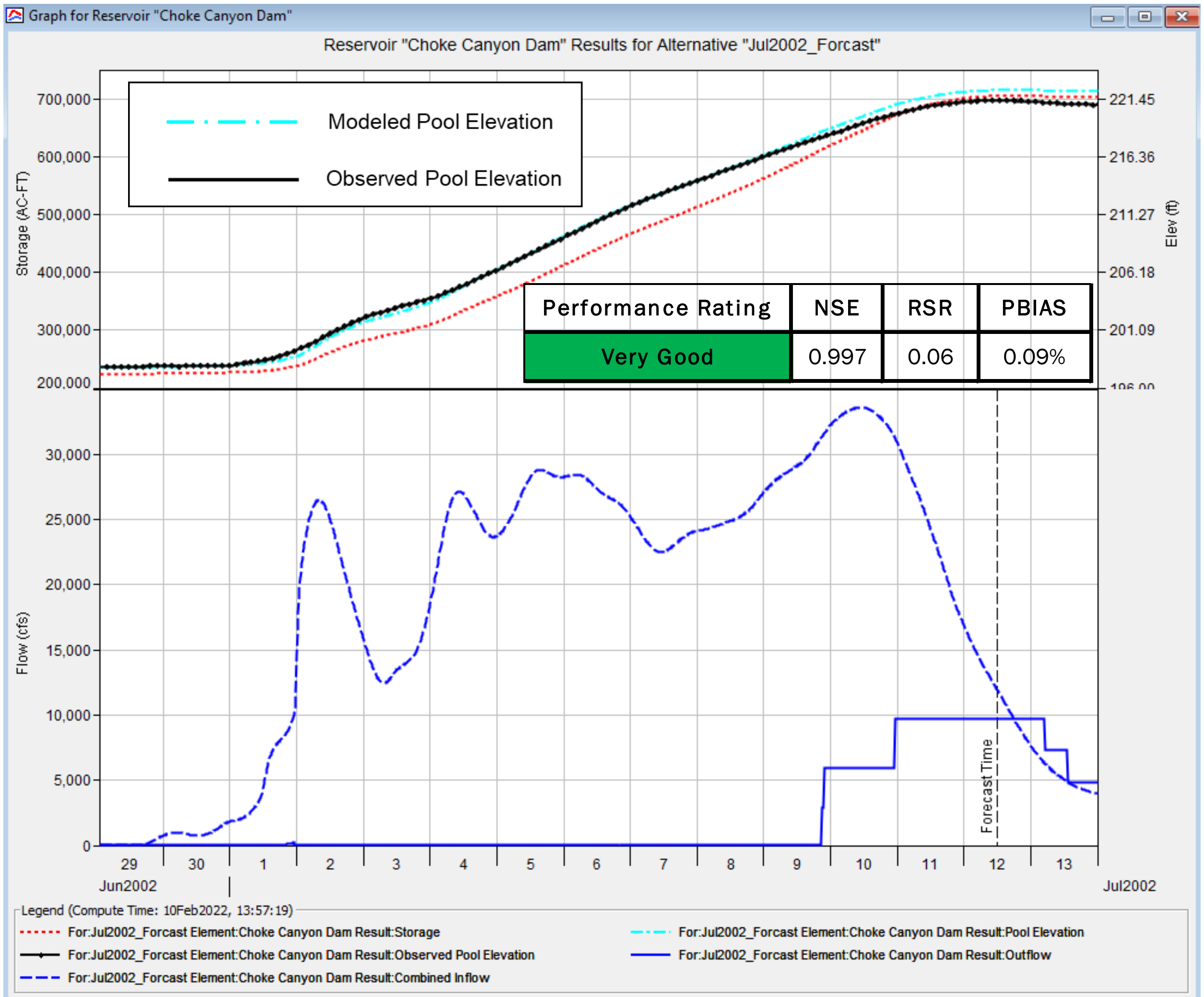


Figure B.78: July 2002 Calibration Results for Choke Canyon Reservoir

The Choke Canyon Reservoir gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the timing, shape, volume and magnitude of the observed pool rise very well. The Choke Canyon radial gate release information was obtained from gate logs supplied by the City of Corpus Christi. The Choke Canyon Reservoir plot is shown above.

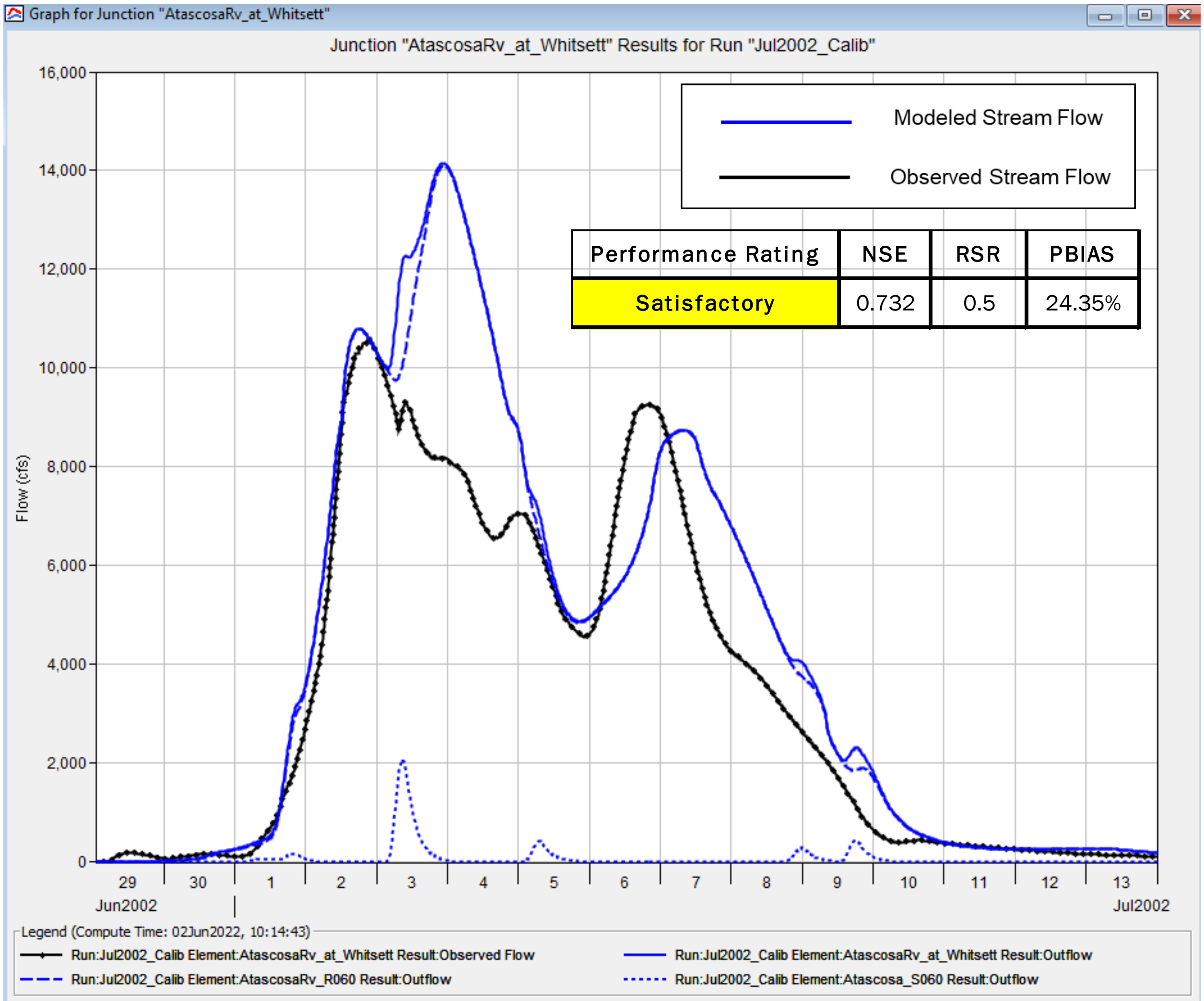


Figure B.79: July 2002 Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage achieved a “Satisfactory” performance rating for the July 2002 event. The HEC-HMS model matched the timing, shape and magnitude of the first peak of observed hydrograph very well, but it had too much runoff volume on July 3-4. The July 2002 event has multiple individual storms occurring over several days. It is extremely difficult to match all peaks with a single set of loss rates. Most likely there is an overestimation of precipitation on July 3rd and 4th. The Atascosa River at Whitsett plot is shown above.

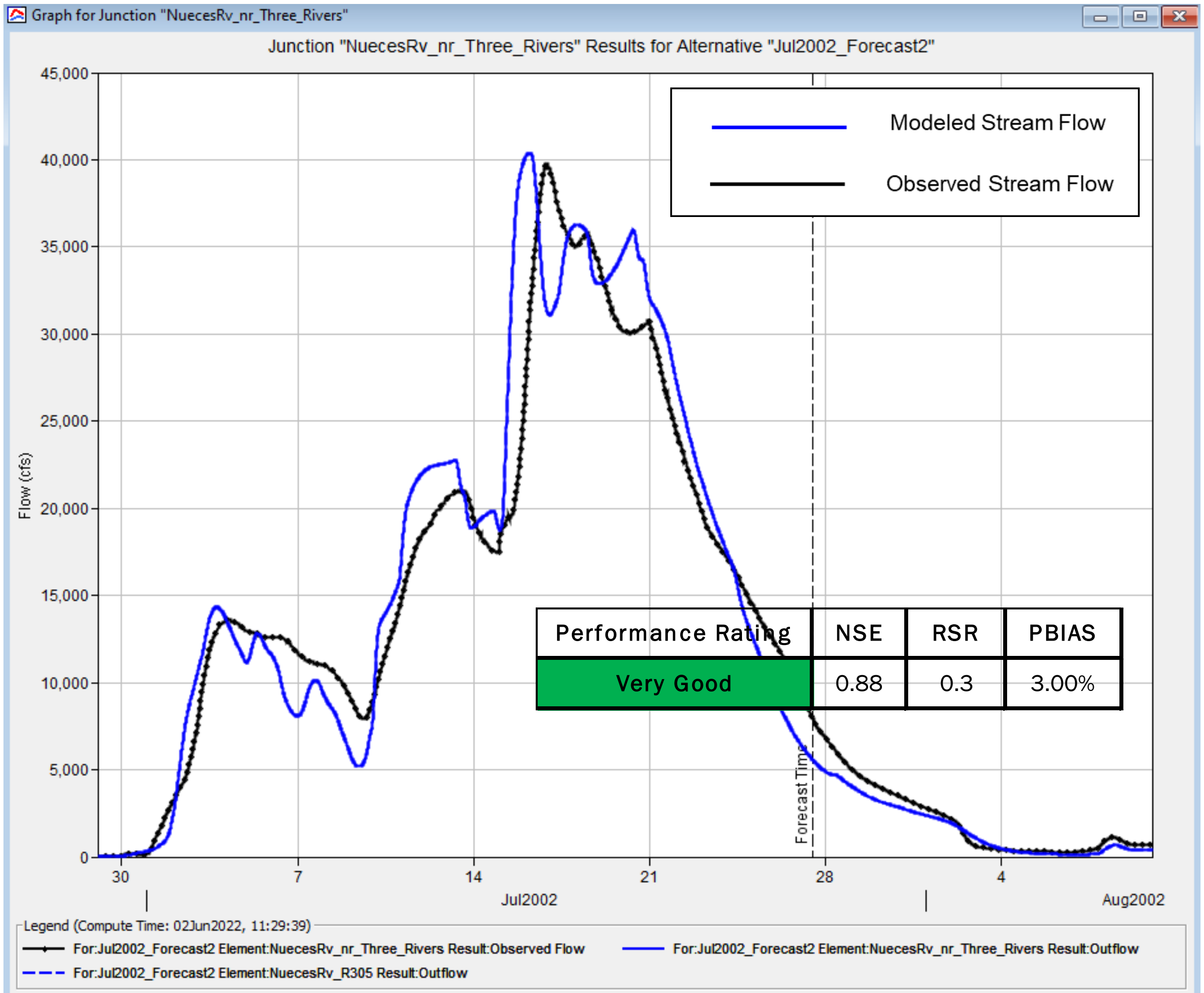


Figure B.80: July 2002 Calibration Results for Nueces River near Three Rivers USGS Gage

The Nueces River near Three Rivers gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the shape, magnitude and volume of the observed hydrograph very well. This gage is located downstream of the confluence of the Nueces River with the Atascosa River as well as Choke Canyon Reservoir. The Nueces River near Three Rivers plot is shown above.

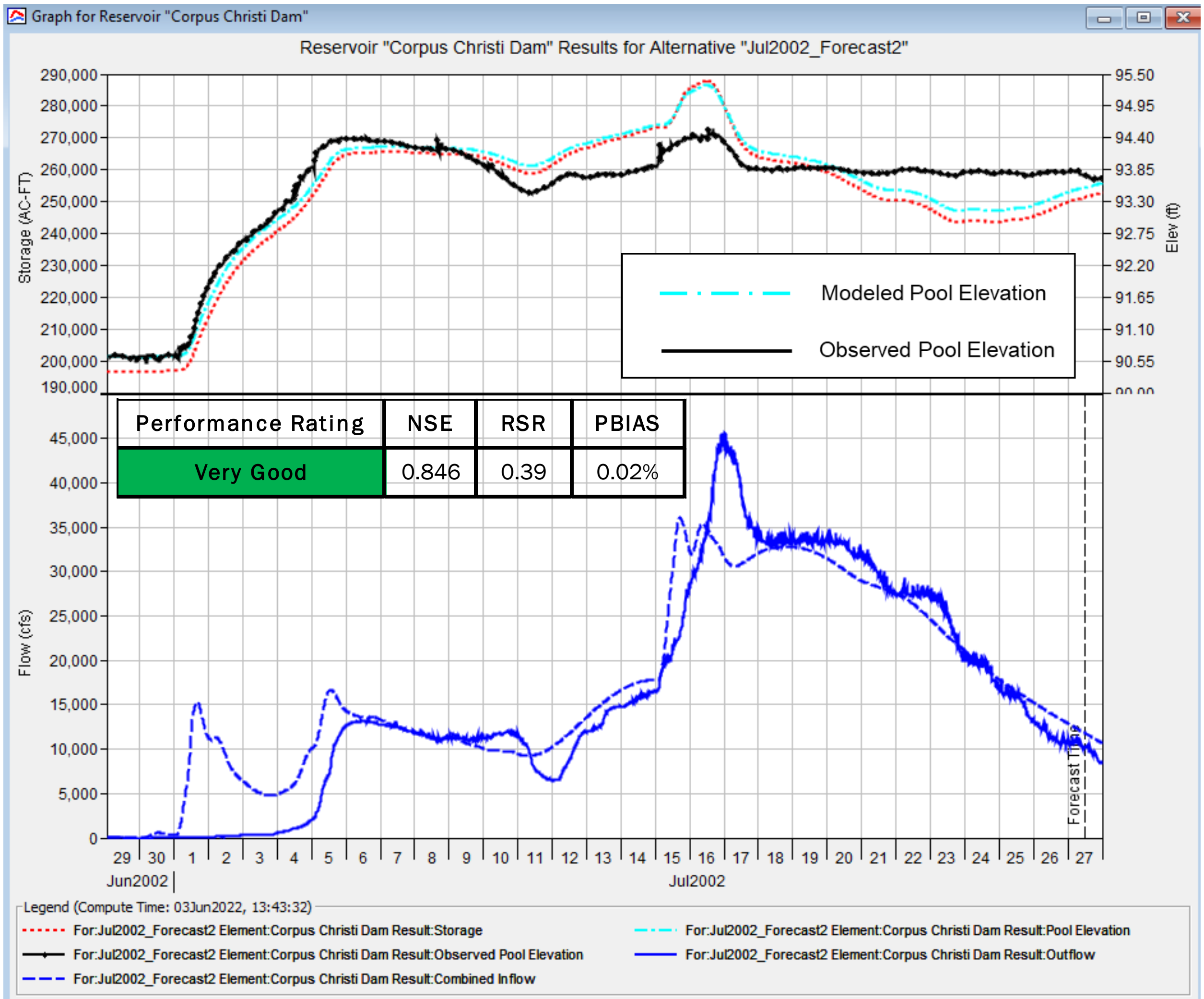


Figure B.81: July 2002 Calibration Results for Lake Corpus Christi

The Lake Corpus Christi gage achieved a “Very Good” performance rating for the July 2002 event. The HEC-HMS model matched the shape, timing and volume of the observed pool rise very well. However, the pool rose higher than observed on the middle portion of the event, most because of an overestimation of precipitation for July 15-16. The final Lake Corpus Christi plot is shown above.

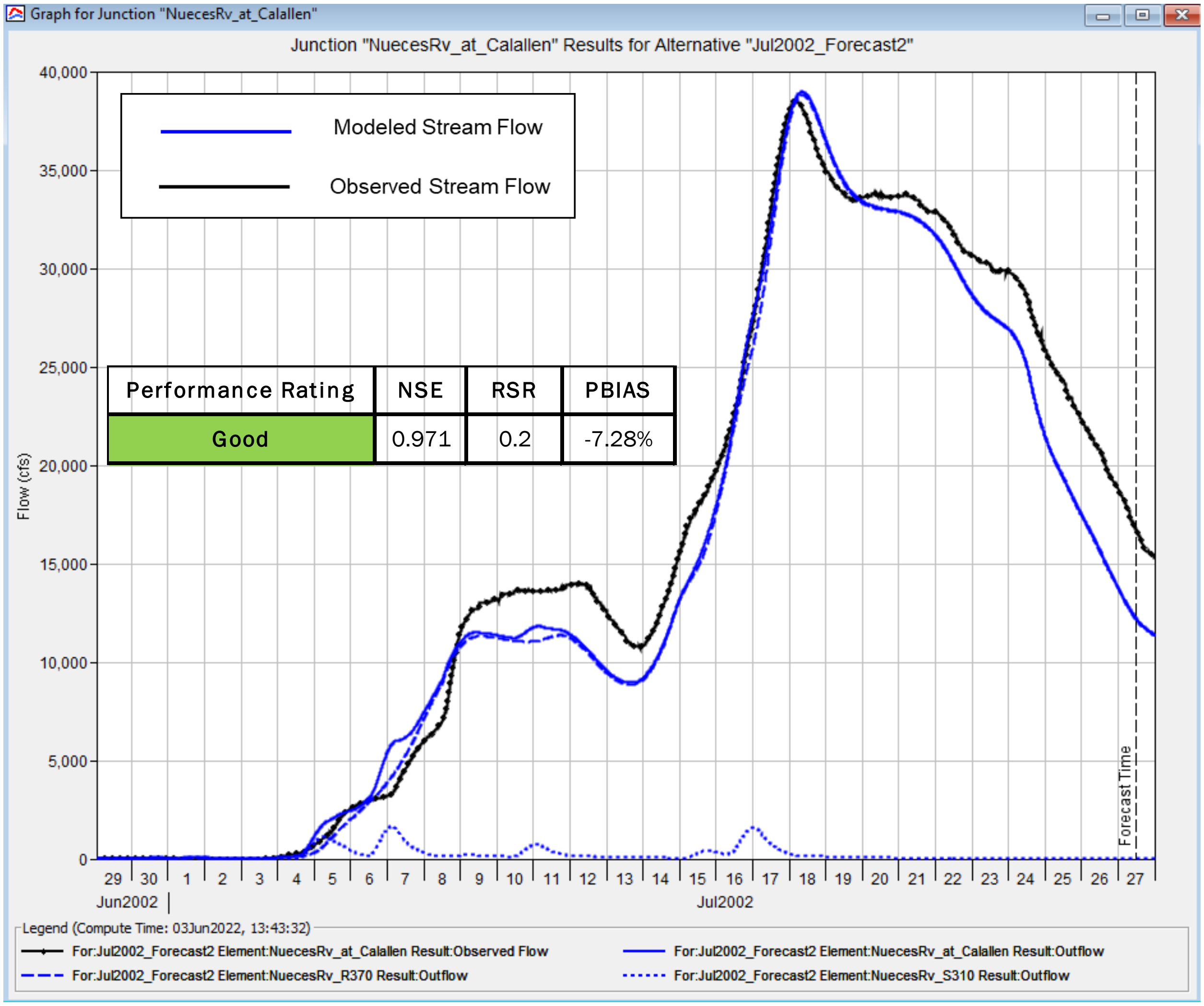


Figure B.82: July 2002 Calibration Results for Nueces River at Calallen USGS Gage

The Nueces River at Calallen gage achieved a "Good" performance rating for the July 2002 event. The HEC-HMS model matched the magnitude, shape and timing of the observed flow hydrograph very well. The computed flow volume was just a bit lower than observed, resulting in the Good rating rather than Very Good. The Nueces River at Calallen plot is shown above.

1.4.4.6 September 2002 Event

The September 2002 event was a lower Nueces River and lower Frio River basin flood. Calibration on the Nueces River basin started at Nueces River near Tilden and Frio River at Tilden gage and ended at the Nueces River near Callen gage. For this flood event, the HEC-HMS model simulation time period was September 6 thru September 29. This food event is a result of Tropical Storm Fay. The Southern Texas Palmer Drought Severity Index (PDSI) was moderately moist (2.00 to 2.99) in August 2002. Southern Texas Palmer Z-index was mid-range (-1.24 to 0.99) in August 2002.

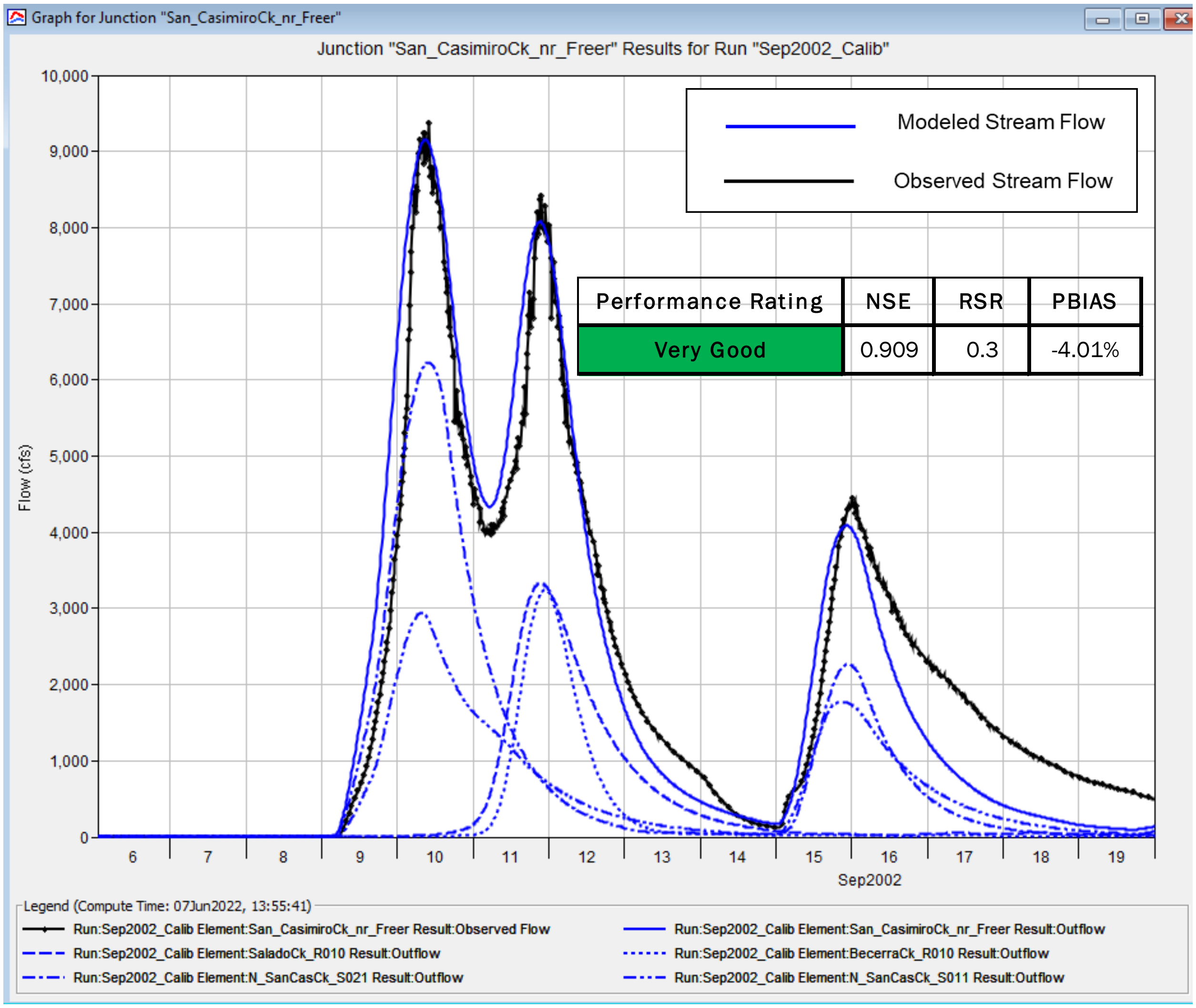


Figure B.83: September 2002 Calibration Results for San Casimiro Creek near Freer USGS Gage

The San Casimiro Creek near Freer gage achieved a "Very Good" performance rating for the September 2002 event. The HEC-HMS model matched the magnitude, shape, timing and volume of the observed hydrograph very well. The HEC-HMS model could not match the recession limb on Sep 16-19, which was most likely caused by the effects of multiple dams located upstream of this gage. These dams are not included in the HEC-HMS model. The San Casimiro Creek near Freer plot is shown above.

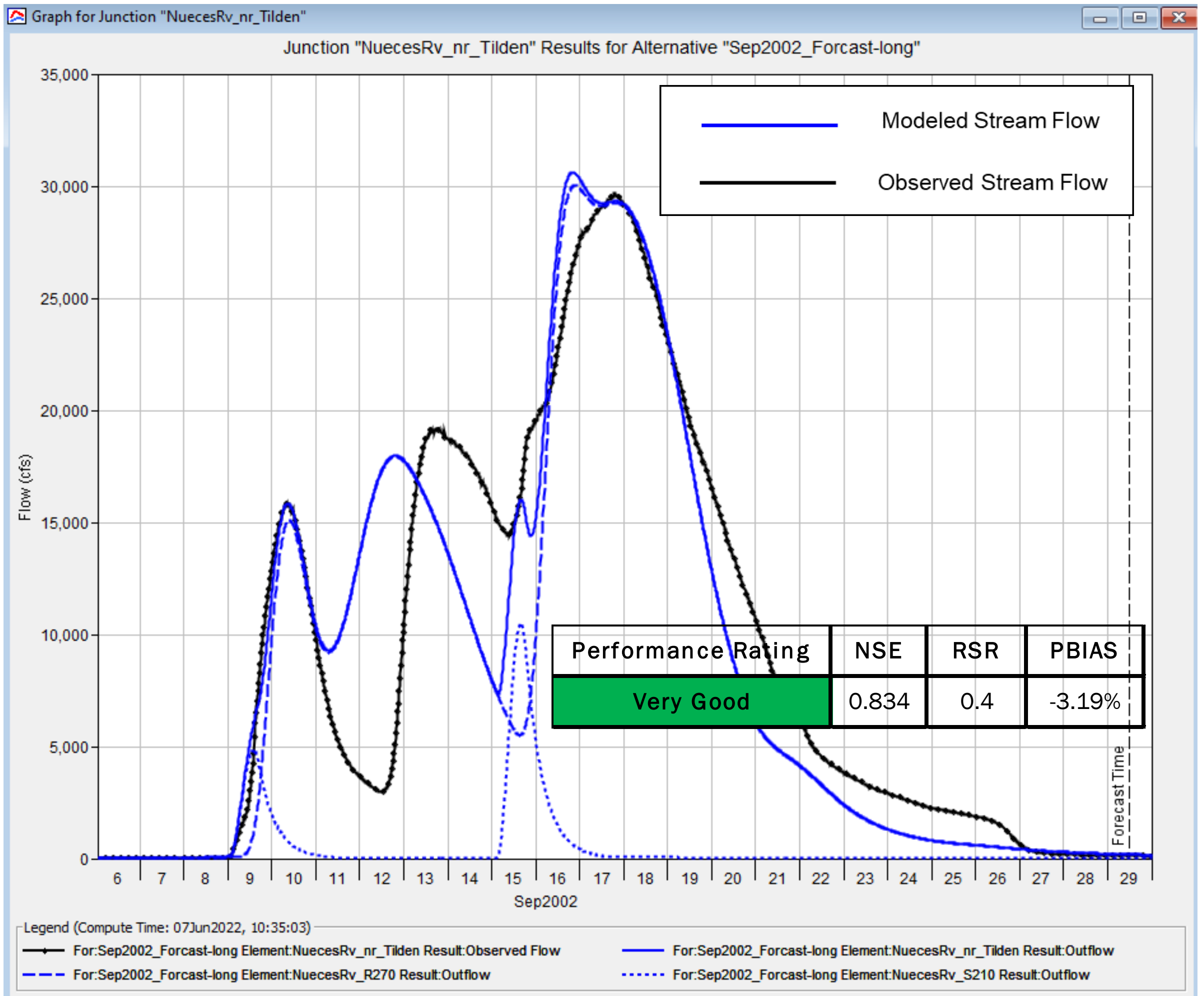


Figure B.84: September 2002 Calibration Results for Nueces River near Tilden USGS Gage

The Nueces River near Tilden gage achieved a "Very Good" performance rating for the September 2002 event. The HEC-HMS model matched the magnitude, shape, timing and volume of the observed hydrograph very well, especially for the first and last peaks. For the second peak, the timing was off by about a day, possibly due to simplified routing methods that could not capture the routing differences from the other peaks. The revised Nueces River near Tilden plot is shown above.

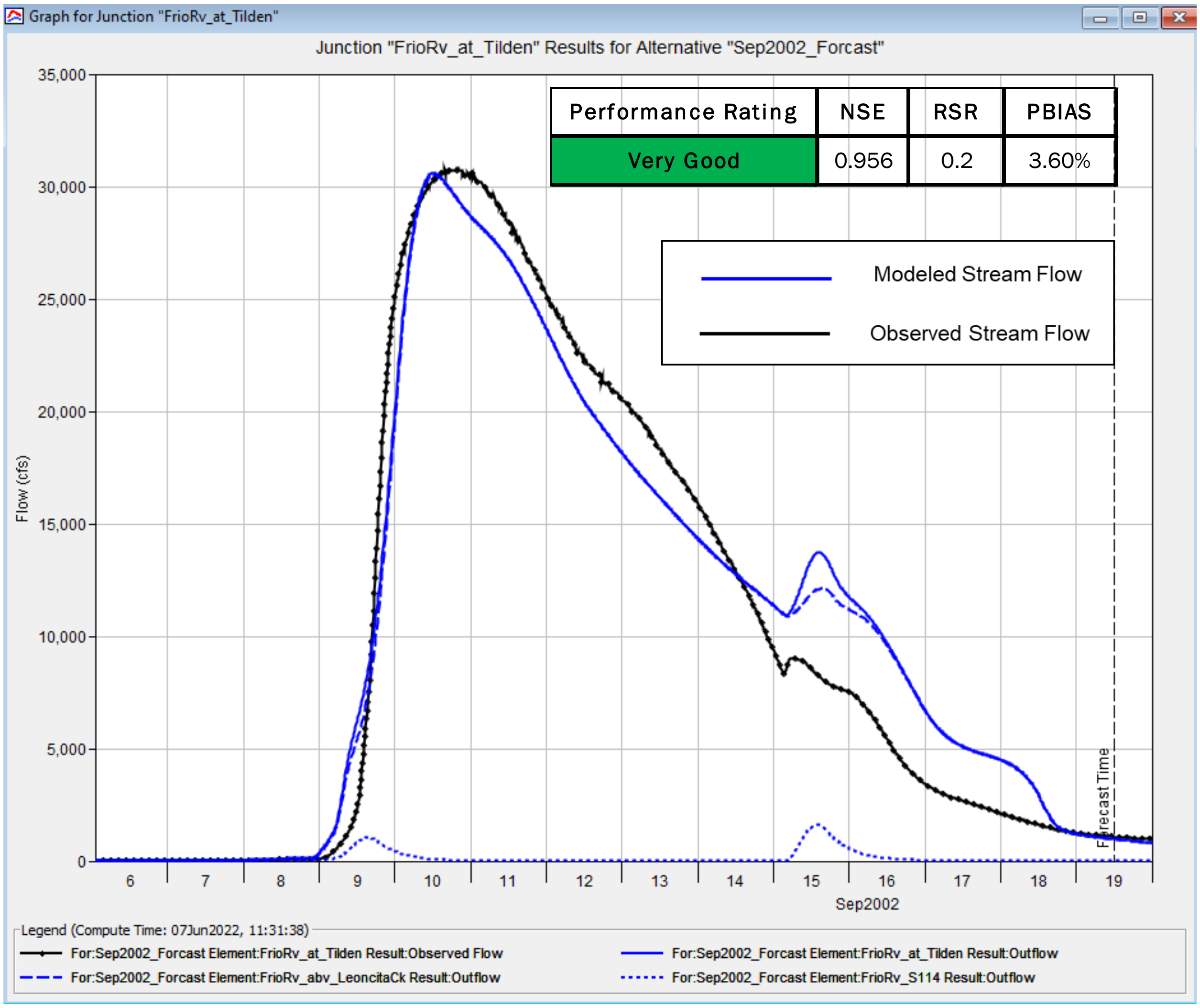


Figure B.85: September 2002 Calibration Results for Frio River at Tilden USGS Gage

The Frio River at Tilden gage achieved a “Very Good” performance rating for the September 2002 event. The HEC-HMS model matched the magnitude, shape, timing and volume of the observed hydrograph very well. Blending of the observed data was used in forecast mode in the HEC-HMS model at the upstream Frio River near Derby gage. The Frio River at Tilden plot is shown above.

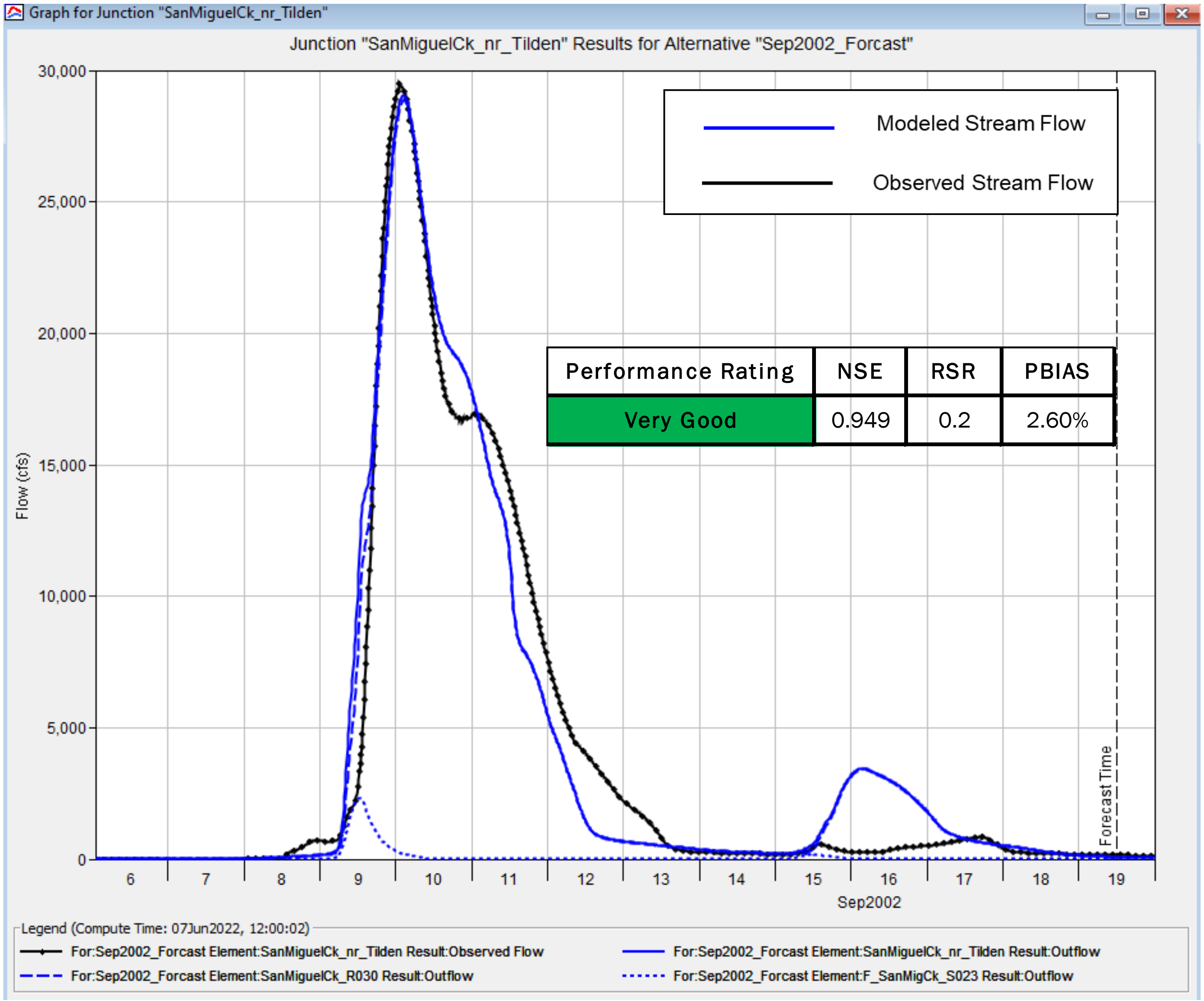


Figure B.86: September 2002 Calibration Results for San Miguel River near Tilden USGS Gage

The San Miguel River near Tilden gage achieved a "Very Good" performance rating for the September 2002 event. The HEC-HMS model matched the magnitude, shape, timing and volume of the observed hydrograph very well. The San Miguel River near Tilden plot is shown above.

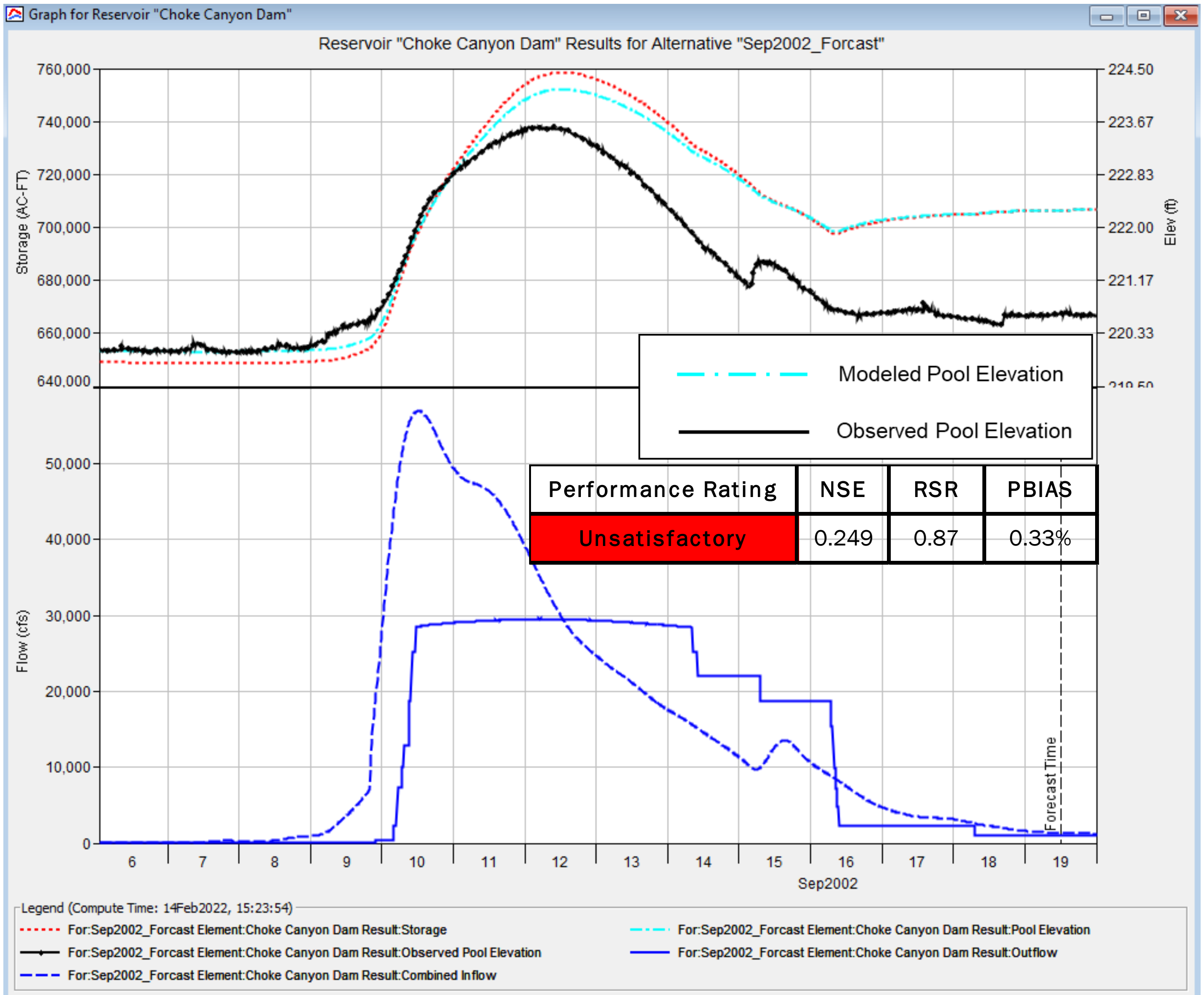
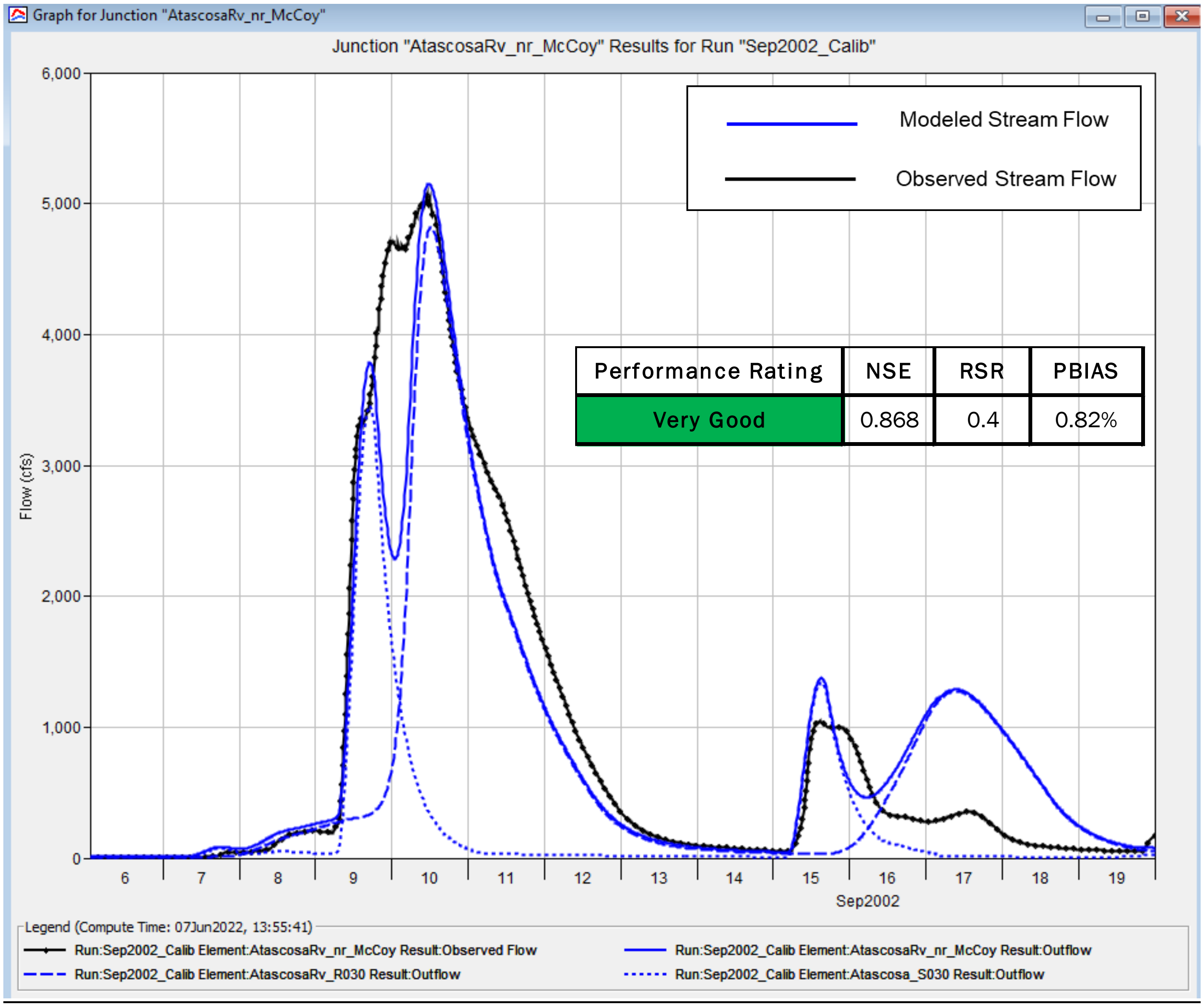


Figure B.87: September 2002 Calibration Results for Choke Canyon Reservoir

The Choke Canyon Reservoir gage achieved an "Unsatisfactory" performance rating for the September 2002 event. The HEC-HMS model matched the timing and shape of the observed pool rise well, but the inflow volume was too much, causing the computed pool to continue to rise above the observed levels. This difference in volume may have been caused by errors in either the observed releases or the observed flow hydrographs at the upstream gages. The Choke Canyon radial gate release information was obtained from gate logs supplied by the City of Corpus Christi. However, they supplied only daily gate opening information that had to be translated into outflows using the gates' rating curves.

At the upstream gages for the Frio River at Tilden gage and San Miguel Creek near Tilden, forecast mode was used in HEC-HMS to blend in the observed hydrographs. However, there is uncertainty associated with the observed flow volumes. At the Frio River at Tilden gage, the highest USGS flow measurements made prior to the September 2002 flood were 30,500 cfs on July 9, 2002 (a fair measurement) and 22,100 cfs on July 11, 2002 (a fair measurement). The estimated peak discharge for this calibration was 30,800 cfs on September 10, 2002. At the San Miguel Creek near Tilden gage, the highest USGS flow measurement prior to the September 2002 flood was 22,800 cfs (a good measurement) on September 10, 2002, 20,600 cfs (good measurement) and 22,100 cfs on July 11, 2002 (a fair measurement). The estimated peak discharge for this calibration was 29,500 cfs on September 10, 2002. It is possible that the USGS is overestimating the discharge from one or both gages for the September event. Since blending is used in HEC-HMS model at these two gages, the observed discharges are adopted and routed downstream to Choke Canyon Reservoir. If the observed discharges are overestimated, the inflow into Choke Canyon Reservoir might be too high causing the computed elevation to be too high. The Choke Canyon Reservoir plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.868	0.4	0.82%

Figure B.88: September 2002 Calibration Results for Atascosa River near McCoy USGS Gage

The Atascosa River near McCoy gage achieved a “Very Good” performance rating for the September 2002 event. The HEC-HMS model matched the magnitude, timing and volume of the observed hydrograph very well. However, there is missing hydrograph volume on September 9-10. The NEXRAD precipitation may be underestimated for two of the headwater subbasins for September 7-8. National Weather Service (NWS) daily precipitation gage at Lytle and Poteet had 10.85 inches and 6.51 inches, respectively for period September 7-10. Lytle gage is in the upper headwaters of Atascosa_S010 and Poteet gage is in the lower portion of Atascosa_S011. The average NEXRAD subarea precipitation was 5.60 inches and 5.12 inches for Atascosa_S010 and Atascosa_S011, respectively for September 7-10. The Atascosa River near McCoy plot is shown above.

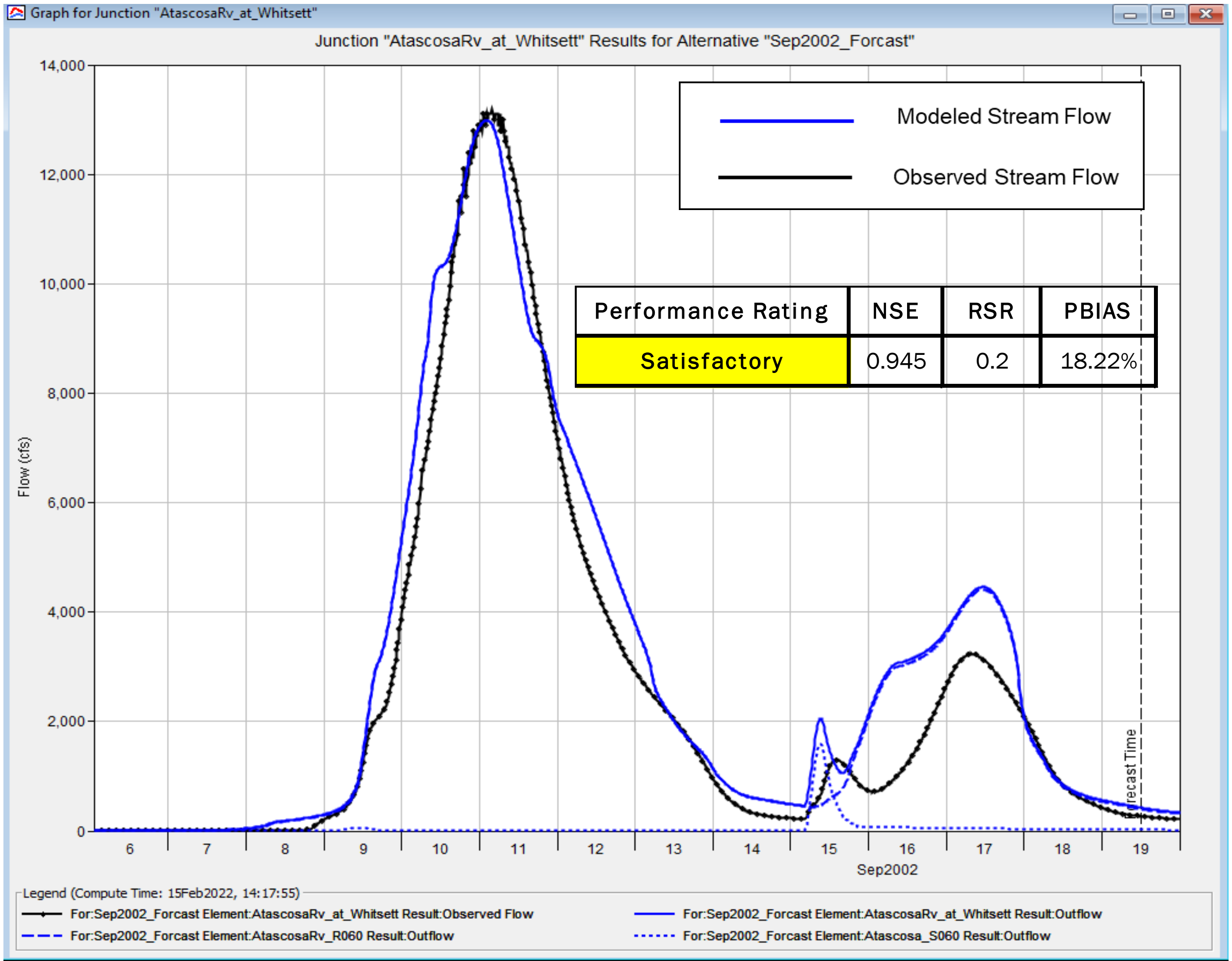


Figure B.89: September 2002 Calibration Results for Atascosa River near Whitsett USGS Gage

The Atascosa River near Whitsett gage achieved a "Satisfactory" performance rating for the September 2002 event. The HEC-HMS model matched the timing, magnitude, shape and magnitude of the main peak very well. The satisfactory performance rating was caused by the computed volume of the second smaller peak being too high, so it is not an accurate representation of the calibration of the main portion of the flood. Atascosa River near Whitsett plot is shown above.

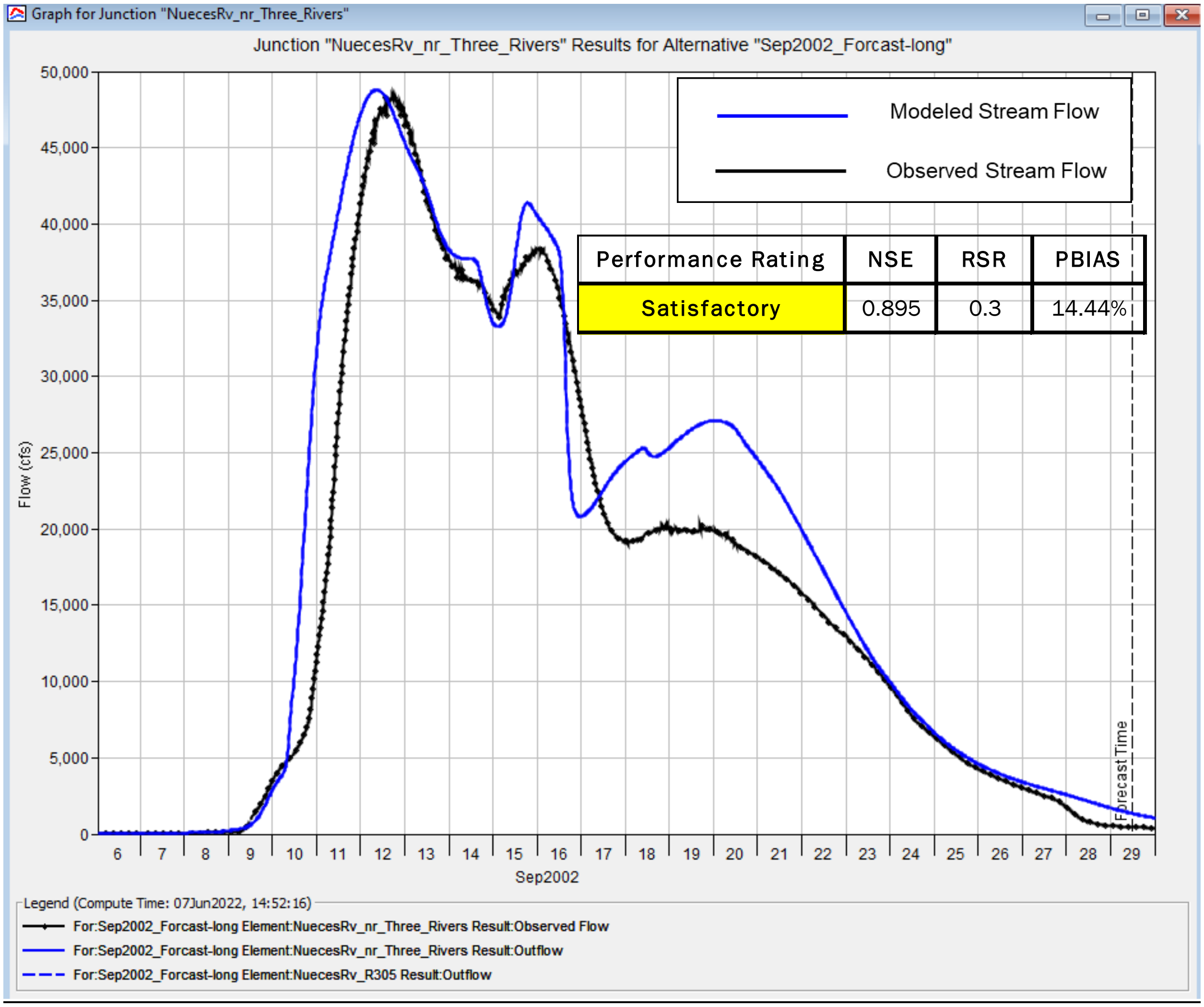


Figure B.90: September 2002 Calibration Results for Nueces River near Three Rivers USGS Gage

The Nueces River near Three Rivers gage achieved a “Satisfactory” performance rating for the September 2002 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the main peak very well. The volume was just a bit high for the third peak, resulting in the satisfactory rating. Forecast mode was used in the HEC-HMS model with blending of the observed data at the upstream Nueces River near Tilden gage and Atascosa River at Whitsett gage. The Nueces River near Three Rivers plot is shown above.

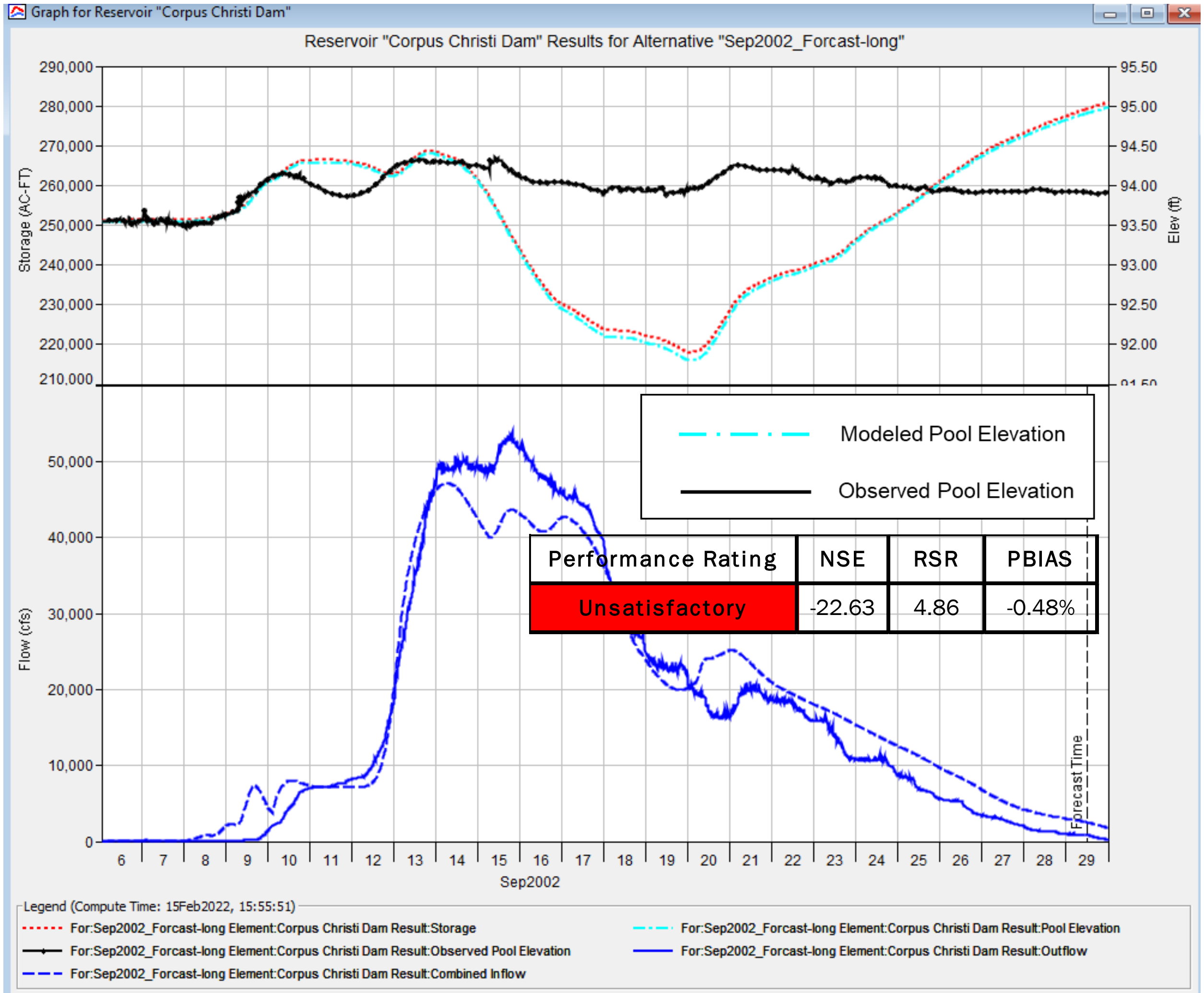


Figure B.91: September 2002 Calibration Results for Lake Corpus Christi

The Lake Corpus Christi calibration for Sep 2002 had an "Unsatisfactory" performance rating. The HEC-HMS model matched the timing, shape and magnitude of the observed pool elevation well through the 14th of September, after which the computed pool elevation dropped about 2 feet below observed. From September 15 - 17, the observed outflow is greater than the computed inflow, resulting in the drop in pool elevation. It appears that there is an underestimation of NEXRAD precipitation for September 15 - 17. Lake Corpus Christi had an unsatisfactory performance rating mainly because of its level pool operations. The observed pool elevation of the lake only varied by less than one foot throughout the entire event. This results in poor statistics for even small computed deviations from the observed pool elevation. Therefore, an underestimation of the rainfall and computed inflow on Sep 15-17 resulted in the poor performance rating, but it is not an accurate representation of the calibration overall. The Lake Corpus Christi plot is shown above.

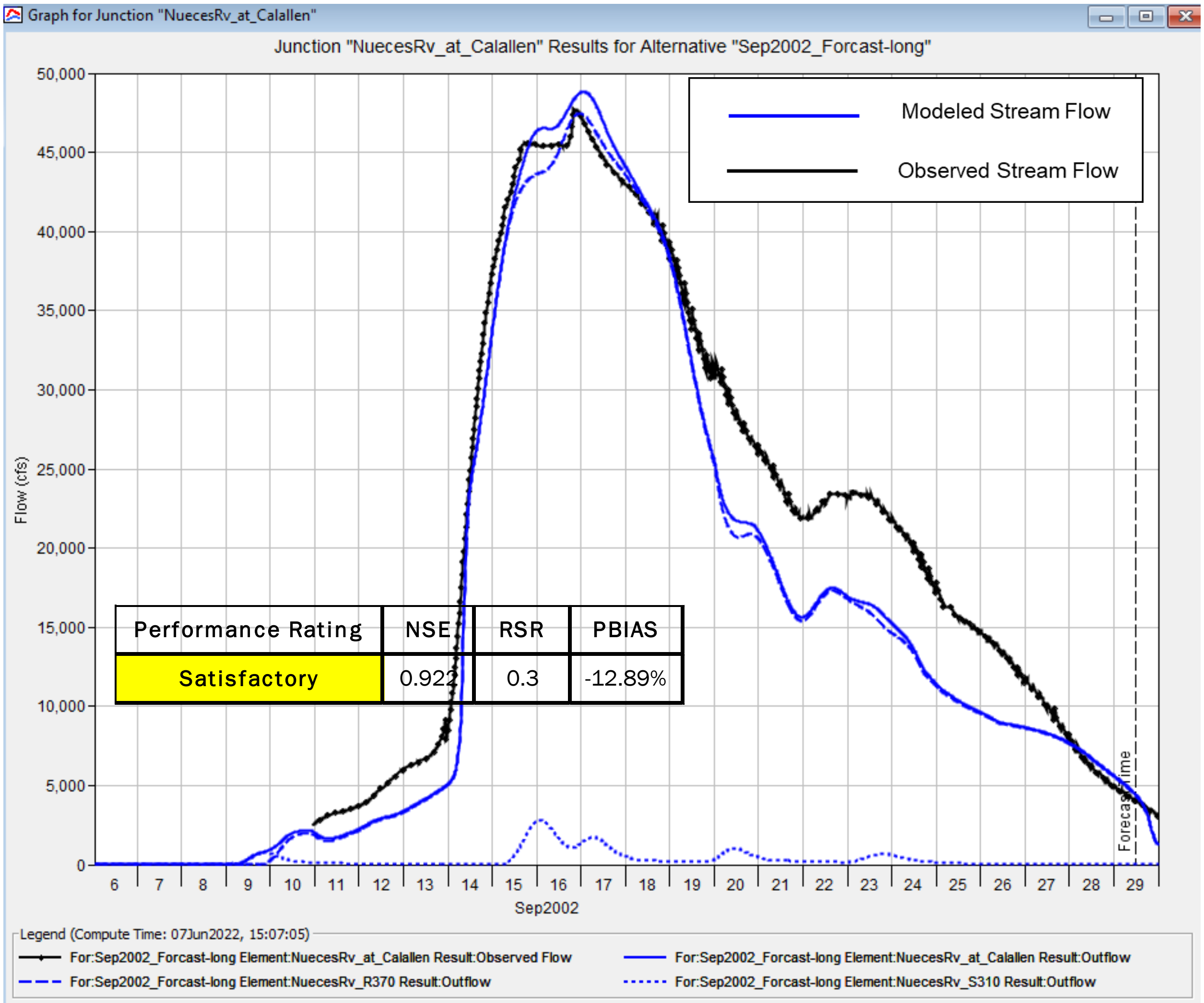


Figure B.92: September 2002 Calibration Results for Nueces River at Calallen USGS Gage

The Nueces River at Calallen gage achieved a “Satisfactory” performance rating for the September 2002 event. The HEC-HMS model matched the timing, magnitude, and shape of the observed hydrograph very well. However, the computed flow volume was low for the recession limb of the hydrograph, resulting in the satisfactory rating. This difference in flow volume may be caused by a discrepancy between the observed releases from Lake Corpus Christi and the USGS rating curve at this gage. The revised Nueces River at Calallen plot is shown above.

1.4.4.7 June 2007 Event

The June 2007 event was a San Casimiro Creek, upper Frio River, Atascosa River, and lower Nueces River Basin flood. For this flood event, the HEC-HMS model simulation time period was June 19 thru July 19. The Southern Texas Palmer Drought Severity Index (PDSI) was very moist (3.00 to 3.99) in May 2007. Southern Texas Palmer Z-index was very moist (2.50 to 3.49) in May 2007.

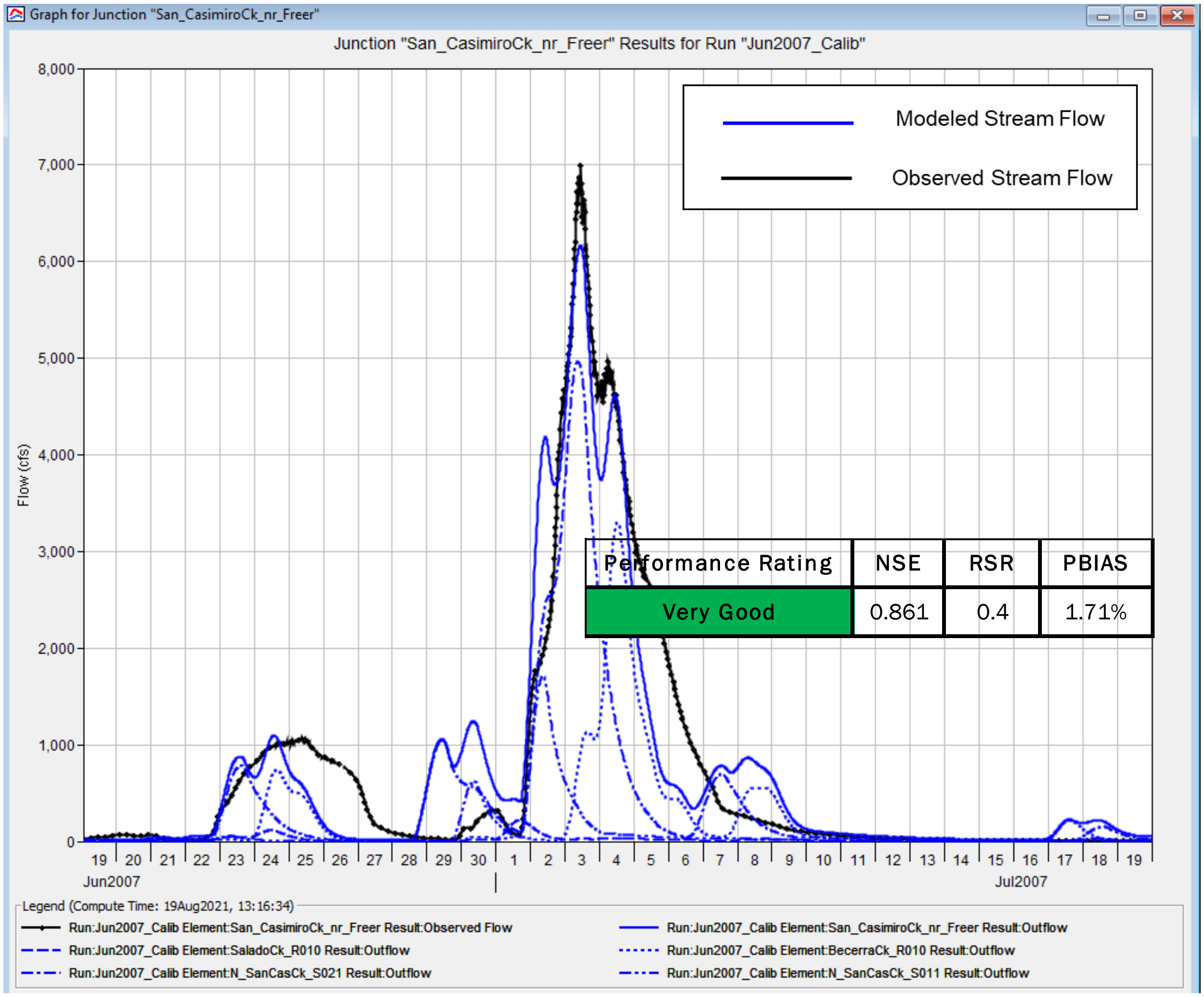


Figure B.93: June 2007 Calibration Results for San Casimiro Creek near Freer USGS Gage

The Nueces River at Calallen gage achieved a “Very Good” performance rating for the June 2007 event. The HEC-HMS model matched the timing, magnitude and volume of the observed hydrograph very well. The computed shape was a bit different as HEC-HMS could not match the extended recession limb seen in the observed data. This extended recession limb is likely being cause be releases from several upstream dams, which are not included in the HEC-HMS model. The San Casimiro Creek near Freer plot is shown above.

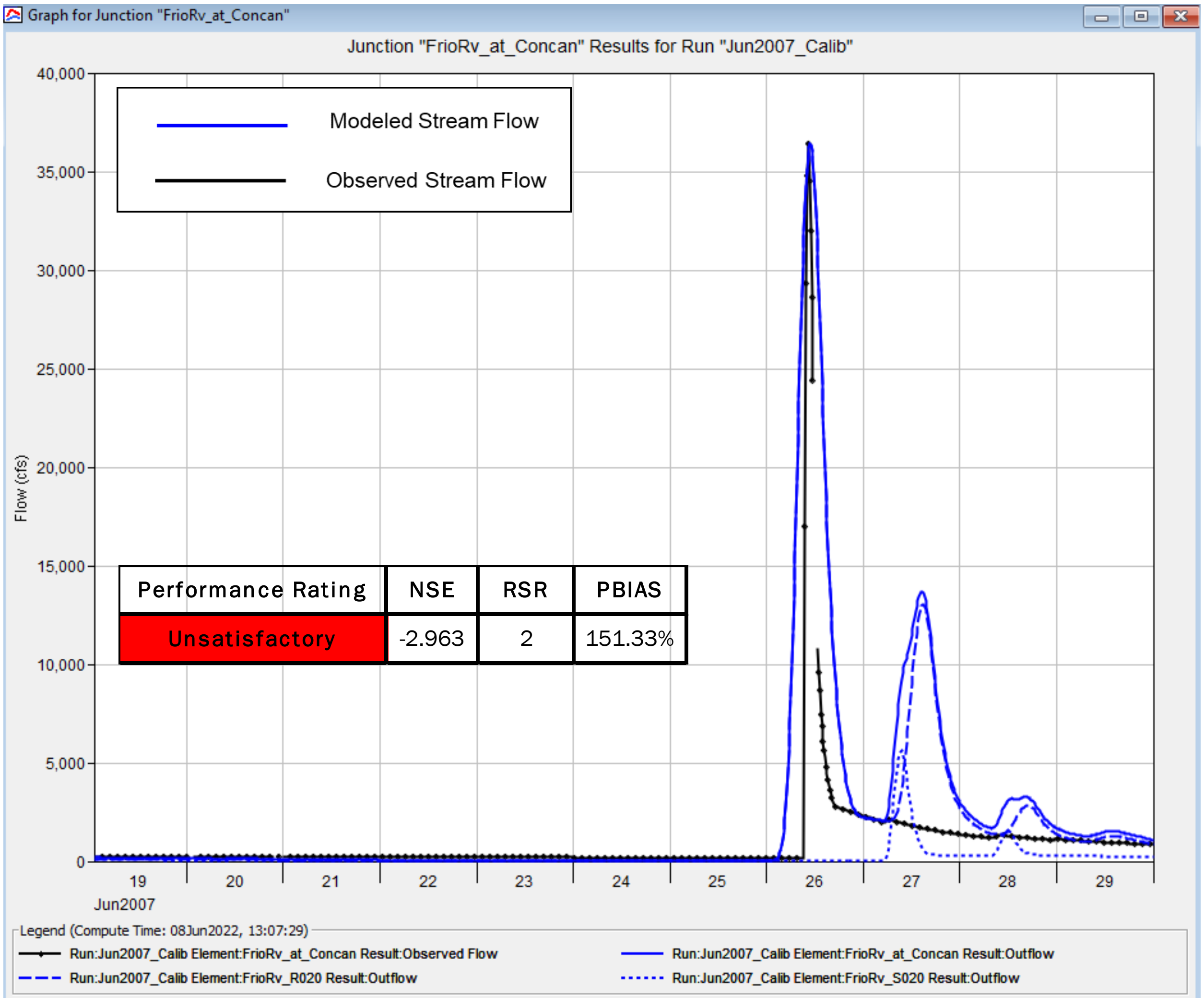
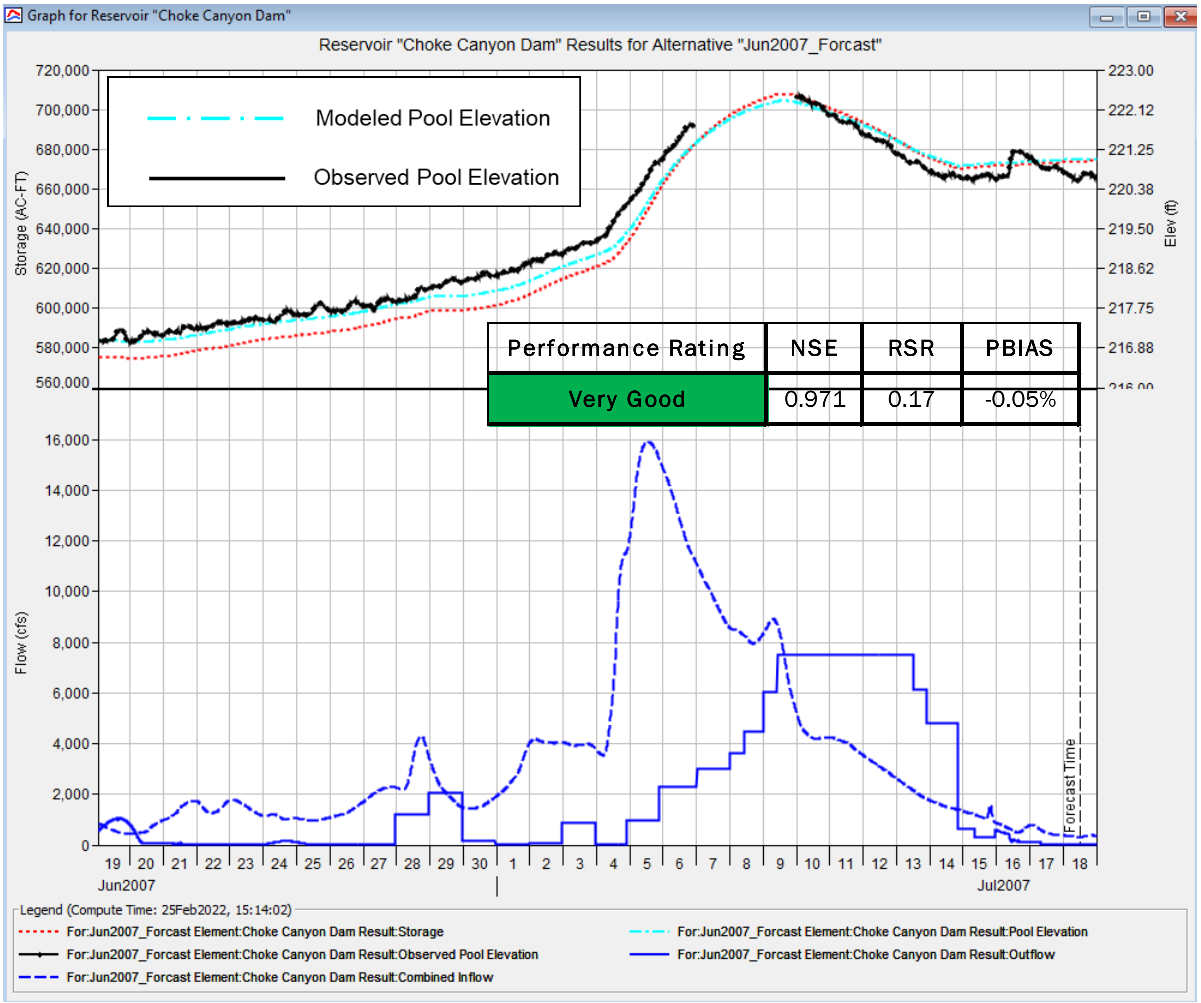


Figure B.94: June 2007 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan gage achieved an “Unsatisfactory” performance rating for the June 2007 event. The HEC-HMS model matched the timing and magnitude of the observed peak very well, but the computed volume is much higher. The Frio River at Concan observed hydrograph also has some missing data, which can skew the statistical computations. The final Frio River at Concan plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.971	0.17	-0.05%

Figure B.95: June 2007 Calibration Results for Choke Canyon Reservoir

The Choke Canyon Reservoir gage achieved a "Very Good" performance rating for the June 2007 event. The HEC-HMS model matched the timing, shape, volume and magnitude of the observed pool rise very well. The Choke Canyon radial gate release information was obtained from gate logs supplied by the City of Corpus Christi. The Choke Canyon Reservoir plot is shown above.

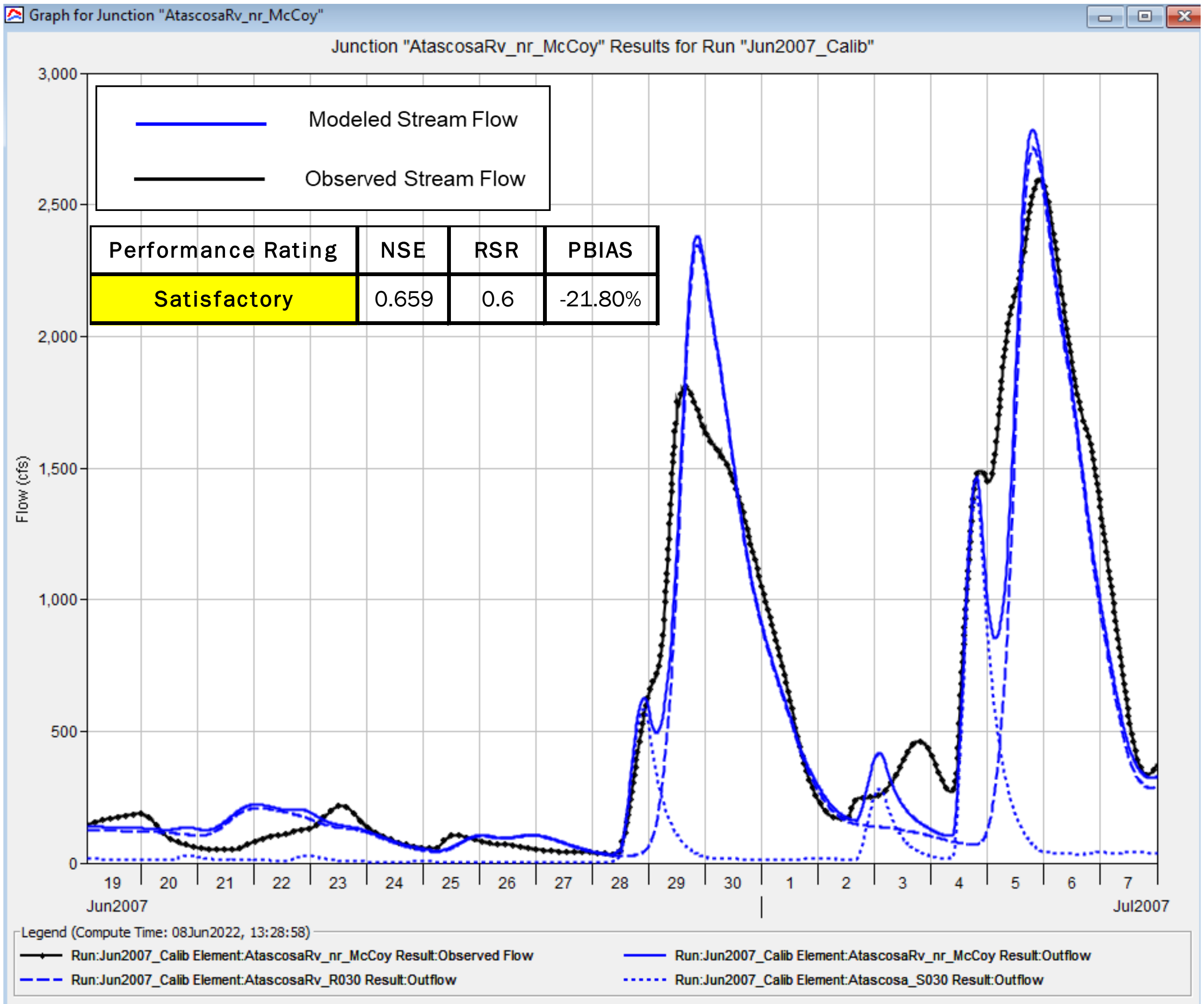


Figure B.96: June 2007 Calibration Results for Atascosa River near McCoy USGS Gage

The Atascosa River near McCoy gage achieved a “Satisfactory” performance rating for the June 2007 event. The HEC-HMS model matched the timing, shape and magnitude of the observed peaks fairly well, but the computed overall flow volume was low, resulting in the satisfactory rating. The June 2007 event has multiple individual storms occurring over several days, and it is extremely difficult to match all peaks with a single set of loss rates. The final Atascosa River near McCoy plot is shown above.

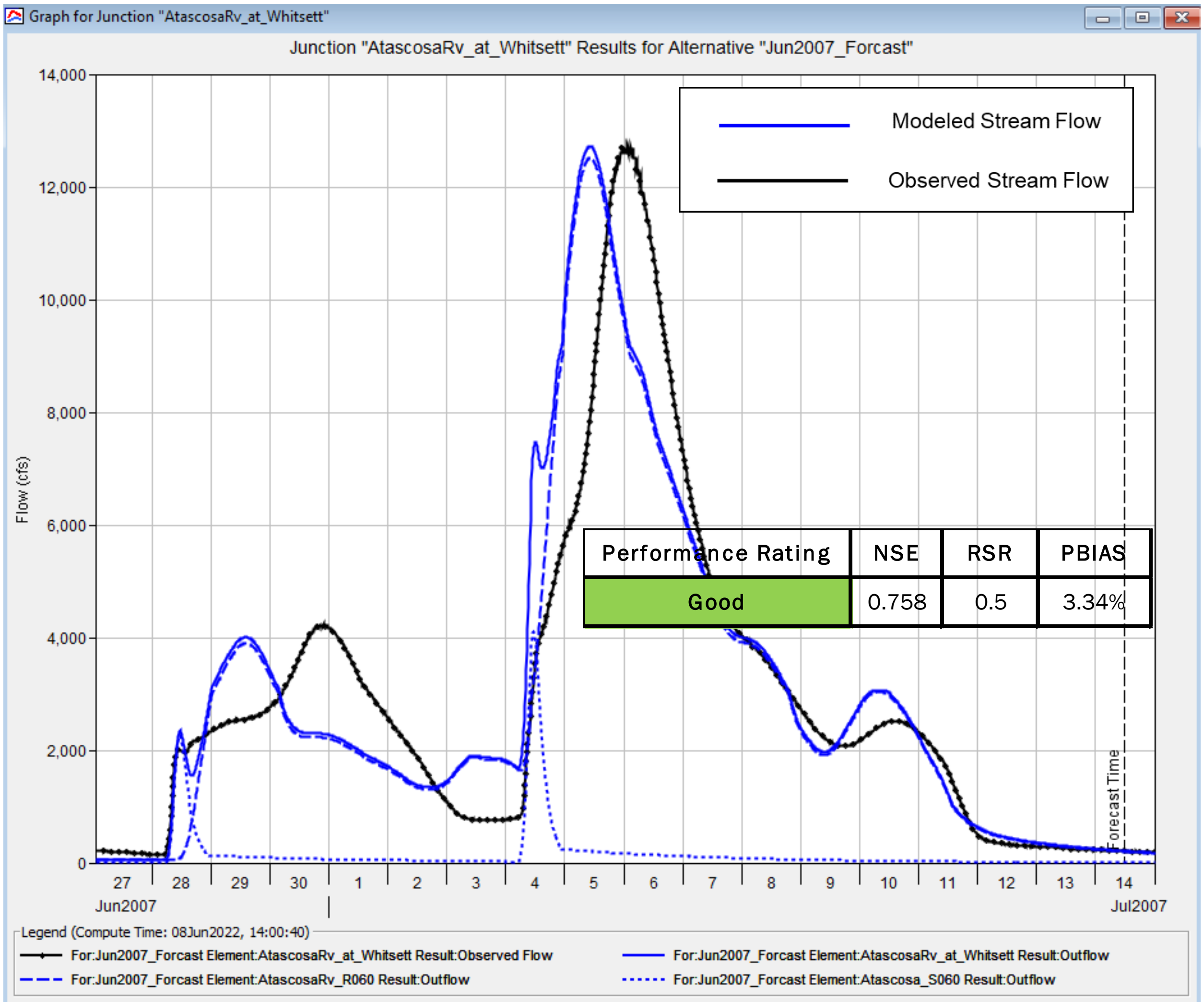


Figure B.97: June 2007 Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage achieved a “Good” performance rating for the June 2007 event. The HEC-HMS model matched the shape, magnitude and volume of the observed hydrograph very well, but the timing of the peak was too early. Forecast mode was used in the HEC-HMS model to blend in the observed data at the Atascosa River near McCoy gage. The final Atascosa River at Whitsett plot is shown above.

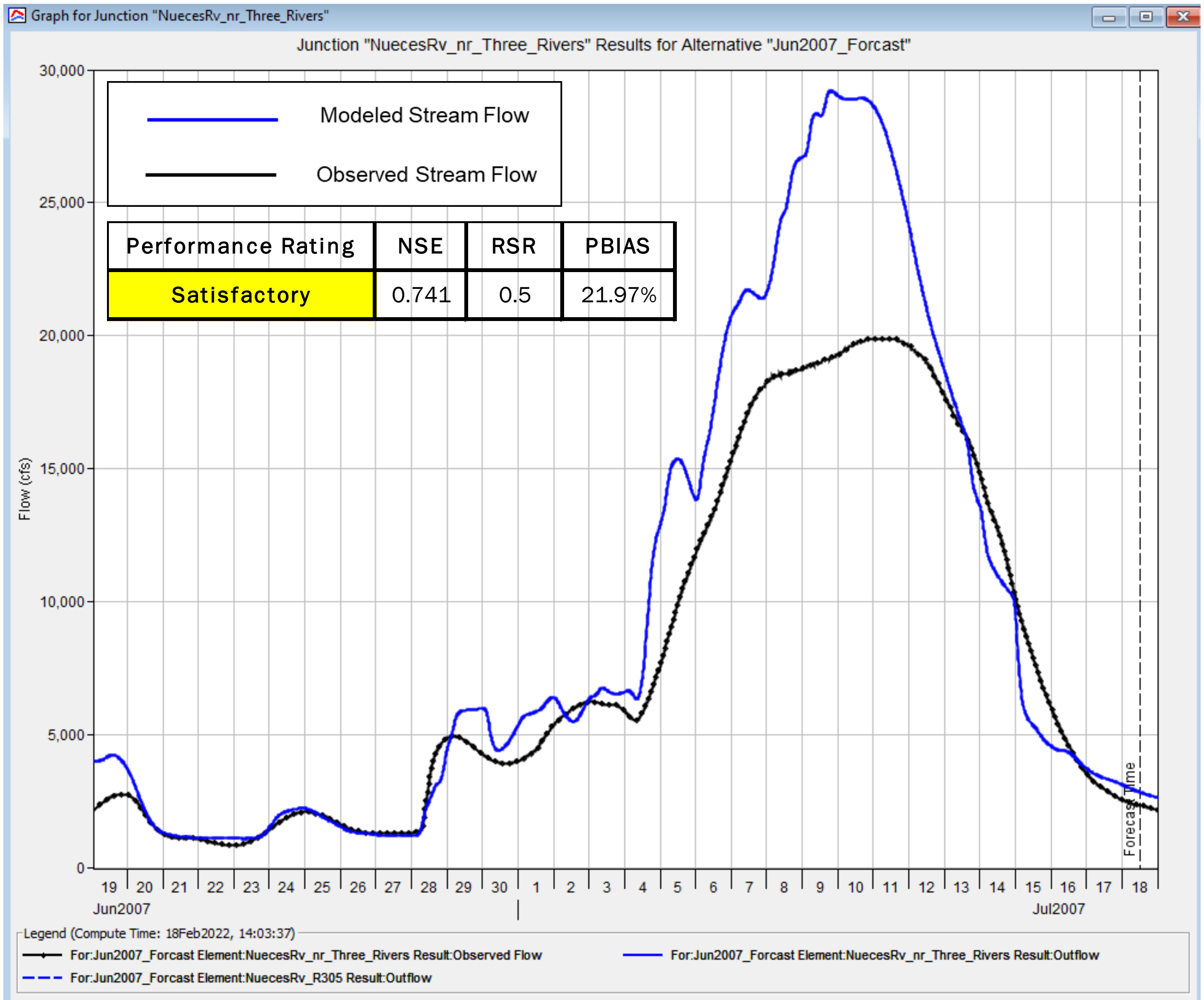


Figure B.98: June 2007 Calibration Results for Nueces River near Three Rivers USGS Gage

The Nueces River near Three Rivers gage achieved a “Satisfactory” performance rating for the June 2007 event. The HEC-HMS model matched the shape and timing of the observed hydrograph well, but the overall volume and peak magnitude were high, as shown in the percent bias. Forecast mode was used in the HEC-HMS model to blend in the observed data at the Nueces River near Tilden gage and Atascosa River at Whitsett gage. The majority of the main peak comes from the Nueces River near Tilden gage, and there is a discrepancy in the observed flows at that gage and this gage. The three upstream gages have a total observed flow volume of 540,000 acre-feet during the simulation period, while only 460,000 acre-feet was observed at Nueces River near Three Rivers. This area is not known to be one with significant channel losses, so there may be a discrepancy between the rating curves at this gage and the Tilden gage. The Nueces River near Three Rivers plot is shown above.

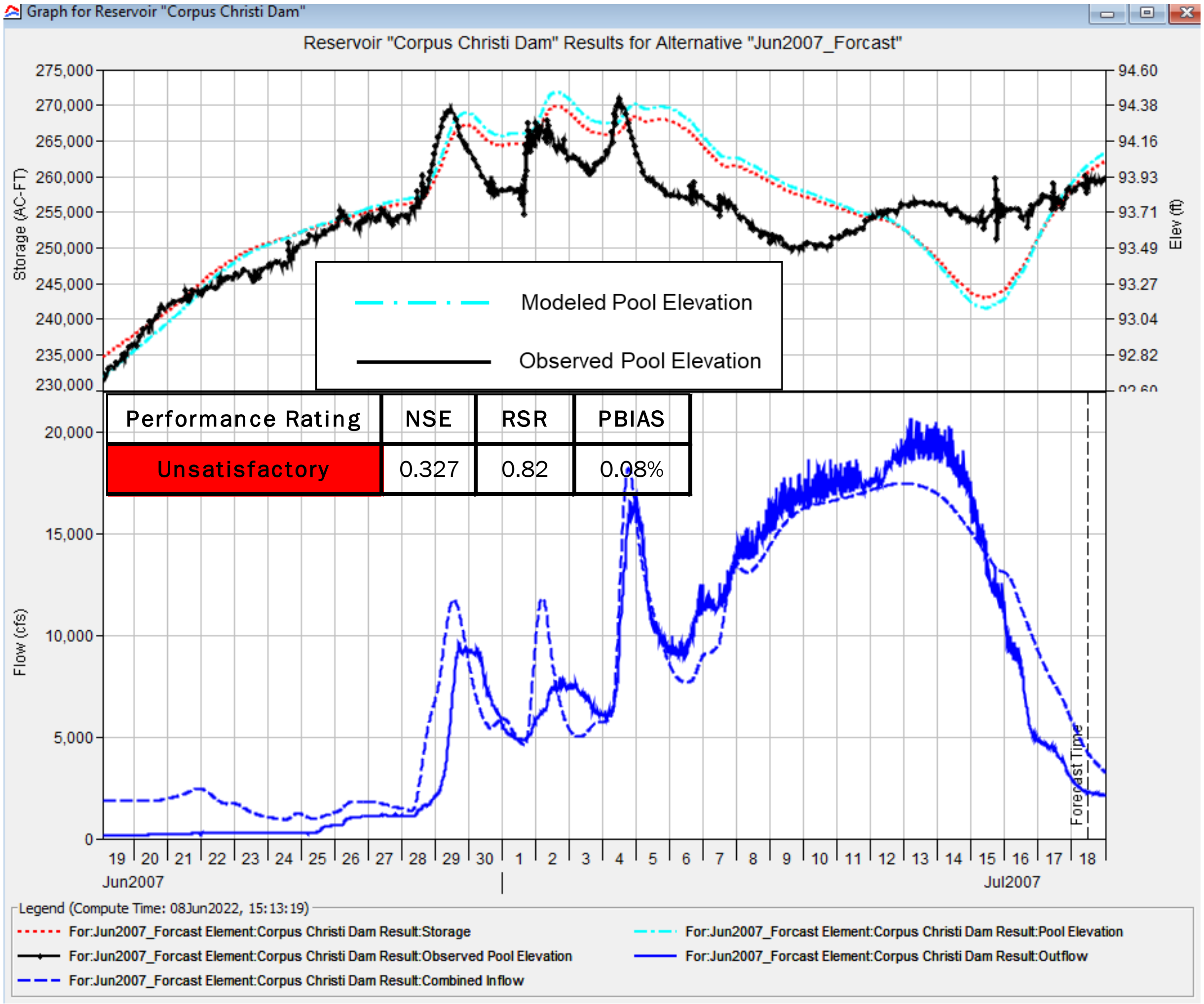


Figure B.99: June 2007 Calibration Results for Lake Corpus Christi

The Lake Corpus Christi calibration for June 2007 had an ”Unsatisfactory” performance rating. The HEC-HMS model matched the timing and magnitude of the observed pool rise, but it did not match the shape on the recession side. Lake Corpus Christi had an unsatisfactory performance rating mainly because of its level pool operations. The observed pool elevation of the lake only varied by less than 1.5 feet throughout the entire event. This results in poor statistics for even small deviations from the observed pool elevation. For example, the largest difference between the computed and observed pool elevation for this event is approximately 0.5 feet. Therefore, the poor performance rating is not an accurate representation of the quality of the calibration. The Lake Corpus Christi plot is shown above.

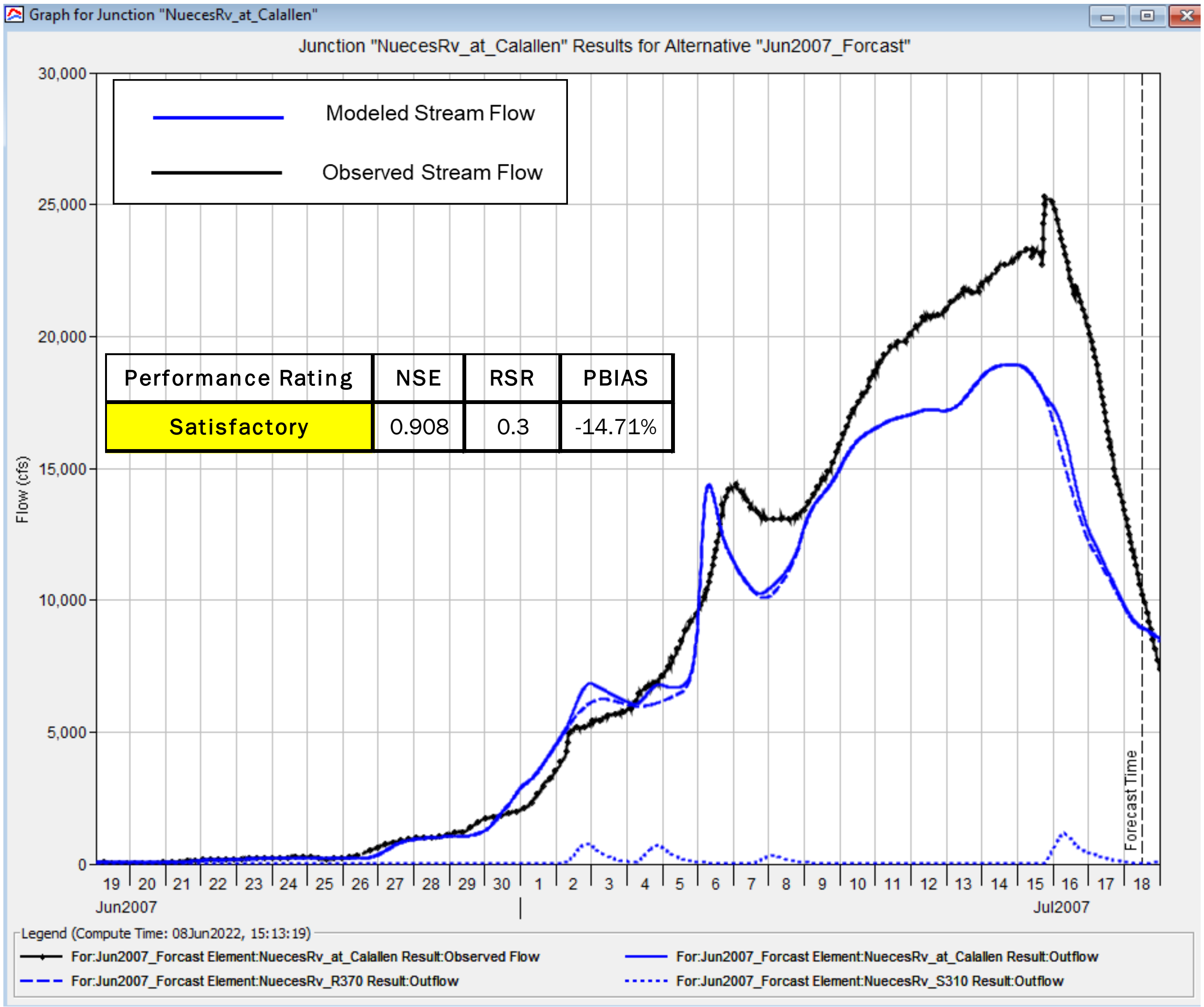


Figure B.100: June 2007 Calibration Results for Nueces River at Calallen USGS Gage

The Nueces River at Calallen gage achieved a "Satisfactory" performance rating for the September 2002 event. The HEC-HMS model matched the timing and shape of the observed hydrograph very well, but the computed flow volume and peak magnitude was low, resulting in the satisfactory rating. This difference in flow volume may be caused by a discrepancy between the observed releases from Lake Corpus Christi and the USGS rating curve at this gage with the Calallen gage reporting about 3,000 cfs more than the dam for the period after June 9th. No model parameter changes can resolve this discrepancy in the observed data, so the satisfactory rating is not an accurate representation of the quality of the calibration. The revised Nueces River at Calallen plot is shown above.

July 2007 Events:

The July 2007 calibration includes three HEC-HMS simulation time periods covering different portions of the Nueces River basin; July 2007 short (July 17 -25); July 2007 late (July 23 - August 5); and July 2007 long (July 17 - August 12). Calibration of July 2007 short event included watersheds in the northern headwater regions of the basin. Calibration of July 2007 late event included watersheds upstream of the West Nueces River near Brackettville gage, Leona River near Uvalde gage, San Miguel Creek near Tilden, and Atascosa River at Whitsett gage. Calibration of July 2007 long event included the entire Nueces River watershed and ended at the Nueces River near Calallen gage. The Southern Texas Palmer Drought Severity Index (PDSI) was extremely moist (3.00 and above) in June 2007. Southern Texas Palmer Z-index was very moist (2.50 to 3.49) in June 2007.

1.4.4.8 July 2007 short Event

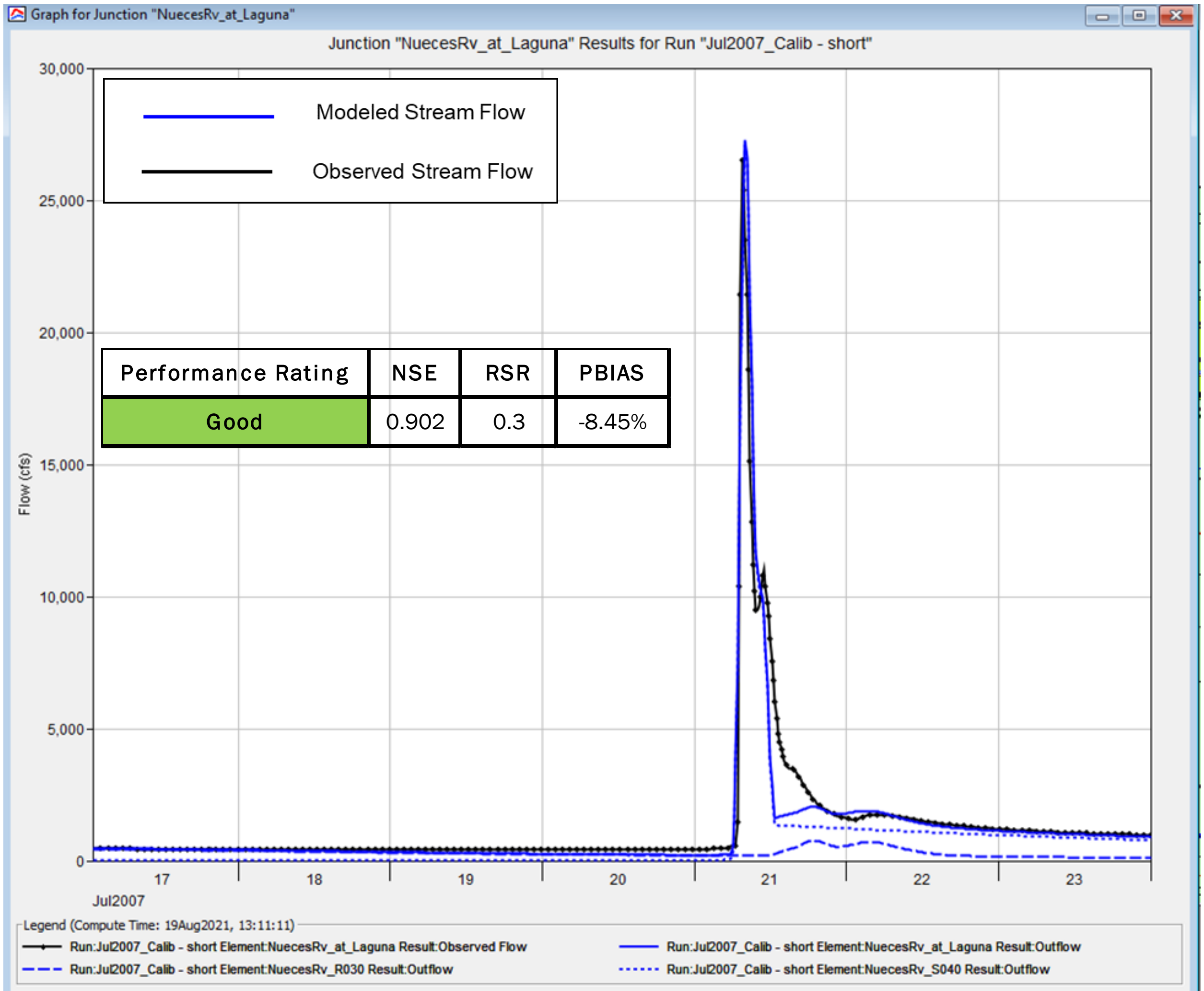


Figure B.101: July 2007 (Short) Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna gage achieved a "Good" performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing, shape and magnitude of the observed hydrograph very well. The computed flow volume was just a bit low, resulting in the good rating rather than very good. The Nueces River at Laguna plot is shown above.

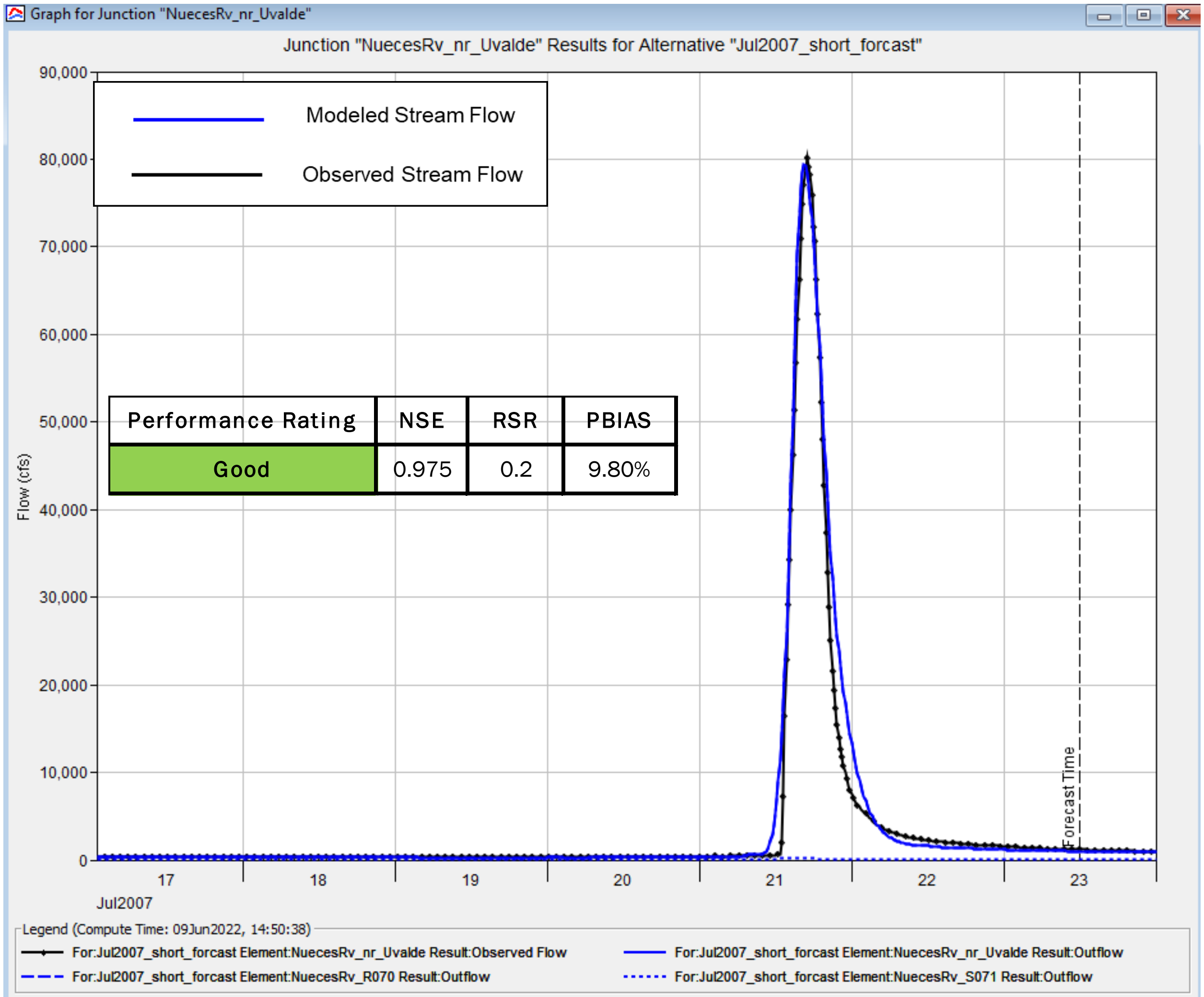


Figure B.102: July 2007 (Short) Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde gage achieved a “Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing, shape and magnitude of the observed hydrograph very well. The computed flow volume was just a bit high, resulting in the good rating rather than very good. The final Nueces River below Uvalde plot is shown above.

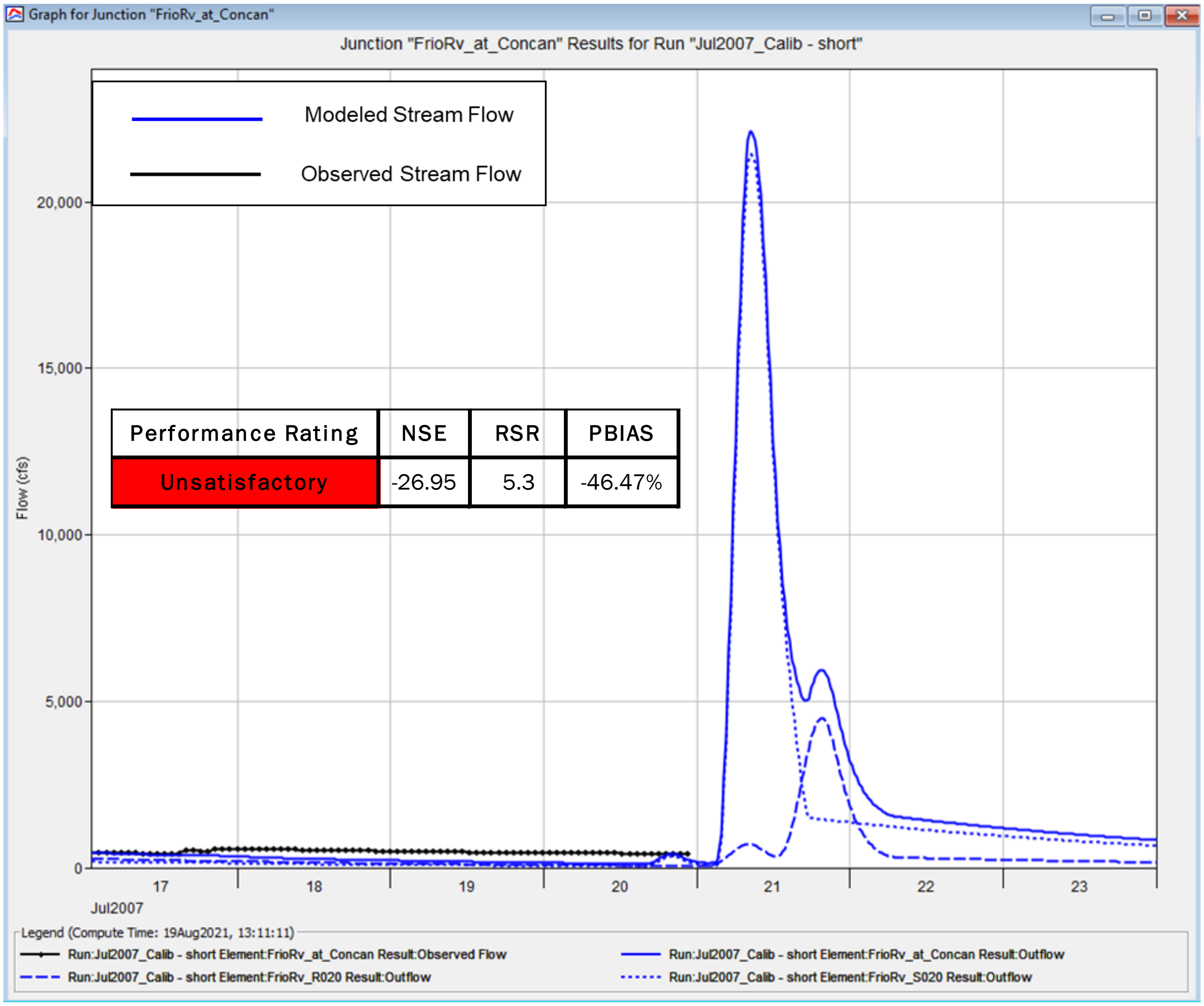


Figure B.103: July 2007 (Short) Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan observed hydrograph was missing. The peak discharge was unknown, but peak discharge was less than the Water Year 2007 annual peak of 36,400 cfs in June 2007. The Frio River at Concan plot is shown above. The unsatisfactory performance rating was due to missing observed data.

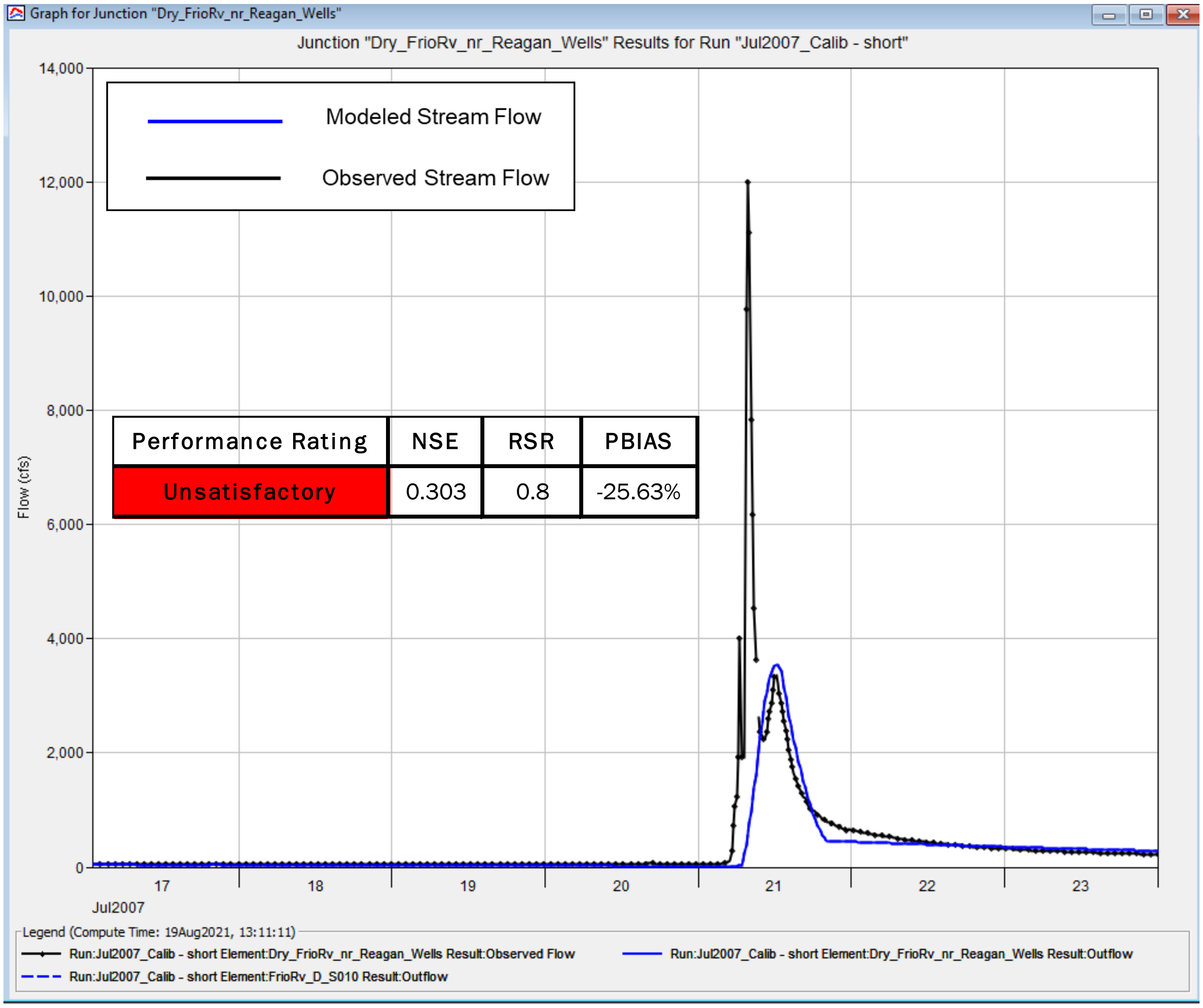
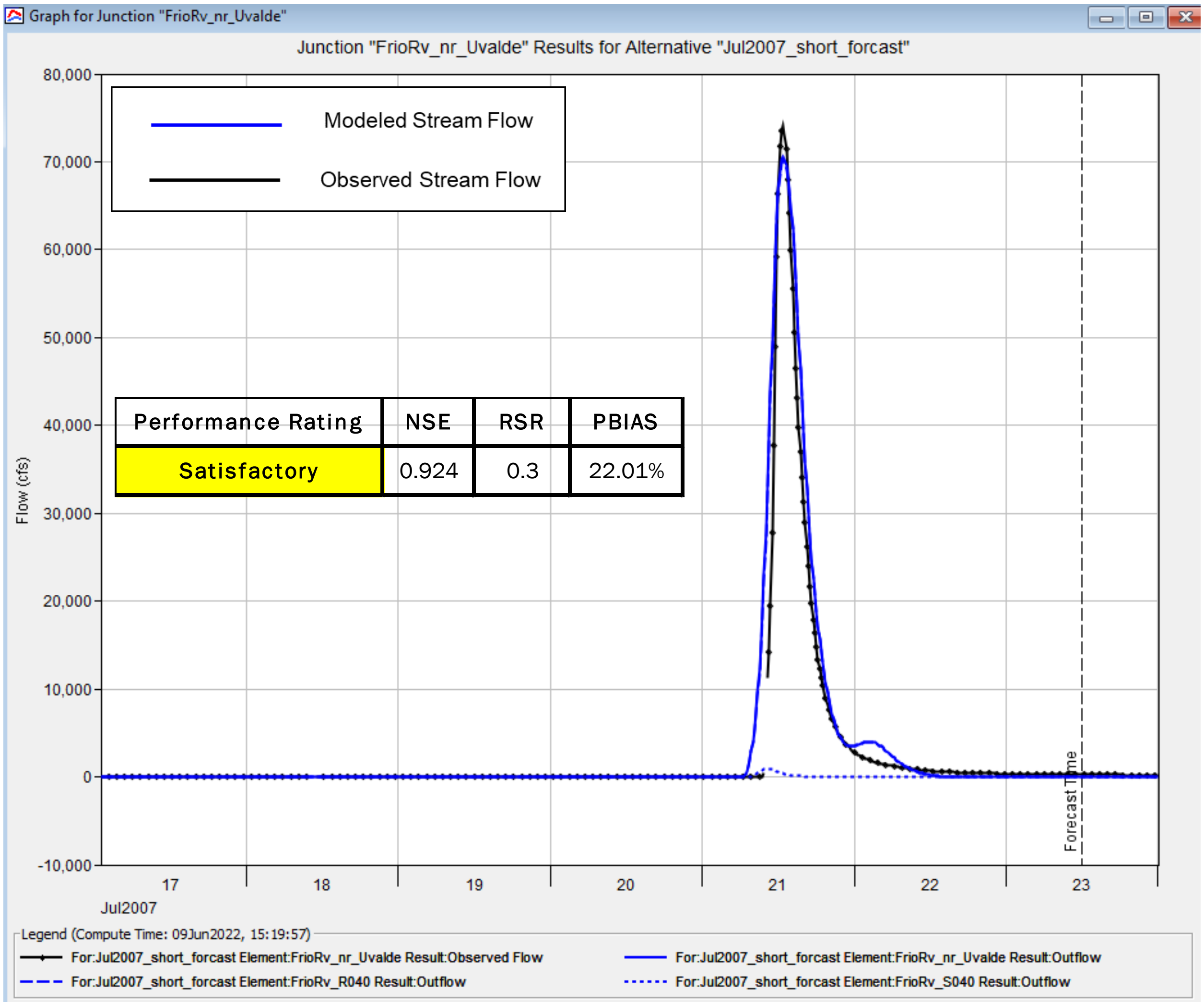


Figure B.104: July 2007 (Short) Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Dry Frio River near Reagan Wells gage had an “Unsatisfactory” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing, shape and magnitude of the second observed hydrograph very well, but it could not match the magnitude of the first peak. Heavy precipitation occurred on the lower portion of the watershed above the gage. NWS daily precipitation gages in the lower watershed at Laguna 3N (0700 hr.) and Utopia (0800 hr.) reported 4.11 inches, and 5.38 inches on July 21, respectively, whereas the subarea average precipitation from the NEXRAD data was only 1.40 inches for 24 hr. period ending at 0700 hr. on July 21. Therefore, the precipitation data likely underestimated the depth and intensity of the rainfall above this gage. The Dry Frio River near Reagan Wells plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Satisfactory	0.924	0.3	22.01%

Figure B.105: July 2007 (Short) Calibration Results for Frio River below Dry Frio near Uvalde USGS Gage

The Dry Frio River near Uvalde gage had a “Satisfactory” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing, shape and magnitude of the observed hydrograph very well, but the overall volume of flow was lower than observed, as reflected in the percent bias. However, a portion of the observed data was missing, which throws off the percent bias calculations. Therefore, the satisfactory performance rating does not accurately reflect the quality of the calibration. The Dry Frio River near Uvalde plot is shown above.

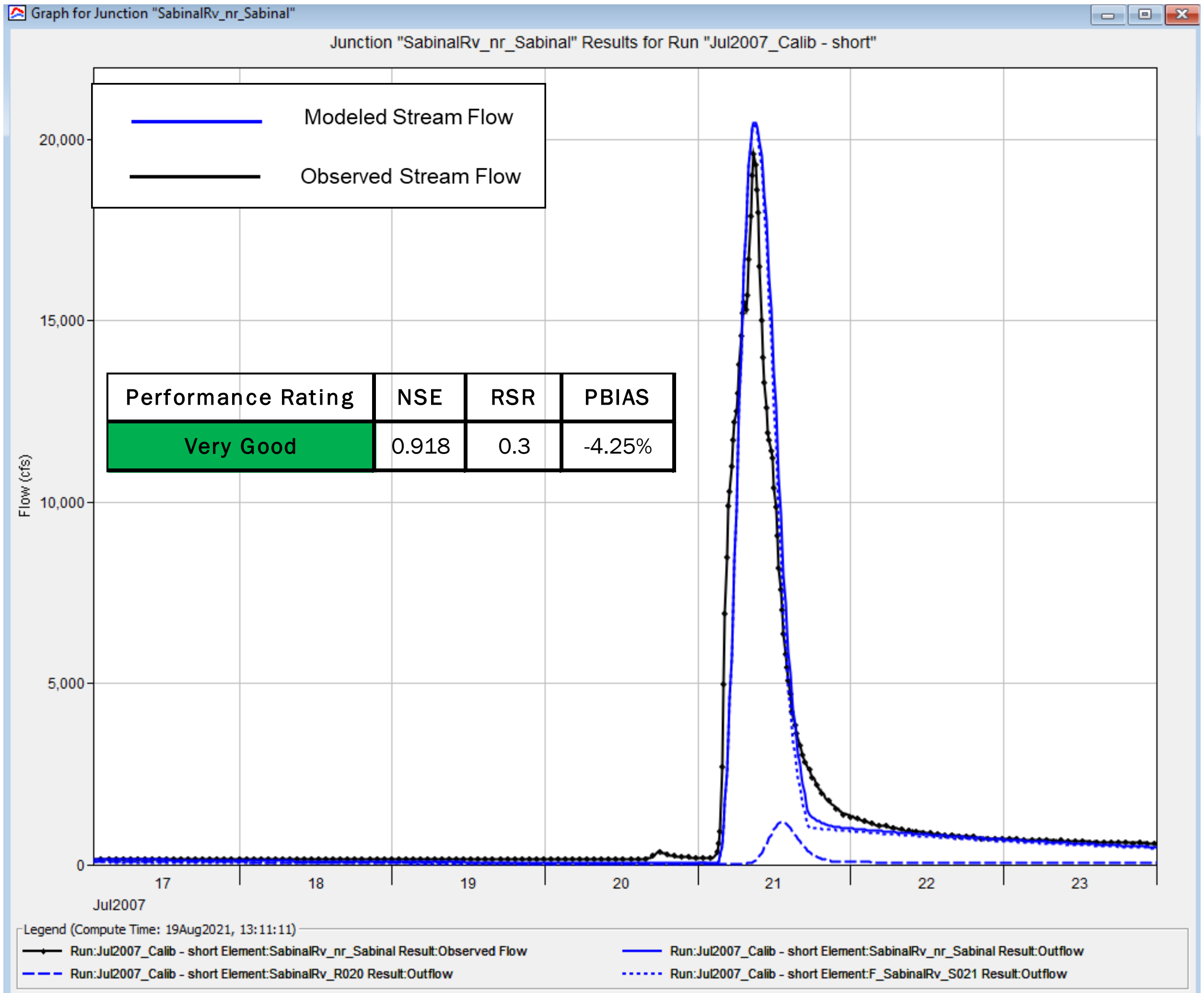


Figure B.106: July 2007 (Short) Calibration Results for Sabinal River near Sabinal USGS Gage

The Sabinal River near Sabinal gage achieved a “Very Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well, as shown in the above plot.

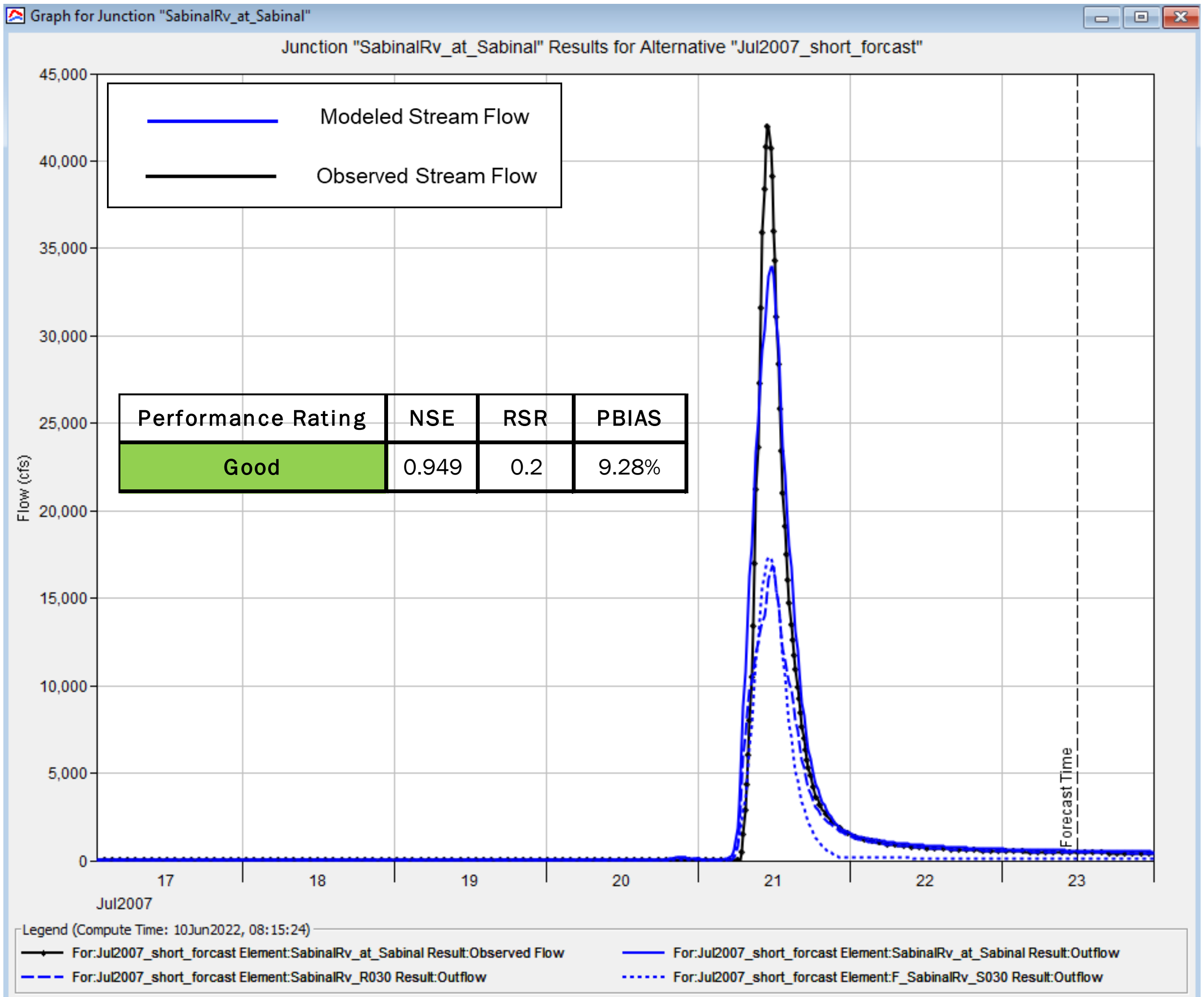


Figure B.107: July 2007 (Short) Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River near Sabinal gage achieved a “Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the timing and shape of the observed hydrograph very well, but it could not match the peak magnitude. The NEXRAD precipitation and or intensity could be underestimated. The Sabinal River at Sabinal plot is shown above.

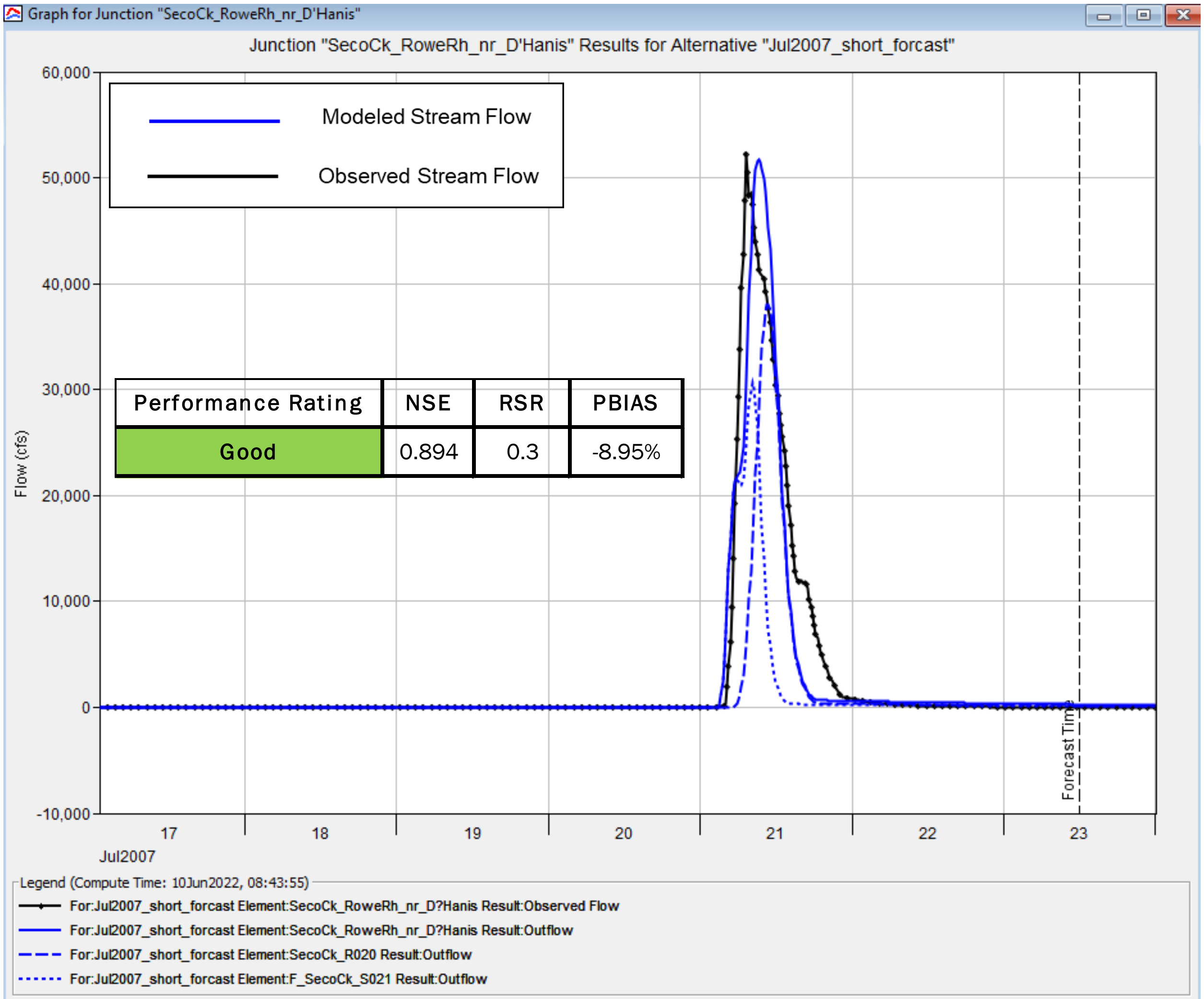


Figure B.108: July 2007 (Short) Calibration Results for Rowe Ranch near D'Hanis USGS Gage

The Seco Creek at Rowe Ranch near D'Hanis gage achieved a "Good" performance rating for the July 2007 (Short) event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph fairly well, but the timing and volume were a bit off. There may be an issue with the timing of the NEXRAD precipitation data. Observed peak at gage occurs at 0715 hrs. on July 21 and peak subarea average precipitation occurs about the same time, which is not physically possible. The Seco Creek at Rowe Ranch near D'Hanis plot is shown above.

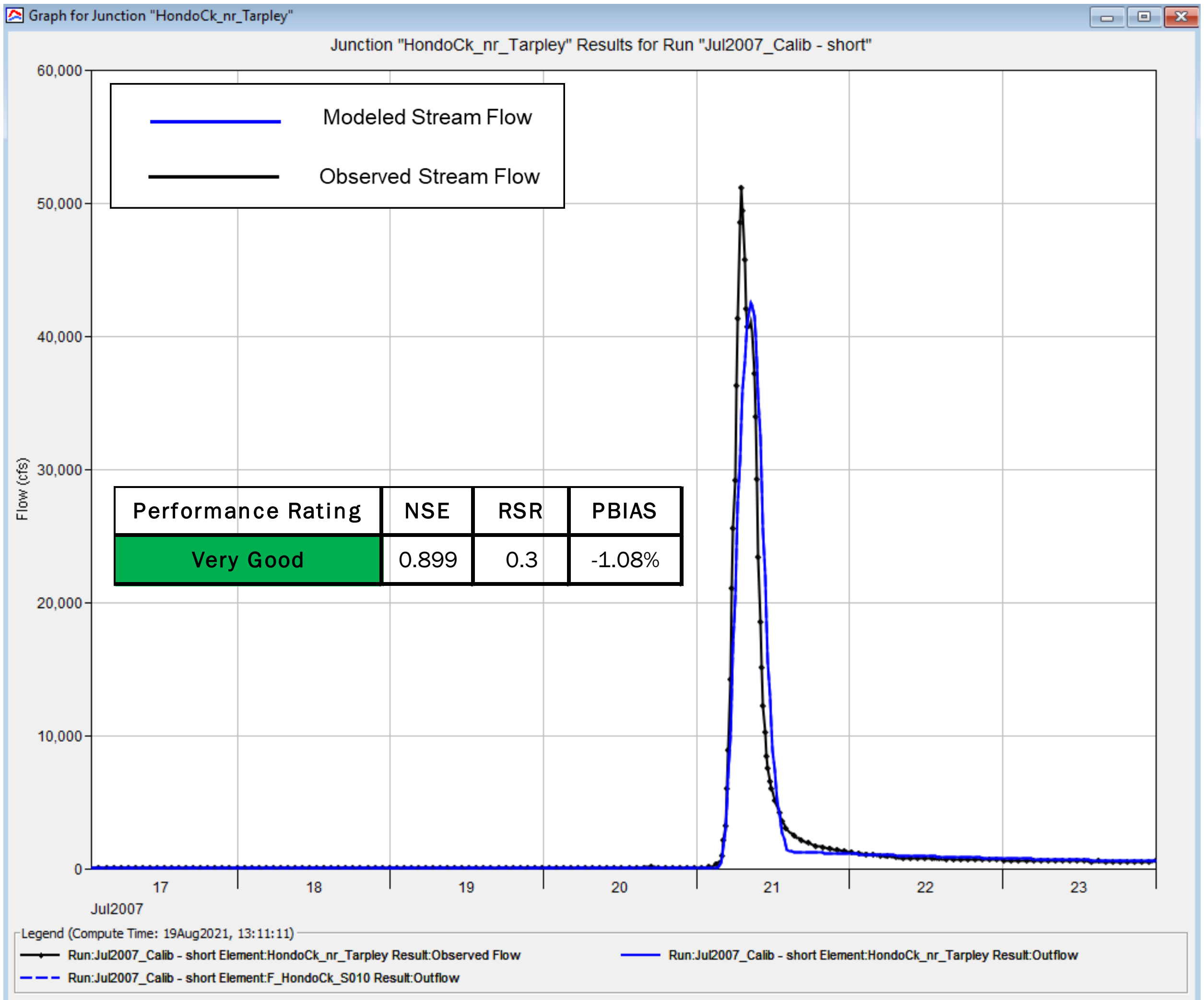


Figure B.109: July 2007 (Short) Calibration Results for Hondo Creek near Tarpley USGS Gage

The Hondo Creek near Tarpley gage achieved a “Very Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the shape and volume of the observed hydrograph very well, but the peak magnitude and timing were a bit off. There may be an issue with the timing of the NEXRAD precipitation data. Observed peak at gage occurs at 0700 hrs. on July 21 and peak subarea average precipitation occurs about the same time, which is not physically possible. The Hondo Creek near Tarpley plot is shown above.

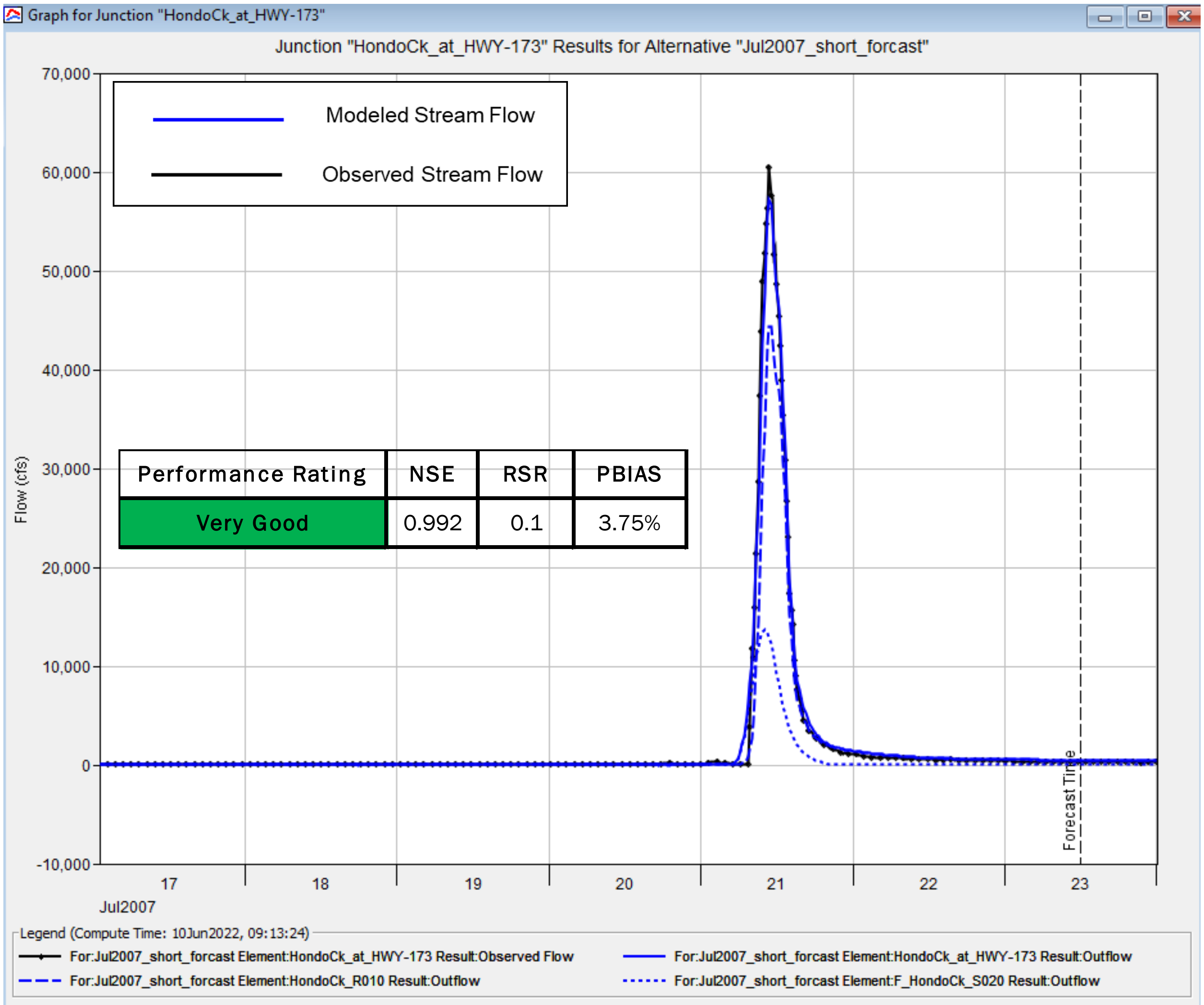
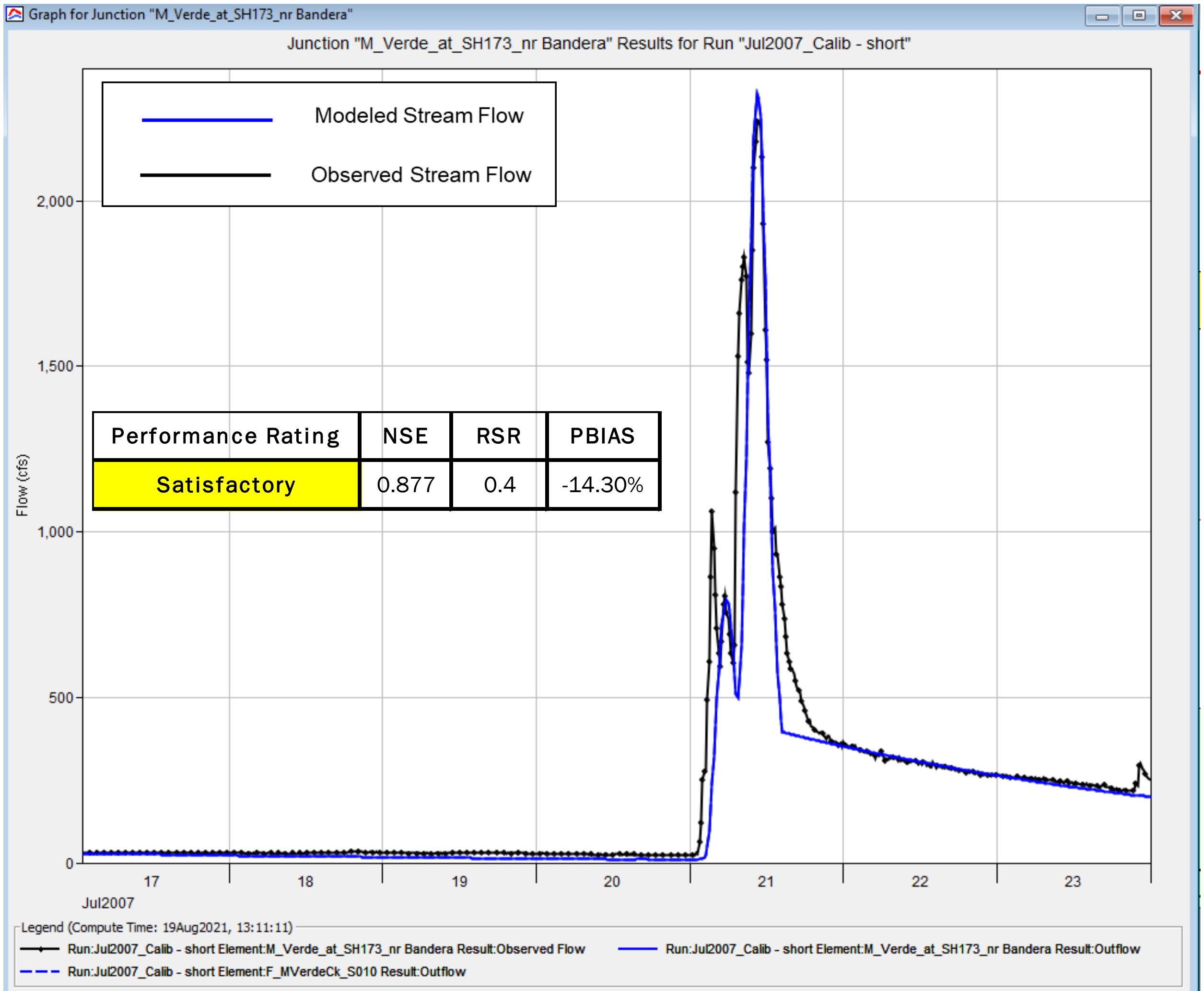


Figure B.110: July 2007 (Short) Calibration Results for Hondo Creek at SH 173 near Hondo USGS Gage

The Hondo Creek at SH 173 near Hondo gage achieved a “Very Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the shape, magnitude, timing and volume of the observed hydrograph very well. The observed peak discharge was 60,400 cfs on July 21, 2007. This gage was relatively new starting in July 2006, so there is greater uncertainty around the observed peak discharge. The Hondo Creek at SH 173 near Hondo plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Satisfactory	0.877	0.4	-14.30%

Figure B.111: July 2007 (Short) Calibration Results for Middle Verde Creek at SH 173 near Bandera USGS Gage

The Middle Verde Creek at SH 173 near Bandera gage had a "Satisfactory" performance rating for the July 2007 (Short) event. The HEC-HMS model matched the peak magnitude and timing of the observed hydrograph well, but the overall flow volume was a bit low, as represented in the percent bias. The Middle Verde Creek at SH 173 near Bandera plot is shown above.

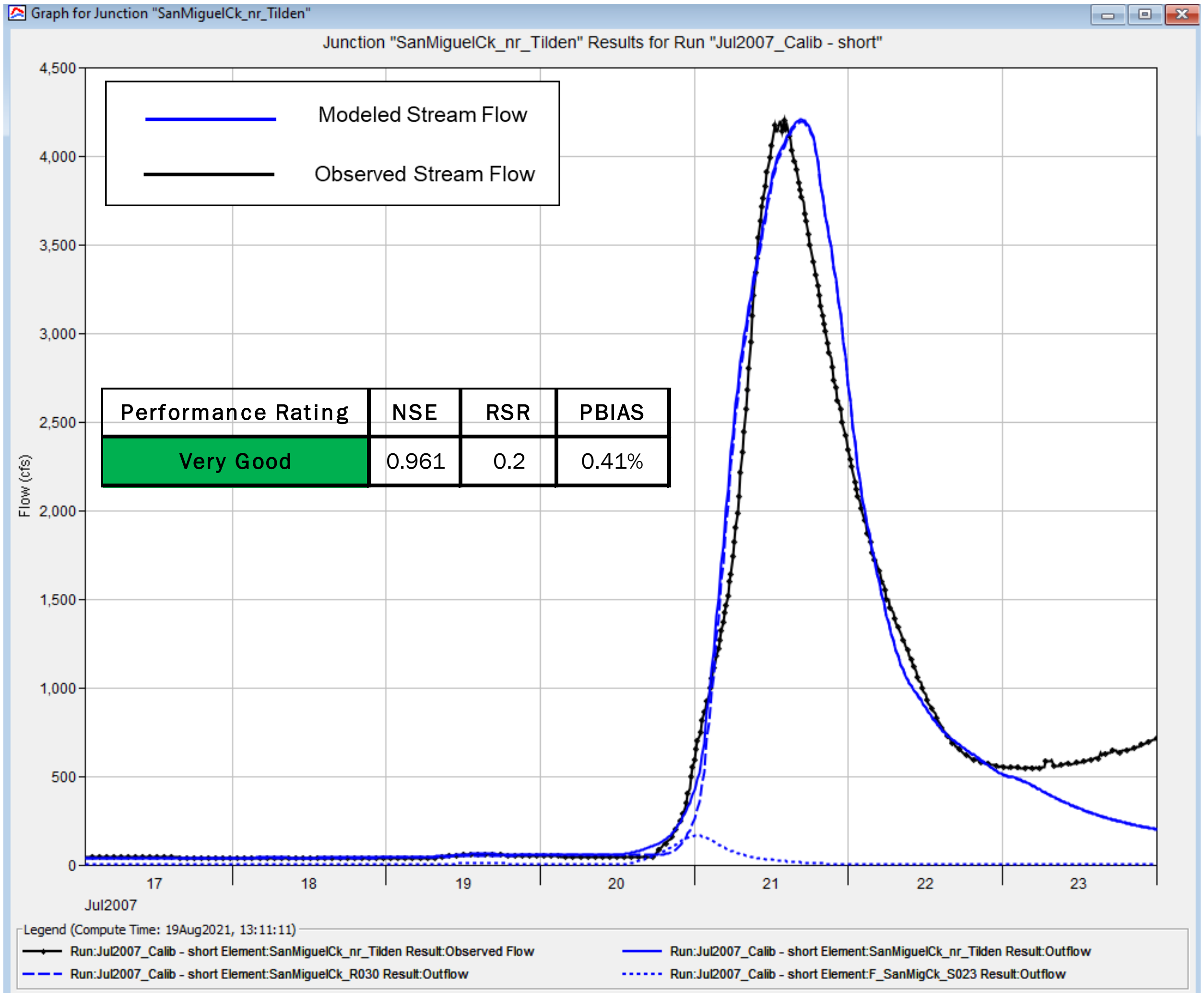


Figure B.112: July 2007 (Short) Calibration Results for San Miguel Creek near Tilden USGS Gage

The San Miguel Creek near Tilden gage achieved a “Very Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the peak magnitude, shape, timing and volume of the observed hydrograph well. The San Miguel Creek near Tilden plot is shown above.

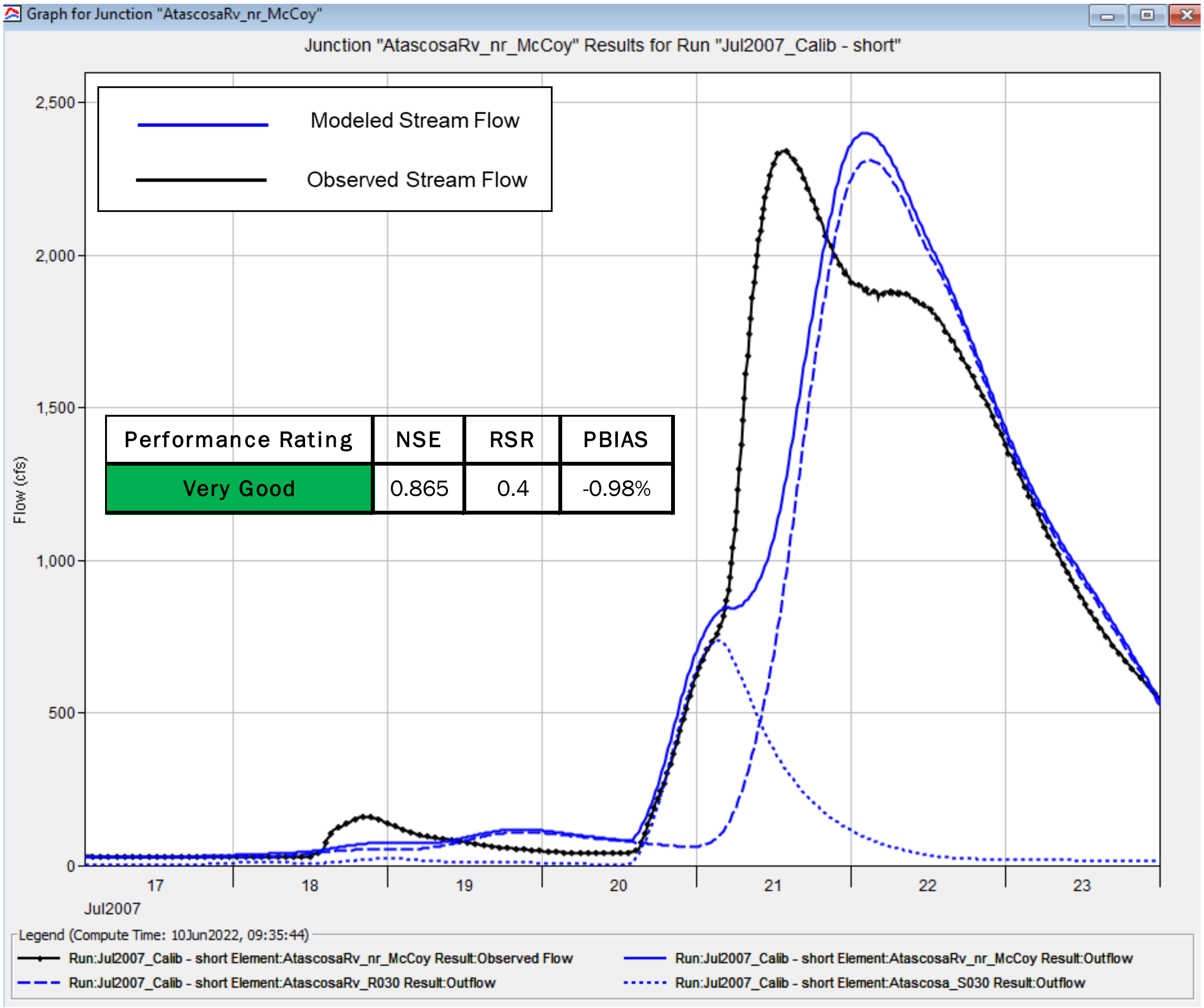


Figure B.113: July 2007 (Short) Calibration Results for Atascosa River near McCoy USGS Gage

The Atascosa River near McCoy gage achieved a “Very Good” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph very well, but the peak timing was off. The NEXRAD precipitation and or intensity is probably underestimated on July 21. The Atascosa River near McCoy plot is shown above.

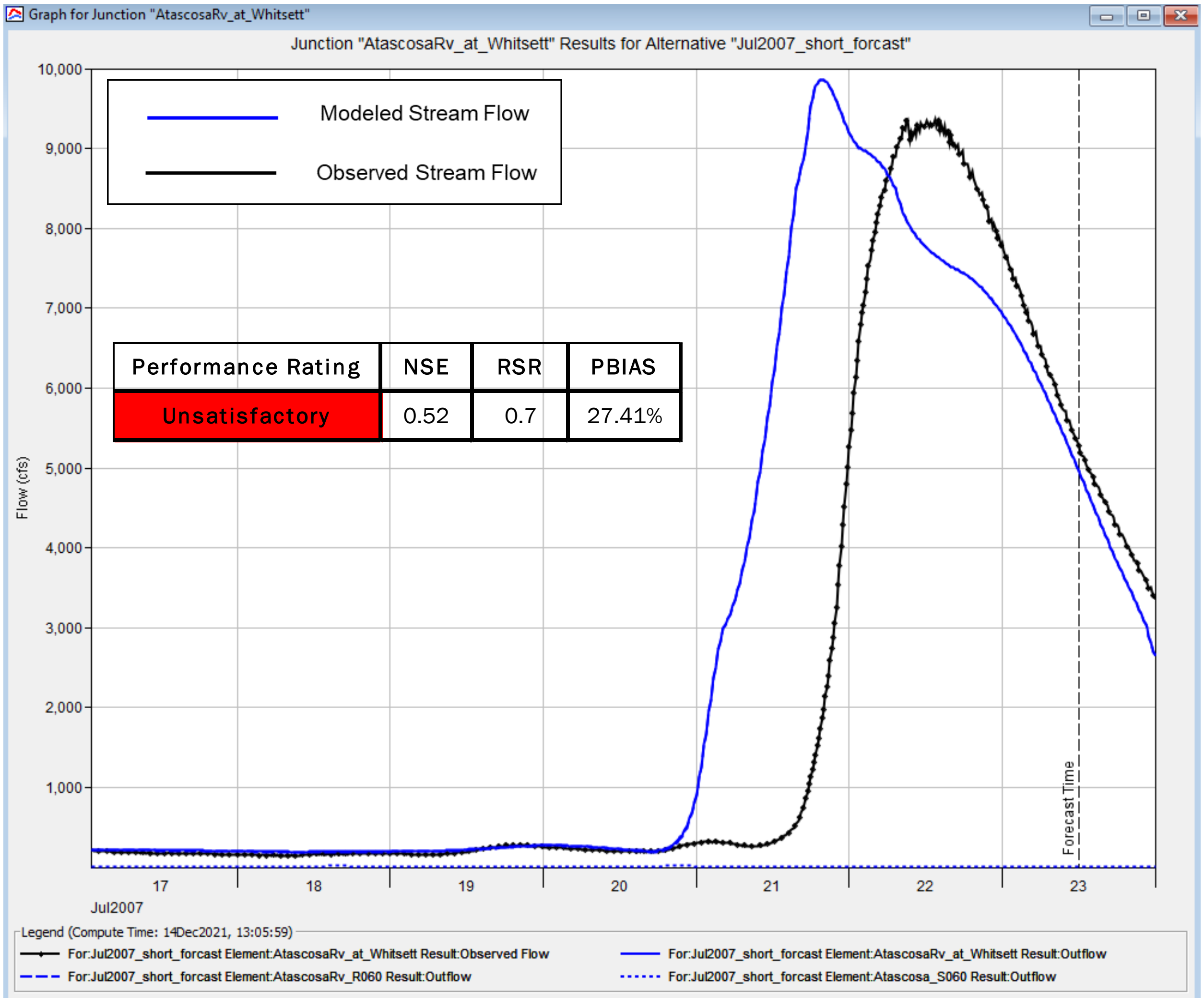


Figure B.114: July 2007 (Short) Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage had an “Unsatisfactory” performance rating for the July 2007 (Short) event. The HEC-HMS model matched the magnitude and shape of the observed hydrograph very well, but the peak timing was off. Based on a comparison to nearby NWS daily rainfall gages, it appears that the NEXRAD precipitation is underestimated on July 22. The unsatisfactory performance rating was due to a higher overall hydrograph volume reflected in the percent bias and the timing issue. The Atascosa River at Whitsett plot is shown above.

1.4.4.9 July 2007 late Event

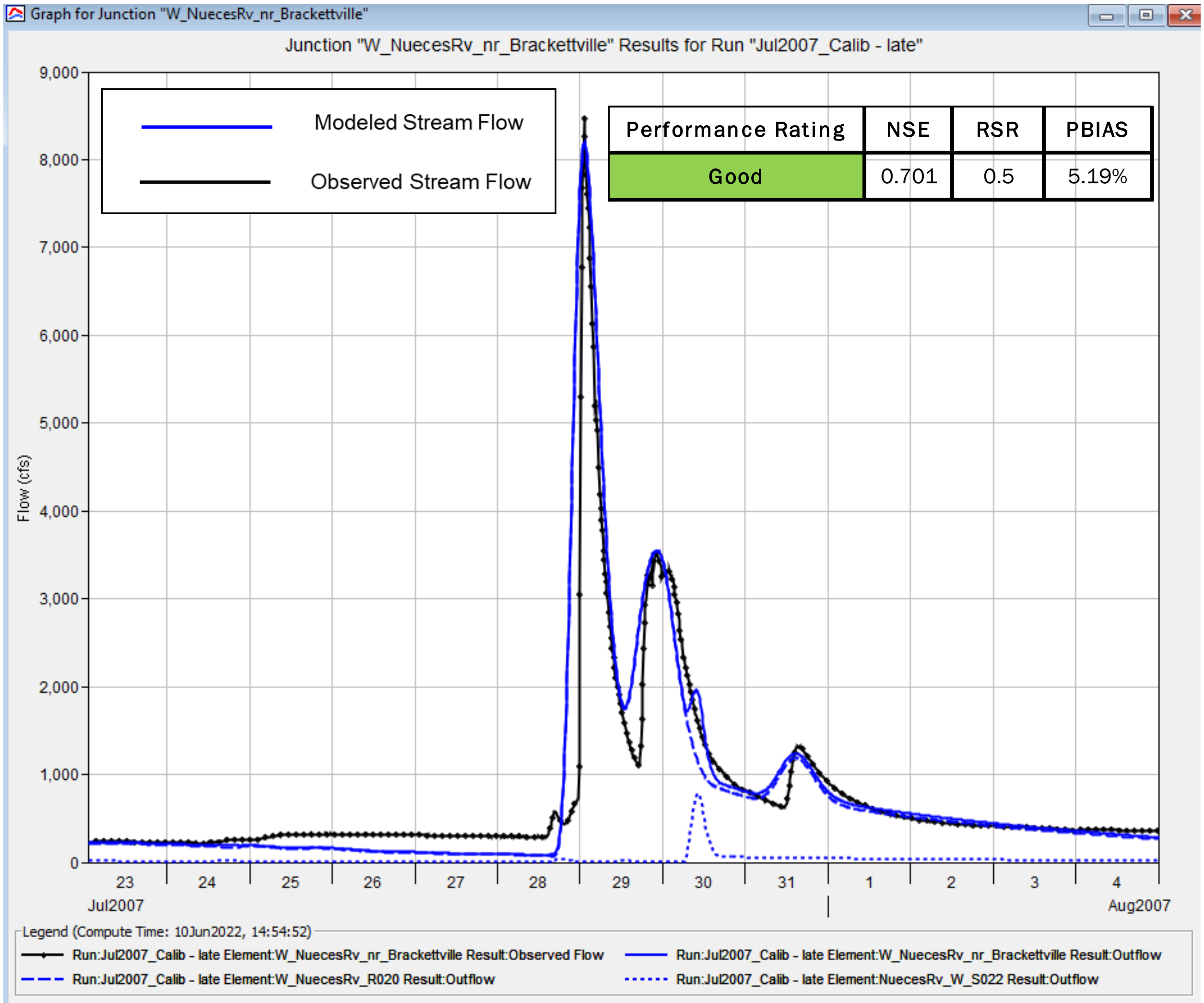


Figure B.115: July 2007 (Late) Calibration Results for West Nueces River near Brackettville USGS Gage

The West Nueces River near Brackettville gage achieved a “Good” performance rating for the July 2007 (Late) event. The HEC-HMS model matched the magnitude, timing and volume of the observed hydrograph very well, but the shape was a bit off in the lower flow range, resulting in the good rating rather than very good. The West Nueces River near Brackettville plot is shown above.

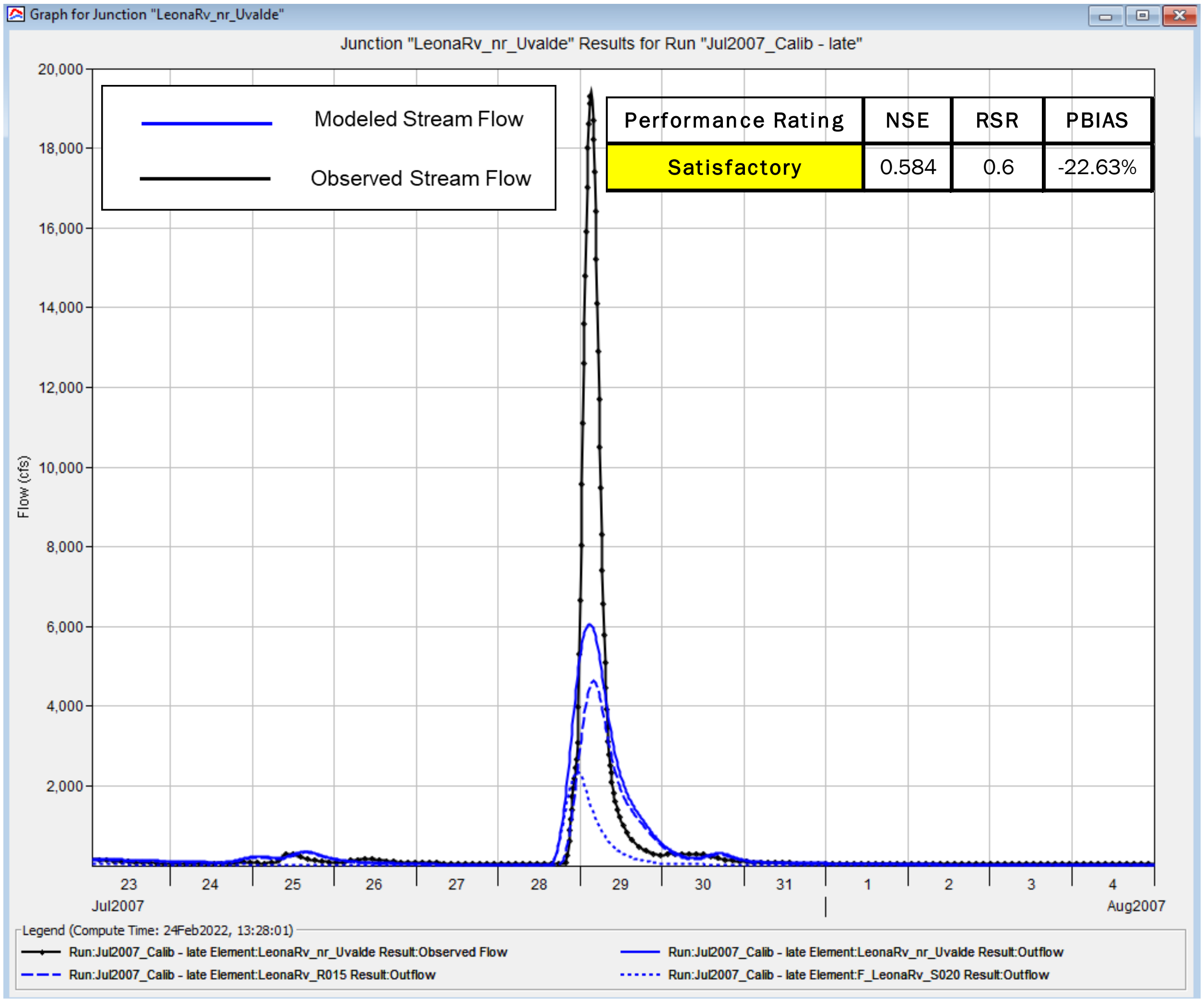


Figure B.116: July 2007 (Late) Calibration Results for Leona River near Uvalde USGS Gage

The Leona River near Uvalde gage had a “Satisfactory” performance rating for the July 2007 (Late) event. The HEC-HMS model matched the timing of the observed hydrograph well, but was not able to match the magnitude of the peak discharge. The overall flow volume was also low, as reflected in the percent bias. The NEXRAD precipitation and or intensity could be underestimated in this location. There may also be some uncertainty with the observed peak discharge since the highest discharge on the USGS rating curve is only 6,000 cfs. This gage was still relatively new in 2007 since it just started in March 2003. The Leona River near Uvalde plot is shown above.

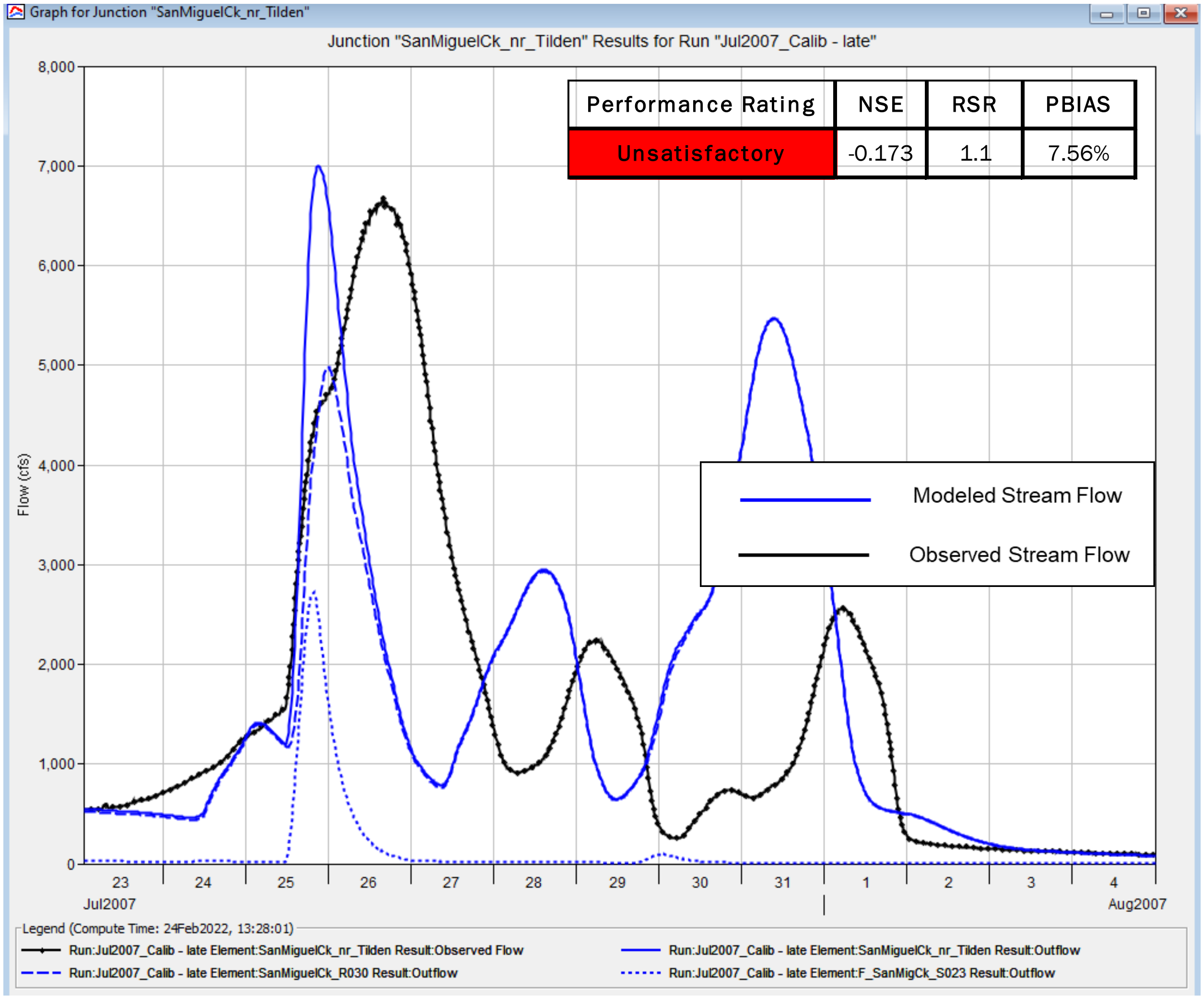


Figure B.117: July 2007 (Late) Calibration Results for San Miguel Creek near Tilden USGS Gage

The San Miguel Creek near Tilden gage had an "Unsatisfactory" performance rating for the July 2007 (Late) event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph fairly well, but the timing was off by about a day. Since this was the only event that had this issue at this location, there may be a problem with the NEXRAD precipitation data. The San Miguel Creek near Tilden plot is shown above.

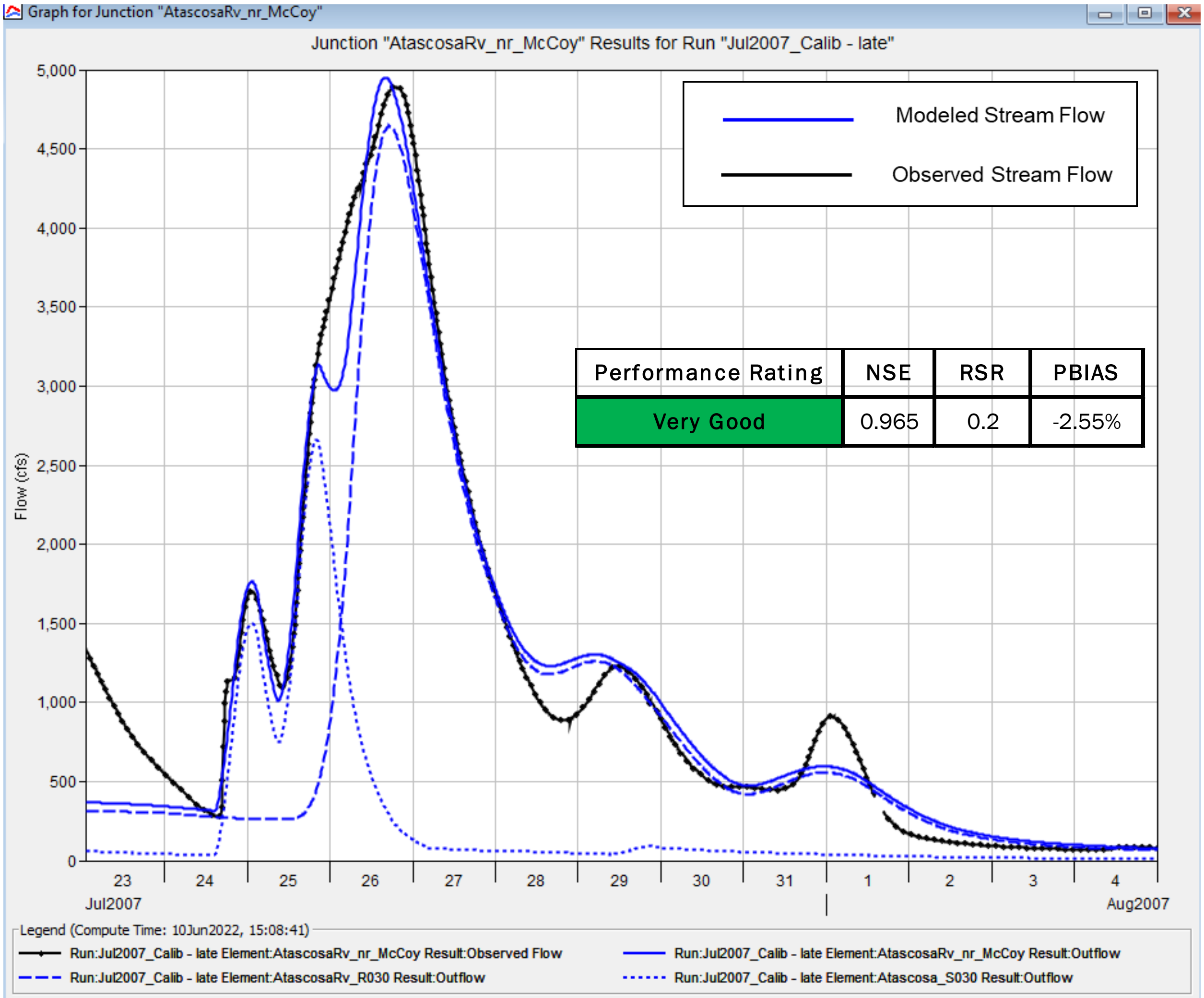


Figure B.118: July 2007 (Late) Calibration Results for Atascosa River near McCoy USGS Gage

The Atascosa River near McCoy gage achieved a “Very Good” performance rating for the July 2007 (Late) event. The HEC-HMS model matched the magnitude, timing, shape and volume of the observed hydrograph very well. The Atascosa River near McCoy plot is shown above.

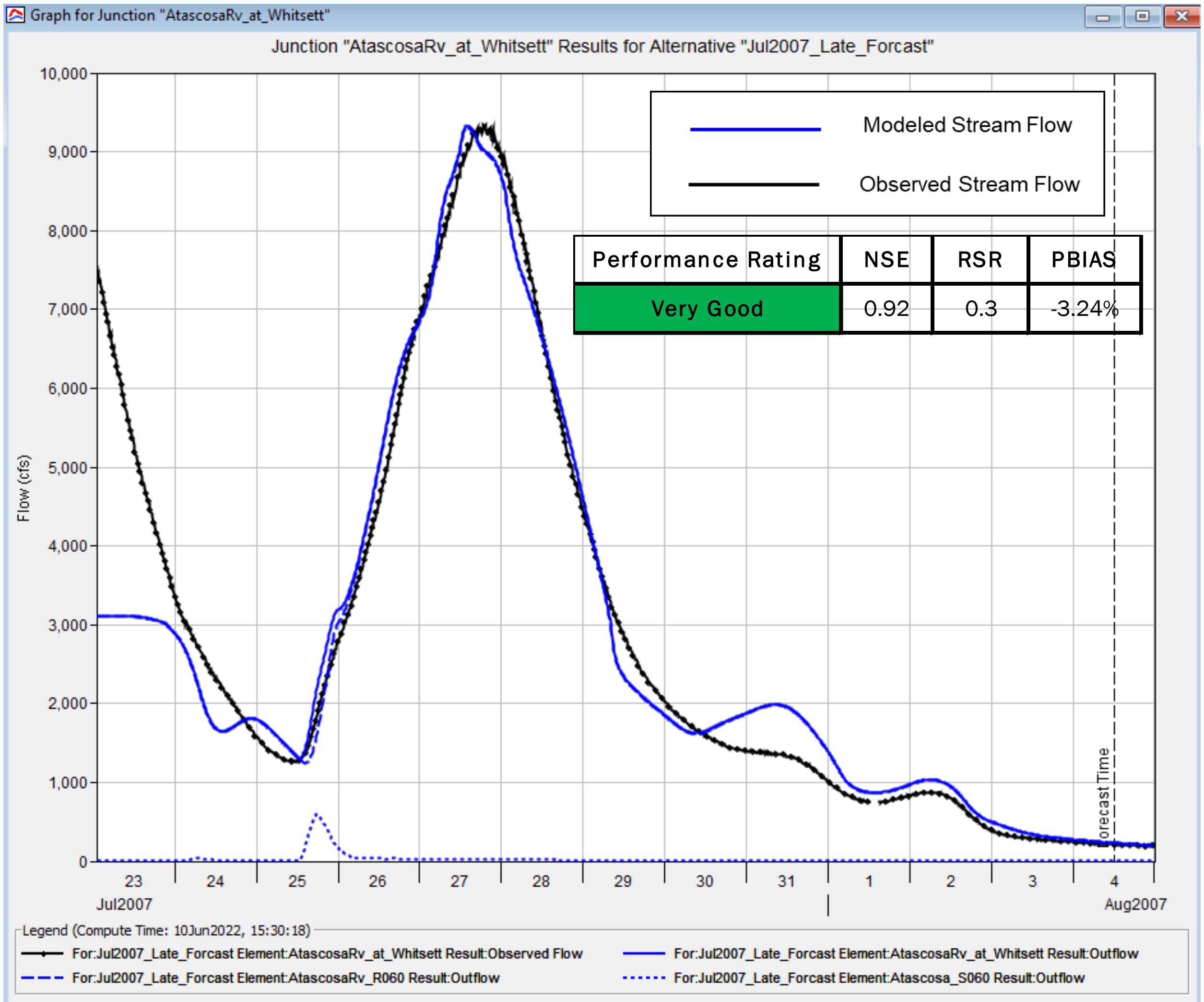
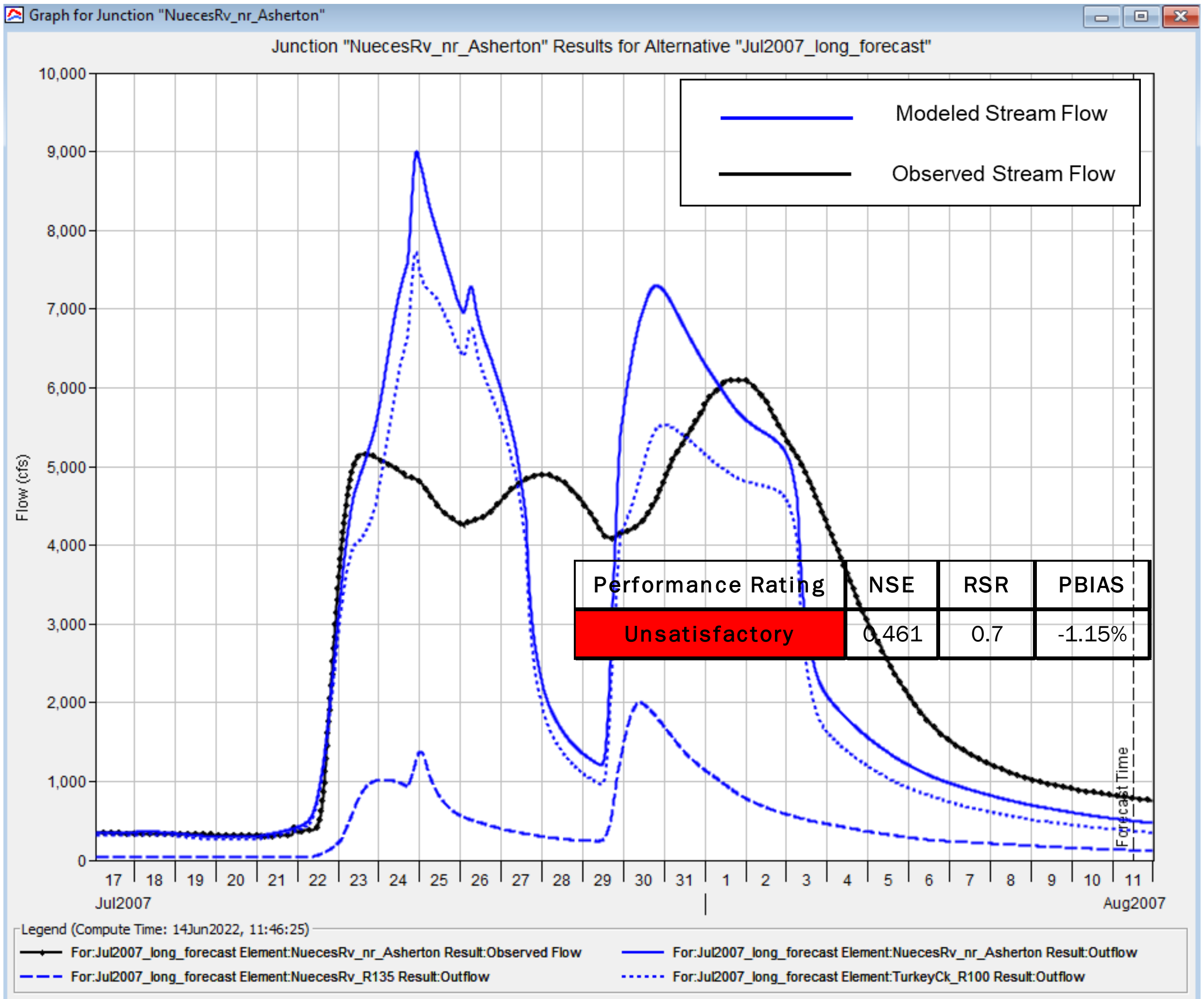


Figure B.119: July 2007 (Late) Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage achieved a “Very Good” performance rating for the July 2007 (Late) event. The HEC-HMS model matched the magnitude, timing, shape and volume of the observed hydrograph very well. The Atascosa River at Whitsett plot is shown above.

1.4.4.10 July 2007 long Event



Performance Rating	NSE	RSR	PBIAS
Unsatisfactory	0.461	0.7	-1.15%

Figure B.120: July 2007 (Long) Calibration Results for Nueces River near Asherton USGS Gage

The Nueces River near Asherton gage had an “Unsatisfactory” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing and volume of the observed hydrograph fairly well, but the shape and peak magnitude were off. This is an area with very complex flow interactions, including a split flow between the Nueces River and Espantosa Slough/Soldier Slough and several low water irrigation dams. A 2D HEC-RAS analysis was used to calculate the split flow diversion as well as the Modified Puls storage volumes in the routing reaches. However, since this was a minor flood event at this gage, there was minimal effort made to calibrate to this event. The Nueces River near Asherton plot is shown above.

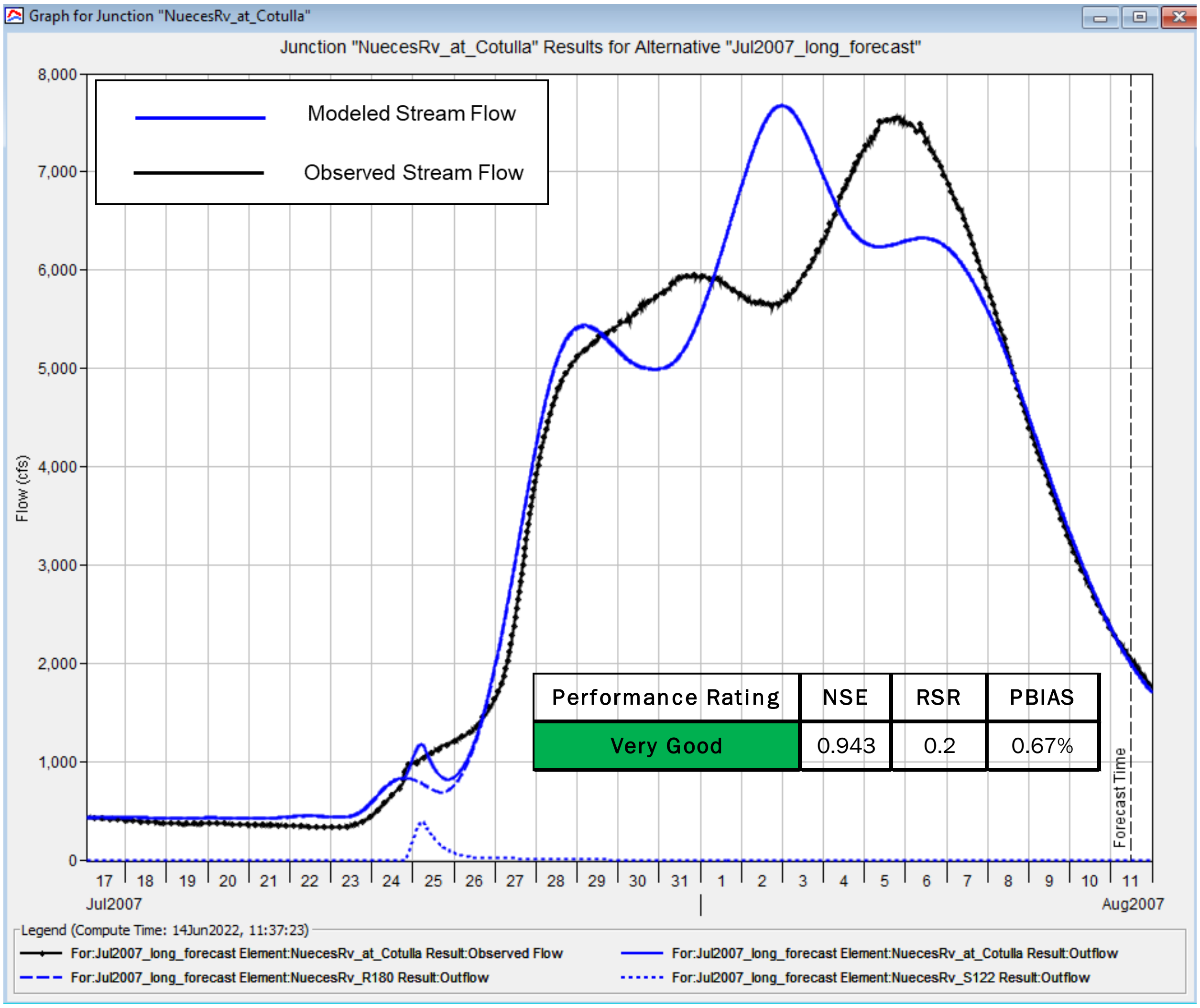


Figure B.121: July 2007 (Long) Calibration Results for Nueces River at Cotulla USGS Gage

The Nueces River at Cotulla gage achieved a “Very Good” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph very well, but the peak timing was off by several days. The timing issue may be related to the Muskingum routing methods above this gage, which assumes a single travel time for all flow rates. However, the peak magnitude was still reasonable, which is what is needed for the frequency storms. The Nueces River at Cotulla plot is shown above.

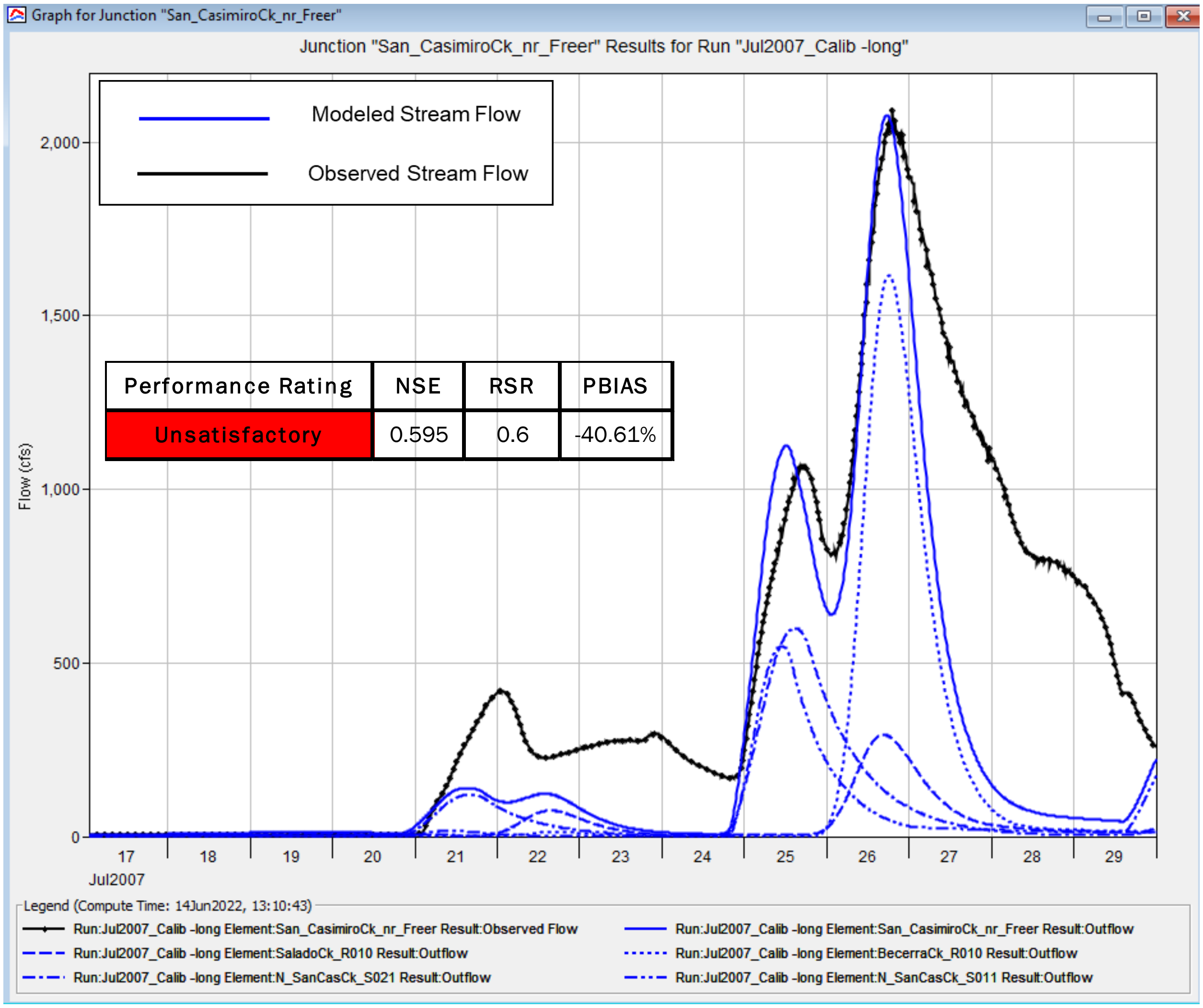


Figure B.122: July 2007 (Long) Calibration Results for San Casimiro Creek near Freer USGS Gage

The San Casimiro Creek near Freer gage had an “Unsatisfactory” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the peak magnitude and timing of the observed hydrograph well, but the shape overall flow volume were off. These differences were most likely caused by the effects of the multiple dams located upstream of this gage. These dams are not included in the HEC-HMS model. The San Casimiro Creek near Freer plot is shown above.

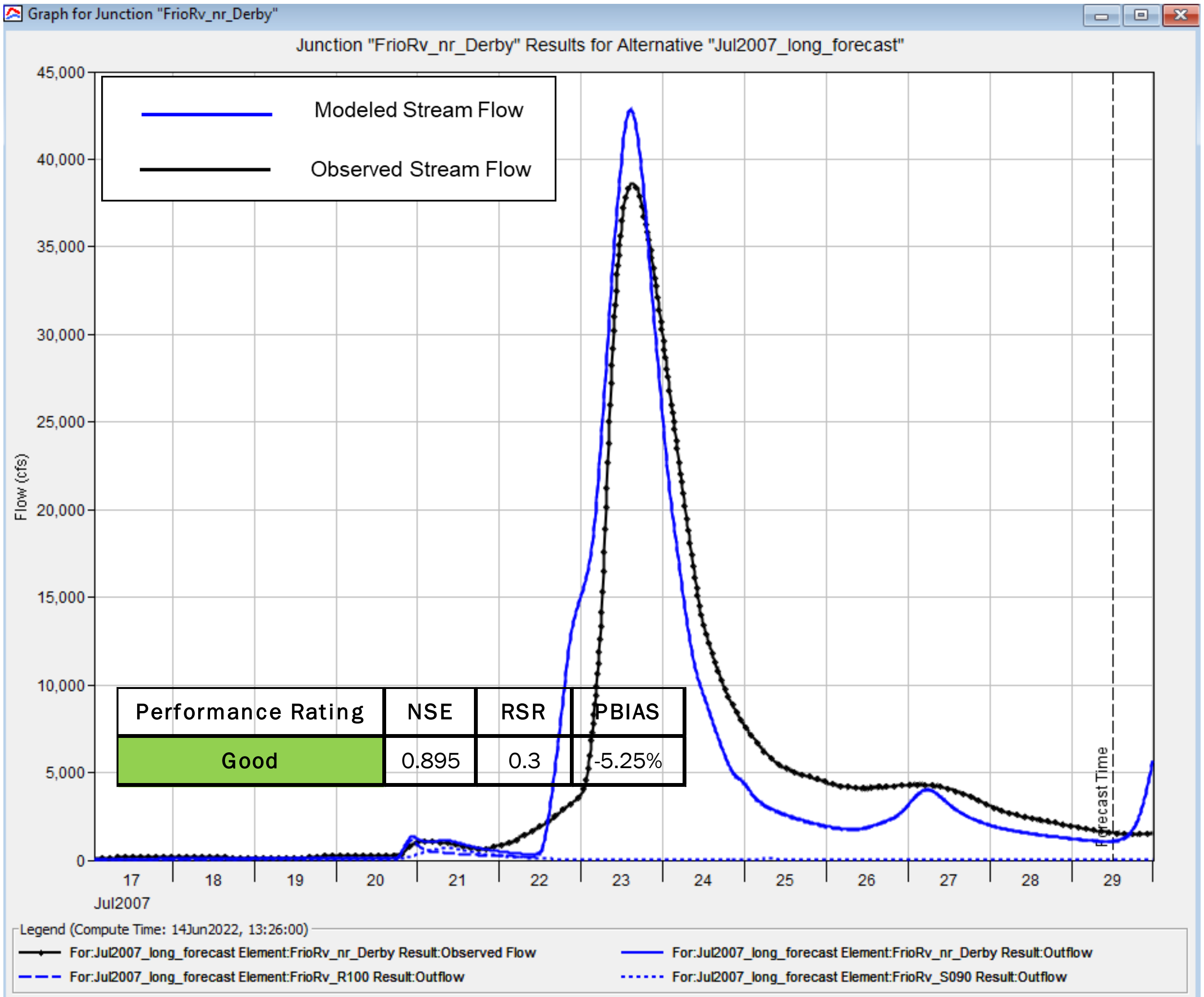


Figure B.123: July 2007 (Long) Calibration Results for Frio River near Derby USGS Gage

The Frio River near Derby gage achieved a “Good” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the shape, timing and volume of the observed hydrograph very well, but the peak magnitude was a bit high. The Frio River near Derby plot is shown above.

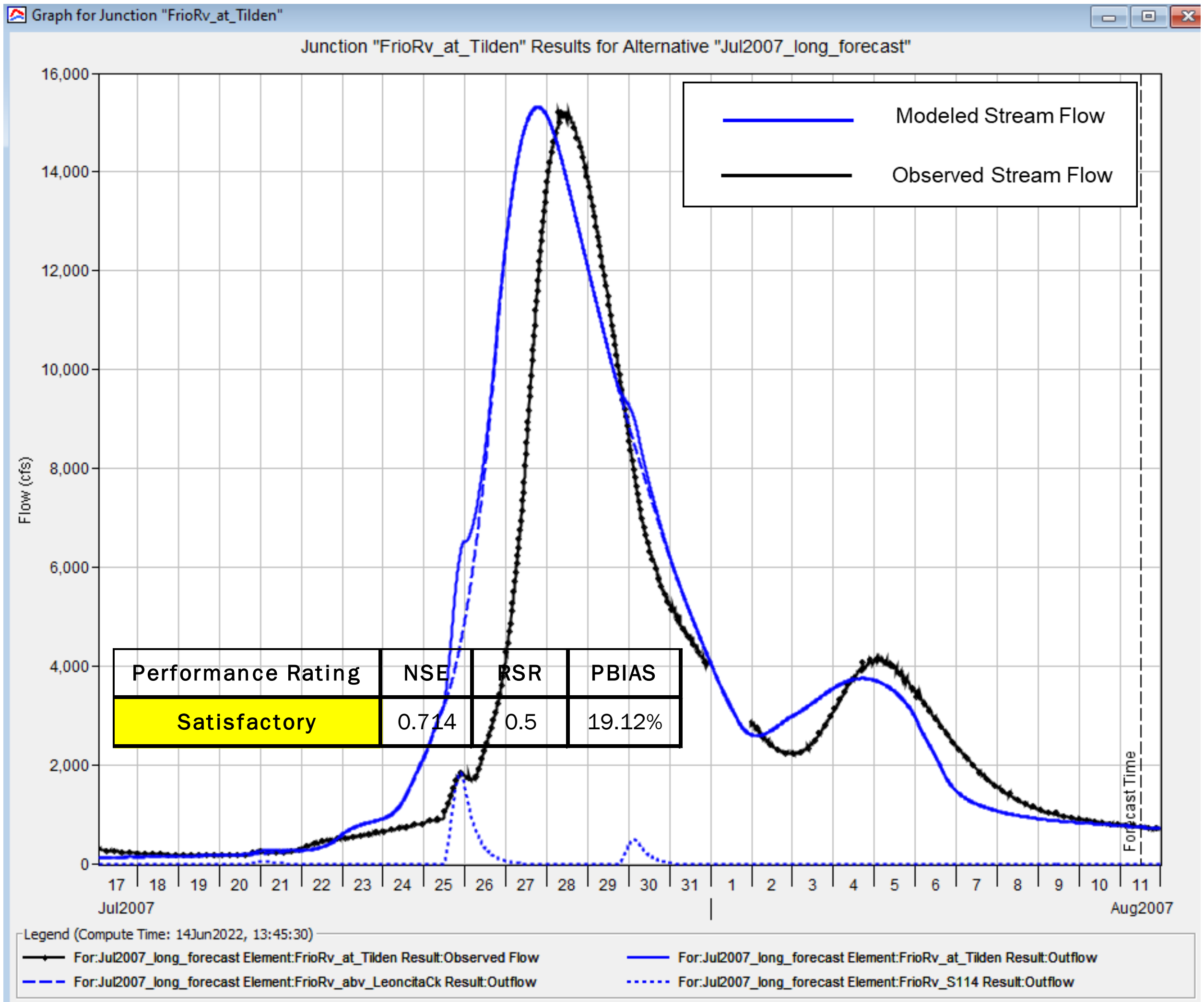


Figure B.124: July 2007 (Long) Calibration Results for Frio River at Tilden USGS Gage

The Frio River at Tilden gage had a "Satisfactory" performance rating for the July 2007 (Long) event. The HEC-HMS model matched the shape and magnitude of the observed hydrograph very well, but the timing and overall flow volume were a bit off. The computed hydrograph is mainly coming from the routed upstream hydrographs of at the Frio River near Derby gage. There could be an issue with Mod Puls routing on the Frio River reaches. However, the other calibration events did not show signs of any problems. The Frio River at Tilden plot is shown above.

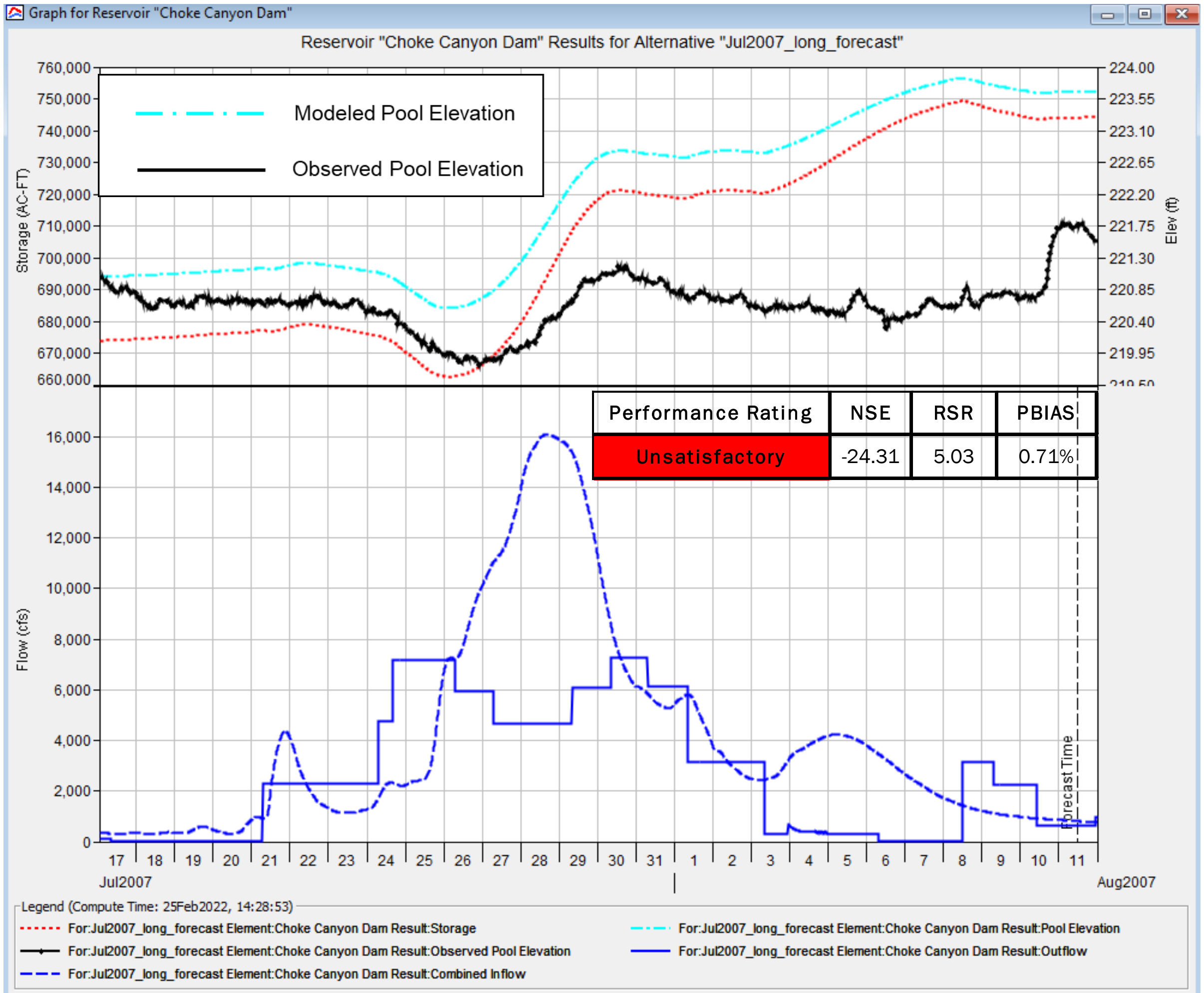


Figure B.125: July 2007 (Long) Calibration Results for Choke Canyon Reservoir Gage

The Choke Canyon Reservoir gage achieved an “Unsatisfactory” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing and shape of the observed pool rise well, but the inflow volume was much larger than the observed outflow, causing the computed pool to continue to rise above the observed levels. This difference in inflow and outflow volumes may have been caused by errors in either the observed releases or the observed flow hydrographs at the upstream gages. The Choke Canyon radial gate release information was obtained from gate logs supplied by the City of Corpus Christi. However, they supplied only daily gate opening information that had to be translated into outflows using the gates’ rating curves. At the upstream gages for the Frio River at Tilden gage and San Miguel Creek near Tilden, forecast mode was used in HEC-HMS to blend in the observed hydrographs. However, there is uncertainty associated with the observed flow volumes due to the limited number of flow measurements in the high flow range. The Choke Canyon Reservoir plot is shown above.

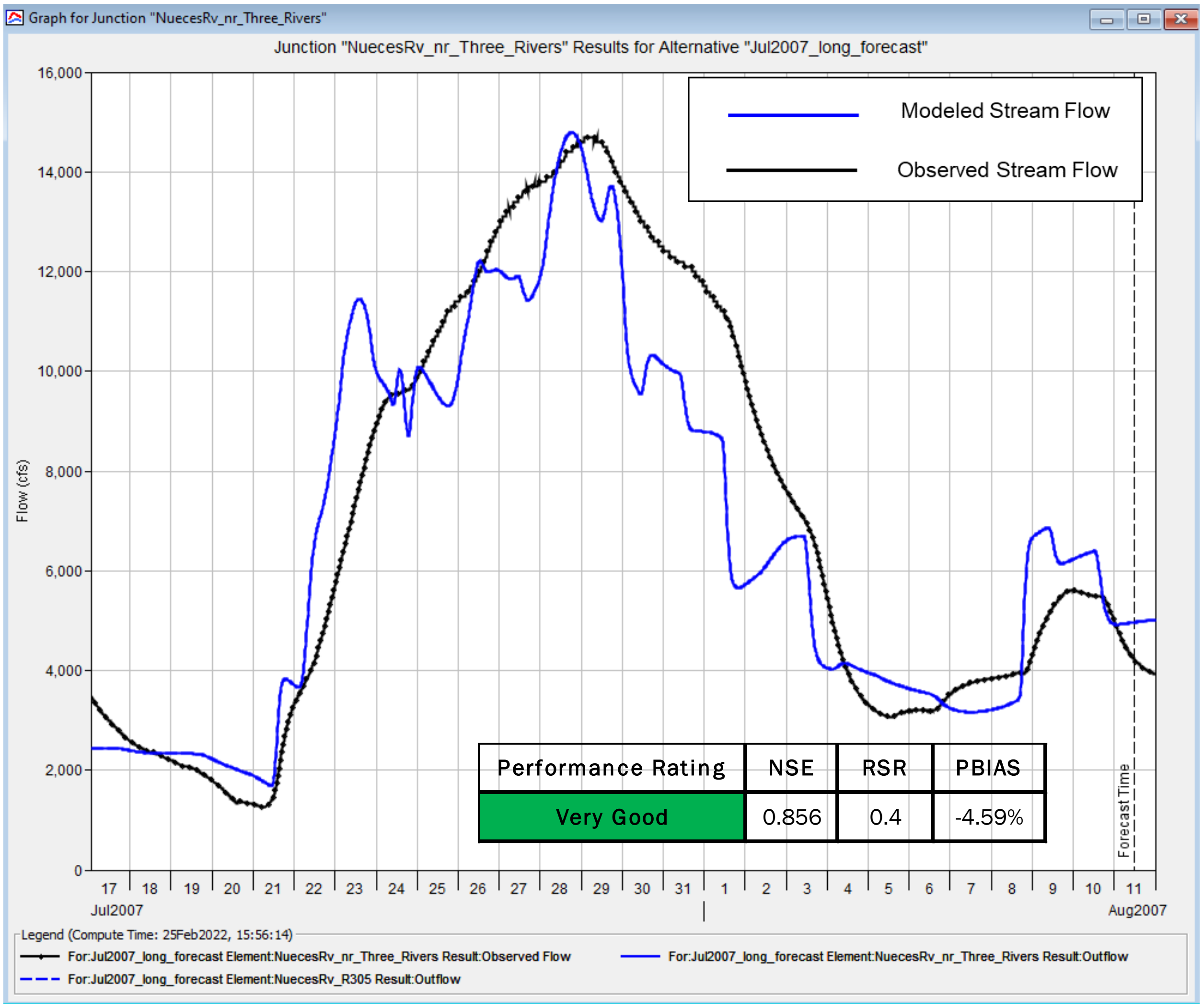


Figure B.126: July 2007 (Long) Calibration Results for Nueces River near Three Rivers Gage

The Nueces River near Three Rivers gage achieved a "Very Good" performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing, magnitude and volume of the observed hydrograph very well, but the shape was different. Forecast mode was used in the HEC-HMS model with blending at the Nueces River near Tilden gage and Atascosa River at Whitsett gage, and the computed observed releases were used in the HEC-HMS model as releases from Choke Canyon Reservoir. Most of the flow at the Three Rivers gage is coming from Atascosa River and Choke Canyon releases. The releases from Choke Canyon Reservoir could be underestimated. The Nueces River near Three Rivers plot is shown above.

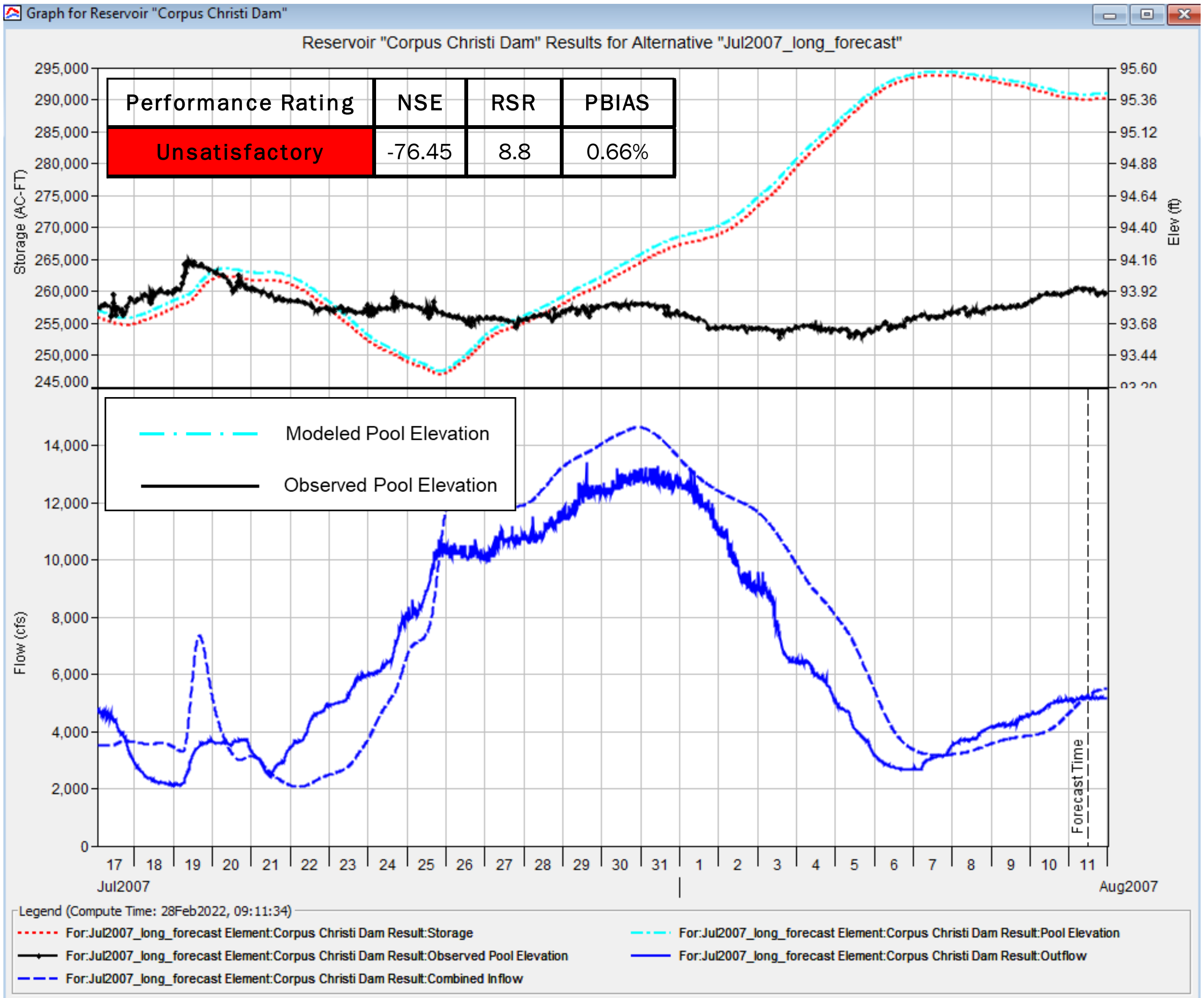


Figure B.127: July 2007 (Long) Calibration Results for Lake Corpus Christi Gage

The Lake Corpus Christi calibration for July 2007 (Long) had an "Unsatisfactory" performance rating. The HEC-HMS model could not match the level observed pool elevations. There seems to be a discrepancy with the observed releases and the inflows from the upstream gage. Lake Corpus Christi also had an unsatisfactory performance rating because of its level pool operations. The observed pool elevation of the lake only varied by less than half a foot throughout the entire event. This results in poor statistics for even small, computed deviations from the observed pool elevation. The Lake Corpus Christi plot is shown above.

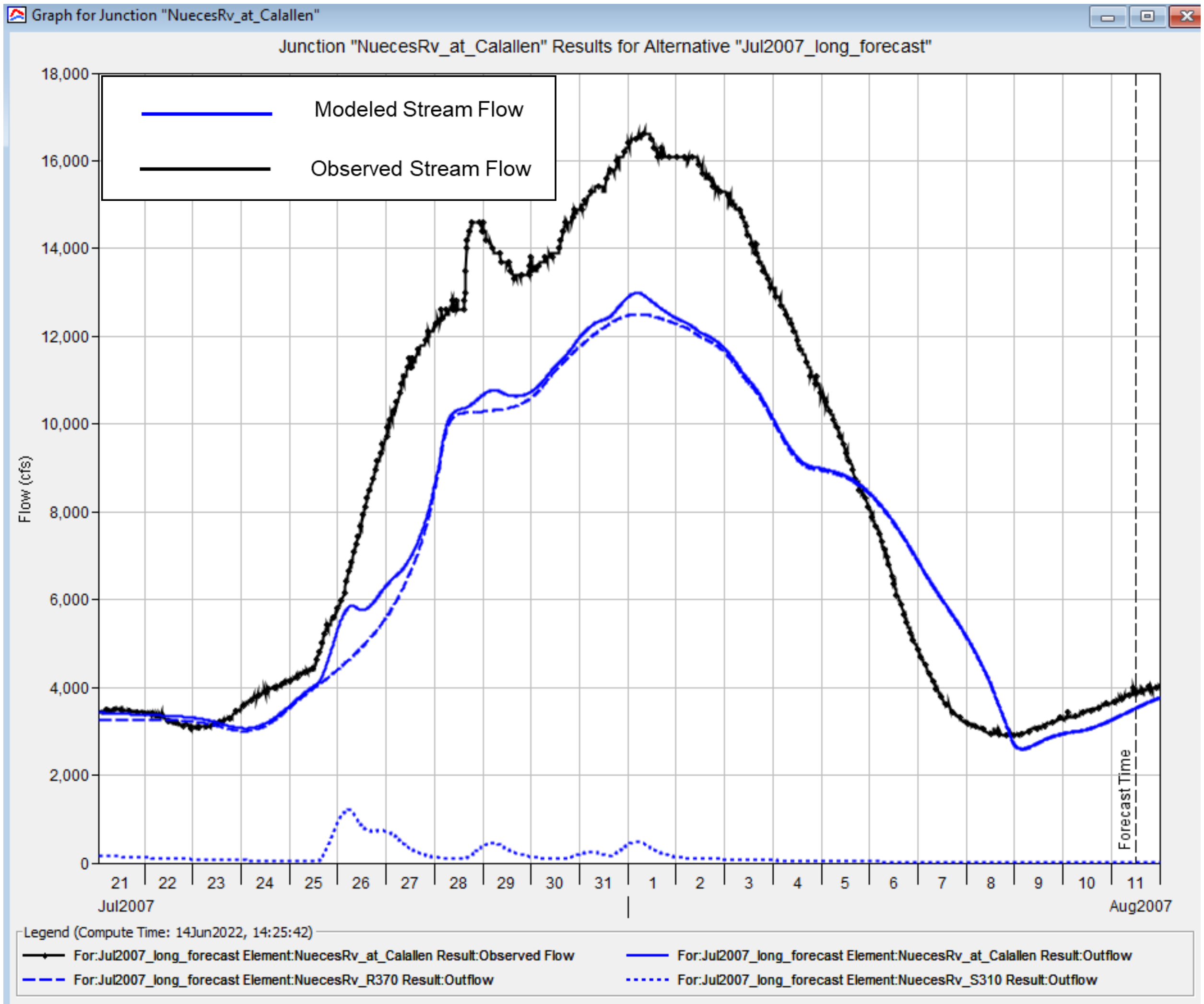


Figure B.128: July 2007 (Long) Calibration Results for Nueces River at Calallen Gage

The Nueces River at Calallen gage had an "Unsatisfactory" performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing and shape of the observed hydrograph very well, but the magnitude and volume were underestimated. This is likely due to a discrepancy between the observed releases from Corpus Christi dam and the rating curve at Calallen, with the Callen gage reporting about 3,500 cfs more than the dam for the period after July 25th. The Nueces River at Calallen plot is shown above.

1.4.4.11 May 2015 Middle Event

The May 2015 event has multiple individual storms occurring over several weeks. The May 2015 calibrations include two HEC-HMS simulation time periods covering different portions of the Nueces River basin; May 2015 middle (May 11 – 24); and May 2015 (May 20 - June 1). Calibration of May 2015 middle event included watersheds upstream of the Leona River near Uvalde gage, Atascosa River at Whitsett gage, Nueces near Three Rivers, and downstream to Nueces at Calallen gage. The Southern Texas Palmer Drought Severity Index (PDSI) was very moist (3.00 to 3.50) in April 2015. Southern Texas Palmer Z-index was very moist (2.50 to 3.49) in April 2015.

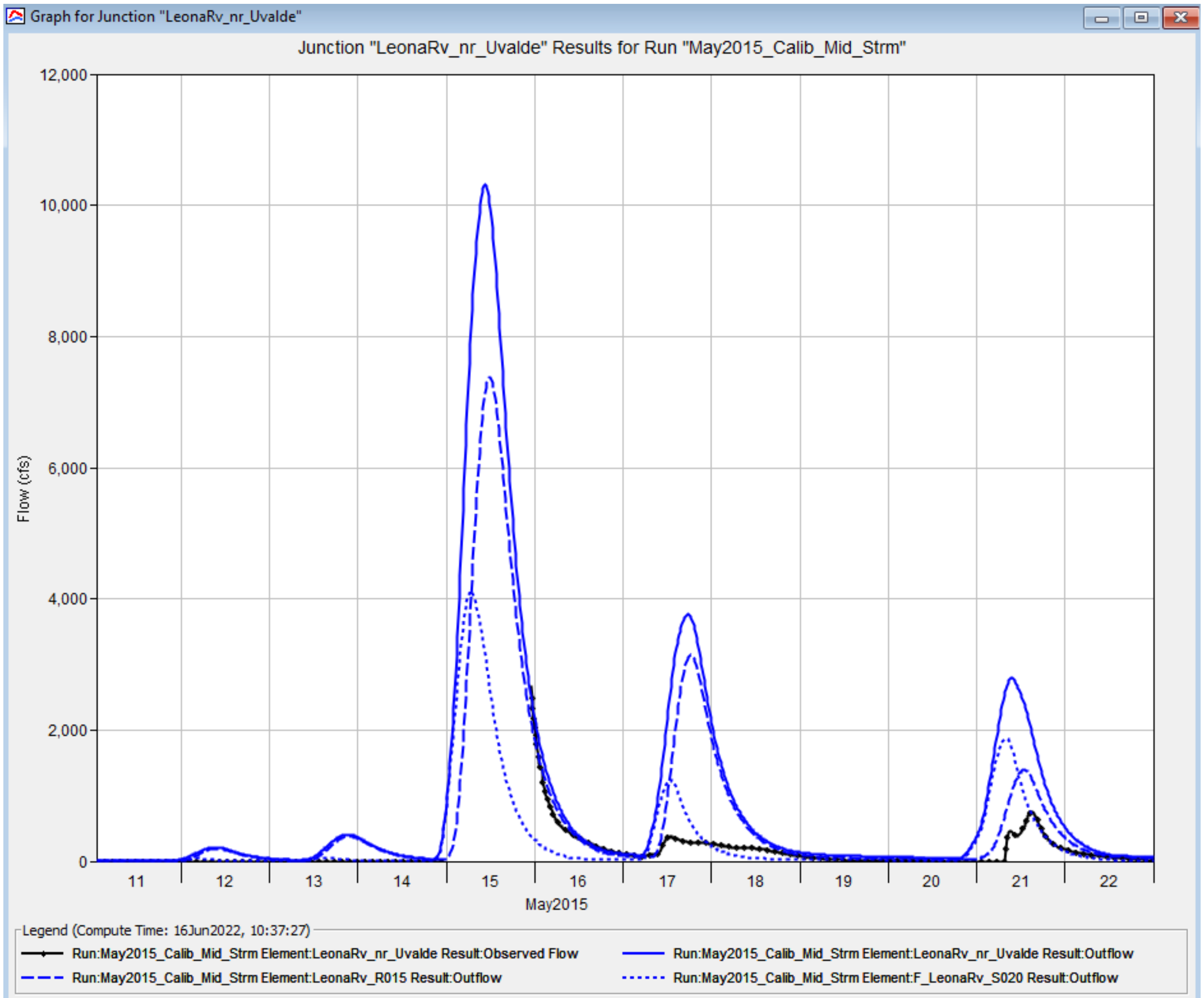


Figure B.129: May 2015 Middle Calibration Results for Leona River near Uvalde USGS Gage

The Leona River near Uvalde observed hydrograph was missing. Only an observed peak discharge of 20,300 cfs on May 15, 2015 was available. The HEC-HMS model could not match the observed peak magnitude, even with zero loss rates. The NEXRAD precipitation and or intensity could be underestimated. There could also be issue with the USGS gage rating since the highest discharge on rating curve is 6,000 cfs. The final Leona River near Uvalde plot is shown above.

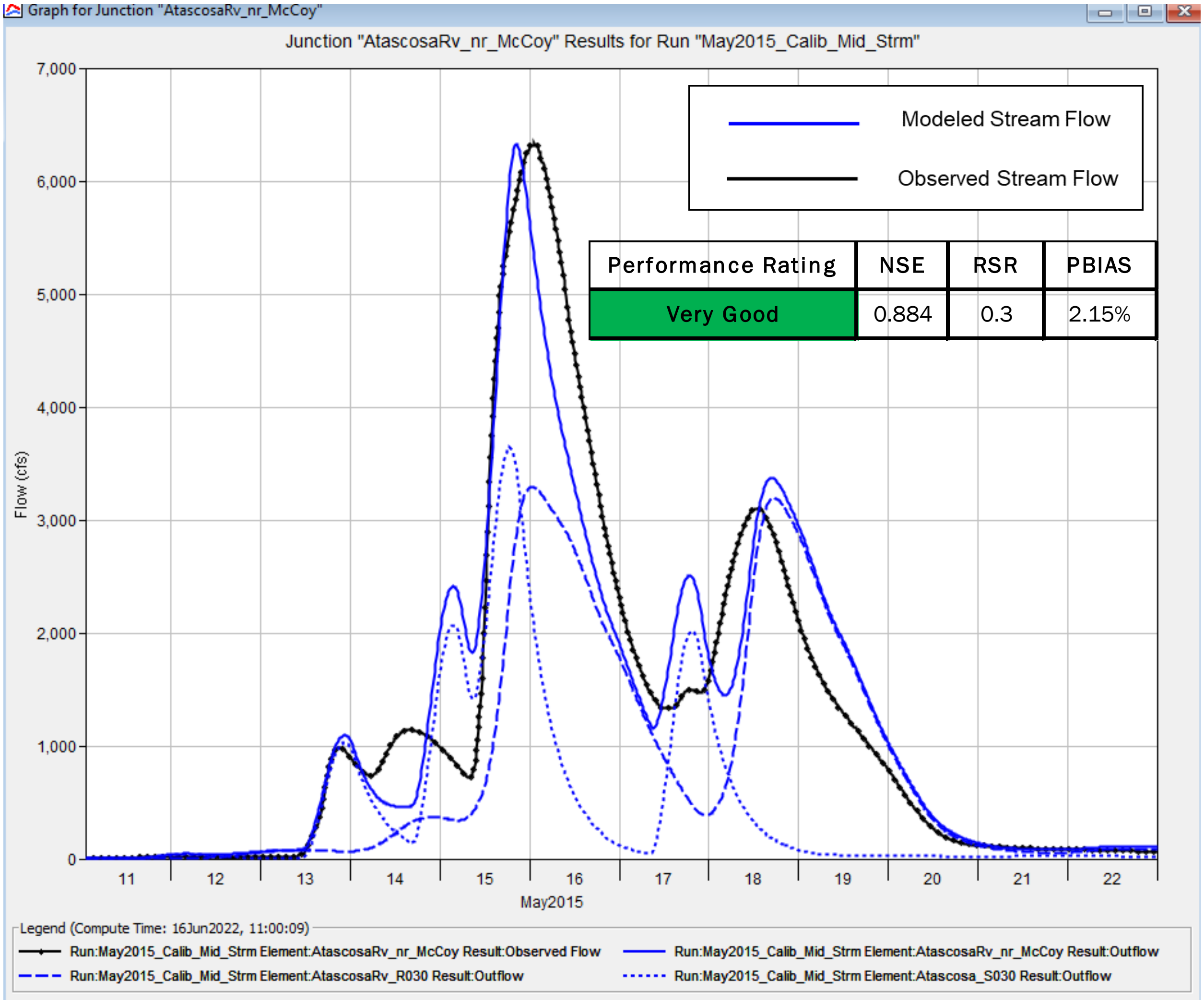


Figure B.130: May 2015 Middle Calibration Results for Atascosa River near McCoy USGS Gage

The Atascosa River near McCoy gage achieved a “Very Good” performance rating for the May 2015 middle event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph fairly well. The May 2015 event has multiple individual storms occurring over several days. It is extremely difficult to match all peaks with a single set of loss rates. The final Atascosa River near McCoy plot is shown above.

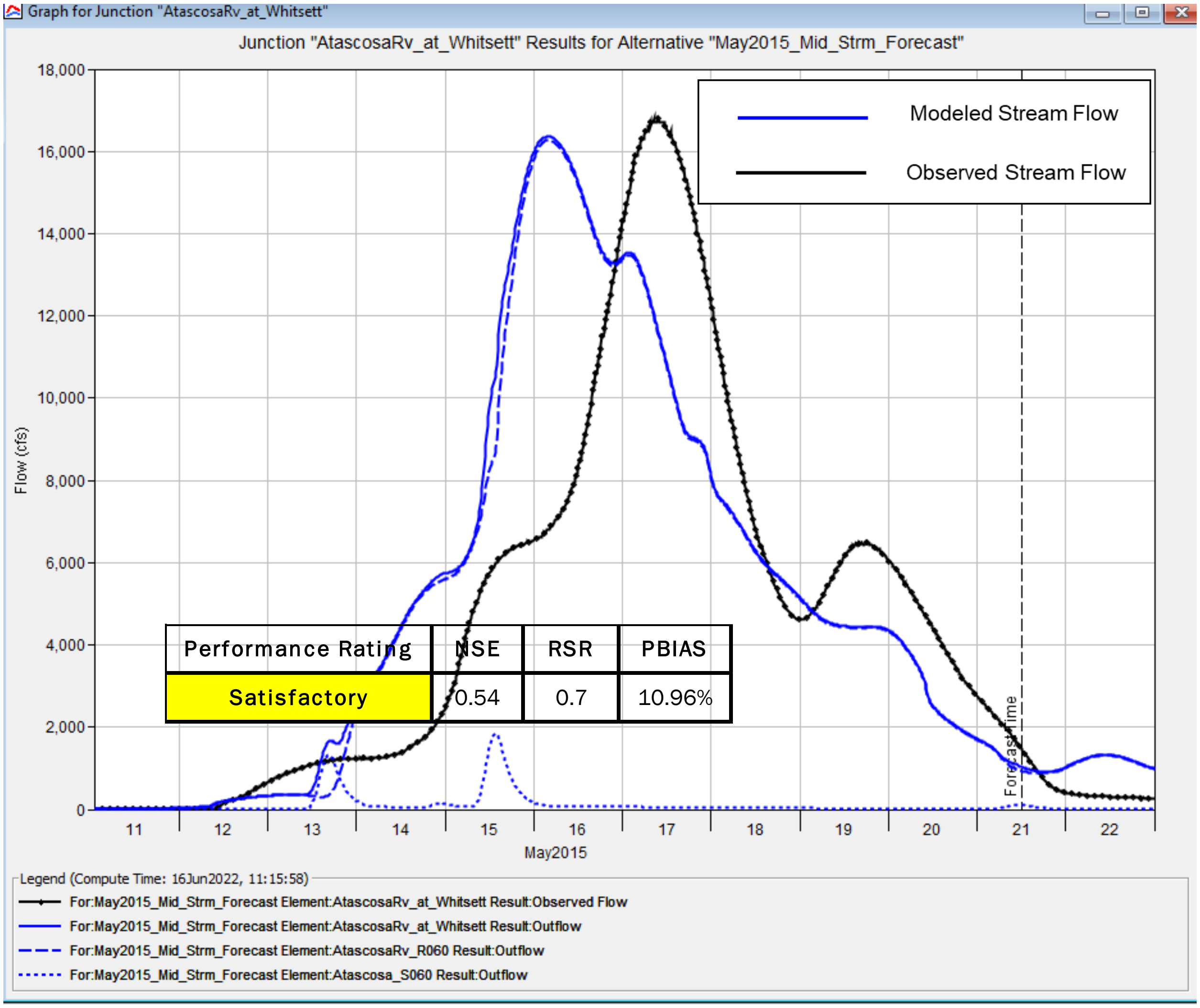


Figure B.131: May 2015 Middle Calibration Results for Atascosa River at Whitsett USGS Gage

The Atascosa River at Whitsett gage had a "Satisfactory" performance rating for the May 2015 middle event. The HEC-HMS model matched the magnitude, shape and volume of the observed hydrograph fairly well, but the timing was off by about a day. The NEXRAD precipitation is likely underestimated for the period of May 16-17, based on a comparison between the NEXRAD precipitation data and nearby NWS daily rain gages in this area. The final Atascosa River at Whitsett plot is shown above.

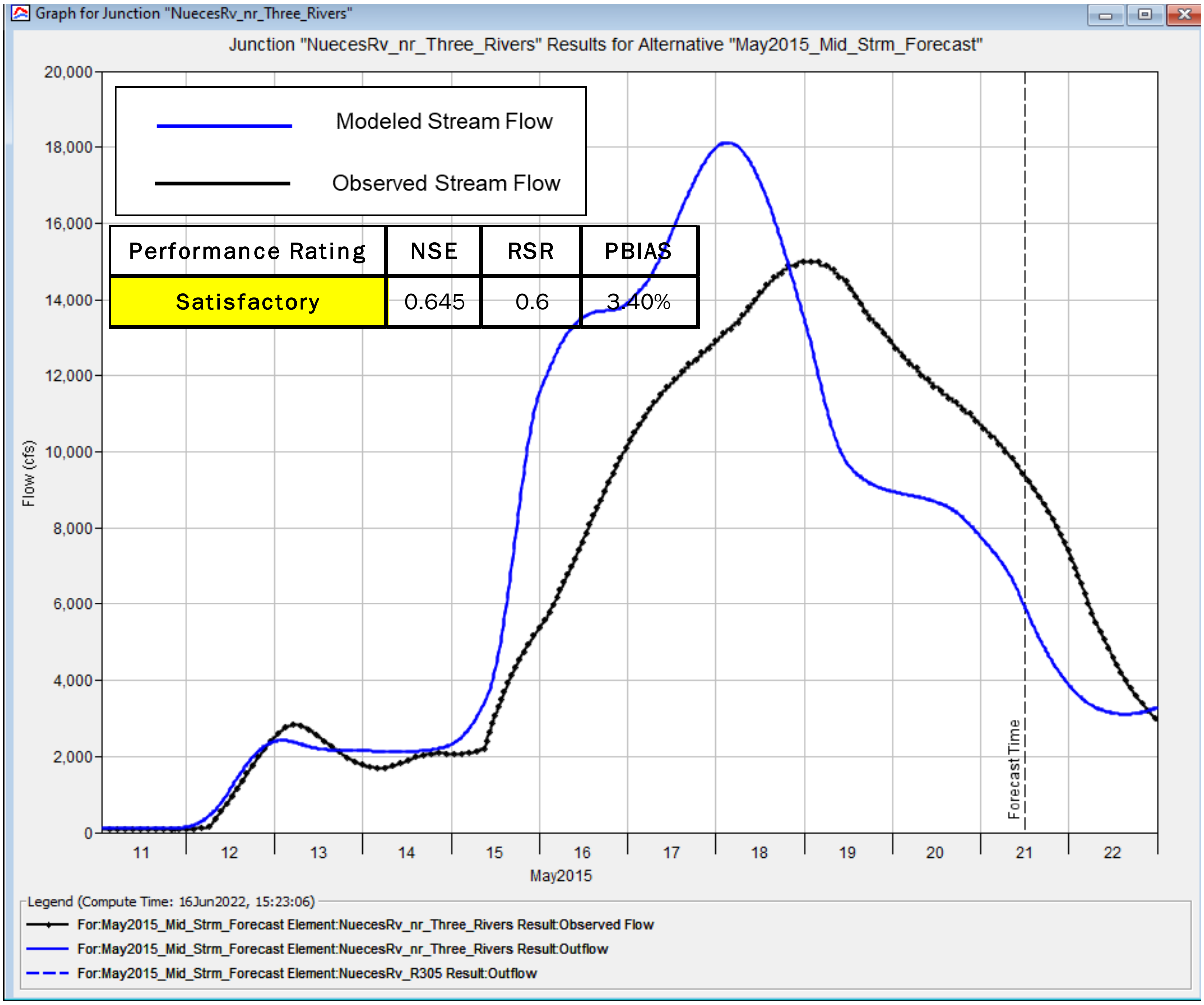


Figure B.132: May 2015 Middle Calibration Results for Nueces River near Three Rivers USGS Gage

The Nueces River near Three Rivers gage had a “Satisfactory” performance rating for the May 2015 middle event. The HEC-HMS model matched the shape and volume of the observed hydrograph fairly well, but the timing and shape were a bit off. Forecast mode was used in the HEC-HMS model with blending at the Nueces River near Tilden and Atascosa River at Whitsett gages. The observed release hydrograph was used in the HEC-HMS model as releases from Choke Canyon Reservoir. Most of the flow at the Three Rivers gage is coming from Atascosa and Nueces Rivers. There was less than 35 cfs release from Choke Canyon Reservoir. The Nueces River has a very wide floodplain in the reaches above the Three Rivers gage, and the routing method may be underestimating the floodplain attenuation. The final Nueces River near Three Rivers plot is shown above.

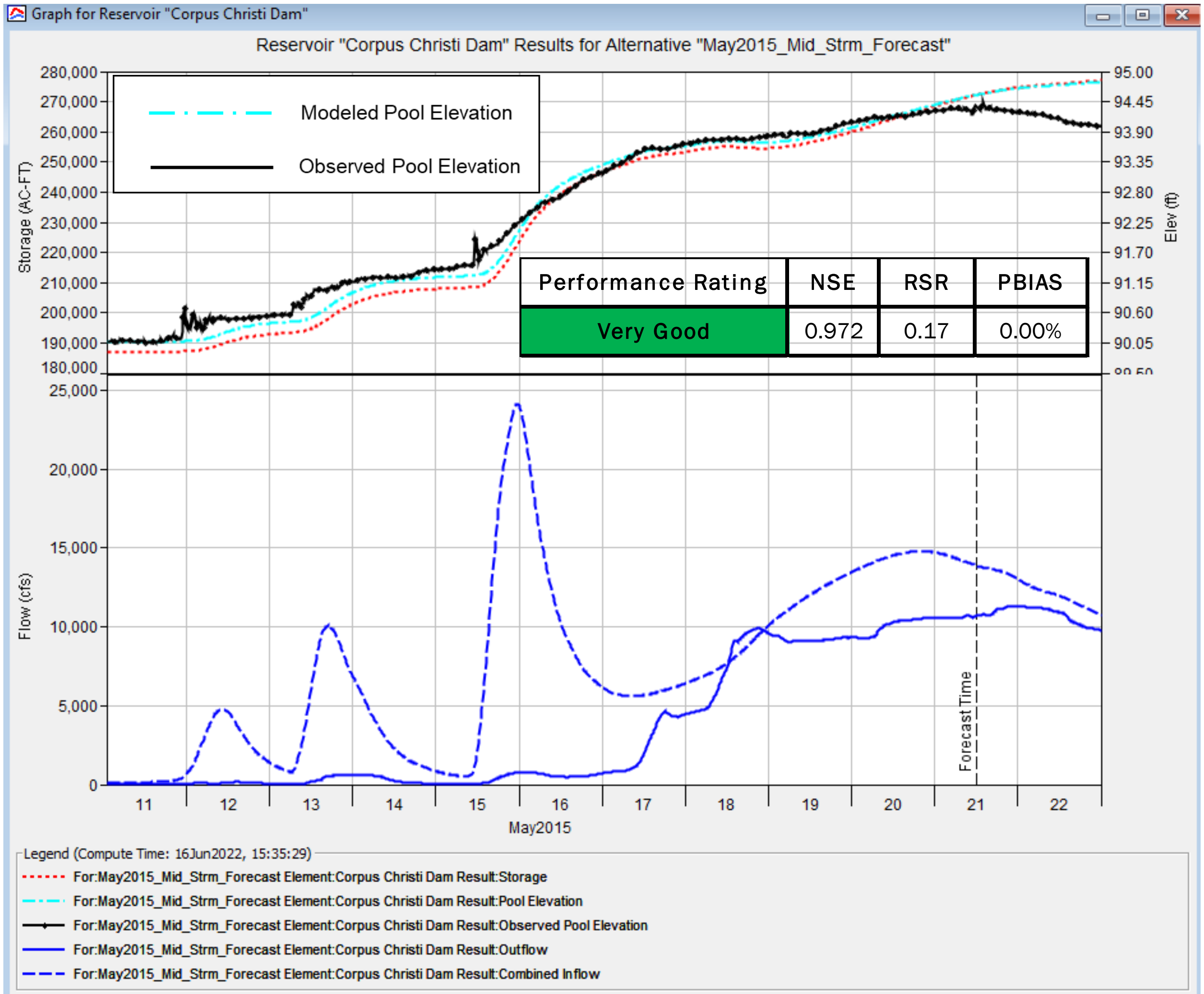


Figure B.133: May 2015 Middle Calibration Results for Lake Corpus Christi

The Lake Corpus Christi gage achieved a “Very Good” performance rating for the May 2015 middle event. The HEC-HMS model matched the shape, timing, magnitude and volume of the observed pool rise very well. However, the pool rose higher than observed on the last two days of the event. The computed inflow hydrograph into Lake Corpus Christi after May 18 is only from the routed observed flows from the Nueces River near Three Rivers gage. The final Lake Corpus Christi plot is shown above.

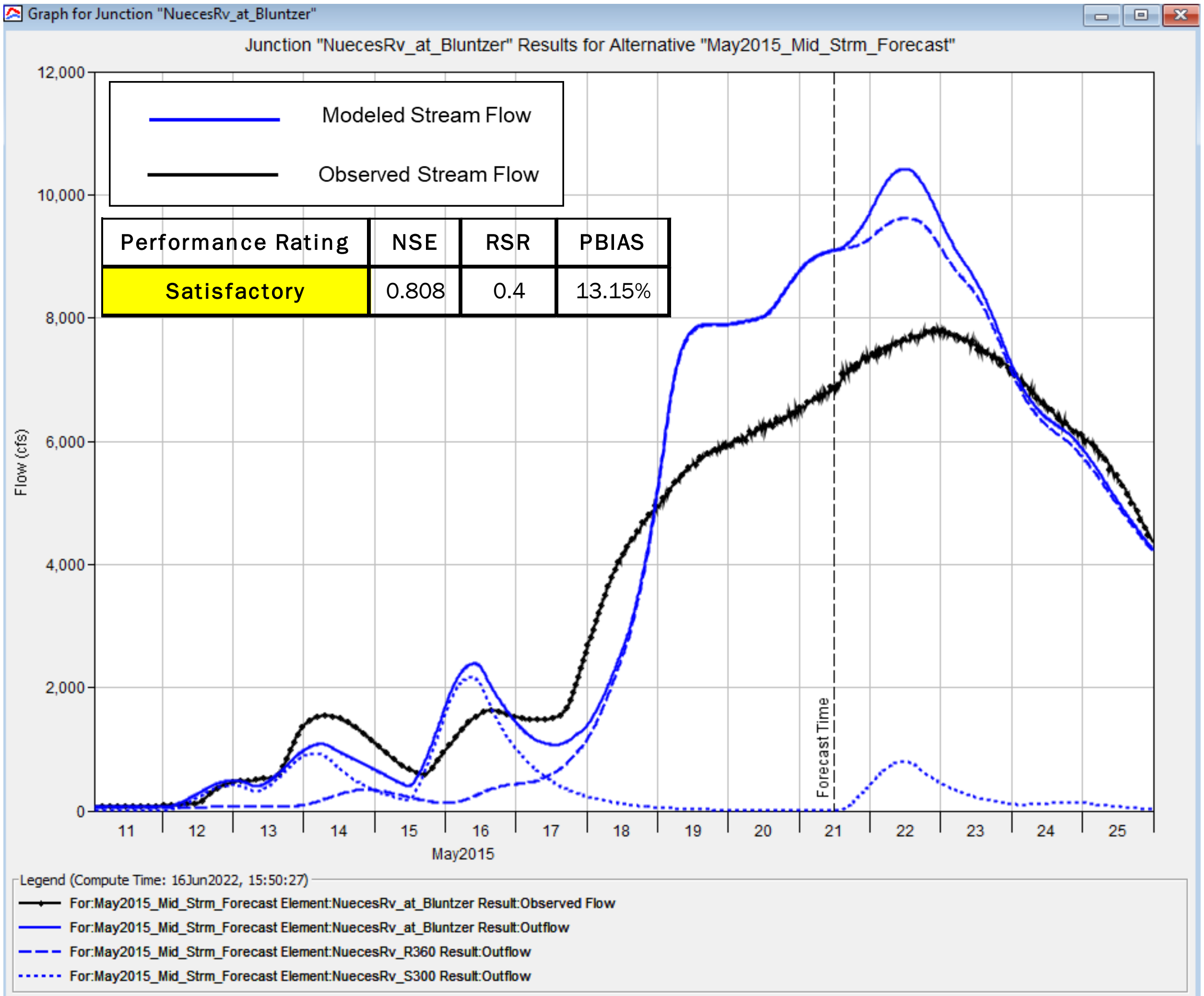


Figure B.134: May 2015 Middle Calibration Results for Nueces River at Bluntzer USGS Gage

The Nueces River at Bluntzer gage had a “Satisfactory” performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing of the observed hydrograph fairly well, but the magnitude and volume were a bit off. This is likely due to a discrepancy between the observed releases from Corpus Christi dam and the rating curve at this gage. The revised Nueces River at Bluntzer plot is shown above.

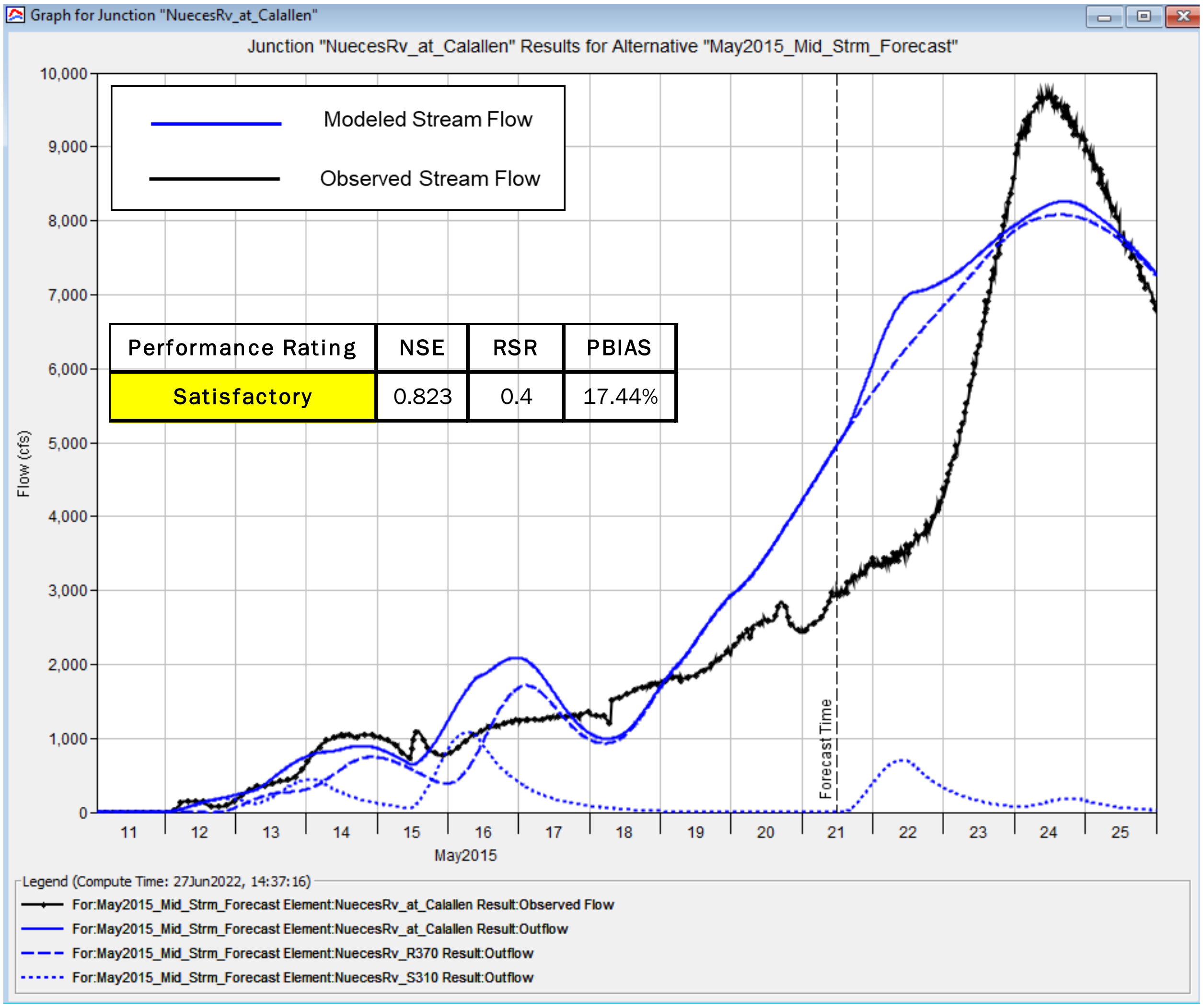


Figure B.135: May 2015 Middle Calibration Results for Nueces River at Calallen USGS Gage

The Nueces River at Calallen gage had a "Satisfactory" performance rating for the July 2007 (Long) event. The HEC-HMS model matched the timing of the observed hydrograph fairly well, but the peak magnitude and overall volume were a bit off. This is likely due to a discrepancy between the observed releases from Corpus Christi dam and the rating curves at Bluntzer and Calallen.

1.4.4.12 May 2015 Event

Calibration of May 2015 event included watersheds upstream of the Nueces River below Uvalde gage, and Frio River above Choke Canyon Reservoir. The Southern Texas Palmer Drought Severity Index (PDSI) was very moist (3.00 to 3.50) in April 2015. Southern Texas Palmer Z-index was very moist (2.50 to 3.49) in April 2015.

At multiple upper Nueces River gages and Frio River gages, on May 29 there is very little to no rise on the observed hydrographs. Yet, the computed hydrograph will show a big rise on May 29. There may be an overestimation of NEXRAD precipitation for May 29. As a result, the HEC-HMS model simulation time period was shortened at some gages to end on May 27 to avoid being influenced by the later erroneous peaks on May 29-30.

At the Nueces River near Barksdale gage, first peak stage was 20.08 ft. on May 23 at 11:00 and second peak was 22.47 ft. on May 24 at 06:30 AM. This gage is relatively new starting in February 2009. A rating curve is not available.

At the Nueces River at CR 414 at Montell gage, first peak stage was 8.73 ft. on May 23 at 09:45 and second peak was 11.56 ft. on May 24 at 10:30 AM. This gage is relatively new starting in January 2011. A rating curve is not available.

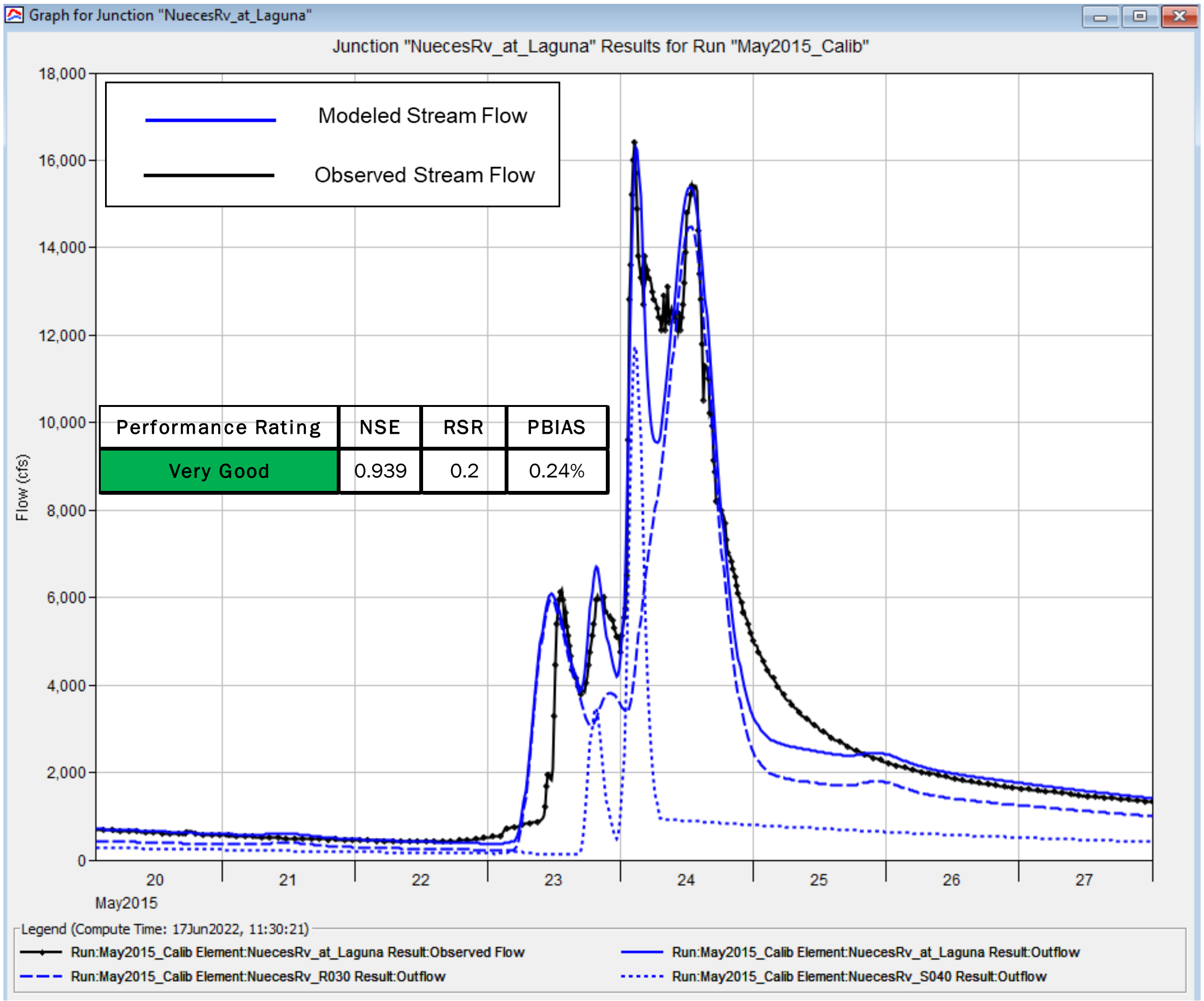


Figure B.136: May 2015 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna gage achieved a “Very Good” performance rating for the May 2015 storm event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The Nueces River at Laguna plot is shown above.

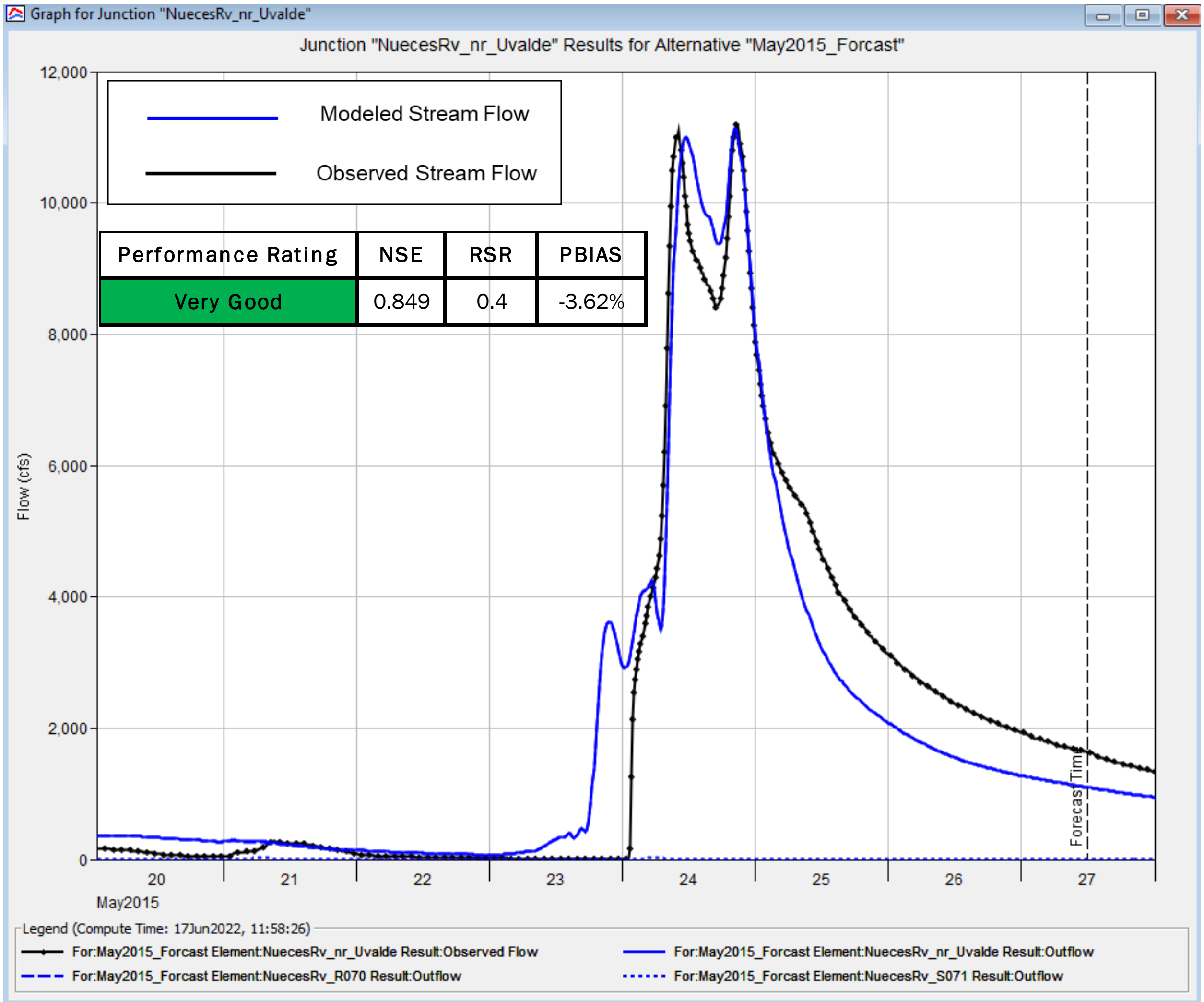


Figure B.137: May 2015 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde gage achieved a “Very Good” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed peaks very well. A loss in the observed flow volume was noted between the upstream gages and this gage. The constant channel loss flow rates and fractions were adjusted accordingly. The final Nueces River below Uvalde plot is shown above.

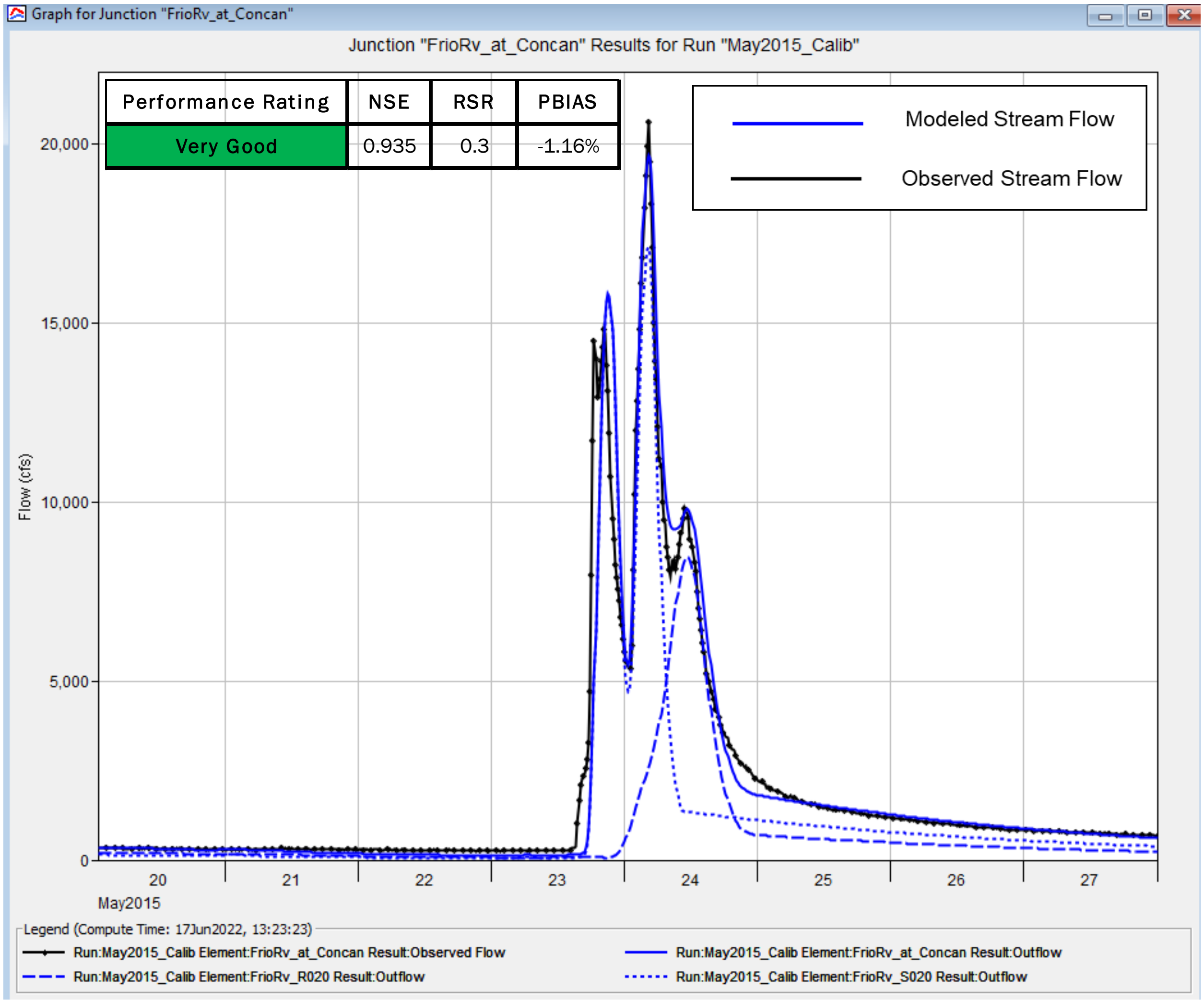


Figure B.138: May 2015 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan gage achieved a “Very Good” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The final Frio River at Concan plot is shown above.

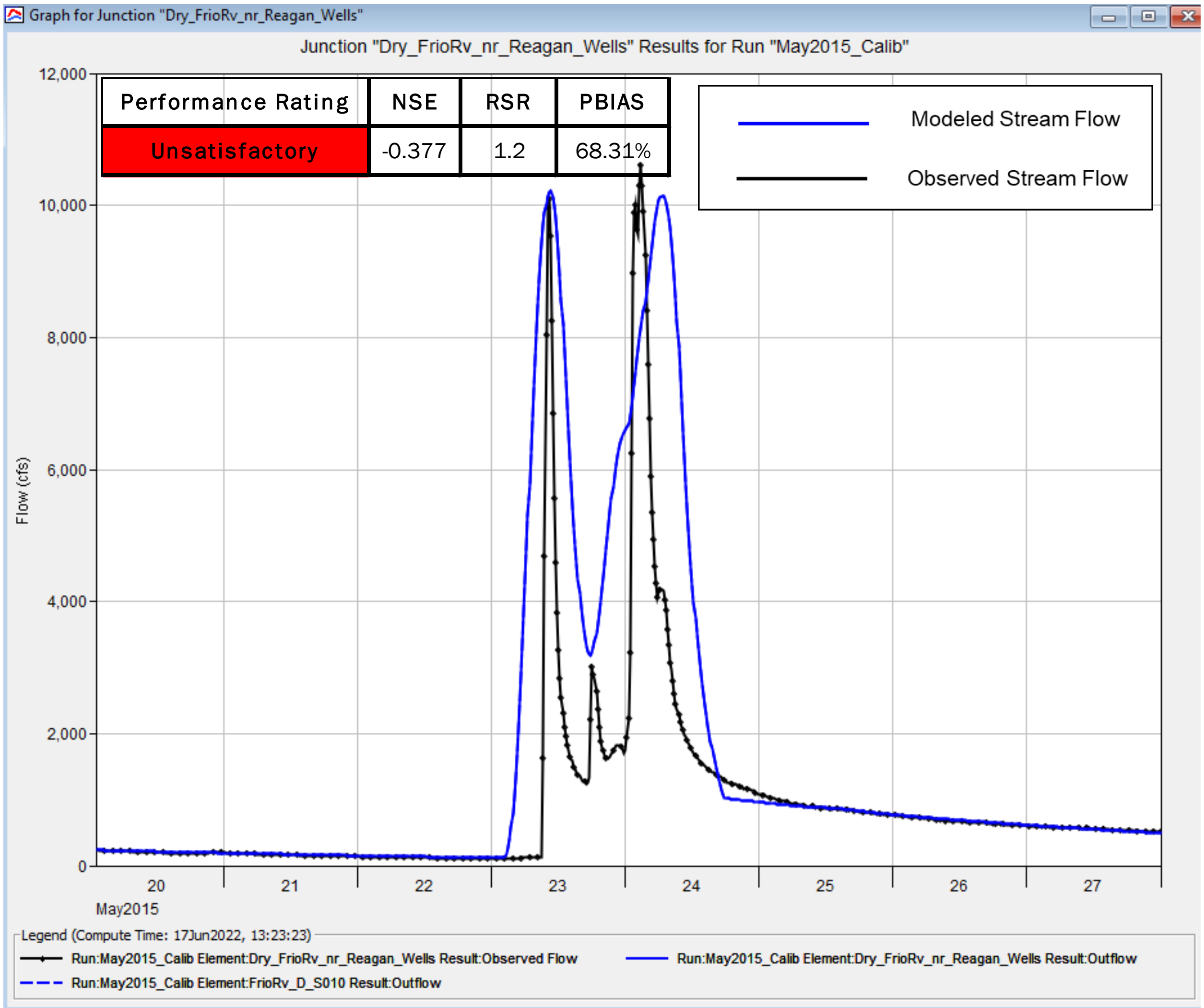


Figure B.139: May 2015 Calibration Results for Dry Frio River near Reagan Wells USGS Gage

The Dry Frio River near Reagan Wells gage had an “Unsatisfactory” performance rating for the May 2015 event. The HEC-HMS model matched the timing and magnitude of the observed hydrograph fairly well, but the computed volume was too high, as reflected in the percent bias. The final Dry Frio River near Reagan Wells plot is shown above.

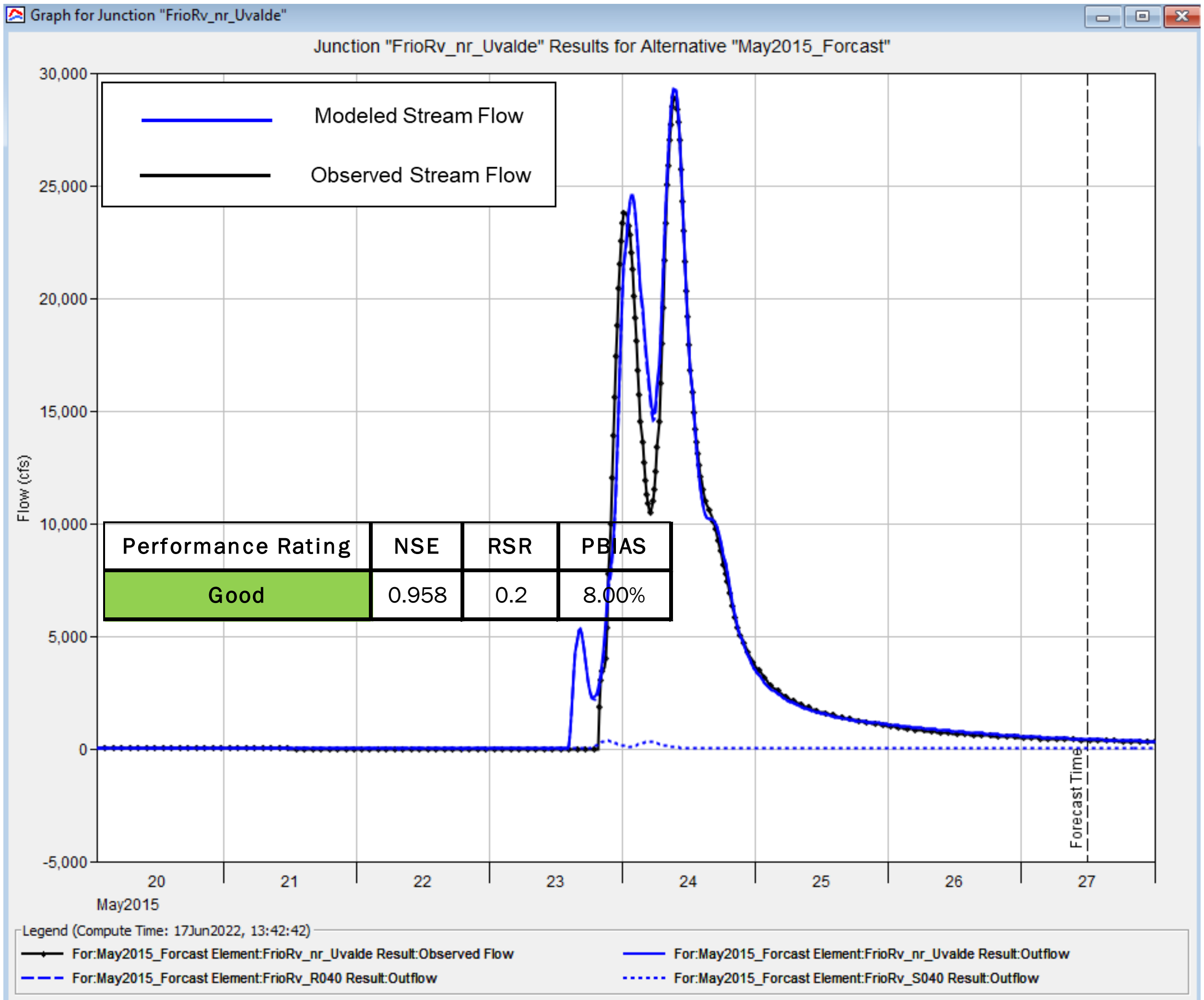


Figure B.140: May 2015 Calibration Results for Frio River below Dry Frio near Uvalde USGS Gage

The Frio River below Dry Frio near Uvalde gage achieved a "Good" performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph very well. The overall flow volume was just a bit high, resulting in the good rating rather than very good. The final Frio River below Dry Frio near Uvalde plot is shown above.

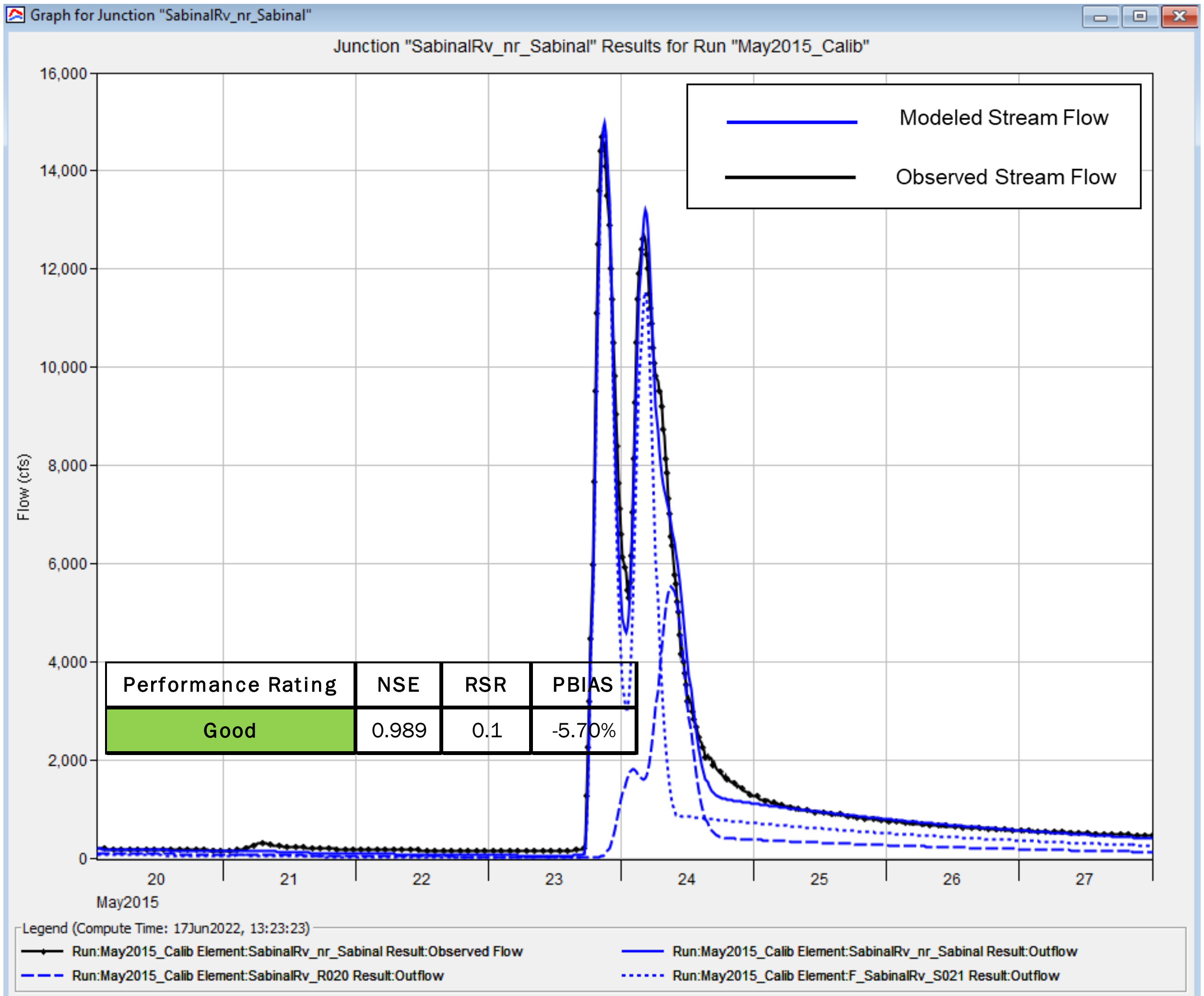


Figure B.141: May 2015 Calibration Results for Sabinal River near Sabinal USGS Gage

The Sabinal River near Sabinal gage achieved a "Good" performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph very well. The overall flow volume was just a bit low, resulting in the good rating rather than very good. The final Sabinal River near Sabinal plot is shown above.

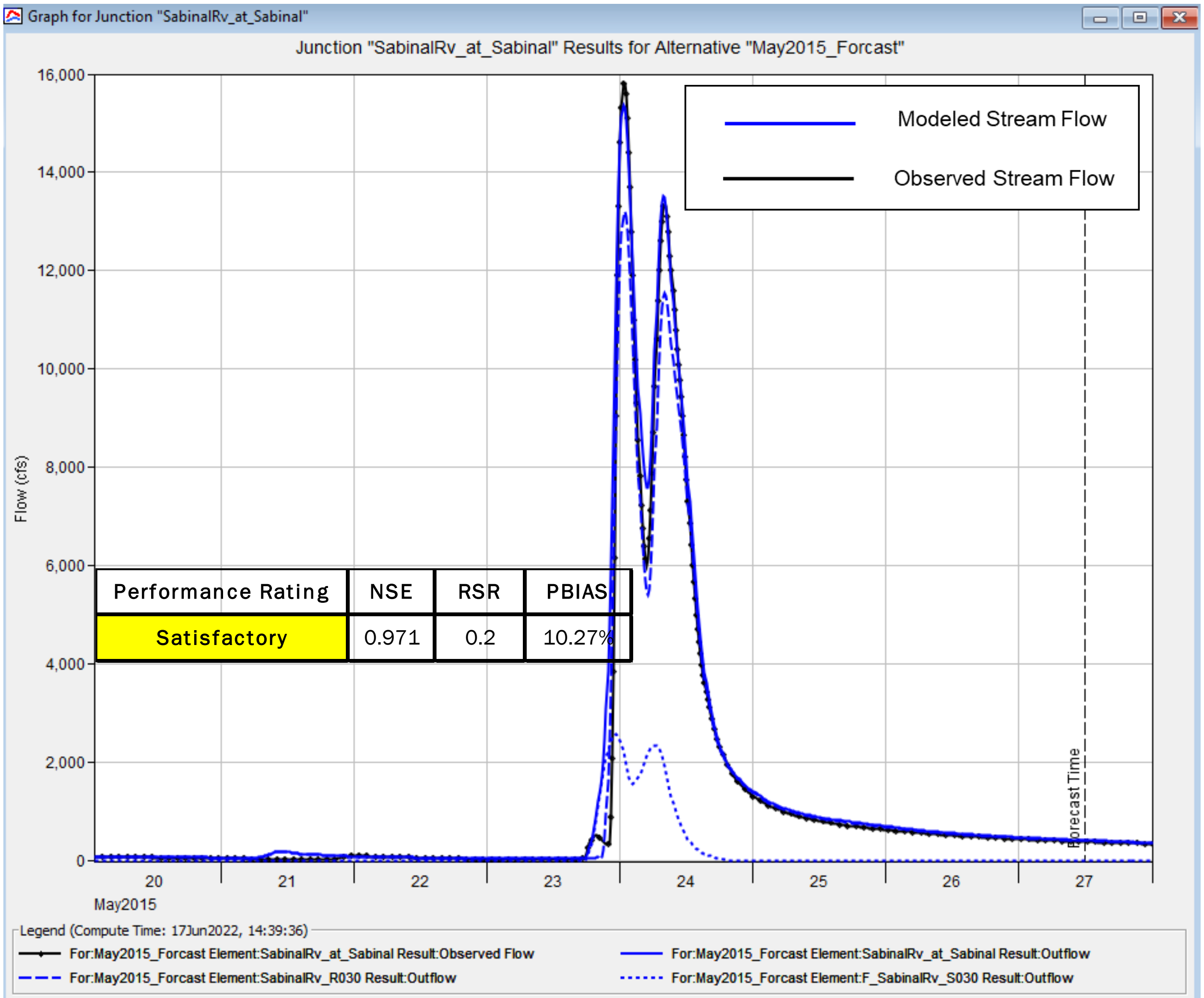


Figure B.142: May 2015 Calibration Results for Sabinal River at Sabinal USGS Gage

The Sabinal River at Sabinal gage had a “Satisfactory” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph very well. The overall flow volume was just a bit high, as reflected in the percent bias. The final Sabinal River at Sabinal plot is shown above.

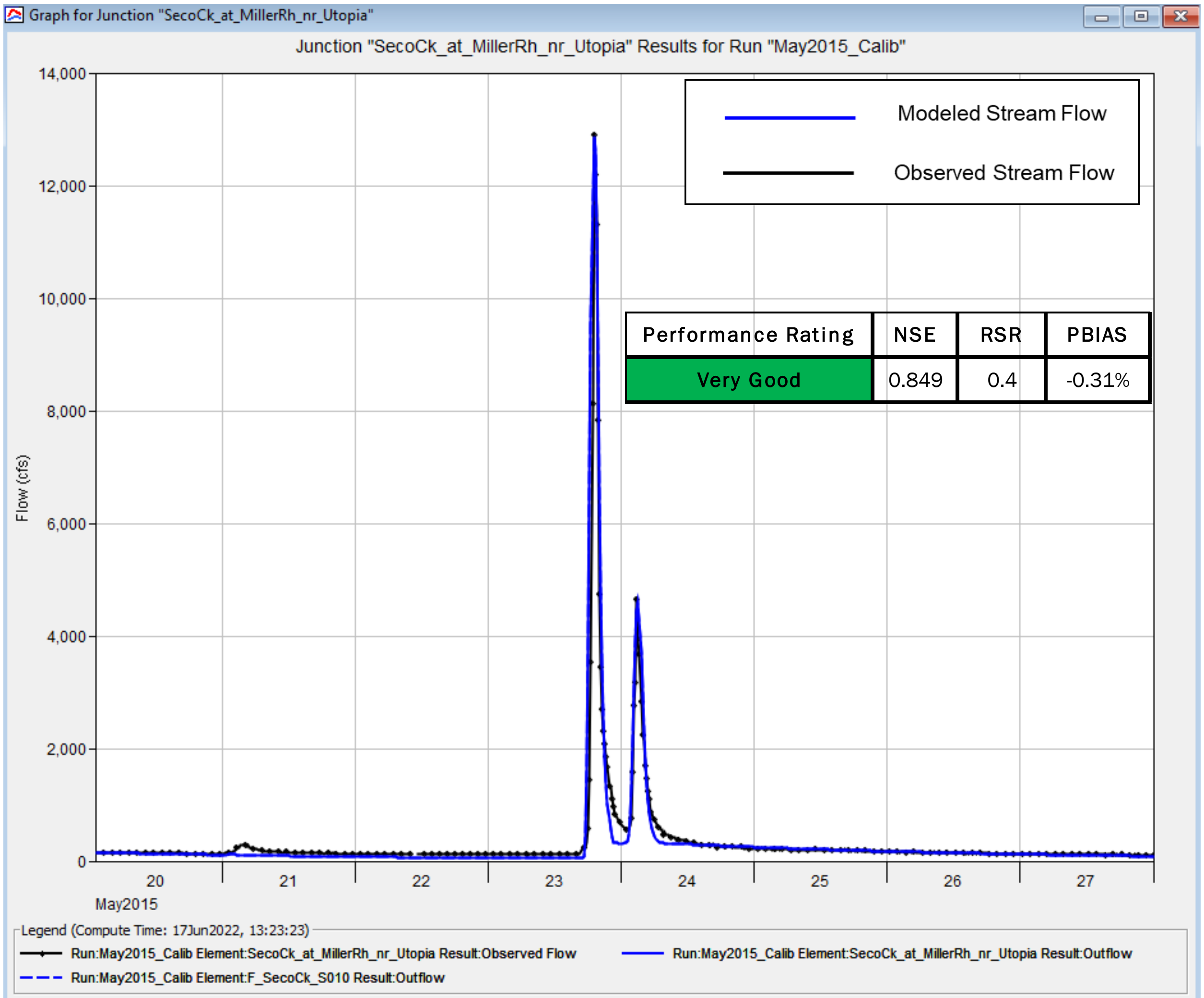


Figure B.143: May 2015 Calibration Results for Seco Creek at Miller Ranch near Utopia USGS Gage

The Seco Creek at Miller Ranch near Utopia gage achieved a “Very Good” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The final Seco Creek at Miller Ranch near Utopia plot is shown above.

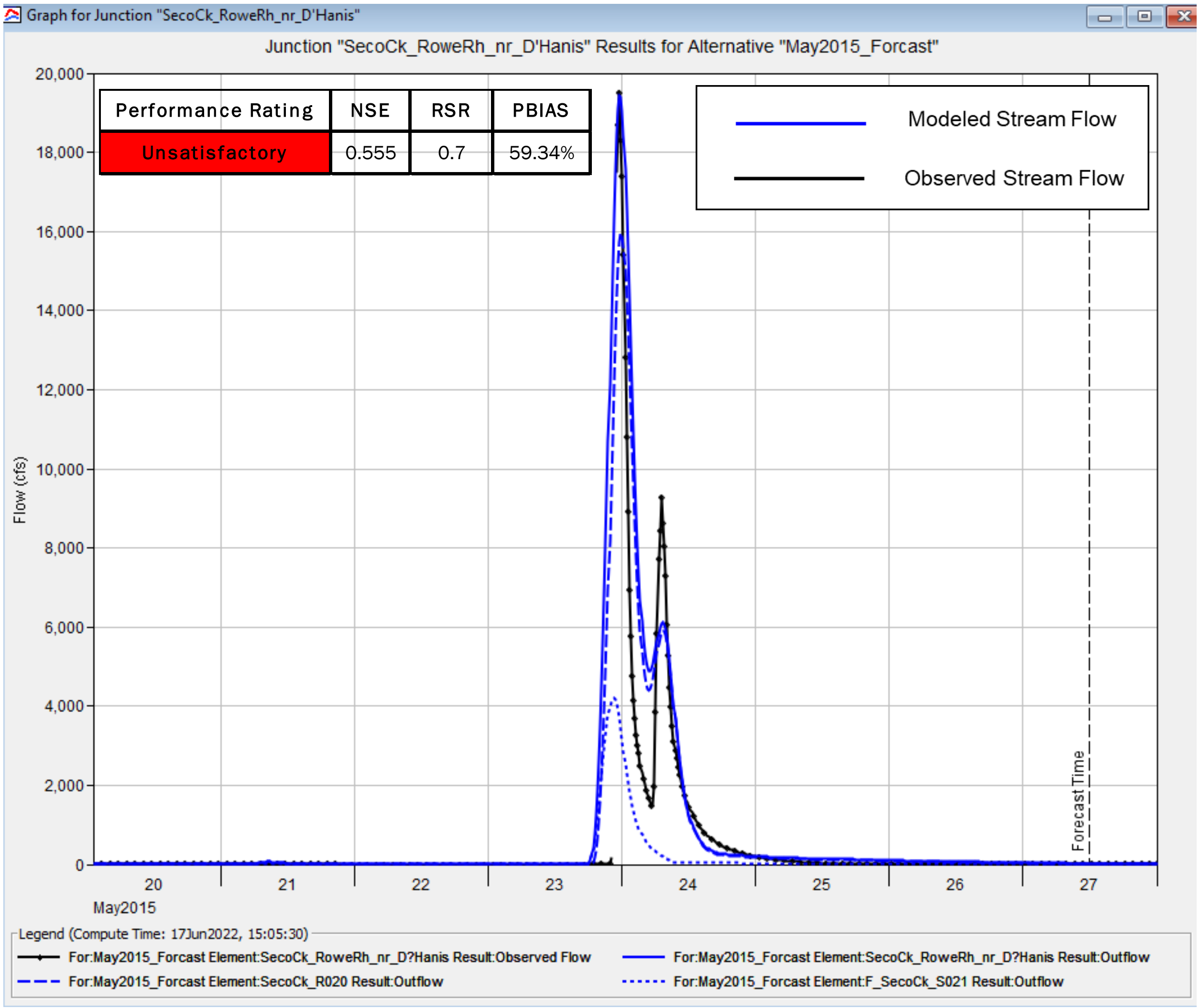


Figure B.144: May 2015 Calibration Results for Seco Creek at Rowe Ranch near D'Hanis USGS Gage

The Seco Creek at Rowe Ranch near D'Hanis gage had an "Unsatisfactory" performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph well. However, the overall volume was too high, as reflected in the percent bias. The May 23-24,2015 event is a multiple burst storm. It is extremely difficult to match all peaks with a single set of loss rates. There was an attempt to match the largest peak in the event. The final Seco Creek at Rowe Ranch near D'Hanis plot is shown above.

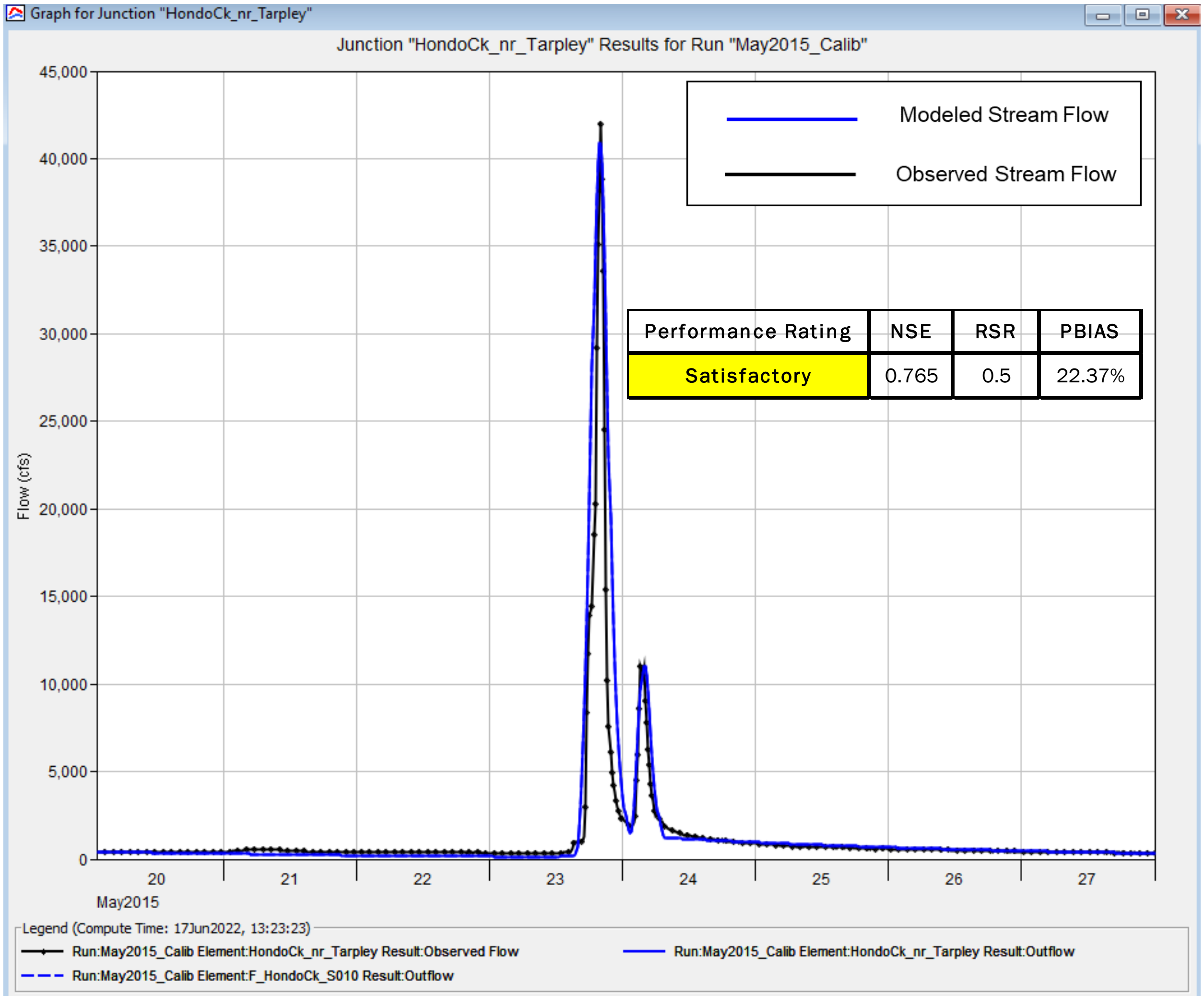


Figure B.145: May 2015 Calibration Results for Hondo Creek near Tarpley USGS Gage

The Hondo Creek near Tarpley gage had a “Satisfactory” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude and shape of the observed hydrograph well. However, the overall volume was too high, as reflected in the percent bias. The final Hondo Creek near Tarpley plot is shown above.

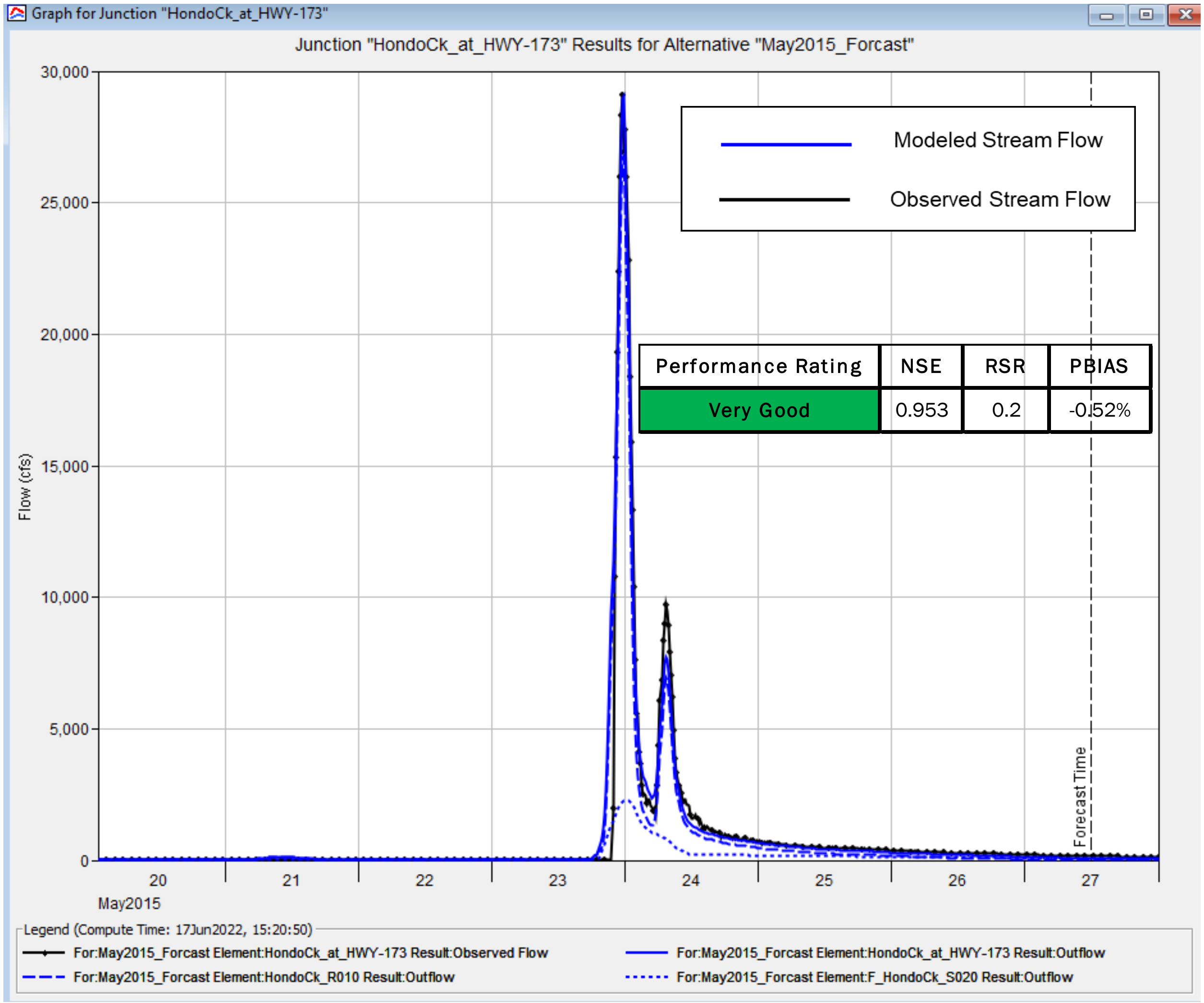


Figure B.146: May 2015 Calibration Results for Hondo Creek at SH 173 near Hondo USGS Gage

The Hondo Creek near Tarpley gage achieved a "Very Good" performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. Forecast mode was used in the HEC-HMS model with blending at the upstream Hondo Creek near Tarpley gage. The final Hondo Creek at SH 173 near Hondo plot is shown above.

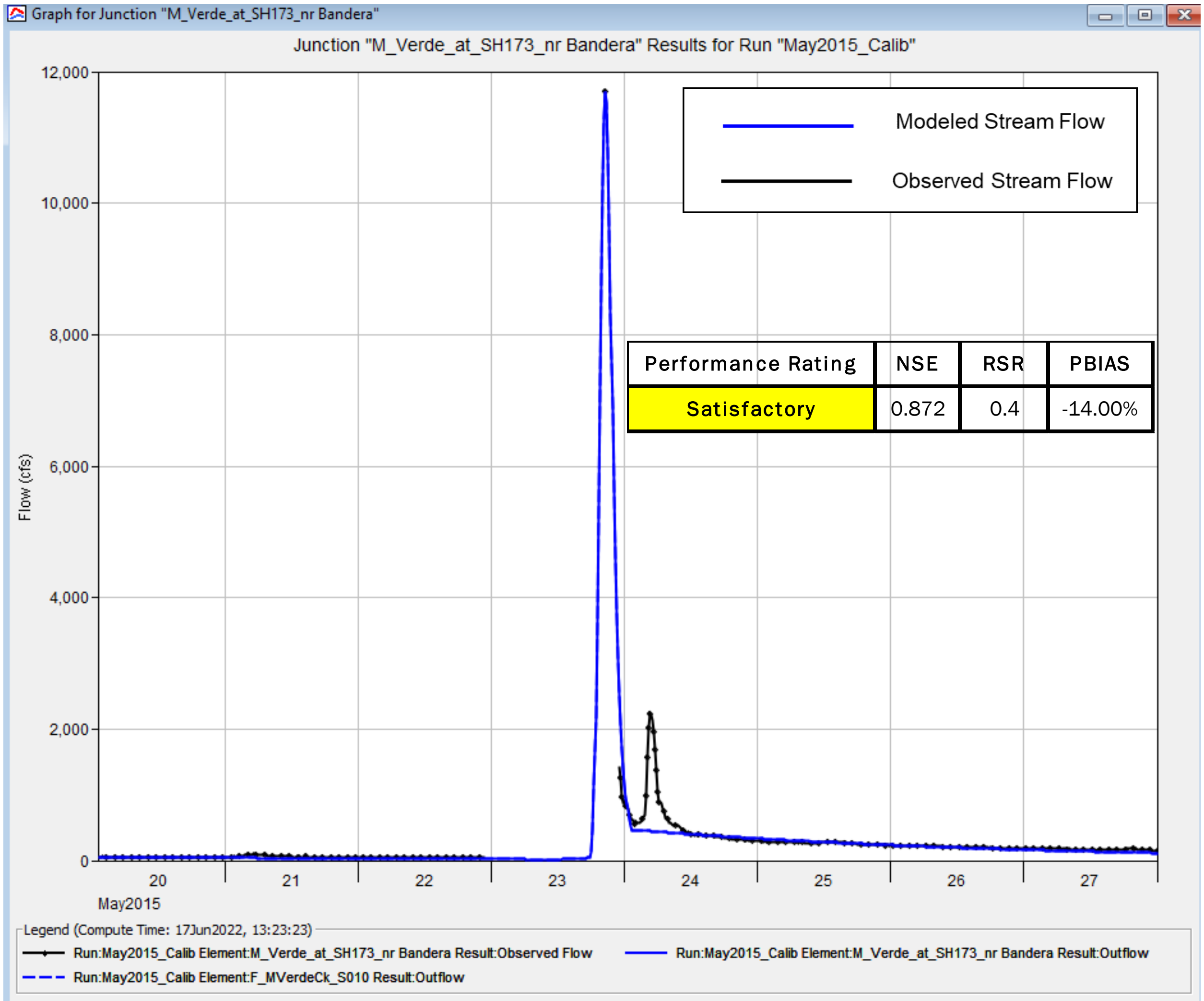


Figure B.147: May 2015 Calibration Results for Middle Verde Creek at SH 173 near Bandera USGS Gage

The Middle Verde Creek at SH 173 near Bandera gage had a “Satisfactory” performance rating for the May 2015 event. The Middle Verde Creek at SH 173 near Bandera observed hydrograph was missing. Only the observed peak discharge and time of peak were available, and the HEC-HMS model matched those well. The satisfactory rating was due to the missing observed data. The final Middle Verde Creek at SH 173 near Bandera plot is shown above.

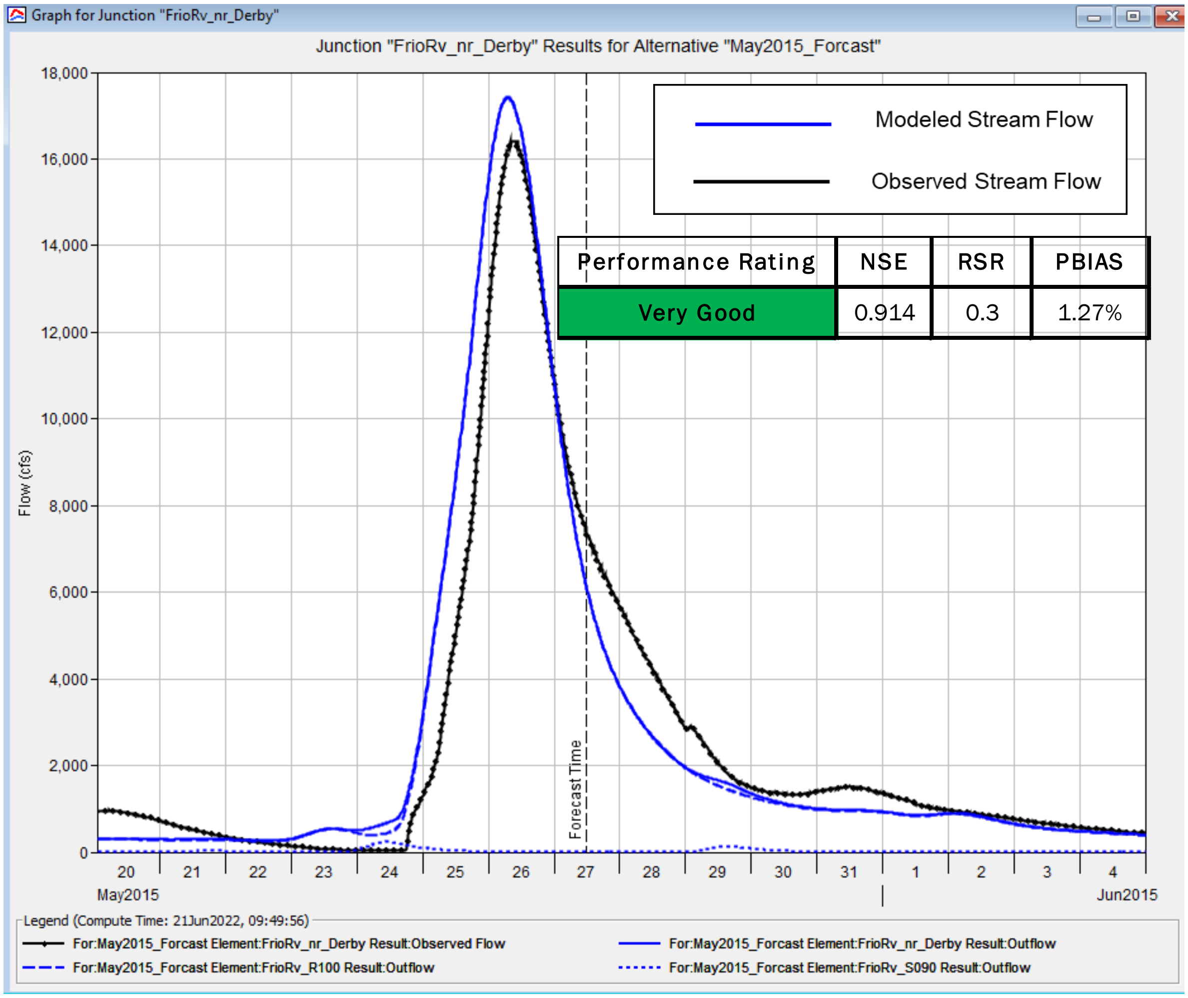


Figure B.148: May 2015 Calibration Results for Frio River near Derby USGS Gage

The Frio River near Derby gage achieved a “Very Good” performance rating for the May 2015 event. The HEC-HMS model matched the timing, magnitude, shape and volume of the observed hydrograph very well. The final Frio River near Derby plot is shown above,

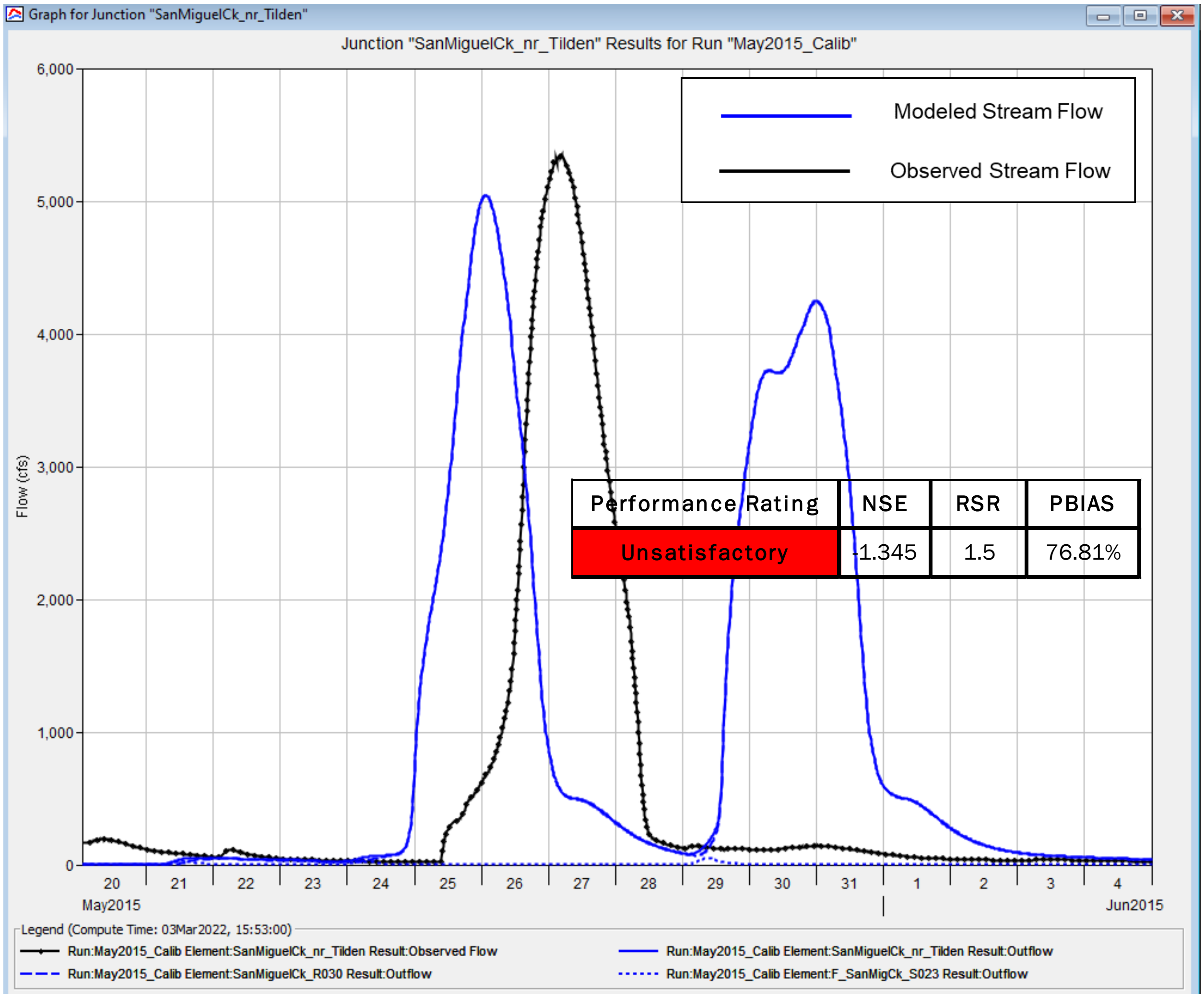


Figure B.149: May 2015 Calibration Results for San Miguel River near Tilden USGS Gage

The San Miguel River near Tilden gage had an “Unsatisfactory” performance rating for the May 2015 event. The HEC-HMS model matched the peak magnitude of the observed hydrograph fairly well, but the timing and volume were way off. The peak precipitation occurs late night on May 23, but the peak of the observed hydrograph does not occur until May 27. There is no precipitation for period May 24-27. These observed flows are fairly low, so there could be an issue with timing in the routing for that low flow range. The second computed peak was due the NEXRAD precipitation being overestimated on May 29, as discussed at the beginning of the May 2015 section. The San Miguel River near Tilden plot is shown above.

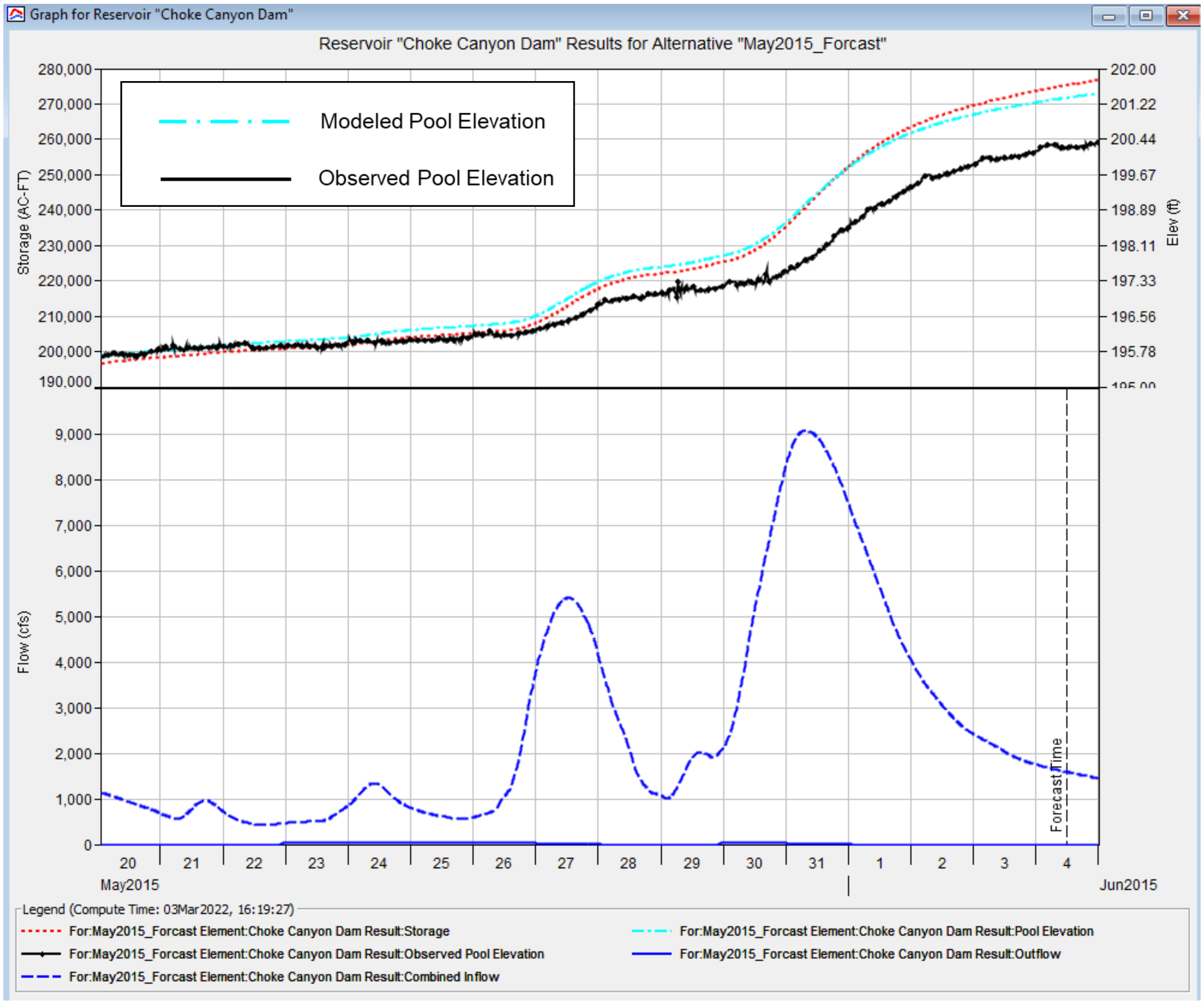


Figure B.150: May 2015 Calibration Results for Choke Canyon Reservoir

For the May 2015 event at Choke Canyon Reservoir, the HEC-HMS model could generally match the rising portion of the observed elevation hydrograph until May 26, where the computed elevation hydrograph began to rise above observed elevation. Forecast mode was used in the HEC-HMS model with blending at the Frio River at Tilden gage and San Miguel Creek near Tilden gage. High initial and uniform loss rates was used for all subareas downstream of the Frio River at Tilden gage and San Miguel River near Tilden gage. There was essentially no runoff from subareas below both gages. There was less than 35 cfs release from Choke Canyon Reservoir. The Choke Canyon radial gate release information was obtained from gate logs supplied by the Stephen Emerson, Choke Canyon Reservoir Supervisor, City of Corpus Christi. The gate logs contained daily radial gate openings with each opening amount in mm for a particular gate on a certain date. The gate logs also contained the radial gate closing amount in mm. for a particular gate on a certain date. Choke Canyon Dam has 7 radial gates. An example in the gate log is Radial Gate 1, 7/10/02, opened to 600 mm. There can be multiple gate actions, opening and or closing, in one day for one particular gate. The gate logs give the date of the action but not the time of occurrence. The Choke Canyon radial gate release was determined from a spillway discharge curve (a table) with incremental gate openings in mm. for 7 radial gates in the Surcharge Operation Criteria, Appendix A-6. The observed elevation hydrograph along with the Spillway Gate Operating Curve in the Surcharge Operation

Criteria, Appendix A-2, was used to determine the estimated gate action time. Using the date, time, radial gate discharge data, and low flow discharge data from the Choke Canyon Reservoir OWC near Three Rivers gage, an observed release hydrograph was determined. This observed release hydrograph was used in the HEC-HMS model as releases from Choke Canyon Reservoir. The Choke Canyon Reservoir plot is shown above.

1.4.4.13 September 2016 Event

The September 2016 event was an upper Nueces River and Frio River Basin flood. Calibration of September 2016 event included watersheds upstream of the Nueces River near Asherton gage, San Casimiro Creek near Freer gage, and Frio River at Concan gage. For this flood event, the HEC-HMS model simulation time period was September 24 thru October 9.

The Southern Texas Palmer Drought Severity Index (PDSI) was mid-range (-1.99 to 1.99) in August 2016. Southern Texas Palmer Z-index was very moist (2.50 to 3.49) in August 2016.

At the Nueces River near Barksdale gage, peak stage was 30.33 ft. on September 25 at 17:45. This gage is relatively new starting in February 2009. A rating curve is not available.

At the Nueces River at CR 414 at Montell gage, peak stage was 16.13 ft. on September 25 at 20:45. This gage is relatively new starting in January 2011. A rating curve is not available.

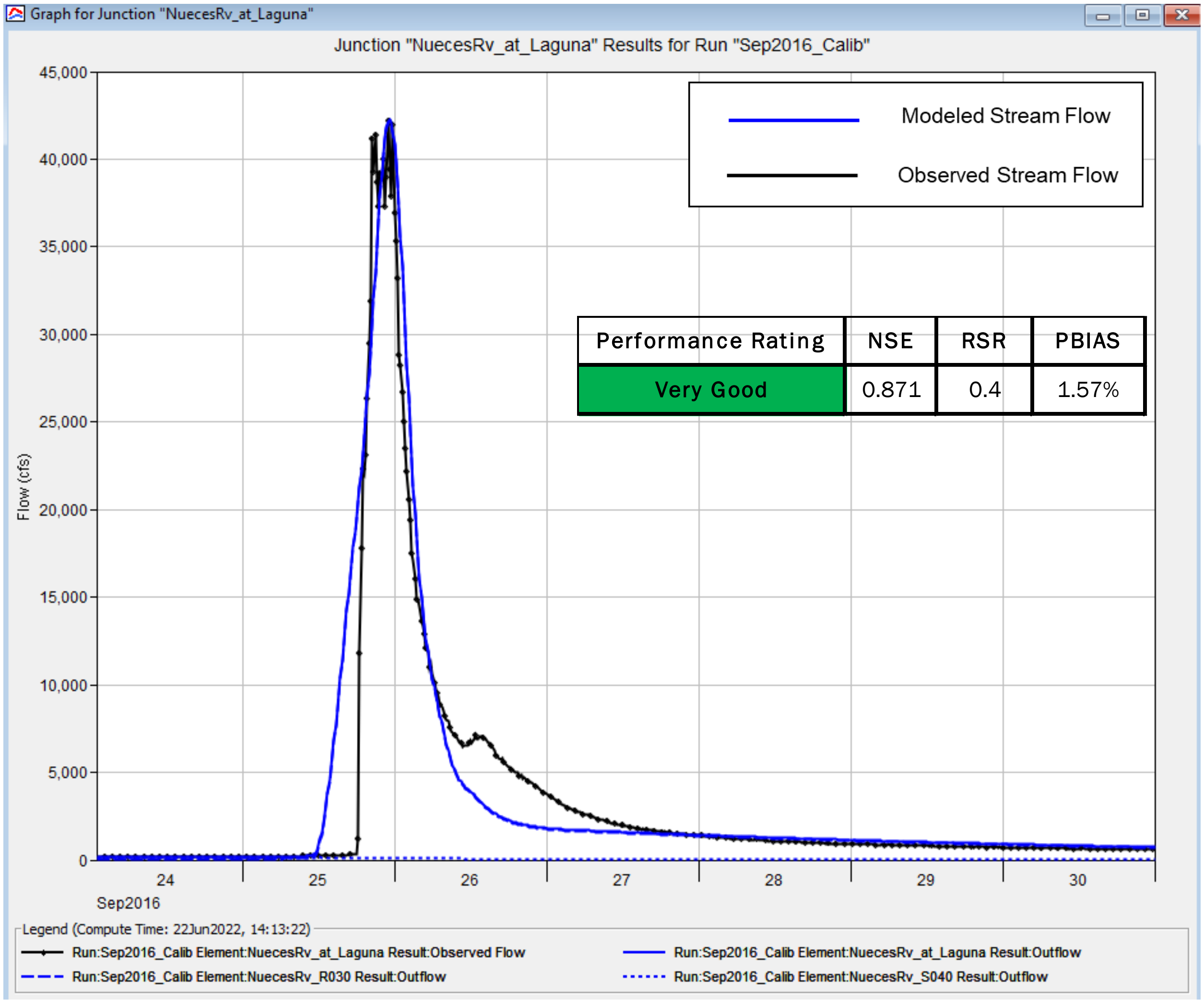


Figure B.151: September 2016 Calibration Results for Nueces River at Laguna USGS Gage

The Nueces River at Laguna for Sep 2016 achieved a “Very Good” performance rating. The HEC-HMS model matched the timing, magnitude and volume of the observed hydrograph very well. The final Nueces River at Laguna plot is shown above.

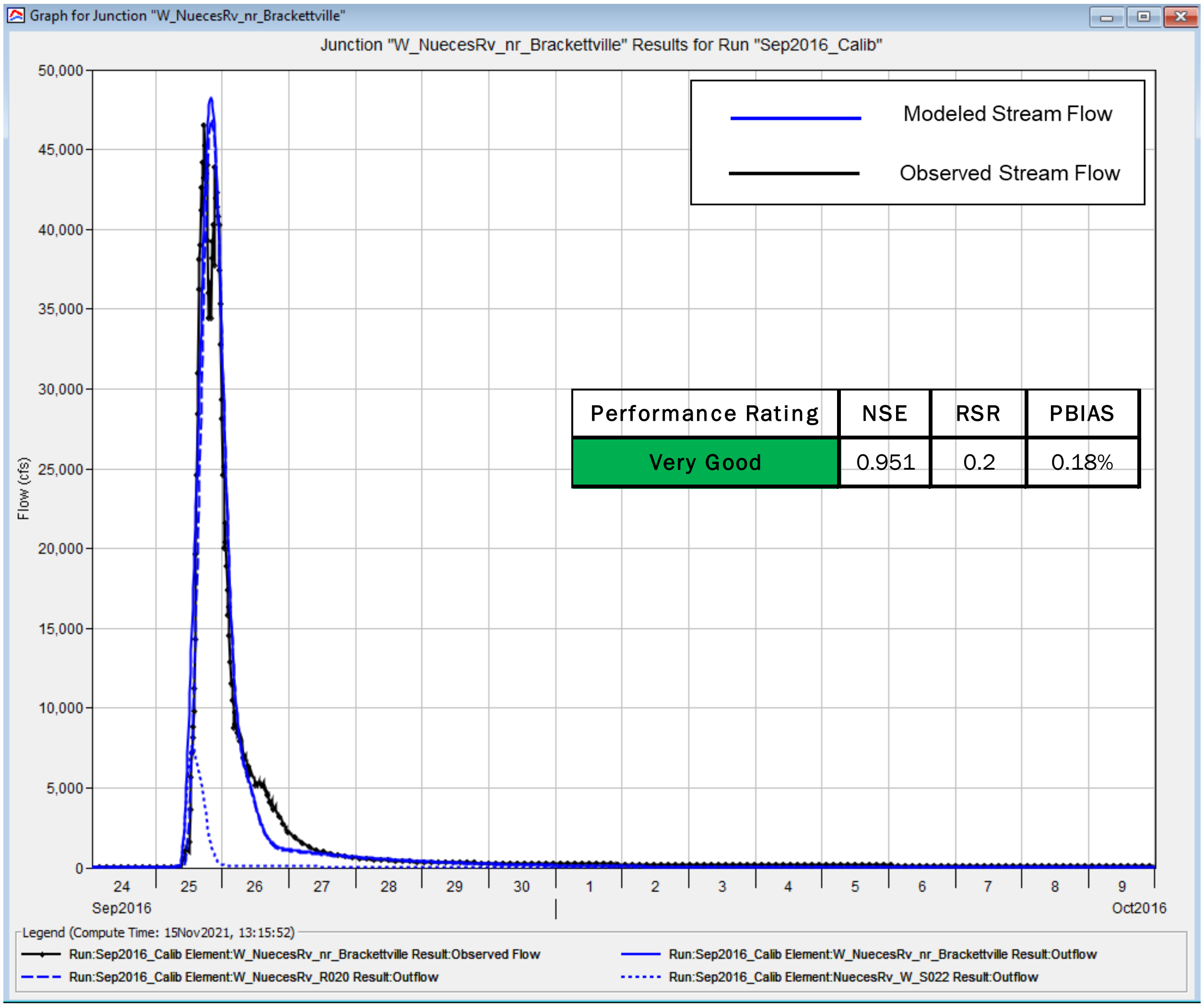
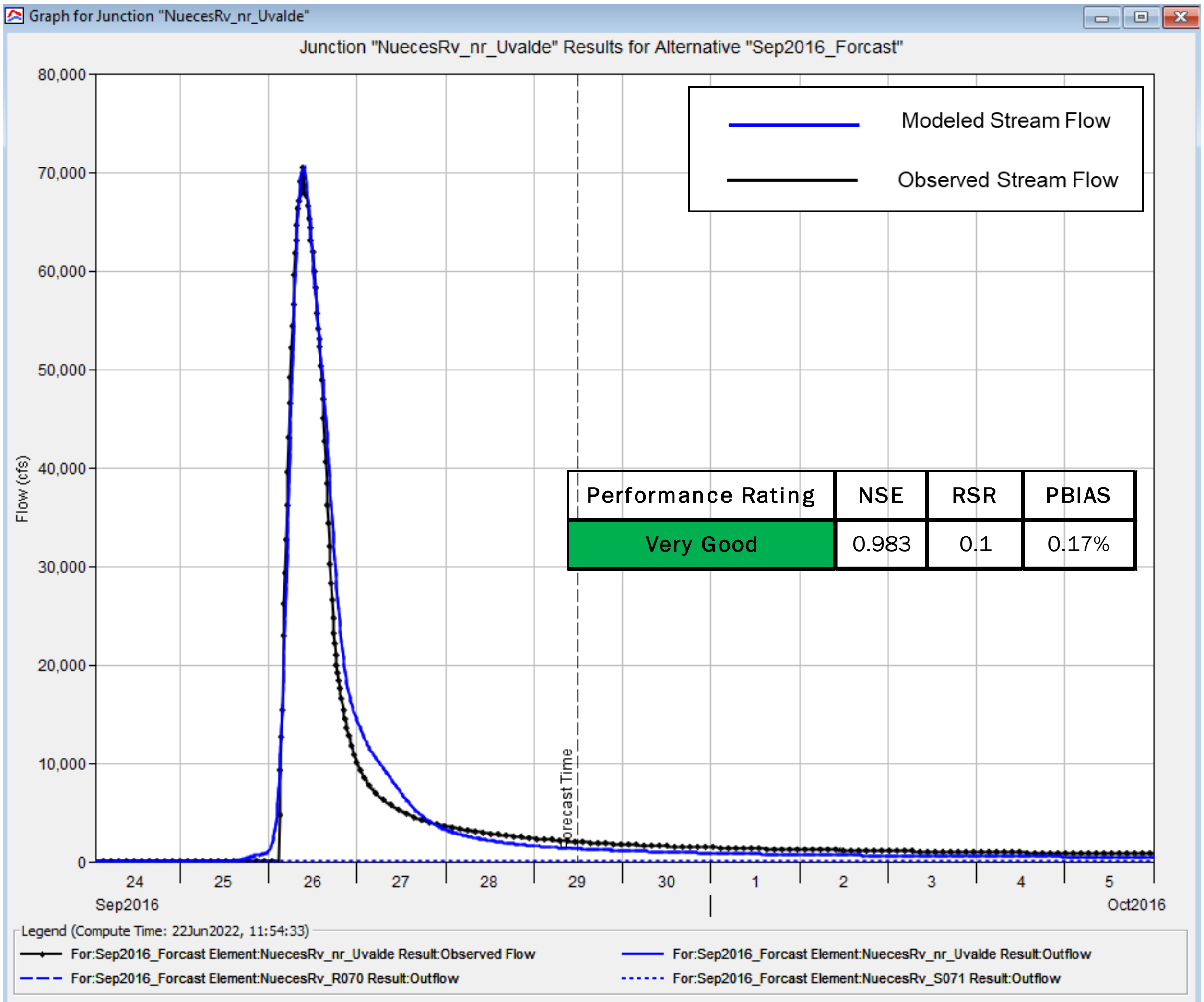


Figure B.152: September 2016 Calibration Results for West Nueces River near Brackettville USGS Gage

The West Nueces River near Brackettville calibration for Sep 2016 achieved a "Very Good" performance rating. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well. The West Nueces River near Brackettville plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.983	0.1	0.17%

Figure B.153: September 2016 Calibration Results for Nueces River below Uvalde USGS Gage

The Nueces River below Uvalde calibration for Sep 2016 achieved a "Very Good" performance rating. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well. The final Nueces River below Uvalde plot is shown above.

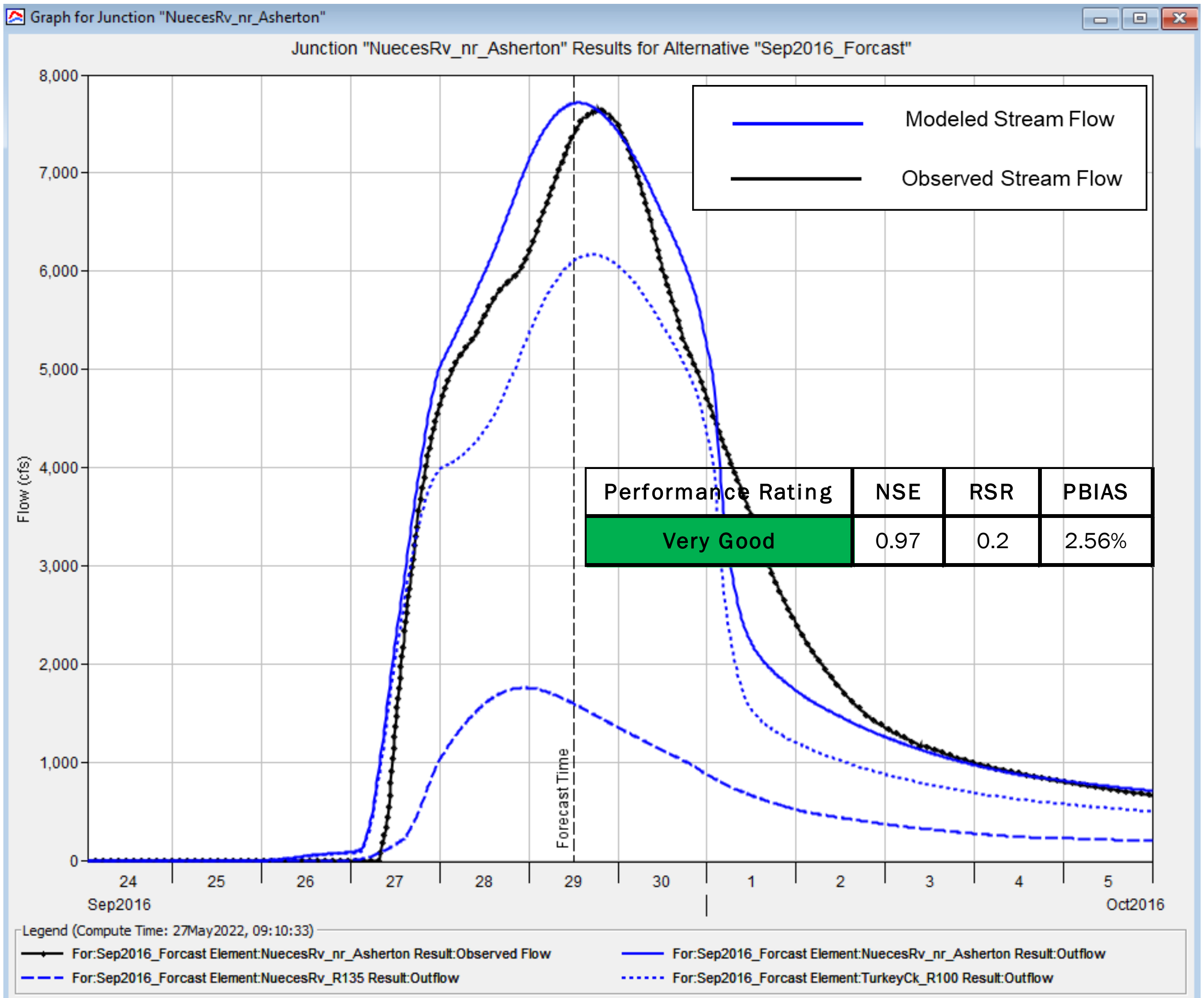


Figure B.154: September 2016 Calibration Results for Nueces River near Asherton USGS Gage

The Nueces River near Asherton calibration for Sep 2016 achieved a "Very Good" performance rating. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well. Detailed modeling of the split flow area along with adjusting the channel losses on the Nueces River downstream of Uvalde helped to achieve this calibration. There is a split flow between the Nueces River and Espantosa Slough/Soldier Slough starting near the town of Crystal City to just upstream of the Nueces River near Asherton gage (State Hwy 190). Espantosa Slough/Soldier Slough has three low water dams and the Nueces River also has three dams. In the HEC-HMS model, a diversion element was set up with diversion method "Inflow Function". The Inflow-Diversion Function, total inflow versus diversion, was estimated with 2D HEC-RAS. It was determined that Espantosa Slough/Soldier Slough is the main channel with most of the flow. The 2D HEC-RAS analysis showed that one of the dams on the Nueces River blocks the flow and only lets a small portion of the flow continue down the Nueces River flow path. The final Nueces River near Asherton plot is shown above. The channel losses were also adjusted during calibration. Since very little rain fell on the Nueces River downstream of Uvalde, the difference in flood volume between the Uvalde and Asherton gages was primarily due to channel losses. These channel losses were adjusted to match the observed flow volume at Asherton. The final Nueces River near Asherton plot is shown above.

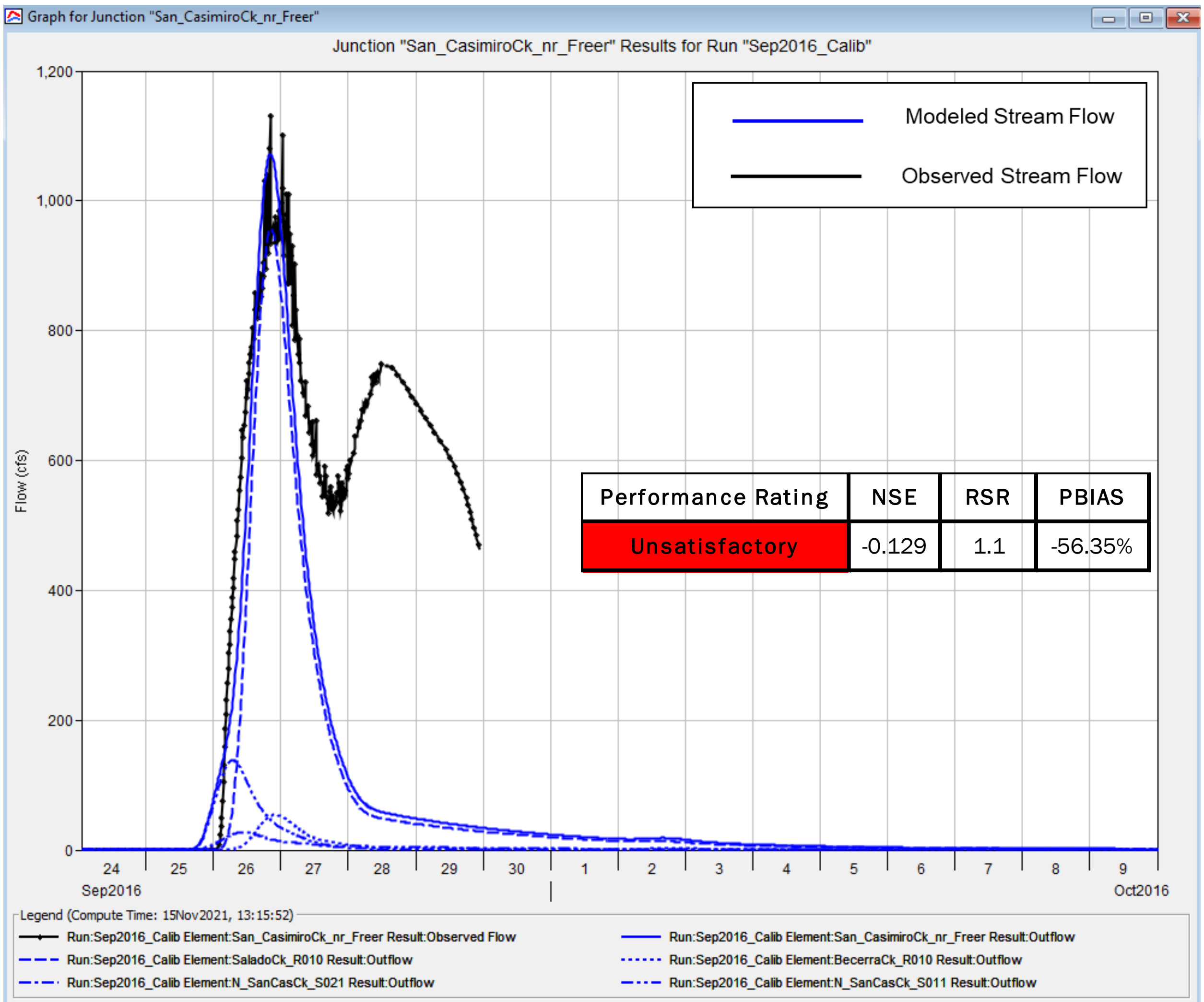
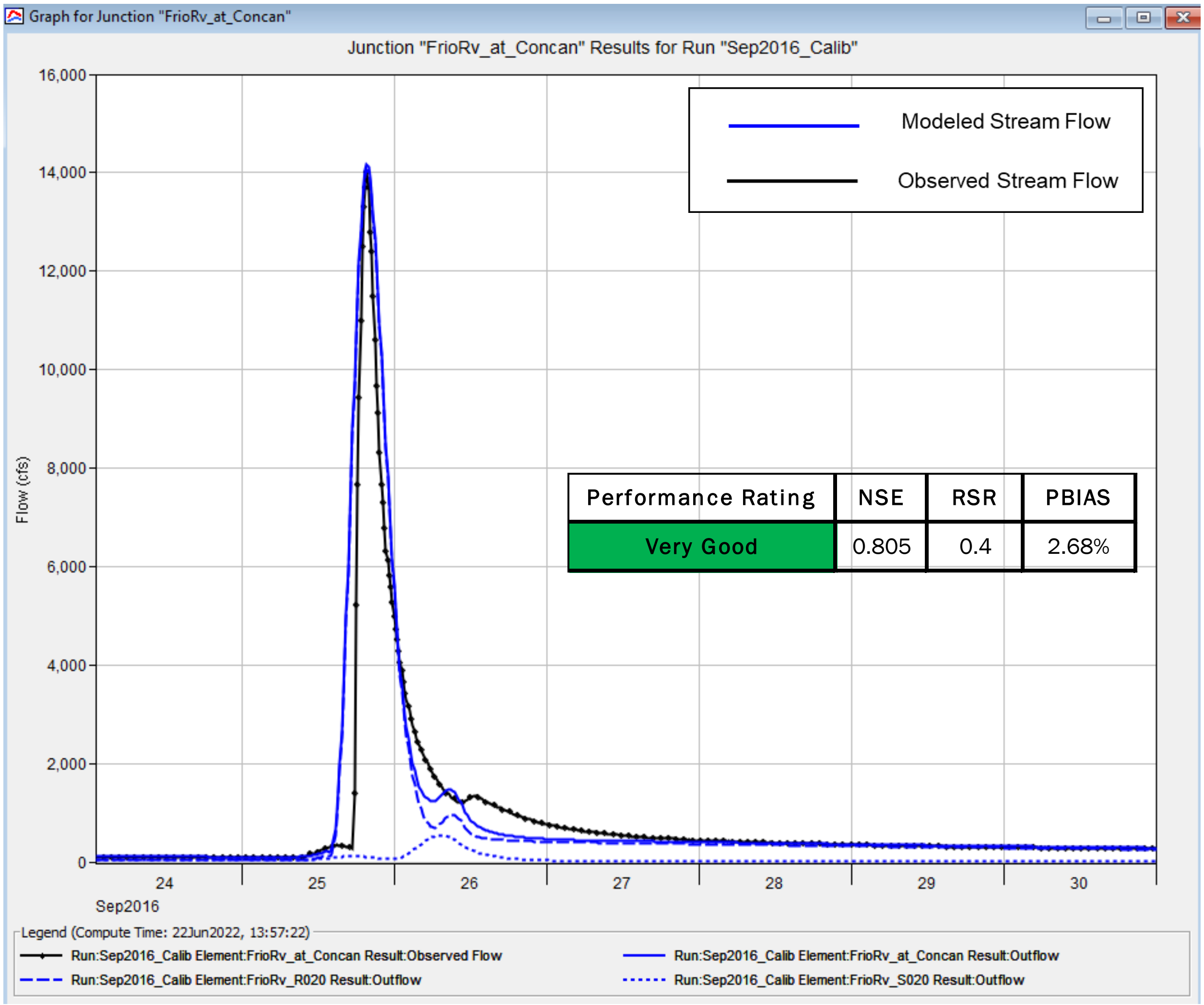


Figure B.155: September 2016 Calibration Results for San Casimiro Creek near Freer USGS Gage

At the San Casimiro Creek near Freer gage, HEC-HMS matched the observed hydrograph on for the first peak on September 26, but not the second peak on September 28. Overall, this resulted in an unsatisfactory performance rating. The majority of the subarea precipitation occurred between September 25 at 1500 hrs thru September 26 at 0100 hr. A check of the NWS daily precipitation gages showed no precipitation on September 27-28. There are multiple dams upstream of the Freer gage on Salado Creek, Caliche Creek, and Alamita Creek in subareas N_SanCasCk_S010 and N_SanCasCk_S011, which were not modeled in HEC-HMS. Delayed releases from these dams could be causing the second peak on September 28. The San Casimiro Creek near Freer plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Very Good	0.805	0.4	2.68%

Figure B.156: September 2016 Calibration Results for Frio River at Concan USGS Gage

The Frio River at Concan calibration for Sep 2016 achieved a "Very Good" performance rating. The HEC-HMS model was able to match the timing, shape, magnitude and volume of the observed hydrograph very well. The revised Frio River at Concan plot is shown above.

October 2018 Events:

The October 2018 calibration includes three HEC-HMS simulation time periods covering different portions of the Nueces River basin; October 2018 early (October 7 – 14); October 2018 middle (October 14 – 21); and October 2018 entire (October 7 - November 25). Calibration of October 2018 early event included watersheds upstream of the Nueces River near Asherton gage, Frio River below Dry Frio River near Uvalde, Sabinal at Sabinal gage. Calibration of October 2018 middle event included watersheds upstream of the Nueces River below Uvalde gage. Calibration of October 2018 entire event included the Lower Nueces River and portions of the Atascosa River and the Lower Frio River. The Southern Texas Palmer Drought Severity Index (PDSI) was moderately moist (2.00 – 2.99) in September 2018. Southern Texas Palmer Z-index was extremely moist (3.50 and above) in September 2018.

1.4.4.14 October 2018 Early Event

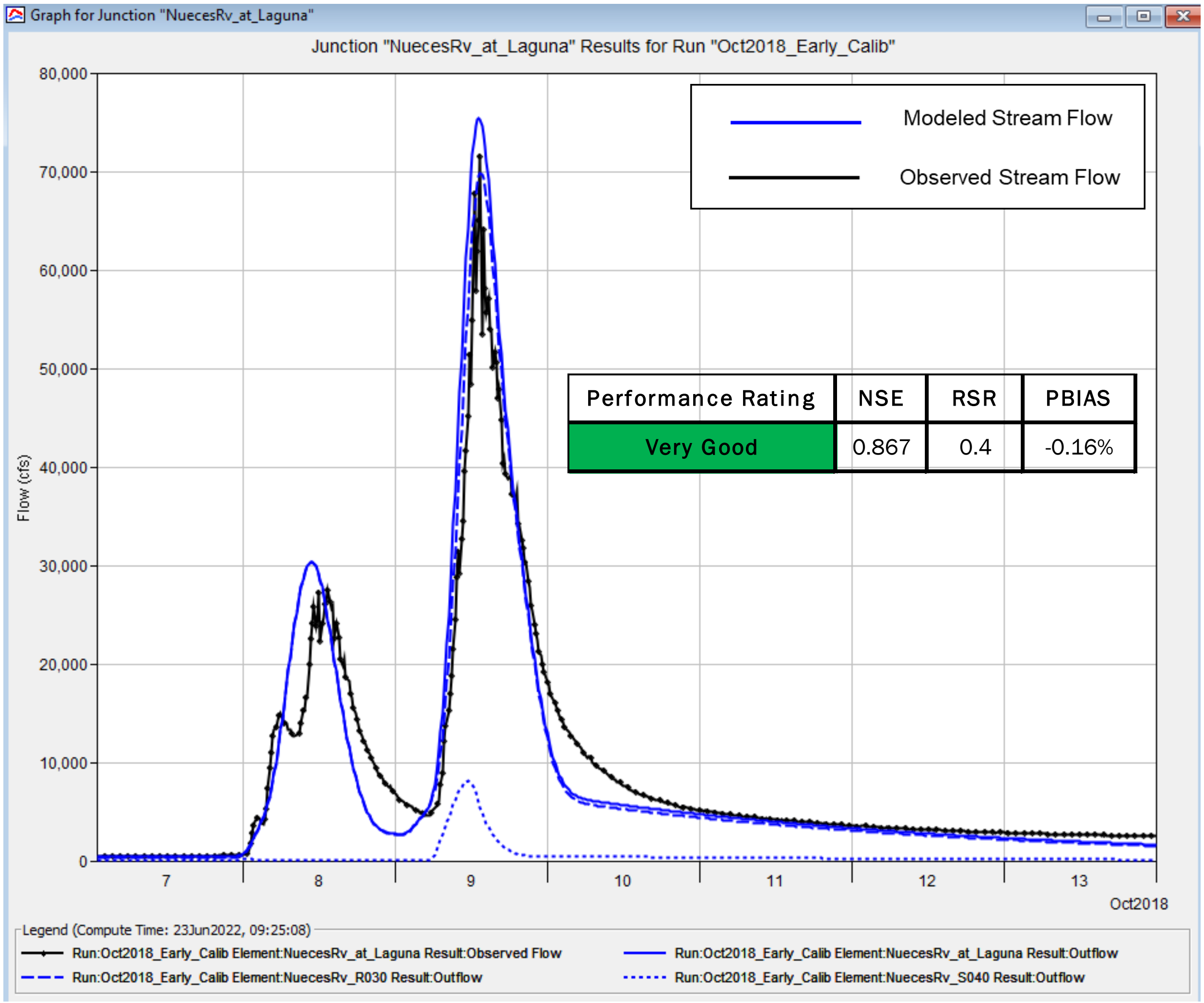


Figure B.157: October 2018 (early) Calibration Results for Nueces River at Laguna Gage

The Nueces River at Laguna calibration achieved a “Very Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, shape, magnitude and volume of the observed hydrograph very well. The Nueces River at Laguna plot is shown above.

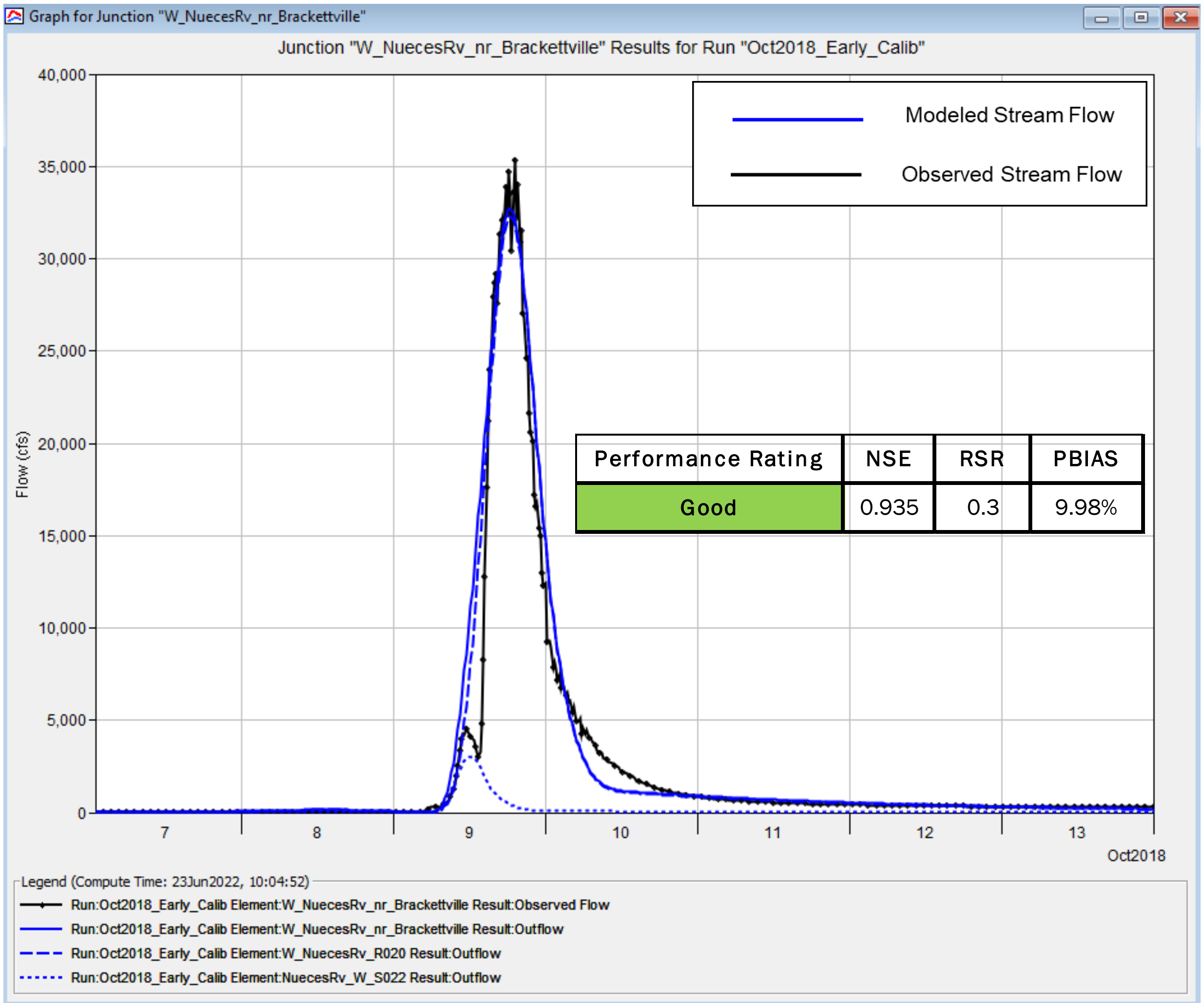


Figure B.158: October 2018 (early) Calibration Results for West Nueces River near Brackettville Gage

The West Nueces River near Brackettville calibration achieved a “Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, shape and magnitude of the observed hydrograph very well. The computed volume was just a bit high, resulting in the good rating rather than very good. The West Nueces River near Brackettville plot is shown above.

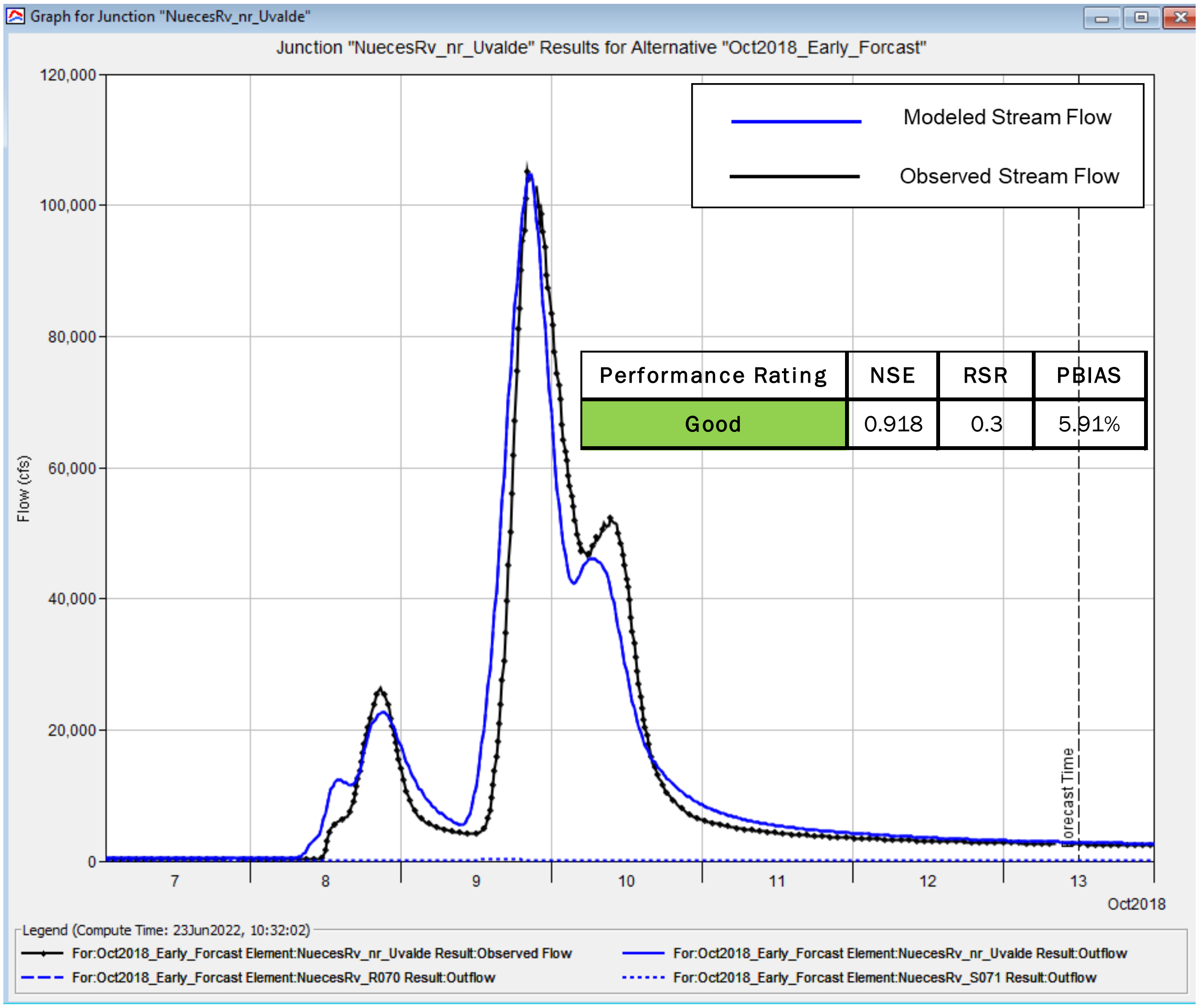


Figure B.159: October 2018 (Early) Calibration Results for Nueces River below Uvalde Gage

The Nueces River below Uvalde calibration achieved a “Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, shape and magnitude of the observed hydrograph very well. The computed volume was just a bit high, resulting in the good rating rather than very good. The Nueces River below Uvalde plot is shown above.

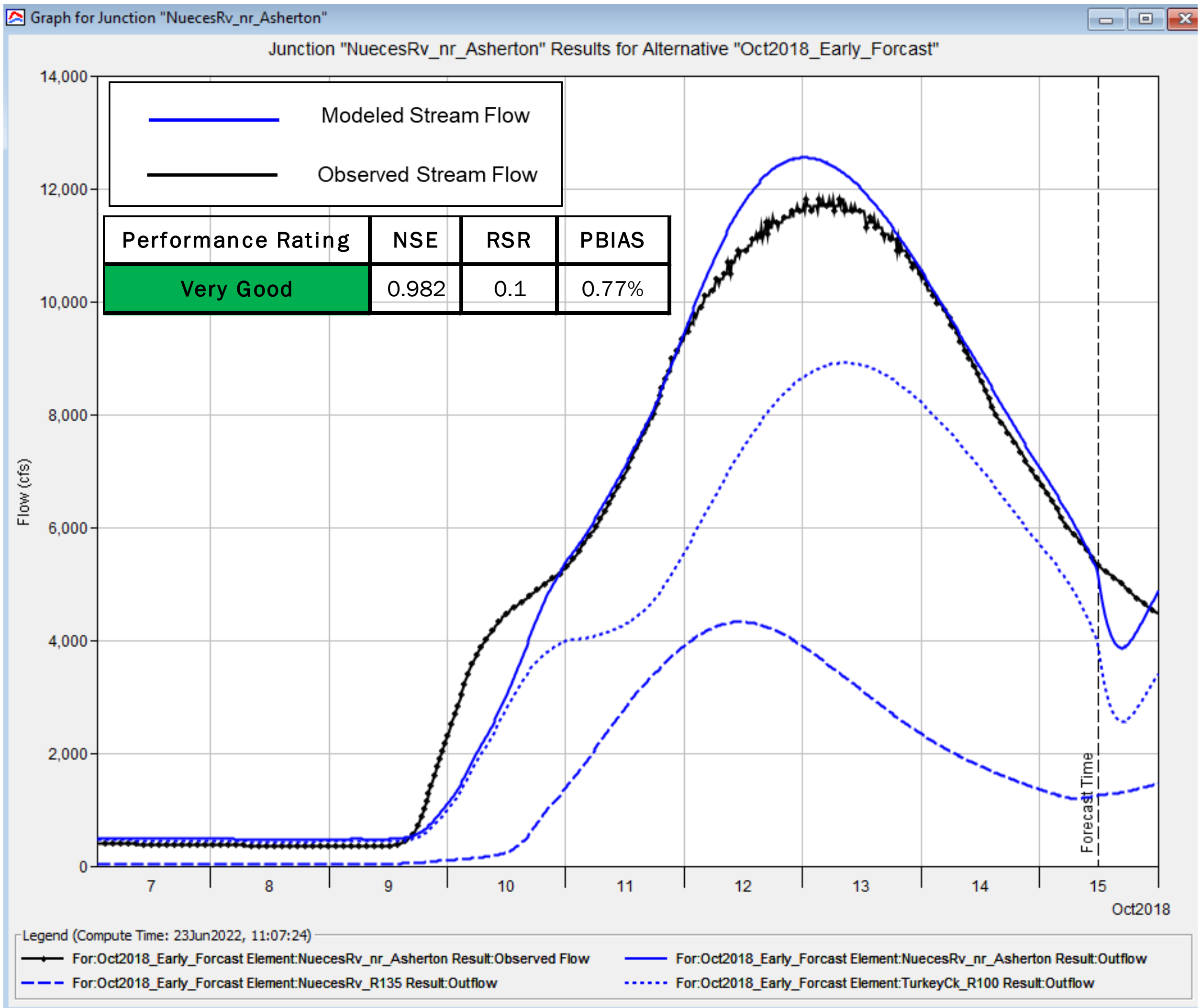


Figure B.160: October 2018 (early) Calibration Results for Nueces River near Asherton Gage

The Nueces River near Asherton calibration for the October 2018 Early event achieved a “Very Good” performance rating. The HEC-HMS model matched the timing, shape, magnitude and volume of the observed hydrograph very well. Detailed modeling of the split flow area along with adjusting the channel losses on the Nueces River downstream of Uvalde helped to achieve this calibration. There is a split flow between the Nueces River and Espantosa Slough/Soldier Slough starting near the town of Crystal City to just upstream of the Nueces River near Asherton gage (State Hwy 190). Espantosa Slough/Soldier Slough has three low water dams and the Nueces River also has three dams. In the HEC-HMS model, a diversion element was set up with diversion method “Inflow Function”. The Inflow-Diversion Function, total inflow versus diversion, was estimated with 2D HEC-RAS. It was determined that Espantosa Slough/Soldier Slough is the main channel with most of the flow. The 2D HEC-RAS analysis showed that one of the dams on the Nueces River blocks the flow and only lets a small portion of the flow continue down the Nueces River flow path. The final Nueces River near Asherton plot is shown above. The final Nueces River near Asherton plot is shown above.

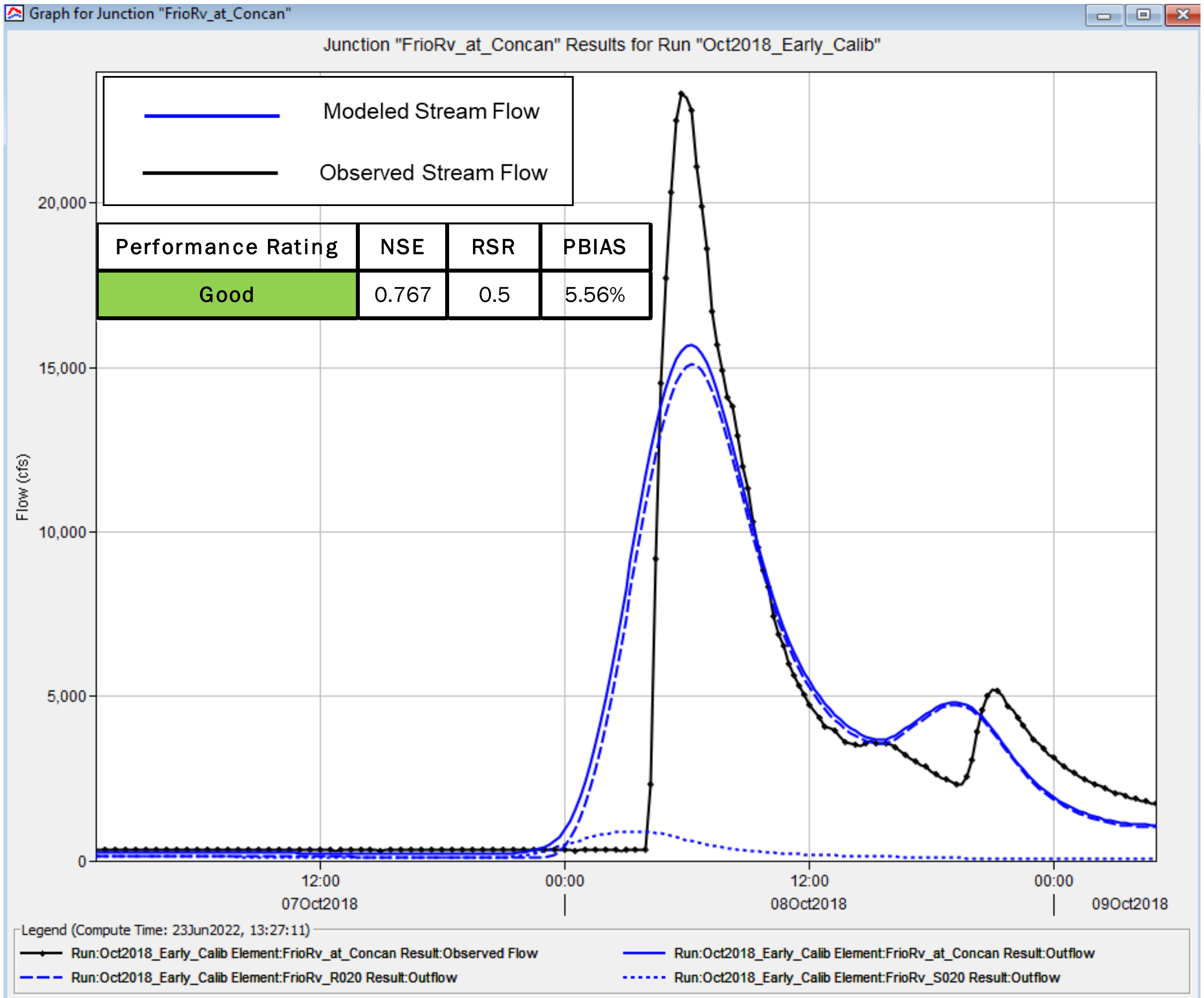
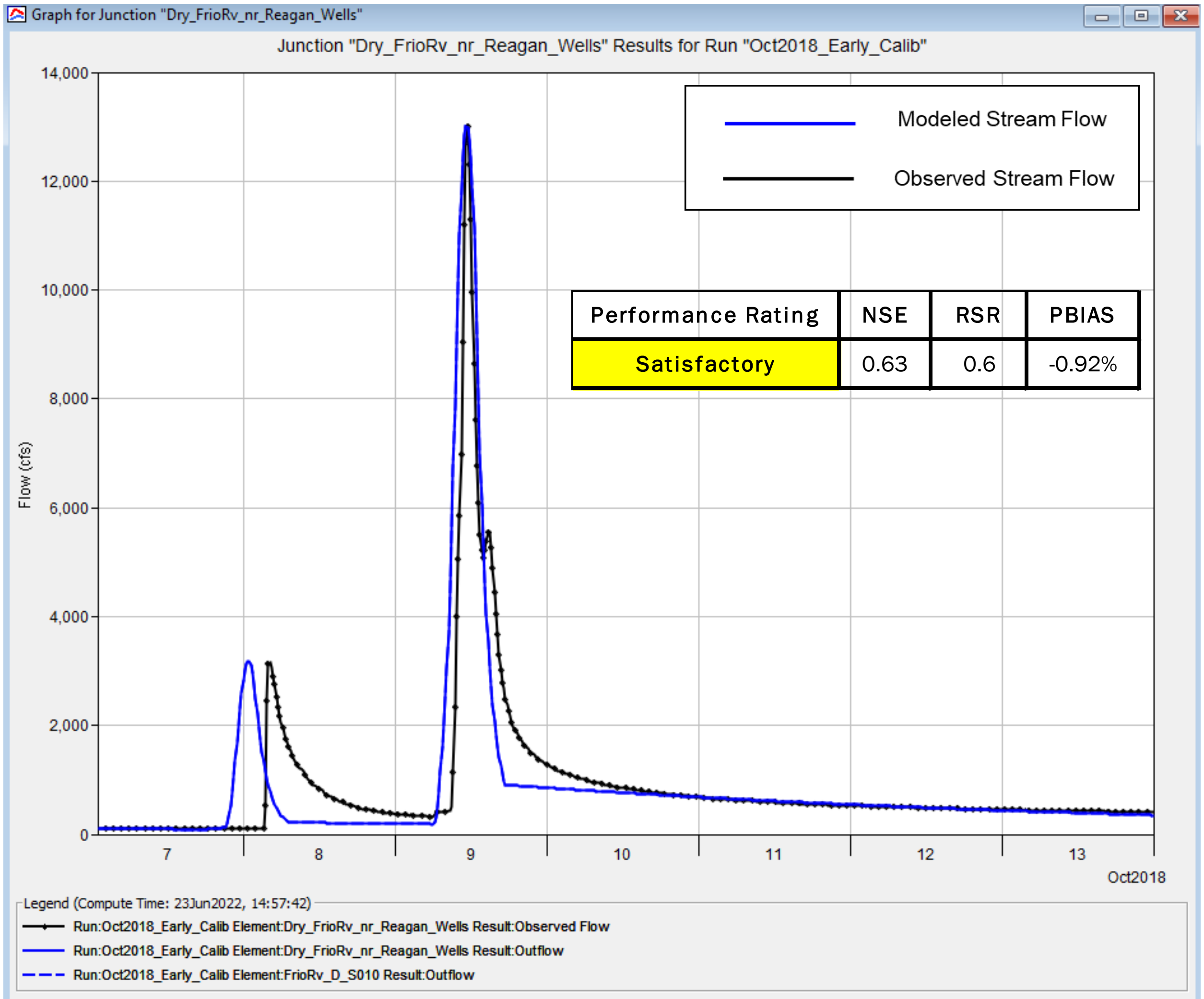


Figure B.161: October 2018 (early) Calibration Results for Frio River at Concan Gage

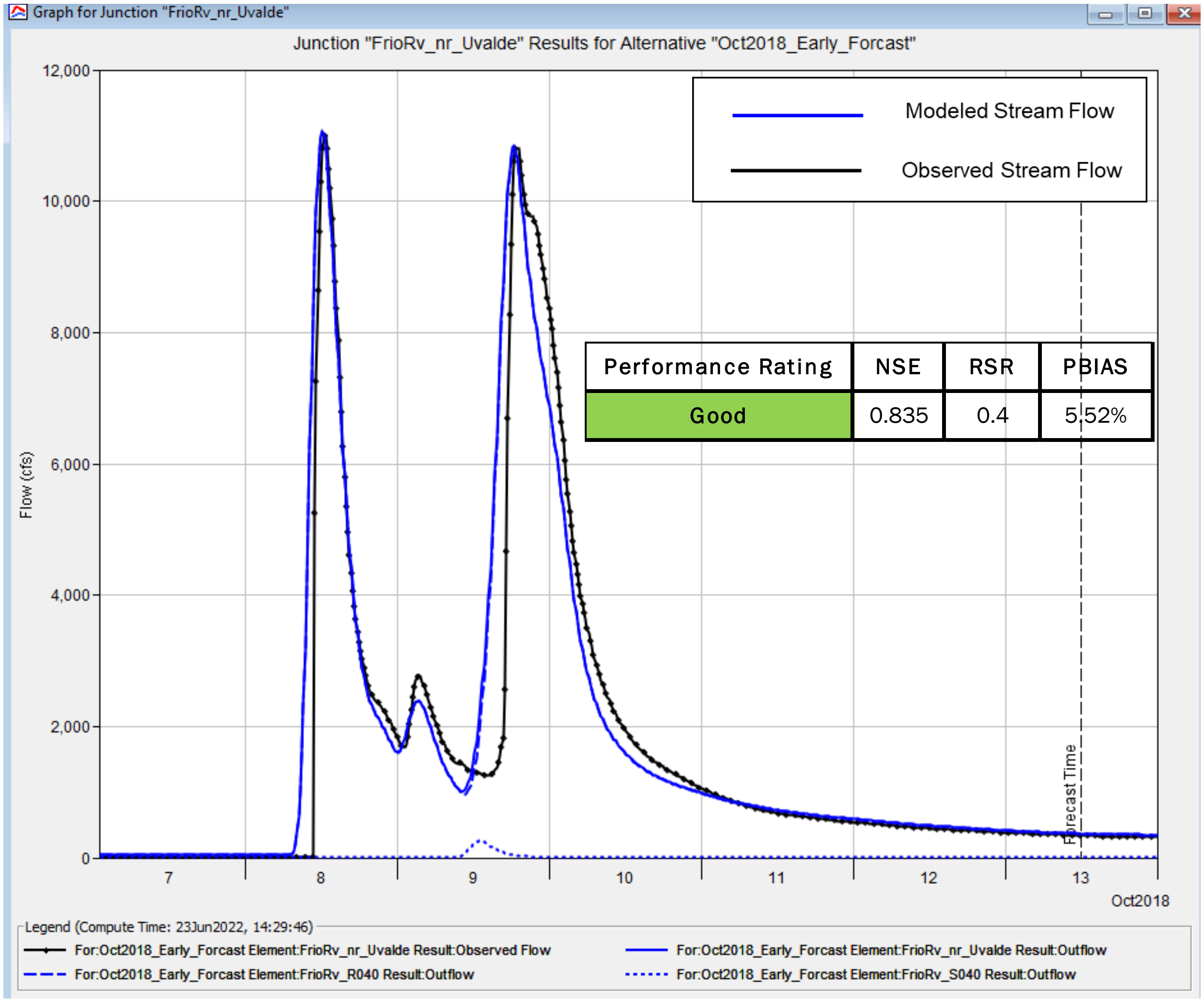
The Frio River at Concan calibration achieved a “Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing and volume of the observed hydrograph fairly well, but it could not match the peak magnitude nor the tall and narrow shape. There may be an issue with the rainfall depths and/or intensity at this location. The National Weather Service daily precipitation gage at Prade Ranch showed 6.50 inches for the 24 hours ending on June 8 at 0900 hrs, whereas the NEXRAD data showed only 4.8 inches for that location. The Frio River at Concan plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Satisfactory	0.63	0.6	-0.92%

Figure B.162: October 2018 (early) Calibration Results for Dry Frio River near Reagan Wells Gage

The Dry Frio River near Reagan Wells calibration had a “Satisfactory” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, magnitude, shape and volume of the largest peak of the observed hydrograph very well, but the timing of the smaller peak was much earlier than the observed, resulting in the lower performance rating. The time to peak of a watershed typically decreases as the rainfall intensity increases. Since the purpose of this study is to simulate larger flood events such as the 1% annual chance (100-year) flood, the calibration focused on the larger peak. The Dry Frio River near Reagan Wells plot is shown above.



Performance Rating	NSE	RSR	PBIAS
Good	0.835	0.4	5.52%

Figure B.163: October 2018 (early) Calibration Results for Frio River below Dry Frio near Uvalde Gage

The Frio River near Uvalde calibration achieved a “Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, magnitude, and shape of the observed hydrograph very well, but the volume was slightly higher than the 5% cutoff needed for a very good rating. The Frio River below Dry Frio near Uvalde plot is shown above.

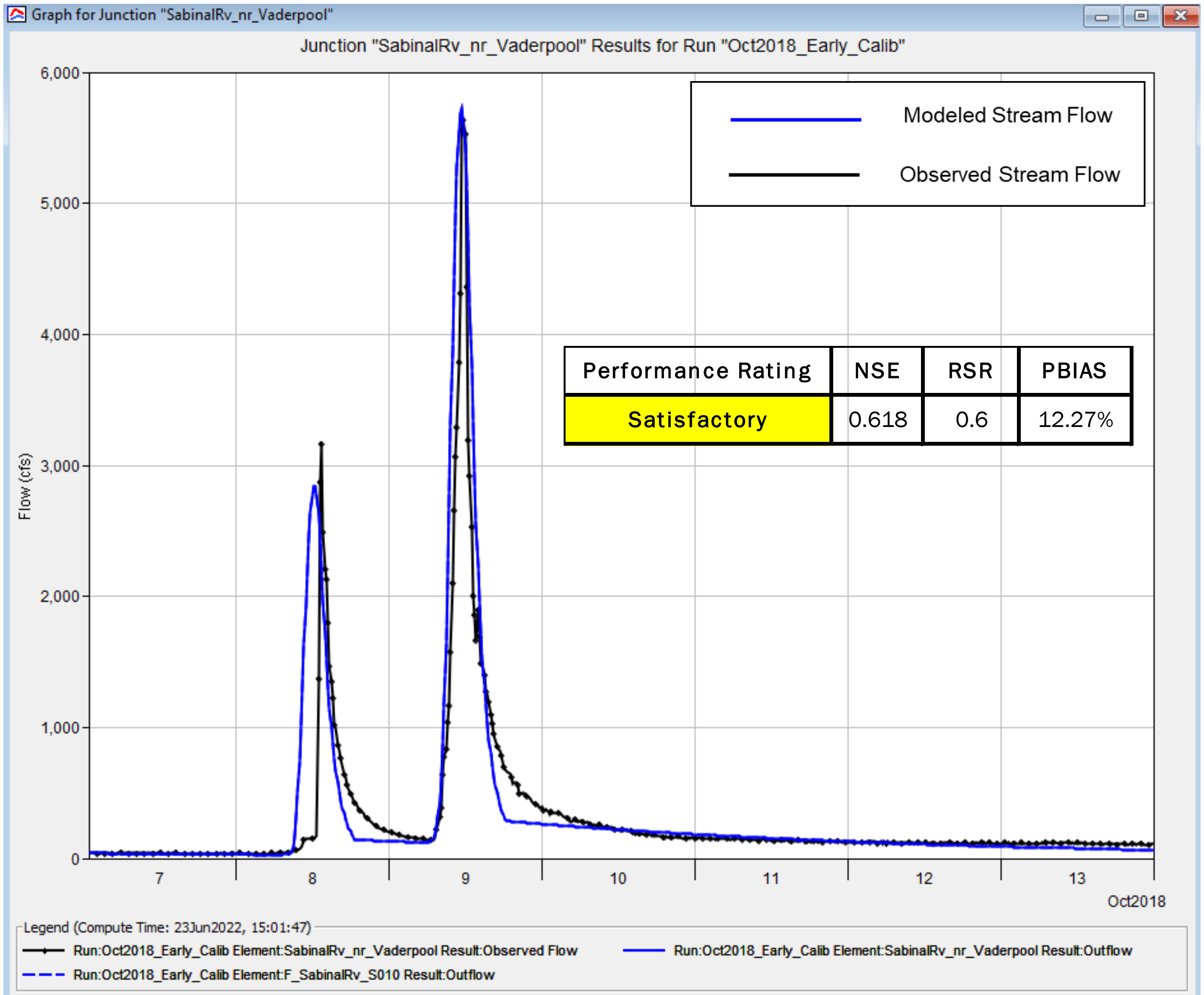


Figure B.164: October 2018 (early) Calibration Results for Sabinal River below Mill Creek near Vanderpool Gage

The Sabinal River below Mill Creek near Vanderpool calibration had a "Satisfactory" performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, magnitude, and shape of the observed hydrograph very well, but the volume was a bit higher than the observed, resulting in the lower performance rating. The Sabinal River below Mill Creek near Vanderpool plot is shown above.

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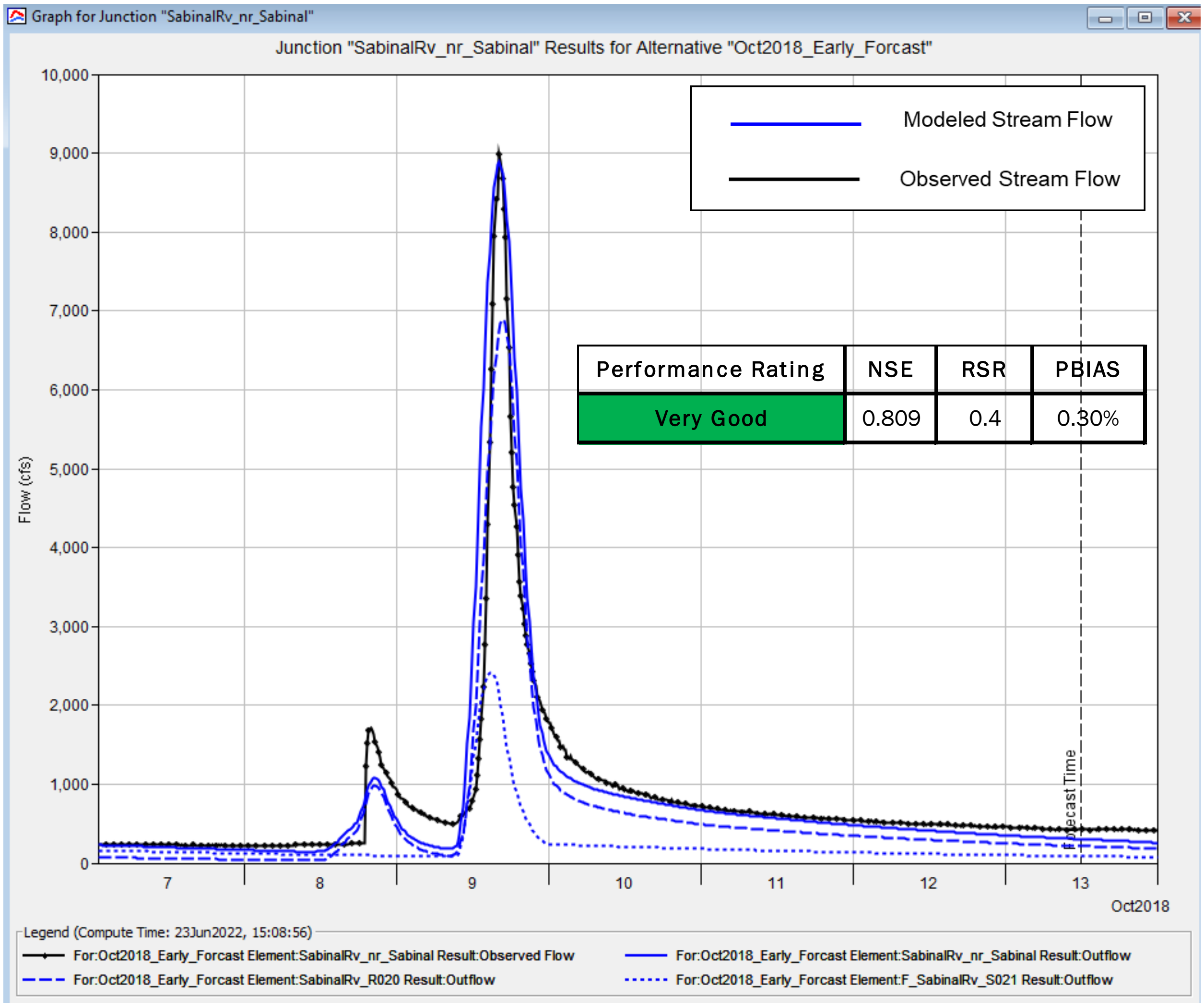

Figure B.165: October 2018 (early) Calibration Results for Sabinal River near Sabinal Gage

The Sabinal River near Sabinal calibration achieved a “Very Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, magnitude, shape and volume of the observed hydrograph very well. The Sabinal River near Sabinal plot is shown above.

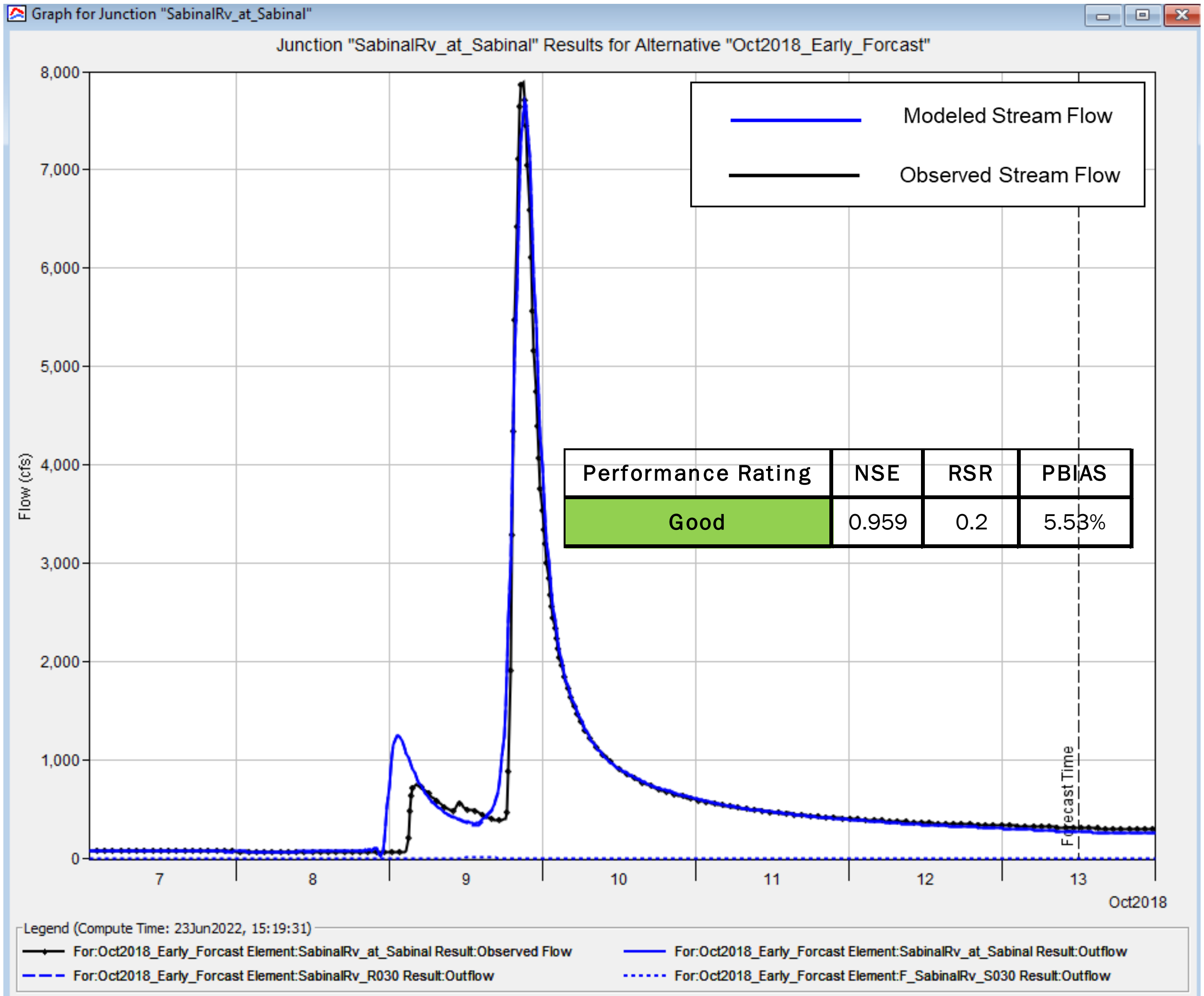

Figure B.166: October 2018 (early) Calibration Results for Sabinal River at Sabinal Gage

The Sabinal River at Sabinal calibration achieved a “Good” performance rating for the Oct 2018 Early event. The HEC-HMS model was able to match the timing, magnitude, shape and volume of the observed hydrograph very well. The volume was just a little high for the first small peak, which resulted in a good rating rather than very good. The Sabinal River at Sabinal plot is shown above.

1.4.4.15 October 2018 middle Event

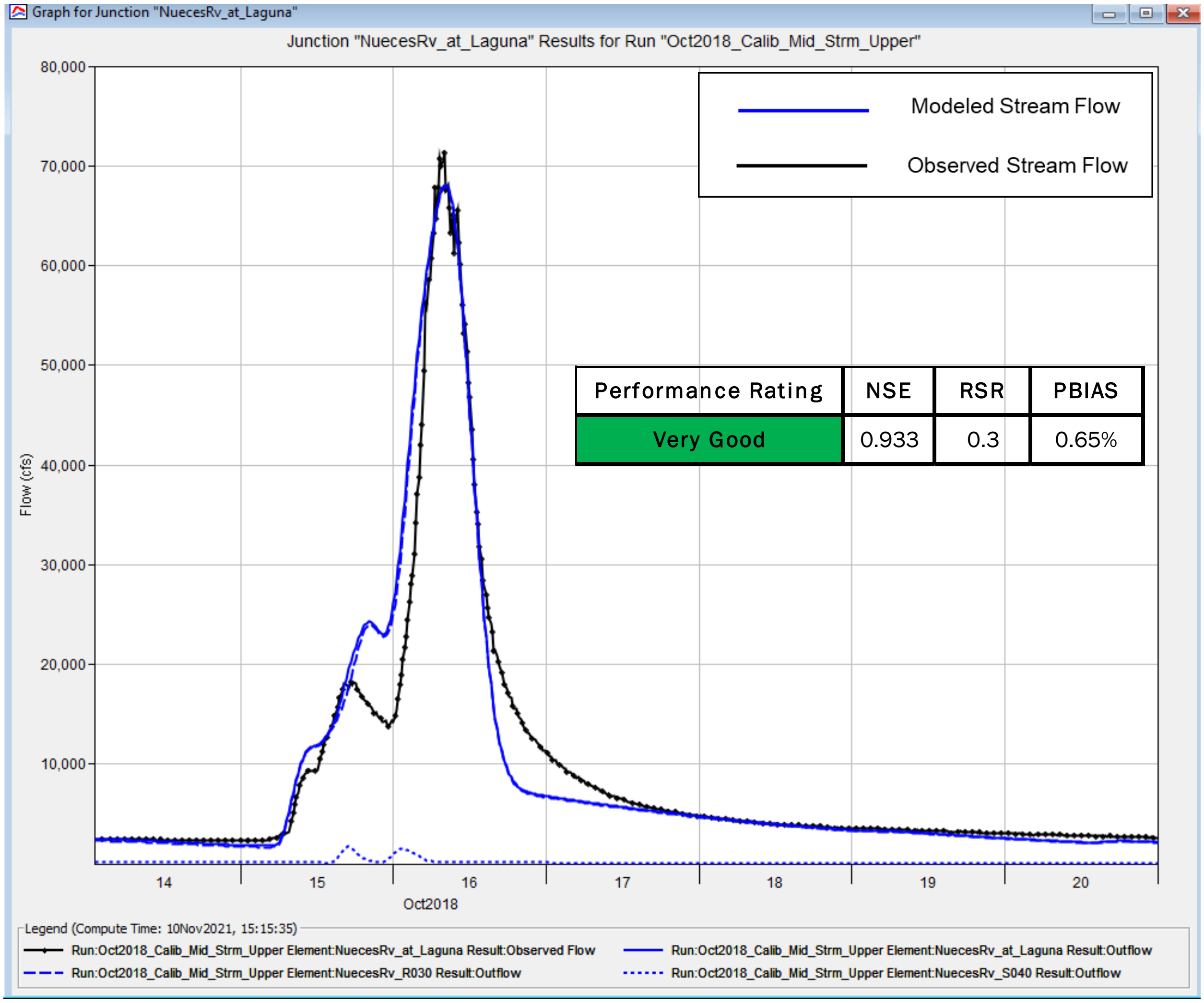

Figure B.167: October 2018 (middle) Calibration Results for Nueces River at Laguna Gage

The Nueces River at Laguna calibration achieved a "Very Good" performance rating for the Oct 2018 middle event. The HEC-HMS model was able to match the timing, magnitude, shape and volume of the observed hydrograph very well. The Nueces River at Laguna plot is shown above.

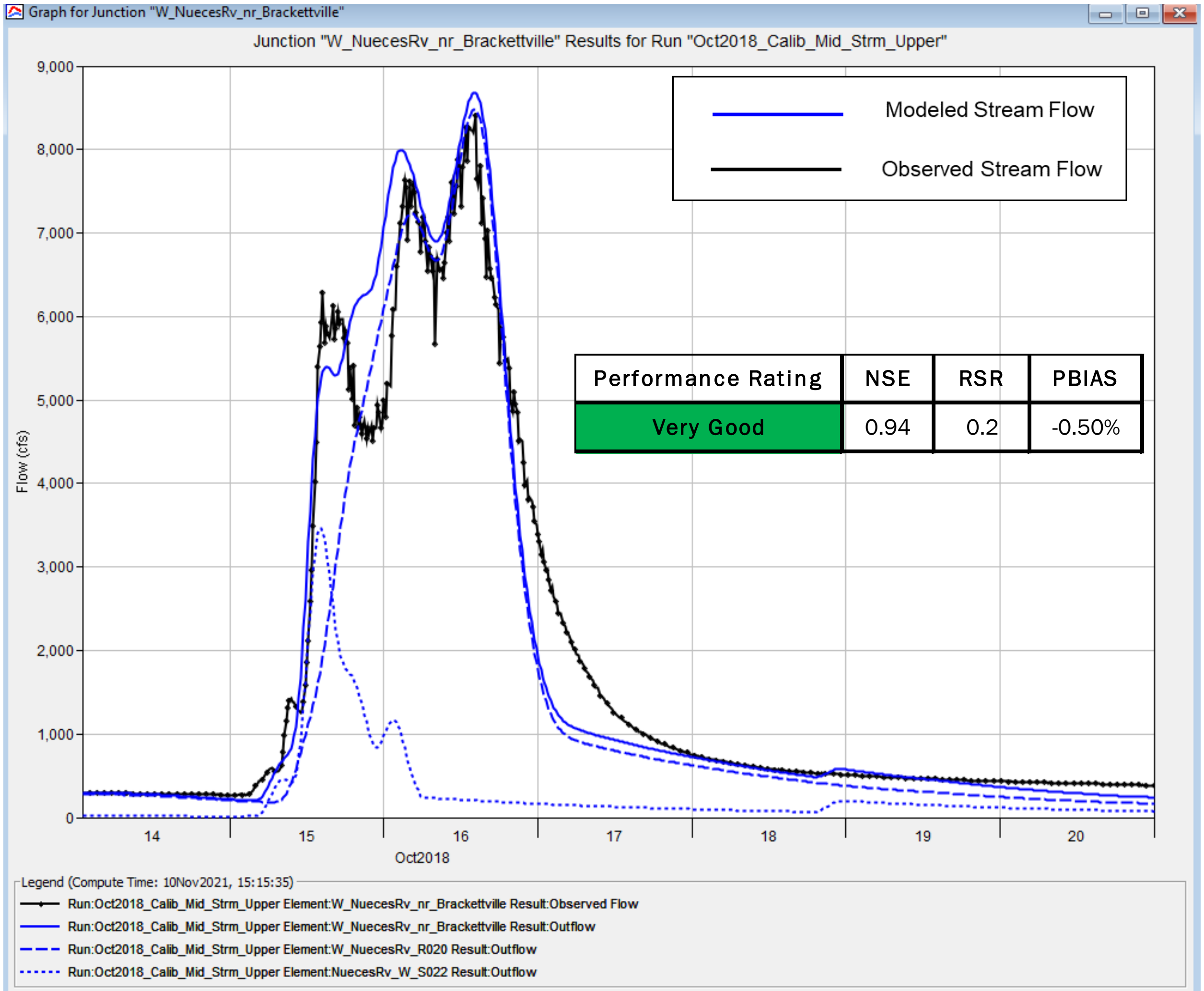

Figure B.168: October 2018 (middle) Calibration Results for West Nueces River near Brackettville Gage

The West Nueces River near Brackettville calibration achieved a “Very Good” performance rating for the Oct 2018 middle event. The HEC-HMS model was able to match the timing, magnitude, shape and volume of the observed hydrograph very well. The West Nueces River near Brackettville plot is shown above.

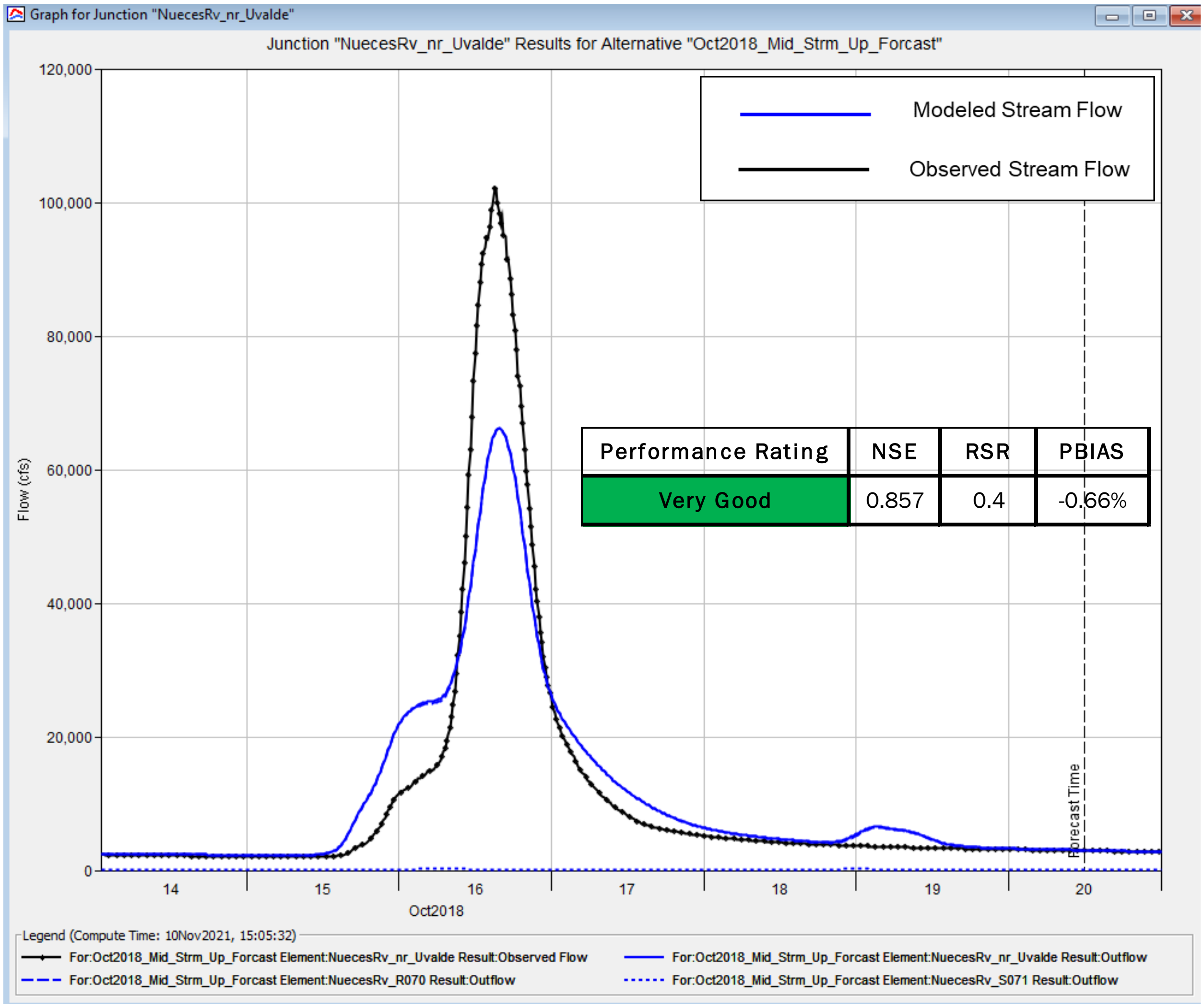

Figure B.169: October 2018 (middle) Calibration Results for Nueces River below Uvalde Gage

The Nueces River below Uvalde calibration achieved a "Very Good" performance rating for the Oct 2018 middle event. The HEC-HMS model was able to match the timing, shape and volume of the observed hydrograph very well, but the peak magnitude was too low. The NEXRAD precipitation and or intensity is most likely underestimated for the subbasins above this gage. The Nueces River below Uvalde plot is shown above.

1.4.4.16 October 2018 entire Event

During the Oct 2017 entire event, there was little to no precipitation and runoff downstream of the Nueces River near Asherton gage, Frio River below Dry Frio River near Uvalde gage and Sabinal at Sabinal gage. Therefore, this event was primarily used for routing calibration. Calibration plots will only be shown on the Nueces River gages downstream of Nueces River near Asherton gage. Forecast mode was used to blend in the observed data at the other upstream gages.

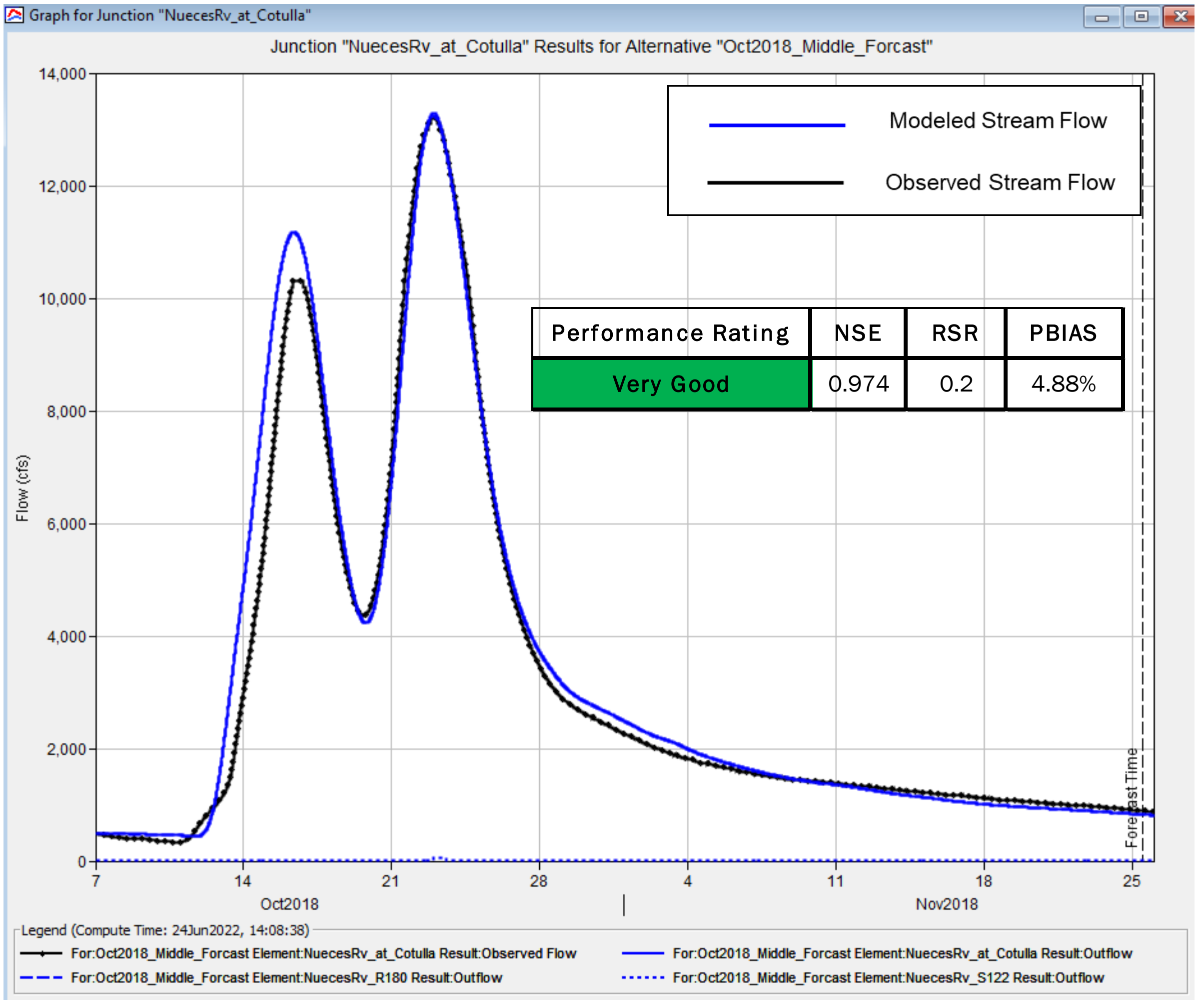

Figure B.170: October 2018 (entire) Calibration Results for Nueces River at Cotulla Gage

The Nueces River at Cotulla calibration achieved a "Very Good" performance rating for the Oct 2018 entire event. The HEC-HMS model was able to match the timing, shape and volume of the observed hydrograph very well, especially for the highest peak. The Muskingum routing parameters were adjusted between Asherton and Cotulla to better match the observed data. The Nueces River at Cotulla plot is shown above.

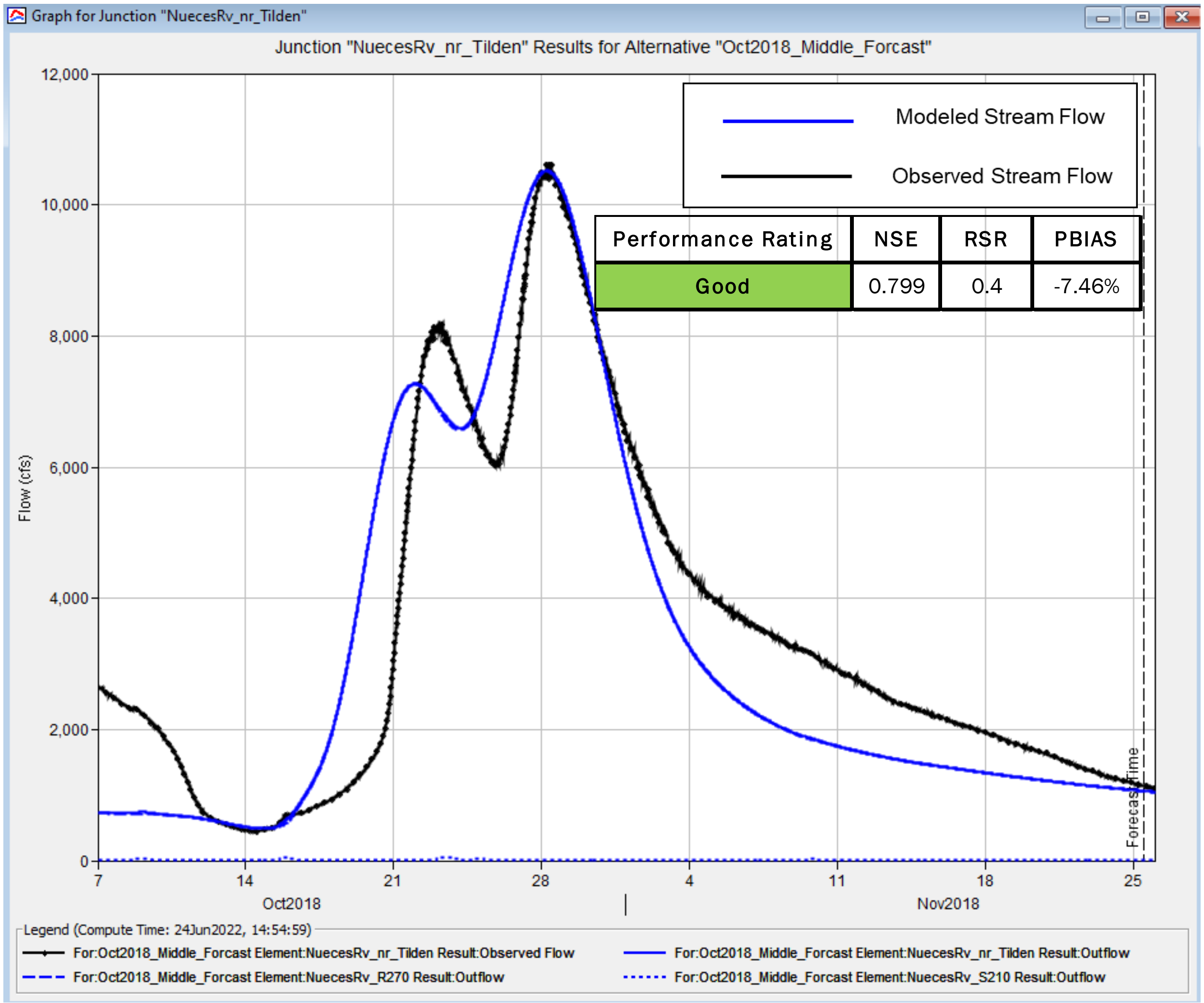

Figure B.171: October 2018 (entire) Calibration Results for Nueces River near Tilden Gage

The Nueces River near Tilden calibration achieved a “Good” performance rating for the Oct 2018 entire event. The HEC-HMS model was able to match the timing, magnitude, and volume of the observed hydrograph fairly well, especially for the largest peak. However, the shape was off for the early peak and the recession limb, resulting in the good rating. A more detailed routing method may improve this calibration, but that option was not available due to a lack of LiDAR data and BLE modeling in this area. However, the model still matched the magnitude and timing of the main peak, which are the most important factors for the frequency storms. The Nueces River near Tilden plot is shown above.

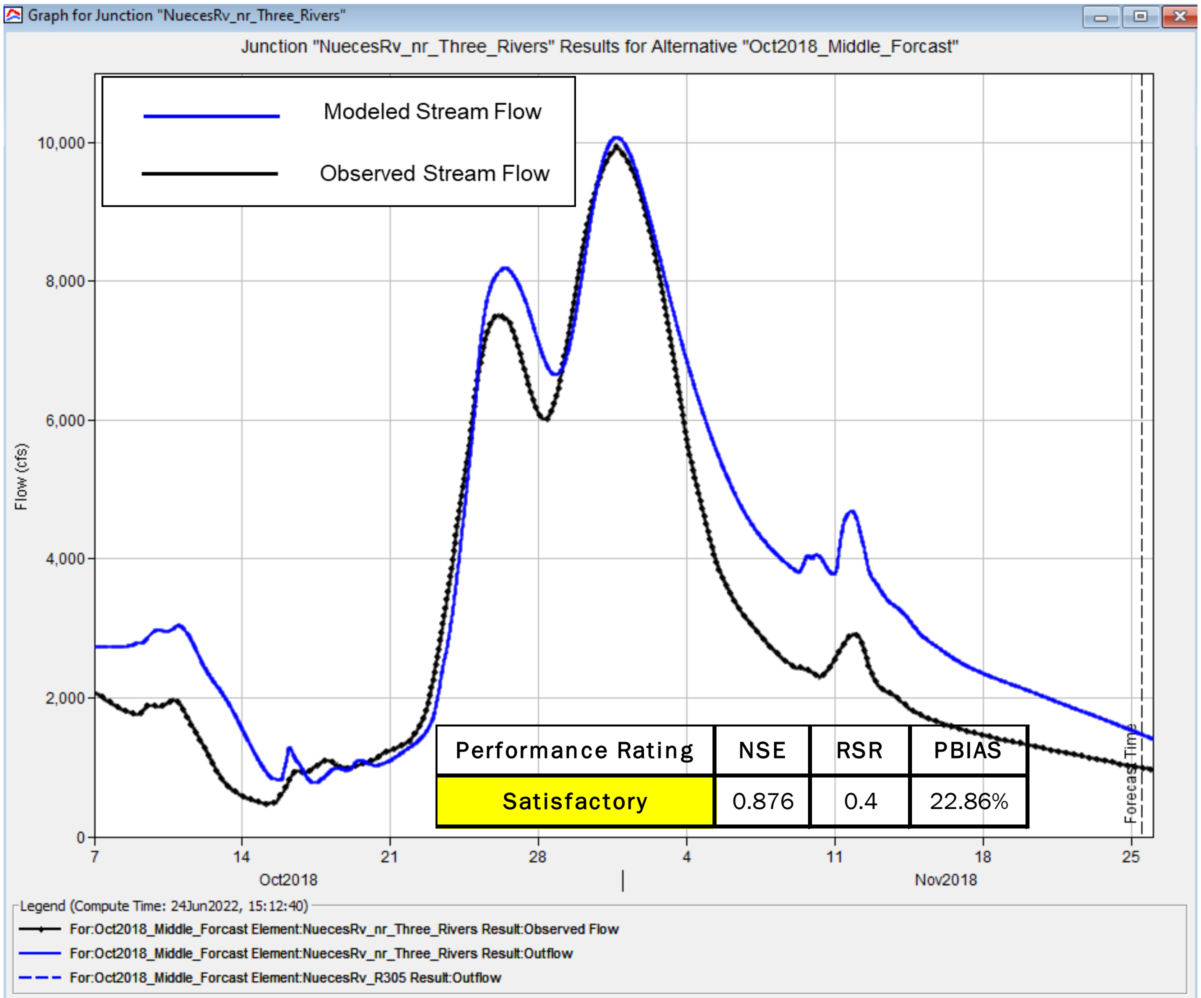

Figure B.172: October 2018 (entire) Calibration Results for Nueces River near Three Rivers Gage

The Nueces River near Three Rivers calibration had a “Satisfactory” performance rating for the Oct 2018 entire event. The HEC-HMS model was able to match the timing, magnitude, and shape of the largest peak of the observed hydrograph well, but the volume was too high in the early and late portions of the hydrograph, resulting in the satisfactory rating. There may be a rating curve discrepancy at the Nueces River near Three Rivers gage causing a difference of 1,000 cfs for through most of the simulation period. The Nueces River near Three Rivers plot is shown above.

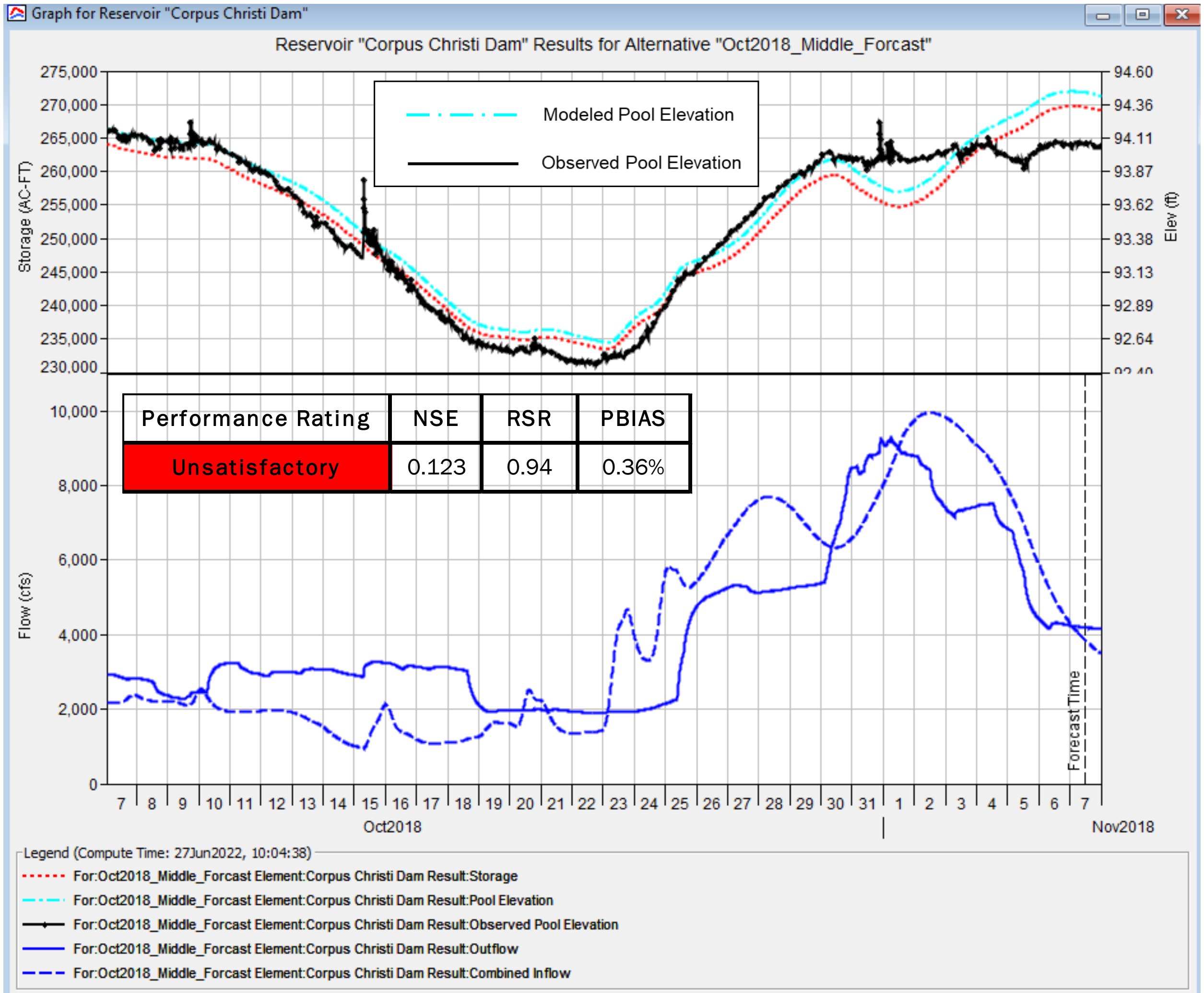

Figure B.173: October 2018 (entire) Calibration Results for Lake Corpus Christi

The Lake Corpus Christi calibration for October 2018 had an ”Unsatisfactory” performance rating. However, the HEC-HMS model matched the timing, shape, magnitude and volume of the observed pool elevation very well until the last week of the event when the computed pool elevation continued to rise. Lake Corpus Christi has a poor performance rating mainly because of its level pool operations, so it is not an accurate representation of the quality of the calibration. The observed pool elevation of the lake only varied by 1.5 feet throughout the entire event. This results in poor statistics for even small deviations from the observed pool elevation. For example, the figure above shows that the computed pool elevation was within 0.2 feet of observed for the entire event, but it still resulted in a poor performance rating. The Lake Corpus Christi plot is shown above.

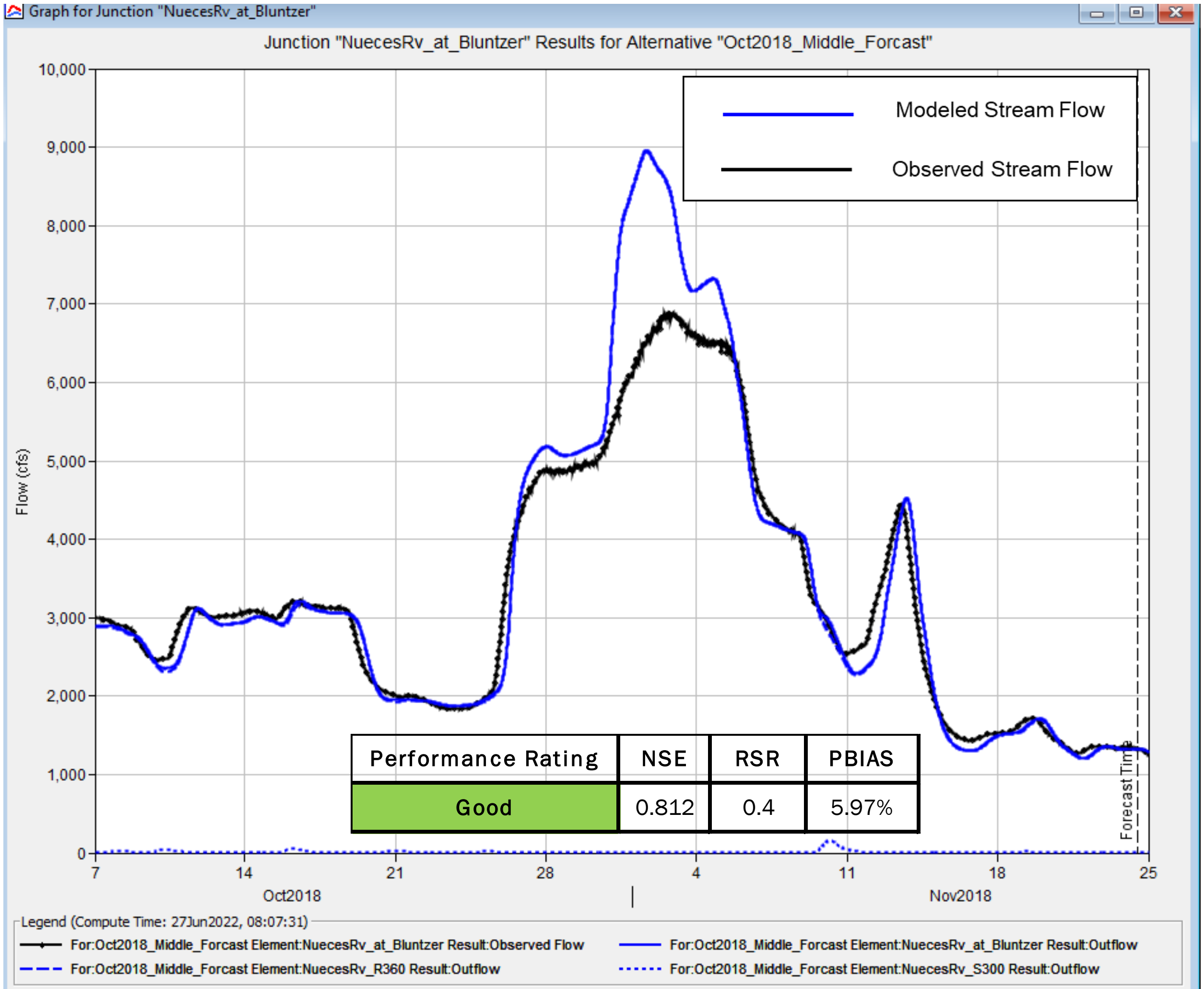

Figure B.174: October 2018 (entire) Calibration Results for Nueces River at Bluntzer Gage

The Nueces River at Bluntzer calibration achieved a “Good” performance rating for the Oct 2018 entire event. The HEC-HMS model was able to match the timing and shape of the observed hydrograph very well, but the peak magnitude and volume were too high in the middle portion of the hydrograph. However, this is a fairly low flow event for the Lower Nueces River, with an observed peak of less than 7,000 cfs. The Modified Puls routing data may not be as accurate for this range of in-channel flows. The Nueces River at Bluntzer plot is shown above.

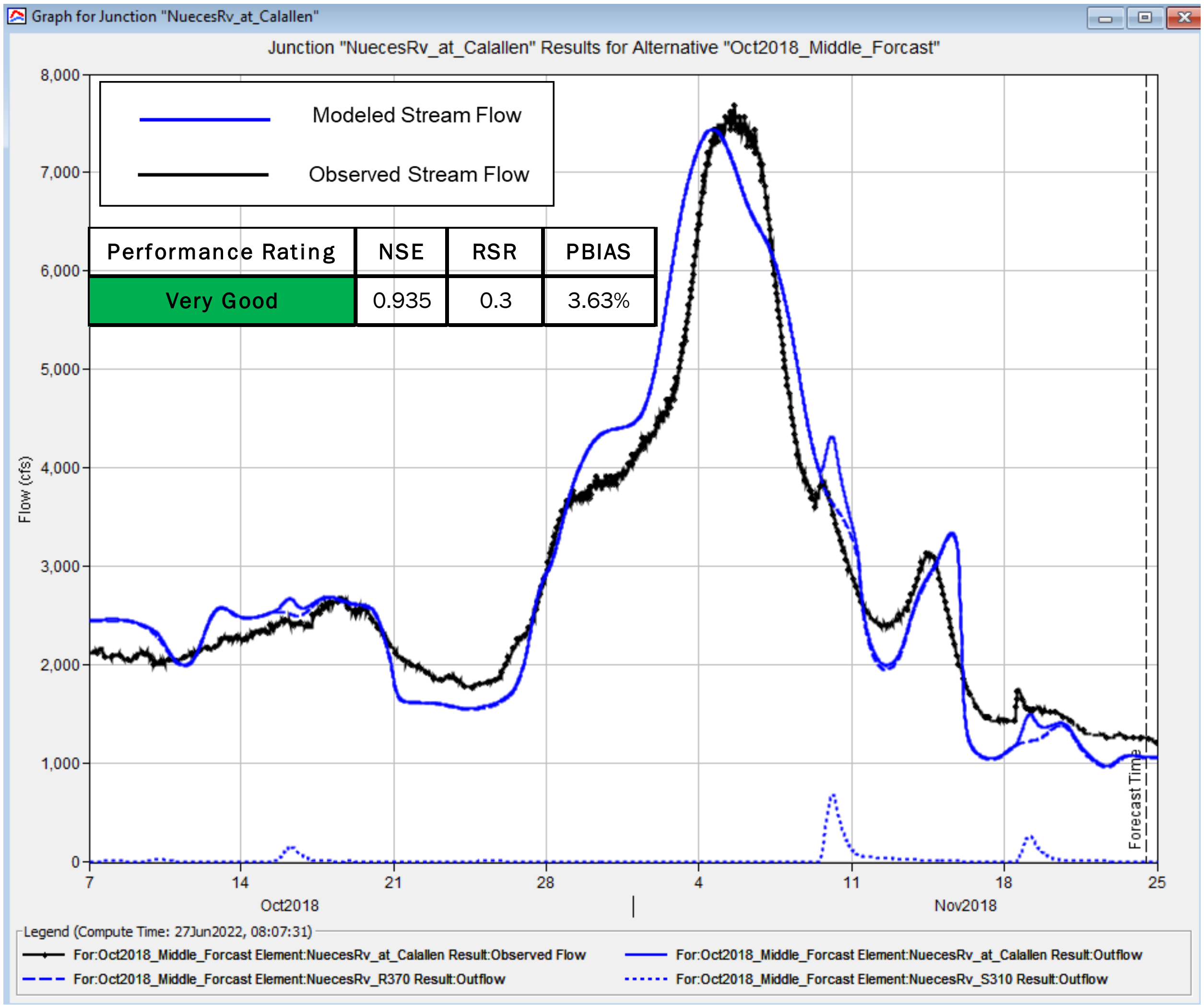

Figure B.175: October 2018 (entire) Calibration Results for Nueces River at Calallen Gage

The Nueces River at Calallen calibration achieved a “Very Good” performance rating for the Oct 2018 entire event. The HEC-HMS model was able to match the timing, shape, magnitude and volume of the observed hydrograph very well. The Nueces River at Calallen plot is shown above.

1.5 FINAL MODEL PARAMETERS

1.5.1 Final Subbasin and Routing Parameters

After the initial parameter estimates were made and the calibration process was completed, the final model parameters were established. The final Snyder's lag times and peaking coefficients were developed by taking a weighted average of those parameters from the calibration events. The peak discharge from the subbasin for that event was used to weight the calibrated lag times. This method has the effect of granting a higher weight to the lag times and peaking coefficients that were calibrated from larger, more intense storms, and it ignores the storms that generated no runoff from a particular subbasin. The final Snyder's lag times and peaking coefficients are shown in Table B.25.

The final baseflow parameters were selected based on the results of the calibration runs. Specifically, the initial flows per square miles were selected based on typical flow rates observed on each reach of the river prior to a large storm event, and the recession constant and ratio to peak were selected based on the slope and shape of the receding limb of the hydrograph at the downstream gages. The final baseflow parameters are also shown in Table B.26.

The Modified Puls storage discharge relationships were calculated from the best available HEC-RAS models, and the final number of subreaches were selected based on calibration to the observed attenuation of the flood hydrograph in between stream gages. Once again, the final subreach values were calculated from a weighted average based on the peak magnitude of the flow through the reach for a given storm event. The final routing subreach values are shown in Table B.27. Similar to the Modified Puls routing, the final Muskingum K, X and subreach values were calculated from a weighted average based on the peak magnitude of the flow through the reach for a given storm event. The final Muskingum routing parameters are shown in Table B.28.

The final channel loss parameters were also selected based on the results of the calibration runs. The final channel loss values were calculated from a weighted average based on the peak magnitude of the flow through the reach for a given storm event. The final channel loss parameters are shown in Table B.29.

Table B.25: Final Subbasin Transform and Baseflow Parameters

No.	Subbasin	Tp (hrs)	Cp
1	NuecesRv_W_S010	6.89	0.78
2	NuecesRv_W_S011	5.97	0.78
3	NuecesRv_W_S020	6.68	0.78
4	NuecesRv_W_S021	6.88	0.78
5	NuecesRv_W_S022	3.49	0.78
6	NuecesRv_W_S030	3.18	0.78
7	NuecesRv_W_S031	4.22	0.78
8	NuecesRv_W_S032	6.82	0.78
9	NuecesRv_S011	4.28	0.78
10	NuecesRv_S010	4.54	0.78

No.	Subbasin	Tp (hrs)	Cp
11	NuecesRv_S012	7.13	0.78
12	NuecesRv_S020	6.52	0.78
13	NuecesRv_S030	5.33	0.78
14	NuecesRv_S041	3.05	0.78
15	NuecesRv_S040	2.35	0.77
16	NuecesRv_S050	3.99	0.78
17	NuecesRv_S061	5.08	0.78
18	NuecesRv_S060	1.12	0.70
19	NuecesRv_S070	5.62	0.70
20	NuecesRv_S071	6.24	0.70
21	NuecesRv_S080	7.10	0.70
22	NuecesRv_S081	12.77	0.70
23	NuecesRv_S082	19.51	0.70
24	NuecesRv_S083	10.85	0.70
25	NuecesRv_S084	13.65	0.70
26	NuecesRv_S090	8.80	0.70
27	N_ChaconCk_S010*	5.77	0.75
28	N_ChaconCk_S020*	4.50	0.75
29	N_ChaconCk_S021*	4.33	0.75
30	N_ChaconCk_S023*	5.63	0.75
31	N_ChaconCk_S022*	6.59	0.75
32	N_PicosaCk_S010*	7.00	0.75
33	N_PicosaCk_S011*	3.68	0.75
34	N_PicosaCk_S020*	3.25	0.75
35	N_TurkeyCk_S010*	4.50	0.75
36	N_TurkeyCk_S011*	4.63	0.75
37	N_TurkeyCk_S012*	4.79	0.75
38	N_ChapCk_S010*	3.95	0.75
39	N_ChapCk_S011*	5.88	0.75
40	N_TurkeyCk_S020*	4.16	0.75
41	N_PicosaCk_S021*	5.43	0.75
42	N_TurkeyCk_S030*	3.97	0.75
43	N_TurkeyCk_S031*	6.44	0.75
44	N_TurkeyCk_S040	4.76	0.70
45	TurkeyCk_S041	6.73	0.70
46	N_TurkeyCk_S050	6.92	0.70
47	N_TurkeyCk_S060	9.55	0.70
48	N_TurkeyCk_S061	7.02	0.70

No.	Subbasin	Tp (hrs)	Cp
49	N_TurkeyCk_S070	8.79	0.70
50	N_TurkeyCk_S080	9.50	0.70
51	N_TurkeyCk_S081	13.55	0.70
52	N_TurkeyCk_S090	4.97	0.70
53	NuecesRv_S100	18.8	0.60
54	NuecesRv_S101	13.6	0.60
55	NuecesRv_S110	11.5	0.60
56	NuecesRv_S111	11.1	0.60
57	N_SanRoqCk_S010	11.4	0.60
58	N_SanRoqCk_S011	10	0.60
59	N_SanRoqCk_S020	5.7	0.60
60	N_SanRoqCk_S021	10.8	0.60
61	NuecesRv_S121	10.1	0.60
62	NuecesRv_S120	9.8	0.60
63	NuecesRv_S122	12.3	0.60
64	NuecesRv_S130	16.85	0.70
65	N_LaRaicesCk_S010	14.70	0.70
66	N_LaRaicesCk_S011	15.35	0.70
67	NuecesRv_S140	12.62	0.70
68	N_CalmanCk_S010	13.02	0.70
69	N_CalmanCk_S011	12.56	0.70
70	NuecesRv_S150	5.15	0.70
71	N_LosOlmosCk_S012	17.12	0.70
72	N_LosOlmosCk_S011	11.85	0.70
73	N_LosOlmosCk_S010	14.82	0.70
74	N_LosOlmosCk_S020	9.07	0.70
75	NuecesRv_S151	8.95	0.70
76	NuecesRv_S160	13.31	0.70
77	NuecesRv_S161	8.89	0.70
78	N_SanCasCk_S010	13.73	0.65
79	N_SanCasCk_S020	10.43	0.70
80	N_SanCasCk_S021	20.21	0.70
81	N_SanCasCk_S011	16.27	0.60
82	N_SanCasCk_S030	12.24	0.70
83	NuecesRv_S170	9.60	0.70
84	N_BlackCk_S010	14.50	0.70
85	N_BlackCk_S020	7.26	0.70
86	N_BlackCk_S021	9.77	0.70

No.	Subbasin	Tp (hrs)	Cp
87	NuecesRv_S180	12.23	0.70
88	NuecesRv_S185	14.89	0.70
89	NuecesRv_S190	12.99	0.70
90	NuecesRv_S200	11.34	0.70
91	NuecesRv_S210	12.63	0.70
92	NuecesRv_S220	13.32	0.70
93	NuecesRv_S221	10.41	0.70
94	NuecesRv_S222	13.33	0.70
95	NuecesRv_S230	10.60	0.70
96	NuecesRv_S231	12.24	0.70
97	FrioRv_S011	5.12	0.78
98	FrioRv_S010	5.96	0.78
99	FrioRv_S020	5.95	0.78
100	FrioRv_S030	5.42	0.78
101	FrioRv_D_S010	5.39	0.78
102	FrioRv_D_S020	3.89	0.78
103	FrioRv_D_S030	5.07	0.70
104	FrioRv_S040	3.02	0.70
105	FrioRv_S051	18.91	0.70
106	F_BlancoCk_S010	6.09	0.78
107	F_BlancoCk_S020	15.42	0.70
108	F_SabinalRv_S010	3.27	0.78
109	F_SabinalRv_S020	3.36	0.78
110	F_SabinalRv_S021	4.46	0.78
111	F_SabinalRv_S030	4.78	0.76
112	F_SabinalRv_S041	12.03	0.70
113	F_SabinalRv_S040	4.09	0.70
114	F_SabinalRv_S050	15.02	0.70
115	F_SabinalRv_S055	11.86	0.70
116	FrioRv_Sab_S060	6.75	0.70
117	FrioRv_S070	15.78	0.70
118	FrioRv_S071	13.14	0.70
119	FrioRv_S072	6.10	0.70
120	F_HondoCk_S010	3.08	0.78
121	F_HondoCk_S020	4.79	0.78
122	F_HondoCk_S021	4.12	0.70
123	F_MVerdeCk_S010	3.22	0.78
124	F_MVerdeCk_S011	2.98	0.78

No.	Subbasin	Tp (hrs)	Cp
125	F_MVerdeCk_S021	8.86	0.70
126	F_MVerdeCk_S020	11.53	0.70
127	F_HondoCk_S030	12.93	0.70
128	F_HondoCk_S031	11.59	0.70
129	F_SecoCk_S010	1.92	0.78
130	F_SecoCk_S020	3.68	0.78
131	F_SecoCk_S021	4.83	0.76
132	F_SecoCk_S030	18.91	0.70
133	F_SecoCk_S031	17.27	0.70
134	F_HondoCk_S040	10.08	0.70
135	FrioRv_S080	13.55	0.70
136	F_LeonaRv_S010	10.79	0.70
137	F_LeonaRv_S011	8.88	0.70
138	F_LeonaRv_S012	8.91	0.70
139	F_LeonaRv_S020	7.85	0.70
140	F_LeonaRv_S021	12.01	0.70
141	F_LeonaRv_S022	12.06	0.70
142	F_LeonaRv_S023	4.71	0.70
143	F_LeonaRv_S030	14.76	0.70
144	F_LeonaRv_S031	15.09	0.70
145	F_LeonaRv_S040	17.55	0.70
146	F_LeonaRv_S041	10.08	0.70
147	F_LeonaRv_S042	4.24	0.70
148	FrioRv_S090	15.92	0.70
149	FrioRv_S100	6.66	0.70
150	FrioRv_S101	14.39	0.70
151	FrioRv_S102	13.38	0.70
152	F_CiboloCk_S010	10.29	0.70
153	F_CiboloCk_S011	8.57	0.70
154	F_CiboloCk_S020	15.54	0.70
155	FrioRv_S110	9.74	0.70
156	FrioRv_S111	13.59	0.70
157	FrioRv_S112	10.74	0.70
158	FrioRv_S113	13.00	0.70
159	FrioRv_S114	10.38	0.70
160	FrioRv_S120	8.52	0.70
161	F_SanMigCk_S010	21.56	0.70
162	F_SanMigCk_S011	14.83	0.70

No.	Subbasin	Tp (hrs)	Cp
163	F_SanMigCk_S020	12.87	0.70
164	F_SanMigCk_S022	8.64	0.70
165	F_SanMigCk_S021	16.12	0.70
166	F_SanMigCk_S023	7.21	0.70
167	F_SanMigCk_S024	13.84	0.70
168	ChokeCanyon_S010	11.80	0.70
169	FrioRv_S130	4.67	0.70
170	Atascosa_S010	14.86	0.70
171	Atascosa_S011	12.75	0.70
172	Atascosa_S020	10.20	0.70
173	Atascosa_S030	11.23	0.70
174	Atascosa_S031	8.54	0.70
175	Atascosa_S040	15.73	0.70
176	Atascosa_S041	11.81	0.70
177	Atascosa_S050	11.88	0.70
178	La_ParitaCk_S010	22.00	0.70
179	La_ParitaCk_S020	17.00	0.70
180	La_ParitaCk_S030	7.00	0.70
181	Atascosa_S060	4.82	0.70
182	Atascosa_S070	12.30	0.70
183	Atascosa_S071	15.52	0.70
184	Atascosa_S080	8.13	0.70
185	FrioRv_S140	9.50	0.70
186	NuecesRv_S240	15.88	0.70
187	NuecesRv_S250	8.05	0.70
188	NuecesRv_S260	3.27	0.70
189	NuecesRv_S261	13.42	0.70
190	NuecesRv_S270	13.22	0.70
191	NuecesRv_S290	12.99	0.70
192	N_LagartoCk_S010	17.12	0.70
193	N_LagartoCk_S020	12.98	0.70
194	RamirenaCk_S010	10.63	0.70
195	RamirenaCk_S020	9.62	0.70
196	CorpusChristi_S010	8.71	0.70
197	CorpusChristi_S011	11.82	0.70
198	NuecesRv_S300	18.56	0.70
199	NuecesRv_S310	15.68	0.70

* Calibrated with a 2D HEC-RAS model

Table B.26: Final Baseflow Parameters

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
1	NuecesRv_W_S010	0.08	0.65	0.01
2	NuecesRv_W_S011	0.08	0.65	0.02
3	NuecesRv_W_S020	0.08	0.65	0.02
4	NuecesRv_W_S021	0.08	0.65	0.02
5	NuecesRv_W_S022	0.08	0.65	0.02
6	NuecesRv_W_S030	0.06	0.65	0.03
7	NuecesRv_W_S031	0.06	0.65	0.03
8	NuecesRv_W_S032	0.06	0.65	0.03
9	NuecesRv_S011	0.28	0.70	0.03
10	NuecesRv_S010	0.28	0.70	0.04
11	NuecesRv_S012	0.28	0.70	0.04
12	NuecesRv_S020	0.37	0.70	0.04
13	NuecesRv_S030	0.53	0.70	0.04
14	NuecesRv_S041	0.79	0.70	0.04
15	NuecesRv_S040	1.25	0.70	0.04
16	NuecesRv_S050	0.06	0.65	0.03
17	NuecesRv_S061	0.06	0.65	0.03
18	NuecesRv_S060	0.06	0.65	0.03
19	NuecesRv_S070	0.06	0.65	0.03
20	NuecesRv_S071	0.06	0.65	0.03
21	NuecesRv_S080	0.09	0.70	0.01
22	NuecesRv_S081	0.09	0.70	0.01
23	NuecesRv_S082	0.09	0.70	0.01
24	NuecesRv_S083	0.09	0.70	0.01
25	NuecesRv_S084	0.09	0.70	0.01
26	NuecesRv_S090	0.09	0.70	0.01
27	N_ChaconCk_S010	0.09	0.70	0.01
28	N_ChaconCk_S020	0.09	0.70	0.01
29	N_ChaconCk_S021	0.09	0.70	0.01
30	N_ChaconCk_S023	0.09	0.70	0.01
31	N_ChaconCk_S022	0.09	0.70	0.01
32	N_PicosaCk_S010	0.09	0.70	0.01
33	N_PicosaCk_S011	0.09	0.70	0.01
34	N_PicosaCk_S020	0.09	0.70	0.01
35	N_TurkeyCk_S010	0.09	0.70	0.01
36	N_TurkeyCk_S011	0.09	0.70	0.01

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
37	N_TurkeyCk_S012	0.09	0.70	0.01
38	N_ChapCk_S010	0.09	0.70	0.01
39	N_ChapCk_S011	0.09	0.70	0.01
40	N_TurkeyCk_S020	0.09	0.70	0.01
41	N_PicosaCk_S021	0.09	0.70	0.01
42	N_TurkeyCk_S030	0.09	0.70	0.01
43	N_TurkeyCk_S031	0.09	0.70	0.01
44	N_TurkeyCk_S040	0.09	0.70	0.01
45	TurkeyCk_S041	0.09	0.70	0.01
46	N_TurkeyCk_S050	0.09	0.70	0.01
47	N_TurkeyCk_S060	0.09	0.70	0.01
48	N_TurkeyCk_S061	0.09	0.70	0.01
49	N_TurkeyCk_S070	0.09	0.70	0.01
50	N_TurkeyCk_S080	0.09	0.70	0.01
51	N_TurkeyCk_S081	0.09	0.70	0.01
52	N_TurkeyCk_S090	0.09	0.70	0.01
53	NuecesRv_S100	0.05	0.70	0.05
54	NuecesRv_S101	0.05	0.70	0.05
55	NuecesRv_S110	0.05	0.70	0.05
56	NuecesRv_S111	0.05	0.70	0.05
57	N_SanRoqCk_S010	0.05	0.70	0.05
58	N_SanRoqCk_S011	0.05	0.70	0.05
59	N_SanRoqCk_S020	0.05	0.70	0.05
60	N_SanRoqCk_S021	0.05	0.70	0.05
61	NuecesRv_S121	0.05	0.70	0.05
62	NuecesRv_S120	0.05	0.70	0.05
63	NuecesRv_S122	0.05	0.70	0.05
64	NuecesRv_S130	0.03	0.70	0.01
65	N_LaRaicesCk_S010	0.03	0.70	0.01
66	N_LaRaicesCk_S011	0.03	0.70	0.01
67	NuecesRv_S140	0.03	0.70	0.01
68	N_CalmanCk_S010	0.03	0.70	0.01
69	N_CalmanCk_S011	0.03	0.70	0.01
70	NuecesRv_S150	0.03	0.70	0.01
71	N_LosOlmosCk_S012	0.03	0.70	0.01
72	N_LosOlmosCk_S011	0.03	0.70	0.01
73	N_LosOlmosCk_S010	0.03	0.70	0.01

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
74	N_LosOlmosCk_S020	0.03	0.70	0.01
75	NuecesRv_S151	0.03	0.70	0.01
76	NuecesRv_S160	0.03	0.70	0.01
77	NuecesRv_S161	0.03	0.70	0.01
78	N_SanCasCk_S010	0.02	0.70	0.04
79	N_SanCasCk_S020	0.02	0.70	0.02
80	N_SanCasCk_S021	0.02	0.70	0.01
81	N_SanCasCk_S011	0.02	0.70	0.02
82	N_SanCasCk_S030	0.03	0.70	0.01
83	NuecesRv_S170	0.03	0.70	0.01
84	N_BlackCk_S010	0.03	0.70	0.01
85	N_BlackCk_S020	0.03	0.70	0.01
86	N_BlackCk_S021	0.03	0.70	0.01
87	NuecesRv_S180	0.03	0.70	0.01
88	NuecesRv_S185	0.03	0.70	0.02
89	NuecesRv_S190	0.03	0.70	0.01
90	NuecesRv_S200	0.03	0.70	0.01
91	NuecesRv_S210	0.03	0.70	0.01
92	NuecesRv_S220	0.03	0.70	0.01
93	NuecesRv_S221	0.03	0.70	0.01
94	NuecesRv_S222	0.03	0.70	0.01
95	NuecesRv_S230	0.03	0.70	0.01
96	NuecesRv_S231	0.03	0.70	0.01
97	FrioRv_S011	0.57	0.70	0.04
98	FrioRv_S010	0.57	0.70	0.04
99	FrioRv_S020	0.57	0.70	0.04
100	FrioRv_S030	0.00	0.65	0.02
101	FrioRv_D_S010	0.50	0.70	0.03
102	FrioRv_D_S020	0.00	0.65	0.02
103	FrioRv_D_S030	0.00	0.65	0.02
104	FrioRv_S040	0.02	0.65	0.02
105	FrioRv_S051	0.09	0.70	0.03
106	F_BlancoCk_S010	0.09	0.70	0.06
107	F_BlancoCk_S020	0.09	0.70	0.03
108	F_SabinalRv_S010	0.50	0.70	0.03
109	F_SabinalRv_S020	0.70	0.70	0.03
110	F_SabinalRv_S021	0.70	0.70	0.04
111	F_SabinalRv_S030	0.01	0.65	0.01

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
112	F_SabinalRv_S041	0.11	0.70	0.02
113	F_SabinalRv_S040	0.09	0.70	0.02
114	F_SabinalRv_S050	0.09	0.70	0.02
115	F_SabinalRv_S055	0.09	0.70	0.02
116	FrioRv_Sab_S060	0.09	0.70	0.10
117	FrioRv_S070	0.09	0.70	0.10
118	FrioRv_S071	0.09	0.70	0.10
119	FrioRv_S072	0.09	0.70	0.02
120	F_HondoCk_S010	1.17	0.70	0.02
121	F_HondoCk_S020	0.03	0.70	0.02
122	F_HondoCk_S021	0.09	0.70	0.02
123	F_MVerdeCk_S010	0.62	0.70	0.08
124	F_MVerdeCk_S011	0.09	0.70	0.02
125	F_MVerdeCk_S021	0.09	0.70	0.02
126	F_MVerdeCk_S020	0.09	0.70	0.02
127	F_HondoCk_S030	0.09	0.70	0.02
128	F_HondoCk_S031	0.09	0.70	0.10
129	F_SecoCk_S010	0.67	0.65	0.02
130	F_SecoCk_S020	0.00	0.60	0.01
131	F_SecoCk_S021	0.00	0.60	0.01
132	F_SecoCk_S030	0.09	0.70	0.02
133	F_SecoCk_S031	0.09	0.70	0.02
134	F_HondoCk_S040	0.09	0.70	0.10
135	FrioRv_S080	0.09	0.70	0.02
136	F_LeonaRv_S010	0.11	0.65	0.02
137	F_LeonaRv_S011	0.11	0.65	0.03
138	F_LeonaRv_S012	0.11	0.65	0.02
139	F_LeonaRv_S020	0.11	0.65	0.03
140	F_LeonaRv_S021	0.09	0.70	0.02
141	F_LeonaRv_S022	0.09	0.70	0.02
142	F_LeonaRv_S023	0.09	0.70	0.02
143	F_LeonaRv_S030	0.09	0.70	0.02
144	F_LeonaRv_S031	0.09	0.70	0.02
145	F_LeonaRv_S040	0.09	0.70	0.02
146	F_LeonaRv_S041	0.09	0.70	0.02
147	F_LeonaRv_S042	0.09	0.70	0.02
148	FrioRv_S090	0.09	0.70	0.02
149	FrioRv_S100	0.04	0.70	0.01

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
150	FrioRv_S101	0.04	0.70	0.01
151	FrioRv_S102	0.04	0.70	0.01
152	F_CiboloCk_S010	0.04	0.70	0.00
153	F_CiboloCk_S011	0.04	0.70	0.00
154	F_CiboloCk_S020	0.04	0.70	0.01
155	FrioRv_S110	0.04	0.70	0.01
156	FrioRv_S111	0.04	0.70	0.01
157	FrioRv_S112	0.04	0.70	0.01
158	FrioRv_S113	0.04	0.70	0.01
159	FrioRv_S114	0.04	0.70	0.02
160	FrioRv_S120	0.05	0.65	0.01
161	F_SanMigCk_S010	0.01	0.70	0.01
162	F_SanMigCk_S011	0.01	0.70	0.01
163	F_SanMigCk_S020	0.01	0.70	0.01
164	F_SanMigCk_S022	0.01	0.70	0.01
165	F_SanMigCk_S021	0.01	0.70	0.01
166	F_SanMigCk_S023	0.01	0.70	0.01
167	F_SanMigCk_S024	0.05	0.65	0.01
168	ChokeCanyon_S010	0.05	0.65	0.02
169	FrioRv_S130	0.07	0.70	0.02
170	Atascosa_S010	0.05	0.70	0.01
171	Atascosa_S011	0.05	0.70	0.02
172	Atascosa_S020	0.05	0.70	0.02
173	Atascosa_S030	0.05	0.70	0.02
174	Atascosa_S031	0.05	0.70	0.04
175	Atascosa_S040	0.05	0.70	0.04
176	Atascosa_S041	0.05	0.70	0.04
177	Atascosa_S050	0.05	0.70	0.04
178	La_ParitaCk_S010	0.05	0.70	0.04
179	La_ParitaCk_S020	0.05	0.70	0.04
180	La_ParitaCk_S030	0.05	0.70	0.02
181	Atascosa_S060	0.05	0.70	0.03
182	Atascosa_S070	0.01	0.70	0.03
183	Atascosa_S071	0.01	0.70	0.03
184	Atascosa_S080	0.01	0.70	0.03
185	FrioRv_S140	0.03	0.70	0.03
186	NuecesRv_S240	0.03	0.70	0.01
187	NuecesRv_S250	0.03	0.70	0.01

No.	Subbasin	Initial (cfs/sq mi)	Recession Constant	Ratio
188	NuecesRv_S260	0.03	0.70	0.01
189	NuecesRv_S261	0.03	0.70	0.01
190	NuecesRv_S270	0.03	0.70	0.01
191	NuecesRv_S290	0.03	0.70	0.01
192	N_LagartoCk_S010	0.00	0.70	0.01
193	N_LagartoCk_S020	0.03	0.70	0.01
194	RamirenaCk_S010	0.03	0.70	0.01
195	RamirenaCk_S020	0.03	0.70	0.01
196	CorpusChristi_S010	0.03	0.70	0.01
197	CorpusChristi_S011	0.03	0.70	0.01
198	NuecesRv_S300	0.11	0.70	0.01
199	NuecesRv_S310	0.12	0.70	0.01

Table B.27: Final Modified Puls Routing Parameters

	Reach	Subreaches
1	NuecesRv_R080	1
2	NuecesRv_R090	1
3	NuecesRv_R100	2
4	NuecesRv_R110	1
5	NuecesRv_R120	1
6	NuecesRv_R130	1
7	ChaconCk_R010	10
8	ChaconCk_R020	6
9	Palo_BlancoCk_R010	1
10	Palo_BlancoCk_R020	1
11	PicosaCk_R010	4
12	Palo_BlancoCk_R030	6
13	ComancheCk_R010	10
14	ComancheCk_R020	1
15	TurkeyCk_R010	11
16	TurkeyCk_R020	7
17	ChaparrosaCk_R010	12
18	TurkeyCk_R030	2
19	TurkeyCk_R040	1
20	Nueces_TurkeyCk_R010	1
21	TurkeyCk_R060	1
22	TurkeyCk_R070	1
23	TurkeyCk_R080	1
24	TurkeyCk_R090	1
25	FrioRv_R050	5
26	FrioRv_R070	4
27	FrioRv_R080	1
28	FrioRv_R090	4
29	FrioRv_R110	2
30	FrioRv_R120	3
31	FrioRv_R130	4
32	CiboloCk_R010	5
33	CiboloCk_R020	19
34	FrioRv_R140	3
35	FrioRv_R150	1
36	FrioRv_R160	4

	Reach	Subreaches
37	FrioRv_R170	7
38	SanMiguelCk_R010	13
39	SanMiguelCk_R020	9
40	SanMiguelCk_R030	4
41	SanMiguelCk_R040	9
42	FrioRv_R180	3
43	FrioRv_R190	1
44	AtascosaRv_R010	11
45	AtascosaRv_R020	7
46	AtascosaRv_R030	9
47	AtascosaRv_R040	10
48	BorregoCk_R010	11
49	AtascosaRv_R050	9
50	La_ParitaCk_R010	3
51	AtascosaRv_R060	3
52	AtascosaRv_R070	4
53	AtascosaRv_R080	2
54	AtascosaRv_R085	1
55	AtascosaRv_R090	4
56	NuecesRv_R310	4
57	NuecesRv_R320	6
58	NuecesRv_R330	1
59	NuecesRv_R340	7
60	NuecesRv_R350	5
61	LagartoCk_R010	13
62	RamirenaCk_R010	9
63	NuecesRv_R360	12
64	NuecesRv_R370	10

Table B.28: Final Muskingum Routing Parameters

No.	Reach	Muskingum K (hrs)	Muskingum X	Subreaches
1	W_NuecesRv_R010	5.3	0.20	13
2	W_NuecesRv_R020	2.6	0.20	6
3	W_NuecesRv_R030	2.6	0.35	7
4	W_NuecesRv_R040	5.3	0.35	13
5	NuecesRv_R010	4.0	0.30	9
6	NuecesRv_R020	2.9	0.30	6
7	NuecesRv_R030	2.1	0.25	5
8	NuecesRv_R040	2.8	0.35	7
9	NuecesRv_R050	0.9	0.35	2
10	NuecesRv_R060	2.0	0.35	5
11	NuecesRv_R070	2.0	0.35	5
12	NuecesRv_R135	0.3	0.10	1
26	TurkeyCk_R050	1.9	0.10	1
27	CarrizoCk_R010	4.6	0.20	2
28	El_MoroCk_R010	0.3	0.10	1
29	TurkeyCk_R100	0.3	0.10	1
30	NuecesRv_R140	18.2	0.10	12
31	Arroyo_Negro_R010	0.9	0.10	1
32	NuecesRv_R150	8.1	0.10	6
33	NuecesRv_R160	18.5	0.10	12
34	San_RoqueCk_R010	7.0	0.10	7
35	San_RoqueCk_R020	14.0	0.10	9
36	NuecesRv_R170	12.9	0.10	8
37	NuecesRv_R180	22.2	0.10	13
38	NuecesRv_R190	28.0	0.10	12
39	La_RaicesCk_R010	16.0	0.10	13
40	NuecesRv_R200	15.9	0.10	7
41	CalmanCk_R010	9.6	0.10	3
42	NuecesRv_R210	6.1	0.10	3
43	Los_OlmosCk_R010	0.7	0.10	1
44	Los_OlmosCk_R020	8.7	0.10	4
45	Los_OlmosCk_R030	9.0	0.10	4
46	NuecesRv_R220	6.3	0.10	3
47	NuecesRv_R225	6.2	0.10	3
48	SaladoCk_R010	22.0	0.20	25
49	BecerraCk_R010	28.0	0.20	33

No.	Reach	Muskingum K (hrs)	Muskingum X	Subreaches
50	San_CasimiroCk_R010	10.7	0.10	7
51	NuecesRv_R230	4.4	0.10	2
52	BlackCk_R010	7.0	0.10	5
53	BlackCk_R020	13.8	0.10	10
54	NuecesRv_R240	30.1	0.10	14
55	NuecesRv_R250	3.5	0.10	2
56	NuecesRv_R260	4.3	0.10	2
57	NuecesRv_R270	23.1	0.10	16
58	NuecesRv_R280	7.6	0.05	3
59	NuecesRv_R285	11.6	0.05	4
60	OldRv_R010	1.0	0.20	1
61	NuecesRv_R290	18.2	0.05	6
62	NuecesRv_R300	21.2	0.05	6
63	FrioRv_R010	1.3	0.25	3
64	FrioRv_R020	3.6	0.25	8
65	FrioRv_R030	6.1	0.30	12
66	Dry_FrioRv_R010	4.5	0.30	9
67	Dry_FrioRv_R020	3.1	0.30	6
68	FrioRv_R040	1.7	0.30	3
69	BlancoCk_R010	22.0	0.20	26
70	FrioRv_R060	1.0	0.10	1
71	SabinalRv_R010	2.6	0.30	6
72	SabinalRv_R020	3.4	0.30	8
73	SabinalRv_R030	3.5	0.35	8
74	SabinalRv_R040	7.0	0.20	11
75	RancherosCk_R010	6.0	0.20	12
76	SabinalRv_R050	10.0	0.20	19
77	SabinalRv_R060	8.0	0.20	15
78	FrioRv_R085	0.3	0.10	1
79	HondoCk_R010	4.9	0.35	16
80	HondoCk_R020	3.6	0.25	4
81	VerdeCk_R010	2.6	0.35	6
82	VerdeCk_R020	16.6	0.30	39
83	VerdeCk_R025	0.4	0.30	2
84	HondoCk_R030	11.9	0.10	15
85	HondoCk_R040	18.3	0.10	20
86	SecoCk_R010	3.7	0.35	7

No.	Reach	Muskingum K (hrs)	Muskingum X	Subreaches
87	SecoCk_R020	2.9	0.35	6
88	SecoCk_R030	31.5	0.20	53
89	SecoCk_R040	4.6	0.20	8
90	HondoCk_R050	7.2	0.10	8
91	LeonaRv_R010	1.9	0.10	2
92	Cooks_Slough_R010	2.0	0.20	3
93	LeonaRv_R015	2.0	0.20	3
94	LeonaRv_R020	11.3	0.10	11
95	LeonaRv_R030	3.1	0.10	3
96	LeonaRv_R040	14.8	0.10	9
97	LeonaRv_R050	15.9	0.10	10
98	LeonaRv_R060	3.4	0.10	2
99	FrioRv_R100	0.5	0.10	1
100	NuecesRv_R305	1.7	0.10	1

Table B.29: Final Channel Loss Parameters

No	Reach	Flow Rate (cfs)	Fraction
1	W_NuecesRv_R030	2.64	0.06
2	W_NuecesRv_R040	5.28	0.06
3	NuecesRv_R040	24.53	0.05
4	NuecesRv_R050	4.24	0.05
5	NuecesRv_R060	13.50	0.05
6	NuecesRv_R070	13.49	0.05
7	NuecesRv_R080	5.00	0.25
8	NuecesRv_R090	13.00	0.25
9	NuecesRv_R100	20.00	0.25
10	NuecesRv_R110	8.00	0.25
11	NuecesRv_R120	0.83	0.05
12	ChaconCk_R020	2.00	0.25
13	Palo_BlancoCk_R010	2.00	0.25
14	Palo_BlancoCk_R020	1.00	0.05
15	PicosaCk_R010	2.00	0.25
16	Palo_BlancoCk_R030	1.00	0.05

No	Reach	Flow Rate (cfs)	Fraction
17	ComancheCk_R010	2.00	0.25
18	TurkeyCk_R010	2.00	0.25
19	TurkeyCk_R020	2.00	0.25
20	ChaparrosaCk_R010	2.00	0.25
21	TurkeyCk_R030	2.00	0.25
22	TurkeyCk_R040	2.00	0.25
23	FrioRv_R010	1.00	0.13
24	FrioRv_R020	6.40	0.14
25	FrioRv_R030	173.34	0.06
26	Dry_FrioRv_R010	221.93	0.05
27	Dry_FrioRv_R020	59.81	0.05
28	FrioRv_R040	63.39	0.05
29	FrioRv_R050	205	0.45
30	SabinalRv_R010	5.00	0.20
31	SabinalRv_R020	10.64	0.17
32	SabinalRv_R030	12.20	0.12
33	FrioRv_R070	67.25	0.05
34	HondoCk_R010	202.92	0.16
35	HondoCk_R020	45	0.10
36	VerdeCk_R010	28	0.25
37	VerdeCk_R020	147	0.25
38	VerdeCk_R025	4	0.25
39	SecoCk_R010	23.45	0.26
40	SecoCk_R020	12.21	0.28
41	SecoCk_R030	92	0.25
42	SecoCk_R040	12	0.10
43	FrioRv_R090	5	0.05
44	NuecesRv_R350	23.00	0.05
45	NuecesRv_R360	94.19	0.02
46	NuecesRv_R370	110.37	0.06

1.5.2 Adopted Loss Rates for the Frequency Storms

In observed storm events, the initial and constant losses vary from storm to storm according to the antecedent moisture conditions of the soil. Therefore, the final set of loss rates was not directly calculated from the calibration results. Instead, the losses for the frequency storms were initially developed using the regional USACE Fort Worth District Method for determining losses based on soil type (percent sand) (Rodman, 1977). After calculating the default frequency loss rates based on soil type, three additional adjustments were made to the loss rate parameters. First, an adjustment was made to the initial deficits to account for the presence of NRCS flood control structures in the watershed that have not been modeled in detail. Second, a climate adjustment was made to both the initial deficits and constant losses to better align them with the observed "average" to "wet" loss rates from recent storm events for different regions of the basin. Third and finally, a Bulletin 17C adjustment was made to the loss rates of the frequent storm events (50% to 4% AEP) to better align the HEC-HMS results with the statistical results at the gages.

The USACE Fort Worth District Method for determining losses method produces a default set of loss rates for each frequency event, based on the soil type in each subbasin (Rodman, 1977). The method assumes that the antecedent moisture conditions become wetter and the losses decrease as the rarity of the flood event increases, which is consistent with other research (McEnroe, 2003). In general, the 50% AEP loss rates are intended to correspond to an "average" or "normal" antecedent soil moisture condition, and the 0.2% AEP loss rates should correspond to a "wet" soil moisture condition. Table B.30 summarizes the range of default loss rates of the Fort Worth District method by frequency and soil type. A geospatial grid of percent sand for the State of Texas developed by the USACE Fort Worth District was used to spatially calculate the percent sand for each subbasin. That percent sand value was then used to interpolate between the 0% and 100% sand loss rate values in Table B.30 to assign the default initial and constant loss rates to each subbasin.

Table B.30: Default Frequency Loss Rates by Soil Type for the USACE Fort Worth District Method

Annual Exceedance Probability (AEP) %	Initial Abstraction (inches) for Soil with 0% Sand	Infiltration Rate (inches per hour) for Soil with 0% Sand	Initial Abstraction (inches) for Soil with 100% Sand	Infiltration Rate (inches per hour) for Soil with 100% Sand
50%	1.50	0.20	2.10	0.26
20%	1.30	0.16	1.80	0.21
10%	1.12	0.14	1.50	0.18
4%	0.95	0.12	1.30	0.15
2%	0.84	0.10	1.10	0.13
1%	0.75	0.07	0.90	0.10
0.4%	0.61	0.06	0.73	0.09
0.2%	0.50	0.05	0.60	0.08

After calculating the default frequency loss rates based on soil type, three additional adjustments were made to the loss rate parameters. First, the default initial deficits were increased to account for the presence of NRCS type flood control structures in the watershed that have not been modeled in detail. This adjustment for the NRCS flood control structures was made based on data from the National Inventory of Dams (NID) (USACE, 2016). In this case, the percent of each subbasin area that was controlled by NRCS type structures was multiplied by the inches of runoff that can typically be stored between the riser and spillway of the NRCS structures in that basin (typically up to 4 inches of runoff). For the frequent storm events (50% to 4% AEP), the initial loss due to the NRCS structures was decreased in proportion to the total depth of rain for that event.

Second, a climate adjustment was made to both the initial deficits and constant losses to better align them with the observed "average" to "wet" loss rates from recent storm events for different regions of the basin. This adjustment was made by adding a factor to the previously calculated loss rates in order to ensure that the range of frequency loss rates (from 50% to 0.2% AEP) lined up well with the observed loss rates from the calibration storms for "average" to "wet" antecedent conditions. However, the InFRM team recognized that the calibration events represent a relatively small sample of observed storm events and may not always include enough data to accurately represent the true range of possible loss rates from "dry" to "wet." Therefore, this adjustment was applied on a regional basis rather than by individual subbasin in order to reduce the possible sample bias.

Third and finally, a Bulletin 17C adjustment was made to the loss rates to better align the HEC-HMS results with the statistical results for the frequent storm events (50% to 4% AEP) at the gages. A comparison was made between the preliminary HEC-HMS results with the calculated frequency loss rates and the statistical flow frequency curves from the USGS gage records. A final adjustment was then made to the initial deficits and constant losses for the 50% through 10% AEP storms in order to have a better correlation with the statistical frequency curves estimated from the USGS gage records. This step was performed because of the increased confidence level in the gage records' statistical frequency curves for the 50% through 10% AEP range. The 4% AEP losses were also adjusted when needed to create a smoother transition between the 2% and 10% AEP flow values. Loss rates for events with an AEP at or below 2% were not adjusted based on the statistical frequency curves because stream gage records in Texas are not long enough and there is too much variability in the rare AEP statistical flow estimates over time (see the change over time plots in Appendix A) to justify adjusting the rare AEP loss rates. Generally, a stream gage record that is 3 to 4 times the length of the return period being estimated is needed before the statistical results can be considered reliable enough for this type of adjustment. For the 1% AEP event, this would require a stream gage record of 300 to 400 years in length, which is not available anywhere in Texas.

The final loss rates after all of these adjustments that were used for the uniform rainfall frequency storm events are documented in Tables B.31 and B.32. These final loss rates line up well with the band of observed losses from the calibration storms, as shown in Figures B.176 and B.177. Based on the range of observed initial and constant losses from the calibration storms, the adopted losses for the frequency storms could be characterized to represent "average" to "wet" conditions (the "average" moisture conditions being applied to the 50% AEP storm, and "wet" moisture conditions being applied to the 0.2% AEP storm), which are appropriate assumptions for modeling hypothetical flood events. However, none of the adopted frequency losses are at the extreme wet or extreme dry ends of the range of calibrated losses.

Table B.31: Final Initial and Constant Loss Rates for the 50% to 4% AEP Storm Events

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
1	NuecesRv_W_S010	2.22	0.23	2.42	0.21	2.08	0.18	1.78	0.15
2	NuecesRv_W_S011	2.21	0.23	2.41	0.21	2.07	0.18	1.77	0.15
3	NuecesRv_W_S020	2.25	0.23	2.45	0.21	2.10	0.18	1.80	0.15
4	NuecesRv_W_S021	2.25	0.23	2.45	0.21	2.10	0.18	1.80	0.15
5	NuecesRv_W_S022	2.25	0.23	2.45	0.21	2.10	0.18	1.80	0.15
6	NuecesRv_W_S030	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
7	NuecesRv_W_S031	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
8	NuecesRv_W_S032	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
9	NuecesRv_S011	2.25	0.21	2.65	0.21	2.65	0.21	2.17	0.17
10	NuecesRv_S010	2.25	0.21	2.65	0.21	2.65	0.21	2.17	0.17
11	NuecesRv_S012	2.26	0.21	2.66	0.21	2.66	0.21	2.17	0.17
12	NuecesRv_S020	2.25	0.20	2.65	0.20	2.65	0.20	2.16	0.17
13	NuecesRv_S030	2.35	0.21	2.75	0.21	2.75	0.21	2.29	0.17
14	NuecesRv_S041	2.30	0.21	2.70	0.21	2.70	0.21	2.20	0.17
15	NuecesRv_S040	2.30	0.21	2.70	0.21	2.70	0.21	2.20	0.17
16	NuecesRv_S050	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
17	NuecesRv_S061	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
18	NuecesRv_S060	2.40	0.23	2.30	0.21	2.00	0.18	1.80	0.15
19	NuecesRv_S070	2.31	0.22	2.23	0.20	1.94	0.17	1.75	0.15
20	NuecesRv_S071	2.29	0.22	2.21	0.20	1.93	0.17	1.74	0.14
21	NuecesRv_S080	1.64	0.18	2.22	0.24	3.18	0.30	2.68	0.28
22	NuecesRv_S081	1.62	0.18	2.20	0.23	3.16	0.29	2.66	0.28
23	NuecesRv_S082	1.58	0.17	2.12	0.23	3.10	0.29	2.61	0.27
24	NuecesRv_S083	1.61	0.18	2.18	0.23	3.15	0.29	2.65	0.28
25	NuecesRv_S084	1.61	0.18	2.18	0.23	3.14	0.29	2.65	0.28
26	NuecesRv_S090	1.57	0.17	2.10	0.22	3.09	0.28	2.59	0.27
27	N_ChaconCk_S010	2.34	0.23	3.45	0.28	3.84	0.34	4.14	0.33
28	N_ChaconCk_S020	2.14	0.22	3.04	0.27	3.34	0.33	3.55	0.32
29	N_ChaconCk_S021	2.13	0.22	3.02	0.27	3.32	0.33	3.54	0.32
30	N_ChaconCk_S023	2.16	0.22	3.07	0.27	3.36	0.33	3.57	0.32
31	N_ChaconCk_S022	2.15	0.22	3.05	0.27	3.35	0.33	3.56	0.32
32	N_PicosaCk_S010	2.23	0.21	3.10	0.26	3.46	0.32	3.71	0.31
33	N_PicosaCk_S011	2.48	0.22	3.30	0.27	3.69	0.33	3.97	0.32
34	N_PicosaCk_S020	2.32	0.22	3.24	0.28	3.58	0.34	3.83	0.32

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
35	N_TurkeyCk_S010	2.35	0.23	3.44	0.28	3.85	0.34	4.14	0.33
36	N_TurkeyCk_S011	2.21	0.23	3.18	0.28	3.44	0.34	3.65	0.33
37	N_TurkeyCk_S012	2.17	0.22	3.10	0.27	3.38	0.33	3.59	0.32
38	N_ChapCk_S010	2.20	0.22	3.16	0.28	3.43	0.34	3.63	0.32
39	N_ChapCk_S011	2.18	0.22	3.12	0.28	3.40	0.34	3.61	0.32
40	N_TurkeyCk_S020	2.12	0.21	2.99	0.26	3.30	0.32	3.52	0.31
41	N_PicosaCk_S021	2.19	0.22	3.14	0.28	3.41	0.34	3.62	0.32
42	N_TurkeyCk_S030	2.13	0.22	3.01	0.27	3.32	0.33	3.53	0.32
43	N_TurkeyCk_S031	2.24	0.23	3.23	0.29	3.49	0.35	3.69	0.33
44	N_TurkeyCk_S040	2.14	0.22	3.04	0.27	3.34	0.33	3.55	0.32
45	TurkeyCk_S041	1.63	0.23	2.22	0.29	2.48	0.35	2.68	0.33
46	N_TurkeyCk_S050	2.14	0.23	3.51	0.29	4.17	0.35	4.20	0.33
47	N_TurkeyCk_S060	1.65	0.23	2.24	0.29	2.89	0.35	2.69	0.33
48	N_TurkeyCk_S061	1.60	0.22	2.16	0.28	3.13	0.34	2.63	0.32
49	N_TurkeyCk_S070	1.60	0.22	2.16	0.28	3.13	0.34	2.64	0.32
50	N_TurkeyCk_S080	1.57	0.22	2.10	0.28	3.09	0.34	2.60	0.32
51	N_TurkeyCk_S081	1.66	0.21	2.06	0.26	3.11	0.32	2.65	0.31
52	N_TurkeyCk_S090	1.55	0.22	2.06	0.27	3.06	0.33	2.57	0.32
53	NuecesRv_S100	1.99	0.22	2.29	0.27	2.84	0.26	2.65	0.24
54	NuecesRv_S101	2.04	0.22	2.39	0.28	2.92	0.27	2.72	0.24
55	NuecesRv_S110	1.95	0.21	2.22	0.26	2.78	0.26	2.60	0.23
56	NuecesRv_S111	2.01	0.22	2.33	0.27	2.87	0.27	2.68	0.24
57	N_SanRoqCk_S010	1.91	0.21	2.13	0.25	2.72	0.25	2.54	0.23
58	N_SanRoqCk_S011	1.95	0.21	2.17	0.26	2.76	0.25	2.59	0.23
59	N_SanRoqCk_S020	1.96	0.21	2.23	0.26	2.80	0.26	2.61	0.23
60	N_SanRoqCk_S021	1.96	0.21	2.23	0.26	2.79	0.26	2.61	0.23
61	NuecesRv_S121	2.10	0.23	2.50	0.29	3.00	0.28	2.80	0.25
62	NuecesRv_S120	2.10	0.23	2.50	0.29	3.00	0.28	2.80	0.25
63	NuecesRv_S122	2.18	0.23	2.54	0.29	3.06	0.28	2.87	0.25
64	NuecesRv_S130	2.15	0.22	2.80	0.22	3.05	0.26	3.06	0.23
65	N_LaRaicesCk_S010	2.25	0.24	3.00	0.24	3.20	0.28	3.20	0.24
66	N_LaRaicesCk_S011	2.22	0.24	2.95	0.24	3.16	0.28	3.17	0.24
67	NuecesRv_S140	2.11	0.21	2.73	0.21	2.99	0.26	3.01	0.22
68	N_CalmanCk_S010	2.22	0.23	2.94	0.23	3.15	0.28	3.16	0.24
69	N_CalmanCk_S011	2.10	0.21	2.72	0.21	2.98	0.26	3.00	0.22

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
70	NuecesRv_S150	2.08	0.21	2.67	0.21	2.95	0.25	2.97	0.22
71	N_LosOlmosCk_S012	2.08	0.21	2.67	0.21	2.95	0.25	2.97	0.22
72	N_LosOlmosCk_S011	2.16	0.22	2.83	0.22	3.07	0.27	3.08	0.23
73	N_LosOlmosCk_S010	2.23	0.24	2.97	0.24	3.18	0.28	3.18	0.24
74	N_LosOlmosCk_S020	2.05	0.20	2.62	0.20	2.91	0.25	2.93	0.22
75	NuecesRv_S151	2.05	0.20	2.61	0.20	2.90	0.25	2.92	0.22
76	NuecesRv_S160	2.07	0.20	2.65	0.20	2.93	0.25	2.95	0.22
77	NuecesRv_S161	2.04	0.20	2.60	0.20	2.89	0.25	2.92	0.22
78	N_SanCasCk_S010	2.27	0.22	2.89	0.24	3.05	0.22	2.73	0.19
79	N_SanCasCk_S020	1.99	0.20	2.42	0.22	2.46	0.21	2.03	0.18
80	N_SanCasCk_S021	2.02	0.21	2.44	0.22	2.48	0.21	2.05	0.18
81	N_SanCasCk_S011	2.03	0.21	2.45	0.22	2.48	0.21	2.05	0.18
82	N_SanCasCk_S030	2.07	0.20	2.65	0.20	2.93	0.25	2.95	0.22
83	NuecesRv_S170	2.09	0.21	2.69	0.21	2.96	0.25	2.98	0.22
84	N_BlackCk_S010	2.20	0.23	2.89	0.23	3.12	0.27	3.13	0.23
85	N_BlackCk_S020	2.16	0.22	2.82	0.22	3.06	0.27	3.07	0.23
86	N_BlackCk_S021	2.12	0.21	2.75	0.21	3.01	0.26	3.02	0.22
87	NuecesRv_S180	2.10	0.21	2.72	0.21	2.98	0.26	3.00	0.22
88	NuecesRv_S185	2.27	0.23	2.97	0.23	3.20	0.28	3.21	0.24
89	NuecesRv_S190	2.23	0.24	2.97	0.24	3.18	0.28	3.18	0.24
90	NuecesRv_S200	2.06	0.20	2.63	0.20	2.92	0.25	2.94	0.22
91	NuecesRv_S210	2.11	0.21	2.67	0.21	2.96	0.25	2.99	0.22
92	NuecesRv_S220	2.70	0.40	3.22	0.35	2.94	0.32	2.74	0.30
93	NuecesRv_S221	2.49	0.38	3.04	0.33	2.81	0.31	2.62	0.28
94	NuecesRv_S222	2.30	0.41	3.00	0.36	3.00	0.33	2.80	0.30
95	NuecesRv_S230	2.55	0.38	3.09	0.34	2.84	0.31	2.65	0.29
96	NuecesRv_S231	2.62	0.39	3.15	0.35	2.89	0.32	2.70	0.29
97	FrioRv_S011	2.16	0.25	2.23	0.24	2.05	0.22	1.55	0.18
98	FrioRv_S010	2.26	0.25	2.49	0.24	2.42	0.23	2.01	0.18
99	FrioRv_S020	2.25	0.26	2.30	0.25	2.10	0.23	1.60	0.18
100	FrioRv_S030	2.30	0.26	1.80	0.21	1.50	0.18	1.30	0.15
101	FrioRv_D_S010	2.30	0.26	2.60	0.25	2.40	0.24	1.60	0.18
102	FrioRv_D_S020	2.30	0.26	1.80	0.21	1.50	0.18	1.30	0.15
103	FrioRv_D_S030	2.20	0.25	1.72	0.20	1.44	0.17	1.24	0.15
104	FrioRv_S040	2.30	0.26	1.80	0.21	1.50	0.18	1.30	0.15

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
105	FrioRv_S051	3.00	0.40	3.92	0.35	4.34	0.35	4.24	0.34
106	F_BlancoCk_S010	2.50	0.41	3.50	0.36	4.20	0.36	4.30	0.34
107	F_BlancoCk_S020	2.25	0.39	3.37	0.35	4.10	0.35	4.21	0.33
108	F_SabinalRv_S010	2.27	0.26	2.98	0.26	3.45	0.25	3.33	0.24
109	F_SabinalRv_S020	2.15	0.26	2.71	0.26	3.07	0.25	2.87	0.24
110	F_SabinalRv_S021	2.20	0.26	2.75	0.26	3.10	0.25	2.90	0.24
111	F_SabinalRv_S030	2.27	0.26	2.07	0.23	1.78	0.20	1.68	0.19
112	F_SabinalRv_S041	2.32	0.39	3.35	0.35	4.09	0.35	4.20	0.33
113	F_SabinalRv_S040	3.00	0.41	3.98	0.36	4.38	0.36	4.28	0.34
114	F_SabinalRv_S050	3.00	0.40	3.94	0.35	4.35	0.36	4.26	0.34
115	F_SabinalRv_S055	3.00	0.39	4.00	0.35	5.00	0.35	5.25	0.33
116	FrioRv_Sab_S060	3.00	0.41	3.96	0.36	4.37	0.36	4.27	0.34
117	FrioRv_S070	3.00	0.41	3.97	0.36	4.37	0.36	4.28	0.34
118	FrioRv_S071	2.97	0.40	3.89	0.35	4.32	0.35	4.23	0.33
119	FrioRv_S072	3.00	0.40	3.93	0.35	4.35	0.35	4.25	0.34
120	F_HondoCk_S010	2.37	0.27	2.74	0.26	2.71	0.25	2.43	0.20
121	F_HondoCk_S020	1.73	0.25	1.74	0.20	1.76	0.20	1.76	0.20
122	F_HondoCk_S021	2.99	0.40	3.91	0.35	4.33	0.35	4.24	0.33
123	F_MVerdeCk_S010	2.50	0.41	3.60	0.36	4.20	0.36	4.30	0.34
124	F_MVerdeCk_S011	2.30	0.40	3.43	0.35	4.15	0.35	4.25	0.34
125	F_MVerdeCk_S021	2.18	0.39	3.32	0.34	4.06	0.35	4.17	0.33
126	F_MVerdeCk_S020	2.48	0.40	3.93	0.35	4.38	0.35	4.30	0.33
127	F_HondoCk_S030	2.91	0.39	3.84	0.34	4.28	0.35	4.19	0.33
128	F_HondoCk_S031	3.00	0.41	3.96	0.36	4.37	0.36	4.27	0.34
129	F_SecoCk_S010	2.55	0.31	3.10	0.30	3.00	0.29	2.30	0.22
130	F_SecoCk_S020	2.28	0.29	2.27	0.27	1.98	0.23	1.78	0.20
131	F_SecoCk_S021	2.11	0.27	2.13	0.25	1.87	0.22	1.68	0.19
132	F_SecoCk_S030	2.96	0.39	4.00	0.34	4.56	0.35	4.54	0.33
133	F_SecoCk_S031	2.98	0.40	3.90	0.35	4.32	0.35	4.23	0.33
134	F_HondoCk_S040	3.00	0.40	3.94	0.35	4.35	0.36	4.26	0.34
135	FrioRv_S080	3.00	0.40	3.94	0.35	4.36	0.36	4.26	0.34
136	F_LeonaRv_S010	2.47	0.35	3.40	0.30	4.20	0.29	5.25	0.29
137	F_LeonaRv_S011	2.38	0.34	3.32	0.29	3.86	0.29	4.17	0.28
138	F_LeonaRv_S012	2.58	0.34	3.50	0.29	4.54	0.29	5.13	0.28
139	F_LeonaRv_S020	2.38	0.34	3.32	0.29	3.86	0.29	4.17	0.28

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
140	F_LeonaRv_S021	2.50	0.40	3.50	0.35	4.34	0.35	4.49	0.34
141	F_LeonaRv_S022	2.49	0.40	3.41	0.35	4.13	0.35	4.24	0.33
142	F_LeonaRv_S023	2.50	0.41	3.47	0.36	4.18	0.36	4.28	0.34
143	F_LeonaRv_S030	2.49	0.40	3.41	0.35	4.13	0.35	4.24	0.33
144	F_LeonaRv_S031	2.50	0.40	3.46	0.36	4.17	0.36	4.27	0.34
145	F_LeonaRv_S040	2.50	0.40	3.45	0.35	4.16	0.36	4.26	0.34
146	F_LeonaRv_S041	2.50	0.41	3.50	0.36	4.20	0.36	4.30	0.34
147	F_LeonaRv_S042	2.50	0.41	3.49	0.36	4.19	0.36	4.29	0.34
148	FrioRv_S090	3.00	0.41	3.99	0.36	4.39	0.36	4.29	0.34
149	FrioRv_S100	2.80	0.38	4.05	0.36	4.40	0.33	4.20	0.30
150	FrioRv_S101	2.80	0.38	4.02	0.36	4.38	0.33	4.18	0.30
151	FrioRv_S102	2.73	0.36	3.91	0.35	4.30	0.32	4.10	0.29
152	F_CiboloCk_S010	2.10	0.36	3.05	0.36	3.00	0.33	3.70	0.30
153	F_CiboloCk_S011	2.10	0.36	3.05	0.36	3.00	0.33	3.70	0.30
154	F_CiboloCk_S020	1.99	0.34	2.83	0.34	2.84	0.31	3.55	0.29
155	FrioRv_S110	2.67	0.36	3.86	0.34	4.25	0.31	4.06	0.29
156	FrioRv_S111	2.55	0.34	3.76	0.33	4.18	0.31	3.99	0.28
157	FrioRv_S112	2.42	0.33	3.65	0.32	4.10	0.30	3.92	0.28
158	FrioRv_S113	2.43	0.33	3.66	0.32	4.10	0.30	3.92	0.28
159	FrioRv_S114	2.45	0.34	3.68	0.32	4.12	0.30	3.94	0.28
160	FrioRv_S120	2.90	0.38	3.81	0.33	4.28	0.31	4.00	0.28
161	F_SanMigCk_S010	2.03	0.31	2.41	0.30	2.67	0.27	2.58	0.26
162	F_SanMigCk_S011	2.15	0.32	2.49	0.31	2.73	0.28	2.63	0.27
163	F_SanMigCk_S020	2.19	0.32	2.57	0.31	2.84	0.28	2.76	0.27
164	F_SanMigCk_S022	1.84	0.29	2.24	0.28	2.53	0.26	2.45	0.25
165	F_SanMigCk_S021	2.07	0.31	2.42	0.30	2.68	0.27	2.58	0.26
166	F_SanMigCk_S023	1.88	0.29	2.33	0.28	2.66	0.26	2.61	0.25
167	F_SanMigCk_S024	3.00	0.38	4.02	0.33	4.56	0.31	4.34	0.28
168	ChokeCanyon_S010	2.81	0.37	3.73	0.32	4.22	0.30	3.94	0.28
169	FrioRv_S130	3.04	0.38	4.09	0.34	3.84	0.31	3.65	0.29
170	Atascosa_S010	2.21	0.33	2.48	0.30	2.52	0.28	2.51	0.26
171	Atascosa_S011	2.19	0.33	2.41	0.30	2.42	0.28	2.38	0.26
172	Atascosa_S020	2.25	0.33	2.59	0.30	2.69	0.28	2.72	0.26
173	Atascosa_S030	2.11	0.32	2.35	0.29	2.39	0.27	2.36	0.26
174	Atascosa_S031	2.19	0.33	2.40	0.30	2.40	0.28	2.36	0.26

	AEP	50%	50%	20%	20%	10%	10%	4%	4%
	Return Period	2-yr	2-yr	5-yr	5-yr	10-yr	10-yr	25-yr	25-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
175	Atascosa_S040	2.04	0.31	2.27	0.29	2.30	0.27	2.27	0.25
176	Atascosa_S041	1.86	0.30	2.13	0.27	2.19	0.26	2.17	0.24
177	Atascosa_S050	1.90	0.30	2.21	0.27	2.30	0.26	2.30	0.24
178	La_ParitaCk_S010	1.99	0.31	2.30	0.28	2.40	0.26	2.40	0.25
179	La_ParitaCk_S020	1.99	0.31	2.24	0.28	2.30	0.27	2.27	0.25
180	La_ParitaCk_S030	1.87	0.30	2.14	0.27	2.20	0.26	2.18	0.24
181	Atascosa_S060	1.92	0.30	2.17	0.28	2.23	0.26	2.20	0.25
182	Atascosa_S070	2.89	0.37	3.47	0.33	3.26	0.30	3.09	0.28
183	Atascosa_S071	2.86	0.36	3.46	0.32	3.27	0.30	3.10	0.28
184	Atascosa_S080	3.01	0.38	3.56	0.34	3.32	0.31	3.13	0.29
185	FrioRv_S140	2.98	0.38	3.54	0.33	3.30	0.31	3.12	0.28
186	NuecesRv_S240	2.73	0.28	2.47	0.24	2.28	0.21	1.99	0.19
187	NuecesRv_S250	2.95	0.30	2.66	0.26	2.42	0.23	2.12	0.20
188	NuecesRv_S260	2.90	0.30	2.62	0.25	2.39	0.22	2.09	0.20
189	NuecesRv_S261	2.94	0.30	2.69	0.25	2.47	0.23	2.19	0.20
190	NuecesRv_S270	2.91	0.30	2.63	0.25	2.40	0.22	2.10	0.20
191	NuecesRv_S290	2.84	0.29	2.57	0.25	2.35	0.22	2.06	0.19
192	N_LagartoCk_S010	2.36	0.31	2.67	0.26	2.43	0.23	2.13	0.20
193	N_LagartoCk_S020	2.36	0.31	2.67	0.26	2.43	0.23	2.13	0.20
194	RamirenaCk_S010	2.36	0.31	2.67	0.26	2.42	0.23	2.13	0.20
195	RamirenaCk_S020	2.33	0.30	2.64	0.25	2.41	0.23	2.11	0.20
196	CorpusChristi_S010	2.73	0.28	2.47	0.24	2.28	0.21	1.99	0.19
197	CorpusChristi_S011	2.90	0.30	2.62	0.25	2.39	0.22	2.09	0.20
198	NuecesRv_S300	2.82	0.28	2.66	0.24	2.36	0.21	2.17	0.19
199	NuecesRv_S310	2.72	0.28	2.37	0.24	1.92	0.21	1.64	0.19

Table B.32: Final Initial and Constant Loss Rates for the 2% to 0.2% AEP Storm Events

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
1	NuecesRv_W_S010	1.58	0.13	1.39	0.10	1.22	0.09	1.09	0.08
2	NuecesRv_W_S011	1.58	0.13	1.39	0.10	1.22	0.09	1.09	0.08
3	NuecesRv_W_S020	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
4	NuecesRv_W_S021	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
5	NuecesRv_W_S022	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
6	NuecesRv_W_S030	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
7	NuecesRv_W_S031	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
8	NuecesRv_W_S032	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
9	NuecesRv_S011	1.58	0.13	1.39	0.10	1.22	0.09	1.09	0.08
10	NuecesRv_S010	1.58	0.13	1.39	0.10	1.22	0.09	1.09	0.08
11	NuecesRv_S012	1.58	0.13	1.39	0.10	1.22	0.09	1.09	0.08
12	NuecesRv_S020	1.57	0.13	1.38	0.10	1.22	0.09	1.09	0.08
13	NuecesRv_S030	1.70	0.13	1.50	0.10	1.33	0.09	1.20	0.08
14	NuecesRv_S041	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
15	NuecesRv_S040	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
16	NuecesRv_S050	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
17	NuecesRv_S061	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
18	NuecesRv_S060	1.60	0.13	1.40	0.10	1.23	0.09	1.10	0.08
19	NuecesRv_S070	1.56	0.13	1.38	0.10	1.21	0.08	1.09	0.08
20	NuecesRv_S071	1.55	0.12	1.37	0.09	1.21	0.08	1.08	0.07
21	NuecesRv_S080	1.59	0.18	1.39	0.15	1.22	0.14	1.09	0.13
22	NuecesRv_S081	1.57	0.18	1.38	0.15	1.22	0.14	1.09	0.13
23	NuecesRv_S082	1.53	0.17	1.36	0.14	1.20	0.13	1.07	0.12
24	NuecesRv_S083	1.56	0.18	1.38	0.15	1.21	0.13	1.09	0.13
25	NuecesRv_S084	1.56	0.18	1.38	0.15	1.21	0.13	1.09	0.13
26	NuecesRv_S090	1.52	0.17	1.35	0.14	1.19	0.13	1.07	0.12
27	N_ChaconCk_S010	3.09	0.23	2.90	0.20	2.73	0.18	2.61	0.18
28	N_ChaconCk_S020	2.49	0.22	2.34	0.19	2.18	0.18	2.06	0.17
29	N_ChaconCk_S021	2.48	0.22	2.33	0.19	2.17	0.17	2.05	0.17
30	N_ChaconCk_S023	2.51	0.22	2.35	0.19	2.19	0.18	2.06	0.17
31	N_ChaconCk_S022	2.50	0.22	2.34	0.19	2.18	0.18	2.06	0.17
32	N_PicosaCk_S010	2.68	0.21	2.53	0.18	2.38	0.17	2.26	0.16
33	N_PicosaCk_S011	2.93	0.22	2.76	0.19	2.60	0.18	2.48	0.17
34	N_PicosaCk_S020	2.77	0.22	2.60	0.19	2.44	0.18	2.31	0.17

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
35	N_TurkeyCk_S010	3.10	0.23	2.91	0.20	2.75	0.18	2.62	0.18
36	N_TurkeyCk_S011	2.56	0.23	2.38	0.20	2.21	0.18	2.09	0.18
37	N_TurkeyCk_S012	2.52	0.22	2.35	0.19	2.19	0.18	2.07	0.17
38	N_ChapCk_S010	2.55	0.22	2.37	0.19	2.21	0.18	2.08	0.17
39	N_ChapCk_S011	2.53	0.22	2.36	0.19	2.20	0.18	2.07	0.17
40	N_TurkeyCk_S020	2.47	0.21	2.32	0.18	2.17	0.17	2.05	0.16
41	N_PicosaCk_S021	2.54	0.22	2.37	0.19	2.20	0.18	2.08	0.17
42	N_TurkeyCk_S030	2.48	0.22	2.33	0.19	2.17	0.17	2.05	0.17
43	N_TurkeyCk_S031	2.59	0.23	2.39	0.20	2.22	0.19	2.10	0.18
44	N_TurkeyCk_S040	2.49	0.22	2.34	0.19	2.18	0.18	2.06	0.17
45	TurkeyCk_S041	1.58	0.23	1.39	0.20	1.22	0.19	1.09	0.18
46	N_TurkeyCk_S050	4.18	0.23	3.98	0.20	3.82	0.19	3.69	0.18
47	N_TurkeyCk_S060	1.60	0.23	1.40	0.20	1.23	0.19	1.10	0.18
48	N_TurkeyCk_S061	1.55	0.22	1.37	0.19	1.21	0.18	1.08	0.17
49	N_TurkeyCk_S070	1.55	0.22	1.37	0.19	1.21	0.18	1.08	0.17
50	N_TurkeyCk_S080	1.52	0.22	1.36	0.19	1.19	0.18	1.07	0.17
51	N_TurkeyCk_S081	1.61	0.21	1.46	0.18	1.31	0.17	1.19	0.16
52	N_TurkeyCk_S090	1.50	0.22	1.34	0.19	1.18	0.18	1.06	0.17
53	NuecesRv_S100	2.49	0.22	2.34	0.19	2.18	0.18	2.06	0.17
54	NuecesRv_S101	2.54	0.22	2.37	0.19	2.20	0.18	2.08	0.17
55	NuecesRv_S110	2.45	0.21	2.32	0.18	2.16	0.17	2.04	0.16
56	NuecesRv_S111	2.51	0.22	2.35	0.19	2.19	0.18	2.07	0.17
57	N_SanRoqCk_S010	2.41	0.21	2.29	0.18	2.14	0.17	2.03	0.16
58	N_SanRoqCk_S011	2.45	0.21	2.32	0.18	2.17	0.17	2.06	0.16
59	N_SanRoqCk_S020	2.46	0.21	2.32	0.18	2.16	0.17	2.05	0.16
60	N_SanRoqCk_S021	2.46	0.21	2.32	0.18	2.16	0.17	2.05	0.16
61	NuecesRv_S121	2.60	0.23	2.40	0.20	2.23	0.19	2.10	0.18
62	NuecesRv_S120	2.60	0.23	2.40	0.20	2.23	0.19	2.10	0.18
63	NuecesRv_S122	2.68	0.23	2.48	0.20	2.31	0.19	2.18	0.18
64	NuecesRv_S130	2.50	0.17	2.34	0.14	2.18	0.13	2.06	0.12
65	N_LaRaicesCk_S010	2.60	0.18	2.40	0.15	2.23	0.14	2.10	0.13
66	N_LaRaicesCk_S011	2.57	0.18	2.39	0.15	2.22	0.14	2.09	0.13
67	NuecesRv_S140	2.46	0.16	2.32	0.13	2.16	0.12	2.05	0.11
68	N_CalmanCk_S010	2.57	0.18	2.38	0.15	2.21	0.13	2.09	0.13
69	N_CalmanCk_S011	2.45	0.16	2.32	0.13	2.16	0.12	2.04	0.11

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
70	NuecesRv_S150	2.43	0.16	2.30	0.13	2.15	0.12	2.03	0.11
71	N_LosOlmosCk_S012	2.43	0.16	2.30	0.13	2.15	0.12	2.03	0.11
72	N_LosOlmosCk_S011	2.51	0.17	2.35	0.14	2.19	0.13	2.07	0.12
73	N_LosOlmosCk_S010	2.58	0.18	2.39	0.15	2.22	0.14	2.09	0.13
74	N_LosOlmosCk_S020	2.40	0.16	2.29	0.13	2.14	0.12	2.02	0.11
75	NuecesRv_S151	2.40	0.16	2.28	0.13	2.13	0.12	2.02	0.11
76	NuecesRv_S160	2.42	0.16	2.29	0.13	2.14	0.12	2.03	0.11
77	NuecesRv_S161	2.39	0.16	2.28	0.13	2.13	0.11	2.02	0.11
78	N_SanCasCk_S010	2.62	0.17	2.47	0.14	2.31	0.12	2.19	0.12
79	N_SanCasCk_S020	1.90	0.16	1.79	0.13	1.64	0.12	1.52	0.11
80	N_SanCasCk_S021	1.91	0.16	1.79	0.13	1.64	0.12	1.53	0.11
81	N_SanCasCk_S011	1.92	0.16	1.79	0.13	1.64	0.12	1.53	0.11
82	N_SanCasCk_S030	2.42	0.16	2.29	0.13	2.14	0.12	2.03	0.11
83	NuecesRv_S170	2.44	0.16	2.31	0.13	2.15	0.12	2.04	0.11
84	N_BlackCk_S010	2.55	0.17	2.38	0.14	2.21	0.13	2.09	0.12
85	N_BlackCk_S020	2.51	0.17	2.35	0.14	2.19	0.13	2.06	0.12
86	N_BlackCk_S021	2.47	0.16	2.32	0.13	2.17	0.12	2.05	0.11
87	NuecesRv_S180	2.45	0.16	2.31	0.13	2.16	0.12	2.04	0.11
88	NuecesRv_S185	2.62	0.18	2.43	0.15	2.27	0.14	2.14	0.13
89	NuecesRv_S190	2.58	0.18	2.39	0.15	2.22	0.14	2.09	0.13
90	NuecesRv_S200	2.41	0.16	2.29	0.13	2.14	0.12	2.03	0.11
91	NuecesRv_S210	2.46	0.16	2.33	0.13	2.18	0.12	2.07	0.11
92	NuecesRv_S220	2.56	0.28	2.38	0.25	2.21	0.23	2.08	0.23
93	NuecesRv_S221	2.47	0.26	2.32	0.23	2.17	0.22	2.05	0.21
94	NuecesRv_S222	2.60	0.28	2.40	0.25	2.23	0.24	2.10	0.23
95	NuecesRv_S230	2.49	0.27	2.34	0.24	2.18	0.23	2.06	0.22
96	NuecesRv_S231	2.52	0.27	2.36	0.24	2.19	0.23	2.07	0.22
97	FrioRv_S011	1.06	0.13	0.88	0.10	0.71	0.08	0.59	0.08
98	FrioRv_S010	1.56	0.13	1.37	0.10	1.20	0.09	1.08	0.08
99	FrioRv_S020	1.10	0.13	0.90	0.10	0.73	0.09	0.60	0.08
100	FrioRv_S030	1.10	0.13	0.90	0.10	0.73	0.09	0.60	0.08
101	FrioRv_D_S010	1.10	0.13	0.90	0.10	0.73	0.09	0.60	0.08
102	FrioRv_D_S020	1.10	0.13	0.90	0.10	0.73	0.09	0.60	0.08
103	FrioRv_D_S030	1.06	0.13	0.88	0.10	0.71	0.08	0.58	0.08
104	FrioRv_S040	1.10	0.13	0.90	0.10	0.73	0.09	0.60	0.08

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
105	FrioRv_S051	3.56	0.28	3.38	0.25	3.21	0.23	3.08	0.23
106	F_BlancoCk_S010	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
107	F_BlancoCk_S020	3.53	0.27	3.36	0.24	3.20	0.23	3.07	0.22
108	F_SabinalRv_S010	2.07	0.18	1.87	0.15	1.70	0.14	1.57	0.13
109	F_SabinalRv_S020	1.58	0.18	1.39	0.15	1.22	0.14	1.09	0.13
110	F_SabinalRv_S021	1.60	0.18	1.40	0.15	1.23	0.14	1.10	0.13
111	F_SabinalRv_S030	1.58	0.18	1.39	0.15	1.22	0.14	1.09	0.13
112	F_SabinalRv_S041	3.52	0.27	3.36	0.24	3.19	0.23	3.07	0.22
113	F_SabinalRv_S040	3.59	0.28	3.39	0.25	3.22	0.24	3.10	0.23
114	F_SabinalRv_S050	3.57	0.28	3.38	0.25	3.21	0.23	3.09	0.23
115	F_SabinalRv_S055	4.50	0.27	4.50	0.24	4.50	0.23	4.50	0.22
116	FrioRv_Sab_S060	3.58	0.28	3.39	0.25	3.22	0.24	3.09	0.23
117	FrioRv_S070	3.58	0.28	3.39	0.25	3.22	0.24	3.09	0.23
118	FrioRv_S071	3.54	0.27	3.37	0.24	3.20	0.23	3.08	0.22
119	FrioRv_S072	3.56	0.28	3.38	0.25	3.21	0.23	3.09	0.23
120	F_HondoCk_S010	2.28	0.18	2.08	0.15	1.91	0.14	1.78	0.13
121	F_HondoCk_S020	1.57	0.18	1.38	0.15	1.22	0.14	1.09	0.13
122	F_HondoCk_S021	3.55	0.27	3.37	0.24	3.21	0.23	3.08	0.22
123	F_MVerdeCk_S010	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
124	F_MVerdeCk_S011	3.57	0.28	3.38	0.25	3.21	0.23	3.09	0.23
125	F_MVerdeCk_S021	3.51	0.27	3.35	0.24	3.19	0.23	3.06	0.22
126	F_MVerdeCk_S020	3.62	0.27	3.45	0.24	3.29	0.23	3.16	0.22
127	F_HondoCk_S030	3.52	0.27	3.35	0.24	3.19	0.23	3.07	0.22
128	F_HondoCk_S031	3.58	0.28	3.39	0.25	3.22	0.24	3.09	0.23
129	F_SecoCk_S010	1.60	0.18	1.40	0.15	1.23	0.14	1.10	0.13
130	F_SecoCk_S020	1.58	0.18	1.39	0.15	1.22	0.14	1.09	0.13
131	F_SecoCk_S021	1.51	0.17	1.35	0.14	1.19	0.13	1.07	0.12
132	F_SecoCk_S030	3.90	0.27	3.74	0.24	3.57	0.23	3.45	0.22
133	F_SecoCk_S031	3.55	0.27	3.37	0.24	3.20	0.23	3.08	0.22
134	F_HondoCk_S040	3.57	0.28	3.38	0.25	3.21	0.24	3.09	0.23
135	FrioRv_S080	3.57	0.28	3.38	0.25	3.22	0.24	3.09	0.23
136	F_LeonaRv_S010	4.50	0.18	4.50	0.15	4.50	0.13	4.50	0.13
137	F_LeonaRv_S011	3.00	0.17	2.84	0.14	2.68	0.13	2.56	0.12
138	F_LeonaRv_S012	4.31	0.17	4.15	0.14	3.99	0.13	3.87	0.12
139	F_LeonaRv_S020	3.01	0.17	2.85	0.14	2.68	0.13	2.56	0.12

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
140	F_LeonaRv_S021	3.82	0.28	3.64	0.25	3.47	0.23	3.35	0.23
141	F_LeonaRv_S022	3.55	0.27	3.37	0.24	3.21	0.23	3.08	0.22
142	F_LeonaRv_S023	3.59	0.28	3.39	0.25	3.22	0.24	3.09	0.23
143	F_LeonaRv_S030	3.55	0.27	3.37	0.24	3.21	0.23	3.08	0.22
144	F_LeonaRv_S031	3.58	0.28	3.39	0.25	3.22	0.24	3.09	0.23
145	F_LeonaRv_S040	3.57	0.28	3.38	0.25	3.22	0.24	3.09	0.23
146	F_LeonaRv_S041	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
147	F_LeonaRv_S042	3.59	0.28	3.40	0.25	3.23	0.24	3.10	0.23
148	FrioRv_S090	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
149	FrioRv_S100	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
150	FrioRv_S101	3.59	0.28	3.39	0.25	3.22	0.24	3.09	0.23
151	FrioRv_S102	3.53	0.27	3.36	0.24	3.20	0.23	3.07	0.22
152	F_CiboloCk_S010	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
153	F_CiboloCk_S011	3.60	0.28	3.40	0.25	3.23	0.24	3.10	0.23
154	F_CiboloCk_S020	3.49	0.27	3.34	0.24	3.18	0.23	3.06	0.22
155	FrioRv_S110	3.50	0.27	3.34	0.24	3.18	0.23	3.06	0.22
156	FrioRv_S111	3.45	0.26	3.31	0.23	3.16	0.22	3.04	0.21
157	FrioRv_S112	3.39	0.26	3.28	0.23	3.13	0.21	3.02	0.21
158	FrioRv_S113	3.39	0.26	3.28	0.23	3.13	0.21	3.02	0.21
159	FrioRv_S114	3.41	0.26	3.29	0.23	3.14	0.22	3.03	0.21
160	FrioRv_S120	3.45	0.26	3.31	0.23	3.16	0.22	3.04	0.21
161	F_SanMigCk_S010	1.80	0.25	1.63	0.22	1.47	0.21	1.34	0.20
162	F_SanMigCk_S011	1.84	0.26	1.64	0.23	1.47	0.22	1.34	0.21
163	F_SanMigCk_S020	1.97	0.26	1.77	0.23	1.60	0.22	1.47	0.21
164	F_SanMigCk_S022	1.70	0.24	1.57	0.21	1.41	0.20	1.29	0.19
165	F_SanMigCk_S021	1.80	0.25	1.62	0.22	1.46	0.21	1.33	0.20
166	F_SanMigCk_S023	1.87	0.24	1.73	0.21	1.57	0.20	1.46	0.19
167	F_SanMigCk_S024	3.81	0.26	3.67	0.23	3.51	0.22	3.39	0.21
168	ChokeCanyon_S010	3.41	0.26	3.29	0.23	3.14	0.22	3.03	0.21
169	FrioRv_S130	3.49	0.27	3.34	0.24	3.18	0.23	3.06	0.22
170	Atascosa_S010	2.26	0.23	2.06	0.20	1.89	0.19	1.76	0.18
171	Atascosa_S011	2.12	0.23	1.92	0.20	1.75	0.19	1.62	0.18
172	Atascosa_S020	2.49	0.23	2.29	0.20	2.12	0.19	1.99	0.18
173	Atascosa_S030	2.12	0.23	1.94	0.20	1.77	0.18	1.65	0.18
174	Atascosa_S031	2.10	0.23	1.90	0.20	1.73	0.19	1.60	0.18

	AEP	2%	2%	1%	1%	0.50%	0.50%	0.20%	0.20%
	Return Period	50-yr	50-yr	100-yr	100-yr	200-yr	200-yr	500-yr	500-yr
No.	Subbasin Name	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)	Initial (in)	Constant (in/hr)
175	Atascosa_S040	2.03	0.22	1.86	0.19	1.70	0.18	1.57	0.17
176	Atascosa_S041	1.96	0.21	1.82	0.18	1.66	0.17	1.55	0.16
177	Atascosa_S050	2.10	0.21	1.95	0.18	1.80	0.17	1.68	0.16
178	La_ParitaCk_S010	2.19	0.22	2.04	0.19	1.88	0.18	1.76	0.17
179	La_ParitaCk_S020	2.05	0.22	1.89	0.19	1.73	0.18	1.60	0.17
180	La_ParitaCk_S030	1.96	0.21	1.82	0.18	1.67	0.17	1.55	0.16
181	Atascosa_S060	1.98	0.22	1.83	0.19	1.67	0.17	1.55	0.17
182	Atascosa_S070	2.95	0.26	2.83	0.23	2.68	0.22	2.56	0.21
183	Atascosa_S071	2.98	0.26	2.86	0.23	2.71	0.22	2.60	0.21
184	Atascosa_S080	2.97	0.27	2.83	0.24	2.67	0.22	2.55	0.22
185	FrioRv_S140	2.96	0.26	2.82	0.23	2.67	0.22	2.55	0.21
186	NuecesRv_S240	1.73	0.17	1.58	0.14	1.42	0.13	1.30	0.12
187	NuecesRv_S250	1.83	0.18	1.64	0.15	1.47	0.14	1.34	0.13
188	NuecesRv_S260	1.81	0.18	1.63	0.15	1.46	0.13	1.33	0.13
189	NuecesRv_S261	1.91	0.18	1.72	0.15	1.56	0.14	1.43	0.13
190	NuecesRv_S270	1.81	0.18	1.63	0.15	1.46	0.13	1.34	0.13
191	NuecesRv_S290	1.78	0.17	1.61	0.14	1.45	0.13	1.32	0.12
192	N_LagartoCk_S010	1.83	0.18	1.64	0.15	1.47	0.14	1.34	0.13
193	N_LagartoCk_S020	1.83	0.18	1.64	0.15	1.47	0.14	1.34	0.13
194	RamirenaCk_S010	1.83	0.18	1.64	0.15	1.47	0.14	1.34	0.13
195	RamirenaCk_S020	1.82	0.18	1.63	0.15	1.47	0.14	1.34	0.13
196	CorpusChristi_S010	1.73	0.17	1.58	0.14	1.42	0.12	1.30	0.12
197	CorpusChristi_S011	1.81	0.18	1.63	0.15	1.46	0.13	1.33	0.13
198	NuecesRv_S300	2.05	0.17	1.90	0.14	1.74	0.13	1.62	0.12
199	NuecesRv_S310	1.48	0.17	1.33	0.14	1.17	0.12	1.05	0.12

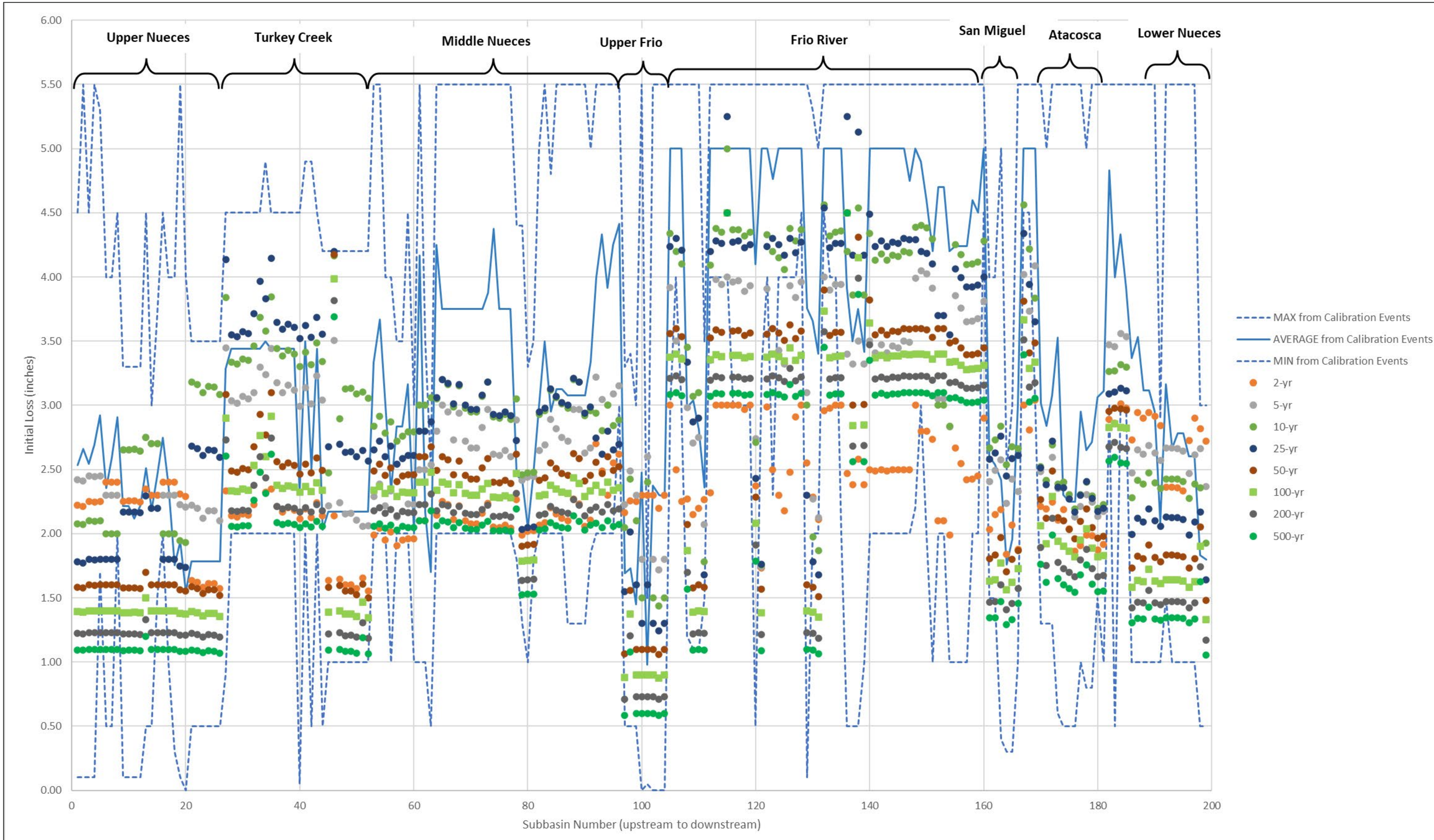

Figure B.176: Comparison of Adopted versus Calibrated Initial Losses (inches)

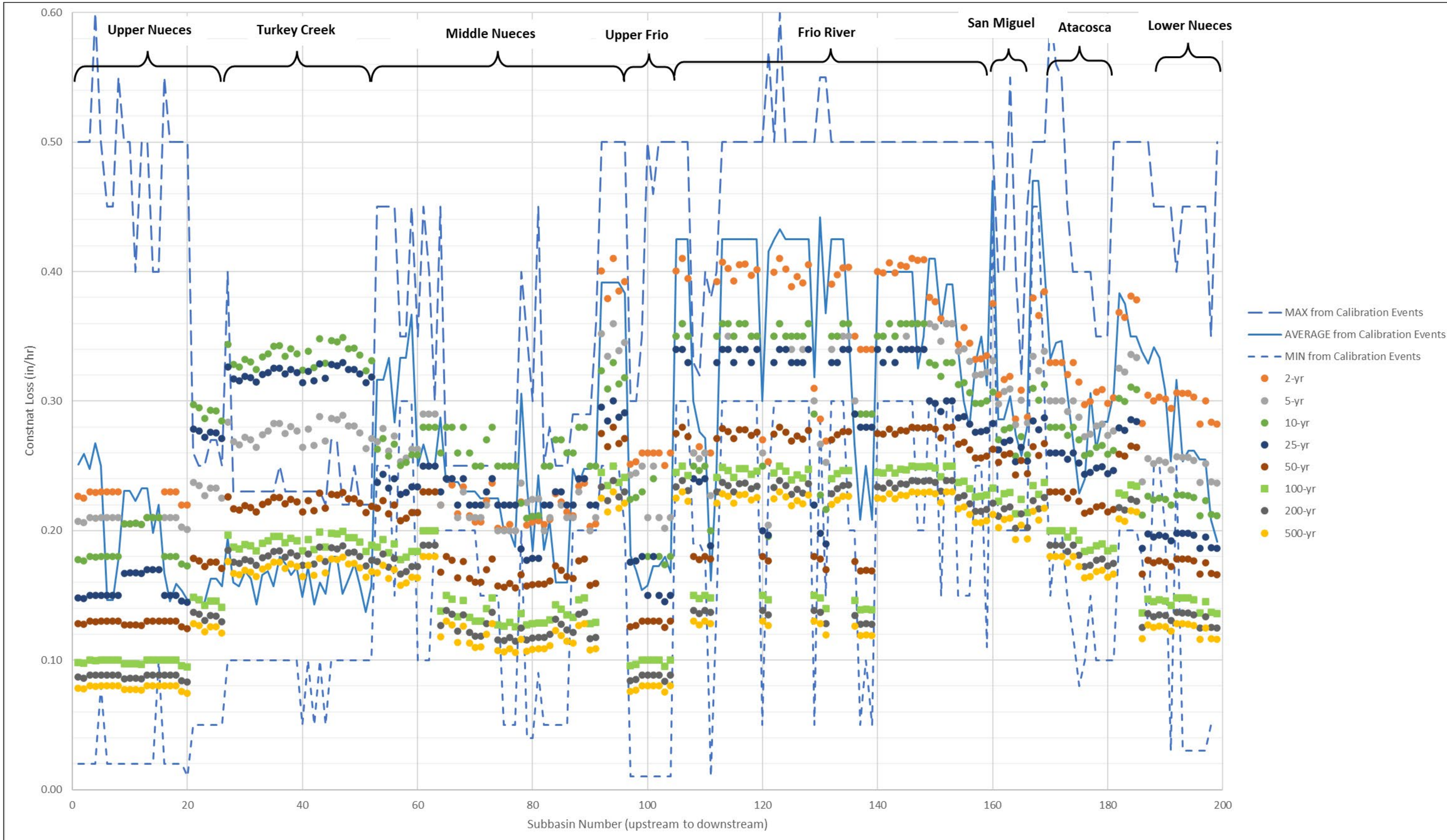

Figure B.177: Comparison of Adopted versus Calibrated Constant Losses (inches per hour)

1.5.3 Reservoir Assumptions for the Frequency Storms

For the reservoirs that were modeled in HEC-HMS, assumptions had to be made regarding the initial pool elevations and reservoir releases when running the hypothetical frequency storms. Table B.33 summarizes the assumptions that were made. As shown in this table, it was assumed that the reservoir's pool elevation would be at top of conservation (also known as normal pool) at the beginning of the frequency storm simulation.

Assumptions also had to be made regarding reservoir releases during the frequency storms. For reservoirs that have gated operations, time series data of the observed releases were used for the calibration events, so different assumptions had to be made for the frequency storms. For Choke Canyon and Lake Corpus Christi, which do make gated releases during storm events, an elevation-discharge curve was added to the model to govern releases for the frequency events. The elevation-discharge curves were created to represent the total release from the reservoir (gated plus spillway) for the full range of possible pool elevations. These curves were calibrated to observed releases and pool elevations during their respective reservoir analyses, which are described in Appendix E.

Table B.33: Assumed Initial Pool Elevations and Reservoir Releases for the Frequency Storms

Reservoir Name	Initial Pool Elev (feet NAVD88)	Initial Pool Source	Reservoir Release Method	Reservoir Release Data Source
Choke Canyon Reservoir	220.6	Conservation Pool	Elevation-Discharge Curve	Total release curve (gated + spillways) based on typical release data from the Reservoir Analysis (Appendix E)
Lake Corpus Christi	93.8	Conservation Pool	Elevation-Discharge Curve	Total release curve (gated + spillways) based on typical release data from the Reservoir Analysis (Appendix E)

1.6 UNIFORM RAINFALL FREQUENCY STORMS

After finalizing the model's parameters based on the calibration events, the frequency flow values were then calculated in HEC-HMS by applying frequency rainfall depths to the final watershed basin models through a series of depth-area analyses. This rainfall pattern is referred to as the uniform rainfall method because the assigned point rainfall depths for each subbasin are reduced uniformly over the entire watershed based on the published depth-area reduction factors from Figure 15 of the National Weather Service TP-40 publication (Herschfield, 1961). A depth area analysis was set up for every junction and node of interest within the HEC-HMS model in order to apply the appropriate depth-area reduction for each drainage area of interest.

In order to select the appropriate storm duration and temporal distribution for the frequency storms, sensitivity tests were run in HEC-HMS for a series of storm durations ranging from 24-hours to 7-days as shown in Table B.34. Please note that the peak flow results shown in this table represents preliminary sensitivity tests that were performed in the model prior to completing calibration; therefore, they do not match the final flow frequency results shown later in this appendix.

From Table B.34, one can see that increasing the storm duration tends to increase the peak discharge for the tested locations. This makes sense as increasing the storm duration increases to total volume of rainfall. However, these increases in peak discharge level off to 1% or less for most of the tested junctions for storm durations longer than 48 hours.

After completing the sensitivity analyses, a 48-hour storm duration with a 50% intensity position and a 15-minute intensity duration was adopted for all the frequency storms in the HEC-HMS model.

Table B.34: Sensitivity Test Results for Various Storm Durations

		1% AEP Peak Flows (cfs) for Various Storm Durations				Percent Difference (%) in Peak Flow:		
Model Location	Drainage Area (sq mi)	24-hours	48-hours	4-day	7-day	48-hr to 24-hr	96-hr to 48-hr	7-day to 4-day
W_NuecesRv_nr_Brackettville	693.9	272442	275135	275171	275161	1.0%	0%	0%
NuecesRv_at_Laguna	736.2	307371	309062	309027	308981	0.5%	0%	0%
NuecesRv_nr_Uvalde	1861.5	406562	413356	413470	413421	1.7%	0%	0%
NuecesRv_nr_Asherton	4024.7	311107	322974	324050	323933	3.8%	0.3%	0%
NuecesRv_at_Cotulla	5172.4	268165	278620	279633	279538	3.9%	0.4%	0%
San_CasimiroCk_nr_Freer	467.7	55663	58161	58594	58598	4.5%	0.7%	0%
NuecesRv_nr_Tilden	8105.9	225645	234127	234989	234925	3.8%	0.4%	0%
FrioRv_at_Concan	389.6	179292	181658	181725	181688	1.3%	0%	0%
Dry_FrioRv_nr_Reagan_Wells	124.5	94439	94716	94704	94692	0.3%	0%	0%
FrioRv_nr_Uvalde	633.1	233104	236394	236491	236447	1.4%	0%	0%
SabinalRv_nr_Sabinal	205.9	127497	128041	128019	127996	0.4%	0%	0%
SabinalRv_at_Sabinal	240.6	126688	127408	127388	127366	0.6%	0%	0%
HondoCk_nr_Tarpley	96.1	110973	111425	111402	111381	0.4%	0%	0%
HondoCk_at_HWY-173	156.4	113603	114198	114178	114159	0.5%	0%	0%
SecoCk_at_MillerRh_nr_Utopia	45.0	69534	69530	69523	69517	0.0%	0%	0%
SecoCk_RoweRh_nr_D'Hanis	165.1	95247	95350	95346	95343	0.1%	0%	0%
FrioRv_nr_Derby	3447.8	356627	371063	372725	373154	4.0%	0.4%	0.1%
FrioRv_at_Tilden	4462.8	316209	327956	329330	329646	3.7%	0.4%	0.1%
SanMiguelCk_nr_Tilden	782.2	79741	82253	82320	82324	3.2%	0.1%	0.0%
ChokeCanyonRes_OWC_nr_3Rv	5490.5	213152	217292	217779	217891	1.9%	0.2%	0.1%
AtascosaRv_at_Whitsett	1145.8	113076	119660	120133	120130	5.8%	0.4%	0.0%
NuecesRv_at_Three_Rivers	15430.5	347396	357880	358939	359117	3.0%	0.3%	0.0%
NuecesRv_nr_Mathis	16502.1	323552	334415	335589	335800	3.4%	0.4%	0.1%
NuecesRv_at_Bluntzer	16617.6	316170	326800	327964	328178	3.4%	0.4%	0.1%
NuecesRv_at_Calallen	16675.3	296312	306347	307434	307636	3.4%	0.4%	0.1%

1.6.1 Point Rainfall Depths for the Uniform Frequency Storms

NOAA Atlas 14 contains precipitation frequency estimates for the United States along with their associated lower and upper 90% confidence bounds. The Atlas is divided into volumes based on geographic sections of the country. NOAA Atlas 14 is intended as the U.S. Government source of precipitation frequency estimates. NOAA Atlas 14 Volume 11, which covers the state of Texas, was published in 2018 (NOAA, 2018). The point rainfall depths that were published in NOAA Atlas 14 (NA14) were applied to the HEC-HMS model for this study, as they are the most up-to-date precipitation frequency estimates in Texas.

NOAA Atlas 14 point rainfall depths from the annual maximum series for various durations and recurrence intervals were collected from the NA14 Precipitation Frequency Data Server (PFDS) for the centroid of each subbasin (NOAA, 2020). This method resulted in 199 separate point rainfall tables being applied in Nueces River basin, one for each subbasin. The appropriate point rainfall depth table was assigned to each subbasin within the HEC-HMS frequency storm editor. It should be noted that precipitation frequency estimates from NOAA Atlas 14 are point estimates and are not directly applicable to larger areas. The conversion from a point to an areal estimate was accomplished for the uniform rainfall method by using the depth area analyses in HEC-HMS with the default TP-40 area reduction curves.

Figure B.178 illustrates how the NA14 1% Annual Exceedance Probability (AEP) point rainfall depths for the 48-hour durations vary spatially across the Nueces River basin. As one can see from this figure, the 1% AEP 48-hr depth varies from 11 inches in the middle portion of the basin to over 15 inches in the upper and lower portions of the basin. The two areas that receive the most rainfall are the steep hill country area near Utopia, TX and the downstream area near the Gulf of Mexico. Geographically, it makes sense that these areas would receive the most rainfall. The downstream end of the basin receives more rainfall because of its proximity to the large source of moisture at the Gulf of Mexico, while the steep hill country reaches near Utopia cause an orographic uplift effect which increases rainfall amounts in that area. Tables B.35 through B.39 give examples of the point rainfall depths that were applied for specific subbasins at five different locations throughout the Nueces River Basin near the cities of Utopia, Uvalde, Carrizo Springs, Three Rivers and Mathis, Texas.

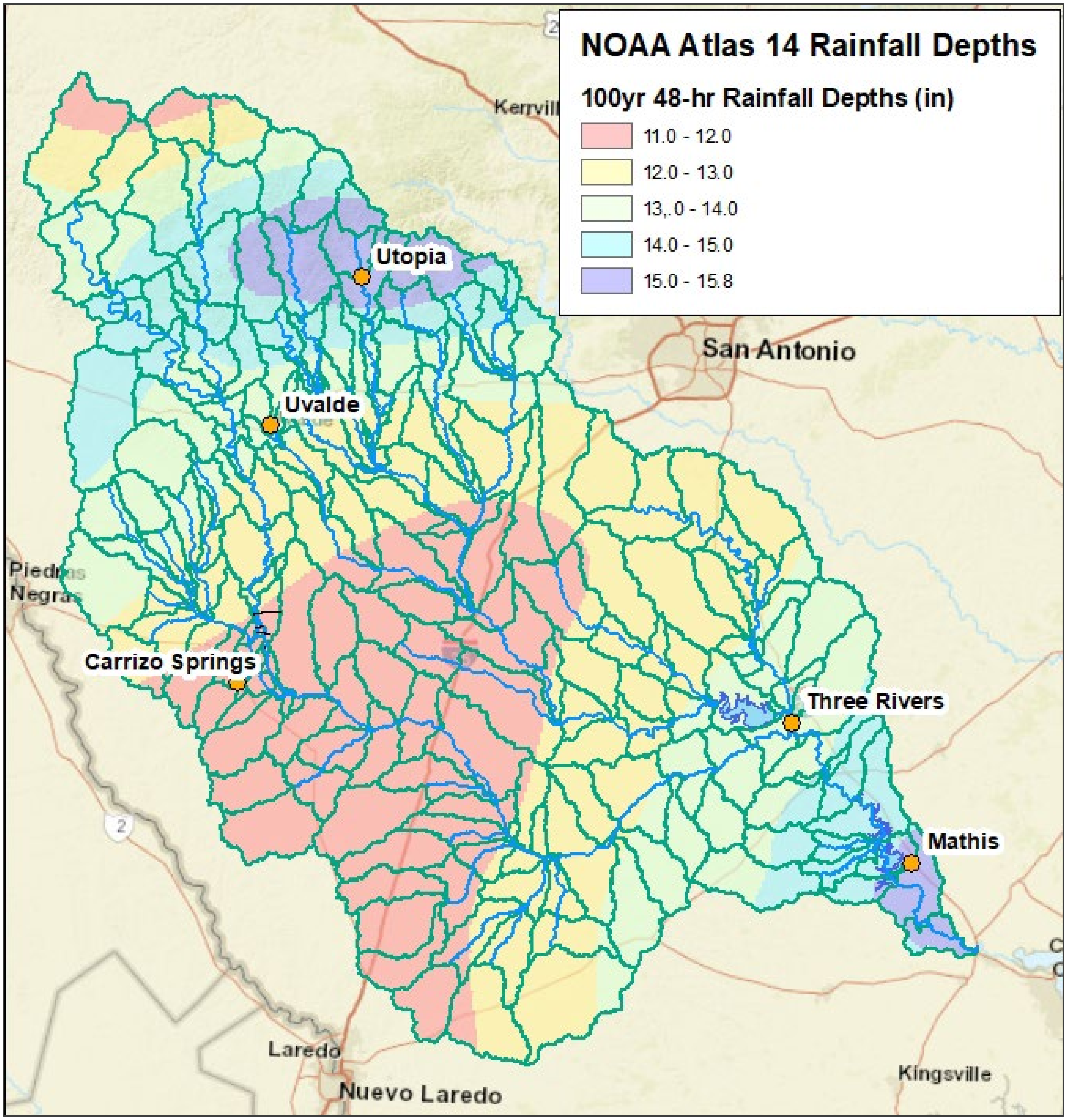

Figure B.178: 1% AEP, 48-hour Rainfall Depths for the Nueces River Basin from NOAA Atlas 14

Table B.35: NOAA Atlas 14 Point Rainfall Depths (inches) for Subbasin F_SabinalRv_S020 near Utopia, TX

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
15-min	1.01	1.35	1.61	1.96	2.22	2.50	2.77	3.12
30-min	1.42	1.90	2.25	2.73	3.09	3.46	3.84	4.37
1-hr	1.86	2.50	2.99	3.65	4.15	4.68	5.24	6.04
2-hr	2.28	3.14	3.84	4.85	5.68	6.59	7.54	8.88
3-hr	2.51	3.53	4.39	5.65	6.75	7.97	9.23	11.0
6-hr	2.93	4.21	5.31	6.99	8.48	10.2	12.0	14.5
12-hr	3.34	4.87	6.18	8.16	9.90	11.9	14.1	17.4
24-hr	3.77	5.54	7.06	9.34	11.3	13.6	16.3	20.2
48-hr	4.21	6.25	8.01	10.6	13.0	15.6	18.6	23.0

Table B.36: NOAA Atlas 14 Point Rainfall Depths (inches) for Subbasin F_LeonaRv_S012 near Uvalde, TX

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
15-min	0.968	1.31	1.57	1.91	2.18	2.44	2.69	3
30-min	1.36	1.83	2.19	2.66	3.02	3.38	3.73	4.19
1-hr	1.76	2.40	2.88	3.53	4.03	4.53	5.04	5.74
2-hr	2.12	3.00	3.69	4.65	5.41	6.22	7.09	8.31
3-hr	2.33	3.36	4.19	5.38	6.34	7.4	8.55	10.2
6-hr	2.66	3.94	4.99	6.52	7.8	9.25	10.9	13.2
12-hr	2.98	4.41	5.62	7.4	8.92	10.7	12.7	15.7
24-hr	3.32	4.91	6.25	8.27	10	12	14.4	17.9
48-hr	3.75	5.53	7.04	9.3	11.3	13.6	16.1	19.9

Table B.37: NOAA Atlas 14 Point Rainfall Depths (inches) for Subbasin N_TurkeyCk_S061 nr Carrizo Springs, TX

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
15-min	0.991	1.36	1.64	2.02	2.3	2.59	2.89	3.32
30-min	1.42	1.94	2.33	2.85	3.23	3.63	4.06	4.69
1-hr	1.83	2.52	3.05	3.76	4.28	4.83	5.46	6.37
2-hr	2.12	3.02	3.73	4.73	5.52	6.39	7.39	8.88
3-hr	2.26	3.29	4.12	5.31	6.29	7.4	8.67	10.6
6-hr	2.53	3.74	4.74	6.22	7.46	8.89	10.5	13
12-hr	2.84	4.18	5.3	6.94	8.33	9.94	11.8	14.5
24-hr	3.16	4.62	5.83	7.61	9.11	10.8	12.8	15.7
48-hr	3.47	5.06	6.36	8.26	9.85	11.6	13.6	16.5

Table B.38: NOAA Atlas 14 Point Rainfall Depths (inches) for Subbasin FrioRv_S130 near Three Rivers, TX

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
15-min	0.981	1.28	1.51	1.81	2.03	2.25	2.47	2.77
30-min	1.38	1.79	2.11	2.51	2.81	3.11	3.43	3.86
1-hr	1.79	2.35	2.77	3.32	3.73	4.15	4.6	5.22
2-hr	2.17	2.94	3.52	4.31	4.89	5.51	6.2	7.19
3-hr	2.38	3.29	3.99	4.94	5.66	6.44	7.31	8.6
6-hr	2.73	3.88	4.78	6.02	7	8.08	9.3	11.1
12-hr	3.07	4.4	5.48	7.03	8.3	9.73	11.3	13.8
24-hr	3.42	4.94	6.21	8.08	9.67	11.5	13.5	16.5
48-hr	3.78	5.56	7.08	9.35	11.4	13.7	16	19.4

Table B.39: NOAA Atlas 14 Point Rainfall Depths (inches) for Subbasin NuecesRv_S300 near Mathis, TX

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr
15-min	1.02	1.32	1.55	1.81	2.1	2.35	2.6	2.94
30-min	1.45	1.87	2.19	2.52	2.95	3.28	3.64	4.13
1-hr	1.9	2.47	2.91	3.34	3.95	4.42	4.93	5.65
2-hr	2.31	3.09	3.7	4.32	5.21	5.92	6.72	7.86
3-hr	2.54	3.46	4.19	4.94	6.05	6.96	7.97	9.45
6-hr	2.95	4.12	5.07	6.01	7.56	8.82	10.2	12.3
12-hr	3.35	4.8	5.99	6.98	9.13	10.7	12.6	15.3
24-hr	3.79	5.54	6.98	8.01	10.8	12.8	15.1	18.5
48-hr	4.3	6.39	8.12	9.31	12.8	15.2	17.9	21.7

1.6.2 Frequency Storm Results – Uniform Rainfall Method

The final frequency results for the uniform rainfall method were then computed in HEC-HMS by applying the NOAA Atlas 14 frequency rainfall depths to the final watershed model through a series of depth-area analyses of the applied frequency storms. This rainfall pattern is referred to as the uniform rainfall method because the assigned point rainfall depths for each subbasin are reduced uniformly over the entire watershed.

The final uniform rain HEC-HMS frequency flow results for all studied locations throughout the watershed model can be seen in Table B.40. In this table, the highlighted rows indicate calibrated gage locations. The final uniform rain HEC-HMS frequency pool elevation results are summarized in Table B.41. These results were then compared to the elliptical shaped storm results from HEC-HMS along with other methods from this study, as shown in Chapter 11 of the main report.

In some cases, one may observe in Table B.40 that the simulated peak discharge decreases in the downstream direction. It is not an uncommon phenomenon to see decreasing frequency peak discharges for some river reaches as flood waters spread out into the floodplain and the hydrograph becomes dampened as it moves downstream. This can be due to a combination of peak attenuation due to river routing as well as the difference in timing between the peak of the main stem river versus the runoff from the local tributaries and subbasins. In addition, there are several major aquifers within the Nueces watershed that divert flow from surface water to groundwater. Part of the flow of the Nueces and Frio Rivers and their headwater tributaries enters the Carrizo and Edwards aquifers and their associated limestones in the Balcones Fault Zone. These channel losses cause not only the peak flow, but the total volume of streamflow to decrease in the downstream direction. These substantial decreases in flood flow volume in the downstream direction are consistent with observed data at several USGS gages in the Nueces basin.

Table B.40: Summary of Discharges (cfs) from the HEC-HMS Uniform Rainfall Frequency Storms

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
West Nueces River at Indian Creek	W_NuecesRv+ IndianCk	373.49	3,070	28,900	66,300	111,800	146,000	185,000	224,000	281,000	Uniform Rain
West Nueces River above Sycamore Creek	W_NuecesRv_abv _SycamoreCk	535.95	3,440	32,300	74,200	128,000	170,000	221,000	271,000	345,000	Uniform Rain
West Nueces River Below Sycamore Creek	W_NuecesRv_blw _SycamoreCk	646.40	4,060	37,000	85,100	148,200	199,000	260,000	320,000	409,000	Uniform Rain
West Nueces River near Brackettville (USGS gage 08190500)	W_NuecesRv_nr _Brackettville	693.94	4,050	36,800	84,400	147,000	197,000	260,000	321,000	412,000	Uniform Rain
West Nueces River above Sycamore Creek	W_NuecesRv_abv _Live OakCk	767.91	3,820	34,900	79,900	139,000	187,000	246,000	304,000	391,000	Uniform Rain
West Nueces River Below Sycamore Creek	W_NuecesRv_blw _Live OakCk	820.22	3,830	35,100	80,400	139,700	188,000	247,000	307,000	396,000	Uniform Rain
West Nueces River above Nueces River	W-NuecesRv_abv _NuecesRv	918.29	3,590	33,000	75,500	131,300	177,000	234,000	292,000	379,000	Uniform Rain
Hackberry Creek at East Prong Nueces River	HackberryCk+ E_Prong _NuecesRv	199.93	4,300	19,900	40,200	76,800	101,000	123,000	144,000	172,000	Uniform Rain
Nueces River above Pulliam Creek	NuecesRv_abv _PulliamCk	354.34	6,520	29,300	58,900	113,600	154,000	191,000	226,000	276,000	Uniform Rain
Nueces River below Pulliam Creek	NuecesRv_blw _PulliamCk	529.82	8,830	41,400	83,800	162,500	222,000	279,000	334,000	411,000	Uniform Rain
Nueces River at CR414 at Montell (USGS gage 08189998)	NuecesRv_at_Cr414 _ at_Montell	659.62	9,170	43,200	87,600	172,700	241,000	307,000	372,000	463,000	Uniform Rain
Nueces River below Montell Creek	NuecesRv_blw _MontellCk	679.24	9,190	43,300	87,800	173,200	242,000	309,000	374,000	467,000	Uniform Rain
Nueces River at Laguna (USGS gage 08190000)	NuecesRv_at _Laguna	736.17	9,090	42,900	86,900	171,600	241,000	308,000	373,000	468,000	Uniform Rain
Nueces River above West Nueces River	NuecesRv_abv_ W_NuecesRv	815.94	8,520	40,600	82,300	162,400	228,000	292,000	356,000	449,000	Uniform Rain
Nueces River below West Nueces River	NuecesRv_blw_ W_NuecesRv	1734.22	11,000	63,600	135,400	255,400	357,000	473,000	588,000	758,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Nueces River below Indian Creek	NuecesRv+ IndianCk	1802.06	10,440	60,600	128,900	243,300	340,000	451,000	563,000	726,000	Uniform Rain
Nueces River at Highway 90	NuecesRv_at_ HWY-90	1838.04	9,860	57,600	122,400	231,100	323,000	429,000	536,000	693,000	Uniform Rain
Nueces River near Uvalde (USGS gage 08192000)	NuecesRv_nr _Uvalde	1861.45	9,320	54,600	116,200	219,300	307,000	408,000	510,000	660,000	Uniform Rain
Nueces River at Highway 83	NuecesRv_at_ HWY-83	1885.45	6,880	40,200	88,200	164,400	232,000	309,000	388,000	503,000	Uniform Rain
Nueces River at Highway 57	NuecesRv_at_ HWY-57	1981.12	4,500	26,700	57,600	122,700	172,000	231,000	291,000	380,000	Uniform Rain
Nueces River at FM 1025 nr Crystal City (USGS gage 08192550)	NuecesRv_at_ FM-1025 _nr_Cryst	2102.48	2,590	14,200	29,600	68,600	132,000	179,000	228,000	301,000	Uniform Rain
Nueces River at The Turkey Creek/Espantosa Slough Split	NuecesRv_ TurkeyCk _Split	2122.77	1,870	10,000	20,000	41,000	75,000	130,000	168,000	226,000	Uniform Rain
Turkey Creek/Espantosa Slough Diversion	TurkeyCk_Diversion	2122.77	1,380	7,230	13,100	29,600	62,000	116,000	153,000	210,000	Uniform Rain
Nueces River Split	NuecesRv_Split _J010	2165.25	1,330	3,540	6,600	10,000	12,000	13,000	16,000	21,000	Uniform Rain
Nueces River above Turkey Creek	NuecesRv_abv _TurkeyCk	2165.25	710	2,740	5,400	8,800	11,000	12,000	13,000	14,000	Uniform Rain
Elm Creek and Stricklin Creek	ElmCk+StricklinCk	254.90	1,590	4,200	15,600	46,000	103,000	143,000	182,000	233,000	Uniform Rain
Chacon Creek at Highway 57	ChaconCk_at _HWY-57	337.55	1,770	4,220	10,800	35,200	90,000	134,000	177,000	233,000	Uniform Rain
Palo Blanco Creek at Highway 57	Palo_BlancoCk_ at_HWY-57	69.98	2,430	5,170	10,700	22,200	41,000	53,000	66,000	82,000	Uniform Rain
Palo Blanco Creek above Chacon Creek	Palo_BlancoCk_ abv_ChaconCk	121.24	1,120	2,650	6,500	15,100	31,000	42,000	55,000	73,000	Uniform Rain
Palo Blanco Creek below Chacon Creek	Palo_BlancoCk_ blw_ChaconCk	520.34	1,690	4,220	10,600	30,100	78,000	122,000	170,000	234,000	Uniform Rain
Palo Blanco Creek above Picosa Creek	Palo_BlancoCk_ abv_PicosaCk	520.34	1,280	3,360	8,900	29,300	76,000	118,000	166,000	230,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Picosa Creek and Chueco Creek	PicosaCk+ ChuecoCk	190.28	2,020	5,890	13,500	31,900	66,000	91,000	115,000	148,000	Uniform Rain
Palo Blanco Creek below Picosa Creek	Palo_BlancoCk_ blw_PicosaCk	744.76	1,880	5,590	15,300	43,000	103,000	157,000	222,000	315,000	Uniform Rain
Palo Blanco Creek above Comanche Creek	Palo_BlancoCk_ abv _ComancheC	744.76	1,840	5,500	15,000	42,600	103,000	157,000	221,000	314,000	Uniform Rain
Comanche Creek at Highway 277	ComancheCk_at _HWY-277	78.18	1,430	3,940	10,300	24,900	51,000	68,000	83,000	105,000	Uniform Rain
Palo Blanco Creek Below Comanche Creek	Palo_BlancoCk_ blw _ComancheC	822.94	2,000	6,250	17,800	51,700	126,000	186,000	248,000	345,000	Uniform Rain
Turkey Creek and Wood Slough	TurkeyCk+ Wood _Slough	111.93	1,380	3,190	9,480	26,100	56,000	76,000	95,000	120,000	Uniform Rain
Turkey Creek at Highway 57	TurkeyCk_at _ HWY-57	170.51	1,090	2,360	6,210	16,200	41,000	64,000	88,000	122,000	Uniform Rain
Turkey Creek above Chaparrosa Creek	TurkeyCk_abv _ChaparrosaCk	210.04	780	1,680	4,490	14,000	36,000	57,000	81,000	117,000	Uniform Rain
Chaparrosa Creek and Muela Creek	ChaparrosaCk+ MuelaCk	132.77	3,370	7,290	18,300	41,900	80,000	103,000	126,000	157,000	Uniform Rain
Chaparrosa Creek above Turkey Creek	ChaparrosaCk_ abv_TurkeyCk	204.55	1,120	2,980	9,800	26,300	63,000	93,000	122,000	161,000	Uniform Rain
Turkey Creek below Chaparrosa Creek	TurkeyCk_blw _ChaparrosaCk	414.59	1,730	3,800	13,000	35,800	87,000	129,000	174,000	248,000	Uniform Rain
Turkey Creek above Picosa Creek	TurkeyCk_abv _PicosaCk	459.10	1,070	2,710	8,800	25,700	60,000	88,000	124,000	179,000	Uniform Rain
Turkey Creek below Picosa Creek	TurkeyCk_blw _PicosaCk	1376.61	2,880	8,520	25,400	72,200	170,000	258,000	351,000	482,000	Uniform Rain
Turkey Creek at Highway 83 (New USGS gage)	TurkeyCk_at_ HWY-83	1554.98	2,640	6,070	19,800	61,600	158,000	242,000	334,000	461,000	Uniform Rain
Turkey Creek above Turkey Split	TurkeyCk_abv_ Turkey_Split	1563.55	2,410	6,030	19,700	61,000	156,000	238,000	328,000	453,000	Uniform Rain
Turkey Creek below Turkey Split	TurkeyCk_blw_ Turkey_Split	1568.83	3,260	11,400	24,900	67,900	165,000	248,000	341,000	499,000	Uniform Rain
Turkey Creek above Carrizo Creek	TurkeyCk_abv _ CarrizoCk	1581.46	3,220	10,600	23,800	64,200	150,000	232,000	330,000	482,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Carrizo Creek at Highway 83	CazziroCk_at _HWY-83	49.73	1,790	3,030	3,640	7,400	12,800	16,500	20,400	26,200	Uniform Rain
Turkey Creek below Carrizo Creek	TurkeyCk_blw _CarrizoCk	1662.70	3,930	10,600	23,900	64,700	152,000	233,000	333,000	486,000	Uniform Rain
Turkey Creek above El Barrosa Creek	TurkeyCk_abv_ El_BarrosaCk	1687.81	3,900	9,400	21,300	61,900	142,000	227,000	320,000	463,000	Uniform Rain
Turkey Creek below El Barrosa Creek	TurkeyCk_blw_ El_BarrosaCk	1718.21	4,630	9,400	21,400	62,000	142,000	227,000	321,000	464,000	Uniform Rain
Turkey Creek and El Moro Creek	TurkeyCk+ El_ MoroCk	1836.07	6,450	9,900	21,000	62,300	143,000	229,000	323,000	467,000	Uniform Rain
Turkey Creek above Nueces River	TurkeyCk_abv _NuecesRv	1847.03	5,280	9,000	20,700	62,200	143,000	228,000	323,000	466,000	Uniform Rain
Nueces River near Asherton (USGS gage 08193000)	NuecesRv_nr _Asherton	4024.67	5,620	10,900	24,900	66,500	149,000	237,000	333,000	478,000	Uniform Rain
Nueces River above Arroyo Negro	NuecesRv_abv_ Arroyo_Negro	4213.49	5,810	10,900	24,800	66,200	147,000	232,000	325,000	465,000	Uniform Rain
Nueces River below Arroyo Negro	NuecesRv_blw_ Arroyo_Negro	4333.02	5,980	11,000	24,900	66,700	148,000	233,000	327,000	467,000	Uniform Rain
Nueces River above Appurceon Creek	NuecesRv_abv_ AppurceonCk	4333.02	5,900	11,000	24,800	66,100	146,000	230,000	322,000	460,000	Uniform Rain
Nueces River below Appurceon Creek	NuecesRv_blw_ AppurceonCk	4411.17	5,950	11,000	24,900	66,400	147,000	231,000	323,000	461,000	Uniform Rain
Nueces River above San Roque Creek	NuecesRv_abv_ San_RoqueCk	4488.43	5,780	11,000	24,700	65,200	143,000	224,000	312,000	444,000	Uniform Rain
San Roque Creek and Canyon Creek	San_RoqueCk+ CanyonCk	255.77	3,650	11,100	14,500	28,800	41,000	55,000	69,000	90,000	Uniform Rain
San Roque Creek below Highway 83	San_RoqueCk_ blw_HWY-83	333.91	3,550	10,900	14,300	28,500	40,000	54,000	69,000	90,000	Uniform Rain
San Roque Creek above Nueces River	SanRoqCk_abv _NuecesRV	415.48	3,250	10,000	13,100	26,300	37,000	51,000	65,000	84,000	Uniform Rain
Nueces River below San Roque Creek	NuecesRv_blw _San_RoqueCk	4903.91	6,150	15,600	25,300	66,700	146,000	227,000	317,000	450,000	Uniform Rain
Nueces River and Espio Creek	NuecesRv+EspioCk	5084.65	6,080	15,200	25,200	66,100	144,000	223,000	310,000	441,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Nueces River at Cotulla (USGS gage 08194000)	NuecesRv_at _Cotulla	5172.43	5,930	14,600	24,900	64,700	140,000	216,000	299,000	423,000	Uniform Rain
Nueces River above La Raices Creek	NuecesRv_abv _La_RaicesCk	5366.43	5,750	13,900	24,400	62,600	135,000	205,000	282,000	398,000	Uniform Rain
La Raices Creek at IH-35	La_RaicesCk_ at_IH-35	175.31	560	2,500	6,040	14,100	24,700	33,900	43,200	56,100	Uniform Rain
La Raices Creek above Nueces River	La_RaicesCk_ abv_NuecesRv	272.12	560	2,500	6,090	14,400	25,200	34,800	44,500	58,100	Uniform Rain
Nueces River below La Raices Creek	NuecesRv_blw _La_RaicesCk	5638.55	5,750	13,900	24,400	62,600	135,000	205,000	282,000	398,000	Uniform Rain
Nueces River above Calman Creek	NuecesRv_abv _CalmanCk	5705.26	5,670	13,700	24,200	61,600	132,000	200,000	274,000	386,000	Uniform Rain
Tecolate Creek and Chucareto Creek	TecolateCk+ ChucaretoCk	115.03	690	2,340	4,990	11,000	19,000	26,000	33,000	42,000	Uniform Rain
Calman Creek above Nueces River	CalmanCk_abv _NuecesRv	185.52	890	2,840	5,520	12,100	21,000	28,000	36,000	47,000	Uniform Rain
Nueces River below Calman Creek	NuecesRv_blw _CalmanCk	5890.78	5,680	13,700	24,200	61,700	132,000	200,000	274,000	387,000	Uniform Rain
Nueces River above Los Olmos Creek	NuecesRv_abv _Los_OlmosCk	5898.22	5,650	13,600	24,100	61,400	131,000	198,000	272,000	383,000	Uniform Rain
Carrizitos Creek above Venado Creek	CarrizitosCk_abv _VenadoCk	90.70	780	2,190	3,670	7,250	11,900	16,000	20,000	25,800	Uniform Rain
Los Olmos Creek and Carrizitos Creek	Los_OlmosCk +CarrizitosCk	322.57	1,720	6,100	12,100	26,700	46,000	62,000	78,000	101,000	Uniform Rain
Los Olmos Creek above TX-44	Los_OlmosCk _J010	403.09	1,700	5,900	11,500	25,100	43,100	58,900	74,600	97,100	Uniform Rain
Los Olmos Creek above Nueces River	Los_OlmosCk_ abv_NuecesRv	455.53	1,660	5,600	10,800	23,600	40,500	55,200	70,100	91,400	Uniform Rain
Nueces River below Los Olmos Creek	NuecesRv_blw _Los_OlmosCk	6353.75	5,670	13,700	24,100	61,400	131,000	198,000	272,000	383,000	Uniform Rain
Nueces River and Sauz Creek	NuecesRv+ SauzCk	6419.66	5,640	13,600	24,000	61,100	131,000	197,000	270,000	380,000	Uniform Rain
Nueces River above San Casimiro Creek	NuecesRv_abv _San_CasimiroCk	6445.15	5,620	13,500	24,000	60,800	130,000	195,000	267,000	376,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Salado Creek and Gato Creek	SaladoCk+GatoC	170.00	800	3,300	7,800	17,300	24,600	33,100	42,300	53,500	Uniform Rain
Beccerra Creek and Pato Creek	BeccerraCk+ PatoCk	105.24	1,870	5,100	9,400	17,800	23,800	30,900	37,900	47,500	Uniform Rain
San Casimiro Creek near Freer (USGS gage 08194200)	San_CasimiroCk_ nr_Freer	467.65	2,310	7,800	16,300	33,600	46,500	62,000	78,600	100,000	Uniform Rain
San Casimiro Creek above Nueces River	San_CasimiroCk_ abv_NuecesRv	537.34	2,150	7,300	15,100	31,100	43,100	57,600	73,200	93,600	Uniform Rain
Nueces River below San Casimiro Creek	NuecesRv_blw_ San_CasimiroCk	6982.49	5,650	18,300	36,700	77,900	130,000	196,000	268,000	377,000	Uniform Rain
Nueces River above Black Creek	NuecesRv_abv _BlackCk	7007.66	5,630	18,000	35,900	76,300	130,000	195,000	266,000	374,000	Uniform Rain
Black Creek near Biel Lake	BlackCk_J010	282.58	1,760	6,030	12,000	25,600	43,000	57,600	72,600	92,800	Uniform Rain
Black Creek at Highway 44	BlackCk_at _ HWY-44	373.84	1,760	5,990	11,900	25,300	42,600	57,300	72,700	94,200	Uniform Rain
Black Creek above Nueces River	BlackCk_abv _ NuecesRv	423.47	1,670	5,600	11,000	23,400	39,500	53,400	68,100	88,700	Uniform Rain
Nueces River below Black Creek	NuecesRv_blw _BlackCk	7431.13	6,330	20,400	40,300	85,600	137,000	195,000	267,000	375,000	Uniform Rain
Nueces River above Ygnacio Creek	NuecesRv_abv _YgnacioCk	7611.07	6,180	19,700	38,200	80,600	130,000	188,000	256,000	359,000	Uniform Rain
Nueces River below Ygnacio Creek	NuecesRv_blw _YgnacioCk	7754.47	6,190	19,700	38,300	80,800	130,000	188,000	257,000	359,000	Uniform Rain
Nueces River above San Jose Creek	NuecesRv_abv _San_JoseCk	7754.47	6,170	19,600	38,100	80,400	129,000	188,000	256,000	358,000	Uniform Rain
Nueces River below San Jose Creek	NuecesRv_blw _San_JoseCk	7857.73	6,170	19,600	38,200	80,500	129,000	188,000	256,000	358,000	Uniform Rain
Nueces River above Green Branch	NuecesRv_ abv _GreenBr	7857.73	6,140	19,500	37,900	79,800	128,000	187,000	254,000	356,000	Uniform Rain
Nueces River below Green Branch	NuecesRv_ blw _GreenBr	7943.10	6,150	19,500	37,900	79,900	128,000	187,000	254,000	356,000	Uniform Rain
Nueces River near Tilden (USGS gage 08194500)	NuecesRv_ nr _Tilden	8105.85	6,040	19,100	37,000	77,800	125,000	184,000	250,000	349,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Nueces River above Cow Creek	NuecesRv_ abv_ CowCk	8105.85	5,960	18,800	36,400	76,500	123,000	182,000	247,000	345,000	Uniform Rain
Nueces River below Cow Creek	NuecesRv_ blw _CowCk	8182.92	5,960	18,800	36,400	76,600	123,000	182,000	247,000	345,000	Uniform Rain
Nueces River above Old River	NuecesRv_ abv _OldRv	8275.85	5,830	18,400	35,500	74,500	121,000	179,000	243,000	339,000	Uniform Rain
Old River and Hill Creek	OldRv+HillCk	78.22	310	1,560	4,320	8,710	12,200	15,900	19,900	26,000	Uniform Rain
Nueces River below Old River	NuecesRv_ blw_OldRv	8354.07	5,830	18,400	35,500	74,500	121,000	179,000	243,000	339,000	Uniform Rain
Nueces River and White Creek	NuecesRv+ WhiteCk	8464.98	5,630	17,700	34,100	71,500	118,000	174,000	236,000	329,000	Uniform Rain
Nueces River above Atascosa River	NuecesRv_abv _AltascosaRv	8519.43	5,380	16,900	32,400	68,000	115,000	169,000	228,000	317,000	Uniform Rain
Frio River and East Frio River	FrioRv+East_ FrioRv	96.68	4,670	16,000	27,200	41,900	55,000	68,000	81,000	98,000	Uniform Rain
Frio River at Leakey (USGS gage 08194840)	FrioRv_at_Leakey	235.06	6,840	27,600	49,300	81,500	108,000	135,000	160,000	196,000	Uniform Rain
Frio River at Concan (USGS gage 08195000)	FrioRv_at_Concan	389.64	7,960	33,300	60,200	103,400	142,000	181,000	219,000	272,000	Uniform Rain
Frio River above Dry Frio River	FrioRv_abv_ Dry_FrioRv	441.57	7,150	30,800	55,700	95,700	132,000	170,000	207,000	259,000	Uniform Rain
Dry Frio River near Reagan Wells (USGS gage 08196000)	Dry_FrioRv_nr _Reagan_Wells	124.55	3,510	15,200	30,000	53,000	71,000	89,000	107,000	132,000	Uniform Rain
Dry Frio River at FM 2690 (USGS gage 08196300)	Dry_FrioRv_at _FM_2690	176.10	2,790	14,000	27,900	50,500	69,000	88,000	107,000	135,000	Uniform Rain
Dry Frio River above Frio River	Dry_FrioRv_abv _FrioRv	187.17	2,490	13,100	26,100	47,500	65,000	84,000	102,000	129,000	Uniform Rain
Frio River below Dry Frio River	FrioRv_blw_ Dry_FrioRv	628.74	9,220	42,400	79,300	138,900	192,000	248,000	303,000	380,000	Uniform Rain
Frio River near Uvalde (USGS gage 08197500)	FrioRv_nr_Uvalde	633.06	8,590	39,800	74,500	130,700	181,000	234,000	286,000	359,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Frio River above Blanco Creek	FrioRv_abv_ BlancoCk	745.82	4,150	27,000	52,000	94,400	131,000	173,000	217,000	276,000	Uniform Rain
Blanco Creek at Highway 90	BlancoCk_at _HWY-90	64.51	310	1,790	3,910	12,800	24,900	35,100	45,000	57,800	Uniform Rain
Blanco Creek above Frio River	BlancoCk_abv _FrioRv	133.59	210	990	2,440	9,100	18,600	26,900	35,500	47,400	Uniform Rain
Frio River below Blanco Creek	FrioRv_blw_ BlancoCk	879.41	4,240	27,300	52,800	98,000	140,000	186,000	234,000	299,000	Uniform Rain
Sabinal River near Vanderpool (USGS gage 08197936)	SabinalRv_nr _Vaderpool	55.75	4,070	9,800	16,400	31,300	46,000	56,000	67,000	81,000	Uniform Rain
Sabinal River at Utopia (USGS gage 08197970)	SabinalRv_at _Utopia	129.54	6,430	16,600	27,400	50,600	77,000	97,000	116,000	143,000	Uniform Rain
Sabinal River near Sabinal (USGS gage 08198000)	SabinalRv_nr _Sabinal	205.92	6,590	18,400	31,300	59,500	92,000	118,000	144,000	179,000	Uniform Rain
Sabinal River at Sabinal (USGS gage 08198500)	SabinalRv_at _Sabinal	240.56	6,080	18,000	31,000	58,600	91,000	117,000	143,000	180,000	Uniform Rain
Rancheros Creek and Elm Creek	RancherosCk +ElmCk	79.64	430	1,180	2,190	7,060	13,800	19,600	25,800	34,200	Uniform Rain
Sabinal River and Rancheros Creek	SabinalRv + RancherosCk	333.99	5,410	16,800	29,300	58,800	95,000	125,000	156,000	198,000	Uniform Rain
Sabinal River above East Elm Creek	SabinalRv_abv _East_ElmCk	398.47	4,810	15,200	27,000	55,300	91,000	121,000	151,000	194,000	Uniform Rain
Sabinal River below East Elm Creek	SabinalRv_blw _East_ElmCk	446.58	4,830	15,200	27,000	55,700	92,000	123,000	154,000	198,000	Uniform Rain
Sabinal River above Frio River	SabinalRv_abv _FrioRv	459.21	4,490	14,300	25,500	52,600	87,000	117,000	147,000	190,000	Uniform Rain
Frio River below Sabinal River	FrioRv_blw_ SabinalRv	1338.62	7,010	27,100	52,800	103,600	158,000	212,000	269,000	351,000	Uniform Rain
Frio River above Elm Creek	FrioRv_abv_ElmCk	1411.00	4,800	23,900	45,600	91,000	145,000	204,000	264,000	346,000	Uniform Rain
Frio River below Elm Creek	FrioRv_blw_ElmCk	1499.66	4,810	23,900	45,700	92,000	147,000	208,000	269,000	354,000	Uniform Rain
Frio River above Hondo Creek	FrioRv_abv _HondoCk	1514.24	4,670	22,300	43,800	90,500	145,000	206,000	267,000	352,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Hondo Creek near Tarpley (USGS gage 8200000)	HondoCk_nr _Tarpley	96.07	4,840	20,000	37,600	63,100	81,000	100,000	118,000	143,000	Uniform Rain
Hondo Creek at Hwy 173 nr Hondo, TX (USGS Gage 08200720)	HondoCk_at _HWY-173	156.45	5,180	19,900	36,000	61,100	80,000	102,000	122,000	150,000	Uniform Rain
Hondo Creek above Verde Creek	HondoCk_abv _VerdeCk	160.76	3,890	13,900	24,900	42,600	57,000	73,000	88,000	109,000	Uniform Rain
Middle Verde Ck at SH 173 nr Bandera (USGS gage 08200977)	M_Verde_at_ SH173_nr Bandera	38.90	1,180	2,900	6,300	16,600	29,000	38,000	46,000	56,000	Uniform Rain
Middle Verde Creek and East Verde Creek	M_VerdCk+ E_VerdeCk	57.54	1,090	2,330	5,130	14,200	25,700	35,100	43,600	54,300	Uniform Rain
Verde Creek below Quihi Creek	VerdeCk_blw _QuihiCk	143.13	1,190	1,870	3,110	9,700	18,600	26,100	33,500	43,600	Uniform Rain
Hondo Creek below Verde Creek	HondoCk_blw _VerdeCk	379.80	4,480	14,700	27,400	54,300	81,000	107,000	133,000	168,000	Uniform Rain
Hondo Creek and Live Oak Creek	HondoCk+ Live _OakCk	521.81	3,710	11,300	21,400	45,800	72,700	99,100	126,000	163,000	Uniform Rain
Hondo Creek above Seco Creek	HondoCk_ abv _SecoCk	666.04	2,890	8,700	16,700	37,500	61,200	84,600	109,000	142,000	Uniform Rain
Seco Creek at Miller RH near Utopia (USGS gage 08201500)	SecoCk_at_MillerRh _nr_Utopia	45.05	2,430	11,600	25,400	44,600	55,000	66,000	77,000	93,000	Uniform Rain
Seco Creek and Rocky Creek	SecoCk+RockyCk	131.94	3,280	19,400	37,600	64,300	83,000	104,000	124,000	153,000	Uniform Rain
Seco Creek Rowe RH near D'Hanis (USGS gage 08201500)	SecoCk_RoweRh _nr_D'Hanis	165.15	2,990	17,000	32,500	54,700	72,000	90,000	109,000	135,000	Uniform Rain
Seco Creek above Squirrel Creek	SecoCk_abv _SquirrelCk	267.24	1,220	7,630	15,400	27,300	38,000	49,900	61,700	78,700	Uniform Rain
Seco Creek above Hondo Creek	SecoCk_abv _HondoCk	353.95	900	5,670	11,600	21,000	29,800	39,400	49,000	62,900	Uniform Rain
Hondo Creek below Seco Creek	HondoCk_ blw_SecoCk	1019.99	3,650	13,900	27,400	57,000	88,700	121,000	154,000	201,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Hondo Creek above Frio River	HondoCk_ abv_FrioRv	1106.85	3,400	12,800	25,400	53,500	84,100	115,000	147,000	193,000	Uniform Rain
Frio River below Hondo Creek	FrioRv_blw _HondoCk	2621.10	8,010	26,900	52,200	109,700	182,000	248,000	324,000	429,000	Uniform Rain
Frio River above Leona River	FrioRv_abv _LeonaRv	2675.30	5,850	25,600	49,500	107,200	180,000	244,000	321,000	427,000	Uniform Rain
Leona River above Taylor Slough	LeonaRv_abv _Taylor_Slough	49.67	300	1,100	1,330	3,450	9,100	13,400	18,200	24,600	Uniform Rain
Leona River below Taylor Slough	LeonaRv_blw _Taylor_Slough	68.61	420	1,510	2,220	5,570	13,700	19,600	26,100	35,000	Uniform Rain
Leona River above Cooks Slough	LeonaRv_abv _Cooks_Slough	68.61	410	1,470	2,150	5,390	13,300	19,100	25,400	34,100	Uniform Rain
Leona River below Cooks Slough	LeonaRv_blw_ Cooks_Slough	102.62	470	1,850	2,690	7,560	19,800	29,000	38,700	52,100	Uniform Rain
Leona River near Uvalde (USGS gage 08204005)	LeonaRv_nr_ Uvalde	131.15	520	2,020	3,240	9,040	23,300	34,000	45,400	61,300	Uniform Rain
Leona River above Camp Lake Slough	LeonaRv_abv_ Camp_Lake_Slough	196.04	450	1,720	2,910	8,920	23,000	33,800	45,400	61,800	Uniform Rain
Leona River below Camp Lake Slough	LeonaRv_blw_ Camp_Lake_Slough	234.02	450	1,750	3,050	9,730	24,800	36,400	48,900	66,600	Uniform Rain
Leona River at Highway 57 (USGS gage)	LeonaRv_at_ HWY-57	240.99	470	1,850	2,690	7,560	19,800	29,000	38,700	52,100	Uniform Rain
Leona River above Live Oak Creek	LeonaRv_abv_ LiveoakCk	380.41	390	1,500	2,740	9,510	23,800	34,900	47,200	64,700	Uniform Rain
Leona River below Live Oak Creek	LeonaRv_blw_ LiveoakCk	460.74	400	1,520	2,820	10,540	24,900	36,700	49,600	68,000	Uniform Rain
Leona River above Todos Santos Creek	LeonaRv_abv_ Todos_SantosCk	585.22	370	1,400	2,660	10,950	26,000	38,400	51,800	71,500	Uniform Rain
Leona River below Todos Santos Creek	LeonaRv_blw_ Todos_SantosCk	660.74	370	1,400	2,670	11,260	26,900	39,700	53,500	73,700	Uniform Rain
Leona River above Frio River	LeonaRv_abv _FrioRv	670.08	360	1,380	2,640	11,130	26,600	39,200	52,900	73,000	Uniform Rain
Frio River below Leona River	FrioRv_blw _LeonaRv	3345.37	6,190	26,800	51,900	117,400	204,000	283,000	373,000	500,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Frio River near Derby (USGS gage 08215500)	FrioRv_nr_Derby	3447.76	6,190	26,800	51,900	117,500	204,000	286,000	378,000	506,000	Uniform Rain
Frio River at Highway 85	FrioRv_at_ HWY-85	3500.89	4,750	24,100	49,000	113,900	200,000	277,000	361,000	488,000	Uniform Rain
Frio River and Ruiz Creek	FrioRv+RuizCk	3653.55	3,930	20,100	42,800	107,700	195,000	273,000	354,000	475,000	Uniform Rain
Frio River above Cibolo Creek	FrioRv_abv_ CiboloCk	3698.16	3,450	15,300	34,300	100,200	188,000	266,000	347,000	466,000	Uniform Rain
Cibolo Creek at Highway 85	CiboloCk_at _HWY-85	83.21	740	1,320	4,940	7,780	12,700	18,600	24,800	33,600	Uniform Rain
Cibolo Creek at Purple Heart Trail	CiboloCk_at _Purple_Heart_Trl	174.41	690	1,320	5,760	9,270	15,500	22,900	33,900	47,500	Uniform Rain
Cibolo Creek above Frio River	CiboloCk_abv _FrioRv	394.76	1,680	3,200	9,100	13,700	21,600	31,500	41,900	56,800	Uniform Rain
Frio River below Cibolo Creek	FrioRv_blw _ CiboloCk	4092.91	3,500	15,400	36,000	104,000	195,000	275,000	358,000	479,000	Uniform Rain
Frio River above Esperanza Creek	FrioRv_abv_ EsperanzaCk	4149.39	3,180	12,500	30,600	95,400	186,000	266,000	348,000	466,000	Uniform Rain
Frio River below Esperanza Creek	FrioRv_blw_ EsperanzaCk	4248.12	3,180	12,500	30,600	95,400	186,000	266,000	348,000	466,000	Uniform Rain
Frio River and Galinda Creek	FrioRv+GalindaCk	4337.72	3,060	11,200	26,500	87,100	176,000	255,000	336,000	452,000	Uniform Rain
Frio River above Leoncita Creek	FrioRv_abv_ LeoncitaCk	4396.25	3,000	10,700	24,700	81,500	168,000	246,000	325,000	439,000	Uniform Rain
Frio River at Tilden (USGS gage 08206600)	FrioRv_at_ Tilden	4462.81	3,000	10,700	24,700	81,500	168,000	246,000	325,000	439,000	Uniform Rain
Frio River above San Miguel Creek	FrioRv_abv_ San_MiguelCk	4519.46	3,000	10,700	24,600	80,700	166,000	243,000	322,000	436,000	Uniform Rain
San Miguel Creek above Black Creek	SanMiguelCk_abv _BlackCk	221.57	1,760	5,250	8,610	15,400	22,000	28,700	35,800	47,000	Uniform Rain
San Miguel Creek below Black Creek	SanMiguelCk_blw _BlackCk	348.53	2,280	8,110	13,800	25,300	36,700	47,600	59,400	77,000	Uniform Rain
San Miguel Creek below Highway 97	SanMiguelCk_blw _HWY-97	516.77	2,180	7,360	13,000	25,300	38,500	51,200	74,600	108,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
San Miguel Creek above Lagunillas Creek	SanMiguelCk_abv _LagunillasCk	574.60	2,140	7,210	12,700	24,800	37,700	50,100	66,600	98,000	Uniform Rain
San Miguel Creek below Lagunillas Creek	SanMiguelCk_blw _LagunillasCk	741.44	2,400	8,630	16,500	32,200	49,500	65,500	81,100	118,000	Uniform Rain
San Miguel Creek near Tilden (USGS gage 08206700)	SanMiguelCk_nr _Tilden	782.15	2,960	8,930	15,900	31,200	48,200	63,900	79,900	114,000	Uniform Rain
San Miguel Creek above Frio River	SanMiguelCk_ abv _FrioRv	854.80	2,870	8,810	15,300	30,600	47,700	65,100	82,300	113,000	Uniform Rain
Frio River below San Miguel Creek	FrioRv_blw_ San_MiguelCk	5374.26	3,780	10,800	24,900	81,400	169,000	248,000	330,000	445,000	Uniform Rain
Choke Canyon Reservoir Inflow	ChokeCanyon _Inflow	5490.45	5,530	11,500	24,900	81,500	169,000	249,000	330,000	445,000	Uniform Rain
Choke Canyon Dam Outflows	Choke Canyon Dam	5490.45	2,510	10,300	23,400	74,100	154,000	187,000	214,000	255,000	Uniform Rain
Frio River below Choke Canyon Dam	ChokeCanyonRes _OWC_nr_3Rv	5490.45	2,510	10,300	23,400	74,100	154,000	187,000	214,000	255,000	Uniform Rain
Frio River above Atascosa River	FrioRv_abv_ AtascosaRv	5496.36	2,510	10,300	23,400	74,100	154,000	187,000	214,000	255,000	Uniform Rain
Atascosa River near FM 2904	AtascosaRv_J010	154.50	1,070	5,000	9,200	15,800	22,000	29,000	37,000	47,000	Uniform Rain
Atascosa River at FM 476 (USGS gage 08207290)	AtascosaRv_at FM-476	315.12	1,280	6,300	11,300	20,700	30,700	42,500	55,300	74,600	Uniform Rain
Atascosa River at Highway 37	AtascosaRv_at _HWY-37	451.31	1,440	7,100	13,800	25,300	37,000	51,000	65,800	87,600	Uniform Rain
Atascosa River near McCoy (USGS gage 08207500)	AtascosaRv_nr _McCoy	510.87	1,250	6,600	13,000	24,800	36,800	52,000	68,100	91,900	Uniform Rain
Atascosa River above Borrego Creek	AtascosaRv_abv _BorregoCk	535.96	1,220	6,350	12,700	24,100	36,100	51,200	67,400	91,500	Uniform Rain
Borrego Creek and Los Cortes Creek	BorregoCk+ Los_CortesCk	142.92	1,460	5,140	8,830	14,600	20,000	26,300	32,700	42,700	Uniform Rain
Borrego Creek above Atascosa River	BorregoCk_abv _AtascosaRv	221.19	1,700	4,540	8,260	14,800	21,400	29,400	37,800	52,400	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Atascosa River below Borrego Creek	AtascosaRv_blw _BorregoCk	757.15	1,950	8,690	17,800	33,500	50,000	72,000	95,000	129,000	Uniform Rain
Atascosa River above La Parita Creek	AtascosaRv_abv _La_ParitaCK	813.17	2,080	8,470	17,100	32,500	48,000	70,000	93,000	128,000	Uniform Rain
La Parita Creek and Metate Creek	La_ParitaCk+ MetateCk	291.40	2,410	7,660	12,900	21,400	29,600	39,000	48,700	63,600	Uniform Rain
La Parita Creek above Atascosa River	La_PartaCk_abv _AtascosaRV	311.40	2,260	7,290	12,300	20,600	29,200	38,700	48,400	63,300	Uniform Rain
Atascosa River below La Parita Creek	AtascosaRv_blw _ La_PartaCk	1124.57	4,300	12,200	20,800	39,900	60,000	88,000	119,000	167,000	Uniform Rain
Atascosa River at Whitsett (USGS gage 0820800)	AtascosaRv_at_ Whitsett	1145.77	4,140	12,200	20,500	39,800	60,000	88,000	118,000	166,000	Uniform Rain
Atascosa River above Weedy Creek	AtascosaRv_abv _WeedyCk	1225.28	4,050	11,300	20,200	39,200	59,000	85,700	116,000	163,000	Uniform Rain
Atascosa river below Weedy Creek	AtascosaRv_blw _WeedyCk	1364.40	4,130	11,500	21,000	39,700	60,000	87,600	119,000	169,000	Uniform Rain
Atascosa River above Frio River	AtascosaRv_abv _FrioRv	1395.61	4,100	10,800	20,500	39,300	59,400	86,500	117,000	167,000	Uniform Rain
Atascosa River below Frio River	AtascosaRv_blw _FrioRv	6891.97	6,000	19,900	37,600	81,100	166,000	200,000	230,000	328,000	Uniform Rain
Atascosa River above Nueces River	AtascosaRv_abv _NuecesRv	6911.11	6,000	19,800	37,400	80,700	165,000	200,000	229,000	326,000	Uniform Rain
Nueces River below Atascosa River	NuecesRv_blw _AltascosaRv	15430.54	7,800	26,600	56,700	122,400	207,000	279,000	367,000	465,000	Uniform Rain
Nueces River at Three Rivers (USGS gage 08210000)	NuecesRv_at_ Three_Rivers	15430.54	7,790	26,600	56,600	122,300	207,000	278,000	367,000	465,000	Uniform Rain
Nueces River and Sulphur Creek	NuecesRv+ SulhpurCk	15619.12	7,730	26,300	56,100	122,200	206,000	277,000	366,000	457,000	Uniform Rain
Nueces River at Highway 59	NuecesRv_at _HWY-59	15715.07	7,600	26,100	55,500	121,900	205,000	275,000	365,000	456,000	Uniform Rain
Nueces River above Spring Creek	NuecesRv_abv _SpringCk	15733.03	7,580	26,100	55,500	121,900	205,000	275,000	364,000	456,000	Uniform Rain

		AEP	50%	20%	10%	4%	2%	1%	0.5%	0.2%	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Method
Nueces River below Spring Creek	NuecesRv_blw _SpringCk	15833.59	7,580	26,100	55,500	122,000	205,000	275,000	364,000	456,000	Uniform Rain
Nueces River and Upper End of Lake Corpus Christi	NuecesRv+UpEnd _LkCorpusChris	15921.68	7,530	25,900	55,300	121,900	205,000	274,000	364,000	456,000	Uniform Rain
Nueces River above Lake Corpus Christi	NuecesRv_abv _LkCorpusCh	16076.35	7,090	24,500	52,400	115,900	195,000	260,000	345,000	433,000	Uniform Rain
Lagarto Creek near George West (USGS gage 08210400)	LagartoCk_nr_ George_West	155.28	450	4,080	9,420	16,600	22,300	29,600	37,100	48,100	Uniform Rain
Lagarto Creek above Lake Corpus Christi	LagartoCk_abv _LkCorpusCh	201.87	330	3,470	8,870	16,400	22,800	31,400	40,000	52,600	Uniform Rain
Ramirena Creek at Highway 281	RamirenaCk_at _HWY-281	81.02	590	3,810	8,400	14,400	19,100	24,700	30,300	38,500	Uniform Rain
Ramirena Creek above Lake Corpus Christi	RamirenaCk_abv _LkCorpusCh	119.60	400	4,100	9,600	16,500	22,300	30,100	38,300	50,700	Uniform Rain
Lake Corpus Christi Inflow	Lk_Corpus_Christi _Inflow	16502.10	7,090	24,500	52,500	116,000	195,000	260,000	345,000	433,000	Uniform Rain
Lake Corpus Christi Dam Outflow	Corpus Christi Dam	16502.10	7,060	24,400	52,300	115,400	191,000	257,000	338,000	428,000	Uniform Rain
Nueces River near Mathis (USGS gage 08211000)	NuecesRv_nr _Mathis	16502.10	7,060	24,400	52,300	115,400	191,000	257,000	338,000	428,000	Uniform Rain
Nueces at Bluntzer (USGS gage 08211200)	NuecesRv_at _Bluntzer	16617.60	6,800	23,700	51,000	112,800	186,000	251,000	330,000	419,000	Uniform Rain
Nueces River at Calallen (USGS gage 08211500)	NuecesRv_at _Calallen	16675.30	5,800	22,000	46,400	105,400	175,000	235,000	309,000	392,000	Uniform Rain

Table B.41: Peak Reservoir Pool Elevations (feet NAVD88) from the HEC-HMS Uniform Rainfall Frequency Storms

			50% AEP	20% AEP	10% AEP	4% AEP	2% AEP	1% AEP	0.5% AEP	0.2% AEP	
Location Description	HMS Element Name	Drainage Area (sq mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Hydrologic Method
Choke Canyon Reservoir	Choke Canyon Dam	5490.45	221.1	221.4	221.8	223.3	225.3	229.0	234.5	243.5	Uniform Rain
Lake Corpus Christi	Corpus Christi Dam	16502.10	93.9	94.1	94.3	95.1	96.1	97.8	99.9	101.9	Uniform Rain

1.6.3 Uniform Rainfall Frequency Results versus Drainage Area

As a quality check, the peak flows results from the 1% AEP uniform rainfall frequency storms were plotted versus drainage area and outliers were examined, as shown in Figure B.179. The relative trends in this graph generally make sense. For example, the peak discharges per square mile are highest for the steep headwater reaches of the Nueces, Frio, and Sabinal Rivers along with Hondo and Seco Creeks. Peak discharges on the Atascosa River, on the other hand, tend to be lower relative to their drainage areas as they are located in the middle portion of the basin, which is drier and flatter. The reaches with the highest peak discharges of the entire basin occurred on the Nueces River above Uvalde. This should be expected since USGS stream gages in this area have recorded peak flows of over 600,000 cfs.

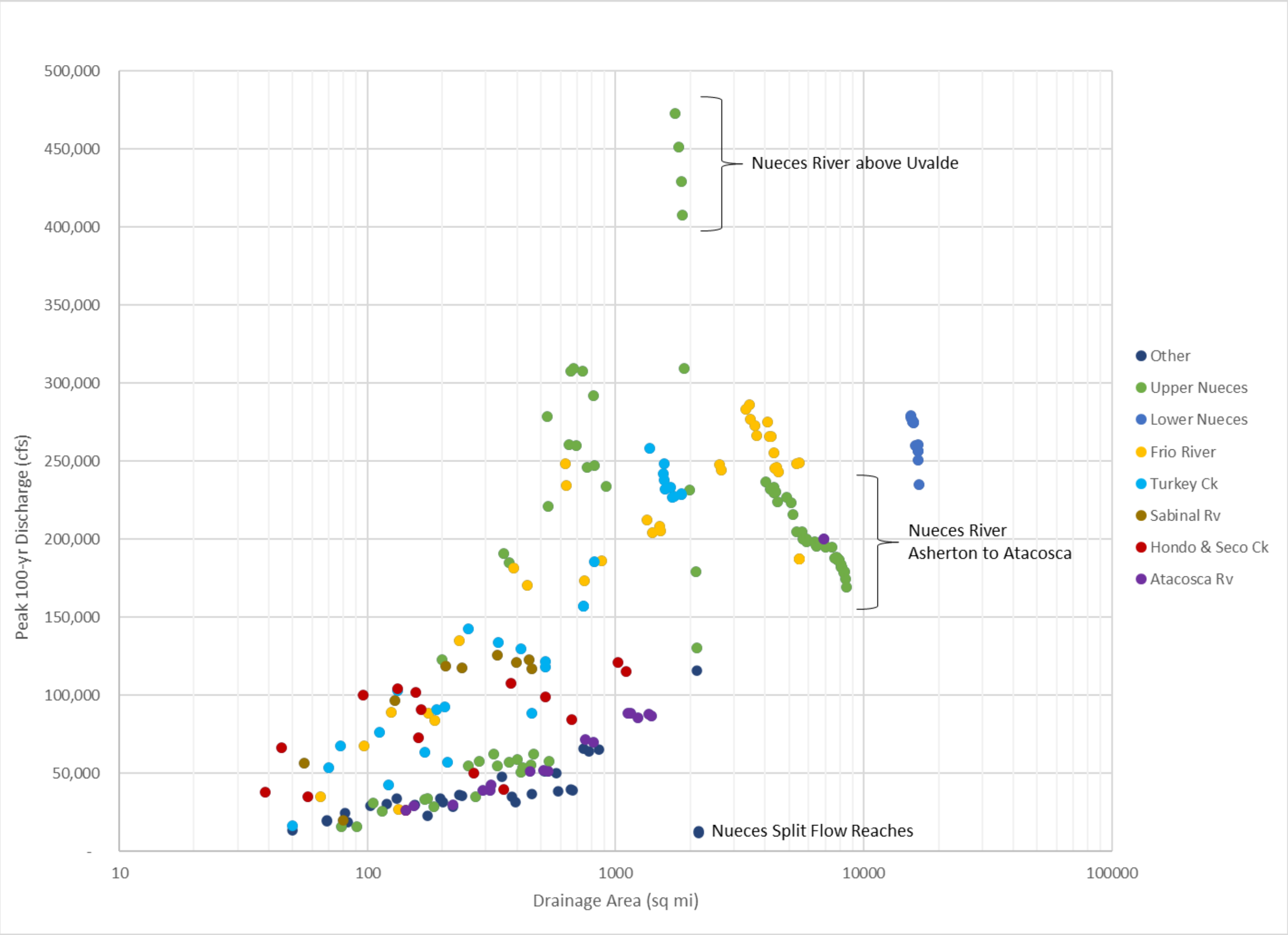

Figure B.179: NA14 1% AEP Uniform Rain HEC-HMS Frequency Results versus Drainage Area

This figure shows that the analyzed junctions followed generally expected patterns of increasing peak flow with drainage area, with some notable exceptions. For example, the observed peak discharges on the Nueces River tend to decrease between the USGS gages at Uvalde and Asherton. Just below Uvalde, the landscape of the Nueces watershed sharply transitions from steep, narrow valleys to wide, flat irrigated fields. This causes decreasing frequency peak discharges as flood waters spread out into the floodplain and the hydrograph becomes dampened as it moves downstream. In addition, the Nueces River cross several major aquifer outcrops in this area which divert flow from surface water to groundwater. Downstream of Asherton, the peak flows on the Nueces River continue to decrease due to routing attenuation and differences in timing between the main stem and its smaller tributaries. This type of routing attenuation is also observed along the lower Frio and Nueces Rivers.

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