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Evaluating the Attainment of Environmental Flow Standards

Prepared for Texas Water Development Board
TWDB Contract No. 2100012465

PURSUANT TO HOUSE BILL 1 AS APPROVED BY THE 86TH TEXAS LEGISLATURE, THIS STUDY REPORT WAS FUNDED FOR THE PURPOSE OF STUDYING ENVIRONMENTAL FLOW NEEDS FOR TEXAS RIVERS AND ESTUARIES AS PART OF THE ADAPTIVE MANAGEMENT PHASE OF THE SENATE BILL 3 PROCESS FOR ENVIRONMENTAL FLOWS ESTABLISHED BY THE 80TH TEXAS LEGISLATURE. THE VIEWS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE AUTHOR(S) AND DO NOT NECESSARILY REFLECT THE VIEWS OF THE TEXAS WATER DEVELOPMENT BOARD.

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Prepared for
Texas Water Development Board
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ABBREVIATIONS

AD	attainment duration
af	acre-feet
AF	attainment frequency
ASPAT	average instream flow shortage as a percentage of the average instream flow target
BBASC	Basin and Bay Area Stakeholder Committee
BBEST	Basin and Bay Expert Science Team
BRA	Brazos River Authority
CBE	consecutive days between engagement of an instream flow target
CE	consecutive days instream flow target is engaged
CEM	consecutive days instream flow target is engaged and met
CES	consecutive days instream flow target is engaged with a shortage
cfs	cubic feet per second
Chelan PUD	Chelan Public Utility District
E	percentage of time instream flow target is engaged
EF	engagement frequency
EPR	engaged period reliability
EVR	engaged volume reliability
FDM	frequency duration met
FERC	Federal Energy Regulatory Commission
FVM	frequency volume met
HEFR	hydrology-based environmental flow regime method
HFP	high flow pulse
IFC	Instream Flow Council
N/A	not applicable
PF	pulse frequency
PS	percent shortage
S	instream flow shortage
SB 3	Senate Bill 3
SD	shortage duration
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TEM	target engagements met
TSJ	Trinity-San Jacinto

TWDB	Texas Water Development Board
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WAM	water availability model
WDFW	Washington Department of Fish and Wildlife
WRAP	Water Rights Analysis Package
ZFD	zero-flow duration
ZFF	zero-flow frequency

Executive Summary

Senate Bill 3 (SB 3) of the 80th Texas legislative session (2007) established a framework for identifying and promulgating environmental flow standards throughout Texas. As part of this process, two groups were established for each river basin (or in some cases, pairs of river basins): 1) a Basin and Bay Area Stakeholder Committee (BBASC; composed of regional stakeholders) and 2) a Basin and Bay Expert Science Team (BBEST; composed of regional scientific experts). Each BBEST authored a report containing environmental flow recommendations, and each BBASC also authored a report of environmental flow recommendations. Following a public comment period, the Texas Commission on Environmental Quality (TCEQ) adopted environmental flow standards for each basin based on the BBEST and BBASC reports and public input. A summary of how TCEQ determined the environmental flow standards follows.

Development of the environmental flow standards was largely based on evaluations of the historical occurrence frequencies of flow levels, such as subsistence and base flows for instream standards. However, these occurrence frequencies were not promulgated as part of the standards; only the flow values themselves were. Furthermore, attainment of standards is a different, and more complex, question than frequency of occurrence of flow values.

Since the adoption of the standards, no study has been performed to provide a comprehensive analysis of their attainment. Accordingly, stakeholders generally have little understanding of where and when the standards are attained. This is the first study to address this issue.

SB 3 also has provisions for adaptive management, which calls for continued studies to validate and refine environmental flow analyses, recommendations, and standards. In support of this effort, the Texas Water Development Board (TWDB) has provided adaptive management funding to further evaluate environmental flows and the associated standards. This report is one such study, with a focus on evaluating the attainment of the environmental flow standards.

The purpose of this report is to provide information and guidance to the TWDB, BBASCs, and BBESTs to better understand when and where environmental flow standards are attained or not attained. This report describes the calculation of the attainment of environmental flow standards under four modeling scenarios in three river basins: the Brazos, Trinity, and Neches. The modeling scenarios include naturalized flow conditions (flows in the absence of most human uses), current water use, partial utilization of permitted diversion rights, and full utilization of permitted diversions.

A key feature of this report is the use of daily time step simulations. During the development of the environmental flow standards, simulations of state water rights and the standards were largely conducted with monthly time steps using the TCEQ water availability model (WAM). Since then, daily time step modeling capabilities of the Water Rights Analysis Package (WRAP), the generalized modeling software that the WAM is built upon, have been refined and applied to a number of WAM basins. Daily time step simulations provide a finer resolution of short-term flow variability within a stream and are an important tool for evaluating environmental flow standards that contain both high and low flow regime components.

With the goal of providing a better understanding of the attainment of environmental flow standards throughout the Brazos, Trinity, and Neches river basins under the four different modeled flow scenarios, the report is organized as follows:

- Literature review of the latest science regarding environmental flow attainment and identification of the most useful attainment metrics and visualization techniques for application to the selected river basins
- Development of flow scenarios with daily simulation capability in the WRAP/WAM framework
- Assessment of the daily modeling outputs and attainment metric calculations for each river basin
- Summary of key findings and guidance

A thorough characterization of the attainment of environmental flow standards is not addressable with a single metric. Factors such as the frequency of engagement of high or low flow requirements, the duration of attainment once the requirements are engaged, and the shortages incurred are important components to the characterization of attainment. This report uses a suite of 10 metrics directly related to subsistence, base, and high flow pulse (HFP) instream flow attainment, 2 metrics to characterize zero-flow events, and an analysis of freshwater inflows from the Trinity river basin to Galveston Bay. The instream flow metrics are found in Table 2-4 of this report. The instream flow metrics were evaluated at all measurement points in each river basin as well as by seasonal requirements, annually, and by hydrologic condition, as applicable. In total, 263 distinct tables of instream flow attainment metrics were developed for the 3 river basins and 4 flow scenarios. Summary figures were also developed to facilitate understanding of the large number of metric calculations and to ease the comparison across measurement points and flow scenarios within the same river basin.

Detailed findings related to basin specific measurement points and flow scenarios are presented in Section 7 of this report. Broad findings that are generally applicable across basins and flow scenarios include the following:

- The absence of regulation by water rights and reservoirs in the naturalized flow scenario allows streamflows to reach the highest values across all four scenarios.
- Naturally occurring low or zero-flow periods may exhibit higher flows in the current, partial, and full utilization scenarios in reaches where reservoir releases are made to provide downstream water supply.
- Return flows in the current and partial utilization scenarios can significantly ease or eliminate extreme low flow or zero-flow days in the reaches below discharge points. These effects do not occur in the full utilization scenario because return flows do not occur in that scenario.
- Subsistence flow engagements are generally highest in the full utilization scenario. Likewise, the percentage of subsistence flow non-attainment tends to be highest in the full utilization scenario, but the effect can be reach-specific if reservoir releases for water supply demands are present.
- Reaches with return flow discharge increase the attainment of subsistence flows.
- Base flow engagements and attainments tend to be the lowest as water right demands increase. However, like substance flow attainments, the effect of water rights can be reach-specific if reservoir releases or return flows are present.
- HFP attainment frequencies are consistently high and do not show significant sensitivity to the four flow scenarios. The HFP trigger flows in the standards are low enough that they are often exceeded with the first moderate storm event; hence, attainment often occurs early in each season. River regulation by large reservoir storage can affect the timing of pulse attainment for individual events.

This report contains numerous tables and figures by which the BBASCs and other interested parties can evaluate specific metrics for specific combinations of location, season, environmental flow component, and flow scenario. Even so, several recommendations for future work are proposed in Section 8.5. Most notably, an expansion of the focus from metrics describing attainment of the standards, limited to where and when they are engaged, to metrics describing attainment of the flow levels tabulated in the standards, without regard to engagement, may be useful for certain scientific disciplines.

1 Introduction

This report describes the calculation of the attainment of environmental flow standards under various modeling scenarios in three river basins: the Brazos, Trinity, and Neches. This work was funded by the Texas Water Development Board (TWDB). The purpose of this report is to provide information and guidance to the TWDB and Basin and Bay Area Stakeholder Committees (BBASCs) to better understand when and where environmental flow standards are attained or not attained.

1.1 Overview of the Senate Bill 3 Environmental Flows Process

Senate Bill 3 (SB 3) of the 80th Texas legislative session (2007) established a framework for identifying and promulgating environmental flow standards throughout Texas. As part of this process, a BBASC (composed of regional stakeholders) and a Basin and Bay Expert Science Team (BBEST; composed of regional scientific experts) were established for each river basin (or, in some cases, pairs of river basins). Each BBEST authored a report containing environmental flow recommendations, and each BBASC also authored a report of environmental flow recommendations. Following a public comment period, the Texas Commission on Environmental Quality (TCEQ) adopted flow standards for each basin.

SB 3 has provisions for adaptive management, which calls for continued studies to validate and refine environmental flow analyses, recommendations, and standards. In support of this effort, the TWDB has provided adaptive management funding to further evaluate environmental flows and the associated standards. This report is one such study, with a focus on evaluating the attainment of the environmental flow standards.

1.2 Background

The environmental flow standards consist of tables of flow values, which vary by location, season, hydrologic condition (only in some basins), and flow component. In some cases, the environmental flow standards also include freshwater inflow standards for the basin's terminal estuary. All flow standards can be found in Chapter 298 of the Texas Administrative Code (TAC; TAC 30.1.298, 2011). These have largely been implemented as permit conditions on new water rights and require passage of flows when present in the river. Few of the environmental flow standards include attainment frequencies (exceptions include high flow pulses [HFPs] and freshwater inflow standards for Galveston Bay). The software used to develop the instream flow standards (the hydrology-based environmental flow regime method, or HEFR) did output historical occurrence frequencies of the subsistence and base flows, but these frequencies were not included in the standards. Furthermore, attainment of standards is a different, and more complex, question than frequency of occurrence. Since the adoption of the standards, no one has performed a comprehensive study of their attainment. Accordingly, stakeholders generally have little understanding of where, and when, the standards are attained. This report is intended to address this issue.

In the context of this report, attainment metrics can refer to attainment frequency, which is the estimated frequency at which an engaged standard is met, or not. Attainment metrics can also include attainment duration, e.g., the number of consecutive days that a standard is met versus the number of consecutive days it is not met. Attainment metrics may also include the amount by which a standard is not met (e.g., if the standards is 100 cubic feet per second [cfs] and the river flow is 80 cfs, then the shortage is 20 cfs). All of these metrics can also be bifurcated by season or other subset of the data. Accordingly, there are a variety of attainment metrics that are evaluated for use in this project.

Also of interest is the attainment of the standards under different flow scenarios. The following four flow scenarios were identified by the TWDB for this project:

1. Naturalized flow (i.e., expected flow in the absence of most human influences)
2. Current water use
3. Partial utilization of permitted diversions
4. Full utilization of permitted diversions

Each of these is determined through the use of a water availability model (WAM).

1.3 Introduction to Water Availability Models

Surface water rights in Texas are granted, amended, and managed under the doctrine of prior appropriation, which is often summarized with the tenant of “first in time, first in right.” New water rights or amendments to existing water rights are held to a standard of no-injury to prior surface water rights, unless a subordination agreement has been approved. Computer models covering each river basin and all surface water rights are used by the TCEQ for numerical evaluations of water availability for surface water rights within the prior appropriation framework. The Water Rights Analysis Package (WRAP) is a generalized computer model for simulating surface water rights in priority order through a hydrologic period of record. WRAP was developed and is maintained at Texas A&M University by Dr. Ralph Wurbs (Wurbs 2021a). Basin-specific model input files for WRAP are maintained by TCEQ. Collectively, the WRAP modeling software and the basin-specific input files are known as the WAM. The WAM is publicly and freely available for use (TCEQ 2020) and, in addition to water right permitting, is an integral part of the TWDB State and Regional Water Planning processes, SB 3 related environmental flow analyses, and numerous other surface water planning activities.

Since the adoption of WRAP and the WAM system in the late 1990s, surface water modeling for permitting and planning purposes has been conducted using monthly simulation time steps. Daily records of streamflows, precipitation, and evaporation are aggregated into monthly volumes with the added step of naturalizing streamflows, which is a process to reverse historical activities of state-granted water rights. The monthly volumes are assembled into a hydrologic sequence typically covering a period of record from the 1940s through the late 1990s. State-granted water rights for streamflow diversion and reservoir storage are simulated through the period of record. Aggregation of hydrologic data into monthly time steps is an appropriate and simplifying modeling assumption for the evaluation of water availability for large basin-wide reservoir storage, water rights, and water right systems. However, monthly aggregation of streamflows may not capture the sensitivity to intra-month or daily flow variability that is important for environmental instream flow analyses.

A version of WRAP was developed with the capability to perform daily time step simulations (Wurbs and Hoffpauir 2021). The evaluation of SB 3 environmental flow standards was the motivating factor for the development of the daily version of WRAP. The high and low flow requirements in the SB 3 environmental flow standards can be modeled with monthly WAMs. However, natural flow variability over the course of days or weeks is lost with monthly time steps. A large rain event may result in flows rising rapidly and receding again within the stream course over the span of days and weeks. The process may repeat multiple times within the same month. Modeling capability for representing flow variability at the daily time scale is an important tool for evaluating environmental flow standards that contain both high and low flow regime components, because these can require finer time scales for evaluation than provided by monthly aggregated volumes.

Monthly WAM input datasets have been adapted for daily-capable simulations for several river basins by ongoing research work at Texas A&M University under contract with TCEQ. The Brazos, Trinity, and Neches River Basin WAMs, which are the focus of this study, are included in the daily time step WAM development. Each daily WAM is documented in a detailed report (Wurbs 2019a, 2019b, 2020) and peer-reviewed research papers have been published using the models (Pauls and Wurbs 2016; Wurbs and Hoffpauir 2016). To date, TCEQ does not use the daily WAMs for evaluating water right permit applications. However, studies are ongoing regarding the potential use of the daily WAMs as a tool for developing SB 3 environmental flow standard targets that can be used within the monthly WAMs.

Daily WAM input data includes daily streamflow patterns for streamflow gages, including all locations associated with SB 3 environmental instream flow standards. Other pertinent locations throughout the basin in each daily WAM, such as major reservoir sites, are provided input daily streamflow patterns. Daily streamflow patterns representing naturalized or nearly naturalized conditions are used in the daily WAMs to disaggregate the monthly naturalized streamflow volumes. Where available, unregulated streamflow patterns provided by the U.S. Army Corps of Engineers (USACE) are used, and other locations with limited water right activity utilize U.S. Geological Survey daily streamflow records. Additional water right management inputs are included in the daily WAMs to simulate daily streamflow diversions, flood control operations, and environmental instream flow standards. The input records associated with daily environmental instream flow standards include the capability to track HFP across days, months, and seasons. Daily instream flow requirements associated with switching between base flow and subsistence flow requirements as the stream is depleted are also included. Where specified, hydrologic conditions are also used as inputs in the daily WAM to switch between components of the environmental flow standards.

The reduction of modeling time steps from monthly to daily creates a need to consider travel time in the daily WAMs. A monthly WAM simulation assumes all changes to streamflow, such as diversions, return flows, or reservoir releases, can propagate through the entire river network within the same monthly time step as they occur. Thus, in a monthly WAM, there are no parameters or options to consider travel time. However, in a daily time step WAM, travel time from watershed headwaters to the outlets of Texas river basins may be measured in days or weeks. Routing parameters are used in daily WAMs to represent generalized travel times of changes to streamflow through river reaches. The use of routing within the simulation requires the use of water availability forecasting to protect future water availability and future regulated streamflow across the priority order of water rights and instream flow requirements. All of the daily WAMs developed for this study use routing parameters to represent travel times through the river networks and water availability forecasting to protect priority order water availability and instream flows.

1.4 Goals and Objectives

The overall goal of this study is to better understand the attainment of environmental flow standards throughout the Brazos, Trinity, and Neches river basins under four different flow scenarios. To achieve this goal, the following objectives have been identified:

- Review the literature to identify useful attainment metrics.
- Develop daily WAMs representing each of the four flow scenarios in each of the three river basins.
- Create WAM output files that inform an understanding of attainment of the standards.

- Develop graphical and tabular depictions of the WAM outputs that are relevant to attainment of the standards and are suitable for a wide variety of audiences and purposes.
- Present the results to the Brazos, Trinity, and Neches BBASCs and document the results in a final report.

For the Brazos, Trinity, and Neches river basins, the instream flow standards consist of fairly complex tables of flow values that vary by location, season, flow component, and, in the case of the Brazos River basin, hydrologic condition. Regarding freshwater inflow standards, the Brazos and Neches Rivers do not have freshwater inflow standards, and the Trinity freshwater inflow standards consist of one table of seasonal flow volumes and target attainment frequencies. Because of the relative simplicity of the freshwater inflow standards, the possible suite of attainment metrics is limited. Accordingly, while attainment of the freshwater inflow standards is described in this report, the majority of the literature review and modeling results are focused on instream flow standards.

1.5 Report Organization

The report is organized as follows:

- Section 1: Introduction
- Section 2: Literature Review and Assessment Methodology
  - This section describes environmental flow standards in general, the environmental flow standards established in the Brazos, Trinity, and Neches river basins, a literature review of attainment metrics, and proposed attainment metrics and visualization techniques for this project.
- Section 3: Development of Flow Scenarios
  - This section describes the construction of the model input files that create the flow scenarios used in this report.
- Section 4: Assessment of the Brazos River Basin
  - This section describes the model outputs for the Brazos River basin.
- Section 5: Assessment of the Trinity River Basin
  - This section describes the model outputs for the Trinity River basin.
- Section 6: Assessment of the Neches River Basin
  - This section describes the model outputs for the Neches River basin.
- Section 7: Key Findings
  - This section summarizes key findings and is organized by river basin.

- Section 8: Guidance Summary
  - This section provides guidance for a variety of users of the study results. It also includes a subsection on study limitations and recommendations for future work.
- Section 9: References

The following appendices are also included:

- Appendix A: WAM Input Files and Modifications
- Appendix B: Attainment Metrics Calculation Methodologies
- Appendix C: Summary Tables
- Appendix D: Flow Duration Curves
- Appendix E: Exceedance Frequency Plots
- Appendix F: Flow Raster Hydrographs
- Appendix G: Attainment Raster Hydrographs
- Appendix H: Attainment Code Frequency Plots
- Appendix I: Column Plot Matrices of Attainment Metrics
- Appendix J: Freshwater Inflow Metrics
- Appendix K: Draft Report Comments and Responses

2 Literature Review and Assessment Methodology

This section describes and compares the environmental flow standards for the Brazos, Trinity, and Neches river basins. It also includes a review of literature relevant to attainment metrics for environmental flows. This section concludes with a description of key findings from the literature review and recommendations for attainment metrics and visualization techniques for the flow standards in the Brazos, Trinity, and Neches river basins.

Terminology varies between authors and regions. The following definitions pertinent to attainment metrics are used in this report:

- **Attained:** A flow standard is attained on a given day when the flow exceeds the standard that is engaged on that day.
- **Base flow:** The range of average flow conditions, in the absence of significant rainfall events that may vary depending on current weather patterns (TAC Rule §298.1, 2011).
- **Duration:** Number of consecutive days of attainment (or non-attainment) of a standard.
- **Engaged:** In the WAMs, a flow target is engaged when it is within the range of allowable instream flow targets specified by the data selection parameters (Pauls and Wurbs 2016). More specifically related to Texas' environmental flow standards, a standard is engaged when, according to the rules for a particular basin and the streamflow at the time, that standard is the one that applies. For example, if the date of interest is in the winter season, the hydrologic condition is dry, and the streamflow exceeds the dry base flow standard yet remains below the applicable HFP trigger, then the winter dry base flow is engaged as the target in the WAM.
- **Flow:** In practice, measured flows are used to evaluate attainment of standards. However, for this effort, long-term model simulations are used to predict daily flows under different water use scenarios. Accordingly, modeled flows will be used to evaluate attainment of standards in this report.
- **HFP:** Relatively short-duration, high flows within the stream channel that occur during or immediately following a storm event (TAC Rule §298.1, 2011).
- **Return flows:** Return flows typically represent water discharged back into the stream after use and may include municipal and industrial wastewater effluent or irrigation return flows (Wurbs 2021a). In the WAM, return flows may also include water being transported to a control point from other locations in the basin or even another river basin.
- **Standards (environmental flow standards):** Requirements adopted by TCEQ based on Section 11.1471 of the Texas Water Code. In the WAMs, the TCEQ standards serve as flow targets, so the term "targets" is sometimes used in the context of the WAMs. In this report, environmental flow standards are sometimes bifurcated into instream flow

standards (which are the primary focus of this report) and freshwater inflow standards (i.e., for estuaries).

- **Subsistence flow:** The minimum streamflow needed during critical drought periods to maintain tolerable water quality conditions and to provide minimal aquatic habitat space for the survival and recolonization of aquatic organisms (TAC Rule §298.1, 2011).

2.1 Environmental Flow Standards

Documents related to the SB 3 environmental flows program, including the BBEST and BBASC recommendations reports, can be found on TCEQ's website (TCEQ 2019). Similarly, the adopted flow standards can be found in Chapter 298 of the TAC (TAC 30.1.298, 2011). The following subsections highlight the features of the standards that are relevant to an assessment of attainment of the standards in the Brazos, Trinity, and Neches river basins.

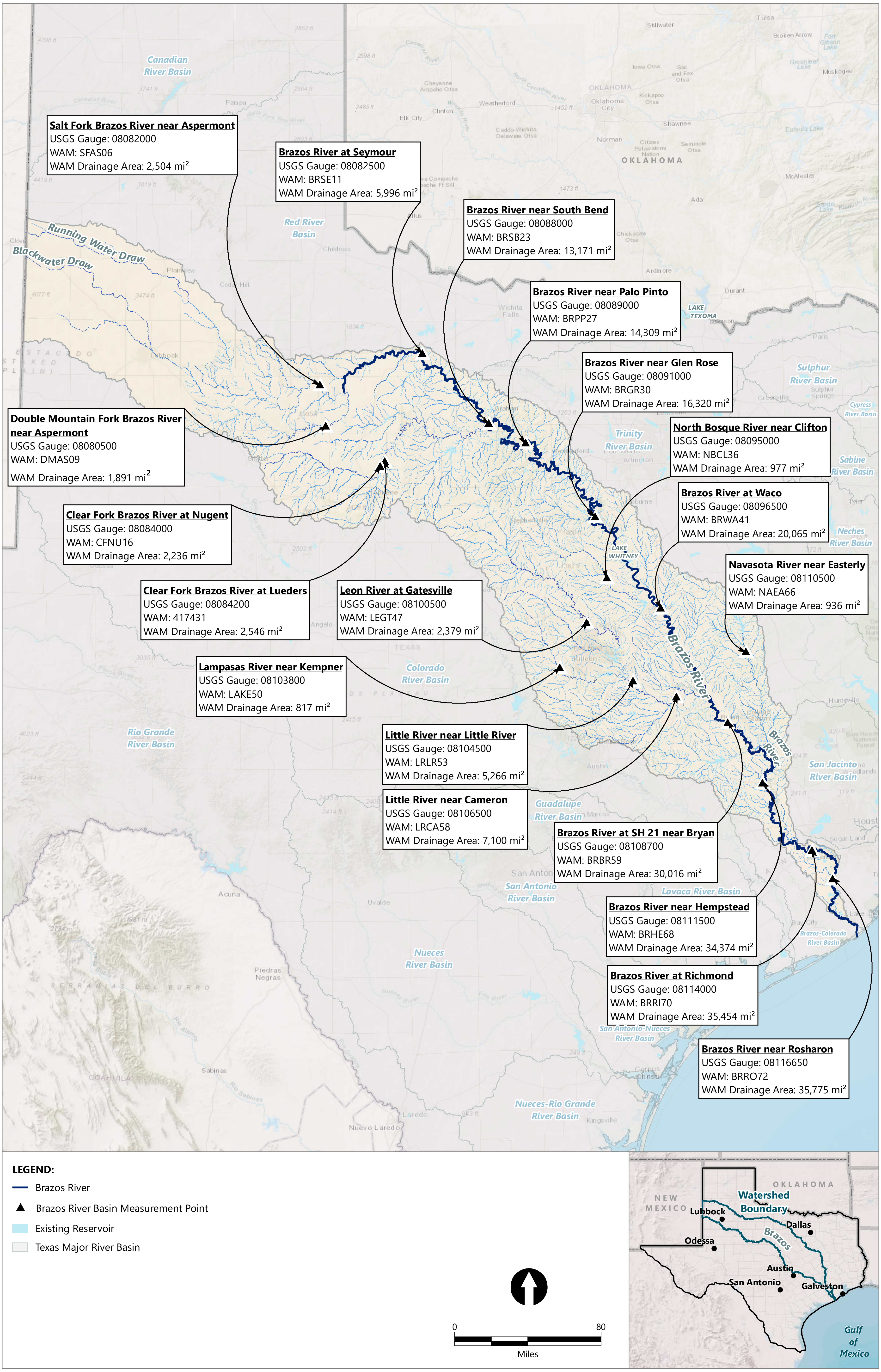
2.1.1 Brazos River Basin

The Brazos River and associated tributaries have instream flow standards at 19 measurement points (Figure 2-1).[1] The standards for the "Brazos River and its Associated Bay and Estuary System" (TAC 30.1.298.480, 2014) include one additional measurement point in the San Bernard River. However, this location is not included in the Brazos WAM and hence is not discussed further in this report.

All 19 measurement points correspond to instream flow standards; the Brazos River does not have freshwater inflow standards. The standards for each measurement point consist of a table of flow values that vary by three seasons (winter [November to February], spring [March to June], and summer [July to October]), hydrologic condition (dry, average, and wet), and flow component (subsistence flows, base flows, and HFPs).

The standards for HFPs vary by hydrologic condition. Each HFP requirement has a trigger value, volume, and duration.

[1] Locations where environmental flow standards are assigned are termed "measurement points" in the TAC. In WAM parlance, locations are often referred to as "control points." As a result, these terms are used synonymously in this report.



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ANCHOR QEA

Figure 2-1
Environmental Flow Measurement Points in the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

2.1.2 Trinity River Basin

The Trinity River and associated tributaries have instream flow standards at four measurement points (Figure 2-2). This basin also has freshwater inflow standards associated with the Trinity River. The standards for the "Trinity and San Jacinto Rivers, and Galveston Bay" (TAC 30.1.298.225, 2011) include two additional measurements points in the San Jacinto River. However, these locations are not included in the Trinity WAM and hence are not discussed further in this report.

The instream flow standards at each measurement point consist of a table of flow values that vary by season (winter [December to February], spring [March to May], summer [June to August], and fall [September to November]), and flow component (subsistence flows, base flows, and HFPs). The Trinity River standards do not include hydrologic conditions. As a result, the standards are somewhat simpler than the standards in the Brazos River.

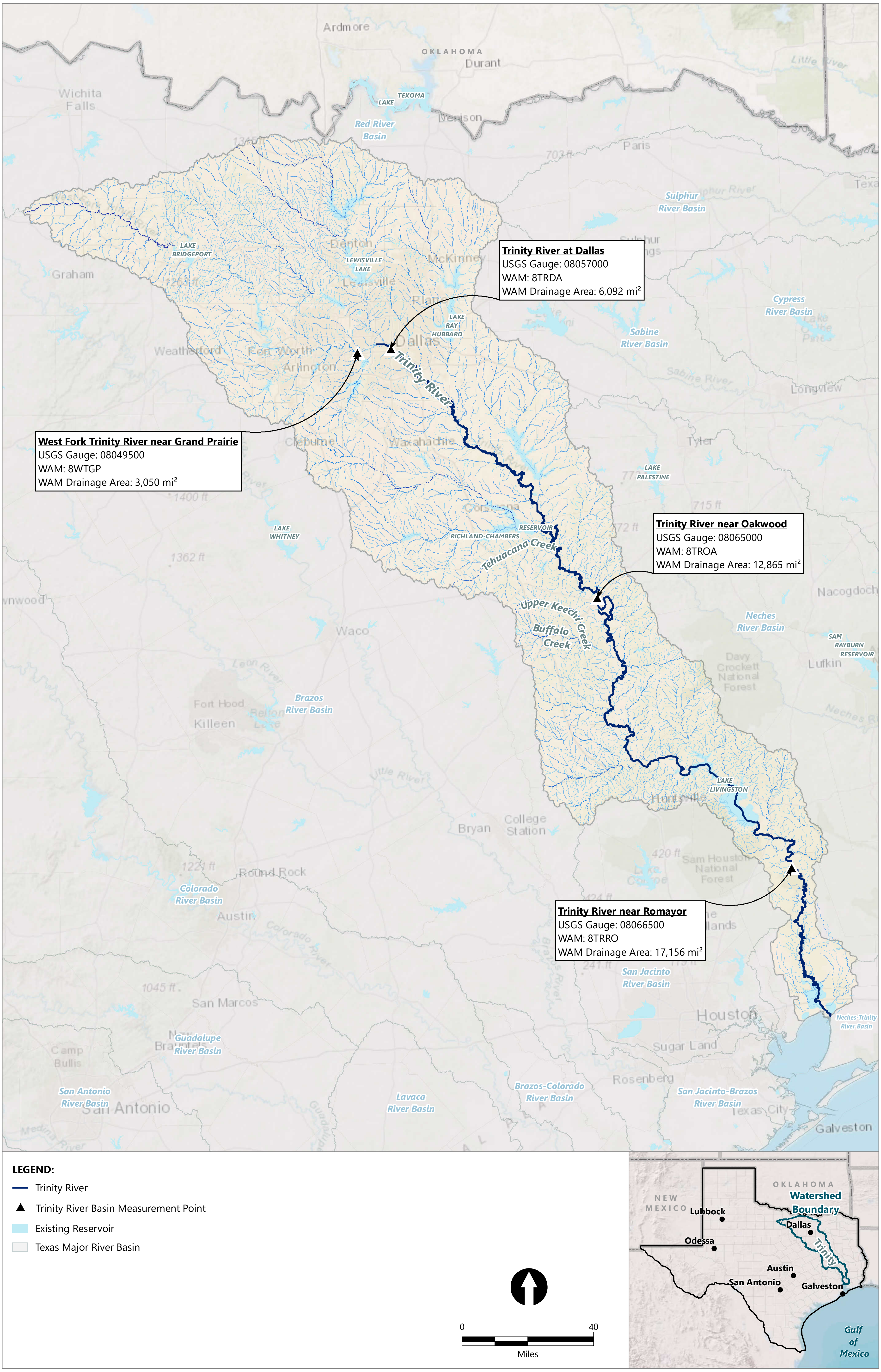

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Figure 2-2
Environmental Flow Measurement Points in the Trinity River Basin

2.1.3 Neches River Basin

The Neches River and associated tributaries have instream flow standards at five measurement points (Figure 2-3). The standards for the "Sabine and Neches Rivers, and Sabine Lake Bay" (TAC 30.1.298.280, 2011) include five additional measurements points in the Sabine River. However, these locations are not included in the Neches WAM and hence are not discussed further in this report.

All five measurement points correspond to instream flow standards; the Neches River does not have freshwater inflow standards. The instream flow standards at each measurement point consist of a table of flow values that vary by season (winter [January to March], spring [April to June], summer [July to September], and fall [October to December]), and flow component (subsistence flows, base flows, and HFPs). Like the Trinity River, the Neches River standards do not include hydrologic condition. As a result, the standards are somewhat simpler than the standards in the Brazos River.

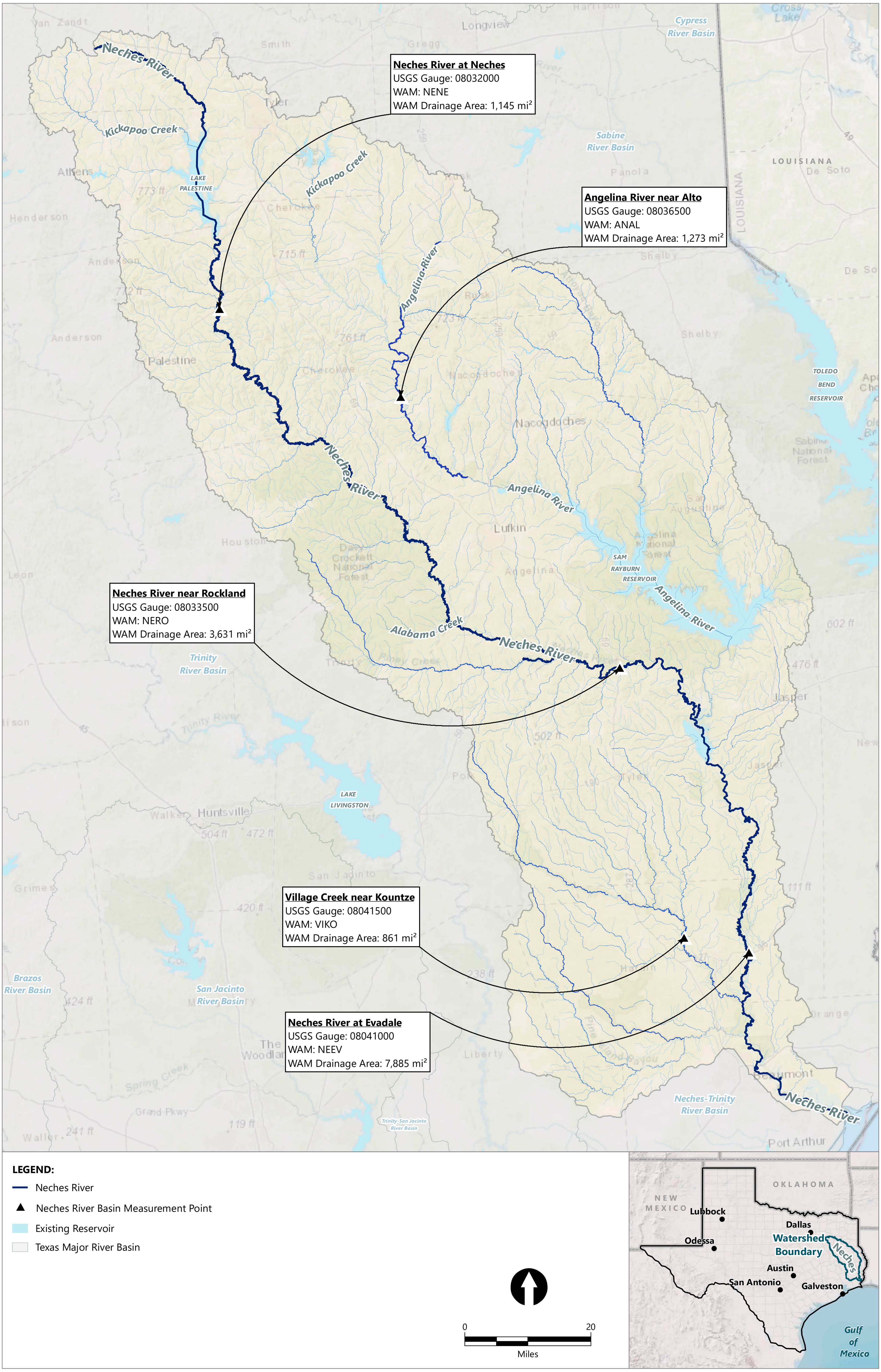

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Figure 2-3
Environmental Flow Measurement Points in the Neches River Basin

2.1.4 Summary

A summary of the characteristics of the standards across the three rivers is shown in Table 2-1.

Table 2-1
Comparison of Environmental Flow Standards Across Basins

Characteristic	Brazos River Basin	Trinity River Basin	Neches River Basin
Seasonality	Three seasons: Winter (November to February) Spring (March to June) Summer (July to October) (TAC Rule §298.455, 2014)	Four seasons: Winter (December to February) Spring (March to May) Summer (June to August) Fall (September to November) (TAC Rule §298.205, 2011)	Four seasons: Winter (January to March) Spring (April to June) Summer (July to September) Fall (October to December) (TAC Rule §298.255, 2011)
Hydrologic Conditions	Three (Dry, Average, Wet) (TAC Rule §298.455, 2014)	N/A	N/A
HFPs	Count: Number of HFPs varies by hydrologic condition, location, and season	Count: Number of HFPs varies by season (winter [2 HFPs], spring [2 HFPs], summer through fall [2 HFPs for summer through fall]	Count: Number of HFPs vary by season (winter [1 HFP], spring [2 HFPs], summer [1 HFP], fall [2 HFPs])
	Size: Vary by hydrologic condition, location, and season	Size: Vary by location and season	Size: Vary by location and season
	Termination: When either volume or duration criteria are met (TAC Rule §298.480, 2014)	Termination: When either volume or duration criteria are met (TAC Rule §298.220, 2011)	Termination: When either volume or duration criteria are met (TAC Rule §298.275, 2011)
Diversions below base flow	Diversions below base flow conditions vary with hydrologic condition. No diversions if the hydrologic condition is average or wet; in dry hydrologic conditions, 50% of the difference between the measured flow and the subsistence flow standard is allowed to be diverted (TAC Rule §298.475, 2014)	If the measured flow is below the base flow standard, diversions are allowed down to the subsistence flow standard (TAC Rule §298.220, 2011)	If the measured flow is below the base flow standard, diversions are allowed down to the subsistence flow standard (TAC Rule §298.275, 2011)

2.2 Literature and Research Approach

Anchor QEA reviewed recent literature to explore and document metrics that have been determined to be useful in the evaluation of environmental flows, where available. Our research included a synthesis of information from Pauls (2014), Pauls and Wurbs (2016), a compilation of instream flow literature for the Instream Flow Council (IFC; Beecher 2020a), other publicly available articles and reports, and personal communications with private consultants and industry professionals.

Some authors have estimated that there are 171 or more different methods for assessing environmental flows (Olden and Poff 2003); Tharme (2003) counted 207 (as cited in Williams and others 2019), while Arthington and others (2006) counted 200. Methods to evaluate environmental flows generally fall into four major categories: 1) hydrological rules; 2) hydraulic rating methods; 3) habitat simulation methods; and 4) holistic methods (Williams and others 2019; Tharme 2003; and Dyson and others 2003 as cited in Arthington and others 2006). This extensive list of alternatives demonstrates the variability and complexity of environmental flow science and highlights the challenges of establishing environmental flow standards and measuring the attainment of those standards.

In the literature, an environmental flow standard has been defined as a statement of flow regime characteristics needed to achieve a certain desired ecological outcome (Poff and others 2010). However, when referring to environmental flow standards in Texas, this report will exclusively refer to the adopted standards in the TAC. A brief summary of our review and contacts are provided in the following sections.

2.2.1 Review of Existing Literature

2.2.1.1 Pauls (2014) and Pauls and Wurbs (2016)

Researchers at Texas A&M University explored metrics that can be used in the WRAP/WAM system to understand attainment of environmental flow standards at each control point. Pauls (2014) and Pauls and Wurbs (2016) discuss the results of this work. Both citations use WAM simulations to model how many days the standards are met in the model's hydrologic period of record. Flow outputs from the model are used to calculate attainment metrics that, overall, address three concepts in attainment: 1) reliability; 2) frequency; and 3) duration. The attainment metrics are described in the results section, Section 2.3.1 of this document. All the metrics are applicable to modeling the attainment of subsistence and base flow standards, while only some of the metrics are applicable to modeling the attainment of HFPs. Pauls (2014) presents results for the Colorado and Trinity river basins, while Pauls and Wurbs (2016) presents result for solely the Colorado River basin. These metrics and results are informative for identifying suitable metrics for the Brazos, Trinity, and Neches river basins.

2.2.1.2 Instream Flow Council

The mission of the IFC is to improve the effectiveness of state, provincial, and territorial instream flow programs and activities in conserving (protecting, maintaining, and restoring) aquatic ecosystems. Membership is currently open to state (United States) and provincial/territorial (Canada) fish and wildlife management agencies whose work involves instream flow responsibilities.

The IFC has held Instream Flow Workshops in 2008, 2011, 2015, and 2018, focusing on science, law, policy, and public dialogue. The IFC has also compiled an extensive bibliography of instream flow-related literature, with a most recent update on November 13, 2020 (Beecher 2020a). Anchor QEA reviewed the presentations from the previous IFC workshops as well as the bibliography.

2.2.1.3 Journals, Books, and Reports

Anchor QEA reviewed journals, books, and reports focusing on environmental flows and attainment metrics, with a focus on hydrological modeling methods and evaluation. Although the intent was to emphasize more recent publications, the review included more than 75 publications due to the relative lack of reports focusing on attainment metrics. These publications include the following:

- American Fisheries Society-reviewed reports and books
  - *Sampling for Environmental Flow Assessments* (Williams 2010)
  - *Instream Flows for Riverine Resource Stewardship* (Annear and others 2004)
- *Environmental Flow Assessment: Methods and Applications* (Williams and others 2019)
- *Freshwater Biology* Volume 63, Issue 8: Special Issue: Evaluating and Managing Environmental Water Regimes in a Water Scarce and Uncertain Future (August 2018)
- Instream Flow Council bibliography (Beecher 2020a)

2.2.1.4 Personal Interviews

2.2.1.4.1 State Natural Resource Agencies

Anchor QEA discussed the state of environmental flow science and recent developments in attainment metrics with Dr. Hal Beecher (past president, IFC; Washington Department of Fish and Wildlife [WDFW] 2020b). Dr. Beecher is currently working with WDFW and the Washington State Department of Ecology on refining the instream flow recommendations and standards in Washington State.

2.2.1.4.2 Public Utility Districts

Anchor QEA discussed flow variability with storage hydropower projects in the Mid-Columbia region of Washington State with Mr. Jeff Osborn (Chelan PUD 2020). Mr. Osborn is the Senior License Compliance Specialist and was heavily involved with the Federal Energy Regulatory

Commission (FERC) relicensing of Chelan Public Utility District's (Chelan PUD's) Lake Chelan Hydroelectric Project (FERC No. 637).

2.2.1.4.3 Consultants

We interviewed colleagues with expertise in the National Oceanic and Atmospheric Administration's (NOAA's) fish passage standards (NOAA 2011) and the standards used in the Columbia River Basin to measure achievement of flow requirements at dams (per FERC licenses). These conversations focused on how compliance with flow requirements is measured and reported. Based on these conversations with colleagues, we also gathered and reviewed additional research papers and publications.

2.3 Literature and Research Results

Poff and others (2017) encouraged stakeholders to develop achievement criteria that are relevant to their particular watersheds and drainages of interest. This section summarizes metrics and methodologies potentially appropriate for the Brazos, Trinity, and Neches river basins.

2.3.1 Pauls, Pauls and Wurbs Metrics

Between Pauls (2014) and Pauls and Wurbs (2016), 34 attainment metrics are identified, some of which are duplicative between the references, even though the terminology and acronyms are often different. Anchor QEA reviewed the metrics and narrowed them down to ones that are potentially relevant to this effort. The Pauls and Wurbs (2016) metrics are presented in Table 2-2. Corresponding metrics from Pauls (2014) are also noted in the table. Pauls (2014) identified additional metrics, most of which are visualization approaches using exceedance frequency plots. These exceedance frequency plots are considered in this report in the context of visualization methods, rather than as attainment metrics, and are discussed in Section 2.5.

Table 2-2
Attainment Metrics (Pauls and Wurbs 2016; summarized from text and Table 2-1)

Abbreviation in Pauls and Wurbs 2016 (Pauls 2014 abbreviation in parentheses)	Metric	Description
E (M1)	Percentage of time instream flow target is engaged	The percentage of days in which the instream flow target is engaged.
EVR (M2)	Engaged volume reliability	Cumulative volume of observed instream flows divided by cumulative volume of instream flow targets for days in which the instream flow target is engaged.
EPR (M3A)	Engaged period reliability	The percentage of days in which the instream flow target is engaged for which the observed instream flow meets or exceeds the instream flow target.
CE (M4A)	Consecutive days instream flow target is engaged	Consecutive days instream flow target is engaged. Note that M4A in Pauls (2014) is the average of CE.
CEM (M5A)	Consecutive days instream flow target is engaged and met	Consecutive days instream flow target is engaged and met. Note that M5A in Pauls (2014) is the average of CEM.
CES (M6A)	Consecutive days instream flow target is engaged with a shortage	Consecutive days instream flow target is engaged with a shortage. Note that M6A in Pauls (2014) is the average of CES.
CBE (M7A)	Consecutive days between engagement of an instream flow target	Tracking parameter incremented each day that an instream flow target was not engaged and set to zero each day that an instream flow target was engaged. Note that M7A in Pauls (2014) is the average of CBE.
S (M9A)	Instream flow shortage	Volume of deficit between flow and target. Only considers days in which shortages are observed. In Pauls (2014) the word vulnerability is used instead of shortage, but the calculations are the same. Note that M9A in Pauls (2014) is the average of S.
PS (M10A)	Instream flow shortage as a percentage of the instream flow target	Only considers days in which shortages are observed. Note that M10A in Pauls (2014) is the average of PS.
ASPAT (M11)	Average instream flow shortage as a percentage of the average instream flow target	Average instream flow shortage as a percentage of the average instream flow target. ASPAT is calculated using both days in which shortages are observed and days in which the flow target is met. The average value of PS differs from ASPAT because the average of PS only considers days in which shortages are observed.

Of the 10 metrics included in Table 2-2, we determined that the following six may be useful as attainment metrics for this project:

- **E:** The percent of time a target is engaged (E) is useful because as water use increases, subsistence flow standards may be engaged more frequently (at the expense of base flow standards). This difference will facilitate comparisons of different model scenarios.
- **EPR:** Engaged period reliability (EPR) is a useful metric because it shows the percentage of days the target is met for a given period, such as a season. Knowing the percentage of days helps to compare different periods, different locations, and different model scenarios.
- **CEM:** The consecutive days the target is engaged and met (CEM) is a useful metric because it shows the duration of periods where the target is met. Longer duration periods of meeting the target could be biologically significant in that it allows for species and ecosystems to recover from flow shortages.
- **CES:** The consecutive days the target is engaged and not met (CES) is the opposite metric to CEM. It is useful to know the duration of periods where the target is not met because longer duration periods could be more stressful from a biological or ecological viewpoint.
- **S:** The instream flow shortage (S) is a useful metric because it represents the volume by which the instream flow was less than the target. This could be summarized for different periods to inform the impact of the shortage.
- **PS:** The percent shortage (PS) is a similar metric to the flow shortage metric, S, but expressed as a percentage of the instream flow target. Percent shortage can also be summarized for different periods or hydrologic conditions.

Of the metrics defined by Pauls and Wurbs (2016), we determined that the following four are of limited usefulness for this effort and will not be discussed further, for the following reasons

- **CE, CBE:** The consecutive number of days that an instream flow target is engaged (CE) and the consecutive number of days between engagement of an instream flow target (CBE) represent statistics of engagement of environmental flow standards that are not directly relevant to understanding attainment of standards.
- **EVR:** Engaged volume reliability (EVR) tracks the cumulative volume of instream flows as a fraction of the cumulative volume of instream flow standards. When there is a shortage, this metric will decrease and at times may be less than one. However, when there is a flood, this metric will increase rapidly and far exceed one. This behavior essentially erases the history of shortage. Because this metric is largely controlled by floods, it was not deemed helpful to this effort.

- **ASPAT:** The average instream flow shortage as a percentage of the average instream flow target (ASPAT) is similar to PS, with the difference that ASPAT is more complicated because it includes both days with shortages and days when the standard is met. PS was perceived as being more useful and more intuitive, and hence ASPAT is not recommended at this time.

Pauls (2014) also provided the following metrics to evaluate HFP events only:

- **P1:** Target number of HFP event engagements
- **P2:** Observed number of HFP event engagements
- **P3:** Observed number of engaged HFP events that satisfied termination criteria
- **P4:** Percentage of target number of HFP events that were engaged (the observed number of HFP event engagements divided by target number of HFP event engagements, i.e., P2/P1)
- **P5:** Percentage of years in which all HFP flow requirements were completely met
- **P6:** Percentage of engaged HFP events that satisfied volume termination criteria

Pauls' (2014) metrics P1, P2, and P3 are counts, while P4, P5, and P6 are frequencies. Frequencies are easier to interpret than counts; accordingly, this effort will focus on P4, P5, and P6.

The metrics described by Pauls (2014) and Pauls and Wurbs (2016) were developed for use with TCEQ's WRAP/WAM system and are useful hydrologic and biological indices; we included many of these in our recommendations section. These authors also note that a variety of statistics can be applied to the metrics. For example, it may be helpful to evaluate the mean and standard deviation of the PS metric for a given season, to understand the average flow shortage and variations in flow shortages for that season.

2.3.2 Other Environmental Flow Attainment Metrics

Anchor QEA was unable to find examples that were both explicit and relevant to Texas where hydrologic metrics were used to evaluate the attainment of environmental flow standards or recommendations, other than Pauls (2014) and Pauls and Wurbs (2016). Table 2-3 is a partial list of the literature Anchor QEA reviewed for this report.

Table 2-3
List of Literature Reviewed for This Report

Author(s)	Title
Allan and Watts 2017	"Revealing Adaptive Management of Environmental Flows"
Arthington and others 2006	"The Challenge of Providing Environmental Flow Rules to Sustain River Ecosystems"
Batalla and Vericat 2009	"Hydrological and Sediment Transport Dynamics of Flushing Flows: Implications for Management in Large Mediterranean Rivers"
Beecher 2020a	*Instream Flow References by Taxa and Geography*
Biggs and others 1990	"Ecological Characterization, Classification, and Modeling of New Zealand Rivers: An Introduction and Synthesis"
Caissie and others 2015	"Hydrologically Based Environmental Flow Methods Applied to Rivers in the Maritime Provinces (Canada)"
Chelan PUD 2019	Lake Chelan Hydroelectric Project No. 637 Article 408; Appendix D, Condition IV.E; and Settlement Agreement Article 7(c)(2)
Christancho 2017	*Environmental Flow Standards in Water Availability Modeling*
Dollar 2000	"Fluvial Geomorphology"
Ecology 2004	Order No. 1233 (Amended Order No. DE 03WQCR-5420)
Gippel and others 2009	"Balancing Environmental Flows Needs and Water Supply Reliability"
Gustard 1979	"The Characterisation of Flow Regimes for Assessing the Impact of Water Resource Management on River Ecology"
Hoekstra and others 2011	*The Water Footprint Assessment Manual: Setting the Global Standard*
Hughes and James 1989	"A Hydrological Regionalization of Streams in Victoria, Australia, with Implications for Stream Ecology"
Hughes and Hannart 2003	"A Desktop Model Used to Provide an Initial Estimate of the Ecological Instream Flow Requirements of Rivers in South Africa"
Joubert and Hurly 1994	"The Use of Daily Flow Data to Classify South African Rivers"
Kennen and others 2007	*Development of the Hydroecological Integrity Assessment Process for Determining Environmental Flows for New Jersey Streams*
Kondolf and others 2019	"Dams and Channel Morphology"
Lytle and Poff 2004	"Adaptation to Natural Flow Regimes"
Mathews and Richter 2007	"Application of the Indicators of Hydrologic Alteration Software in Environmental Flow Setting"
Mazor and others 2018	"Tools for Managing Hydrologic Alteration on a Regional Scale: Setting Targets to Protect Stream Health"
Mierau and others 2018	"Managing Diversions in Unregulated Streams Using a Modified Percent-of-Flow Approach"
Olden and Poff 2003	"Redundancy and the Choice of Hydrologic Indices for Characterizing Streamflow Regimes"

Author(s)	Title
Pauls 2014	*Incorporating and Evaluating Environmental Instream Flows in a Priority Order Based Surface Water Allocation Model*
Pauls and Wurbs 2016	“Environmental Flow Attainment Metrics for Water Allocation Modeling”
Petts and others 1985	“Wave-Movement and Water-Quality Variations During a Controlled Release from Kielder Reservoir, North Tyne River, U.K.”
Poff and others 1997	The Natural Flow Regime: A Paradigm for River Conservation and Restoration”
Poff and others 2003	“River Flows and Water Wars: Emerging Science for Environmental Decision Making”
Poff and others 2010	“The Ecological Limits of Hydrologic Alteration (ELOHA): A New Framework for Developing Regional Environmental Flow Standards”
Poff and others 2017	“Evolution of Environmental Flows Assessment Science, Principles, and Methodologies”
Richter and others 1996	“A Method for Assessing Hydrologic Alteration Within a River Network”
Richter and others 1997	“How Much Water Does a River Need?”
Richter and others 1998	“A Spatial Assessment of Hydrologic Alteration Within a River Network”
Richter and others 2012	“A Presumptive Standard for Environmental Flow Protection”
Rivaes and others 2015	“Reducing River Regulation Effects on Riparian Vegetation Using Flushing Flow Regimes”
Searcy 1959	*Flow-Duration Curves: Manual of Hydrology: Part 2: Low-Flow Techniques*
Tena and others 2012	“Reach-Scale Suspended Sediment Balance Downstream from Dams in a Large Mediterranean River”
Tennant 1976	“Instream Flow Regimens for Fish, Wildlife, Recreation and Related Environmental Resources”
Tharme 1996	*Review of International Methodologies for the Quantification of the Instream Flow Requirements of Rivers*
Tharme 2003	“A Global Perspective on Environmental Flow Assessment: Emerging Trends in the Development and Application of Environmental Flow Methodologies for Rivers”
Watts and others 2009	*Pulsed Flows: A Review of Environmental Costs and Benefits and Best Practice*
Wilcock and others 1996	“Specification of Sediment Maintenance Flows for a Large Gravel-Bed River”
Wilcox and Shafroth 2013	“Coupled Hydrogeomorphic and Woody-Seedling Responses to Controlled Flood Releases in a Dryland River”
Williams and others 2019	*Environmental Flow Assessment: Methods and Applications*

Several examples where attainment metrics, or related topics, were discussed are given in the following sections.

2.3.2.1 Lake Chelan Hydroelectric Project Biological Objectives and Instream Flow Requirements

As part of the relicensing of the Lake Chelan Hydroelectric Project (FERC No. 637), Chelan PUD was required to meet biological objectives, some of which were tied to a range of flows to be released from Lake Chelan over an annual basis. These flows were established in the Chelan River Biological Evaluation and Implementation Plan (Chelan PUD 2003) and 401 Water Quality Certification (Ecology 2004). Flows were established according to wet, normal, and dry years to meet biological criteria. Standards included seasonal flow levels, duration, and rate of change (i.e., ramping rates).

The established schedule is consistent with parameters established in natural flow regimes. These included meeting targets for flow magnitude, frequency, duration, timing, and rate of change. Achievement of standards was accomplished when instantaneous flow releases met or exceeded target values and ramping rates complied with specific values (i.e., reduction in stage of 2 inches per hour or less). Seasonal targets were set for specific durations. If there were a deviation from that release schedule (i.e., seasonal flows and duration) or if standards were not met 100% of the time, an explanation had to be provided, as well as a discussion of compliance measures to be undertaken to ensure achieving project standards. Achievement criteria were set at 100% and reductions from this standard were a concern and needed to be addressed. Standards and metrics were established by the development of flows set to achieve biological objectives and adaptive management.

This Lake Chelan Hydroelectric Project provides an example of a highly controlled hydrologic system in which attainment of the standards is largely achieved by reservoir operations. This example is informative but not directly applicable to Texas, because Texas reservoirs rarely exert this level of control over river flows and because environmental flow standards only require pass-through of flows, not release of previously stored water. Reservoir operators in Texas may choose to voluntarily make releases to meet environmental flow standards if making such releases could be demonstrated to have little to no effect on reliability of water supplies.

2.3.2.2 Jiaojiang Basin, Taizhou, Whejiang Province, People’s Republic of China

Gippel and others (2009) described an approach to evaluating a flow series for its degree of compliance with a specified flow regime. As stated in their article, compliance is defined as the degree to which specified flow components occur in a flow series. As an example, to comply with the requirements of a component (e.g., HFP event), the specifications of all three facets of the component must be satisfied (frequency, duration, and magnitude).

In Gippel and others (2009), a flow series could be said to comply (i.e., reach the attainment metric) when a target was met more than a prescribed percentage of time, in a certain percentage of years (i.e., a long-term frequency). For example, compliance for low base flow and high base flow components was calculated by the percentage of time that the base flows exceeded the threshold (Gippel and others [2009] defined this as "duration," but it will be described as frequency herein). The acceptance thresholds were established by an expert panel. A required frequency of 65% of the time over the relevant season was set as the lower limit of annual compliance for each base flow component. Due to the high degree of variability of flow from year to year, it was expected that the threshold base flow frequency would be met in 5 years of every rolling 10-year period, recognizing that the other years were too dry to meet this requirement.

In summary, if a low base flow for a given season was met 65% of the time, in 5 years out of a rolling 10-year period, the environmental flow component was considered to be in compliance (both low and high base flows had the same compliance metrics in their report). Gippel and others (2009) cautioned that this percentage target would likely vary between river systems.

HFPs were analyzed differently, in that flows had to meet a certain magnitude (m^3s^{-1}), duration (days), annual/season frequency, and long-term period frequency (i.e., 5 out of 10 years). Results would be reviewed by the expert panel, and could be revised, based upon adaptive management.

Gippel and others (2009) provide an example of stakeholders establishing attainment metrics with associated numerical targets. However, the authors stress that these are site specific and hence the specific metrics used in Gippel and others (2009) are not necessarily applicable to Texas.

2.3.2.3 Columbia River Basin

Based on conversations regarding NOAA fish passage standards and the Columbia River basins with John Ferguson, PhD, and Tracy Hillman, PhD, Anchor QEA gathered the following general input:

- From an ecological standpoint, consider the importance of temperature in determining whether standards are attained in a biologically relevant way.
- Consider the duration of the hydrologic record that is appropriate to use in the model and what this may mean for the likelihood and biological relevance of attainment, especially given climate change.
- Similar to NOAA's standards (NOAA 2011), consider using the proportion of time (such as 90%) flows are within a given range as an attainment metric.

In Washington State, there is a group forming to address the efficacy of instream flows with climate change and population growth. While acknowledging there are shortfalls in meeting instream flow standards, the group has not yet established attainment standards on instream flows (i.e., is meeting the standard 80% of the time adequately), but is working towards that goal (Beecher 2020b).

2.3.2.4 Flow Duration Curves

A flow duration curve is a cumulative frequency curve that shows the percent of time specified discharges were equal to or exceeded during a given period (Searcy 1959). The function of the curve describes the flow variability at a specific site during a specific period and represents the streamflow values against their probability of exceedance (Ridolfi and others 2020). Flow duration curves are useful because they answer the question, "what percentage of time does flow exceed (or not exceed) a given value (e.g., 100 cfs)?" For example, the given value may be set at a biologically relevant target, such as the flow level that would be too low to support a particular fish species, or an environmental flow standard. By plotting standards on flow duration curves, managers can understand the probability of a flow standard being met in a given period of time.

Flow duration curves plot flow against percentage of time. This type of plot can be generalized to other measures. For example, Pauls (2014) presents a series of exceedance frequency plots that plot attainment metrics against percentage of time. For this report, the more general term exceedance frequency plot will be used, because it will not always be flow that is represented in the plot.

2.3.2.5 Zero-Flow Days

Texas rivers and streams sometimes exhibit no flow, especially in headwaters and the western portions of river basins. While not part of Texas' environmental flow standards, zero flows have important biological implications (Olden and Poff 2003) and are easily understood by a wide variety of audiences. In particular, understanding the frequency, timing, and duration of zero flows may be informative to stakeholders. The following metrics were identified as potentially helpful:

- Frequency of zero-flow dates by year and season
- Consecutive duration of zero-flow dates by year and season

2.4 Conclusions

The overall questions in the evaluation and achievement of environmental flow metrics are: 1) "What are the appropriate performance indicators and metrics?"; 2) "Once these metrics are selected, how does one evaluate the degree of compliance?"; and 3) "Is this degree of compliance adequate?" (Poff and others 2017; Gippel and others 2009). This search found few examples that are directly applicable to Texas. However, the Pauls (2014) and Pauls and Wurbs (2016) citations provide a strong starting point for the identification of attainment metrics and the other sources of information provide important insights for modifying and expanding upon the metrics used by Pauls (2014) and Pauls and Wurbs (2016).

2.5 Final Attainment Metric Recommendations

2.5.1 Metrics for Instream Flow Standards

The metrics shown in Table 2-4 are recommended for use in this effort. Metrics can be applied seasonally, annually, and by hydrologic condition, as applicable.

Table 2-4
Metrics Recommended for Use in This Project

Flow Component	Metric	Abbreviation			Description
		This Report	Pauls and Wurbs 2016	Pauls 2014	
Subsistence and Base Flows	Engagement Frequency	EF	E	M1	Percent of time each target is engaged
	Attainment Frequency	AF	EPR	M3A	Of the days that an instream flow standard is engaged, this is the percentage that it is also met
	Attainment Duration	AD	CEM	M5A[1]	Consecutive days instream flow standard is engaged and met
	Shortage Duration	SD	CES	M6A[1]	Consecutive days instream flow standard is engaged but not met (i.e., there is a shortage)
	Shortage	S	S	M9A[1]	Instream flow shortage for a given day
	Percent Shortage	PS	PS	M10A[1]	Instream flow shortage as a percentage of the instream flow standard for a given day
HFP	Pulse Frequency	PF		P4	HFP engagements as a percentage of the target number of HFP engagements
	Target Engagements Met	TEM		Similar to P5	Percentage of seasons when all HFPs were met
	Frequency Volume Met	FVM		P6	Percentage of HFPs that meet volume criteria
	Frequency Duration Met	FDM			Percentage of HFPs that meet duration criteria (equal to 100% minus FVM)
Zero Flow	Zero-Flow Frequency	ZFF			Frequency of zero-flow days
	Zero-Flow Duration	ZFD			Consecutive duration of zero-flow days

Note:
1. This Pauls (2014) metric is the average of the corresponding Pauls and Wurbs (2016) metric.

In this table, one metric that is complementary to P6 from Pauls (2014) is included: frequency duration met (FDM). This metric reports the percentage of engaged HFP events that satisfy the duration termination criteria.

Table 2-4 includes abbreviations for metrics proposed for use in this report, as well as abbreviations used by Pauls and Wurbs (2016) and Pauls (2014). While the abbreviations used in Pauls and Wurbs (2016) and Pauls (2014) are reasonable, they are relatively cryptic for stakeholders less familiar with WAMs. Hence different, more approachable, abbreviations are proposed for most metrics in this report. Both sets of abbreviations will be used in this section, to help orient the reader, but only the abbreviations shown in the "This Report" column will be used in subsequent sections.

When possible, hydrologic statistics should collectively describe the full range of natural hydrologic variability, including the magnitude, frequency, duration, and timing of flow events, including floods, droughts, and intermittent flows (Richter and others 1996; Poff and others 1997; Olden and Poff 2003; Kennen and others 2007; Mathews and Richter 2007). Collectively, the metrics shown in Table 2-4 address these issues, as follows:

- **Magnitude:** Attainment frequency (AF [EPR]), S, and PS
- **Frequency:** Engagement frequency (EF [E]), AF (EPR), pulse frequency (PF [P4]), target engagements met (TEM [P5]), frequency volume met (FVM [P6]), FDM, and zero-flow frequency (ZFF)
- **Duration:** AD (CEM), shortage duration (SD [CES]), and zero-flow duration (ZFD)
- **Timing:** Metrics will be reported seasonally

Some of the calculations will result in values that require careful interpretation. For example, in the Trinity and Neches river basins, and in the Brazos River basin during dry hydrologic conditions, when the flow goes below the base flow standard, the subsistence flow standard automatically engages and the base flow standard disengages. As a result, the attainment frequency of these base flow standards should be 100%. However, when shifting from a low water use scenario (e.g., naturalized flows) to a high water use scenario, while the attainment frequency of the base flow standard will remain unchanged at 100%, the engagement frequency of the base flow standard may drop, while the engagement frequency of the subsistence flow standard increases. This shift, from the base flow standard being engaged to the subsistence flow standard being engaged in some days, may be helpful information to stakeholders. Another option would be to assign days in which the flow is below the base flow standard as days in which the base flow standard is not attained, and assign the same days as attaining the subsistence flow standard (assuming the flows are above the subsistence flow standard). However, this would result in the same day being counted in two separate frequencies. In turn, this would result in sums of frequencies exceeding 100% and could cause significant confusion in interpreting results. Accordingly, the metrics proposed here are explicitly mutually exclusive. Only one standard is engaged on a given day.

2.5.2 Metrics for Freshwater Inflow Standards

Of the three river basins included in this effort, only the Trinity River has associated freshwater inflow standards. These consist of three levels of seasonal and annual inflow volumes, each with target attainment frequencies. Because the attainment frequencies are part of the standards and are all less than 100%, if the inflow does not meet a target flow volume for a given season, this does not necessarily mean that the standards are not attained. Only if one or more of the long-term frequencies of meeting the target flow volumes were less than the frequencies identified in the standards would it be concluded that the standard is not attained. The end result is that only simplified attainment metrics are practicable.

The following metrics are proposed for freshwater inflow standards:

- Frequency of attainment
  - Frequency of attainment of each seasonal flow volume and the annual flow volume, compared to the target attainment frequency of each
- Duration of flows less than the lowest inflow targets
  - Median duration (i.e., number of consecutive seasons) of flows less than the lowest flow volume targets
  - Because the target attainment frequency of the lowest inflow targets is less than 100%, it is expected that some seasons will fall below these targets. However, the duration of consecutive seasons less than the lowest inflow targets may be valuable to stakeholders

2.5.3 Visualization Techniques for Instream Flow Standards (Tables and Graphs)

This section provides a proposed list of tables and graphs to help stakeholders understand the attainment metrics. This list is subject to change based on new information and in consultation with TWDB.

2.5.3.1 Summary Tables

Attainment of environmental flow standards can be visualized in a summary table for each location, hydrologic condition, and season, with frequency metrics reported for each standard. Tables 2-5a, 2-5b, and 2-5c provide a hypothetical example for the Brazos River basin.
Table 2-5a presents simple flow statistics (minimum and median flows). Table 2-5b presents attainment metrics for the entire period of record. Table 2-5c presents attainment metrics for a given season and hydrologic condition. These tables serve as a template proposal; they are not populated with numbers here but will be in subsequent sections of this report.

Table 2-5a
Flow Statistics for Hypothetical Location in Brazos River

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire period of record	#	#	#	#	#	#	#	#
Winter – All	#	#	#	#	#	#	#	#
Spring – All	#	#	#	#	#	#	#	#
Summer – All	#	#	#	#	#	#	#	#
Winter – Dry	#	#	#	#	#	#	#	#
Winter – Average	#	#	#	#	#	#	#	#
Winter – Wet	#	#	#	#	#	#	#	#
Spring – Dry	#	#	#	#	#	#	#	#
Spring – Average	#	#	#	#	#	#	#	#
Spring – Wet	#	#	#	#	#	#	#	#
Summer – Dry	#	#	#	#	#	#	#	#
Summer – Average	#	#	#	#	#	#	#	#
Summer – Wet	#	#	#	#	#	#	#	#

Table 2-5b
Attainment Metrics for Entire Period of Record for Hypothetical Location in Brazos River

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	# (#, #)	# (#, #)	# (#, #)	# (#, #)
	SD-POR	# (#, #)	# (#, #)	# (#, #)	# (#, #)
Subsistence Flow	AD-POR	# (#, #)	# (#, #)	# (#, #)	# (#, #)
	SD-POR	# (#, #)	# (#, #)	# (#, #)	# (#, #)
Zero Flow	ZFD-POR	# (#, #)	# (#, #)	# (#, #)	# (#, #)

Table 2-5c
Attainment Metrics for Hypothetical Location in Brazos River

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: # Trigger (cfs): # Volume (af): # Duration (days): #	PF	#%	#%	#%	#%
		TEM	#%	#%	#%	#%
		FVM	#%	#%	#%	#%
		FDM	#%	#%	#%	#%
Base Flow	# cfs	EF	#%	#%	#%	#%
		AF	#%	#%	#%	#%
		AD	# (#, #)	# (#, #)	# (#, #)	# (#, #)
		SD	# (#, #)	# (#, #)	# (#, #)	# (#, #)
		S	# af	# af	# af	# af
		PS	#%	#%	#%	#%
Subsistence Flow	# cfs	EF	#%	#%	#%	#%
		AF	#%	#%	#%	#%
		AD	# (#, #)	# (#, #)	# (#, #)	# (#, #)
		SD	# (#, #)	# (#, #)	# (#, #)	# (#, #)
		S	# af	# af	# af	# af
		PS	#%	#%	#%	#%
Zero Flow	N/A	ZFF	#%	#%	#%	#%
		ZFD	# (#, #)	# (#, #)	# (#, #)	# (#, #)

Table 2-6
Notes Associated with Attainment Metric Calculations

Notes for Attainment Metric Calculations	
EF	Percentage of time that an instream flow target is engaged
AF	Of those days in which an instream flow target is engaged, this is the percentage of which the target is also met
AD	Median consecutive days instream flow target is engaged and met (minimum days, maximum days)
SD	Median consecutive days instream flow target is engaged with a shortage (minimum days, maximum days)
S	Median instream flow shortage for days in which a shortage occurs, in acre-feet
PS	Median instream flow shortage as a percentage of the instream flow standard; only considers days in which shortages are observed
PF	HFP engagements as a percentage of the target number of HFP engagements
TEM	Percentage of seasons when all HFPs are met
FVM	Frequency of attainment of HFP standard for volume, which is calculated as the number of HFPs that terminated because the HFP volume criteria was met, divided by the number of HFPs engaged
FDM	Frequency of attainment of HFP standard for duration, which is calculated as the number of HFPs that terminated because the HFP duration criteria was met, divided by the number of HFPs engaged
ZFF	Percentage of zero-flow days out of total days
ZFD	Median consecutive days of zero flow (minimum days, maximum days)

In Table 2-4, median values are proposed for some metrics (as well as minimum and maximum values). For many of these metrics, Pauls (2014) and Pauls and Wurbs (2016) used average values. The modeling results are expected to generate skewed distributions for these metrics, accordingly, medians are recommended over averages for this effort, to reduce the influence of outliers.

As proposed, this approach will result in 263 distinct tables, as follows:

- Brazos River basin
  - Flow statistics
    - 19 locations
    - Subtotal of 19 tables
  - Period of record attainment metrics
    - 19 locations
    - Subtotal of 19 tables
  - Seasonal attainment metrics
    - 19 locations
    - 3 seasons
    - 3 hydrologic conditions
    - Subtotal of 171 tables

- Total of 209 tables

- Trinity River basin
  - Flow statistics
    - 4 locations
    - Subtotal of 4 tables
  - Period of record attainment metrics
    - 4 locations
    - Subtotal of 4 tables
  - Seasonal attainment metrics
    - 4 locations
    - 4 seasons
    - Subtotal of 16 tables
  - Total of 24 tables
- Neches River basin
  - Flow statistics
    - 5 locations
    - Subtotal of 5 tables
  - Period of record attainment metrics
    - 5 locations
    - Subtotal of 5 tables
  - Seasonal attainment metrics
    - 5 locations
    - 4 seasons
    - Subtotal of 20 tables
  - Total of 30 tables

In addition to summarizing attainment metrics for different standards in tables, it will be helpful to visualize certain metrics using plots. The following subsections suggest plots that could be used to visualize some of the attainment metrics.

2.5.3.2 Summary Figures

2.5.3.2.1 Exceedance Frequency Plots

Pauls (2014) uses exceedance frequency plots to demonstrate metrics such as AD and SD. For these attainment metrics, exceedance frequency plots show the distribution of model results. Exceedance frequency plots also provide a depiction of the median and other percentiles of the distribution of each metric. The following metrics are recommended for presenting as exceedance frequency plots (Pauls and Wurbs [2016] abbreviations in parenthesis and Pauls [2014] abbreviations in brackets):

- AD (CEM [M5B]) for subsistence flows
- AD (CEM [M5B]) for base flows
- SD (CES [M6B]) for subsistence flows
- SD (CES [M6B]) for base flows
- S (S [(M9B]) for subsistence flows
- S (S [(M9B]) for base flows
- PS (PS, [M10B]) for subsistence flows
- PS (PS, [M10B]) for base flows
- ZFD

As proposed, each of these plots will include all the data for a location, regardless of season or hydrologic condition. Also, in each of these plots, up to four datasets may be presented, each corresponding to a different modeled flow scenario. As a result, 252 exceedance frequency plots for attainment metrics would be constructed, as follows:

- Brazos River basin
  - 19 locations
  - 9 attainment metrics
  - Total of 171 plots
- Trinity River basin
  - 4 locations
  - 9 attainment metrics
  - Total of 36 plots
- Neches River basin
  - 5 locations
  - 9 attainment metrics
  - Total of 45 plots

2.5.3.2.2 Flow Duration Curves

In addition to exceedance frequency plots of attainment metrics, similar plots of the modeled flows themselves (i.e., flow duration curves) are proposed, to provide additional context to the reader regarding hydrologic characteristics at a particular location. In these plots, horizontal lines will be added corresponding to subsistence flow, base flow, and HFP trigger values. Also, in each of these plots, up to four datasets may be presented, each corresponding to a different modeled flow scenario. Plots may be developed for the entire period of record and by season. As a result, 121 flow duration curves may be constructed, as follows:

- Brazos River basin
  - 19 locations
  - Annual plus three seasons
  - Total of 76 plots
- Trinity River basin
  - 4 locations
  - Annual plus four seasons
  - Total of 20 plots
- Neches River basin
  - 5 locations
  - Annual plus four seasons
  - Total of 25 plots

2.5.3.2.3 Raster Hydrographs

Raster hydrographs (Koehler 2004) can be developed to present at least three different types of outputs, as follows:

- Flow raster hydrograph
  - In this plot, the raster hydrograph would be colored according to the flow on each date. Low flows may be red, while high flows may be blue (final formatting will be determined later).
  - This figure will provide a concise yet detailed illustration of the modeled flows at a location for the entire period of record.
  - A total of 112 flow raster hydrographs would be generated, as follows:
    - Brazos River Basin
      - 19 locations
      - 4 flow scenarios
      - Total of 76 plots
    - Trinity River Basin
      - 4 locations
      - 4 flow scenarios
      - Total of 16 plots

- Neches River Basin
  - 5 locations
  - 4 flow scenarios
  - Total of 20 plots

- Attainment raster hydrograph
  - In this plot, the raster hydrograph would be colored according to the attainment status (also referred to as attainment code) for each day.
  - Although the final formatting will be determined later, one example could include black diagonal hatching for zero-flow days, light red for subsistence engaged but not attained, dark red for subsistence engaged and attained, light green for base flow engaged but not attained, dark green for base flow engaged and attained (possible multiple colors for various hydrologic conditions), and blue for HFPs engaged and attained (HFPs are only engaged when the trigger flow is met, which means once engaged they are automatically also attained).
  - This plot format would provide a visual depiction of the information contained in the metrics EF (E), AF (EPR), AD (CEM), SD (CES), PF (P4), TEM (P5), ZFF, and ZFD.
  - A total of 112 attainment status raster hydrographs would be generated, as follows:
    - Brazos River Basin
      - 19 locations
      - 4 flow scenarios
      - Total of 76 plots
    - Trinity River Basin
      - 4 locations
      - 4 flow scenarios
      - Total of 16 plots
    - Neches River Basin
      - 5 locations
      - 4 flow scenarios
      - Total of 20 plots
- Attainment Code Frequency Plots
  - In this plot, the frequency of each attainment code for an entire simulation is presented in one row. Each row represents a combination of location and flow scenario.
  - A total of three attainment frequency raster hydrographs would be generated, one for each basin.

2.5.3.2.4 Column Plots of Attainment Metrics

Examples of potential column plots of attainment metrics are shown in Figures 2-4 and 2-5. These are selected to facilitate comparisons across locations within a given river basin, as such comparisons will be important to the stakeholders and are relatively difficult to perform using the tables, exceedance frequency plots, and raster hydrographs. These plots may be developed by season and hydrologic condition, and may be arranged in a matrix to facilitate viewing (Figure 2-4). Final formatting will make accommodations to allow for larger font size for all text.

Figure 2-4
Median Consecutive Days of Shortage in the Brazos River Basin

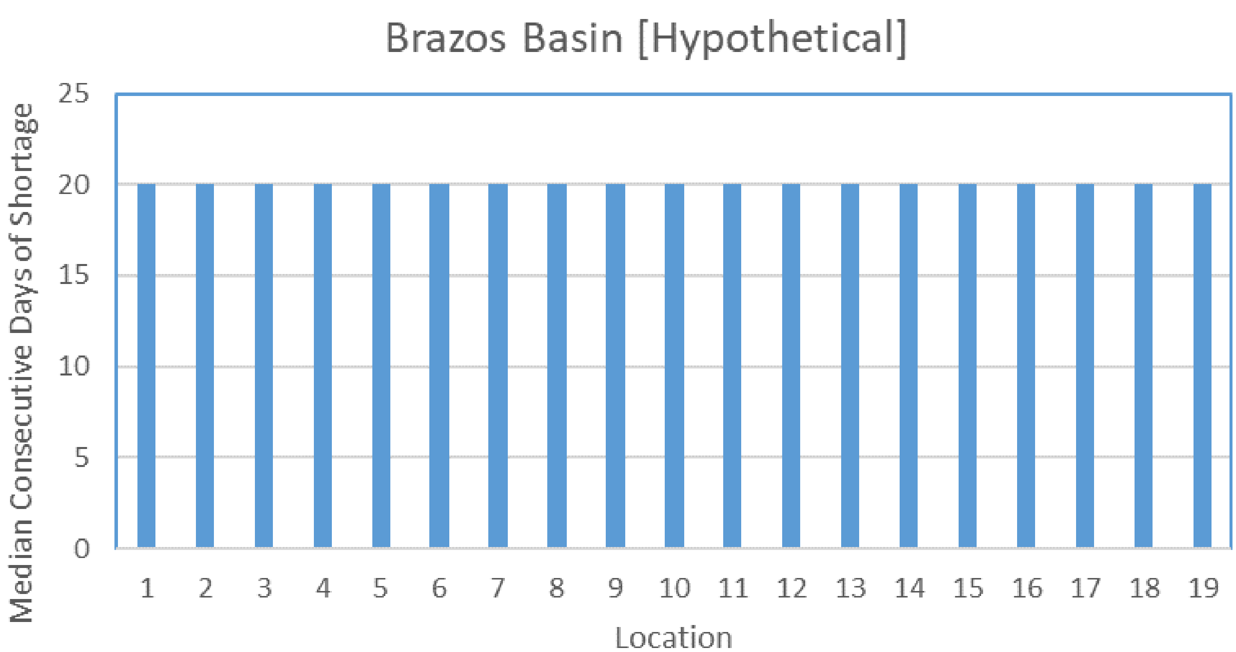
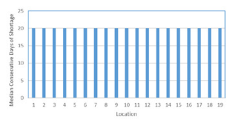
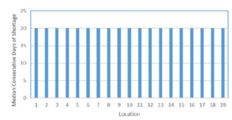
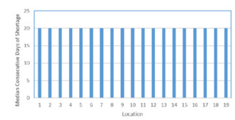
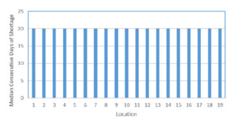
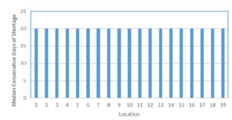
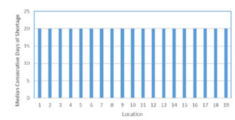
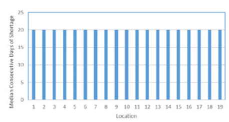
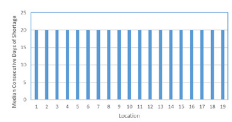
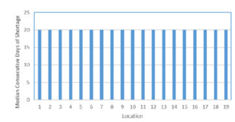


Figure 2-5
Median Consecutive Days of Shortage in the Brazos Basin River by Season and Hydrologic Condition

Season	Hydrologic Condition		
	Dry	Average	Wet
Winter			
Spring			
Summer			

The following metrics are recommended for presenting as column plots (related Pauls and Wurbs [2016] abbreviations in parentheses and Pauls [2014] abbreviations in brackets):

- EF (E) for subsistence flows
- EF (E) for base flows
- AF (EPR) for subsistence flows
- AF (EPR) for base flows
- Median of AD (CEM [M5A]) for subsistence flows
- Median of AD (CEM [M5A]) for base flows
- Median of SD (CES [M6A]) for subsistence flows
- Median of SD (CES [M6A]) for base flows
- Median of PS (PS [M10A]) for subsistence flows
- Median of PS (PS [M10A]) for base flows
- PF [P4]
- TEM [P5]
- FVM [P6]
- FDM
- ZFF
- Median of ZFD

A total of 1,088 column plots would be generated, as follows:

- Brazos River Basin
  - 3 seasons
  - 3 hydrologic conditions
  - 16 attainment metrics
  - 4 flow scenarios
  - Total of 576 plots
- Trinity River Basin
  - 4 seasons
  - 16 attainment metrics
  - 4 flow scenarios
  - Total of 256 plots
- Neches River Basin
  - 4 seasons
  - 16 attainment metrics
  - 4 flow scenarios
  - Total of 256 plots

2.5.3.3 Visualization Summary

The recommendations include a large number of tables and figures. This is perhaps unavoidable, as this project contemplates understanding attainment of complex environmental flow standards across numerous permutations of locations, seasons, hydrologic conditions, metrics, and flow scenarios. It is anticipated that the tables and figures will primarily be used as follows:

- Tables
  - Best source of specific numerical values for all metrics, by location, season, hydrologic condition, and flow scenario
- Exceedance frequency plot
  - Best source to compare one location and metric across flow scenarios
  - Under the proposed approach, will not differentiate by season or hydrologic condition
- Flow duration curves
  - Best source to compare flow percentiles across flow scenarios and against flow standards
  - Under the proposed approach, will not differentiate by hydrologic condition
- Raster hydrographs
  - Best source to quickly understand a single location and flow scenario

- Column plots
  - Best source to compare across locations in a river basin

This list of proposed tables and figures may be reduced, expanded, or modified, based on further evaluations and in consultation with TWDB.

2.5.4 Visualization Techniques for Freshwater Inflow Standards (Tables and Graphs)

The freshwater inflow standards are more straightforward than the instream flow standards and are limited to one location in the Trinity River basin. Accordingly, complex tables and figures are not necessary. The following tables and figures are proposed:

- One table of attainment frequencies of the freshwater inflow quantities in the standard, both annually and by season, constructed similarly to the table in TAC Rule §298.225(a)
  - This table would be repeated for each of the four flow scenarios.
- An exceedance frequency plot of the durations of non-attainment of the lowest inflow volume targets
  - This plot would have four datasets, one for each of the four flow scenarios.

3 Development of Flow Scenarios

WAM input files capable of daily time step simulation and evaluation of environmental flow standards at all measurement points were developed for the three river basins and four flow scenarios. The flow scenarios identified by the TWDB for this project include the following:

- Naturalized flow
- Current water use
- Partial utilization of permitted diversions
- Full utilization of permitted diversions

Existing WAMs of the three river basins (hereafter referred to as source models) were obtained from Dr. Ralph Wurbs' professorial website at Texas A&M University (TAMU 2021) and the TCEQ WAM website (TCEQ 2020) and used as the basis for the models developed for this project. Modifications to the source model files were made as necessary to produce the flow-scenario model files used in the project simulations. A comprehensive description of the modifications made to the source model files is contained in Appendix A of this report. The Brazos River basin required the combined use of the source model files available from Wurbs 2019a and TCEQ to develop the project flow scenarios. Additionally, the Brazos River basin current water use scenario uses the information for the Brazos G Regional Planning group WAM to identify downstream delivery points for releases of reservoir stored water to meet contractual demands. The Trinity and Neches river basin flow scenario models were adapted directly from the source models available from Wurbs 2019b and Wurbs 2020, respectively. The hydrologic period of record for each flow scenario matches the period of record for the currently approved TCEQ monthly WAMs for each basin, which are 1940 to 1997 for the Brazos River basin and 1940 to 1996 for the Trinity and Neches river basins.

3.1 Naturalized Flow

The naturalized flow scenario is used to assess the environmental flow standards under conditions that would occur in the absence of most human influences. The WAM's hydrologic inputs include time series of naturalized streamflow volumes and net evaporation-precipitation depths. The net evaporation-precipitation depths are used for reservoir water balance computations, and as such, are not applicable in this modeling scenario. All water right input records in the WAM input file are removed except those applicable to the environmental flow standards. The daily naturalized flows are used within the simulation to set components of the environmental flow standards without the effects of state-granted water rights.

3.2 Current Water Use

The TCEQ Current Conditions model, also known as Run 8, was adopted as the current water use scenario. The scenario sets a level of water right utilization equal to the maximum of the previous 10-year period and return flow discharges equal to the minimum monthly volumes of the previous 5 years. Sedimentation is taken into account in setting reservoir storage capacities. The current water use scenario also contains any granted return flow reuse permits. For this analysis, the water right use data within the TCEQ current conditions models correspond to the period of 2003 to 2015 for the Brazos River basin, 1996 to 2005 for the Trinity River basin, and 1986 to 1996 for the Neches River basin. Return flows in the TCEQ current conditions models correspond to the period of 2007 to 2011 for the Brazos River basin, 2002 to 2006 for the Trinity River basin, and pre-1997 years for the Neches River basin. However, within the TCEQ current condition models for the Trinity and Neches river basin, water use for some individual water rights and return flows may reflect more recent data.

3.3 Partial Utilization

The partial utilization scenario is intended to represent overall water right diversion amounts greater than those in the current water use scenario, but less than the full utilization scenario. The partial utilization scenario is not based on a specific time horizon or other externally predicted water right diversion amounts. The full utilization scenario serves as the basis for the development of the partial utilization scenario. Demands in the partial utilization scenario are adjusted to a midpoint between full and current use. The reservoir storage capacities in the partial utilization scenario are the same as the full use scenario.

Return flows are included in the partial utilization scenario. Return flows from the current water use model are scaled up to match the increased level of municipal water right use of the partial utilization model. Return flow reuse rights from the current water use scenario are included in the partial utilization scenario without increasing the reuse demands above the current use levels.

3.4 Full Utilization

Water right demands in the full utilization scenario are set equal to the fully authorized water right amounts. The daily models used in this project were adapted from the TCEQ full authorization WAM, also known as Run 3. The model does not contain return flows, does not include reuse of return flows, and uses authorized reservoir storage without sedimentation.

3.5 Summary of Modeled Flood Control Operations

The daily simulation models for the current use, partial utilization, and full utilization flow scenarios used in this project contain flood control reservoir operations, which are not included in the monthly WAM. The flood control operations in the daily WAMs follow the USACE Fort Worth District procedures regarding triggers for impoundment to mitigate downstream flooding and release rules following flooding events. Descriptions of the flood control operations used in the daily WAMs are found in the daily modeling reports (Wurbs 2019a, 2019b, 2020). Flood control operations can influence the attainment of environmental flow standards. However, the effects are limited to periods of extreme high flow events and the weeks thereafter when most environmental flow standards are already attained, including HFPs.

3.6 Summary of Modeled Water Demands

Tables 3-1, 3-2, and 3-3 provide a summary of demands by flow scenario and by the four main categories of use as well as other miscellaneous smaller uses, reuse of return flows, and non-consumptive hydropower releases. The miscellaneous small uses were not adjusted from full utilization levels in the partial utilization scenario. The naturalized flow scenario contains zero water use demands.

Table 3-1
Summary of Brazos WAM Demands by Flow Scenario (acre-feet per year)

Use Type	Current Use	Partial Utilization	Full Utilization
Municipal	623,632	1,079,075	1,534,518
Industrial	687,218	753,269	819,320
Irrigation	268,048	254,901	241,754
Mining	7,950	45,636	83,321
Other	3,215	6,762	6,762
Reuse	3,784	3,784	0
Hydropower	0	459,160	918,319
Total, Ex-Hydro	1,593,847	2,143,427	2,685,675

The average annual naturalized flow at the mouth of the Brazos River basin is 6.1 million acre-feet per year over the 1940 to 1997 period of record. Return flow discharges in the current and partial utilization scenarios are 142,175 and 246,006 acre-feet per year, respectively. No return flows are included in the full utilization scenario.

Table 3-2
Summary of Trinity WAM Demands by Flow Scenario (acre-feet per year)

Use Type	Current Use	Partial Utilization	Full Utilization
Municipal	1,731,268	2,485,397	3,239,526
Industrial	293,132	604,753	916,374
Irrigation	162,647	238,895	315,143
Mining	2,111	6,352	10,593
Other	798	1,454	1,454
Reuse	151,418	151,418	0
Total	2,341,374	3,488,269	4,483,090

The average annual naturalized flow at the mouth of the Trinity River basin is 6.8 million acre-feet per year over the 1940 to 1996 period of record. Return flow discharges in the current and partial utilization scenarios are 635,282 and 912,292 acre-feet per year, respectively. No return flows are included in the full utilization scenario.

Table 3-3
Summary of Neches WAM Demands by Flow Scenario (acre-feet per year)

Use Type	Current Use	Partial Utilization	Full Utilization
Municipal	85,407	304,242	523,077
Industrial	201,269	476,438	751,607
Irrigation	221,927	333,058	444,189
Mining	102	695	1,287
Other	10,961	10,271	10,271
Reuse	0	0	0
Total	519,666	1,124,704	1,730,431

The average annual naturalized flow at the mouth of the Neches River basin is 6.2 million acre-feet per year over the 1940 to 1996 period of record. Return flow discharges in the current and partial utilization scenarios are 46,368 and 155,790 acre-feet per year, respectively. No return flows are included in the full utilization scenario.

4 Assessment of the Brazos River Basin

Sections 4, 5, and 6 introduce the model results for the Brazos, Trinity, and Neches river basins, respectively. Because of the large number of figures and tables, and the wide variety of possible perspectives for examining these tables, only a few broad patterns are discussed. Additional patterns, including patterns across basins, are discussed in Sections 7 and 8.

Before examining the tables and figures, a few pointers are worth reiterating, as follows:

- In the Brazos River basin during dry hydrologic conditions, when the flow is below the base flow standard, the subsistence flow standard engages (not the base flow standard). Accordingly, the attainment frequency of base flows during dry hydrologic conditions will always be 100%. This behavior can be seen in many of the outputs; e.g., in the Appendix G attainment raster hydrographs, where there is a single yellow line (which denotes dry hydrologic conditions), light green (which denotes base flow standard engaged but not attained) does not occur.
- In the Brazos River basin during average and wet hydrologic conditions, the subsistence flow standard does not apply. Accordingly, all associated tables and figures are labeled "n/a" for not applicable.
- Reservoirs releases of stored water from the Brazos River Authority (BRA) system are made for downstream users. During low flow periods, this often increases the flow in the river below the dams relative to naturalized conditions. The original TCEQ current conditions WAM represents all stored water use from BRA reservoirs as occurring from the lake's perimeter without making releases to downstream delivery locations. However, the current water use scenario developed for this study, as described in Appendix A, includes assumptions for making releases of stored water to downstream delivery points. The partial and full utilization scenarios are derived from the TCEQ full authorization WAM, which already includes assumptions for downstream deliveries of stored water from BRA reservoirs.
- Many control points in the Brazos River basin, particularly downstream control points, receive substantial return flows in the current conditions and partial utilization flow scenarios. Return flows do not occur in the full utilization flow scenario, which generally results in lower flows during dry conditions for this scenario.
- The Navasota River near Easterly measurement point is used in this section as an example of tributary flow for the examination of raster hydrograph plots (Appendices F, G, and H). Similarly, the Brazos River at Richmond measurement point is used in this section as an example of lower river mainstem flow for the examination of raster hydrograph plots.

Figures showing model results at these locations are listed as examples. Related figures from other tributary and mainstem locations typically illustrate similar patterns.

- At some locations (e.g., Salt Fork near Aspermont), the subsistence flow standard and the dry base flow standard are both equal to 1 cfs. This results in a tie during dry hydrologic conditions (i.e., when the subsistence flow standard is considered). In this case, the base flow standard is considered to be engaged and attained if the stream flow is 1 cfs or greater. The subsistence flow standard is considered to be engaged and unmet if the stream flow is less than 1 cfs.

4.1 Naturalized Flow Scenario

4.1.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-61 and G-69).
- The pulse frequency ranges from 40% to 100% across locations and seasons (Figure I-1), and the target engagements met are equal to, or slightly lower than, the pulse frequency (Figure I-2). Some locations, particularly in the upper Brazos River and on smaller tributaries, do not have winter or summer pulse requirements; thus, their respective pulse frequency values are not available.
- The frequency volume met is more than 70% across locations and seasons (Figure I-3) which indicates pulses are more likely to achieve their volumetric criterion prior to reaching their maximum duration.

4.1.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 55% to 85% of the time, depending on the location, season, and hydrologic condition (Figures D-1 through D-76).
- Flows are generally higher in the winter and spring months, and base flow attainment is correspondingly more frequent in these seasons on tributaries (Figures F-61 and G-61).
- Likewise, flows are generally higher in the winter and spring months, and base flow attainment is correspondingly more frequent in these seasons along the lower mainstem (Figures F-69 and G-69).
- The base flow engagement frequency ranges from 20% to 80% during dry hydrologic conditions, depending on location and season (Figure I-5). The base flow engagement frequency during average and wet conditions is much higher because the subsistence flow standard does not engage during these conditions. Base flow engagement

frequency is often slightly less than 100% during average and wet conditions due to days of pulse flow engagements.

- The base flow attainment frequency is always 100% during dry hydrologic conditions because, when the flow is below the base flow standard, the subsistence flow standard engages (Figure I-6). The base flow attainment frequency ranges from 40% to nearly 100% during average and wet conditions and is generally lower in the summer than in the winter or spring.
- The percent shortage ranges from 20% to 100%, depending on location and season, and the values generally decrease from upstream to downstream (Figure I-9).

4.1.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 65% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Low flow periods are frequent and persistent during drought periods on tributaries (Figures F-61 and G-61).
- Lower flow periods are visible in the lower portion of the mainstem, particularly in the summer season, though less common outside of major drought periods (Figures F-69 and G-69).
- Subsistence flow engagement frequencies range from 10% to 80%, depending on location and season, and are generally lower at the more upstream locations (Figure I-10).
- Subsistence flow attainment frequencies range from 0% to 80% depending on location and season (Figure I-11).
- The median percent shortage ranges from 20% to 100%, depending on location and season, and the values generally decrease from upstream to downstream (Figure I-14). At many upstream and tributary locations, the PS of the subsistence flow standard is 100%, meaning that when the subsistence flow standard is engaged but not met, the river is often dry.

4.1.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 80% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Zero flows occur when the monthly naturalized flow volume is zero for an entire month, or when there is a zero in the daily flow pattern used to disaggregate the monthly volume. Whole months of zero flows are more common in the summer season (Figures G-61 and G-69).

- The zero-flow frequencies range from 0% to 40% by season, are higher in the summer than in the winter or spring, and generally decrease from upstream to downstream (Figure I-15).

4.2 Current Conditions Flow Scenario

4.2.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-62 and G-70).
- The pulse frequencies are generally similar to that in the naturalized flow scenario (Figure I-17). The target engagements met are equal to, or somewhat lower than, the pulse frequency (Figure I-18).
- The frequency volumes met are similar to the naturalized flow scenario and are more than 50% across locations and seasons, with most locations exhibiting a frequency volume met greater than 80% (Figure I-19).

4.2.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 50% to 80% of the time, depending on the location, season, and hydrologic condition (Figures D-1 through D-76).
- The base flow engagement frequency is generally similar to that in the naturalized flow scenario during dry hydrologic conditions (Figures G-62, G-70, and I-21).
- The base flow attainment frequency is generally lower than that in the naturalized flow scenario (Figure I-22).
- The base flow percent shortage is generally higher than that in the naturalized flow scenario (Figure I-25).

4.2.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 60% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Return flow discharges and reservoir releases of stored water tend to increase low flow periods (Figures F-62 and F-70), though the frequency of subsistence flow engagements and attainments may still be similar over the period of record to the naturalized flow scenario (Figures G-62 and G-70).
- The percent shortage of the subsistence flow standard is generally less than that shown for the naturalized flow scenario (compare Figures I-30 and I-14).
- The subsistence flow engagement frequency is generally similar to that in the naturalized flow scenario, although some locations and seasons are higher or lower (Figure I-26).

- The subsistence flow attainment frequency is generally similar to, or higher than, that in the naturalized flow scenario (Figure I-27).
- The subsistence flow percent shortage is generally similar to, or lower than, that in the naturalized flow scenario, and several sites and seasons exhibit a median percent shortage of 100% (Figure I-30).

4.2.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 80% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Return flow discharges and reservoir releases of stored water tend to reduce the occurrence of zero-flow days at locations downstream of population centers (Figures F-62 and F-70) over the entire period of record as compared to the naturalized flow scenario.
- Zero-flow frequencies generally decrease from upstream to downstream, are generally similar to those in the naturalized flow scenario for upstream locations, and are generally lower than those in the naturalized flow scenario for downstream locations (Figure I-31).

4.3 Partial Utilization Flow Scenario

4.3.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-63 and G-71).
- The pulse frequencies are generally similar to that in the current conditions flow scenario (Figure I-33). The target engagements met are equal to, or somewhat lower than, the pulse frequency (Figure I-34).
- The frequency volumes met are similar to the current conditions flow scenario and are more than 50% across locations and seasons, with most locations exhibiting a frequency volume met greater than 80% (Figure I-35).

4.3.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 50% to 75% of the time, depending on the location, season, and hydrologic condition (Figures D-1 through D-76).
- Base flow engagement and attainment frequency is generally similar to that in the current conditions scenario, though the number of consecutive days of attainment can be interrupted by increasing water use (Figures G-63 and G-71).
- The base flow engagement frequency is generally similar to that in the current conditions flow scenario during dry hydrologic conditions (Figure I-37).

- The base flow attainment frequency is generally similar to that in the current conditions flow scenario (Figure I-38).
- The base flow percent shortage is generally similar to that in the current conditions flow scenario (Figure I-41).

4.3.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 55% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Lower flow tributaries as well as high flow mainstem river locations have more frequent to similar occurrences of subsistence flow engagements, depending on the relative increase in return flow discharges compared to consumptive use (Figures G-63 and G-71).
- The subsistence flow engagement frequency is generally similar to that in the current conditions flow scenario, although some locations and seasons are higher or lower (Figure I-42).
- The subsistence flow attainment frequency is generally similar to that in the current conditions flow scenario, with some upstream locations having lower attainment frequencies and some downstream locations having higher (Figure I-43).
- The subsistence flow percent shortage is generally similar to that in the current conditions flow scenario, and several sites and seasons exhibit a median percent shortage of 100% (Figure I-46).

4.3.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 75% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Lower flow tributaries as well as high flow mainstem river locations have more frequent to similar occurrences of zero-flow engagements, depending on the relative increase in return flow discharges compared to consumptive use (Figures G-63 and G-71).
- Basin-wide, however, zero-flow frequencies are generally similar to those in the current conditions flow scenario (Figure I-47).

4.4 Full Utilization Flow Scenario

4.4.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-64 and G-72).

- The pulse frequencies range from 50% to 100% and are generally similar to that in the partial utilization scenario (Figure I-49). The target engagements met are equal to, or somewhat lower than, the pulse frequency (Figure I-50).
- The frequency volumes met are similar to the partial utilization scenario and are more than 40% across locations and seasons, with most locations exhibiting a frequency volume met greater than 80% (Figure I-51).

4.4.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 40% to 80% of the time, depending on the location, season, and hydrologic condition (Figures D-1 through D-76).
- The base flow engagement frequency is generally similar to, or lower than, that in the partial utilization scenario during dry hydrologic conditions (Figure I-53).
- The base flow attainment frequency is generally similar to that in the partial utilization scenario (Figure I-54) along tributaries (Figure G-64) as well as the lower mainstem river (Figure G-72).
- The base flow percent shortage is generally similar to that in the partial utilization scenario (Figure I-57).

4.4.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 55% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Increased demand for water use and the removal of return flows from the full utilization scenario tends to increase low flow periods for tributaries as well as the lower mainstem river compared to the partial utilization scenario (Figures F-64 and F-72).
- The subsistence flow engagement frequency is generally similar to, or higher than, that in the partial utilization scenario (Figure I-58) along tributaries (Figure G-64) as well as the lower mainstem river (Figure G-72).
- The subsistence flow attainment frequency is generally similar to, or lower than, that in the partial utilization scenario (Figure I-59).
- The subsistence flow percent shortage is generally similar to, or higher than, that in the partial utilization scenario, and many sites and seasons exhibit a median percent shortage of 100% (Figure I-62).

4.4.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 75% to 100% of the time, depending on the location and season (Figures D-1 through D-76).
- Increased demand for water use and the removal of return flows from the full utilization scenario tends to increase zero-flow days for tributaries as well as the lower mainstem river compared to the partial utilization scenario (Figures G-64 and G-72).
- Zero-flow frequencies generally decrease from upstream to downstream and are generally similar to, or higher than, those in the partial utilization scenario (Figure I-63).

5 Assessment of the Trinity River Basin

Before examining the tables and figures, a few pointers are worth reiterating, as follows:

- In the Trinity River basin, when the flow is below the base flow standard, the subsistence flow standard engages (not the base flow standard). Accordingly, the attainment frequency of base flows will always be 100%. This behavior can be seen in many of the outputs; e.g., in Appendix E, the base flow shortage duration, base flow shortage, and base flow percent shortage figures are blank, and in Appendix G, light green (which denotes base flow standard engaged but not attained) will not occur.
- Zero-flow periods often have a duration of 30 days. This is because the input hydrology of the daily WAM preserves the total monthly streamflow volumes of the monthly WAM. When the monthly WAM has zero flow for a month, the daily WAM, by definition, sets all the days of that month to zero flow.
- All control points in the Trinity River basin receive return flows in the current conditions and partial utilization flow scenarios. Return flows do not occur in the full utilization flow scenario. As a result, except at the Trinity River near Romayor, current conditions and partial use scenarios generally have more water in the river during low flow periods than the naturalized flow and full utilization scenarios (Figure D-77 to D-96). For most locations and seasons, the full utilization scenario has the lowest flows.
- The West Fork Trinity River near Grand Prairie and the Trinity River near Romayor are the upper- and lowermost measurement points in the basin and used here for the examination of raster hydrographs (Appendices F, G, and H).

5.1 Naturalized Flow Scenario

5.1.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-77 and G-89).
- The pulse frequency is above 80% at all locations and seasons (Figure I-65). Likewise, the target engagements met are above 80% at all locations and seasons (Figure I-66).
- The frequency volume met is generally high (often above 80%) across locations and seasons, with the Grand Prairie location having the lowest frequency volume met at approximately 60% during the spring season (Figure I-67).

5.1.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 85% to 90% of the time, depending on the location and season (Figures D-77 through D-96).

- The base flow engagement frequency varies by season but is fairly consistent across measurement points (Figure I-69).
- The base flow engagement frequency is 100% in all seasons, at all measurement points, and across all water use scenarios (Figures G-77 and G-89). Streamflows less than the base flow requirement always engage the subsistence requirement.

5.1.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 80% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Low flow periods are more common in summer and fall (Figures F-77 and F-89), and likewise, subsistence flow engagement is more common in these seasons (Figures G-77 and G-89).
- The subsistence flow engagement frequency varies by season but is fairly consistent across measurement points (Figure I-74).
- The subsistence flow attainment frequency generally increases from upstream to downstream, especially in the summer and fall (Figure I-75). Similarly, the subsistence flow percent shortage generally decreases from upstream to downstream, especially in the winter, summer, and fall (Figure I-78).

5.1.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 85% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Zero flows occur when the monthly naturalized flow volume is zero for an entire month or when there is a zero in the daily flow pattern used to disaggregate the monthly volume. Whole months of zero flows are more common in the summer season (Figures G-77 and G-89).
- The zero-flow frequencies are generally low and decrease from upstream to downstream (Figure I-79).

5.2 Current Conditions Flow Scenario

5.2.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-78 and G-90).

- Similar to under naturalized conditions, the pulse frequency is above 80% at all locations and seasons (Figure I-81). The target engagements met are above 80% at all locations and seasons (Figure I-82).
- The frequency volume met is generally high (often above 70%) across locations and seasons, with the primary exception being the Grand Prairie station in the winter (Figure I-83).

5.2.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 90% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- As subsistence flow engagement decreases with the inclusion of return flows, the base flow engagement frequency increases (Figures F-78 and F-90) compared to the naturalized flow scenario.
- The base flow engagement frequency is high (generally above 80%) and decreases slightly from upstream to downstream (Figure I-85).

5.2.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 95% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Low flow periods generally decrease across the basin due to return flows (Figures F-78 and F-90).
- Subsistence flow engagement is generally lower over the period of record (Figures G-78 and G-90) compared to the naturalized flow scenario.
- The subsistence flow engagement frequency varies by season but is fairly consistent across measurement points (Figure I-74).
- The subsistence flow attainment frequency generally increases from upstream to downstream (Figure I-91).

5.2.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) 100%, or nearly 100%, of the time, at all locations during all seasons (Figures D-77 through D-96).
- The zero-flow frequencies are nearly zero at all locations and seasons (Figures G-78, G-90, and I-95).

5.3 Partial Utilization Flow Scenario

5.3.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-79 and G-91).
- Similar to under naturalized and current conditions, the pulse frequency is above 80% at all locations and seasons (Figure I-97). The target engagements met are above 80% at all locations and seasons (Figure I-98).
- The frequency volume met is generally high (often above 70%) across locations and seasons, with the primary exception being the Grand Prairie station in the winter (Figure I-99).

5.3.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 90% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Base flow engagement frequency is high in the upper basin (Figure G-79) but decreases in the fall season in the lower basin at Romayor (Figure G-91).
- The base flow engagement frequency is high (generally above 80%) and decreases slightly from upstream to downstream (Figure I-101).

5.3.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 90% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Subsistence flow engagement frequency is low in the upper basin (Figure G-79) but increases in the fall season in the lower basin at Romayor (Figure G-91).
- The subsistence flow engagement frequency is low; the only station above 5% is the most downstream station, Romayor (Figure I-106).
- The subsistence flow attainment frequency generally increases from upstream to downstream (Figure I-107). Because subsistence flows are rarely engaged, the attainment frequency only applies to a small number of days.

5.3.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) over 99% of the time, at all locations during all seasons (Figures D-77 through D-96).
- The zero-flow frequencies are zero or nearly zero at all locations and seasons (Figure I-111).

5.4 Full Utilization Flow Scenario

5.4.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-80 and G-92).
- Similar to under naturalized, current, and partial utilization scenarios, the pulse frequency is 70% or greater at all locations and seasons (Figure I-113). The target engagements met are somewhat lower than in the other scenarios but remain above 70% at all locations and seasons (Figure I-114).
- The frequency volume met is more variable across locations than in other flow scenarios but is always above 50% (Figure I-115).

5.4.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 65% to 85% of the time, depending on the location and season (Figures D-77 through D-96).
- The base flow engagement frequency is notably lower than in the current conditions or partial utilization scenarios and generally increases from upstream to downstream (Figure I-117).

5.4.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 60% to 100% of the time, depending on the location and season (Figures D-77 through D-96).
- Increased demand for water use and the removal of return flows from the full utilization scenario tends to increase the frequency and persistence of low flow periods (Figures F-80 and F-92).
- The subsistence flow engagement frequency is notably higher than in the current conditions or partial utilization scenarios, and the frequency generally decreases from upstream to downstream (Figures G-80, G-92, and I-122).
- The subsistence flow attainment frequency is generally less than 50% (Figure I-123). Because subsistence flows are engaged less often, the attainment frequency typically applies to a small number of days.

5.4.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 70% to 100% of the time, depending on the location and season (Figures D-77 through D-96).

- Increased demand for water use and the removal of return flows from the full utilization scenario tends to increase the frequency and persistence of zero-flow periods (Figures F-80 and F-92).
- Zero-flow frequencies are higher than in other flow scenarios, with the two most upstream measurement points having zero-flow frequencies in excess of 20% in the summer and fall (Figure I-127).

5.5 Flow Regime Group Recommendations

The Trinity-San Jacinto (TSJ) BBEST and BBASC each had members with differing opinions, which resulted in two sets of recommendations from each, one by a majority "Conditional Phased" group and one by a minority "Flow Regime" group (TSJ BBEST 2009; TSJ BBASC 2010a, 2010b). Similar to the Brazos and Sabine-Neches BBESTs and BBASCs, the Conditional Phased groups did not propose attainment frequencies for their flow recommendations; however, both TSJ Flow Regime groups did. Although none of the Flow Regime recommended attainment frequencies were incorporated into the environmental flow standards, some of the flow values were. For these, Table 5-1 indicates the location, season, and TCEQ base flow standard, along with the recommended frequency that the flow value be exceeded (by either the BBEST or BBASC Flow Regime group) and the modeled frequency that the flow value is exceeded in each of the four flow scenarios used in this study. Note that the BBEST Flow Regime group recommended dry, average, and wet base flows, whereas the BBASC Flow Regime group recommended low, medium, and high base flows. Because TCEQ adopted neither, Table 5-1 was developed without regard to these qualifiers.

The frequencies in Table 5-1 are provided for informational purposes only. The recommended frequencies are not part of the environmental flow standards, nor do they represent the opinions of the majority of either the TSJ BBEST or TSJ BBASC.

Table 5-1
Modeled Exceedance Frequencies of Base Flow Standards in the Trinity River Basin and Comparisons with Flow Regime Group Recommendations

Location	Season	TCEQ Standard (cfs)	Frequency that the TCEQ Standard Is Exceeded (%)					
			BBEST Regime Group Recommended	BBASC Regime Group Recommended	Naturalized Flows	Current Condition	Partial Utilization	Full Utilization
West Fork Trinity River near Grand Prairie	Fall	35	N/A	65	74	99	100	51
Trinity River at Dallas	Winter	50	N/A	70	95	100	100	70
	Spring	70	N/A	75	98	100	100	79
	Summer	40	N/A	65	81	99	100	63
	Fall	50	76	65	79	100	100	54
Trinity River near Oakwood	Winter	340	85	75	90	98	99	74
	Spring	450	N/A	80	97	100	100	87
	Summer	250	N/A	55	78	100	100	67
	Fall	260	N/A	60	75	99	99	61
Trinity River at Romayor	Winter	875	86	75	88	88	91	82
	Spring	1,150	N/A	85	95	92	93	80
	Summer	575	N/A	65	76	98	95	96
	Fall	625	N/A	70	73	90	73	87

5.6 Freshwater Inflows

Freshwater inflows for all four flow scenarios are described in this section.

Table J-1 indicates that all target frequencies (i.e., across all flow levels and seasons) are achieved in all four flow scenarios, except for the lowest annual target inflow in the full utilization flow scenario. This target is 75%, and the predicted attainment frequency is 74%.

Table J-2 and Figure J-5 indicate that when the seasonal inflow is less than the lowest target inflow, the median duration of shortage is one season in the naturalized and current water use flow scenarios and two seasons in the partial and full utilization scenarios. The longest duration of flow lower than the lowest inflow target is six seasons, and this occurs once in the full utilization period of record.

Figures J-1 through J-4 illustrate flow duration curves for seasonal inflows combined with the target inflow levels and frequencies. In these figures, each intersection of a target inflow quantity with a target frequency is denoted with a square. Whenever a flow line is above a square, the associated target inflow and frequency are attained. Generally, the current water use and partial utilization flow scenarios are similar to each other, with the partial utilization scenario being lower than the current water use scenario during dry periods in the winter (Figure J-2) and summer (Figure J-4). The naturalized flow scenario has the highest inflows, and the full utilization scenario has the lowest inflows.

6 Assessment of the Neches River Basin

Before examining the tables and figures, a few pointers are worth reiterating, as follows:

- Similar to the Trinity River basin, when the flow is below the base flow standard in the Neches River basin, the subsistence flow standard always engages. Accordingly, the attainment frequency of base flows will always be 100%.
- Zero-flow periods often have a duration of 30 days. This is because the input hydrology of the daily WAM preserves the total monthly streamflow volumes of the monthly WAM. When the monthly WAM has zero flow for a month, the daily WAM, by definition, sets all the days of that month to zero flow.
- Similar to the Trinity River basin, all control points in the Neches River basin receive substantial return flows in the current conditions and partial utilization flow scenarios. Return flows do not occur in the full utilization flow scenario, which generally results in lower flows during dry conditions for this scenario.
- The monthly to daily flow disaggregation approach led to increased pixelation of the flow record after the construction of Lake Palestine in 1962. This pixelation is most apparent in the raster figures (Appendices F and G) and is discussed in Appendix A.
- The Neches River at Neches and the Neches River at Evadale are the upper- and lowermost measurement points along the Neches River and used here for the examination of raster hydrographs (Appendices F, G, and H).

6.1 Naturalized Flow Scenario

6.1.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-93 and G-105).
- The pulse frequency is more than 70% across locations and seasons (Figure I-129), and the target engagements met are equal to, or slightly lower than, the pulse frequency (Figure I-130).
- The frequency volume met is more than 50% across locations and seasons (Figure I-131).

6.1.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 75% to 85% of the time, depending on the location and season (Figures D-97 through D-121).
- The base flow engagement frequencies are fairly high and consistent across measurement points in the winter and spring (Figure I-133). Base flow engagement

frequencies are somewhat lower, due to higher engagement of subsistence flows, in the summer and fall (Figures G-93 and G-105).

6.1.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 75% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- Low flow periods are more common in summer and fall (Figures F-93 and F-105), and likewise, subsistence flow engagement is more common in these seasons (Figures G-93 and G-105).
- The subsistence flow engagement frequency varies by season but is fairly consistent across measurement points (Figure I-138). Generally, the highest engagement frequencies, and the greatest variability across measurements points, occur in summer.
- The subsistence flow attainment frequency is high in the winter and spring and is generally above 80%. Subsistence flow attainment is lower and more variable across stations in the summer and fall, with most attainment frequency values between 45% and 80% (Figure I-139).
- The percent shortage is generally higher in the summer and fall than the winter and spring, generally decreases from upstream to downstream, and is as high as 90% at the most upstream measurement point (Neches River at Neches) in the summer (Figure I-142).

6.1.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 90% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- The zero-flow frequencies are zero across all measurement points in the winter and spring and are low (or zero) and decrease from upstream to downstream in the summer and fall (Figures G-93, G-105, and I-143).

6.2 Current Conditions Flow Scenario

- In the current conditions and partial use scenarios, there is generally more water in the river during low flow periods than in the naturalized flow scenario due primarily to return flows.

6.2.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-94 and G-106).
- The pulse frequency is more than 70% across locations and seasons and is generally equal to, or slightly lower than, the pulse frequency in the naturalized flow scenario (Figure I-145). The target engagements met are equal to or slightly lower than the pulse frequency (Figure I-146).
- As in the naturalized flow scenario, the frequency volume met is more than 50% across locations and seasons (Figure I-147).

6.2.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 60% to 85% of the time, depending on the location and season (Figures D-97 through D-121).
- The base flow engagement frequencies are generally lower than under naturalized flow conditions due to the increase in frequency of the subsistence flow standard being engaged (Figures G-94, G-106, and I-149).

6.2.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 50% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- Low flow periods tend to increase in the summer and fall (Figures F-94 and F-106) as compared to the naturalized flow scenario.
- Likewise, the occurrence of subsistence flow engagements increase (Figures G-94 and F-106) as compared to the naturalized flow scenario.
- The subsistence flow engagement frequencies are generally higher than under naturalized flow conditions (Figure I-154).
- The subsistence flow attainment frequencies are more variable than under naturalized flow conditions, with some attainment frequencies higher and some lower, depending on the location and season (Figure I-155).
- As in the naturalized flow scenario, the subsistence flow percent shortage generally decreases from upstream to downstream (Figure I-158).

6.2.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 90% to 100% of the time, depending on the location and season (Figures D-97 through D-121).

- Whole months of zero flows are eliminated at the Neches River at Neches due to return flows (Figure G-94). In the lower basin at Evadale, some zero-flow days occur (Figure G-106) where none were present in the naturalized flow scenario.
- The zero-flow frequencies are low (or zero) and decrease from upstream to downstream (Figure I-159).

6.3 Partial Utilization Flow Scenario

- Lake Palestine is located upstream of the Neches River at Neches measurement point. The current conditions scenario, based on the TCEQ current conditions WAM, does not include releases of stored water from Lake Palestine. The partial and full utilization scenarios, based on the TCEQ full authorization WAM, do include releases of store water from Lake Palestine for meeting downstream demands. Thus, the Neches River at Neches measurement point has generally lower flows in the current conditions scenario than in the higher water use scenarios.

6.3.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-95 and G-107).
- The pulse frequency is more than 70% across most locations and seasons and is generally equal to, or slightly lower than, the pulse frequency in the current conditions flow scenario (Figure I-161). The target engagements met are equal to or slightly lower than the pulse frequency (Figure I-162).
- The frequency volume met is generally equal to or slightly lower than the frequency volume met under current conditions (Figure I-163).

6.3.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 55% to 85% of the time, depending on the location and season (Figures D-97 through D-121).
- The base flow engagement frequencies are generally similar to those under current conditions (Figures G-95, G-107, and I-165).

6.3.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 60% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- The subsistence flow engagement frequencies are generally similar to those under current conditions (Figure I-170).

- The subsistence flow attainment frequencies are generally similar to or higher than those under current conditions (Figure I-171). The Neches River at Neches measurement point has much higher subsistence flow attainment in the summer and fall seasons (Figure G-95) as compared to the current conditions scenario.
- The subsistence flow percent shortage is highly variable by location and season and does not have an apparent upstream-to-downstream trend (as in the current conditions flow scenario, Figure I-174).

6.3.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 95% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- Zero-flow days tend to shift from the summer and fall to a more year-round occurrence with a slight increase in winter (Figures G-95 and G-107).
- The zero-flow frequencies are low (or zero) and decrease from upstream to downstream (Figure I-175).

6.4 Full Utilization Flow Scenario

6.4.1 High Flow Pulse Standards

- HFP events tend to be triggered early in each season due to the magnitude of pulse trigger rates relative to the typical flow variability on all reaches (Figures G-96 and G-108).
- The pulse frequency is more than 70% across most locations and seasons and is generally similar to the pulse frequency in the partial utilization flow scenario (Figure I-177). The target engagements met are equal to or slightly lower than the pulse frequency (Figure I-178).
- The frequency volume met is generally similar to the frequency volume met under current conditions (Figure I-179).

6.4.2 Base Flow Standards

- Daily flows exceed the base flow standards approximately 50% to 85% of the time, depending on the location and season (Figures D-97 through D-121).
- Summer base flow engagement tends to increase for the Neches River at Neches (Figure G-96) compared to the partial utilization scenario as stored water releases increase from Lake Palestine. The base engagements of the other seasons are similar at this location.

- Base flow engagements for the Neches River at Evadale are similar to those under partial utilization (Figure G-108).
- The base flow engagement frequencies are similar to those under partial utilization, with a few locations exhibiting higher or lower frequencies (Figure I-181).

6.4.3 Subsistence Flow Standards

- Daily flows exceed the subsistence flow standards approximately 55% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- Low flow periods are similar in occurrence to those under the partial utilization scenario (Figures F-96 and F-108).
- The subsistence flow engagement frequencies are similar to those under partial utilization, with a few locations exhibiting higher or lower frequencies (Figure I-186).
- The subsistence flow attainment frequencies are generally similar to, or lower than, those under partial utilization (Figures G-96, G-108, and I-187).
- The subsistence flow percent shortage is generally higher than that under partial utilization (Figure I-190).

6.4.4 Zero Flows

- Daily flows exceed the nominal value for being considered a zero-flow day (0.1 cfs) approximately 95% to 100% of the time, depending on the location and season (Figures D-97 through D-121).
- The zero-flow frequencies are higher than under partial utilization but remain low (less than 5% of days except at Neches River at Neches in the fall (Figure G-96) and decrease from upstream to downstream (Figure I-191).

7 Key Findings

This section summarizes key findings of the four modeled flow scenarios and provides insights to the conditions under which attainment of environmental flow standards are met or not met. The modeling results are described from a high level in Sections 4, 5, and 6 based on the extensive catalogue of figures and metrics included in the appendices. Although some conclusions can be drawn from examination of each flow scenario on an individual basis, the reader is encouraged to make a comparative examination of the changes in both flow characteristics and environmental flow standard attainment across the flow scenarios for each basin.

Four flow scenarios were modeled for each basin to represent a range of flow conditions for comparative purposes. The flow scenarios are described in Section 3 and include the following:

- Naturalized flow
- Current water use
- Partial utilization of permitted diversions
- Full utilization of permitted diversions

Within the naturalized flow scenario, daily streamflows are reflective of conditions without the exercise of state-granted water rights including the construction of reservoirs. The current conditions scenario includes water right demands and return flows according to recent levels of utilization and discharge. Reservoirs are operated for water supply and flood control purposes in the current, partial, and full utilization scenarios. Within the partial use scenario, water right diversions are increased to a level representing a midpoint between the current and full utilization scenarios. Return flows are also increased in the same proportion to demands from the current use scenario. The full utilization scenario includes water right demands at the fully authorized amounts in their permits. No return flow discharges are simulated in the full utilization scenario. The three flow scenarios that contain water rights and reservoirs are simulated with daily adherence to the prior appropriation system.

Broad findings that are generally applicable across basins and flow scenarios include the following:

- The absence of regulation by water rights and reservoirs in the naturalized flow scenario allows streamflows to reach the highest values across all four scenarios.
- Naturally occurring low or zero-flow periods may exhibit higher flows in the current, partial, and full utilization scenarios in reaches where reservoir releases are made to provide downstream water supply.

- Return flows in the current and partial utilization scenarios can significantly ease or eliminate extreme low flow or zero-flow days in the reaches below discharge points.
- Subsistence flow engagements are generally highest in the full utilization scenario. Likewise, the percentage of subsistence flow non-attainment tends to be highest in the full utilization scenario, but the effect can be reach-specific if reservoir releases for water supply demands are present.
- Reaches with return flow discharge increase the attainment of subsistence flows.
- Base flow engagements and attainments tend to be the lowest as water right demands increase. However, like substance flow attainments, the effect of water rights can be reach-specific if reservoir releases or return flows are present.
- HFP attainment frequencies are consistently high and do not show significant sensitivity to the four flow scenarios. The HFP trigger flows in the standards are low enough that they are often exceeded with the first moderate storm event; hence, attainment often occurs early in each season. River regulation by large reservoir storage can affect the timing of pulse attainment for individual events.

7.1 Brazos River Basin

The assessment of the Brazos River basin environmental flow standard engagement and attainment is discussed in Section 4 of this report. The Brazos River basin has 19 measurement points for environmental flows. The Brazos River basin is the only basin within this report that uses a hydrologic condition for determining whether subsistence flow requirements can be engaged as well as modifying the base and pulse flow requirements within each season. The hydrologic condition is calculated independently of streamflows and thus independently of the flow scenarios.

7.1.1 Attainment of Subsistence and Base Flows

Within the Brazos River basin, base flows are always attained under dry hydrologic conditions. If the streamflow falls below the base requirement during dry hydrologic conditions, the subsistence flow is engaged. Outside of dry hydrologic conditions, subsistence flows are not engaged, and consequently base flows can be engaged and attained or not attained. The transitions over the period of record between subsistence and base flow as the lowest engaged requirement can be seen in the attainment raster hydrographs in Appendix G. The yellow lines in Appendix G indicate dry hydrologic conditions with a clustering of yellow lines during the 1950s drought.

Attainment of subsistence and base flows is generally lowest across the basin for the full utilization scenario (Figure H-1). Non-attainment of subsistence or base flows is indicated by pink and light green color codes, with or without black diagonal hatching (zero flow days).

Discharge of return flows play an important role in maintaining flow in the river and subsistence or base flow attainment during dry periods. The following measurement points show increases in zero-flow days and subsistence or base non-attainment in the full utilization scenario as compared to the naturalized flow scenario or the scenarios that include return flow discharge (Figure H-1):

- Clear Fork Brazos River at Lueders
- Brazos River near Glen Rose
- North Bosque River near Clifton
- Little River near Little River
- Little River near Cameron
- Brazos River near Rosharon

Some measurement points are located in watersheds with low amounts of upstream water right demands or are located in reaches with offsetting amounts of water right demands, return flow discharges, and reservoir releases. These factors result in little change in subsistence and base flow attainment across all four flow scenarios. The following measurement points generally show similar levels of subsistence and base flow attainments across all flow scenarios:

- Brazos River at Seymour
- Brazos River near South Bend
- Lampasas River near Kempner
- Brazos River near Hempstead

A few measurement points exhibit an exception to the general trend of lower subsistence and base attainment with increasing water right utilization. Reservoir releases for meeting downstream demands raise streamflows at times when the natural flow of the river is low. The following measurement points show reduced zero-flow days or increased subsistence and base flow attainment as water right demands increase through the full utilization scenario:

- Brazos River near Palo Pinto
- Leon River at Gatesville
- Navasota River near Easterly

7.1.2 Attainment of High Flow Pulses

Once the daily flow rate in the river exceeds the HFP trigger rate, a pulse is considered simultaneously engaged and attained. Pulse frequency is highest during the spring season under wet hydrologic conditions and lowest during the dry winters (Figures I-1, I-17, I-33, and I-49). The naturalized flow scenario generally shows increased pulse frequency compared to the full utilization scenario for dry winters and slightly increased pulse frequency for the remaining seasons and hydrologic conditions (Figures I-1 and I-49), the exception being the measurement points at Palo Pinto and Glen Rose, which have higher pulse frequency under the full utilization scenario versus naturalized under dry hydrologic conditions. The majority of pulse flow events meet their volumetric requirement (FVM) under all flow scenarios (Figures I-3, I-19, I-35, and I-51). Even without meeting their volumetric requirement, pulses are attained and terminated after the requisite duration (FDM) has passed (Figures I-4, I-20, I-36, and I-52).

By comparison of locations in Figure H-1, tributary and upper basin locations in the Brazos River basin exhibit a lower percentage of time under pulse flow engagement as compared to the middle and lower mainstem locations on the Brazos River. A couple of factors contribute to this finding. Measurement points in the Brazos River basin upstream of Palo Pinto and on the Bosque, Leon, and Navasota rivers do not have pulse requirements under certain seasons and hydrologic conditions. Additionally, under dry-average-wet hydrologic conditions at locations upstream of Palo Pinto, the number of pulse requirements is one-two-one pulses per season, whereas at the remaining locations in the basin the number of pulse requirements is at least one-three-two pulses per season.

7.2 Trinity River Basin

The assessment of the Trinity River basin environmental flow standard engagement and attainment is discussed in Section 5 of this report. The Trinity River basin has four measurement points for instream environmental flows, plus a freshwater inflow requirement for Galveston Bay. The Trinity River basin does not use a hydrologic condition. Thus, subsistence flows are eligible for engagement at any time, and only seasons define changes to the requirements.

7.2.1 Attainment of Subsistence and Base Flows

Within the Trinity River basin, base flows are always attained when engaged. If the streamflow falls below the base requirement, the subsistence flow is engaged. Consequently, subsistence is the only requirement in the basin that can be engaged and not attained. The attainment raster hydrographs in Appendix G (Figures G-77 through G-92) pertain to the Trinity River basin.

Discharge of return flows plays a dominant role in raising streamflows above the subsistence requirements at the three measurement points upstream of the Trinity River near Romayor. This effect can be seen in the shift to mostly green (base flow) color coding in the Appendix G figures for the current and partial utilization scenarios as compared to the naturalized and full utilization scenario figures.

Attainment of subsistence and base flows is generally lowest across the basin for the full utilization scenario (Figure H-2). Subsistence non-attainment is indicated by the pink color code, with or without black diagonal hatching (zero flow days).

7.2.2 Attainment of Pulse Flows

Once the daily flow rate in the river exceeds the pulse trigger rate, a pulse is considered simultaneously engaged and attained. Pulse frequency is generally higher in the winter and spring seasons under the naturalized, current, and partial utilization scenarios compared to the full utilization scenario (Figures I-65, I-81, I-97, and I-113). The full utilization scenario has the lowest pulse frequency across all seasons compared to the other three flow scenarios. The majority of pulse flow events meet their volumetric requirement (FVM) under all flow scenarios (Figures I-67, I-83, I-99, and I-115), with the exception of winter pulses at the Grand Prairie measurement point under the current and partial utilization scenarios. Even without meeting their volumetric requirements, pulses are attained and terminated after the requisite duration (FDM) has passed (Figures I-68, I-84, I-100, and I-116).

Pulse flow engagement early within each season can be seen by the vertical bands of blue color codes in the figures of Appendix G. There are four seasons within the Trinity Basin, but the two-per-season pulse requirement is combined for the summer (June through August) and fall (September through November) seasons. With the two-per-season requirement being most frequently met in June, pulses are engaged infrequently in the months of July through November. In the Trinity River basin, the HFP trigger levels are typically between the 15th and 40th percent flow exceedances in the naturalized flow scenario. This means that 15% to 40% of days exceed these flows, and it is not surprising that the HFPs are triggered early in each season.

7.2.3 Freshwater Inflows

The environmental flow standards for the Trinity River basin include long-term frequency requirements for freshwater inflows to Galveston Bay. Analyses of the freshwater inflows across the four flow scenarios are provided in Appendix J. Table J-1 indicates that all target frequencies (i.e., across all flow levels and seasons) are achieved in all four flow scenarios, except for the lowest annual target inflow in the full utilization flow scenario. This target is 75%, and the predicted attainment frequency is 74%. The annual and seasonal exceedance curves (Figures J-1 through J-4) illustrate the shift to lower freshwater inflows with increasing water right demands.

7.3 Neches River Basin

The assessment of the Neches River basin environmental flow standard engagement and attainment is discussed in Section 6 of this report. The Trinity River basin has five measurement points for environmental flows. The Neches River basin does not use a hydrologic condition. Thus, subsistence flows are eligible for engagement at any time, and only seasons define changes to the requirements.

7.3.1 Attainment of Subsistence and Base Flows

Within the Neches River basin, base flows are always attained when engaged. If the streamflow falls below the base requirement, the subsistence flow is engaged. Consequently, subsistence is the only requirement in the basin that can be engaged and not attained. The attainment raster hydrographs in Appendix G (Figures G-93 through G-112) pertain to the Neches River basin. The dominant factor for shifting from base engagement and attainment to subsistence requirements in the Neches River basin is the increase in water use across the flow scenarios. This effect can be seen in the shift to increasing occurrences of pink and red (subsistence flow) color coding in the Appendix G figures while progressing from the naturalized to full utilization scenarios. Village Creek near Kountze is an exception to this trend. Very few water rights are located on this tributary.

Attainment of subsistence and base flows is generally lowest across the Neches River basin for the full utilization scenario (Figure H-3). Subsistence non-attainment is indicated by the pink color code, with or without black diagonal hatching (zero flow days). The measurement point for the Neches River at Neches has a notable increase in subsistence non-attainment with the inclusion of water rights in the current utilization scenario. Subsistence attainment increases in the partial and full utilization scenarios from Lake Palestine reservoir releases to meet downstream demands, though the overall reduction in base flow engagement days is the same across the scenarios that include water rights. The measurement point for the Neches River at Evadale shows a steady trend towards subsistence non-attainment with increasing water demands while base engagement and attainment days decrease.

7.3.2 Attainment of Pulse Flows

Once the daily flow rate in the river exceeds the pulse trigger rate, a pulse is considered simultaneously engaged and attained. Pulse frequency is generally highest in the spring and lowest in the fall seasons across the flow scenarios (Figures I-129, I-145, I-161, and I-177), with the exception of the Evadale measurement point, which achieves 100% pulse frequency, or nearly that level, in the winter season across all flow scenarios. The majority of pulse flow events meet their volumetric requirement (FVM) under all flow scenarios (Figures I-131, I-147, I-163, and I-179) with the exception of the Neches River at Neches measurement point for the summer and fall seasons under the partial and full utilization scenarios. Even without meeting their volumetric requirements, pulses are attained and terminated after the requisite duration (FDM) has passed (Figures I-132, I-148, I-164, and I-180).

There are four seasons within the Neches River basin. The winter (January through March) and summer (July through September) seasons require one pulse event. The spring (April through June) and fall (October through December) seasons require two pulse events. Pulse flows are typically engaged early within the winter, spring, and summer seasons and can be seen by the vertical bands of blue color codes in the figures of Appendix G. Pulse engagements during the fall season tend to be more spread out across the season. In the Neches River basin, the HFP trigger levels exhibit a wide range relative to modeled flows. An extreme example is the Neches River at Evadale site, where in the winter the HFP trigger value corresponds to the flow that is exceeded 90% of the time in the naturalized flow scenario (Figure D-113). This means that 90% of winter days exceed the HFP trigger value in this scenario, and it is not surprising that the HFPs are triggered early in each season.

8 Guidance Summary

This section provides guidance targeted to different readers of this report and users of the model outputs, tables, and figures.

8.1 Guidance for All Users

The following items will be useful to all audiences of this report:

- All duration metrics are difficult to interpret because duration counts terminate due to changes in the engaged standard (which can be caused by flow going up or down) and changes in season. A different approach to calculating durations is presented in Section 8.5.
- The target engagements met metric (TEM) is very similar to pulse frequency metric (PF), and TEM is always equal to or less than PF.
- Some exceedance frequency plots of attainment metrics (Appendix E), all flow duration curves (Appendix D), and all flow raster hydrographs (Appendix F) necessarily use logarithmic scaling to allow data to be visible across a wide range of values. The reader is advised to carefully examine such figures because logarithmic scales can be less intuitive to interpret than traditional, linear scales.
- Exceedance frequency plots of attainment metrics (Appendix E) and flow duration curves (Appendix D) are constructed by ranking the data and plotting them in descending order without regard to the sequence of occurrence, with the highest value at the left edge of the plot and the lowest value at the right. The x axis portrays the percent of data that exceed the value plotted. For example, in Figure D-1, 50% of the naturalized flows exceed a value of approximately 7 cfs, and 15% of the naturalized flows exceed a value of approximately 80 cfs.
- Observations based on the flow duration curves in Appendix D do not account for engagement of the standards and should not be construed as an indication of attainment of the standards.
- In some tables and figures, zero-flow statistics are presented. Zero flows are not part of the environmental flow standards, but they have important biological significance. Zero-flow days are always days in which the subsistence flow standard is engaged but not attained, except in the Brazos River basin under average or wet hydrologic conditions when base flow is the lowest engaged requirement. In Appendices G and H, zero flow days in the Brazos River basin are indicated with black diagonal hatching over the pink color code for days in which there is subsistence non-attainment during dry hydrologic conditions, or with black diagonal hatching over the light green color code for days in

which there is base non-attainment during average or wet hydrologic conditions. In the Trinity and Neches river basins, zero-flow days are only indicated with black diagonal hatching over the pink color code for days in which there is subsistence non-attainment. In the Trinity and Neches river basins, base flow is always attained (green color code) when the river flow meets or exceeds the base flow requirement.

- The attainment frequencies matter, but attention should also be paid to the engagement frequencies. In comparing some simulations, the attainment frequencies may not be meaningfully different, but if base flow days in simulation A convert into subsistence flow days in simulation B, that may be ecologically important. For example, consider the Neches River at Evadale in Figure H-3. In each consecutive flow scenario (from naturalized to current, partial, and then full utilization), the attainment frequency of the subsistence flow standard changes only modestly, but the engagement of the subsistence flow standard increases, at the expense of base flow days. Between the naturalized and full utilization flow scenarios, approximately 25% of the entire period of record has been converted from the base flow standard being engaged to the subsistence flow standard being engaged.
- The structure of the standards varies by basin and can influence engagement and attainment. For example, in the Trinity and Neches river basins, when flows drop below the base flow standard, the subsistence flow standard automatically engages (Table 2-1). This means that in the Trinity and Neches river basins, when the base flow standard is engaged, it is always attained. It also means that light green does not appear in figures in Appendices G and H for these river basins; rather, when flows are below the base flow standard, this is shown in red or pink. Conversely, in the Brazos River basin, during average and wet conditions, if the flow drops below the base flow standard, the subsistence flow standard does not apply and light green (non-attainment of the base flow standard) is shown in Appendices G and H. This difference in rules results in red and pink in the Trinity and Neches river basin figures, whereas the same flows (relative to standards) might be plotted as light green in the Brazos River basin figures.

8.2 Guidance for BBASCs and Other Stakeholders

Sections 4 through 7 provide results and findings specific to each BBASC. This section provides overall guidance relevant to all three BBASCs.

The tables and figures in the appendices to this report provide a wide variety of perspectives on the environmental flow standards. For stakeholders wishing to learn about a specific location, the PDF bookmarks and a simple word search in each appendix for your location of interest will efficiently guide you to relevant information. The following bullets identify common categories of interests and the best source(s) of such information:

- Overview of flow at a location and relationship to the flow values in the environmental flow standards
  - Appendix D: Flow Duration Curves
- Quantitative attainment metrics for a specific location, season, and hydrologic condition
  - Appendix C: Summary Tables
- Patterns of attainment metrics across locations within a river basin
  - Appendix H: Attainment Code Frequency Plots
  - Appendix I: Column Plot Matrices of Attainment Metrics
- Impacts of water use on flow at a location
  - Appendix D: Flow Duration Curves
  - Appendix F: Flow Raster Hydrographs
    - Can be used but requires switching from page to page
- Flow patterns over time at a location
  - Appendix F: Flow Raster Hydrographs
- Attainment metric patterns over time at a location
  - Appendix G: Attainment Raster Hydrographs
- Impacts of water use on attainment metrics at a location
  - Appendix E: Exceedance Frequency Plots
  - Appendix G: Attainment Raster Hydrographs
    - Can be used but requires switching from page to page
  - Appendix H: Attainment Code Frequency Plots
- Freshwater inflows
  - Appendix J: Freshwater Inflow Metrics

Appendix H (Attainment Code Frequency Plots) provides perhaps the simplest summary of attainment frequencies across an entire river basin and for all four flow scenarios.

8.3 Guidance for WAM Modelers

The WAM modeling assumptions and revisions used in this study are described in Appendix A. The following guidance is provided for WAM modelers who conduct similar studies in other basins:

- Attention and scrutiny should be given to daily disaggregation patterns, especially when modeling environmental flows. Although the WAM monthly naturalized flows control the volume of water per month, the disaggregation patterns should also represent natural daily flow fluctuations as closely as possible.

- The physical location of major water demands should be modeled as accurately as possible, regardless of the location of the original water right being used to meet the demand. Demands for reservoir stored water should be placed at actual delivery locations. Reservoir releases to meet downstream demands can greatly influence environmental flow attainment as opposed to aggregating demands for stored water at the reservoir perimeter.
- Routing, water availability forecasting, and negative incremental flow options can greatly affect water availability computations for run-of-river rights and reservoir filling. Consequently, environmental flow attainment, particularly for low flow periods, will be affected. Simulations that do not employ routing and forecasting can maximize water right diversions and increase the frequency of zero-flow days. However, activating routing and water availability forecasting are important options for representing travel times through the river network and the effects on environmental flows.
- Development of daily WAMs from existing monthly models may require numerous changes to the input records, especially to records associated with target building, water right backups, and water right special conditions. WRAP contains a large suite of options for representing water rights. Each water right should be examined for daily computational logic where target building, backup, and special conditions are represented in the model.
- Flood control reservoirs are typically modeled without regard to downstream water availability or instream flow requirements. Flood control reservoir operations are only focused on reducing regulated flows below established flood stage levels. Impounding water in flood control reservoirs can change simulated regulated streamflows after the priority date at which environmental flow standards have been engaged. At the high flow levels at which flood control reservoirs operate, this will rarely affect the attainment or engagement of environmental flow standards. However, although rare, it is possible for flood control reservoirs to affect attainment or engagement of the standards, especially when flood control reservoirs impound water to reduce flooding events at far downstream locations even if an environmental flow measurement point closer to the reservoir is experiencing base flow standard or lower flow conditions. For example, at the priority date of the environmental flow standards, a location downstream of a reservoir may be attaining the base flow standard, but at the end of the WRAP algorithm for that day, flooding further downstream is identified, triggering the upstream reservoir to hold back water. This could cause the status of environmental flows location to switch to

non-attainment of the base flow standard. Attention should be given to travel time between flood control reservoirs and downstream environmental flow measurement points. Additionally, flood control reservoirs may release stored water for many days, weeks, or occasionally months after a flood event has subsided. Flood control releases may increase environmental flow attainment during post-flooding periods.

8.4 Guidance for TWDB and other Technical Experts

The appendices to this report contain more than 200 pages of tables and 1,000 pages of figures. Even so, certain model conclusions may be easier to ascertain by developing new and improved visuals. For this reason, model outputs and the Python code used to generate the tables and figures are being provided to TWDB for staff use and enhancement. In this study, efforts were made to use intuitive and consistent colors and patterns where possible. It is recommended that these be maintained in any revisions to the Python code.

8.5 Study Limitations and Recommendations for Future Work

8.5.1 Geographic Scope

This study was limited to three river basins, the Brazos, Trinity, and Neches. TWDB or others may wish to adapt this assessment to additional basins. Every attempt was made to generalize the Python code with the intent that it could be relatively easily adapted for other basins in the future. However, each basin has specific locations and environmental flow standards, which will necessitate a moderate level of effort to develop code enhancements for each new basin. This will particularly be true for basins that have different styles of standards (e.g., the freshwater inflow standards in the Guadalupe-San Antonio river basin).

8.5.2 Additional metrics

As the TWDB receives comments on this study and as staff review the draft deliverable, other concepts for attainment metrics may be suggested. These should be able to be accommodated with revisions to the Python code.

8.5.3 Comparison to USGS Gaged Flows

This study used four daily WAM simulations to evaluate the attainment of environmental flow standards under different modeled flow scenarios. An additional option could be to similarly evaluate the attainment of the environmental flow standards using U.S. Geological Survey (USGS) daily average gaged flow rates. This calculation is possible because each of the environmental flow measurement points corresponds to a USGS flow gage. If this calculation is pursued, the following should be considered:

- Gages with relatively short periods of record may result in biased results if the gaged period of record is not representative of the long-term flow behavior at the location. The Senate Bill 3 Science Advisory Committee for Environmental Flows (SAC 2011) cites recommendations of having 20 to 30 years of data as a minimum to represent hydrologic variability at a site.
- Gaged records necessarily reflect changes in water demands, return flow discharges, and the construction of reservoirs over time. Long-term records at gages downstream of significant demands, return flow discharge points, or reservoirs often show a changing pattern to the flow regime over time. This may confound the interpretation of environmental flow standard attainment when comparing older and newer gaged records.

8.5.4 Improvements to the Partial Utilization Flow Scenario

This study uses the daily WAMs and accordingly is dependent on the assumptions and limitations of the monthly WAMs and the daily WAMs. For this project, current conditions are represented by the most recent versions of WAM Run 8, and full utilization is represented by WAM Run 3, both of which are commonly used WAM runs. However, the partial utilization scenario was developed specifically for this study, essentially as an average between current conditions and full utilization, and is not based on a defined future time horizon. Regional water planning groups and TWDB have developed, or are developing, more robust estimates of future water demands, including demands based on specific decades (e.g., 2030 or 2040). Once finalized, these estimates could be incorporated into the methods developed for this study to provide projections of the attainment of environmental flow standards based on time horizons.

8.5.5 Attainment Without Regard to Engagement

This study focused on attainment of environmental flow standards when they are engaged. This kept the focus on the regulatory standards and what they require of permit holders who are subject to them. For example, at the Brazos River at Rosharon, using the naturalized flow scenario, the engagement frequency of the subsistence flow standard in winter is 11.9%, and the attainment frequency (i.e., when engaged) is 72.7% (Table C-23C). A somewhat different way to evaluate environmental flows would be to calculate the attainment of each environmental flow standard value, regardless of whether the corresponding standard is engaged or not. This alternative method was not performed in the current study, but the flow duration curves in Appendix D can provide some insights. For example, Figure D-74 (Brazos River at Rosharon) indicates that the flow value corresponding to the winter subsistence flow standard is exceeded approximately 96% of the time in winter in the naturalized flow scenario. In the following paragraphs, this value of 96% can be thought of as an exceedance frequency of a flow value that happens to be an environmental flow standard.

Metrics describing the exceedance frequency of a flow value, which can be viewed as attainment without engagement, can be useful in environmental evaluations, including water quality, biology, and geomorphology. Such metrics would be more straightforward to calculate than the metrics developed in this study but would require modifications to the Python code. Similarly, other metrics describing attainment of a flow value without regard to engagement of a flow standard could be developed. In particular, duration metrics may be useful.

In this study, the consecutive day counts that result in duration metrics are frequently interrupted by changes in the engaged flow standard, resulting in short attainment (or non-attainment) durations and confounding the interpretation of these durations. Instead, if the algorithm simply tracked consecutive days above the environment flow standard's values, but without regard to which is engaged on a given day, the duration metrics may be more useful. They would still be interrupted by changes in season because changes in season often are associated with changes in the value of the environmental flow standard, but such interruptions would be less frequent than in the current study. For example, consider a hydrograph where the flow is above the base flow for 2 days, then above the HFP trigger flow for 1 day (which initiates a high flow pulse), and then remains above the base flow for 2 more days, at which time the HFP ends due to achieving the volume criteria. The flow in all 5 days is above the base flow standard. In the current study, the attainment duration of the base flow standard is 2 days because the base flow standard is engaged in only the first 2 days. In an approach that considers attainment without regard to engagement, the duration of base flow attainment would be 5 days. This latter way of reporting may be useful for scientists and stakeholders, even though it is not strictly adhering to what the environmental flow standards require.

8.5.6 Define Attainment Thresholds to Protect a Sound Ecological Environment

SB 3 defined an environmental flow regime as a schedule of flow quantities adequate to support a sound ecological environment. TCEQ adopted environmental flow standards that contain flow rates but not frequencies of occurrence or other metrics. Furthermore, TCEQ has largely used the standards as pass-through requirements on new water rights or major amendments to existing water rights. Given that the flow standards were never intended to be attained 100% of the time, and that TCEQ has not adopted attainment frequencies (or other metrics), there is currently no basis to identify which sites or flow scenarios could be at risk of not supporting a sound ecological environment. The inability to identify potential failures, either under real-world conditions or projected flow scenarios, limits the ability of stakeholders to develop suitable strategies to supplement flows. Simply put, it is difficult to generate broad support and funding to fix a problem if the problem cannot clearly be identified.

Ideally, scientists, stakeholders, and TCEQ will establish minimum frequencies of occurrence (or other metrics) of the flow values in the environmental flow standards, which would facilitate identification of sites or flow scenarios at risk. These could then form the basis for voluntary measures to protect environmental flows, or other strategies, as envisioned in SB 3. In the absence of specific frequencies or other metrics, the best way to identify sites or flow scenarios at risk is to look at relative attainment and investigate site- or watershed-specific factors driving changes in attainment.

8.5.7 Translate Flow Metrics to Habitat Metrics

This study focused on hydrology and attainment of the flow values in the environmental flow standards when the standards were engaged. An important enhancement would be to expand this work to develop metrics of flow-dependent ecosystem features. For example, the Texas Instream Flow Program (2018) presents curves of weighted useable area for different habitat types against flow at multiple locations in the Brazos River. These curves could be combined with frequencies of attainment of environmental flow standards to develop frequencies of occurrence of habitat areas. Such information could be useful in defining the adequacy of the environmental flow standards to support a sound ecological environment.

9 References

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[2] This reference is cited in Appendix A of this report.

Appendix A
WAM Input Files and Modifications

August 2021
Evaluating the Attainment of Environmental Flow Standards

WAM Input Files and Modifications

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ABBREVIATIONS

BRA	Brazos River Authority
BRA SysOps	Brazos River Authority Systems Operations
cfs	cubic feet per second
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
WAM	water availability model
WRAP	Water Rights Analysis Package
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

1 Water Availability Model Input Files and Modifications

Model input files and software for the Texas Water Development Board (TWDB) project are provided in four directories:

1. Brazos: daily Brazos River basin model input files
2. Trinity: daily Trinity River basin model input files
3. Neches: daily Neches River basin model input files
4. Water Rights Analysis Package (WRAP): executable programs and supporting manuals

Subdirectories are contained within each basin directory. Subdirectories are named with a numerical convention, which is designated by the first character of each subdirectory name as follows:

- 0: Source model files used to construct the four flow scenarios
- 1: Naturalized flow scenario
- 2: Current conditions flow scenario
- 3: Partial utilization flow scenario
- 4: Full authorization flow scenario

1.1 Source Model Files

The daily water availability models (WAMs) created by Ralph Wurbs (Wurbs 2019a, 2019b, 2020)[1] representing full authorization and current conditions are included within the source subdirectories. The reports that describe the Wurbs models are included with the model input files. The Trinity and Neches river basins only contain the Wurbs daily models within the source subdirectory. The Texas Commission on Environmental Quality (TCEQ) monthly full authorization and current condition WAMs are also included in the Brazos River basin source subdirectory. This appendix describes the combined use of the TCEQ monthly models and the Wurbs daily model for creation of the TWDB daily flow scenario models for the Brazos River basin.

The daily WAMs developed for the TWDB project adopt the input files and modeling assumptions of the source model files to the extent possible. The TWDB project was not focused on modifications or improvements of the source models other than to activate daily modeling capabilities (in the cases where monthly time step WAM input files were the source models) and to facilitate the assessment of environmental flow attainment. Daily WAM specific inputs, such as routing parameters, flow patterns, and flood control reservoir operations, are shared features

[1] The references for all citations in this appendix can be found in the References section of *Evaluating the Attainment of Environmental Flow Standards*.

between the source models and the daily WAMs developed for this project, unless otherwise noted in this appendix.

1.2 TWDB Project Model Files

The TWDB project model input files are contained within each river basin's subdirectories (1, 2, 3, and 4). The model input files are composed of a set of DAT, DIS, DIF, and DSS files. The model input files are configured for running with the January 2021 Draft Test version of WRAP-SIMD, which is included in the WRAP directory. Additional post-processing TIN files are included for extraction of time series outputs from the models using WRAP-Tables. The project primary input files, DAT, for each basin and flow scenario contains a set of comment records near the top of the file. The comment records identify the version of the source input files used to create the set of project modeling files.

The project model DAT files are named with the following convention: basin name, flow scenario identifier, "D" for daily, and "-TWDB.DAT." For example, the DAT file corresponding to the full authorization scenario for the Brazos River basin is named *Brazos3D-TWDB.DAT*. The names of all primary input files for each basin and flow scenario are given in the following table.

Table A-1
Primary Input Files for WAM Simulations

Flow Scenario	Brazos Basin	Trinity Basin	Neches Basin
Full Authorization	Brazos3D-TWDB.DAT	Trinity3D-TWDB.DAT	Neches3D-TWDB.DAT
Current Conditions	Brazos8D-TWDB.DAT	Trinity8D-TWDB.DAT	Neches8D-TWDB.DAT
Partial Utilization	BrazosPD-TWDB.DAT	TrinityPD-TWDB.DAT	NechesPD-TWDB.DAT
Naturalized Flow	BrazosND-TWDB.DAT	TrinityND-TWDB.DAT	NechesND-TWDB.DAT

The hydrology input files for each project model are named for the river basin followed by the file extension. Three hydrology files with file extensions DIS, DIF, and DSS are provided with each flow scenario. The DSS file contains the additional identifier HYD preceding the file extension per the naming convention for the use of U.S. Army Corps of Engineers (USACE) HEC-DSS formatted files described in the WRAP Users Manual (Wurbs 2021b).

Six files are included in each flow scenario subdirectory with the file extension TIN for use with WRAP-Tables to extract output from the simulation daily output SUB file. The TIN files use the following naming convention: "TS-" for time series, name of the time series to be extracted, a 4-character river basin identifier, and a 1-character flow scenario identifier followed by the file extension. For example, the extraction of daily base flow target time series from the Brazos River basin full authorization simulation is directed by file TS-Base-Braz3.TIN. Time series are extracted at all environmental flow standard control points using the TIN files. The TIN files include the following:

- Base: base flow targets without subsistence and pulse flow targets
- Flag: simulation generated daily flags to identify components of the final instream flow target (IFT) building process and an attainment calculation of either subsistence or base flow requirements when engaged
- IFT: final daily instream flow target applied at control points equal to the maximum of subsistence, base, and pulse flow targets
- Pulse: pulse flow targets without subsistence and base flow targets
- Reg: end-of-day final regulated flow at control points
- Subs: subsistence flow targets without base flow, pulse flow, and without the 50% rule application for the Brazos River basin

1.2.1 Modifications to Input Files

Source model files used to develop the four flow scenarios were downloaded from Dr. Ralph Wurbs' professorial website at Texas A&M University (TAMU 2021) and the TCEQ WAM website (TCEQ 2020). Modifications were made to the source model files to develop the flow scenarios. The Brazos River basin required the combined use of the source models available from Dr. Wurbs and TCEQ to develop flow scenarios. The Trinity and Neches river basin flow scenario models were adapted directly from the source models available from Dr. Wurbs.

1.2.2 Brazos River Basin – Full Authorization

The full authorization scenario, also known as Run 3, of the daily Brazos River basin WAM described in Wurbs 2019a was built from a previous version of the monthly full authorization model that did not contain the Brazos River Authority Systems Operations (BRA SysOps) permit. Much of the information in the DAT file described by Wurbs 2019a is still relevant to a daily Brazos River basin simulation. However, the newer version of the monthly TCEQ Brazos River basin full authorization DAT file differs enough from the Wurbs 2019a version, that the newer TCEQ monthly simulation version was chosen as the base model DAT file to adapt for daily simulation. The newer TCEQ monthly version of the monthly TCEQ Brazos River basin full authorization DAT file is marked with a date of February 1, 2018. Relevant input records from the Wurbs 2019a daily Brazos River basin DAT file were transferred to the newer TCEQ monthly Brazos River basin DAT file to create a new daily Brazos River basin DAT file for this project. Additional input records were added to the DAT file to convert the BRA SysOps permit to a daily simulation format. Modifications to each input file of the monthly TCEQ full authorization model to create a daily simulation model are described in the following sections.

1.2.2.1 DAT File

The following list includes all modifications made to the monthly TCEQ DAT file to convert it into a daily simulation. The list of modifications follows the order of appearance from top to bottom within the DAT file.

- *JD* record field 9 negative incremental flow parameter ADJINC is changed from 5 to 7. Option 5 does not work in daily models and options 4 or 7 are recommended for daily simulations depending on the use of routing and forecasting.
- *JD* record field 12 table length parameter *TL* is changed to 13 to accommodate additional entries on *SV/SA* records related to flood control pools.
- *JO* record fields 2 and 6 parameters INEV and DSSHI are changed to values of 6 and 1, respectively, to accommodate DSS file format hydrologic inputs with the 2021 version of WRAP-SIMD.
- Daily input records *JT* and *JU* are adopted from the Wurbs 2019a daily Brazos River basin model, but with modifications to activate forecasting on the JU record: WRMETH option 1, WRFCST option 2, and FCST option 2.
- *OF*, *OFV*, *HI*, and *DF* records controlling DSS file options are adopted from the Wurbs 2019a daily Brazos River basin model.
- Coefficient *UC* records relating to the monthly environmental flow standards are deleted. These records will not be used with the daily environmental flow standard target setting records specified towards the bottom of the DAT file and described in item 19.
- *UC* records for winter, spring, and summer environmental flow standards seasons are added.
- Control point *CP* records associated with the monthly environmental flow standards are deleted.
- *CP* records associated with daily hydrologic condition *HI* records are added with identifiers UPPER, MIDDLE, and LOWER.
- *CP* records are added and associated with tracking water availability within the BRA SysOps permit. The additional control point records begin with AC5155.
- *CP* records are added and associated with setting and tracking daily environmental flow standard instream flow targets. The additional control point records begin with REGFLW. Input records associated with the environmental flow standards are described further in item 19.

- Constant inflow *CI* records associated with the BRA SysOps permit, beginning with control point identifier (CPID) SR5155, are increased with an extra digit to ensure sufficient accounting volumes are available in the daily computations.
- *CI* records associated with the monthly environmental flow standards are deleted.
- Numerous *DO* records are added to facilitate daily target setting computations.
- Supplemental option *SO* records using the BACKUP option were changed to the updated backup *BU* record format. A *DO* record with field 2 option 15 was added to allow water right shortages and backup targets to be considered on a daily basis.
- *WR*/*WS*/*PX*/*DW* records were added to establish accounting reservoirs to track daily water availability during the second simulation based on monthly volumes established during the first simulation. The first input record can be found in the DAT file by searching for water right identifier SET-AC5155.
- Water right priority dates equal to 99999999 were switched to 89999999 to move these actions within the priority order before simulating flood control operations. An example of this modification can be found by searching for water right identifier IFPOSDOM_UP.
- *WS* records were modified for water rights that only divert from storage, also known as "type 2 or 3" water rights, which are connected to a reservoir associated with a reservoir evaporation allocation *EA* record. The *EA* record identifier was removed from the *WS* record to eliminate warning messages in the MSS file.
- Input records in the monthly WAM associated with computing and assigning the environmental flow standards at 19 control points in the Brazos River basin were removed. Input records for the daily environmental flow standards were adapted from the Wurbs 2019a daily Brazos River basin model and added. Additional input records were added to perform computations to compile information on the target building process and attainment of subsistence and base flow requirements. The information is rolled-up into a daily time series output flag.
- Reservoir flood control operation records were added directly from the Wurbs 2019a daily Brazos River basin model with alteration for accommodating the Belton evaporation allocation component reservoir.
- Storage volume and surface area *SV/SA* records were modified to accommodate flood control storage volumes and surface areas.
- Evaporation allocation *EA* records were modified to include flood control pools.

The more complex modifications for converting the monthly TCEQ full authorization DAT file into a daily time step capable model are described in further detail as follows:

- *Items 10 and 16*: The BRA SysOps permit is simulated in a dual simulation configuration. During the first simulation, stream flow depletions of water rights are recorded using *PX* records with field 2 option 4. The total monthly depletions are transferred into the second simulation using *PX* records with field 2 option 5. However, the amount of monthly stream flow depletion from the first simulation is available within the second simulation only on the first day of each month in a daily simulation. Therefore, the accounting control points and the *WR* records connected to these accounting control points establish a framework to allow the monthly stream flow depletion volume to be accessible within the second simulation throughout the entire month using accounting reservoirs. The accounting reservoirs receive an accounting volume in the form of artificial return flows from the control point that tracts first simulation streamflow depletions. For example, control point SR5155 is used to track first simulation streamflow depletions associated with the Possum Kingdom water right. In the second simulation, the monthly amount of streamflow depletion is transferred from SR5155 to control point AC5155 on the first day of each month in the second simulation. Accounting reservoir AC5155 holds the accounting storage until second simulation water rights make streamflow depletions up to an amount not to exceed the storage held in AC5155 over the course of an entire month.
- *Item 14*: Daily simulation target building steps are described in Chapter 2 of the Daily Manual. Steps 1 through 12 are used to build a target based on monthly volumes on the first day of each month. The day 1 targets are then distributed to daily target volumes in step 13. Steps 14 through 22 are used to build daily targets based on daily volumes. Daily target building steps can be accessed with *DO* and *DW* records. The most common application of daily option *DO* record target building in the Brazos River basin WAM involves changing *TO* records from monthly to daily computations. Without a *DO* record, the *TO* records in a daily model will set a target based on the *TO* record variable on the first day of the month. The first-day target will be uniformly distributed to daily volumes in step 13 of the target building process. In most instances, the intention of the *TO* record is to build a target based on a variable, which is measured in each time step. A *DO* record with field 3 option 16 allows the target to be computed from the *TO* record on a daily basis rather than only once on the first day of the month. For example, a *TO* record may measure regulated flow at a particular control point to set a target. Without converting the *TO* record computations to a daily time step basis, the regulated flow on the first day of the month will be used to set a target which is uniformly applied to all days of the month and thus miss the variability in regulated flow on the second through the last days of the month.

- *Item 15*: Without the *DO* record, water right backup target setting occurs monthly and is based on the previous month's shortages. If multiple *WR/BU* records are connected, it may take many months for the initial *WR* record shortage to reach the final *WR/BU* record in the series. Adding a *DO* record with field 2 option 15 allows the initial *WR* record shortage to be passed each day through the *WR/BU* series.
- *Item 19*: The focus of the TWDB project is an attainment assessment of the environmental flow standards under four flow scenarios. The description of the modifications within item 19 addresses the establishment of the environmental flow standards' instream flow targets within the daily time step simulation and calculations used for attainment assessment. All other modifications described in this document are a necessary part of building the daily time step simulation framework and flow scenarios, but are not directly associated with the environmental flow standards.

Environmental flow standards are processed in accounting control points not connected to the mainstem of the river. This differs from the approach used in the Wurbs 2019a daily model in which all environmental flow standards are processed on the mainstem of the river. Accounting control points are used in this work so that the regulated flow at the location and priority of the environmental flow standard can be copied into the accounting control points with an additional volume of 0.01 acre-feet per day added to the copy of the regulated flow. The additional volume is used to track the duration of pulse flow events when the regulated flow in the river is equal to zero. Pulse flow events are tracked in the internal computations of WRAP-SIMD when regulated flow is zero. However, the pulse flow target is set to zero on these days and thus obscures whether the pulse is still engaged or has terminated when analyzing the simulation time series output. The additional volume of 0.01 acre-feet allows a non-zero pulse flow target to continue to be set and tracked while remaining small enough to not affect the overall environmental flow standards target setting process. An additional 0.01 acre-feet per day is equivalent to 0.005 cubic feet per second (cfs) and is sufficiently less than the numerical precision for identifying zero-flow days in the daily SUB output file.

The *IF/HC/ES/PF* records from the Wurbs 2019 Brazos River basin model (Wurbs 2019a) are copied into the accounting control point framework. Additional input records are included to perform computations related to the creation of an output variable, EFS-FLAG. Each of the 19 environmental flow standard control points has a corresponding EFS-FLAG, which forms a daily time series. The digits of the daily flag form a code, ABCDEF.G, which is used for automated output processing of the environmental flow standard target building process and attainment metrics for subsistence and base flow. The first 6 digits, ABCDEF, record information related to the daily environmental flow standard target building process. The final digit, G, records whether subsistence or base flow requirements are attained when they are setting the daily instream flow target. Information regarding pulse attainment is automatically output to the SMM message file using *PF* record field 15 option 1. The SMM file results are organized by date and according to the *PF* record field 17 identifiers.

The digits in the EFS-FLAG time series are decoded as follows:

- **A** = 1,2,3,4 if subsistence, base, pulse, or large pulse, respectively, sets the daily instream flow target, and is referred to as the “controlling” requirement in the following discussion.
- **B** = 4 if a large pulse is engaged, 0 otherwise. Only the Palo Pinto and Glen Rose control points have large pulses included in their environmental flow standards.
- **C** = 3 if a small or single-tier seasonal pulse is engaged, 0 otherwise. Only Palo Pinto and Glen Rose in the Brazos River basin have both large and small pulses. All other control points in the Brazos River basin and all control points in the Trinity and Neches river basins have single-tier seasonal pulses.
- **D** = 1,2,3,4 for winter, spring, summer, or fall seasons, respectively, for consideration of subsistence and base flow requirements. For the Brazos and Neches river basins, digits D and E will always be the same. No fall season is specified in the Brazos River basin.
- **E** = 1,2,3,4 for winter, spring, summer, or fall seasons, respectively, for consideration of pulse flow requirements. For pulses in the Trinity River basin, summer and fall are treated as a single season.
- **F** = 1,2,3 for dry, average, or wet hydrologic conditions, respectively. Digit F will be zero for the Trinity and Neches river basins, which do not have a hydrologic condition.
- **G** = 0,1,2,3,4 added to the tenths decimal place.
  - 1 if subsistence is controlling and is not met by end-of-day regulated flow.
  - 2 if subsistence is controlling and is met by regulated flow.
  - 3 if base flow is controlling and is not met by regulated flow.
  - 4 if base flow is controlling and is met by regulated flow.
  - 0 if a pulse is controlling the daily instream flow target.

For ease of reading, within the main body of this report, *Evaluating the Attainment of Environmental Flow Standard*s, the term “engaged” is synonymous with the environmental flow requirement that has been selected by the WRAP to set the daily instream flow target, i.e., the requirement that has been determined to be controlling.

However, in this appendix, the term “engaged” has a slightly different meaning than it does in the main body of the report. Furthermore, the term “controlling” in this appendix is synonymous with the term “engaged” in the main body. This inconsistency was consciously selected as the best, albeit not perfect, solution to reconciling the following two conflicting goals of this report:

1. Maintaining readability of the main body of the report for most readers
2. Using language in this appendix that precisely represents the complexity of the environmental flow standards and the algorithm for how WRAP reconciles multiple standards.

The environmental flow standards are multifaceted to address a range of flow regimes, which requires tracking of flow conditions, hydrologic conditions, and engagement and termination criteria for more than one requirement on any given day. In essence, there are times when more than one requirement is engaged by WRAP, but only one can be in control of the daily instream flow target. Thus, the discussion in this appendix distinguishes between the terms ”engaged” and “controlling” to explain the calculations occurring within the model.

There are intermediate steps within the WRAP instream flow target building process that are relevant to the creation of the EFS-FLAG variable. Specifically, digits B and C of the flag indicate whether a pulse event has been initiated and has yet to be terminated according to volumetric or duration criteria. An initiated and active pulse event is referred to as ”engaged” in the WRAP manuals. As will be shown, there are days in which an engaged pulse is not the controlling requirement that sets the daily instream flow target as indicated by digit A of the flag.

The daily WAMs have input records that set a single daily instream flow target at the priority date of the environmental flow standards at each of the pertinent control points. The instream flow target represents the amount of regulated flow that must remain in the river before junior water rights can make diversions. Instream flow targets are calculated by WRAP using both the regulated flow and the flow rate requirements set forth by the standards and organized on the *HC*/*ES*/*PF* input records. WRAP’s methodology identifies which requirements are engaged according to season, hydrologic conditions, and regulated flow. The largest engaged requirement is selected as the final daily instream flow target. The following definitions provide further insight into WRAP’s methodological steps to set daily instream flow targets and how those steps are translated into digits for the flag:

- **Engaged**: The requirements that are identified by WRAP for protecting a daily flow rate (acre-feet per day derived from input record values in cfs). In the case of subsistence or base flow requirements, WRAP will only engage one of the requirements based on the regulated flow. A pulse is engaged when the regulated flow exceeds the trigger criterion and is only terminated after meeting volumetric or duration criteria. A pulse is engaged simultaneously with either a subsistence or base flow requirement. Pulse engagements are identified with EFS-FLAG digits B and C.

- **Requirement**: A specific flow rate in cfs to be protected from diversions by water rights to which the environmental flow standards apply. Pulse requirements differ from subsistence and base flow requirements in that the flow rate requirement is equal to the lesser of the regulated flow or the pulse trigger criterion.
- **Controlling**: The largest engaged requirement each day. The controlling requirement is used by WRAP to set the daily instream flow target at each control point. If a pulse is engaged, but the regulated flow is less than the engaged subsistence or base flow requirement, then the engaged subsistence or base flow requirement is chosen by WRAP as the controlling requirement. The controlling requirement is denoted with EFS-FLAG digit A.
- **Target**: The final calculated flow rate to be protected each day. Daily instream flow targets are set by WRAP according to the controlling requirement.

The *IF*/*HC*/*ES*/*PF* input records in the daily WAM DAT files organize all requirements of the environmental flow standards. The hydrologic condition, if specified, is provided on the *HC* record and is used by the *ES* and *PF* input records to identify which requirements are eligible for consideration. Subsistence and base flow requirements are provided on the *ES* input records and are considered each day of the simulation for determining which requirement to engage. Based on this information, WRAP develops an intermediate target, pending further computations by the *PF* records. Pulse flow requirements are provided on the *PF* record and engage a pulse event when the regulated flow has exceeded the trigger criterion and the volumetric, duration, and pulse count criteria are unmet. WRAP then selects the larger of the pulse flow target or prior target as the final target (this selection is set when the default value of *PF* record field 14 is used, which is the case for all *PF* records in all daily WAM DAT files used in this project). Thus, either the *ES* record subsistence/base flow target or *PF* record pulse flow target will be designated as the final, or controlling, instream flow target and passed to the instream flow *IF* record. In instances when a pulse flow is engaged and the regulated flow has fallen below the subsistence or base flow target, then the final instream flow target will be equal to the subsistence or base flow target.

The following examples illustrate the concepts of engagement, selection of a controlling requirement, and instream flow target setting:

1. The regulated flow is above the base flow requirement for the given season and hydrologic condition. A pulse has not been triggered, and a pulse is not currently engaged from a previous day.

a. Only one requirement is engaged: the base flow requirement.
b. The base flow requirement is the largest and is selected as the controlling value.
c. WRAP sets an instream flow target equal to the base flow requirement.
d. The first three digits of the EFS-FLAG, as read from left to right, are 200.

2. The regulated flow is above both the base flow requirement and pulse flow trigger criterion. A pulse was not engaged in the day prior, and the number of seasonal pulses has not been met.
   a. The base flow requirement is engaged, and an intermediate target is set.
   b. A new pulse flow event is engaged. The pulse requirement is set equal to the trigger criterion because the regulated flow exceeds the criterion flow rate.
   c. There are two requirements that are engaged: the base flow and the pulse trigger flow rate.
   d. The pulse trigger flow rate is the largest of the two engaged requirements and is selected as the controlling requirement.
   e. WRAP sets an instream flow target equal to the pulse trigger criterion.
   f. The first three digits of EFS-FLAG are 303.
3. The regulated flow is below the base flow requirement and above the subsistence flow requirement. For this example, there is no 50% rule for the subsistence flow requirement. A pulse was recently triggered and remains engaged as the volumetric and duration criteria are unmet.
   a. The subsistence flow requirement is engaged, and an intermediate target is set.
   b. The pulse requirement is equal to the regulated flow because it is below the pulse trigger criterion.
   c. There are two requirements that are engaged: the subsistence flow and the regulated flow (pulse requirement).
   d. The regulated flow is the largest of the two engaged requirements and is selected as the controlling requirement.
   e. WRAP sets an instream flow target equal to the regulated flow.
   f. The first three digits of EFS-FLAG are 303.
4. The regulated flow is below the base flow requirement, and there is no subsistence flow requirement, such as in the Brazos River during average or wet hydrologic conditions. A pulse was recently triggered and remains engaged.
   a. The base flow requirement is engaged, and an intermediate target is set.
   b. The pulse requirement is equal to the regulated flow.
   c. There are two requirements that are engaged: the base flow and the regulated flow.
   d. The base flow requirement is the largest of the two and is selected as the controlling requirement.

   e. WRAP sets an instream flow target equal to the base flow requirement.
   f. The first three digits of the EFS-FLAG are 203.
5. The regulated flow is zero. There is a subsistence flow requirement, and a pulse was recently triggered and remains engaged.
   a. The subsistence flow requirement is engaged, and an intermediate target is set.
   b. The pulse requirement is equal to zero, i.e., the value of the regulated flow, but remains engaged and is still being tracked by WRAP for compliance with termination criteria.
   c. There are two requirements that are engaged: the subsistence flow requirement and the regulated flow (zero value).
   d. The subsistence flow is the largest of the two engaged requirements and is selected as the controlling requirement.
   e. WRAP sets an instream flow target equal to the subsistence requirement.
   f. The first three digits of the EFS-FLAG are 103.

The previous examples illustrate the concepts and steps considered by WRAP in the instream flow target setting process. Whether the instream flow target is met or unmet by the regulated flow is a separate consideration. Attainment metrics are a function of the instream flow target (controlling requirement) and the end-of-day regulated flow. Daily attainments of subsistence and base flow are calculated within the daily WAMs by input records designed for this project. End-of-day regulated flow is compared to the instream flow target when either subsistence or base flow are the controlling requirements. The input records calculate a value that is set as the decimal digit (i.e., the G digit) of EFS-FLAG according to whether subsistence or base flow are met or unmet when they are the controlling requirement.

Pulse flows are not addressed by the decimal digit G of EFS-FLAG. If a pulse is engaged and is the controlling requirement, then the decimal digit is set to zero for that day. Pulses are always considered to be attained once they are engaged by the regulated flow exceeding the trigger criterion. Information relevant to the number of pulses per season, whether the pulse event meets the volumetric criterion, and the number of days the pulse is engaged is recorded by WRAP and sent to the SMM output file (*PF* record field 15 option 1). The pulse flow event information contained in the SMM output file is processed to develop the pulse metrics introduced in Table 4 of the main report.

The end-of-day regulated flow may be different from the regulated flow used to set the instream flow target at the priority date of the environmental flow standards. Water rights junior to the priority date of the environmental flow standards may change the flow throughout the river basin. Flood control reservoir operations and the BRA SysOps permit are examples of junior rights that can affect the regulated flow after establishment of instream flow targets. In the case of the BRA SysOps permit, junior run-of-river diversions are constrained by the instream flow targets. However, releases of stored water under the BRA SysOps permit are not constrained by the instream flow targets. Reservoir releases of stored water can raise the flow in the river to a level that otherwise would have engaged a different requirement. For example, at the priority date of the environmental flow standards, the regulated flow at the control point may engage the subsistence flow requirement. The end-of-day regulated flow, however, may rise above the base flow requirement due to upstream reservoir releases of stored water. The controlling requirement and instream flow target are not changed for end-of-day regulated flow conditions.

1.2.2.2 DIS File

The DIS input file contains information used for distributing naturalized flows from primary to secondary control points. The DIS file modifications included removing *FD* and *WP* records for control points associated with the monthly environmental flow standards at Lueders.

1.2.2.3 HIS File

The HIS input file used by the monthly Brazos River basin WAM contains *HI* records associated with the monthly environmental flow standard hydrologic conditions. The HIS file was deleted and replaced with the *HI* records contained in the BrazosHYD.DSS input file. The *HI* records contained in the DSS are designed to be read by the *HC* records for developing daily instream flow targets.

1.2.2.4 FLO and EVA Files

The FLO and EVA input files contain monthly naturalized flow and monthly net evaporation-precipitation volumes. These files were deleted and replaced with identical values contained in the BrazosHYD.DSS input file.

1.2.2.5 BrazosHYD.DSS File

The WRAP Daily Manual and daily Brazos River basin WAM report (Wurbs and Hoffpauir 2021) describe the use of HEC-DSS as a file input and output format for the daily model. The hydrologic inputs for the daily Brazos River basin WAM are stored in DSS format. Input time series within the BrazosHYD.DSS file include, monthly naturalized streamflow, monthly net evaporation-precipitation, monthly hydrologic conditions, and daily streamflow patterns. The DSS file is not used with the monthly TCEQ version of the Brazos River basin WAM. The DIS file from Wurbs 2019a was adopted with modification to remove *TS* records used in the monthly WAM.

1.2.2.6 DIF File

The DIF input file contains records associated with stream flow routing and monthly to daily stream flow disaggregation patterns. The file is not used with monthly simulations but is an integral part of the daily model. The DIF file from Wurbs 2019a was adopted without modification.

2 Brazos River Basin

A detailed description of the necessary modifications to create the Brazos Full Authorization are provided in section 1.2.2. The Brazos Full Authorization also serves as an example of the types of modifications made to other basin scenario models, especially with regards to the computations for the EFS-FLAG. The necessary modifications to create the remaining Brazos River Basin scenario models are described below.

2.1 Current Conditions

The current conditions scenario, also known as Run 8, is not included in the Wurbs 2019a report and accompanying datasets. A new daily current conditions model was created for this project using the monthly TCEQ current conditions model. However, hydrologic inputs contained in the Wurbs 2019a BrazosHYD.DSS file and the Brazos.DIF file for the daily full authorization scenario were able to be directly used in the current conditions scenario. Input records pertaining to flood control pools from the Wurbs 2019a daily full authorization scenario DAT file were likewise directly used in the creation of the daily current conditions scenario.

The monthly TCEQ current conditions version of the Brazos River basin WAM is marked with a date of May 30, 2015 in the DAT file. The DAT file does not contain the BRA SysOps permit since the utilization of this permit has been minimal to date. The TCEQ monthly current conditions DAT file differs from the full authorization DAT file in the assumptions related to stored water releases from Brazos River Authority (BRA)-owned or -managed reservoirs. In the TCEQ current conditions DAT file, all stored water demands met from BRA reservoirs are drawn directly from the perimeter of the lake, also known as a “lakeside” assumption. In the full authorization DAT file, downstream delivery points are included for stored water releases from BRA reservoirs. The absence or presence of stored water releases for meeting water use demands can have a major impact on environmental flow metrics.

A copy of the DAT file used by the Region G (Brazos G) Regional Water Planning Group in development of the 2016 Brazos G Plan was obtained. The DAT file contains delivery points for stored water releases downstream of the BRA reservoirs for customer/contractual demands. The 2016 Brazos G DAT file predates the inclusion of the BRA SysOps permit in the modeling framework and in this way is consistent with the current conditions flow scenario used for this study. The current conditions scenario DAT file for this study was modified to disaggregate the lakeside-only use of stored water from BRA reservoirs for mixed lakeside and downstream release operations. The total demands for each use category for each reservoir in the TCEQ current conditions model were unchanged. Only the locations of diversion were disaggregated proportional to the locations represented in the 2016 Brazos G DAT file.

Other modifications to the monthly TCEQ DAT file to create a daily simulation are similar to those described for the Brazos full authorization scenario excluding modifications to address the BRA SysOps permit as described in items 10 and 16. Most of the modifications to the monthly TCEQ DAT file are related to changing *TO* record target building and water right backups from monthly to daily time steps as described in items 14 and 15. The environmental flow standard input records, as described in item 19, were copied directly from the full authorization to the current conditions scenario.

Modifications to the DIS, HIS, FLO, and EVA files follow the descriptions provided in the Brazos River basin full authorization scenario. The same DSS file is used for all Brazos River basin modeling scenarios.

2.2 Partial Utilization

The partial utilization scenario is intended to represent overall water right diversion amounts greater than those in the current conditions scenario, but less than the full authorization scenario. The partial utilization scenario is not based on a specific time horizon or other externally predicted water right diversion amounts. The full authorization scenario serves as the basis for the development of the partial utilization scenario. Demands in the partial utilization scenario are adjusted to a midpoint between full and current use. The reservoir storage capacities in the partial utilization scenario are the same as the full use scenario.

Water right demands are summarized in the full authorization and current conditions scenarios according to their use coefficient *UC* record using the WRAP-Tables 1SUM job. The total demands by *UC* record in each scenario are used to calculate a midpoint of demand. The ratio of the midpoint demands to the full authorization demands by *UC* records are used as a multiplier on *UP* records, which are inserted into the partial utilization scenario DAT file after all *UC* records are stated. The *UP* record field 6 multiplier automatically adjusts the full authorization *WR* record demands during the simulation. The numerous miscellaneous small use *WR* record demands were not adjusted from full authorization levels in the partial utilization scenario.

The Brazos River basin full authorization scenario contains the BRA SysOps permit and is implemented in a dual simulation configuration. Prior to calculating water right demands by *UC* record, the *UC* records of the first and second simulation water rights associated with the BRA SysOps permit are modified to distinguish their first and second simulation status. Only the second simulation water right demands are of interest in comparing demands to the current conditions scenario. The *UP* record demand multipliers are created to adjust demands for second simulation water rights only. The set of *UP* records added to the partial utilization scenario are accompanied by additional information that details the number of *WR* records and total demands by *UC* record.

Return flow discharges are provided in the monthly TCEQ Brazos River basin current conditions DAT file, and not in the full authorization scenario. The return flow discharges are incorporated into constant inflow *CI* records. The return flow *CI* records in the current conditions scenario were modified prior to inserting them into the partial utilization scenario DAT file. The modification methodology involves first calculating the ratio of the overall volume of return flow discharge to the overall volume of municipal demand in the current conditions scenario. The ratio is then scaled according to the overall volume of municipal demand in the partial utilization scenario.

A reuse water right in the current conditions scenario was copied directly from the current conditions scenario and added to the partial utilization scenario. The water right can be found by searching the DAT file for the identifier IF4196C. The demands of the return flow reuse water right was not modified. Information related to a midpoint level of reuse is not able to be calculated as reuse water rights are not included in the full authorization scenario.

2.3 Naturalized Flow

The naturalized flow scenario is used to assess environmental flow standard attainment in the absence of state granted water rights. The naturalized flow scenario was developed from the full authorization scenario by deleting all input records associated with water rights, except those input records associated with the environmental flow standards.

2.4 Flood Control

The Brazos River basin DAT files for the current, partial, and full utilization scenarios contain nine flood control pools. There are no routing control points between Lake Waco and the Brazos River at Waco, control point BRWA41. Accordingly, depletions made by impounding flood waters in Lake Waco arrive within the same time step at BRWA41. This results in occasional low or zero-flow days at BRWA41 when there is mistiming of flood control depletions and the arrival of high flow events at BRWA41. Such depletion of flows as a result of flood control operations is allowed regardless of downstream water availability constraints. These low or zero-flow days may create base flow requirement failure days in the analysis of environmental flows when base flow requirements are controlling at BRWA41 under dry hydrologic conditions at the priority of the standards. In the Brazos River basin, subsistence flow requirements are engaged under dry hydrologic conditions at the priority of the standards. Thus, in the Brazos River basin, no failures of base flow requirements are expected under dry hydrologic conditions.

To avoid unusual or confusing effects on environmental flow attainment, the field 6 FCDEP option on the Lake Waco flood reservoir *FR* record was changed from the default value of 2 to a value of 0. The default value allows flood control operations to ignore all downstream control points when determining water availability for making flood control depletions. With FCDEP set to 0, downstream control points are included in water availability calculations. Depletions still occur for flood control operations; however, downstream water availability serves as an additional constraint. This is the only modification made to the Brazos River basin flood control input records developed by Wurbs (2019a).

3 Trinity and Neches River Basin Flow Scenarios

The Trinity and Neches river basins have daily full authorization and current conditions scenarios developed and documented by Wurbs 2019b and Wurbs 2020, respectively. These models were adopted largely as-is. Modifications were applied to the Trinity and Neches river basin DAT files consistent with the descriptions provided in items 14, 15, and 19 for the Brazos River basin full authorization scenario. Additional TCEQ monthly models were not used as source files to develop scenarios for this project as was the case for the Brazos River basin.

The Trinity and Neches river basin partial utilization and naturalized flow scenarios were developed in a manner consistent with the descriptions provided for the Brazos River basin. Return flow reuse water rights in the Trinity River basin were added to the partial utilization DAT file at the top immediately after all return flows are provided on *CI* records. The Neches River basin current conditions DAT file assigns most of the return flows on *CI* records. However, two *WR* records in the Neches River basin current conditions DAT file generate return flows using *RF* record identifier F4853F. These return flows were converted from *RF* records into *CI* record inputs in the Neches River basin partial utilization DAT file for discharge into control points R4853N and R4853A. No return flow reuse water rights were found in the Neches River basin current conditions DAT file.

3.1 Trinity River Basin – Flood Control

The Trinity basin DAT files for the current, partial, and full utilization scenarios contain eight flood control pools. The flood control routing parameters between Joe Pool Lake and the Trinity River at Dallas, control point 8TRDA, allow for depletions made by impounding flood waters in Joe Pool Lake to arrive within the same time step at 8TRDA. This results in occasional low or zero-flow days at 8TRDA when there is mistiming of flood control depletions and the arrival of high flow events at 8TRDA. Zero-flow days may also occur when flood control operations at Joe Pool Lake deplete all regulated flow on Mountain Creek in an effort to alleviate downstream flooding. Such depletion of flows as a result of flood control operations is allowed regardless of water availability constraints at 8TRDA. These low or zero-flow days may create base flow requirement failure days in the analysis of environmental flows when base flow requirements are controlling at 8TRDA at the priority of the standards.

To avoid unusual or confusing effects on environmental flow attainment, the field 6 FCDEP option on the Joe Pool Lake flood reservoir *FR* record was changed from the default value of 2 to a value of 0. This is the only modification made to the Trinity River basin flood control input records developed by Wurbs (2019b). This is the same modification made to the Lake Waco flood control pool in the Brazos River basin, as described in Section 2.4 of this appendix.

Flood control operations at Joe Pool Lake on Mountain Creek are still responsive to downstream flood flow (*FF input records)* gages at 8TRDA, 8TRRS (Trinity River near Rosser), and 8TROA (Trinity River near Oakwood). For comparative purposes, the largest pulse requirement at 8TRDA is for the spring season with a pulse trigger flow rate of 4,000 cfs. The *FF* records in the DAT file for 8TRDA, 8TRRS, and 8TROA are 13,000, 15,000, and 24,000 cfs, respectively. Flow events capable of triggering a pulse at 8TRDA are still likely to occur regardless of the change to the FCDEP option at Joe Pool Lake.

3.2 Neches River Basin – Daily Flow Patterns

The daily WAMs use flow patterns for disaggregation of monthly WAM naturalized flow volumes. The monthly WAM naturalized flow volumes are preserved, but the day-to-day fluctuations of the hydrograph within each month are controlled by the flow patterns. Daily flow patterns are entered on *DF* records and contained within the DSS file. Ideally, daily flow patterns consist of naturalized or minimally impacted stream gage records. Alternatively, the USACE daily unregulated flows are used at numerous locations within the Brazos, Trinity, and Neches daily WAMs below major flood control reservoirs. The use of USACE unregulated flow patterns is discussed in the daily WAM reports developed by Wurbs.

Within the Neches River basin, the USACE unregulated daily flows are available at the dams of lakes Sam Rayburn and B.A. Steinhagen and at stream gages downstream of these two flood control lakes. Upstream of lakes Sam Rayburn and Steinhagen, however, only U.S. Geological Survey (USGS) stream gage records are available for use as daily flow patterns. The report by Wurbs 2020 describes a methodology to reverse the impact of historical reservoir construction and operations from the USGS stream gages on the upstream portions of the Neches and Angelina rivers and their associated tributaries.

The process of reversing the historical impacts appears to have created abrupt transitions between elevated flows, zero flows, and back to elevated flows within successive days for many of the stream gages. The effect of flow transitions is particularly noticeable for the Neches River near Neches, control point NENE, in the period after the construction of Lake Palestine in the early 1960s. Control point NENE also serves as an environmental flow standards measurement point. The rapid and successive flow transition represented in the daily flow patterns creates difficulties for analyzing environmental flow attainment and significantly increases the occurrence of zeroes in the daily naturalized flow hydrograph in the period after Lake Palestine's construction.

The daily flow input *DF* records were modified for locations upstream of lakes Sam Rayburn and B.A. Steinhagen. The modification consisted of averaging zero-flow days with the prior and following days. This removed much of the rapid and abrupt transitions between elevated flows and zero flows on successive days. The monthly WAM naturalized flow volume is unchanged by the smoothing of zero-flow days in the *DF* records. Zero-flow days still occur in the simulation when an entire month of naturalized flow is zero and for intra-month periods when zero flows persist in the *DF* records.

Appendix B
Attainment Metrics Calculation Methodologies

August 2021
Evaluating the Attainment of Environmental Flow Standards

Attainment Metrics Calculation Methodologies

Prepared for
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ABBREVIATIONS

AD	attainment duration
AF	attainment frequency
afd	acre-feet per day
cfs	cubic feet per second
EF	engagement frequency
FDM	frequency duration met
FVM	frequency volume met
HFP	high flow pulse
PF	pulse frequency
PS	percent shortage
S	instream flow shortage
SD	shortage duration
TEM	target engagements met
WAM	water availability model
ZFD	zero-flow duration
ZFF	zero-flow frequency

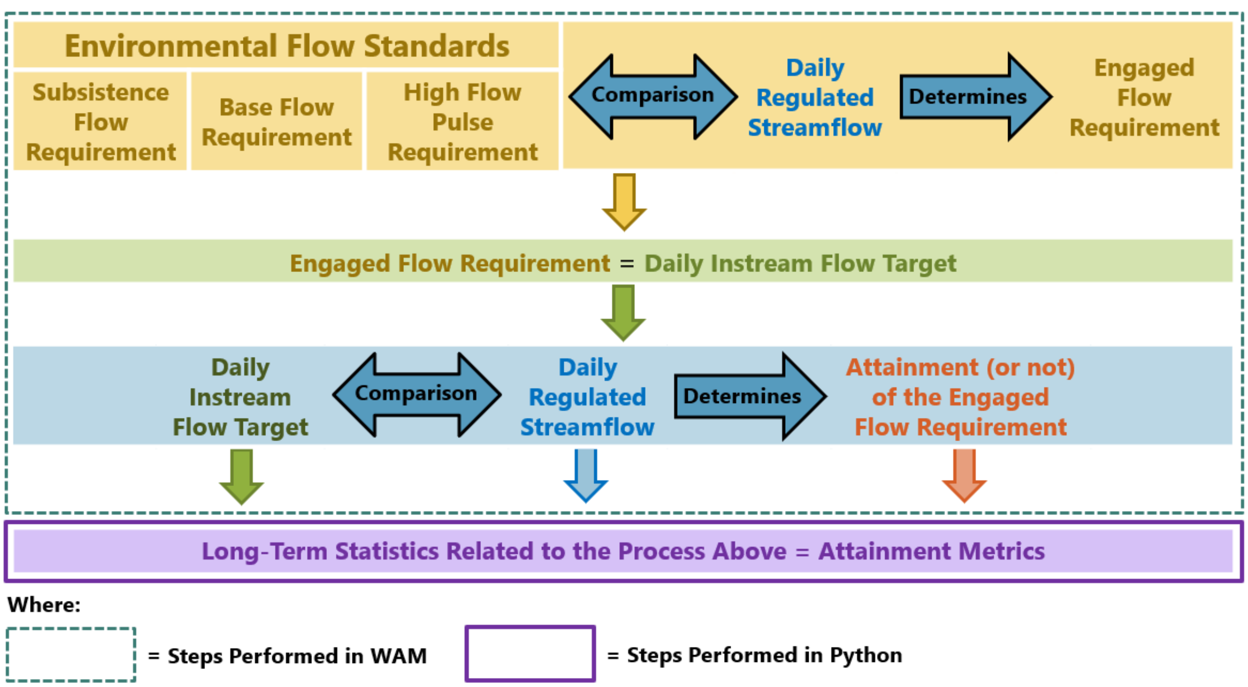
1 Introduction

The overall goal of this study is to better understand the attainment of environmental flow standards throughout the Brazos, Trinity, and Neches river basins under four different flow scenarios modeled with daily water availability model (WAM) simulations. To that end, 12 attainment metrics have been selected as a means of quantifying the attainment of the various components of the environmental flow standards that are tracked in the WAM throughout each basin.

1.1 Overall Framework of Evaluation Procedure

The flow chart in Figure B-1 illustrates the overall framework of the methods and tools used to calculate the attainment of the environmental flow standards at each WAM control point. The terminology used in this flow chart, as well as throughout the remainder of this appendix, are consistent with the definitions provided in Section 2 of *Evaluating the Attainment of Environmental Flow Standards*, hereafter referred to as the main report.

Figure B-1
Overall Framework for Calculating the Attainment of Environmental Flow Standards at Each WAM Control Point



As shown in Figure B-1, the bulk of the evaluation procedure for this study is conducted within the WAM, including the tracking and outputting of information related to daily flow standard engagements and attainments. More details on this process are provided in Appendix A of the main report; however, for illustrative purposes, Figure B-2 provides a simplified example of how daily flow standard engagements and attainments are determined at each control point within the WAM.

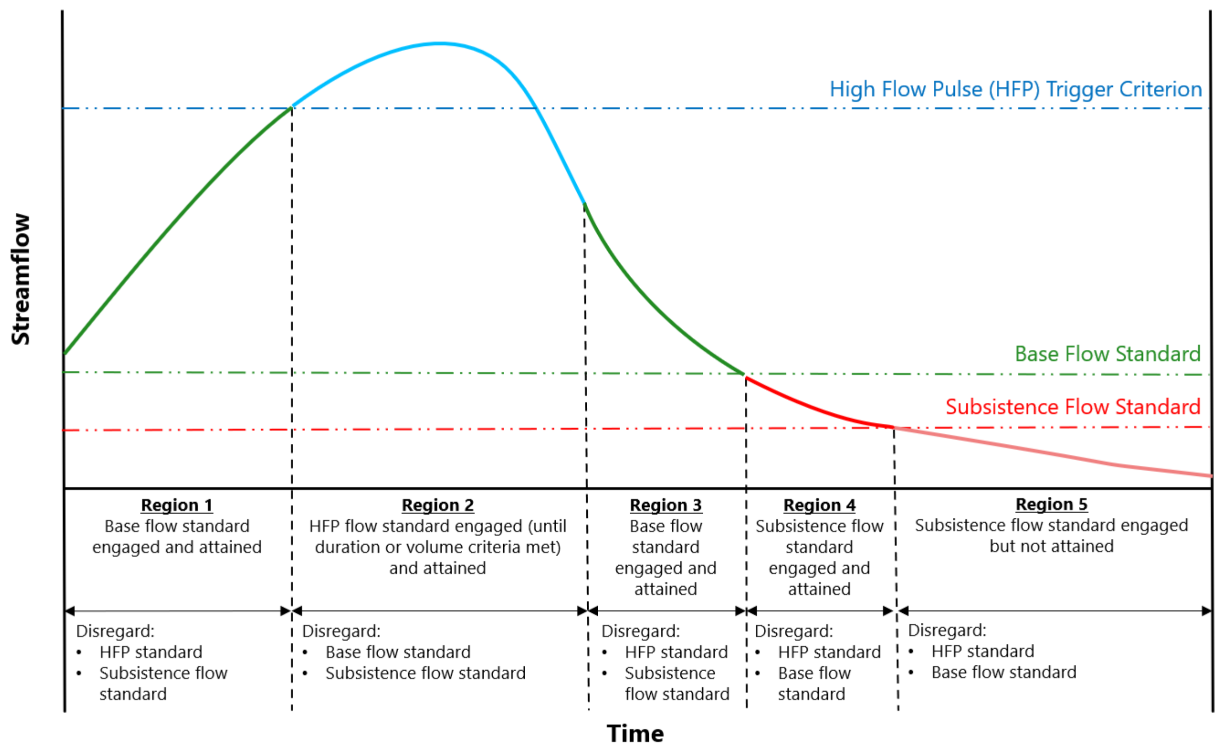
Figure B-2 shows a conceptual hydrograph at a hypothetical WAM control point, where the x-axis is time and the y-axis is streamflow. In this figure, the blue, green, and red horizontal dashed-dotted lines represent the streamflow values corresponding to the high flow pulse (HFP) trigger criterion, the base flow standard, and the subsistence flow standard, respectively, for a particular season. In general, the magnitude of the daily streamflow in relation to these three horizontal lines determines the engagement and attainment of the environmental flow standard for that day. In the example shown in Figure B-2, as the streamflow changes over time, transitions between different flow standard engagements and attainments occur and are denoted by dashed vertical black lines; these transitions result in five distinct regions of the hydrograph, which are summarized as follows:

- Region 1 (from the start of the hydrograph to the first vertical transition line)
  - Daily streamflow values are above the base flow standard but below the HFP trigger criterion. Therefore, the base flow standard is the engaged flow standard, and it is also attained.
  - Because the HFP and subsistence flow standards are not engaged, they are ignored during this time.
- Region 2 (from the first vertical transition line to the second vertical transition line)
  - The daily streamflow value exceeds the HFP trigger criterion at the time denoted by the first vertical transition line, which engages the HFP standard. The HFP standard remains engaged until either the HFP duration or the volume criteria are met, which is denoted by the second vertical transition line. Within this time period, the HFP standard is both engaged and attained.
  - Because the base and subsistence flow standards are not engaged, they are ignored during this time.
- Region 3 (from the second vertical transition line to the third vertical transition line)
  - Daily streamflow values are above the base flow standard but below the HFP trigger criterion. Therefore, the base flow standard is the engaged flow standard, and it is also attained.

- Because the HFP and subsistence flow standards are not engaged, they are ignored during this time.

- Region 4 (from the third vertical transition line to the fourth vertical transition line)
  - Daily streamflow values are above the subsistence flow standard but below the base flow standard. Therefore, the subsistence flow standard is the engaged flow standard, and it is also attained.
  - Because the HFP and base flow standards are not engaged, they are ignored during this time.
- Region 5 (from the fourth vertical transition line to the end of the hydrograph)
  - Daily streamflow values are below the subsistence flow standard. Therefore, the subsistence flow standard is the engaged flow standard, but it is not attained.
  - Because the HFP and base flow standards are not engaged, they are ignored during this time.

Figure B-2
Conceptual Hydrograph Depicting Flow Standard Engagements and Attainments



Note:
This graphic applies to control points in the Brazos River basin during dry hydrologic conditions and to control points in the Trinity and Neches river basins (which do not use hydrologic conditions), for which the target number of seasonal HFPs has not been met prior to the time period shown.

This appendix will focus on details of the last component of the flow chart in Figure B-1, denoted by purple shading—the calculation of the attainment metrics. As noted in the flow chart, the software selected for use in the calculation of the attainment metrics is Python, an open-source programming language well-suited to a variety of scientific computing and data visualization applications. The Python analyses for this study were performed with the Anaconda distribution of Python version 3.7.4. In addition to the standard library of tools included in the Python distribution, the following third-party Python libraries were installed (via the Anaconda package manager) to assist with various components of the WAM data processing and metrics calculation routines:

- dill (version 0.3.3): An extension of Python's built-in pickle module, used in this study to import/export Python variables and data structures from/to binary storage files
- NumPy (version 1.20.1): A library that assists specifically with numerical computing within Python, used in this study to construct conditional statements for detecting Not a Number (i.e., undefined numerical value) occurrences
- pandas (version 1.2.3): A library that assists specifically with data manipulation and analysis within Python, used in this study to process and work with WAM output data as two-dimensional data frame objects

1.2 Purpose

The selection and visualization methods for the 12 attainment metrics are described in Section 2 of the main report. The purpose of this appendix is to provide additional details on the methodologies used to calculate each metric.

1.3 Appendix Organization

Details on the calculation methodology for each attainment metric are presented in Section B-2 of this appendix and consist of the following information:

- The mathematical formula used to calculate the metric
- A brief description of the calculation procedure performed with Python
- An example calculation of the metric, using example WAM output data

The examples in this appendix are based on draft WAM outputs that may have been updated for the final figures and tables in the main body of the report and Appendices C through H. The use of draft WAM outputs in this appendix does not change the utility of the examples for the purpose of explaining the calculations.

2 Attainment Metrics Calculation Methodologies

2.1 Engagement Frequency

The engagement frequency (EF) metric is applicable to both subsistence and base flow standards and is defined as the percentage of time that the flow standard is engaged.

2.1.1 Mathematical Formula

The mathematical formula used to calculate EF is shown in Equation B-1.

Equation B-1

$$\mathrm{EF} = \frac{n_{en}}{n_t} \times 100$$

where:

EF	=	engagement frequency
n_{en}	=	number of days that the instream flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin
n_t	=	total number of days corresponding to each combination of season and hydrologic condition defined for the control point's river basin

2.1.2 Description of Calculation Procedure

As shown in Equation B-1, the calculation of the EF metric depends upon two terms, referred to as n_{en} and n_t, which must first be calculated. The information for calculating these two terms is contained within the WAM EFS-FLAG output variable.[1] A description of the procedure used to calculate terms n_{en} and n_t, and finally EF, in Python is summarized as follows:

- The WAM output file containing the daily EFS-FLAG variable for each control point is imported into Python.
- For each control point, variables for incrementally counting the following types of occurrences in the daily EFS-FLAG variable over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):

[1] For details regarding the WAM EFS-FLAG output variable, refer to Appendix A.

  - Days within each combination of season and hydrologic condition defined for the control point's river basin (c_t[*season*][*hydrologic condition*])
  - Days that the subsistence flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin (c_{en_subs}[*season*][*hydrologic condition*])
  - Days that the base flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin (c_{en_base}[*season*][*hydrologic condition*])

  These variables are hereafter referred to as "counters" for the remainder of this summary.
- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - The entry of the c_t counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated (i.e., increased by a value of 1).
  - If digit A of the day's EFS-FLAG value indicates engagement of the subsistence flow standard, the entry of the c_{en_subs} counter corresponding to the day's season and hydrologic condition is updated.
  - If digit A of the day's EFS-FLAG value indicates engagement of the base flow standard, the entry of the c_{en_base} counter corresponding to the day's season and hydrologic condition is updated.
- After all of the control point's daily EFS-FLAG values have been parsed and the counters finalized accordingly, the EF metric for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - Term n_t of the EF formula is assigned the final count of the c_t entry.
  - For the subsistence flow standard:
    - Term n_{en} of the EF formula is assigned the final count of the c_{en_subs} entry.
  - For the base flow standard:
    - Term n_{en} of the EF formula is assigned the final count of the c_{en_base} entry.
  - EF is calculated as shown in Equation B-1, by dividing n_{en} by n_t and multiplying by 100.

2.1.3 Example Calculation

The following example provides a sample calculation for the EF metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.1.3.1 Problem Statement

Calculate the EF metric for the base flow standard at the Brazos River near Glen Rose for dry springs over the time period from February 24, 1940, through March 6, 1940, using WAM output file "TS-Flag-Braz3.txt."

2.1.3.2 Solution

Table B-1 illustrates the first step of the EF calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the c_t and c_{en_base} counters for dry springs are updated, as applicable.

Table B-1
WAM Output Data and Counters for Example EF Calculation

Year	Month	Day	EFS-FLAG Value[1]	c_t [*Spring*][*Dry*]	c_{en_base} [*Spring*][*Dry*]
1940	2	24	100111.1	0	0
1940	2	25	100111.1	0	0
1940	2	26	100111.1	0	0
1940	2	27	100111.1	0	0
1940	2	28	100111.1	0	0
1940	2	29	100111.2	0	0
1940	3	1	200221.4	1	1
1940	3	2	100221.1	2	1
1940	3	3	100221.1	3	1
1940	3	4	100221.2	4	1
1940	3	5	200221.4	5	2
1940	3	6	200221.4	6	3

Notes:
1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G."

Data from WAM output file "TS-Flag-Braz3.txt" for the Brazos River near Glen Rose
Intermediate data calculated for input into the EF metric formula

As shown in Table B-1, both the c_t and c_{en_base} counters for dry springs during this time period remain zero until March 1, 1940, when a dry spring is actually initiated.

- From March 1 through March 6, the counter c_t is increased by a value of 1 each day, due to the following criteria being met:

- Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
- Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.

- On March 1, March 5, and March 6, the counter c_{en_base} is increased by a value of 1, due to the following criteria being met:
  - Digit A of the EFS-FLAG value is equal to 2, indicating engagement of the base flow standard.
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.

Using the final values of the c_t and c_{en_base} counters from Table B-1, the second step of the EF calculation for this example is performed as follows, using the formula from Equation B-1.

$$\text{EF} = \frac{n_{en}}{n_t} \times 100 = \frac{c_{en\_base}}{c_t} \times 100 = \frac{3}{6} \times 100 = \mathbf{50}$$

2.2 Attainment Frequency

The attainment frequency (AF) metric is applicable to both subsistence and base flow standards and is defined as the percentage of days that the instream flow standard is met, relative to the number of days that it is engaged.

2.2.1 Mathematical Formula

The mathematical formula used to calculate AF is shown in Equation B-2.

Equation B-2

$$\text{AF} = \frac{n_{at}}{n_{en}} \times 100$$

where:

AF	=	attainment frequency
n_{at}	=	number of days that the instream flow standard is attained, for each combination of season and hydrologic condition defined for the control point's river basin
n_{en}	=	number of days that the instream flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin

2.2.2 Description of Calculation Procedure

As shown in Equation B-2, the calculation of the AF metric depends upon two terms, referred to as n_{at} and n_{en}, which must first be calculated.[2] The information for calculating these two terms is contained within the WAM EFS-FLAG output variable. A description of the procedure used to calculate terms n_{at} and n_{en}, and finally AF, in Python is summarized as follows:

- The WAM output file containing the daily EFS-FLAG variable for each control point is imported into Python.
- For each control point, variables for incrementally counting the following types of occurrences in the daily EFS-FLAG variable over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - Days that the subsistence flow standard is both engaged and attained, for each combination of season and hydrologic condition defined for the control point's river basin (c_{at_subs}[*season*][*hydrologic condition*])
  - Days that the base flow standard is both engaged and attained, for each combination of season and hydrologic condition defined for the control point's river basin (c_{at_base}[*season*][*hydrologic condition*])
  - Days that the subsistence flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin (c_{en_subs}[*season*][*hydrologic condition*])
  - Days that the base flow standard is engaged, for each combination of season and hydrologic condition defined for the control point's river basin (c_{en_base}[*season*][*hydrologic condition*])

  These variables are hereafter referred to as "counters" for the remainder of this summary.
- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - If digit G of the day's EFS-FLAG value indicates engagement and attainment of the subsistence flow standard, the entry of the c_{at_subs} counter corresponding to the day's season and hydrologic condition is updated.
  - If digit G of the day's EFS-FLAG value indicates engagement and attainment of the base flow standard, the entry of the c_{at_base} counter corresponding to the day's season and hydrologic condition is updated.

---

[2] The term n_{en} used in the AF calculation is the same n_{en} term used in the EF calculation presented in Section B-2.1. However, for the sake of completeness, it is re-presented in full in Section B-2.2 in the context of the AF calculation.

- If digit A of the day's EFS-FLAG value indicates engagement of the subsistence flow standard, the entry of the c_{en_subs} counter corresponding to the day's season and hydrologic condition is updated.
- If digit A of the day's EFS-FLAG value indicates engagement of the base flow standard, the entry of the c_{en_base} counter corresponding to the day's season and hydrologic condition is updated.

- After all of the control point's daily EFS-FLAG values have been parsed and the counters finalized accordingly, the AF metric for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - For the subsistence flow standard:
    - Term n_{at} of the AF formula is assigned the final count of the c_{at_subs} entry.
    - Term n_{en} of the AF formula is assigned the final count of the c_{en_subs} entry.
  - For the base flow standard:
    - Term n_{at} of the AF formula is assigned the final count of the c_{at_base} entry.
    - Term n_{en} of the AF formula is assigned the final count of the c_{en_base} entry.
  - AF is calculated as shown in Equation B-1, by dividing n_{at} by n_{en} and multiplying by 100.

2.2.3 Example Calculation

The following example provides a sample calculation for the AF metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.2.3.1 Problem Statement

Calculate the AF metric for the base flow standard at the Brazos River near Glen Rose for dry springs over the time period from February 24, 1940, through March 6, 1940, using WAM output file "TS-Flag-Braz3.txt."

2.2.3.2 Solution

Table B-2 illustrates the first step of the AF calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the c_{at_base} and c_{en_base} counters for dry springs are updated, as applicable.

Table B-2
WAM Output Data and Counters for Example AF Calculation

Year	Month	Day	EFS-FLAG Value[1]	c_{at_base} [*Spring*][*Dry*]	c_{en_base} [*Spring*][*Dry*]
1940	2	24	100111.1	0	0
1940	2	25	100111.1	0	0
1940	2	26	100111.1	0	0
1940	2	27	100111.1	0	0
1940	2	28	100111.1	0	0
1940	2	29	100111.2	0	0
1940	3	1	200221.4	1	1
1940	3	2	100221.1	1	1
1940	3	3	100221.1	1	1
1940	3	4	100221.2	1	1
1940	3	5	200221.4	2	2
1940	3	6	200221.4	3	3

Notes:
1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G."

Data from WAM output file "TS-Flag-Braz3.txt" for the Brazos River near Glen Rose

Intermediate data calculated for input into the AF metric formula

As shown in Table B-2, both the c_{at_base} and c_{en_base} counters for dry springs during this time period remain zero until March 1, 1940, when a dry spring is actually initiated.

- On March 1, March 5, and March 6, the counter c_{at_base} is increased by a value of 1, due to the following criteria being met:
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.
  - Digit G of the EFS-FLAG value is equal to 4, indicating engagement and attainment of the base flow standard.
- On March 1, March 5, and March 6, the counter c_{en_base} is increased by a value of 1, due to the following criteria being met:
  - Digit A of the EFS-FLAG value is equal to 2, indicating engagement of the base flow standard.
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.

Using the final values of the $c_{\boldsymbol{at\_base}}$ and c_{en_base} counters from Table B-2, the second step of the AF calculation for this example is performed as follows, using the formula from Equation B-2.

$$\mathrm{AF} = \frac{n_{at}}{n_{en}} \times 100 = \frac{c_{at\_base}}{c_{en\_base}} \times 100 = \frac{3}{3} \times 100 = \mathbf{100}$$

2.3 Attainment Duration

The attainment duration (AD) metric is applicable to both subsistence and base flow standards and is defined as the median consecutive days that the instream flow target is engaged and met. The minimum consecutive days and maximum consecutive days are also calculated and reported.

2.3.1 Mathematical Formula

The mathematical formula used to calculate AD is shown in Equation B-3.

Equation B-3

$$\mathrm{AD} = median(na_{cons});\ (min(na_{cons}), max(na_{cons}))$$

where:

AD	=	attainment duration
na_{cons}	=	discrete numbers of consecutive days that the instream flow standard is engaged and attained, for each combination of season and hydrologic condition defined for the control point's river basin

2.3.2 Description of Calculation Procedure

As shown in Equation B-3, the calculation of the AD metric depends upon one term, referred to as na_{cons}, which must first be calculated. The information for calculating this term is contained within the WAM EFS-FLAG output variable. A description of the procedure used to calculate term na_{cons}, and finally AD, in Python is summarized as follows:

- The WAM output file containing the daily EFS-FLAG variable for each control point is imported into Python.
- For each control point, variables for incrementally counting the following types of occurrences in the daily EFS-FLAG variable over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):

- Consecutive days that the subsistence flow standard is both engaged and attained, for each combination of season and hydrologic condition defined for the control point's river basin (ca_{cons_subs}[*season*][*hydrologic condition*])
- Consecutive days that the base flow standard is both engaged and attained, for each combination of season and hydrologic condition defined for the control point's river basin (ca_{cons_base}[*season*][*hydrologic condition*])

These variables are hereafter referred to as "counters" for the remainder of this summary.

- For each control point, the following blank lists representing term na_{cons} are created, to be appended with discrete consecutive-day counts from the counters above (where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - na_{cons_subs}[*season*][*hydrologic condition*])
  - na_{cons_base}[*season*][*hydrologic condition*])
- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - If digit G of the day's EFS-FLAG value indicates both the engagement and attainment of the subsistence flow standard:
    - The entry of the ca_{cons_subs} counter corresponding to the day's season and hydrologic condition is updated.
    - The next day's EFS-FLAG is parsed. If any of the following criteria are met, the current value of the ca_{cons_subs} entry is added to the list in the na_{cons_subs} entry corresponding to the day's season and hydrologic condition, and the ca_{cons_subs} entry is reset to a value of zero:
      - Digit G of the next day's EFS-FLAG value does not indicate both the engagement and attainment of the subsistence flow standard.
      - Digits D and F of the next day's EFS-FLAG value do not indicate the continuation of the season and hydrologic of the current day.[3]
      - The next day's EFS-FLAG value does not exist, indicating that the current day is the last day of the WAM simulation.

[3] In the standard way of calculating the AD metric presented here (specific to each combination of season and hydrologic condition), this criterion resets the ca_{cons} counter and forces the na_{cons} list to be updated whenever there is a change in season or hydrologic condition, regardless of whether the attainment of the flow standard continues on the next day. However, a supplemental version of the AD metric, referred to as the "Period of Record" version, is separately calculated in Python and reported in the Summary Tables in Appendix C, whereby this criterion is not imposed and the resulting version of the metric is not specific to season and hydrologic condition.

- If digit G of the day's EFS-FLAG value indicates both the engagement and attainment of the base flow standard:
    - The entry of the ca_{cons_base} counter corresponding to the day's season and hydrologic condition is updated.
    - The next day's EFS-FLAG is parsed. If any of the following criteria are met, the current value of the ca_{cons_base} entry is added to the list in the na_{cons_base} entry corresponding to the day's season and hydrologic condition, and the ca_{cons_base} entry is reset to a value of zero:
        - Digit G of the next day's EFS-FLAG value does not indicate both the engagement and attainment of the base flow standard.
        - Digits D and F of the next day's EFS-FLAG value do not indicate the continuation of the season and hydrologic of the current day.[4]
        - The next day's EFS-FLAG value does not exist, indicating that the current day is the last day of the WAM simulation.

- After all of the control point's daily EFS-FLAG values have been parsed and the counters and lists finalized accordingly, the AD metric for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
    - For the subsistence flow standard:
        - AD is calculated by finding the minimum, median, and maximum values of the list that constitutes the na_{cons_subs} entry.
    - For the base flow standard:
        - AD is calculated by finding the minimum, median, and maximum values of the list that constitutes the na_{cons_base} entry.

2.3.3 Example Calculation

The following example provides a sample calculation for the AD metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

[4] See Note 3.

2.3.3.1 Problem Statement

Calculate the AD metric for the base flow standard at the Brazos River near Glen Rose for dry springs over the time period from February 24, 1940, through March 6, 1940, using WAM output file "TS-Flag-Braz3.txt."

2.3.3.2 Solution

Table B-3 illustrates the first step of the AD calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the ca_{cons_base} counter and na_{cons_base} list for dry springs are updated, as applicable.

Table B-3
WAM Output Data, Counter and List for Example AD Calculation

Year	Month	Day	EFS-FLAG Value[1]	ca_{cons_base} [*Spring*][*Dry*]	na_{cons_base} [*Spring*][*Dry*]
1940	2	24	100111.1	0	
1940	2	25	100111.1	0	
1940	2	26	100111.1	0	
1940	2	27	100111.1	0	
1940	2	28	100111.1	0	
1940	2	29	100111.2	0	
1940	3	1	200221.4	1	1
1940	3	2	100221.1	0	
1940	3	3	100221.1	0	
1940	3	4	100221.2	0	
1940	3	5	200221.4	1	
1940	3	6	200221.4	2	2

Notes:
1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

Data from WAM output file "TS-Flag-Braz3.txt" for the Brazos River near Glen Rose

Intermediate data calculated for input into the AD metric formula

As shown in Table B-3, both the ca_{cons_base} counter for dry springs during this time period remains zero until March 1, 1940, when a dry spring is actually initiated.

- On March 1, March 5, and March 6, the counter ca_{cons_base} is increased by a value of 1, due to the following criteria being met:
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.

  - Digit G of the EFS-FLAG value is equal to 4, indicating engagement and attainment of the base flow standard.
- On March 1, the na_{cons_base} list is appended with the value of the ca_{cons_base} counter, and the ca_{cons_base} counter is reset to zero, due to the following criterion being met:
  - Digit G of the next day's EFS-FLAG value is not equal to 4, indicating that the engagement and attainment of the base flow standard is not continued on the next day.
- On March 6, the na_{cons_base} list is appended with the value of the ca_{cons_base} counter, due to the following criterion being met:
  - For the window of time defined in the problem statement, the next day's EFS-FLAG value does not exist.

Using the list of the $\boldsymbol{na_{cons\_base}}$ values from Table B-3, the second step of the AD calculation for this example is performed as follows, using the formula from Equation B-3.

$$
\begin{aligned}
\mathrm{AD} &= median(na_{cons});\ (min(na_{cons}), max(na_{cons})) \\
&= median\left(na_{cons\_base}\right);\ \left(min\left(na_{cons\_base}\right), max\left(na_{cons\_base}\right)\right) \\
&= median([1,2]);\ (min([1,2]), max([1,2])) \\
&= \mathbf{1.5}; (\mathbf{1}, \mathbf{2})
\end{aligned}
$$

2.4 Shortage Duration

The shortage duration (SD) metric is applicable to both subsistence and base flow standards and is defined as the median consecutive days that the instream flow standard is engaged but not met (i.e., there is a shortage).

2.4.1 Mathematical Formula

The mathematical formula used to calculate SD is shown in Equation B-4.

Equation B-4

$$\text{SD} = median(ns_{cons});\ (min(ns_{cons}), max(ns_{cons}))$$

where:

SD	=	shortage duration
ns_{cons}	=	discrete numbers of consecutive days that an instream flow standard is engaged but not attained, for each combination of season and hydrologic condition defined for the control point's river basin

2.4.2 *Description of Calculation Procedure*

As shown in Equation B-4, the calculation of the SD metric depends upon one term, referred to as ns_{cons}, which must first be calculated. The information for calculating this term is contained within the WAM EFS-FLAG output variable. A description of the procedure used to calculate term ns_{cons}, and finally AD, in Python is summarized as follows.

- The WAM output file containing the daily EFS-FLAG variable for each control point is imported into Python.
- For each control point, variables for incrementally counting the following types of occurrences in the daily EFS-FLAG variable over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - Consecutive days that the subsistence flow standard is engaged but not attained, for each combination of season and hydrologic condition defined for the control point's river basin (cs_{cons_subs}[*season*][*hydrologic condition*])
  - Consecutive days that the base flow standard is engaged but not attained, for each combination of season and hydrologic condition defined for the control point's river basin (cs_{cons_base}[*season*][*hydrologic condition*])

  These variables are hereafter referred to as "counters" for the remainder of this summary.
- For each control point, the following blank lists representing term ns_{cons} are created, to be appended with discrete consecutive-day counts from the counters above (where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - ns_{cons_subs}[*season*][*hydrologic condition*])

- ns_{cons_base}[*season*][*hydrologic condition*])

- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the subsistence flow standard:
    - The entry of the cs_{cons_subs} counter corresponding to the day's season and hydrologic condition is updated.
    - The next day's EFS-FLAG is parsed. If any of the following criteria are met, the current value of the cs_{cons_subs} entry is added to the list in the ns_{cons_subs} entry corresponding to the day's season and hydrologic condition, and the cs_{cons_subs} entry is reset to a value of zero:
      - Digit G of the next day's EFS-FLAG value does not indicate the engagement but non-attainment of the subsistence flow standard.
      - Digits D and F of the next day's EFS-FLAG value do not indicate the continuation of the season and hydrologic of the current day.[5]
      - The next day's EFS-FLAG value does not exist, indicating that the current day is the last day of the WAM simulation.
  - If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the base flow standard:
    - The entry of the cs_{cons_base} counter corresponding to the day's season and hydrologic condition is updated.
    - The next day's EFS-FLAG is parsed. If any of the following criteria are met, the current value of the cs_{cons_base} entry is added to the list in the ns_{cons_base} entry corresponding to the day's season and hydrologic condition, and the cs_{cons_base} entry is reset to a value of zero:
      - Digit G of the next day's EFS-FLAG value does not indicate the engagement and non-attainment of the base flow standard.
      - Digits D and F of the next day's EFS-FLAG value do not indicate the continuation of the season and hydrologic of the current day.[6]
      - The next day's EFS-FLAG value does not exist, indicating that the current day is the last day of the WAM simulation.

---

[5] In the standard way of calculating the SD metric presented here (specific to each combination of season and hydrologic condition), this criterion resets the cs_{cons} counter and forces the ns_{cons} list to be updated whenever there is a change in season or hydrologic condition, regardless of whether the attainment of the flow standard continues on the next day. However, a supplemental version of the SD metric, referred to as the "Period of Record" version, is separately calculated in Python and reported in the Summary Tables in Appendix C, whereby this criterion is not imposed and the resulting version of the metric is not specific to season and hydrologic condition.

[6] See Note 5.

- After all of the control point's daily EFS-FLAG values have been parsed and the counters and lists finalized accordingly, the SD metrics for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - For the subsistence flow standard:
    - SD is calculated by finding the minimum, median, and maximum values of the list that constitutes the ns_{cons_subs} entry.
  - For the base flow standard:
    - SD is calculated by finding the minimum, median, and maximum values of the list that constitutes the ns_{cons_base} entry.

2.4.3 Example Calculation

The following example provides a sample calculation for the SD metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.4.3.1 Problem Statement

Calculate the SD metric for the base flow standard at the Brazos River near Glen Rose for wet summers over the time period from July 7, 1940, through July 20, 1940, using WAM output file "TS-Flag-Braz3.txt."

2.4.3.2 Solution

Table B-4 illustrates the first step of the SD calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the cs_{cons_base} counter and ns_{cons_base} list for wet summers are updated, as applicable.

Table B-4
WAM Output Data, Counter and List for Example SD Calculation

Year	Month	Day	EFS-FLAG Value[1]	cs_{cons_base} [*Summer*][*Wet*]	ns_{cons_base} [*Summer*][*Wet*]
1940	7	7	440333.0	0	
1940	7	8	343333.0	0	
1940	7	9	303333.0	0	
1940	7	10	203333.3	1	
1940	7	11	203333.3	2	
1940	7	12	203333.3	3	
1940	7	13	203333.3	4	
1940	7	14	203333.3	5	5
1940	7	15	303333.0	0	
1940	7	16	200333.4	0	
1940	7	17	303333.0	0	
1940	7	18	303333.0	0	
1940	7	19	203333.3	1	
1940	7	20	203333.3	2	2

Notes:

1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

Data from WAM output file "TS-Flag-Braz3.txt" for the Brazos River near Glen Rose

Intermediate data calculated for input into the SD metric formula

- As shown in Table B-4, the cs_{cons_base} counter for wet summers is increased by a value of 1 each day on July 10 through 14, July 19, and July 20, due to the following criteria being met:
  - Digit D of the EFS-FLAG value is equal to 3, indicating the summer season.
  - Digit F of the EFS-FLAG value is equal to 3, indicating a wet hydrologic condition.
  - Digit G of the EFS-FLAG value is equal to 3, indicating engagement and non-attainment of the base flow standard.
- On July 14, the ns_{cons_base} list is appended with the value of the cs_{cons_base} counter, and the cs_{cons_base} counter is reset to zero, due to the following criterion being met:
  - Digit G of the next day's EFS-FLAG value is not equal to 3, indicating that the engagement and non-attainment of the base flow standard is not continued on the next day.
- On July 20, the ns_{cons_base} list is appended with the value of the cs_{cons_base} counter, due to the following criterion being met:

- For the window of time defined in the problem statement, the next day's EFS-FLAG value does not exist.

Using the list of the $ns_{\boldsymbol{cons\_base}}$ values from Table B-4, the second step of the SD calculation for this example is performed as follows, using the formula from Equation B-4.

$$\begin{aligned} \mathrm{SD} &= median(ns_{cons});\ (min(ns_{cons}), max(ns_{cons})) \\ &= median(ns_{cons\_base});\ (min(ns_{cons\_base}), max(ns_{cons\_base})) \\ &= median([5,2]);\ (min([5,2]), max([5,2])) \\ &= \mathbf{3.5}; (\mathbf{2}, \mathbf{5}) \end{aligned}$$

2.5 Shortage

The instream flow shortage (S) metric is applicable to both subsistence and base flow standards and is defined as the median instream flow shortage for days in which a shortage occurs, in acre-feet per day (afd).

2.5.1 Mathematical Formula

The mathematical formula used to calculate S is shown in Equation B-5.

Equation B-5

$$\mathrm{S} = median(shortages)$$

where:

S = shortage

$shortages$ = discrete shortage values for days in which the instream flow standard is engaged but not attained, for each combination of season and hydrologic condition defined for the control point's river basin

2.5.2 Description of Calculation Procedure

As shown in Equation B-5, the calculation of the S metric depends upon one term, referred to as $shortages$, which must first be calculated. The information for calculating this term is contained within the following four WAM outputs:[7]

- The EFS-FLAG output variable
- The daily base flow targets without subsistence and base flow targets
- The daily subsistence flow targets without base flow and pulse flow and without the 50% rule application for the Brazos River basin
- The end-of-day final regulated flow

A description of the procedure used to calculate term $shortages$, and finally S, in Python is summarized as follows.

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The WAM output file containing the time series of daily subsistence flow targets for each control point
  - The WAM output file containing the time series of daily base flow targets for each control point
  - The WAM output file containing the time series of end-of-day regulated flows for each control point
- For each control point, the following blank lists representing term $shortages$ are created, to be appended with discrete shortage values (where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - $shortages_{subs}$[*season*][*hydrologic condition*])
  - $shortages_{base}$[*season*][*hydrologic condition*])
- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the subsistence flow standard:
    - The day's regulated flow is obtained from the time series of end-of-day regulated flows.
    - The day's subsistence flow target is obtained from the time series of daily subsistence flow targets.

[7] For details regarding these four WAM outputs, refer to Appendix A.

    - The day's subsistence flow shortage is calculated by subtracting the day's regulated flow from the day's subsistence flow target.
    - The day's subsistence flow shortage is appended to the list in the $shortages_{subs}$ entry corresponding to the day's season and hydrologic condition.
  - If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the base flow standard:
    - The day's regulated flow is obtained from the time series of end-of-day regulated flows.
    - The day's base flow target is obtained from the time series of daily base flow targets.
    - The day's base flow shortage is calculated by subtracting the day's regulated flow from the day's base flow target.
    - The day's base flow shortage is appended to the list in the $shortages_{base}$ entry corresponding to the day's season and hydrologic condition.
- After all of the control point's daily EFS-FLAG values have been parsed and the $shortages$ lists finalized accordingly, the S metrics for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - For the subsistence flow standard:
    - S is calculated by finding the median value of the list that constitutes the $shortages_{subs}$ entry.
  - For the base flow standard:
    - S is calculated by finding the median value of the list that constitutes the $shortages_{base}$ entry.

2.5.3 Example Calculation

The following example provides a sample calculation for the S metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.5.3.1 Problem Statement

Calculate the S metric for the base flow standard at the Brazos River near Glen Rose for wet summers over the time period from July 7, 1940, through July 20, 1940, using WAM output files "TS-Flag-Braz3.txt," "TS-Reg-Braz3.txt," and "TS-Base-Braz3.txt."

2.5.3.2 Solution

Table B-5 illustrates the first step of the S calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the $shortages_{base}$ list for wet summers is updated, as applicable.

Table B-5
WAM Output Data and Shortages List for Example S Calculation

Year	Month	Day	EFS-FLAG Value[1]	Regulated Flow (afd)	Base Flow Target (afd)	$shortages_{base}$ [*Summer*][*Wet*] (afd)[2]
1940	7	7	440333.0	482	317	
1940	7	8	343333.0	2,618	317	
1940	7	9	303333.0	2,625	317	
1940	7	10	203333.3	0	317	317
1940	7	11	203333.3	0	317	317
1940	7	12	203333.3	0	317	317
1940	7	13	203333.3	230	317	87
1940	7	14	203333.3	99	317	218
1940	7	15	303333.0	1,170	317	
1940	7	16	200333.4	2,147	317	
1940	7	17	303333.0	2,893	317	
1940	7	18	303333.0	2,479	317	
1940	7	19	203333.3	0	317	317
1940	7	20	203333.3	0	317	317

Notes:

1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

Data from WAM output files "TS-Flag-Braz3.txt," "TS-Reg-Braz3.txt," and "TS-Base-Braz3.txt" for the Brazos River near Glen Rose

Intermediate data calculated for input into the S metric formula

- As shown in Table B-5, the discrete shortages with respect to the base flow target for wet summers are calculated for July 10 through 14, July 19, and July 20, due to the following criterion being met:
  - Digit G of the EFS-FLAG value is equal to 3, indicating engagement and non-attainment of the base flow standard.
- On each of these days, the $shortages_{base}$ list is appended with the shortage value, equal to the base flow target minus the regulated flow, in afd.

Using the list of the $shortages_{\boldsymbol{base}}$ values from Table B-5, the second step of the S calculation for this example is performed as follows, using the formula from Equation B-5.

$$\begin{aligned} \mathrm{S} &= median(shortages) \\ &= median(shortages_{base}) \\ &= median([317, 317, 317, 87, 218, 317, 317]) \\ &= \mathbf{317} \end{aligned}$$

2.6 Percent Shortage

The percent shortage (PS) metric is applicable to both subsistence and base flow standards and is defined as the median of instream flow shortages, as a percentage of the instream flow standard for the day.

2.6.1 Mathematical Formula

The mathematical formula used to calculate PS is shown in Equation B-6.

Equation B-6

$$\mathrm{PS} = median(pct\_shortages)$$

where:

PS = percent shortage

$pct\_shortages$ = discrete percent shortage values for days in which the instream flow standard is engaged but not attained, for each combination of season and hydrologic condition defined for the control point's river basin

2.6.2 Description of Calculation Procedure

As shown in Equation B-6, the calculation of the PS metric depends upon one term, referred to as $pct\_shortages$, which must first be calculated. The information for calculating this term is contained within the following four WAM outputs:

- The EFS-FLAG output variable
- The daily base flow targets without subsistence and base flow targets
- The daily subsistence flow targets without base flow and pulse flow and without the 50% rule application for the Brazos River basin
- The end-of-day final regulated flow

A description of the procedure used to calculate term $pct\_shortages$, and finally PS, in Python is summarized as follows:

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The WAM output file containing the time series of daily subsistence flow targets for each control point
  - The WAM output file containing the time series of daily base flow targets for each control point
  - The WAM output file containing the time series of end-of-day regulated flows for each control point
- For each control point, the following blank lists representing term $pct\_shortages$ are created, to be appended with discrete shortage values (where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - $pct\_shortages_{subs}$[*season*][*hydrologic condition*])
  - $pct\_shortages_{base}$[*season*][*hydrologic condition*])
- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the subsistence flow standard:
    - The day's regulated flow is obtained from the time series of end-of-day regulated flows.
    - The day's subsistence flow target is obtained from the time series of daily subsistence flow targets.
    - The day's subsistence flow PS is calculated by:

    - Subtracting the day's regulated flow from the day's subsistence flow target to obtain the day's subsistence flow shortage
    - Dividing the day's subsistence flow shortage by the day's subsistence flow target
  - The day's subsistence flow PS is appended to the list in the $pct\_shortages_{subs}$ entry corresponding to the day's season and hydrologic condition.
- If digit G of the day's EFS-FLAG value indicates the engagement and non-attainment of the base flow standard:
  - The day's regulated flow is obtained from the time series of end-of-day regulated flows.
  - The day's base flow target is obtained from the time series of daily base flow targets.
  - The day's base flow PS is calculated by:
    - Subtracting the day's regulated flow from the day's base flow target to obtain the day's subsistence flow shortage
    - Dividing the day's base flow shortage by the day's base flow target
  - The day's base flow PS is appended to the list in the $pct\_shortages_{base}$ entry corresponding to the day's season and hydrologic condition.

- After all of the control point's daily EFS-FLAG values have been parsed and the $pct\_shortages$ lists finalized accordingly, the PS metric for the subsistence and base flow standards are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - For the subsistence flow standard:
    - PS is calculated by finding the median value of the list that constitutes the $pct\_shortages_{subs}$ entry.
  - For the base flow standard:
    - PS is calculated by finding the median value of the list that constitutes the $pct\_shortages_{base}$ entry.

2.6.3 Example Calculation

The following example provides a sample calculation for the PS metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.6.3.1 Problem Statement

Calculate the PS metric for the base flow standard at the Brazos River near Glen Rose for wet summers over the time period from July 7, 1940, through July 20, 1940, using WAM output files "TS-Flag-Braz3.txt," "TS-Reg-Braz3.txt," and "TS-Base-Braz3.txt."

2.6.3.2 Solution

Table B-6 illustrates the first step of the PS calculation for this example, in which each day's EFS-FLAG value is evaluated in sequence (row by row, from the top of the table to the bottom) and the $pct\_shortages_{base}$ list for wet summers is updated, as applicable.

Table B-6
WAM Output Data and Percent Shortages List for Example PS Calculation

Year	Month	Day	EFS-FLAG Value[1]	Regulated Flow (afd)	Base Flow Target (afd)	$pct\_shortages_{base}$ [*Summer*][*Wet*]
1940	7	7	440333.0	482	317	
1940	7	8	343333.0	2,618	317	
1940	7	9	303333.0	2,625	317	
1940	7	10	203333.3	0	317	100
1940	7	11	203333.3	0	317	100
1940	7	12	203333.3	0	317	100
1940	7	13	203333.3	230	317	27
1940	7	14	203333.3	99	317	69
1940	7	15	303333.0	1,170	317	
1940	7	16	200333.4	2,147	317	
1940	7	17	303333.0	2,893	317	
1940	7	18	303333.0	2,479	317	
1940	7	19	203333.3	0	317	100
1940	7	20	203333.3	0	317	100

Notes:

1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

(tan) Data from WAM output files "TS-Flag-Braz3.txt," "TS-Reg-Braz3.txt," and "TS-Base-Braz3.txt" for the Brazos River near Glen Rose

(blue) Intermediate data calculated for input into the PS metric formula

- As shown in Table B-6, the discrete PSs with respect to the base flow target for wet summers are calculated for July 10 through 14, July 19, and July 20, due to the following criterion being met:

- Digit G of the EFS-FLAG value is equal to 3, indicating engagement and non-attainment of the base flow standard.
- On each of these days, the $pct\_shortages_{base}$ list is appended with the base flow PS value, equal to the base flow shortage value divided by the base flow target.

Using the list of the $pct\_shortages_{\boldsymbol{base}}$ values from Table B-6, the second step of the PS calculation for this example is performed as follows, using the formula from Equation B-6.

$$\begin{aligned}\text{PS} &= median(pct\_shortages)\\ &= median(pct\_shortages_{base})\\ &= median([100, 100, 100, 27, 69, 100, 100])\\ &= \mathbf{100}\end{aligned}$$

2.7 Pulse Frequency

The pulse frequency (PF) metric is applicable to HFP standards and is defined as the percentage of HFP engagements, relative to the target number of HFP engagements.

2.7.1 Mathematical Formula

The mathematical formula used to calculate PF is shown in Equation B-7.

Equation B-7

$$\text{PF} = \frac{np_{en}}{np_t} \times 100$$

where:

PF	=	pulse frequency
np_{en}	=	number of high flow pulse engagements over the number of complete seasons within the WAM simulation period, for each combination of pulse type, season, and hydrologic condition defined for the control point
np_t	=	total number of target high flow pulse engagements over the number of complete seasons within the WAM simulation period, for each combination of pulse type, season, and hydrologic condition defined for the control point

2.7.2 Description of Calculation Procedure

As shown in Equation B-7, the calculation of the PF metric depends upon two terms, referred to as np_{en} and np_t, which must first be calculated. The information for calculating these two terms is contained within the following files:

- WAM outputs[8]
  - The time series file containing the EFS-FLAG output variable
  - The SMM message file containing information regarding pulse attainments
- Manually created Python inputs
  - Copies of the pulse standards (target numbers of pulse engagements per season, pulse trigger flow rates, target pulse volumes, and target pulse durations) for each combination of pulse type, season, and hydrologic condition defined for each control point, transcribed from the standards to comma-delimited text (*.csv) files for use by Python in the metrics calculations
  - Start and end dates of each season defined in the standards for each river basin, manually coded into a Python input file for use in the metrics calculations
  - Start and end dates of the WAM simulation, manually coded into a Python input file for use in the metrics calculations

A description of the procedure used to calculate terms np_{en} and $np_{t'}$, and finally PF, in Python is summarized as follows:

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The SMM message file containing information regarding pulse attainments for each control point
  - The *.csv files of the transcribed pulse standards for each control point
  - The Python input file containing the start and end dates of each season defined for each control point's river basin, as well as the start and end dates of the WAM simulation
- For each control point, variables for incrementally counting the following types of occurrences over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - Complete seasons (cs_t[*season*][*hydrologic condition*])

[8] For details regarding the these two WAM outputs, refer to Appendix A.

  - HFP engagements within complete seasons (cp_{en}[*season*][*hydrologic condition*])

  These variables are hereafter referred to as "counters" for the remainder of this summary.
- For each control point and each complete season that falls between the WAM simulation start and end dates:
  - The EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, for the median date of the season is parsed.
    - The entry of the cs_t counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
  - All pulse engagements for the control point (for each pulse type defined in the standards) that fall between the season start and end dates are extracted from the SMM message file output data.
    - The entry of the cp_{en} counter corresponding to the current season and hydrologic condition is sequentially updated with each pulse engagement that occurs during the season, as indicated by unique values of the "Pulse Count" field of the extracted SMM data.
- After all complete seasons within the WAM simulation period have been assessed and the cs_t and cp_{en} counters finalized accordingly, the PF metric is calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - Term np_{en} of the PF formula is assigned the final count of the cp_{en} entry.
  - The target number of pulses for each combination of season and hydrologic condition obtained from the input *.csv files (for each pulse type defined in the standards) is multiplied by the corresponding entry in the cs_t counter to produce the term np_t of the PF formula.
  - PF is calculated as shown in Equation B-7 by dividing np_{en} by np_t and multiplying by 100.

2.7.3 Example Calculation

The following example provides a sample calculation for the PF metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.7.3.1 Problem Statement

Calculate the PF metric for the Brazos River near Waco for average winters over the time period from December 5, 1944, through January 26, 1945, using SMM message file "PulseComputations-Braz3.txt" and the following assumptions:

- The WAM simulation includes the complete 1944 to 1945 average winter season (spanning November 1, 1944, through February 28, 1945, inclusive).
- There is only one type of HFP defined in the standards for the Brazos River near Waco, with a target of three pulse engagements per season for average winters.
- The "Pulse ID" field of the file "PulseComputations-Braz3.txt" SMM message file consists of four dash-separated codes, defined as follows:
  - CP_ID-SEASON_ID-HYD_ID-PULSE_TYPE
  - Where:
    - CP_ID = a four-character control point identification code
      = "BRWA" for the Brazos River near Waco
    - SEASON_ID = a three-character season identification code
      = "WIN" for winter
    - HYD_ID = a three-character hydrologic condition identification code
      = "AVG" for average
    - PULSE_TYPE = a three-character code for the pulse type, if multiple pulse types are
      defined in the standards for the control point (otherwise, this code is omitted)
      = omitted for the Brazos River near Waco

2.7.3.2 Solution

Table B-7 illustrates the first step of the PF calculation for this example, in which each day's "Pulse Count" and "Pulse ID" values from the SMM message file are evaluated in sequence (row by row, from the top of the table to the bottom) and the cp_{en} counter for average winters is updated, as applicable.

Table B-7
WAM Output Data and Pulse Engagement Counter for Example PF Calculation

Control Point Code	Year	Month	Day	Pulse Count	Pulse ID	cp_{en} [*Winter*][*Average*]
EFLRLR	1944	12	5	3	LRLR-WIN-AVG	0
EFLRCA	1944	12	5	3	LRCA-WIN-AVG	0
EFNAEA	1944	12	5	3	NAEA-WIN-AVG	0
EFBRRO	1944	12	5	3	BRRO-WIN-AVG	0
EFNAEA	1944	12	6	3	NAEA-WIN-AVG	0
EFBRRO	1944	12	6	3	BRRO-WIN-AVG	0
EFBRWA	1945	1	18	1	BRWA-WIN-AVG	1
EFBRWA	1945	1	19	2	BRWA-WIN-AVG	2
EFBRGR	1945	1	20	1	BRGR-WIN-AVG-SML	2
EFBRWA	1945	1	20	2	BRWA-WIN-AVG	2
EFBRGR	1945	1	21	1	BRGR-WIN-AVG-SML	2
EFBRWA	1945	1	21	2	BRWA-WIN-AVG	2
EFBRGR	1945	1	22	1	BRGR-WIN-AVG-SML	2
EFBRWA	1945	1	22	3	BRWA-WIN-AVG	3
EFBRWA	1945	1	23	3	BRWA-WIN-AVG	3
EFBRWA	1945	1	24	3	BRWA-WIN-AVG	3
EFBRWA	1945	1	25	3	BRWA-WIN-AVG	3
EFBRWA	1945	1	26	3	BRWA-WIN-AVG	3

Notes:

Data from SMM message file "PulseComputations-Braz3.txt" for the Brazos River near Waco

Intermediate data calculated for input into the PF metric formula

- As shown in Table B-7, three HFPs are engaged at the Brazos River near Waco during the portion of the average winter season defined in the problem statement:
  - The first pulse is engaged on January 18, 1945.
  - The second pulse is engaged on January 19, 1945, and remains active through January 21, 1945.
  - The third pulse is engaged on January 22, 1945, and remains active through January 26, 1945.
- For each of these engagements, the cp_{en} counter is increased by a value of 1.

Using the final value of the cp_{en} counter from Table B-7, the second step of the PF calculation for this example is performed as follows, using the formula from Equation B-7.

$$\text{PF} = \frac{np_{en}}{np_t} \times 100 = \frac{cp_{en}}{cs_t \times target\ pulse\ engagements\ per\ season} \times 100$$

$$= \frac{3}{1 \times 3} \times 100 = \frac{3}{3} \times 100 = \mathbf{100}$$

2.8 Target Engagements Met

The target engagements met (TEM) metric is applicable to HFP standards and is defined as the percentage of seasons in which all target HFP engagements were met.

2.8.1 Mathematical Formula

The mathematical formula used to calculate TEM is shown in Equation B-8.

Equation B-8

$$\text{TEM} = \frac{np_{at}}{ns_t} \times 100$$

where:

TEM	=	target engagements met
np_{at}	=	number of seasons in which all of the target pulse engagements were met, for each combination of pulse type, season, and hydrologic condition defined for the control point
ns_t	=	total number of complete seasons within the WAM simulation period, for each combination of pulse type, season, and hydrologic condition defined for the control point

2.8.2 Description of Calculation Procedure

As shown in Equation B-8, the calculation of the TEM metric depends upon two terms, referred to as np_{at} and ns_t,[9] which must first be calculated. The information for calculating these two terms is contained within the following files:

- WAM outputs
    - The time series file containing the EFS-FLAG output variable

[9] The term n_{st} used in the TEM calculation is the same ns_t term used in the PF calculation presented in Section B-2.7. However, for the sake of completeness, it is re-presented in full in Section B-2.8. in the context of the TEM calculation.

  - The SMM message file containing information regarding pulse attainments
- Manually created Python inputs
  - Copies of the pulse standards (target numbers of pulse engagements per season, pulse trigger flow rates, target pulse volumes, and target pulse durations) for each combination of pulse type, season, and hydrologic condition defined for each control point, transcribed from the standards to comma-delimited text (*.csv) files for use by Python in the metrics calculations
  - Start and end dates of each season defined in the standards for each river basin, manually coded into a Python input file for use in the metrics calculations
  - Start and end dates of the WAM simulation, manually coded into a Python input file for use in the metrics calculations

A description of the procedure used to calculate terms np_{at} and ns_{t}, and finally TEM, in Python is summarized as follows:

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The SMM message file containing information regarding pulse attainments for each control point
  - The *.csv files of the transcribed pulse standards for each control point
  - The Python input file containing the start and end dates of each season defined for each control point's river basin, as well as the start and end dates of the WAM simulation
- For each control point, variables for incrementally counting the following types of occurrences over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - Complete seasons (cs_t[*season*][*hydrologic condition*])
  - Complete seasons in which all HFP engagements were met (cp_{at}[*season*][*hydrologic condition*])

  These variables are hereafter referred to as "counters" for the remainder of this summary.
- For each control point and each complete season that falls between the WAM simulation start and end dates:
  - The EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, for the median date of the season is parsed.

        - The entry of the cs_t counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
    - All pulse engagements for the control point (for each pulse type defined in the standards) that fall between the season start and end dates are extracted from the SMM message file output data.
        - For each pulse type defined in the standards for the control point, if the largest unique value of the "Pulse Count" field of the extracted portion of the SMM message file is equal to the target number of pulse engagements per season obtained from the input *.csv files, then the entry of the cp_{at} counter corresponding to the current season and hydrologic condition is updated.
- After all complete seasons within the WAM simulation period have been assessed and the cs_t and cp_{at} counters finalized accordingly, the TEM metric is calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
    - Term np_{at} of the TEM formula is assigned the final count of the cp_{at} entry.
    - TEM is calculated as shown in Equation B-8 by dividing np_{en} by np_t and multiplying by 100.

2.8.3 2.8.3. Example Calculation

The following example provides a sample calculation for the TEM metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.8.3.1 Problem Statement

Calculate the TEM metric for the Brazos River near Waco for average winters from the 1949/1950 through the 1959/1960 winter seasons, using SMM message file "PulseComputations-Braz3.txt" and the following assumptions:

- The WAM simulation includes all complete winter seasons from the 1949/1950 through the 1959/1960 seasons.
- Over this time period, there were four average winters in the Brazos River basin:
    - 1949/1950 winter season
    - 1950/1951 winter season
    - 1958/1959 winter season
    - 1959/1960 winter season

- There is only one type of HFP defined in the standards for the Brazos River near Waco, with a target of three pulse engagements per season for average winters.
- The “Pulse ID” field of the “PulseComputations-Braz3.txt” SMM message file consists of four dash-separated codes, defined as follows:
  - CP_ID-SEASON_ID-HYD_ID-PULSE_TYPE
  - Where:
    - CP_ID = a four-character control point identification code
      = “BRWA” for the Brazos River near Waco
    - SEASON_ID = a three-character season identification code
      = “WIN” for winter
    - HYD_ID = a three-character hydrologic condition identification code
      = “AVG” for average
    - PULSE_TYPE = a three-character code for the pulse type, if multiple pulse types are
      defined in the standards for the control point (otherwise, this code is omitted)
      = omitted for the Brazos River near Waco

2.8.3.2 Solution

Table B-8 illustrates the first step of the TEM calculation for this example, in which each day’s ”Pulse Count” and “Pulse ID” values from the SMM message file are evaluated in sequence (row by row, from the top of the table to the bottom) and the cp_{at} counter for average winters is updated, as applicable.

Table B-8
WAM Output Data and Pulse Target Attainment Counter for Example TEM Calculation

Control Point Code	Year	Month	Day	Pulse Count	Pulse ID	cp_{at} [*Winter*][*Average*]
BRWA pulse data for the 1949/1950 Average Winter Season:						
EFBRWA	1950	2	2	1	BRWA-WIN-AVG	0
EFBRWA	1950	2	3	1	BRWA-WIN-AVG	
EFBRWA	1950	2	4	1	BRWA-WIN-AVG	
EFBRWA	1950	2	12	2	BRWA-WIN-AVG	
EFBRWA	1950	2	13	2	BRWA-WIN-AVG	
BRWA pulse data for the 1959/1960 Average Winter Season: (No BRWA pulse data between 1949/1950 and 1959/1960 seasons)						
EFBRWA	1959	11	4	1	BRWA-WIN-AVG	1
EFBRWA	1959	11	5	1	BRWA-WIN-AVG	
EFBRWA	1959	11	6	1	BRWA-WIN-AVG	
EFBRWA	1959	12	15	2	BRWA-WIN-AVG	
EFBRWA	1959	12	16	3	BRWA-WIN-AVG	
EFBRWA	1959	12	17	3	BRWA-WIN-AVG	
EFBRWA	1959	12	18	3	BRWA-WIN-AVG	

Notes:

- Data from SMM message file "PulseComputations-Braz3.txt" for the Brazos River near Waco
- Notes regarding data from processed "PulseComputations-Braz3.txt" file
- Intermediate data calculated for input into the TEM metric formula

- As shown in Table B-8, two HFPs are engaged at the Brazos River near Waco during the 1949/1950 winter season:
  - The first pulse is engaged on February 2, 1950, and remains active through February 4, 1950.
  - The second pulse is engaged on February 12, 1950, and remains active through February 13, 1950.

  Because a third pulse is not engaged, the 1949/1950 average winter season does not meet the target number of pulses, and the cp_{at} counter for average winters is therefore not updated for the 1949/1950 winter season.
- Because no additional pulses are engaged until the 1959/1960 winter seasons, the cp_{at} counter for average winters is not updated prior to the 1959/1960 winter season.
- For the 1959/1960 winter season, three HFPs are engaged:
  - The first pulse is engaged on November 4, 1959, and remains active through November 6, 1959.

- The second pulse is engaged on December 15, 1959.
- The third pulse is engaged on December 16, 1959, and remains active through December 18, 1959.

Because three pulses are engaged, the 1959/1960 average winter season meets the target number of pulses, and the cp_{at} counter for average winters is therefore updated for the 1959/1960 winter season.

Using the final value of the cp_{at} counter from Table B-8, the second step of the TEM calculation for this example is performed as follows, using the formula from Equation B-8.

$$\text{TEM} = \frac{np_{at}}{ns_t} \times 100 = \frac{cp_{at}}{ns_t} \times 100 = \frac{1}{4} \times 100 = \mathbf{25}$$

2.9 Frequency Volume Met and Frequency Duration Met

The frequency volume met (FVM) and frequency duration met (FDM) metrics are applicable to HFP standards and are defined as the percentage of HFPs that meet volume criteria and duration criteria, respectively.

2.9.1 Mathematical Formula

The mathematical formulas used to calculate FVM and FDM are shown in Equation B-9.

Equation B-9

$$\text{FVM} = \frac{nv_{at}}{np_{en}} \times 100, \text{FDM} = 100 - \text{FVM}$$

where:

FVM	=	frequency volume met
FDM	=	frequency duration met
nv_{at}	=	number of engaged pulses for which the target pulse volume was met, for each combination of pulse type, season, and hydrologic condition defined for the control point
np_{en}	=	number of high flow pulse engagements over the number of complete seasons within the WAM simulation period, for each combination of pulse type, season, and hydrologic condition defined for the control point

2.9.2 Description of Calculation Procedure

As shown in Equation B-9, the calculation of the FVM and FDM metrics depends upon two terms, referred to as nv_{at} and np_{en},[10] which must first be calculated. The information for calculating these two terms is contained within the following files:

- WAM outputs
  - The time series file containing the EFS-FLAG output variable
  - The SMM message file containing information regarding pulse attainments
- Manually created Python inputs
  - Copies of the pulse standards (target numbers of pulse engagements per season, pulse trigger flow rates, target pulse volumes, and target pulse durations) for each combination of pulse type, season, and hydrologic condition defined for each control point, transcribed from the standards to comma-delimited text (*.csv) files for use by Python in the metrics calculations
  - Start and end dates of each season defined in the standards for each river basin, manually coded into a Python input file for use in the metrics calculations
  - Start and end dates of the WAM simulation, manually coded into a Python input file for use in the metrics calculations

A description of the procedure used to calculate terms nv_{at} and np_{en}, and finally FVM and FDM, in Python is summarized as follows:

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The SMM message file containing information regarding pulse attainments for each control point
  - The *.csv files of the transcribed pulse standards for each control point
  - The Python input file containing the start and end dates of each season defined for each control point's river basin, as well as the start and end dates of the WAM simulation
- For each control point, variables for incrementally counting the following types of occurrences over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):

[10] The term np_{en} used in the FVM and FDM calculations is the same np_{en} term used in the PF calculation presented in Section B-2.7. However, for the sake of completeness, it is re-presented in full in Section B-2.9. in the context of the FVM and FDM calculations.

- HFP engagements within complete seasons (cp_{en}[*season*][*hydrologic condition*])
- HFP engagements within complete seasons that meet the target pulse volume (cv_{at}[*season*][*hydrologic condition*])

These variables are hereafter referred to as "counters" for the remainder of this summary.

- For each control point and each complete season that falls between the WAM simulation start and end dates:
  - The EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, for the median date of the season is parsed.
    - The hydrologic condition for the season is determined from digit F of the day's EFS-FLAG value.
  - All pulse engagements for the control point (for each pulse type defined in the standards) that fall between the season start and end dates are extracted from the SMM message file output data.
    - The entry of the cp_{en} counter corresponding to the current season and hydrologic condition is sequentially updated with each pulse engagement that occurs during the season, as indicated by unique values of the "Pulse Count" field of the extracted SMM data.
      - For each pulse engagement that occurs, if the final cumulative volume of the pulse is greater than or equal to the target pulse volume obtained from the input *.csv files and the target pulse duration (also obtained from the input *.csv files) is not met, then the then the entry of the cv_{at} counter corresponding to the current season and hydrologic condition is updated.[11]
- After all complete seasons within the WAM simulation period have been assessed and the cp_{en} and cv_{at} counters finalized accordingly, the FVM and FDM metrics are calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - Term np_{en} of the FVM formula is assigned the final count of the cp_{en} entry.
  - Term nv_{at} of the FVM formula is assigned the final count of the cv_{at} entry.
  - FVM is calculated as shown in Equation B-9 by dividing nv_{at} by np_{en} and multiplying by 100.
  - FDM is calculated as shown in Equation B-9 by subtracting FVM from 100.

[11] In the case of both the target pulse volume and the target pulse duration being met on the same day, the duration criterion is considered to supersede the volume criterion, and the pulse is included in the FDM metric rather than the FVM metric (i.e., the cv_{at} counter is not updated).

2.9.3 *Example Calculation*

The following example provides a sample calculation for the FVM and FDM metrics, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.9.3.1 Problem Statement

Calculate the FVM and FDM metrics for the Brazos River near Waco for average winters from the 1949/1950 through the 1959/1960 winter seasons, using SMM message file "PulseComputations-Braz3.txt" and the following assumptions:

- The WAM simulation includes all complete winter seasons from the 1949/1950 through the 1959/1960 seasons.
- Over this time period, there were four average winters in the Brazos River basin:
  - 1949/1950 winter season
  - 1950/1951 winter season
  - 1958/1959 winter season
  - 1959/1960 winter season
- There is only one type of HFP defined in the standards for the Brazos River near Waco, with a target volume of 12,400 acre-feet and a target duration of 7 days for average winters.
- The "Pulse ID" field of the file "PulseComputations-Braz3.txt" SMM message file consists of four dash-separated codes, defined as follows:
  - CP_ID-SEASON_ID-HYD_ID-PULSE_TYPE
  - Where:
    - CP_ID = a four-character control point identification code
      = "BRWA" for the Brazos River near Waco
    - SEASON_ID = a three-character season identification code
      = "WIN" for winter
    - HYD_ID = a three-character hydrologic condition identification code
      = "AVG" for average
    - PULSE_TYPE = a three-character code for the pulse type, if multiple pulse types are
      defined in the standards for the control point (otherwise, this code is omitted)
      = omitted for the Brazos River near Waco

2.9.3.2 Solution

Table B-9 illustrates the first step of the FVM and FDM calculation for this example, in which each day's "Pulse Count" and "Pulse ID" values from the SMM message file are evaluated in sequence (row by row, from the top of the table to the bottom) and the cv_{at} counter for average winters is updated, as applicable.

Table B-9
WAM Output Data and Pulse Volume Attainment Counter for Example FVM and FDM Calculation

Control Point Code	Year	Month	Day	Pulse Count	Pulse Volume (acre-feet)	Pulse ID	cp_{en} [*Winter*] [*Average*]	cv_{at} [*Winter*] [*Average*]
BRWA pulse data for the 1949/1950 Average Winter Season:								
EFBRWA	1950	2	2	1	6,266.9	BRWA-WIN-AVG	1	1
EFBRWA	1950	2	3	1	10,838.1	BRWA-WIN-AVG	1	
EFBRWA	1950	2	4	1	12,599.2	BRWA-WIN-AVG	1	
EFBRWA	1950	2	12	2	7,791.8	BRWA-WIN-AVG	2	2
EFBRWA	1950	2	13	2	19,422.3	BRWA-WIN-AVG	2	
BRWA pulse data for the 1959/1960 Average Winter Season: (No BRWA pulse data between 1949/1950 and 1959/1960 seasons)								
EFBRWA	1959	11	4	1	4,981.9	BRWA-WIN-AVG	3	3
EFBRWA	1959	11	5	1	9,709.1	BRWA-WIN-AVG	3	
EFBRWA	1959	11	6	1	14,666.0	BRWA-WIN-AVG	3	
EFBRWA	1959	12	15	2	15,059.9	BRWA-WIN-AVG	4	4
EFBRWA	1959	12	16	3	5,969.4	BRWA-WIN-AVG	5	5
EFBRWA	1959	12	17	3	10,591.7	BRWA-WIN-AVG	5	
EFBRWA	1959	12	18	3	18,768.5	BRWA-WIN-AVG	5	

Notes:

- Data from SMM message file "PulseComputations-Braz3.txt" for the Brazos River near Waco
- Final cumulative volume of engaged pulse (target volume met if >= 12,400)
- Notes regarding data from processed "PulseComputations-Braz3.txt" file
- Intermediate data calculated for input into the FVM and FDM metric formulas

- As shown in Table B-9, two HFPs are engaged at the Brazos River near Waco during the 1949/1950 winter season:
  - The first pulse is engaged on February 2, 1950, and remains active through February 4, 1950.

- The second pulse is engaged on February 12, 1950, and remains active through February 13, 1950.

For each of these engagements, the cp_{en} counter is increased by a value of 1. Because the final cumulative volume of each of these pulses meets the target volume of 12,400 acre-feet and the duration of each pulse does not meet the target duration of 7 days, the cv_{at} counter is increased by a value of 1 for each of these engagements.

- Because no additional pulses are engaged until the 19591960 winter season, neither the cp_{en} nor the cv_{at} counter for average winters is updated prior to the 1959/1960 winter season.
- For the 1959/1960 winter season, three HFPs are engaged:
  - The first pulse is engaged on November 4, 1959, and remains active through November 6, 1959.
  - The second pulse is engaged on December 15, 1959.
  - The third pulse is engaged on December 16, 1959, and remains active through December 18, 1959.

For each of these engagements, the cp_{en} counter is increased by a value of 1. Because the final cumulative volume of each of these pulses meets the target volume of 12,400 acre-feet and the duration of each pulse does not meet the target duration of 7 days, the cv_{at} counter is increased by a value of 1 for each of these engagements.

Using the final values of the cp_{en} and cv_{at} counters from Table B-9, the second step of the FVM and FDM calculation for this example is performed as follows, using the formula from Equation B-9.

$$\mathrm{FVM} = \frac{nv_{at}}{np_{en}} \times 100 = \frac{cv_{at}}{cp_{en}} \times 100 = \frac{5}{5} \times 100 = \mathbf{100}$$

$$\mathrm{FDM} = 100 - \mathrm{FVM} = 100 - 100 = \mathbf{0}$$

2.10 Zero-Flow Frequency

The zero-flow frequency (ZFF) metric is a generic metric that not specifically based on any of the defined environmental flow standards. It is defined as the frequency of zero-flow days.

2.10.1 Mathematical Formula

The mathematical formula used to calculate ZFF is shown in Equation B-10.

Equation B-10

$$\text{ZFF} = \frac{n_z}{n_t} \times 100$$

where:

ZFF	=	zero-flow frequency
n_z	=	number of days of zero flow, for each combination of season and hydrologic condition defined for the control point's river basin
n_t	=	total number of days corresponding to each combination of season and hydrologic condition defined for the control point's river basin

2.10.2 Description of Calculation Procedure

As shown in Equation B-10, the calculation of the ZFF metric depends upon two terms, referred to as n_z and n_t, which must first be calculated.[12] The information for calculating these two terms is contained within the following two WAM outputs:

- The EFS-FLAG output variable
- The end-of-day final regulated flow

A description of the procedure used to calculate terms n_z and n_t, and finally ZFF, in Python is summarized below.

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The WAM output file containing the time series of end-of-day regulated flows for each control point
- For each control point, variables for incrementally counting the following types of occurrences in the daily EFS-FLAG variable over the WAM simulation period are initialized (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - Days within each combination of season and hydrologic condition defined for the control point's river basin (c_t[*season*][*hydrologic condition*])

[12] The term n_t used in the ZFF calculation is the same n_t term used in the EF calculation presented in Section B-2.1. However, for the sake of completeness, it is re-presented in full in Section B-2.10. in the context of the ZFF calculation.

- Days of zero flow, for each combination of season and hydrologic condition defined for the control point's river basin (c_z[*season*][*hydrologic condition]*)[13]

These variables are hereafter referred to as "counters" for the remainder of this summary.

- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - The entry of the c_t counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
  - The day's regulated flow is then obtained from the time series of end-of-day regulated flows.
  - If the day's regulated flow is less than or equal to 0.1 cubic foot per second (cfs; 0.2 afd), the entry of the c_z counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
- After all of the control point's daily EFS-FLAG values have been parsed and the counters finalized accordingly, the ZFF metric is calculated as follows, for each combination of season and hydrologic condition defined for the control point's river basin:
  - Term n_t of the ZFF formula is assigned the final count of the c_t entry.
  - Term n_z of the ZFF formula is assigned the final count of the c_z entry.
  - ZFF is calculated as shown in Equation B-10, by dividing n_z by n_t and multiplying by 100.

2.10.3 Example Calculation

The following example provides a sample calculation for the ZFF metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.10.3.1 Problem Statement

Calculate the ZFF metric for the Salt Fork near Aspermont in the Brazos River basin for dry springs over the time period from March 1, 1940, through March 10, 1940, using WAM output files "TS-Flag-Braz3.txt" and "TS-Reg-Braz3.txt."

2.10.3.2 Solution

Table B-10 illustrates the first step of the ZFF calculation for this example, in which each day's EFS-FLAG and regulated flow values are evaluated in sequence (row by row, from the top of the table to the bottom) and the c_z and c_t counters for dry springs are updated, as applicable.

[13] For this evaluation, zero flow is defined as any final regulated flow value less than or equal to 0.1 cfs (0.2 afd).

Table B-10
WAM Output Data and Counters for Example ZFF Calculation

Year	Month	Day	EFS-FLAG Value[1]	Regulated Flow (afd)	c_z [*Spring*][*Dry*]	c_t [*Spring*][*Dry*]
1940	3	1	100221.1	0.1	1	1
1940	3	2	100221.1	0.0	2	2
1940	3	3	100221.1	0.1	3	3
1940	3	4	100221.1	0.3	3	4
1940	3	5	100221.1	0.6	3	5
1940	3	6	100221.1	0.4	3	6
1940	3	7	100221.1	0.3	3	7
1940	3	8	100221.1	0.3	3	8
1940	3	9	100221.1	0.0	4	9
1940	3	10	100221.1	0.0	5	10

Notes:
1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

Data from "TS-Reg-Braz3.txt" and "TS-Reg-Braz3.txt" for the Salt Fork near Aspermont

Intermediate data calculated for input into the ZFF metric formula

- As shown in Table B-10, from March 1 through March 10, 1940, the counter c_t is increased by a value of 1 each day, due to the following criteria being met:
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.
- On March 1 through March 3, March 9, and March 10, the counter c_z is increased by a value of 1, due to the following criterion being met:
  - The day's regulated flow is less than or equal to 0.2 afd.

Using the final values of the c_t and c_z counters from Table B-10, the second step of the ZFF calculation for this example is performed as follows, using the formula from Equation B-10.

$$\text{ZFF} = \frac{n_z}{n_t} \times 100 = \frac{c_z}{c_t} \times 100 = \frac{5}{10} \times 100 = \mathbf{50}$$

2.11 Zero-Flow Duration

The zero-flow duration (ZFD) metric is a generic metric that not specifically based on any of the defined environmental flow standards. It is defined as the median consecutive days of zero flow.

2.11.1 Mathematical Formula

The mathematical formula used to calculate ZFD is shown in Equation B-11.

Equation B-11

$$\mathrm{ZFD} = median(nz_{cons});\ (min(nz_{cons}), max(nz_{cons}))$$

where:

ZFD	=	zero-flow duration
nz_{cons}	=	discrete numbers of consecutive days that zero flow occurs, for the season and hydrologic condition being assessed

2.11.2 Description of Calculation Procedure

As shown in Equation B-11, the calculation of the ZFD metric depends upon one term, referred to as nz_{cons}, which must first be calculated. The information for calculating this term is contained within the following two WAM outputs:

- The EFS-FLAG output variable
- The end-of-day final regulated flow

A description of the procedure used to calculate term nz_{cons}, and finally ZFD, in Python is summarized as follows:

- The following files are imported into Python:
  - The WAM output file containing the daily EFS-FLAG variable for each control point
  - The WAM output file containing the time series of end-of-day regulated flows for each control point.
- For each control point, the following variable is initialized for incrementally counting the occurrence of zero-flow days over the WAM simulation period (with the variable name noted in parentheses, where bracketed text indicates separate entries in the variable's data structure corresponding to each combination of season and hydrologic condition defined for the control point's river basin):
  - cz_{cons}[*season*][*hydrologic condition*]

  This variable is hereafter referred to as a "counter" for the remainder of this summary.
- For each control point, the following blank list representing term nz_{cons} is created, to be appended with discrete consecutive-day counts from the cz_{cons} counter above (where bracketed text indicates separate entries in the variable's data structure corresponding to

each combination of season and hydrologic condition defined for the control point's river basin):

  - nz_{cons}[*season*][*hydrologic condition*]

- For each control point, each day's EFS-FLAG value, consisting of a seven-digit code in the format ABCDEF.G, is individually parsed.
  - The day's regulated flow is then obtained from the time series of end-of-day regulated flows.
  - If the day's regulated flow is less than or equal to 0.1 cfs (0.2 afd), the entry of the cz_{cons} counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
    - The next day's EFS-FLAG is then parsed.
      - If any of the following criteria are met, the current value of the cz_{cons_subs} entry is added to the list in the nz_{cons} entry corresponding to the day's season and hydrologic condition, and the cz_{cons} entry is reset to a value of zero:
        - Digits D and F of the next day's EFS-FLAG value do not indicate the continuation of the season and hydrologic of the current day.[14]
        - The next day's EFS-FLAG value does not exist, indicating that the current day is the last day of the WAM simulation.
      - Otherwise, next day's regulated flow is obtained from the time series of end-of-day regulated flows.
        - If the next day's regulated flow value is greater than 0.1 cfs (0.2 afd), the entry of the cz_{cons} counter corresponding to the season and hydrologic condition indicated by the day's EFS-FLAG digits D and F is updated.
- After all of the control point's daily EFS-FLAG values have been parsed and the counters and lists finalized accordingly, the ZFD metric is calculated by finding the minimum, median, and maximum values of the list that constitutes the nz_{cons} entry, for each combination of season and hydrologic condition defined for the control point's river basin.

[14] In the standard way of calculating the ZFD metric presented here (specific to each combination of season and hydrologic condition), this criterion resets the cz_{cons} counter and forces the nz_{cons} list to be updated whenever there is a change in season or hydrologic condition, regardless of whether a zero-flow condition continues on the next day. However, a supplemental version of the ZFD metric, referred to as the "Period of Record" version, is separately calculated in Python and reported in the Summary Tables in Appendix C, whereby this criterion is not imposed and the resulting version of the metric is not specific to season and hydrologic condition.

2.11.3 Example Calculation

The following example provides a sample calculation for the ZFD metric, using WAM output data from the Brazos River basin full utilization scenario. The purpose of this example is to provide a simplified illustration of the calculation procedure itself over a short window of time, not an actual complete calculation of the metric over the entire simulation period.

2.11.3.1 Problem Statement

Calculate the ZFD metric for the Salt Fork near Aspermont in the Brazos River basin for dry springs over the time period from March 1, 1940, through March 10, 1940, using WAM output files "TS-Flag-Braz3.txt" and "TS-Reg-Braz3.txt."

2.11.3.2 Solution

Table B-11 illustrates the first step of the ZFD calculation for this example, in which each day's EFS-FLAG and regulated flow values are evaluated in sequence (row by row, from the top of the table to the bottom) and the cz_{cons} counter and nz_{cons} list for dry springs are updated, as applicable.

Table B-11
WAM Output Data, Counter and List for Example ZFD Calculation

<table>
<tr><th>Year</th><th>Month</th><th>Day</th><th>EFS-FLAG Value[1]</th><th>Regulated Flow (afd)</th><th>cz_{cons} [Spring][Dry]</th><th>nz_{cons} [Spring][Dry]</th></tr>
<tr><td>1940</td><td>3</td><td>1</td><td>100221.1</td><td>0.1</td><td>1</td><td rowspan="3">3</td></tr>
<tr><td>1940</td><td>3</td><td>2</td><td>100221.1</td><td>0.0</td><td>2</td></tr>
<tr><td>1940</td><td>3</td><td>3</td><td>100221.1</td><td>0.1</td><td>3</td></tr>
<tr><td>1940</td><td>3</td><td>4</td><td>100221.1</td><td>0.3</td><td>0</td><td rowspan="5"></td></tr>
<tr><td>1940</td><td>3</td><td>5</td><td>100221.1</td><td>0.6</td><td>0</td></tr>
<tr><td>1940</td><td>3</td><td>6</td><td>100221.1</td><td>0.4</td><td>0</td></tr>
<tr><td>1940</td><td>3</td><td>7</td><td>100221.1</td><td>0.3</td><td>0</td></tr>
<tr><td>1940</td><td>3</td><td>8</td><td>100221.1</td><td>0.3</td><td>0</td></tr>
<tr><td>1940</td><td>3</td><td>9</td><td>100221.1</td><td>0.0</td><td>1</td><td rowspan="2">2</td></tr>
<tr><td>1940</td><td>3</td><td>10</td><td>100221.1</td><td>0.0</td><td>2</td></tr>
</table>

Notes:

1. EFS-FLAG values are seven-digit codes in the format "ABCDEF.G"

(tan) Data from "TS-Reg-Braz3.txt" and "TS-Reg-Braz3.txt" for the Salt Fork near Aspermont

(blue) Intermediate data calculated for input into the ZFD metric formula

- As shown in Table B-11, the $cz_{\boldsymbol{cons}}$ counter for dry springs is increased by a value of 1 each day on March 1 through March 3, March 9, and March 10, due to the following criteria being met:
  - Digit D of the EFS-FLAG value is equal to 2, indicating the spring season.
  - Digit F of the EFS-FLAG value is equal to 1, indicating a dry hydrologic condition.
  - The day's regulated flow is less than or equal to 0.2 afd.
- On March 3, the nz_{cons} list is appended with the value of the cz_{cons} counter, and the cz_{cons} counter is reset to zero, due to the following criterion being met:
  - The next day's regulated flow is greater than 0.2 afd.
- On March 10, the nz_{cons} list is appended with the value of the cz_{cons} counter, due to the following criterion being met:
  - For the window of time defined in the problem statement, the next day's EFS-FLAG value does not exist.

Using the list of the $nz_{\boldsymbol{cons}}$ values from Table B-11, the second step of the ZFD calculation for this example is performed as follows, using the formula from Equation B-11.

$$\begin{aligned}\mathrm{ZFD} &= median(nz_{cons});\ (min(nz_{cons}), max(nz_{cons}))\\ &= median([3,2]);\ (min([3,2]), max([3,2]))\\ &= \mathbf{2.5}; (\mathbf{2}, \mathbf{3})\end{aligned}$$

Appendix C
Summary Tables

ABBREVIATIONS

AD	attainment duration
af	acre-feet
AF	attainment frequency
afd	acre-feet per day
cfs	cubic feet per second
EF	engagement frequency
FDM	frequency duration met
FVM	frequency volume met
HFP	high flow pulse
N/A	not applicable
PF	pulse frequency
POR	period of record
PS	percent shortage
S	shortage
SD	shortage duration
TEM	target engagements met
ZFD	zero-flow duration
ZFF	zero-flow frequency

Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains summary tables of attainment metrics for each location, hydrologic condition, season, and flow scenario. Each location contains three types of tables, as presented in Section 2.5.3.1 of the main report:

- A flow statistics table (Table 2-5a of the main report)
- Table containing attainment metrics for the entire period of record (Table 2-5b of the main report)
- Tables containing the attainment metrics for each combination of season and hydrologic condition defined for the location's river basin (Table 2-5c of the main report)

This appendix contains a total of 263 distinct tables, which are arranged as follows:

- Brazos River basin
  - Tables C-1A through C-19K: Tables for each of the 19 locations in the Brazos River basin, with letter designations A through K corresponding to the three types of tables as follows:
    - Table C-#A: Flow statistics table
    - Table C-#B: Attainment metrics for the entire period of record
    - Table C-#C through C-#K: Attainment metrics for each combination of season and hydrologic condition for the Brazos River basin
- Trinity River basin
  - Tables C-20A through C-23F: Tables for each of the four locations in the Trinity River basin, with letter designations A through F corresponding to the three types of tables as follows:
    - Table C-#A: Flow statistics table
    - Table C-#B: Attainment metrics for the entire period of record
    - Table C-#C through C-#F: Attainment metrics for each season for the Trinity River basin
- Neches River basin
  - Tables C-24A through C-28F: Tables for each of the five locations in the Neches River basin, with letter designations A through F corresponding to the three types of tables as follows:
    - Table C-#A: Flow statistics table

- Table C-#B: Attainment metrics for the entire period of record
- Table C-#C through C-#F: Attainment metrics for each season for the Neches River basin

C-1. Brazos River Basin: Salt Fork near Aspermont

Table C-1A
Brazos River Basin: Salt Fork near Aspermont
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	7	6	6	6
Winter - All	0	0	0	0	8	7	7	7
Spring - All	0	0	0	0	8	7	7	7
Summer - All	0	0	0	0	4	3	3	3
Winter - Dry	0	0	0	0	2	1	2	2
Winter - Average	0	0	0	0	8	7	8	8
Winter - Wet	0	0	0	0	12	11	12	12
Spring - Dry	0	0	0	0	2	2	2	1
Spring - Average	0	0	0	0	7	6	6	6
Spring - Wet	0	0	0	0	24	19	20	20
Summer - Dry	0	0	0	0	1	1	1	1
Summer - Average	0	0	0	0	5	3	3	4
Summer - Wet	0	0	0	0	8	6	7	6

Note: cfs: cubic feet per second

Table C-1B
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	7 (1, 278)	7 (1, 277)	7 (1, 266)	7 (1, 268)
	SD-POR	7 (1, 172)	6 (1, 175)	6 (1, 172)	6 (1, 172)
Subsistence Flow	AD-POR	N/A	N/A	N/A	N/A
	SD-POR	8 (1, 71)	8 (1, 230)	8 (1, 71)	8 (1, 71)
Zero Flow	ZFD-POR	3 (1, 59)	4 (1, 175)	4 (1, 76)	4 (1, 117)

Note: N/A: not applicable

Table C-1C
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	1 cfs	EF	57.4%	54.4%	55.3%	55.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 121)	5 (1, 121)	5 (1, 121)	5 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	42.6%	45.6%	44.7%	44.3%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	10 (1, 69)	9 (1, 121)	10 (1, 69)	10 (1, 69)
		S	1 afd	2 afd	2 afd	2 afd
		PS	70.0%	80.0%	75.0%	75.0%
Zero Flow	N/A	ZFF	3.6%	14.8%	10.0%	9.0%
		ZFD	2 (1, 36)	4 (1, 103)	7 (1, 36)	6 (1, 36)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1D
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	4 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	70.6%	67.9%	68.3%	69.1%
		AD	10 (1, 121)	9 (1, 121)	8 (1, 121)	9 (1, 121)
		SD	8 (1, 119)	7 (1, 120)	6 (1, 119)	8 (1, 119)
		S	6 afd	7 afd	6 afd	6 afd
		PS	74.7%	83.5%	78.5%	79.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.8%	12.3%	6.4%	6.7%
		ZFD	13 (7, 28)	9 (1, 120)	5 (2, 76)	9 (1, 79)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1E
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	9 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	61.1%	57.7%	59.3%	58.6%
		AD	9 (1, 121)	6 (1, 121)	9 (1, 121)	8 (1, 121)
		SD	7 (1, 78)	6 (1, 95)	6 (1, 78)	6 (1, 78)
		S	8 afd	9 afd	8 afd	8 afd
		PS	45.3%	48.6%	45.8%	46.4%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	1.1%	0.9%	0.9%
		ZFD	N/A	3 (1, 8)	5 (2, 10)	6 (3, 7)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1F
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 160 Volume (af): 720 Duration (days): 10	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	76.9%	76.9%	76.9%	76.9%
		FDM	23.1%	23.1%	23.1%	23.1%
Base Flow	1 cfs	EF	59.5%	53.6%	53.1%	52.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 79)	7 (1, 54)	7 (1, 54)	7 (1, 79)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	38.0%	44.1%	44.5%	45.1%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	8 (1, 48)	6 (1, 48)	6 (1, 48)	7 (1, 48)
		S	2 afd	2 afd	2 afd	2 afd
		PS	75.0%	85.0%	85.0%	85.0%
Zero Flow	N/A	ZFF	7.6%	19.6%	19.0%	19.2%
		ZFD	5 (1, 29)	3 (1, 39)	3 (1, 39)	5 (1, 37)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1G
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 160 Volume (af): 720 Duration (days): 10	PF	98.4%	98.4%	98.4%	98.4%
		TEM	96.8%	96.8%	96.8%	96.8%
		FVM	96.7%	96.7%	96.7%	96.7%
		FDM	3.3%	3.3%	3.3%	3.3%
Base Flow	2 cfs	EF	96.7%	96.9%	96.7%	96.8%
		AF	75.2%	70.2%	71.5%	71.2%
		AD	9 (1, 74)	9 (1, 68)	8 (1, 68)	9 (1, 68)
		SD	5 (1, 53)	5 (1, 53)	6 (1, 53)	5 (1, 53)
		S	3 afd	4 afd	4 afd	4 afd
		PS	80.0%	90.0%	87.5%	87.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.3%	10.3%	7.8%	8.4%
		ZFD	2 (1, 31)	4 (1, 53)	4 (1, 31)	4 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1H
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 300 Volume (af): 1350 Duration (days): 11	PF	92.9%	92.9%	92.9%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	92.3%	92.3%	92.3%	92.3%
		FDM	7.7%	7.7%	7.7%	7.7%
Base Flow	5 cfs	EF	98.4%	98.4%	98.4%	98.4%
		AF	79.9%	74.8%	75.7%	74.7%
		AD	17 (1, 102)	11 (1, 89)	13 (1, 102)	13 (1, 89)
		SD	6 (1, 28)	4 (1, 28)	5 (1, 28)	6 (1, 28)
		S	6 afd	8 afd	8 afd	8 afd
		PS	62.6%	83.3%	77.3%	81.8%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.9%	7.6%	5.6%	7.3%
		ZFD	2 (2, 12)	5 (1, 19)	3 (1, 23)	5 (1, 23)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1l
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 140 Volume (af): 560 Duration (days): 8	PF	85.7%	85.7%	85.7%	85.7%
		TEM	85.7%	85.7%	85.7%	85.7%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	1 cfs	EF	48.4%	44.0%	43.0%	45.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 83)	4 (1, 67)	5 (1, 67)	4 (1, 67)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	50.5%	55.0%	55.9%	53.8%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	6 (1, 52)	7 (1, 61)	7 (1, 53)	7 (1, 52)
		S	2 afd	2 afd	2 afd	2 afd
		PS	80.0%	85.0%	85.0%	80.0%
Zero Flow	N/A	ZFF	6.5%	19.7%	18.8%	14.4%
		ZFD	3 (1, 30)	4 (1, 61)	4 (1, 30)	4 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1J
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 140 Volume (af): 560 Duration (days): 8	PF	96.6%	96.6%	96.6%	96.6%
		TEM	93.1%	93.1%	93.1%	93.1%
		FVM	89.3%	89.3%	91.1%	89.3%
		FDM	10.7%	10.7%	8.9%	10.7%
Base Flow	1 cfs	EF	96.9%	97.0%	97.2%	97.0%
		AF	62.9%	56.5%	58.1%	58.2%
		AD	6 (1, 105)	6 (1, 97)	6 (1, 97)	6 (1, 97)
		SD	7 (1, 109)	6 (1, 109)	6 (1, 109)	7 (1, 109)
		S	2 afd	2 afd	2 afd	2 afd
		PS	80.0%	90.0%	90.0%	85.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	7.0%	20.6%	16.1%	14.6%
		ZFD	6 (1, 53)	4 (1, 58)	4 (1, 58)	5 (1, 58)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-1K
Brazos River Basin: Salt Fork near Aspermont
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 260 Volume (af): 1090 Duration (days): 10	PF	86.7%	86.7%	86.7%	86.7%
		TEM	86.7%	86.7%	86.7%	86.7%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	3 cfs	EF	98.8%	98.8%	98.9%	98.9%
		AF	61.6%	56.4%	59.3%	57.5%
		AD	6 (1, 103)	6 (1, 59)	6 (1, 102)	6 (1, 94)
		SD	8 (1, 33)	8 (1, 46)	8 (1, 33)	8 (1, 46)
		S	4 afd	5 afd	5 afd	5 afd
		PS	76.3%	88.1%	81.4%	84.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.1%	12.1%	4.2%	8.6%
		ZFD	1 (1, 1)	2 (1, 46)	3 (1, 29)	2 (1, 46)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-2. Brazos River Basin: Double Mountain Fork near Aspermont

Table C-2A
Brazos River Basin: Double Mountain Fork near Aspermont
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	8	8	7	7
Winter - All	0	0	0	0	7	6	6	6
Spring - All	0	0	0	0	10	9	8	8
Summer - All	0	0	0	0	9	8	8	8
Winter - Dry	0	0	0	0	1	1	1	1
Winter - Average	0	0	0	0	8	8	8	7
Winter - Wet	0	0	0	0	15	15	14	12
Spring - Dry	0	0	0	0	1	1	1	1
Spring - Average	0	0	0	0	8	7	7	6
Spring - Wet	0	0	0	0	33	30	28	27
Summer - Dry	0	0	0	0	4	3	3	3
Summer - Average	0	0	0	0	9	8	7	7
Summer - Wet	0	0	0	0	16	15	14	14

Note: cfs: cubic feet per second

Table C-2B
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	6 (1, 290)	6 (1, 276)	5 (1, 278)	5 (1, 270)
	SD-POR	10 (1, 128)	9 (1, 128)	7 (1, 128)	8 (1, 128)
Subsistence Flow	AD-POR	N/A	N/A	N/A	N/A
	SD-POR	9 (1, 216)	8 (1, 216)	8 (1, 216)	8 (1, 217)
Zero Flow	ZFD-POR	7 (1, 213)	5 (1, 213)	3 (1, 213)	4 (1, 213)

Note: N/A: not applicable

Table C-2C
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	1 cfs	EF	51.0%	48.9%	47.1%	47.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 121)	7 (1, 121)	5 (1, 121)	5 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	49.0%	51.1%	52.9%	52.5%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	10 (1, 121)	9 (1, 121)	8 (1, 121)	10 (1, 121)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	32.2%	34.0%	38.1%	38.3%
		ZFD	11 (1, 121)	7 (1, 121)	4 (1, 121)	7 (1, 121)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2D
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	4 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	62.1%	60.6%	60.2%	60.1%
		AD	7 (1, 121)	6 (1, 121)	6 (1, 121)	5 (1, 121)
		SD	11 (1, 120)	8 (1, 120)	8 (1, 120)	10 (1, 120)
		S	7 afd	7 afd	7 afd	7 afd
		PS	91.1%	91.1%	93.7%	92.4%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	8.9%	11.3%	13.6%	13.2%
		ZFD	7 (1, 59)	6 (1, 59)	1 (1, 59)	3 (1, 59)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2E
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	15 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	50.2%	49.2%	48.3%	46.1%
		AD	8 (1, 121)	6 (1, 121)	6 (1, 121)	6 (1, 120)
		SD	13 (1, 115)	8 (1, 115)	5 (1, 115)	7 (1, 115)
		S	21 afd	22 afd	22 afd	22 afd
		PS	71.1%	72.5%	72.8%	72.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.7%	2.5%	1.6%	2.7%
		ZFD	2 (2, 7)	2 (1, 17)	1 (1, 7)	2 (1, 12)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2F
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 280 Volume (af): 1270 Duration (days): 10	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	76.9%	76.9%	76.9%	76.9%
		FDM	23.1%	23.1%	23.1%	23.1%
Base Flow	1 cfs	EF	50.3%	49.4%	48.1%	48.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 77)	6 (1, 77)	6 (1, 77)	6 (1, 77)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	48.1%	48.9%	50.1%	50.1%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	8 (1, 50)	8 (1, 50)	7 (1, 55)	6 (1, 55)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	33.0%	34.6%	37.3%	36.8%
		ZFD	7 (1, 48)	4 (1, 48)	3 (1, 48)	3 (1, 48)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2G
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 280 Volume (af): 1270 Duration (days): 10	PF	96.8%	96.8%	96.8%	96.8%
		TEM	96.8%	96.8%	96.8%	96.8%
		FVM	98.3%	96.7%	98.3%	98.3%
		FDM	1.7%	3.3%	1.7%	1.7%
Base Flow	3 cfs	EF	96.6%	96.7%	96.9%	96.6%
		AF	59.2%	58.6%	57.5%	57.0%
		AD	6 (1, 110)	6 (1, 110)	5 (1, 110)	6 (1, 78)
		SD	10 (1, 70)	9 (1, 70)	8 (1, 70)	9 (1, 70)
		S	6 afd	6 afd	6 afd	6 afd
		PS	94.9%	96.6%	96.6%	96.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	16.3%	18.0%	19.8%	20.1%
		ZFD	5 (1, 42)	4 (1, 42)	4 (1, 43)	3 (1, 43)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2H
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 570 Volume (af): 2600 Duration (days): 12	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	92.9%	100.0%	92.9%	92.9%
		FDM	7.1%	0.0%	7.1%	7.1%
Base Flow	8 cfs	EF	98.0%	98.5%	97.8%	97.9%
		AF	73.9%	72.2%	71.0%	69.8%
		AD	11 (1, 91)	10 (1, 91)	8 (1, 91)	7 (1, 79)
		SD	7 (1, 38)	6 (1, 38)	6 (1, 38)	5 (1, 38)
		S	12 afd	12 afd	13 afd	13 afd
		PS	72.3%	78.3%	79.9%	81.8%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.3%	3.8%	5.5%	6.0%
		ZFD	7 (3, 22)	3 (1, 23)	3 (1, 23)	2 (1, 22)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2l
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 230 Volume (af): 990 Duration (days): 9	PF	92.9%	92.9%	92.9%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	84.6%	84.6%	76.9%	84.6%
		FDM	15.4%	15.4%	23.1%	15.4%
Base Flow	1 cfs	EF	53.6%	53.0%	52.2%	52.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 121)	4 (1, 118)	4 (1, 108)	4 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	44.8%	45.4%	45.9%	46.1%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	8 (1, 60)	7 (1, 60)	8 (1, 60)	8 (1, 75)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	34.0%	34.4%	36.4%	35.9%
		ZFD	7 (1, 44)	7 (1, 44)	5 (1, 44)	5 (1, 44)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2J
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 230 Volume (af): 990 Duration (days): 9	PF	94.8%	94.8%	94.8%	94.8%
		TEM	93.1%	93.1%	93.1%	93.1%
		FVM	96.4%	94.5%	94.5%	96.4%
		FDM	3.6%	5.5%	5.5%	3.6%
Base Flow	2 cfs	EF	97.3%	97.3%	97.3%	97.3%
		AF	61.7%	61.2%	60.2%	60.1%
		AD	6 (1, 88)	5 (1, 86)	5 (1, 88)	5 (1, 88)
		SD	9 (1, 95)	8 (1, 95)	7 (1, 95)	7 (1, 95)
		S	4 afd	4 afd	4 afd	4 afd
		PS	100.0%	100.0%	100.0%	100.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	20.2%	21.3%	22.7%	22.6%
		ZFD	6 (1, 49)	5 (1, 49)	5 (1, 50)	5 (1, 49)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-2K
Brazos River Basin: Double Mountain Fork near Aspermont
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 480 Volume (af): 2160 Duration (days): 12	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	93.3%	93.3%	93.3%	93.3%
		FDM	6.7%	6.7%	6.7%	6.7%
Base Flow	7 cfs	EF	97.7%	98.0%	97.8%	97.8%
		AF	59.8%	59.2%	59.0%	58.4%
		AD	7 (1, 79)	7 (1, 79)	6 (1, 79)	7 (1, 77)
		SD	10 (1, 37)	10 (1, 37)	8 (1, 37)	8 (1, 37)
		S	12 afd	12 afd	12 afd	12 afd
		PS	84.9%	85.6%	87.1%	87.8%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	8.1%	8.6%	10.1%	10.9%
		ZFD	7 (2, 31)	6 (1, 31)	3 (1, 31)	6 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-3. Brazos River Basin: Brazos River at Seymour

Table C-3A
Brazos River Basin: Brazos River at Seymour
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	45	43	43	43
Winter - All	0	0	0	0	37	36	36	36
Spring - All	0	0	0	0	60	57	56	56
Summer - All	0	0	0	0	48	45	45	45
Winter - Dry	0	0	0	0	16	16	15	15
Winter - Average	0	0	0	0	39	38	38	38
Winter - Wet	0	0	0	0	62	61	61	60
Spring - Dry	0	0	0	0	22	21	21	20
Spring - Average	0	0	0	0	47	46	45	45
Spring - Wet	1	0	0	0	142	136	137	136
Summer - Dry	0	0	0	0	19	18	17	17
Summer - Average	0	0	0	0	49	46	46	45
Summer - Wet	0	0	0	0	73	70	70	70

Note: cfs: cubic feet per second

Table C-3B
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	7 (1, 272)	7 (1, 272)	7 (1, 272)	7 (1, 212)
	SD-POR	7 (1, 120)	7 (1, 120)	6 (1, 120)	6 (1, 120)
Subsistence Flow	AD-POR	2 (1, 61)	3 (1, 61)	2 (1, 61)	2 (1, 61)
	SD-POR	7 (1, 114)	6 (1, 114)	6 (1, 114)	5 (1, 114)
Zero Flow	ZFD-POR	6 (1, 108)	5 (1, 108)	6 (1, 108)	5 (1, 108)

Table C-3C
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	10 cfs	EF	60.3%	59.7%	59.3%	59.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 121)	7 (1, 121)	7 (1, 121)	7 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	39.7%	40.3%	40.7%	40.7%
		AF	62.2%	61.9%	61.8%	61.9%
		AD	5 (1, 61)	5 (1, 61)	4 (1, 61)	4 (1, 61)
		SD	13 (1, 42)	8 (1, 42)	5 (1, 42)	5 (1, 42)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	10.8%	11.2%	11.7%	11.1%
		ZFD	5 (2, 42)	7 (2, 42)	7 (1, 42)	5 (1, 42)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3D
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	25 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	66.4%	65.3%	65.3%	65.3%
		AD	11 (1, 121)	9 (1, 121)	9 (1, 121)	9 (1, 121)
		SD	6 (1, 120)	6 (1, 120)	6 (1, 120)	6 (1, 120)
		S	18 afd	19 afd	19 afd	19 afd
		PS	36.5%	38.9%	38.4%	39.1%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.2%	0.7%	0.3%	0.4%
		ZFD	4 (2, 6)	3 (1, 10)	2 (2, 6)	3 (2, 6)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3E
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	46 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	58.9%	58.3%	58.4%	58.1%
		AD	16 (1, 121)	16 (1, 121)	16 (1, 121)	18 (1, 121)
		SD	24 (1, 90)	24 (1, 90)	24 (1, 90)	24 (1, 90)
		S	40 afd	41 afd	40 afd	41 afd
		PS	43.9%	44.6%	44.1%	45.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3F
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 560 Volume (af): 2960 Duration (days): 10	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	7 cfs	EF	66.2%	64.4%	65.1%	64.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 79)	6 (1, 79)	6 (1, 79)	6 (1, 79)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	32.0%	33.8%	33.1%	33.9%
		AF	50.3%	46.8%	46.7%	45.5%
		AD	3 (1, 17)	3 (1, 17)	3 (1, 17)	3 (1, 17)
		SD	7 (1, 35)	5 (1, 35)	5 (1, 35)	5 (1, 35)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	12.1%	14.6%	14.4%	15.3%
		ZFD	5 (1, 34)	4 (1, 34)	5 (1, 34)	5 (1, 34)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3G
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 560 Volume (af): 2960 Duration (days): 10	PF	93.5%	93.5%	93.5%	93.5%
		TEM	93.5%	93.5%	93.5%	93.5%
		FVM	98.3%	98.3%	98.3%	98.3%
		FDM	1.7%	1.7%	1.7%	1.7%
Base Flow	19 cfs	EF	96.4%	96.5%	96.5%	96.6%
		AF	71.4%	70.7%	69.8%	69.7%
		AD	7 (1, 107)	7 (1, 107)	7 (1, 107)	6 (1, 107)
		SD	6 (1, 59)	6 (1, 59)	6 (1, 59)	6 (1, 59)
		S	23 afd	23 afd	23 afd	22 afd
		PS	59.9%	59.8%	60.2%	59.2%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.8%	2.0%	3.0%	2.4%
		ZFD	4 (1, 13)	4 (1, 13)	4 (1, 17)	4 (1, 13)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3H
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1040 Volume (af): 5870 Duration (days): 12	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	35 cfs	EF	98.0%	97.8%	97.8%	97.8%
		AF	83.9%	82.9%	82.3%	82.3%
		AD	14 (1, 119)	13 (1, 119)	9 (1, 119)	9 (1, 119)
		SD	5 (1, 32)	5 (1, 33)	4 (1, 33)	4 (1, 32)
		S	33 afd	35 afd	34 afd	34 afd
		PS	47.3%	51.1%	49.0%	48.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.5%	0.2%
		ZFD	N/A	2 (2, 2)	2 (1, 6)	2 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3I
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 370 Volume (af): 1870 Duration (days): 8	PF	92.9%	92.9%	92.9%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	92.3%	92.3%	92.3%	92.3%
		FDM	7.7%	7.7%	7.7%	7.7%
Base Flow	4 cfs	EF	59.8%	59.5%	59.2%	59.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 122)	6 (1, 122)	6 (1, 122)	6 (1, 122)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	38.3%	38.5%	38.9%	38.9%
		AF	13.5%	13.1%	12.3%	13.4%
		AD	1 (1, 6)	1 (1, 7)	1 (1, 7)	1 (1, 7)
		SD	8 (1, 100)	8 (1, 100)	7 (1, 100)	6 (1, 100)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	28.3%	29.3%	30.1%	30.0%
		ZFD	6 (1, 94)	6 (1, 94)	8 (1, 94)	6 (1, 94)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3J
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 370 Volume (af): 1870 Duration (days): 8	PF	93.1%	93.1%	93.1%	93.1%
		TEM	93.1%	93.1%	93.1%	93.1%
		FVM	94.4%	94.4%	92.6%	92.6%
		FDM	5.6%	5.6%	7.4%	7.4%
Base Flow	13 cfs	EF	97.0%	96.9%	96.9%	96.9%
		AF	65.2%	64.4%	64.1%	64.1%
		AD	8 (1, 107)	8 (1, 90)	8 (1, 86)	8 (1, 89)
		SD	6 (1, 70)	7 (1, 70)	6 (1, 70)	6 (1, 70)
		S	24 afd	25 afd	25 afd	25 afd
		PS	94.6%	95.7%	96.9%	95.3%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	14.1%	15.6%	16.1%	15.3%
		ZFD	8 (1, 62)	8 (1, 62)	8 (1, 62)	6 (1, 62)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-3K
Brazos River Basin: Brazos River at Seymour
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 800 Volume (af): 4290 Duration (days): 11	PF	93.3%	93.3%	93.3%	93.3%
		TEM	93.3%	93.3%	93.3%	93.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	32 cfs	EF	98.3%	98.3%	98.3%	98.3%
		AF	66.5%	65.2%	65.8%	65.5%
		AD	8 (1, 108)	7 (1, 108)	8 (1, 108)	8 (1, 108)
		SD	7 (1, 33)	6 (1, 33)	7 (1, 33)	7 (1, 33)
		S	41 afd	41 afd	41 afd	42 afd
		PS	64.9%	64.4%	64.8%	65.4%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.9%	3.5%	3.7%	3.7%
		ZFD	5 (1, 9)	4 (1, 9)	4 (1, 9)	4 (1, 12)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-4. Brazos River Basin: Clear Fork at Nugent

Table C-4A
Brazos River Basin: Clear Fork at Nugent
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	22	13	12	13
Winter - All	0	0	0	0	18	11	10	10
Spring - All	0	0	0	0	32	19	18	18
Summer - All	0	0	0	0	16	10	9	10
Winter - Dry	0	0	0	0	6	4	4	4
Winter - Average	0	0	0	0	17	11	10	10
Winter - Wet	0	0	0	0	36	20	20	20
Spring - Dry	0	0	0	0	12	7	7	8
Spring - Average	0	0	0	0	31	18	17	17
Spring - Wet	0	0	0	0	68	31	32	32
Summer - Dry	0	0	0	0	5	3	2	2
Summer - Average	0	0	0	0	15	10	9	10
Summer - Wet	0	0	0	0	28	16	15	16

Note: cfs: cubic feet per second

Table C-4B
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	9 (1, 342)	3 (1, 312)	3 (1, 308)	4 (1, 312)
	SD-POR	6 (1, 123)	3 (1, 100)	3 (1, 120)	4 (1, 133)
Subsistence Flow	AD-POR	2 (1, 31)	1 (1, 38)	2 (1, 33)	3 (1, 39)
	SD-POR	9 (1, 92)	4 (1, 92)	4 (1, 83)	5 (1, 92)
Zero Flow	ZFD-POR	9 (1, 123)	2 (1, 85)	1 (1, 65)	3 (1, 133)

Table C-4C
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	5 cfs	EF	54.9%	46.0%	42.4%	41.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 121)	1 (1, 82)	2 (1, 83)	4 (1, 81)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	45.1%	54.0%	57.6%	58.8%
		AF	35.0%	46.4%	46.8%	45.7%
		AD	4 (1, 31)	1 (1, 38)	1 (1, 33)	4 (1, 39)
		SD	16 (1, 92)	4 (1, 92)	6 (1, 61)	7 (1, 92)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	24.6%	22.3%	22.9%	27.1%
		ZFD	7 (1, 92)	3 (1, 47)	2 (1, 61)	4 (1, 81)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4D
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	8 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	82.3%	61.4%	57.3%	61.1%
		AD	59 (1, 121)	1 (1, 121)	2 (1, 121)	5 (1, 121)
		SD	18 (1, 92)	1 (1, 100)	2 (1, 91)	5 (1, 102)
		S	15 afd	6 afd	6 afd	6 afd
		PS	95.9%	36.5%	37.7%	40.9%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	8.1%	6.9%	5.0%	8.0%
		ZFD	30 (28, 92)	1 (1, 85)	1 (1, 34)	28 (1, 102)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4E
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 26 Volume (af): 160 Duration (days): 9	PF	100.0%	100.0%	93.3%	100.0%
		TEM	100.0%	100.0%	93.3%	100.0%
		FVM	100.0%	100.0%	100.0%	93.3%
		FDM	0.0%	0.0%	0.0%	6.7%
Base Flow	13 cfs	EF	98.5%	98.4%	98.6%	98.6%
		AF	83.6%	68.8%	67.6%	67.2%
		AD	20 (1, 120)	3 (1, 120)	3 (1, 119)	3 (1, 119)
		SD	8 (1, 85)	4 (1, 88)	4 (1, 88)	4 (1, 88)
		S	14 afd	12 afd	12 afd	11 afd
		PS	55.0%	45.3%	45.7%	41.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	3.3%	3.5%	3.6%	3.4%
		ZFD	30 (30, 31)	16 (2, 31)	1 (1, 30)	16 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4F
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 180 Volume (af): 860 Duration (days): 9	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	84.6%	84.6%	92.3%	84.6%
		FDM	15.4%	15.4%	7.7%	15.4%
Base Flow	3 cfs	EF	69.7%	61.6%	58.8%	62.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 72)	3 (1, 71)	4 (1, 71)	4 (1, 71)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	27.9%	35.9%	39.0%	34.8%
		AF	34.8%	36.5%	33.6%	31.5%
		AD	2 (1, 17)	2 (1, 19)	2 (1, 24)	2 (1, 17)
		SD	5 (1, 38)	3 (1, 30)	3 (1, 31)	3 (1, 38)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	14.3%	14.5%	15.6%	16.8%
		ZFD	6 (1, 34)	2 (1, 29)	3 (1, 31)	2 (1, 34)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4G
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 180 Volume (af): 860 Duration (days): 9	PF	90.3%	88.7%	87.1%	88.7%
		TEM	90.3%	87.1%	83.9%	87.1%
		FVM	96.4%	100.0%	92.6%	96.4%
		FDM	3.6%	0.0%	7.4%	3.6%
Base Flow	6 cfs	EF	97.1%	97.1%	97.3%	97.2%
		AF	86.6%	78.3%	77.0%	78.5%
		AD	20 (1, 122)	7 (1, 105)	6 (1, 110)	6 (1, 110)
		SD	6 (1, 61)	3 (1, 64)	3 (1, 64)	4 (1, 64)
		S	8 afd	7 afd	8 afd	8 afd
		PS	64.7%	60.5%	66.4%	64.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.4%	4.1%	4.9%	4.5%
		ZFD	7 (2, 31)	2 (1, 64)	2 (1, 34)	3 (1, 64)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4H
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 590 Volume (af): 2800 Duration (days): 12	PF	100.0%	85.7%	92.9%	92.9%
		TEM	100.0%	85.7%	92.9%	92.9%
		FVM	85.7%	66.7%	61.5%	53.8%
		FDM	14.3%	33.3%	38.5%	46.2%
Base Flow	12 cfs	EF	96.7%	96.7%	97.1%	96.3%
		AF	90.6%	79.5%	77.9%	79.0%
		AD	20 (1, 120)	4 (1, 119)	4 (1, 118)	4 (1, 119)
		SD	3 (1, 29)	3 (1, 42)	3 (1, 45)	3 (1, 42)
		S	8 afd	11 afd	11 afd	11 afd
		PS	31.5%	46.2%	47.1%	47.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.2%	0.4%	0.4%
		ZFD	N/A	1 (1, 1)	2 (2, 3)	1 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4l
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 100 Volume (af): 460 Duration (days): 8	PF	100.0%	100.0%	92.9%	100.0%
		TEM	100.0%	100.0%	92.9%	100.0%
		FVM	78.6%	71.4%	76.9%	71.4%
		FDM	21.4%	28.6%	23.1%	28.6%
Base Flow	1 cfs	EF	56.7%	54.1%	52.0%	53.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 99)	4 (1, 90)	4 (1, 90)	5 (1, 90)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	40.8%	44.0%	46.4%	44.4%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	11 (1, 52)	6 (1, 41)	6 (1, 41)	11 (1, 52)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	29.8%	31.1%	31.3%	31.3%
		ZFD	8 (1, 45)	4 (1, 40)	2 (1, 40)	6 (1, 46)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4J
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 100 Volume (af): 460 Duration (days): 8	PF	96.6%	96.6%	96.6%	96.6%
		TEM	96.6%	96.6%	96.6%	96.6%
		FVM	96.4%	92.9%	91.1%	91.1%
		FDM	3.6%	7.1%	8.9%	8.9%
Base Flow	4 cfs	EF	97.6%	97.1%	97.4%	97.4%
		AF	70.3%	63.5%	60.6%	63.4%
		AD	9 (1, 118)	5 (1, 109)	5 (1, 109)	6 (1, 109)
		SD	6 (1, 71)	3 (1, 62)	4 (1, 89)	4 (1, 89)
		S	8 afd	8 afd	8 afd	7 afd
		PS	96.2%	94.9%	97.5%	93.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	13.6%	12.4%	10.7%	13.2%
		ZFD	10 (1, 39)	1 (1, 42)	1 (1, 50)	2 (1, 32)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-4K
Brazos River Basin: Clear Fork at Nugent
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 390 Volume (af): 1890 Duration (days): 12	PF	86.7%	73.3%	86.7%	86.7%
		TEM	86.7%	73.3%	86.7%	86.7%
		FVM	100.0%	72.7%	76.9%	76.9%
		FDM	0.0%	27.3%	23.1%	23.1%
Base Flow	9 cfs	EF	97.8%	97.3%	96.9%	97.1%
		AF	77.5%	68.8%	66.2%	68.4%
		AD	8 (1, 123)	7 (1, 123)	7 (1, 119)	6 (1, 123)
		SD	7 (1, 72)	3 (1, 73)	5 (1, 73)	3 (1, 73)
		S	16 afd	14 afd	14 afd	13 afd
		PS	91.6%	78.8%	79.3%	72.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	8.8%	8.2%	4.5%	8.7%
		ZFD	30 (1, 61)	3 (1, 46)	1 (1, 29)	3 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-5. Brazos River Basin: Clear Fork at Lueders

Table C-5A
Brazos River Basin: Clear Fork at Lueders
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	23	14	16	10
Winter - All	0	0	0	0	19	12	14	10
Spring - All	0	0	0	0	37	19	21	15
Summer - All	0	0	0	0	18	12	14	6
Winter - Dry	0	0	0	0	7	6	6	2
Winter - Average	0	0	0	0	19	12	14	10
Winter - Wet	0	0	0	0	39	22	24	20
Spring - Dry	0	0	0	0	12	10	12	6
Spring - Average	0	0	0	0	35	19	21	14
Spring - Wet	0	0	0	0	90	37	42	32
Summer - Dry	0	0	0	0	13	10	13	5
Summer - Average	0	0	0	0	14	10	12	4
Summer - Wet	0	0	0	0	31	17	19	11

Note: cfs: cubic feet per second

Table C-5B
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	20 (1, 241)	5 (1, 165)	5 (1, 189)	5 (1, 143)
	SD-POR	7 (1, 118)	2 (1, 92)	2 (1, 106)	3 (1, 141)
Subsistence Flow	AD-POR	4 (1, 62)	1 (1, 59)	1 (1, 59)	2 (1, 60)
	SD-POR	12 (1, 122)	1 (1, 30)	1 (1, 60)	3 (1, 123)
Zero Flow	ZFD-POR	15 (1, 92)	1 (1, 27)	1 (1, 14)	2 (1, 123)

Table C-5C
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	7 cfs	EF	48.3%	43.5%	45.0%	27.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	11 (1, 120)	1 (1, 51)	2 (1, 39)	4 (1, 39)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	51.7%	56.5%	55.0%	72.5%
		AF	36.4%	80.3%	75.4%	40.4%
		AD	5 (1, 62)	1 (1, 59)	1 (1, 59)	2 (1, 60)
		SD	29 (1, 92)	1 (1, 17)	1 (1, 31)	4 (1, 93)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	90.0%	90.0%	100.0%
Zero Flow	N/A	ZFF	27.2%	4.8%	5.4%	35.1%
		ZFD	30 (1, 92)	1 (1, 4)	1 (1, 14)	4 (1, 79)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5D
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	10 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	72.1%	57.4%	61.1%	50.4%
		AD	20 (1, 121)	3 (1, 121)	3 (1, 121)	5 (1, 121)
		SD	7 (1, 112)	2 (1, 85)	2 (1, 92)	4 (1, 120)
		S	10 afd	10 afd	9 afd	13 afd
		PS	52.0%	51.0%	44.9%	63.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	5.1%	1.3%	1.9%	9.9%
		ZFD	26 (2, 30)	1 (1, 12)	1 (1, 6)	2 (1, 61)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5E
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 26 Volume (af): 158 Duration (days): 9	PF	93.3%	93.3%	100.0%	93.3%
		TEM	93.3%	93.3%	100.0%	93.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	16 cfs	EF	98.7%	98.7%	98.7%	98.7%
		AF	79.3%	63.9%	68.5%	56.5%
		AD	16 (1, 120)	4 (1, 119)	3 (1, 119)	4 (1, 119)
		SD	13 (1, 69)	3 (1, 68)	2 (1, 62)	3 (1, 99)
		S	16 afd	16 afd	15 afd	17 afd
		PS	51.1%	49.2%	48.3%	53.3%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.2%	0.6%	0.3%	2.6%
		ZFD	4 (4, 4)	1 (1, 3)	1 (1, 1)	2 (1, 29)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5F
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 18 Volume (af): 74 Duration (days): 2	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	92.3%	76.9%	76.9%	84.6%
		FDM	7.7%	23.1%	23.1%	15.4%
Base Flow	4 cfs	EF	68.0%	72.3%	81.4%	54.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	21 (1, 77)	6 (1, 95)	5 (1, 94)	5 (1, 58)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	30.8%	26.5%	17.3%	44.7%
		AF	43.1%	47.7%	22.5%	24.7%
		AD	3 (1, 34)	1 (1, 17)	1 (1, 9)	1 (1, 20)
		SD	10 (1, 32)	2 (1, 14)	1 (1, 12)	3 (1, 37)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	95.0%	100.0%
Zero Flow	N/A	ZFF	11.8%	7.9%	7.1%	25.5%
		ZFD	6 (1, 31)	1 (1, 11)	1 (1, 10)	2 (1, 37)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5G
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 37 Volume (af): 148 Duration (days): 2	PF	96.8%	96.8%	96.8%	96.8%
		TEM	96.8%	96.8%	96.8%	96.8%
		FVM	96.7%	90.0%	90.0%	90.0%
		FDM	3.3%	10.0%	10.0%	10.0%
Base Flow	7 cfs	EF	97.5%	97.6%	97.6%	97.7%
		AF	85.6%	74.7%	80.6%	61.4%
		AD	19 (1, 120)	6 (1, 67)	7 (1, 104)	4 (1, 57)
		SD	7 (1, 49)	2 (1, 48)	2 (1, 27)	3 (1, 53)
		S	9 afd	10 afd	14 afd	14 afd
		PS	63.3%	71.9%	98.6%	97.1%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.6%	6.1%	5.4%	14.4%
		ZFD	11 (8, 30)	1 (1, 27)	1 (1, 9)	2 (1, 48)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5H
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 355 Volume (af): 2054 Duration (days): 9	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	85.7%	85.7%	85.7%
		FDM	0.0%	14.3%	14.3%	14.3%
Base Flow	15 cfs	EF	97.7%	97.5%	97.8%	97.8%
		AF	89.9%	69.8%	73.5%	64.6%
		AD	18 (1, 121)	5 (1, 121)	5 (1, 121)	5 (1, 120)
		SD	3 (1, 64)	3 (1, 64)	3 (1, 37)	3 (1, 65)
		S	12 afd	21 afd	16 afd	25 afd
		PS	41.9%	69.8%	52.9%	83.9%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.7%	4.6%	3.2%	6.6%
		ZFD	12 (12, 12)	2 (1, 8)	1 (1, 5)	2 (1, 21)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5l
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 18 Volume (af): 74 Duration (days): 2	PF	85.7%	92.9%	100.0%	85.7%
		TEM	85.7%	92.9%	100.0%	85.7%
		FVM	100.0%	92.3%	92.9%	100.0%
		FDM	0.0%	7.7%	7.1%	0.0%
Base Flow	1 cfs	EF	73.9%	85.8%	85.9%	61.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	29 (1, 100)	13 (1, 100)	8 (1, 121)	8 (1, 69)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	25.3%	13.2%	12.8%	37.8%
		AF	0.0%	0.0%	0.0%	0.0%
		AD	N/A	N/A	N/A	N/A
		SD	12 (1, 61)	2 (1, 25)	1 (1, 60)	3 (1, 63)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	95.0%	90.0%	100.0%
Zero Flow	N/A	ZFF	20.4%	6.7%	5.0%	26.7%
		ZFD	10 (1, 36)	1 (1, 19)	1 (1, 6)	3 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5J
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 37 Volume (af): 148 Duration (days): 2	PF	96.6%	96.6%	96.6%	94.8%
		TEM	96.6%	96.6%	96.6%	93.1%
		FVM	98.2%	96.4%	94.6%	92.7%
		FDM	1.8%	3.6%	5.4%	7.3%
Base Flow	5 cfs	EF	98.0%	98.0%	98.0%	98.1%
		AF	64.3%	70.0%	77.5%	46.6%
		AD	18 (1, 121)	6 (1, 100)	6 (1, 96)	5 (1, 74)
		SD	14 (1, 67)	2 (1, 34)	2 (1, 29)	4 (1, 74)
		S	10 afd	9 afd	10 afd	10 afd
		PS	100.0%	91.9%	98.0%	100.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	19.1%	7.4%	5.4%	26.8%
		ZFD	16 (3, 41)	1 (1, 22)	1 (1, 10)	2 (1, 45)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-5K
Brazos River Basin: Clear Fork at Lueders
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 170 Volume (af): 779 Duration (days): 5	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	11 cfs	EF	99.0%	99.0%	99.0%	98.9%
		AF	73.9%	63.1%	69.7%	49.7%
		AD	20 (1, 122)	5 (1, 107)	6 (1, 92)	4 (1, 55)
		SD	6 (1, 66)	3 (1, 61)	3 (1, 61)	3 (1, 67)
		S	17 afd	12 afd	12 afd	20 afd
		PS	79.4%	57.3%	53.2%	92.2%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	8.2%	2.3%	2.2%	12.3%
		ZFD	61 (30, 61)	1 (1, 6)	1 (1, 6)	1 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-6. Brazos River Basin: Brazos River near South Bend

Table C-6A
Brazos River Basin: Brazos River near South Bend
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	129	114	117	114
Winter - All	0	0	0	0	99	90	92	90
Spring - All	0	0	0	0	204	167	175	172
Summer - All	0	0	0	0	131	117	119	116
Winter - Dry	0	0	0	0	42	36	36	36
Winter - Average	1	0	0	0	106	97	98	97
Winter - Wet	4	0	0	0	146	129	136	131
Spring - Dry	0	0	0	0	66	55	57	55
Spring - Average	0	0	0	0	160	134	136	133
Spring - Wet	30	0	0	0	522	425	454	441
Summer - Dry	0	0	0	0	63	56	57	54
Summer - Average	0	0	0	0	121	106	106	104
Summer - Wet	7	0	0	5	187	170	179	174

Note: cfs: cubic feet per second

Table C-6B
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	8 (1, 270)	6 (1, 258)	6 (1, 237)	6 (1, 257)
	SD-POR	6 (1, 132)	4 (1, 133)	5 (1, 133)	5 (1, 133)
Subsistence Flow	AD-POR	6 (1, 98)	3 (1, 100)	3 (1, 96)	4 (1, 94)
	SD-POR	10 (1, 66)	2 (1, 39)	1 (1, 40)	4 (1, 66)
Zero Flow	ZFD-POR	8 (2, 36)	1 (1, 30)	1 (1, 36)	2 (1, 61)

Table C-6C
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	36 cfs	EF	52.9%	49.8%	50.1%	49.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 121)	5 (1, 121)	4 (1, 121)	5 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	47.1%	50.2%	49.9%	50.3%
		AF	81.8%	82.3%	84.3%	75.9%
		AD	9 (1, 98)	2 (1, 100)	3 (1, 96)	5 (1, 94)
		SD	23 (2, 34)	1 (1, 22)	1 (1, 15)	3 (1, 35)
		S	2 afd	2 afd	1 afd	2 afd
		PS	100.0%	95.0%	70.0%	100.0%
Zero Flow	N/A	ZFF	5.2%	4.6%	3.0%	6.8%
		ZFD	11 (3, 33)	1 (1, 8)	1 (1, 11)	2 (1, 34)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6D
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	73 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	62.1%	59.2%	59.9%	59.2%
		AD	10 (1, 121)	8 (1, 121)	7 (1, 121)	6 (1, 121)
		SD	9 (1, 120)	6 (1, 120)	6 (1, 120)	5 (1, 120)
		S	66 afd	68 afd	68 afd	69 afd
		PS	45.6%	47.2%	47.1%	47.9%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.4%	0.4%	0.5%
		ZFD	N/A	1 (1, 6)	2 (1, 4)	4 (1, 6)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6E
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	120 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	56.3%	52.5%	54.3%	52.4%
		AD	12 (1, 121)	10 (1, 121)	12 (1, 121)	10 (1, 121)
		SD	17 (1, 120)	7 (1, 120)	7 (1, 120)	8 (1, 120)
		S	96 afd	106 afd	105 afd	106 afd
		PS	40.5%	44.4%	44.1%	44.4%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.1%	0.1%
		ZFD	N/A	2 (2, 2)	2 (2, 2)	1 (1, 1)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6F
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1260 Volume (af): 7280 Duration (days): 10	PF	92.3%	92.3%	92.3%	92.3%
		TEM	92.3%	92.3%	92.3%	92.3%
		FVM	91.7%	91.7%	91.7%	91.7%
		FDM	8.3%	8.3%	8.3%	8.3%
Base Flow	29 cfs	EF	64.2%	60.5%	61.8%	60.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	9 (1, 80)	7 (1, 78)	7 (1, 78)	6 (1, 78)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	34.2%	38.0%	36.8%	38.2%
		AF	77.2%	75.0%	80.6%	70.1%
		AD	5 (1, 44)	3 (1, 44)	3 (1, 44)	3 (1, 44)
		SD	9 (2, 36)	2 (1, 36)	1 (1, 36)	4 (1, 36)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	4.9%	6.1%	6.3%	7.4%
		ZFD	16 (2, 36)	2 (1, 13)	1 (1, 36)	2 (1, 29)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6G
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1260 Volume (af): 7280 Duration (days): 10	PF	88.7%	88.7%	88.7%	88.7%
		TEM	87.1%	87.1%	87.1%	87.1%
		FVM	96.4%	94.5%	94.5%	94.5%
		FDM	3.6%	5.5%	5.5%	5.5%
Base Flow	60 cfs	EF	96.5%	96.5%	96.4%	96.4%
		AF	73.8%	70.4%	70.5%	69.6%
		AD	6 (1, 118)	5 (1, 96)	5 (1, 115)	5 (1, 118)
		SD	6 (1, 83)	5 (1, 83)	5 (1, 83)	5 (1, 83)
		S	55 afd	59 afd	57 afd	60 afd
		PS	46.0%	49.8%	48.1%	50.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	1.0%	1.5%	1.3%
		ZFD	N/A	1 (1, 5)	2 (1, 15)	2 (1, 11)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6H
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2480 Volume (af): 15700 Duration (days): 13	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	100 cfs	EF	97.6%	97.2%	97.3%	97.3%
		AF	89.6%	85.1%	86.6%	85.9%
		AD	15 (1, 121)	7 (1, 121)	10 (1, 121)	9 (1, 121)
		SD	5 (1, 25)	4 (1, 31)	4 (1, 27)	4 (1, 28)
		S	56 afd	71 afd	71 afd	77 afd
		PS	28.2%	35.8%	35.9%	39.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.2%	0.4%	0.2%
		ZFD	N/A	1 (1, 1)	1 (1, 2)	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6I
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 580 Volume (af): 3140 Duration (days): 8	PF	92.9%	92.9%	92.9%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	92.3%	92.3%	92.3%	92.3%
		FDM	7.7%	7.7%	7.7%	7.7%
Base Flow	16 cfs	EF	68.3%	66.0%	66.3%	64.0%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	14 (1, 122)	8 (1, 121)	9 (1, 121)	8 (1, 122)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	30.1%	32.3%	32.0%	34.4%
		AF	50.1%	54.8%	71.1%	49.8%
		AD	6 (1, 29)	2 (1, 26)	5 (1, 31)	5 (1, 29)
		SD	8 (1, 66)	3 (1, 39)	2 (1, 40)	6 (1, 66)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	95.0%	85.0%	100.0%
Zero Flow	N/A	ZFF	9.6%	8.6%	3.7%	13.8%
		ZFD	6 (2, 34)	2 (1, 30)	1 (1, 12)	4 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6J
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 580 Volume (af): 3140 Duration (days): 8	PF	93.1%	93.1%	93.1%	93.1%
		TEM	93.1%	93.1%	93.1%	93.1%
		FVM	96.3%	94.4%	94.4%	94.4%
		FDM	3.7%	5.6%	5.6%	5.6%
Base Flow	46 cfs	EF	96.8%	96.6%	96.6%	96.6%
		AF	65.9%	63.7%	63.7%	63.2%
		AD	9 (1, 117)	6 (1, 117)	6 (1, 117)	7 (1, 117)
		SD	8 (1, 87)	5 (1, 79)	4 (1, 78)	5 (1, 105)
		S	67 afd	69 afd	67 afd	70 afd
		PS	73.4%	75.2%	73.6%	76.8%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.4%	2.7%	1.9%	3.9%
		ZFD	6 (3, 31)	2 (1, 29)	2 (1, 12)	3 (1, 32)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-6K
Brazos River Basin: Brazos River near South Bend
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1180 Volume (af): 7050 Duration (days): 11	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	93.3%	100.0%	100.0%	100.0%
		FDM	6.7%	0.0%	0.0%	0.0%
Base Flow	95 cfs	EF	98.1%	98.3%	98.3%	98.3%
		AF	72.0%	68.7%	69.8%	68.9%
		AD	7 (1, 121)	6 (1, 96)	7 (1, 121)	6 (1, 109)
		SD	6 (1, 57)	3 (1, 57)	5 (1, 57)	6 (1, 57)
		S	85 afd	86 afd	82 afd	89 afd
		PS	45.3%	45.7%	43.3%	47.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.3%	0.2%	0.0%
		ZFD	N/A	2 (1, 2)	1 (1, 2)	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-7. Brazos River Basin: Brazos River near Palo Pinto

Table C-7A
Brazos River Basin: Brazos River near Palo Pinto
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	4	0	0	181	187	133	152
Winter - All	0	4	0	0	99	99	76	92
Spring - All	0	8	0	0	323	201	122	138
Summer - All	0	5	0	0	204	327	207	266
Winter - Dry	0	4	0	0	50	146	93	108
Winter - Average	0	4	0	0	85	93	64	92
Winter - Wet	0	4	0	0	229	125	82	65
Spring - Dry	0	9	0	0	155	199	118	156
Spring - Average	0	8	0	0	245	132	98	112
Spring - Wet	24	9	0	0	929	663	399	260
Summer - Dry	0	5	0	0	115	345	228	342
Summer - Average	0	5	0	0	242	327	207	295
Summer - Wet	0	5	0	0	256	283	193	192

Note: cfs: cubic feet per second

Table C-7B
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	4 (1, 145)	4 (1, 395)	3 (1, 261)	3 (1, 245)
	SD-POR	2 (1, 188)	2 (1, 77)	2 (1, 104)	2 (1, 152)
Subsistence Flow	AD-POR	2 (1, 15)	1 (1, 25)	1 (1, 21)	1 (1, 22)
	SD-POR	3 (1, 164)	1 (1, 16)	1 (1, 32)	1 (1, 99)
Zero Flow	ZFD-POR	31 (1, 184)	N/A	1 (1, 10)	1 (1, 63)

Note: N/A: not applicable

Table C-7C
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 850 Volume (af): 3690 Duration (days): 5	PF	45.5%	31.8%	45.5%	54.5%
		TEM	36.4%	27.3%	36.4%	45.5%
		FVM	80.0%	100.0%	70.0%	83.3%
		FDM	20.0%	0.0%	30.0%	16.7%
Base Flow	40 cfs	EF	53.9%	88.0%	75.2%	65.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 62)	4 (1, 121)	3 (1, 99)	4 (1, 98)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	17 cfs	EF	43.8%	11.0%	22.8%	32.2%
		AF	36.6%	73.7%	45.9%	24.2%
		AD	2 (1, 11)	1 (1, 10)	1 (1, 12)	1 (1, 12)
		SD	3 (1, 121)	1 (1, 4)	1 (1, 32)	2 (1, 73)
		S	23 afd	17 afd	31 afd	34 afd
		PS	66.8%	51.6%	92.0%	99.7%
Zero Flow	N/A	ZFF	6.7%	0.0%	3.5%	15.0%
		ZFD	31 (31, 31)	N/A	2 (1, 10)	2 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7D
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 850 | 1390 Volume (af): 3690 | 7180 Duration (days): 5 | 7	PF	62.9% | 58.1%	48.4% | 48.4%	49.2% | 46.8%	61.3% | 51.6%
		TEM	54.8% | 51.6%	32.3% | 41.9%	32.3% | 35.5%	41.9% | 48.4%
		FVM	93.6% | 75.0%	88.3% | 76.7%	88.5% | 62.1%	82.9% | 68.8%
		FDM	6.4% | 25.0%	11.7% | 23.3%	11.5% | 37.9%	17.1% | 31.2%
Base Flow	61 cfs	EF	94.1%	95.7%	96.3%	95.0%
		AF	56.1%	71.9%	51.3%	59.3%
		AD	3 (1, 98)	3 (1, 120)	2 (1, 96)	2 (1, 120)
		SD	2 (1, 65)	1 (1, 77)	2 (1, 68)	2 (1, 66)
		S	75 afd	72 afd	84 afd	84 afd
		PS	61.7%	59.2%	69.3%	69.2%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	4.0%	0.0%	0.5%	1.3%
		ZFD	30 (30, 61)	N/A	1 (1, 2)	1 (1, 15)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7E
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 850 | 1390 Volume (af): 3690 | 7180 Duration (days): 5 | 7	PF	80.0% | 68.9%	70.0% | 64.4%	73.3% | 68.9%	73.3% | 66.7%
		TEM	73.3% | 66.7%	66.7% | 53.3%	66.7% | 60.0%	66.7% | 60.0%
		FVM	97.9% | 96.8%	97.6% | 96.6%	93.2% | 90.3%	93.2% | 83.3%
		FDM	2.1% | 3.2%	2.4% | 3.4%	6.8% | 9.7%	6.8% | 16.7%
Base Flow	100 cfs	EF	94.1%	96.1%	94.6%	94.3%
		AF	69.0%	50.9%	41.2%	39.0%
		AD	3 (1, 114)	3 (1, 42)	2 (1, 47)	2 (1, 51)
		SD	2 (1, 61)	2 (1, 70)	2 (1, 104)	2 (1, 71)
		S	110 afd	100 afd	115 afd	161 afd
		PS	55.4%	50.2%	57.8%	81.1%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	3.4%	0.0%	0.4%	0.1%
		ZFD	30 (30, 31)	N/A	1 (1, 1)	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7F
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1400 Volume (af): 6600 Duration (days): 6	PF	90.6%	84.4%	84.4%	87.5%
		TEM	87.5%	75.0%	81.2%	87.5%
		FVM	79.3%	100.0%	85.2%	89.3%
		FDM	20.7%	0.0%	14.8%	10.7%
Base Flow	39 cfs	EF	76.0%	78.1%	67.7%	68.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 116)	4 (1, 92)	3 (1, 122)	4 (1, 85)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	17 cfs	EF	20.2%	19.1%	28.9%	28.4%
		AF	43.1%	79.6%	62.9%	42.3%
		AD	2 (1, 9)	2 (1, 25)	1 (1, 21)	1 (1, 22)
		SD	3 (1, 31)	1 (1, 16)	1 (1, 27)	1 (1, 30)
		S	27 afd	13 afd	31 afd	33 afd
		PS	79.1%	38.9%	90.8%	97.2%
Zero Flow	N/A	ZFF	2.0%	0.0%	1.0%	6.5%
		ZFD	1 (1, 30)	N/A	1 (1, 7)	1 (1, 20)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7G
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 1400 | 3370 Volume (af): 6600 | 20200 Duration (days): 6 | 10	PF	89.8% | 74.1%	89.8% | 70.4%	88.9% | 68.5%	88.9% | 70.4%
		TEM	88.9% | 70.4%	88.9% | 66.7%	85.2% | 63.0%	85.2% | 66.7%
		FVM	93.8% | 97.5%	94.8% | 84.2%	90.6% | 83.8%	91.7% | 84.2%
		FDM	6.2% | 2.5%	5.2% | 15.8%	9.4% | 16.2%	8.3% | 15.8%
Base Flow	75 cfs	EF	92.2%	93.0%	93.1%	93.2%
		AF	75.2%	71.2%	58.5%	56.2%
		AD	5 (1, 105)	3 (1, 122)	3 (1, 92)	3 (1, 122)
		SD	2 (1, 34)	2 (1, 37)	2 (1, 64)	2 (1, 64)
		S	77 afd	101 afd	113 afd	113 afd
		PS	51.7%	67.6%	76.0%	75.7%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.9%	0.0%	0.6%	0.4%
		ZFD	30 (30, 30)	N/A	1 (1, 2)	1 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7H
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 1400 | 3370 Volume (af): 6600 | 20200 Duration (days): 6 | 10	PF	100.0% | 91.1%	100.0% | 88.9%	100.0% | 77.8%	98.3% | 75.6%
		TEM	100.0% | 86.7%	100.0% | 80.0%	100.0% | 60.0%	93.3% | 53.3%
		FVM	98.3% | 95.1%	95.0% | 92.5%	93.3% | 91.4%	93.2% | 88.2%
		FDM	1.7% | 4.9%	5.0% | 7.5%	6.7% | 8.6%	6.8% | 11.8%
Base Flow	120 cfs	EF	89.9%	90.4%	91.6%	91.5%
		AF	91.9%	78.1%	61.9%	53.4%
		AD	10 (1, 118)	6 (1, 73)	3 (1, 69)	2 (1, 91)
		SD	3 (1, 11)	2 (1, 37)	2 (1, 55)	2 (1, 57)
		S	98 afd	65 afd	142 afd	202 afd
		PS	41.2%	27.2%	59.8%	84.8%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.5%	0.3%
		ZFD	N/A	N/A	1 (1, 2)	1 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7l
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1230 Volume (af): 5920 Duration (days): 6	PF	67.6%	76.5%	73.5%	82.4%
		TEM	64.7%	70.6%	70.6%	82.4%
		FVM	95.7%	92.3%	88.0%	89.3%
		FDM	4.3%	7.7%	12.0%	10.7%
Base Flow	40 cfs	EF	63.9%	94.8%	89.6%	72.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 77)	24 (1, 123)	8 (1, 123)	5 (1, 97)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	17 cfs	EF	33.7%	2.1%	7.8%	24.2%
		AF	39.8%	83.7%	71.2%	34.9%
		AD	2 (1, 15)	3 (1, 5)	1 (1, 8)	1 (1, 10)
		SD	4 (1, 79)	2 (1, 3)	1 (1, 6)	1 (1, 79)
		S	32 afd	12 afd	30 afd	31 afd
		PS	94.4%	36.8%	90.2%	90.8%
Zero Flow	N/A	ZFF	7.4%	0.0%	0.0%	6.0%
		ZFD	31 (31, 62)	N/A	1 (1, 1)	3 (1, 63)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7J
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 1230 | 2260 Volume (af): 5920 | 13000 Duration (days): 6 | 9	PF	89.0% | 80.0%	84.0% | 80.0%	85.0% | 80.0%	90.0% | 80.0%
		TEM	88.0% | 80.0%	80.0% | 76.0%	84.0% | 80.0%	84.0% | 80.0%
		FVM	95.5% | 100.0%	97.6% | 97.5%	94.1% | 97.5%	96.7% | 100.0%
		FDM	4.5% | 0.0%	2.4% | 2.5%	5.9% | 2.5%	3.3% | 0.0%
Base Flow	72 cfs	EF	92.3%	92.5%	93.0%	91.6%
		AF	70.8%	93.1%	79.9%	82.4%
		AD	5 (1, 72)	7 (1, 123)	4 (1, 123)	4 (1, 94)
		SD	2 (1, 123)	1 (1, 24)	2 (1, 30)	2 (1, 43)
		S	102 afd	78 afd	104 afd	108 afd
		PS	71.5%	54.7%	72.8%	75.4%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	7.9%	0.0%	0.1%	0.0%
		ZFD	46 (30, 123)	N/A	1 (1, 1)	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-7K
Brazos River Basin: Brazos River near Palo Pinto
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 1230 | 2260 Volume (af): 5920 | 13000 Duration (days): 6 | 9	PF	96.9% | 81.2%	84.4% | 75.0%	84.4% | 72.9%	85.9% | 70.8%
		TEM	87.5% | 75.0%	75.0% | 68.8%	75.0% | 62.5%	75.0% | 56.2%
		FVM	98.4% | 100.0%	98.1% | 94.4%	92.6% | 94.3%	98.2% | 97.1%
		FDM	1.6% | 0.0%	1.9% | 5.6%	7.4% | 5.7%	1.8% | 2.9%
Base Flow	120 cfs	EF	92.6%	93.5%	93.5%	93.6%
		AF	63.9%	86.6%	75.0%	70.5%
		AD	3 (1, 119)	5 (1, 93)	4 (1, 112)	3 (1, 114)
		SD	2 (1, 65)	2 (1, 33)	2 (1, 43)	3 (1, 81)
		S	153 afd	90 afd	121 afd	203 afd
		PS	64.4%	37.7%	50.8%	85.1%
Subsistence Flow	17 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	3.1%	0.0%	0.0%	0.0%
		ZFD	61 (61, 61)	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-8. Brazos River Basin: Brazos River near Glen Rose

Table C-8A
Brazos River Basin: Brazos River near Glen Rose
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	328	205	127	178
Winter - All	0	0	0	0	229	118	77	115
Spring - All	0	0	0	0	558	286	193	226
Summer - All	0	0	0	0	306	275	143	250
Winter - Dry	0	1	0	0	96	96	47	96
Winter - Average	0	0	0	0	204	95	67	99
Winter - Wet	3	1	0	0	492	310	198	188
Spring - Dry	0	1	0	0	251	185	92	203
Spring - Average	5	0	0	0	448	206	144	151
Spring - Wet	0	0	0	0	1459	1032	823	589
Summer - Dry	0	1	0	0	209	288	171	363
Summer - Average	0	0	0	0	337	279	140	236
Summer - Wet	0	1	0	0	365	251	109	167

Note: cfs: cubic feet per second

Table C-8B
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	9 (1, 194)	2 (1, 179)	2 (1, 130)	3 (1, 182)
	SD-POR	3 (1, 71)	2 (1, 128)	2 (1, 93)	2 (1, 71)
Subsistence Flow	AD-POR	2 (1, 28)	1 (1, 14)	1 (1, 12)	1 (1, 15)
	SD-POR	3 (1, 31)	1 (1, 30)	1 (1, 31)	2 (1, 49)
Zero Flow	ZFD-POR	3 (1, 31)	1 (1, 1)	1 (1, 19)	1 (1, 55)

Table C-8C
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 930 Volume (af): 5400 Duration (days): 8	PF	59.1%	50.0%	54.5%	59.1%
		TEM	54.5%	45.5%	45.5%	54.5%
		FVM	100.0%	81.8%	100.0%	92.3%
		FDM	0.0%	18.2%	0.0%	7.7%
Base Flow	42 cfs	EF	72.6%	70.5%	51.7%	61.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	10 (1, 95)	2 (1, 121)	2 (1, 97)	3 (1, 82)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	16 cfs	EF	25.4%	27.1%	46.5%	36.0%
		AF	69.2%	48.0%	42.8%	46.4%
		AD	2 (1, 22)	1 (1, 9)	1 (1, 11)	1 (1, 14)
		SD	2 (1, 28)	2 (1, 28)	1 (1, 26)	2 (1, 40)
		S	8 afd	12 afd	17 afd	22 afd
		PS	26.7%	36.3%	55.0%	71.0%
Zero Flow	N/A	ZFF	0.7%	0.0%	0.4%	5.1%
		ZFD	2 (1, 5)	N/A	1 (1, 3)	1 (1, 10)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8D
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 930 | 1700 Volume (af): 5400 | 10800 Duration (days): 8 | 10	PF	64.5% | 50.0%	51.6% | 45.2%	52.4% | 45.2%	56.5% | 43.5%
		TEM	54.8% | 41.9%	38.7% | 38.7%	38.7% | 38.7%	38.7% | 35.5%
		FVM	100.0% | 100.0%	90.6% | 92.9%	95.4% | 92.9%	94.3% | 92.6%
		FDM	0.0% | 0.0%	9.4% | 7.1%	4.6% | 7.1%	5.7% | 7.4%
Base Flow	77 cfs	EF	94.8%	95.5%	95.3%	95.2%
		AF	80.4%	54.9%	44.8%	54.5%
		AD	7 (1, 116)	2 (1, 92)	2 (1, 31)	2 (1, 58)
		SD	2 (1, 35)	2 (1, 42)	2 (1, 38)	2 (1, 40)
		S	81 afd	103 afd	112 afd	113 afd
		PS	53.0%	67.8%	73.6%	74.0%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	3.5%	0.0%	1.3%	8.8%
		ZFD	30 (1, 31)	N/A	1 (1, 7)	1 (1, 35)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8E
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 930 | 1700 Volume (af): 5400 | 10800 Duration (days): 8 | 10	PF	88.3% | 86.7%	86.7% | 82.2%	85.0% | 77.8%	83.3% | 80.0%
		TEM	86.7% | 86.7%	86.7% | 80.0%	80.0% | 73.3%	80.0% | 73.3%
		FVM	100.0% | 100.0%	98.1% | 97.3%	92.2% | 97.1%	98.0% | 91.7%
		FDM	0.0% | 0.0%	1.9% | 2.7%	7.8% | 2.9%	2.0% | 8.3%
Base Flow	160 cfs	EF	94.1%	93.4%	93.7%	94.2%
		AF	83.6%	63.0%	53.0%	51.2%
		AD	7 (1, 117)	3 (1, 57)	2 (1, 96)	2 (1, 57)
		SD	3 (1, 30)	2 (1, 93)	2 (1, 67)	2 (1, 33)
		S	143 afd	237 afd	227 afd	241 afd
		PS	45.1%	74.8%	71.4%	75.9%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.3%	5.2%
		ZFD	N/A	N/A	2 (1, 2)	1 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8F
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 2350 Volume (af): 14300 Duration (days): 10	PF	87.5%	87.5%	87.5%	87.5%
		TEM	87.5%	87.5%	87.5%	87.5%
		FVM	96.4%	89.3%	96.4%	96.4%
		FDM	3.6%	10.7%	3.6%	3.6%
Base Flow	47 cfs	EF	83.5%	72.4%	57.5%	68.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	12 (1, 122)	3 (1, 63)	3 (1, 43)	4 (1, 73)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	16 cfs	EF	12.9%	23.3%	38.8%	27.9%
		AF	53.0%	53.3%	48.0%	42.9%
		AD	2 (1, 28)	1 (1, 14)	1 (1, 10)	1 (1, 15)
		SD	3 (1, 30)	1 (1, 30)	1 (1, 31)	2 (1, 30)
		S	32 afd	19 afd	18 afd	31 afd
		PS	100.0%	59.9%	57.4%	96.5%
Zero Flow	N/A	ZFF	3.6%	0.0%	0.5%	5.7%
		ZFD	20 (2, 30)	N/A	2 (1, 6)	1 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8G
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 2350 | 6480 Volume (af): 14300 | 46700 Duration (days): 10 | 14	PF	88.9% | 74.1%	86.1% | 70.4%	87.0% | 66.7%	88.0% | 64.8%
		TEM	77.8% | 66.7%	77.8% | 63.0%	77.8% | 59.3%	77.8% | 55.6%
		FVM	97.9% | 95.0%	94.6% | 86.8%	90.4% | 83.3%	87.4% | 85.7%
		FDM	2.1% | 5.0%	5.4% | 13.2%	9.6% | 16.7%	12.6% | 14.3%
Base Flow	92 cfs	EF	90.4%	91.7%	91.8%	91.0%
		AF	90.8%	62.2%	61.0%	57.2%
		AD	10 (1, 106)	2 (1, 45)	2 (1, 66)	3 (1, 40)
		SD	2 (1, 18)	2 (1, 31)	1 (1, 27)	2 (1, 30)
		S	58 afd	116 afd	137 afd	148 afd
		PS	31.6%	63.8%	74.8%	81.1%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.3%	7.9%
		ZFD	N/A	1 (1, 1)	2 (1, 3)	1 (1, 16)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8H
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 2350 | 6480 Volume (af): 14300 | 46700 Duration (days): 10 | 14	PF	100.0% | 82.2%	98.3% | 82.2%	96.7% | 82.2%	93.3% | 82.2%
		TEM	100.0% | 80.0%	93.3% | 80.0%	93.3% | 80.0%	86.7% | 80.0%
		FVM	100.0% | 100.0%	98.3% | 97.3%	98.3% | 94.6%	96.4% | 89.2%
		FDM	0.0% | 0.0%	1.7% | 2.7%	1.7% | 5.4%	3.6% | 10.8%
Base Flow	170 cfs	EF	89.6%	89.6%	89.1%	88.5%
		AF	97.6%	80.6%	74.6%	65.4%
		AD	17 (1, 116)	4 (1, 62)	3 (1, 100)	2 (1, 44)
		SD	2 (1, 5)	2 (1, 14)	1 (1, 21)	2 (1, 21)
		S	95 afd	175 afd	237 afd	304 afd
		PS	28.1%	51.9%	70.4%	90.3%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.1%	0.1%	0.8%	7.3%
		ZFD	1 (1, 1)	1 (1, 1)	1 (1, 6)	1 (1, 8)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8I
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1320 Volume (af): 7830 Duration (days): 8	PF	70.6%	73.5%	73.5%	76.5%
		TEM	64.7%	70.6%	70.6%	70.6%
		FVM	95.8%	100.0%	96.0%	96.2%
		FDM	4.2%	0.0%	4.0%	3.8%
Base Flow	37 cfs	EF	76.7%	90.1%	79.0%	76.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	10 (1, 120)	4 (1, 115)	3 (1, 123)	5 (1, 118)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	16 cfs	EF	20.6%	7.5%	18.4%	20.6%
		AF	43.9%	49.0%	44.5%	35.7%
		AD	2 (1, 20)	1 (1, 8)	1 (1, 12)	1 (1, 12)
		SD	3 (1, 31)	1 (1, 3)	1 (1, 31)	2 (1, 32)
		S	24 afd	20 afd	17 afd	30 afd
		PS	77.3%	63.1%	54.6%	95.3%
Zero Flow	N/A	ZFF	3.9%	0.0%	0.3%	5.8%
		ZFD	2 (1, 31)	N/A	3 (3, 3)	1 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8J
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 2 Trigger (cfs): 1320 | 3090 Volume (af): 7830 | 21200 Duration (days): 8 | 12	PF	87.0% | 84.0%	87.0% | 82.0%	87.0% | 84.0%	88.0% | 86.0%
		TEM	84.0% | 80.0%	84.0% | 76.0%	84.0% | 80.0%	84.0% | 84.0%
		FVM	98.9% | 100.0%	97.7% | 95.1%	96.6% | 97.6%	96.6% | 100.0%
		FDM	1.1% | 0.0%	2.3% | 4.9%	3.4% | 2.4%	3.4% | 0.0%
Base Flow	70 cfs	EF	92.8%	91.4%	92.7%	92.7%
		AF	80.8%	77.5%	59.0%	63.9%
		AD	10 (1, 114)	3 (1, 94)	2 (1, 80)	3 (1, 100)
		SD	3 (1, 71)	1 (1, 72)	1 (1, 70)	1 (1, 71)
		S	98 afd	100 afd	109 afd	138 afd
		PS	70.6%	72.3%	78.5%	99.7%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	3.7%	0.0%	1.1%	15.0%
		ZFD	2 (1, 31)	1 (1, 1)	1 (1, 19)	1 (1, 55)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-8K
Brazos River Basin: Brazos River near Glen Rose
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 4 | 3 Trigger (cfs): 1320 | 3090 Volume (af): 7830 | 21200 Duration (days): 8 | 12	PF	98.4% | 83.3%	93.8% | 81.2%	95.3% | 81.2%	95.3% | 77.1%
		TEM	93.8% | 68.8%	93.8% | 68.8%	93.8% | 68.8%	93.8% | 62.5%
		FVM	100.0% | 100.0%	100.0% | 97.4%	96.7% | 92.3%	93.4% | 94.6%
		FDM	0.0% | 0.0%	0.0% | 2.6%	3.3% | 7.7%	6.6% | 5.4%
Base Flow	160 cfs	EF	92.6%	92.2%	91.7%	92.6%
		AF	70.0%	58.0%	38.8%	47.4%
		AD	5 (1, 110)	2 (1, 52)	1 (1, 34)	2 (1, 42)
		SD	4 (1, 36)	2 (1, 35)	2 (1, 61)	3 (1, 48)
		S	140 afd	225 afd	284 afd	287 afd
		PS	44.1%	71.0%	89.4%	90.4%
Subsistence Flow	16 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.1%	0.0%	2.9%	16.7%
		ZFD	1 (1, 1)	N/A	1 (1, 14)	1 (1, 46)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-9. Brazos River Basin: North Bosque near Clifton

Table C-9A
Brazos River Basin: North Bosque near Clifton
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	25	24	23	20
Winter - All	0	0	0	0	23	23	22	14
Spring - All	0	0	0	0	74	68	66	61
Summer - All	0	0	0	0	12	11	10	11
Winter - Dry	0	0	0	0	4	4	5	4
Winter - Average	0	0	0	0	21	21	21	14
Winter - Wet	0	0	0	0	90	86	84	73
Spring - Dry	0	0	0	0	14	15	17	13
Spring - Average	0	0	0	0	67	64	62	57
Spring - Wet	7	9	11	4	294	290	287	281
Summer - Dry	0	0	0	0	1	3	4	1
Summer - Average	0	0	0	0	12	11	9	11
Summer - Wet	1	0	0	0	35	34	32	34

Note: cfs: cubic feet per second

Table C-9B
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	12 (1, 438)	9 (1, 405)	12 (1, 377)	9 (1, 388)
	SD-POR	11 (1, 233)	5 (1, 231)	4 (1, 230)	5 (1, 237)
Subsistence Flow	AD-POR	5 (1, 65)	6 (1, 134)	2 (1, 162)	4 (1, 65)
	SD-POR	20 (1, 244)	1 (1, 3)	1 (1, 5)	3 (1, 244)
Zero Flow	ZFD-POR	14 (1, 244)	1 (1, 3)	1 (1, 5)	2 (1, 244)

Table C-9C
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	5 cfs	EF	47.5%	48.9%	65.2%	45.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 120)	8 (1, 120)	12 (1, 121)	7 (1, 120)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	52.5%	51.1%	34.8%	54.5%
		AF	48.5%	97.1%	95.0%	47.3%
		AD	5 (1, 60)	10 (1, 101)	2 (1, 121)	4 (1, 60)
		SD	18 (1, 121)	1 (1, 2)	1 (1, 5)	3 (1, 121)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	25.2%	1.0%	1.5%	26.5%
		ZFD	24 (3, 121)	1 (1, 1)	1 (1, 5)	2 (1, 121)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9D
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	12 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	69.8%	73.0%	75.1%	59.8%
		AD	14 (1, 121)	16 (1, 121)	18 (1, 121)	13 (1, 121)
		SD	12 (1, 120)	3 (1, 120)	3 (1, 120)	8 (1, 120)
		S	11 afd	13 afd	9 afd	9 afd
		PS	45.4%	54.2%	38.2%	37.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.6%	0.1%	0.4%	2.3%
		ZFD	61 (61, 61)	1 (1, 1)	1 (1, 5)	1 (1, 61)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9E
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 120 Volume (af): 750 Duration (days): 10	PF	89.3%	89.3%	89.3%	85.7%
		TEM	85.7%	85.7%	85.7%	78.6%
		FVM	96.0%	96.0%	96.0%	95.8%
		FDM	4.0%	4.0%	4.0%	4.2%
Base Flow	25 cfs	EF	97.4%	97.3%	97.4%	97.2%
		AF	81.8%	82.2%	82.9%	74.3%
		AD	11 (1, 119)	11 (1, 119)	13 (1, 119)	11 (1, 119)
		SD	8 (1, 105)	6 (1, 84)	2 (1, 104)	3 (1, 106)
		S	10 afd	9 afd	12 afd	22 afd
		PS	19.4%	18.6%	24.2%	43.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.5%	0.0%	0.0%	0.7%
		ZFD	9 (9, 9)	N/A	N/A	2 (1, 9)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9F
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 710 Volume (af): 3490 Duration (days): 12	PF	87.5%	87.5%	87.5%	87.5%
		TEM	87.5%	87.5%	87.5%	87.5%
		FVM	92.9%	92.9%	92.9%	92.9%
		FDM	7.1%	7.1%	7.1%	7.1%
Base Flow	7 cfs	EF	67.2%	71.9%	75.7%	64.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	14 (1, 107)	14 (1, 93)	12 (1, 94)	10 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	31.0%	26.1%	22.1%	33.0%
		AF	69.1%	95.5%	93.5%	61.2%
		AD	6 (1, 35)	7 (1, 42)	3 (1, 43)	4 (1, 30)
		SD	9 (1, 36)	1 (1, 3)	1 (1, 3)	3 (1, 36)
		S	2 afd	1 afd	2 afd	2 afd
		PS	100.0%	60.0%	95.0%	100.0%
Zero Flow	N/A	ZFF	5.2%	0.5%	0.8%	7.6%
		ZFD	5 (1, 36)	1 (1, 3)	1 (1, 3)	3 (1, 36)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9G
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 710 Volume (af): 3490 Duration (days): 12	PF	75.3%	75.3%	75.3%	75.3%
		TEM	66.7%	66.7%	66.7%	66.7%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	16 cfs	EF	95.7%	96.0%	95.7%	96.0%
		AF	79.9%	81.4%	82.8%	77.7%
		AD	18 (1, 116)	10 (1, 116)	14 (1, 116)	10 (1, 115)
		SD	6 (1, 90)	4 (1, 90)	4 (1, 88)	4 (1, 90)
		S	18 afd	14 afd	14 afd	18 afd
		PS	55.2%	45.7%	44.2%	55.5%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.9%	0.1%	0.3%	1.8%
		ZFD	16 (1, 30)	1 (1, 2)	1 (1, 2)	1 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9H
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 710 Volume (af): 3490 Duration (days): 12	PF	100.0%	95.6%	97.8%	95.6%
		TEM	100.0%	86.7%	93.3%	86.7%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	33 cfs	EF	94.9%	95.4%	95.1%	95.1%
		AF	97.5%	96.8%	96.6%	96.0%
		AD	16 (1, 119)	12 (1, 118)	12 (1, 118)	14 (1, 119)
		SD	4 (1, 13)	5 (1, 13)	4 (1, 15)	3 (1, 18)
		S	13 afd	14 afd	17 afd	26 afd
		PS	19.1%	21.9%	25.4%	39.3%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9I
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	3 cfs	EF	27.6%	48.9%	96.9%	26.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (2, 123)	5 (1, 114)	15 (1, 123)	7 (1, 65)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	72.4%	51.1%	3.1%	73.1%
		AF	22.6%	95.0%	22.4%	21.9%
		AD	4 (1, 54)	3 (1, 111)	1 (1, 2)	2 (1, 54)
		SD	22 (1, 123)	1 (1, 3)	1 (1, 3)	8 (1, 123)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	100.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	46.7%	2.0%	1.9%	47.2%
		ZFD	18 (1, 123)	1 (1, 2)	1 (1, 3)	10 (1, 123)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9J
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	8 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	63.1%	59.3%	60.2%	60.2%
		AD	11 (1, 123)	9 (1, 123)	8 (1, 123)	9 (1, 123)
		SD	13 (1, 116)	4 (1, 115)	4 (1, 116)	4 (1, 120)
		S	9 afd	8 afd	8 afd	10 afd
		PS	59.1%	50.3%	50.3%	59.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	4.6%	0.8%	1.2%	5.6%
		ZFD	7 (1, 61)	1 (1, 3)	1 (1, 5)	2 (1, 61)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-9K
Brazos River Basin: North Bosque near Clifton
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 130 Volume (af): 500 Duration (days): 6	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	17 cfs	EF	97.8%	97.9%	97.9%	97.9%
		AF	69.8%	69.0%	69.8%	68.6%
		AD	16 (1, 119)	12 (1, 119)	14 (1, 119)	10 (1, 119)
		SD	13 (4, 89)	12 (1, 89)	10 (1, 89)	9 (1, 89)
		S	15 afd	16 afd	17 afd	16 afd
		PS	45.4%	46.6%	49.9%	46.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.2%
		ZFD	N/A	N/A	N/A	2 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-10. Brazos River Basin: Brazos River near Waco

Table C-10A
Brazos River Basin: Brazos River near Waco
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	703	411	536	587
Winter - All	0	0	0	0	523	266	346	390
Spring - All	1	0	0	0	1429	808	900	942
Summer - All	0	0	0	0	491	357	499	576
Winter - Dry	4	0	0	0	196	124	120	248
Winter - Average	0	1	0	0	496	250	300	332
Winter - Wet	63	0	1	4	1284	855	947	866
Spring - Dry	1	0	0	0	566	342	329	501
Spring - Average	28	1	0	0	1187	693	766	751
Spring - Wet	256	5	12	0	3279	2535	2311	2254
Summer - Dry	0	0	0	0	298	351	251	540
Summer - Average	0	0	0	0	532	368	488	493
Summer - Wet	0	0	9	0	609	338	724	831

Note: cfs: cubic feet per second

Table C-10B
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	5 (1, 172)	3 (1, 141)	3 (1, 154)	3 (1, 160)
	SD-POR	3 (1, 75)	2 (1, 77)	2 (1, 80)	2 (1, 81)
Subsistence Flow	AD-POR	2 (1, 34)	1 (1, 40)	1 (1, 24)	1 (1, 24)
	SD-POR	3 (1, 62)	1 (1, 35)	1 (1, 62)	1 (1, 62)
Zero Flow	ZFD-POR	31 (8, 31)	1 (1, 3)	1 (1, 2)	1 (1, 8)

Table C-10C
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2320 Volume (af): 12400 Duration (days): 7	PF	58.3%	50.0%	50.0%	50.0%
		TEM	58.3%	50.0%	50.0%	50.0%
		FVM	100.0%	83.3%	66.7%	83.3%
		FDM	0.0%	16.7%	33.3%	16.7%
Base Flow	120 cfs	EF	65.8%	50.8%	48.9%	63.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 117)	2 (1, 31)	2 (1, 61)	3 (1, 90)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	56 cfs	EF	32.6%	48.1%	49.9%	34.9%
		AF	68.4%	64.3%	36.2%	41.9%
		AD	3 (1, 34)	1 (1, 40)	1 (1, 6)	1 (1, 7)
		SD	2 (1, 62)	1 (1, 35)	1 (1, 62)	1 (1, 62)
		S	57 afd	48 afd	54 afd	74 afd
		PS	51.2%	42.9%	48.2%	66.7%
Zero Flow	N/A	ZFF	0.0%	0.2%	0.4%	1.1%
		ZFD	N/A	1 (1, 1)	1 (1, 2)	1 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10D
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 2320 Volume (af): 12400 Duration (days): 7	PF	75.3%	63.4%	62.4%	62.4%
		TEM	67.7%	51.6%	48.4%	48.4%
		FVM	98.6%	94.9%	93.1%	96.6%
		FDM	1.4%	5.1%	6.9%	3.4%
Base Flow	210 cfs	EF	95.4%	96.2%	95.8%	96.1%
		AF	75.9%	53.9%	60.2%	62.9%
		AD	5 (1, 115)	2 (1, 95)	2 (1, 105)	2 (1, 105)
		SD	2 (1, 50)	2 (1, 60)	2 (1, 80)	2 (1, 81)
		S	162 afd	223 afd	192 afd	218 afd
		PS	38.9%	53.5%	46.1%	52.4%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.8%	0.0%	0.0%	0.2%
		ZFD	30 (30, 30)	N/A	1 (1, 1)	1 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10E
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4180 Volume (af): 25700 Duration (days): 9	PF	78.6%	78.6%	78.6%	78.6%
		TEM	78.6%	78.6%	78.6%	78.6%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	480 cfs	EF	97.3%	97.4%	97.4%	97.2%
		AF	82.8%	65.9%	74.1%	68.3%
		AD	5 (1, 119)	3 (1, 88)	3 (1, 118)	2 (1, 70)
		SD	3 (1, 25)	2 (1, 50)	2 (1, 25)	2 (1, 59)
		S	311 afd	515 afd	346 afd	485 afd
		PS	32.7%	54.1%	36.3%	51.0%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.2%	0.0%	0.0%
		ZFD	N/A	2 (1, 2)	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10F
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 5330 Volume (af): 32700 Duration (days): 10	PF	93.8%	87.5%	87.5%	87.5%
		TEM	93.8%	87.5%	87.5%	87.5%
		FVM	86.7%	92.9%	92.9%	92.9%
		FDM	13.3%	7.1%	7.1%	7.1%
Base Flow	150 cfs	EF	81.0%	75.1%	68.1%	75.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	10 (1, 94)	4 (1, 59)	4 (1, 53)	6 (1, 88)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	56 cfs	EF	16.4%	22.7%	29.6%	22.4%
		AF	61.6%	65.3%	66.4%	59.4%
		AD	2 (1, 10)	1 (1, 17)	1 (1, 17)	1 (1, 24)
		SD	3 (1, 30)	1 (1, 29)	1 (1, 9)	1 (1, 16)
		S	56 afd	65 afd	38 afd	61 afd
		PS	50.5%	58.6%	34.4%	55.1%
Zero Flow	N/A	ZFF	0.0%	0.1%	0.1%	0.0%
		ZFD	N/A	1 (1, 1)	1 (1, 1)	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10G
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 5330 Volume (af): 32700 Duration (days): 10	PF	84.0%	79.0%	79.0%	77.8%
		TEM	77.8%	70.4%	66.7%	63.0%
		FVM	100.0%	93.8%	95.3%	98.4%
		FDM	0.0%	6.2%	4.7%	1.6%
Base Flow	270 cfs	EF	94.1%	95.1%	94.4%	95.0%
		AF	90.7%	72.3%	78.7%	78.8%
		AD	9 (1, 115)	3 (1, 80)	3 (1, 115)	4 (1, 96)
		SD	2 (1, 19)	2 (1, 29)	1 (1, 24)	1 (1, 24)
		S	160 afd	243 afd	202 afd	205 afd
		PS	29.9%	45.4%	37.7%	38.3%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.1%	0.1%
		ZFD	N/A	N/A	1 (1, 1)	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10H
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 13600 Volume (af): 102000 Duration (days): 14	PF	83.3%	83.3%	80.0%	80.0%
		TEM	80.0%	80.0%	73.3%	73.3%
		FVM	100.0%	92.0%	100.0%	100.0%
		FDM	0.0%	8.0%	0.0%	0.0%
Base Flow	690 cfs	EF	95.6%	95.7%	95.4%	94.9%
		AF	95.6%	84.6%	90.0%	89.1%
		AD	16 (1, 117)	5 (1, 114)	6 (1, 116)	5 (1, 116)
		SD	2 (1, 9)	2 (1, 14)	1 (1, 14)	1 (1, 14)
		S	342 afd	527 afd	374 afd	567 afd
		PS	25.0%	38.5%	27.3%	41.4%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10I
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1980 Volume (af): 10500 Duration (days): 7	PF	84.6%	76.9%	84.6%	84.6%
		TEM	84.6%	76.9%	84.6%	84.6%
		FVM	100.0%	100.0%	72.7%	100.0%
		FDM	0.0%	0.0%	27.3%	0.0%
Base Flow	140 cfs	EF	68.7%	82.7%	67.9%	74.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 98)	4 (1, 103)	4 (1, 76)	4 (1, 123)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	56 cfs	EF	29.8%	15.9%	30.1%	23.5%
		AF	64.1%	72.8%	69.9%	54.0%
		AD	2 (1, 14)	1 (1, 24)	1 (1, 24)	1 (1, 14)
		SD	4 (1, 31)	1 (1, 7)	1 (1, 17)	2 (1, 29)
		S	43 afd	73 afd	52 afd	65 afd
		PS	38.8%	65.4%	47.2%	58.1%
Zero Flow	N/A	ZFF	2.4%	0.2%	0.2%	1.1%
		ZFD	20 (8, 31)	3 (3, 3)	1 (1, 1)	1 (1, 8)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10J
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 1980 Volume (af): 10500 Duration (days): 7	PF	94.4%	92.2%	94.4%	93.3%
		TEM	90.0%	86.7%	90.0%	90.0%
		FVM	95.3%	96.4%	95.3%	96.4%
		FDM	4.7%	3.6%	4.7%	3.6%
Base Flow	250 cfs	EF	95.1%	95.0%	94.8%	95.3%
		AF	68.7%	62.7%	67.9%	67.6%
		AD	4 (1, 116)	3 (1, 62)	3 (1, 72)	3 (1, 59)
		SD	4 (1, 61)	2 (1, 51)	1 (1, 57)	1 (1, 51)
		S	265 afd	252 afd	248 afd	292 afd
		PS	53.5%	50.9%	50.0%	58.8%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.8%	0.1%	0.0%	0.1%
		ZFD	31 (31, 31)	1 (1, 1)	1 (1, 1)	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-10K
Brazos River Basin: Brazos River near Waco
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4160 Volume (af): 26400 Duration (days): 10	PF	80.0%	73.3%	76.7%	73.3%
		TEM	80.0%	66.7%	73.3%	73.3%
		FVM	95.8%	100.0%	95.7%	100.0%
		FDM	4.2%	0.0%	4.3%	0.0%
Base Flow	590 cfs	EF	97.0%	97.6%	97.5%	97.7%
		AF	49.6%	33.9%	63.4%	60.0%
		AD	5 (1, 80)	2 (1, 36)	3 (1, 72)	2 (1, 68)
		SD	5 (1, 75)	4 (1, 76)	2 (1, 43)	2 (1, 51)
		S	626 afd	796 afd	526 afd	694 afd
		PS	53.5%	68.1%	45.0%	59.3%
Subsistence Flow	56 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.7%	0.1%	0.0%	0.1%
		ZFD	31 (31, 31)	1 (1, 1)	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-11. Brazos River Basin: Leon River at Gatesville

Table C-11A
Brazos River Basin: Leon River at Gatesville
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	54	50	46	51
Winter - All	0	0	0	0	42	37	35	39
Spring - All	0	0	0	0	119	93	91	96
Summer - All	0	0	0	0	26	28	26	37
Winter - Dry	0	0	0	0	4	7	13	20
Winter - Average	0	0	0	0	46	40	40	43
Winter - Wet	1	0	0	0	137	128	123	125
Spring - Dry	0	0	0	0	31	35	26	31
Spring - Average	0	0	0	0	98	76	77	88
Spring - Wet	12	0	0	0	490	458	437	432
Summer - Dry	0	0	0	0	2	8	18	27
Summer - Average	0	0	0	0	30	28	28	39
Summer - Wet	0	0	0	0	73	70	67	73

Note: cfs: cubic feet per second

Table C-11B
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	7 (1, 320)	5 (1, 317)	4 (1, 315)	5 (1, 316)
	SD-POR	7 (1, 161)	4 (1, 190)	3 (1, 138)	2 (1, 139)
Subsistence Flow	AD-POR	4 (1, 60)	3 (1, 137)	3 (1, 61)	2 (1, 30)
	SD-POR	11 (1, 262)	2 (1, 61)	1 (1, 63)	2 (1, 102)
Zero Flow	ZFD-POR	8 (1, 262)	1 (1, 5)	1 (1, 32)	2 (1, 102)

Table C-11C
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	9 cfs	EF	34.8%	43.2%	54.3%	70.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 106)	2 (1, 120)	7 (1, 121)	7 (1, 121)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	65.2%	56.8%	45.7%	29.9%
		AF	51.5%	80.6%	75.9%	35.1%
		AD	6 (1, 57)	4 (1, 81)	3 (1, 61)	3 (1, 21)
		SD	24 (1, 121)	7 (1, 30)	2 (1, 29)	2 (1, 71)
		S	2 afd	1 afd	0 afd	2 afd
		PS	100.0%	35.0%	20.0%	100.0%
Zero Flow	N/A	ZFF	25.8%	1.0%	2.0%	18.5%
		ZFD	15 (1, 121)	1 (1, 4)	1 (1, 6)	5 (1, 71)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11D
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	20 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	65.3%	64.4%	66.0%	76.7%
		AD	7 (1, 121)	4 (1, 121)	4 (1, 121)	4 (1, 121)
		SD	10 (1, 120)	5 (1, 120)	3 (1, 120)	2 (1, 121)
		S	25 afd	24 afd	16 afd	10 afd
		PS	62.2%	60.7%	39.3%	24.1%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	5.2%	0.4%	0.6%	4.3%
		ZFD	5 (1, 67)	2 (1, 4)	2 (1, 8)	40 (1, 69)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11E
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 100 Volume (af): 540 Duration (days): 6	PF	89.3%	89.3%	85.7%	92.9%
		TEM	85.7%	85.7%	85.7%	85.7%
		FVM	92.0%	96.0%	95.8%	92.3%
		FDM	8.0%	4.0%	4.2%	7.7%
Base Flow	52 cfs	EF	97.6%	97.7%	97.6%	97.4%
		AF	74.5%	71.0%	70.7%	71.0%
		AD	5 (1, 119)	4 (1, 119)	4 (1, 119)	3 (1, 118)
		SD	5 (1, 105)	4 (1, 106)	4 (1, 117)	3 (1, 105)
		S	62 afd	70 afd	69 afd	42 afd
		PS	60.4%	67.7%	67.3%	40.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.2%	2.0%
		ZFD	N/A	1 (1, 1)	1 (1, 1)	18 (1, 34)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11F
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 340 Volume (af): 1910 Duration (days): 10	PF	93.8%	93.8%	93.8%	93.8%
		TEM	93.8%	93.8%	93.8%	93.8%
		FVM	100.0%	93.3%	93.3%	93.3%
		FDM	0.0%	6.7%	6.7%	6.7%
Base Flow	10 cfs	EF	67.4%	67.7%	69.5%	77.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 84)	4 (1, 100)	5 (1, 99)	8 (1, 111)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	30.9%	30.4%	28.6%	20.5%
		AF	80.6%	93.6%	72.8%	46.0%
		AD	5 (1, 27)	2 (1, 26)	3 (1, 30)	2 (1, 20)
		SD	6 (1, 31)	1 (1, 17)	1 (1, 25)	2 (1, 51)
		S	2 afd	1 afd	0 afd	2 afd
		PS	100.0%	40.0%	25.0%	100.0%
Zero Flow	N/A	ZFF	4.1%	0.5%	1.5%	8.1%
		ZFD	6 (3, 31)	1 (1, 2)	1 (1, 4)	2 (1, 51)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11G
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 340 Volume (af): 1910 Duration (days): 10	PF	91.4%	88.9%	90.1%	90.1%
		TEM	88.9%	85.2%	85.2%	85.2%
		FVM	100.0%	100.0%	100.0%	98.6%
		FDM	0.0%	0.0%	0.0%	1.4%
Base Flow	24 cfs	EF	96.2%	95.9%	95.8%	95.5%
		AF	79.5%	74.4%	76.3%	86.2%
		AD	7 (1, 119)	5 (1, 118)	5 (1, 118)	8 (1, 118)
		SD	6 (1, 68)	3 (1, 70)	2 (1, 71)	2 (1, 70)
		S	26 afd	32 afd	25 afd	26 afd
		PS	54.5%	66.4%	52.3%	55.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	2.0%	0.9%	0.7%	2.0%
		ZFD	7 (2, 30)	1 (1, 3)	1 (1, 7)	2 (1, 18)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11H
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 630 Volume (af): 4050 Duration (days): 13	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	54 cfs	EF	97.3%	96.6%	96.3%	96.6%
		AF	95.6%	92.2%	92.2%	93.3%
		AD	17 (2, 120)	10 (1, 120)	6 (1, 119)	8 (1, 120)
		SD	3 (1, 16)	2 (1, 16)	1 (1, 16)	2 (1, 16)
		S	35 afd	43 afd	51 afd	55 afd
		PS	32.8%	40.5%	48.0%	51.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.3%	0.3%	0.1%
		ZFD	N/A	1 (1, 1)	1 (1, 2)	2 (2, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11I
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 58 Volume (af): 220 Duration (days): 4	PF	92.3%	100.0%	92.3%	92.3%
		TEM	92.3%	100.0%	92.3%	92.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	4 cfs	EF	40.5%	68.5%	61.2%	75.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 90)	5 (1, 121)	6 (1, 115)	8 (1, 123)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	58.6%	30.3%	37.9%	23.5%
		AF	20.5%	59.0%	50.8%	19.5%
		AD	2 (1, 30)	2 (1, 56)	3 (1, 31)	1 (1, 30)
		SD	11 (1, 110)	2 (1, 31)	1 (1, 63)	3 (1, 93)
		S	2 afd	1 afd	1 afd	2 afd
		PS	100.0%	40.0%	40.0%	100.0%
Zero Flow	N/A	ZFF	38.0%	1.6%	3.1%	16.4%
		ZFD	15 (1, 110)	2 (1, 5)	2 (1, 7)	4 (1, 90)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11J
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 58 Volume (af): 220 Duration (days): 4	PF	97.8%	97.8%	97.8%	96.7%
		TEM	96.7%	96.7%	96.7%	96.7%
		FVM	100.0%	96.6%	100.0%	98.9%
		FDM	0.0%	3.4%	0.0%	1.1%
Base Flow	12 cfs	EF	97.2%	97.1%	97.2%	97.0%
		AF	66.4%	65.6%	69.7%	78.3%
		AD	7 (1, 120)	5 (1, 120)	4 (1, 120)	6 (1, 120)
		SD	7 (1, 48)	3 (1, 73)	4 (1, 48)	6 (1, 39)
		S	20 afd	18 afd	21 afd	22 afd
		PS	86.1%	77.7%	88.2%	92.4%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	12.5%	1.6%	5.2%	9.7%
		ZFD	6 (1, 38)	1 (1, 3)	2 (1, 32)	4 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-11K
Brazos River Basin: Leon River at Gatesville
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 140 Volume (af): 600 Duration (days): 6	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	27 cfs	EF	97.6%	97.7%	97.7%	97.7%
		AF	63.2%	62.3%	66.2%	85.2%
		AD	5 (1, 121)	5 (1, 121)	4 (1, 121)	7 (1, 121)
		SD	7 (1, 79)	6 (1, 79)	5 (1, 42)	2 (1, 40)
		S	37 afd	38 afd	34 afd	20 afd
		PS	69.2%	71.7%	64.1%	37.1%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	5.7%	1.8%	3.2%	3.4%
		ZFD	8 (1, 17)	2 (1, 5)	1 (1, 16)	5 (1, 17)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-12. Brazos River Basin: Lampasas River near Kempner

Table C-12A
Brazos River Basin: Lampasas River near Kempner
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	30	30	28	27
Winter - All	1	0	0	0	31	31	29	28
Spring - All	0	0	0	0	55	54	50	49
Summer - All	0	0	0	0	21	20	19	18
Winter - Dry	1	0	0	0	13	13	12	11
Winter - Average	3	4	0	0	31	31	29	27
Winter - Wet	12	12	12	11	68	68	63	63
Spring - Dry	0	0	0	0	20	20	19	18
Spring - Average	3	0	1	0	47	46	42	41
Spring - Wet	20	18	18	17	282	282	269	275
Summer - Dry	0	0	0	0	8	8	8	7
Summer - Average	0	0	0	0	21	21	19	18
Summer - Wet	7	7	4	4	35	34	31	30

Note: cfs: cubic feet per second

Table C-12B
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	4 (1, 263)	4 (1, 222)	4 (1, 220)	4 (1, 213)
	SD-POR	7 (1, 167)	6 (1, 178)	7 (1, 195)	8 (1, 207)
Subsistence Flow	AD-POR	3 (1, 48)	3 (1, 39)	3 (1, 50)	2 (1, 38)
	SD-POR	9 (1, 163)	7 (1, 163)	6 (1, 163)	6 (1, 163)
Zero Flow	ZFD-POR	11 (1, 31)	2 (2, 3)	2 (1, 4)	2 (1, 31)

Table C-12C
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 78 Volume (af): 430 Duration (days): 8	PF	58.3%	58.3%	58.3%	58.3%
		TEM	58.3%	58.3%	58.3%	58.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	18 cfs	EF	29.7%	29.3%	27.2%	24.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 103)	4 (1, 103)	4 (1, 103)	3 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	10 cfs	EF	68.9%	69.2%	71.7%	74.6%
		AF	41.8%	42.0%	42.8%	39.3%
		AD	3 (1, 48)	3 (1, 39)	3 (1, 50)	3 (1, 38)
		SD	11 (1, 121)	6 (1, 121)	5 (1, 121)	5 (1, 121)
		S	9 afd	9 afd	9 afd	10 afd
		PS	47.7%	46.0%	43.9%	50.5%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12D
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 78 Volume (af): 430 Duration (days): 8	PF	60.2%	60.2%	60.2%	60.2%
		TEM	54.8%	54.8%	54.8%	54.8%
		FVM	98.2%	98.2%	98.2%	98.2%
		FDM	1.8%	1.8%	1.8%	1.8%
Base Flow	27 cfs	EF	97.2%	97.2%	97.3%	97.2%
		AF	56.3%	56.6%	52.1%	48.9%
		AD	4 (1, 120)	5 (1, 120)	4 (1, 120)	3 (1, 117)
		SD	6 (1, 121)	5 (1, 121)	6 (1, 121)	8 (1, 121)
		S	25 afd	25 afd	25 afd	26 afd
		PS	46.2%	46.2%	46.4%	48.6%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12E
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 190 Volume (af): 1150 Duration (days): 11	PF	64.3%	64.3%	64.3%	64.3%
		TEM	57.1%	57.1%	57.1%	57.1%
		FVM	94.4%	94.4%	100.0%	100.0%
		FDM	5.6%	5.6%	0.0%	0.0%
Base Flow	39 cfs	EF	97.8%	97.8%	97.8%	97.8%
		AF	72.8%	72.9%	69.5%	67.3%
		AD	7 (1, 120)	7 (1, 120)	4 (1, 120)	6 (1, 116)
		SD	11 (1, 89)	8 (1, 120)	8 (1, 120)	10 (1, 120)
		S	23 afd	24 afd	24 afd	25 afd
		PS	29.6%	30.6%	30.7%	31.8%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12F
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 780 Volume (af): 4020 Duration (days): 13	PF	62.5%	62.5%	62.5%	62.5%
		TEM	62.5%	62.5%	62.5%	62.5%
		FVM	80.0%	80.0%	70.0%	70.0%
		FDM	20.0%	20.0%	30.0%	30.0%
Base Flow	21 cfs	EF	46.3%	45.3%	42.2%	40.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 98)	5 (1, 98)	4 (1, 98)	4 (1, 88)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	10 cfs	EF	50.8%	51.8%	55.0%	56.4%
		AF	49.1%	48.4%	48.8%	46.8%
		AD	3 (1, 30)	3 (1, 33)	3 (1, 33)	3 (1, 33)
		SD	8 (1, 61)	5 (1, 61)	6 (1, 61)	5 (1, 61)
		S	10 afd	9 afd	9 afd	10 afd
		PS	48.5%	46.7%	44.4%	51.5%
Zero Flow	N/A	ZFF	1.2%	0.2%	0.3%	1.4%
		ZFD	2 (1, 18)	3 (3, 3)	2 (2, 3)	2 (1, 18)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12G
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 780 Volume (af): 4020 Duration (days): 13	PF	56.8%	56.8%	56.8%	55.6%
		TEM	37.0%	37.0%	37.0%	37.0%
		FVM	89.1%	89.1%	89.1%	91.1%
		FDM	10.9%	10.9%	10.9%	8.9%
Base Flow	29 cfs	EF	96.1%	96.1%	96.1%	96.2%
		AF	65.0%	64.4%	61.4%	59.5%
		AD	6 (1, 116)	6 (1, 116)	5 (1, 116)	5 (1, 116)
		SD	7 (1, 98)	7 (1, 98)	8 (1, 98)	8 (1, 98)
		S	23 afd	24 afd	24 afd	25 afd
		PS	40.3%	40.9%	41.9%	42.8%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12H
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1310 Volume (af): 6860 Duration (days): 16	PF	90.0%	90.0%	90.0%	90.0%
		TEM	86.7%	86.7%	86.7%	86.7%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	43 cfs	EF	96.3%	96.3%	96.3%	96.4%
		AF	94.1%	93.8%	92.6%	92.3%
		AD	22 (1, 119)	22 (1, 119)	20 (1, 119)	21 (1, 119)
		SD	6 (1, 22)	6 (1, 22)	6 (1, 39)	6 (1, 39)
		S	25 afd	26 afd	27 afd	29 afd
		PS	29.7%	30.7%	31.4%	33.5%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12I
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 77 Volume (af): 270 Duration (days): 4	PF	92.3%	92.3%	92.3%	92.3%
		TEM	92.3%	92.3%	92.3%	92.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	16 cfs	EF	23.5%	22.6%	20.6%	19.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	2 (1, 98)	2 (1, 58)	2 (1, 46)	2 (1, 45)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	10 cfs	EF	75.6%	76.5%	78.5%	79.2%
		AF	25.2%	25.1%	24.4%	22.0%
		AD	2 (1, 25)	2 (1, 25)	2 (1, 25)	2 (1, 22)
		SD	9 (1, 73)	8 (1, 73)	8 (1, 73)	8 (1, 73)
		S	13 afd	12 afd	12 afd	13 afd
		PS	65.7%	63.1%	61.6%	66.2%
Zero Flow	N/A	ZFF	10.1%	0.1%	0.2%	10.4%
		ZFD	18 (1, 31)	2 (2, 2)	3 (3, 3)	14 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12J
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 77 Volume (af): 270 Duration (days): 4	PF	80.0%	80.0%	77.8%	77.8%
		TEM	76.7%	76.7%	73.3%	73.3%
		FVM	98.6%	98.6%	100.0%	100.0%
		FDM	1.4%	1.4%	0.0%	0.0%
Base Flow	23 cfs	EF	97.5%	97.5%	97.7%	97.6%
		AF	45.4%	43.5%	38.6%	36.5%
		AD	3 (1, 120)	3 (1, 120)	3 (1, 77)	3 (1, 77)
		SD	7 (1, 72)	6 (1, 72)	7 (1, 91)	8 (1, 114)
		S	20 afd	20 afd	21 afd	22 afd
		PS	43.0%	43.4%	46.3%	48.0%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.2%	0.1%	0.4%	0.5%
		ZFD	4 (2, 6)	2 (2, 2)	1 (1, 4)	2 (1, 6)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-12K
Brazos River Basin: Lampasas River near Kempner
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 190 Volume (af): 680 Duration (days): 6	PF	80.0%	80.0%	80.0%	80.0%
		TEM	80.0%	80.0%	80.0%	80.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	32 cfs	EF	98.2%	98.2%	98.0%	98.0%
		AF	55.8%	53.7%	47.6%	46.2%
		AD	5 (1, 119)	4 (1, 119)	4 (1, 102)	4 (1, 102)
		SD	8 (1, 60)	6 (1, 61)	8 (1, 66)	8 (1, 66)
		S	27 afd	26 afd	26 afd	27 afd
		PS	42.4%	41.6%	40.8%	42.0%
Subsistence Flow	10 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-13. Brazos River Basin: Little River near Little River

Table C-13A
Brazos River Basin: Little River near Little River
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	280	139	166	96
Winter - All	2	0	0	0	238	102	134	77
Spring - All	0	0	0	0	686	287	344	222
Summer - All	0	0	0	0	153	101	120	60
Winter - Dry	3	0	9	0	47	44	67	22
Winter - Average	2	0	0	0	229	96	131	73
Winter - Wet	39	0	0	0	694	392	378	267
Spring - Dry	0	0	0	0	161	91	110	42
Spring - Average	6	0	3	0	580	245	288	181
Spring - Wet	35	0	3	0	2244	1633	1983	1691
Summer - Dry	0	0	0	0	34	61	57	12
Summer - Average	3	0	0	0	161	104	122	59
Summer - Wet	7	0	0	0	310	217	259	221

Note: cfs: cubic feet per second

Table C-13B
Brazos River Basin: Little River near Little River
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	4 (1, 278)	2 (1, 111)	2 (1, 119)	2 (1, 117)
	SD-POR	4 (1, 155)	2 (1, 147)	1 (1, 147)	1 (1, 156)
Subsistence Flow	AD-POR	1 (1, 15)	1 (1, 34)	1 (1, 30)	1 (1, 7)
	SD-POR	6 (1, 125)	2 (1, 95)	1 (1, 113)	2 (1, 163)
Zero Flow	ZFD-POR	7 (1, 34)	1 (1, 8)	1 (1, 2)	1 (1, 5)

Table C-13C
Brazos River Basin: Little River near Little River
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 520 Volume (af): 2350 Duration (days): 5	PF	91.7%	75.0%	83.3%	75.0%
		TEM	91.7%	75.0%	83.3%	75.0%
		FVM	81.8%	88.9%	80.0%	88.9%
		FDM	18.2%	11.1%	20.0%	11.1%
Base Flow	82 cfs	EF	31.4%	22.6%	35.0%	15.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 61)	2 (1, 32)	2 (1, 52)	2 (1, 36)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	55 cfs	EF	67.1%	76.5%	63.4%	83.0%
		AF	16.7%	21.1%	38.4%	6.2%
		AD	2 (1, 15)	1 (1, 29)	2 (1, 29)	1 (1, 3)
		SD	6 (1, 116)	2 (1, 95)	1 (1, 113)	4 (1, 121)
		S	60 afd	53 afd	17 afd	81 afd
		PS	54.7%	48.4%	15.3%	74.1%
Zero Flow	N/A	ZFF	0.0%	0.3%	0.0%	0.3%
		ZFD	N/A	1 (1, 2)	N/A	1 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13D
Brazos River Basin: Little River near Little River
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 520 Volume (af): 2350 Duration (days): 5	PF	77.4%	72.0%	73.1%	71.0%
		TEM	71.0%	64.5%	71.0%	64.5%
		FVM	97.2%	92.5%	98.5%	92.4%
		FDM	2.8%	7.5%	1.5%	7.6%
Base Flow	110 cfs	EF	96.6%	97.0%	96.9%	97.1%
		AF	66.8%	45.1%	56.2%	39.8%
		AD	4 (1, 120)	2 (1, 111)	2 (1, 115)	1 (1, 117)
		SD	4 (1, 120)	2 (1, 111)	1 (1, 111)	1 (1, 120)
		S	115 afd	113 afd	82 afd	144 afd
		PS	52.6%	51.7%	37.7%	66.2%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.0%	0.8%
		ZFD	N/A	1 (1, 1)	1 (1, 1)	1 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13E
Brazos River Basin: Little River near Little River
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1600 Volume (af): 11800 Duration (days): 11	PF	71.4%	67.9%	75.0%	78.6%
		TEM	71.4%	64.3%	71.4%	71.4%
		FVM	95.0%	89.5%	85.7%	81.8%
		FDM	5.0%	10.5%	14.3%	18.2%
Base Flow	190 cfs	EF	97.1%	97.0%	96.8%	95.8%
		AF	85.1%	63.7%	66.6%	56.0%
		AD	6 (1, 120)	3 (1, 108)	2 (1, 96)	1 (1, 85)
		SD	3 (1, 34)	3 (1, 55)	2 (1, 60)	1 (1, 80)
		S	112 afd	190 afd	155 afd	215 afd
		PS	29.6%	50.3%	41.2%	56.9%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.5%	0.2%	0.2%
		ZFD	N/A	4 (1, 8)	2 (1, 2)	2 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13F
Brazos River Basin: Little River near Little River
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1420 Volume (af): 9760 Duration (days): 10	PF	87.5%	87.5%	87.5%	68.8%
		TEM	87.5%	87.5%	87.5%	68.8%
		FVM	100.0%	85.7%	85.7%	90.9%
		FDM	0.0%	14.3%	14.3%	9.1%
Base Flow	95 cfs	EF	63.0%	45.8%	52.7%	32.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 80)	3 (1, 39)	2 (1, 37)	2 (1, 24)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	55 cfs	EF	34.2%	50.9%	44.3%	66.1%
		AF	30.7%	41.9%	47.9%	14.3%
		AD	1 (1, 13)	1 (1, 26)	1 (1, 23)	1 (1, 7)
		SD	5 (1, 37)	1 (1, 32)	1 (1, 30)	2 (1, 48)
		S	58 afd	50 afd	5 afd	93 afd
		PS	53.4%	45.7%	4.6%	85.4%
Zero Flow	N/A	ZFF	0.1%	0.2%	0.1%	1.0%
		ZFD	1 (1, 1)	1 (1, 1)	1 (1, 1)	1 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13G
Brazos River Basin: Little River near Little River
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 1420 Volume (af): 9760 Duration (days): 10	PF	95.1%	86.4%	88.9%	87.7%
		TEM	92.6%	77.8%	77.8%	74.1%
		FVM	98.7%	91.4%	93.1%	85.9%
		FDM	1.3%	8.6%	6.9%	14.1%
Base Flow	150 cfs	EF	93.6%	93.7%	93.7%	93.7%
		AF	84.3%	59.5%	66.6%	51.6%
		AD	6 (1, 118)	2 (1, 75)	2 (1, 103)	2 (1, 77)
		SD	4 (1, 47)	2 (1, 57)	1 (1, 57)	1 (1, 58)
		S	133 afd	153 afd	113 afd	192 afd
		PS	44.7%	51.6%	38.1%	64.4%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.3%	0.0%	0.7%
		ZFD	N/A	2 (1, 5)	N/A	1 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13H
Brazos River Basin: Little River near Little River
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 3290 Volume (af): 32200 Duration (days): 17	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	93.3%	96.7%	96.7%
		FDM	0.0%	6.7%	3.3%	3.3%
Base Flow	340 cfs	EF	95.0%	93.0%	93.5%	92.9%
		AF	96.5%	80.3%	84.7%	81.2%
		AD	16 (1, 118)	3 (1, 79)	2 (1, 101)	3 (1, 102)
		SD	3 (1, 8)	1 (1, 17)	1 (1, 17)	1 (1, 21)
		S	130 afd	370 afd	261 afd	331 afd
		PS	19.2%	54.8%	38.7%	49.0%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.0%	0.8%
		ZFD	N/A	1 (1, 1)	N/A	1 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13I
Brazos River Basin: Little River near Little River
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 430 Volume (af): 1560 Duration (days): 4	PF	84.6%	76.9%	76.9%	76.9%
		TEM	84.6%	76.9%	76.9%	76.9%
		FVM	100.0%	90.0%	100.0%	90.0%
		FDM	0.0%	10.0%	0.0%	10.0%
Base Flow	84 cfs	EF	34.4%	35.7%	33.8%	18.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 65)	3 (1, 31)	2 (1, 35)	2 (1, 27)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	55 cfs	EF	64.4%	63.3%	65.2%	80.9%
		AF	8.6%	25.1%	27.9%	5.8%
		AD	1 (1, 12)	1 (1, 34)	1 (1, 30)	1 (1, 5)
		SD	8 (1, 75)	3 (1, 63)	2 (1, 36)	2 (1, 92)
		S	90 afd	55 afd	15 afd	95 afd
		PS	82.5%	50.9%	13.7%	87.1%
Zero Flow	N/A	ZFF	9.4%	0.3%	0.0%	0.2%
		ZFD	8 (1, 34)	1 (1, 1)	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13J
Brazos River Basin: Little River near Little River
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 430 Volume (af): 1560 Duration (days): 4	PF	91.1%	87.8%	90.0%	88.9%
		TEM	90.0%	83.3%	86.7%	86.7%
		FVM	100.0%	96.2%	98.8%	91.2%
		FDM	0.0%	3.8%	1.2%	8.8%
Base Flow	120 cfs	EF	96.9%	97.0%	97.1%	97.3%
		AF	57.4%	44.1%	50.3%	32.2%
		AD	4 (1, 82)	2 (1, 73)	2 (1, 48)	1 (1, 82)
		SD	5 (1, 61)	2 (1, 98)	2 (1, 65)	2 (1, 101)
		S	133 afd	131 afd	99 afd	177 afd
		PS	55.7%	55.0%	41.7%	74.3%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.4%	0.0%	0.2%
		ZFD	N/A	2 (1, 2)	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-13K
Brazos River Basin: Little River near Little River
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1060 Volume (af): 5890 Duration (days): 8	PF	93.3%	90.0%	90.0%	90.0%
		TEM	93.3%	86.7%	86.7%	86.7%
		FVM	100.0%	96.3%	100.0%	92.6%
		FDM	0.0%	3.7%	0.0%	7.4%
Base Flow	200 cfs	EF	96.9%	97.5%	97.7%	97.6%
		AF	60.4%	50.7%	54.4%	50.7%
		AD	3 (1, 118)	2 (1, 72)	2 (1, 94)	2 (1, 100)
		SD	8 (1, 62)	2 (1, 62)	1 (1, 116)	1 (1, 110)
		S	222 afd	252 afd	212 afd	285 afd
		PS	55.9%	63.5%	53.5%	71.8%
Subsistence Flow	55 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.4%	0.0%	0.2%
		ZFD	N/A	1 (1, 3)	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-14. Brazos River Basin: Little River near Cameron

Table C-14A
Brazos River Basin: Little River near Cameron
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	475	285	350	209
Winter - All	3	0	0	0	437	265	324	192
Spring - All	0	0	0	0	1130	642	746	545
Summer - All	0	0	0	0	253	170	218	93
Winter - Dry	4	16	19	0	88	72	122	20
Winter - Average	3	19	0	0	425	254	318	189
Winter - Wet	70	0	20	0	1207	921	930	715
Spring - Dry	1	0	20	0	252	151	215	54
Spring - Average	0	0	0	0	988	534	640	446
Spring - Wet	111	0	0	0	3137	2816	3162	2926
Summer - Dry	0	0	0	0	34	53	95	0
Summer - Average	2	20	20	0	253	174	220	90
Summer - Wet	2	20	0	0	519	390	505	370

Note: cfs: cubic feet per second

Table C-14B
Brazos River Basin: Little River near Cameron
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	6 (1, 239)	3 (1, 119)	3 (1, 166)	2 (1, 116)
	SD-POR	5 (1, 144)	2 (1, 145)	1 (1, 145)	1 (1, 213)
Subsistence Flow	AD-POR	3 (1, 45)	2 (1, 112)	2 (1, 94)	1 (1, 16)
	SD-POR	7 (1, 132)	2 (1, 133)	2 (1, 29)	3 (1, 204)
Zero Flow	ZFD-POR	18 (1, 62)	1 (1, 9)	2 (1, 3)	1 (1, 159)

Table C-14C
Brazos River Basin: Little River near Cameron
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1080 Volume (af): 6680 Duration (days): 8	PF	83.3%	58.3%	75.0%	50.0%
		TEM	83.3%	58.3%	75.0%	50.0%
		FVM	90.0%	57.1%	66.7%	50.0%
		FDM	10.0%	42.9%	33.3%	50.0%
Base Flow	110 cfs	EF	39.8%	33.0%	56.6%	17.0%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 58)	3 (1, 49)	3 (1, 57)	2 (1, 57)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	32 cfs	EF	57.7%	64.9%	40.0%	81.4%
		AF	57.7%	49.4%	73.9%	14.3%
		AD	4 (1, 45)	2 (1, 33)	1 (1, 27)	1 (1, 14)
		SD	7 (1, 61)	2 (1, 111)	2 (1, 26)	8 (1, 121)
		S	25 afd	24 afd	24 afd	37 afd
		PS	39.8%	37.5%	37.5%	58.3%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	18.9%
		ZFD	N/A	N/A	N/A	3 (1, 87)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14D
Brazos River Basin: Little River near Cameron
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 1080 Volume (af): 6680 Duration (days): 8	PF	77.4%	74.2%	75.3%	72.0%
		TEM	74.2%	67.7%	71.0%	64.5%
		FVM	97.2%	95.7%	97.1%	98.5%
		FDM	2.8%	4.3%	2.9%	1.5%
Base Flow	190 cfs	EF	96.0%	96.1%	96.0%	96.3%
		AF	72.7%	56.0%	69.4%	48.0%
		AD	7 (1, 120)	3 (1, 118)	4 (1, 117)	2 (1, 116)
		SD	6 (1, 110)	3 (1, 110)	2 (1, 110)	2 (1, 121)
		S	149 afd	167 afd	120 afd	266 afd
		PS	39.5%	44.3%	31.8%	70.5%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	3.1%
		ZFD	N/A	N/A	N/A	1 (1, 50)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14E
Brazos River Basin: Little River near Cameron
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 2140 Volume (af): 14900 Duration (days): 10	PF	89.3%	85.7%	89.3%	89.3%
		TEM	85.7%	85.7%	85.7%	85.7%
		FVM	96.0%	91.7%	92.0%	88.0%
		FDM	4.0%	8.3%	8.0%	12.0%
Base Flow	460 cfs	EF	96.1%	96.3%	96.2%	96.6%
		AF	78.5%	66.2%	70.7%	59.3%
		AD	6 (1, 118)	4 (1, 113)	3 (1, 114)	3 (1, 96)
		SD	8 (1, 53)	3 (1, 105)	2 (1, 106)	2 (1, 106)
		S	229 afd	397 afd	345 afd	484 afd
		PS	25.1%	43.5%	37.8%	53.1%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.1%	0.0%	0.9%
		ZFD	N/A	1 (1, 1)	N/A	1 (1, 6)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14F
Brazos River Basin: Little River near Cameron
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 3200 Volume (af): 23900 Duration (days): 12	PF	81.2%	75.0%	68.8%	68.8%
		TEM	81.2%	75.0%	68.8%	68.8%
		FVM	76.9%	66.7%	81.8%	54.5%
		FDM	23.1%	33.3%	18.2%	45.5%
Base Flow	140 cfs	EF	63.9%	48.4%	61.0%	33.0%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 113)	5 (1, 72)	4 (1, 72)	2 (1, 64)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	32 cfs	EF	32.4%	47.3%	34.7%	63.3%
		AF	72.8%	70.1%	82.4%	31.5%
		AD	4 (1, 36)	2 (1, 36)	2 (1, 35)	1 (1, 16)
		SD	4 (1, 33)	1 (1, 22)	2 (1, 8)	3 (1, 53)
		S	27 afd	24 afd	24 afd	63 afd
		PS	42.8%	37.5%	37.5%	98.9%
Zero Flow	N/A	ZFF	0.0%	0.2%	0.0%	17.0%
		ZFD	N/A	2 (1, 2)	N/A	1 (1, 35)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14G
Brazos River Basin: Little River near Cameron
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 3200 Volume (af): 23900 Duration (days): 12	PF	88.9%	84.0%	88.9%	85.2%
		TEM	77.8%	70.4%	77.8%	74.1%
		FVM	97.2%	91.2%	91.7%	84.1%
		FDM	2.8%	8.8%	8.3%	15.9%
Base Flow	310 cfs	EF	93.1%	92.2%	91.0%	91.7%
		AF	81.5%	60.6%	69.6%	54.4%
		AD	7 (1, 115)	3 (1, 102)	3 (1, 114)	2 (1, 108)
		SD	4 (1, 64)	2 (1, 68)	2 (1, 64)	2 (1, 70)
		S	231 afd	302 afd	244 afd	413 afd
		PS	37.6%	49.1%	39.7%	67.2%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.4%	0.1%	3.4%
		ZFD	N/A	3 (1, 9)	2 (1, 3)	1 (1, 43)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14H
Brazos River Basin: Little River near Cameron
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4790 Volume (af): 38400 Duration (days): 14	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	96.7%	100.0%	100.0%
		FDM	0.0%	3.3%	0.0%	0.0%
Base Flow	760 cfs	EF	94.9%	93.9%	93.4%	93.6%
		AF	94.9%	83.2%	86.3%	83.5%
		AD	14 (1, 118)	2 (1, 114)	1 (1, 102)	2 (1, 94)
		SD	4 (1, 17)	1 (1, 24)	1 (1, 16)	1 (1, 24)
		S	301 afd	617 afd	485 afd	577 afd
		PS	20.0%	40.9%	32.2%	38.3%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14I
Brazos River Basin: Little River near Cameron
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 560 Volume (af): 2860 Duration (days): 6	PF	76.9%	69.2%	69.2%	69.2%
		TEM	76.9%	69.2%	69.2%	69.2%
		FVM	100.0%	100.0%	88.9%	88.9%
		FDM	0.0%	0.0%	11.1%	11.1%
Base Flow	97 cfs	EF	32.4%	26.5%	45.0%	16.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 87)	2 (1, 60)	4 (1, 47)	2 (1, 15)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	32 cfs	EF	64.1%	70.4%	52.0%	81.1%
		AF	24.7%	75.2%	73.8%	13.0%
		AD	2 (1, 19)	3 (1, 100)	2 (1, 81)	1 (1, 16)
		SD	10 (1, 108)	2 (1, 25)	3 (1, 29)	2 (1, 123)
		S	49 afd	24 afd	24 afd	64 afd
		PS	76.5%	37.5%	37.5%	100.0%
Zero Flow	N/A	ZFF	10.6%	0.5%	0.0%	48.7%
		ZFD	18 (1, 62)	1 (1, 3)	N/A	2 (1, 123)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14J
Brazos River Basin: Little River near Cameron
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 560 Volume (af): 2860 Duration (days): 6	PF	88.9%	81.1%	86.7%	84.4%
		TEM	83.3%	70.0%	83.3%	76.7%
		FVM	100.0%	97.3%	97.4%	96.1%
		FDM	0.0%	2.7%	2.6%	3.9%
Base Flow	160 cfs	EF	88.7%	90.6%	89.7%	91.5%
		AF	60.6%	47.5%	60.9%	33.3%
		AD	4 (1, 110)	3 (1, 75)	3 (1, 70)	2 (1, 58)
		SD	6 (1, 49)	3 (1, 90)	2 (1, 77)	2 (1, 102)
		S	169 afd	177 afd	99 afd	274 afd
		PS	53.4%	55.7%	31.2%	86.2%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	8.2%
		ZFD	N/A	N/A	N/A	2 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-14K
Brazos River Basin: Little River near Cameron
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 990 Volume (af): 5550 Duration (days): 8	PF	96.7%	96.7%	96.7%	96.7%
		TEM	93.3%	93.3%	93.3%	93.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	330 cfs	EF	88.2%	89.6%	89.4%	89.4%
		AF	59.7%	47.4%	53.9%	46.2%
		AD	4 (1, 89)	3 (1, 87)	2 (1, 111)	2 (1, 106)
		SD	6 (1, 82)	3 (1, 119)	1 (1, 95)	1 (1, 120)
		S	279 afd	343 afd	276 afd	444 afd
		PS	42.6%	52.4%	42.1%	67.9%
Subsistence Flow	32 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	2.1%
		ZFD	N/A	N/A	N/A	1 (1, 12)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-15. Brazos River Basin: Brazos River near Bryan

Table C-15A
Brazos River Basin: Brazos River near Bryan
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	7	2	0	1667	1159	1389	1253
Winter - All	13	16	9	0	1379	941	1121	945
Spring - All	47	9	2	0	3550	2556	2751	2610
Summer - All	0	7	2	0	1086	795	1088	986
Winter - Dry	13	16	9	0	418	331	426	436
Winter - Average	50	17	12	3	1309	879	1045	858
Winter - Wet	270	25	287	14	3230	2583	2897	2538
Spring - Dry	52	17	6	0	1176	749	819	796
Spring - Average	47	9	2	3	3068	2106	2293	2185
Spring - Wet	960	187	365	416	8387	8343	7756	7310
Summer - Dry	0	7	2	0	486	499	464	671
Summer - Average	56	28	28	0	1163	807	1107	948
Summer - Wet	112	26	172	2	1502	1536	2193	2062

Note: cfs: cubic feet per second

Table C-15B
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	5 (1, 144)	3 (1, 142)	4 (1, 145)	3 (1, 174)
	SD-POR	5 (1, 127)	3 (1, 131)	3 (1, 132)	3 (1, 139)
Subsistence Flow	AD-POR	3 (1, 18)	2 (1, 42)	2 (1, 42)	2 (1, 24)
	SD-POR	5 (1, 68)	2 (1, 76)	2 (1, 55)	2 (1, 70)
Zero Flow	ZFD-POR	31 (31, 31)	N/A	N/A	2 (1, 52)

Note: N/A: not applicable

Table C-15C
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 3230 Volume (af): 21100 Duration (days): 7	PF	75.0%	66.7%	66.7%	58.3%
		TEM	75.0%	66.7%	66.7%	58.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	540 cfs	EF	37.4%	27.4%	34.5%	37.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 56)	3 (1, 56)	2 (1, 56)	2 (1, 56)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	300 cfs	EF	60.8%	71.3%	64.2%	61.2%
		AF	42.7%	38.2%	63.5%	42.3%
		AD	2 (1, 18)	2 (1, 23)	2 (1, 42)	2 (1, 18)
		SD	4 (1, 68)	2 (1, 76)	2 (1, 54)	2 (1, 70)
		S	198 afd	151 afd	135 afd	337 afd
		PS	33.3%	25.4%	22.8%	56.6%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	2.0%
		ZFD	N/A	N/A	N/A	15 (2, 28)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15D
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 3230 Volume (af): 21100 Duration (days): 7	PF	79.6%	77.4%	77.4%	77.4%
		TEM	77.4%	74.2%	74.2%	74.2%
		FVM	100.0%	94.4%	98.6%	98.6%
		FDM	0.0%	5.6%	1.4%	1.4%
Base Flow	860 cfs	EF	95.9%	96.0%	95.6%	96.0%
		AF	62.3%	48.8%	55.2%	47.7%
		AD	4 (1, 116)	2 (1, 116)	3 (1, 116)	3 (1, 115)
		SD	4 (1, 110)	4 (1, 112)	3 (1, 110)	3 (1, 120)
		S	662 afd	809 afd	631 afd	878 afd
		PS	38.8%	47.4%	37.0%	51.5%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15E
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 5570 Volume (af): 41900 Duration (days): 10	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	1760 cfs	EF	95.8%	95.9%	95.5%	96.2%
		AF	72.1%	61.1%	66.4%	61.4%
		AD	6 (1, 118)	4 (1, 117)	5 (1, 112)	5 (1, 95)
		SD	5 (1, 44)	4 (1, 84)	3 (1, 71)	3 (1, 84)
		S	1236 afd	1544 afd	1268 afd	1641 afd
		PS	35.4%	44.2%	36.3%	47.0%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15F
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 6050 Volume (af): 49000 Duration (days): 11	PF	93.8%	93.8%	93.8%	93.8%
		TEM	93.8%	93.8%	93.8%	93.8%
		FVM	93.3%	86.7%	86.7%	93.3%
		FDM	6.7%	13.3%	13.3%	6.7%
Base Flow	710 cfs	EF	62.8%	48.8%	53.0%	51.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 114)	4 (1, 77)	5 (1, 78)	4 (1, 75)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	300 cfs	EF	34.2%	47.2%	43.4%	44.9%
		AF	59.7%	68.7%	69.5%	58.4%
		AD	3 (1, 18)	2 (1, 33)	2 (1, 32)	2 (1, 24)
		SD	4 (1, 33)	2 (1, 25)	3 (1, 19)	2 (1, 43)
		S	144 afd	171 afd	147 afd	298 afd
		PS	24.2%	28.7%	24.7%	50.1%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.2%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15G
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 6050 Volume (af): 49000 Duration (days): 11	PF	96.3%	93.8%	92.6%	92.6%
		TEM	96.3%	88.9%	85.2%	85.2%
		FVM	98.7%	96.1%	98.7%	97.3%
		FDM	1.3%	3.9%	1.3%	2.7%
Base Flow	1260 cfs	EF	93.3%	92.7%	93.0%	93.0%
		AF	75.1%	60.4%	66.0%	60.0%
		AD	5 (1, 117)	4 (1, 107)	4 (1, 116)	4 (1, 107)
		SD	5 (1, 67)	3 (1, 71)	3 (1, 70)	4 (1, 70)
		S	814 afd	1132 afd	944 afd	1130 afd
		PS	32.6%	45.3%	37.8%	45.2%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15H
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 10400 Volume (af): 97000 Duration (days): 14	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	2460 cfs	EF	95.5%	94.7%	94.6%	94.7%
		AF	92.9%	87.5%	89.8%	87.2%
		AD	9 (1, 119)	4 (1, 118)	5 (1, 118)	6 (1, 117)
		SD	3 (1, 12)	2 (1, 15)	2 (1, 14)	2 (1, 15)
		S	759 afd	1708 afd	1141 afd	1392 afd
		PS	15.5%	35.0%	23.4%	28.5%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15I
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2060 Volume (af): 12700 Duration (days): 7	PF	84.6%	84.6%	84.6%	69.2%
		TEM	84.6%	84.6%	84.6%	69.2%
		FVM	90.9%	100.0%	90.9%	100.0%
		FDM	9.1%	0.0%	9.1%	0.0%
Base Flow	630 cfs	EF	38.8%	38.5%	36.1%	50.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 78)	4 (1, 31)	3 (1, 44)	4 (1, 29)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	300 cfs	EF	59.3%	59.8%	62.0%	47.7%
		AF	36.0%	65.3%	46.6%	38.8%
		AD	3 (1, 13)	2 (1, 42)	2 (1, 16)	2 (1, 19)
		SD	7 (1, 57)	2 (1, 35)	2 (1, 51)	2 (1, 52)
		S	324 afd	176 afd	224 afd	405 afd
		PS	54.5%	29.5%	37.6%	68.0%
Zero Flow	N/A	ZFF	1.9%	0.0%	0.0%	4.2%
		ZFD	31 (31, 31)	N/A	N/A	3 (1, 52)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15J
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 2060 Volume (af): 12700 Duration (days): 7	PF	97.8%	97.8%	98.9%	100.0%
		TEM	96.7%	96.7%	96.7%	100.0%
		FVM	100.0%	97.7%	98.9%	98.9%
		FDM	0.0%	2.3%	1.1%	1.1%
Base Flow	920 cfs	EF	95.5%	95.6%	95.6%	95.1%
		AF	55.5%	42.8%	54.9%	48.9%
		AD	5 (1, 77)	3 (1, 65)	3 (1, 117)	3 (1, 118)
		SD	6 (1, 61)	3 (1, 64)	3 (1, 55)	3 (1, 69)
		S	834 afd	727 afd	747 afd	893 afd
		PS	45.7%	39.8%	41.0%	48.9%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-15K
Brazos River Basin: Brazos River near Bryan
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 2990 Volume (af): 20100 Duration (days): 8	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	1470 cfs	EF	97.2%	97.0%	97.0%	97.0%
		AF	49.3%	49.5%	60.1%	58.7%
		AD	4 (1, 87)	4 (1, 107)	3 (1, 120)	5 (1, 116)
		SD	8 (1, 67)	6 (1, 102)	3 (1, 64)	3 (1, 64)
		S	1325 afd	1594 afd	1212 afd	1476 afd
		PS	45.4%	54.7%	41.6%	50.6%
Subsistence Flow	300 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-16. Brazos River Basin: Navasota River near Easterly

Table C-16A
Brazos River Basin: Navasota River near Easterly
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	36	16	13	20
Winter - All	0	0	0	0	58	18	15	26
Spring - All	0	0	0	0	98	48	31	43
Summer - All	0	0	0	0	5	9	10	12
Winter - Dry	0	0	0	0	15	8	8	11
Winter - Average	0	3	0	0	57	18	16	30
Winter - Wet	1	3	0	0	142	53	39	46
Spring - Dry	0	0	0	0	29	16	14	19
Spring - Average	0	5	0	0	106	55	31	47
Spring - Wet	0	5	2	0	204	133	68	86
Summer - Dry	0	0	0	0	1	8	7	12
Summer - Average	0	4	0	0	7	9	10	13
Summer - Wet	0	4	0	0	13	9	9	12

Note: cfs: cubic feet per second

Table C-16B
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	11 (1, 193)	4 (1, 170)	4 (1, 128)	4 (1, 129)
	SD-POR	5 (1, 153)	3 (1, 157)	2 (1, 157)	2 (1, 164)
Subsistence Flow	AD-POR	6 (1, 60)	3 (1, 81)	3 (1, 212)	3 (1, 144)
	SD-POR	20 (2, 132)	4 (1, 23)	3 (1, 26)	3 (1, 176)
Zero Flow	ZFD-POR	30 (1, 153)	2 (1, 6)	2 (1, 26)	2 (1, 176)

Table C-16C
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 260 Volume (af): 1610 Duration (days): 9	PF	91.7%	83.3%	91.7%	91.7%
		TEM	91.7%	83.3%	91.7%	91.7%
		FVM	90.9%	90.0%	90.9%	90.9%
		FDM	9.1%	10.0%	9.1%	9.1%
Base Flow	9 cfs	EF	56.6%	42.0%	28.3%	29.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	12 (1, 98)	4 (1, 36)	3 (1, 32)	4 (1, 32)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	41.2%	56.2%	69.8%	68.7%
		AF	88.0%	95.7%	79.3%	74.2%
		AD	8 (1, 60)	2 (1, 81)	3 (1, 69)	3 (1, 66)
		SD	9 (4, 30)	5 (1, 11)	3 (1, 25)	4 (1, 34)
		S	2 afd	2 afd	2 afd	2 afd
		PS	100.0%	95.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	3.3%	1.5%	10.8%	14.8%
		ZFD	8 (4, 30)	2 (1, 6)	2 (1, 24)	2 (1, 33)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16D
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 260 Volume (af): 1610 Duration (days): 9	PF	82.8%	79.6%	81.7%	81.7%
		TEM	80.6%	74.2%	80.6%	80.6%
		FVM	100.0%	94.6%	93.4%	90.8%
		FDM	0.0%	5.4%	6.6%	9.2%
Base Flow	14 cfs	EF	95.9%	96.5%	96.4%	96.6%
		AF	76.3%	53.4%	52.3%	68.3%
		AD	9 (1, 115)	3 (1, 78)	3 (1, 57)	3 (1, 79)
		SD	4 (1, 92)	3 (1, 95)	2 (1, 106)	2 (1, 43)
		S	12 afd	16 afd	13 afd	7 afd
		PS	45.0%	57.2%	46.8%	26.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.6%	0.0%	1.0%	1.4%
		ZFD	30 (1, 30)	N/A	2 (1, 4)	2 (1, 8)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16E
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 800 Volume (af): 5440 Duration (days): 12	PF	85.7%	82.1%	85.7%	85.7%
		TEM	85.7%	78.6%	85.7%	85.7%
		FVM	95.8%	100.0%	91.7%	95.8%
		FDM	4.2%	0.0%	8.3%	4.2%
Base Flow	23 cfs	EF	96.4%	96.6%	96.3%	96.7%
		AF	83.3%	59.0%	57.6%	60.5%
		AD	9 (1, 117)	3 (1, 70)	3 (1, 89)	3 (1, 117)
		SD	5 (1, 49)	3 (1, 55)	2 (1, 74)	2 (1, 74)
		S	22 afd	34 afd	31 afd	25 afd
		PS	47.8%	73.9%	67.5%	55.3%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.1%	0.5%
		ZFD	N/A	N/A	1 (1, 1)	1 (1, 4)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16F
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 720 Volume (af): 4590 Duration (days): 11	PF	68.8%	68.8%	68.8%	68.8%
		TEM	68.8%	68.8%	68.8%	68.8%
		FVM	100.0%	100.0%	100.0%	90.9%
		FDM	0.0%	0.0%	0.0%	9.1%
Base Flow	10 cfs	EF	70.2%	62.4%	45.7%	48.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	16 (1, 102)	5 (1, 62)	4 (1, 58)	6 (1, 58)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	28.3%	36.2%	52.8%	50.3%
		AF	83.2%	99.3%	91.4%	83.1%
		AD	6 (1, 39)	3 (1, 59)	3 (1, 44)	3 (1, 59)
		SD	30 (3, 30)	5 (5, 5)	2 (1, 23)	2 (1, 26)
		S	2 afd	1 afd	2 afd	2 afd
		PS	100.0%	60.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	4.6%	0.1%	4.3%	7.4%
		ZFD	30 (30, 30)	1 (1, 1)	2 (1, 23)	2 (1, 26)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16G
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 720 Volume (af): 4590 Duration (days): 11	PF	93.8%	87.7%	87.7%	87.7%
		TEM	92.6%	85.2%	81.5%	81.5%
		FVM	97.4%	98.6%	93.0%	93.0%
		FDM	2.6%	1.4%	7.0%	7.0%
Base Flow	19 cfs	EF	94.4%	94.5%	93.5%	94.7%
		AF	85.1%	67.9%	61.5%	69.5%
		AD	15 (1, 115)	5 (1, 56)	4 (1, 49)	4 (1, 62)
		SD	3 (1, 86)	3 (1, 76)	2 (1, 108)	2 (1, 76)
		S	19 afd	19 afd	19 afd	13 afd
		PS	51.5%	49.3%	50.1%	35.0%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.9%	0.0%	0.0%	0.4%
		ZFD	30 (30, 30)	N/A	1 (1, 1)	1 (1, 4)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16H
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1340 Volume (af): 8990 Duration (days): 13	PF	100.0%	100.0%	96.7%	96.7%
		TEM	100.0%	100.0%	93.3%	93.3%
		FVM	100.0%	100.0%	100.0%	93.1%
		FDM	0.0%	0.0%	0.0%	6.9%
Base Flow	29 cfs	EF	94.9%	95.1%	94.6%	94.9%
		AF	89.4%	71.6%	67.6%	68.3%
		AD	16 (2, 110)	6 (1, 60)	4 (1, 71)	4 (1, 55)
		SD	4 (1, 32)	2 (1, 35)	2 (1, 32)	2 (1, 35)
		S	32 afd	42 afd	39 afd	33 afd
		PS	56.0%	72.5%	67.3%	57.2%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	1.6%	0.0%	0.0%	0.5%
		ZFD	30 (30, 30)	N/A	N/A	1 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16I
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	3 cfs	EF	34.2%	93.2%	27.7%	19.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 55)	123 (1, 123)	5 (1, 25)	5 (1, 43)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	1 cfs	EF	65.8%	6.8%	72.3%	80.1%
		AF	30.0%	56.0%	77.6%	65.9%
		AD	5 (1, 42)	3 (1, 24)	3 (1, 123)	3 (1, 122)
		SD	19 (2, 123)	4 (1, 23)	3 (1, 26)	4 (1, 123)
		S	2 afd	0 afd	2 afd	2 afd
		PS	100.0%	10.0%	100.0%	100.0%
Zero Flow	N/A	ZFF	37.8%	0.0%	10.9%	25.1%
		ZFD	15 (1, 123)	N/A	2 (1, 26)	4 (1, 123)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16J
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	N/A	PF	N/A	N/A	N/A	N/A
		TEM	N/A	N/A	N/A	N/A
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	8 cfs	EF	100.0%	100.0%	100.0%	100.0%
		AF	46.6%	71.6%	87.7%	93.5%
		AD	10 (1, 92)	4 (1, 116)	7 (1, 123)	13 (1, 123)
		SD	12 (1, 104)	2 (1, 59)	2 (1, 27)	2 (1, 9)
		S	12 afd	4 afd	7 afd	6 afd
		PS	74.2%	28.3%	46.5%	37.7%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	14.2%	0.0%	0.5%	1.9%
		ZFD	30 (1, 62)	N/A	1 (1, 2)	1 (1, 7)

Notes: afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-16K
Brazos River Basin: Navasota River near Easterly
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 49 Volume (af): 220 Duration (days): 5	PF	83.3%	80.0%	80.0%	80.0%
		TEM	80.0%	80.0%	80.0%	80.0%
		FVM	100.0%	95.8%	95.8%	91.7%
		FDM	0.0%	4.2%	4.2%	8.3%
Base Flow	16 cfs	EF	97.9%	97.9%	98.2%	98.3%
		AF	45.1%	34.9%	29.0%	36.1%
		AD	8 (1, 65)	3 (1, 80)	3 (1, 33)	3 (1, 35)
		SD	9 (1, 123)	3 (1, 123)	2 (1, 123)	2 (1, 123)
		S	26 afd	16 afd	14 afd	8 afd
		PS	81.1%	49.2%	42.6%	24.6%
Subsistence Flow	1 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	18.5%	0.0%	2.0%	7.0%
		ZFD	31 (1, 123)	N/A	2 (1, 25)	2 (1, 47)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-17. Brazos River Basin: Brazos River near Hempstead

Table C-17A
Brazos River Basin: Brazos River near Hempstead
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	2	28	0	0	2529	2081	2294	2185
Winter - All	31	28	34	0	2440	1949	2176	1976
Spring - All	170	33	14	0	5294	4494	4543	4334
Summer - All	2	63	0	0	1489	1287	1520	1499
Winter - Dry	31	28	34	0	743	652	751	870
Winter - Average	67	39	47	0	2257	1762	1920	1776
Winter - Wet	555	32	489	479	5685	5186	5461	5035
Spring - Dry	170	33	14	0	1744	1312	1312	1401
Spring - Average	255	96	39	0	4763	3953	4067	3893
Spring - Wet	1105	270	749	316	12303	12397	12021	11309
Summer - Dry	2	63	32	0	612	673	644	956
Summer - Average	70	78	44	0	1534	1304	1512	1490
Summer - Wet	235	83	0	0	2185	2284	2792	2720

Note: cfs: cubic feet per second

Table C-17B
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	8 (1, 169)	4 (1, 147)	5 (1, 164)	4 (1, 171)
	SD-POR	8 (1, 129)	4 (1, 139)	4 (1, 133)	4 (1, 123)
Subsistence Flow	AD-POR	3 (1, 43)	2 (1, 38)	2 (1, 36)	2 (1, 31)
	SD-POR	8 (1, 77)	2 (1, 77)	2 (1, 63)	2 (1, 65)
Zero Flow	ZFD-POR	N/A	N/A	2 (2, 2)	2 (1, 6)

Note: N/A: not applicable

Table C-17C
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 5720 Volume (af): 49800 Duration (days): 10	PF	66.7%	66.7%	66.7%	66.7%
		TEM	66.7%	66.7%	66.7%	66.7%
		FVM	100.0%	87.5%	87.5%	87.5%
		FDM	0.0%	12.5%	12.5%	12.5%
Base Flow	920 cfs	EF	41.0%	35.2%	38.2%	44.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 60)	4 (1, 60)	4 (1, 60)	4 (1, 60)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	510 cfs	EF	57.1%	62.6%	59.3%	53.2%
		AF	34.3%	36.1%	62.9%	55.1%
		AD	3 (1, 17)	2 (1, 23)	2 (1, 28)	2 (1, 26)
		SD	8 (1, 77)	3 (1, 77)	2 (1, 42)	2 (1, 56)
		S	384 afd	325 afd	202 afd	598 afd
		PS	37.9%	32.1%	19.9%	59.1%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.3%
		ZFD	N/A	N/A	N/A	2 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17D
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 5720 Volume (af): 49800 Duration (days): 10	PF	79.6%	77.4%	77.4%	77.4%
		TEM	74.2%	71.0%	71.0%	71.0%
		FVM	98.6%	97.2%	98.6%	98.6%
		FDM	1.4%	2.8%	1.4%	1.4%
Base Flow	1440 cfs	EF	94.0%	94.0%	93.9%	93.8%
		AF	62.1%	53.5%	57.0%	53.4%
		AD	6 (1, 117)	4 (1, 114)	4 (1, 114)	4 (1, 114)
		SD	7 (1, 120)	6 (1, 120)	4 (1, 114)	4 (1, 120)
		S	1166 afd	1283 afd	1046 afd	1103 afd
		PS	40.8%	44.9%	36.6%	38.6%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17E
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 11200 Volume (af): 125000 Duration (days): 15	PF	100.0%	96.4%	96.4%	96.4%
		TEM	100.0%	92.9%	92.9%	92.9%
		FVM	100.0%	100.0%	100.0%	96.3%
		FDM	0.0%	0.0%	0.0%	3.7%
Base Flow	2890 cfs	EF	93.9%	93.2%	93.3%	93.0%
		AF	71.6%	66.5%	69.7%	66.2%
		AD	7 (1, 117)	6 (1, 116)	5 (1, 116)	6 (1, 93)
		SD	7 (1, 83)	4 (1, 95)	3 (1, 83)	3 (1, 95)
		S	2076 afd	2539 afd	2154 afd	2394 afd
		PS	36.2%	44.3%	37.6%	41.8%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17F
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 8530 Volume (af): 85000 Duration (days): 13	PF	93.8%	81.2%	87.5%	81.2%
		TEM	93.8%	81.2%	87.5%	81.2%
		FVM	93.3%	100.0%	92.9%	92.3%
		FDM	6.7%	0.0%	7.1%	7.7%
Base Flow	1130 cfs	EF	59.7%	51.9%	51.2%	55.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	10 (1, 82)	5 (1, 71)	4 (1, 70)	5 (1, 70)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	510 cfs	EF	35.9%	44.8%	44.4%	41.4%
		AF	58.5%	72.1%	75.2%	72.2%
		AD	4 (1, 43)	2 (1, 30)	2 (1, 30)	2 (1, 31)
		SD	7 (1, 35)	2 (1, 21)	2 (1, 17)	2 (1, 20)
		S	282 afd	212 afd	232 afd	357 afd
		PS	27.9%	21.0%	23.0%	35.3%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.2%
		ZFD	N/A	N/A	N/A	2 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17G
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 8530 Volume (af): 85000 Duration (days): 13	PF	93.8%	88.9%	86.4%	87.7%
		TEM	88.9%	81.5%	81.5%	81.5%
		FVM	98.7%	97.2%	100.0%	100.0%
		FDM	1.3%	2.8%	0.0%	0.0%
Base Flow	1900 cfs	EF	91.9%	91.8%	91.9%	91.7%
		AF	75.9%	68.0%	70.1%	68.1%
		AD	8 (1, 116)	5 (1, 99)	6 (1, 110)	5 (1, 99)
		SD	8 (1, 57)	3 (1, 59)	4 (1, 59)	4 (1, 57)
		S	1204 afd	1443 afd	1307 afd	1321 afd
		PS	32.0%	38.3%	34.7%	35.1%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17H
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 16800 Volume (af): 219000 Duration (days): 19	PF	100.0%	96.7%	96.7%	96.7%
		TEM	100.0%	93.3%	93.3%	93.3%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	3440 cfs	EF	92.3%	92.0%	91.6%	91.4%
		AF	92.2%	90.6%	92.0%	89.4%
		AD	21 (1, 118)	12 (1, 116)	11 (1, 117)	12 (1, 113)
		SD	4 (1, 27)	3 (1, 29)	2 (1, 15)	3 (1, 15)
		S	1331 afd	1831 afd	1768 afd	1561 afd
		PS	19.5%	26.8%	25.9%	22.9%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17I
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2620 Volume (af): 17000 Duration (days): 7	PF	84.6%	92.3%	92.3%	92.3%
		TEM	84.6%	92.3%	92.3%	92.3%
		FVM	100.0%	83.3%	91.7%	91.7%
		FDM	0.0%	16.7%	8.3%	8.3%
Base Flow	950 cfs	EF	34.6%	32.0%	31.5%	48.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 77)	3 (1, 32)	4 (1, 44)	4 (1, 28)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	510 cfs	EF	63.5%	65.5%	66.4%	49.7%
		AF	30.5%	55.2%	44.8%	41.6%
		AD	3 (1, 17)	2 (1, 38)	2 (1, 36)	2 (1, 20)
		SD	8 (1, 65)	2 (1, 36)	3 (1, 52)	2 (1, 54)
		S	488 afd	264 afd	304 afd	634 afd
		PS	48.2%	26.1%	30.1%	62.7%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	1.6%
		ZFD	N/A	N/A	N/A	2 (1, 6)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17J
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 2620 Volume (af): 17000 Duration (days): 7	PF	96.7%	96.7%	97.8%	98.9%
		TEM	93.3%	93.3%	93.3%	96.7%
		FVM	100.0%	98.9%	100.0%	98.9%
		FDM	0.0%	1.1%	0.0%	1.1%
Base Flow	1330 cfs	EF	95.4%	95.9%	95.4%	95.2%
		AF	53.5%	46.7%	54.7%	53.8%
		AD	6 (1, 80)	3 (1, 61)	4 (1, 62)	4 (1, 68)
		SD	9 (1, 66)	4 (1, 68)	3 (1, 64)	3 (1, 52)
		S	1132 afd	969 afd	979 afd	924 afd
		PS	42.9%	36.7%	37.1%	35.0%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-17K
Brazos River Basin: Brazos River near Hempstead
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 5090 Volume (af): 40900 Duration (days): 9	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	2050 cfs	EF	96.4%	96.7%	96.6%	96.5%
		AF	51.4%	52.9%	61.1%	59.1%
		AD	7 (1, 67)	5 (1, 106)	6 (1, 119)	6 (1, 104)
		SD	11 (1, 100)	5 (1, 101)	4 (1, 93)	5 (1, 64)
		S	1594 afd	1915 afd	1525 afd	1555 afd
		PS	39.2%	47.1%	37.5%	38.2%
Subsistence Flow	510 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.1%	0.0%
		ZFD	N/A	N/A	2 (2, 2)	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-18. Brazos River Basin: Brazos River at Richmond

Table C-18A
Brazos River Basin: Brazos River at Richmond
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	2	3	0	3012	2264	2460	2364
Winter - All	36	8	3	0	2946	2264	2430	2233
Spring - All	79	2	5	0	6099	4703	4719	4291
Summer - All	0	2	3	0	1815	1296	1596	1730
Winter - Dry	36	8	22	0	948	707	968	1083
Winter - Average	97	8	3	0	2840	2102	2294	2070
Winter - Wet	301	13	56	0	6842	6165	6433	5858
Spring - Dry	79	2	5	0	1909	1075	1190	1375
Spring - Average	201	19	12	0	5428	4092	4152	3800
Spring - Wet	1124	39	373	369	12892	12097	11826	10841
Summer - Dry	0	14	10	0	762	521	853	962
Summer - Average	101	2	3	0	1908	1298	1583	1735
Summer - Wet	296	18	199	0	2761	2600	3216	2926

Note: cfs: cubic feet per second

Table C-18B
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	8 (1, 151)	6 (1, 142)	5 (1, 151)	5 (1, 150)
	SD-POR	7 (1, 123)	4 (1, 141)	4 (1, 124)	3 (1, 114)
Subsistence Flow	AD-POR	3 (1, 26)	2 (1, 17)	3 (1, 47)	2 (1, 65)
	SD-POR	4 (1, 64)	4 (1, 69)	2 (1, 18)	2 (1, 67)
Zero Flow	ZFD-POR	31 (31, 31)	N/A	N/A	2 (1, 34)

Note: N/A: not applicable

Table C-18C
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 6410 Volume (af): 60600 Duration (days): 11	PF	75.0%	66.7%	66.7%	66.7%
		TEM	75.0%	66.7%	66.7%	66.7%
		FVM	88.9%	87.5%	87.5%	62.5%
		FDM	11.1%	12.5%	12.5%	37.5%
Base Flow	990 cfs	EF	45.5%	36.8%	37.3%	44.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	7 (1, 60)	6 (1, 60)	4 (1, 61)	5 (1, 61)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	550 cfs	EF	51.9%	60.8%	60.6%	53.2%
		AF	41.5%	33.2%	85.1%	64.1%
		AD	2 (1, 20)	2 (1, 17)	4 (1, 47)	2 (1, 65)
		SD	4 (1, 50)	5 (1, 67)	2 (1, 18)	3 (1, 40)
		S	277 afd	397 afd	266 afd	523 afd
		PS	25.3%	36.4%	24.4%	47.9%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.7%
		ZFD	N/A	N/A	N/A	2 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18D
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 6410 Volume (af): 60600 Duration (days): 11	PF	82.8%	79.6%	79.6%	77.4%
		TEM	77.4%	71.0%	71.0%	71.0%
		FVM	97.4%	93.2%	90.5%	94.4%
		FDM	2.6%	6.8%	9.5%	5.6%
Base Flow	1650 cfs	EF	92.1%	93.3%	93.4%	93.5%
		AF	65.0%	53.3%	59.7%	59.2%
		AD	7 (1, 117)	5 (1, 114)	5 (1, 114)	4 (1, 114)
		SD	4 (1, 120)	4 (1, 120)	4 (1, 120)	3 (1, 114)
		S	1135 afd	1461 afd	989 afd	941 afd
		PS	34.7%	44.6%	30.2%	28.8%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18E
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 12400 Volume (af): 150000 Duration (days): 16	PF	96.4%	96.4%	96.4%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	100.0%	92.6%	100.0%	96.2%
		FDM	0.0%	7.4%	0.0%	3.8%
Base Flow	3310 cfs	EF	93.2%	92.8%	92.9%	93.6%
		AF	73.0%	68.6%	72.1%	68.7%
		AD	10 (1, 115)	6 (1, 110)	7 (1, 110)	6 (1, 109)
		SD	6 (1, 81)	4 (1, 92)	3 (1, 87)	3 (1, 84)
		S	2488 afd	3145 afd	2420 afd	2832 afd
		PS	37.9%	47.9%	36.9%	43.1%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18F
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 8930 Volume (af): 94000 Duration (days): 13	PF	93.8%	93.8%	93.8%	87.5%
		TEM	93.8%	93.8%	93.8%	87.5%
		FVM	86.7%	80.0%	80.0%	85.7%
		FDM	13.3%	20.0%	20.0%	14.3%
Base Flow	1190 cfs	EF	59.6%	42.3%	42.2%	46.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	9 (1, 73)	6 (1, 70)	4 (1, 71)	5 (1, 71)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	550 cfs	EF	34.9%	52.4%	51.9%	49.6%
		AF	60.1%	38.4%	78.7%	81.8%
		AD	3 (1, 26)	2 (1, 15)	3 (1, 34)	2 (1, 34)
		SD	4 (1, 31)	4 (1, 37)	2 (1, 17)	1 (1, 14)
		S	301 afd	542 afd	330 afd	487 afd
		PS	27.6%	49.6%	30.3%	44.7%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.2%
		ZFD	N/A	N/A	N/A	2 (1, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18G
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 8930 Volume (af): 94000 Duration (days): 13	PF	96.3%	95.1%	93.8%	95.1%
		TEM	92.6%	88.9%	88.9%	88.9%
		FVM	98.7%	92.2%	93.4%	92.2%
		FDM	1.3%	7.8%	6.6%	7.8%
Base Flow	2140 cfs	EF	91.0%	91.5%	91.5%	91.2%
		AF	77.0%	64.7%	67.9%	66.9%
		AD	9 (1, 111)	6 (1, 98)	6 (1, 105)	4 (1, 98)
		SD	8 (1, 46)	4 (1, 49)	5 (1, 54)	3 (1, 48)
		S	1241 afd	1946 afd	1442 afd	1399 afd
		PS	29.2%	45.9%	34.0%	33.0%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18H
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 16300 Volume (af): 215000 Duration (days): 19	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	3980 cfs	EF	92.9%	91.4%	91.5%	91.3%
		AF	93.1%	90.1%	91.2%	89.0%
		AD	18 (1, 118)	12 (1, 112)	14 (1, 113)	12 (1, 108)
		SD	4 (1, 28)	1 (1, 27)	1 (1, 14)	2 (1, 15)
		S	2032 afd	3021 afd	2372 afd	2284 afd
		PS	25.7%	38.3%	30.1%	28.9%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18I
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2460 Volume (af): 16400 Duration (days): 6	PF	92.3%	92.3%	92.3%	92.3%
		TEM	92.3%	92.3%	92.3%	92.3%
		FVM	100.0%	100.0%	91.7%	91.7%
		FDM	0.0%	0.0%	8.3%	8.3%
Base Flow	930 cfs	EF	41.2%	29.9%	34.6%	42.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 77)	4 (1, 28)	5 (1, 31)	6 (1, 38)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	550 cfs	EF	57.0%	68.2%	63.3%	55.8%
		AF	33.2%	23.9%	64.1%	52.9%
		AD	2 (1, 12)	2 (1, 14)	2 (1, 33)	2 (1, 24)
		SD	6 (1, 55)	5 (1, 56)	2 (1, 15)	3 (1, 53)
		S	504 afd	604 afd	244 afd	770 afd
		PS	46.2%	55.4%	22.4%	70.5%
Zero Flow	N/A	ZFF	3.9%	0.0%	0.0%	3.1%
		ZFD	31 (31, 31)	N/A	N/A	4 (1, 34)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18J
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 2460 Volume (af): 16400 Duration (days): 6	PF	100.0%	98.9%	100.0%	100.0%
		TEM	100.0%	96.7%	100.0%	100.0%
		FVM	100.0%	97.8%	97.8%	91.1%
		FDM	0.0%	2.2%	2.2%	8.9%
Base Flow	1330 cfs	EF	95.4%	95.8%	95.6%	95.5%
		AF	61.6%	47.0%	58.8%	64.6%
		AD	6 (1, 120)	4 (1, 53)	4 (1, 57)	4 (1, 68)
		SD	7 (1, 56)	4 (1, 64)	4 (1, 41)	3 (1, 39)
		S	1061 afd	1292 afd	766 afd	764 afd
		PS	40.2%	49.0%	29.0%	29.0%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	2 (2, 2)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-18K
Brazos River Basin: Brazos River at Richmond
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 5430 Volume (af): 46300 Duration (days): 10	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	2190 cfs	EF	96.5%	96.7%	96.6%	96.7%
		AF	57.7%	52.8%	62.7%	63.5%
		AD	8 (1, 80)	6 (1, 95)	7 (1, 95)	7 (1, 95)
		SD	10 (1, 69)	6 (1, 88)	5 (1, 44)	4 (1, 46)
		S	1587 afd	2204 afd	1626 afd	1494 afd
		PS	36.5%	50.7%	37.4%	34.4%
Subsistence Flow	550 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-19. Brazos River Basin: Brazos River at Rosharon

Table C-19A
Brazos River Basin: Brazos River at Rosharon
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	3331	2135	2090	1488
Winter - All	99	3	0	0	3217	2289	2097	1707
Spring - All	74	0	0	0	6554	4588	4160	3203
Summer - All	0	1	0	0	2232	1212	1271	930
Winter - Dry	99	8	0	0	1006	573	461	344
Winter - Average	227	3	1	0	3144	2197	2090	1699
Winter - Wet	737	7	74	1	7696	6345	6189	5142
Spring - Dry	74	0	0	0	2148	848	680	511
Spring - Average	138	11	10	0	6048	3961	3562	2594
Spring - Wet	1811	6	28	12	14915	12728	12109	10942
Summer - Dry	0	1	0	0	875	341	334	176
Summer - Average	107	9	1	0	2236	1153	1252	939
Summer - Wet	442	18	11	0	3486	2667	2745	2538

Note: cfs: cubic feet per second

Table C-19B
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	7 (1, 154)	5 (1, 118)	4 (1, 135)	4 (1, 118)
	SD-POR	6 (1, 132)	5 (1, 139)	5 (1, 151)	5 (1, 151)
Subsistence Flow	AD-POR	4 (1, 41)	2 (1, 19)	2 (1, 34)	2 (1, 18)
	SD-POR	4 (1, 48)	4 (1, 146)	3 (1, 133)	3 (1, 133)
Zero Flow	ZFD-POR	31 (31, 31)	N/A	1 (1, 1)	2 (1, 31)

Note: N/A: not applicable

Table C-19C
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Dry Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 9090 Volume (af): 94700 Duration (days): 12	PF	58.3%	58.3%	58.3%	50.0%
		TEM	58.3%	58.3%	58.3%	50.0%
		FVM	100.0%	71.4%	85.7%	66.7%
		FDM	0.0%	28.6%	14.3%	33.3%
Base Flow	1140 cfs	EF	44.3%	29.2%	23.7%	21.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 60)	4 (1, 59)	2 (1, 59)	3 (1, 43)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	430 cfs	EF	53.5%	67.8%	72.9%	75.9%
		AF	79.1%	41.5%	41.5%	27.4%
		AD	6 (1, 41)	2 (1, 19)	2 (1, 34)	2 (1, 18)
		SD	6 (2, 31)	4 (1, 79)	3 (1, 34)	3 (1, 91)
		S	163 afd	392 afd	371 afd	559 afd
		PS	19.1%	45.9%	43.5%	65.6%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	1.9%
		ZFD	N/A	N/A	N/A	5 (1, 16)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19D
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Average Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 9090 Volume (af): 94700 Duration (days): 12	PF	77.4%	74.2%	75.3%	72.0%
		TEM	71.0%	67.7%	67.7%	67.7%
		FVM	95.8%	91.3%	90.0%	95.5%
		FDM	4.2%	8.7%	10.0%	4.5%
Base Flow	2090 cfs	EF	91.7%	92.0%	91.9%	92.4%
		AF	60.1%	46.7%	46.8%	40.5%
		AD	6 (1, 113)	5 (1, 112)	5 (1, 110)	4 (1, 109)
		SD	8 (1, 120)	6 (1, 120)	4 (1, 120)	5 (1, 120)
		S	1696 afd	2323 afd	2392 afd	2874 afd
		PS	40.9%	56.0%	57.7%	69.3%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19E
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Wet Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 13600 Volume (af): 168000 Duration (days): 16	PF	96.4%	96.4%	92.9%	92.9%
		TEM	92.9%	92.9%	92.9%	92.9%
		FVM	100.0%	100.0%	96.2%	100.0%
		FDM	0.0%	0.0%	3.8%	0.0%
Base Flow	4700 cfs	EF	91.4%	92.2%	92.5%	93.1%
		AF	65.5%	56.4%	59.7%	52.8%
		AD	7 (1, 94)	7 (1, 83)	7 (1, 110)	4 (1, 78)
		SD	4 (1, 95)	4 (1, 100)	4 (1, 101)	5 (1, 100)
		S	4297 afd	4694 afd	4731 afd	5258 afd
		PS	46.1%	50.4%	50.8%	56.4%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19F
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Dry Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 6580 Volume (af): 58500 Duration (days): 10	PF	93.8%	93.8%	93.8%	93.8%
		TEM	93.8%	93.8%	93.8%	93.8%
		FVM	93.3%	93.3%	93.3%	93.3%
		FDM	6.7%	6.7%	6.7%	6.7%
Base Flow	1250 cfs	EF	65.5%	39.5%	36.6%	31.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 111)	5 (1, 74)	3 (1, 74)	3 (1, 72)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	430 cfs	EF	31.5%	57.7%	60.0%	64.7%
		AF	78.5%	40.4%	48.0%	32.4%
		AD	4 (1, 38)	2 (1, 19)	2 (1, 18)	1 (1, 10)
		SD	3 (1, 15)	3 (1, 38)	2 (1, 20)	3 (1, 38)
		S	287 afd	515 afd	444 afd	617 afd
		PS	33.7%	60.4%	52.1%	72.4%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.9%
		ZFD	N/A	N/A	N/A	3 (1, 8)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19G
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Average Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 6580 Volume (af): 58500 Duration (days): 10	PF	100.0%	98.8%	98.8%	96.3%
		TEM	100.0%	96.3%	96.3%	88.9%
		FVM	100.0%	96.2%	95.0%	93.6%
		FDM	0.0%	3.8%	5.0%	6.4%
Base Flow	2570 cfs	EF	92.7%	92.9%	92.4%	92.6%
		AF	74.8%	56.8%	58.0%	51.7%
		AD	6 (1, 119)	5 (1, 92)	5 (1, 108)	4 (1, 106)
		SD	7 (1, 48)	6 (1, 57)	6 (1, 57)	7 (1, 59)
		S	1587 afd	2820 afd	2790 afd	3256 afd
		PS	31.1%	55.3%	54.7%	63.9%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	2 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19H
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Wet Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 14200 Volume (af): 184000 Duration (days): 18	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	4740 cfs	EF	93.4%	92.4%	91.9%	91.7%
		AF	91.1%	85.7%	87.0%	83.9%
		AD	14 (1, 118)	11 (1, 118)	11 (1, 118)	11 (1, 118)
		SD	4 (1, 36)	3 (1, 37)	4 (1, 36)	3 (1, 35)
		S	2341 afd	3513 afd	3099 afd	3451 afd
		PS	24.9%	37.4%	33.0%	36.7%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19I
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Dry Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2490 Volume (af): 14900 Duration (days): 6	PF	76.9%	69.2%	61.5%	61.5%
		TEM	76.9%	69.2%	61.5%	61.5%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	930 cfs	EF	47.0%	29.4%	27.1%	23.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 121)	3 (1, 41)	3 (1, 29)	3 (1, 21)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	430 cfs	EF	51.5%	69.2%	71.5%	75.1%
		AF	60.0%	19.4%	20.0%	14.4%
		AD	4 (1, 29)	2 (1, 13)	1 (1, 7)	1 (1, 5)
		SD	3 (1, 48)	4 (1, 123)	3 (1, 123)	4 (1, 122)
		S	310 afd	572 afd	585 afd	776 afd
		PS	36.4%	67.0%	68.6%	91.0%
Zero Flow	N/A	ZFF	3.9%	0.0%	0.1%	2.6%
		ZFD	31 (31, 31)	N/A	1 (1, 1)	2 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19J
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Average Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 3 Trigger (cfs): 2490 Volume (af): 14900 Duration (days): 6	PF	100.0%	95.6%	97.8%	94.4%
		TEM	100.0%	93.3%	96.7%	93.3%
		FVM	100.0%	100.0%	97.7%	95.3%
		FDM	0.0%	0.0%	2.3%	4.7%
Base Flow	1420 cfs	EF	96.0%	96.2%	95.6%	95.5%
		AF	71.4%	41.9%	43.3%	35.5%
		AD	6 (1, 120)	4 (1, 55)	3 (1, 60)	2 (1, 67)
		SD	5 (1, 45)	5 (1, 106)	5 (1, 107)	5 (1, 96)
		S	879 afd	1743 afd	1639 afd	1929 afd
		PS	31.2%	61.9%	58.2%	68.5%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	N/A	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-19K
Brazos River Basin: Brazos River at Rosharon
Attainment Metrics for Wet Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4980 Volume (af): 39100 Duration (days): 9	PF	100.0%	100.0%	100.0%	100.0%
		TEM	100.0%	100.0%	100.0%	100.0%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	2630 cfs	EF	96.8%	96.8%	96.4%	96.2%
		AF	61.4%	48.9%	53.4%	46.8%
		AD	14 (1, 87)	7 (1, 108)	6 (1, 118)	6 (1, 87)
		SD	9 (1, 87)	9 (1, 101)	5 (1, 97)	7 (1, 97)
		S	2000 afd	3028 afd	2715 afd	3248 afd
		PS	38.3%	58.0%	52.0%	62.3%
Subsistence Flow	430 cfs	EF	N/A	N/A	N/A	N/A
		AF	N/A	N/A	N/A	N/A
		AD	N/A	N/A	N/A	N/A
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-20. Trinity River Basin: West Fork Trinity River near Grand Prairie

Table C-20A
Trinity River Basin: West Fork Trinity River near Grand Prairie
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	2	0	0	196	214	272	75
Winter - All	0	3	0	0	196	219	274	78
Spring - All	12	2	0	0	432	334	398	175
Summer - All	0	4	0	0	131	177	232	53
Fall - All	0	3	0	0	108	175	228	37

Note: cfs: cubic feet per second

Table C-20B
Trinity River Basin: West Fork Trinity River near Grand Prairie
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	21 (1, 201)	43 (1, 311)	55 (1, 327)	3 (1, 130)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	2 (1, 22)	1 (1, 2)	1 (1, 1)	1 (1, 15)
	SD-POR	4 (1, 184)	1 (1, 4)	1 (1, 2)	2 (1, 255)
Zero Flow	ZFD-POR	31 (1, 184)	N/A	1 (1, 2)	1 (1, 251)

Note: N/A: not applicable

Table C-20C
Trinity River Basin: West Fork Trinity River near Grand Prairie
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 300 Volume (af): 3500 Duration (days): 4	PF	88.4%	89.3%	94.6%	79.5%
		TEM	85.7%	85.7%	92.9%	75.0%
		FVM	62.6%	37.0%	30.2%	58.4%
		FDM	37.4%	63.0%	69.8%	41.6%
Base Flow	45 cfs	EF	83.6%	93.0%	92.4%	58.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	10 (1, 88)	28 (1, 91)	32 (1, 90)	3 (1, 84)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	19 cfs	EF	10.4%	0.3%	0.2%	36.8%
		AF	60.1%	30.8%	25.0%	47.2%
		AD	2 (1, 19)	1 (1, 1)	1 (1, 1)	1 (1, 15)
		SD	2 (1, 33)	1 (1, 1)	1 (1, 2)	2 (1, 90)
		S	38 afd	31 afd	38 afd	27 afd
		PS	100.0%	83.3%	99.5%	72.5%
Zero Flow	N/A	ZFF	2.4%	0.0%	0.0%	7.1%
		ZFD	31 (31, 31)	N/A	1 (1, 1)	1 (1, 90)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-20D
Trinity River Basin: West Fork Trinity River near Grand Prairie
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1200 Volume (af): 8000 Duration (days): 8	PF	94.7%	86.8%	88.6%	86.8%
		TEM	93.0%	80.7%	84.2%	78.9%
		FVM	97.2%	94.9%	96.0%	81.8%
		FDM	2.8%	5.1%	4.0%	18.2%
Base Flow	45 cfs	EF	90.6%	92.9%	93.0%	73.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	26 (1, 92)	28 (1, 92)	28 (1, 92)	4 (1, 74)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	25 cfs	EF	3.0%	0.5%	0.3%	19.5%
		AF	62.7%	8.0%	16.7%	34.1%
		AD	2 (1, 22)	1 (1, 1)	1 (1, 1)	1 (1, 6)
		SD	3 (1, 13)	1 (1, 1)	1 (1, 1)	1 (1, 44)
		S	11 afd	42 afd	50 afd	34 afd
		PS	21.6%	85.3%	100.0%	69.3%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.2%	3.8%
		ZFD	N/A	N/A	1 (1, 1)	1 (1, 41)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-20E
Trinity River Basin: West Fork Trinity River near Grand Prairie
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 300 Volume (af): 1800 Duration (days): 3	PF	91.2%	88.6%	93.9%	84.2%
		TEM	89.5%	84.2%	93.0%	80.7%
		FVM	94.2%	83.2%	88.8%	83.3%
		FDM	5.8%	16.8%	11.2%	16.7%
Base Flow	35 cfs	EF	71.2%	95.7%	95.5%	53.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	14 (1, 90)	36 (1, 92)	70 (1, 92)	3 (1, 59)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	23 cfs	EF	25.5%	0.7%	0.4%	43.3%
		AF	12.4%	12.8%	5.3%	9.9%
		AD	1 (1, 9)	1 (1, 1)	1 (1, 1)	1 (1, 5)
		SD	6 (1, 92)	1 (1, 2)	1 (1, 2)	2 (1, 92)
		S	46 afd	35 afd	46 afd	46 afd
		PS	100.0%	77.6%	100.0%	100.0%
Zero Flow	N/A	ZFF	16.0%	0.0%	0.3%	26.2%
		ZFD	31 (2, 92)	N/A	1 (1, 2)	2 (1, 92)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-20F
Trinity River Basin: West Fork Trinity River near Grand Prairie
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 300 Volume (af): 1800 Duration (days): 3	PF	0.0%	0.0%	0.0%	0.0%
		TEM	0.0%	0.0%	0.0%	0.0%
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	35 cfs	EF	74.1%	98.9%	99.4%	50.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	20 (1, 91)	73 (1, 91)	91 (1, 91)	3 (1, 63)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	21 cfs	EF	25.7%	0.7%	0.3%	49.1%
		AF	21.3%	10.5%	11.1%	19.9%
		AD	2 (1, 17)	2 (2, 2)	1 (1, 1)	1 (1, 14)
		SD	5 (1, 91)	1 (1, 4)	1 (1, 2)	2 (1, 91)
		S	42 afd	33 afd	42 afd	42 afd
		PS	100.0%	79.4%	100.0%	100.0%
Zero Flow	N/A	ZFF	15.8%	0.0%	0.2%	24.7%
		ZFD	30 (1, 91)	N/A	1 (1, 2)	2 (1, 91)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-21. Trinity River Basin: Trinity River at Dallas

Table C-21A
Trinity River Basin: Trinity River at Dallas
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	1	0	0	449	504	663	140
Winter - All	0	3	0	0	481	514	659	145
Spring - All	7	1	0	0	1088	790	944	322
Summer - All	0	4	0	0	303	439	602	101
Fall - All	0	4	0	0	237	417	569	65

Note: cfs: cubic feet per second

Table C-21B
Trinity River Basin: Trinity River at Dallas
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	36 (1, 256)	58 (1, 415)	59 (1, 322)	5 (1, 102)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	3 (1, 36)	1 (1, 2)	1 (1, 1)	1 (1, 31)
	SD-POR	30 (1, 184)	2 (1, 8)	1 (1, 4)	2 (1, 199)
Zero Flow	ZFD-POR	31 (30, 184)	N/A	1 (1, 4)	2 (1, 185)

Note: N/A: not applicable

Table C-21C
Trinity River Basin: Trinity River at Dallas
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 700 Volume (af): 3500 Duration (days): 3	PF	94.6%	94.6%	98.2%	83.9%
		TEM	91.1%	92.9%	98.2%	80.4%
		FVM	96.2%	93.4%	97.3%	85.1%
		FDM	3.8%	6.6%	2.7%	14.9%
Base Flow	50 cfs	EF	91.0%	95.6%	95.2%	66.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	29 (1, 91)	36 (1, 91)	32 (1, 91)	4 (1, 81)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	26 cfs	EF	5.1%	0.3%	0.1%	30.2%
		AF	56.3%	0.0%	0.0%	27.8%
		AD	2 (1, 36)	N/A	N/A	1 (1, 12)
		SD	5 (1, 31)	2 (1, 5)	1 (1, 1)	2 (1, 57)
		S	52 afd	46 afd	52 afd	51 afd
		PS	100.0%	88.4%	100.0%	99.6%
Zero Flow	N/A	ZFF	1.8%	0.0%	0.1%	10.6%
		ZFD	31 (31, 31)	N/A	1 (1, 1)	2 (1, 54)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-21D
Trinity River Basin: Trinity River at Dallas
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4000 Volume (af): 40000 Duration (days): 9	PF	88.6%	82.5%	83.3%	81.6%
		TEM	84.2%	75.4%	75.4%	75.4%
		FVM	87.1%	83.0%	80.0%	65.6%
		FDM	12.9%	17.0%	20.0%	34.4%
Base Flow	70 cfs	EF	90.1%	90.9%	90.5%	70.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	36 (1, 92)	30 (1, 92)	30 (1, 92)	5 (1, 73)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	37 cfs	EF	1.9%	0.4%	0.2%	21.2%
		AF	53.0%	4.8%	7.7%	22.1%
		AD	3 (1, 23)	1 (1, 1)	1 (1, 1)	1 (1, 7)
		SD	2 (1, 31)	2 (1, 5)	2 (1, 3)	2 (1, 60)
		S	30 afd	67 afd	73 afd	73 afd
		PS	40.5%	91.6%	100.0%	100.0%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.2%	10.0%
		ZFD	N/A	N/A	2 (1, 3)	2 (1, 59)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-21E
Trinity River Basin: Trinity River at Dallas
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1000 Volume (af): 8500 Duration (days): 5	PF	87.7%	86.0%	88.6%	82.5%
		TEM	87.7%	84.2%	86.0%	78.9%
		FVM	89.0%	87.8%	92.1%	79.8%
		FDM	11.0%	12.2%	7.9%	20.2%
Base Flow	40 cfs	EF	76.1%	95.1%	94.9%	59.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	26 (1, 90)	62 (1, 92)	73 (1, 92)	5 (1, 85)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	22 cfs	EF	19.4%	0.6%	0.2%	36.6%
		AF	15.1%	25.0%	33.3%	12.1%
		AD	2 (1, 31)	1 (1, 2)	1 (1, 1)	1 (1, 31)
		SD	31 (1, 62)	1 (1, 8)	1 (1, 4)	2 (1, 90)
		S	44 afd	35 afd	44 afd	44 afd
		PS	100.0%	80.5%	100.0%	100.0%
Zero Flow	N/A	ZFF	13.6%	0.0%	0.1%	27.1%
		ZFD	31 (31, 62)	N/A	1 (1, 4)	2 (1, 89)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-21F
Trinity River Basin: Trinity River at Dallas
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1000 Volume (af): 8500 Duration (days): 5	PF	0.0%	0.0%	0.0%	0.0%
		TEM	0.0%	0.0%	0.0%	0.0%
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	50 cfs	EF	78.5%	98.9%	99.4%	53.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	30 (1, 91)	73 (1, 91)	91 (2, 91)	5 (1, 75)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	15 cfs	EF	21.0%	0.5%	0.1%	45.8%
		AF	30.6%	33.3%	33.3%	26.5%
		AD	4 (1, 35)	1 (1, 1)	1 (1, 1)	1 (1, 26)
		SD	30 (1, 91)	1 (1, 4)	1 (1, 1)	2 (1, 91)
		S	30 afd	21 afd	28 afd	30 afd
		PS	100.0%	71.1%	95.1%	100.0%
Zero Flow	N/A	ZFF	13.4%	0.0%	0.0%	28.4%
		ZFD	30 (30, 91)	N/A	1 (1, 1)	2 (1, 91)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-22. Trinity River Basin: Trinity River near Oakwood

Table C-22A
Trinity River Basin: Trinity River near Oakwood
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	1806	1568	1847	978
Winter - All	0	0	0	0	2235	1717	2043	1157
Spring - All	104	0	0	0	4611	3438	3717	2505
Summer - All	0	0	0	0	1051	1155	1461	601
Fall - All	0	0	0	0	871	990	1264	443

Note: cfs: cubic feet per second

Table C-22B
Trinity River Basin: Trinity River near Oakwood
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	38 (1, 274)	50 (1, 294)	63 (1, 455)	9 (1, 120)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	8 (1, 63)	1 (1, 3)	1 (1, 2)	2 (1, 59)
	SD-POR	25 (1, 153)	2 (1, 18)	1 (1, 11)	2 (1, 154)
Zero Flow	ZFD-POR	31 (3, 153)	2 (1, 3)	2 (1, 11)	1 (1, 59)

Note: N/A: not applicable

Table C-22C
Trinity River Basin: Trinity River near Oakwood
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 3000 Volume (af): 18000 Duration (days): 5	PF	89.3%	87.5%	87.5%	84.8%
		TEM	89.3%	85.7%	85.7%	83.9%
		FVM	100.0%	100.0%	100.0%	100.0%
		FDM	0.0%	0.0%	0.0%	0.0%
Base Flow	340 cfs	EF	86.2%	94.0%	95.0%	70.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	23 (1, 91)	31 (1, 91)	40 (1, 91)	8 (1, 88)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	120 cfs	EF	10.0%	1.9%	0.7%	25.6%
		AF	82.5%	49.0%	25.0%	63.2%
		AD	6 (1, 53)	1 (1, 3)	1 (1, 2)	2 (1, 29)
		SD	11 (1, 31)	2 (1, 18)	1 (1, 11)	2 (1, 59)
		S	93 afd	230 afd	238 afd	135 afd
		PS	39.2%	96.8%	100.0%	56.9%
Zero Flow	N/A	ZFF	0.7%	0.1%	0.3%	2.3%
		ZFD	17 (3, 31)	2 (1, 2)	1 (1, 11)	2 (1, 59)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-22D
Trinity River Basin: Trinity River near Oakwood
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 7000 Volume (af): 130000 Duration (days): 11	PF	89.5%	83.3%	84.2%	82.5%
		TEM	87.7%	78.9%	80.7%	77.2%
		FVM	86.3%	83.2%	83.3%	78.7%
		FDM	13.7%	16.8%	16.7%	21.3%
Base Flow	450 cfs	EF	84.4%	87.6%	87.5%	74.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	38 (1, 92)	32 (1, 92)	40 (1, 92)	10 (1, 86)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	160 cfs	EF	3.5%	0.4%	0.2%	12.9%
		AF	87.4%	42.9%	30.8%	59.0%
		AD	8 (4, 31)	1 (1, 2)	1 (1, 1)	2 (1, 21)
		SD	23 (23, 23)	2 (1, 3)	2 (1, 2)	1 (1, 39)
		S	70 afd	316 afd	317 afd	228 afd
		PS	22.0%	99.6%	100.0%	71.8%
Zero Flow	N/A	ZFF	0.0%	0.1%	0.1%	1.2%
		ZFD	N/A	2 (1, 3)	1 (1, 2)	1 (1, 13)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-22E
Trinity River Basin: Trinity River near Oakwood
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 2500 Volume (af): 23000 Duration (days): 5	PF	85.1%	86.0%	88.6%	80.7%
		TEM	84.2%	82.5%	86.0%	78.9%
		FVM	92.8%	91.8%	94.1%	93.5%
		FDM	7.2%	8.2%	5.9%	6.5%
Base Flow	250 cfs	EF	73.7%	95.3%	95.1%	63.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	30 (1, 91)	75 (1, 92)	76 (1, 92)	7 (1, 89)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	75 cfs	EF	22.1%	0.2%	0.2%	32.7%
		AF	45.1%	81.8%	54.5%	46.7%
		AD	9 (1, 50)	1 (1, 1)	1 (1, 2)	2 (1, 49)
		SD	31 (5, 62)	1 (1, 1)	1 (1, 2)	2 (1, 62)
		S	130 afd	144 afd	145 afd	148 afd
		PS	87.2%	96.9%	97.4%	99.7%
Zero Flow	N/A	ZFF	5.3%	0.0%	0.0%	2.4%
		ZFD	31 (31, 62)	1 (1, 1)	2 (2, 2)	2 (1, 21)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-22F
Trinity River Basin: Trinity River near Oakwood
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 2500 Volume (af): 23000 Duration (days): 5	PF	0.0%	0.0%	0.0%	0.0%
		TEM	0.0%	0.0%	0.0%	0.0%
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	260 cfs	EF	74.6%	98.5%	98.6%	60.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	30 (1, 91)	62 (1, 91)	62 (1, 91)	9 (1, 88)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	100 cfs	EF	24.7%	0.7%	0.6%	38.6%
		AF	43.3%	32.4%	38.7%	33.8%
		AD	7 (1, 37)	1 (1, 2)	1 (1, 1)	2 (1, 24)
		SD	24 (1, 91)	2 (1, 4)	1 (1, 4)	2 (1, 91)
		S	186 afd	191 afd	196 afd	198 afd
		PS	93.6%	96.1%	99.0%	99.7%
Zero Flow	N/A	ZFF	6.4%	0.1%	0.2%	2.3%
		ZFD	30 (30, 91)	2 (1, 2)	3 (2, 4)	1 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-23. Trinity River Basin: Trinity River near Romayor

Table C-23A
Trinity River Basin: Trinity River near Romayor
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	3512	2666	2848	2040
Winter - All	117	1	0	0	5258	4207	4603	1827
Spring - All	299	1	0	0	8465	6349	6594	3911
Summer - All	0	4	0	0	2032	1966	1889	2301
Fall - All	0	0	0	0	1560	1389	1293	1418

Note: cfs: cubic feet per second

Table C-23B
Trinity River Basin: Trinity River near Romayor
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	20 (1, 303)	7 (1, 217)	6 (1, 218)	6 (1, 187)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	4 (1, 67)	1 (1, 12)	1 (1, 26)	1 (1, 26)
	SD-POR	3 (1, 123)	1 (1, 9)	2 (1, 30)	2 (1, 89)
Zero Flow	ZFD-POR	31 (30, 92)	1 (1, 1)	1 (1, 6)	1 (1, 5)

Note: N/A: not applicable

Table C-23C
Trinity River Basin: Trinity River near Romayor
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 8000 Volume (af): 80000 Duration (days): 7	PF	81.2%	80.4%	80.4%	72.3%
		TEM	78.6%	78.6%	78.6%	69.6%
		FVM	90.1%	91.1%	90.0%	79.0%
		FDM	9.9%	8.9%	10.0%	21.0%
Base Flow	875 cfs	EF	80.7%	80.9%	83.0%	75.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	13 (1, 90)	3 (1, 90)	15 (1, 90)	4 (1, 85)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	495 cfs	EF	11.9%	11.6%	9.4%	18.1%
		AF	72.7%	67.3%	21.9%	36.1%
		AD	3 (1, 49)	1 (1, 12)	1 (1, 8)	1 (1, 7)
		SD	3 (1, 49)	1 (1, 6)	3 (1, 30)	2 (1, 33)
		S	206 afd	449 afd	666 afd	813 afd
		PS	21.0%	45.7%	67.8%	82.8%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.1%	0.3%
		ZFD	N/A	N/A	2 (1, 3)	1 (1, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-23D
Trinity River Basin: Trinity River near Romayor
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 10000 Volume (af): 150000 Duration (days): 9	PF	92.1%	90.4%	90.4%	82.5%
		TEM	89.5%	87.7%	87.7%	78.9%
		FVM	89.5%	84.5%	85.4%	77.7%
		FDM	10.5%	15.5%	14.6%	22.3%
Base Flow	1150 cfs	EF	83.7%	80.4%	81.5%	69.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	28 (1, 87)	7 (1, 87)	12 (1, 87)	4 (1, 81)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	700 cfs	EF	5.3%	8.4%	7.2%	19.4%
		AF	60.6%	57.5%	56.4%	49.1%
		AD	2 (1, 14)	1 (1, 10)	1 (1, 26)	1 (1, 26)
		SD	2 (1, 20)	1 (1, 9)	2 (1, 14)	2 (1, 7)
		S	259 afd	340 afd	629 afd	1064 afd
		PS	18.6%	24.5%	45.3%	76.7%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.1%	1.0%
		ZFD	N/A	N/A	1 (1, 2)	1 (1, 4)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-23E
Trinity River Basin: Trinity River near Romayor
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4000 Volume (af): 60000 Duration (days): 5	PF	85.1%	86.0%	84.2%	85.1%
		TEM	82.5%	84.2%	84.2%	78.9%
		FVM	82.5%	74.5%	74.0%	57.7%
		FDM	17.5%	25.5%	26.0%	42.3%
Base Flow	575 cfs	EF	70.3%	91.6%	89.3%	89.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	16 (1, 90)	26 (1, 92)	17 (1, 90)	10 (1, 92)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	200 cfs	EF	23.9%	2.3%	4.7%	4.2%
		AF	65.4%	61.0%	60.6%	27.5%
		AD	6 (1, 46)	1 (1, 3)	1 (1, 7)	1 (1, 4)
		SD	3 (1, 62)	1 (1, 4)	1 (1, 4)	1 (1, 22)
		S	193 afd	322 afd	339 afd	396 afd
		PS	48.6%	81.2%	85.5%	99.7%
Zero Flow	N/A	ZFF	1.2%	0.0%	0.1%	0.6%
		ZFD	62 (62, 62)	N/A	1 (1, 1)	2 (1, 4)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-23F
Trinity River Basin: Trinity River near Romayor
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 4000 Volume (af): 60000 Duration (days): 5	PF	0.0%	0.0%	0.0%	0.0%
		TEM	0.0%	0.0%	0.0%	0.0%
		FVM	N/A	N/A	N/A	N/A
		FDM	N/A	N/A	N/A	N/A
Base Flow	625 cfs	EF	72.3%	89.9%	72.0%	86.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	11 (1, 91)	9 (1, 91)	2 (1, 91)	7 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	230 cfs	EF	26.5%	9.5%	27.2%	13.2%
		AF	57.8%	74.1%	69.3%	36.9%
		AD	4 (1, 61)	1 (1, 10)	1 (1, 21)	1 (1, 6)
		SD	7 (1, 66)	1 (1, 8)	2 (1, 17)	2 (1, 67)
		S	262 afd	441 afd	337 afd	423 afd
		PS	57.5%	96.6%	73.8%	92.7%
Zero Flow	N/A	ZFF	2.9%	0.0%	0.6%	0.5%
		ZFD	30 (30, 31)	1 (1, 1)	1 (1, 6)	1 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-24. Neches River Basin: Neches River at Neches

Table C-24A
Neches River Basin: Neches River at Neches
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	289	184	106	85
Winter - All	1	0	0	0	760	699	439	242
Spring - All	0	0	0	0	530	458	313	166
Summer - All	0	0	0	0	47	13	33	50
Fall - All	0	0	0	0	211	100	67	58

Note: cfs: cubic feet per second

Table C-24B
Neches River Basin: Neches River at Neches
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	4 (1, 175)	2 (1, 127)	2 (1, 106)	2 (1, 94)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	1 (1, 111)	1 (1, 89)	2 (1, 92)	2 (1, 89)
	SD-POR	1 (1, 135)	2 (1, 202)	1 (1, 31)	2 (1, 161)
Zero Flow	ZFD-POR	6 (1, 97)	1 (1, 19)	1 (1, 5)	1 (1, 92)

Note: N/A: not applicable

Table C-24C
Neches River Basin: Neches River at Neches
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 833 Volume (af): 19104 Duration (days): 10	PF	89.5%	82.5%	78.9%	77.2%
		TEM	89.5%	82.5%	78.9%	77.2%
		FVM	56.9%	55.3%	51.1%	45.5%
		FDM	43.1%	44.7%	48.9%	54.5%
Base Flow	196 cfs	EF	83.0%	73.0%	59.1%	49.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 88)	3 (1, 88)	2 (1, 88)	2 (1, 85)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	51 cfs	EF	9.1%	20.4%	34.5%	44.3%
		AF	87.0%	65.7%	59.1%	52.8%
		AD	1 (1, 35)	1 (1, 89)	1 (1, 89)	1 (1, 89)
		SD	1 (1, 7)	1 (1, 31)	1 (1, 31)	2 (1, 31)
		S	32 afd	85 afd	82 afd	58 afd
		PS	31.8%	84.4%	80.7%	57.5%
Zero Flow	N/A	ZFF	0.0%	2.4%	3.5%	4.7%
		ZFD	N/A	1 (1, 4)	1 (1, 3)	1 (1, 5)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-24D
Neches River Basin: Neches River at Neches
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 820 Volume (af): 20405 Duration (days): 12	PF	89.5%	87.7%	86.8%	85.1%
		TEM	87.7%	86.0%	86.0%	82.5%
		FVM	71.6%	76.0%	68.7%	53.6%
		FDM	28.4%	24.0%	31.3%	46.4%
Base Flow	96 cfs	EF	73.5%	63.5%	56.1%	49.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	5 (1, 91)	3 (1, 89)	2 (1, 84)	2 (1, 79)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	21 cfs	EF	11.7%	23.0%	30.7%	36.4%
		AF	79.6%	55.1%	63.9%	74.4%
		AD	1 (1, 30)	1 (1, 20)	1 (1, 31)	2 (1, 30)
		SD	1 (1, 8)	1 (1, 30)	1 (1, 14)	1 (1, 17)
		S	23 afd	41 afd	31 afd	42 afd
		PS	54.4%	99.3%	74.3%	100.0%
Zero Flow	N/A	ZFF	0.0%	4.1%	4.1%	5.1%
		ZFD	N/A	1 (1, 5)	1 (1, 4)	1 (1, 15)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-24E
Neches River Basin: Neches River at Neches
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 113 Volume (af): 1339 Duration (days): 4	PF	91.2%	73.7%	78.9%	89.5%
		TEM	91.2%	73.7%	78.9%	89.5%
		FVM	61.5%	54.8%	46.7%	39.2%
		FDM	38.5%	45.2%	53.3%	60.8%
Base Flow	46 cfs	EF	46.6%	24.7%	32.2%	65.2%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	3 (1, 88)	2 (1, 87)	2 (1, 88)	4 (1, 83)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	12 cfs	EF	49.5%	72.5%	64.8%	31.1%
		AF	48.0%	33.6%	87.3%	81.4%
		AD	2 (1, 66)	1 (1, 37)	2 (1, 61)	2 (1, 29)
		SD	2 (1, 92)	2 (1, 92)	1 (1, 11)	1 (1, 81)
		S	23 afd	21 afd	13 afd	24 afd
		PS	95.4%	87.8%	53.8%	100.0%
Zero Flow	N/A	ZFF	11.5%	9.7%	2.5%	3.5%
		ZFD	6 (1, 92)	1 (1, 10)	1 (1, 4)	1 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-24F
Neches River Basin: Neches River at Neches
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 345 Volume (af): 5391 Duration (days): 8	PF	87.7%	82.5%	78.9%	78.9%
		TEM	84.2%	80.7%	75.4%	75.4%
		FVM	64.0%	56.4%	45.6%	45.6%
		FDM	36.0%	43.6%	54.4%	54.4%
Base Flow	80 cfs	EF	61.9%	44.9%	38.6%	35.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 83)	2 (1, 82)	2 (1, 67)	2 (1, 67)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	13 cfs	EF	27.4%	46.2%	52.5%	55.6%
		AF	67.2%	42.5%	77.8%	77.3%
		AD	2 (1, 57)	1 (1, 44)	2 (1, 92)	2 (1, 80)
		SD	1 (1, 41)	2 (1, 80)	1 (1, 6)	2 (1, 80)
		S	22 afd	26 afd	21 afd	26 afd
		PS	84.1%	98.8%	81.8%	100.0%
Zero Flow	N/A	ZFF	2.7%	10.8%	4.0%	7.1%
		ZFD	5 (1, 31)	1 (1, 19)	1 (1, 5)	1 (1, 31)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-25. Neches River Basin: Neches River near Rockland

Table C-25A
Neches River Basin: Neches River near Rockland
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	952	834	716	578
Winter - All	20	0	0	0	2690	2611	2401	2014
Spring - All	2	0	0	0	2134	2068	1907	1519
Summer - All	0	0	0	0	193	149	163	120
Fall - All	0	0	0	0	479	382	343	267

Note: cfs: cubic feet per second

Table C-25B
Neches River Basin: Neches River near Rockland
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	4 (1, 183)	4 (1, 129)	4 (1, 183)	4 (1, 127)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	2 (1, 62)	2 (1, 64)	2 (1, 139)	1 (1, 61)
	SD-POR	1 (1, 105)	1 (1, 55)	1 (1, 38)	2 (1, 106)
Zero Flow	ZFD-POR	29 (1, 61)	1 (1, 30)	1 (1, 5)	1 (1, 61)

Note: N/A: not applicable

Table C-25C
Neches River Basin: Neches River near Rockland
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 3080 Volume (af): 82195 Duration (days): 14	PF	89.5%	89.5%	89.5%	89.5%
		TEM	89.5%	89.5%	89.5%	89.5%
		FVM	72.5%	68.6%	60.8%	58.8%
		FDM	27.5%	31.4%	39.2%	41.2%
Base Flow	603 cfs	EF	77.1%	74.2%	69.9%	66.1%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 88)	6 (1, 88)	4 (1, 88)	5 (1, 87)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	67 cfs	EF	12.7%	15.7%	20.0%	23.9%
		AF	97.1%	90.6%	88.5%	76.3%
		AD	2 (1, 39)	2 (1, 60)	2 (1, 60)	2 (1, 61)
		SD	1 (1, 6)	1 (1, 21)	1 (1, 10)	1 (1, 26)
		S	14 afd	109 afd	74 afd	133 afd
		PS	10.5%	81.9%	55.9%	99.8%
Zero Flow	N/A	ZFF	0.0%	0.1%	0.2%	1.4%
		ZFD	N/A	1 (1, 3)	1 (1, 5)	1 (1, 10)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-25D
Neches River Basin: Neches River near Rockland
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1720 Volume (af): 39935 Duration (days): 12	PF	96.5%	95.6%	95.6%	94.7%
		TEM	96.5%	94.7%	94.7%	93.0%
		FVM	86.4%	84.4%	83.5%	78.7%
		FDM	13.6%	15.6%	16.5%	21.3%
Base Flow	420 cfs	EF	73.2%	69.5%	67.0%	62.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	6 (1, 89)	6 (1, 89)	5 (1, 89)	5 (1, 87)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	29 cfs	EF	12.5%	16.4%	18.9%	23.1%
		AF	97.5%	87.2%	89.8%	69.0%
		AD	2 (1, 44)	2 (1, 31)	2 (1, 45)	2 (1, 45)
		SD	1 (1, 4)	1 (1, 7)	1 (1, 5)	2 (1, 27)
		S	26 afd	50 afd	35 afd	57 afd
		PS	45.2%	87.7%	60.5%	99.0%
Zero Flow	N/A	ZFF	0.0%	0.6%	0.0%	0.0%
		ZFD	N/A	1 (1, 6)	N/A	1 (1, 1)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-25E
Neches River Basin: Neches River near Rockland
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 195 Volume (af): 1548 Duration (days): 5	PF	94.7%	94.7%	94.7%	94.7%
		TEM	94.7%	94.7%	94.7%	94.7%
		FVM	94.4%	88.9%	96.3%	87.0%
		FDM	5.6%	11.1%	3.7%	13.0%
Base Flow	67 cfs	EF	72.3%	68.1%	76.5%	60.9%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 91)	3 (1, 91)	4 (1, 91)	3 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	21 cfs	EF	25.6%	29.7%	21.1%	36.7%
		AF	56.7%	60.0%	88.8%	40.8%
		AD	1 (1, 33)	2 (1, 48)	1 (1, 61)	1 (1, 39)
		SD	1 (1, 61)	1 (1, 55)	1 (1, 8)	2 (1, 61)
		S	32 afd	17 afd	32 afd	41 afd
		PS	77.0%	39.8%	77.6%	97.6%
Zero Flow	N/A	ZFF	3.0%	1.3%	0.0%	2.4%
		ZFD	29 (1, 31)	1 (1, 10)	N/A	1 (1, 30)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-25F
Neches River Basin: Neches River near Rockland
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 515 Volume (af): 8172 Duration (days): 8	PF	92.1%	90.4%	91.2%	89.5%
		TEM	91.2%	89.5%	91.2%	87.7%
		FVM	69.5%	69.9%	66.3%	71.6%
		FDM	30.5%	30.1%	33.7%	28.4%
Base Flow	90 cfs	EF	72.5%	66.2%	68.1%	58.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	4 (1, 92)	4 (1, 90)	4 (1, 92)	3 (1, 90)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	21 cfs	EF	17.0%	23.5%	20.9%	31.7%
		AF	68.1%	58.0%	84.4%	39.8%
		AD	2 (1, 45)	2 (1, 46)	2 (1, 78)	1 (1, 40)
		SD	1 (1, 44)	1 (1, 44)	1 (1, 38)	2 (1, 45)
		S	37 afd	23 afd	38 afd	41 afd
		PS	88.8%	54.9%	91.8%	98.6%
Zero Flow	N/A	ZFF	1.7%	1.9%	0.1%	3.1%
		ZFD	27 (6, 31)	2 (1, 30)	2 (1, 3)	2 (1, 35)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-26. Neches River Basin: Angelina River near Alto

Table C-26A
Neches River Basin: Angelina River near Alto
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	0	0	0	0	370	317	263	233
Winter - All	30	0	17	0	1015	947	806	690
Spring - All	18	9	17	0	698	647	544	464
Summer - All	0	0	0	0	85	80	77	54
Fall - All	0	0	0	0	235	197	160	138

Note: cfs: cubic feet per second

Table C-26B
Neches River Basin: Angelina River near Alto
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	30 (1, 194)	24 (1, 193)	16 (1, 184)	13 (1, 194)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	6 (1, 96)	6 (1, 112)	4 (1, 182)	6 (1, 86)
	SD-POR	8 (1, 153)	2 (1, 35)	4 (1, 22)	4 (1, 153)
Zero Flow	ZFD-POR	5 (1, 94)	2 (1, 4)	4 (4, 4)	5 (1, 94)

Note: N/A: not applicable

Table C-26C
Neches River Basin: Angelina River near Alto
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1620 Volume (af): 37114 Duration (days): 13	PF	77.2%	75.4%	73.7%	70.2%
		TEM	77.2%	75.4%	73.7%	70.2%
		FVM	88.6%	83.7%	81.0%	77.5%
		FDM	11.4%	16.3%	19.0%	22.5%
Base Flow	277 cfs	EF	82.0%	77.8%	72.9%	70.3%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	23 (1, 90)	19 (1, 88)	14 (1, 88)	14 (1, 86)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	55 cfs	EF	10.5%	14.3%	19.3%	22.5%
		AF	95.4%	95.1%	96.7%	94.1%
		AD	5 (1, 53)	7 (1, 85)	6 (1, 85)	8 (1, 86)
		SD	25 (25, 25)	2 (2, 25)	4 (2, 22)	3 (1, 27)
		S	45 afd	31 afd	24 afd	40 afd
		PS	41.5%	28.9%	22.5%	36.5%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.1%
		ZFD	N/A	2 (2, 2)	N/A	2 (2, 3)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-26D
Neches River Basin: Angelina River near Alto
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1100 Volume (af): 24117 Duration (days): 14	PF	86.8%	84.2%	82.5%	77.2%
		TEM	86.0%	82.5%	77.2%	71.9%
		FVM	88.9%	85.4%	83.0%	84.1%
		FDM	11.1%	14.6%	17.0%	15.9%
Base Flow	90 cfs	EF	79.4%	79.3%	78.8%	75.5%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	31 (1, 89)	24 (1, 89)	18 (1, 87)	17 (1, 86)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	18 cfs	EF	6.2%	6.5%	7.8%	11.8%
		AF	99.7%	99.1%	99.8%	97.7%
		AD	6 (1, 30)	6 (1, 35)	5 (1, 32)	6 (1, 35)
		SD	1 (1, 1)	2 (1, 2)	1 (1, 1)	2 (1, 6)
		S	1 afd	10 afd	2 afd	36 afd
		PS	2.0%	27.5%	4.5%	100.0%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.2%
		ZFD	N/A	N/A	N/A	4 (2, 6)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-26E
Neches River Basin: Angelina River near Alto
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 146 Volume (af): 2632 Duration (days): 8	PF	75.4%	75.4%	75.4%	75.4%
		TEM	75.4%	75.4%	75.4%	75.4%
		FVM	83.7%	83.7%	81.4%	79.1%
		FDM	16.3%	16.3%	18.6%	20.9%
Base Flow	40 cfs	EF	65.4%	71.1%	79.2%	56.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	18 (1, 91)	16 (1, 92)	9 (1, 92)	8 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	11 cfs	EF	31.2%	25.6%	17.1%	39.5%
		AF	65.7%	99.0%	99.4%	67.2%
		AD	9 (1, 92)	7 (1, 92)	2 (1, 92)	5 (1, 68)
		SD	10 (1, 92)	2 (1, 3)	5 (5, 5)	4 (1, 92)
		S	8 afd	14 afd	22 afd	8 afd
		PS	37.2%	64.7%	100.0%	37.6%
Zero Flow	N/A	ZFF	2.3%	0.0%	0.1%	3.1%
		ZFD	30 (30, 61)	2 (2, 2)	4 (4, 4)	10 (1, 61)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-26F
Neches River Basin: Angelina River near Alto
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 588 Volume (af): 12038 Duration (days): 12	PF	75.4%	71.9%	64.0%	60.5%
		TEM	70.2%	66.7%	57.9%	56.1%
		FVM	74.4%	68.3%	76.7%	78.3%
		FDM	25.6%	31.7%	23.3%	21.7%
Base Flow	52 cfs	EF	69.4%	70.8%	72.5%	62.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	22 (1, 92)	16 (1, 92)	17 (1, 92)	12 (1, 92)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	16 cfs	EF	18.0%	17.6%	16.9%	27.4%
		AF	67.8%	84.2%	99.4%	65.0%
		AD	6 (1, 52)	4 (1, 62)	8 (1, 83)	4 (1, 54)
		SD	8 (1, 61)	4 (1, 35)	2 (1, 4)	6 (1, 61)
		S	24 afd	2 afd	32 afd	25 afd
		PS	75.7%	4.9%	100.0%	78.2%
Zero Flow	N/A	ZFF	1.4%	0.1%	0.1%	3.6%
		ZFD	5 (1, 33)	1 (1, 4)	4 (4, 4)	6 (1, 38)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-27. Neches River Basin: Neches River at Evadale

Table C-27A
Neches River Basin: Neches River at Evadale
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	11	0	0	0	2949	2420	1411	964
Winter - All	221	0	0	0	7778	7475	6197	4368
Spring - All	129	0	0	0	5848	6074	4937	3254
Summer - All	11	0	0	0	819	497	408	413
Fall - All	21	0	0	0	1509	903	445	317

Note: cfs: cubic feet per second

Table C-27B
Neches River Basin: Neches River at Evadale
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	11 (1, 140)	5 (1, 106)	3 (1, 104)	2 (1, 116)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	5 (1, 62)	3 (1, 74)	2 (1, 102)	2 (1, 57)
	SD-POR	5 (1, 69)	2 (1, 102)	1 (1, 86)	2 (1, 105)
Zero Flow	ZFD-POR	N/A	1 (1, 23)	1 (1, 22)	1 (1, 19)

Note: N/A: not applicable

Table C-27C
Neches River Basin: Neches River at Evadale
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2020 Volume (af): 20920 Duration (days): 6	PF	100.0%	100.0%	100.0%	98.2%
		TEM	100.0%	100.0%	100.0%	98.2%
		FVM	94.7%	86.0%	84.2%	87.5%
		FDM	5.3%	14.0%	15.8%	12.5%
Base Flow	1925 cfs	EF	87.3%	80.6%	69.9%	61.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	49 (1, 90)	26 (1, 90)	9 (1, 90)	6 (1, 89)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	228 cfs	EF	10.0%	16.4%	27.1%	34.9%
		AF	99.4%	83.0%	71.9%	66.2%
		AD	6 (1, 43)	4 (1, 45)	3 (1, 38)	2 (1, 57)
		SD	3 (3, 3)	1 (1, 30)	1 (1, 32)	2 (1, 32)
		S	13 afd	240 afd	417 afd	402 afd
		PS	2.8%	53.1%	92.1%	88.8%
Zero Flow	N/A	ZFF	0.0%	0.3%	2.1%	1.6%
		ZFD	N/A	1 (1, 3)	1 (1, 22)	1 (1, 19)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-27D
Neches River Basin: Neches River at Evadale
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 3830 Volume (af): 68784 Duration (days): 12	PF	95.6%	93.9%	92.1%	89.5%
		TEM	93.0%	93.0%	89.5%	89.5%
		FVM	97.2%	97.2%	97.1%	95.1%
		FDM	2.8%	2.8%	2.9%	4.9%
Base Flow	1804 cfs	EF	73.4%	68.2%	59.9%	51.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	13 (1, 87)	12 (1, 88)	6 (1, 87)	3 (1, 87)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	266 cfs	EF	16.9%	22.5%	31.1%	38.4%
		AF	97.8%	94.0%	83.9%	81.4%
		AD	6 (1, 49)	6 (1, 62)	4 (1, 43)	3 (1, 53)
		SD	4 (1, 11)	1 (1, 12)	1 (1, 18)	1 (1, 14)
		S	141 afd	201 afd	312 afd	434 afd
		PS	26.7%	38.0%	59.1%	82.3%
Zero Flow	N/A	ZFF	0.0%	0.1%	0.0%	0.0%
		ZFD	N/A	1 (1, 1)	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-27E
Neches River Basin: Neches River at Evadale
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 1540 Volume (af): 21605 Duration (days): 9	PF	84.2%	80.7%	75.4%	71.9%
		TEM	84.2%	80.7%	75.4%	71.9%
		FVM	83.3%	78.3%	74.4%	68.3%
		FDM	16.7%	21.7%	25.6%	31.7%
Base Flow	580 cfs	EF	57.2%	40.9%	32.5%	34.7%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 91)	3 (1, 91)	2 (1, 65)	2 (1, 44)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	228 cfs	EF	38.7%	55.5%	64.2%	61.7%
		AF	63.4%	62.0%	60.7%	52.5%
		AD	5 (1, 62)	3 (1, 55)	2 (1, 59)	2 (1, 38)
		SD	5 (1, 42)	2 (1, 40)	1 (1, 33)	2 (1, 42)
		S	178 afd	157 afd	185 afd	217 afd
		PS	39.3%	34.8%	41.0%	48.0%
Zero Flow	N/A	ZFF	0.0%	0.6%	0.1%	0.6%
		ZFD	N/A	1 (1, 5)	1 (1, 1)	1 (1, 6)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-27F
Neches River Basin: Neches River at Evadale
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1570 Volume (af): 17815 Duration (days): 7	PF	94.7%	84.2%	78.1%	72.8%
		TEM	93.0%	78.9%	71.9%	68.4%
		FVM	91.7%	77.1%	76.4%	85.5%
		FDM	8.3%	22.9%	23.6%	14.5%
Base Flow	512 cfs	EF	70.1%	51.9%	41.8%	36.4%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	8 (1, 90)	3 (1, 89)	2 (1, 87)	2 (1, 81)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	228 cfs	EF	21.5%	40.4%	51.3%	57.7%
		AF	53.8%	28.6%	19.6%	22.3%
		AD	3 (1, 36)	2 (1, 20)	1 (1, 14)	1 (1, 18)
		SD	6 (1, 46)	2 (1, 82)	2 (1, 72)	2 (1, 82)
		S	127 afd	294 afd	311 afd	312 afd
		PS	28.1%	65.0%	68.8%	69.0%
Zero Flow	N/A	ZFF	0.0%	3.4%	1.1%	1.1%
		ZFD	N/A	1 (1, 23)	1 (1, 6)	1 (1, 10)

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

C-28. Neches River Basin: Village Creek near Kountze

Table C-28A
Neches River Basin: Village Creek near Kountze
Flow Statistics

Period	Minimum Flow (cfs)				Median Flow (cfs)			
	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Entire Period of Record	16	17	18	16	337	338	340	337
Winter - All	83	85	87	83	830	830	832	829
Spring - All	44	45	48	44	428	429	431	427
Summer - All	18	19	20	18	142	143	145	142
Fall - All	16	17	18	16	238	239	242	238

Note: cfs: cubic feet per second

Table C-28B
Neches River Basin: Village Creek near Kountze
Attainment Metrics for Entire Period of Record

Component	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Base Flow	AD-POR	20 (1, 176)	21 (1, 176)	23 (1, 176)	20 (1, 176)
	SD-POR	N/A	N/A	N/A	N/A
Subsistence Flow	AD-POR	8 (1, 75)	8 (1, 75)	7 (1, 75)	7 (1, 75)
	SD-POR	9 (1, 93)	3 (1, 86)	11 (1, 53)	3 (1, 93)
Zero Flow	ZFD-POR	N/A	N/A	N/A	N/A

Note: N/A: not applicable

Table C-28C
Neches River Basin: Village Creek near Kountze
Attainment Metrics for All Winters

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 2010 Volume (af): 36927 Duration (days): 13	PF	75.4%	75.4%	75.4%	75.4%
		TEM	75.4%	75.4%	75.4%	75.4%
		FVM	83.7%	83.7%	83.7%	83.7%
		FDM	16.3%	16.3%	16.3%	16.3%
Base Flow	264 cfs	EF	80.9%	80.9%	81.1%	80.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	19 (1, 90)	20 (1, 90)	20 (1, 90)	20 (1, 90)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	83 cfs	EF	12.4%	12.4%	12.2%	12.5%
		AF	99.7%	100.0%	100.0%	100.0%
		AD	7 (1, 43)	7 (1, 43)	7 (1, 42)	7 (1, 43)
		SD	2 (2, 2)	N/A	N/A	N/A
		S	0 afd	N/A	N/A	N/A
		PS	0.1%	N/A	N/A	N/A
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-28D
Neches River Basin: Village Creek near Kountze
Attainment Metrics for All Springs

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 1380 Volume (af): 23093 Duration (days): 13	PF	86.0%	86.0%	86.0%	86.0%
		TEM	80.7%	80.7%	80.7%	80.7%
		FVM	85.7%	85.7%	84.7%	85.7%
		FDM	14.3%	14.3%	15.3%	14.3%
Base Flow	117 cfs	EF	78.7%	78.8%	79.2%	78.6%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	25 (1, 87)	25 (1, 87)	22 (1, 87)	25 (1, 87)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	49 cfs	EF	9.0%	9.0%	8.3%	9.1%
		AF	98.7%	99.1%	99.5%	97.7%
		AD	12 (1, 28)	12 (1, 28)	12 (1, 28)	11 (1, 28)
		SD	2 (1, 3)	1 (1, 2)	1 (1, 1)	2 (1, 5)
		S	5 afd	5 afd	2 afd	2 afd
		PS	5.2%	5.1%	1.9%	2.3%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-28E
Neches River Basin: Village Creek near Kountze
Attainment Metrics for All Summers

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 1 Trigger (cfs): 341 Volume (af): 6159 Duration (days): 8	PF	82.5%	82.5%	82.5%	82.5%
		TEM	82.5%	82.5%	82.5%	82.5%
		FVM	63.8%	63.8%	63.8%	63.8%
		FDM	36.2%	36.2%	36.2%	36.2%
Base Flow	77 cfs	EF	74.1%	74.3%	76.1%	73.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	13 (1, 91)	12 (1, 91)	12 (1, 91)	13 (1, 91)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	41 cfs	EF	20.9%	20.7%	18.9%	21.1%
		AF	82.6%	83.4%	83.4%	82.3%
		AD	6 (1, 66)	5 (1, 63)	6 (1, 69)	5 (1, 66)
		SD	19 (2, 63)	18 (1, 36)	18 (2, 35)	19 (2, 63)
		S	19 afd	20 afd	15 afd	18 afd
		PS	23.2%	24.4%	18.2%	22.4%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Table C-28F
Neches River Basin: Village Creek near Kountze
Attainment Metrics for All Falls

Component	Standard	Attainment Metric	Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
High Flow Pulse	Number per season: 2 Trigger (cfs): 712 Volume (af): 11426 Duration (days): 9	PF	76.3%	76.3%	76.3%	75.4%
		TEM	71.9%	71.9%	71.9%	70.2%
		FVM	79.3%	79.3%	78.2%	80.2%
		FDM	20.7%	20.7%	21.8%	19.8%
Base Flow	98 cfs	EF	71.8%	71.9%	72.9%	71.8%
		AF	100.0%	100.0%	100.0%	100.0%
		AD	15 (1, 92)	16 (1, 92)	16 (1, 92)	15 (1, 92)
		SD	N/A	N/A	N/A	N/A
		S	N/A	N/A	N/A	N/A
		PS	N/A	N/A	N/A	N/A
Subsistence Flow	41 cfs	EF	19.9%	19.8%	18.7%	20.1%
		AF	85.6%	85.4%	88.1%	84.5%
		AD	8 (1, 62)	8 (1, 62)	8 (1, 62)	7 (1, 62)
		SD	15 (1, 67)	9 (1, 67)	9 (1, 34)	3 (1, 69)
		S	14 afd	13 afd	17 afd	12 afd
		PS	17.1%	16.5%	20.4%	15.0%
Zero Flow	N/A	ZFF	0.0%	0.0%	0.0%	0.0%
		ZFD	N/A	N/A	N/A	N/A

Notes: af: acre-feet; afd: acre-feet per day; cfs: cubic feet per second; HFP: high flow pulse; N/A: not applicable

Appendix D
Flow Duration Curves

Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains exceedance frequency plots of modeled flows (i.e., flow duration curves), as described in Section 2.5.3.2 of the main report.

This appendix contains a total of 121 distinct figures, which are arranged as follows:

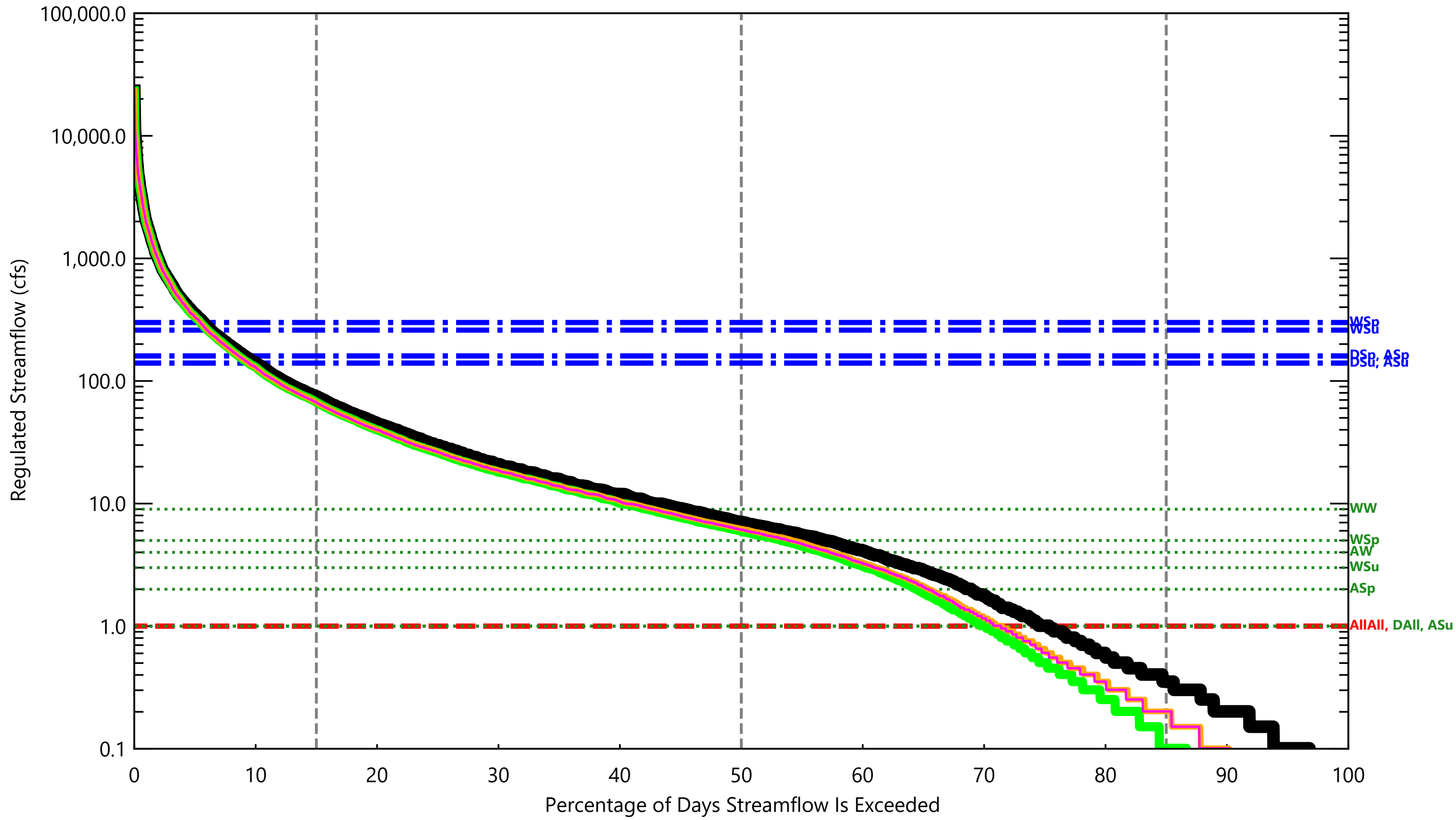
- Brazos River basin
  - Figures D-1 through D-76 contain flow duration curves for each of the 19 locations and four temporal periods (entire period of record and three seasons) in the Brazos River basin; these figures are grouped by location, and each figure contains four flow duration curves—one for each of the modeled flow scenarios.
  - Each of these figures contains horizontal reference lines corresponding to the subsistence flow, base flow, and high flow pulse (HFP) trigger values applicable to the location and temporal period of the plot, using the following line-type and color schemes:
    - Subsistence flow standards: Dashed red lines, with red labels printed to the right of each plot denoting the hydrologic condition and season corresponding to each line; in cases where the subsistence flow standard is the same for multiple hydrologic conditions and/or seasons in the plot, all applicable labels for the line are printed in a comma-separated series
    - Base flow standards: Dotted green lines, with green labels printed to the right of the plot denoting the hydrologic condition and season corresponding to each line; in cases where the base flow standard is the same for multiple hydrologic conditions and/or seasons in the plot, all applicable labels for the line are printed in a comma-separated series
    - HFP trigger standards: Dash-dotted blue lines, with blue labels printed to the right of the plot denoting the hydrologic condition and season corresponding to each line; in cases where the HFP trigger value is the same for multiple hydrologic conditions and/or seasons in the plot, all applicable labels for the line are printed in a comma-separated series

- The labeling convention for the horizontal reference lines consists of an abbreviation for the hydrologic condition, followed by an abbreviation for the season. The abbreviations used in the labeling scheme are as follows:
    - Hydrologic Condition
        - All: All hydrologic conditions (dry, average, and wet) for a particular season
        - D: Dry
        - A: Average
        - W: Wet
    - Season
        - All: All seasons (winter, spring, and summer) for a particular hydrologic condition
        - W: Winter
        - Sp: Spring
        - Su: Summer

- Trinity River basin
    - Figures D-77 through D-96 contain flow duration curves for each of the four locations and five temporal periods (entire period of record and four seasons) in the Trinity River basin; these figures are grouped by location, and each figure contains four flow duration curves—one for each of the modeled flow scenarios.
    - Each of these figures contains horizontal reference lines corresponding to the subsistence flow, base flow, and HFP trigger values applicable to the location and temporal period of the plot, using the following line-type and color schemes:
        - Subsistence flow standards: Dashed red lines, with red labels printed to the right of each plot denoting the season corresponding to each line; in cases where the subsistence flow standard is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series
        - Base flow standards: Dotted green lines, with green labels printed to the right of the plot denoting the season corresponding to each line; in cases where the base flow standard is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series
        - HFP trigger standards: Dash-dotted blue lines, with blue labels printed to the right of the plot denoting the season corresponding to each line; in cases where the HFP trigger value is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series

- The labeling convention for the horizontal reference lines consists of an abbreviation for the season. The season abbreviations used in the labeling scheme are as follows:
  - All: All seasons (winter, spring, summer, and fall)
  - W: Winter
  - Sp: Spring
  - Su: Summer
  - F: Fall

- Neches River basin
  - Figures D-97 through D-121 contain flow duration curves for each of the five locations and five temporal periods (entire period of record and four seasons) in the Neches River basin; these figures are grouped by location, and each figure contains four flow duration curves—one for each of the modeled flow scenarios.
  - Each of these figures contains horizontal reference lines corresponding to the subsistence flow, base flow, and HFP trigger values applicable to the location and temporal period of the plot, using the following line-type and color schemes:
    - Subsistence flow standards: Dashed red lines, with red labels printed to the right of each plot denoting the season corresponding to each line; in cases where the subsistence flow standard is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series
    - Base flow standards: Dotted green lines, with green labels printed to the right of the plot denoting the season corresponding to each line; in cases where the base flow standard is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series
    - HFP trigger standards: Dash-dotted blue lines, with blue labels printed to the right of the plot denoting the season corresponding to each line; in cases where the HFP trigger value is the same for multiple seasons in the plot, all applicable labels for the line are printed in a comma-separated series
  - The labeling convention for the horizontal reference lines consists of an abbreviation for the season. The season abbreviations used in the labeling scheme are as follows:
    - All: All seasons (winter, spring, summer, and fall)
    - W: Winter
    - Sp: Spring
    - Su: Summer
    - F: Fall



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario	Full Utilization Scenario	Base Flow Standard
Current Water Use Scenario	Subsistence Flow Standard	HFP Trigger Standard
Partial Utilization Scenario		

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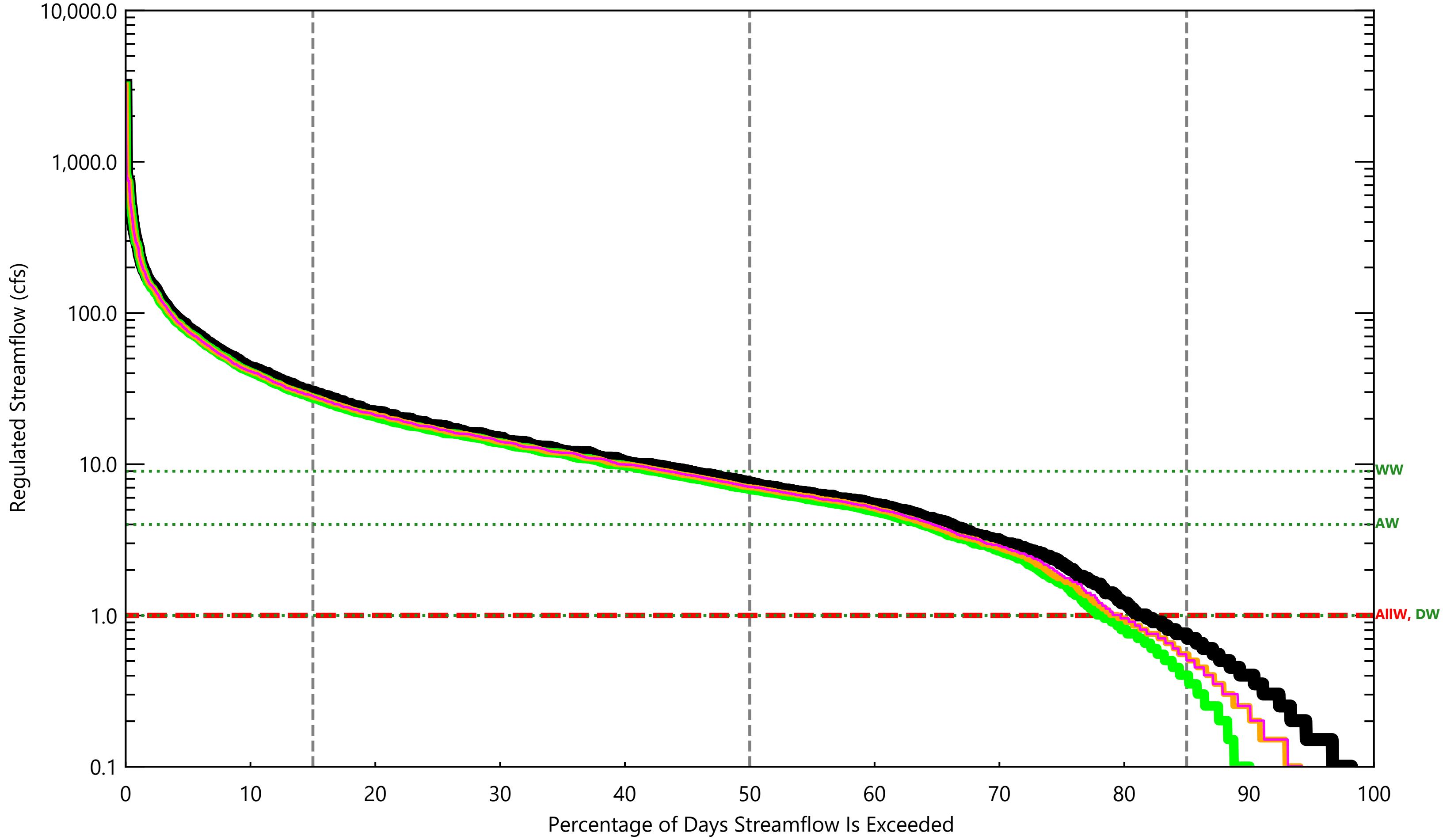
Figure D-1
Salt Fork near Aspermont
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard

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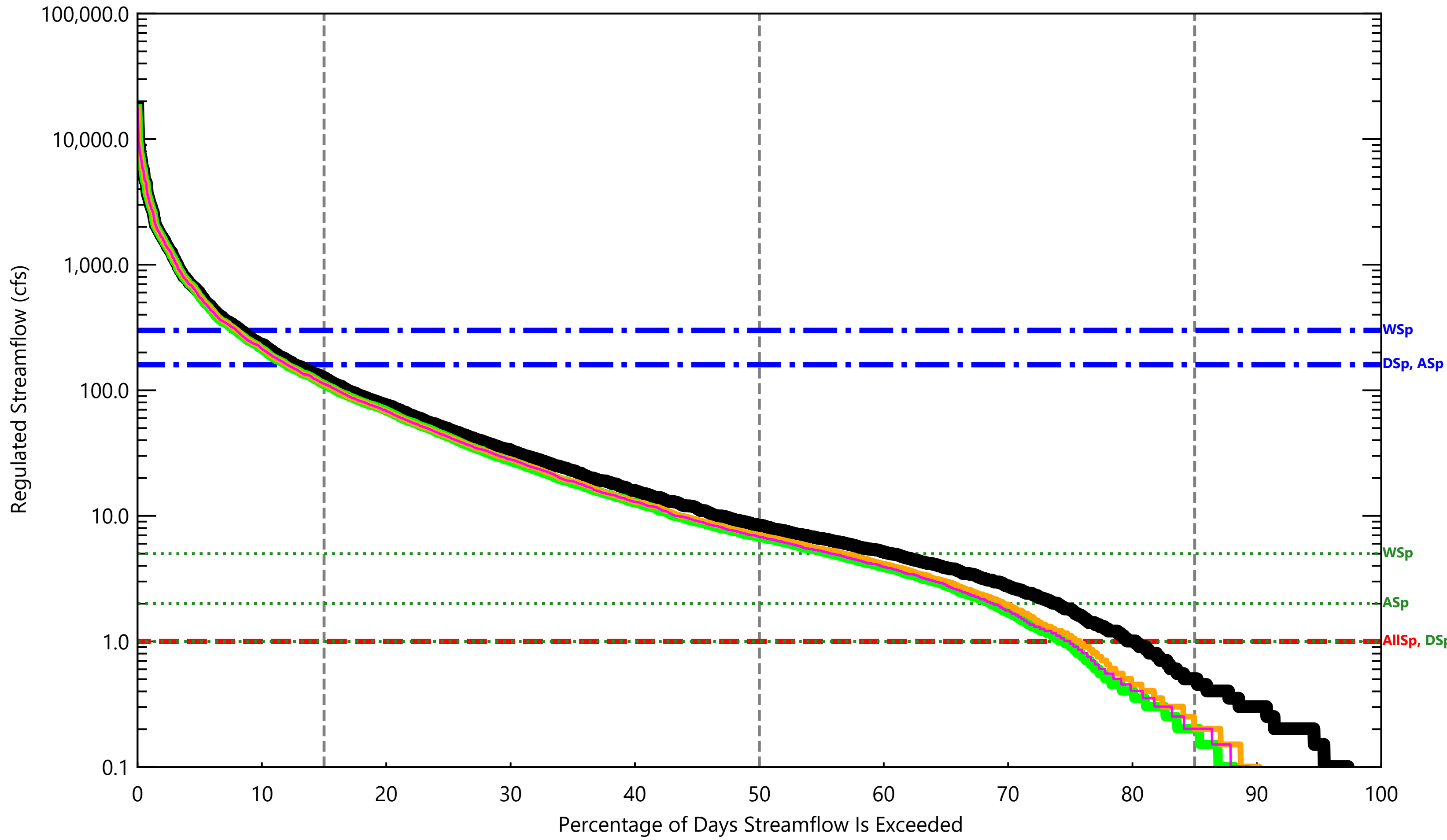
Figure D-2
Salt Fork near Aspermont
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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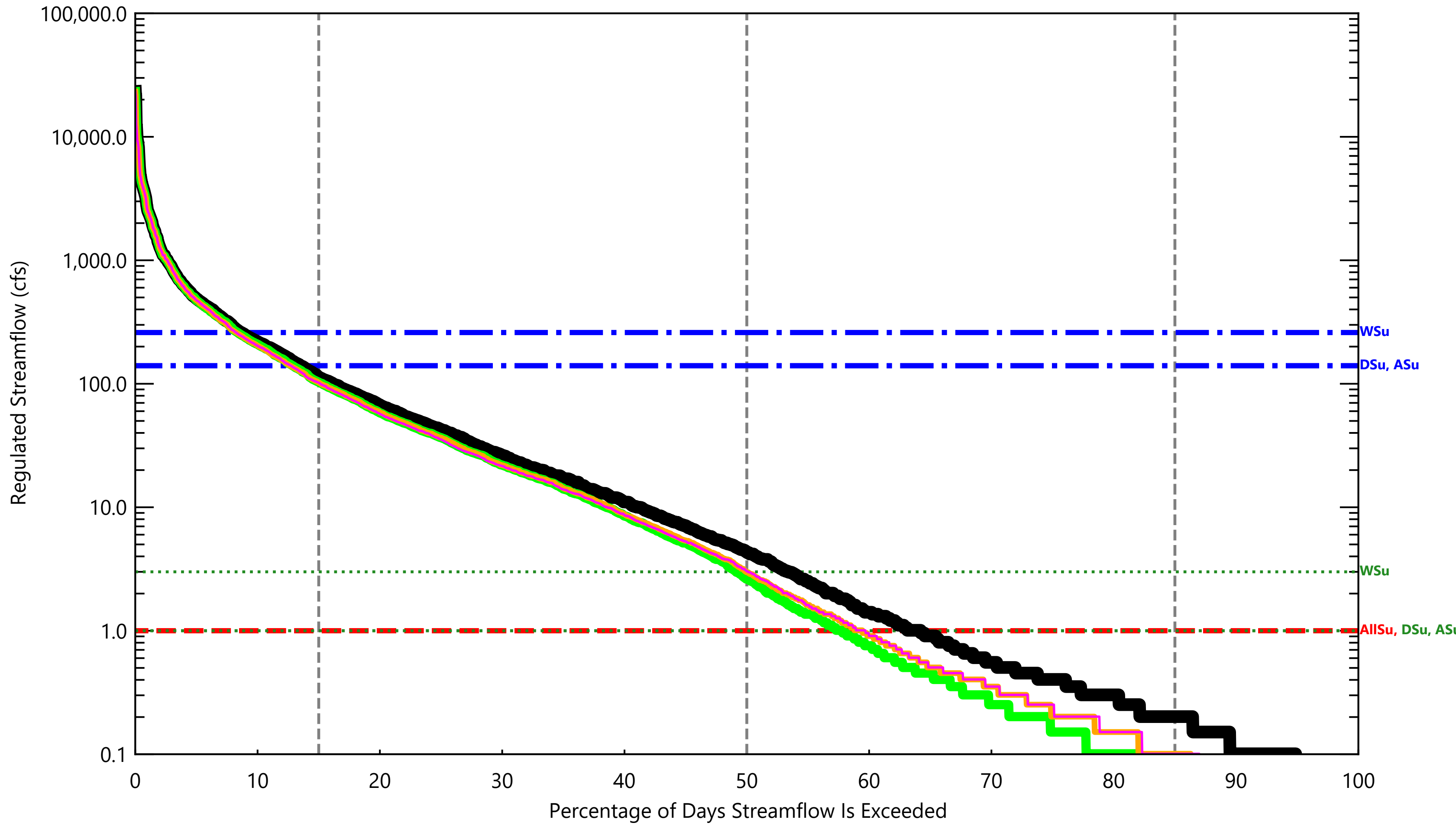
Figure D-3
Salt Fork near Aspermont
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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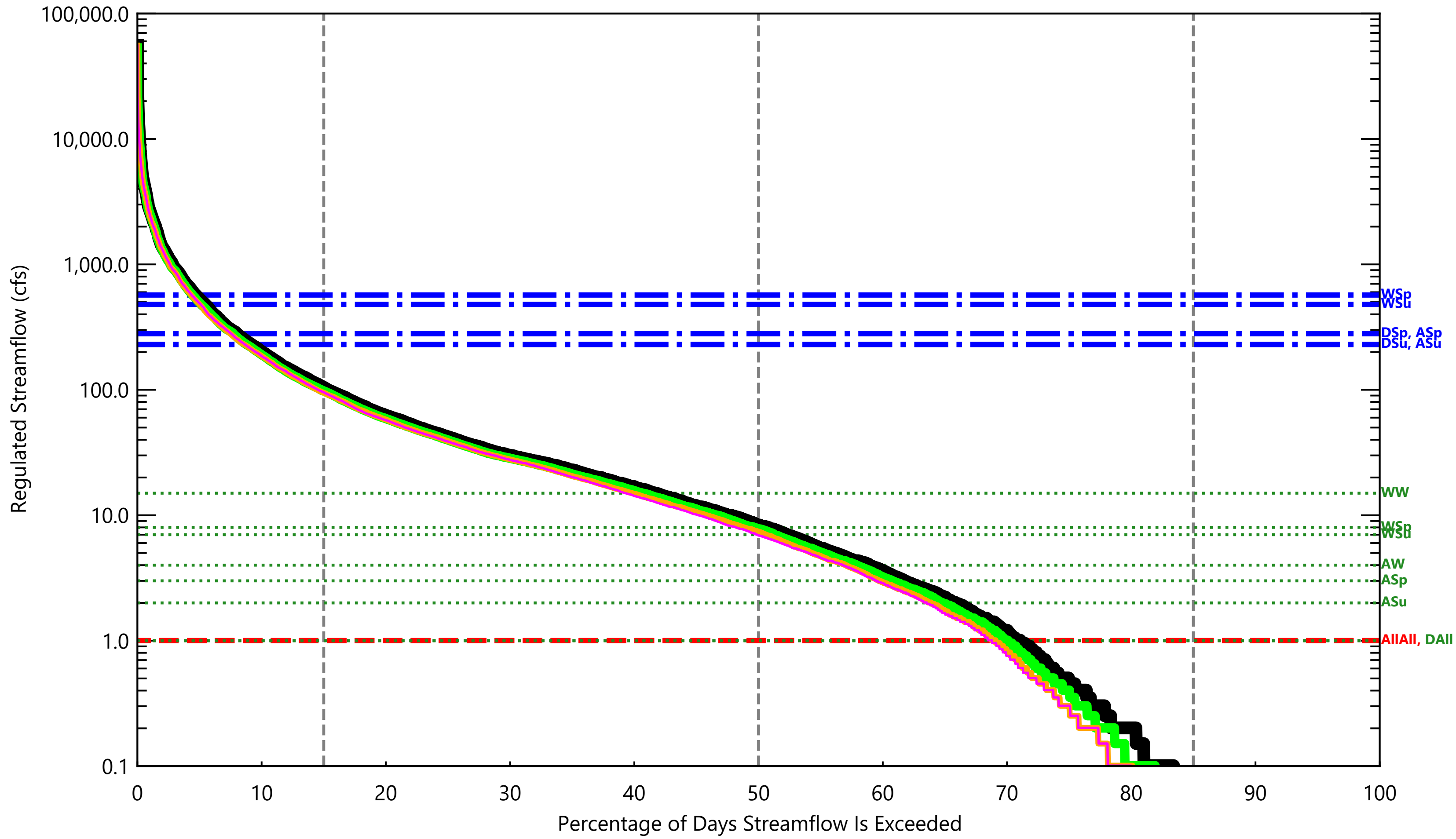
Figure D-4
Salt Fork near Aspermont
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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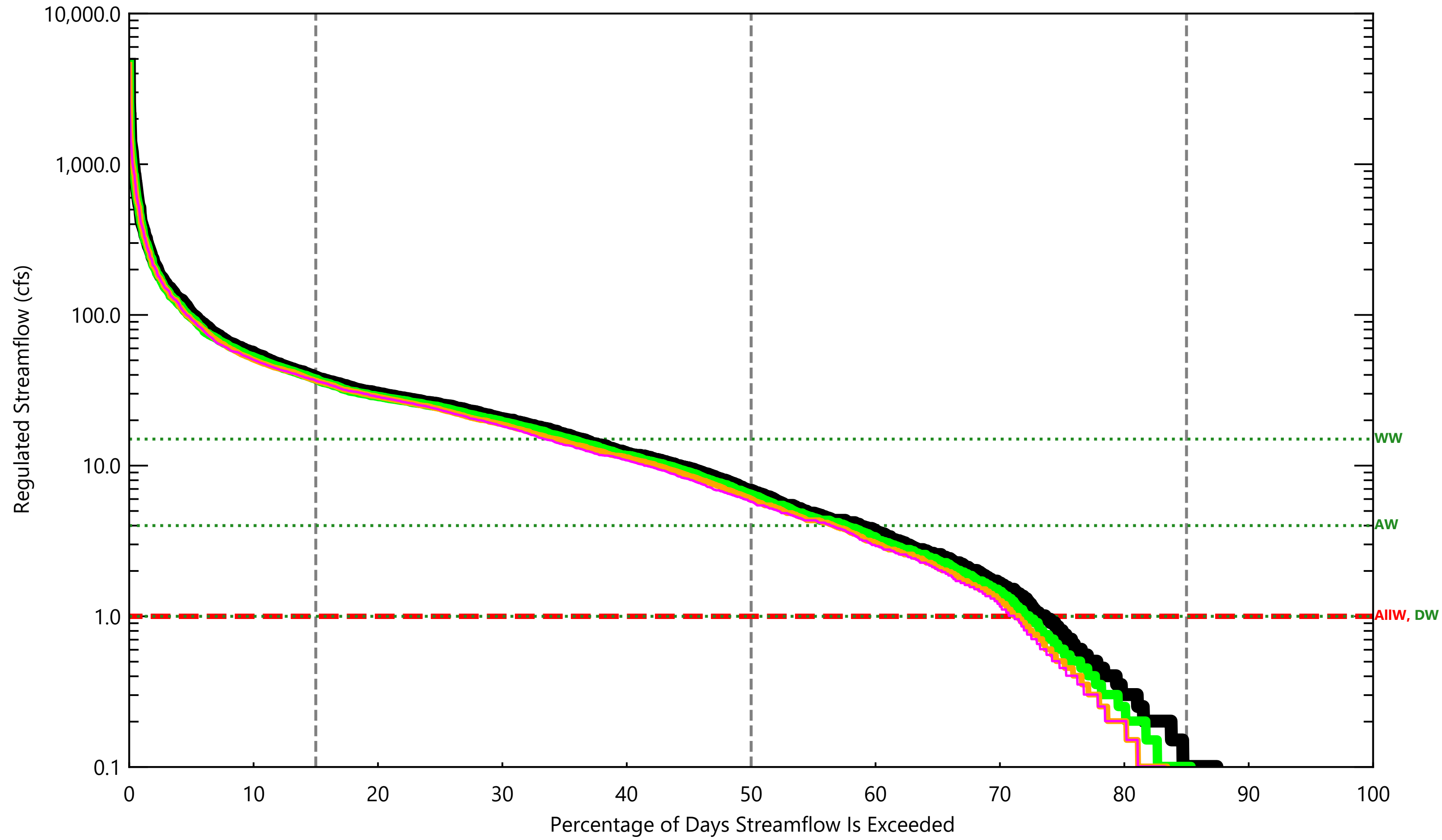
Figure D-5
Double Mountain Fork near Aspermont
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard

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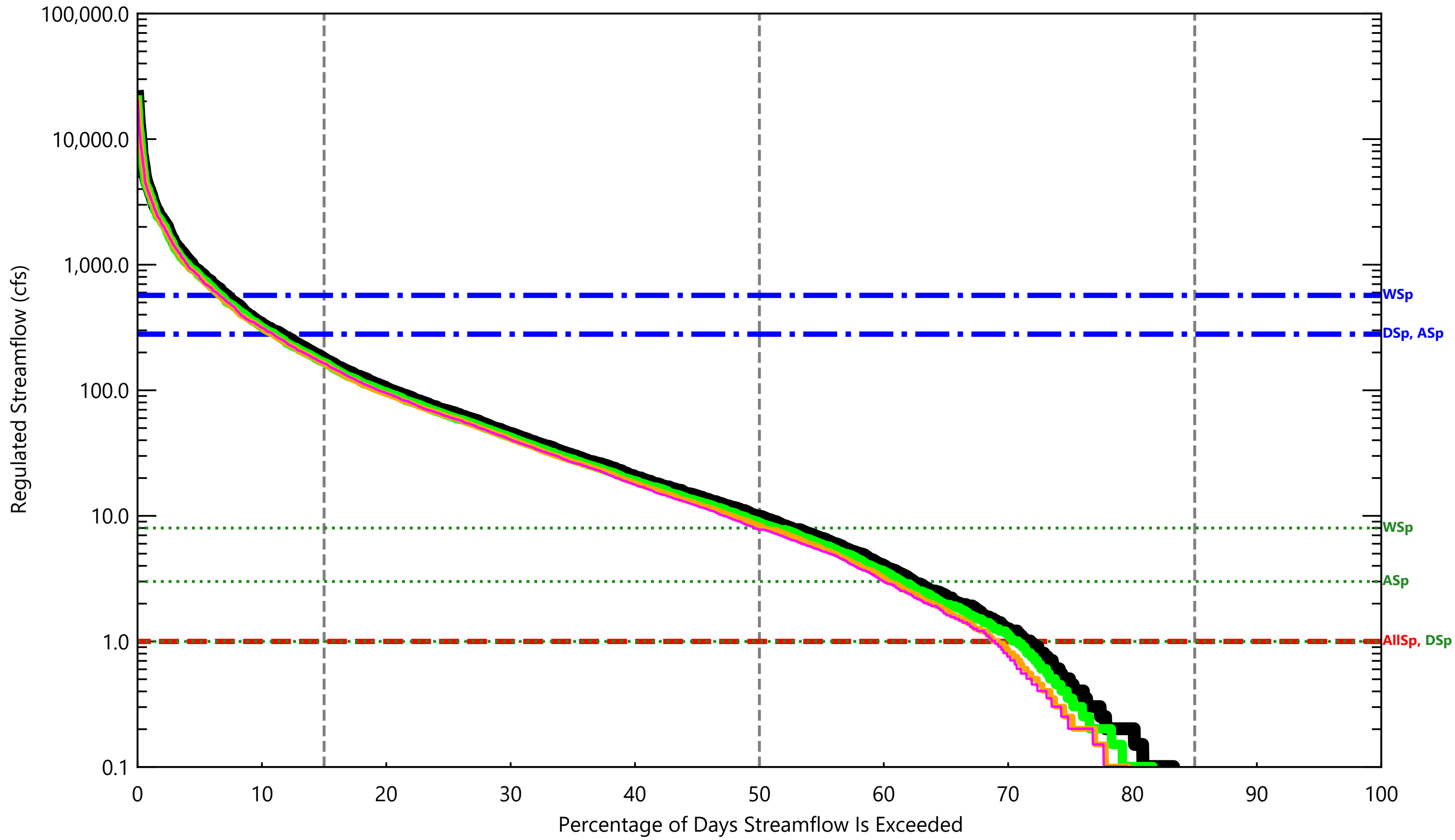
Figure D-6
Double Mountain Fork near Aspermont
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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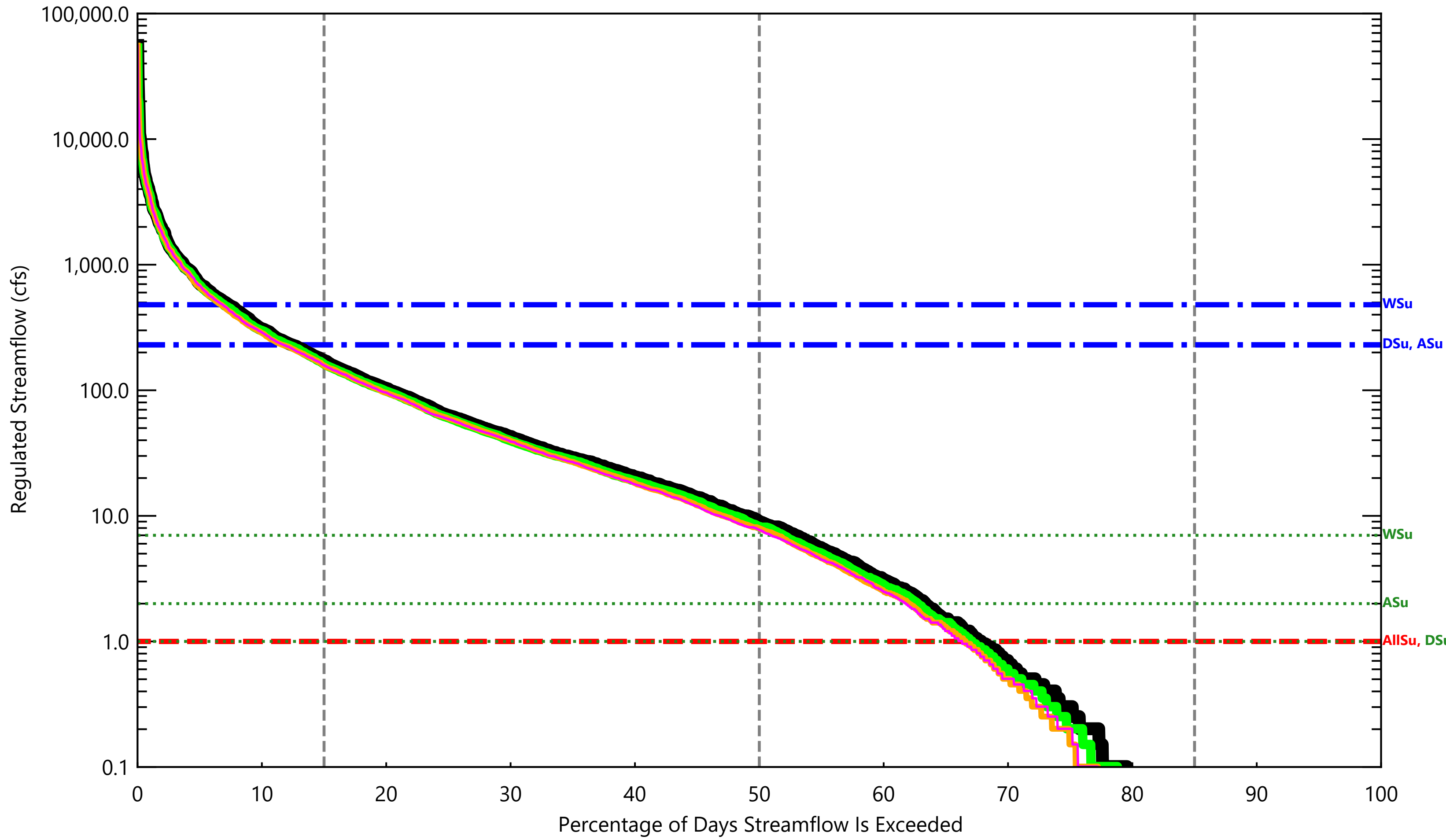
Figure D-7
Double Mountain Fork near Aspermont
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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Figure D-8
Double Mountain Fork near Aspermont
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

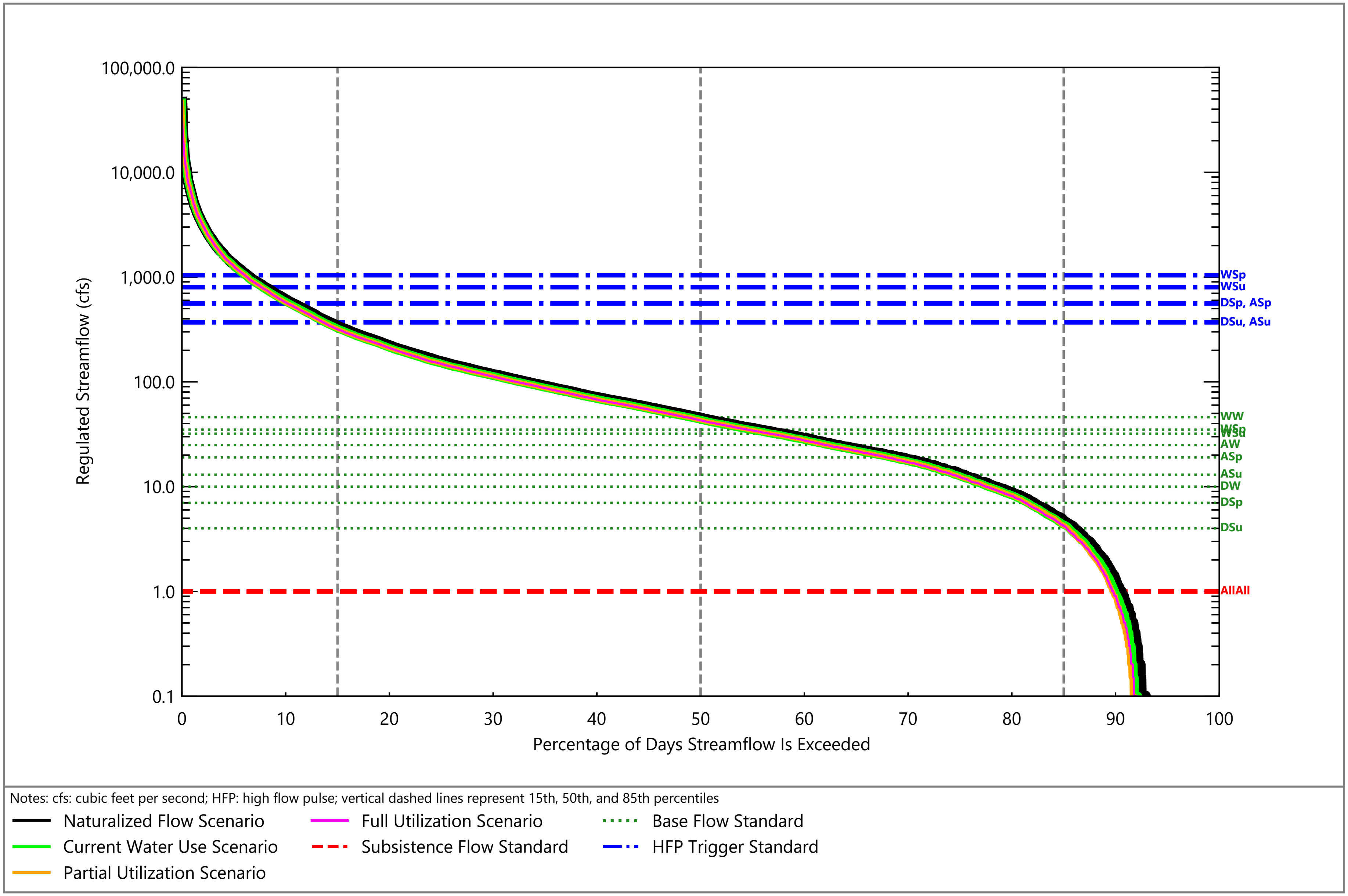

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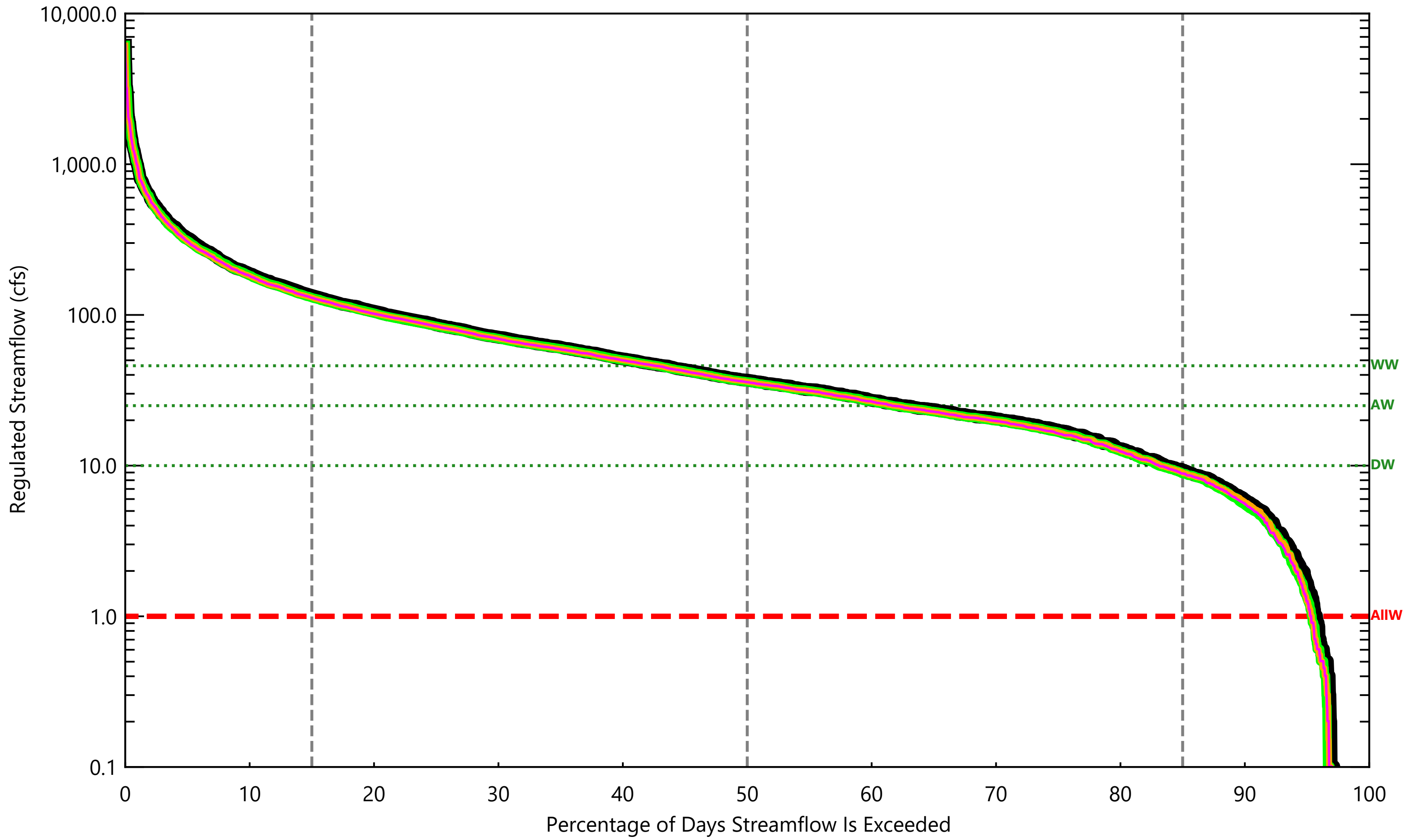
Figure D-9
Brazos River at Seymour
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard

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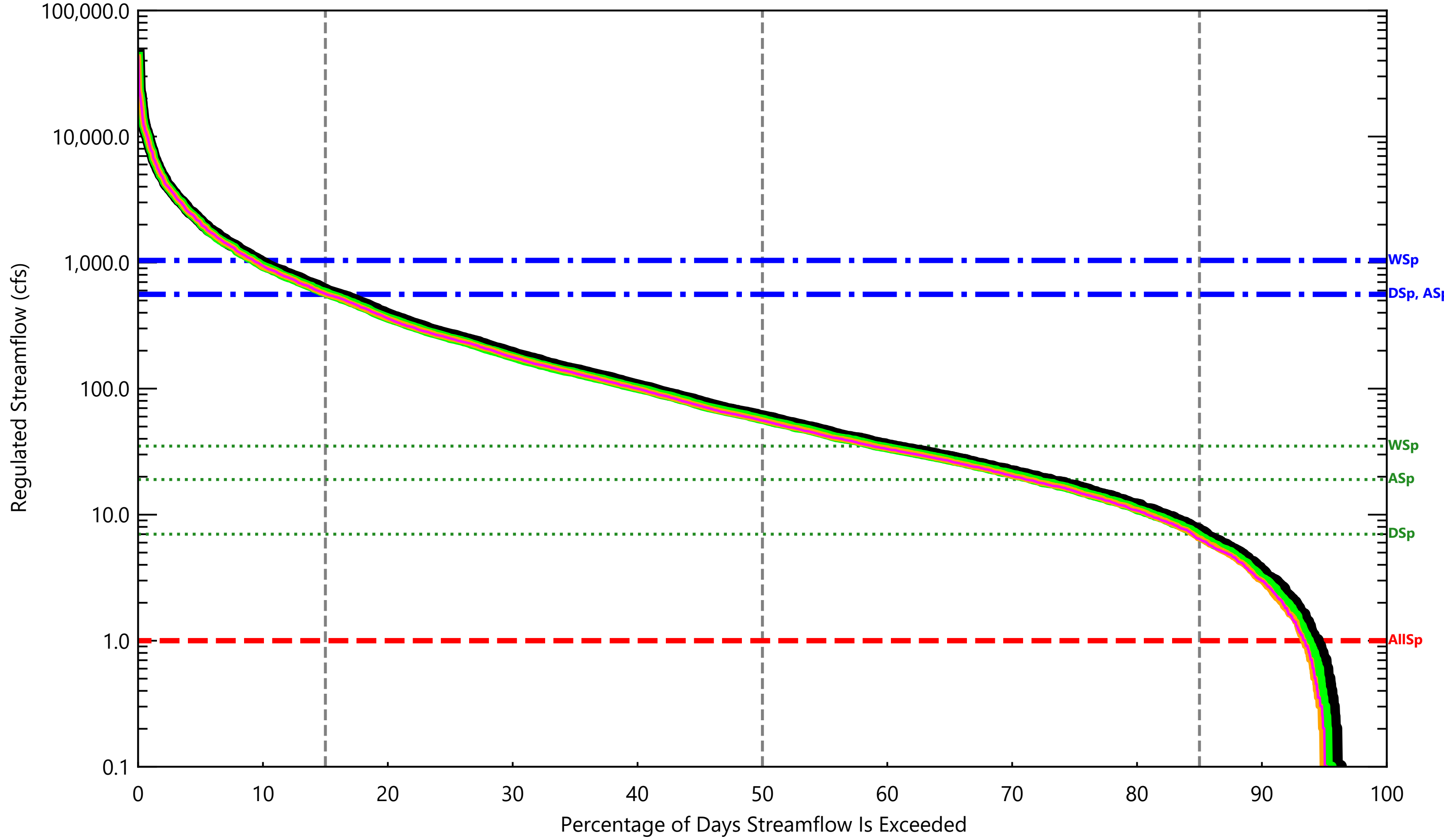
Figure D-10
Brazos River at Seymour
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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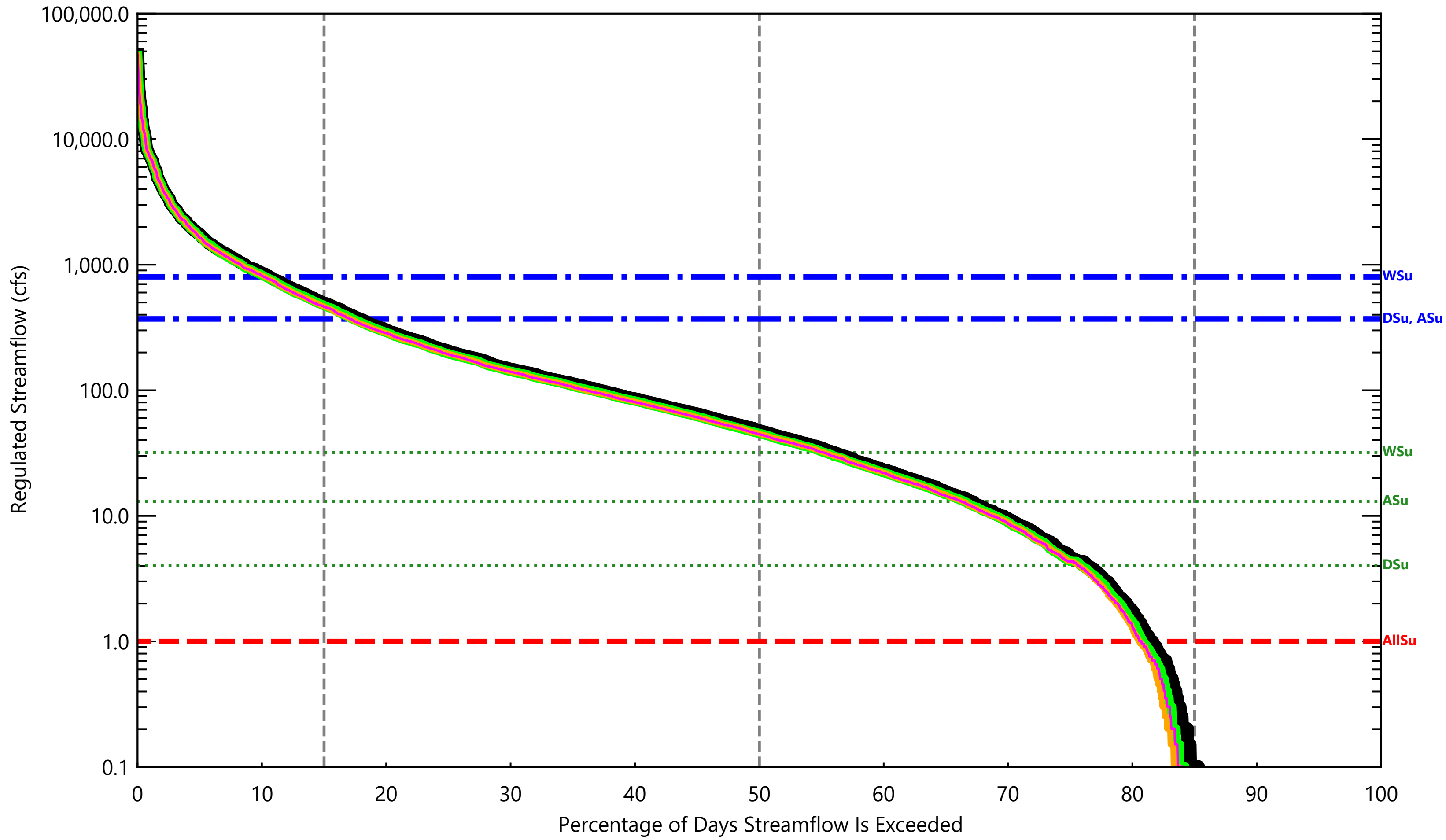
Figure D-11
Brazos River at Seymour
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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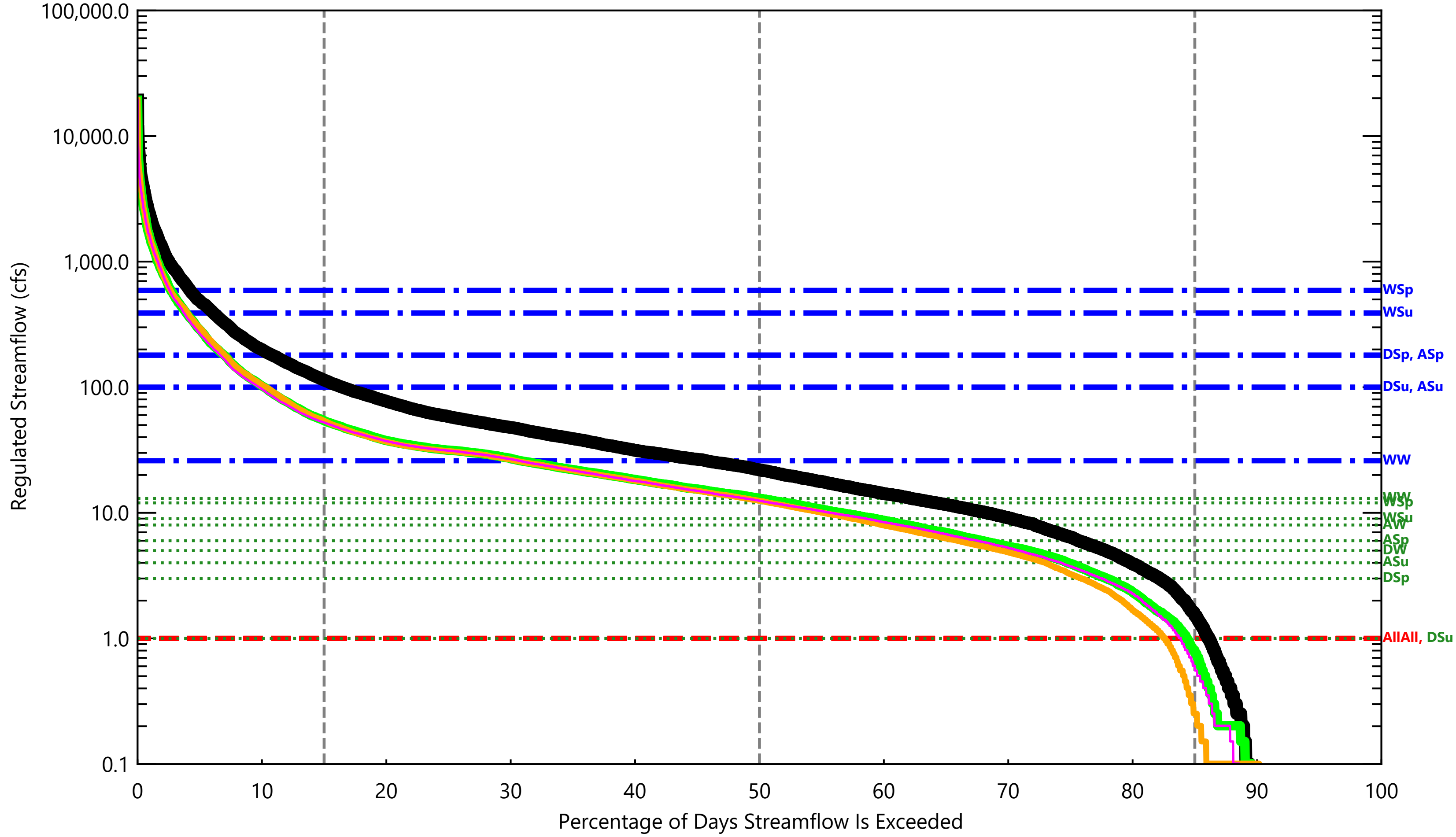
Figure D-12
Brazos River at Seymour
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario	Full Utilization Scenario	Base Flow Standard
Current Water Use Scenario	Subsistence Flow Standard	HFP Trigger Standard
Partial Utilization Scenario		

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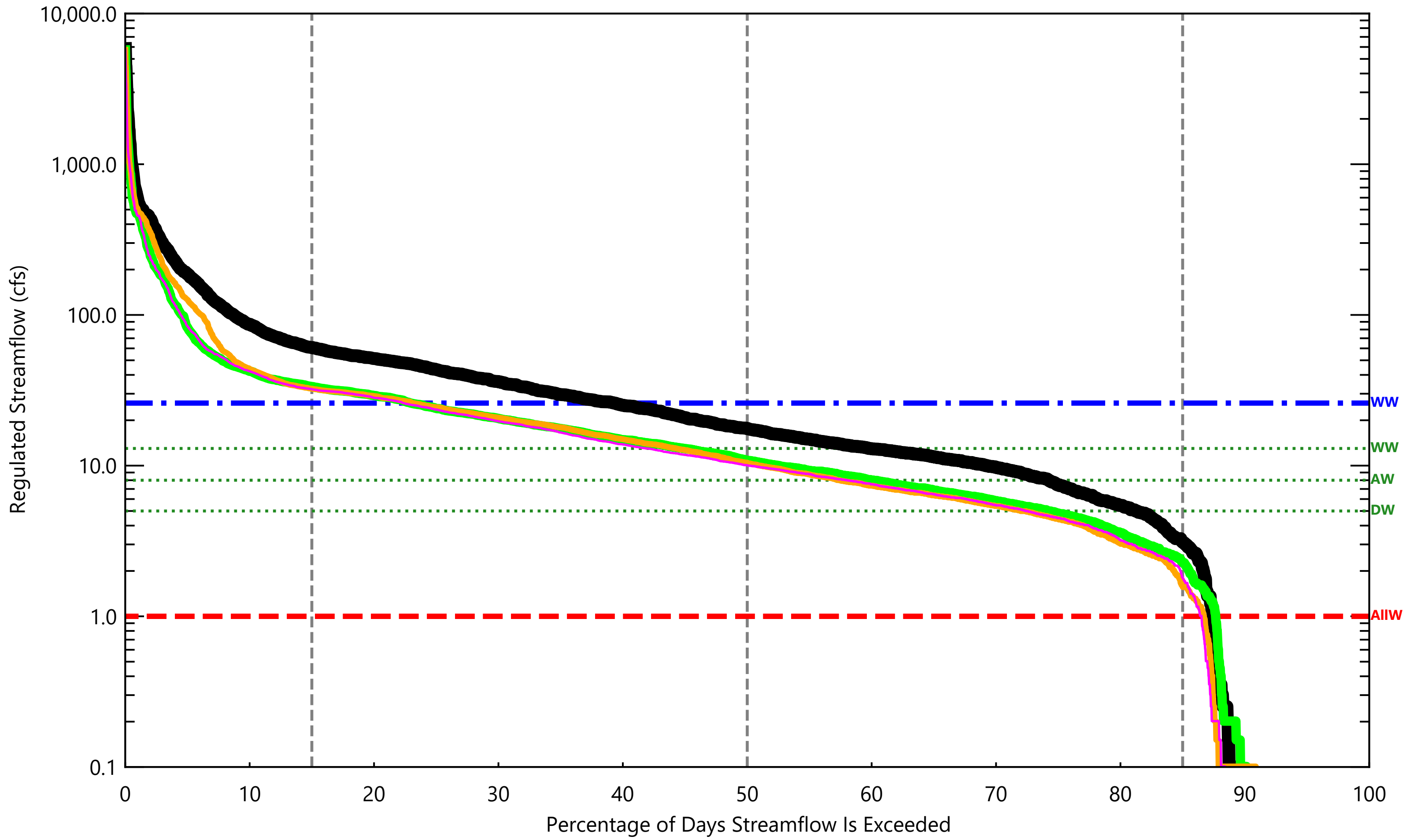
Figure D-13
Clear Fork at Nugent
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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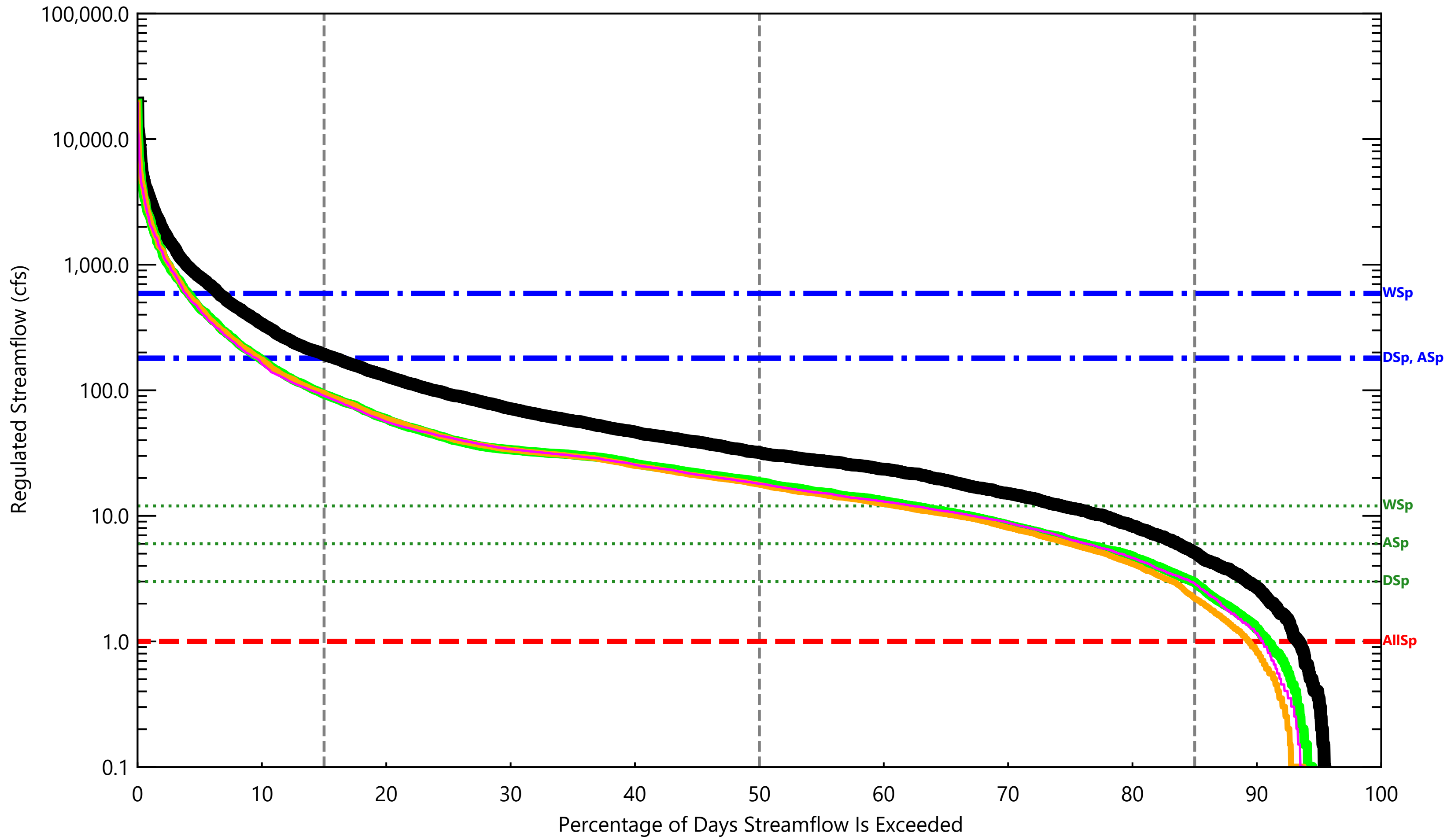
Figure D-14
Clear Fork at Nugent
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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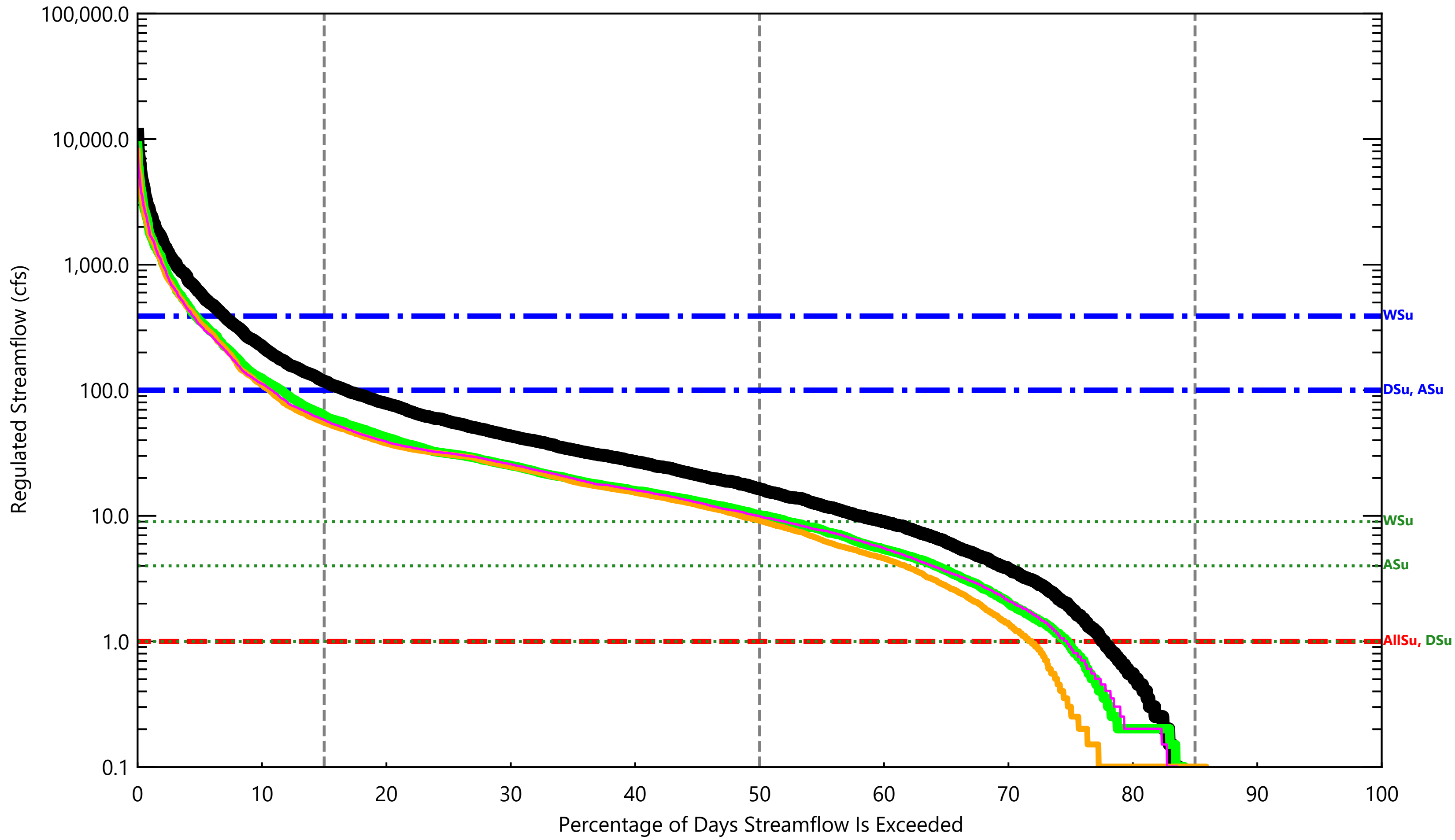
Figure D-15
Clear Fork at Nugent
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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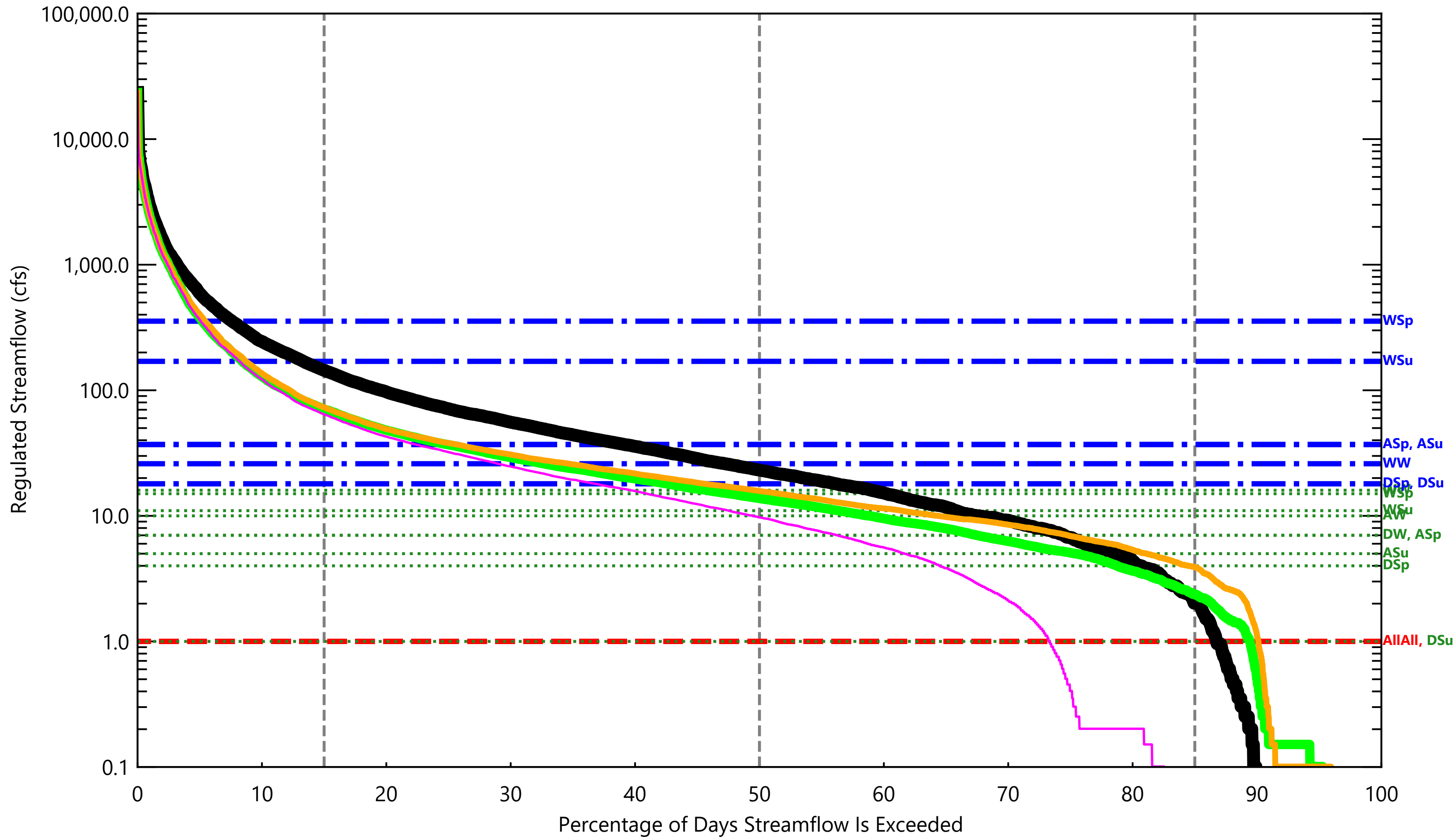

Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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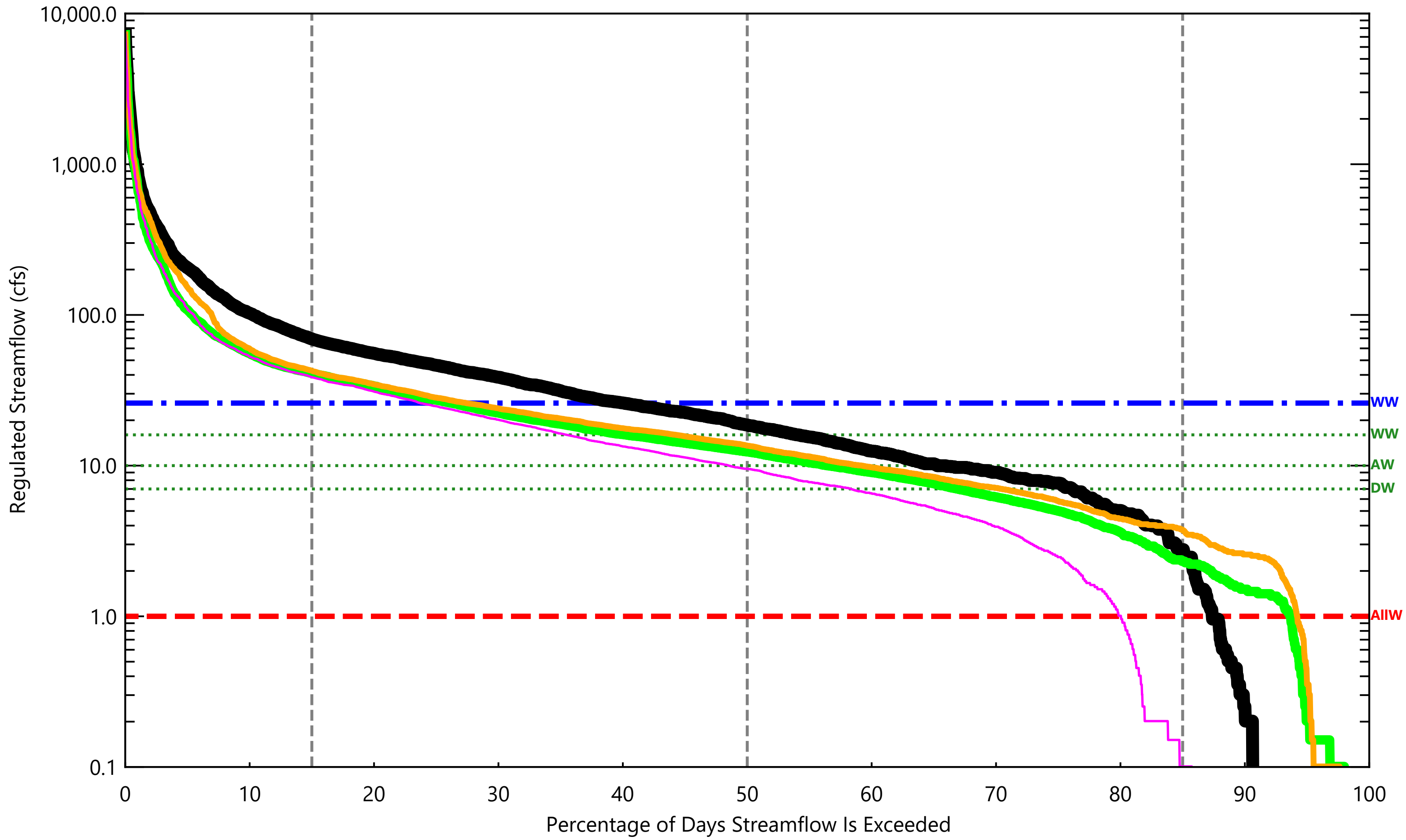
Figure D-17
Clear Fork at Lueders
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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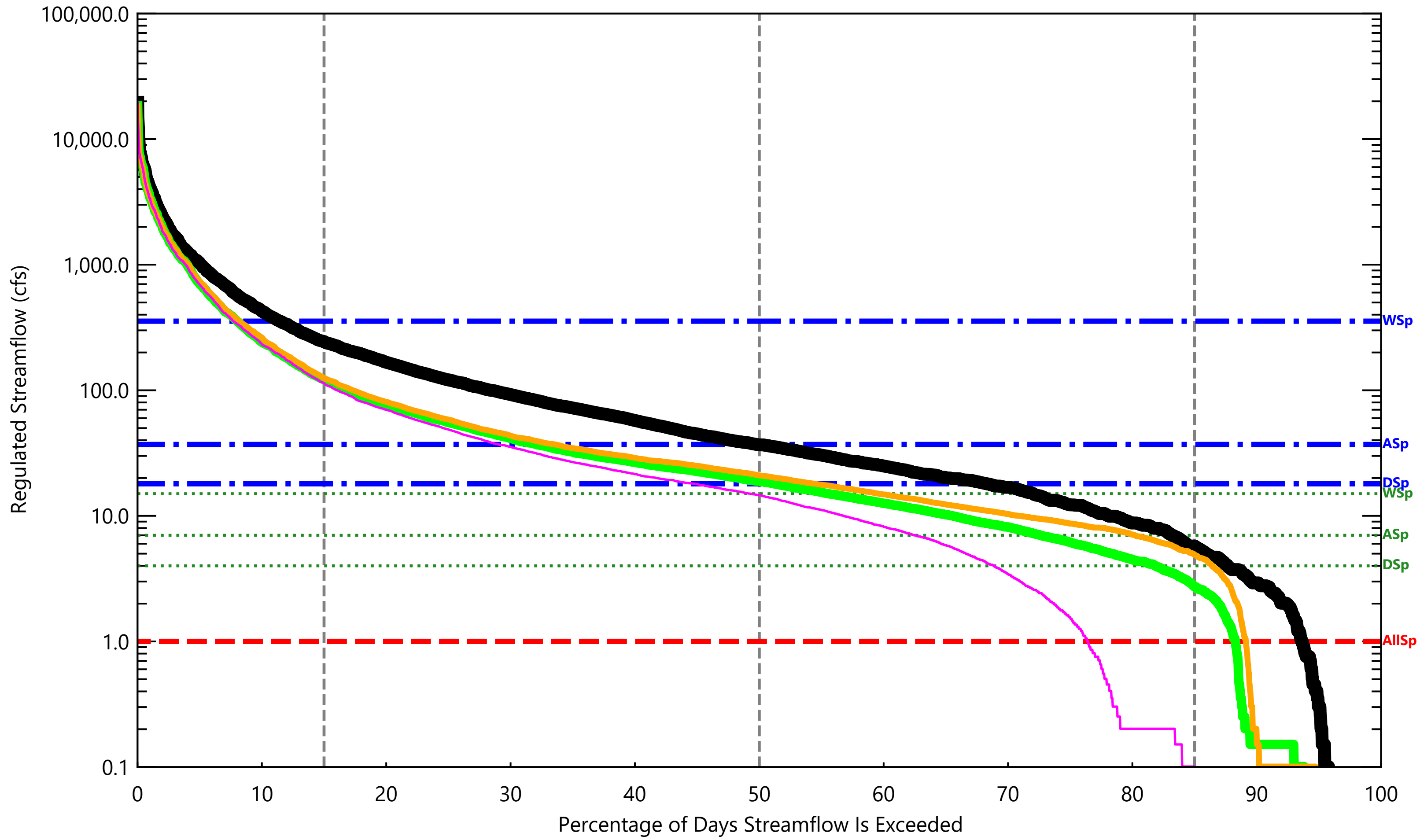
Figure D-18
Clear Fork at Lueders
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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Figure D-19
Clear Fork at Lueders
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

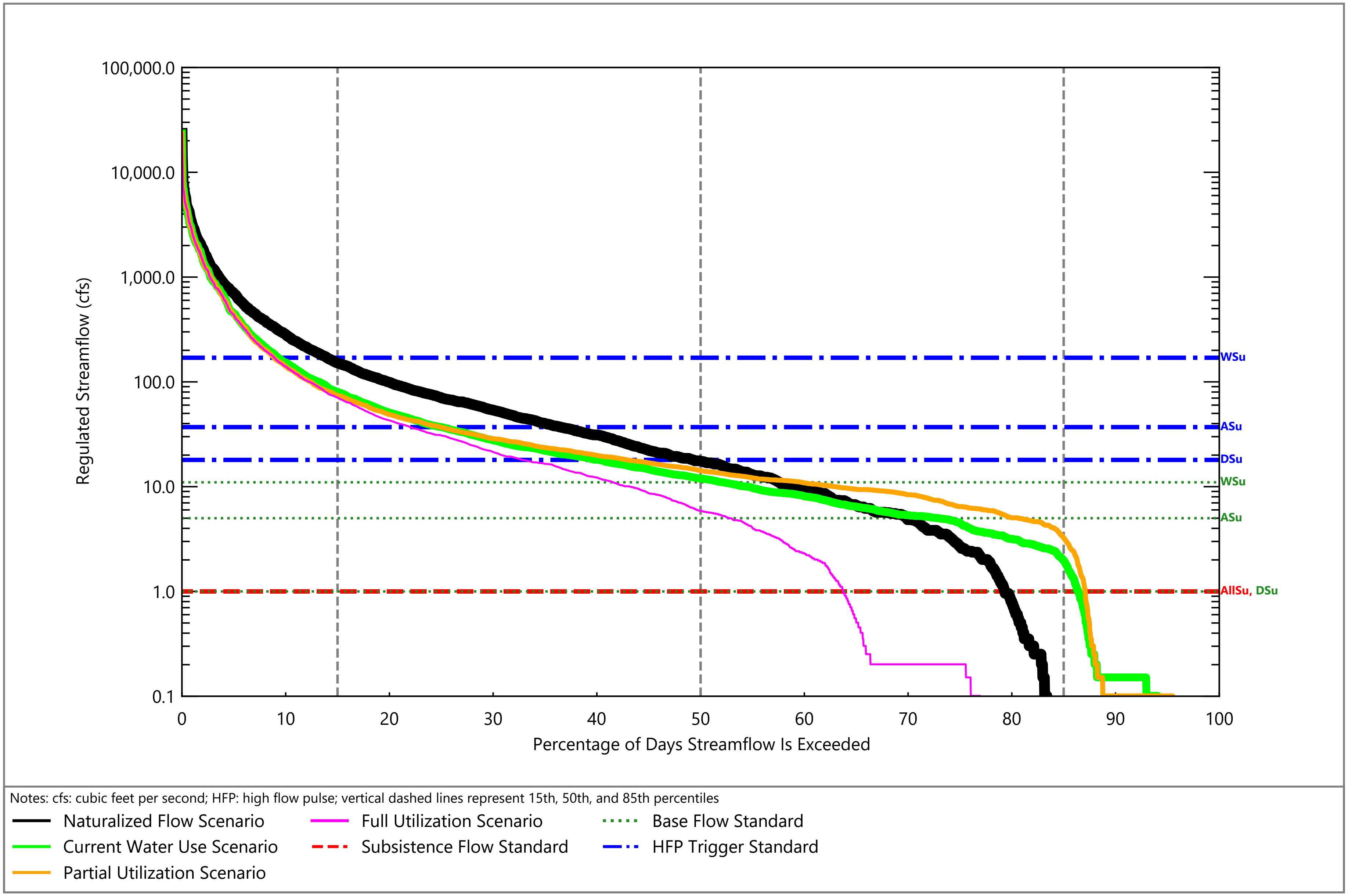

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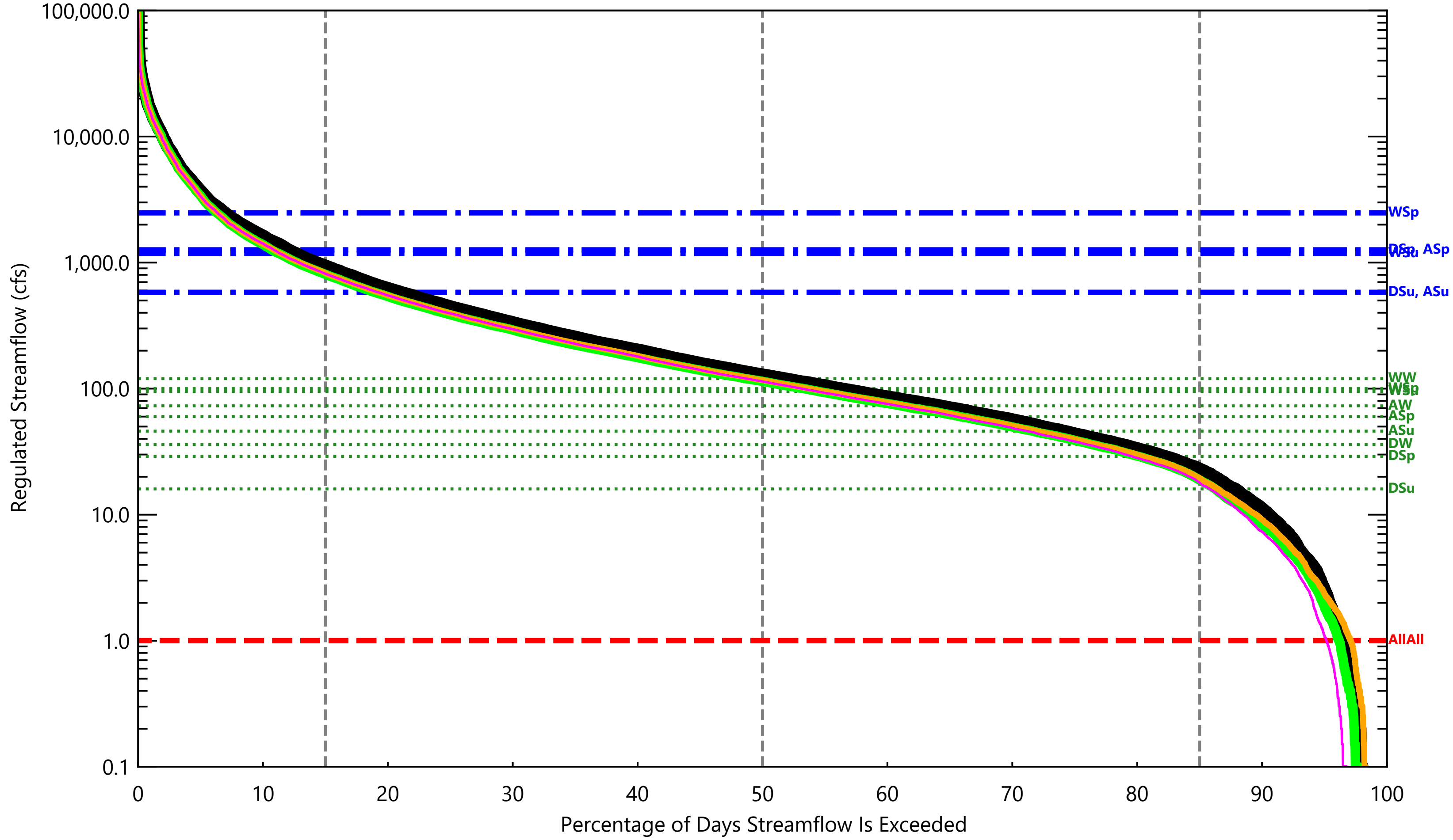
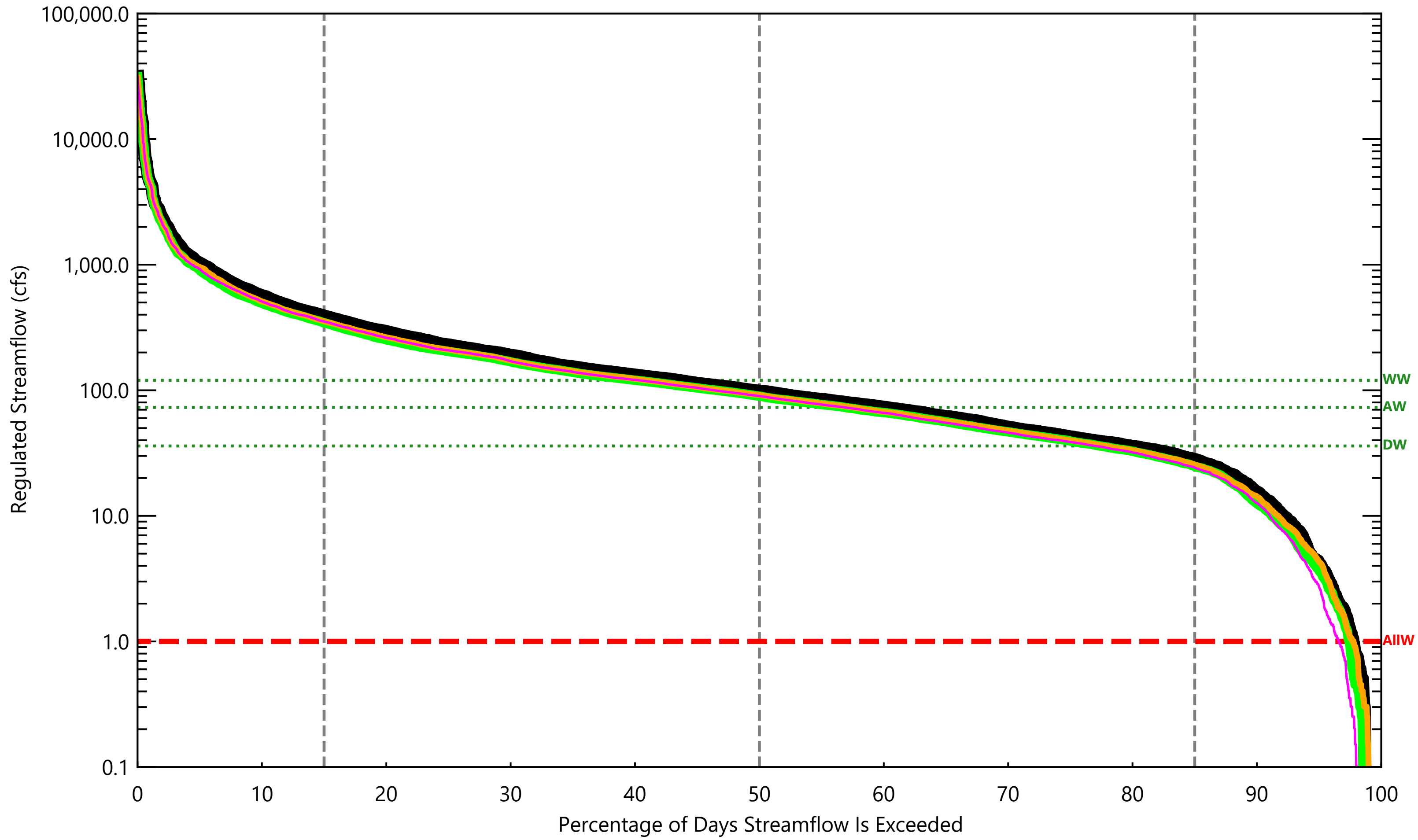
Figure D-20
Clear Fork at Lueders
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Figure D-21
Brazos River near South Bend
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard

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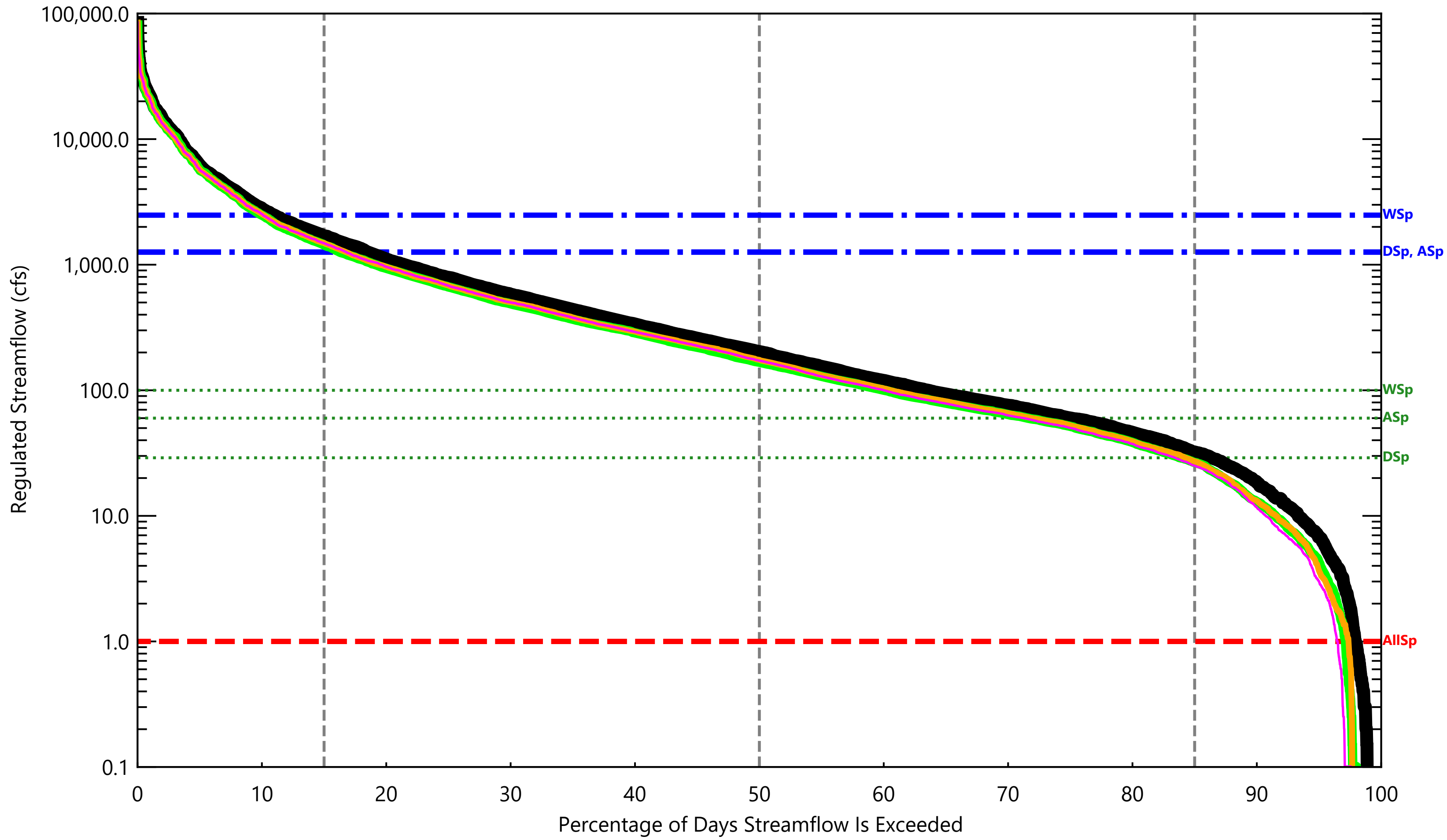
Figure D-22
Brazos River near South Bend
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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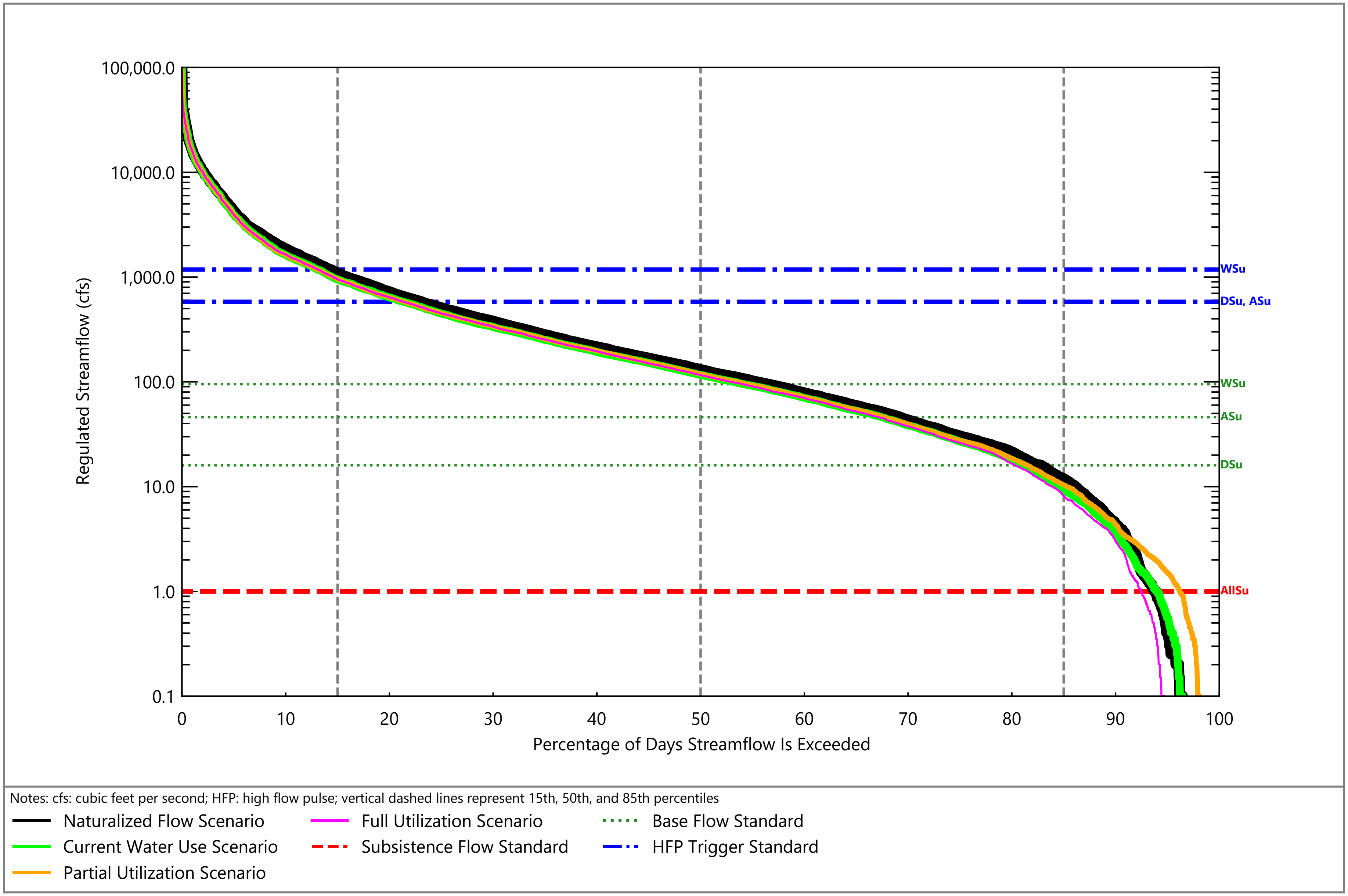
Figure D-23
Brazos River near South Bend
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 14:12 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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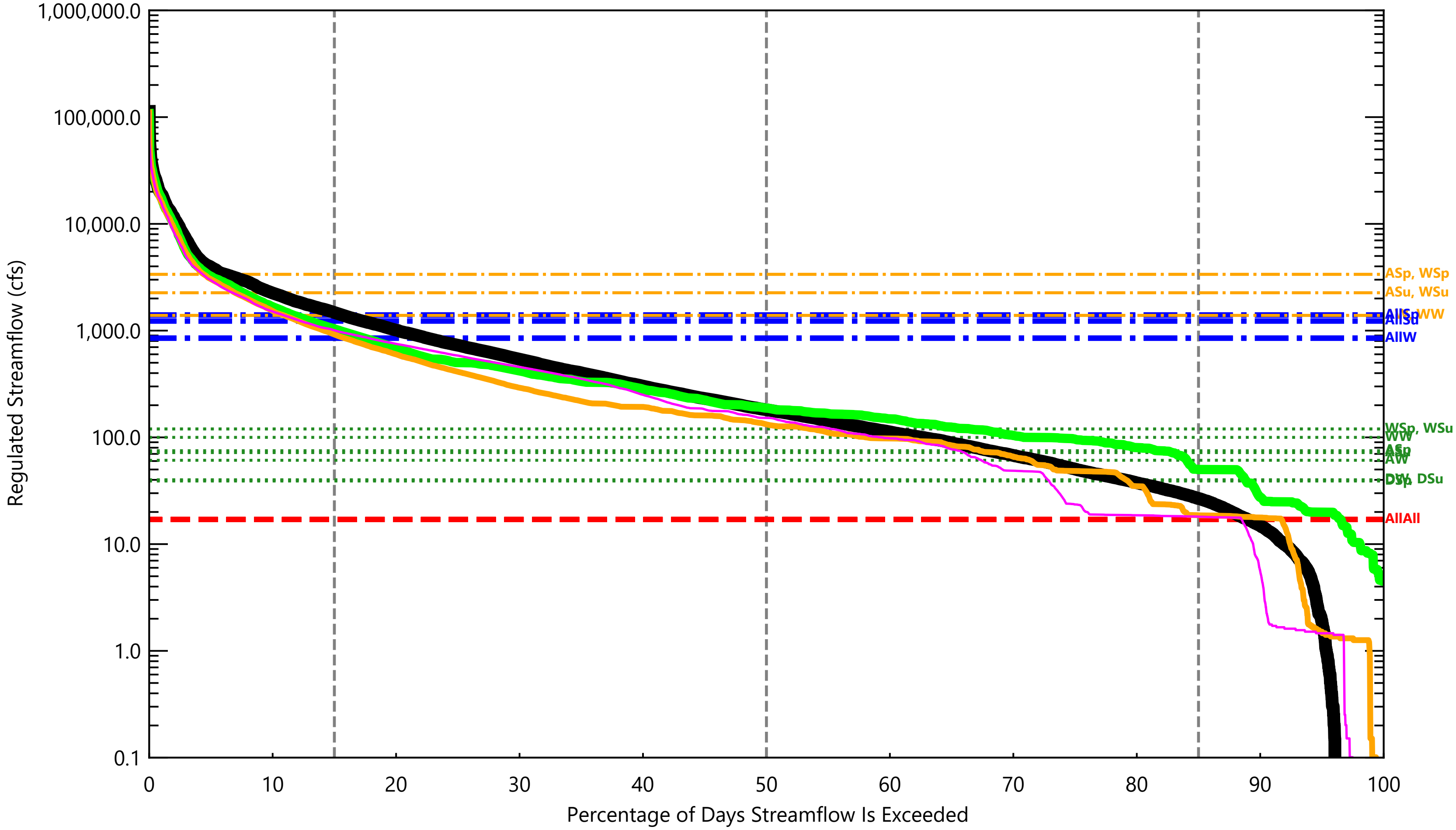
Figure D-24
Brazos River near South Bend
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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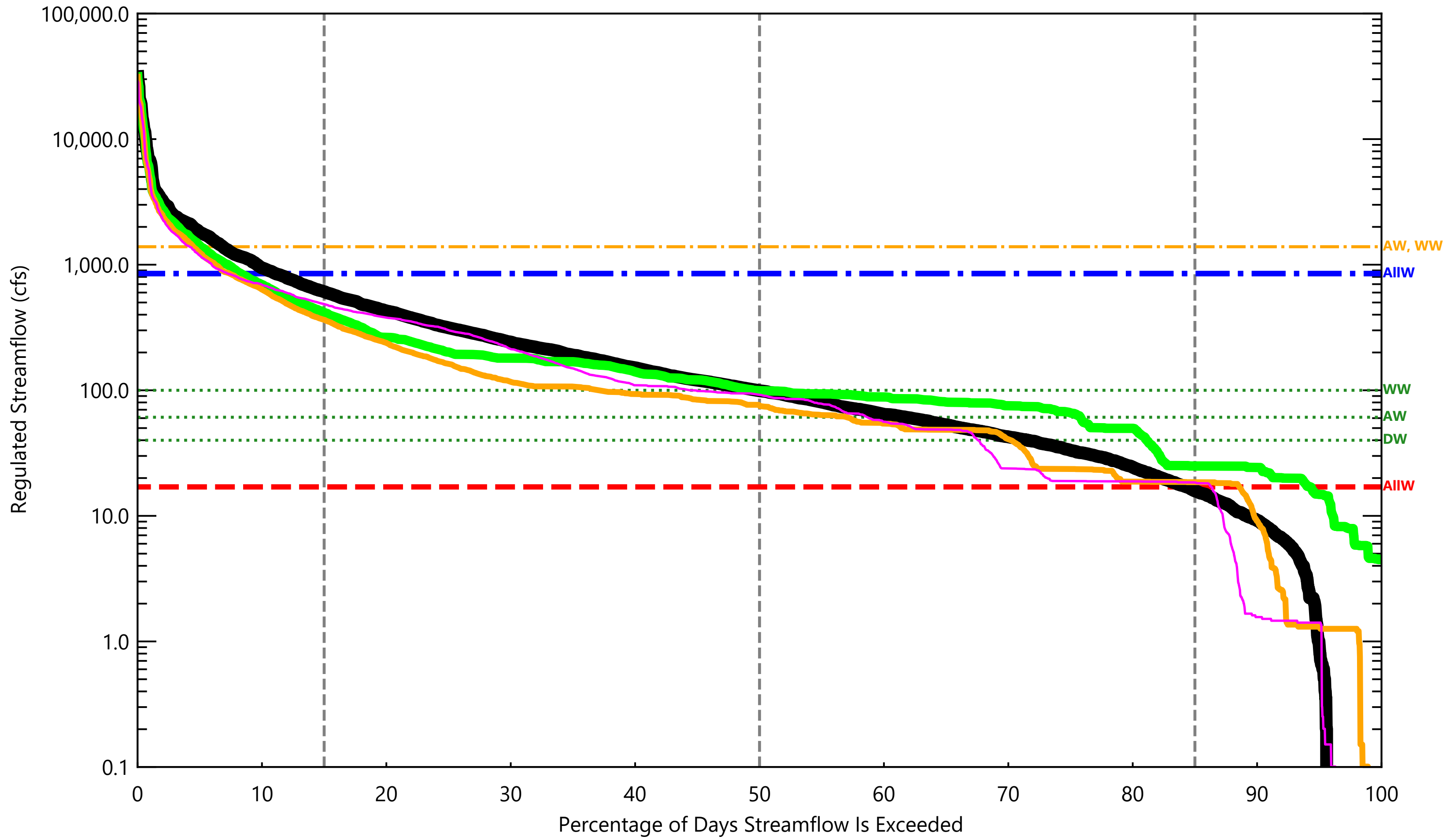
Figure D-25
Brazos River near Palo Pinto
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard (Tier 1 Pulse)
- HFP Trigger Standard (Tier 2 Pulse)

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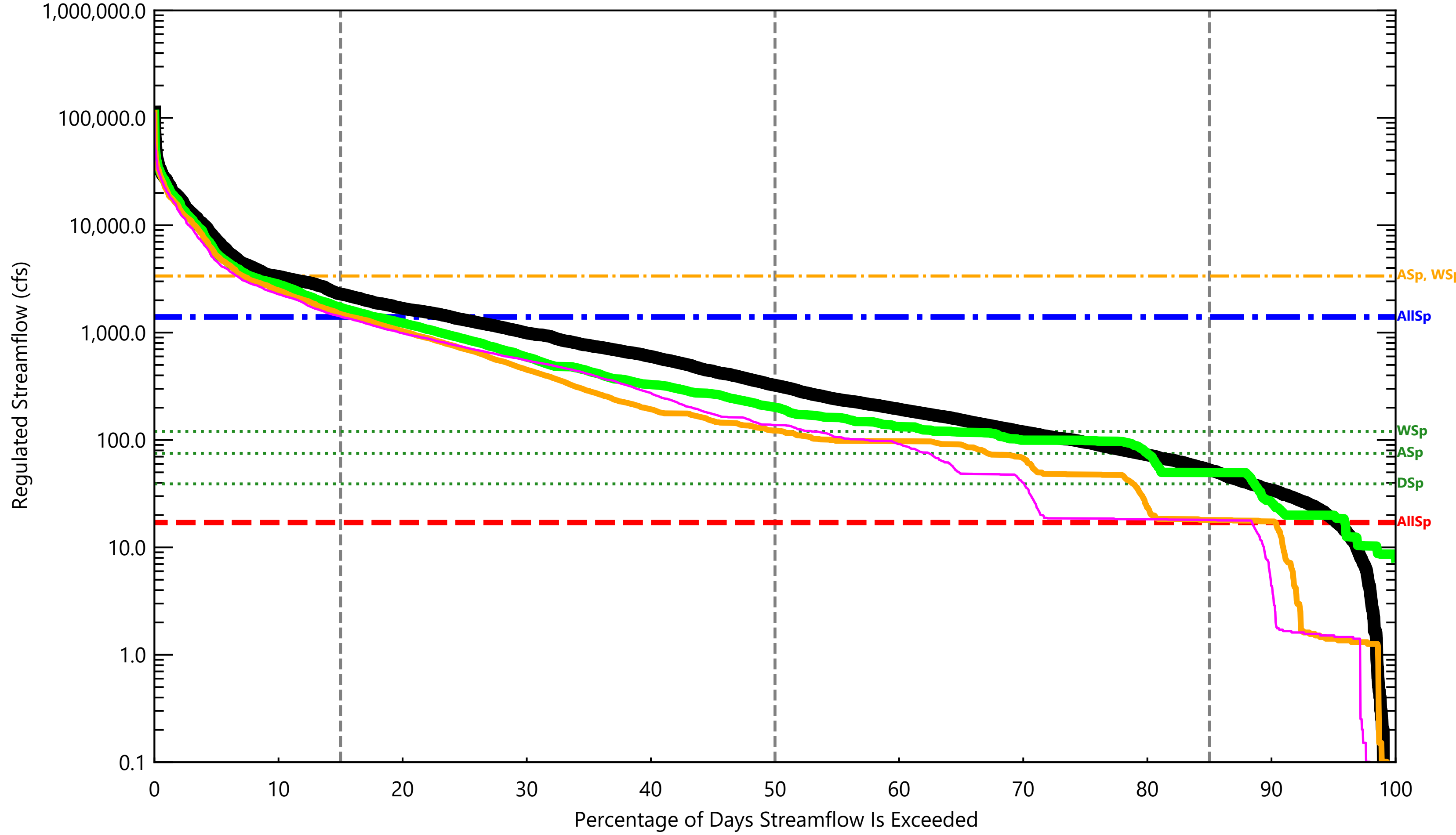
Figure D-26
Brazos River near Palo Pinto
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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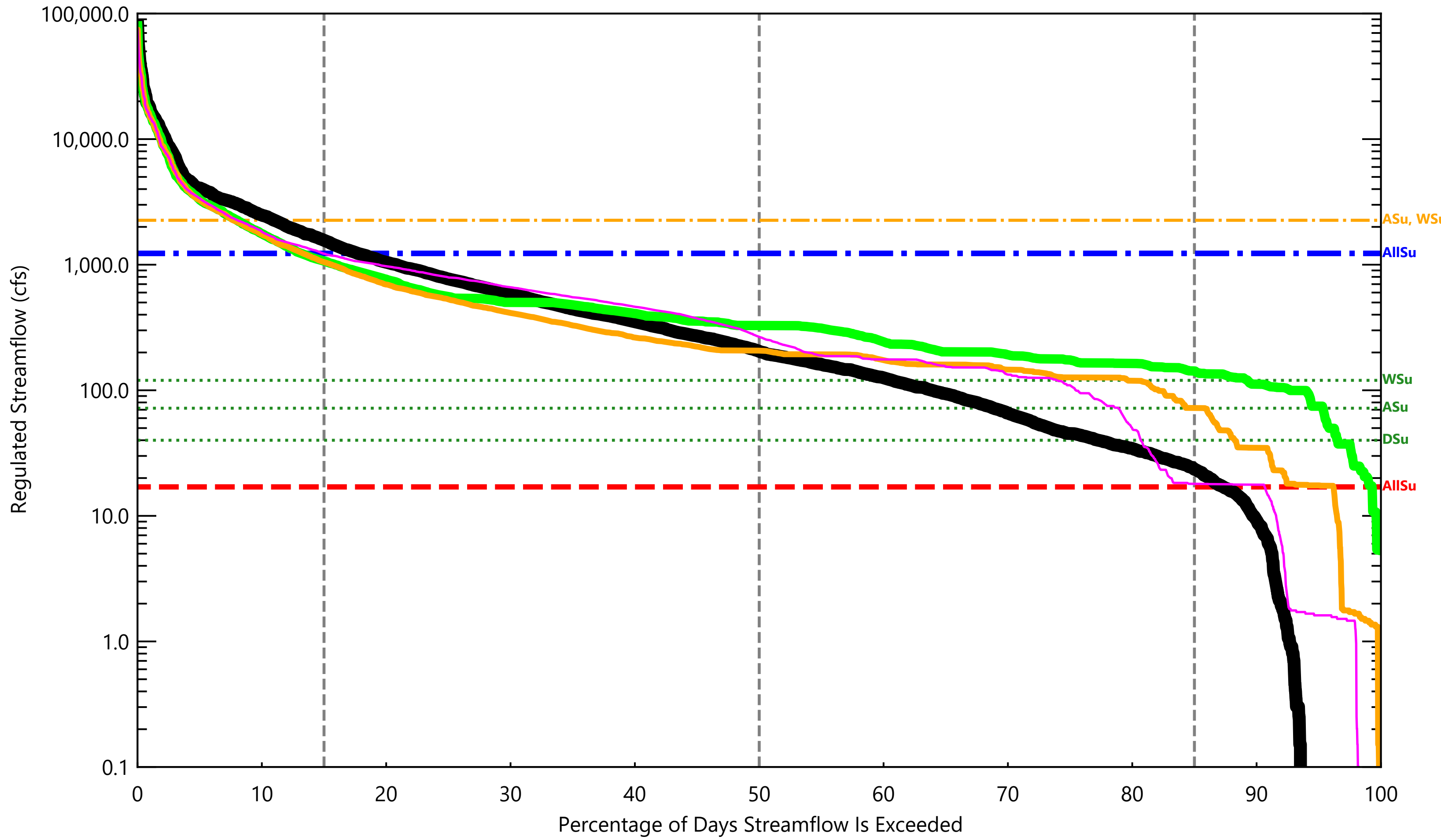
Figure D-27
Brazos River near Palo Pinto
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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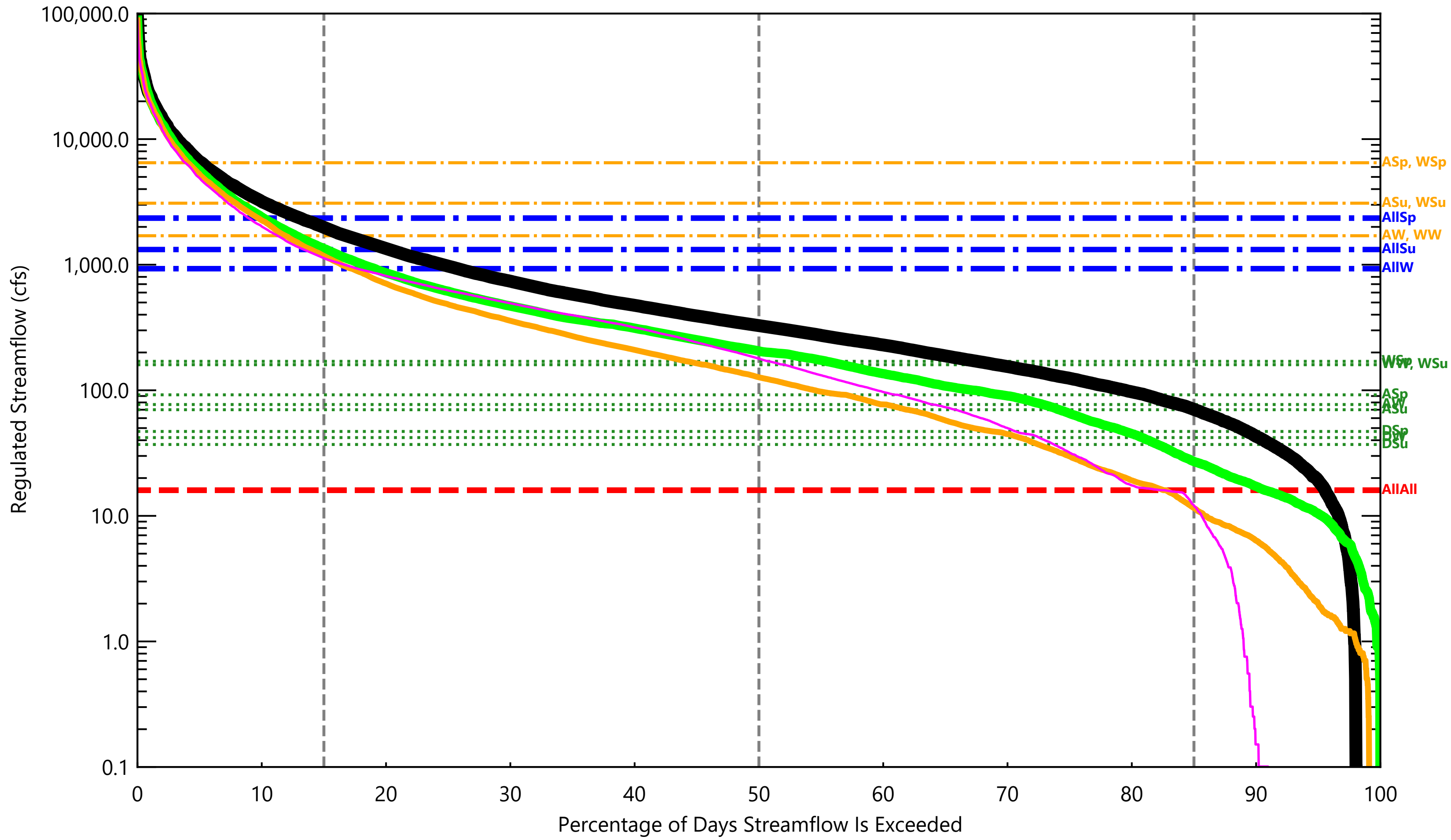
Figure D-28
Brazos River near Palo Pinto
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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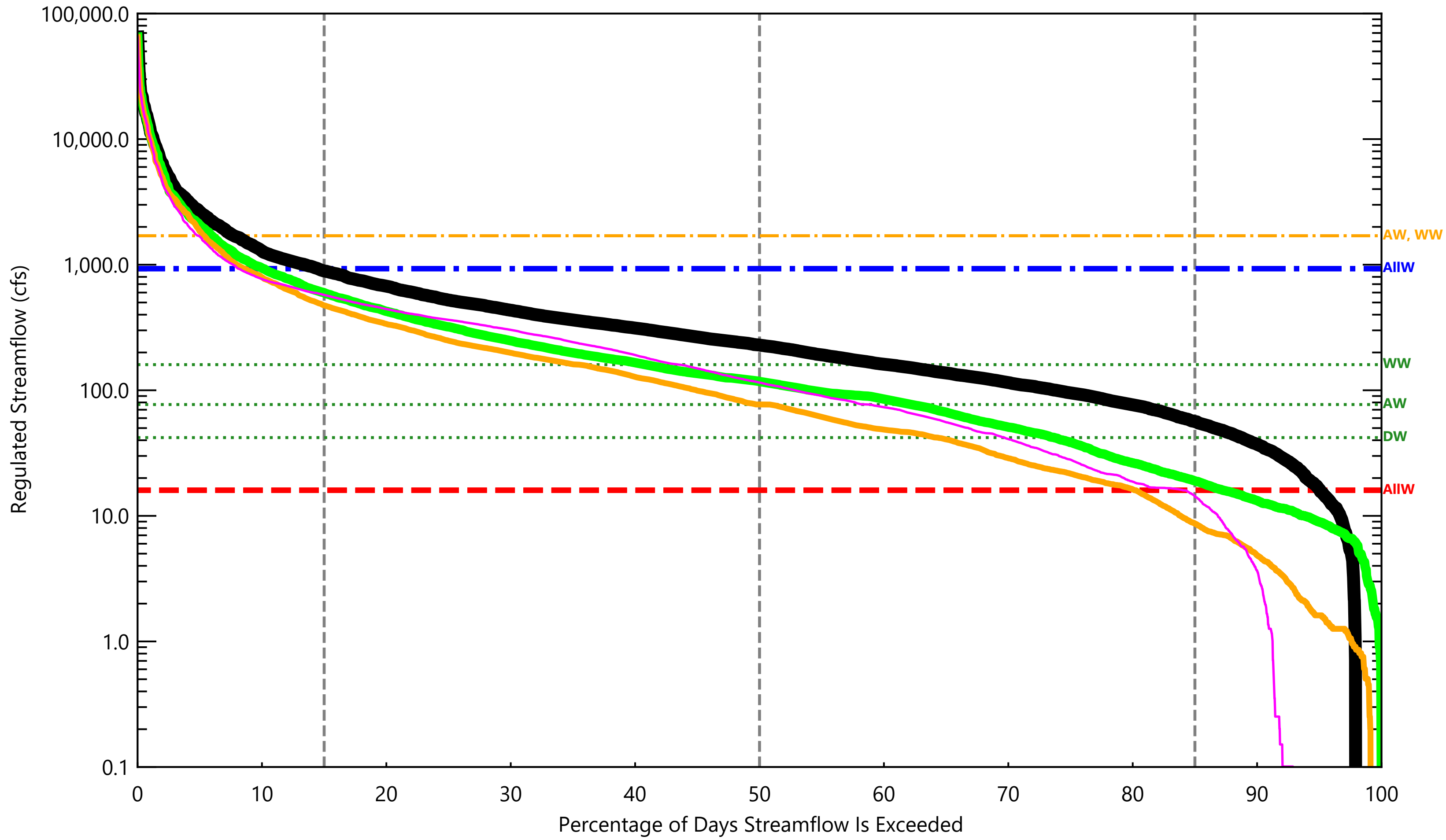
Figure D-29
Brazos River near Glen Rose
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario	Full Utilization Scenario	HFP Trigger Standard (Tier 1 Pulse)
Current Water Use Scenario	Subsistence Flow Standard	HFP Trigger Standard (Tier 2 Pulse)
Partial Utilization Scenario	Base Flow Standard	

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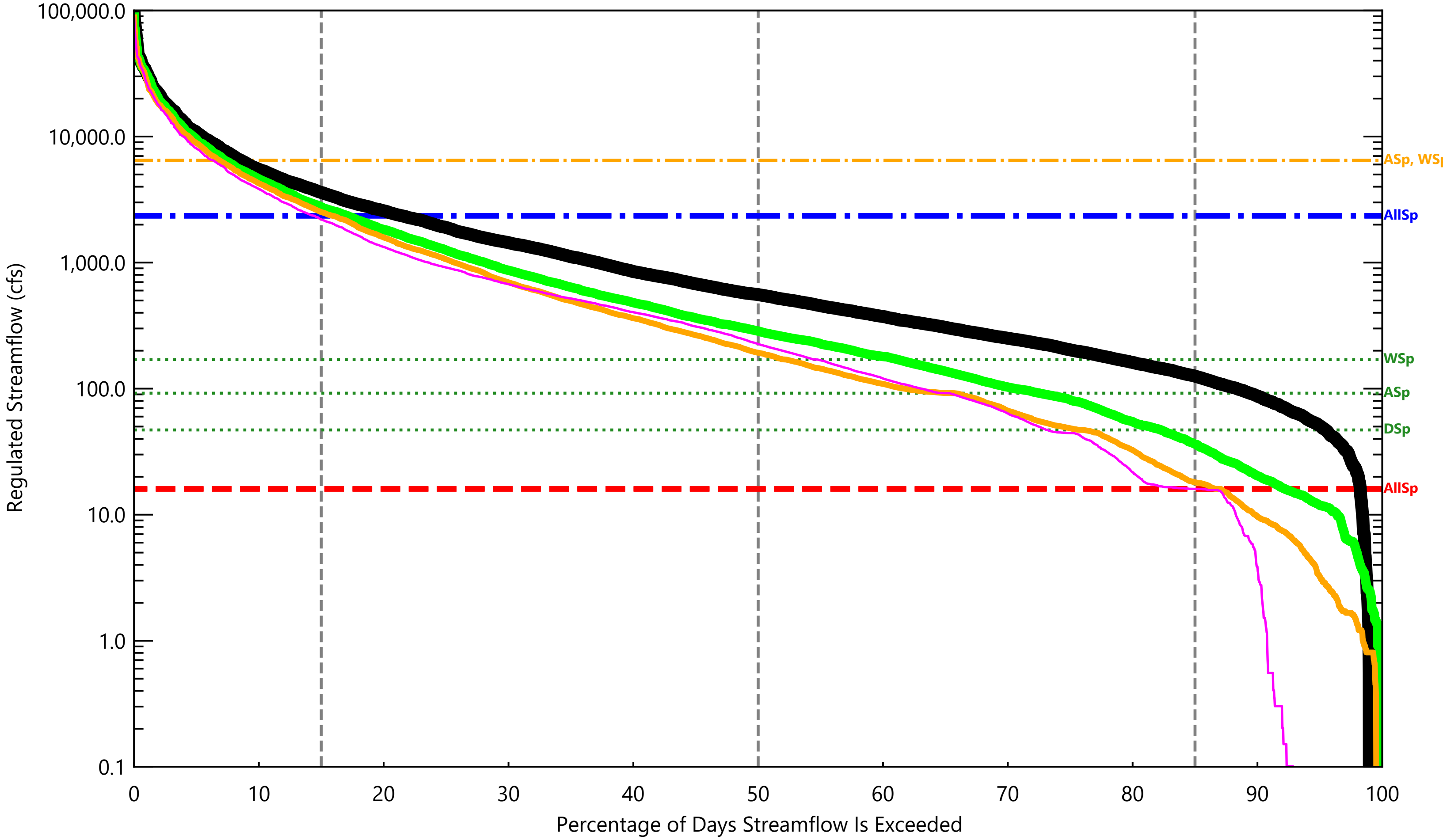
Figure D-30
Brazos River near Glen Rose
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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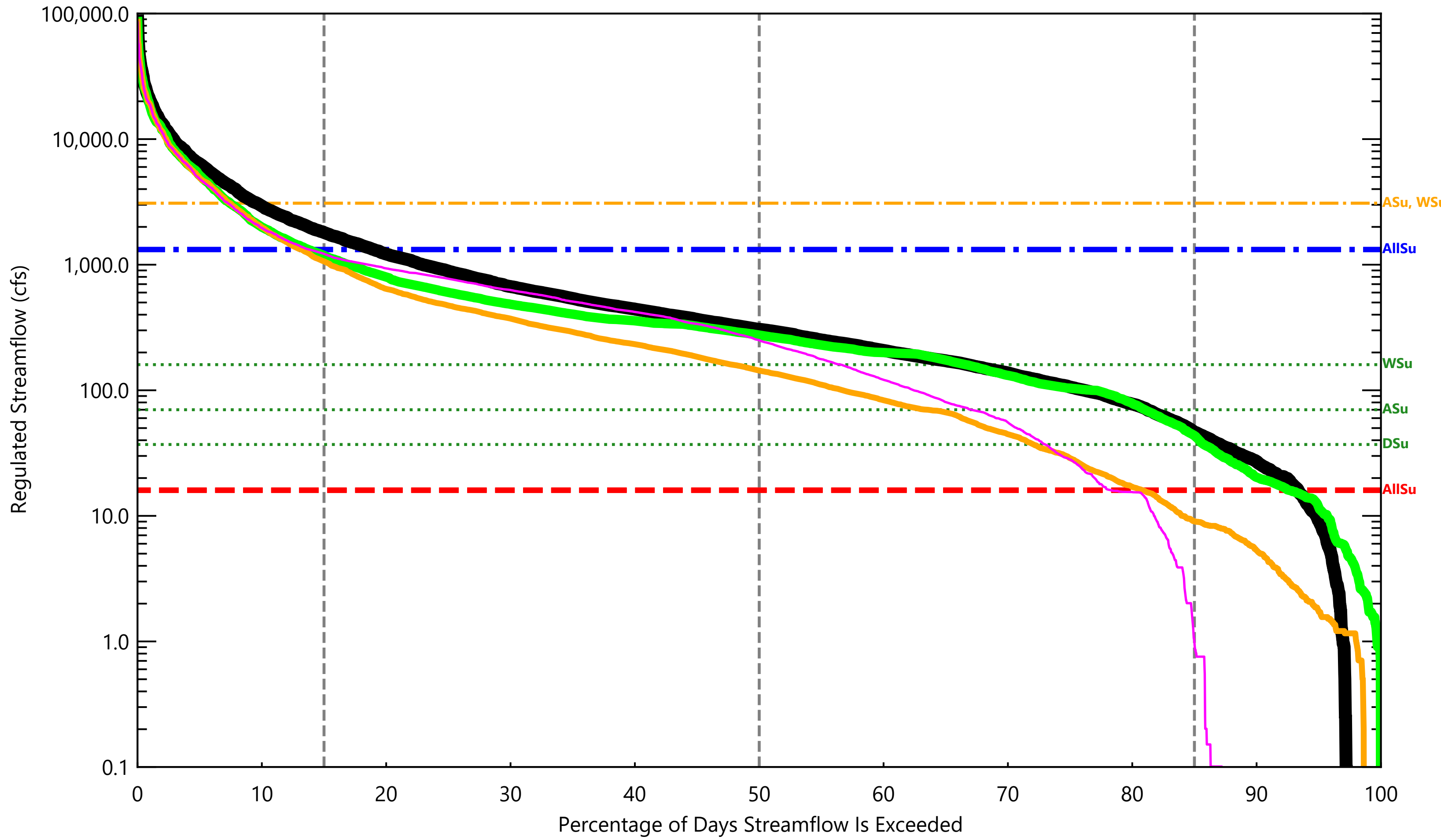
Figure D-31
Brazos River near Glen Rose
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard (Tier 1 Pulse)
HFP Trigger Standard (Tier 2 Pulse)

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Figure D-32
Brazos River near Glen Rose
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

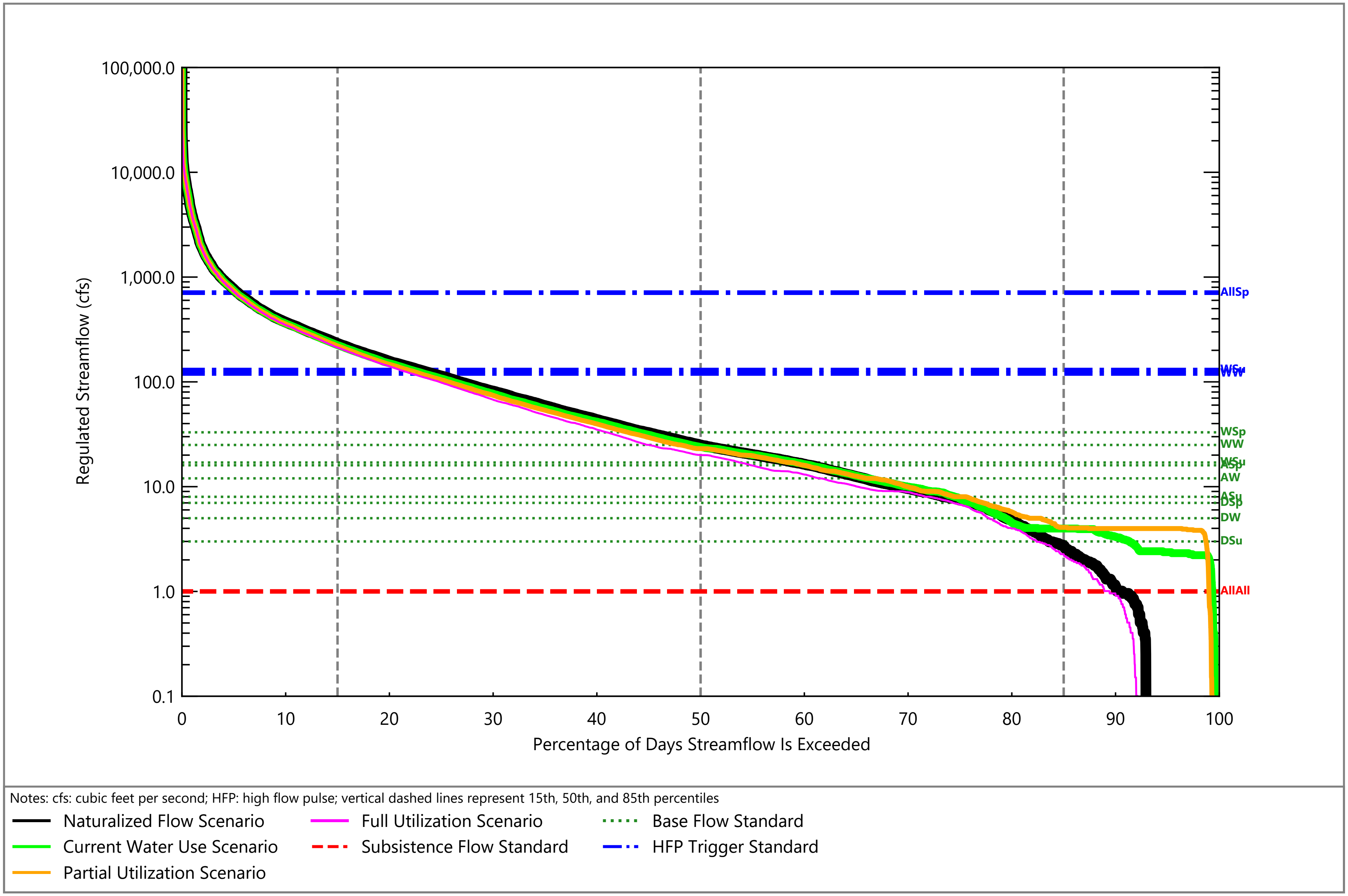

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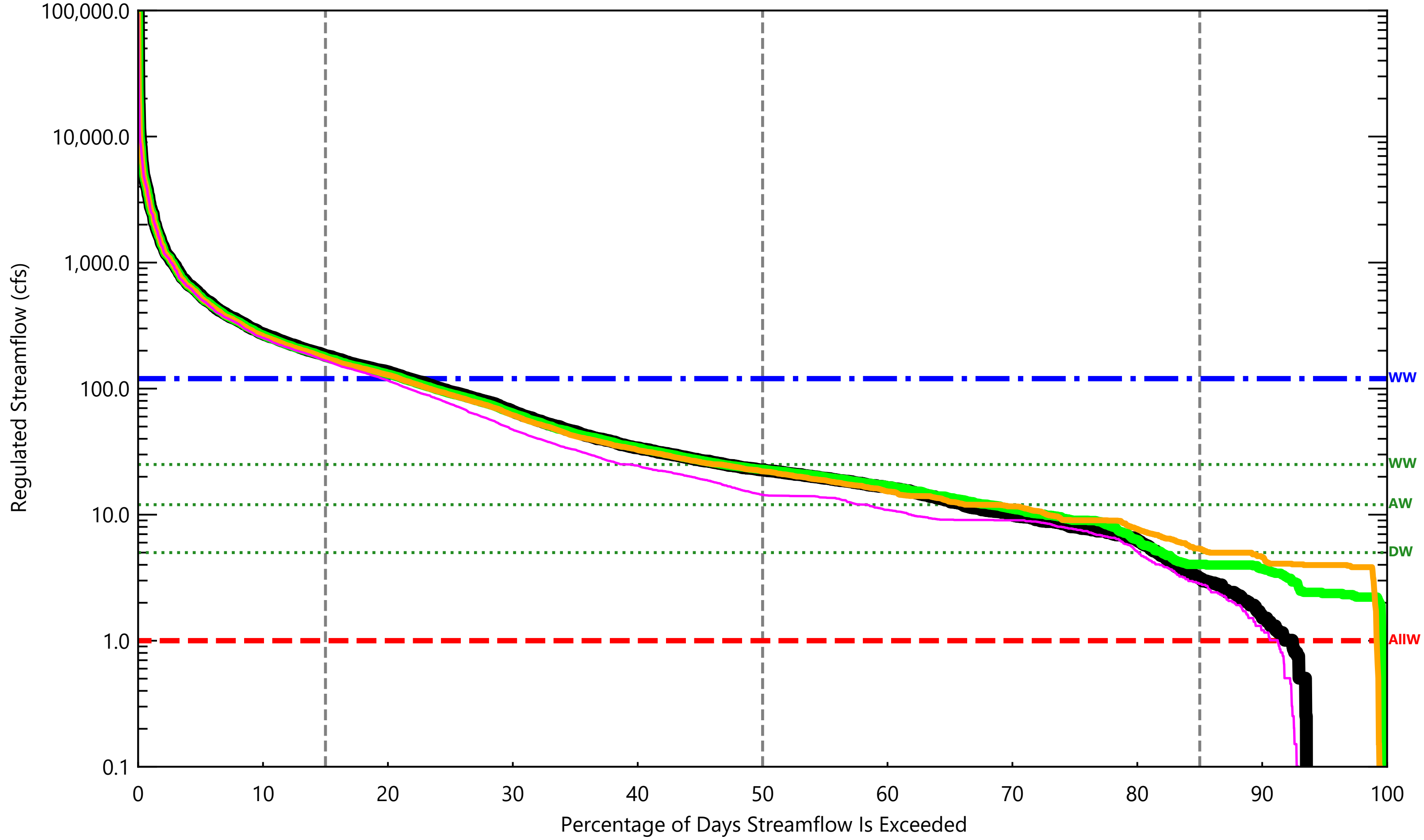
Figure D-33
North Bosque near Clifton
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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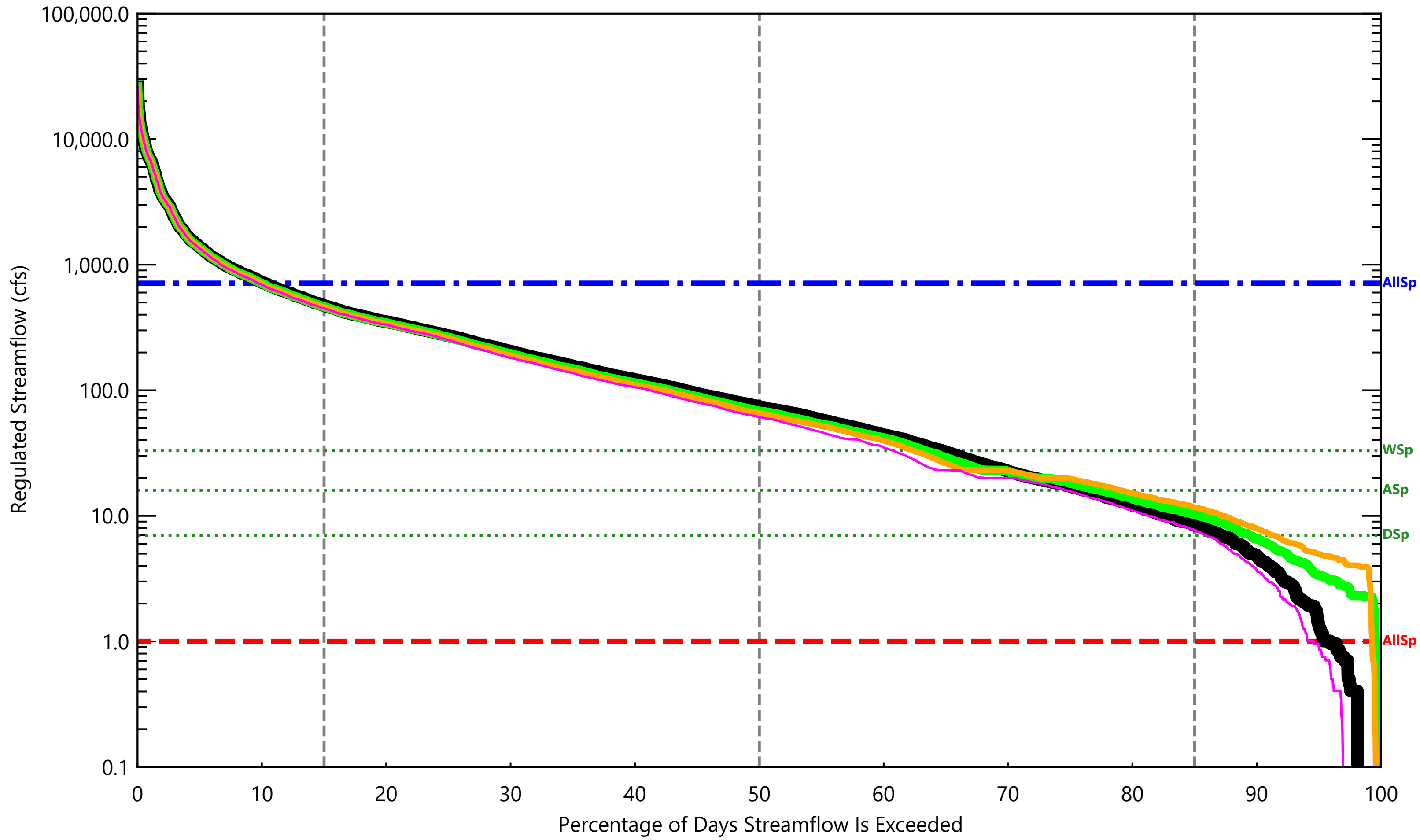
Figure D-34
North Bosque near Clifton
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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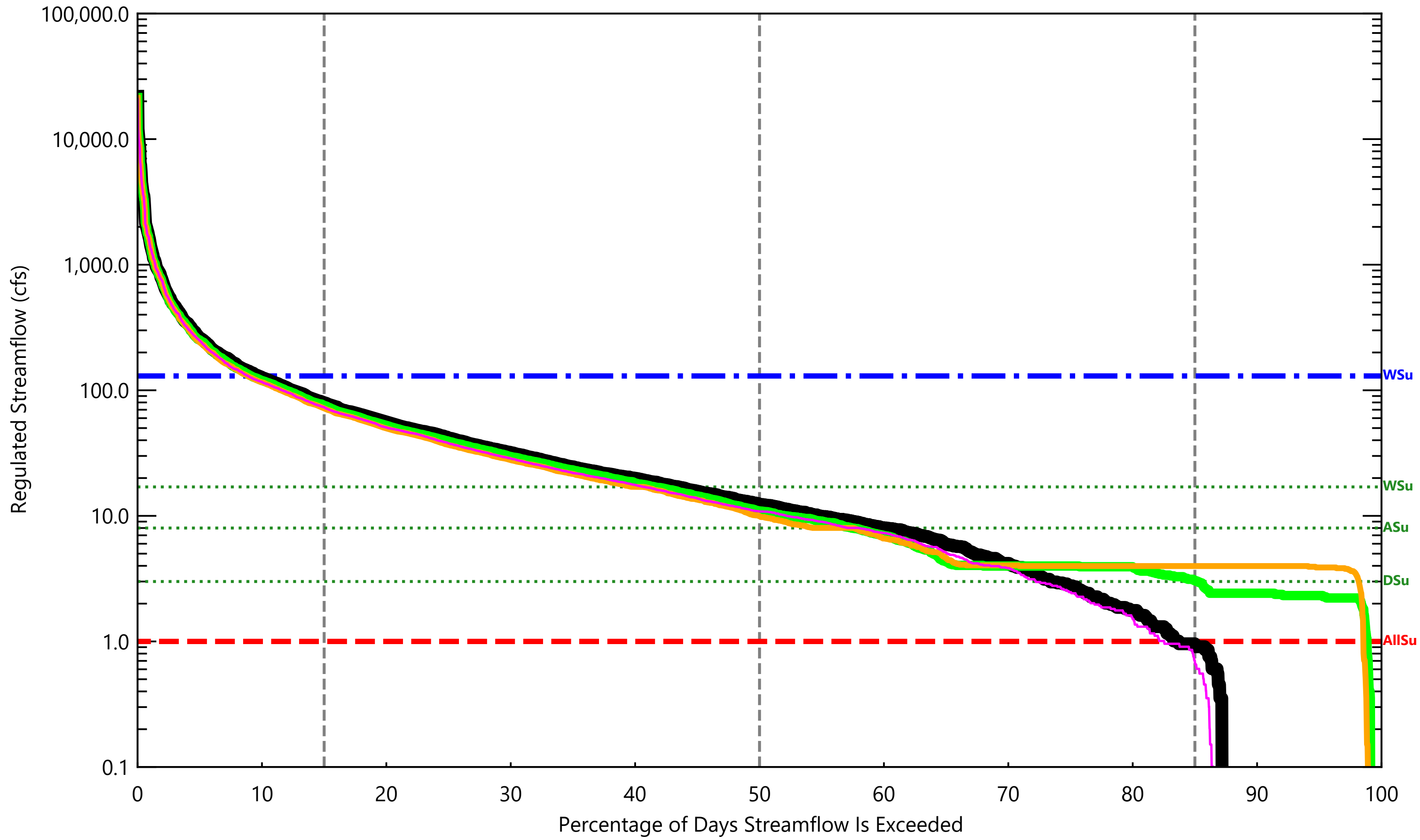
Figure D-35
North Bosque near Clifton
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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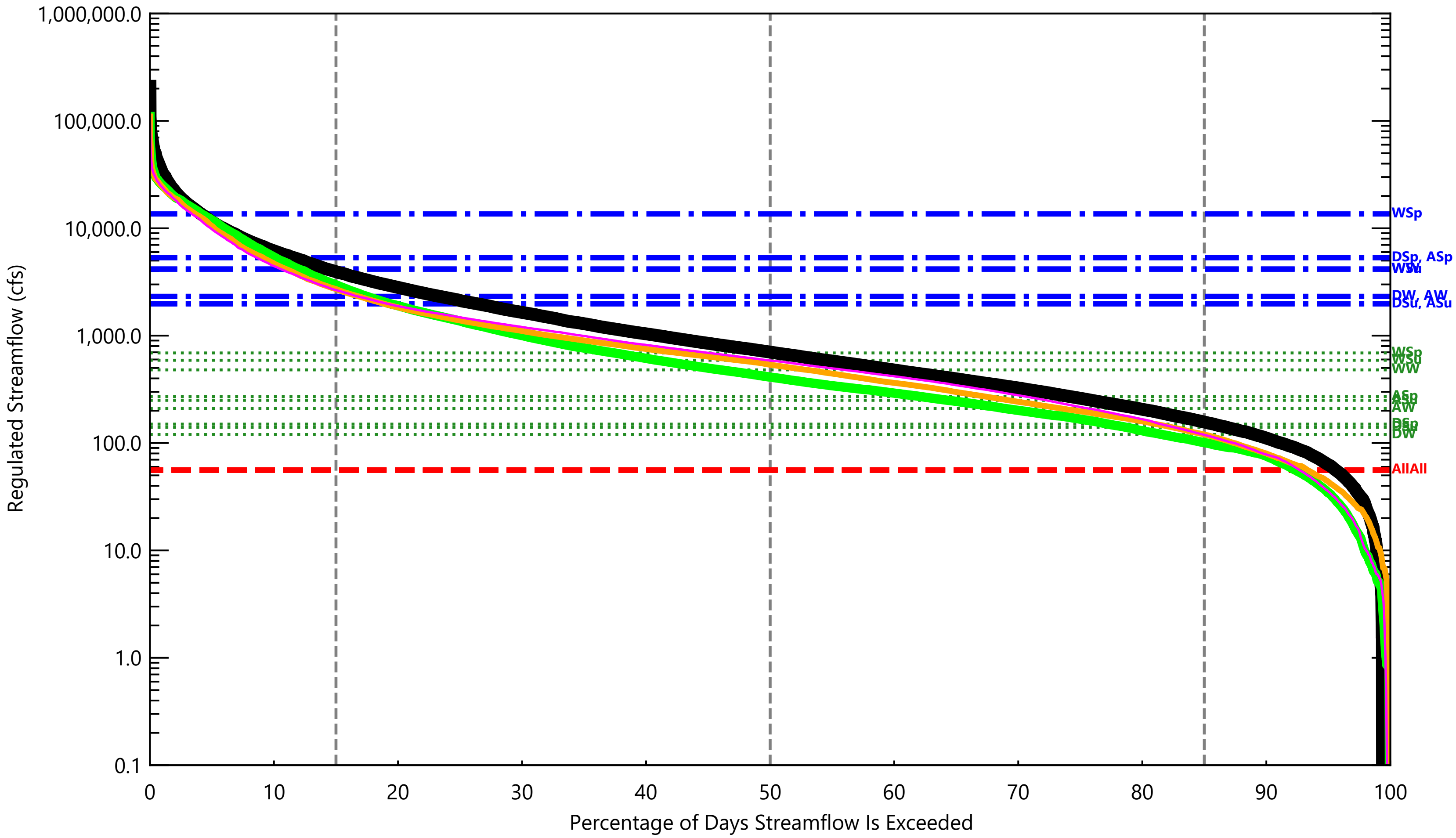
Figure D-36
North Bosque near Clifton
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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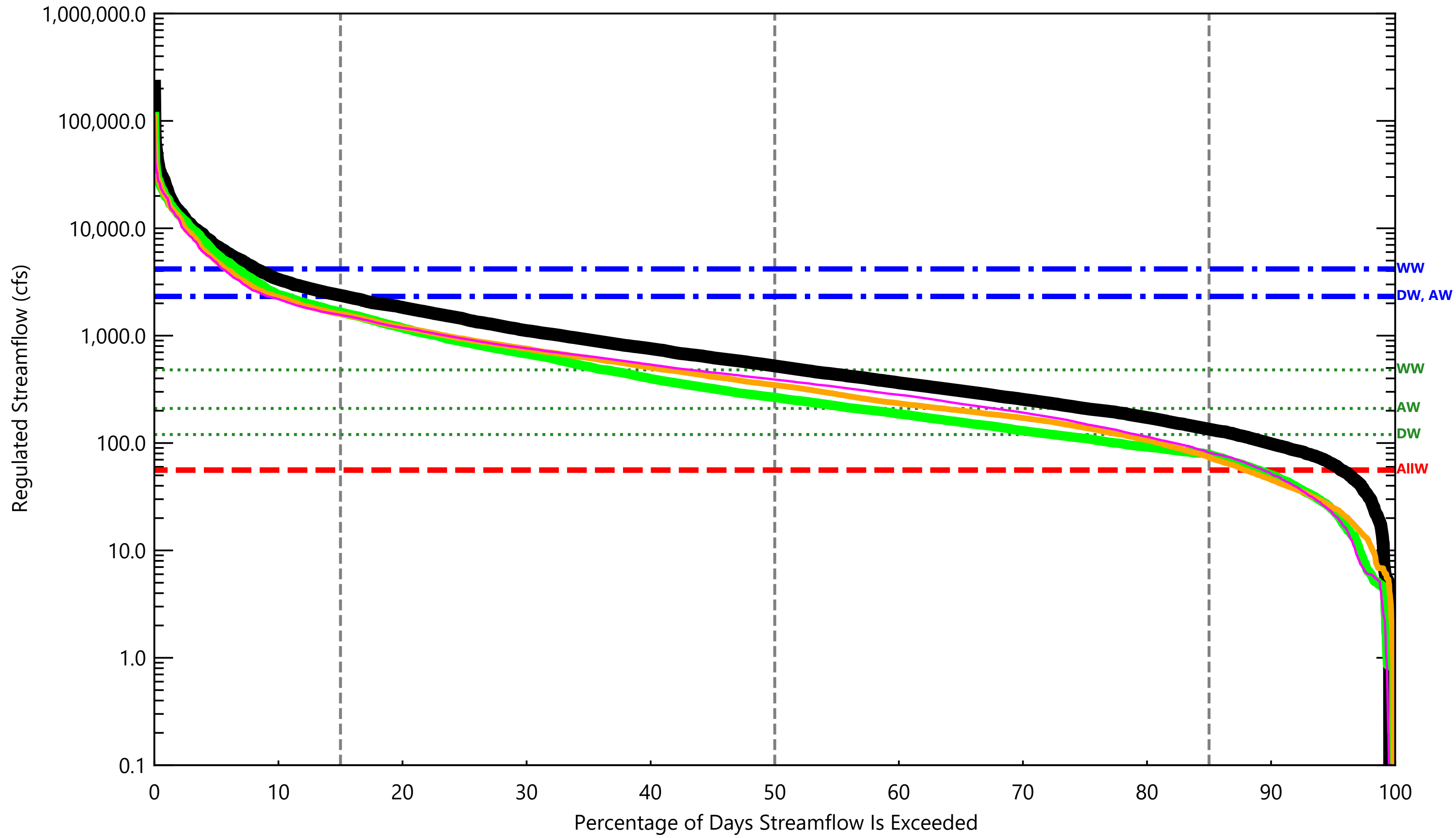
Figure D-37
Brazos River near Waco
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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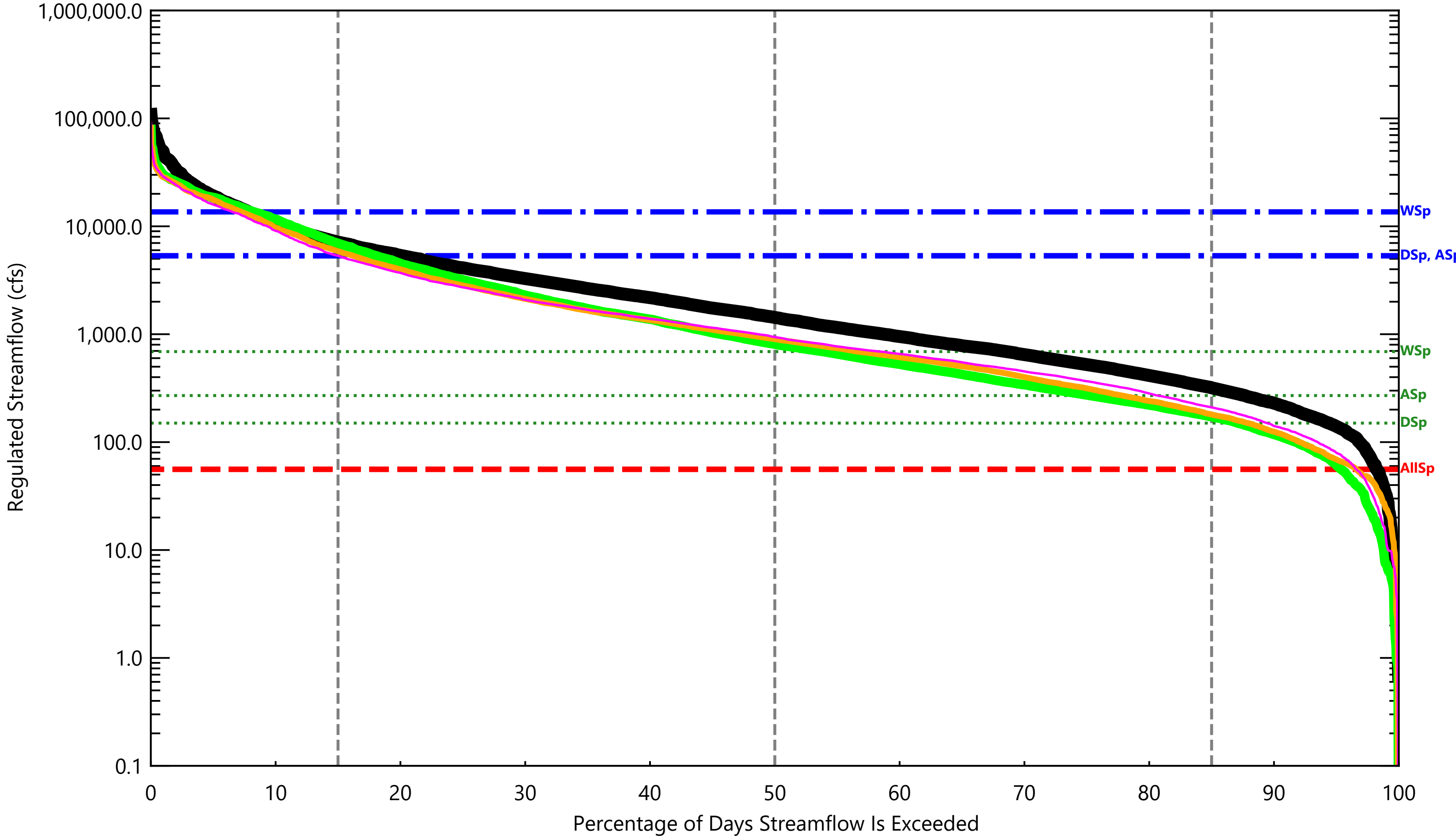
Figure D-38
Brazos River near Waco
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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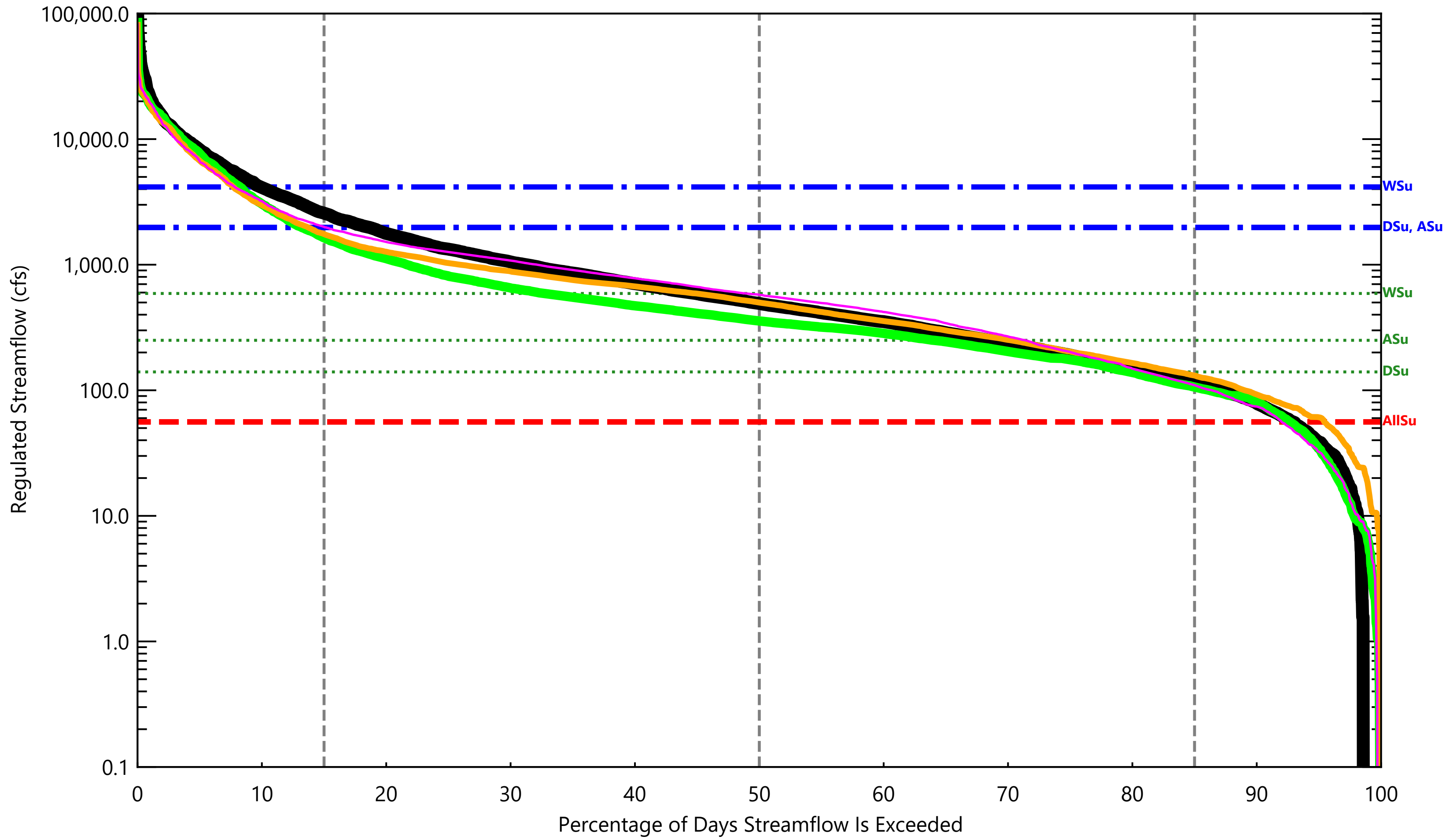
Figure D-39
Brazos River near Waco
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

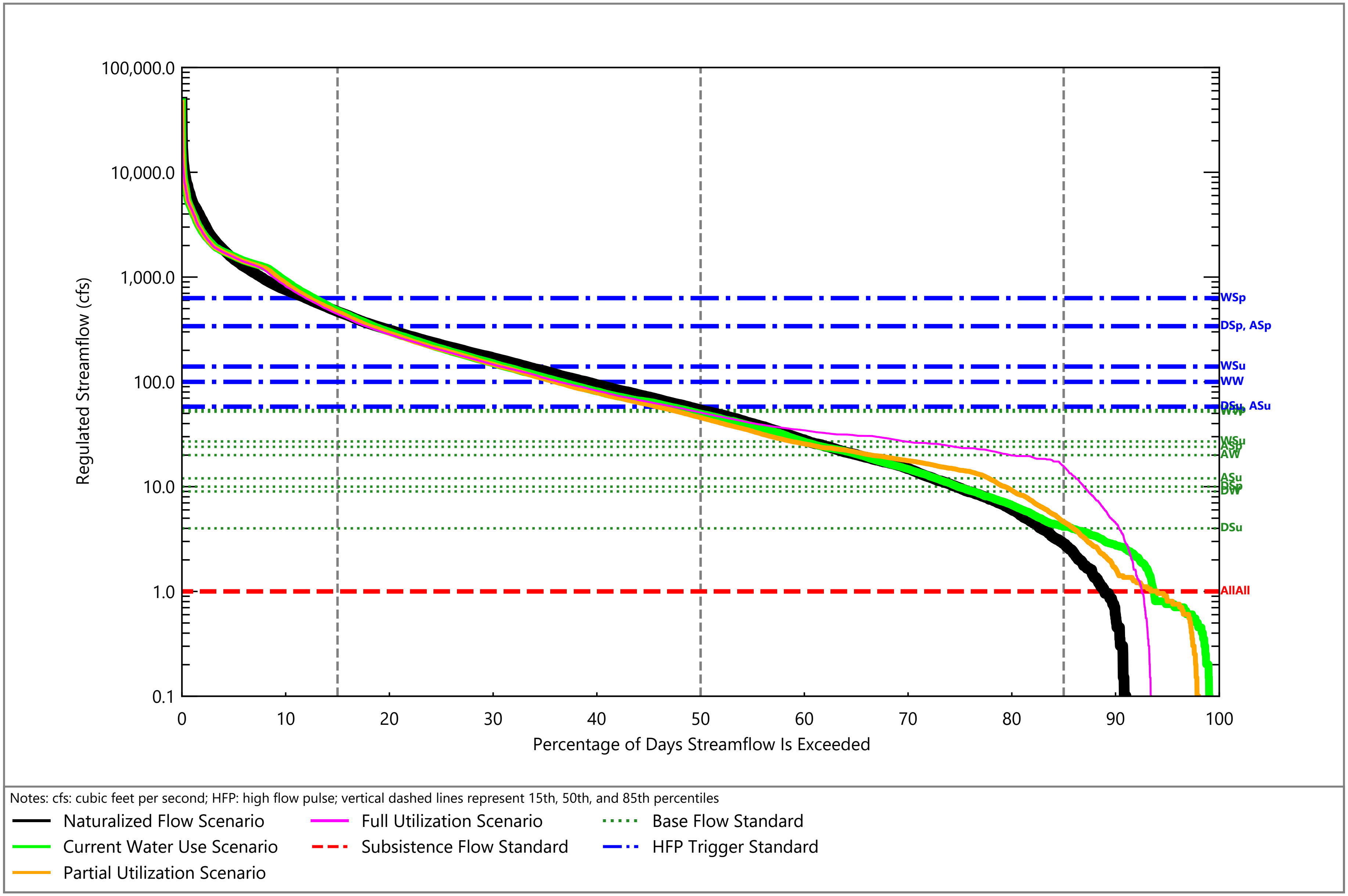

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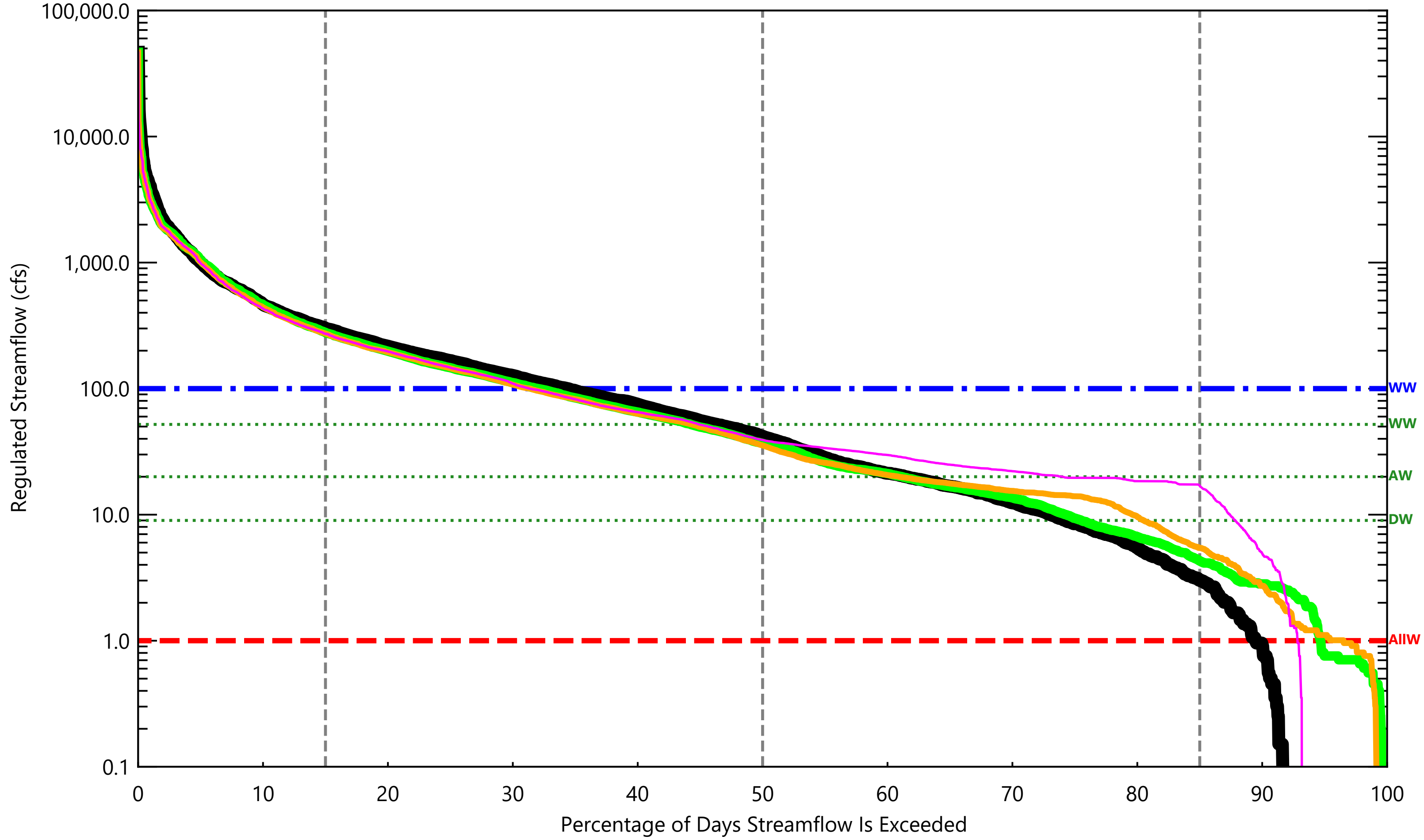
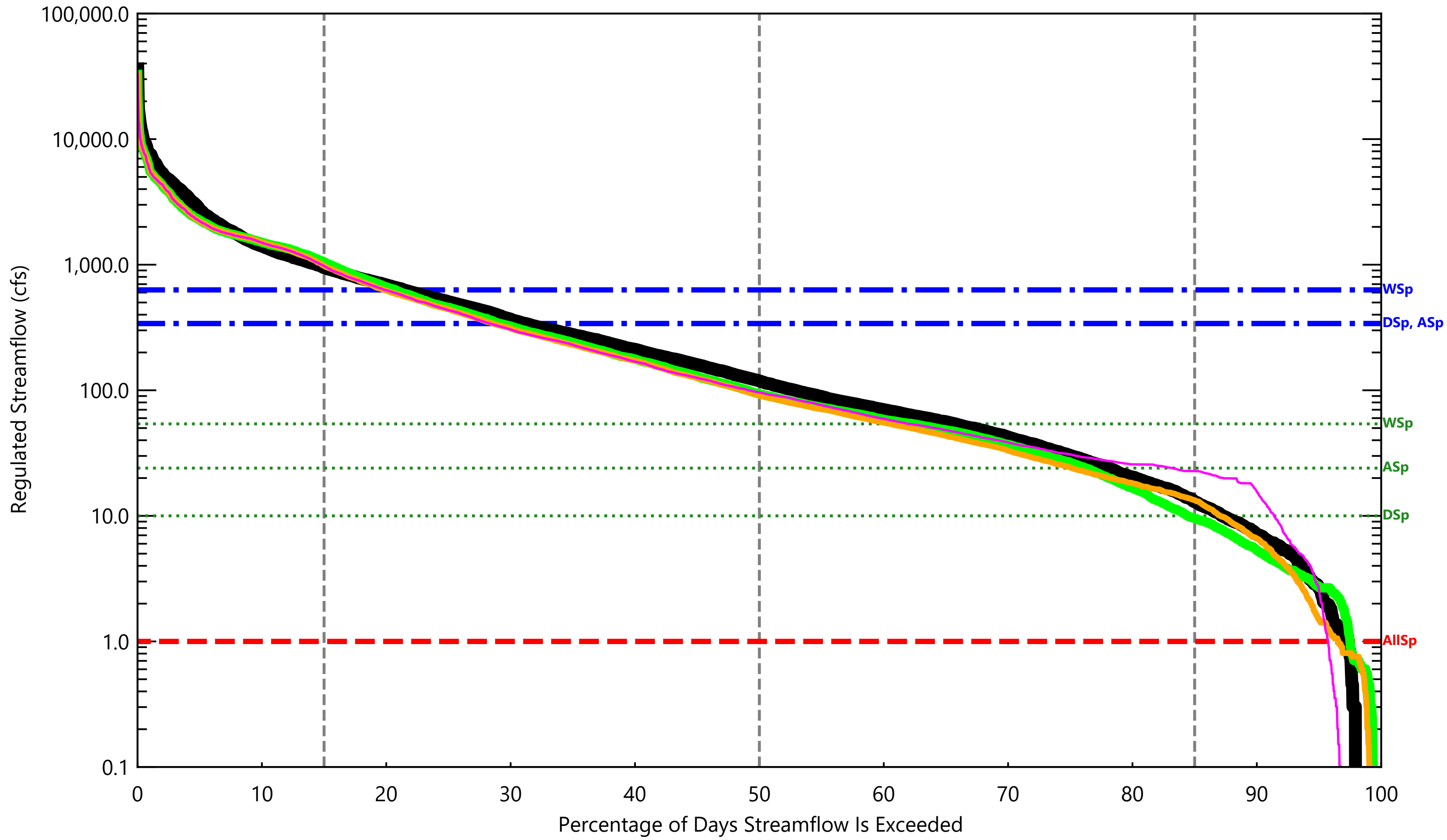
Figure D-41
Leon River at Gatesville
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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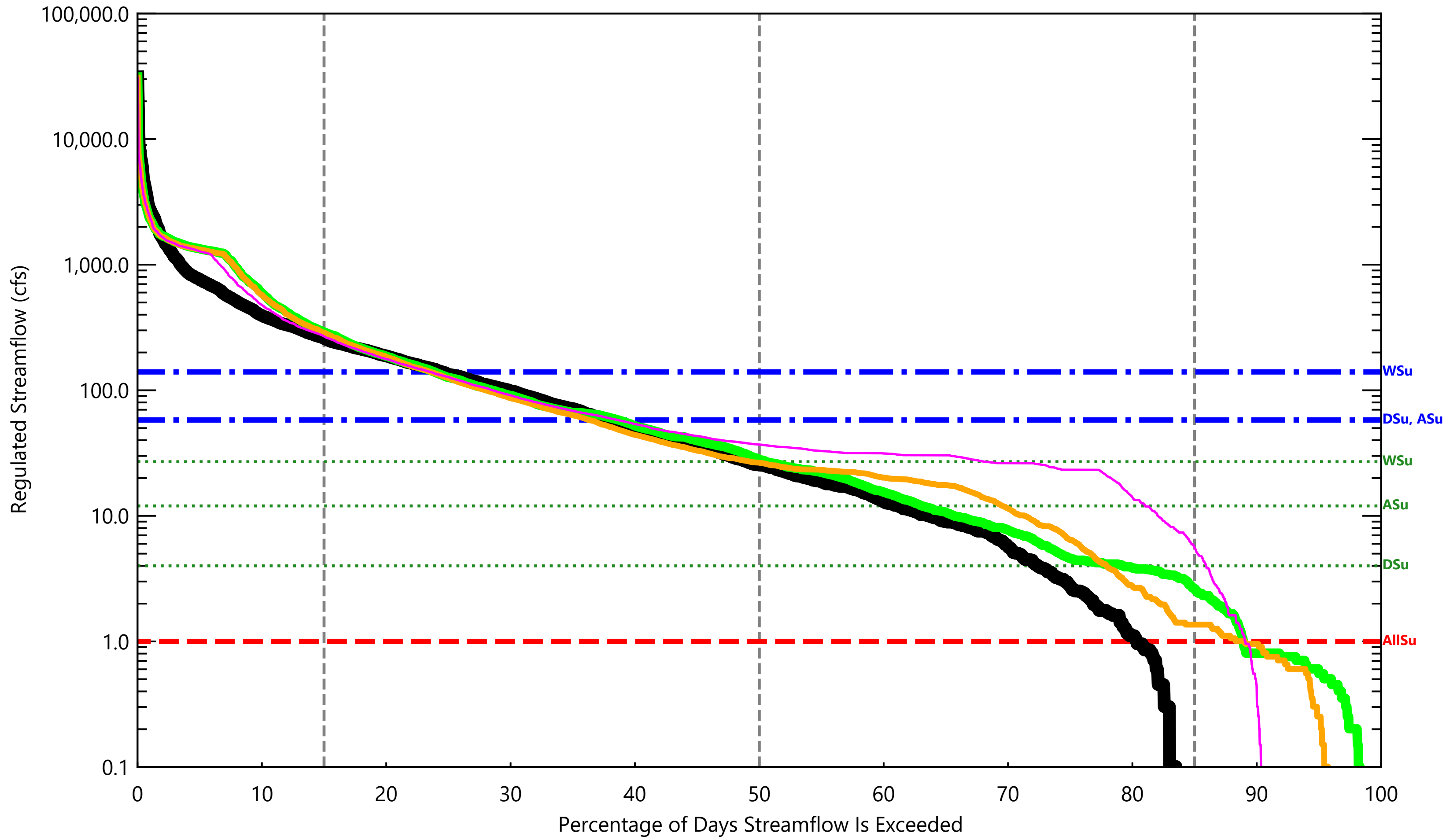
Figure D-43
Leon River at Gatesville
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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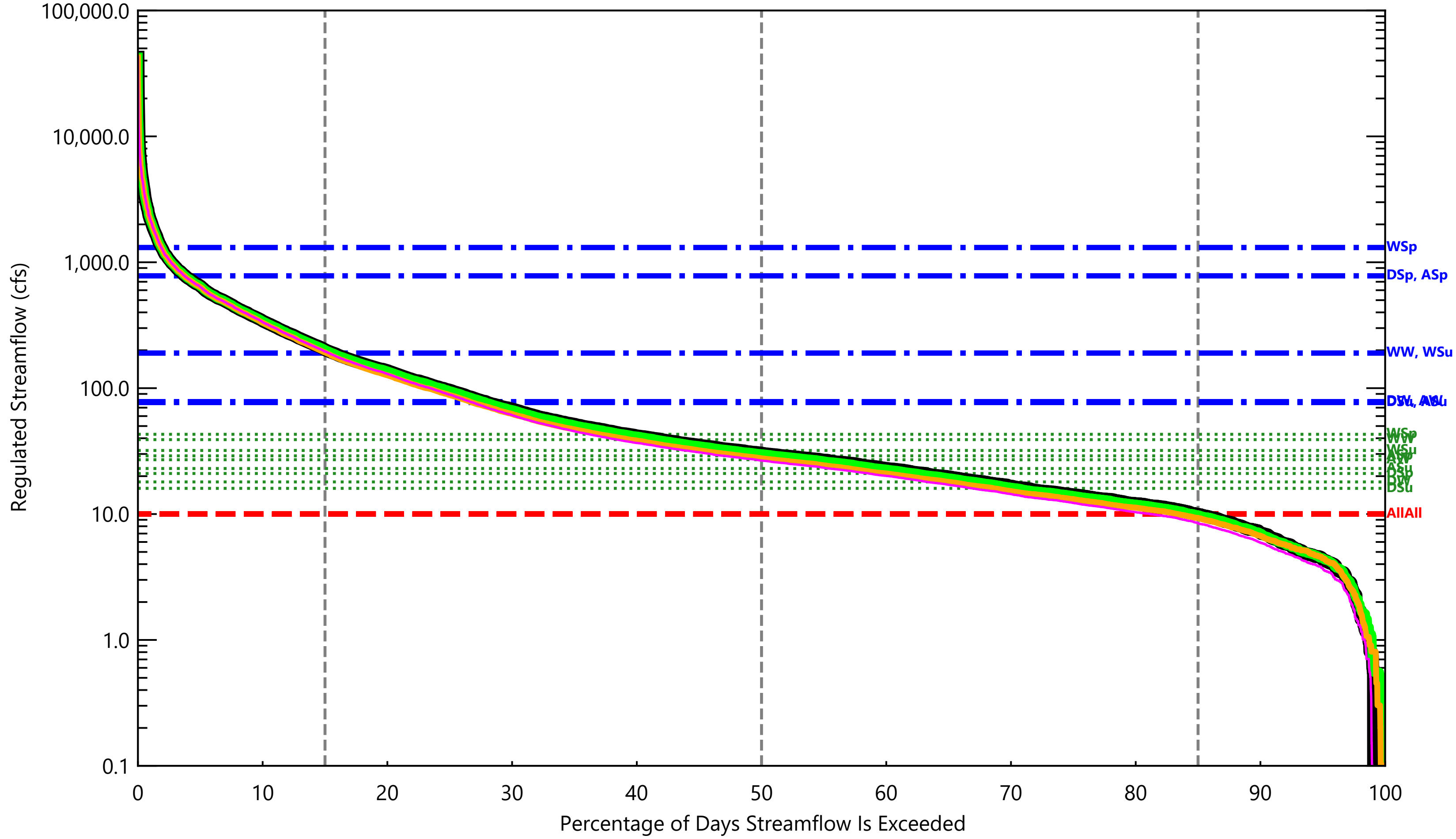
Figure D-44
Leon River at Gatesville
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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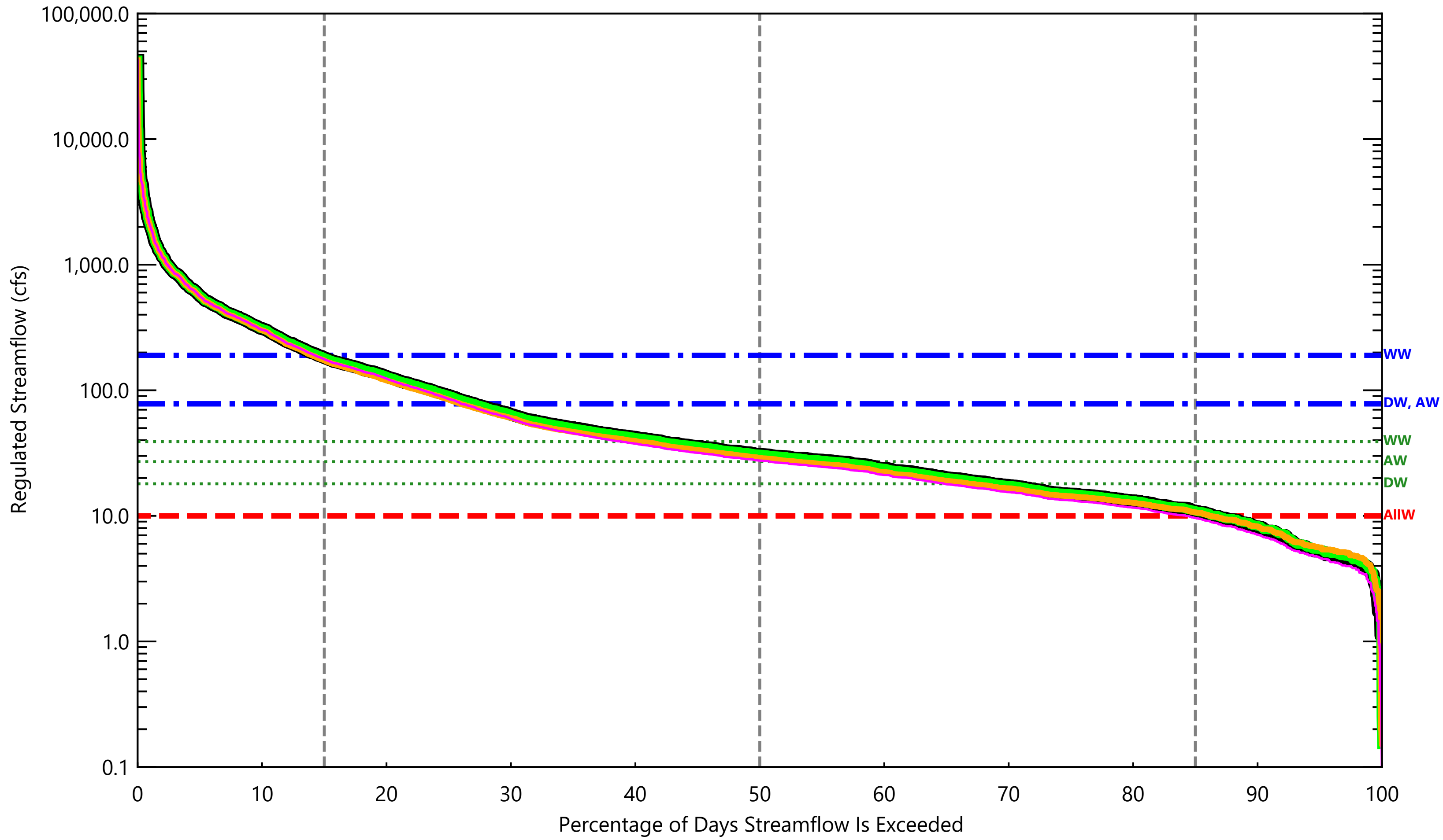
Figure D-45
Lampasas River near Kempner
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:12 PM | User: JH
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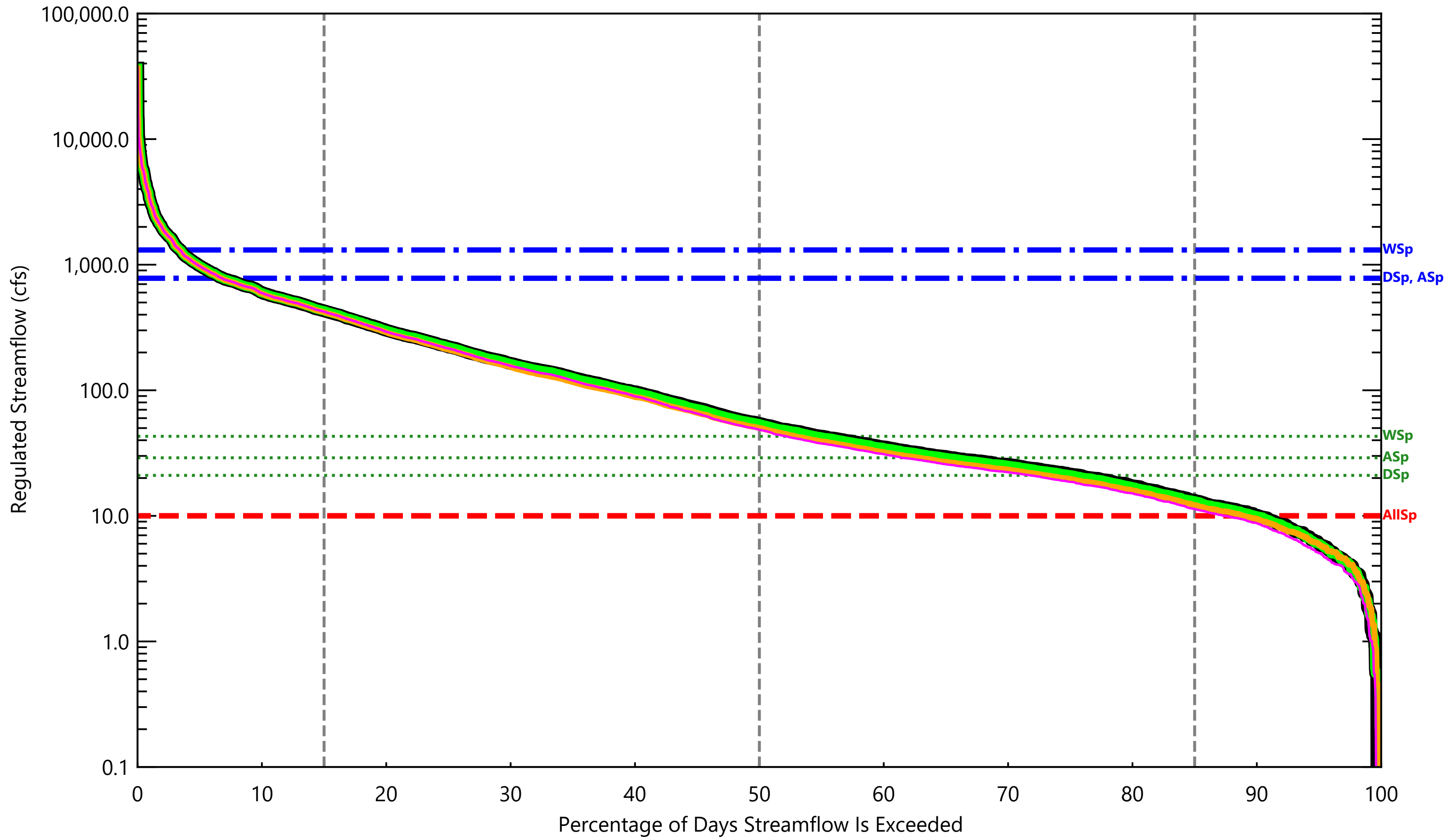
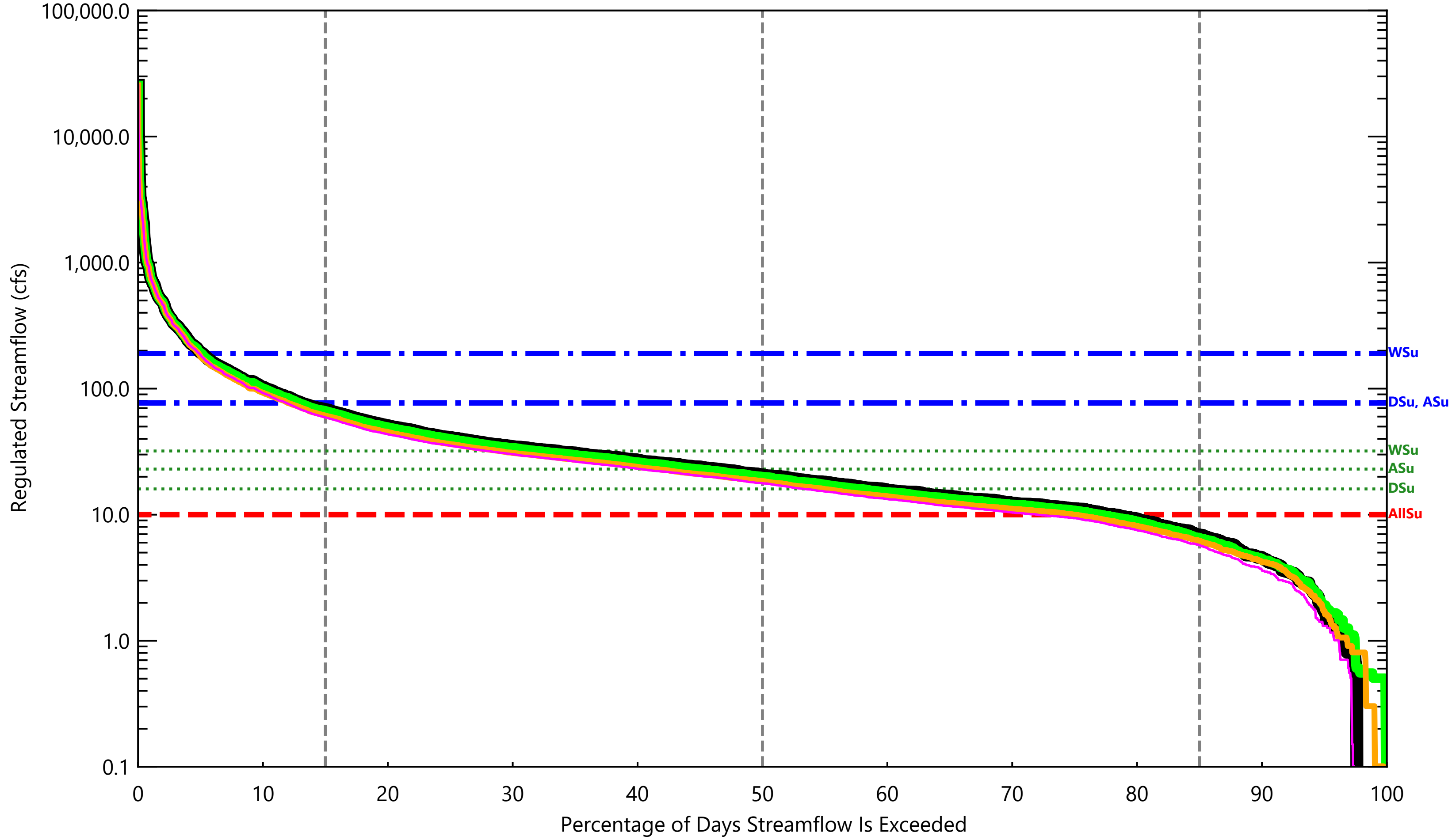
Figure D-46
Lampasas River near Kempner
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Figure D-47
Lampasas River near Kempner
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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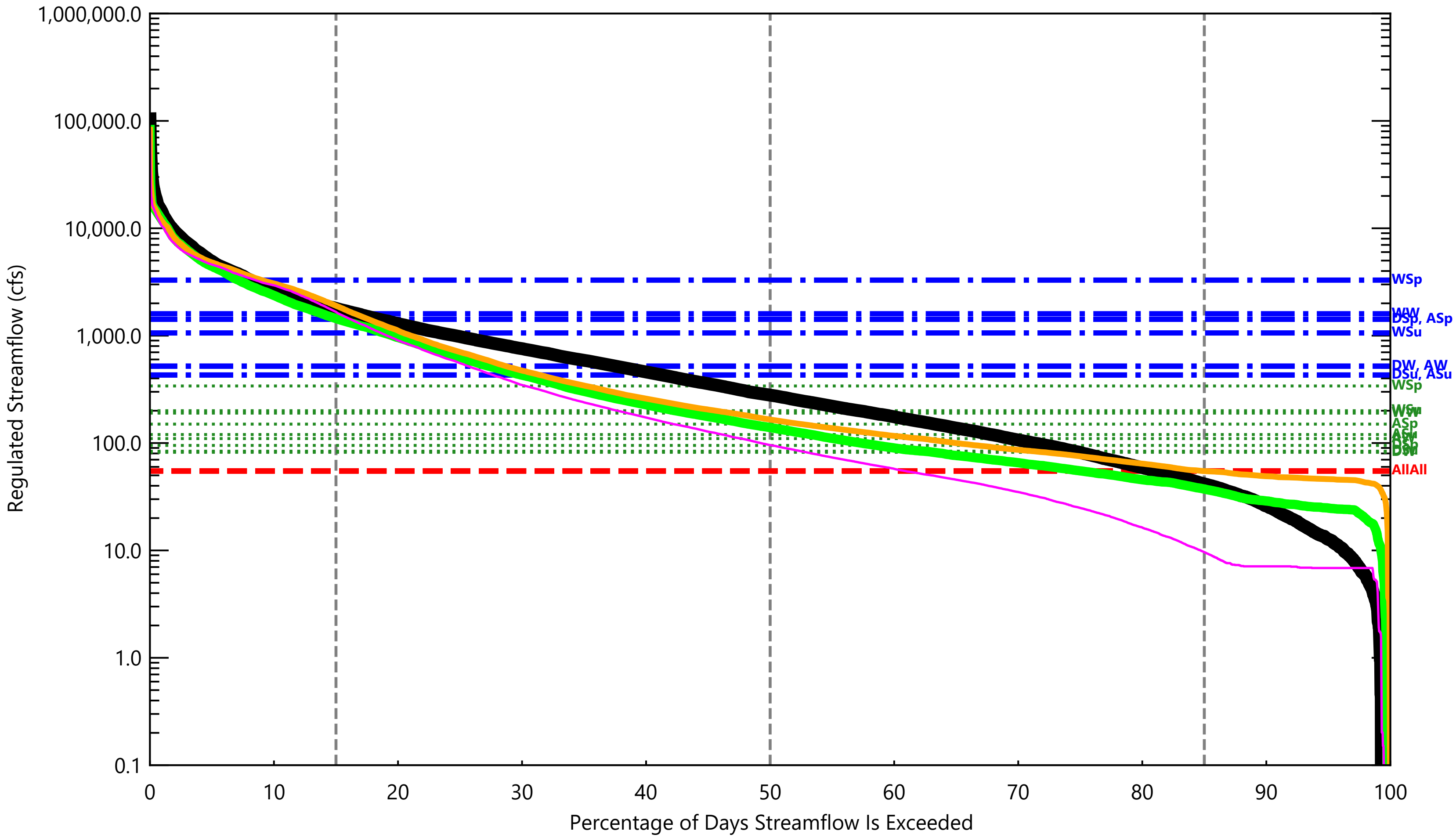
Figure D-48
Lampasas River near Kempner
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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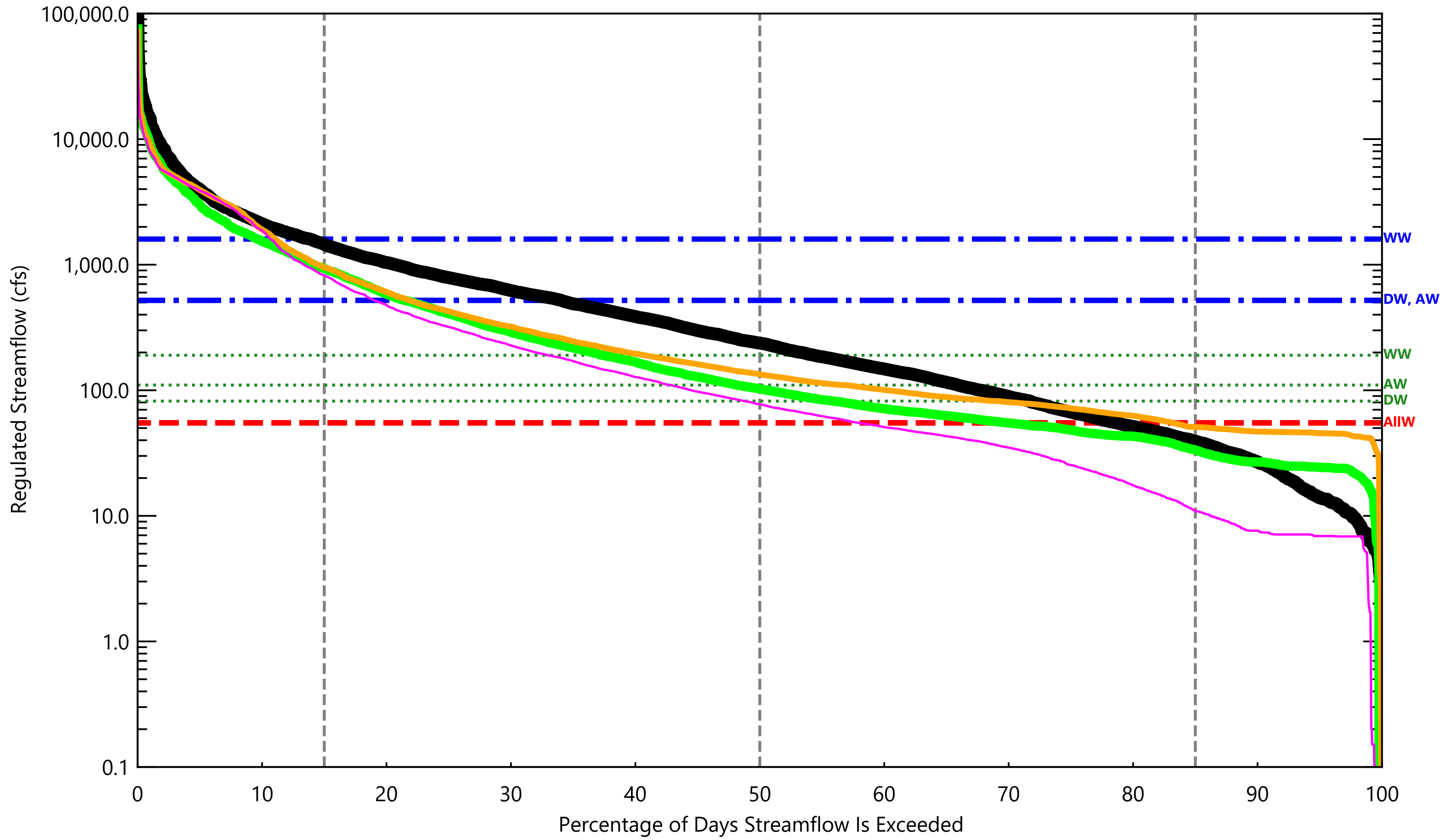
Figure D-49
Little River near Little River
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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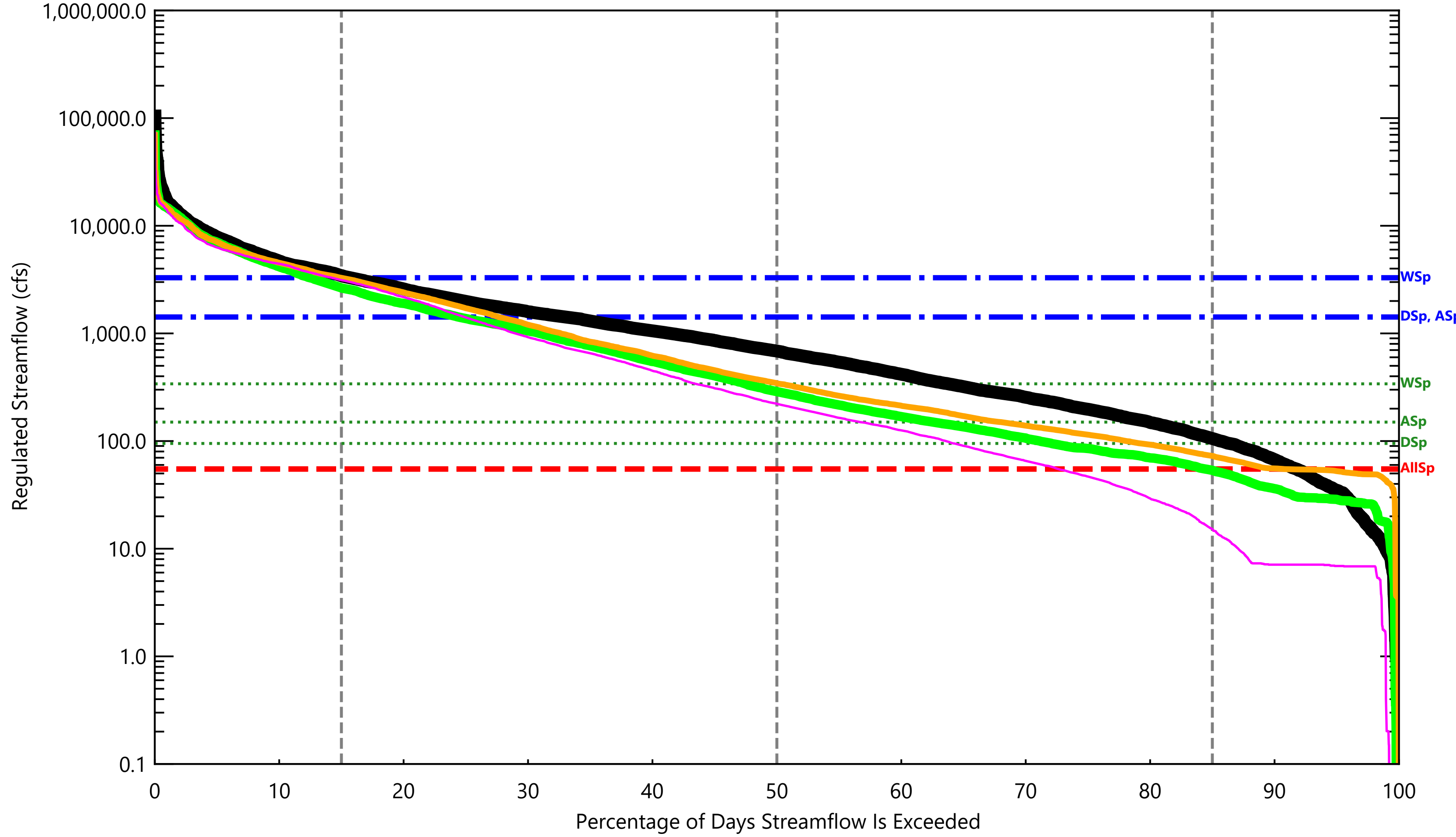
Figure D-50
Little River near Little River
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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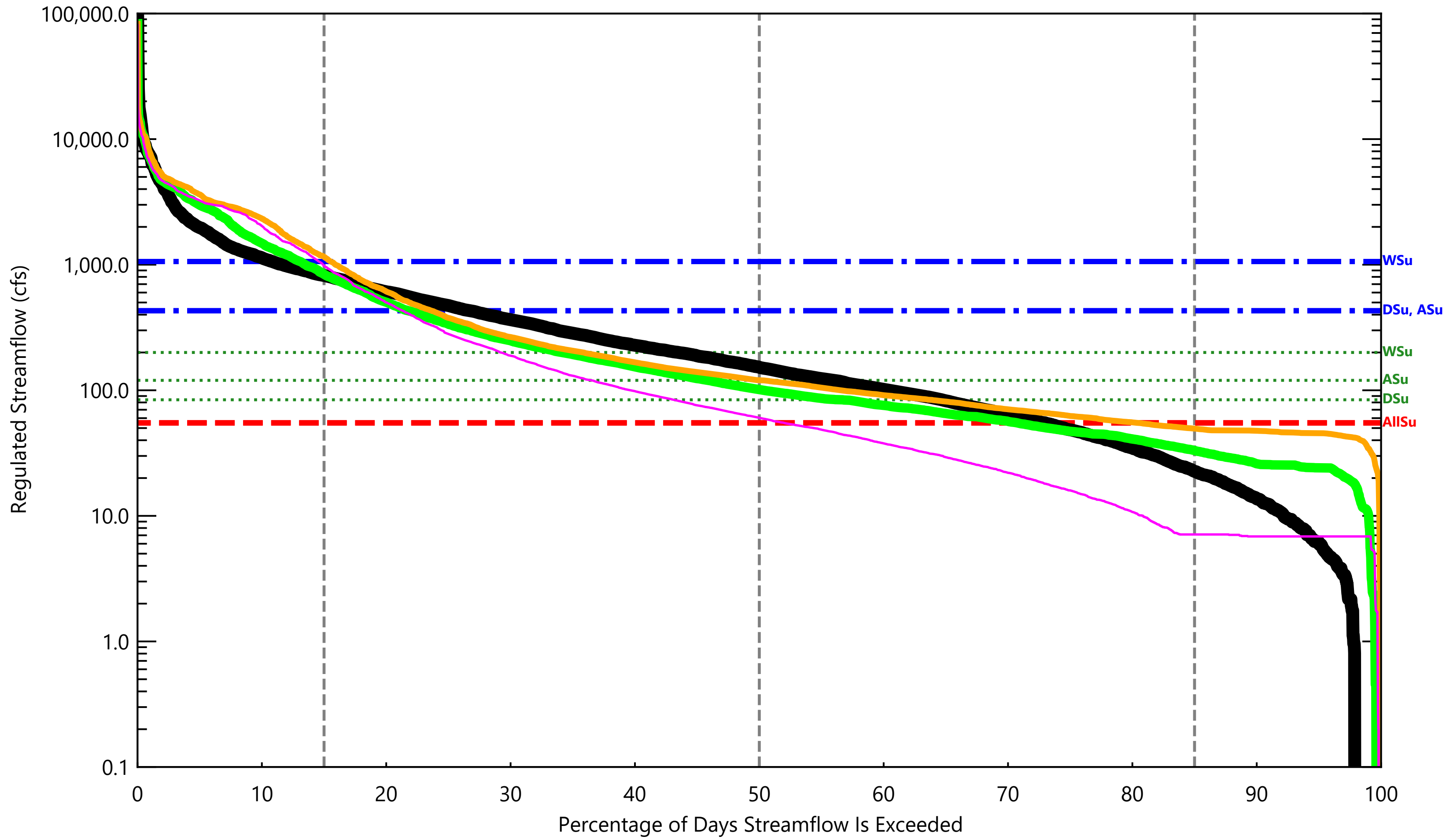
Figure D-51
Little River near Little River
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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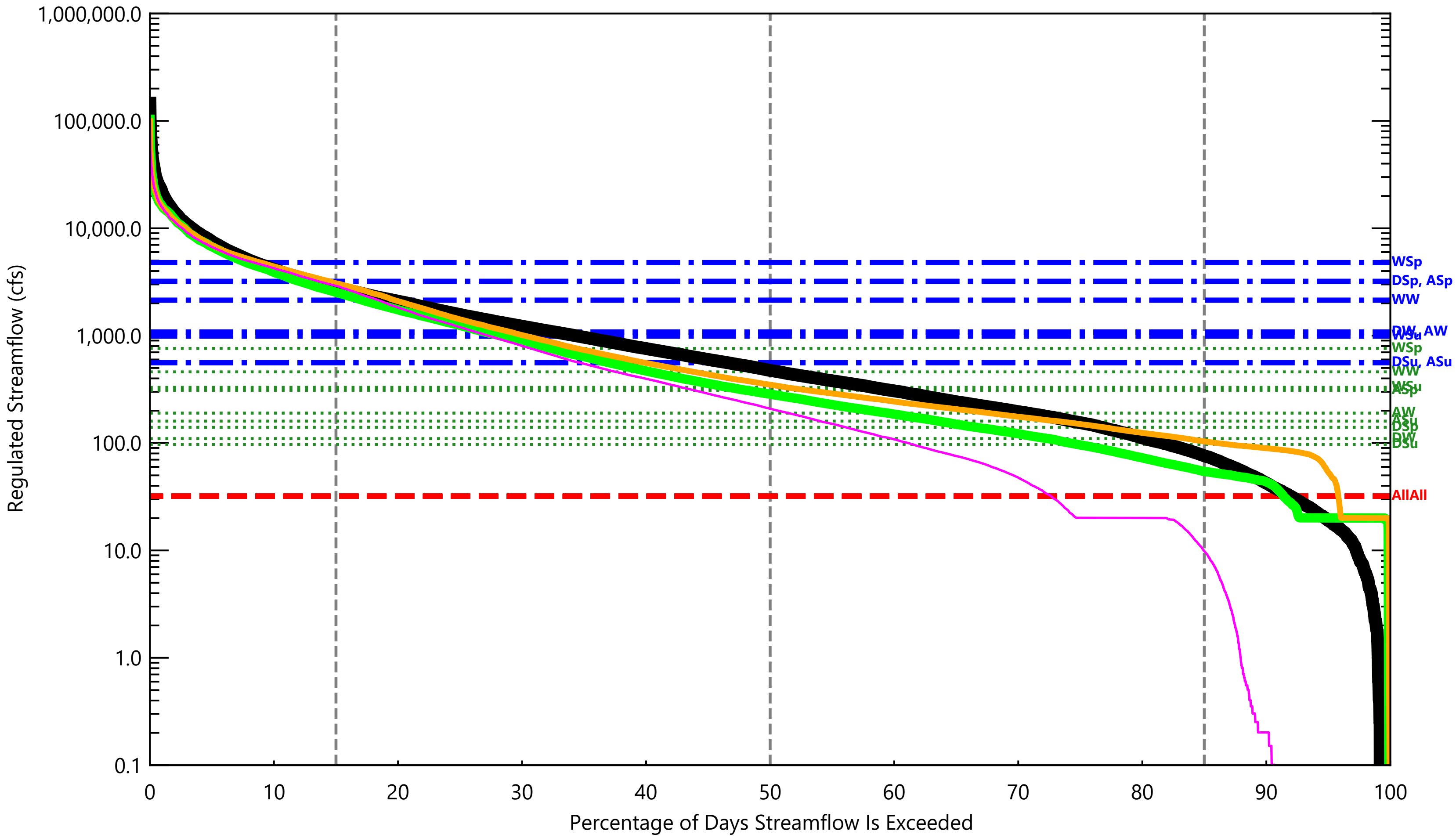
Figure D-52
Little River near Little River
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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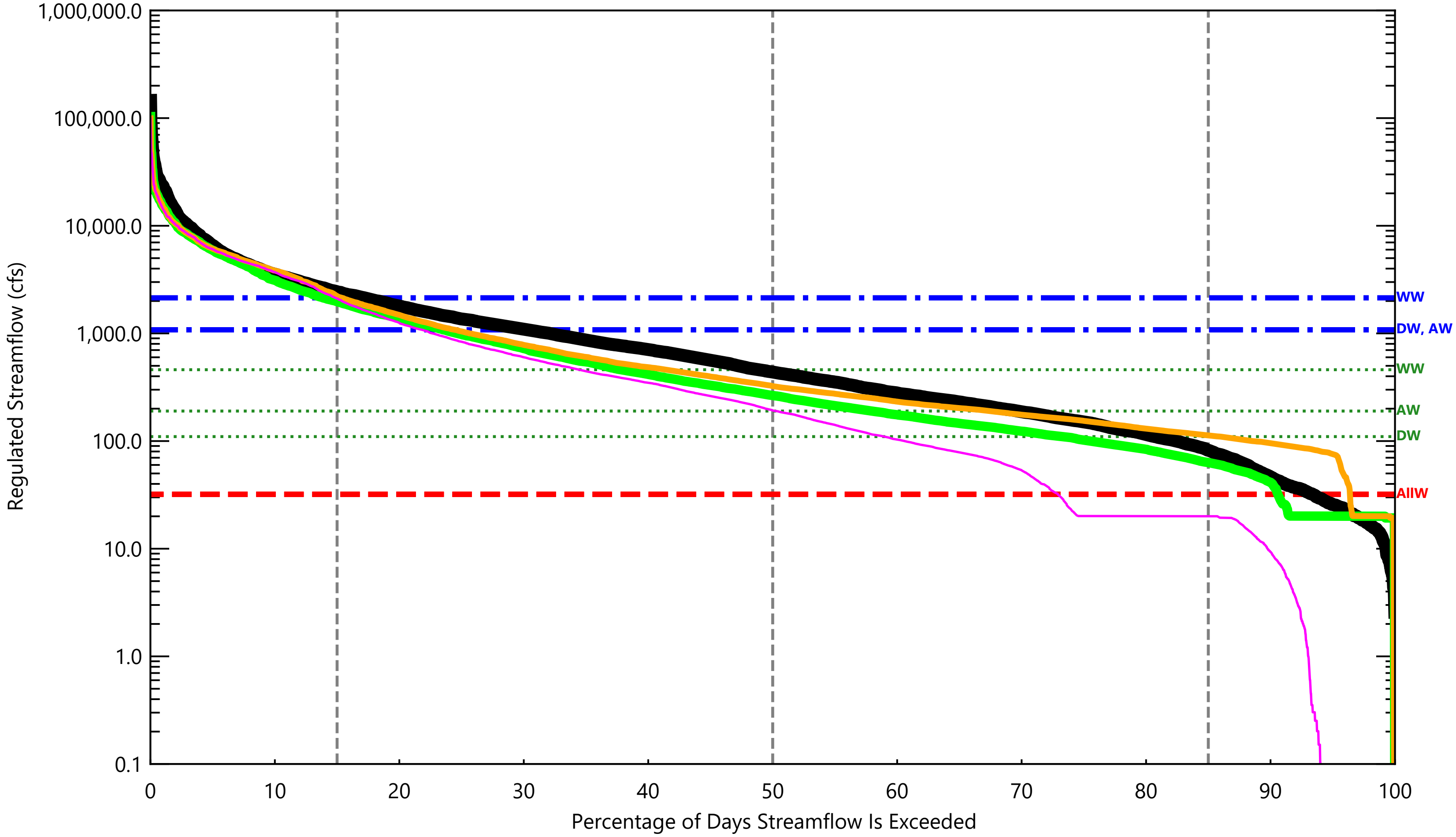
Figure D-53
Little River near Cameron
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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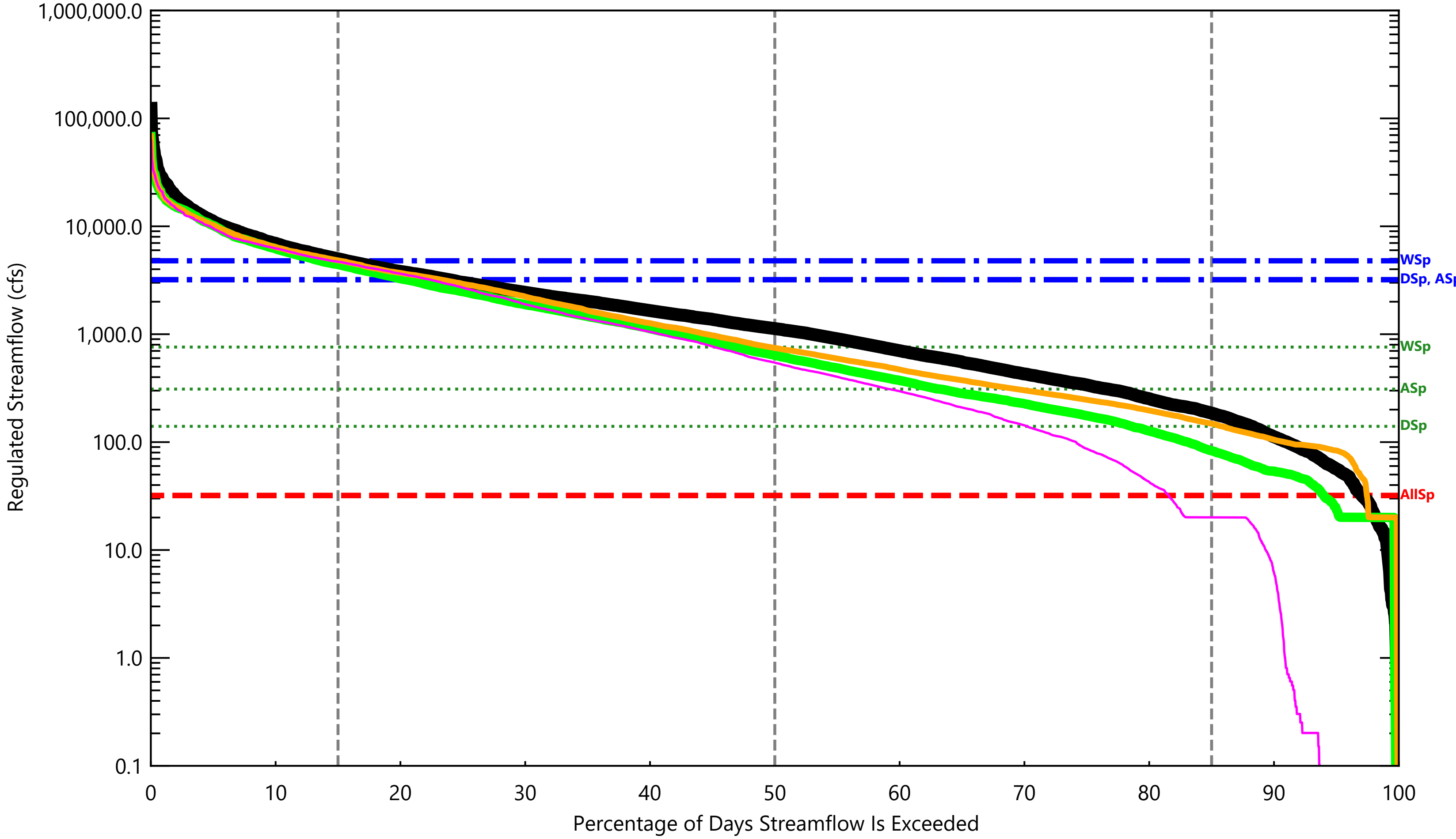
Figure D-54
Little River near Cameron
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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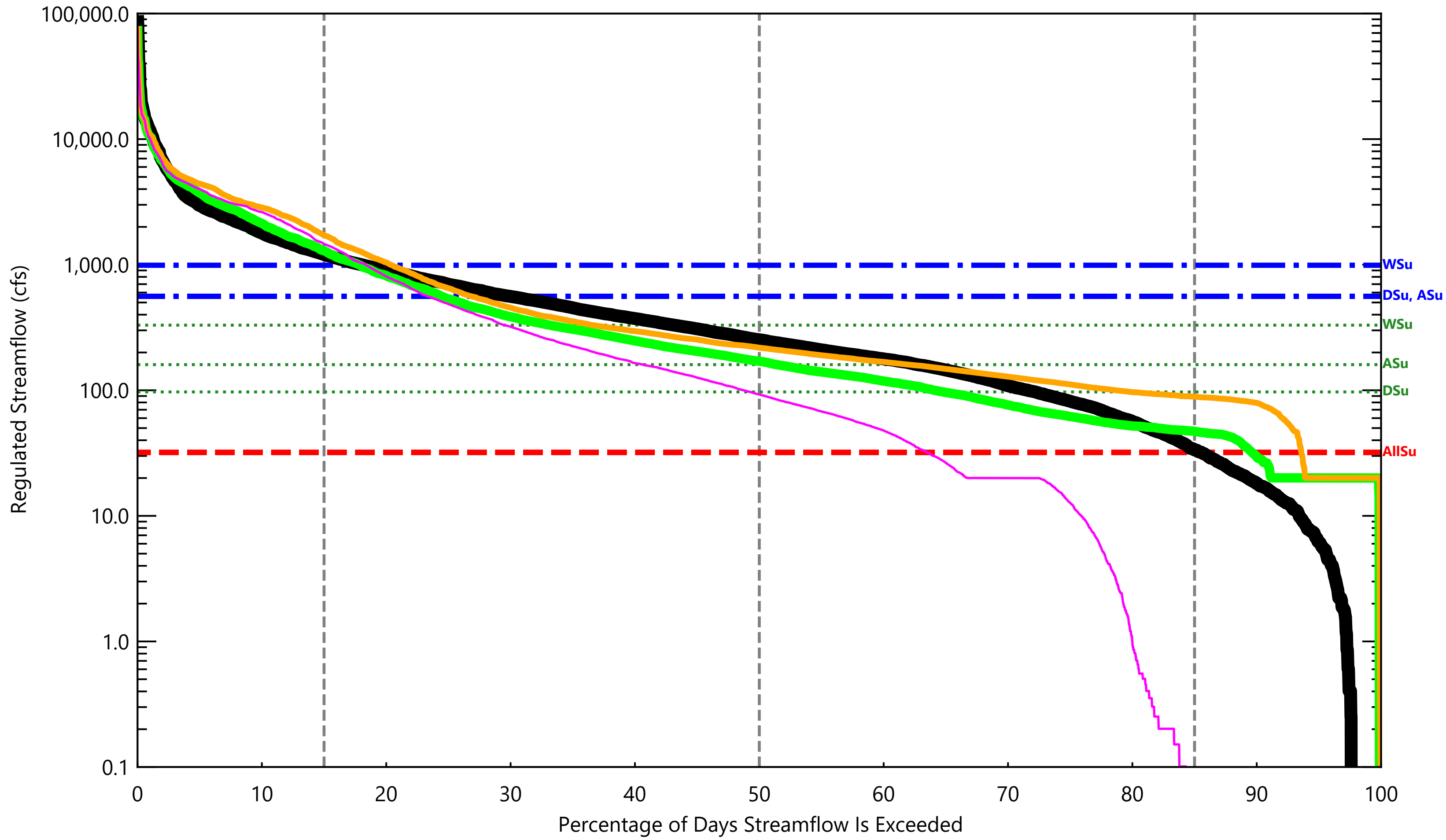
Figure D-55
Little River near Cameron
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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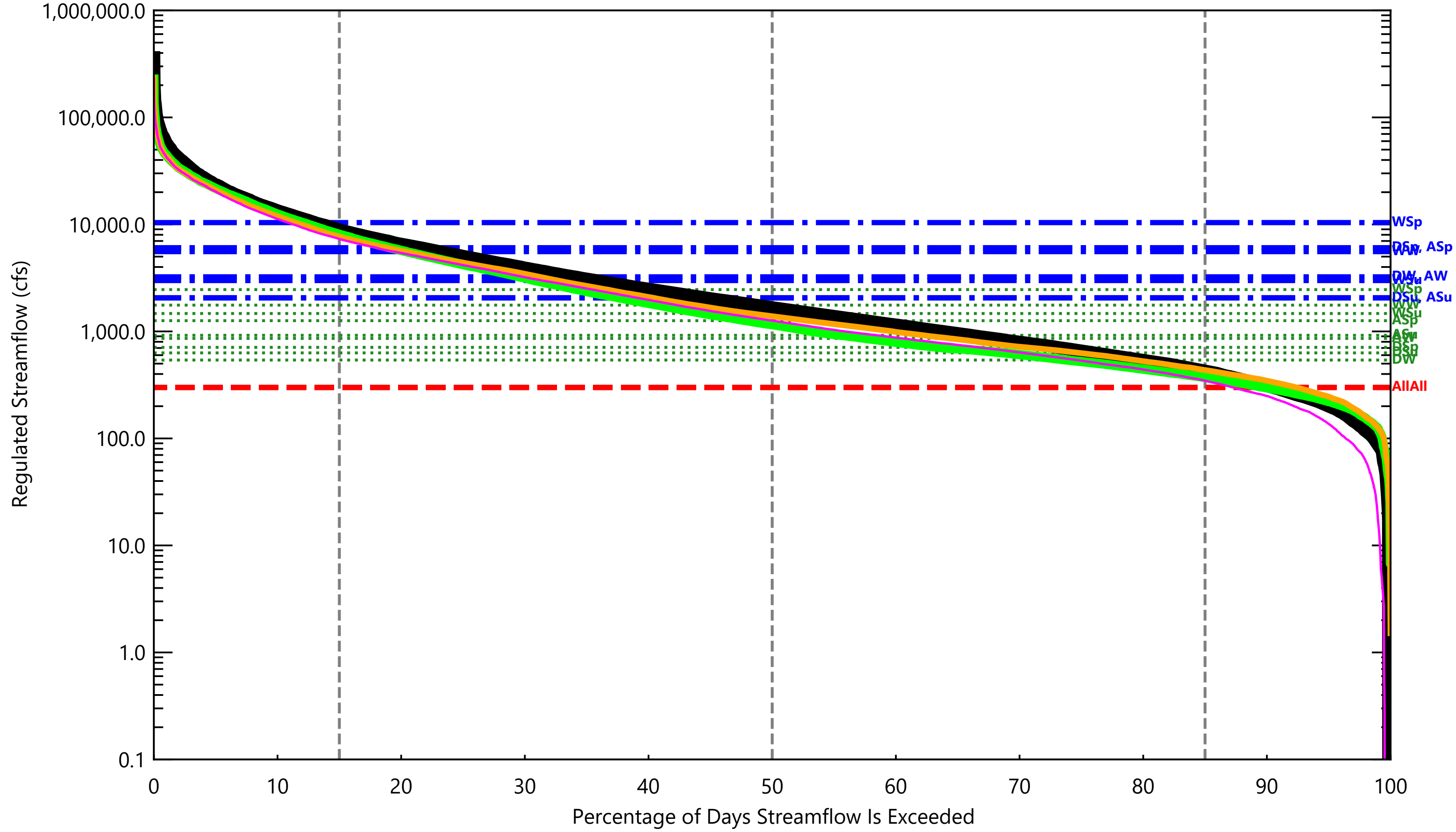
Figure D-56
Little River near Cameron
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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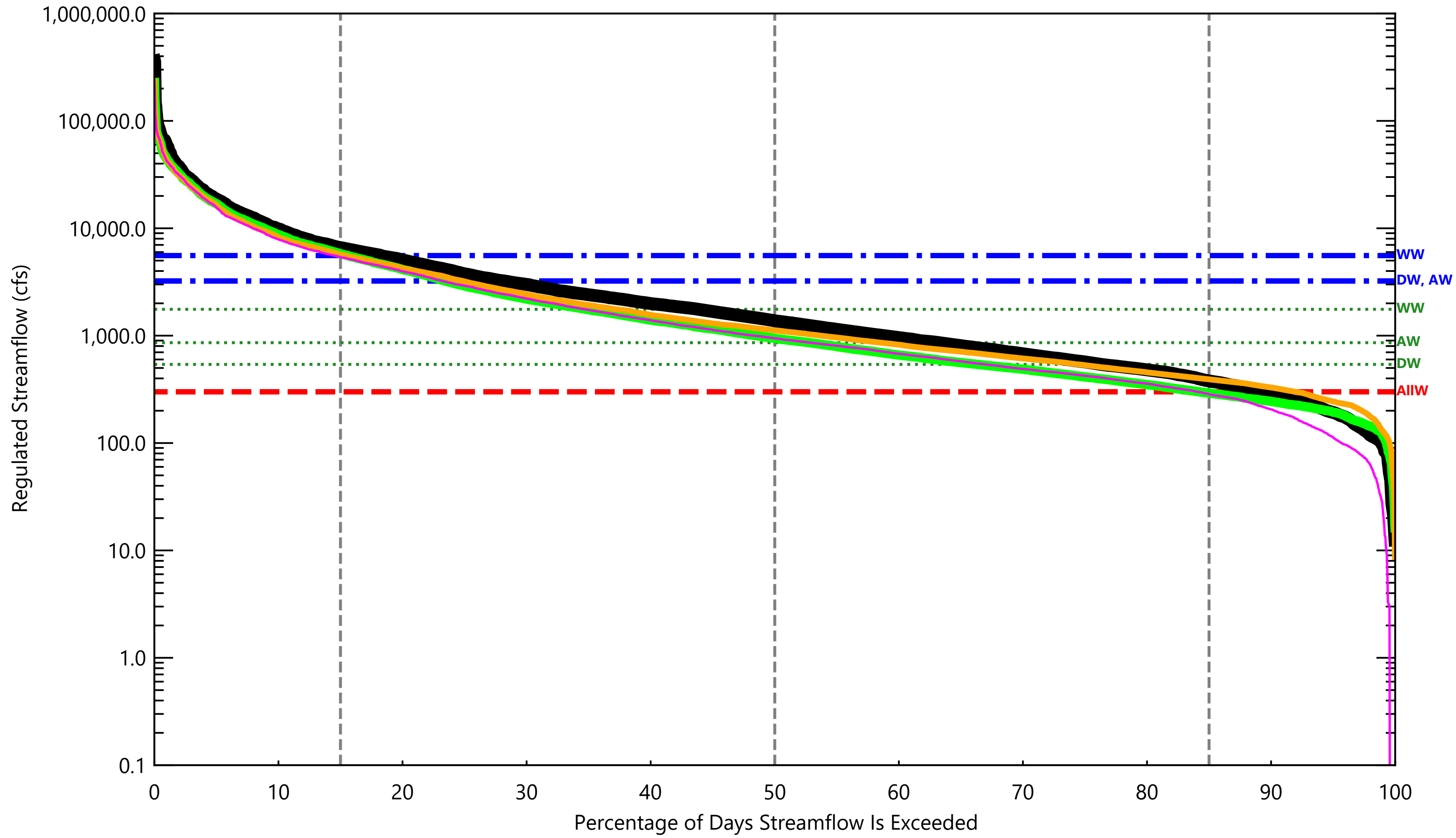
Figure D-57
Brazos River near Bryan
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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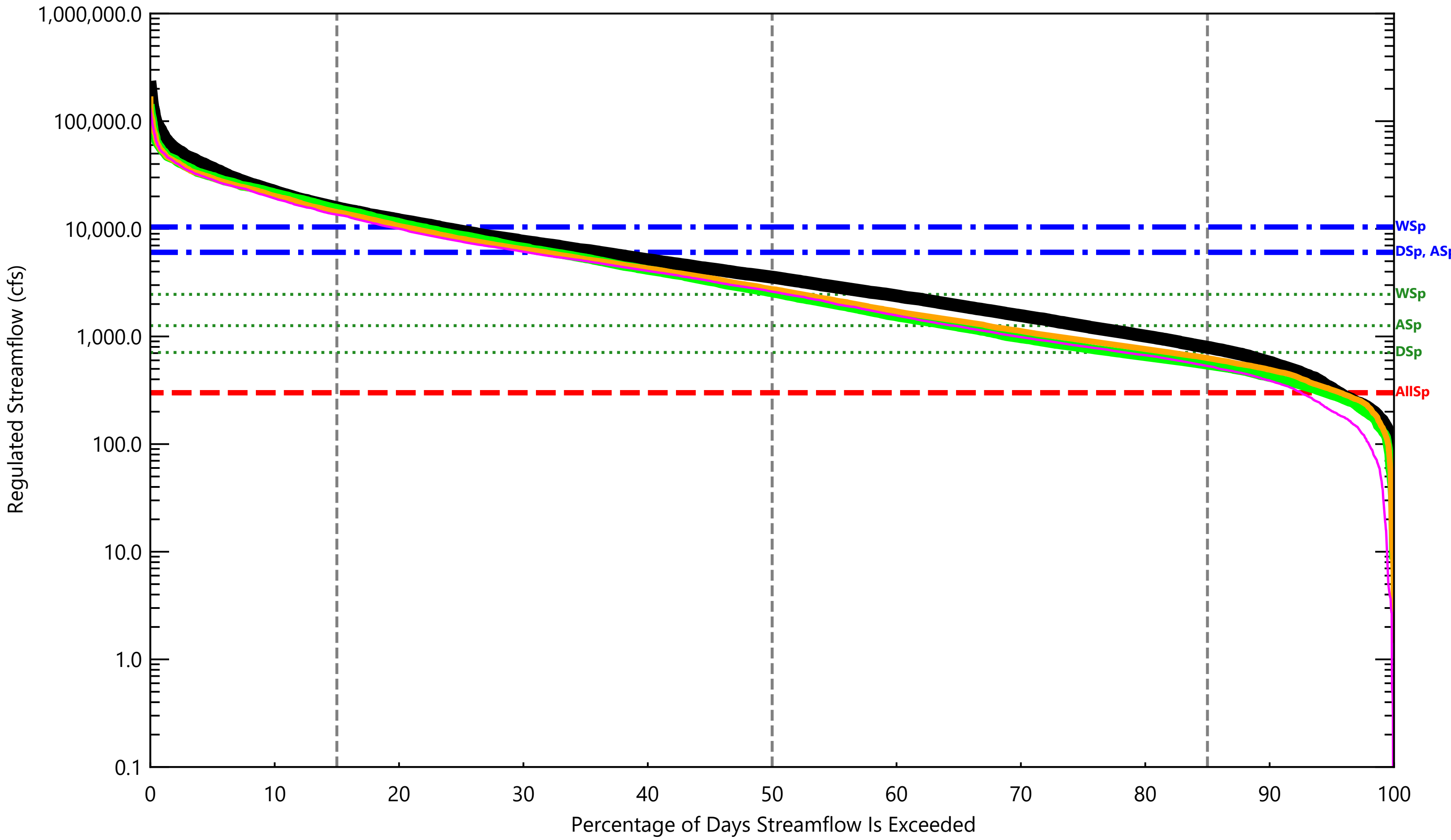
Figure D-58
Brazos River near Bryan
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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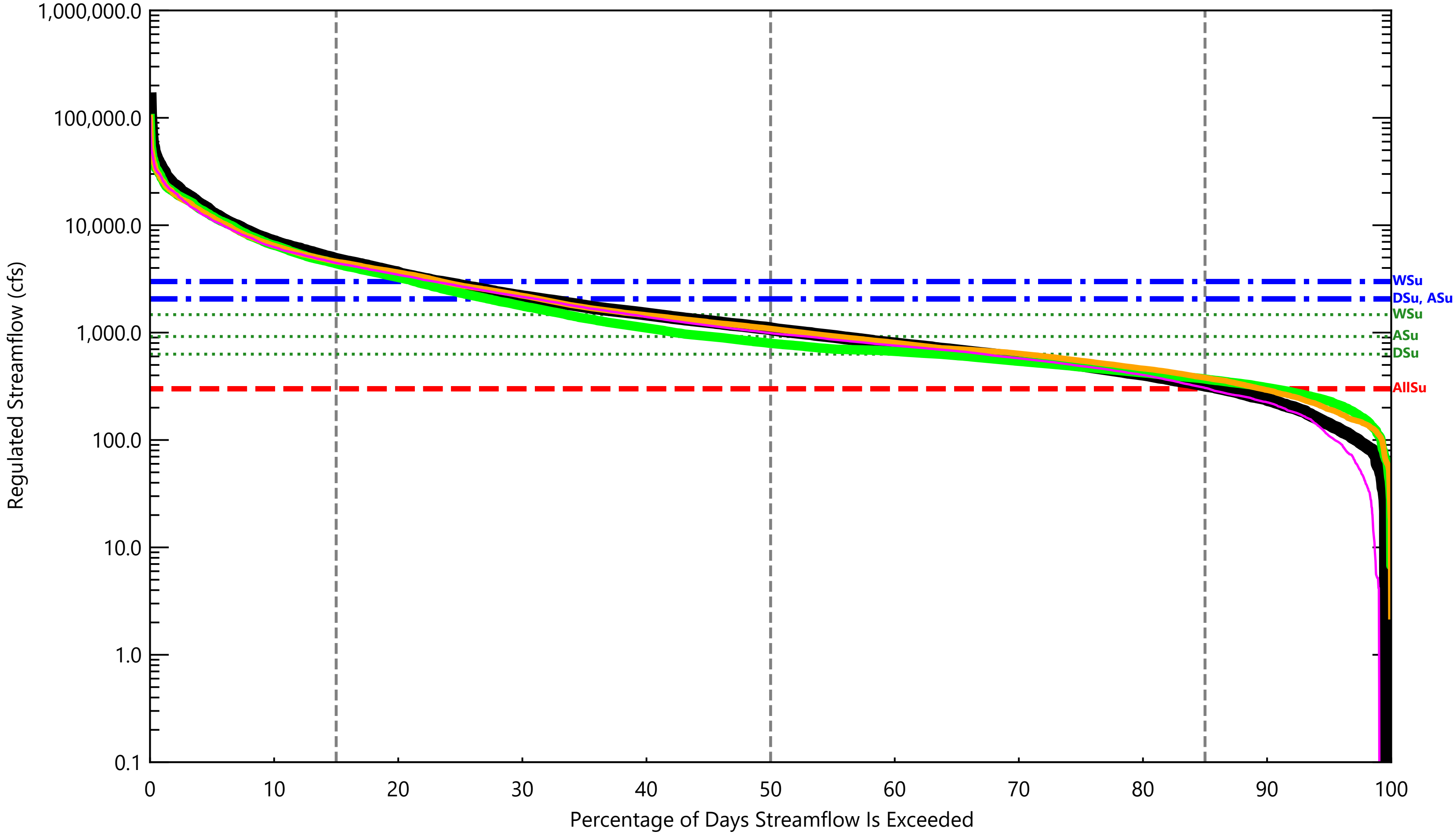
Figure D-59
Brazos River near Bryan
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

Publish Date: 08/15/2021 14:12 PM | User: JH
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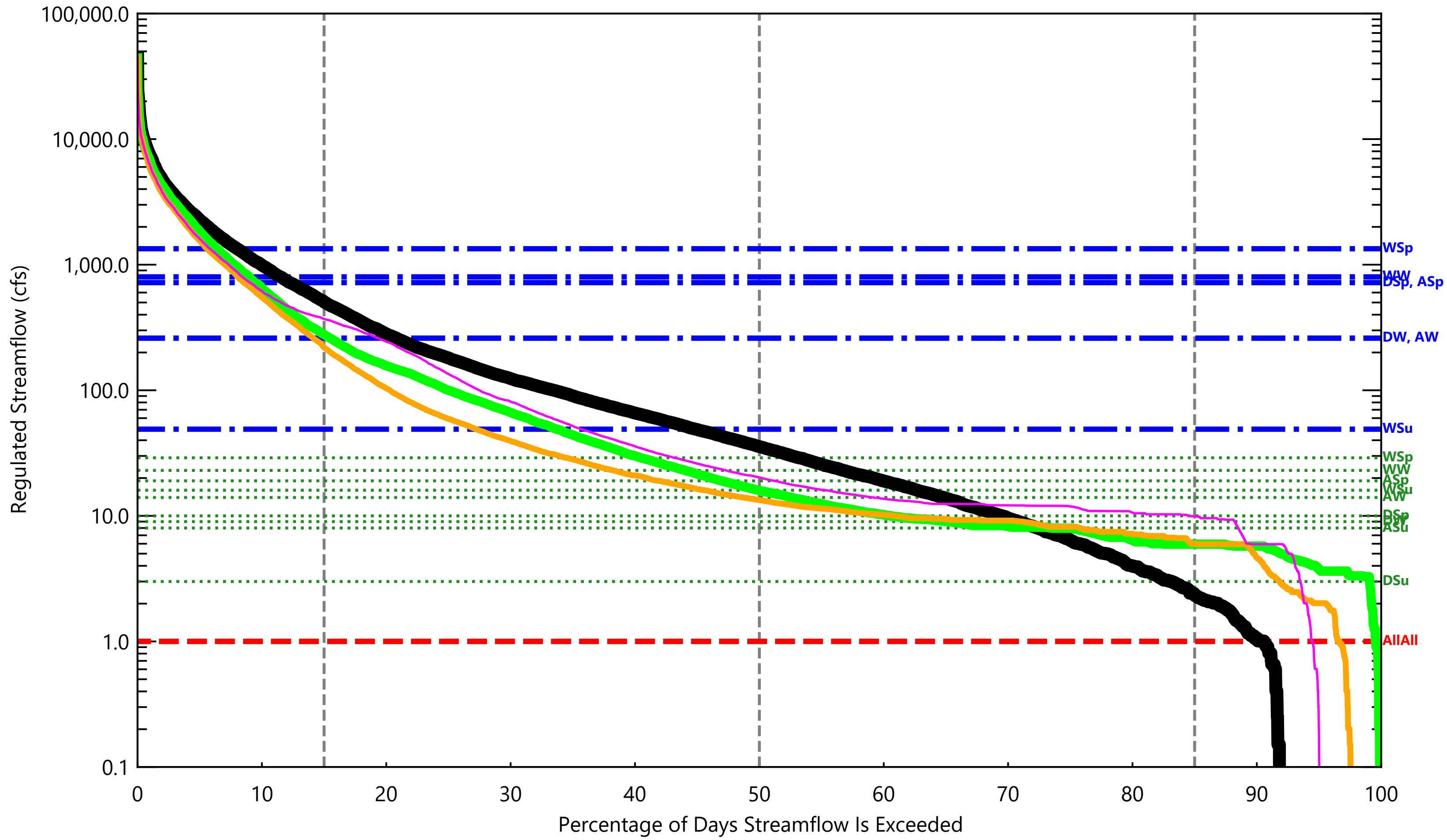
Figure D-60
Brazos River near Bryan
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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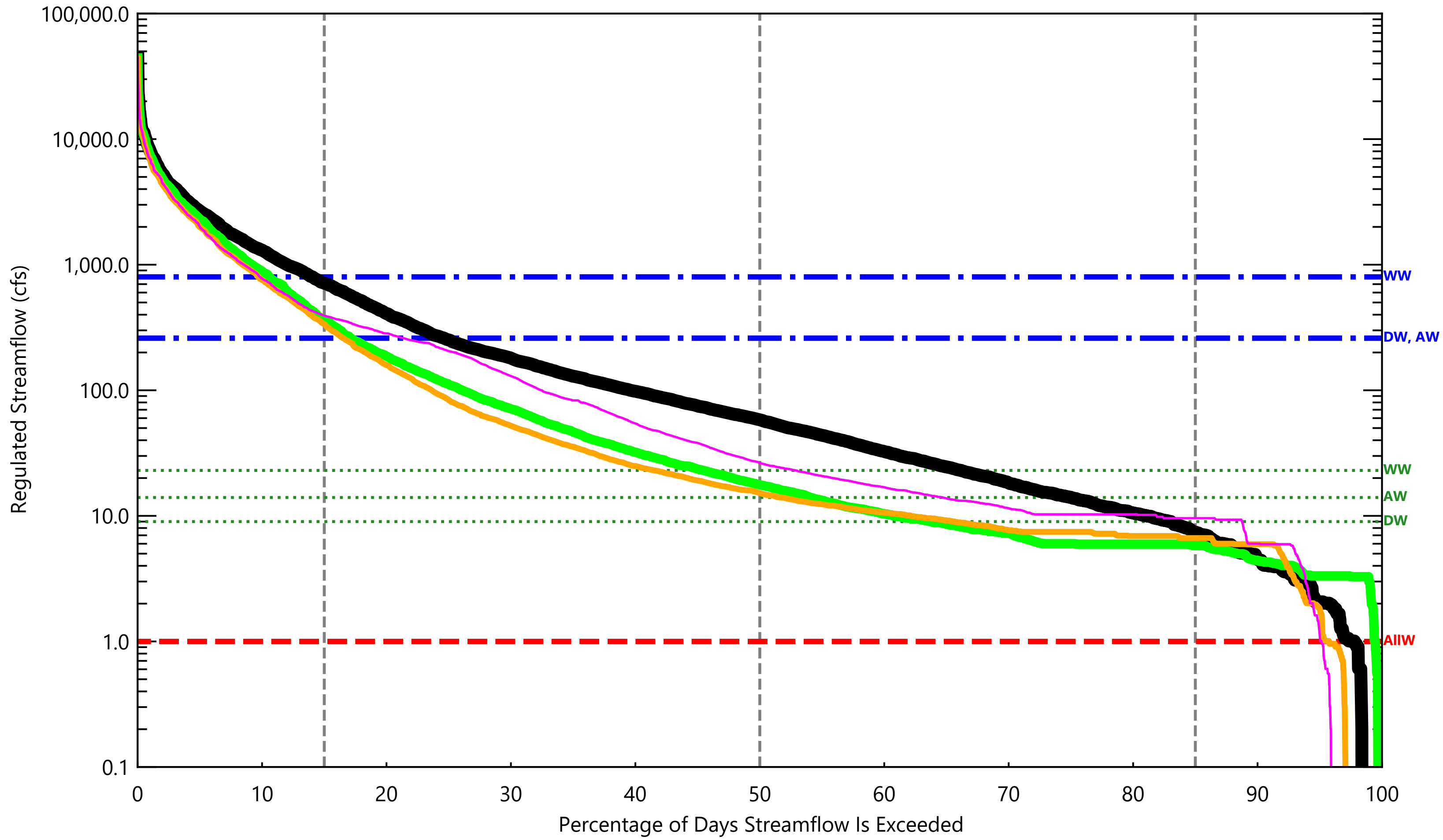
Figure D-61
Navasota River near Easterly
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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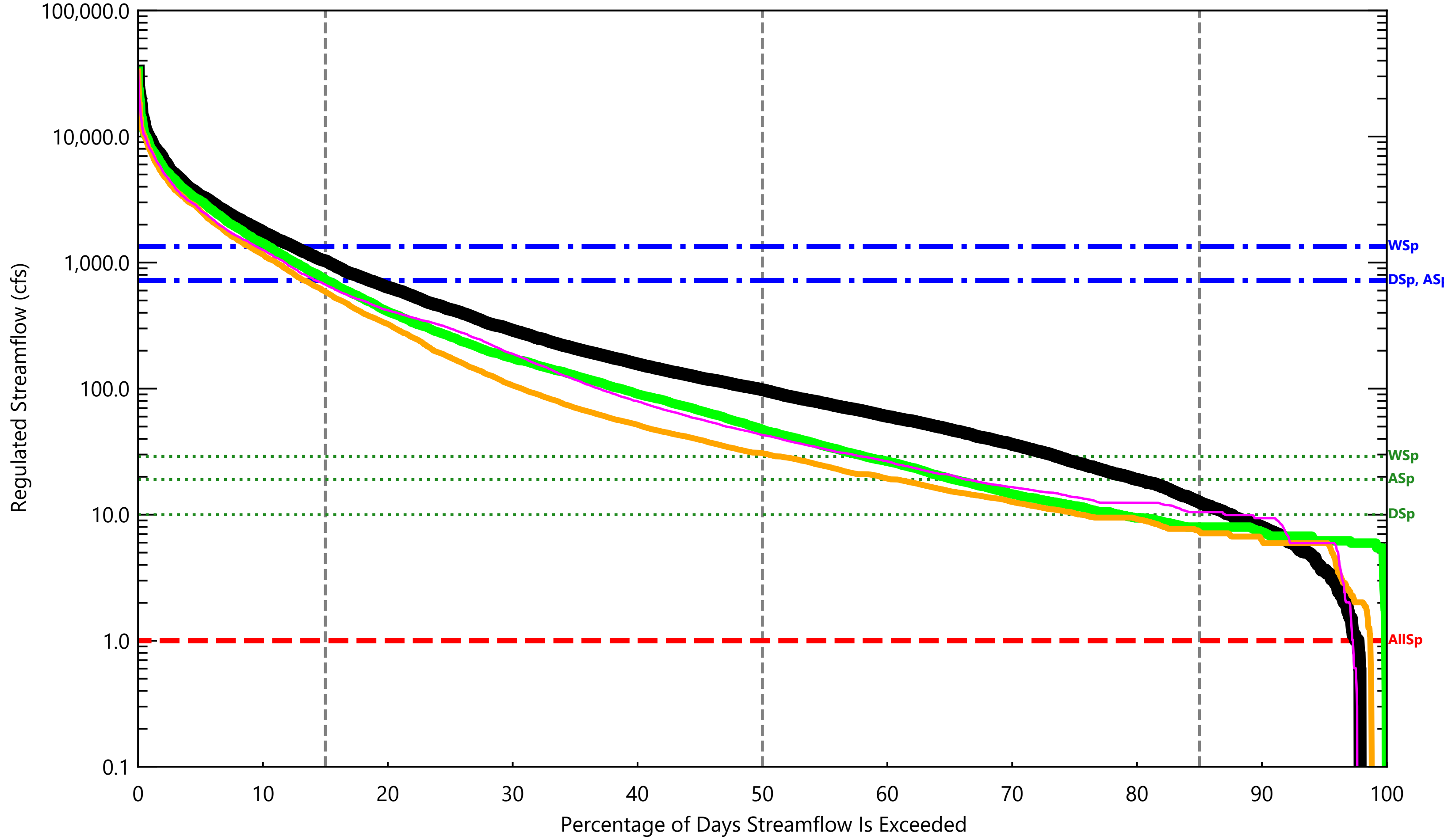
Figure D-62
Navasota River near Easterly
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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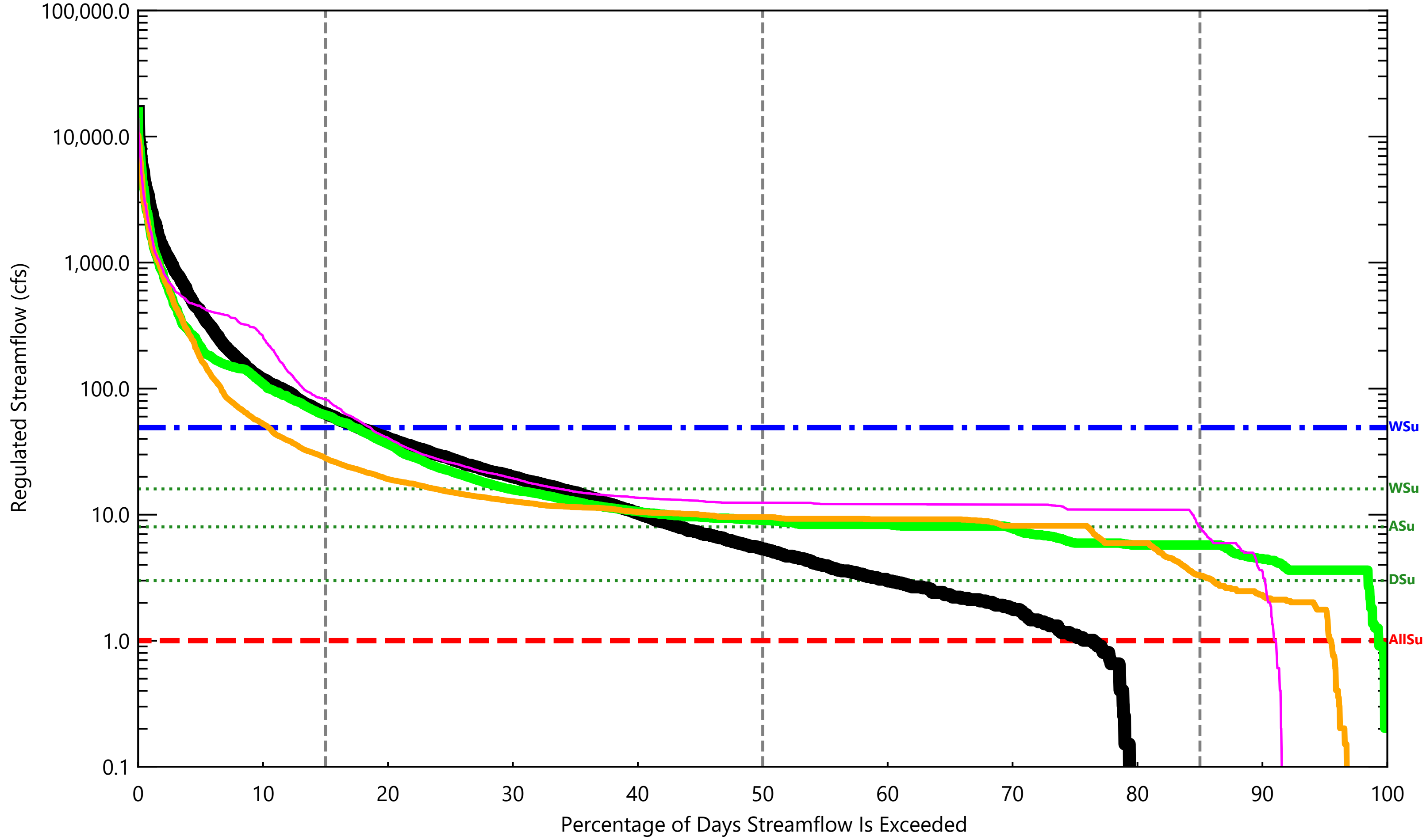
Figure D-63
Navasota River near Easterly
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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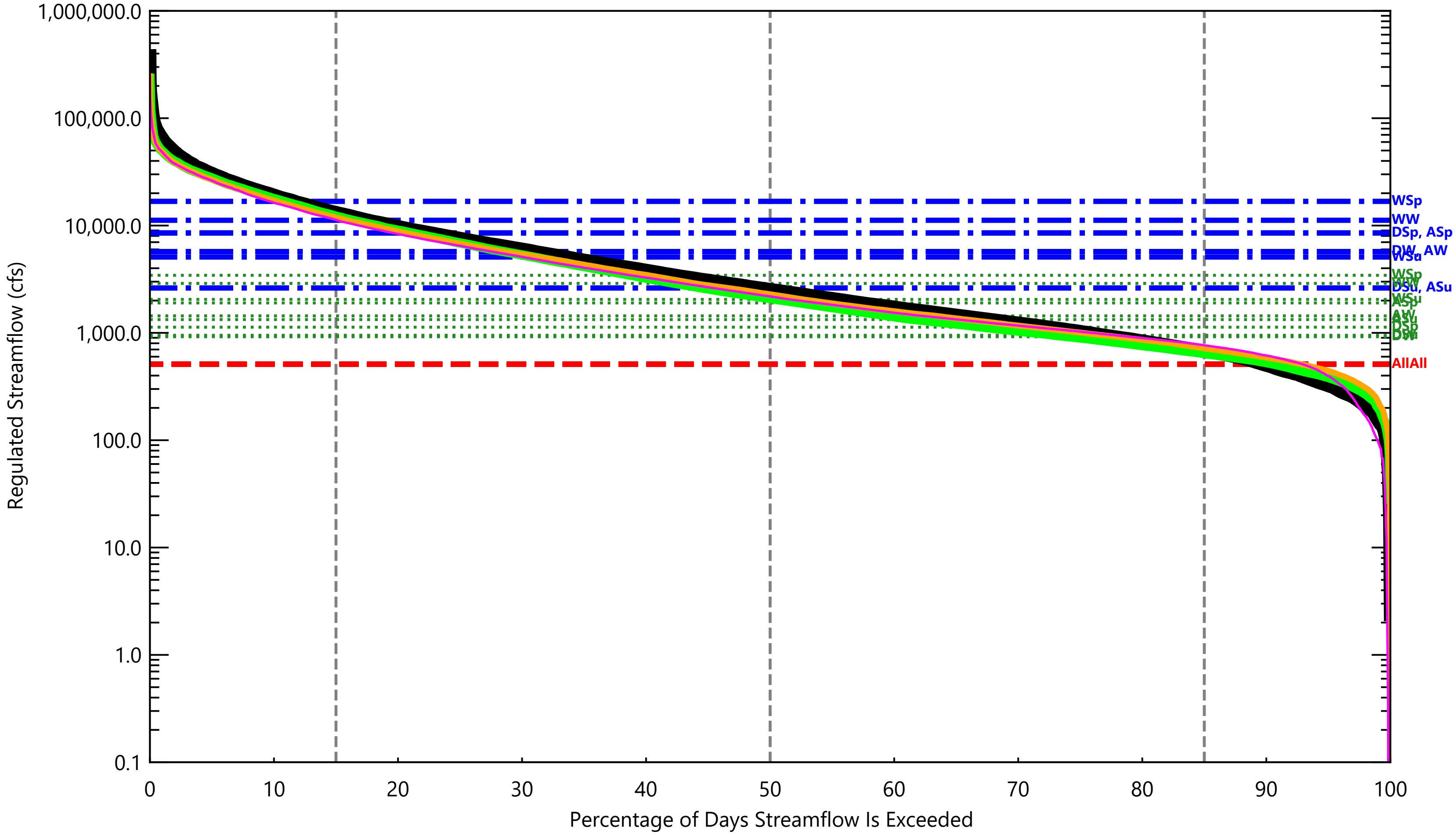
Figure D-64
Navasota River near Easterly
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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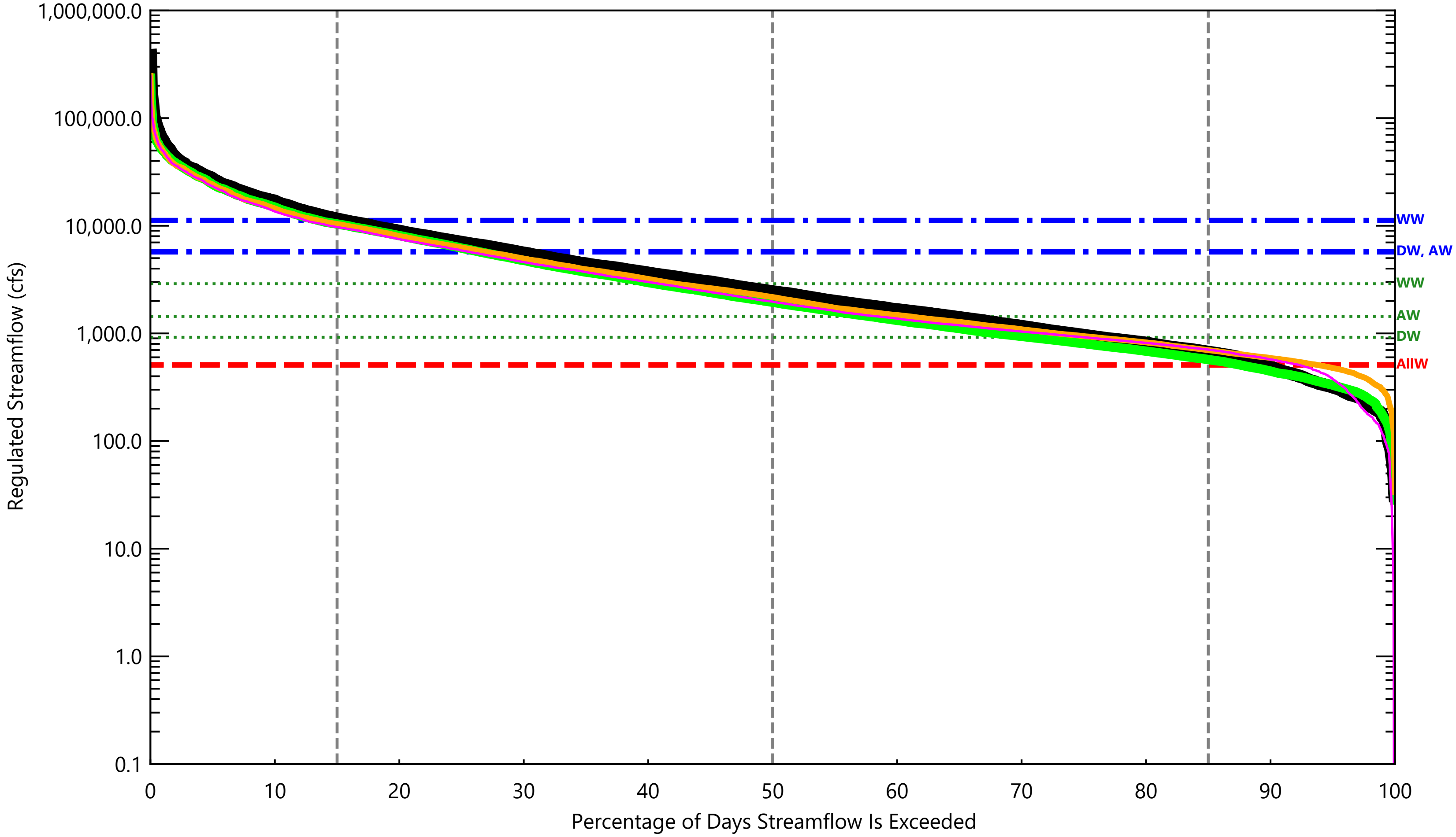
Figure D-65
Brazos River near Hempstead
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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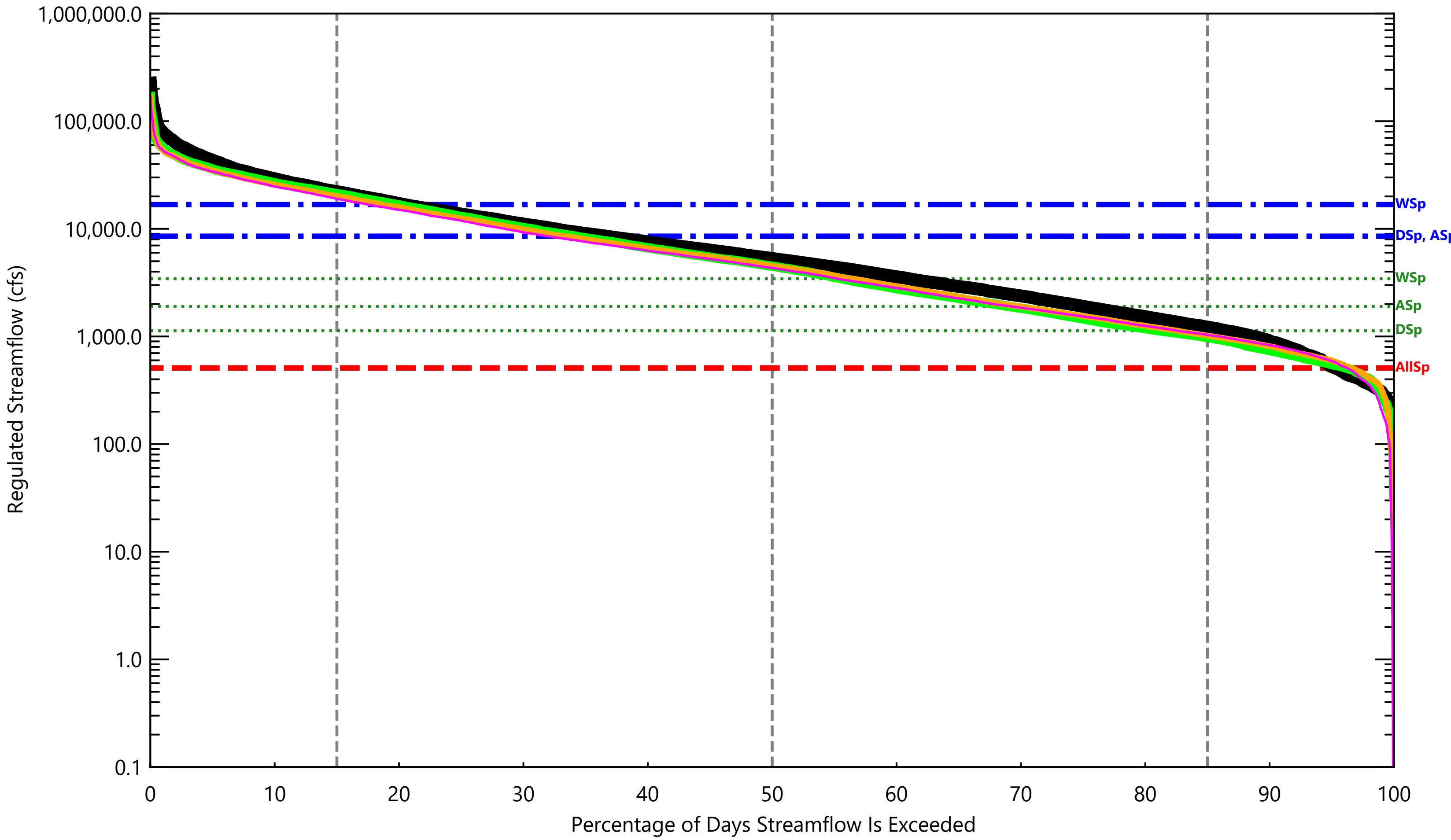
Figure D-66
Brazos River near Hempstead
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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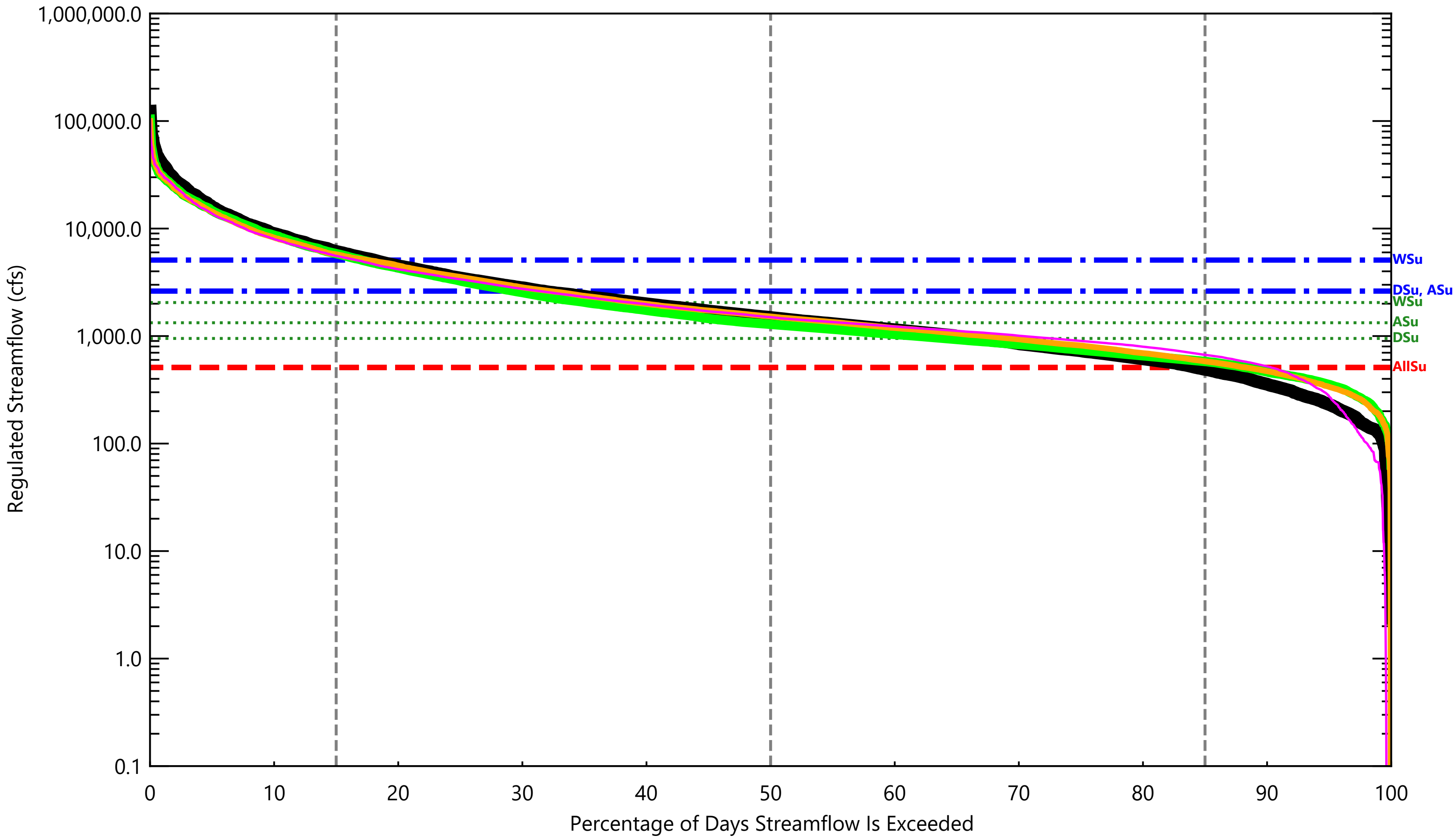
Figure D-67
Brazos River near Hempstead
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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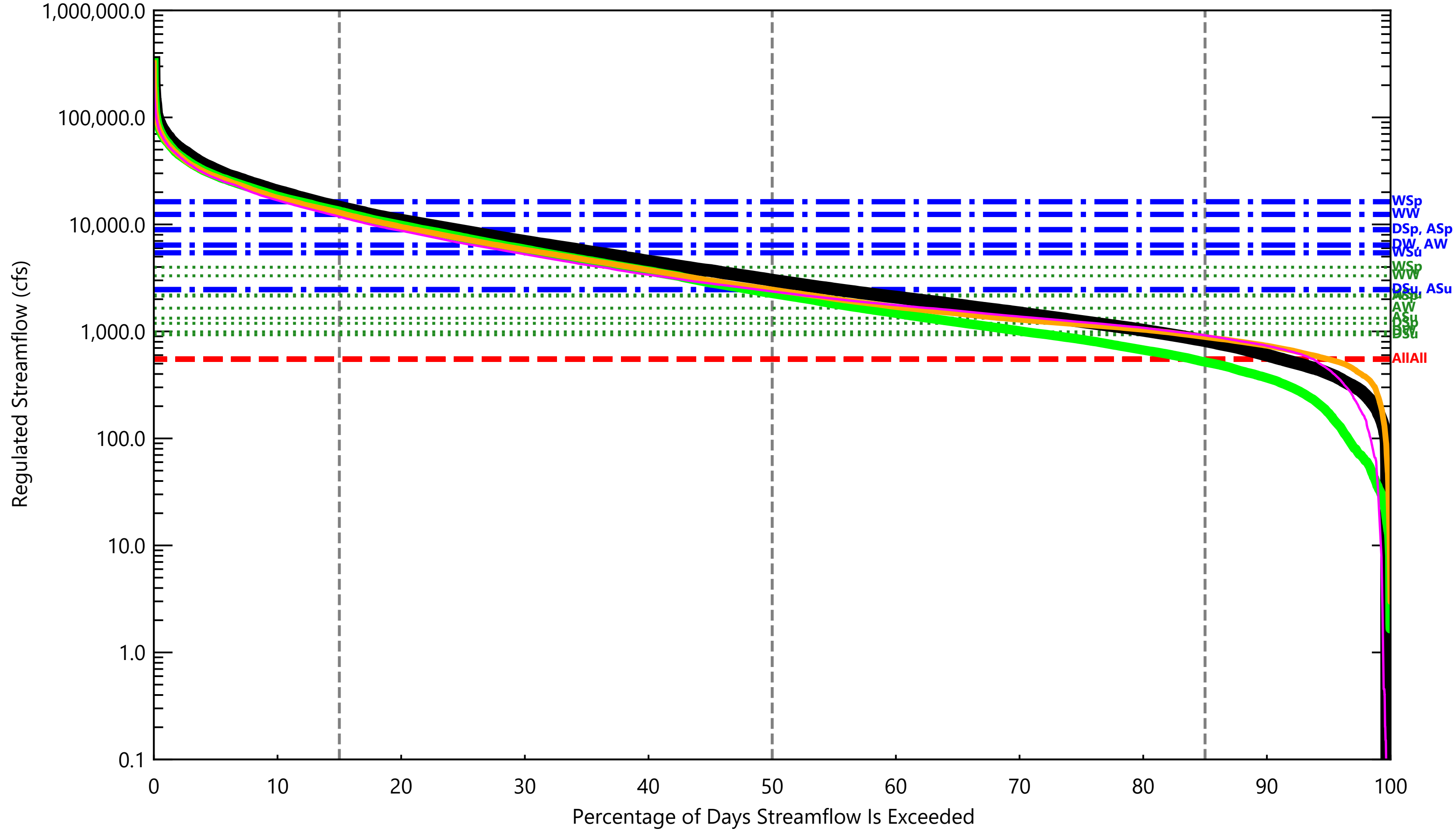
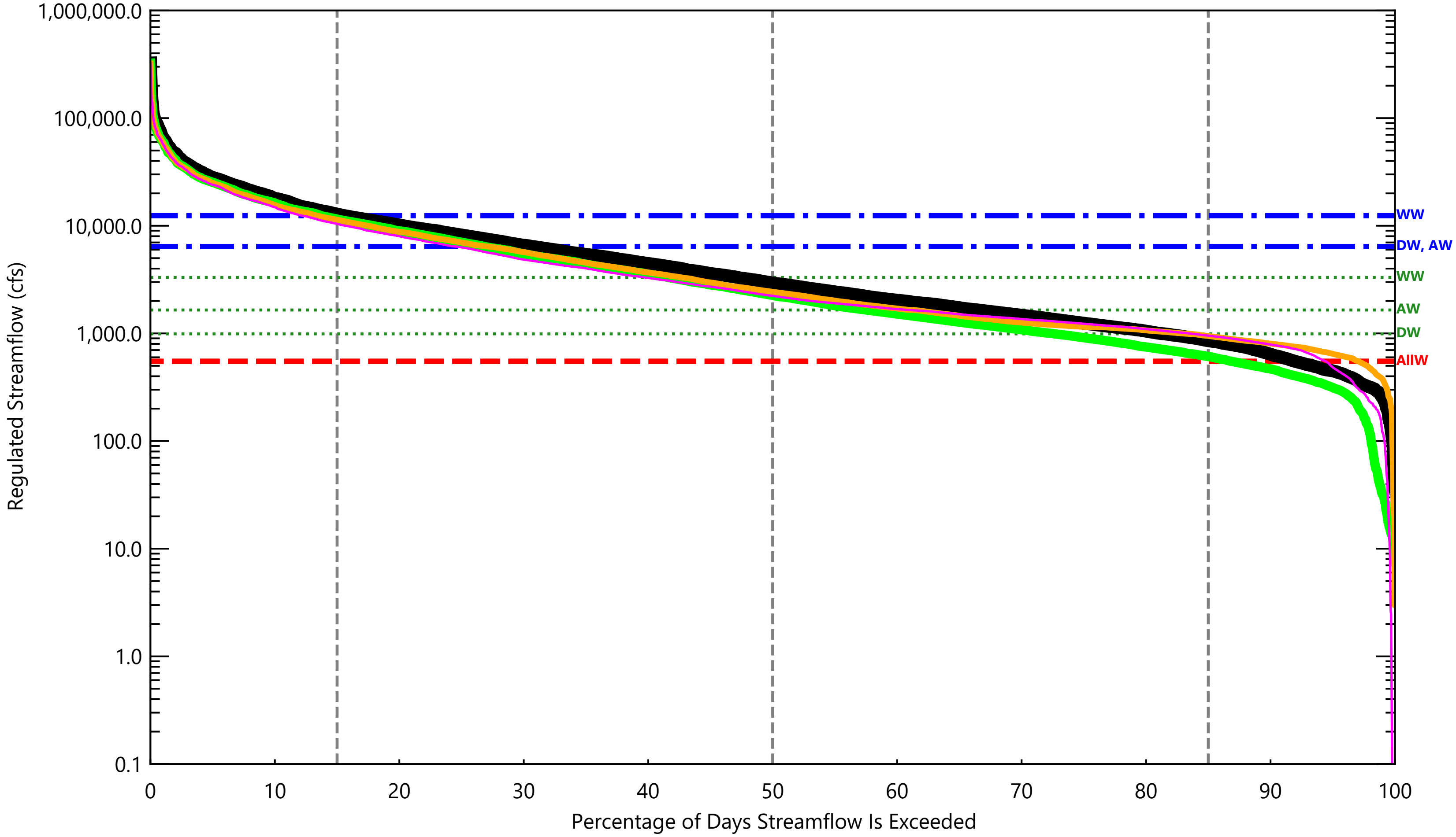
Figure D-68
Brazos River near Hempstead
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Figure D-69
Brazos River at Richmond
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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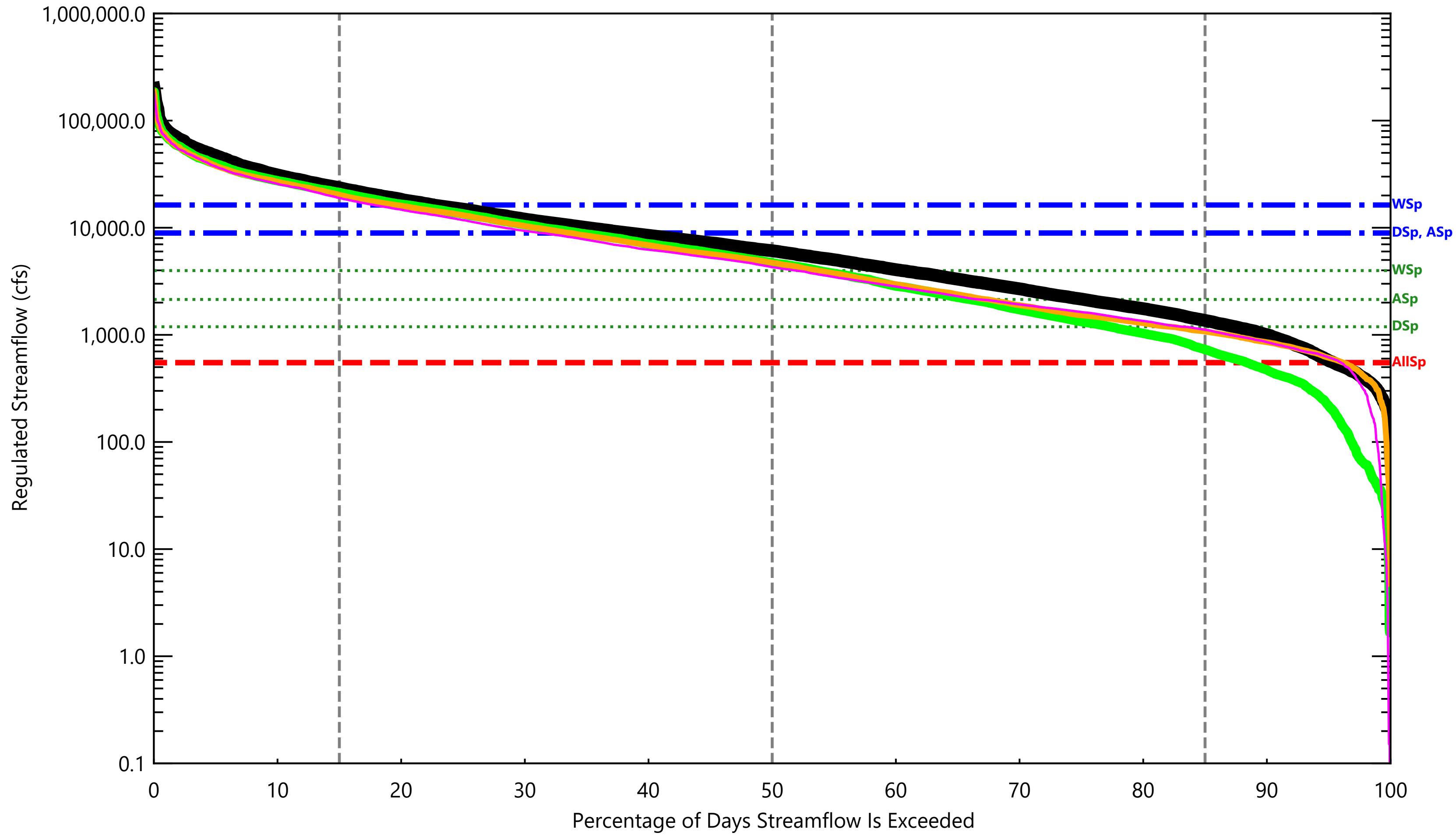
Figure D-70
Brazos River at Richmond
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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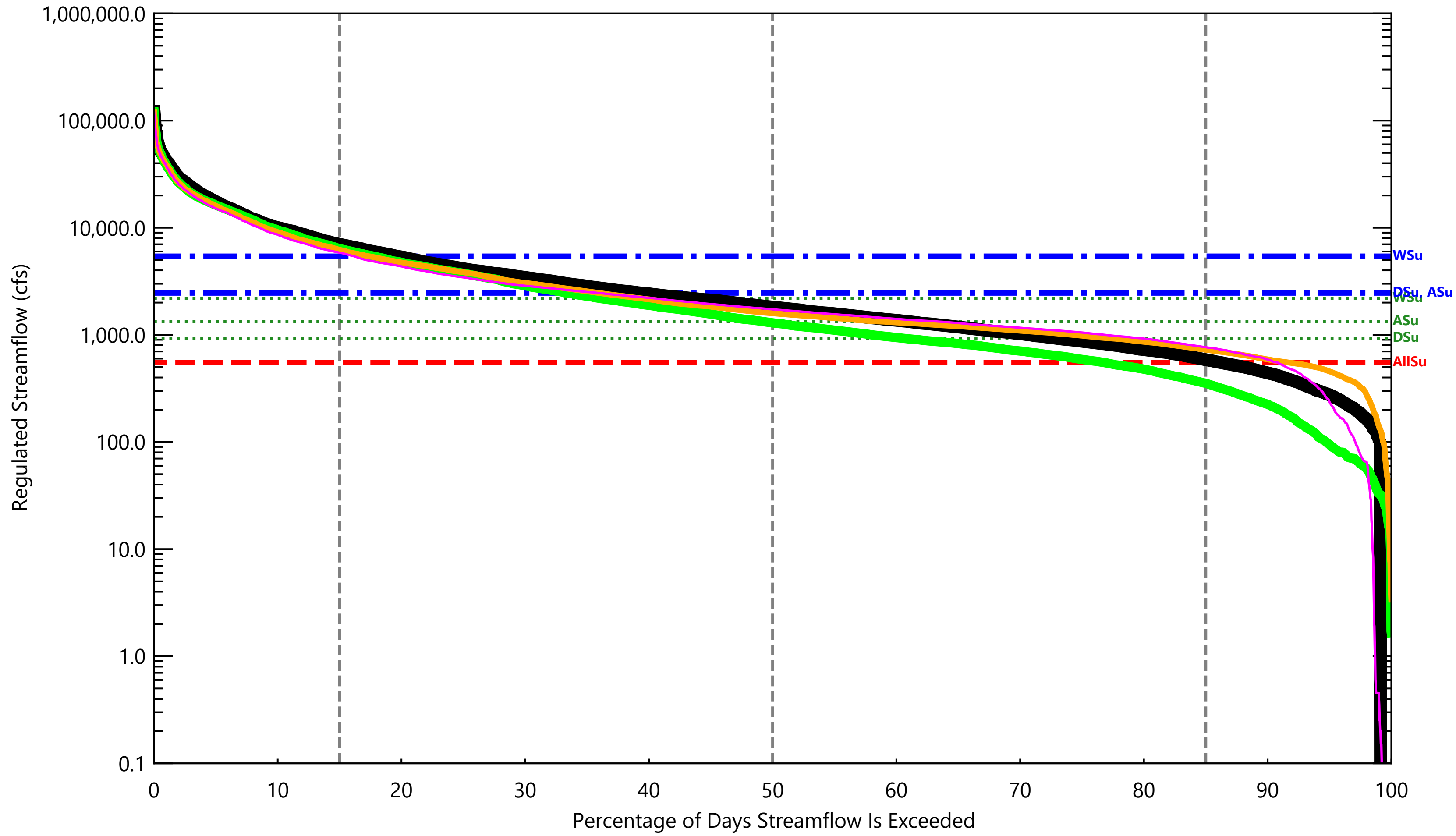
Figure D-71
Brazos River at Richmond
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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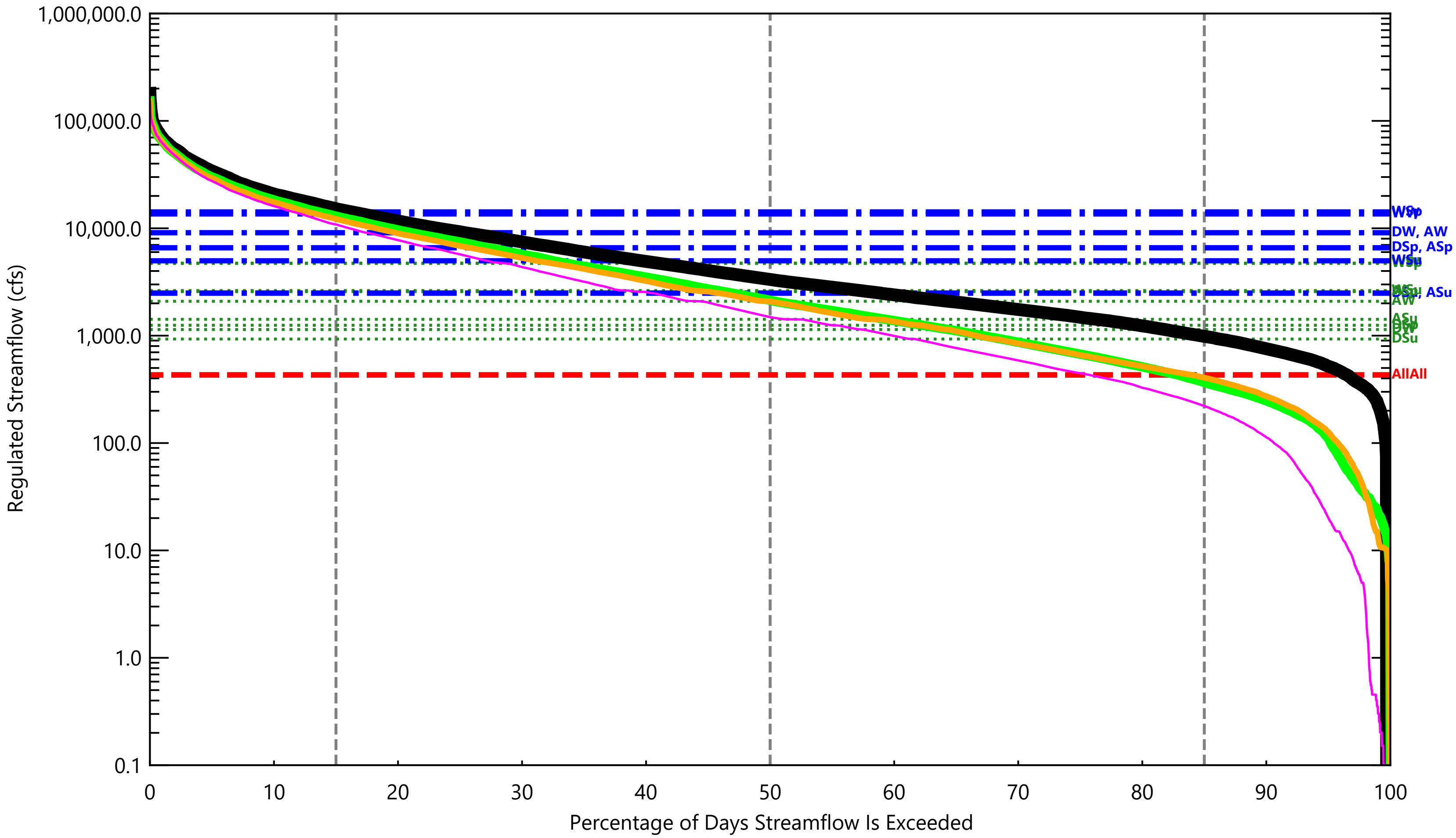
Figure D-72
Brazos River at Richmond
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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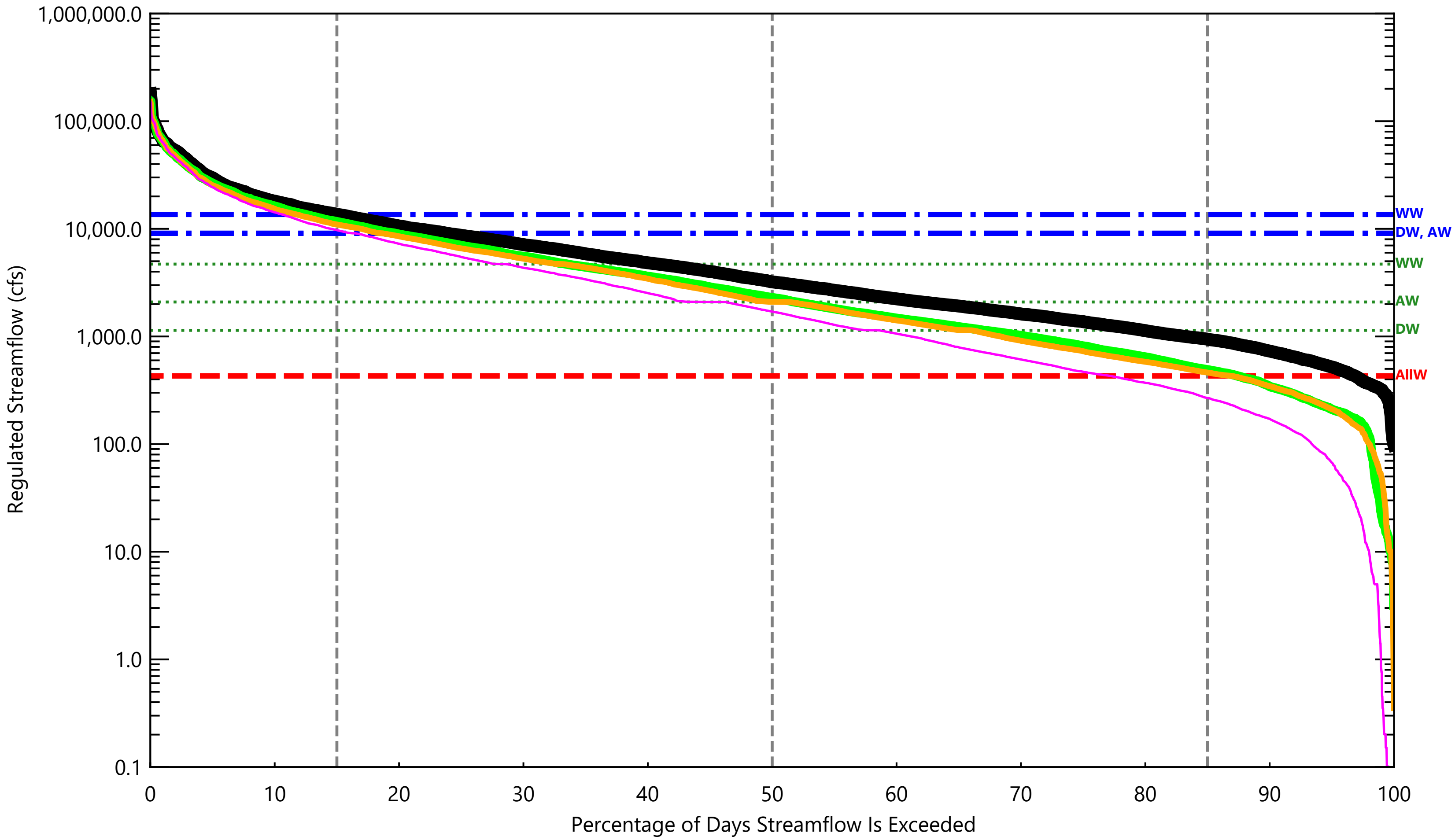
Figure D-73
Brazos River at Rosharon
Annual Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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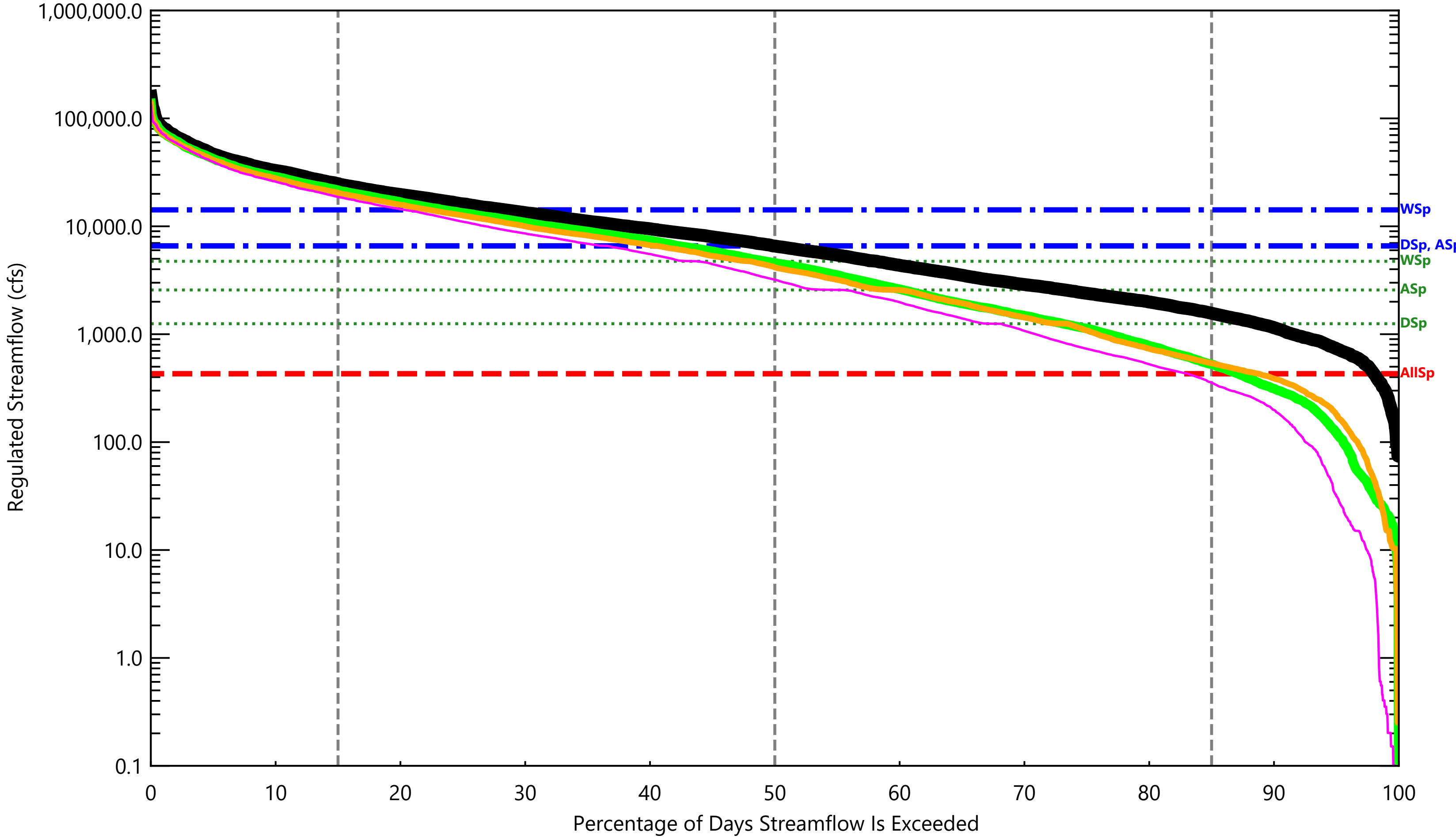
Figure D-74
Brazos River at Rosharon
Winter Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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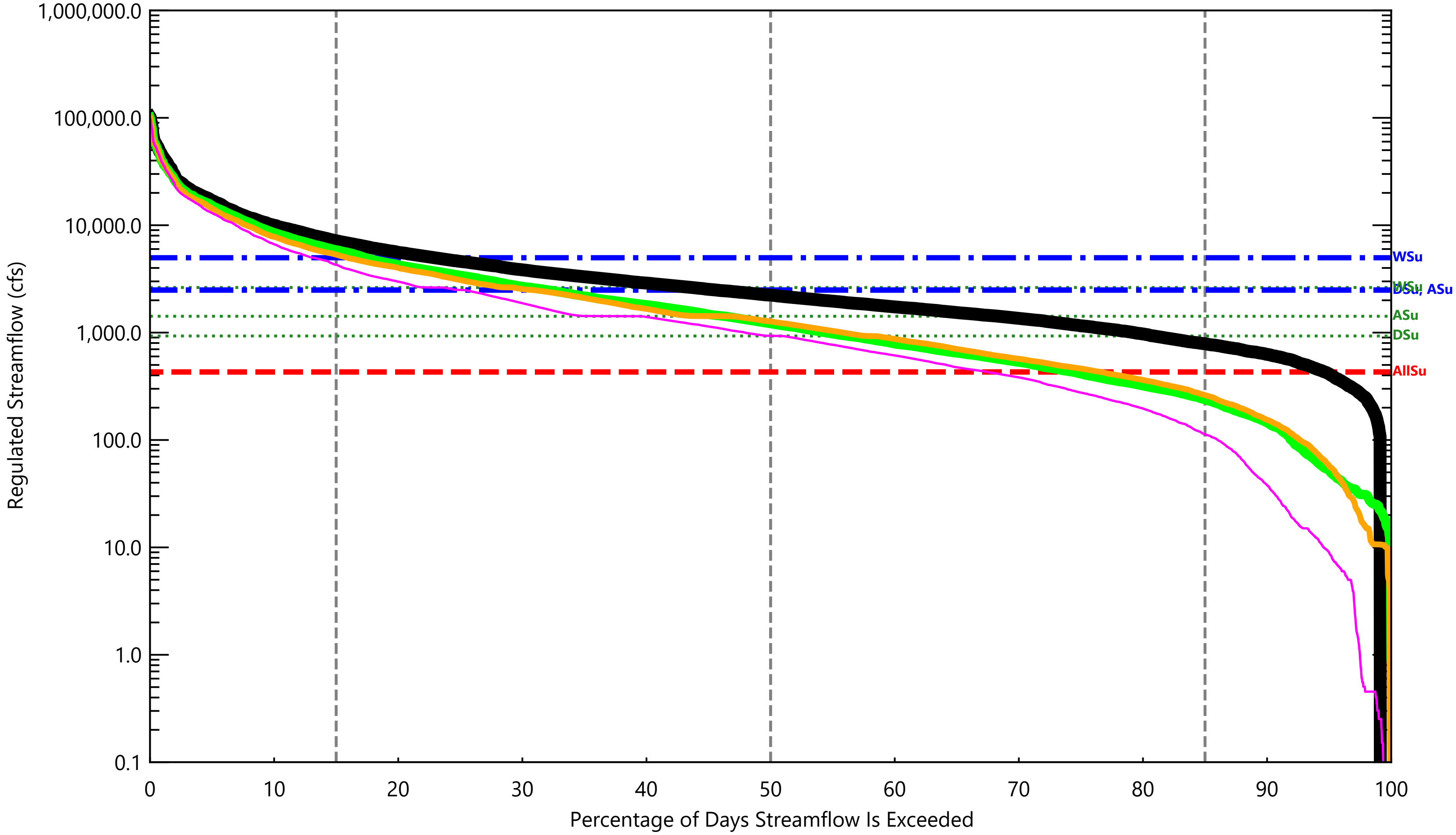
Figure D-75
Brazos River at Rosharon
Spring Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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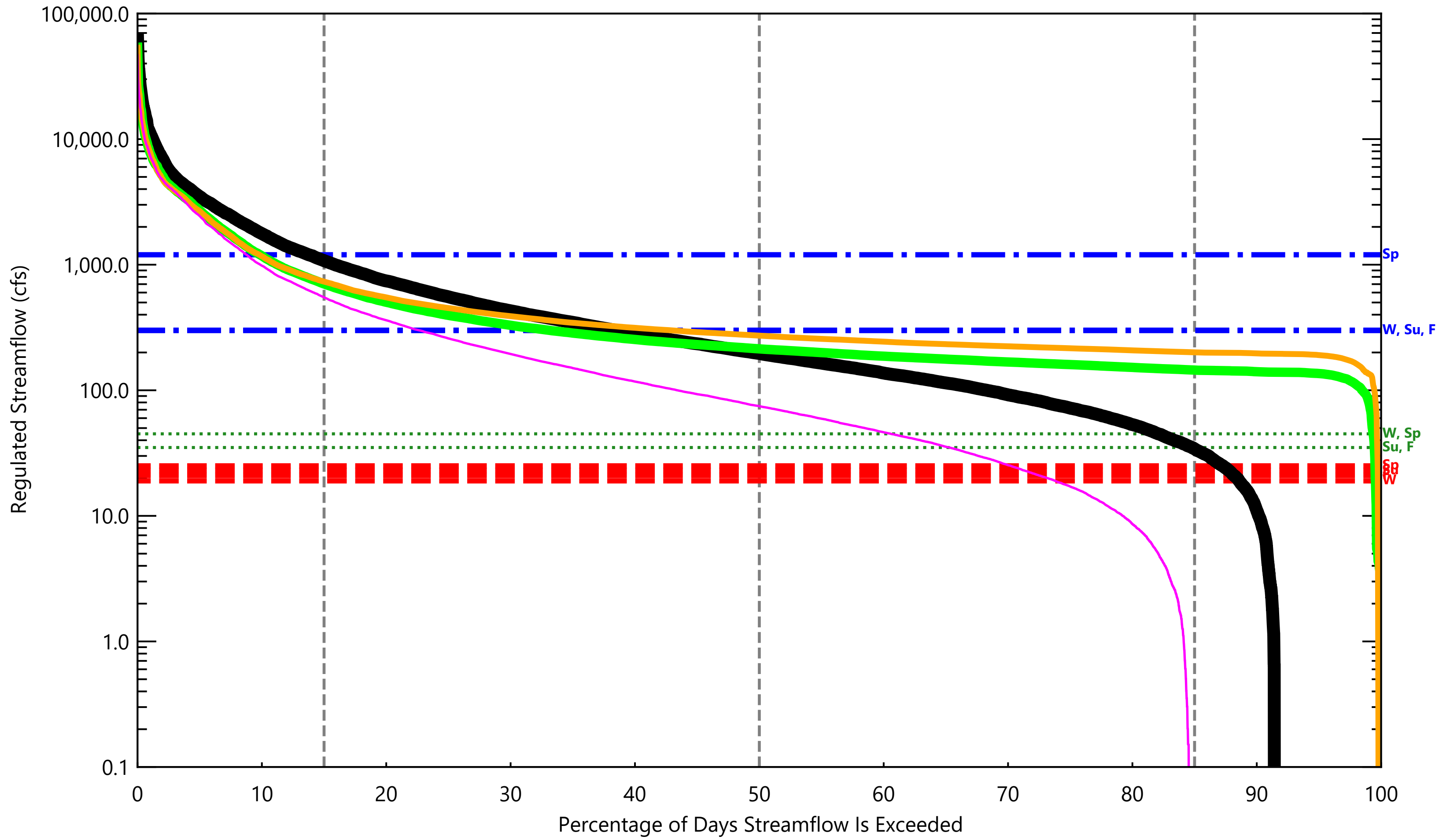
Figure D-76
Brazos River at Rosharon
Summer Flow Duration Curves for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario	Full Utilization Scenario	Base Flow Standard
Current Water Use Scenario	Subsistence Flow Standard	HFP Trigger Standard
Partial Utilization Scenario		

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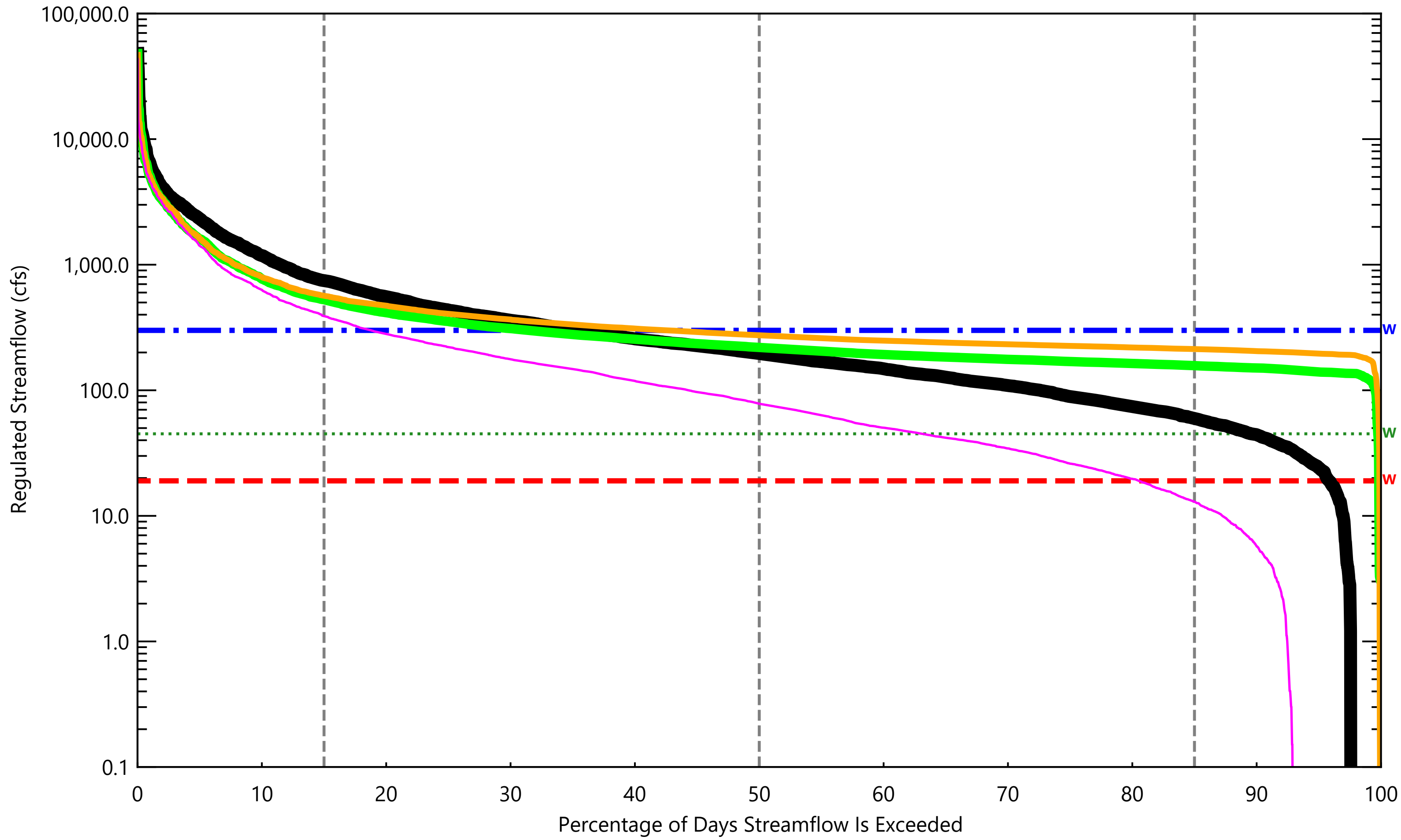
Figure D-77
West Fork Trinity River near Grand Prairie
Annual Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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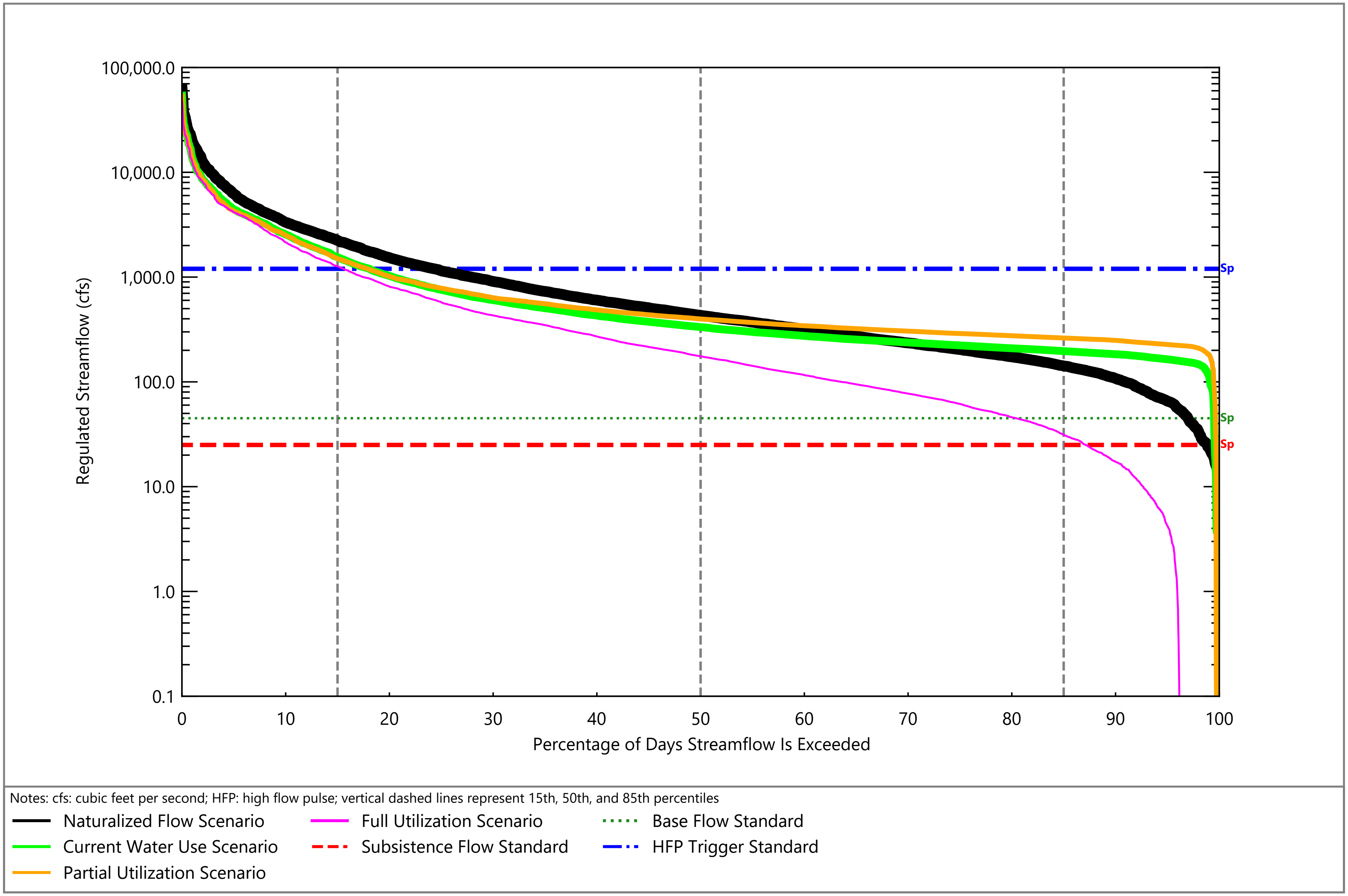
Figure D-78
West Fork Trinity River near Grand Prairie
Winter Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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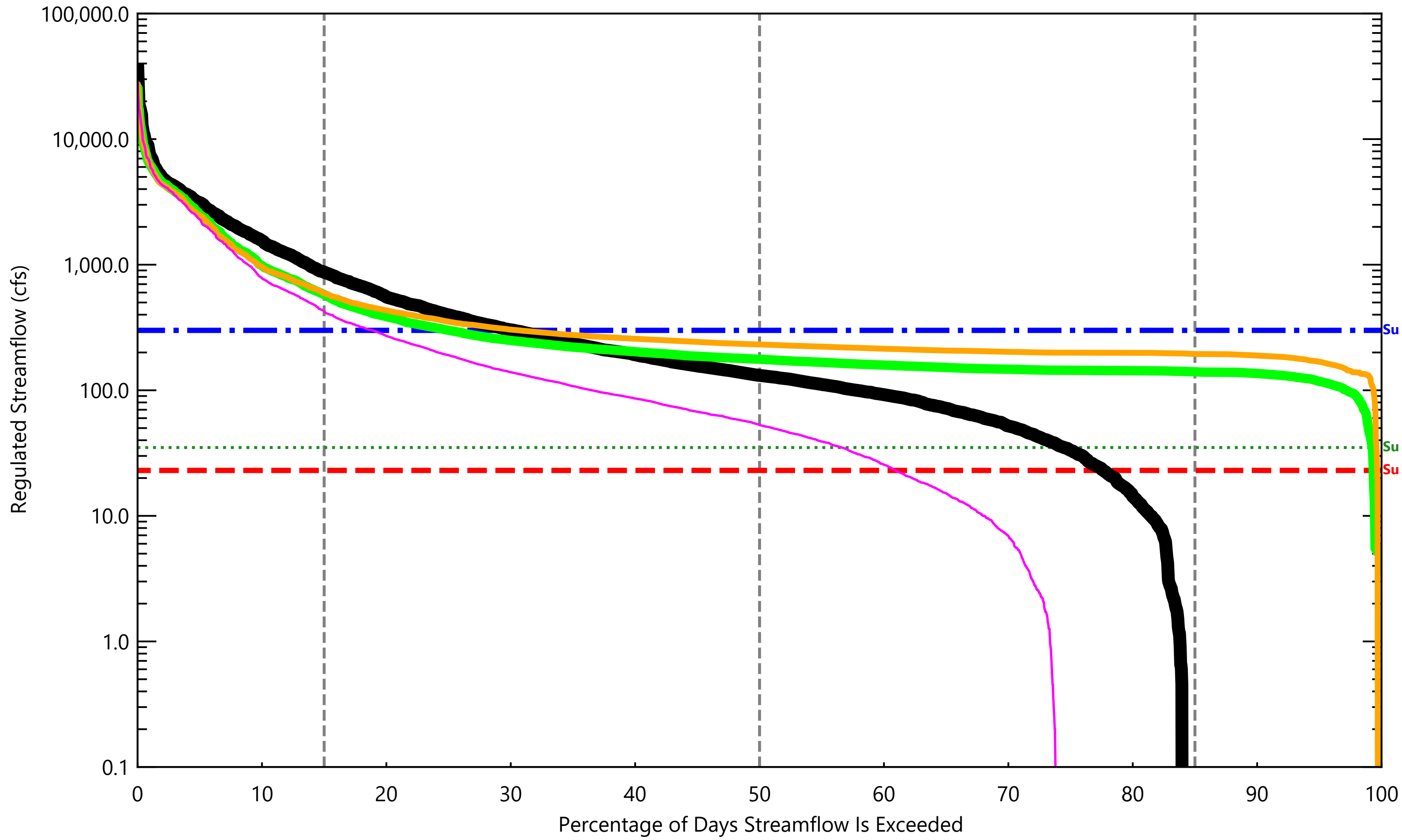
Figure D-79
West Fork Trinity River near Grand Prairie
Spring Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



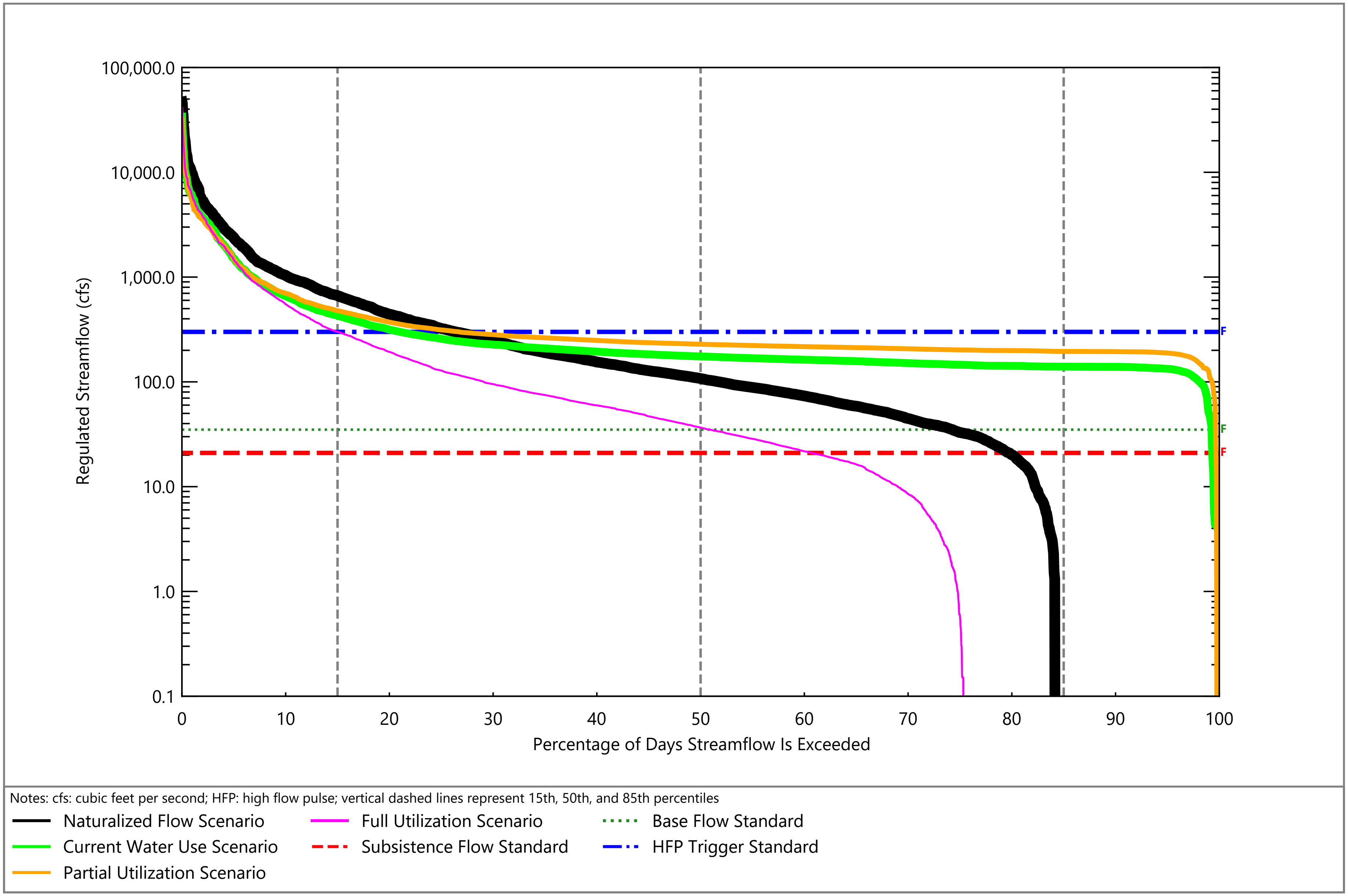
Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

ANCHOR QEA

Figure D-80
West Fork Trinity River near Grand Prairie
Summer Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 14:13 PM | User: JH
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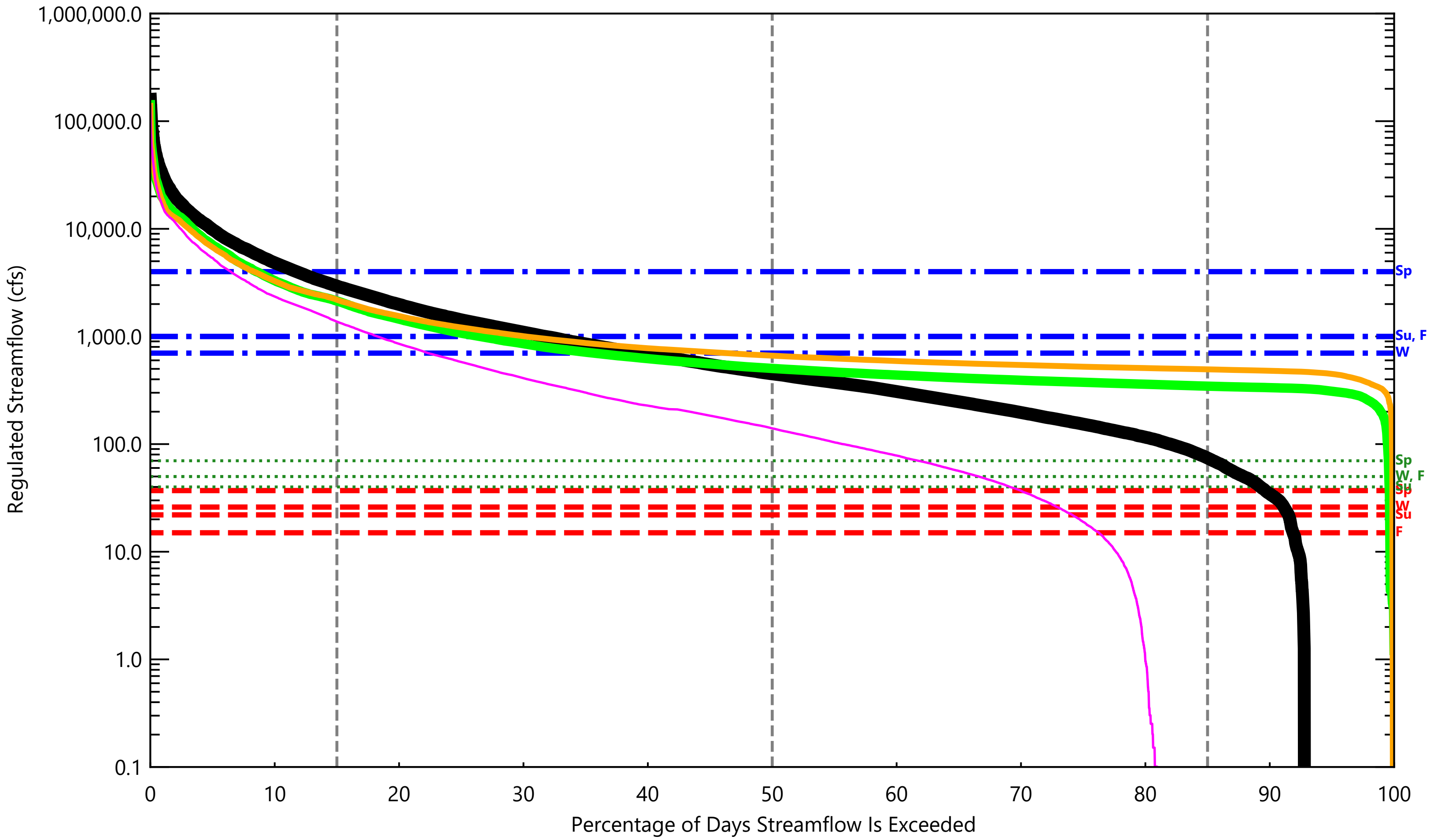
Figure D-81
West Fork Trinity River near Grand Prairie
Fall Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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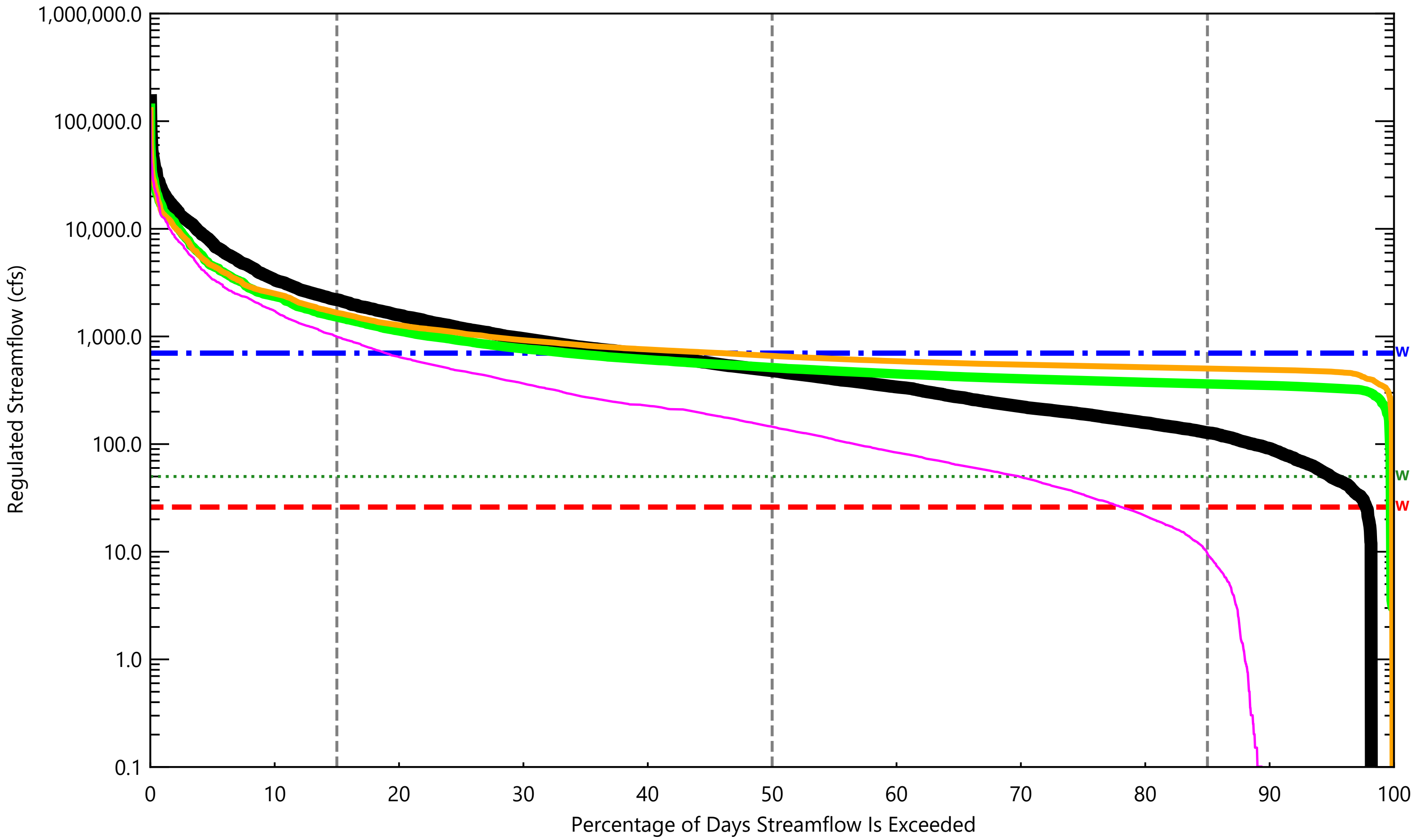
Figure D-82
Trinity River at Dallas
Annual Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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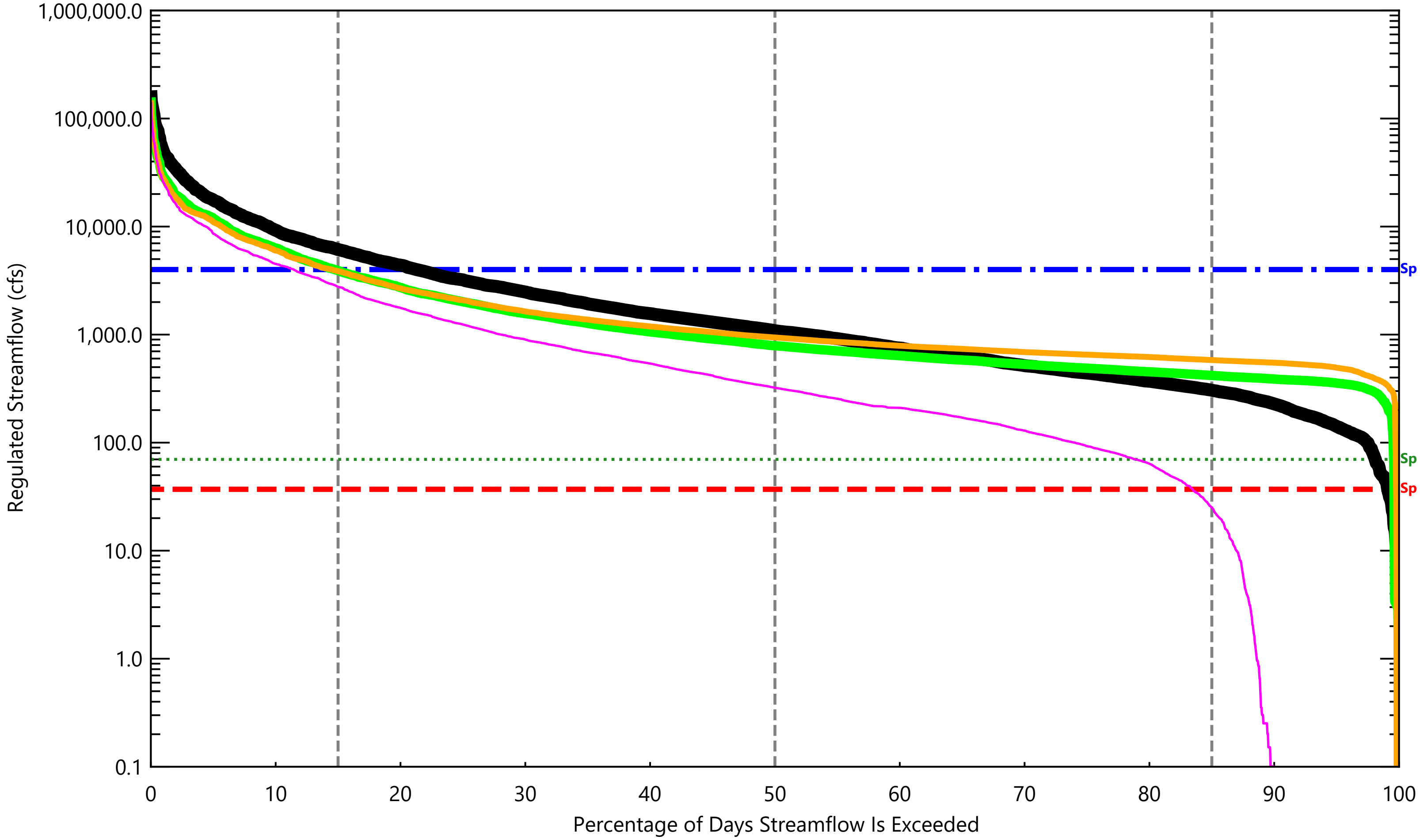
Figure D-83
Trinity River at Dallas
Winter Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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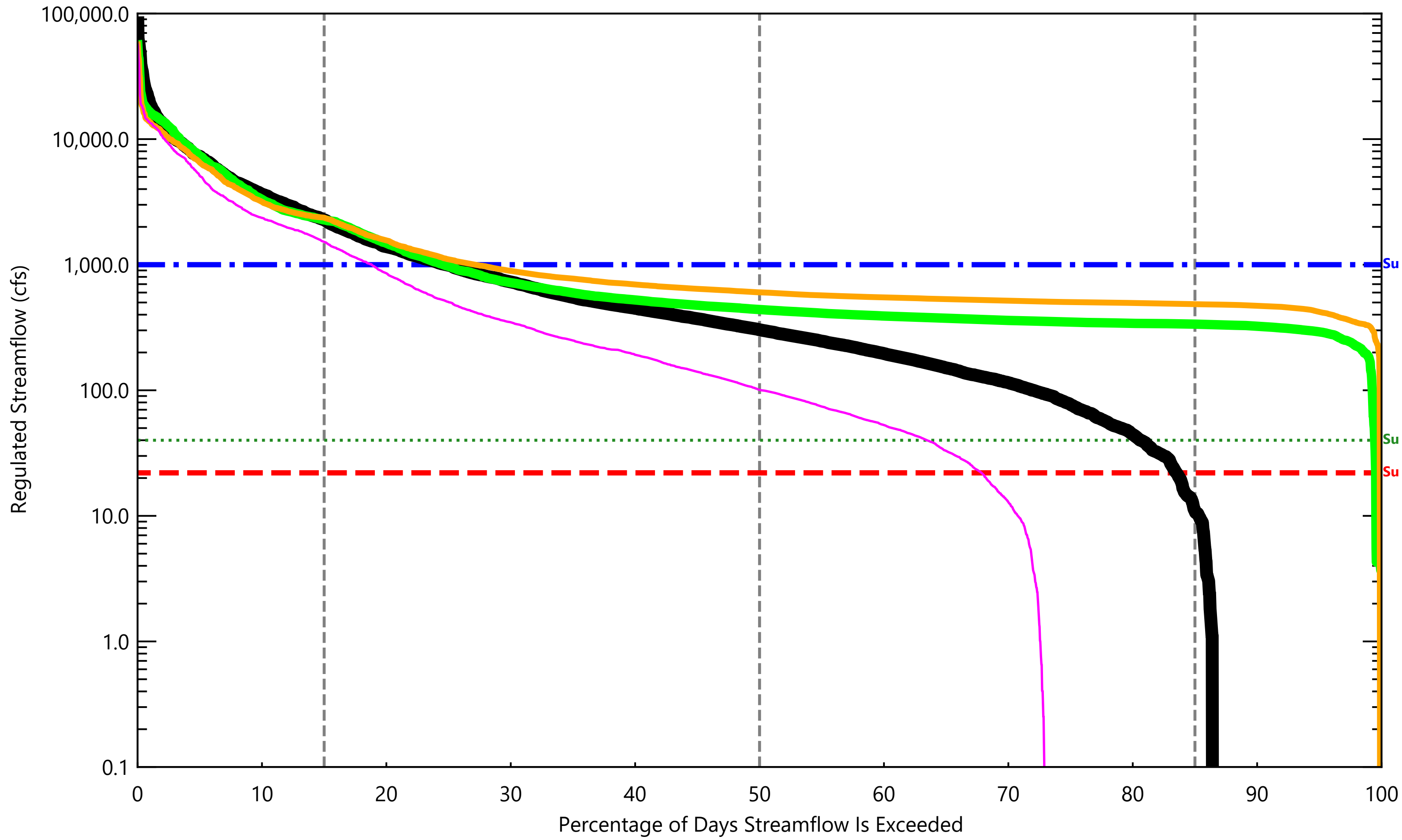
Figure D-84
Trinity River at Dallas
Spring Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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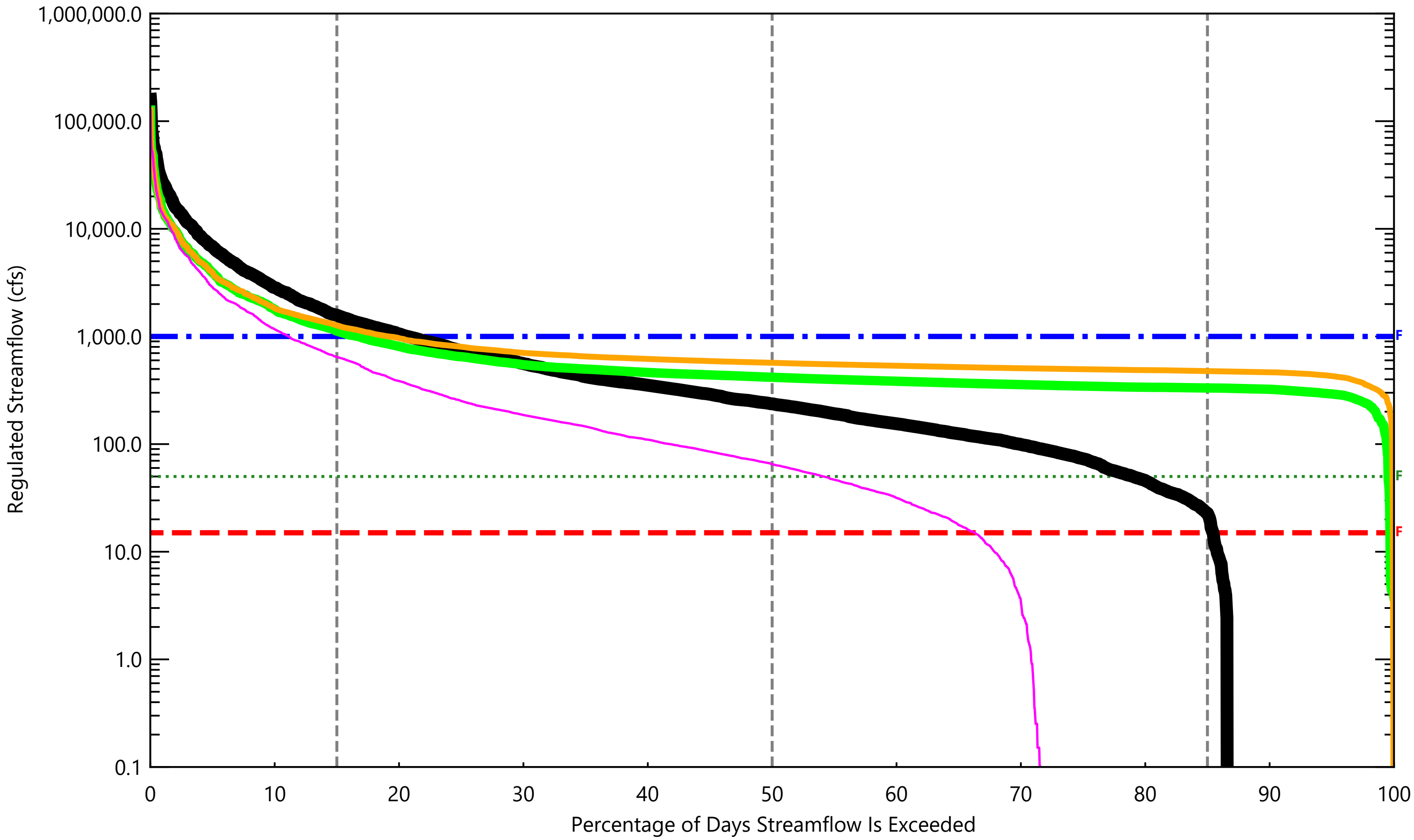
Figure D-85
Trinity River at Dallas
Summer Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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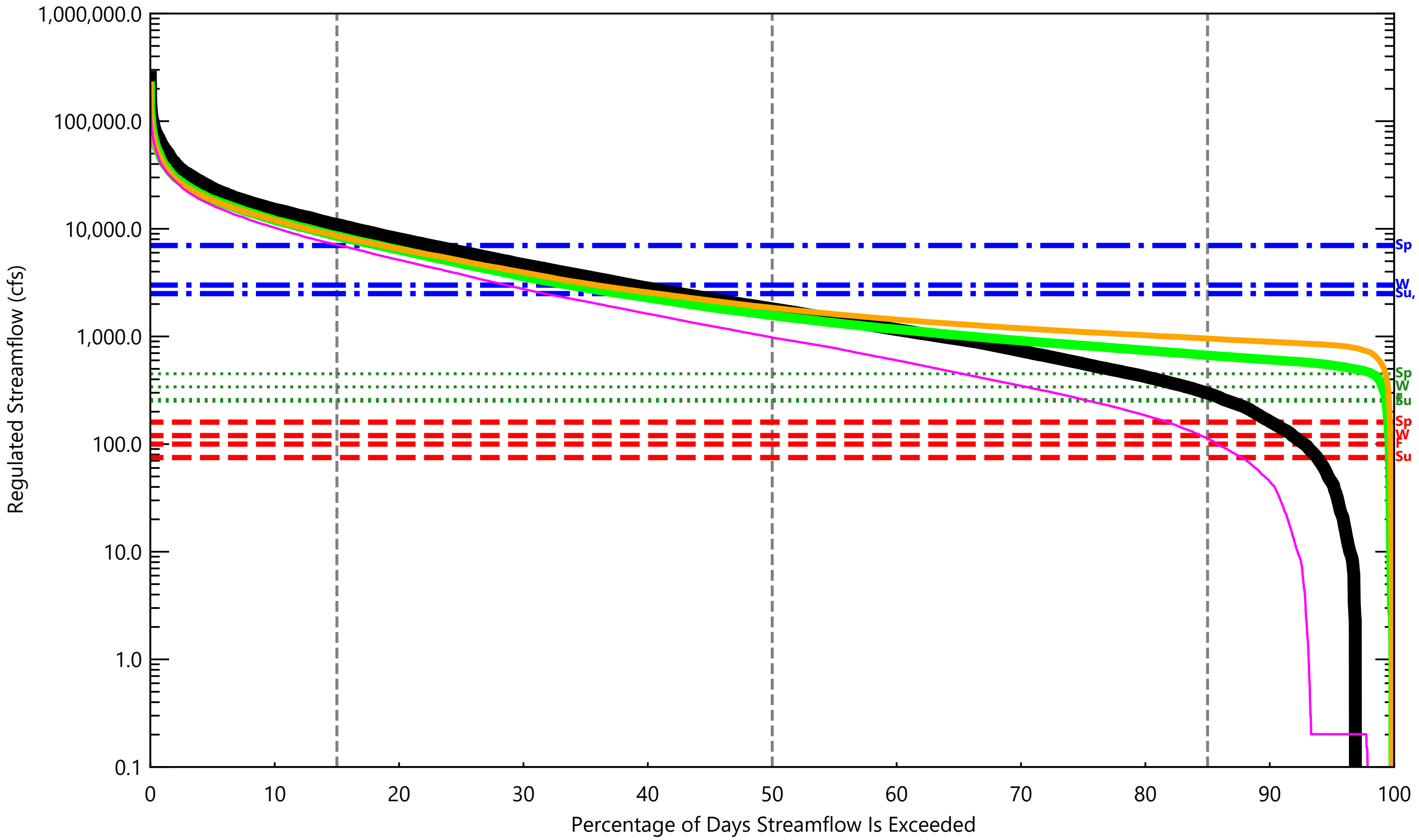
Figure D-86
Trinity River at Dallas
Fall Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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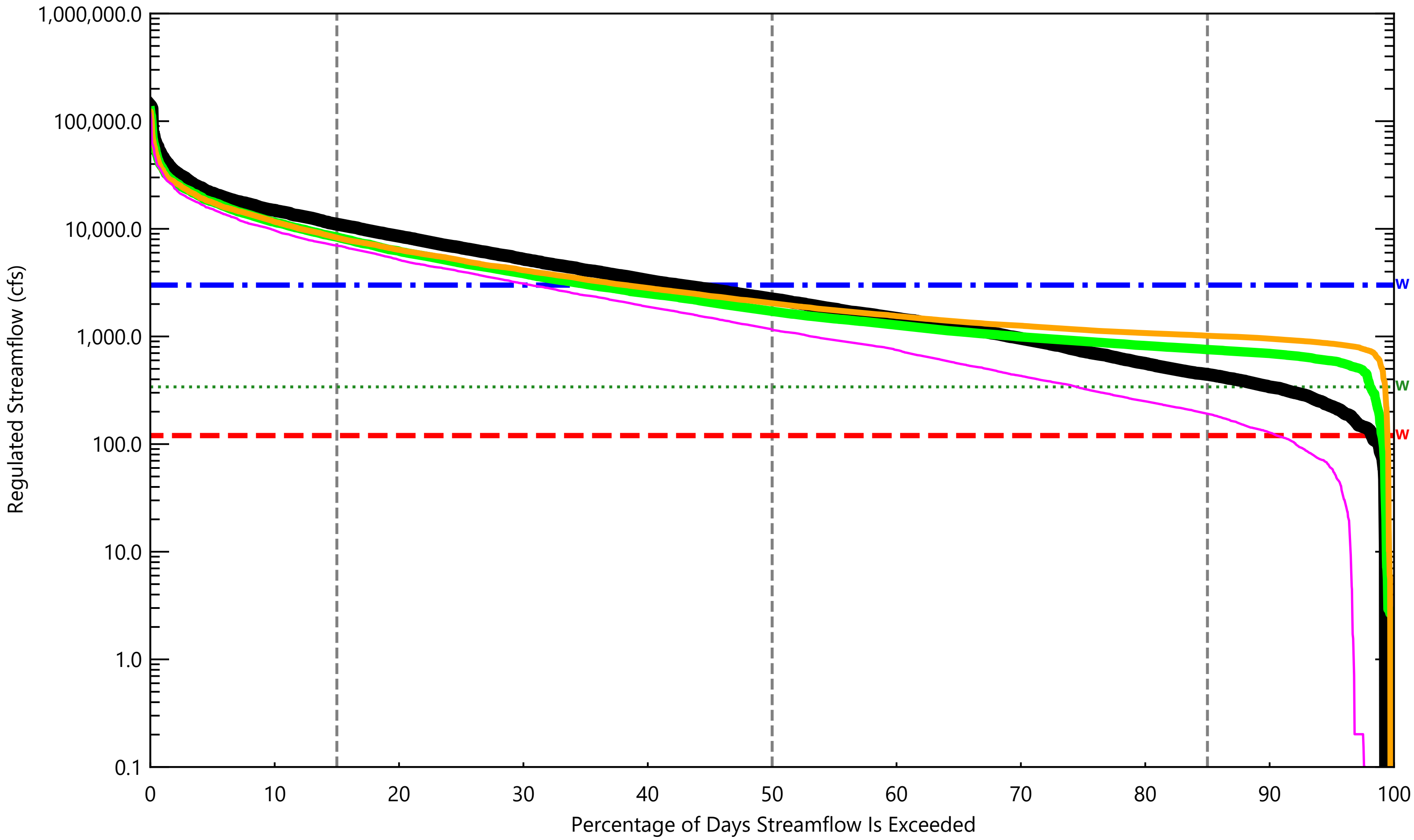
Figure D-87
Trinity River near Oakwood
Annual Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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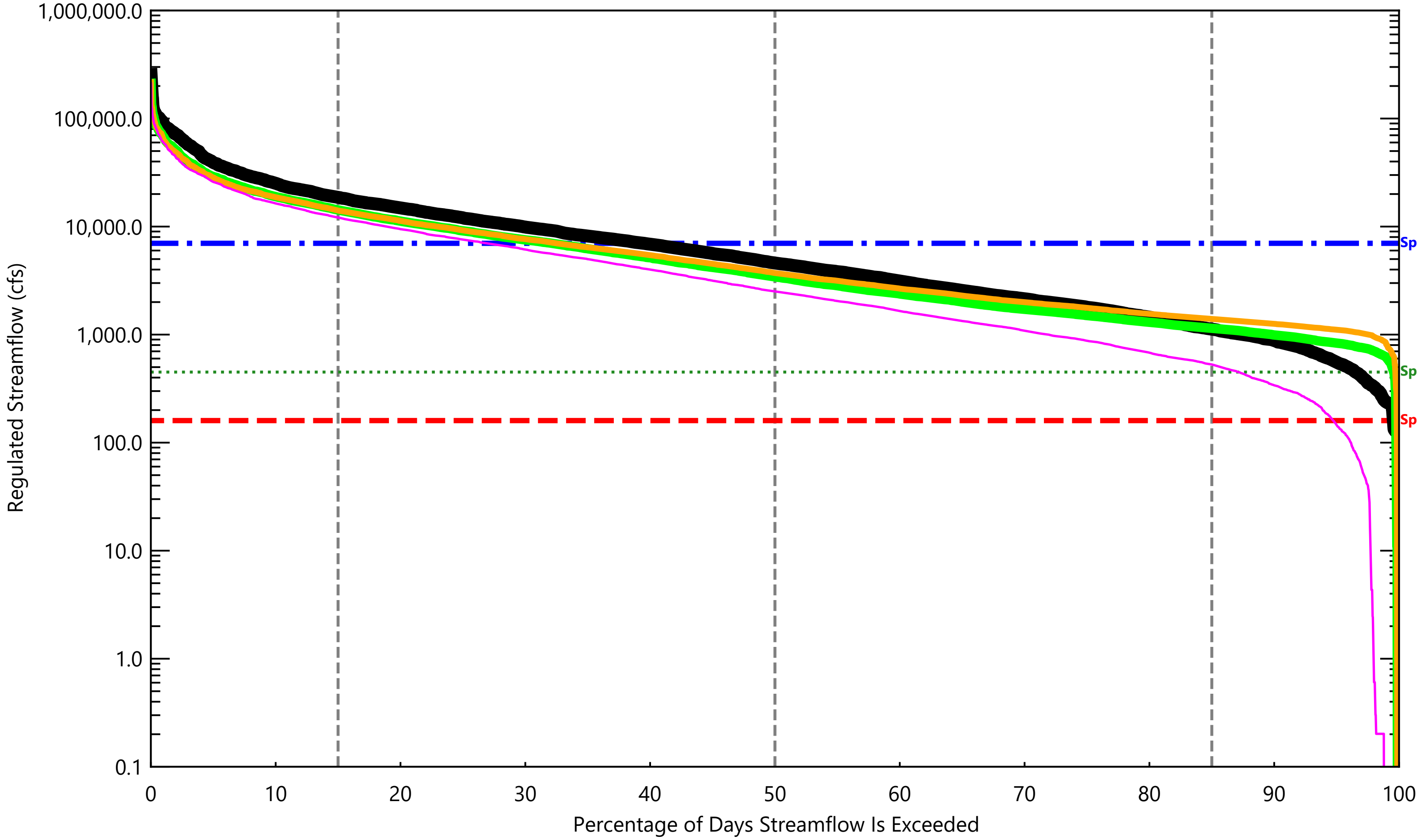
Figure D-88
Trinity River near Oakwood
Winter Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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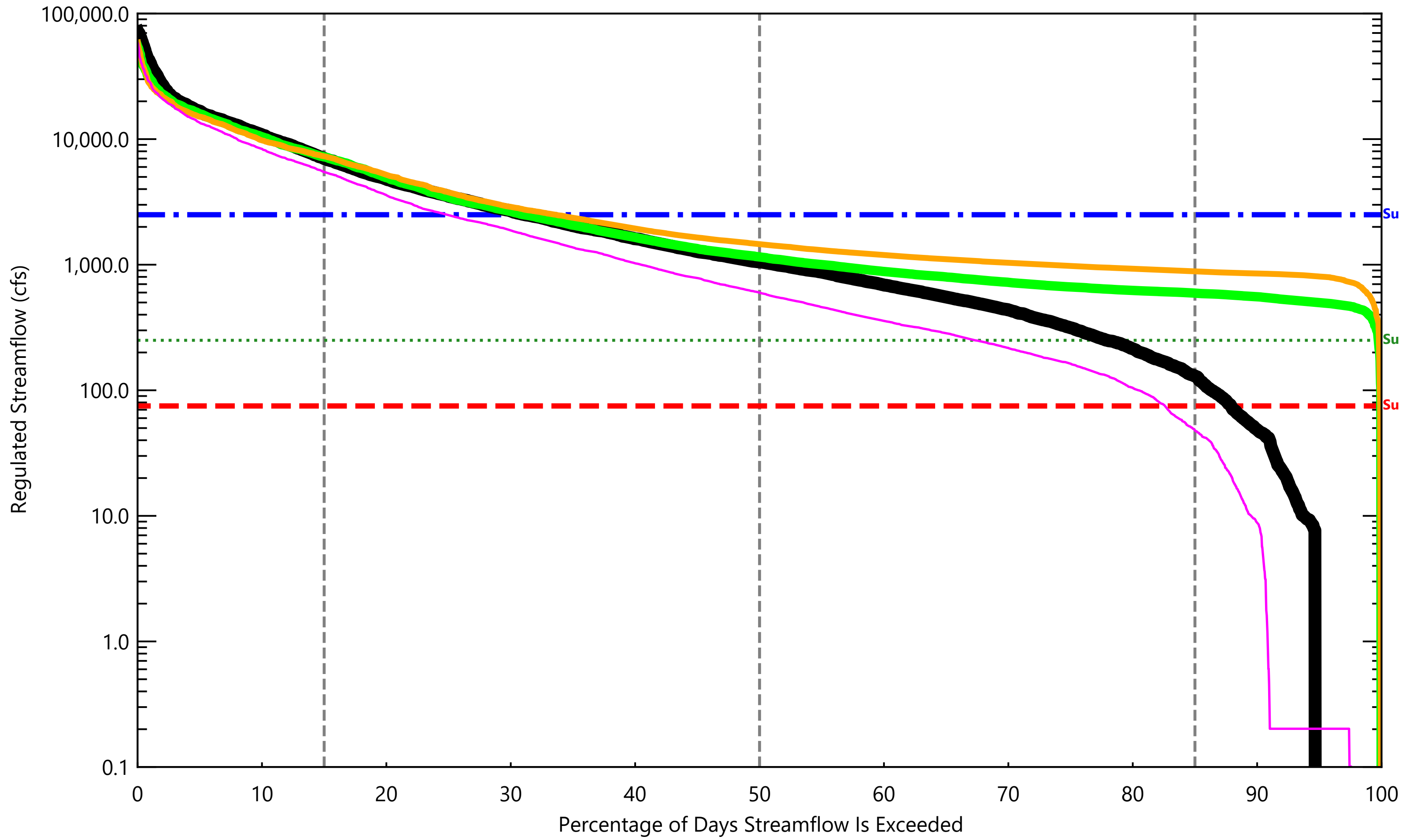
Figure D-89
Trinity River near Oakwood
Spring Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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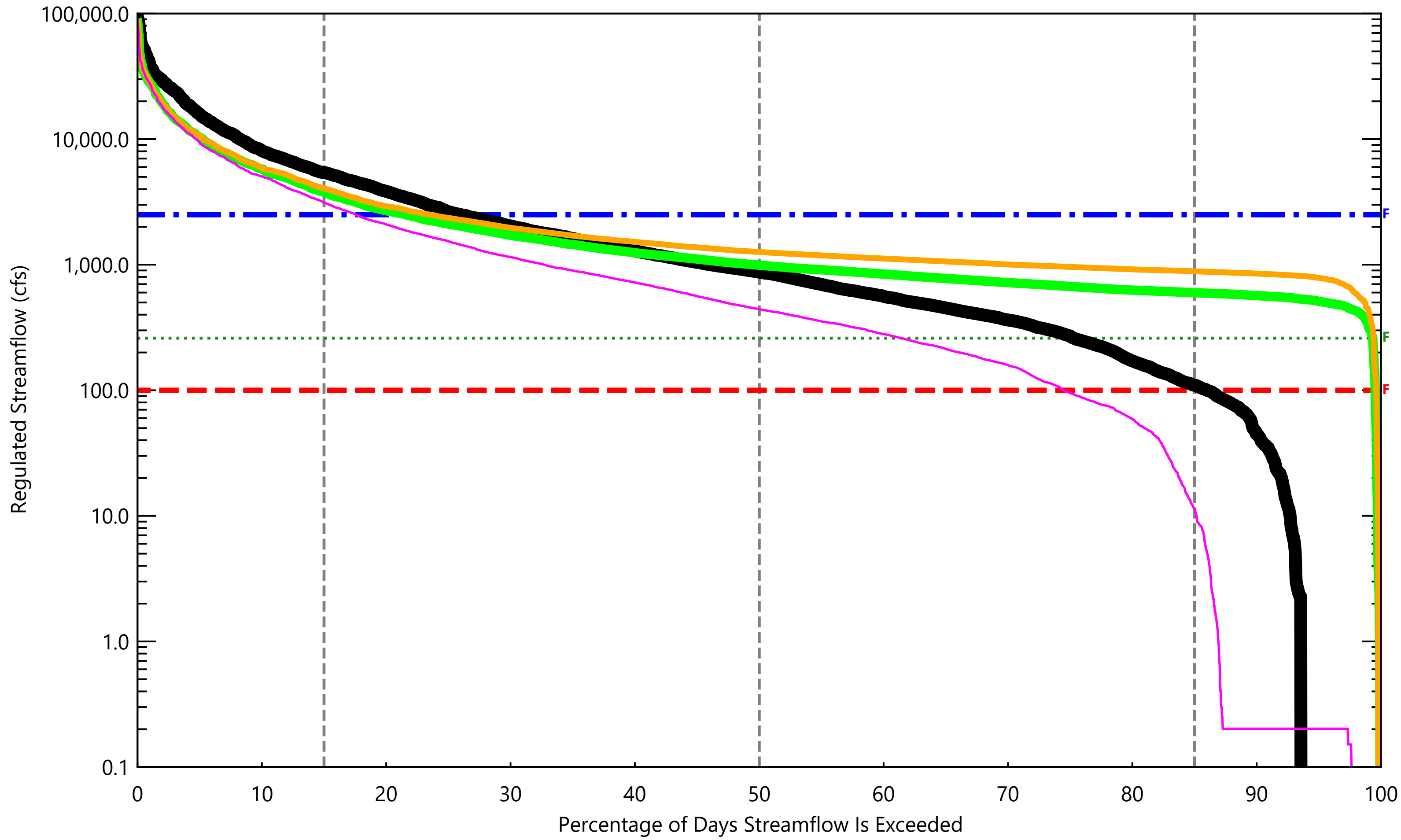
Figure D-90
Trinity River near Oakwood
Summer Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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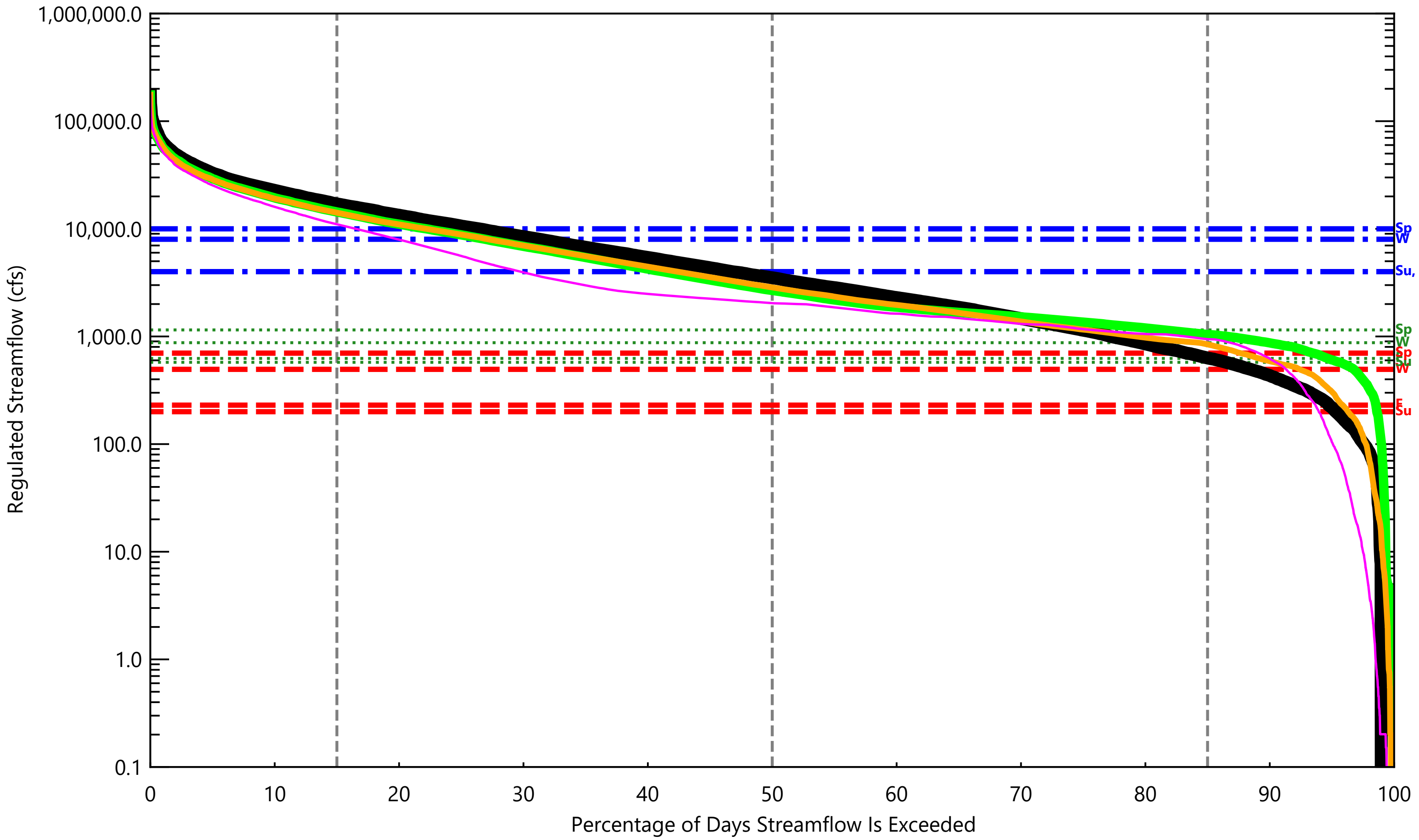
Figure D-91
Trinity River near Oakwood
Fall Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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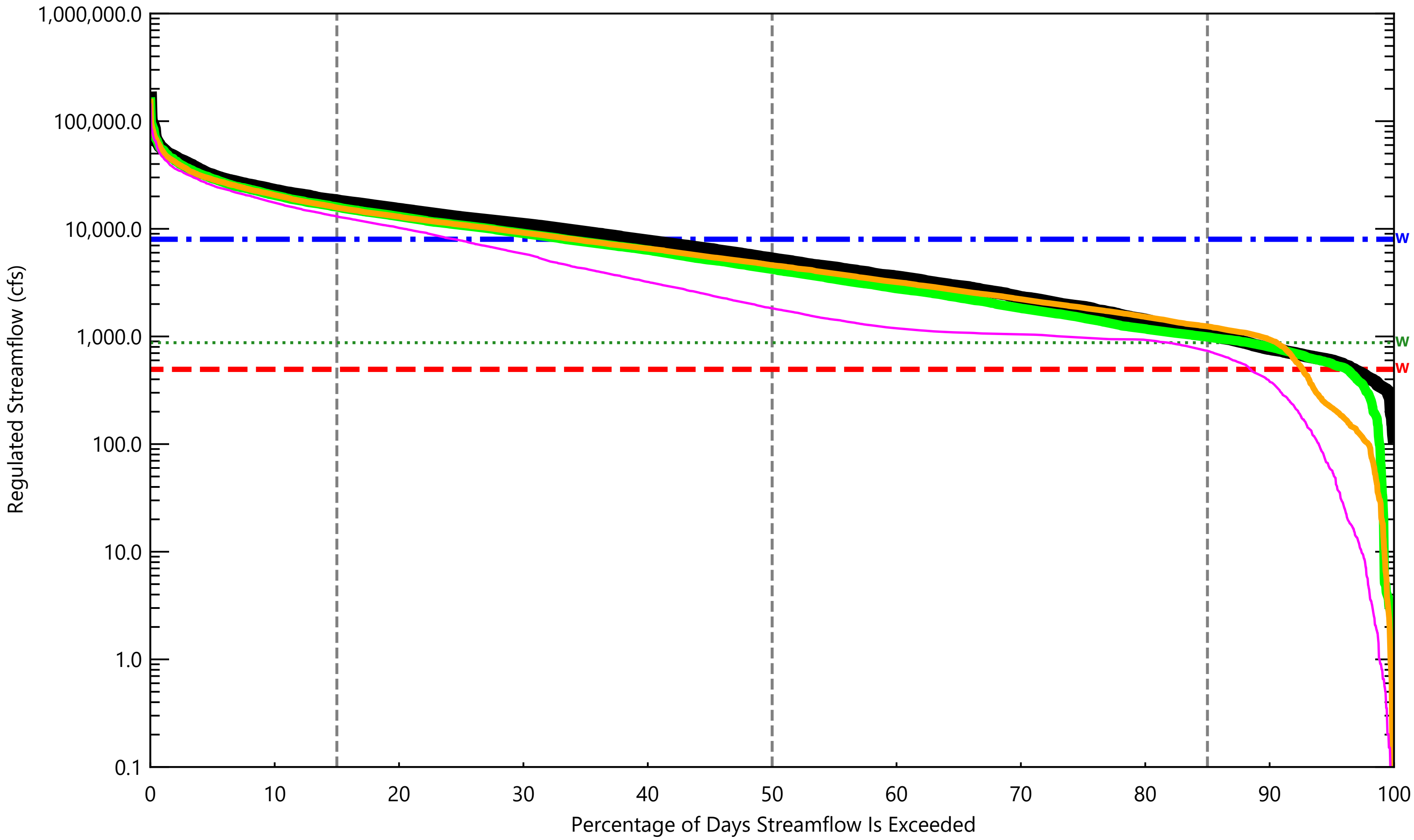
Figure D-92
Trinity River near Romayor
Annual Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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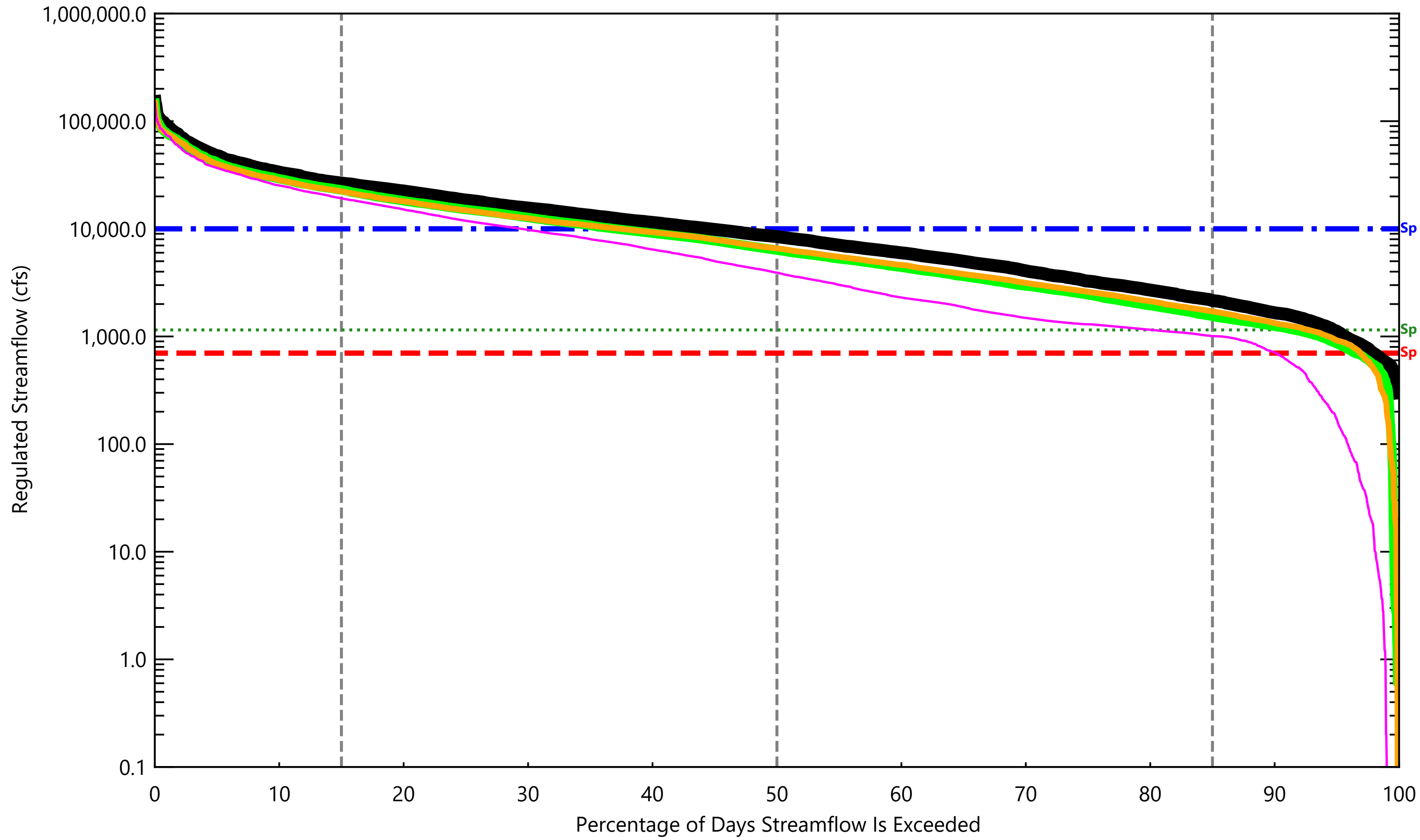
Figure D-93
Trinity River near Romayor
Winter Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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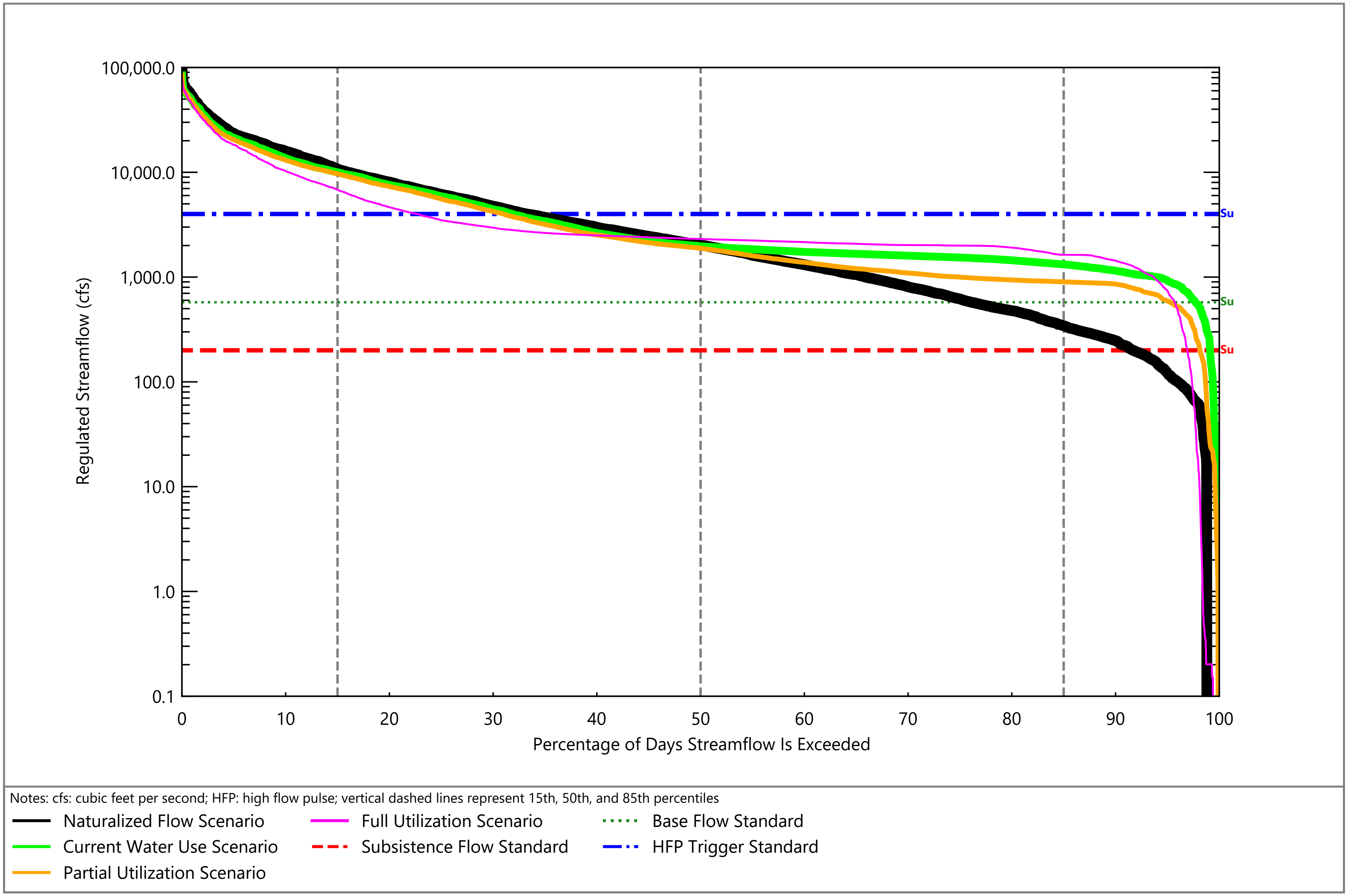
Figure D-94
Trinity River near Romayor
Spring Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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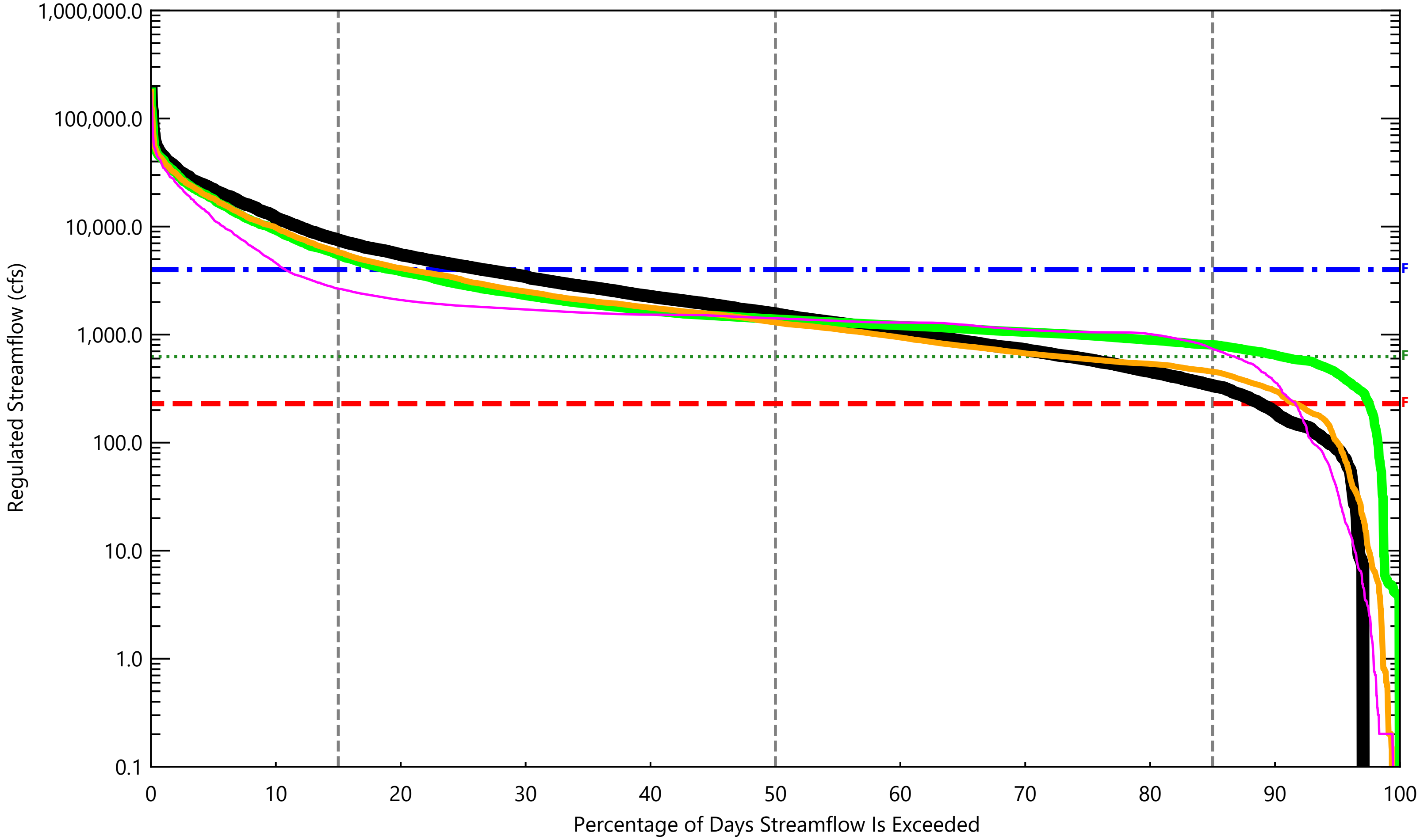
Figure D-95
Trinity River near Romayor
Summer Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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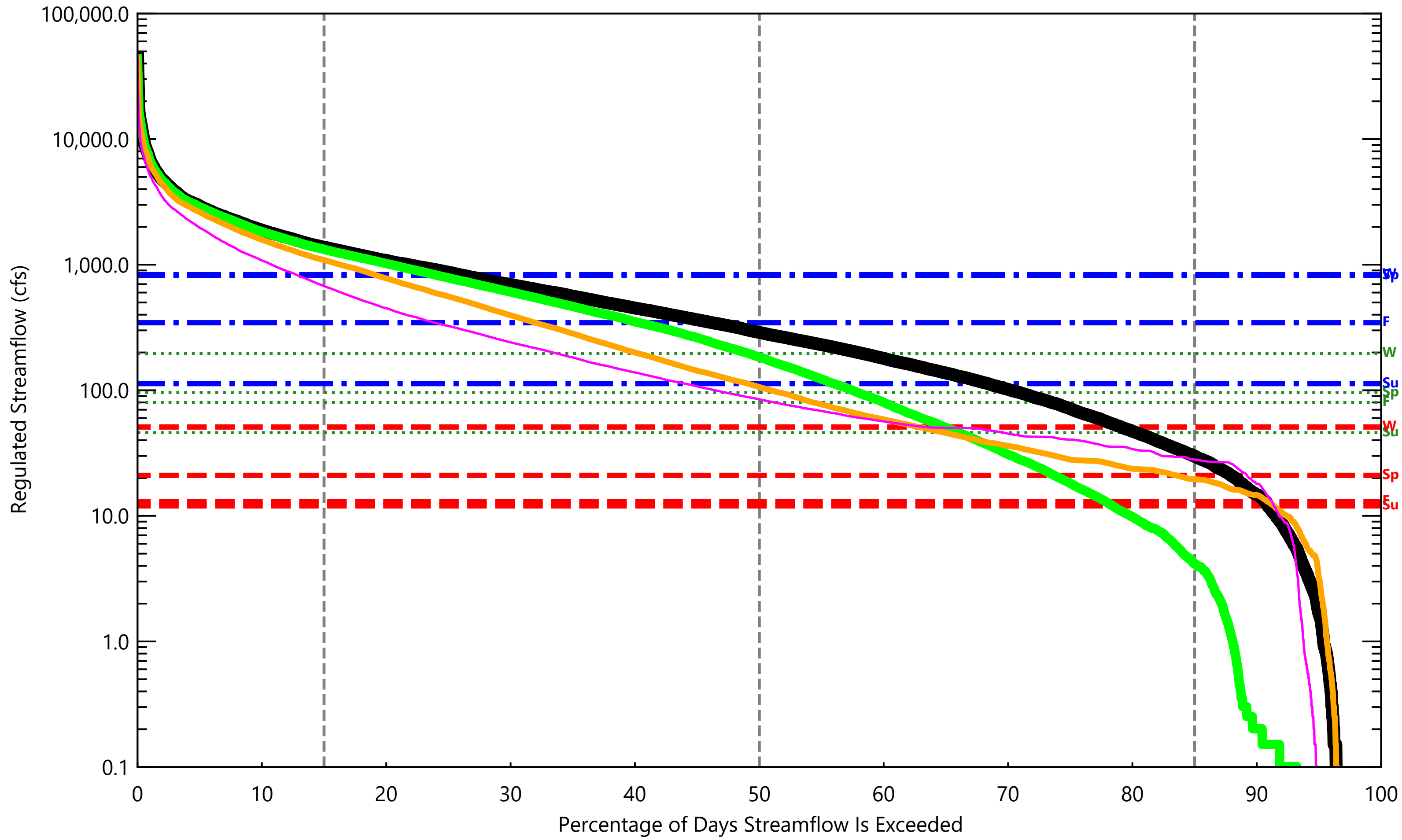
Figure D-96
Trinity River near Romayor
Fall Flow Duration Curves for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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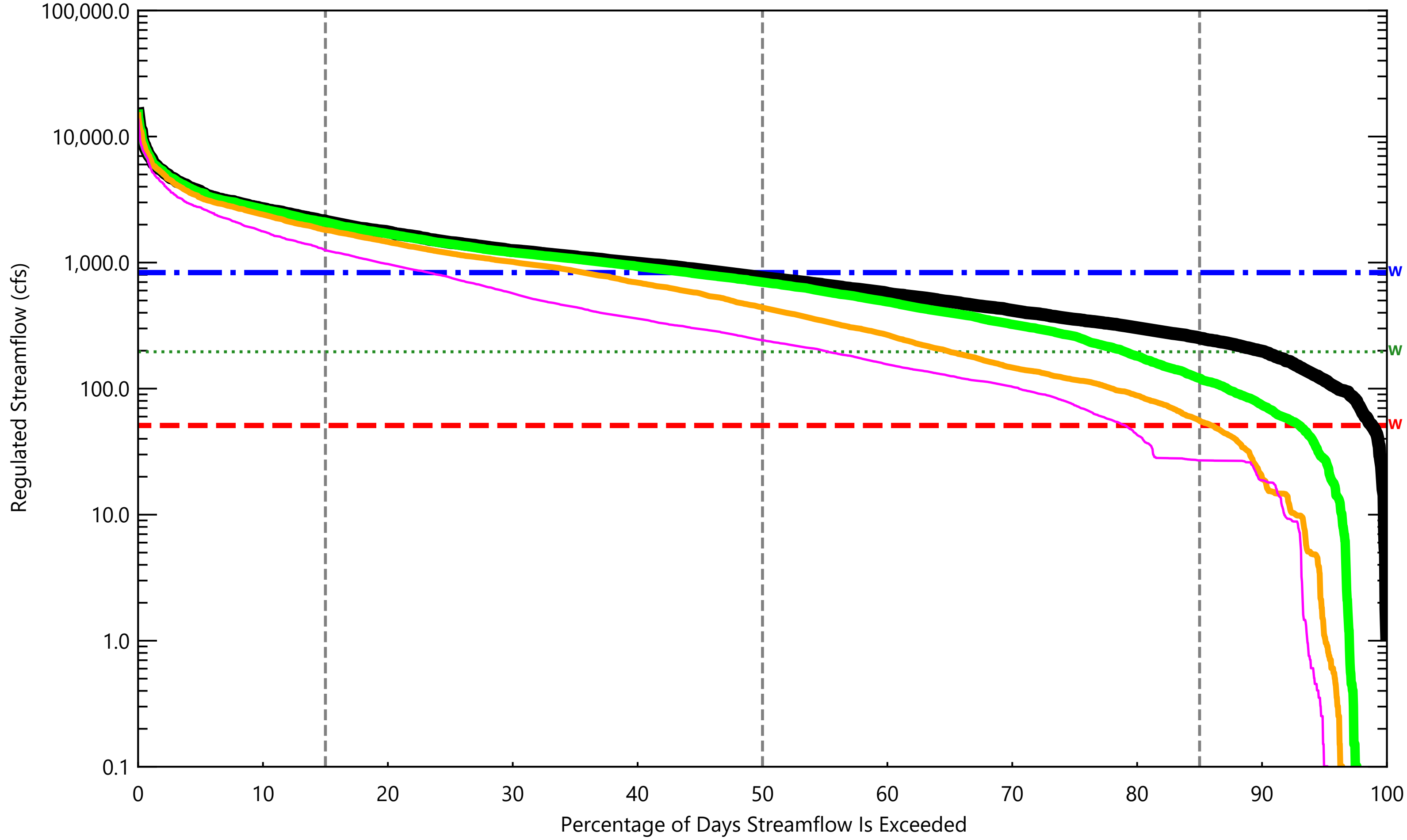
Figure D-97
Neches River at Neches
Annual Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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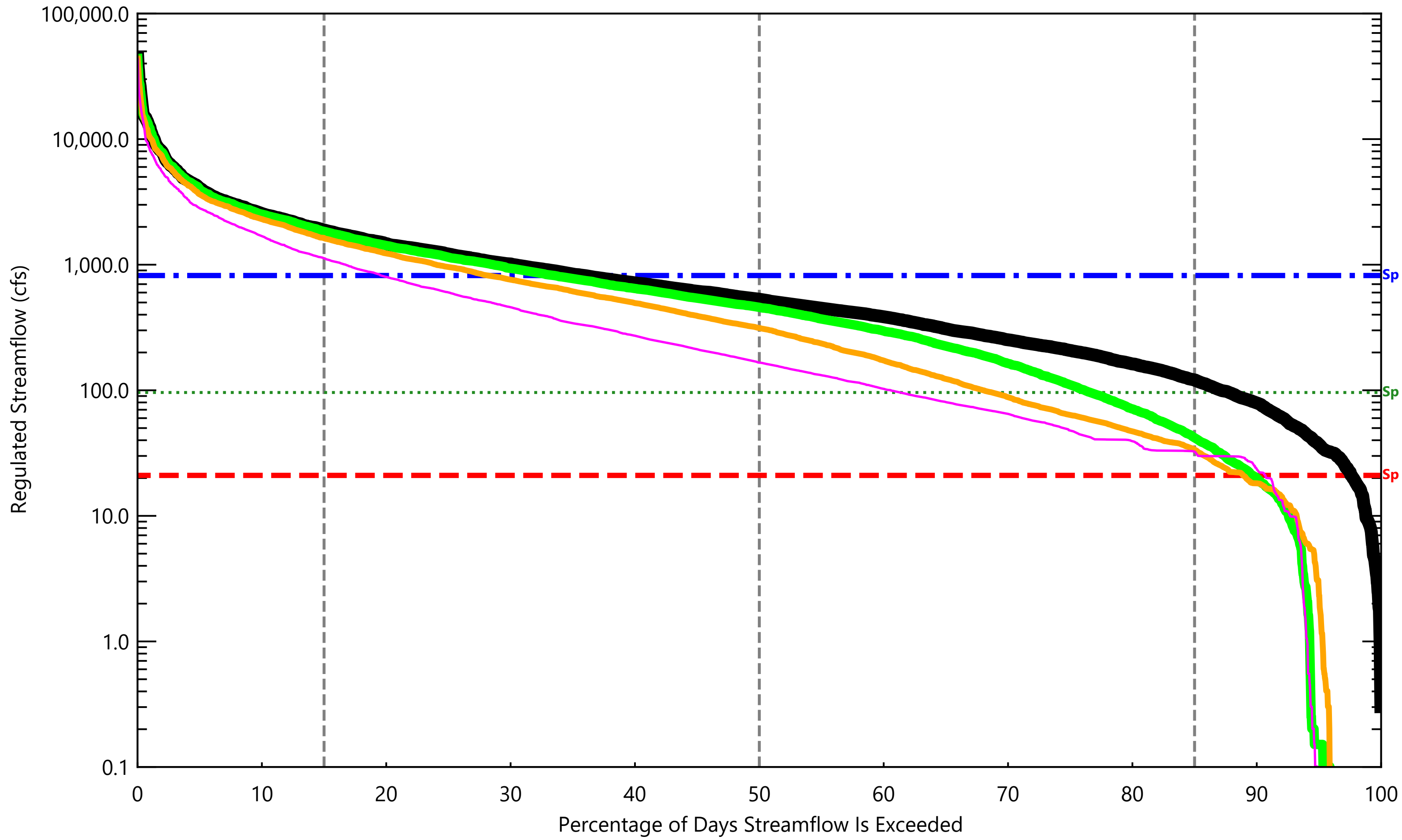
Figure D-98
Neches River at Neches
Winter Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

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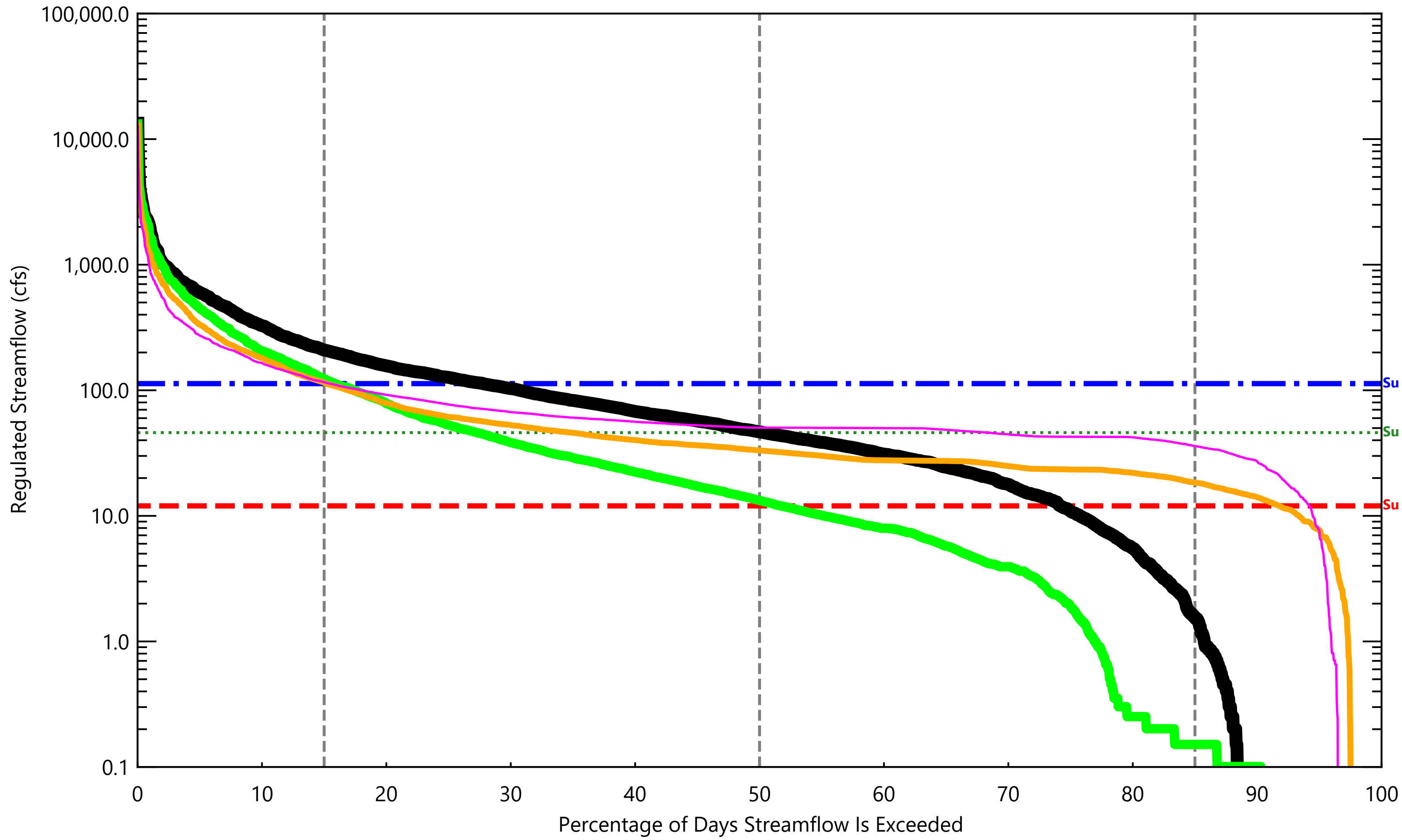
Figure D-99
Neches River at Neches
Spring Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario | Full Utilization Scenario | Base Flow Standard
Current Water Use Scenario | Subsistence Flow Standard | HFP Trigger Standard
Partial Utilization Scenario

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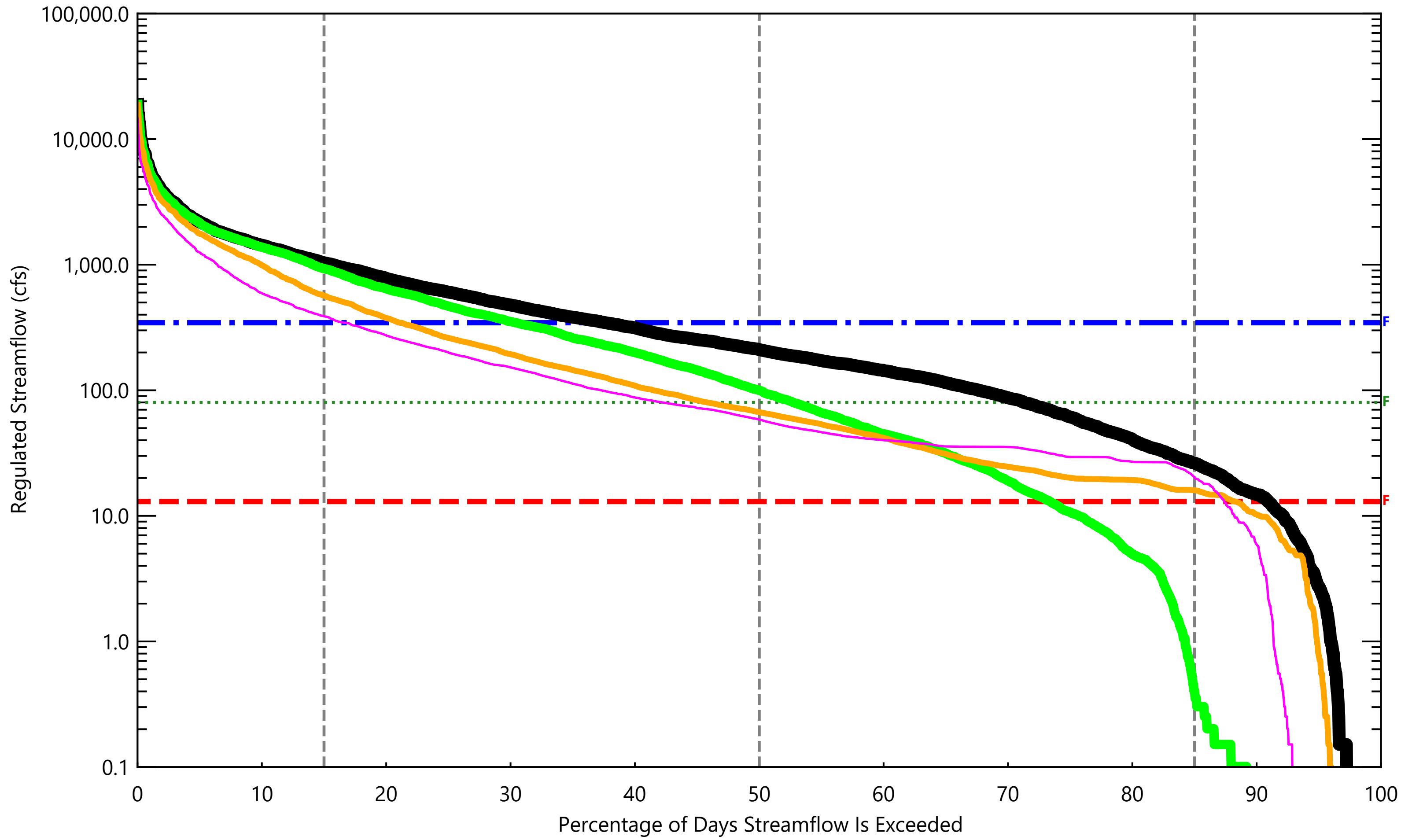
Figure D-100
Neches River at Neches
Summer Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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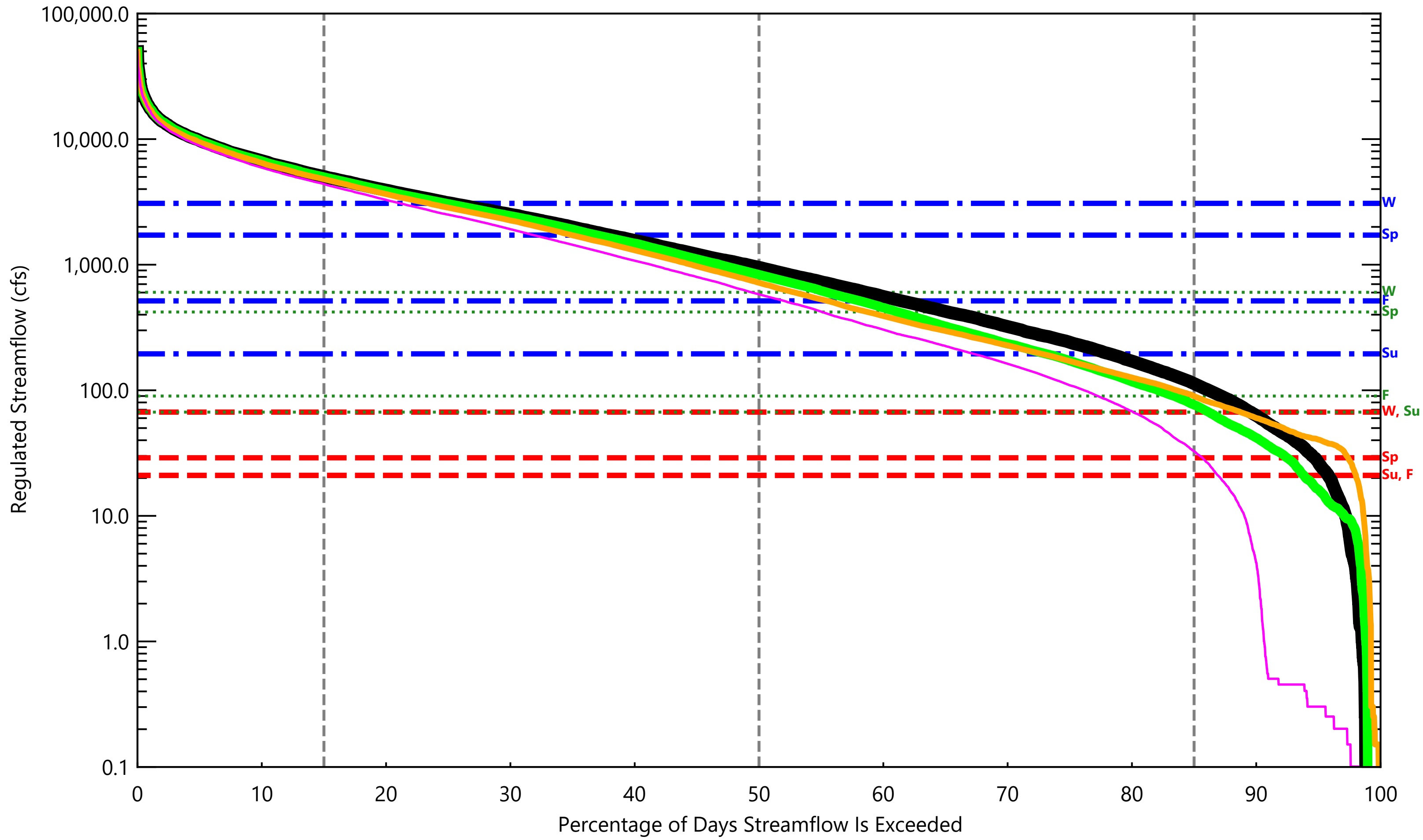
Figure D-101
Neches River at Neches
Fall Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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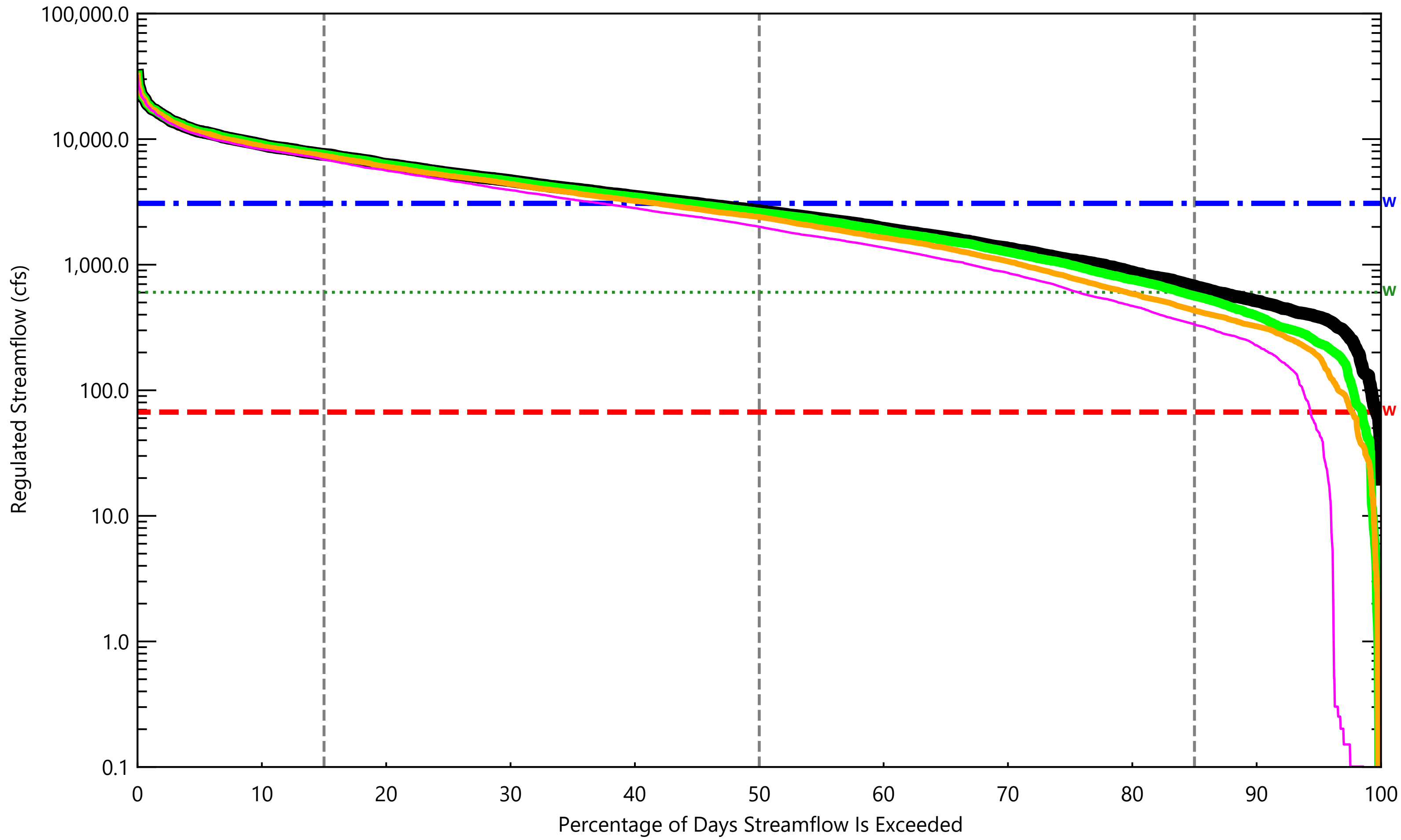
Figure D-102
Neches River near Rockland
Annual Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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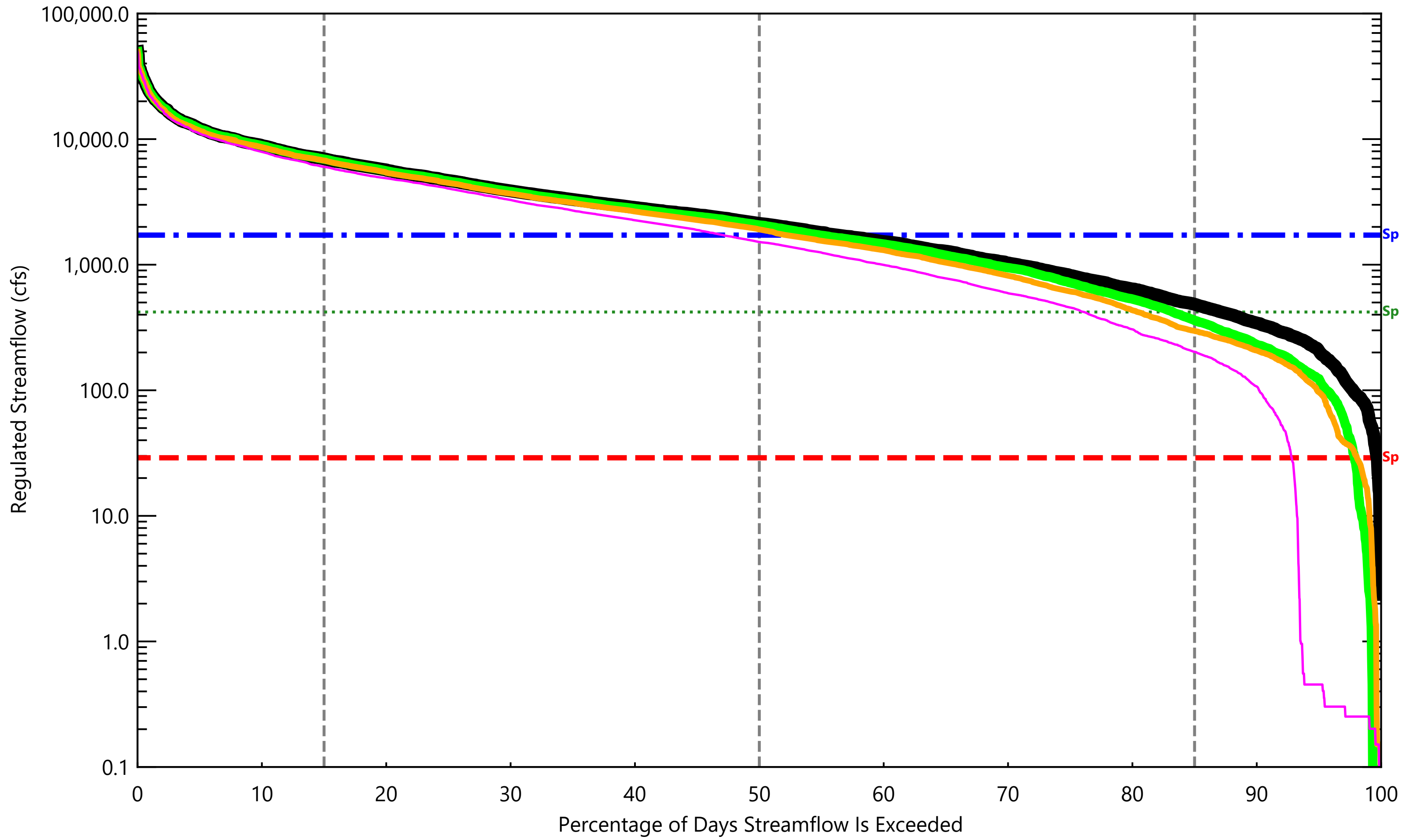
Figure D-103
Neches River near Rockland
Winter Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
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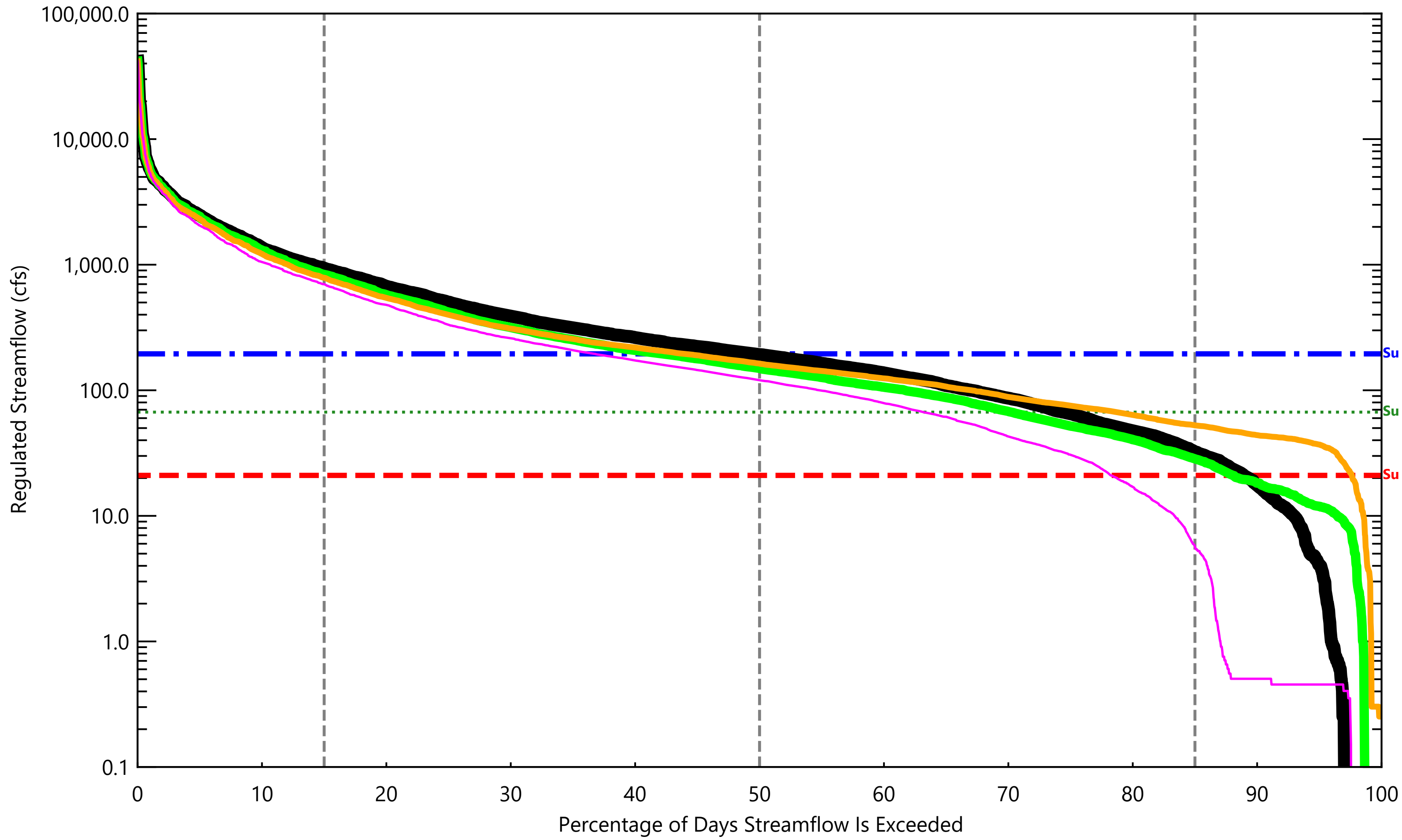
Figure D-104
Neches River near Rockland
Spring Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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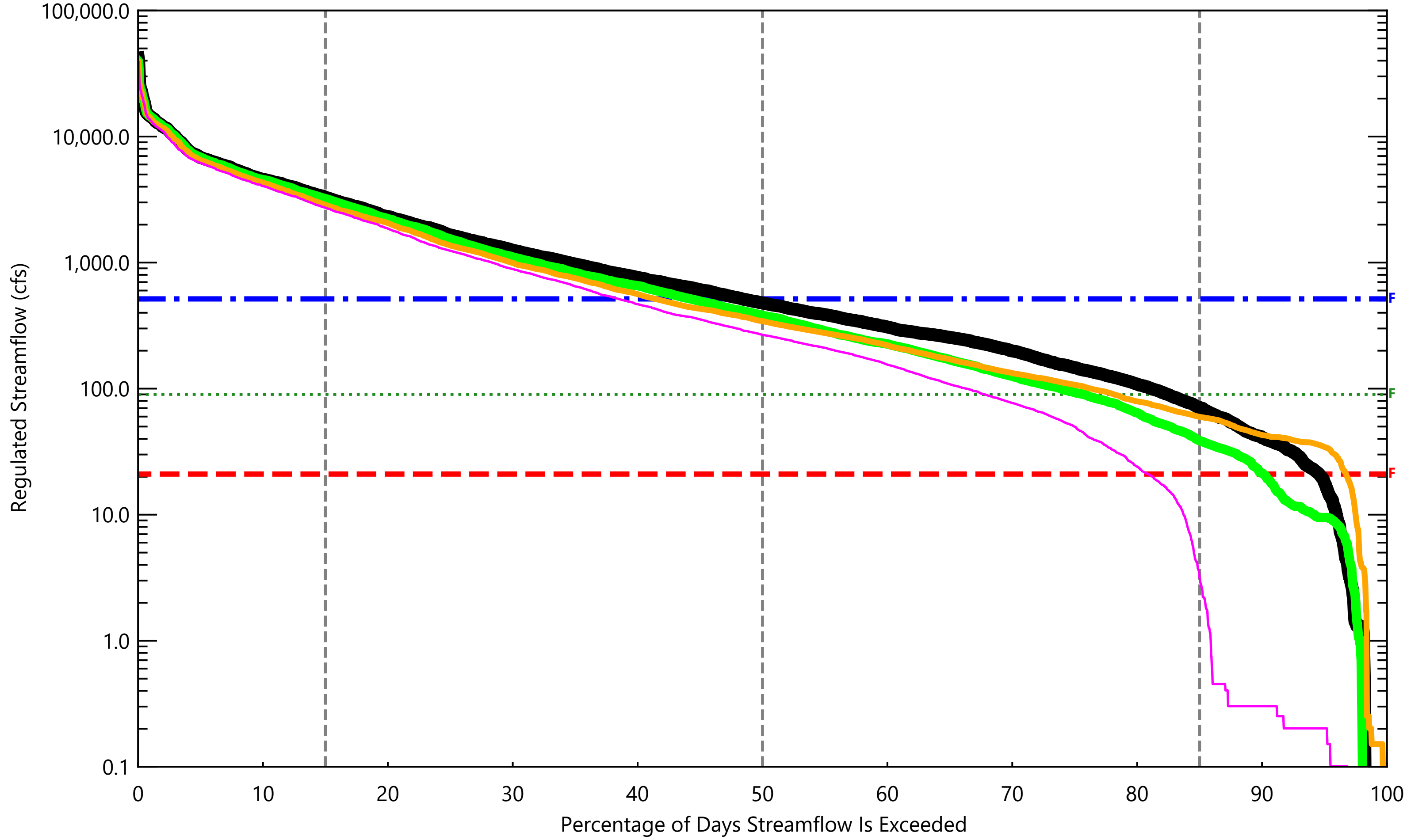
Figure D-105
Neches River near Rockland
Summer Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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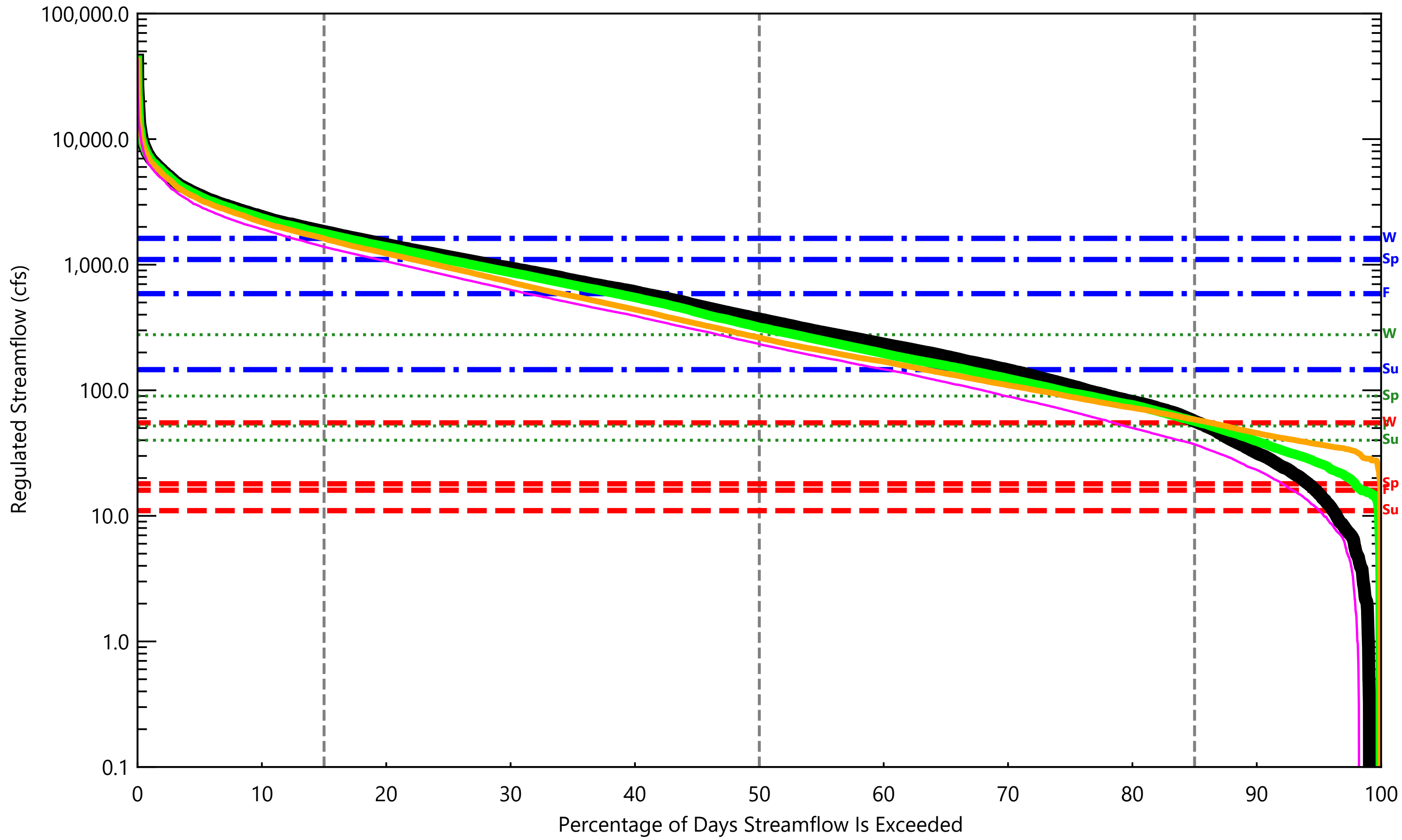
Figure D-106
Neches River near Rockland
Fall Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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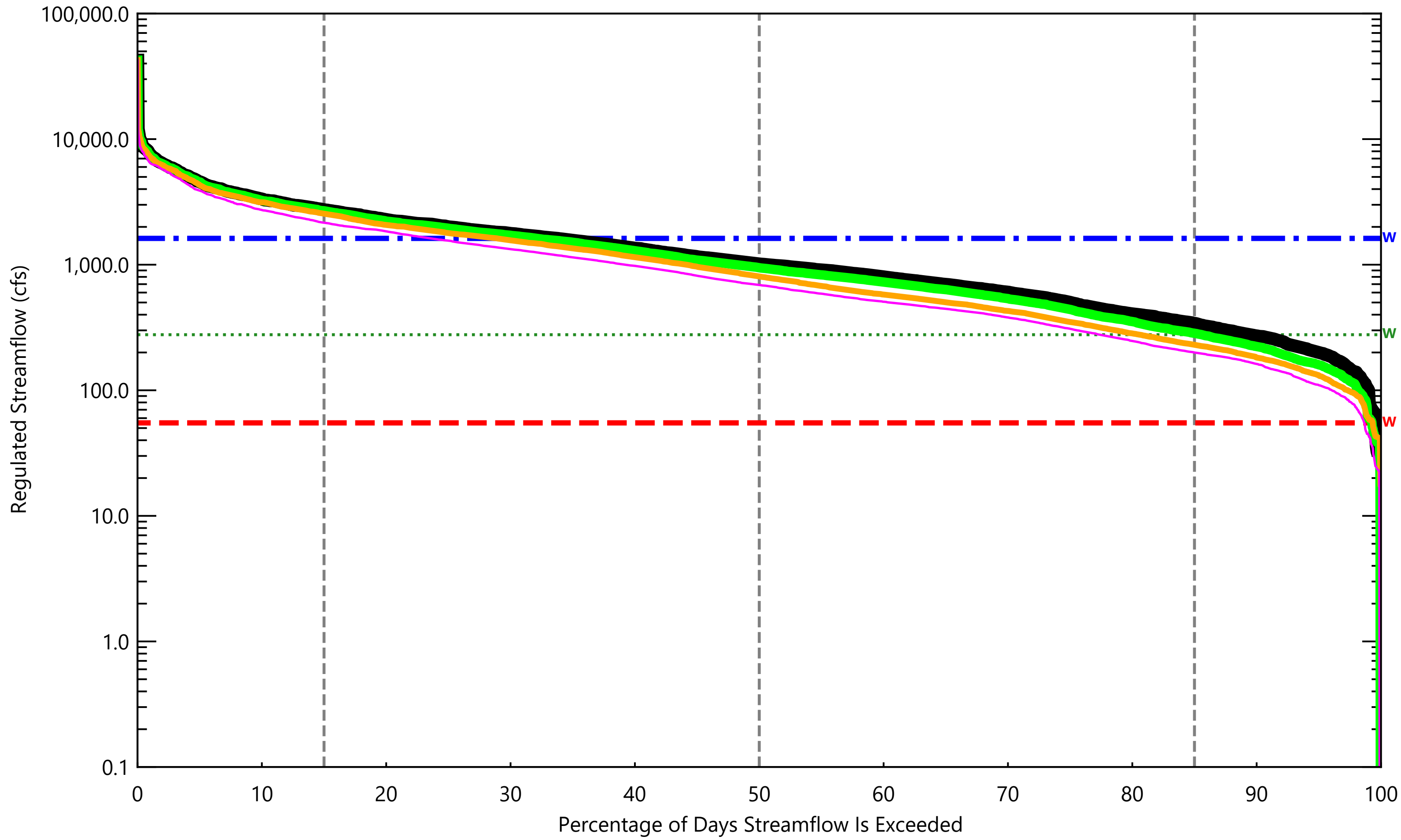
Figure D-107
Angelina River near Alto
Annual Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

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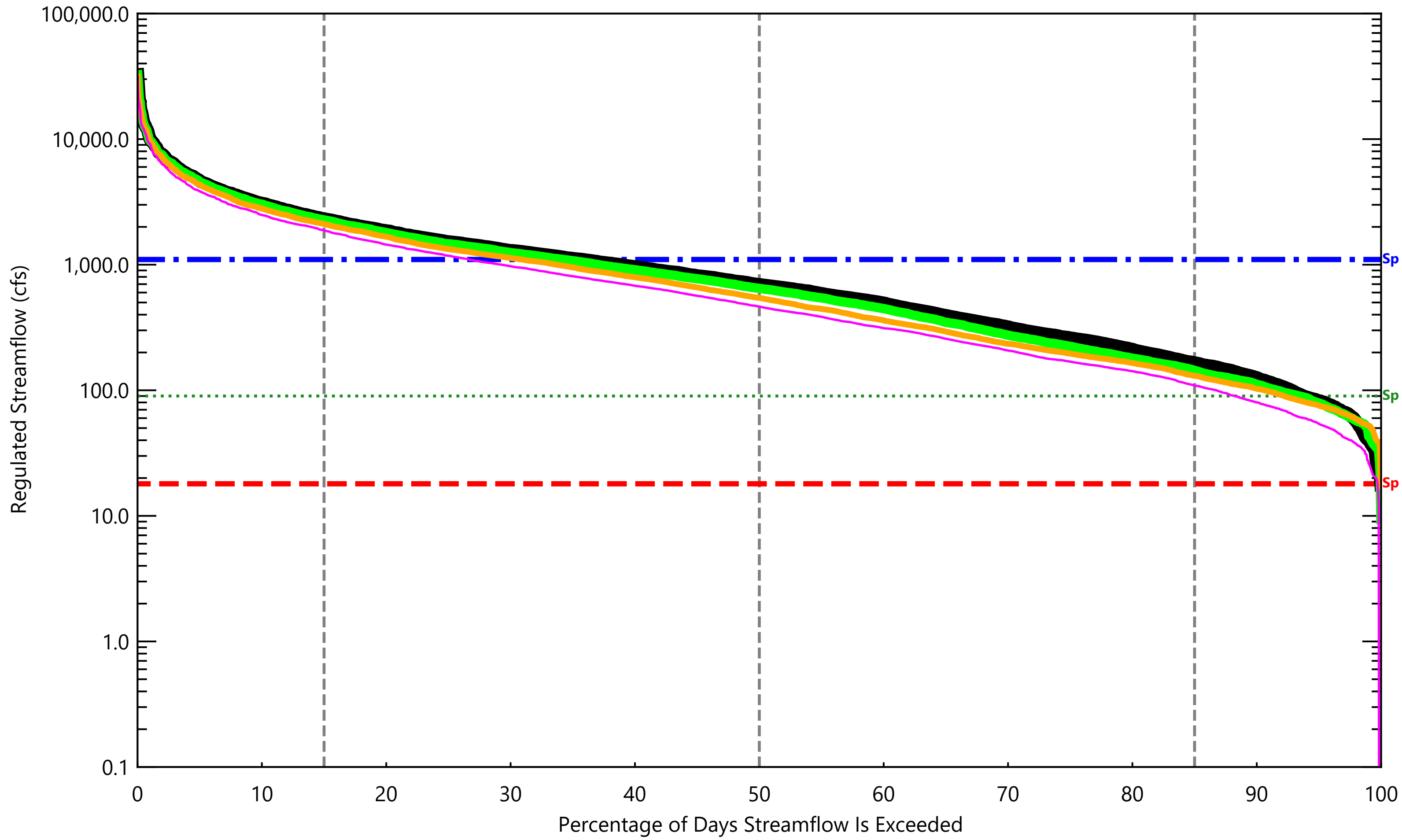
Figure D-108
Angelina River near Alto
Winter Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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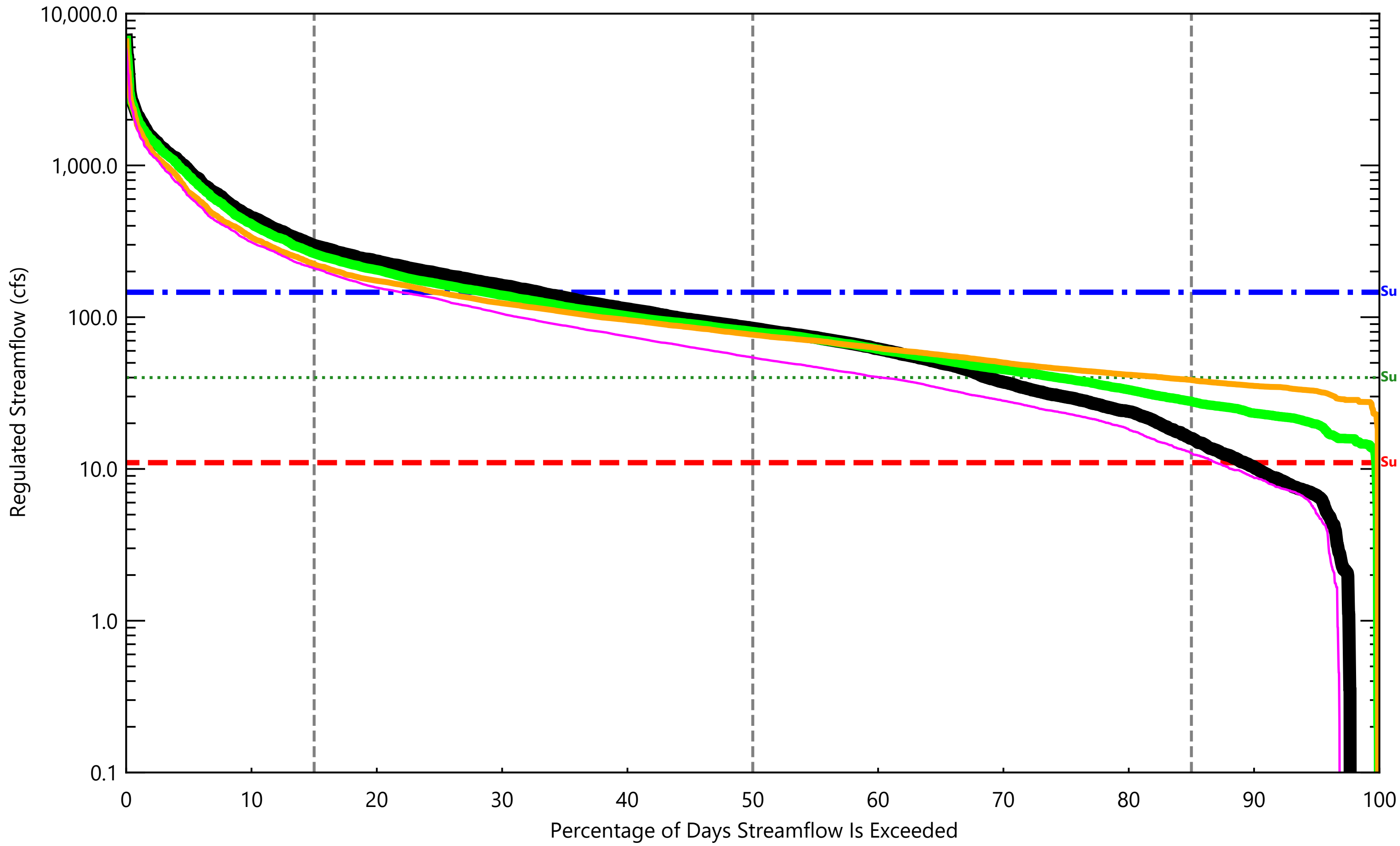
Figure D-109
Angelina River near Alto
Spring Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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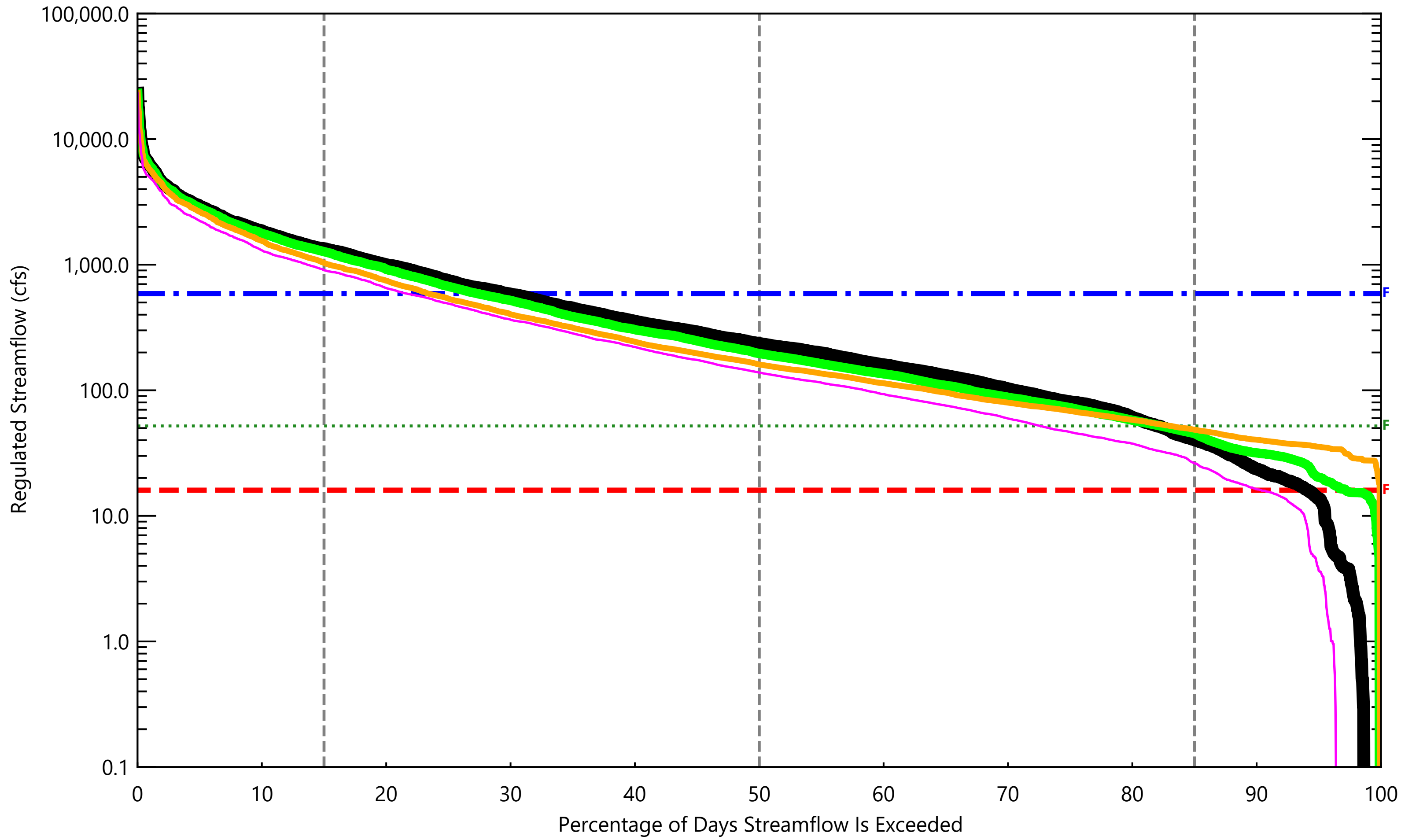
Figure D-110
Angelina River near Alto
Summer Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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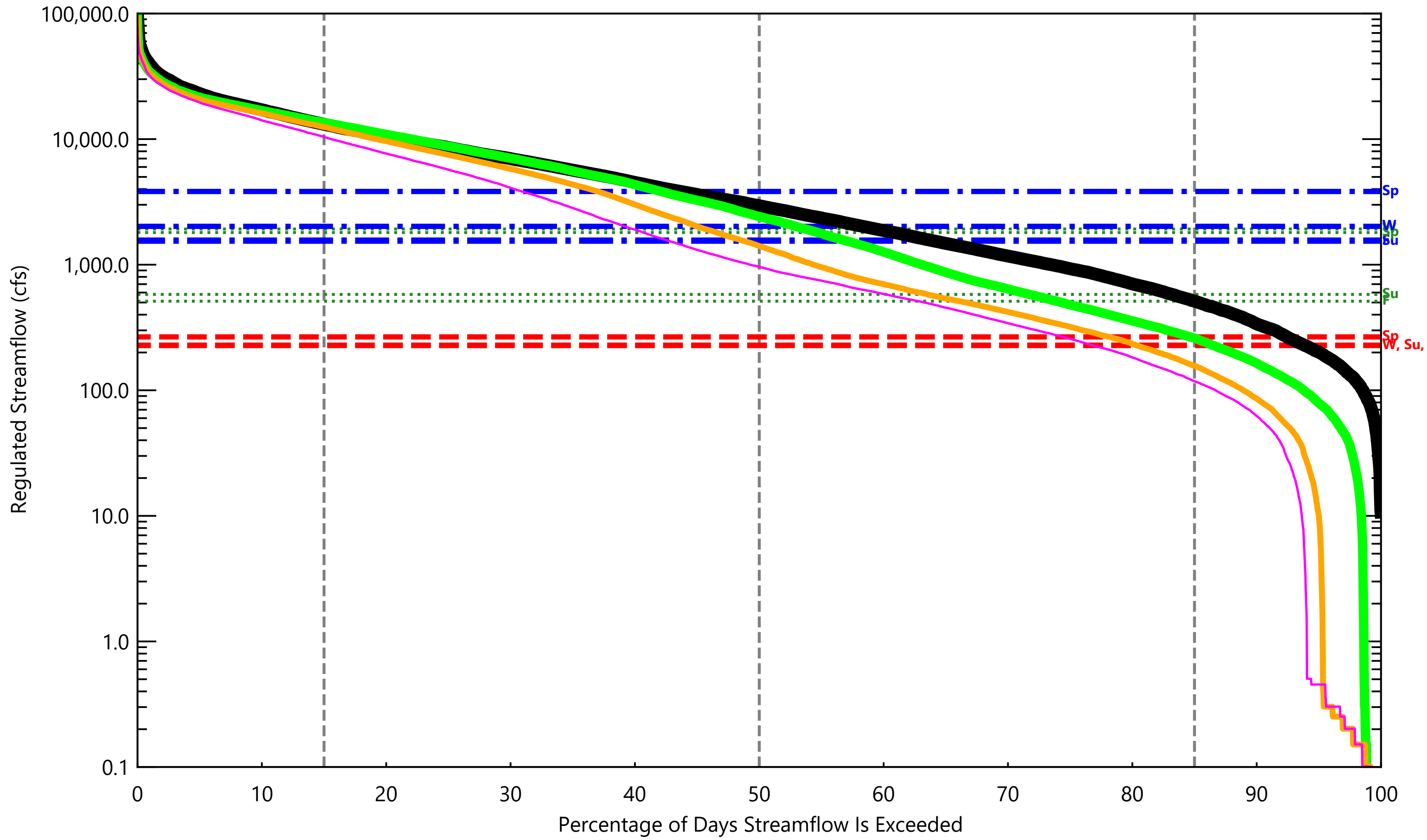
Figure D-111
Angelina River near Alto
Fall Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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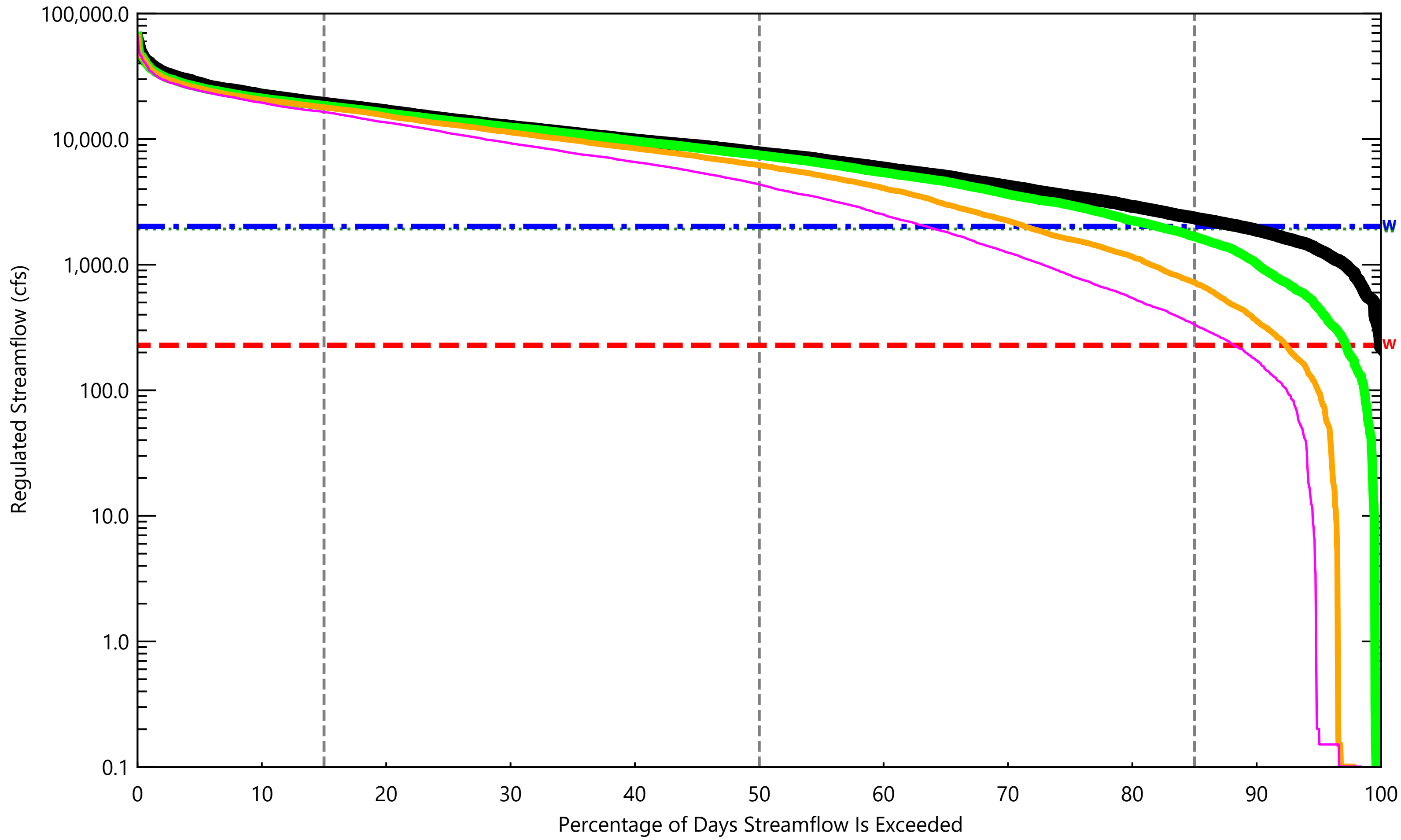
Figure D-112
Neches River at Evadale
Annual Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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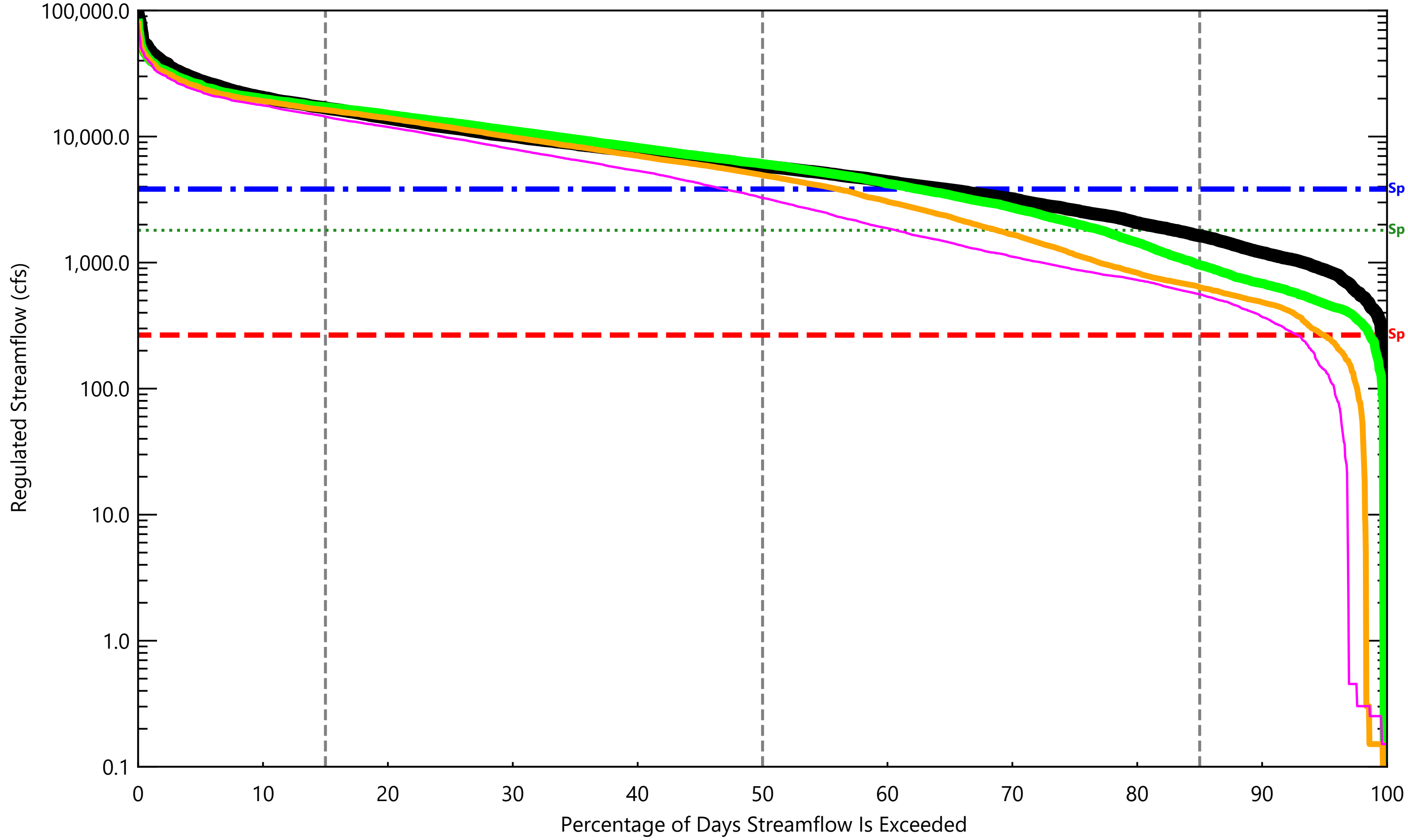
Figure D-113
Neches River at Evadale
Winter Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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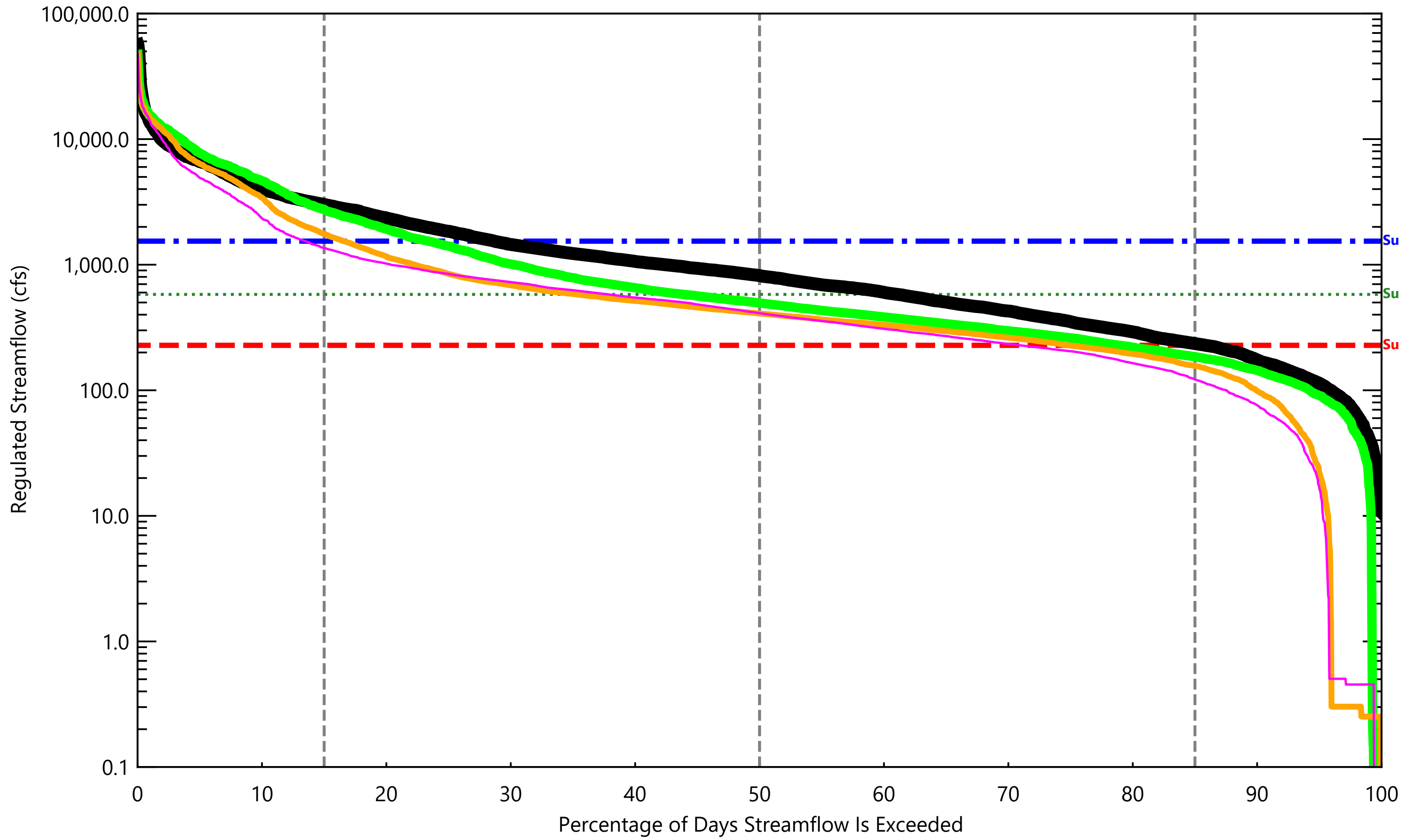
Figure D-114
Neches River at Evadale
Spring Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

Publish Date: 08/15/2021 14:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_duration_curves.py

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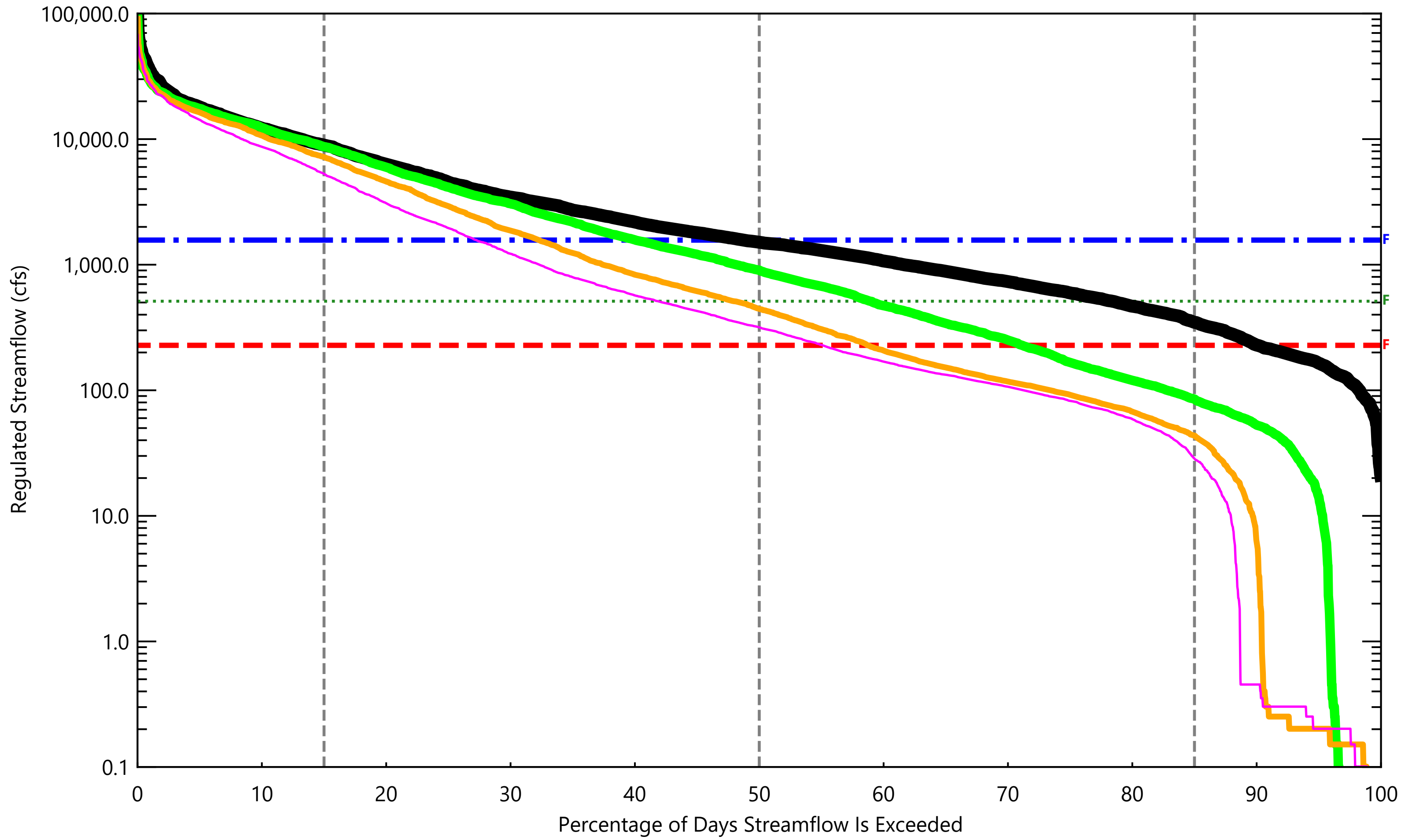
Figure D-115
Neches River at Evadale
Summer Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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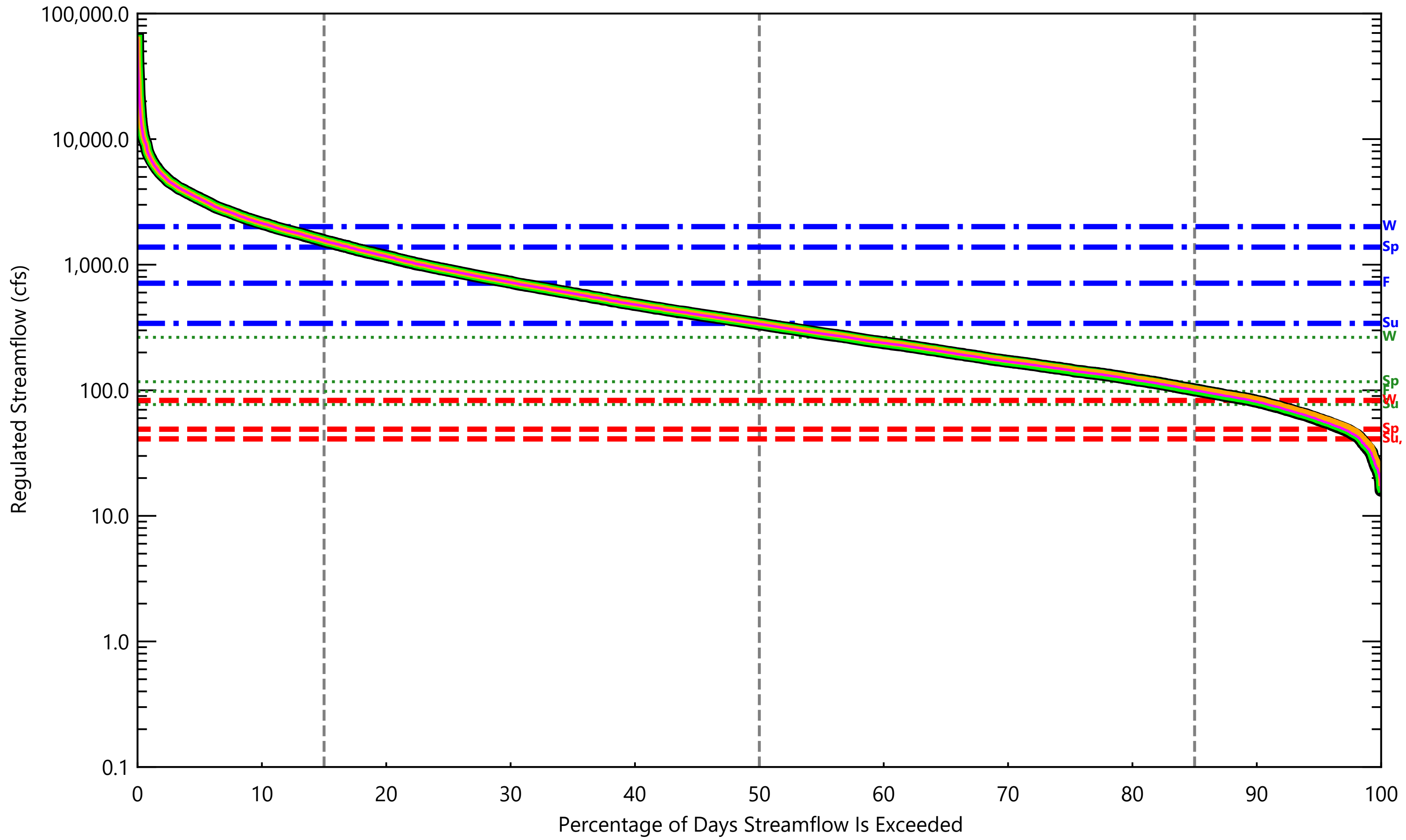
Figure D-116
Neches River at Evadale
Fall Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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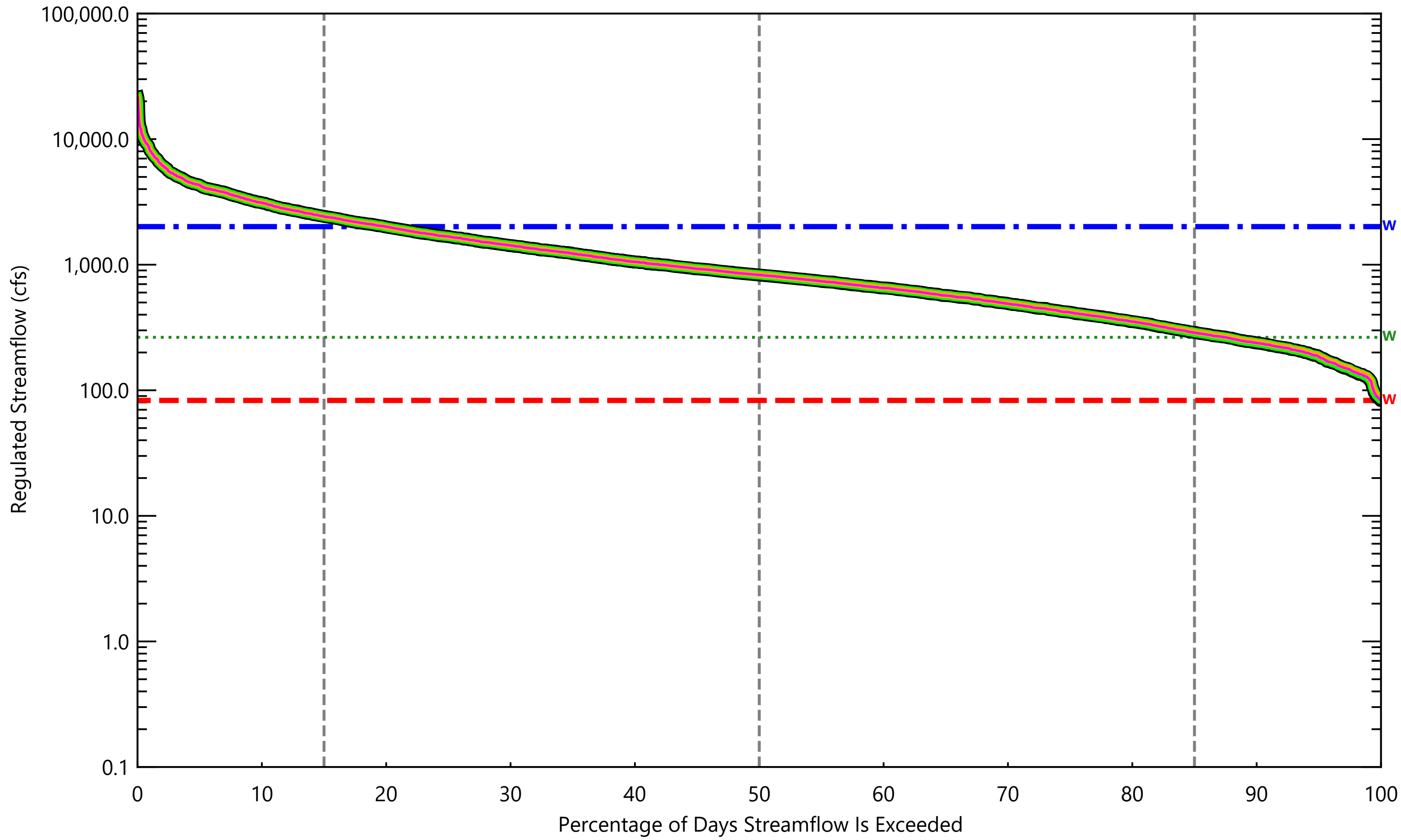
Figure D-117
Village Creek near Kountze
Annual Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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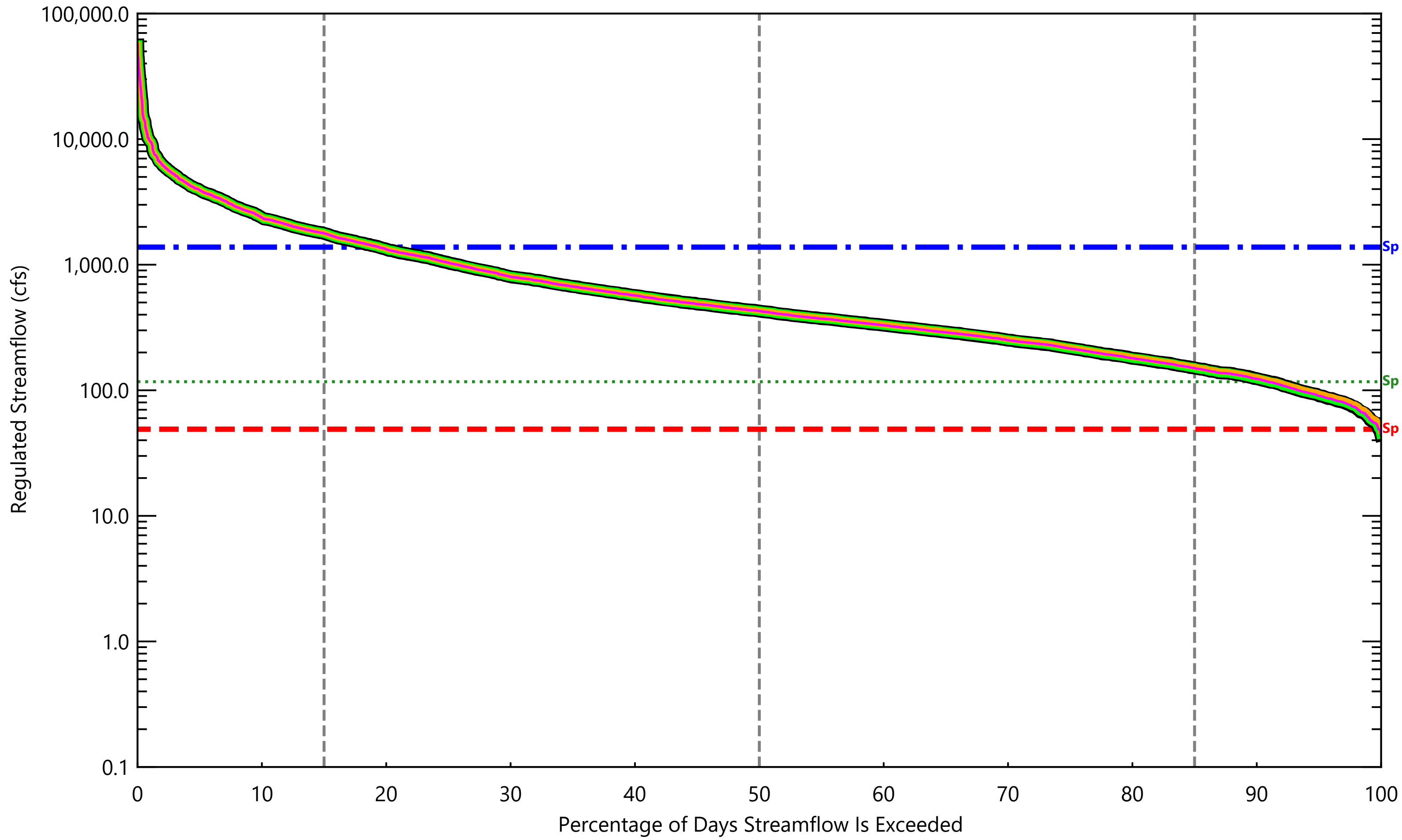
Figure D-118
Village Creek near Kountze
Winter Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
Subsistence Flow Standard
Base Flow Standard
HFP Trigger Standard

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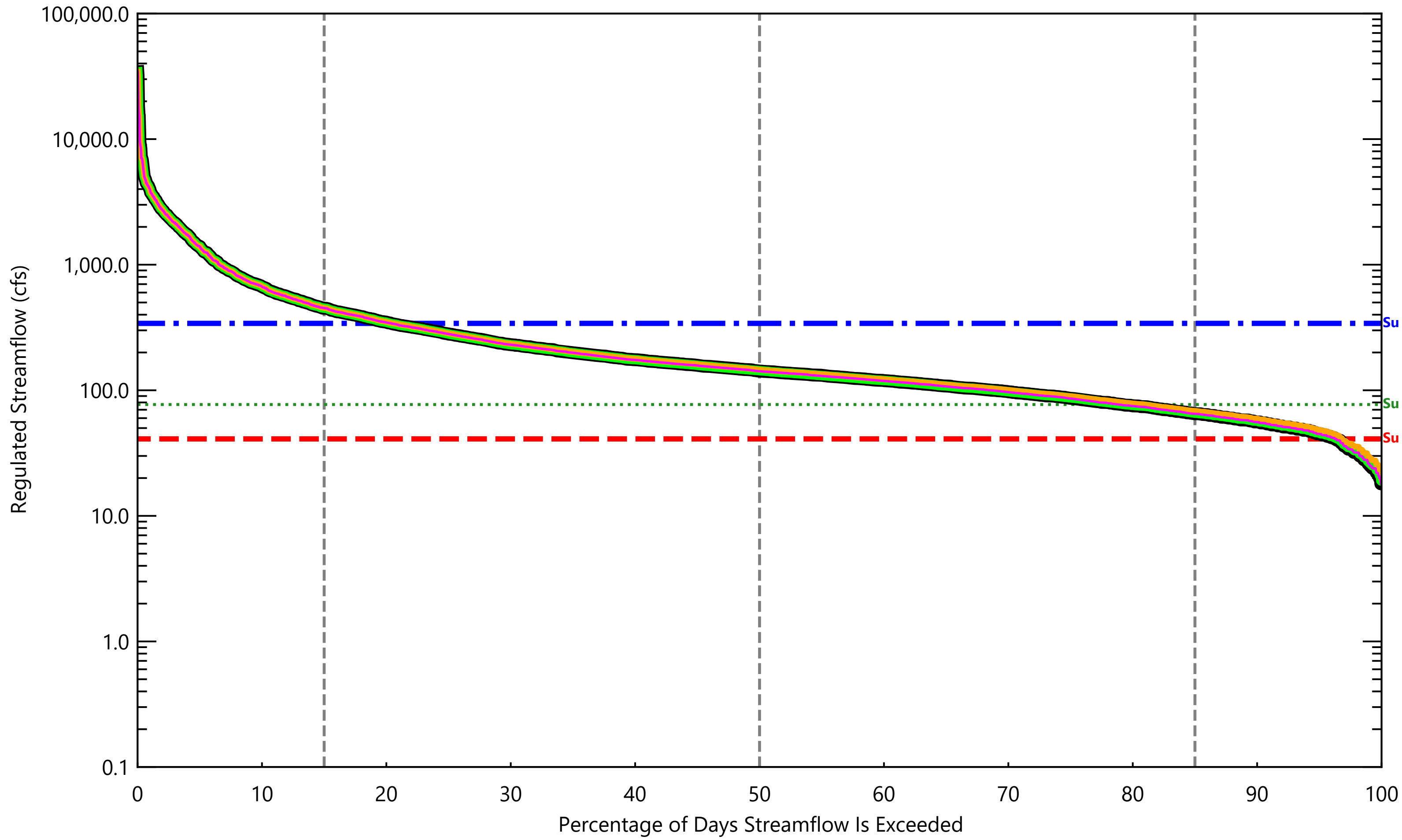
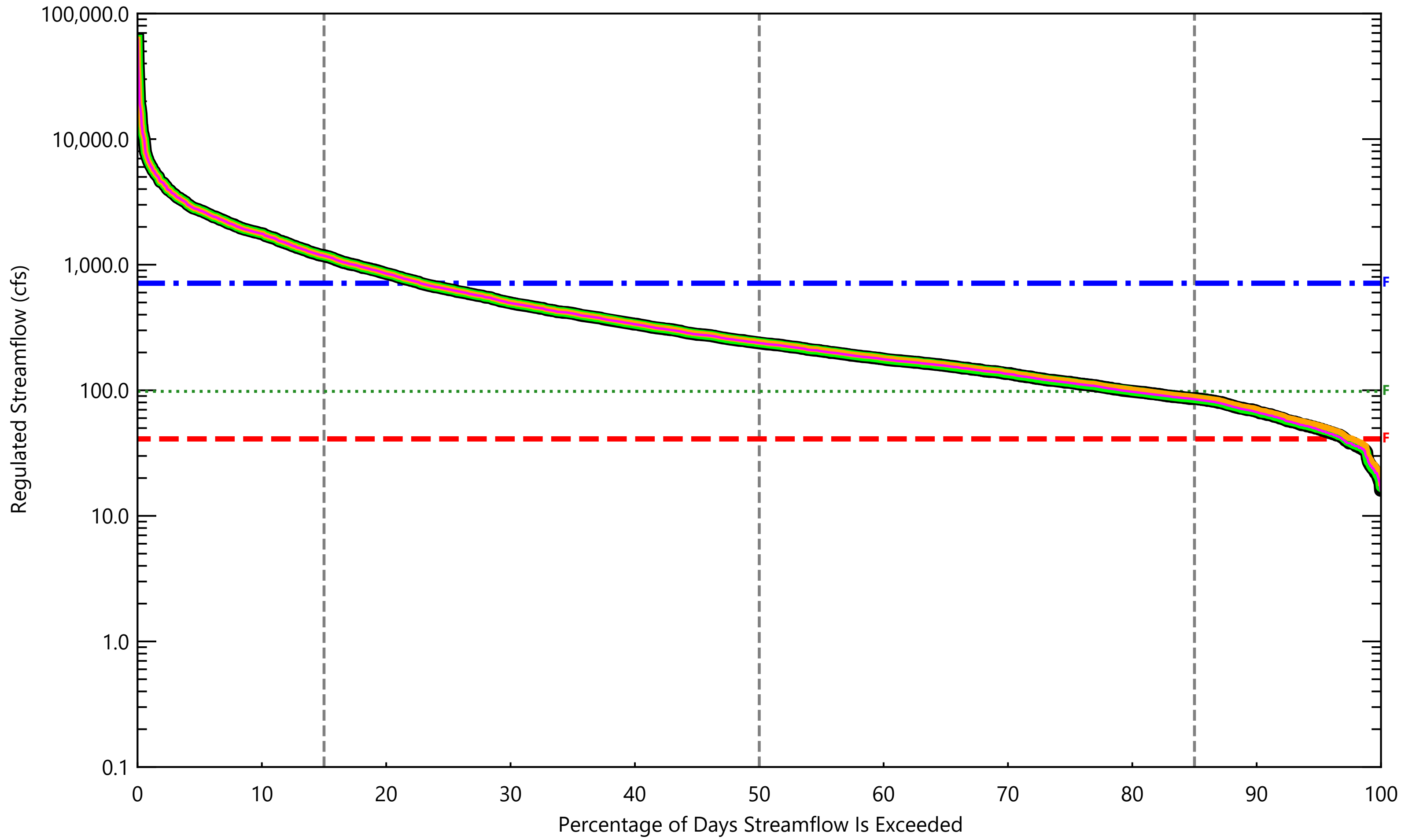
Figure D-119
Village Creek near Kountze
Spring Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

Figure D-120
Village Creek near Kountze
Summer Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; HFP: high flow pulse; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- Subsistence Flow Standard
- Base Flow Standard
- HFP Trigger Standard

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Figure D-121
Village Creek near Kountze
Fall Flow Duration Curves for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

Appendix E
Exceedance Frequency Plots

Introduction

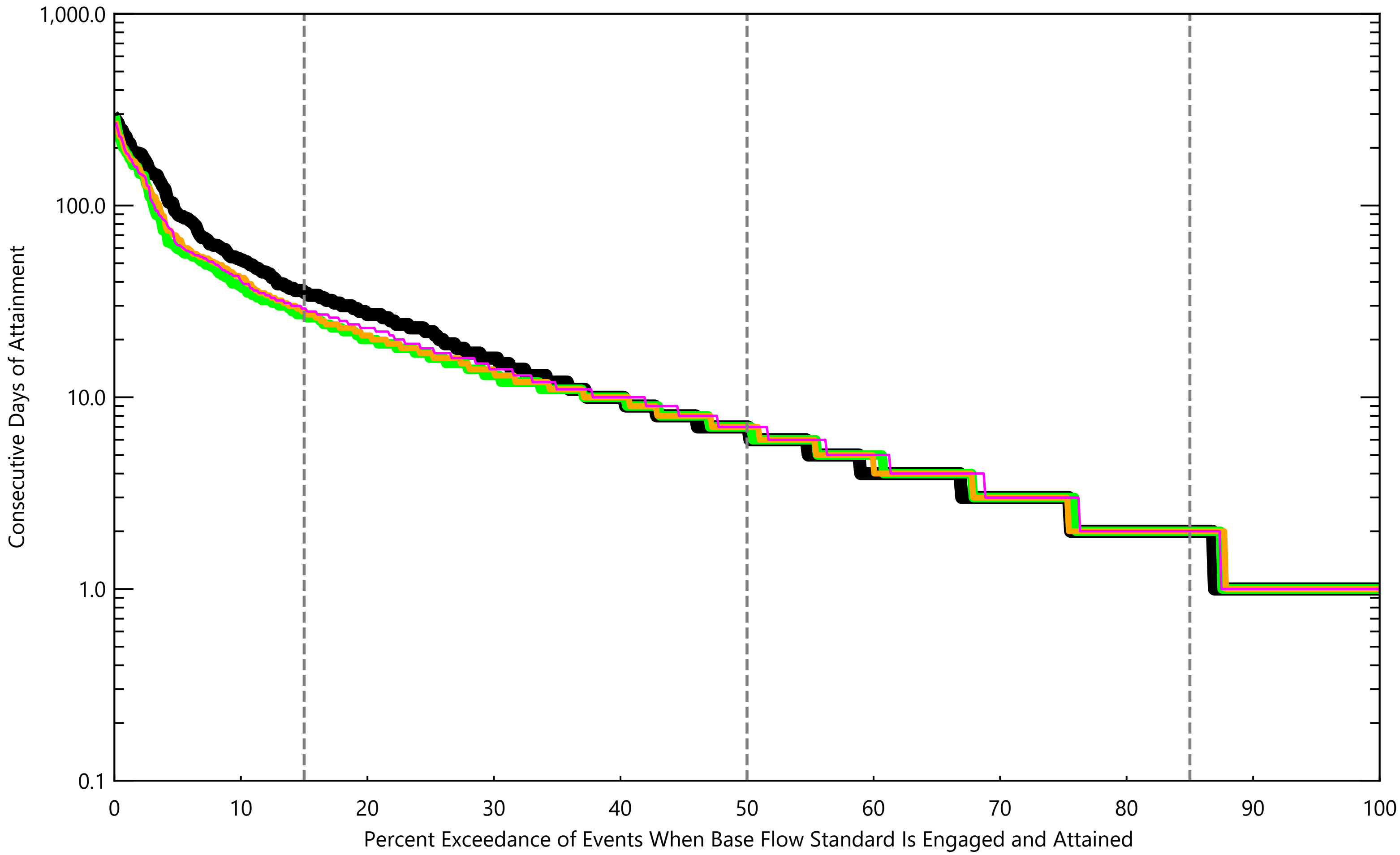
This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains exceedance frequency plots of attainment metrics, as described in Section 2.5.3.2 of the main report.

This appendix contains a total of 252 distinct figures, which are arranged as follows:

- Brazos River basin
  - Figures E-1 through E-171: Exceedance frequency plots for each of the 19 locations in the Brazos River basin and the nine attainment metrics presented in Section 2.5.3.2 of the main report; these figures are grouped by location, and each figure contains up to four exceedance frequency plots—one for each of the modeled flow scenarios
- Trinity River basin
  - Figures E-172 through E-207: Exceedance frequency plots for each of the four locations in the Trinity River basin and the nine attainment metrics presented in Section 2.5.3.2 of the main report; these figures are grouped by location, and each figure contains up to four exceedance frequency plots—one for each of the modeled flow scenarios
- Neches River basin
  - Figures E-208 through E-252: Exceedance frequency plots for each of the five locations in the Neches River basin and the nine attainment metrics presented in Section 2.5.3.2 of the main report; these figures are grouped by location, and each figure contains up to four exceedance frequency plots—one for each of the modeled flow scenarios.

The following notes apply to all of the figures in this appendix:

1. Attainment metrics with at least two data points for a particular flow scenario are plotted as lines (e.g., all flow scenarios in Figure E-1).
2. Attainment metrics with only one data point for a particular flow scenario are plotted as a circle marker at the 50th percentile along the x-axis (e.g., the Partial Utilization Scenario in Figure E--171).
3. Attainment metrics with no data points for a particular flow scenario are not plotted (e.g., the Current Water Use Scenario in Figure E-63).
4. If an attainment metric contains no data points for any of the four flow scenarios, then no data are plotted, and the text "N/A" ("not applicable") is printed in the center of the plot (e.g., Figure E-5).



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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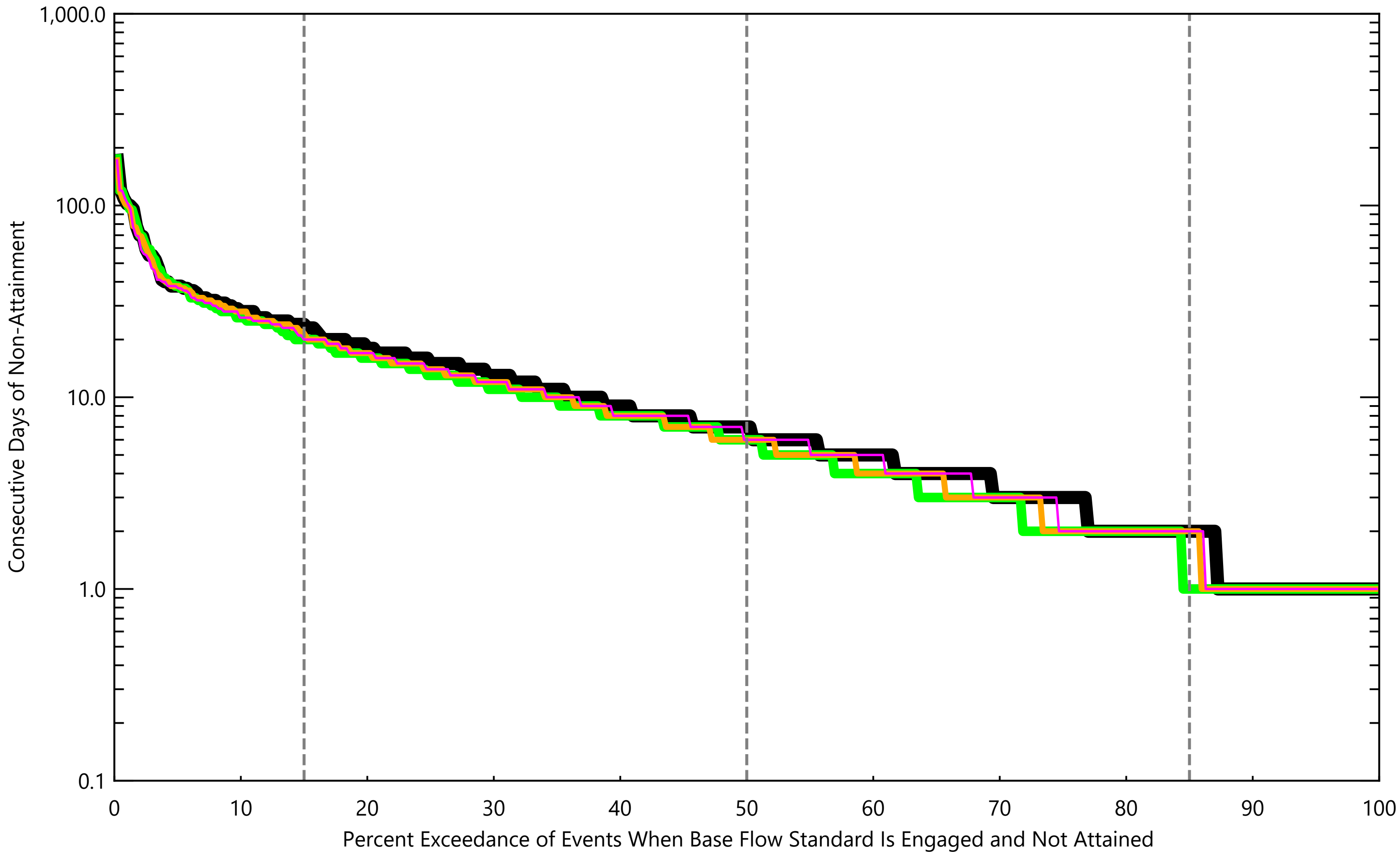
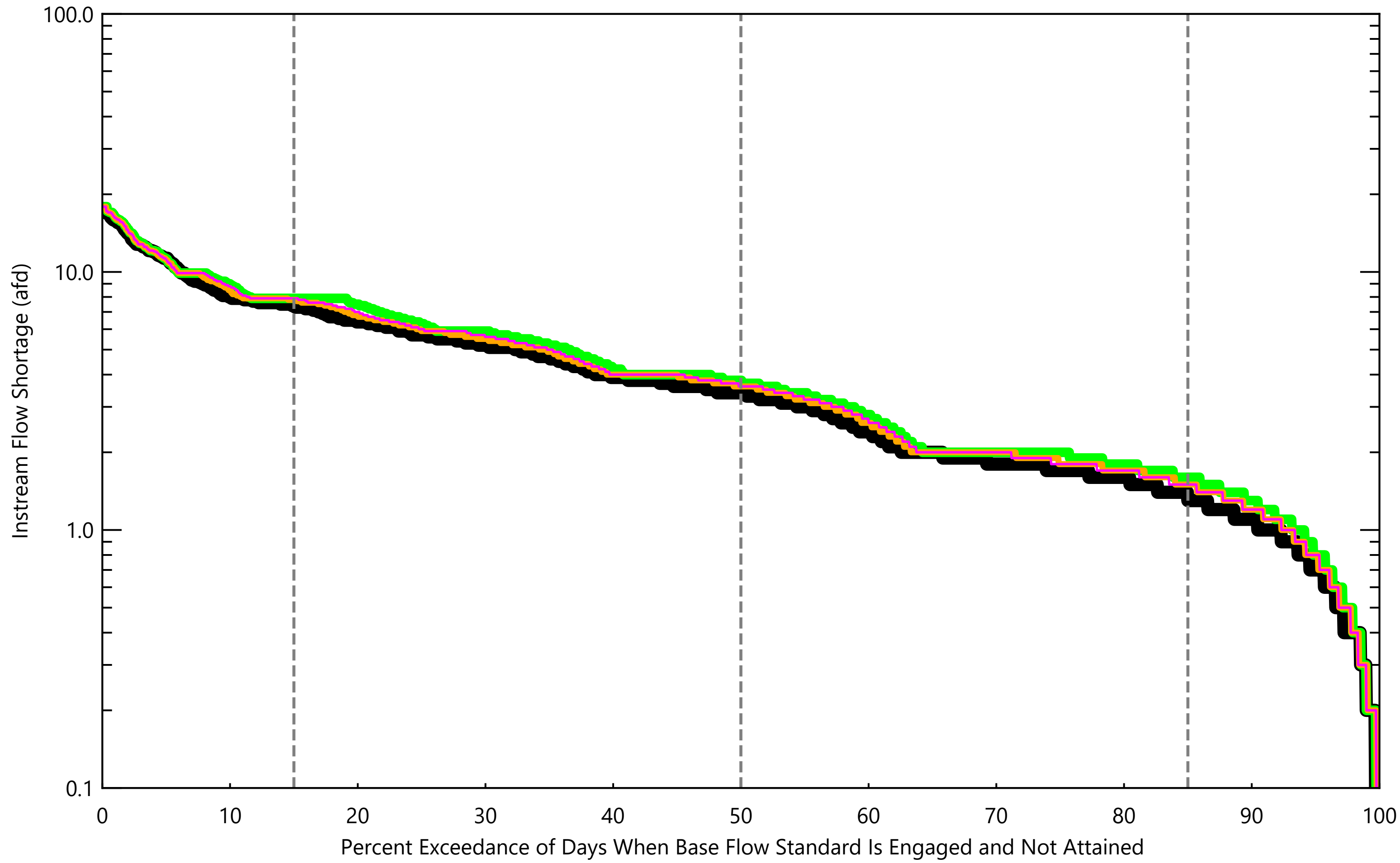
Figure E-1
Salt Fork near Aspermont: Base Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

Figure E-2
Salt Fork near Aspermont: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-3
Salt Fork near Aspermont: Base Flow Shortage, Entire Period of Record (S-POR)

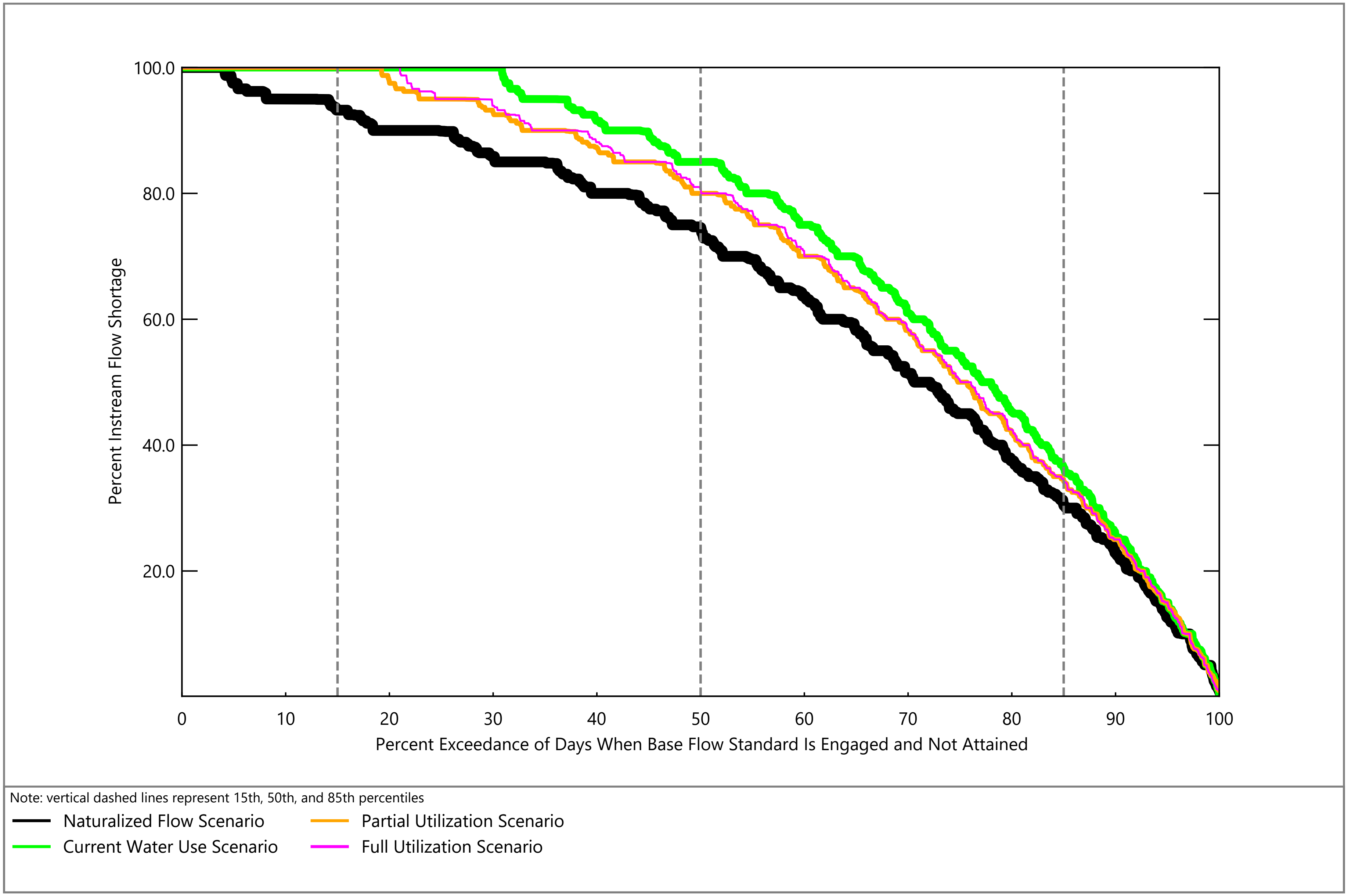

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Figure E-4
Salt Fork near Aspermont: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

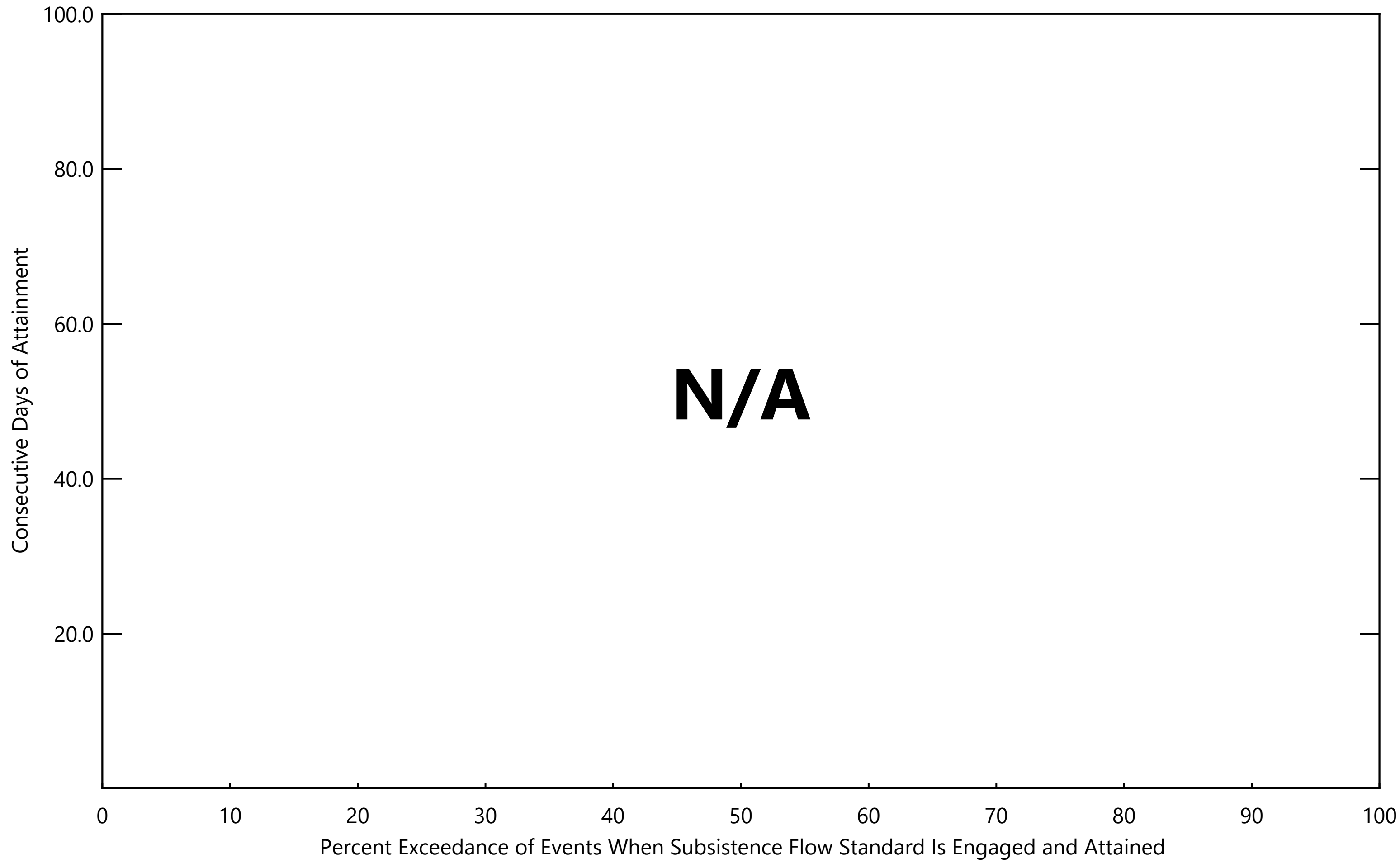
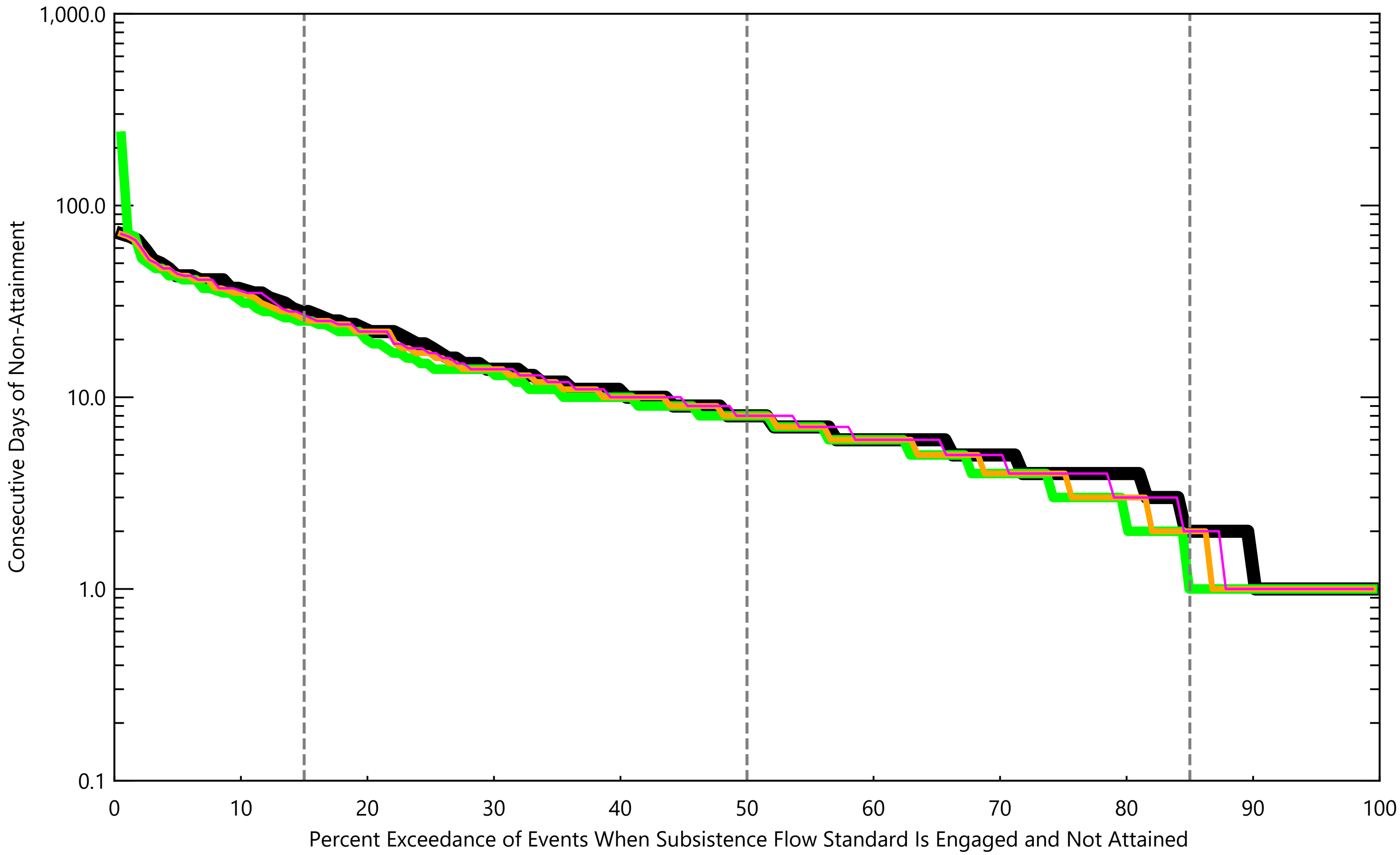


Figure E-5

Salt Fork near Aspermont: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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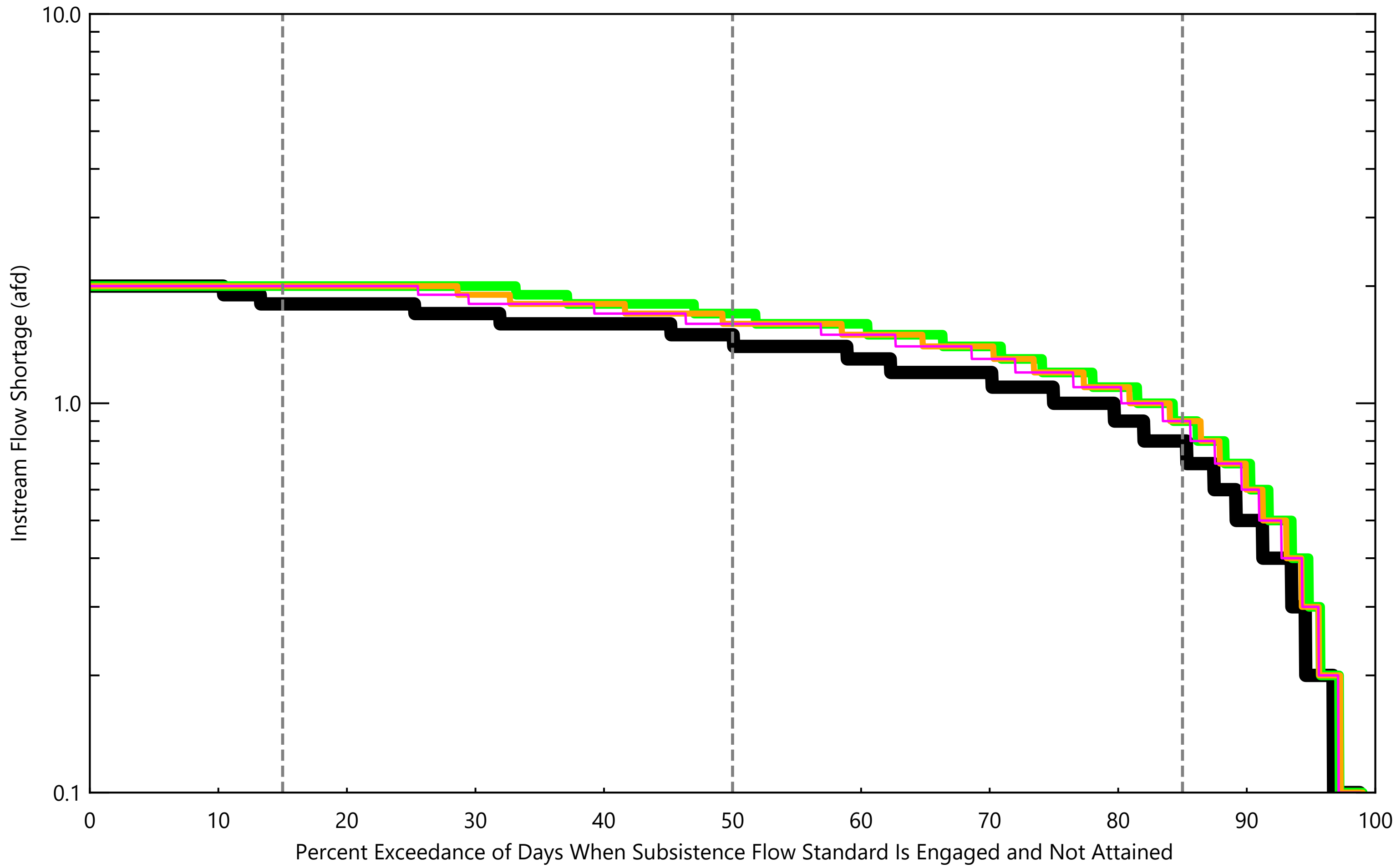
Figure E-6

Salt Fork near Aspermont: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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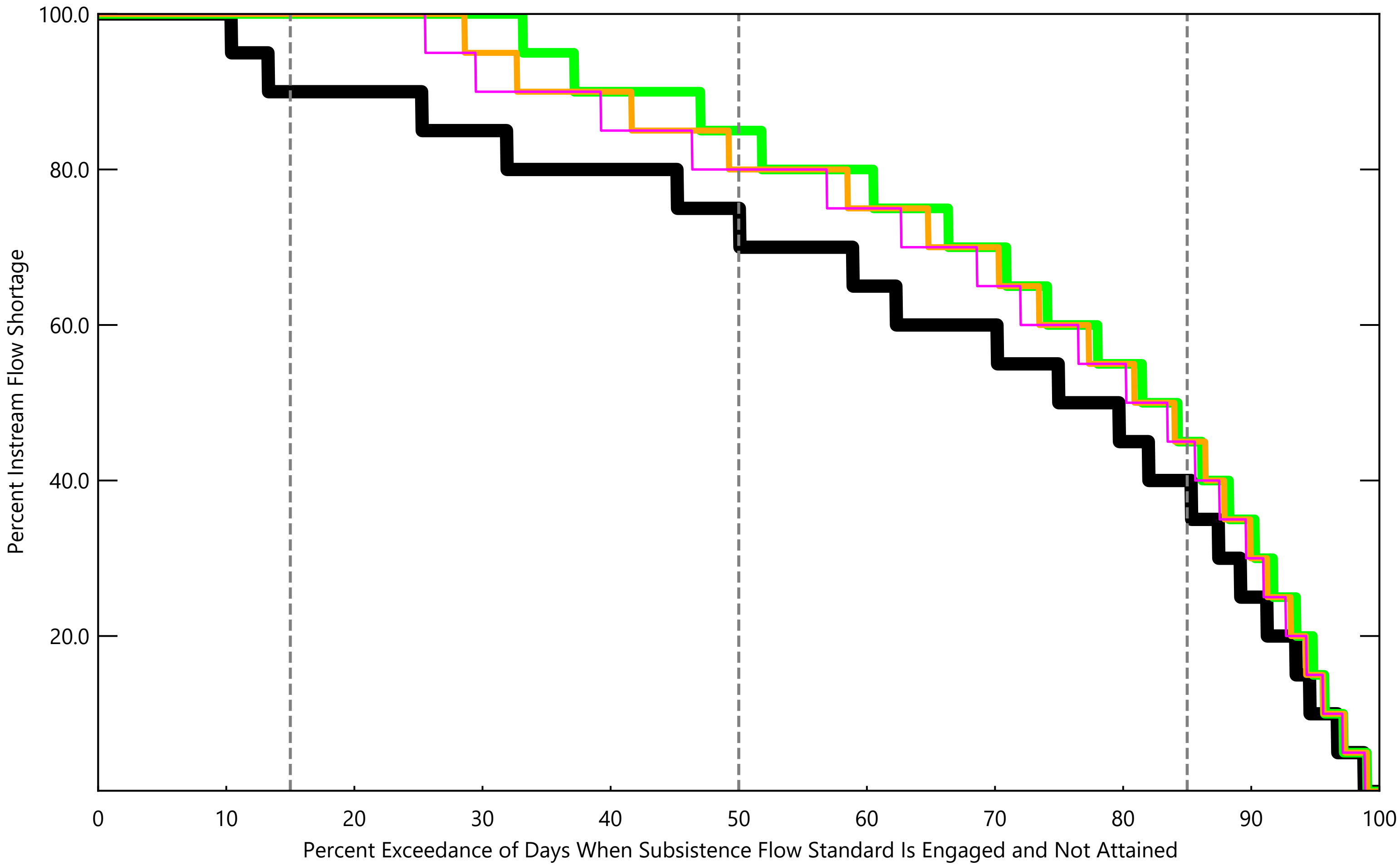
Figure E-7
Salt Fork near Aspermont: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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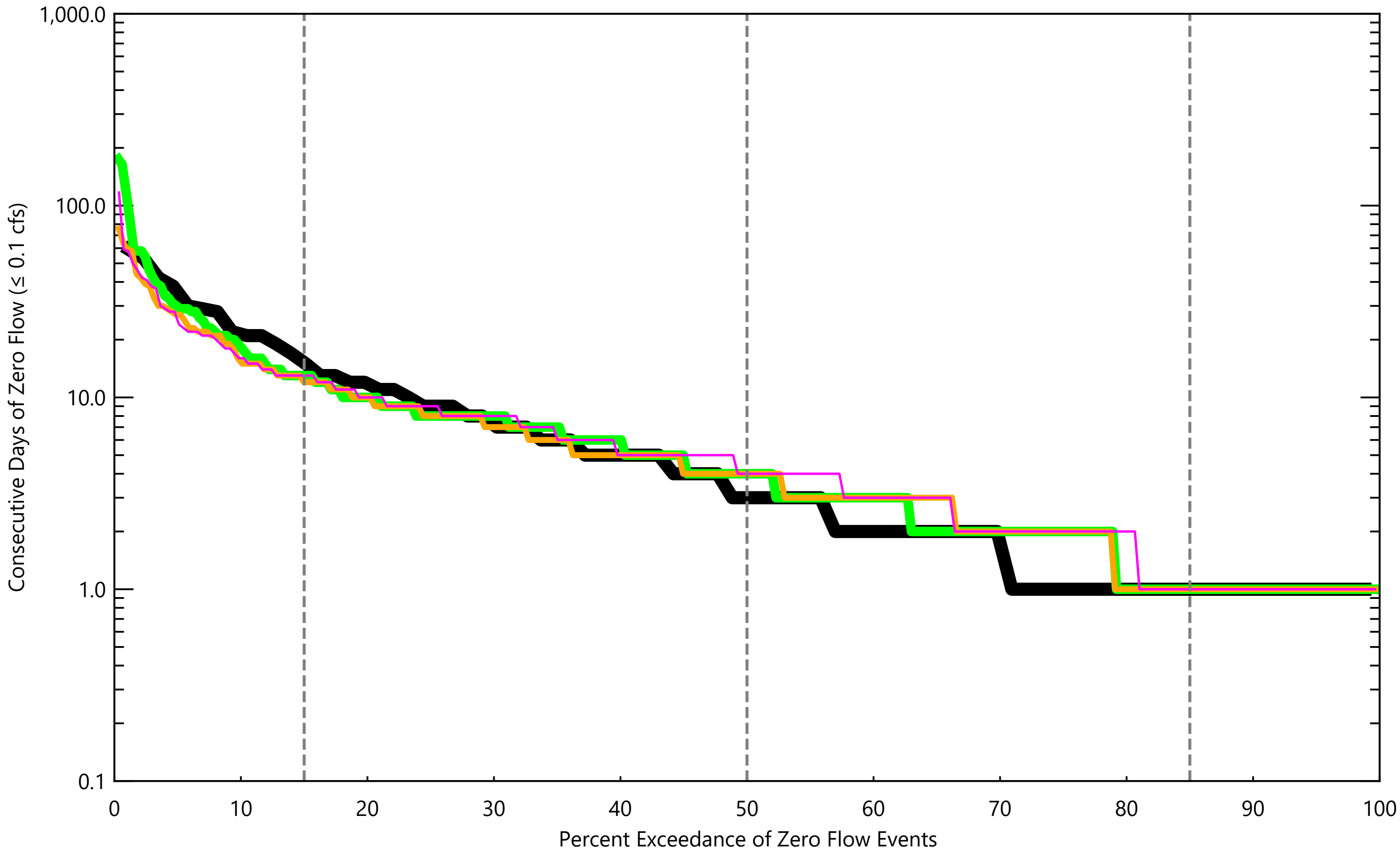
Figure E-8
Salt Fork near Aspermont: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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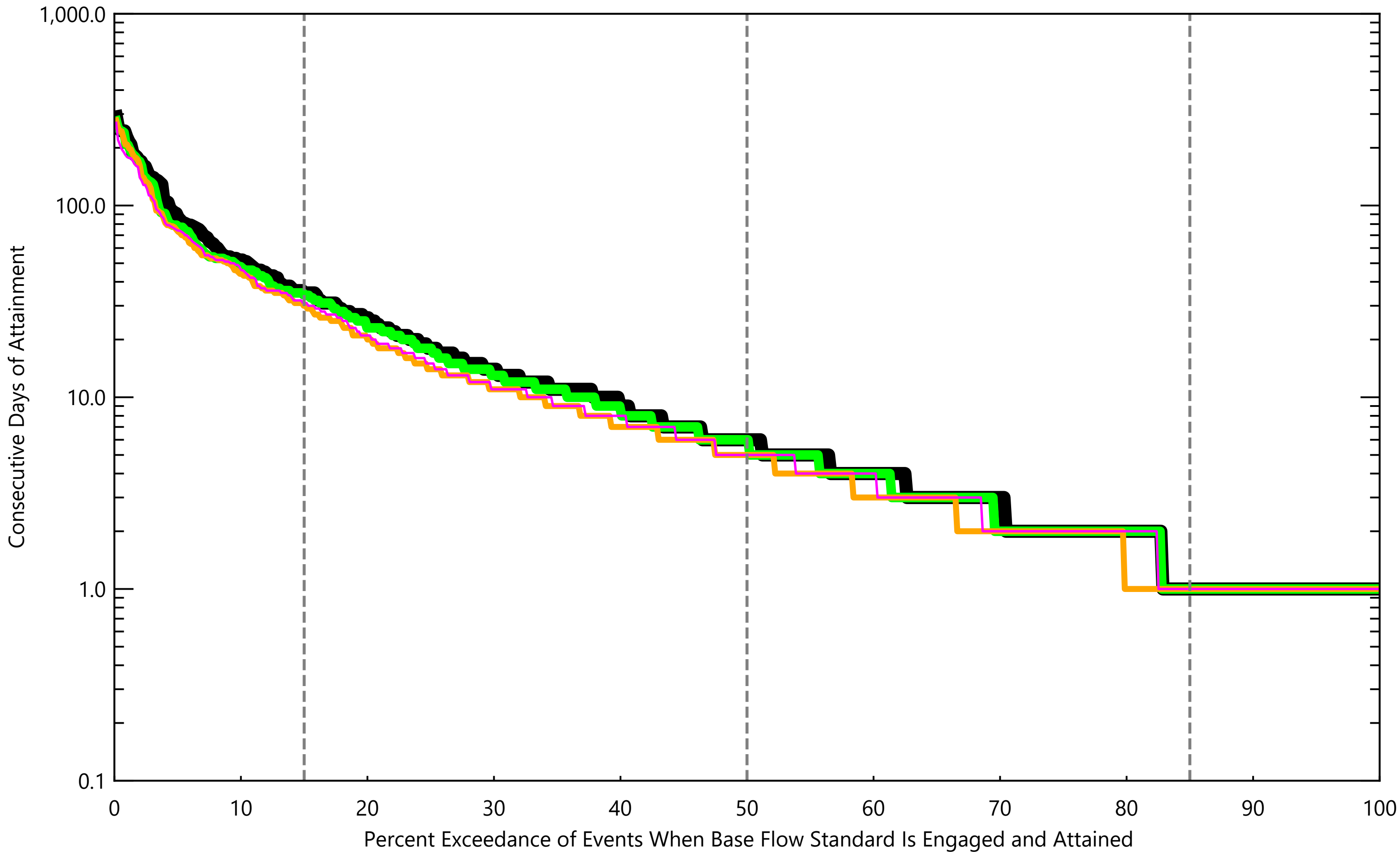
Figure E-9
Salt Fork near Aspermont: Zero-Flow Duration, Entire Period of Record (ZFD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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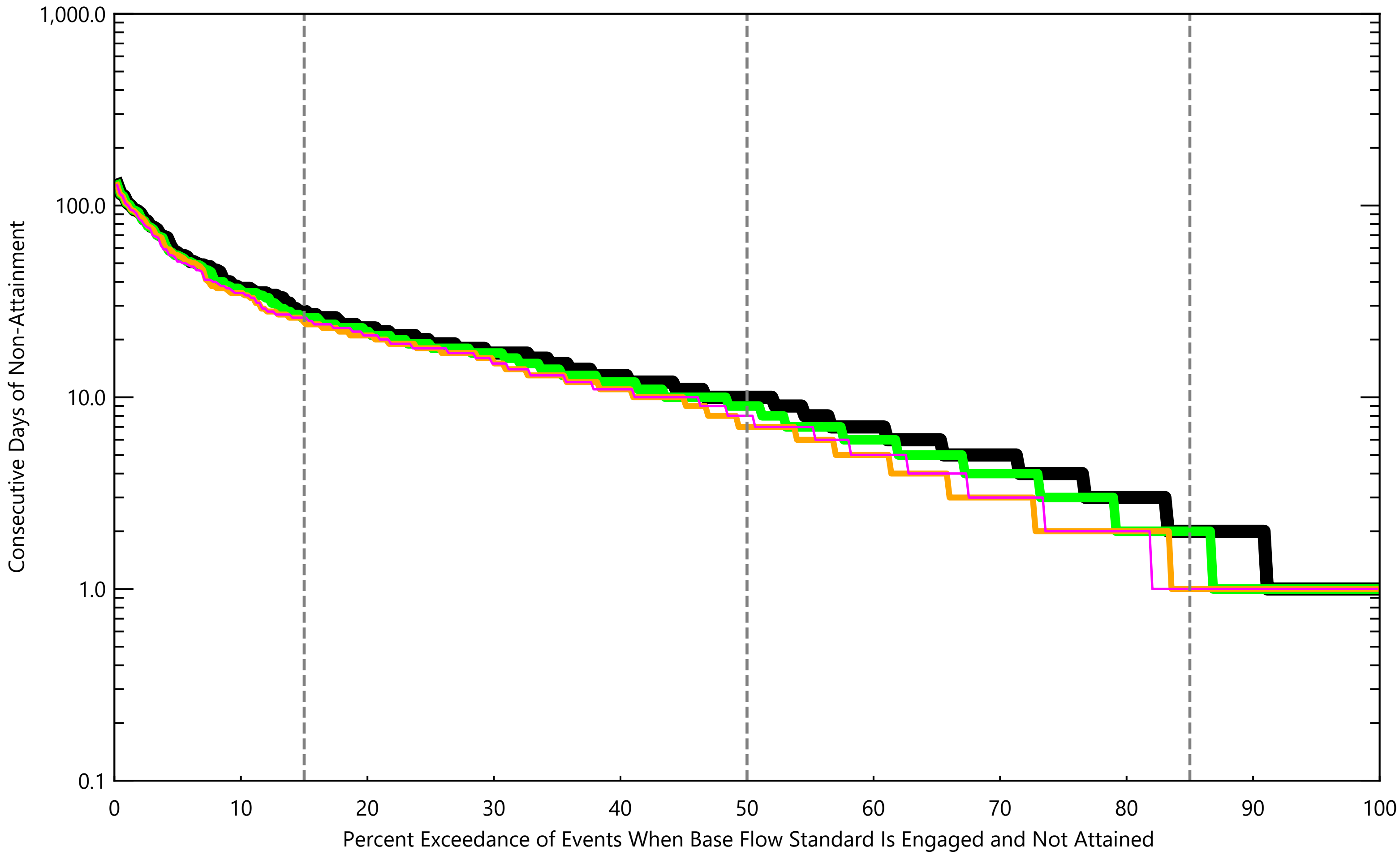
Figure E-10
Double Mountain Fork near Aspermont: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



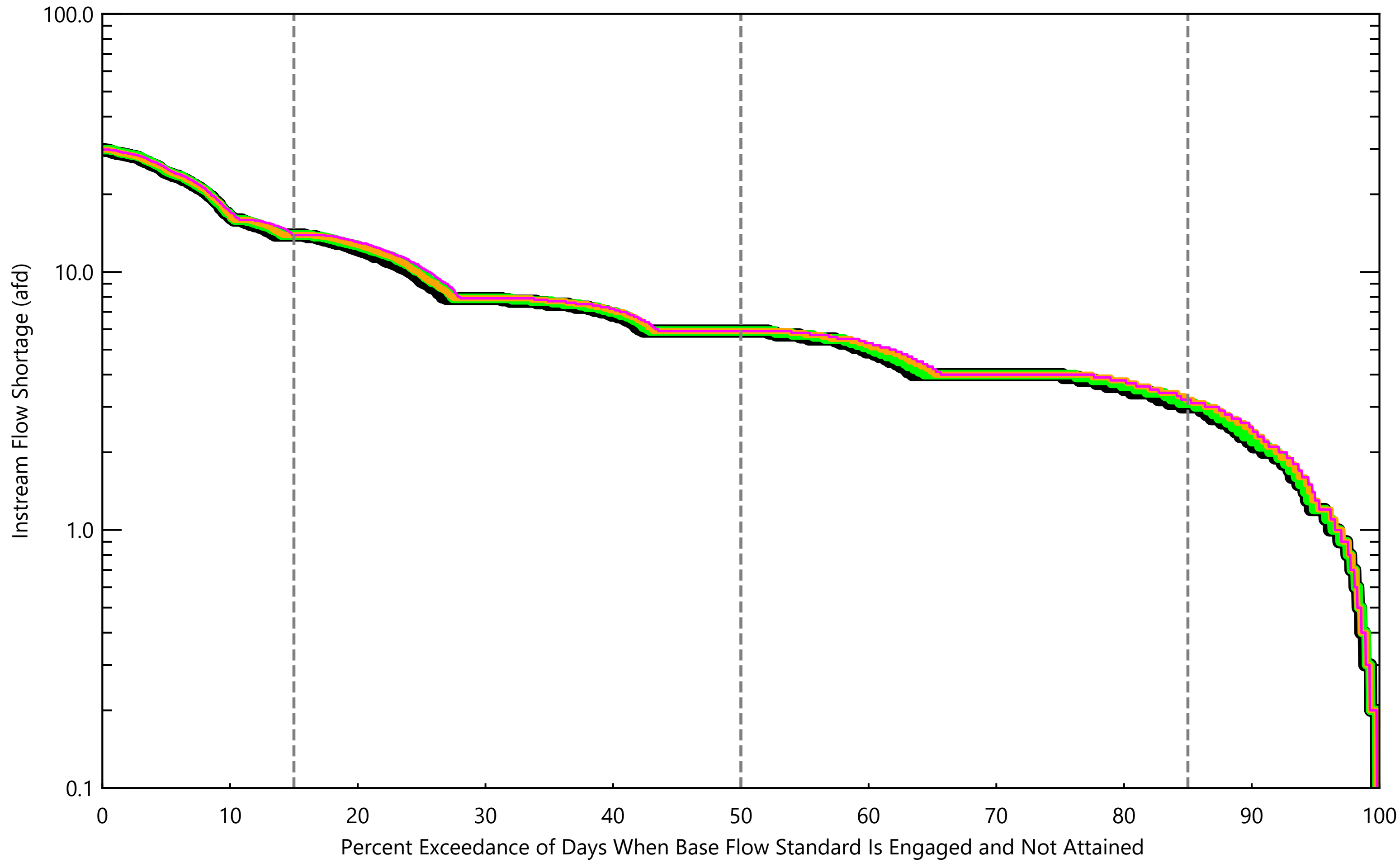
Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Figure E-11

Double Mountain Fork near Aspermont: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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Figure E-12

Double Mountain Fork near Aspermont: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards

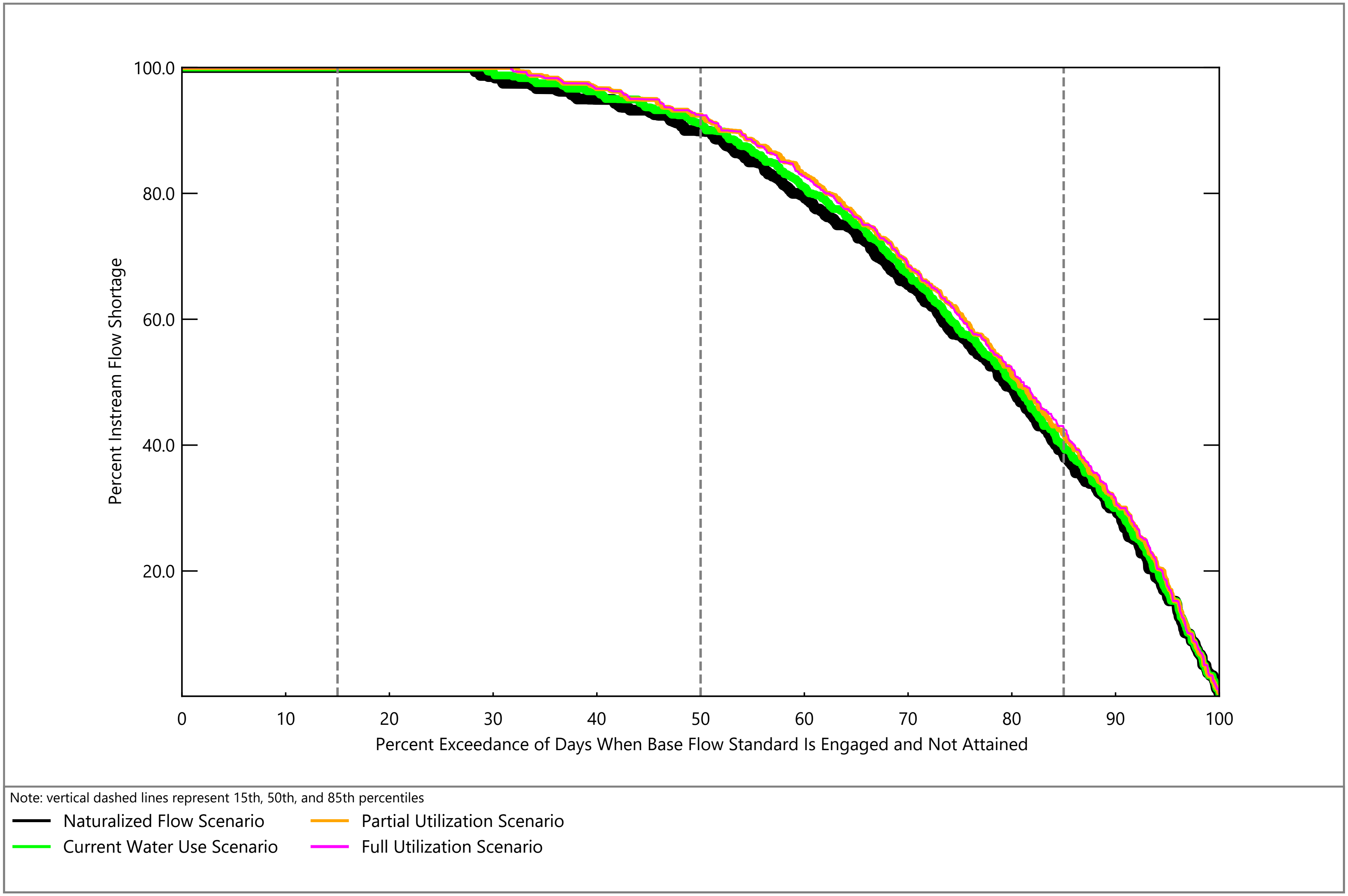

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Figure E-13

Double Mountain Fork near Aspermont: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

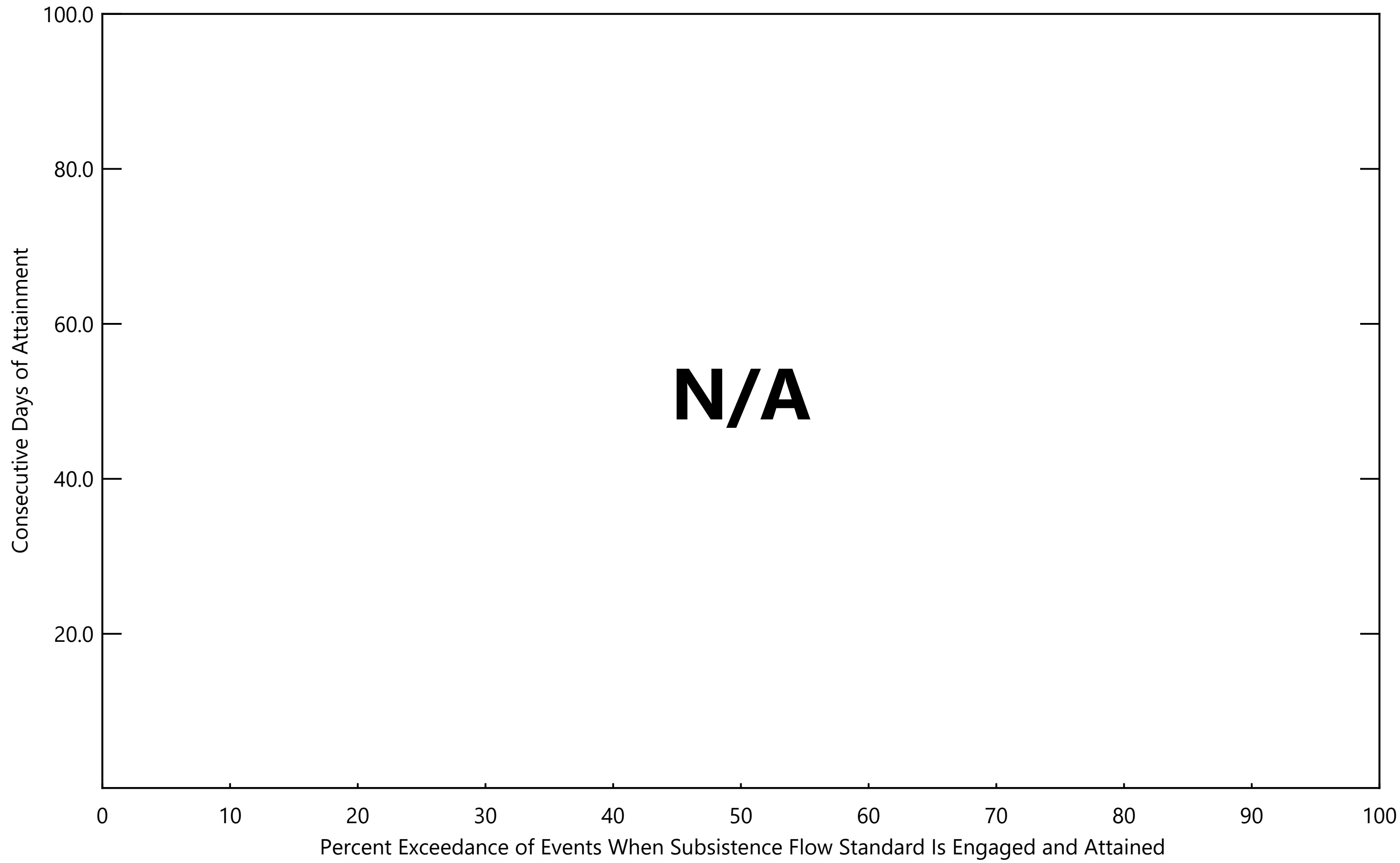

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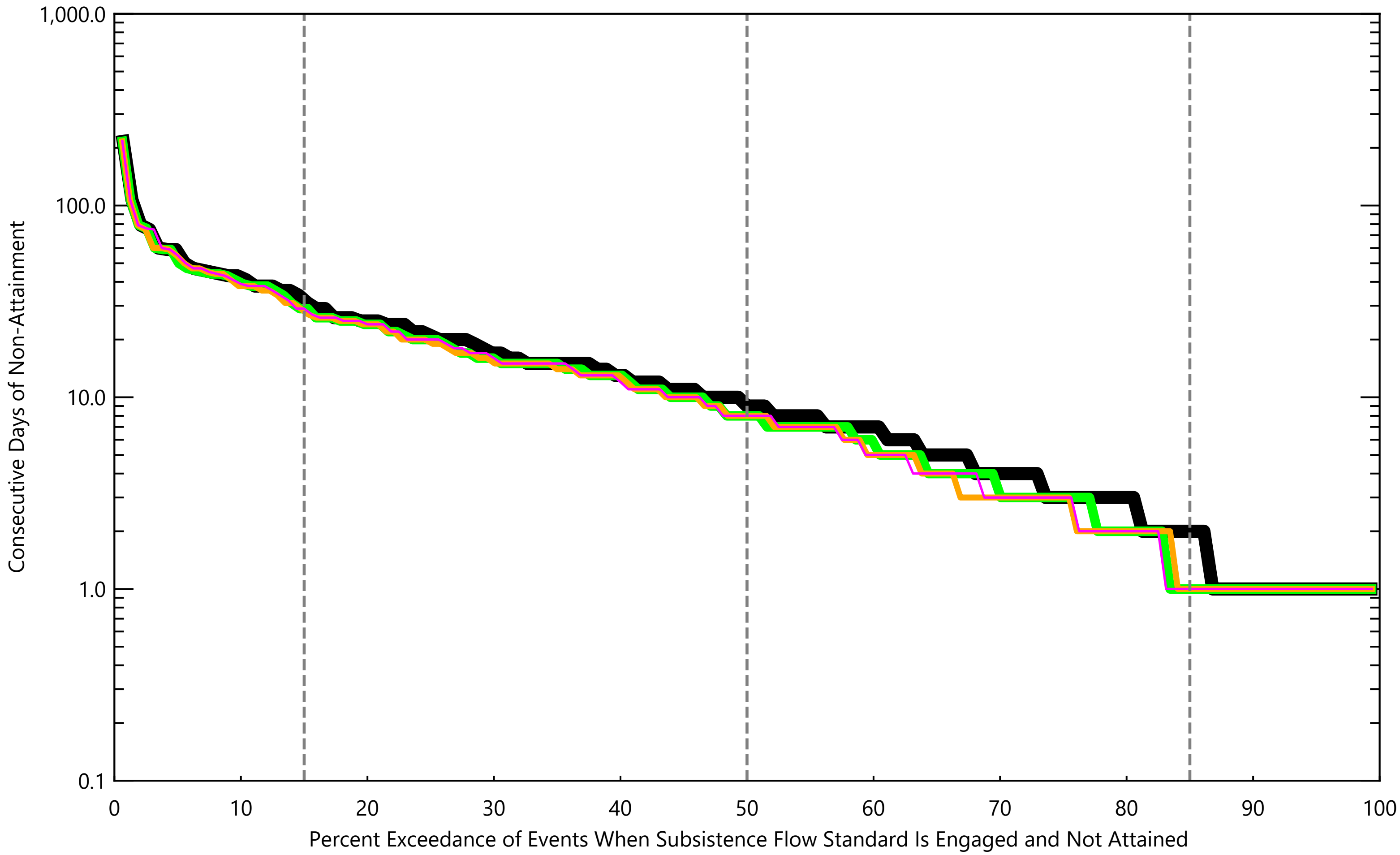
Figure E-14
Double Mountain Fork near Aspermont: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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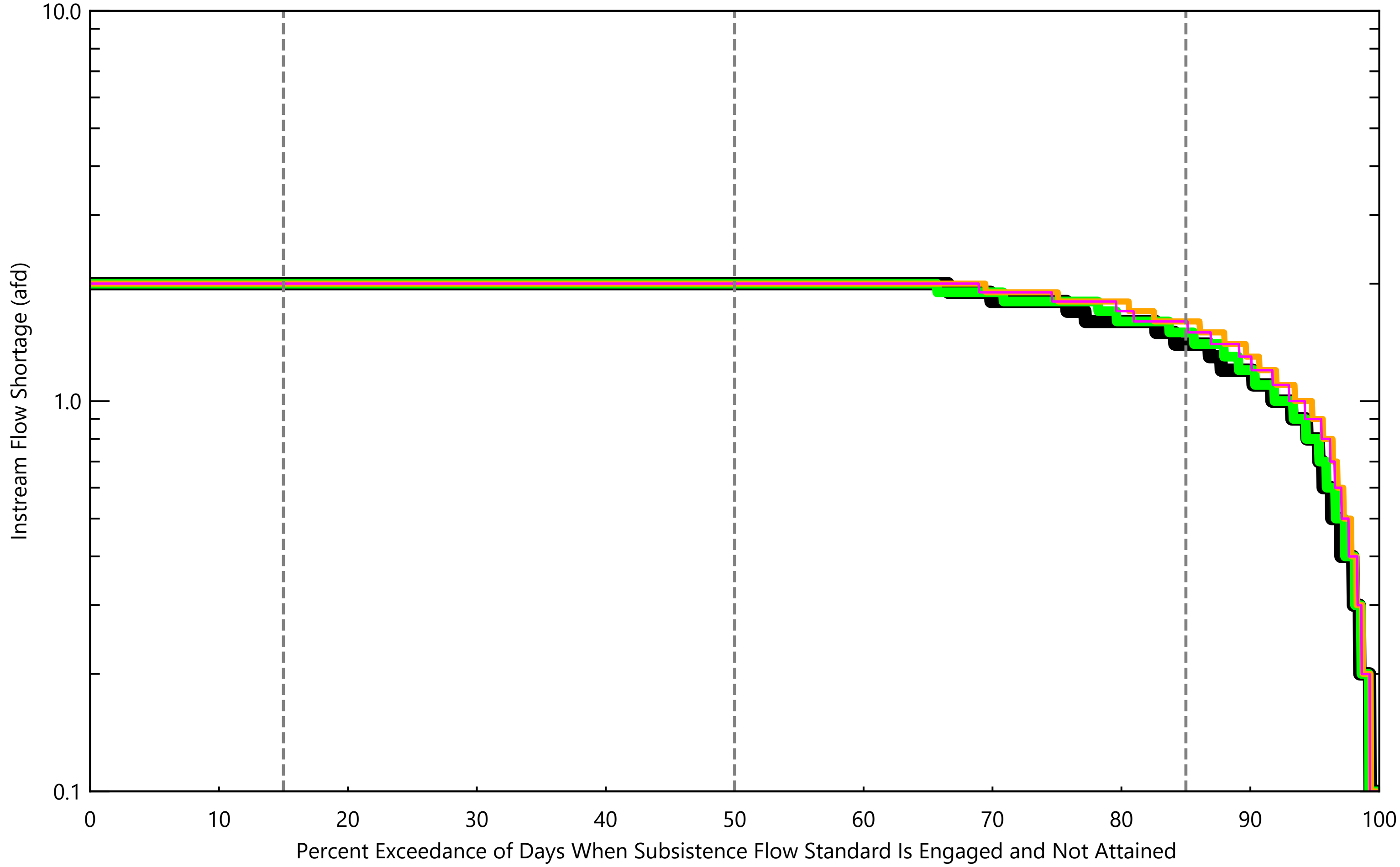
Figure E-15

Double Mountain Fork near Aspermont: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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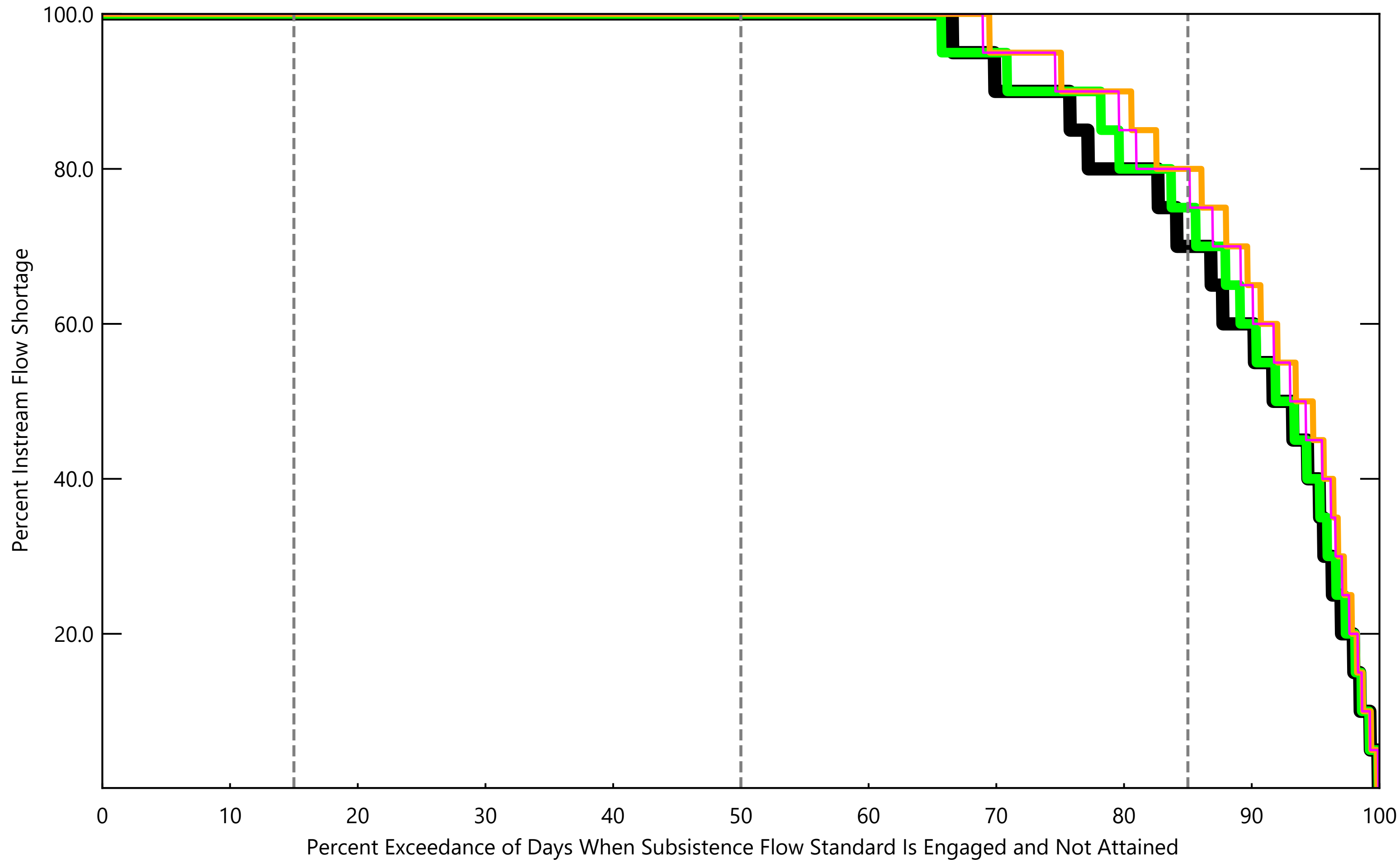
Figure E-16

Double Mountain Fork near Aspermont: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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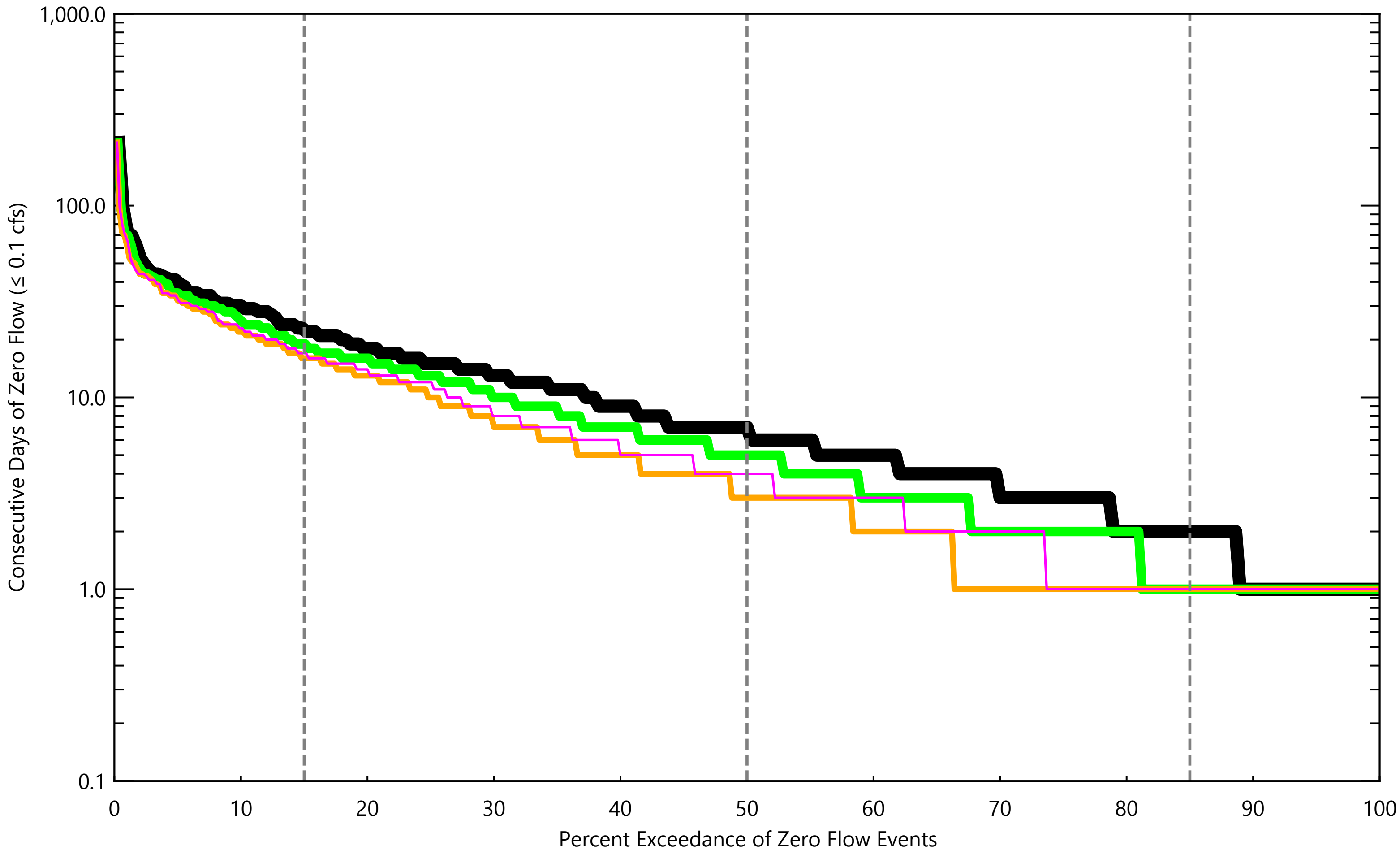
Figure E-17
Double Mountain Fork near Aspermont: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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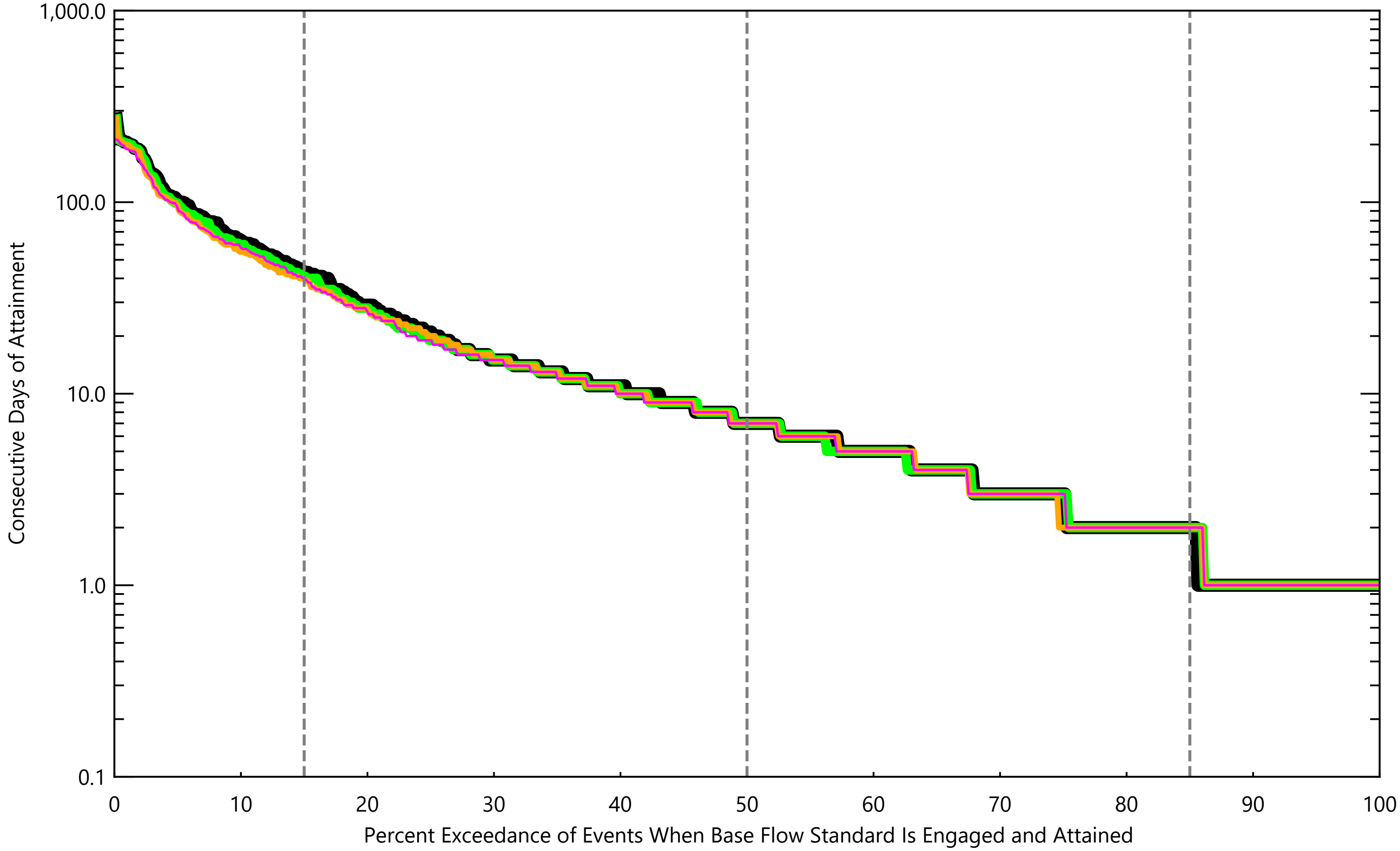
Figure E-18

Double Mountain Fork near Aspermont: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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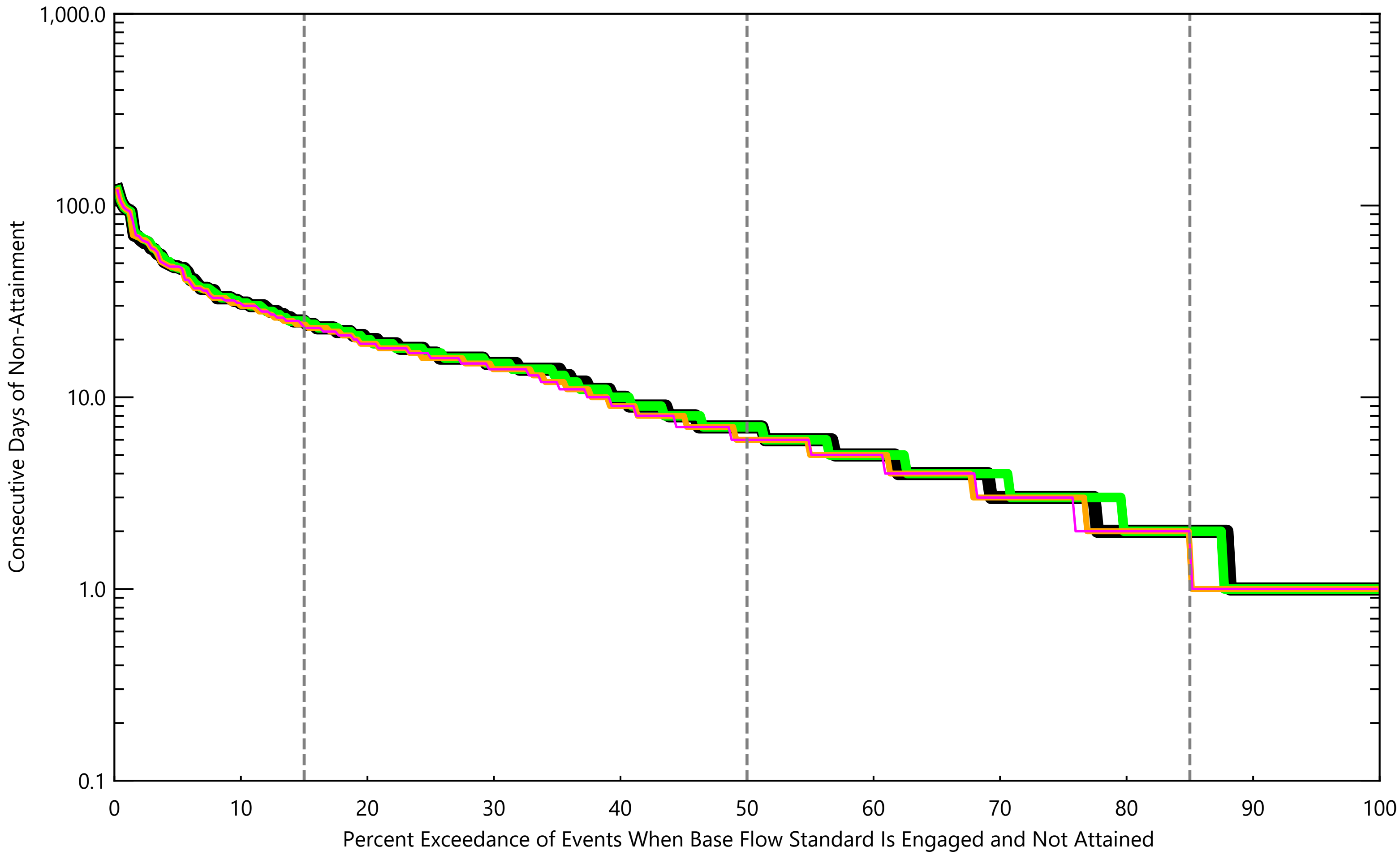
Figure E-19
Brazos River at Seymour: Base Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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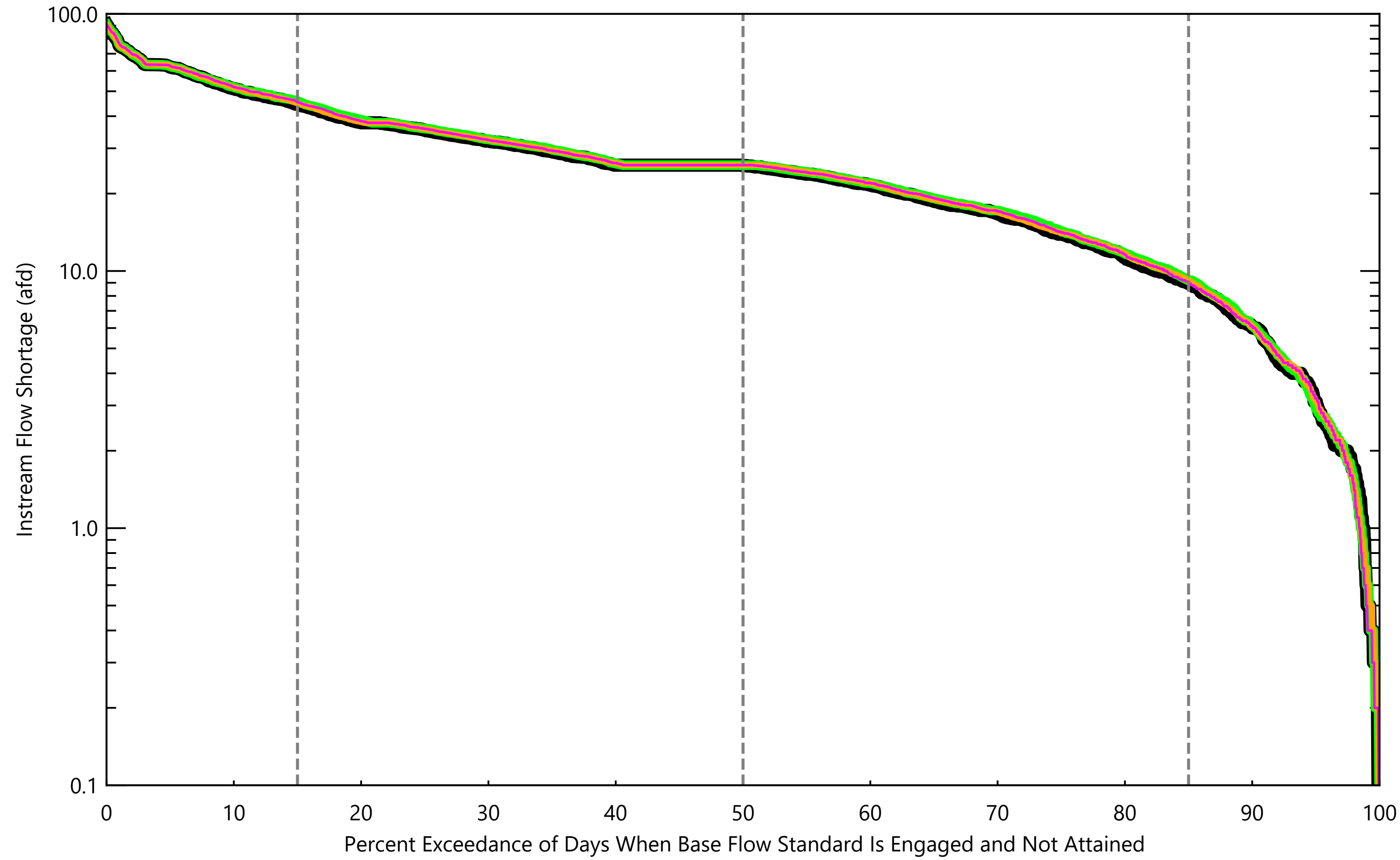
Figure E-20

Brazos River at Seymour: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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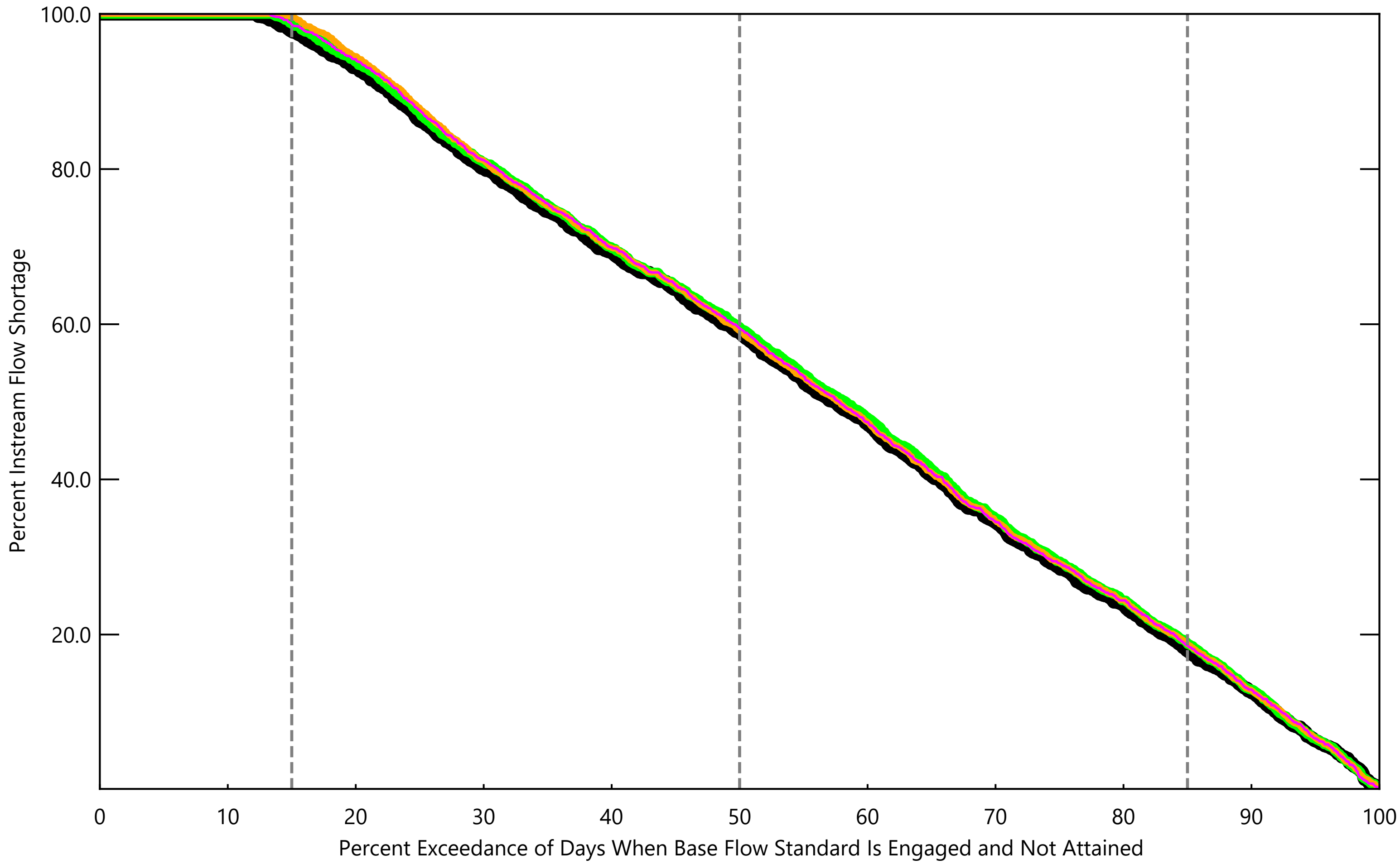
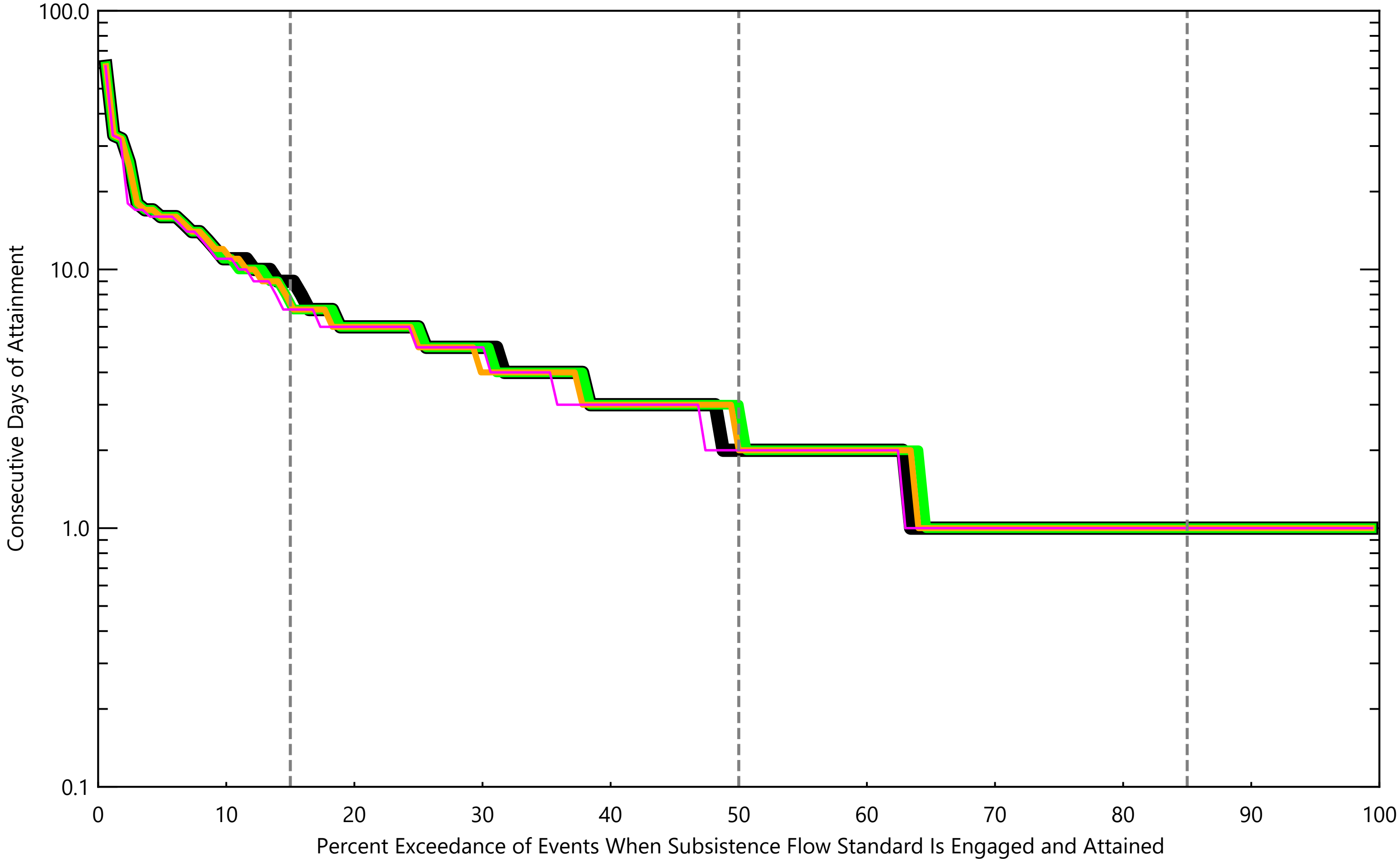
Figure E-21
Brazos River at Seymour: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-22
Brazos River at Seymour: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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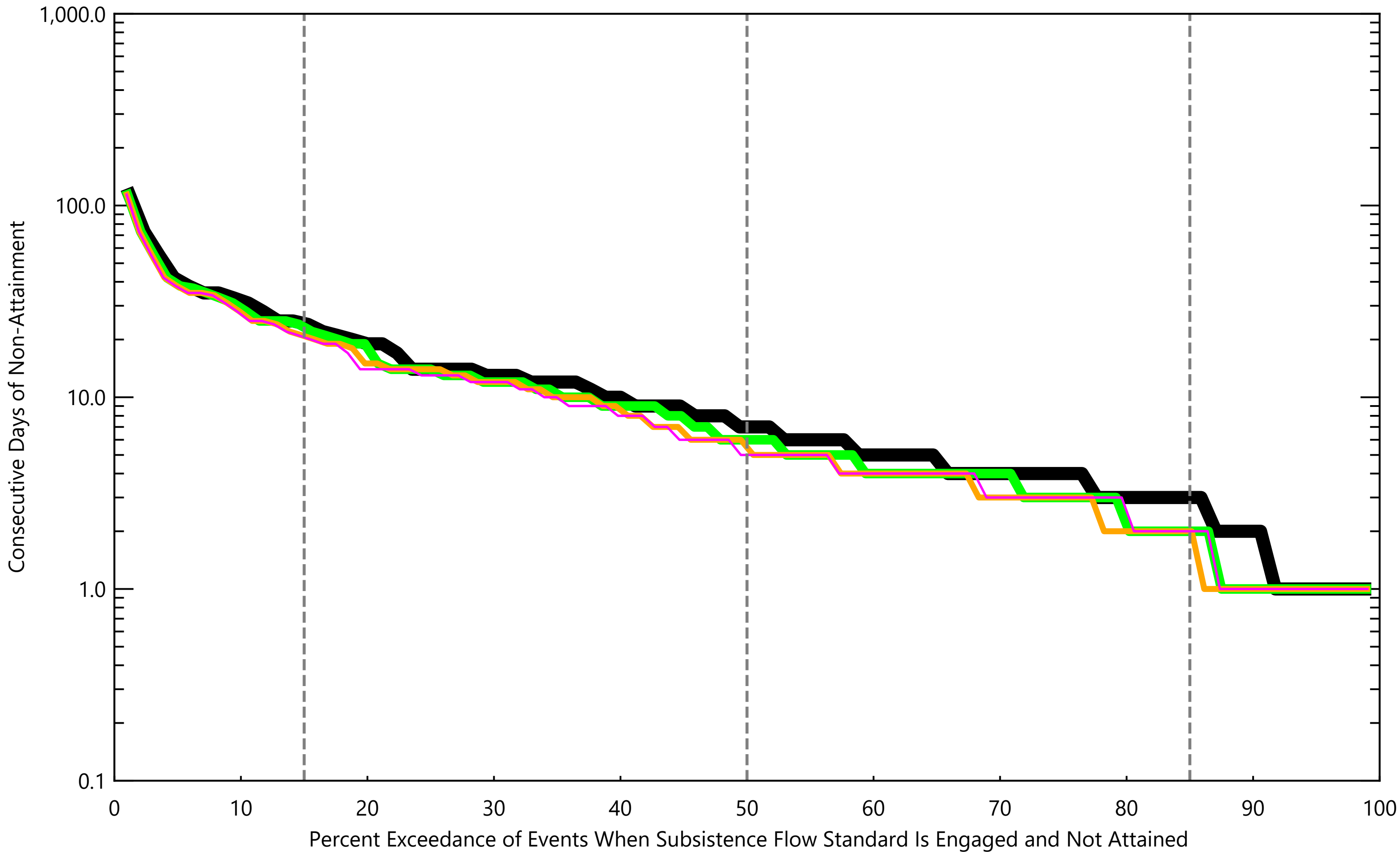
Figure E-23

Brazos River at Seymour: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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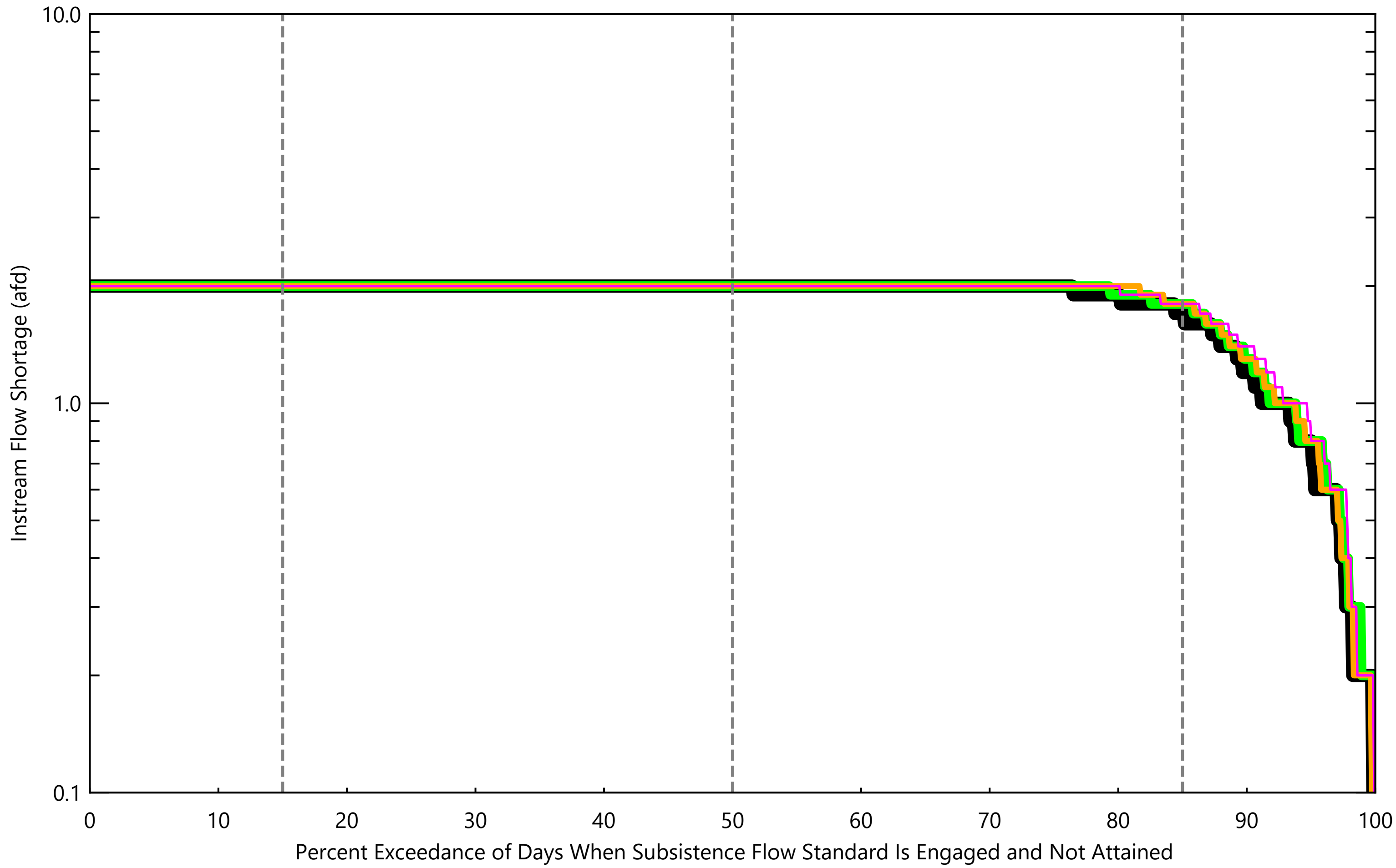
Figure E-24
Brazos River at Seymour: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

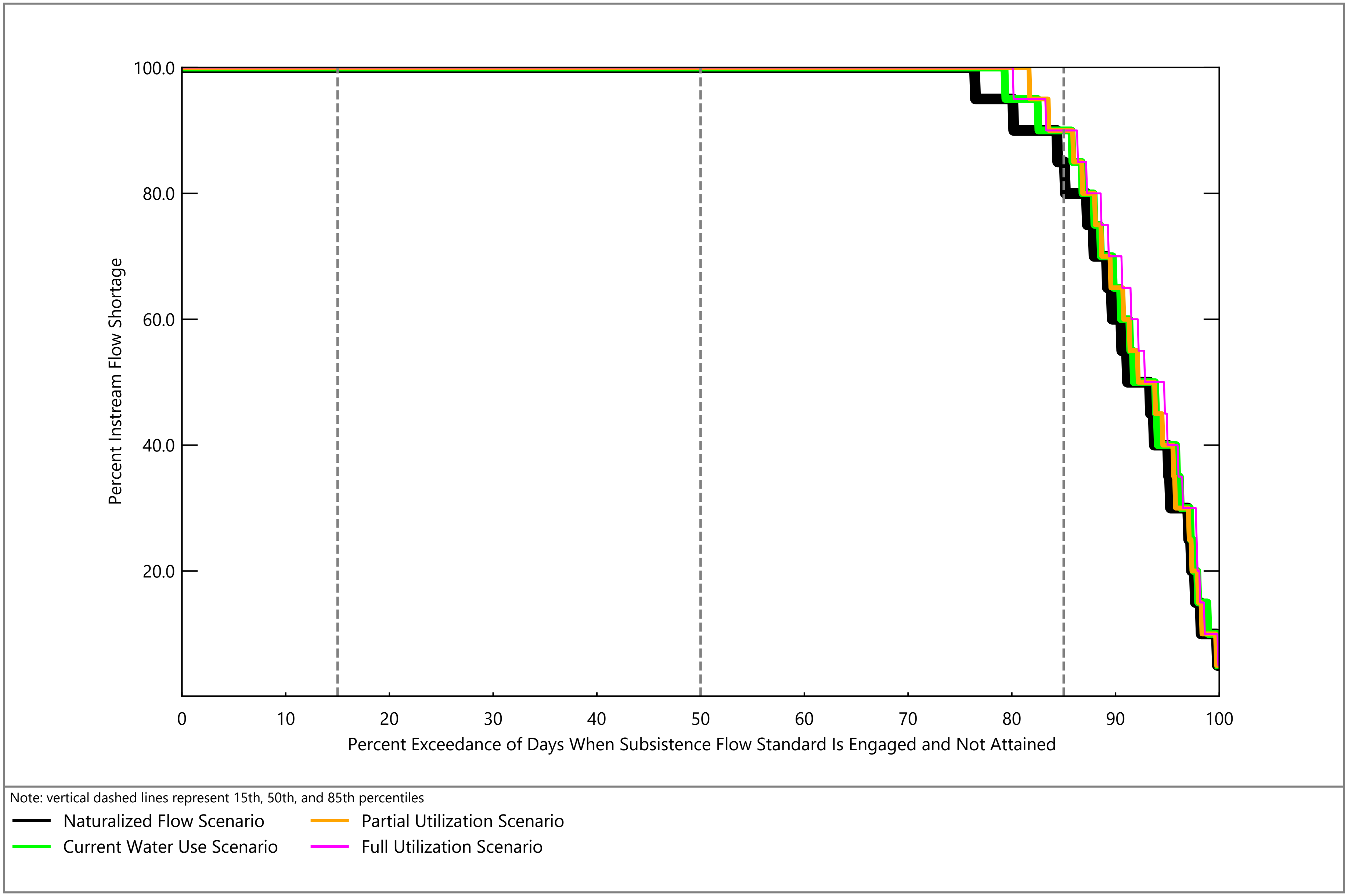


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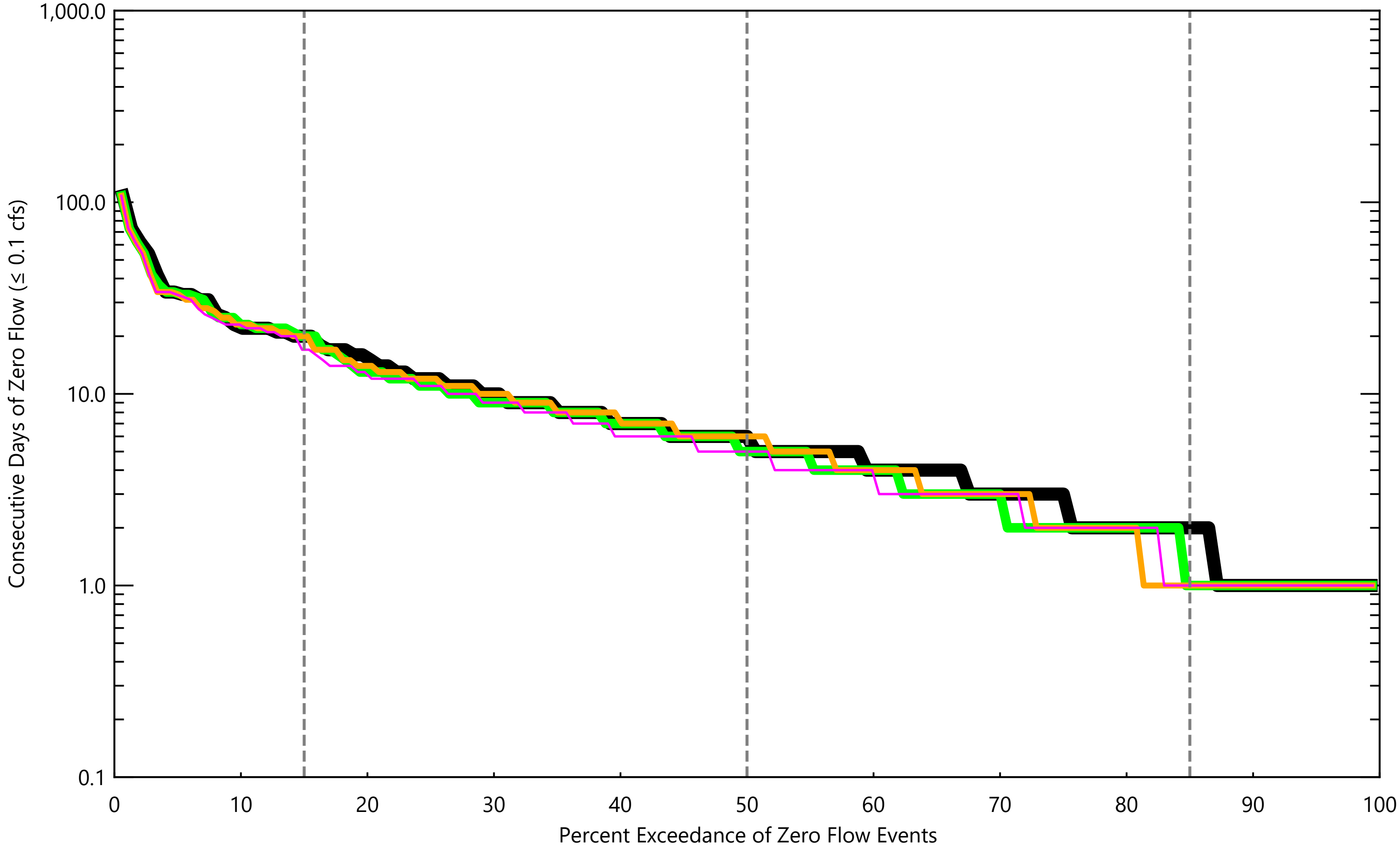
Figure E-26
Brazos River at Seymour: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

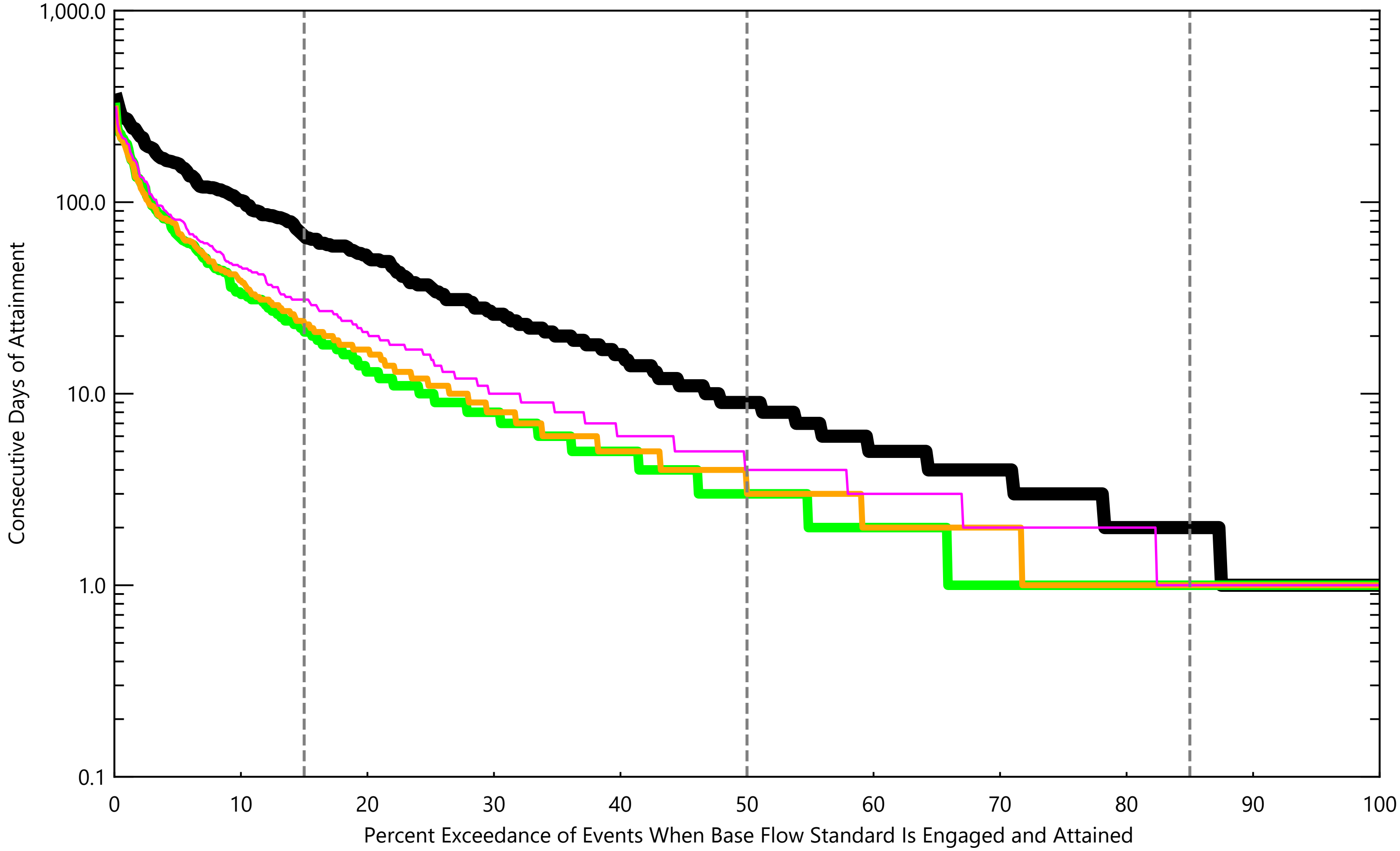
Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

Figure E-27

Brazos River at Seymour: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin

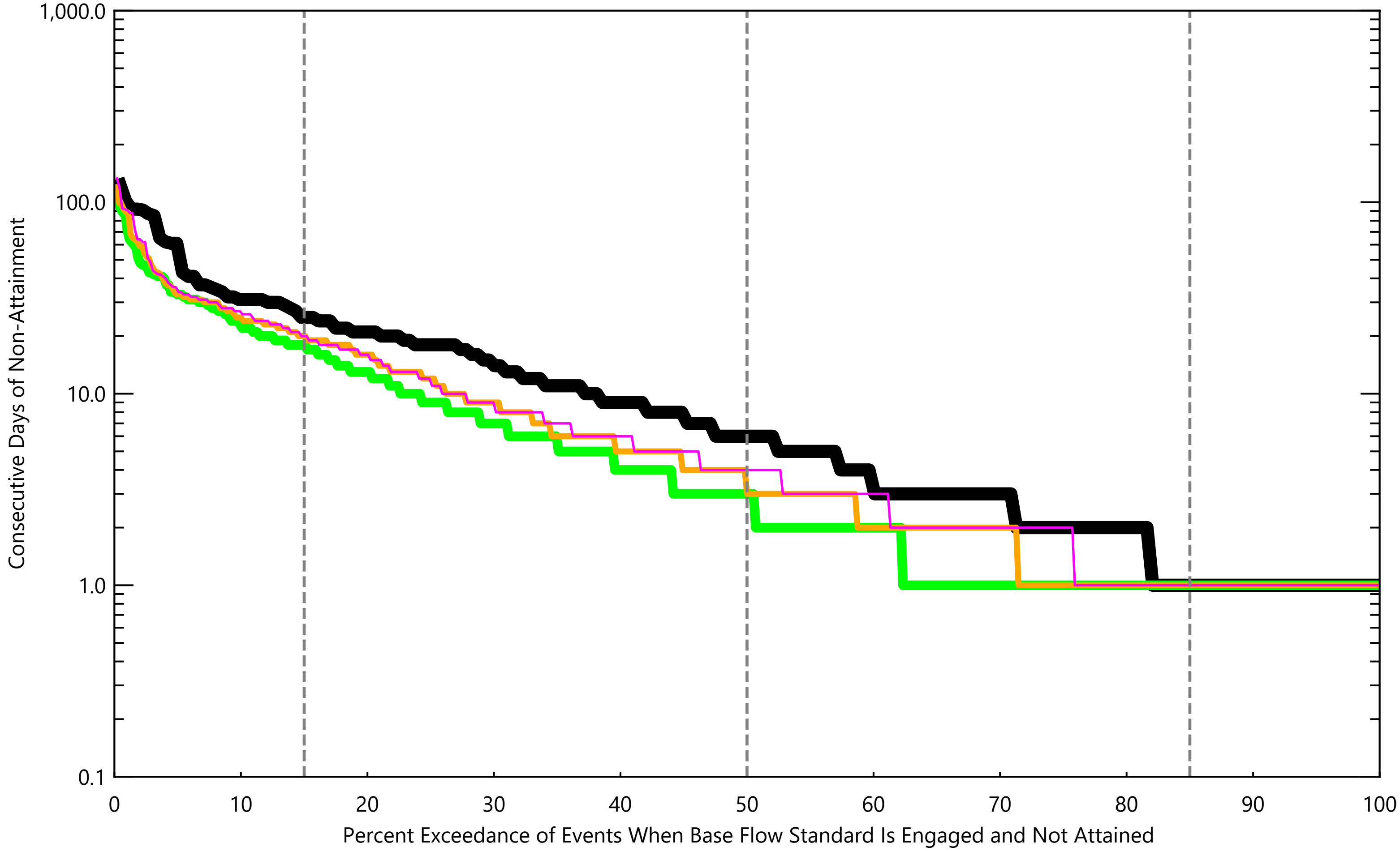
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

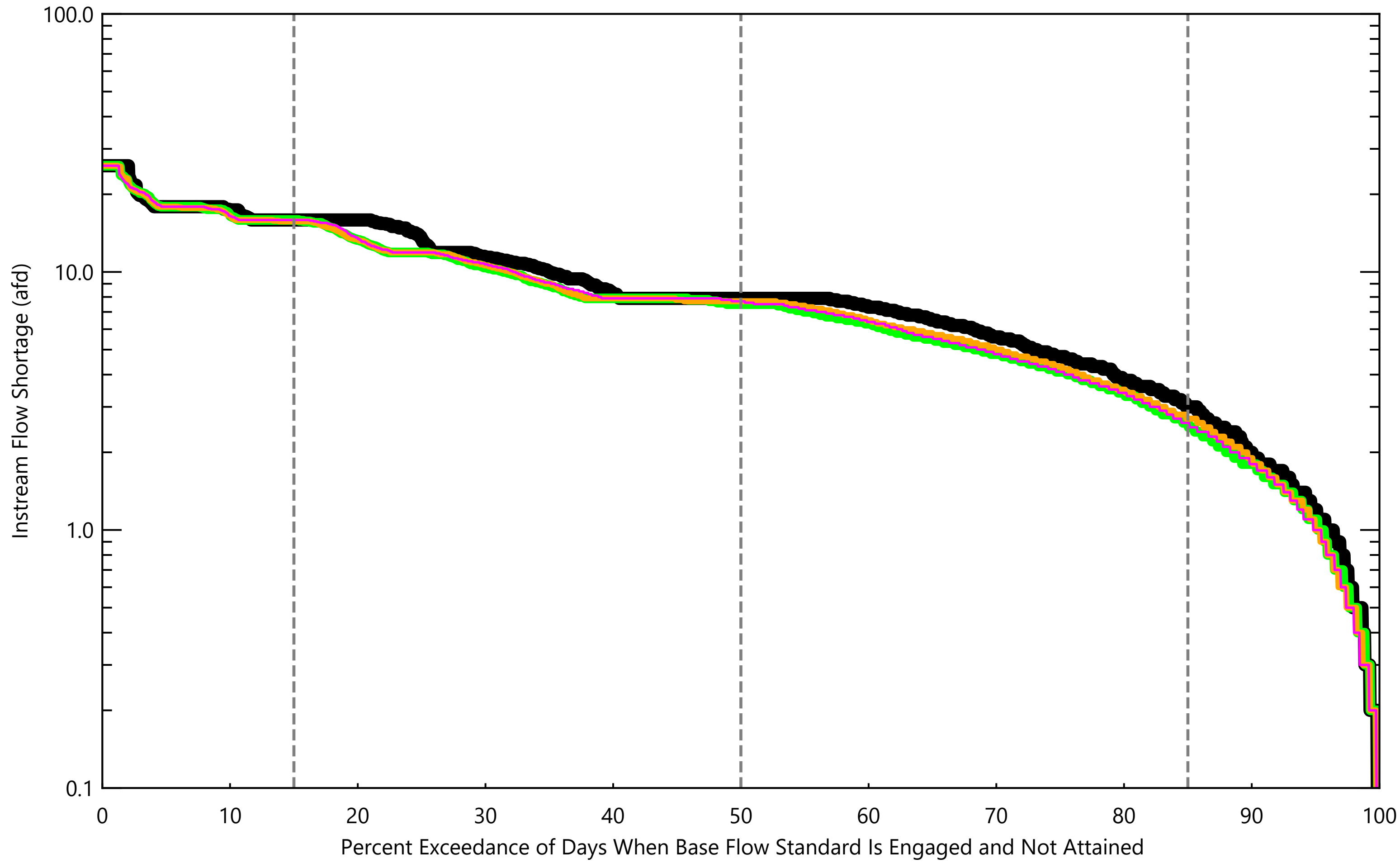
- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

Figure E-28
Clear Fork at Nugent: Base Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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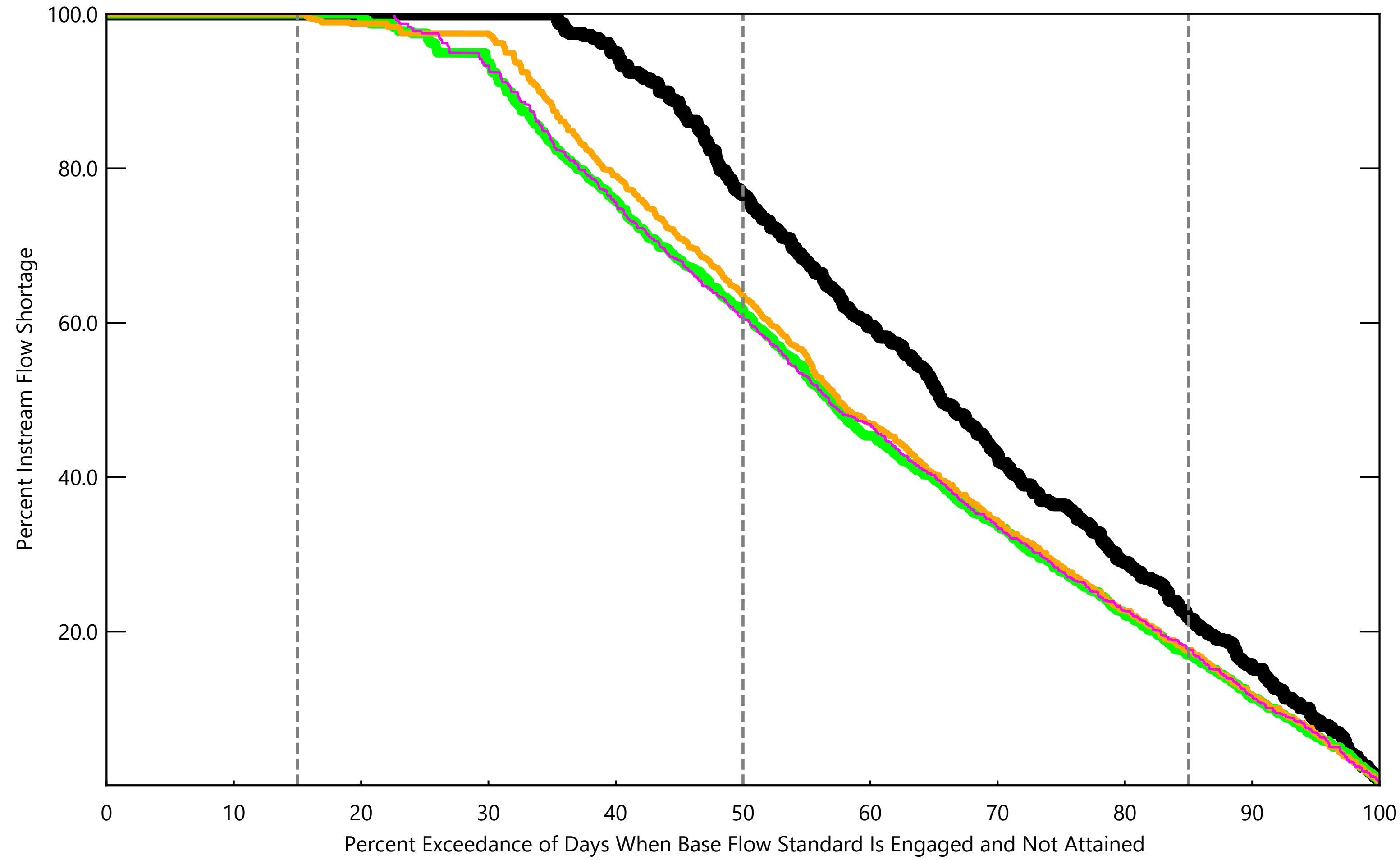
Figure E-30
Clear Fork at Nugent: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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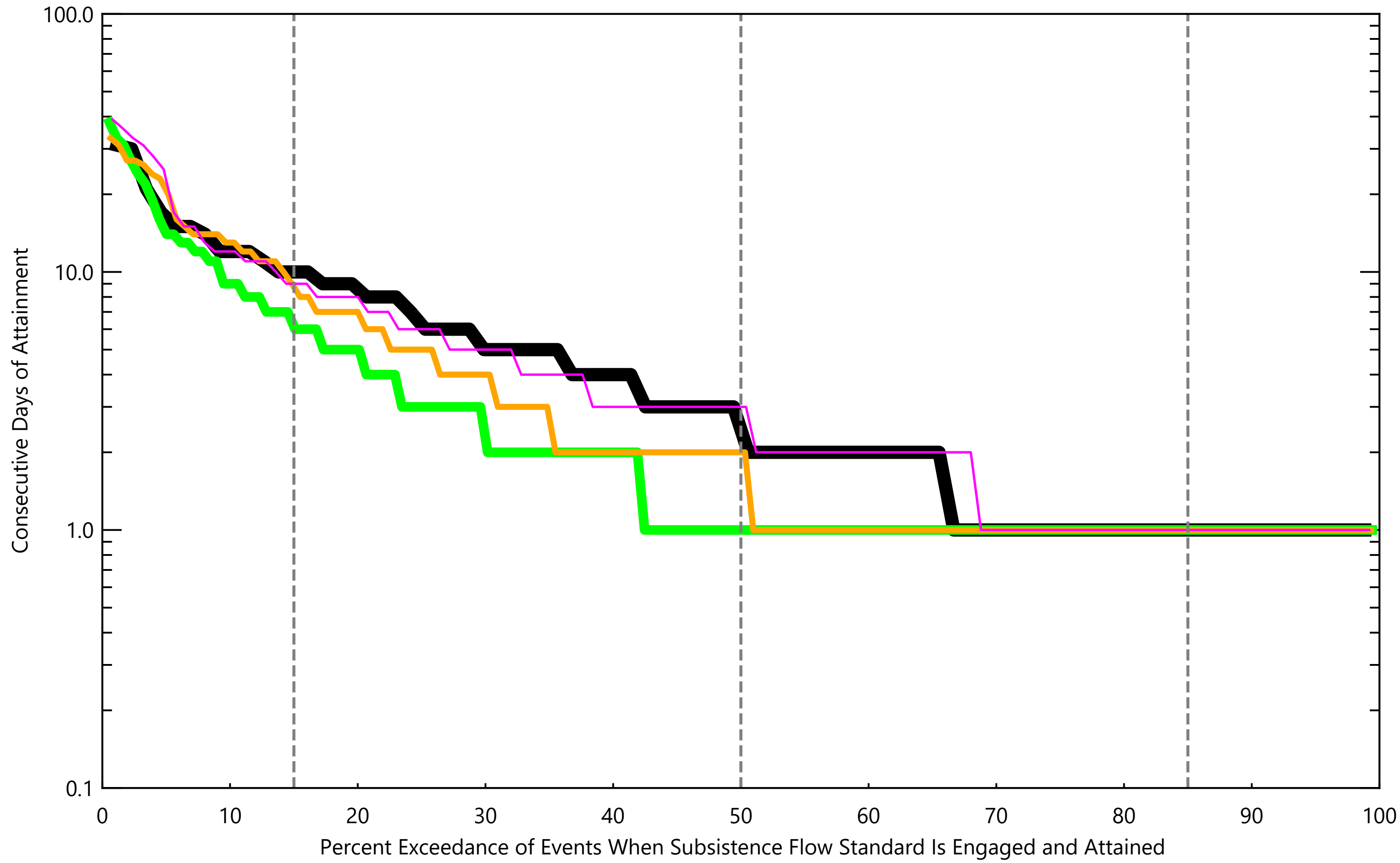
Figure E-31
Clear Fork at Nugent: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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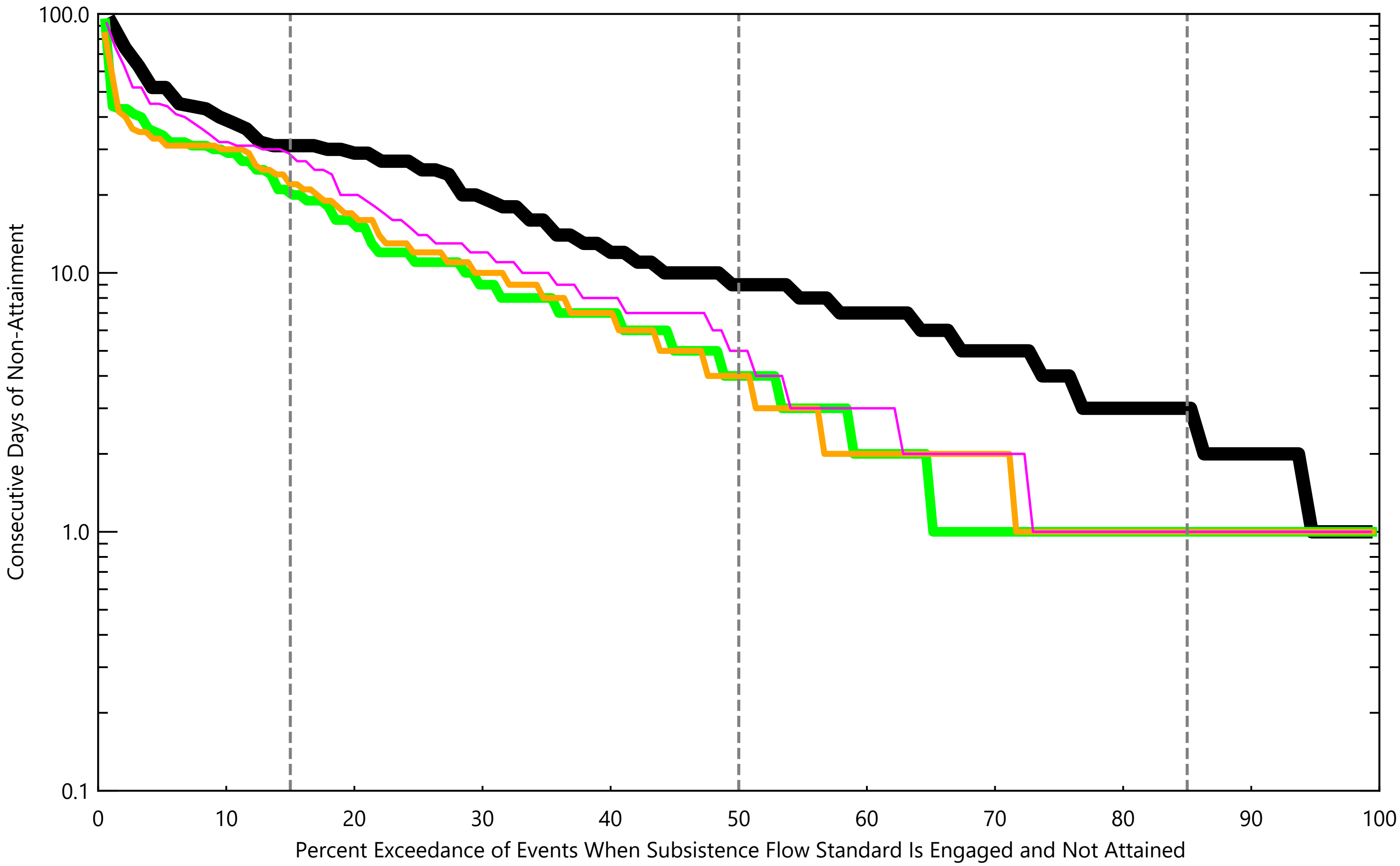
Figure E-32
Clear Fork at Nugent: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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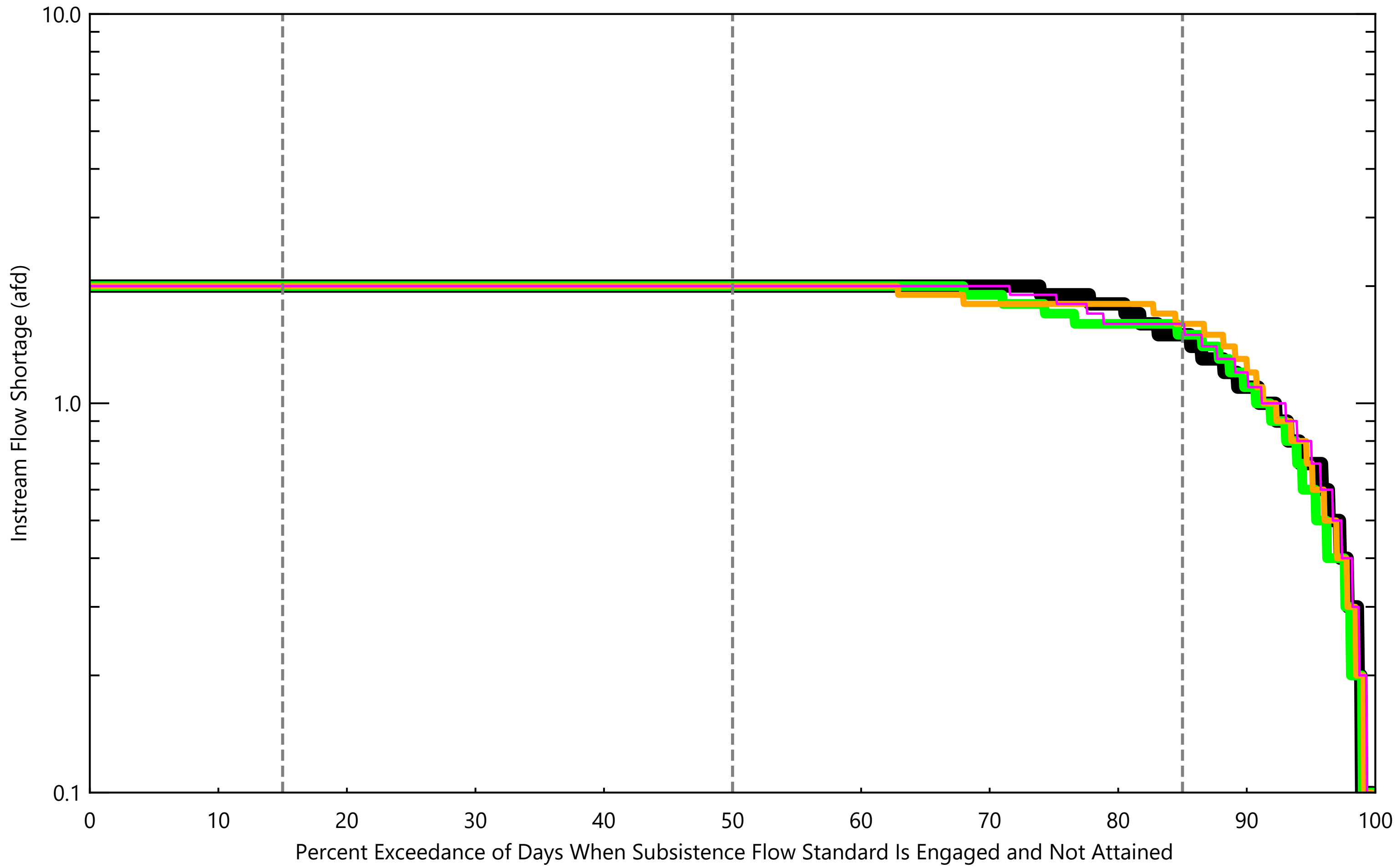
Figure E-33

Clear Fork at Nugent: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-34
Clear Fork at Nugent: Subsistence Flow Shortage, Entire Period of Record (S-POR)

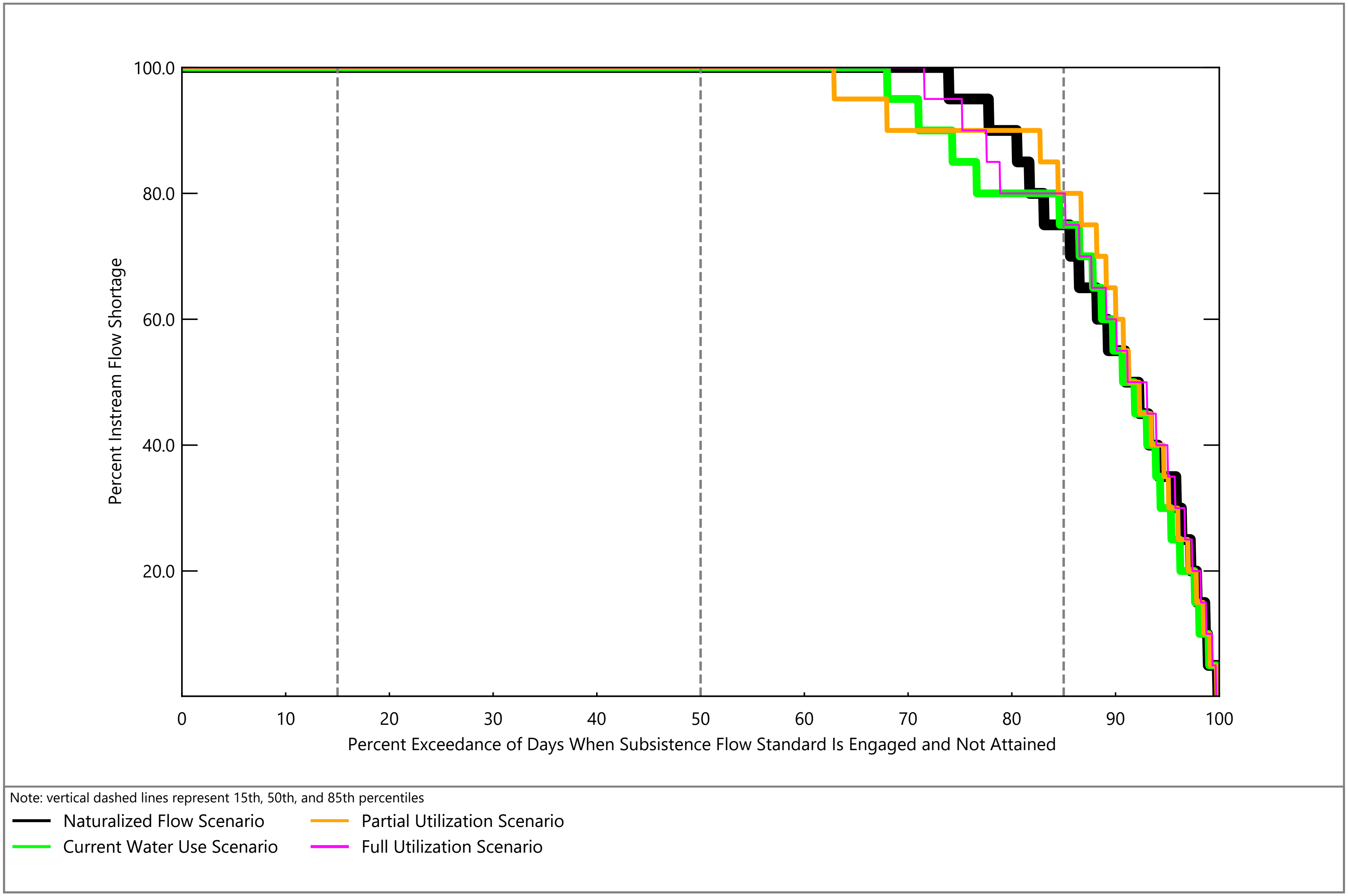

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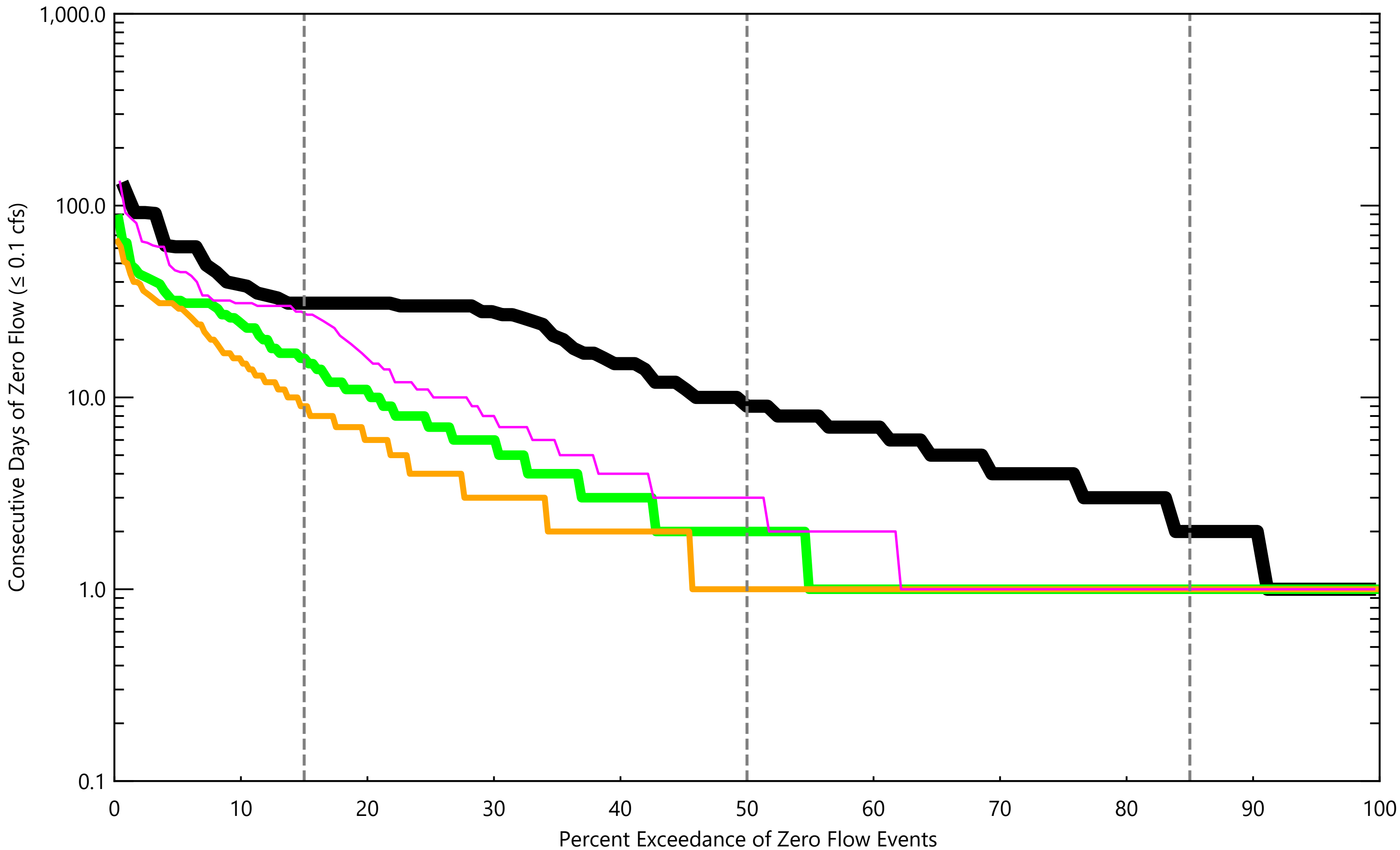
Figure E-35
Clear Fork at Nugent: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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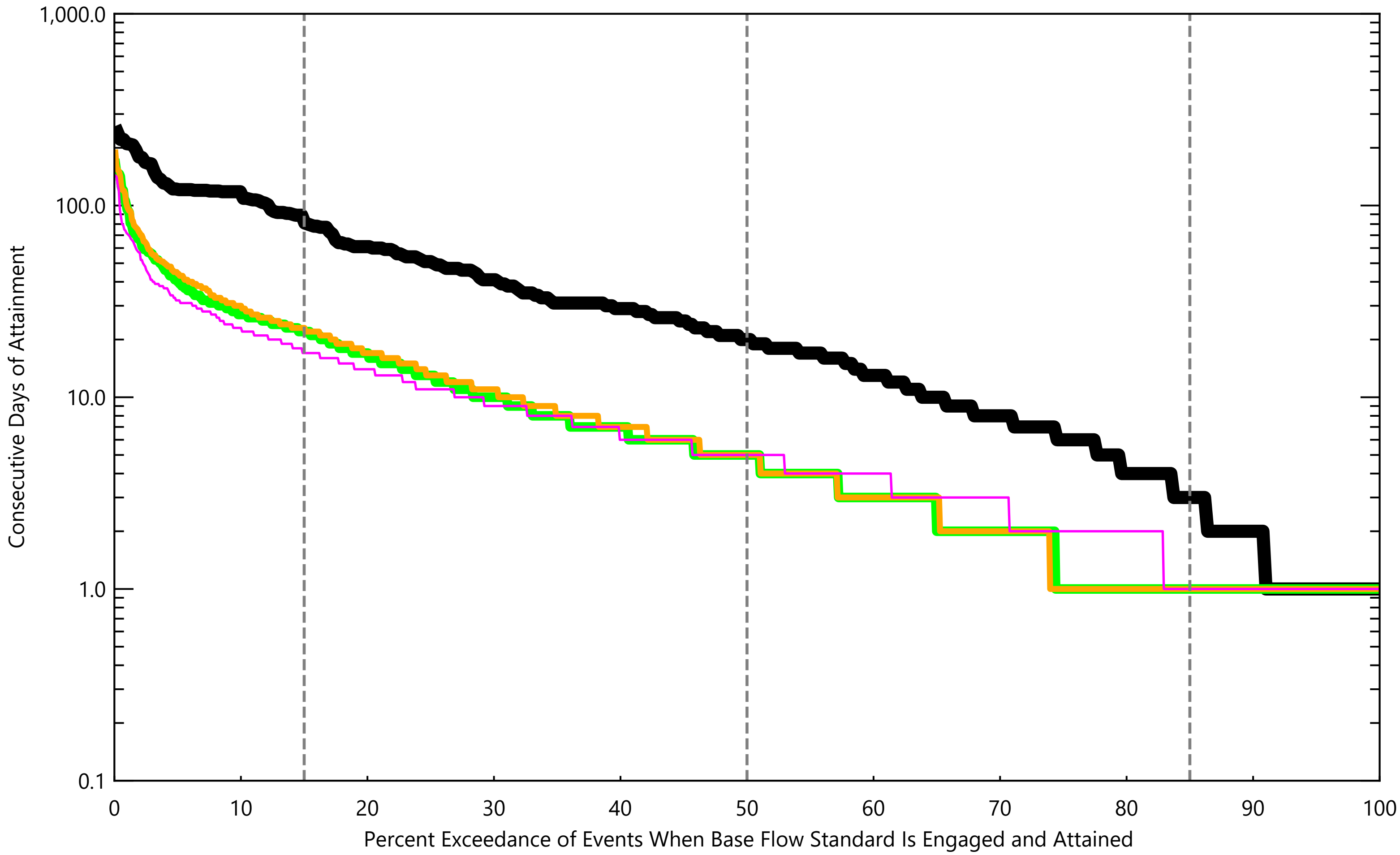
Figure E-36
Clear Fork at Nugent: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-37

Clear Fork at Lueders: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

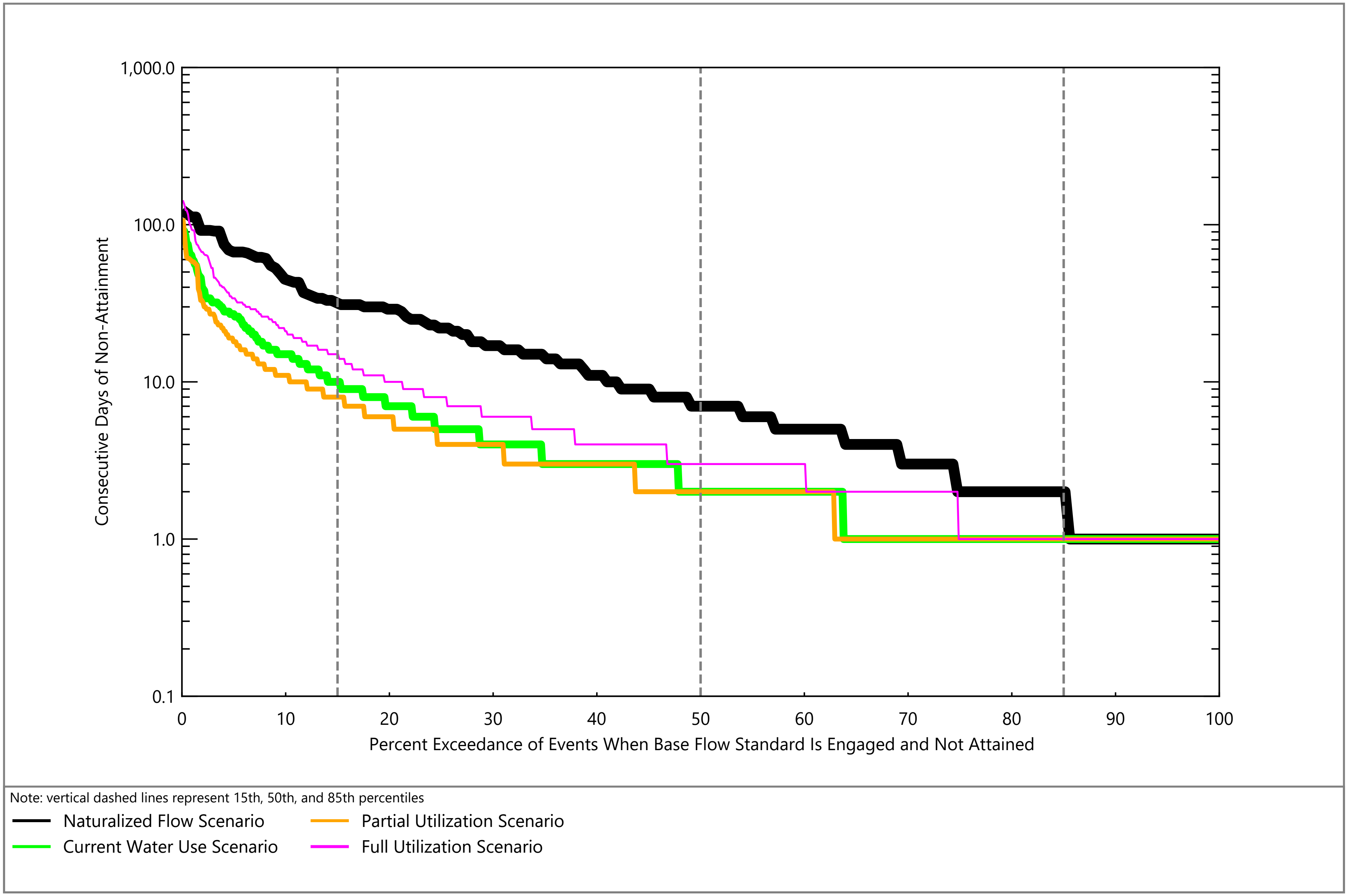

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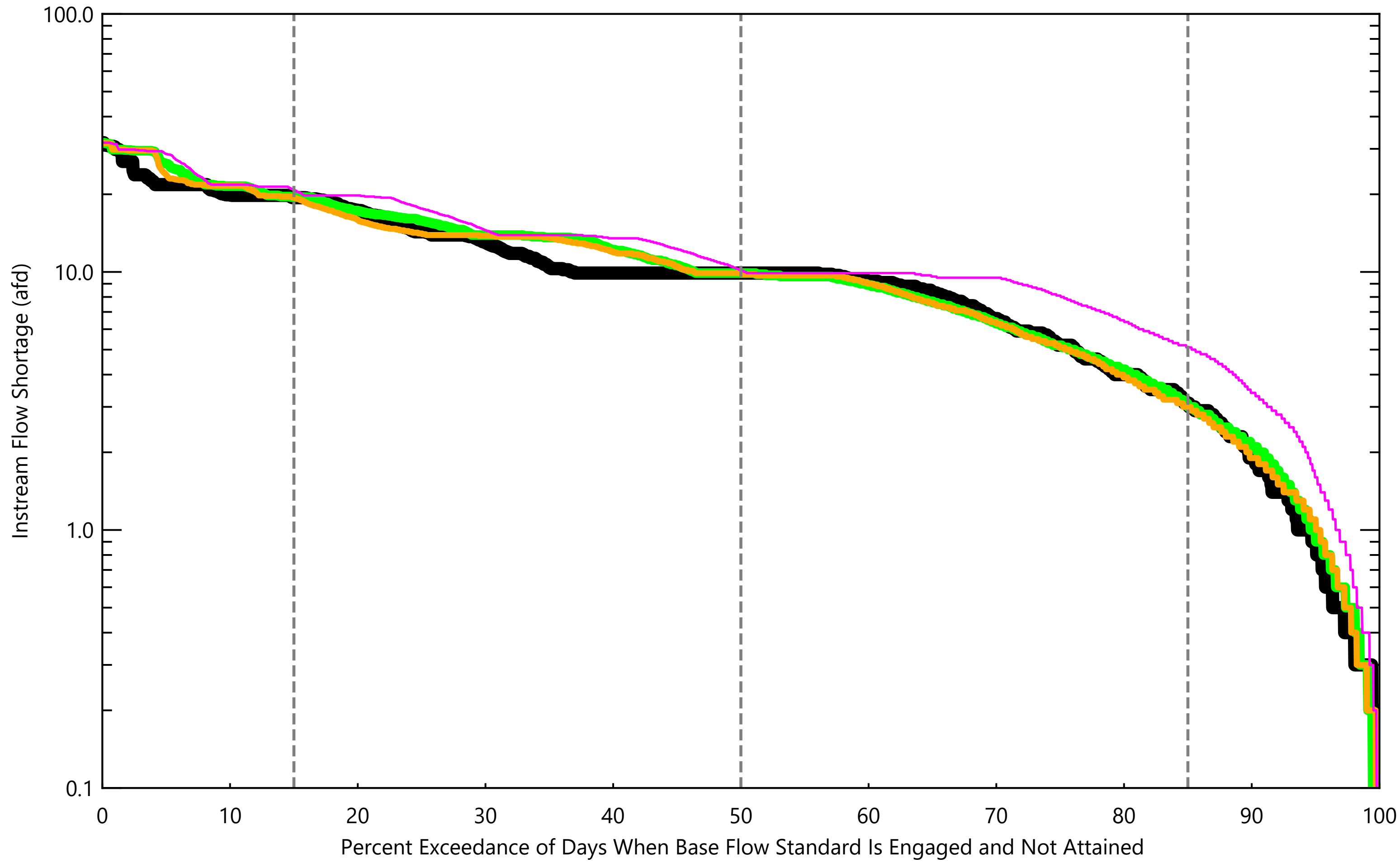
Figure E-38
Clear Fork at Lueders: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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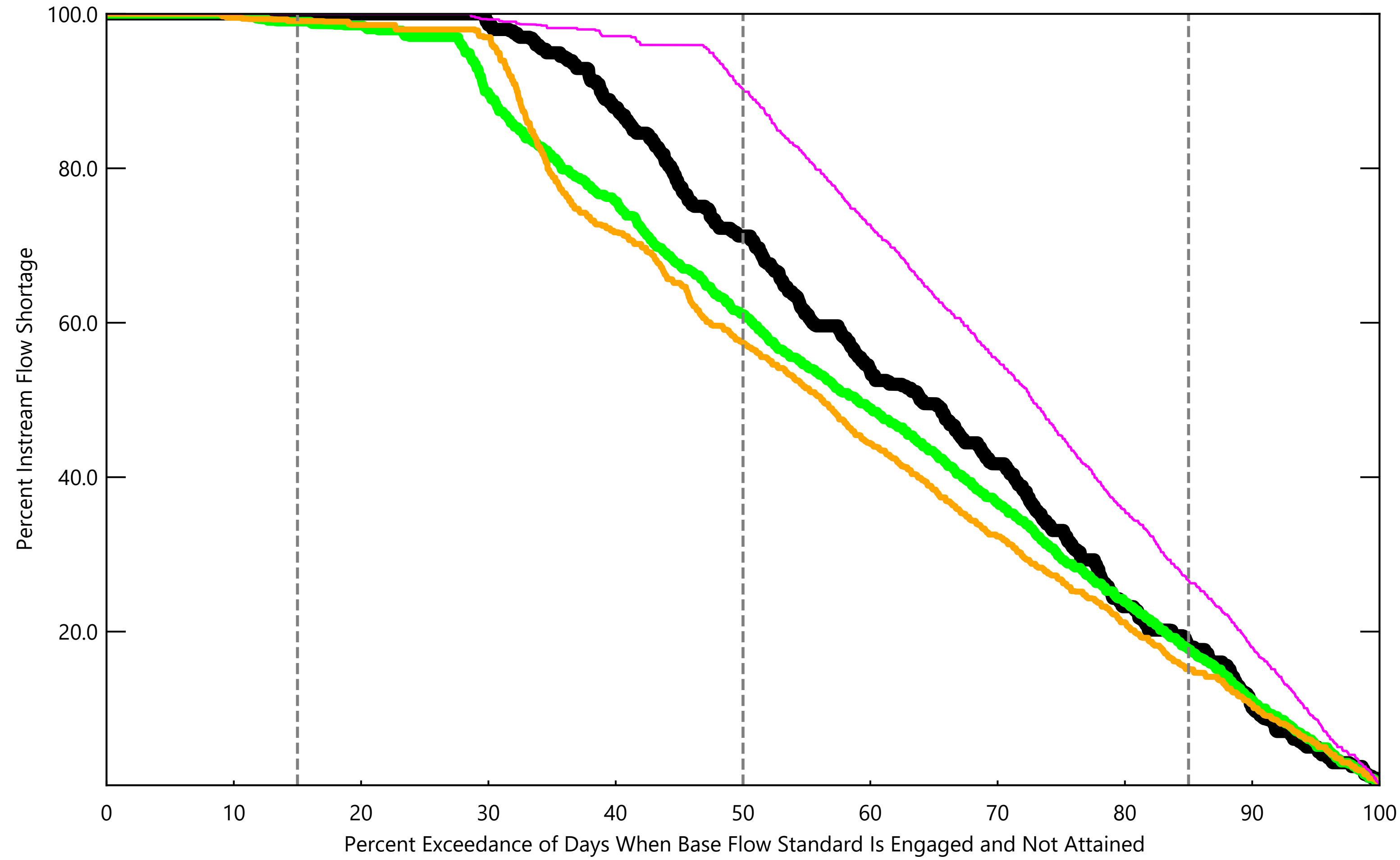
Figure E-39
Clear Fork at Lueders: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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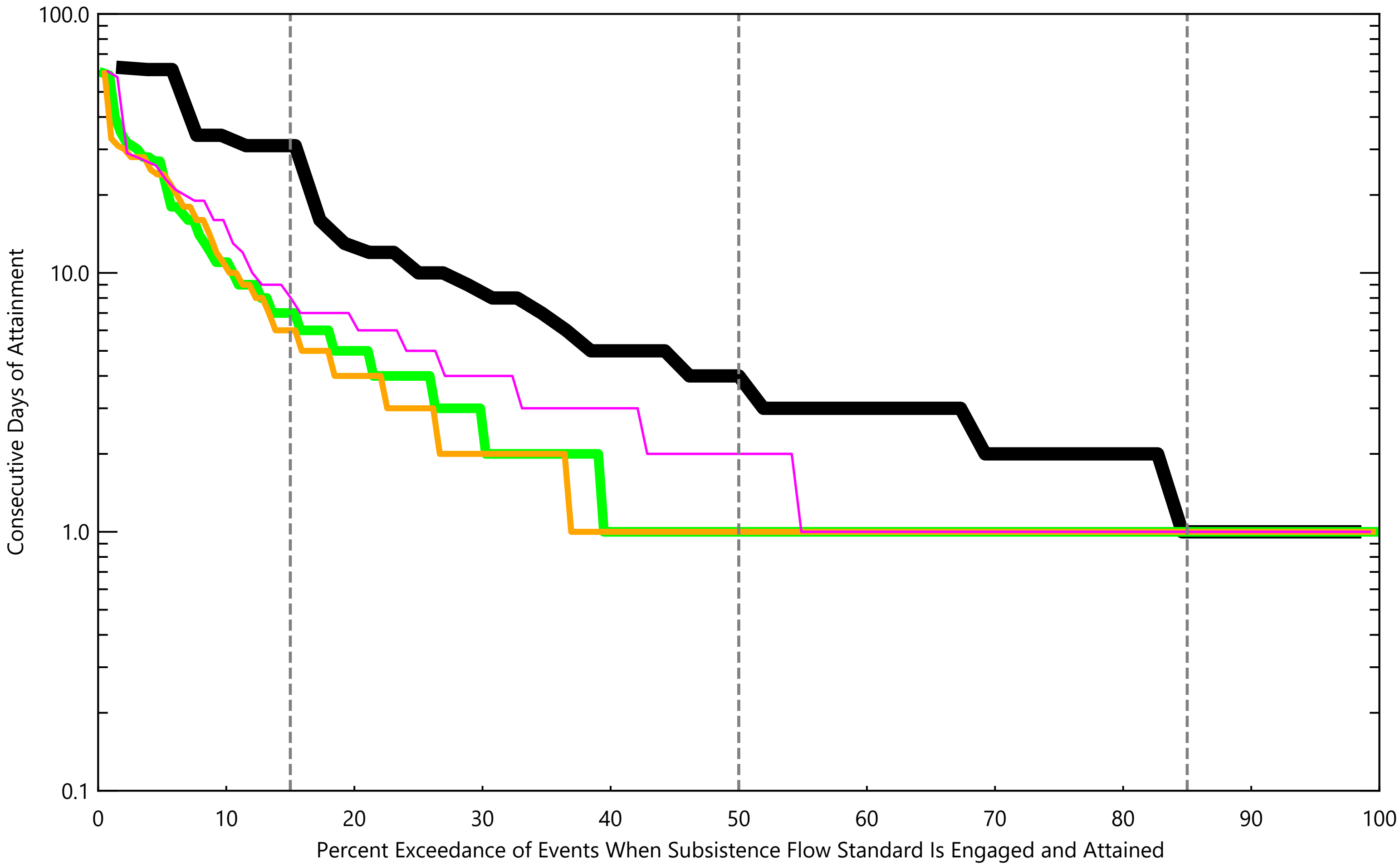
Figure E-40
Clear Fork at Lueders: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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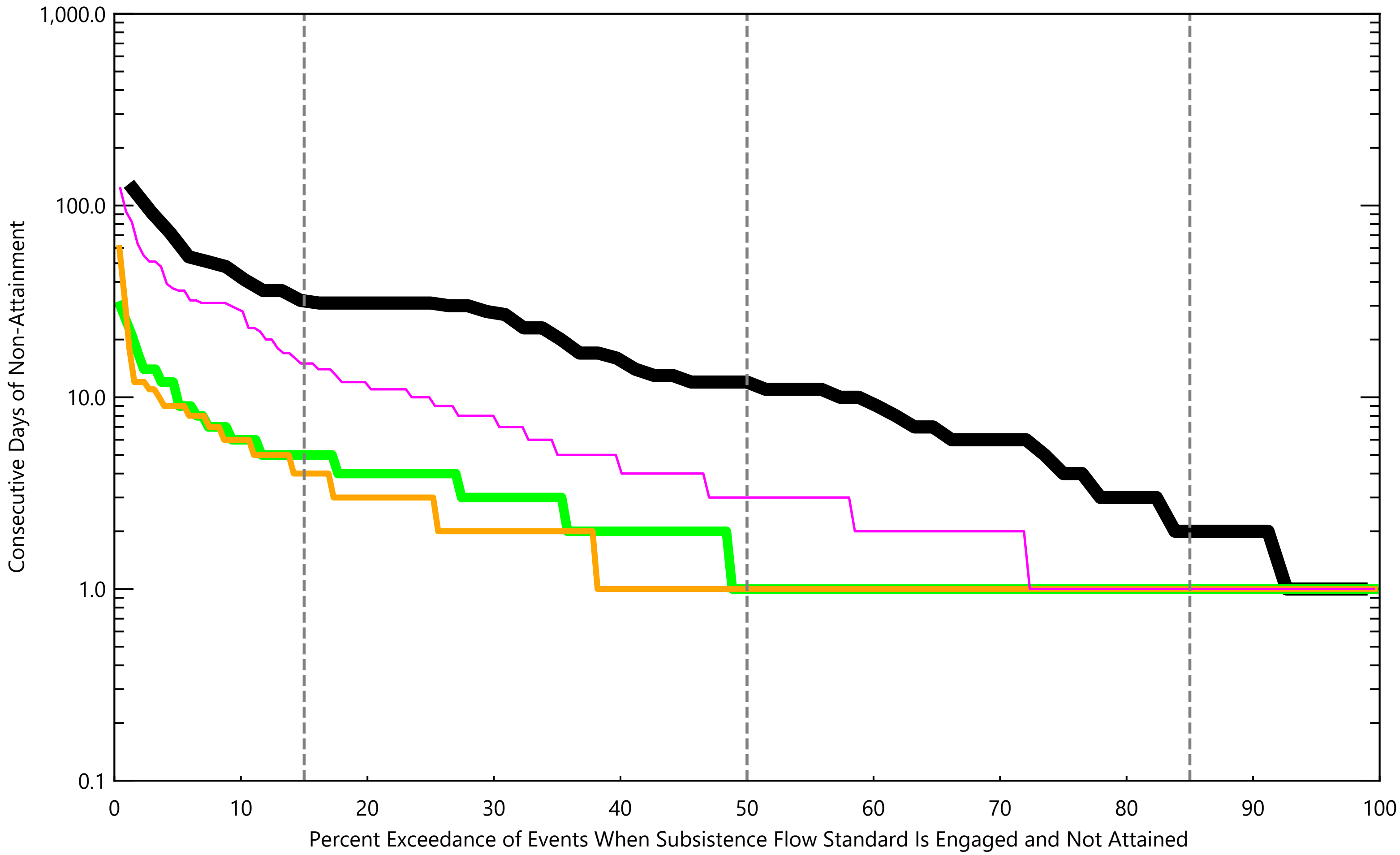
Figure E-41
Clear Fork at Lueders: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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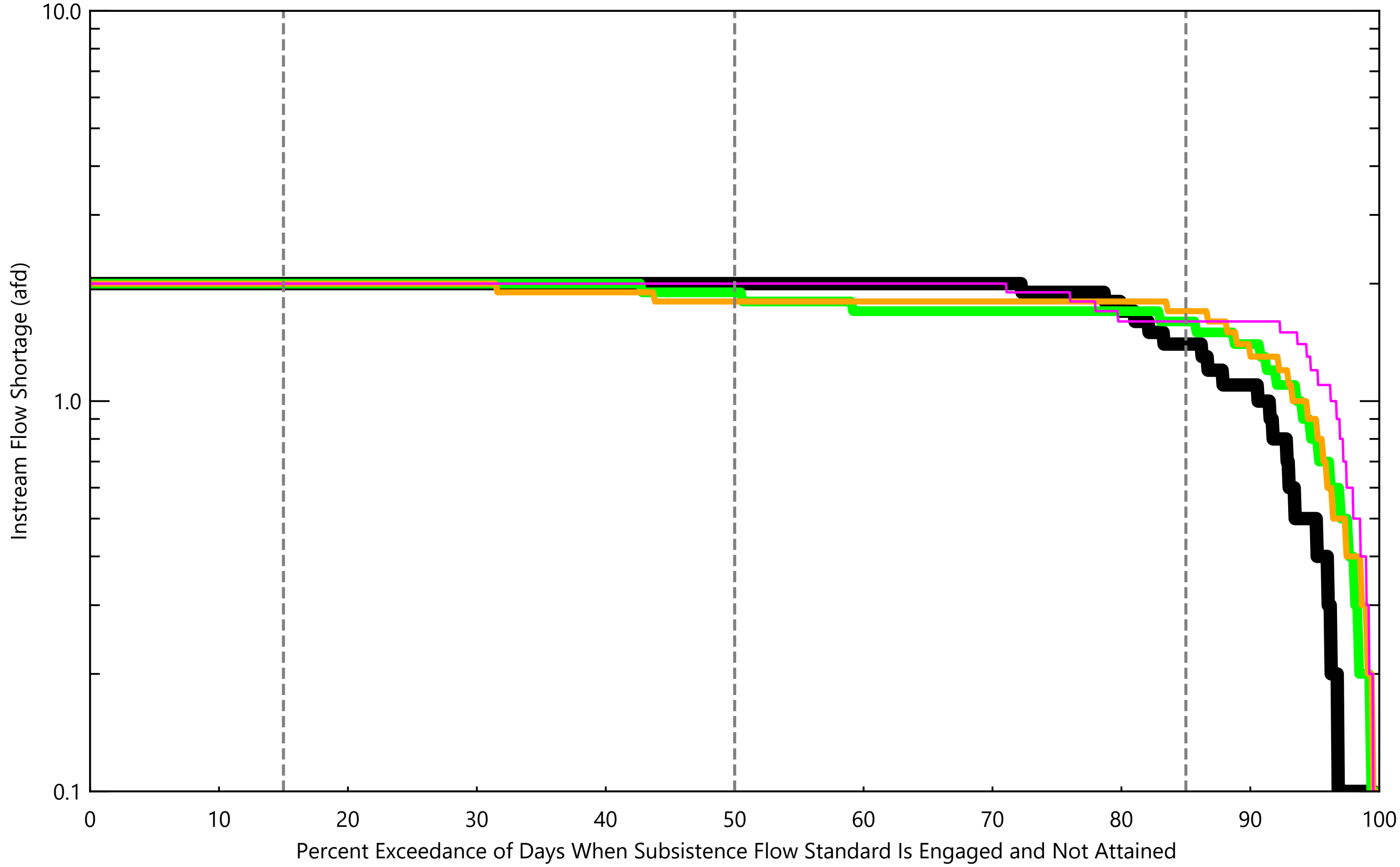
Figure E-42
Clear Fork at Lueders: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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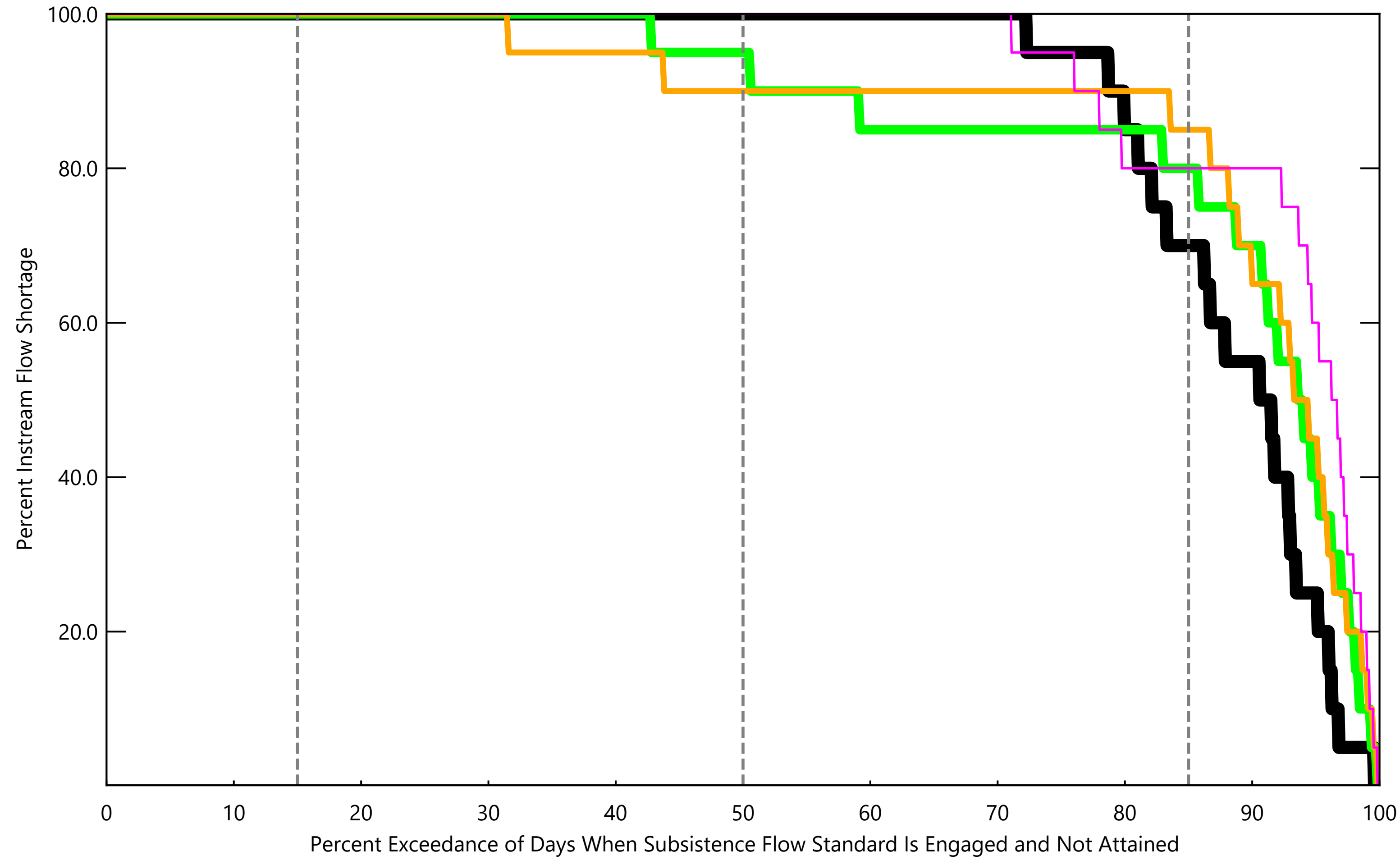
Figure E-43
Clear Fork at Lueders: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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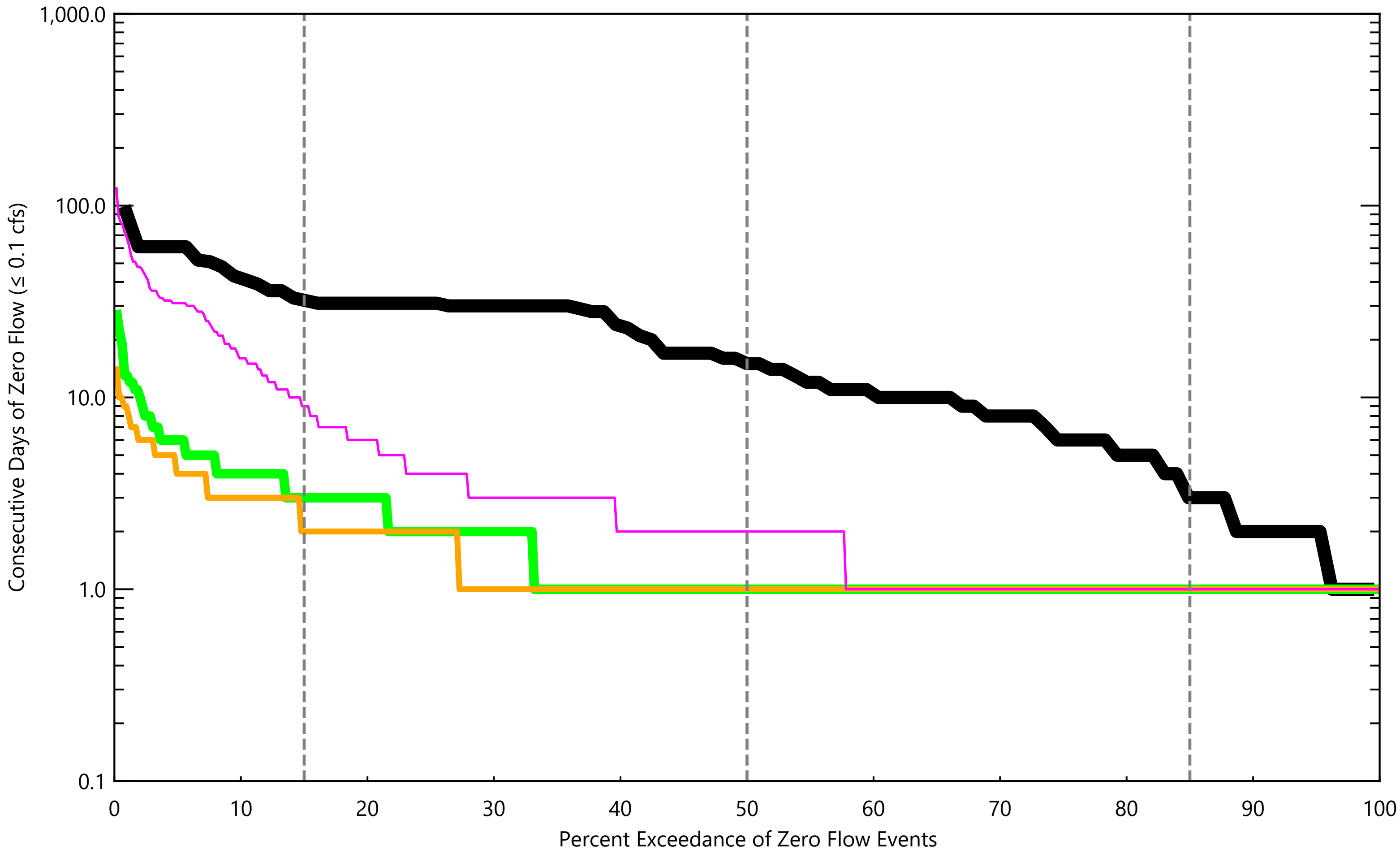
Figure E-44

Clear Fork at Lueders: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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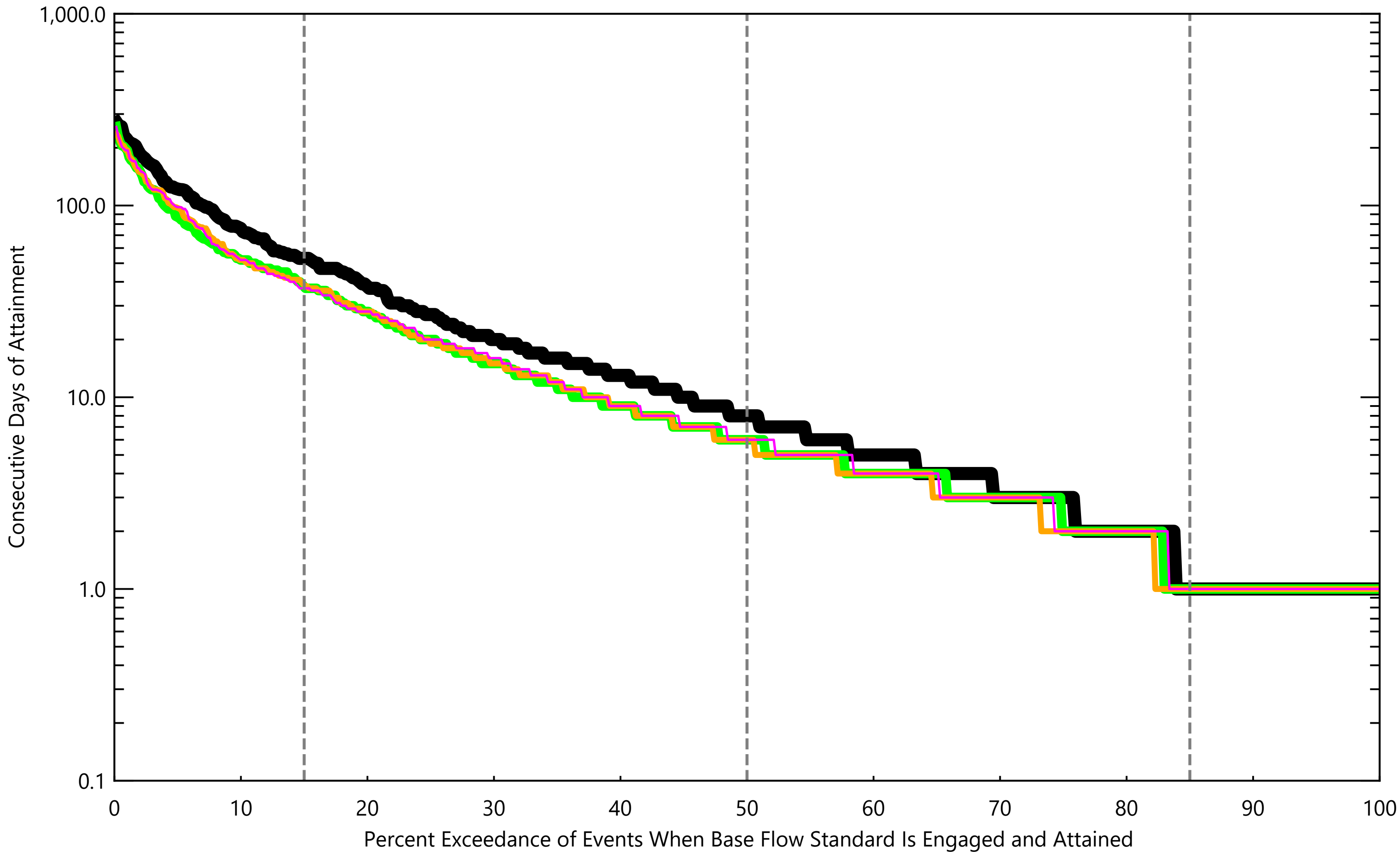
Figure E-45
Clear Fork at Lueders: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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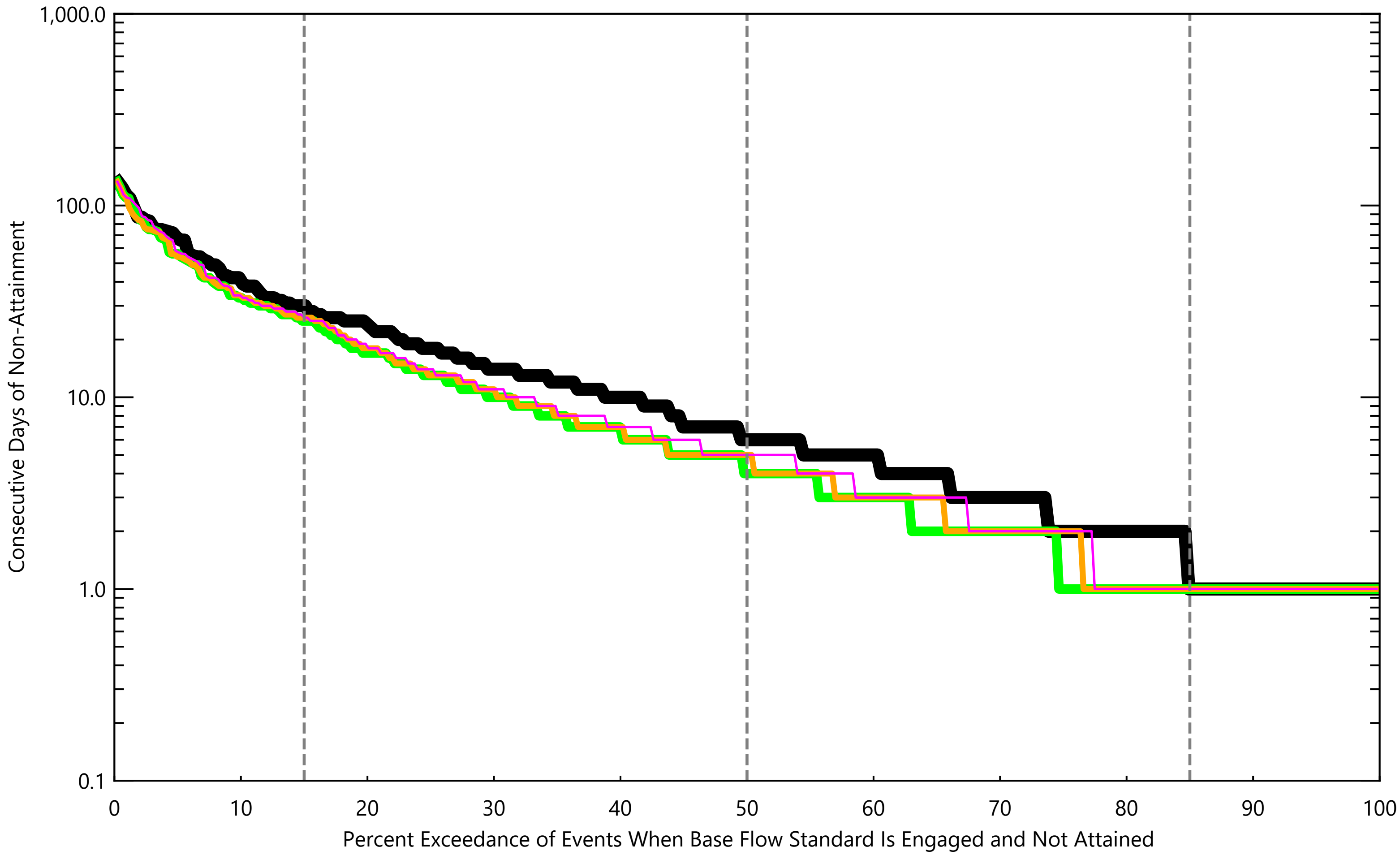
Figure E-46
Brazos River near South Bend: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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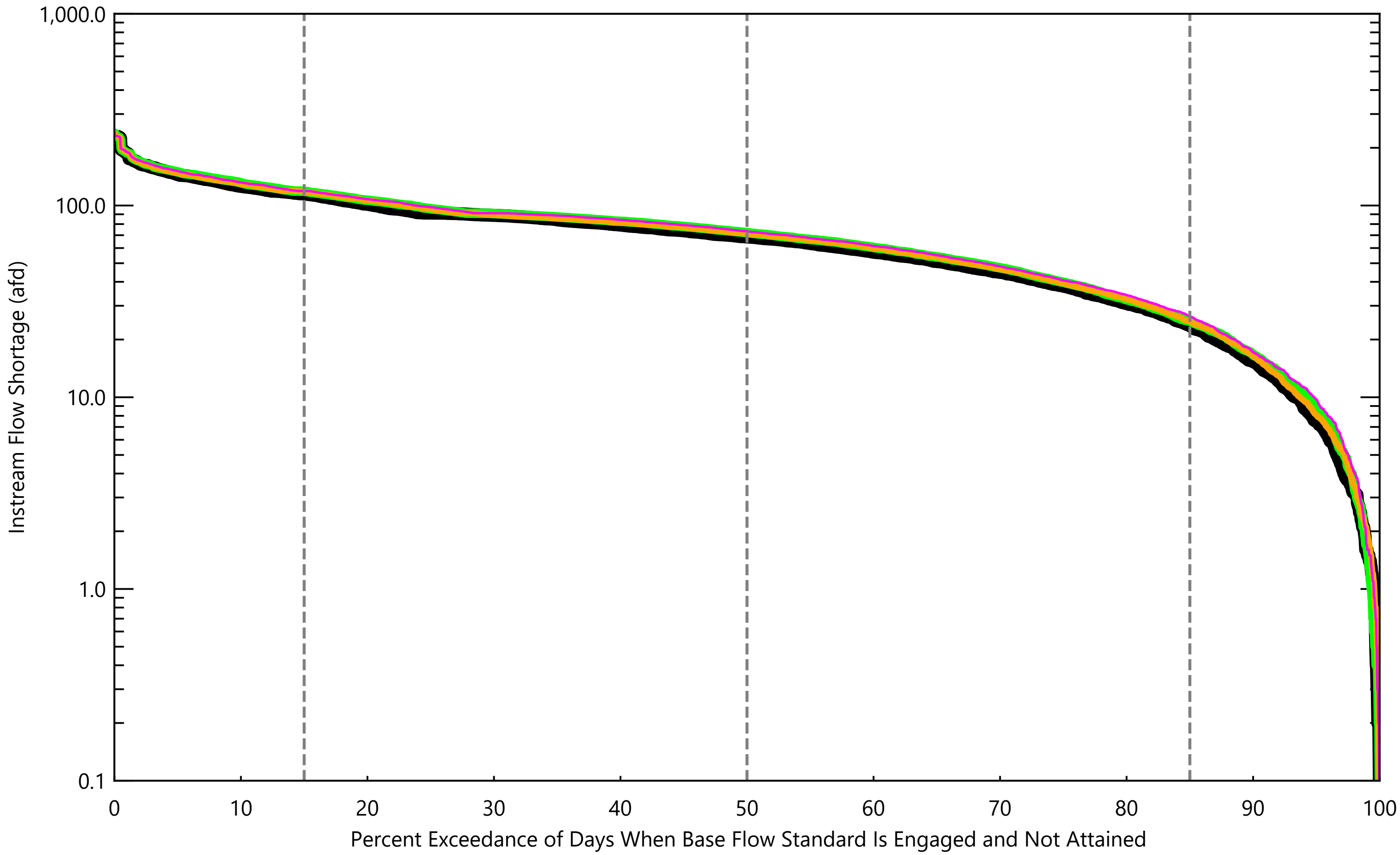
Figure E-47
Brazos River near South Bend: Base Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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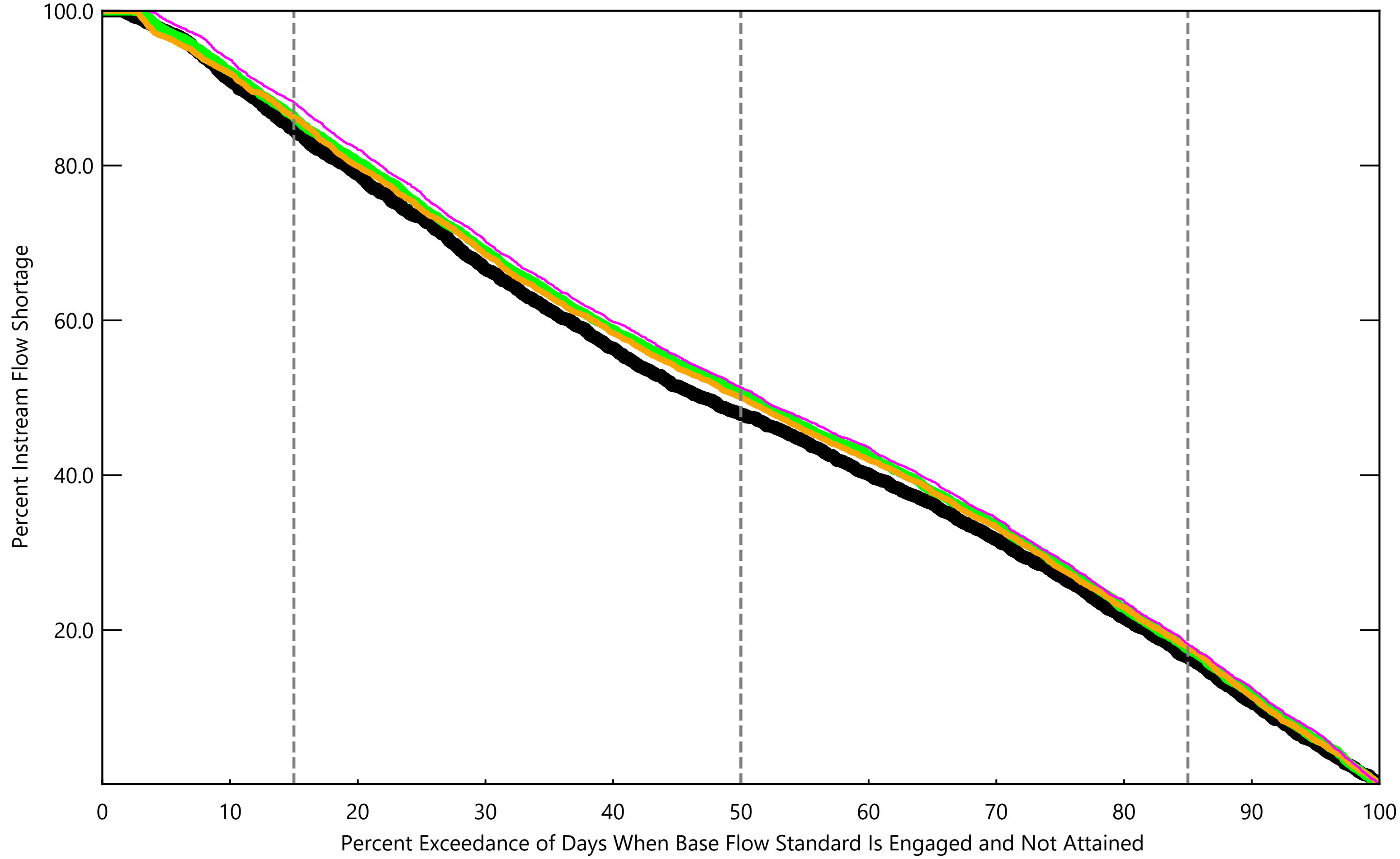
Figure E-48
Brazos River near South Bend: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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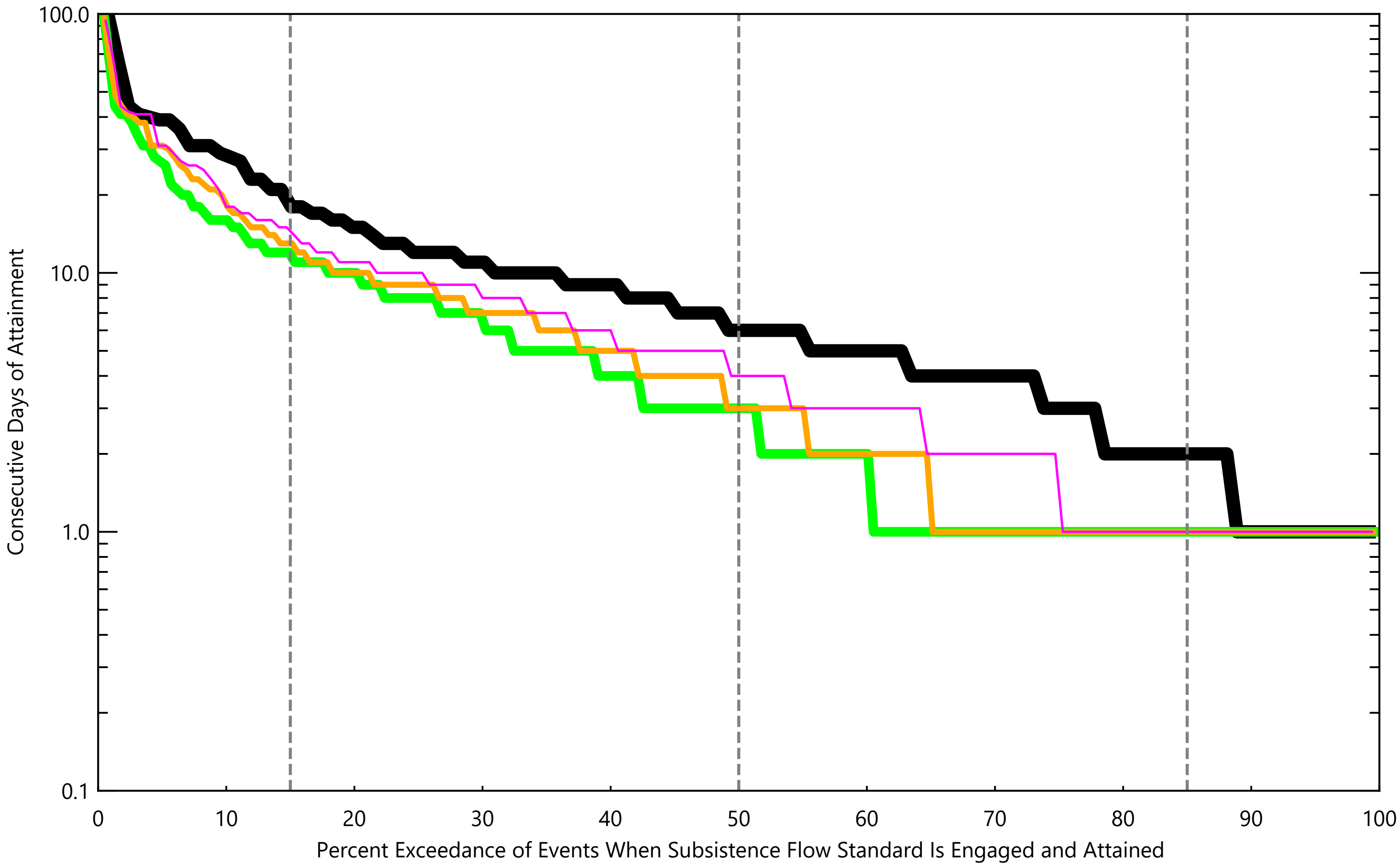
Figure E-49

Brazos River near South Bend: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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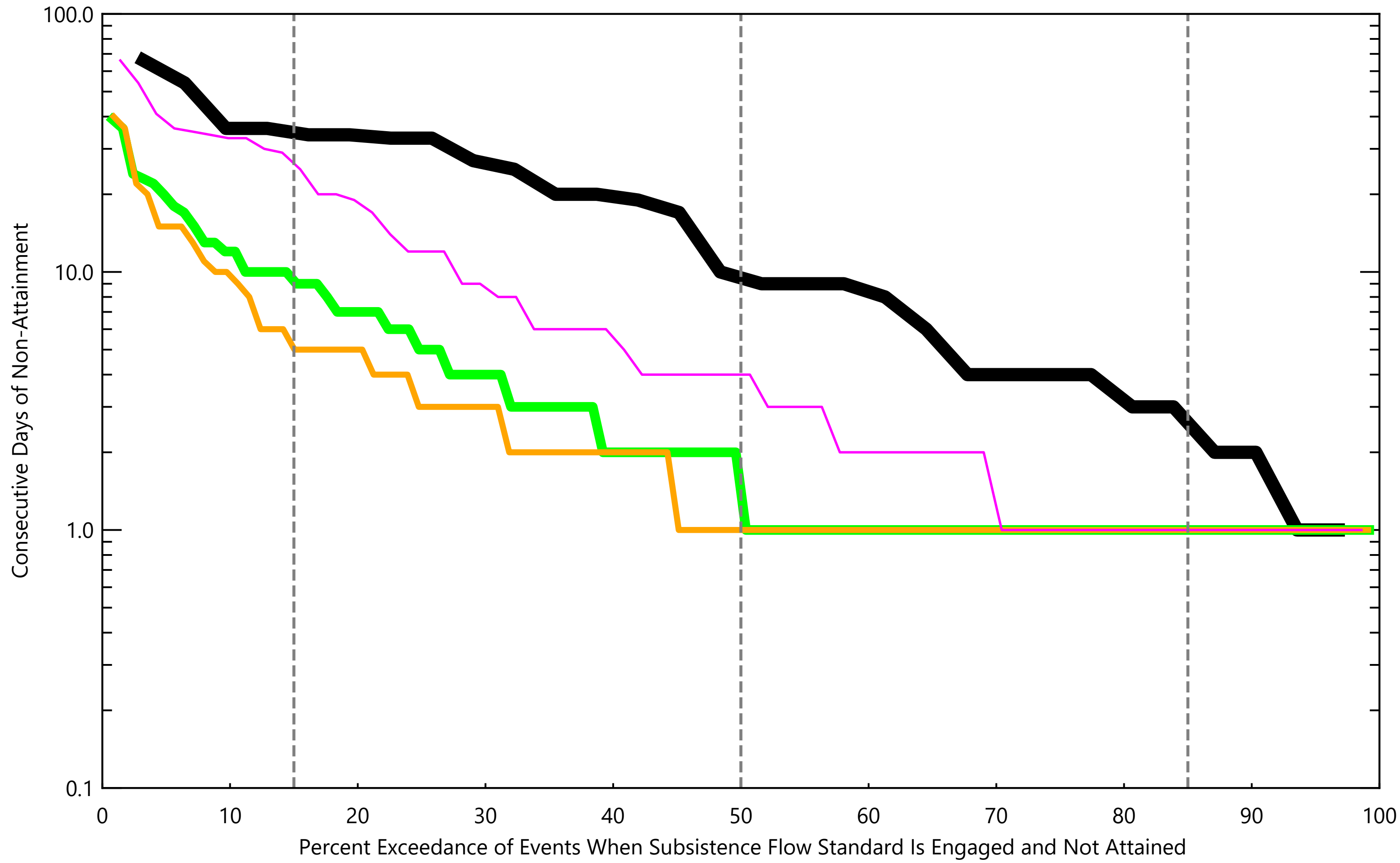
Figure E-50

Brazos River near South Bend: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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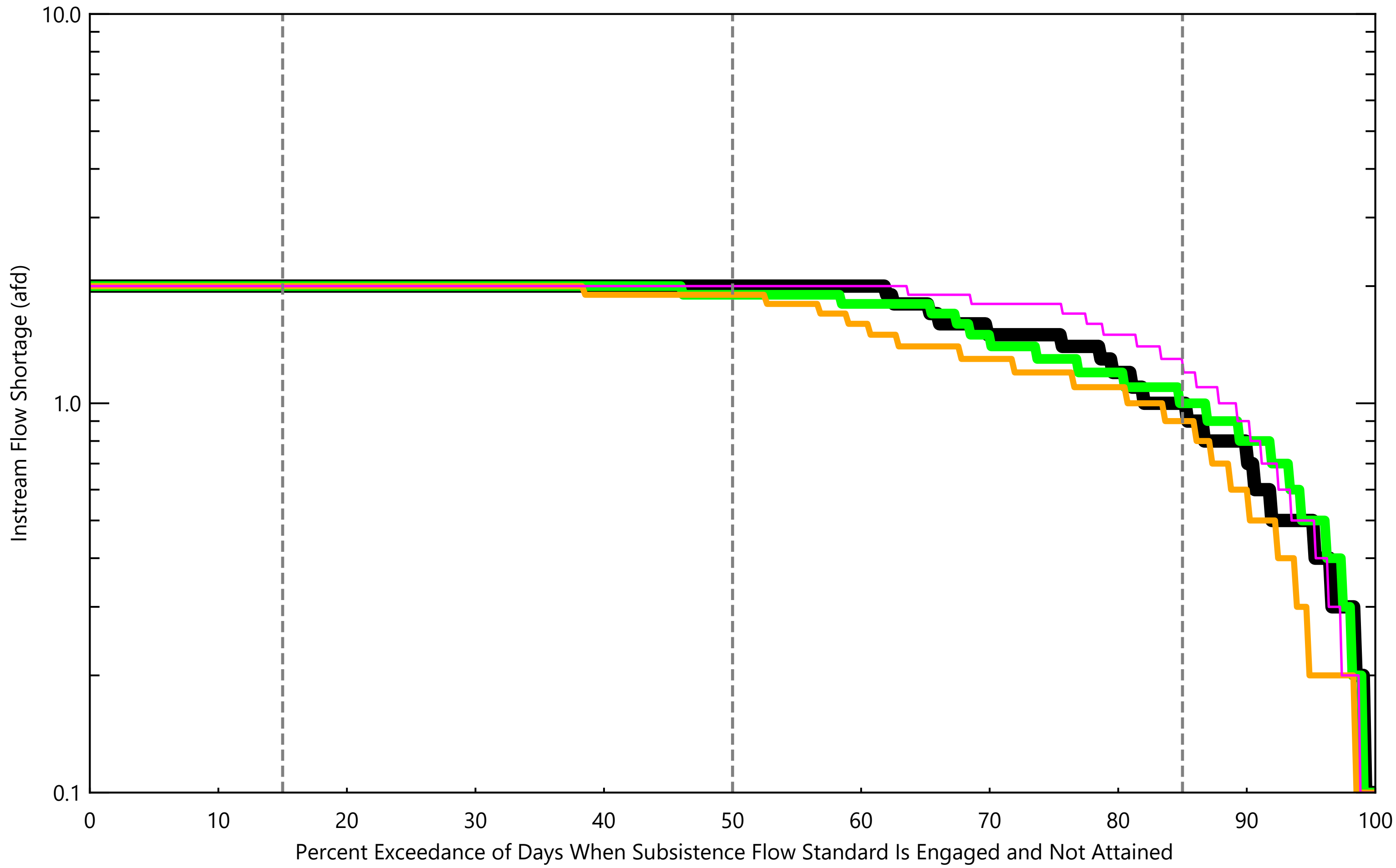
Figure E-51
Brazos River near South Bend: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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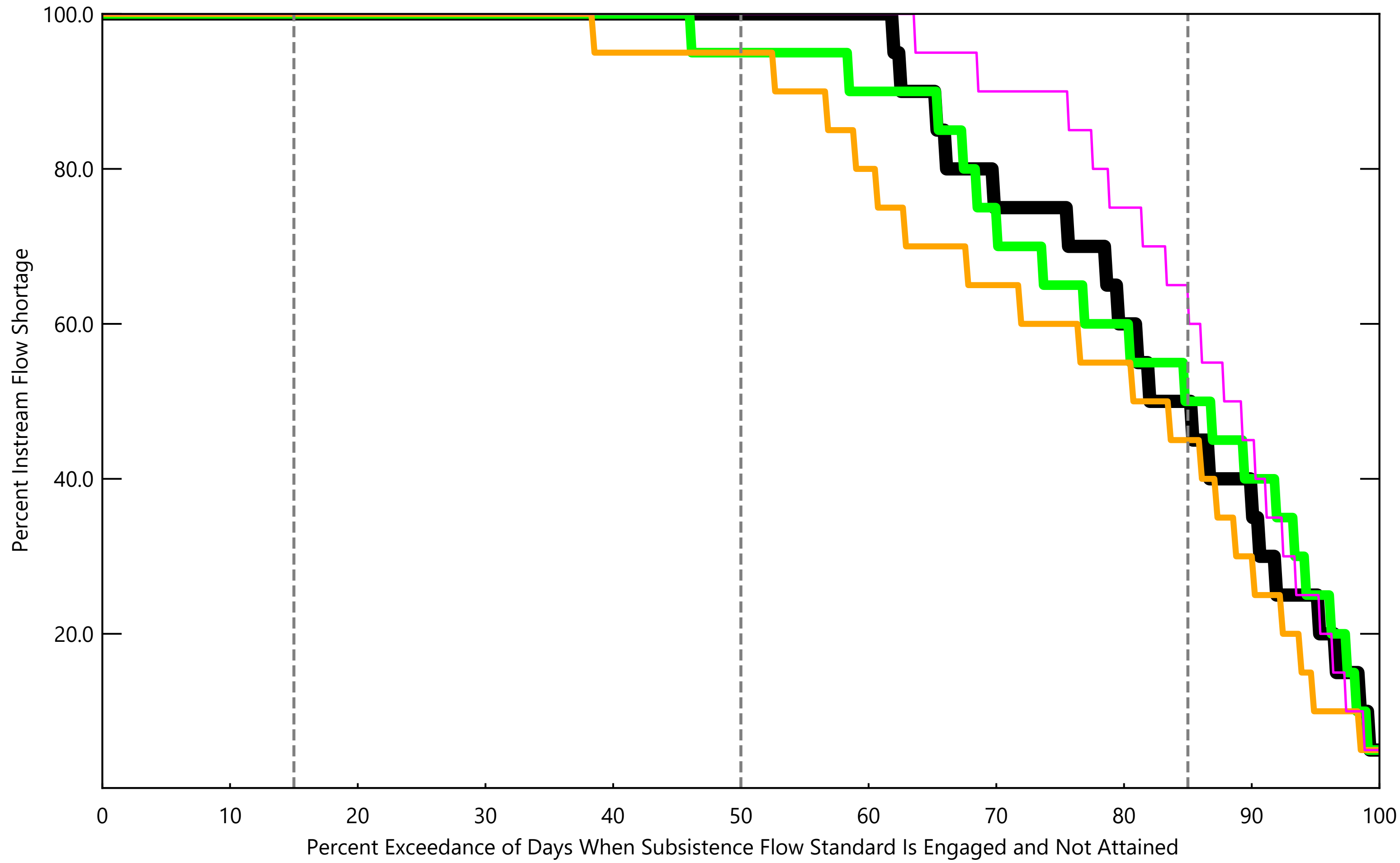
Figure E-52

Brazos River near South Bend: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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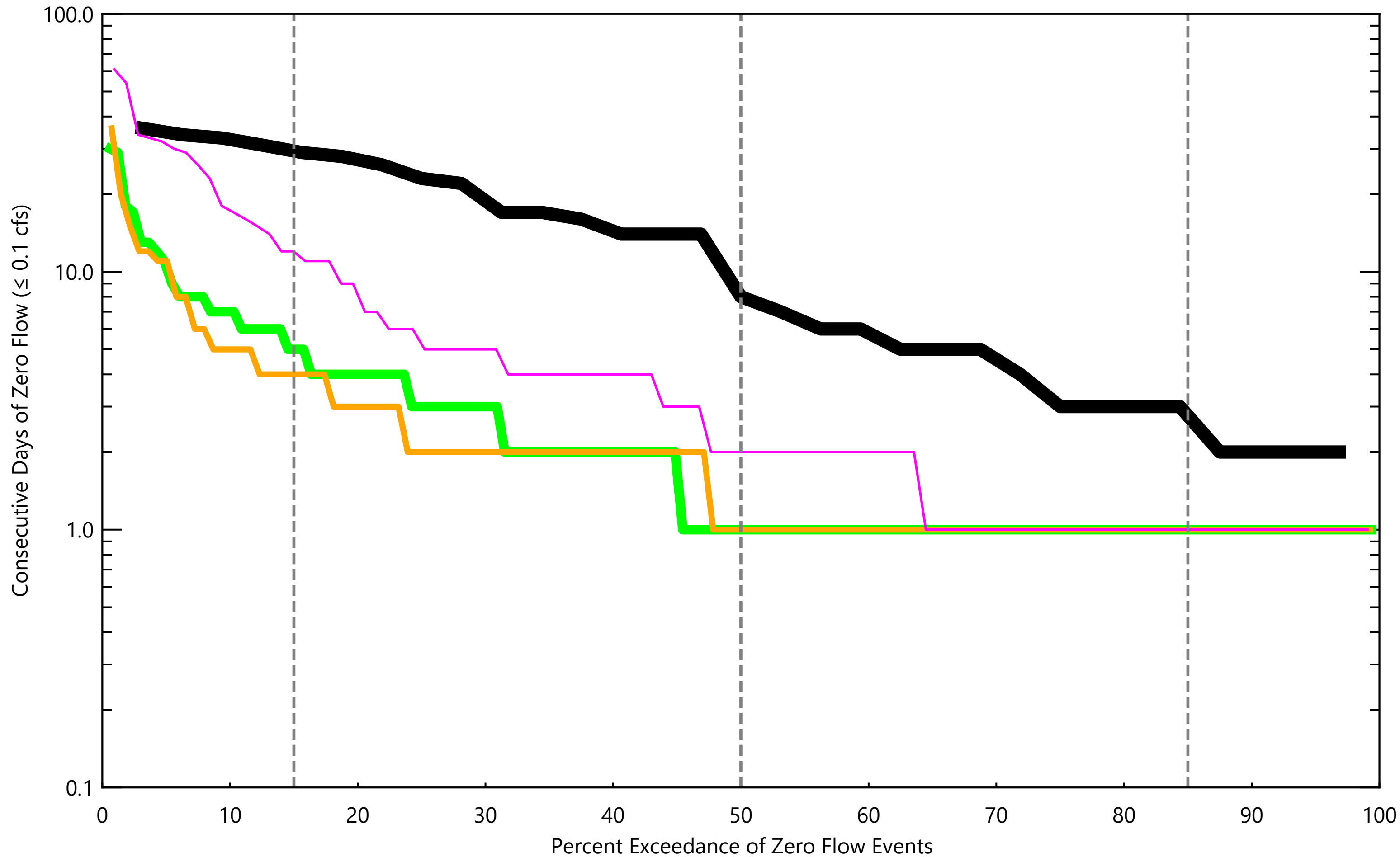
Figure E-53

Brazos River near South Bend: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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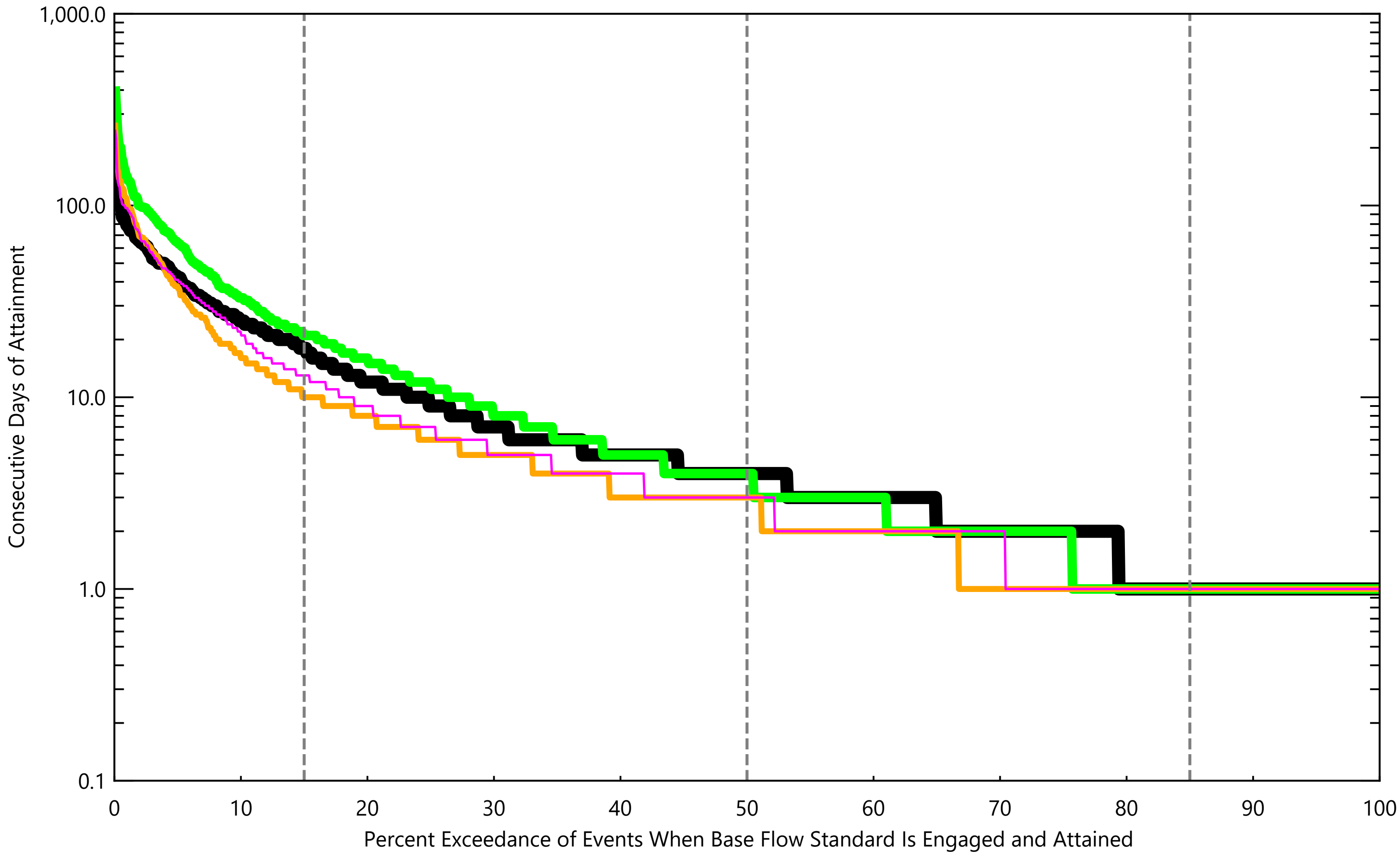
Figure E-54
Brazos River near South Bend: Zero-Flow Duration, Entire Period of Record (ZFD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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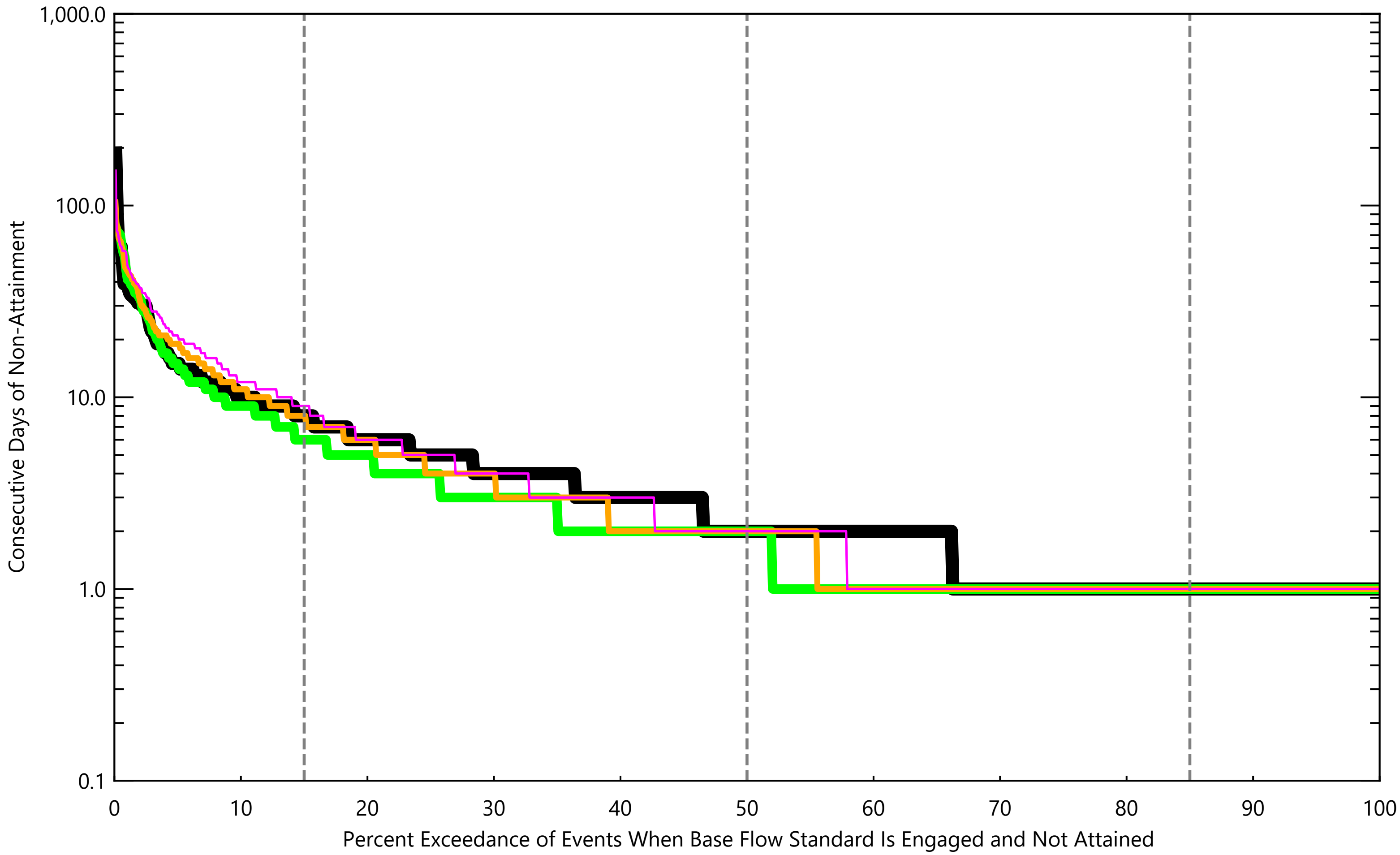
Figure E-55

Brazos River near Palo Pinto: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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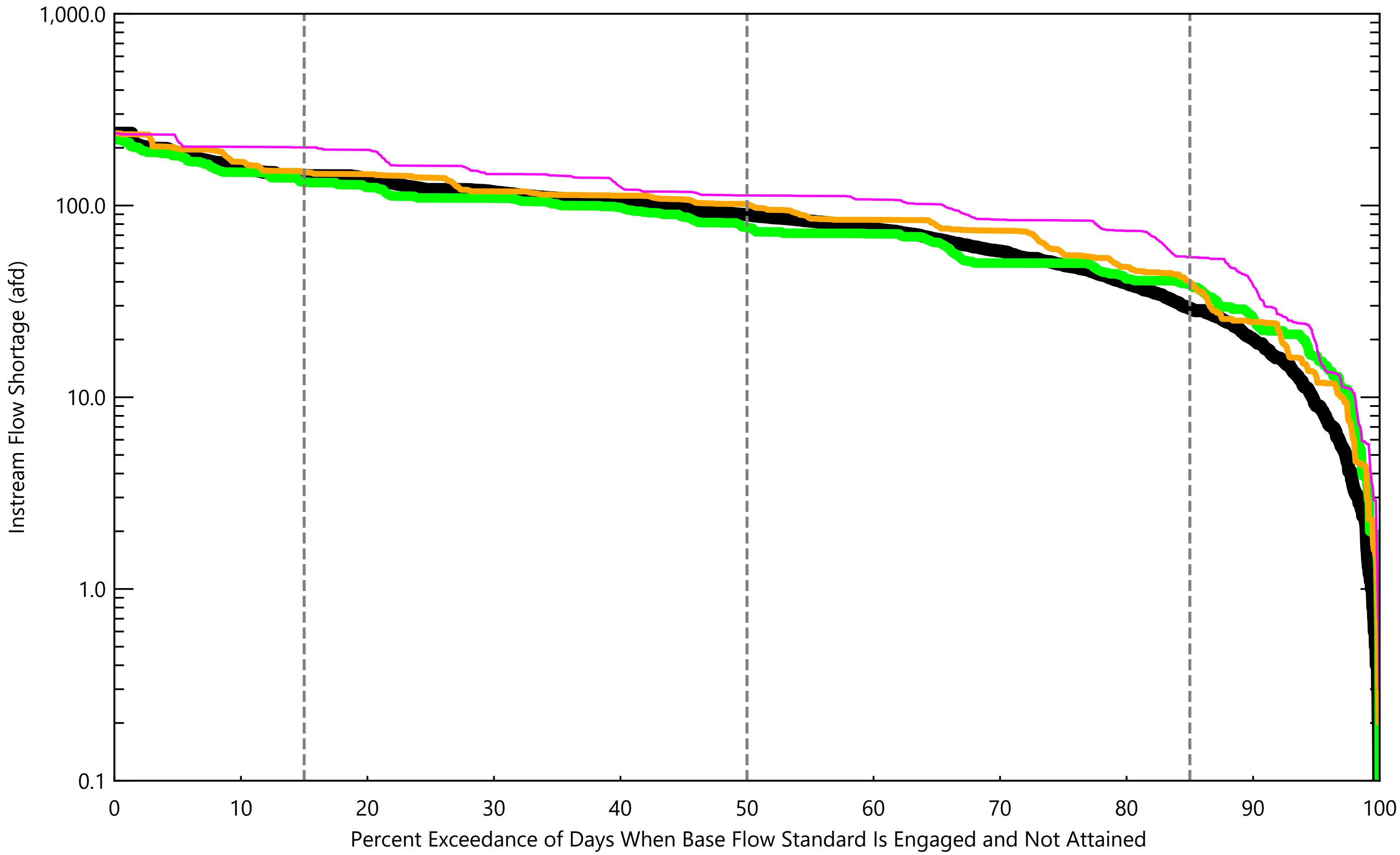
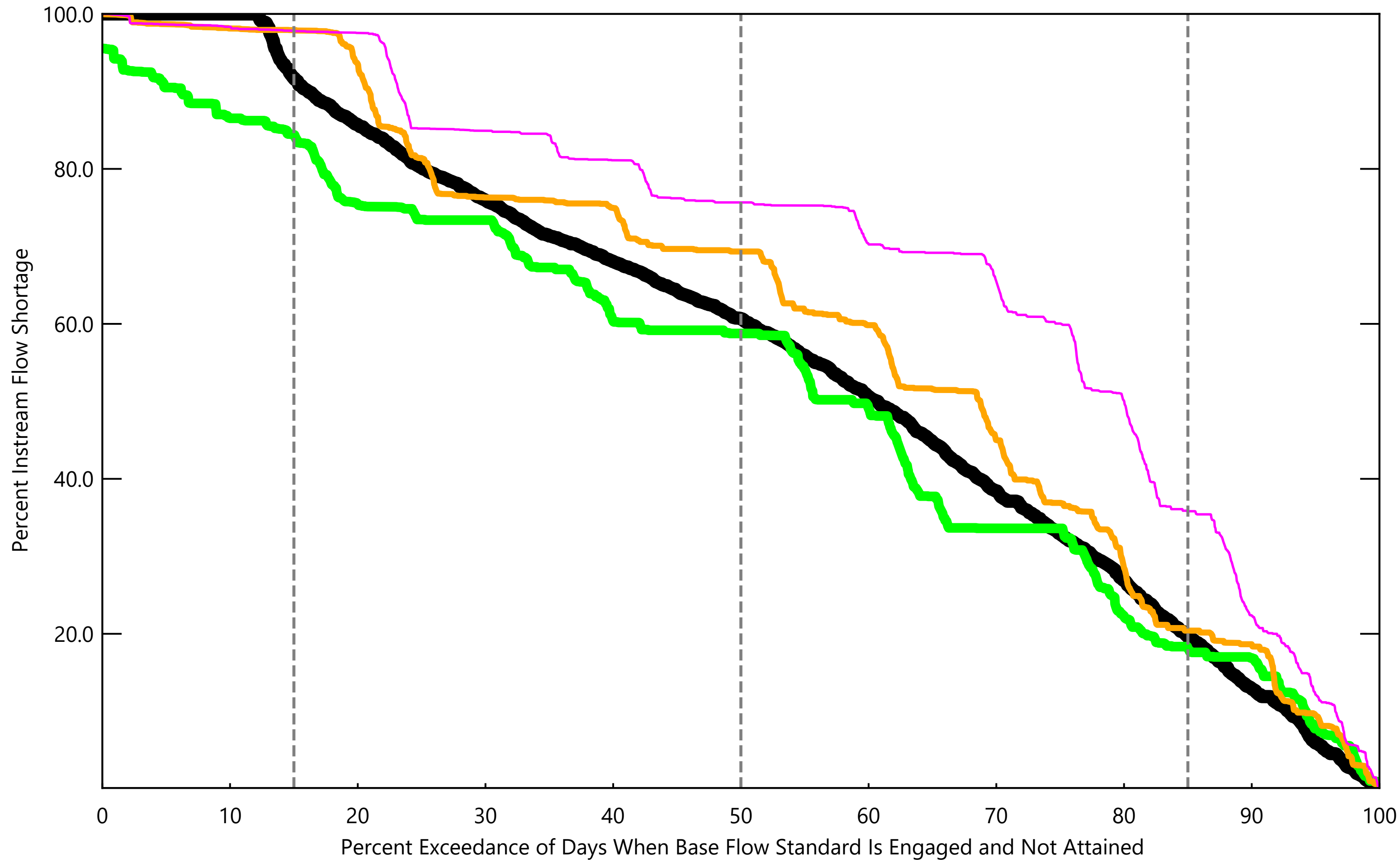
Figure E-56
Brazos River near Palo Pinto: Base Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

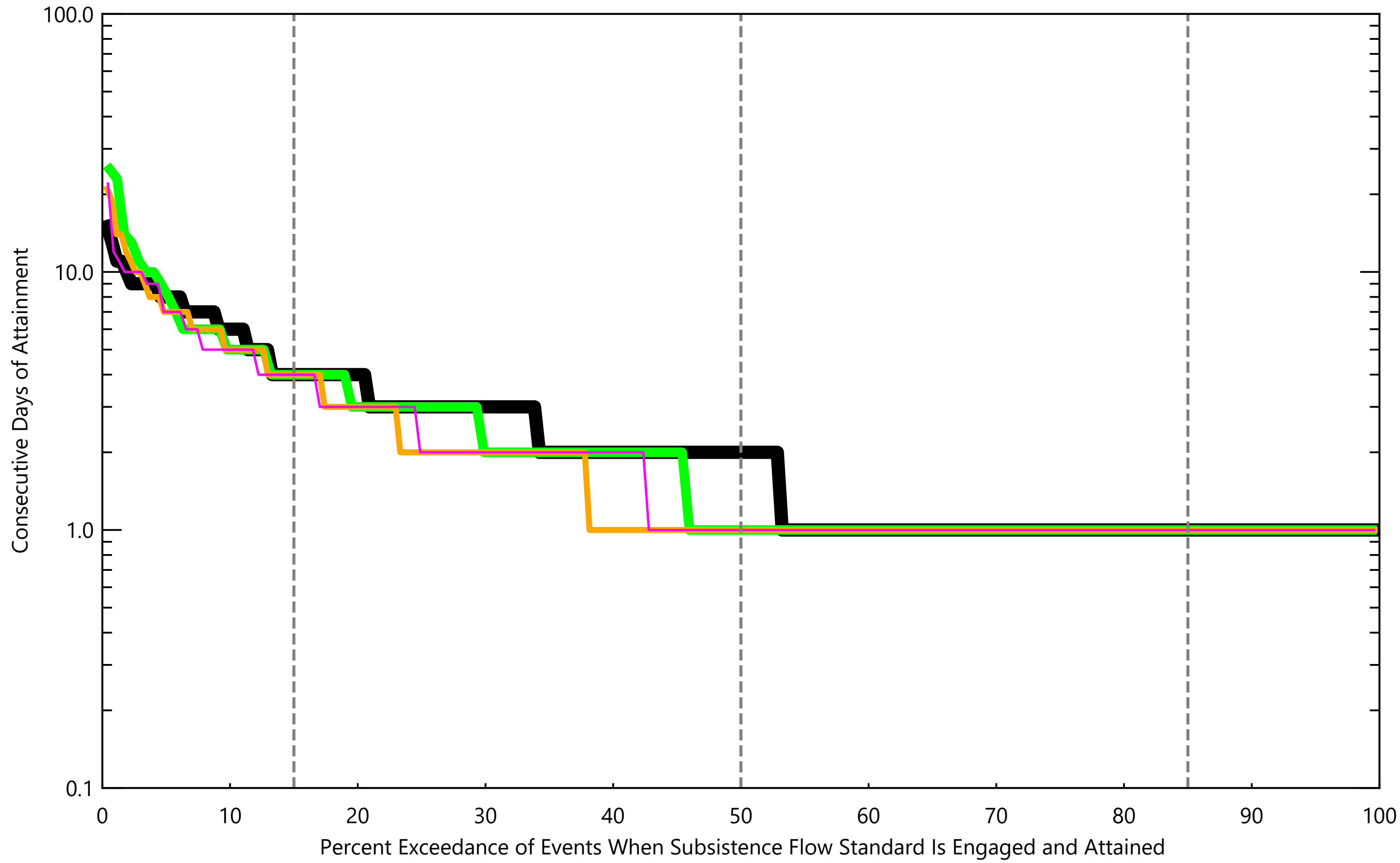
Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-57
Brazos River near Palo Pinto: Base Flow Shortage, Entire Period of Record (S-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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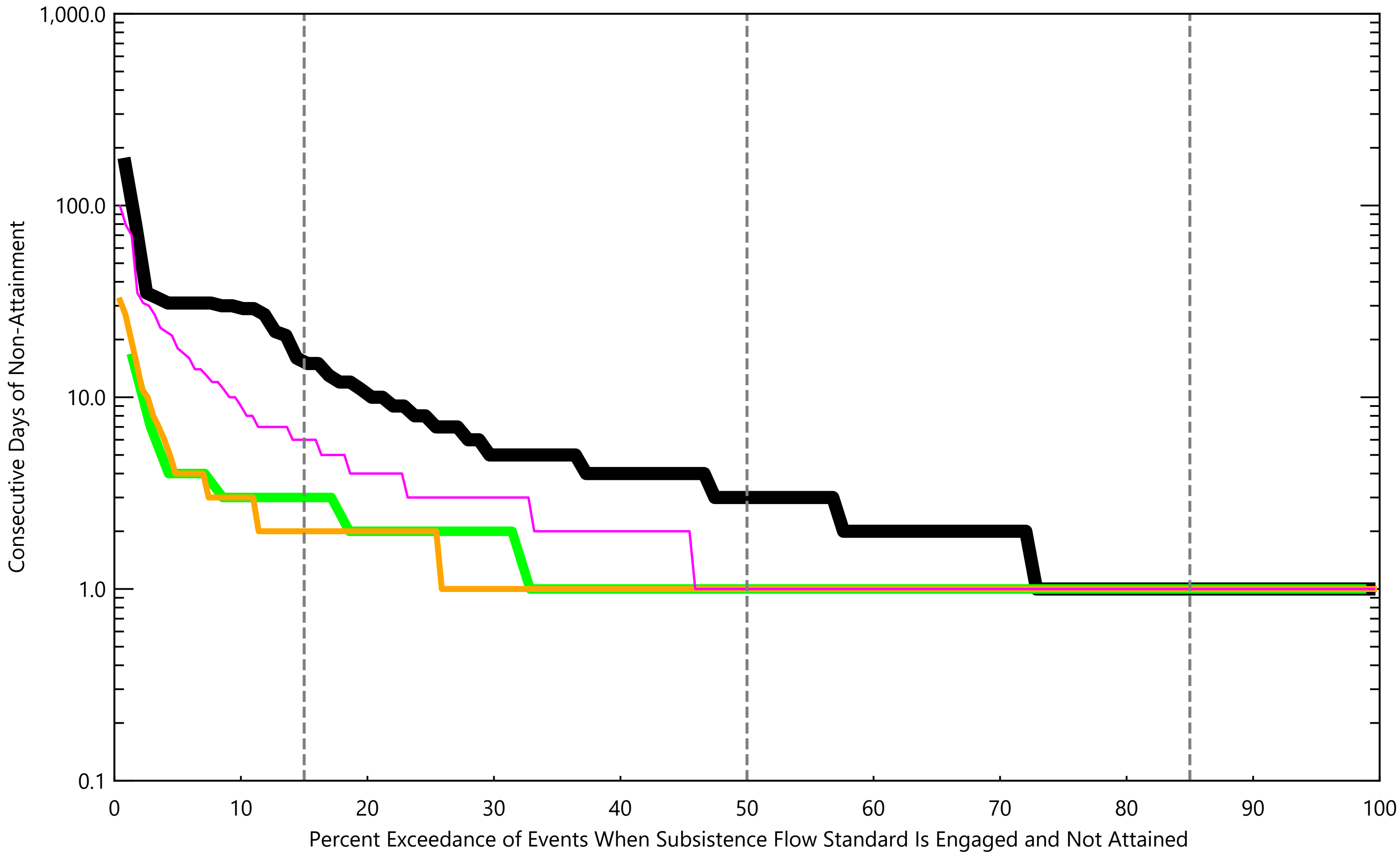
Figure E-59
Brazos River near Palo Pinto: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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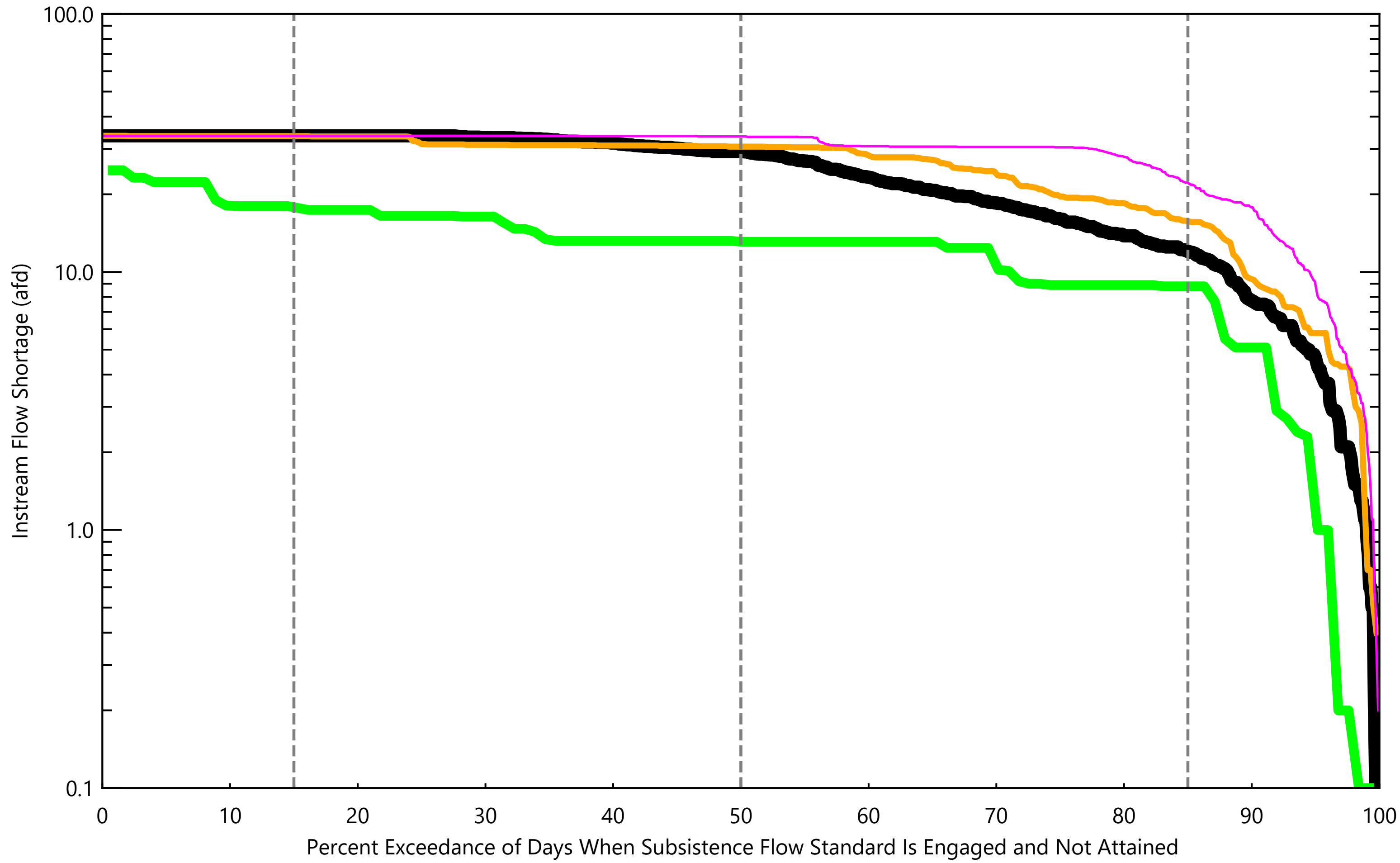
Figure E-60
Brazos River near Palo Pinto: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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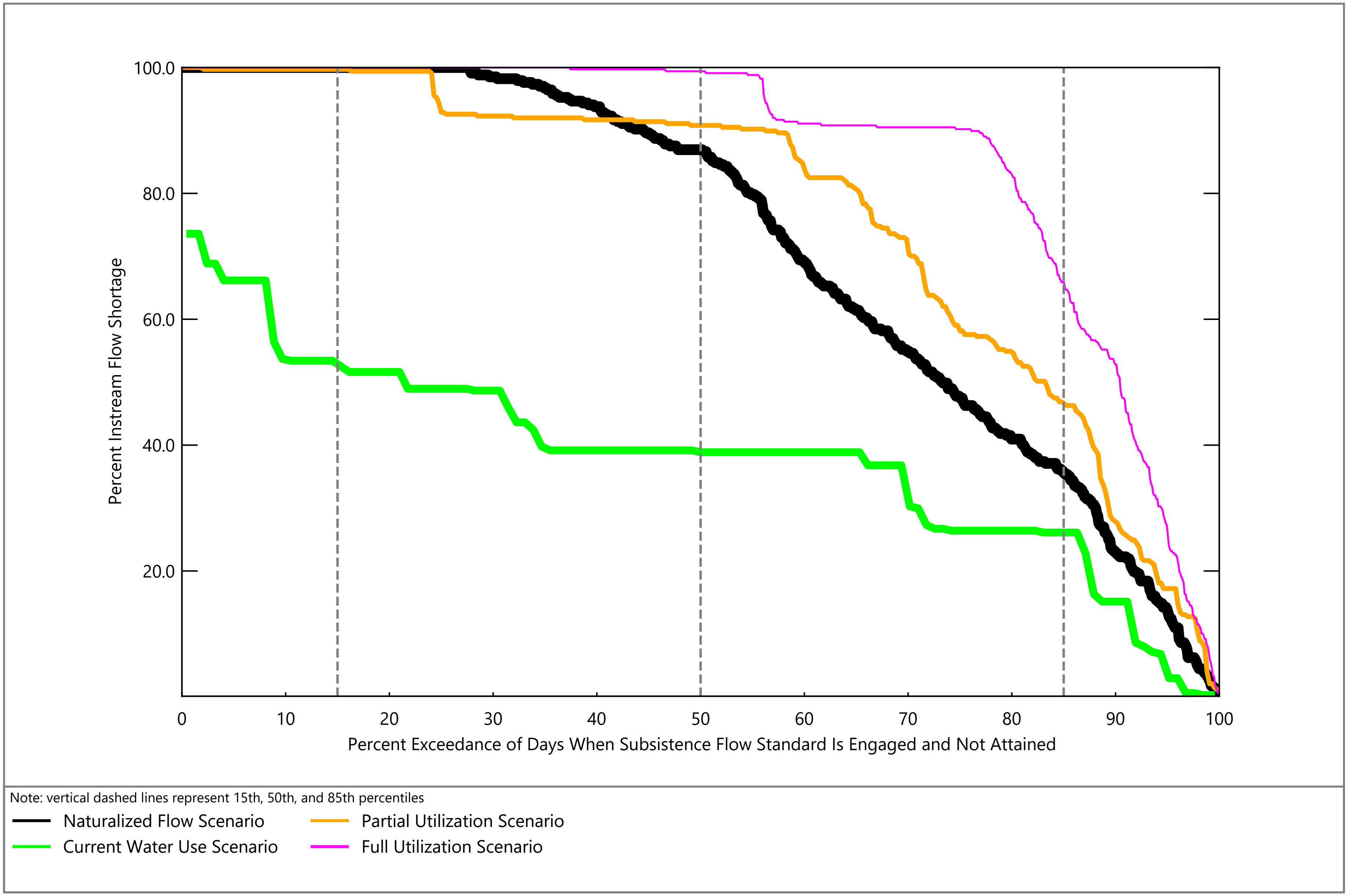
Figure E-61
Brazos River near Palo Pinto: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:10 PM | User: JH
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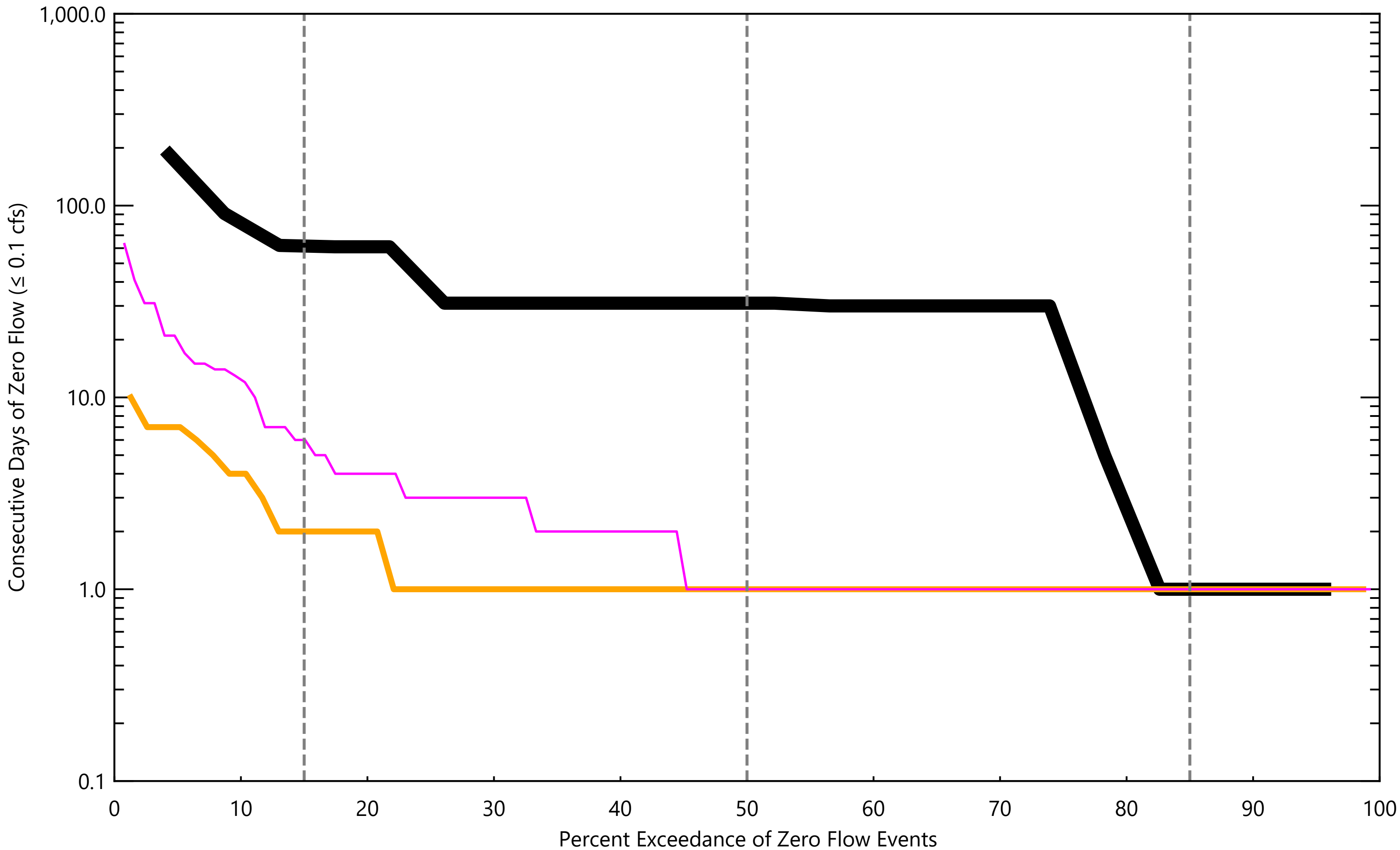
Figure E-62
Brazos River near Palo Pinto: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Full Utilization Scenario

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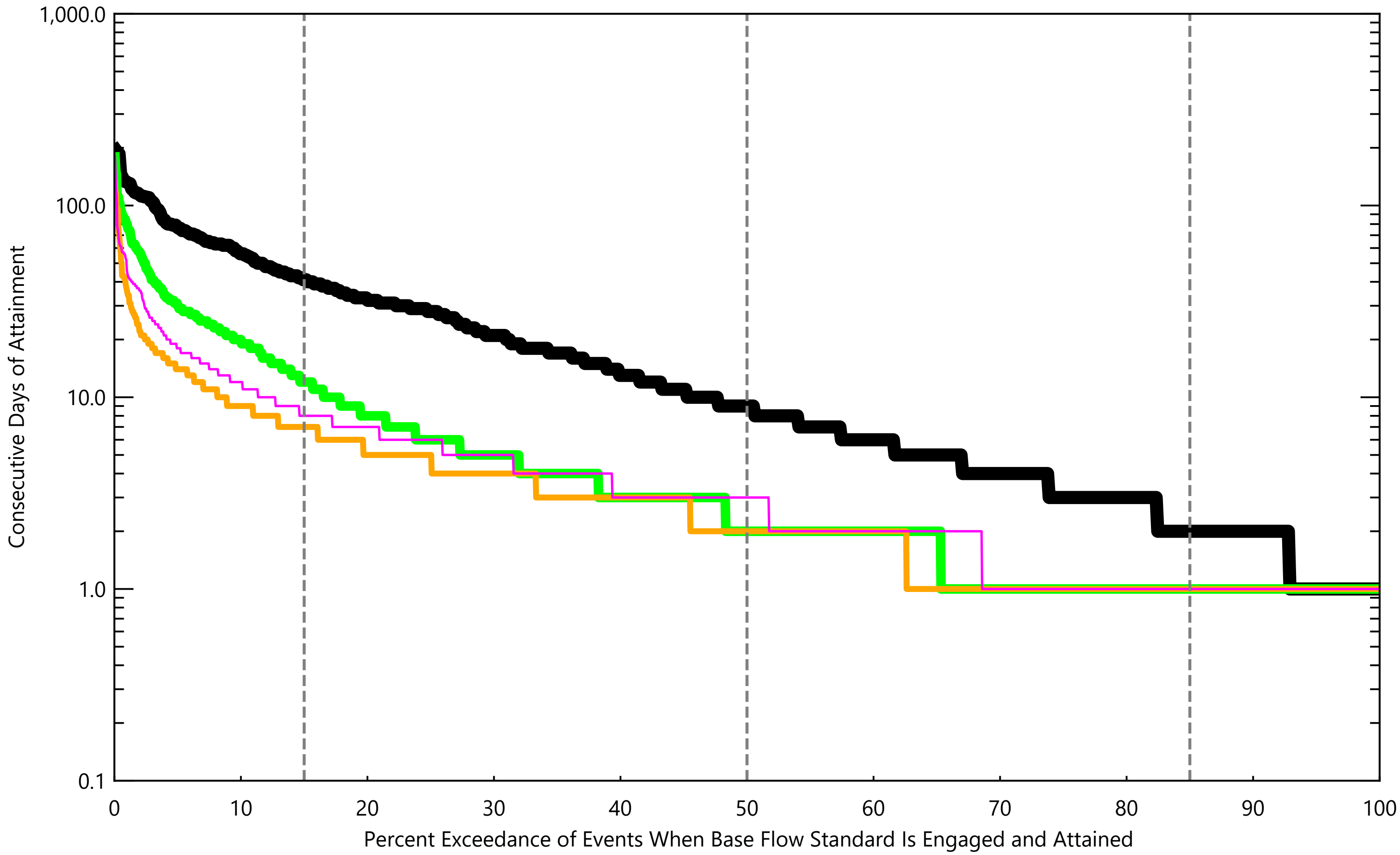
Figure E-63
Brazos River near Palo Pinto: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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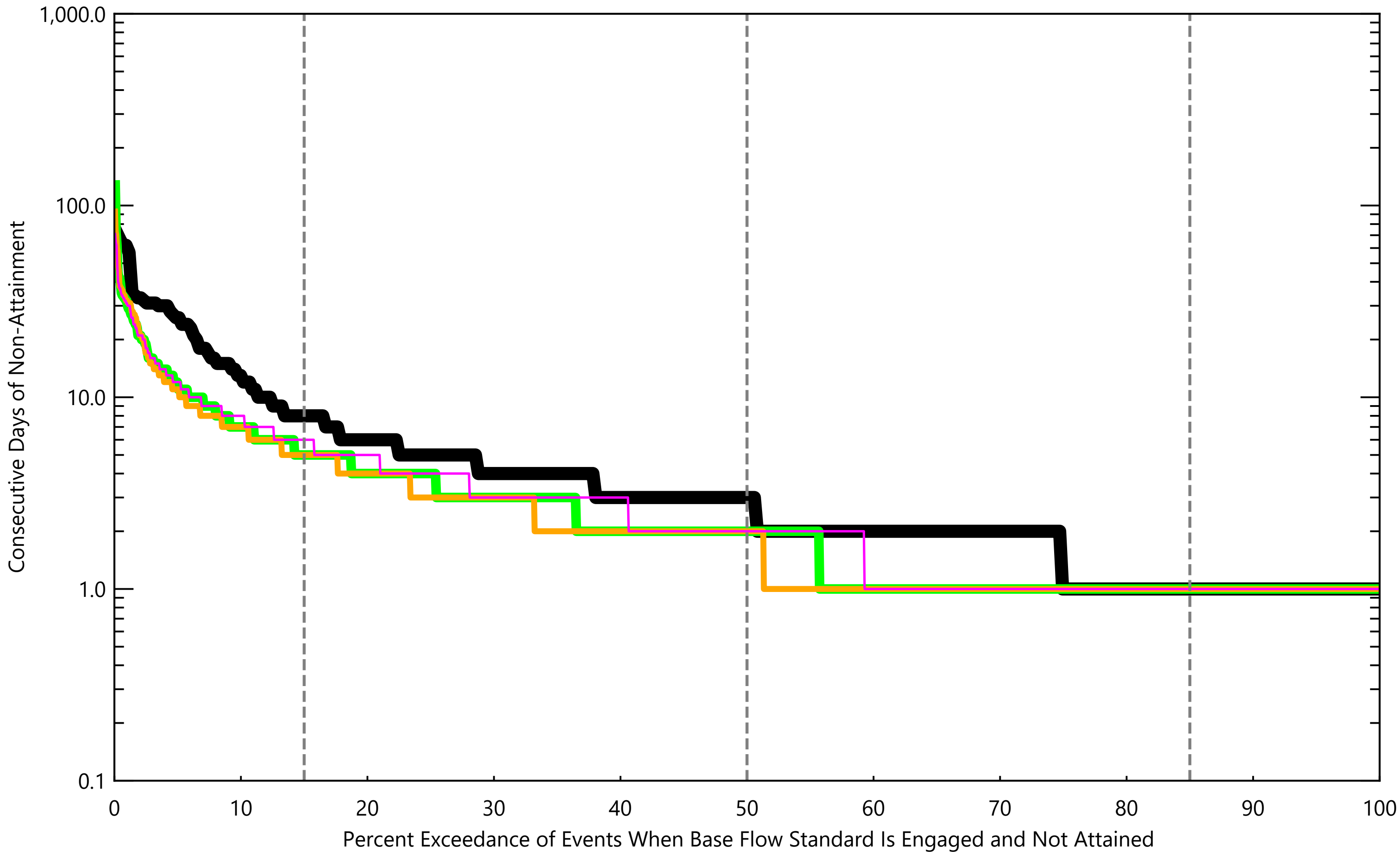
Figure E-64
Brazos River near Glen Rose: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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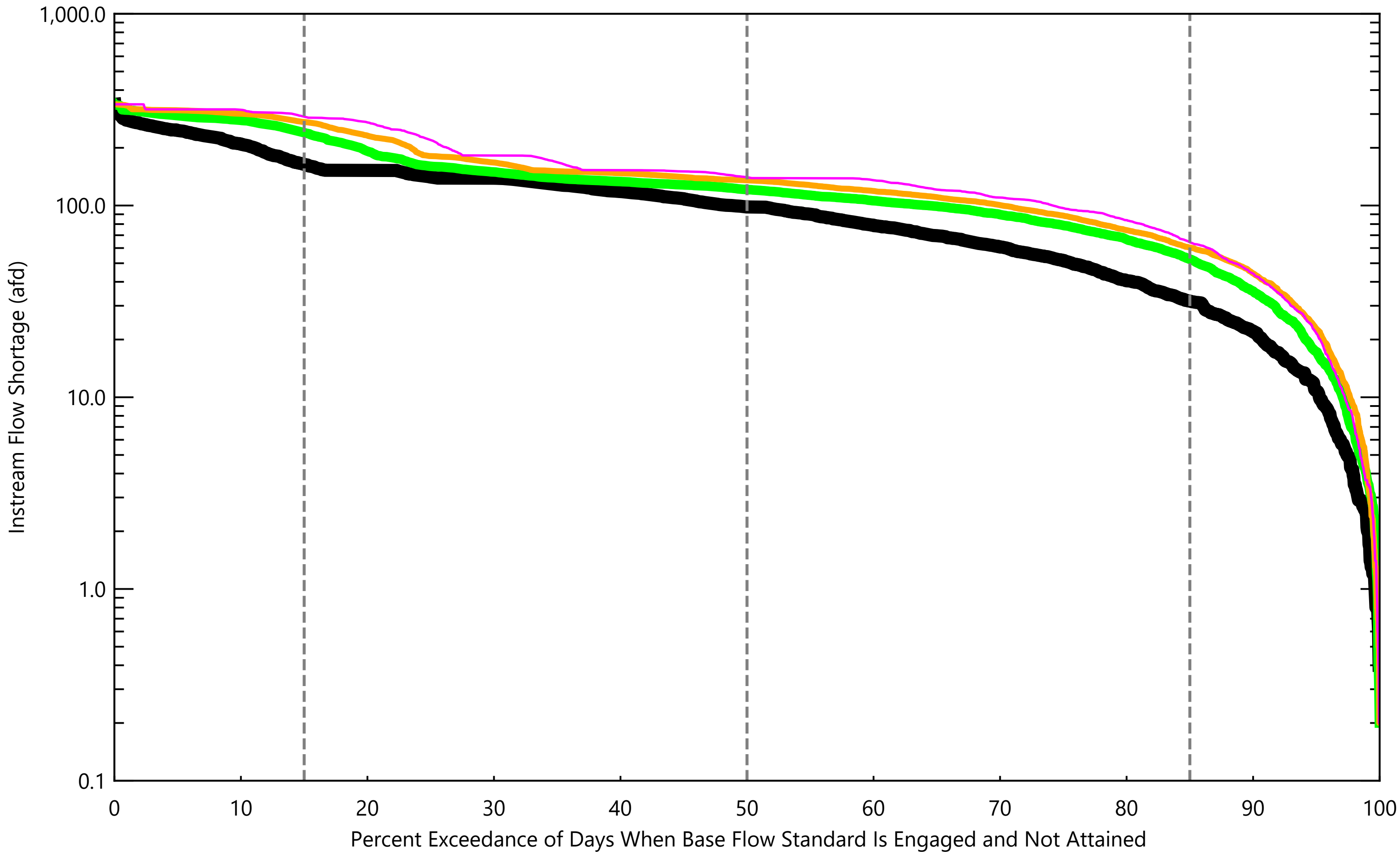
Figure E-65
Brazos River near Glen Rose: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-66

Brazos River near Glen Rose: Base Flow Shortage, Entire Period of Record (S-POR)

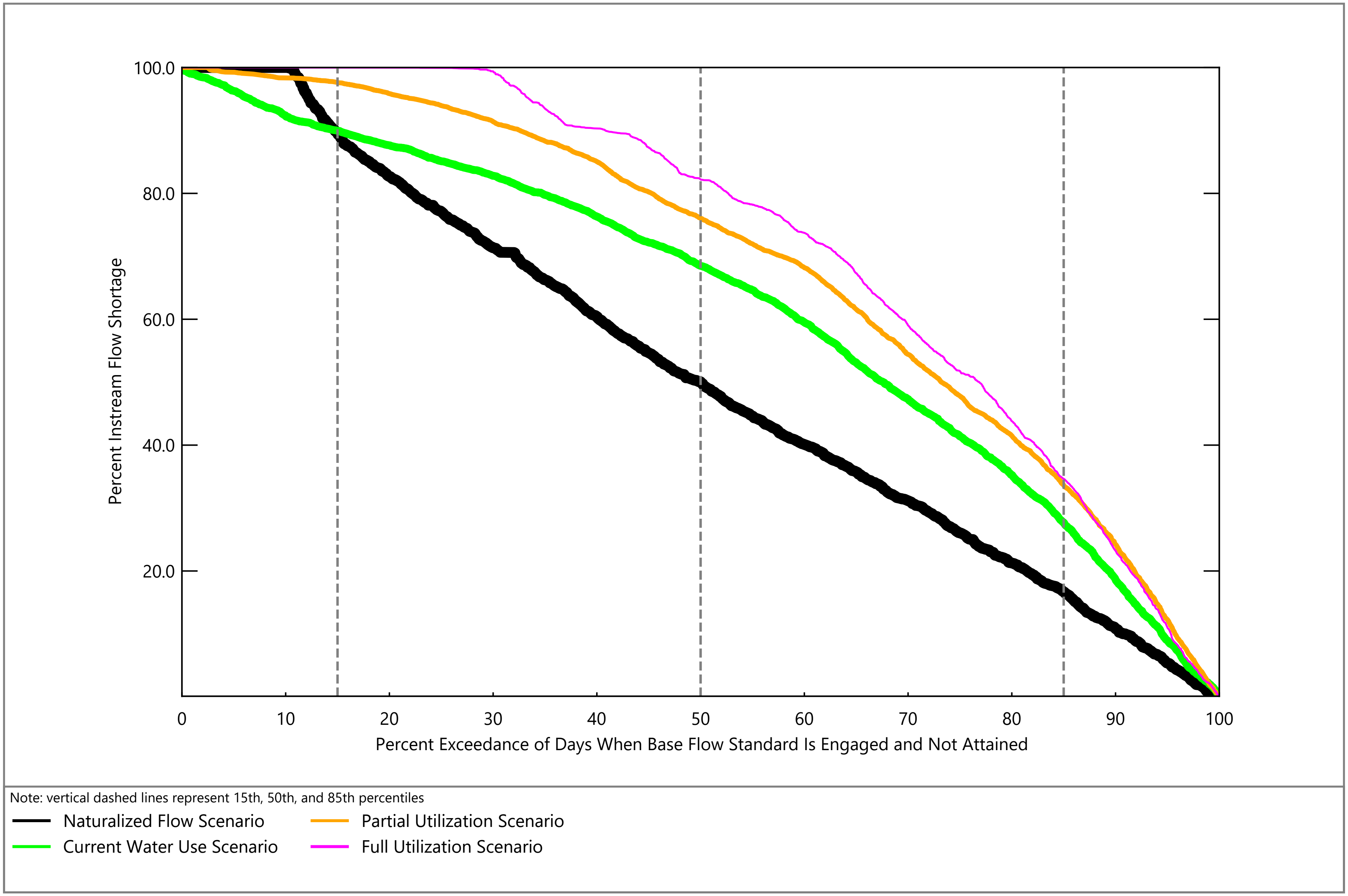

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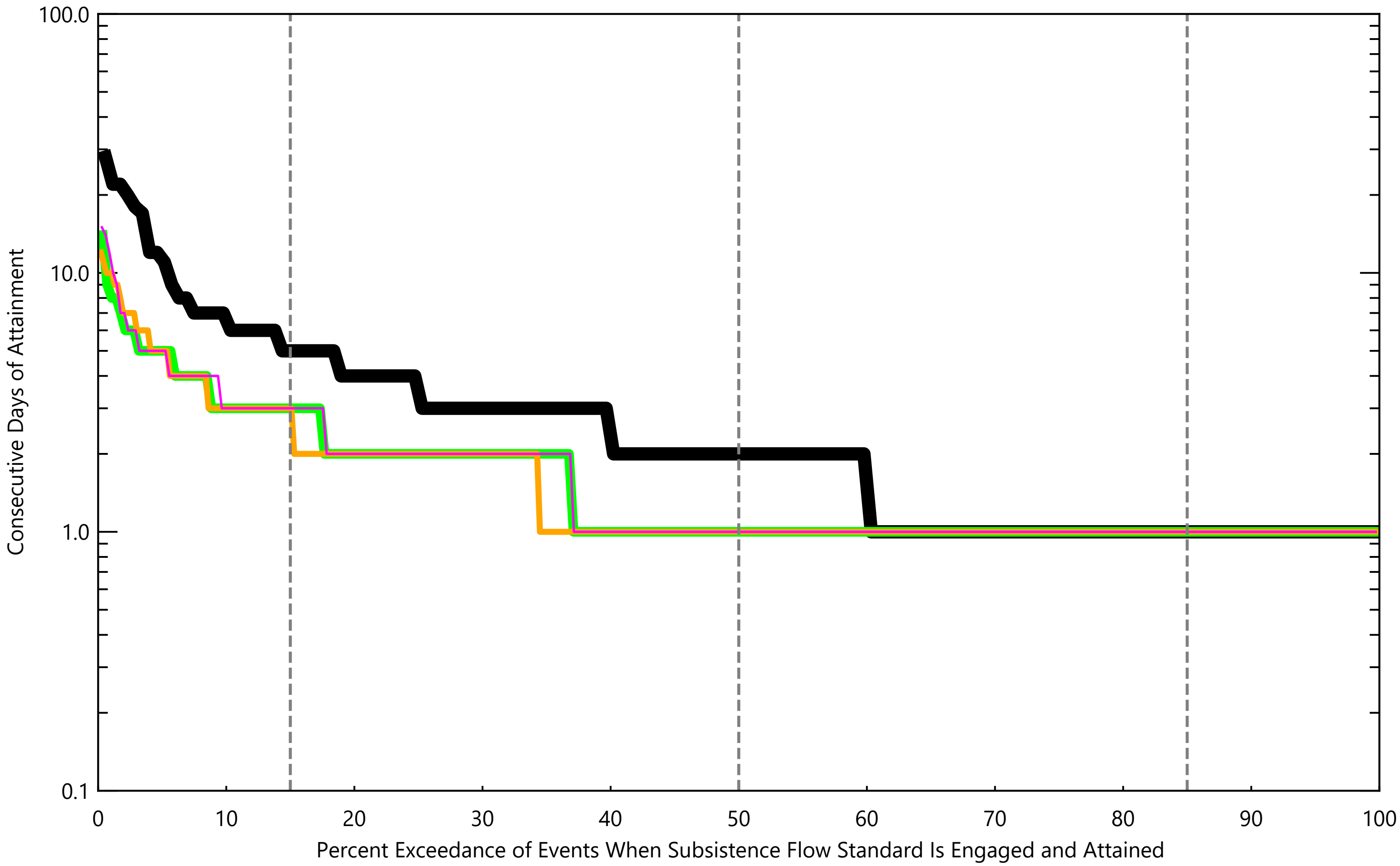
Figure E-67

Brazos River near Glen Rose: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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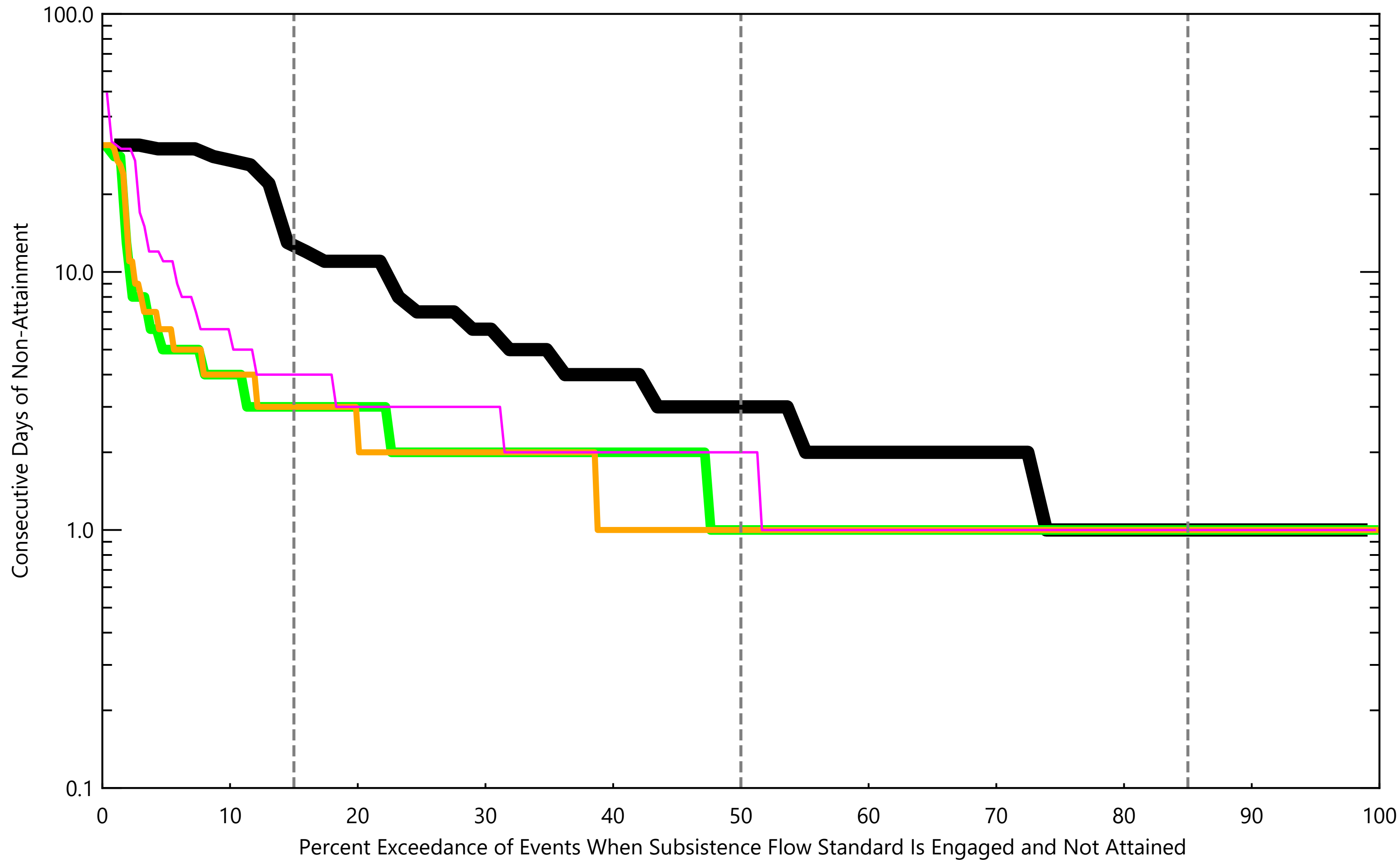
Figure E-68
Brazos River near Glen Rose: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario

Current Water Use Scenario

Partial Utilization Scenario

Full Utilization Scenario

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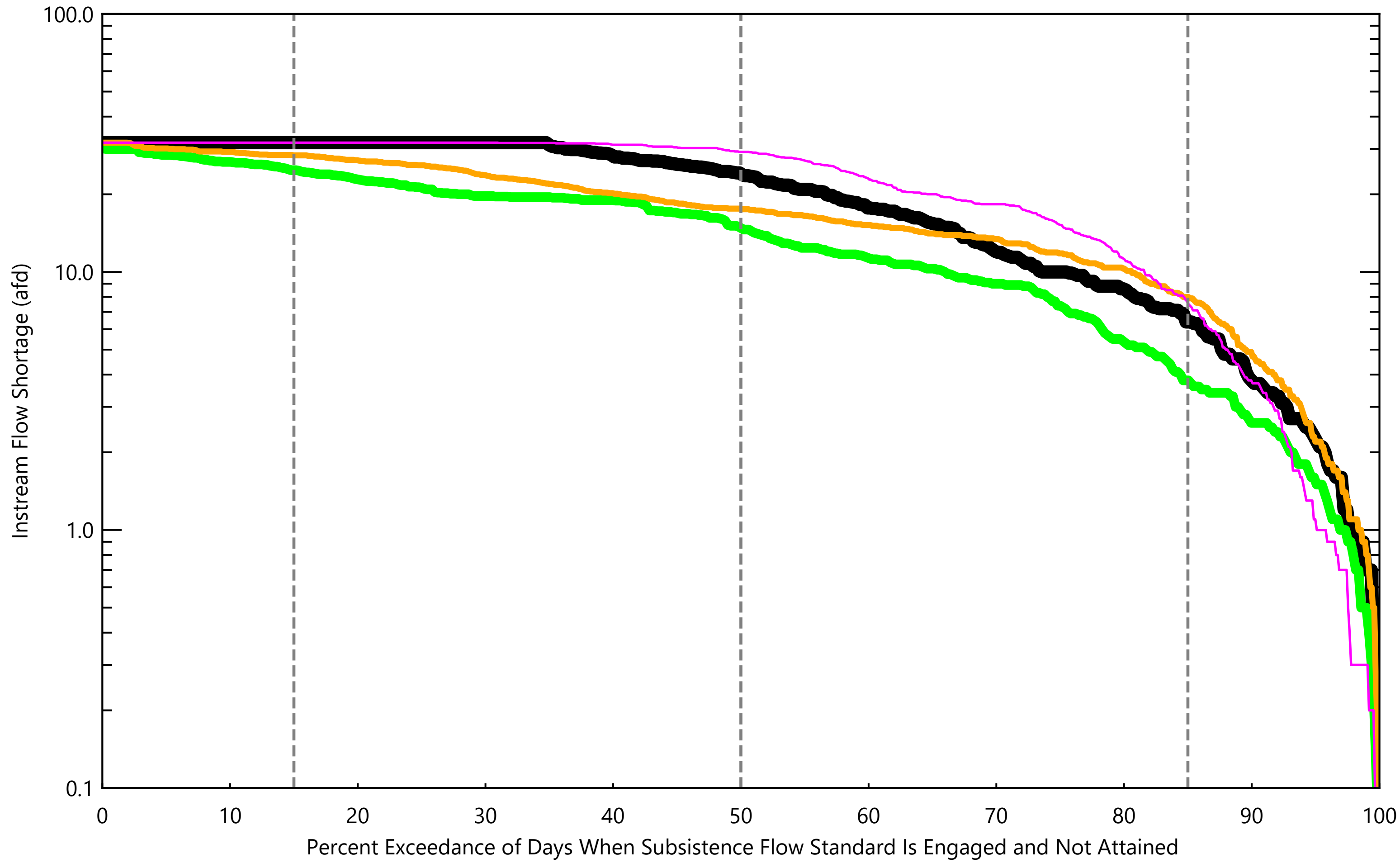
Figure E-69

Brazos River near Glen Rose: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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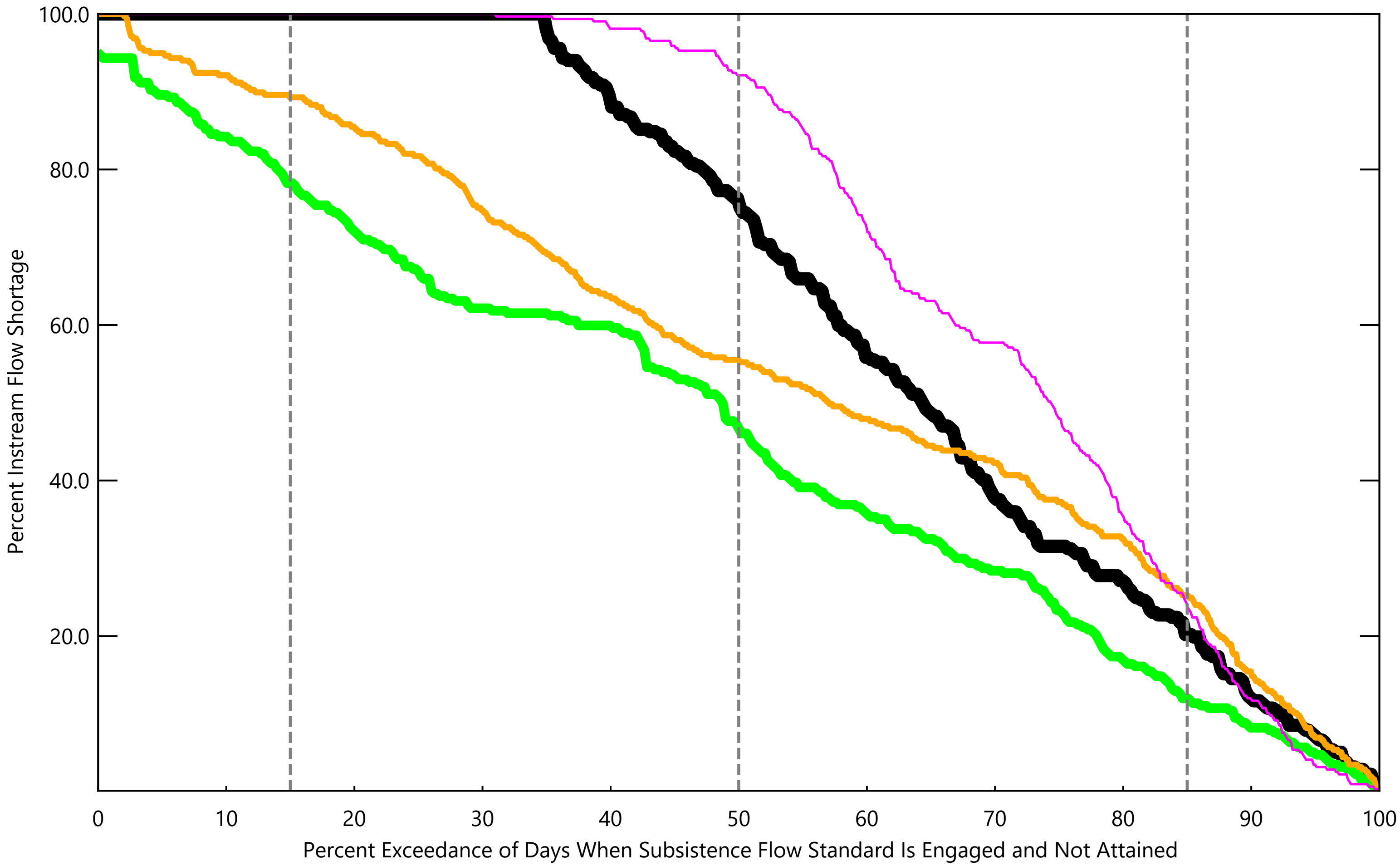
Figure E-70
Brazos River near Glen Rose: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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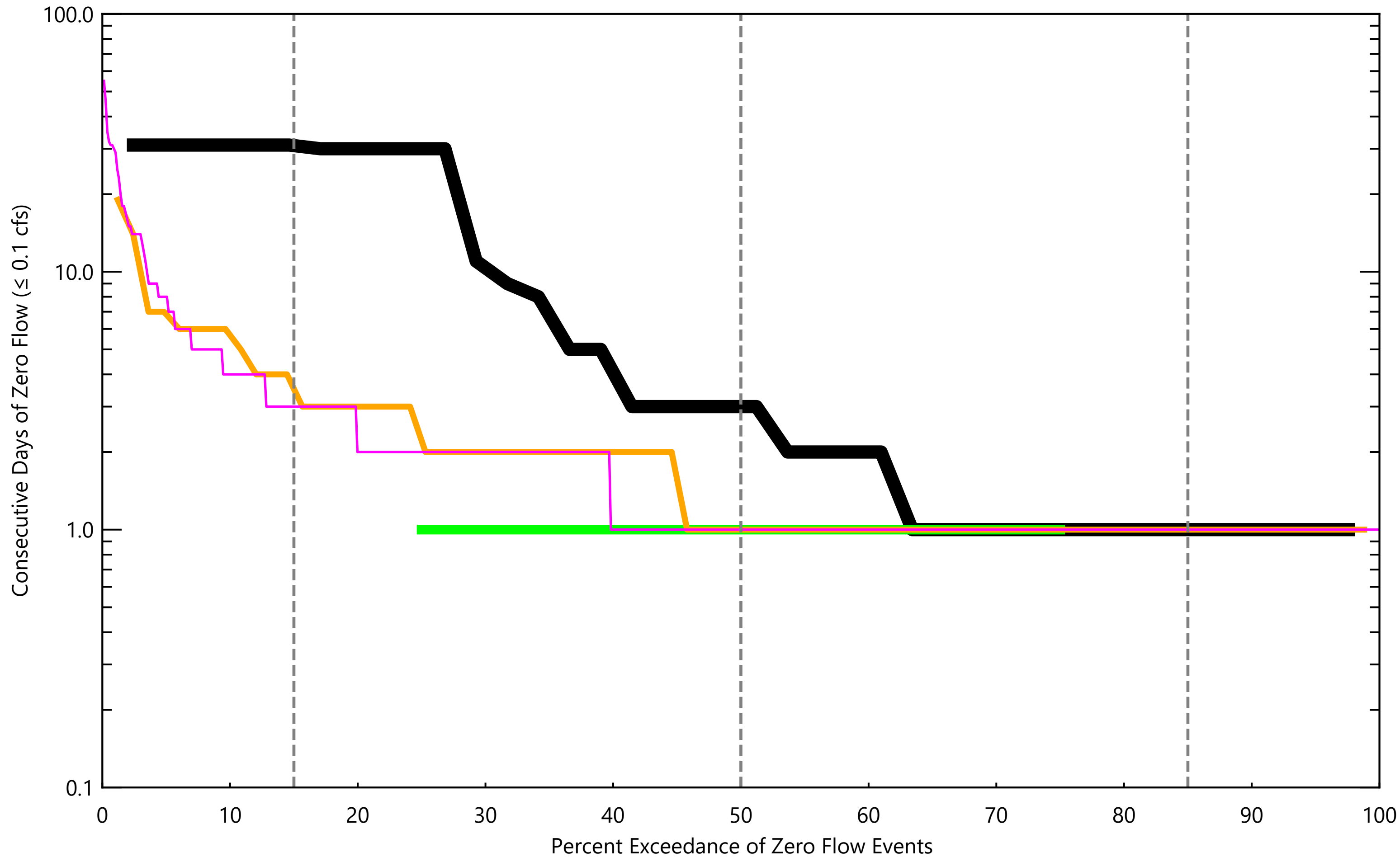
Figure E-71

Brazos River near Glen Rose: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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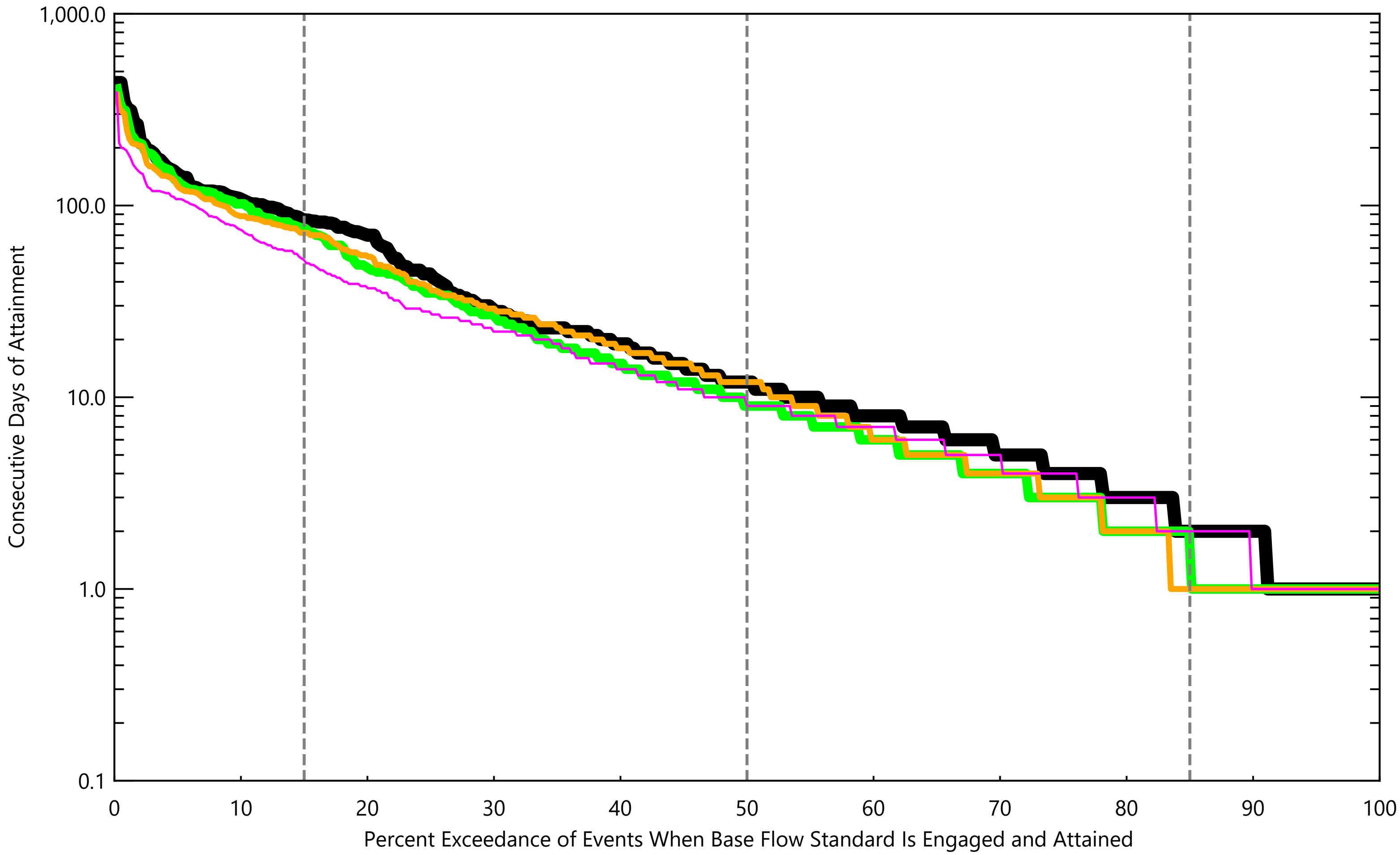
Figure E-72

Brazos River near Glen Rose: Zero-Flow Duration, Entire Period of Record (ZFD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

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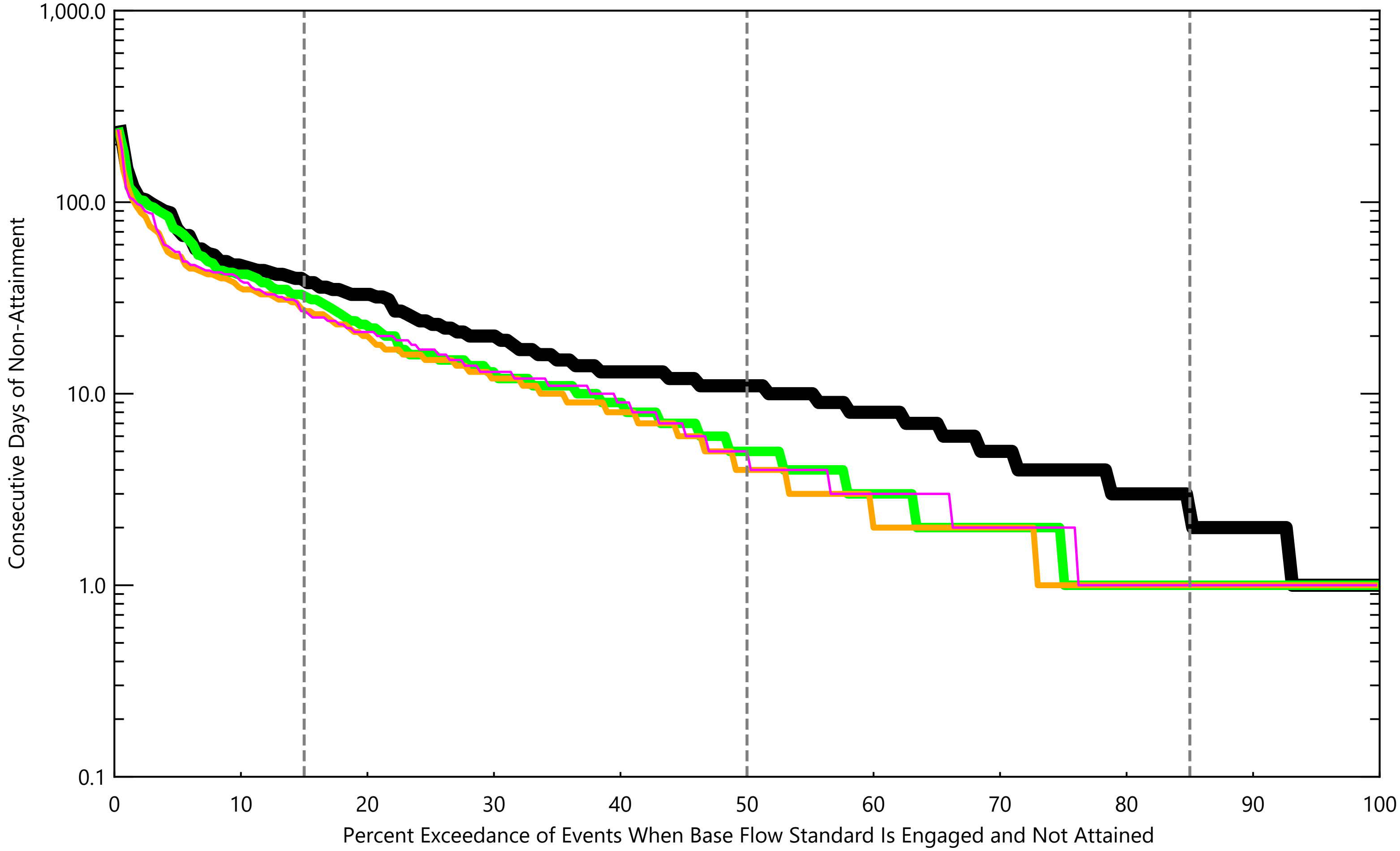
Figure E-73
North Bosque near Clifton: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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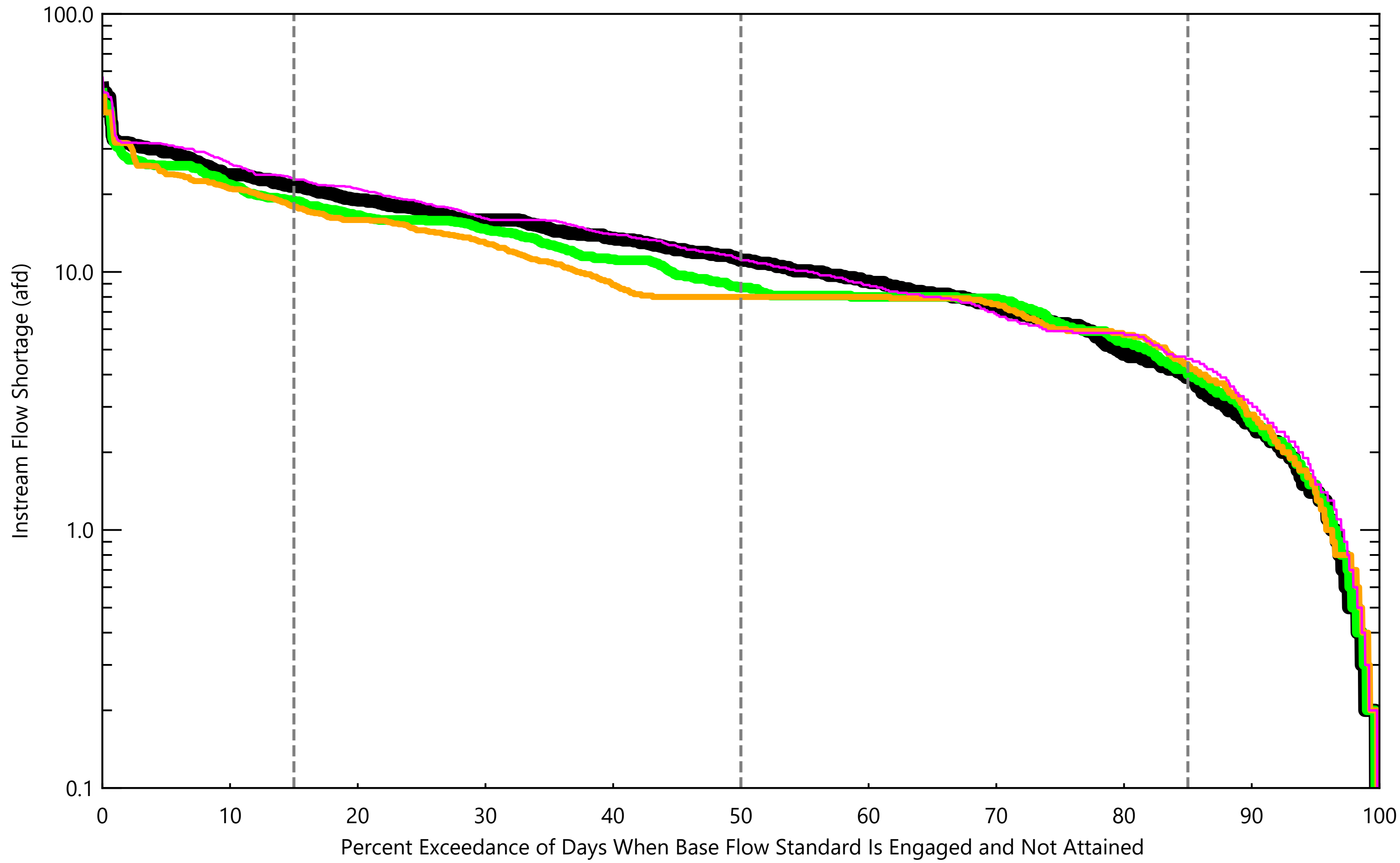
Figure E-74

North Bosque near Clifton: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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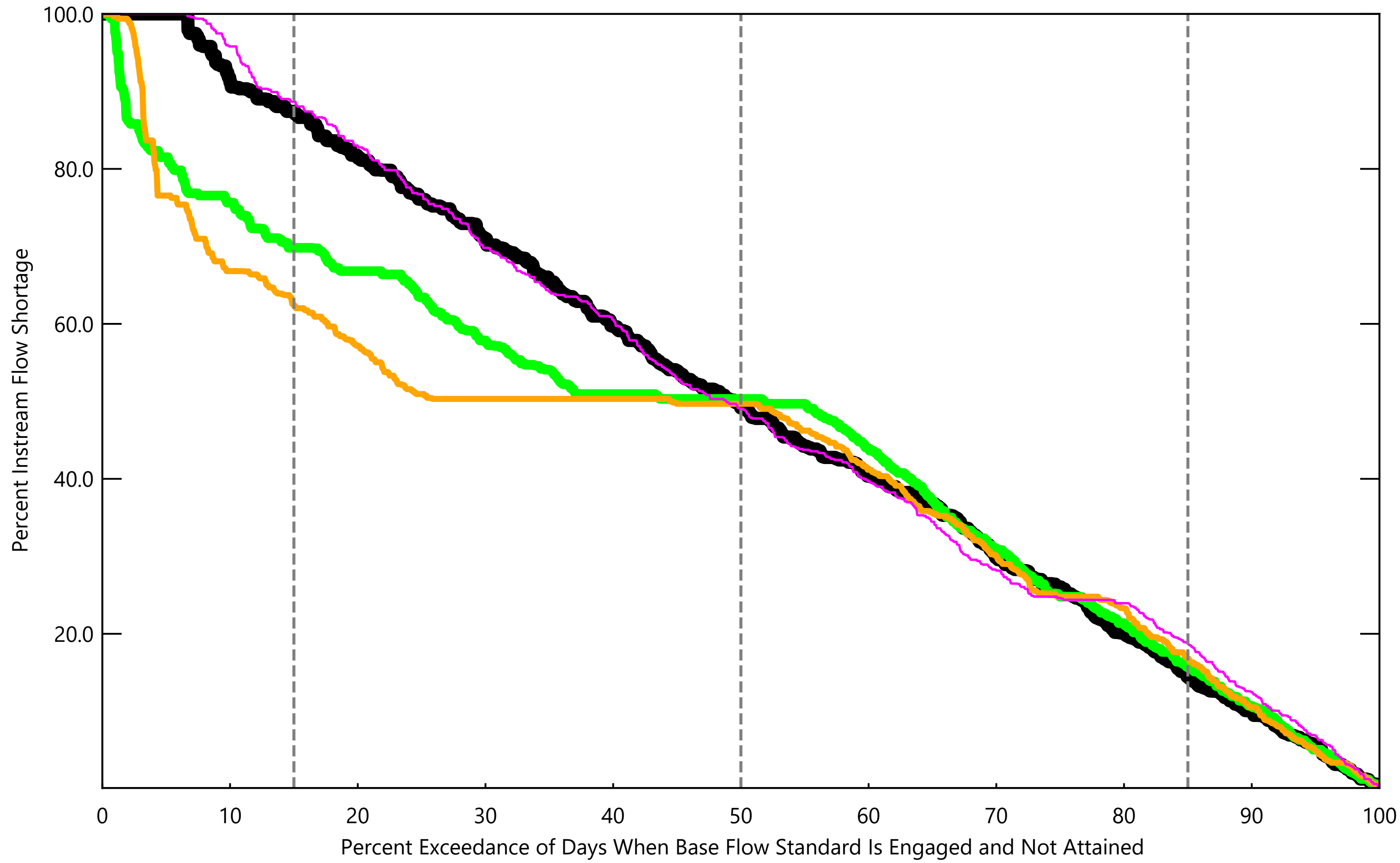
Figure E-75
North Bosque near Clifton: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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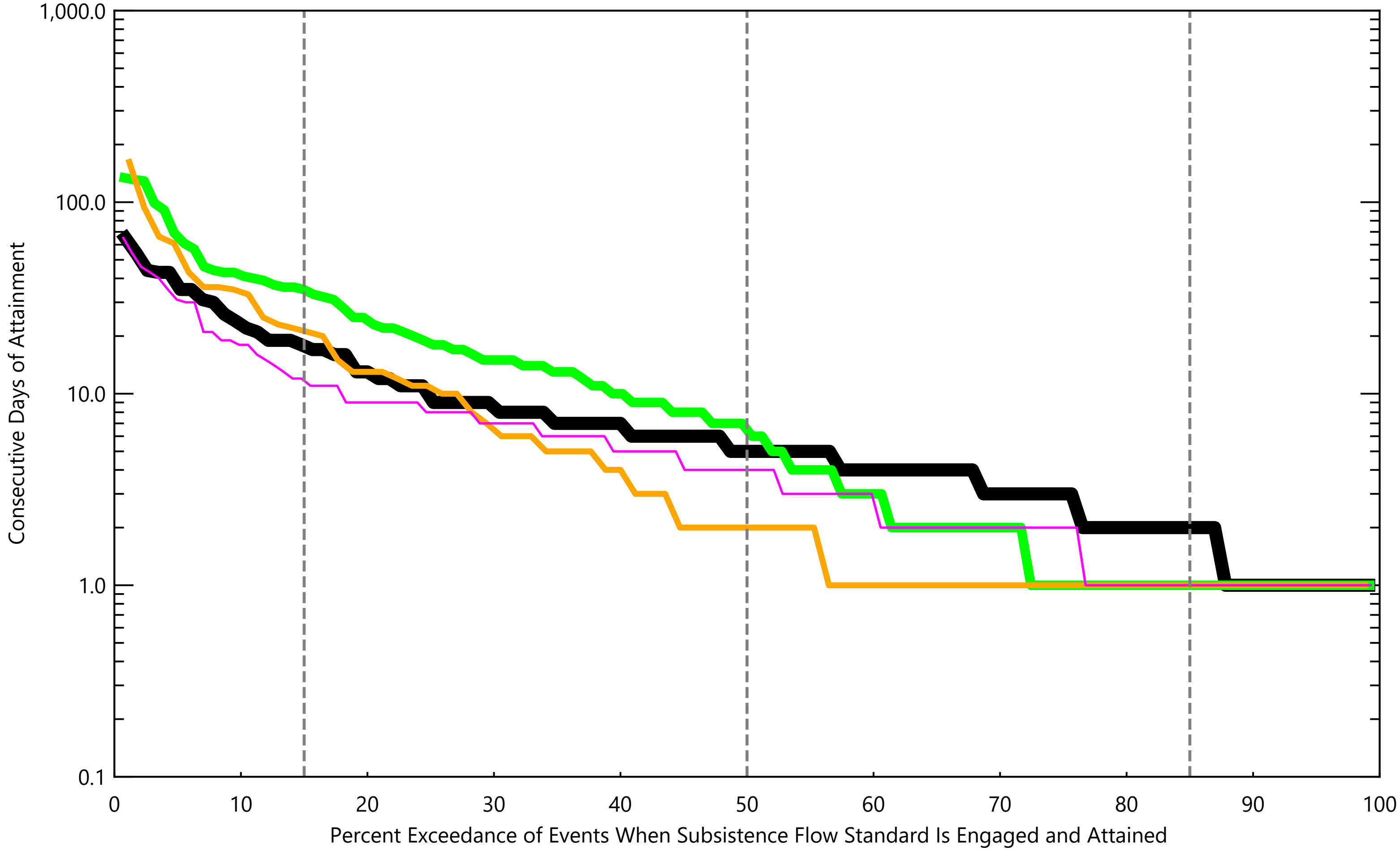
Figure E-76
North Bosque near Clifton: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

Figure E-77
North Bosque near Clifton: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

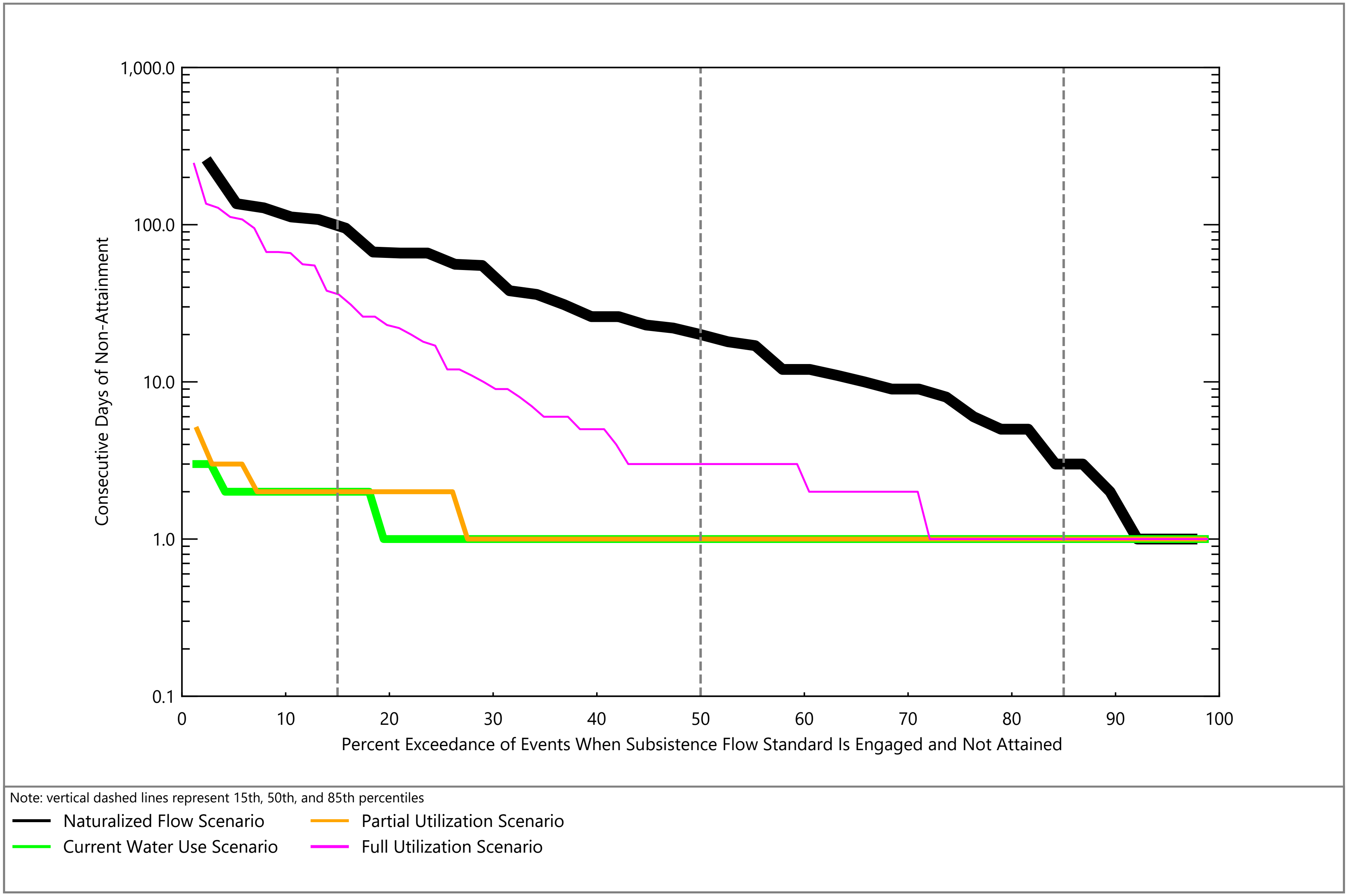


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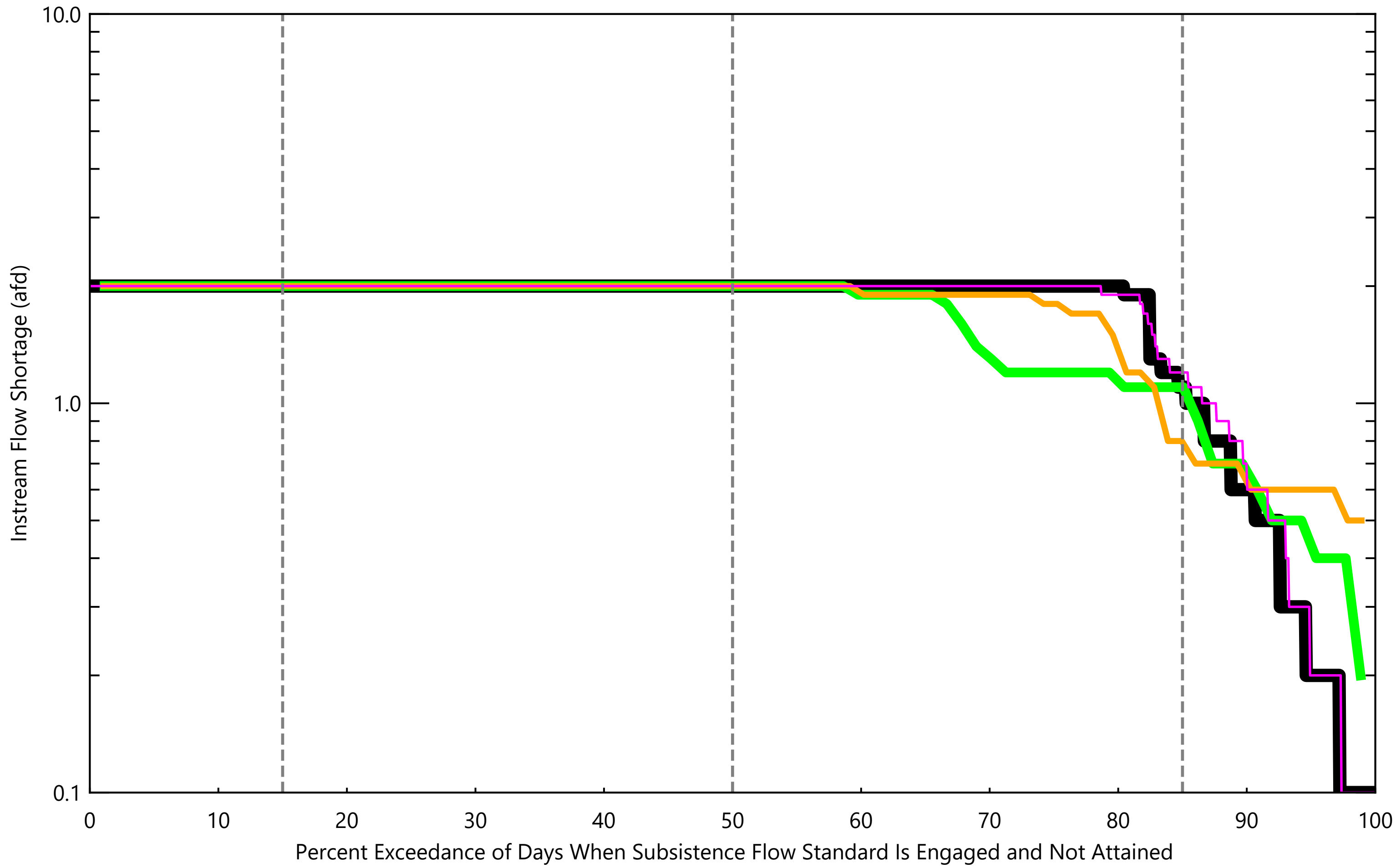
Figure E-78
North Bosque near Clifton: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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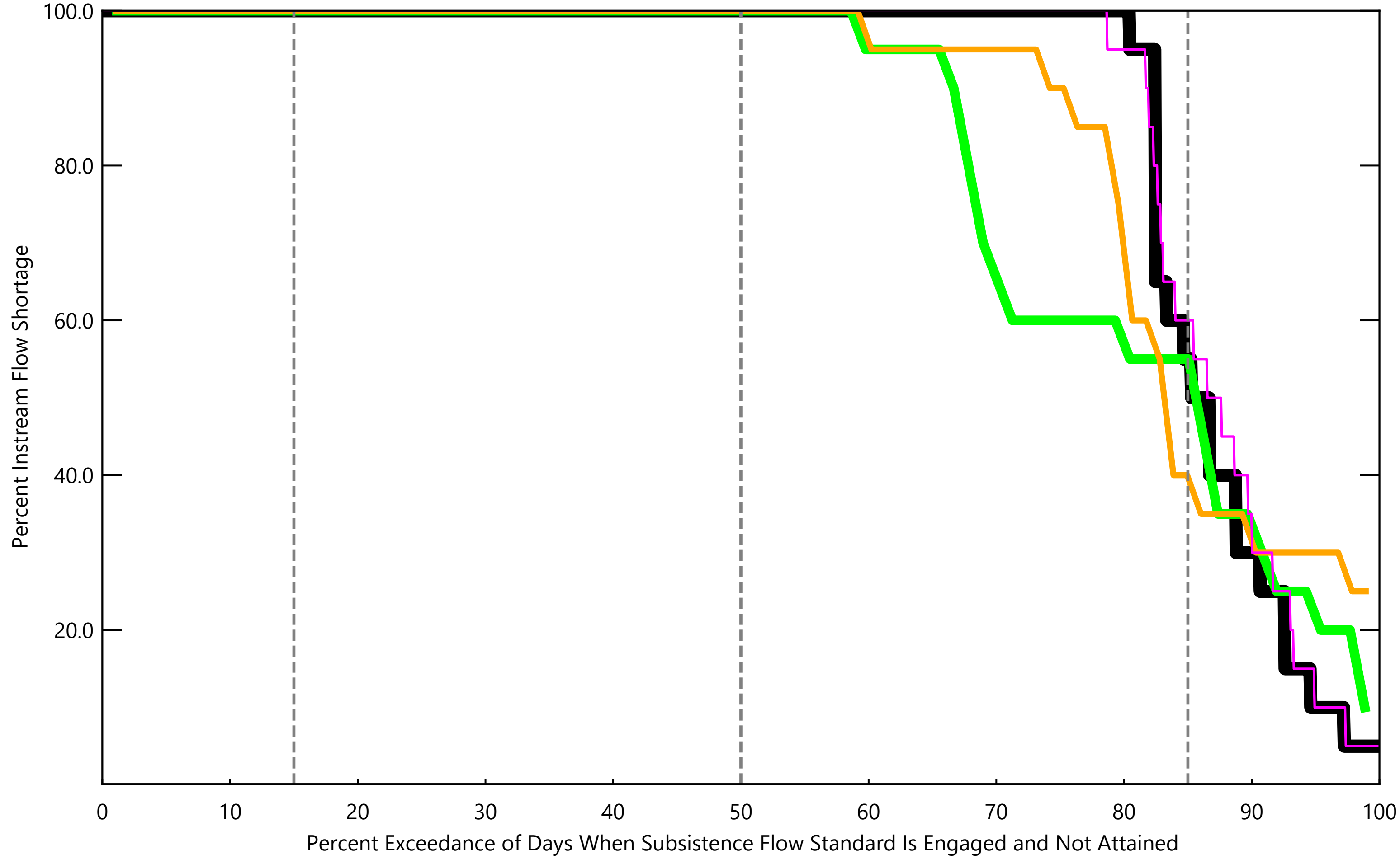
Figure E-79

North Bosque near Clifton: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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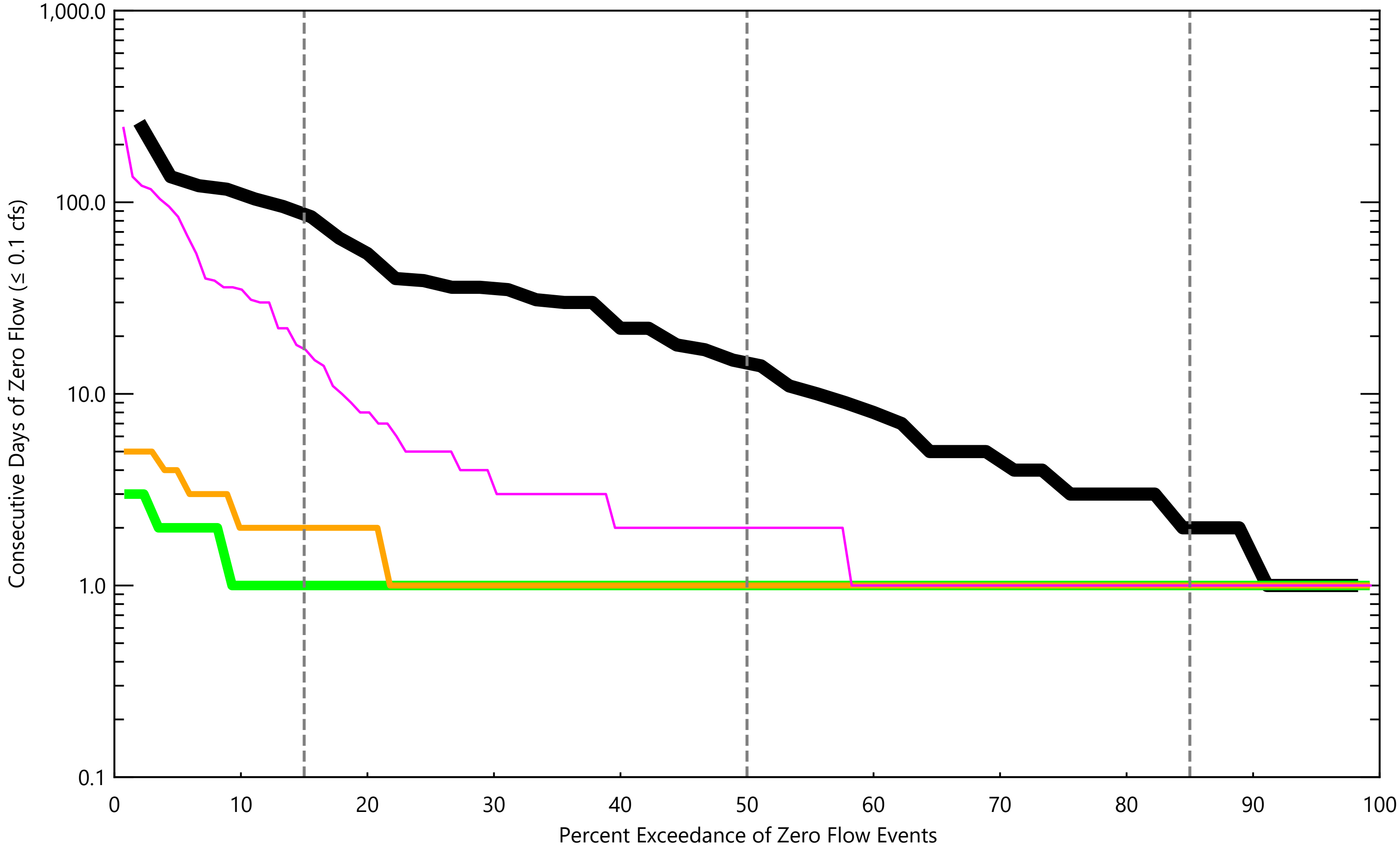
Figure E-80

North Bosque near Clifton: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

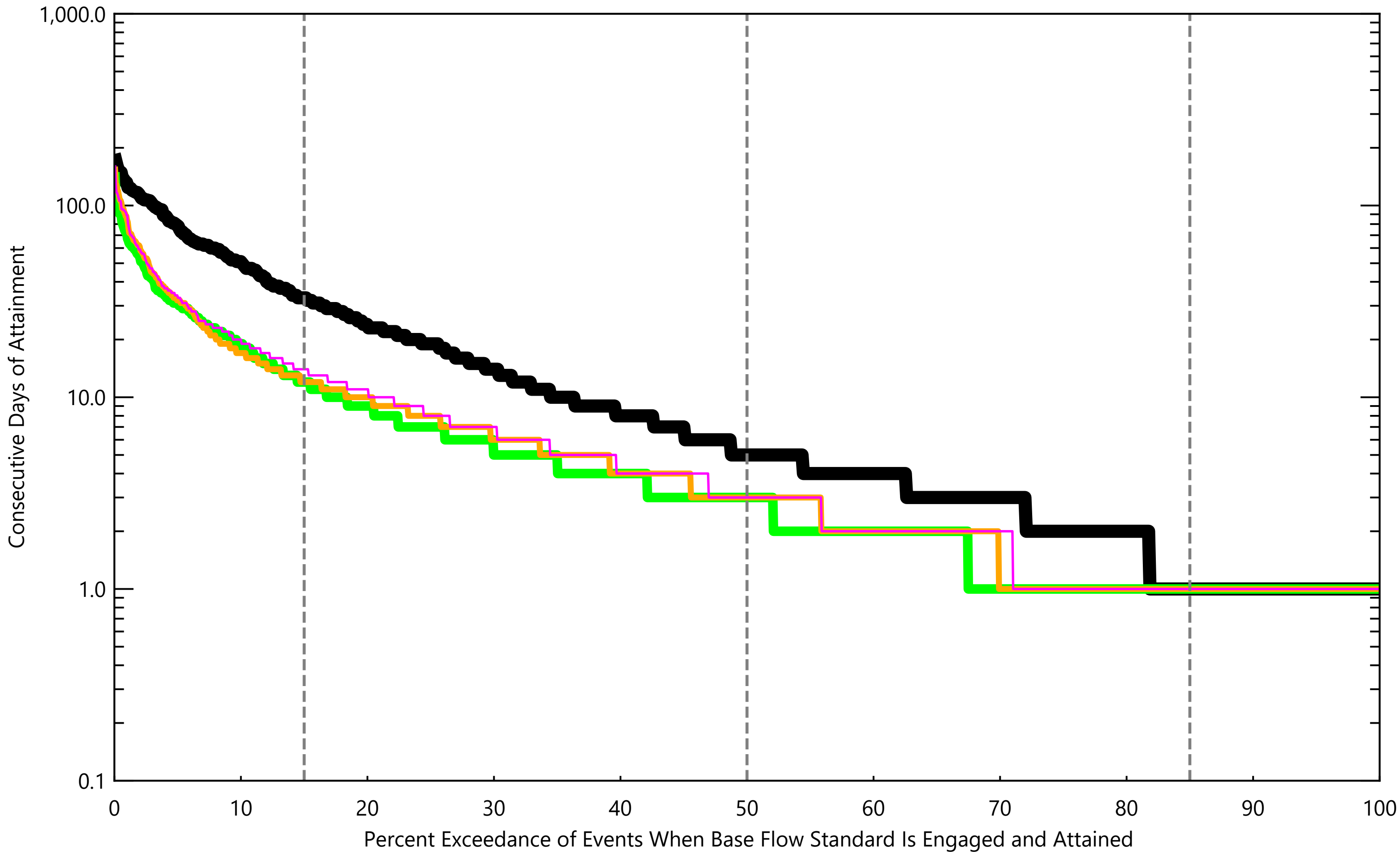
Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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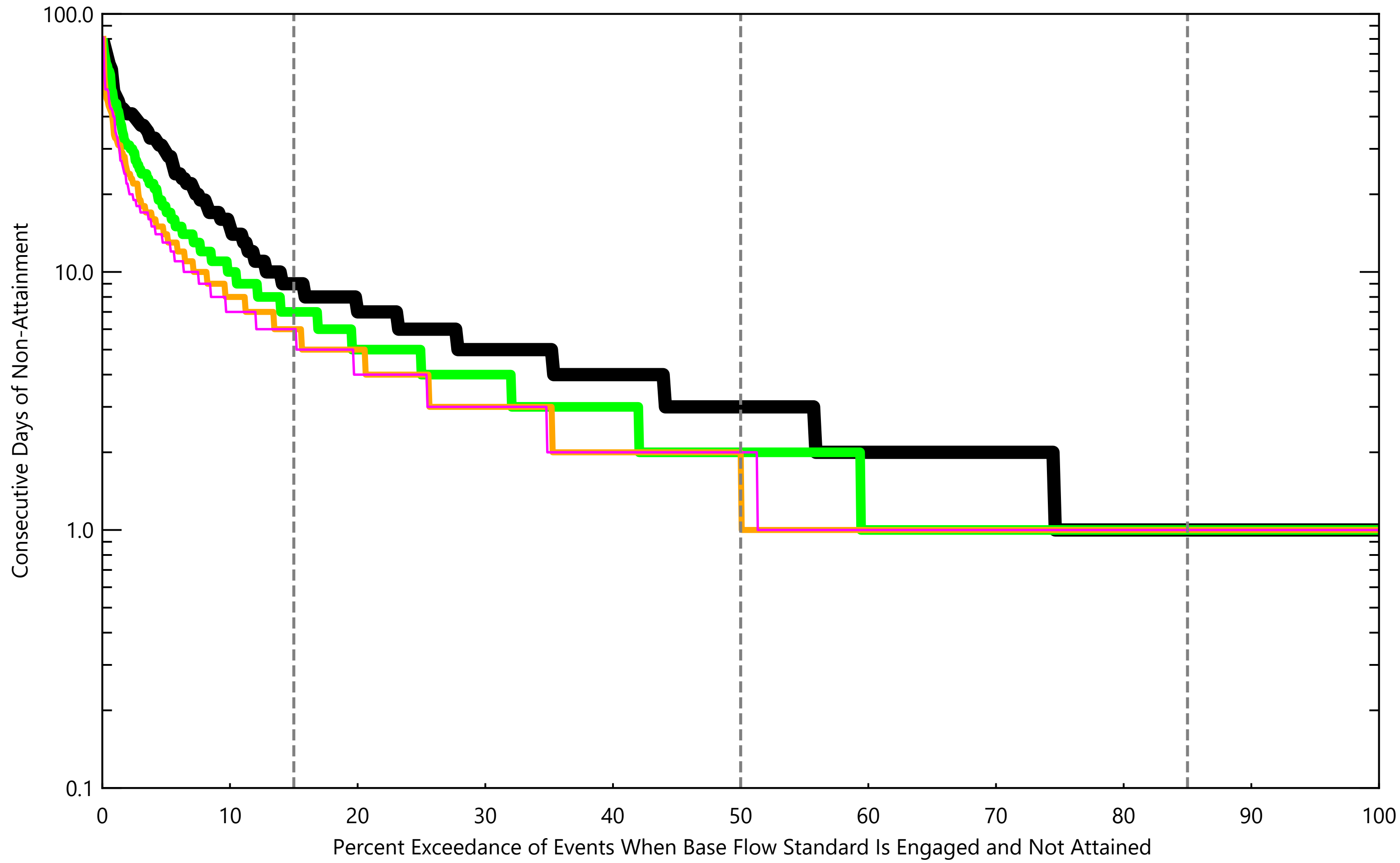
Figure E-82
Brazos River near Waco: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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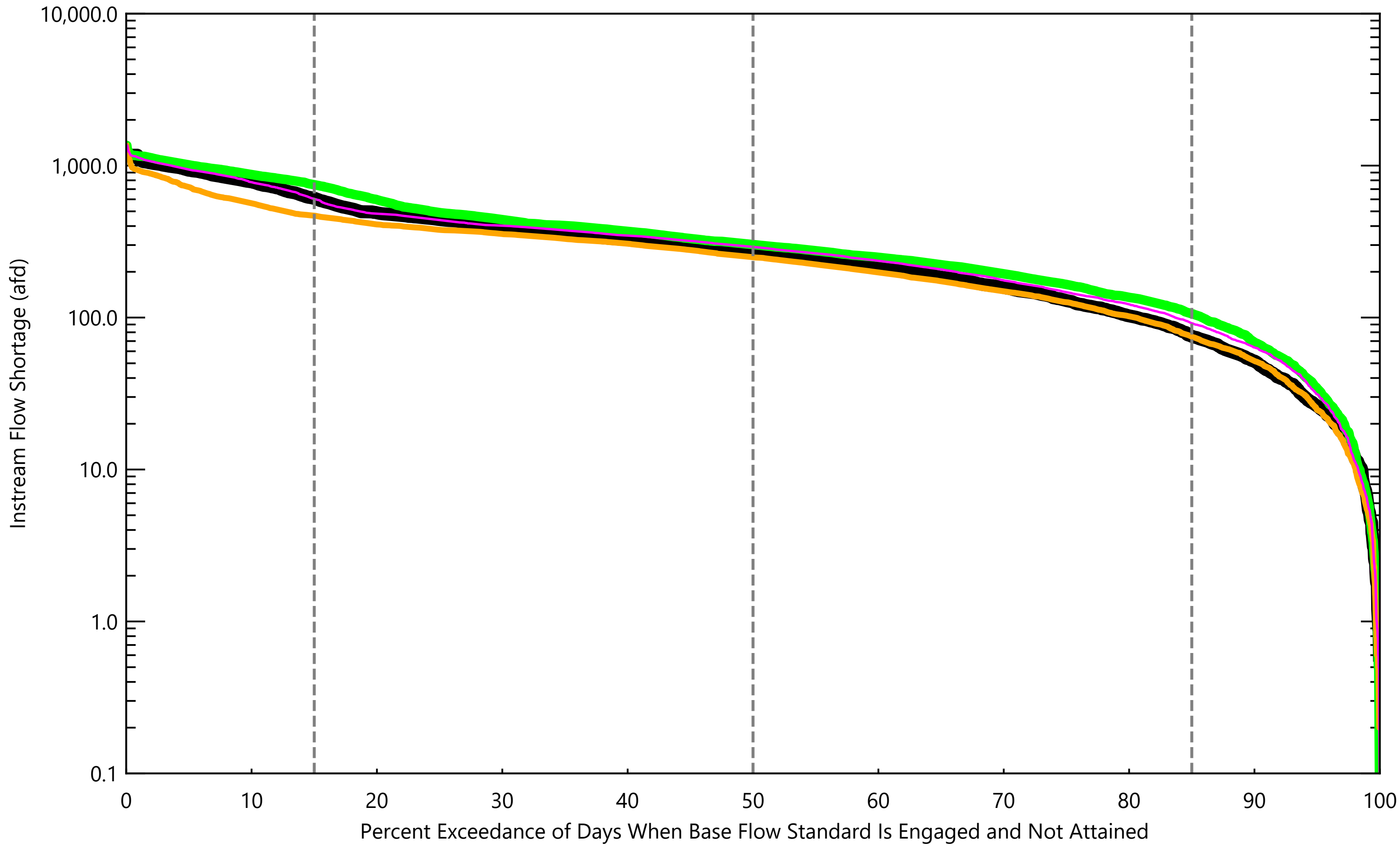
Figure E-83

Brazos River near Waco: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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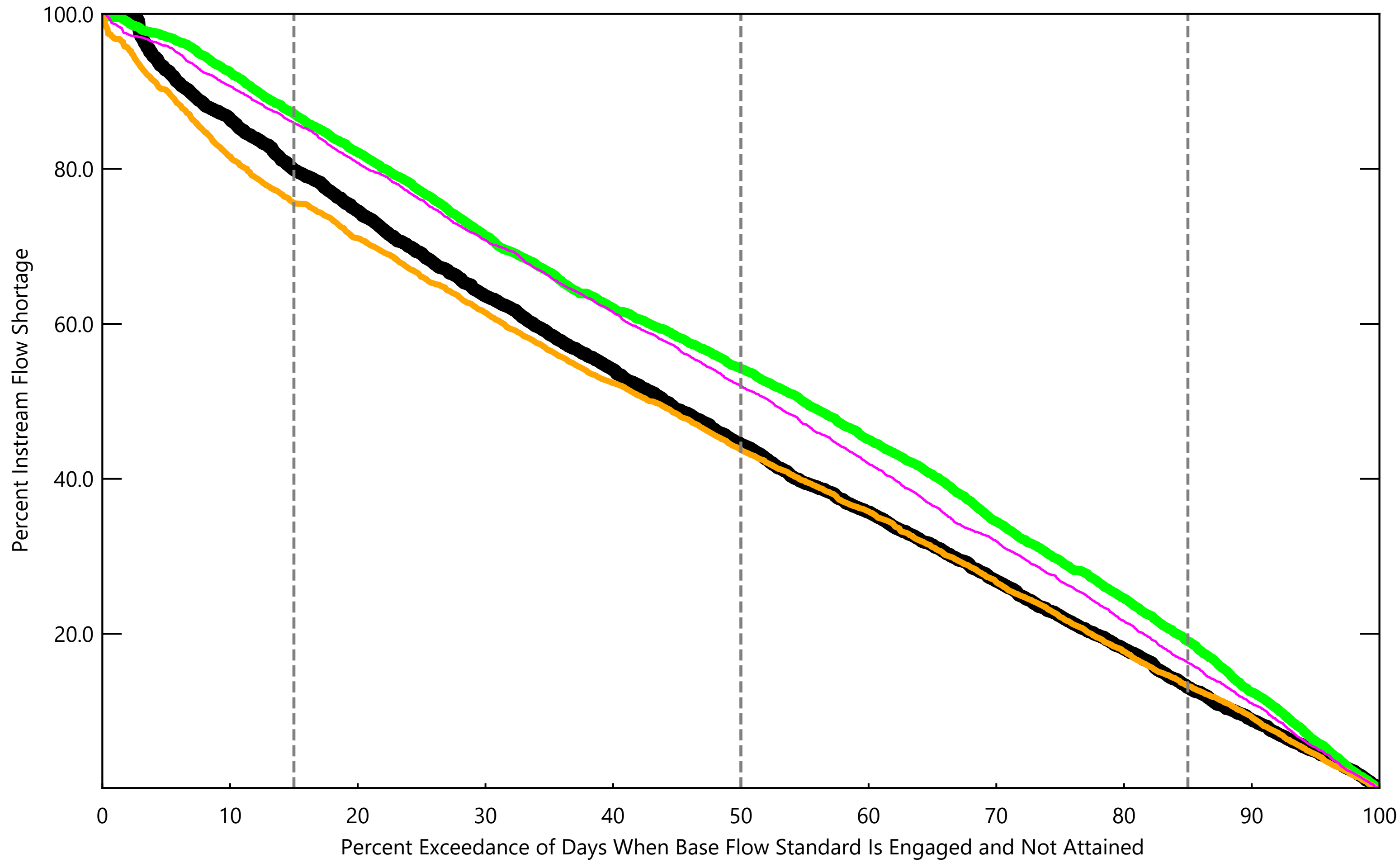
Figure E-84
Brazos River near Waco: Base Flow Shortage, Entire Period of Record (S-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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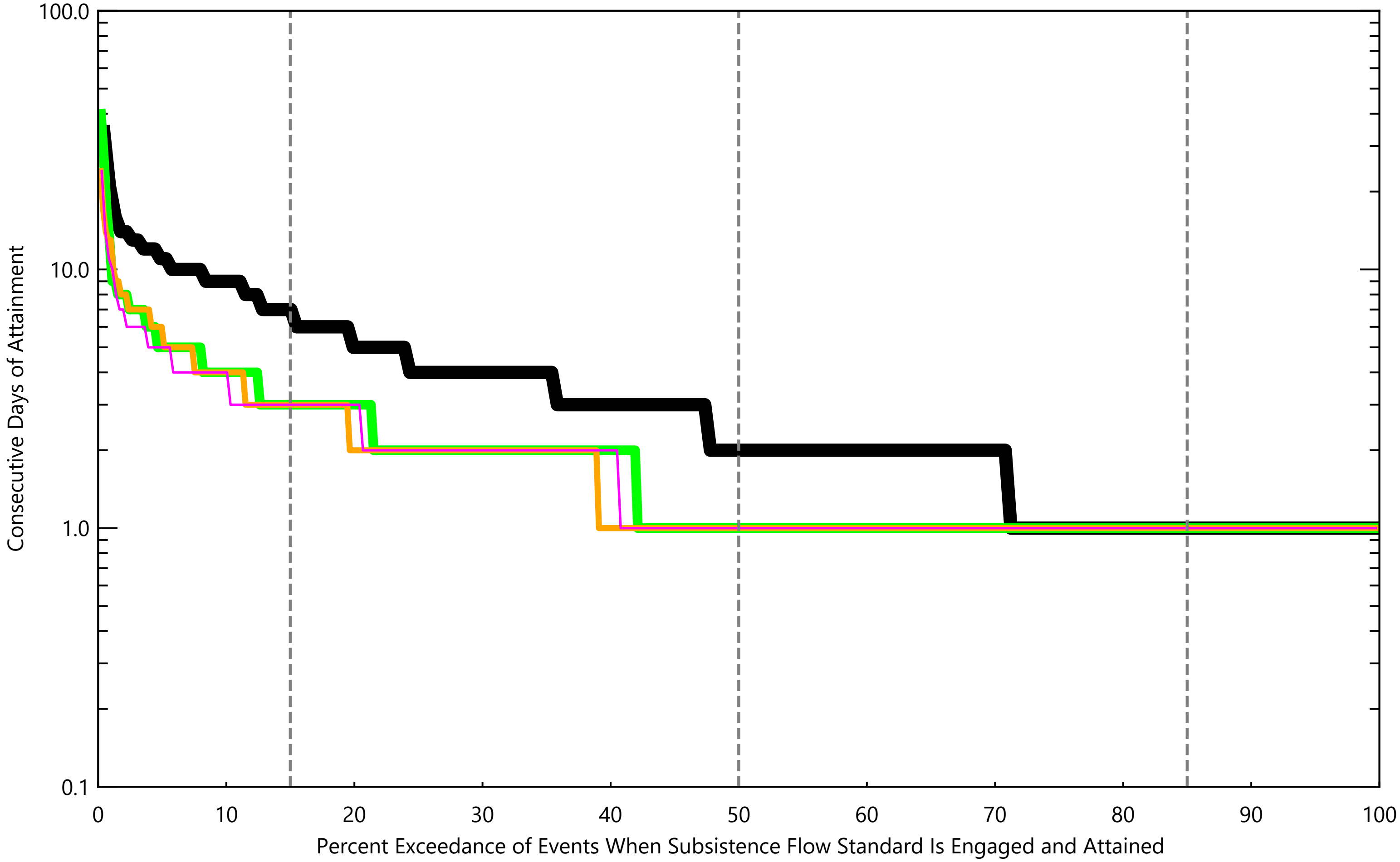
Figure E-85
Brazos River near Waco: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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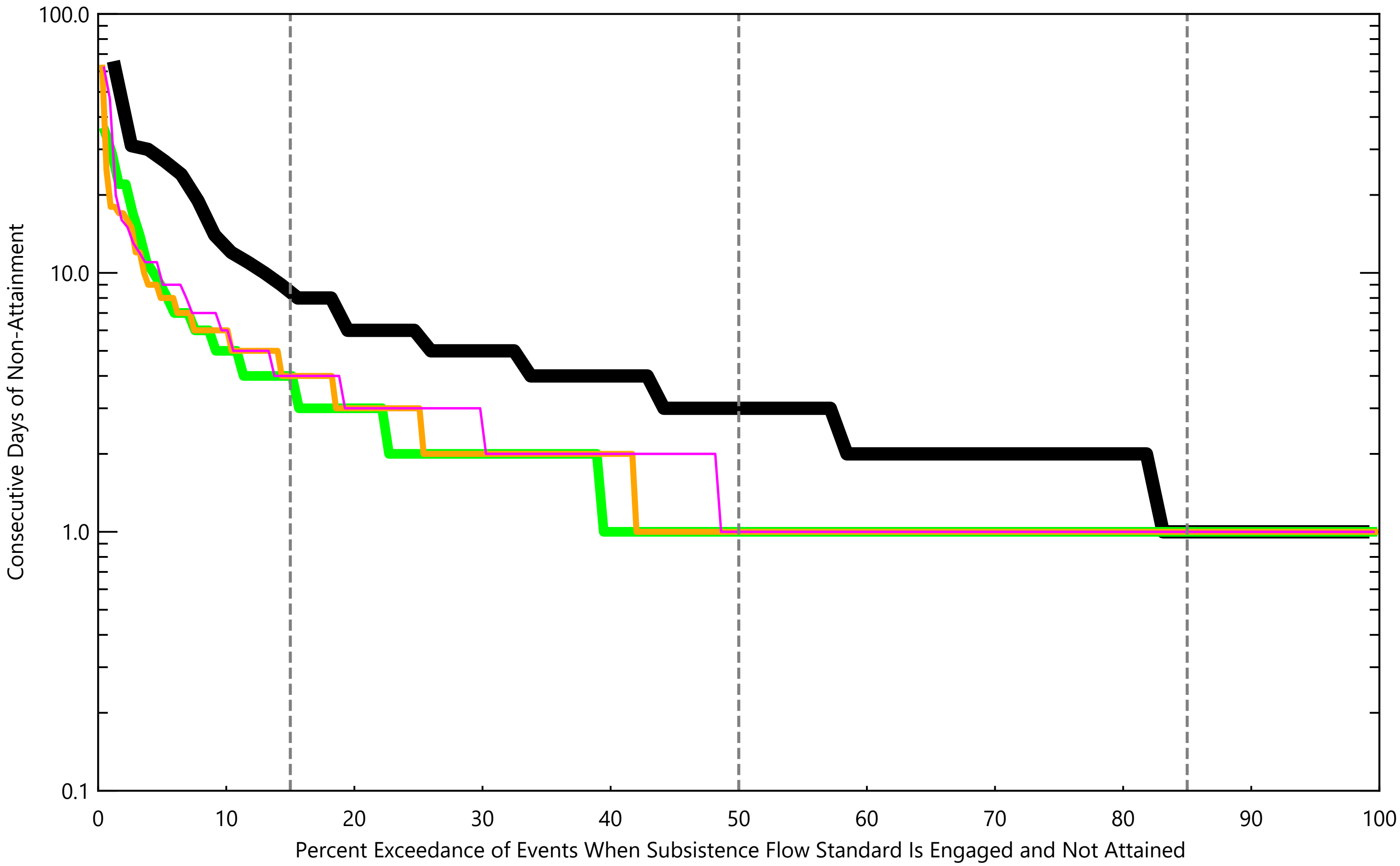
Figure E-86
Brazos River near Waco: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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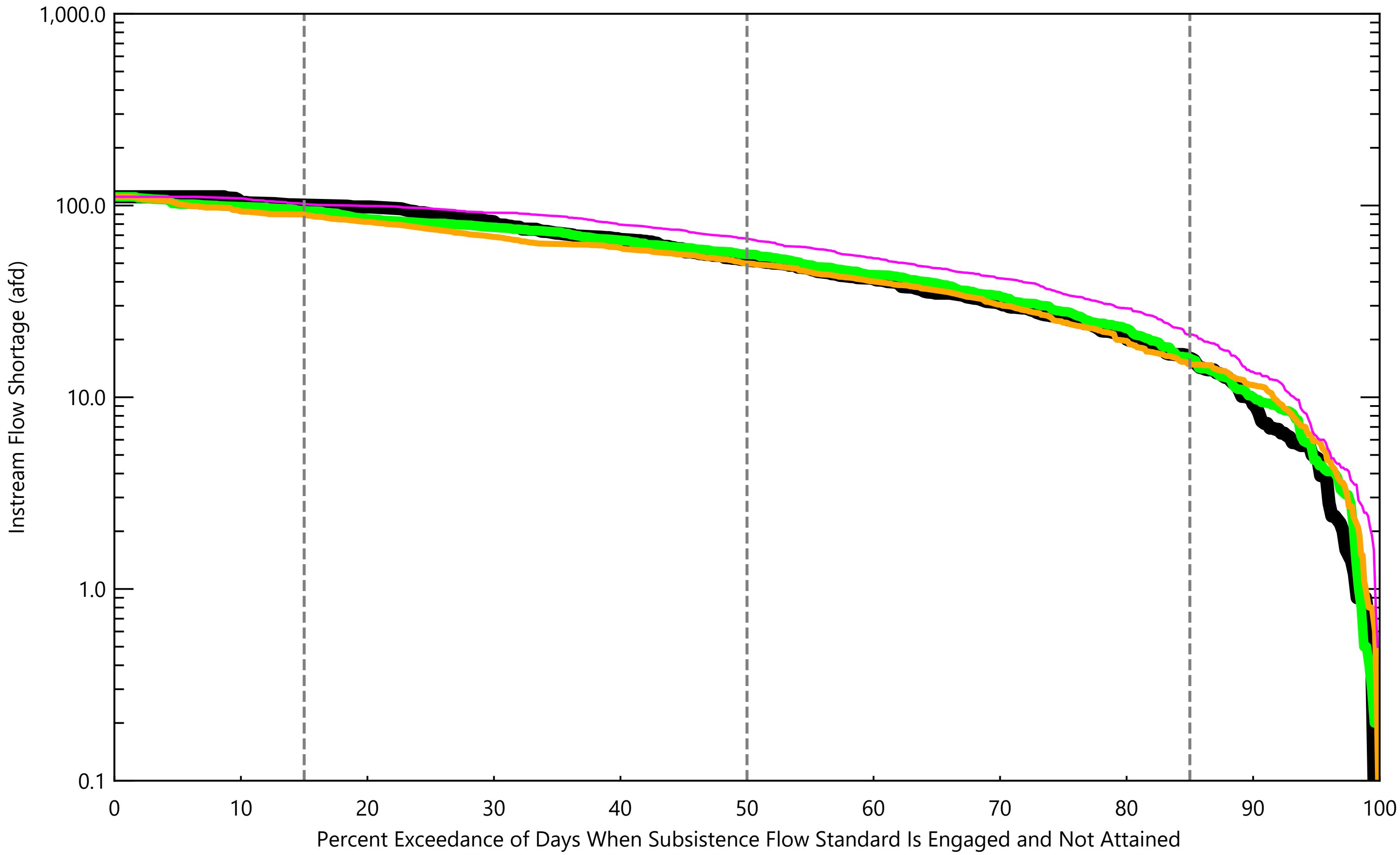
Figure E-87
Brazos River near Waco: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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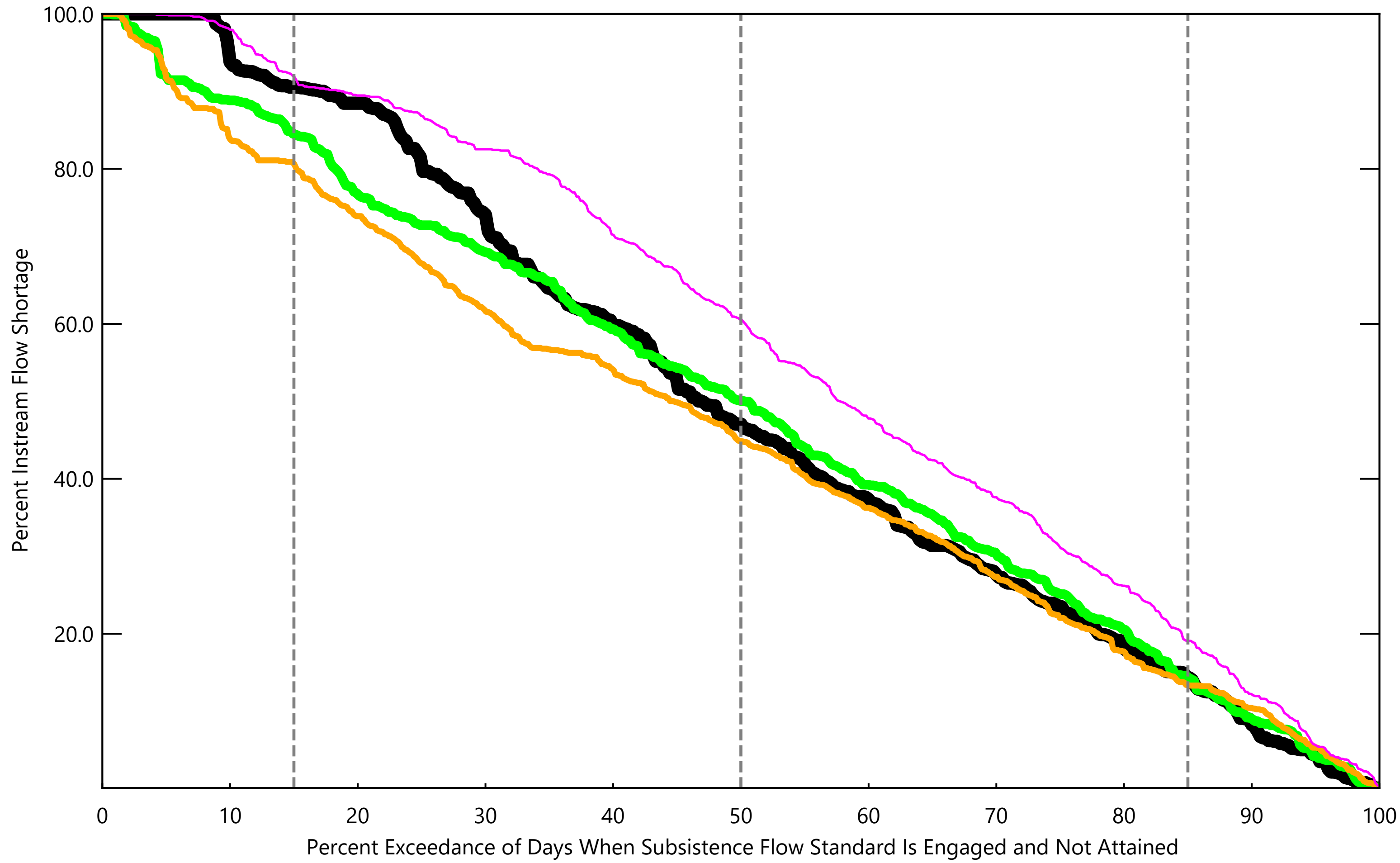
Figure E-88
Brazos River near Waco: Subsistence Flow Shortage, Entire Period of Record (S-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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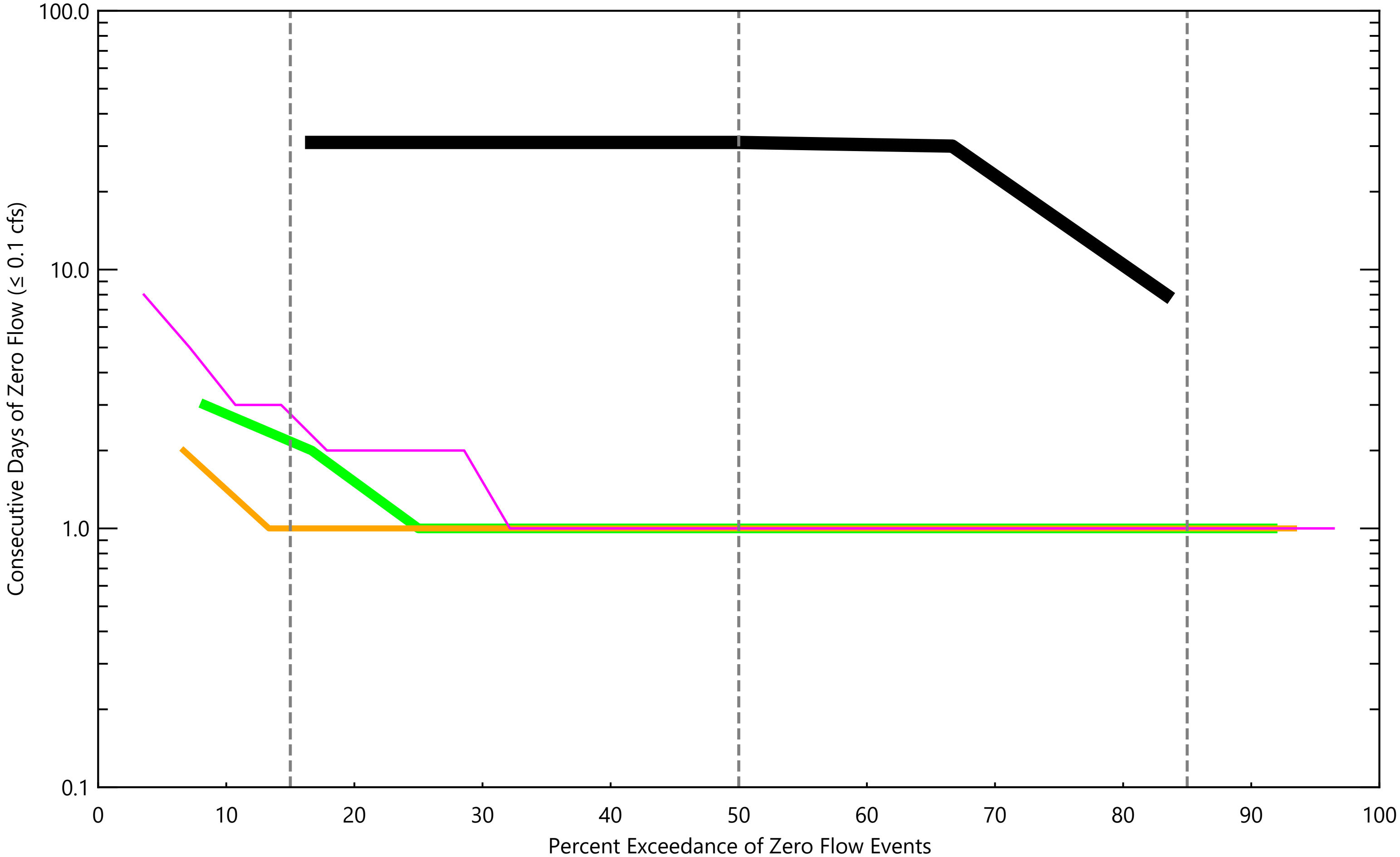
Figure E-89
Brazos River near Waco: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-90
Brazos River near Waco: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

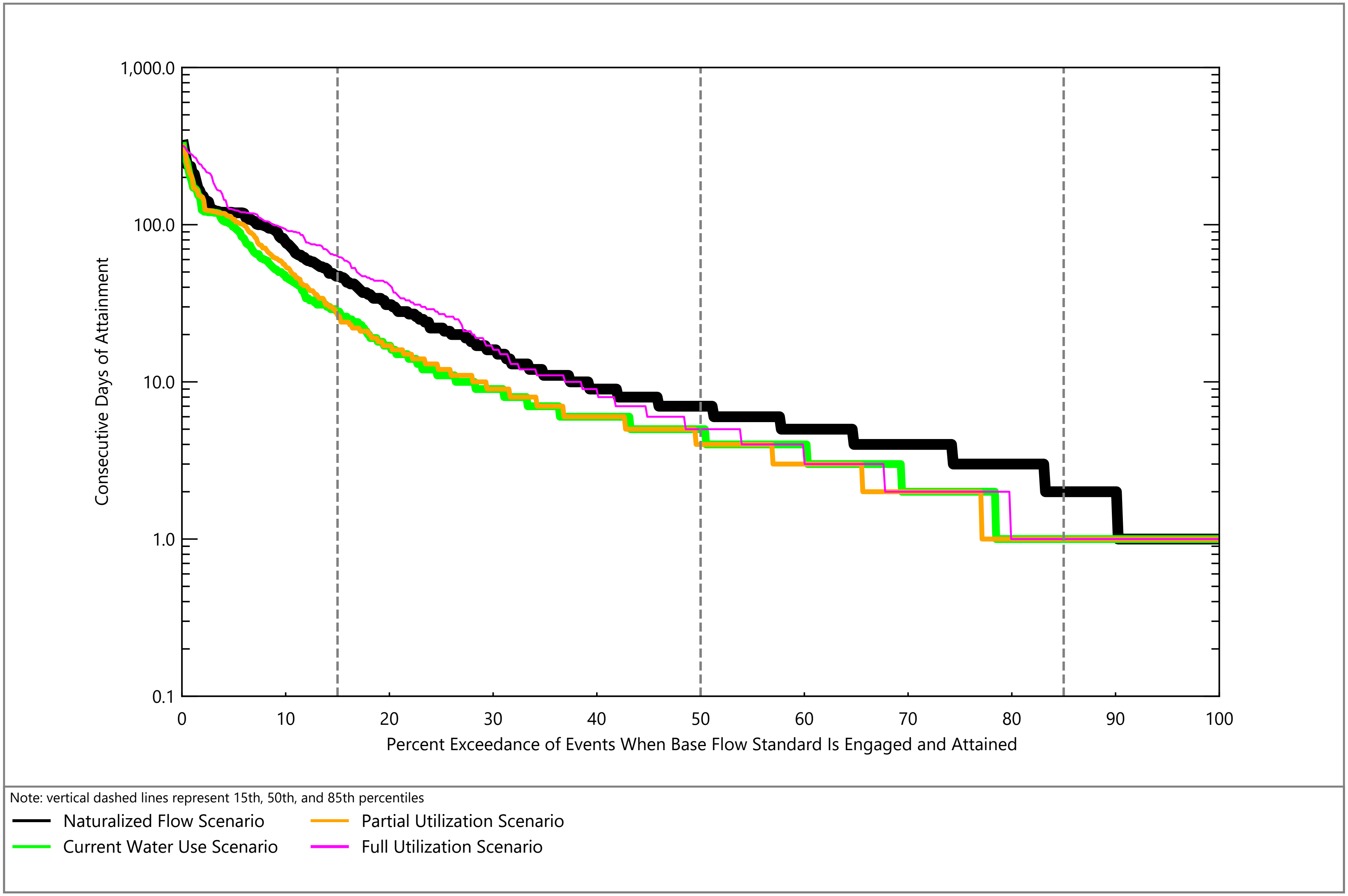

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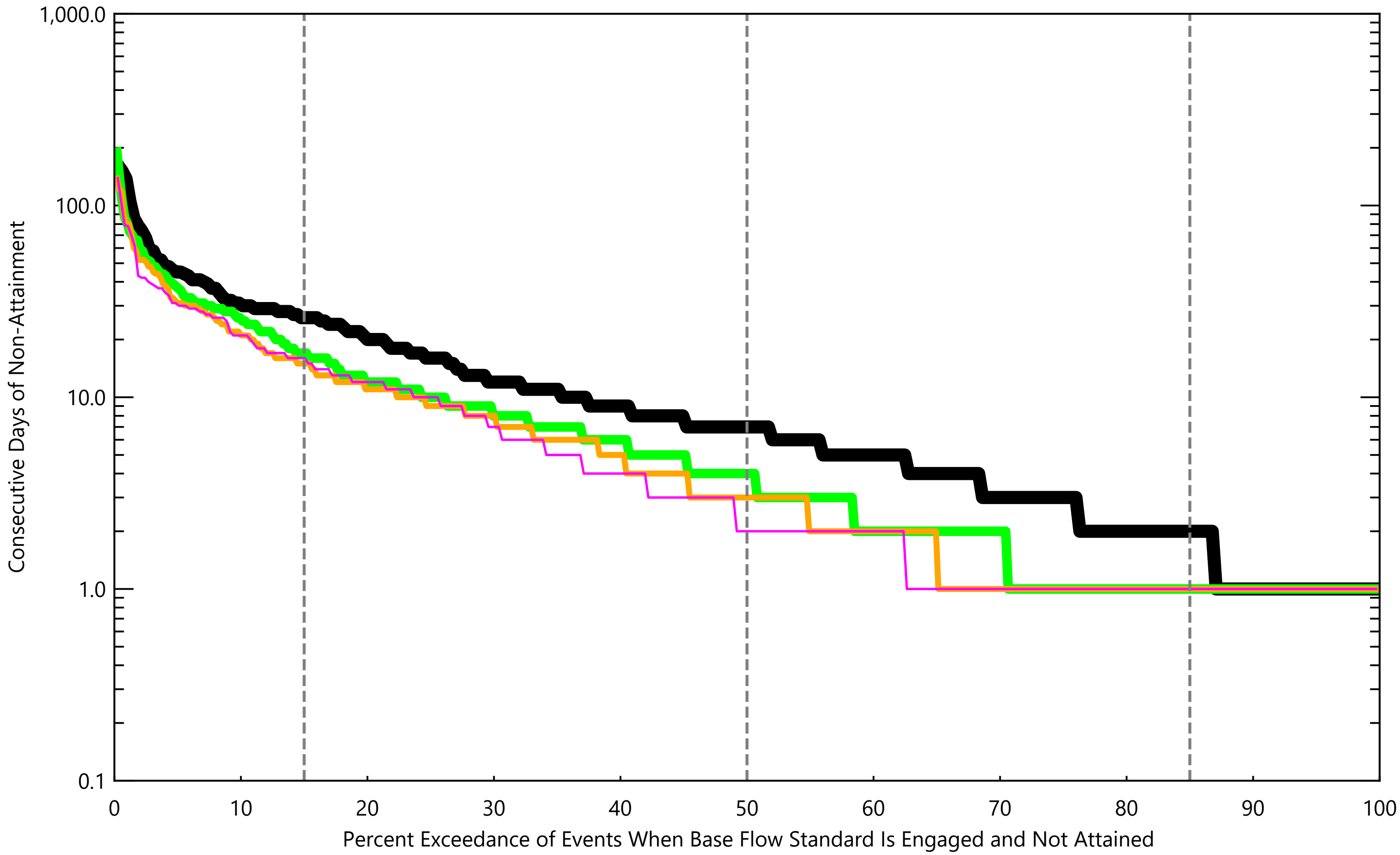
Figure E-91

Leon River at Gatesville: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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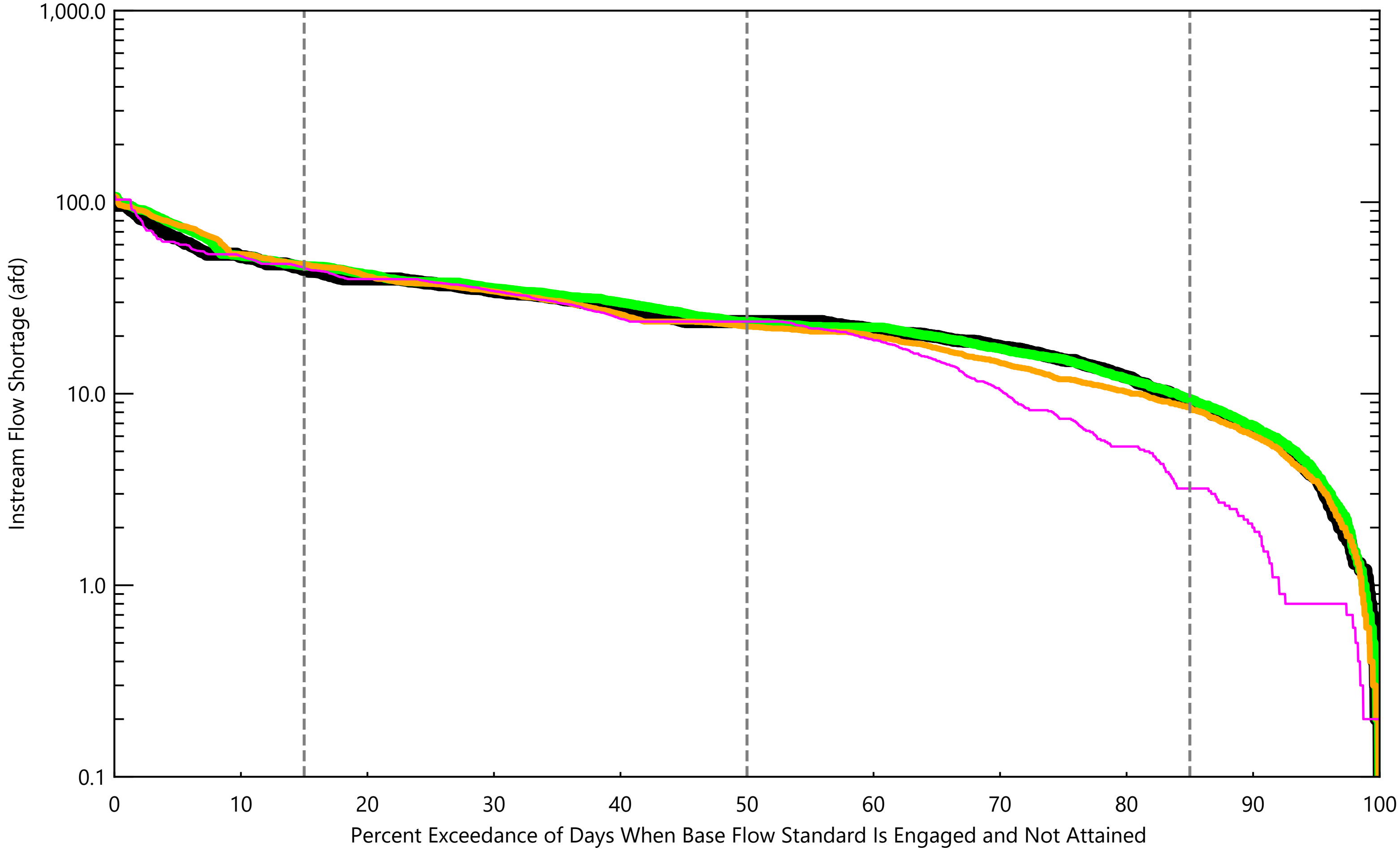
Figure E-92
Leon River at Gatesville: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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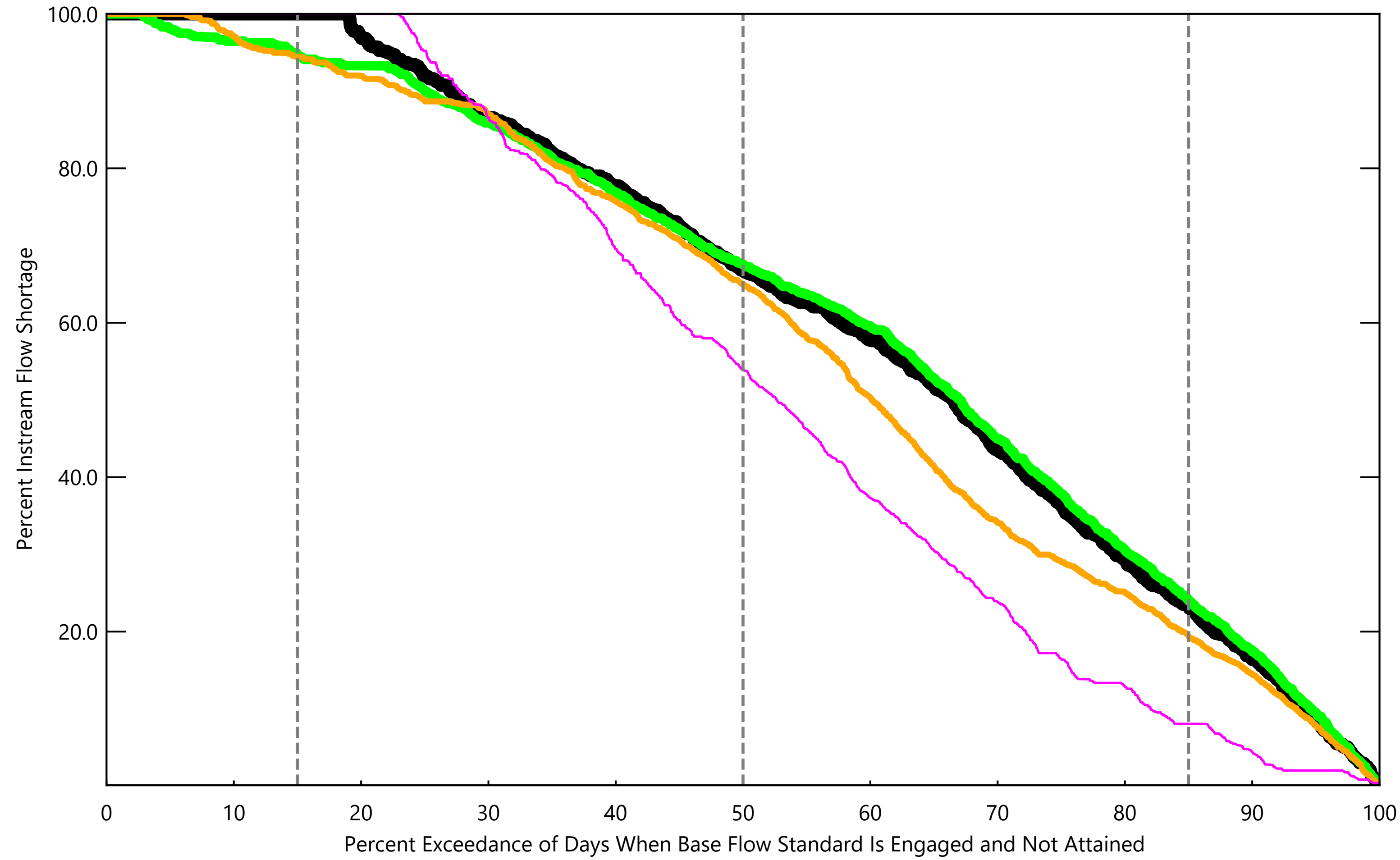
Figure E-93

Leon River at Gatesville: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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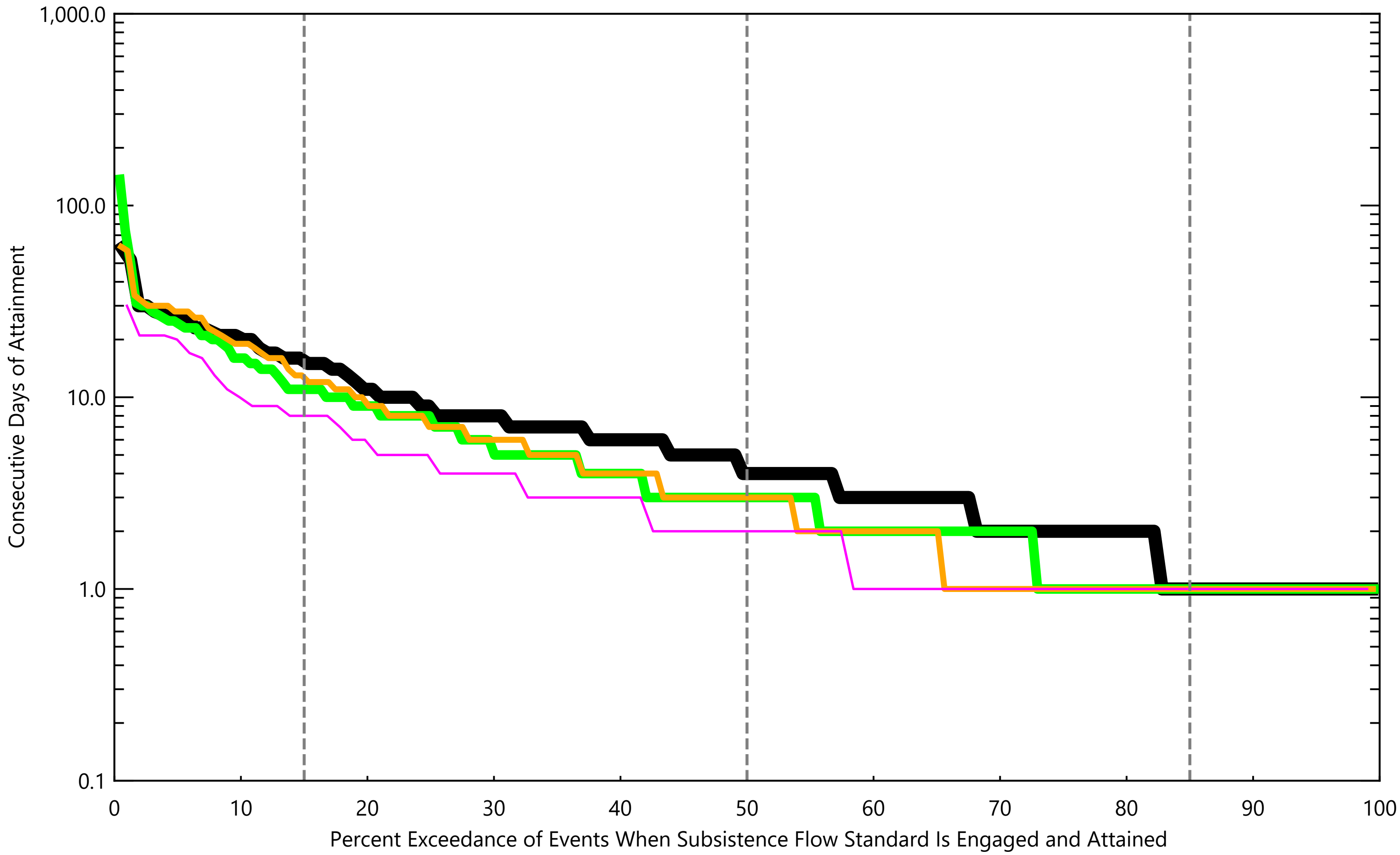
Figure E-94
Leon River at Gatesville: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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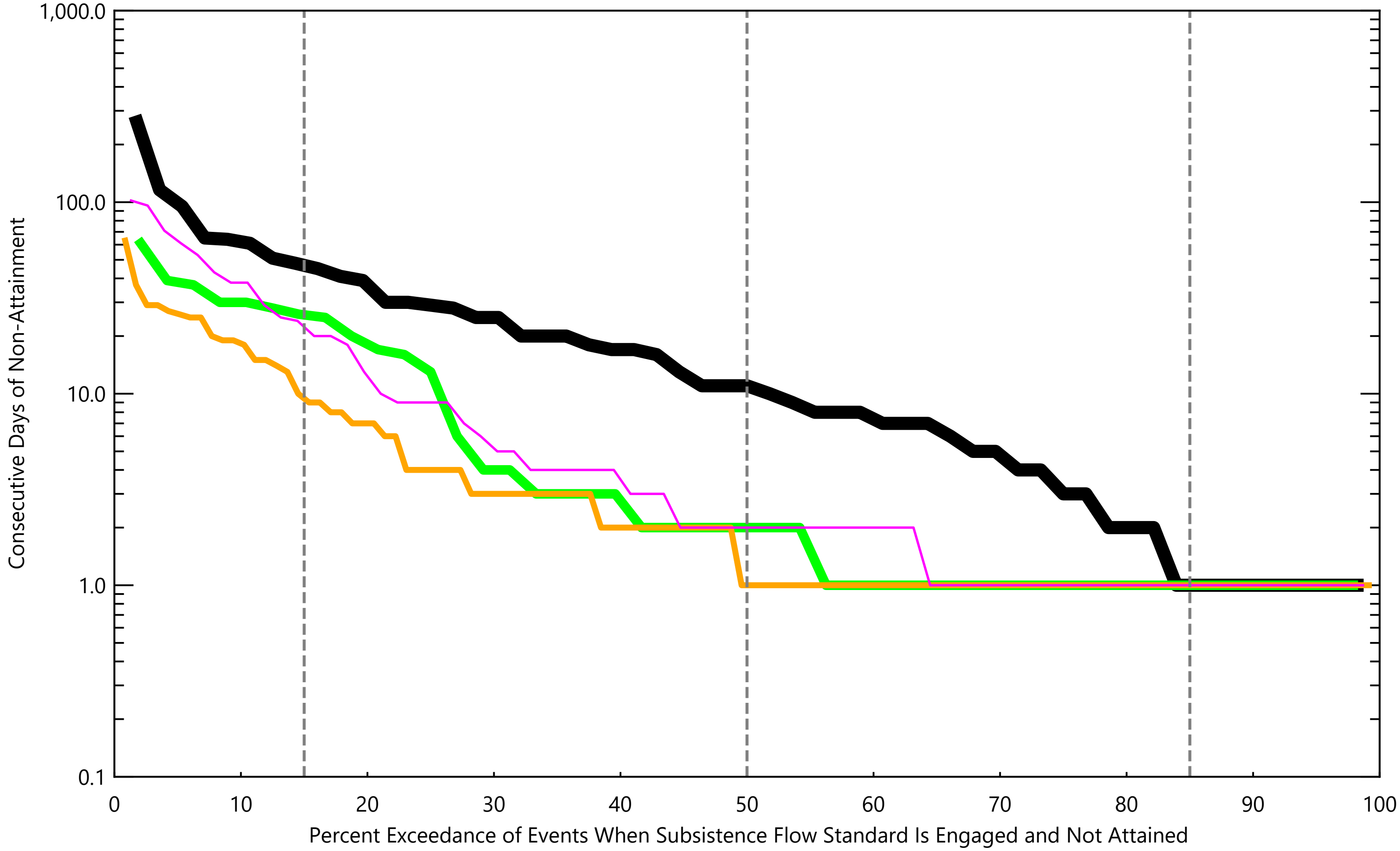
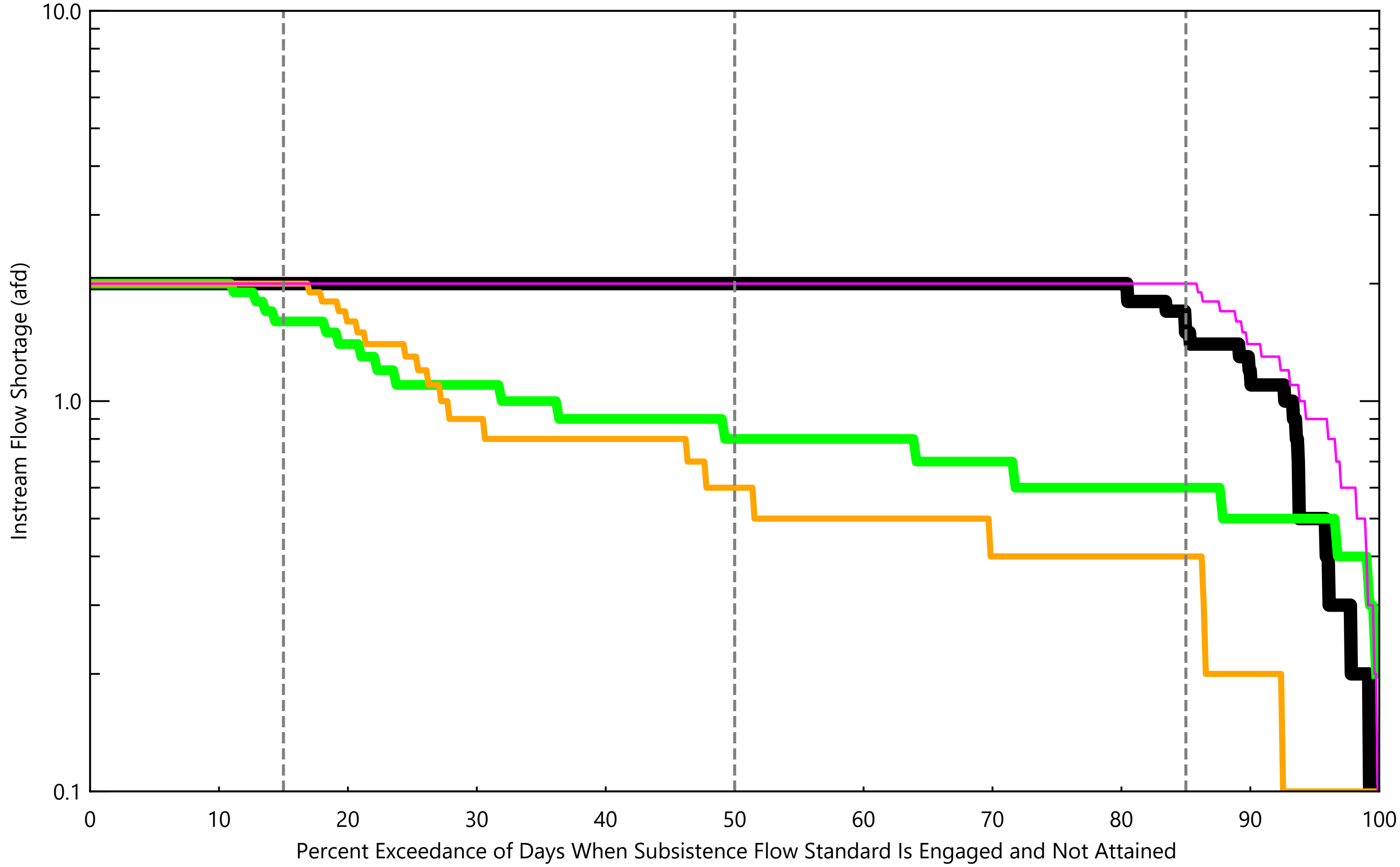
Figure E-95
Leon River at Gatesville: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-96
Leon River at Gatesville: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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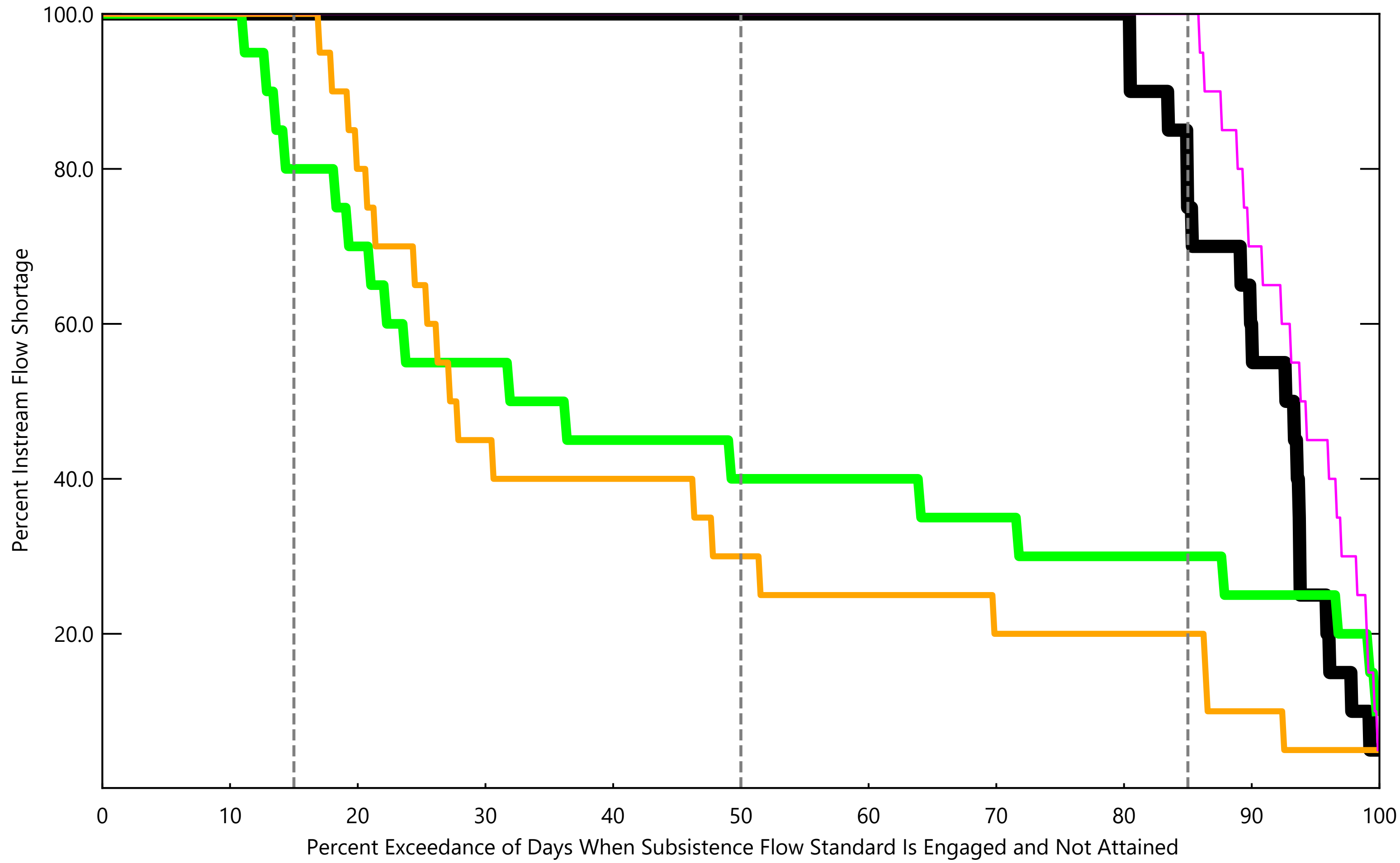
Figure E-97
Leon River at Gatesville: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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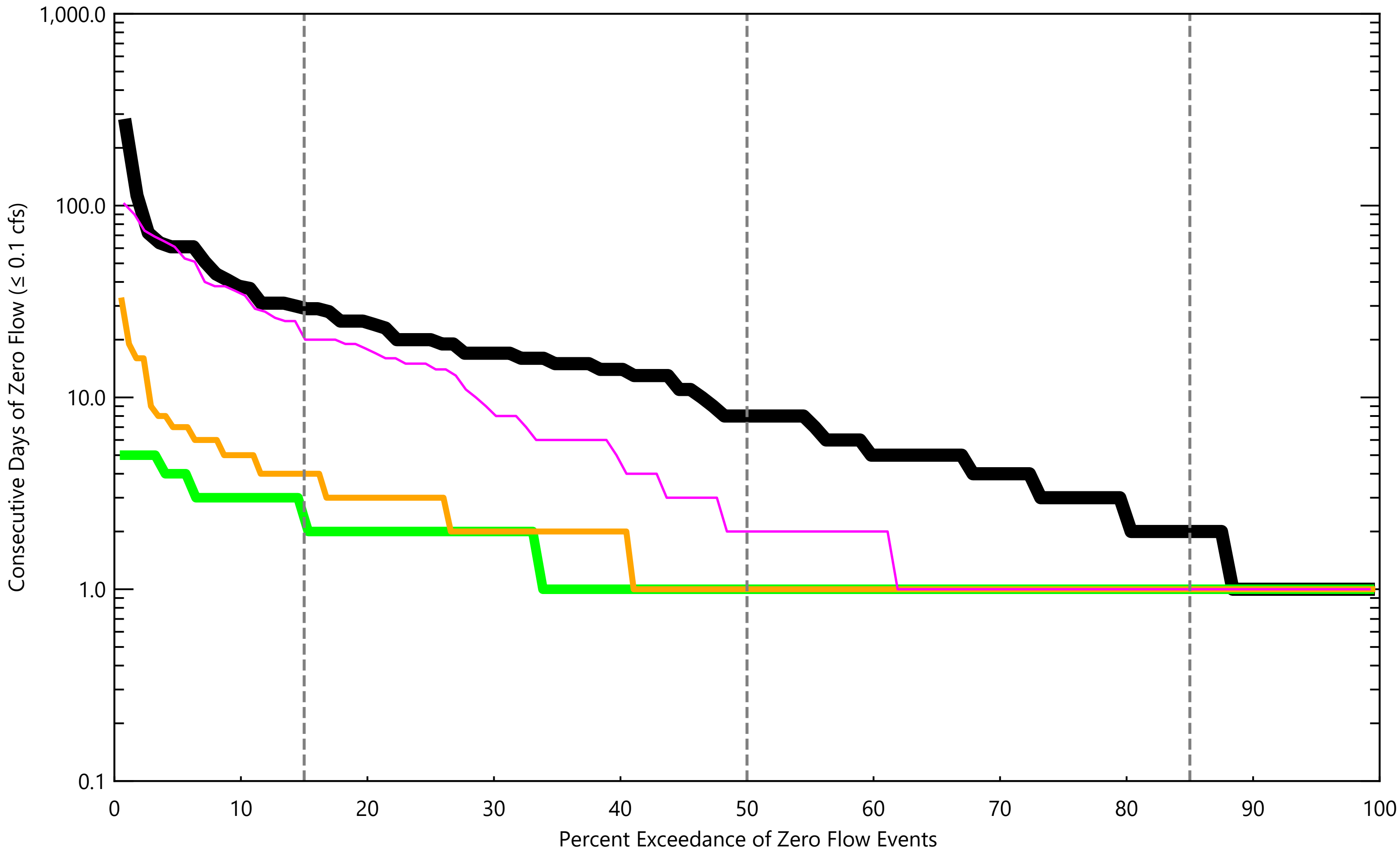
Figure E-98
Leon River at Gatesville: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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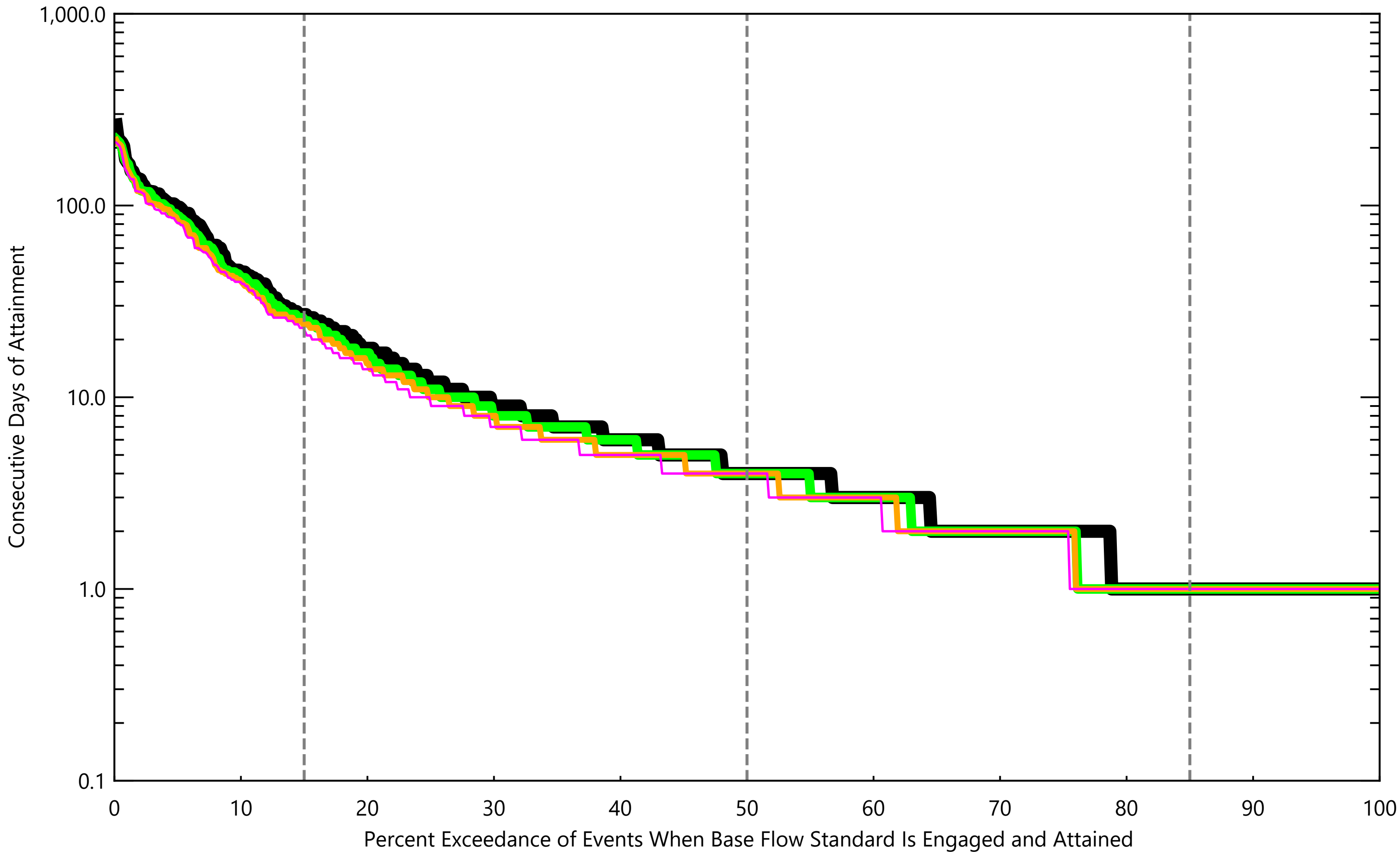
Figure E-99

Leon River at Gatesville: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

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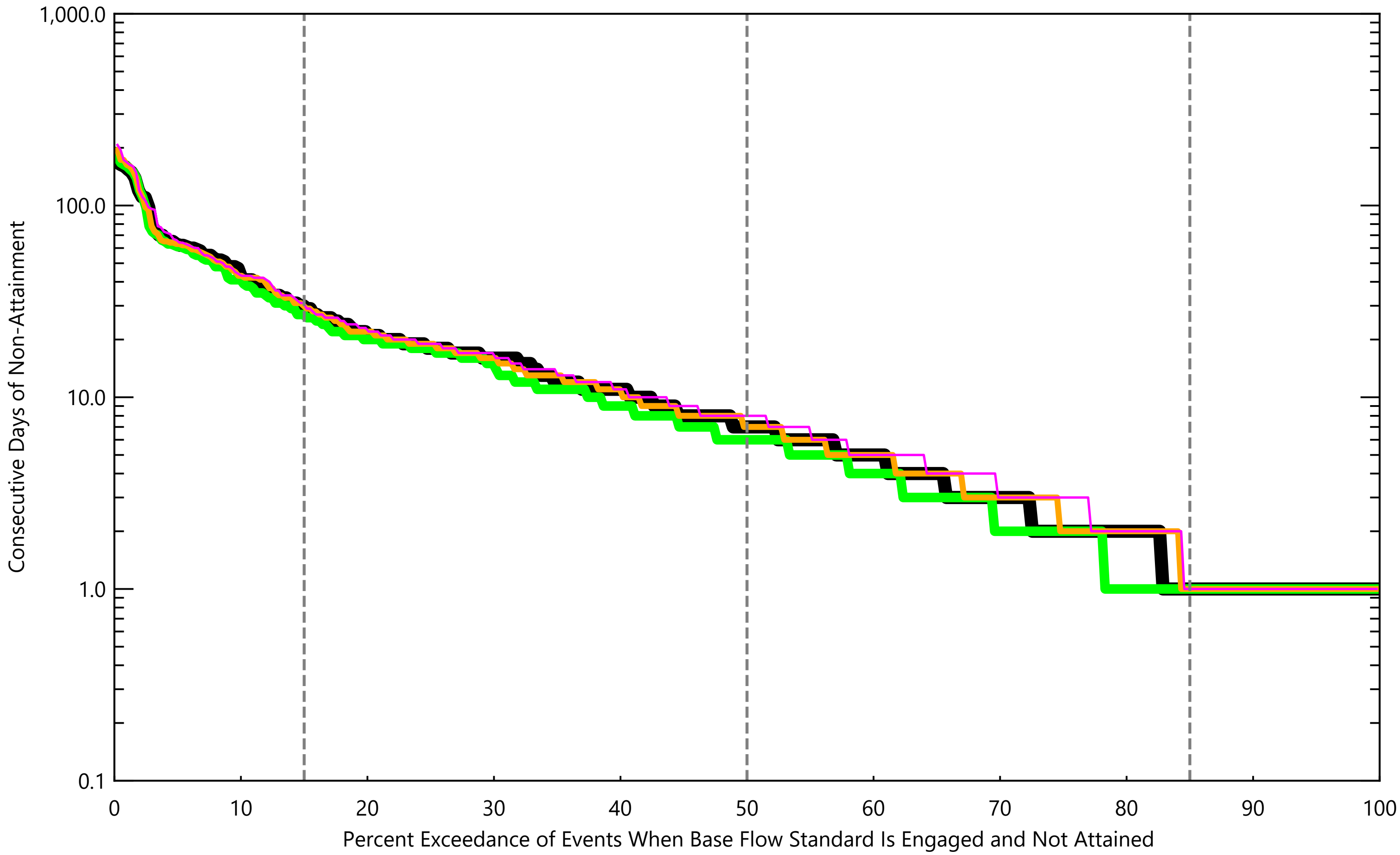
Figure E-100

Lampasas River near Kempner: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

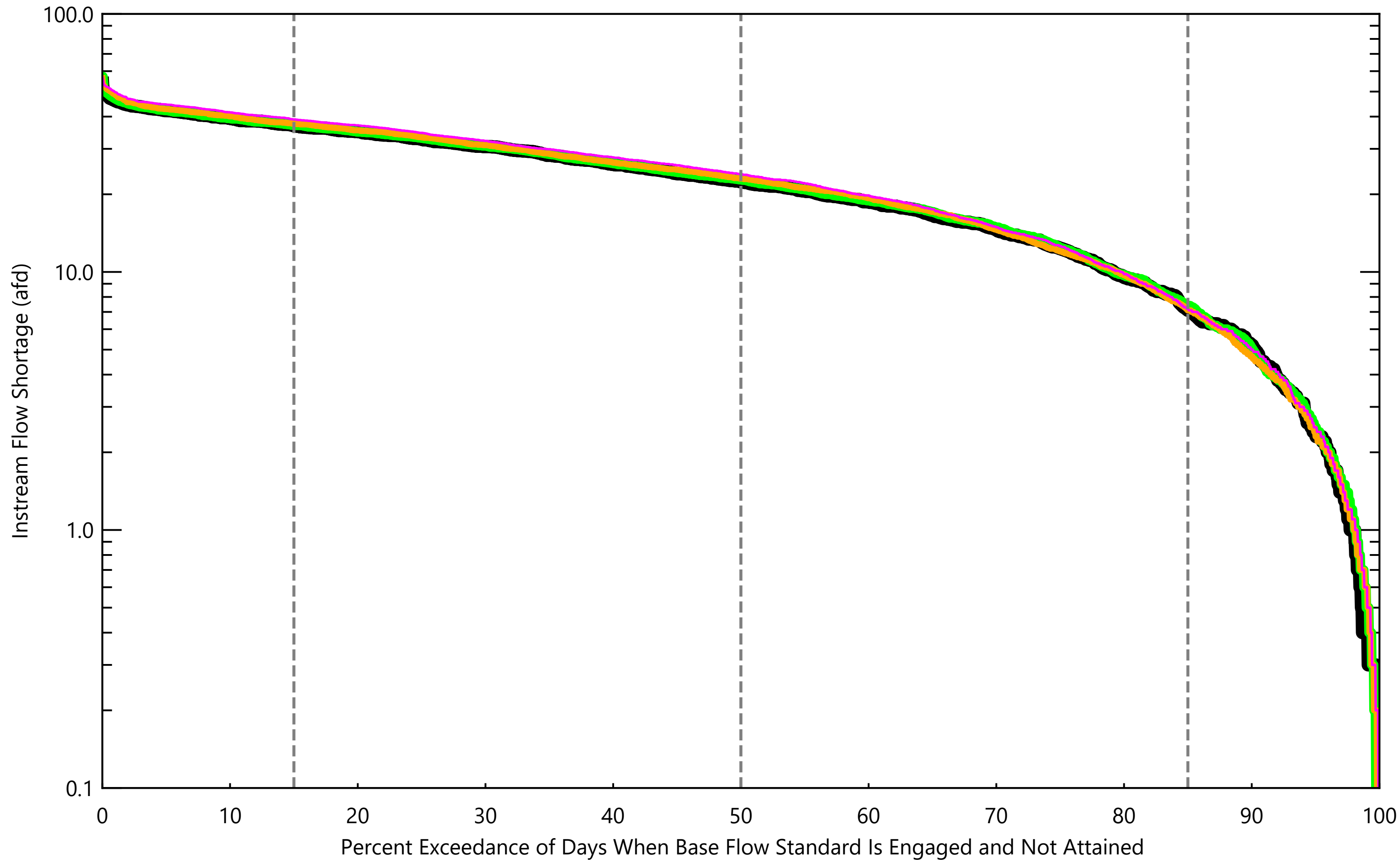
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario | Partial Utilization Scenario
Current Water Use Scenario | Full Utilization Scenario

Figure E-101
Lampasas River near Kempner: Base Flow Shortage Duration, Entire Period of Record (SD-POR)



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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Figure E-102

Lampasas River near Kempner: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

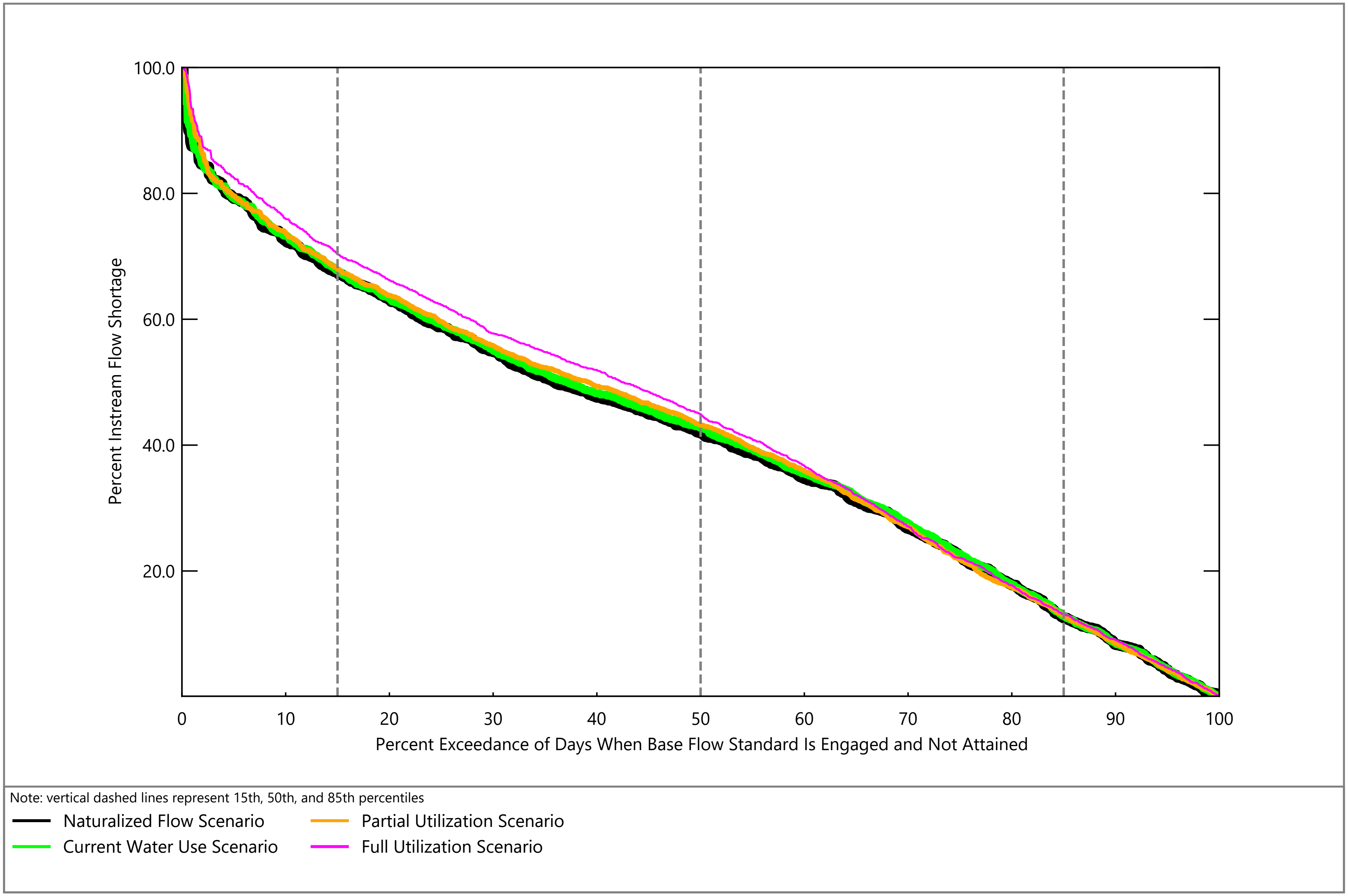

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Figure E-103

Lampasas River near Kempner: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards

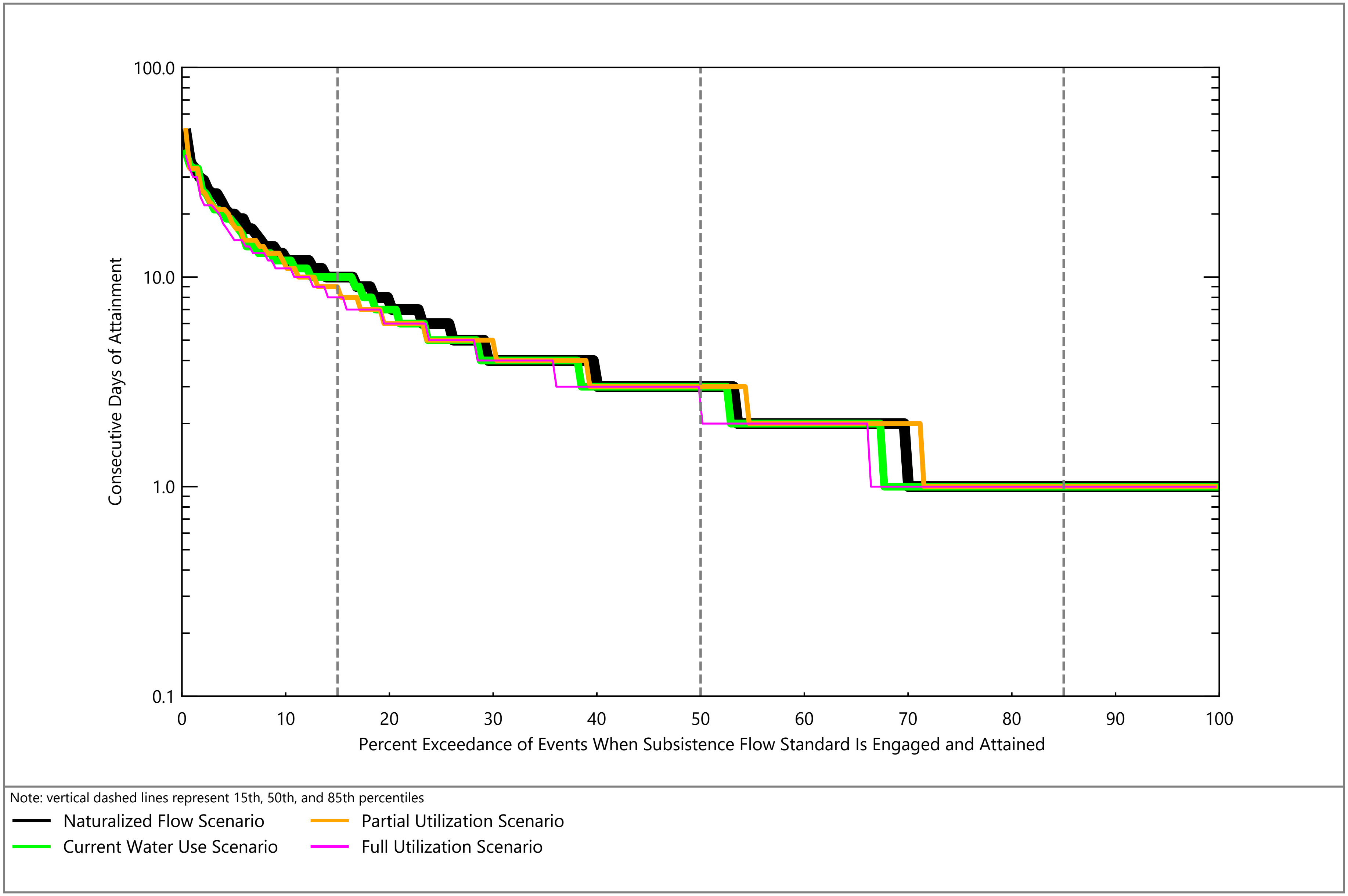

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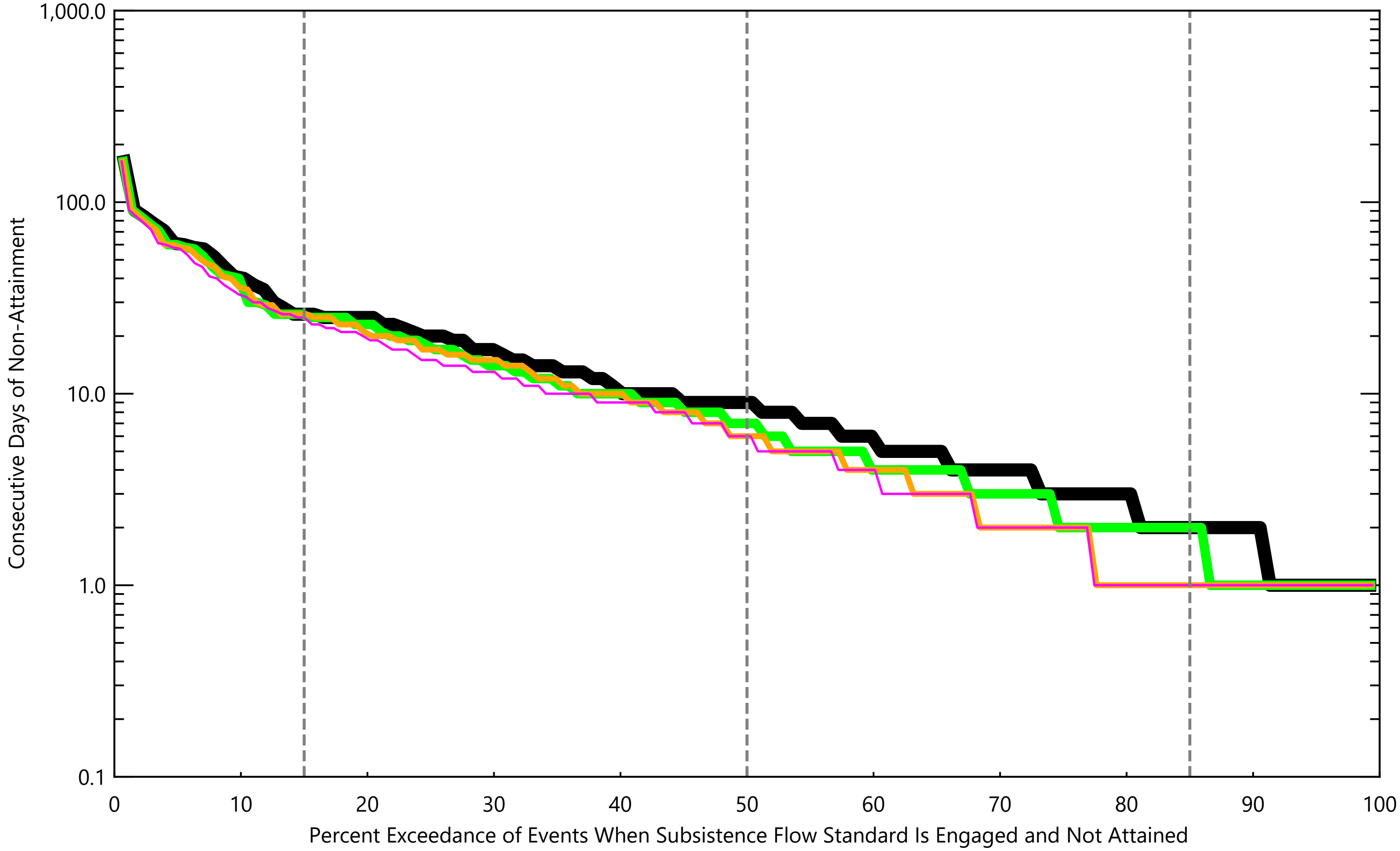
Figure E-104

Lampasas River near Kempner: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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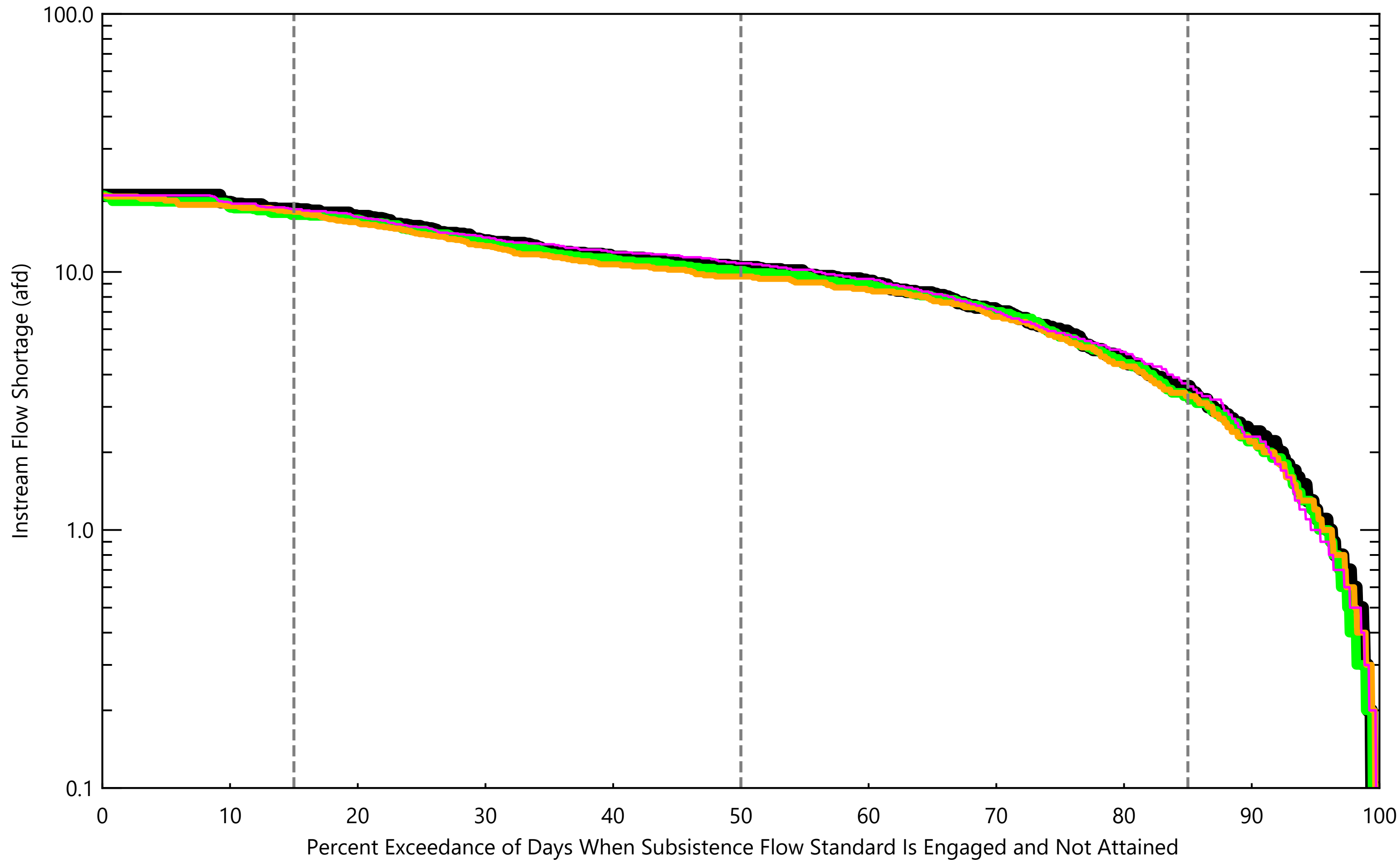
Figure E-105
Lampasas River near Kempner: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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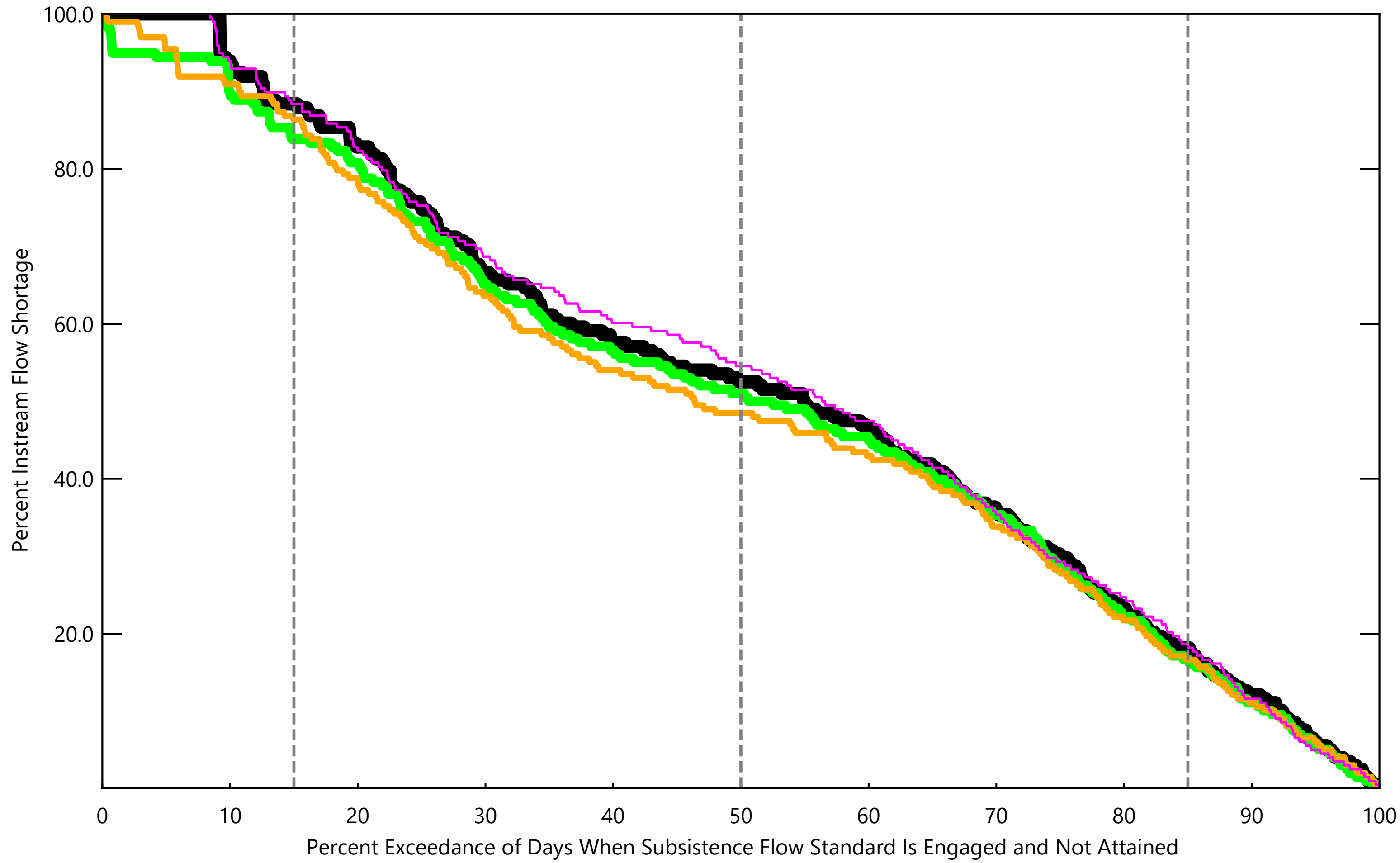
Figure E-106

Lampasas River near Kempner: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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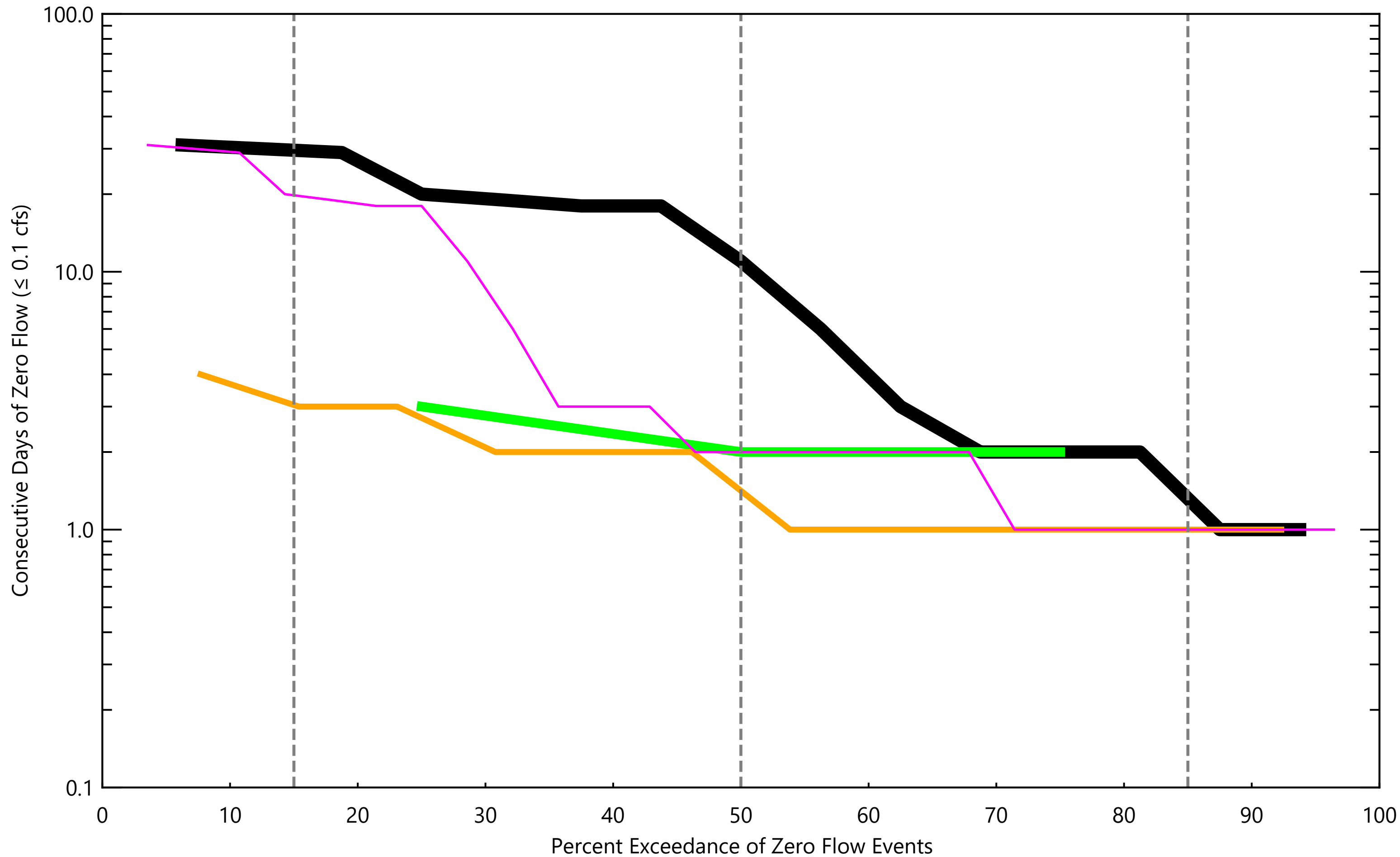
Figure E-107
Lampasas River near Kempner: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

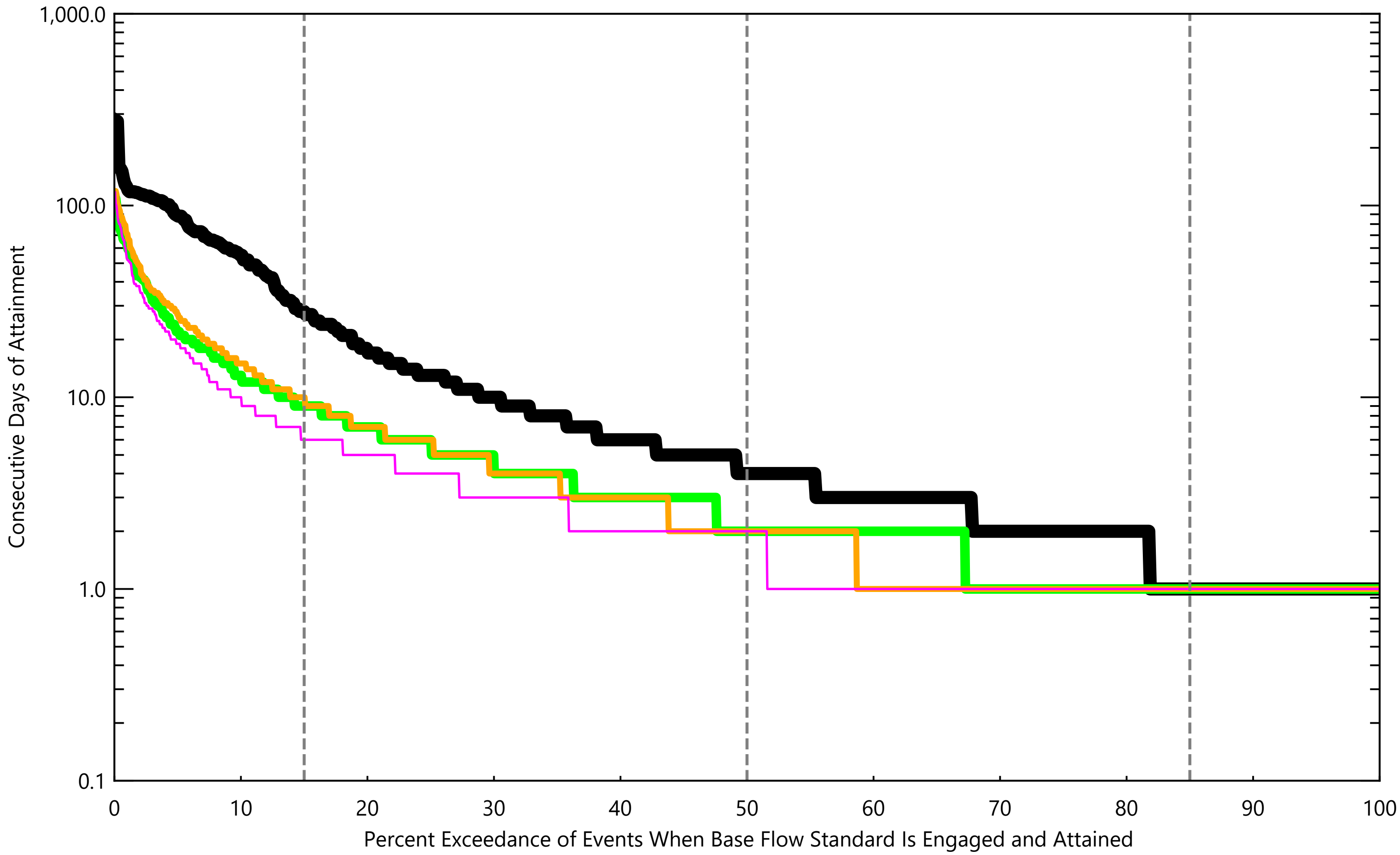
Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

ANCHOR QEA

Figure E-108

Lampasas River near Kempner: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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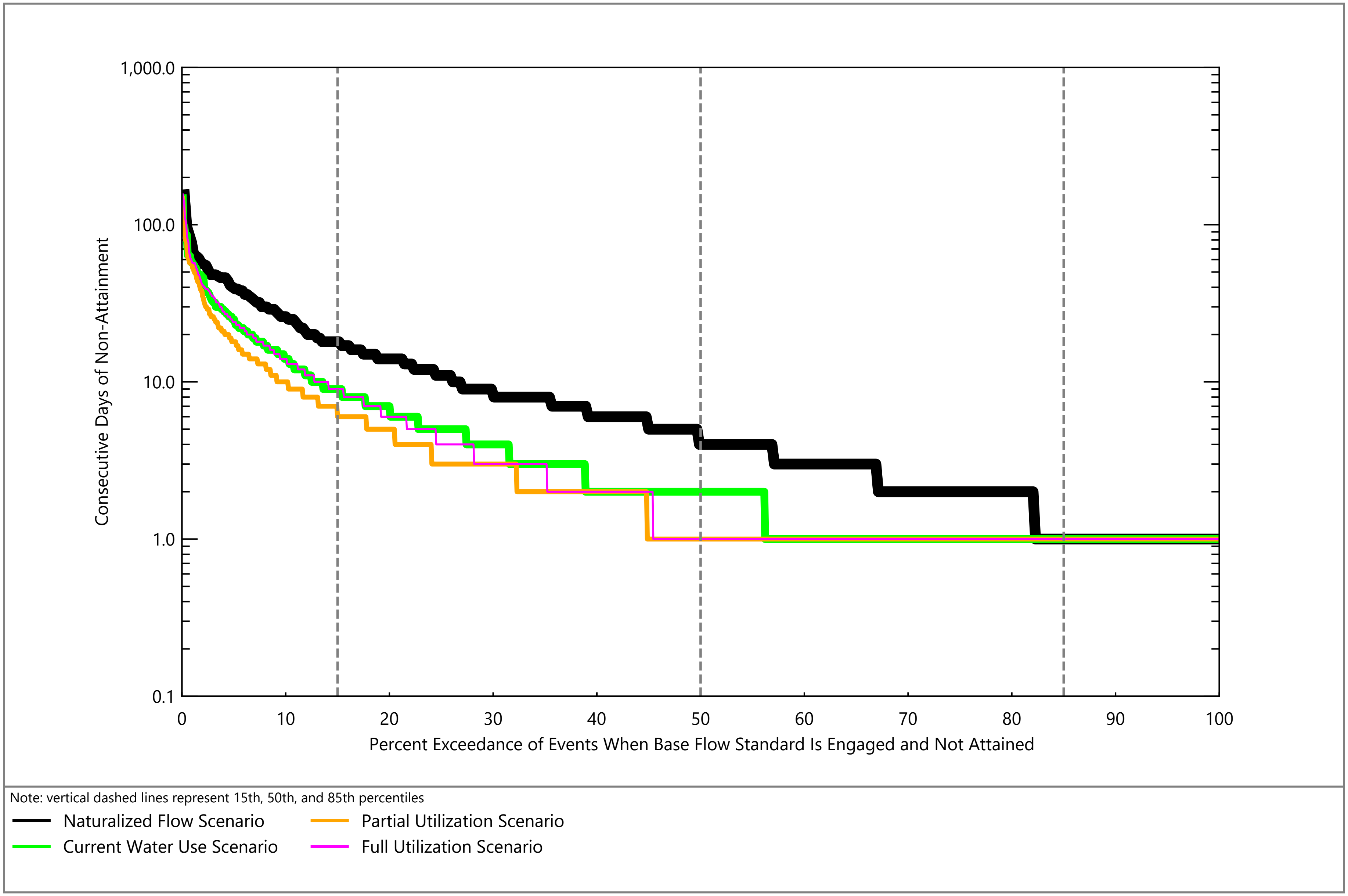
Figure E-109

Little River near Little River: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:11 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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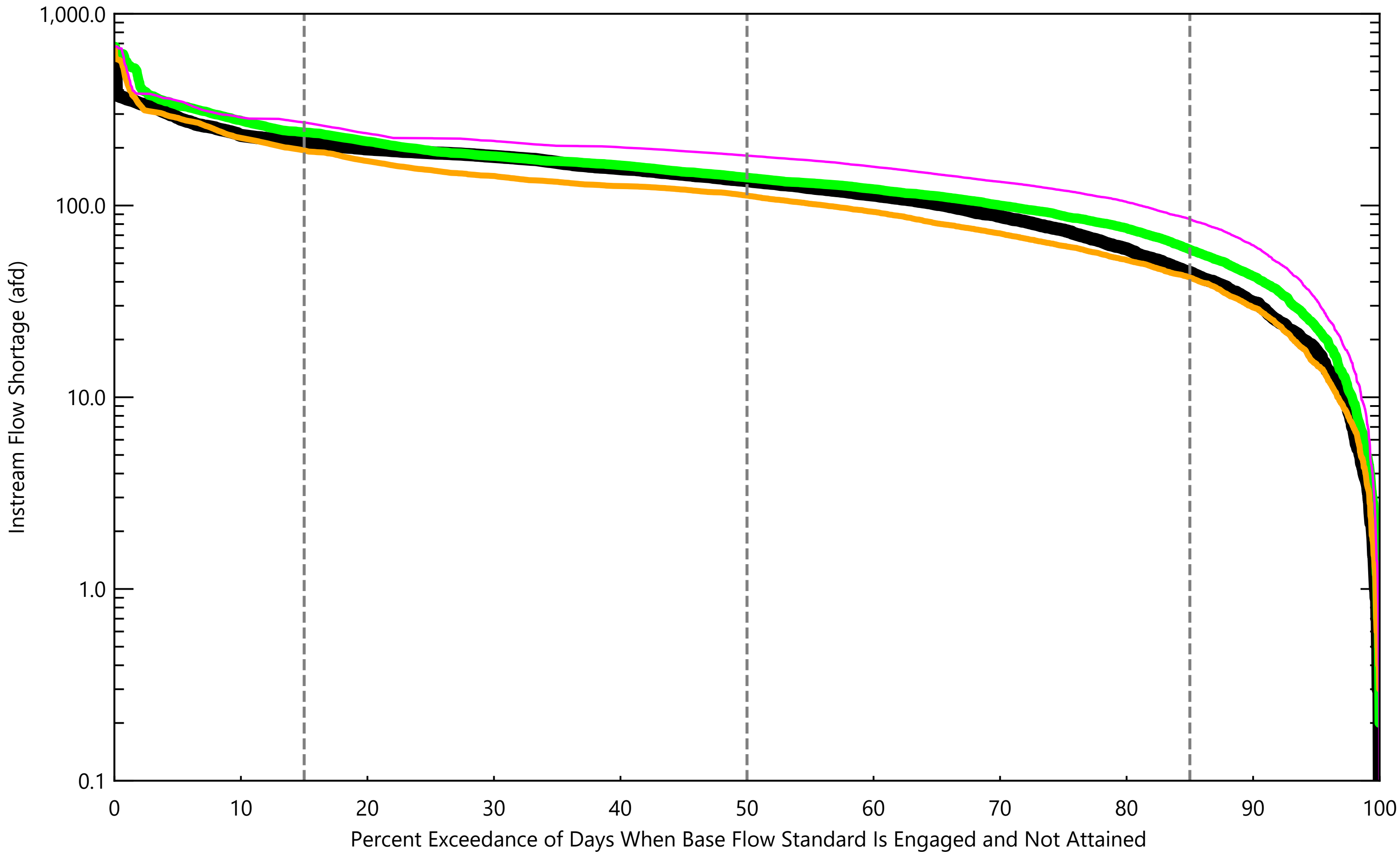
Figure E-110
Little River near Little River: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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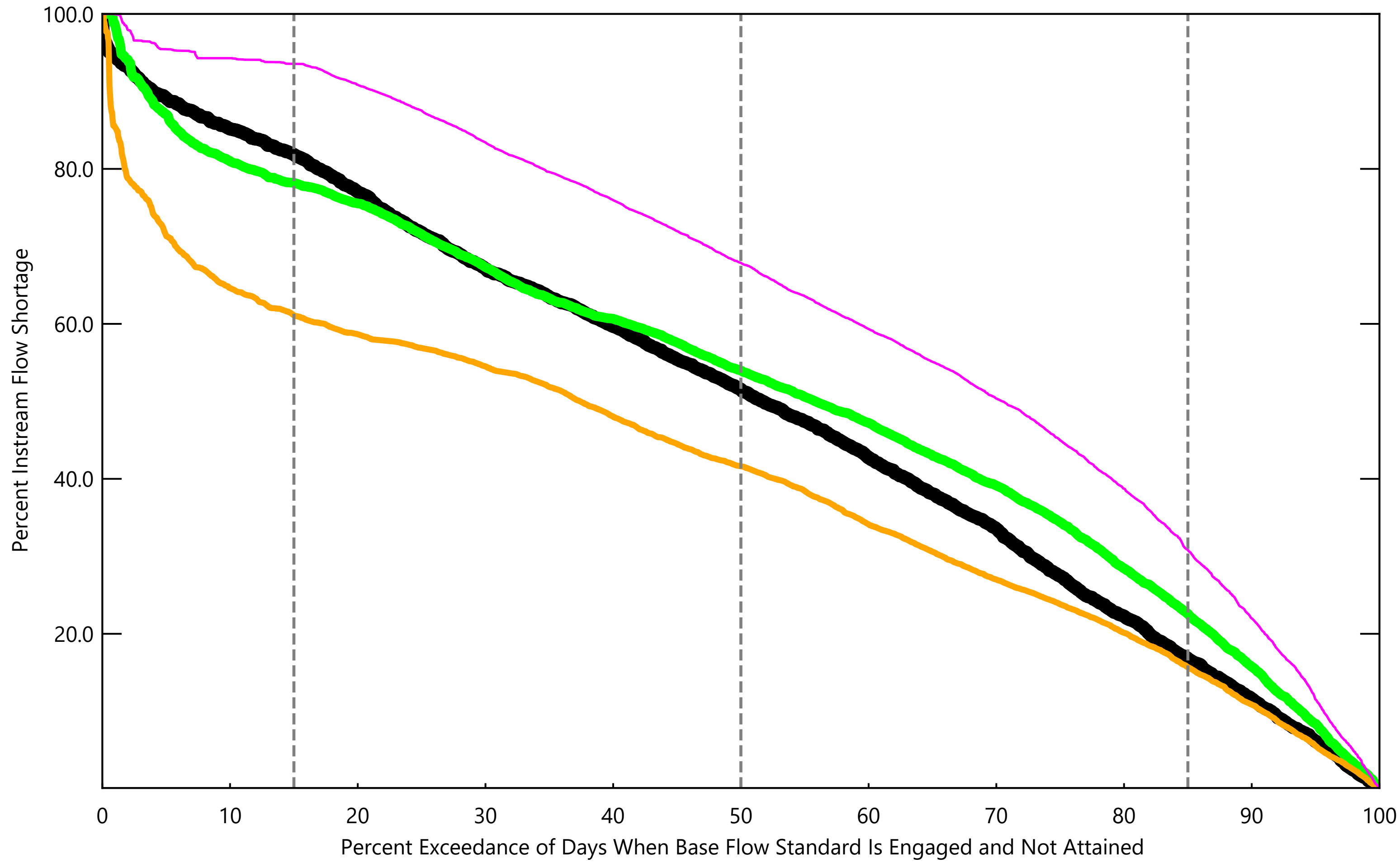
Figure E-111

Little River near Little River: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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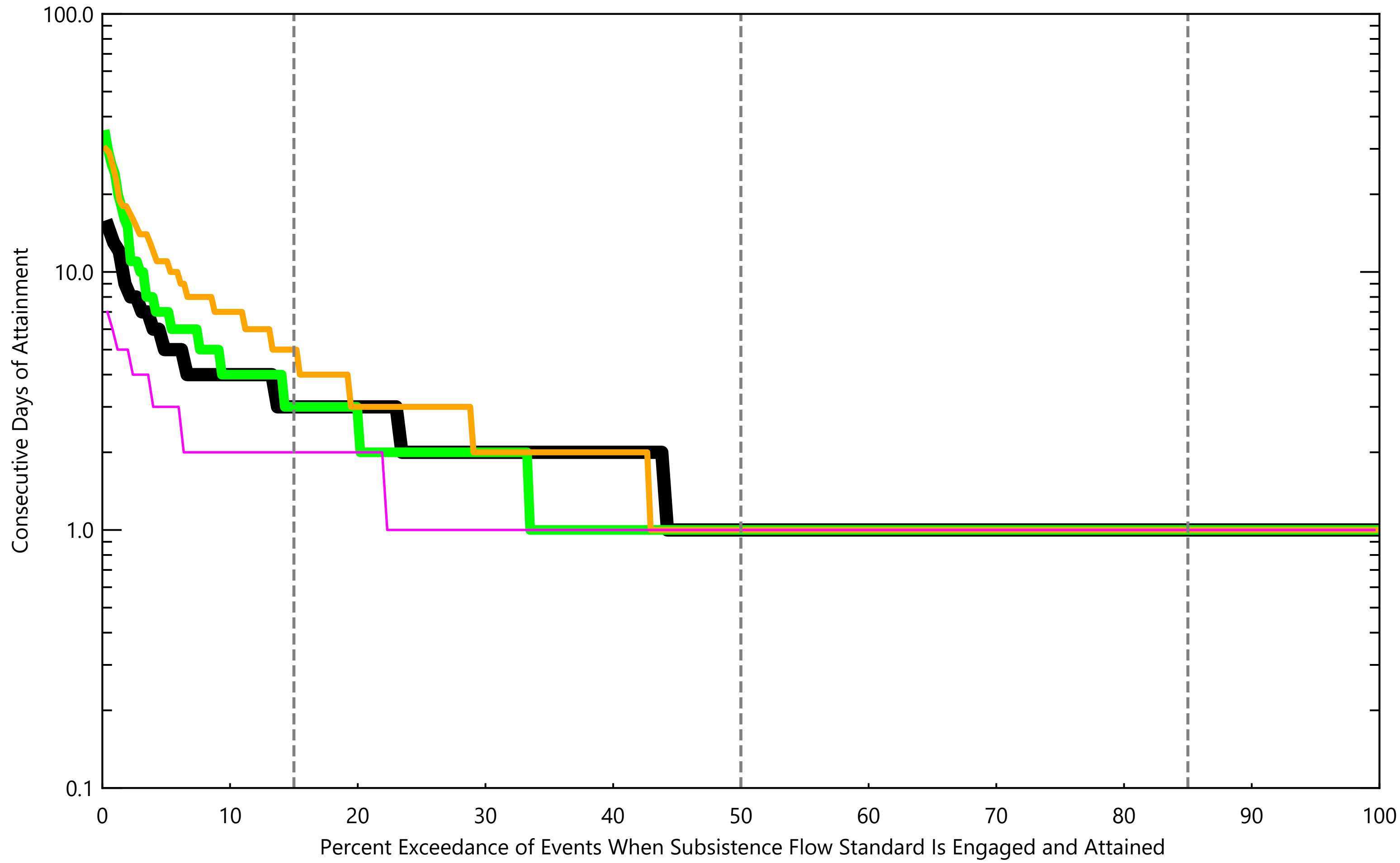
Figure E-112

Little River near Little River: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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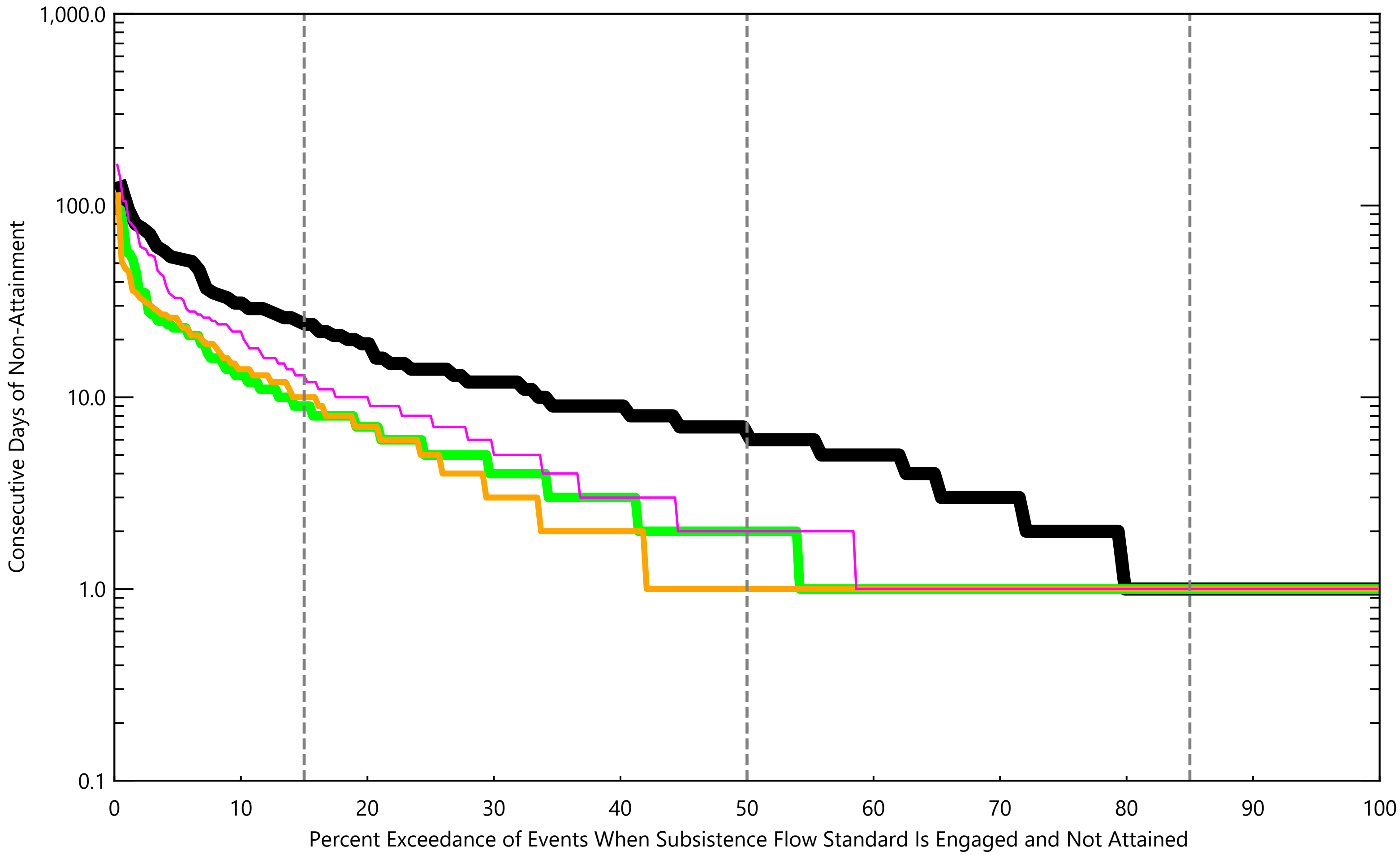
Figure E-113

Little River near Little River: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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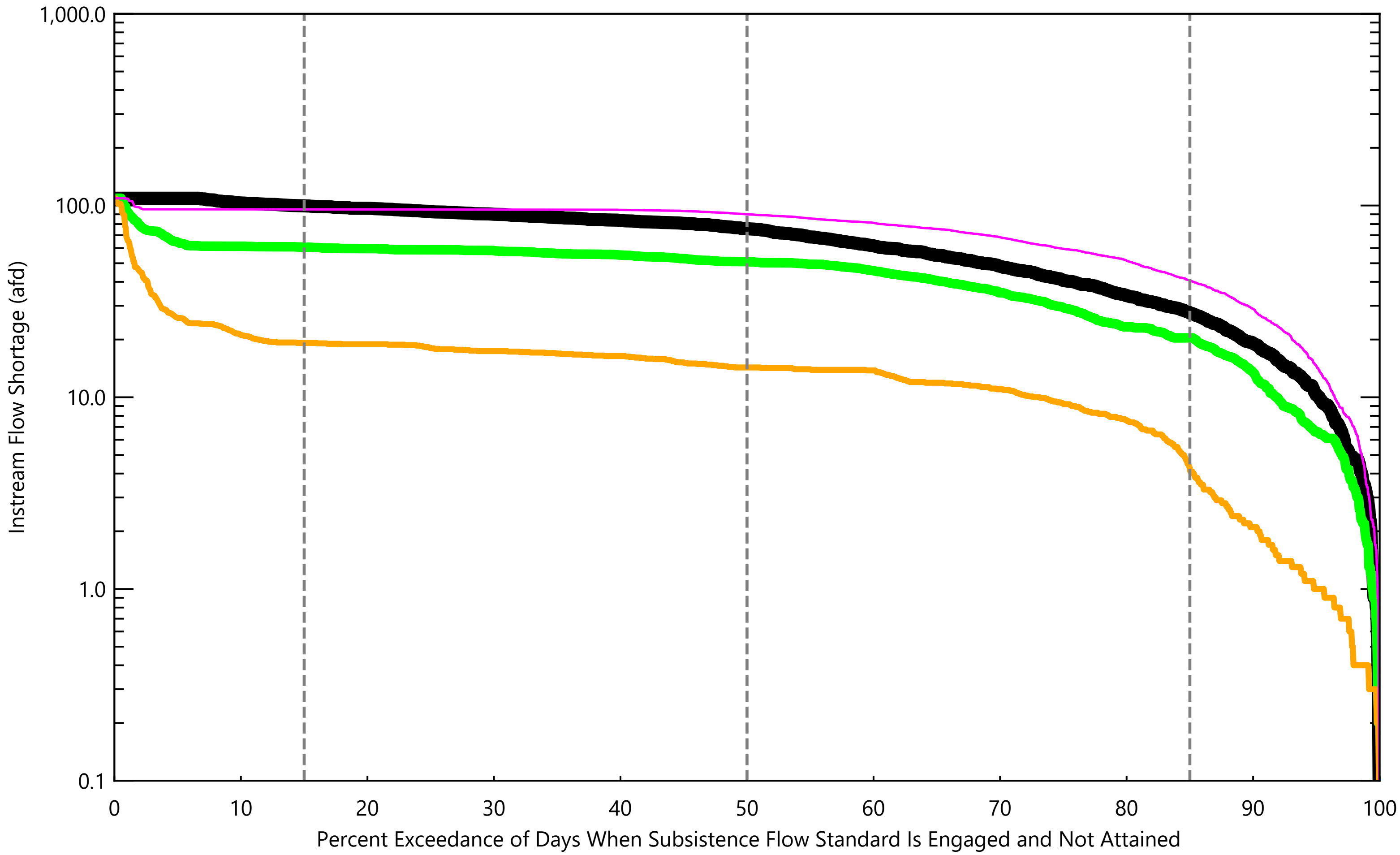
Figure E-114

Little River near Little River: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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Figure E-115
Little River near Little River: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

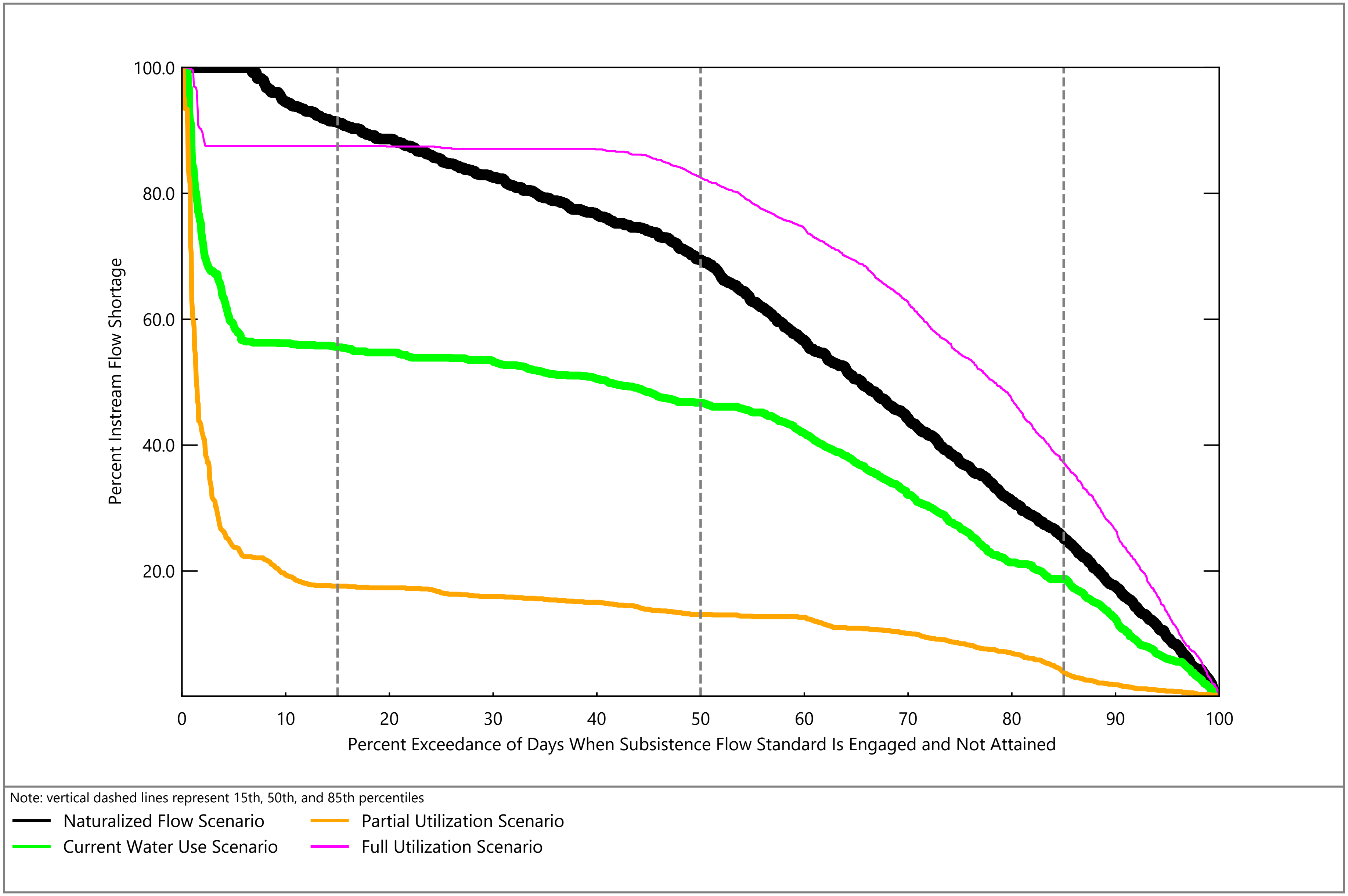

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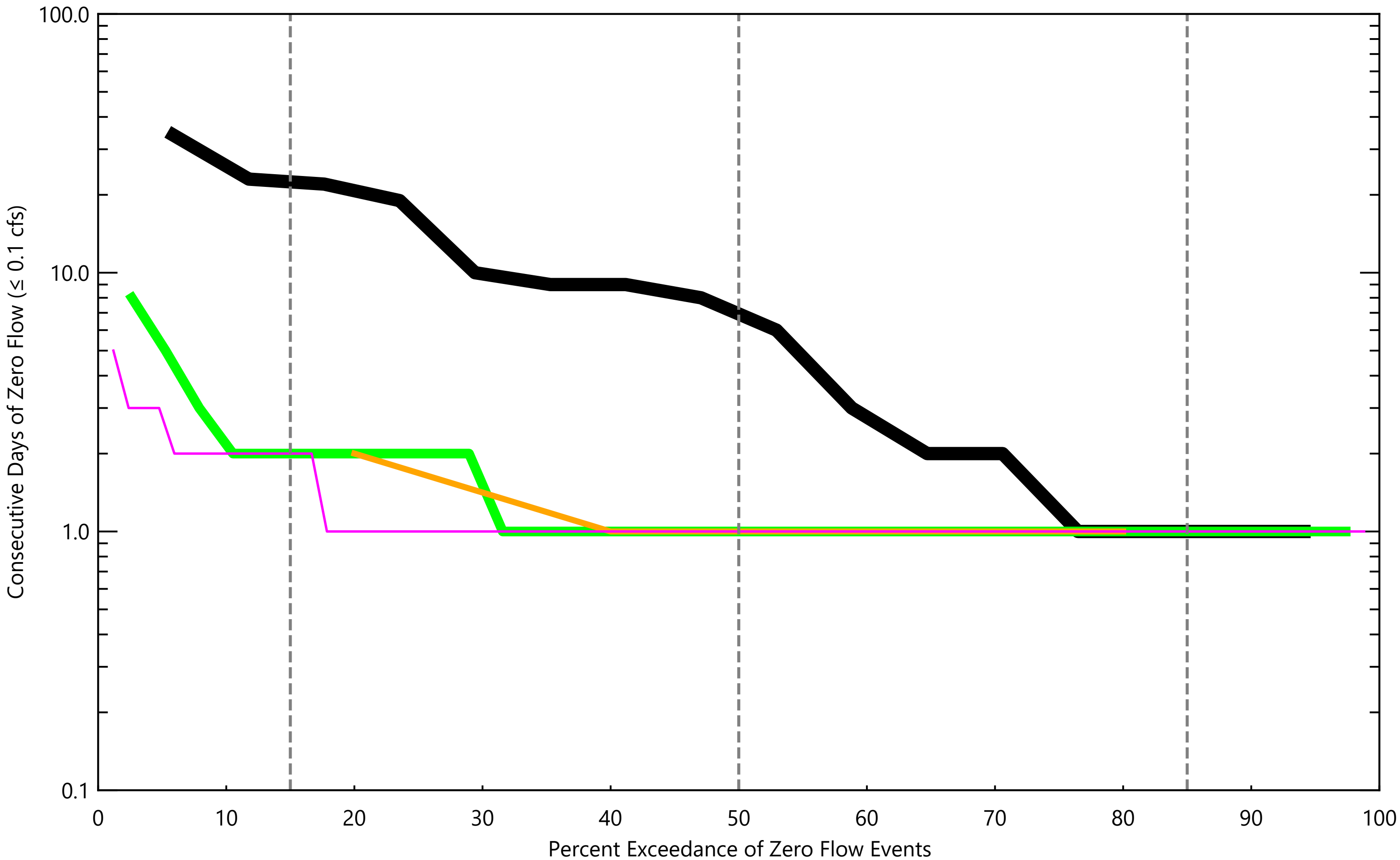
Figure E-116

Little River near Little River: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

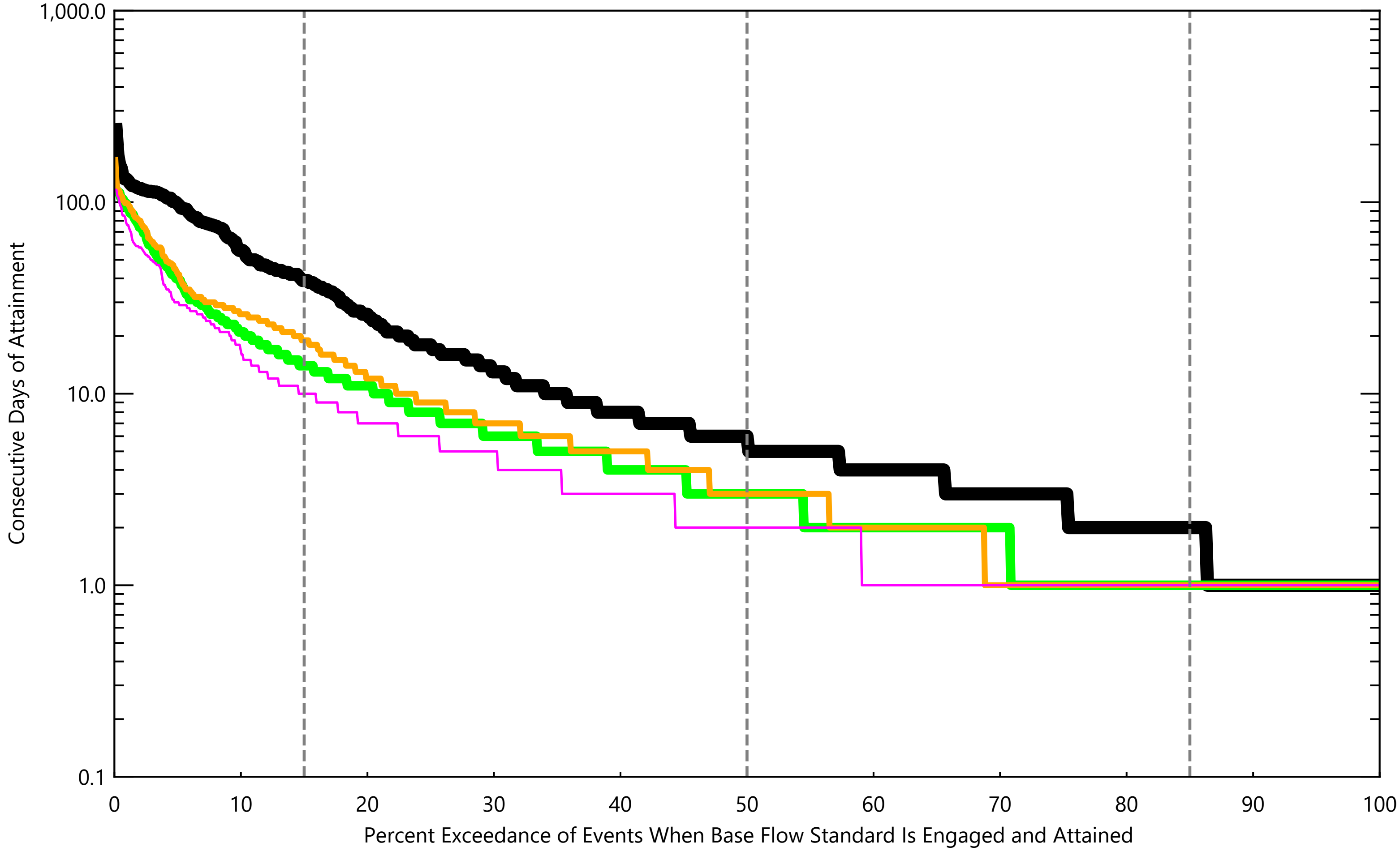
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-117
Little River near Little River: Zero-Flow Duration, Entire Period of Record (ZFD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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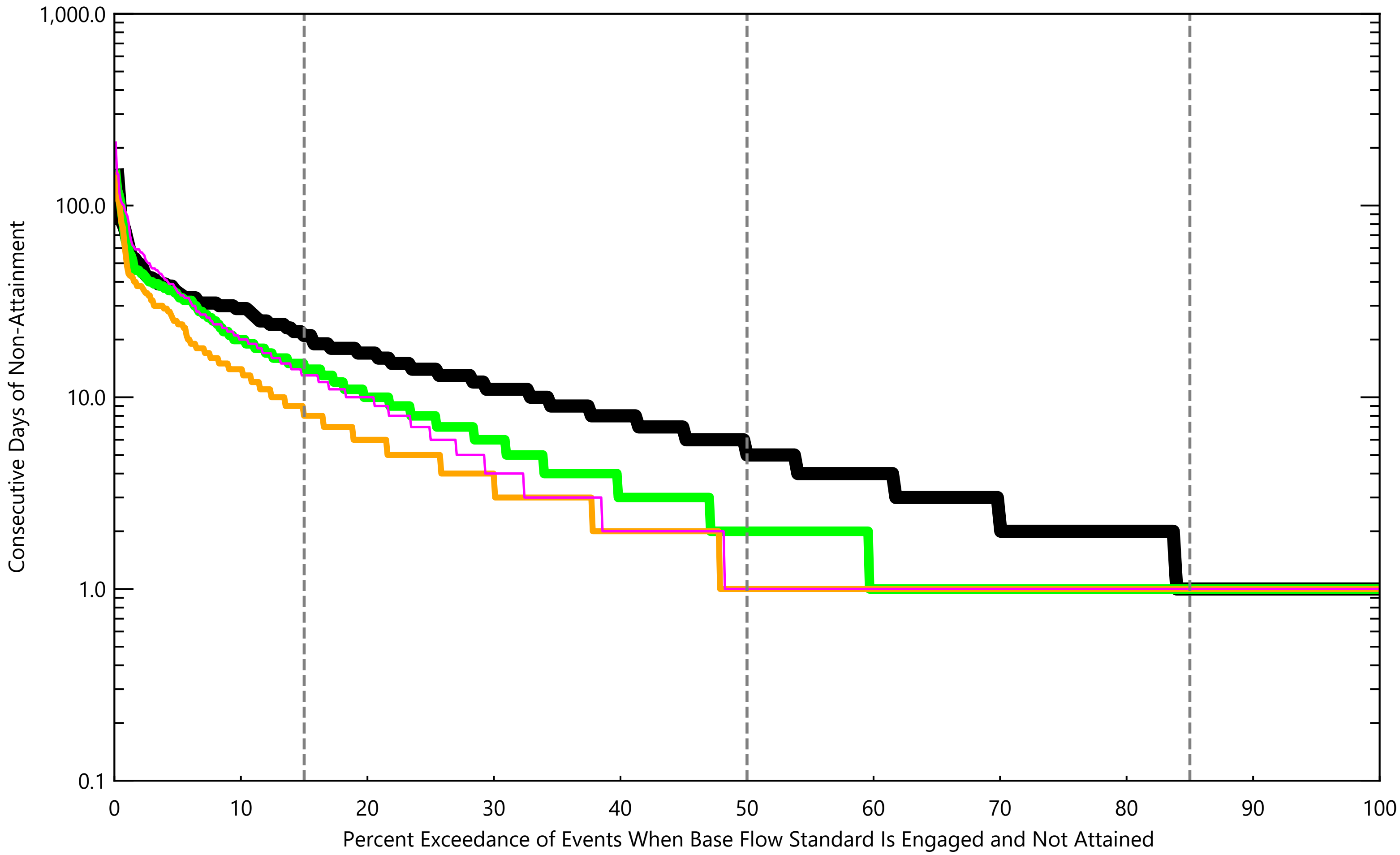
Figure E-118
Little River near Cameron: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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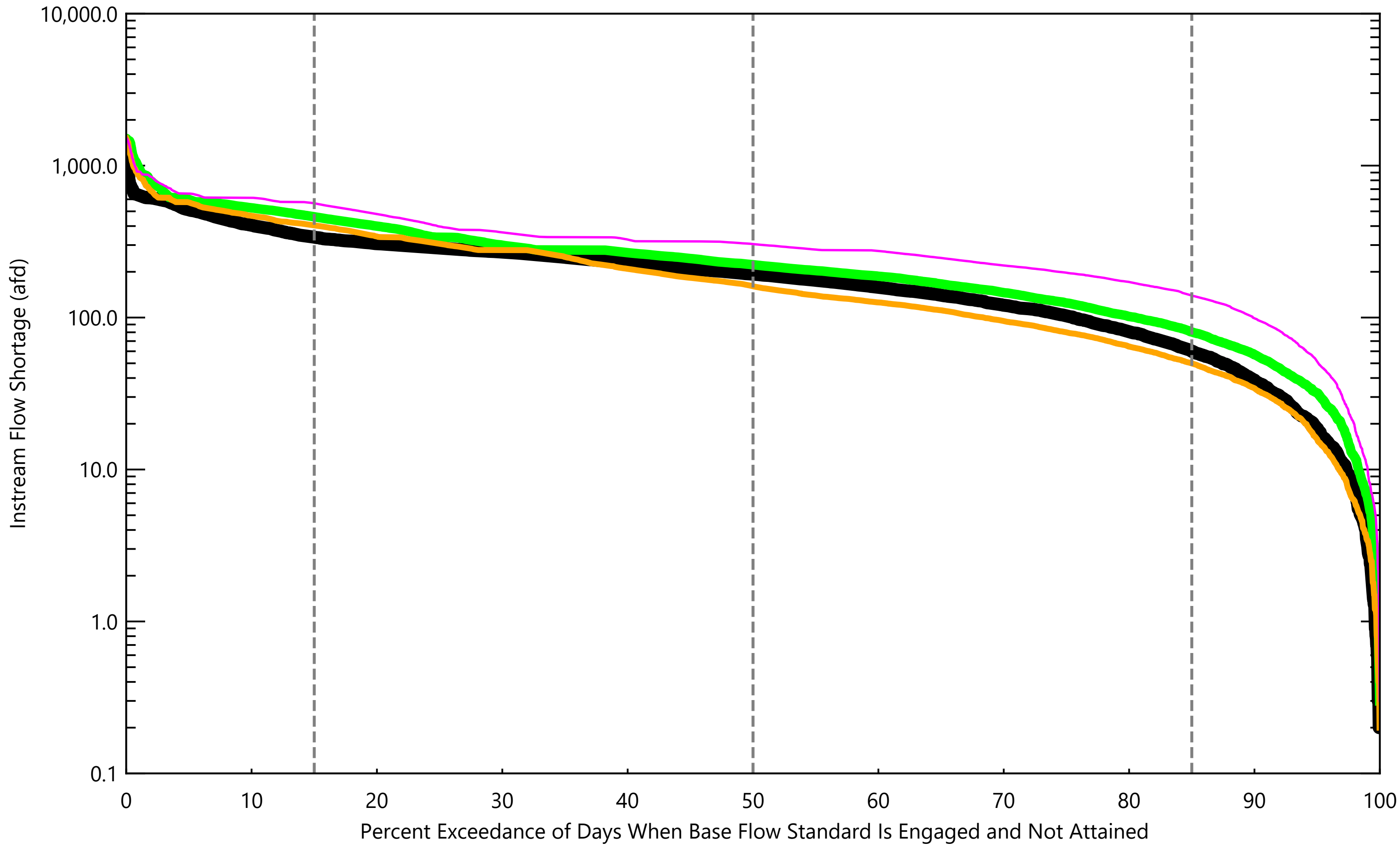
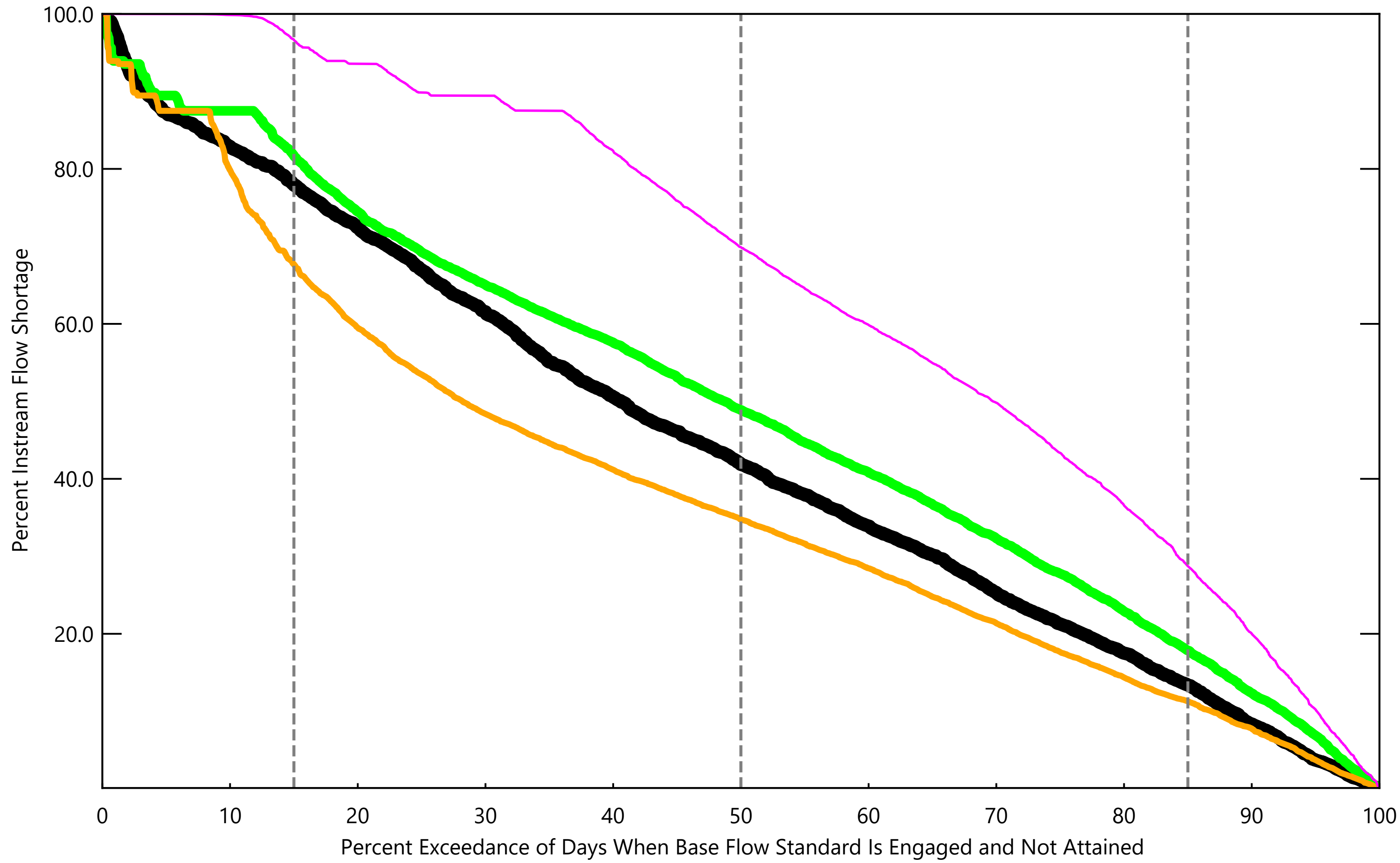
Figure E-119
Little River near Cameron: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-120
Little River near Cameron: Base Flow Shortage, Entire Period of Record (S-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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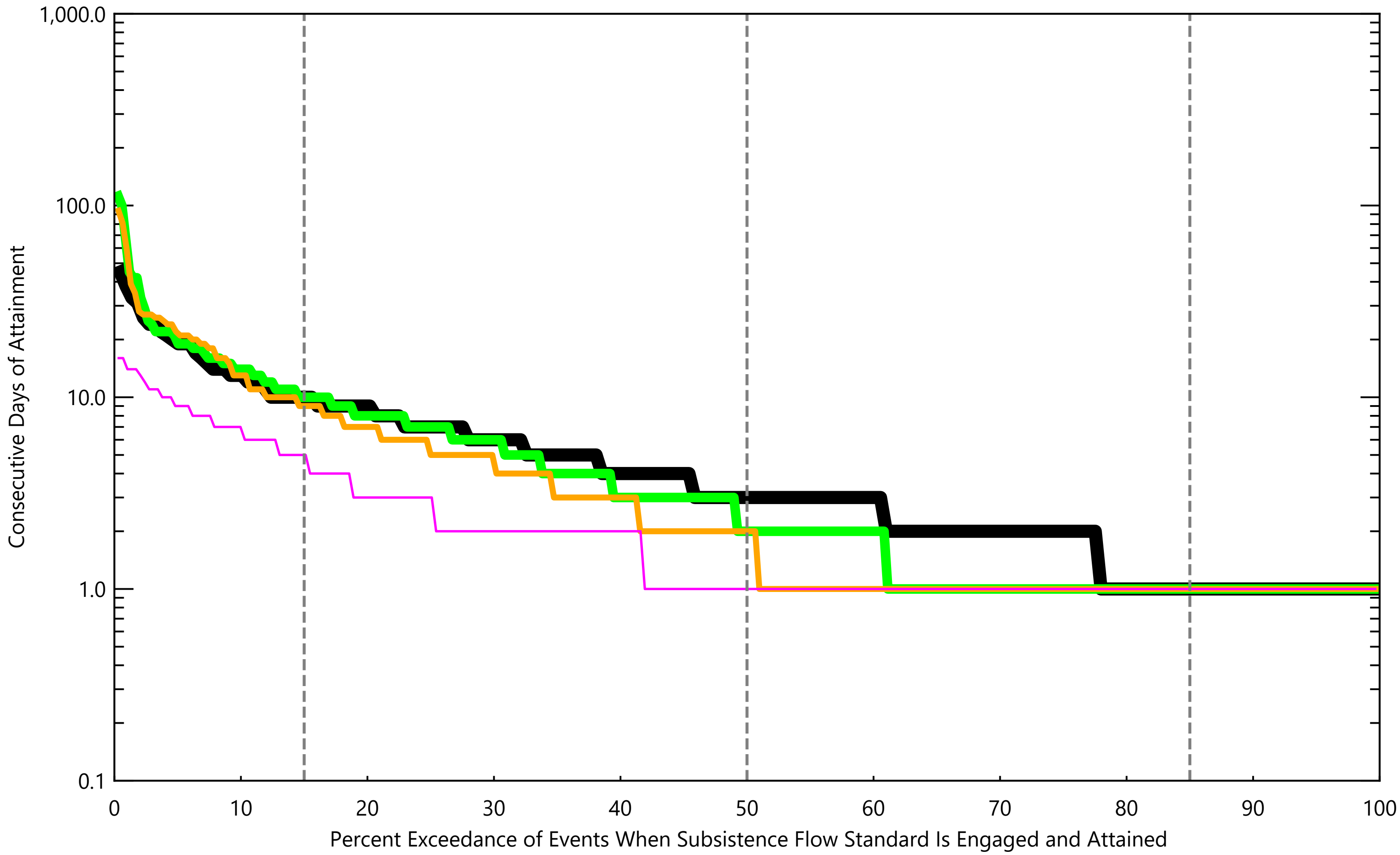
Figure E-121
Little River near Cameron: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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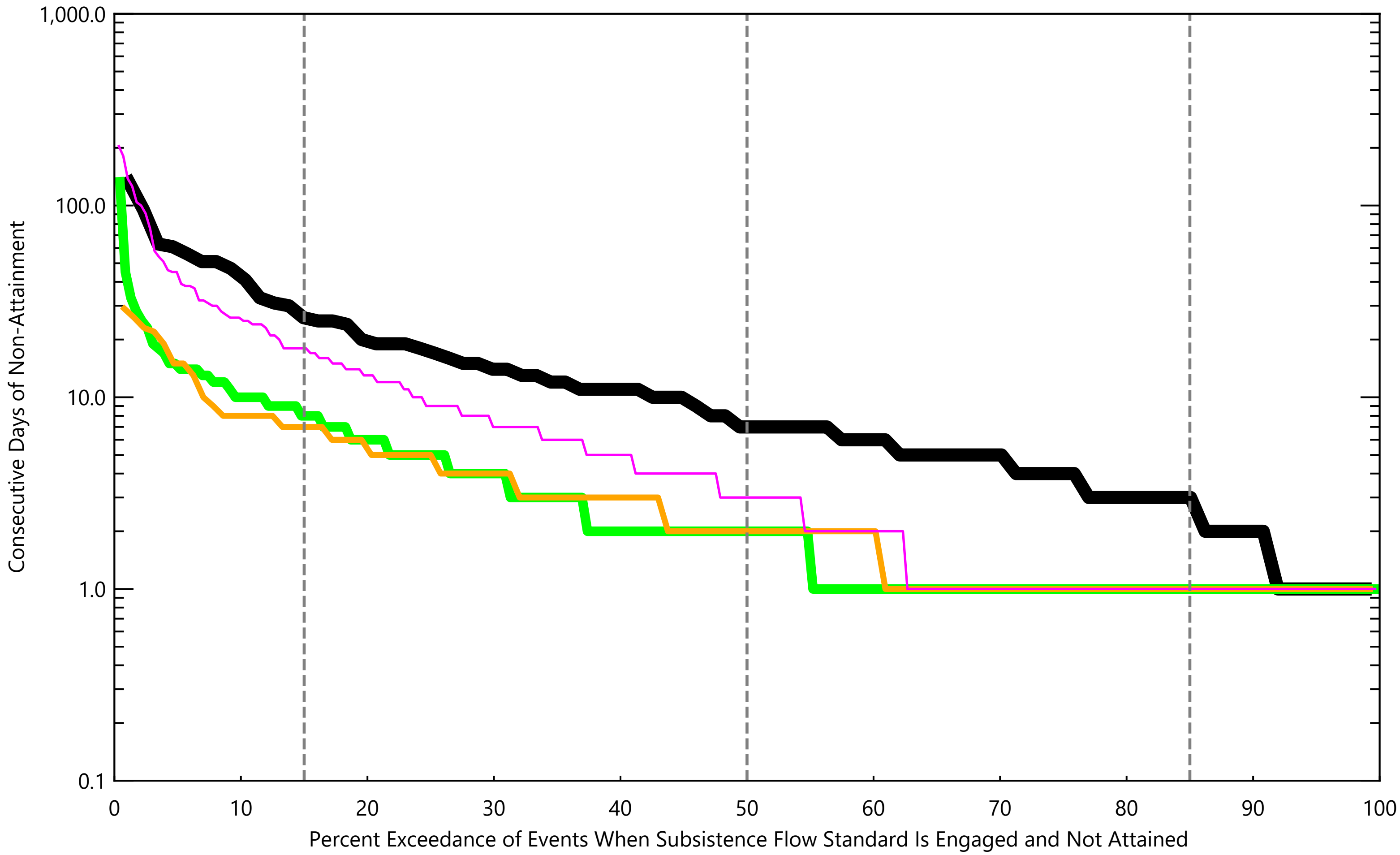
Figure E-122
Little River near Cameron: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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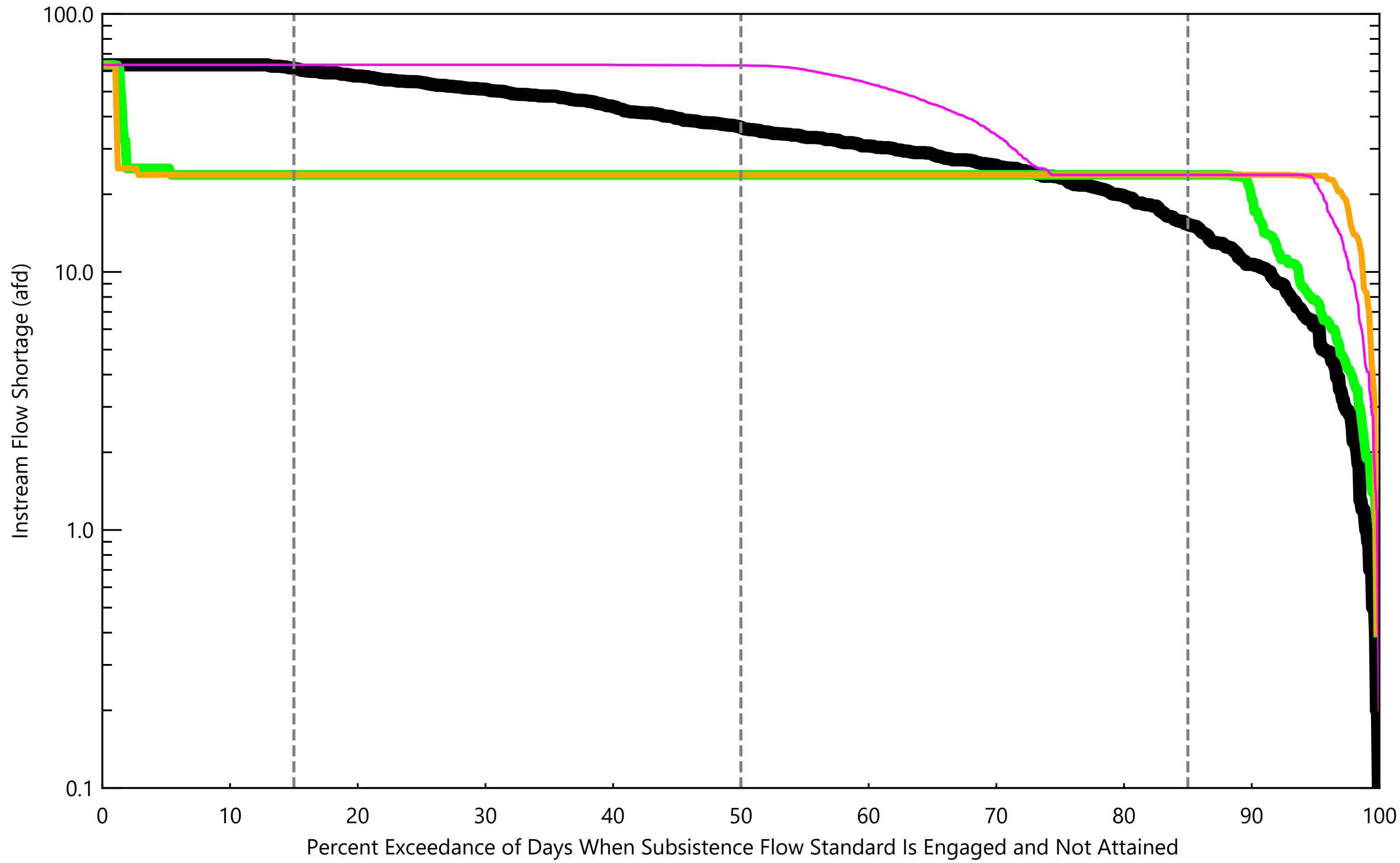
Figure E-123
Little River near Cameron: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario — Partial Utilization Scenario

Current Water Use Scenario — Full Utilization Scenario

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Figure E-124

Little River near Cameron: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards

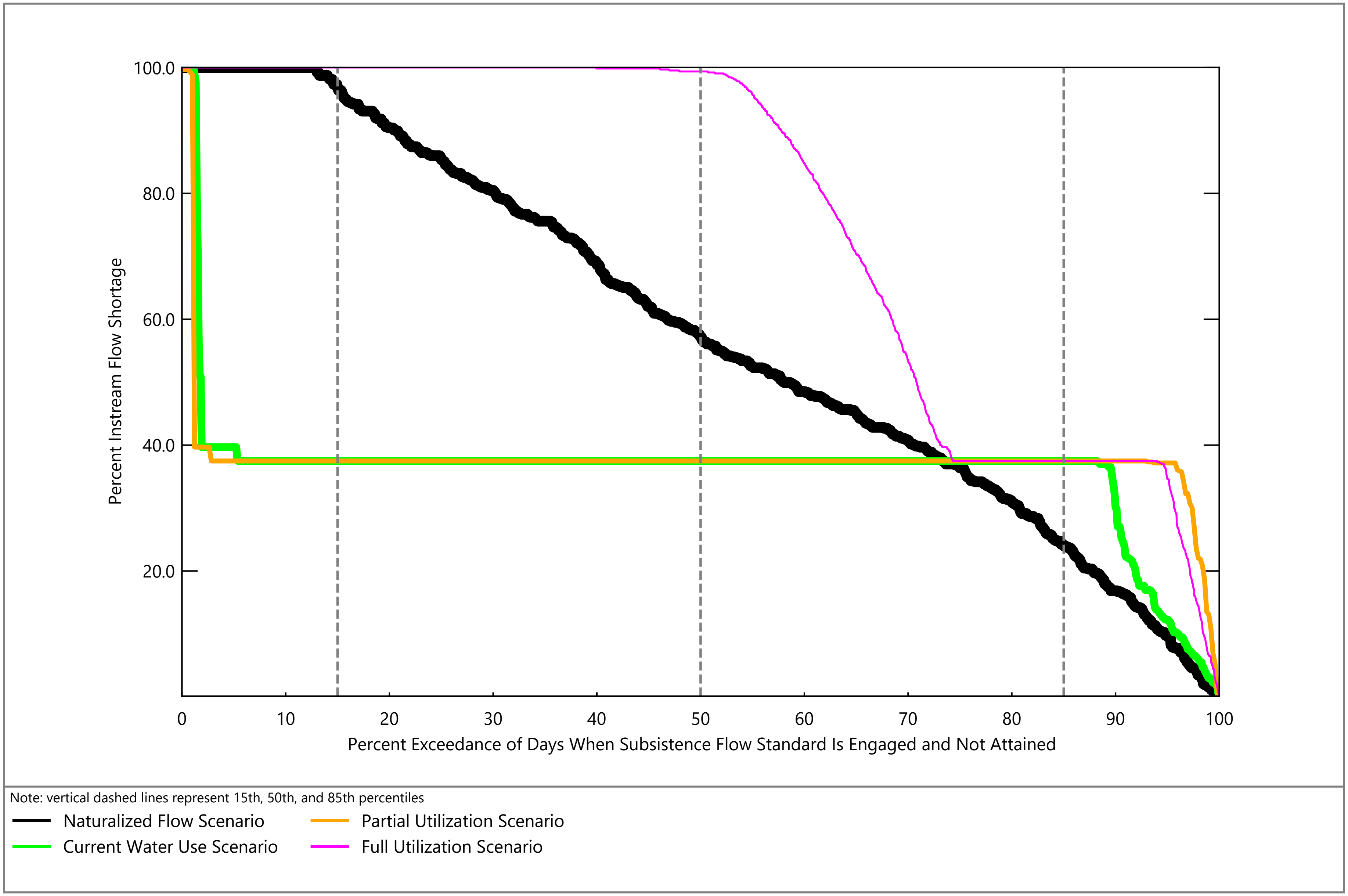

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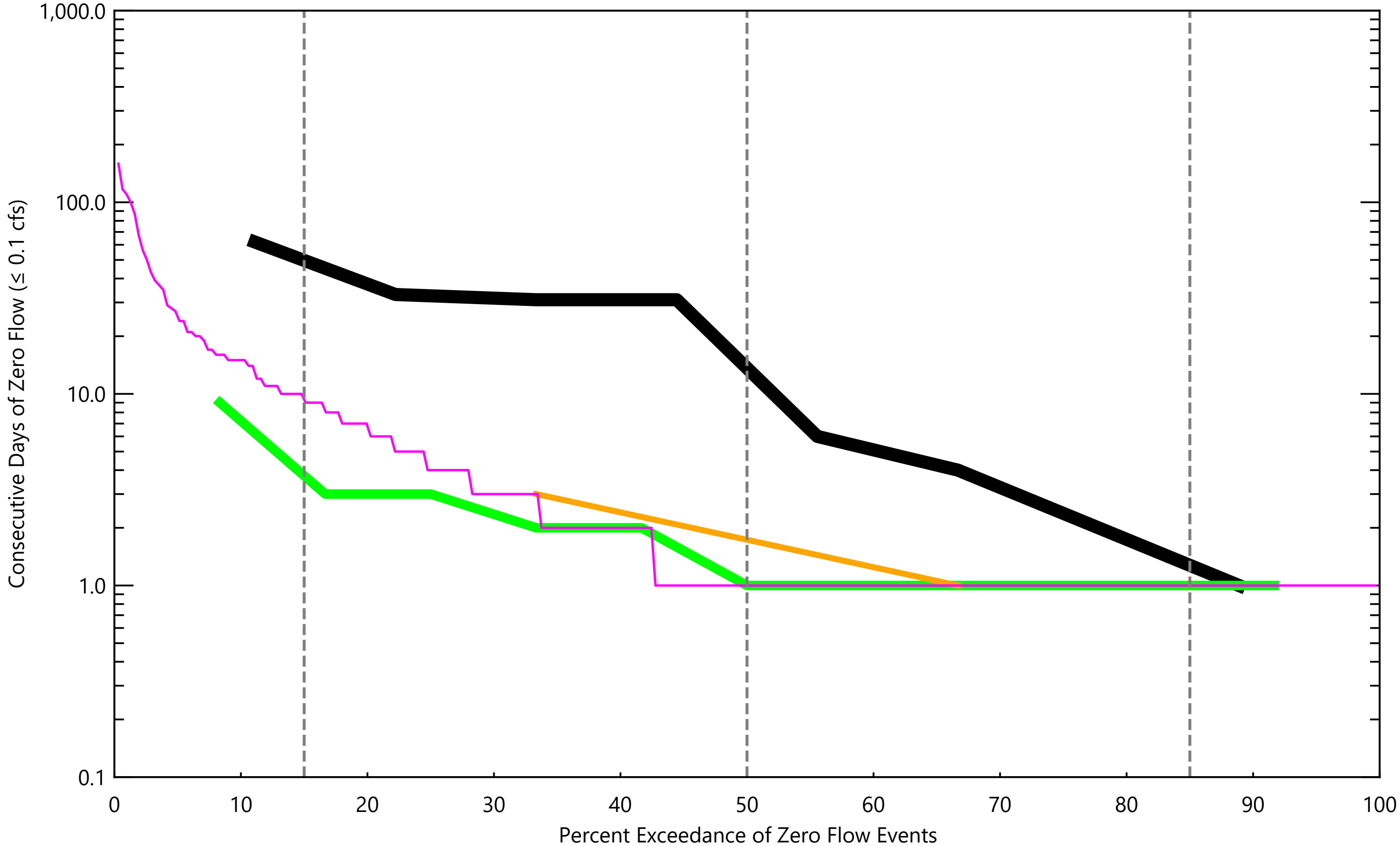
Figure E-125

Little River near Cameron: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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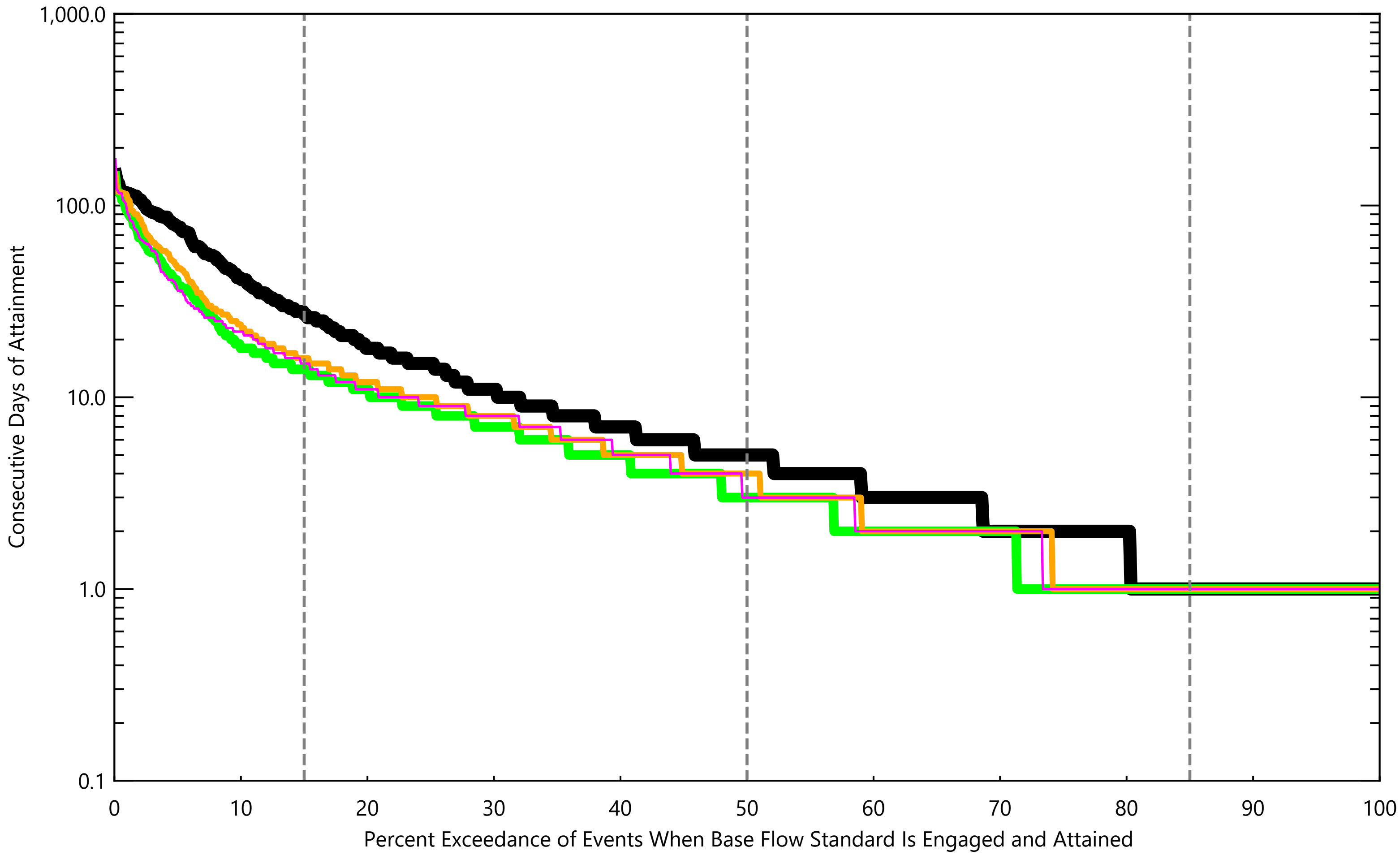
Figure E-126
Little River near Cameron: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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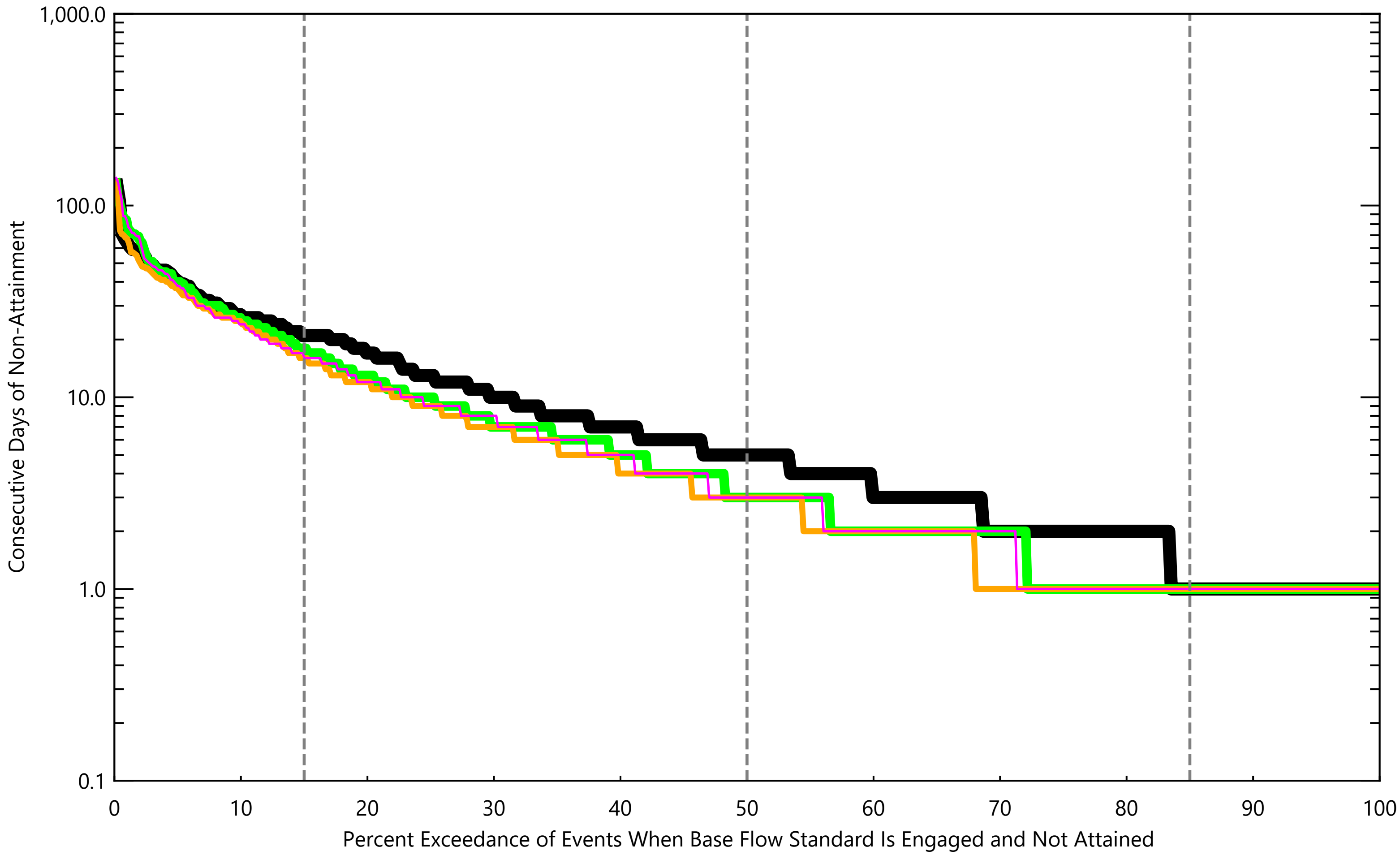
Figure E-127

Brazos River near Bryan: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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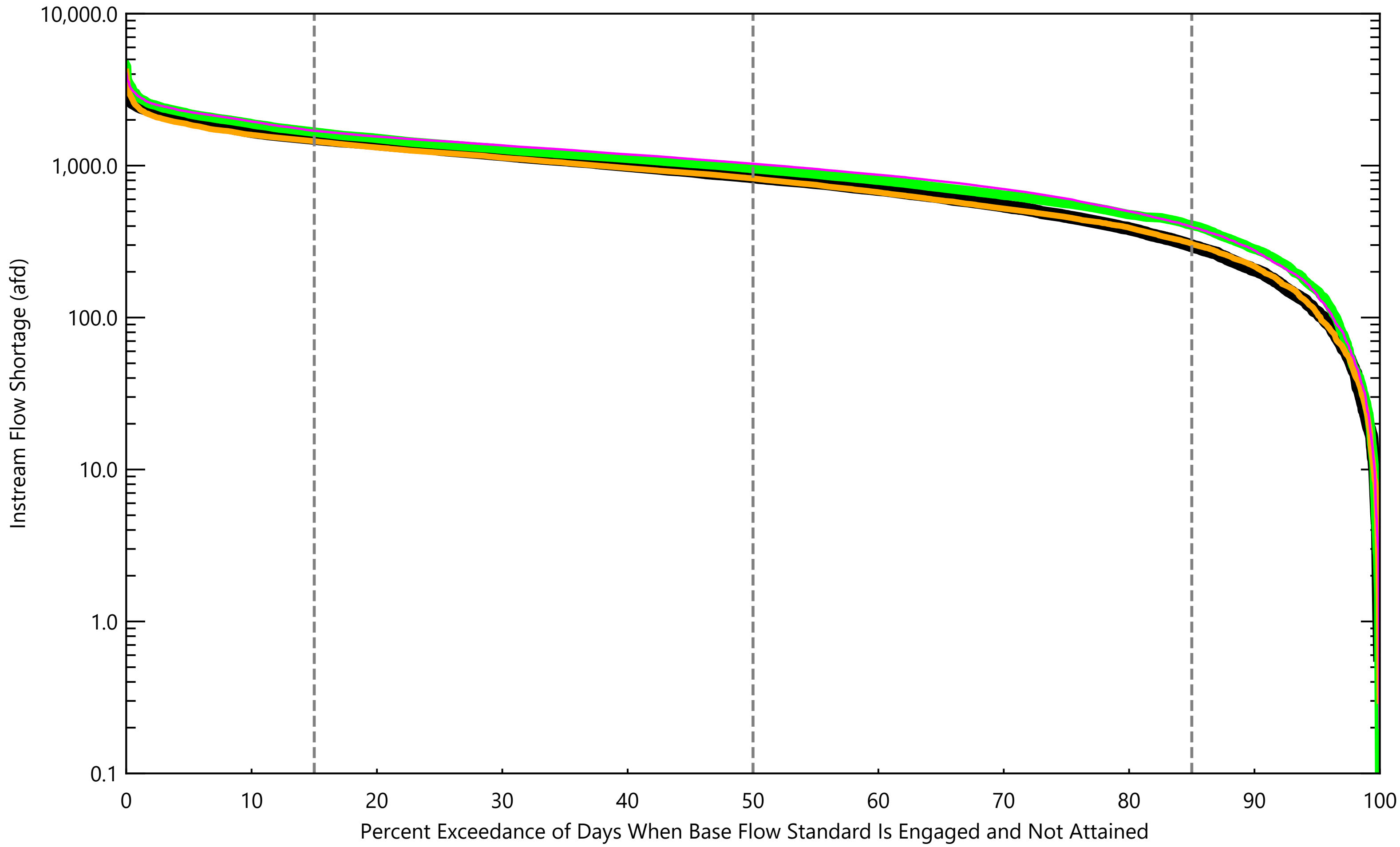
Figure E-128
Brazos River near Bryan: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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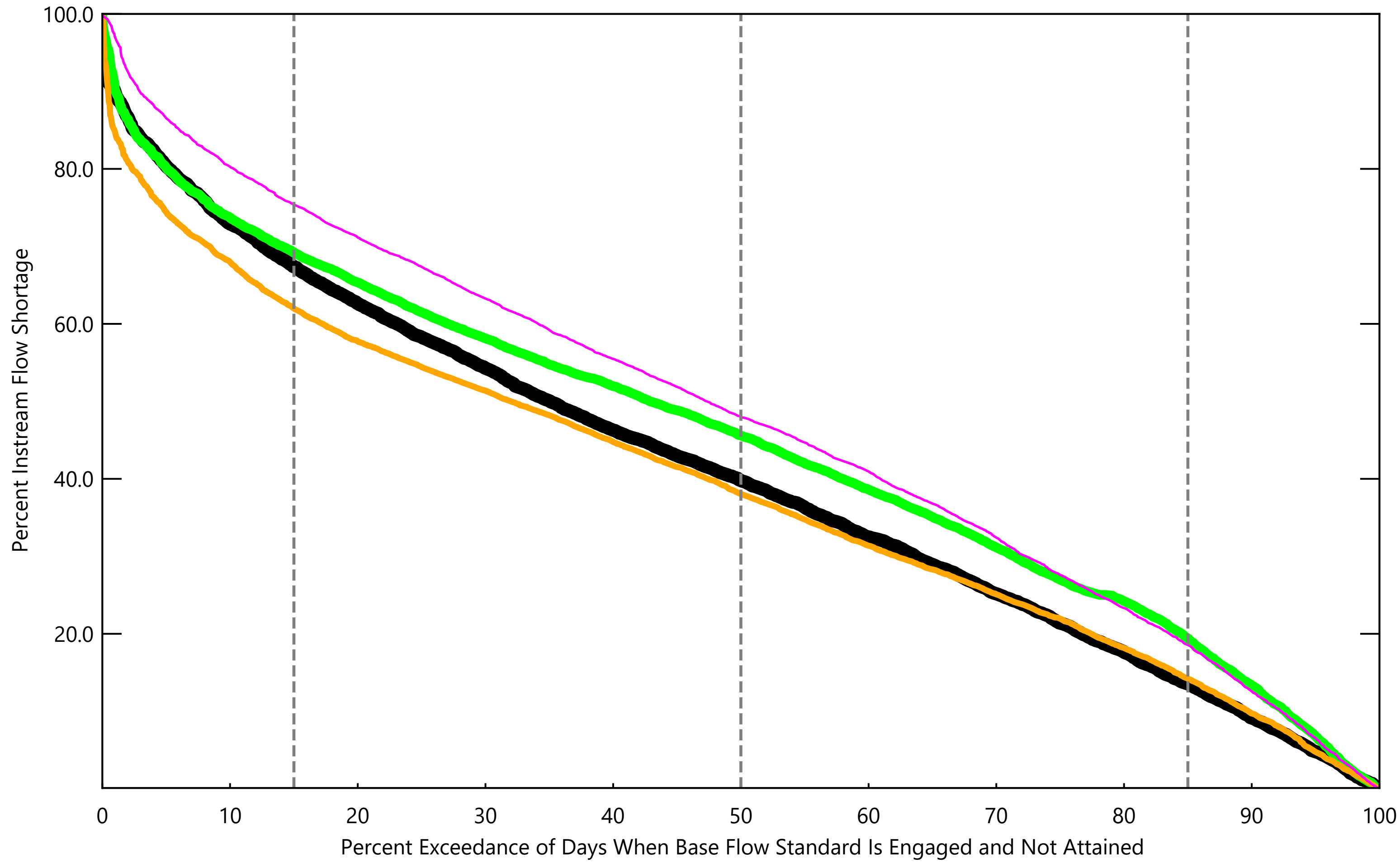
Figure E-129
Brazos River near Bryan: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario — Partial Utilization Scenario
Current Water Use Scenario — Full Utilization Scenario

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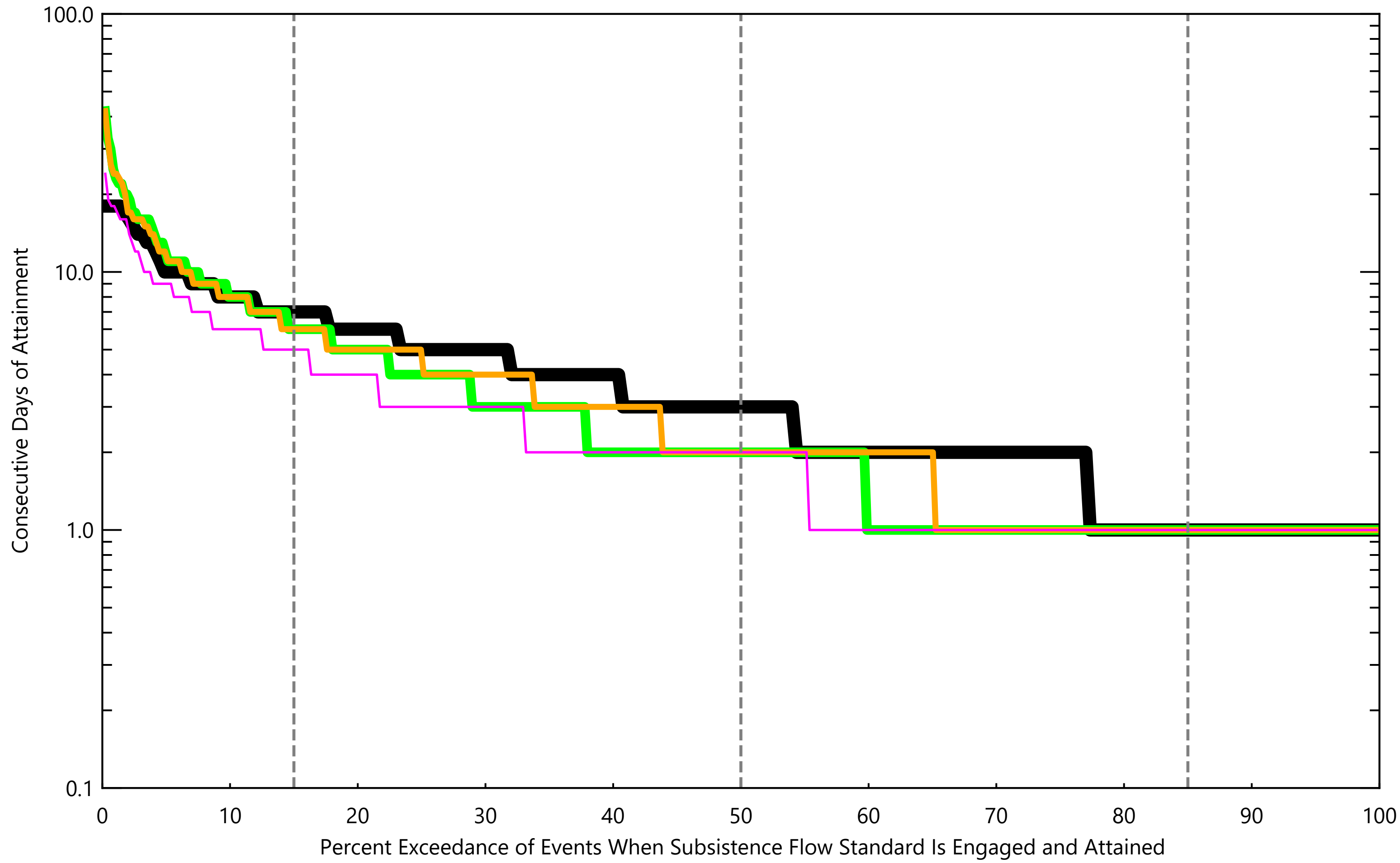
Figure E-130
Brazos River near Bryan: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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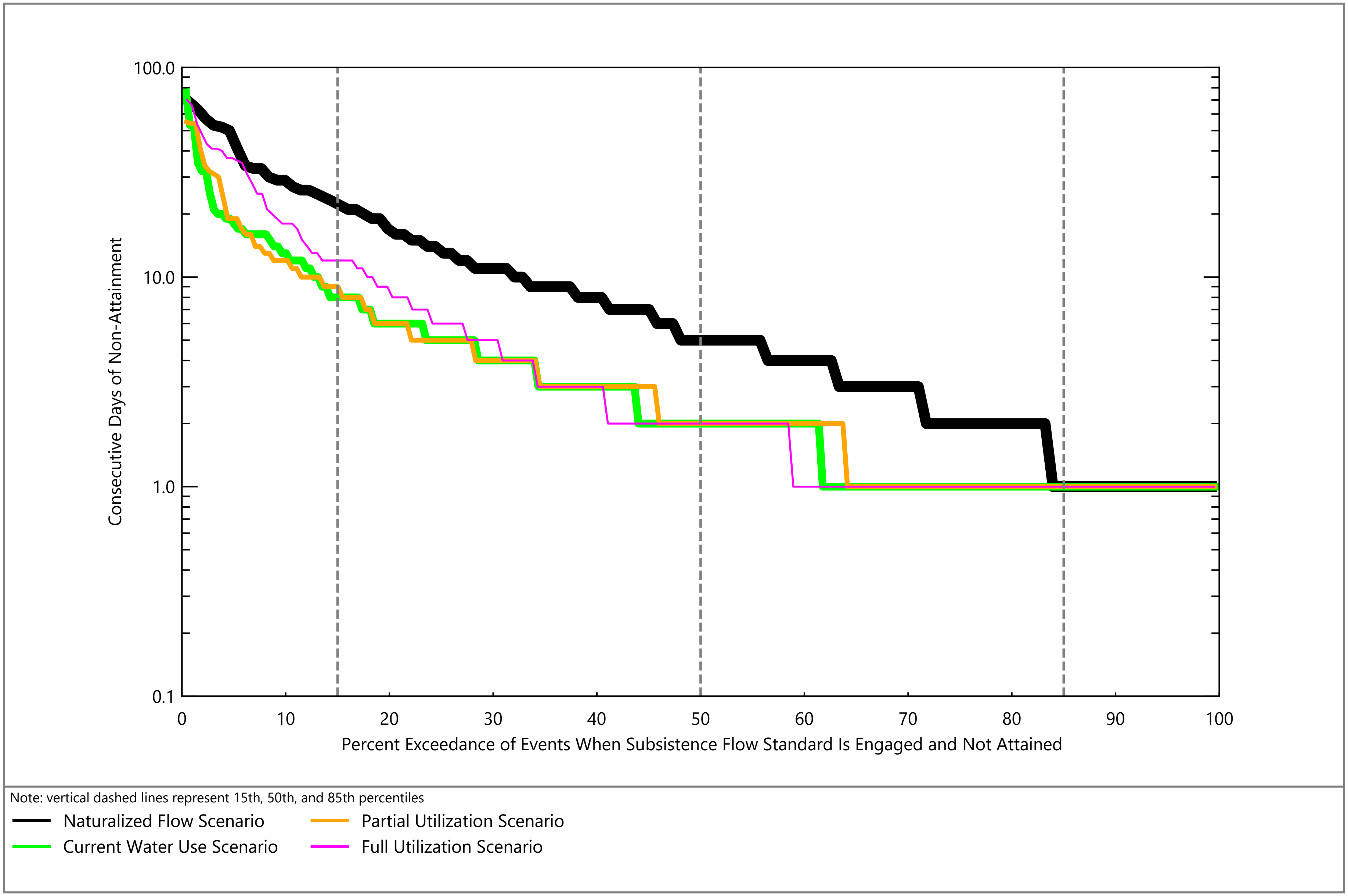
Figure E-131

Brazos River near Bryan: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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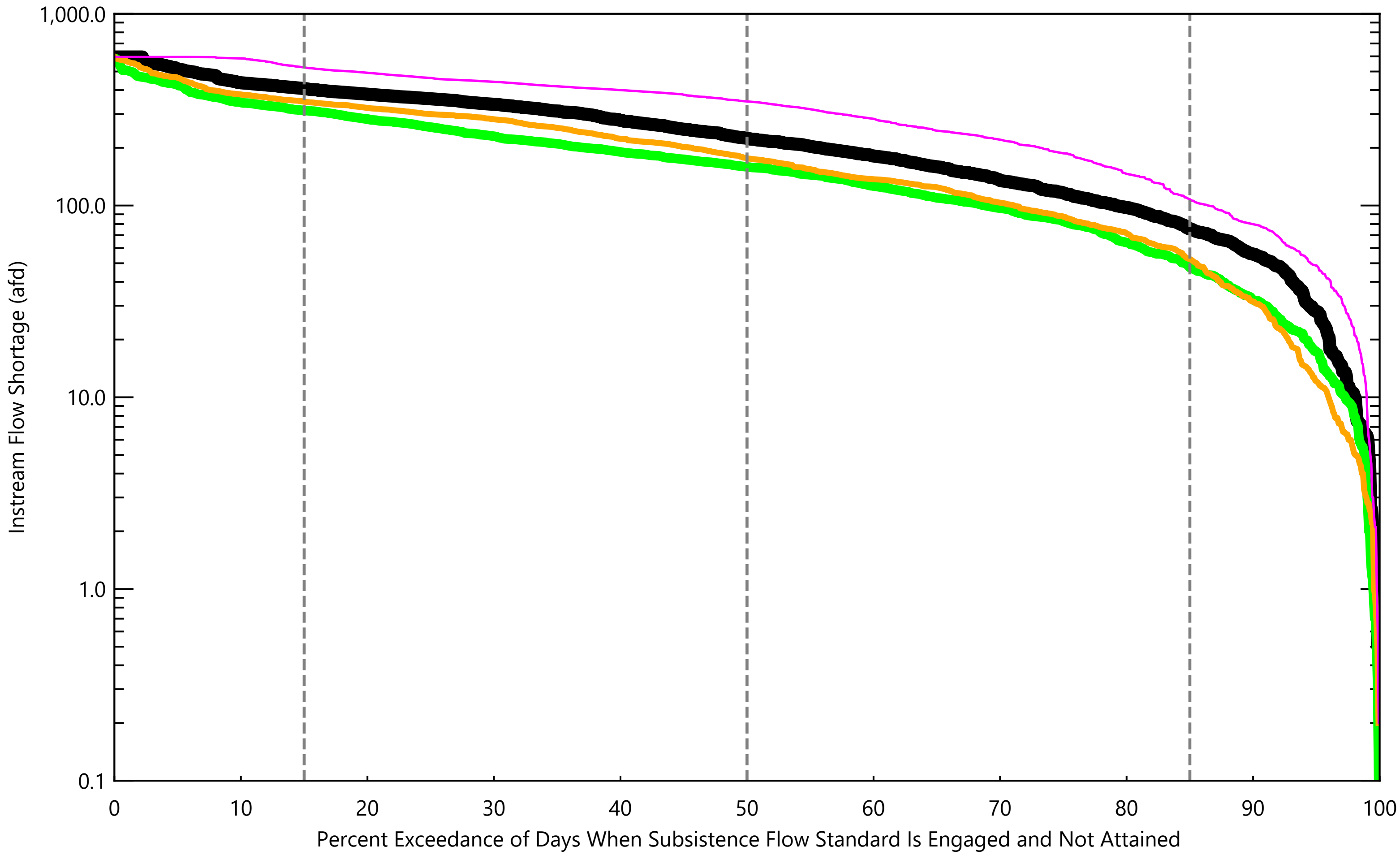
Figure E-132

Brazos River near Bryan: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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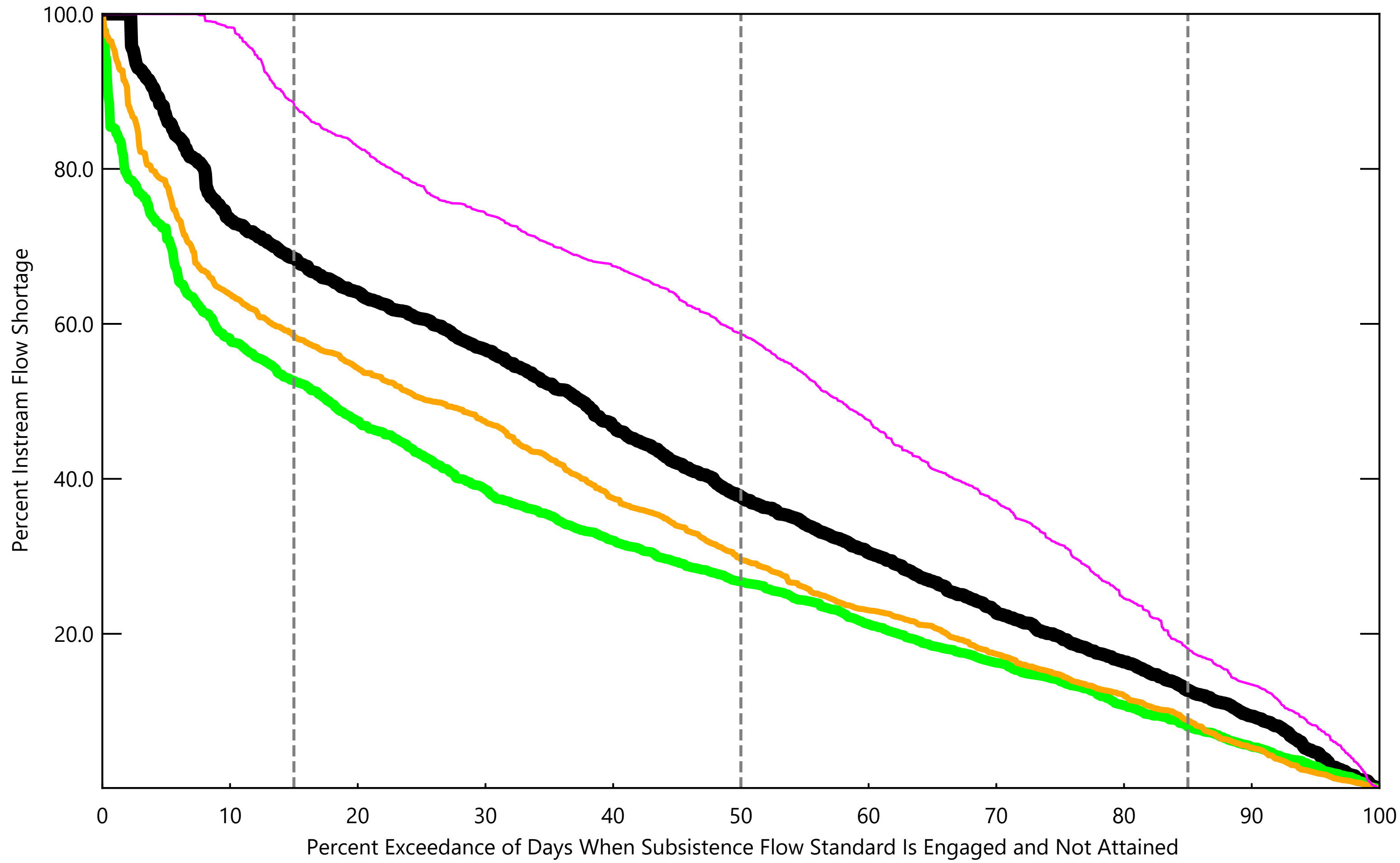
Figure E-133

Brazos River near Bryan: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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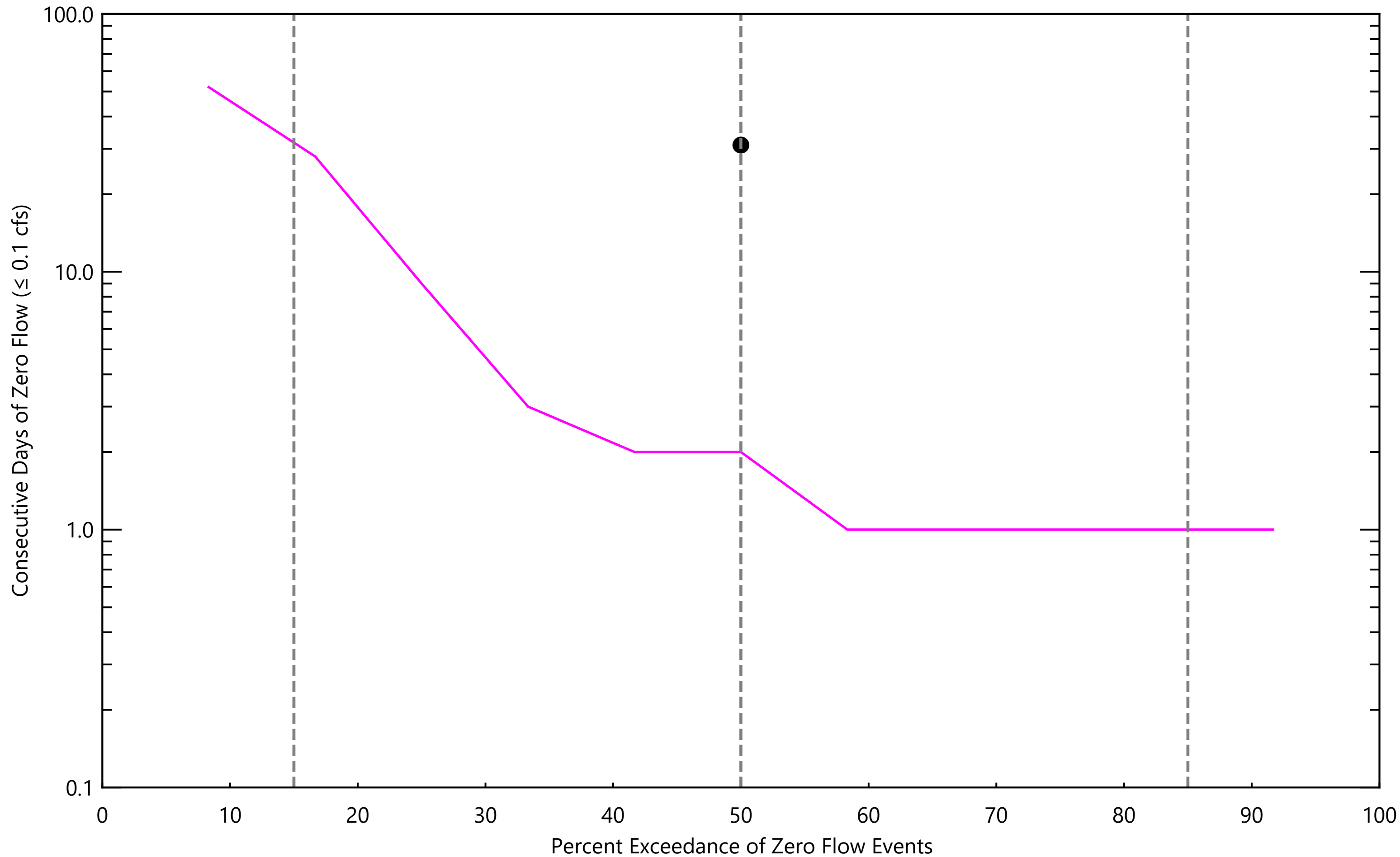
Figure E-134
Brazos River near Bryan: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

● Naturalized Flow Scenario

— Full Utilization Scenario

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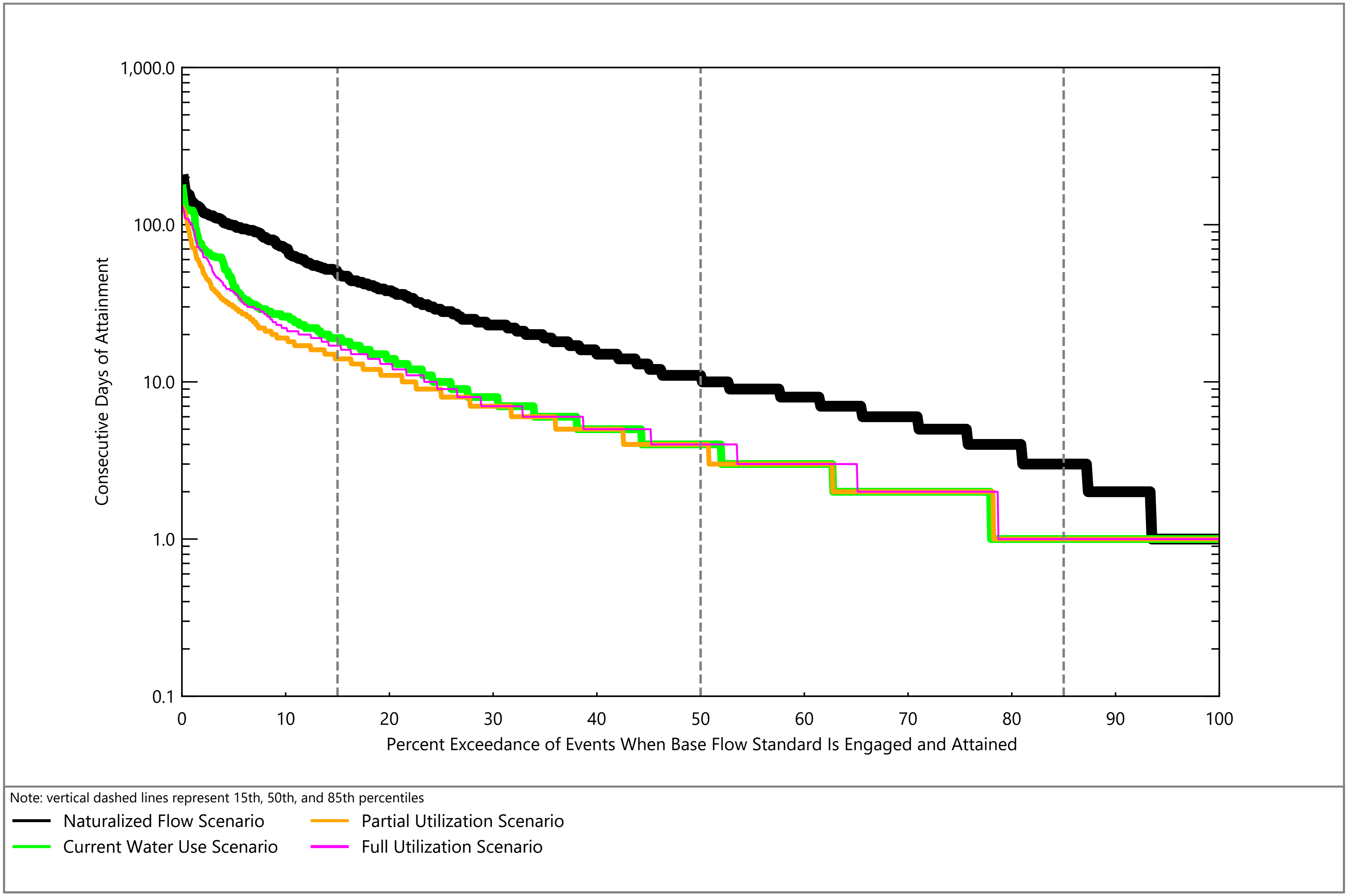
Figure E-135

Brazos River near Bryan: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:11 PM | User: JH
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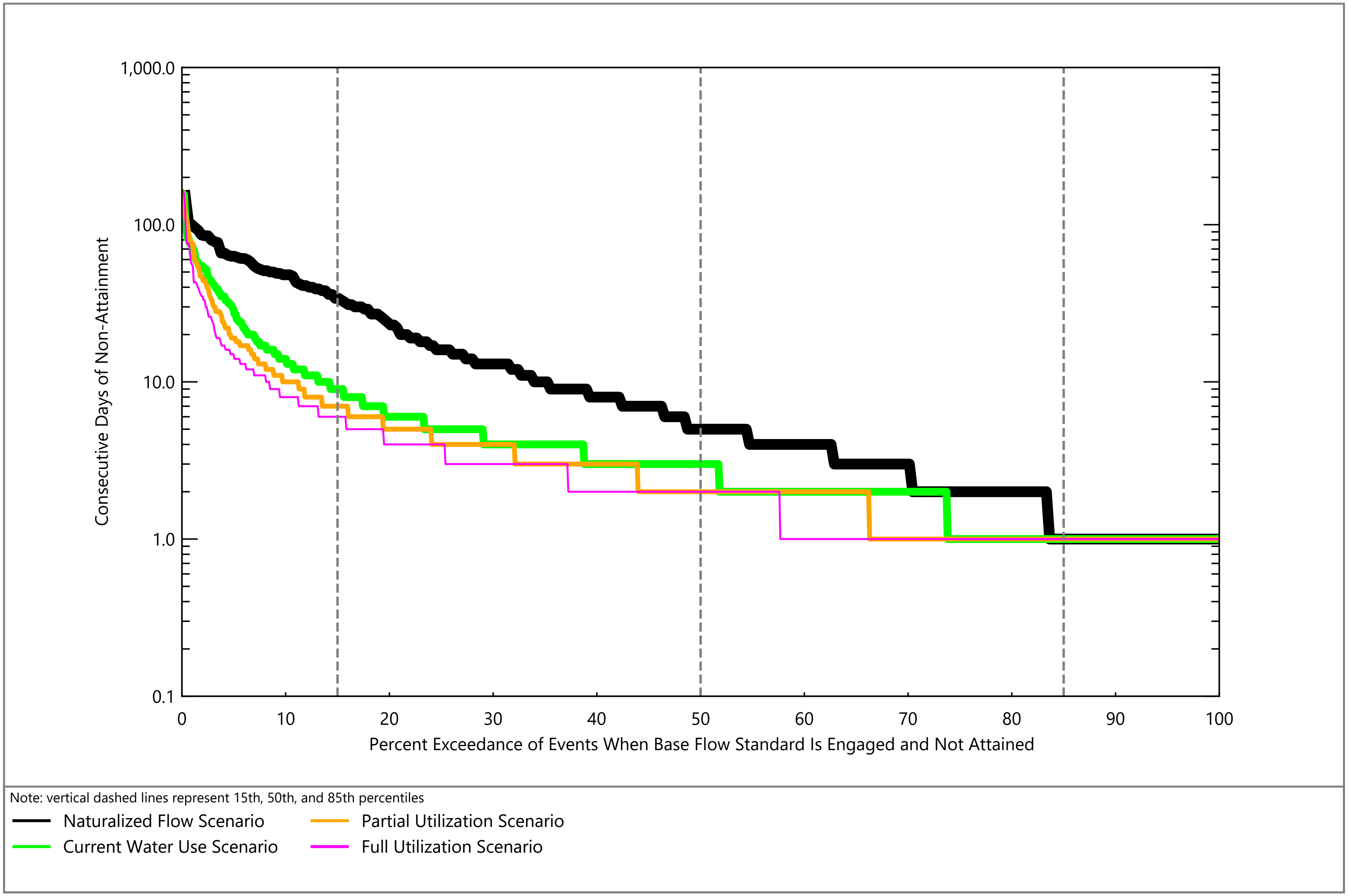
Figure E-136

Navasota River near Easterly: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:11 PM | User: JH
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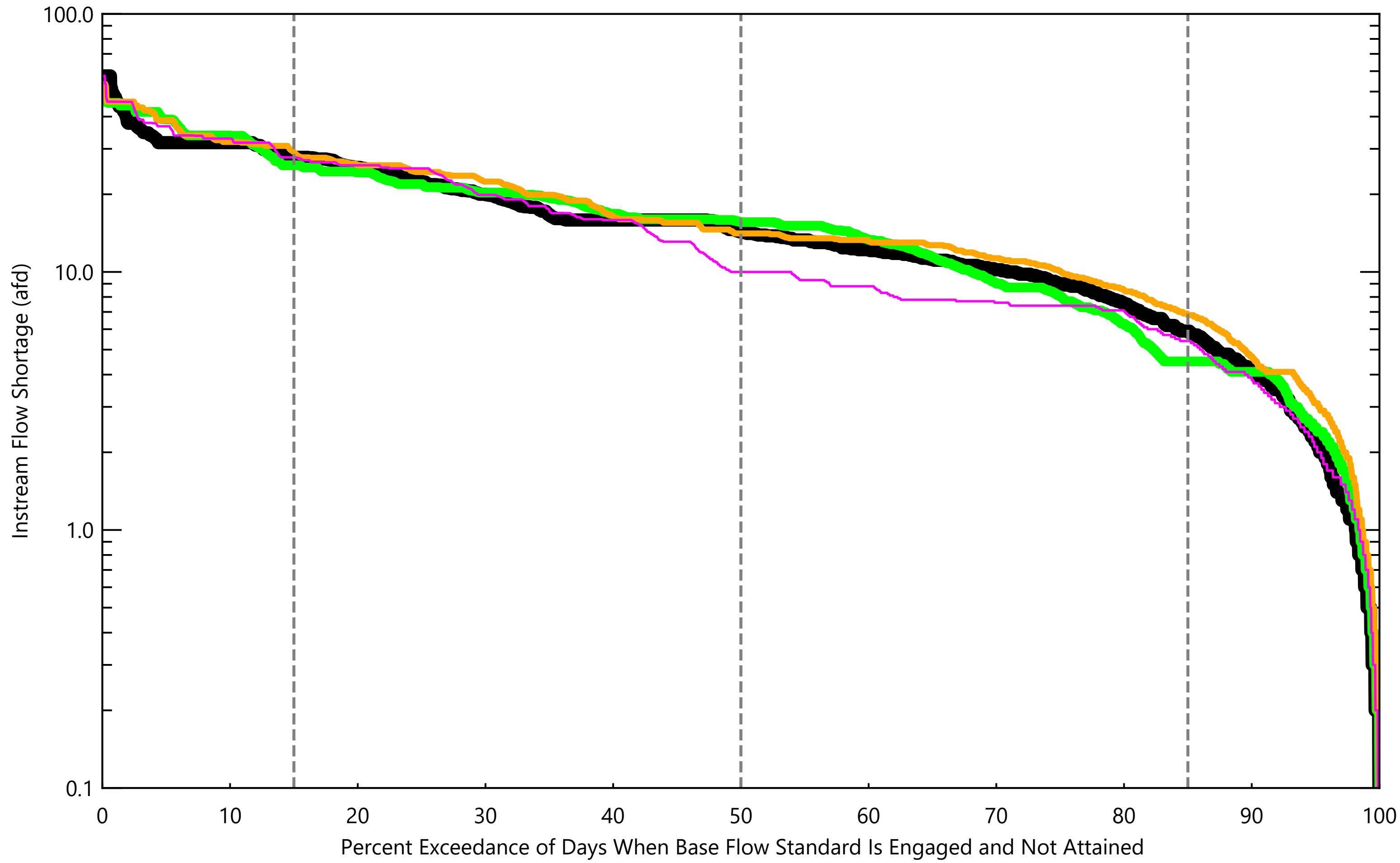
Figure E-137

Navasota River near Easterly: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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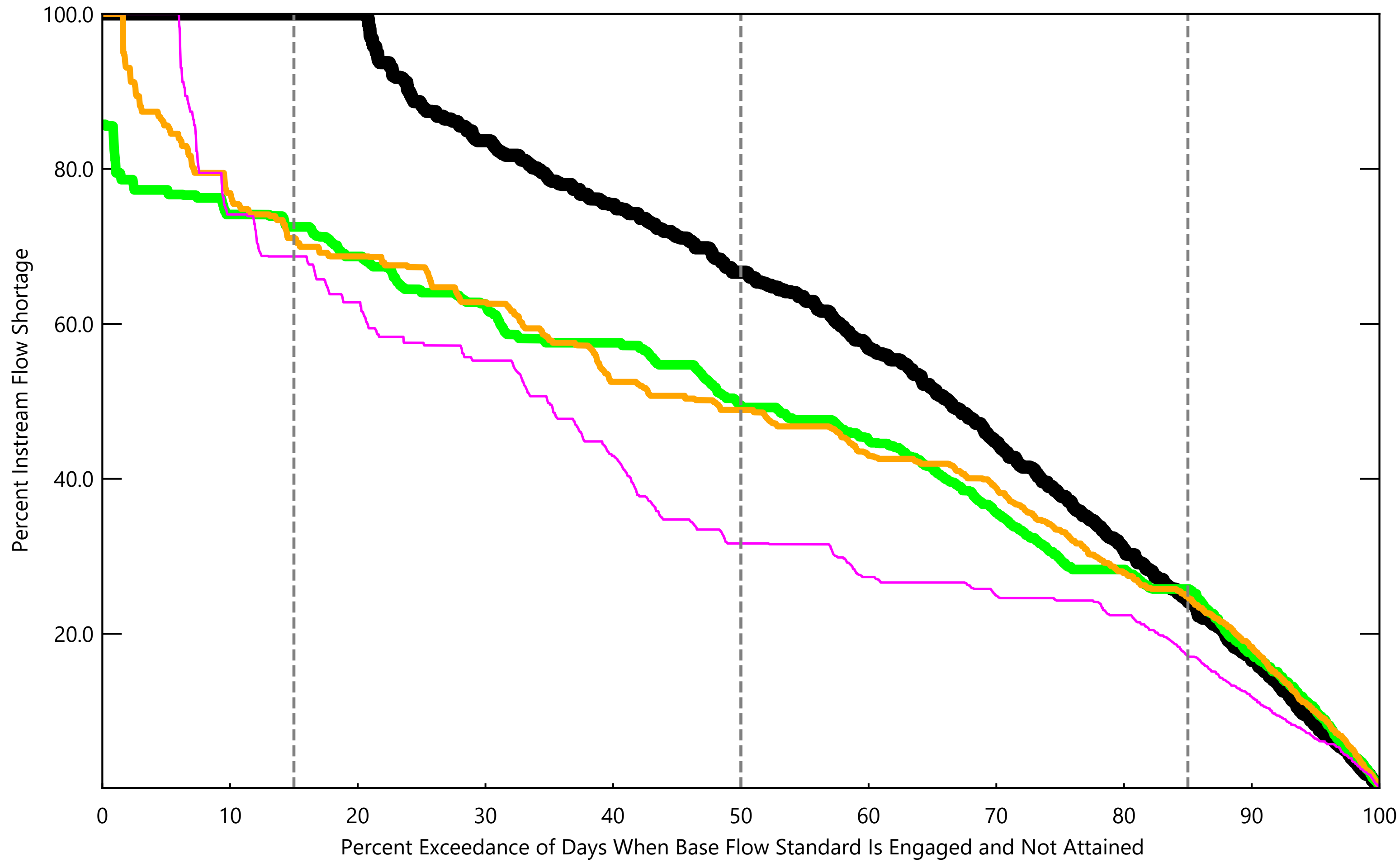
Figure E-138
Navasota River near Easterly: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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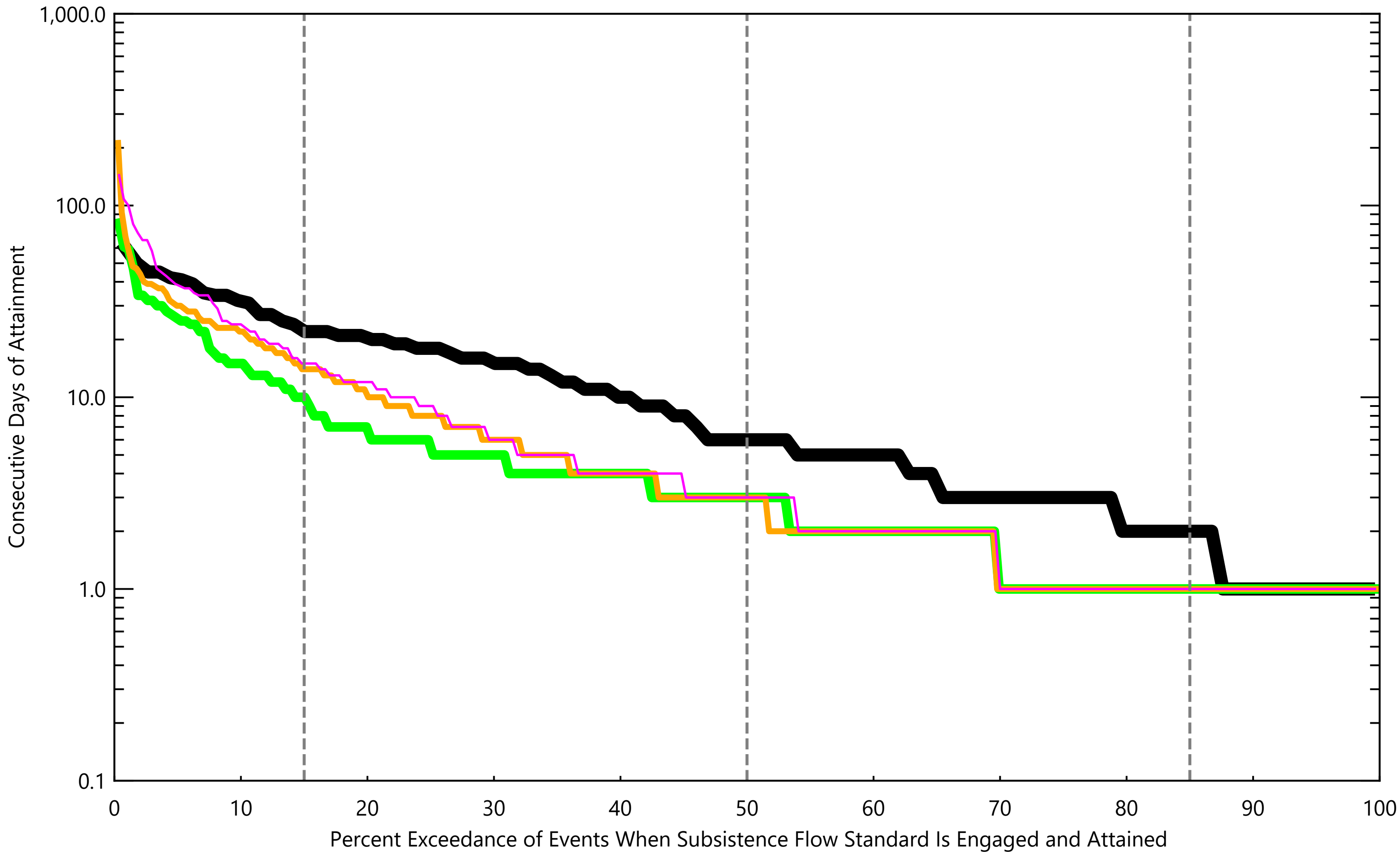
Figure E-139

Navasota River near Easterly: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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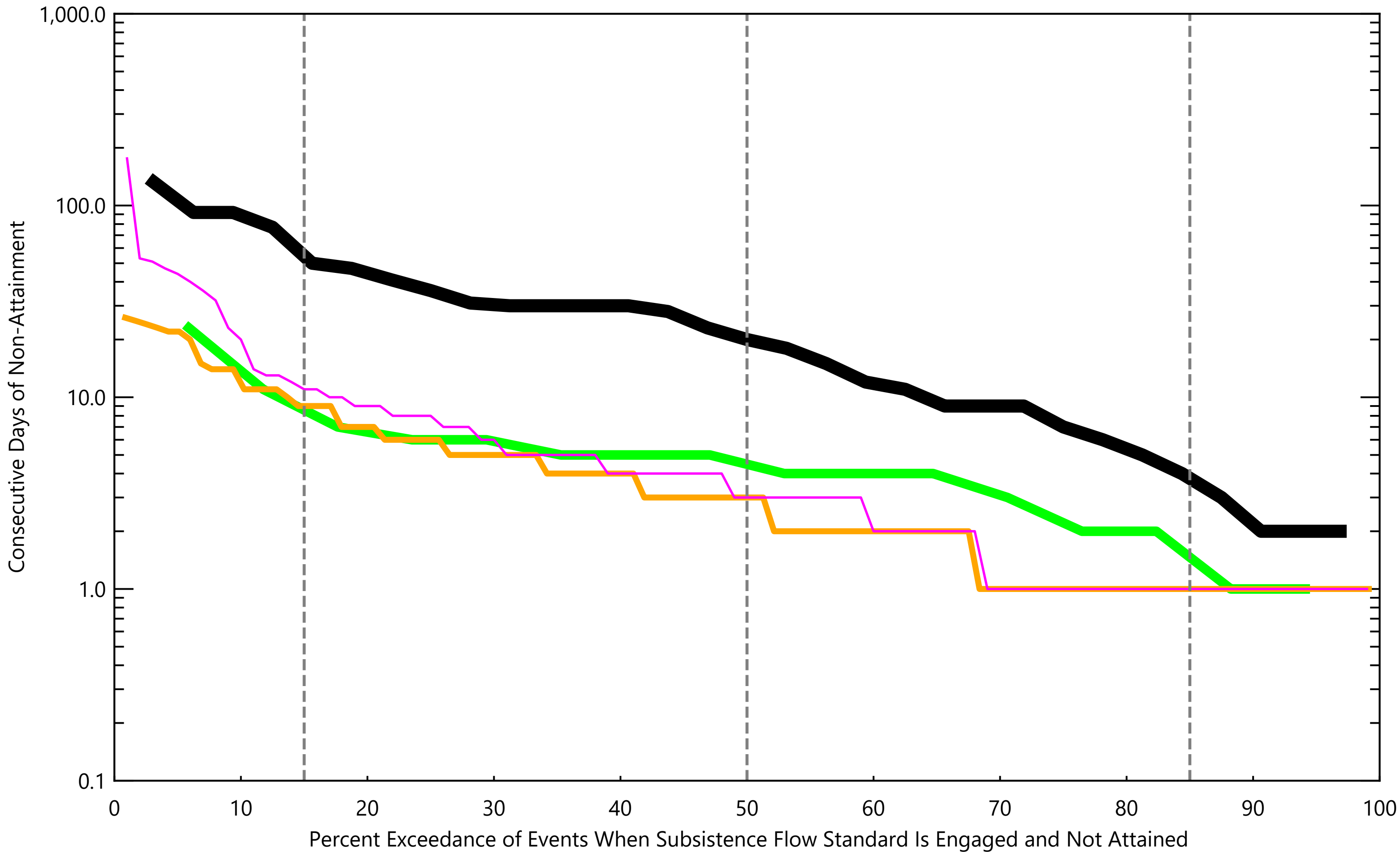
Figure E-140

Navasota River near Easterly: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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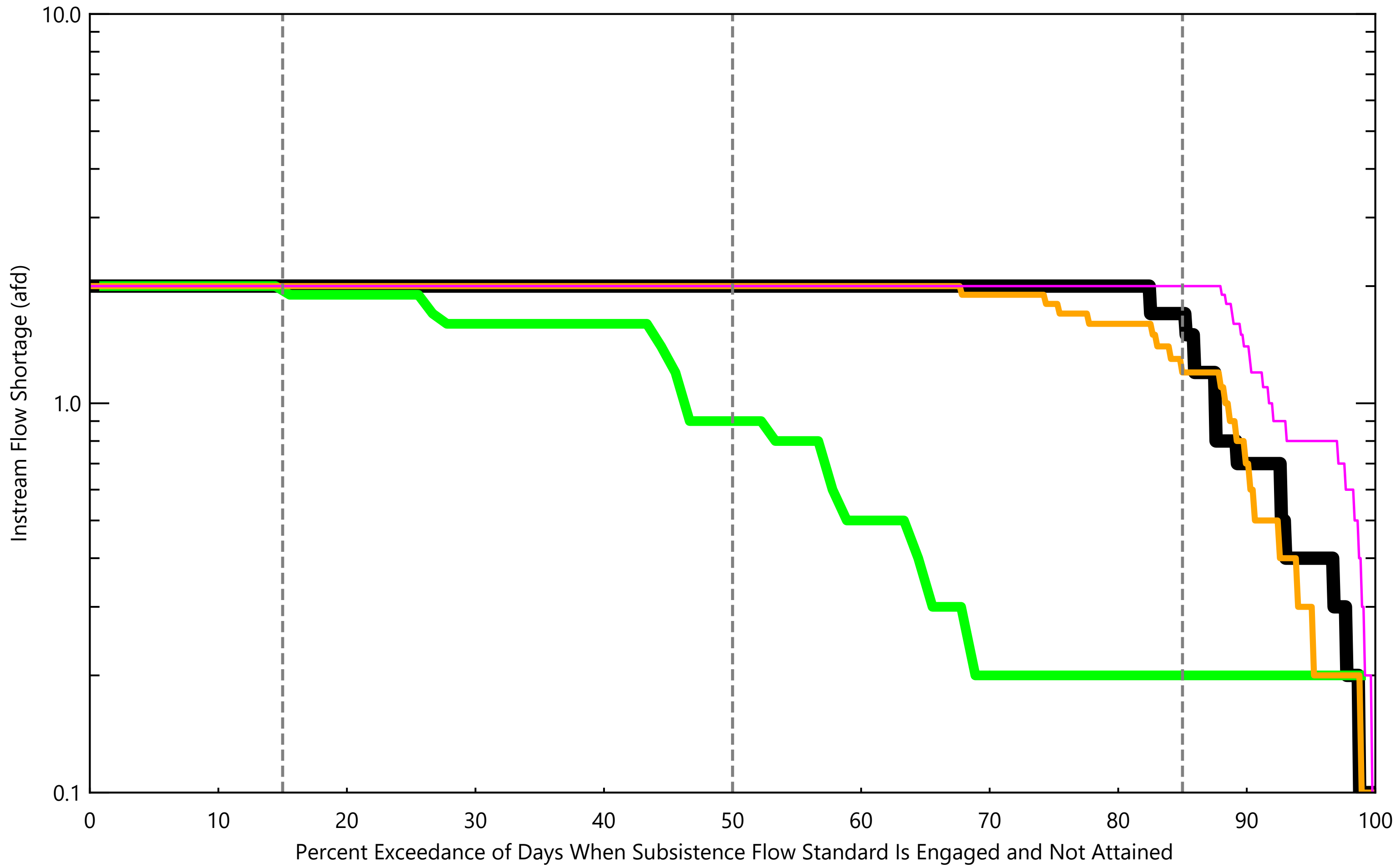
Figure E-141

Navasota River near Easterly: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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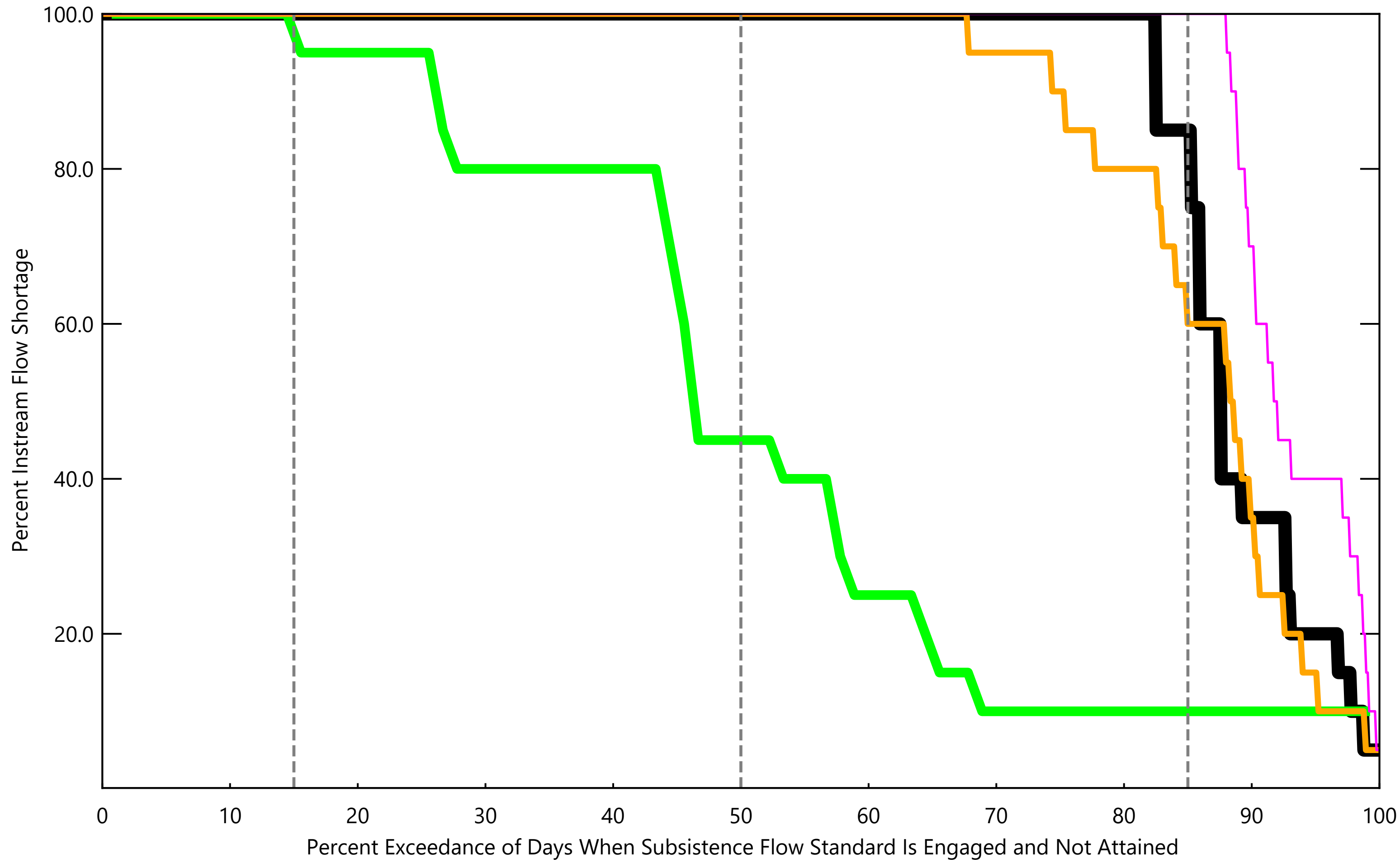
Figure E-142

Navasota River near Easterly: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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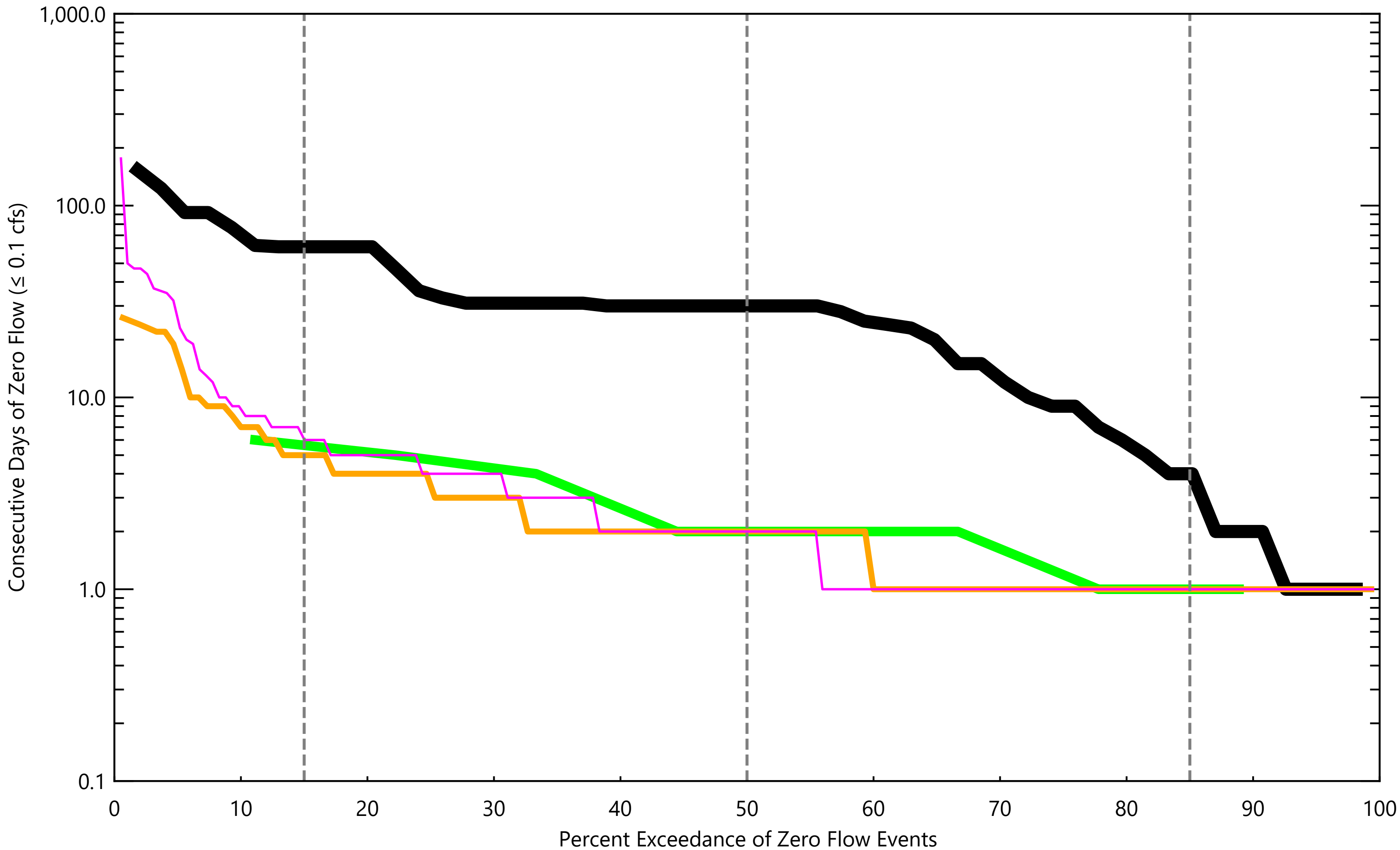
Figure E-143

Navasota River near Easterly: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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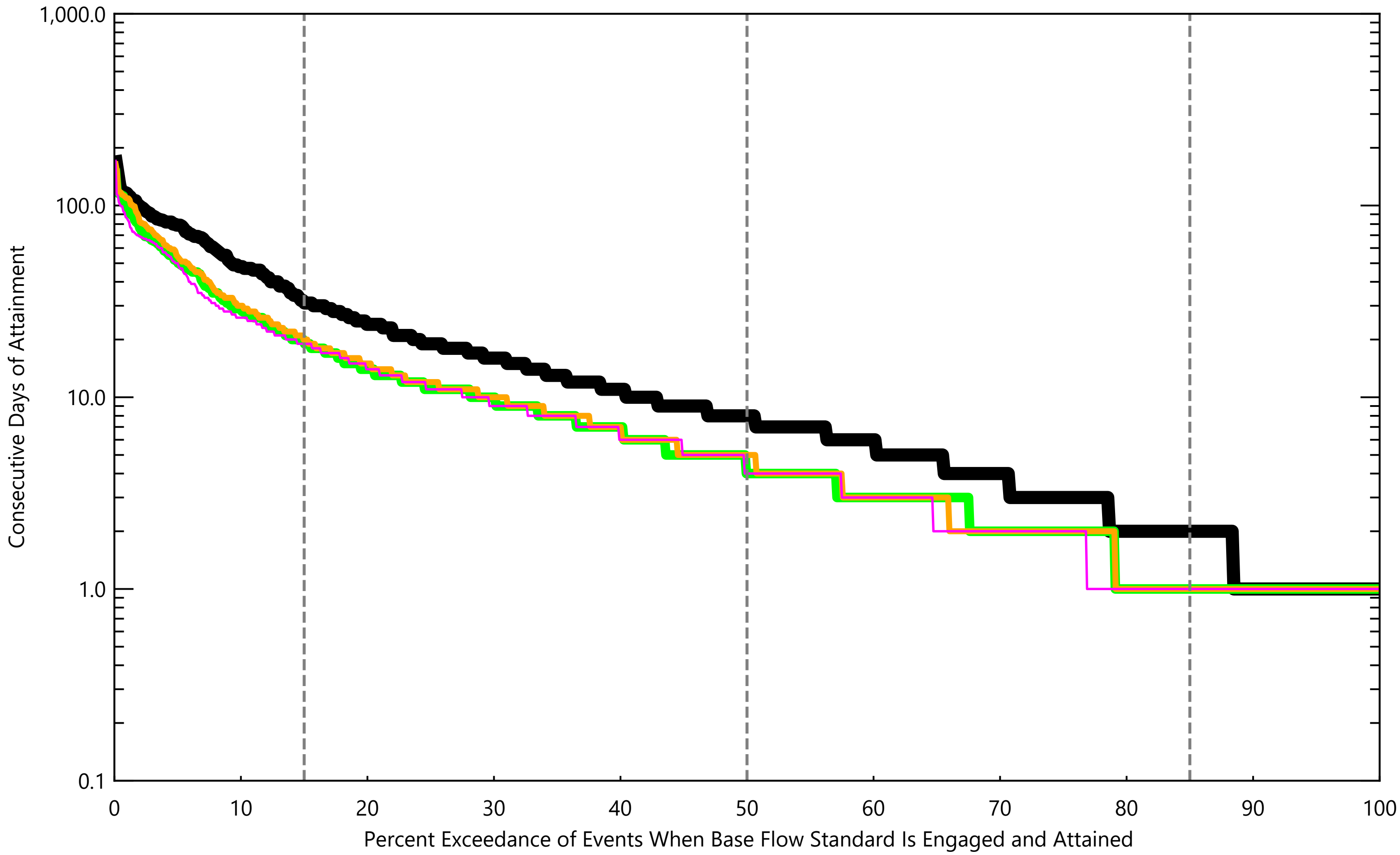
Figure E-144

Navasota River near Easterly: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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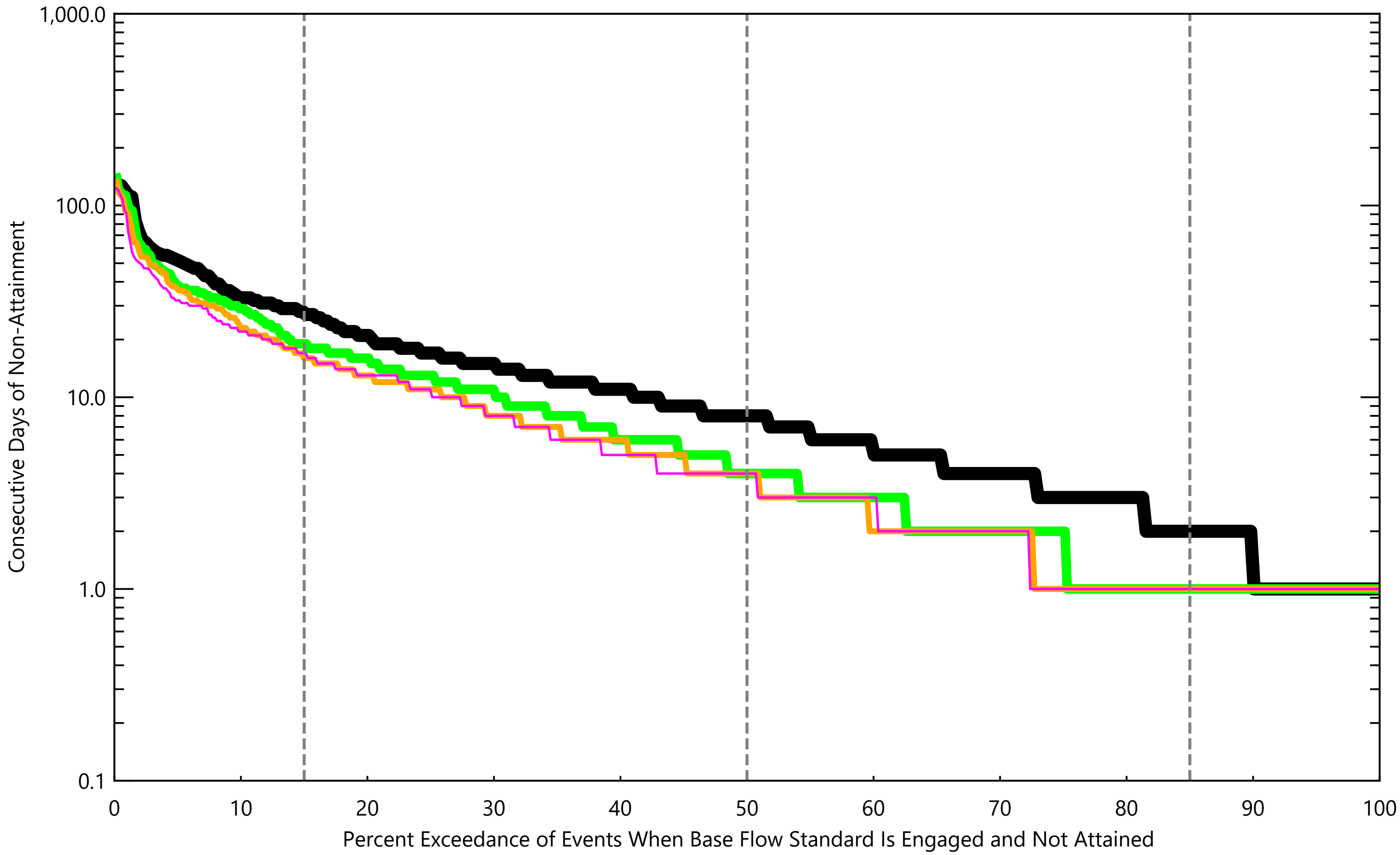
Figure E-145

Brazos River near Hempstead: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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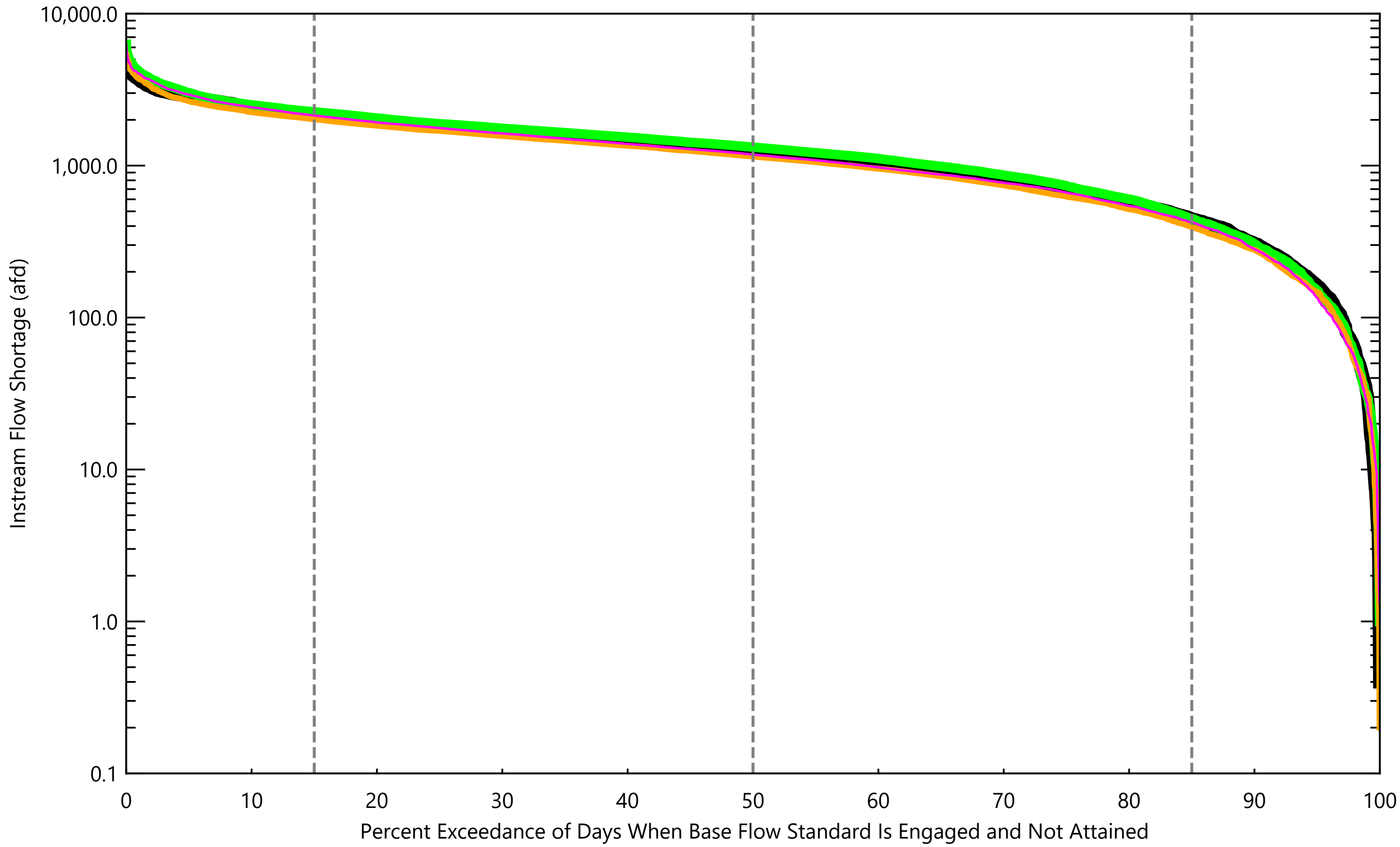
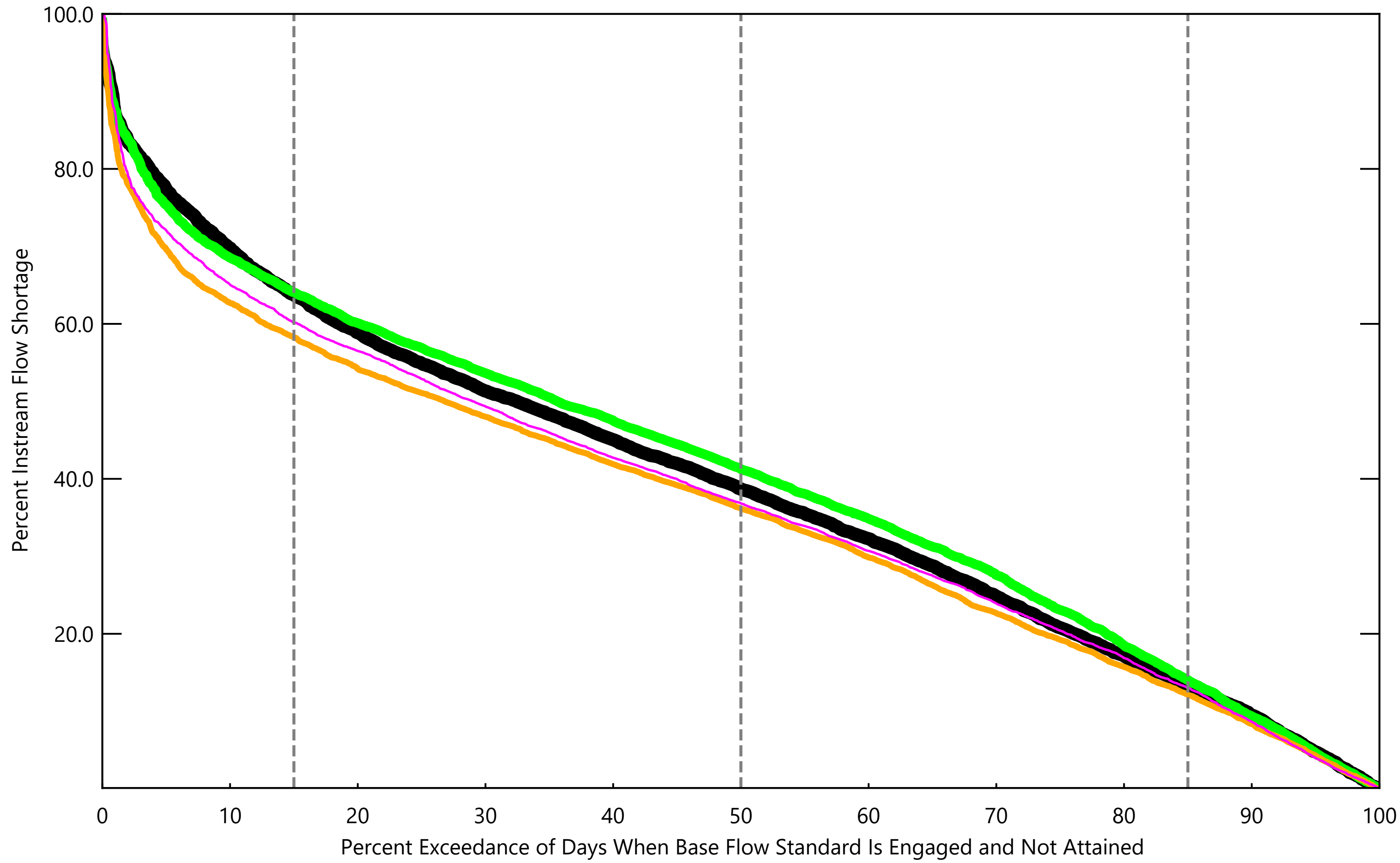
Figure E-146
Brazos River near Hempstead: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-147
Brazos River near Hempstead: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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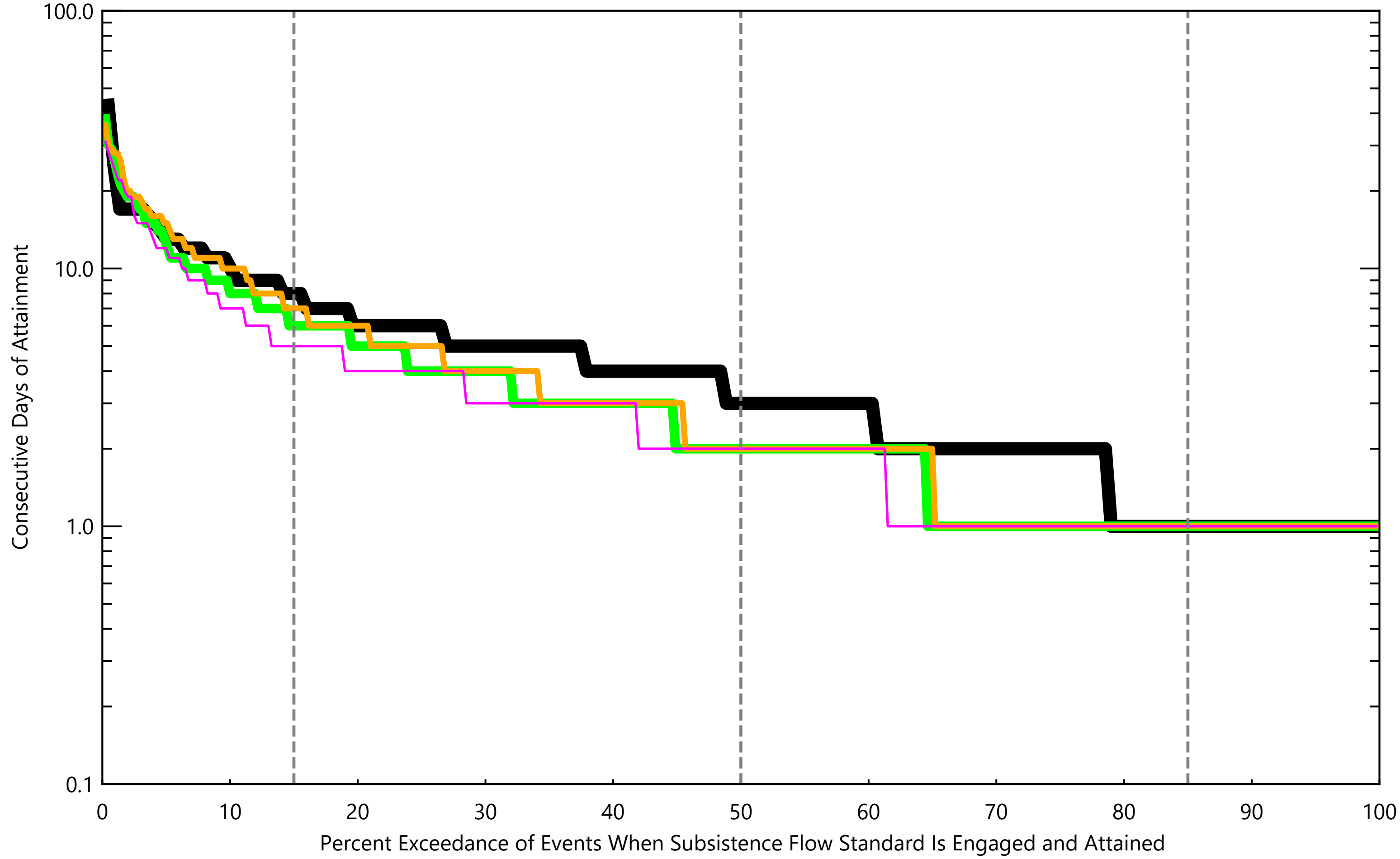
Figure E-148
Brazos River near Hempstead: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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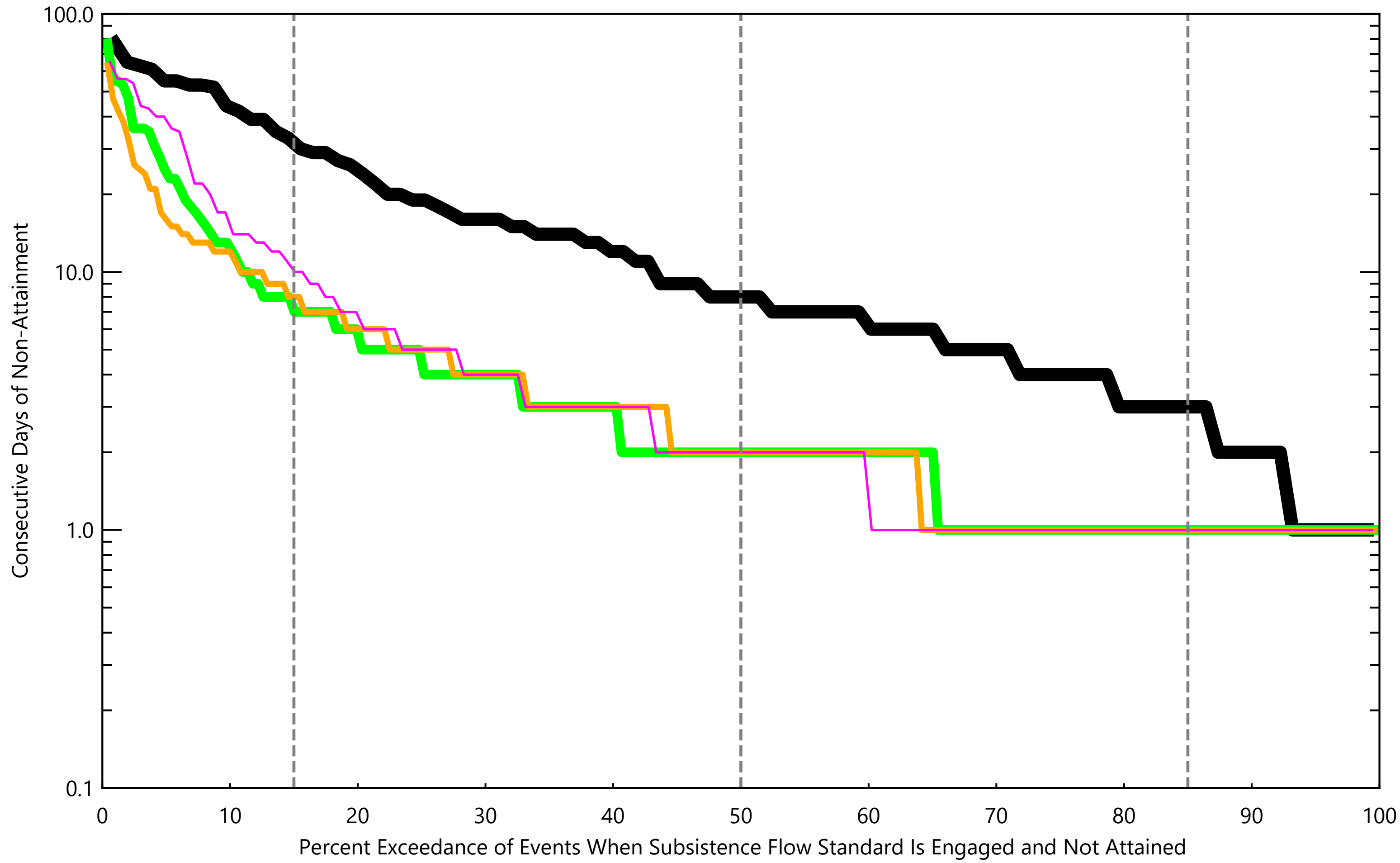
Figure E-149
Brazos River near Hempstead: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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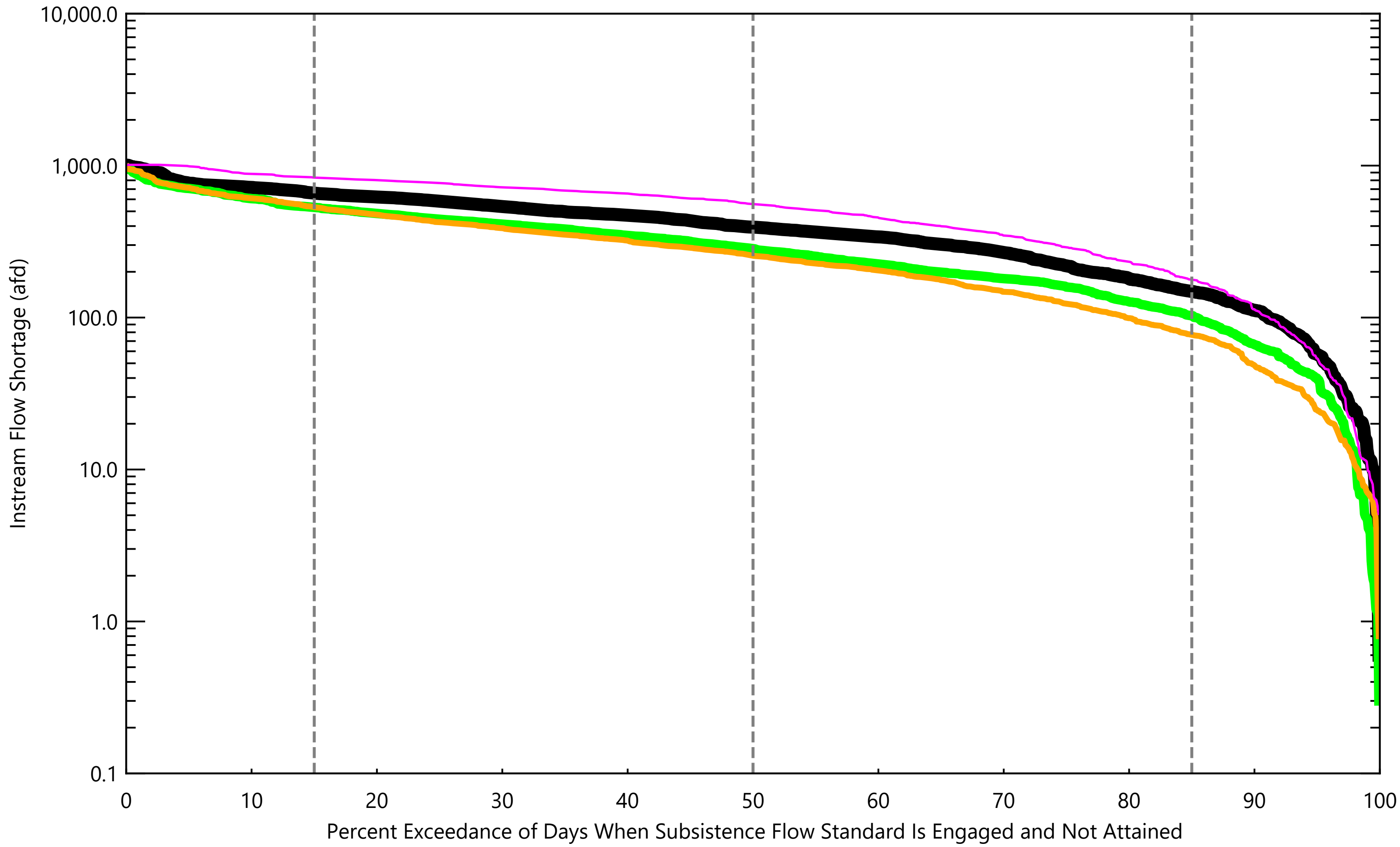
Figure E-150

Brazos River near Hempstead: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

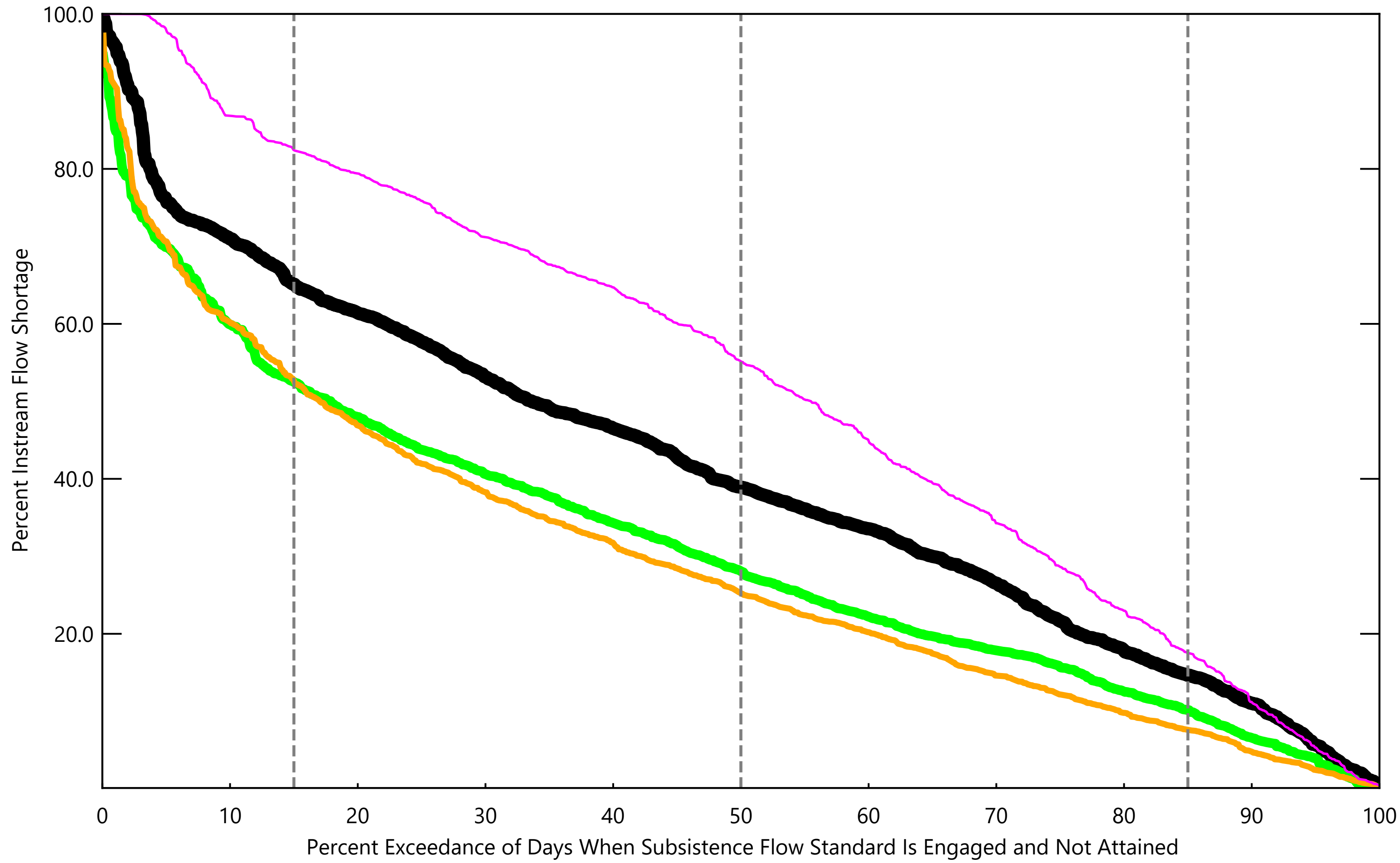
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

Figure E-151
Brazos River near Hempstead: Subsistence Flow Shortage, Entire Period of Record (S-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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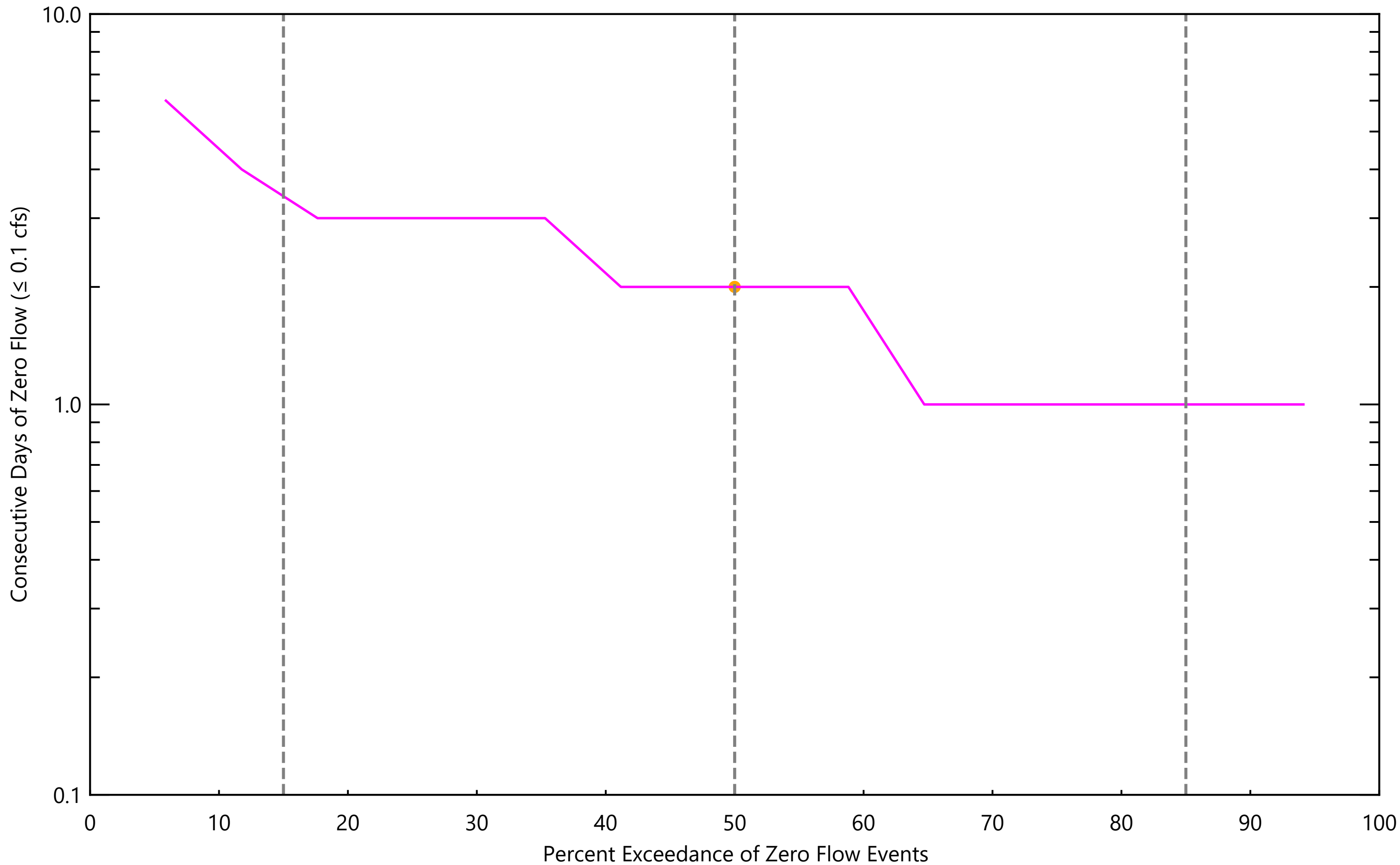
Figure E-152

Brazos River near Hempstead: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Partial Utilization Scenario
- Full Utilization Scenario

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Figure E-153
Brazos River near Hempstead: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

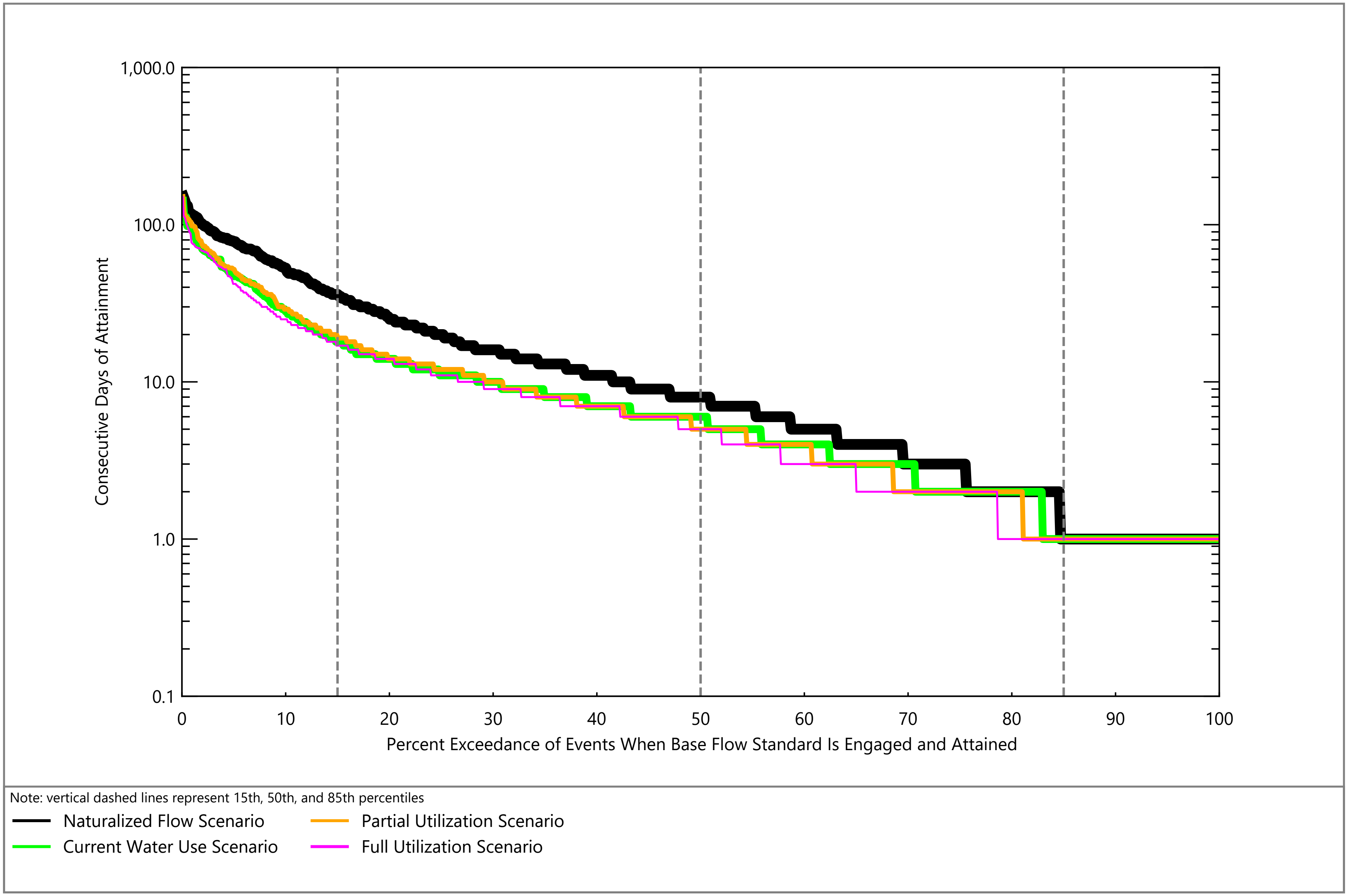
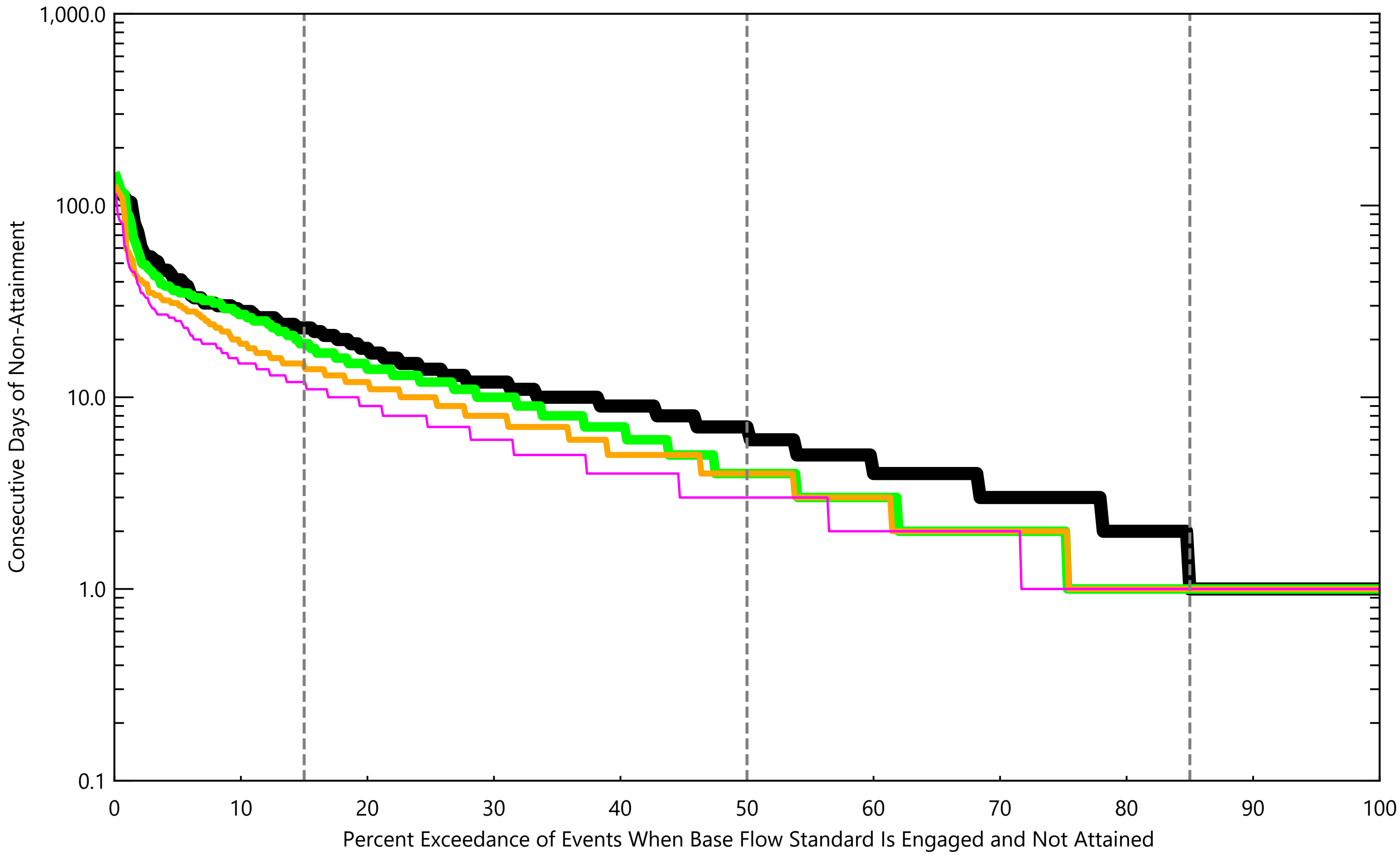


Figure E-154
Brazos River at Richmond: Base Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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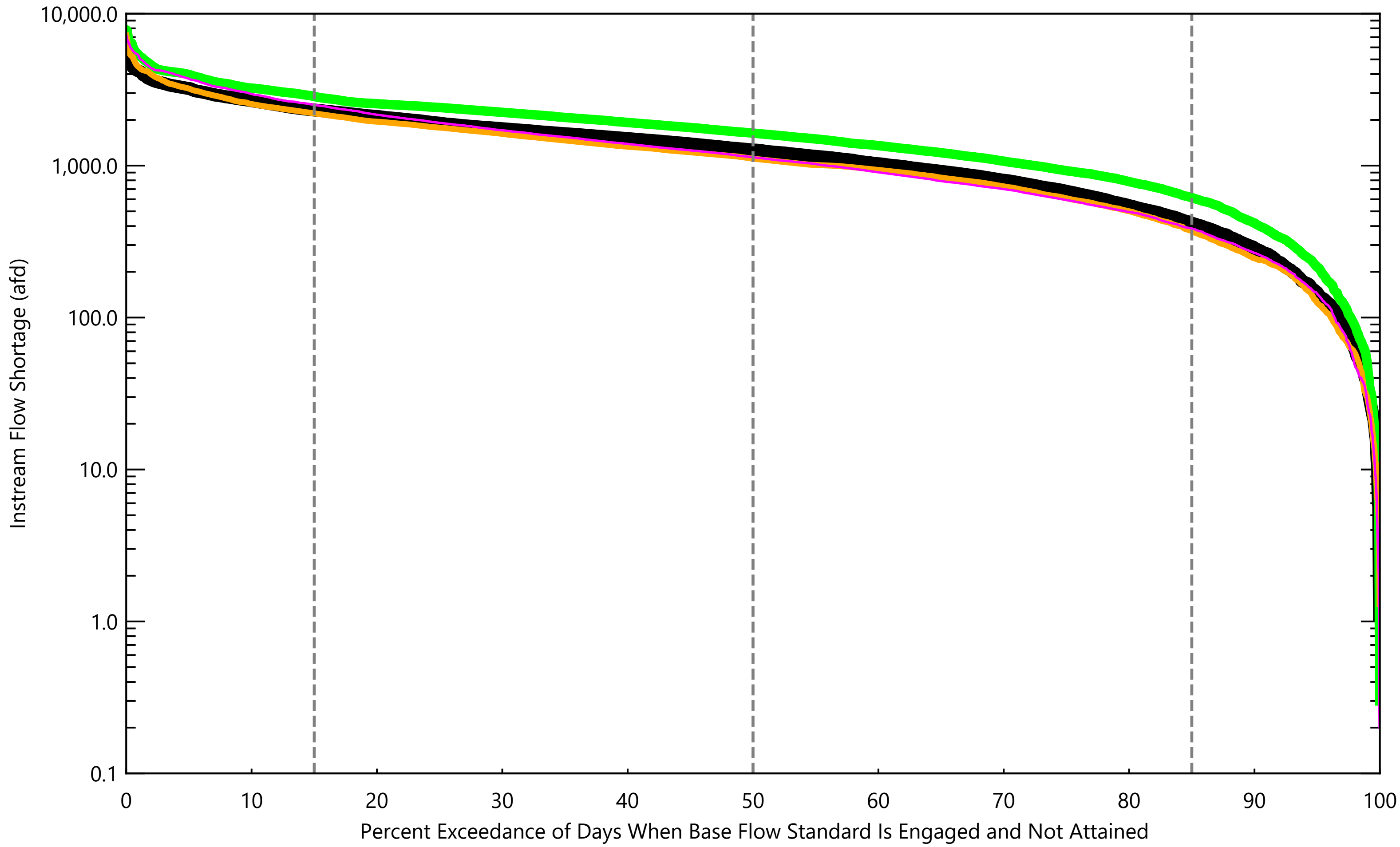
Figure E-155
Brazos River at Richmond: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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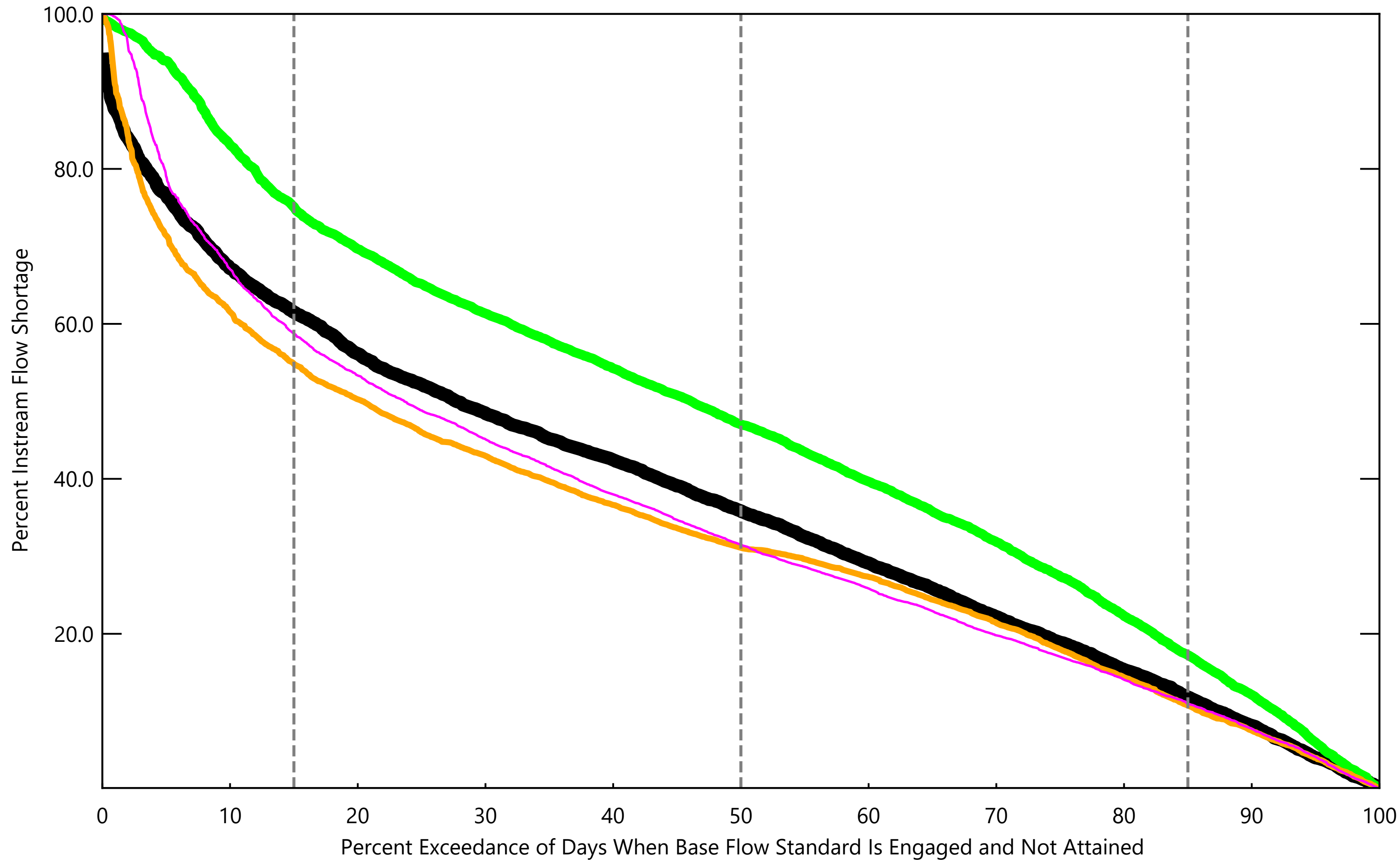
Figure E-156
Brazos River at Richmond: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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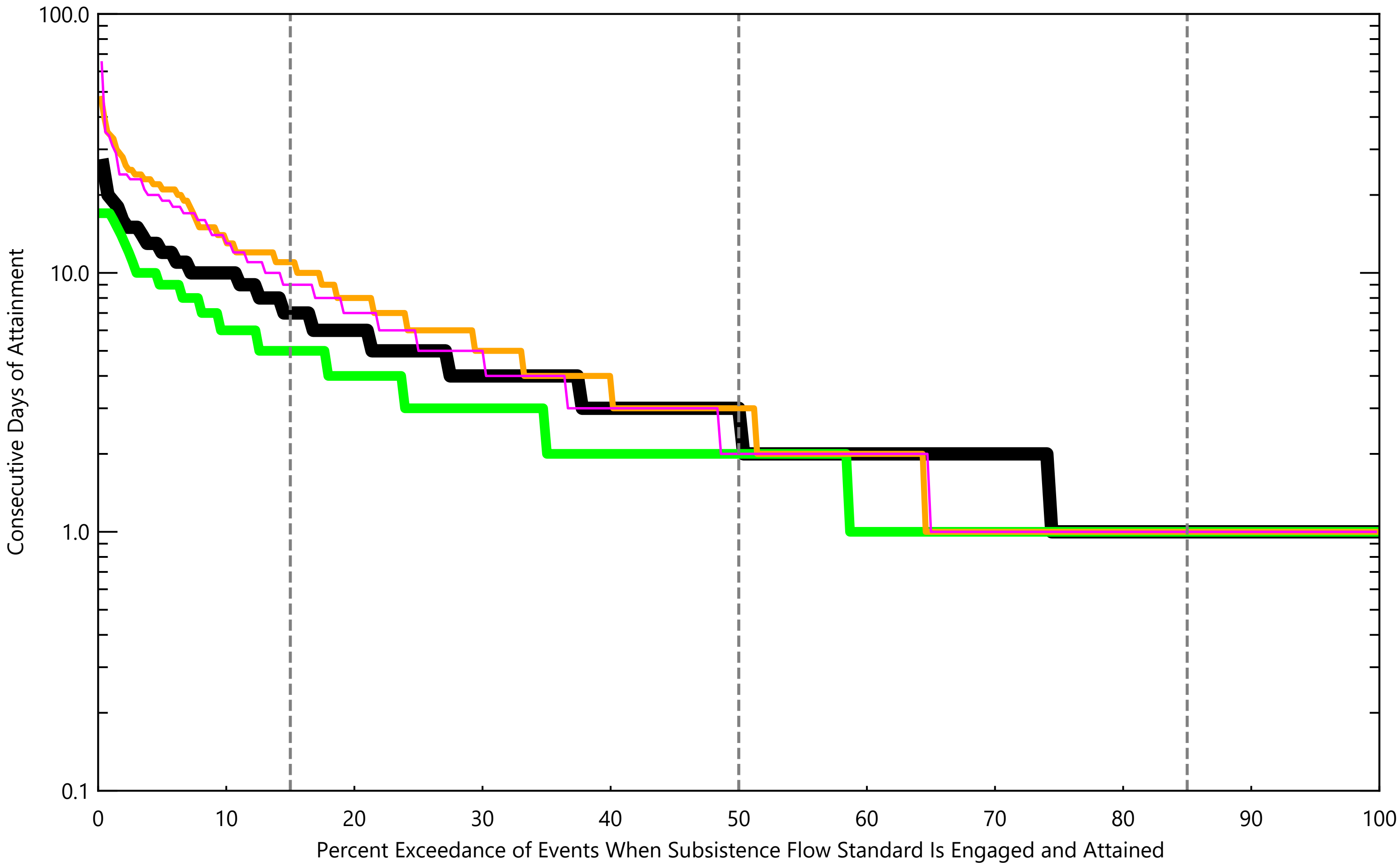
Figure E-157

Brazos River at Richmond: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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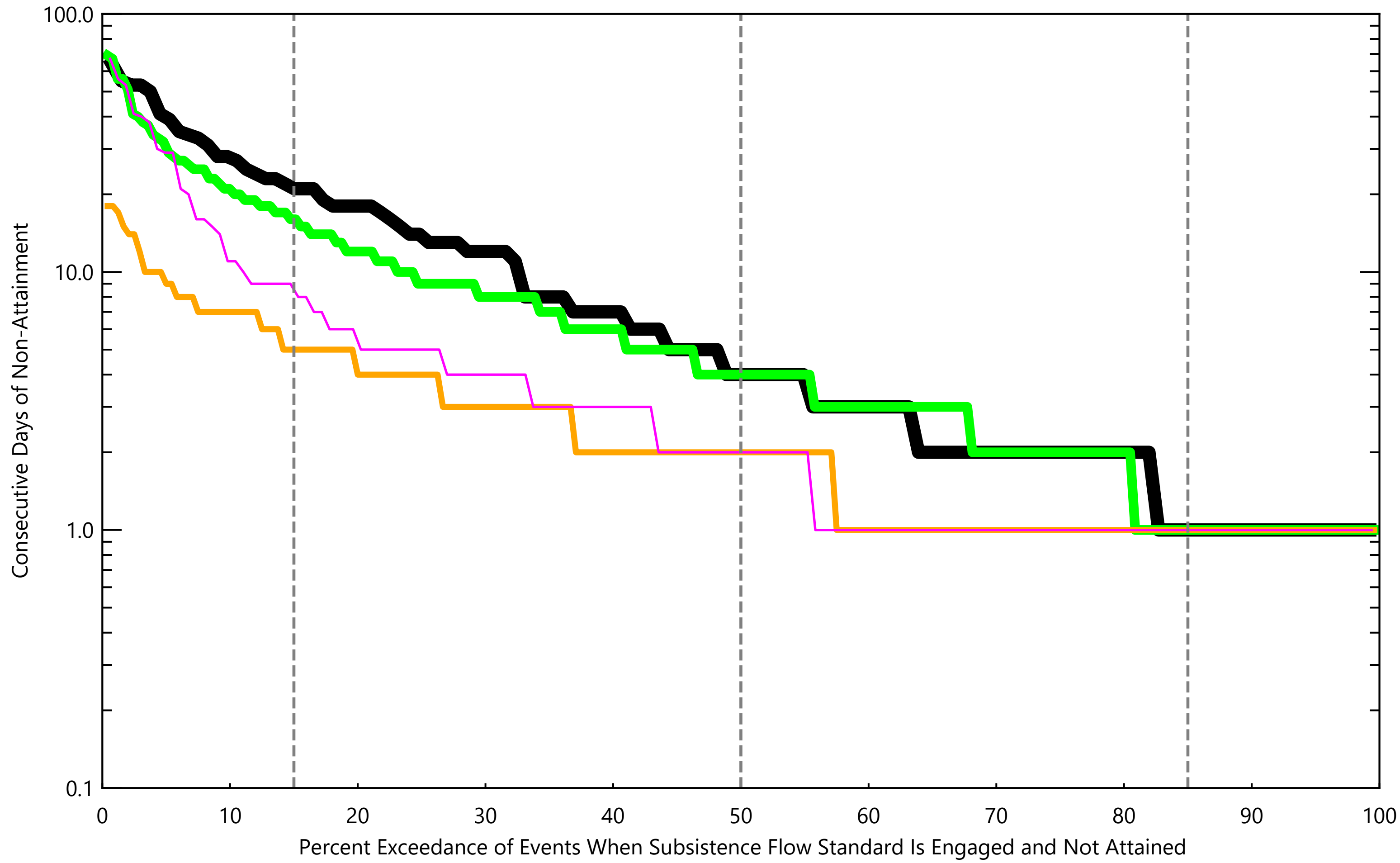
Figure E-158

Brazos River at Richmond: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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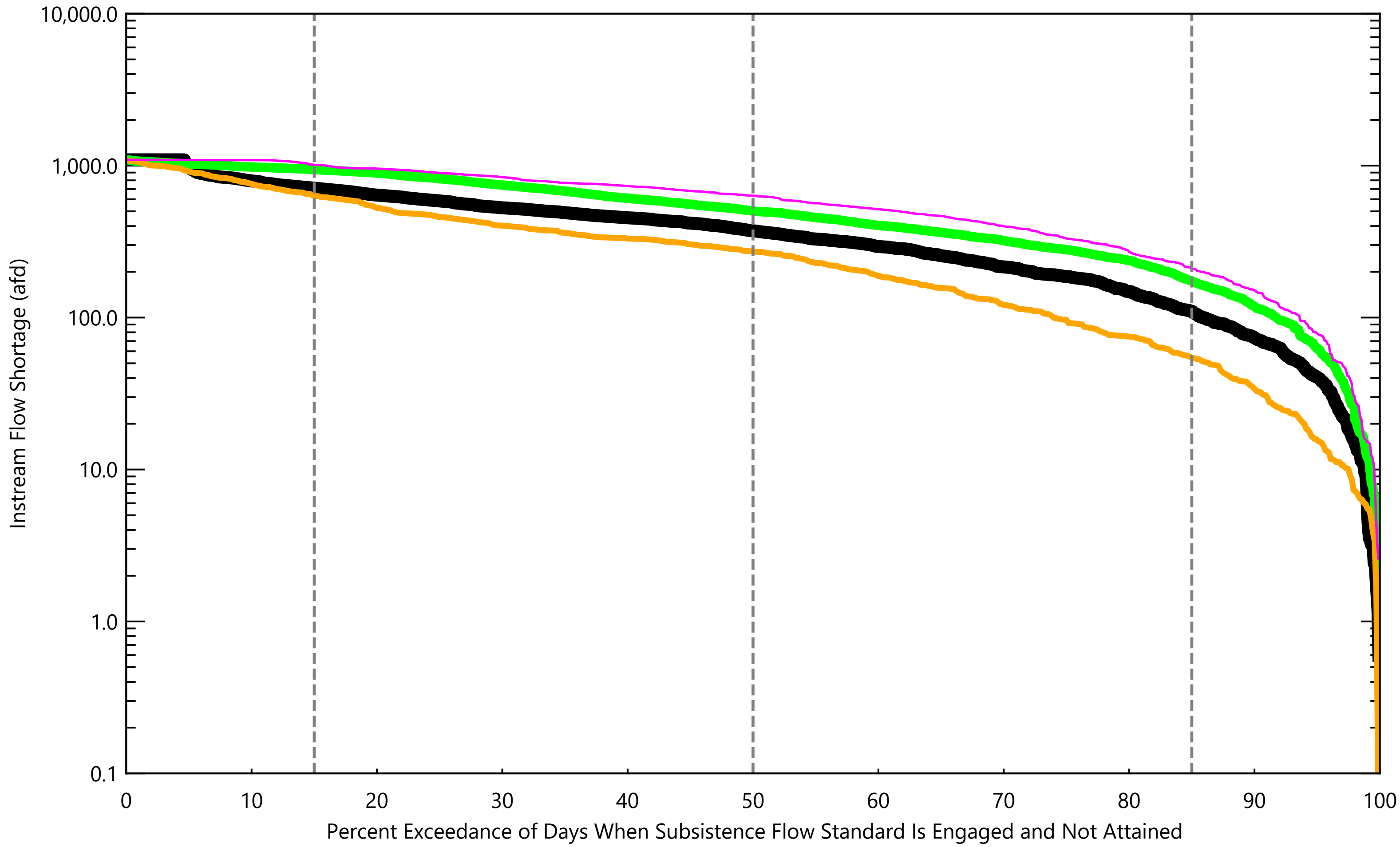
Figure E-159

Brazos River at Richmond: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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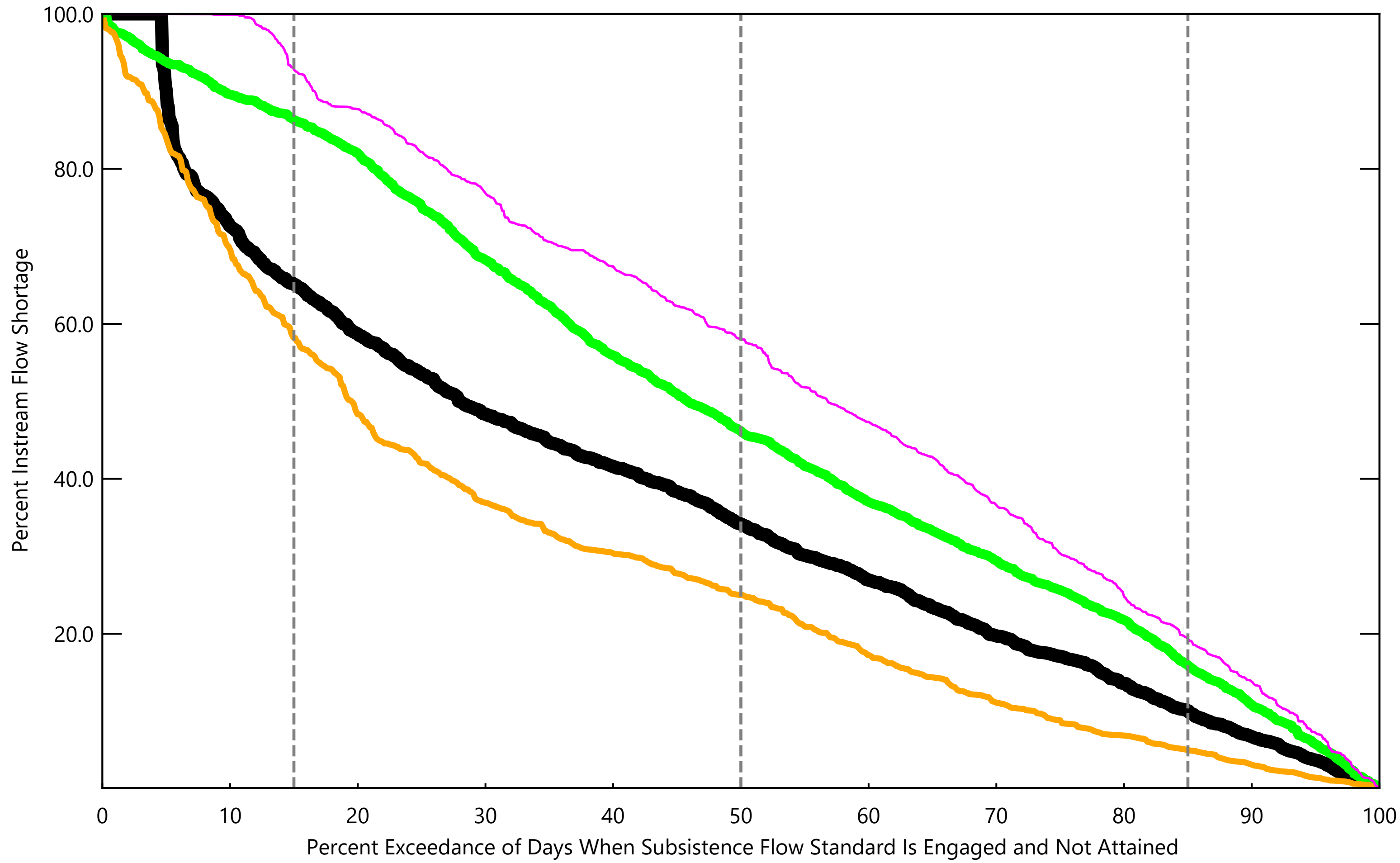
Figure E-160

Brazos River at Richmond: Subsistence Flow Shortage, Entire Period of Record (S-POR)

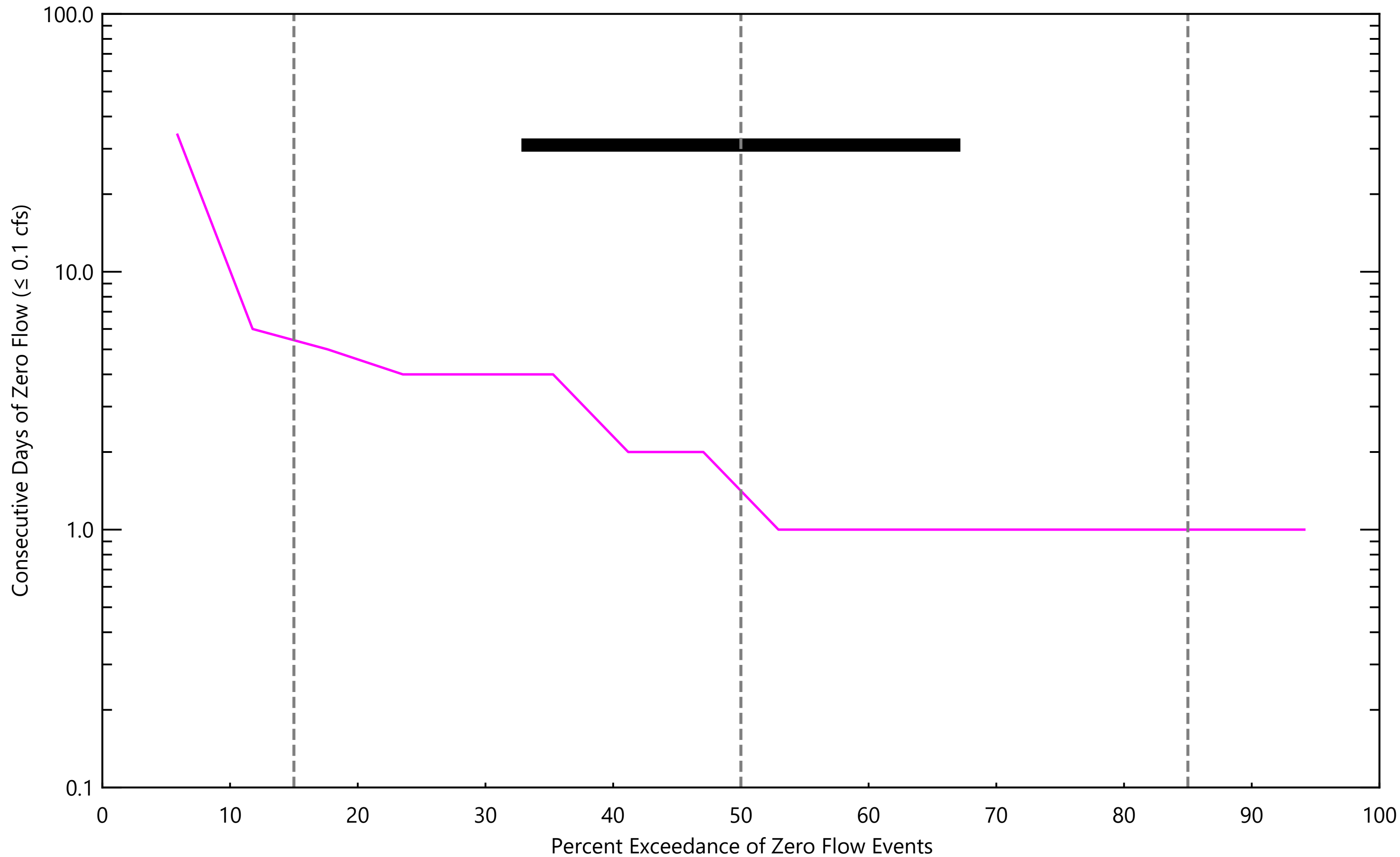


Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Figure E-161

Brazos River at Richmond: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario

Full Utilization Scenario

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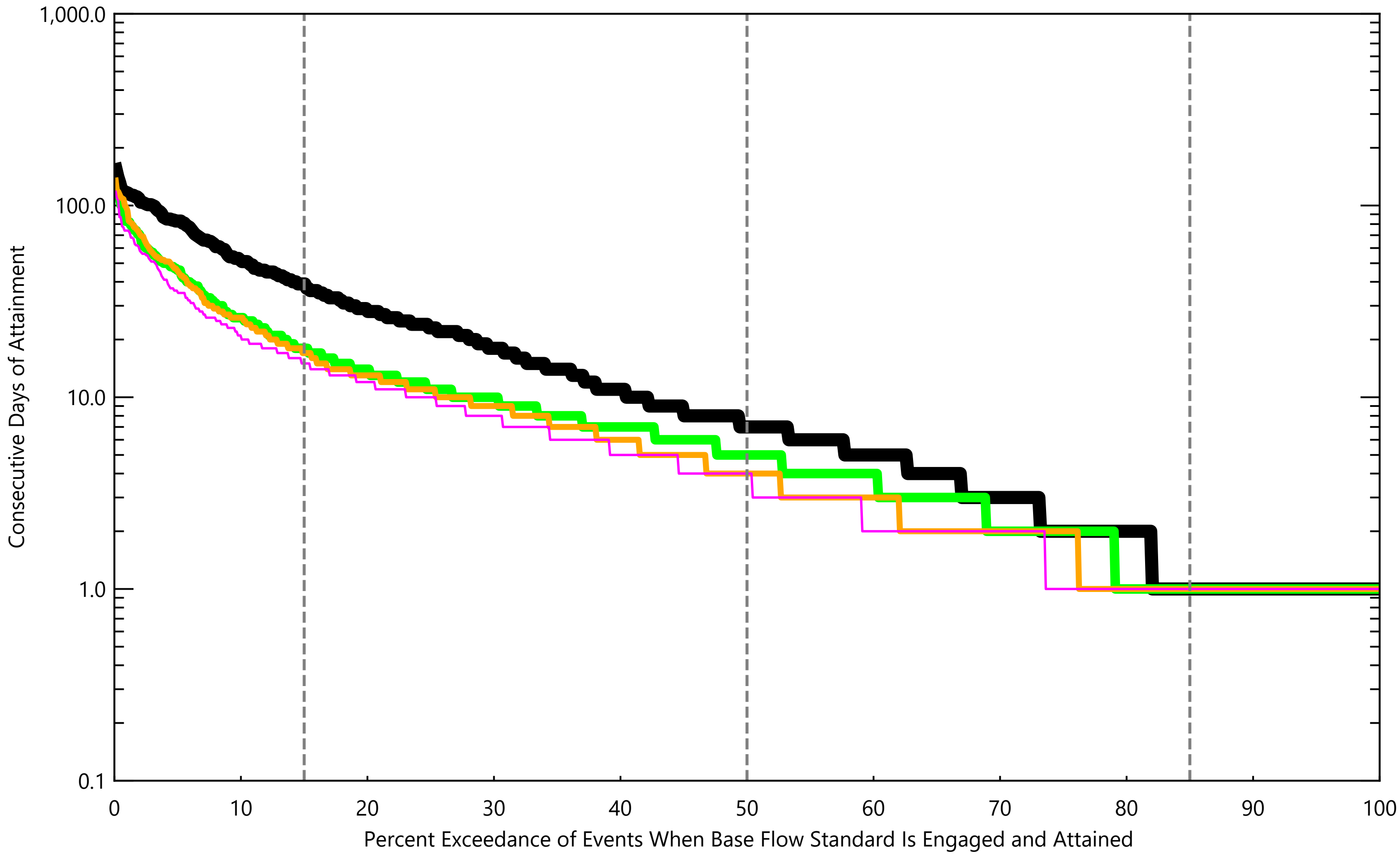
Figure E-162

Brazos River at Richmond: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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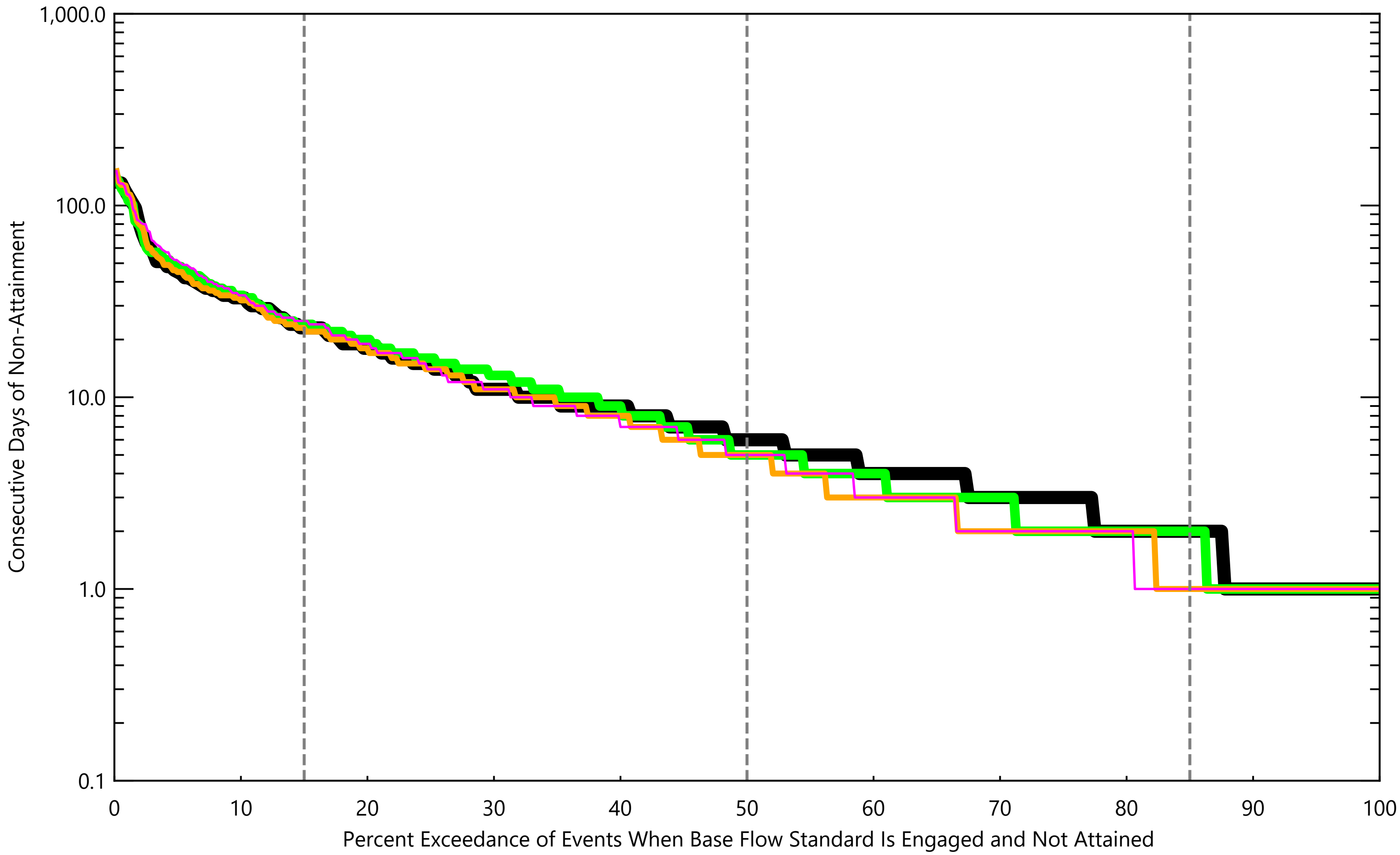
Figure E-163
Brazos River at Rosharon: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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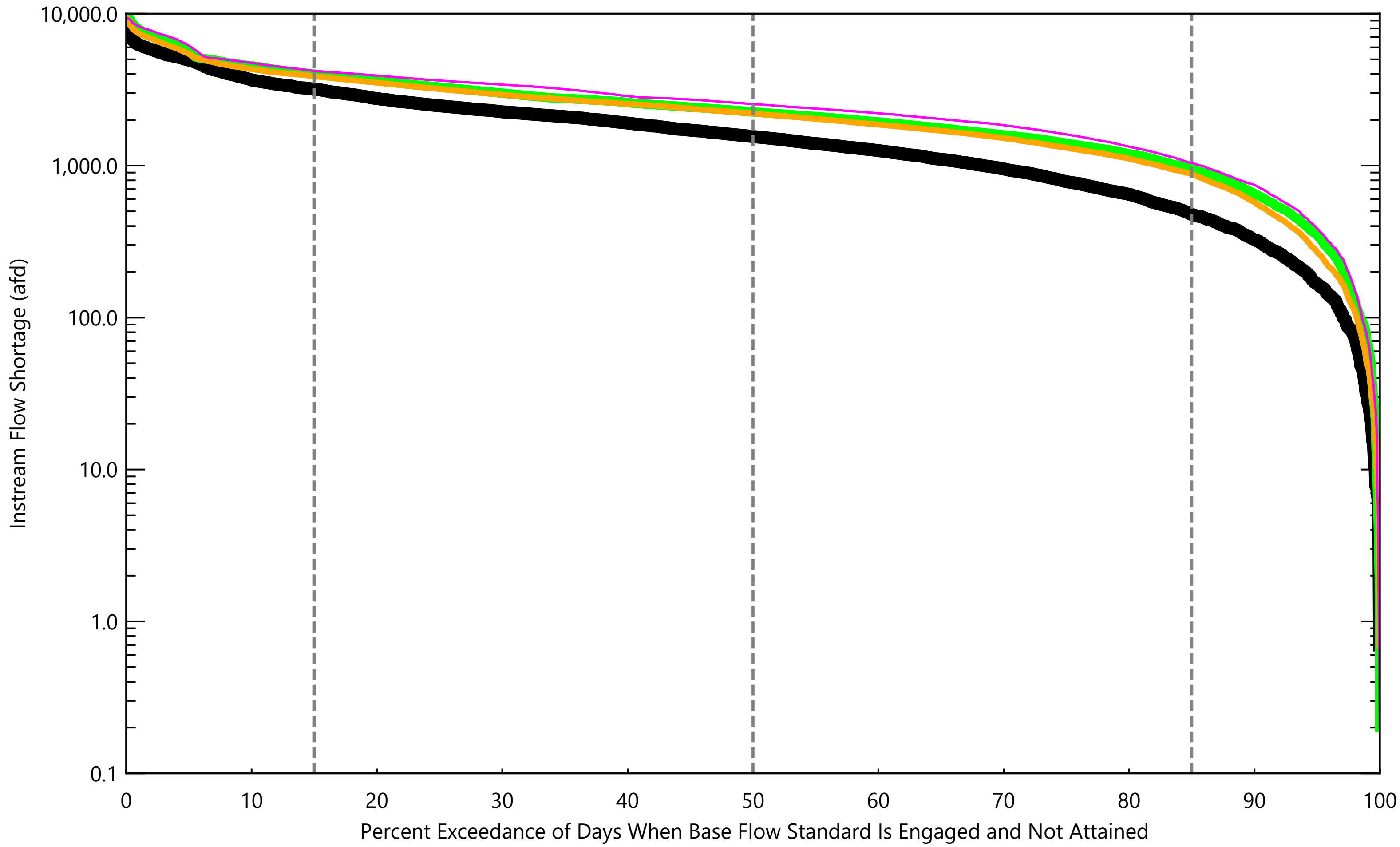
Figure E-164

Brazos River at Rosharon: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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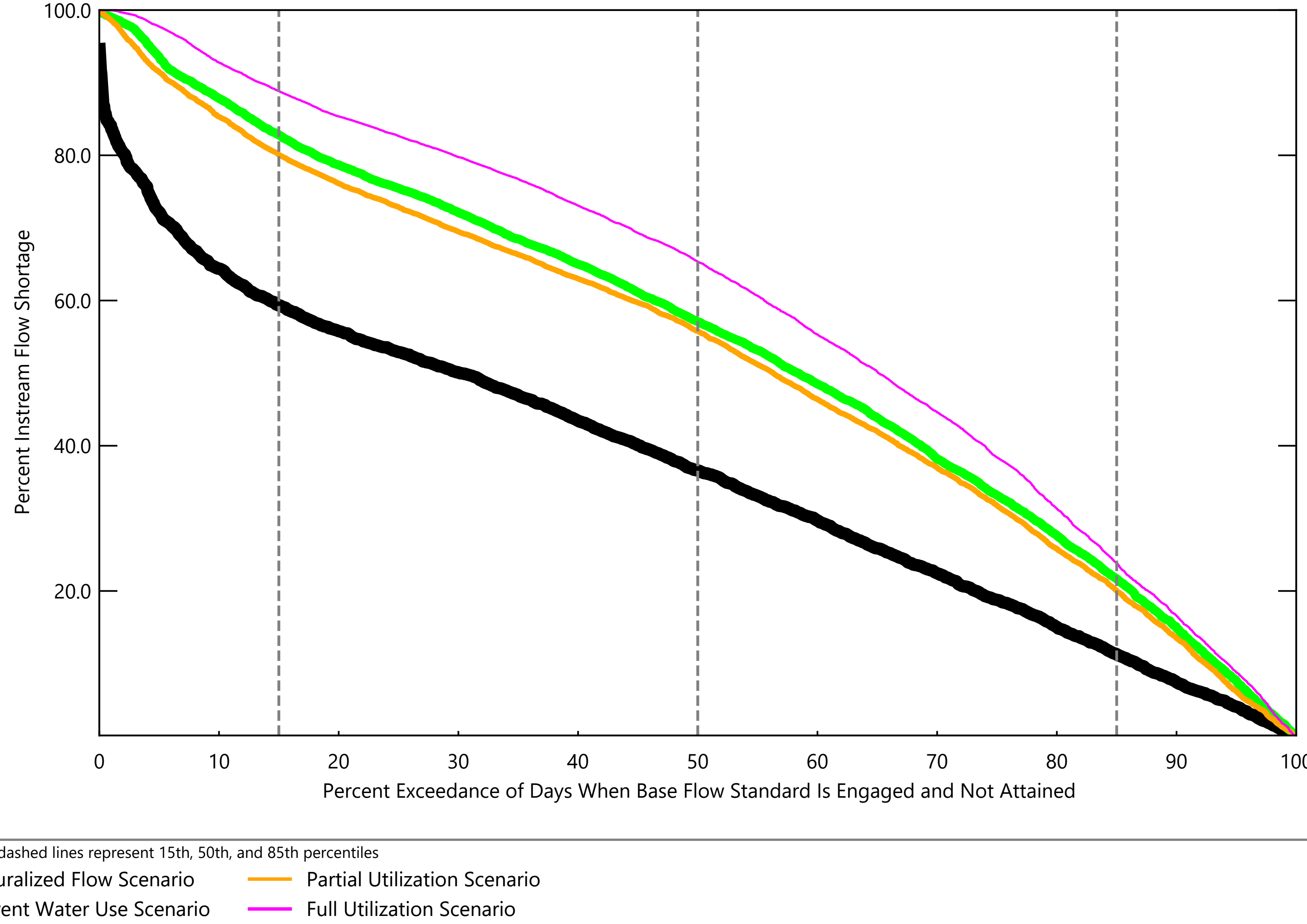
Figure E-165

Brazos River at Rosharon: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:12 PM | User: JH
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Figure E-166
Brazos River at Rosharon: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

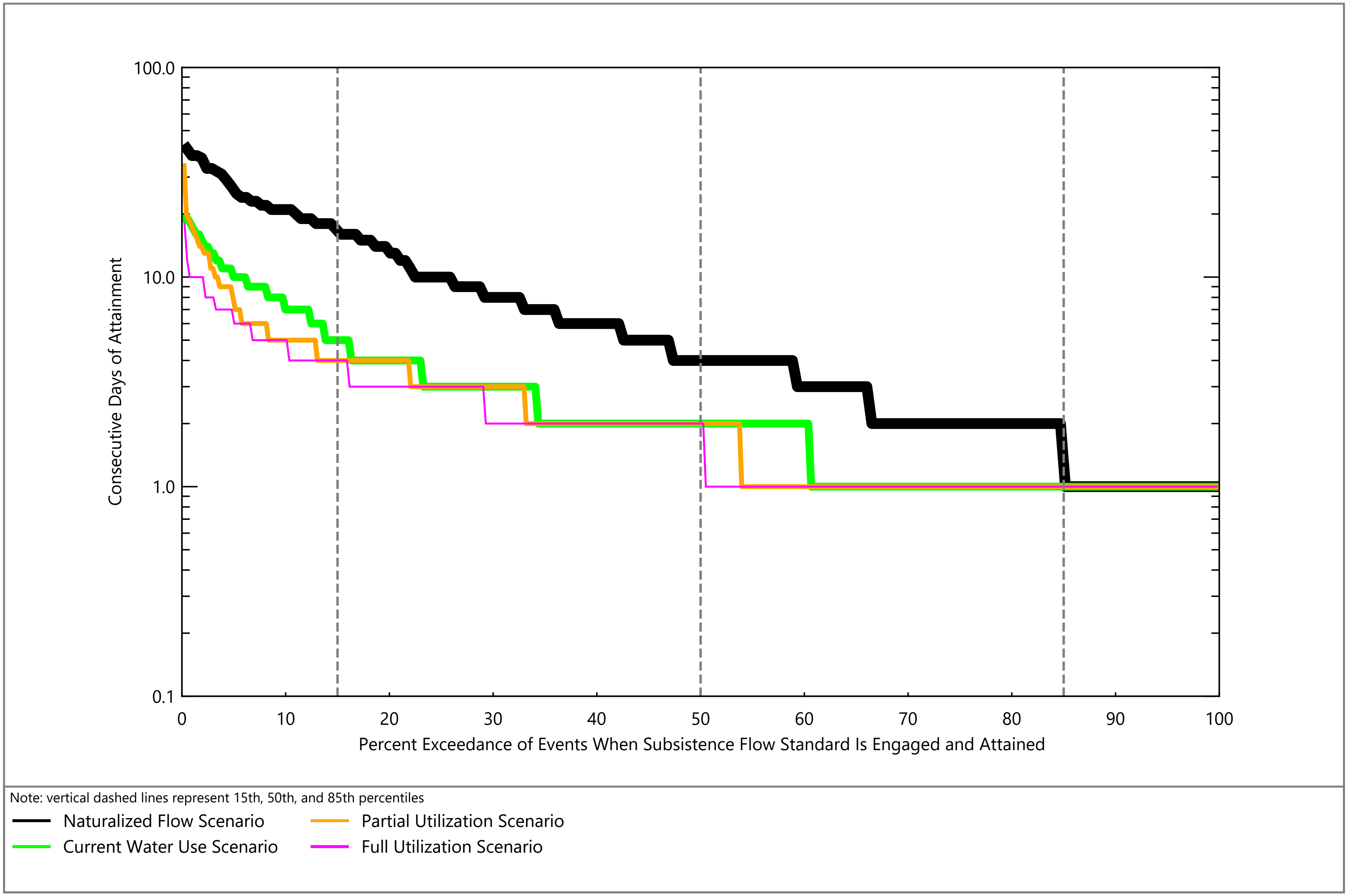

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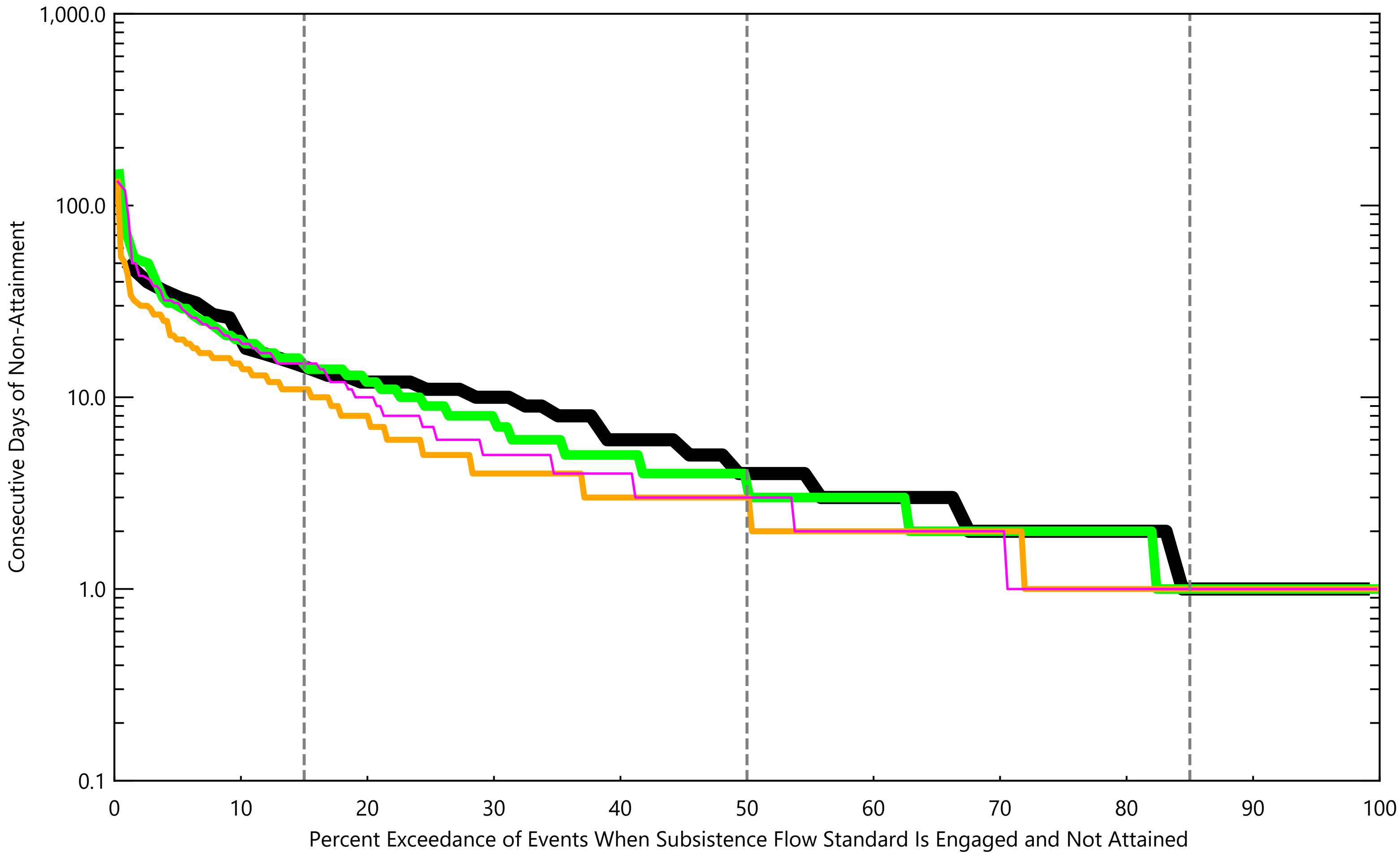
Figure E-167

Brazos River at Rosharon: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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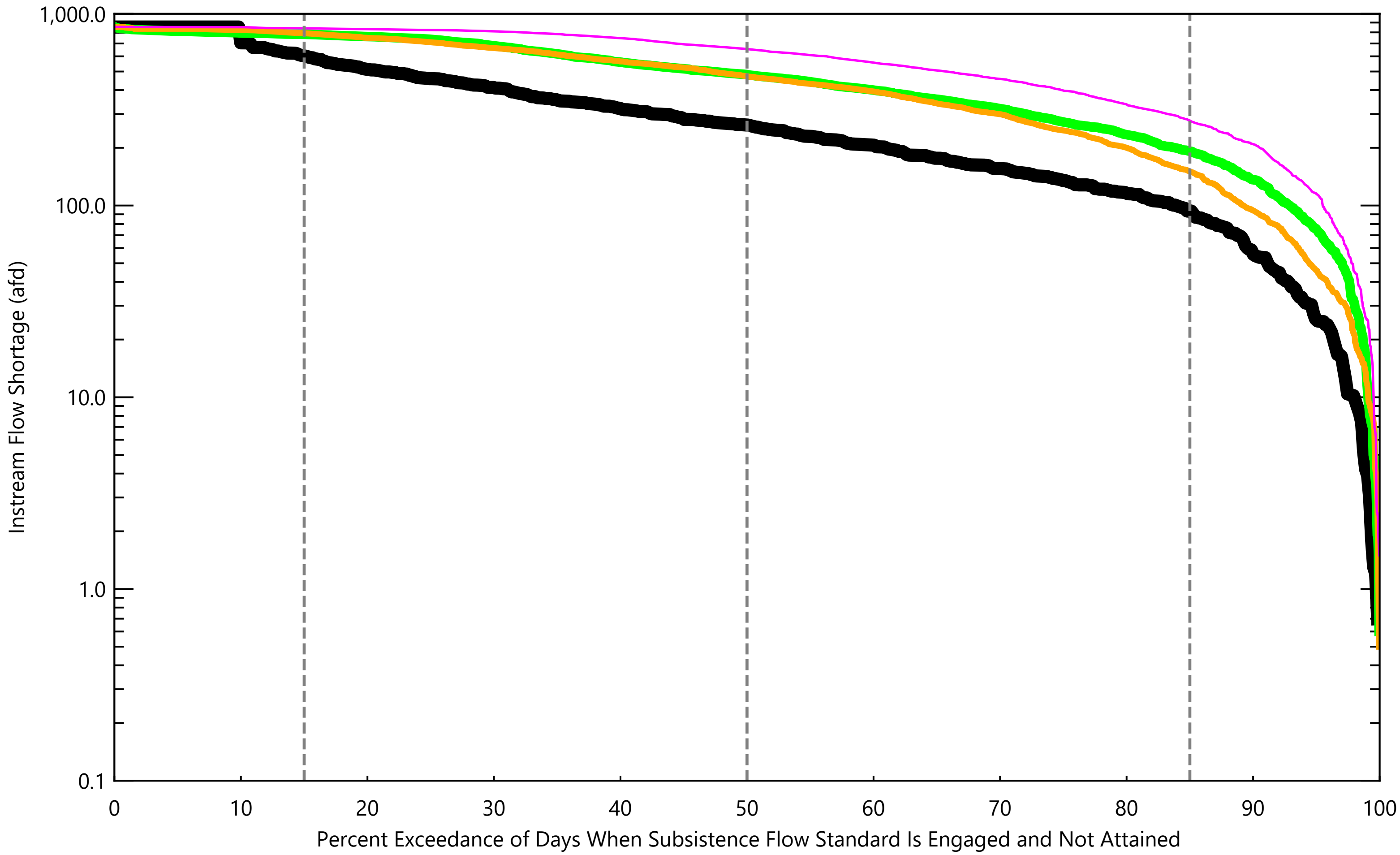
Figure E-168

Brazos River at Rosharon: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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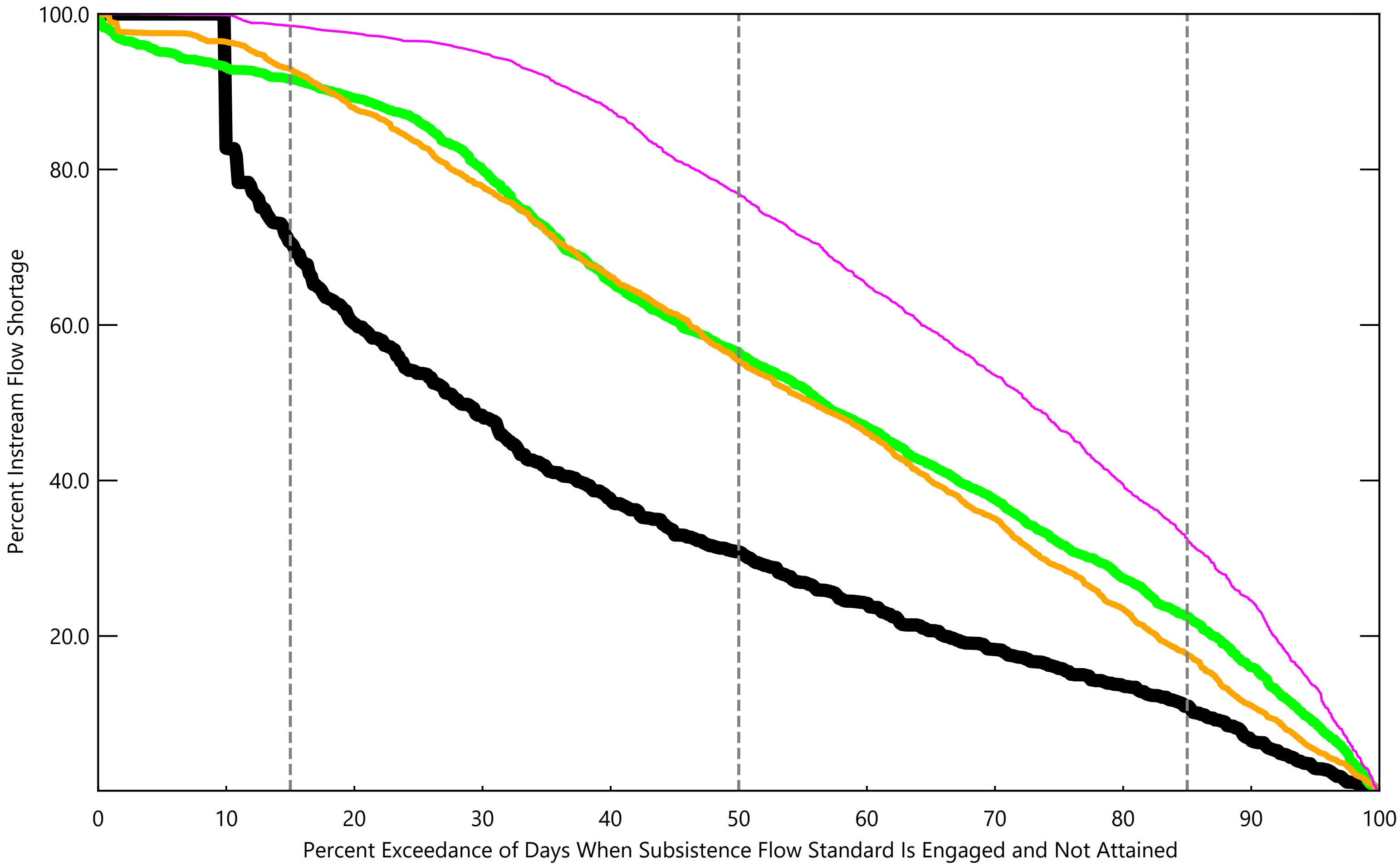
Figure E-169
Brazos River at Rosharon: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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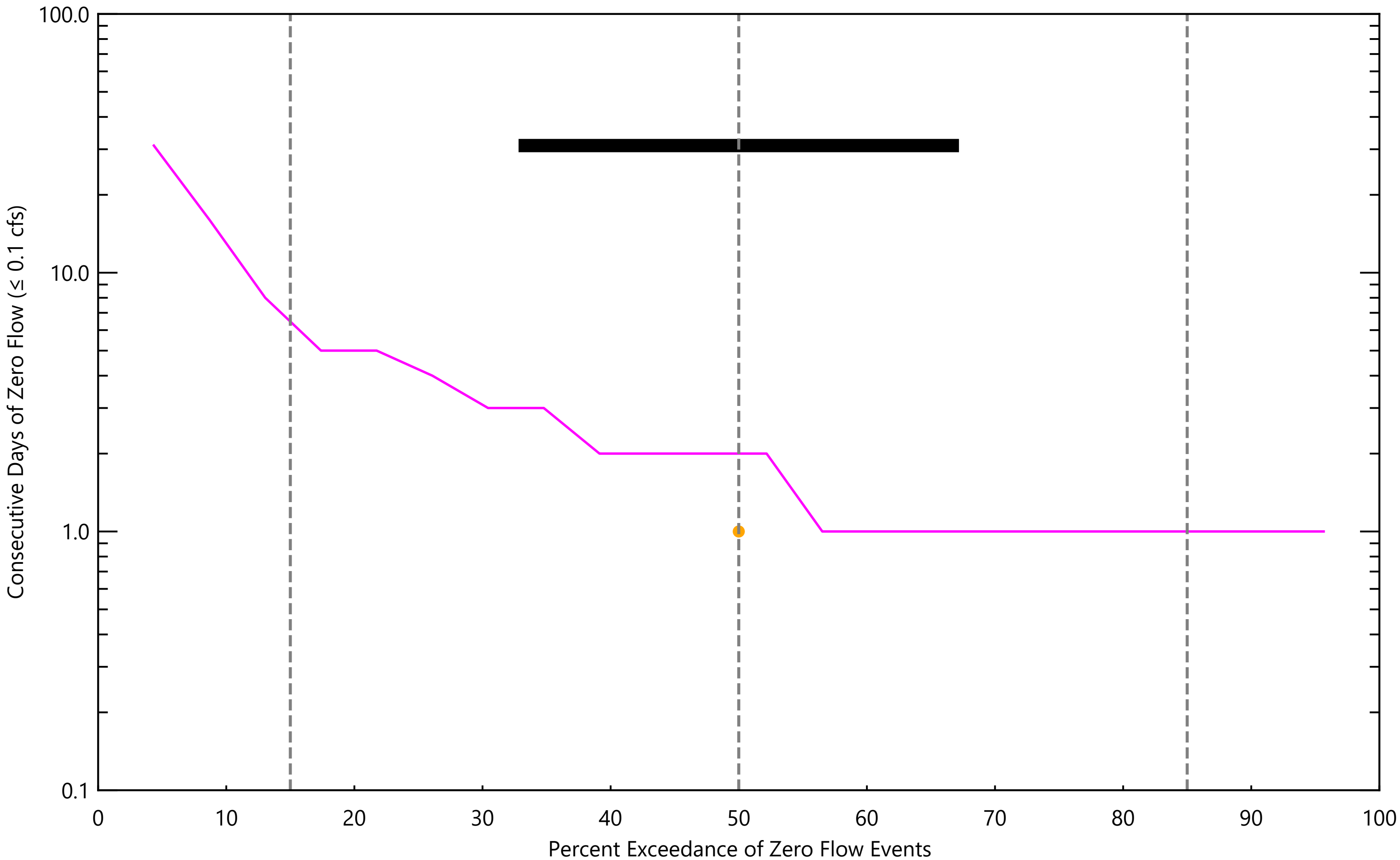
Figure E-170

Brazos River at Rosharon: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario

Partial Utilization Scenario

Full Utilization Scenario

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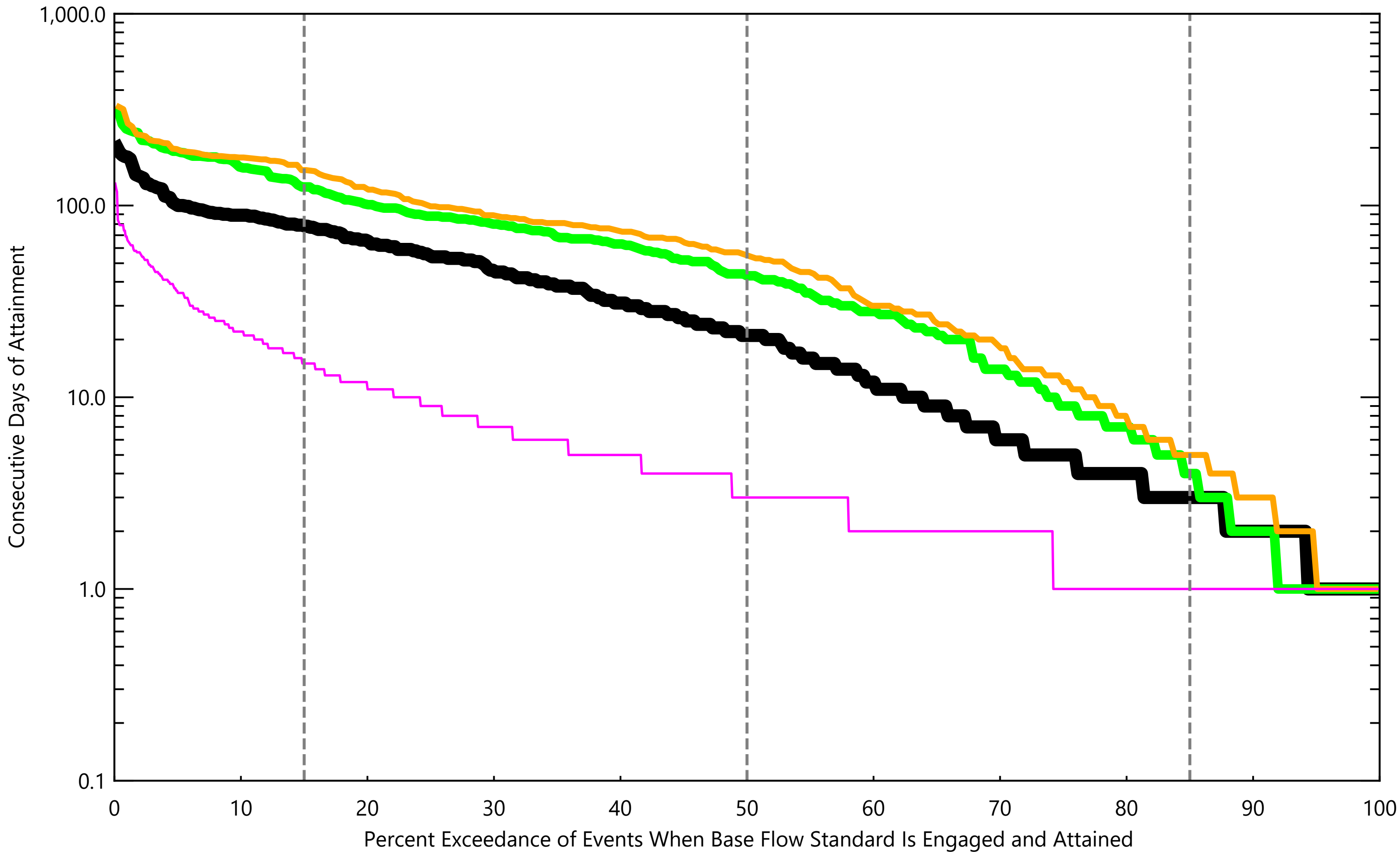
Figure E-171
Brazos River at Rosharon: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-172

West Fork Trinity River near Grand Prairie: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

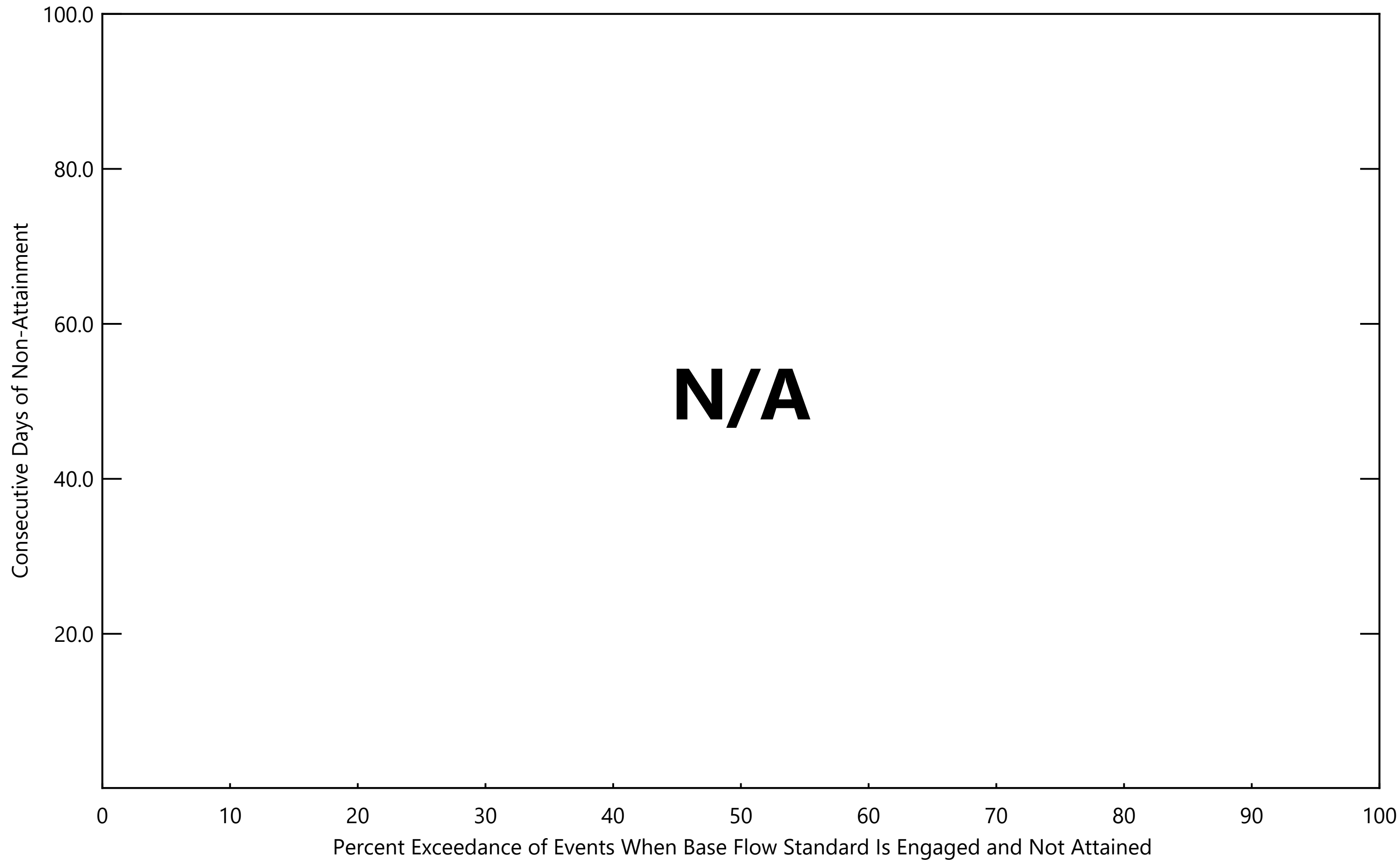

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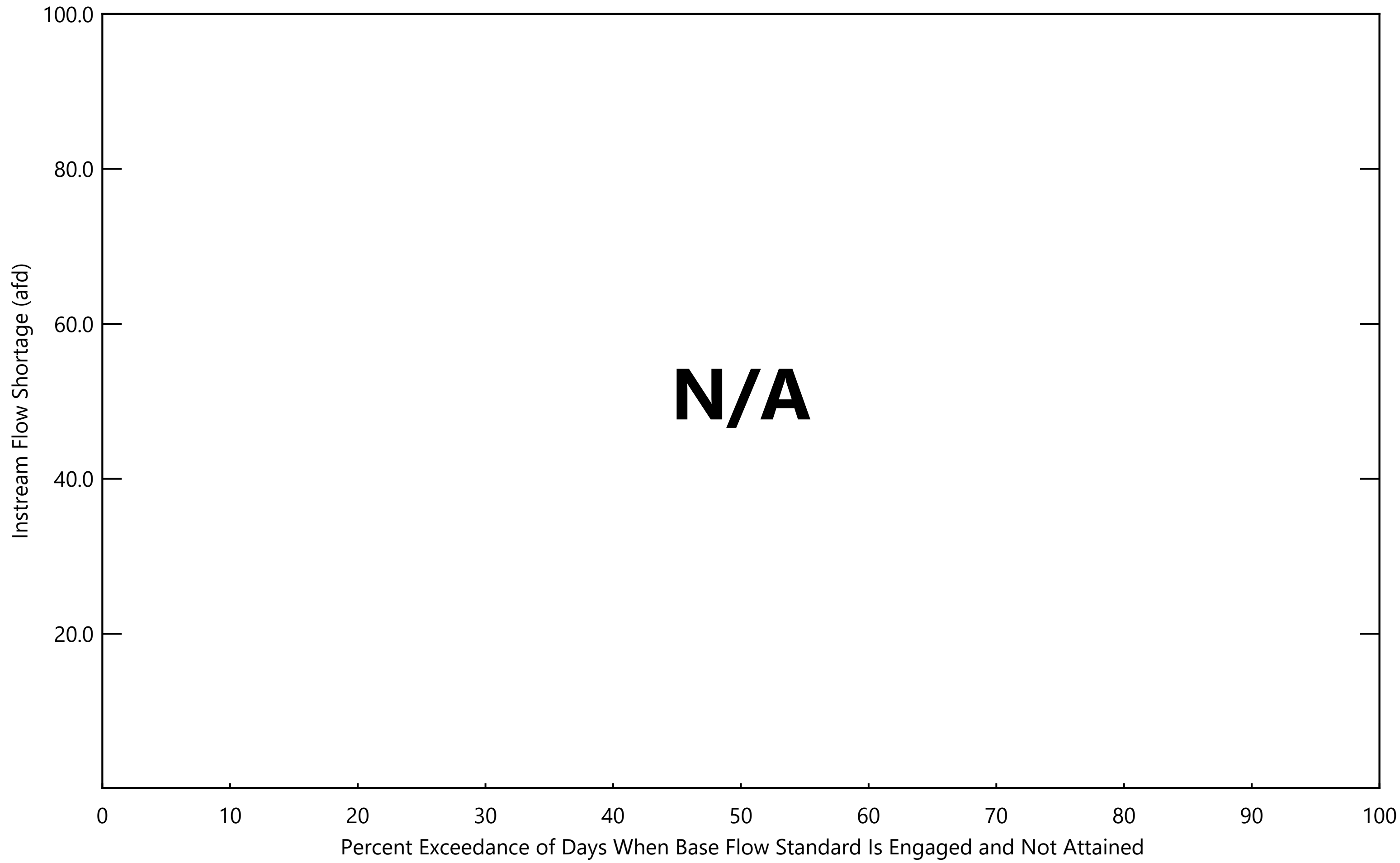
Figure E-173
West Fork Trinity River near Grand Prairie: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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Figure E-174

West Fork Trinity River near Grand Prairie: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards

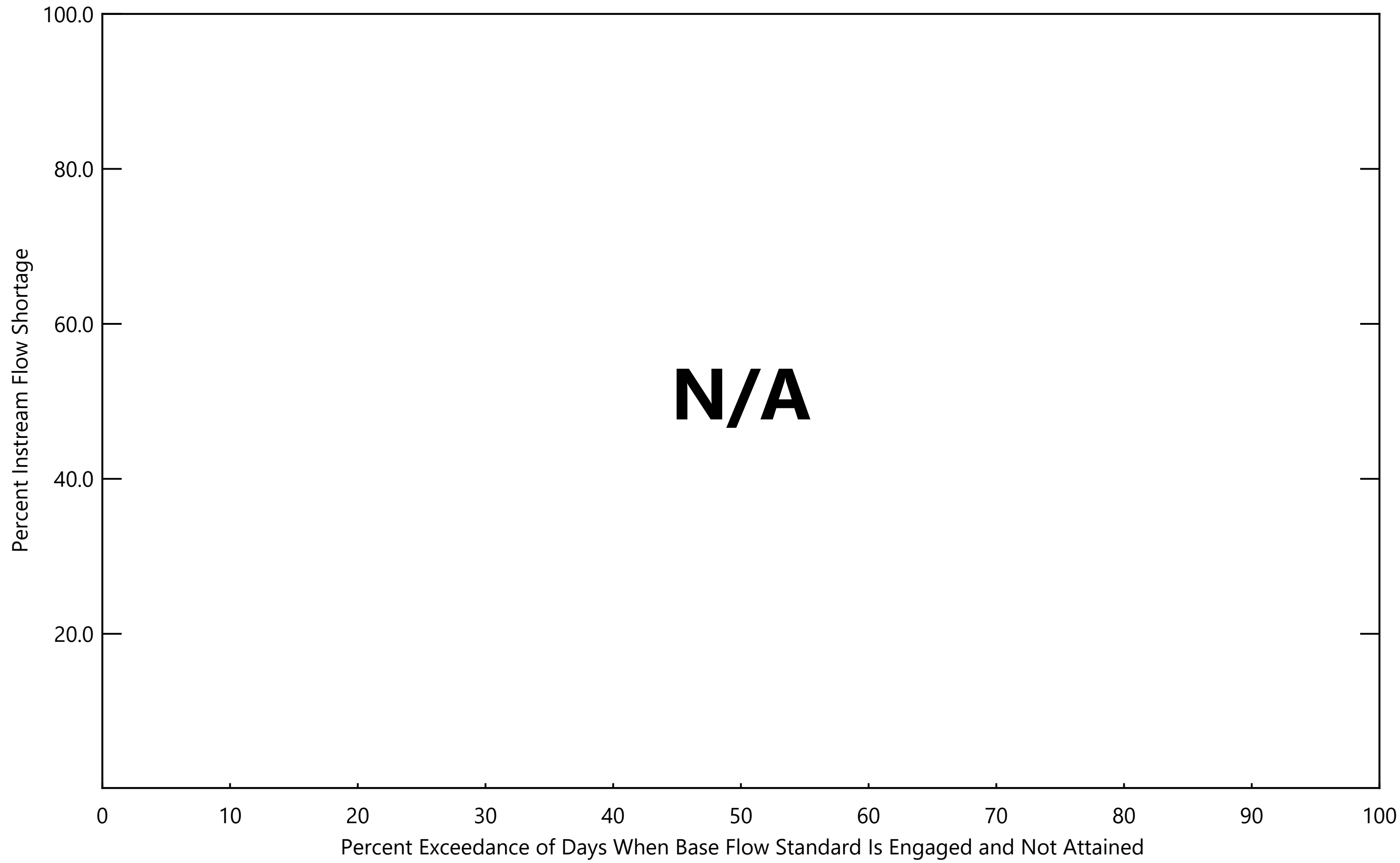

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Figure E-175
West Fork Trinity River near Grand Prairie: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

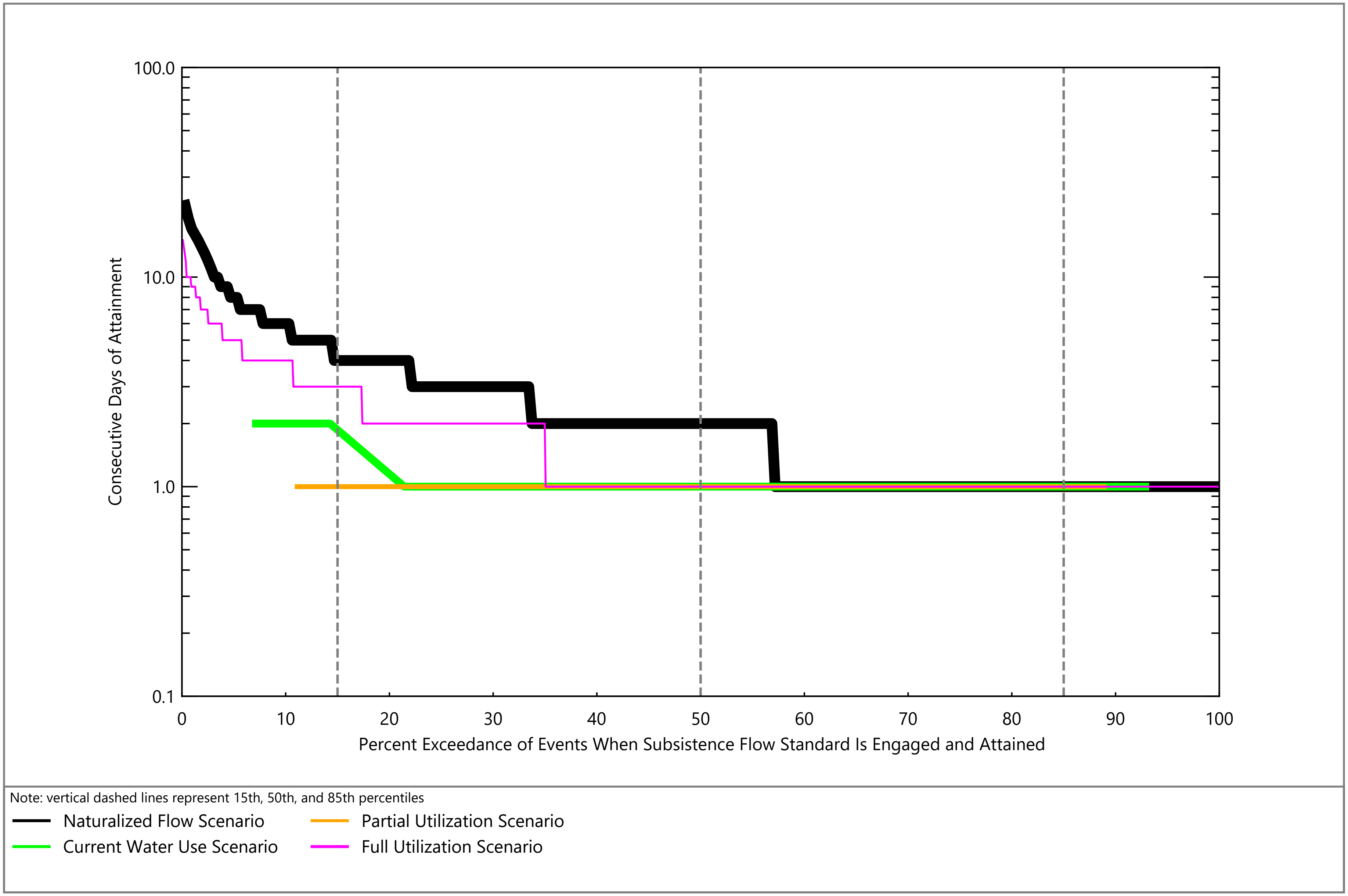

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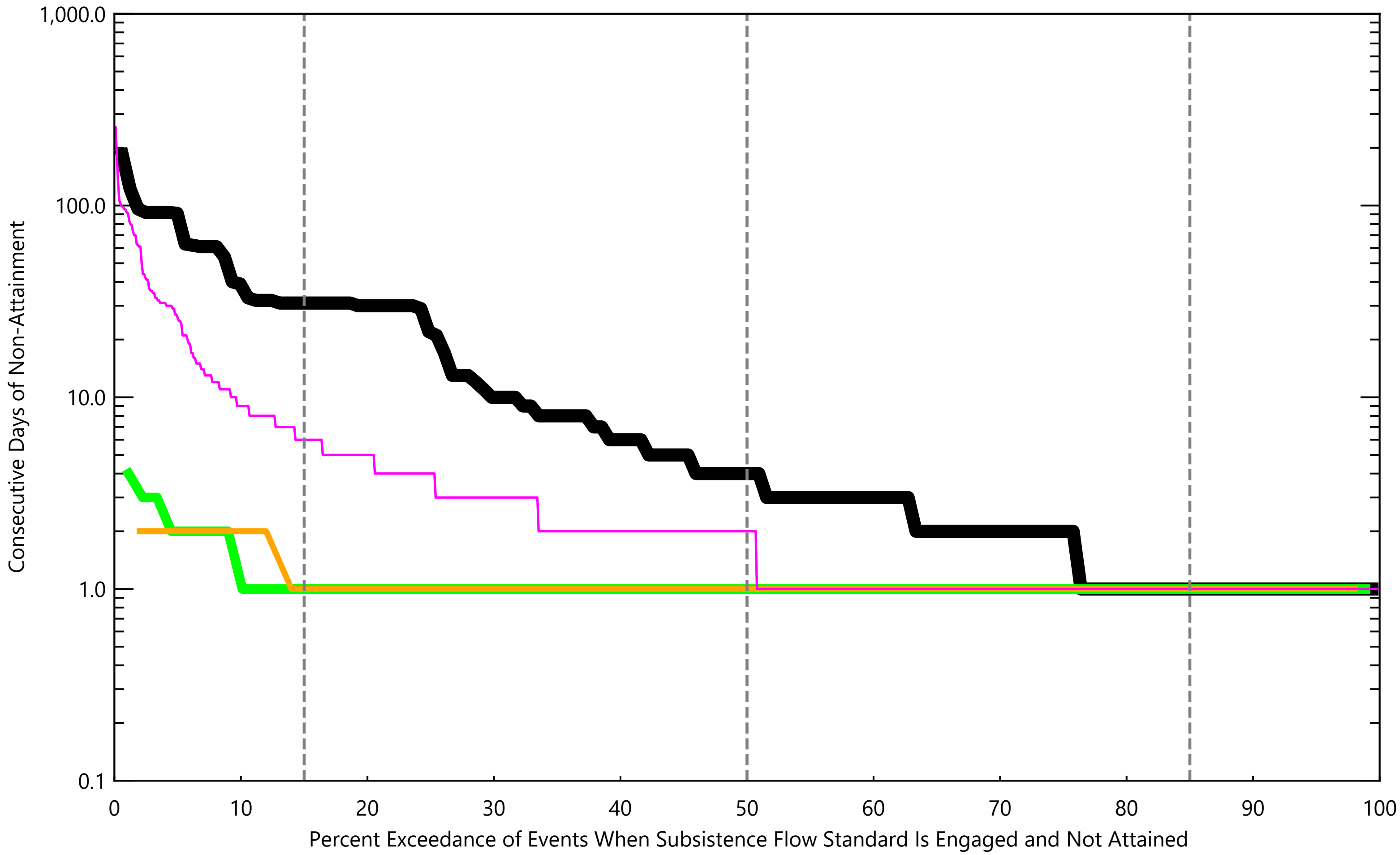
Figure E-176
West Fork Trinity River near Grand Prairie: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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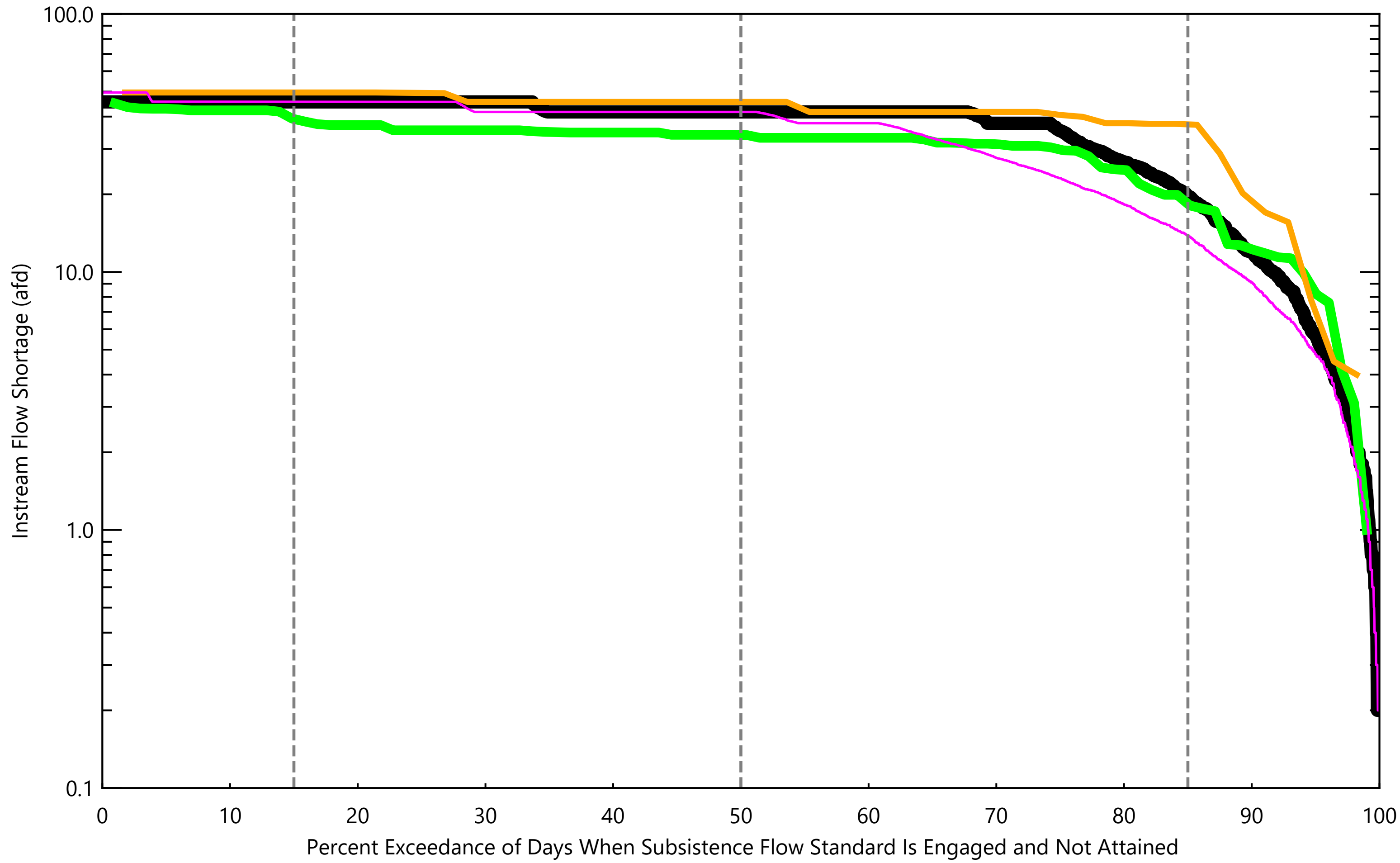
Figure E-177

West Fork Trinity River near Grand Prairie: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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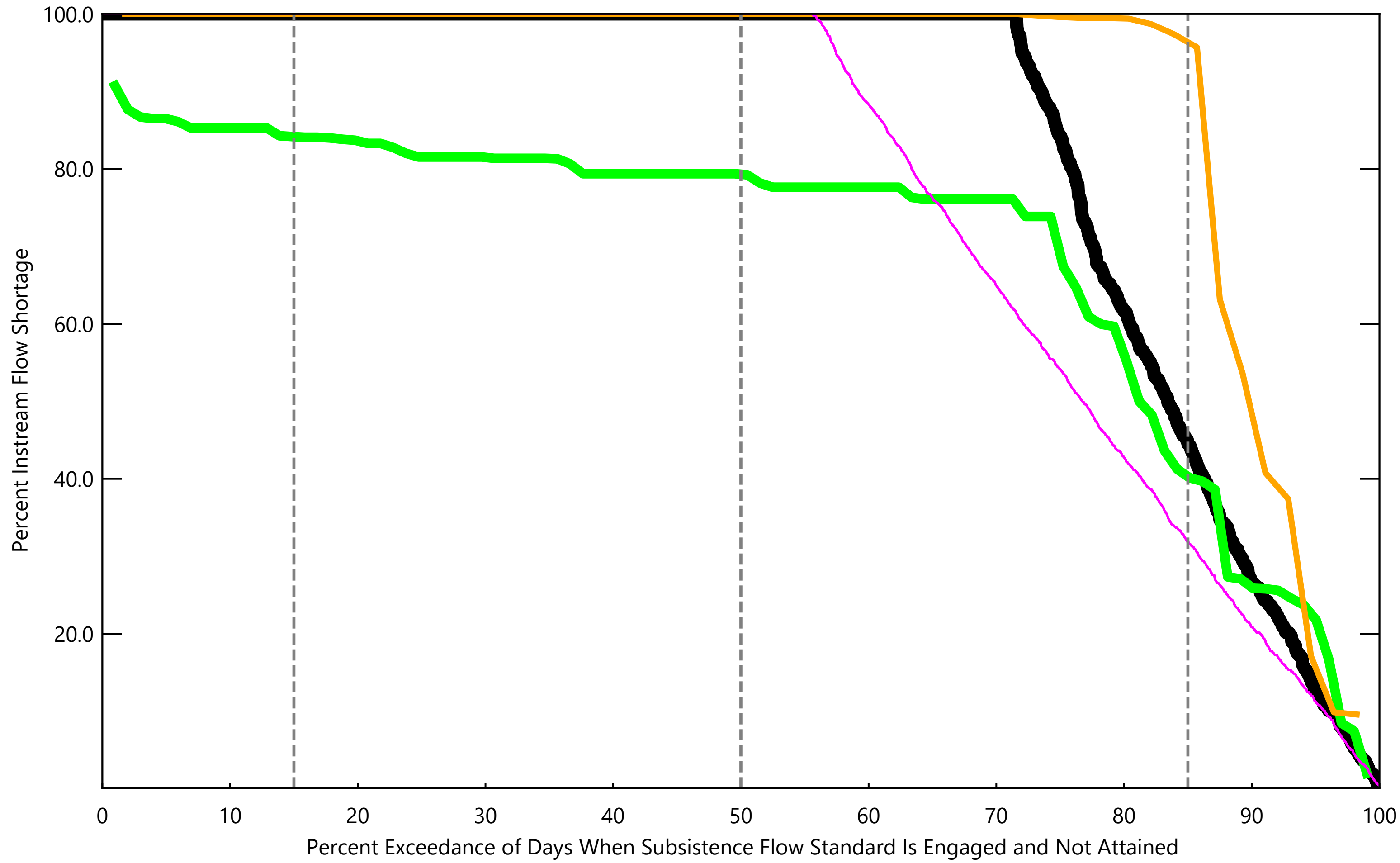
Figure E-178

West Fork Trinity River near Grand Prairie: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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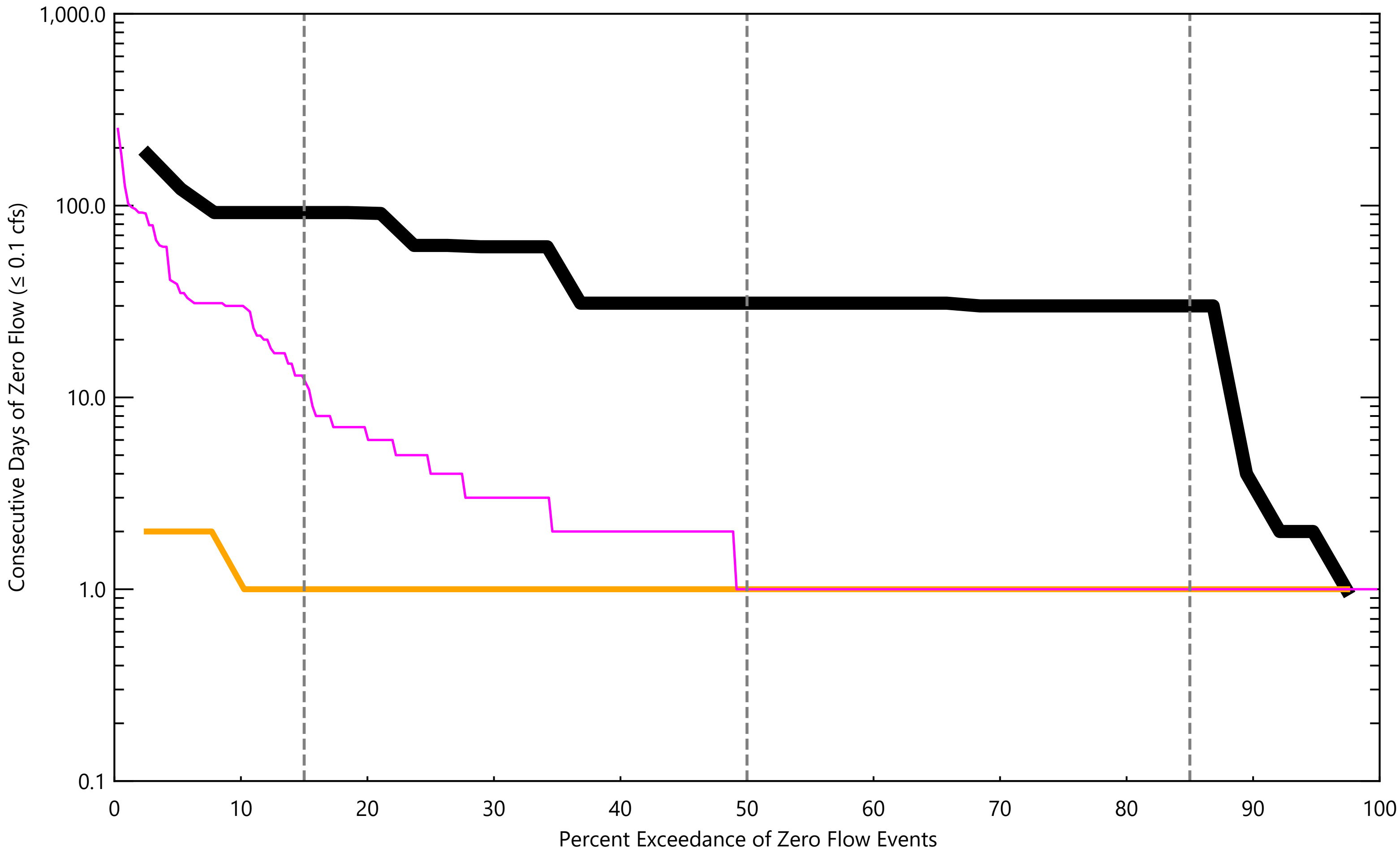
Figure E-179

West Fork Trinity River near Grand Prairie: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Full Utilization Scenario

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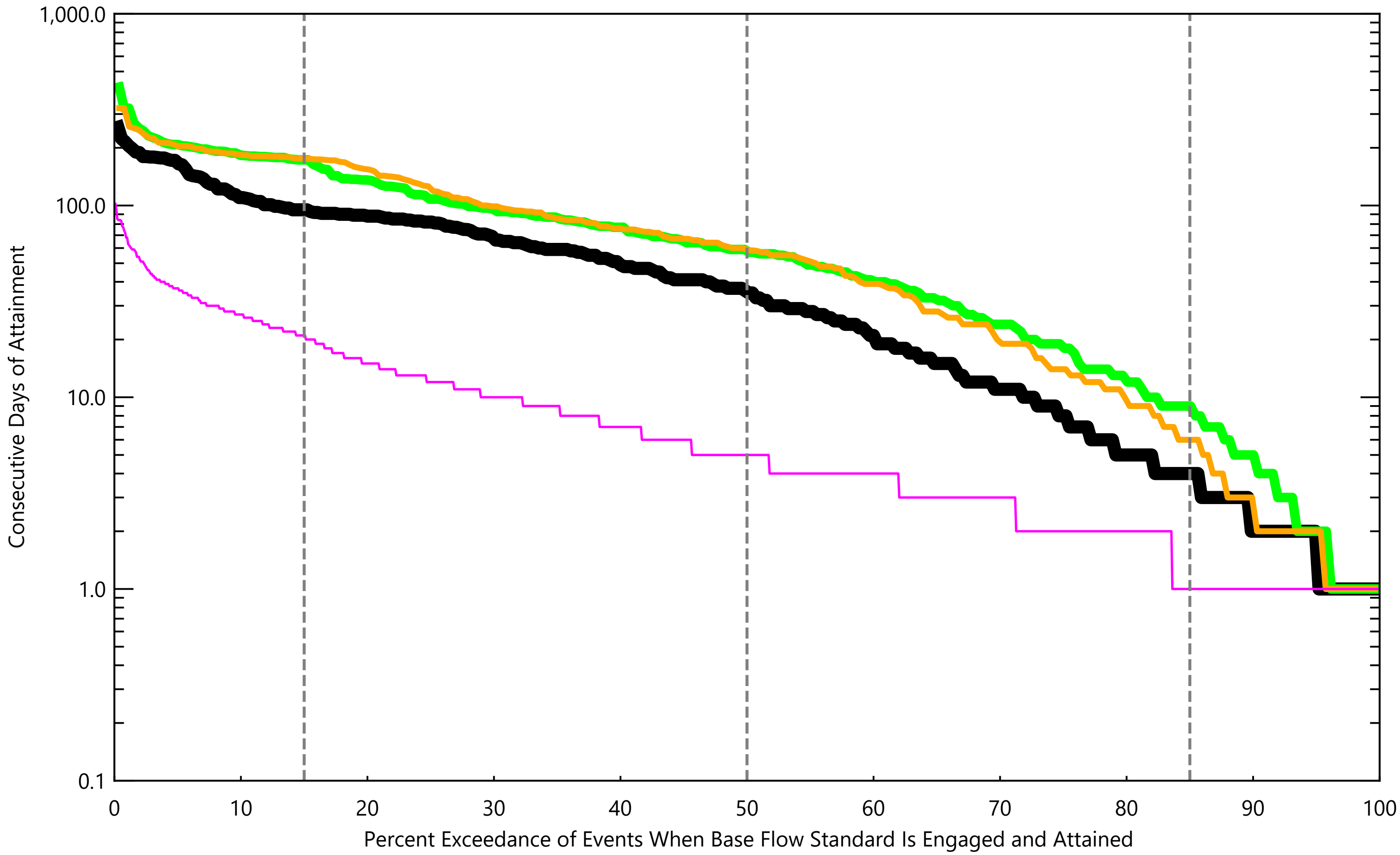
Figure E-180
West Fork Trinity River near Grand Prairie: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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Figure E-181
Trinity River at Dallas: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

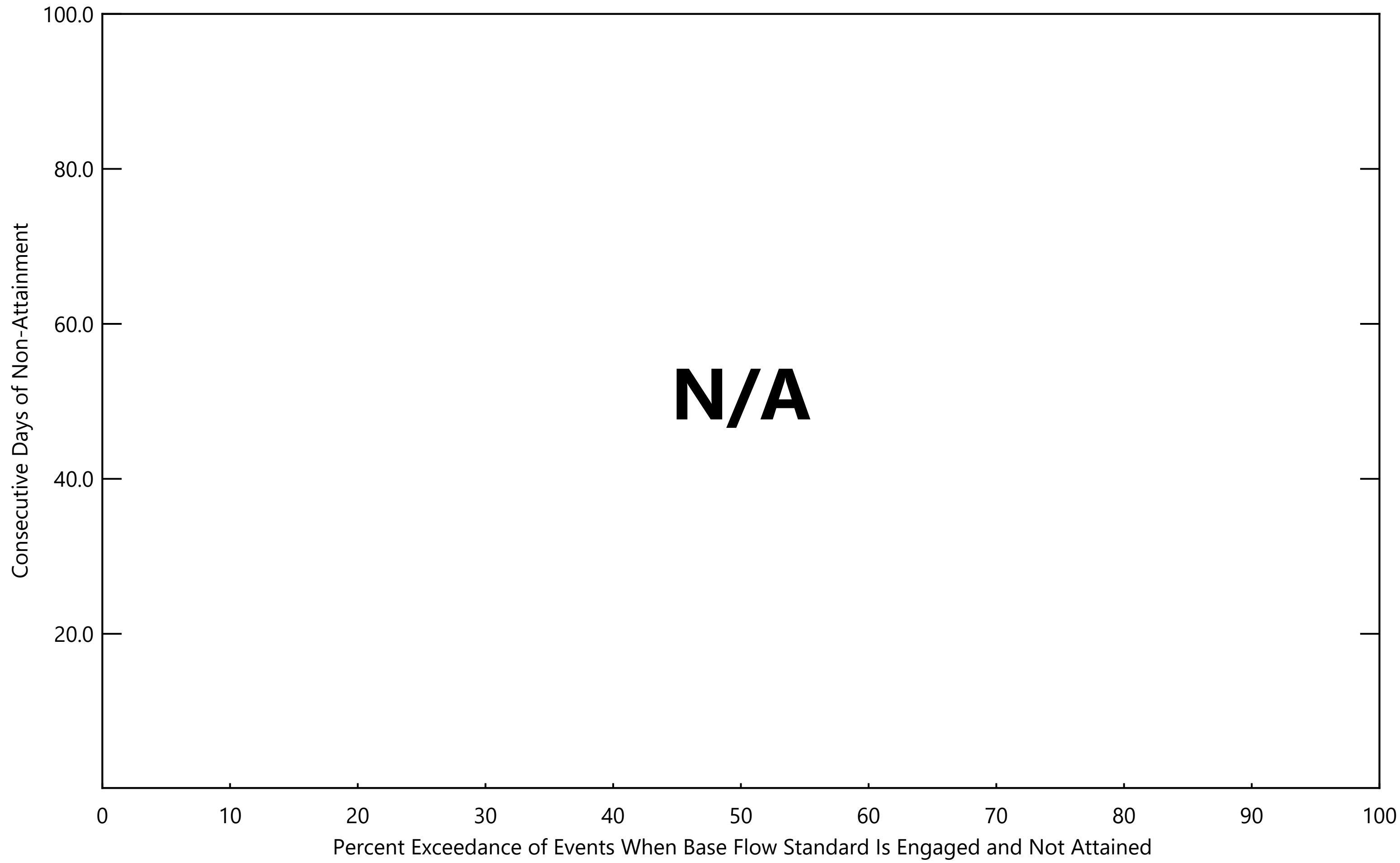
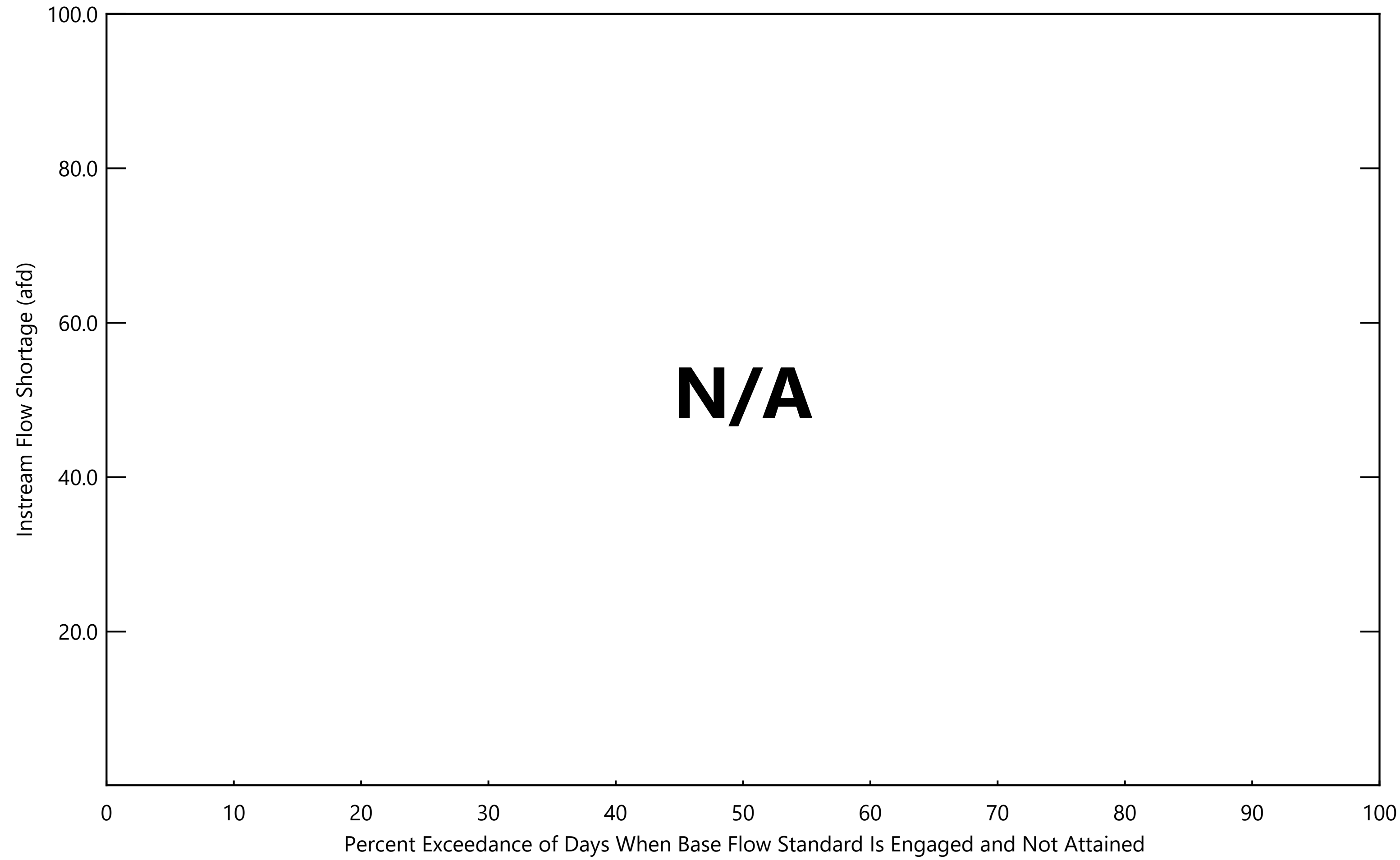


Figure E-182

Trinity River at Dallas: Base Flow Shortage Duration, Entire Period of Record (SD-POR)



Note: afd = acre-feet per day

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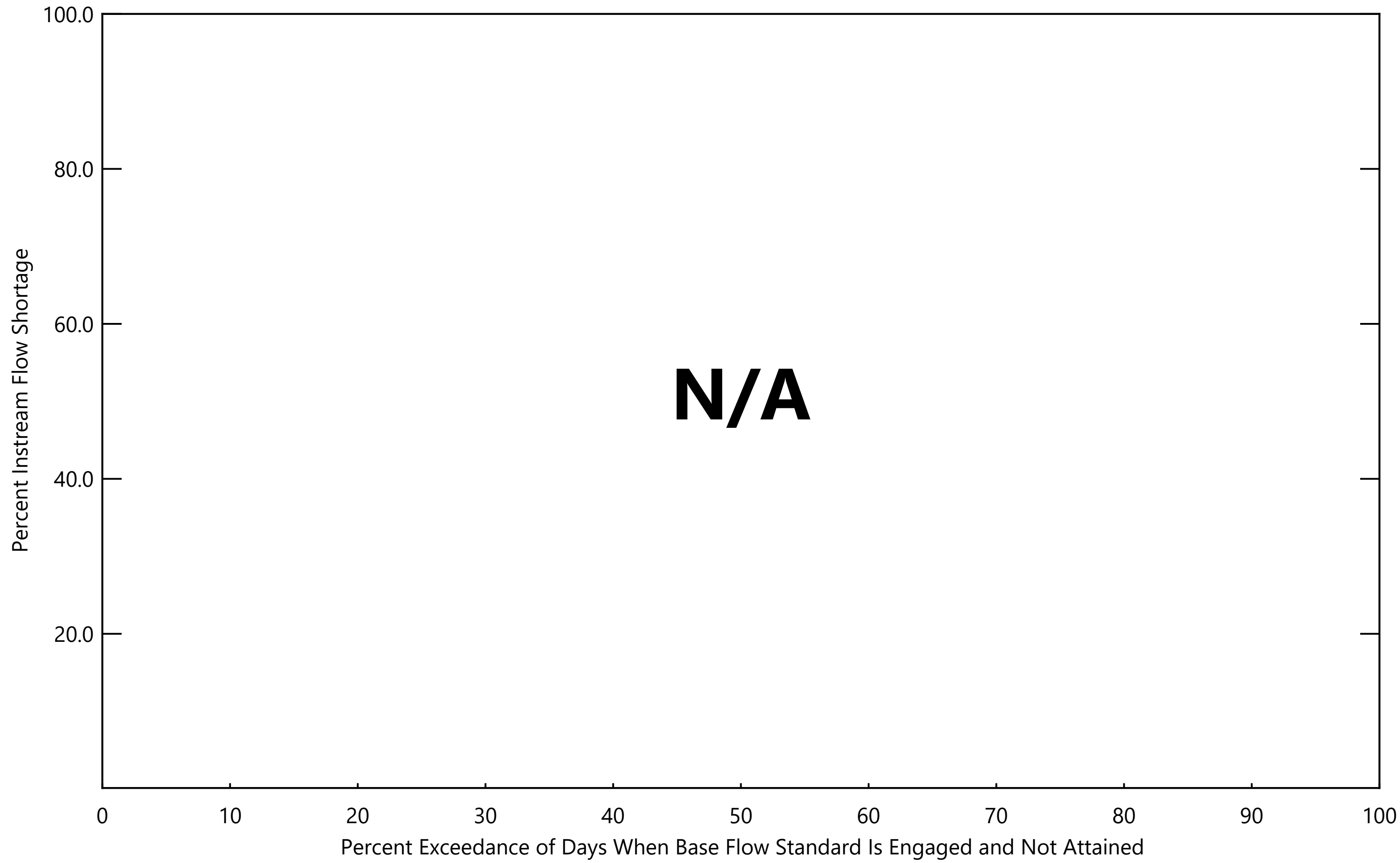
Figure E-183
Trinity River at Dallas: Base Flow Shortage, Entire Period of Record (S-POR)



Publish Date: 08/15/2021 16:12 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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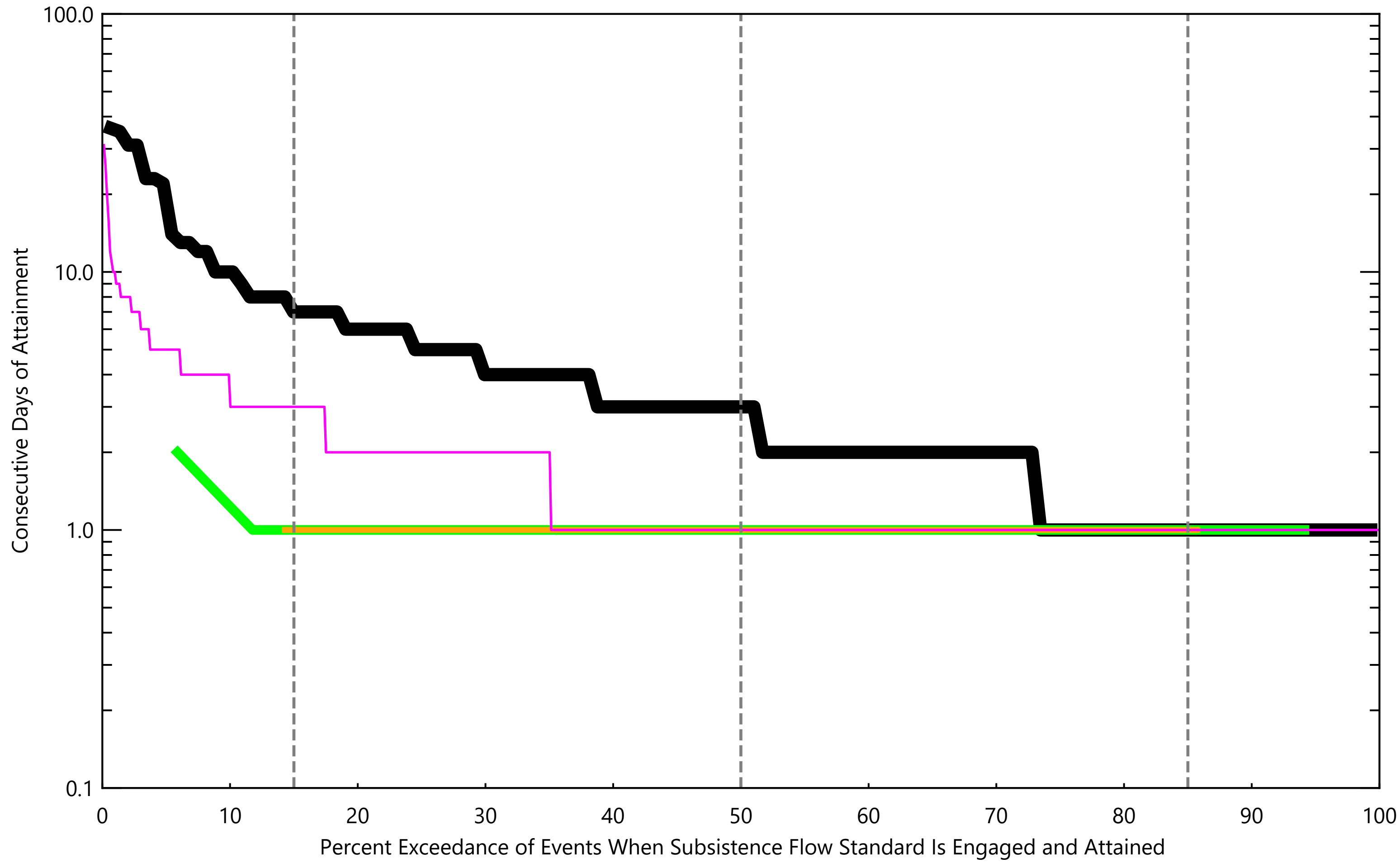
Figure E-184
Trinity River at Dallas: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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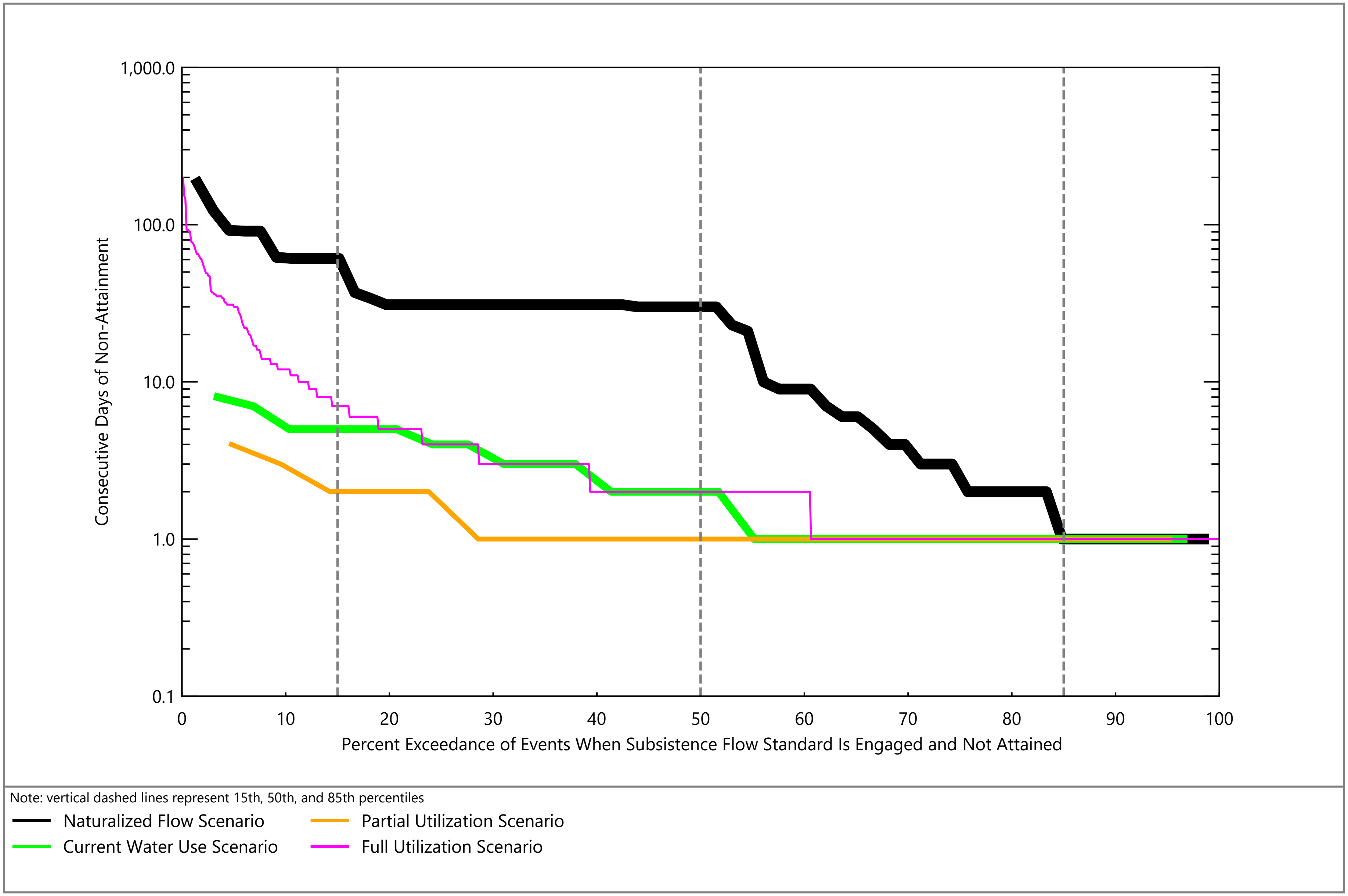

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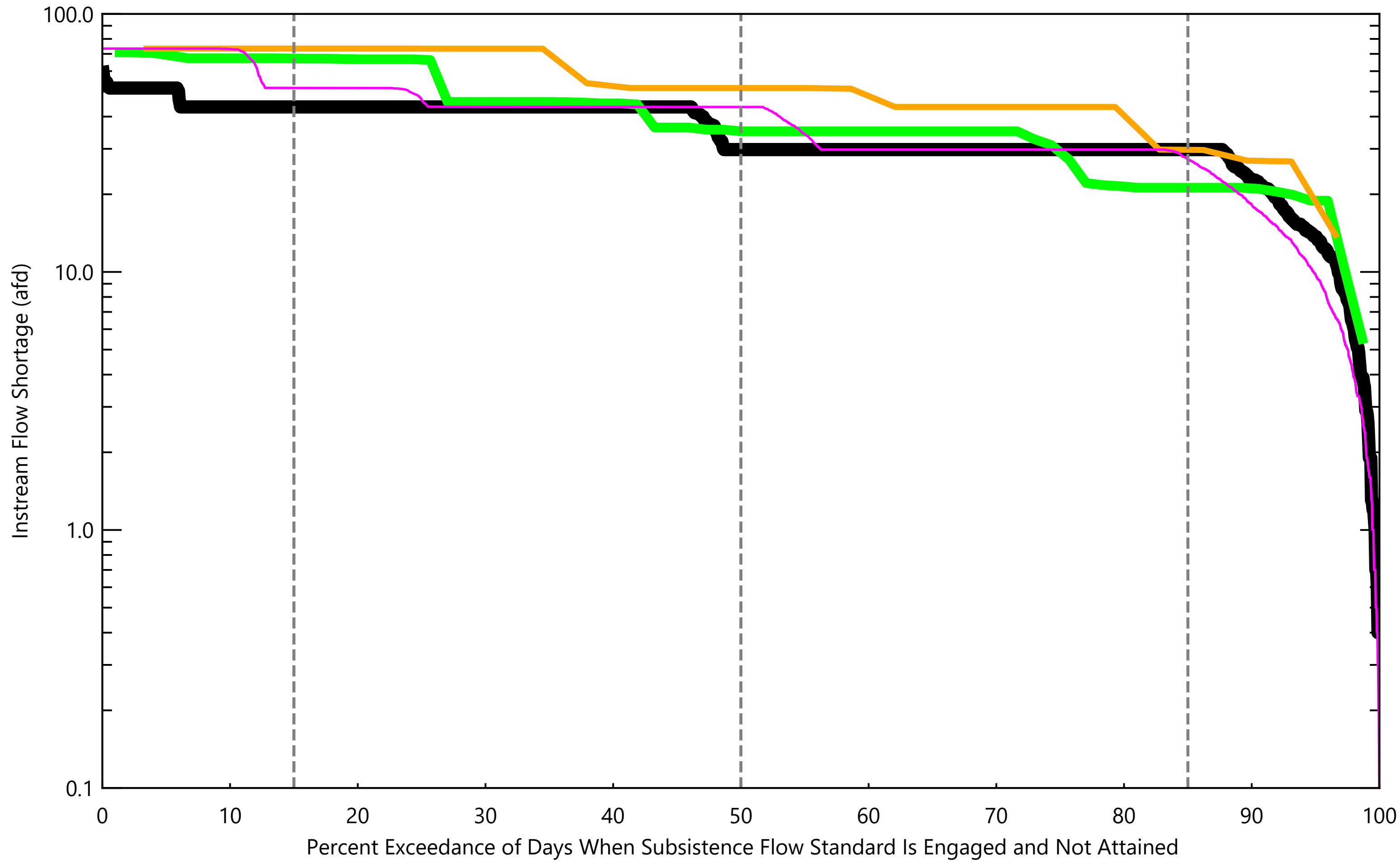
Figure E-186
Trinity River at Dallas: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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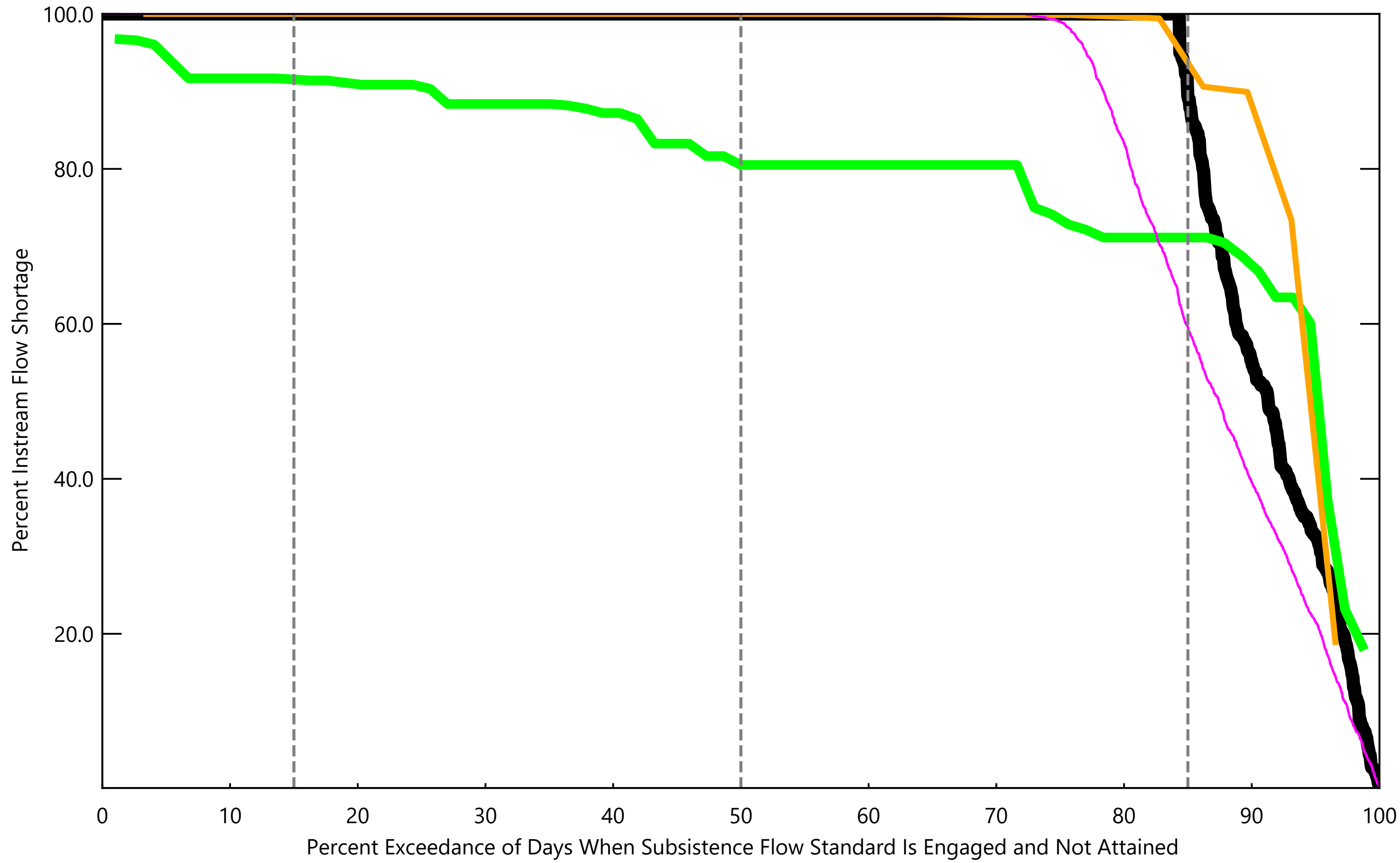
Figure E-187

Trinity River at Dallas: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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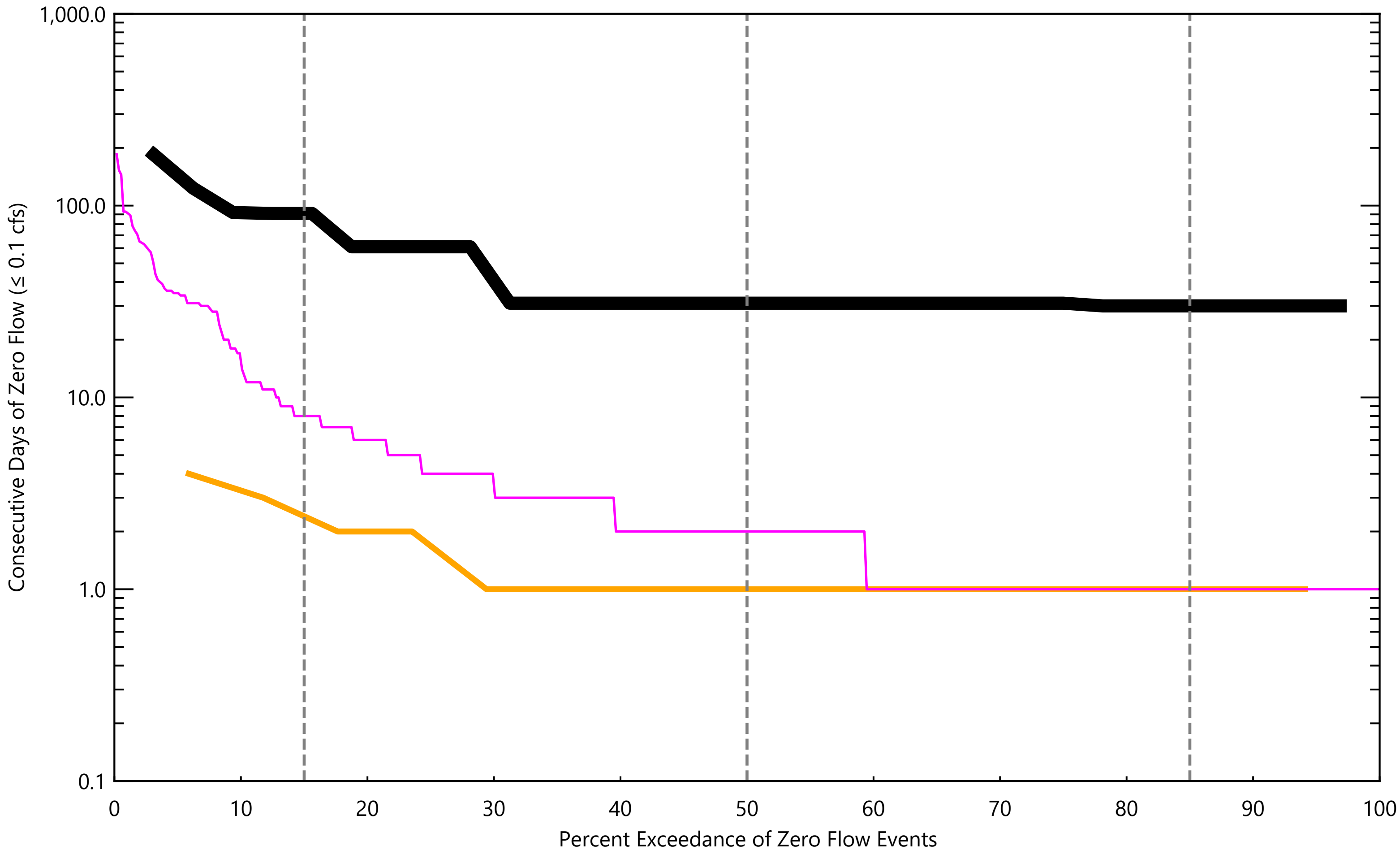
Figure E-188

Trinity River at Dallas: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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Figure E-189

Trinity River at Dallas: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards

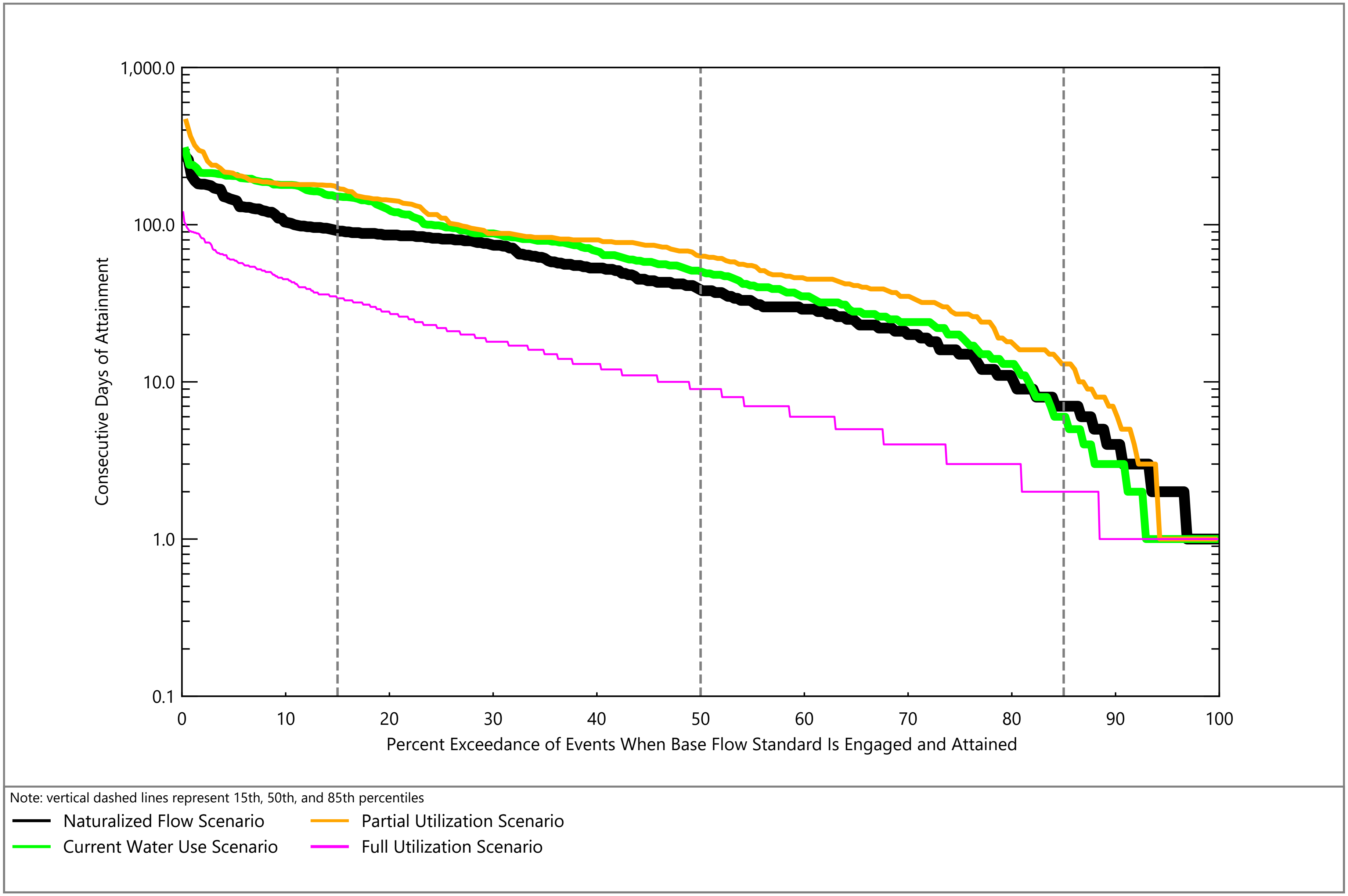

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Figure E-190

Trinity River near Oakwood: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards

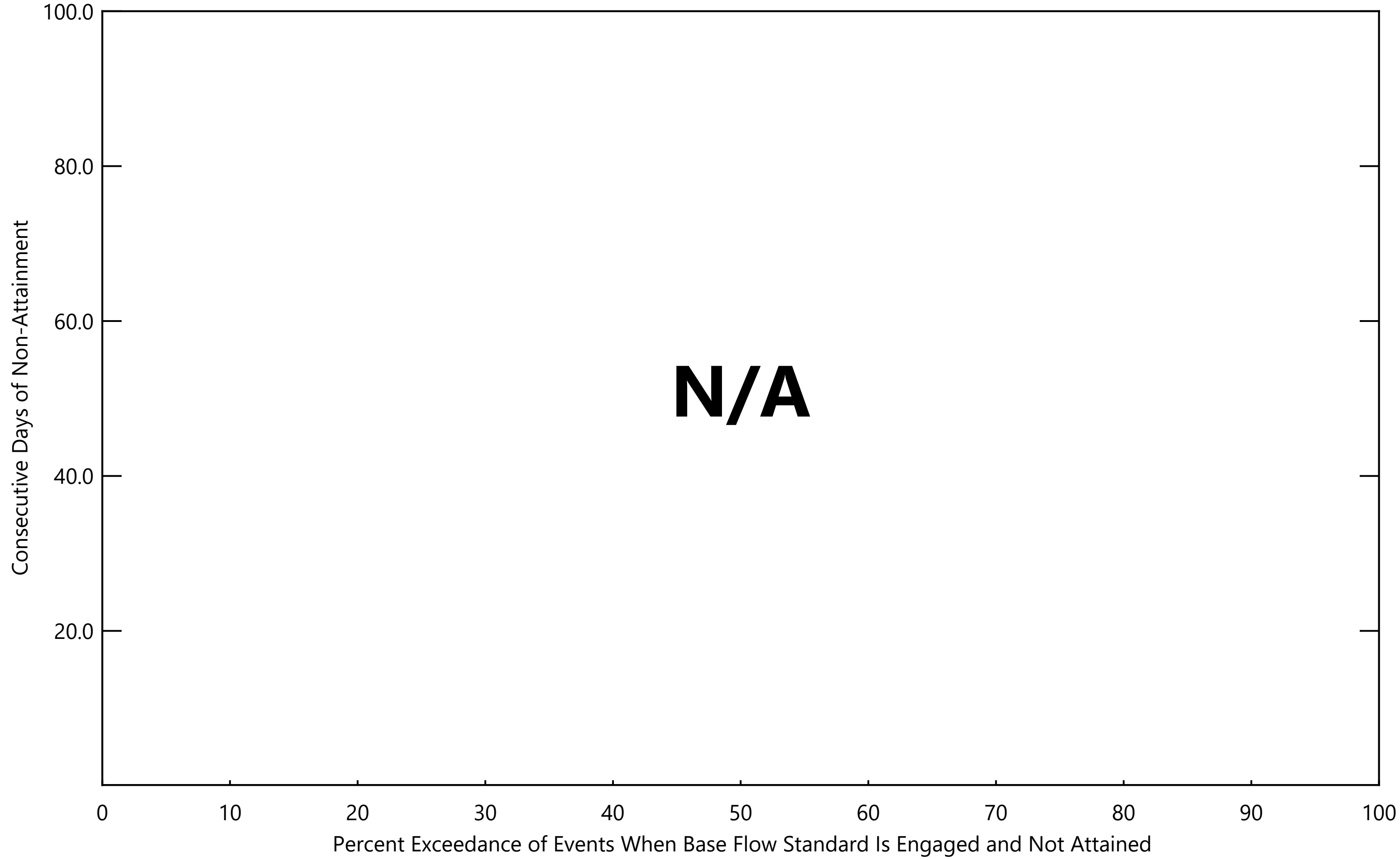

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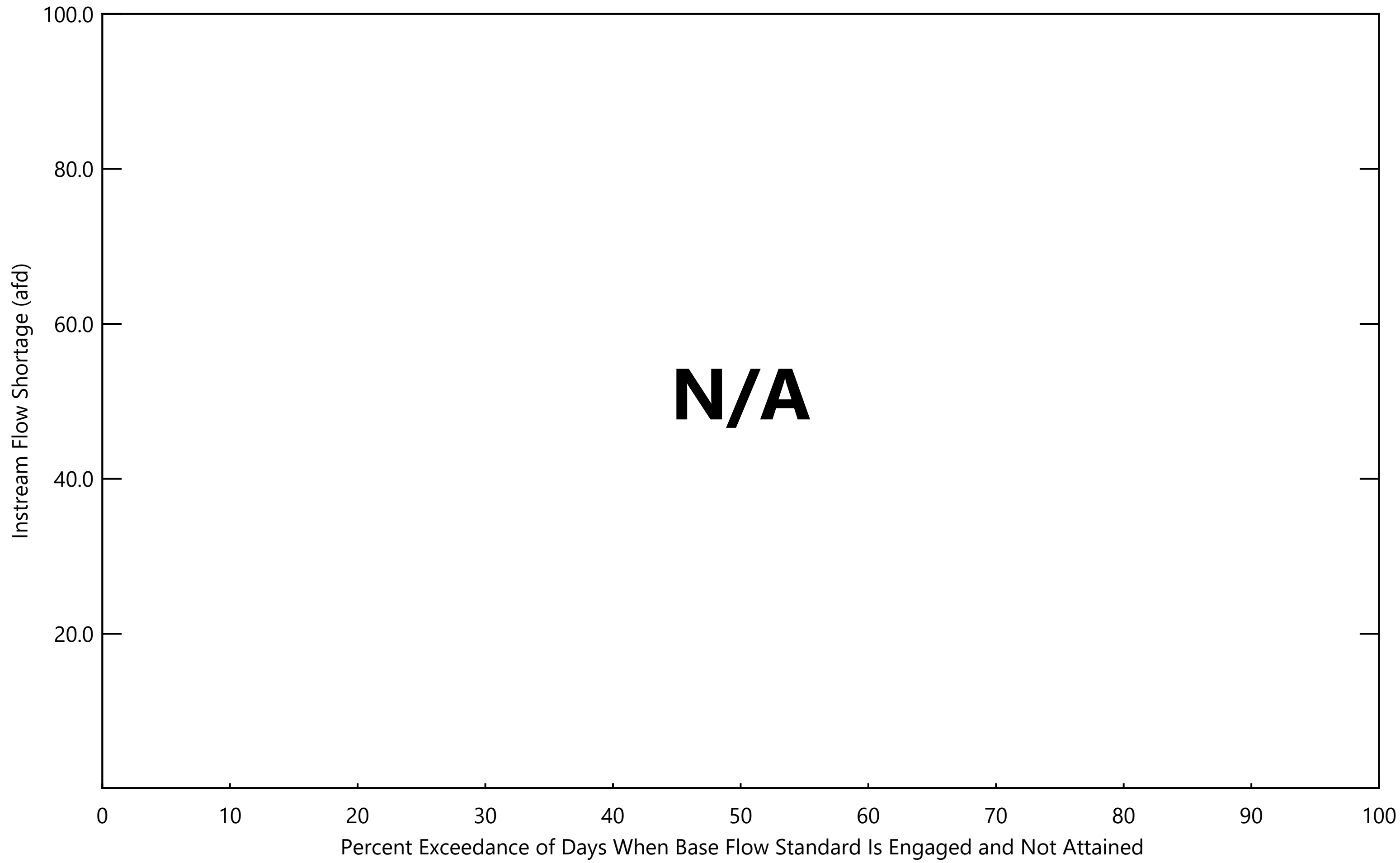
Figure E-191

Trinity River near Oakwood: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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Figure E-192
Trinity River near Oakwood: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

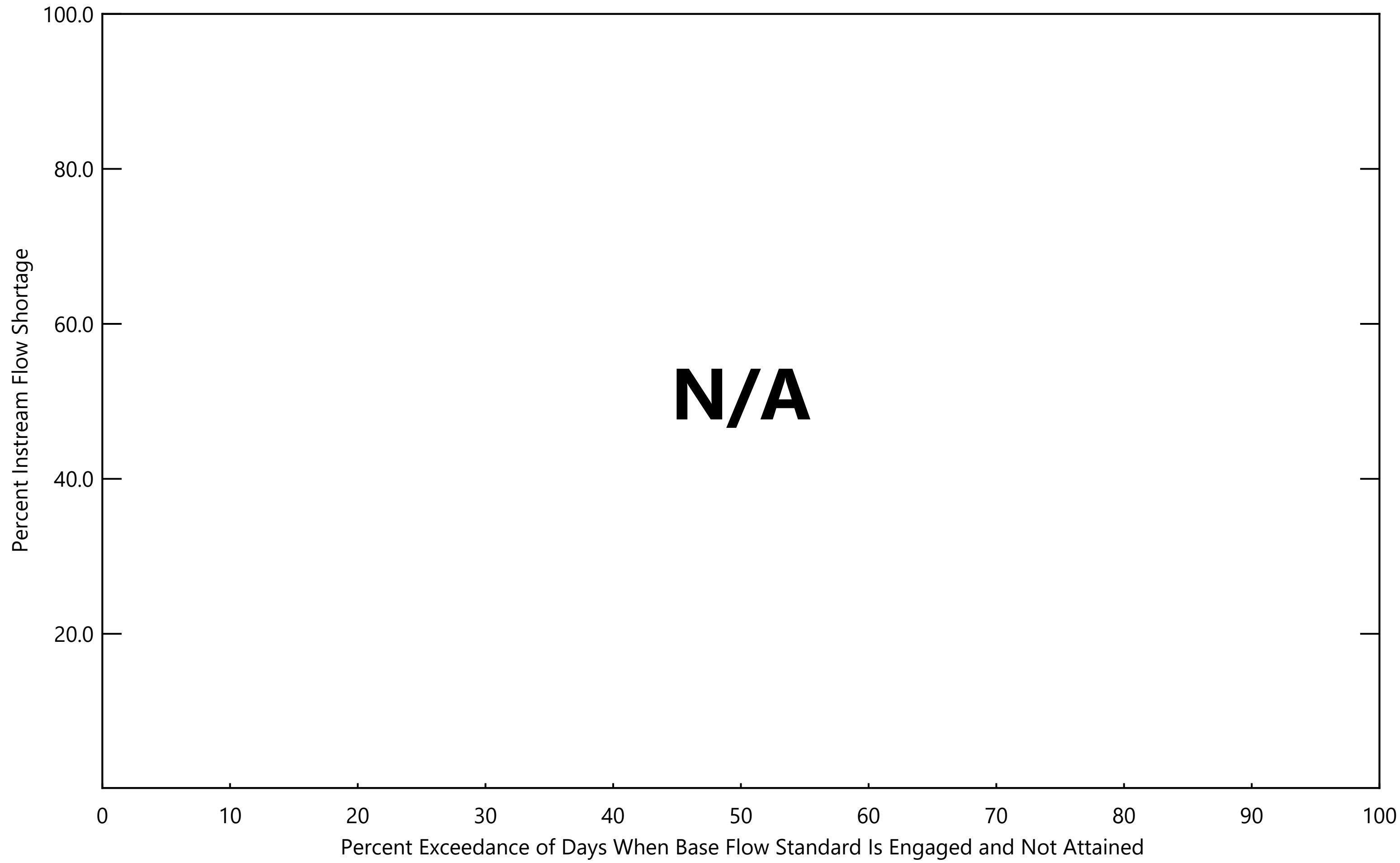

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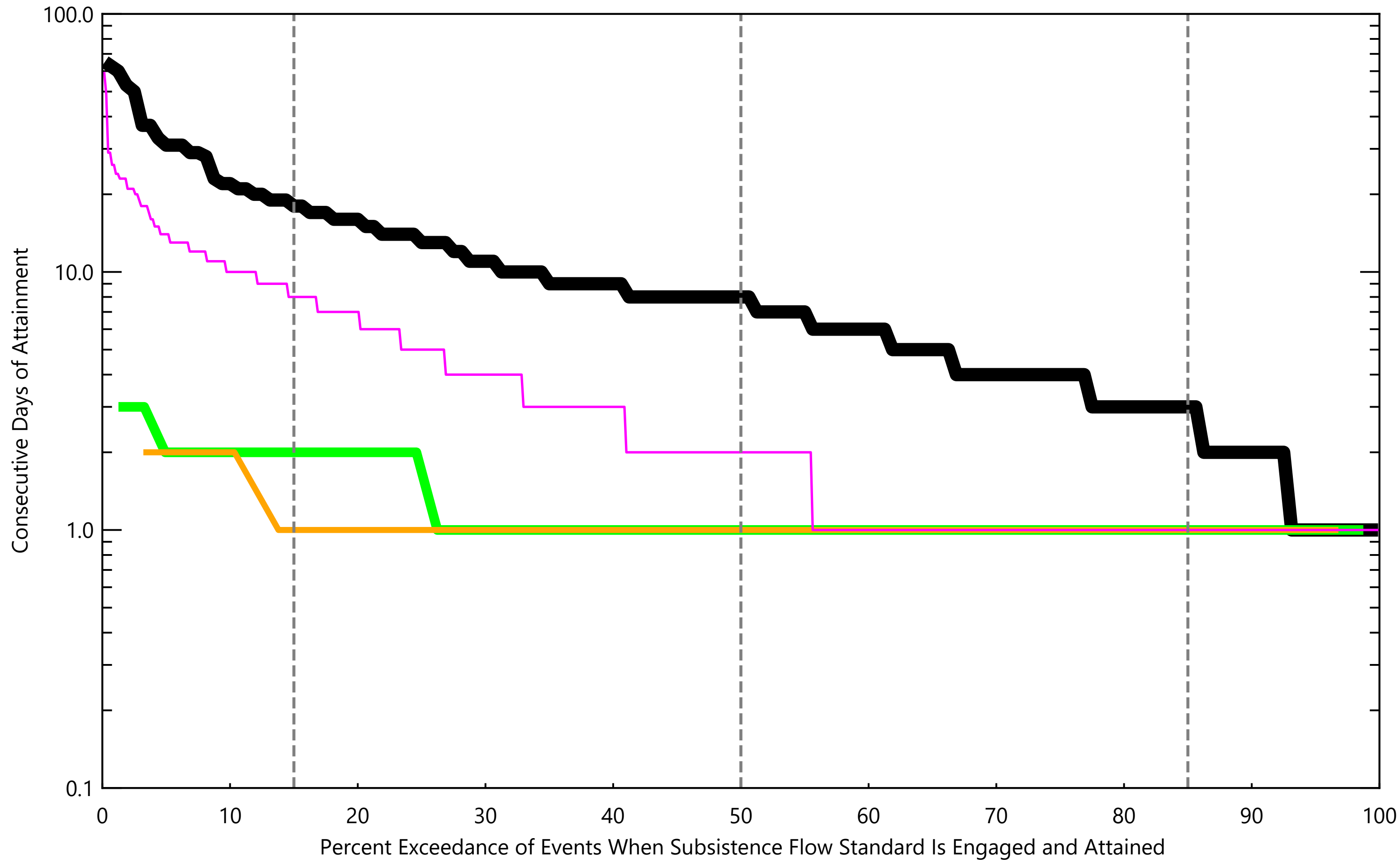
Figure E-193
Trinity River near Oakwood: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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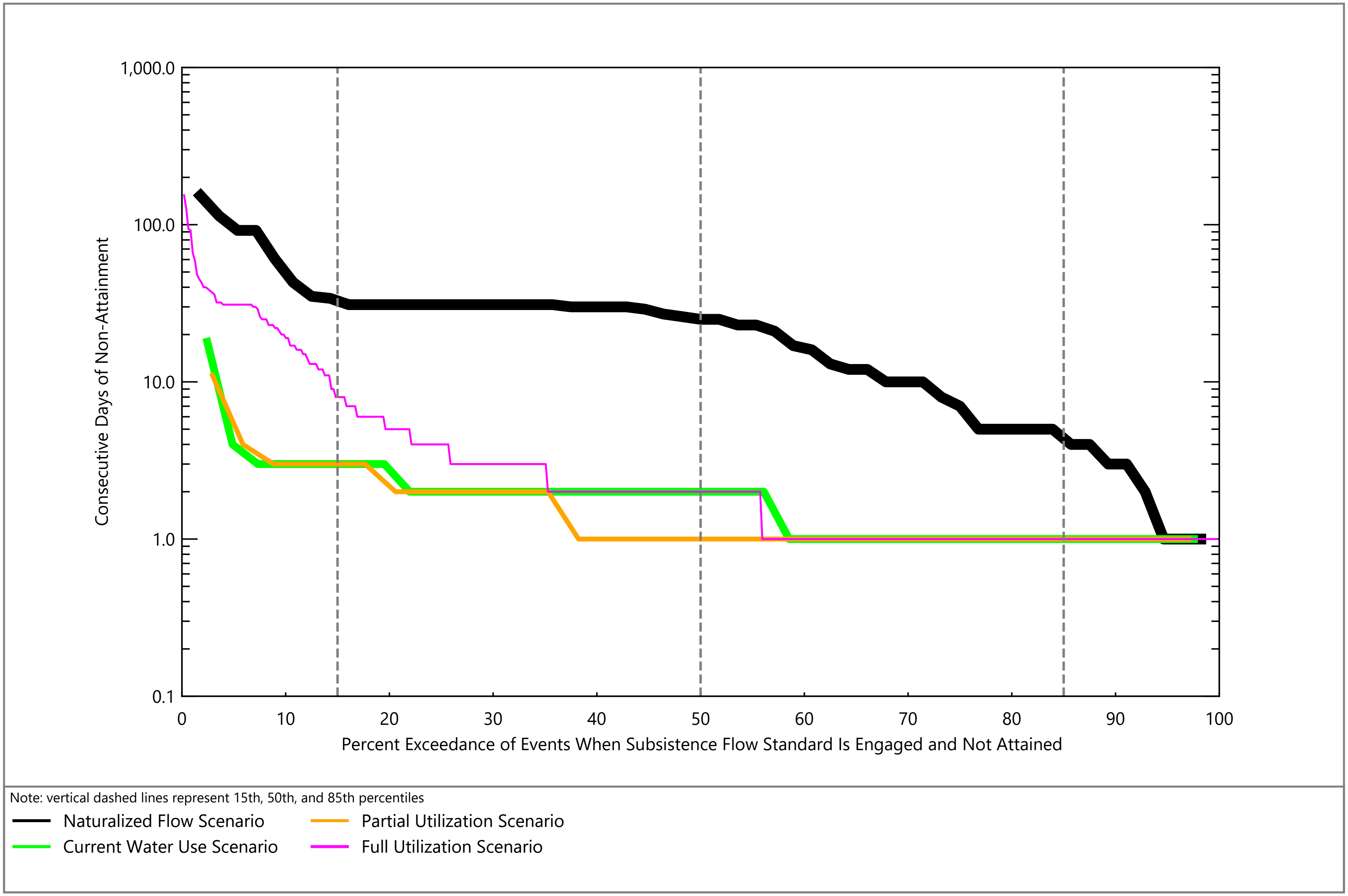
Figure E-194

Trinity River near Oakwood: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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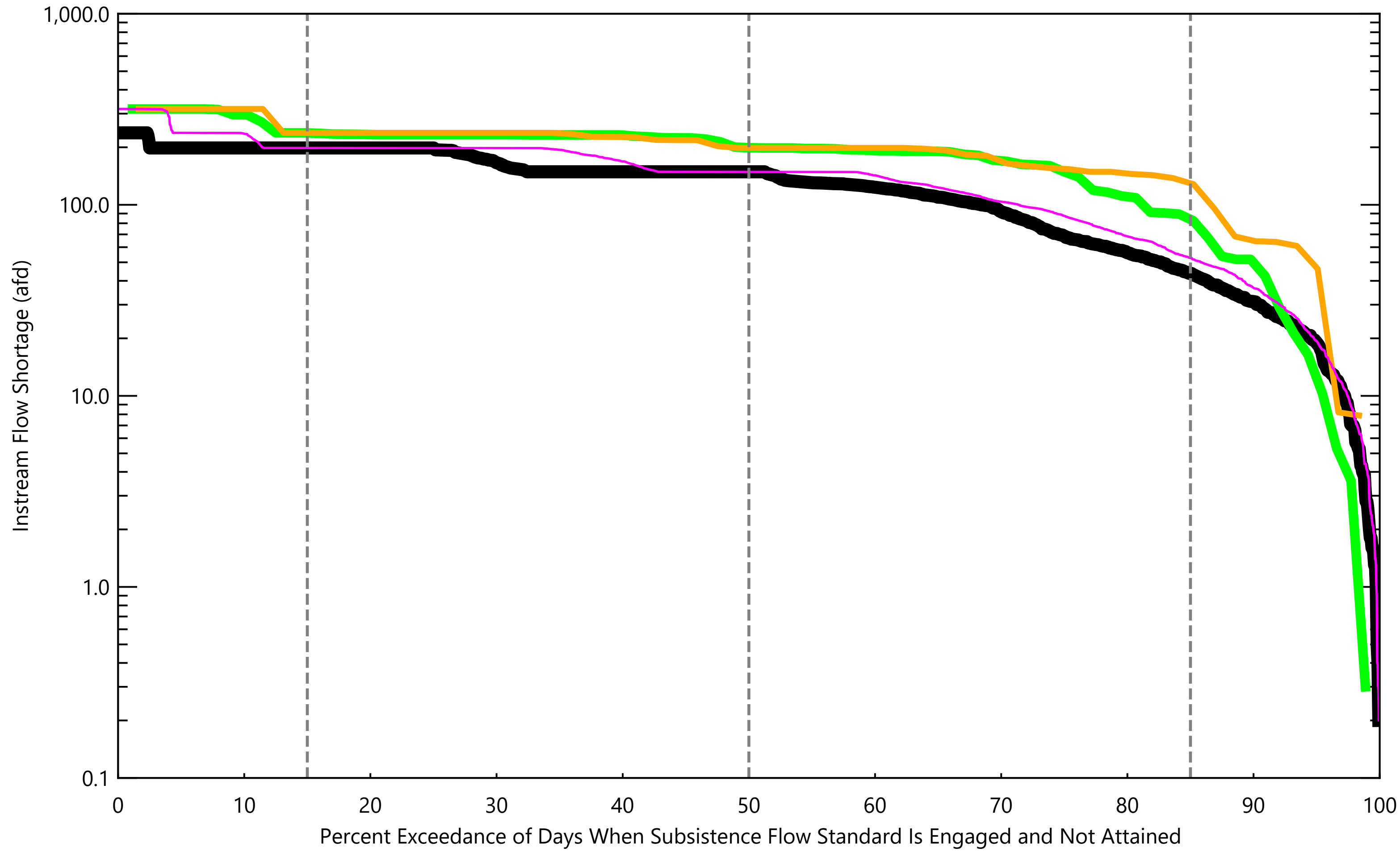
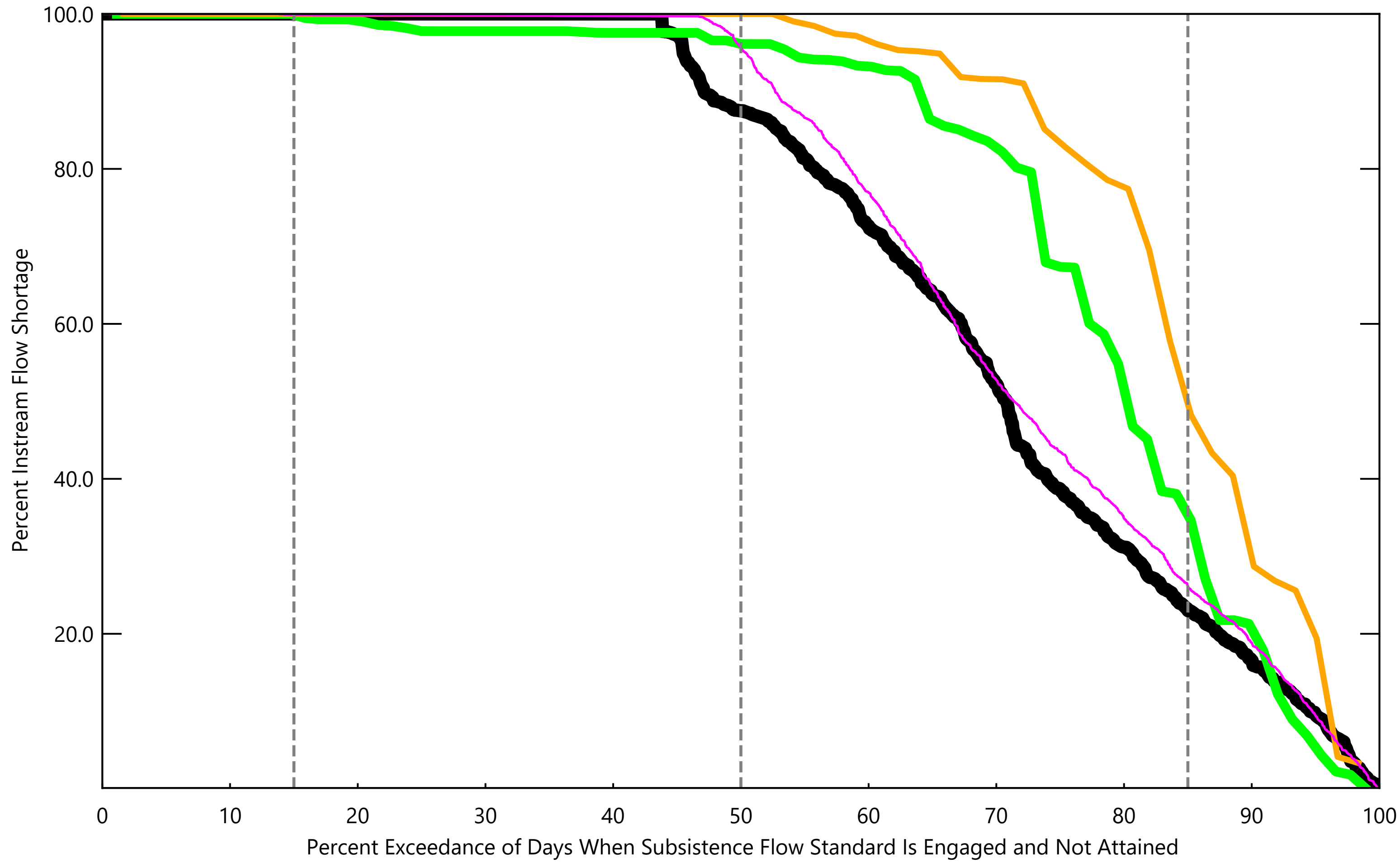
Figure E-195
Trinity River near Oakwood: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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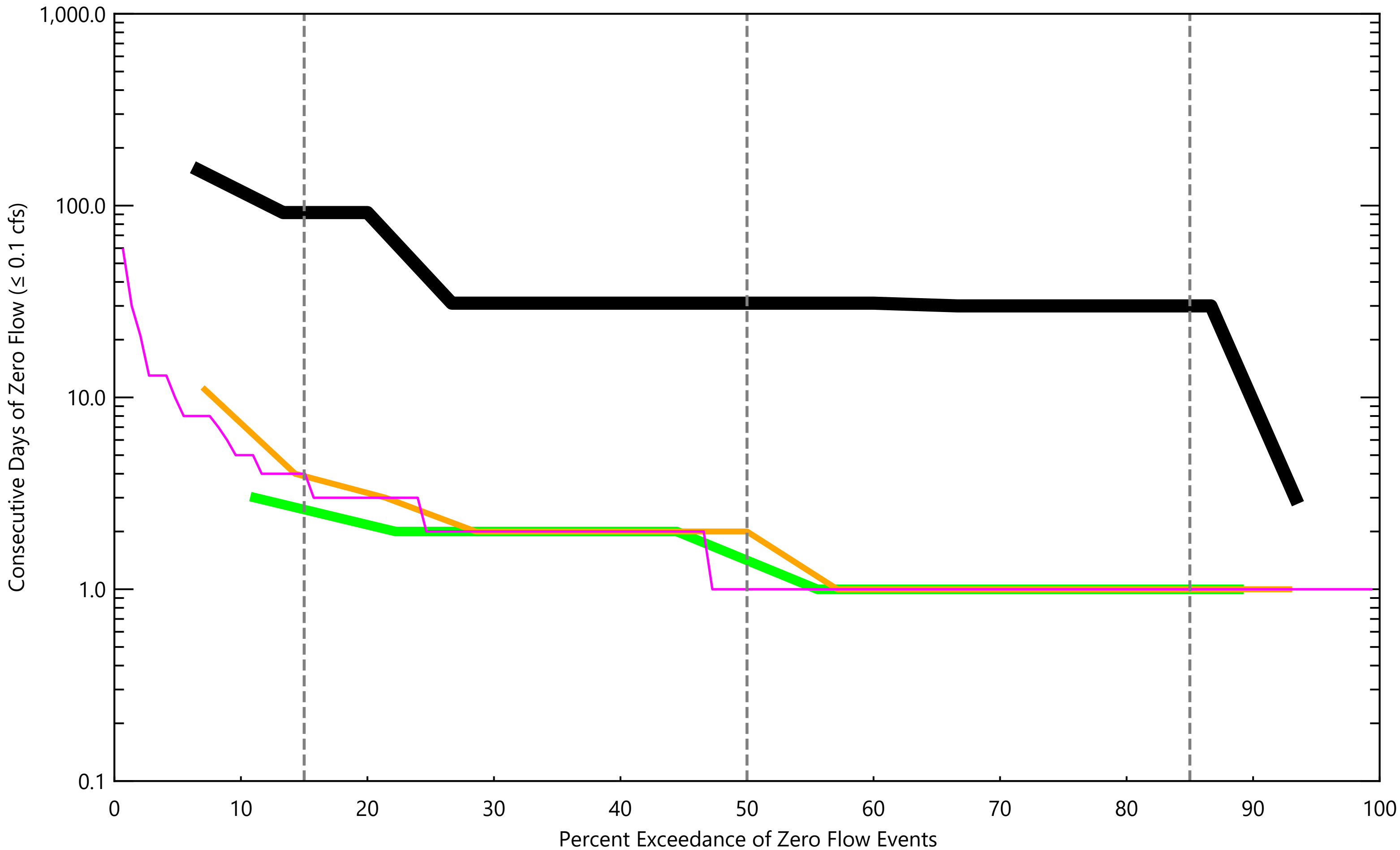
Figure E-197

Trinity River near Oakwood: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

Publish Date: 08/15/2021 16:12 PM | User: JH
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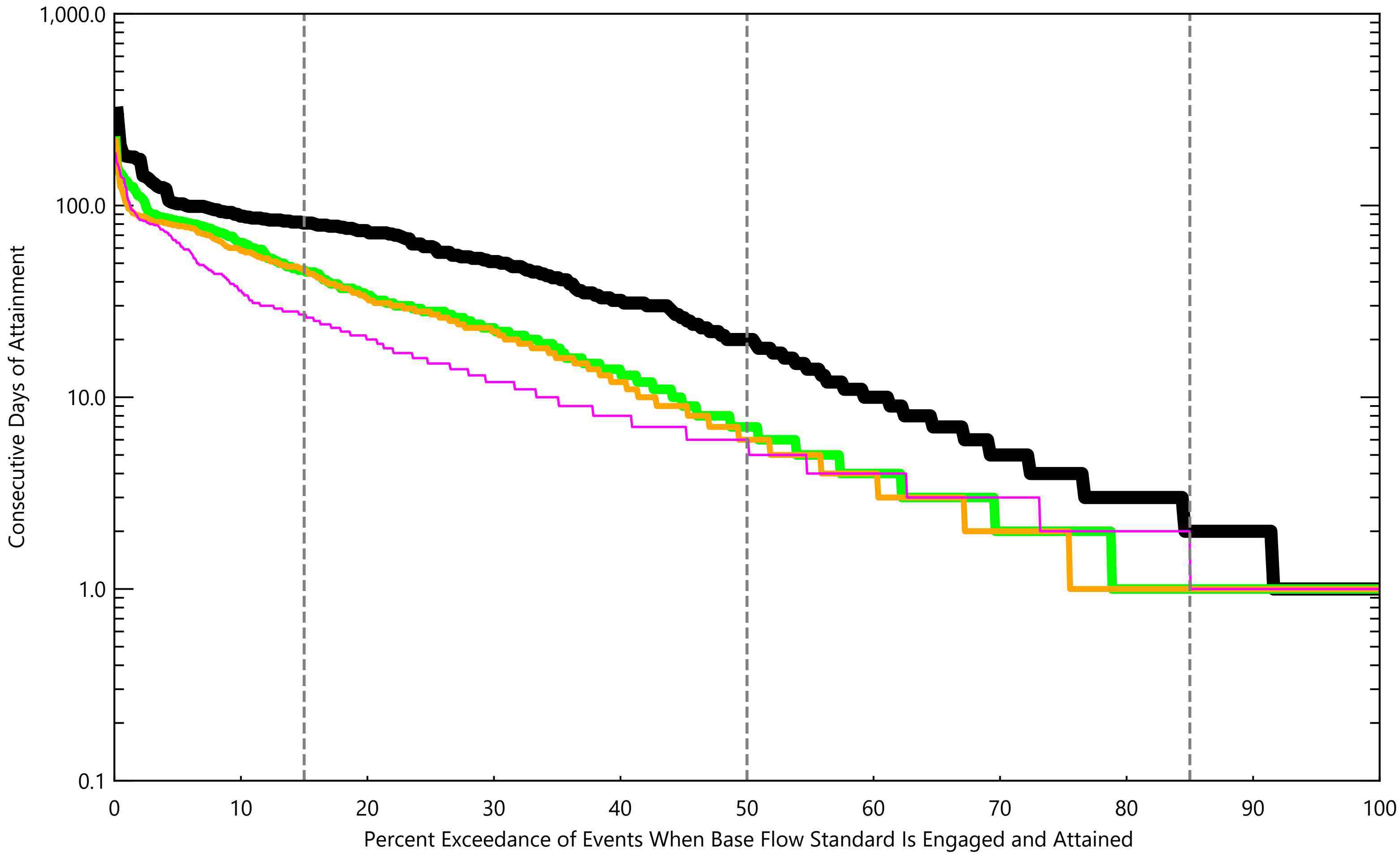
Figure E-198
Trinity River near Oakwood: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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Figure E-199

Trinity River near Romayor: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards

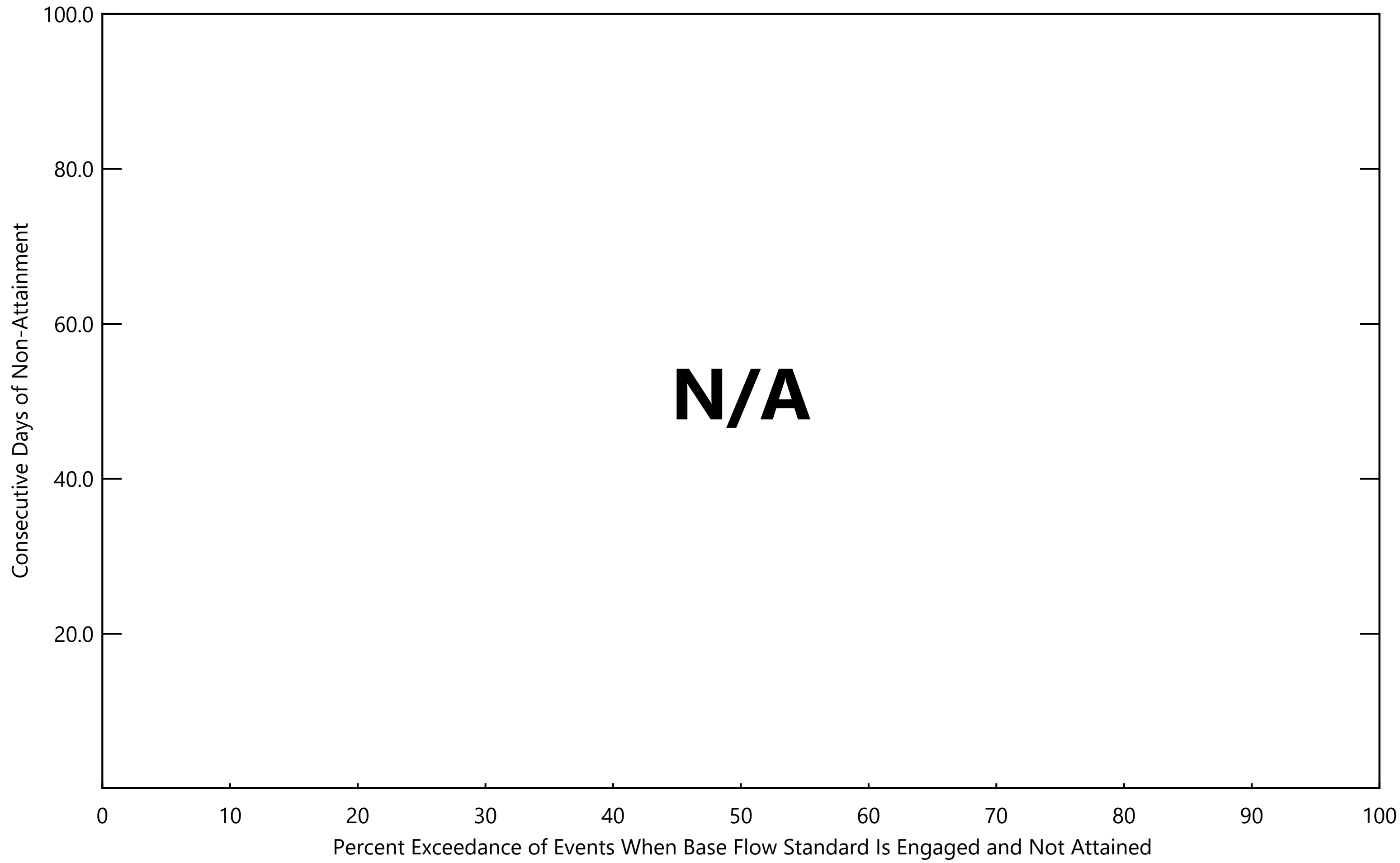

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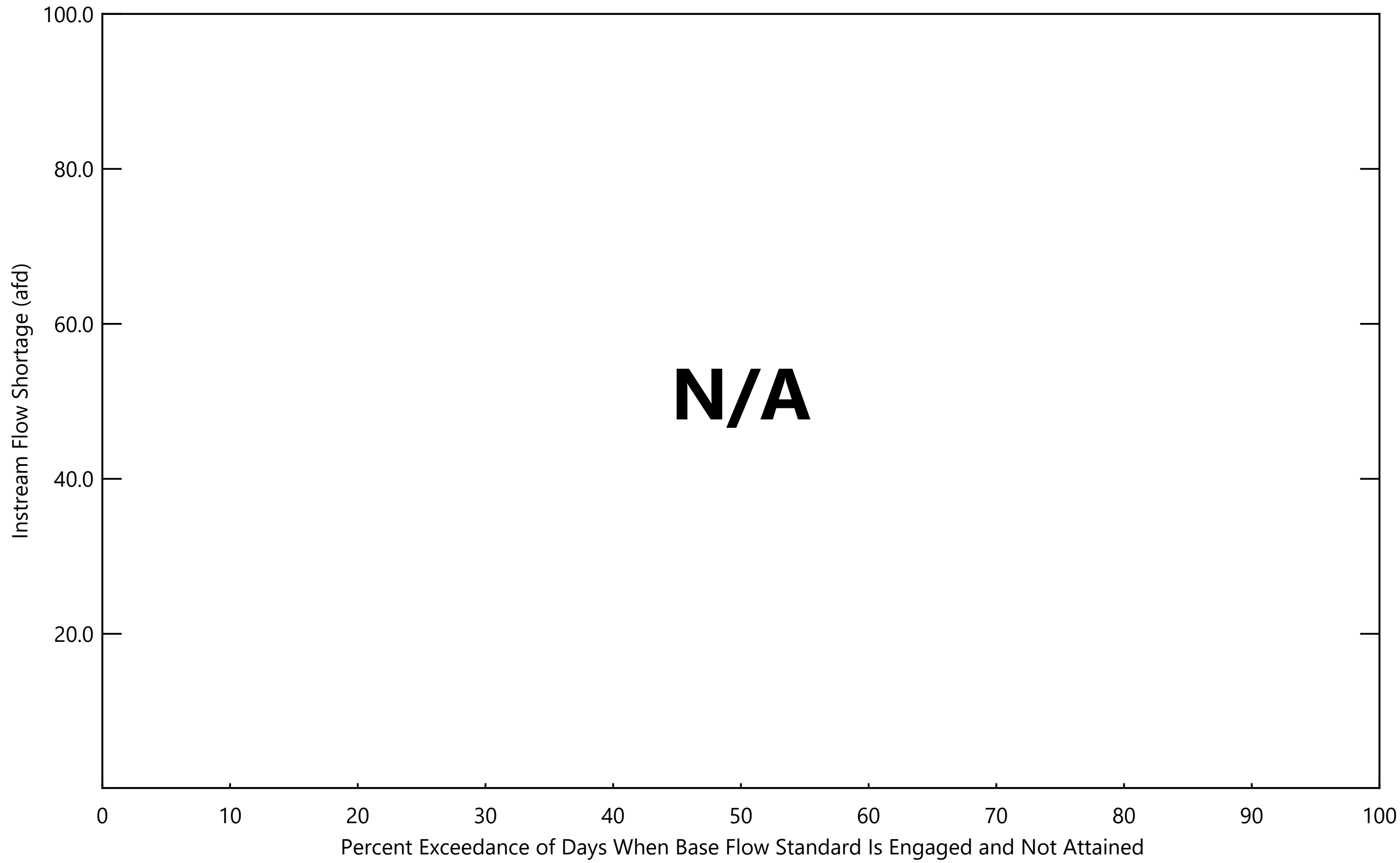
Figure E-200
Trinity River near Romayor: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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Figure E-201
Trinity River near Romayor: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

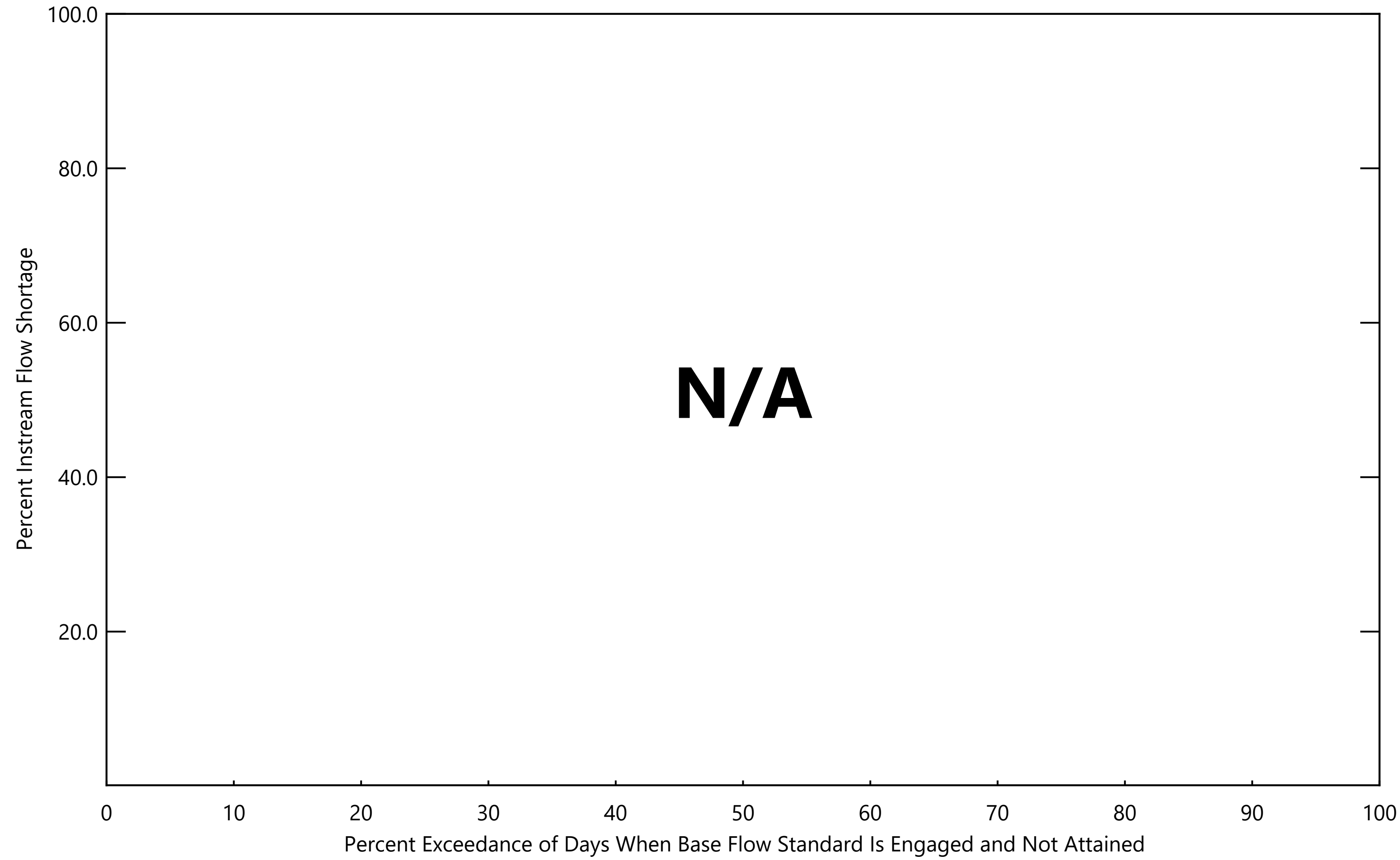

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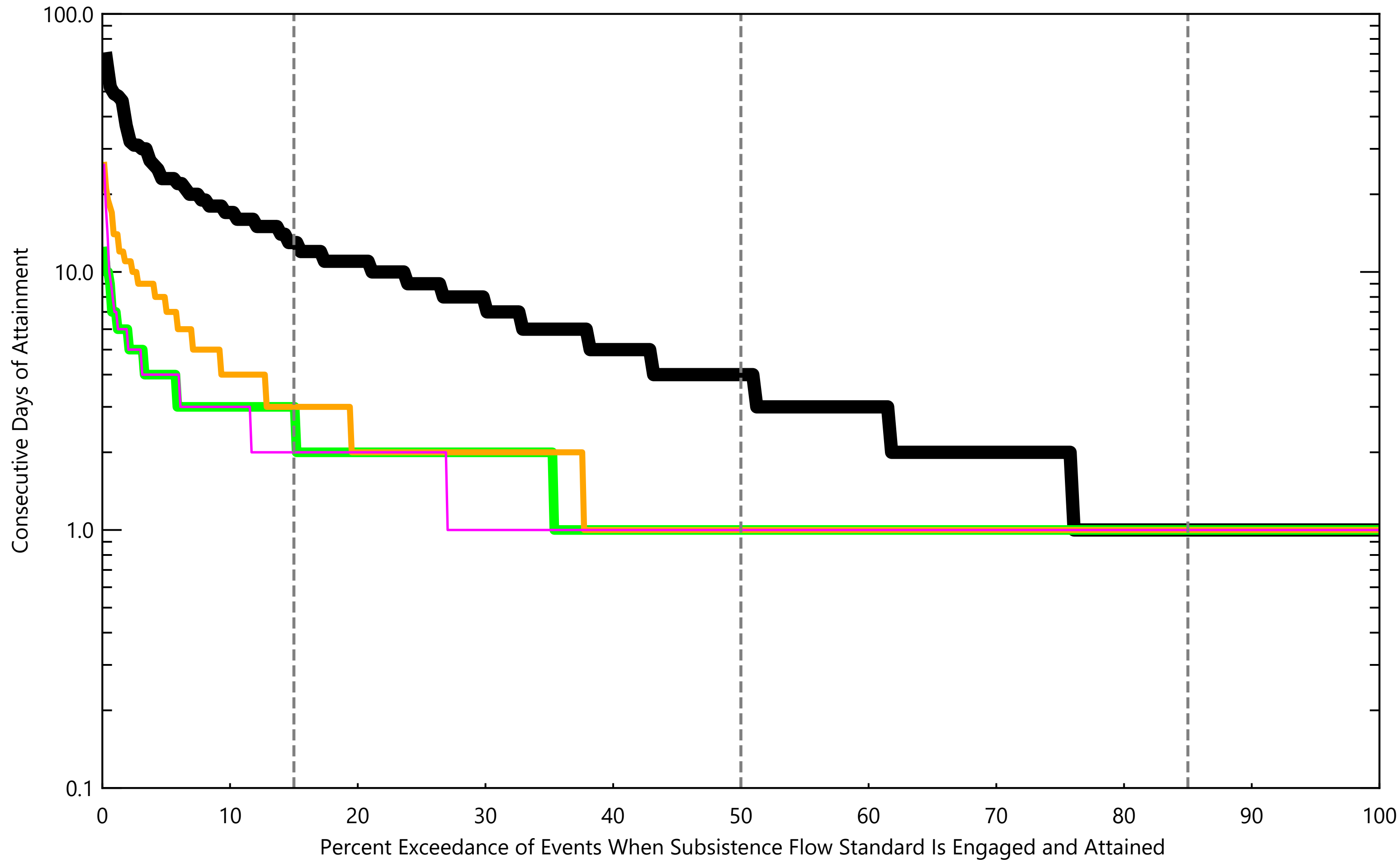
Figure E-202

Trinity River near Romayor: Base Flow Percent Shortage, Entire Period of Record (PS-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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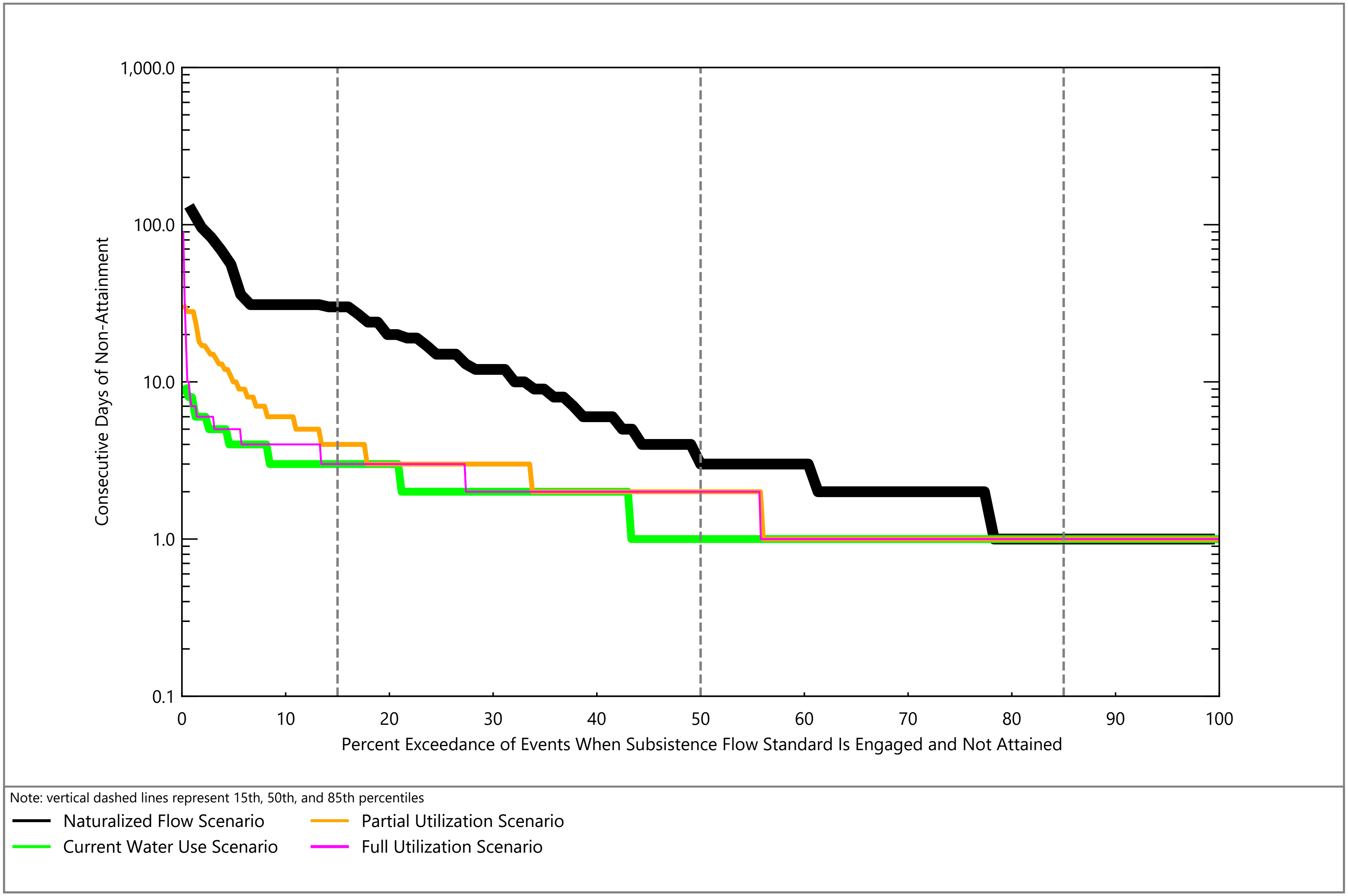
Figure E-203

Trinity River near Romayor: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:12 PM | User: JH
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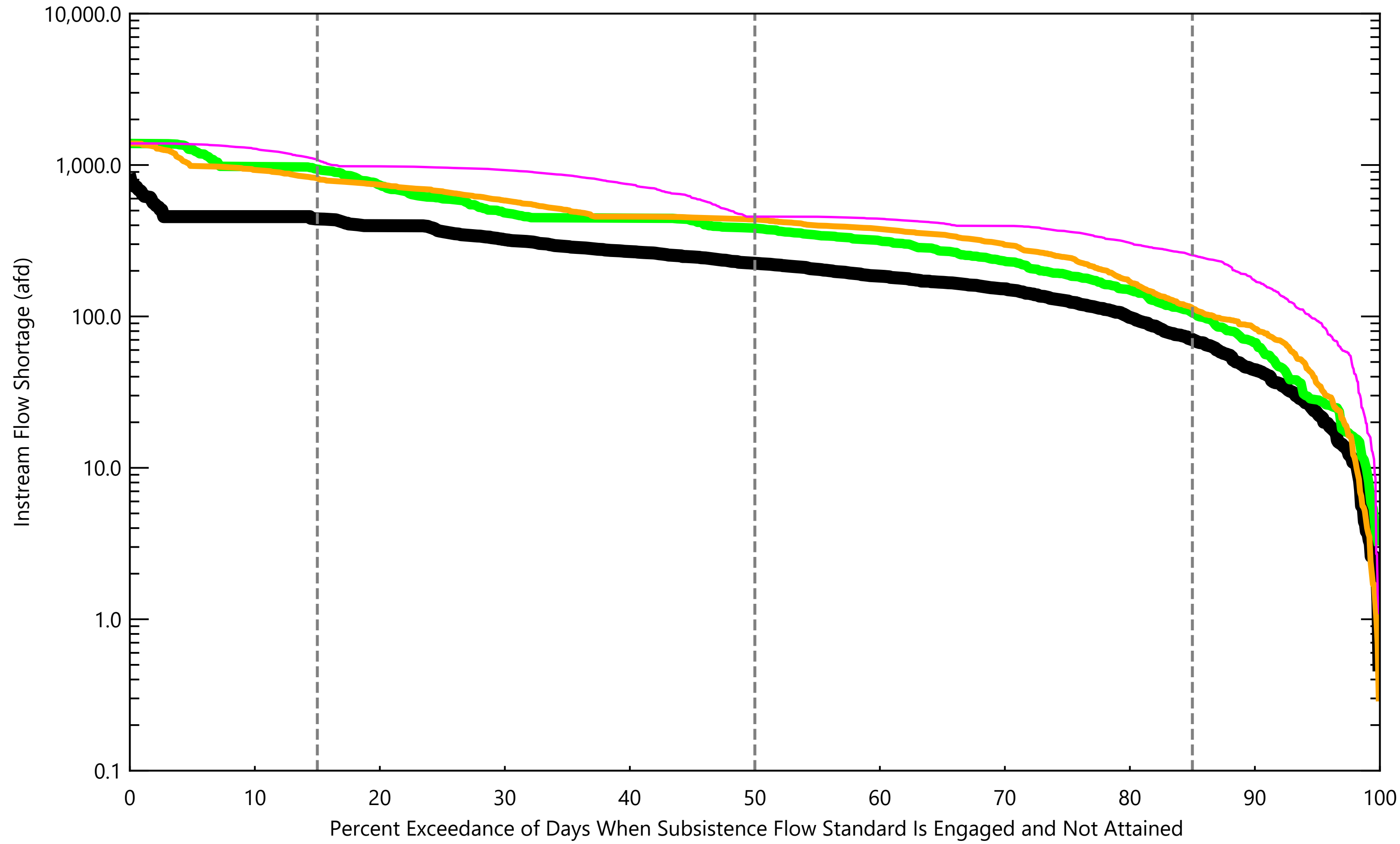
Figure E-204

Trinity River near Romayor: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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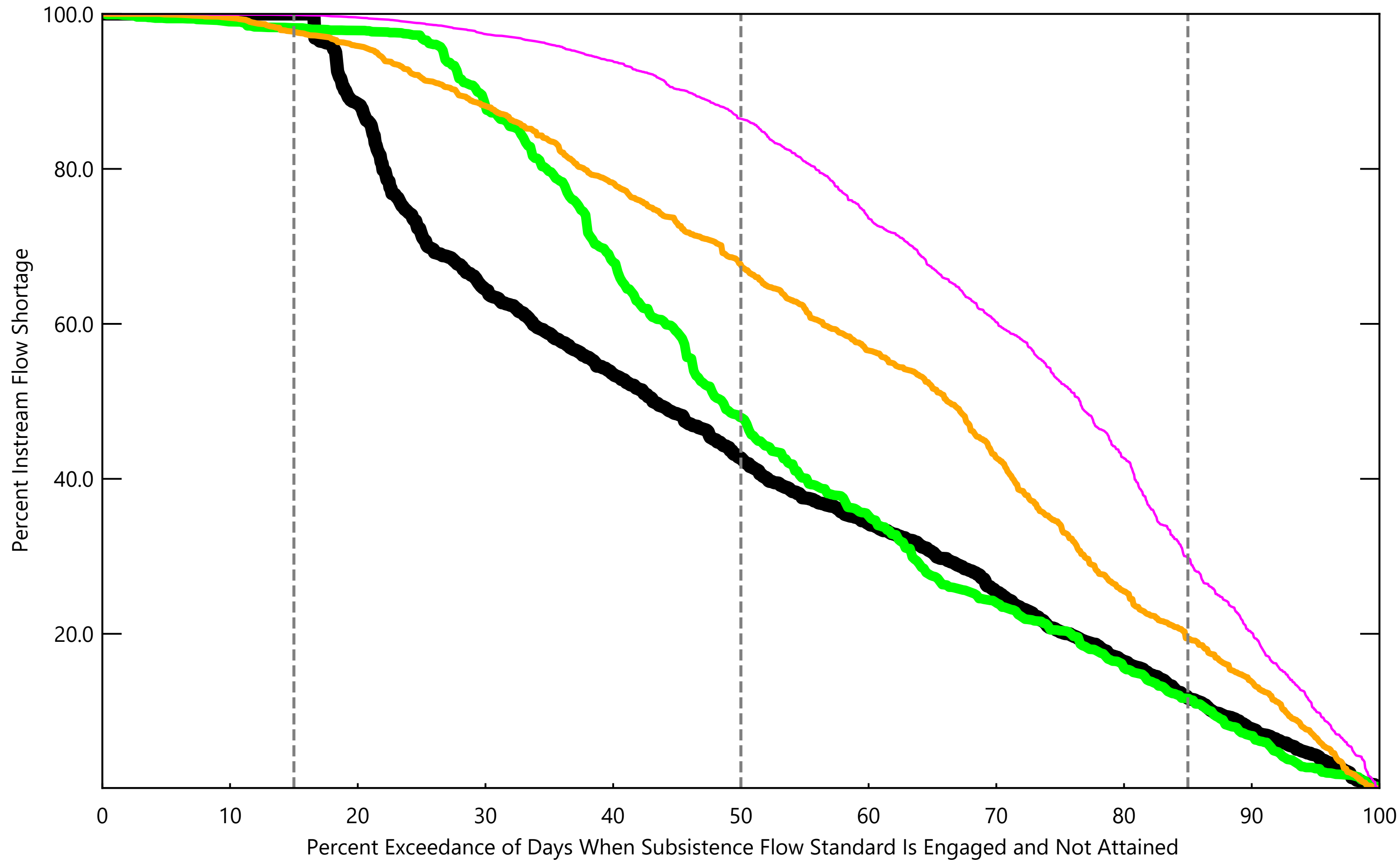
Figure E-205

Trinity River near Romayor: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Partial Utilization Scenario
- Current Water Use Scenario
- Full Utilization Scenario

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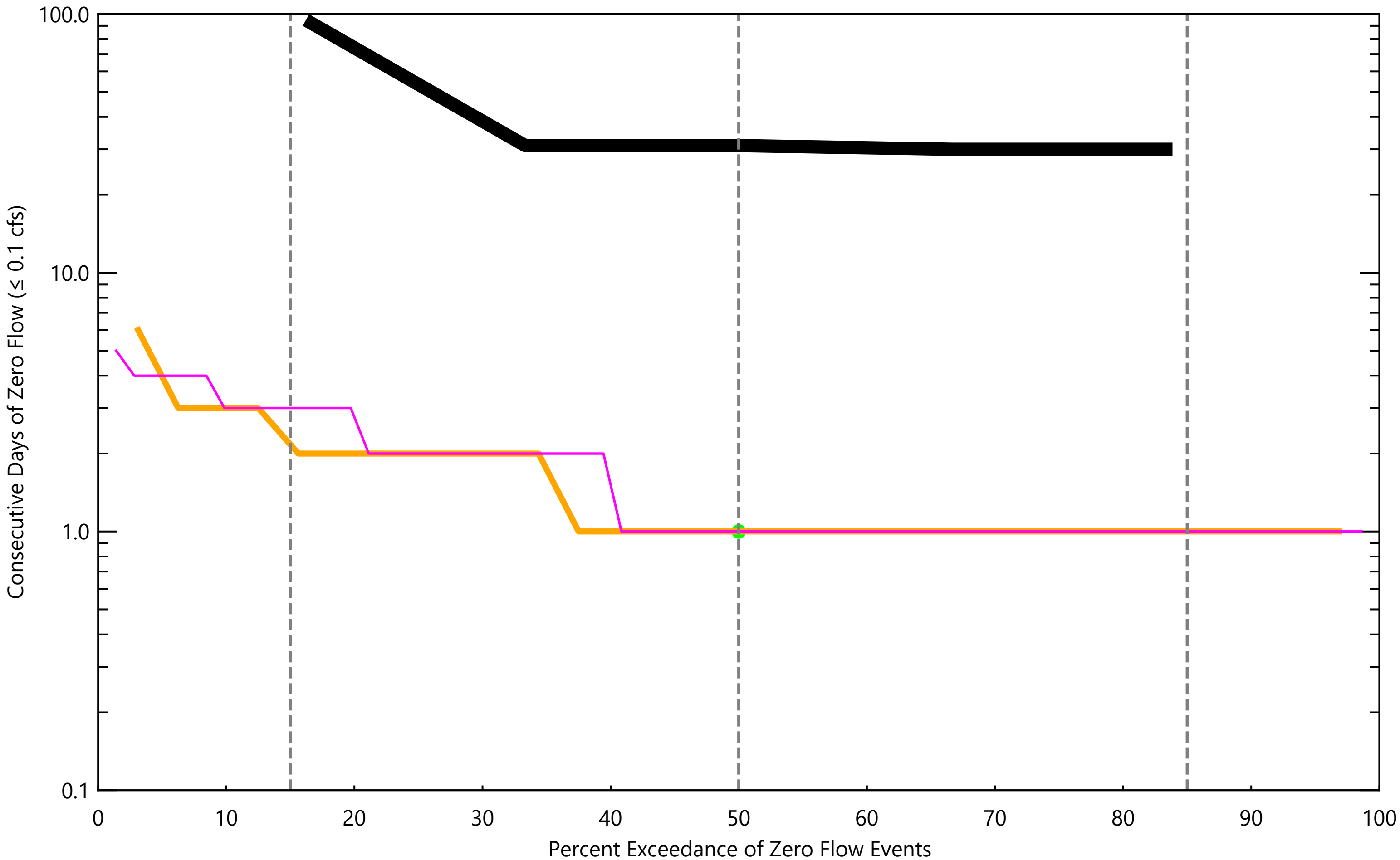
Figure E-206

Trinity River near Romayor: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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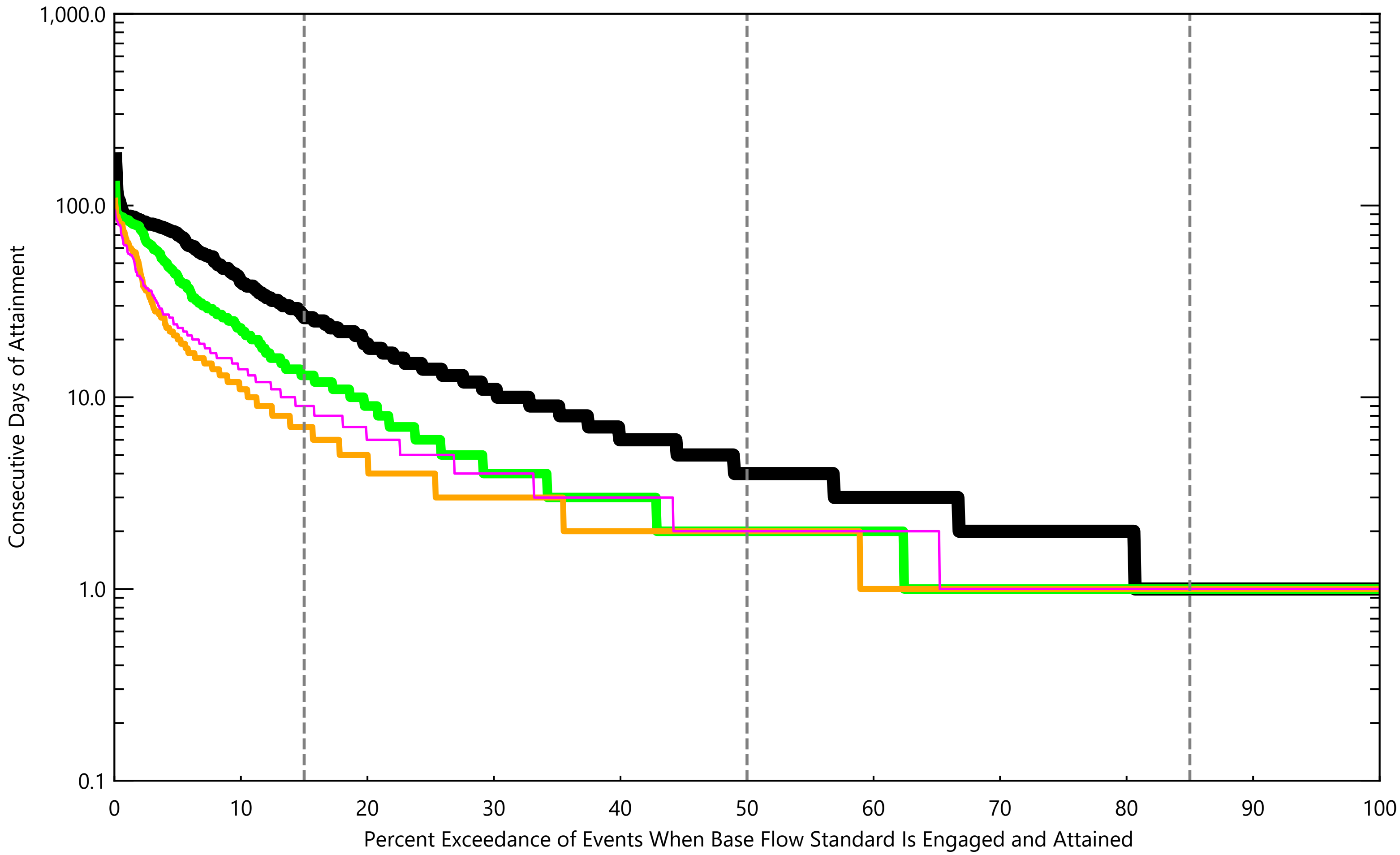
Figure E-207
Trinity River near Romayor: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-208

Neches River at Neches: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards

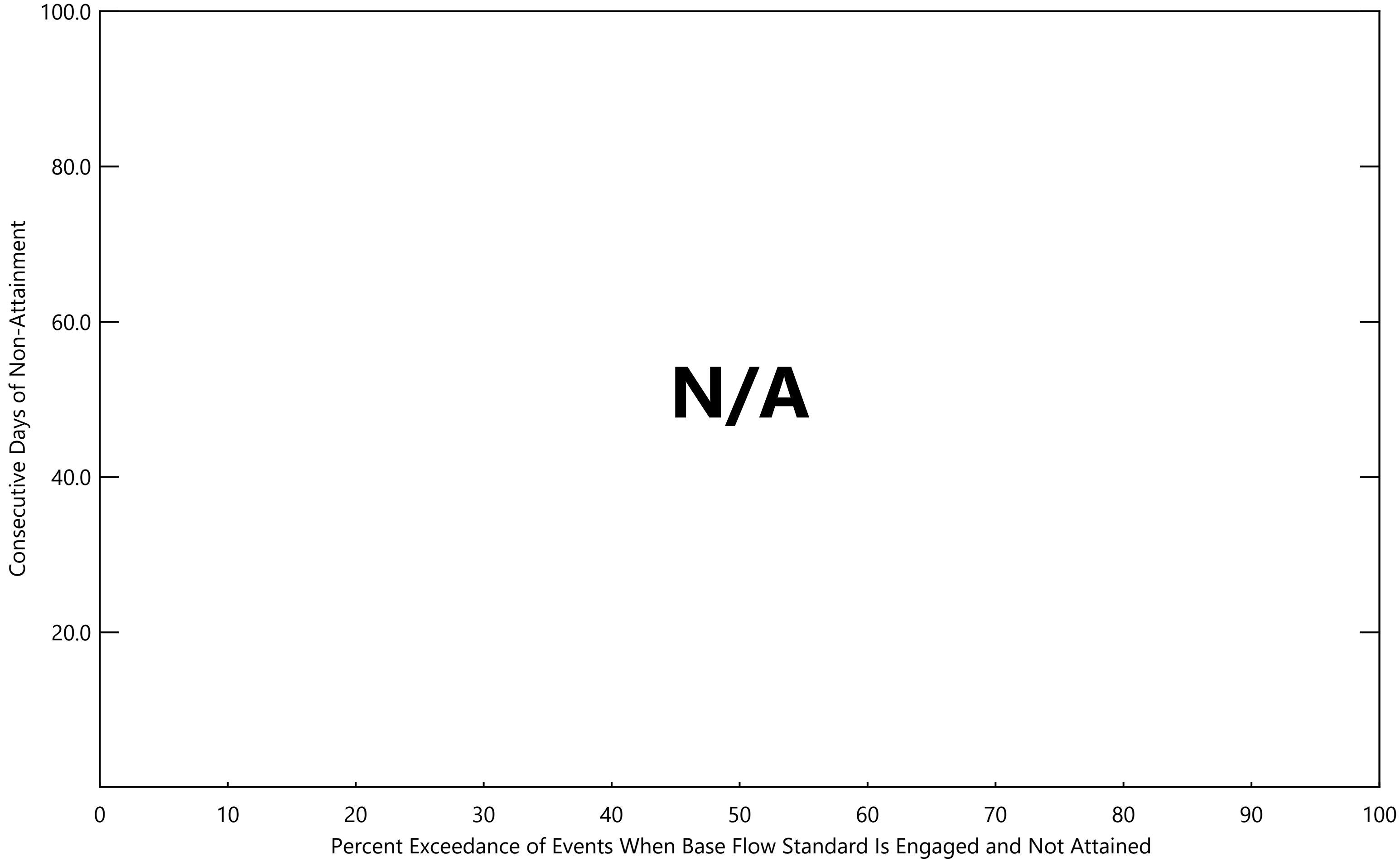

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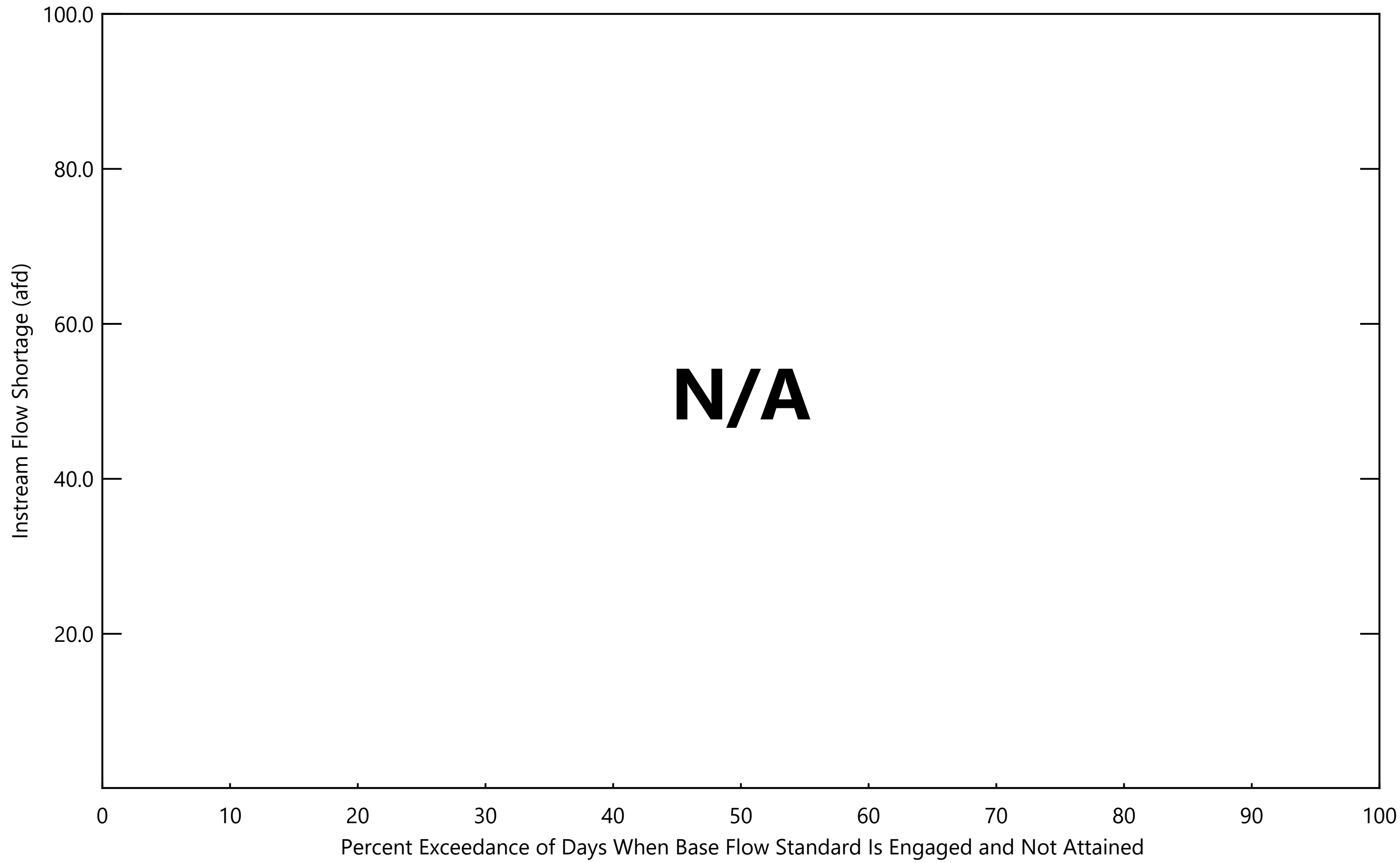
Figure E-209

Neches River at Neches: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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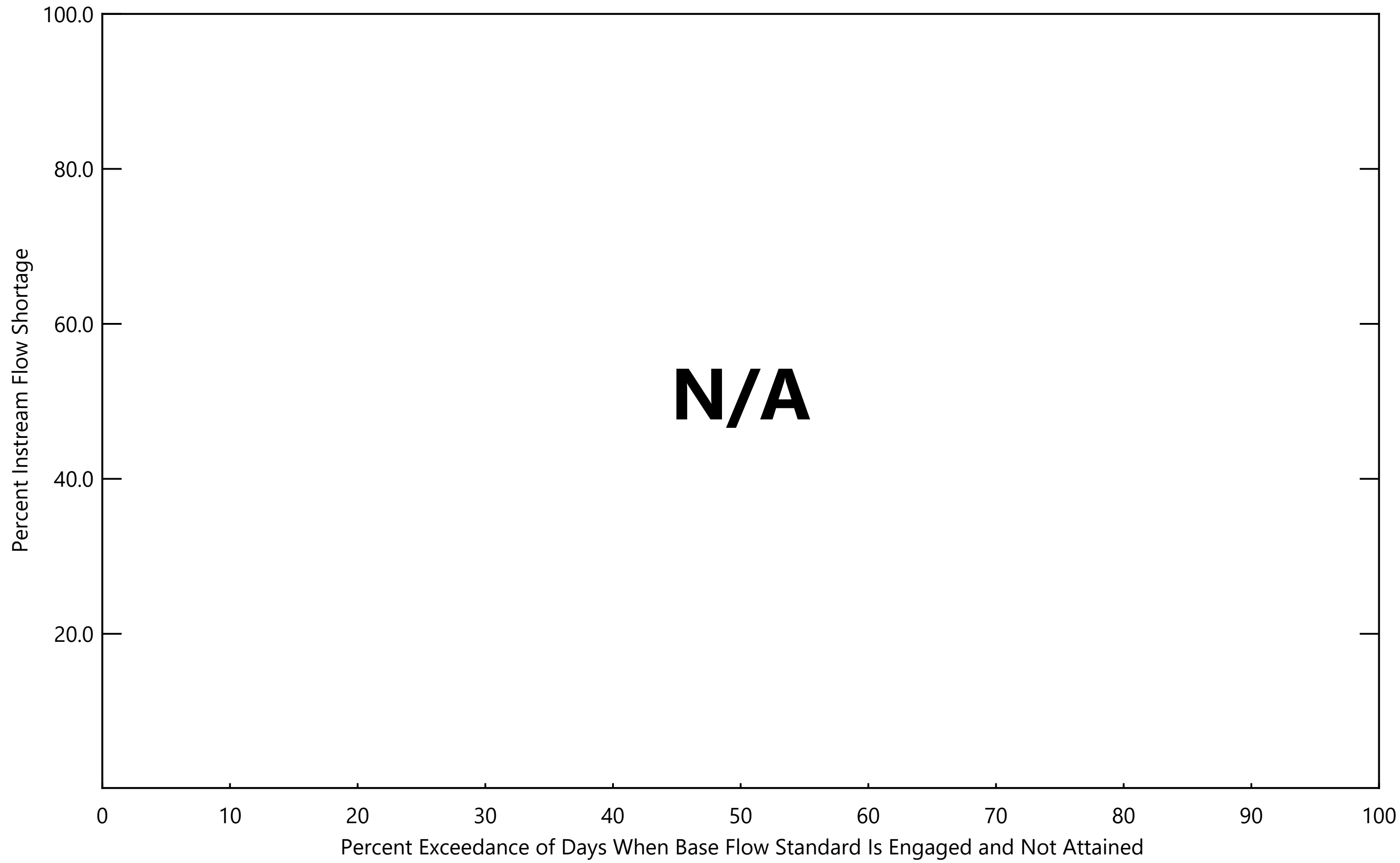
Figure E-210
Neches River at Neches: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:12 PM | User: JH
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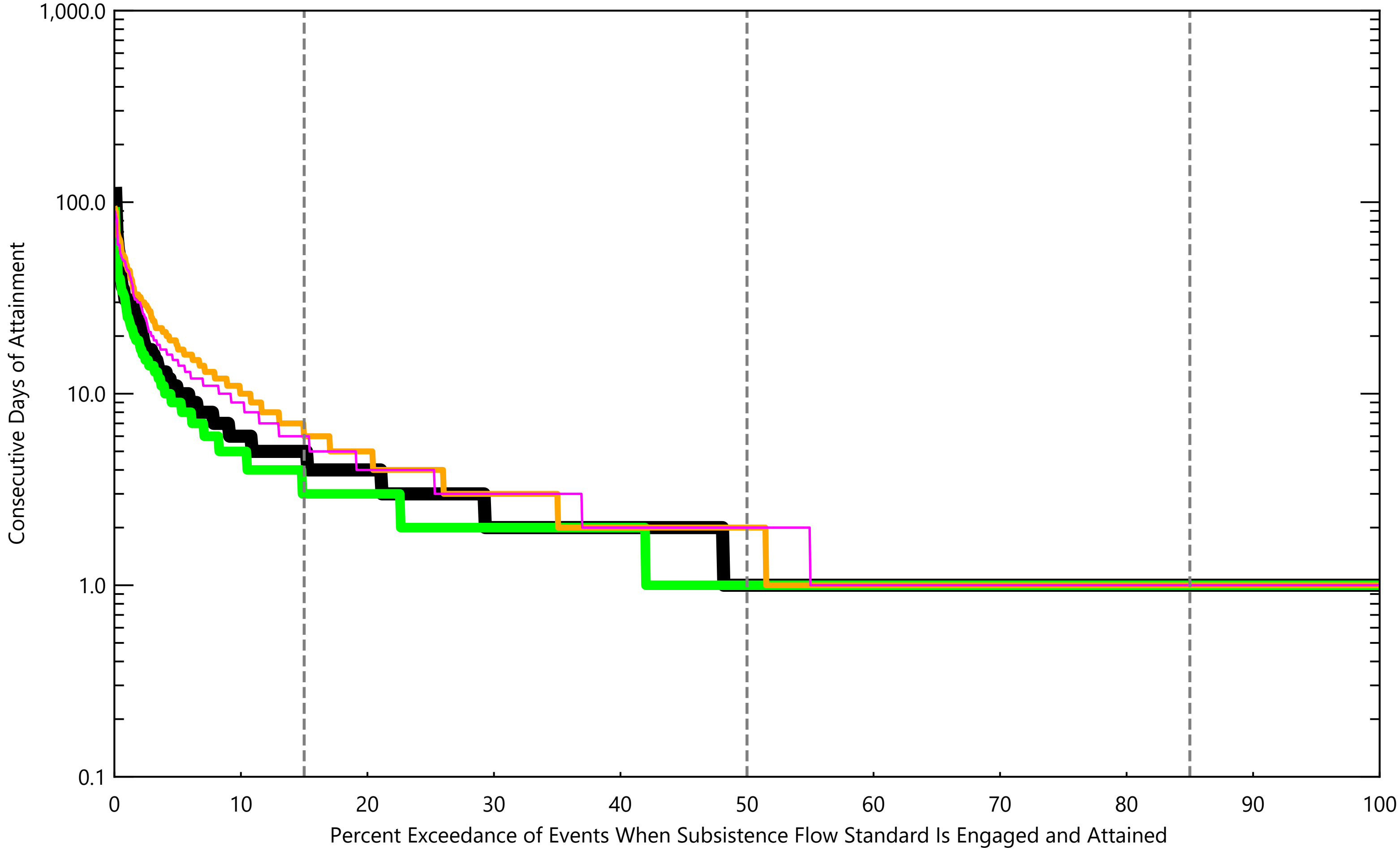
Figure E-211
Neches River at Neches: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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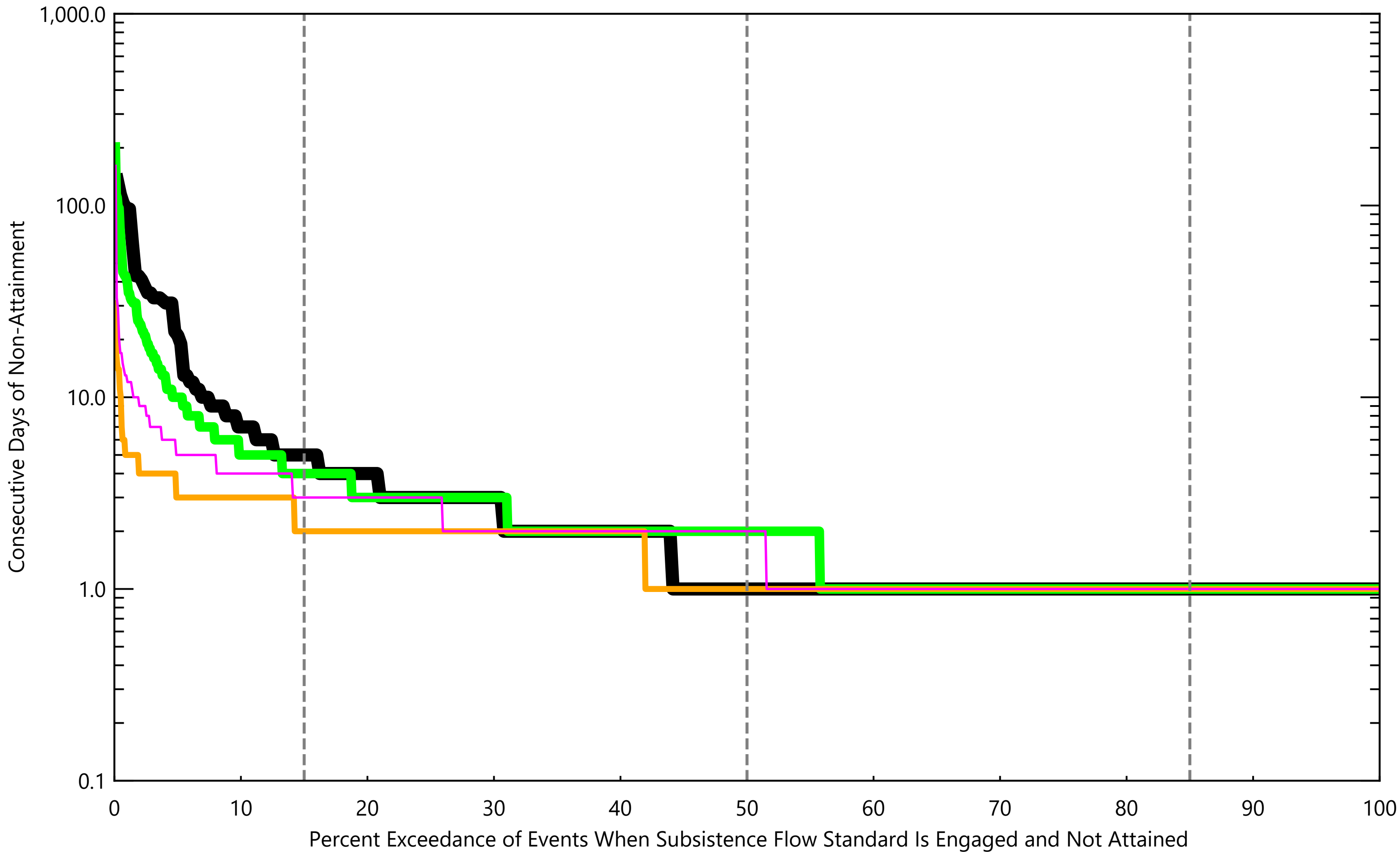
Figure E-212
Neches River at Neches: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Publish Date: 08/15/2021 16:13 PM | User: JH
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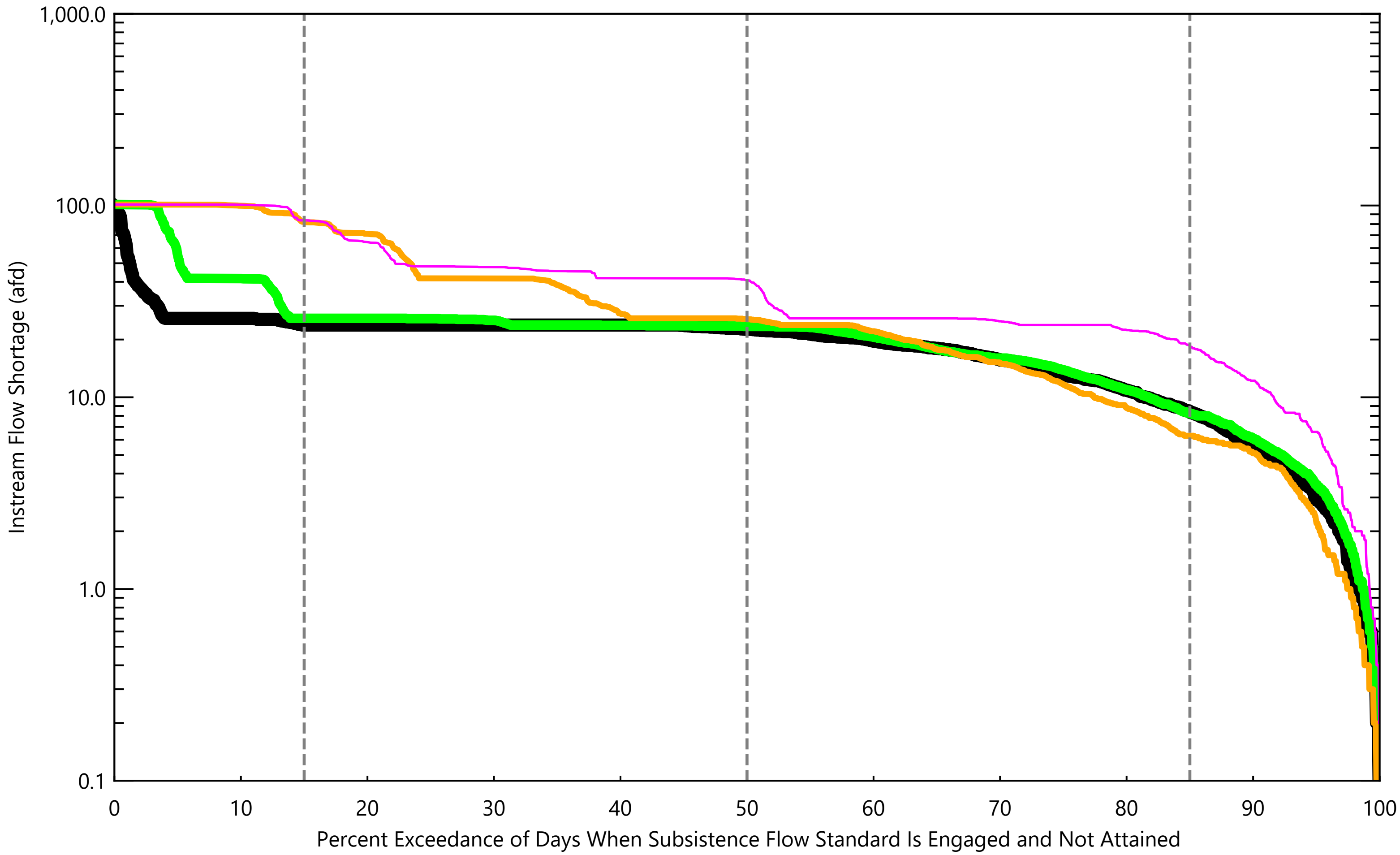
Figure E-213

Neches River at Neches: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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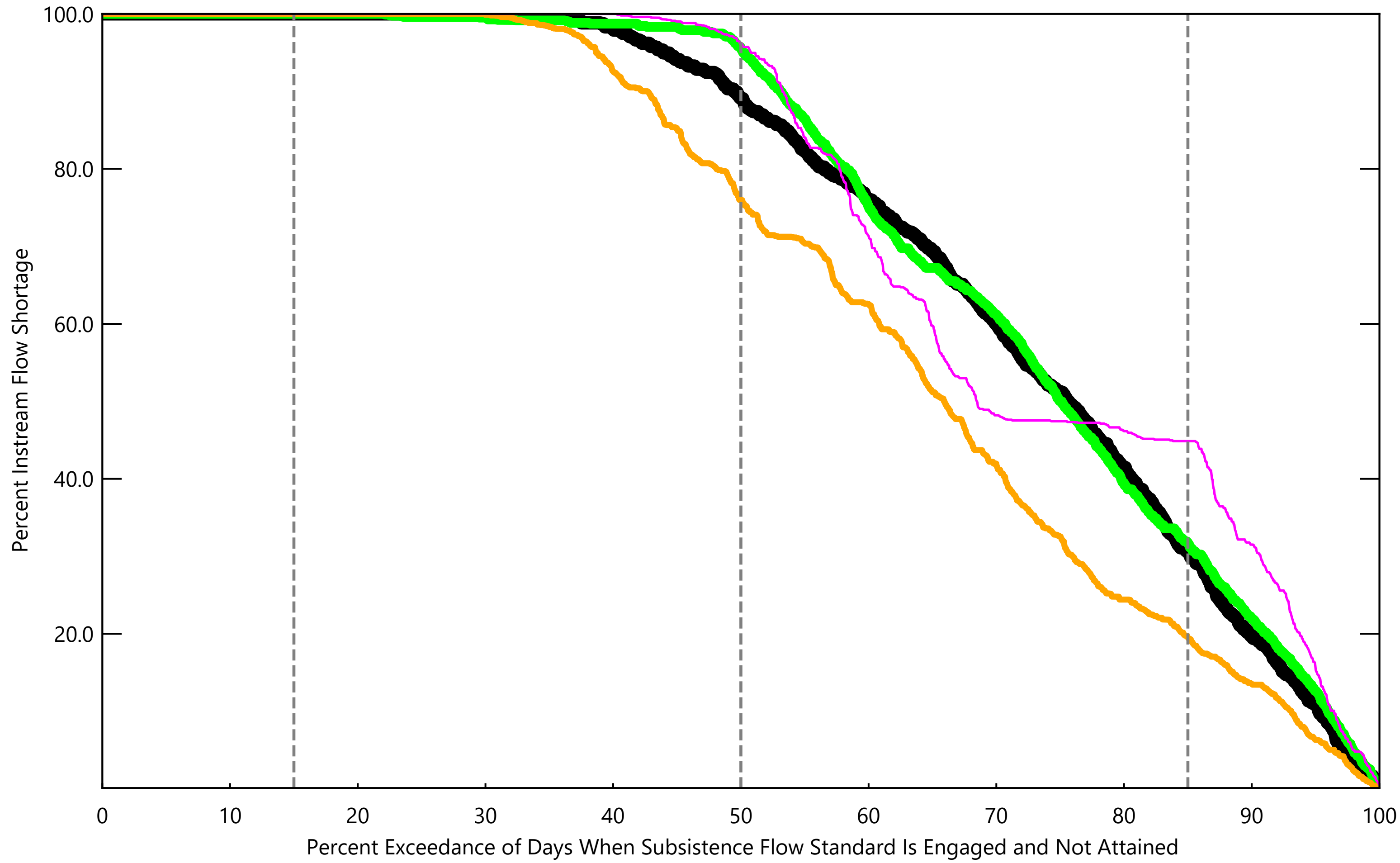
Figure E-214

Neches River at Neches: Subsistence Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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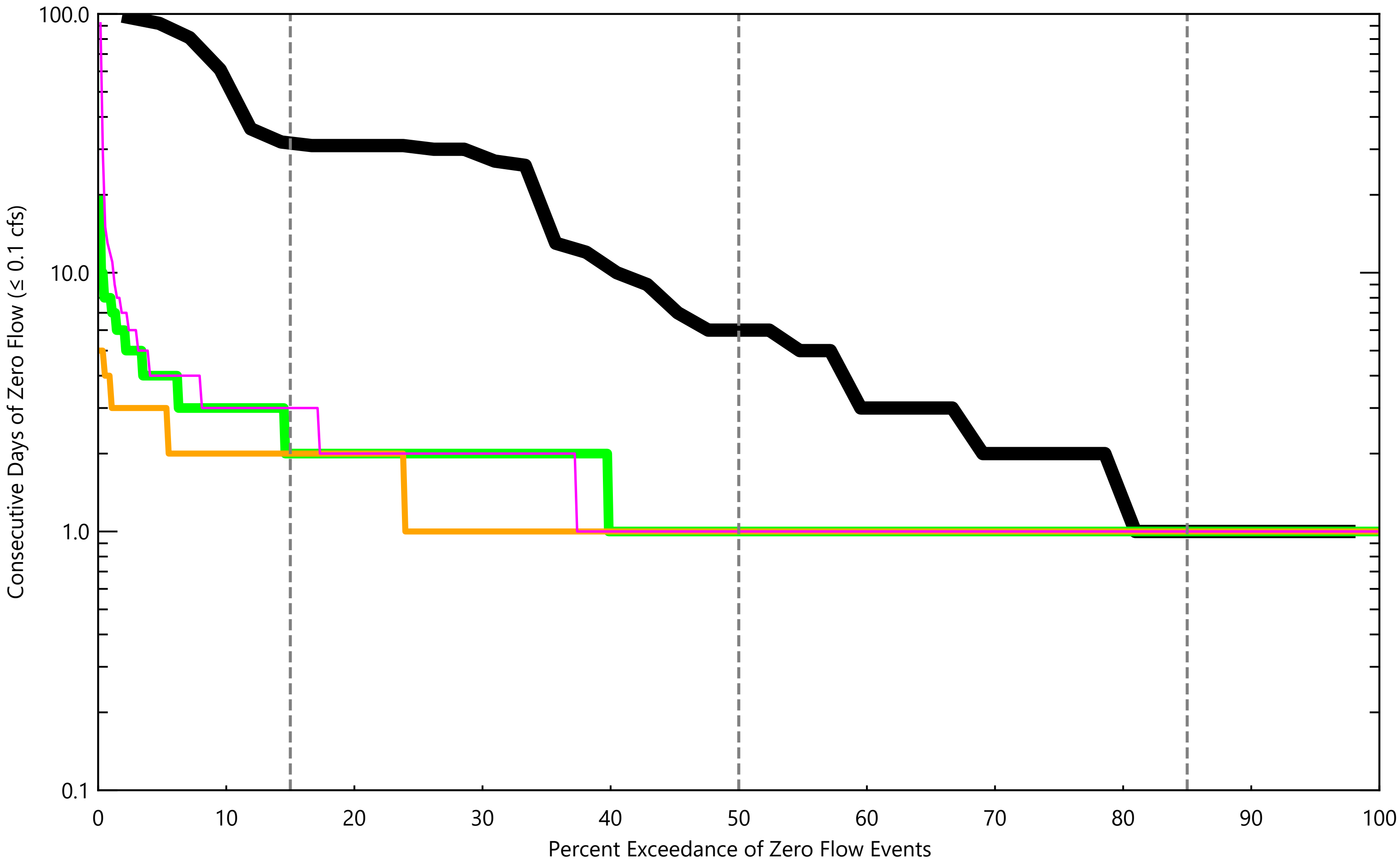
Figure E-215

Neches River at Neches: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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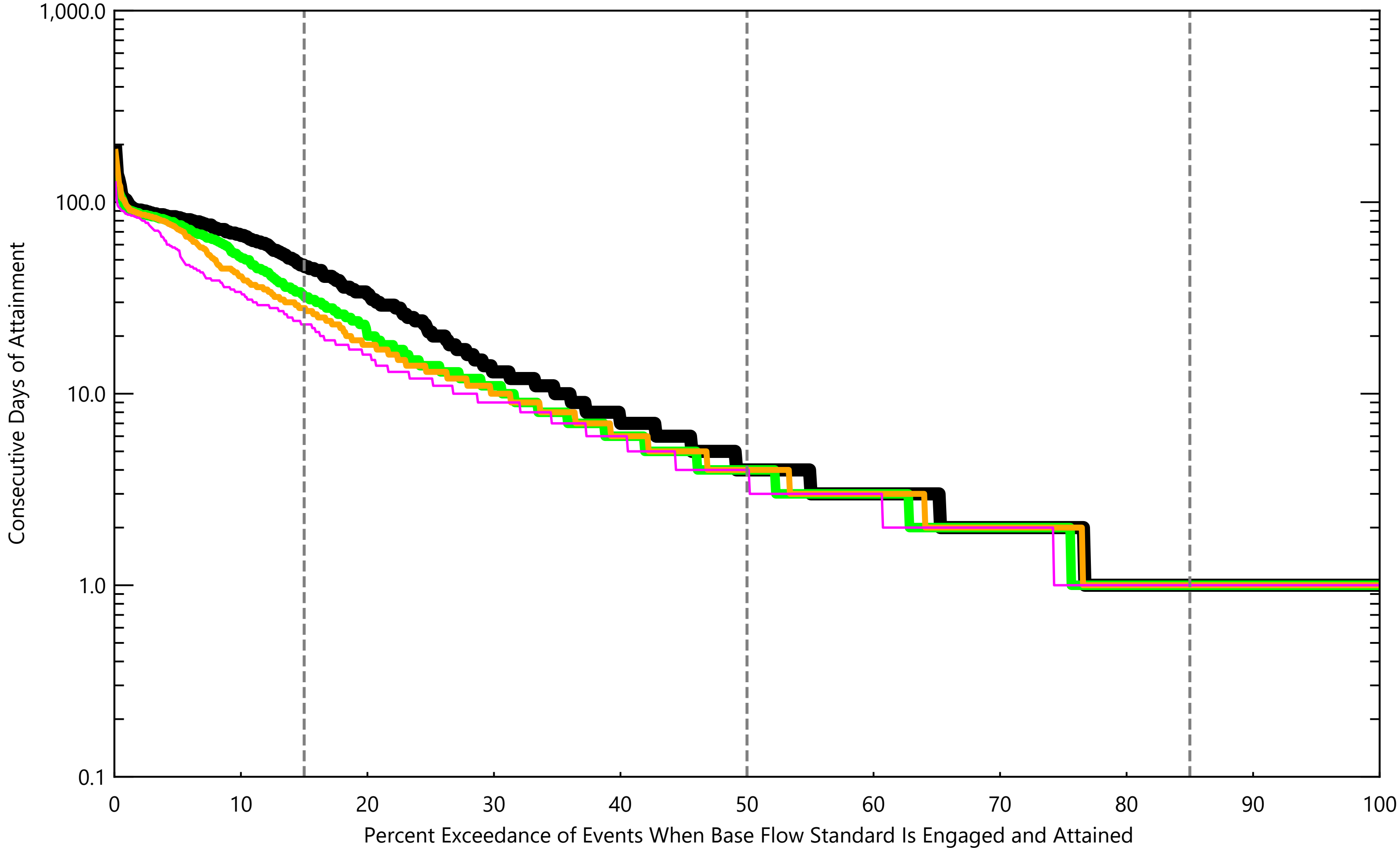
Figure E-216
Neches River at Neches: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-217
Neches River near Rockland: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

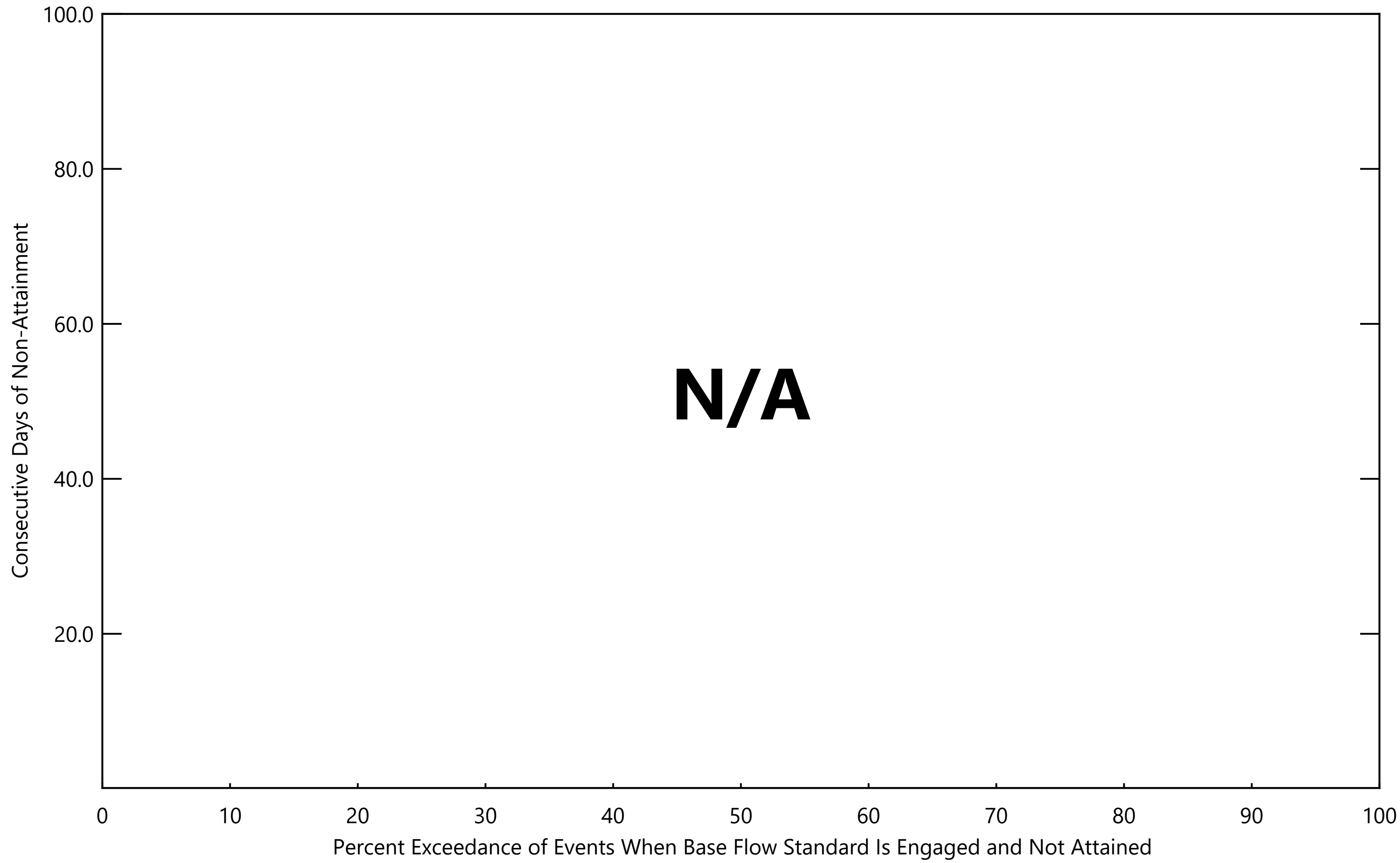

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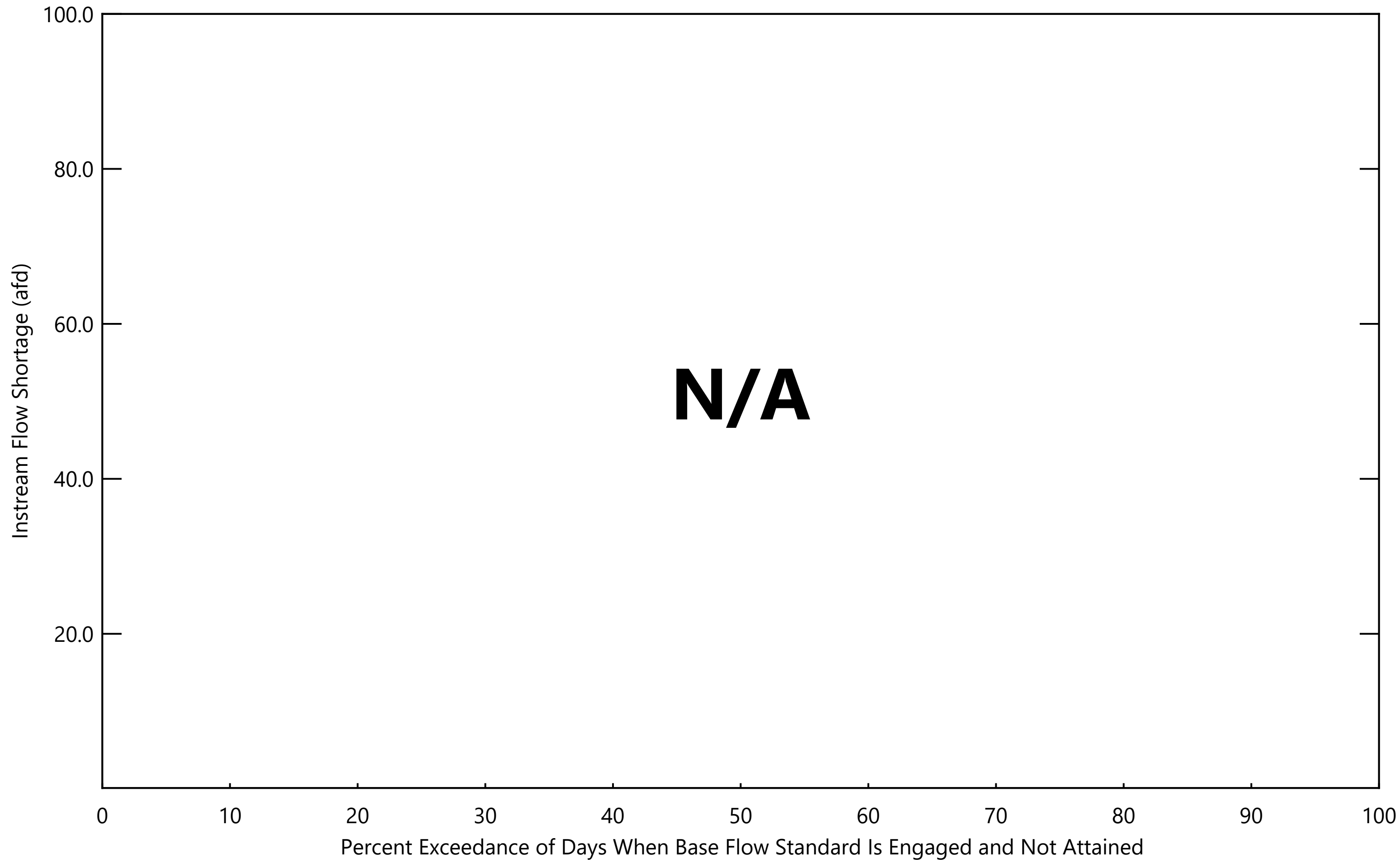
Figure E-218

Neches River near Rockland: Base Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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Figure E-219
Neches River near Rockland: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

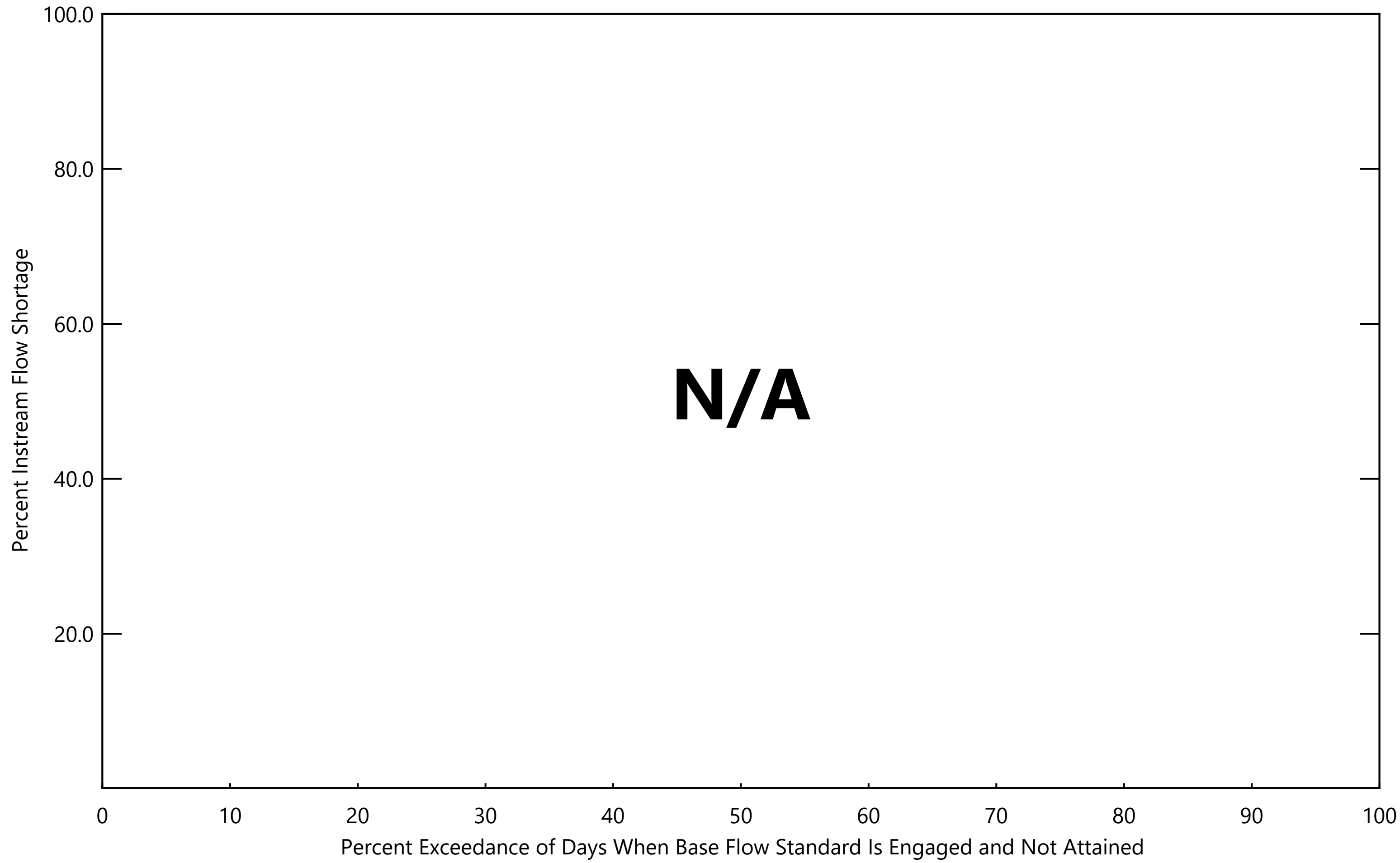

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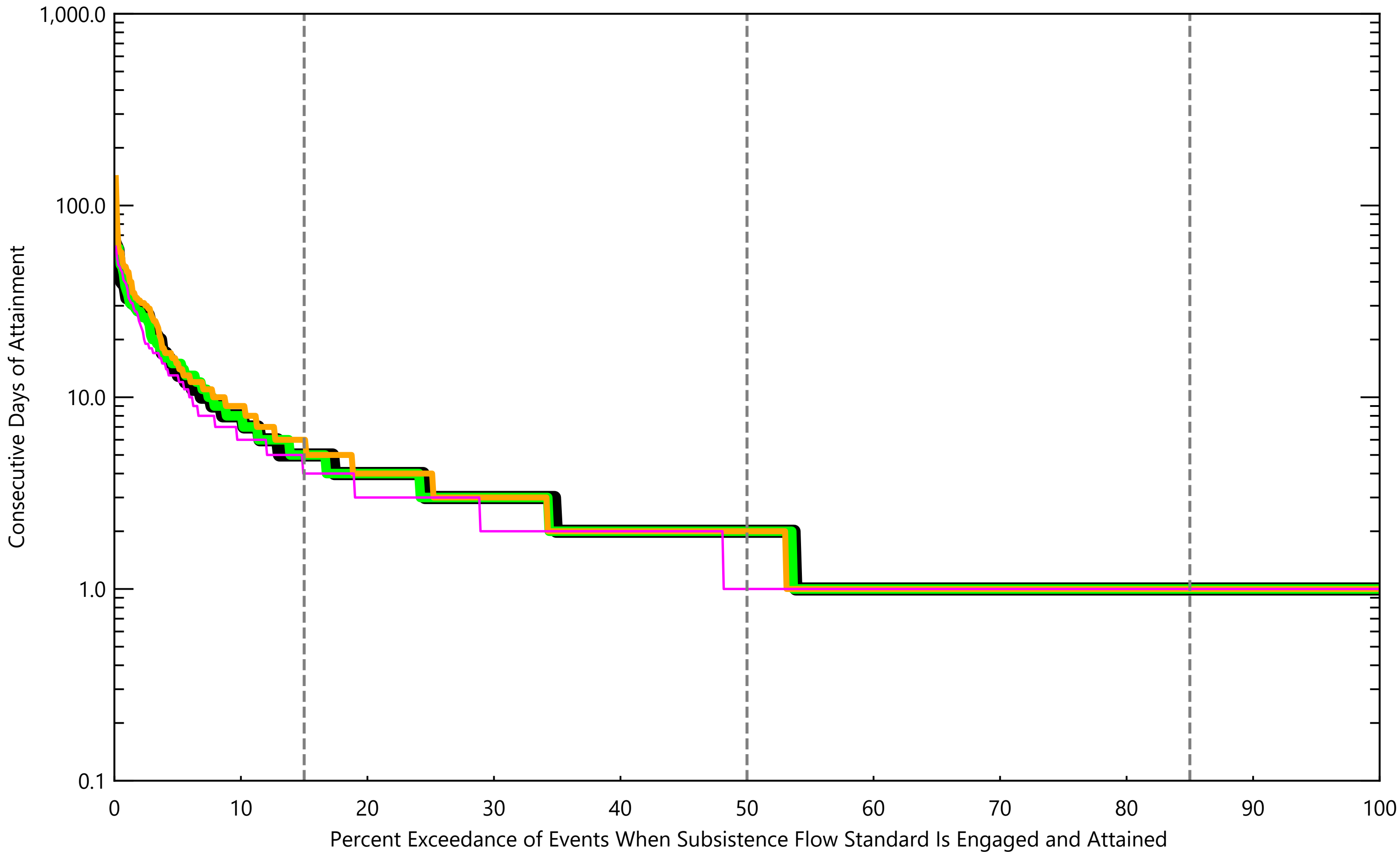
Figure E-220

Neches River near Rockland: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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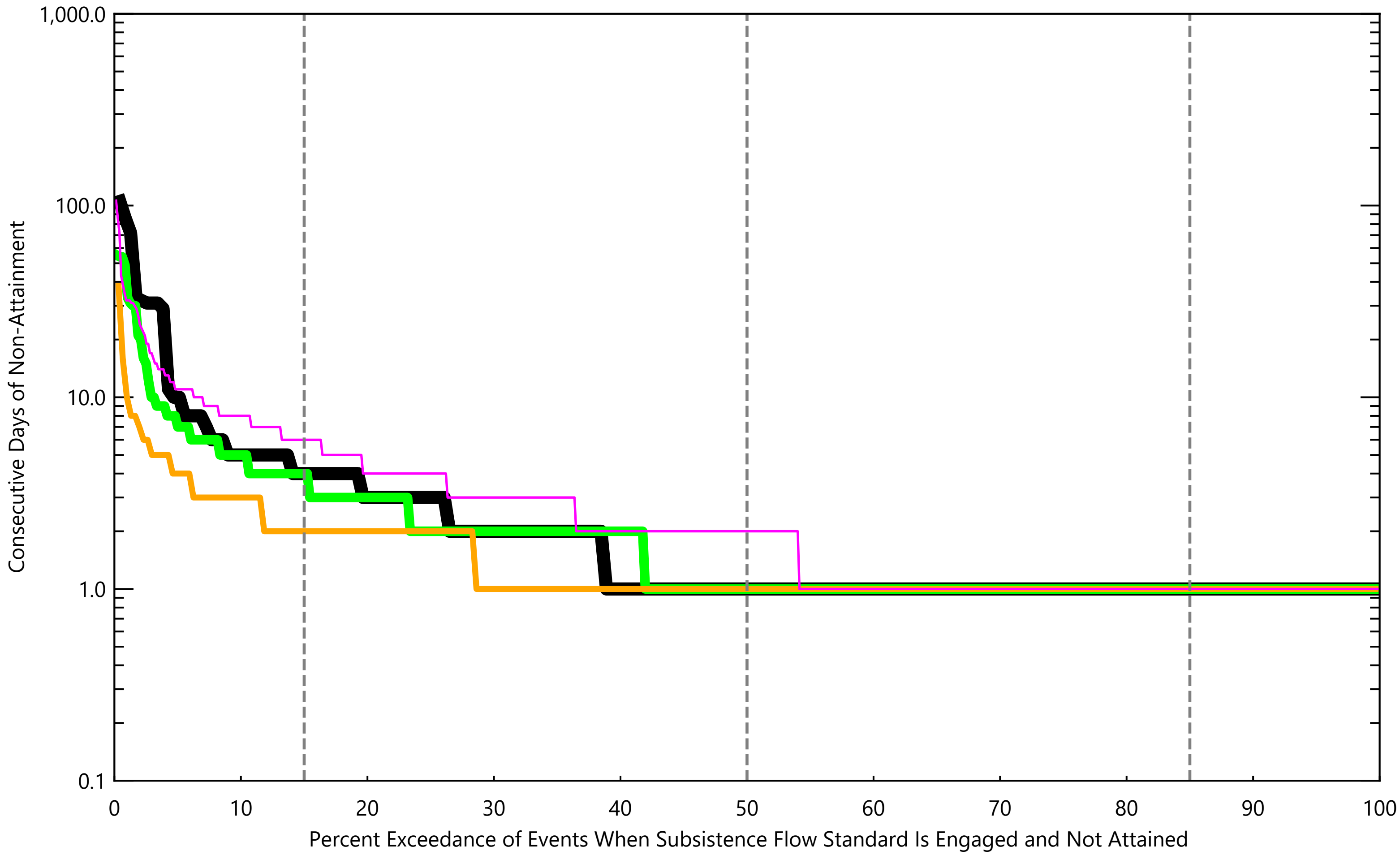
Figure E-221

Neches River near Rockland: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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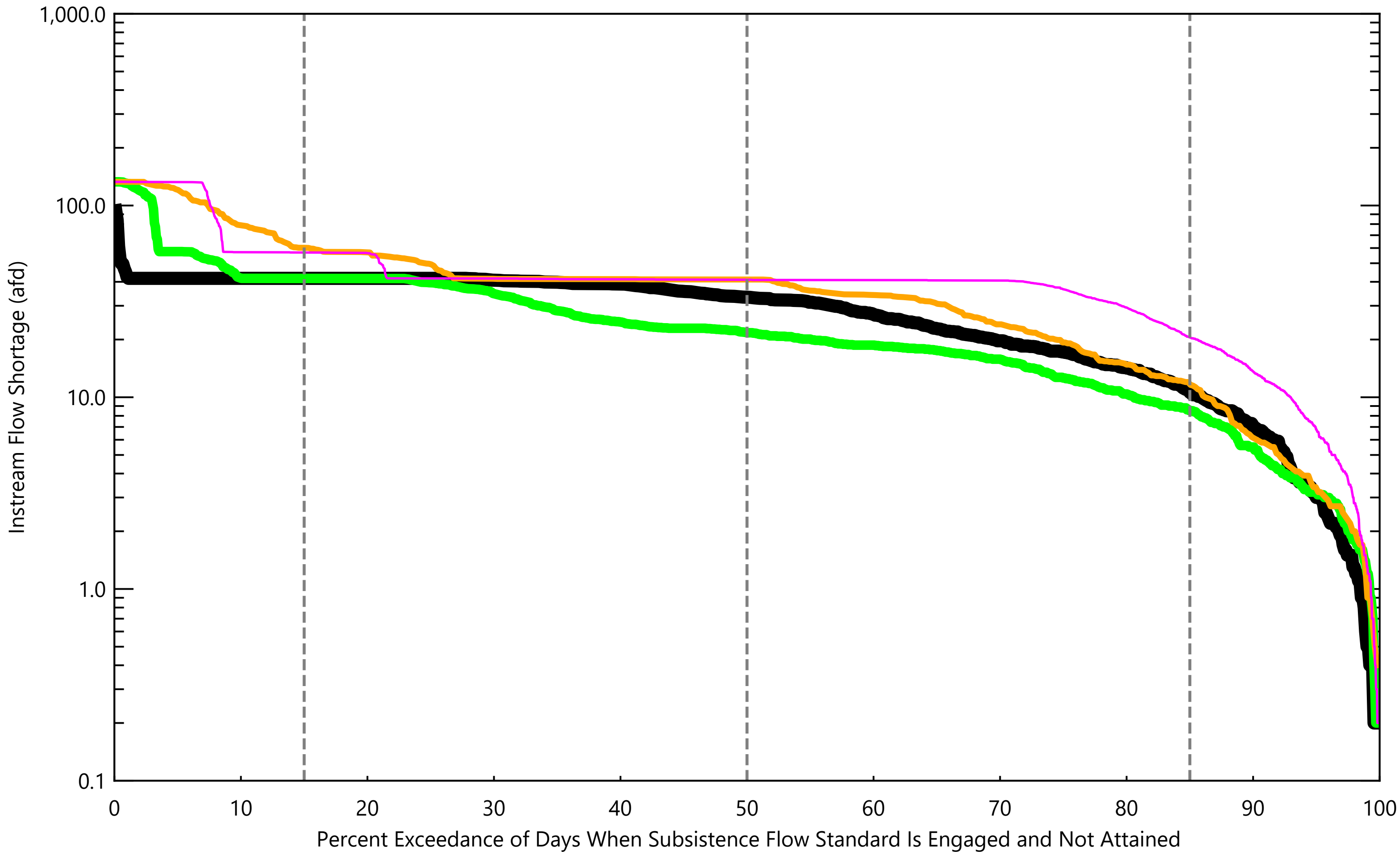
Figure E-222

Neches River near Rockland: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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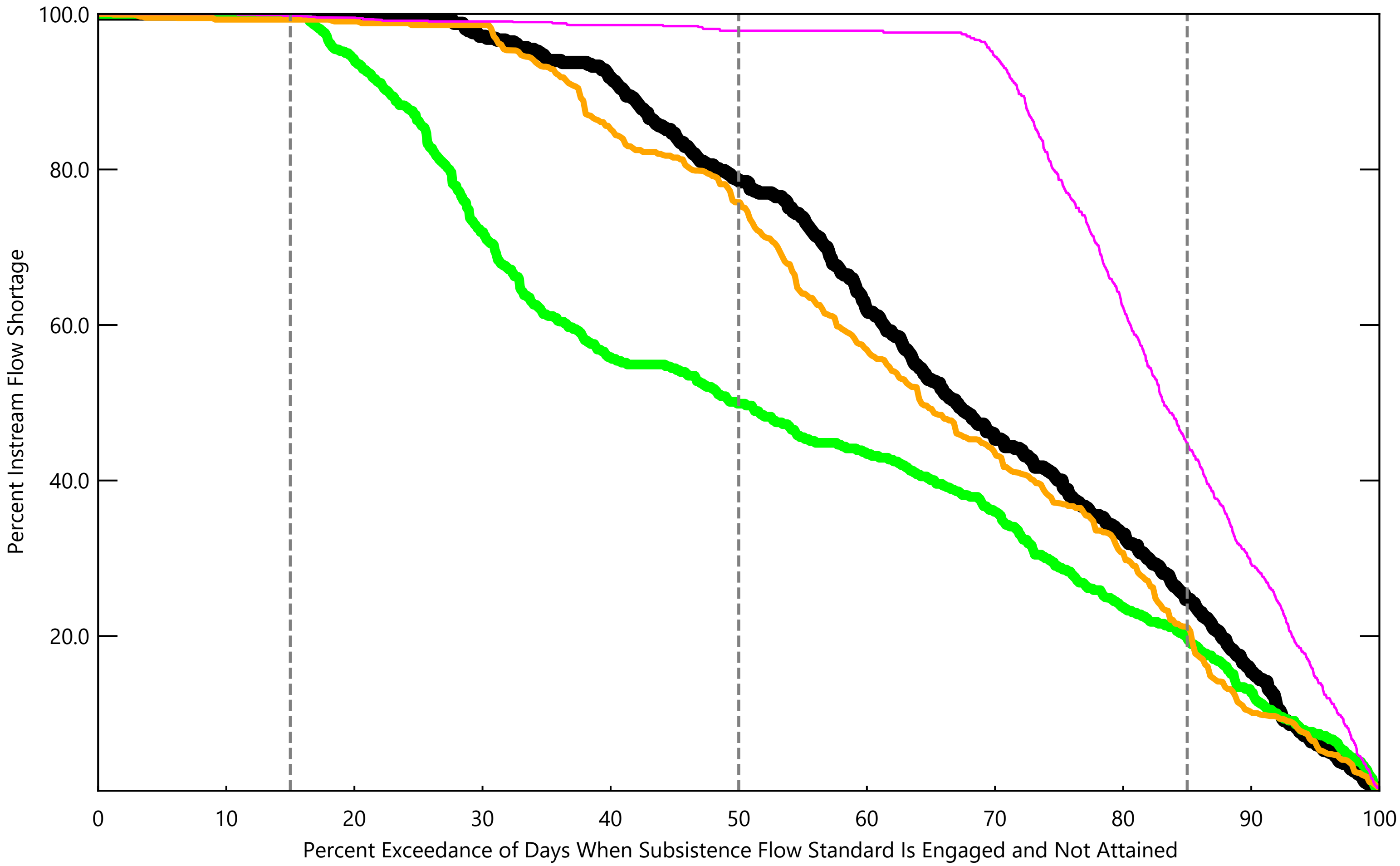
Figure E-223
Neches River near Rockland: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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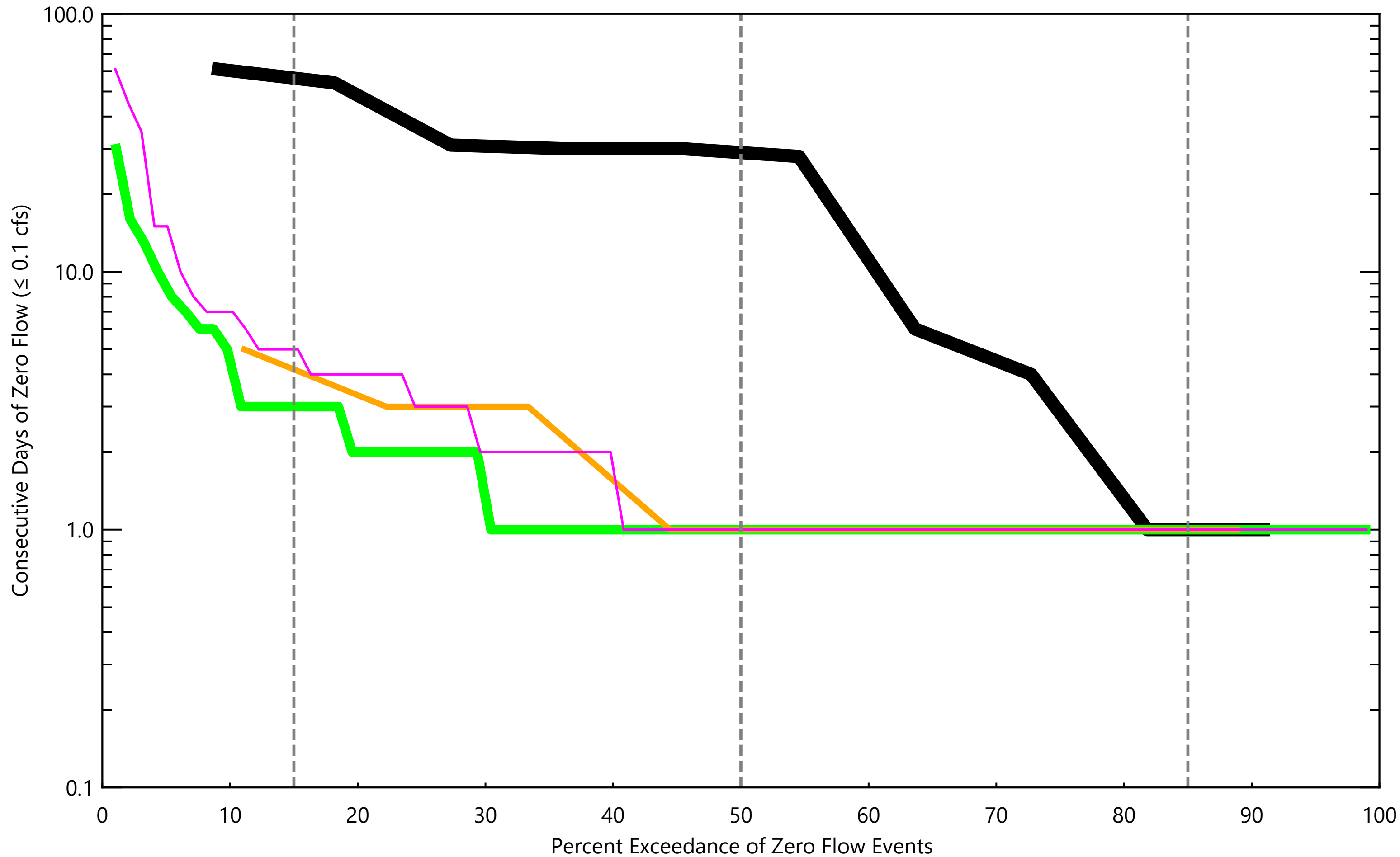
Figure E-224

Neches River near Rockland: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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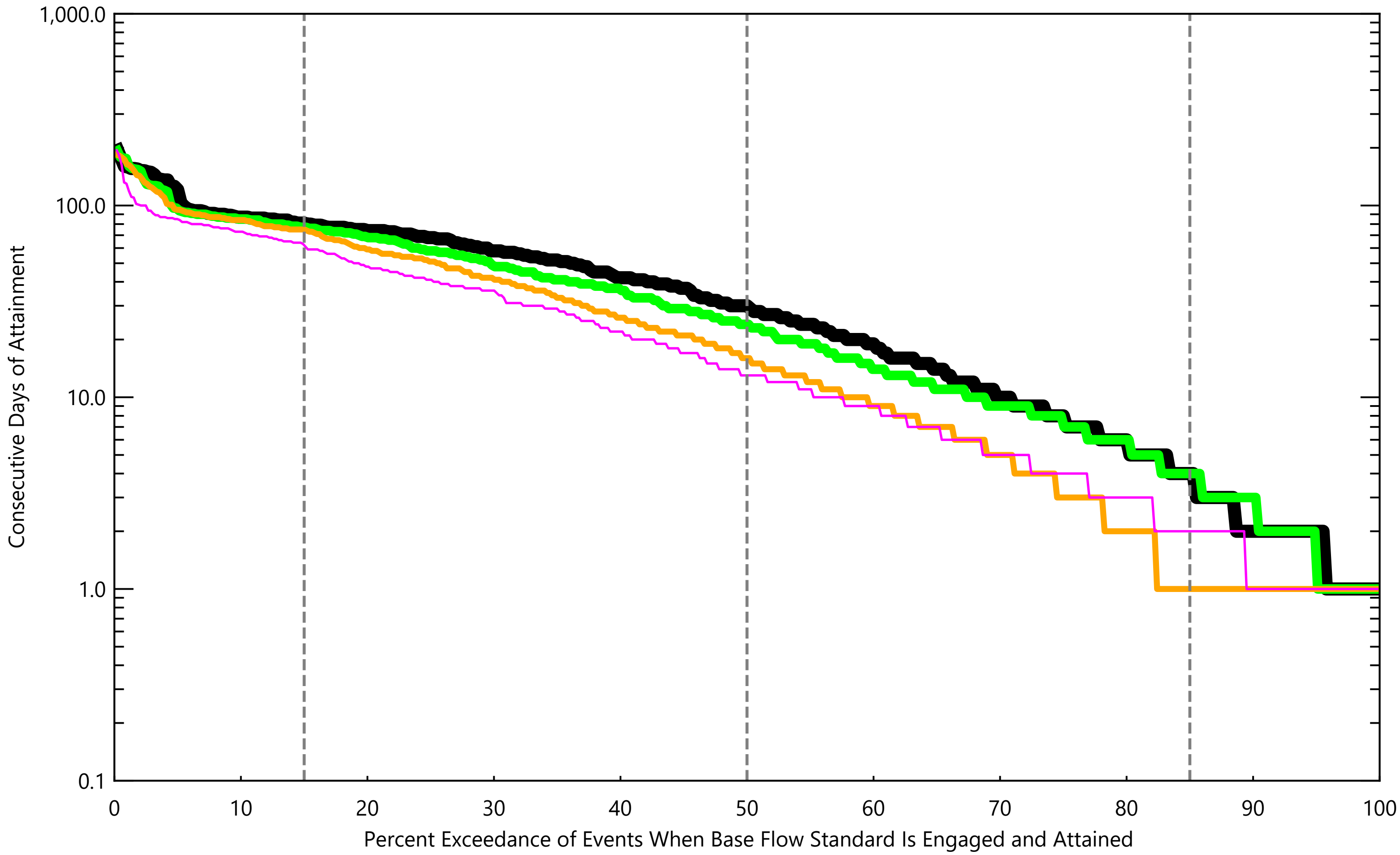

Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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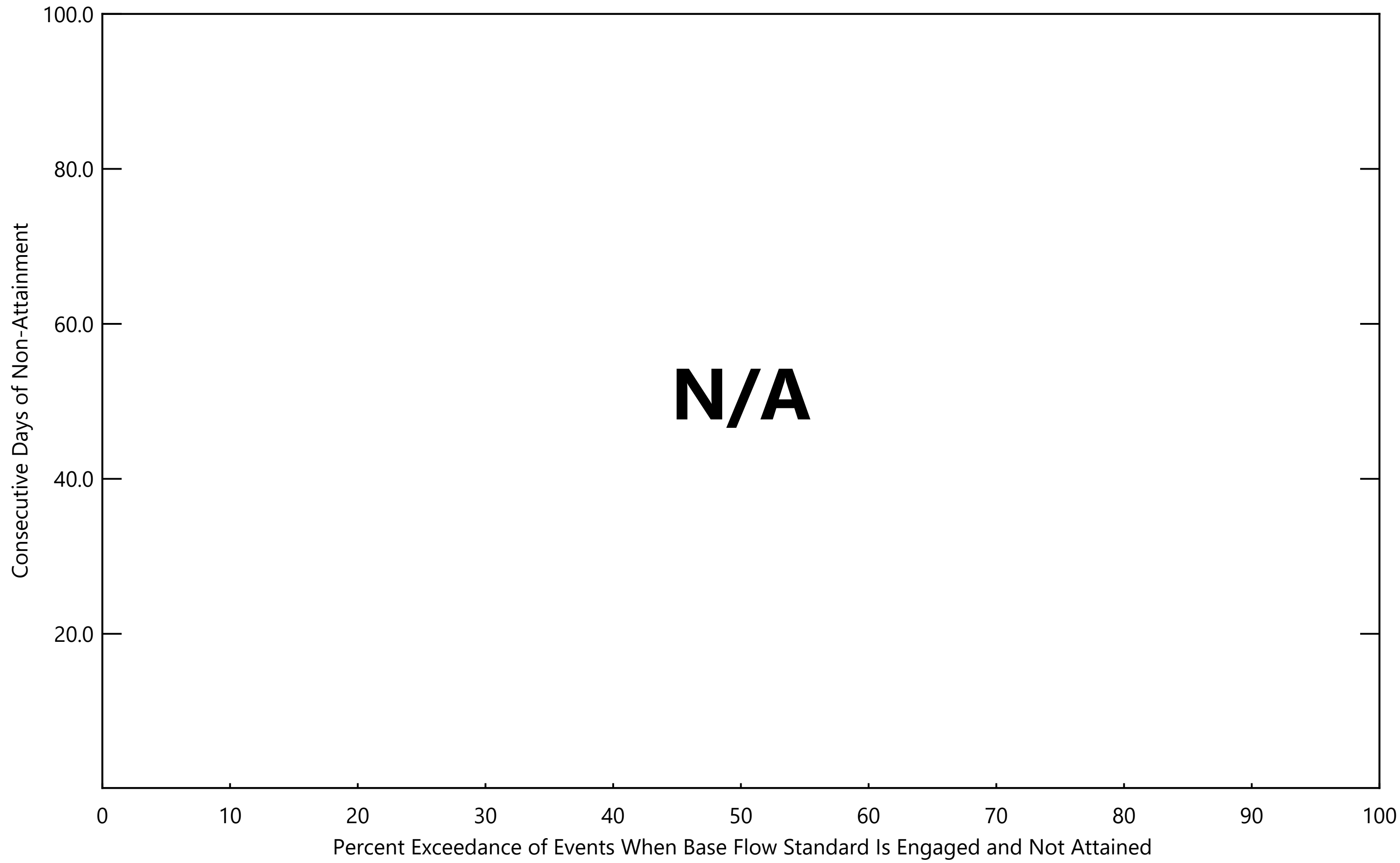
Figure E-226
Angelina River near Alto: Base Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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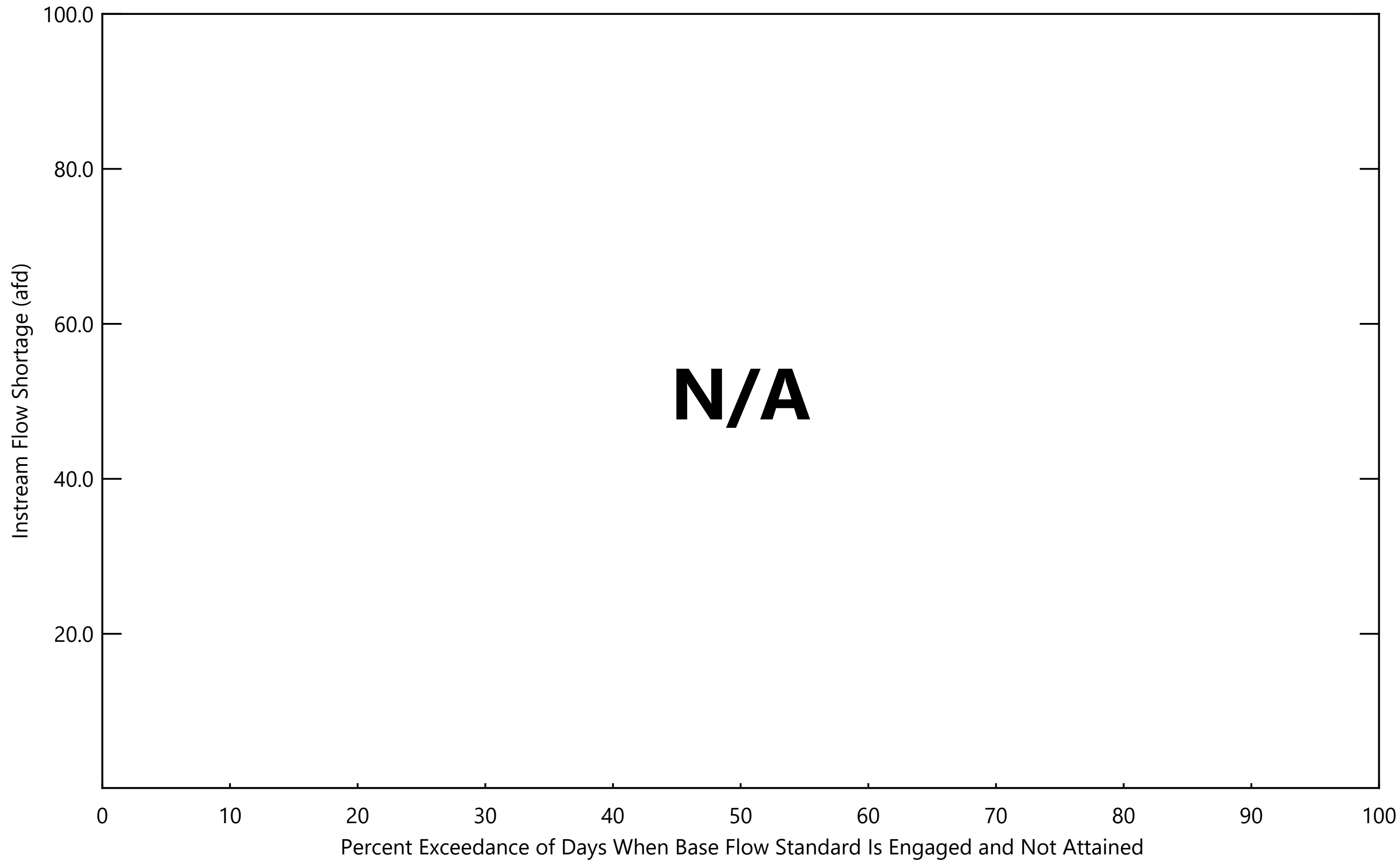
Figure E-227

Angelina River near Alto: Base Flow Shortage Duration, Entire Period of Record (SD-POR)



Note: afd = acre-feet per day

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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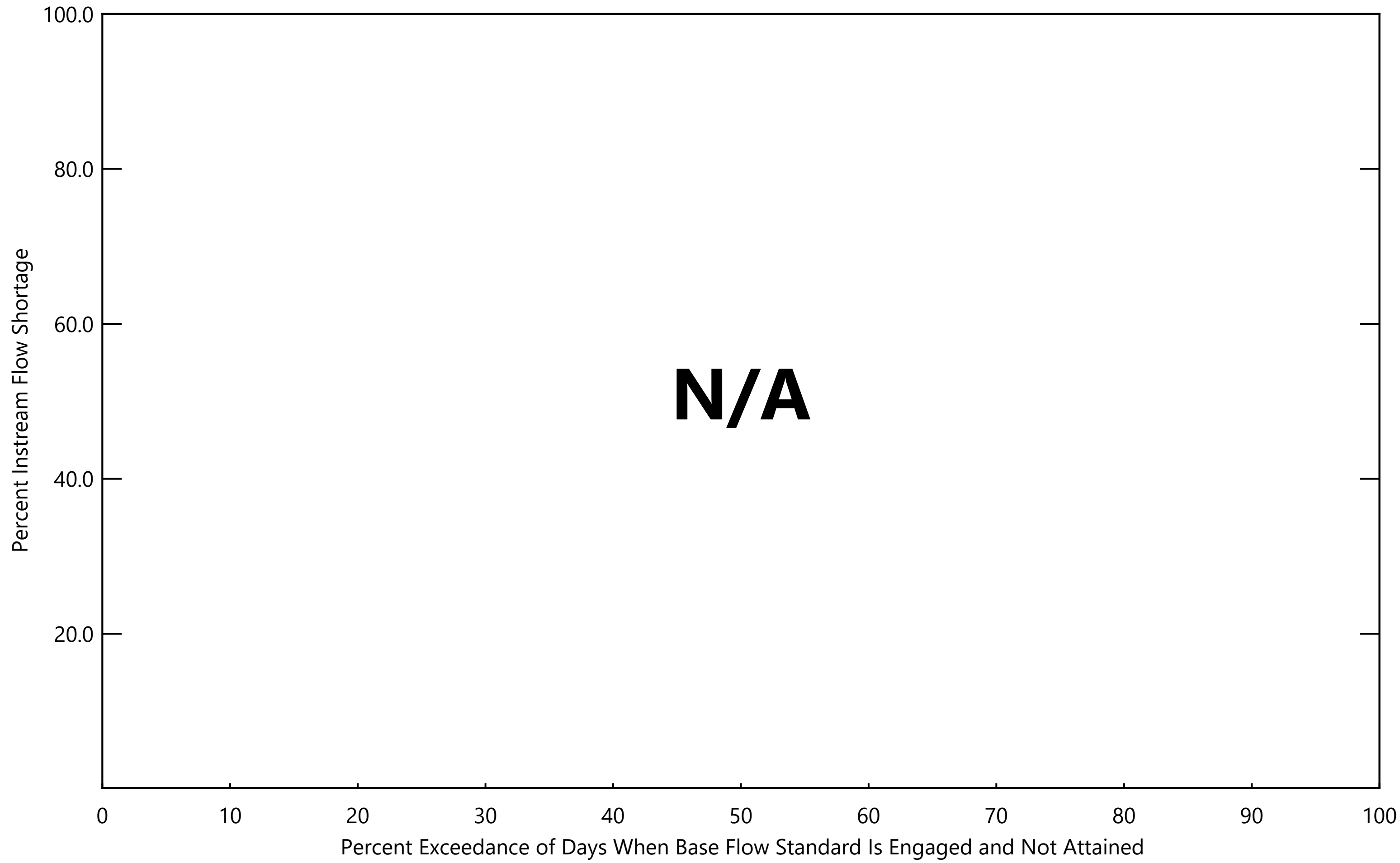
Figure E-228
Angelina River near Alto: Base Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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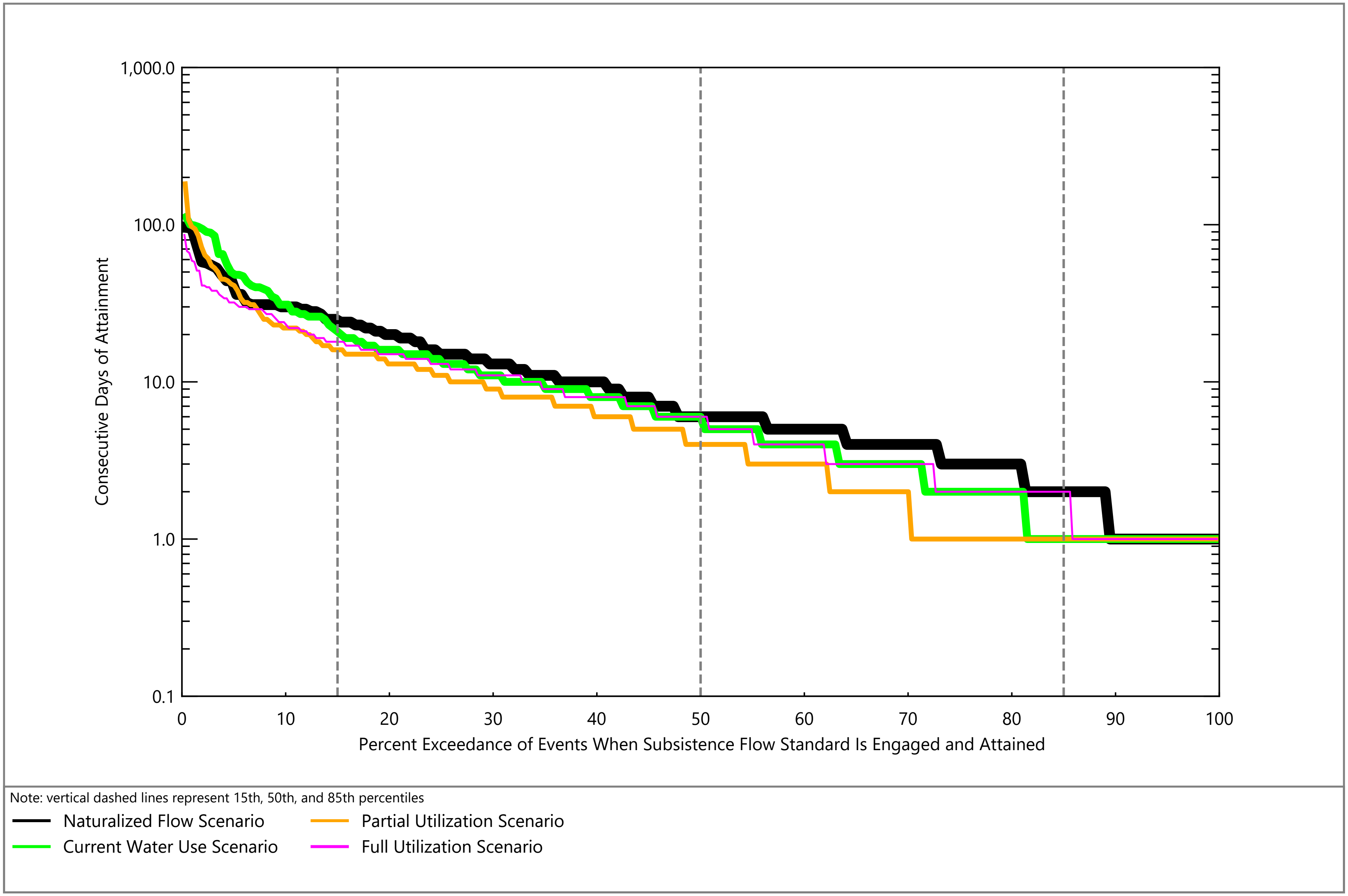
Figure E-229

Angelina River near Alto: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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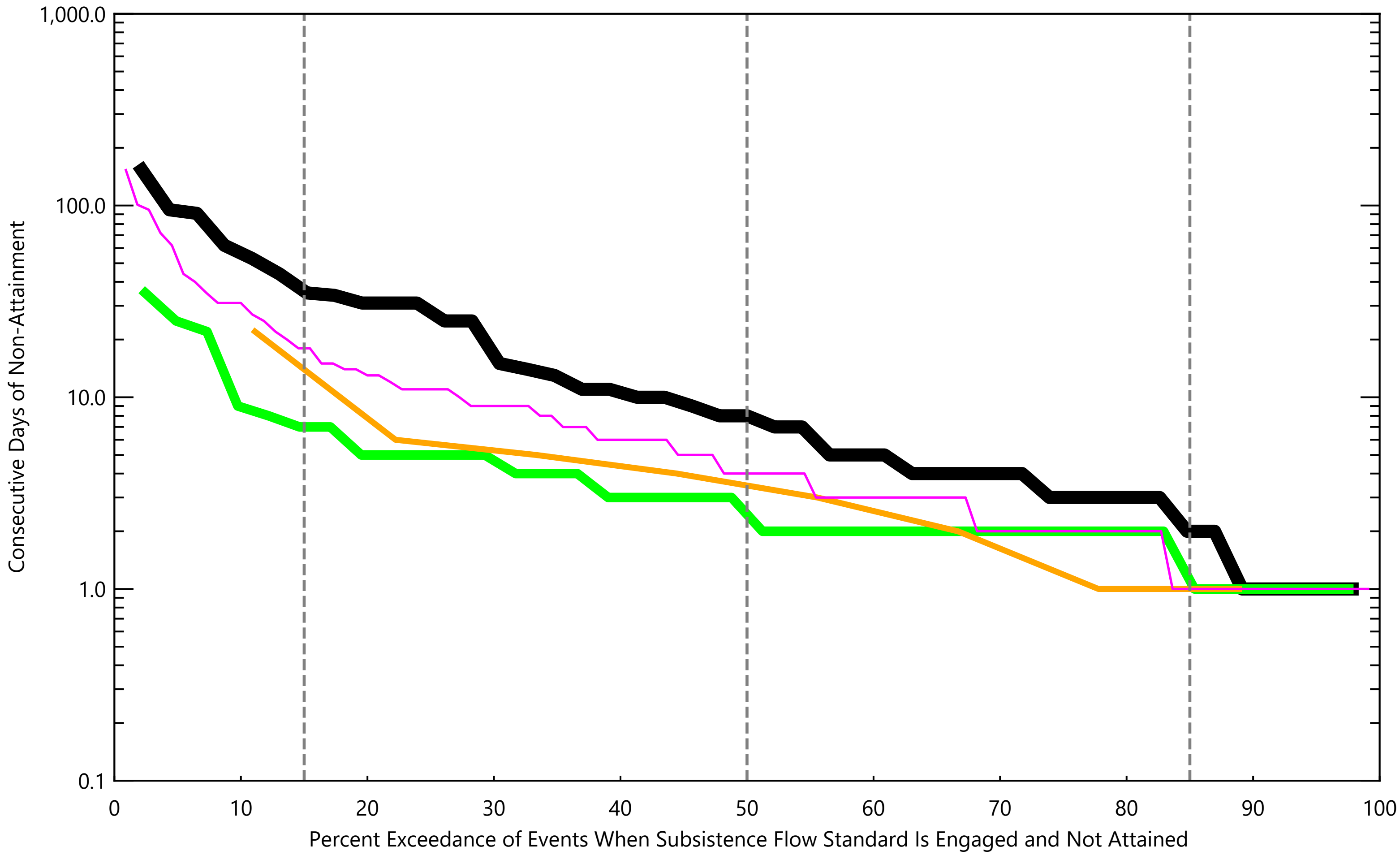
Figure E-230
Angelina River near Alto: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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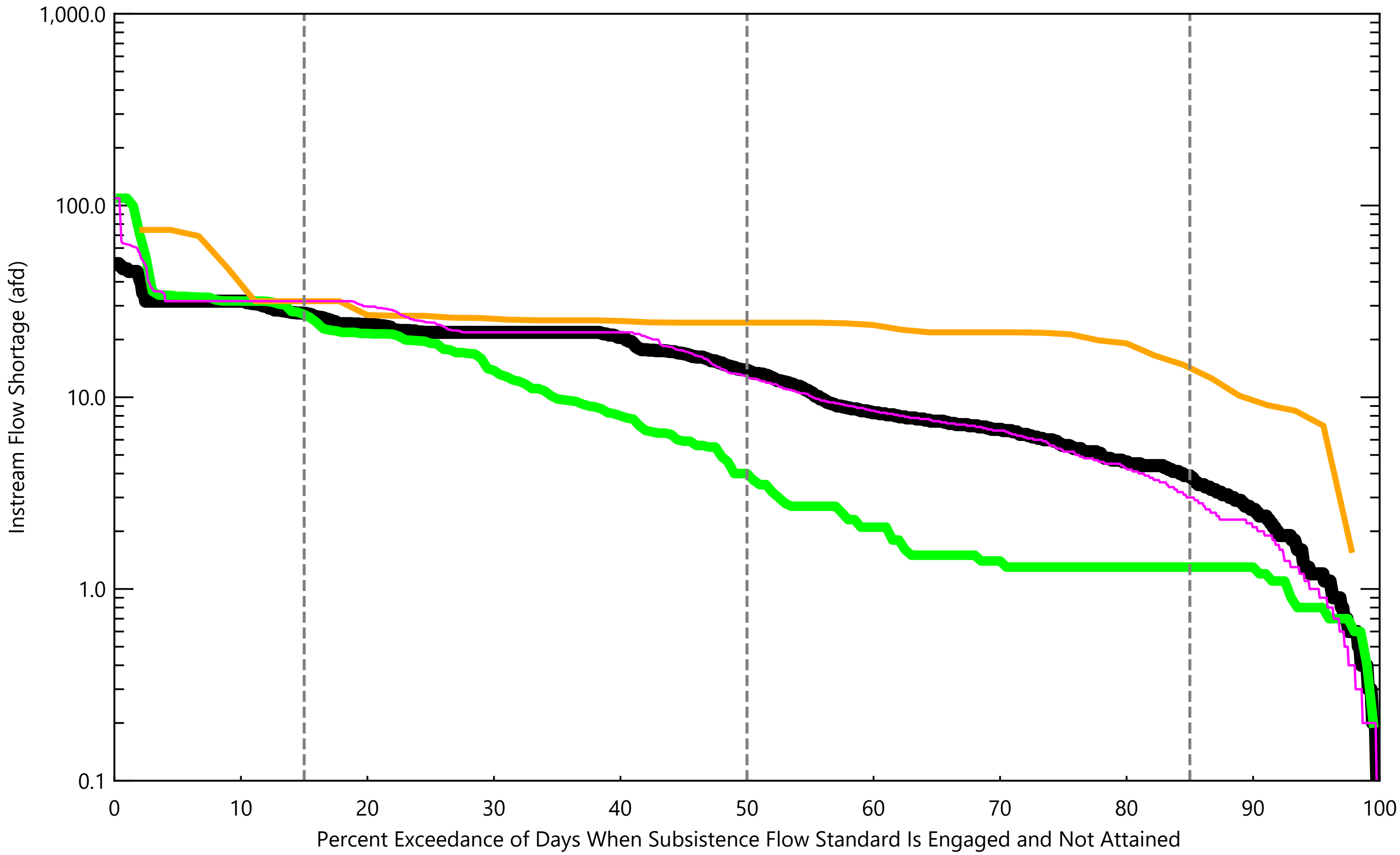
Figure E-231

Angelina River near Alto: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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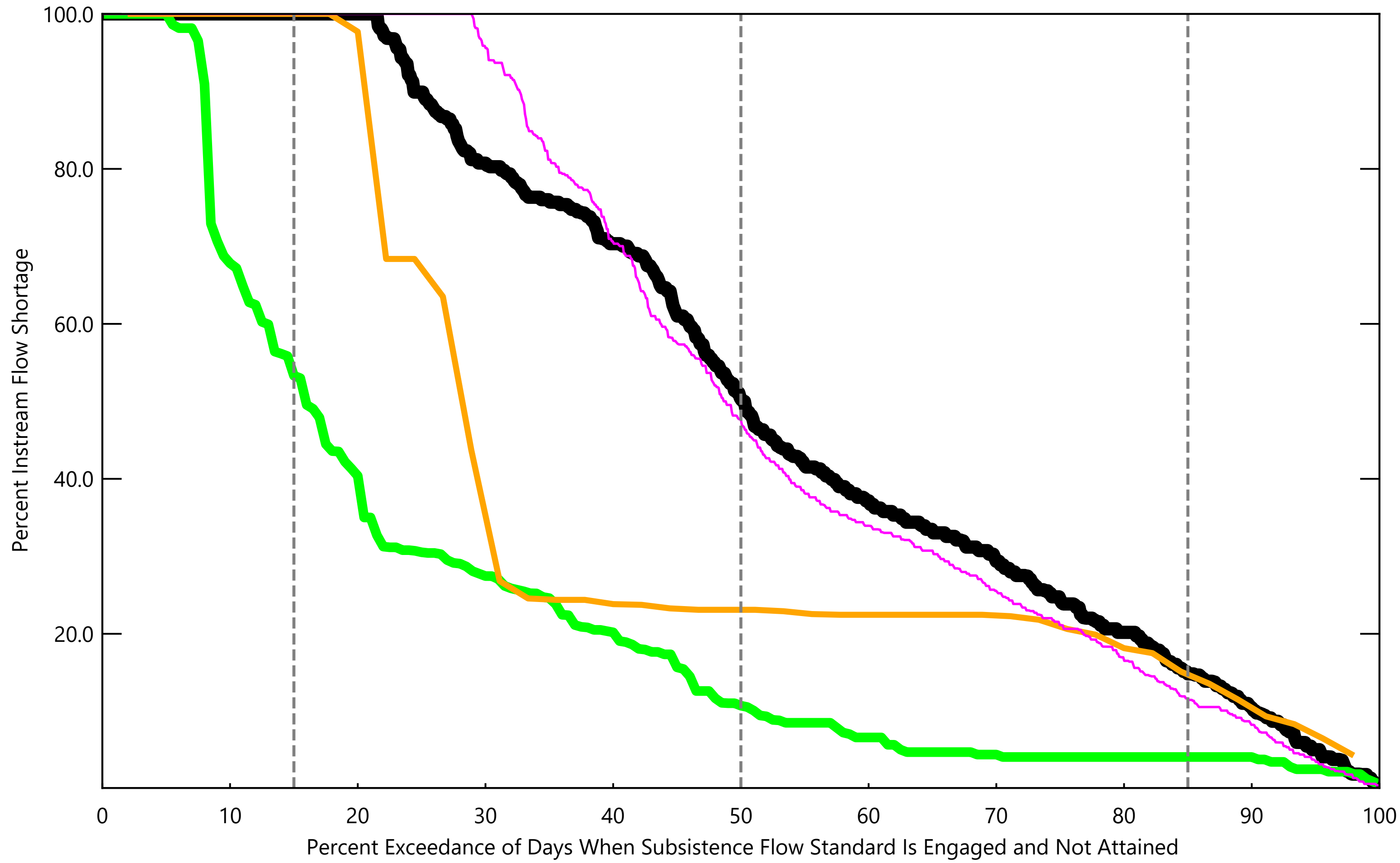
Figure E-232
Angelina River near Alto: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario | Partial Utilization Scenario
Current Water Use Scenario | Full Utilization Scenario

Publish Date: 08/15/2021 16:13 PM | User: JH
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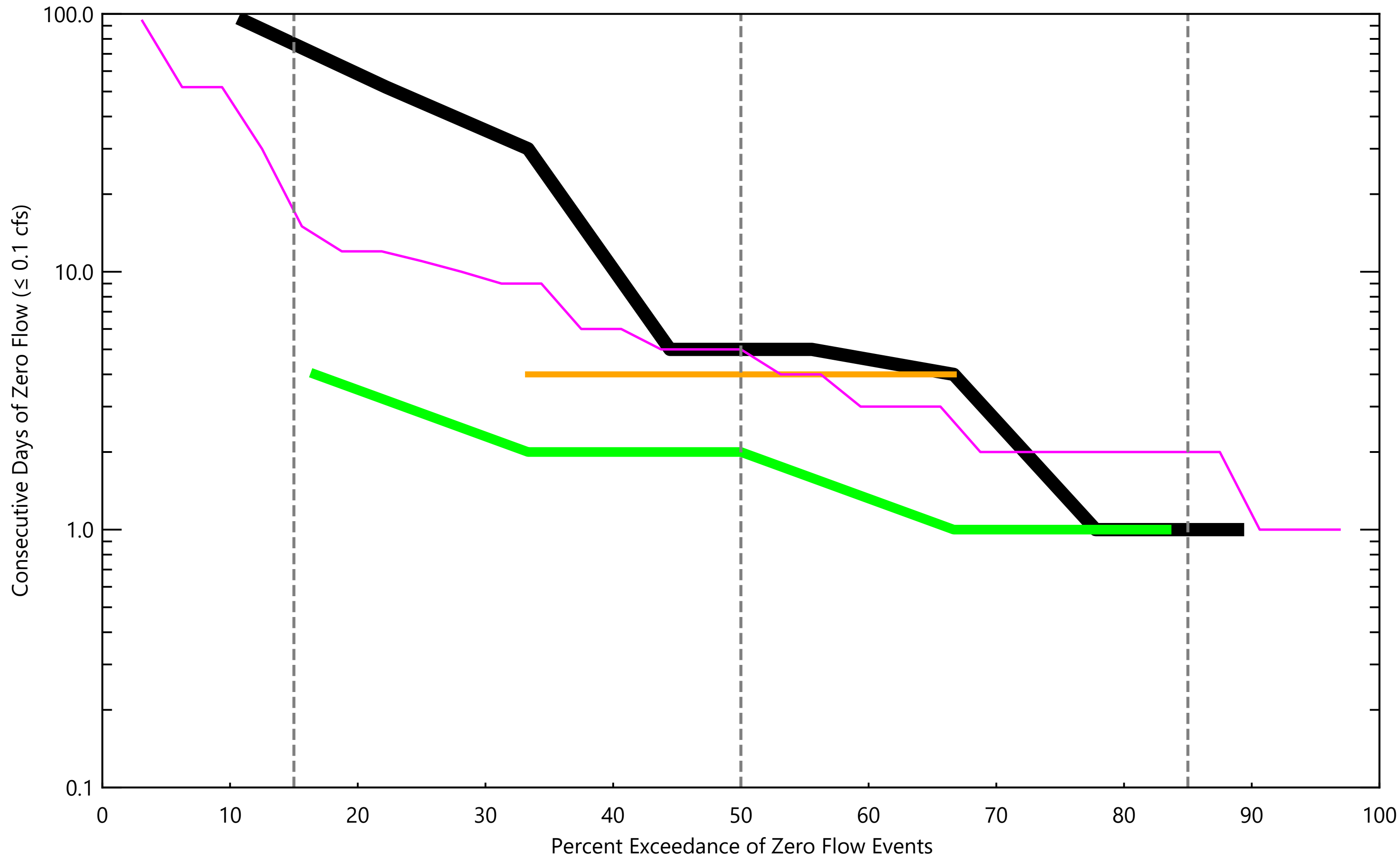
Figure E-233

Angelina River near Alto: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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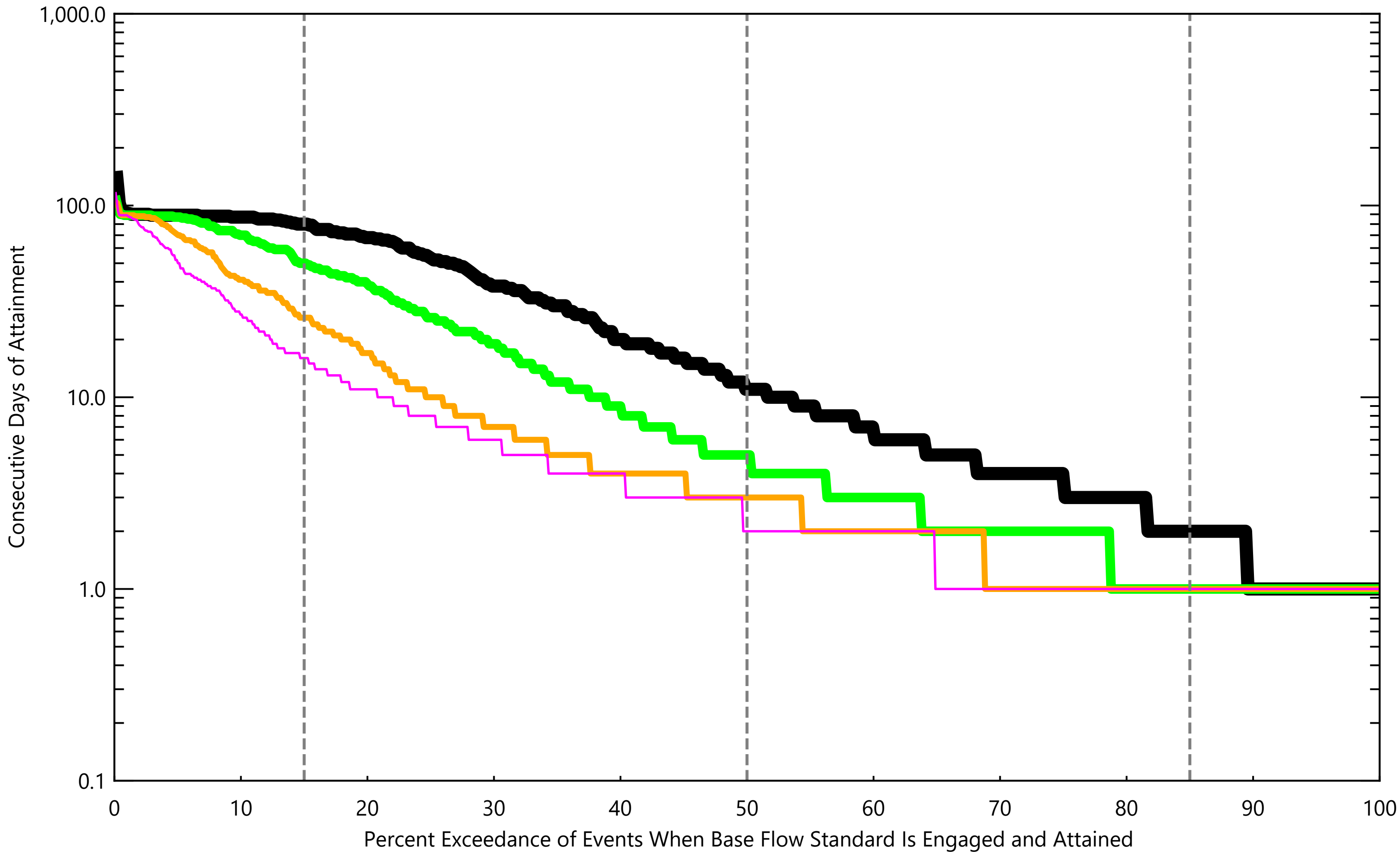
Figure E-234
Angelina River near Alto: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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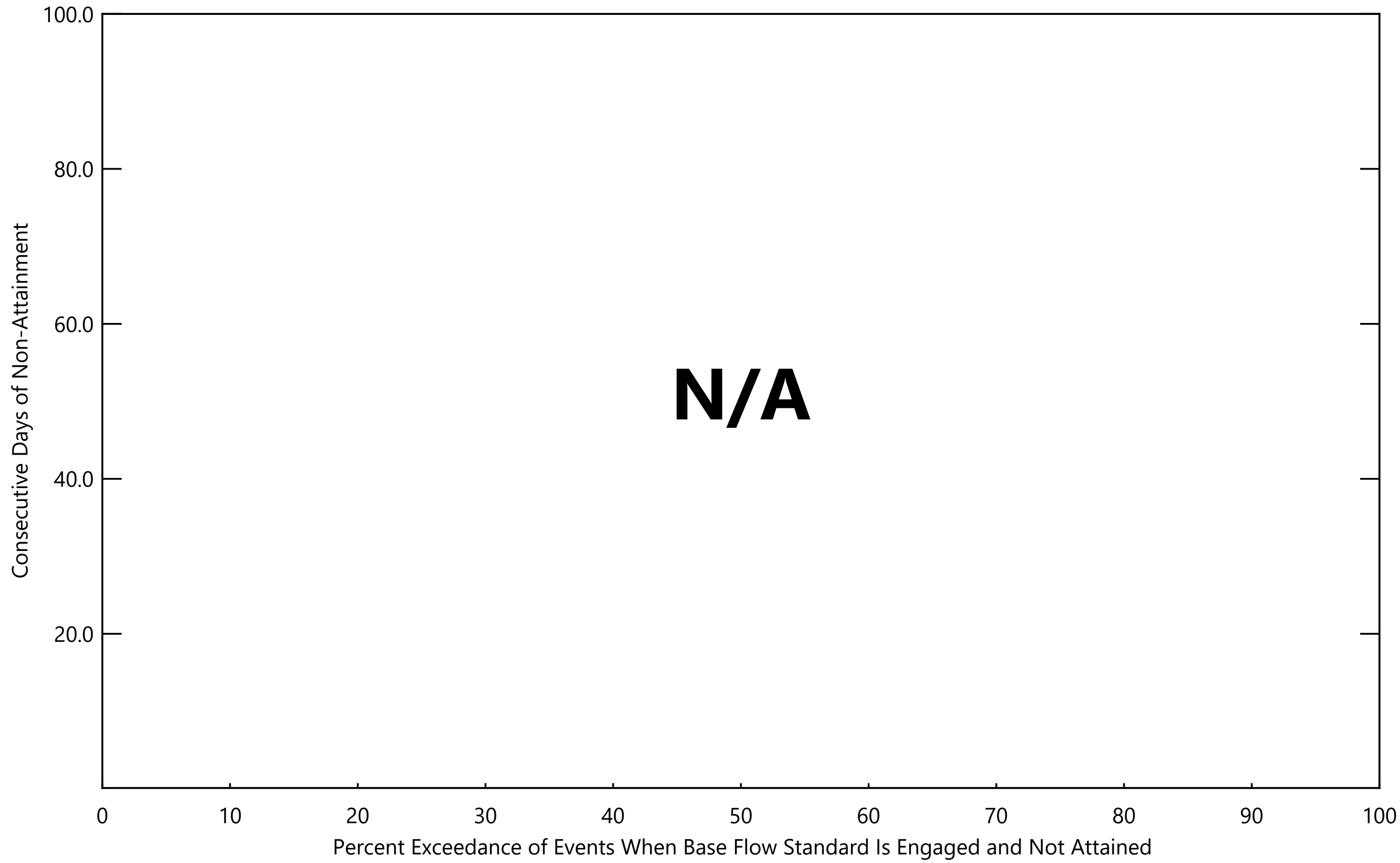
Figure E-235

Neches River at Evadale: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Publish Date: 08/15/2021 16:13 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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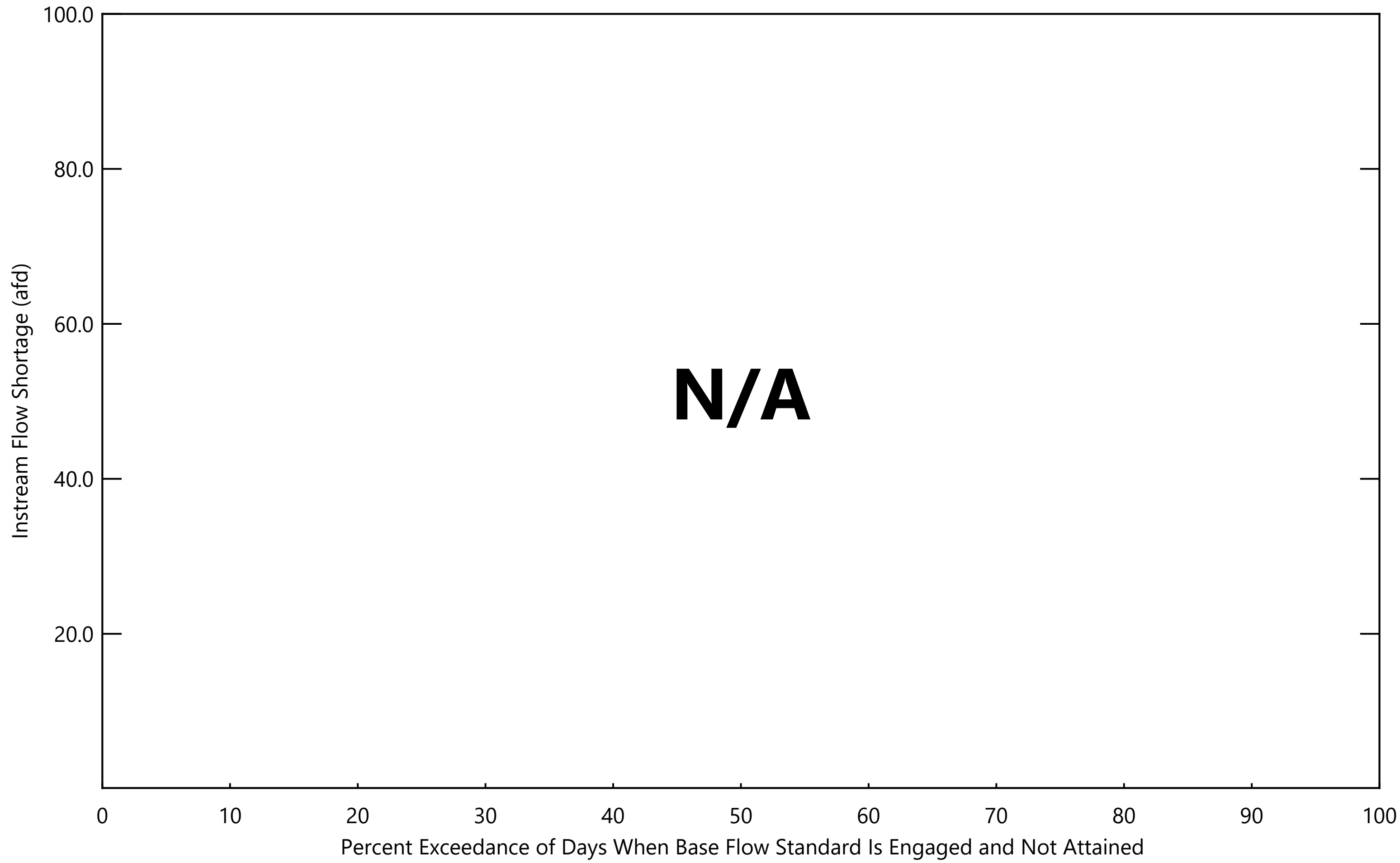
Figure E-236
Neches River at Evadale: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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Figure E-237

Neches River at Evadale: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards

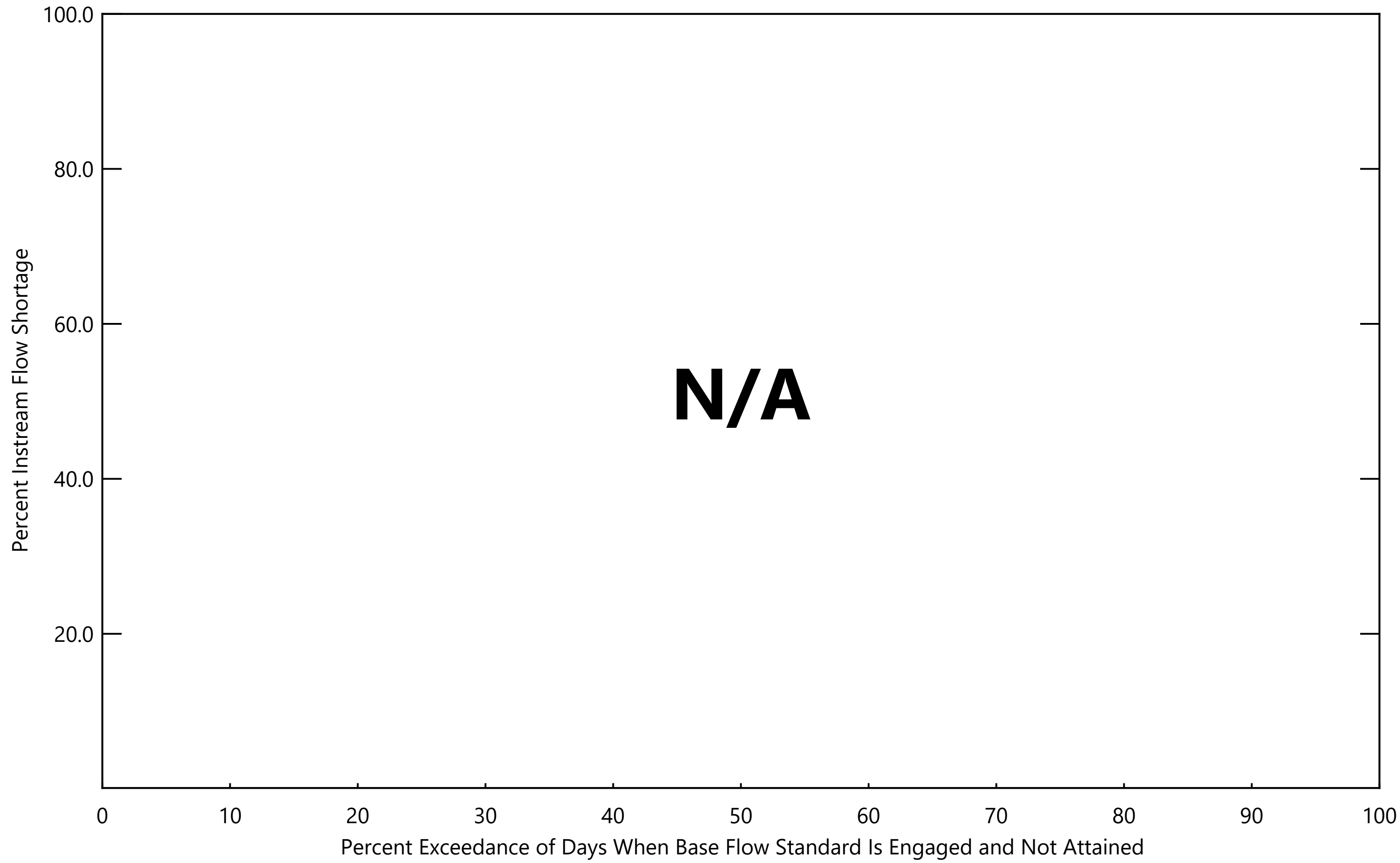

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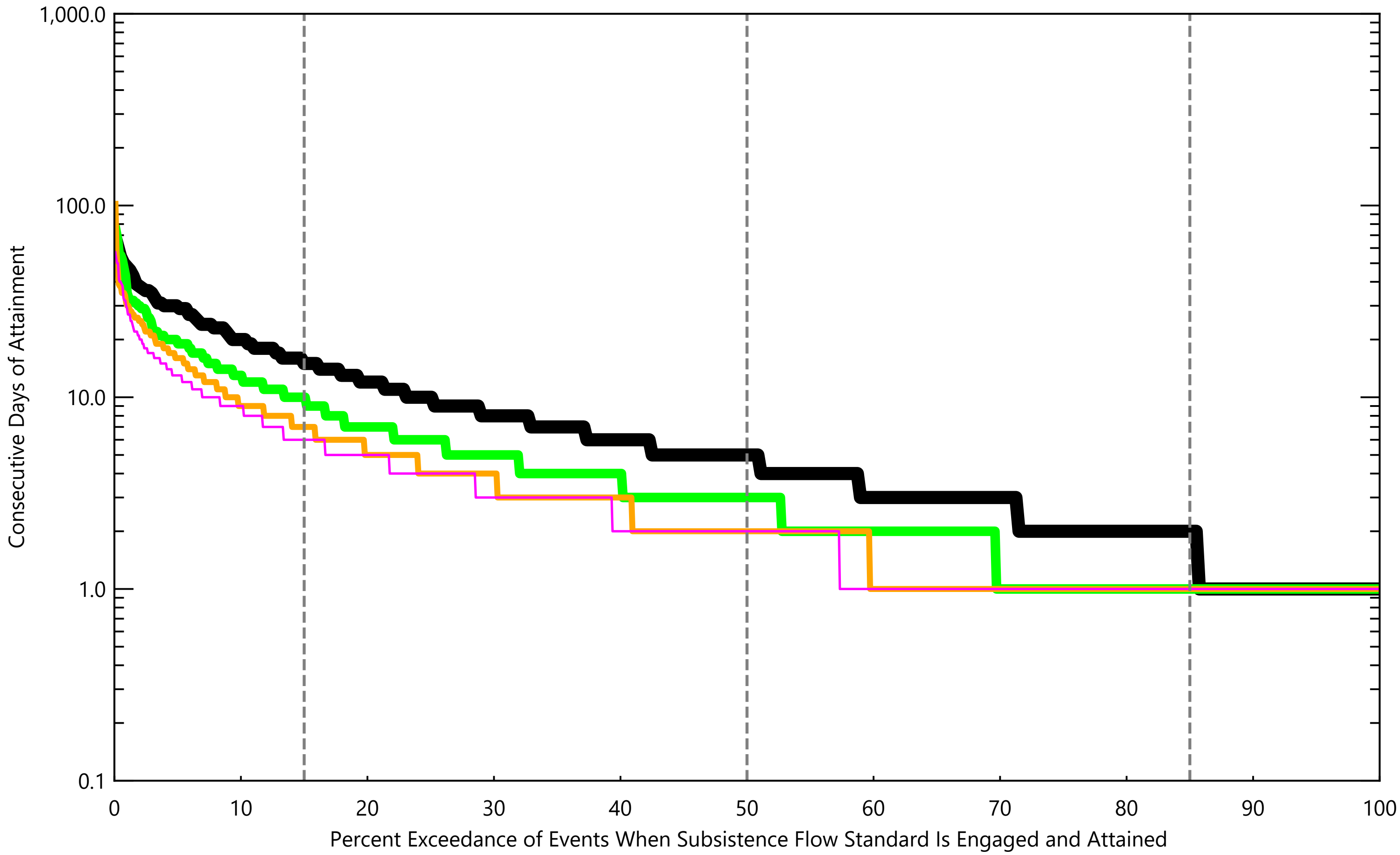
Figure E-238

Neches River at Evadale: Base Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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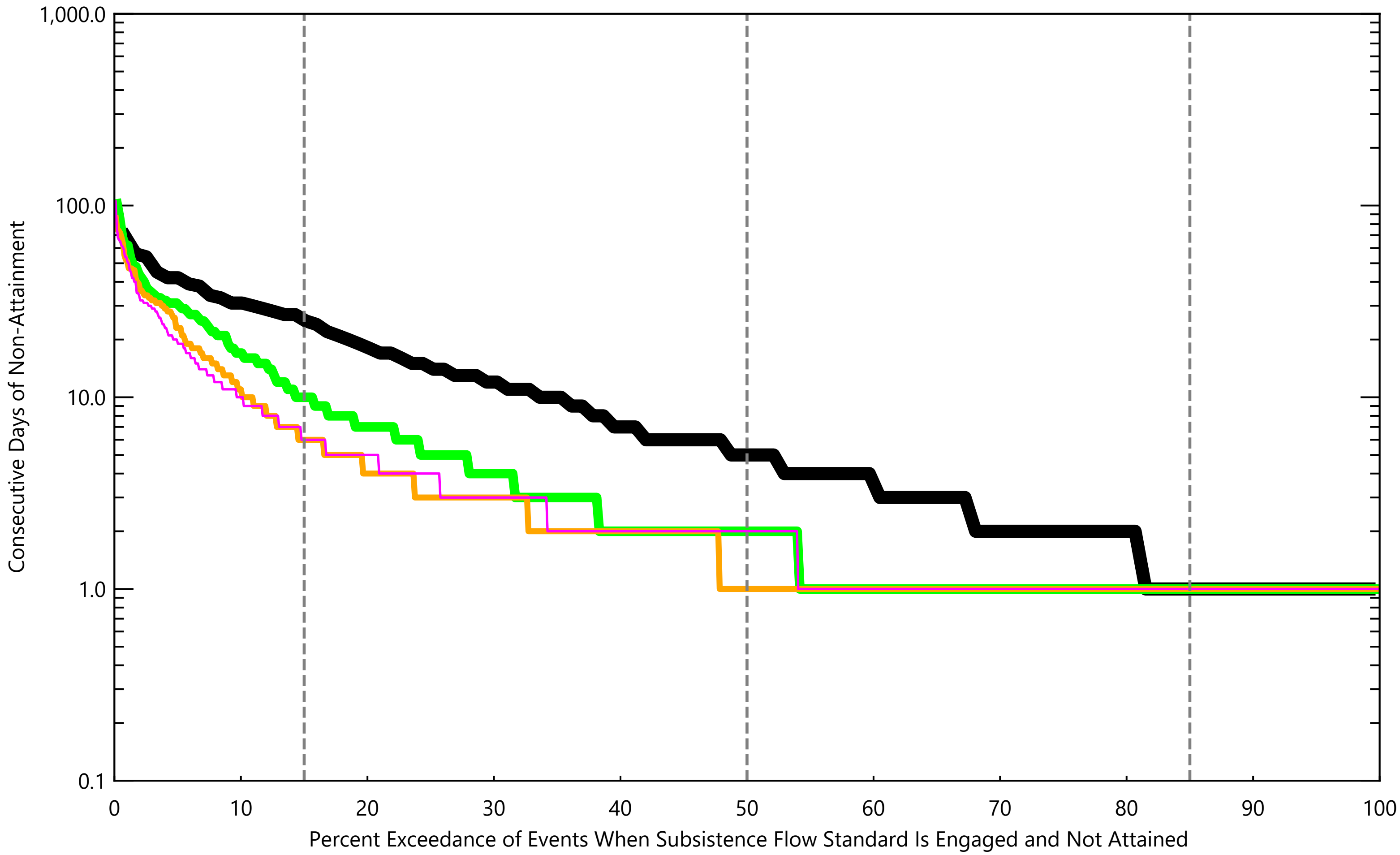
Figure E-239

Neches River at Evadale: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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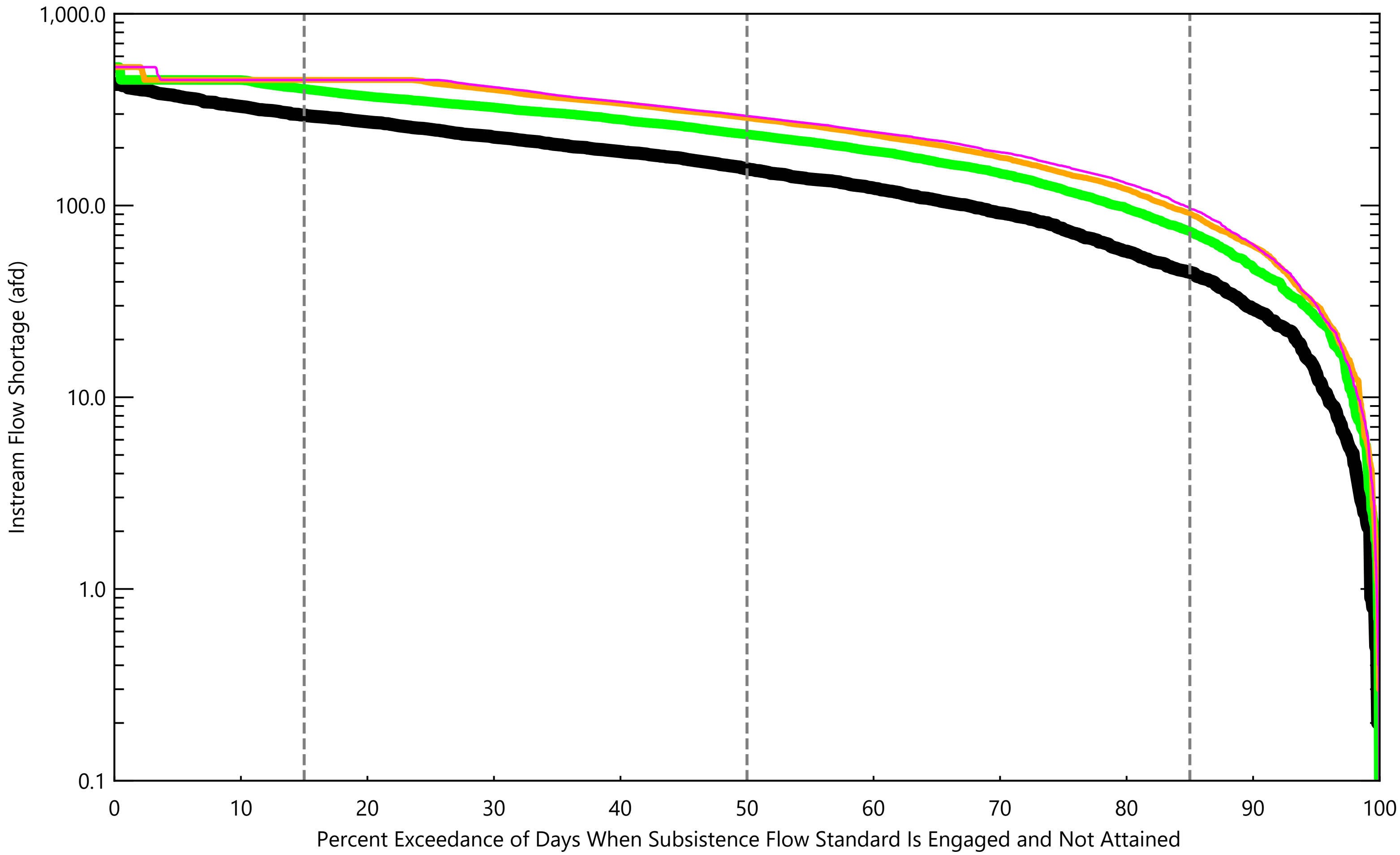
Figure E-240

Neches River at Evadale: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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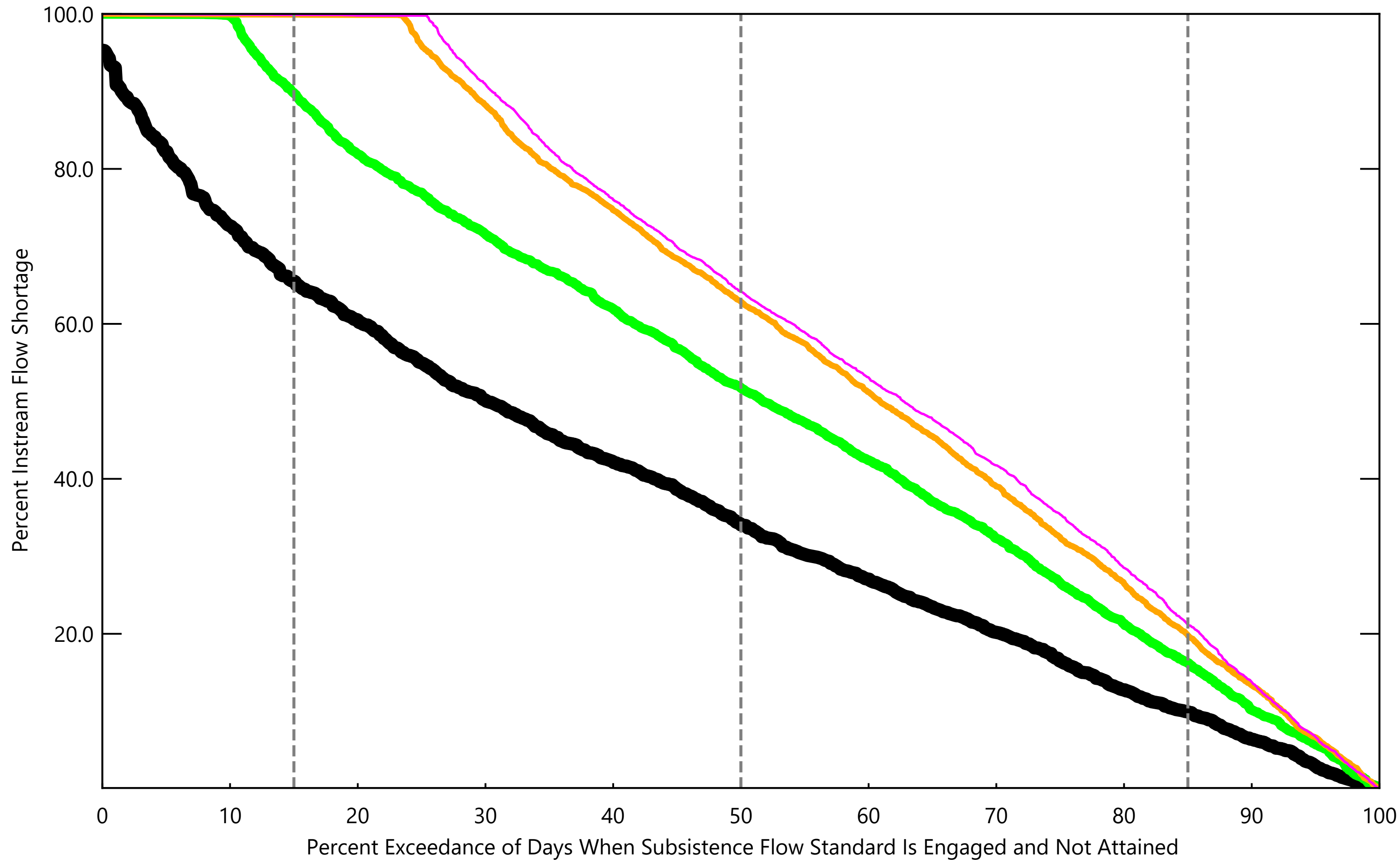
Figure E-241
Neches River at Evadale: Subsistence Flow Shortage, Entire Period of Record (S-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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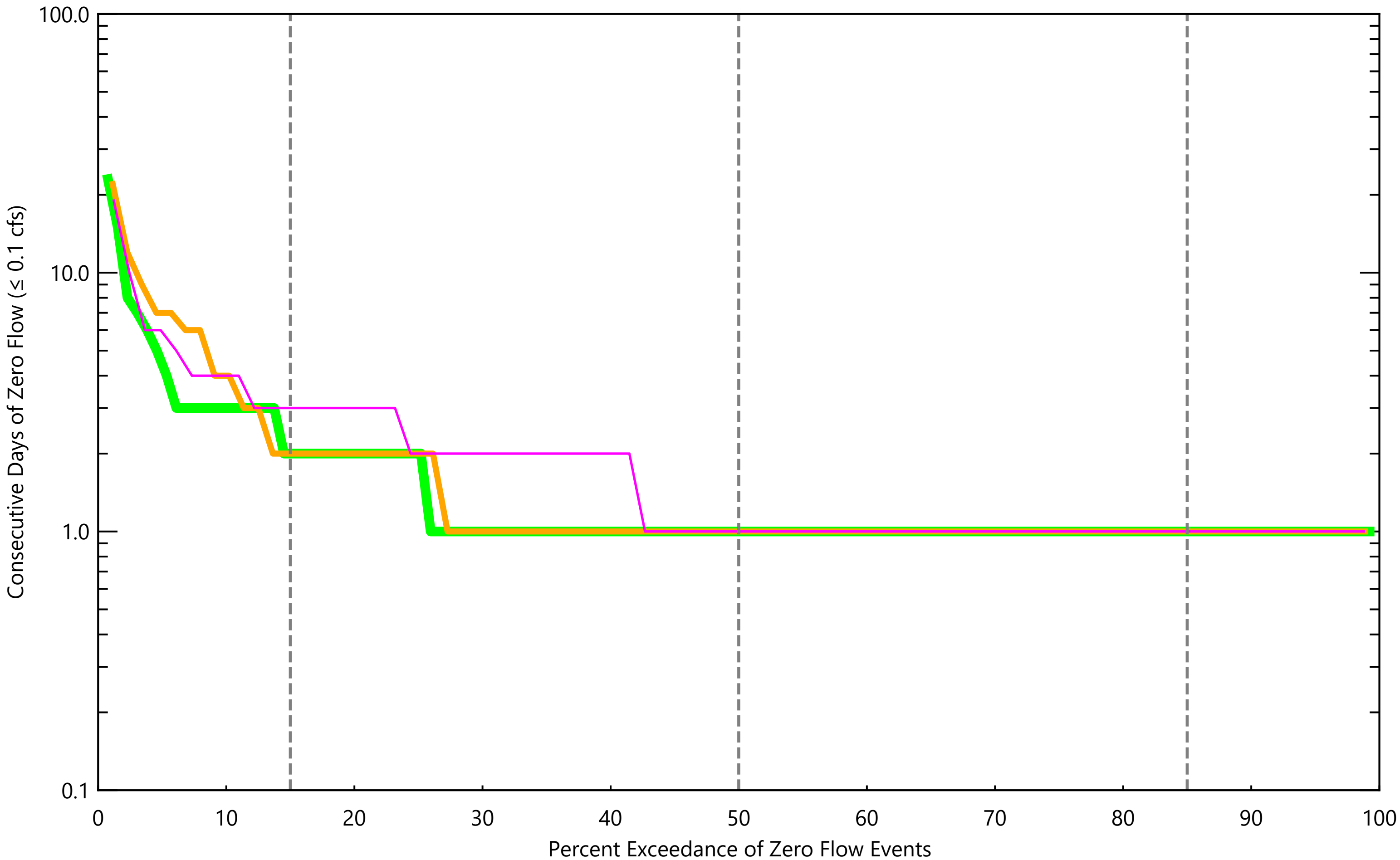
Figure E-242
Neches River at Evadale: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: cfs: cubic feet per second; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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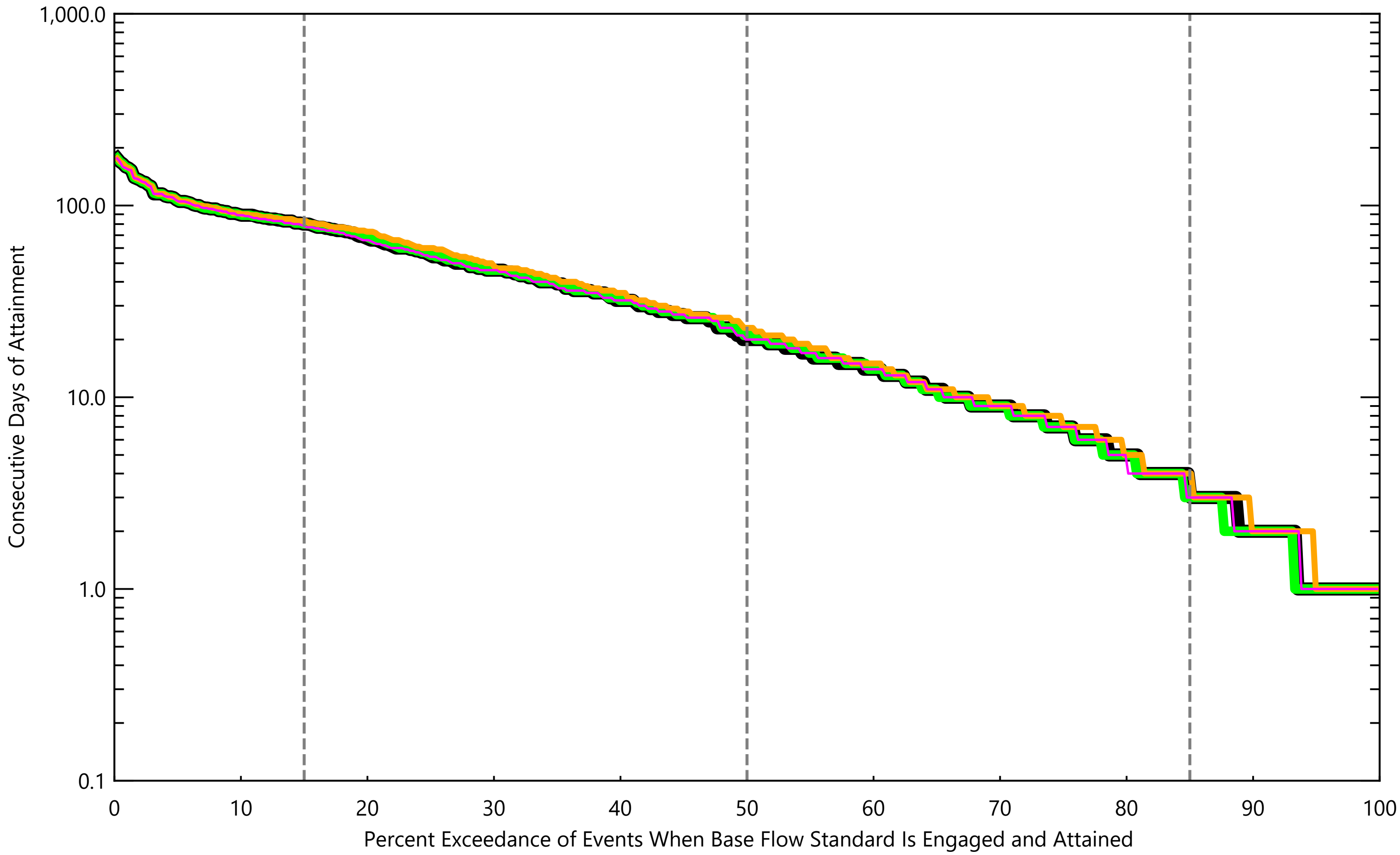
Figure E-243
Neches River at Evadale: Zero-Flow Duration, Entire Period of Record (ZFD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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Figure E-244

Village Creek near Kountze: Base Flow Attainment Duration, Entire Period of Record (AD-POR)

Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

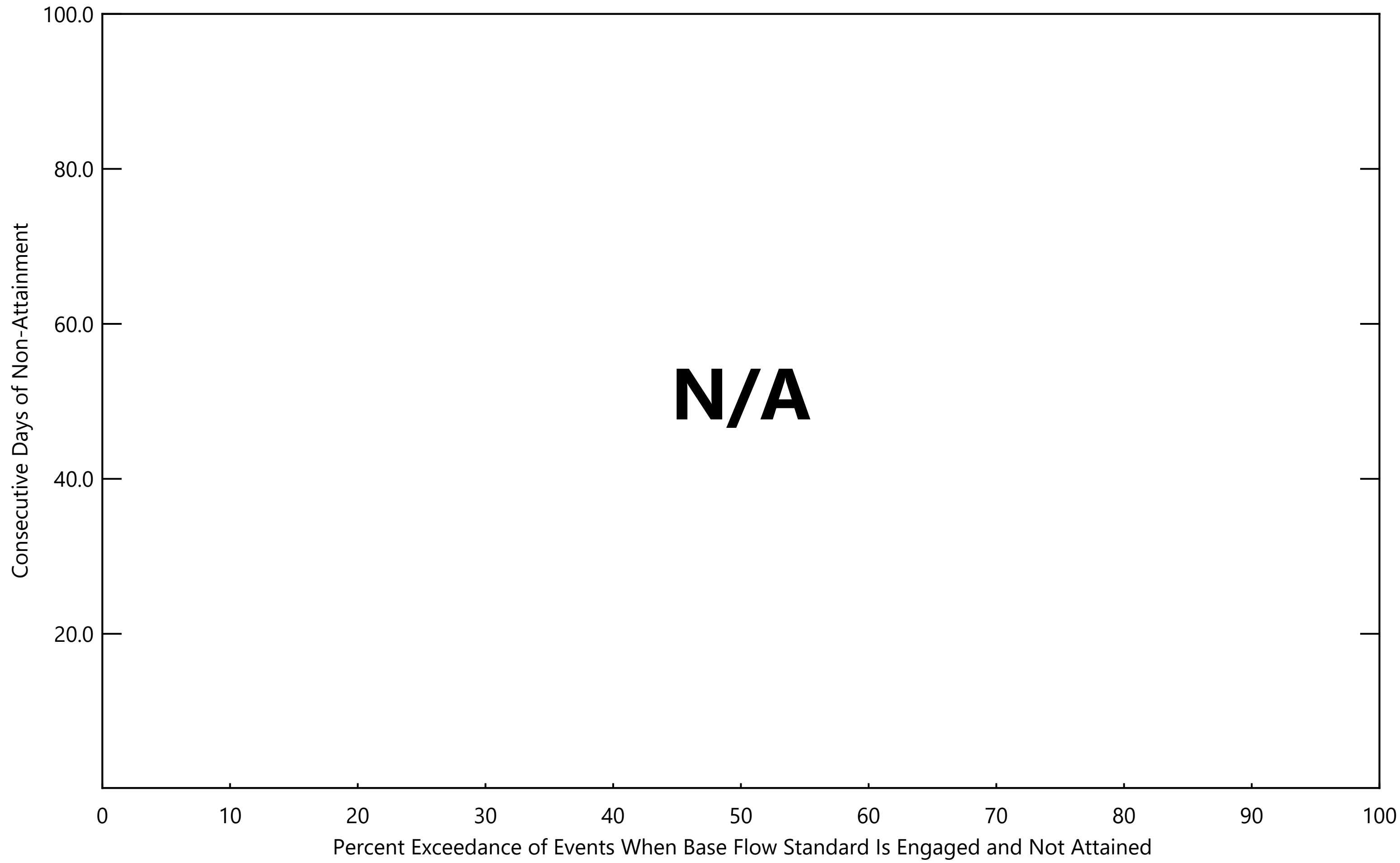

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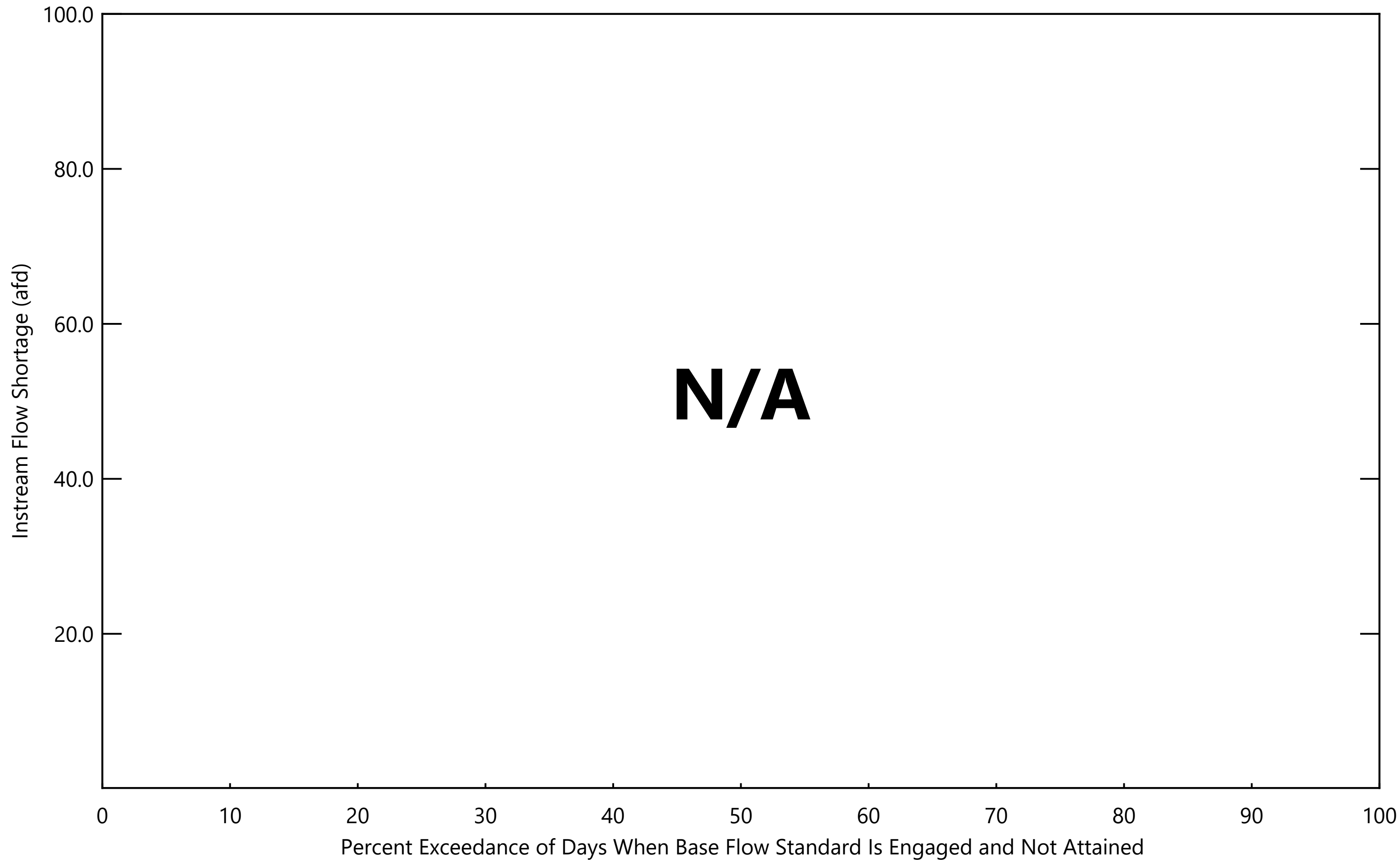
Figure E-245
Village Creek near Kountze: Base Flow Shortage Duration, Entire Period of Record (SD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: afd = acre-feet per day

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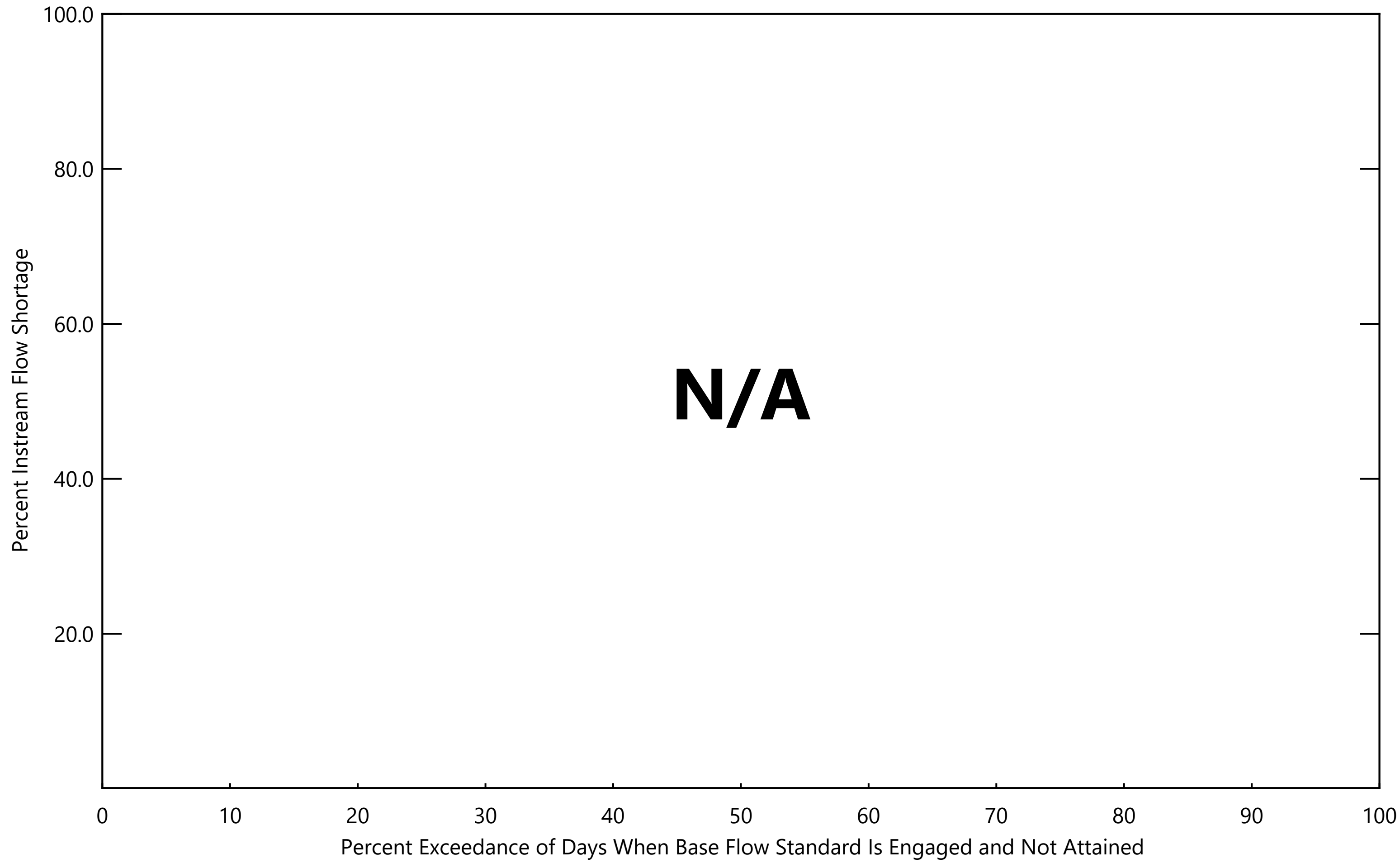
Figure E-246

Village Creek near Kountze: Base Flow Shortage, Entire Period of Record (S-POR)

Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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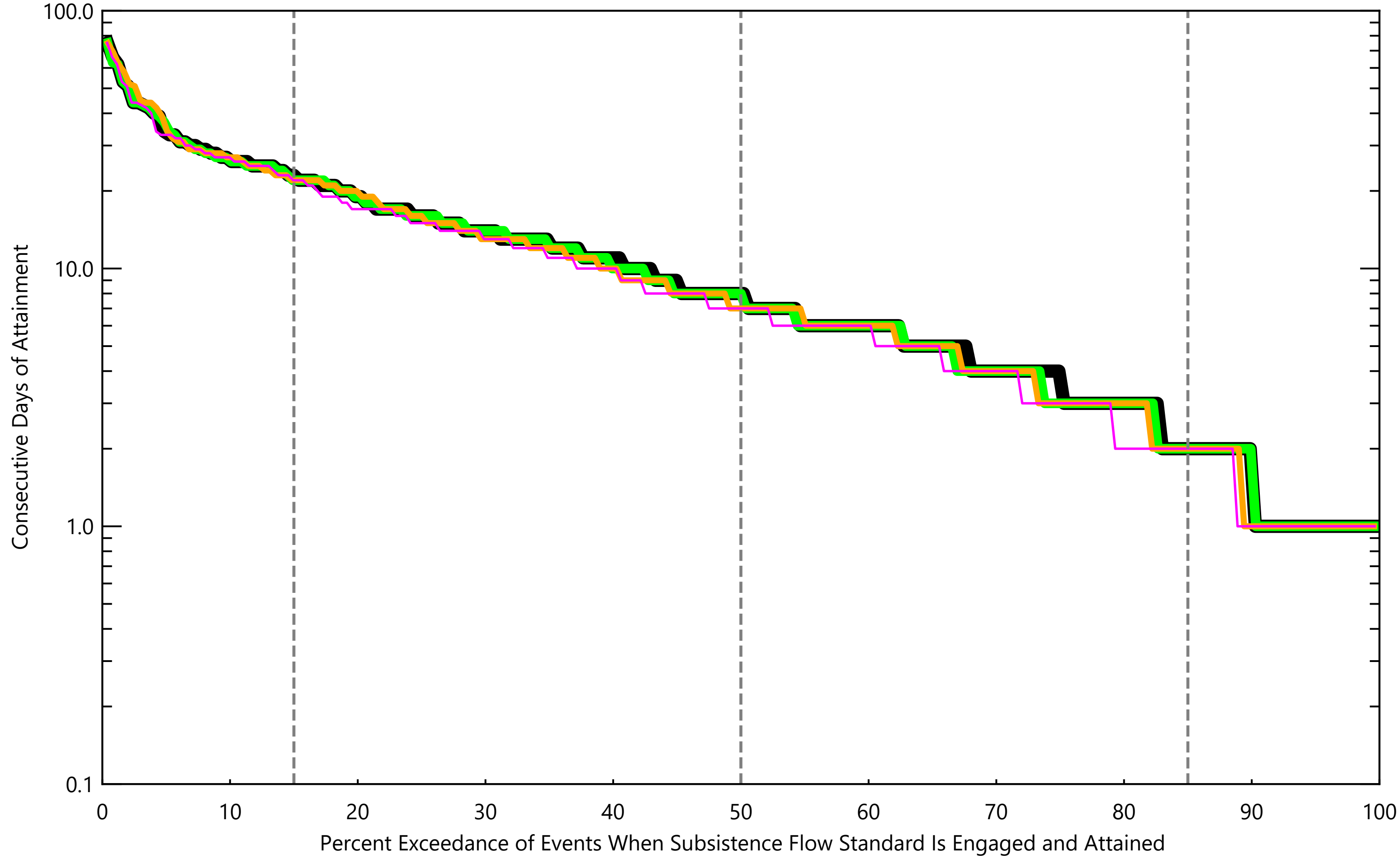
Figure E-247
Village Creek near Kountze: Base Flow Percent Shortage, Entire Period of Record (PS-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Partial Utilization Scenario
Current Water Use Scenario
Full Utilization Scenario

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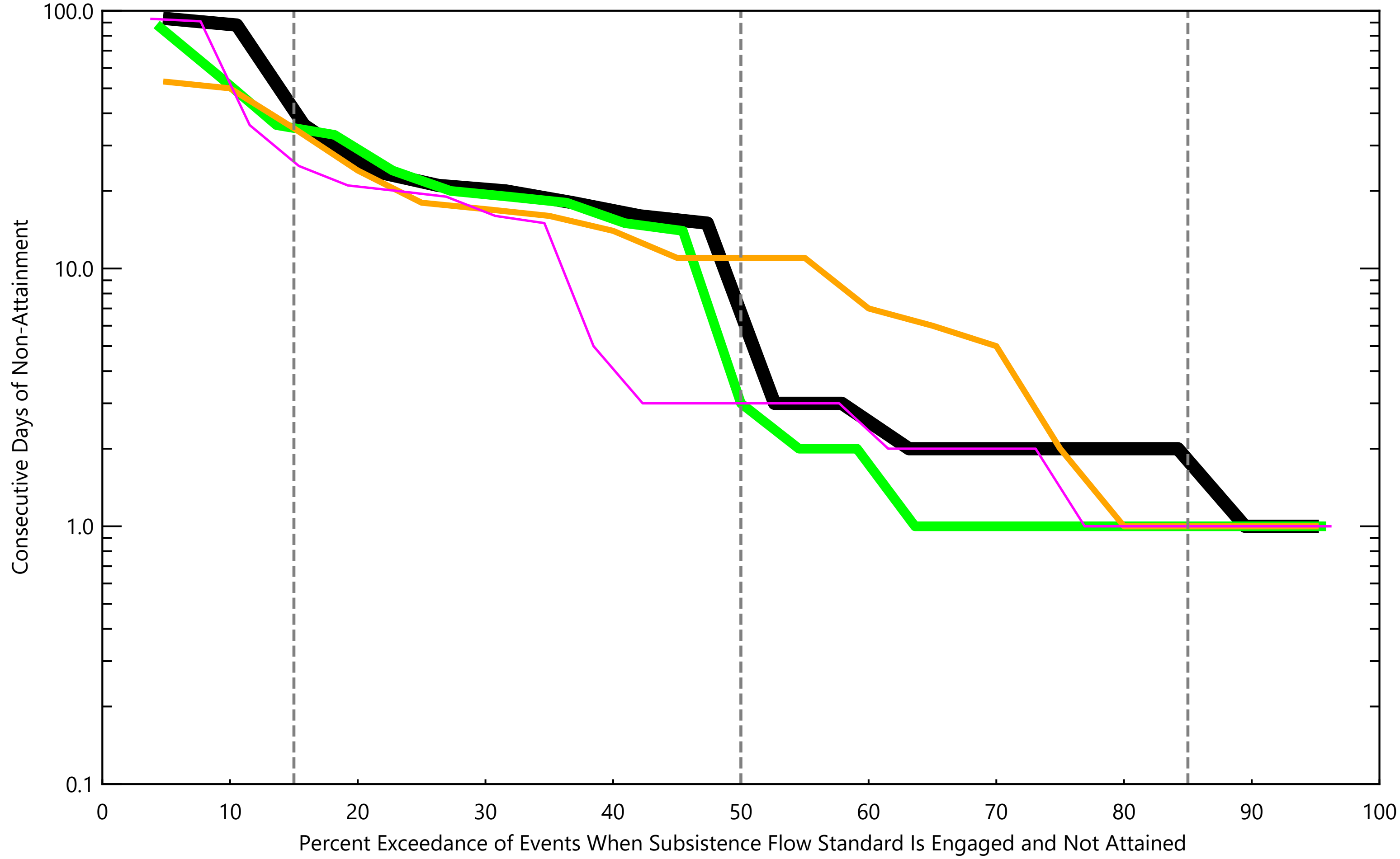
Figure E-248
Village Creek near Kountze: Subsistence Flow Attainment Duration, Entire Period of Record (AD-POR)
Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

Publish Date: 08/15/2021 16:13 PM | User: JH
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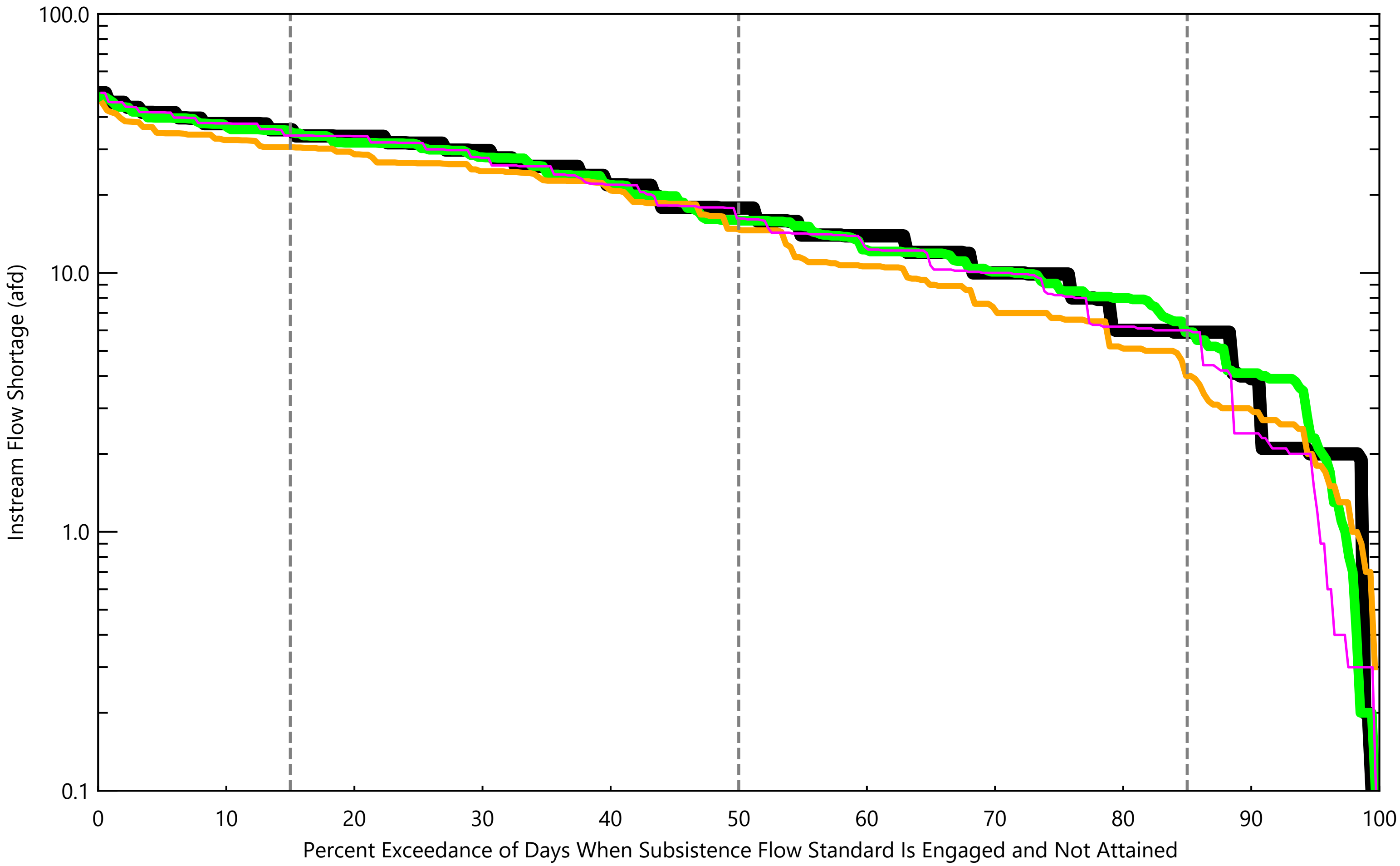
Figure E-249

Village Creek near Kountze: Subsistence Flow Shortage Duration, Entire Period of Record (SD-POR)

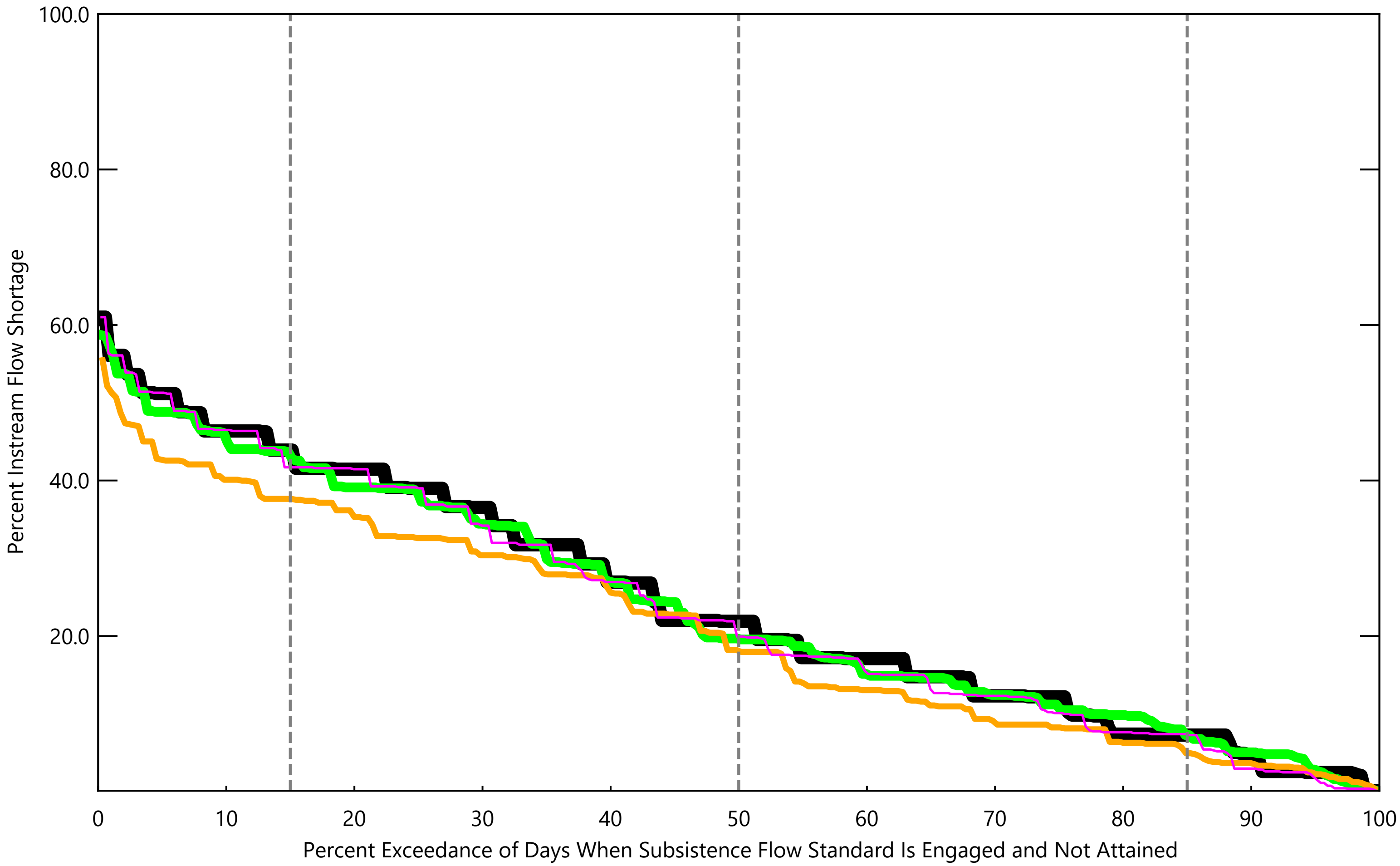
Exceedance Frequency Plots for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: afd: acre-feet per day; vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario



Note: vertical dashed lines represent 15th, 50th, and 85th percentiles

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario

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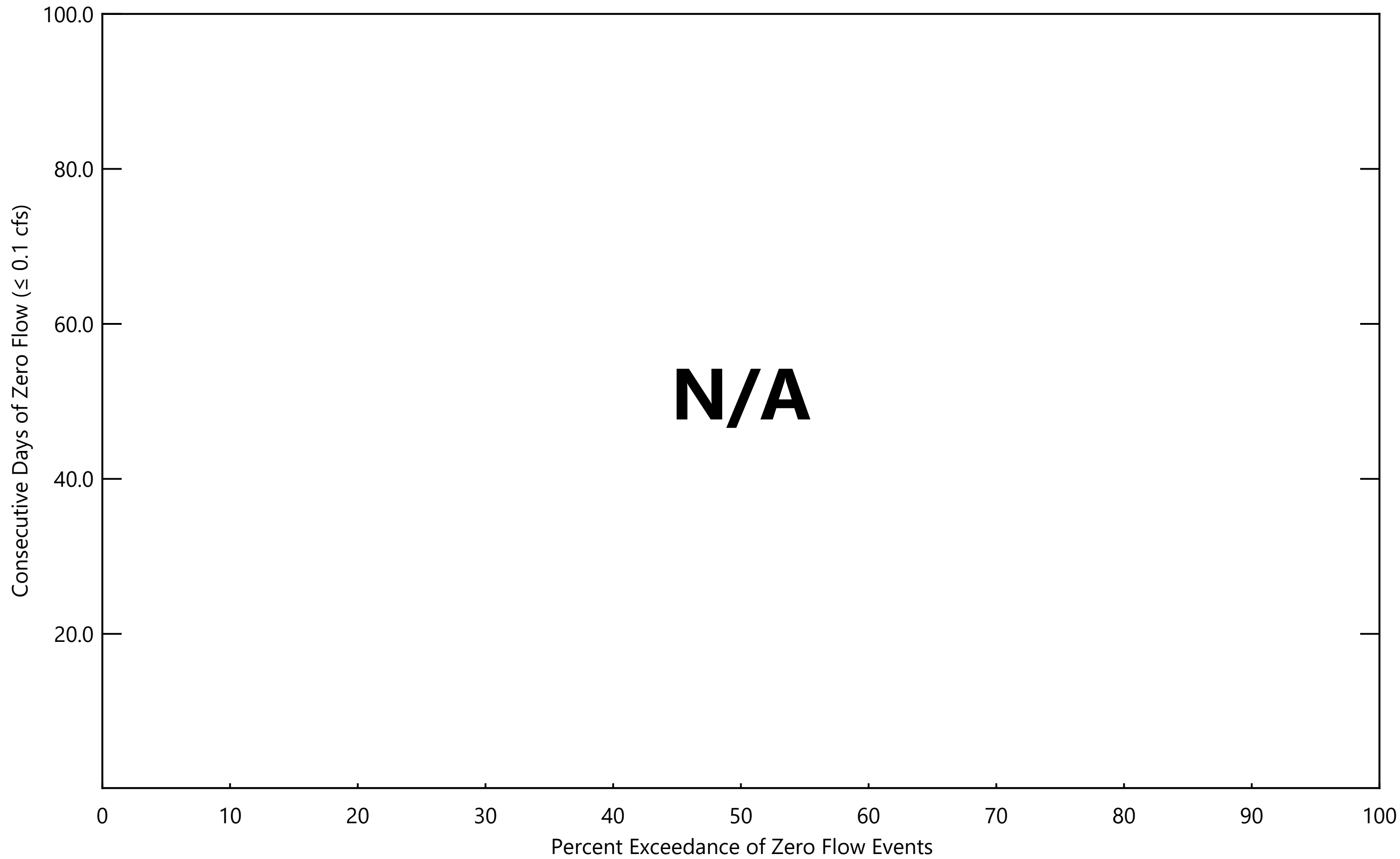
Figure E-251

Village Creek near Kountze: Subsistence Flow Percent Shortage, Entire Period of Record (PS-POR)

Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_exceedance_frequencies.py

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Figure E-252
Village Creek near Kountze: Zero-Flow Duration, Entire Period of Record (ZFD-POR)

Exceedance Frequency Plots for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

Appendix F
Flow Raster Hydrographs

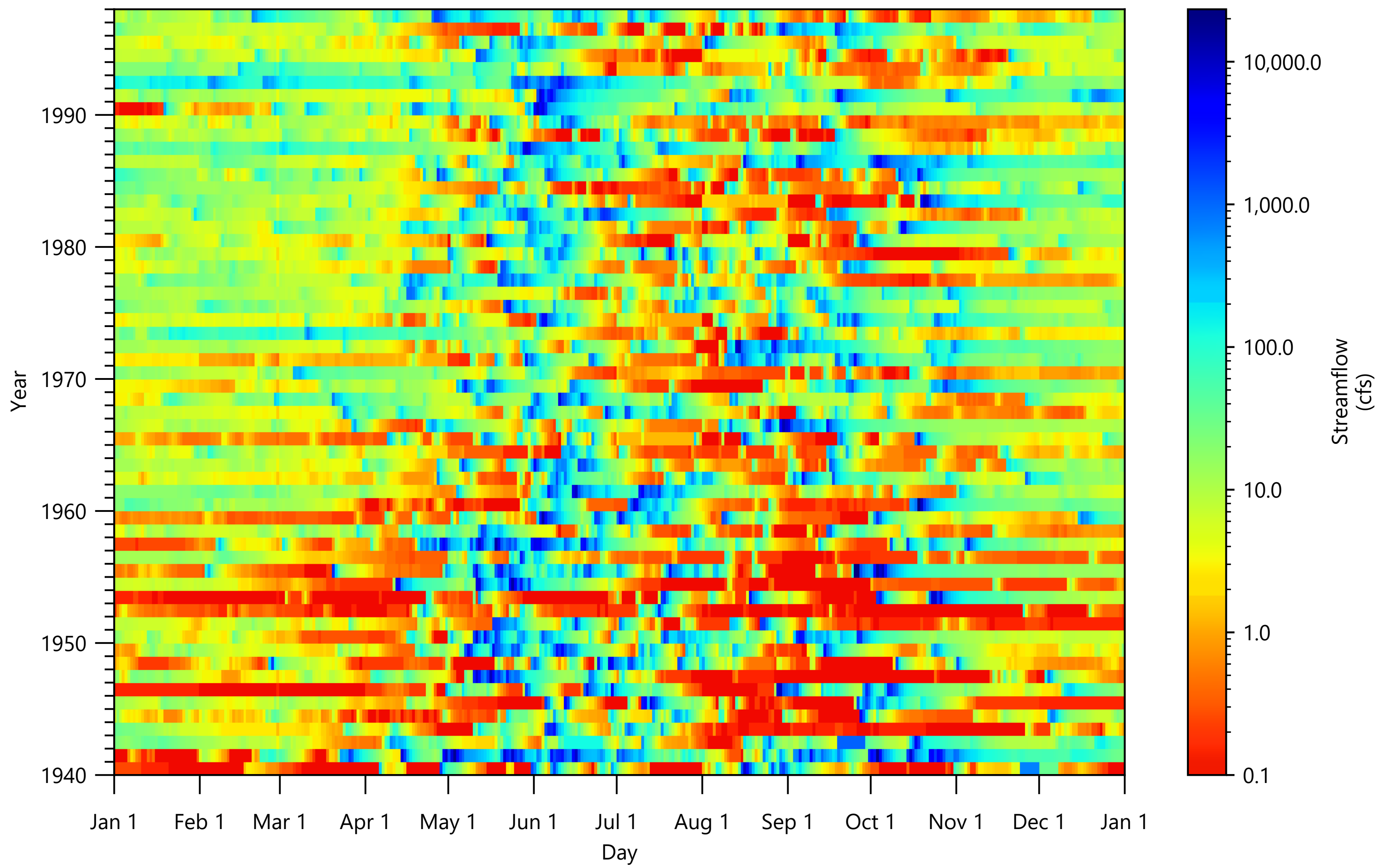
Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains raster hydrographs of modeled flows, as described in Section 2.5.3.2 of the main report.

This appendix contains a total of 112 distinct figures, which are arranged as follows:

- Brazos River basin
  - Figures F-1 through F-76: Flow raster hydrographs for each of the 19 locations and four flow scenarios in the Brazos River basin, grouped by location
- Trinity River basin
  - Figures F-77 through F-92: Flow raster hydrographs for each of the four locations and four flow scenarios in the Trinity River basin, grouped by location
- Neches River basin
  - Figures F-93 through F-112: Flow raster hydrographs for each of the five locations and four flow scenarios in the Neches River basin, grouped by location

In each figure, the color band is scaled from zero flow to the maximum of the model outputs shown in that figure. As a result, the flow corresponding to a given color may change from figure to figure.



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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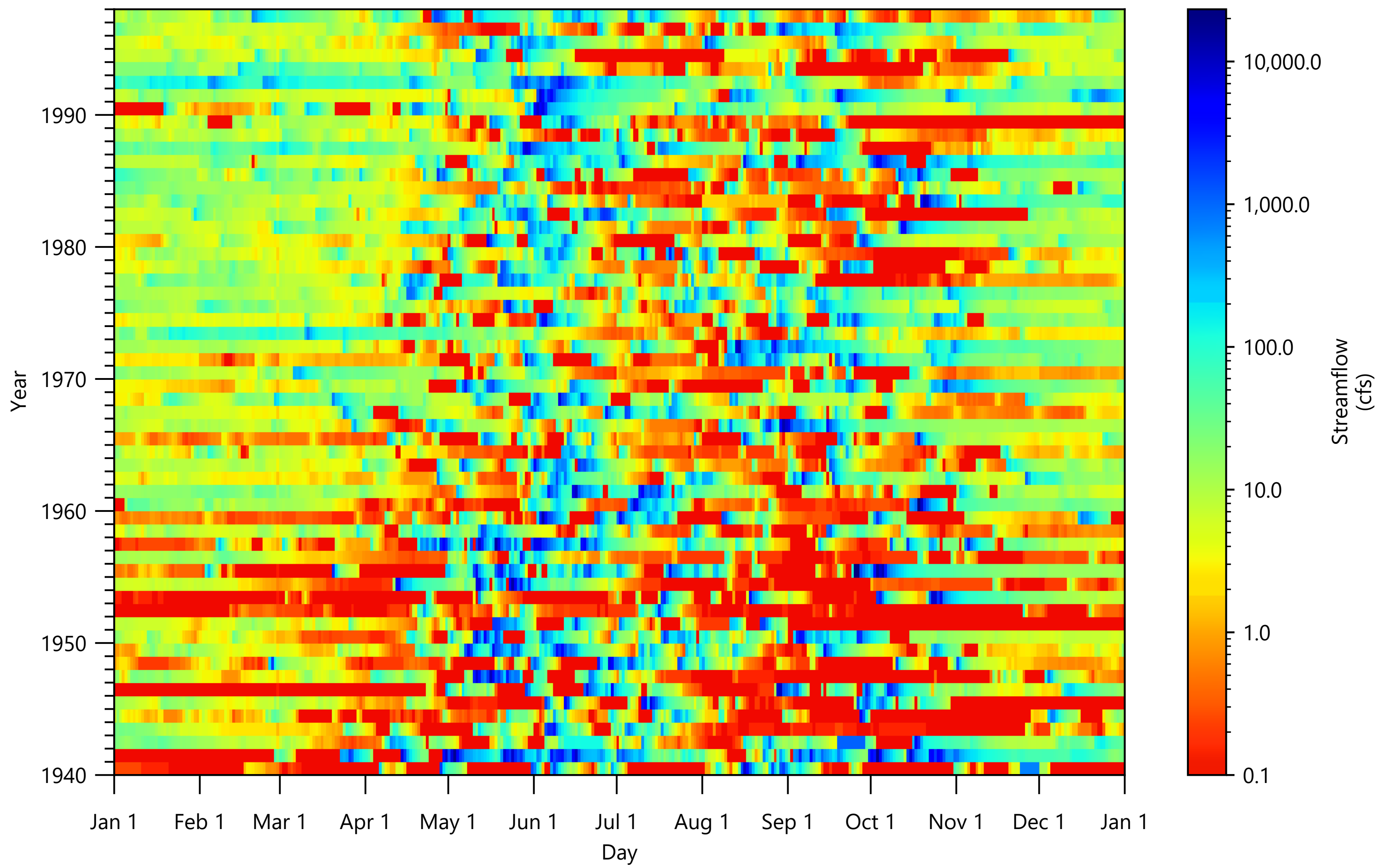
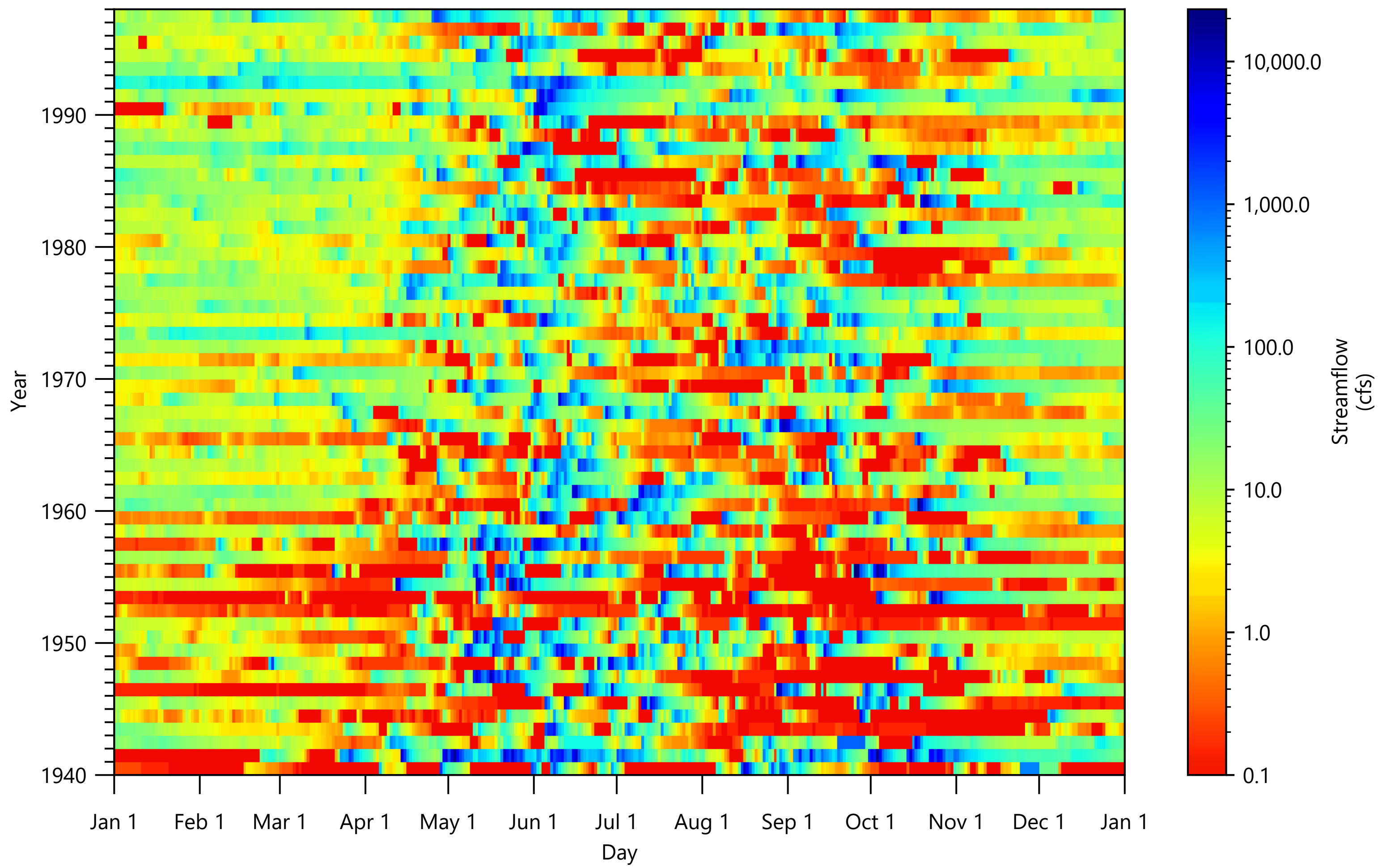
Figure F-1
Salt Fork near Aspermont: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Figure F-2
Salt Fork near Aspermont: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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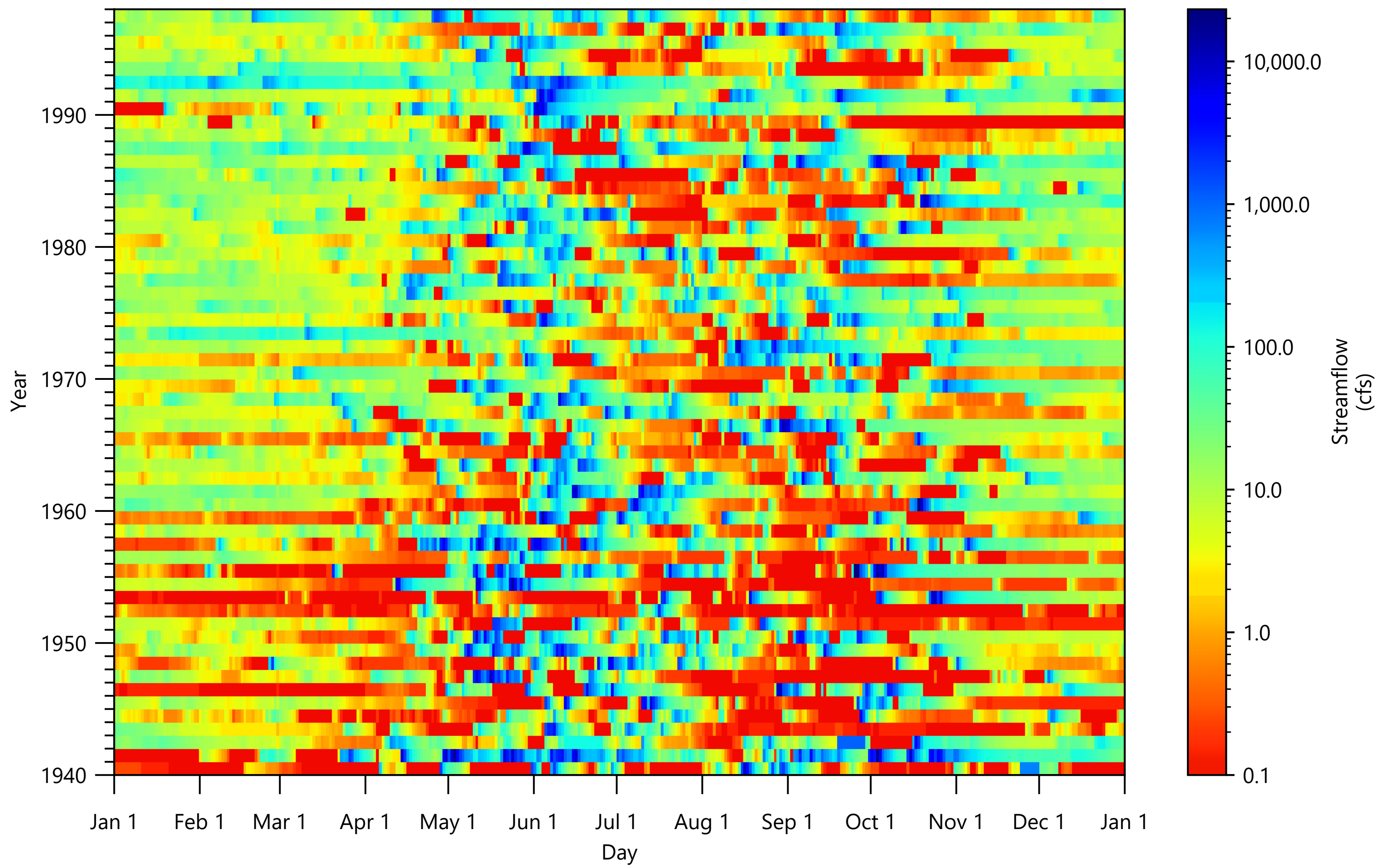
Figure F-3
Salt Fork near Aspermont: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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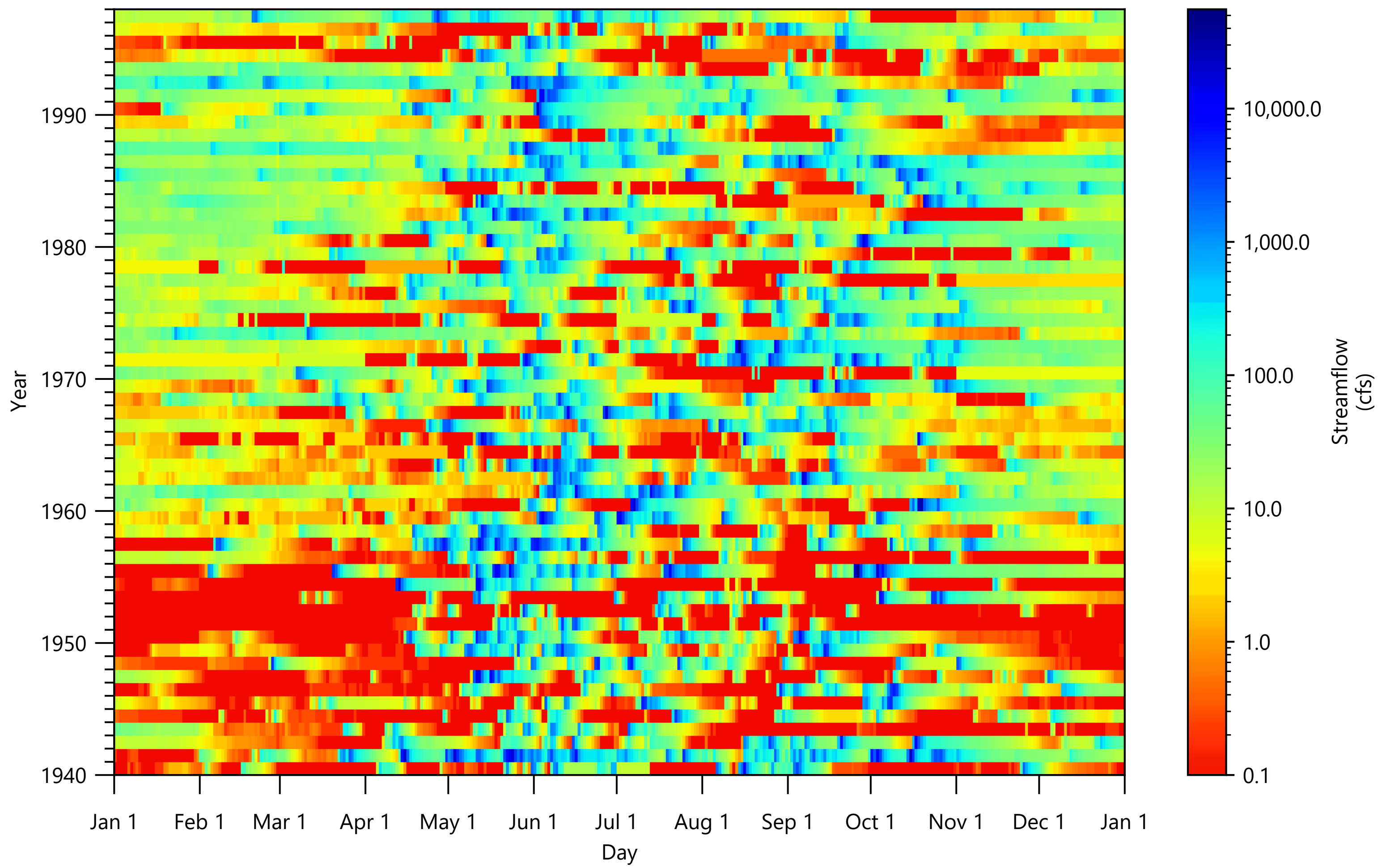
Figure F-4
Salt Fork near Aspermont: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:19 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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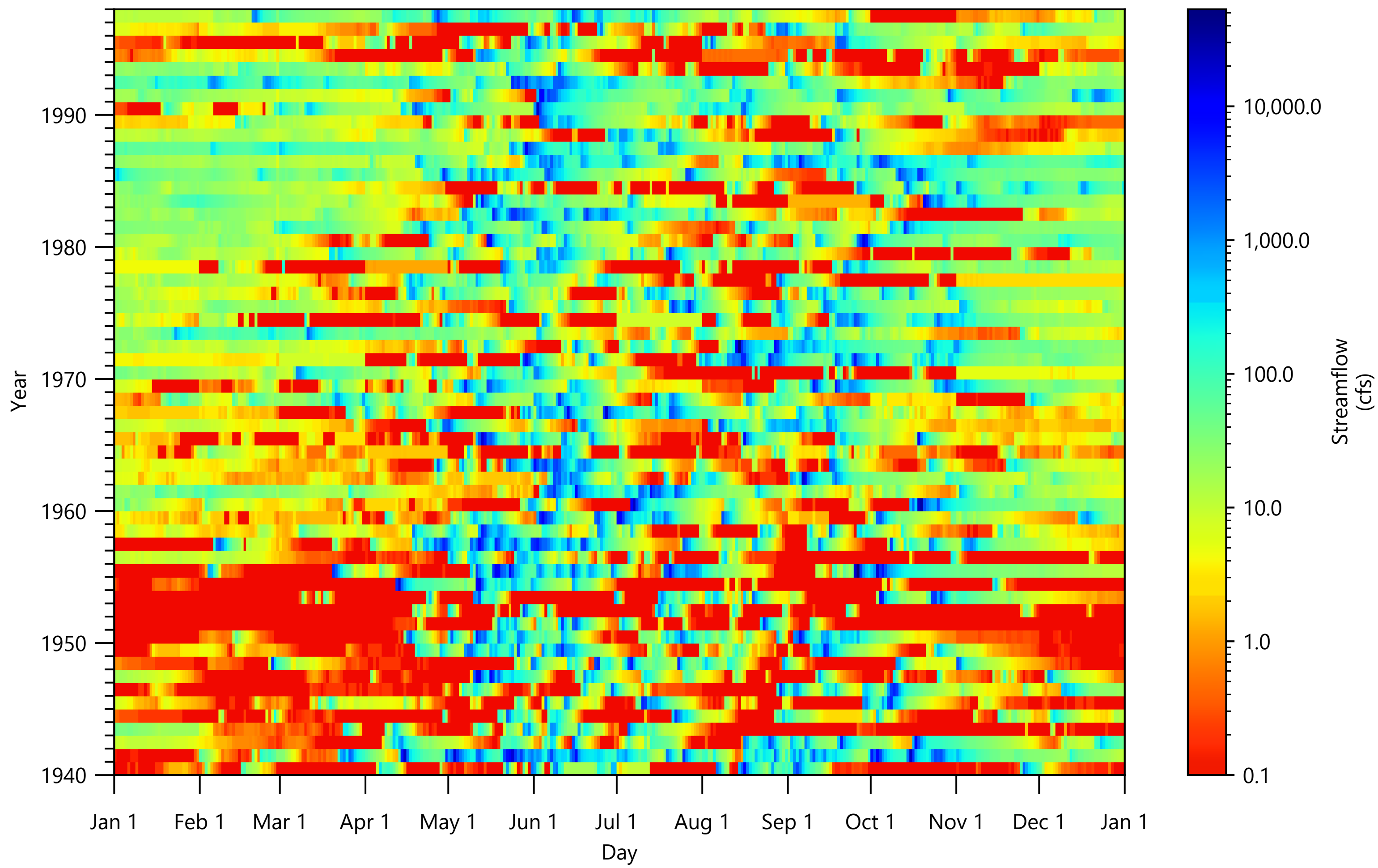
Figure F-5
Double Mountain Fork near Aspermont: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:19 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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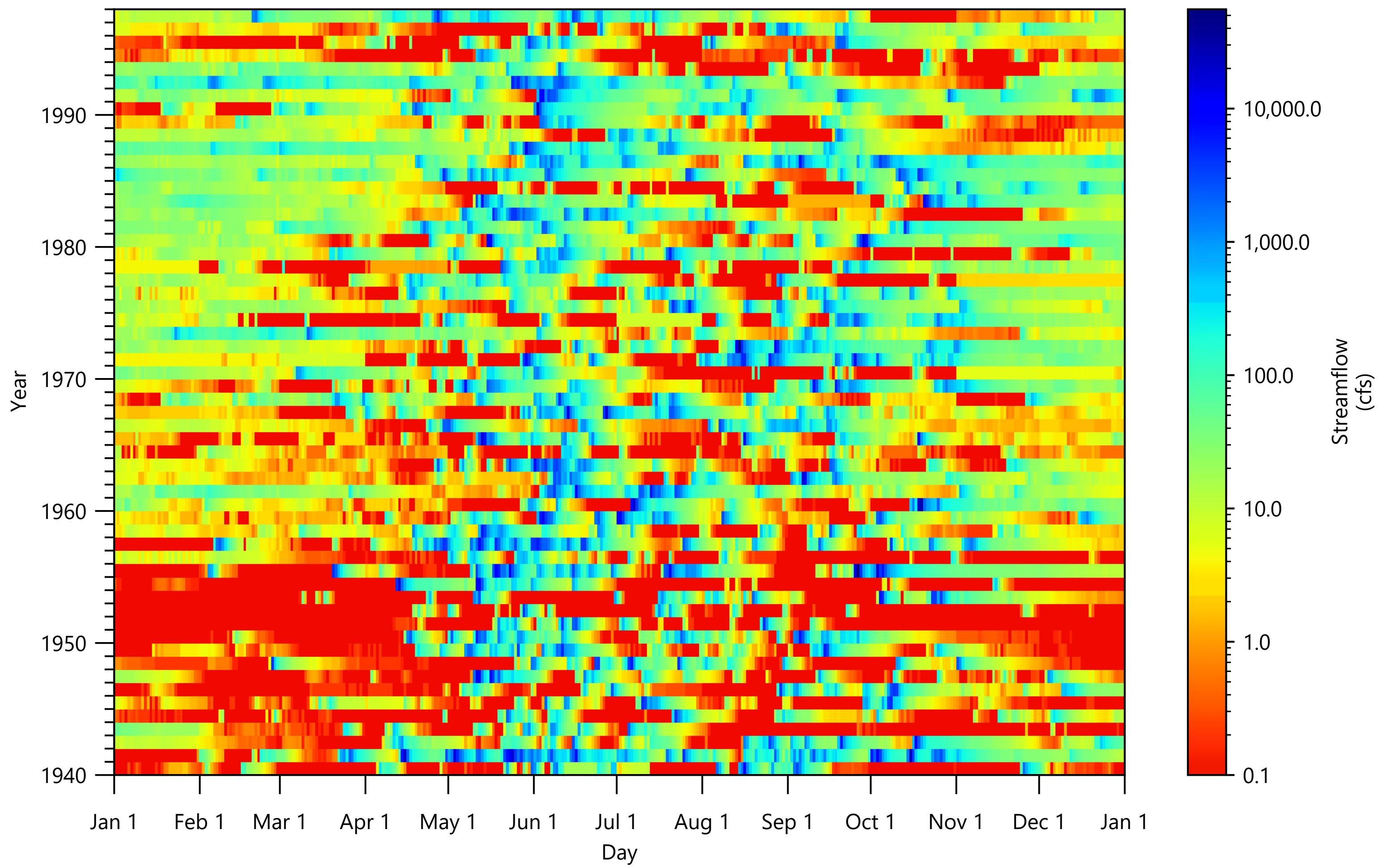
Figure F-6
Double Mountain Fork near Aspermont: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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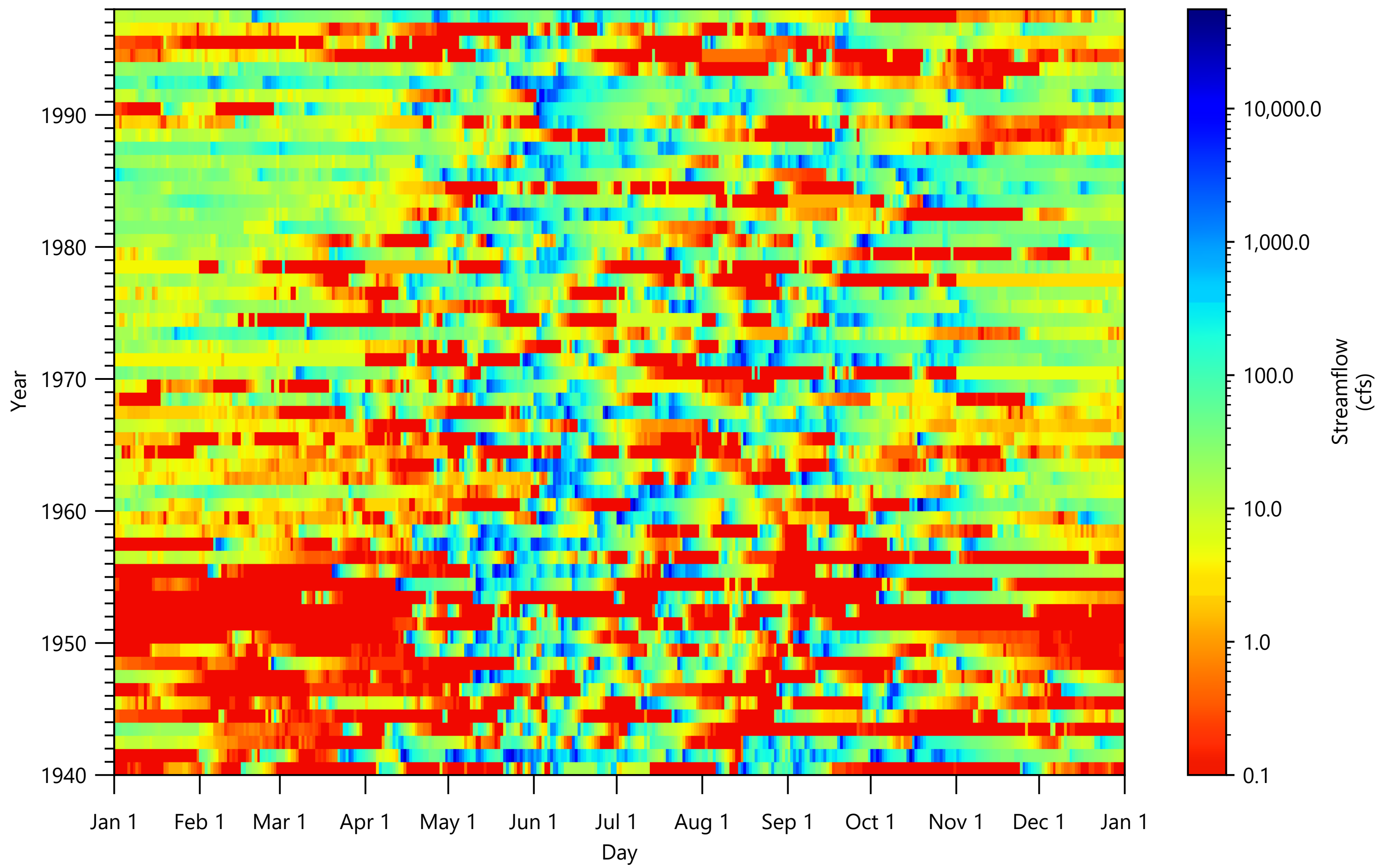
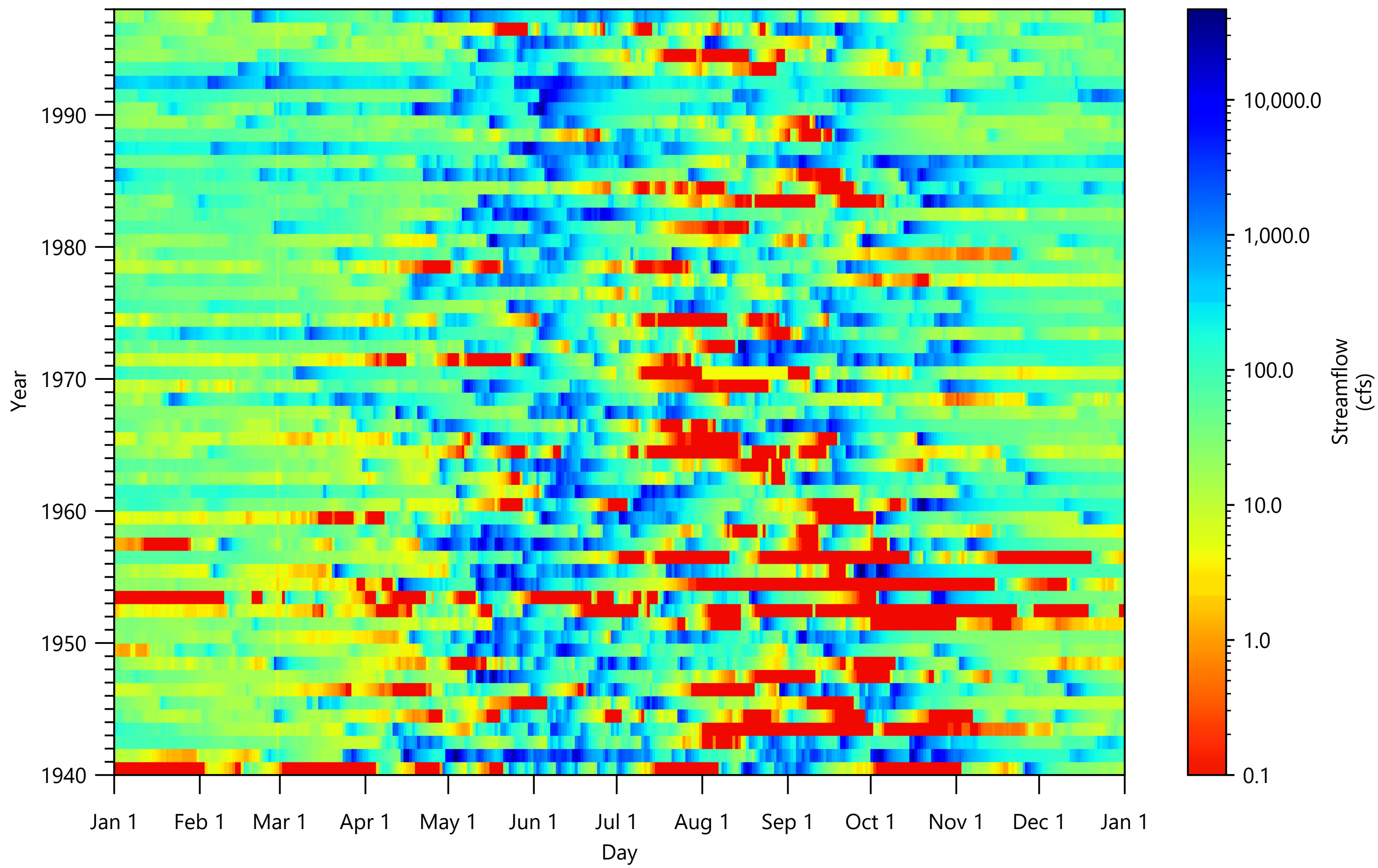
Figure F-7
Double Mountain Fork near Aspermont: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Figure F-8
Double Mountain Fork near Aspermont: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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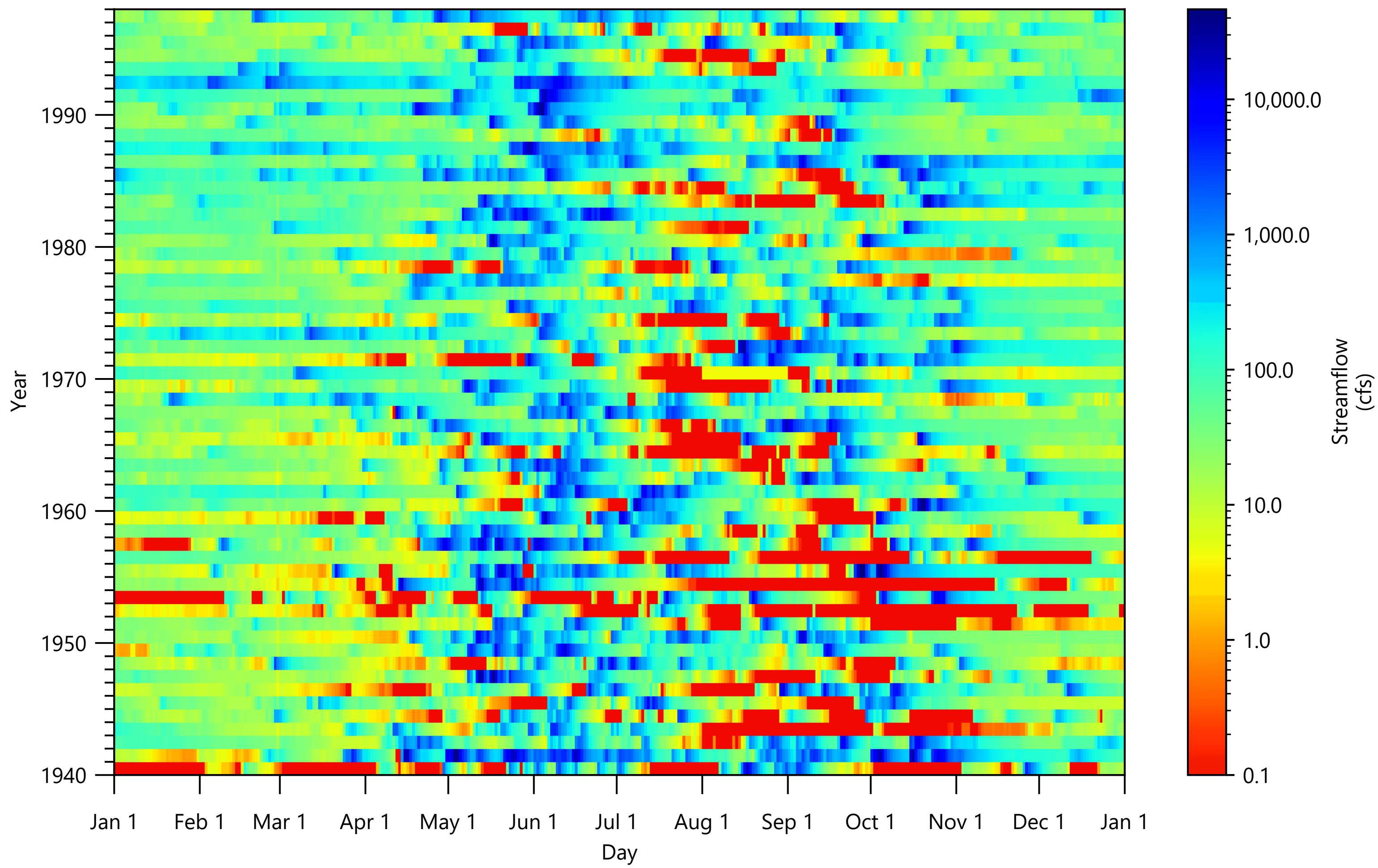
Figure F-9
Brazos River at Seymour: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:20 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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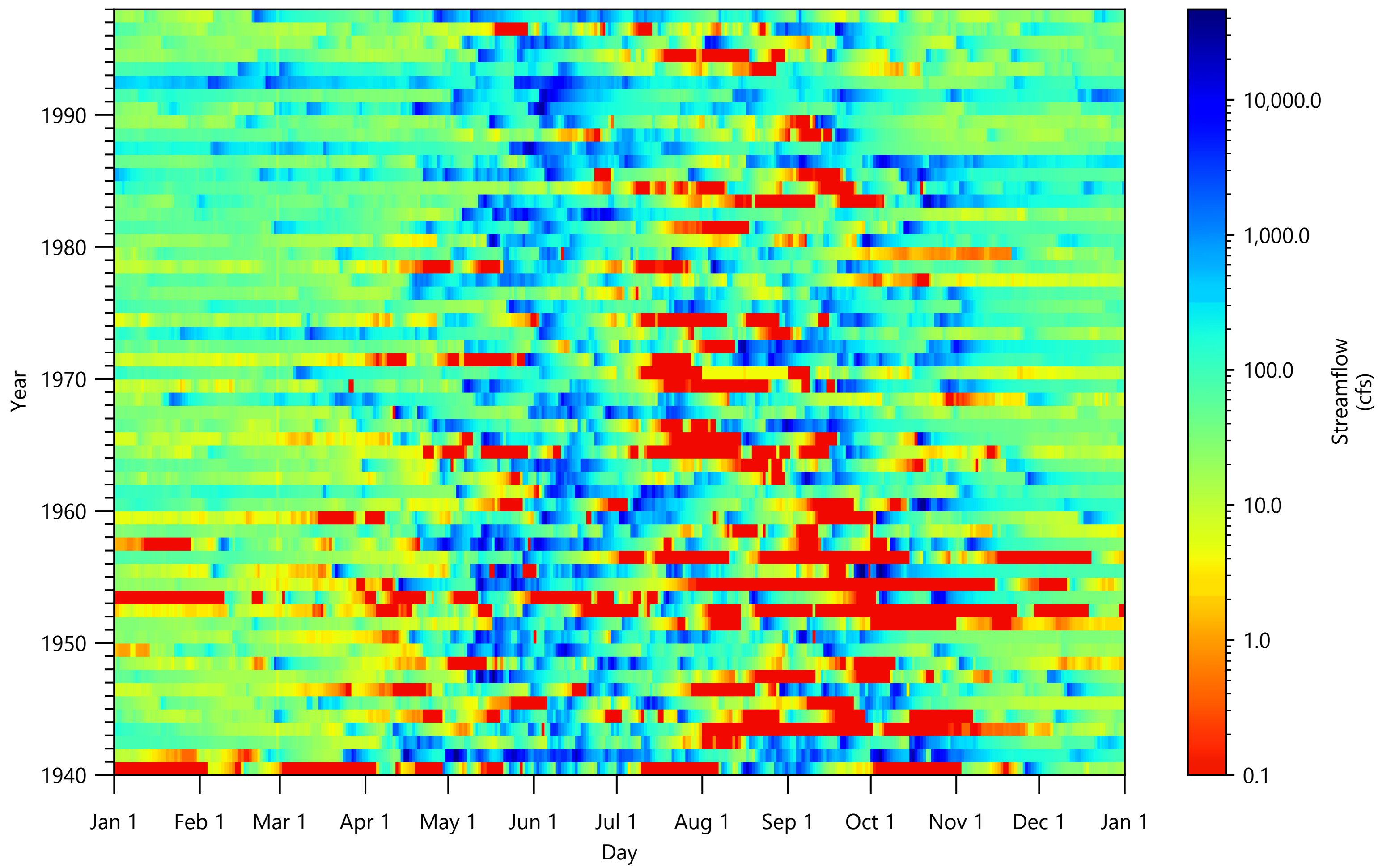
Figure F-10
Brazos River at Seymour: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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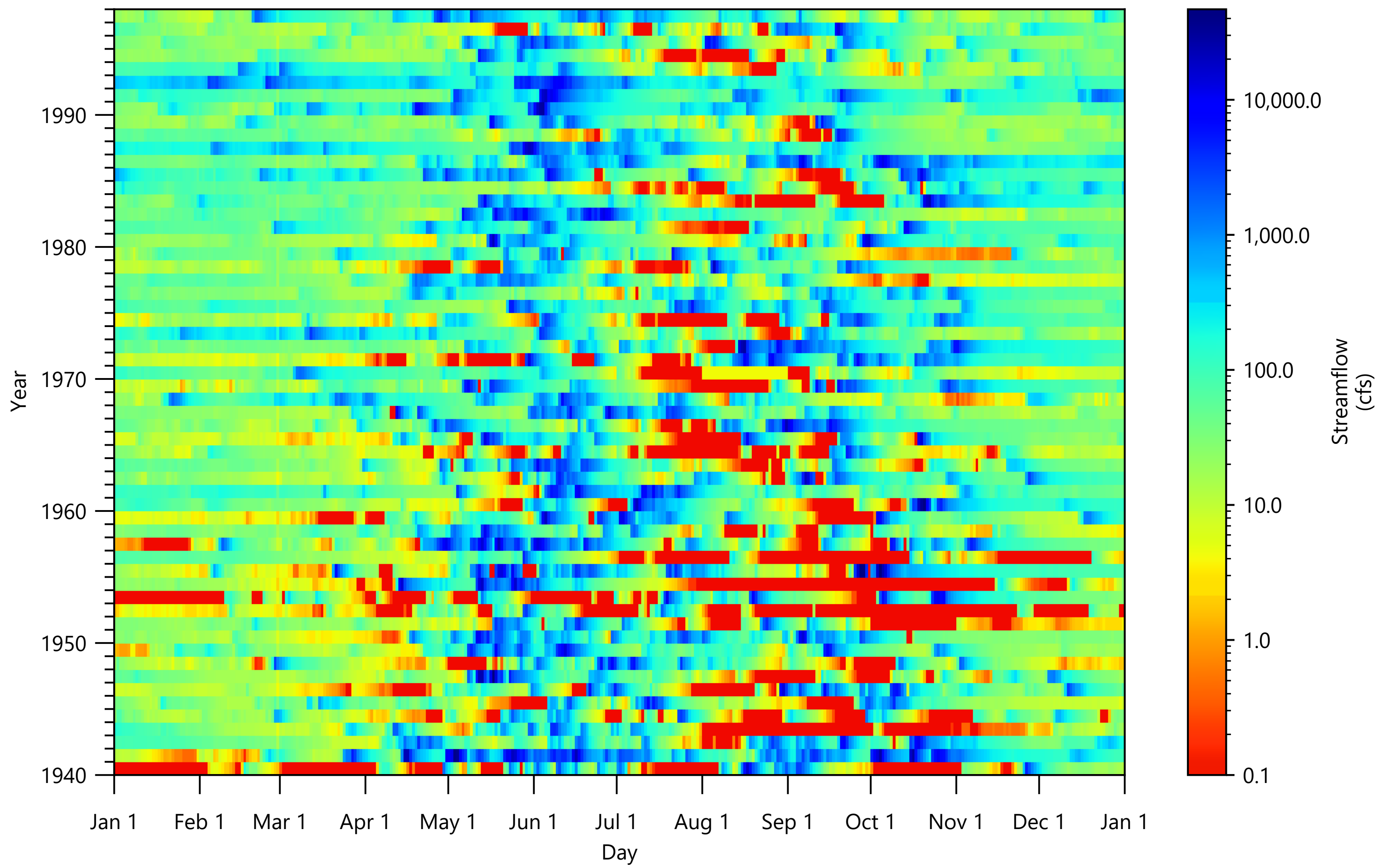
Figure F-11
Brazos River at Seymour: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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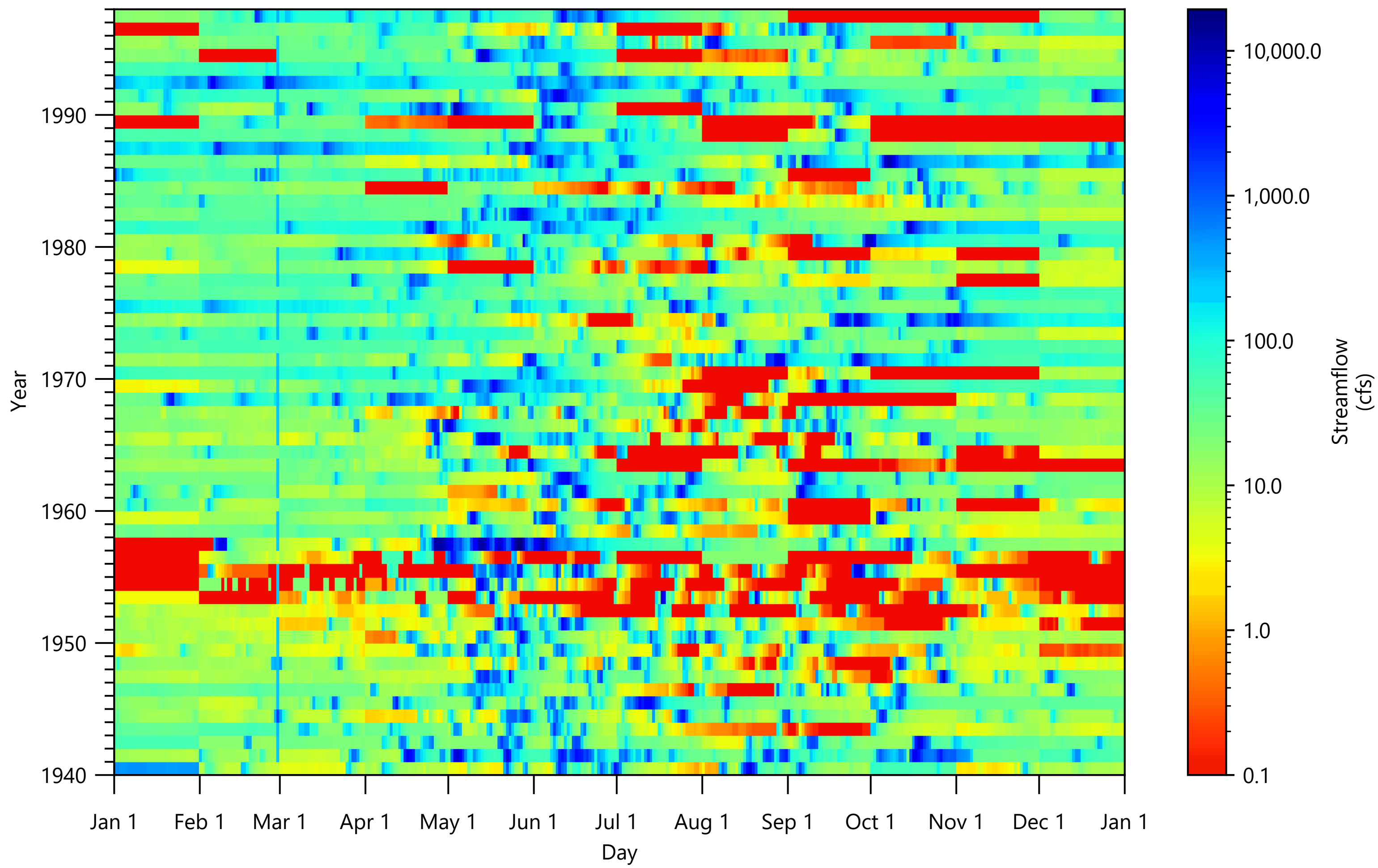
Figure F-12
Brazos River at Seymour: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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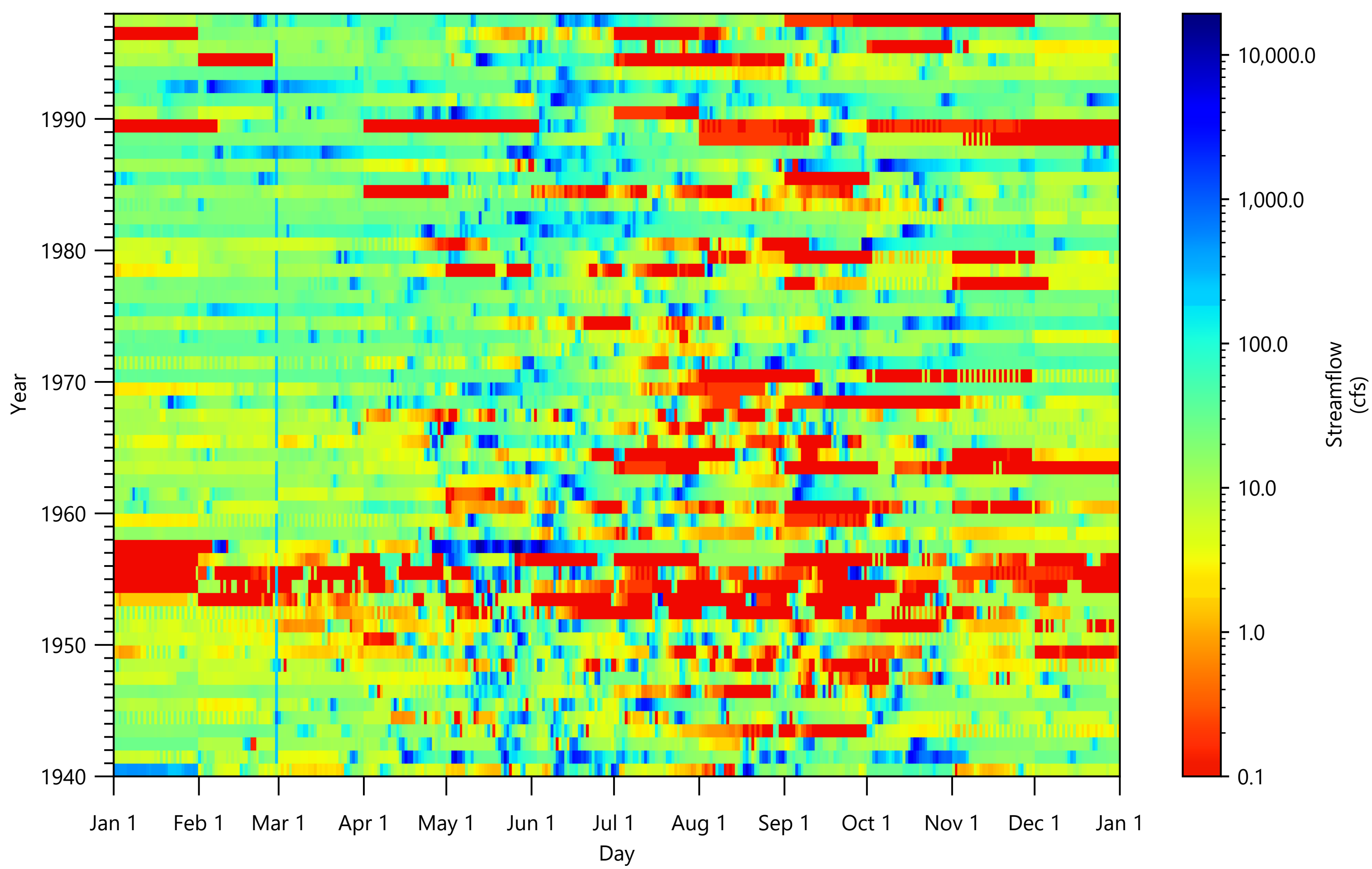
Figure F-13
Clear Fork at Nugent: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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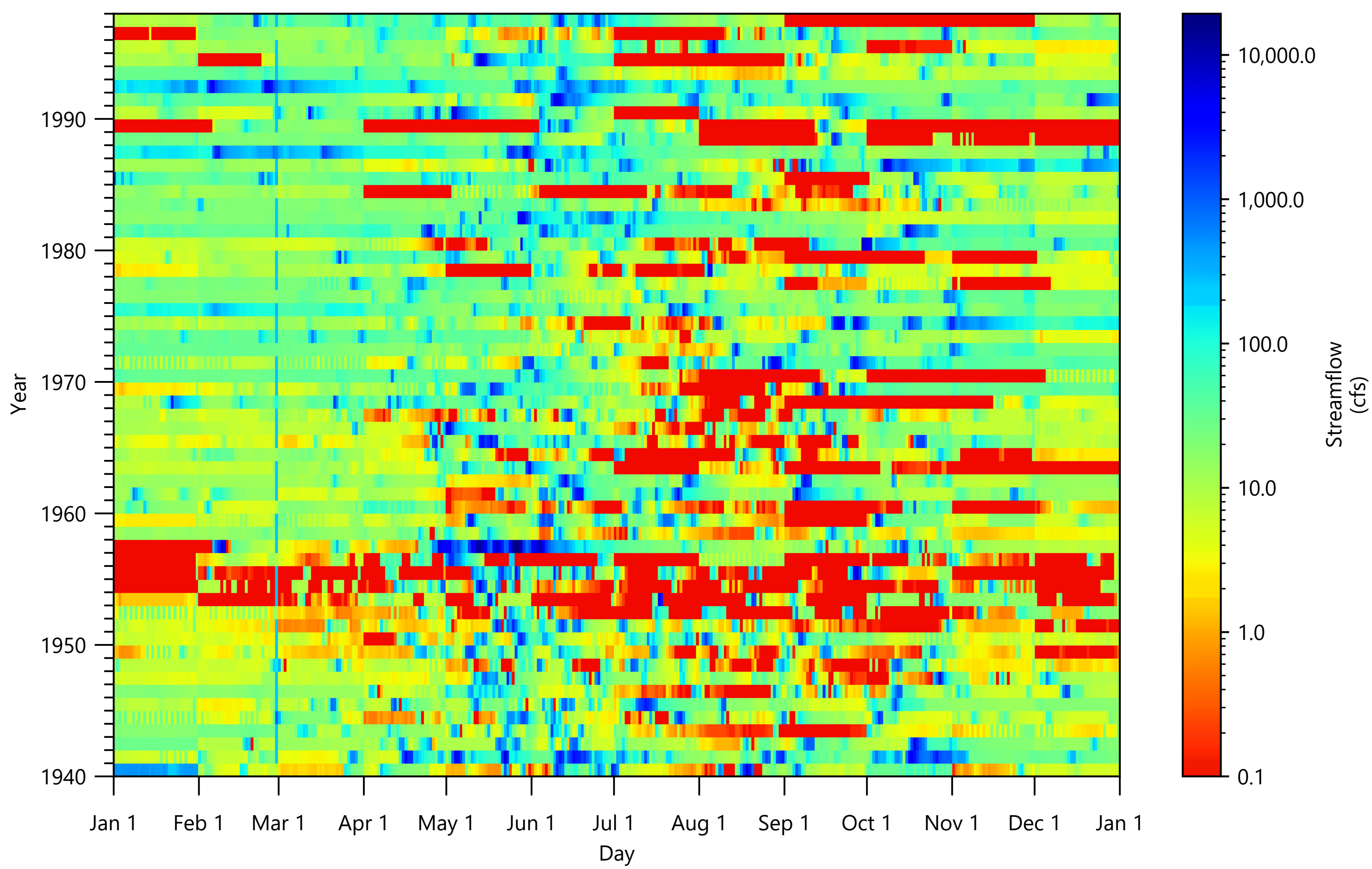
Figure F-14
Clear Fork at Nugent: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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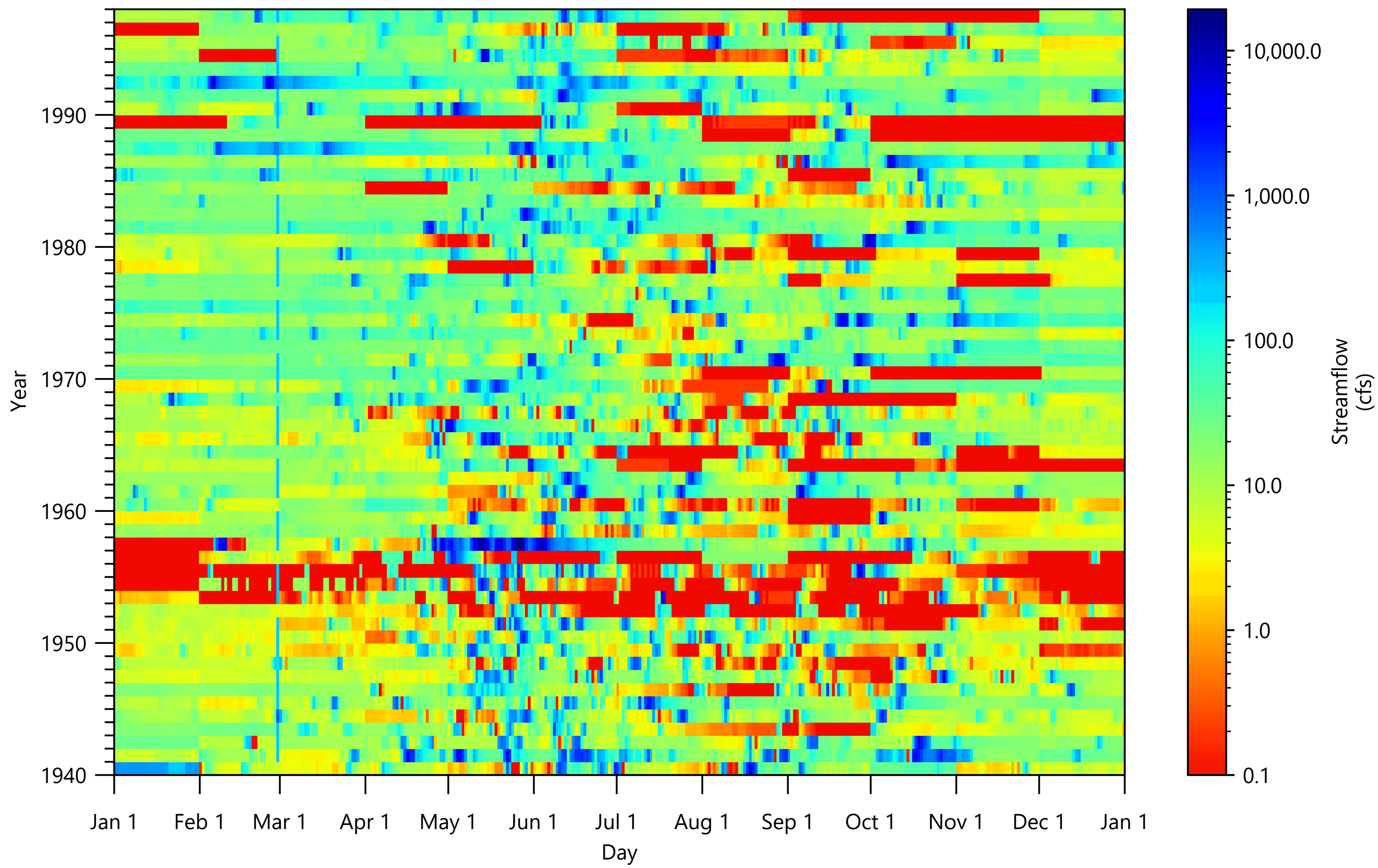
Figure F-15
Clear Fork at Nugent: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:21 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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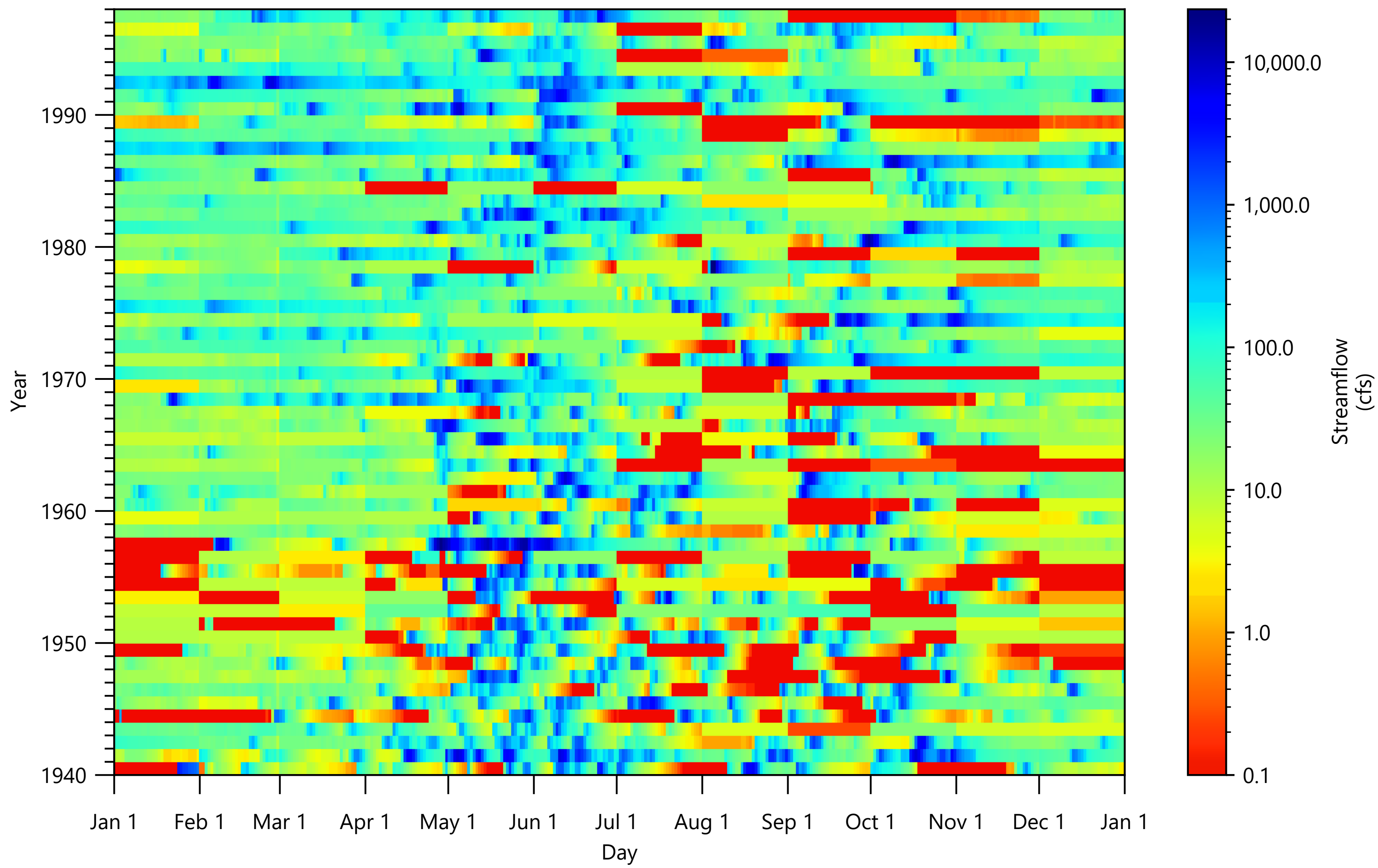
Figure F-16
Clear Fork at Nugent: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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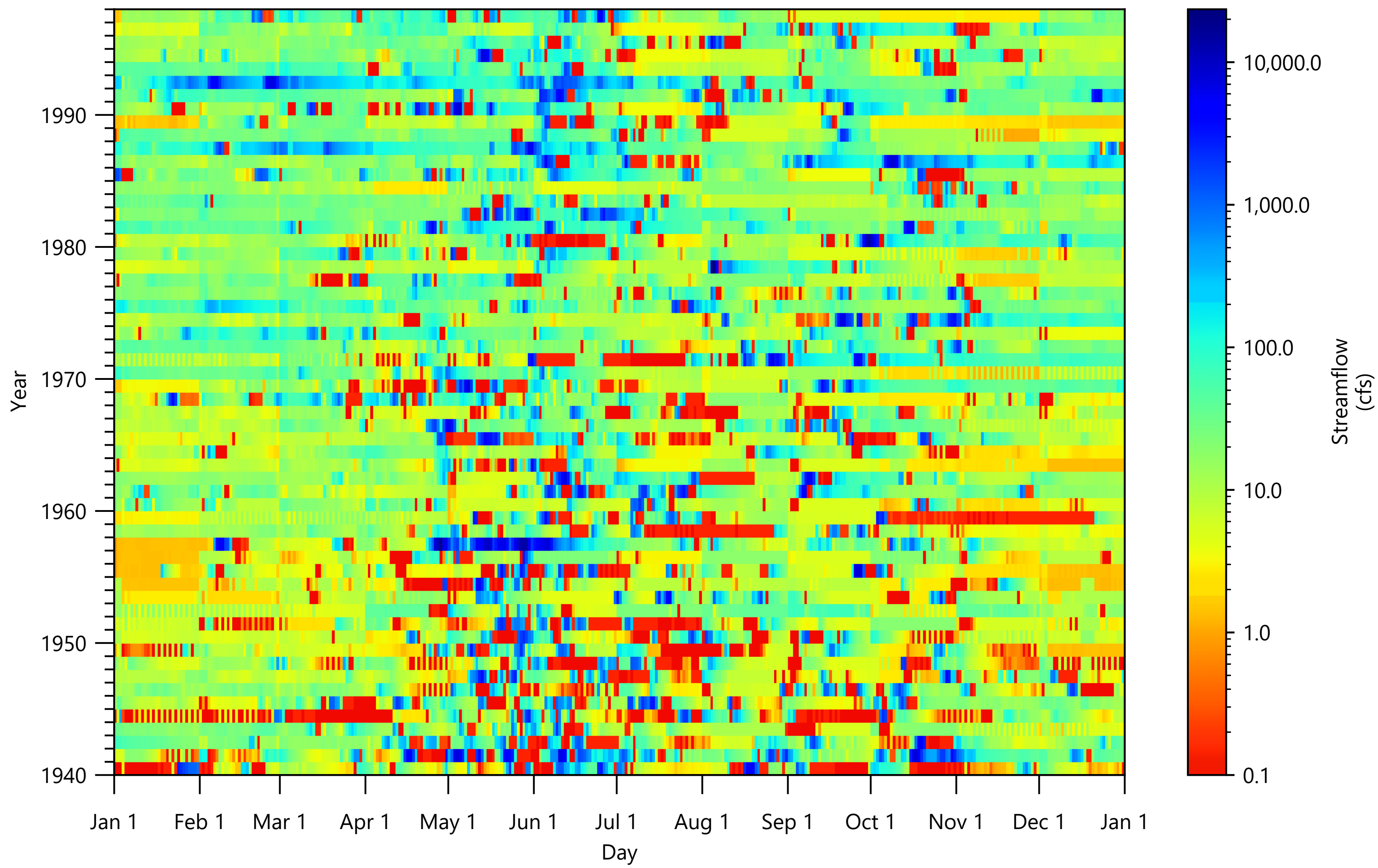
Figure F-17
Clear Fork at Lueders: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

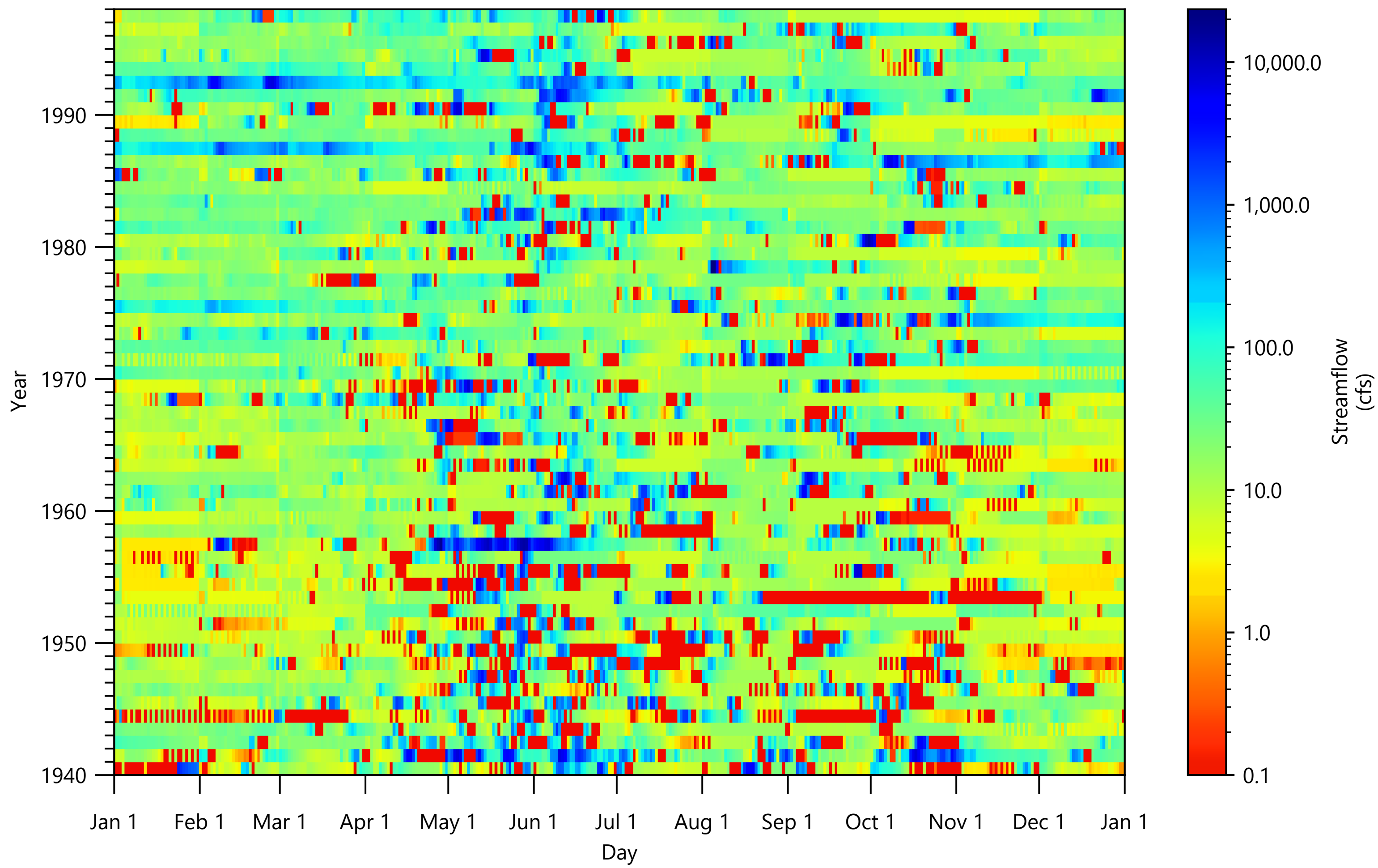


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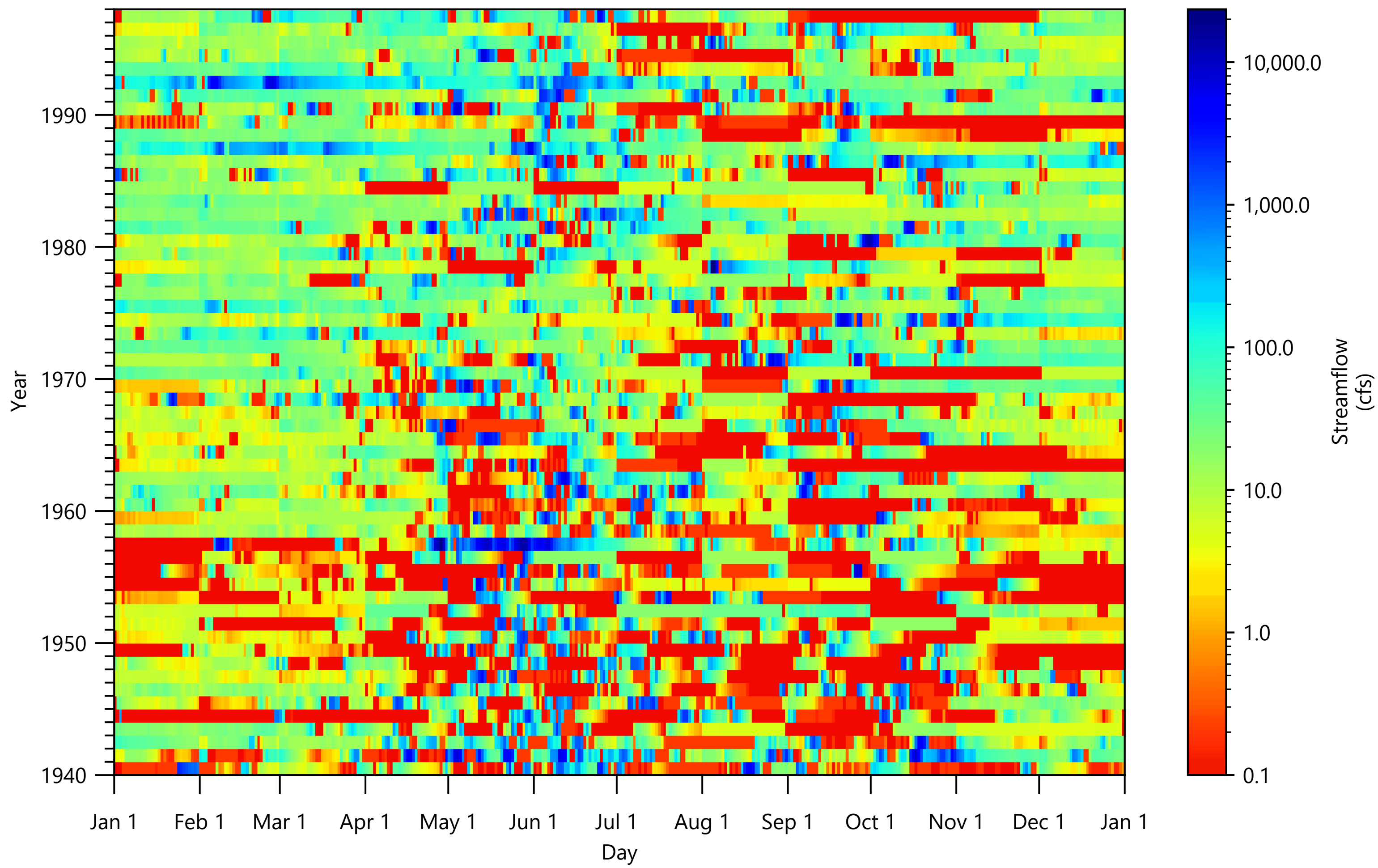
Figure F-19
Clear Fork at Lueders: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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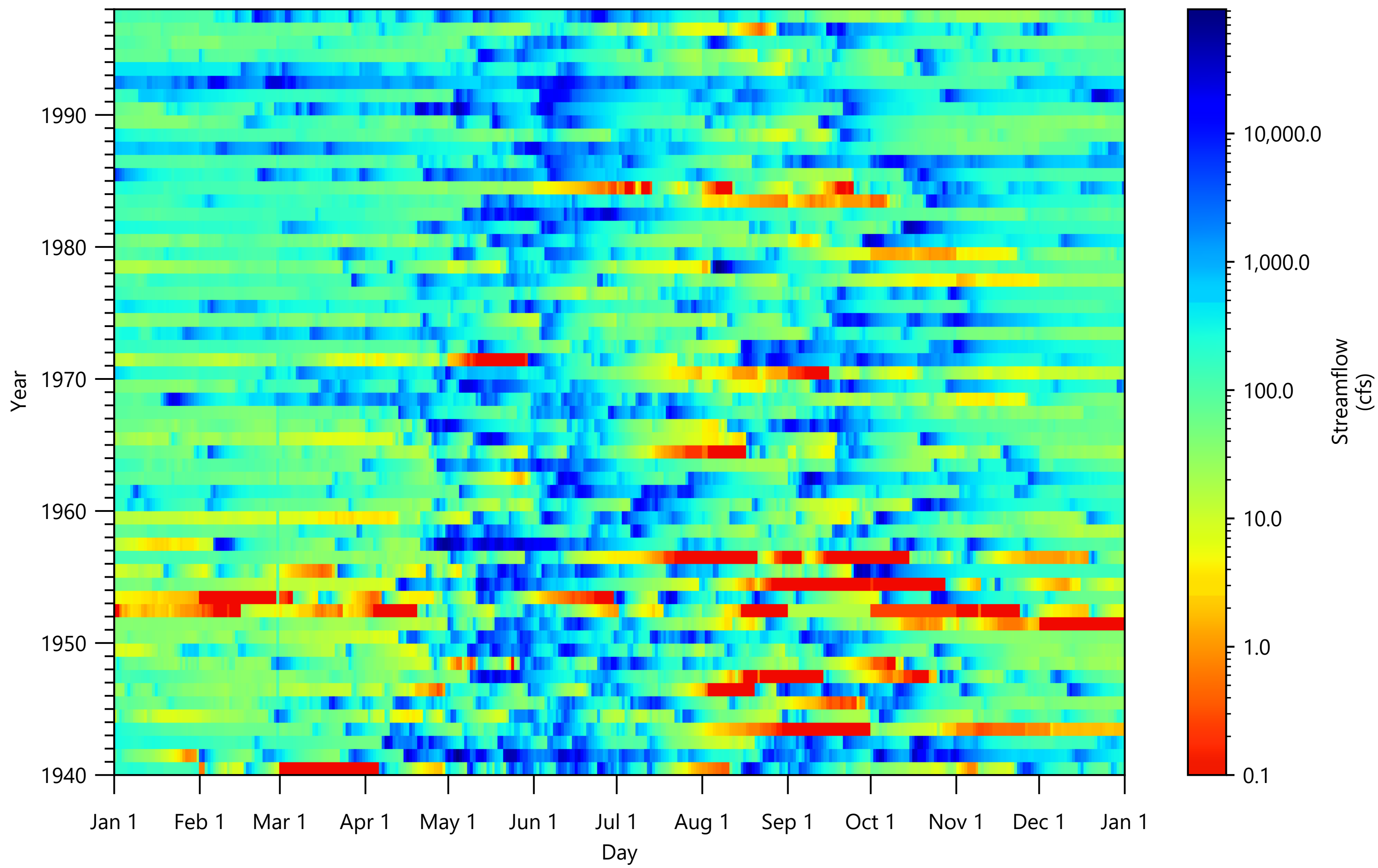
Figure F-20
Clear Fork at Lueders: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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Figure F-21
Brazos River near South Bend: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

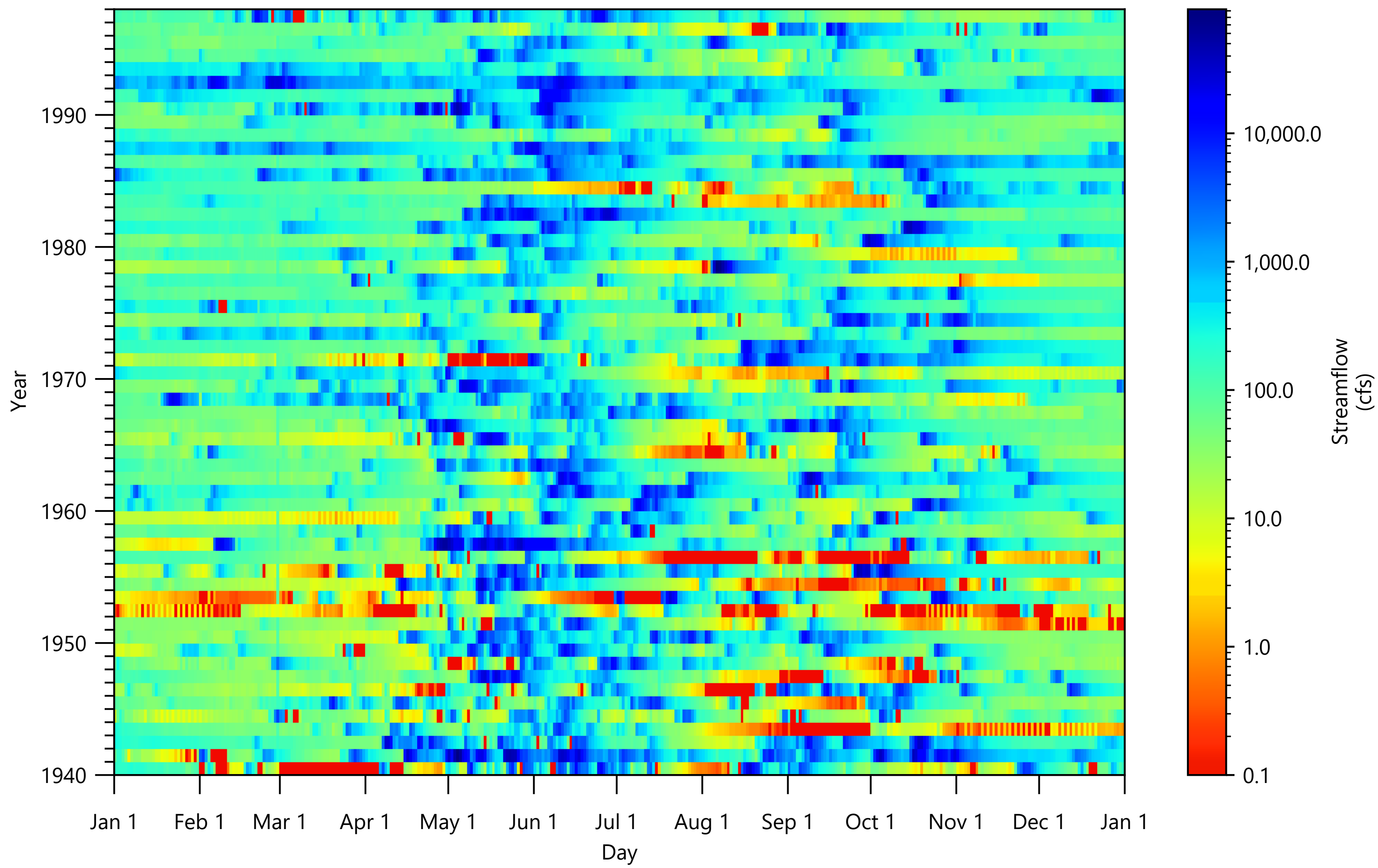

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Figure F-22
Brazos River near South Bend: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

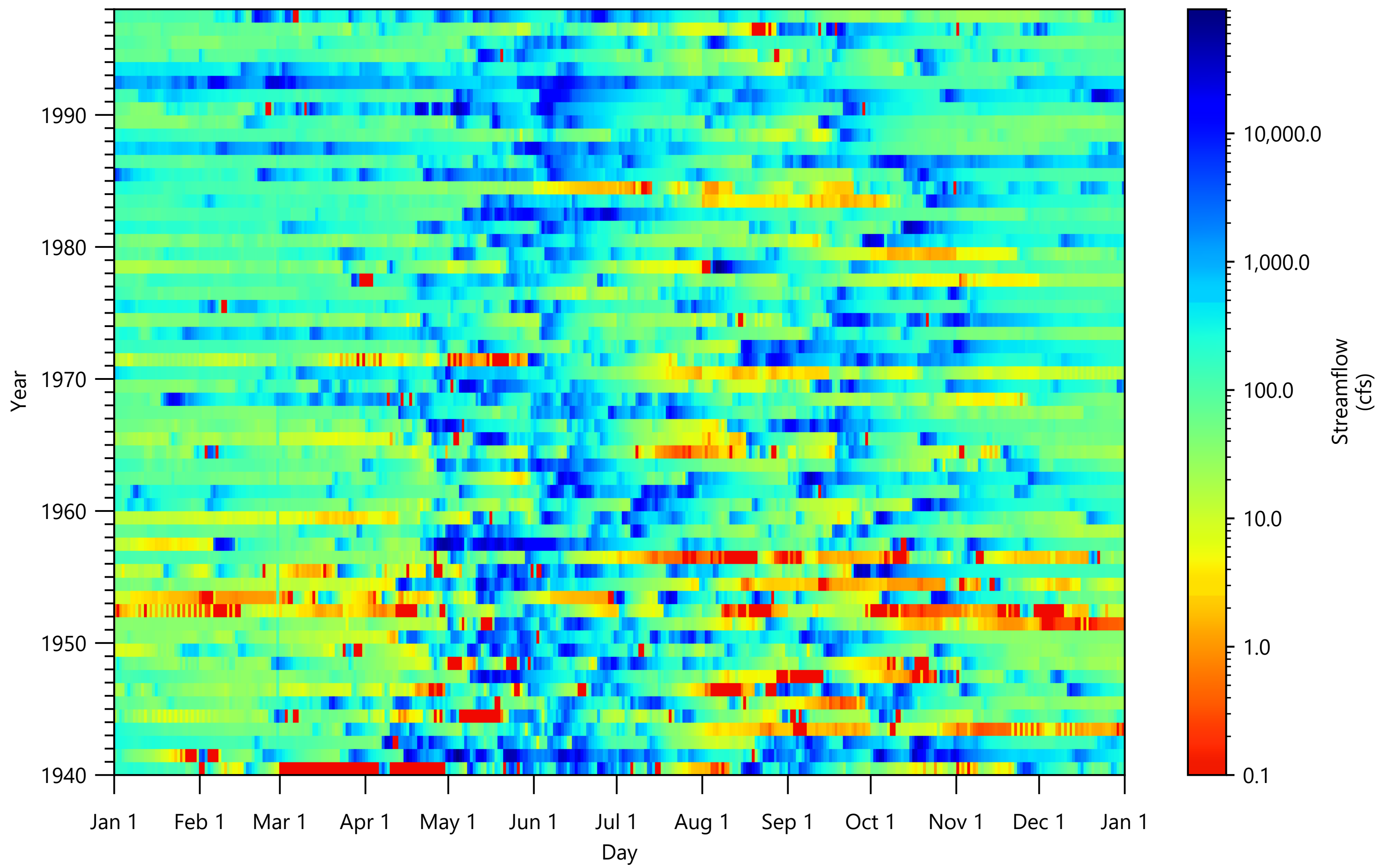

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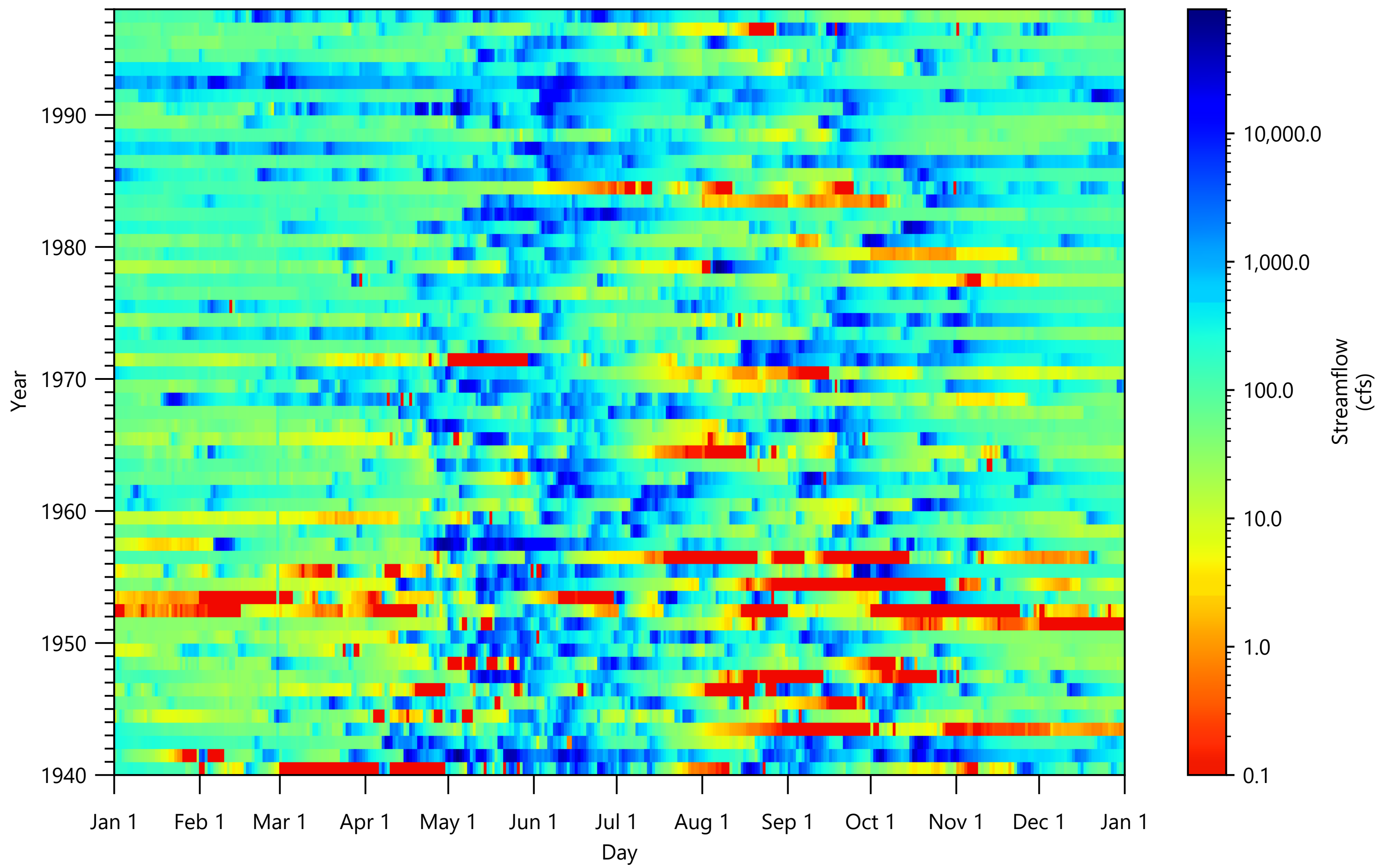
Figure F-23
Brazos River near South Bend: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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Figure F-24
Brazos River near South Bend: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

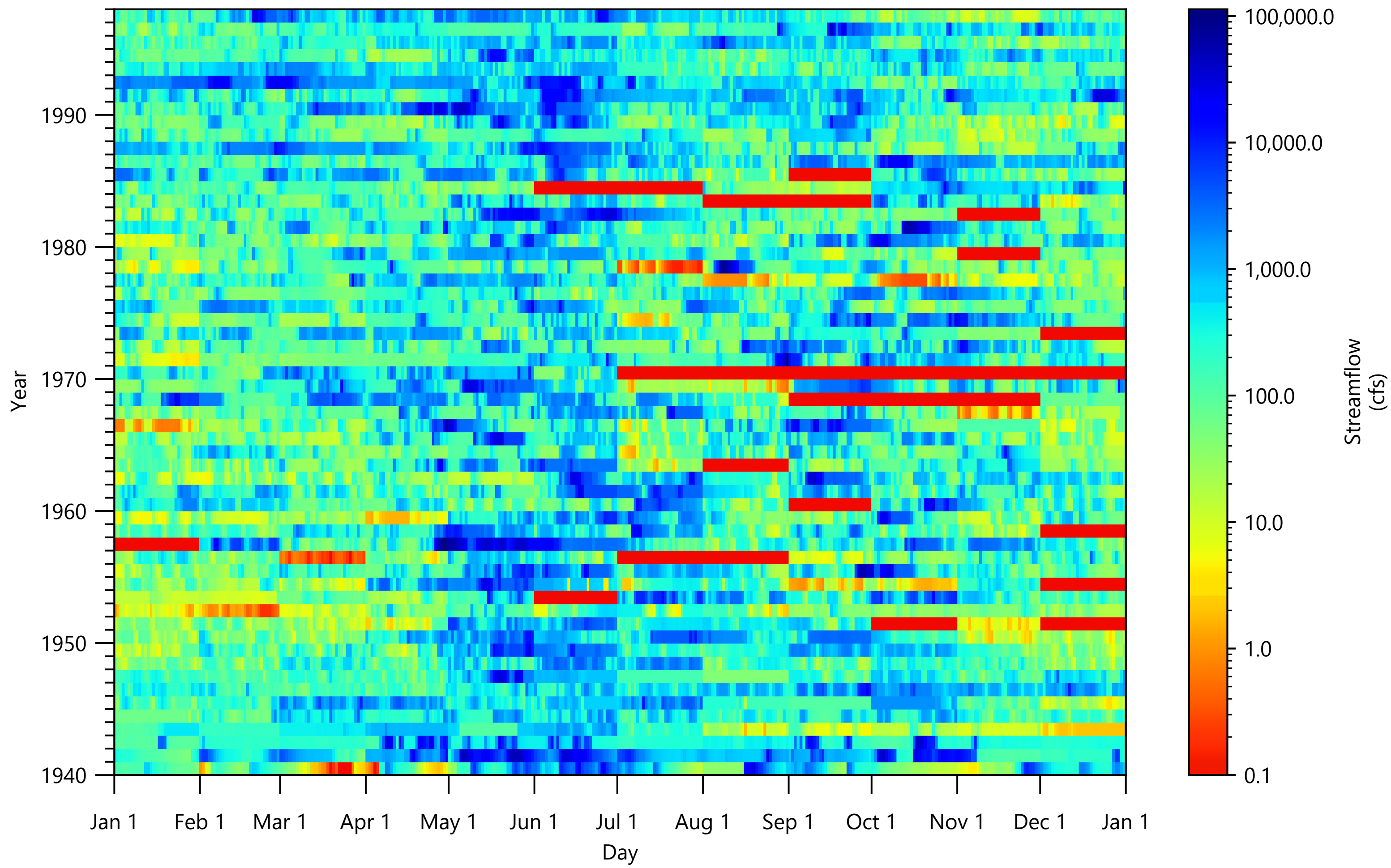

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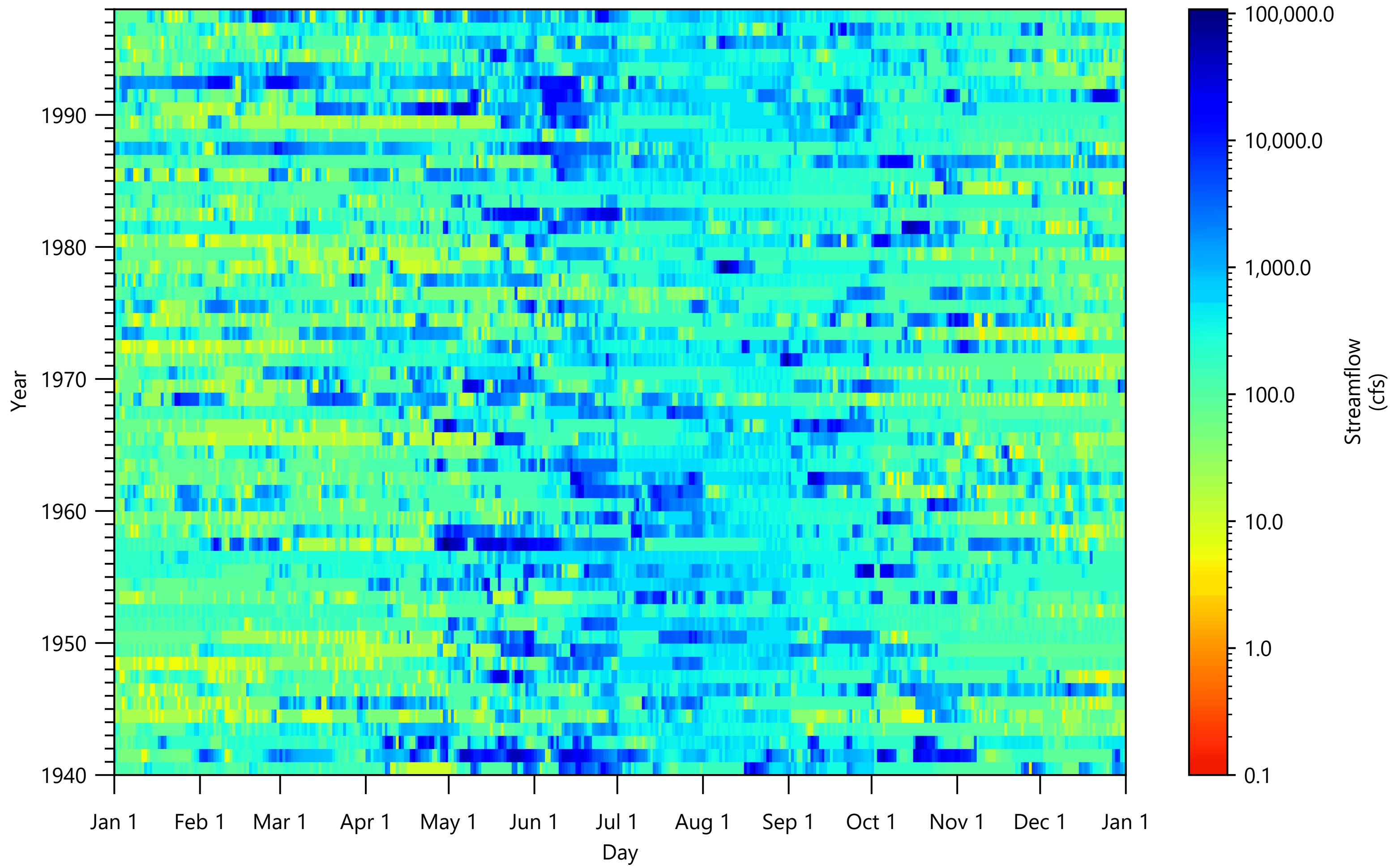
Figure F-25
Brazos River near Palo Pinto: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



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Publish Date: 08/15/2021 14:22 PM | User: JH
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Figure F-26
Brazos River near Palo Pinto: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

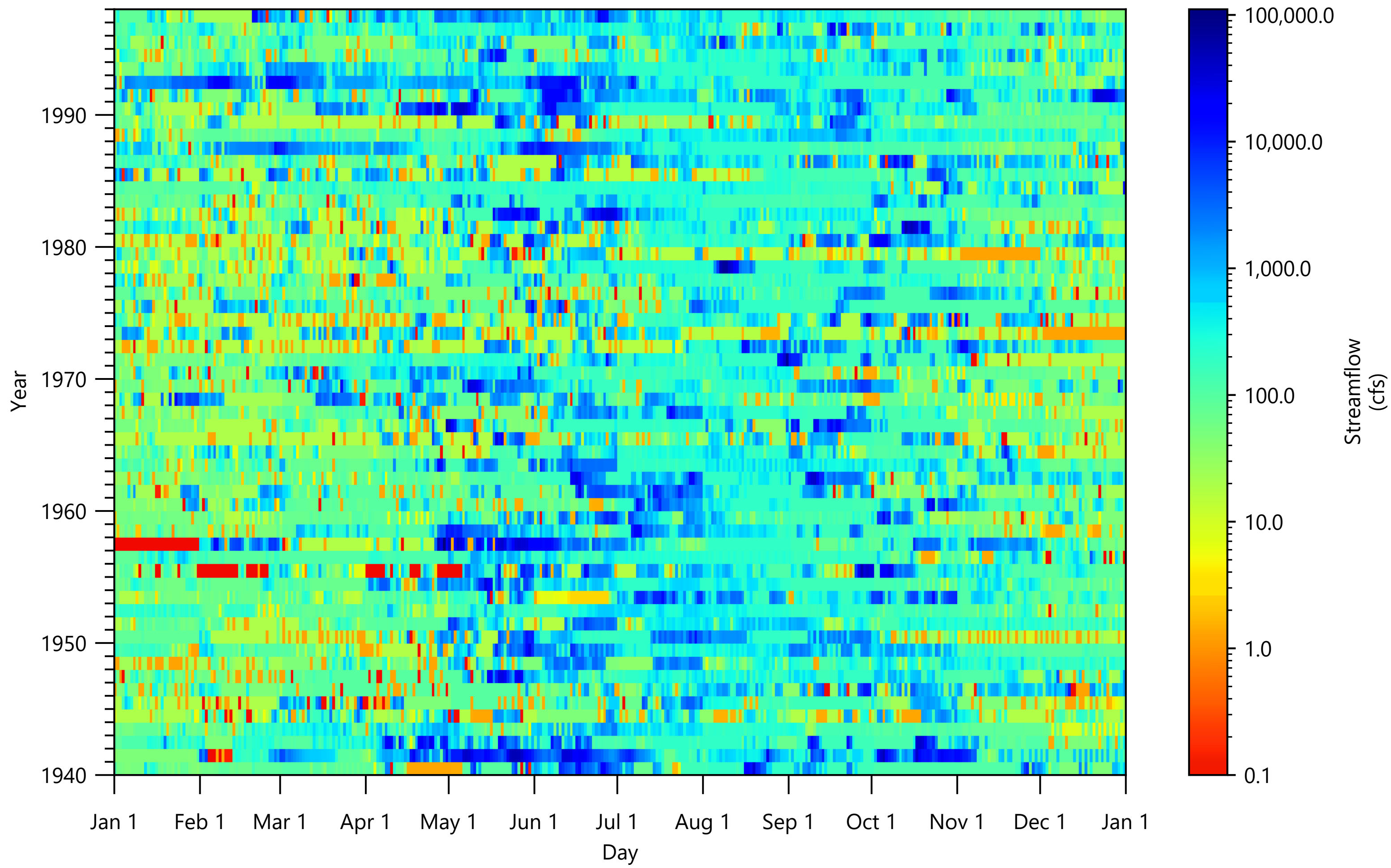

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Figure F-27
Brazos River near Palo Pinto: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

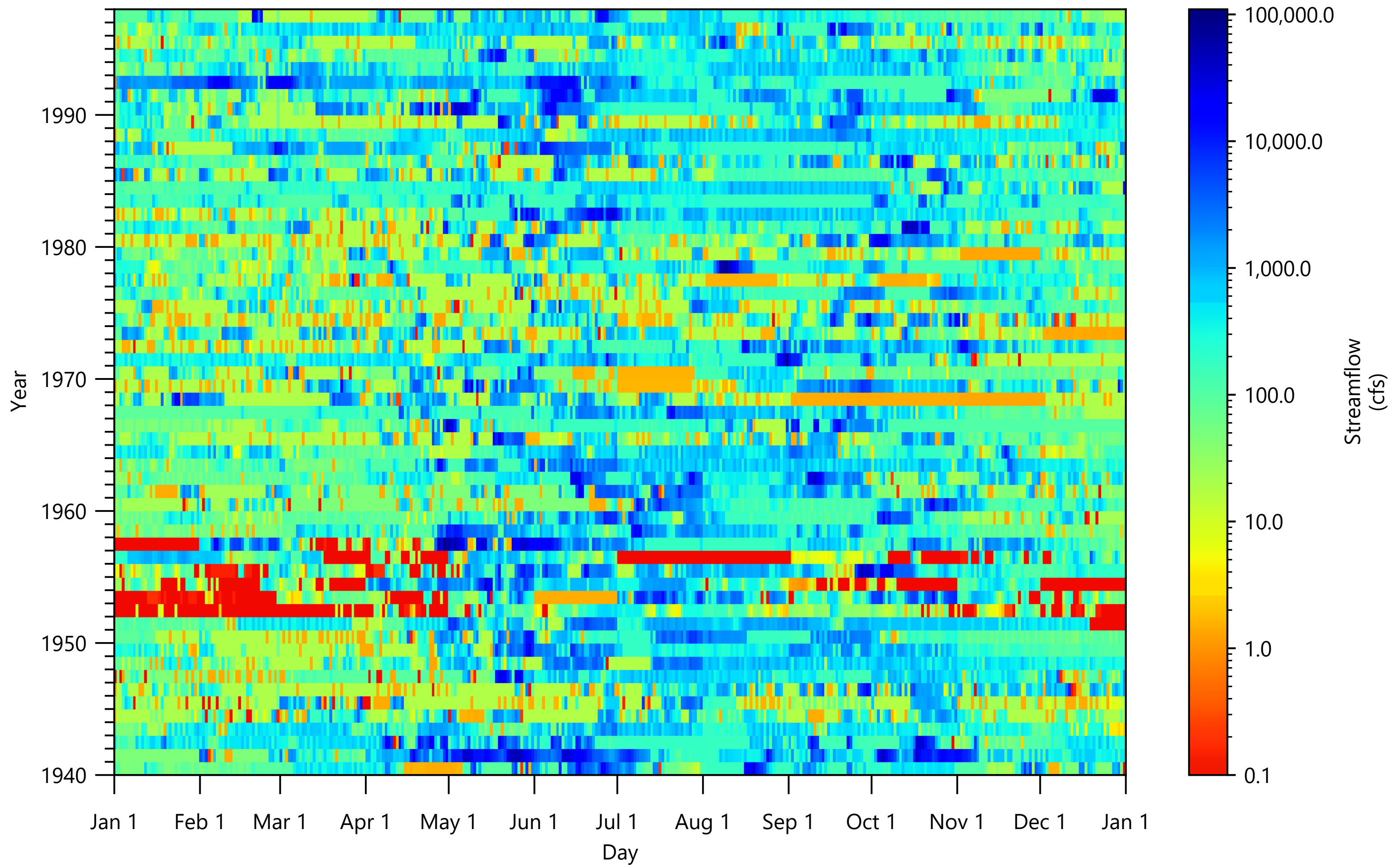

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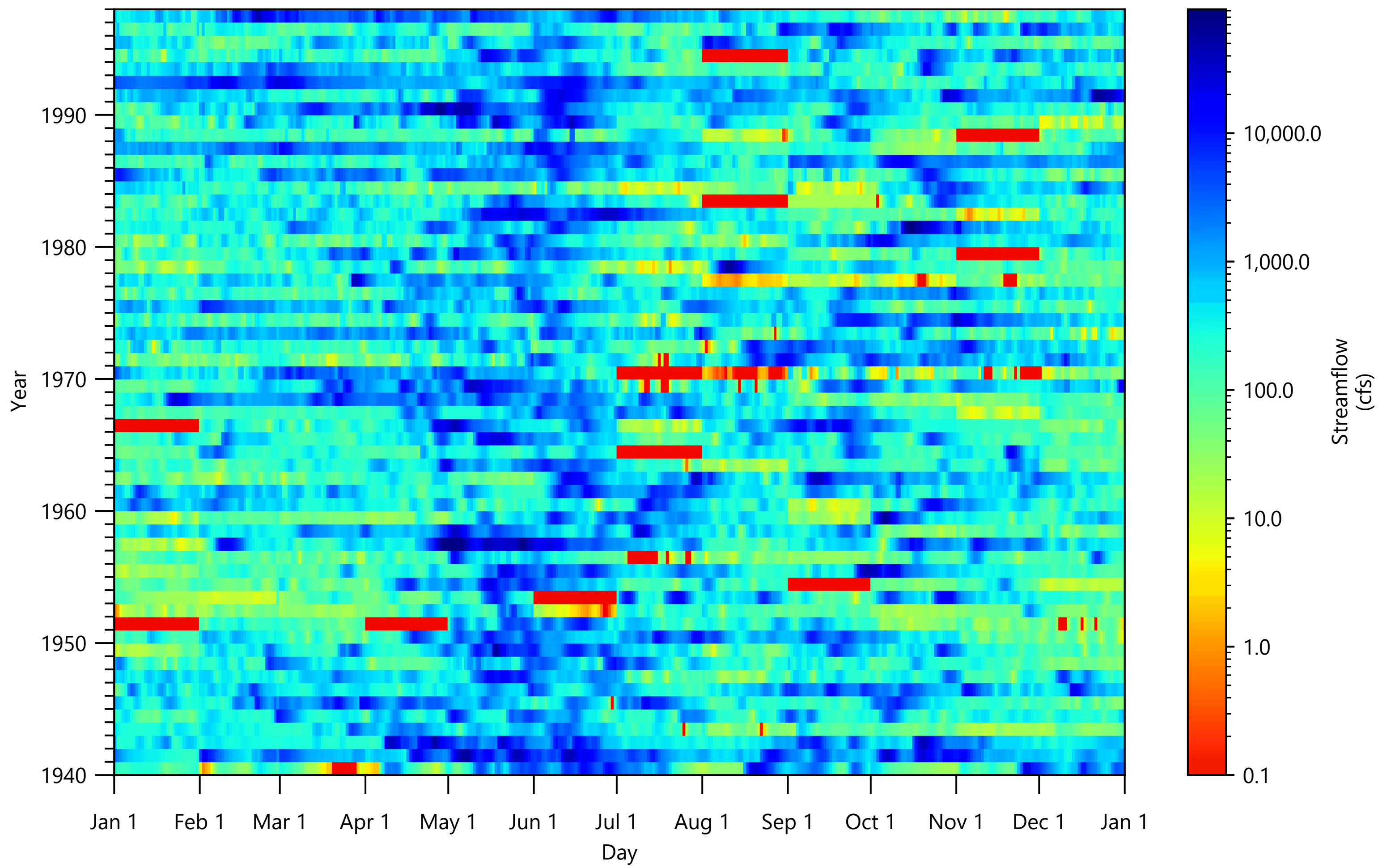
Figure F-28
Brazos River near Palo Pinto: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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Figure F-29
Brazos River near Glen Rose: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

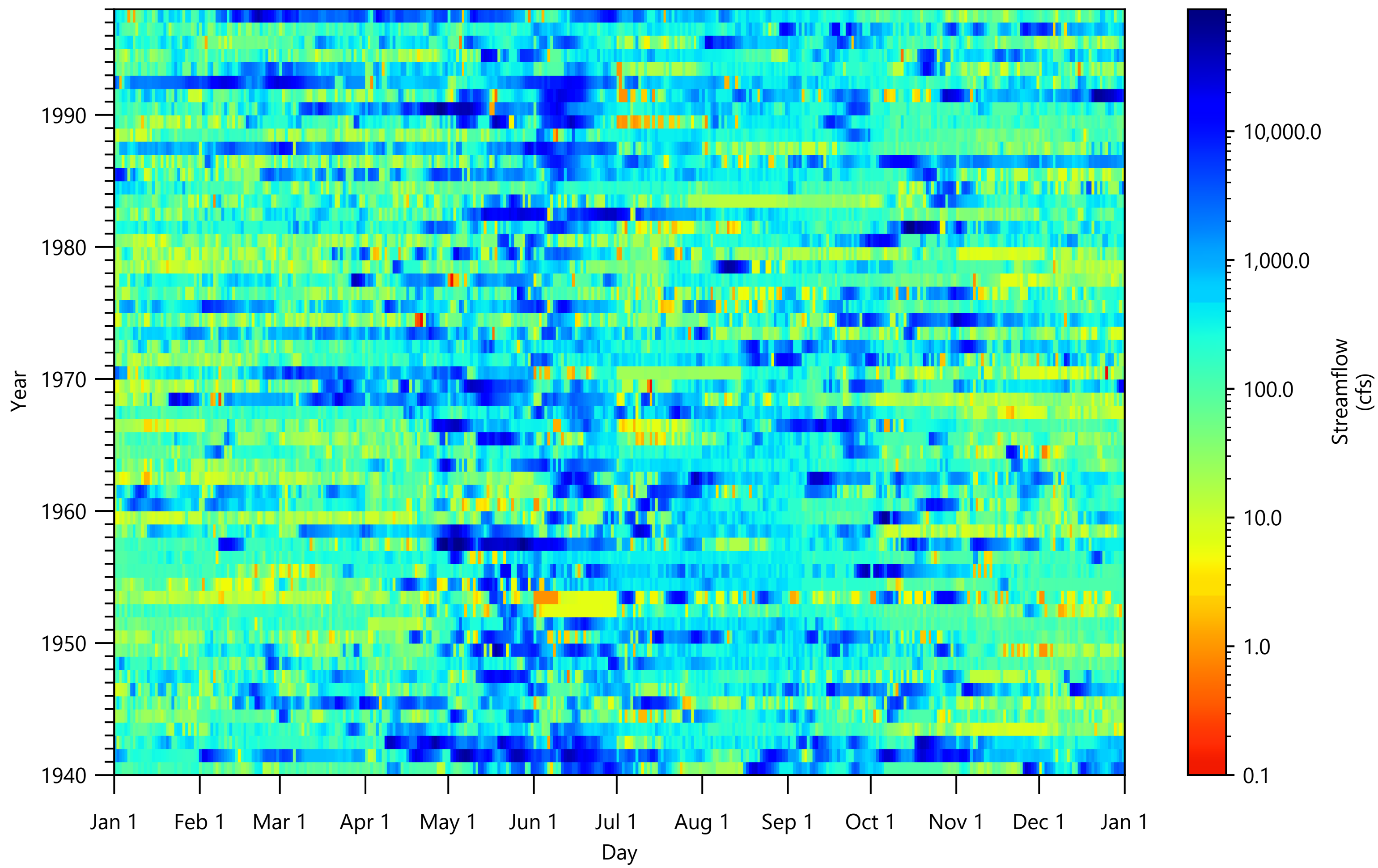

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Figure F-30
Brazos River near Glen Rose: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

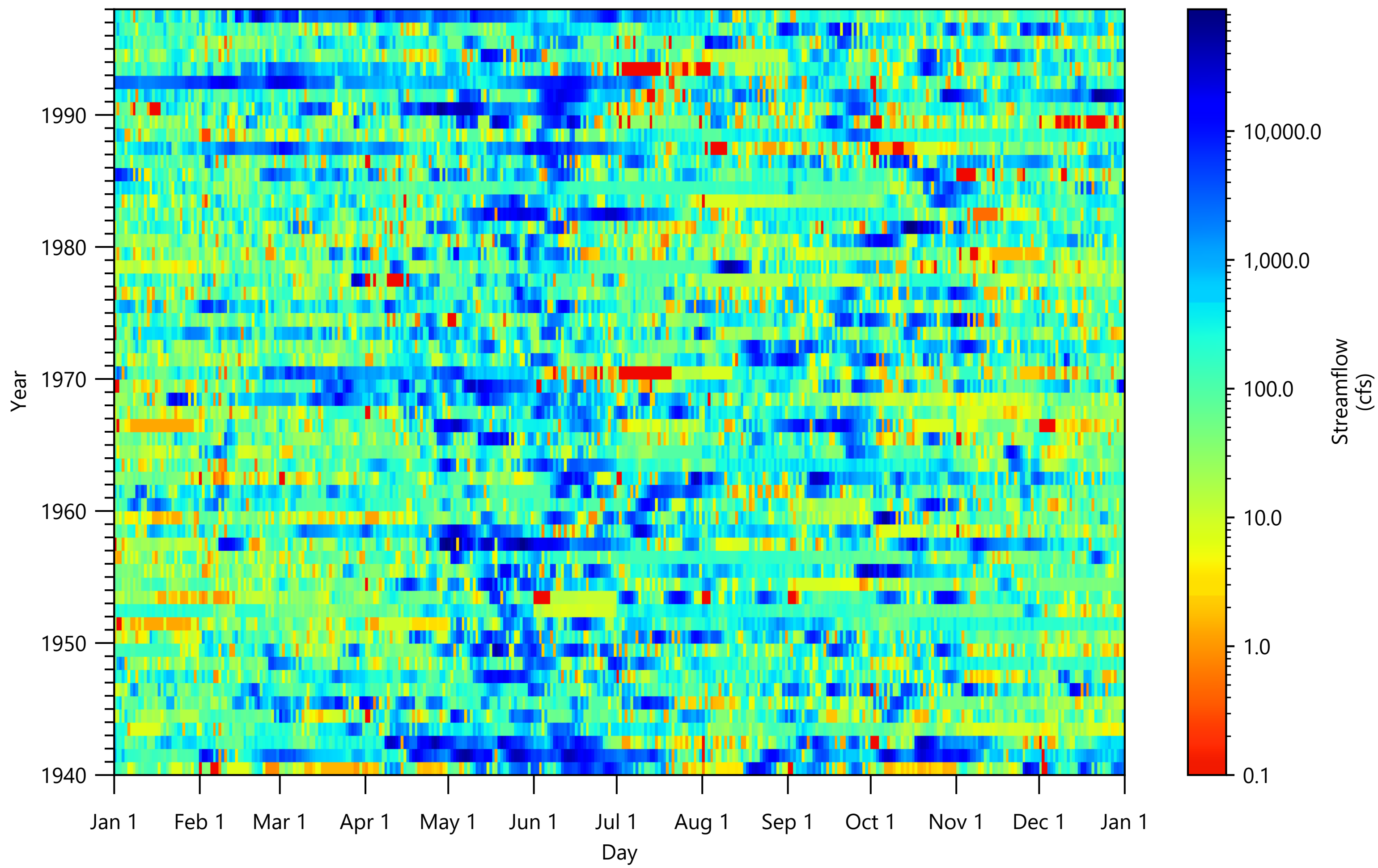

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Figure F-31
Brazos River near Glen Rose: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

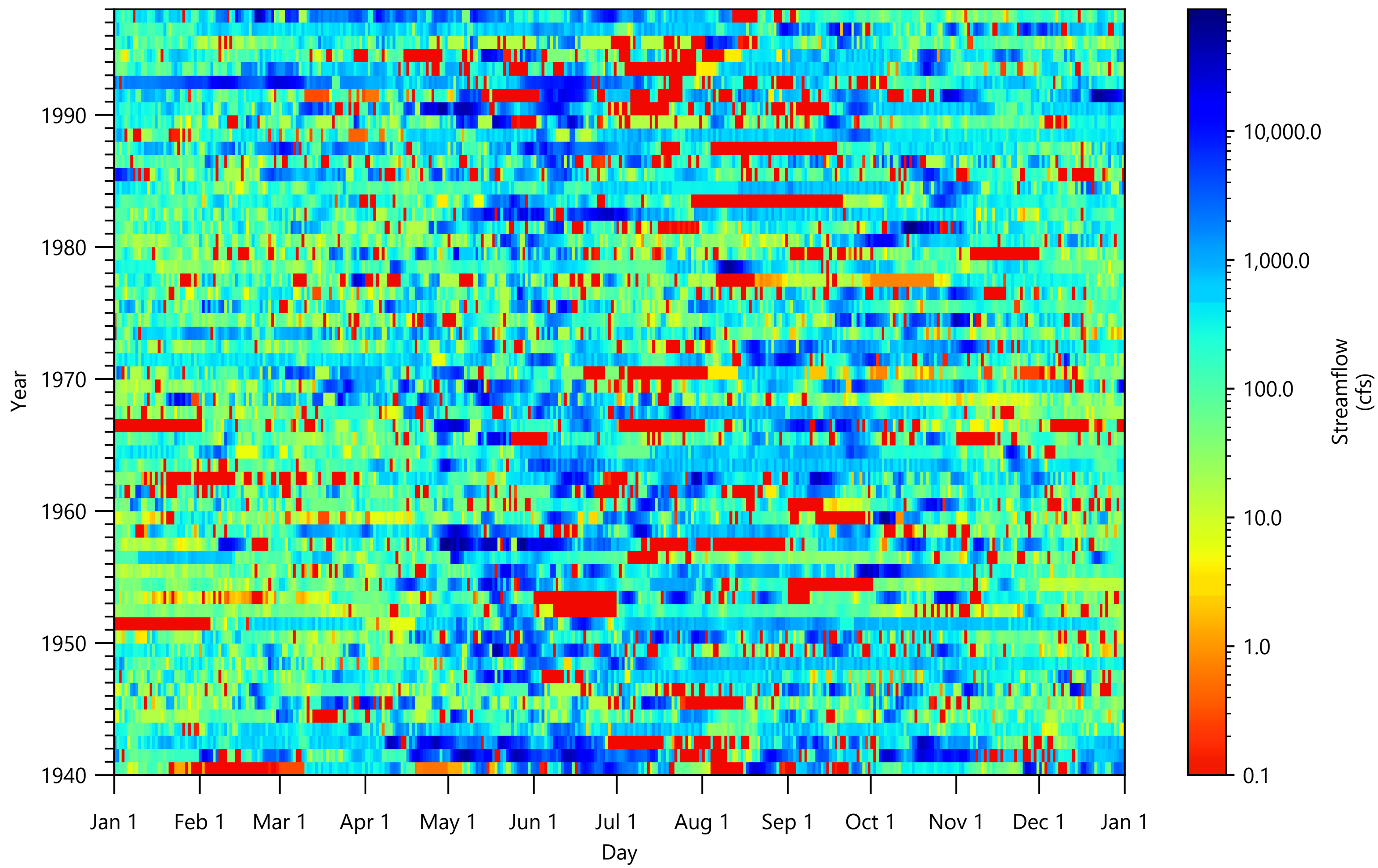

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Figure F-32
Brazos River near Glen Rose: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

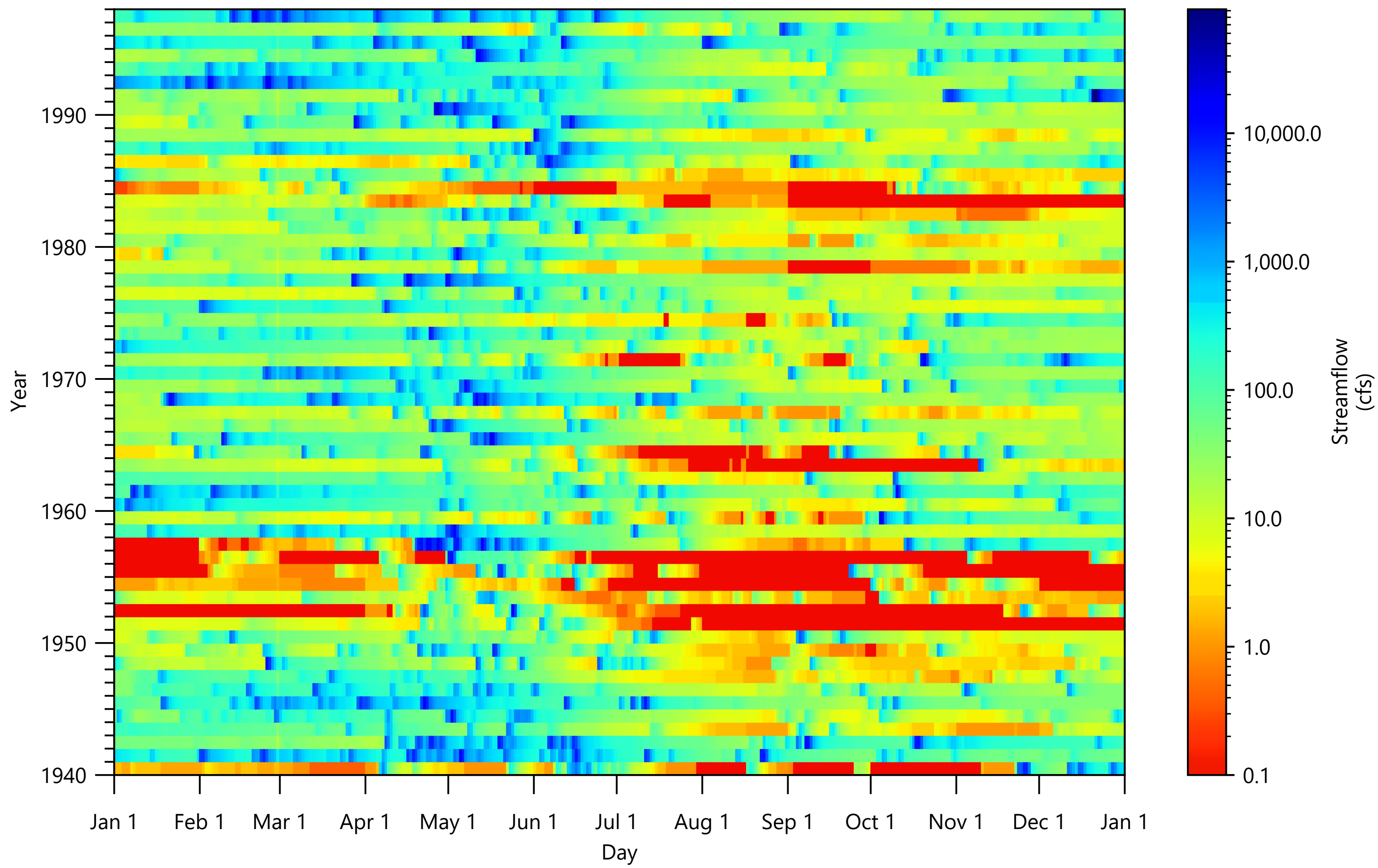

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Figure F-33
North Bosque near Clifton: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

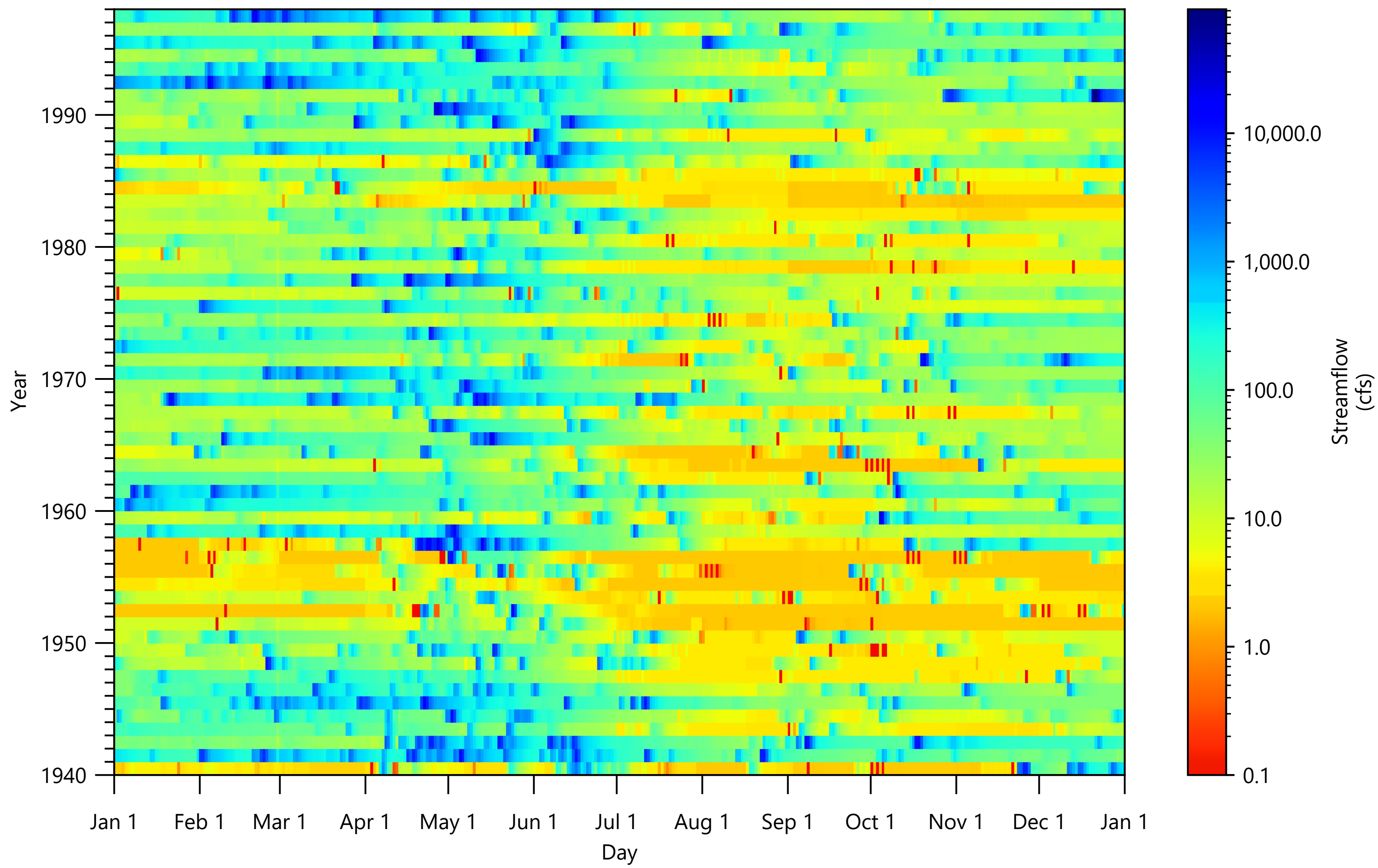

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Figure F-34
North Bosque near Clifton: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

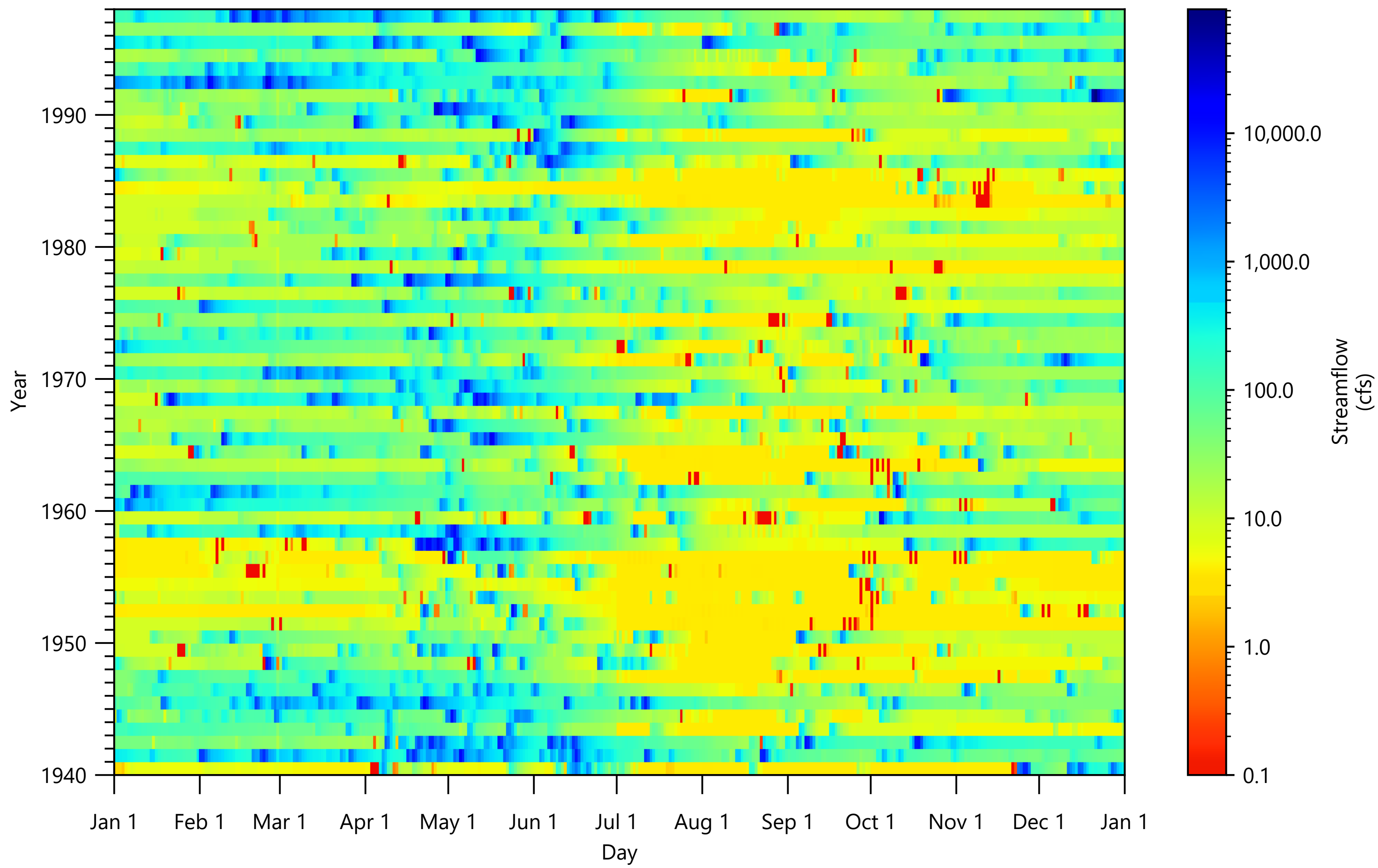

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Figure F-35
North Bosque near Clifton: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

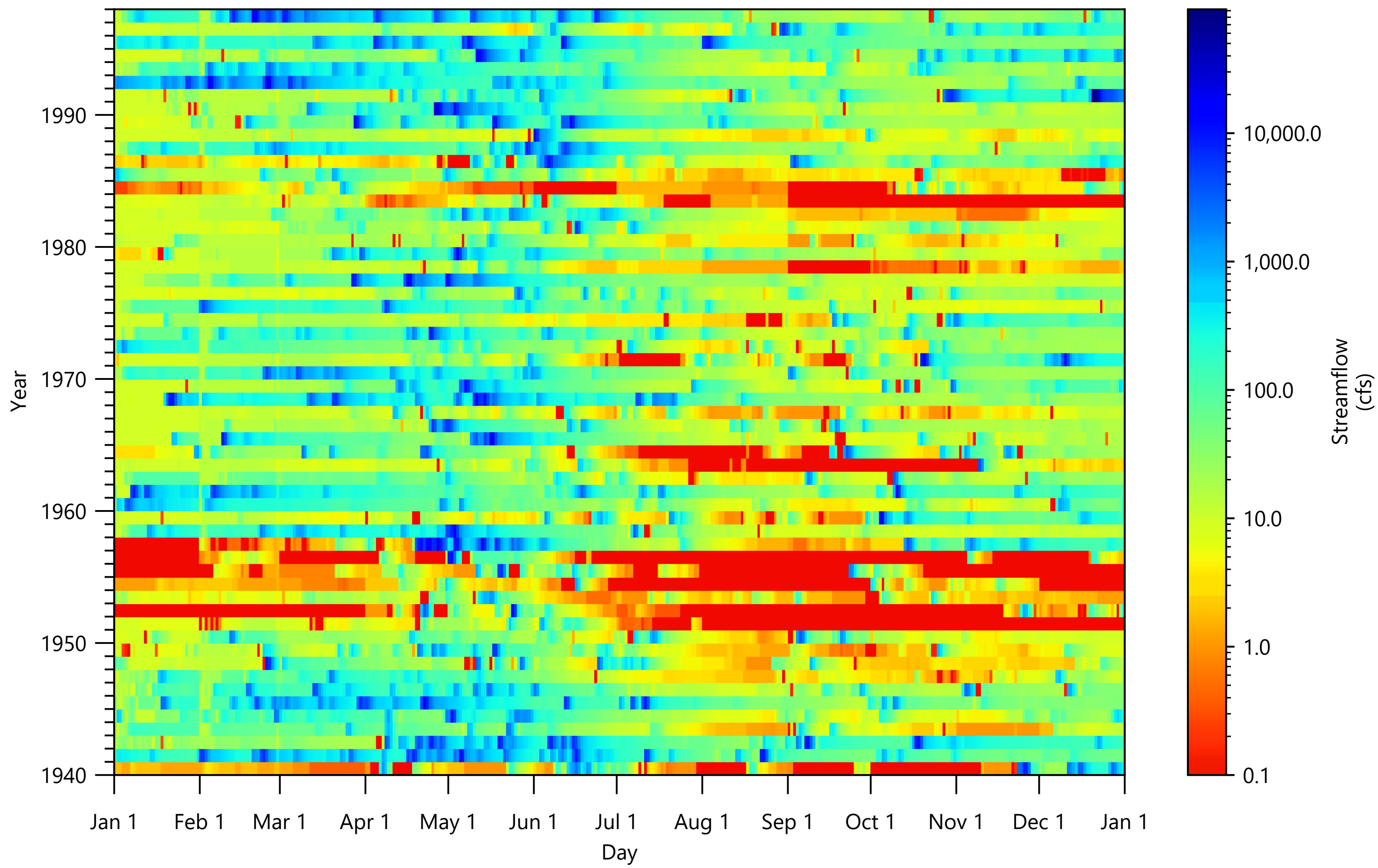

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Figure F-36
North Bosque near Clifton: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

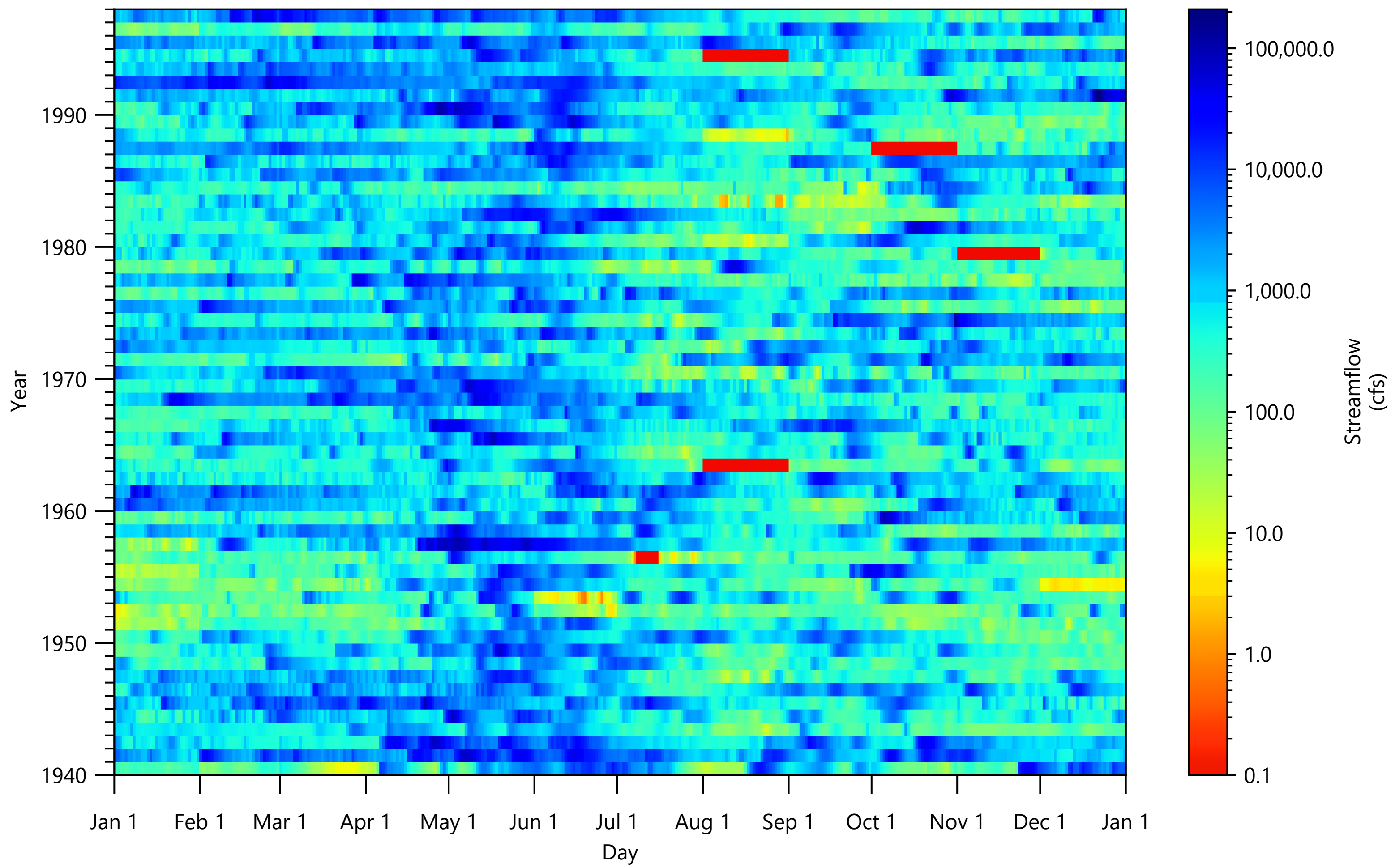

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Figure F-37
Brazos River near Waco: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

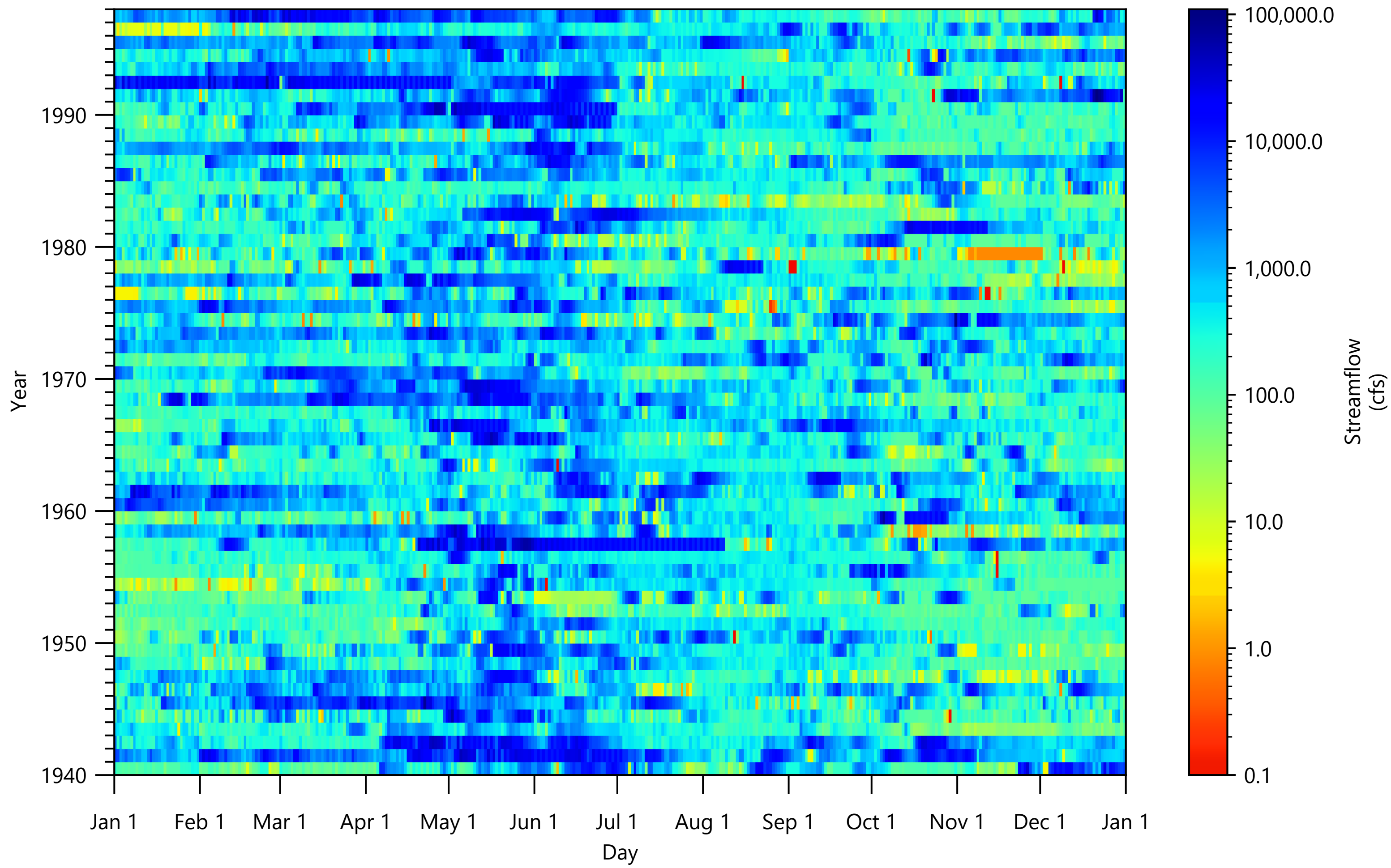

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Figure F-38
Brazos River near Waco: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

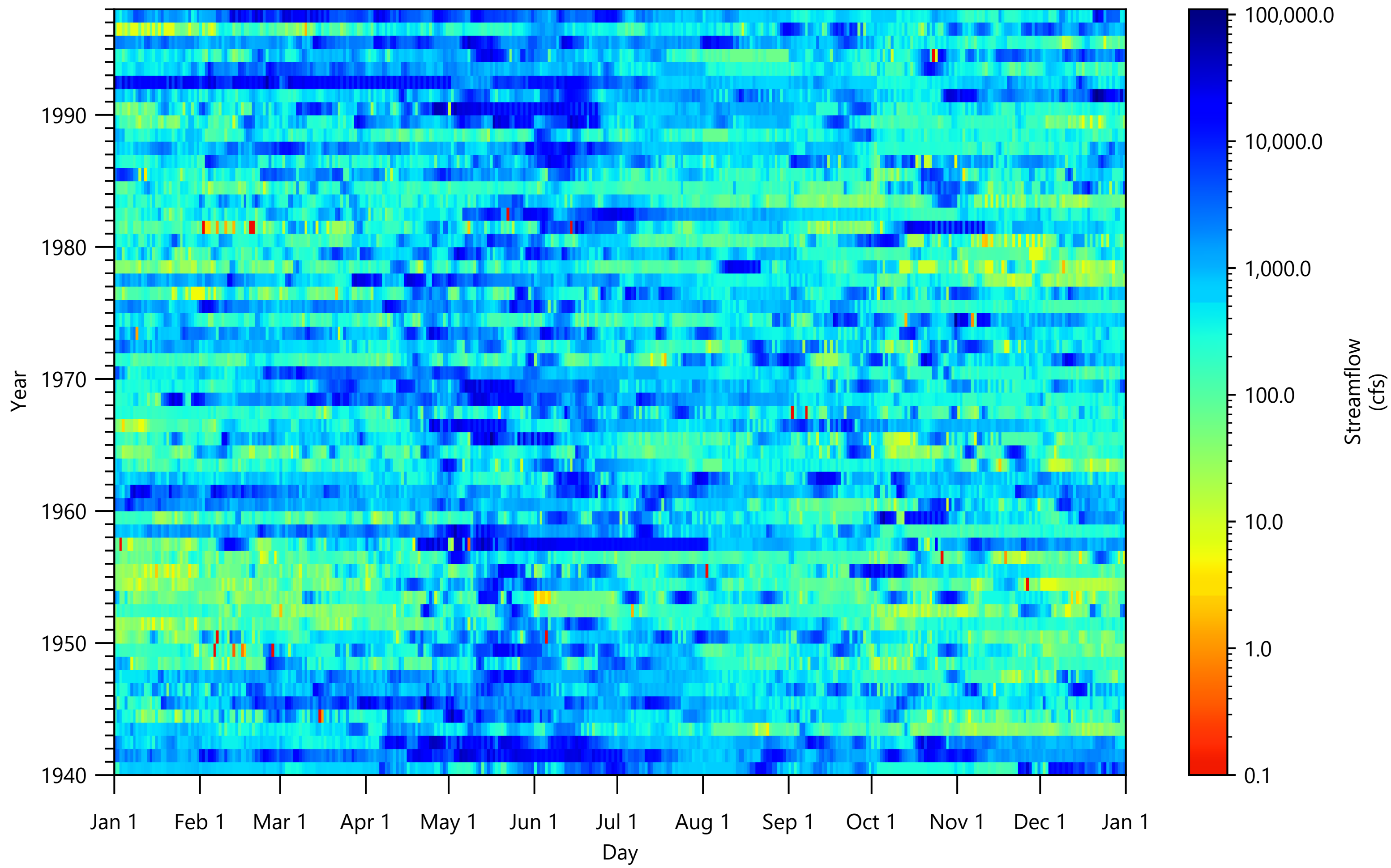

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Figure F-39
Brazos River near Waco: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

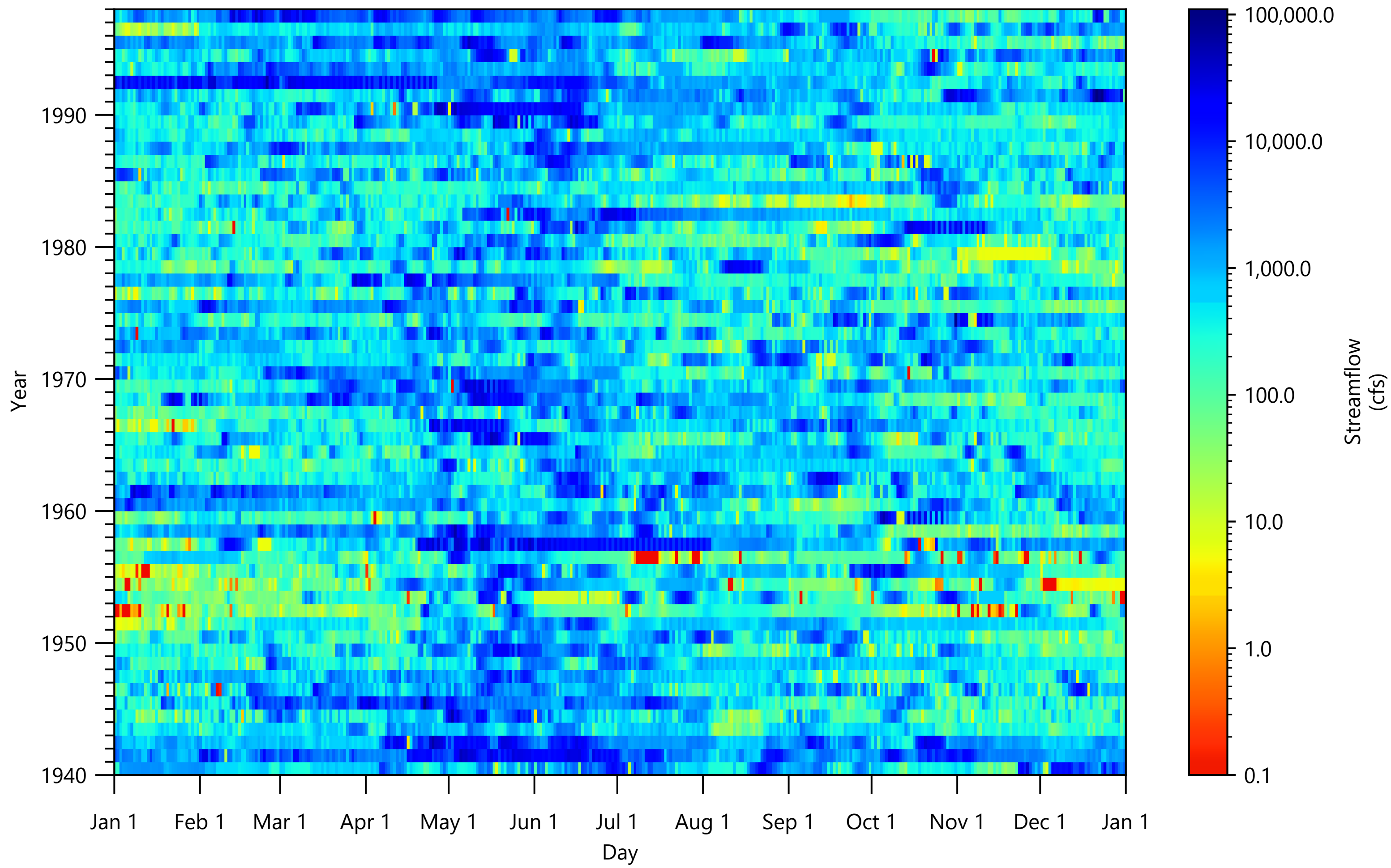

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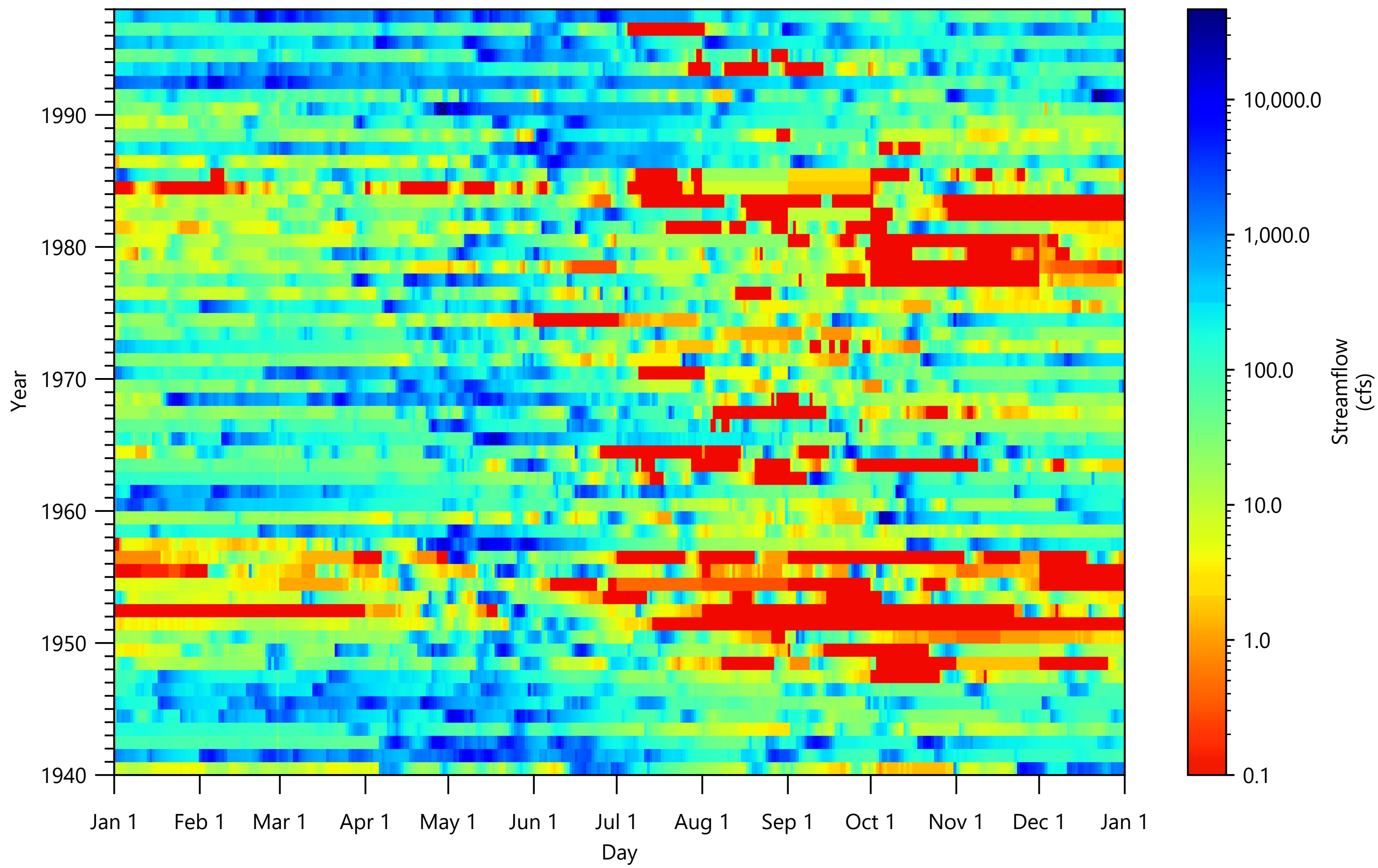
Figure F-40
Brazos River near Waco: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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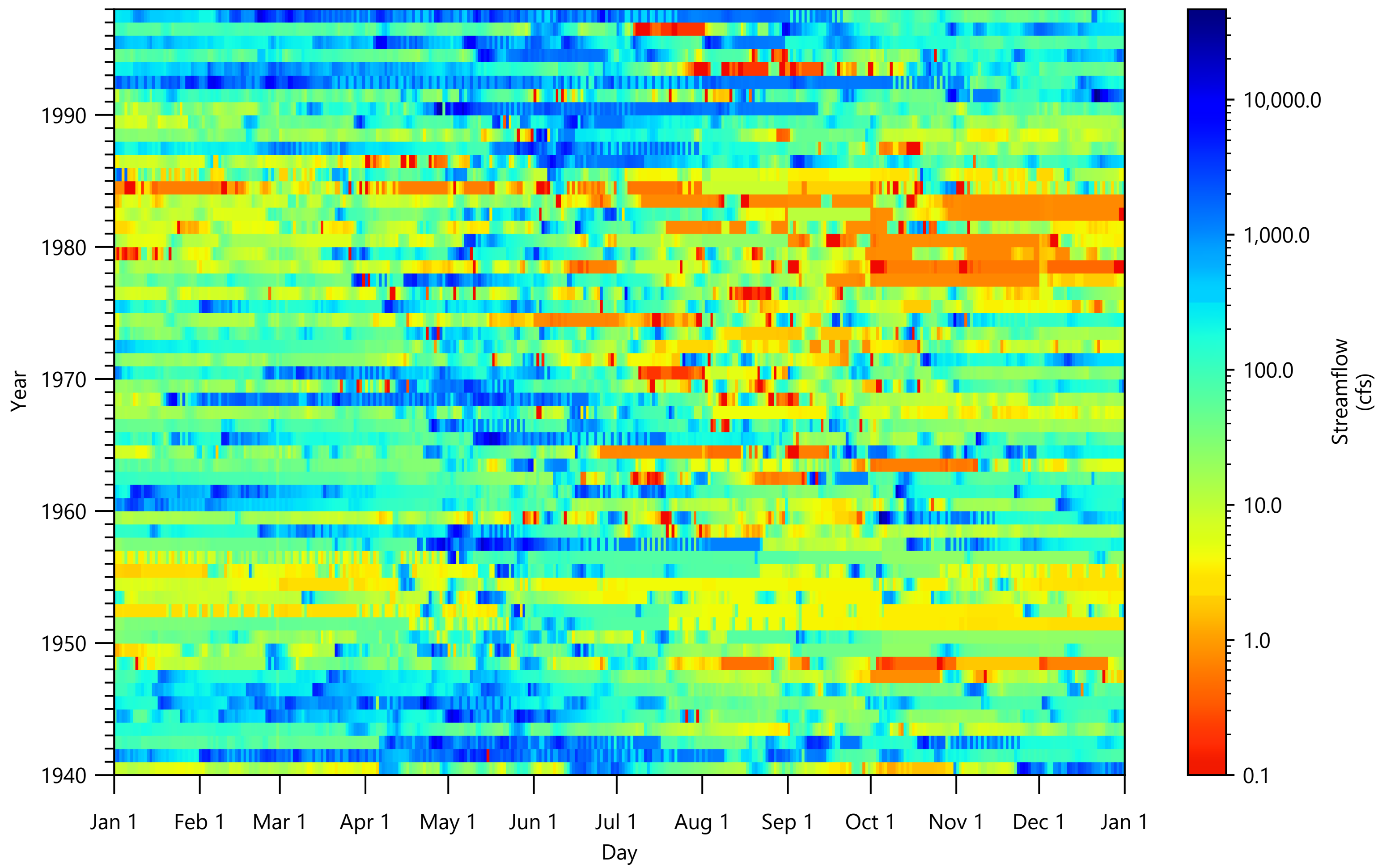
Figure F-41
Leon River at Gatesville: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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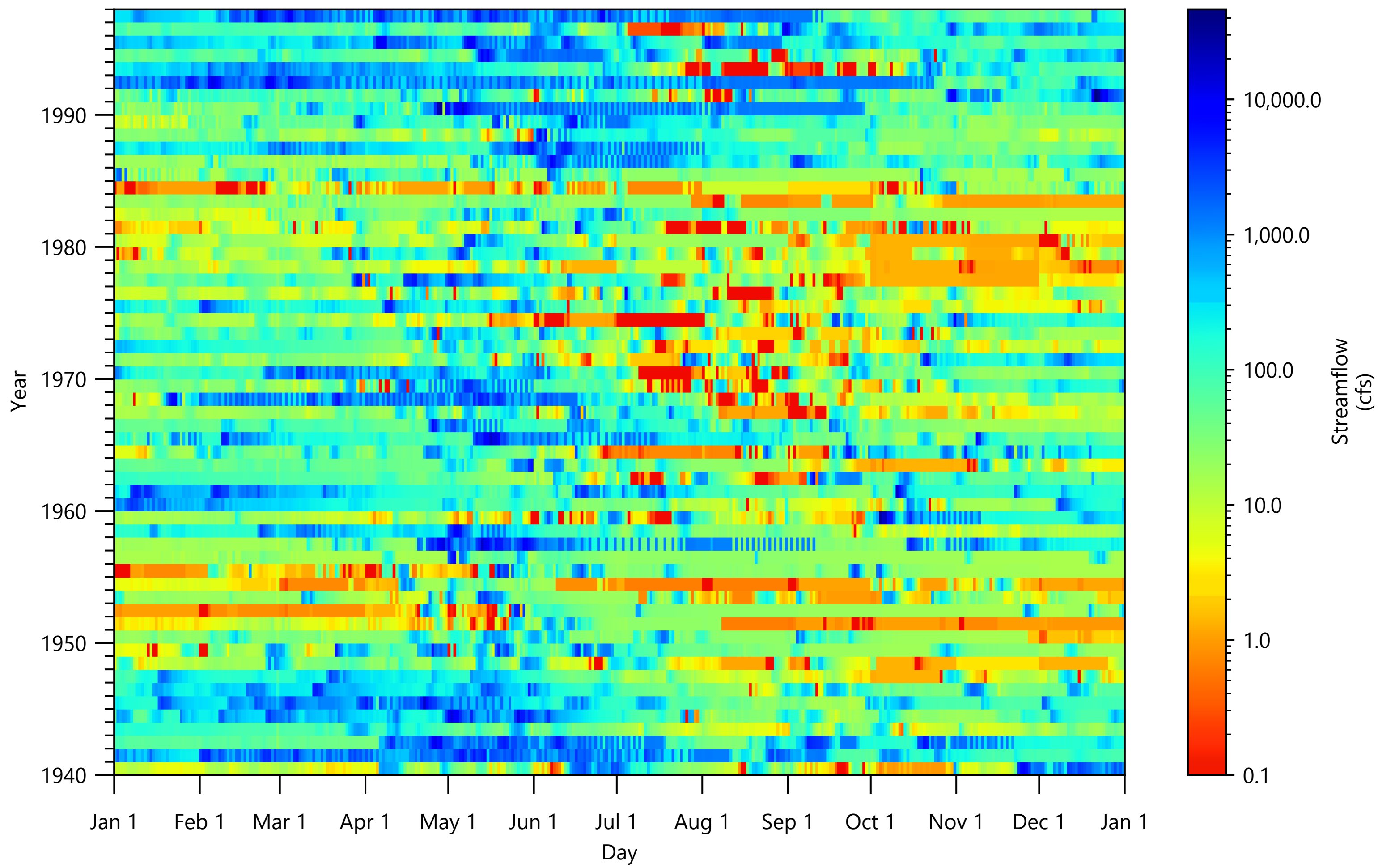
Figure F-42
Leon River at Gatesville: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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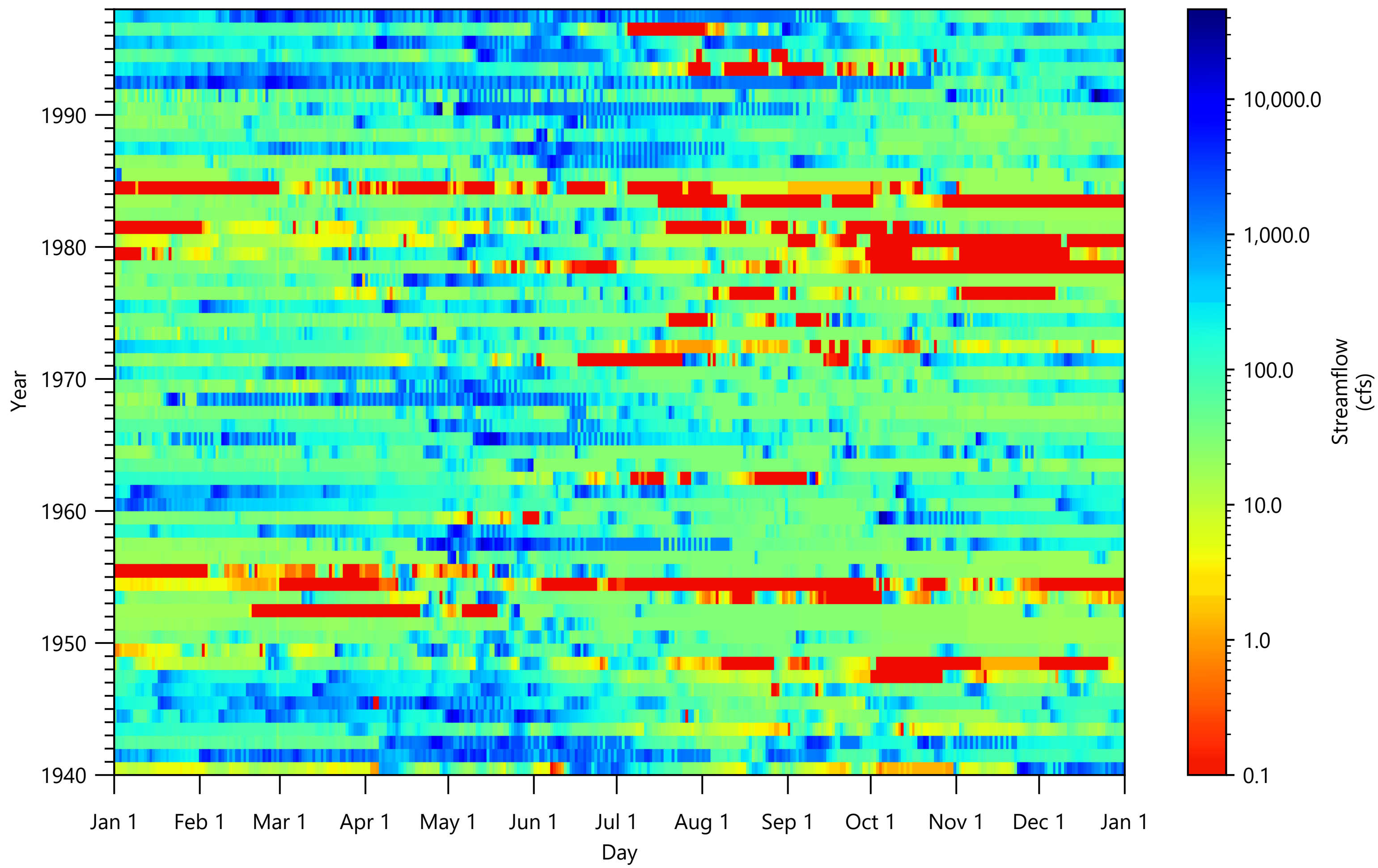
Figure F-43
Leon River at Gatesville: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:24 PM | User: JH
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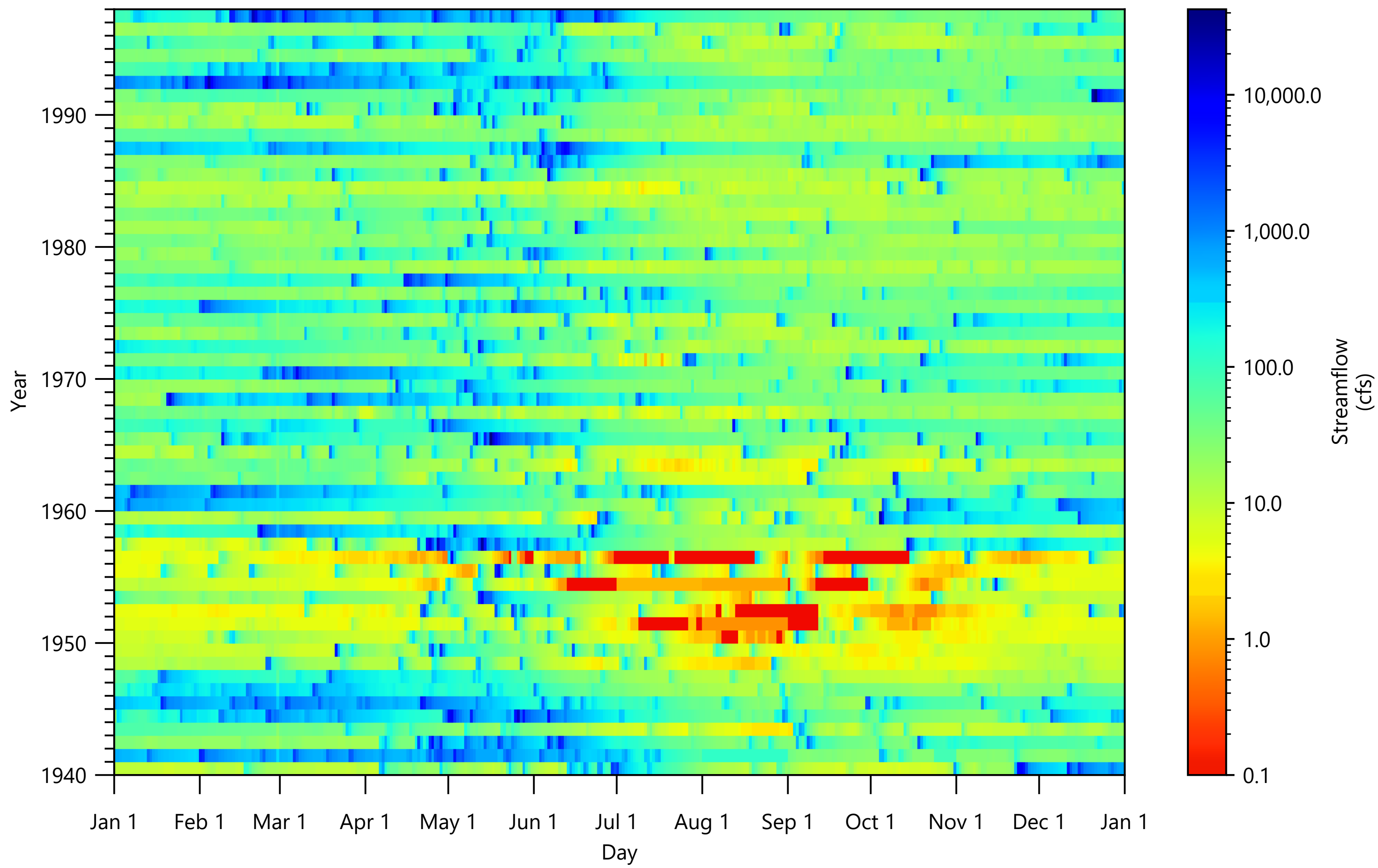
Figure F-44
Leon River at Gatesville: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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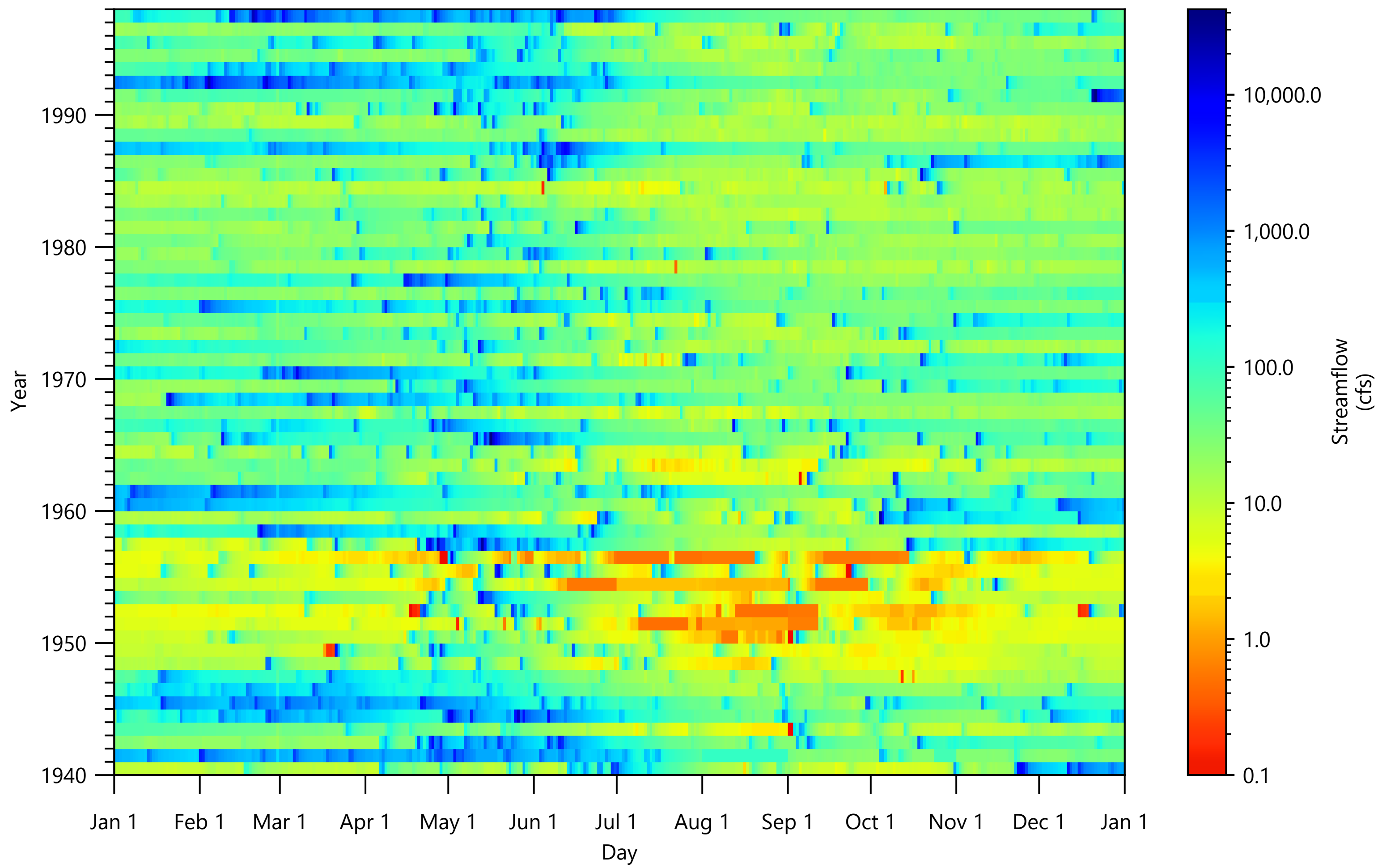
Figure F-45
Lampasas River near Kempner: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:24 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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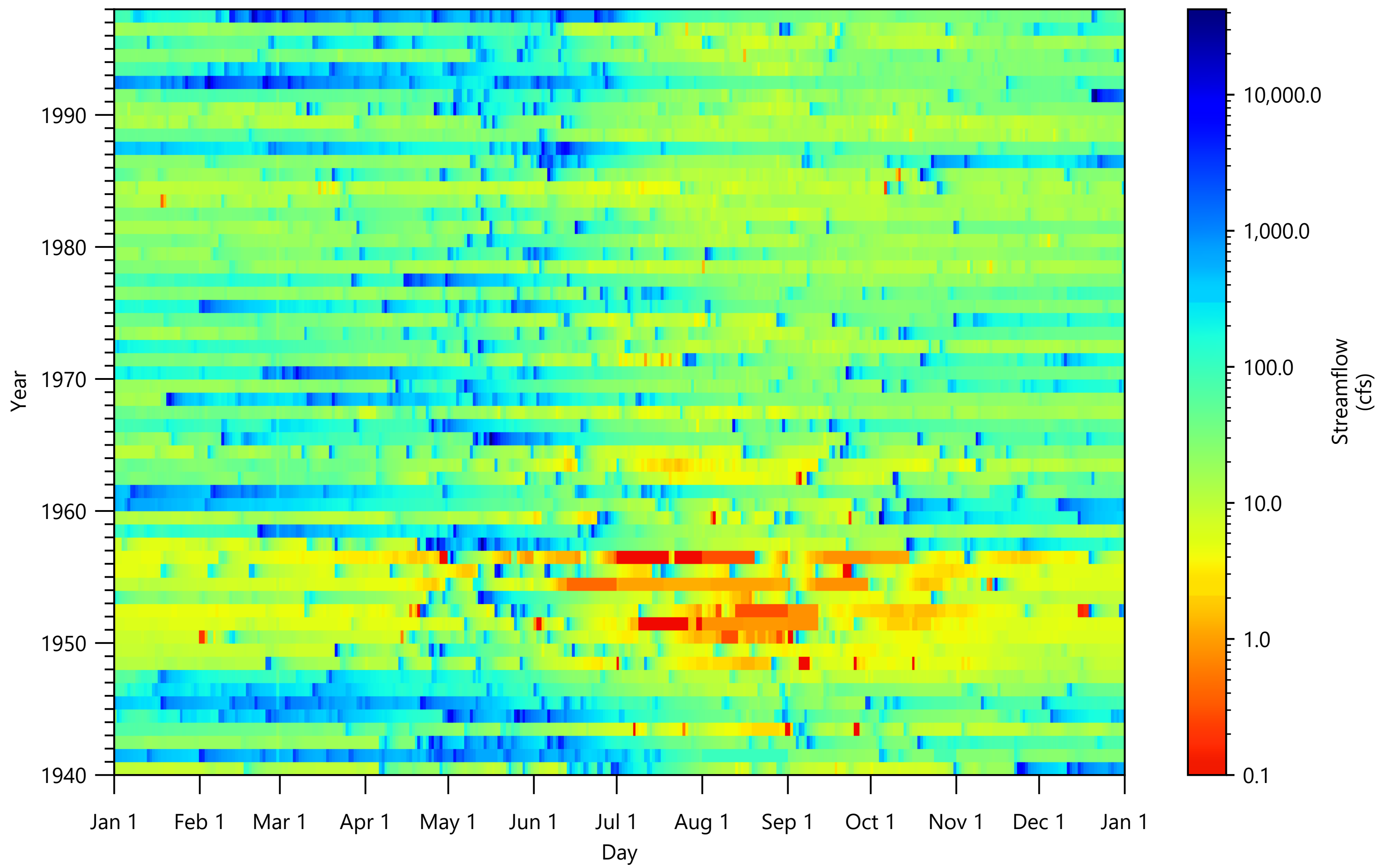
Figure F-46
Lampasas River near Kempner: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:24 PM | User: JH
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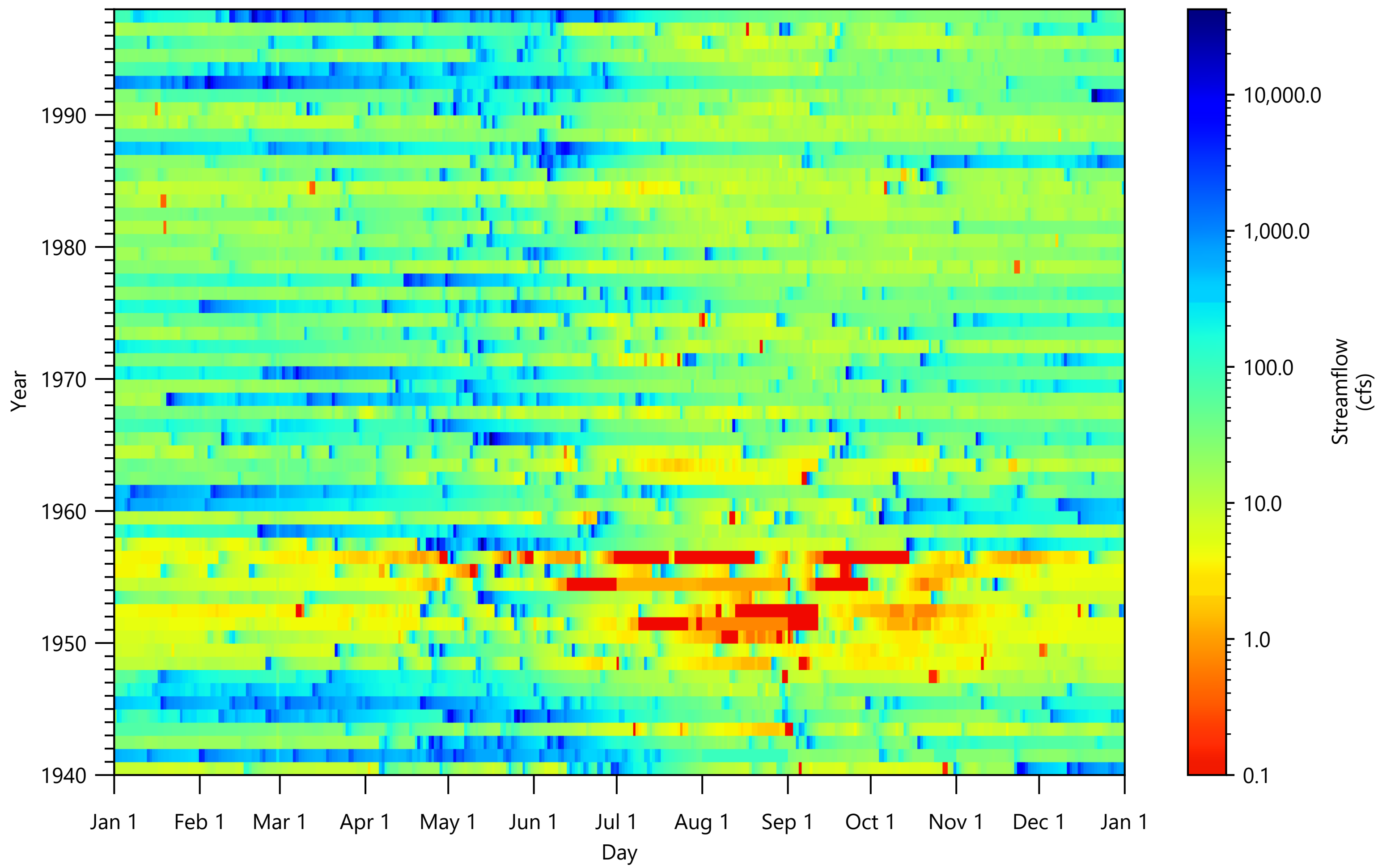
Figure F-47
Lampasas River near Kempner: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:25 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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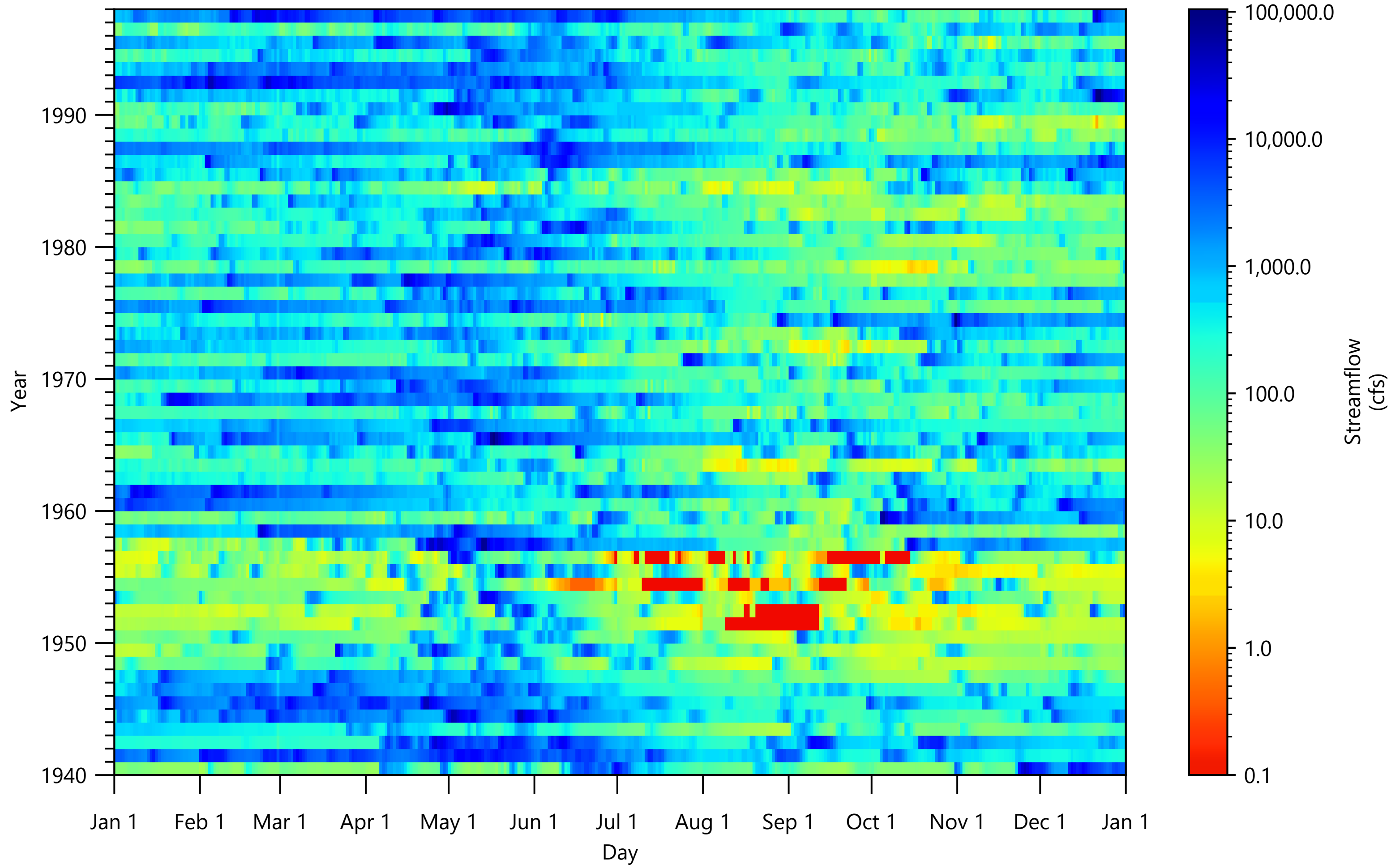
Figure F-48
Lampasas River near Kempner: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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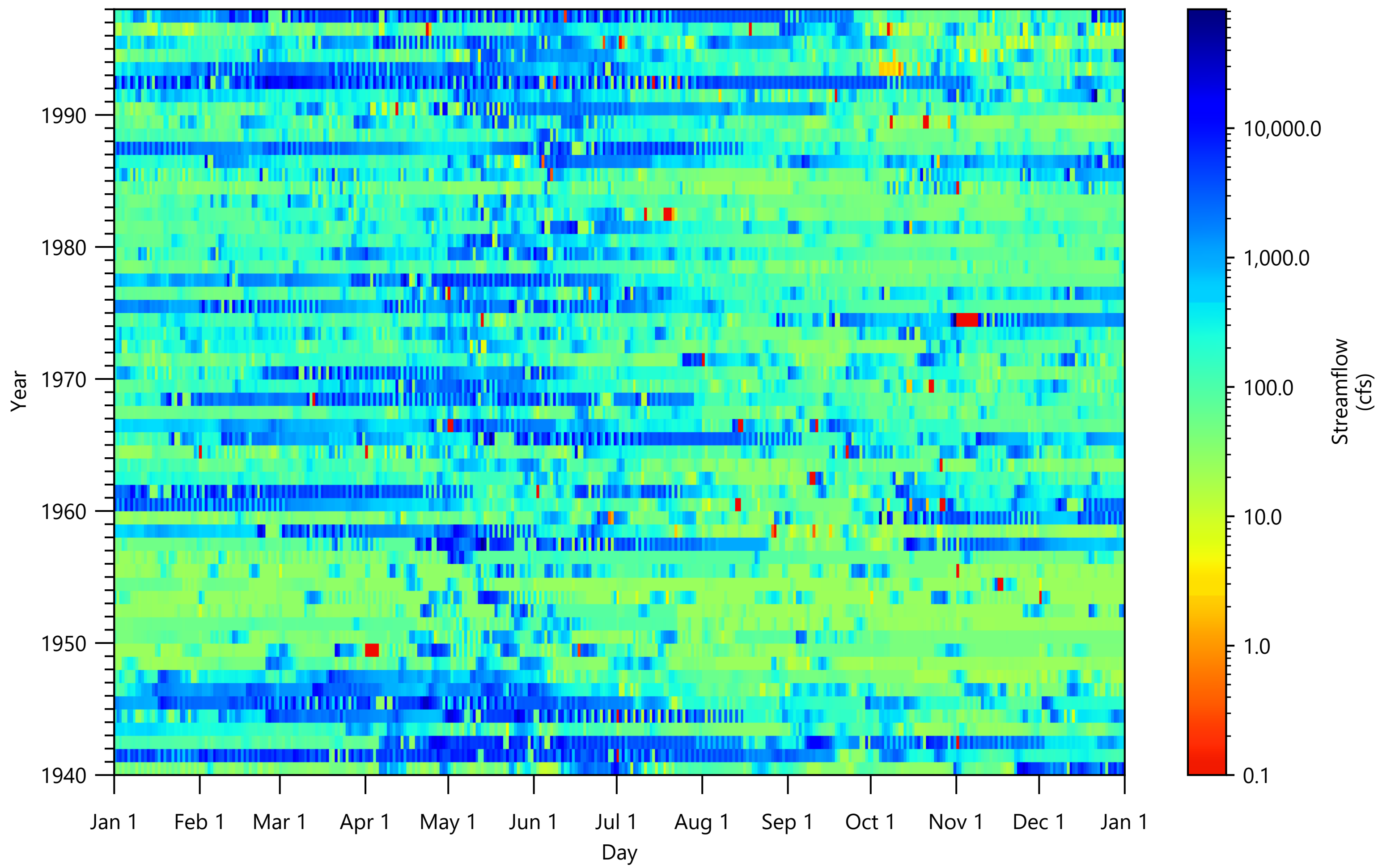
Figure F-49
Little River near Little River: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:25 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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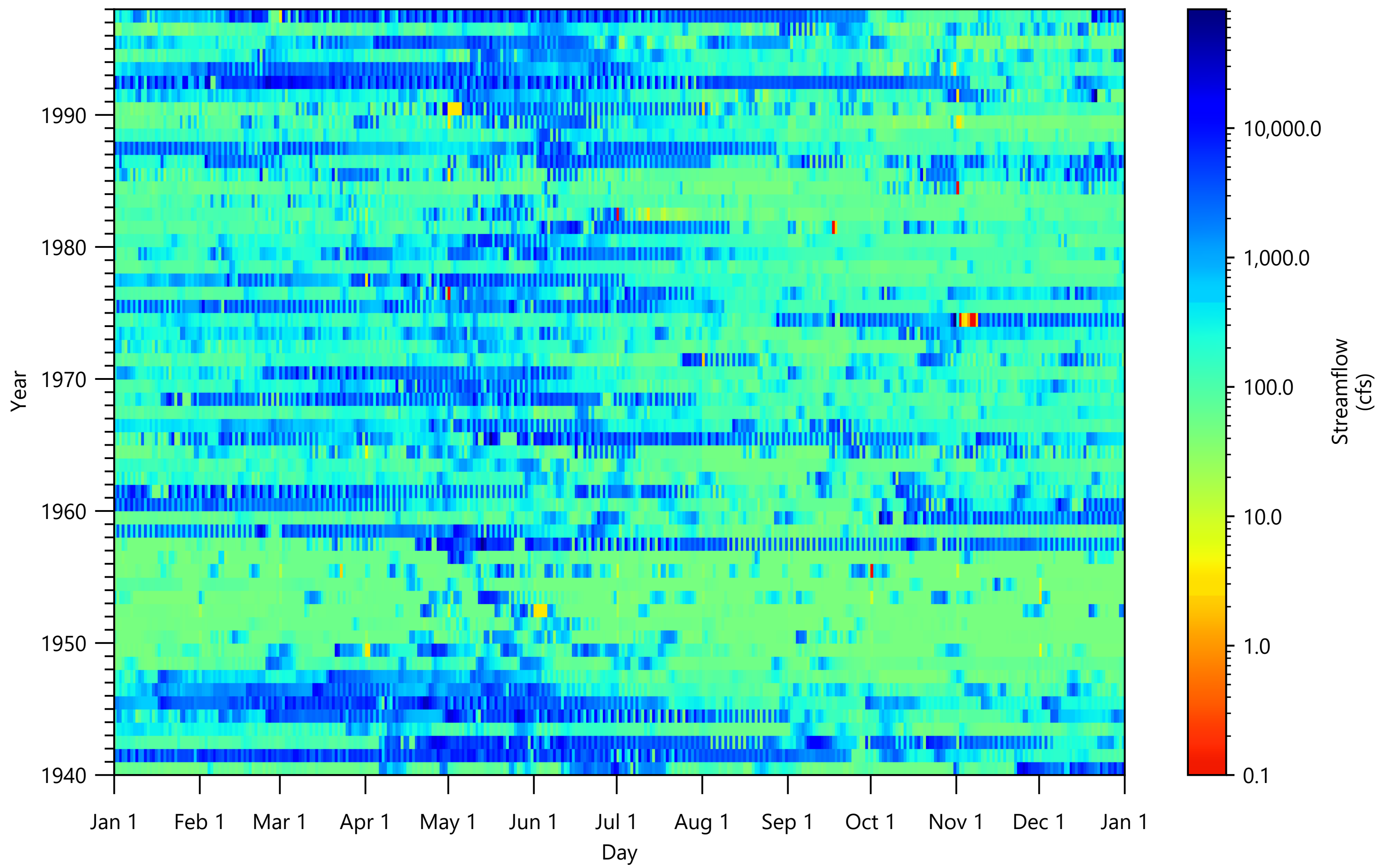
Figure F-50
Little River near Little River: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:25 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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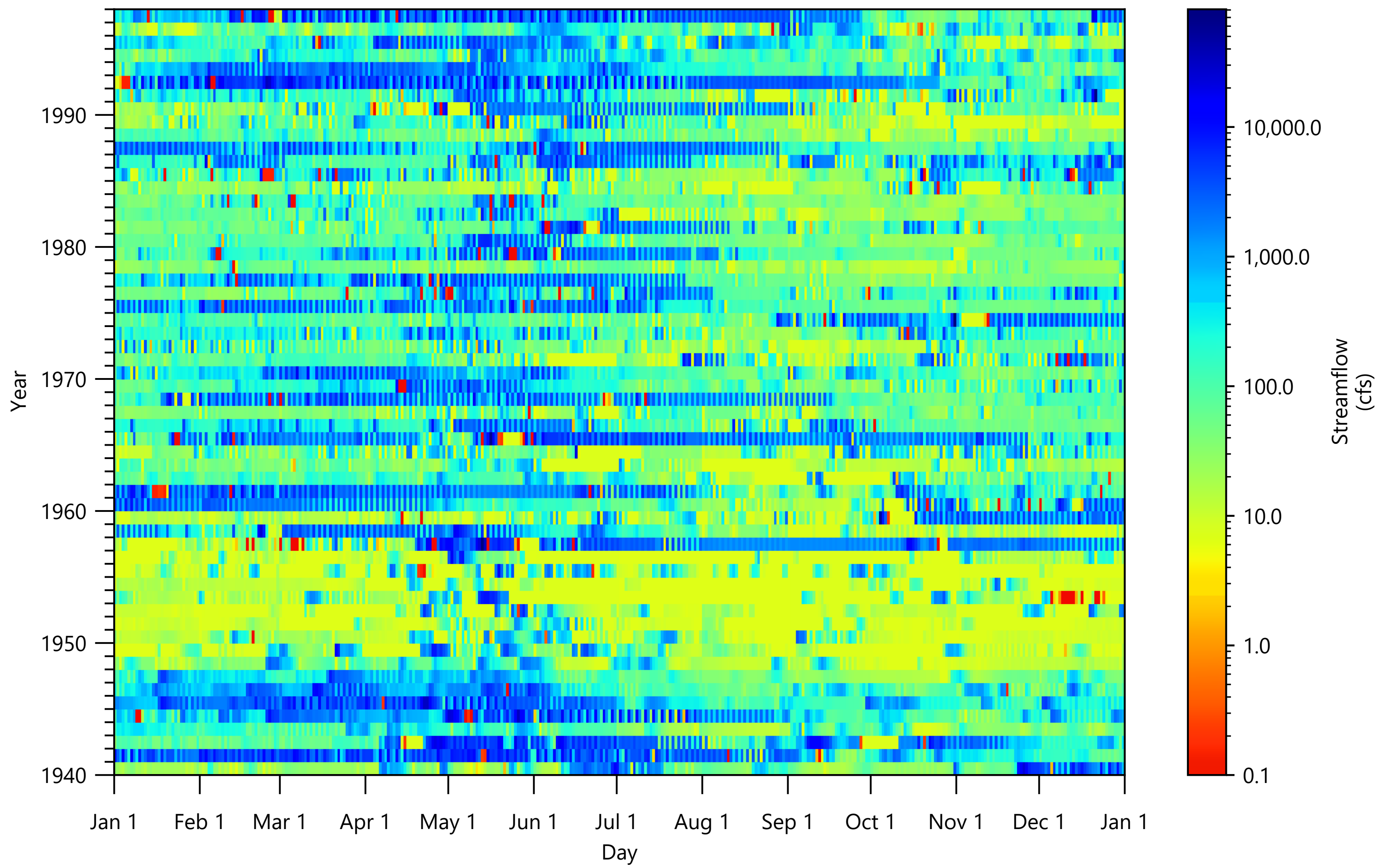
Figure F-51
Little River near Little River: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:25 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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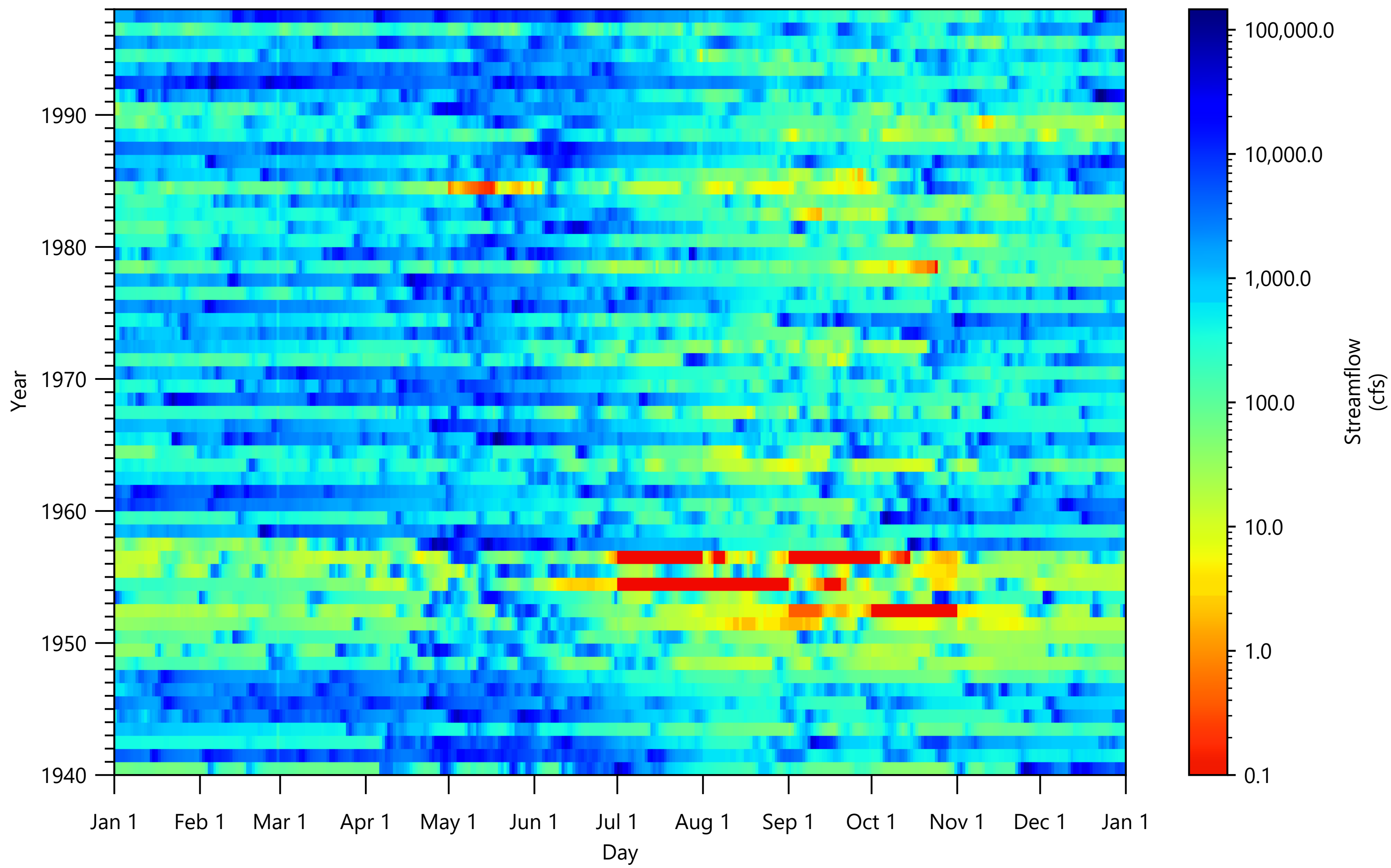
Figure F-52
Little River near Little River: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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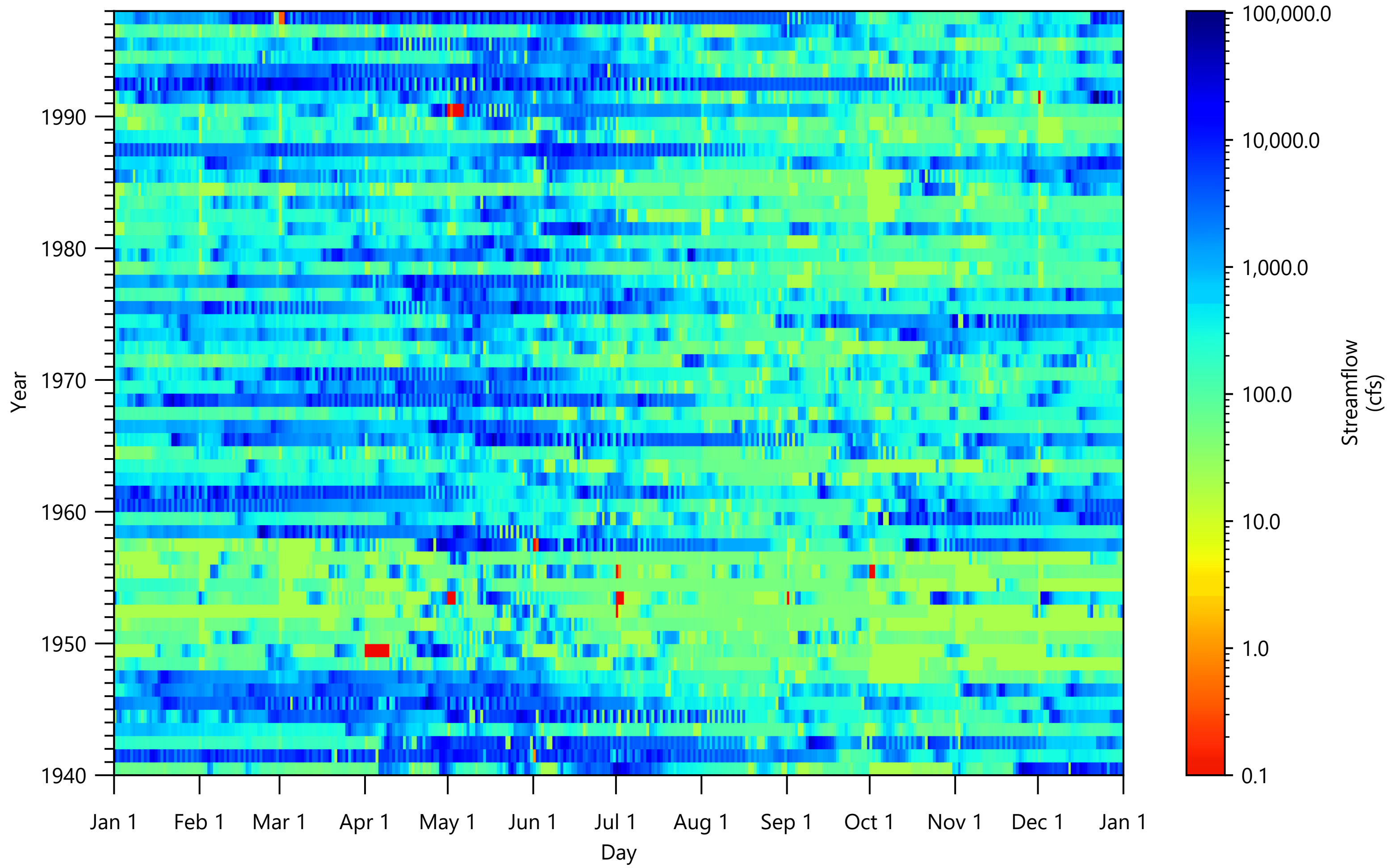
Figure F-53
Little River near Cameron: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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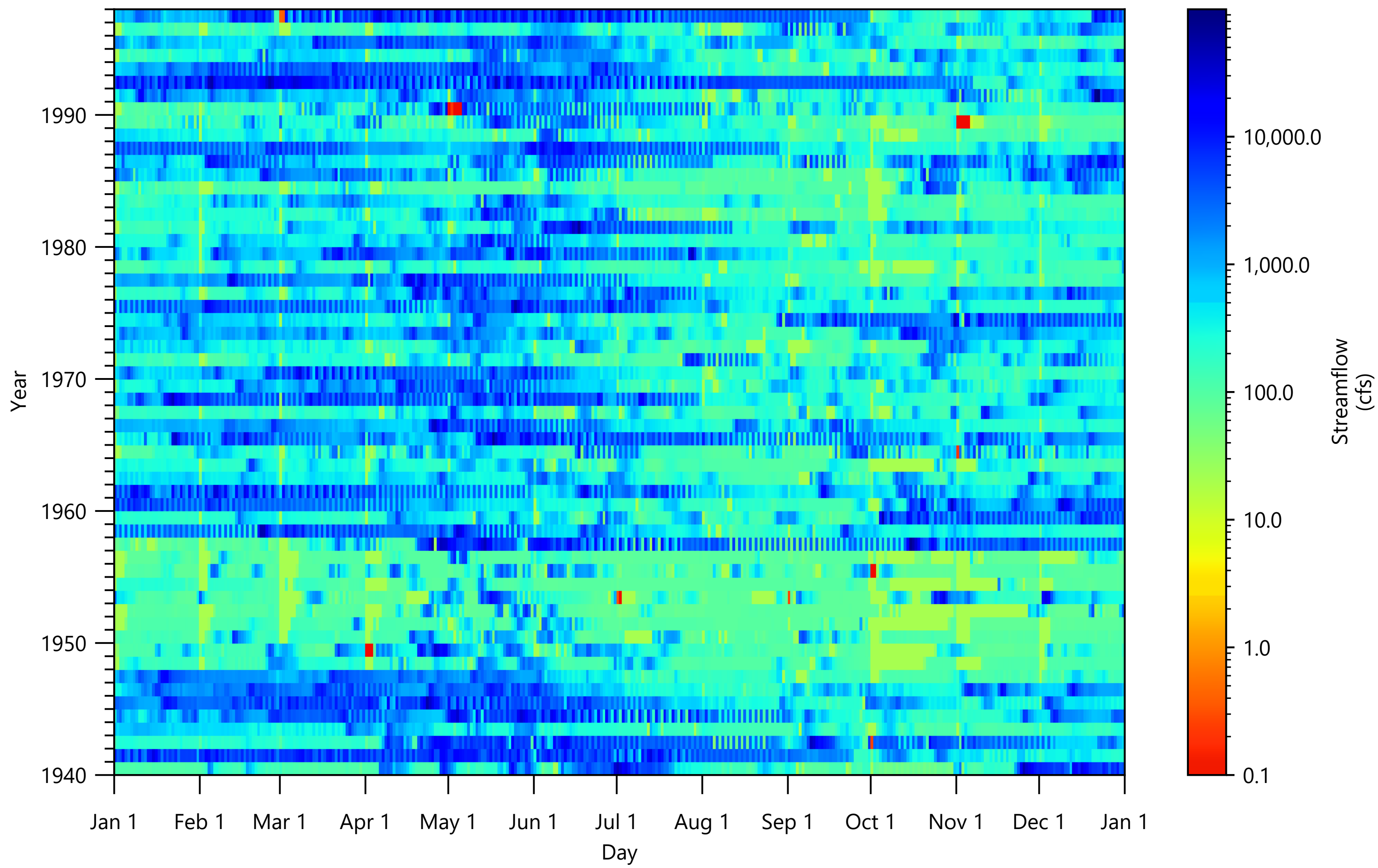
Figure F-54
Little River near Cameron: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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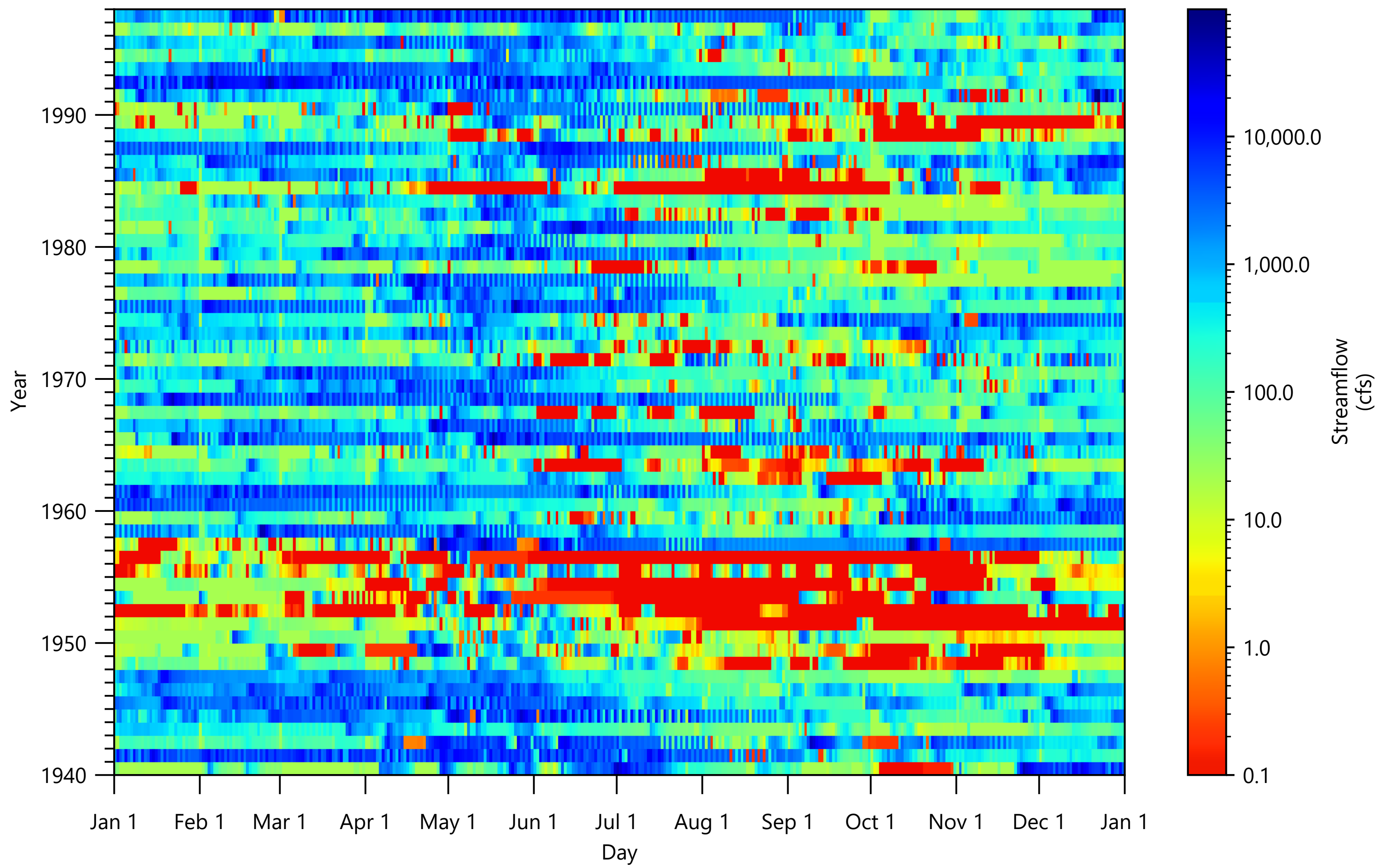
Figure F-55
Little River near Cameron: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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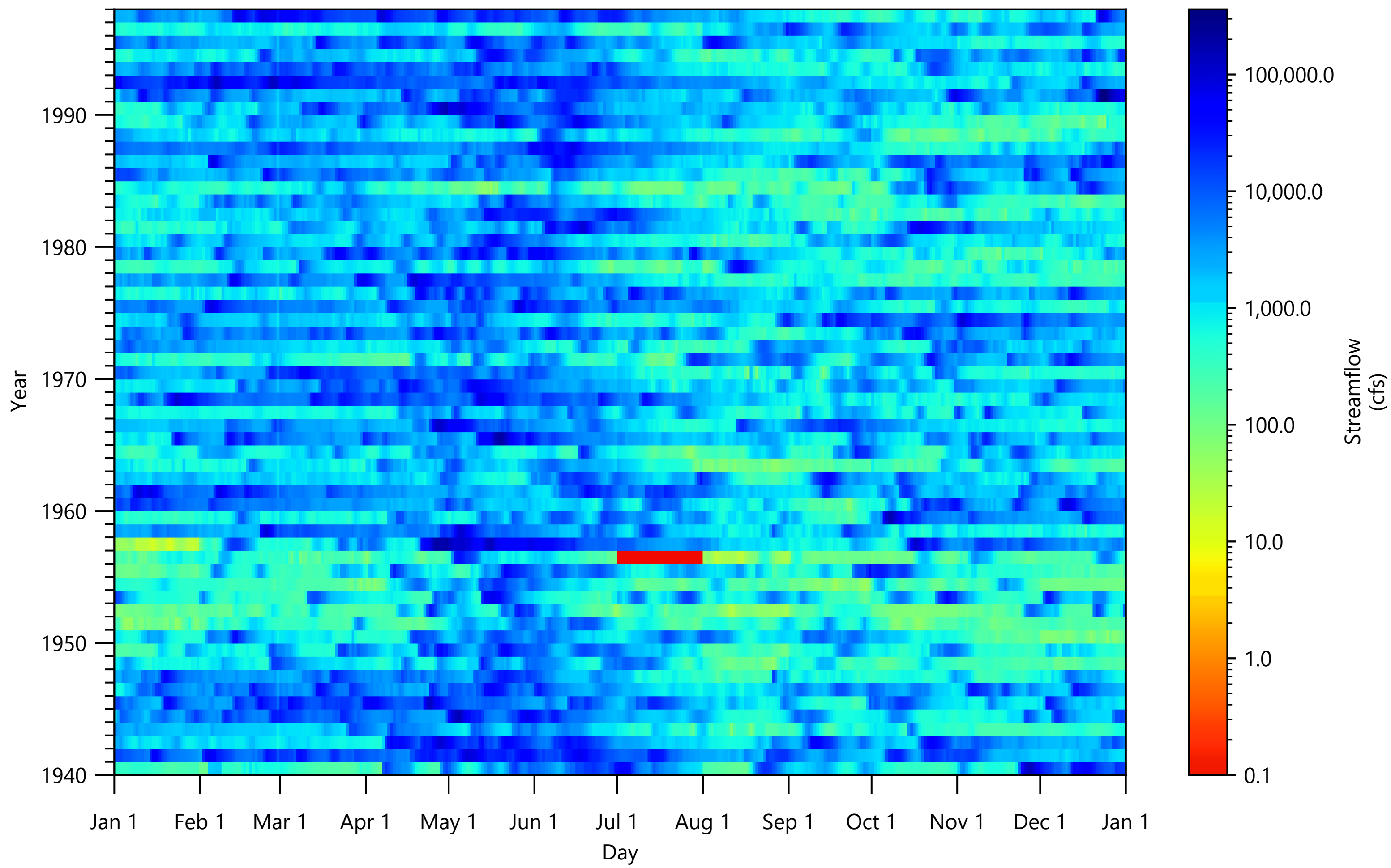
Figure F-56
Little River near Cameron: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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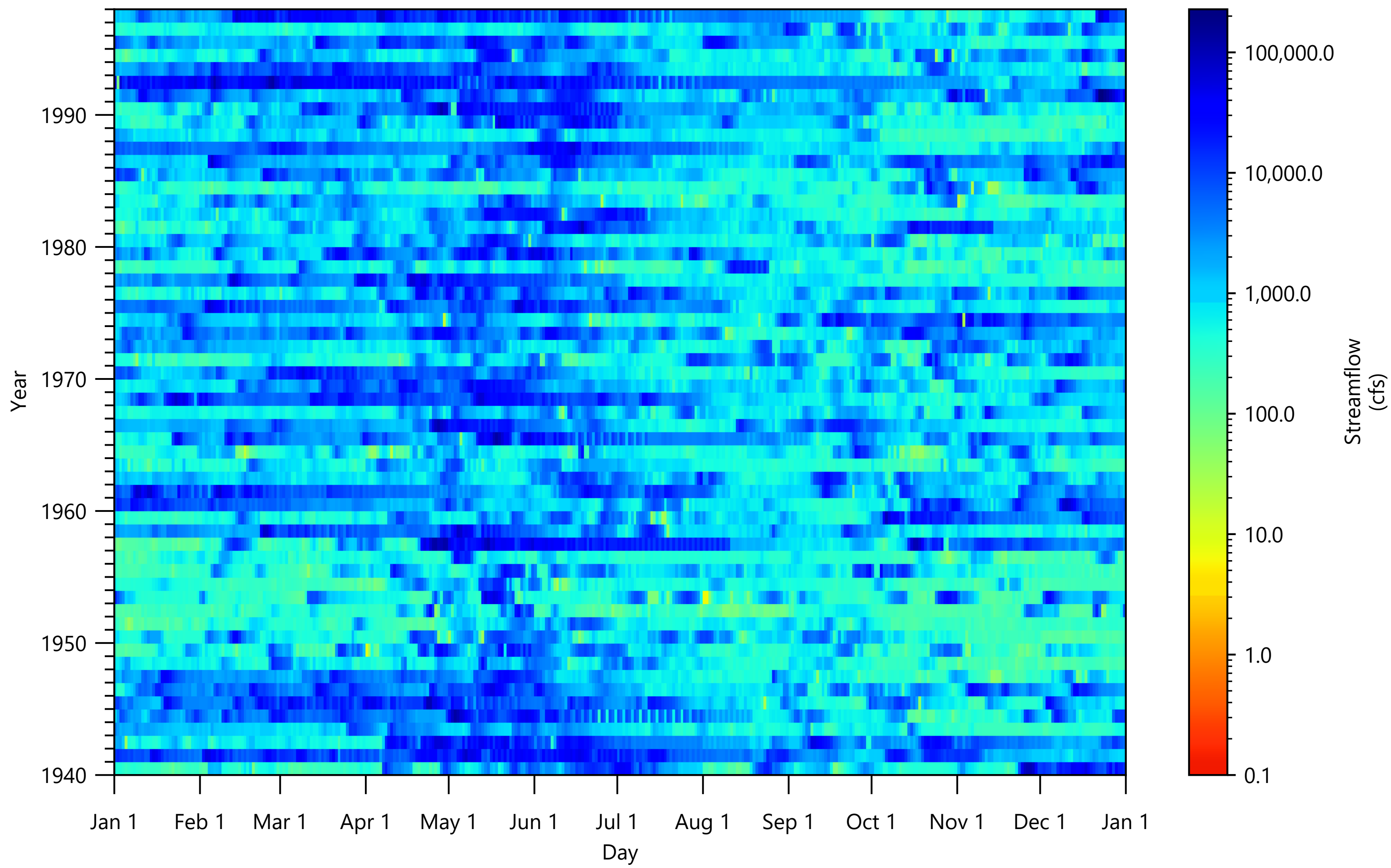
Figure F-57
Brazos River near Bryan: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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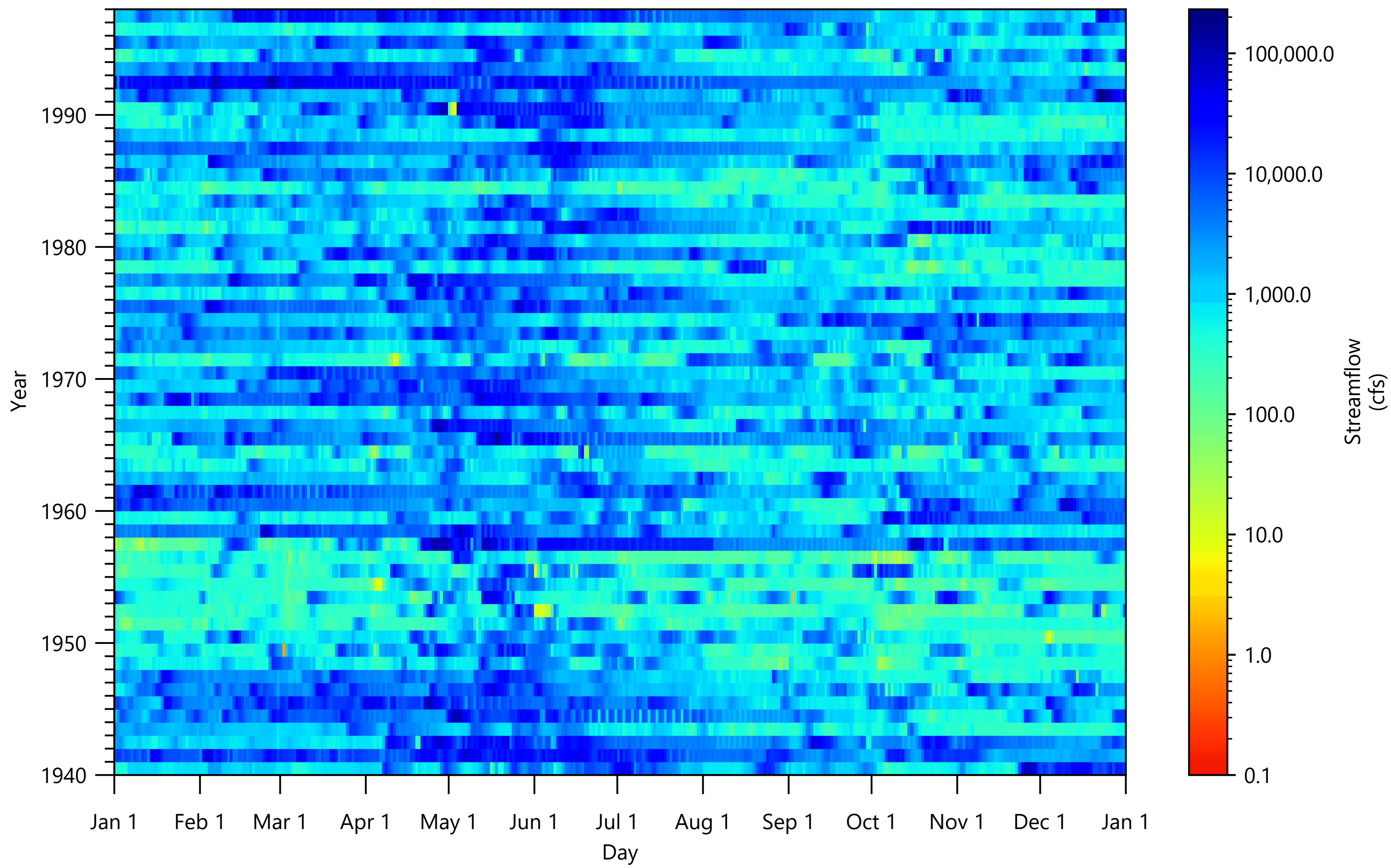
Figure F-58
Brazos River near Bryan: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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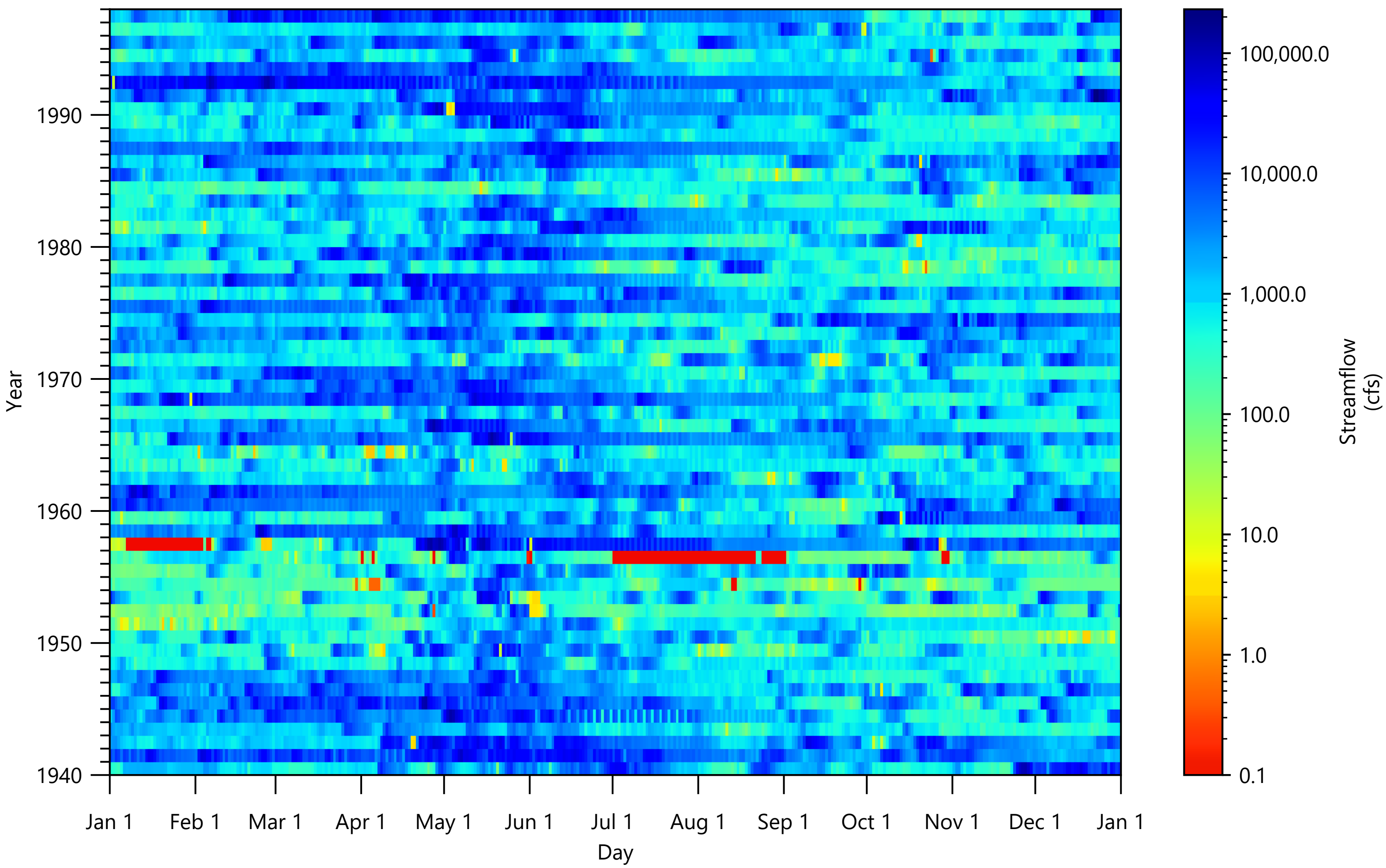
Figure F-59
Brazos River near Bryan: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

Figure F-60
Brazos River near Bryan: Full Utilization Scenario

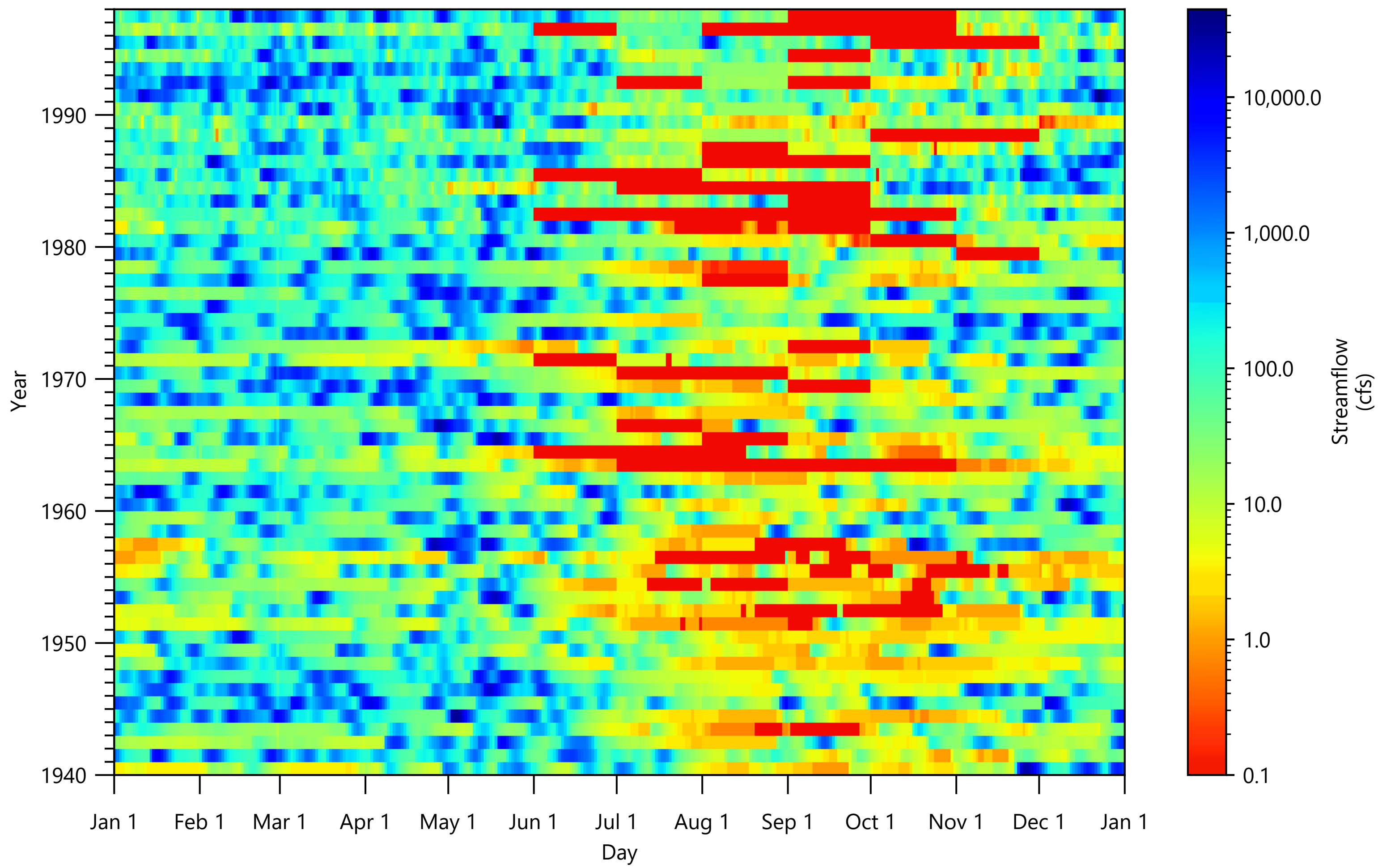

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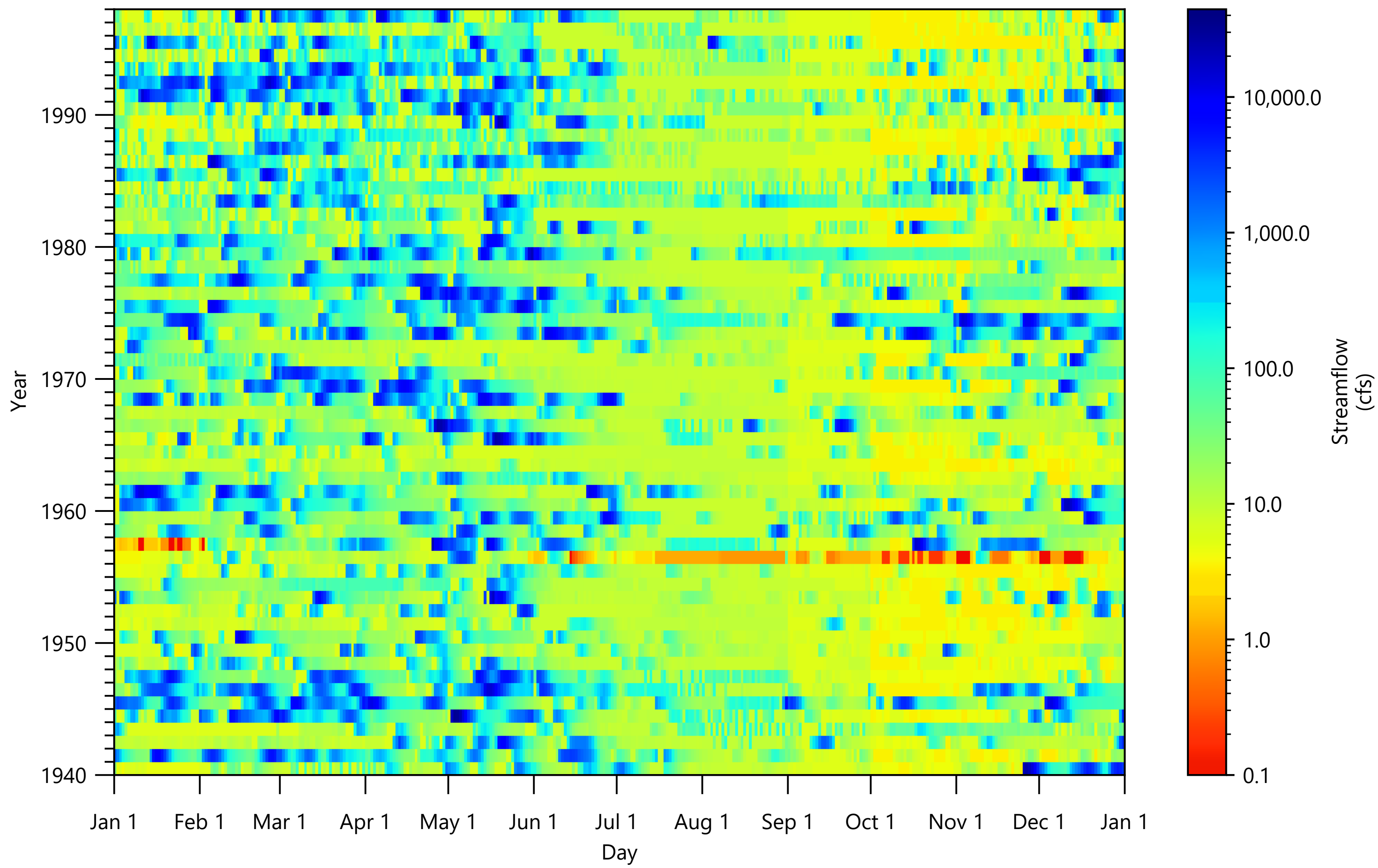
Figure F-61
Navasota River near Easterly: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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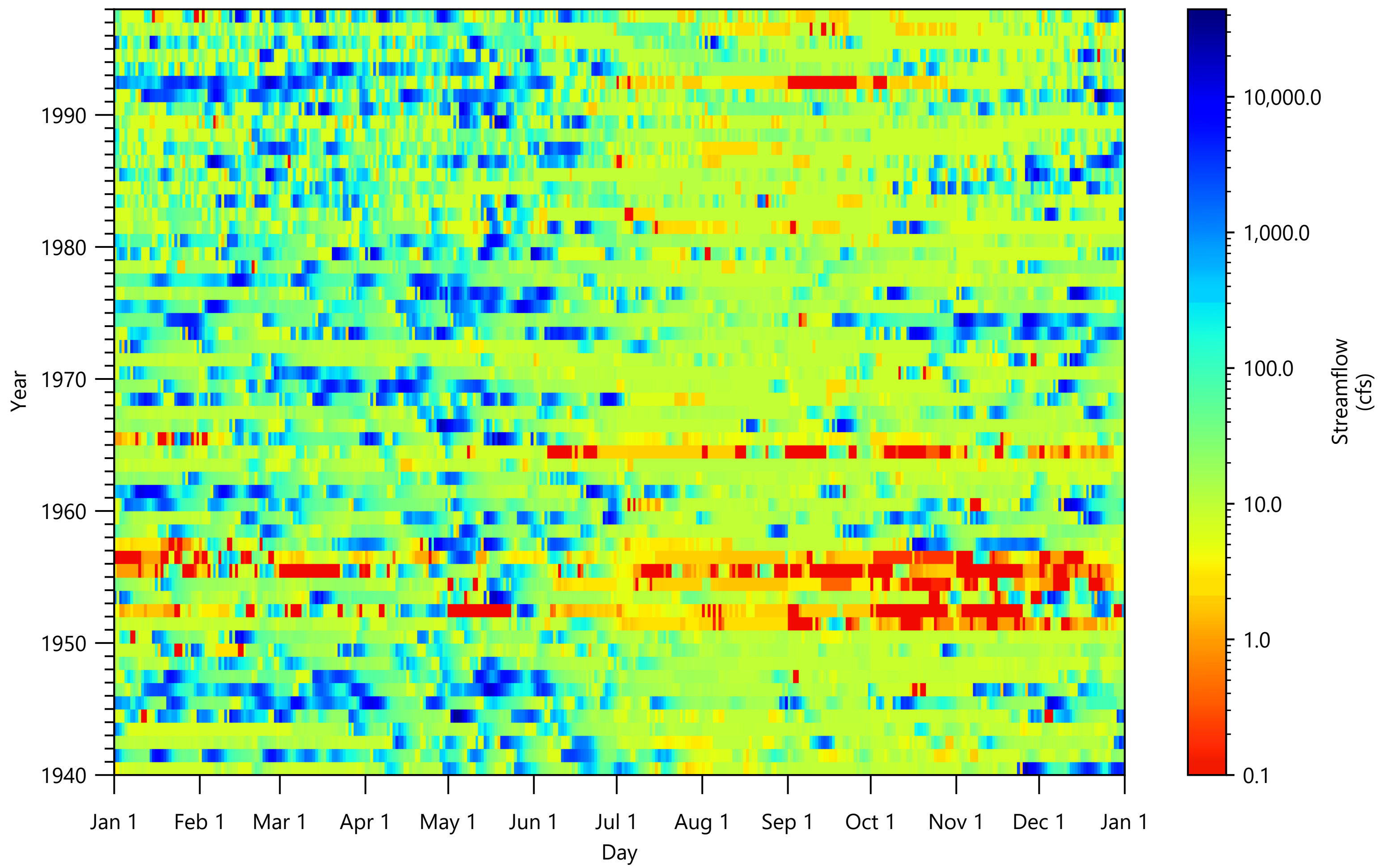
Figure F-62
Navasota River near Easterly: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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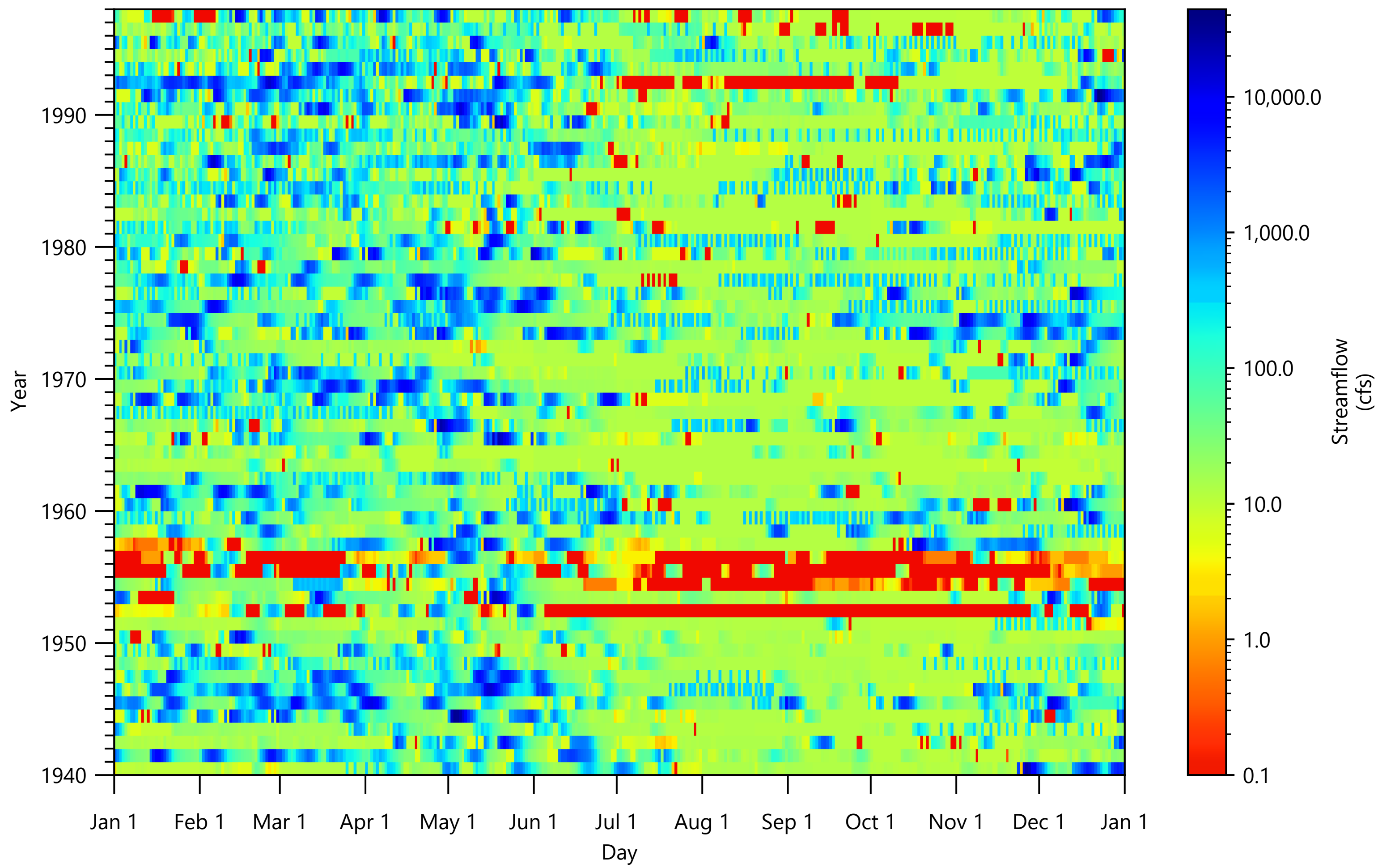
Figure F-63
Navasota River near Easterly: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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Figure F-64
Navasota River near Easterly: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

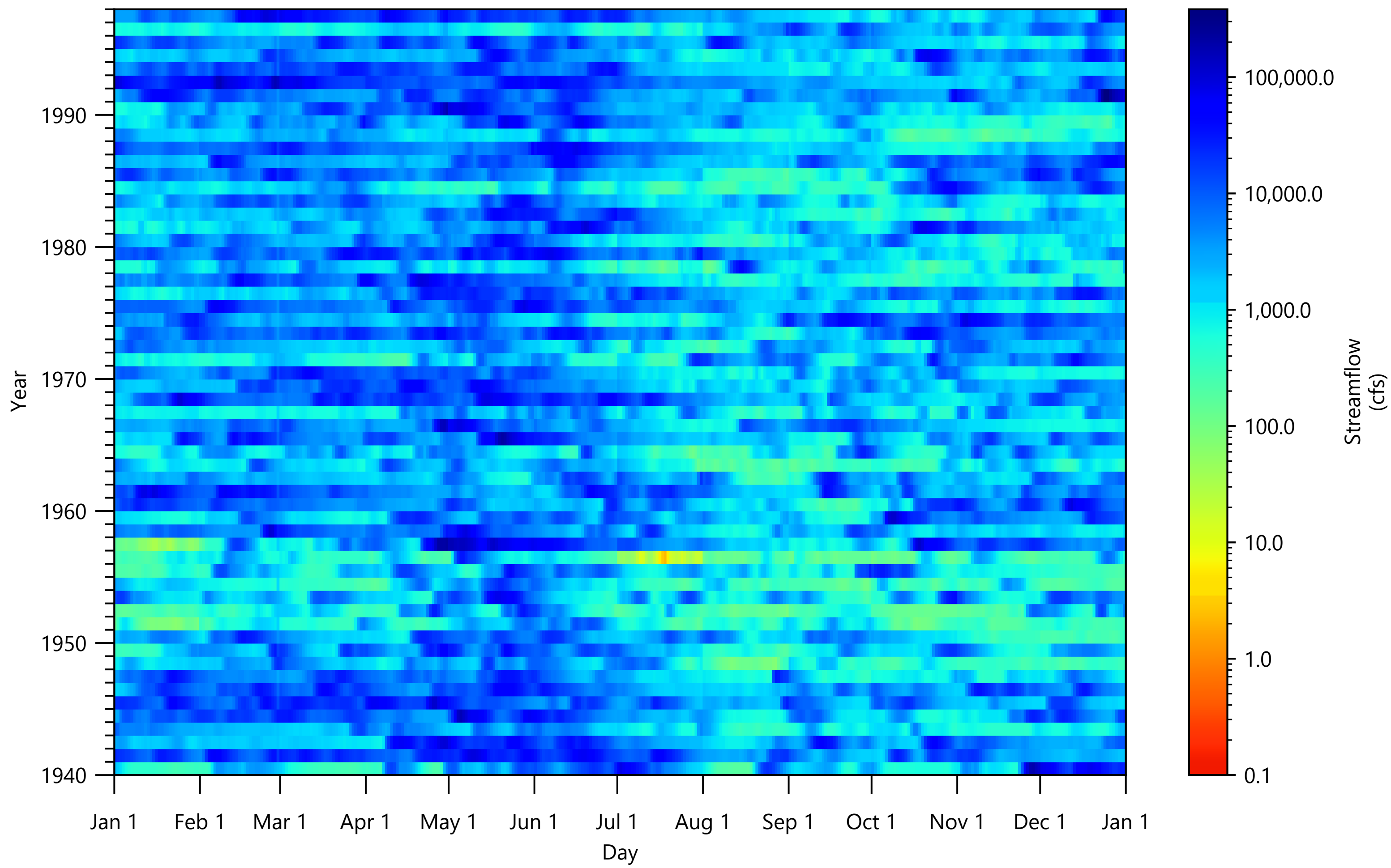

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Figure F-65
Brazos River near Hempstead: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

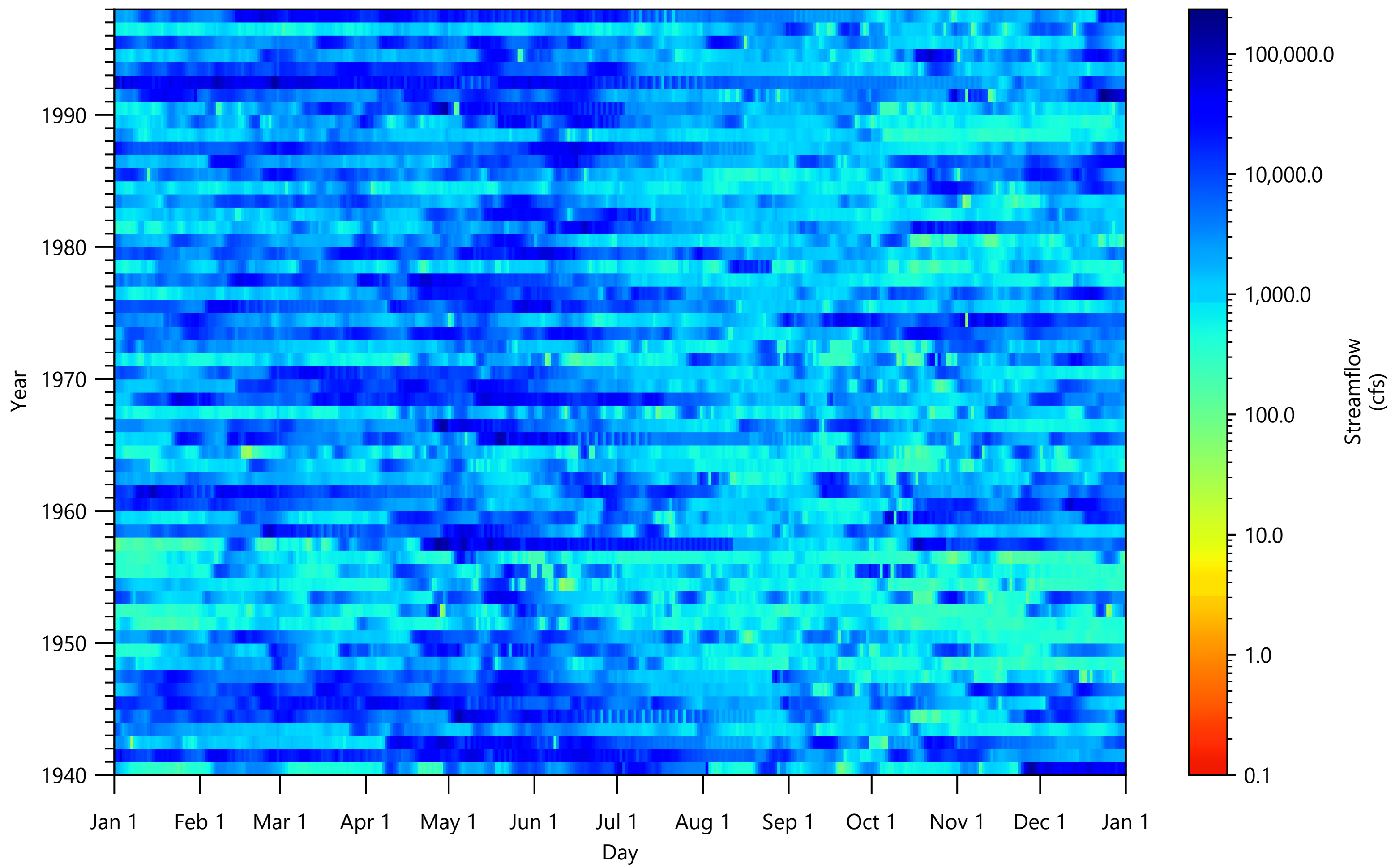

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Figure F-66
Brazos River near Hempstead: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

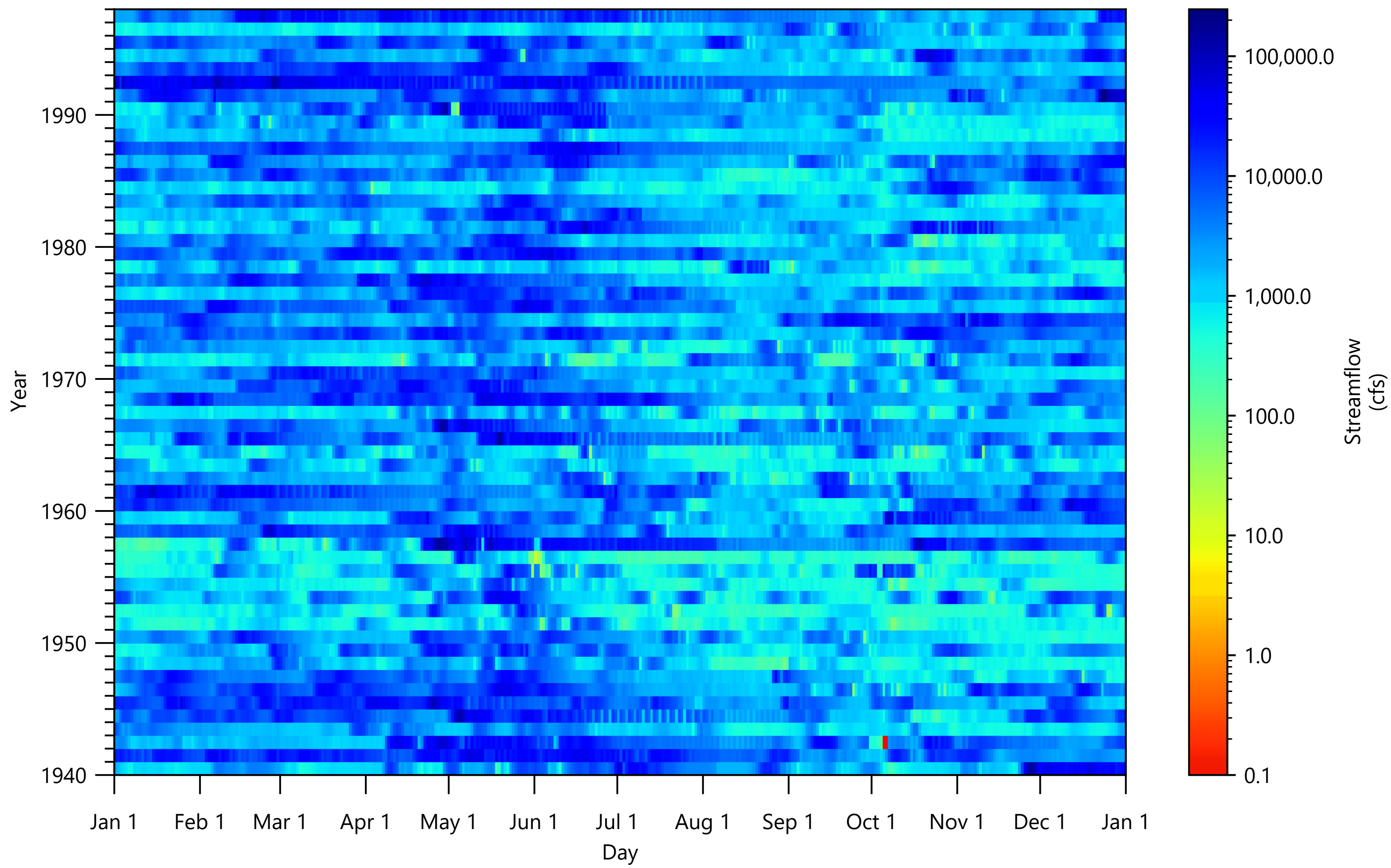

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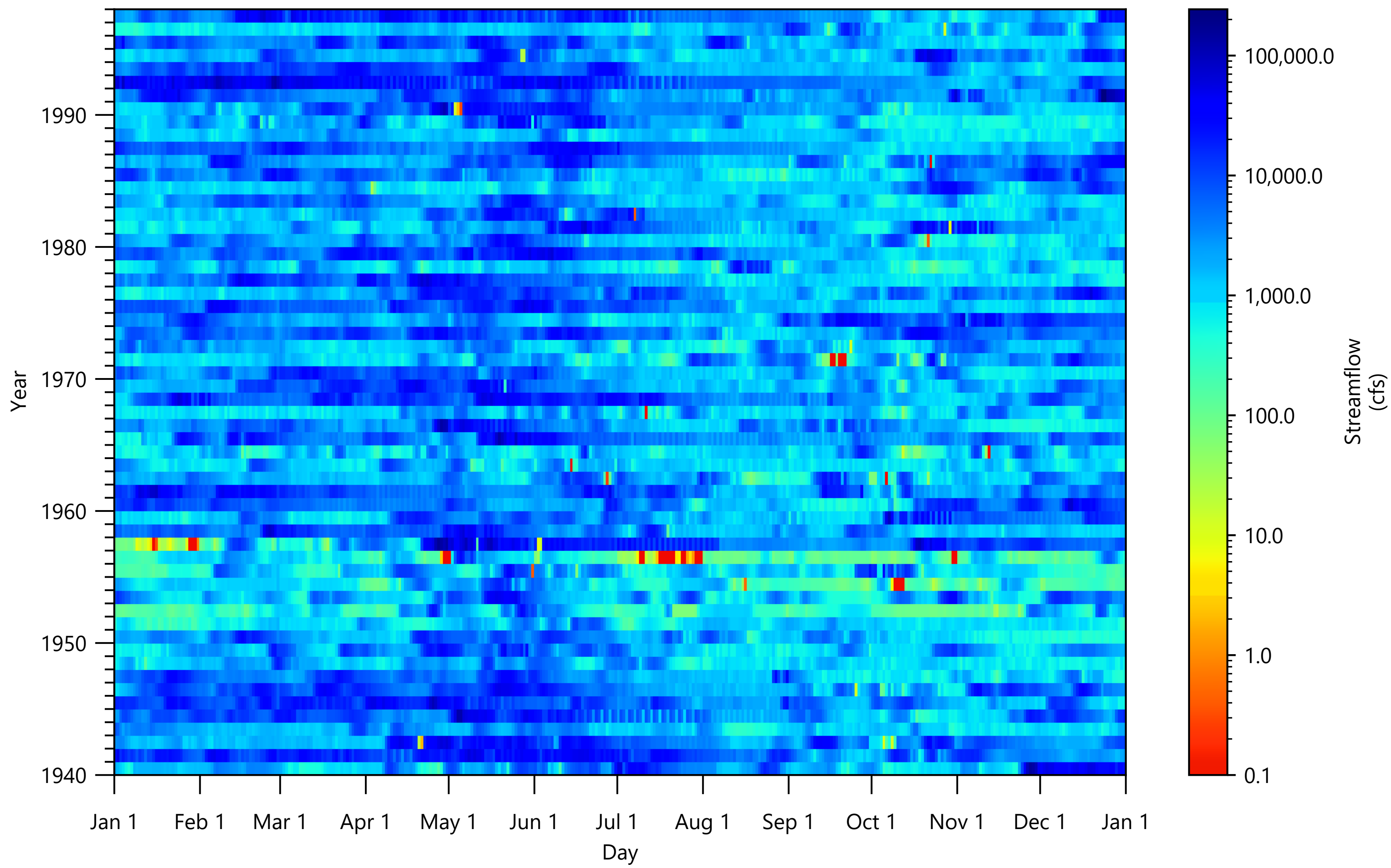
Figure F-67
Brazos River near Hempstead: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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Figure F-68
Brazos River near Hempstead: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

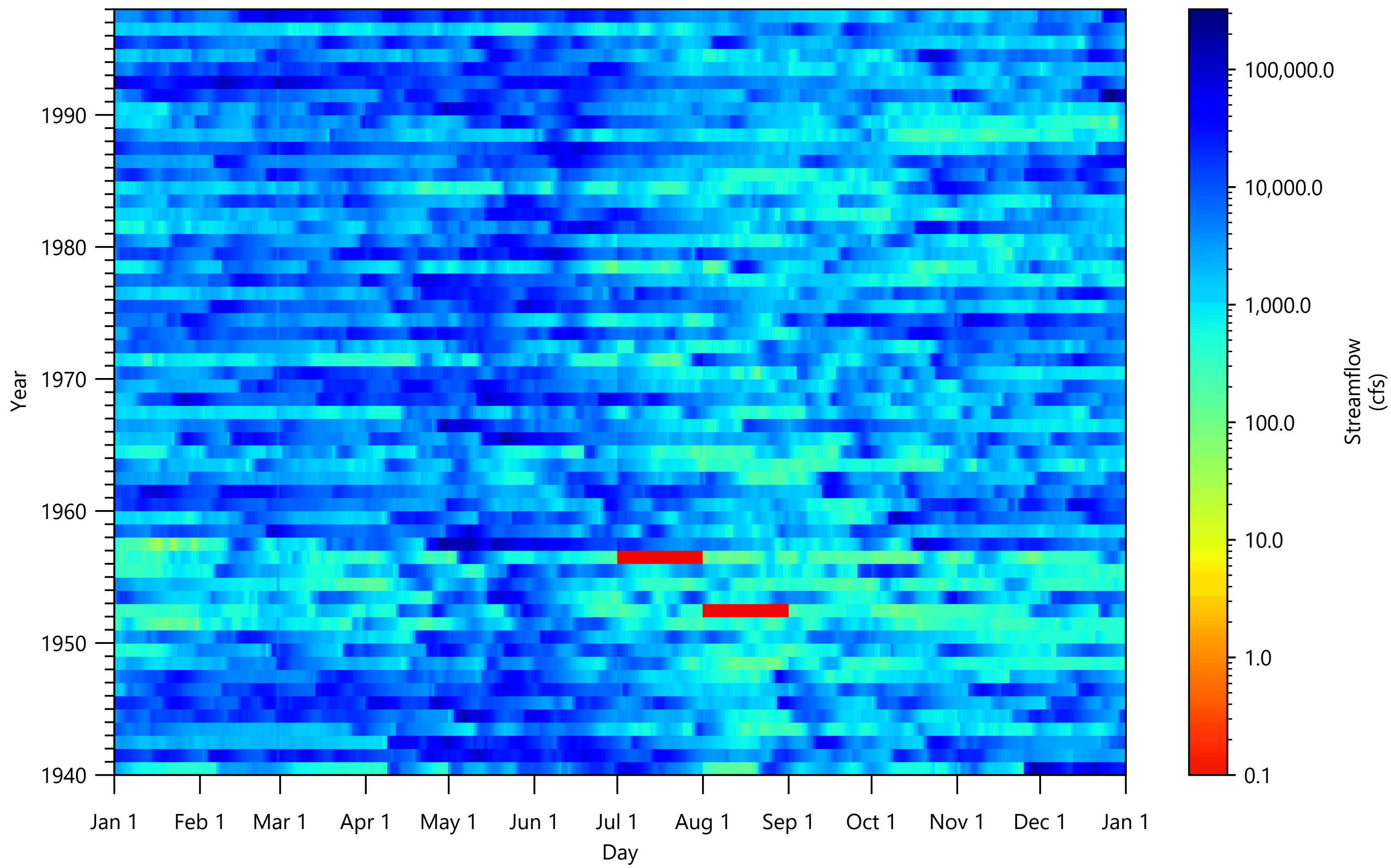

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Figure F-69
Brazos River at Richmond: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

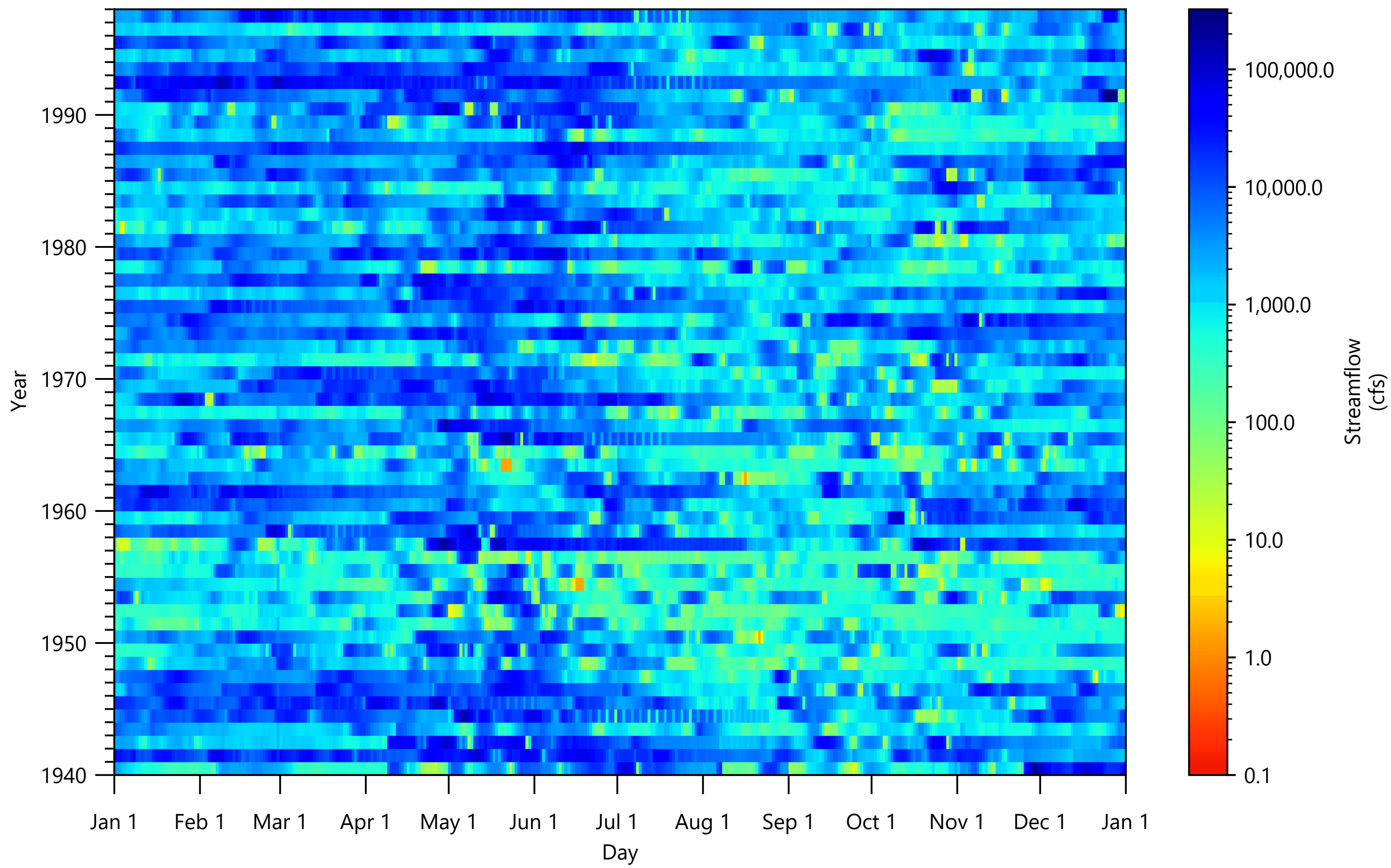

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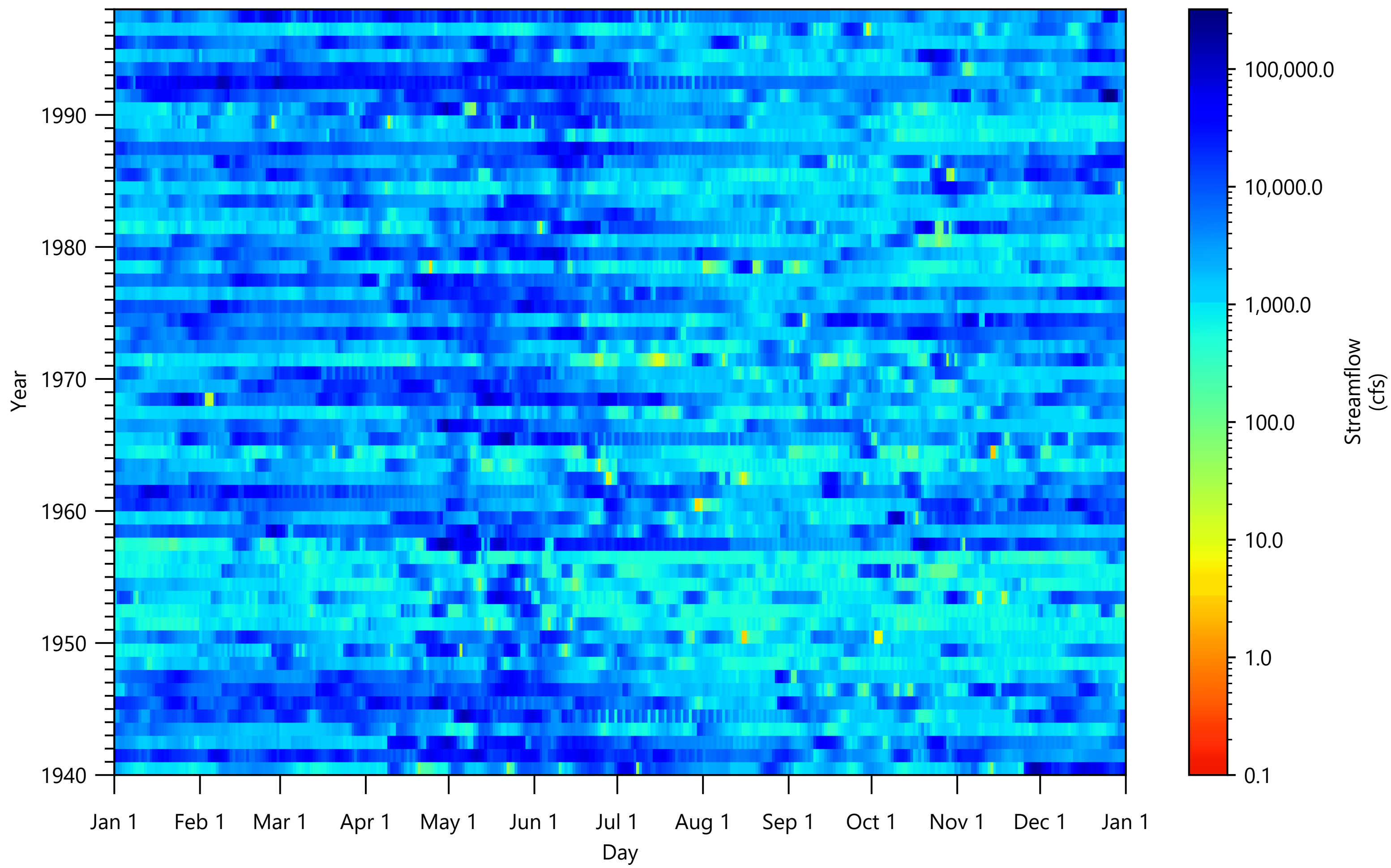
Figure F-70
Brazos River at Richmond: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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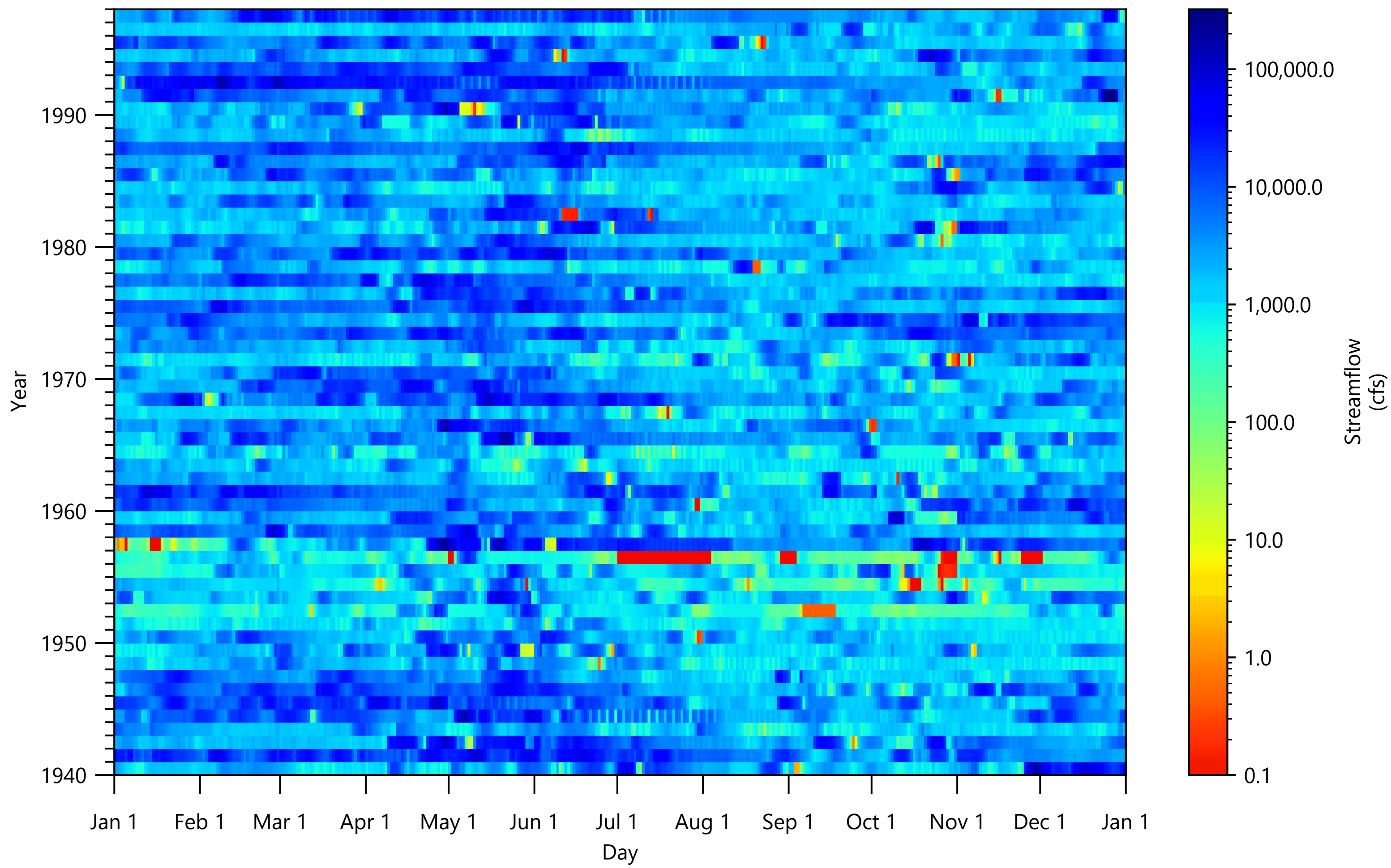
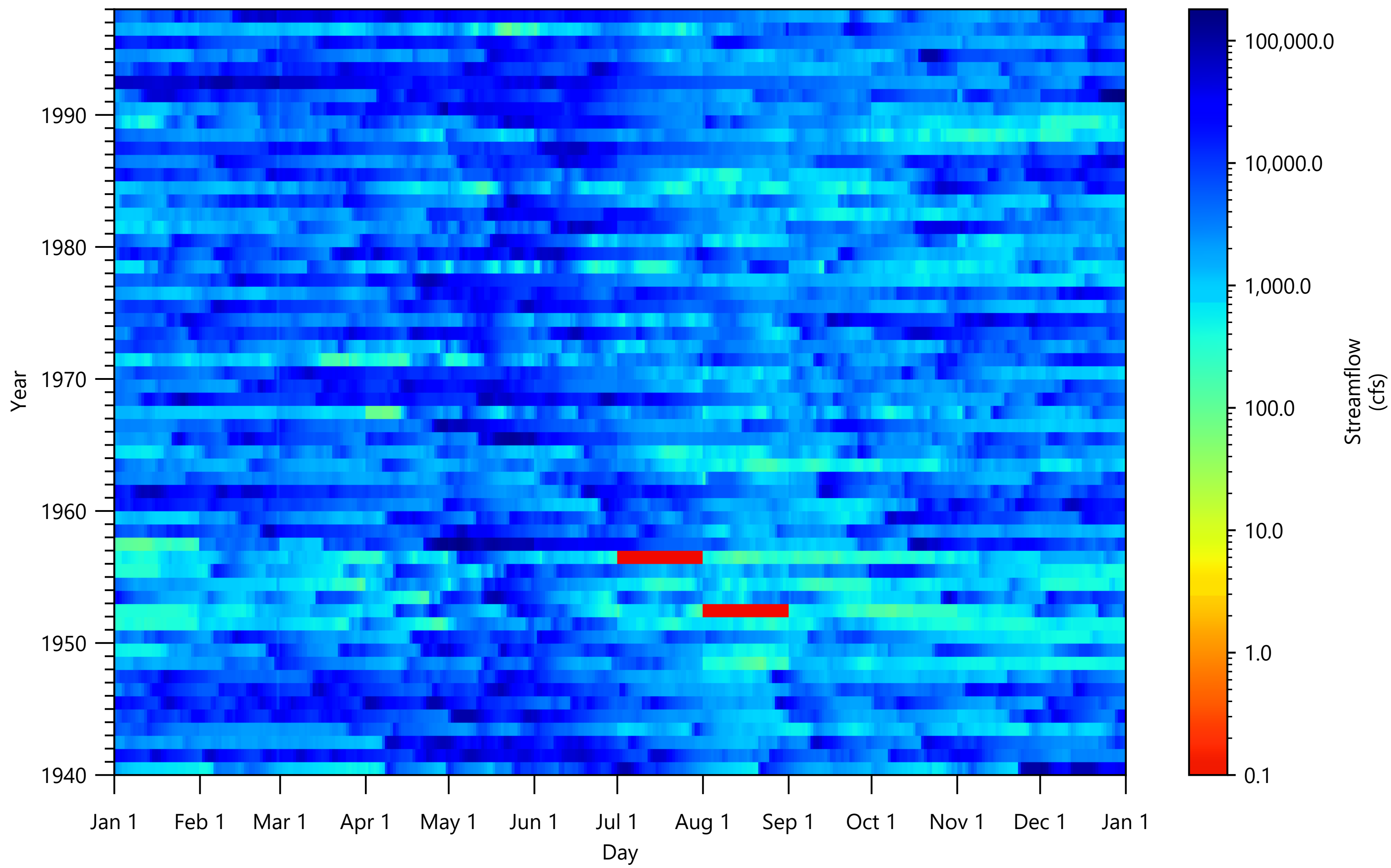
Figure F-71
Brazos River at Richmond: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second



Note: cfs: cubic feet per second

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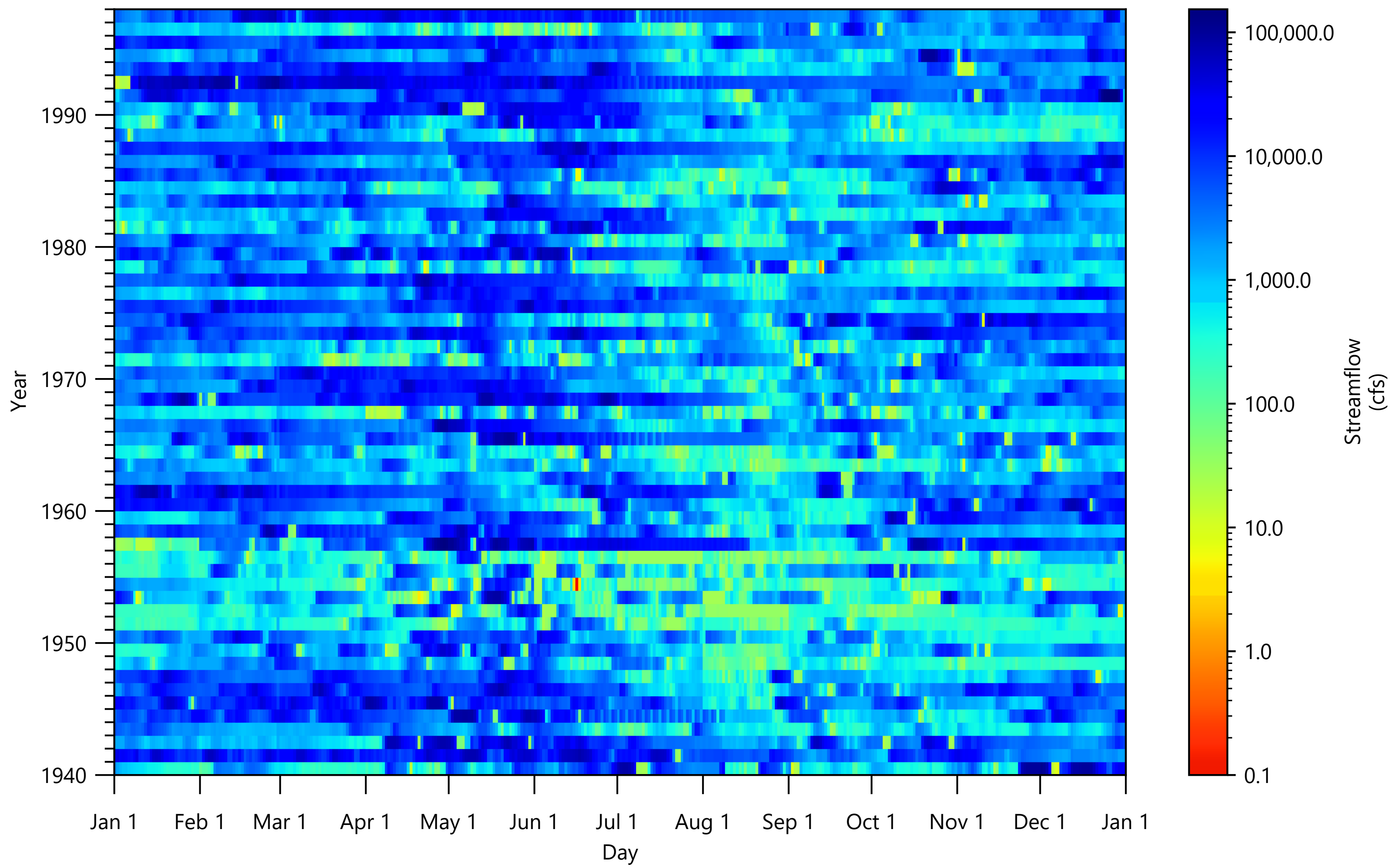
Figure F-73
Brazos River at Rosharon: Naturalized Flow Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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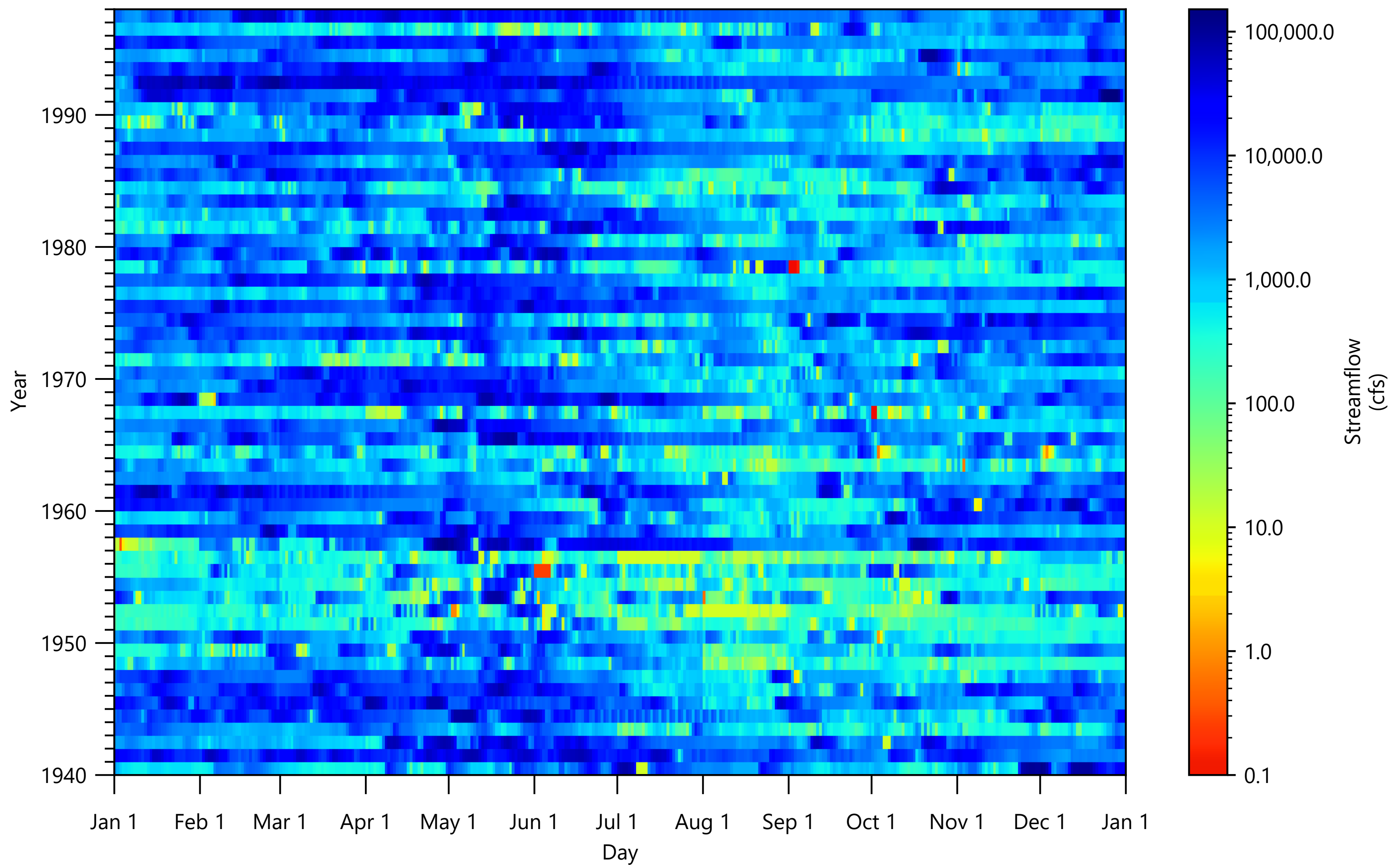
Figure F-74
Brazos River at Rosharon: Current Water Use Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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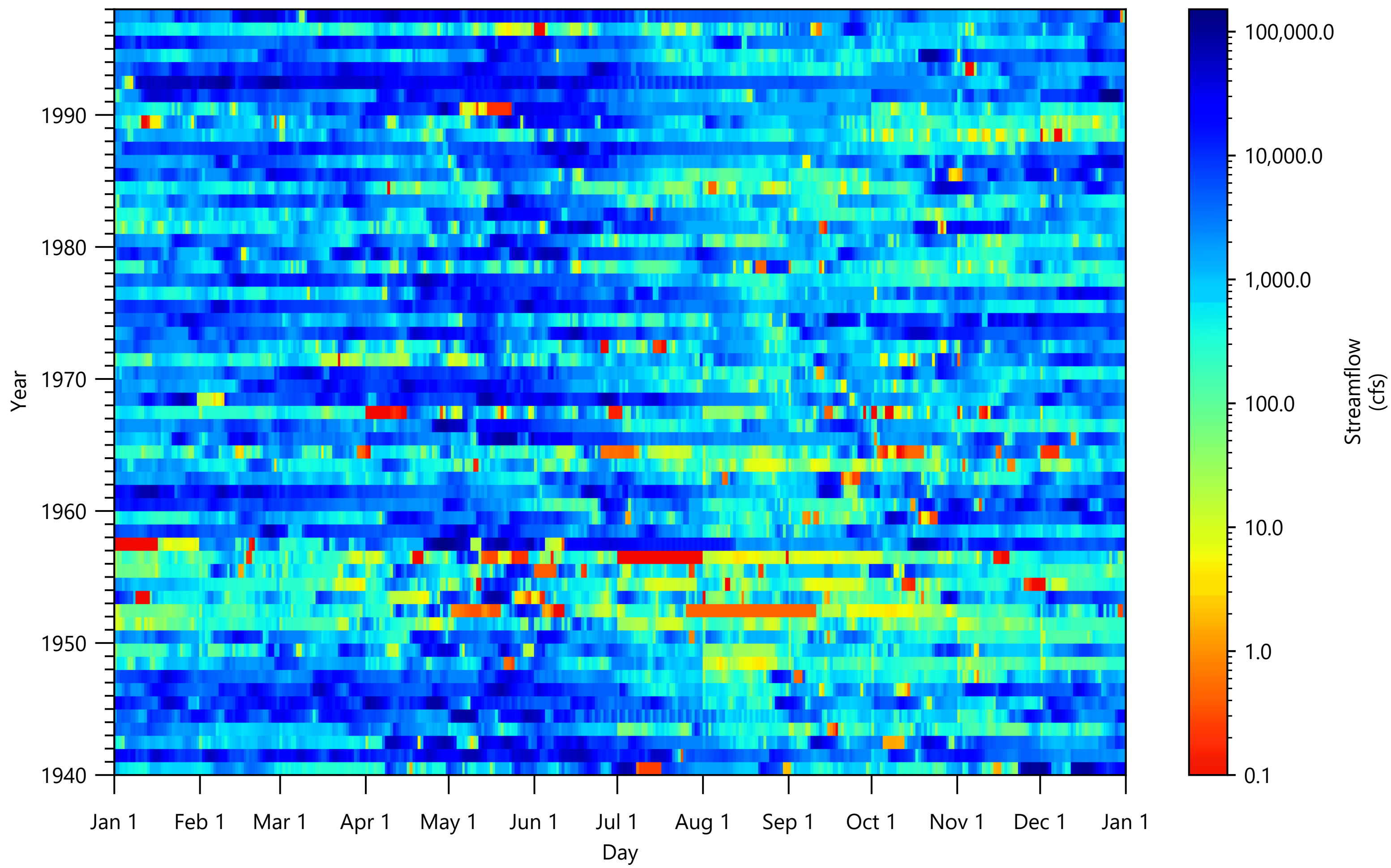
Figure F-75
Brazos River at Rosharon: Partial Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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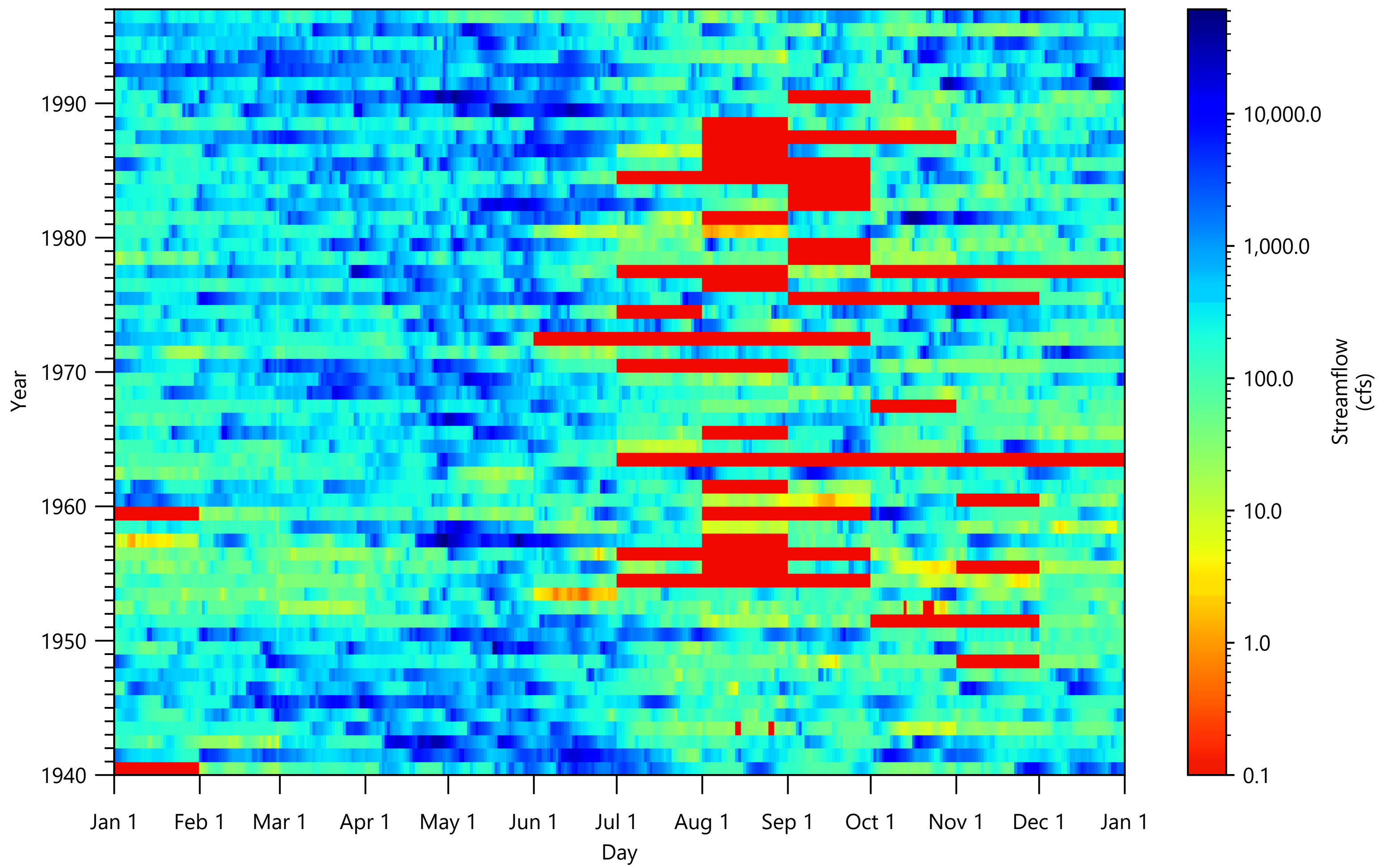
Figure F-76
Brazos River at Rosharon: Full Utilization Scenario
Flow Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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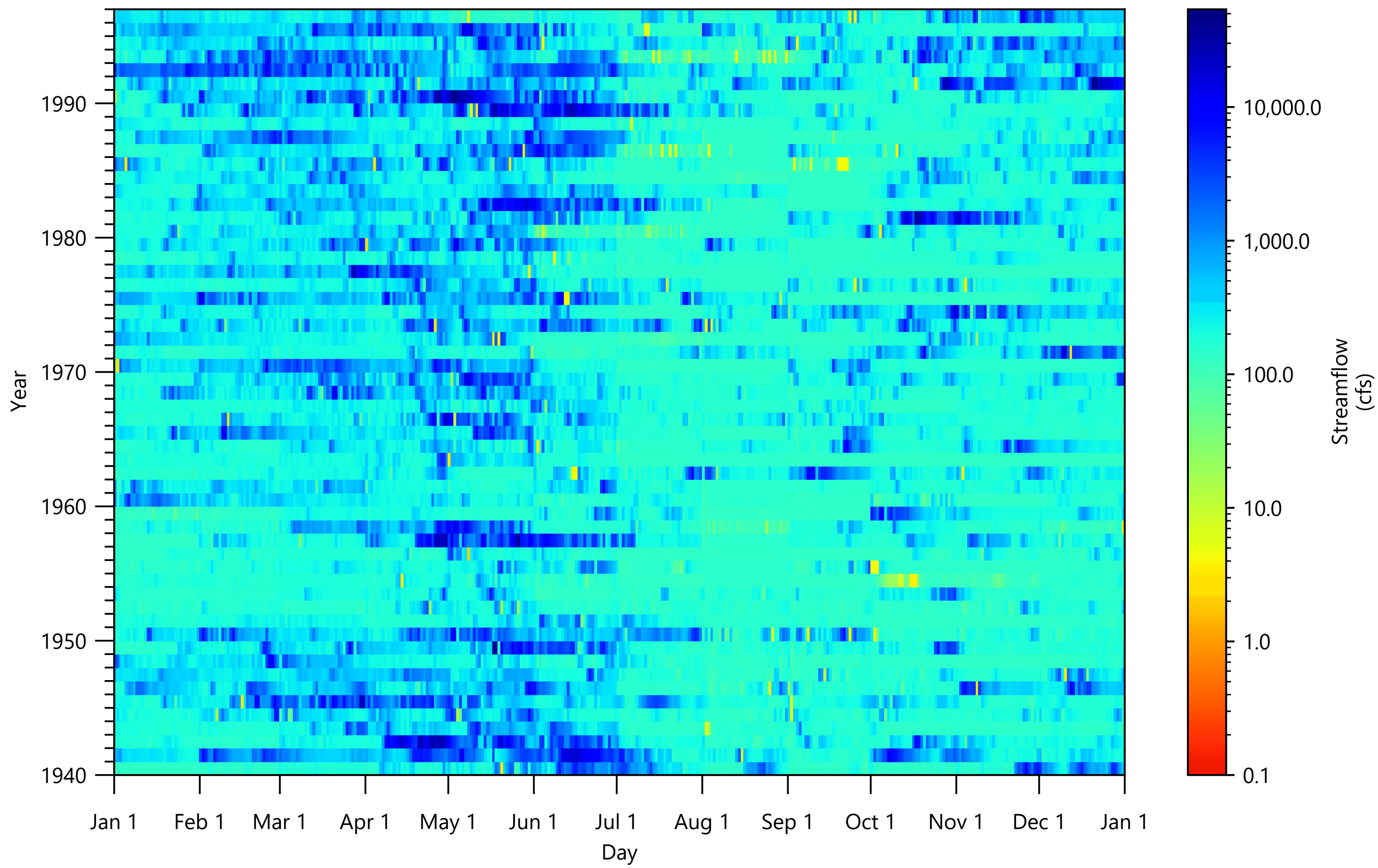
Figure F-77
West Fork Trinity River near Grand Prairie: Naturalized Flow Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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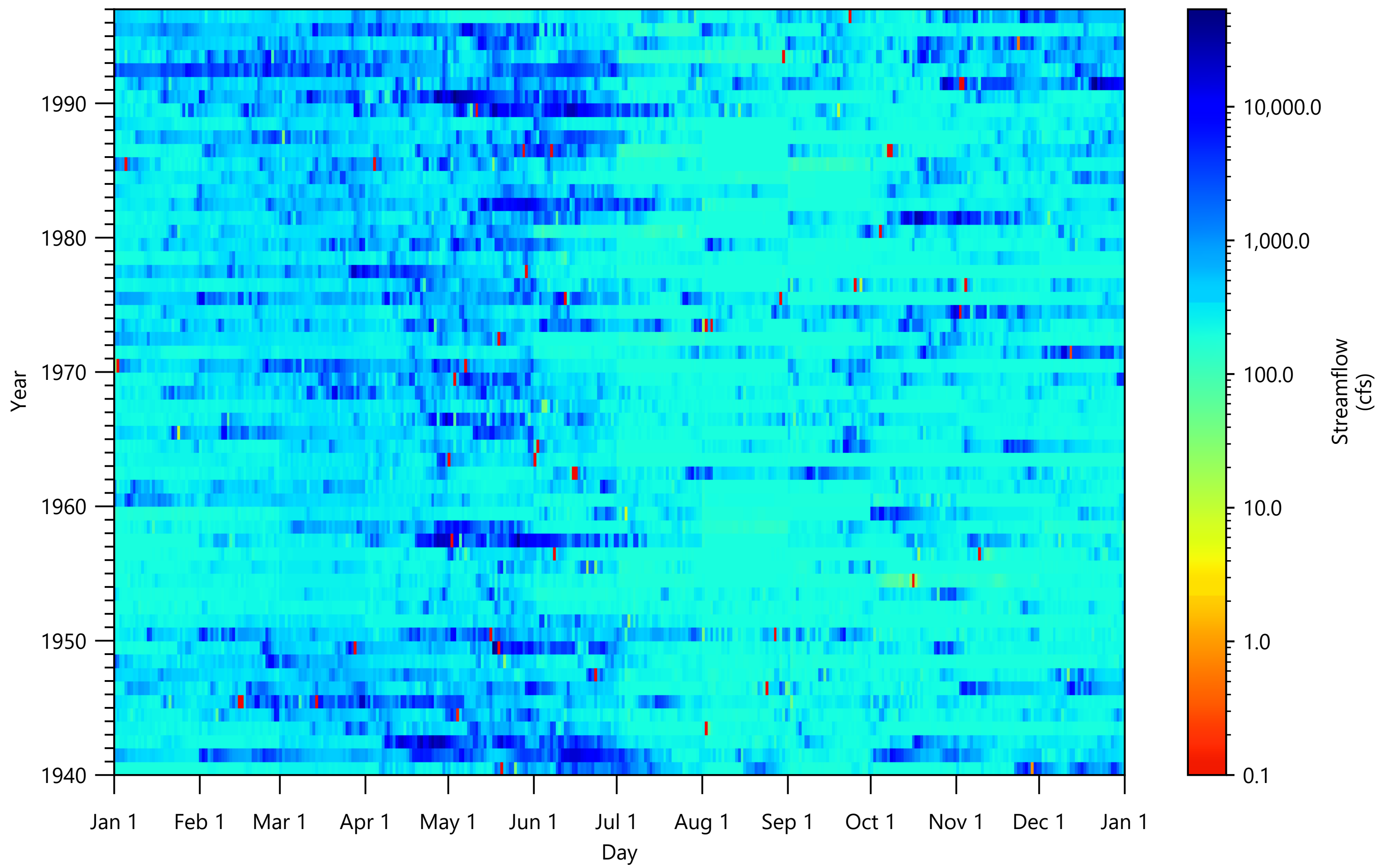
Figure F-78
West Fork Trinity River near Grand Prairie: Current Water Use Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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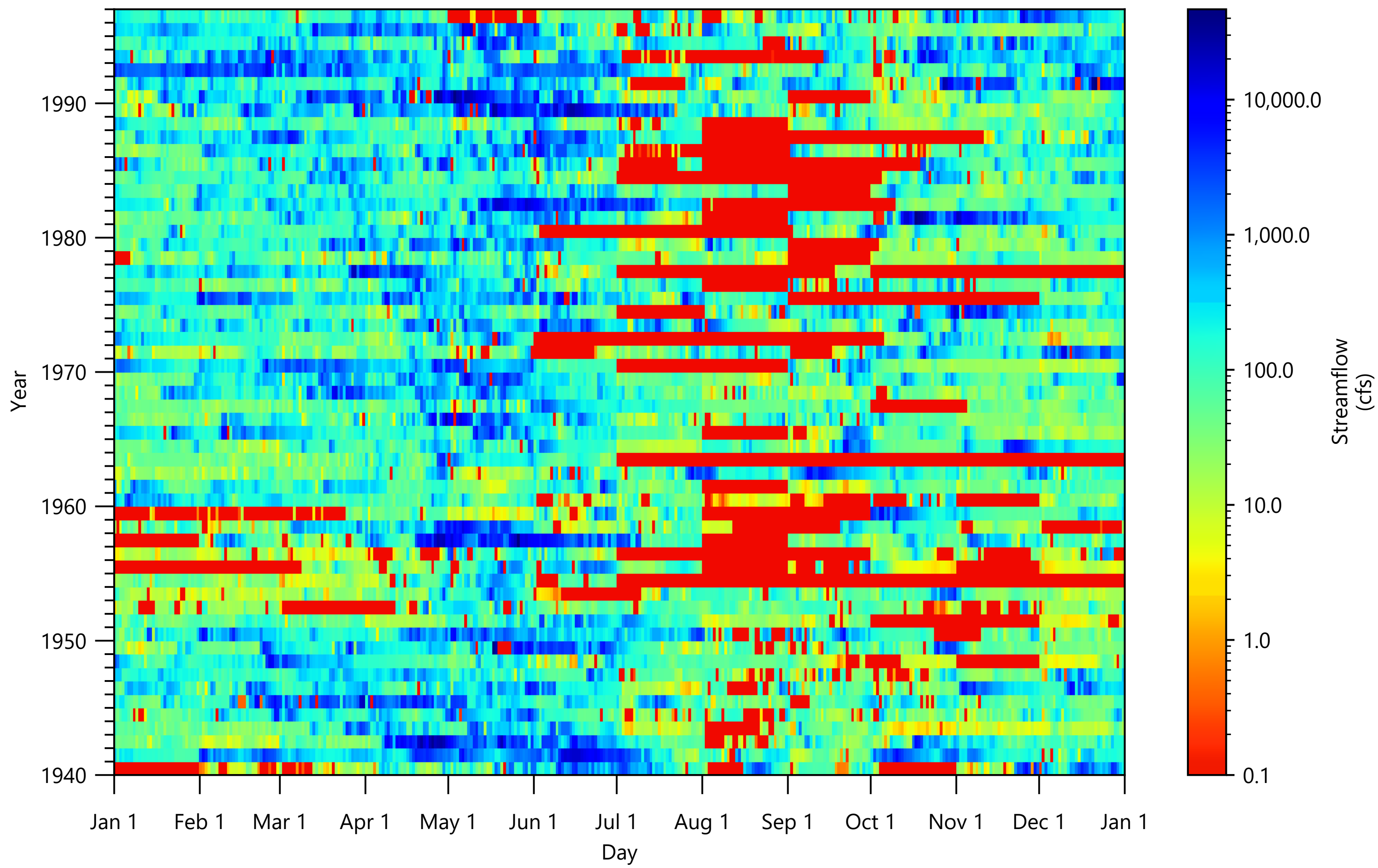
Figure F-79
West Fork Trinity River near Grand Prairie: Partial Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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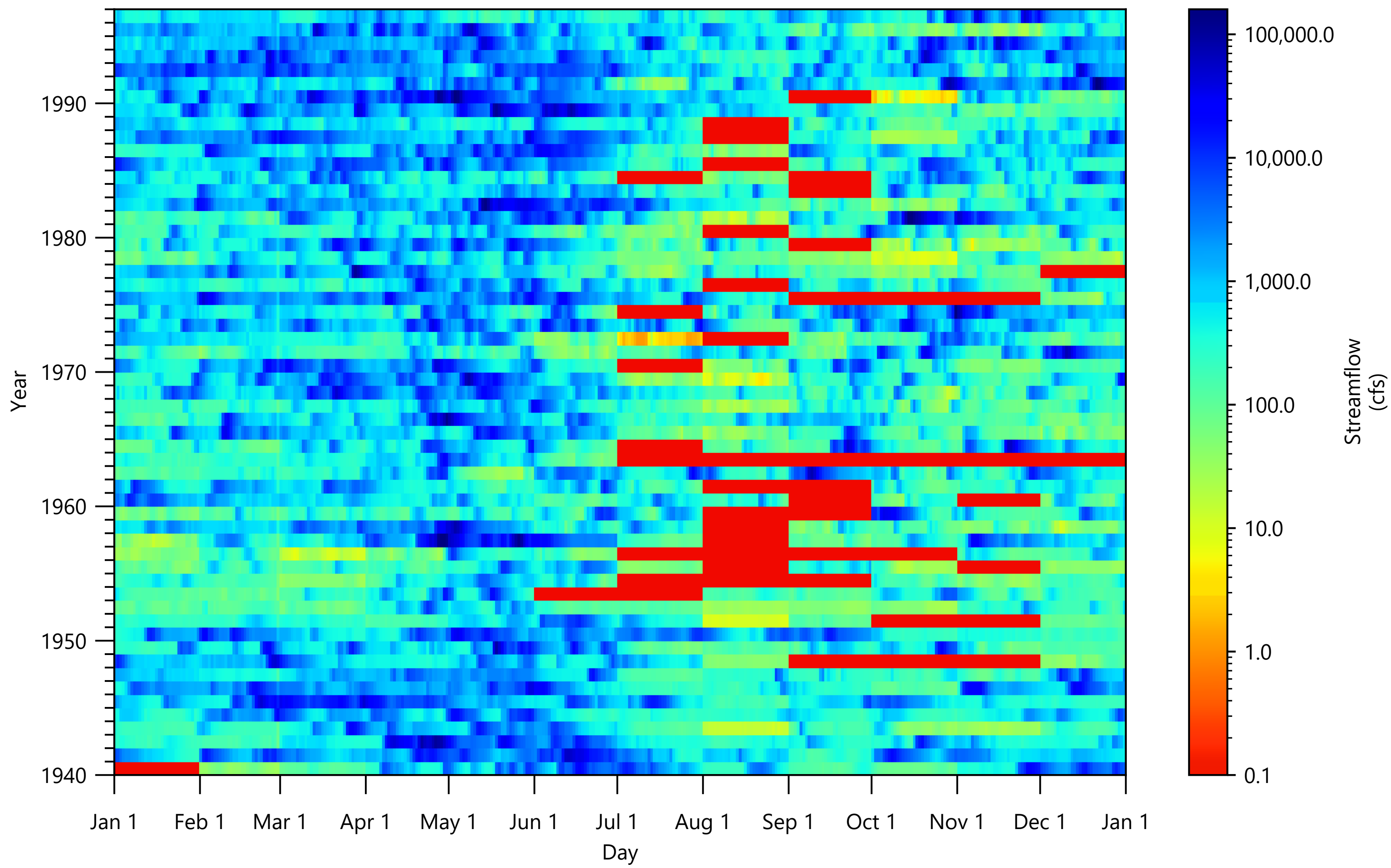
Figure F-80
West Fork Trinity River near Grand Prairie: Full Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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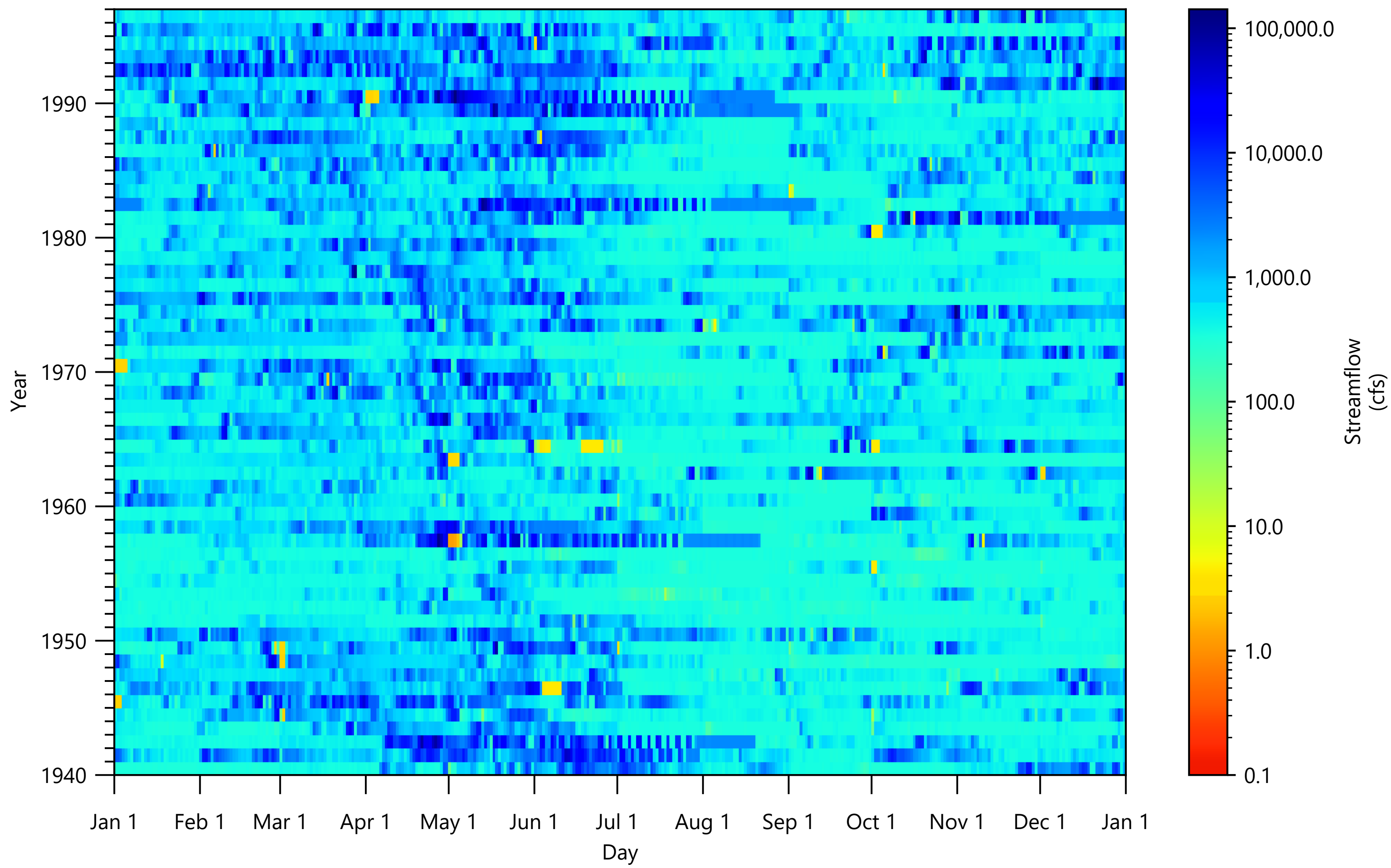
Figure F-81
Trinity River at Dallas: Naturalized Flow Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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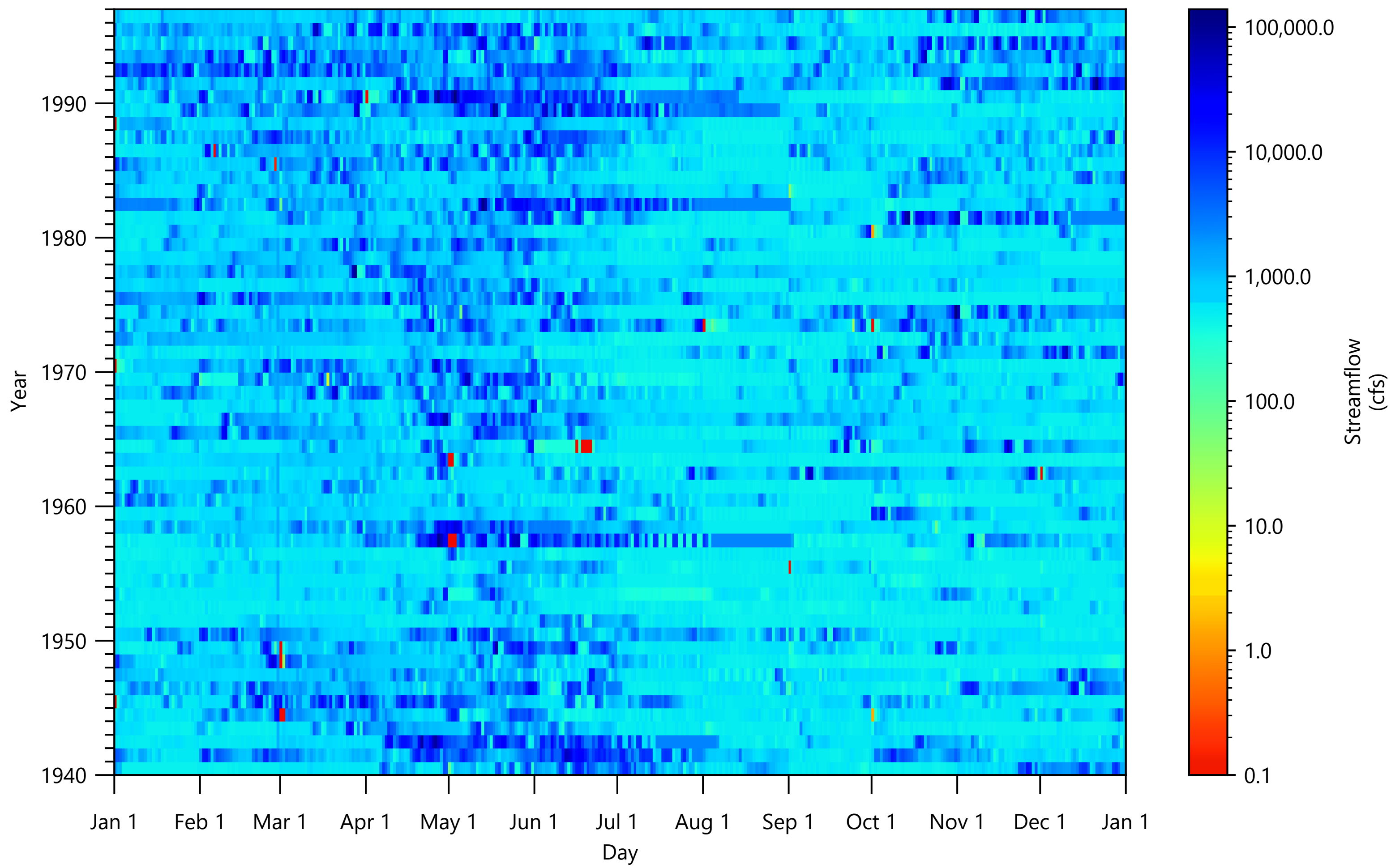
Figure F-82
Trinity River at Dallas: Current Water Use Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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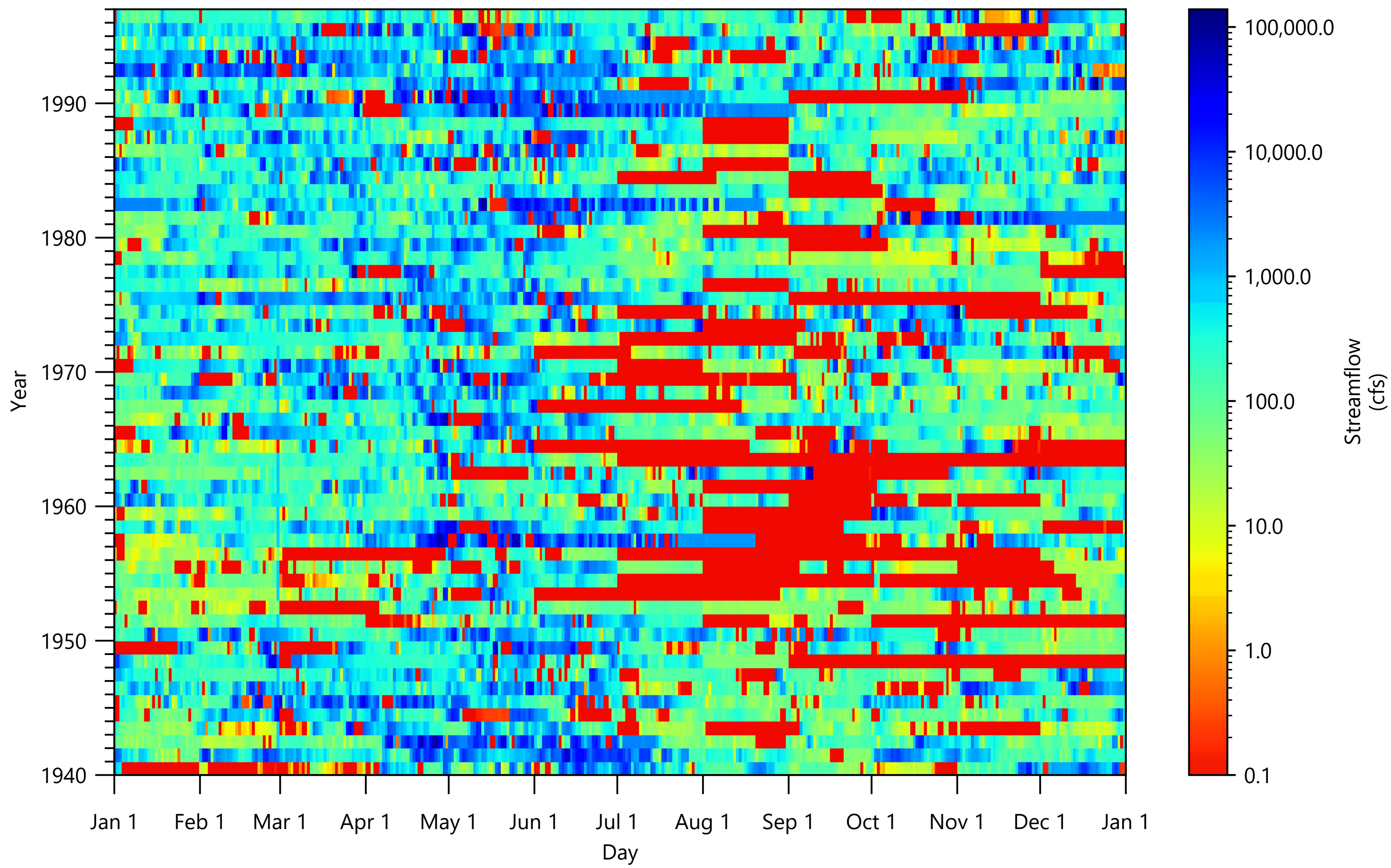
Figure F-83
Trinity River at Dallas: Partial Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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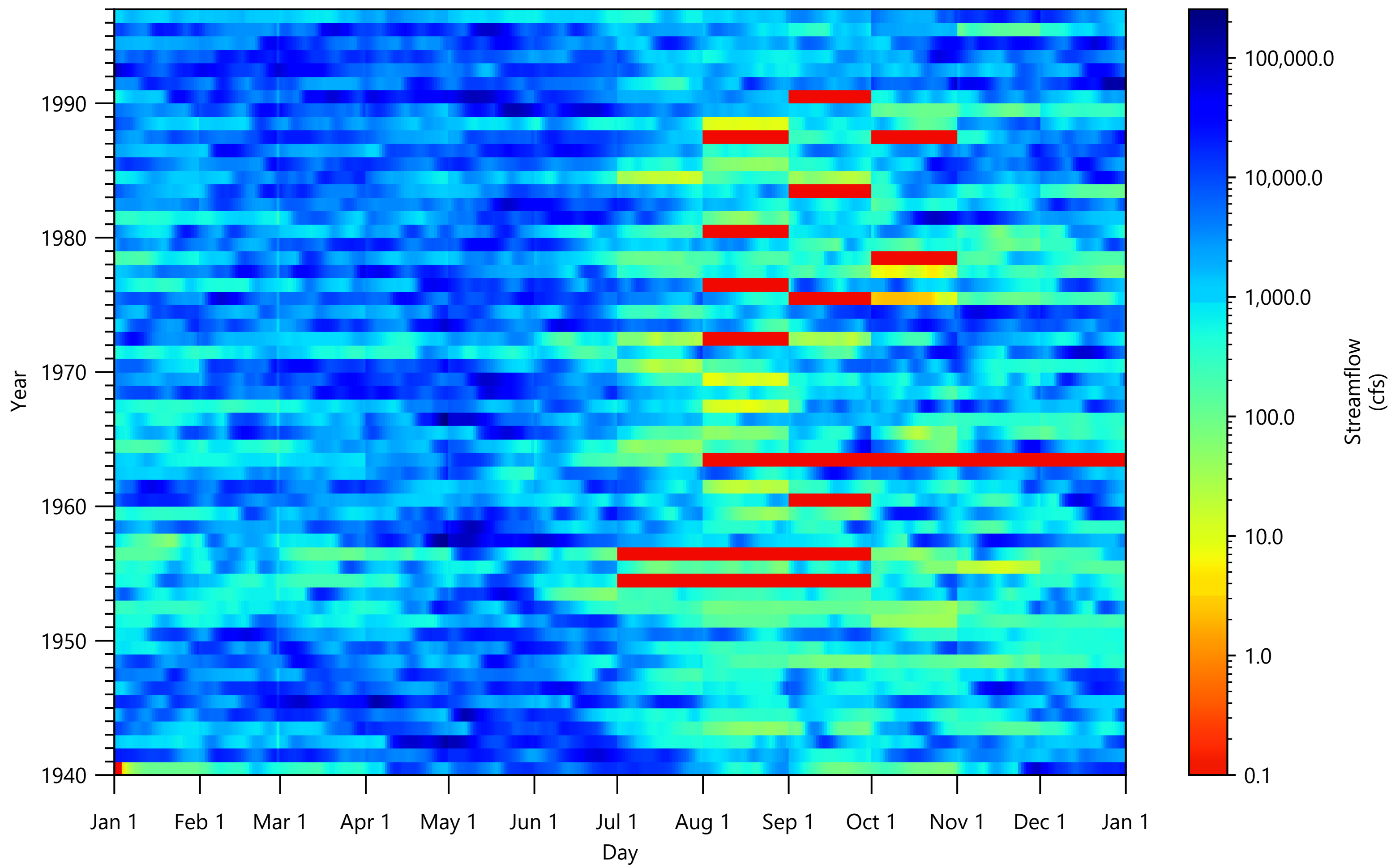
Figure F-84
Trinity River at Dallas: Full Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:29 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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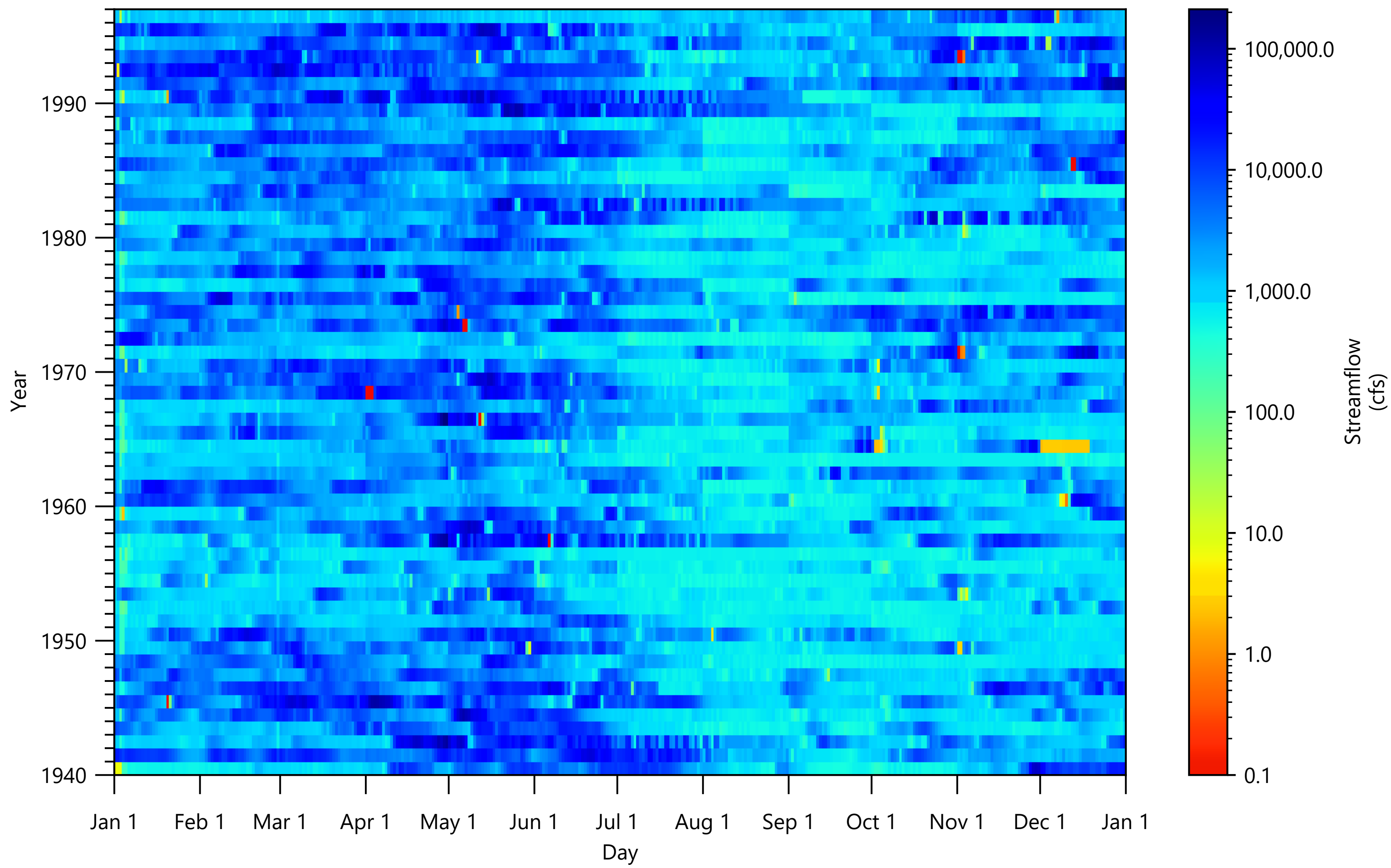
Figure F-85
Trinity River near Oakwood: Naturalized Flow Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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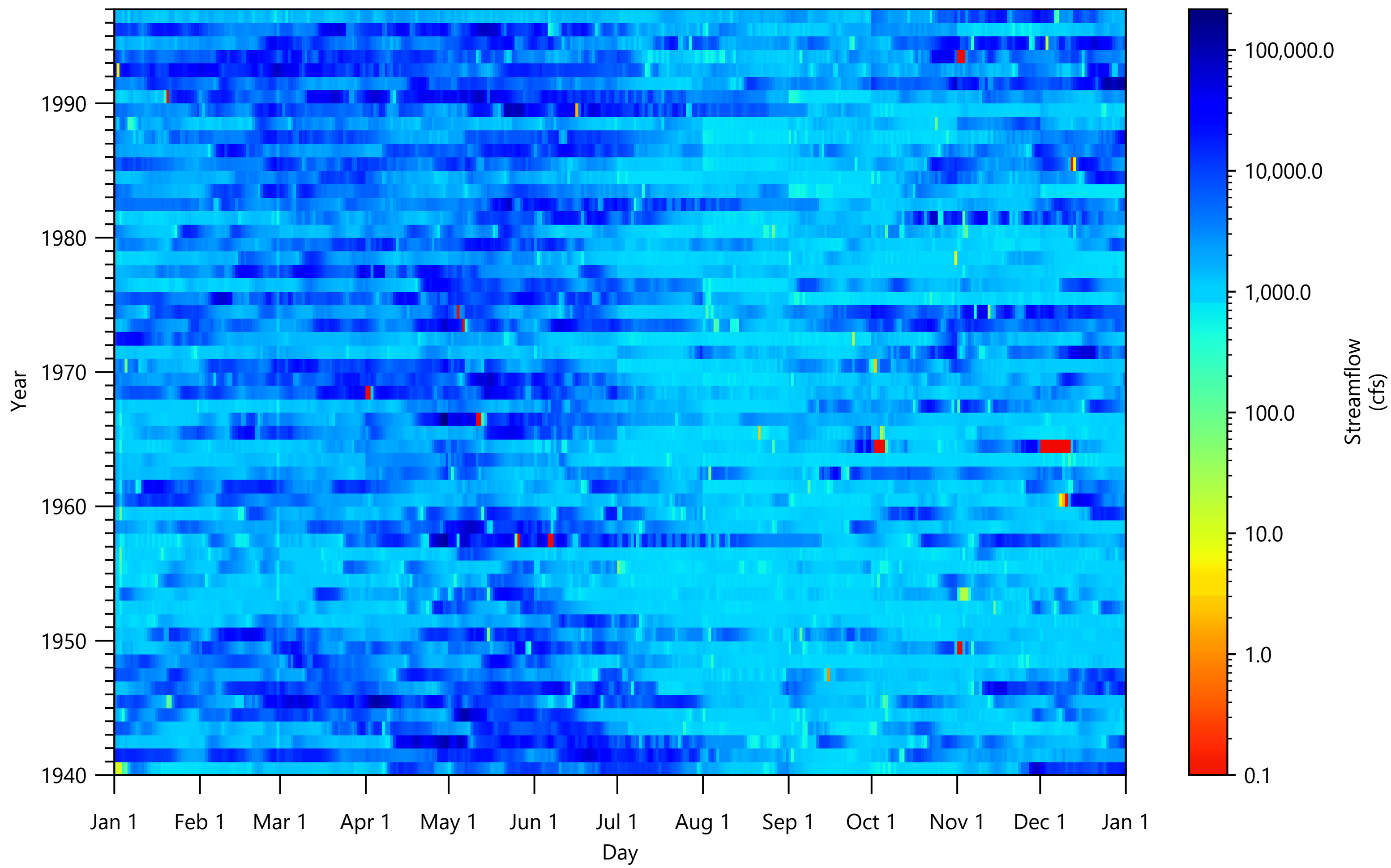
Figure F-86
Trinity River near Oakwood: Current Water Use Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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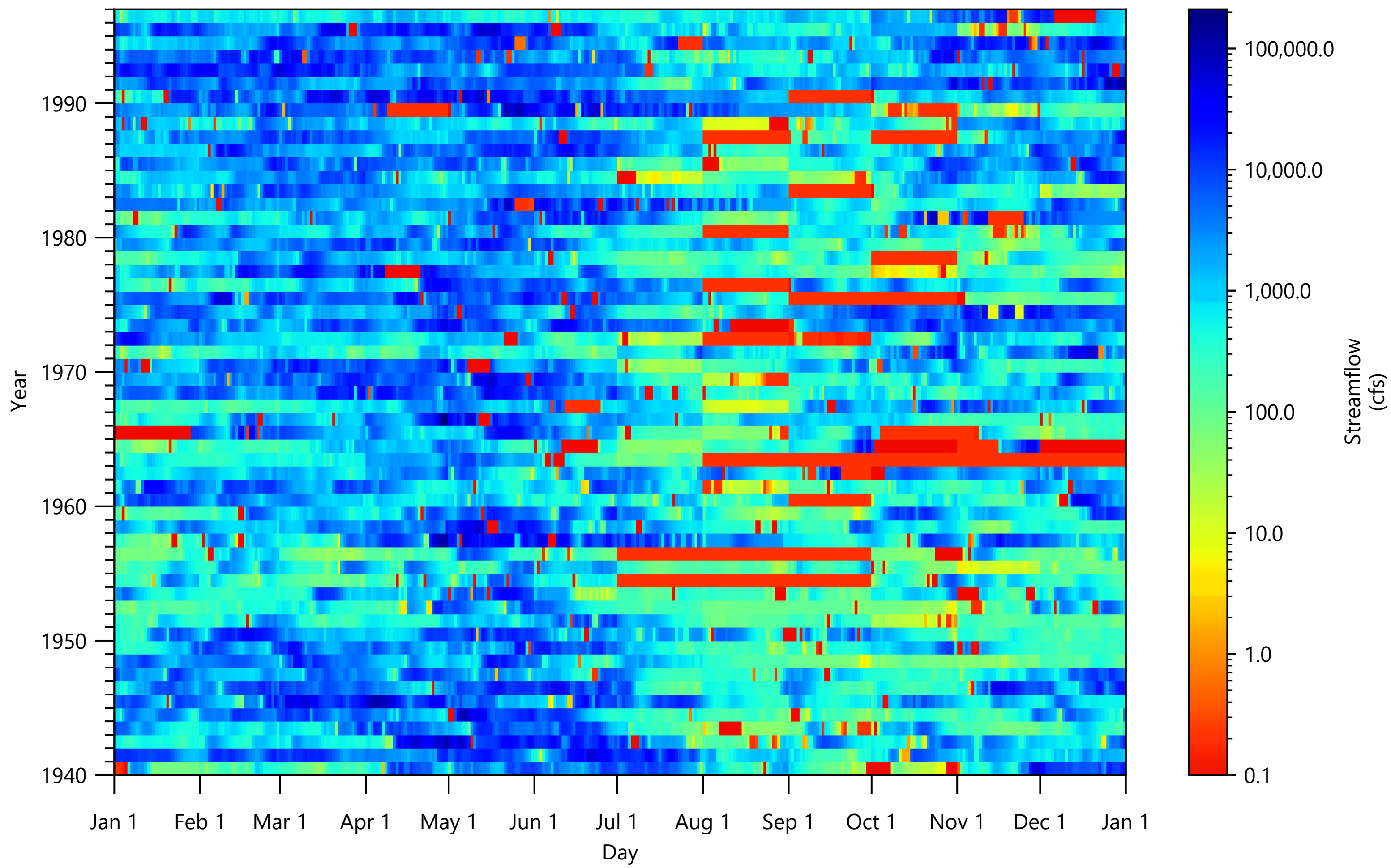
Figure F-87
Trinity River near Oakwood: Partial Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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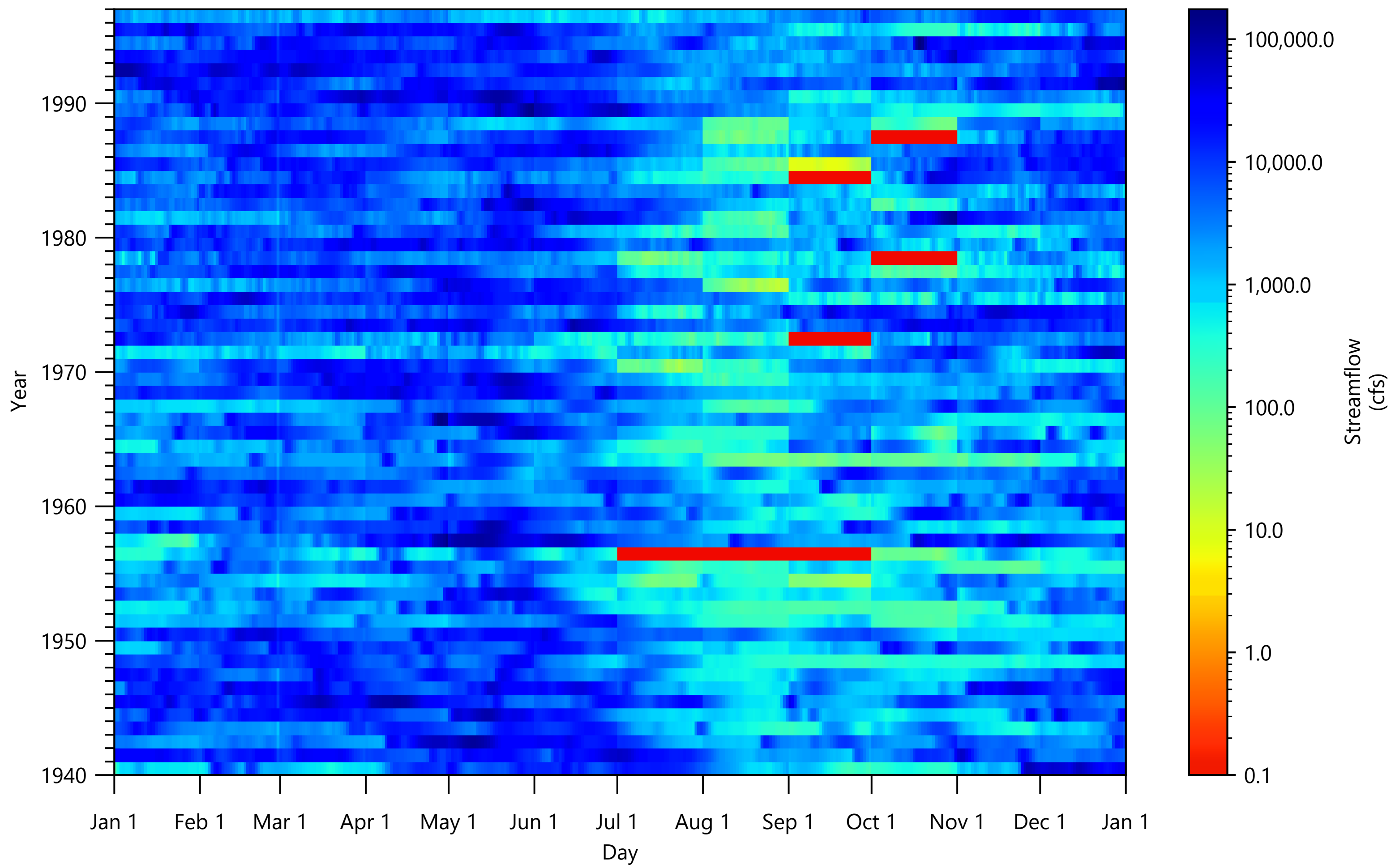
Figure F-88
Trinity River near Oakwood: Full Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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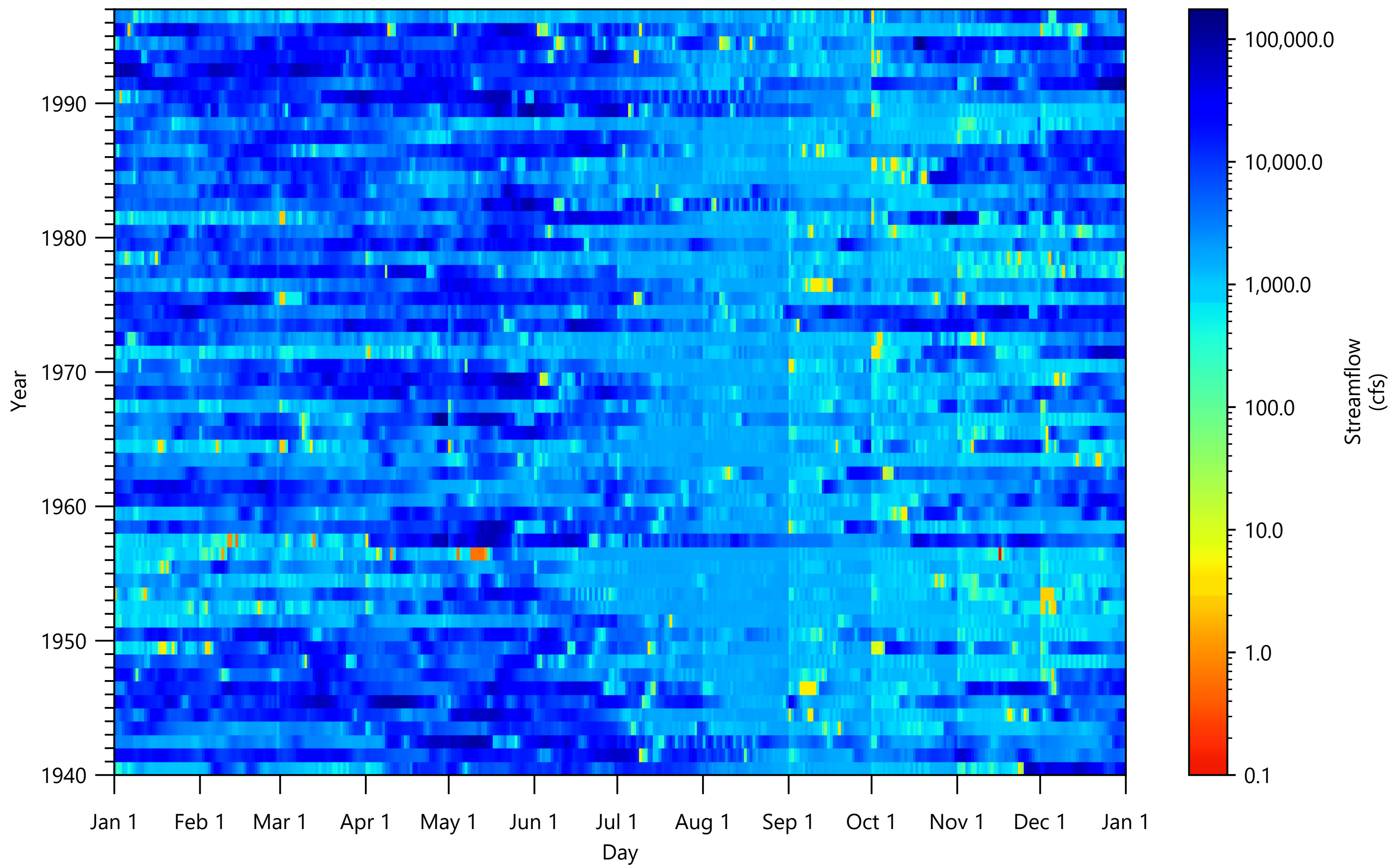
Figure F-89
Trinity River near Romayor: Naturalized Flow Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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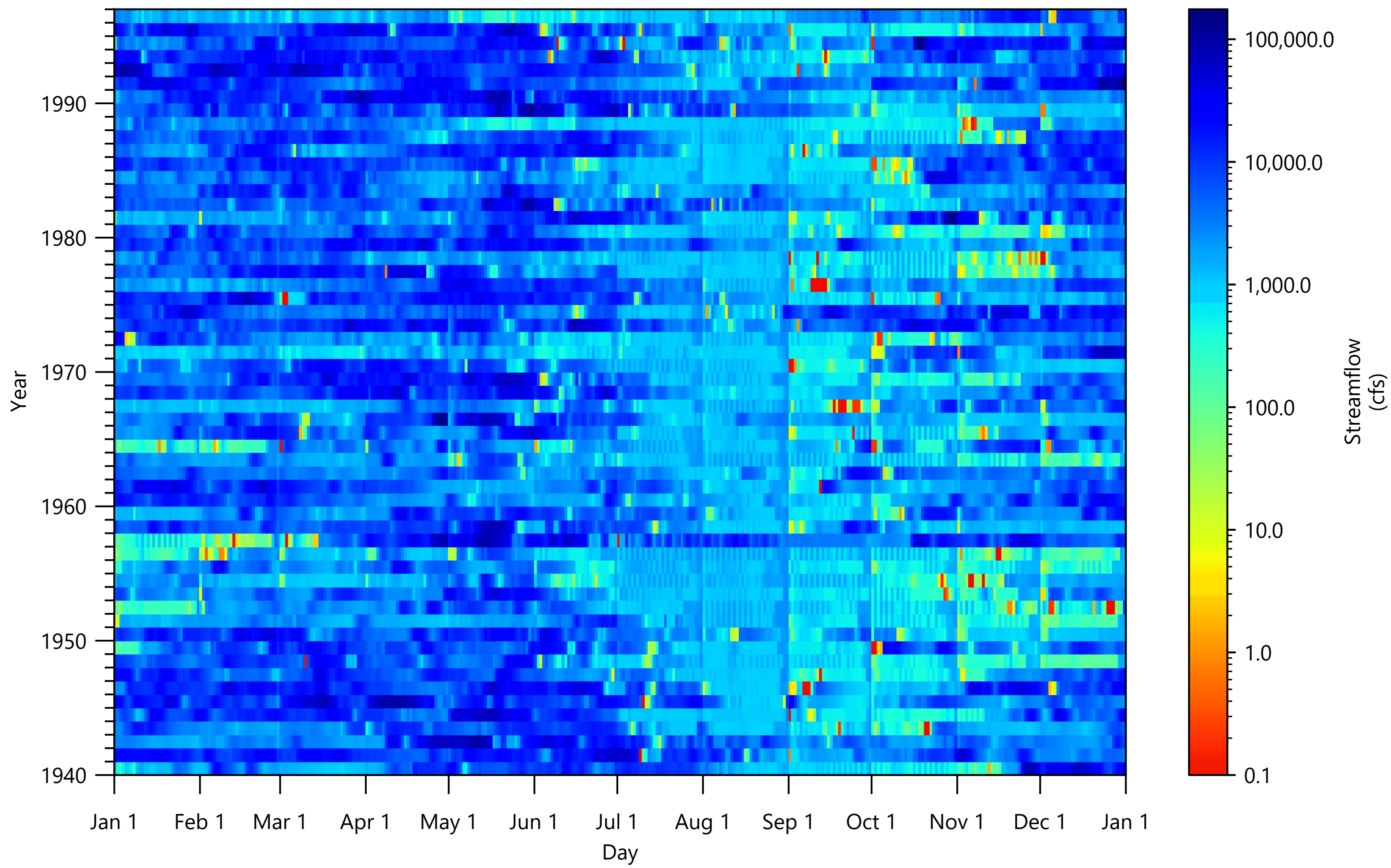
Figure F-90
Trinity River near Romayor: Current Water Use Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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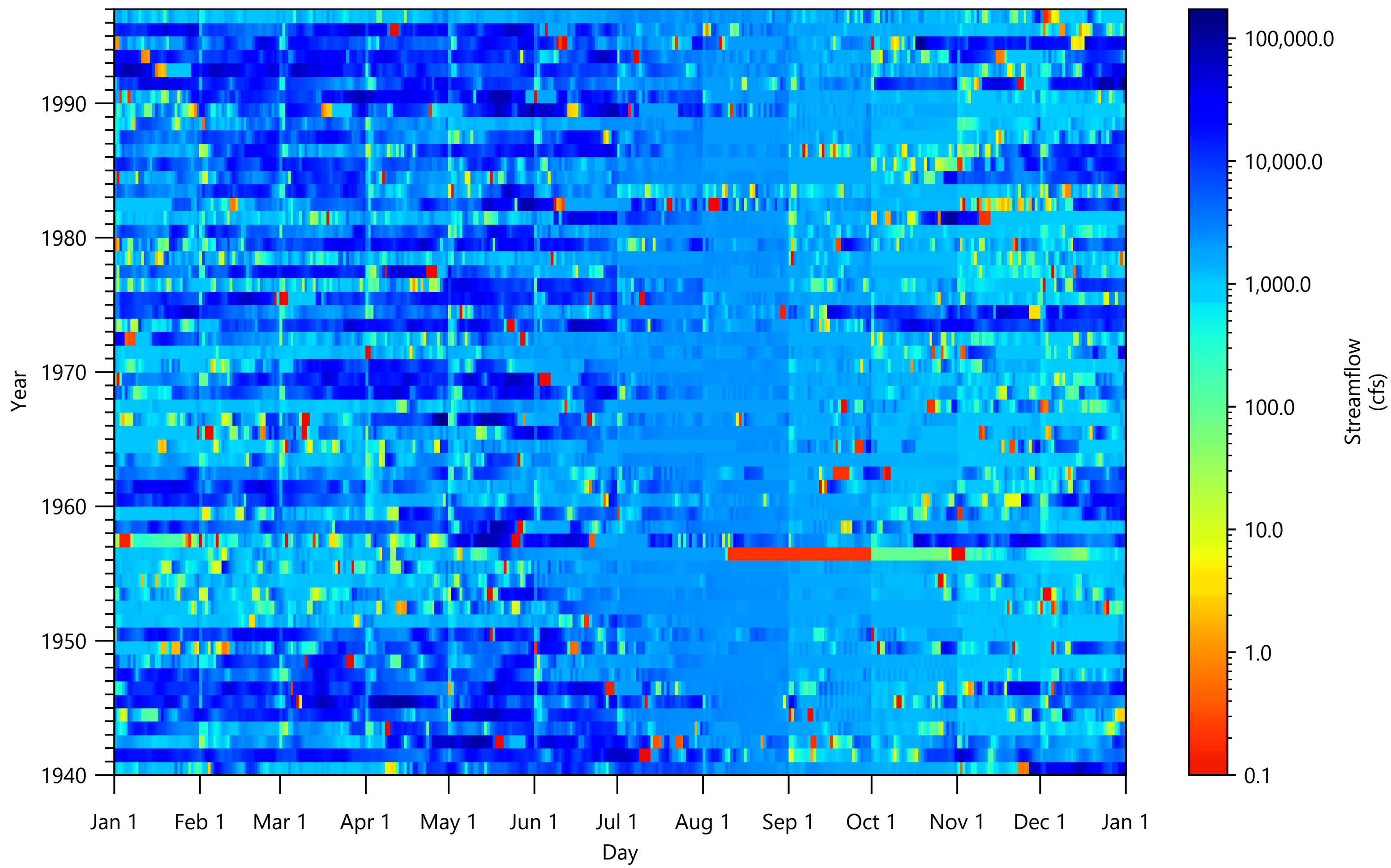
Figure F-91

Trinity River near Romayor: Partial Utilization Scenario

Flow Raster Hydrographs for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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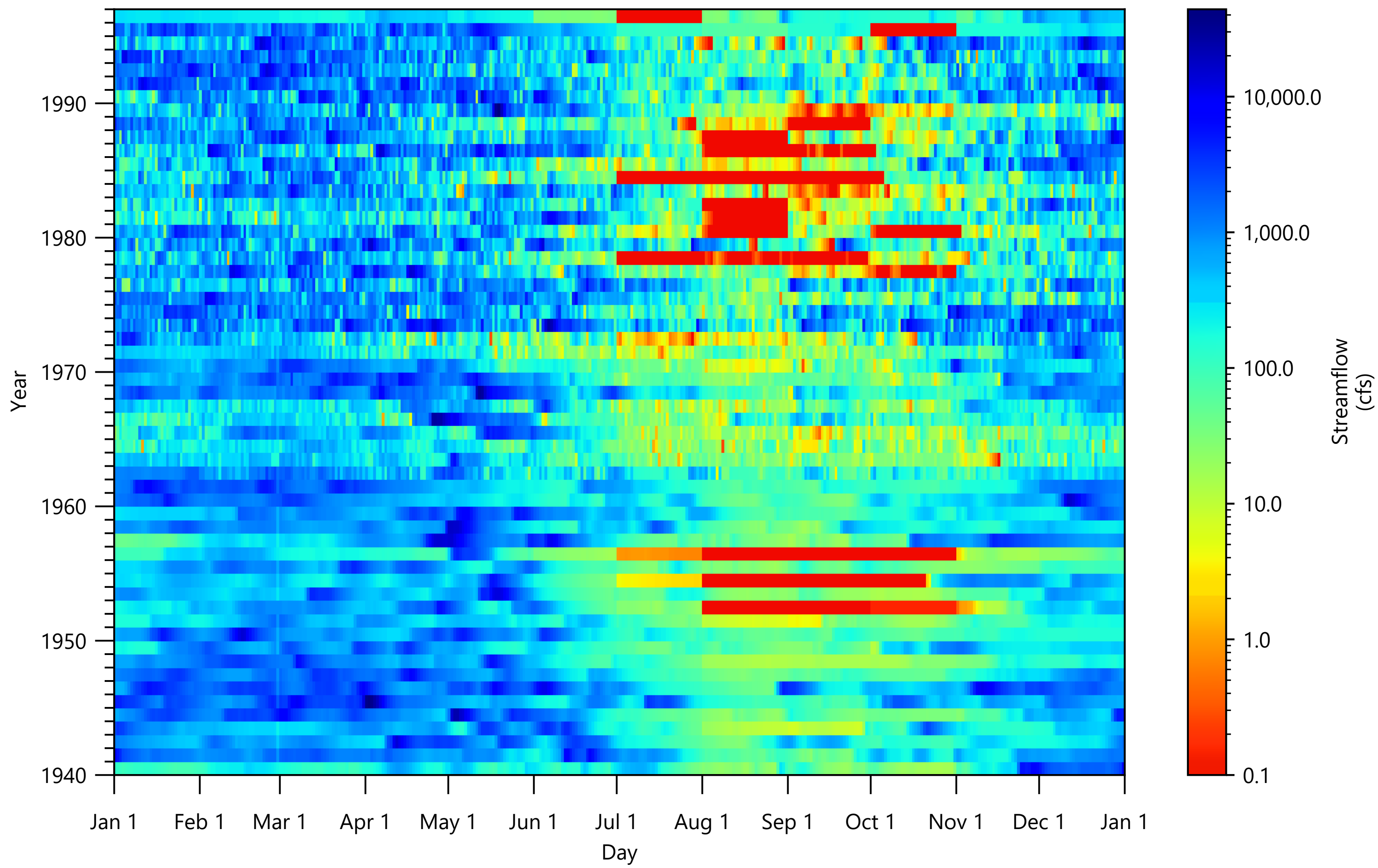
Figure F-92
Trinity River near Romayor: Full Utilization Scenario
Flow Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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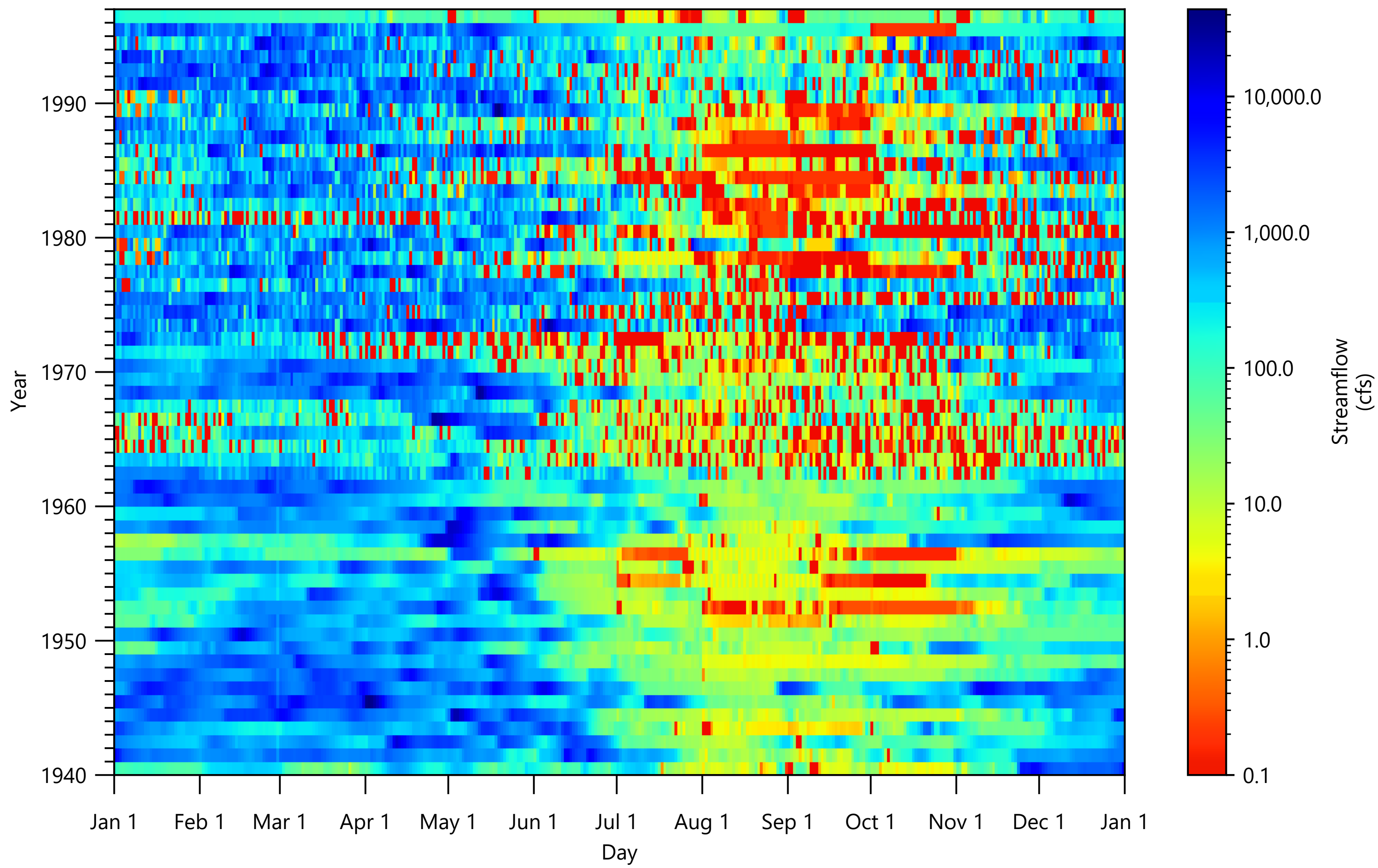
Figure F-93
Neches River at Neches: Naturalized Flow Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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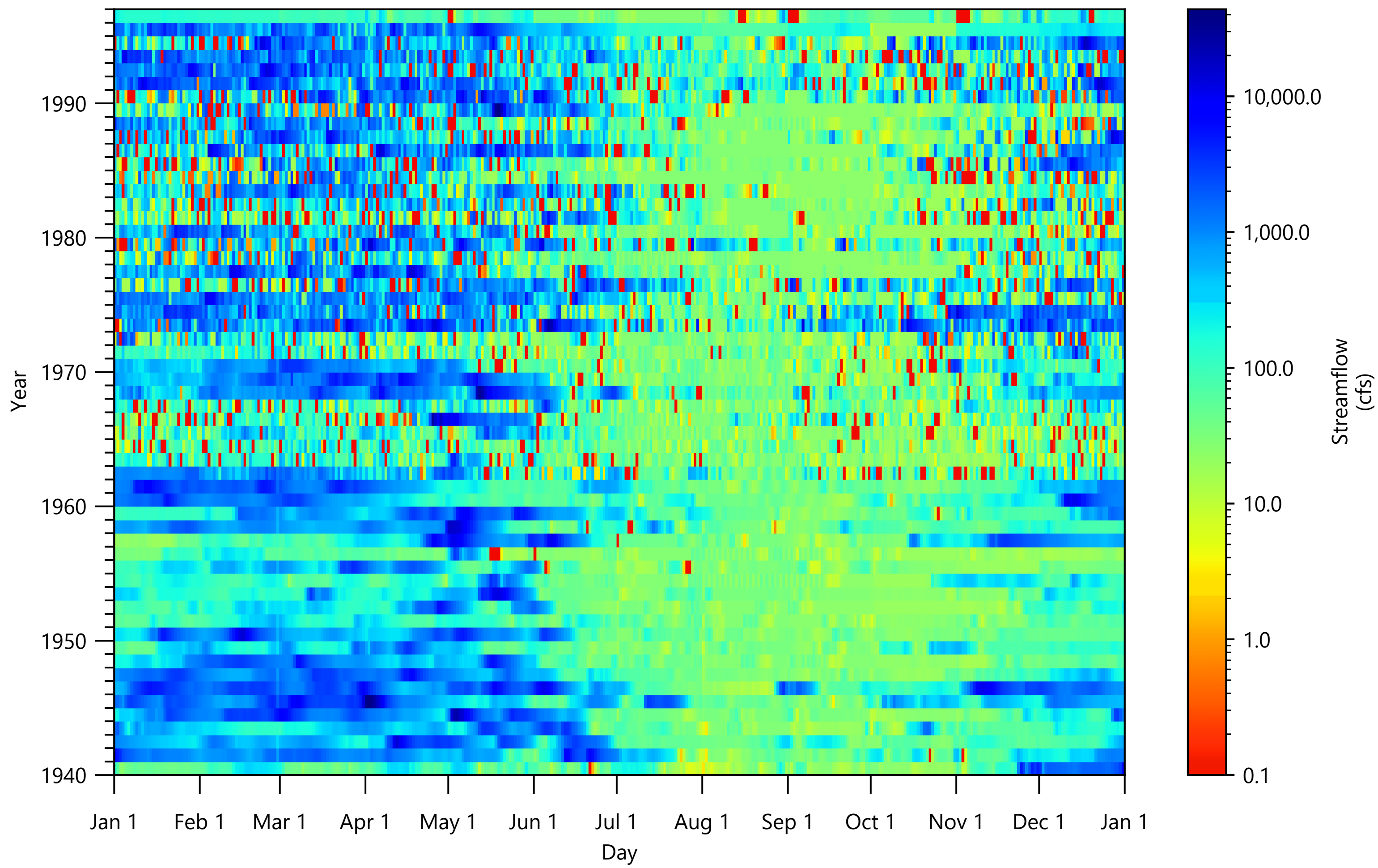
Figure F-94
Neches River at Neches: Current Water Use Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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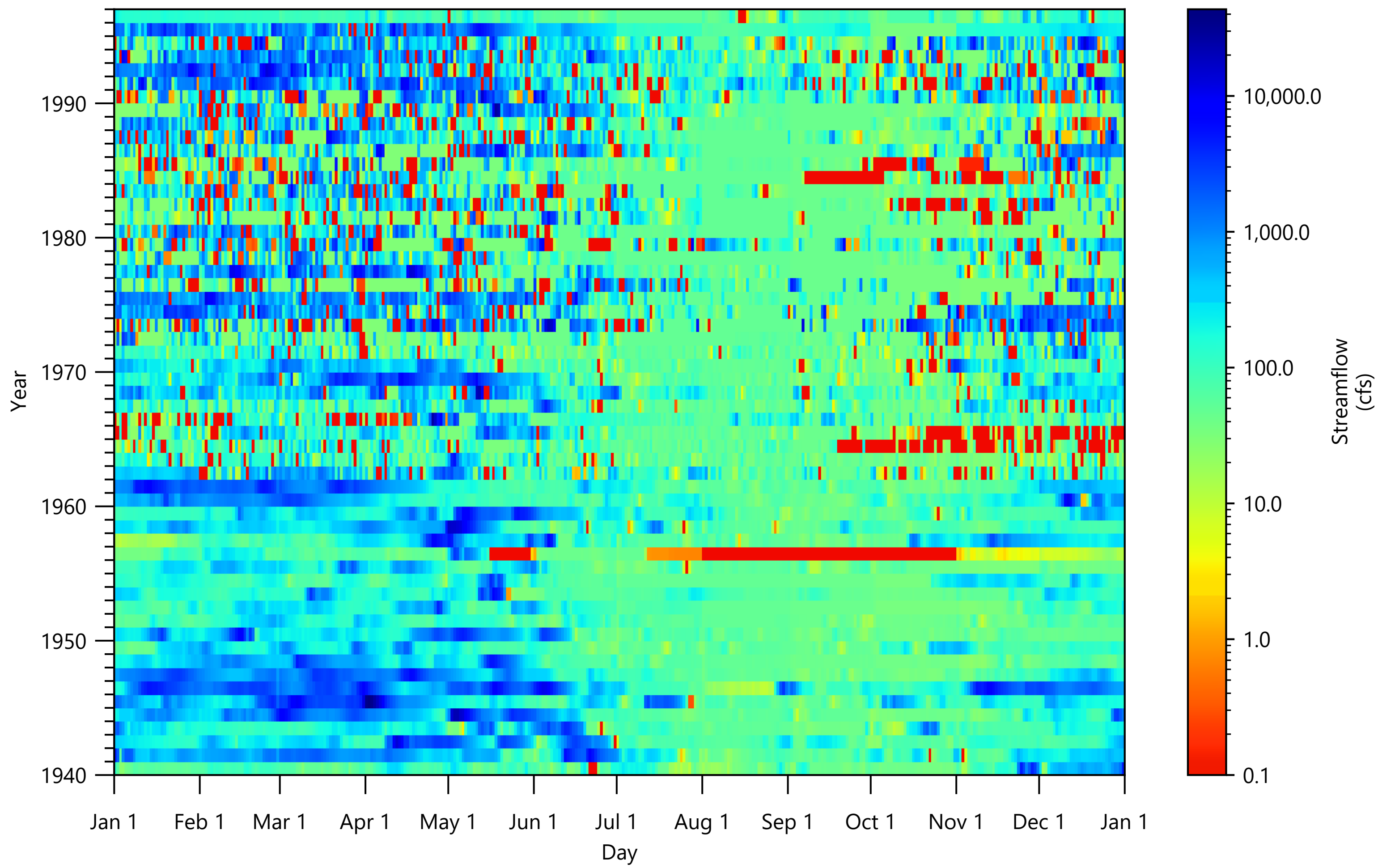
Figure F-95
Neches River at Neches: Partial Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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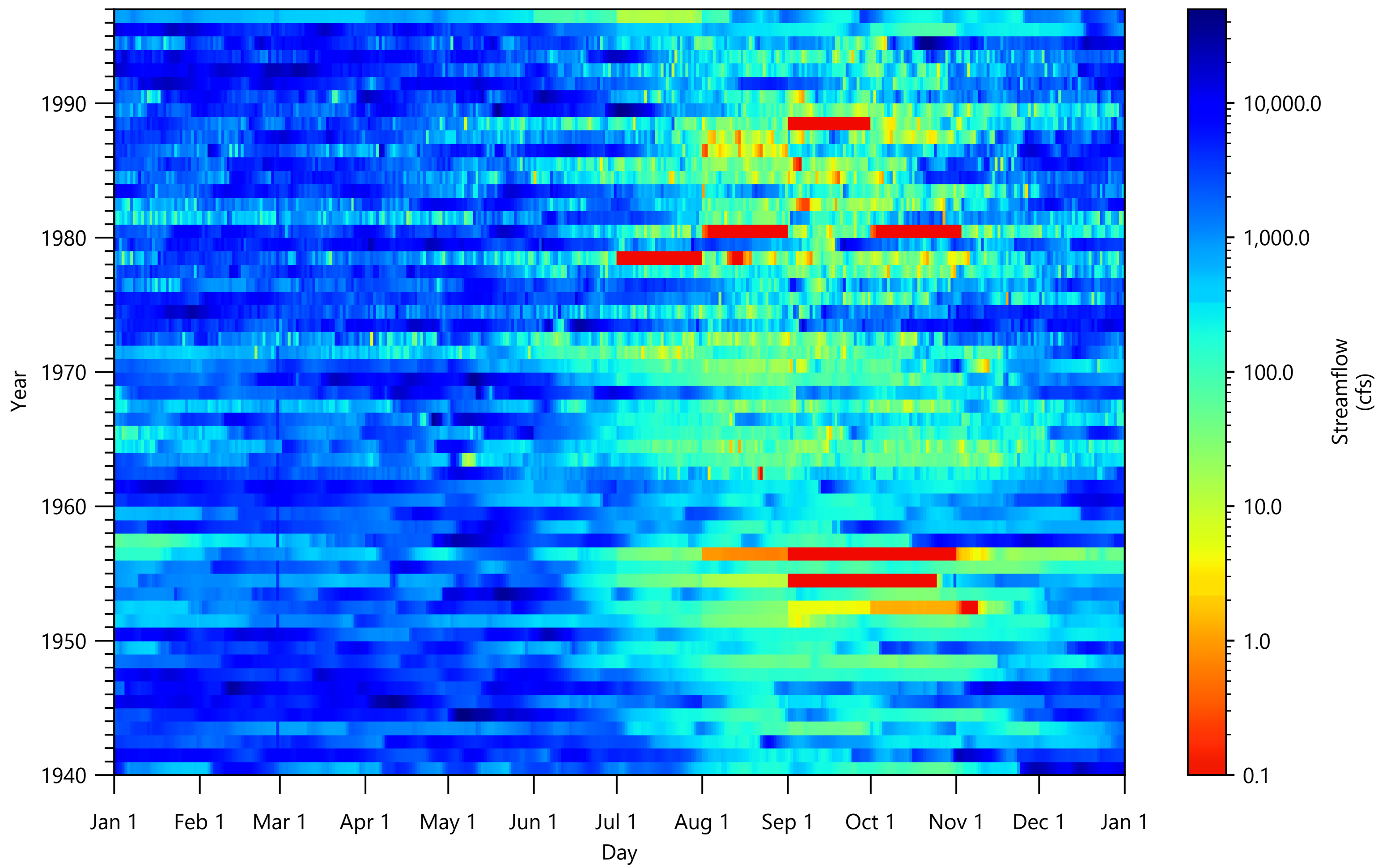
Figure F-96

Neches River at Neches: Full Utilization Scenario

Flow Raster Hydrographs for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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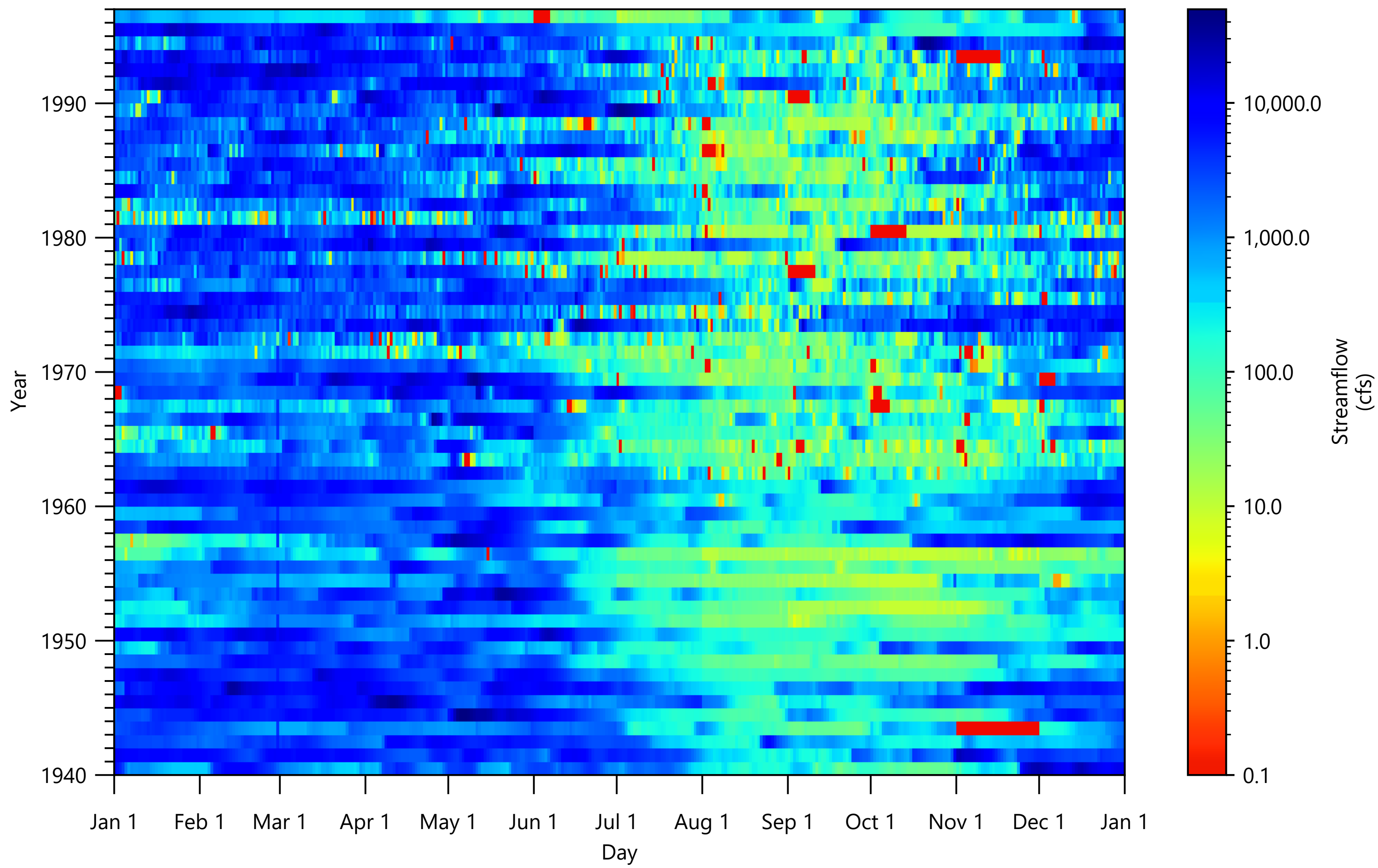
Figure F-97
Neches River near Rockland: Naturalized Flow Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:30 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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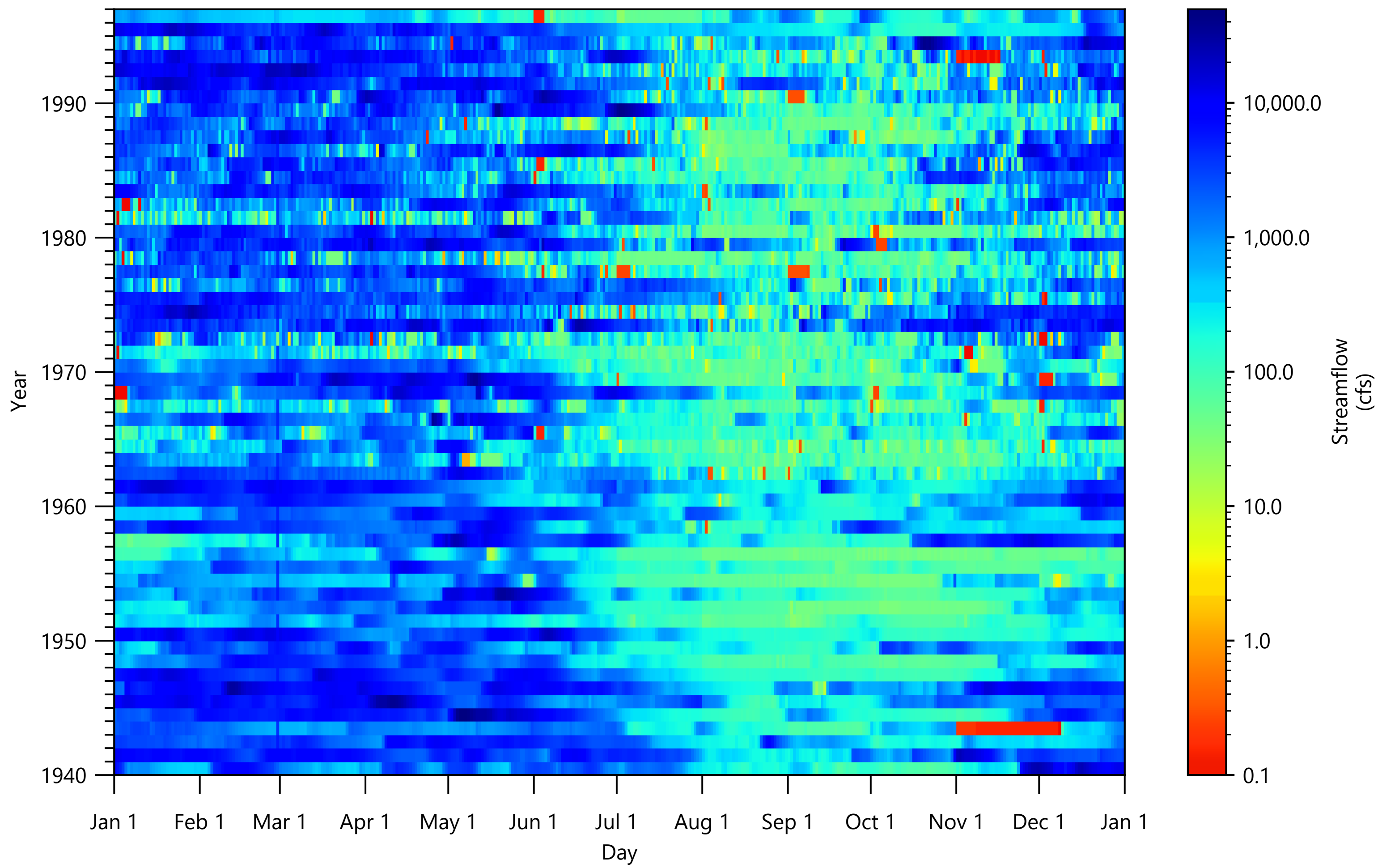
Figure F-98
Neches River near Rockland: Current Water Use Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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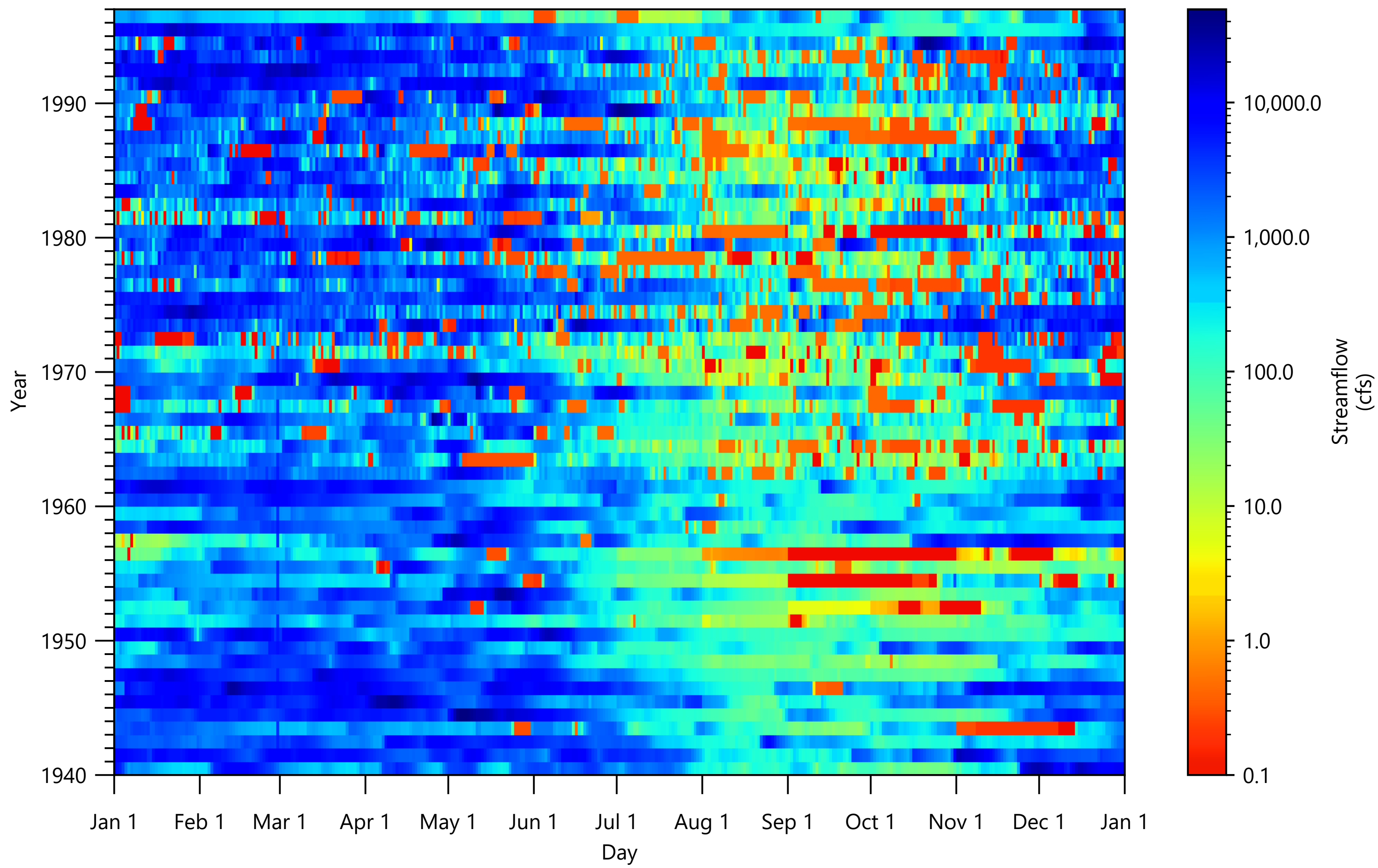
Figure F-99
Neches River near Rockland: Partial Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:31 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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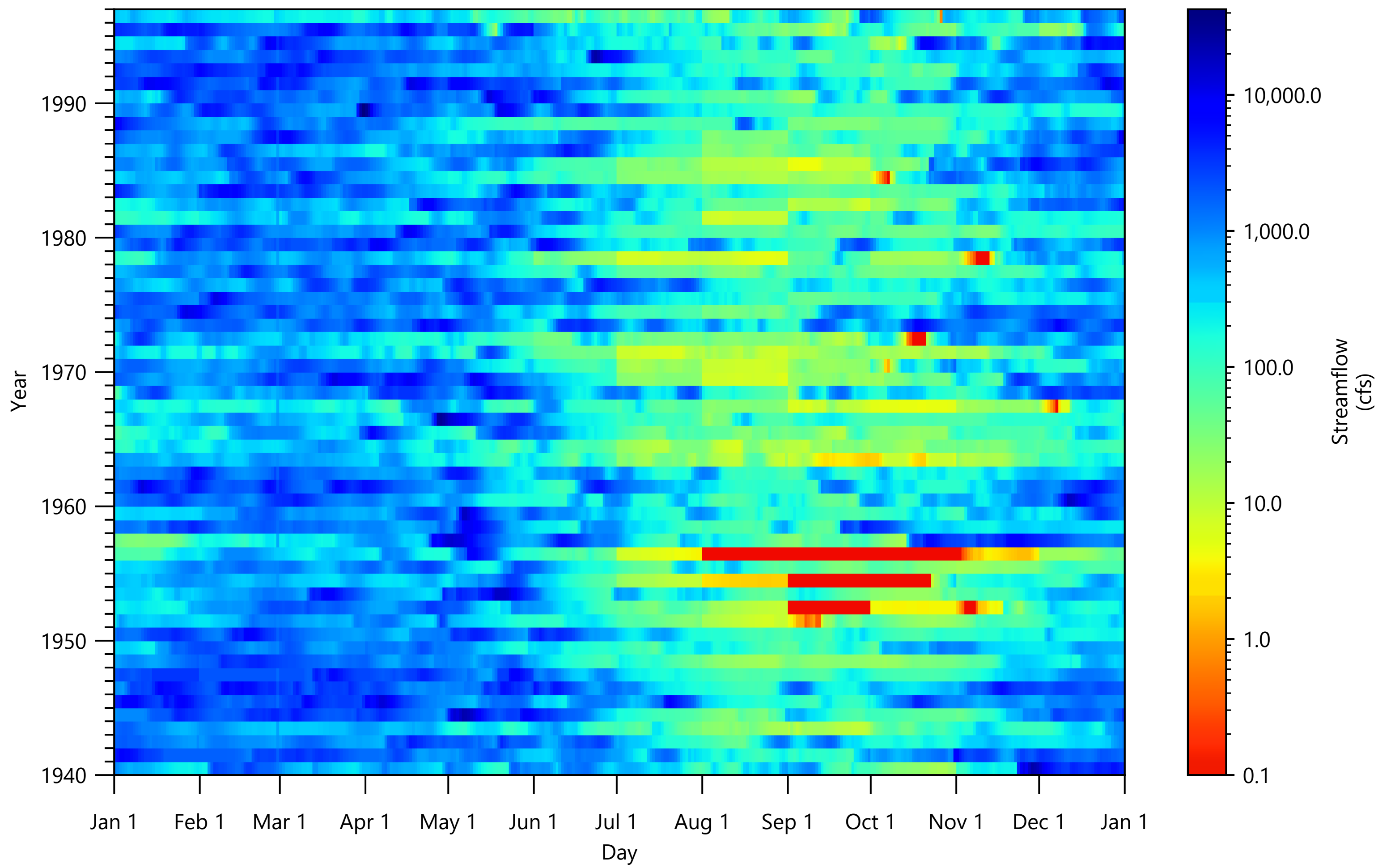
Figure F-100
Neches River near Rockland: Full Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

Publish Date: 08/15/2021 14:31 PM | User: JH
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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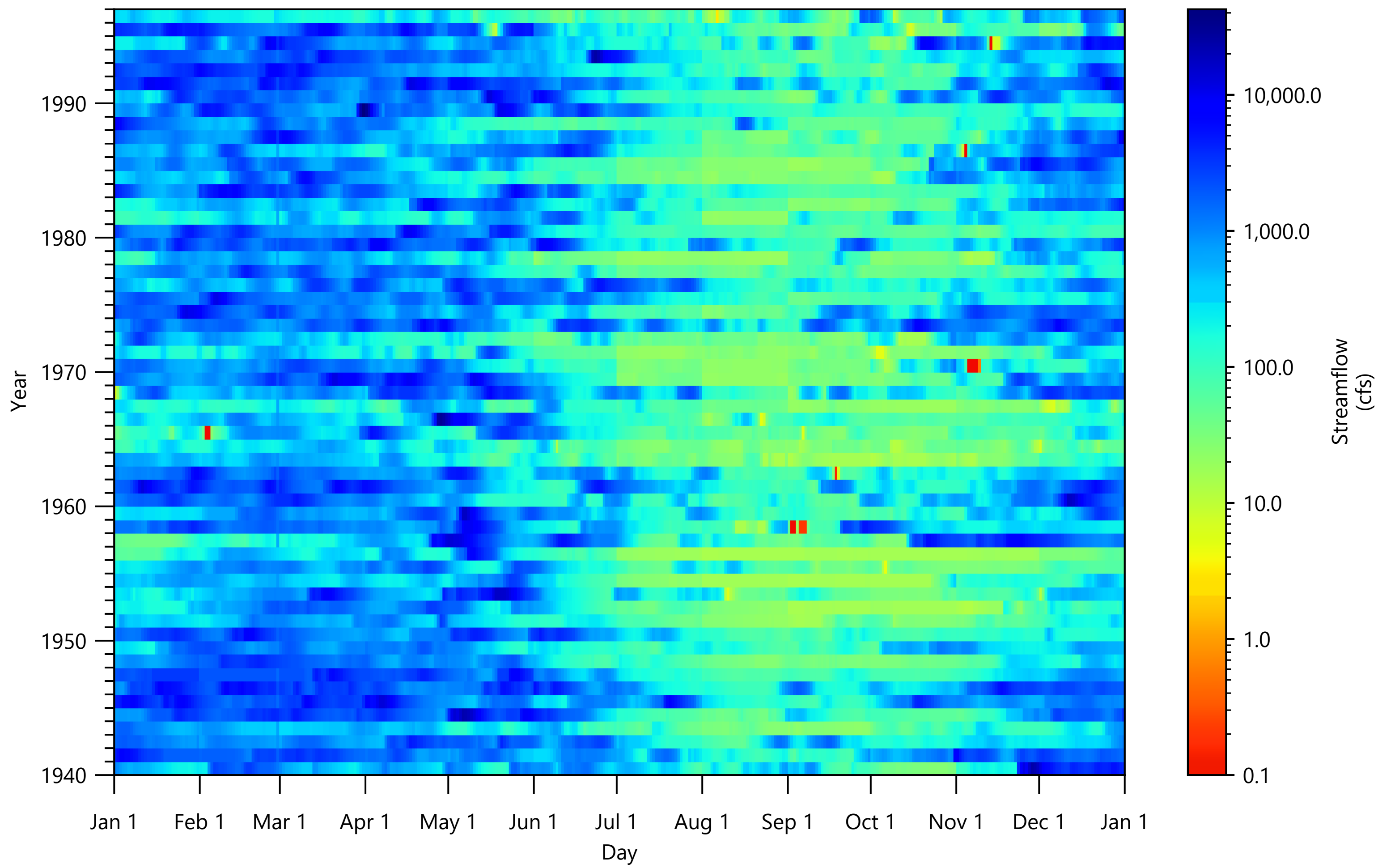
Figure F-101
Angelina River near Alto: Naturalized Flow Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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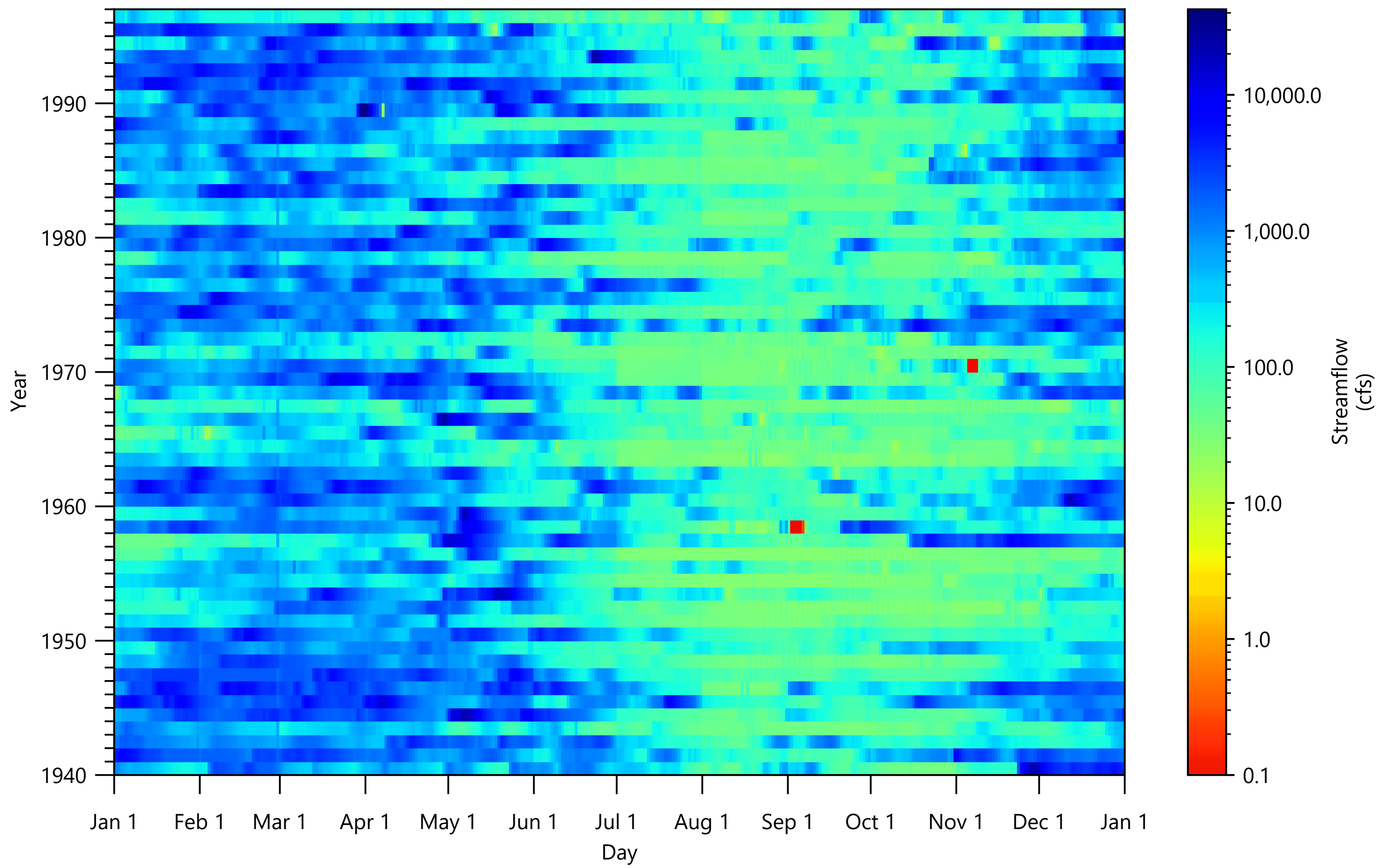
Figure F-102
Angelina River near Alto: Current Water Use Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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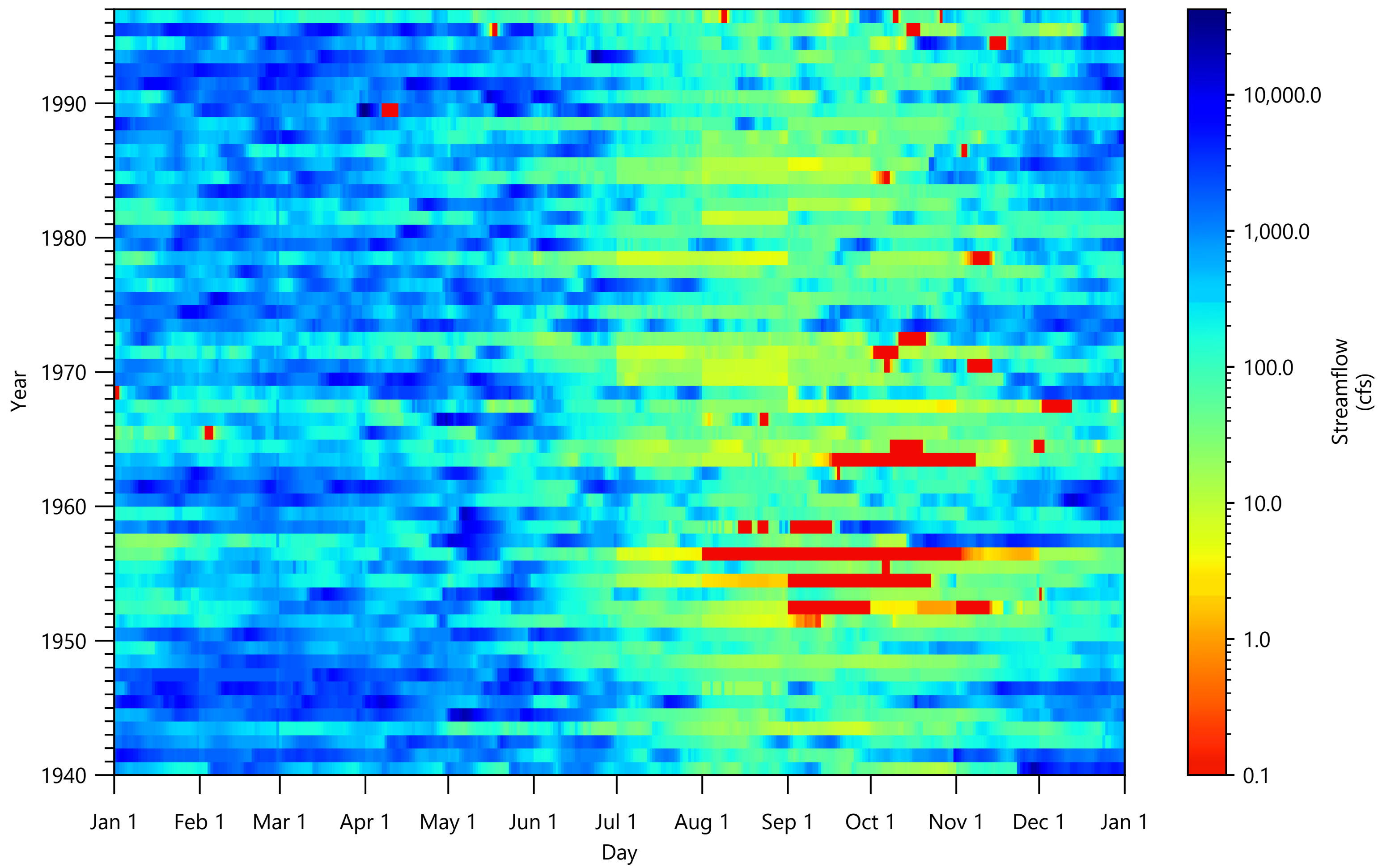
Figure F-103
Angelina River near Alto: Partial Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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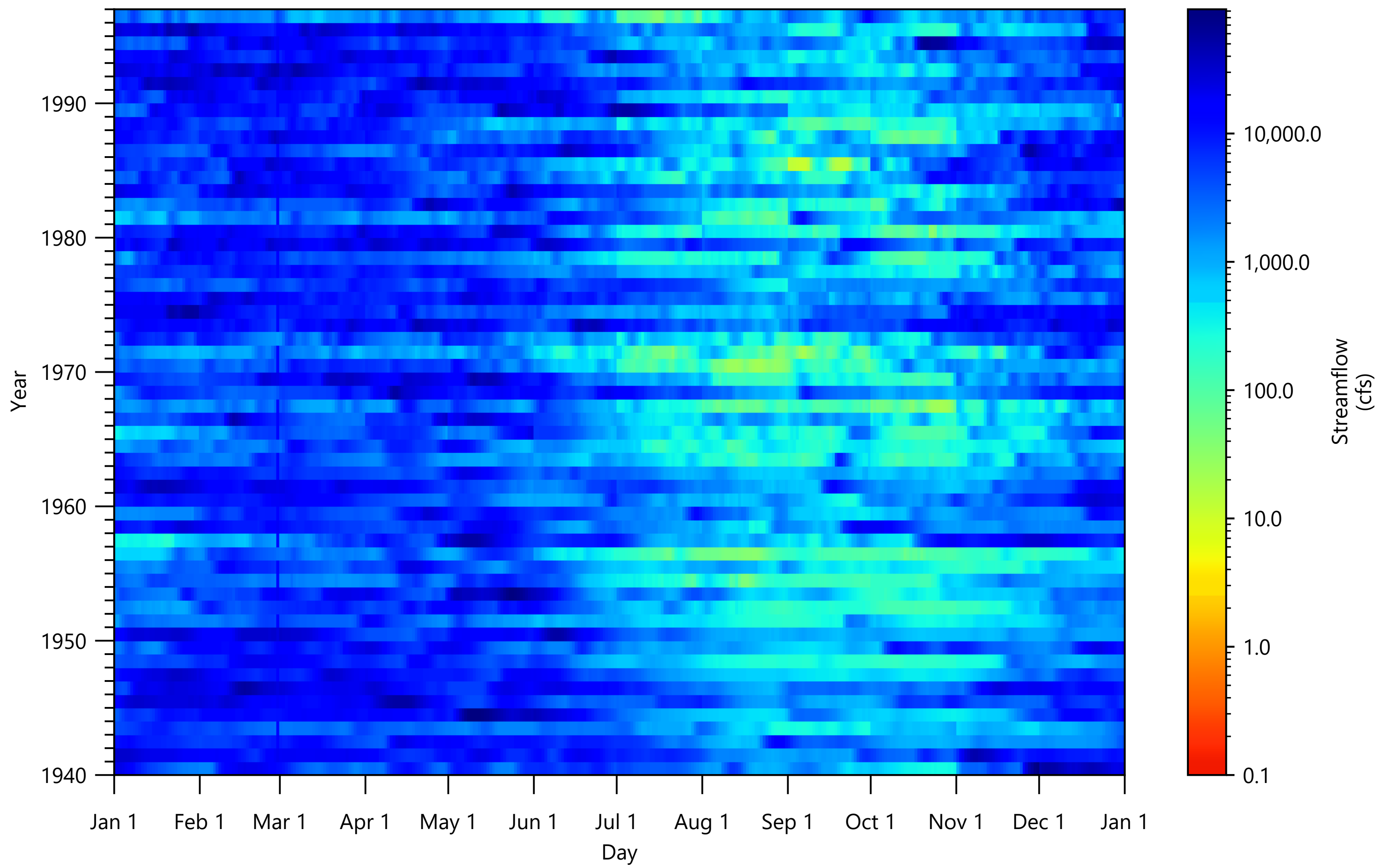
Figure F-104
Angelina River near Alto: Full Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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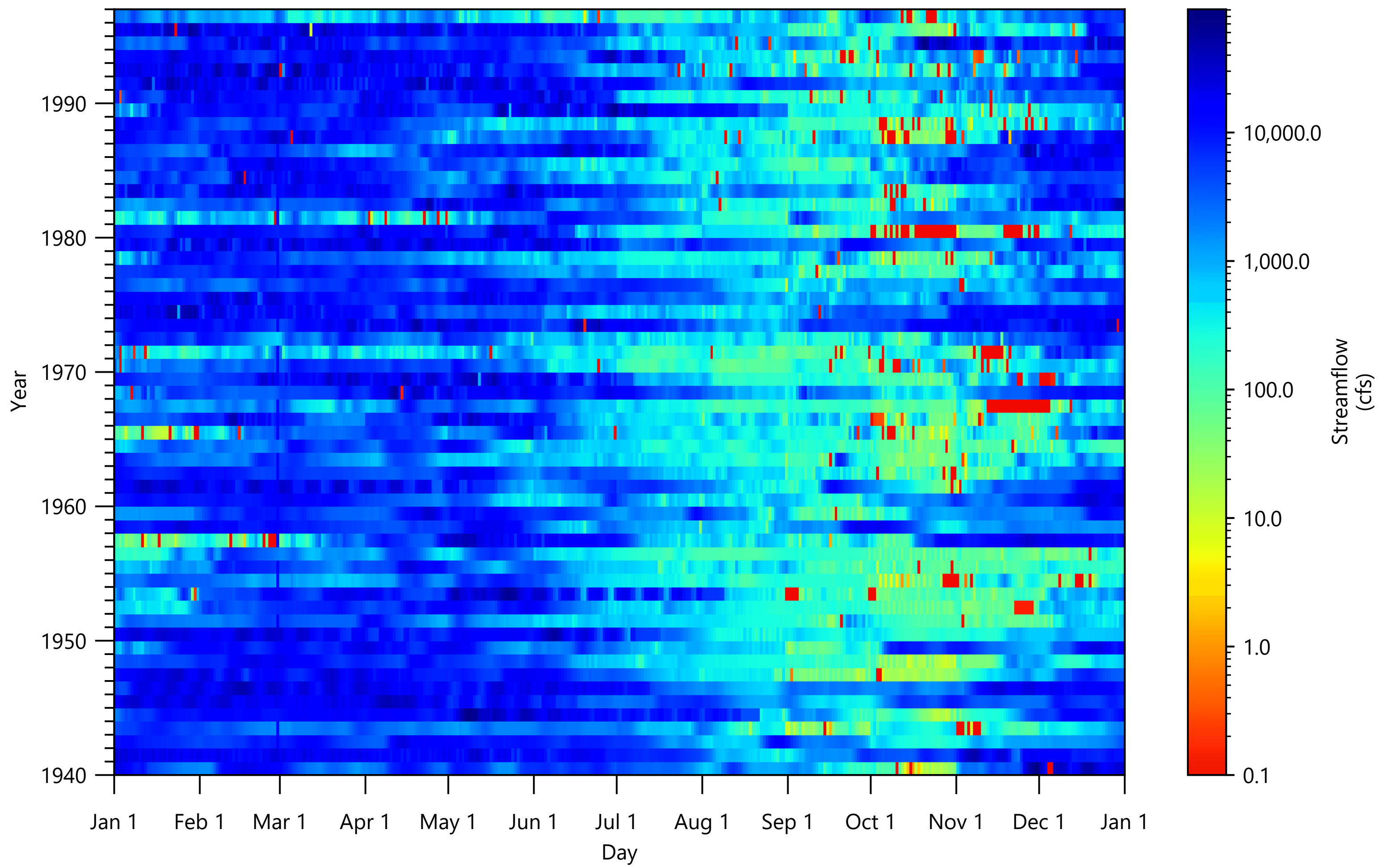
Figure F-105
Neches River at Evadale: Naturalized Flow Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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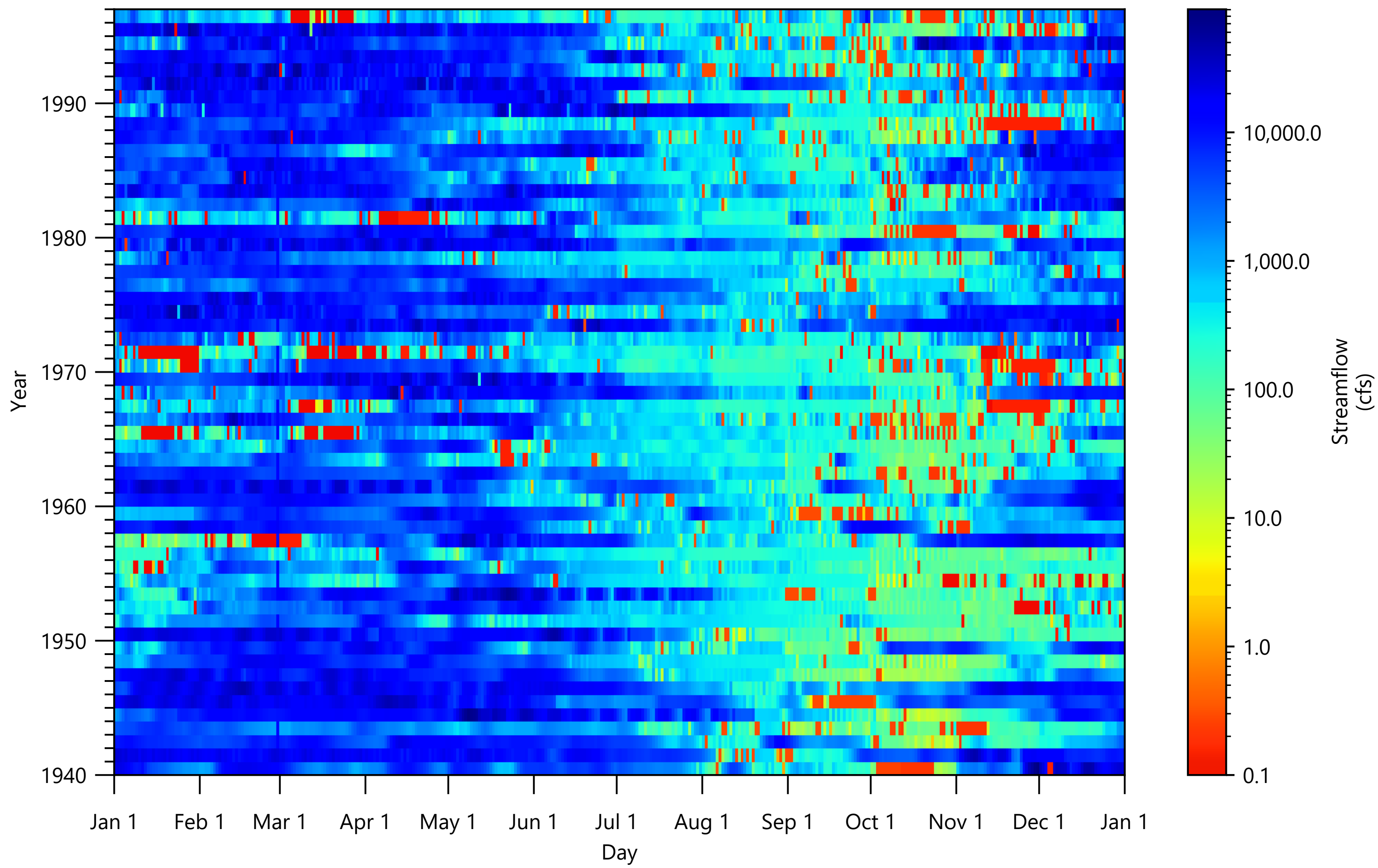
Figure F-106
Neches River at Evadale: Current Water Use Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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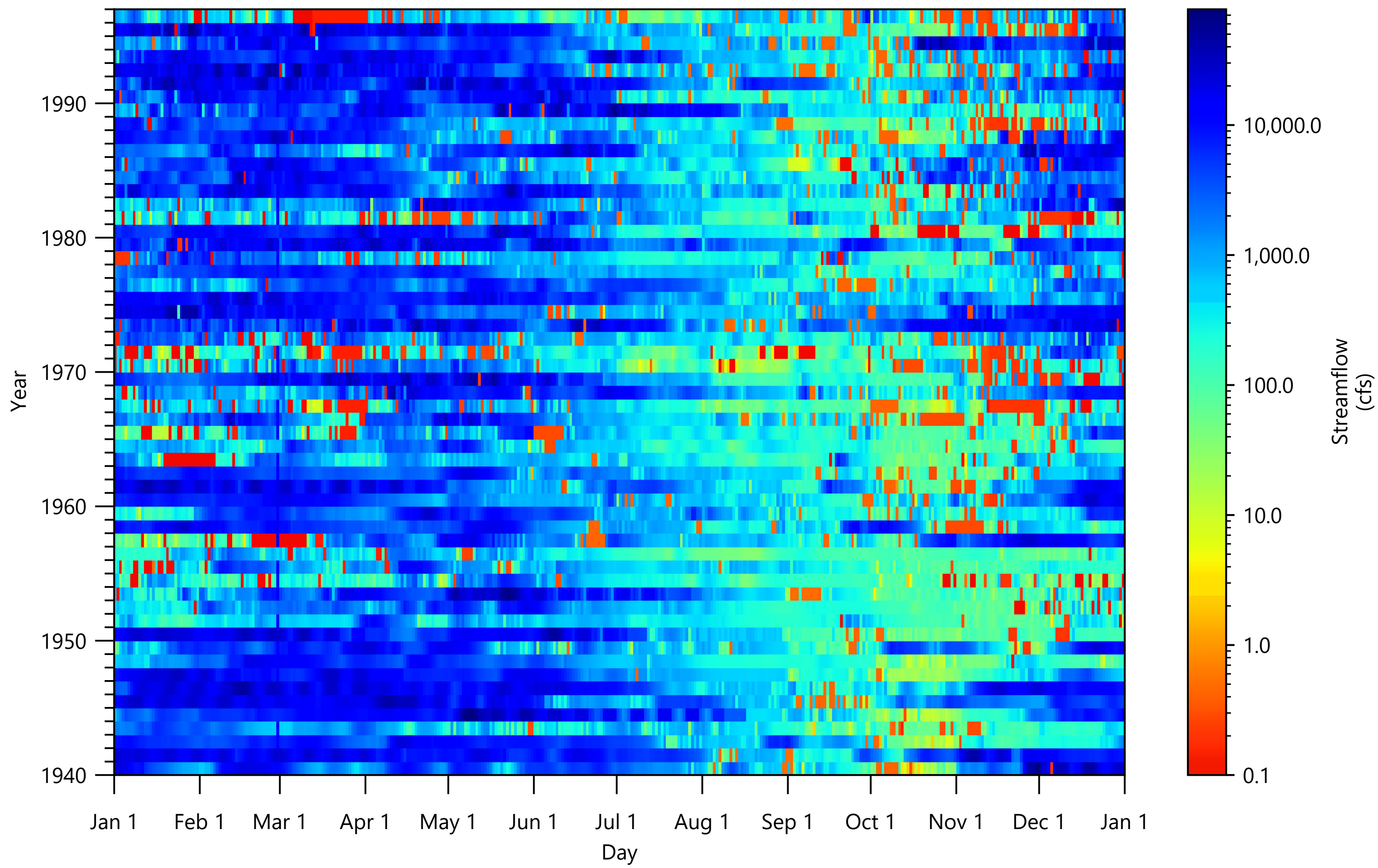
Figure F-107
Neches River at Evadale: Partial Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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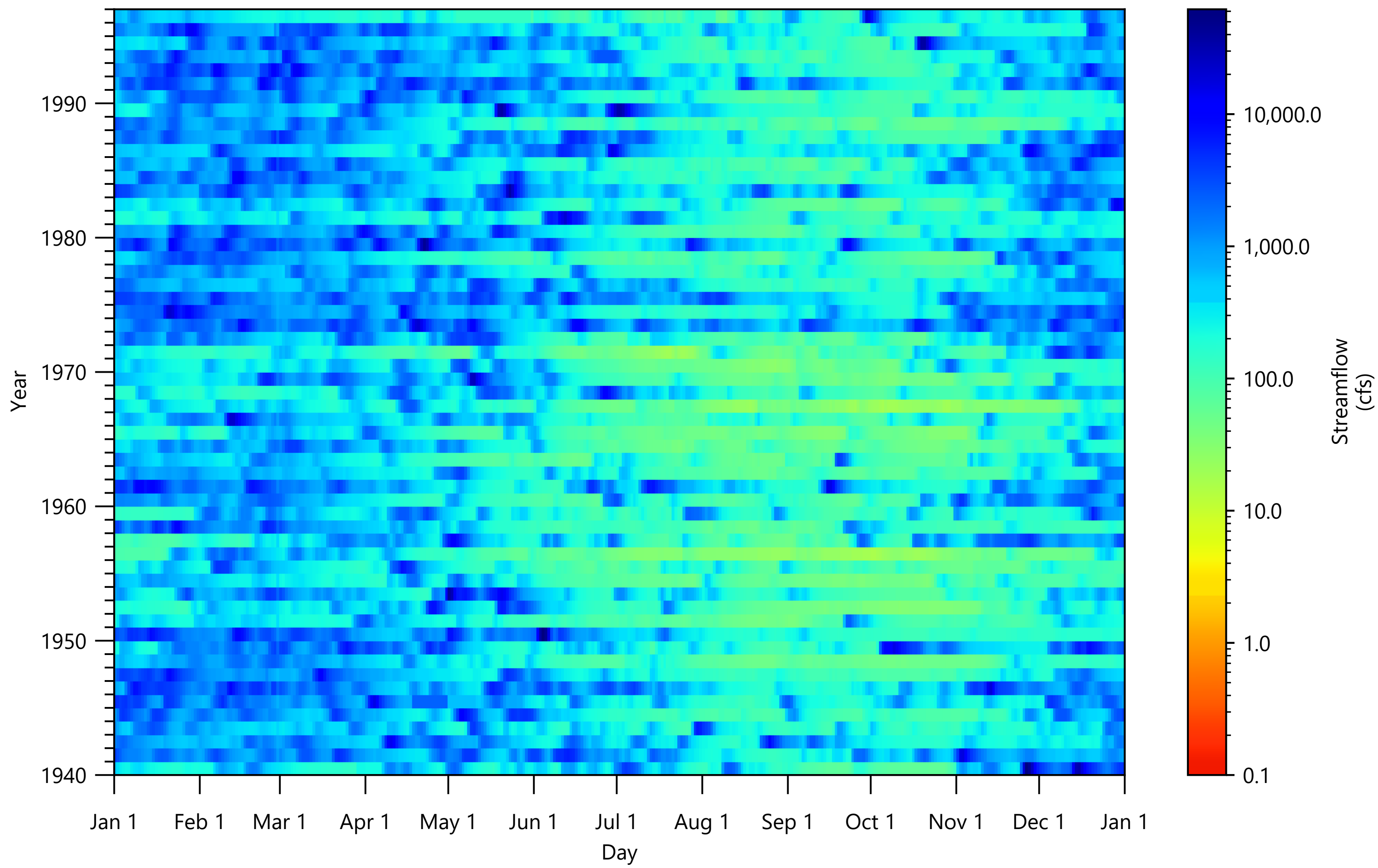
Figure F-108
Neches River at Evadale: Full Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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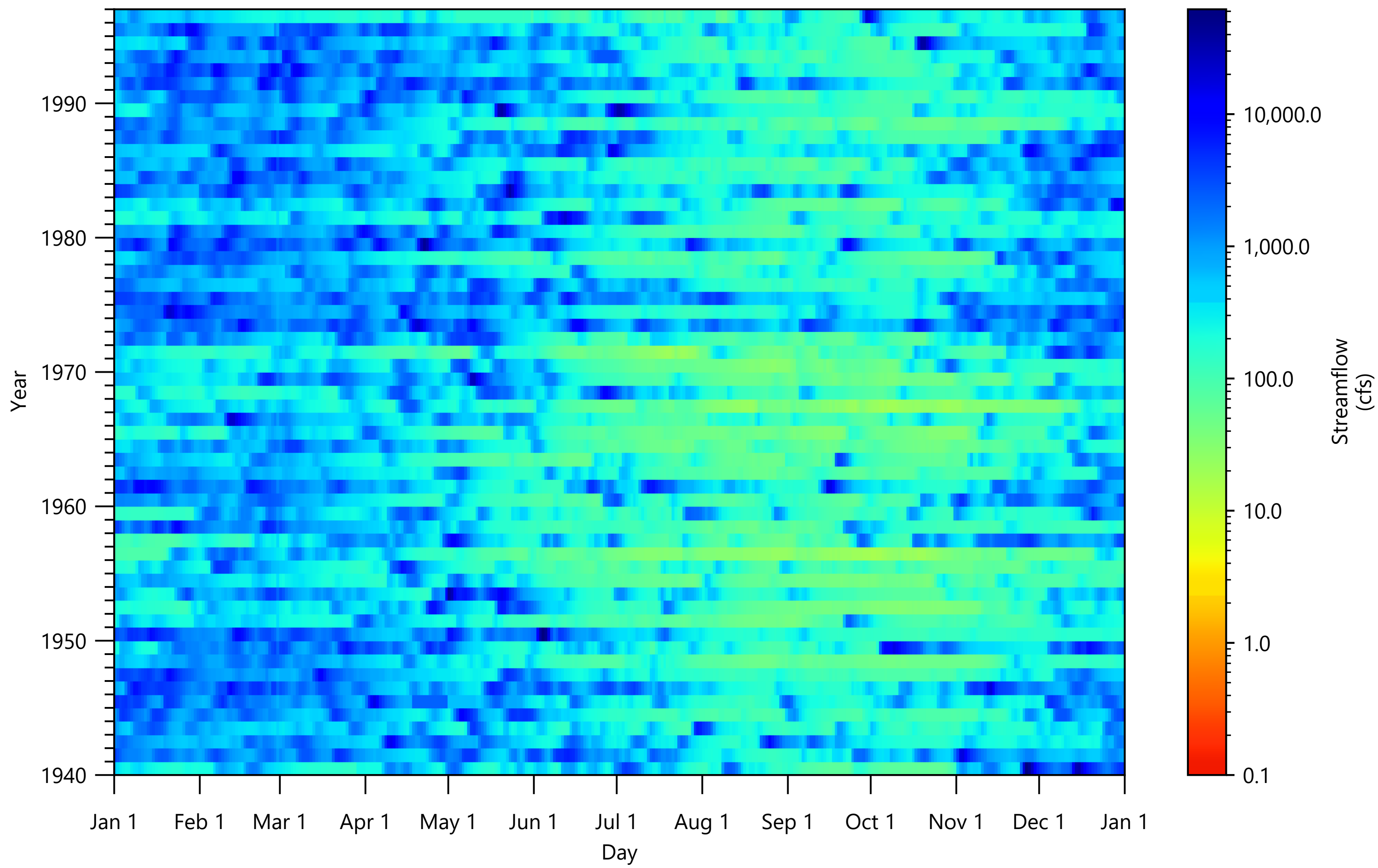
Figure F-109
Village Creek near Kountze: Naturalized Flow Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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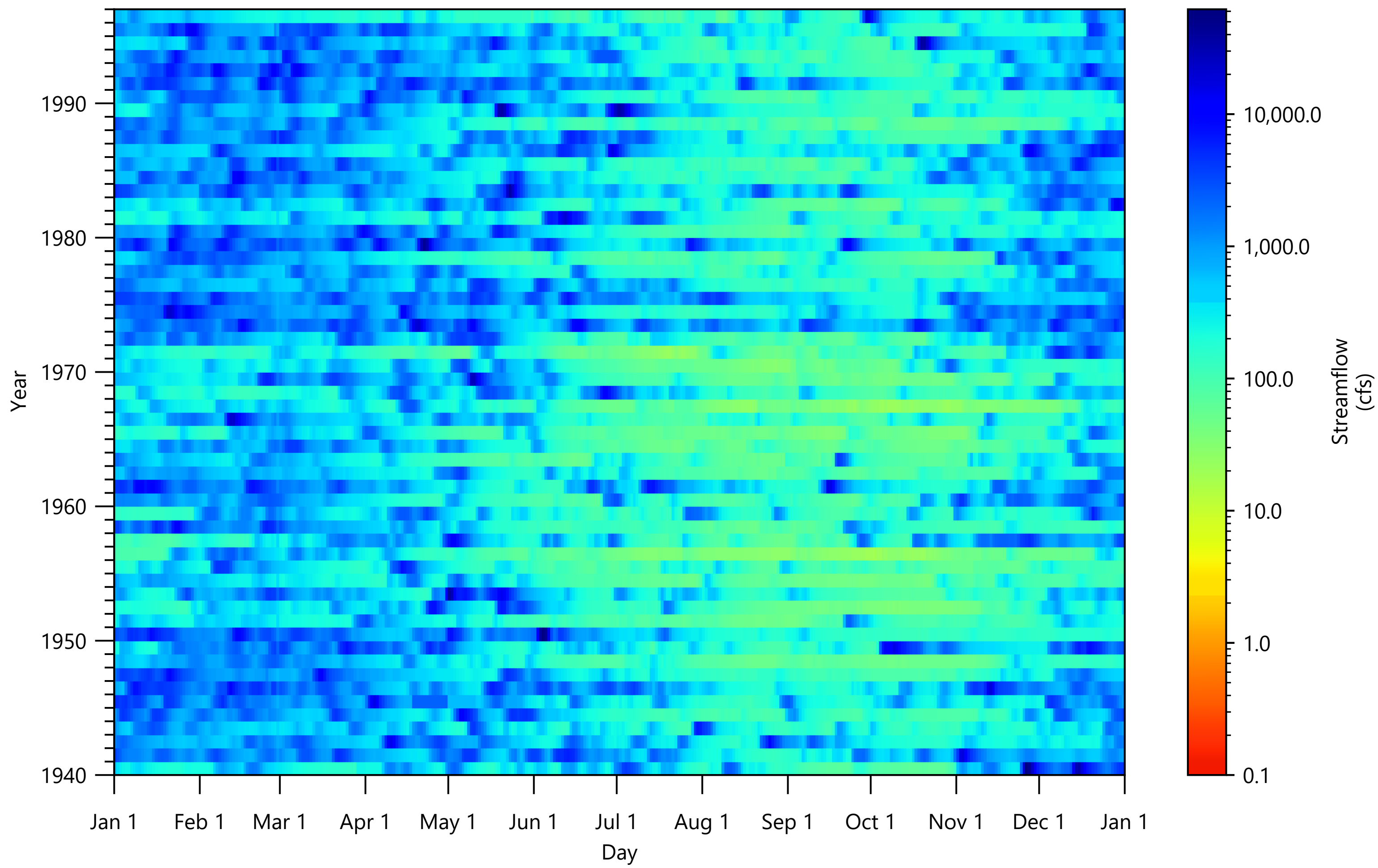
Figure F-110
Village Creek near Kountze: Current Water Use Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_flow_raster_hydrographs.py

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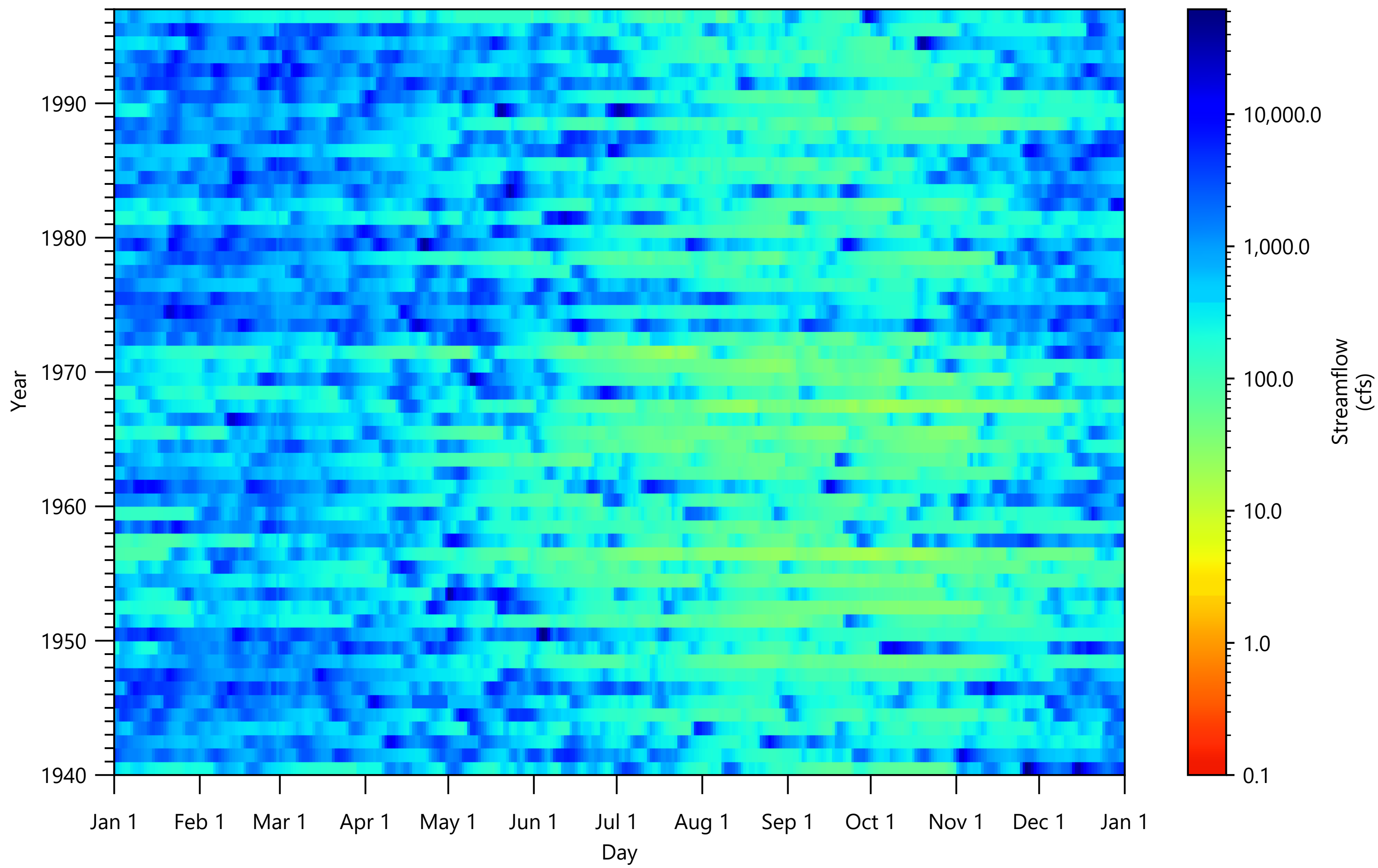
Figure F-111
Village Creek near Kountze: Partial Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: cfs: cubic feet per second

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Figure F-112
Village Creek near Kountze: Full Utilization Scenario
Flow Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

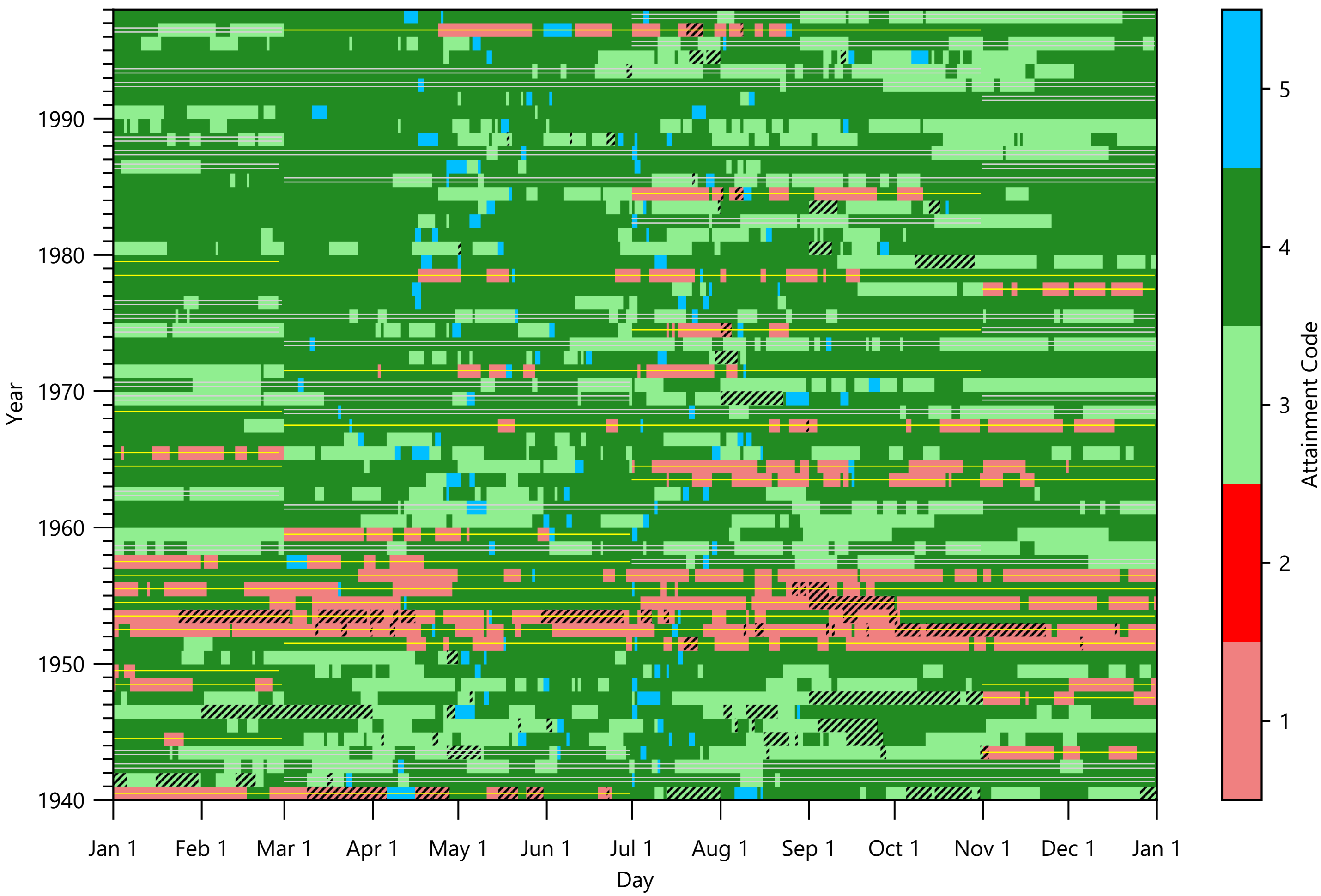
Appendix G
Attainment Raster Hydrographs

Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains raster hydrographs of the attainment status for each day, as described in Section 2.5.3.2 of the main report.

This appendix contains a total of 112 distinct figures, which are arranged as follows:

- Brazos River basin
  - Figures G-1 through G-76: Attainment raster hydrographs for each of the 19 locations and four flow scenarios in the Brazos River basin, grouped by location
- Trinity River basin
  - Figures G-77 through G-92: Attainment raster hydrographs for each of the four locations and four flow scenarios in the Trinity River basin, grouped by location
- Neches River basin
  - Figures G-93 through G-112: Attainment raster hydrographs for each of the five locations and four flow scenarios in the Neches River basin, grouped by location



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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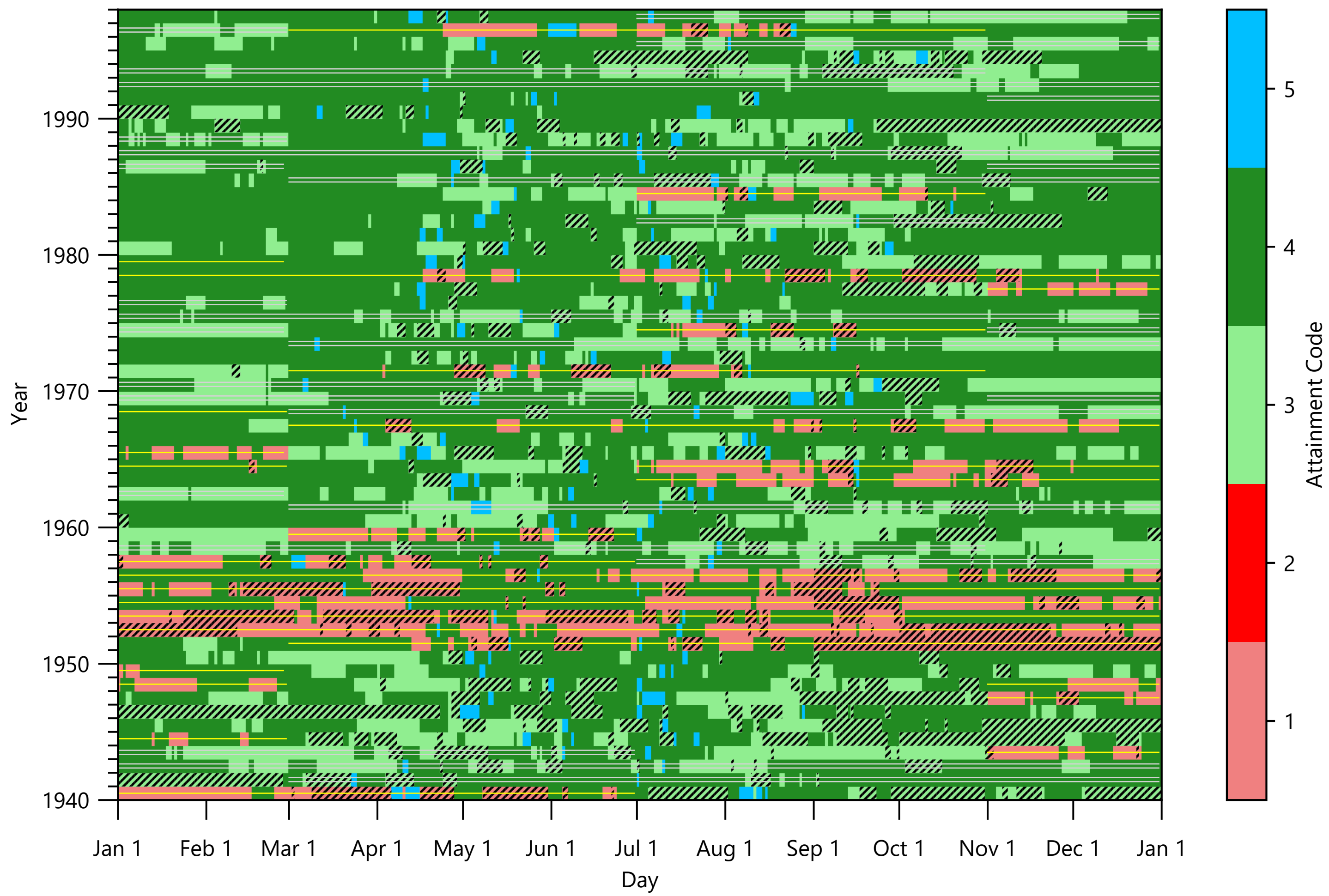
Figure G-1
Salt Fork near Aspermont: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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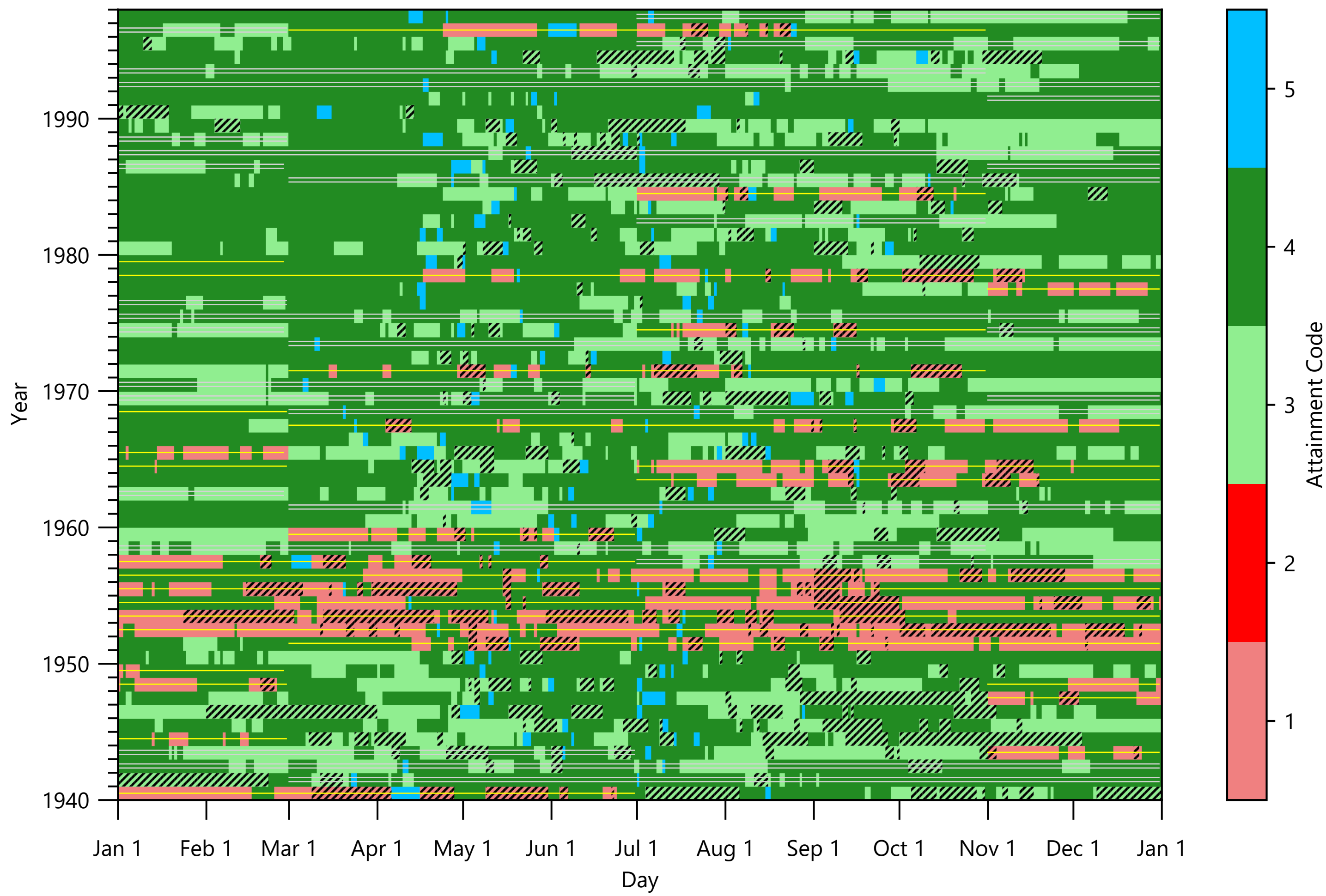
Figure G-2
Salt Fork near Aspermont: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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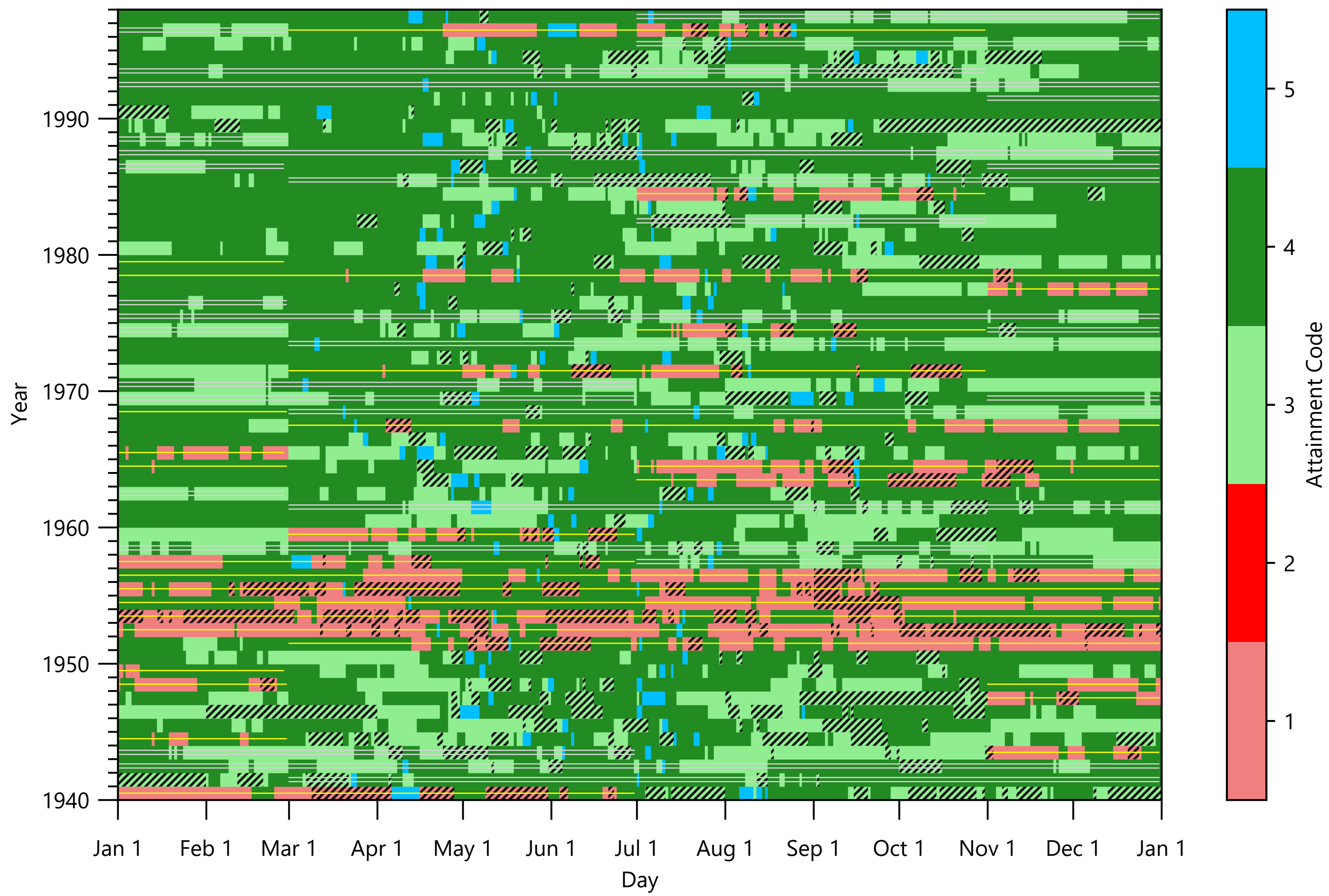
Figure G-3
Salt Fork near Aspermont: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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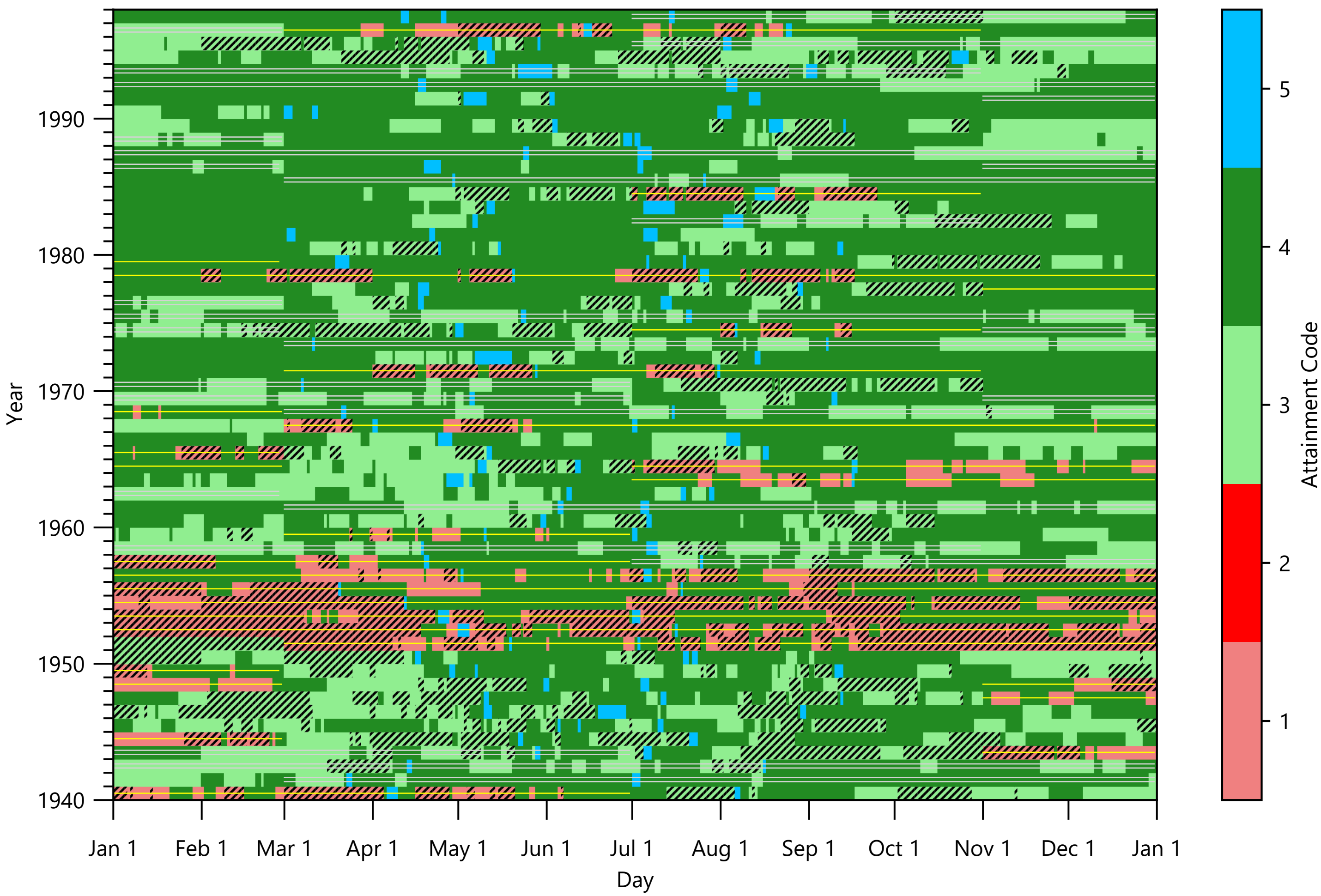
Figure G-4
Salt Fork near Aspermont: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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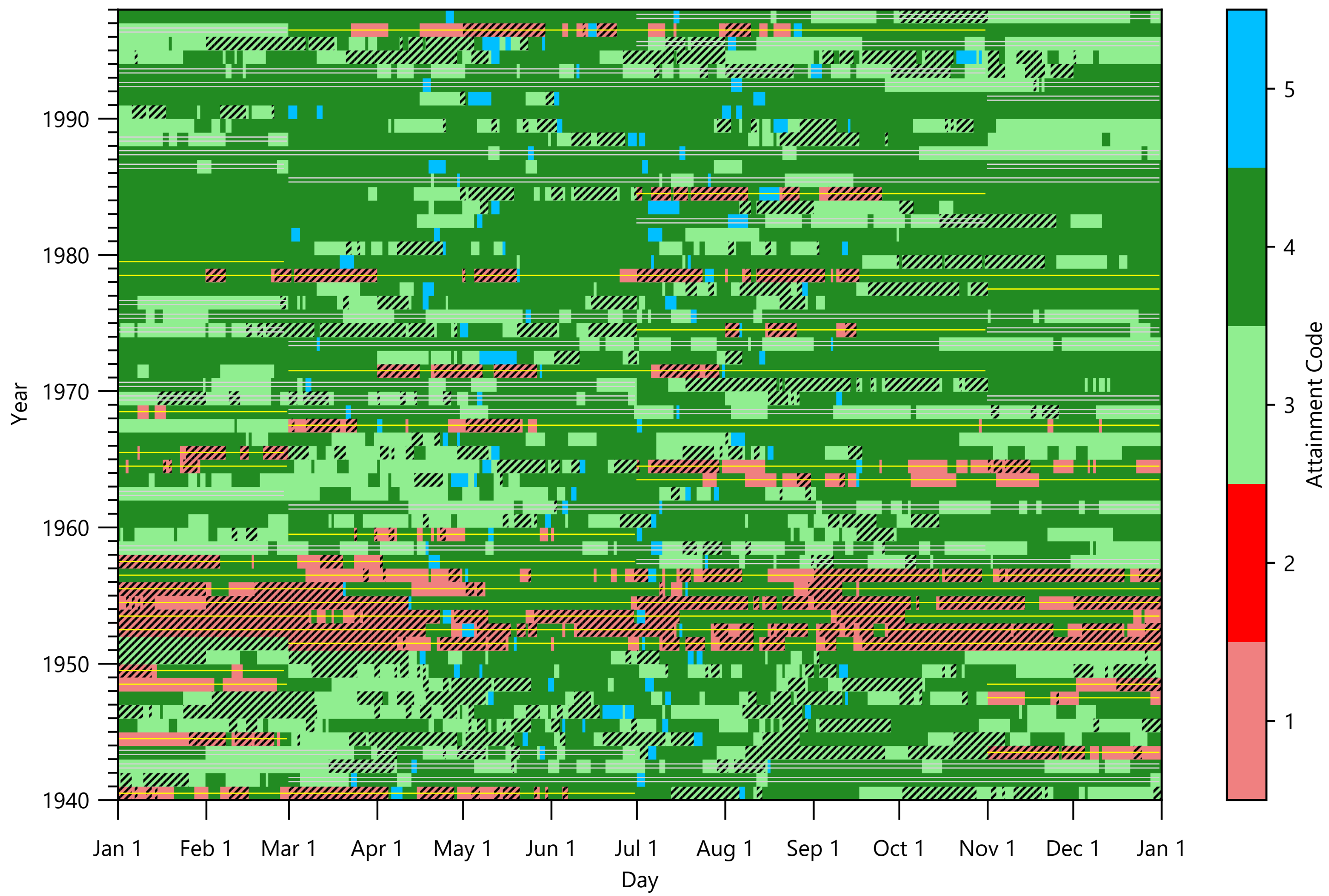

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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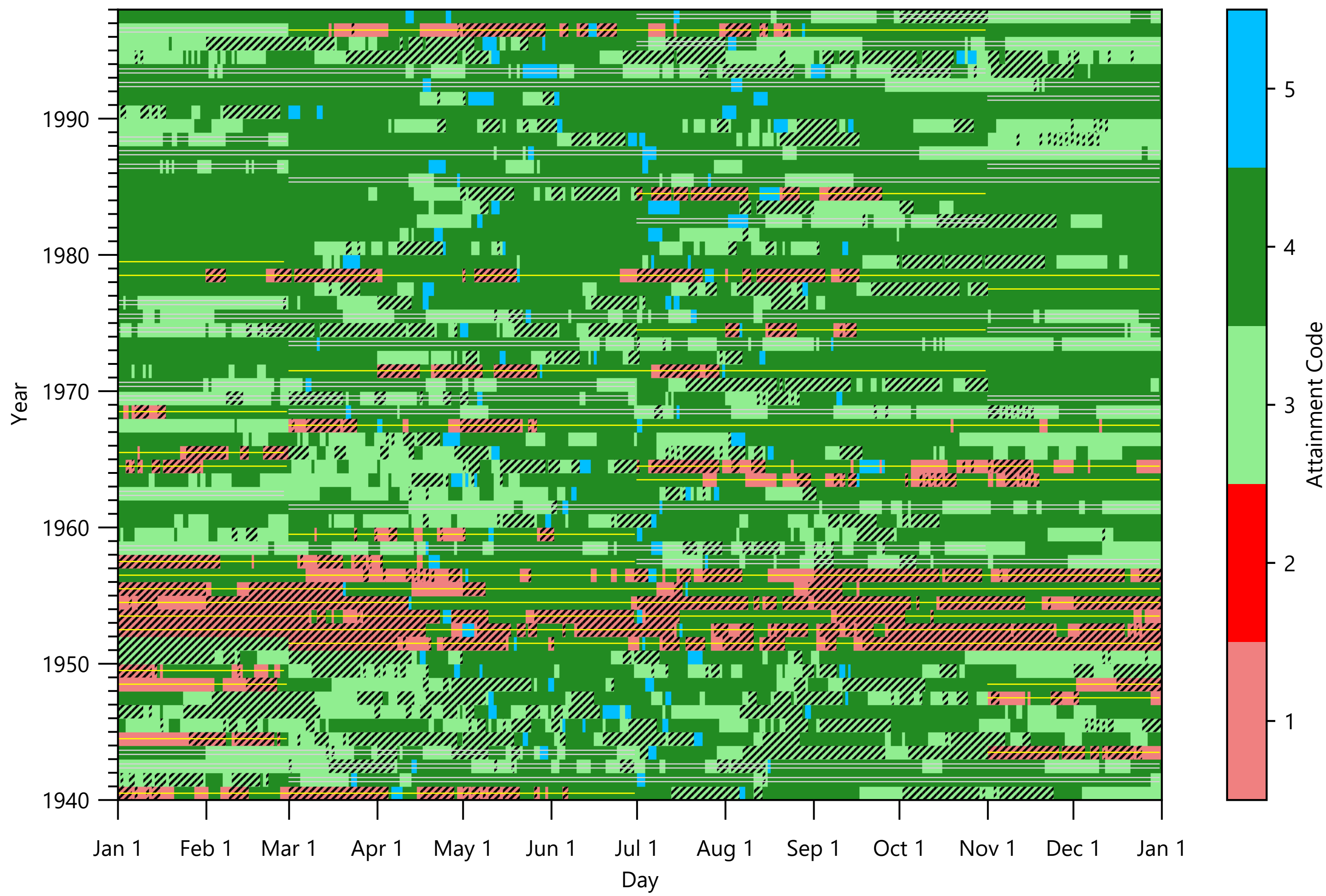
Figure G-6
Double Mountain Fork near Aspermont: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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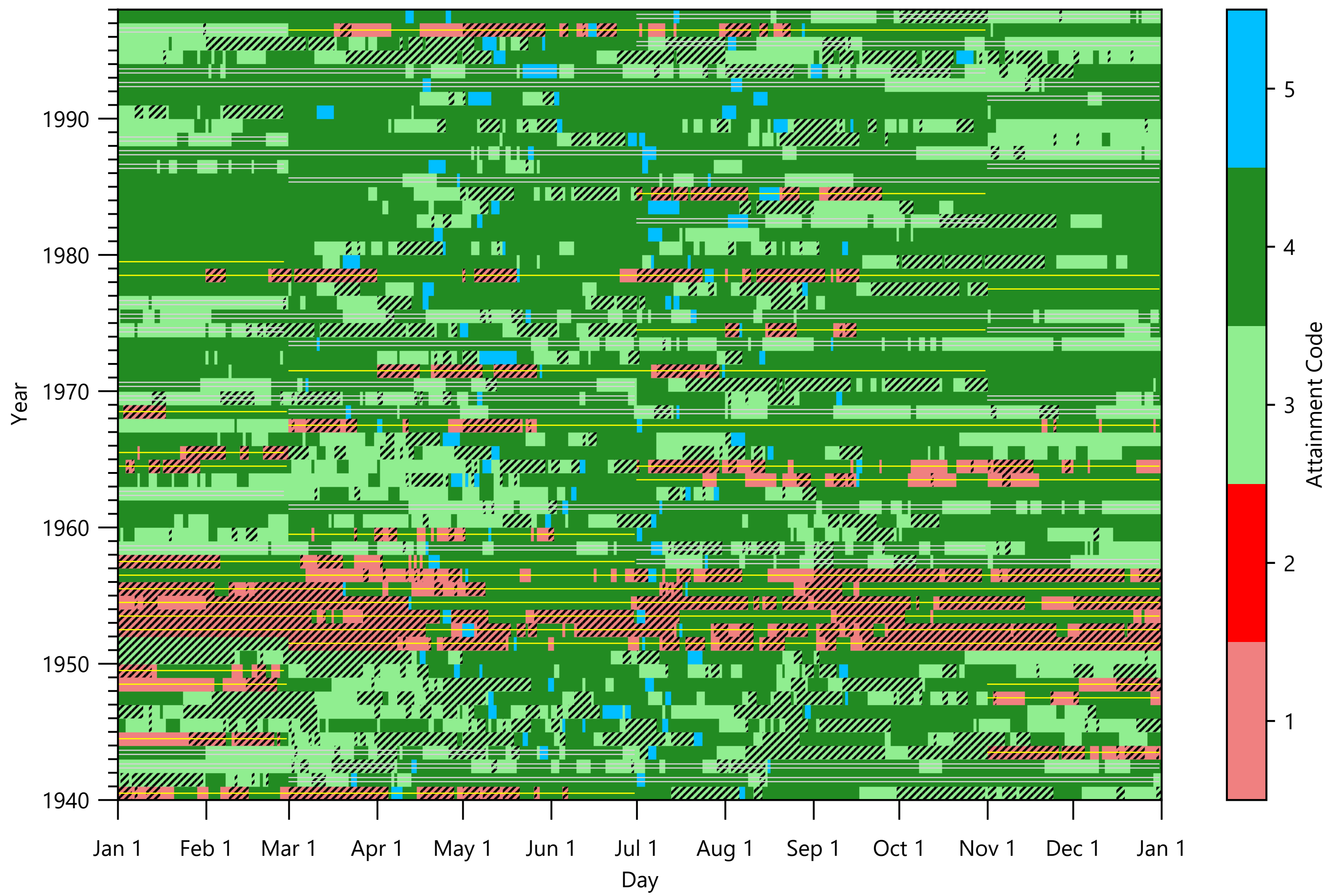
Figure G-7
Double Mountain Fork near Aspermont: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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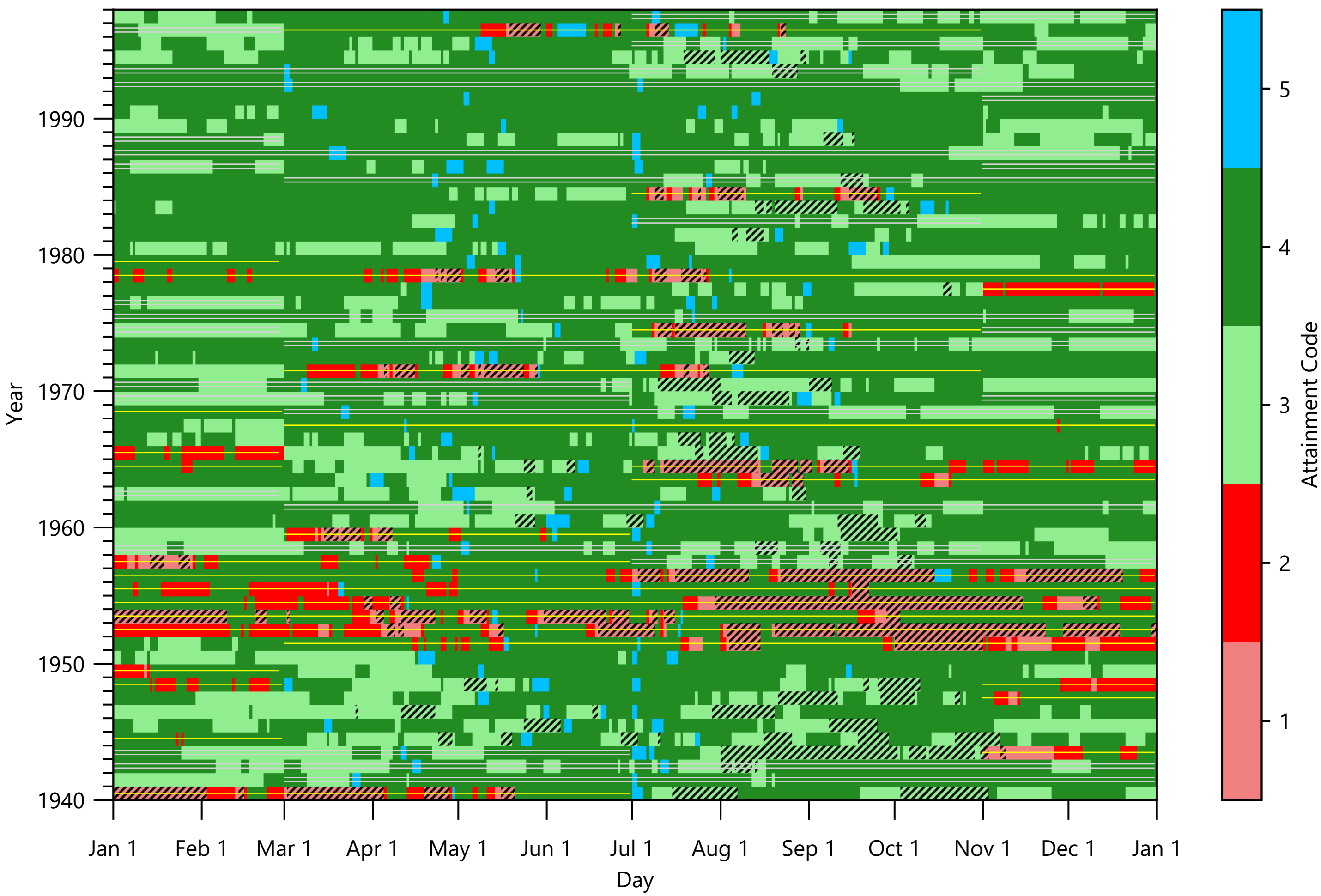

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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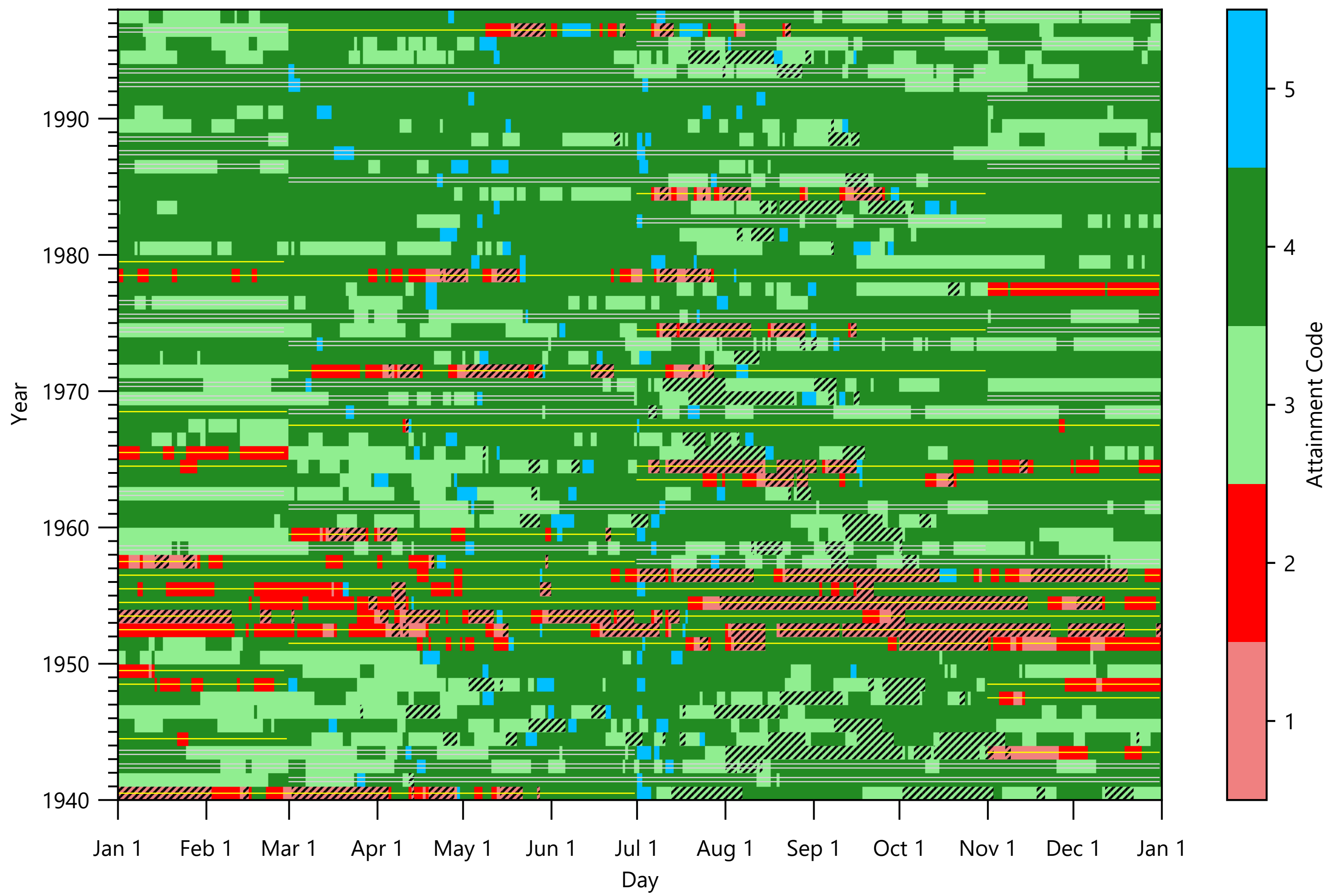
Figure G-9
Brazos River at Seymour: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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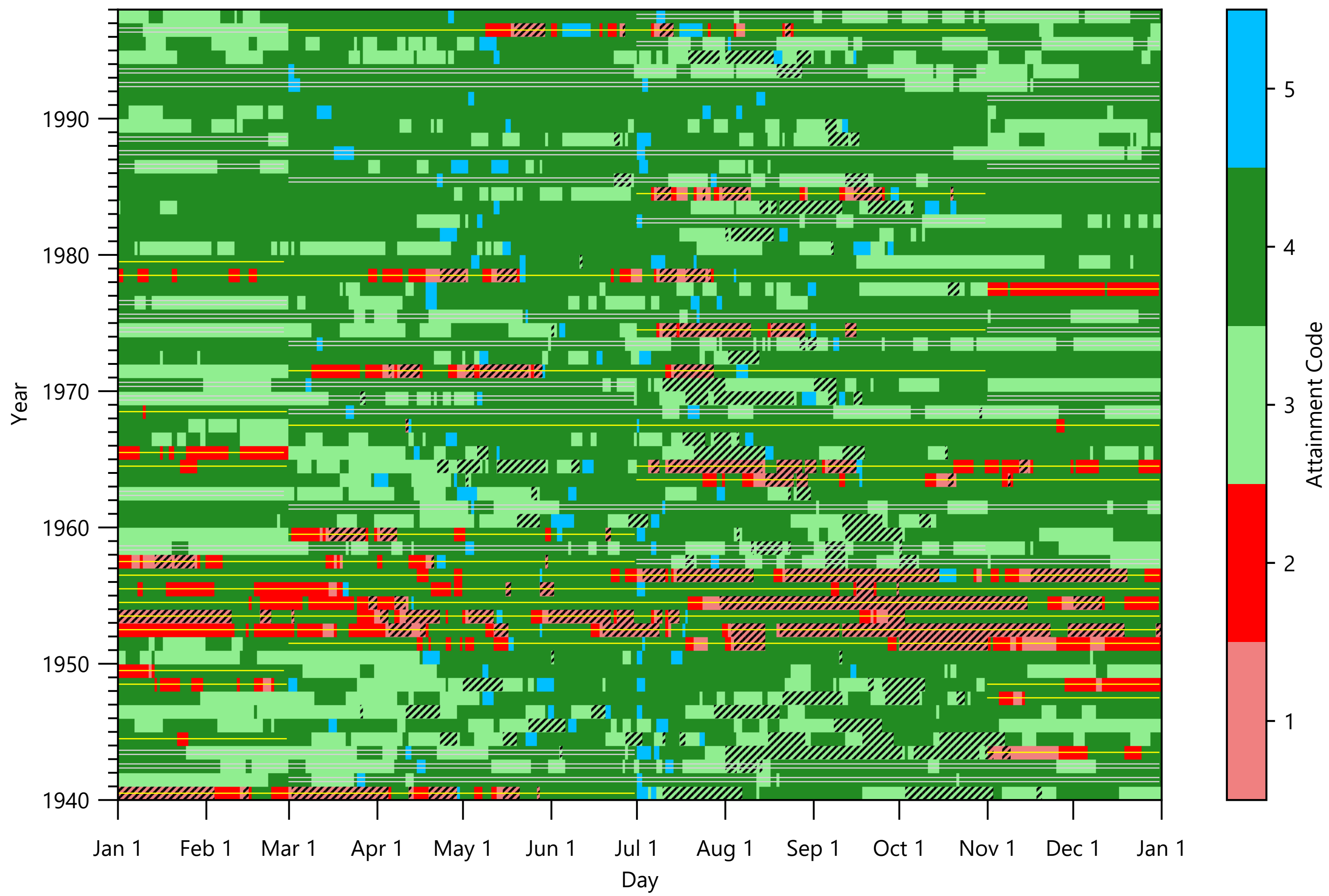
Figure G-10
Brazos River at Seymour: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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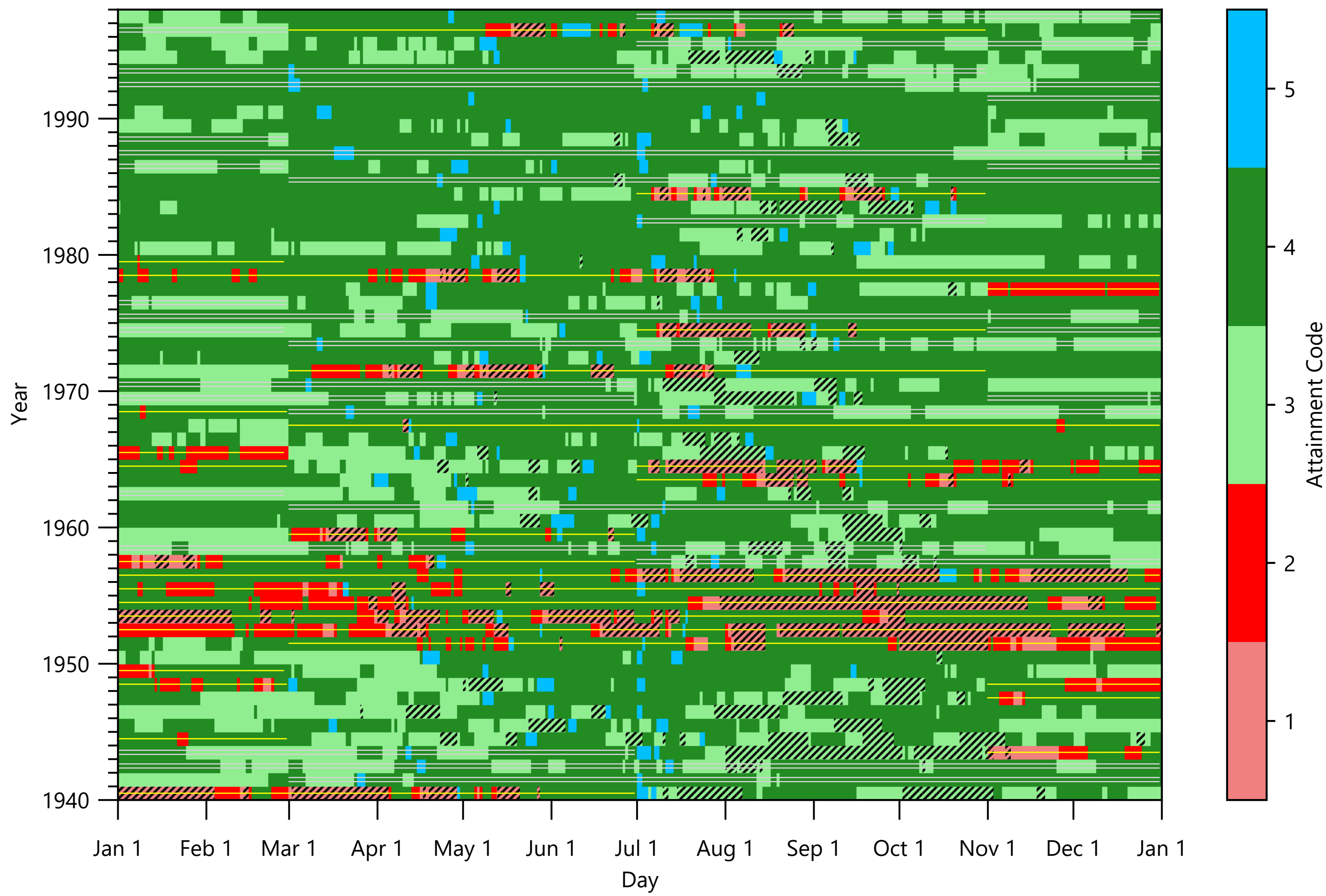

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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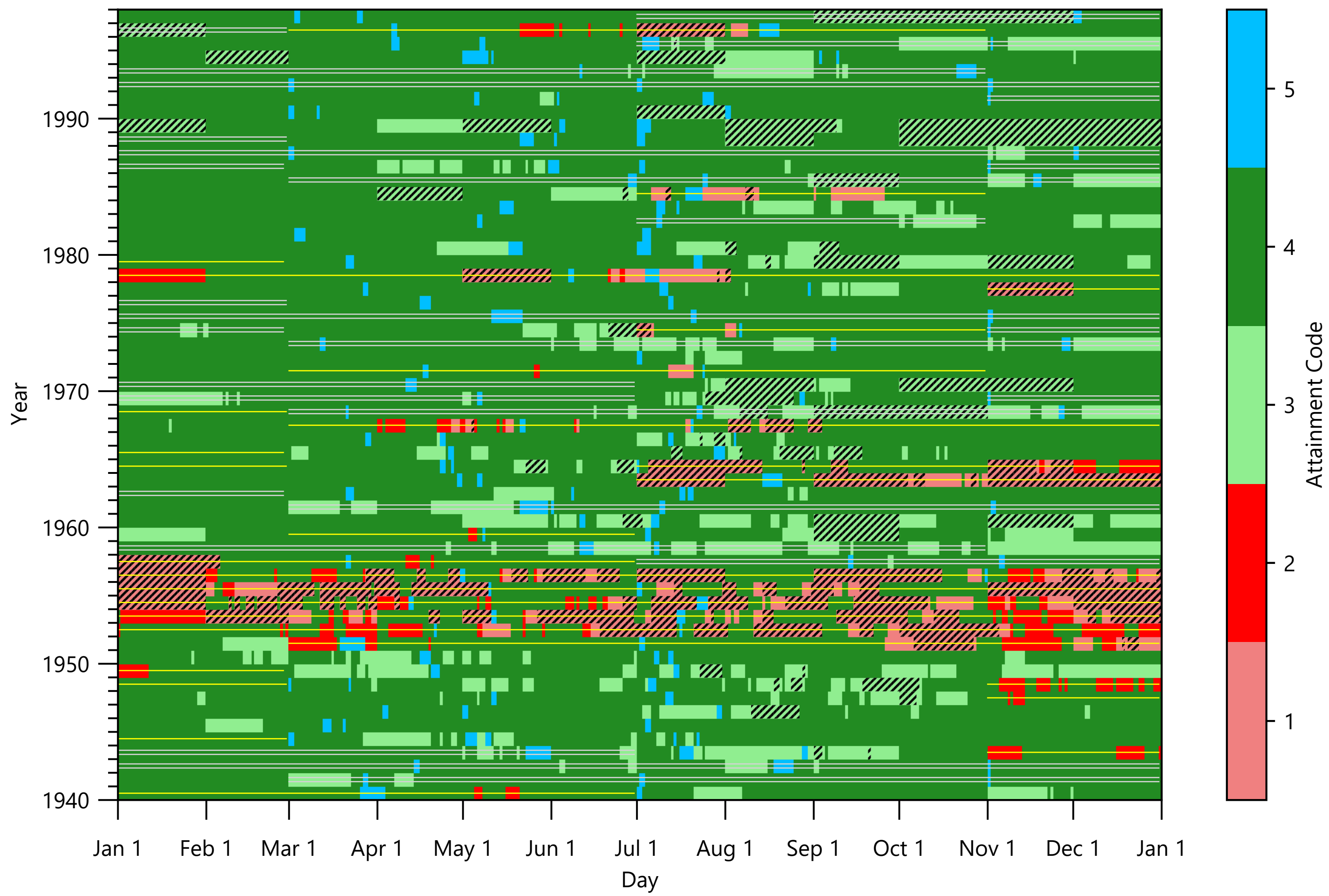
Figure G-12
Brazos River at Seymour: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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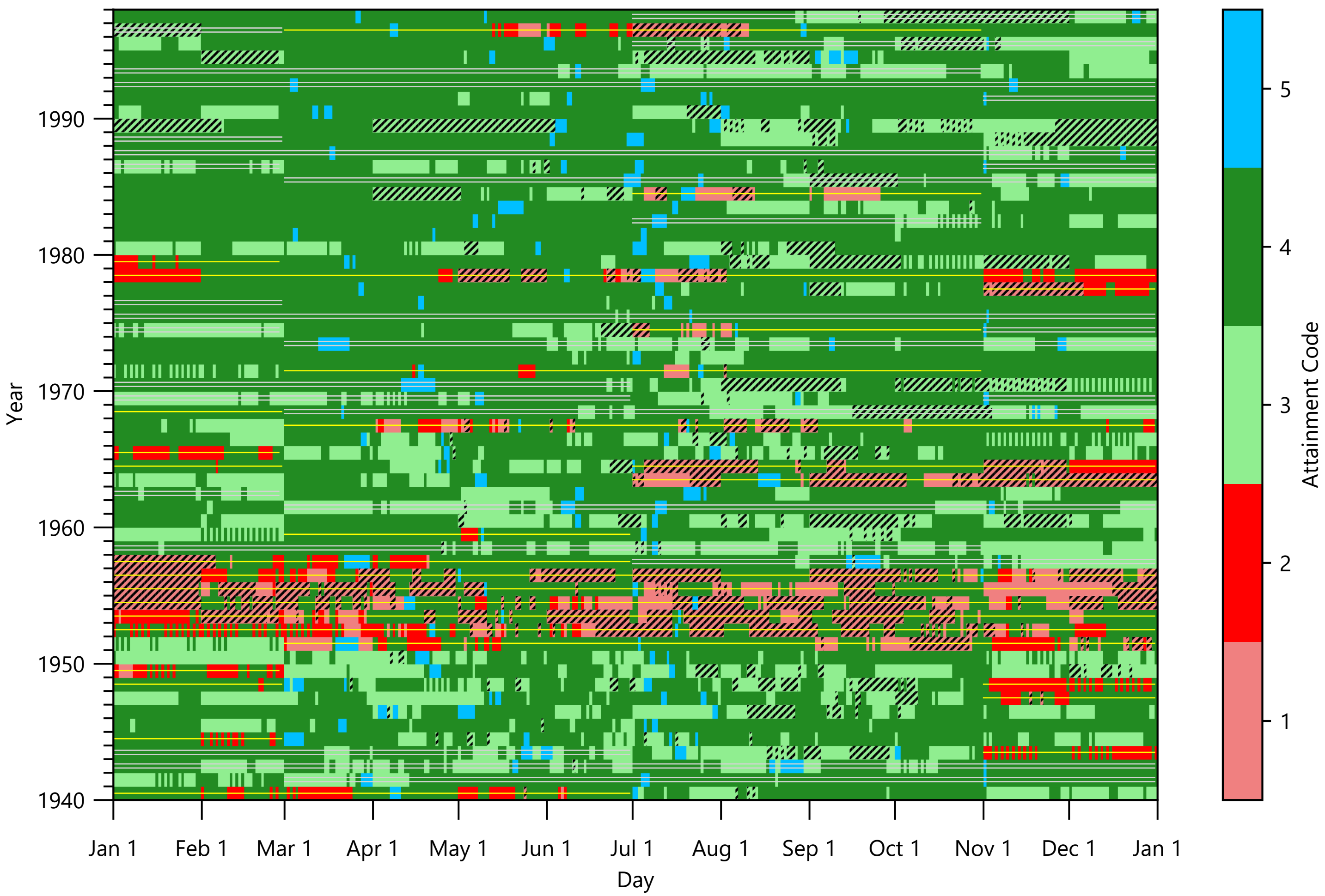
Figure G-13
Clear Fork at Nugent: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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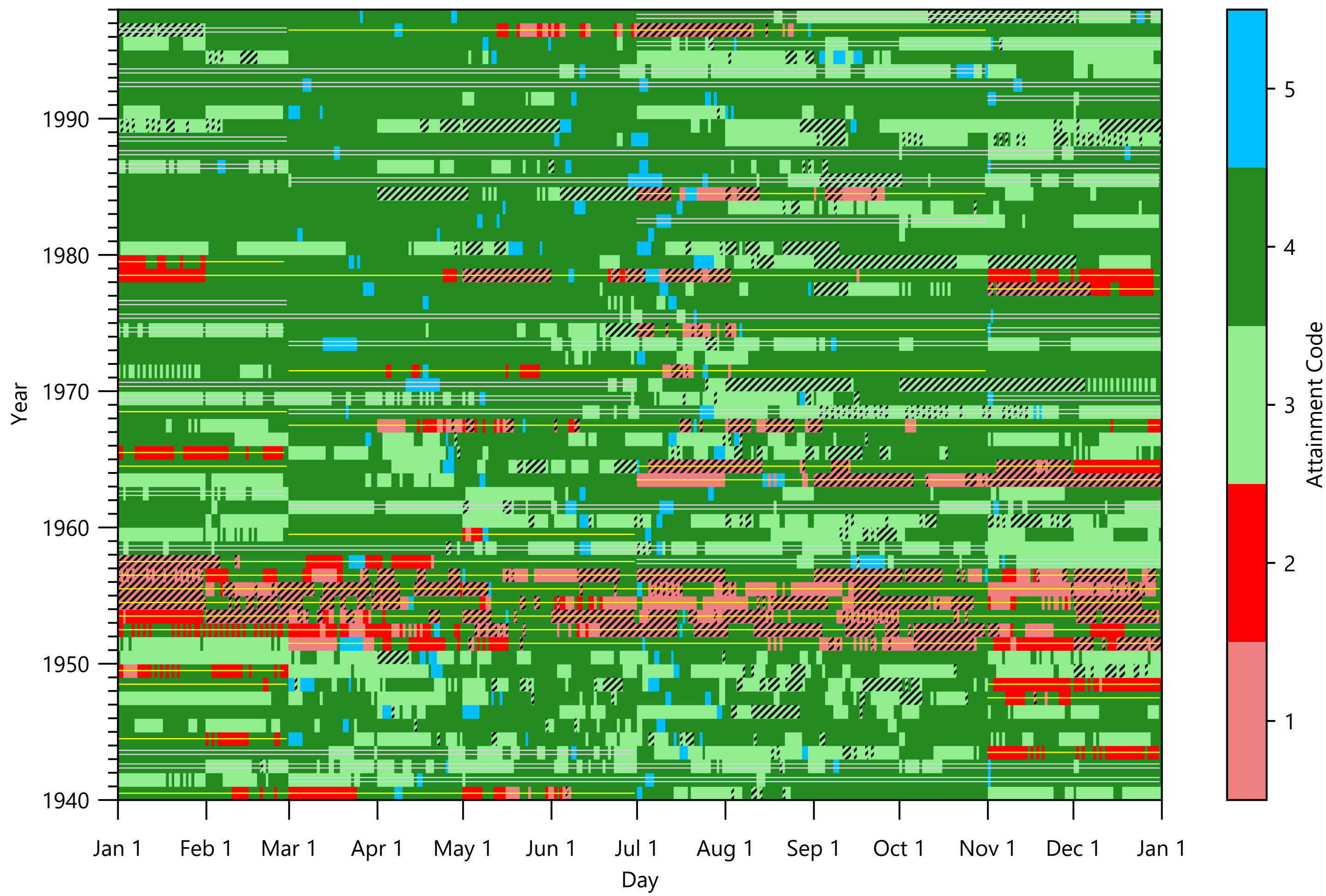
Figure G-14
Clear Fork at Nugent: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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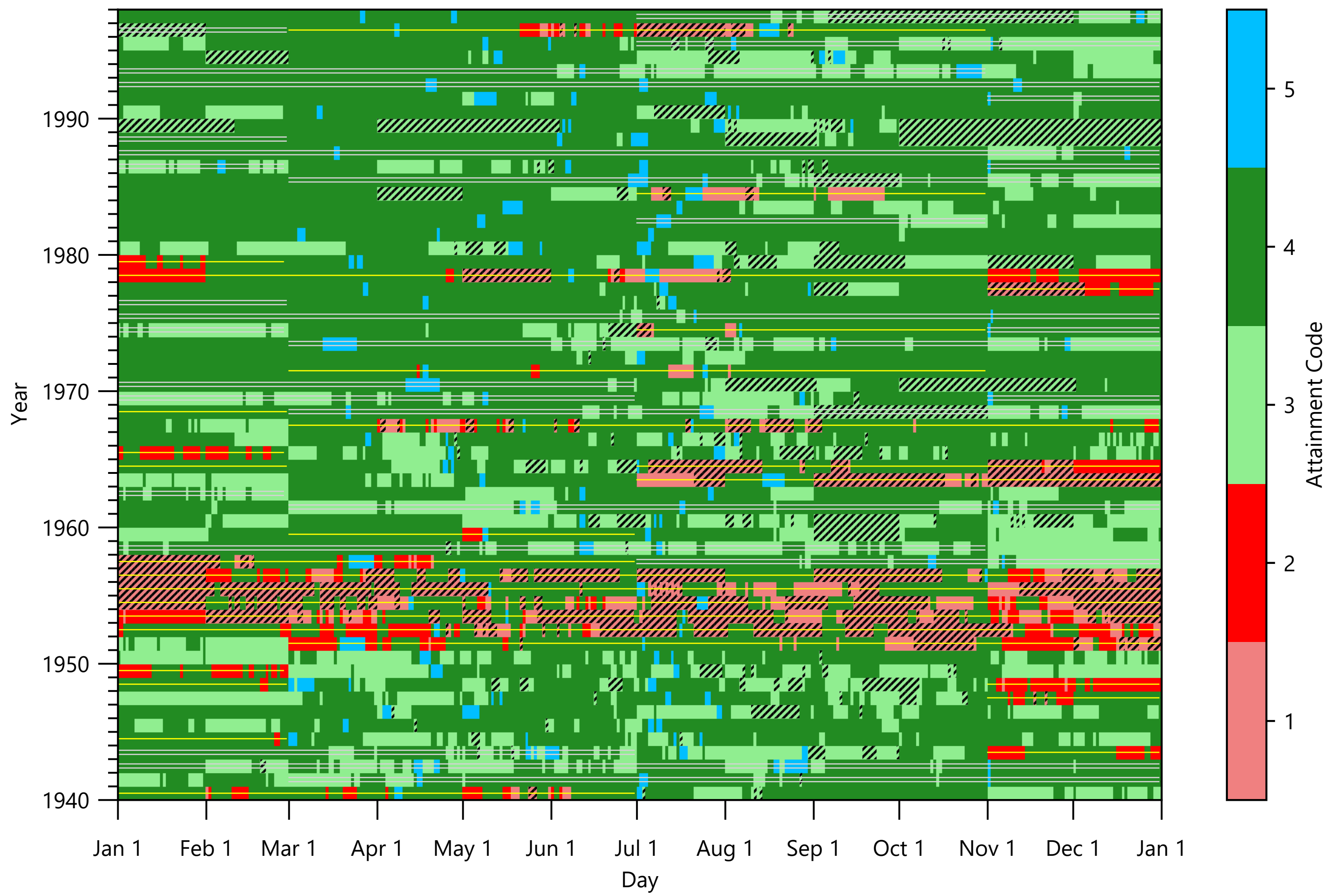
Figure G-15
Clear Fork at Nugent: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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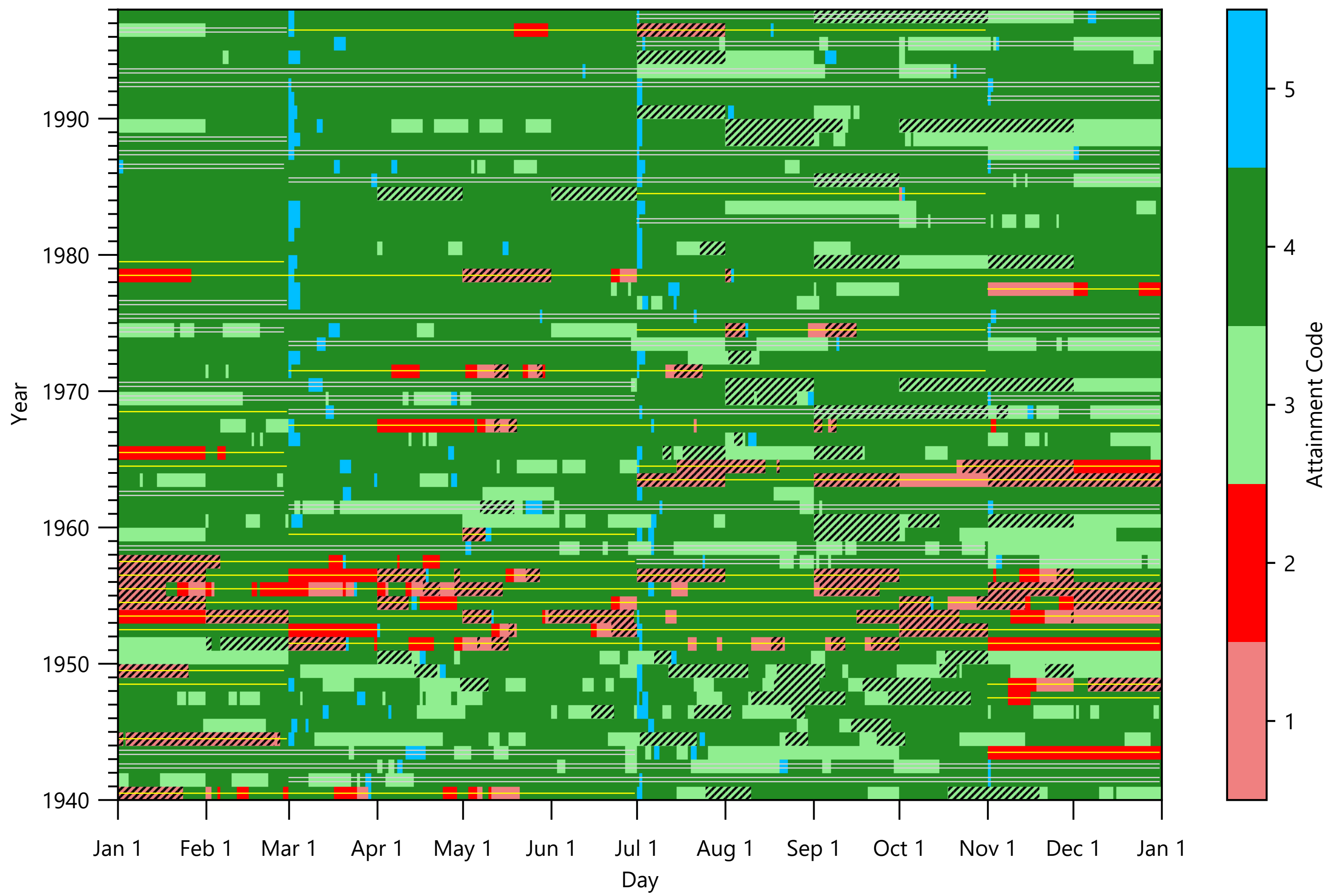
Figure G-16
Clear Fork at Nugent: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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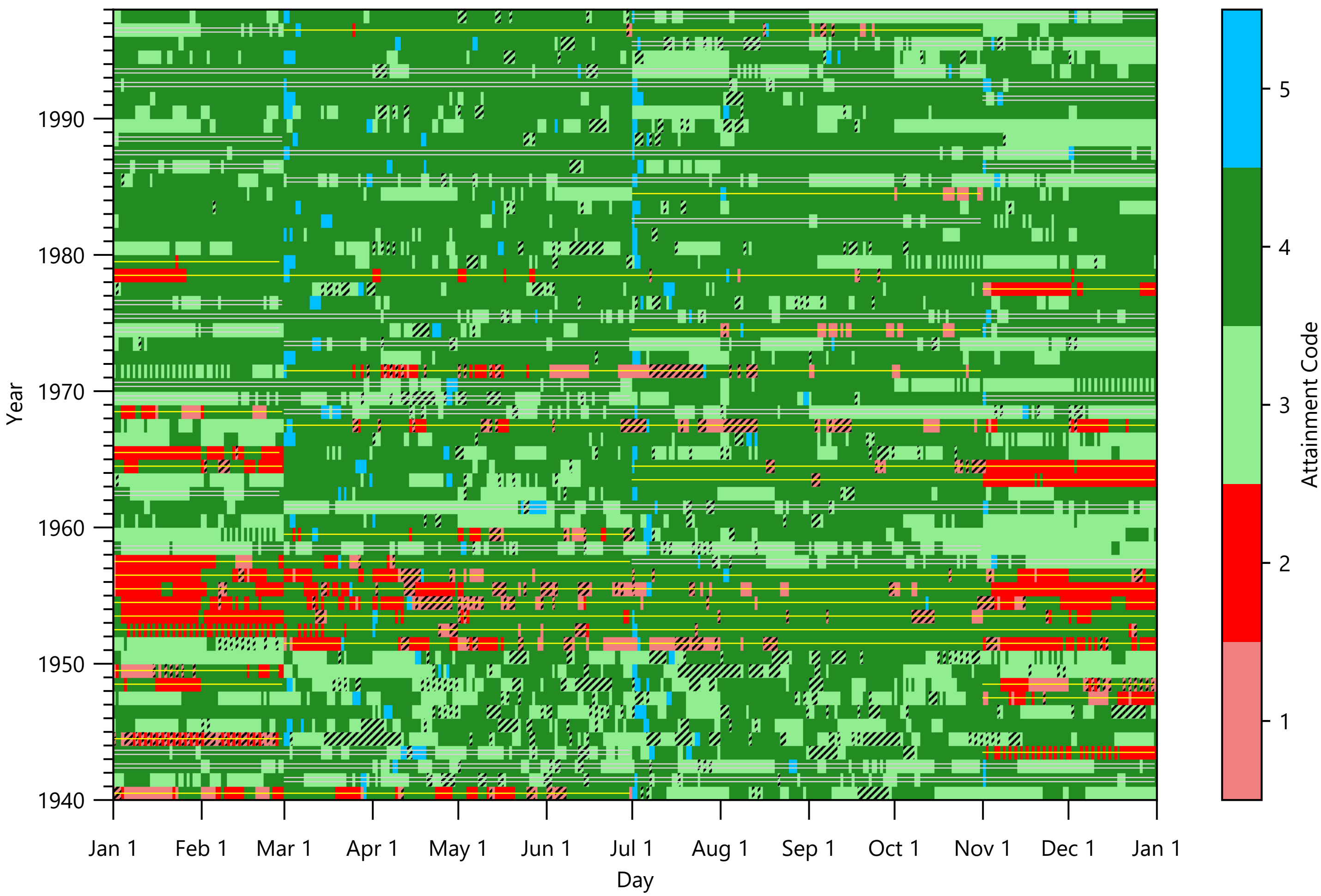
Figure G-17
Clear Fork at Lueders: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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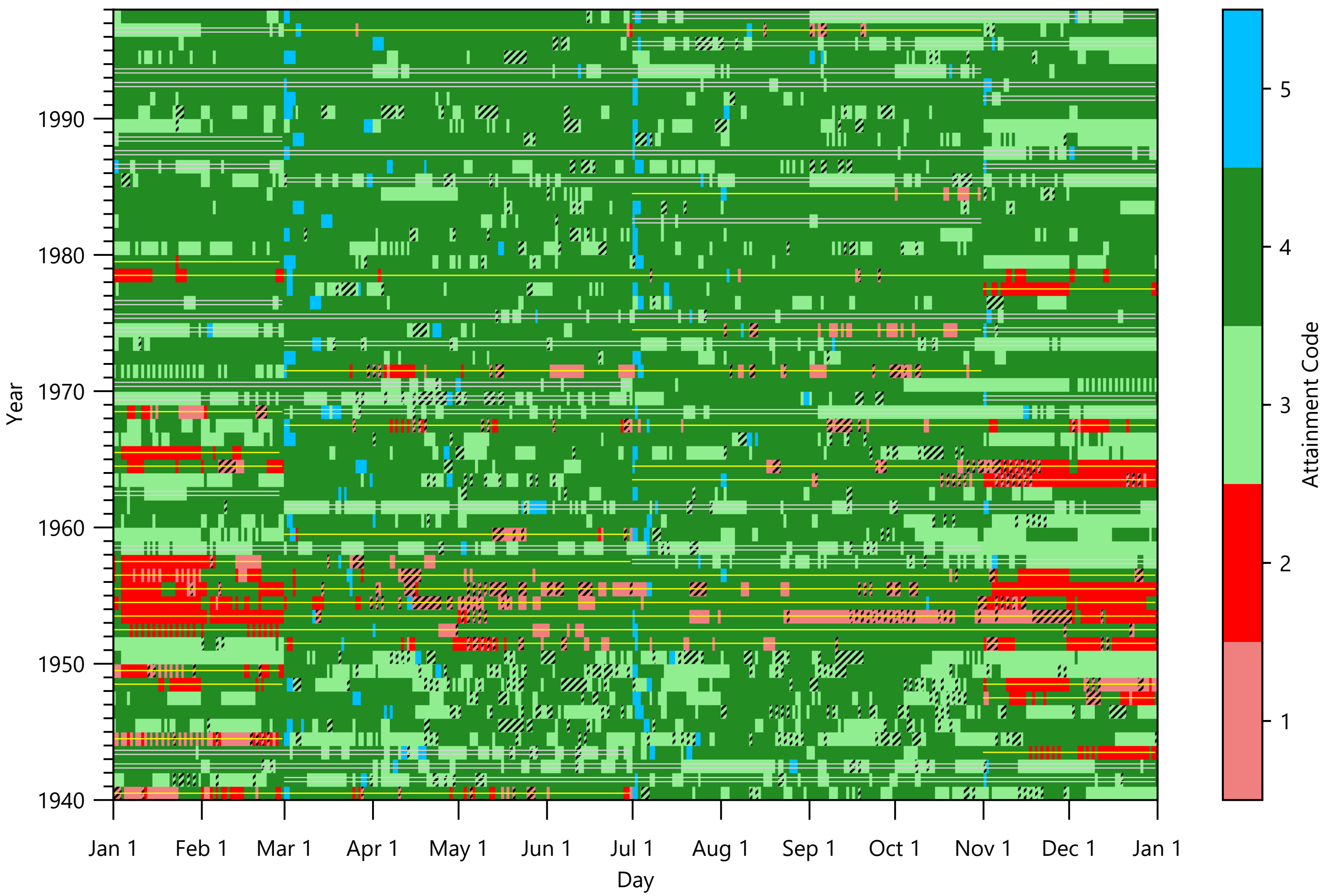
Figure G-18

Clear Fork at Lueders: Current Water Use Scenario

Attainment Raster Hydrographs for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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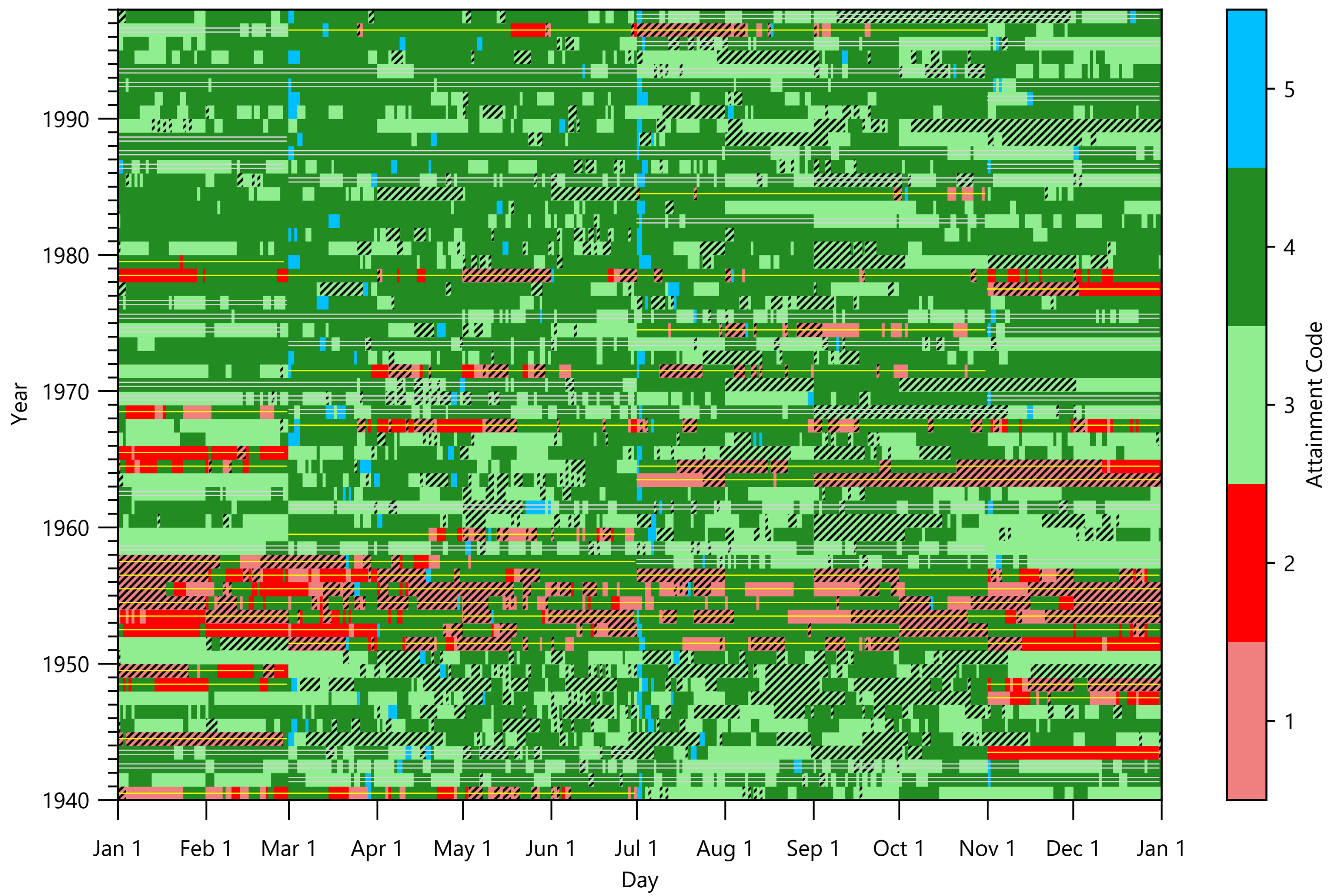
Figure G-19
Clear Fork at Lueders: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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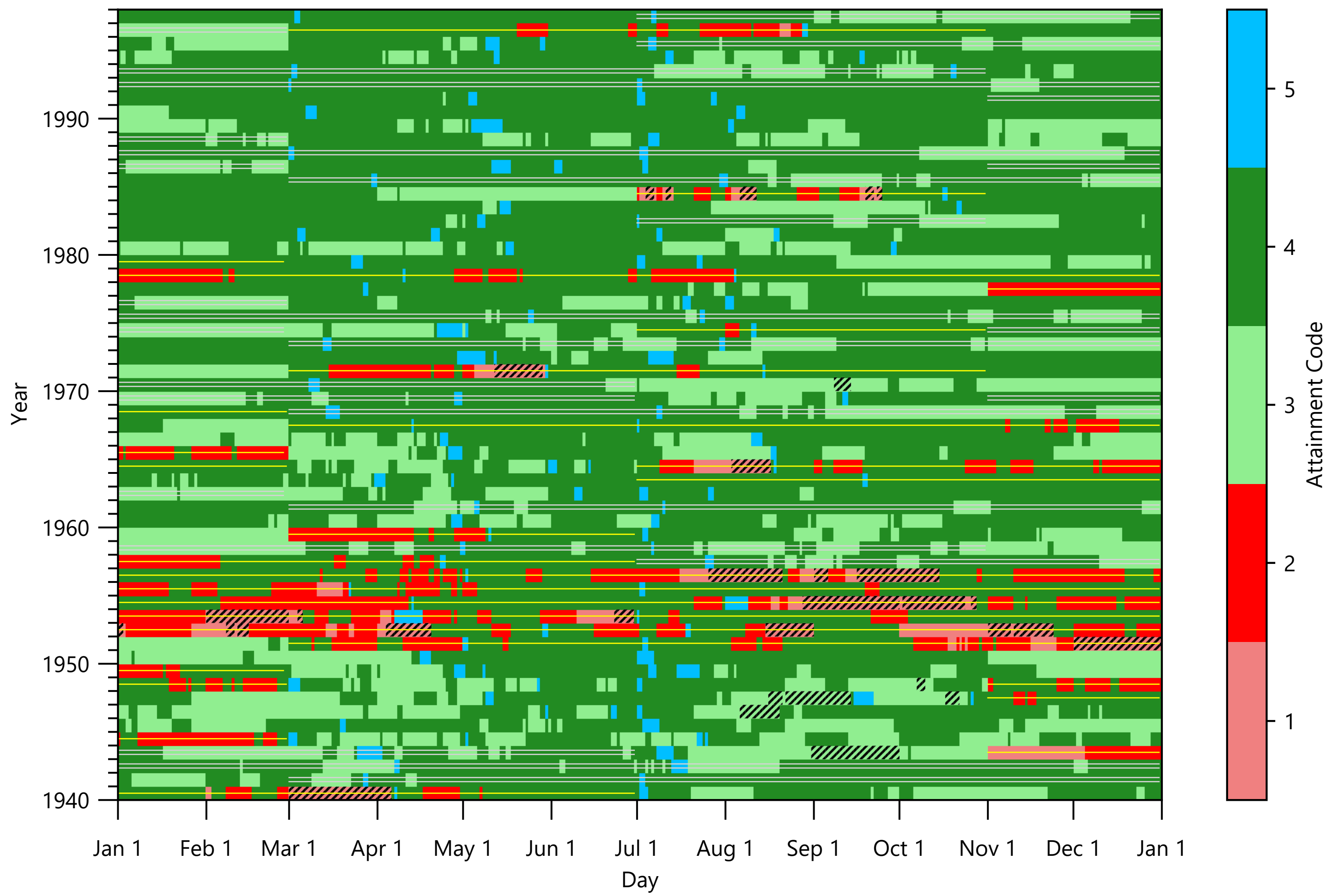
Figure G-20
Clear Fork at Lueders: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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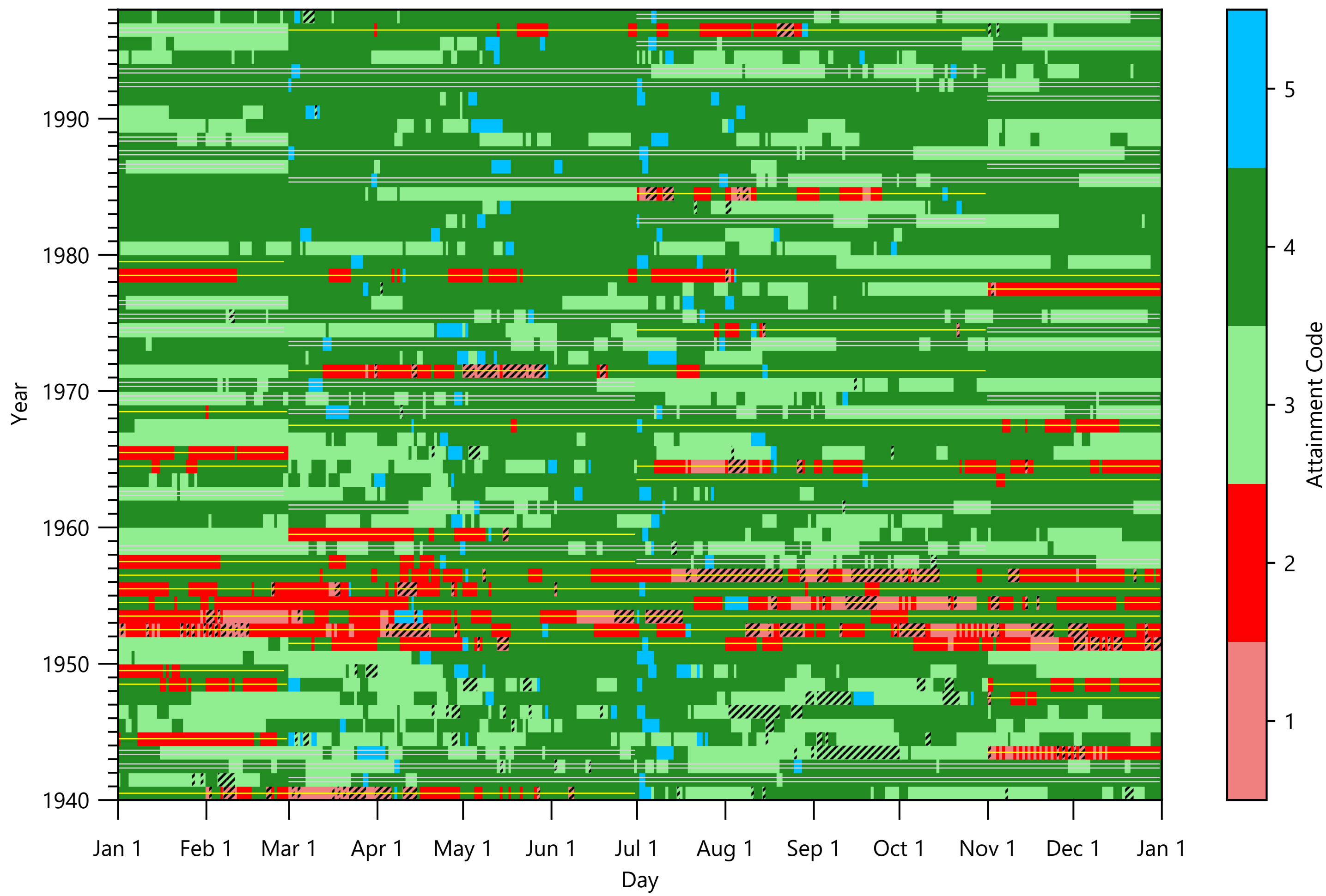
Figure G-21
Brazos River near South Bend: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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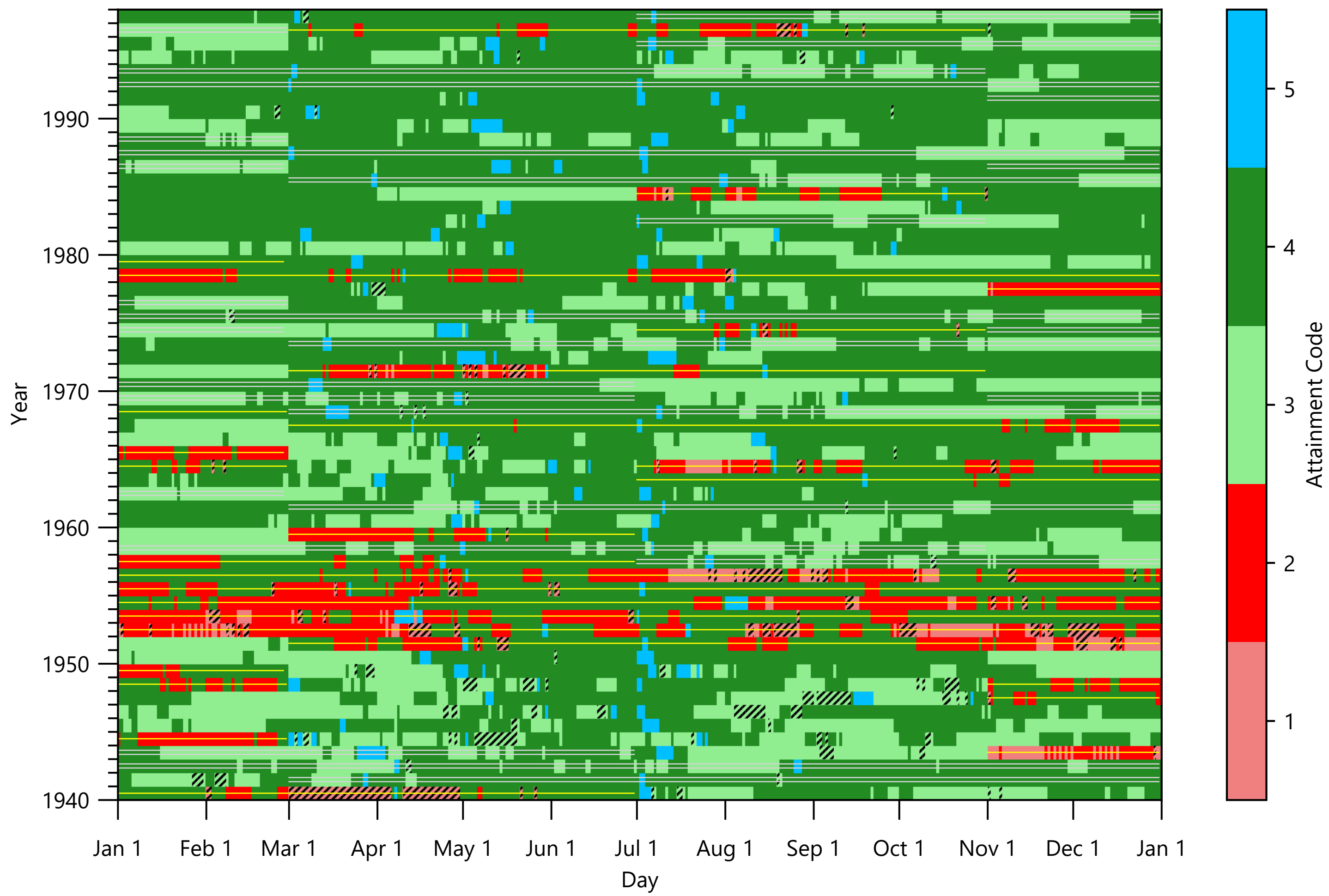

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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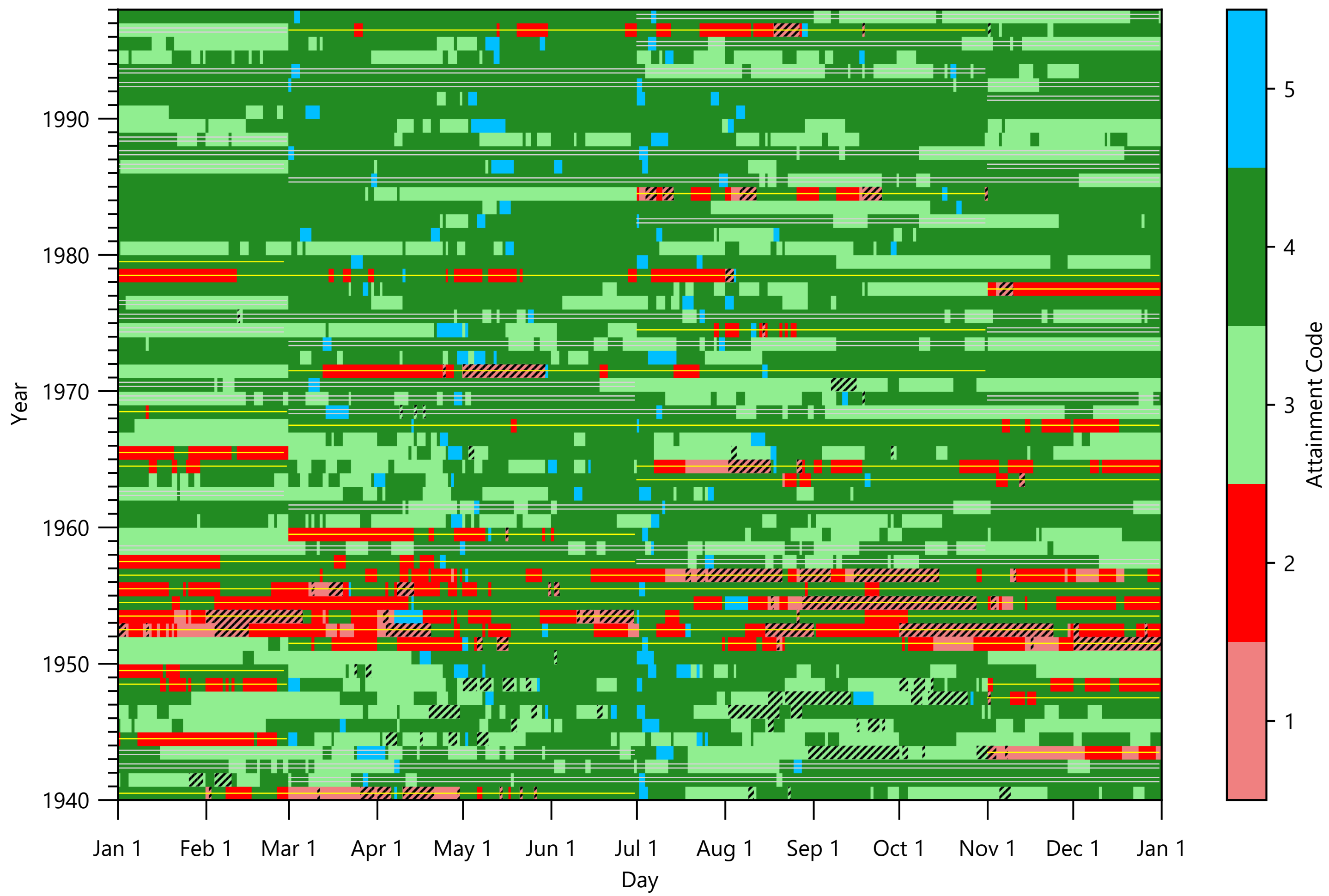
Figure G-23

Brazos River near South Bend: Partial Utilization Scenario

Attainment Raster Hydrographs for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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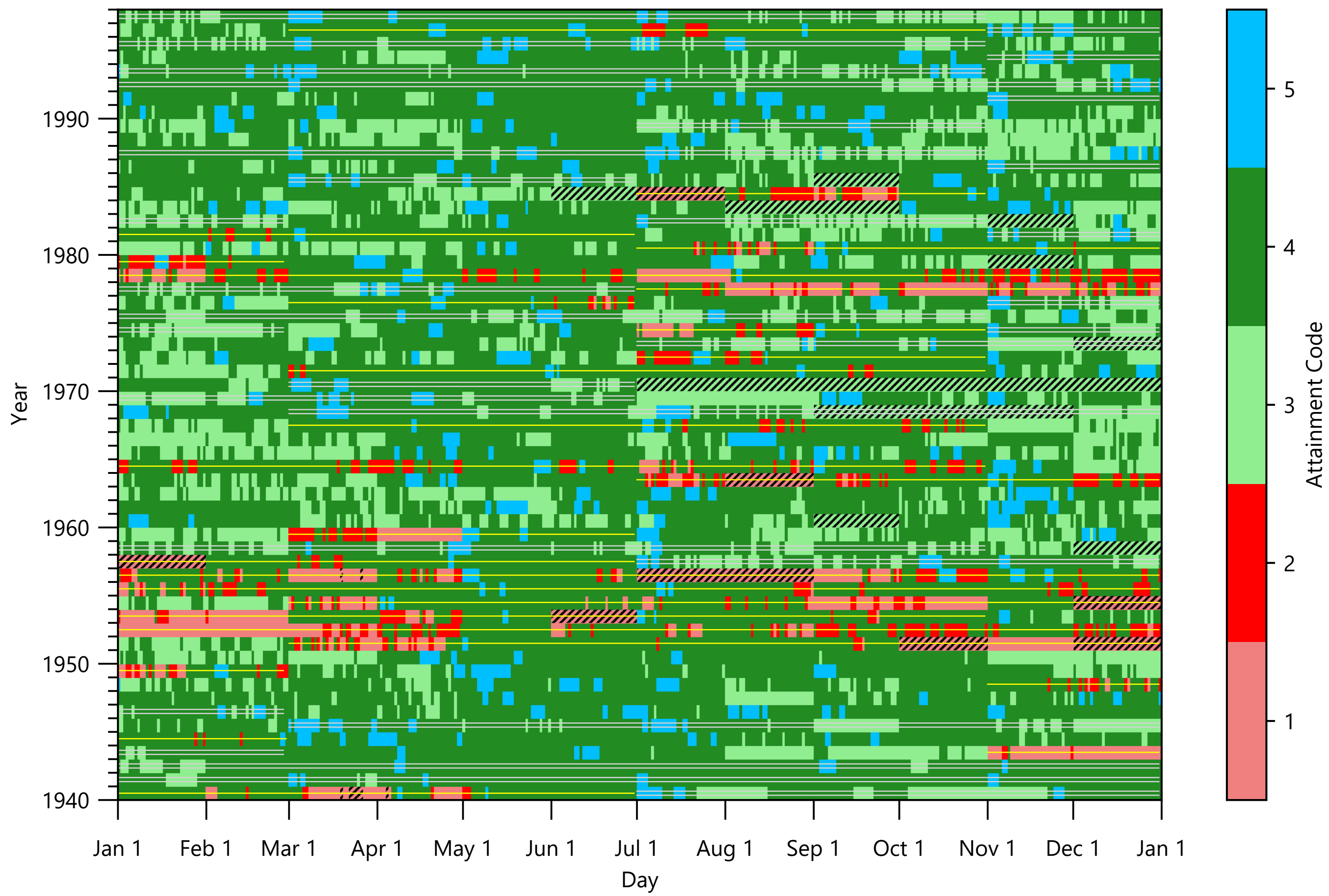
Figure G-24
Brazos River near South Bend: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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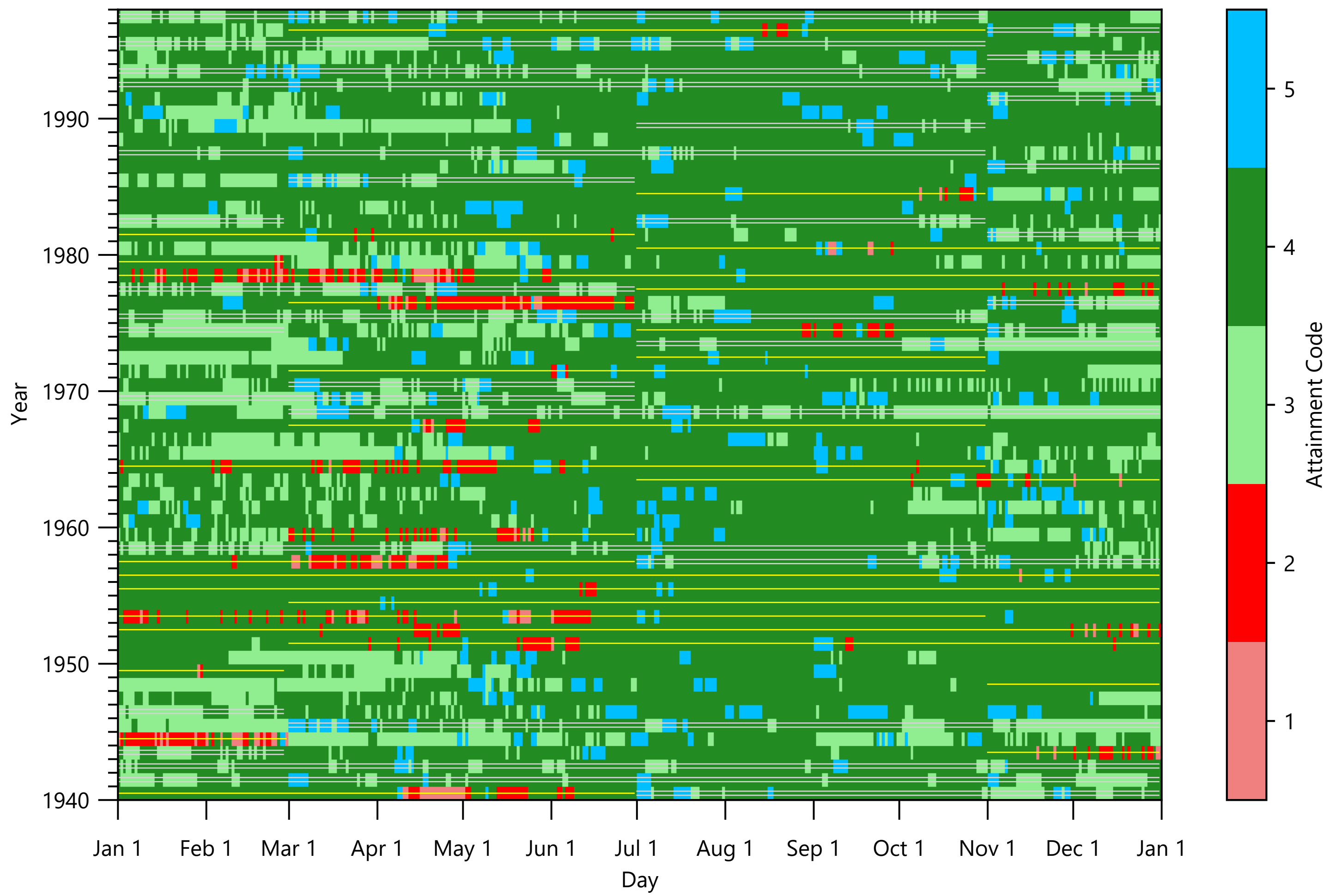
Figure G-25
Brazos River near Palo Pinto: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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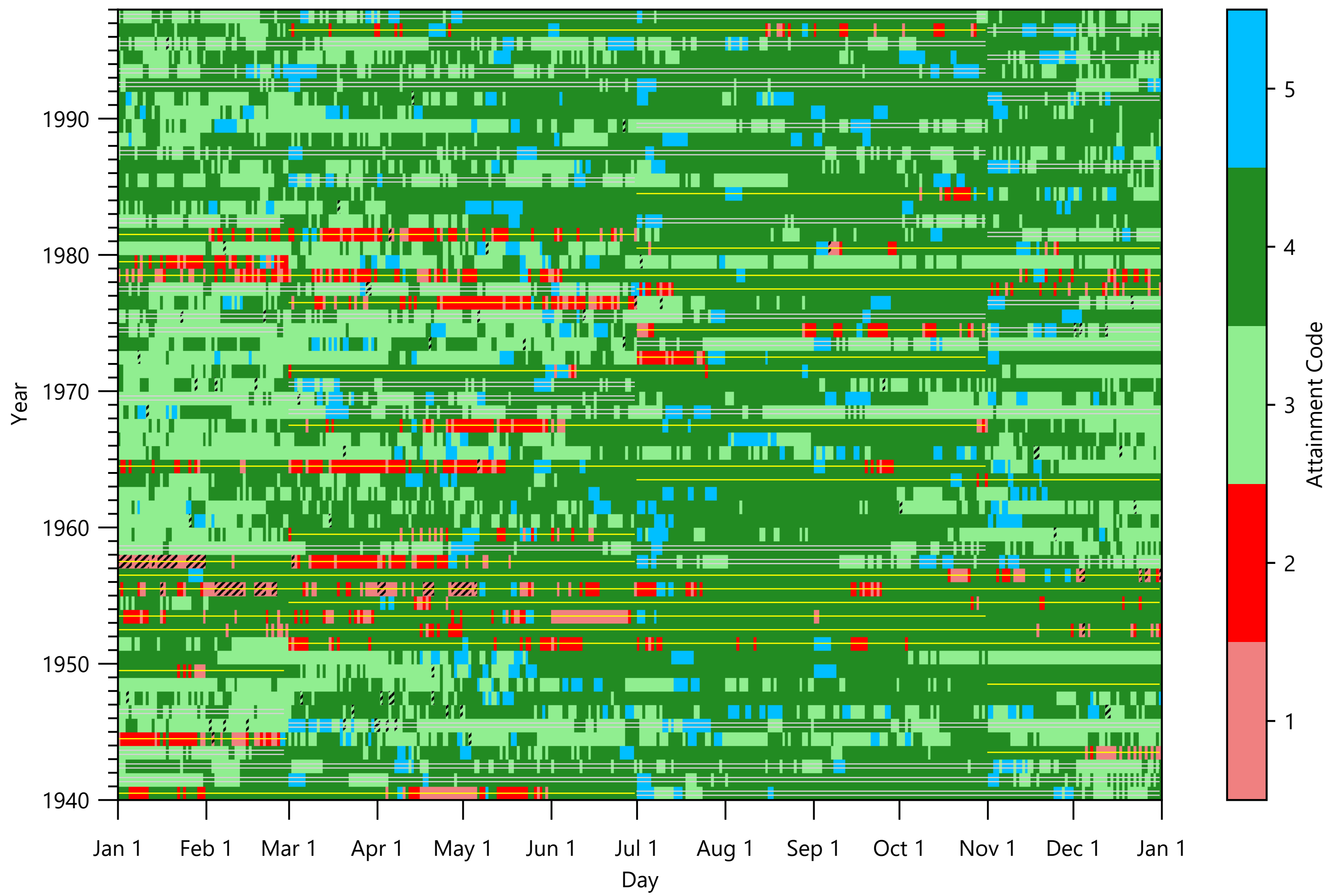
Figure G-26
Brazos River near Palo Pinto: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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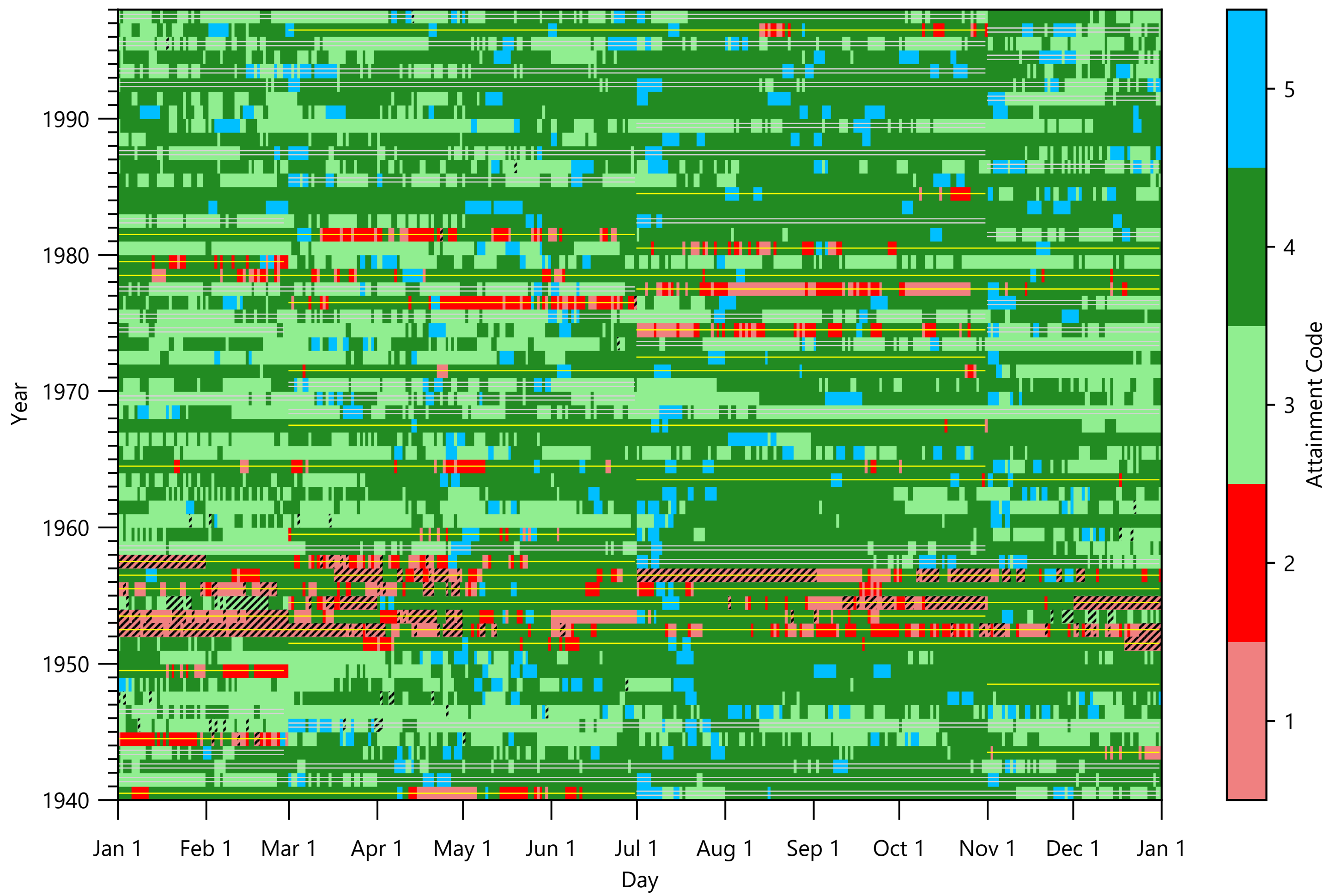
Figure G-27
Brazos River near Palo Pinto: Partial Utilization Scenario



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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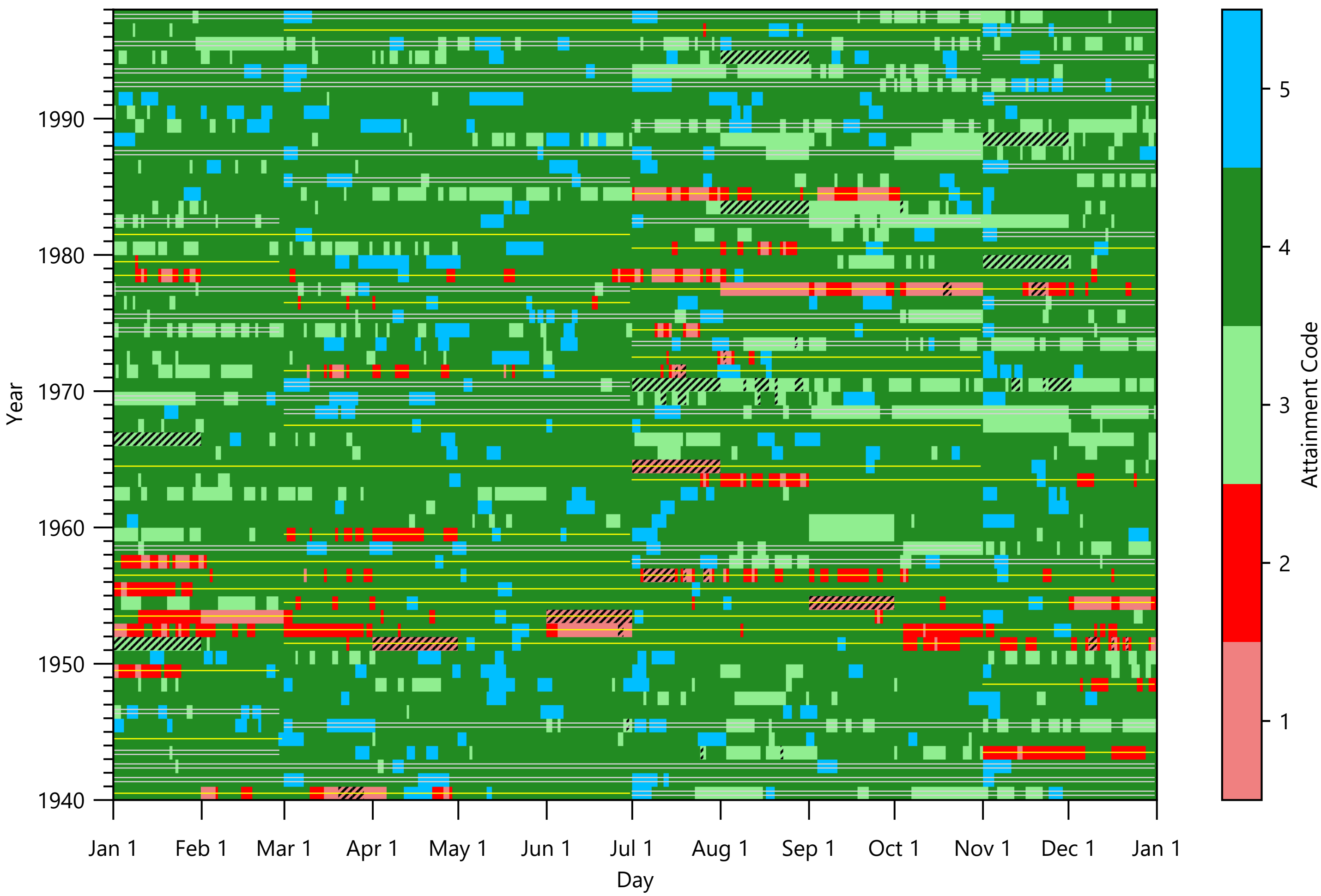
Figure G-28
Brazos River near Palo Pinto: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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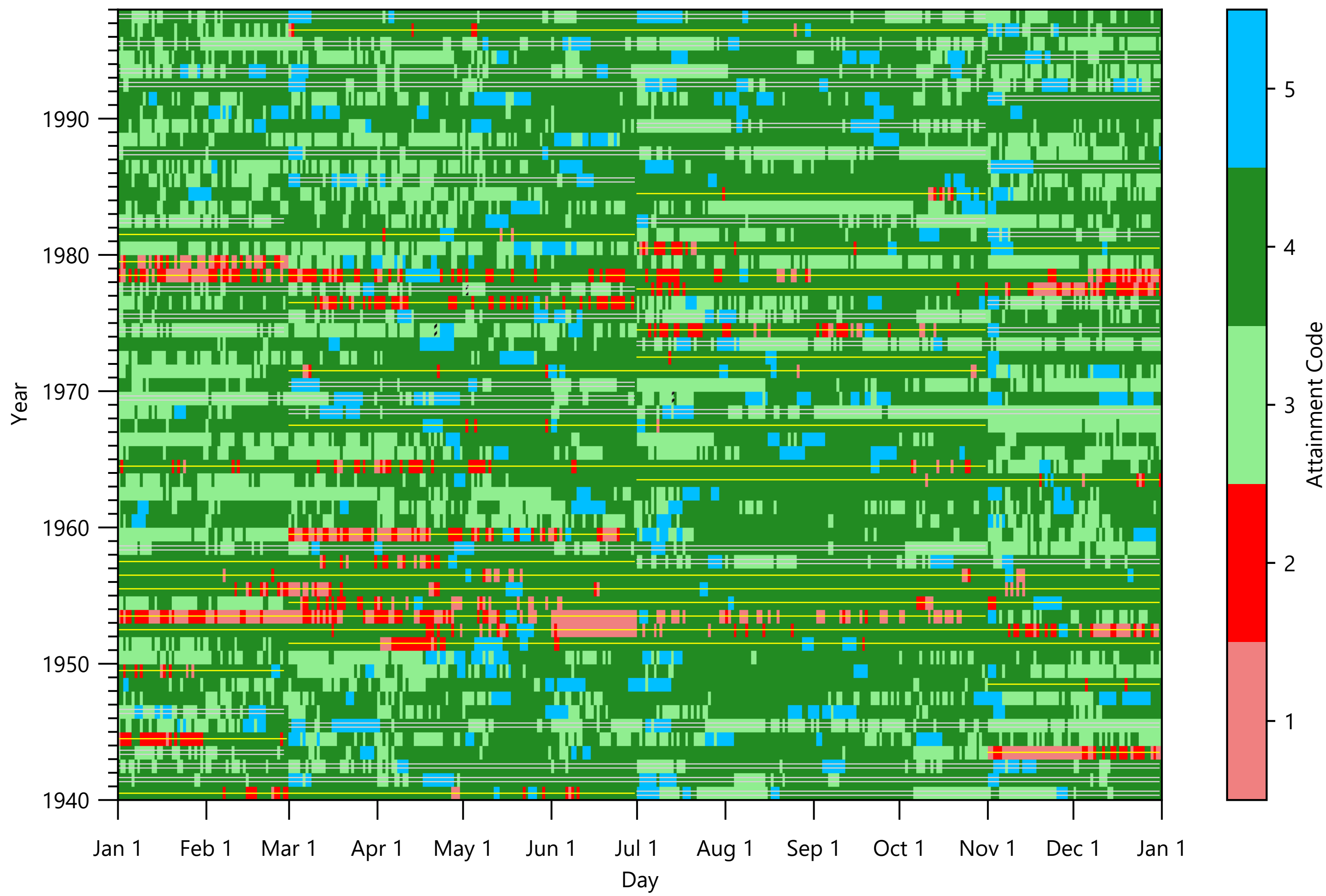
Figure G-29
Brazos River near Glen Rose: Naturalized Flow Scenario



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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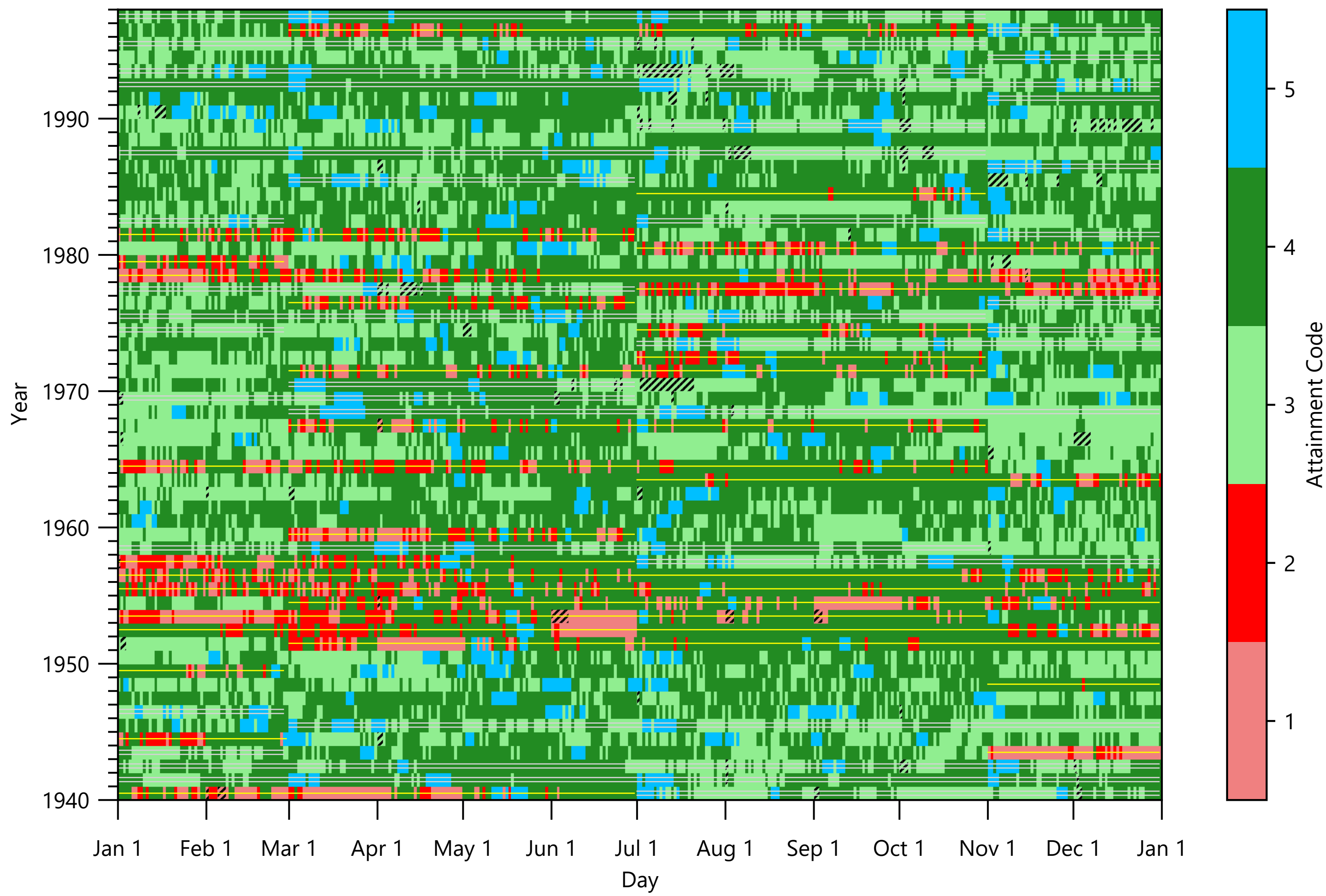
Figure G-30
Brazos River near Glen Rose: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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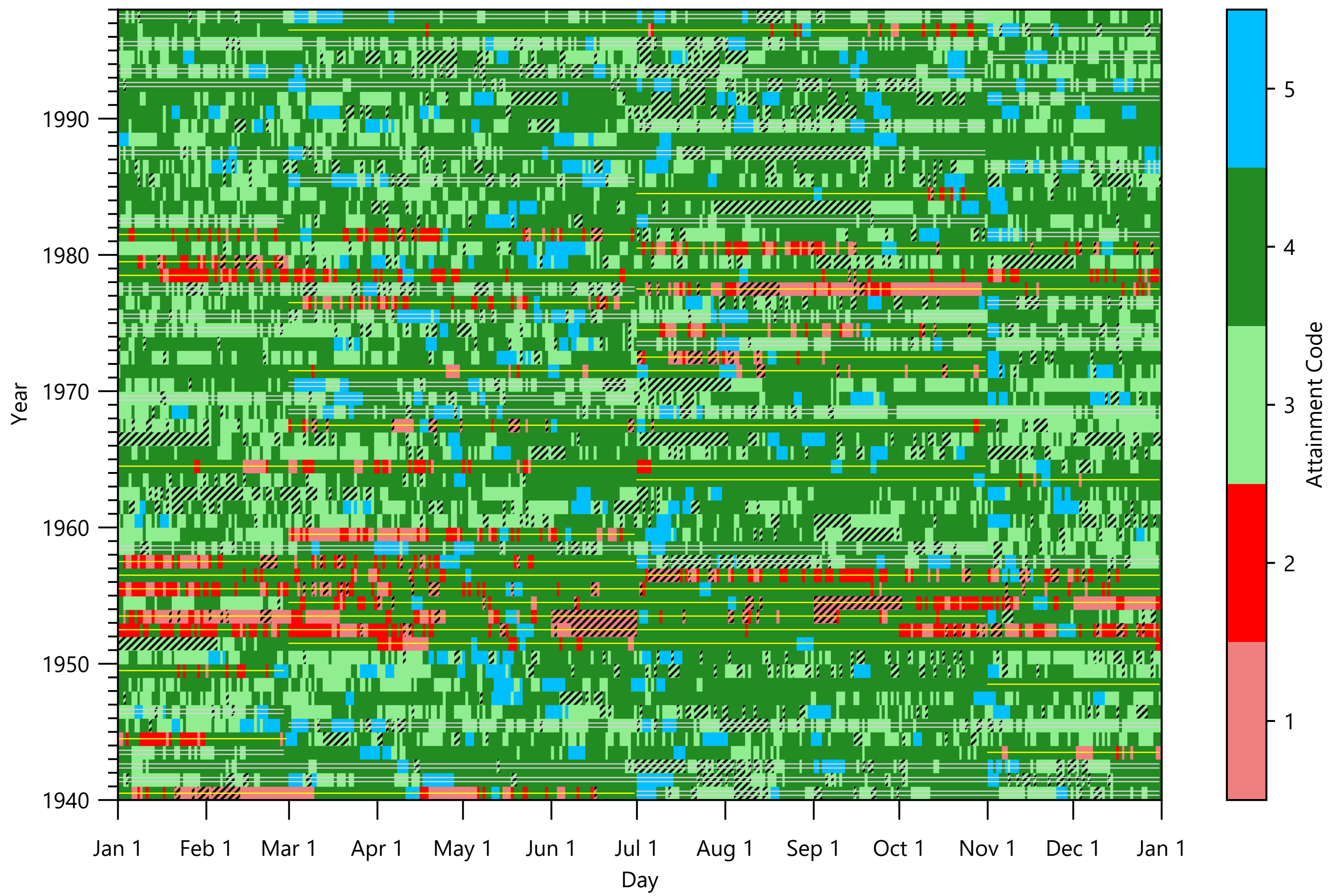
Figure G-31
Brazos River near Glen Rose: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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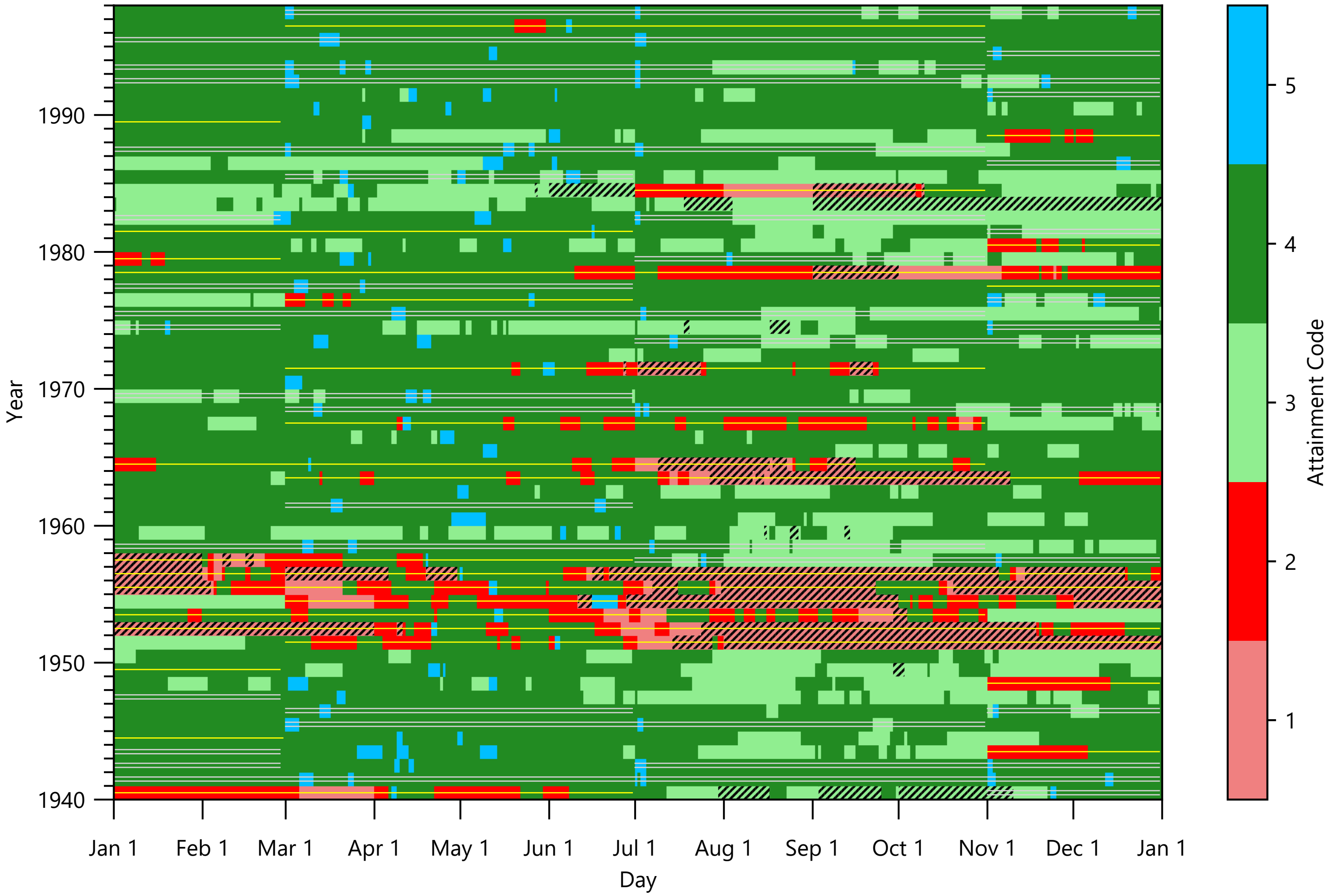
Figure G-32
Brazos River near Glen Rose: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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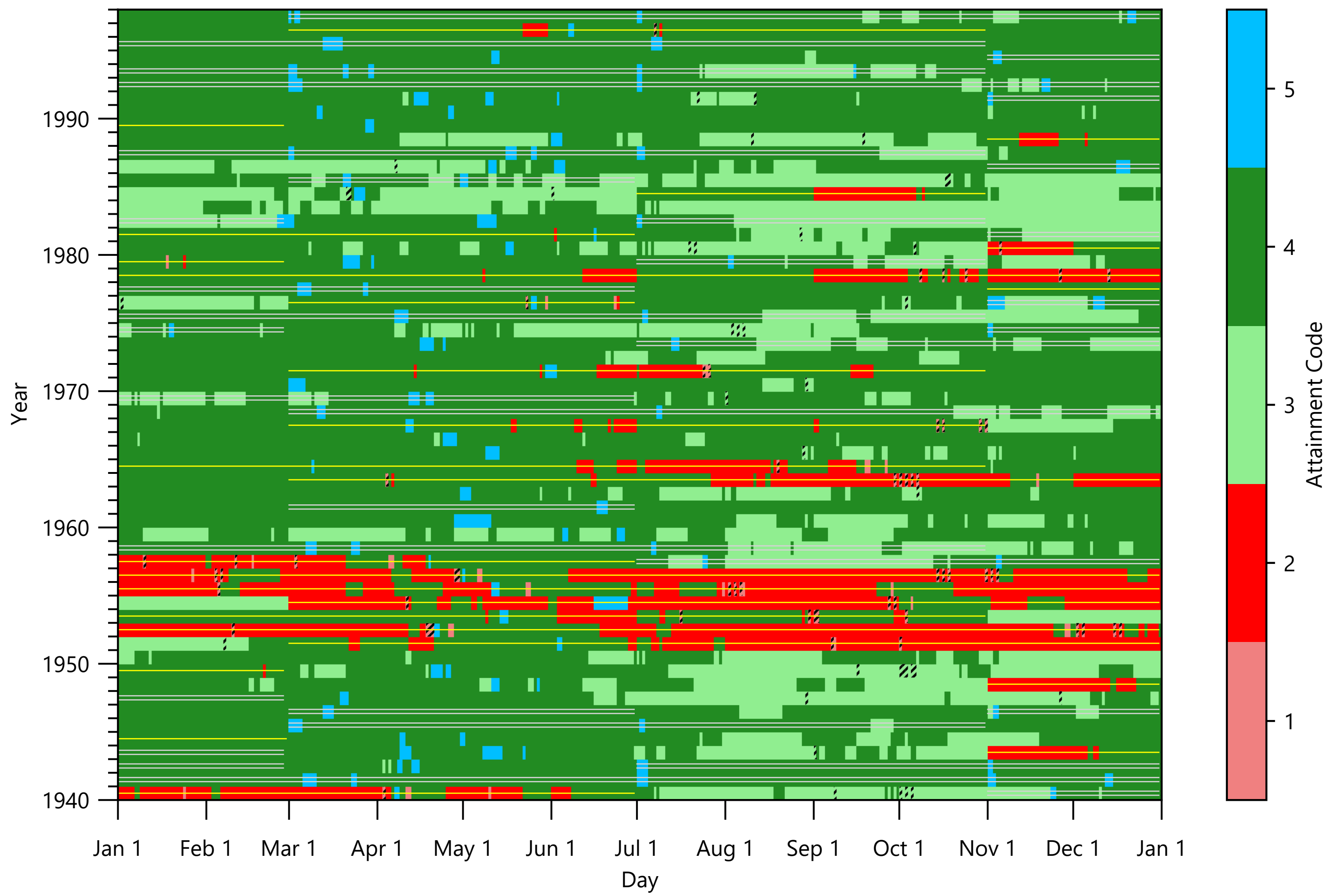
Figure G-33
North Bosque near Clifton: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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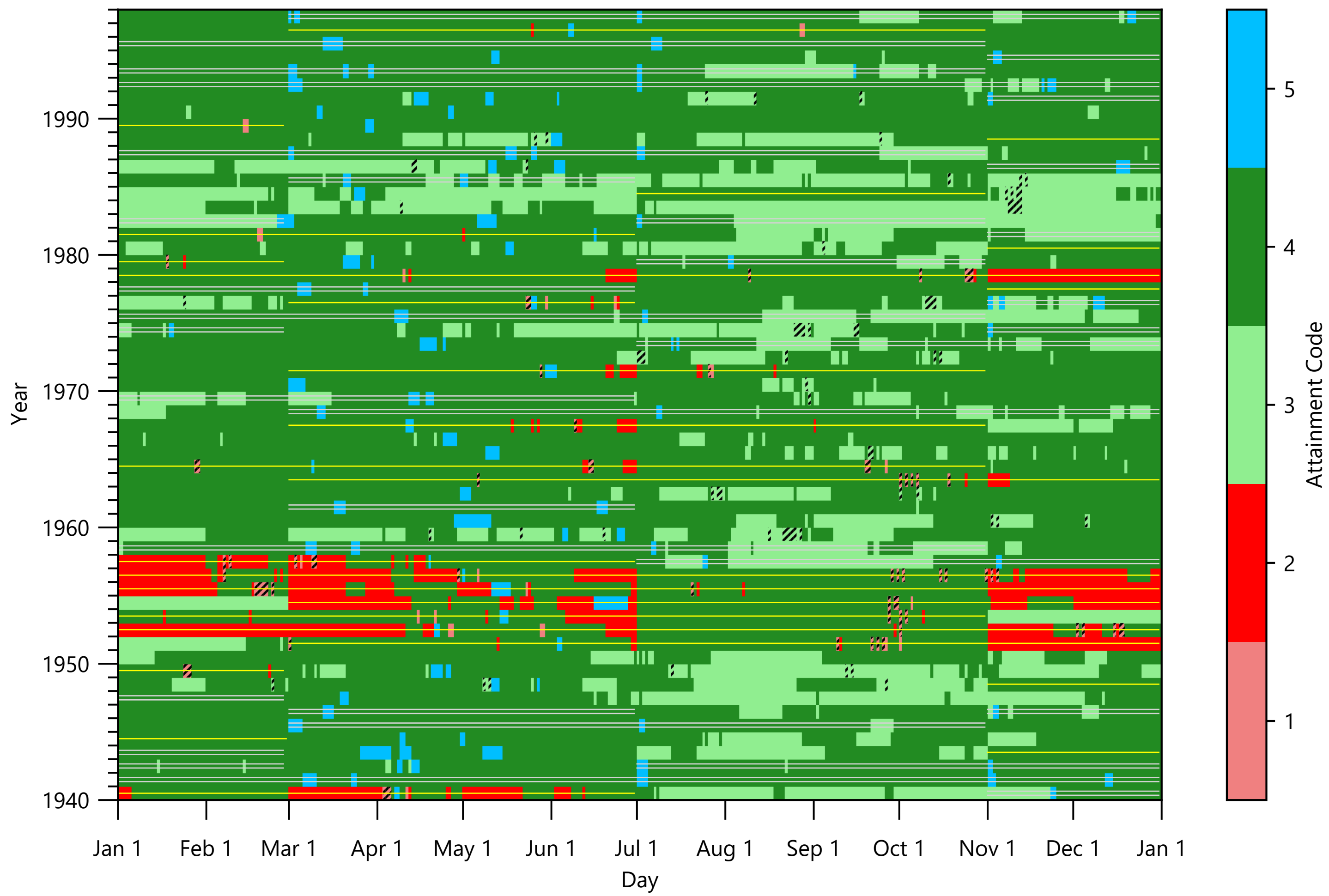
Figure G-34
North Bosque near Clifton: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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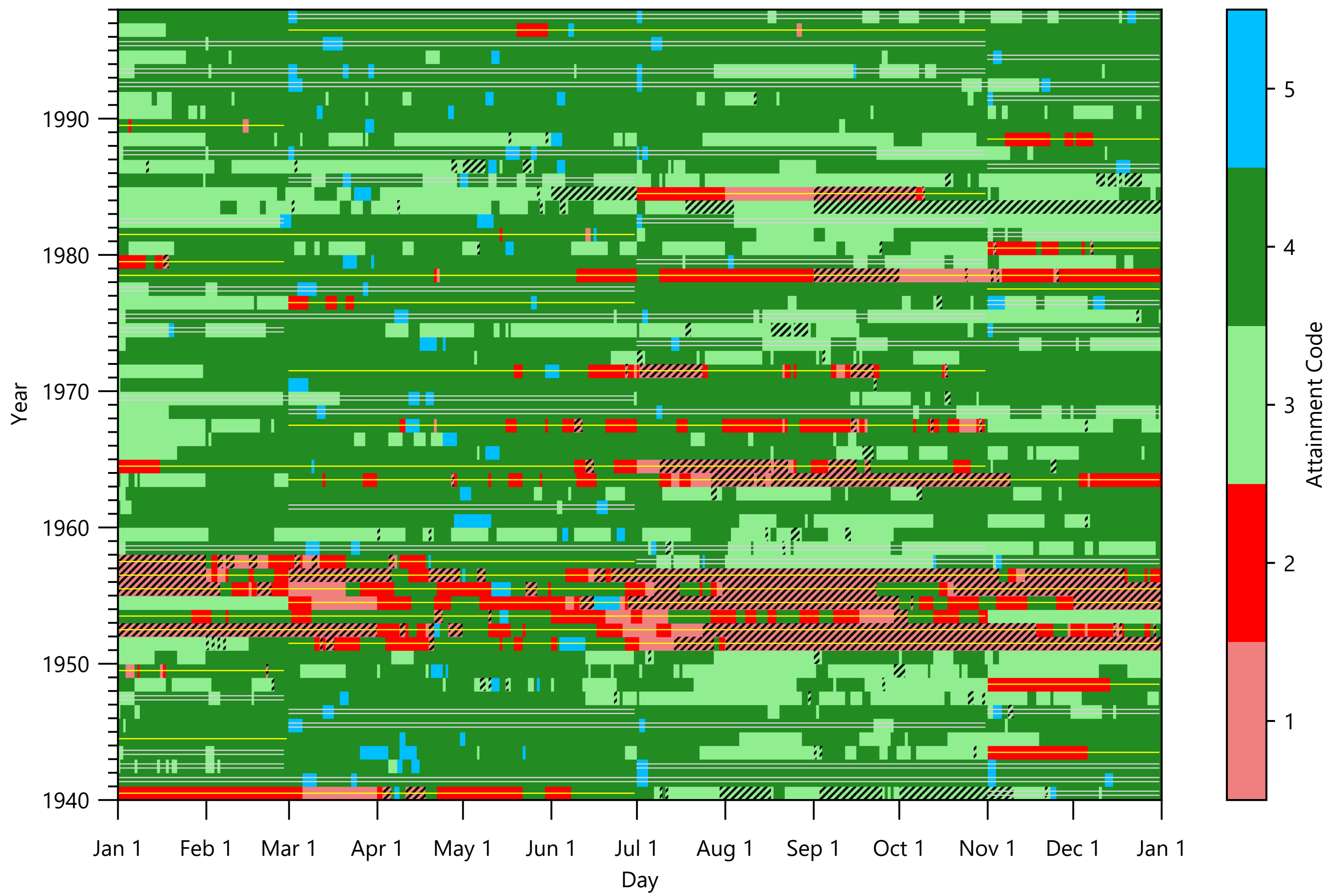
Figure G-35
North Bosque near Clifton: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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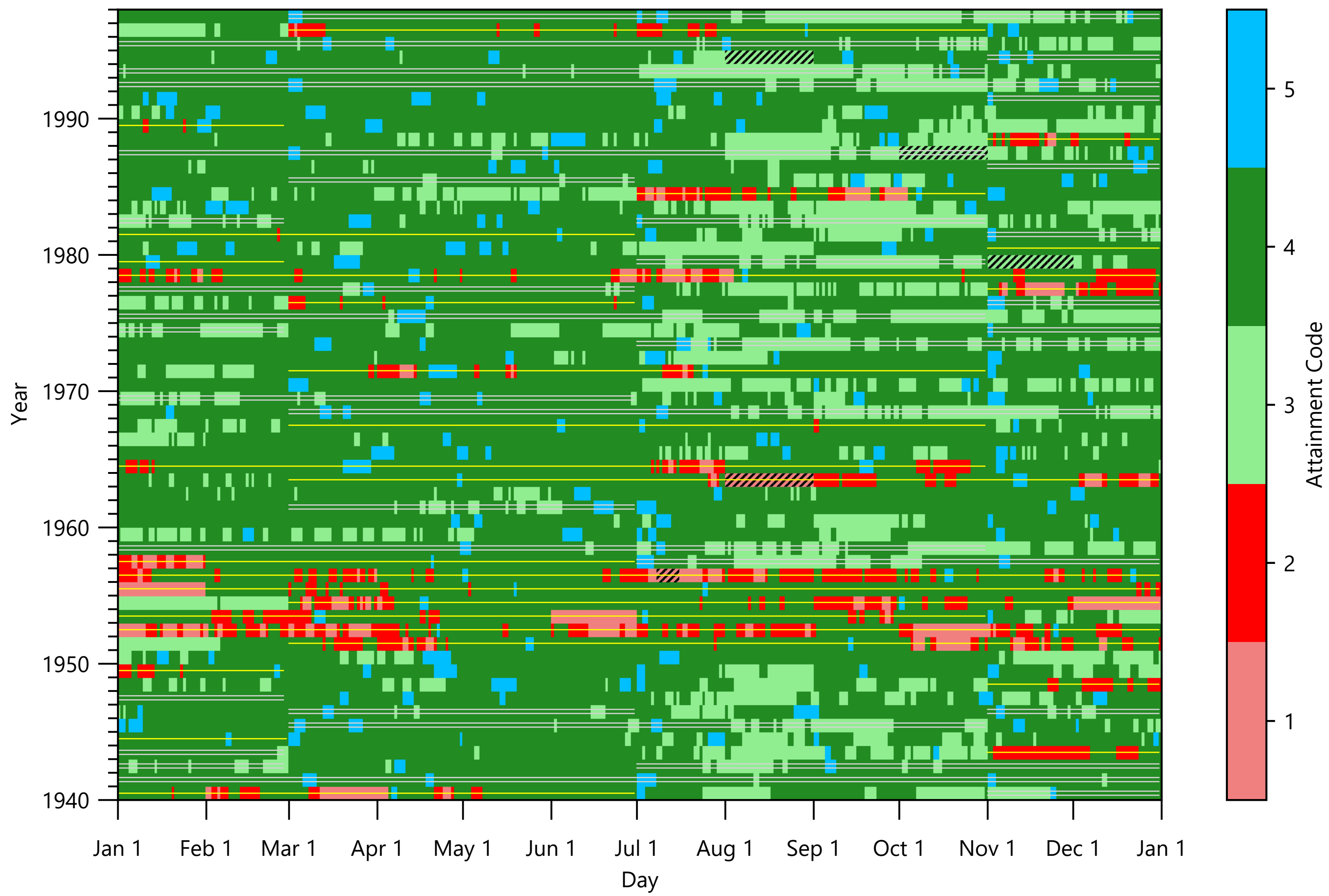
Figure G-36
North Bosque near Clifton: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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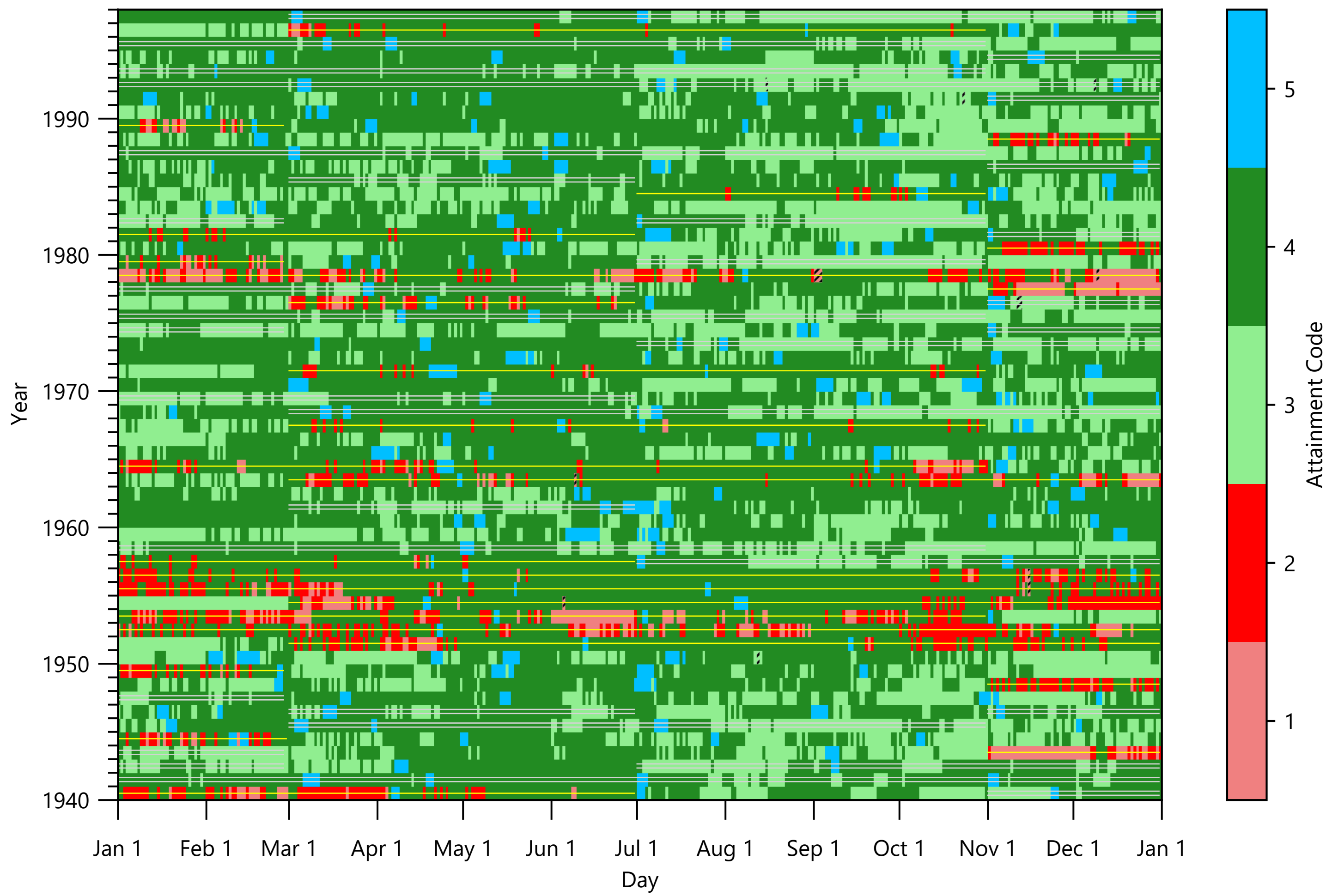
Figure G-37
Brazos River near Waco: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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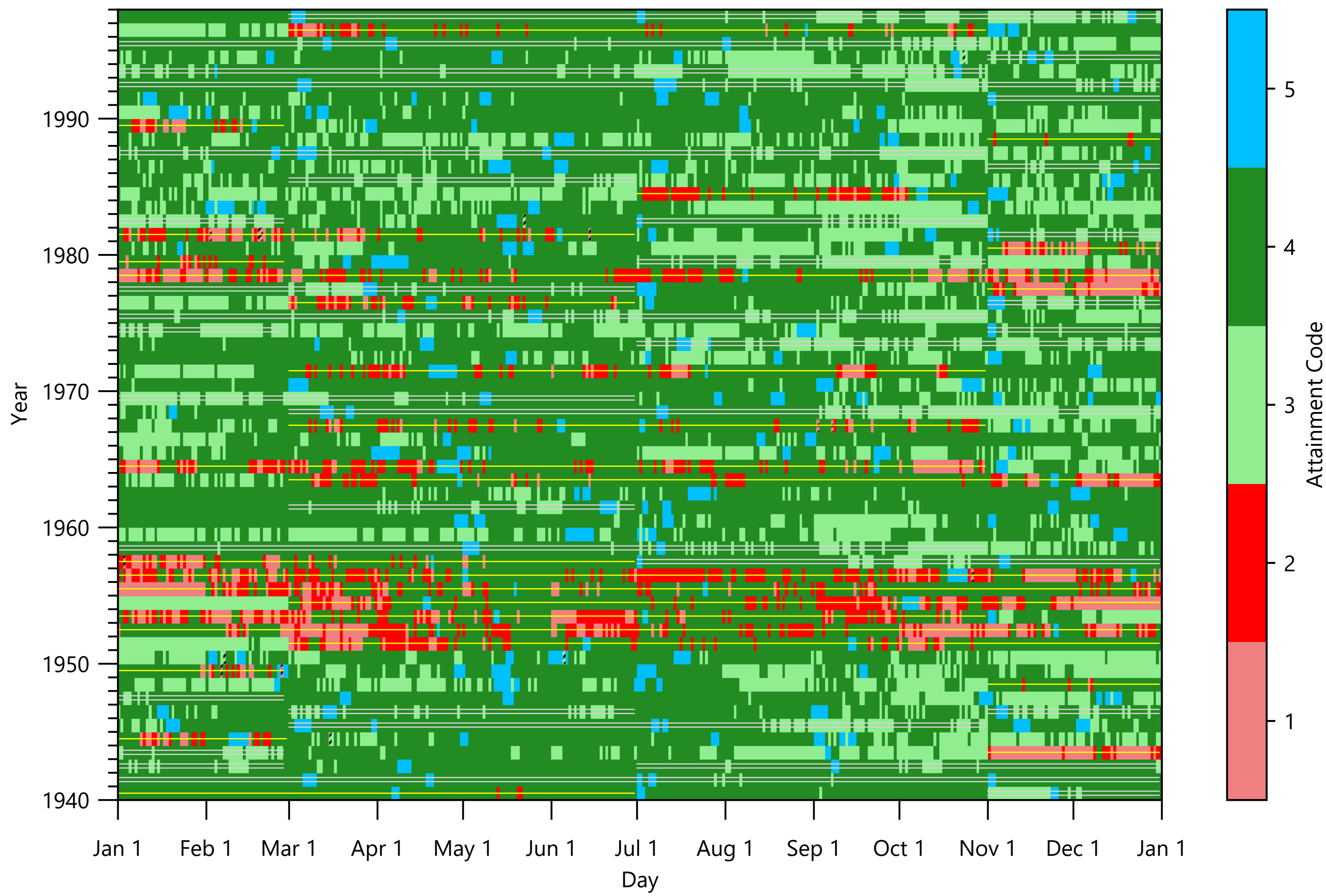
Figure G-38
Brazos River near Waco: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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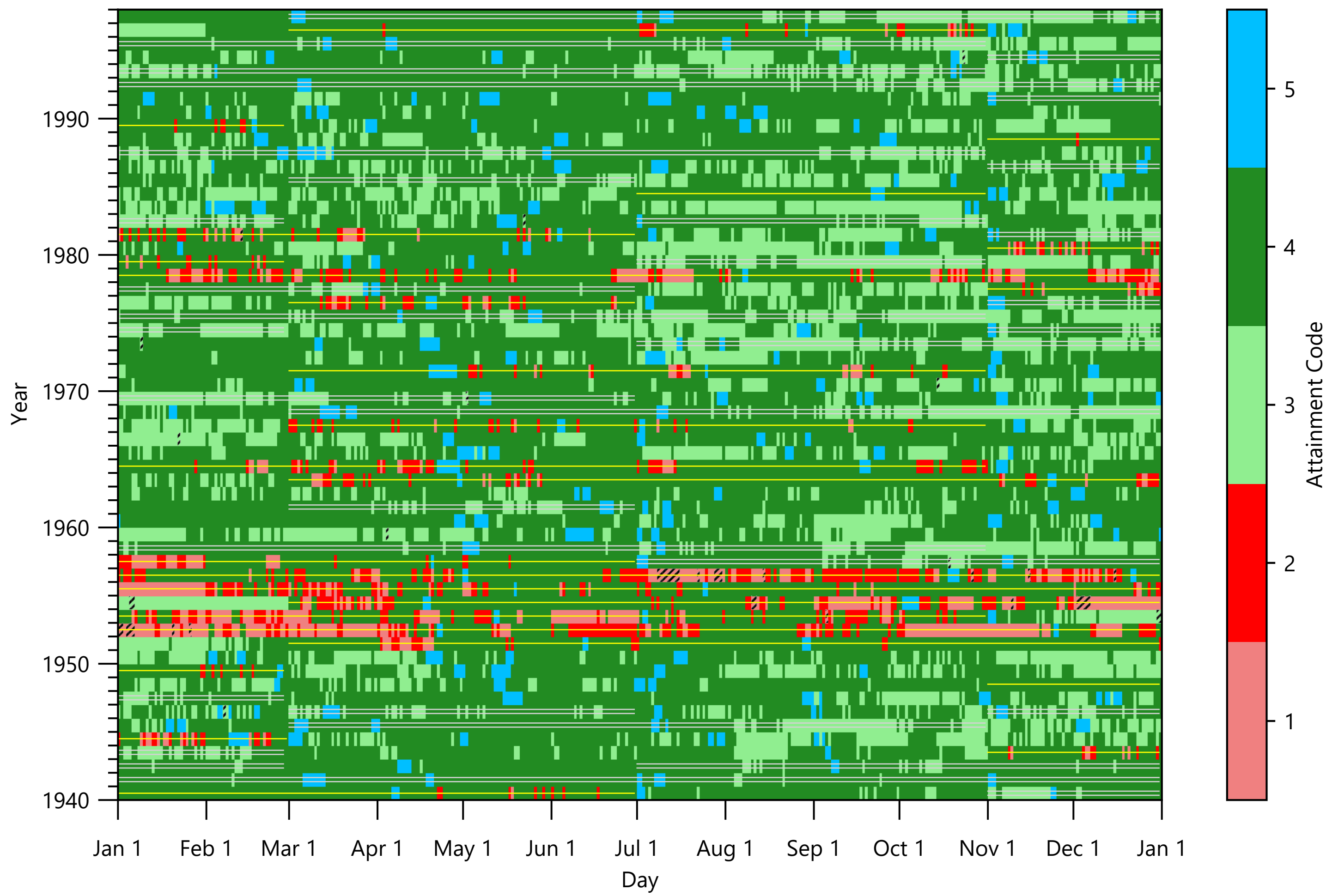
Figure G-39
Brazos River near Waco: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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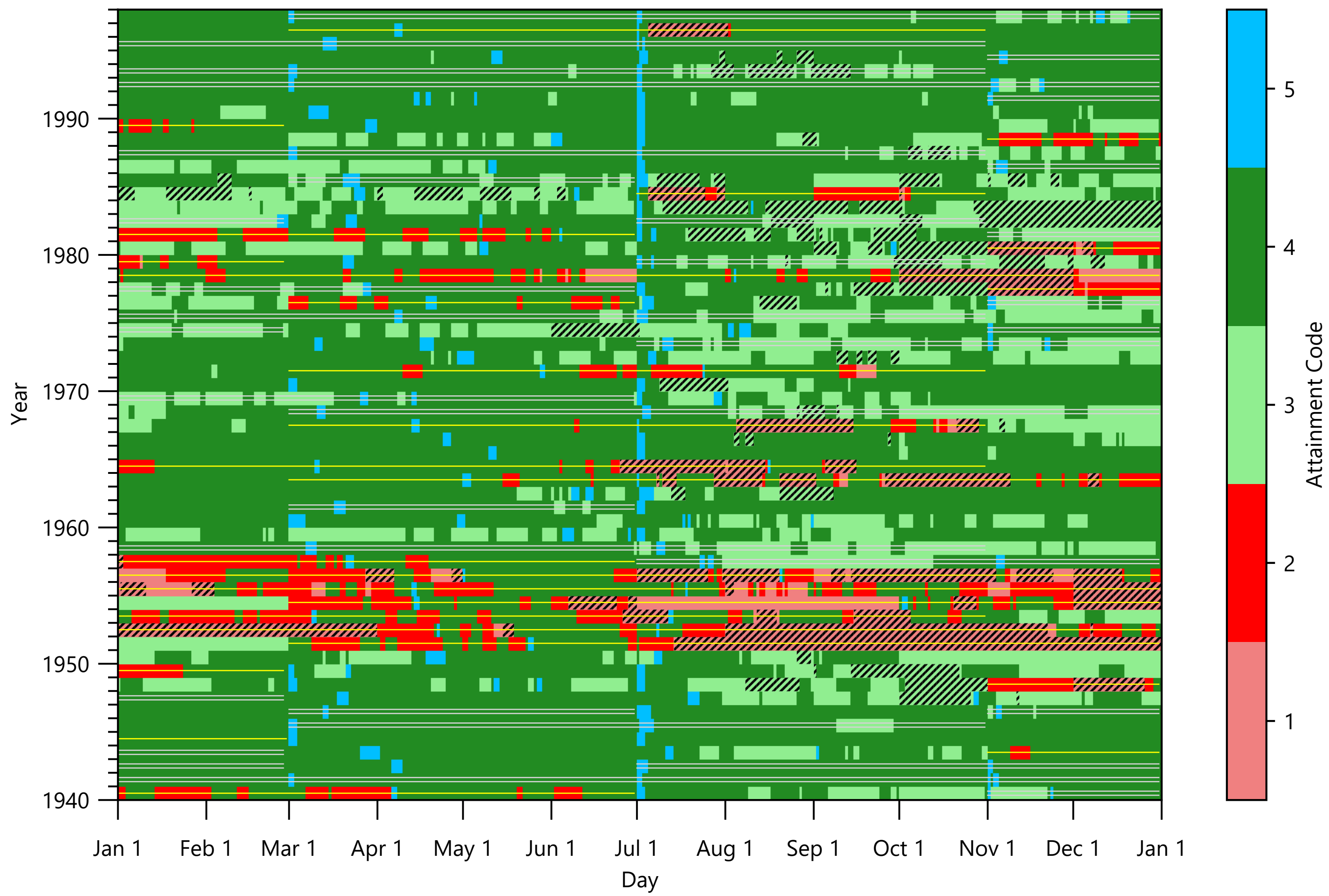
Figure G-40
Brazos River near Waco: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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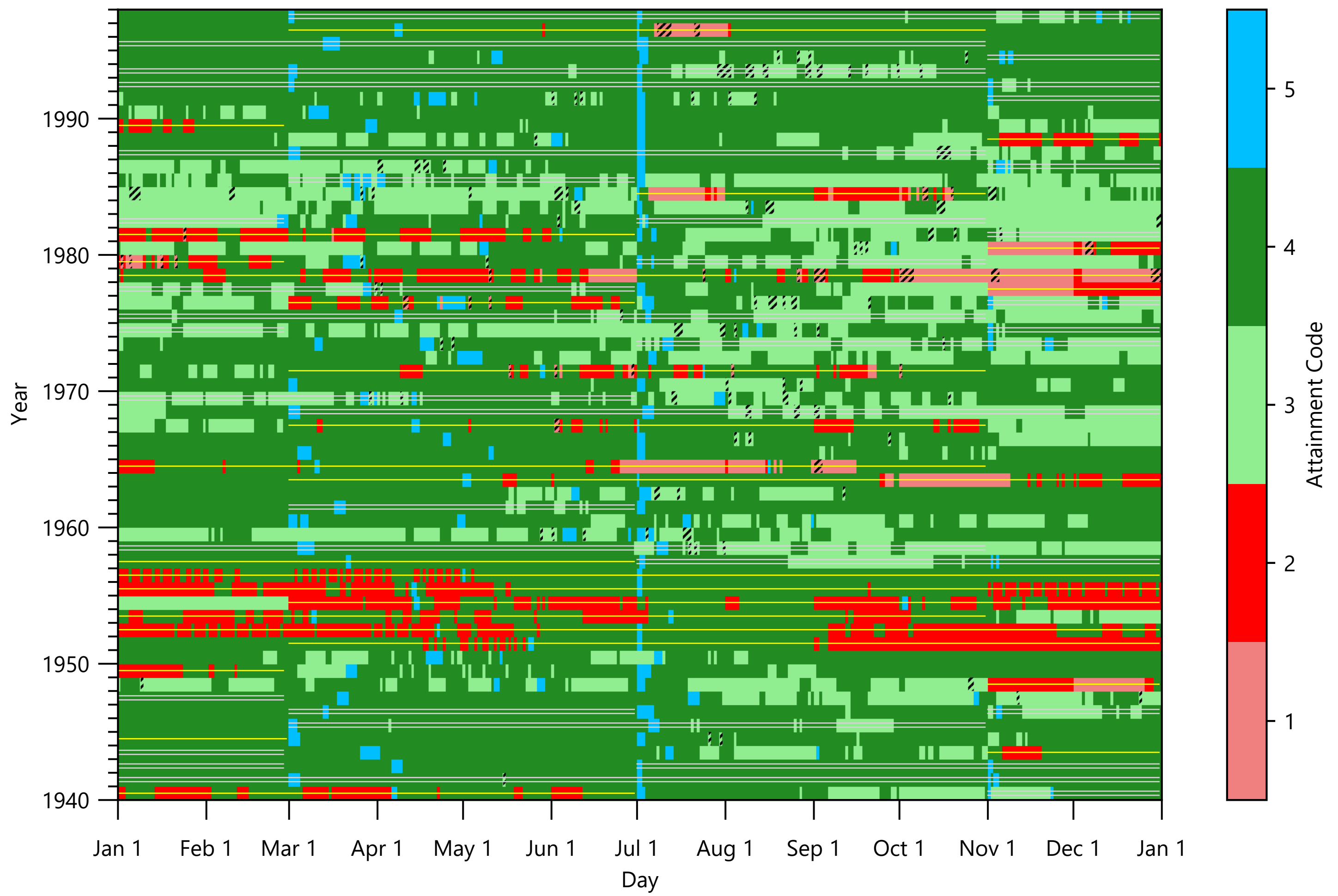
Figure G-41
Leon River at Gatesville: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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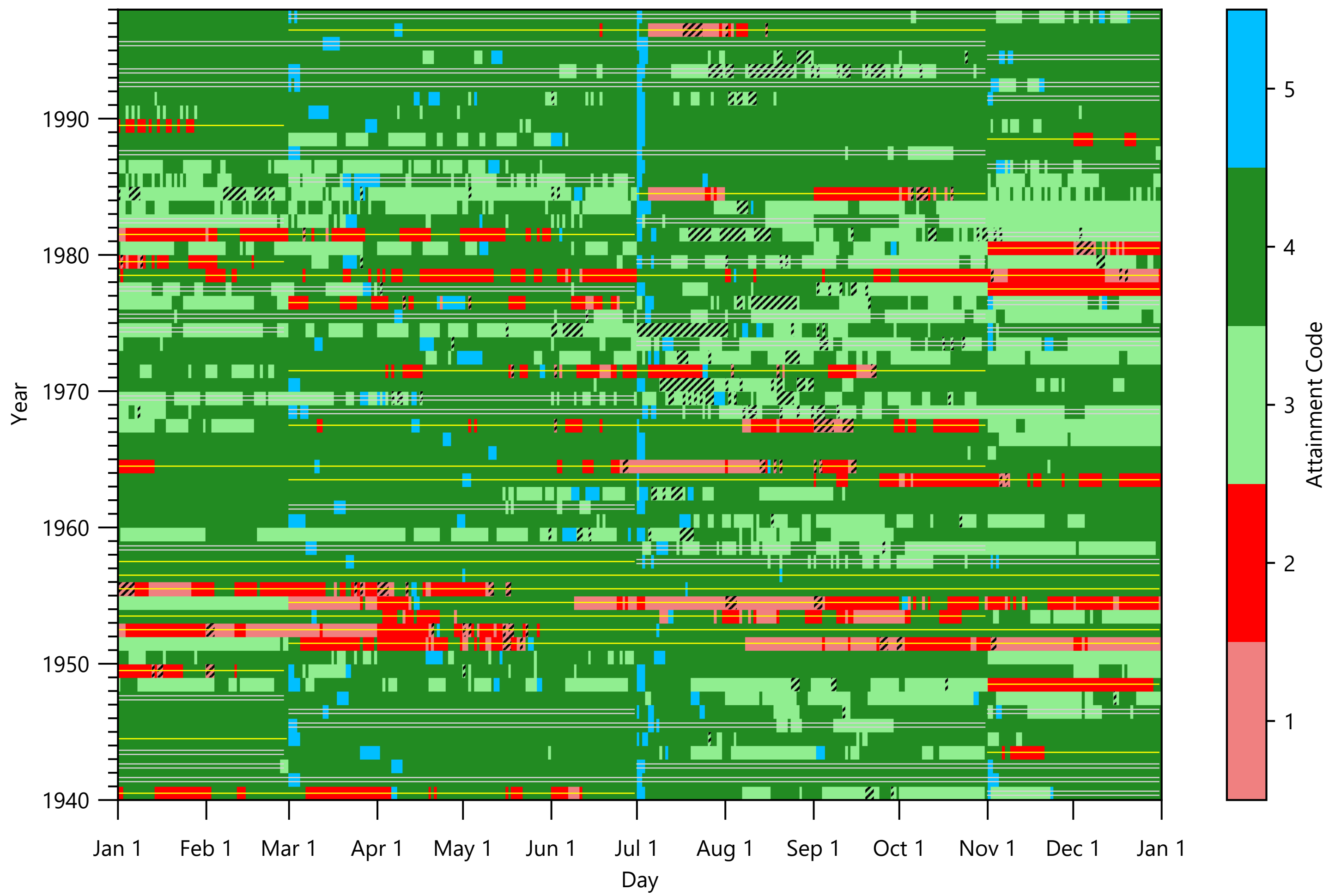
Figure G-42
Leon River at Gatesville: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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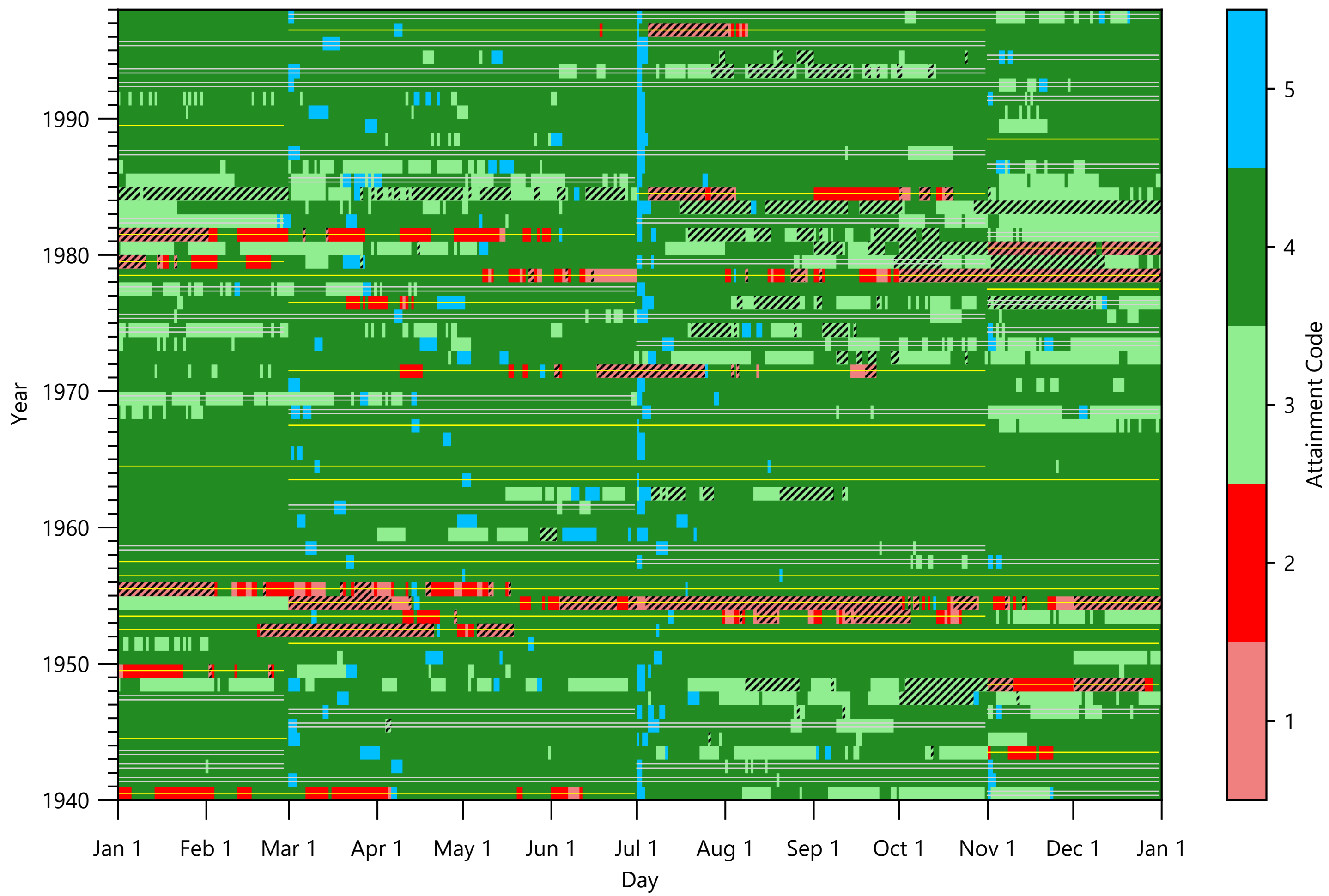
Figure G-43
Leon River at Gatesville: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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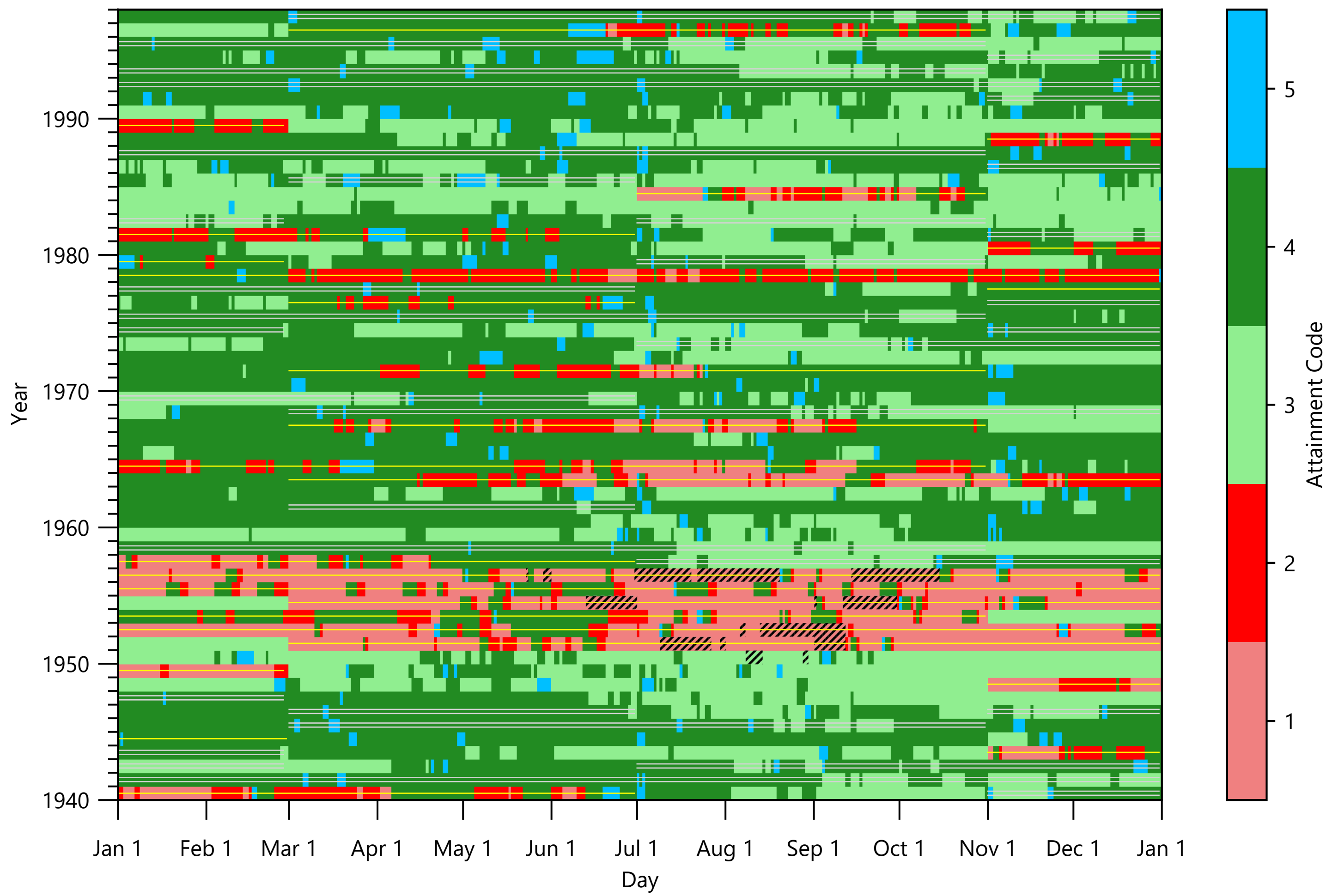
Figure G-44
Leon River at Gatesville: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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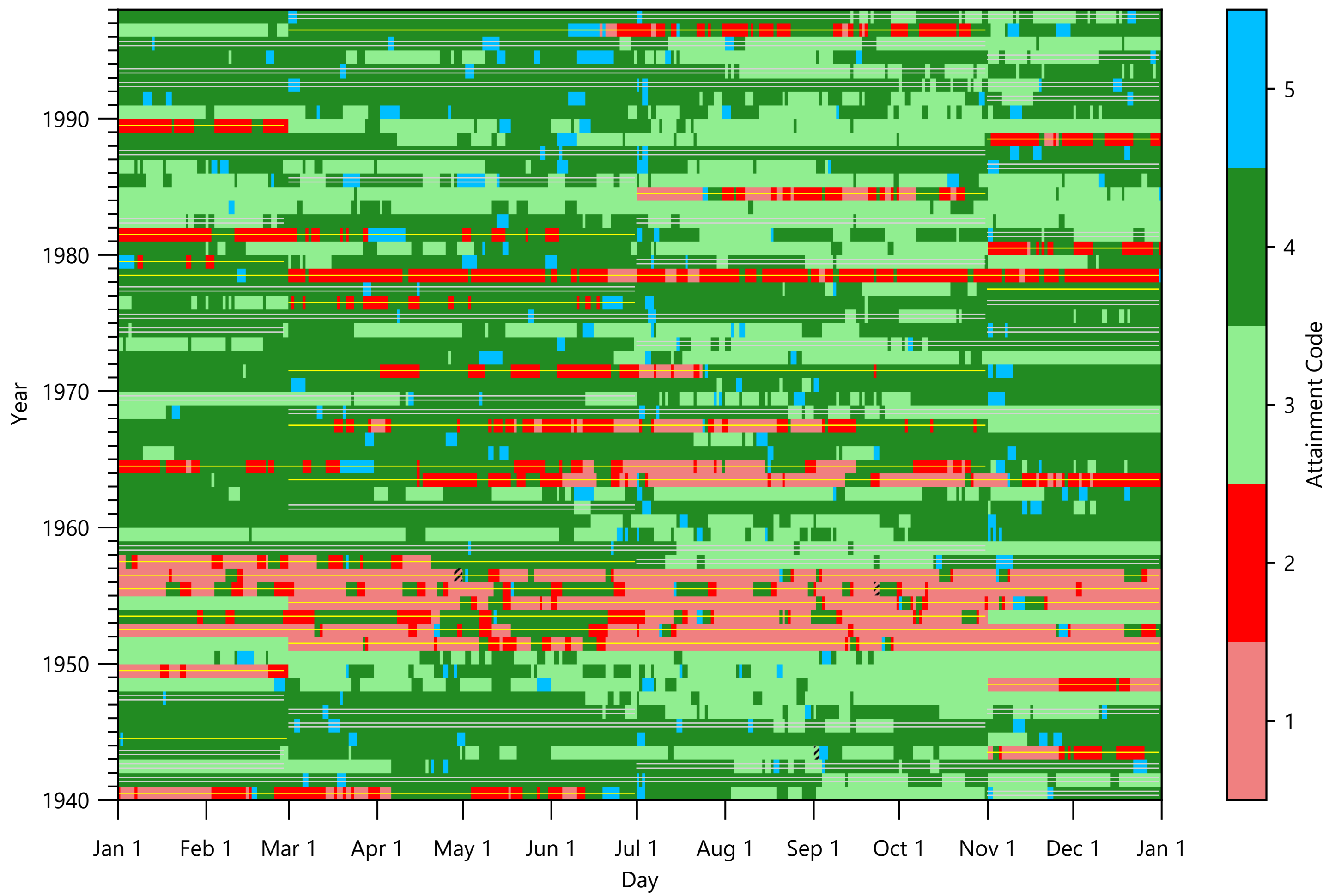
Figure G-45
Lampasas River near Kempner: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

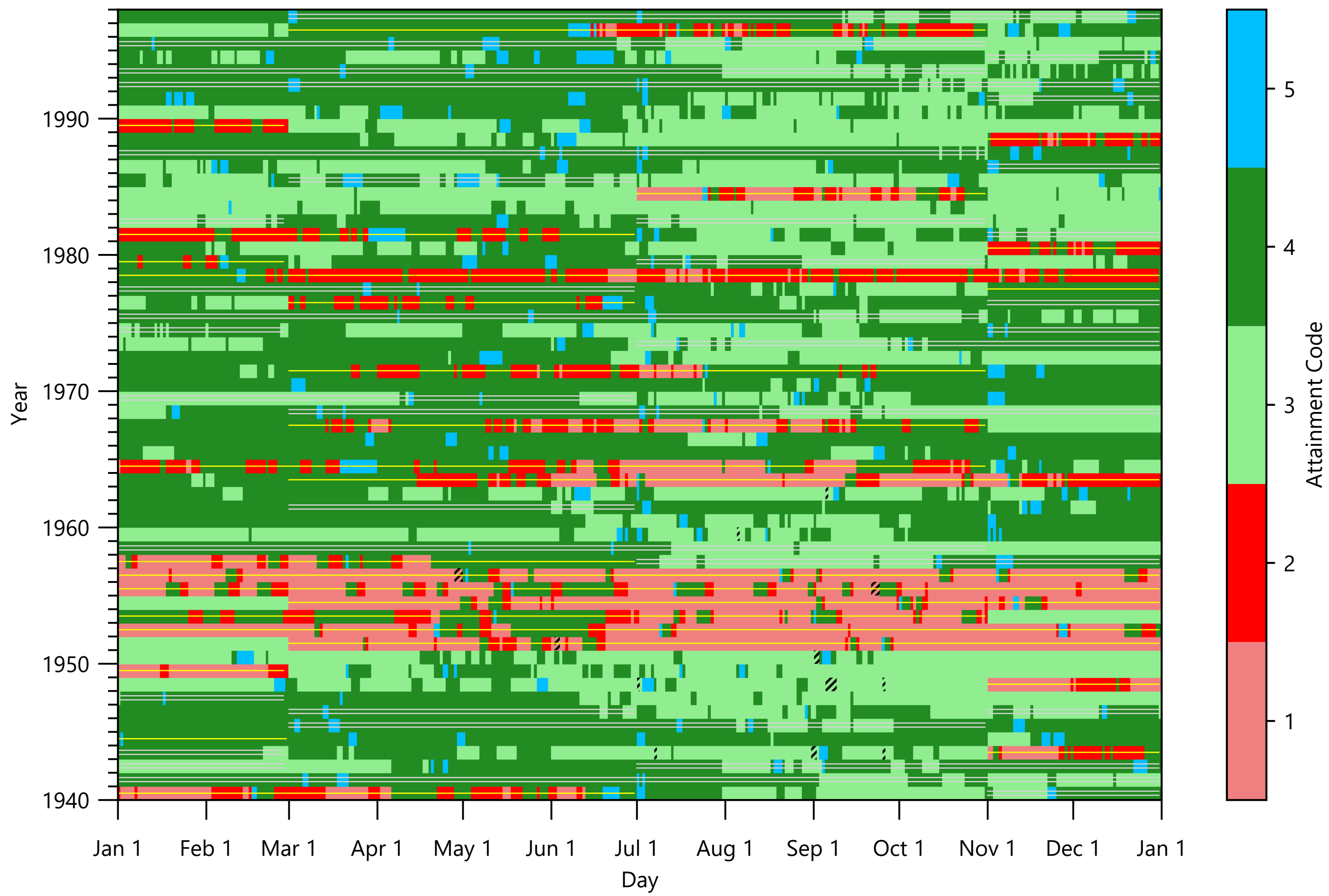


Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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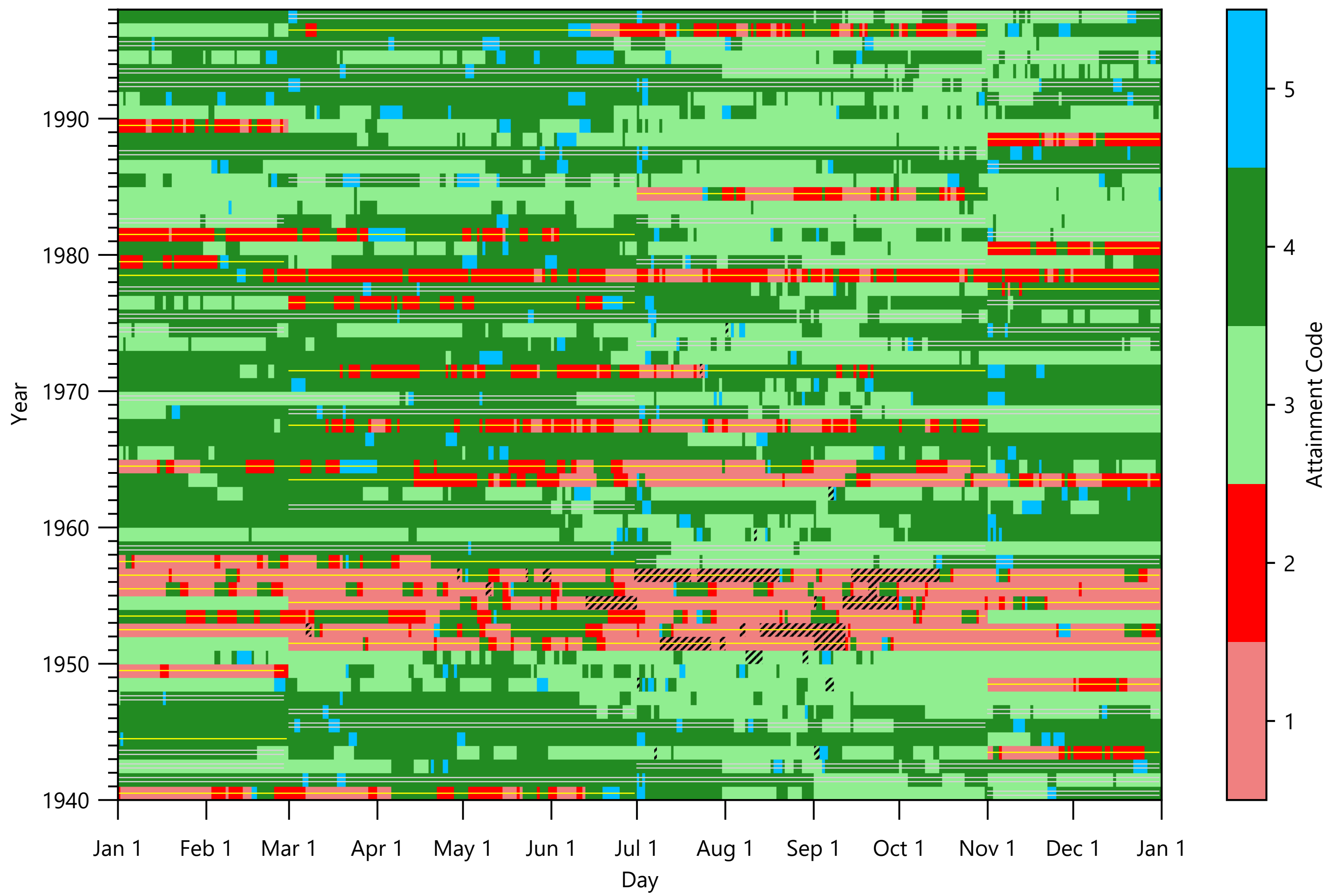
Figure G-47
Lampasas River near Kempner: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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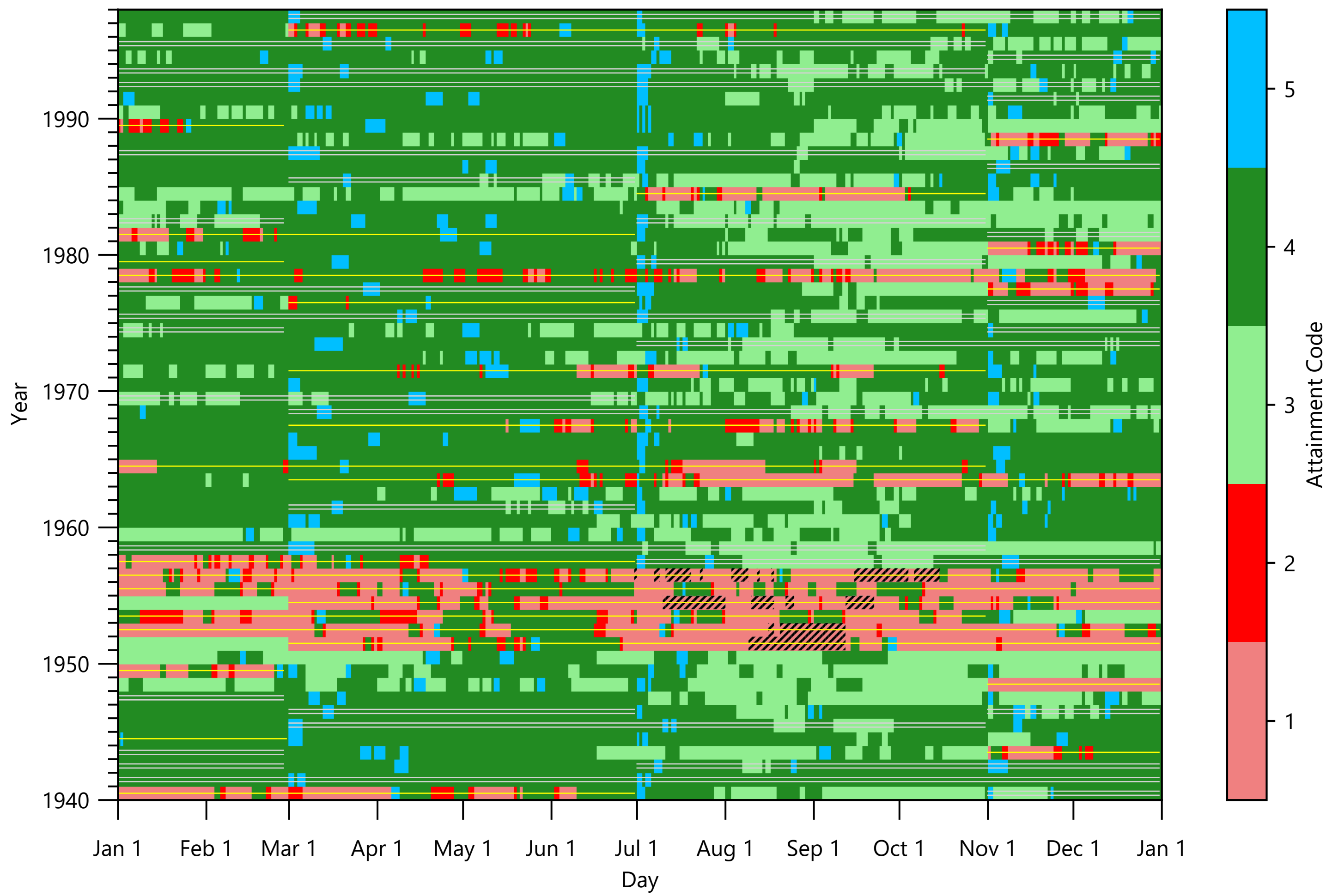
Figure G-48
Lampasas River near Kempner: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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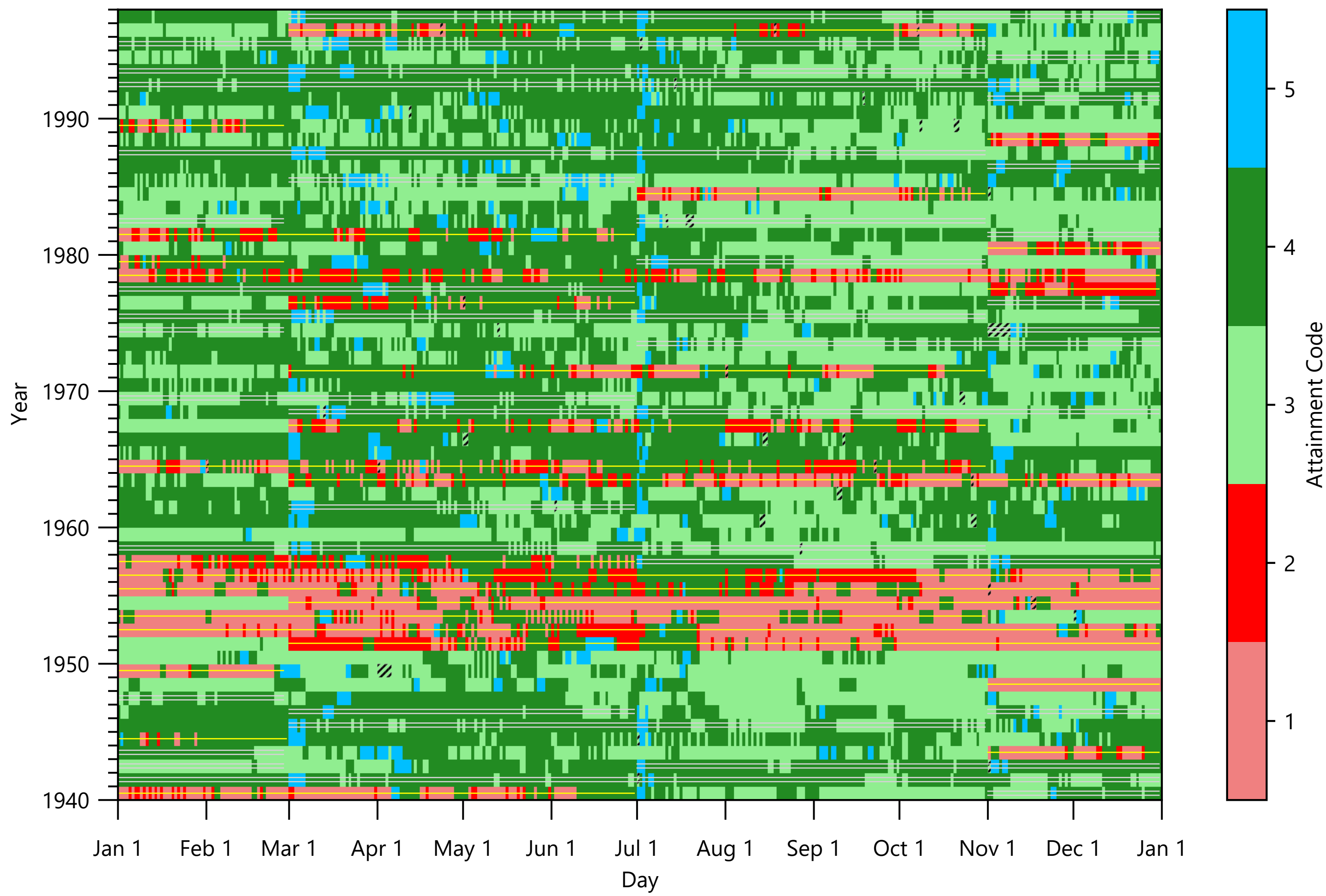
Figure G-49
Little River near Little River: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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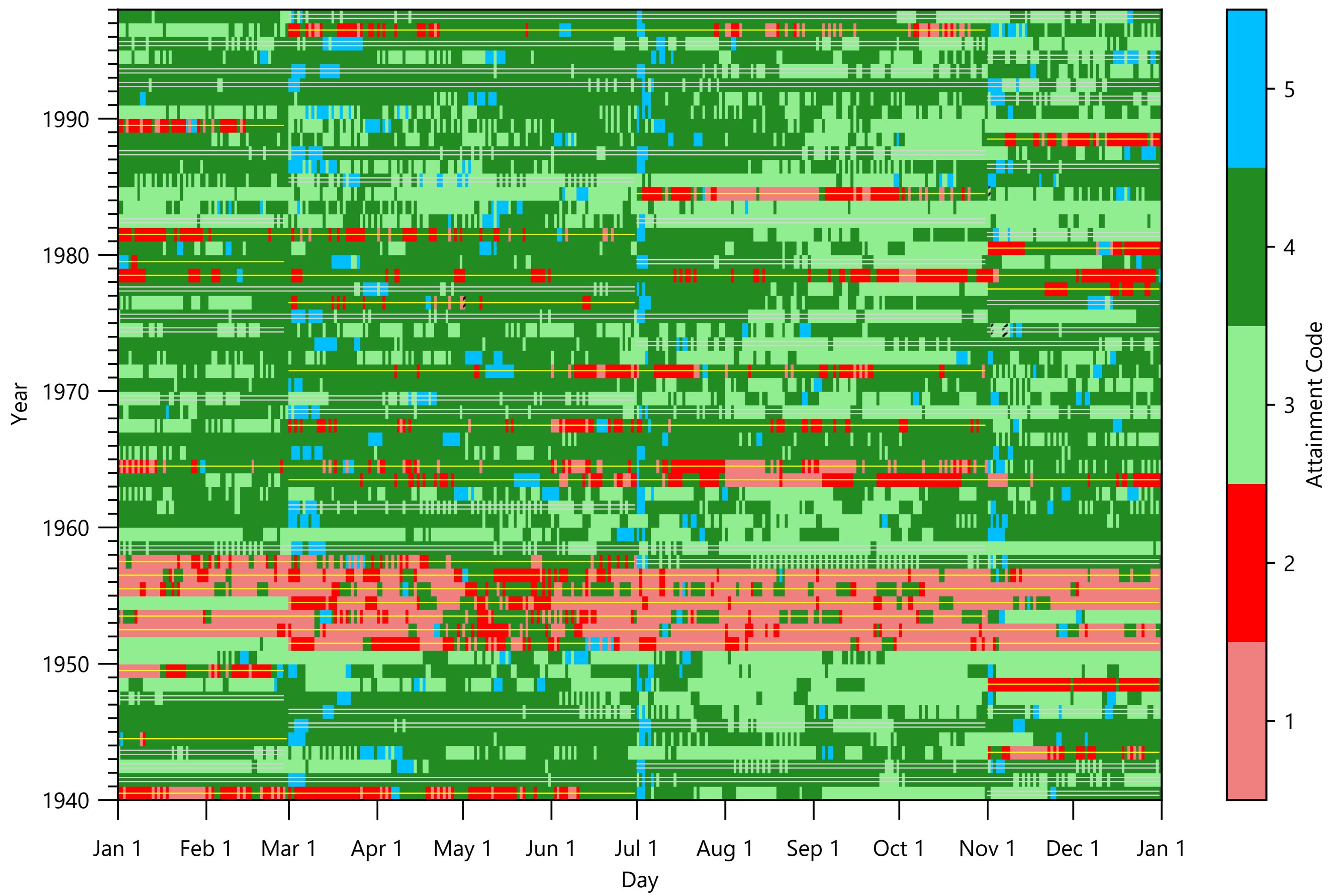
Figure G-50
Little River near Little River: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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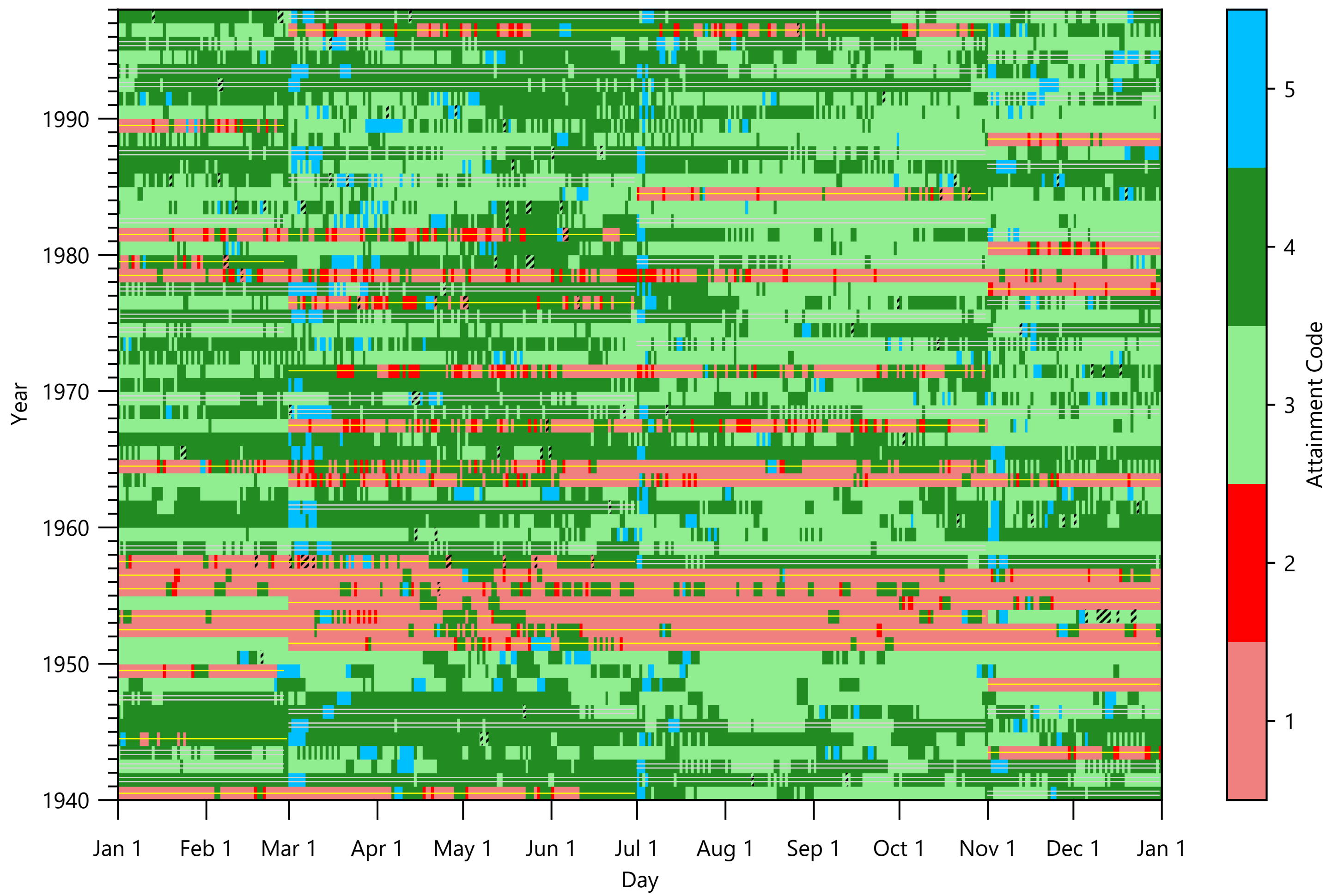
Figure G-51
Little River near Little River: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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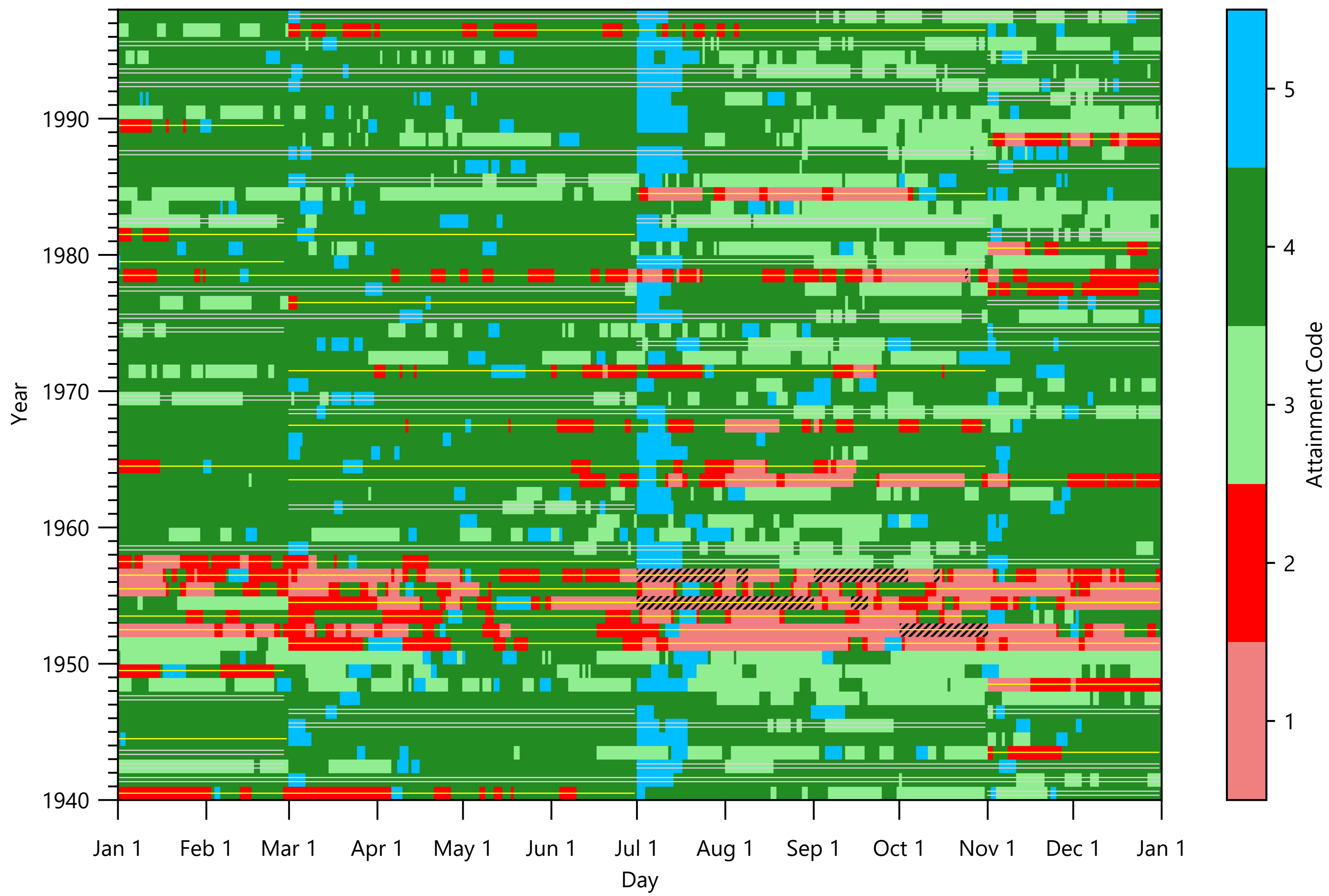
Figure G-52
Little River near Little River: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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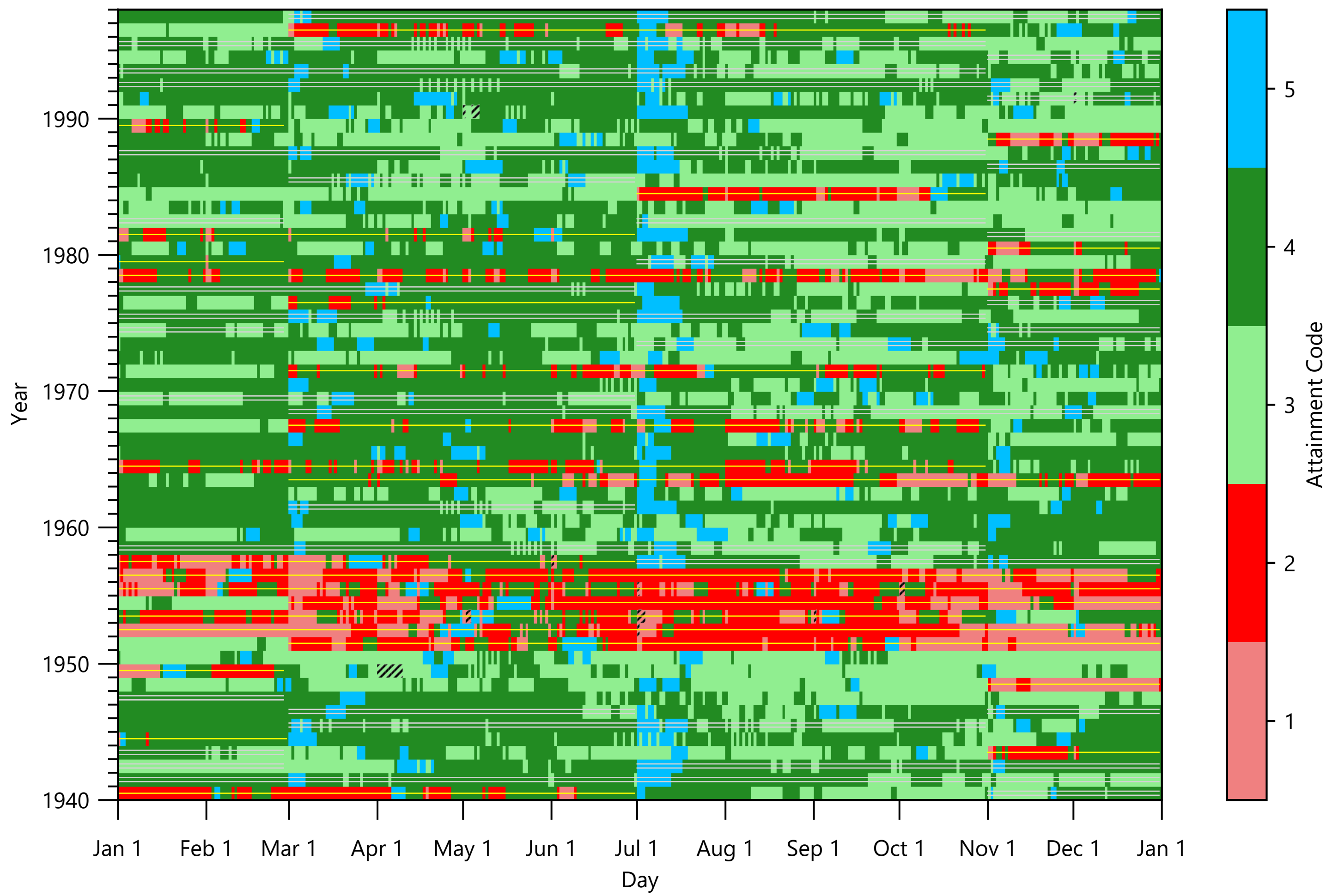
Figure G-53
Little River near Cameron: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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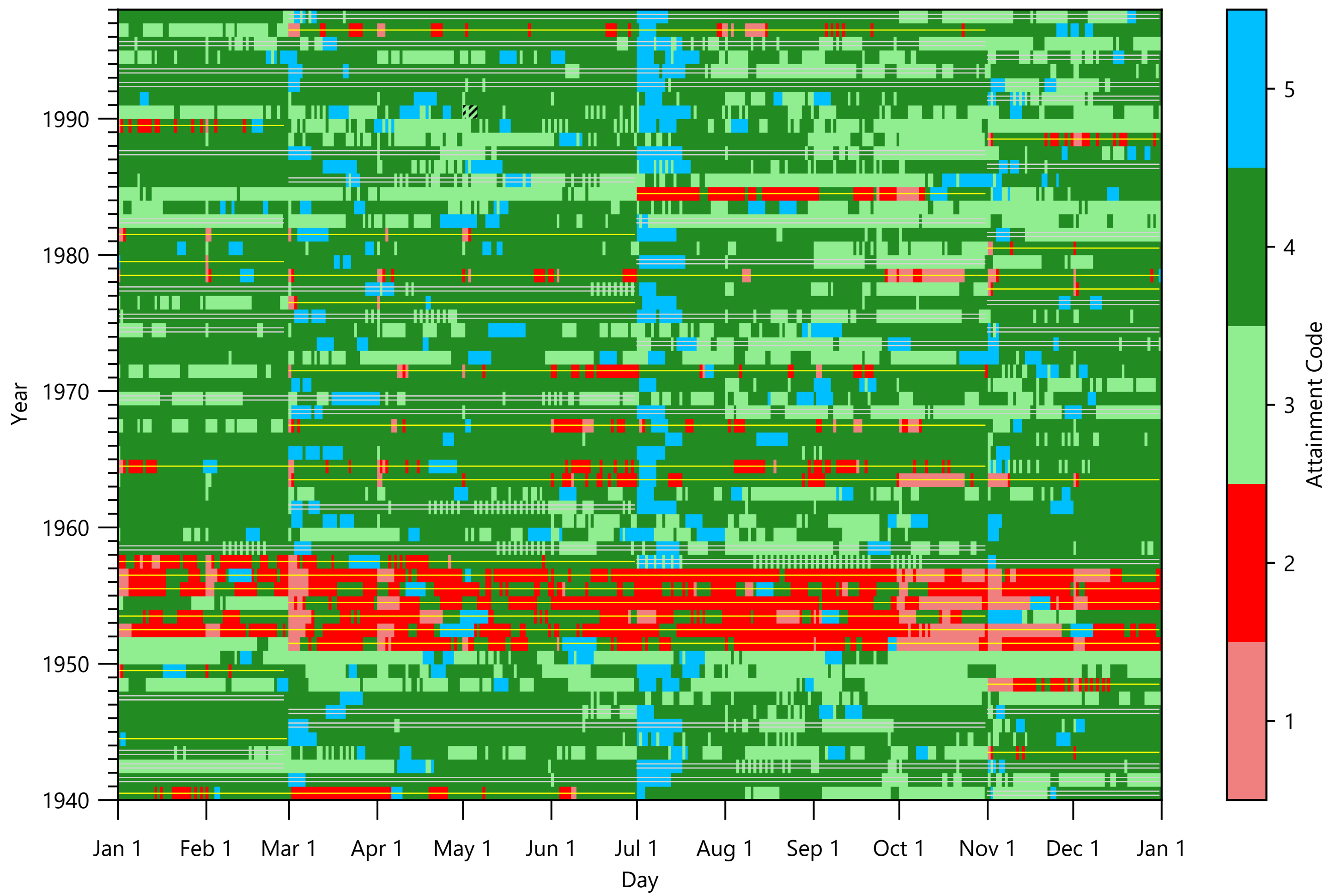
Figure G-54
Little River near Cameron: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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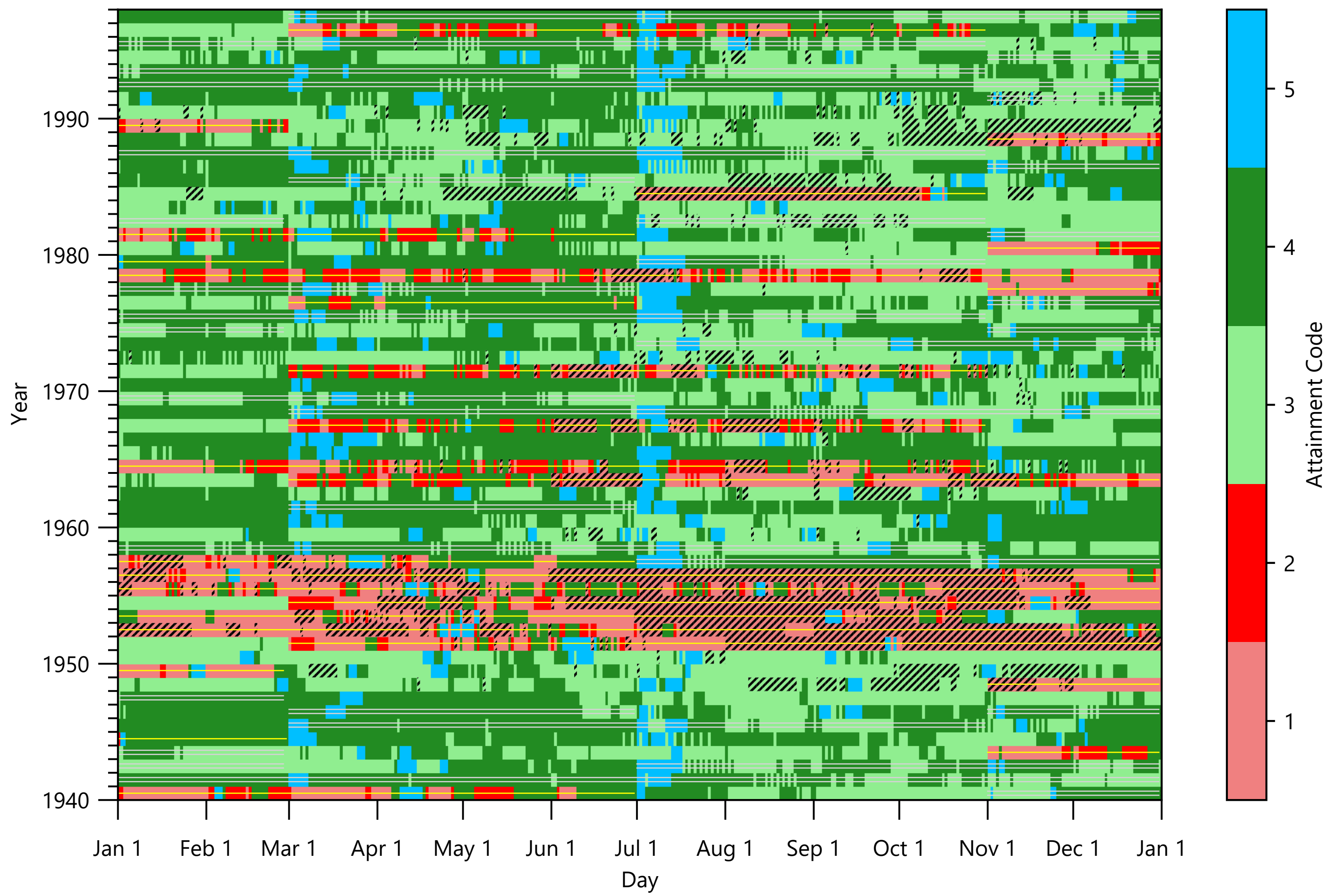
Figure G-55

Little River near Cameron: Partial Utilization Scenario

Attainment Raster Hydrographs for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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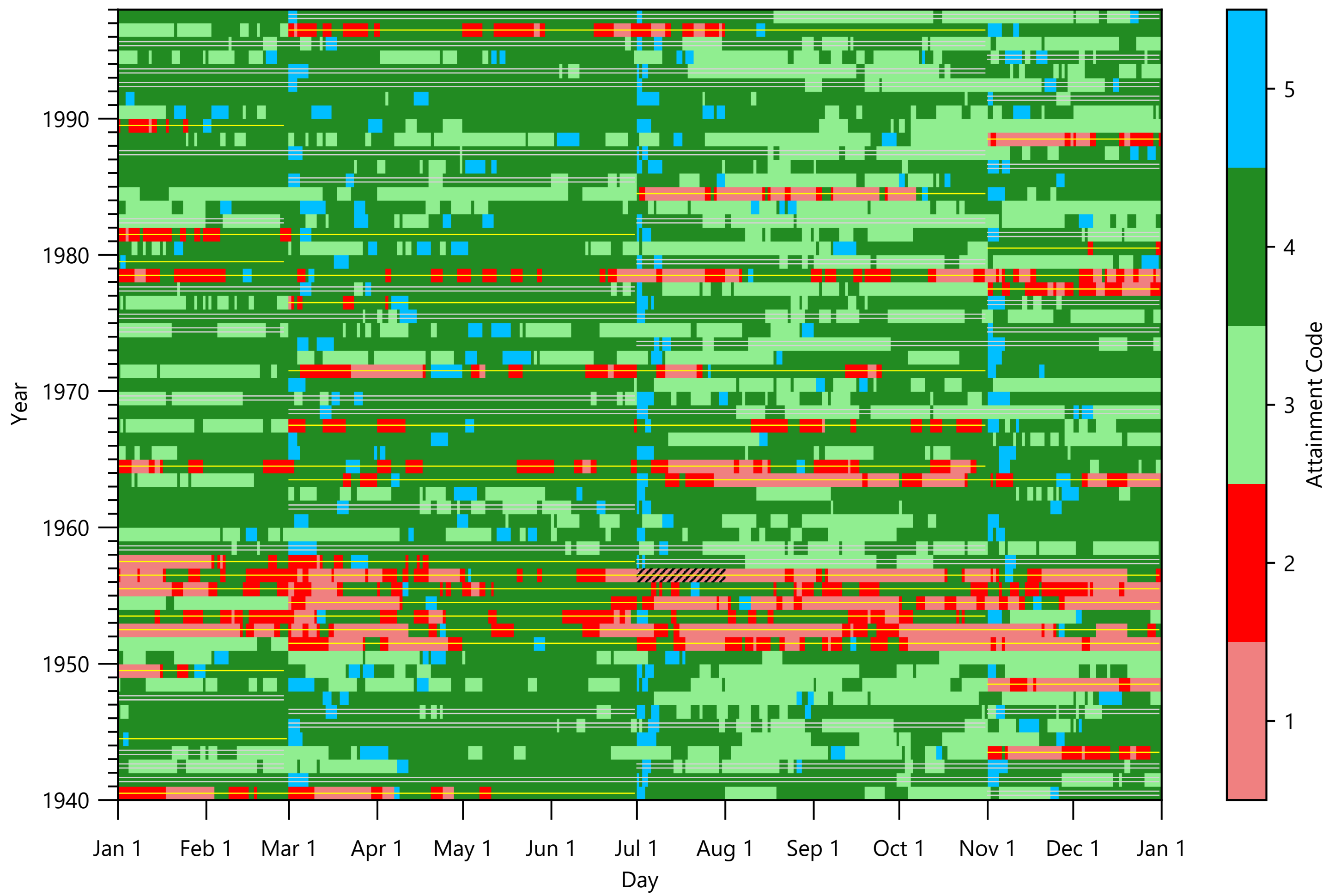
Figure G-56
Little River near Cameron: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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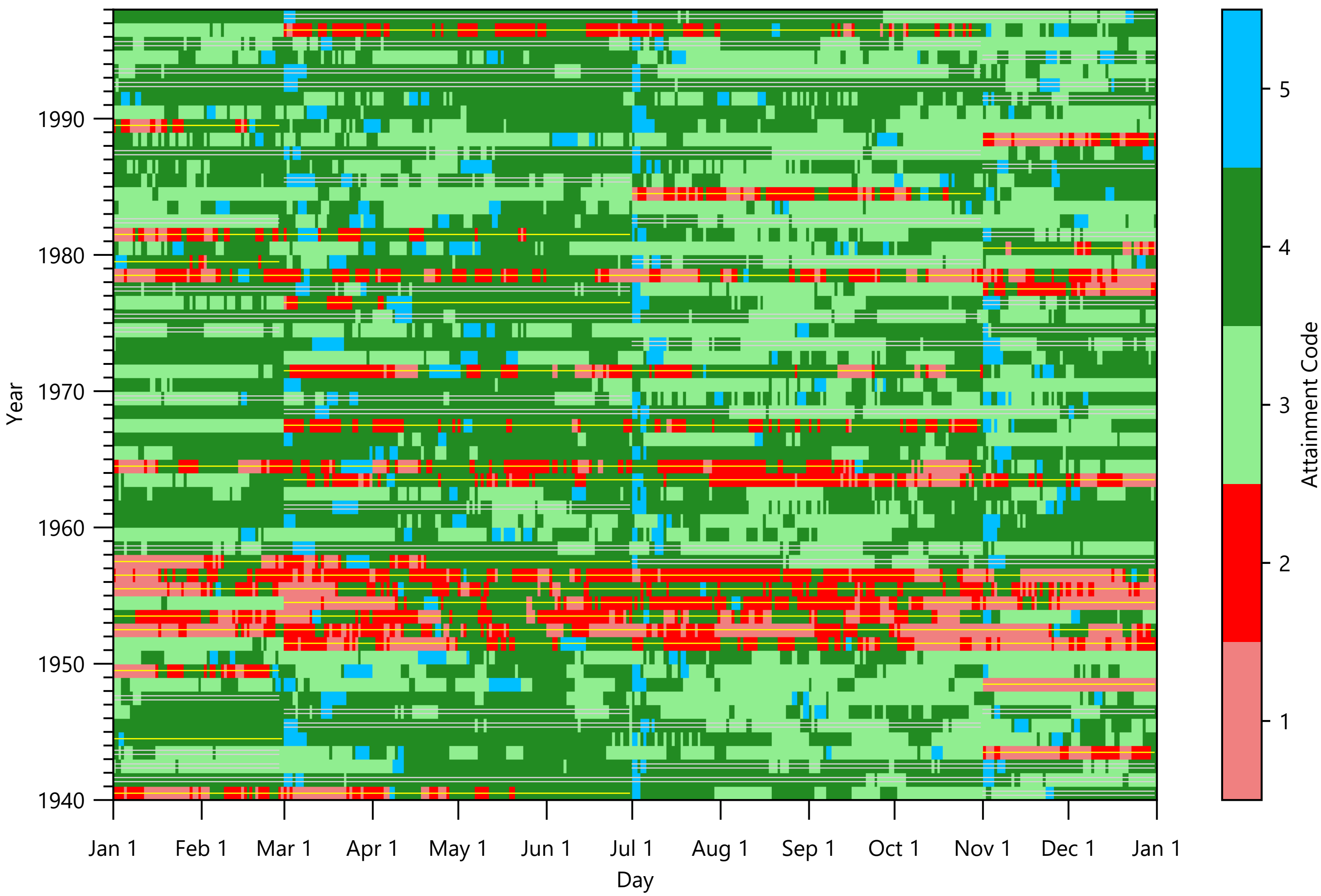
Figure G-57
Brazos River near Bryan: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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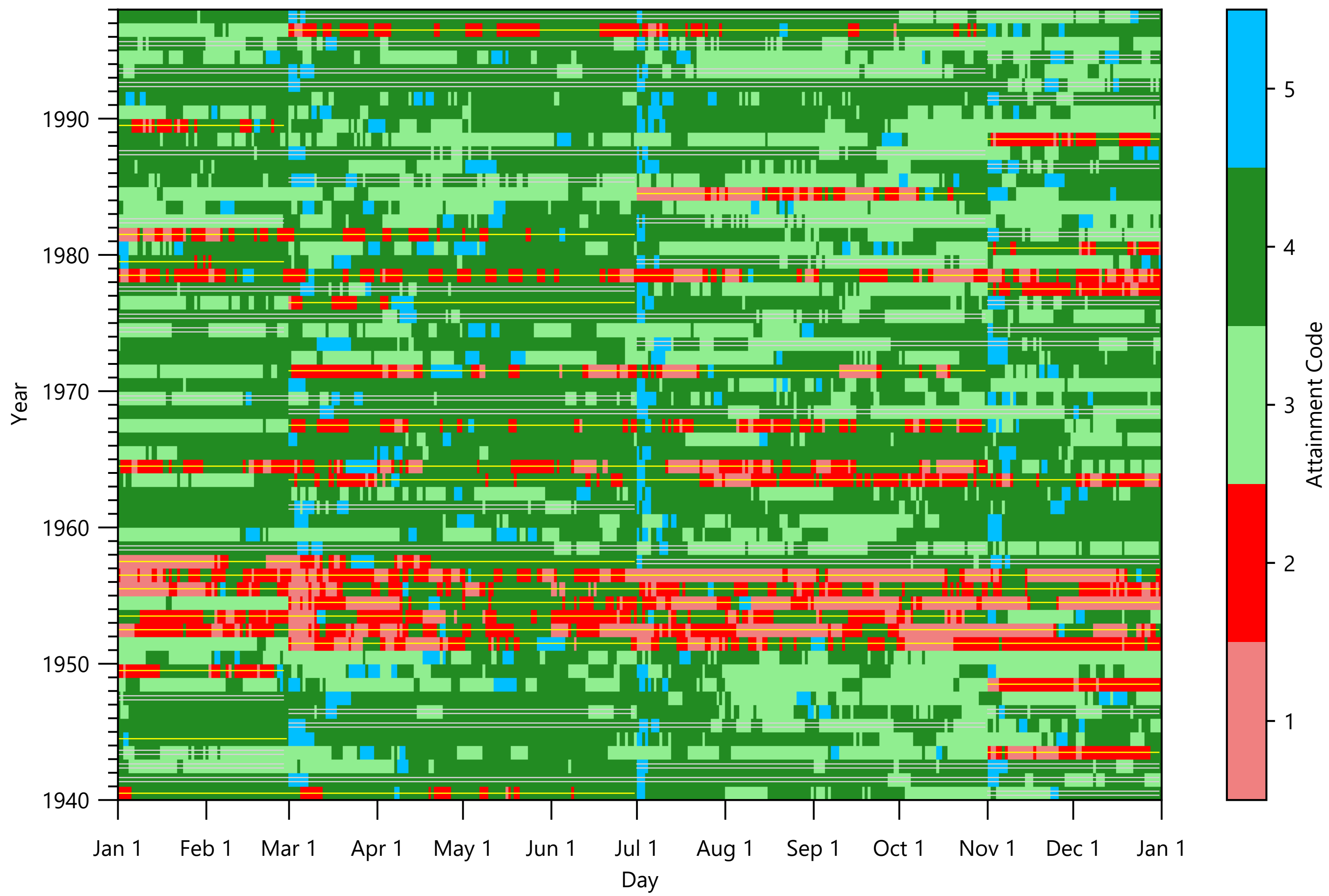
Figure G-58

Brazos River near Bryan: Current Water Use Scenario

Attainment Raster Hydrographs for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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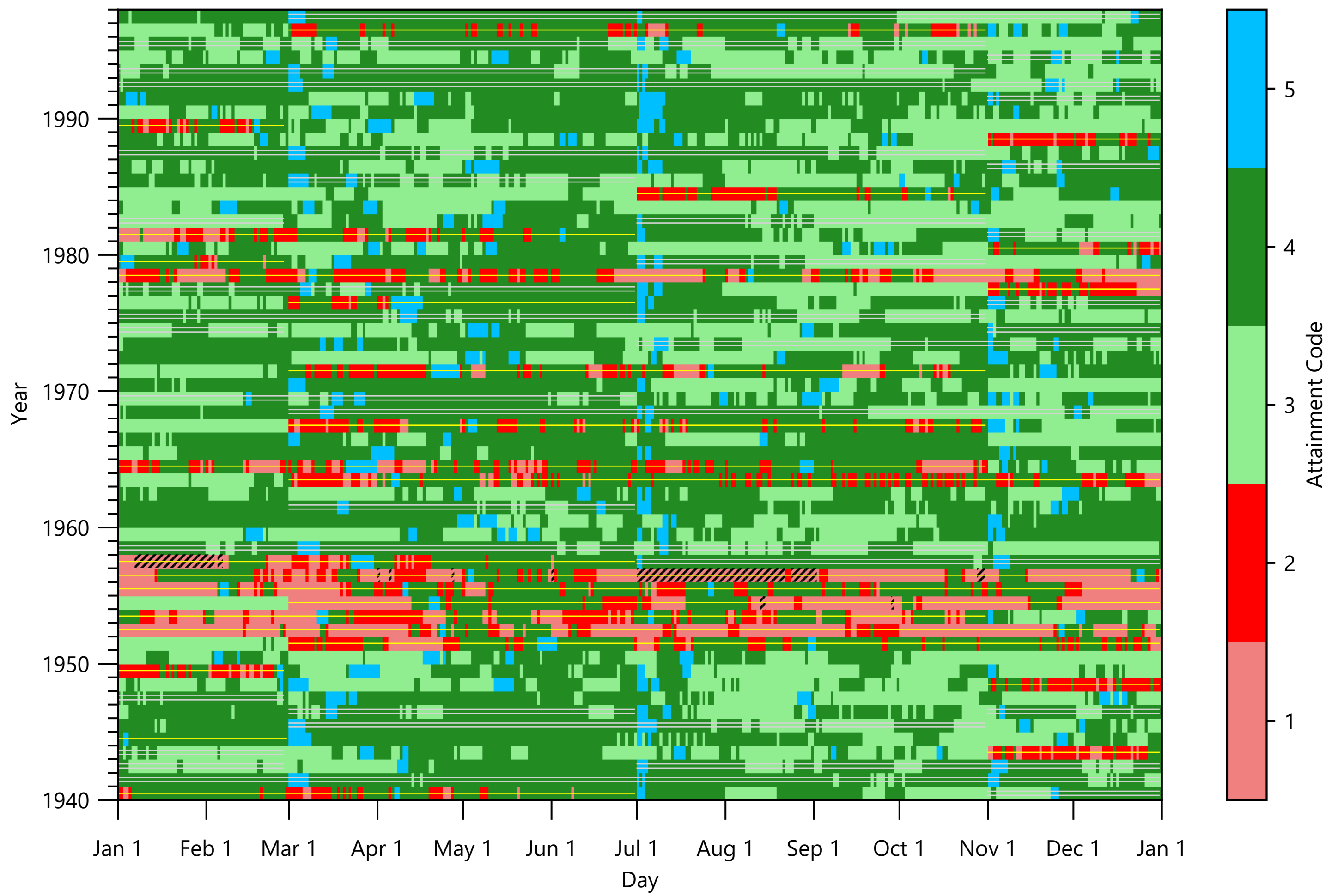
Figure G-59
Brazos River near Bryan: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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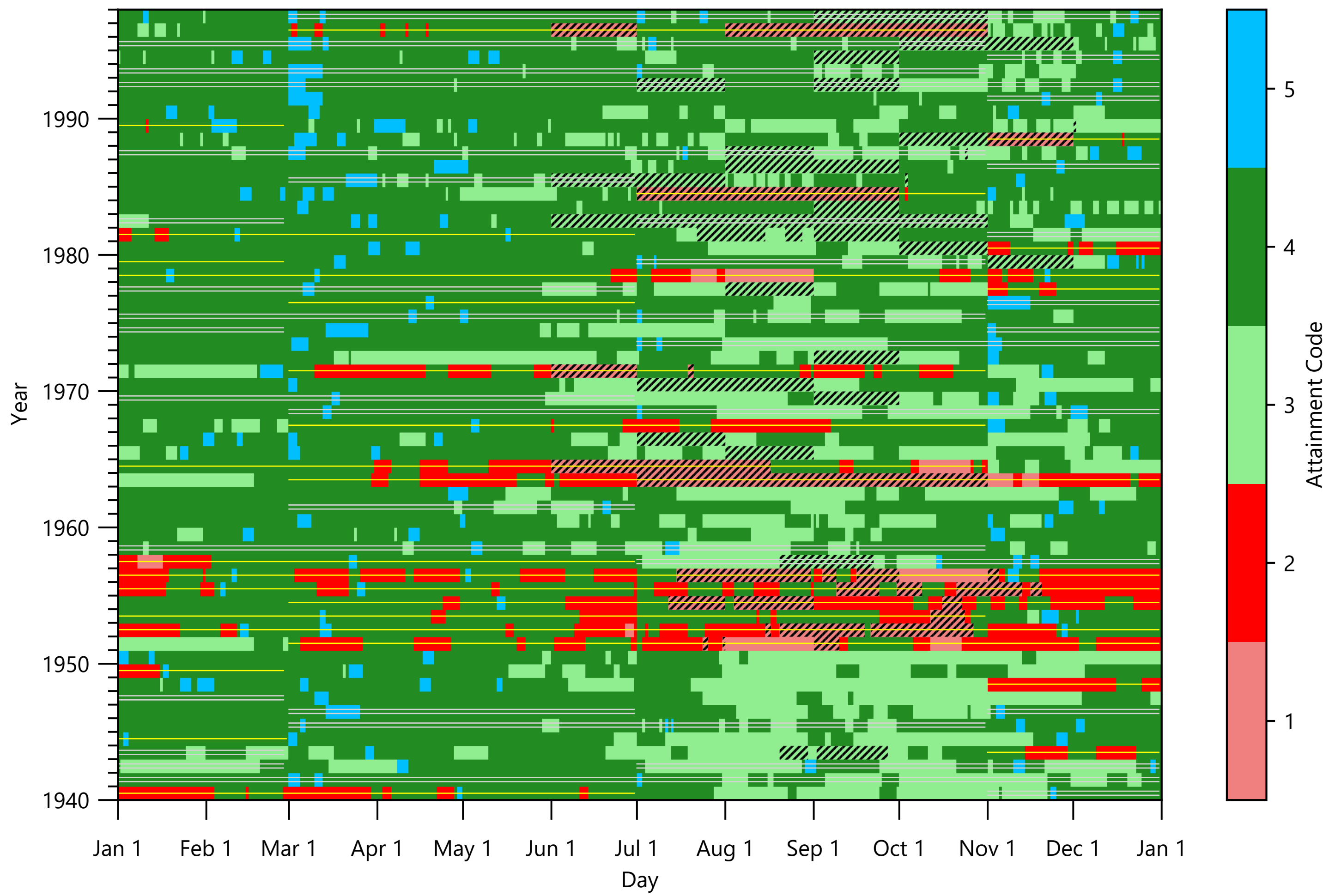
Figure G-60
Brazos River near Bryan: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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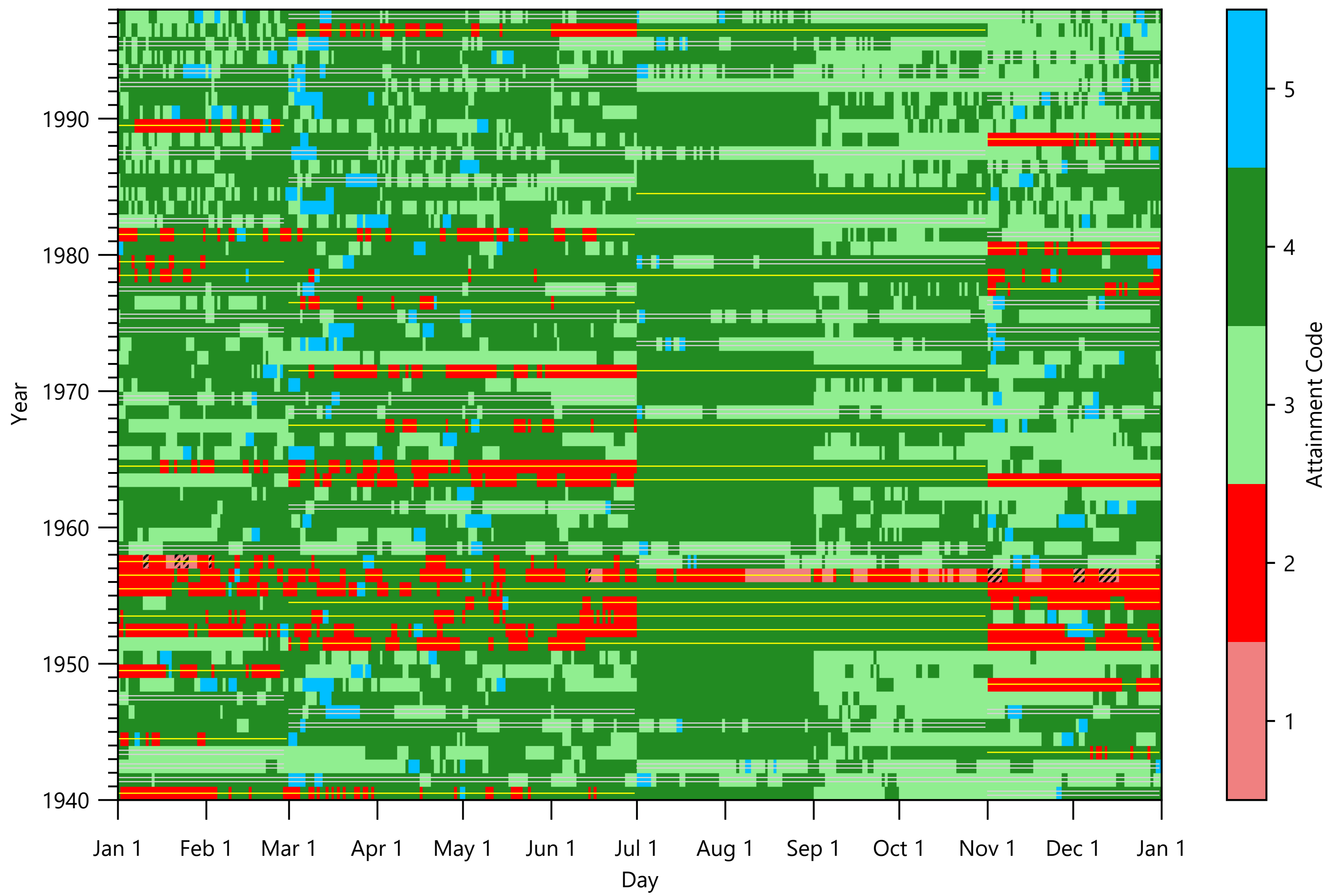
Figure G-61
Navasota River near Easterly: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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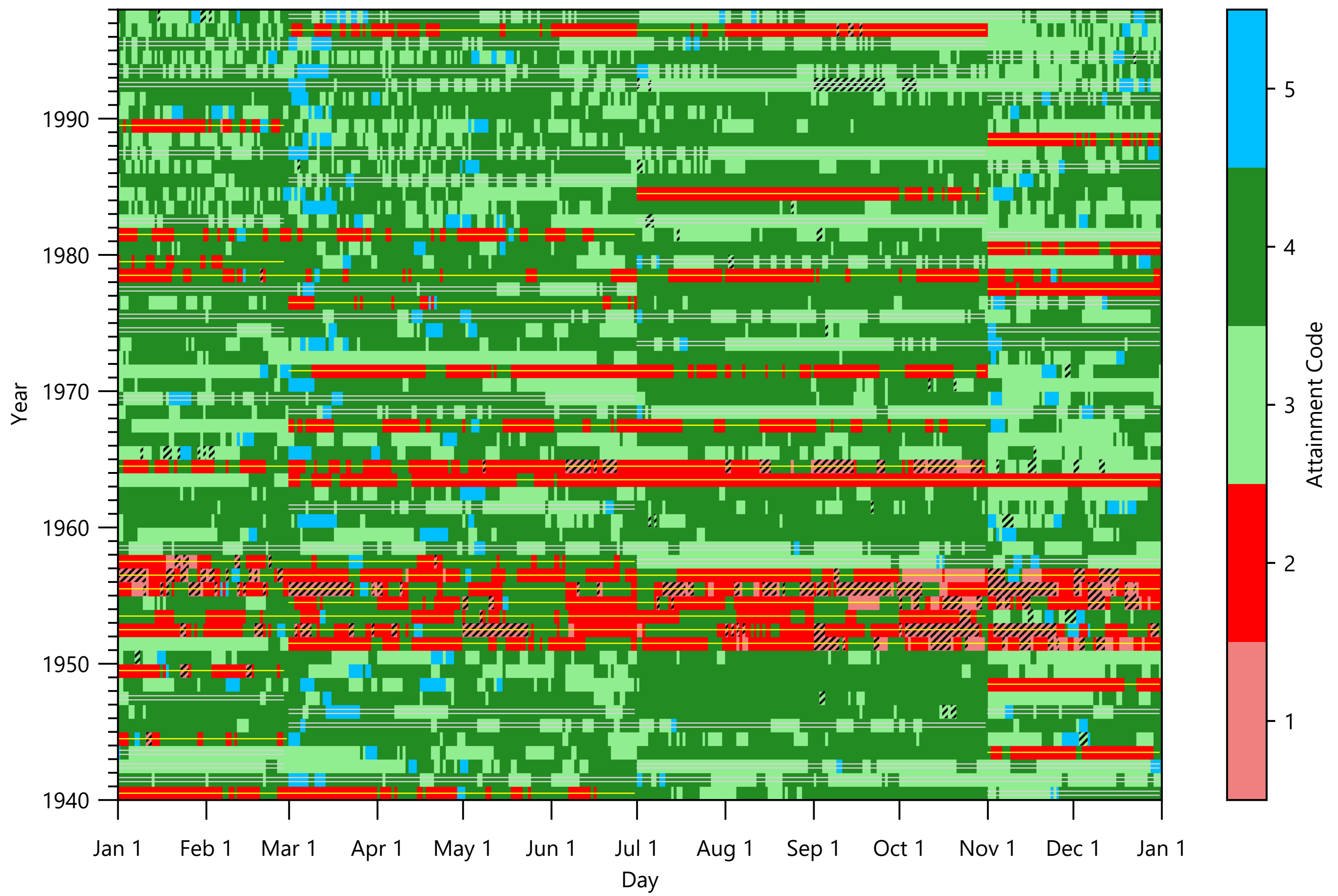
Figure G-62
Navasota River near Easterly: Current Water Use Scenario



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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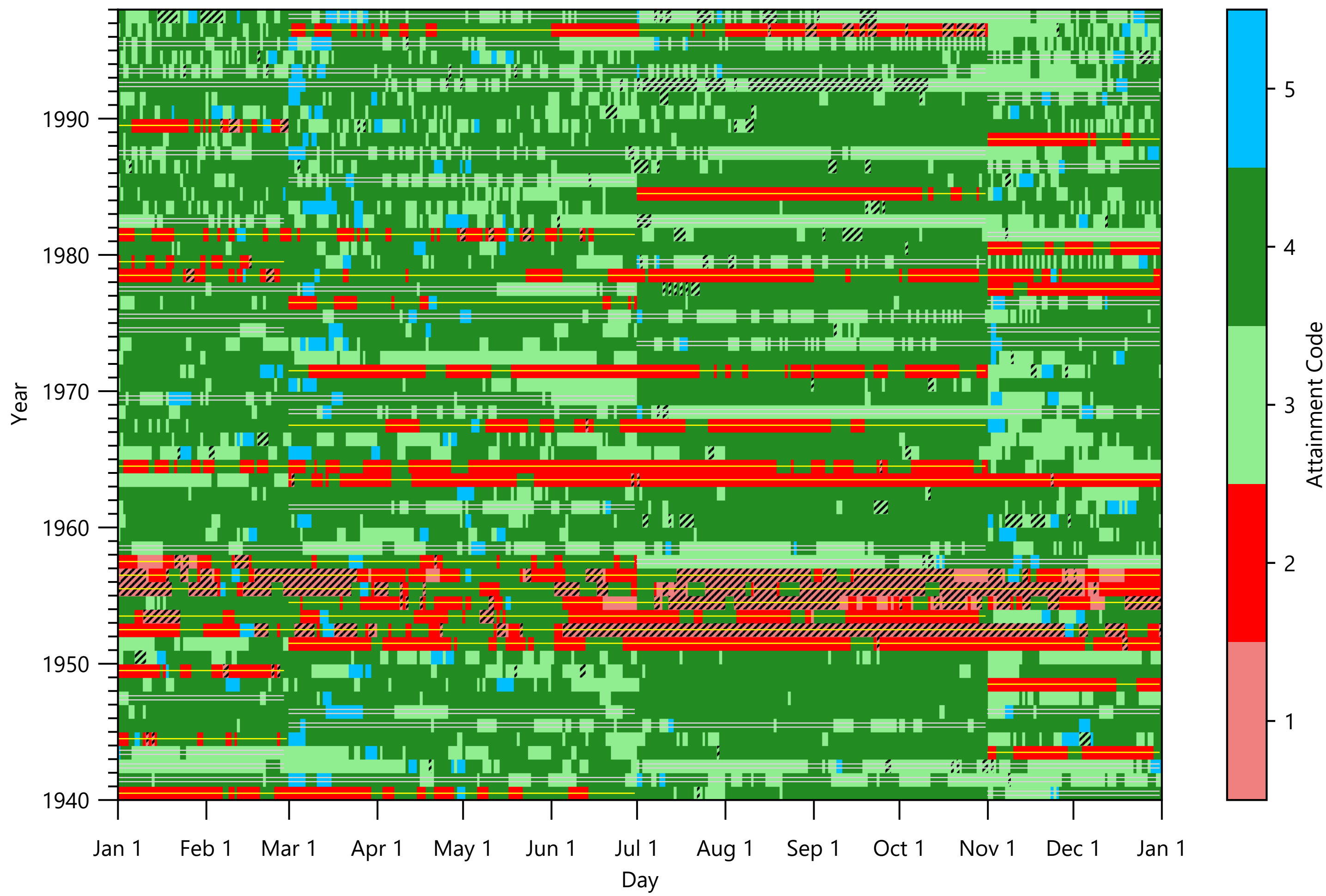
Figure G-63
Navasota River near Easterly: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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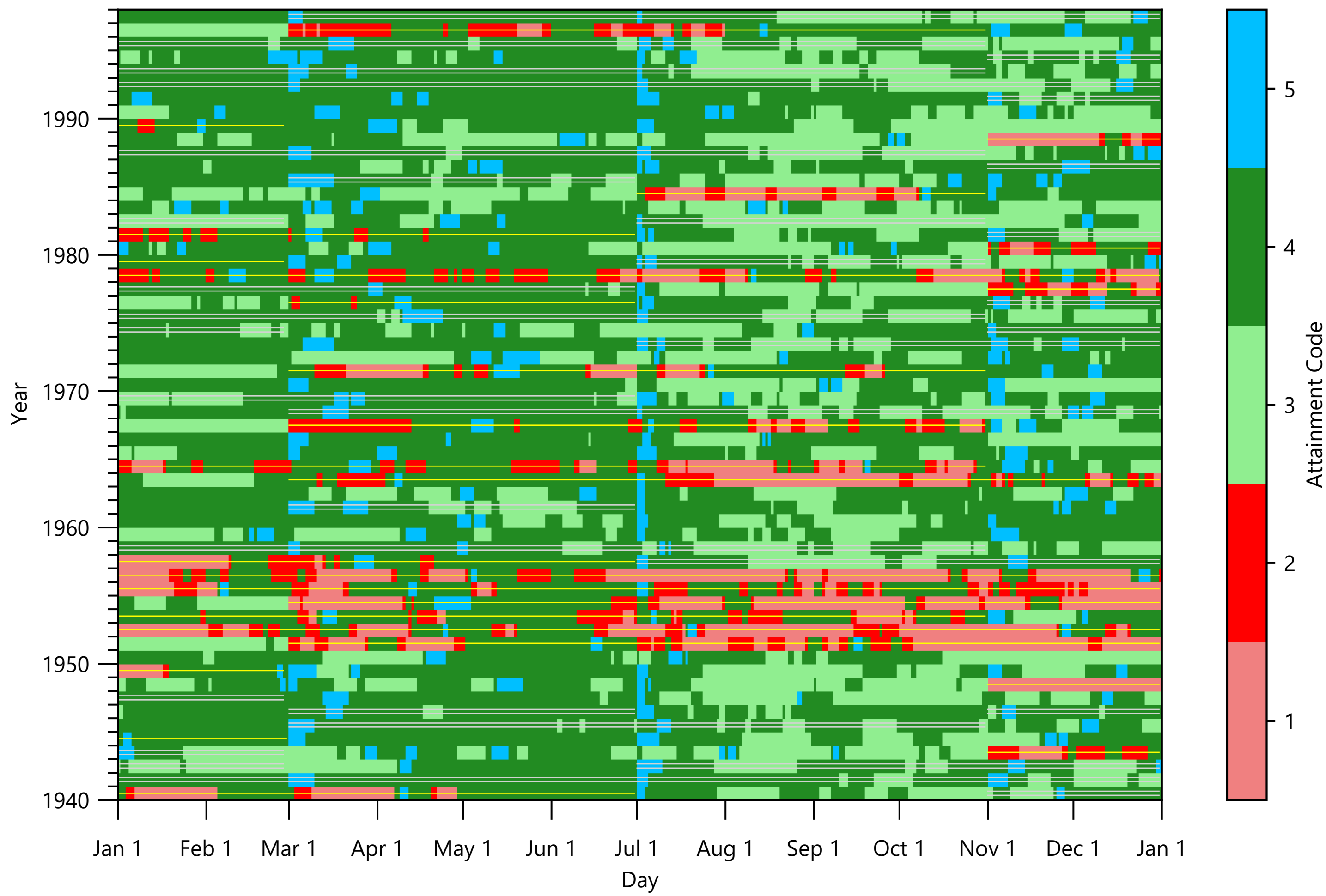
Figure G-64
Navasota River near Easterly: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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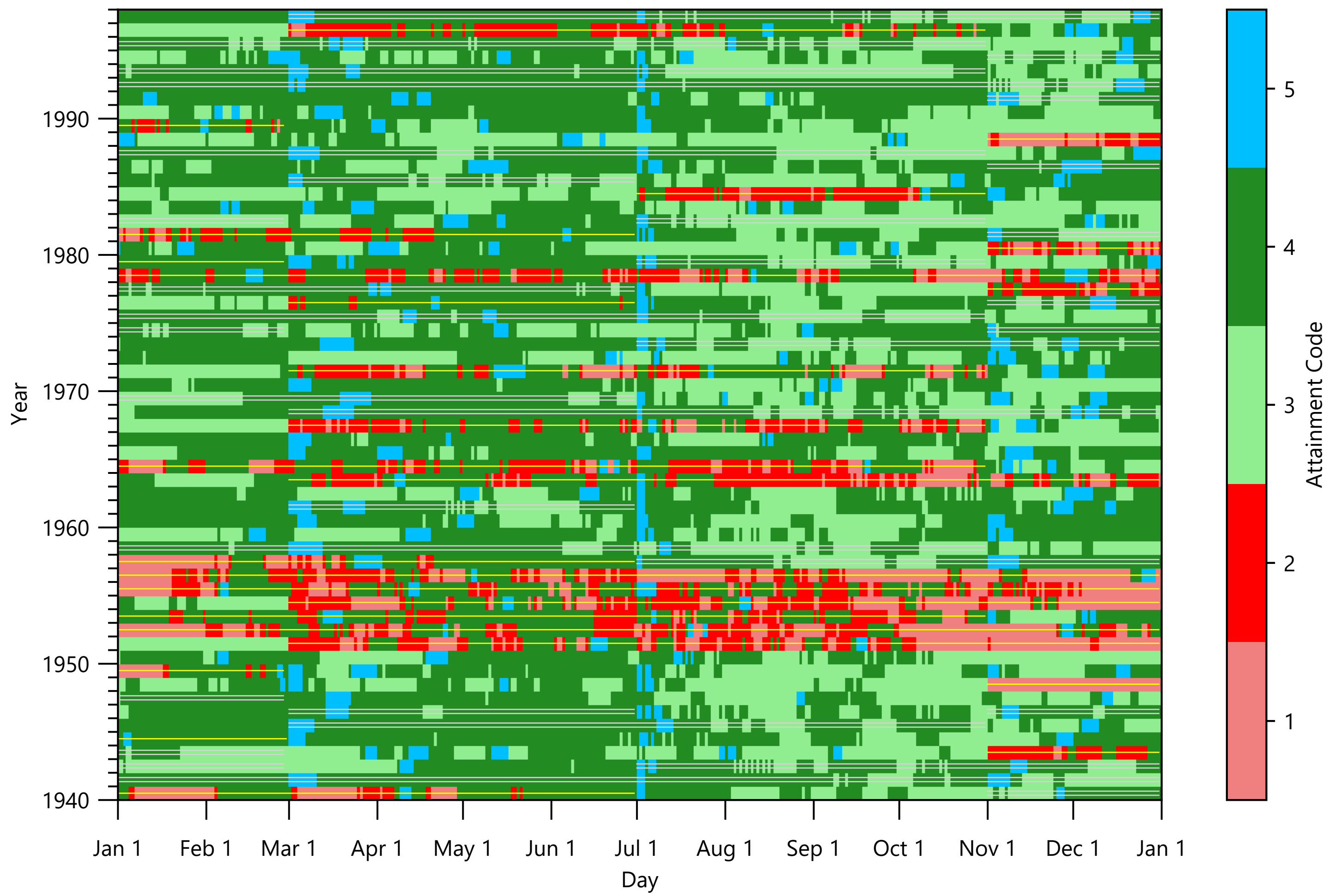
Figure G-65
Brazos River near Hempstead: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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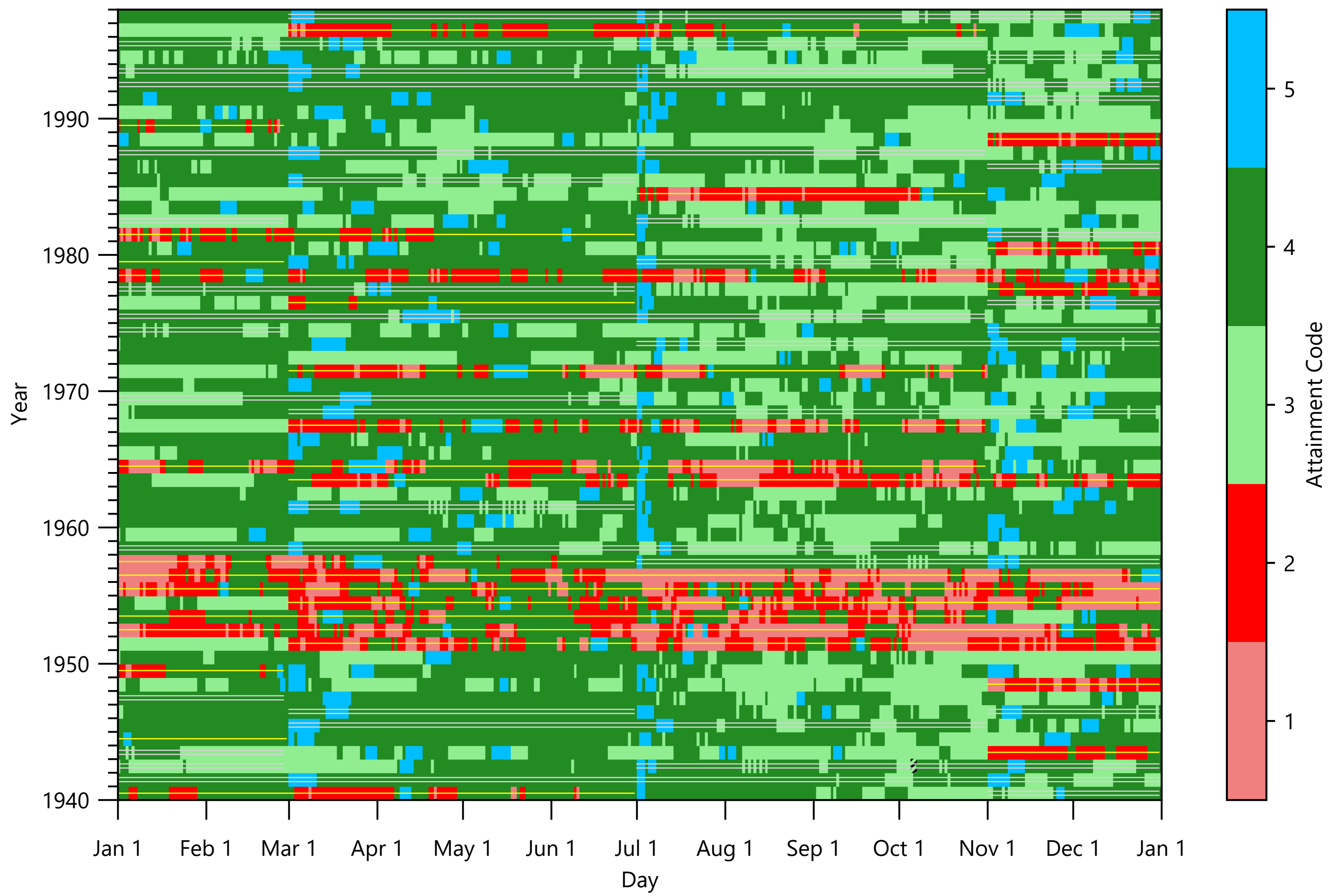
Figure G-66
Brazos River near Hempstead: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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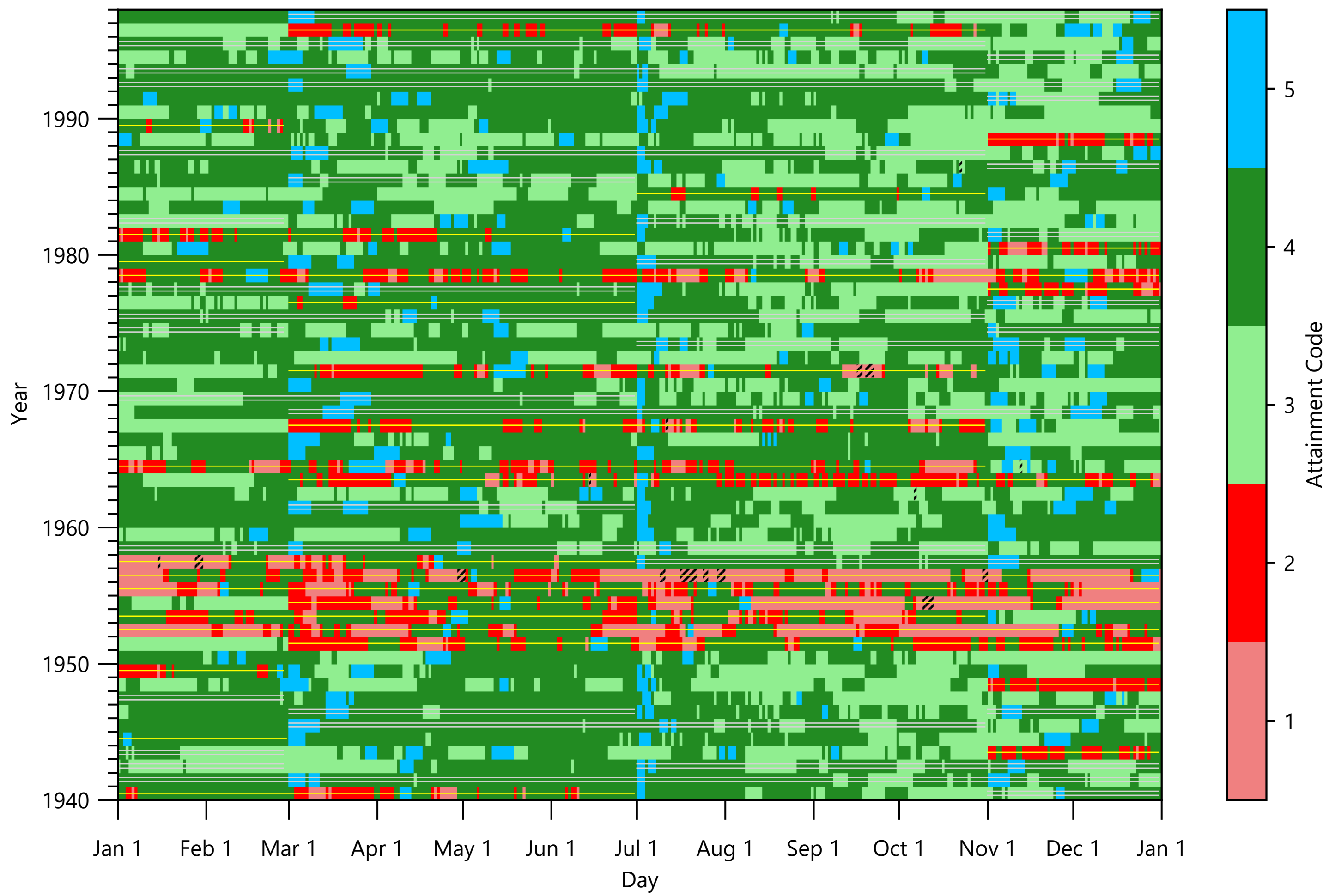
Figure G-67
Brazos River near Hempstead: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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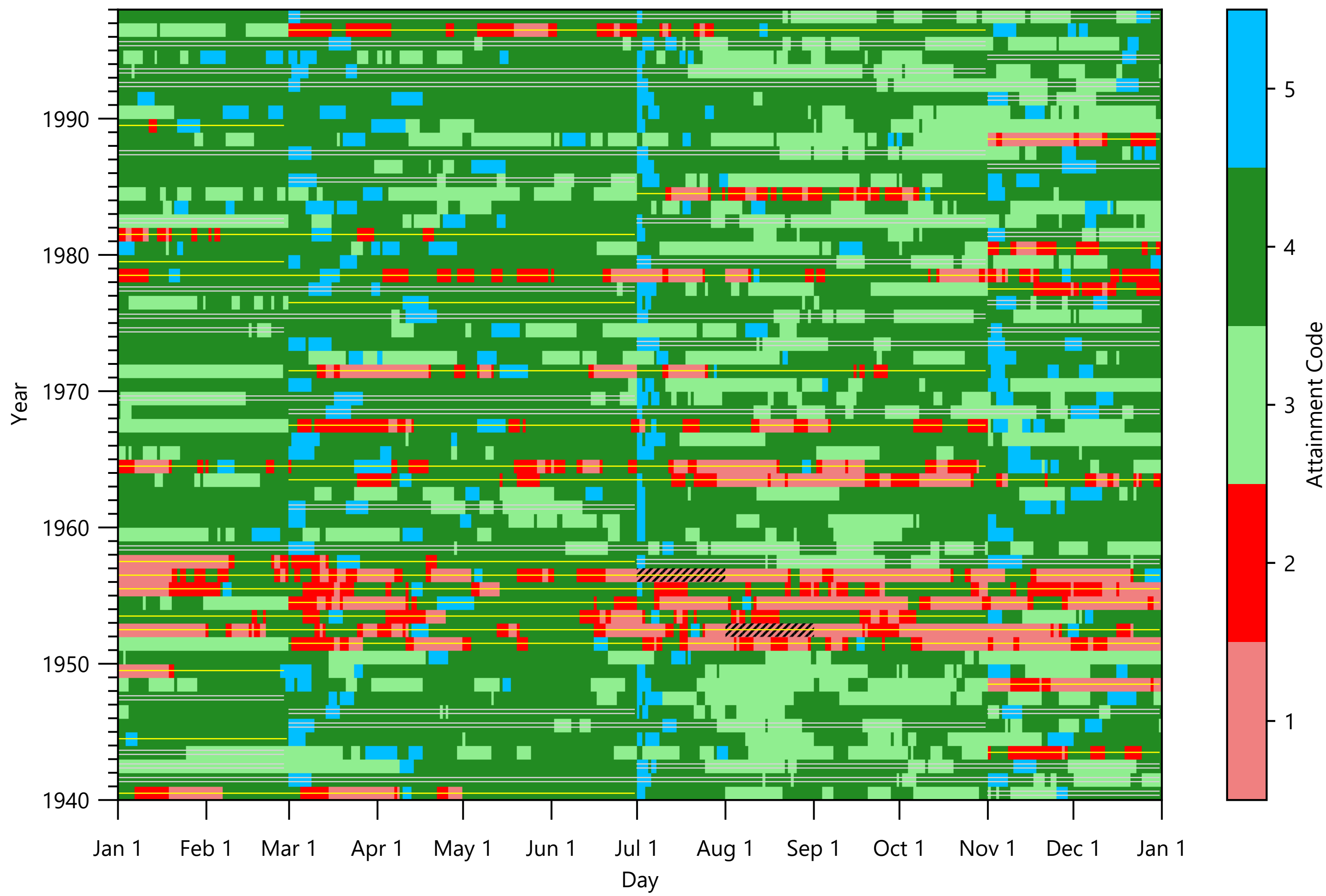
Figure G-68
Brazos River near Hempstead: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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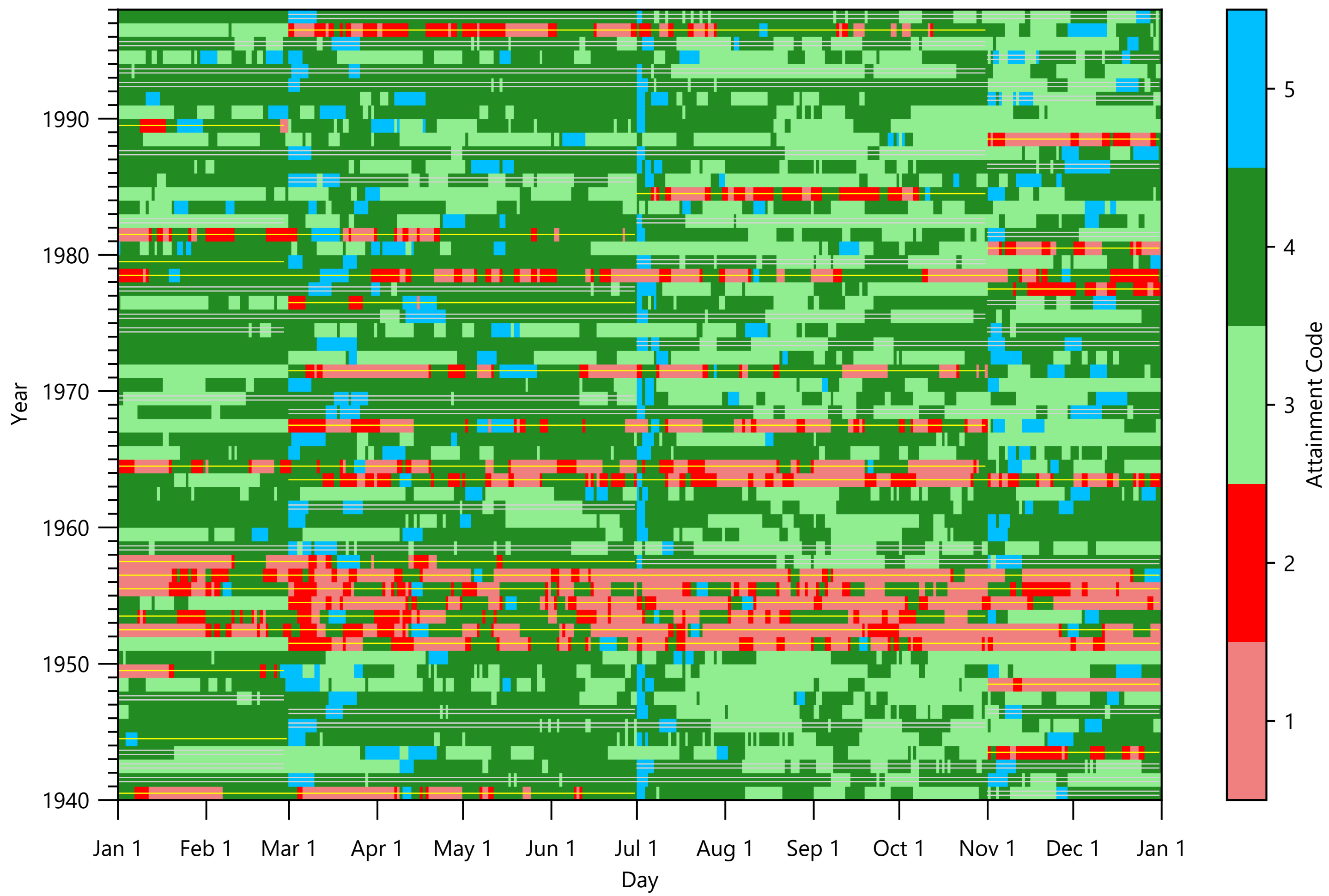
Figure G-69
Brazos River at Richmond: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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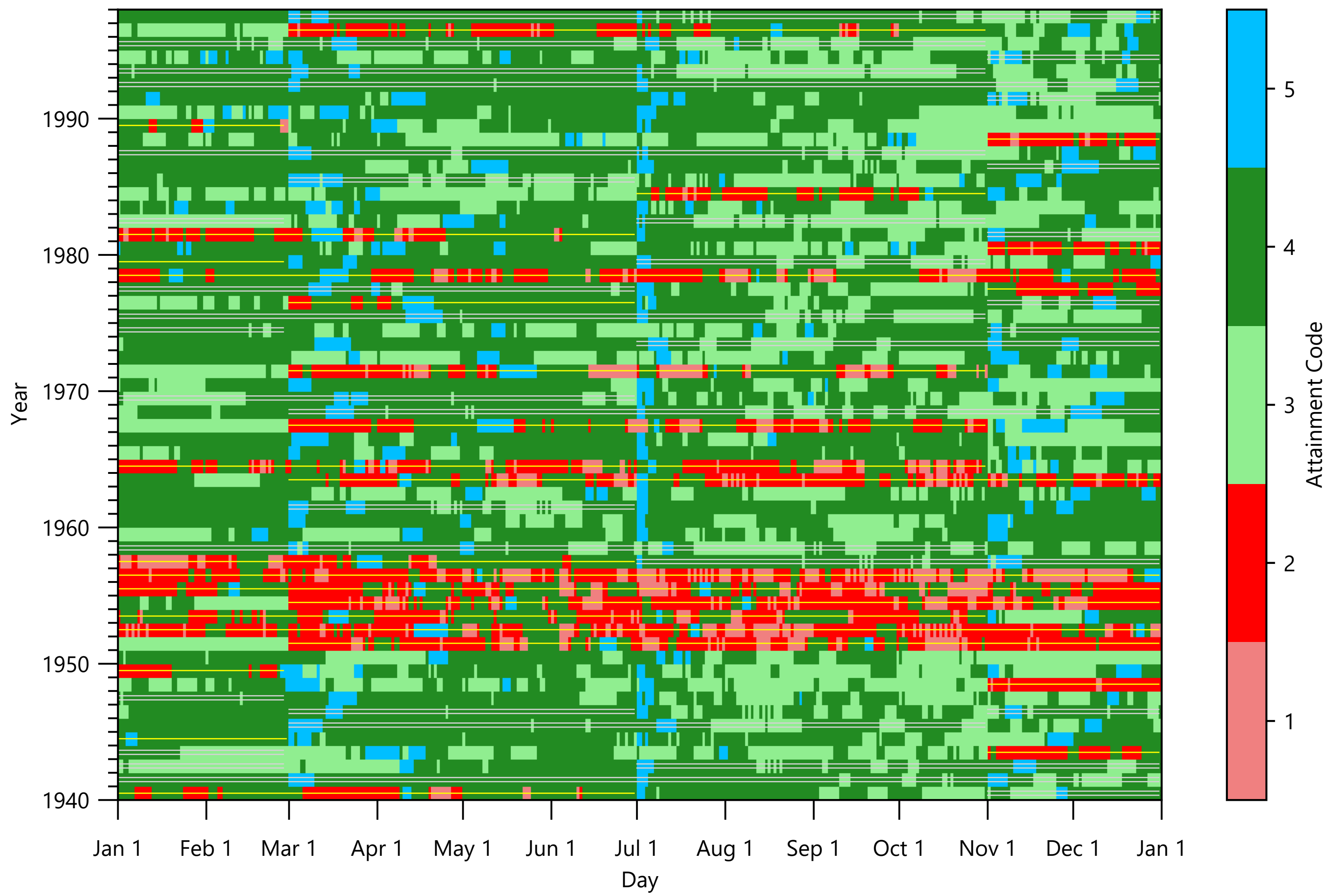
Figure G-70
Brazos River at Richmond: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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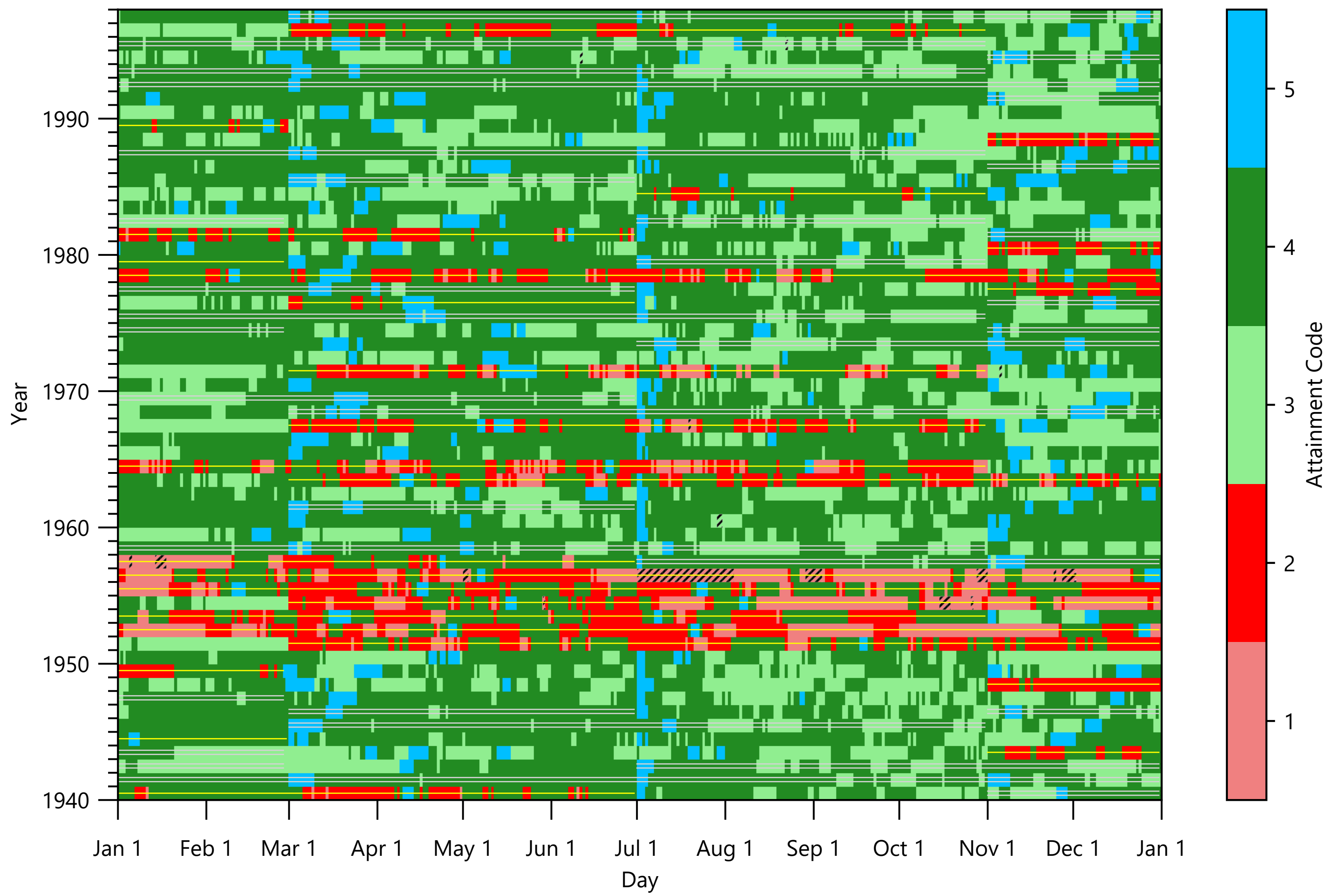
Figure G-71

Brazos River at Richmond: Partial Utilization Scenario

Attainment Raster Hydrographs for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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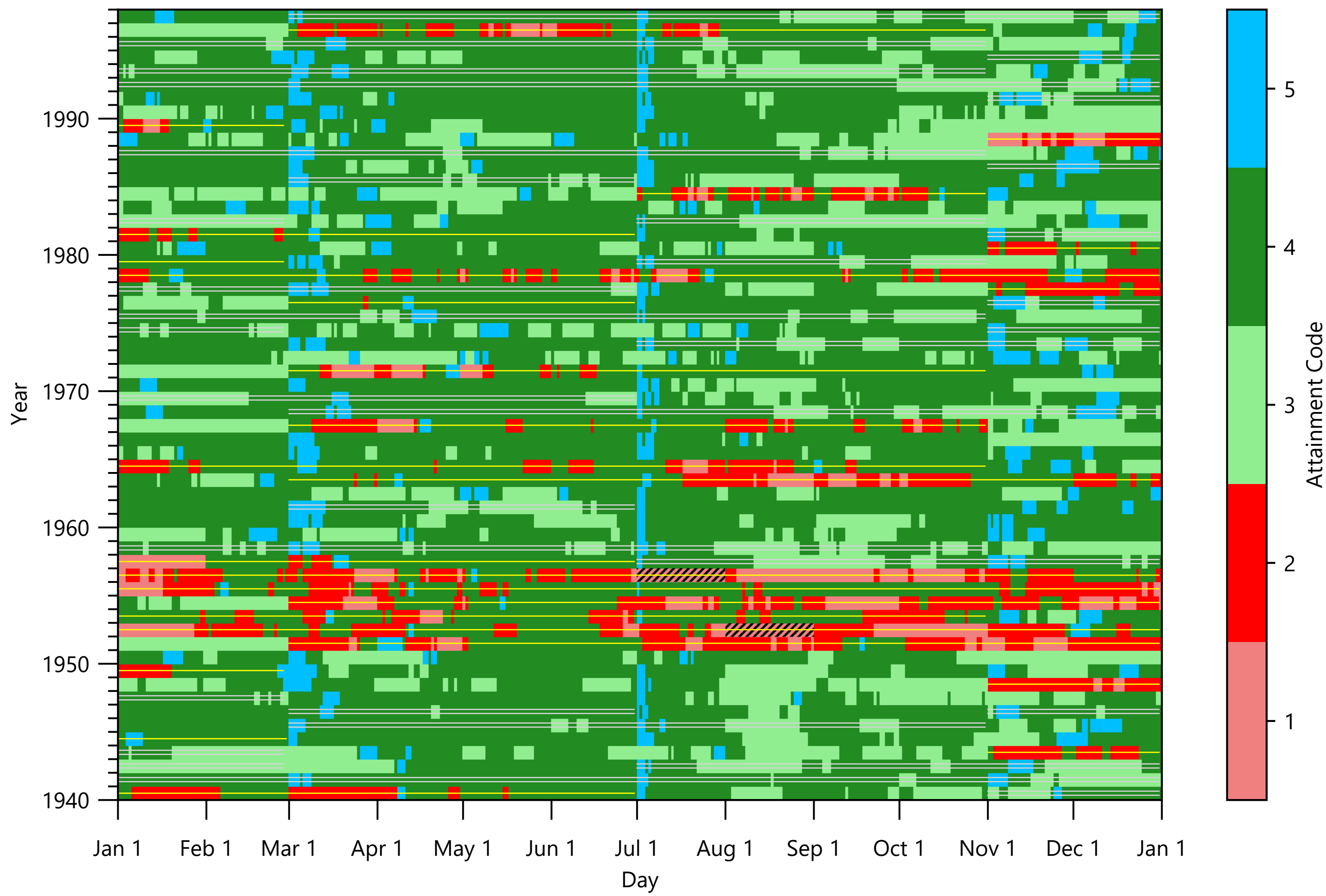
Figure G-72
Brazos River at Richmond: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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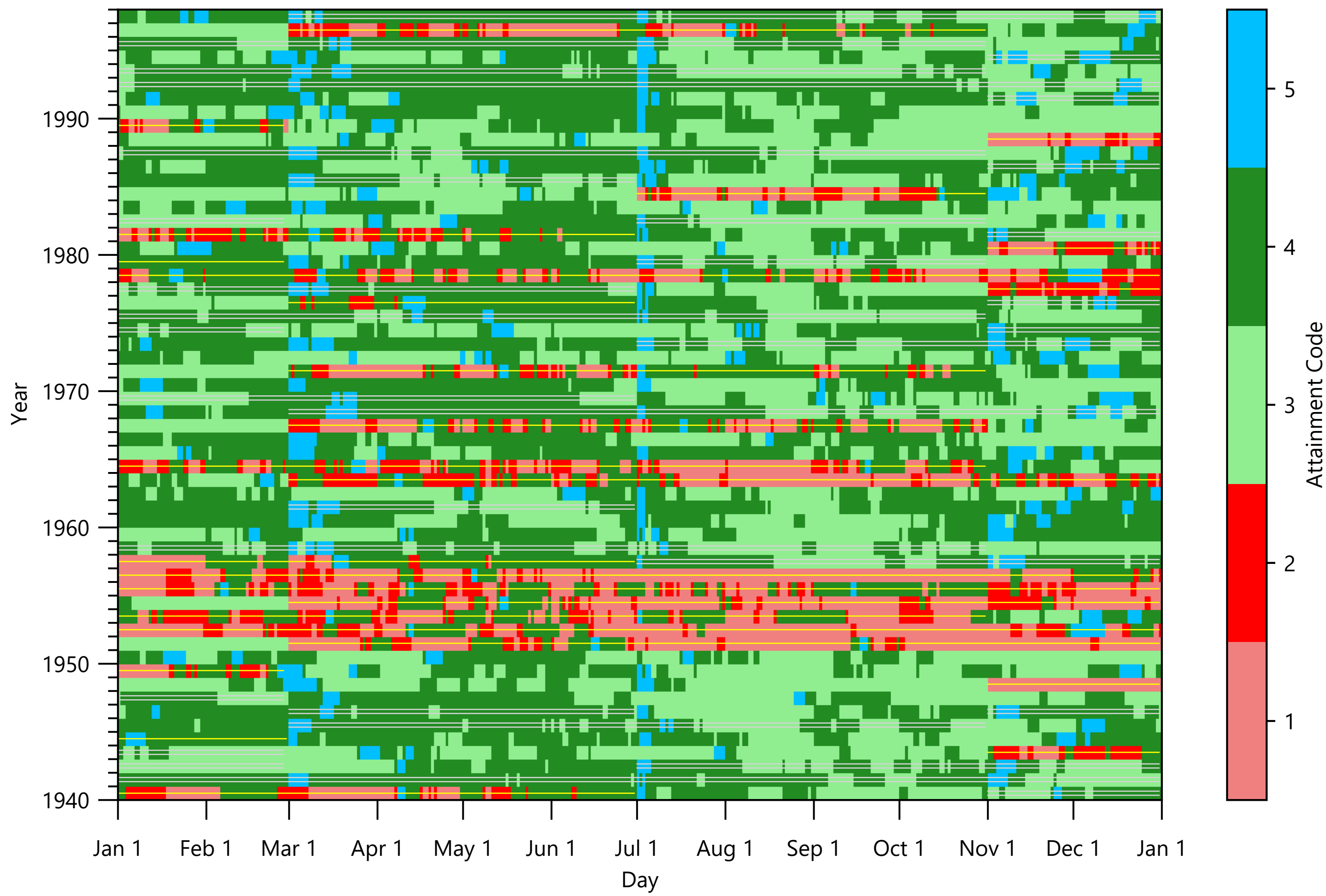
Figure G-73
Brazos River at Rosharon: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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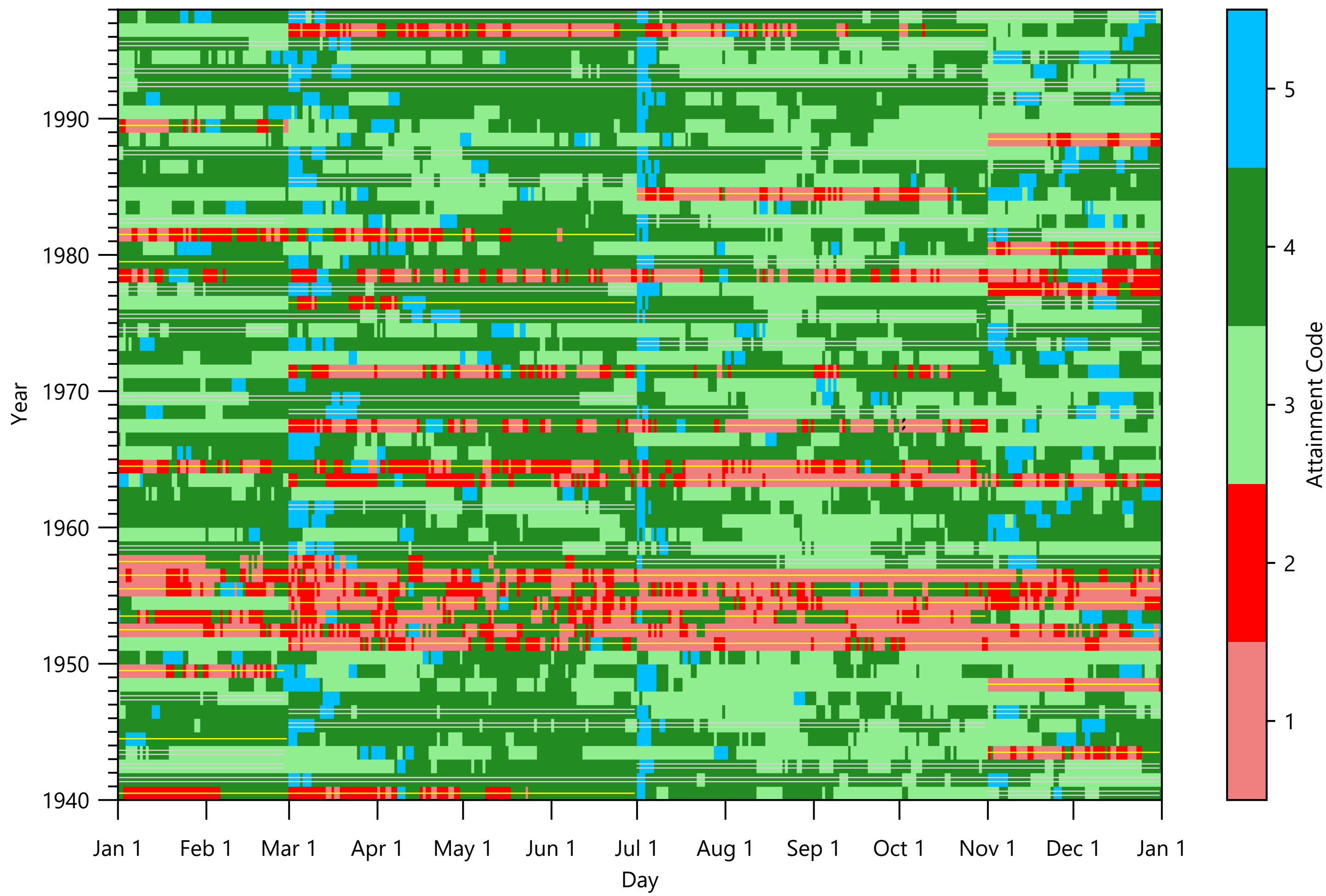
Figure G-74
Brazos River at Rosharon: Current Water Use Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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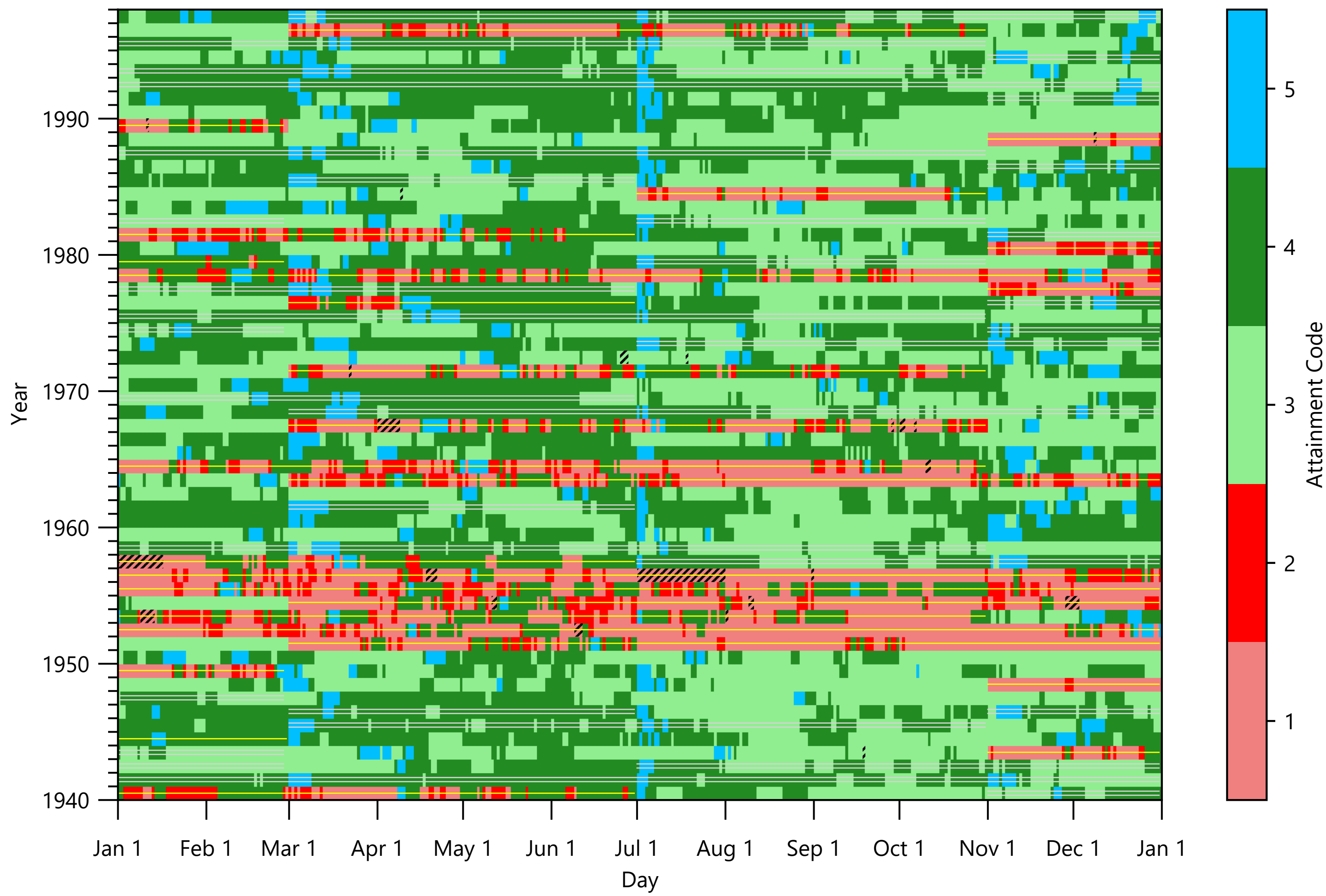
Figure G-75
Brazos River at Rosharon: Partial Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).
(3) Single horizontal yellow lines through raster cells denote dry hydrologic conditions. Double horizontal gray lines through raster cells denote wet hydrologic conditions.

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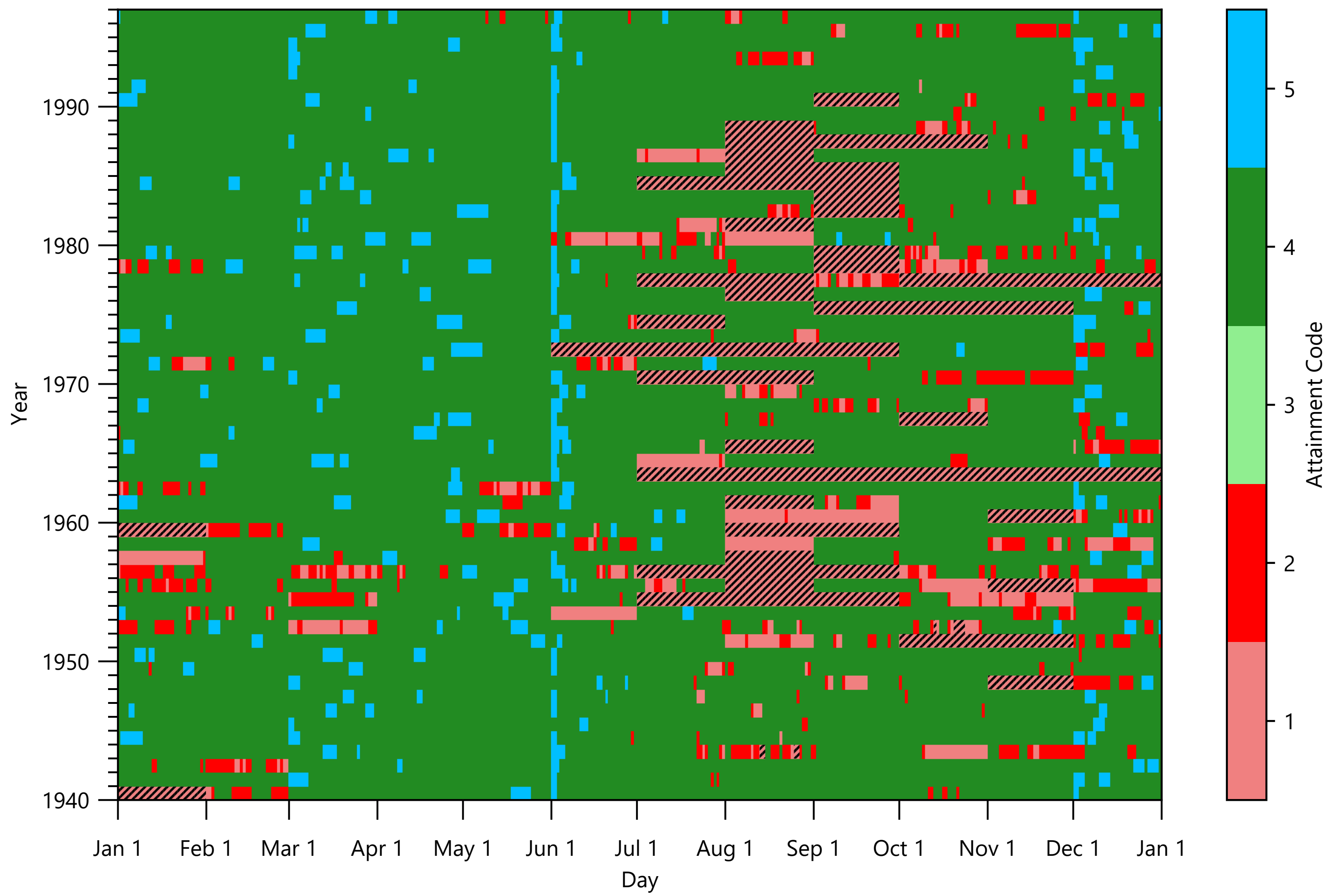
Figure G-76
Brazos River at Rosharon: Full Utilization Scenario
Attainment Raster Hydrographs for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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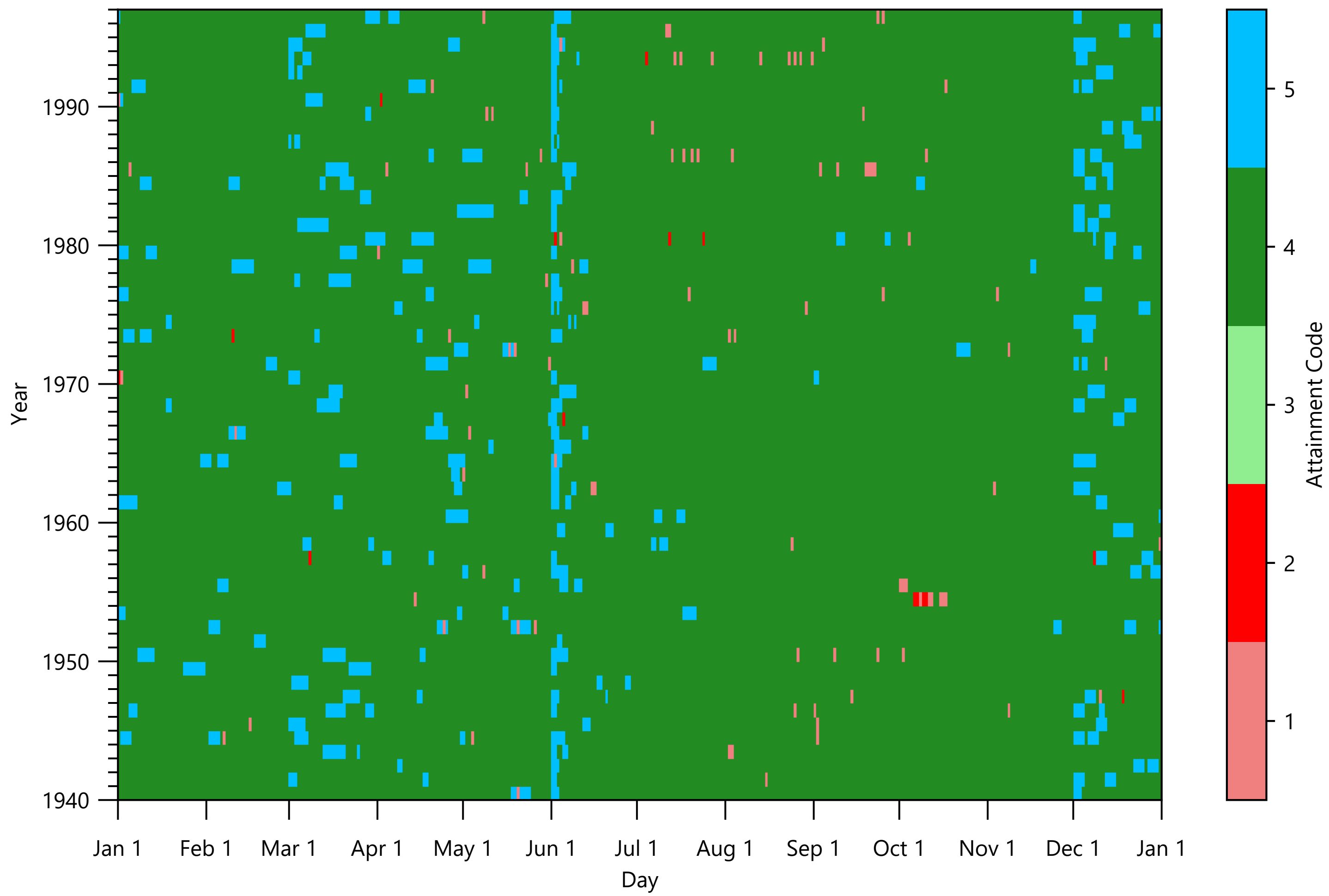
Figure G-77
West Fork Trinity River near Grand Prairie: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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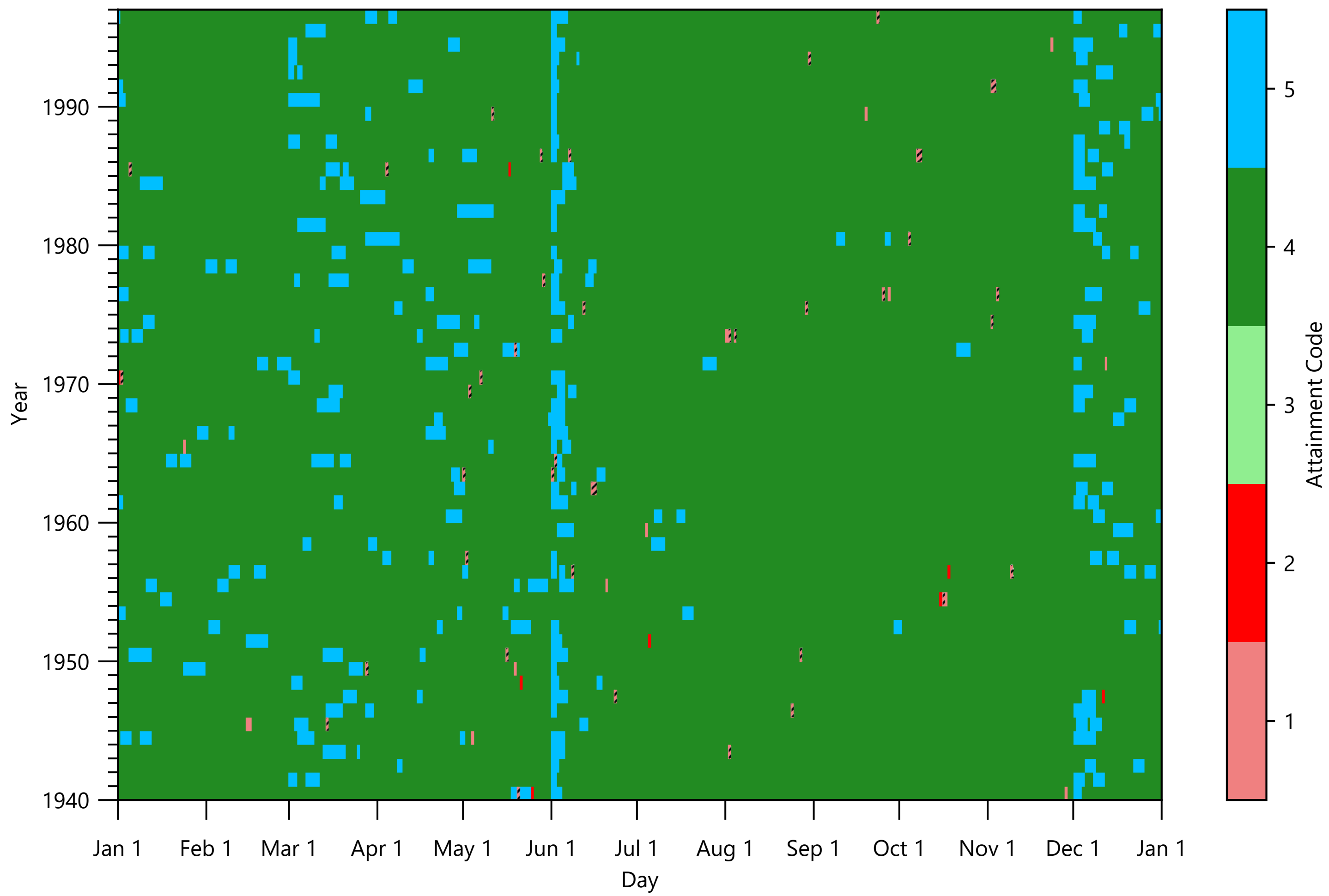
Figure G-78
West Fork Trinity River near Grand Prairie: Current Water Use Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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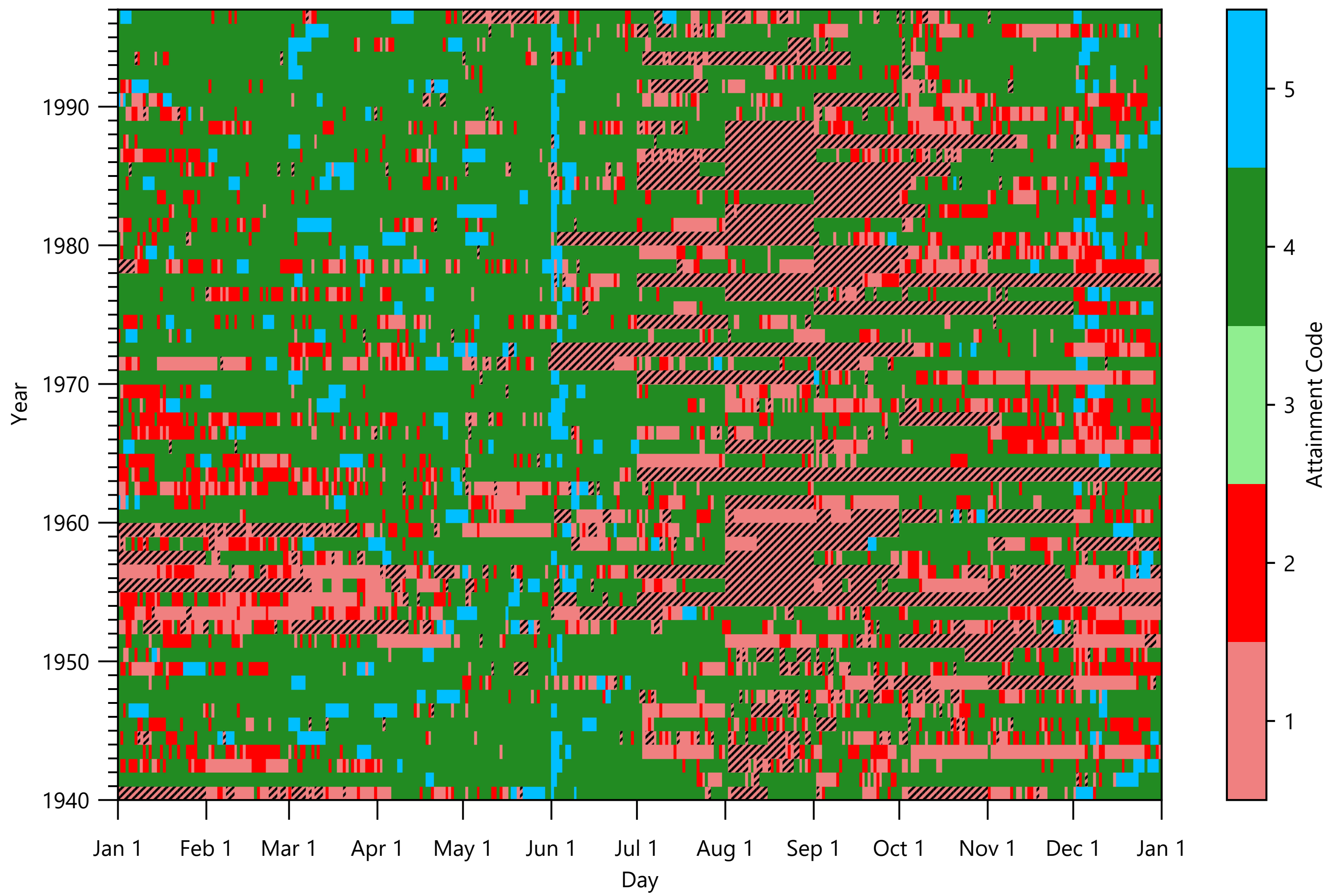
Figure G-79

West Fork Trinity River near Grand Prairie: Partial Utilization Scenario

Attainment Raster Hydrographs for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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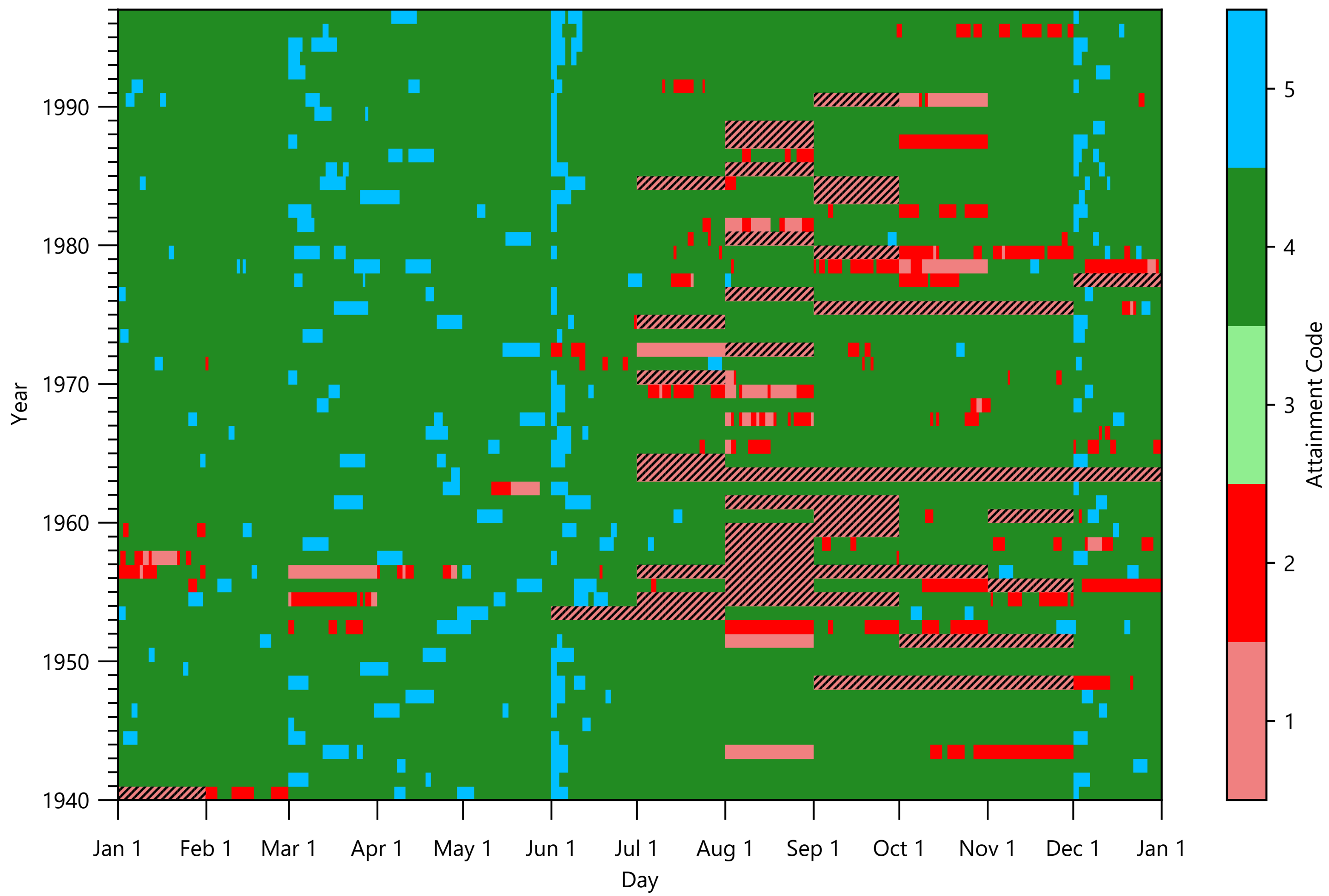
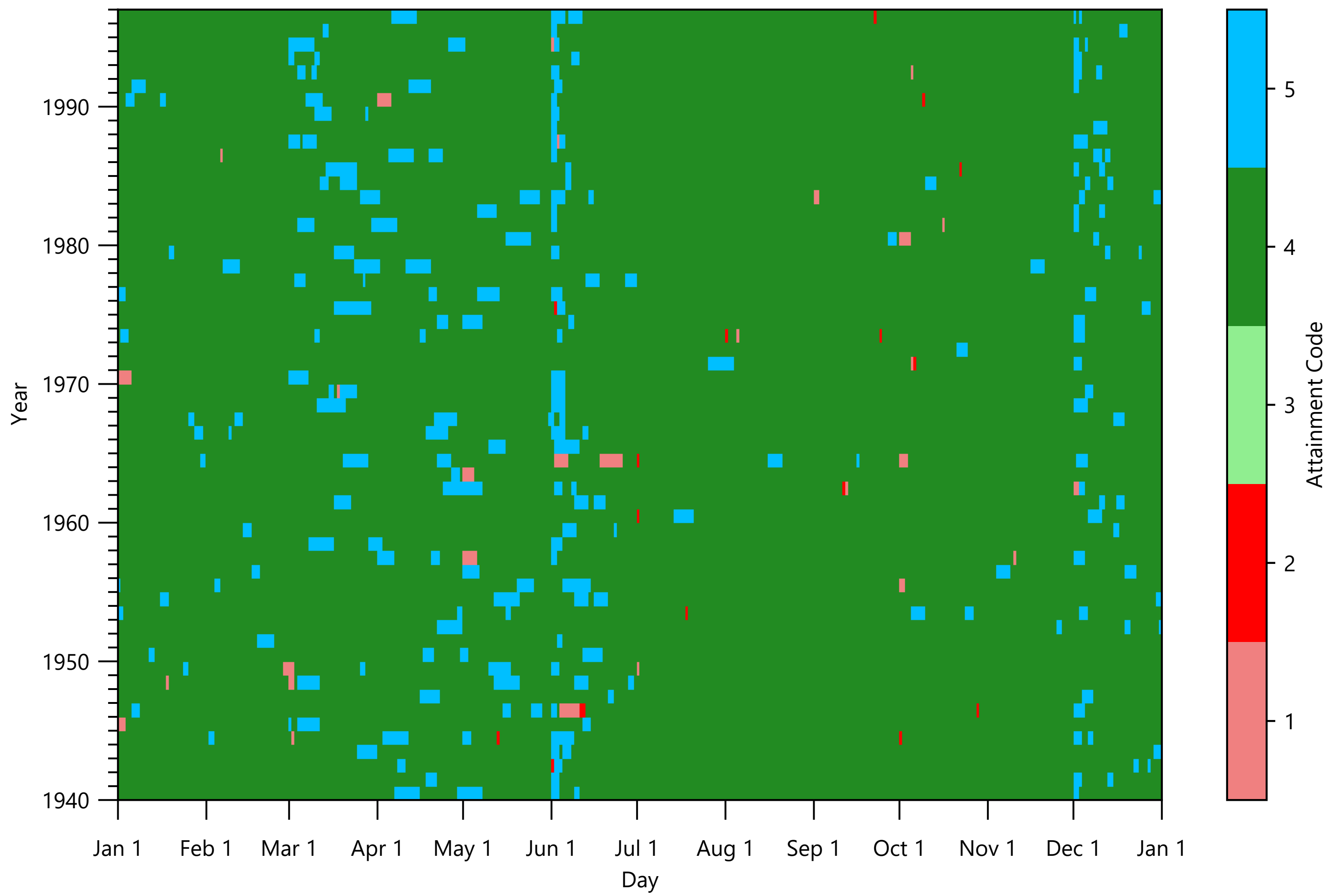
Figure G-80
West Fork Trinity River near Grand Prairie: Full Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

Figure G-81
Trinity River at Dallas: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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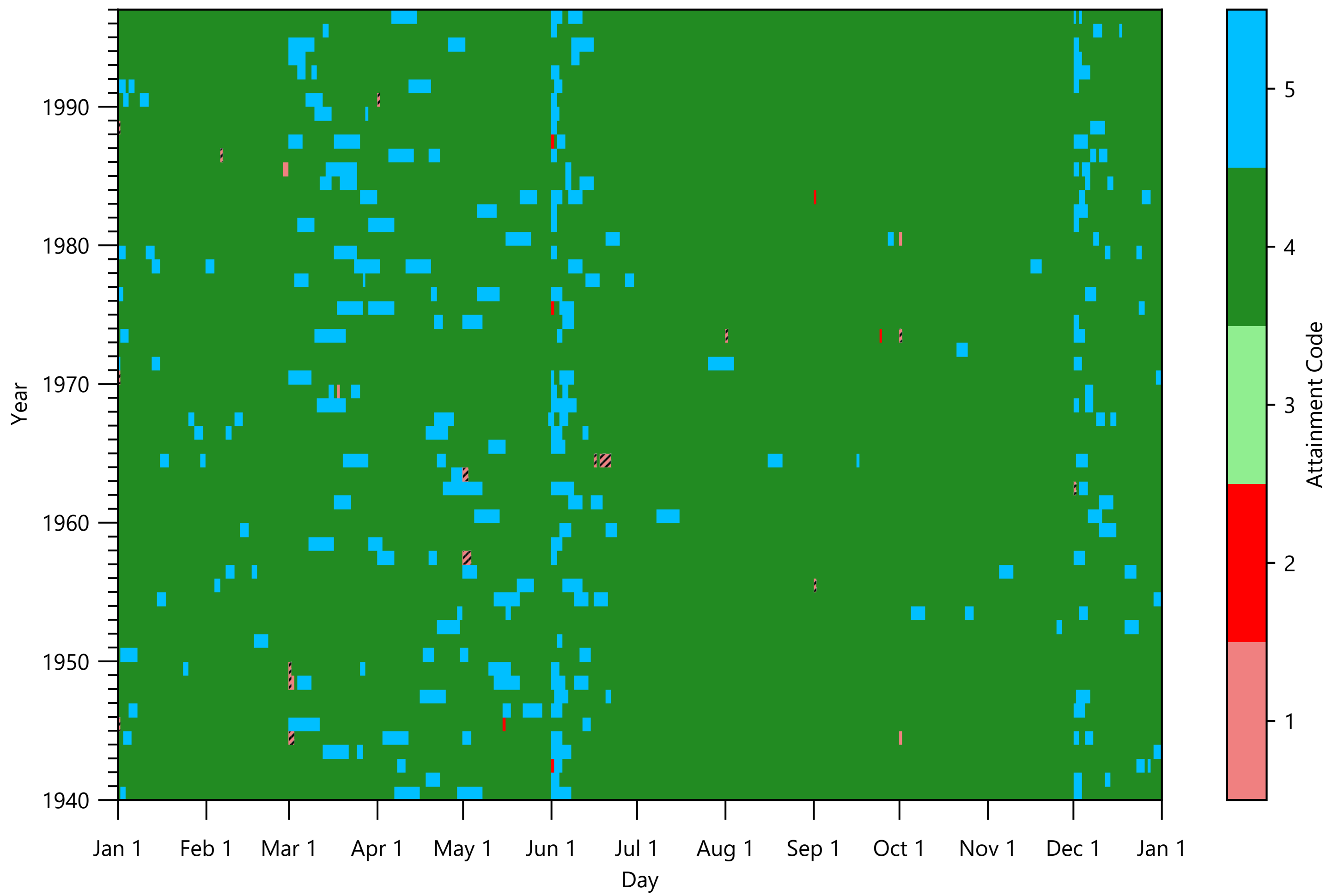
Figure G-82
Trinity River at Dallas: Current Water Use Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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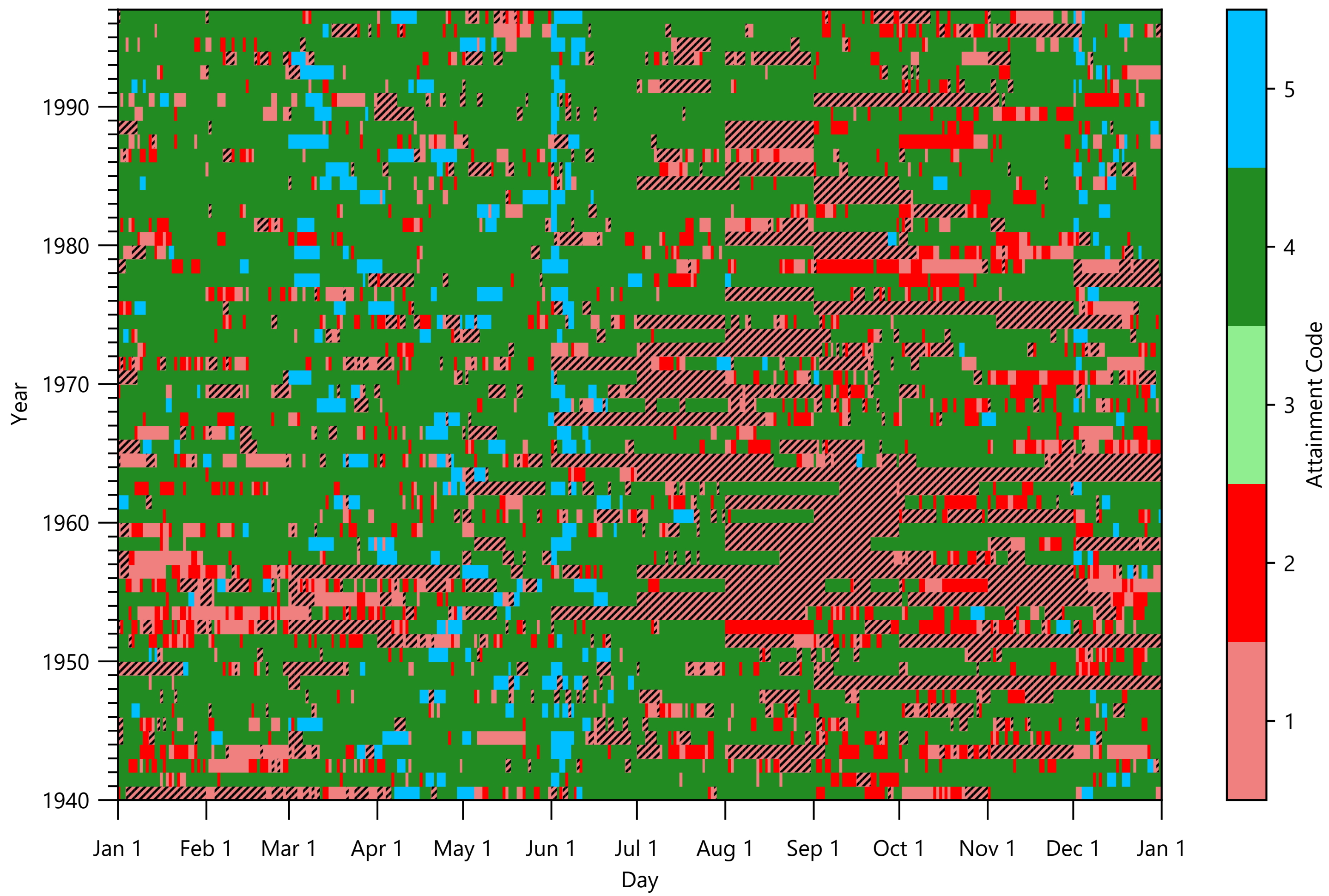
Figure G-83
Trinity River at Dallas: Partial Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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Figure G-84
Trinity River at Dallas: Full Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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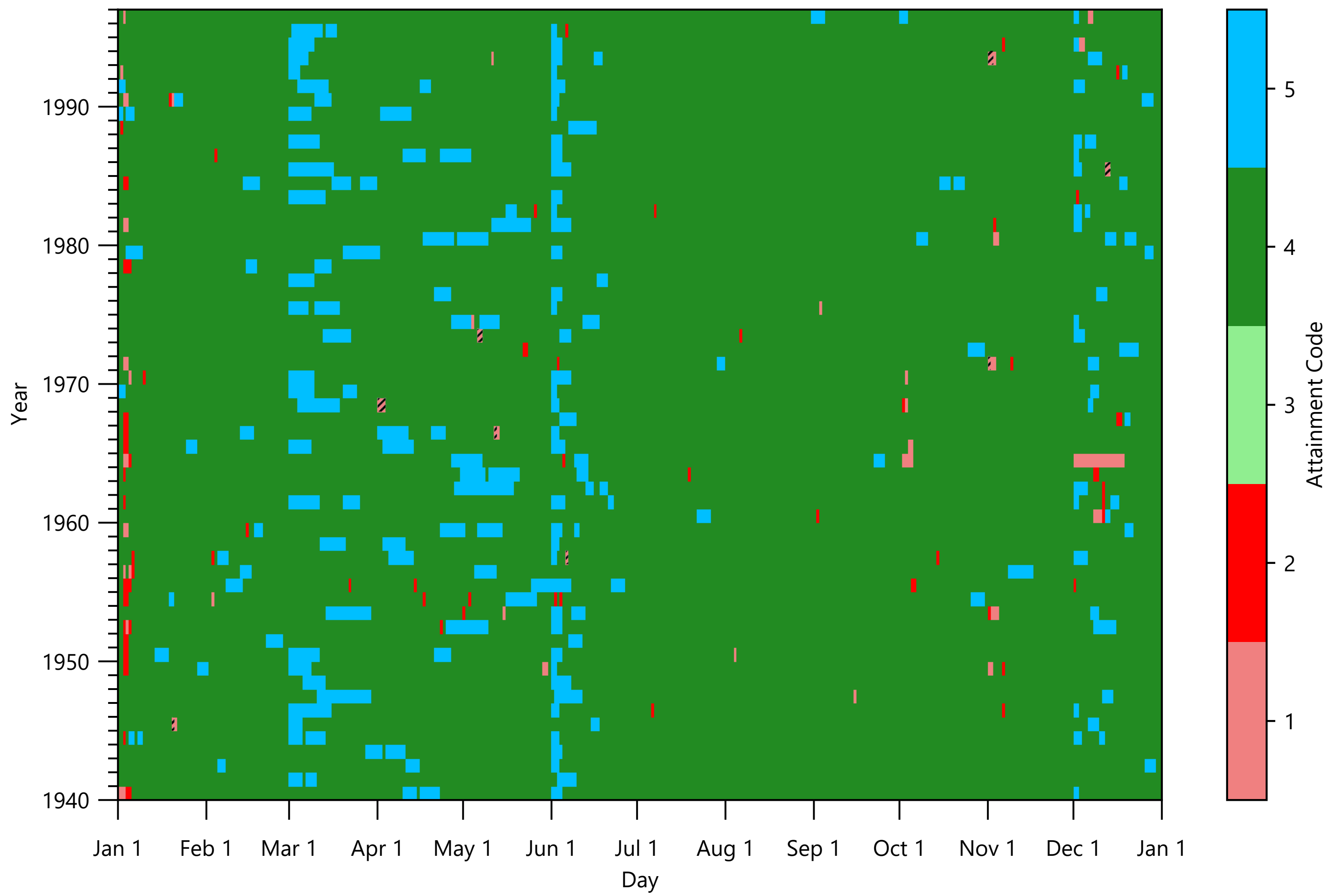
Figure G-85
Trinity River near Oakwood: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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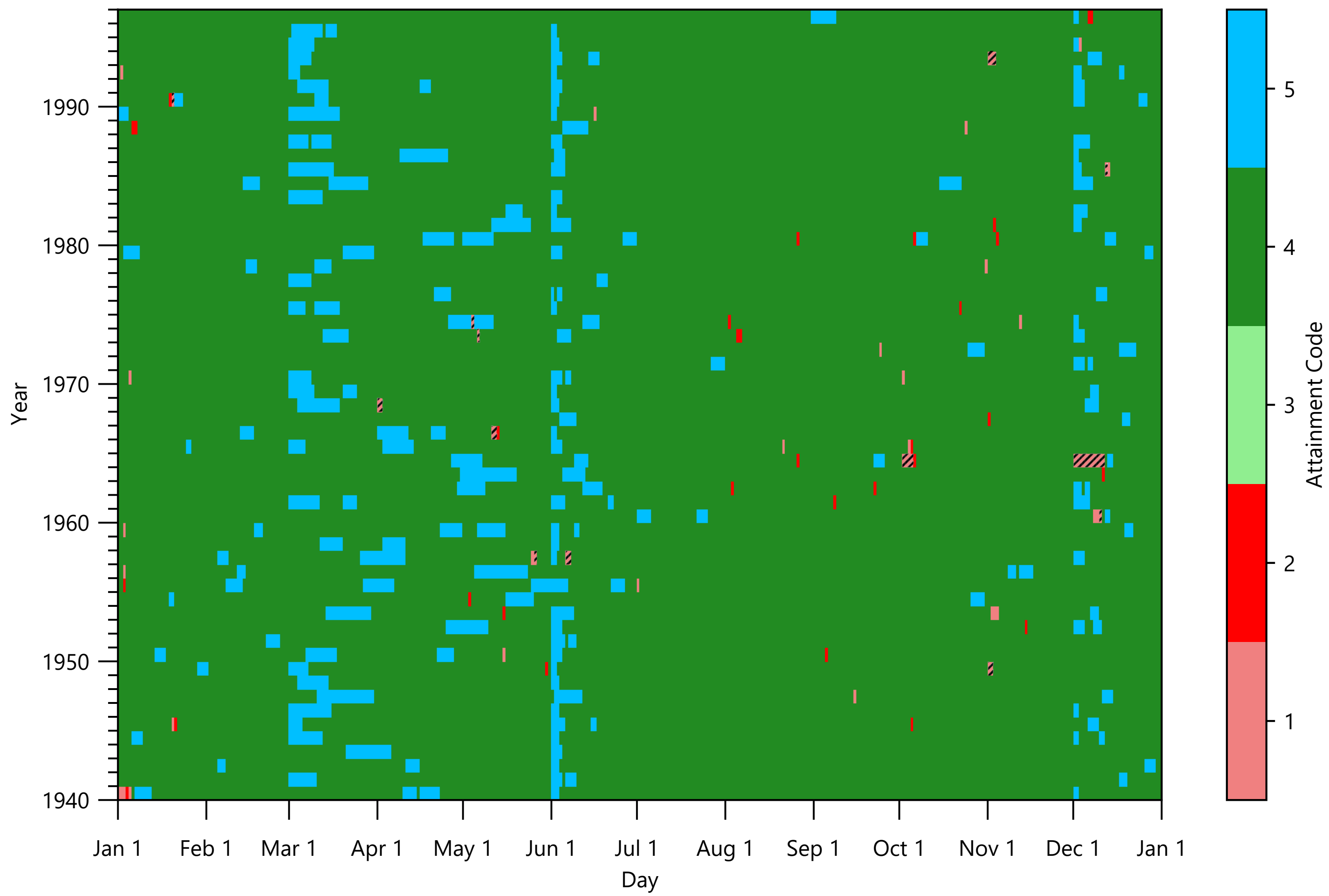
Figure G-86
Trinity River near Oakwood: Current Water Use Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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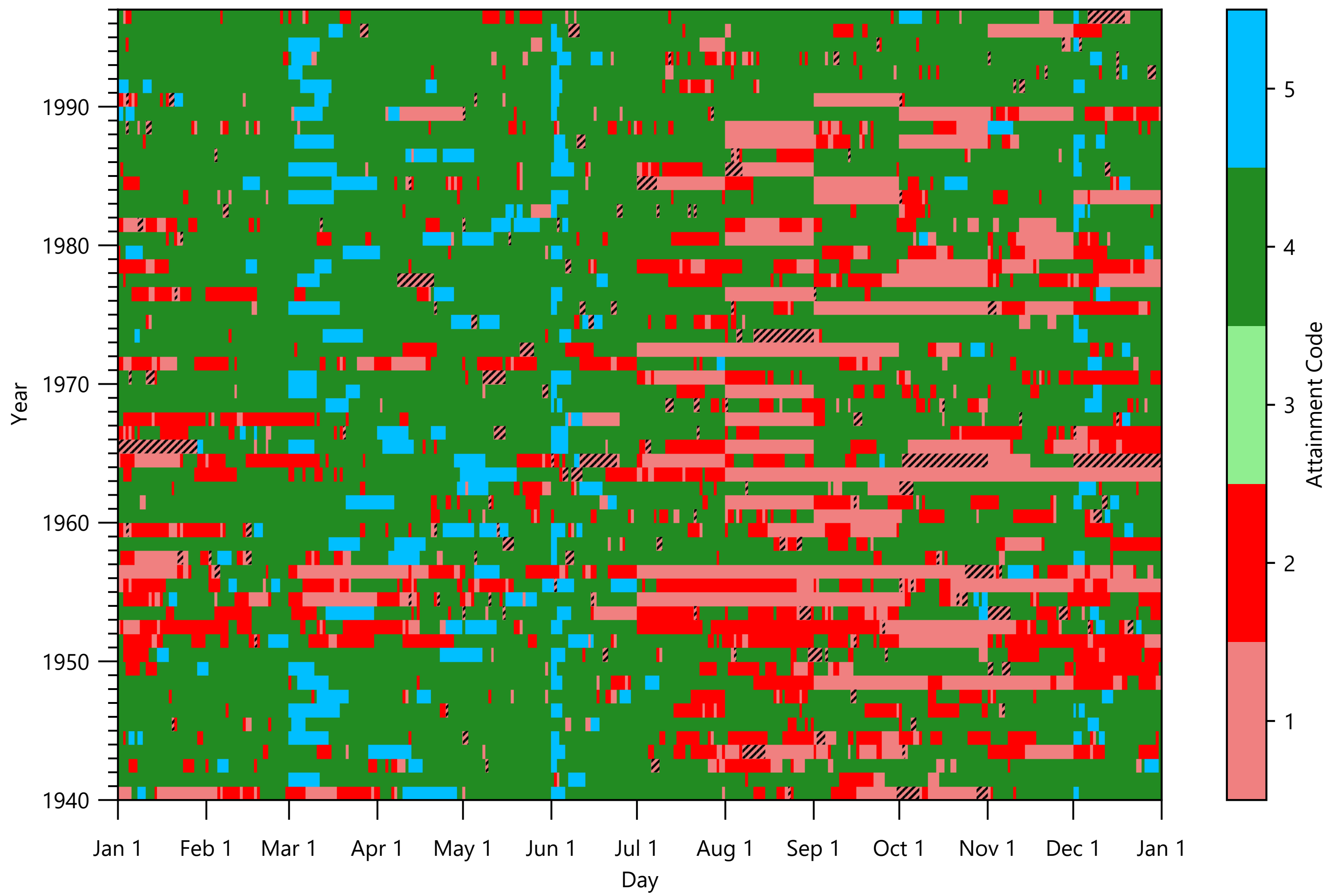
Figure G-87
Trinity River near Oakwood: Partial Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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Figure G-88
Trinity River near Oakwood: Full Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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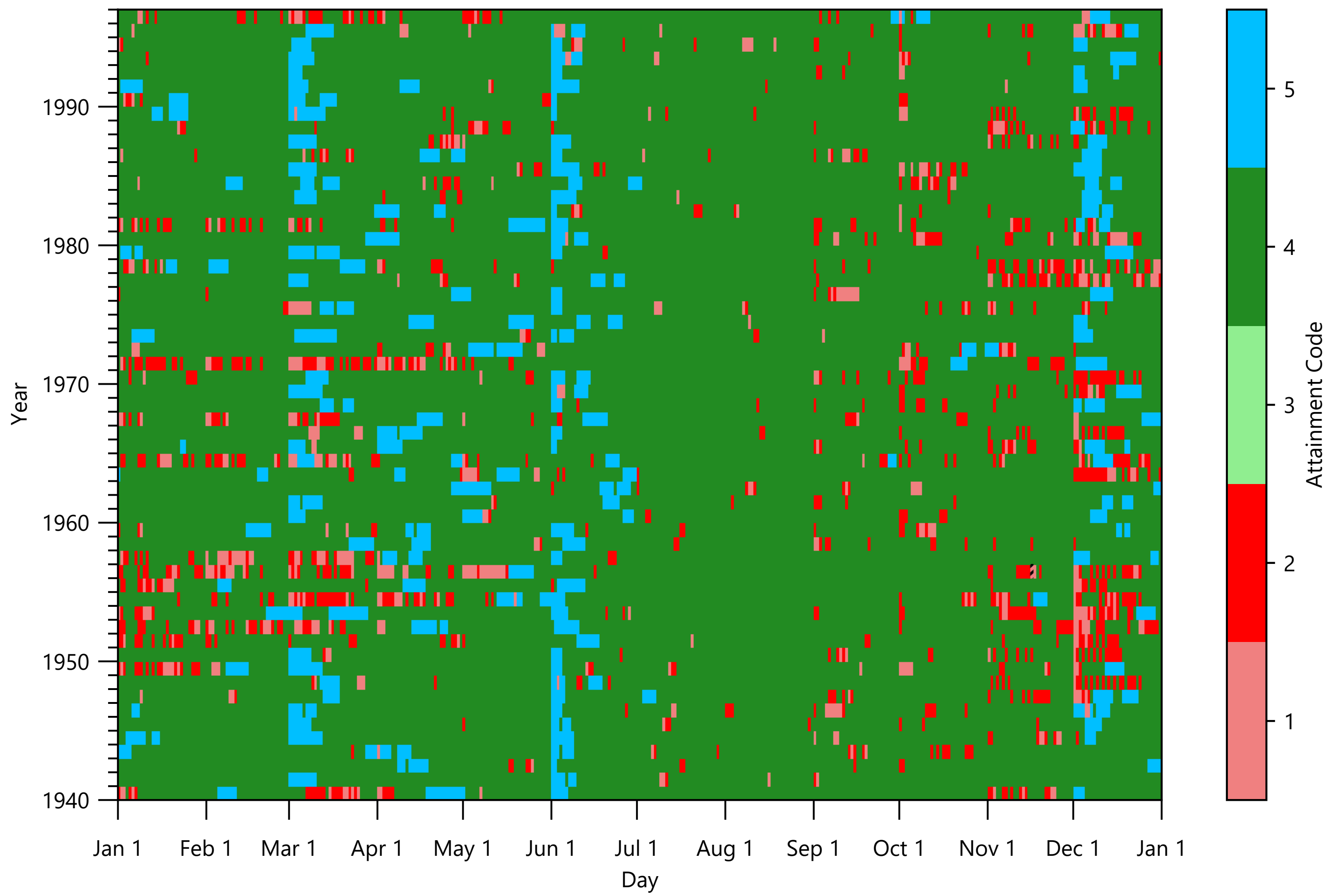
Figure G-89
Trinity River near Romayor: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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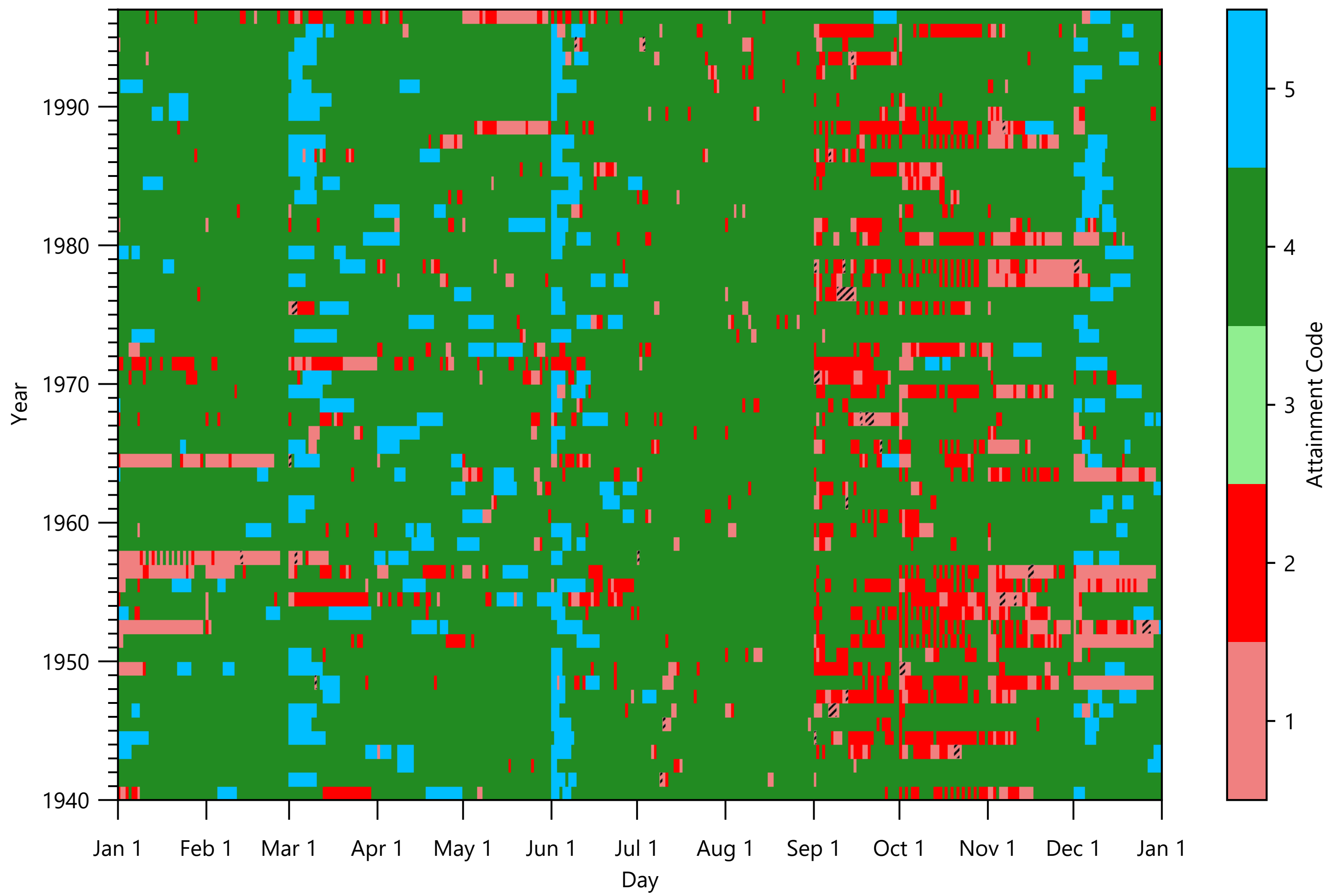
Figure G-90
Trinity River near Romayor: Current Water Use Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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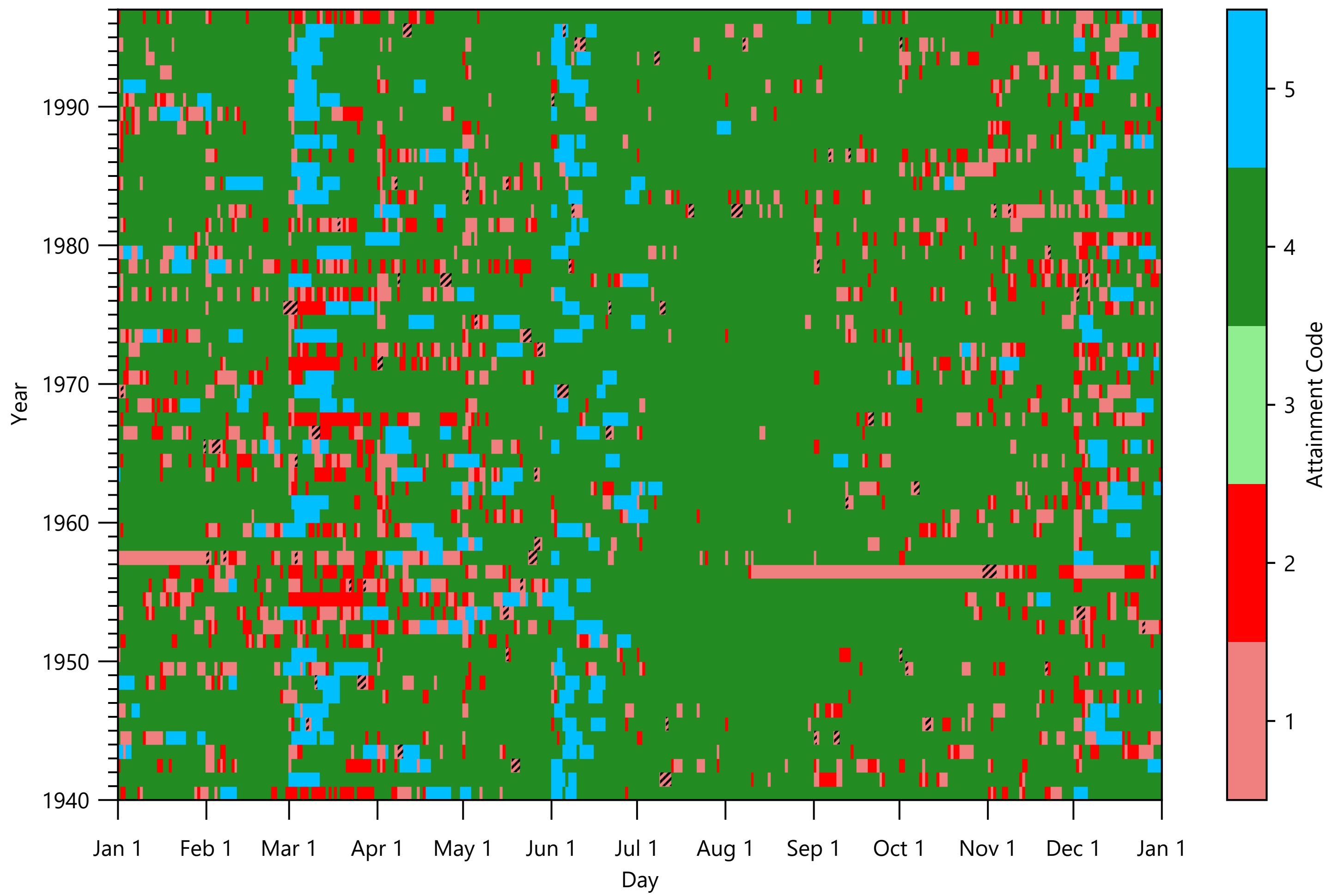
Figure G-91
Trinity River near Romayor: Partial Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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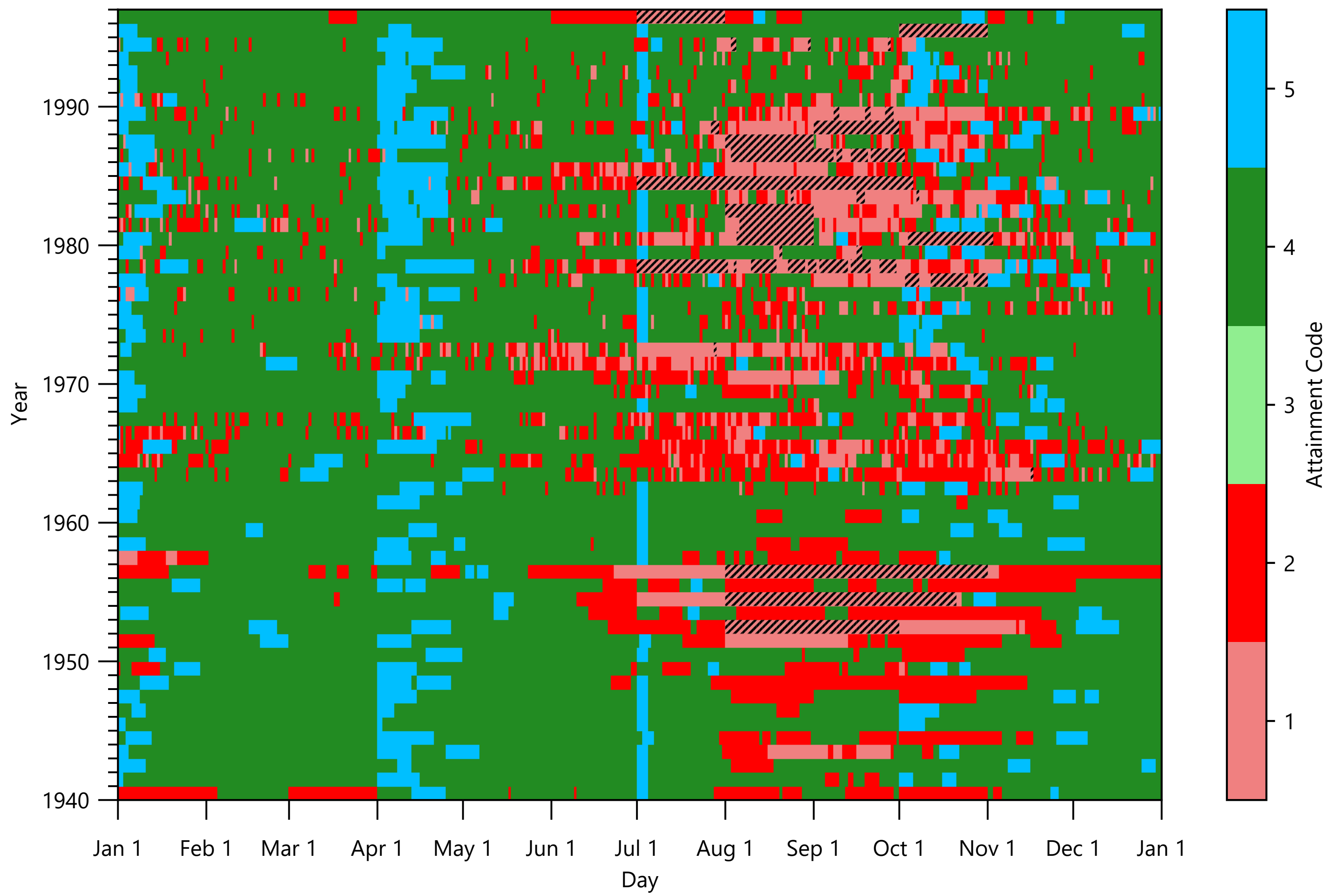
Figure G-92
Trinity River near Romayor: Full Utilization Scenario
Attainment Raster Hydrographs for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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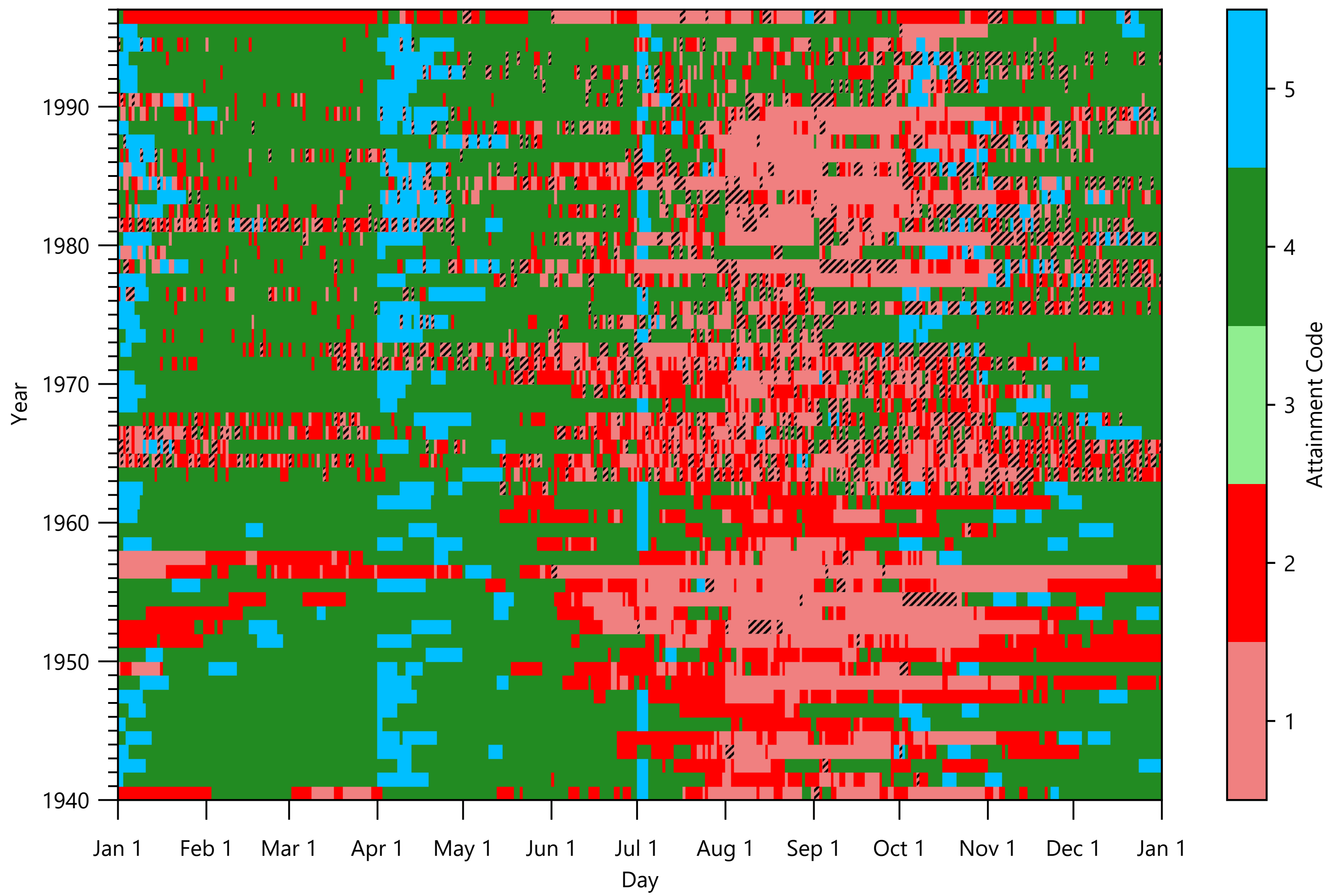
Figure G-93
Neches River at Neches: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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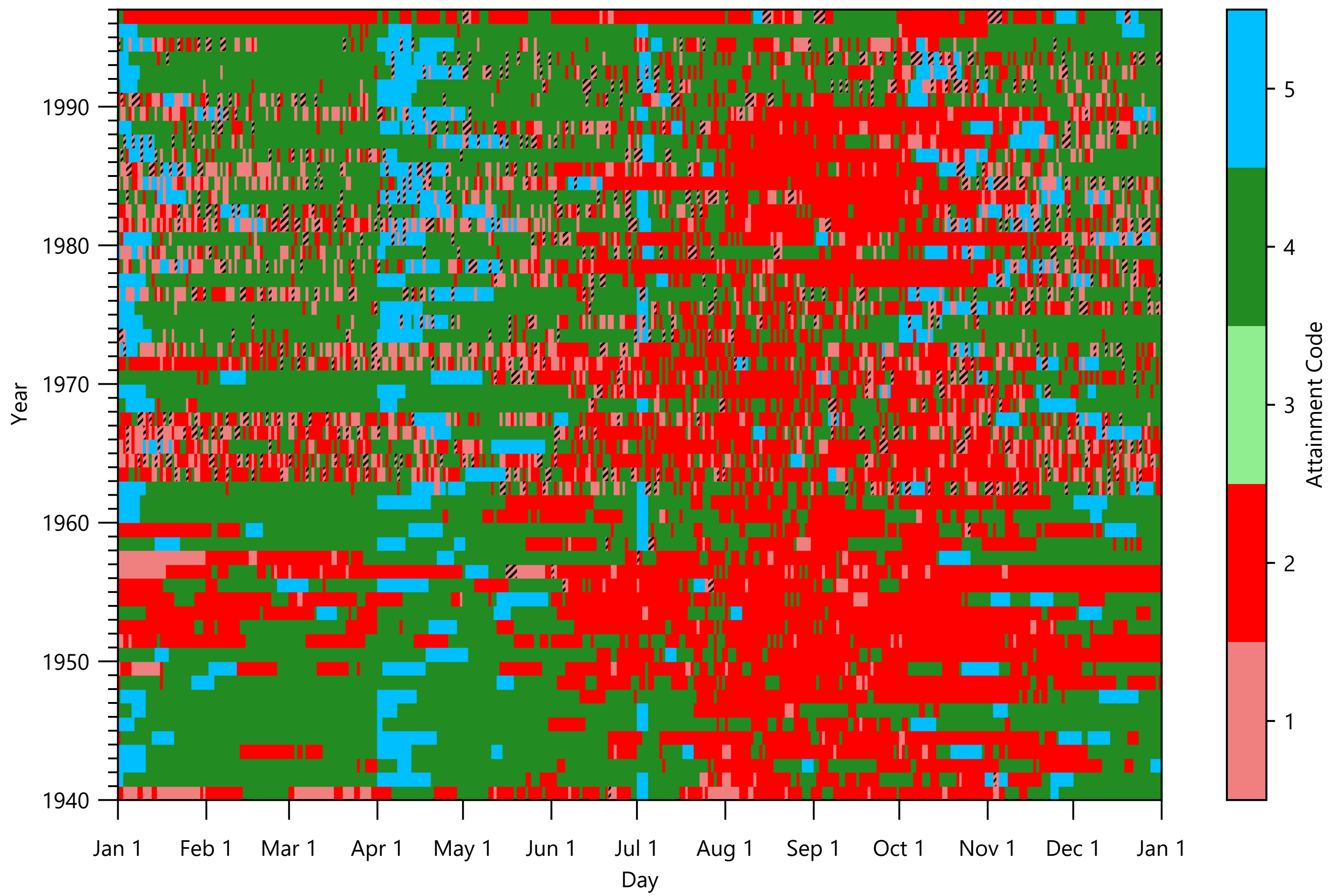
Figure G-94
Neches River at Neches: Current Water Use Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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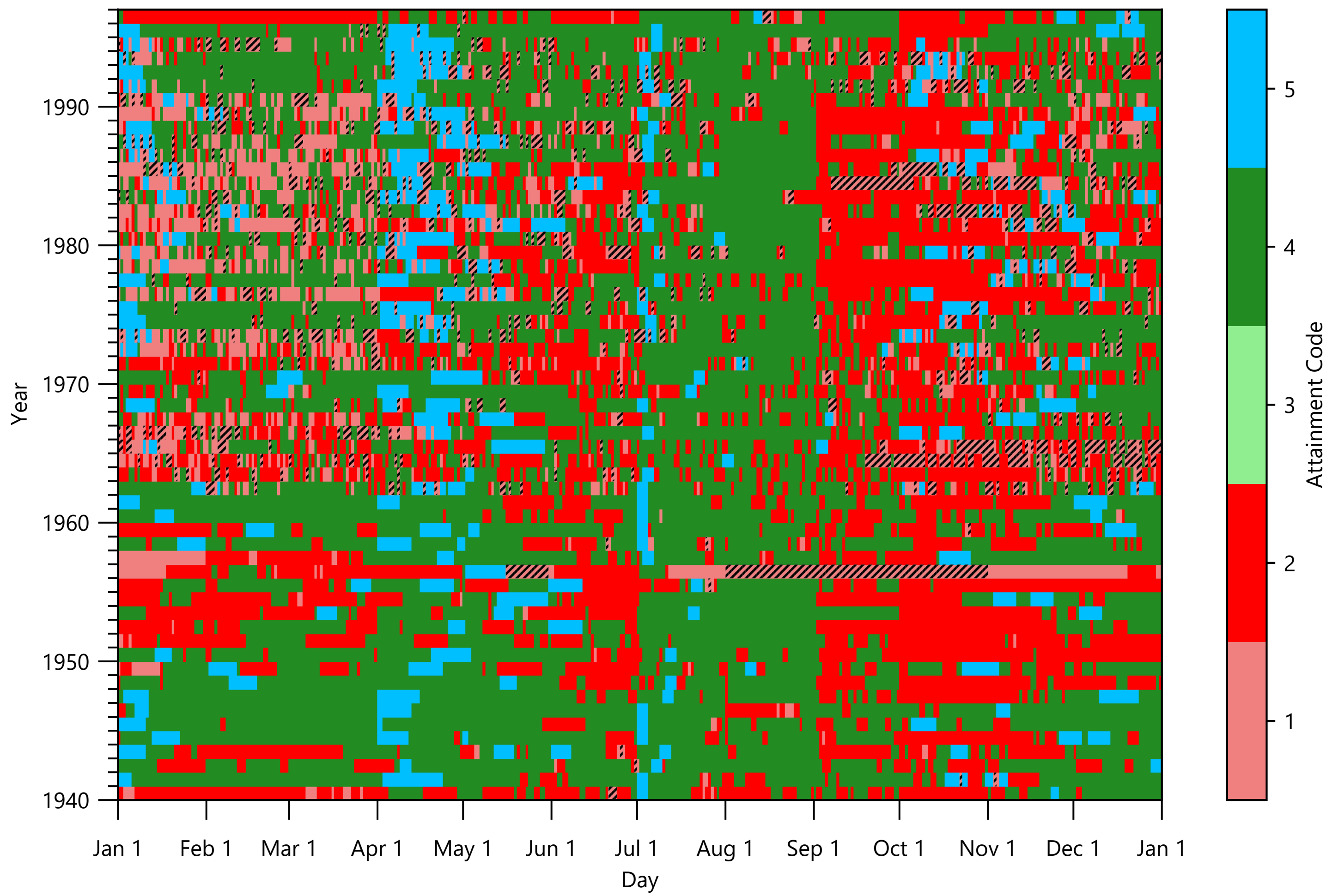
Figure G-95
Neches River at Neches: Partial Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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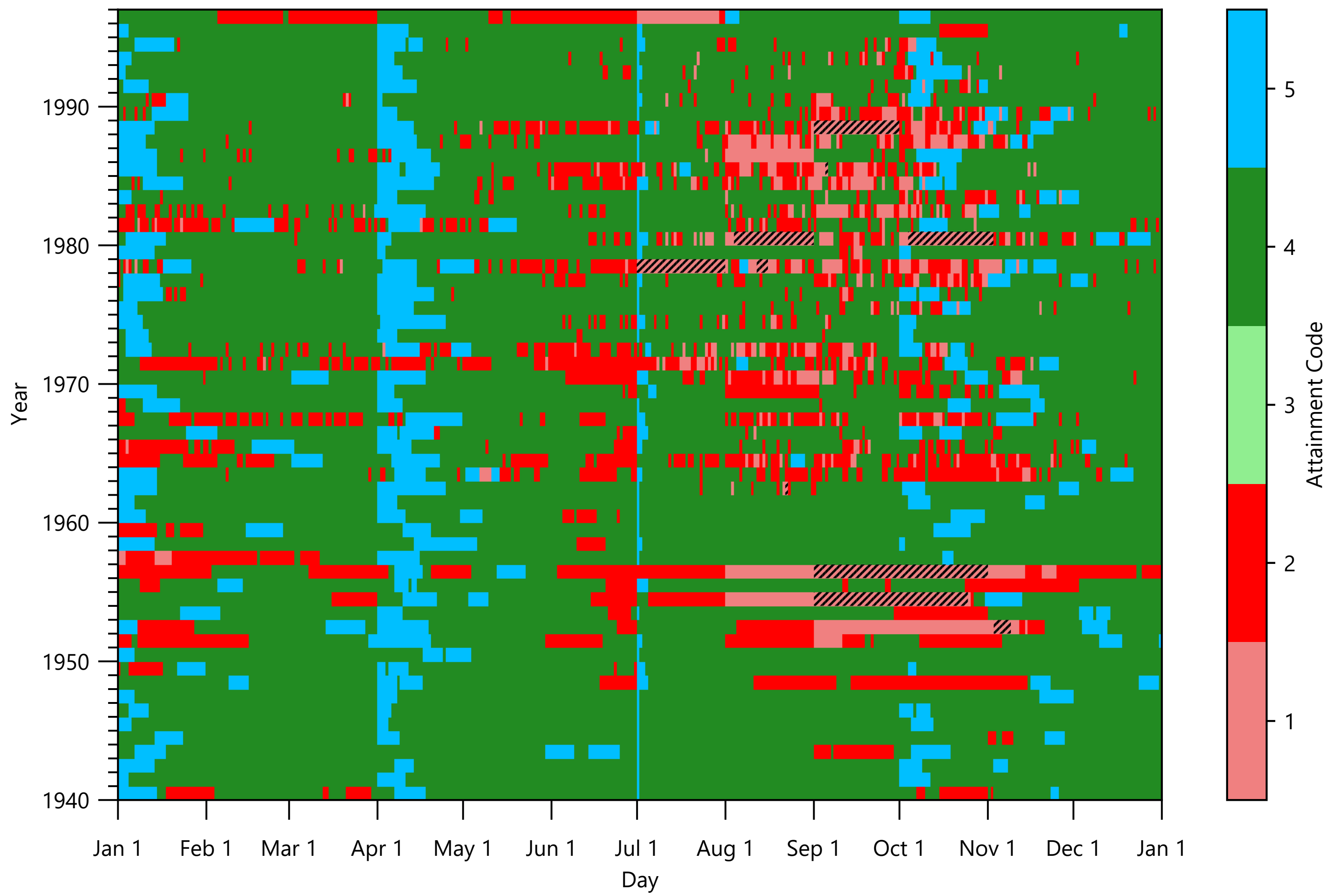
Figure G-96
Neches River at Neches: Full Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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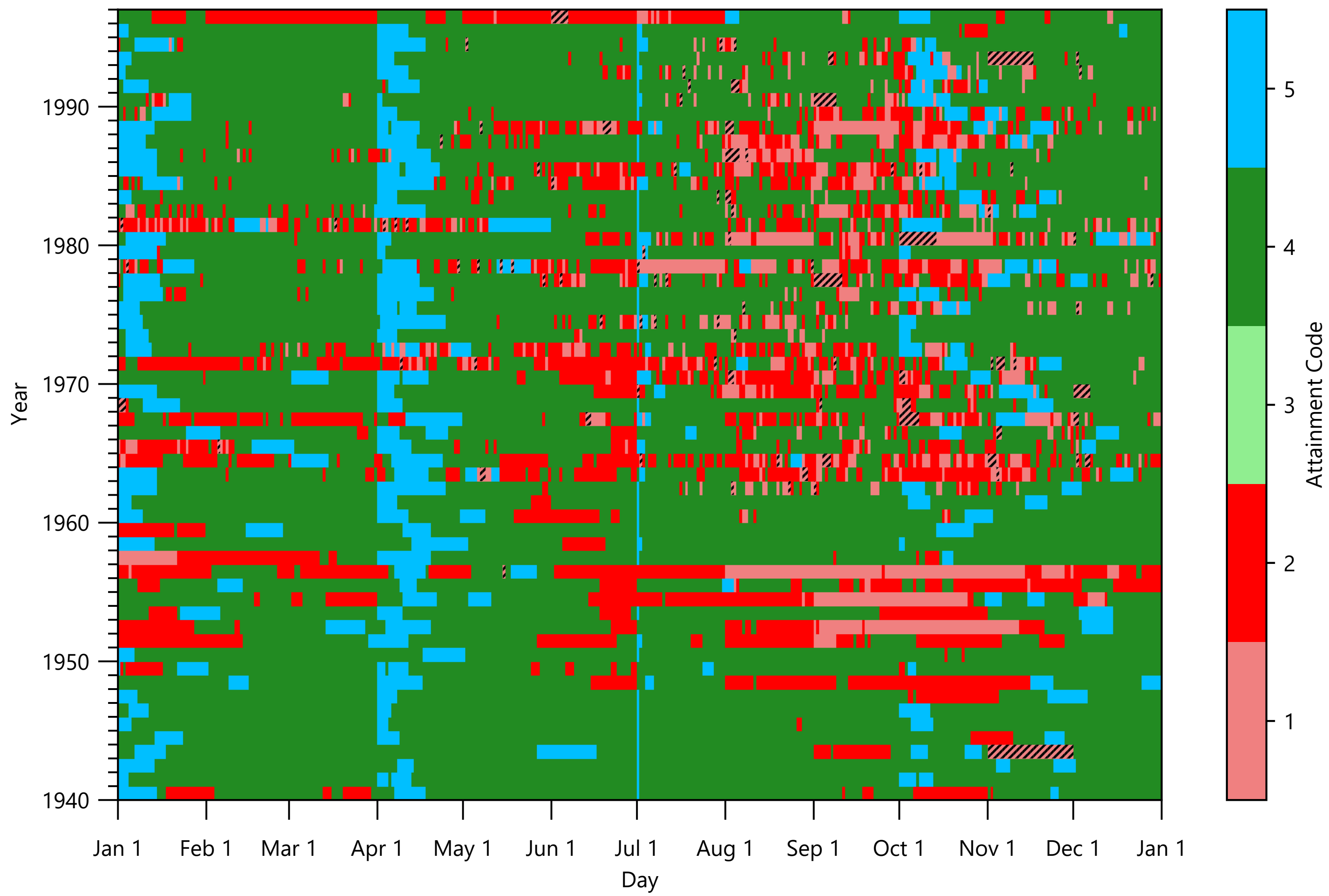
Figure G-97
Neches River near Rockland: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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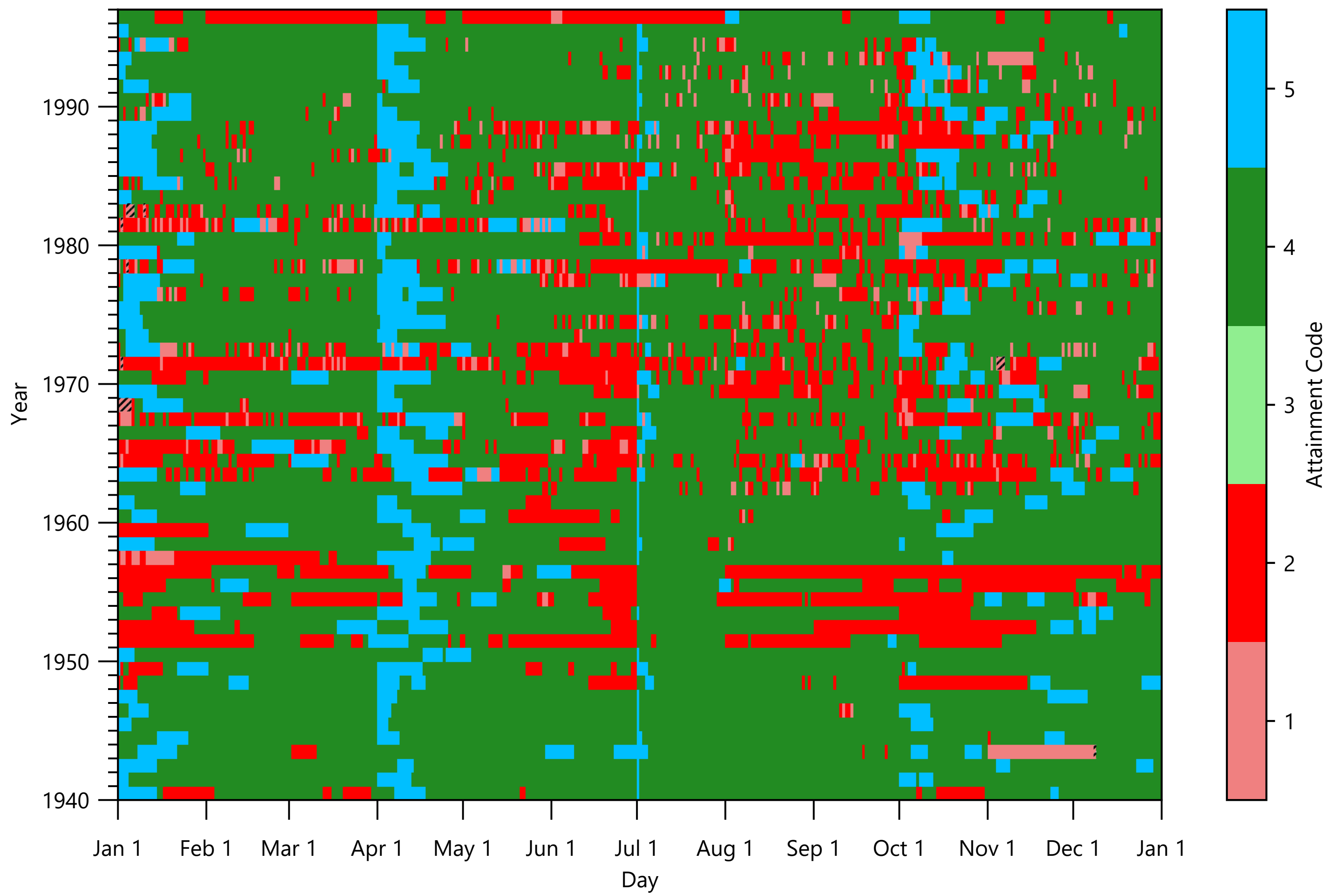
Figure G-98
Neches River near Rockland: Current Water Use Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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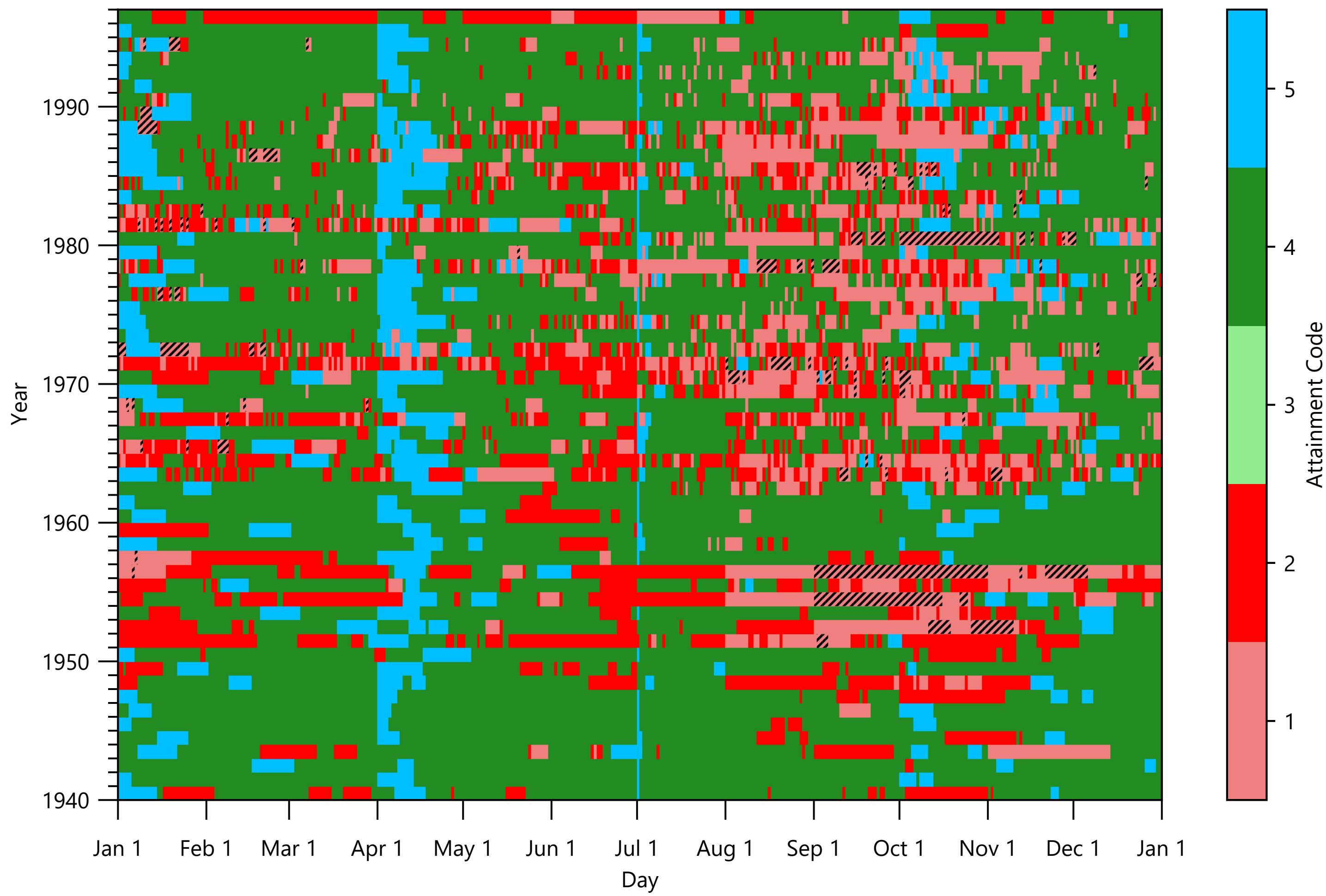
Figure G-99

Neches River near Rockland: Partial Utilization Scenario

Attainment Raster Hydrographs for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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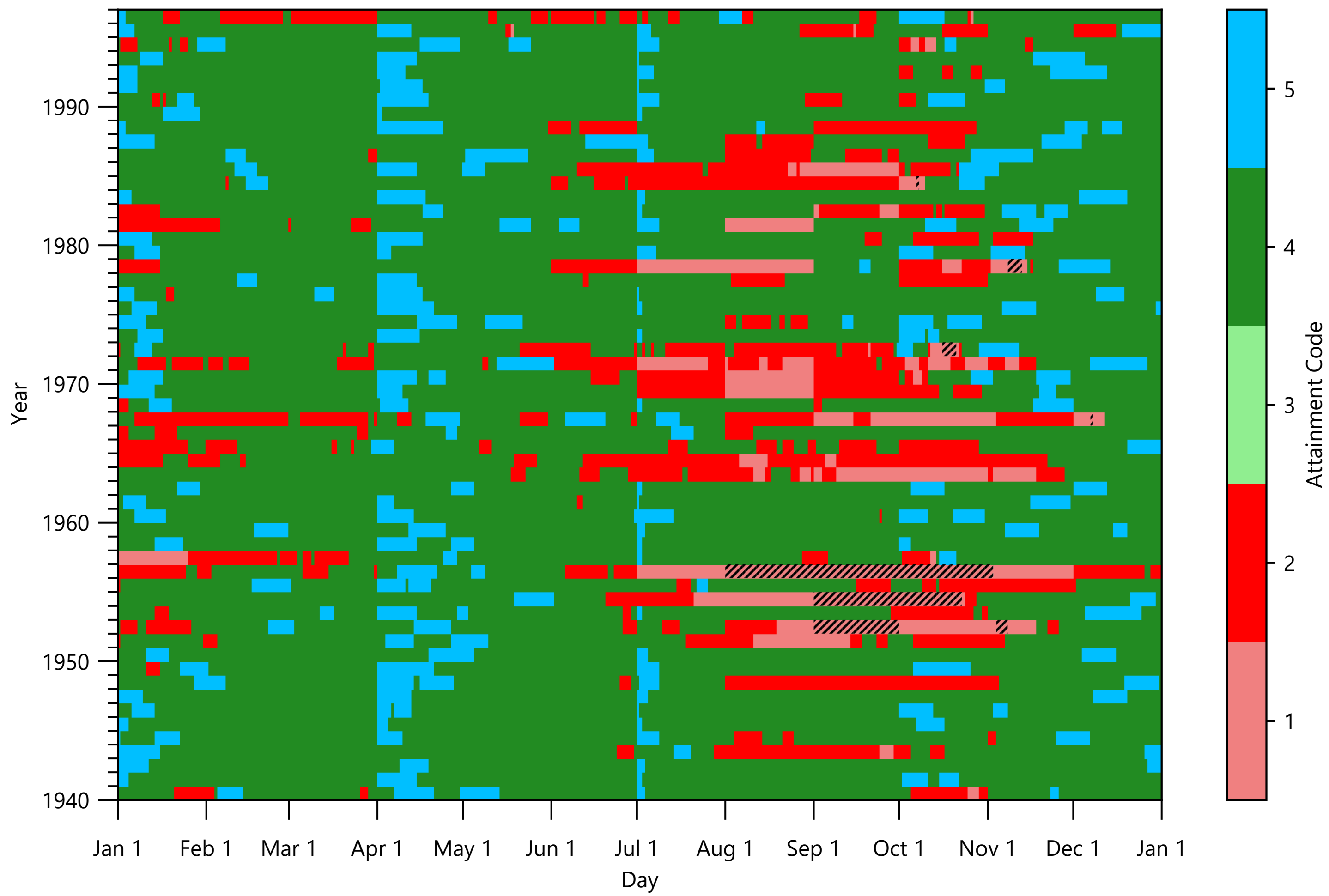
Figure G-100
Neches River near Rockland: Full Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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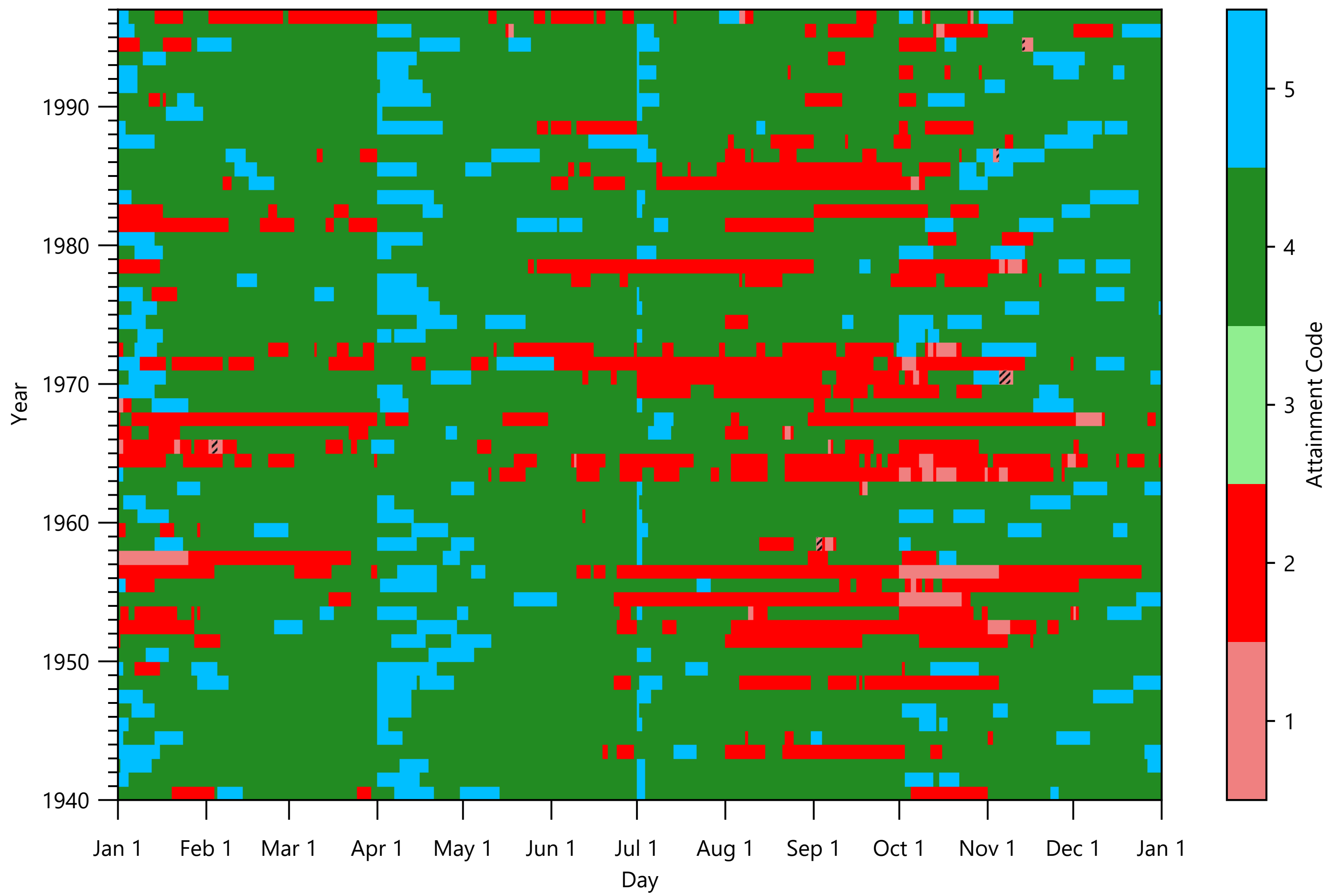
Figure G-101
Angelina River near Alto: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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Figure G-102
Angelina River near Alto: Current Water Use Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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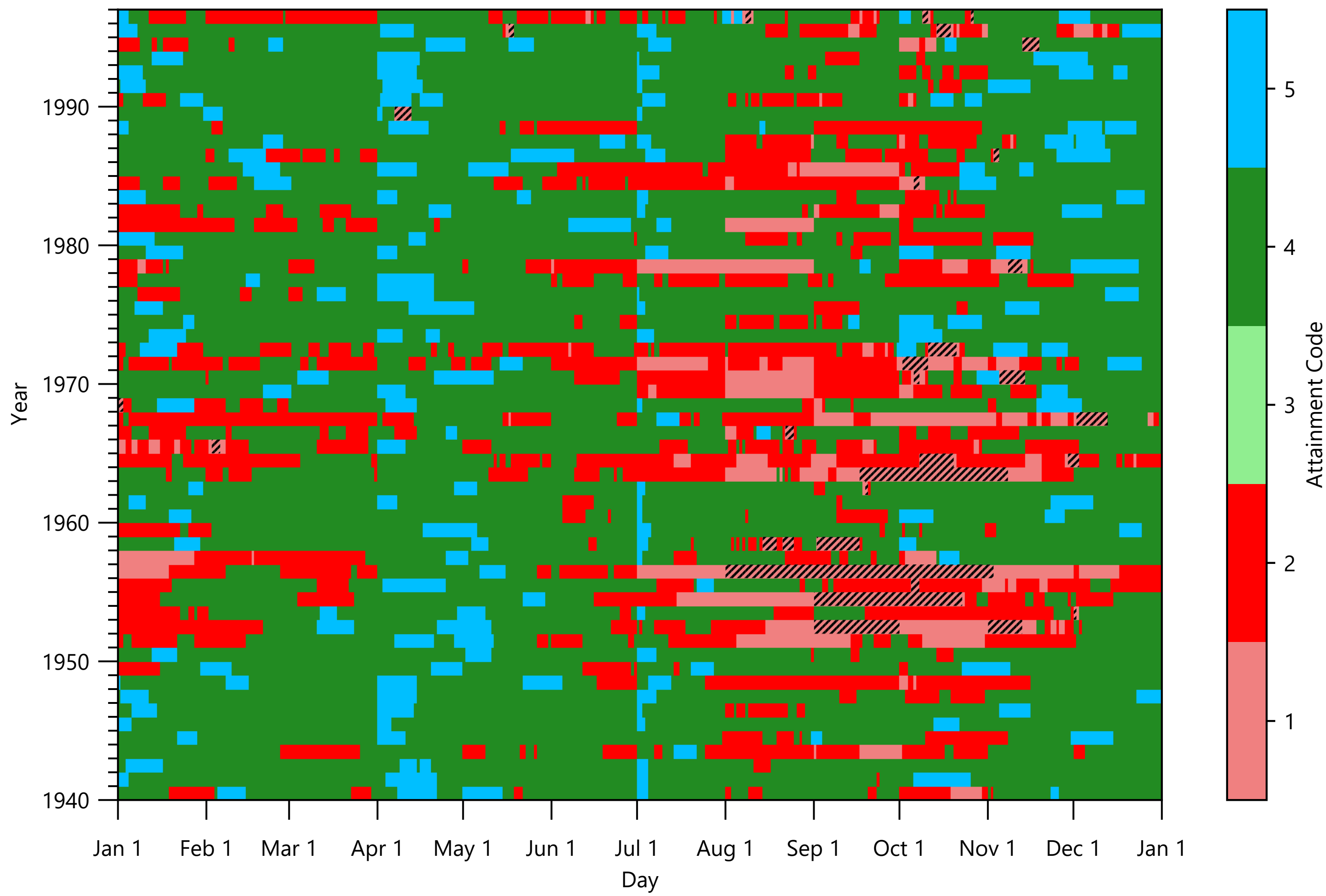
Figure G-103
Angelina River near Alto: Partial Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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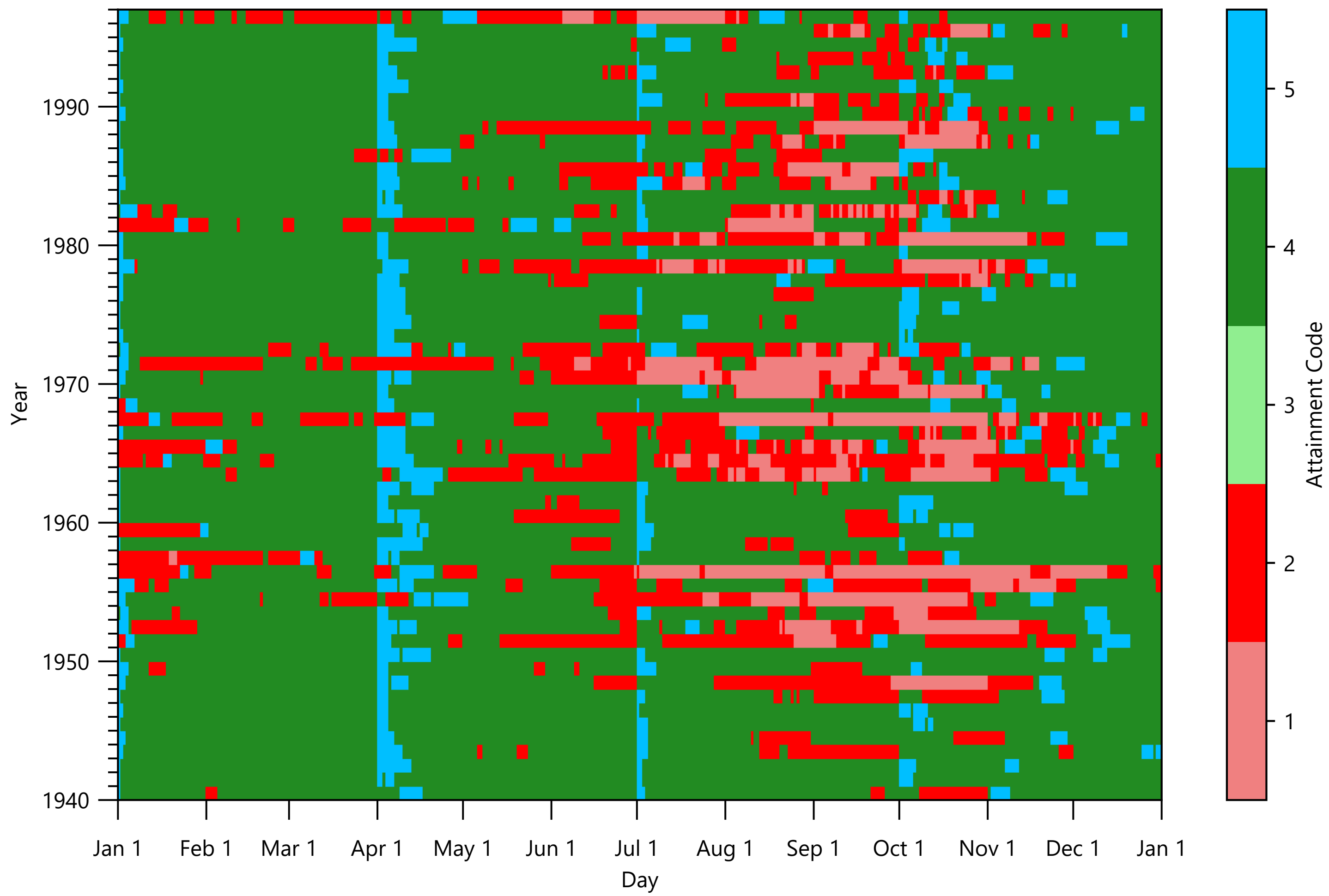
Figure G-104
Angelina River near Alto: Full Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

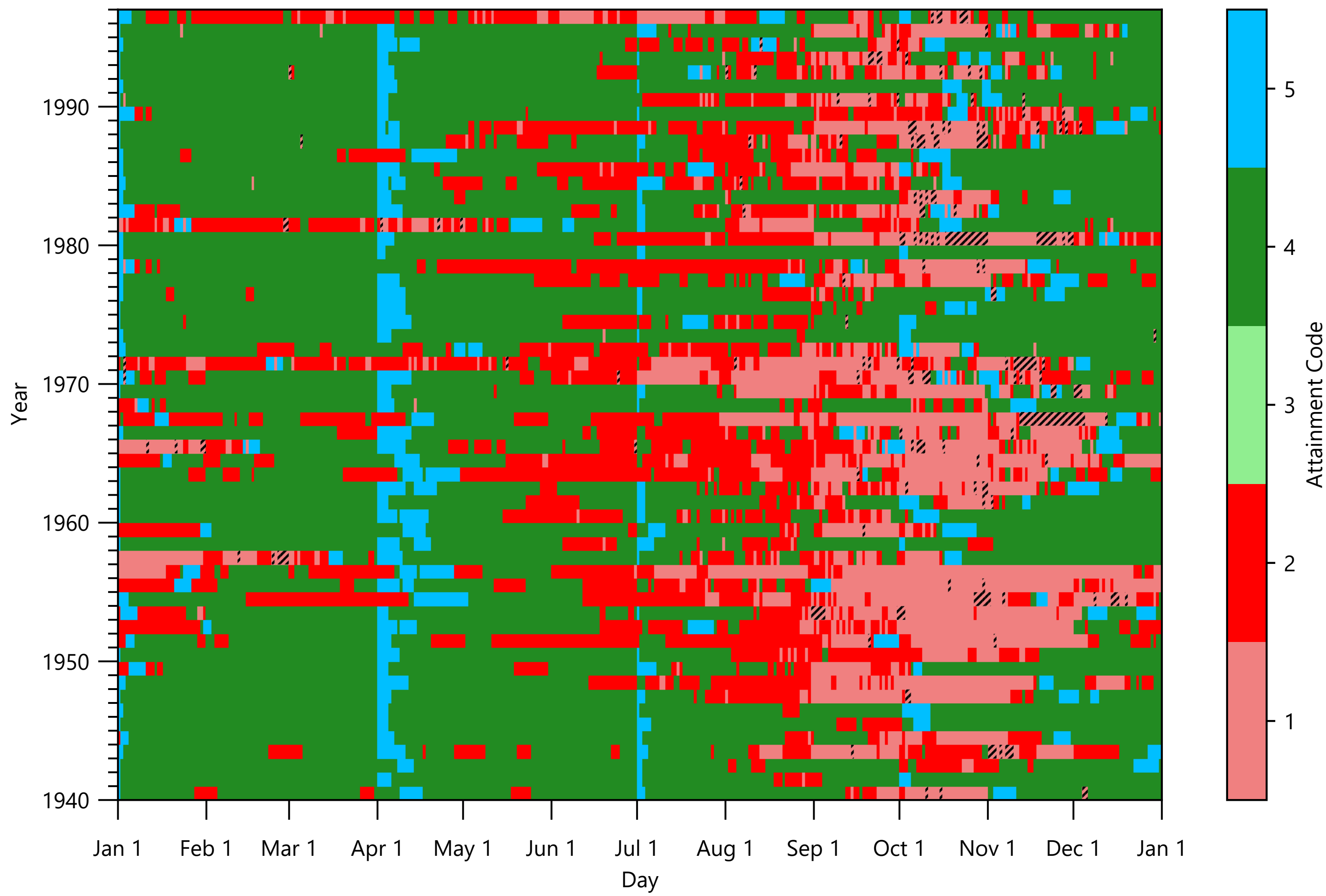


Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

Figure G-105
Neches River at Evadale: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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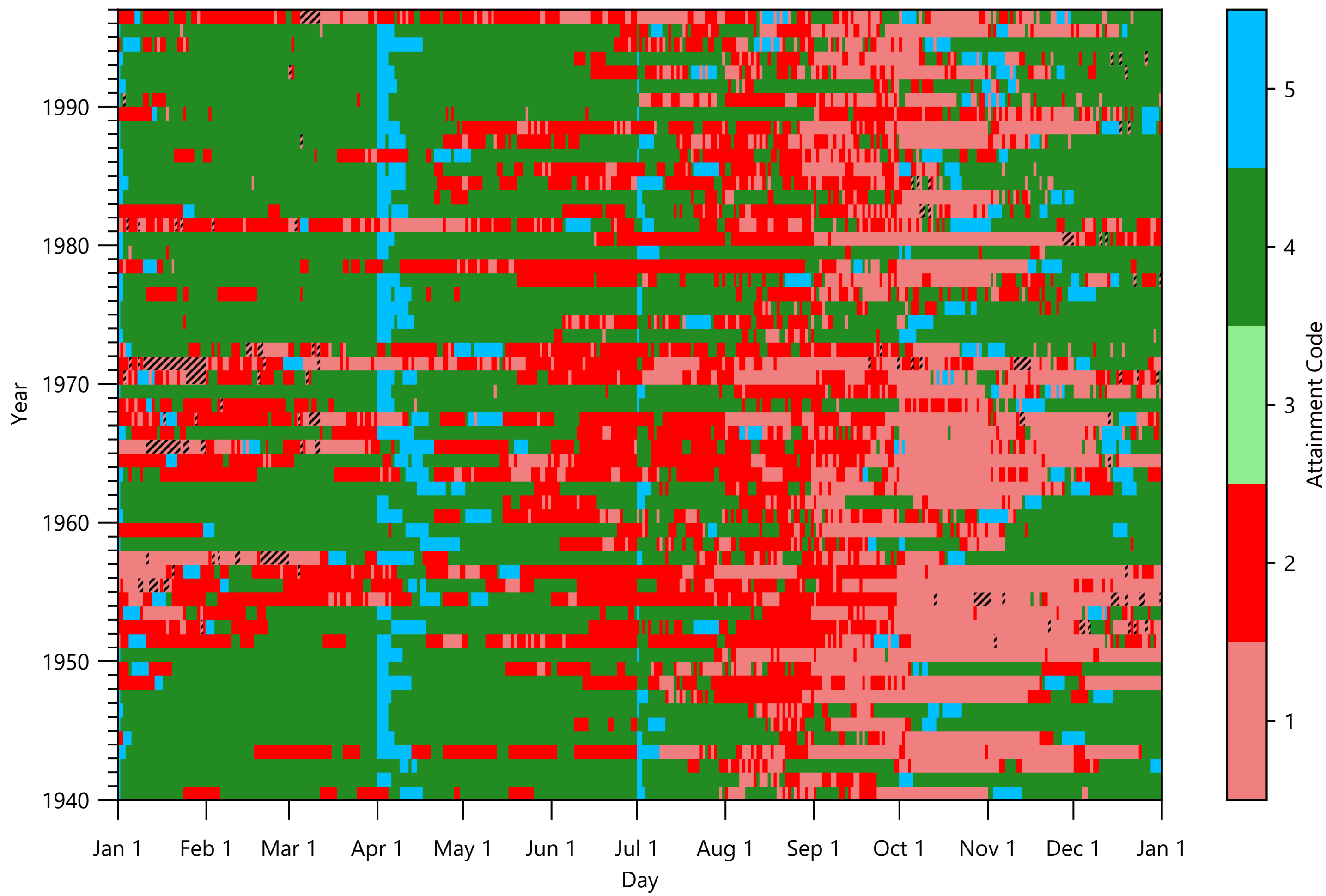
Figure G-106
Neches River at Evadale: Current Water Use Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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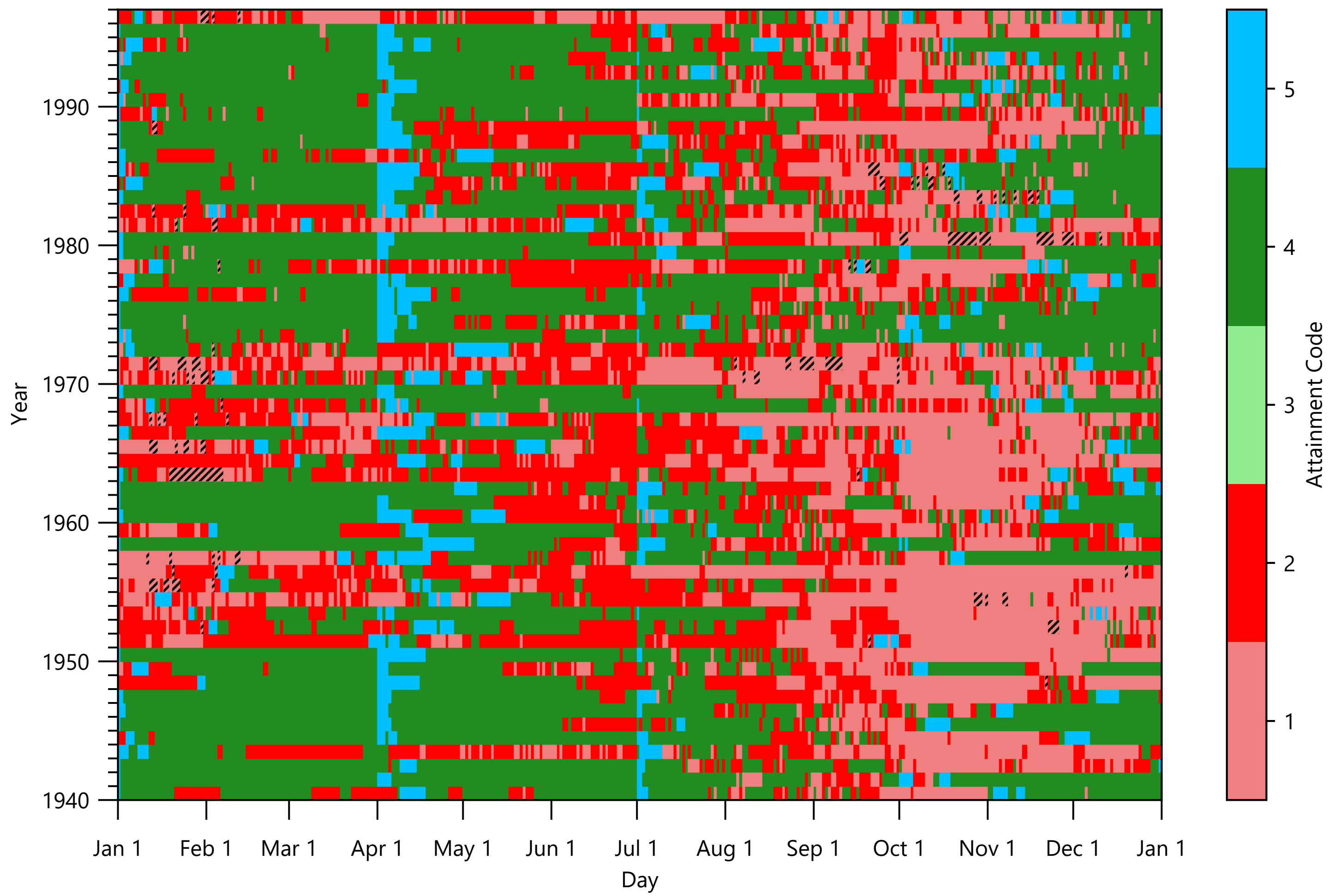
Figure G-107
Neches River at Evadale: Partial Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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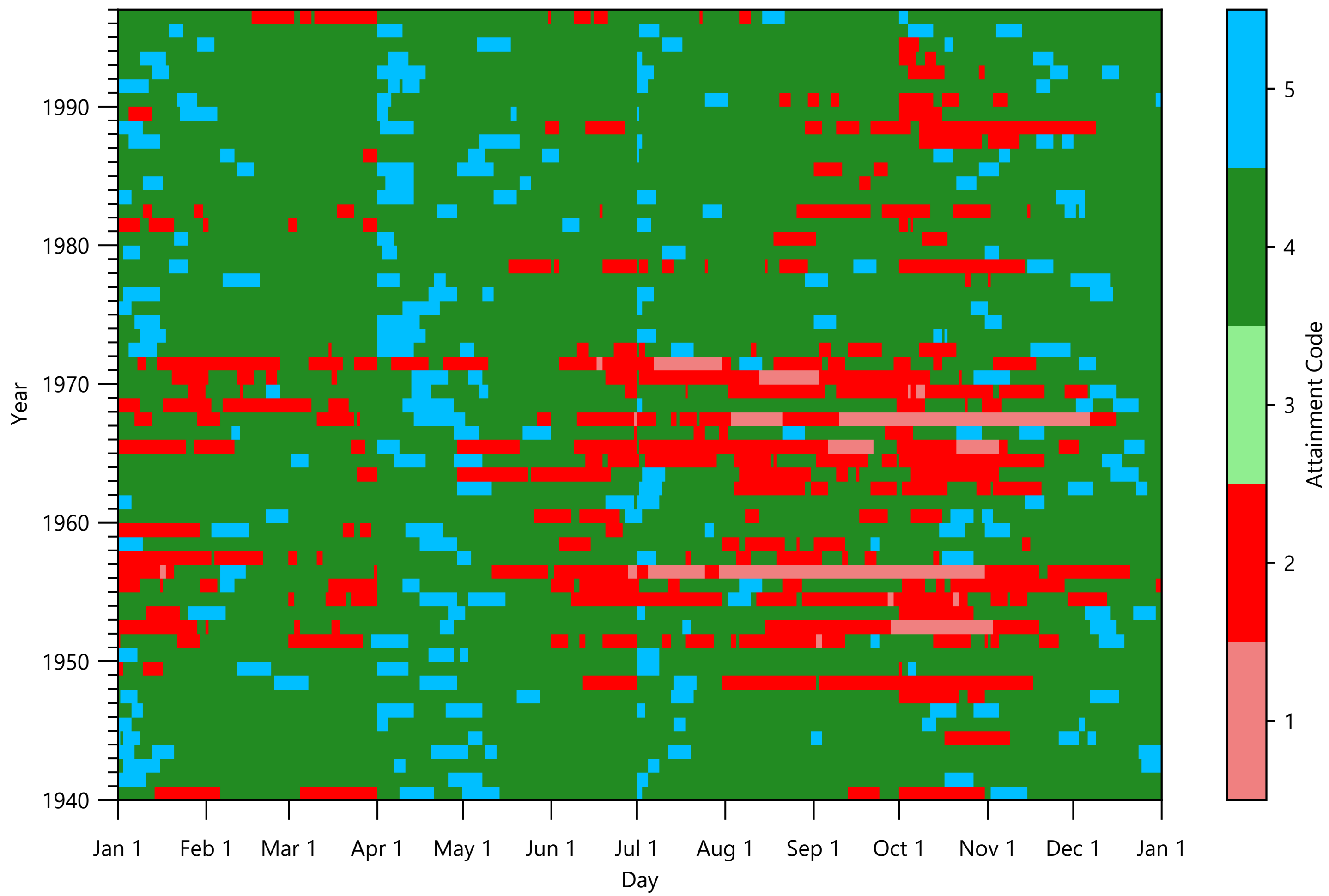
Figure G-108
Neches River at Evadale: Full Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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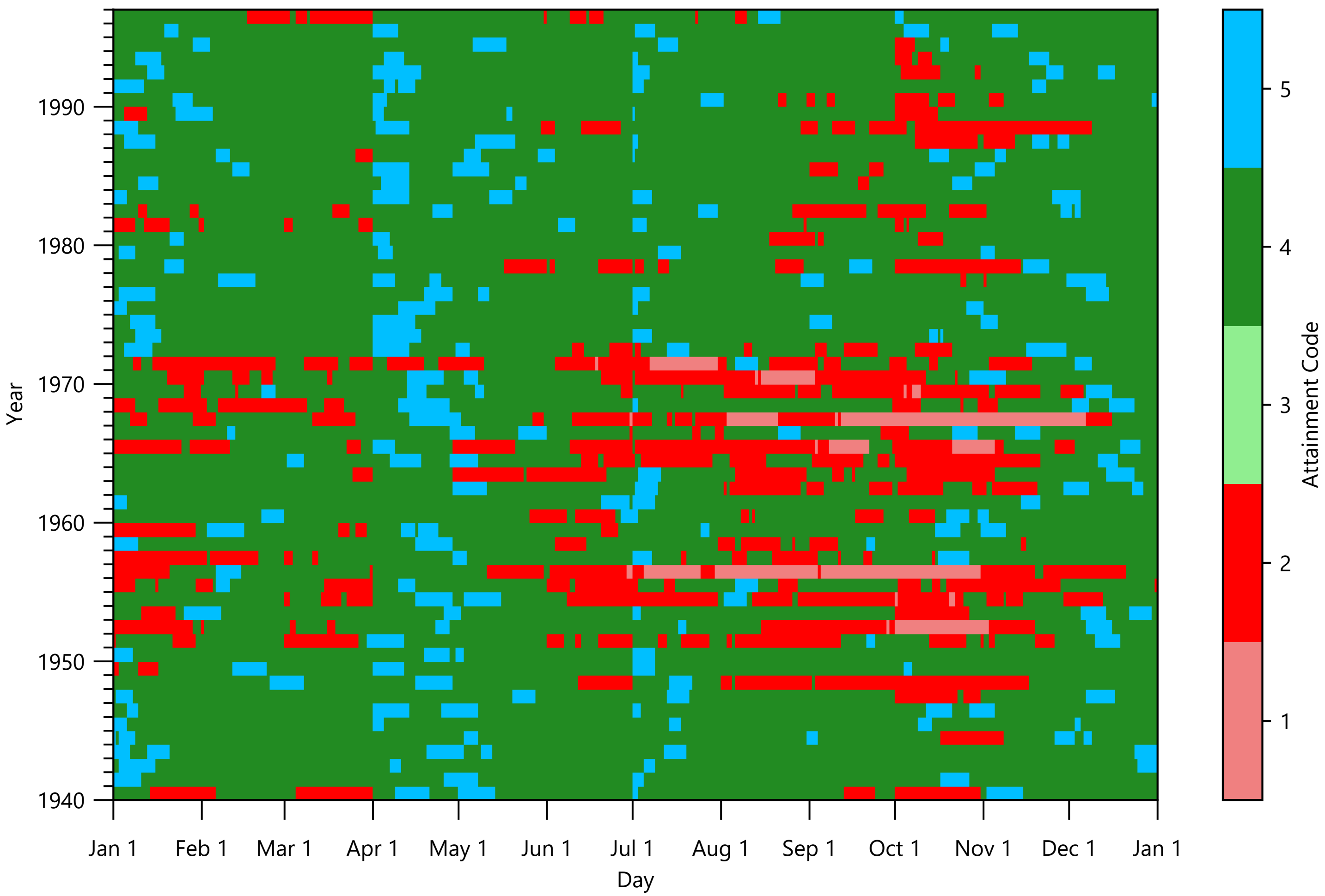
Figure G-109
Village Creek near Kountze: Naturalized Flow Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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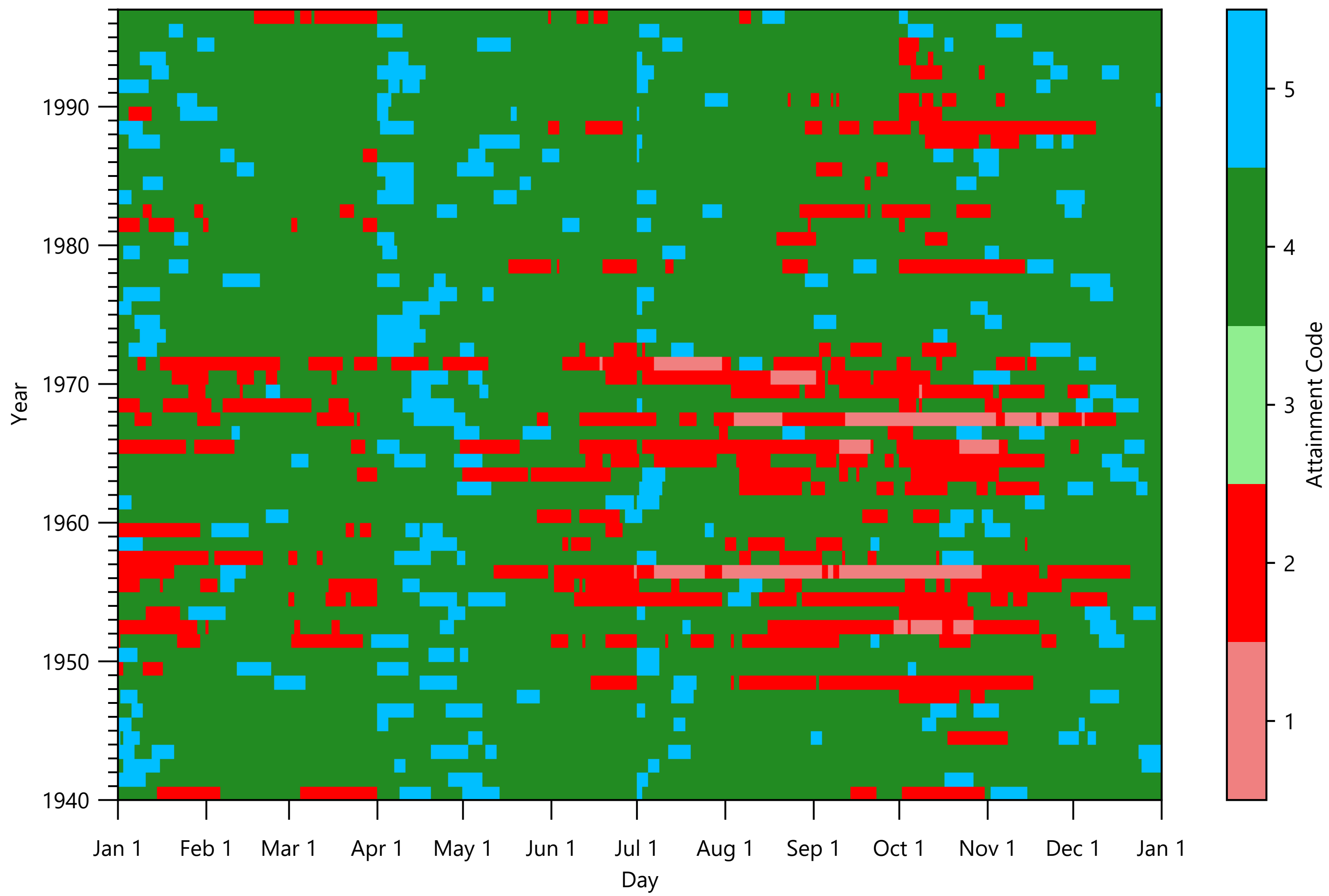
Figure G-110
Village Creek near Kountze: Current Water Use Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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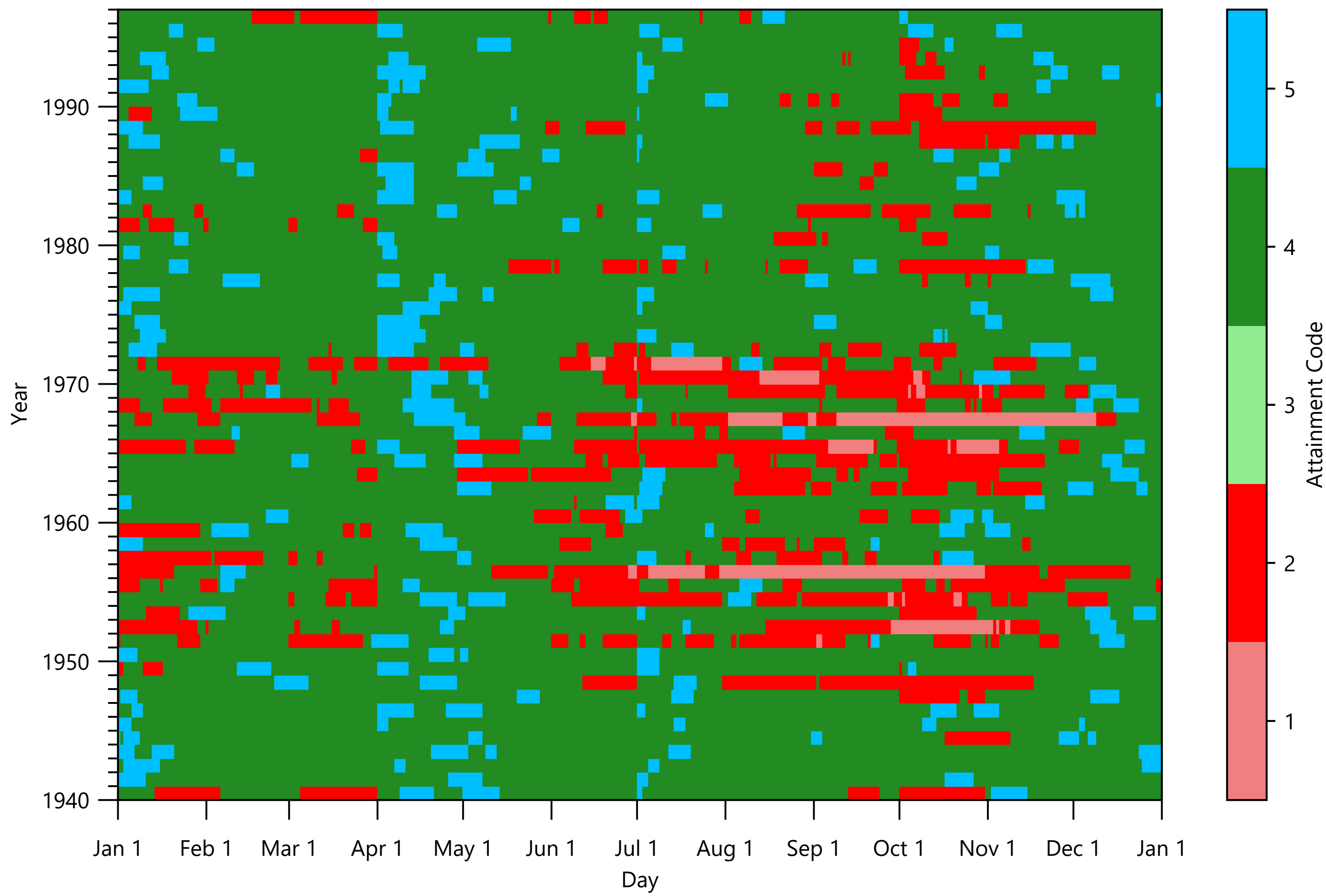
Figure G-111
Village Creek near Kountze: Partial Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

Figure G-112
Village Creek near Kountze: Full Utilization Scenario
Attainment Raster Hydrographs for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

Appendix H
Attainment Code Frequency Plots

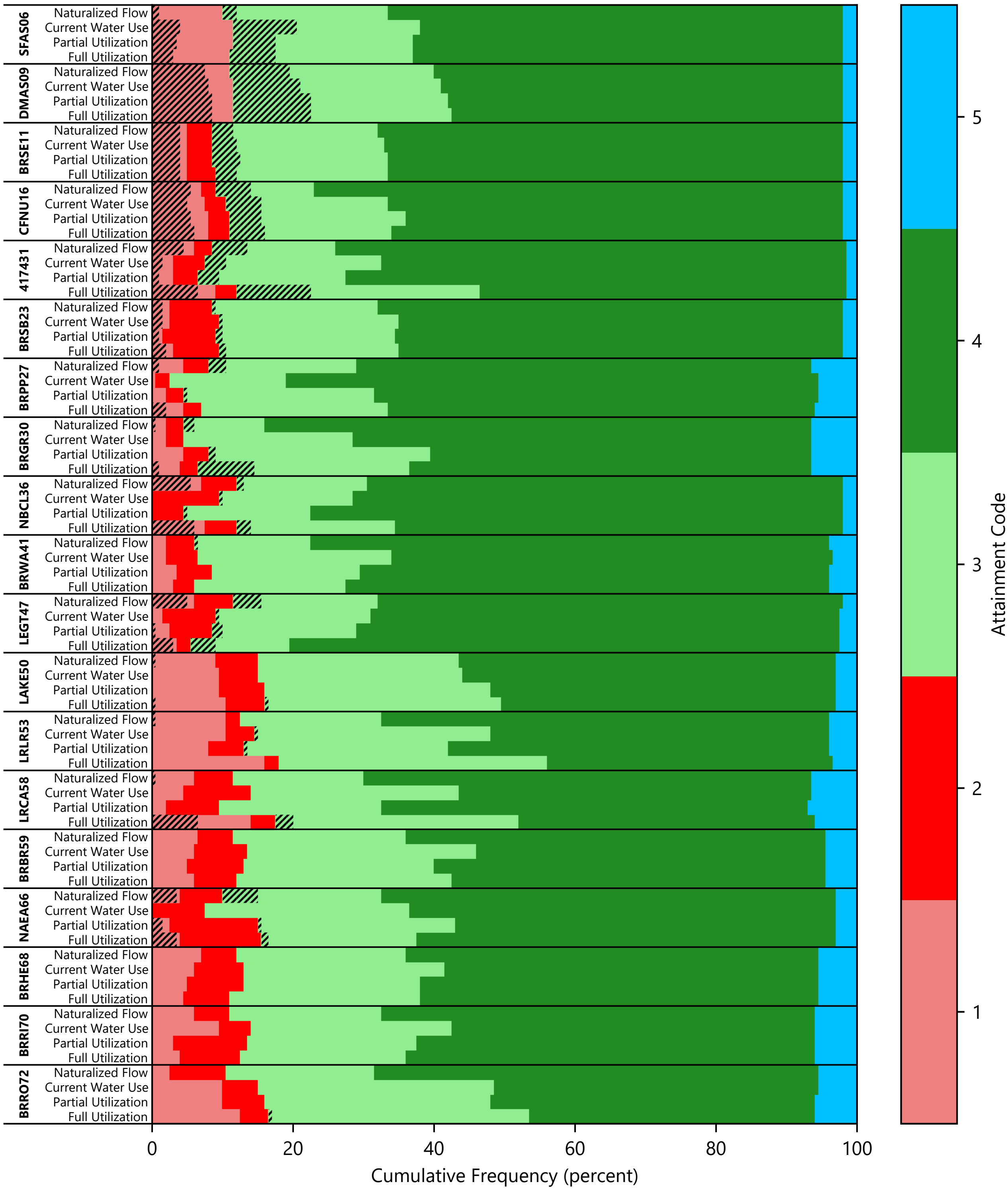
Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* contains frequency plots of the attainment codes presented in Appendix G: Attainment Raster Hydrographs.

This appendix contains a total of three distinct figures, which are arranged as follows:

- Brazos River basin
  - Figure H-1: A frequency plot of the attainment codes for all locations and all flow scenarios in the Brazos River basin; locations are labeled along the y-axis of the plot (from upstream to downstream), using the following six-digit designations used by the water availability model (WAM):
    - SFAS06: Salt Fork near Aspermont
    - DMAS09: Double Mountain Fork near Aspermont
    - BRSE11: Brazos River at Seymour
    - CFNU16: Clear Fork at Nugent
    - 417431: Clear Fork at Lueders
    - BRSB23: Brazos River near South Bend
    - BRPP27: Brazos River near Palo Pinto
    - BRGR30: Brazos River near Glen Rose
    - NBCL36: North Bosque near Clifton
    - BRWA41: Brazos River near Waco
    - LEGT47: Leon River at Gatesville
    - LAKE50: Lampasas River near Kempner
    - LRLR53: Little River near Little River
    - LRCA58: Little River near Cameron
    - BRBR59: Brazos River near Bryan
    - NAEA66: Navasota River near Easterly
    - BRHE68: Brazos River near Hempstead
    - BRRI70: Brazos River at Richmond
    - BRRO72: Brazos River at Rosharon
- Trinity River basin
  - Figure H-2: A frequency plot of the attainment codes for all locations and all flow scenarios in the Trinity River basin; locations are labeled along the y-axis of the plot (from upstream to downstream), using the following five-digit designations used by WAM:
    - 8WTGP: West Fork Trinity River near Grand Prairie

        - 8TRDA: Trinity River at Dallas
        - 8TROA: Trinity River near Oakwood
        - 8TRRO: Trinity River near Romayor
- Neches River basin
    - Figure H-3: A frequency plot of the attainment codes for all locations and all flow scenarios in the Neches River basin; locations are labeled along the y-axis of the plot (from upstream to downstream), using the following four-digit designations used by WAM:
        - NENE: Neches River at Neches
        - NERO: Neches River near Rockland
        - ANAL: Angelina River near Alto
        - NEEV: Neches River at Evadale
        - VIKO: Village Creek near Kountze



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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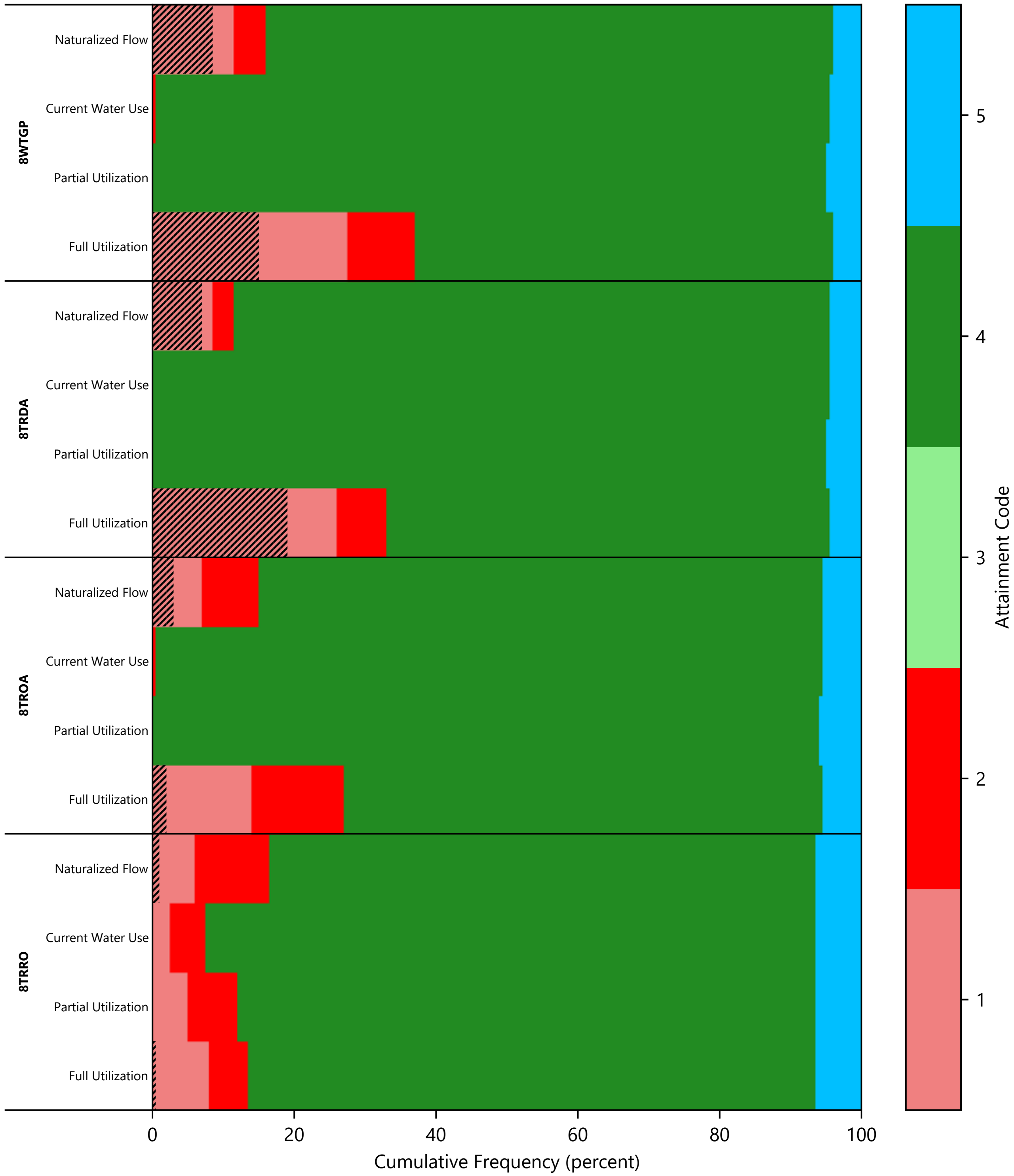
Figure H-1
Attainment Codes by Location and Model Scenario in the Brazos River Basin
Attainment Code Frequency Plots
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:

1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained

(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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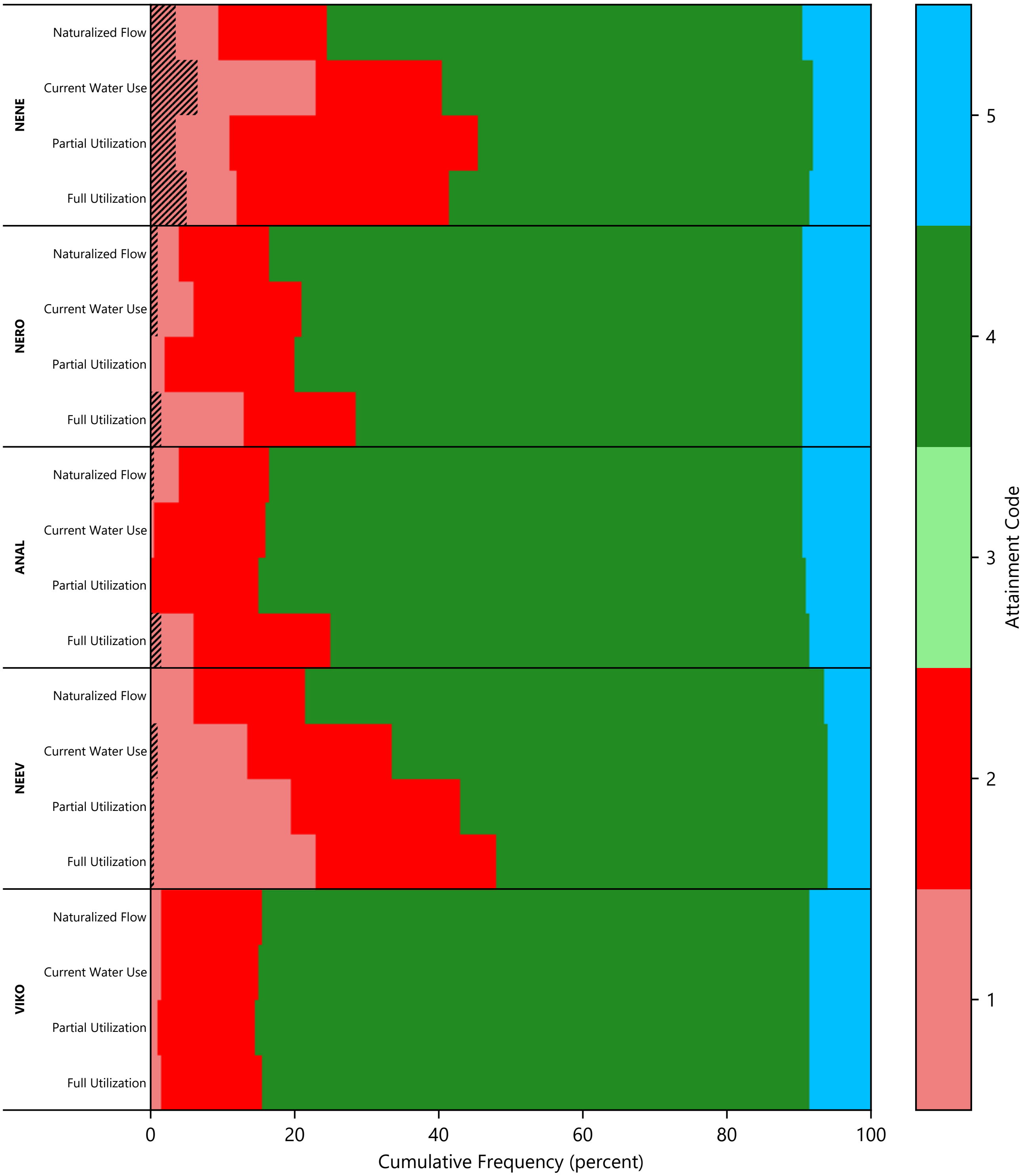
Figure H-2
Attainment Codes by Location and Model Scenario in the Trinity River Basin
Attainment Code Frequency Plots
Evaluating the Attainment of Environmental Flow Standards



Notes: (1) Attainment codes for this raster hydrograph are defined as follows:
1: Subsistence flow engaged but not attained
2: Subsistence flow engaged and attained
3: Base flow engaged but not attained
4: Base flow engaged and attained
5: High flow pulse engaged and attained
(2) Diagonal black lines denote zero-flow days (i.e., days of instream flow values ≤ 0.1 cubic foot per second).

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Figure H-3
Attainment Codes by Location and Model Scenario in the Neches River Basin
Attainment Code Frequency Plots
Evaluating the Attainment of Environmental Flow Standards

Appendix I
Column Plot Matrices of Attainment Metrics

Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains column plot matrices of attainment metrics, as described in Section 2.5.3.2 of the main report.

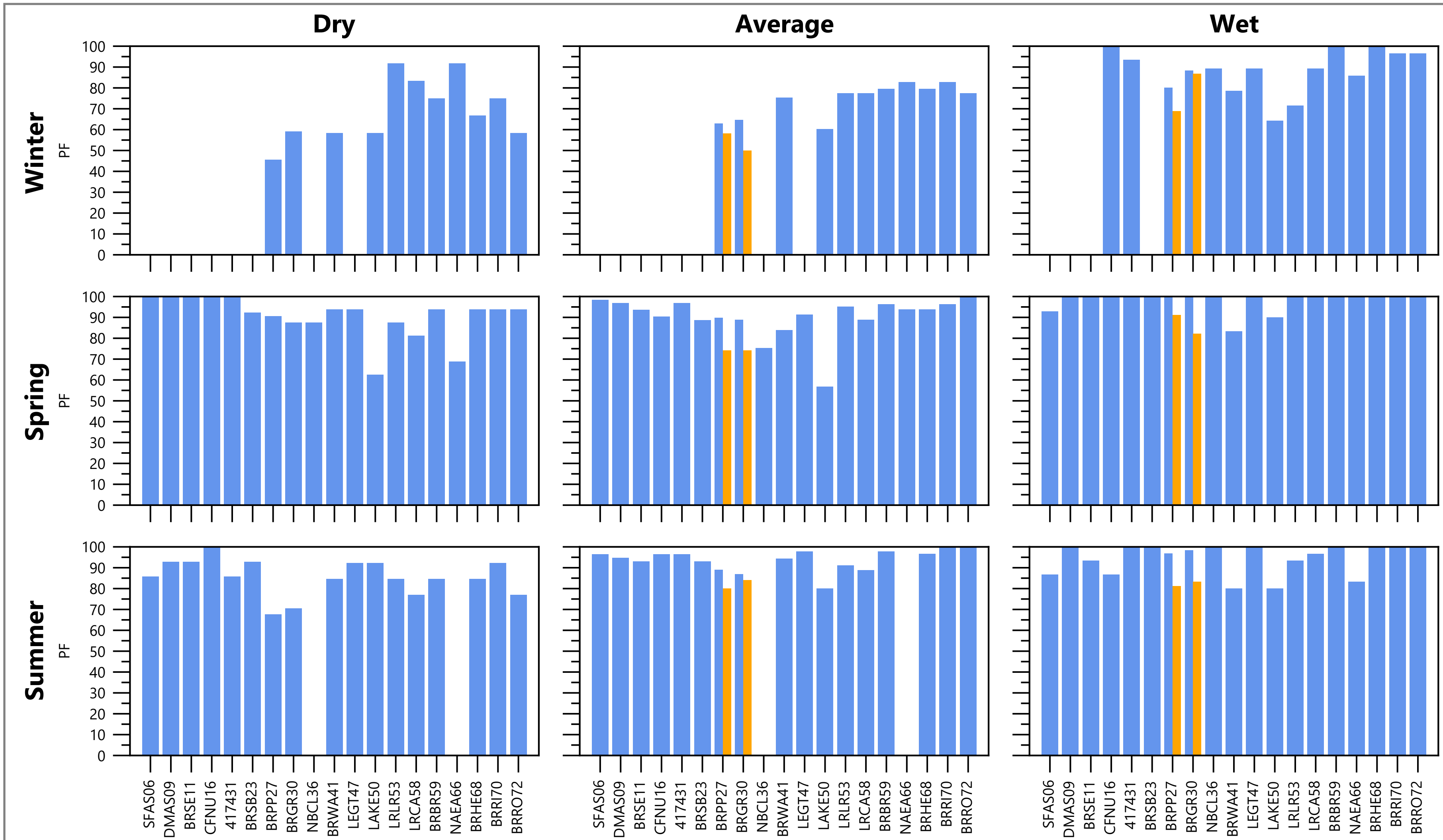
This appendix contains a total of 192 distinct figures, which are arranged as follows:

- Brazos River basin
  - Figures I-1 through I-64: Matrices of column plots for four flow scenarios, each with four high flow pulse (HFP) attainment metrics, five base flow attainment metrics, five subsistence flow attainment metrics, and two zero-flow attainment metrics. These figures are grouped by flow scenario, with each containing nine individual column plots for three seasons and three hydrologic conditions in the Brazos River basin. The x-axis of each column plot contains the 19 locations in the Brazos River basin, which are labeled according to the following six-digit designations used by the water availability model (WAM):
    - SFAS06: Salt Fork near Aspermont
    - DMAS09: Double Mountain Fork near Aspermont
    - BRSE11: Brazos River at Seymour
    - CFNU16: Clear Fork at Nugent
    - 417431: Clear Fork at Lueders
    - BRSB23: Brazos River near South Bend
    - BRPP27: Brazos River near Palo Pinto
    - BRGR30: Brazos River near Glen Rose
    - NBCL36: North Bosque near Clifton
    - BRWA41: Brazos River near Waco
    - LEGT47: Leon River at Gatesville
    - LAKE50: Lampasas River near Kempner
    - LRLR53: Little River near Little River
    - LRCA58: Little River near Cameron
    - BRBR59: Brazos River near Bryan
    - NAEA66: Navasota River near Easterly
    - BRHE68: Brazos River near Hempstead
    - BRRI70: Brazos River at Richmond
    - BRRO72: Brazos River at Rosharon

- Trinity River basin
  - Figures I-65 through I-128: Matrices of column plots for four flow scenarios, each with four HFP attainment metrics, five base flow attainment metrics, five subsistence flow attainment metrics, and two zero-flow attainment metrics. These figures are grouped by flow scenario, with each containing four individual column plots for the four seasons in the Trinity River basin. The x-axis of each column plot contains the four locations in the Trinity River basin, which are labeled according to the following five-digit designations used by WAM:
    - 8WTGP: West Fork Trinity River near Grand Prairie
    - 8TRDA: Trinity River at Dallas
    - 8TROA: Trinity River near Oakwood
    - 8TRRO: Trinity River near Romayor
- Neches River basin
  - Figures I-129 through I-192: Matrices of column plots for four flow scenarios, each with four HFP attainment metrics, five base flow attainment metrics, five subsistence flow attainment metrics, and two zero-flow attainment metrics. These figures are grouped by flow scenario, with each containing four individual column plots for the four seasons in the Neches River basin. The x-axis of each column plot contains the five locations in the Neches River basin, which are labeled according to the following four-digit designations used by WAM:
    - NENE: Neches River at Neches
    - NERO: Neches River near Rockland
    - ANAL: Angelina River near Alto
    - NEEV: Neches River at Evadale
    - VIKO: Village Creek near Kountze

The following notes apply to all of the figures in this appendix:

1. An attainment metric with a value of zero at a particular location does not have a data column plotted (e.g., location SFAS06 for all hydrologic conditions during the winter season in Figure I-1).
2. An attainment metric for which no value was calculated at a particular location has the text "N/A" ("not applicable") printed in the place of a data column (e.g., location SFAS06 for all dry seasons in Figure I-12).
3. If an attainment metric has no calculated values for any of the locations in a particular column plot, then no data columns are plotted, and the text "N/A" ("not applicable") is printed in the center of the plot (e.g., all dry seasons in Figure I-8).



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

Tier 1 Pulse
Tier 2 Pulse

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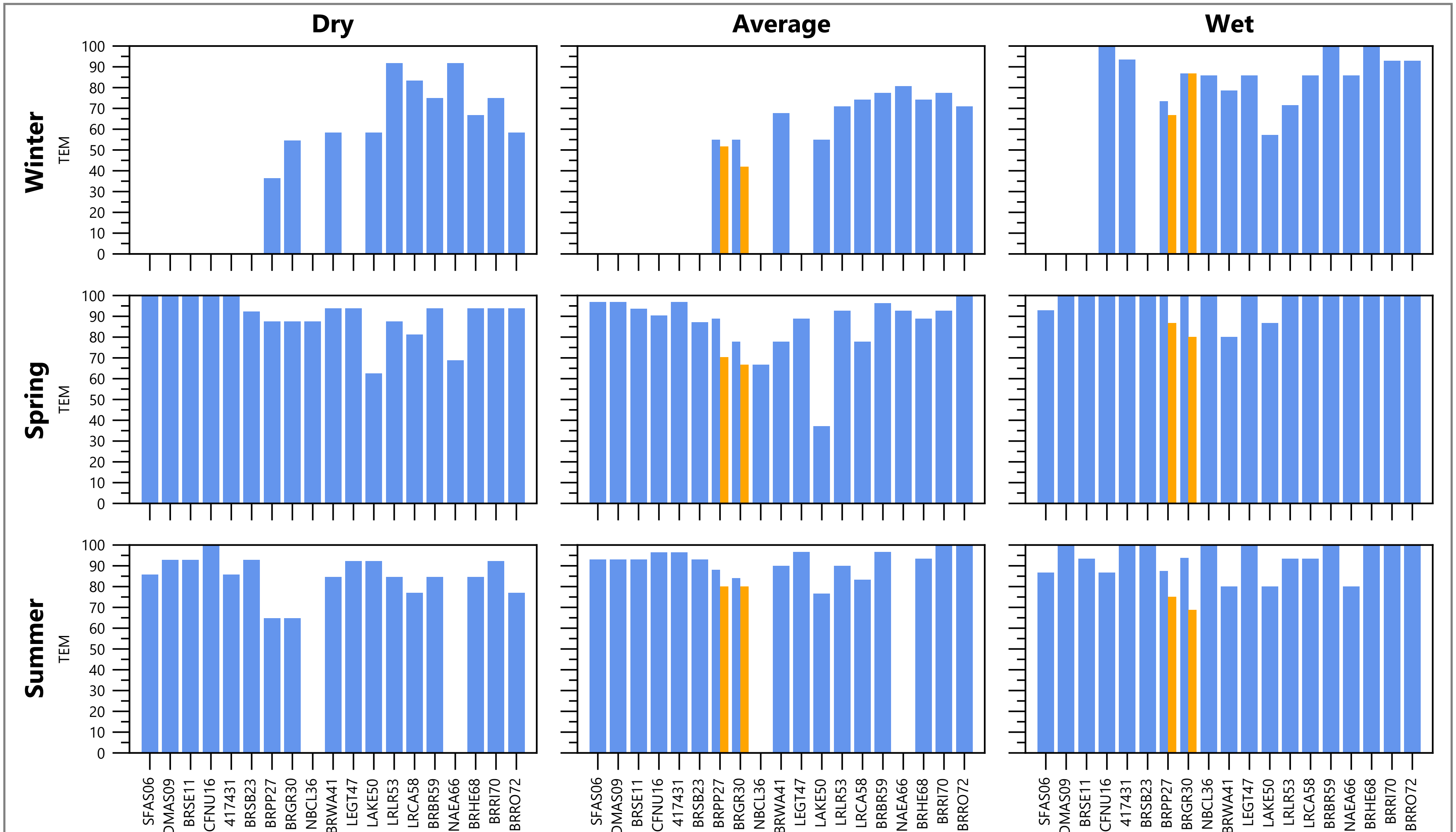
Figure I-1

Pulse Frequencies (PF) by Season and Hydrologic Condition: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

Tier 1 Pulse
Tier 2 Pulse

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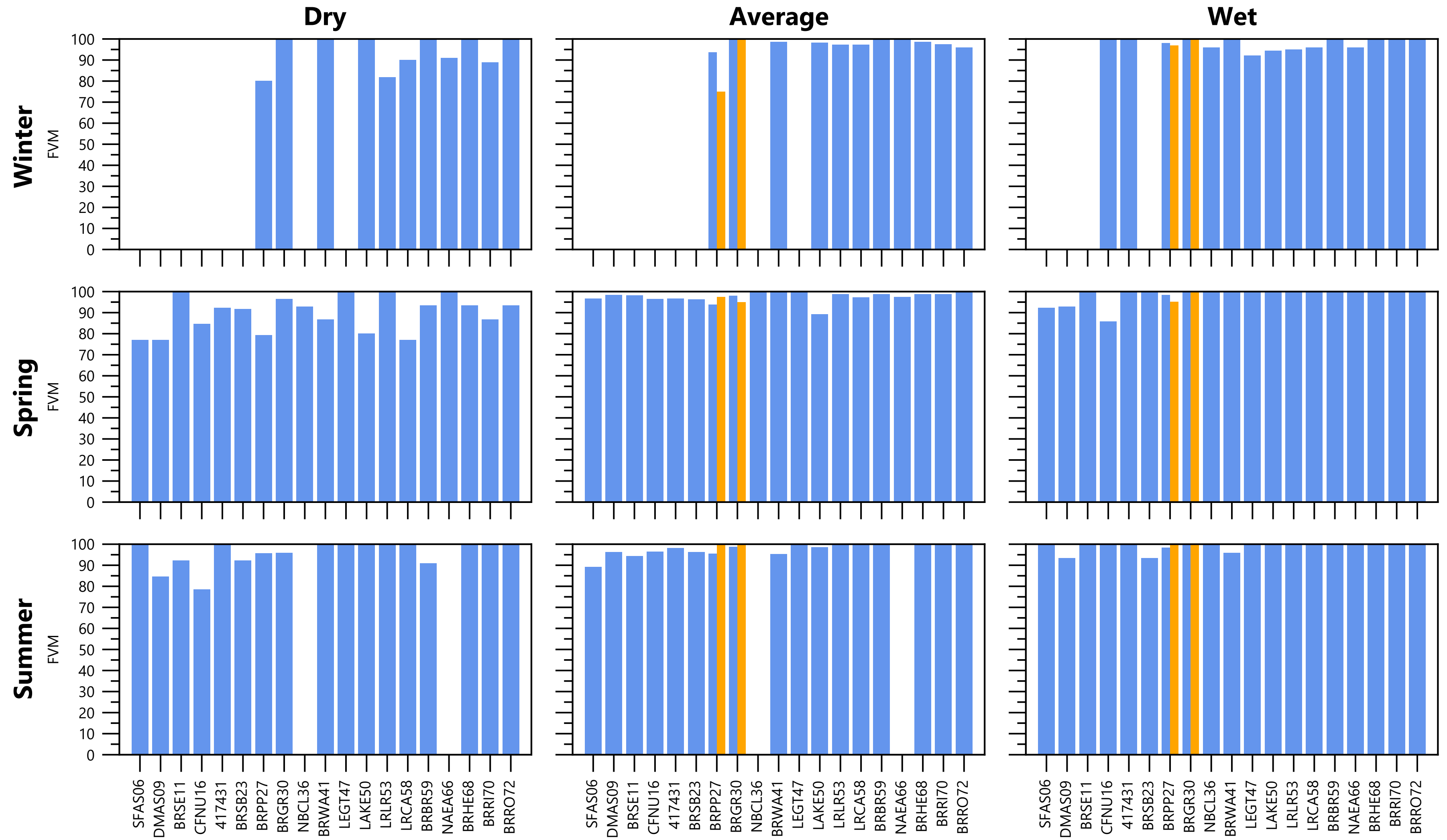
Figure I-2
Target Engagements Met (TEM) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

- Tier 1 Pulse
- Tier 2 Pulse

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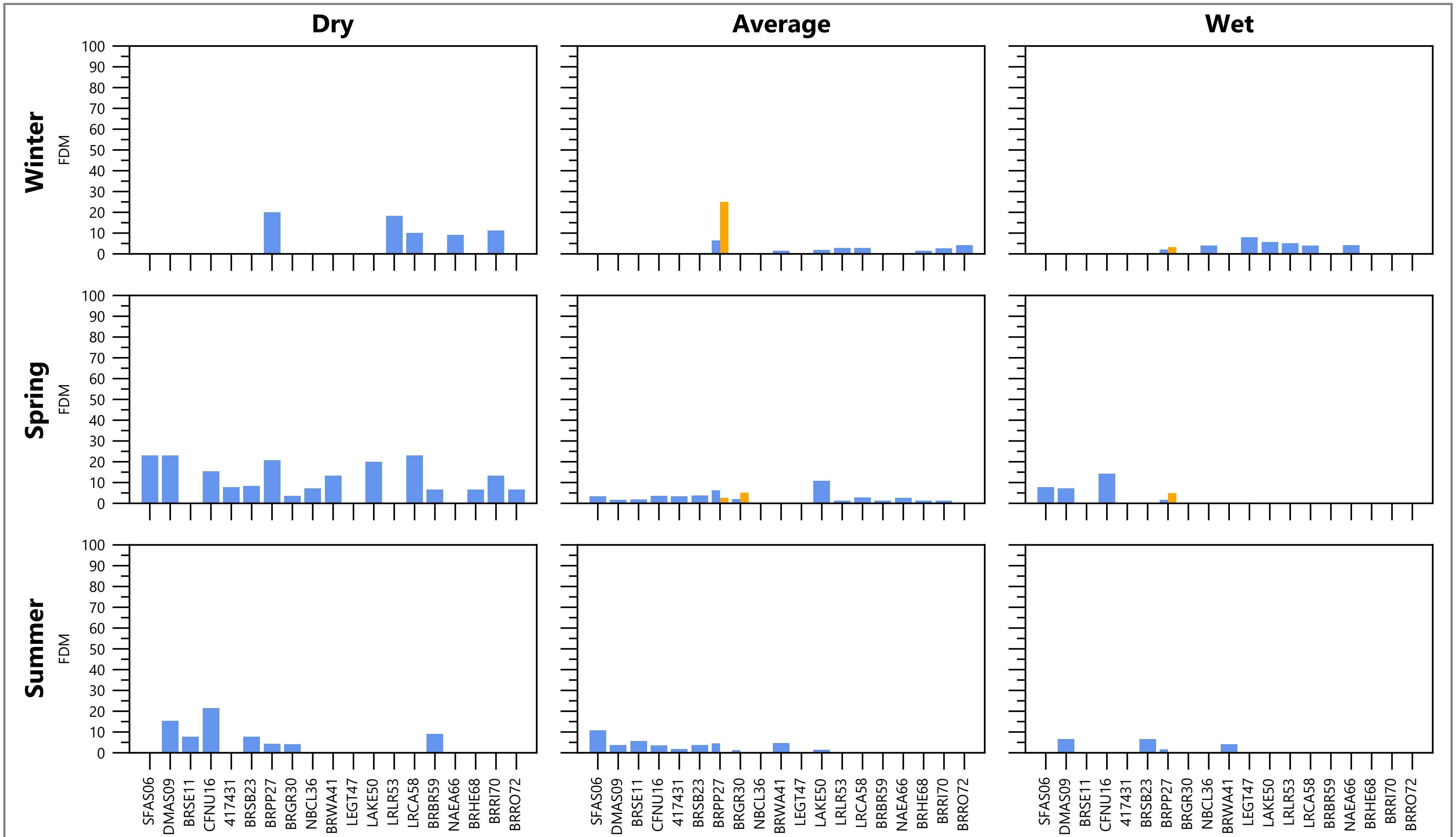
Figure I-3
Frequency Volume Met (FVM) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

Tier 1 Pulse

Tier 2 Pulse

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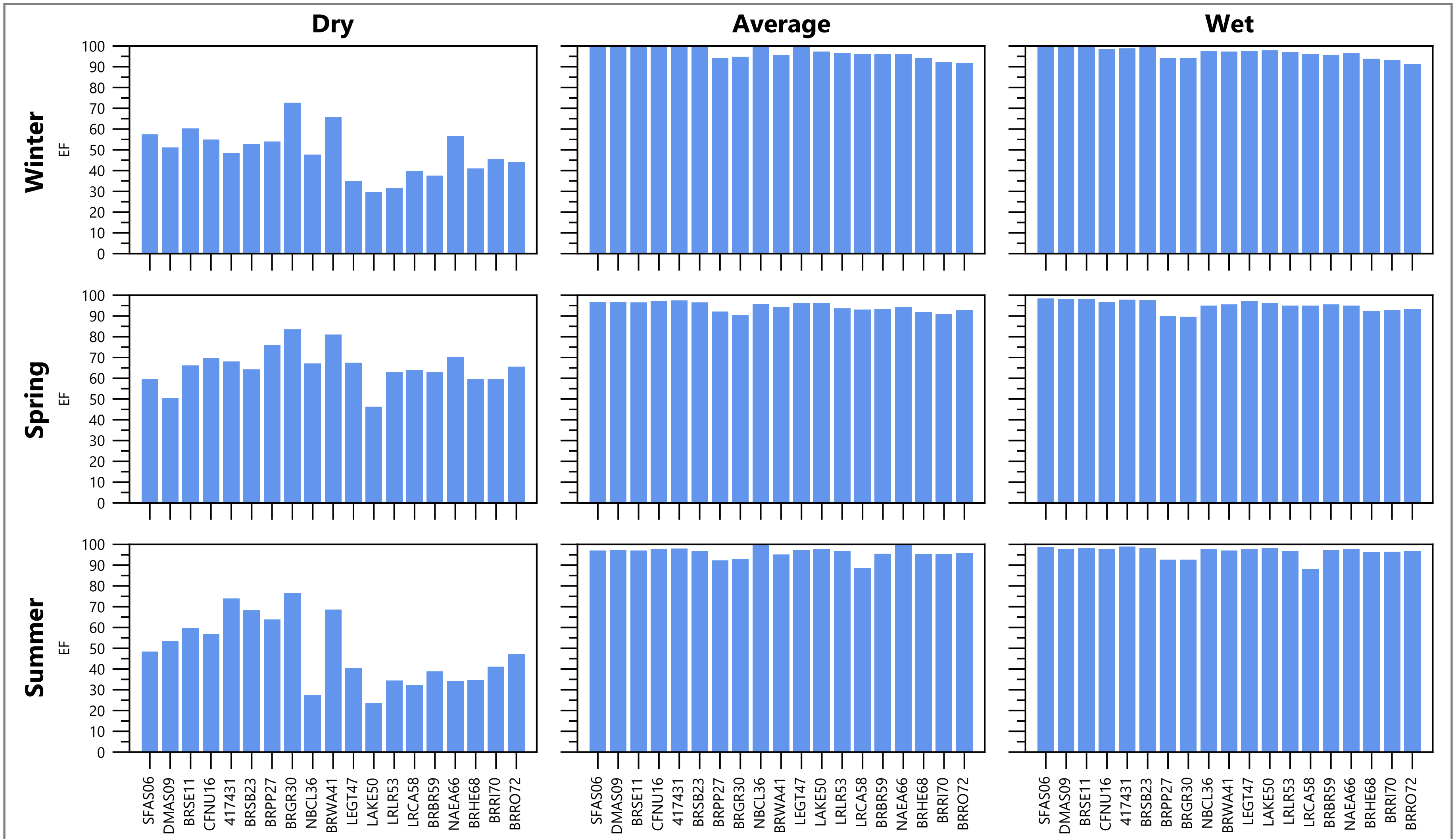
Figure I-4

Frequency Duration Met (FDM) by Season and Hydrologic Condition: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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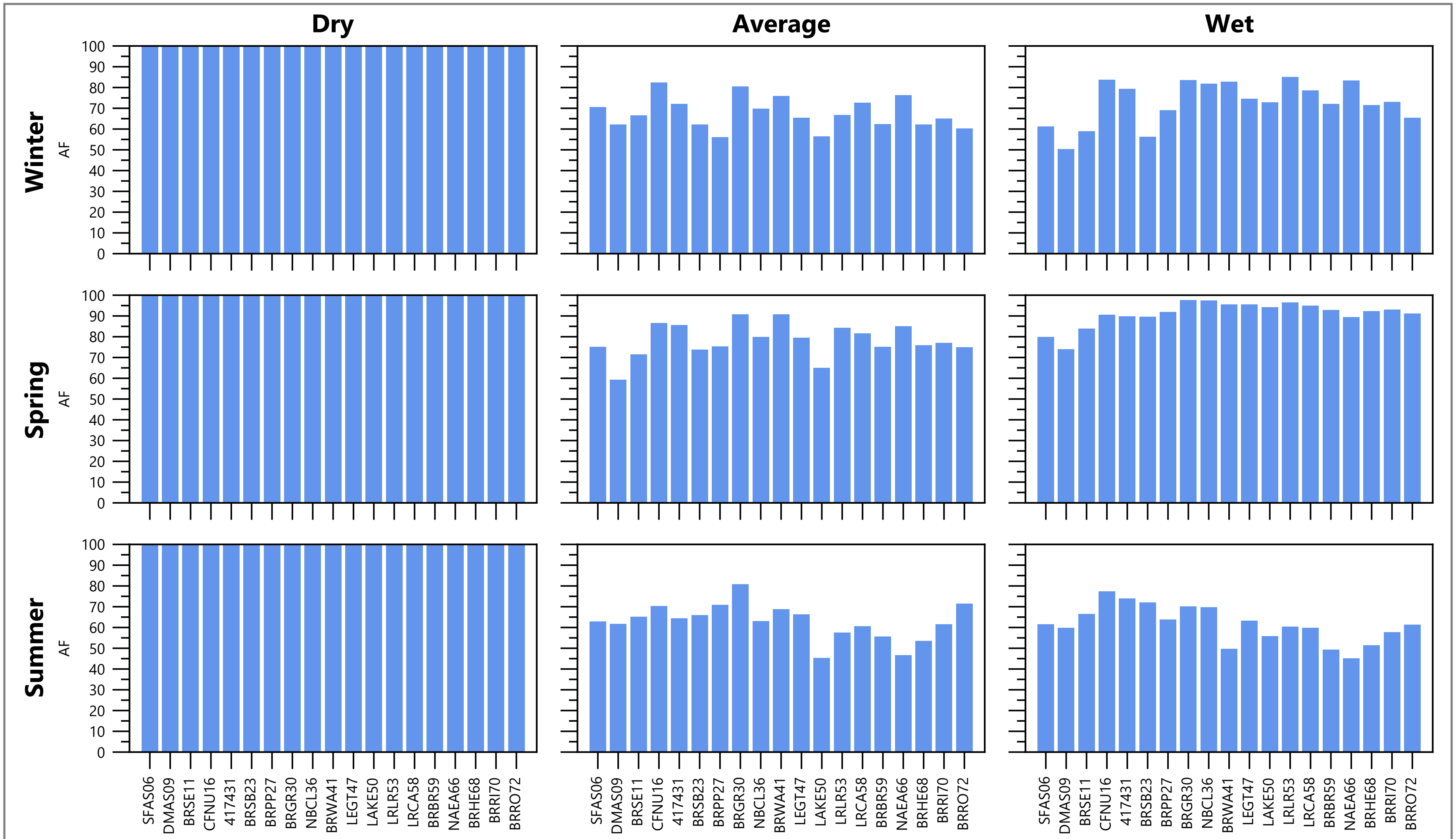
Figure I-5
Base Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



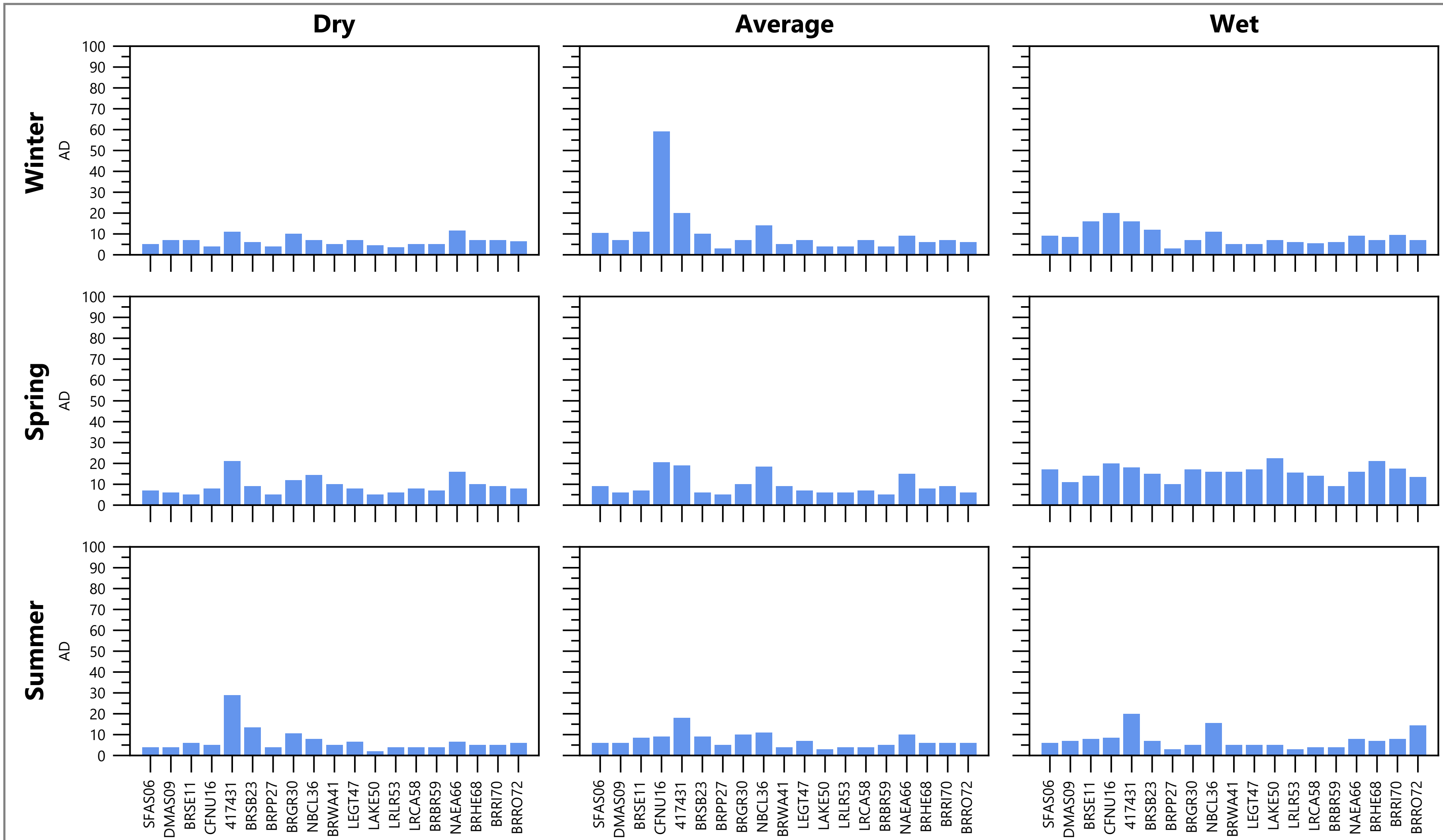
Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

Figure I-6

Base Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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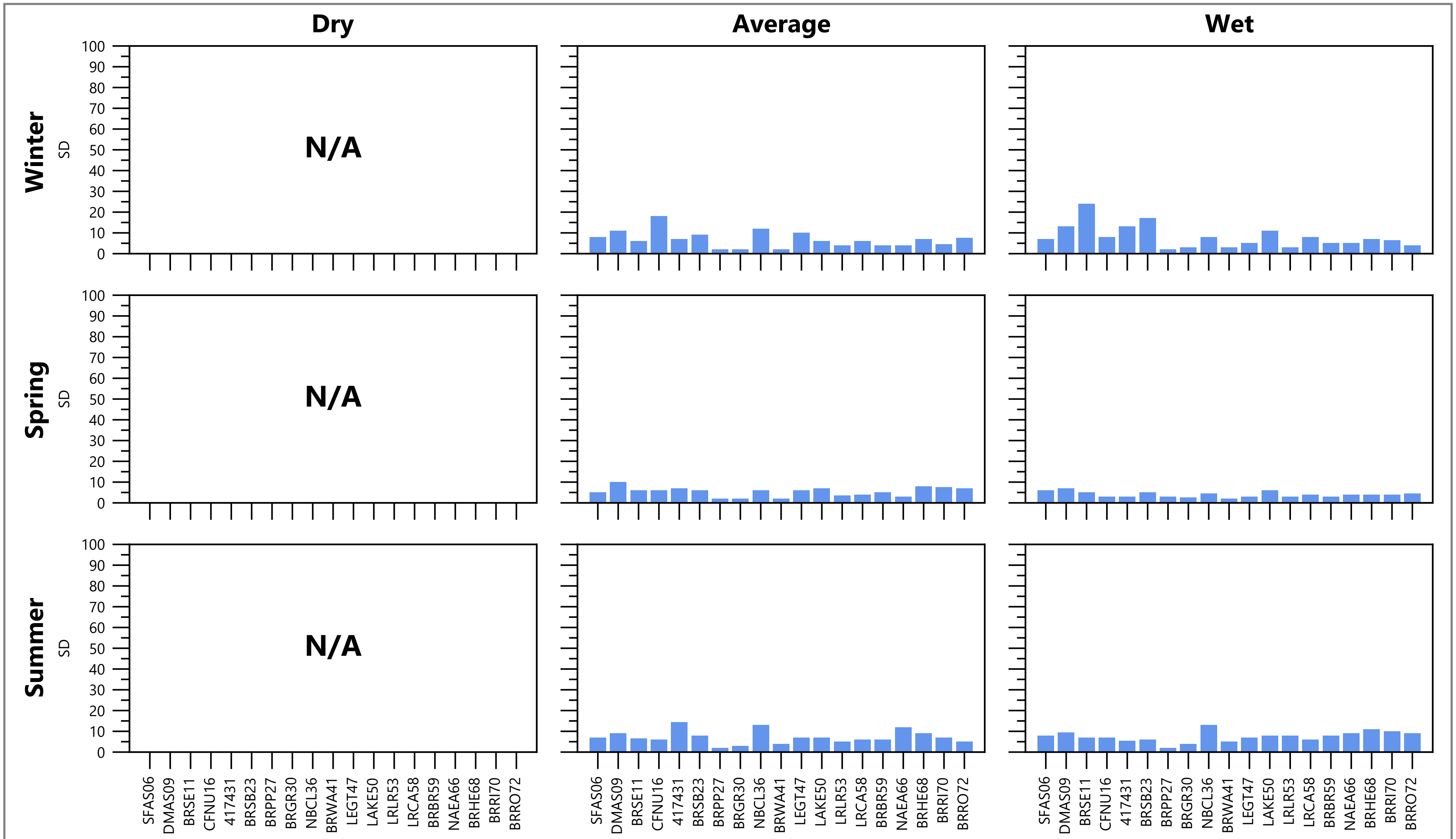
Figure I-7
Base Flow Attainment Duration (AD) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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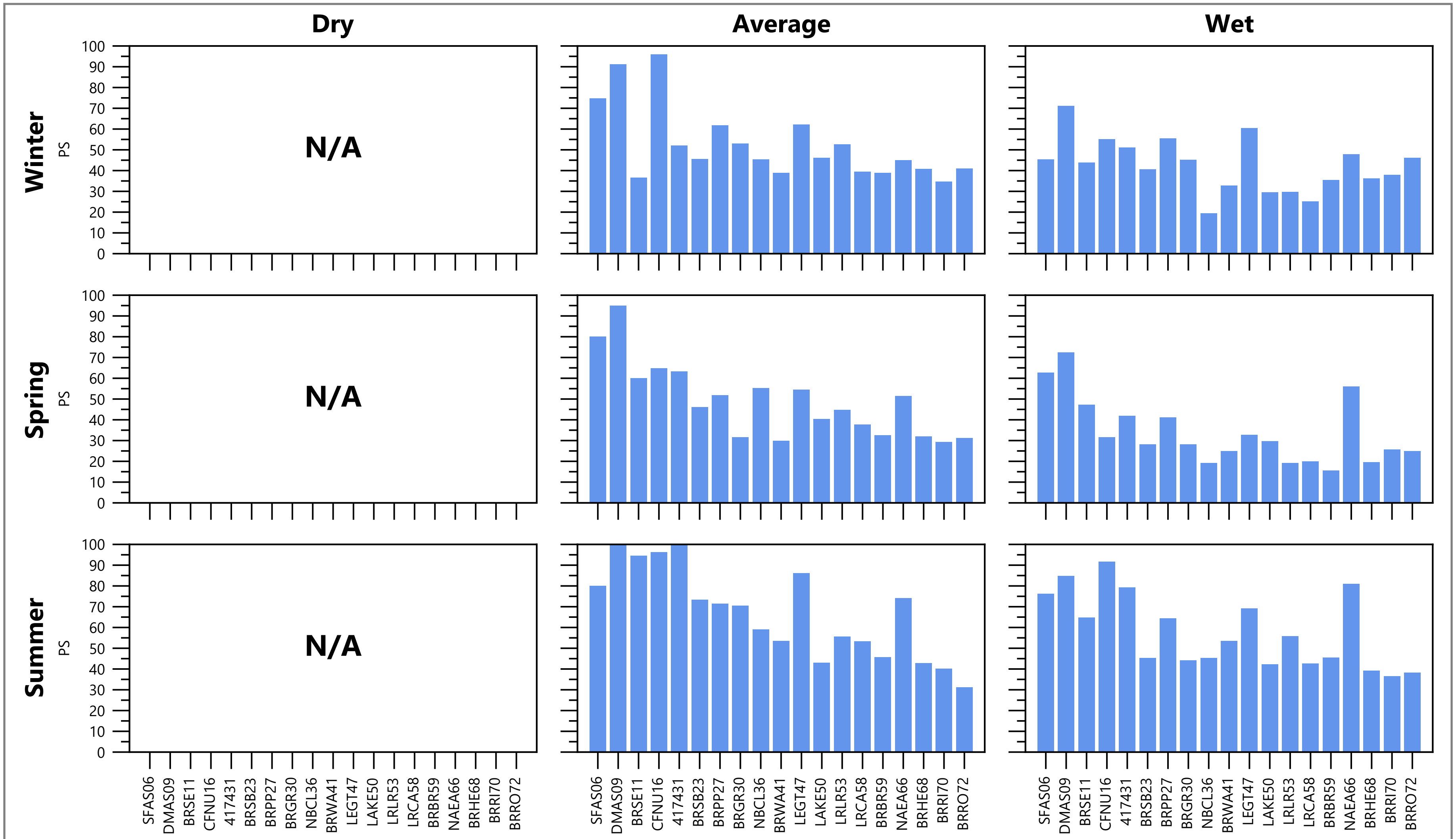
Figure I-8
Base Flow Shortage Duration (SD) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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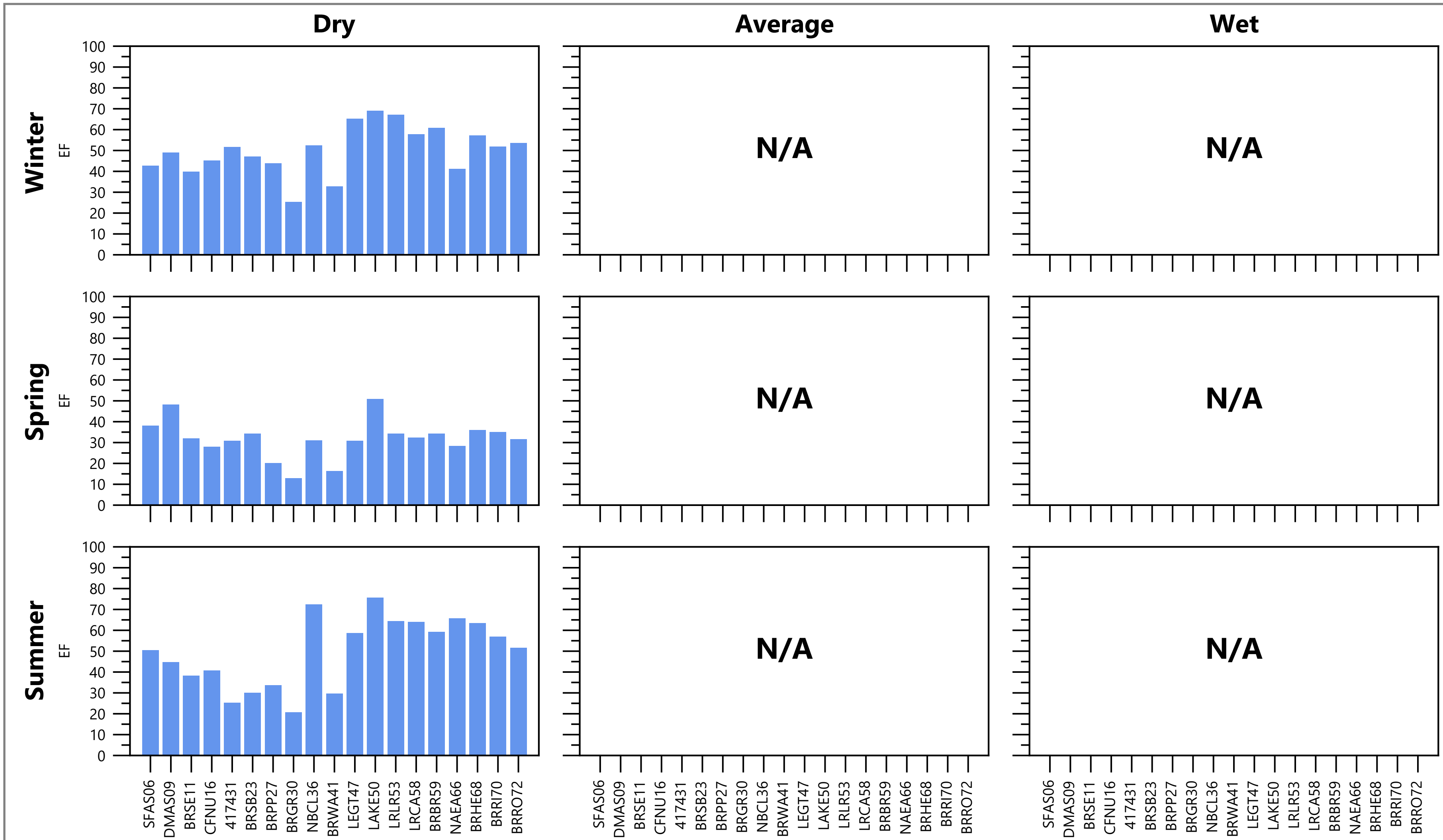
Figure I-9

Base Flow Percent Shortage (PS) by Season and Hydrologic Condition: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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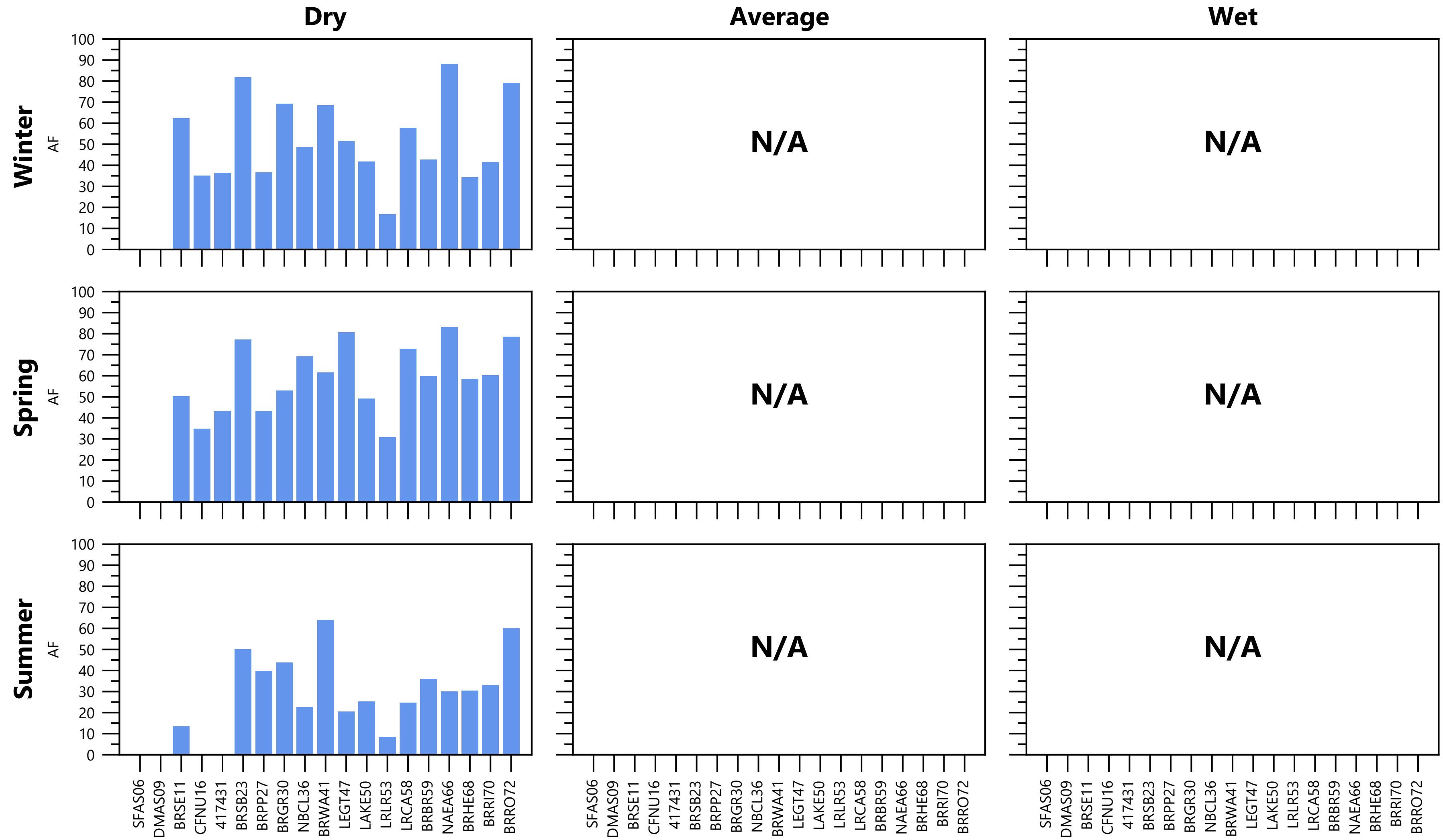
Figure I-10
Subsistence Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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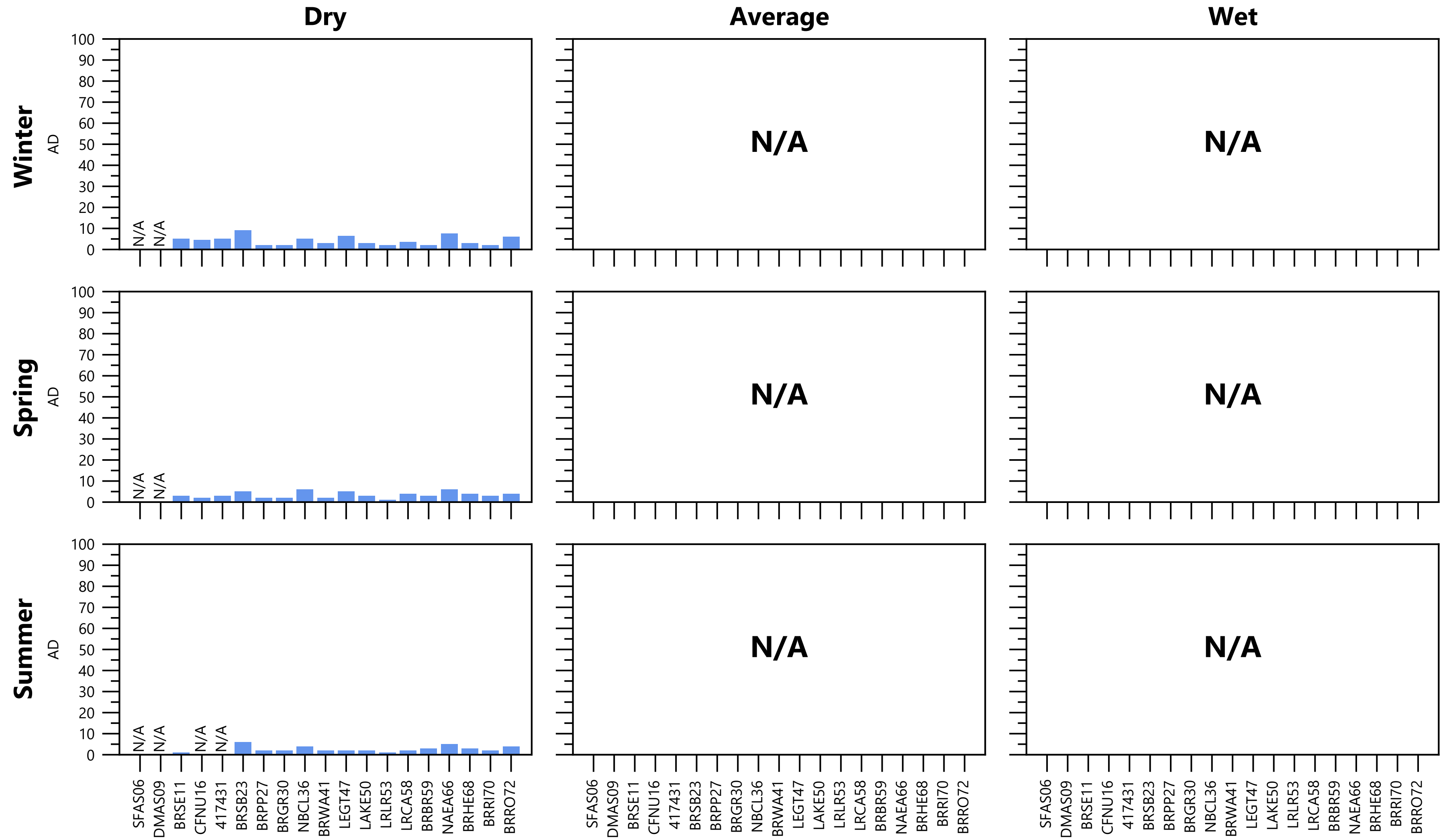
Figure I-11

Subsistence Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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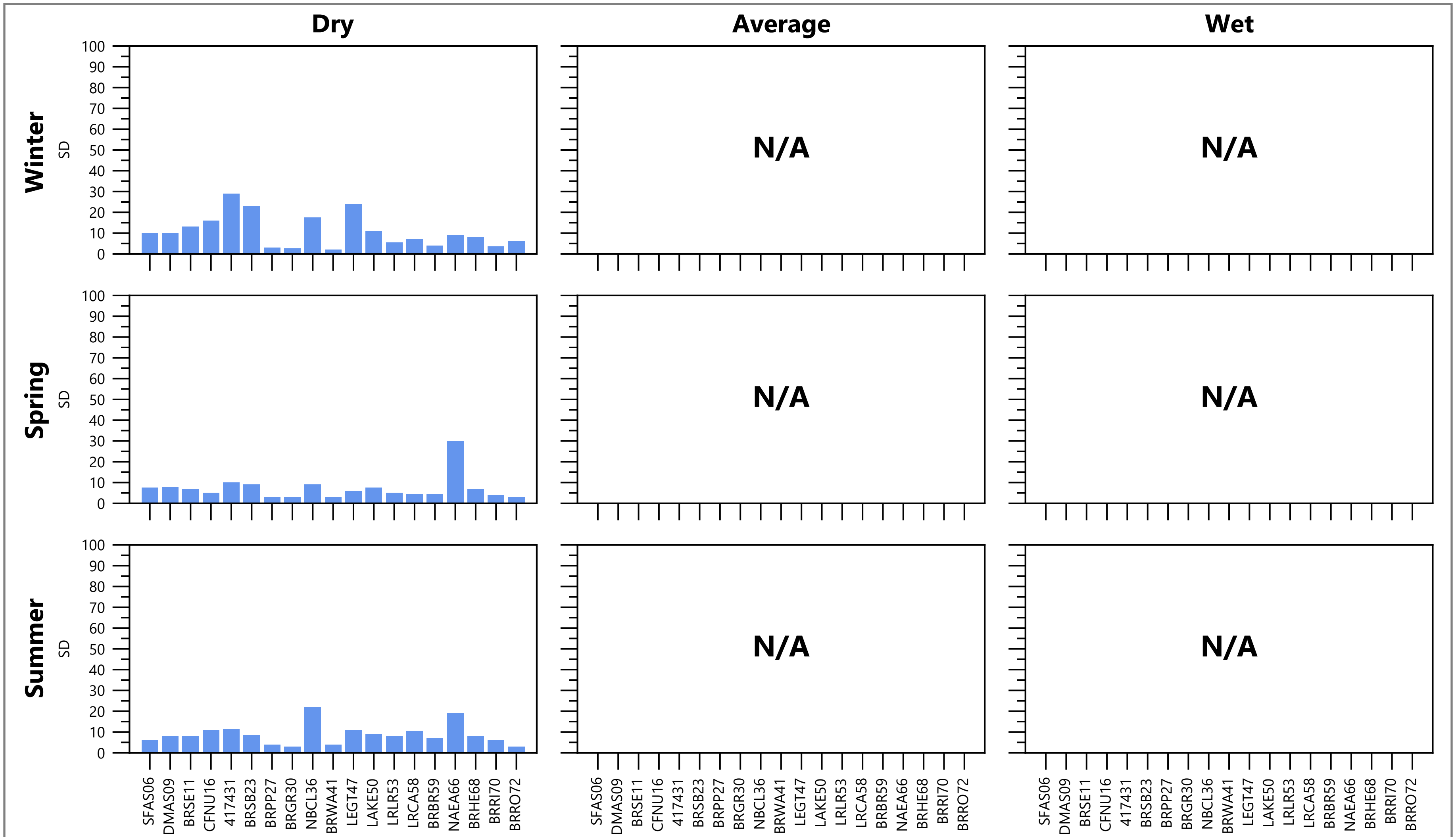
Figure I-12
Subsistence Flow Attainment Duration (AD) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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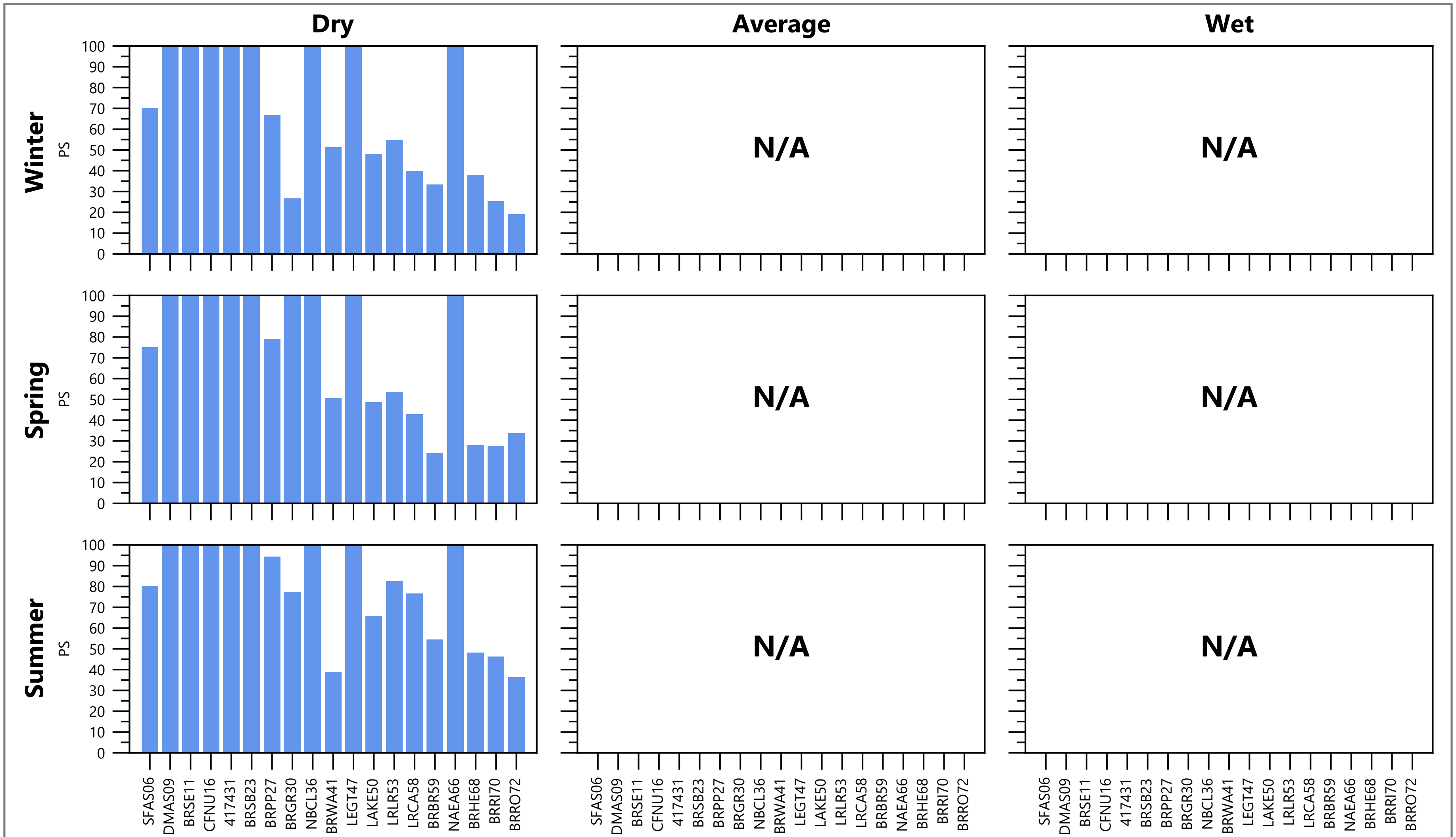
Figure I-13
Subsistence Flow Shortage Duration (SD) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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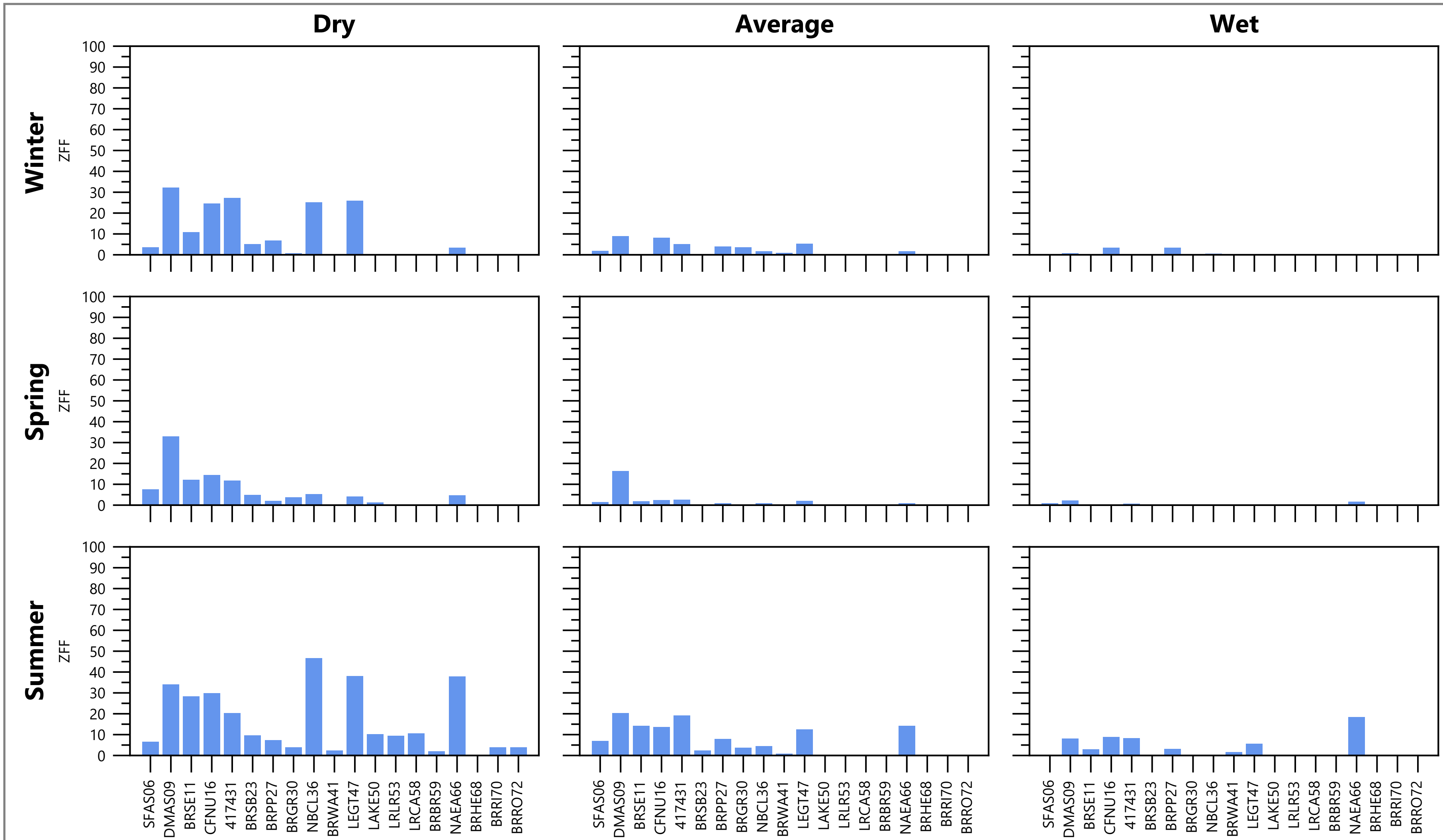
Figure I-14
Subsistence Flow Percent Shortage (PS) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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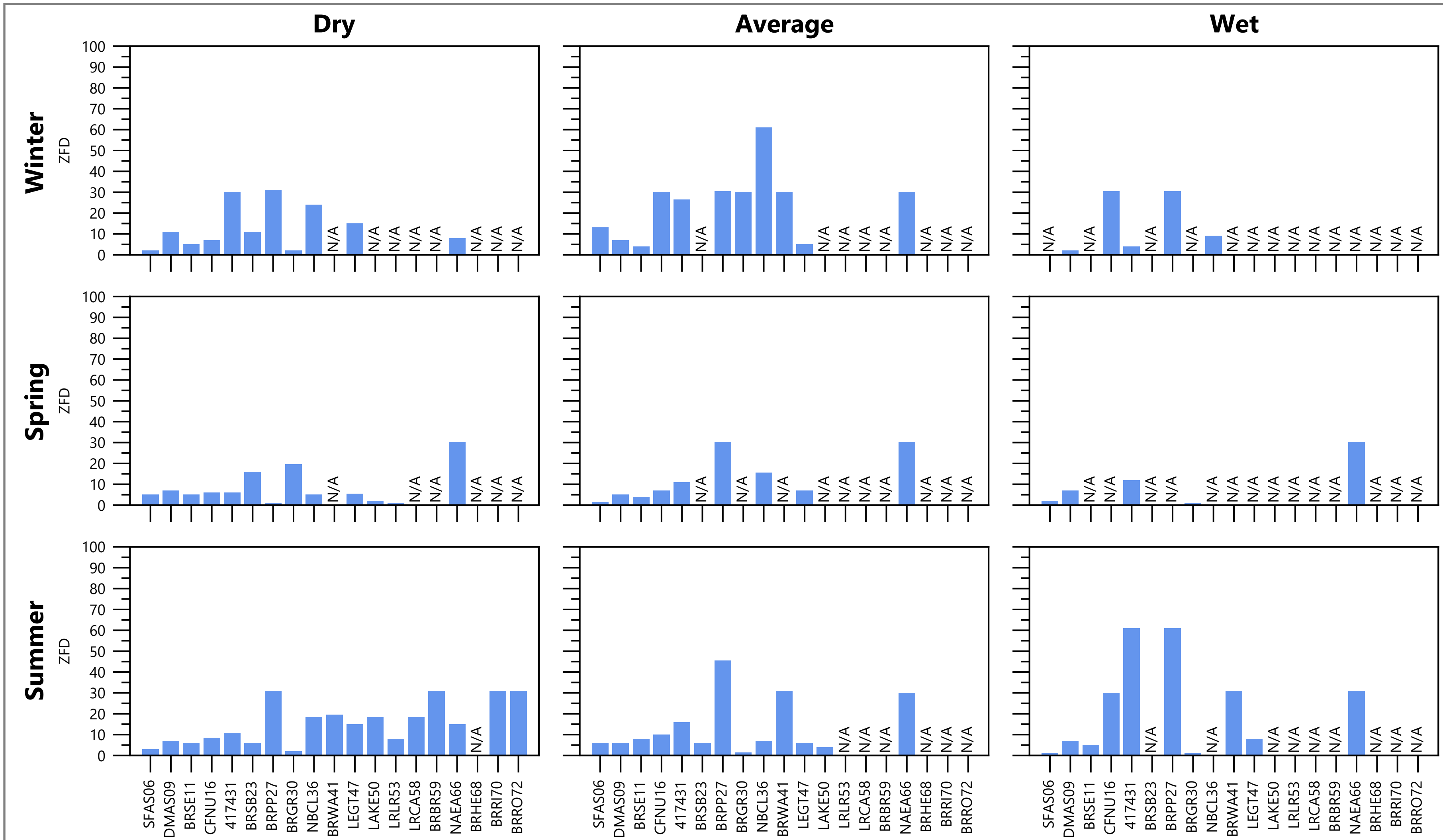
Figure I-15
Zero-Flow Frequencies (ZFF) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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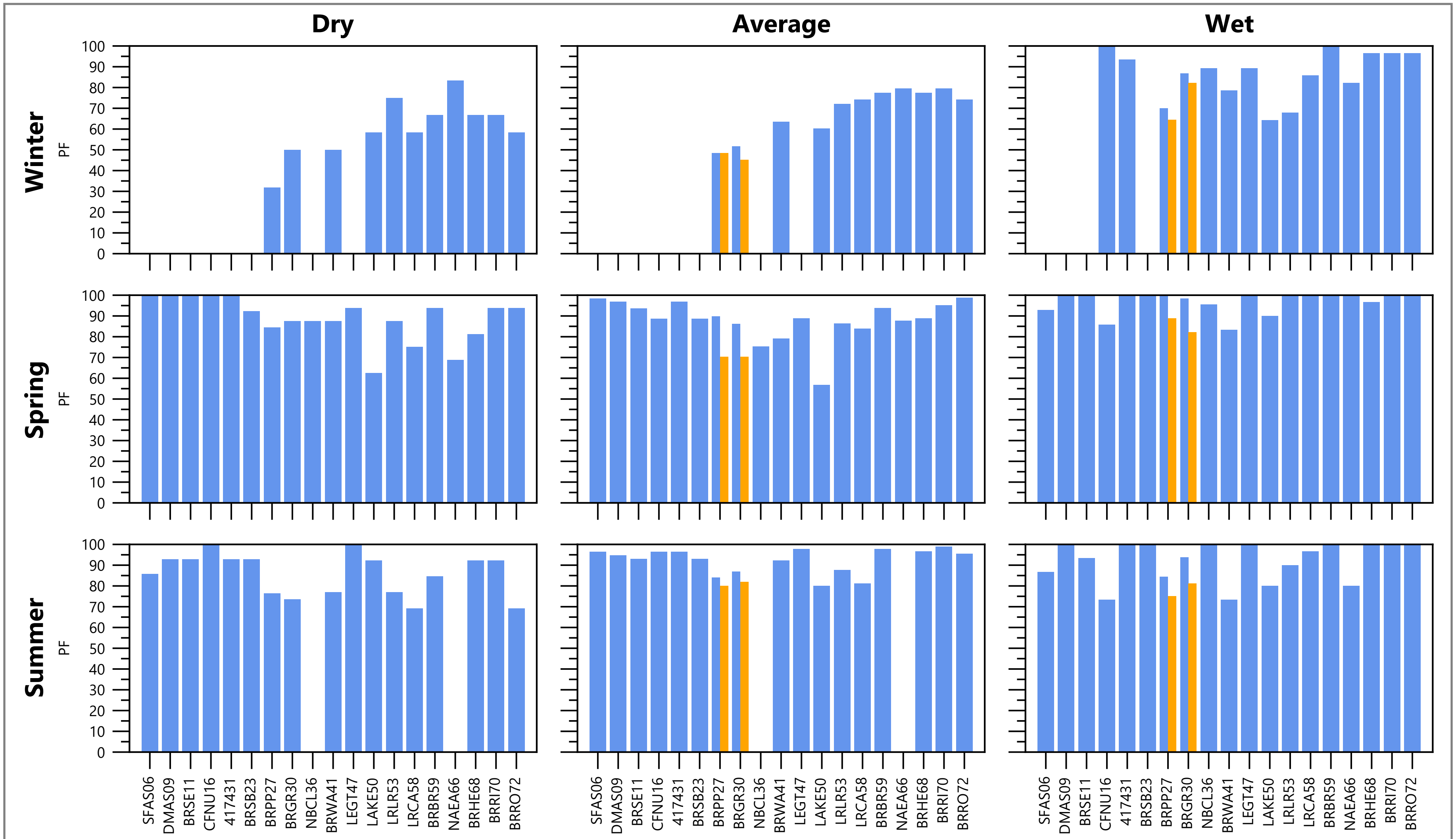
Figure I-16
Zero-Flow Durations (ZFD) by Season and Hydrologic Condition: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

Tier 1 Pulse
Tier 2 Pulse

Figure I-17
Pulse Frequencies (PF) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards

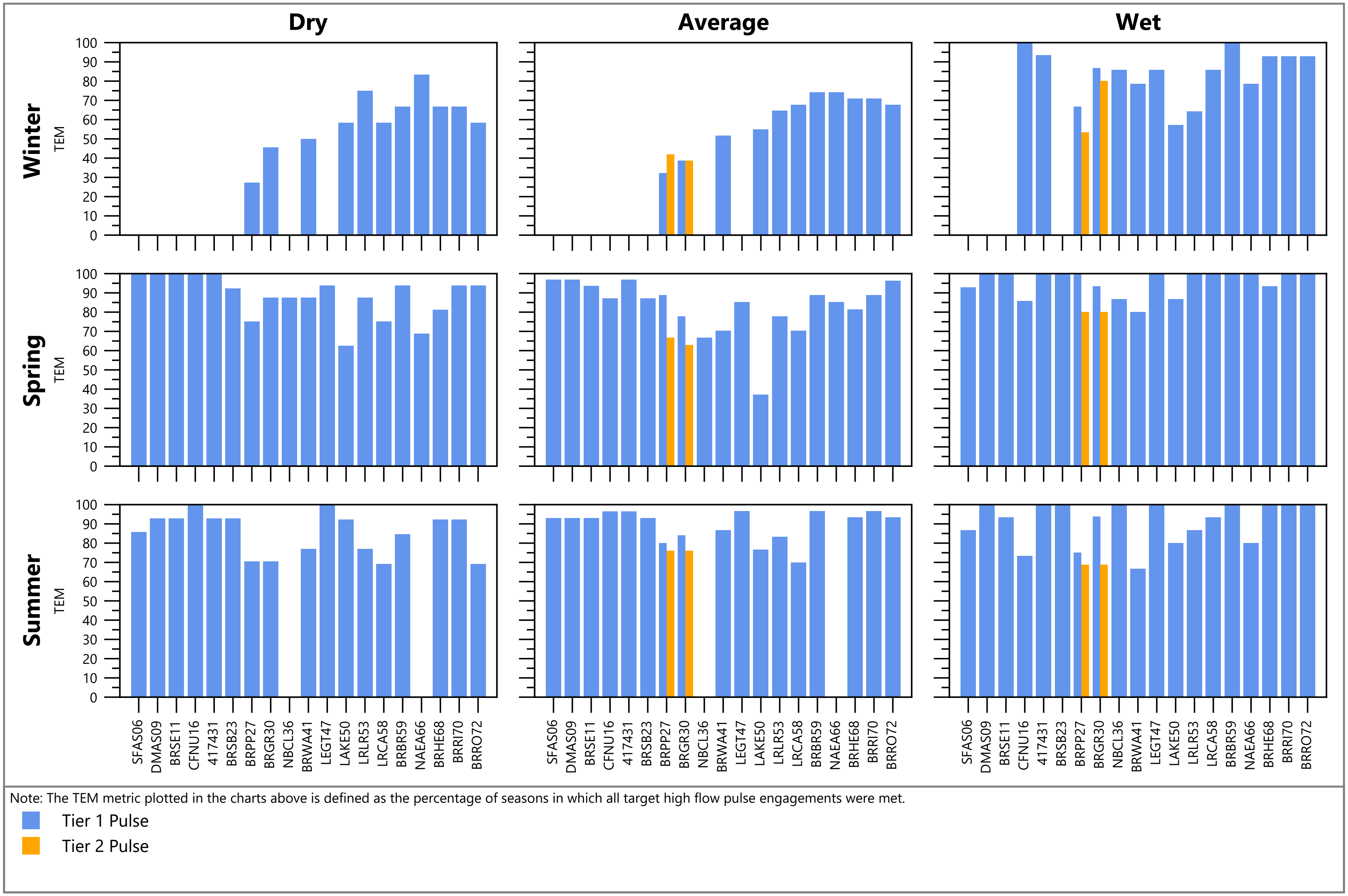


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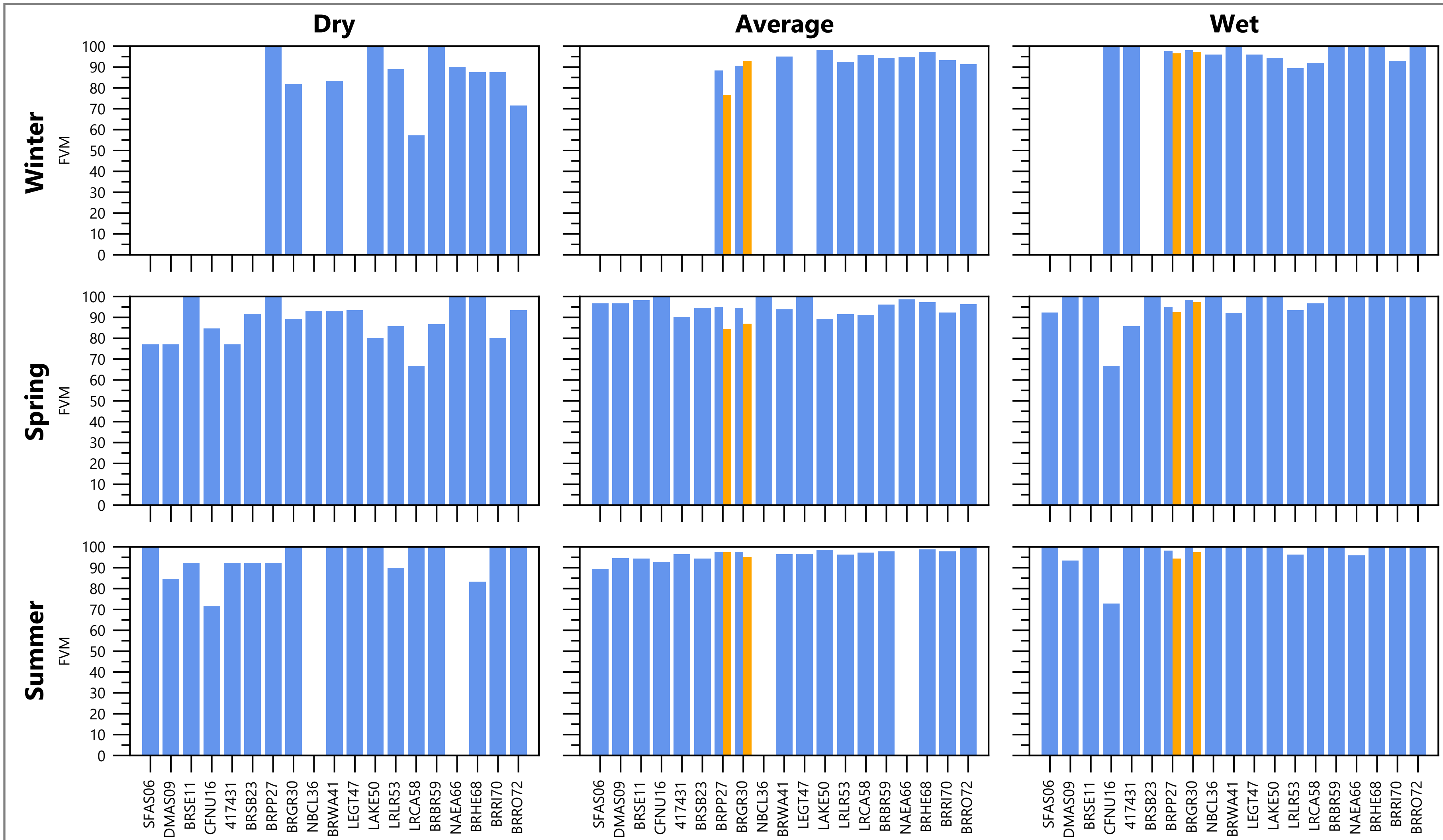
Figure I-18

Target Engagements Met (TEM) by Season and Hydrologic Condition: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

Tier 1 Pulse

Tier 2 Pulse

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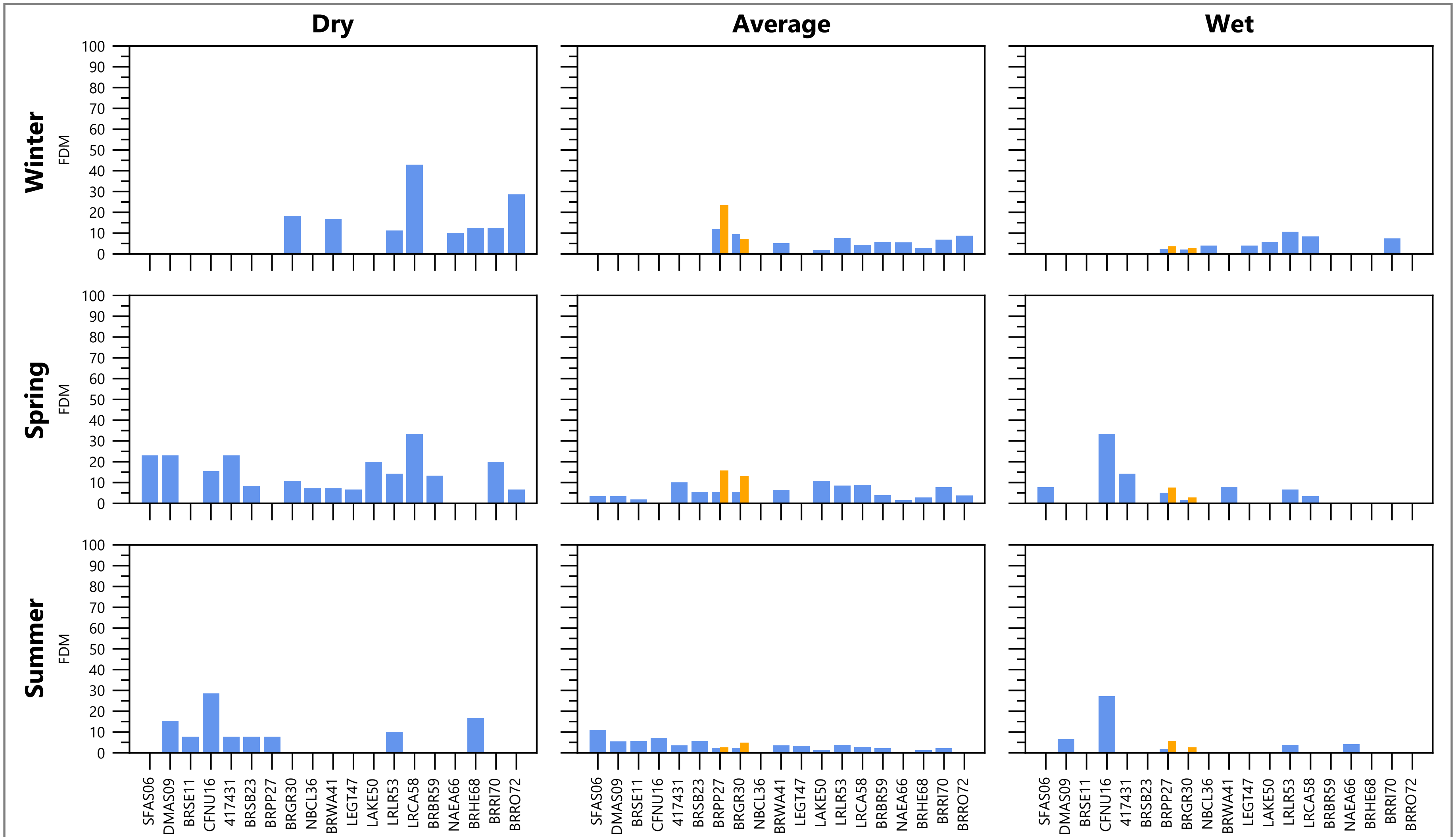
Figure I-19

Frequency Volume Met (FVM) by Season and Hydrologic Condition: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

- Tier 1 Pulse
- Tier 2 Pulse

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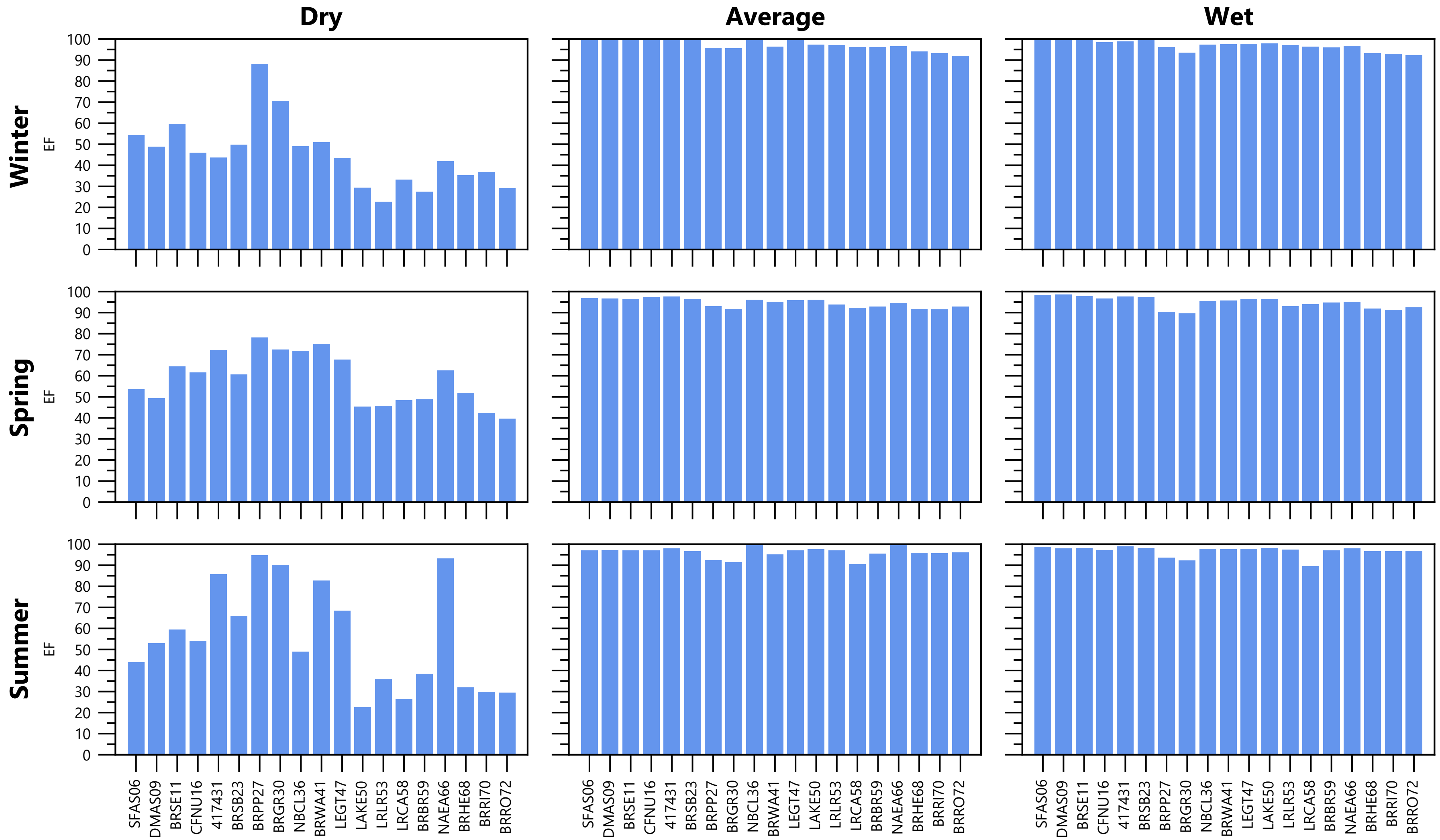
Figure I-20

Frequency Duration Met (FDM) by Season and Hydrologic Condition: Current Water Use Scenario

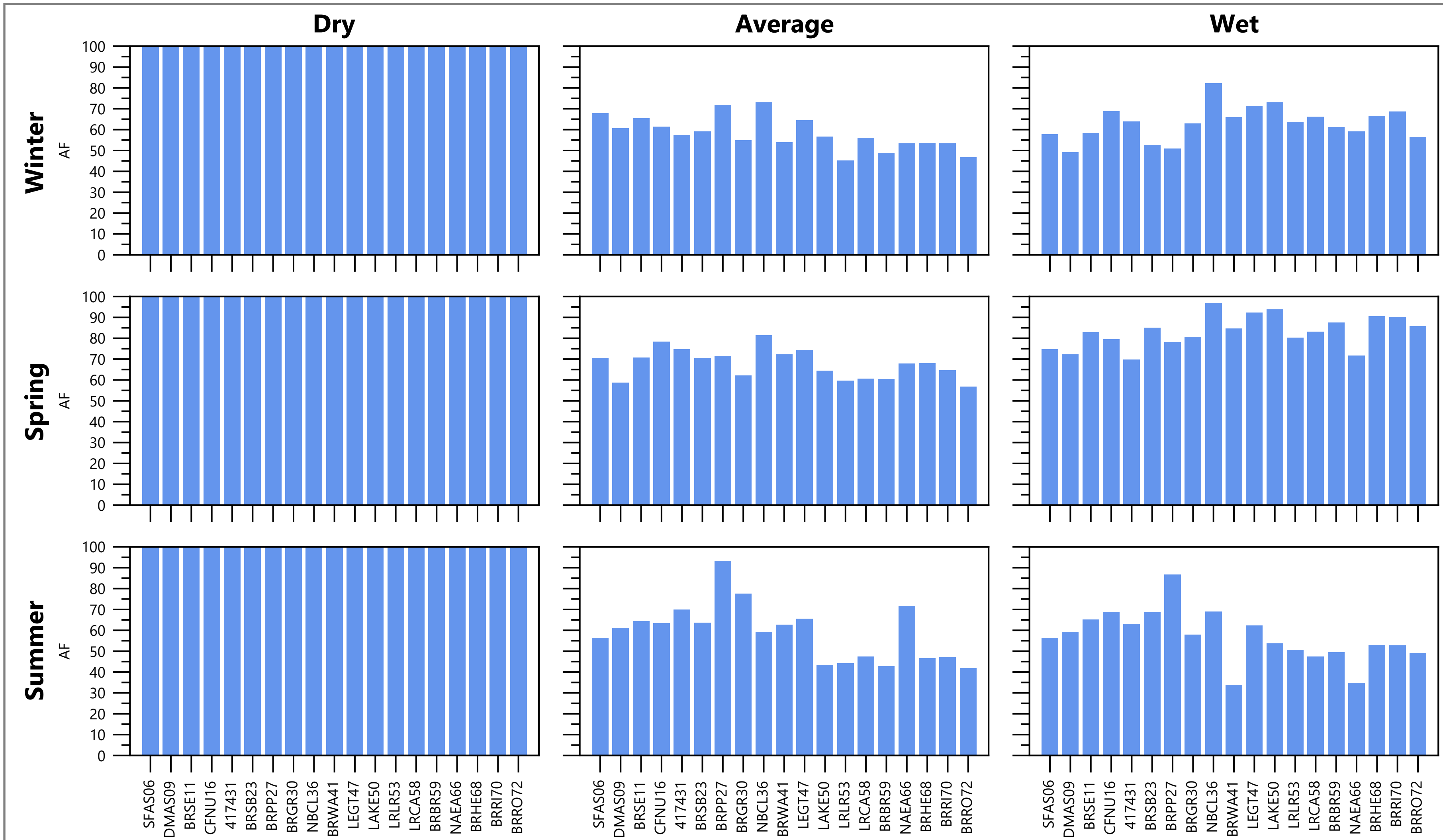
Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

Figure I-21
Base Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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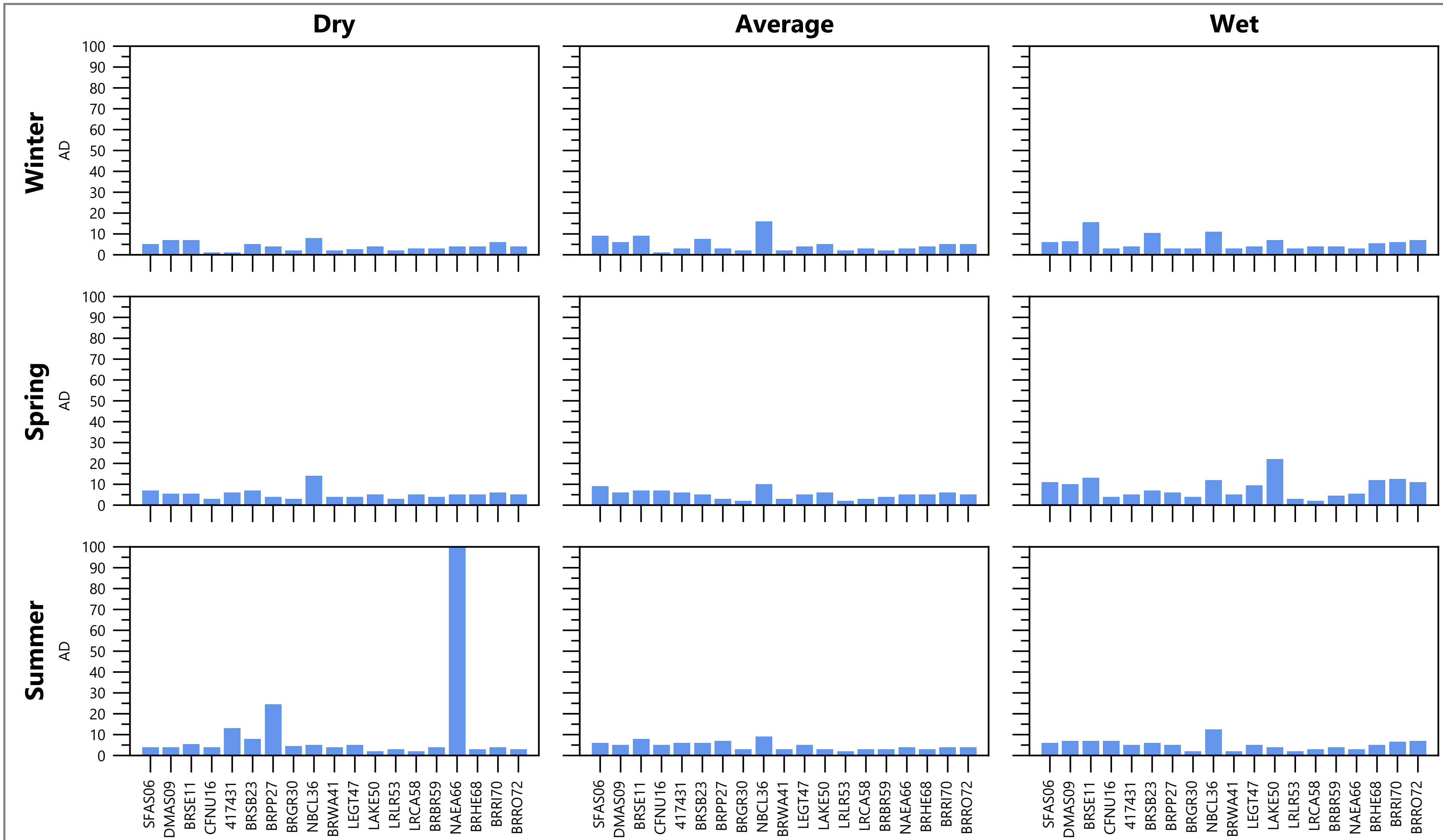
Figure I-22
Base Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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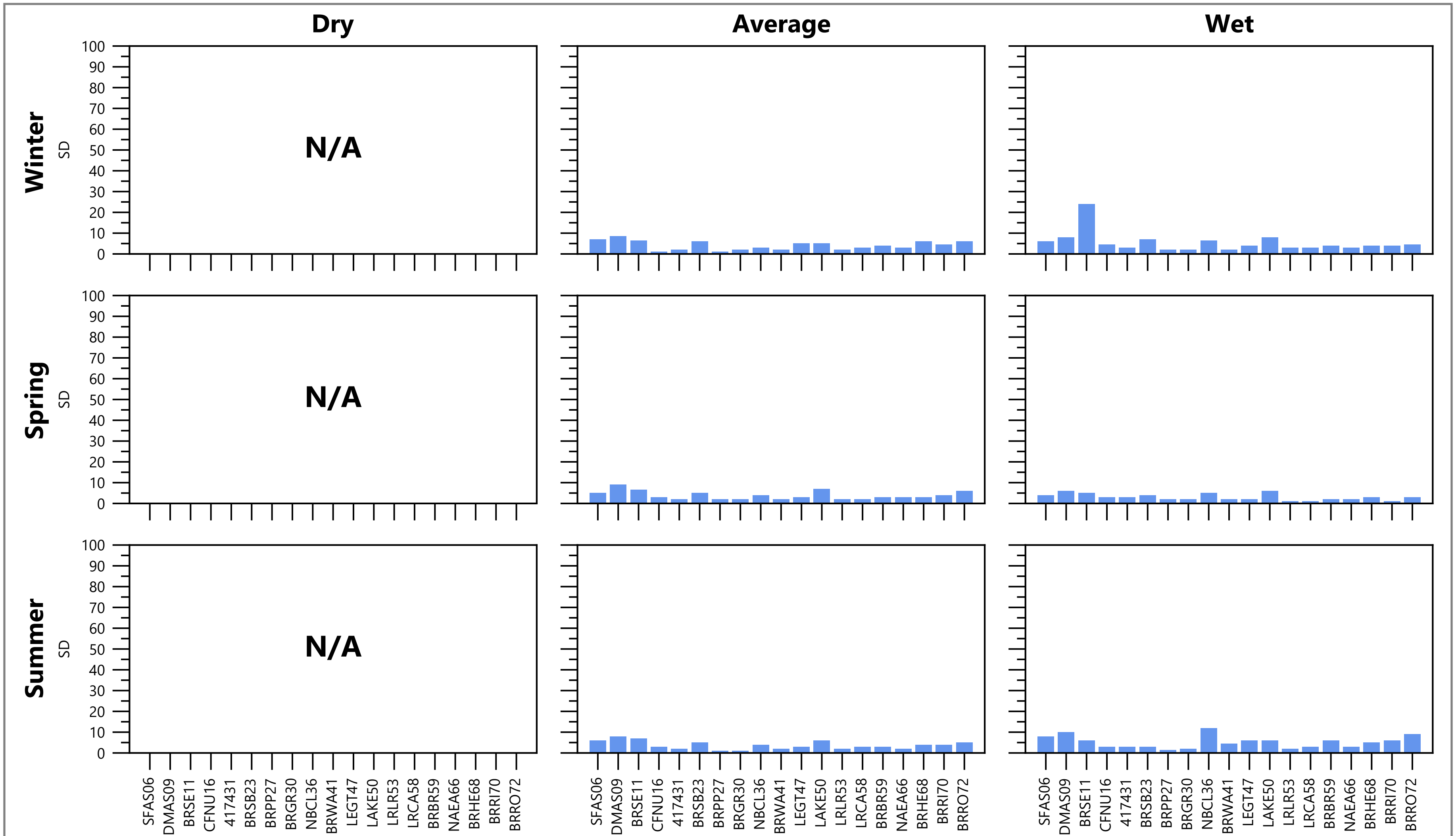
Figure I-23
Base Flow Attainment Duration (AD) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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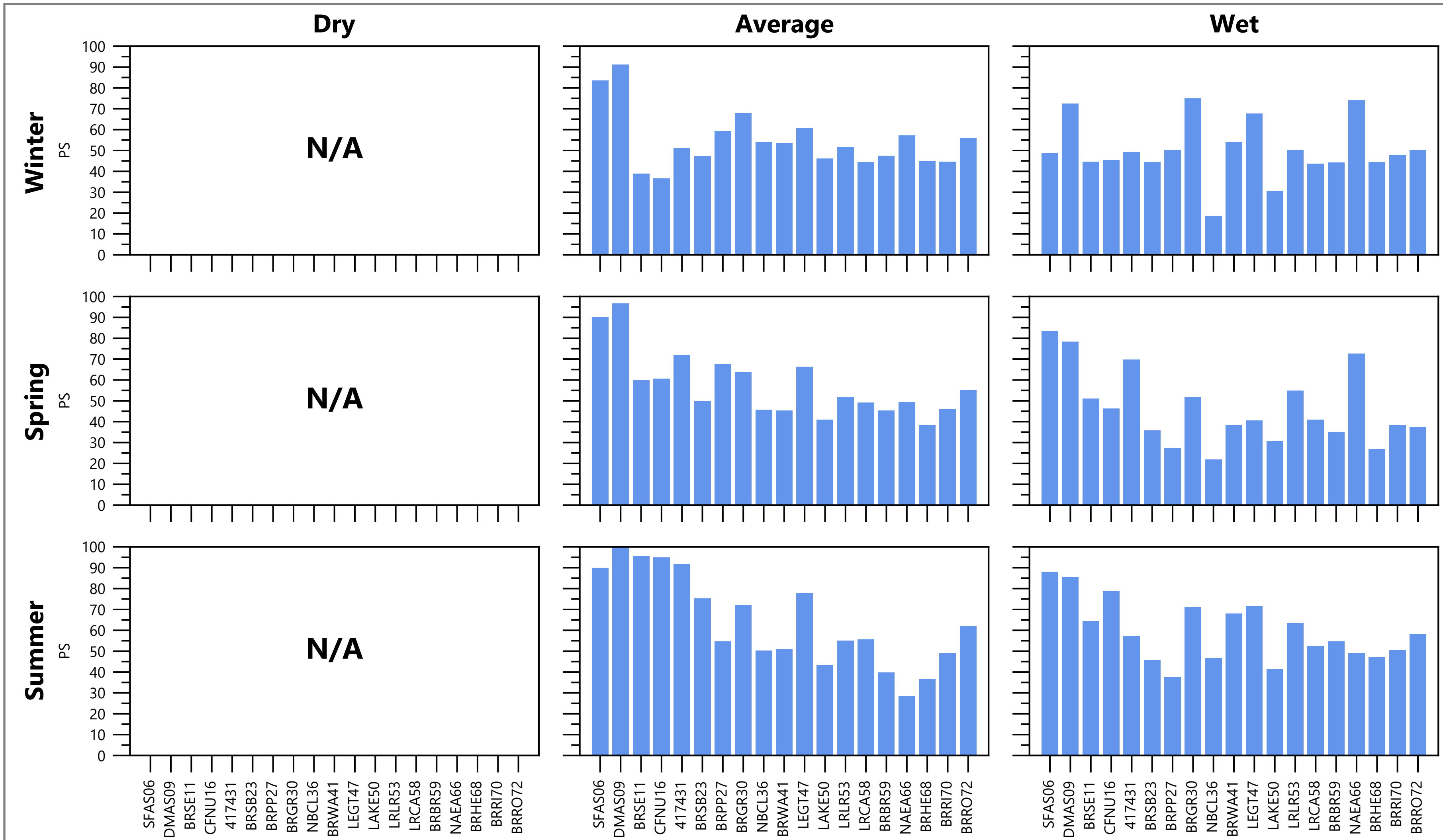
Figure I-24
Base Flow Shortage Duration (SD) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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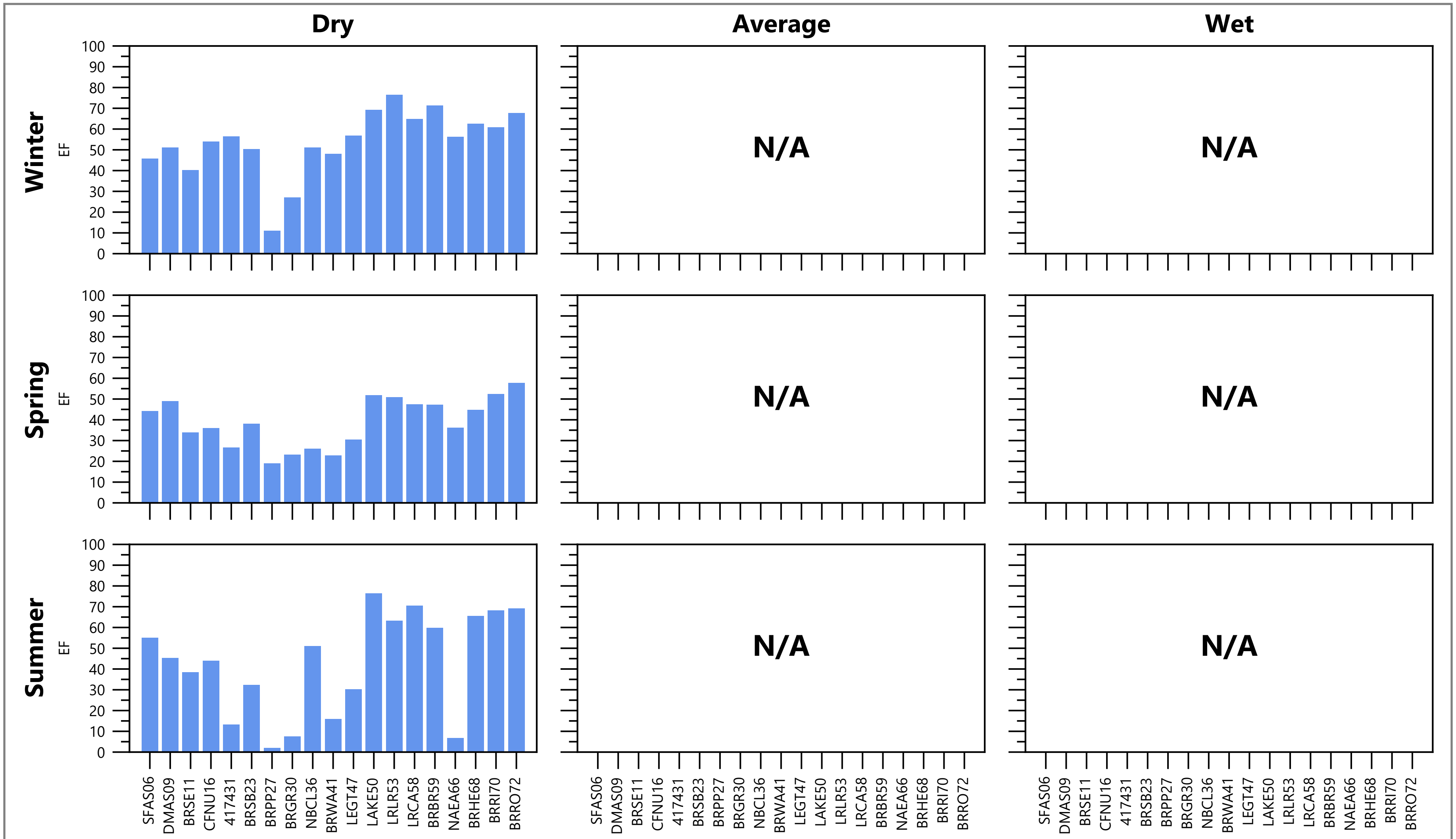
Figure I-25
Base Flow Percent Shortage (PS) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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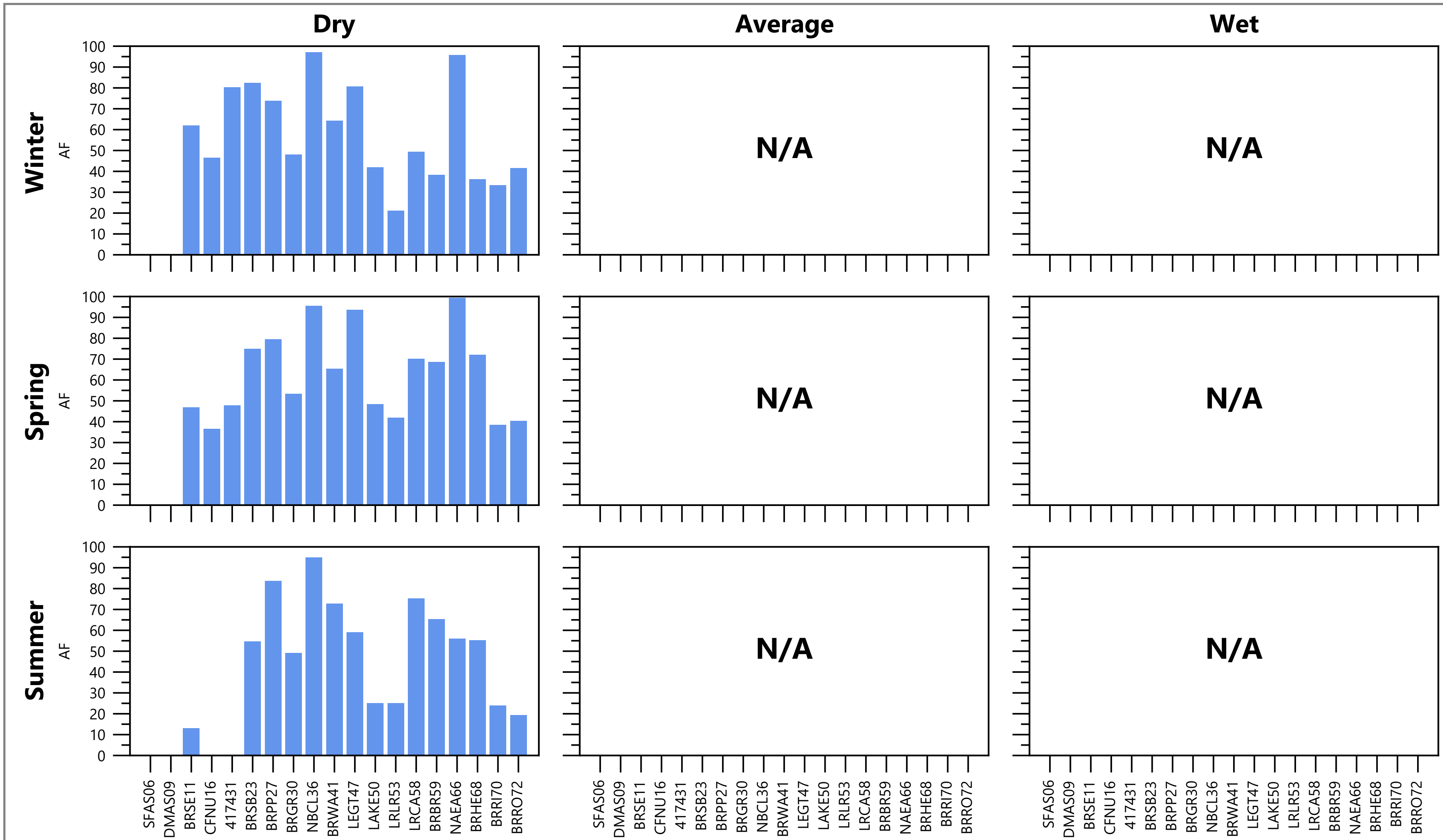
Figure I-26
Subsistence Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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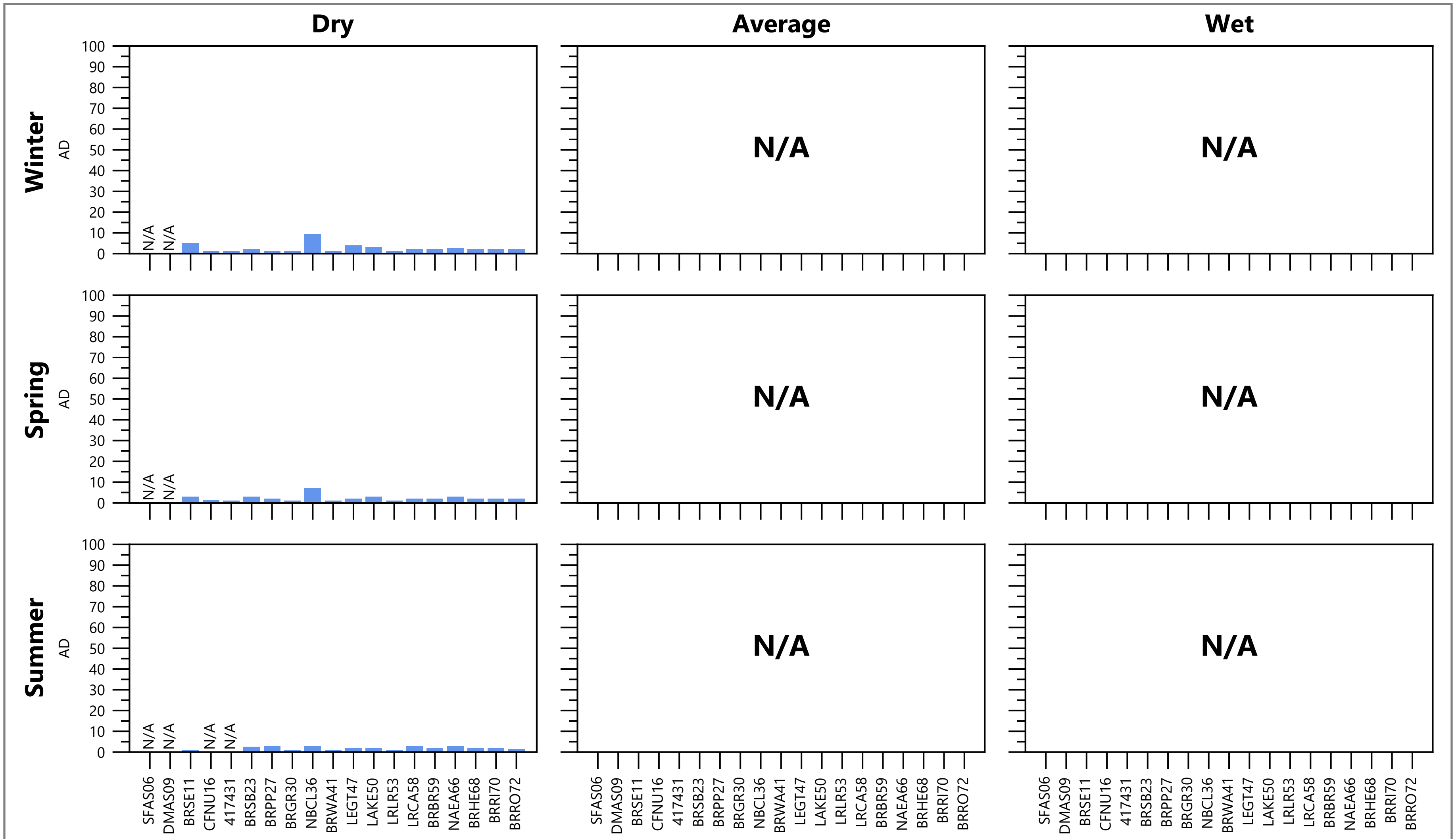
Figure I-27
Subsistence Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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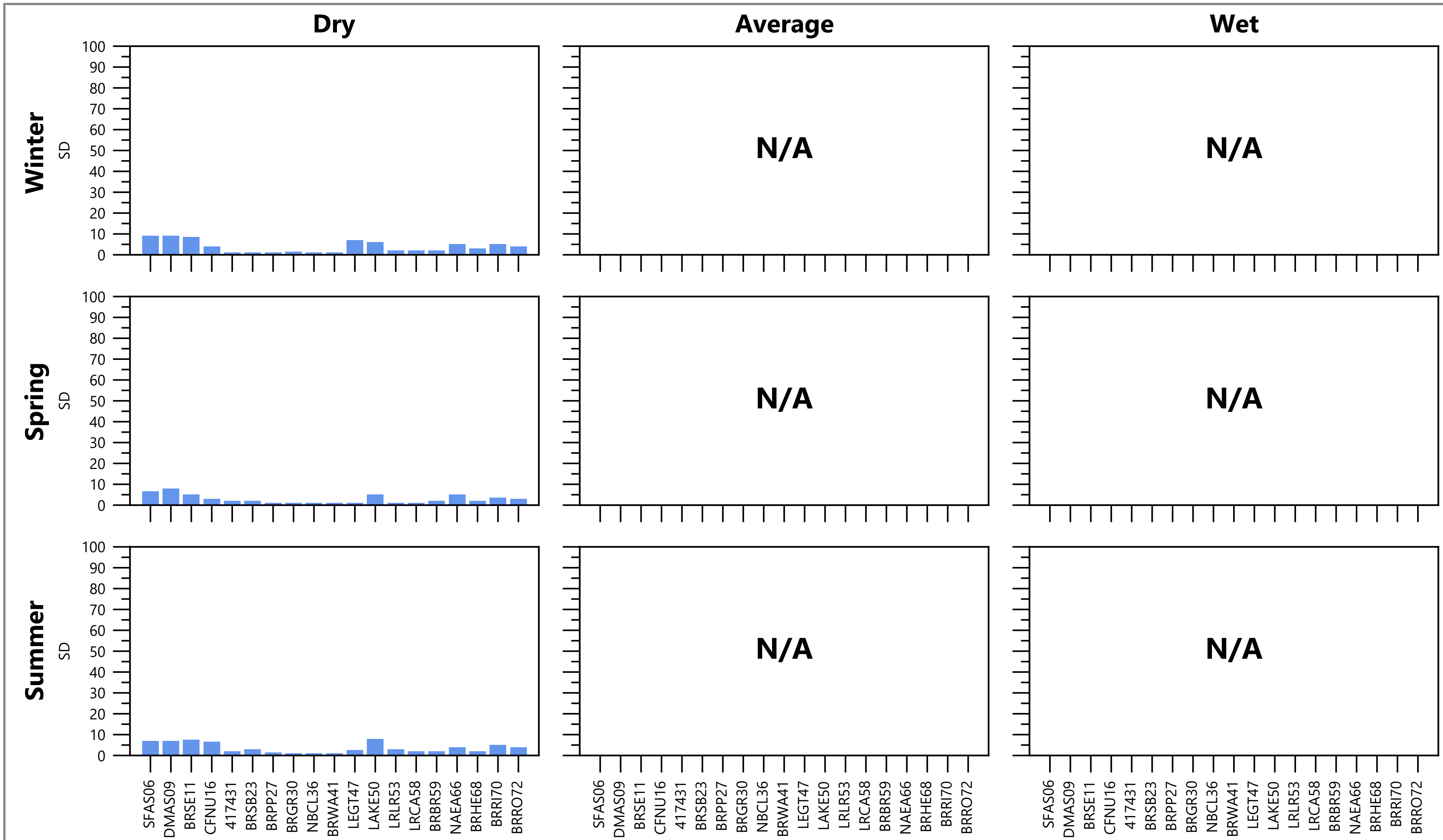
Figure I-28
Subsistence Flow Attainment Duration (AD) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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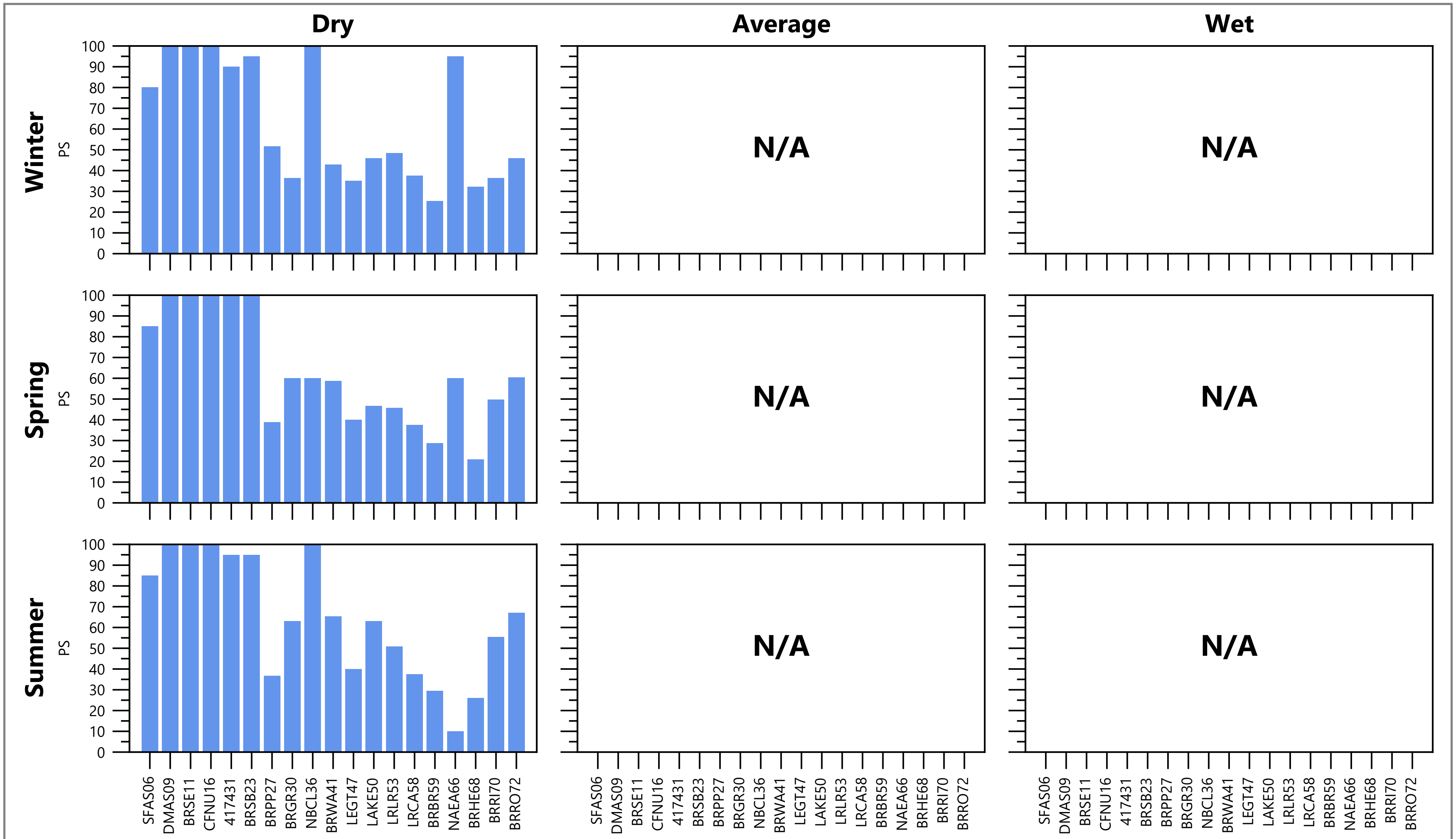
Figure I-29
Subsistence Flow Shortage Duration (SD) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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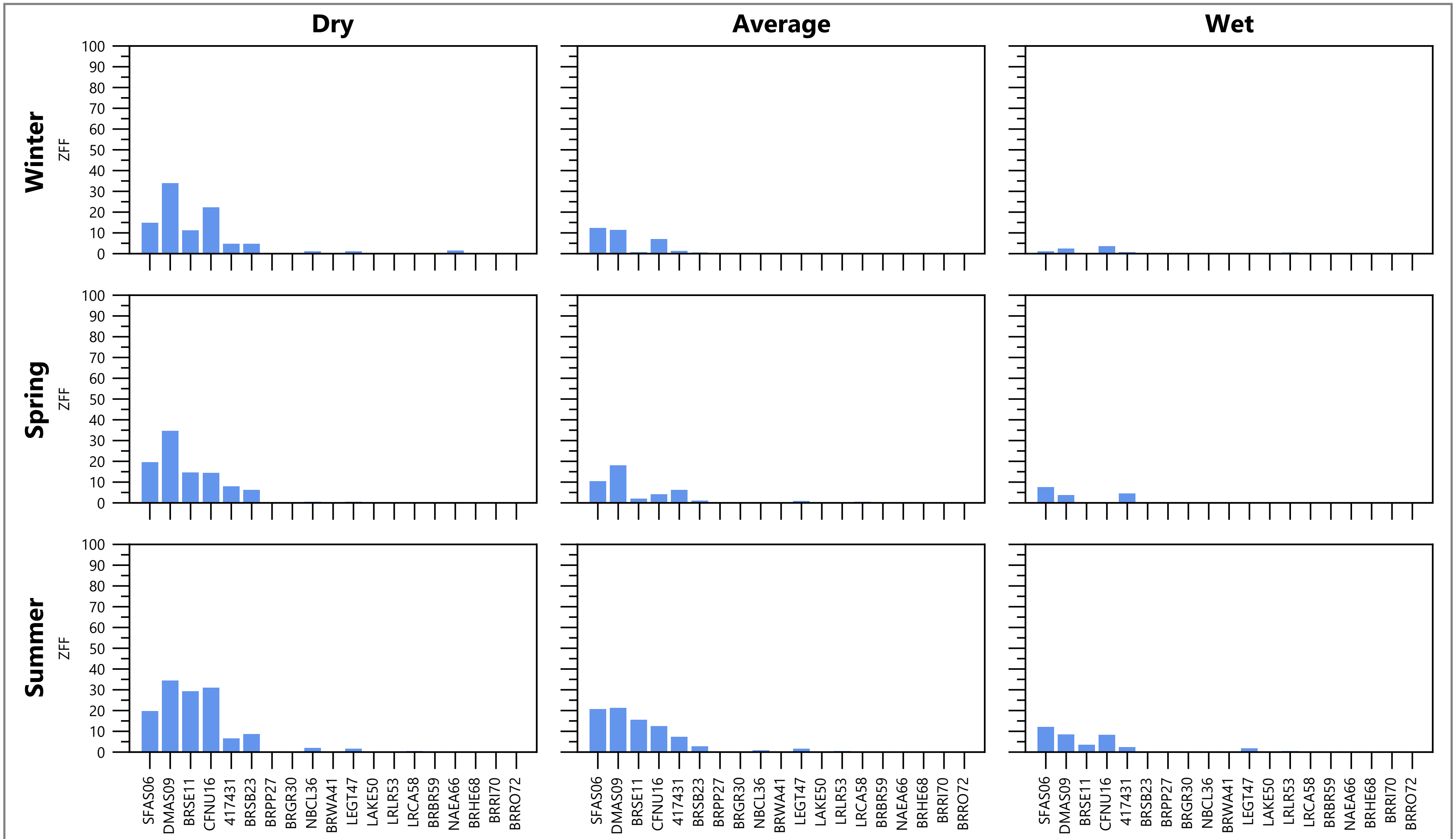
Figure I-30
Subsistence Flow Percent Shortage (PS) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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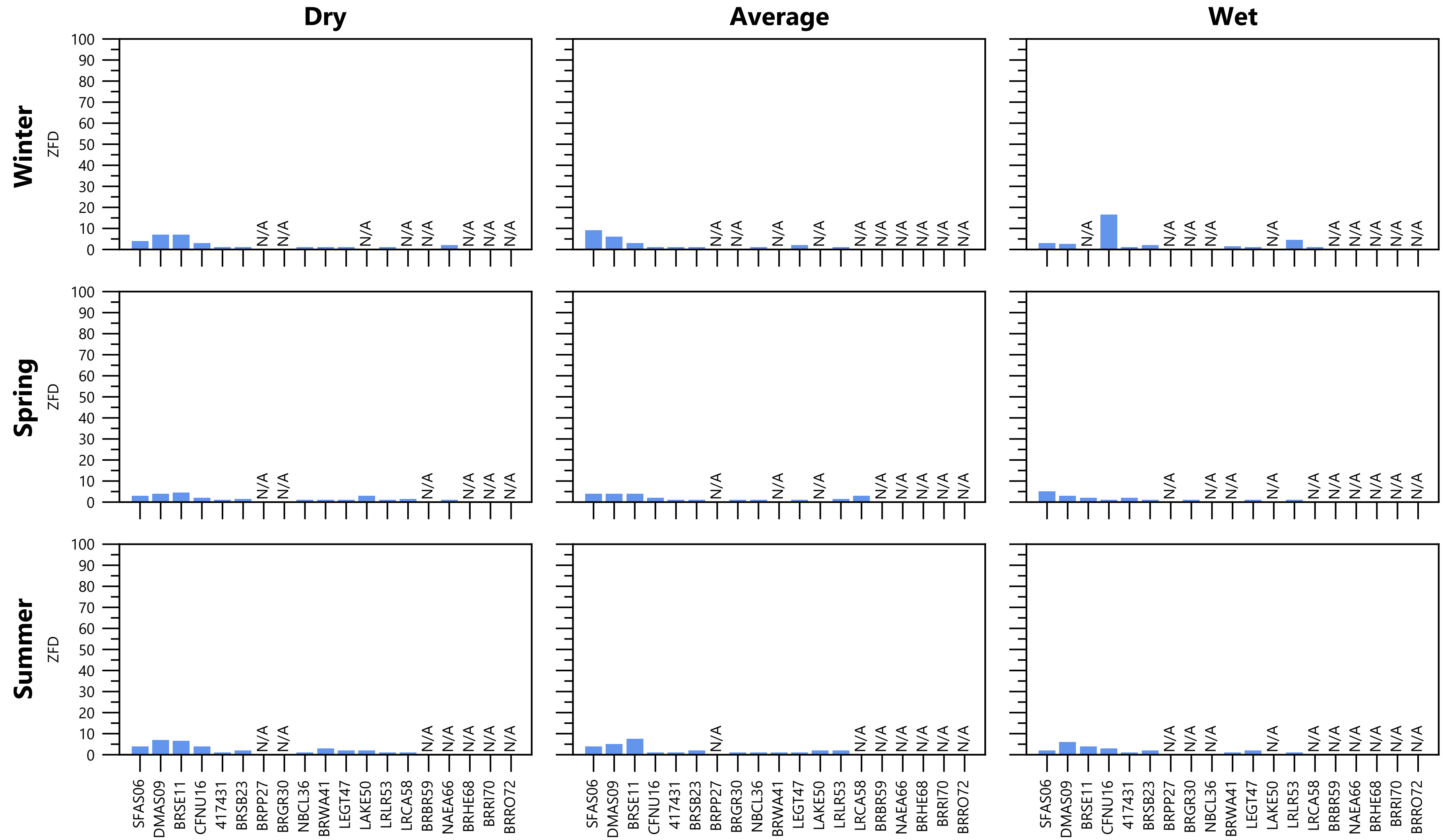
Figure I-31

Zero-Flow Frequencies (ZFF) by Season and Hydrologic Condition: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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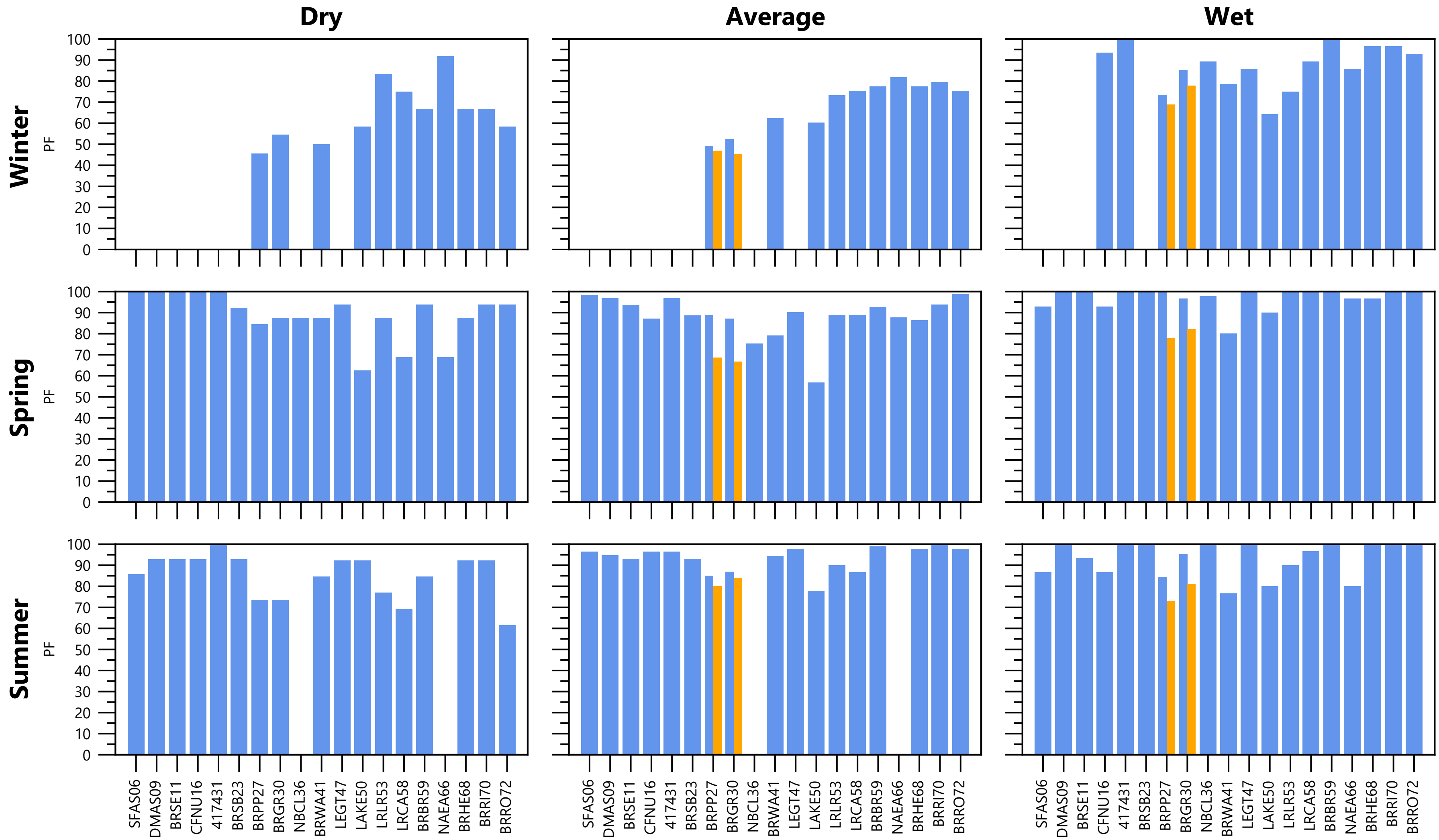
Figure I-32
Zero-Flow Durations (ZFD) by Season and Hydrologic Condition: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

Tier 1 Pulse
Tier 2 Pulse

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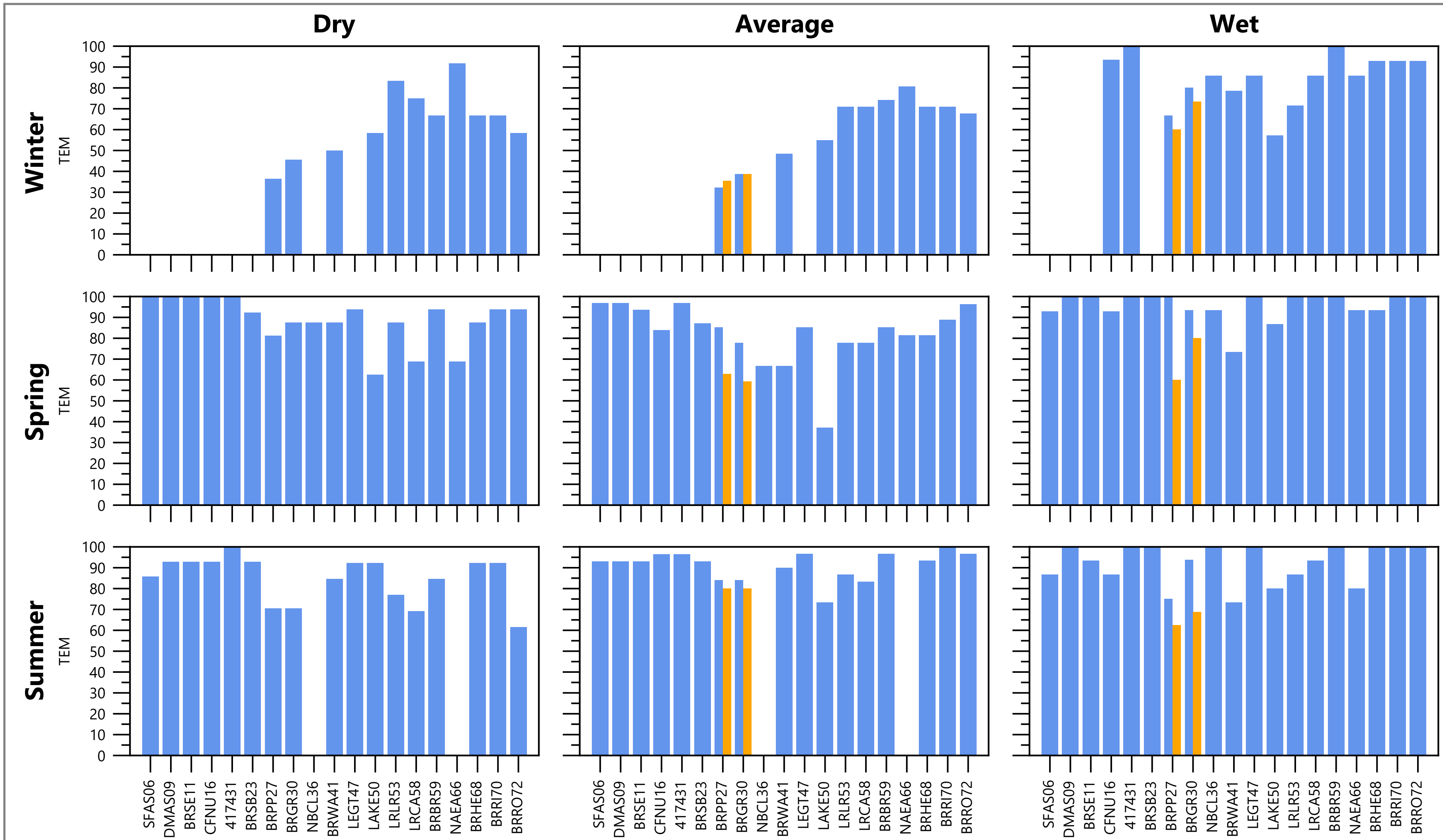
Figure I-33
Pulse Frequencies (PF) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

Tier 1 Pulse

Tier 2 Pulse

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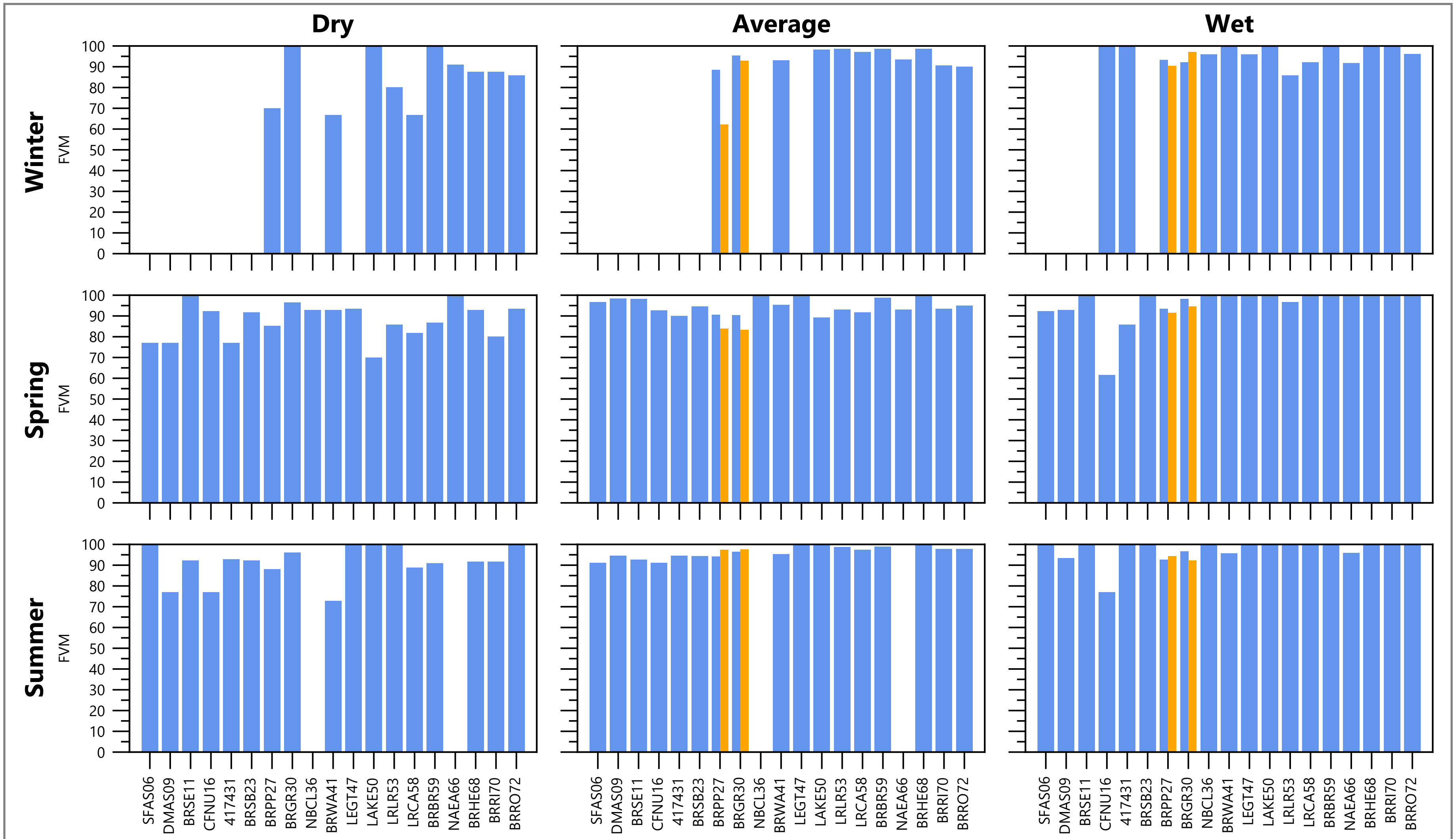
Figure I-34

Target Engagements Met (TEM) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

Tier 1 Pulse

Tier 2 Pulse

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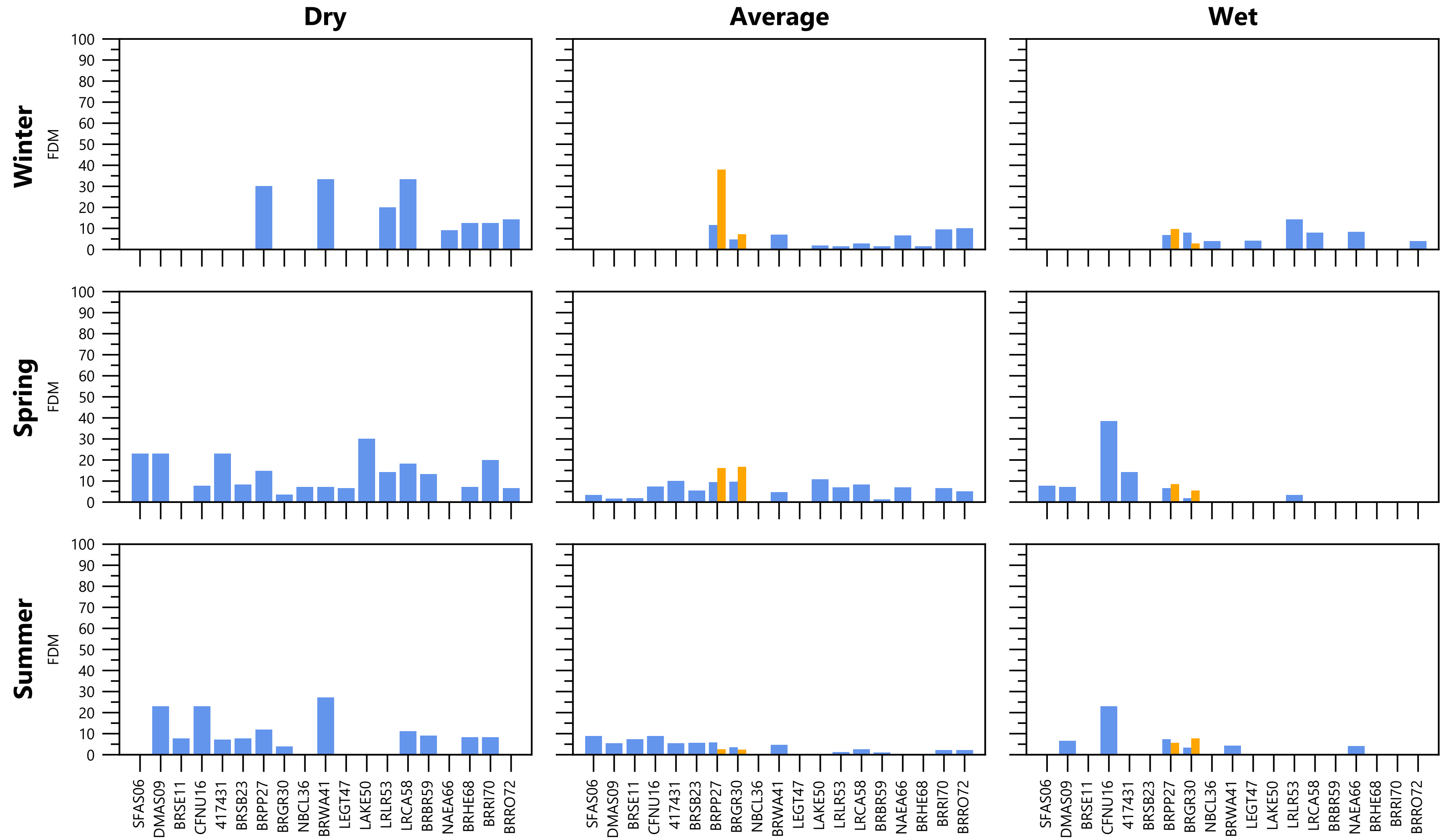
Figure I-35

Frequency Volume Met (FVM) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

Tier 1 Pulse

Tier 2 Pulse

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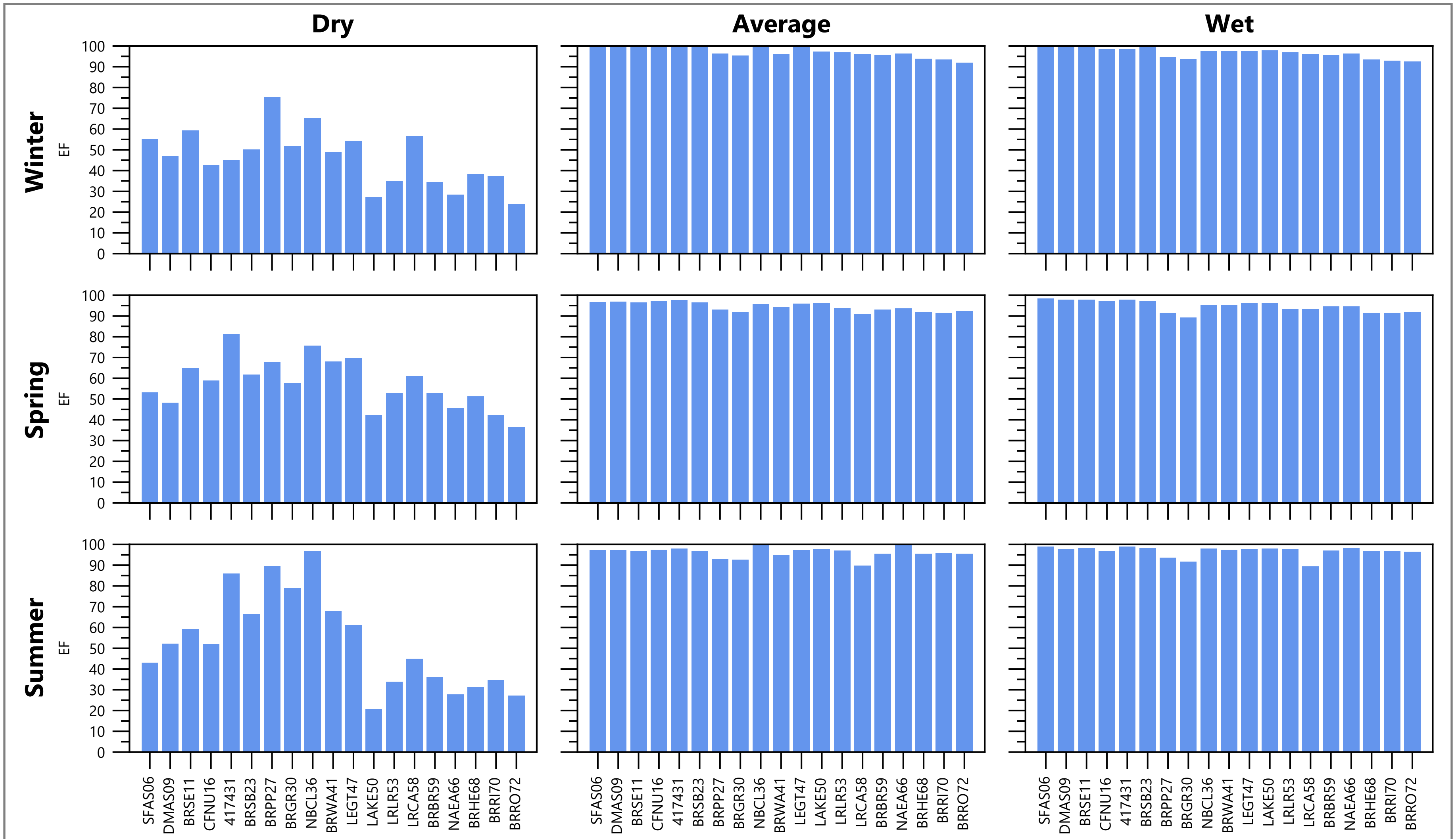
Figure I-36

Frequency Duration Met (FDM) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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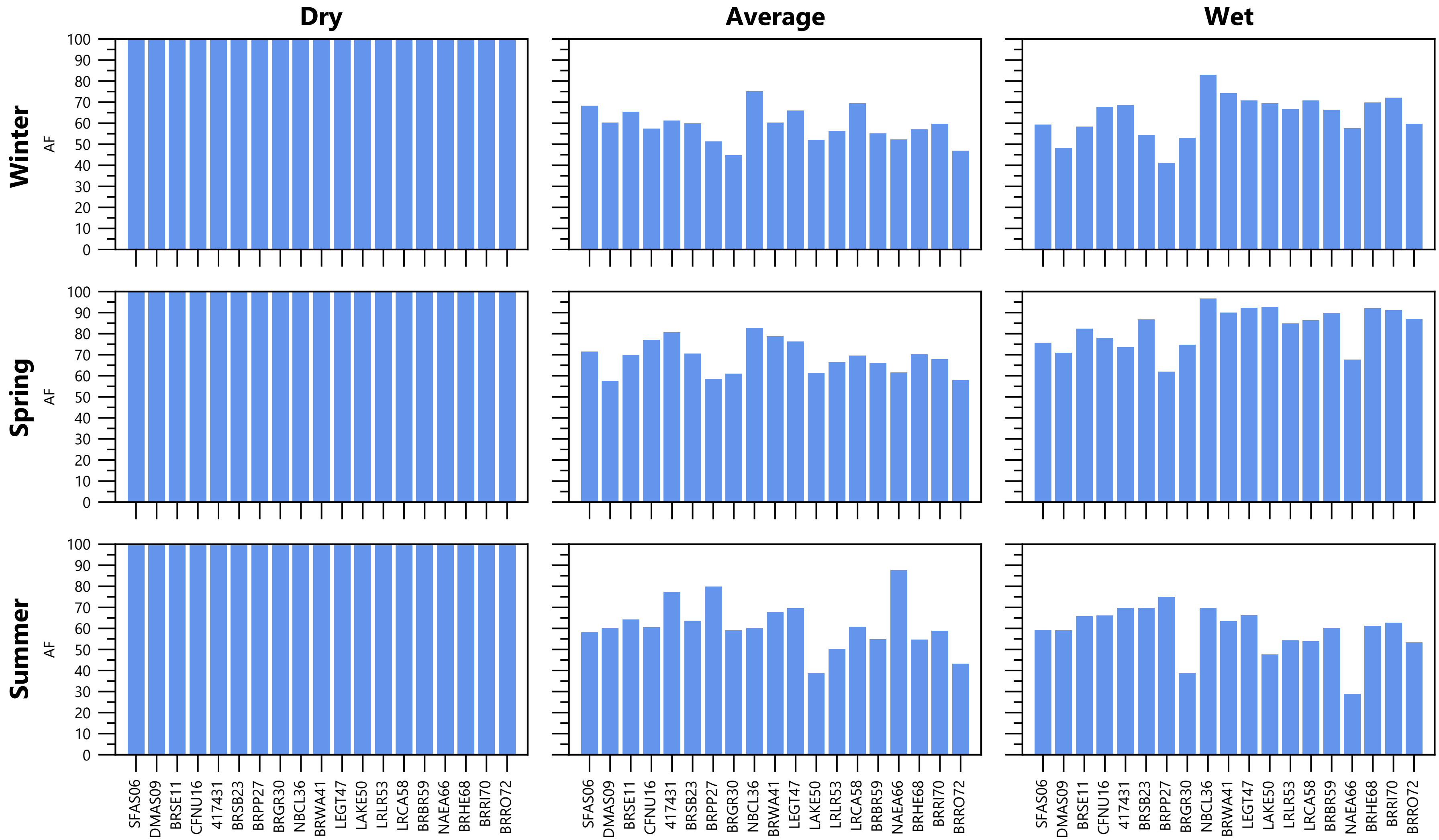
Figure I-37
Base Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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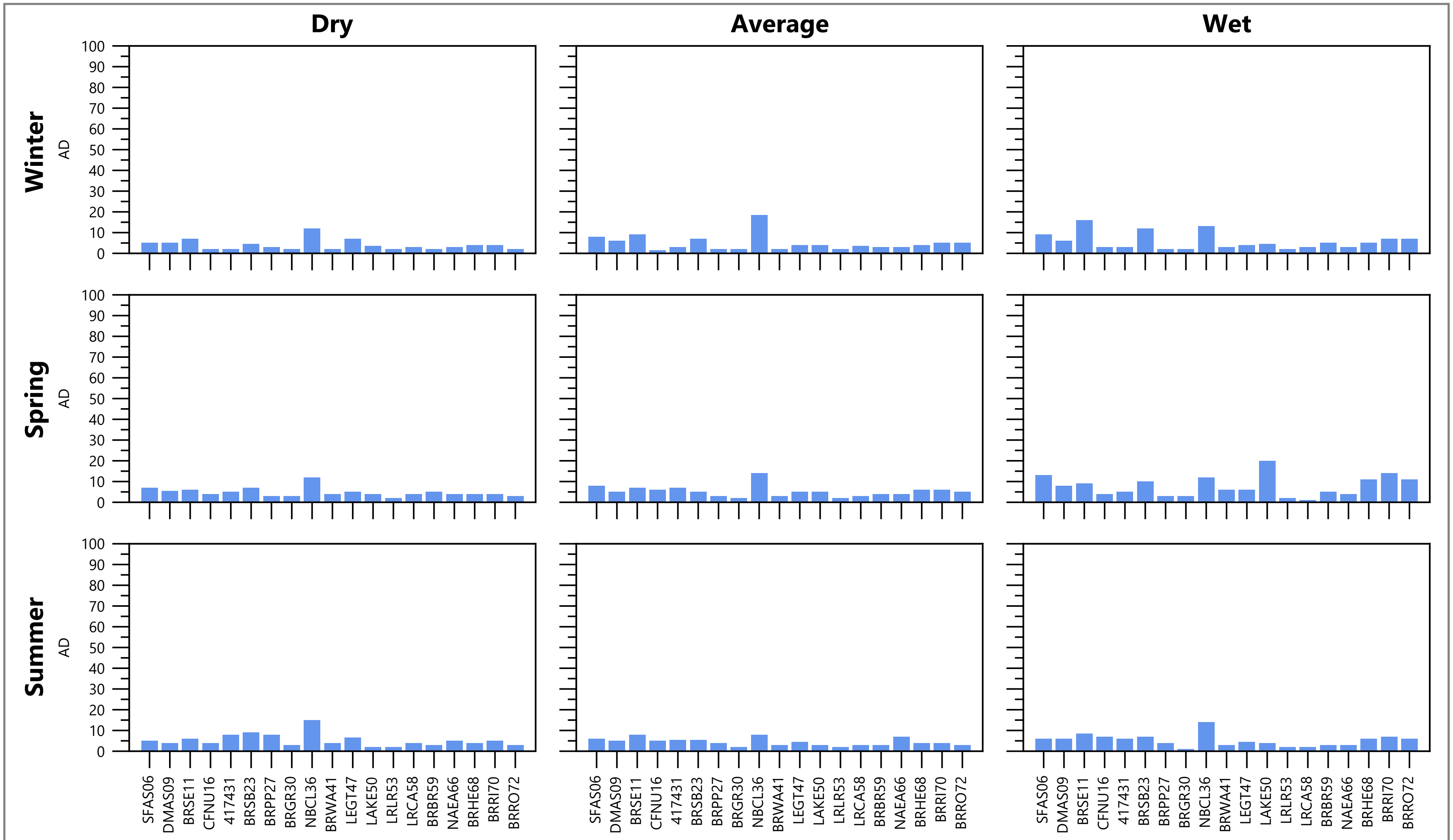
Figure I-38

Base Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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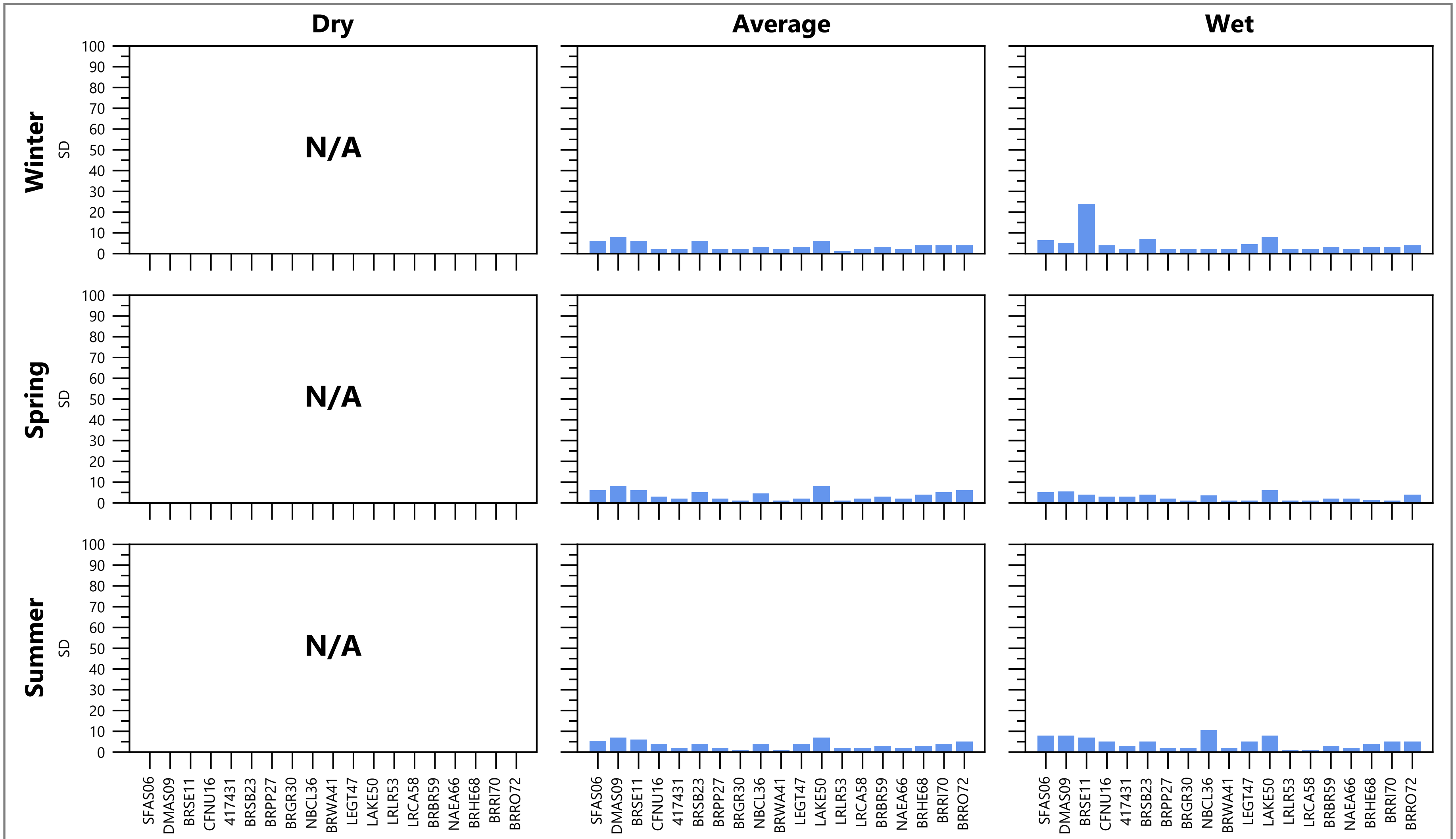
Figure I-39
Base Flow Attainment Duration (AD) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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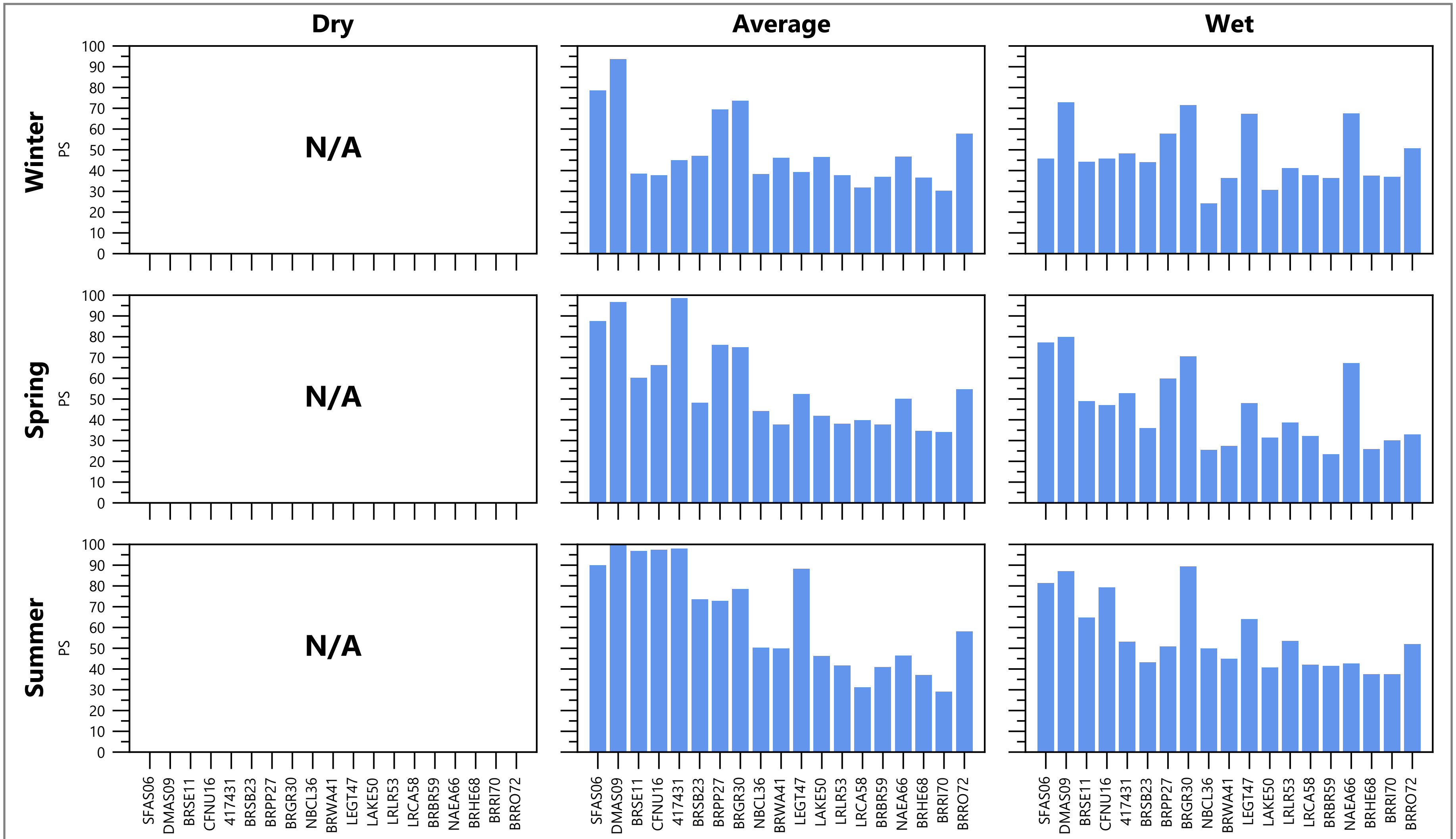
Figure I-40
Base Flow Shortage Duration (SD) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



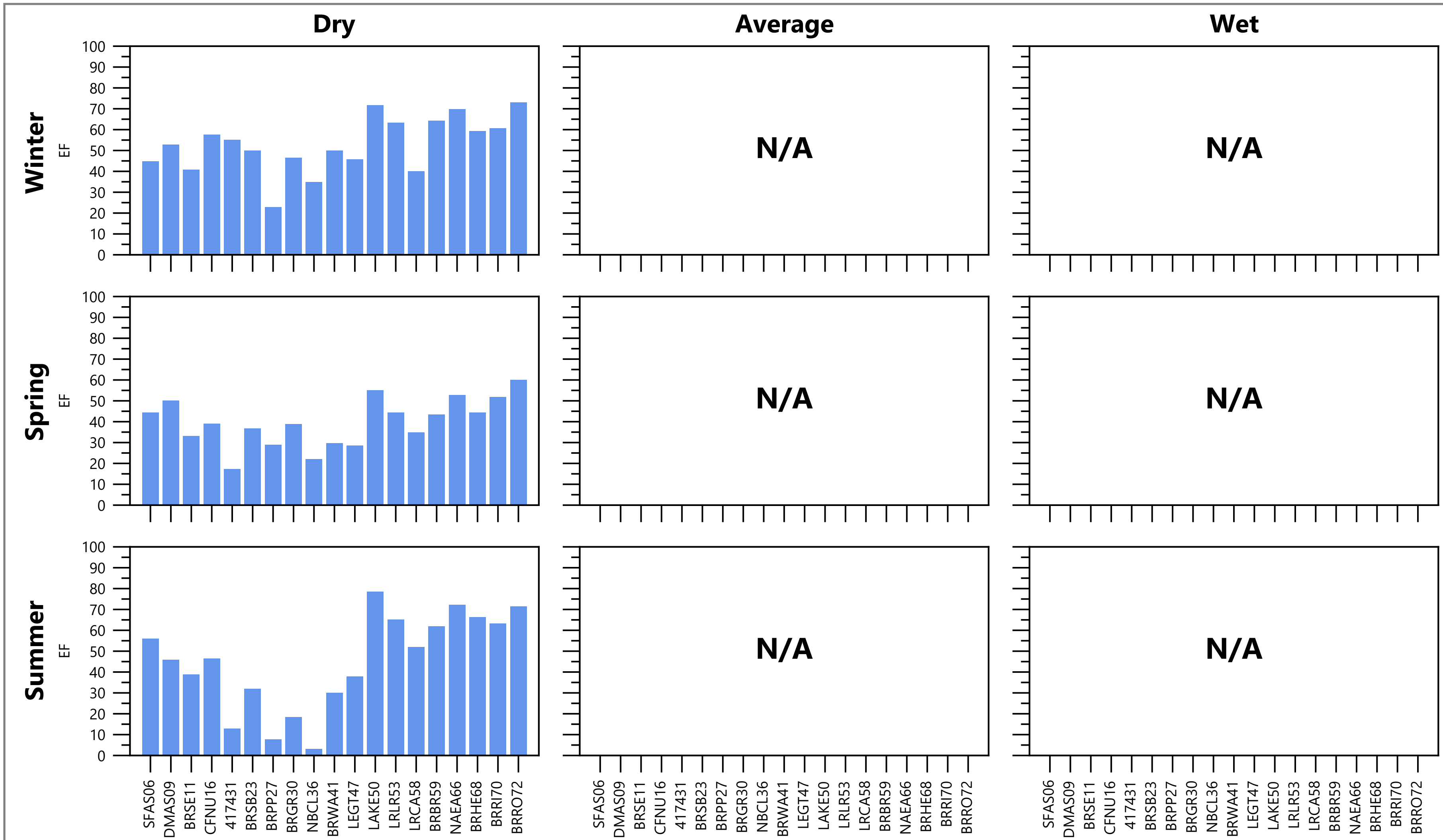
Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

Figure I-41

Base Flow Percent Shortage (PS) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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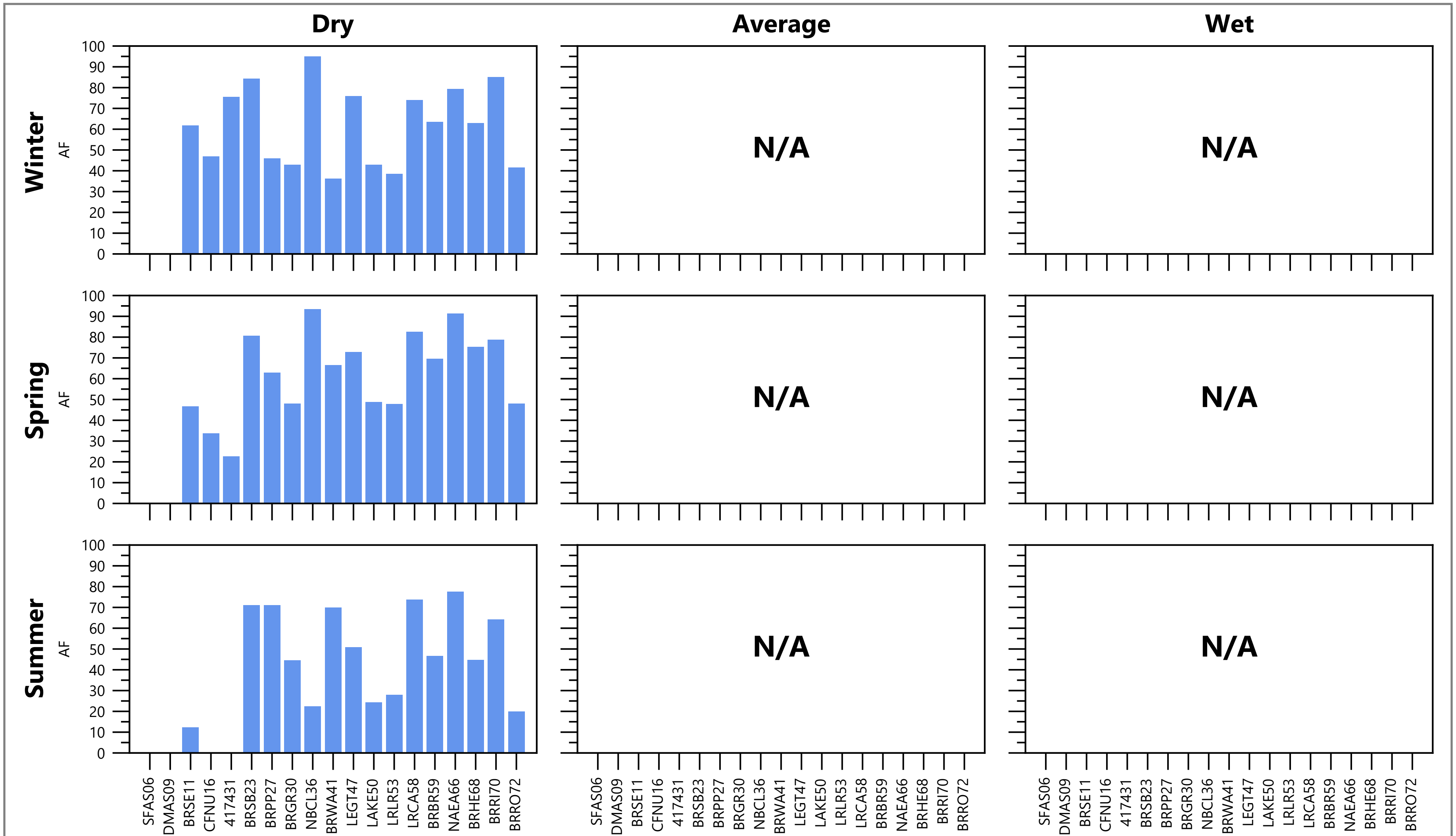
Figure I-42
Subsistence Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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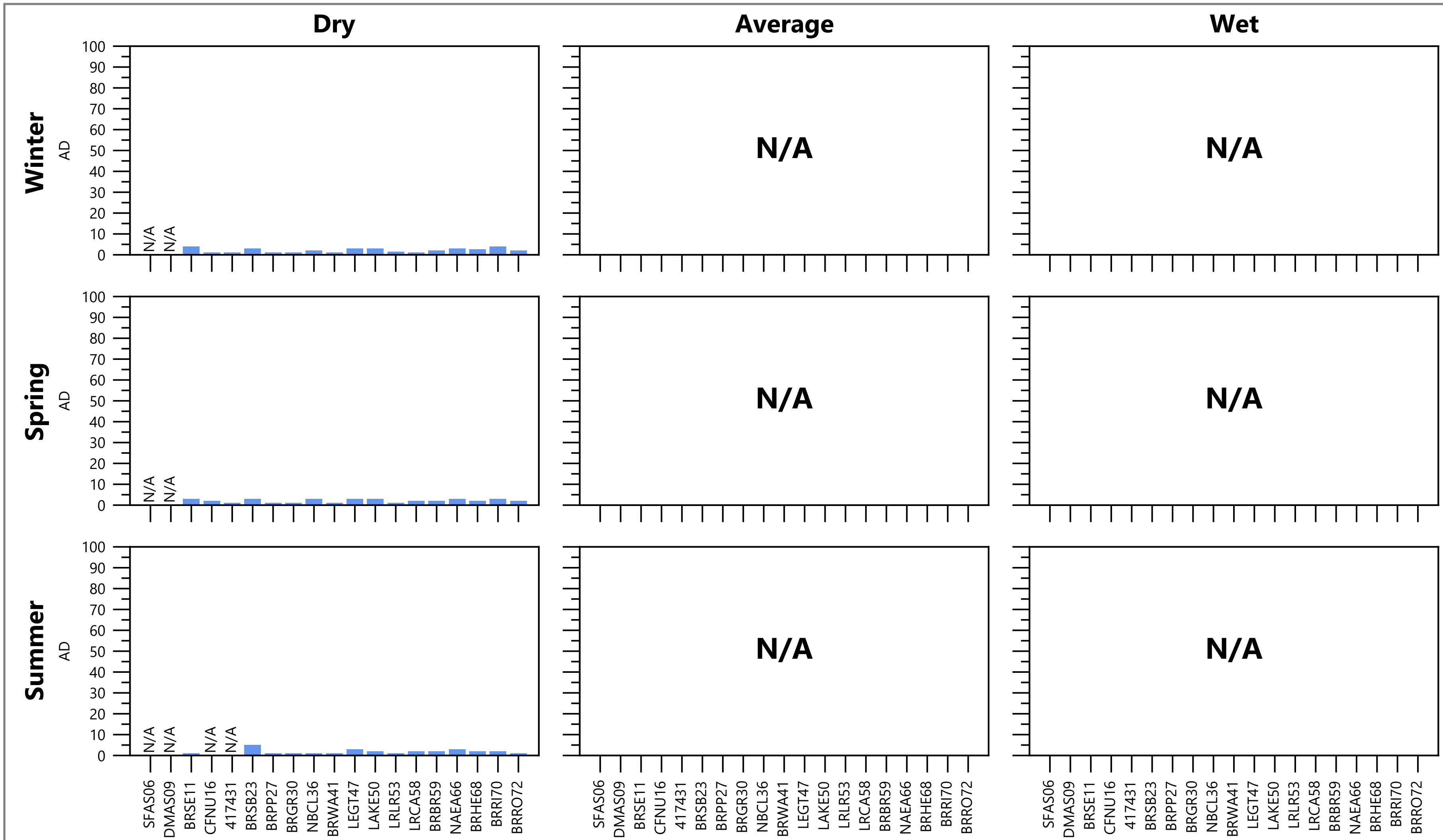
Figure I-43
Subsistence Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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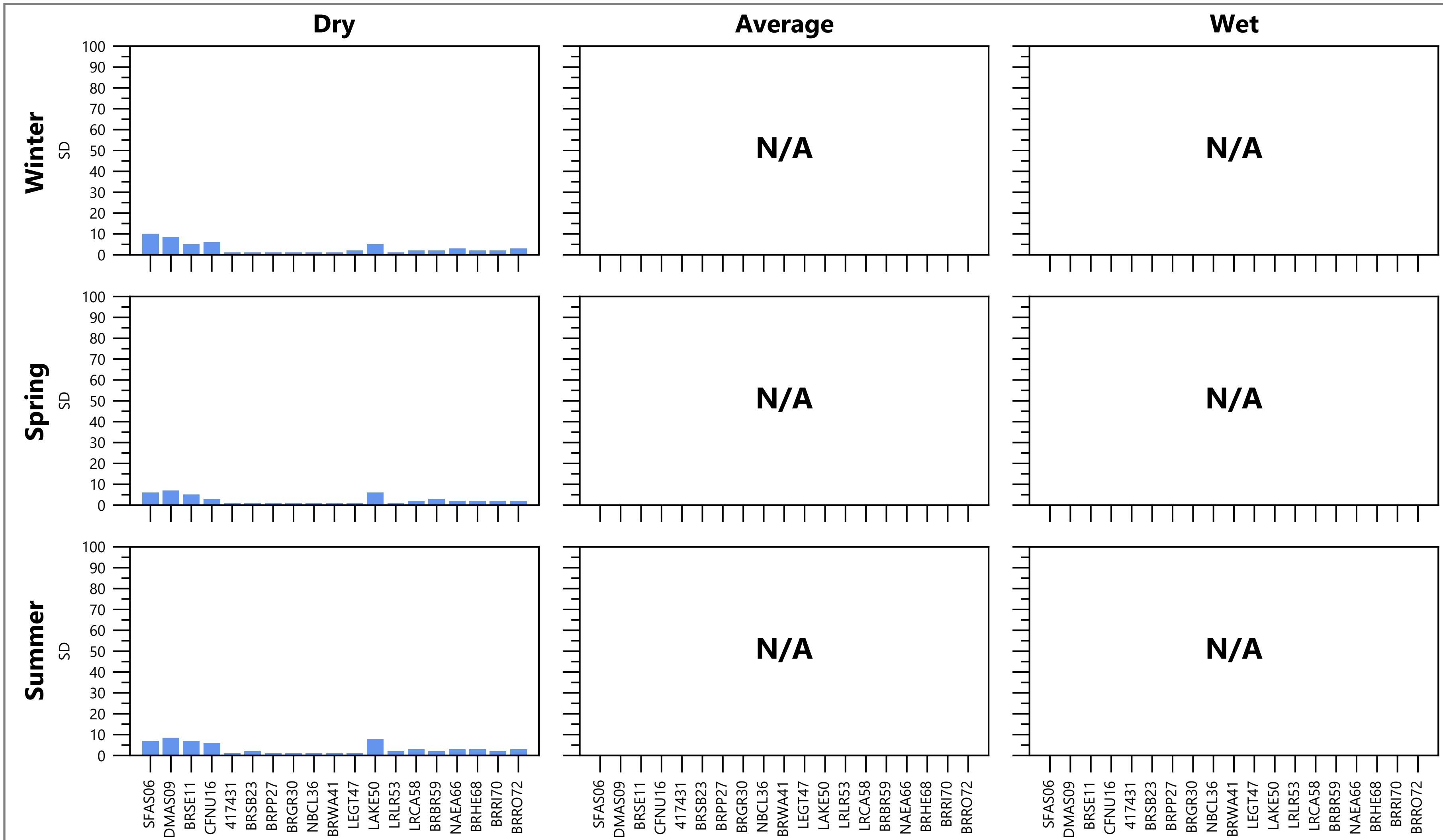
Figure I-44
Subsistence Flow Attainment Duration (AD) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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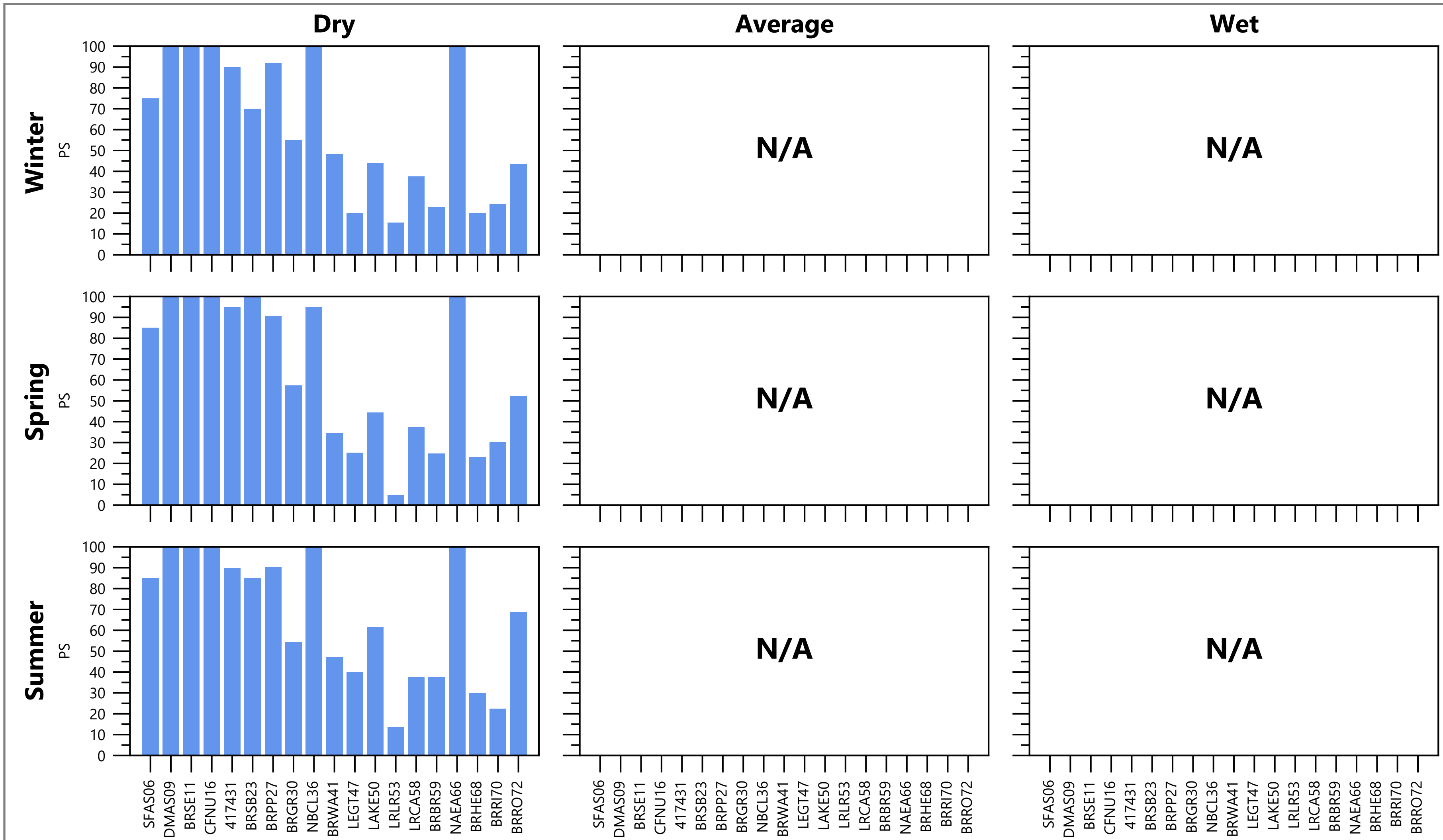
Figure I-45

Subsistence Flow Shortage Duration (SD) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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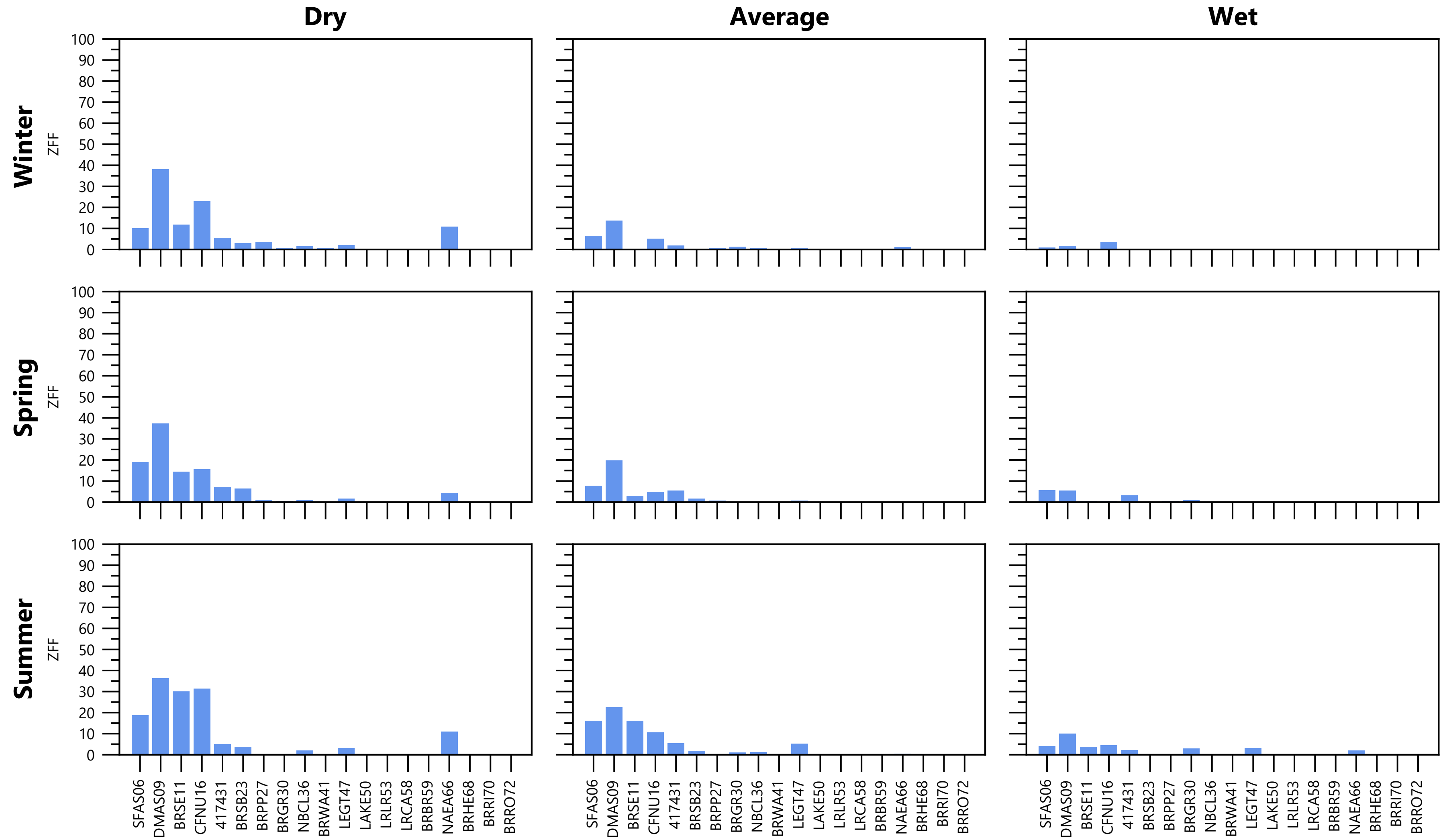
Figure I-46

Subsistence Flow Percent Shortage (PS) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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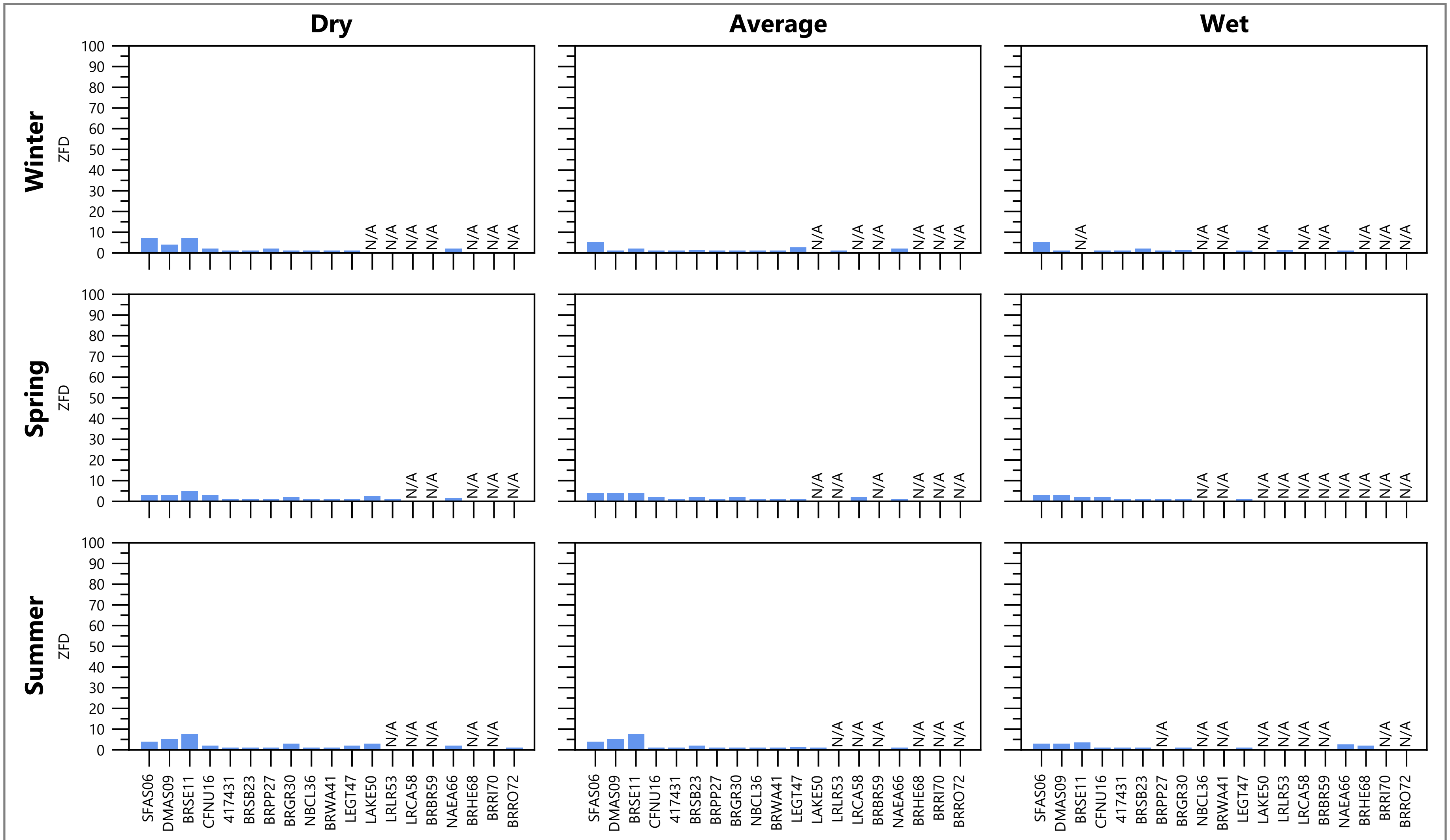
Figure I-47
Zero-Flow Frequencies (ZFF) by Season and Hydrologic Condition: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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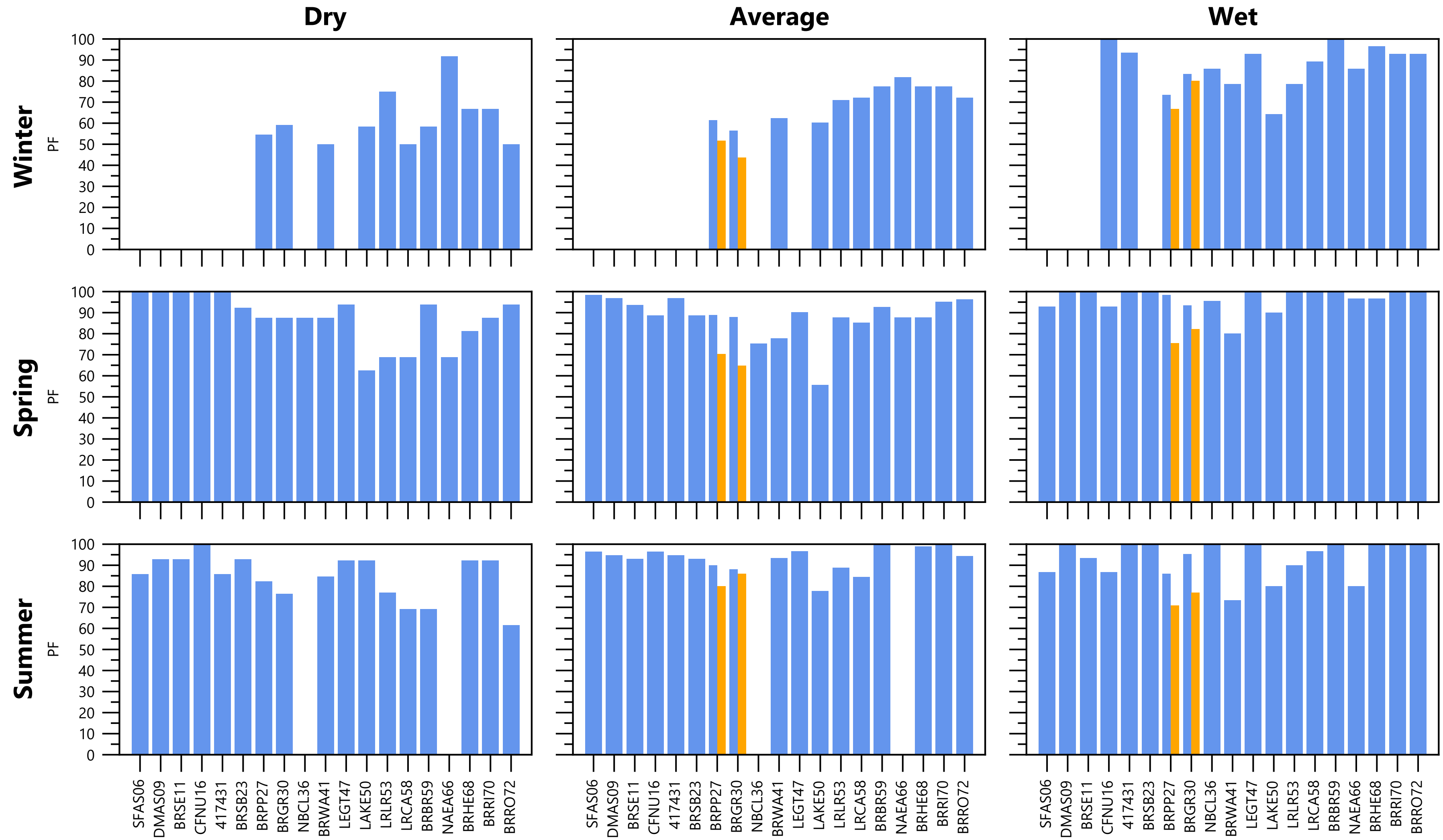
Figure I-48

Zero-Flow Durations (ZFD) by Season and Hydrologic Condition: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

Tier 1 Pulse
Tier 2 Pulse

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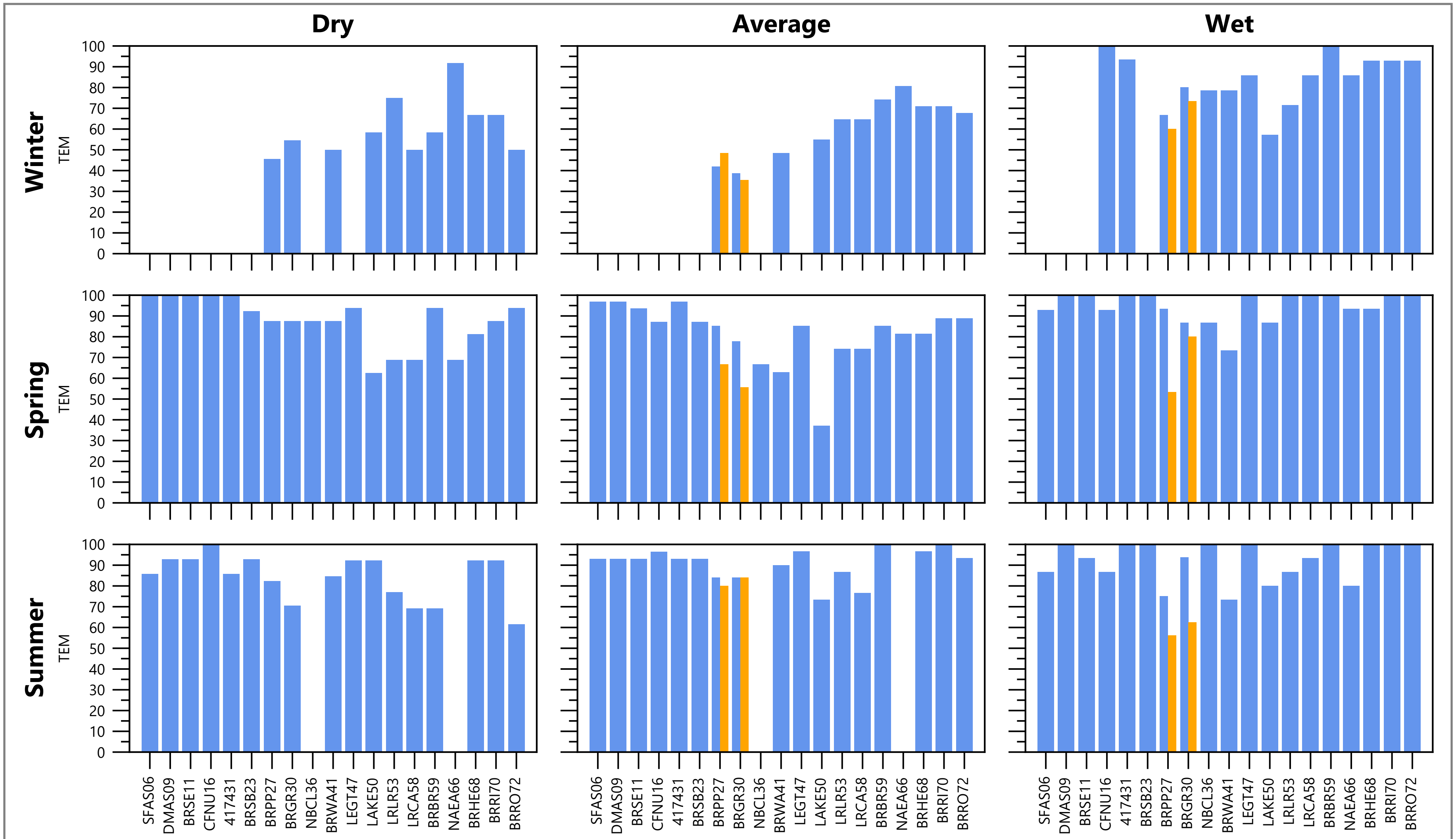
Figure I-49

Pulse Frequencies (PF) by Season and Hydrologic Condition: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

Tier 1 Pulse

Tier 2 Pulse

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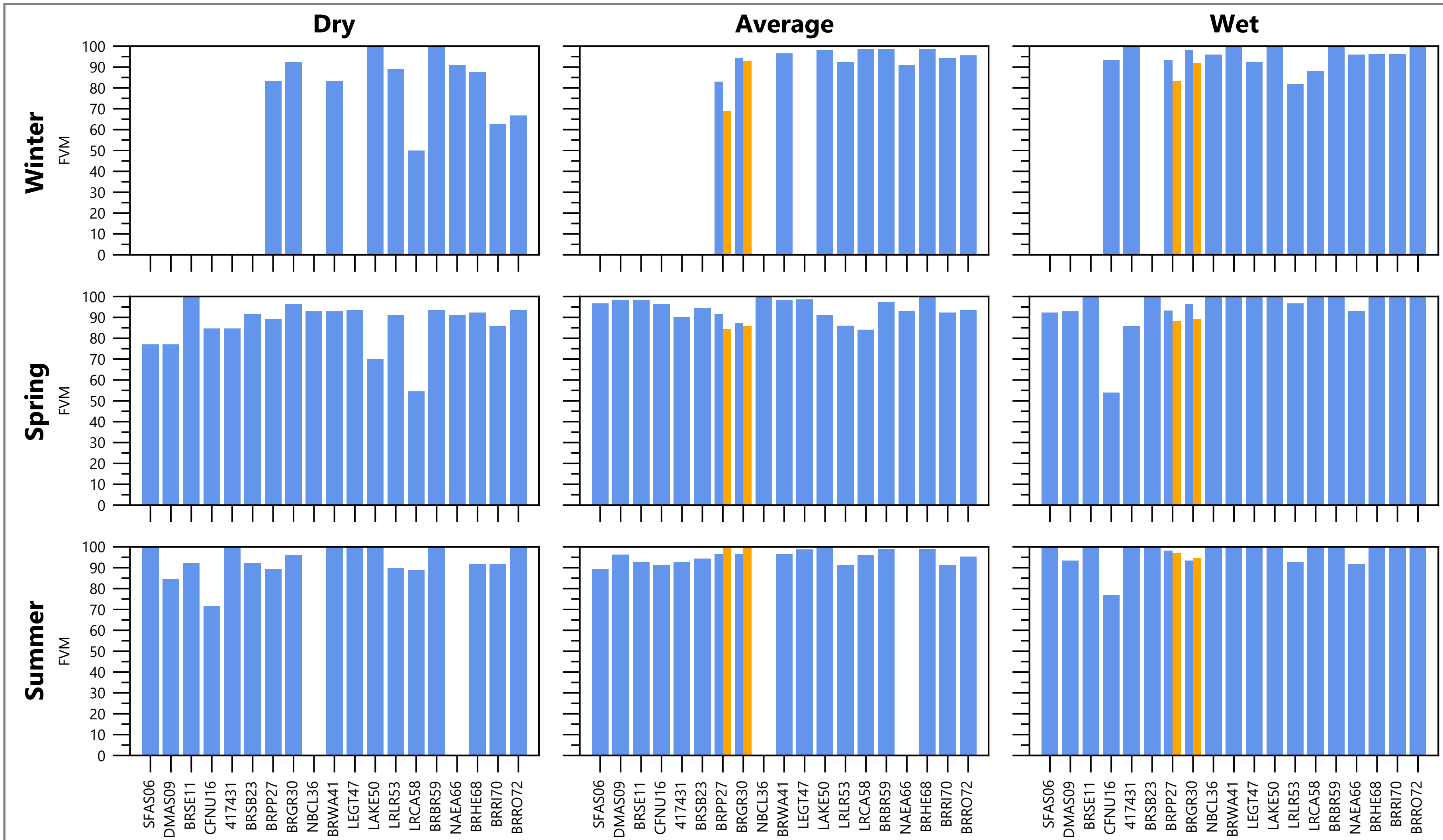
Figure I-50

Target Engagements Met (TEM) by Season and Hydrologic Condition: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

Tier 1 Pulse

Tier 2 Pulse

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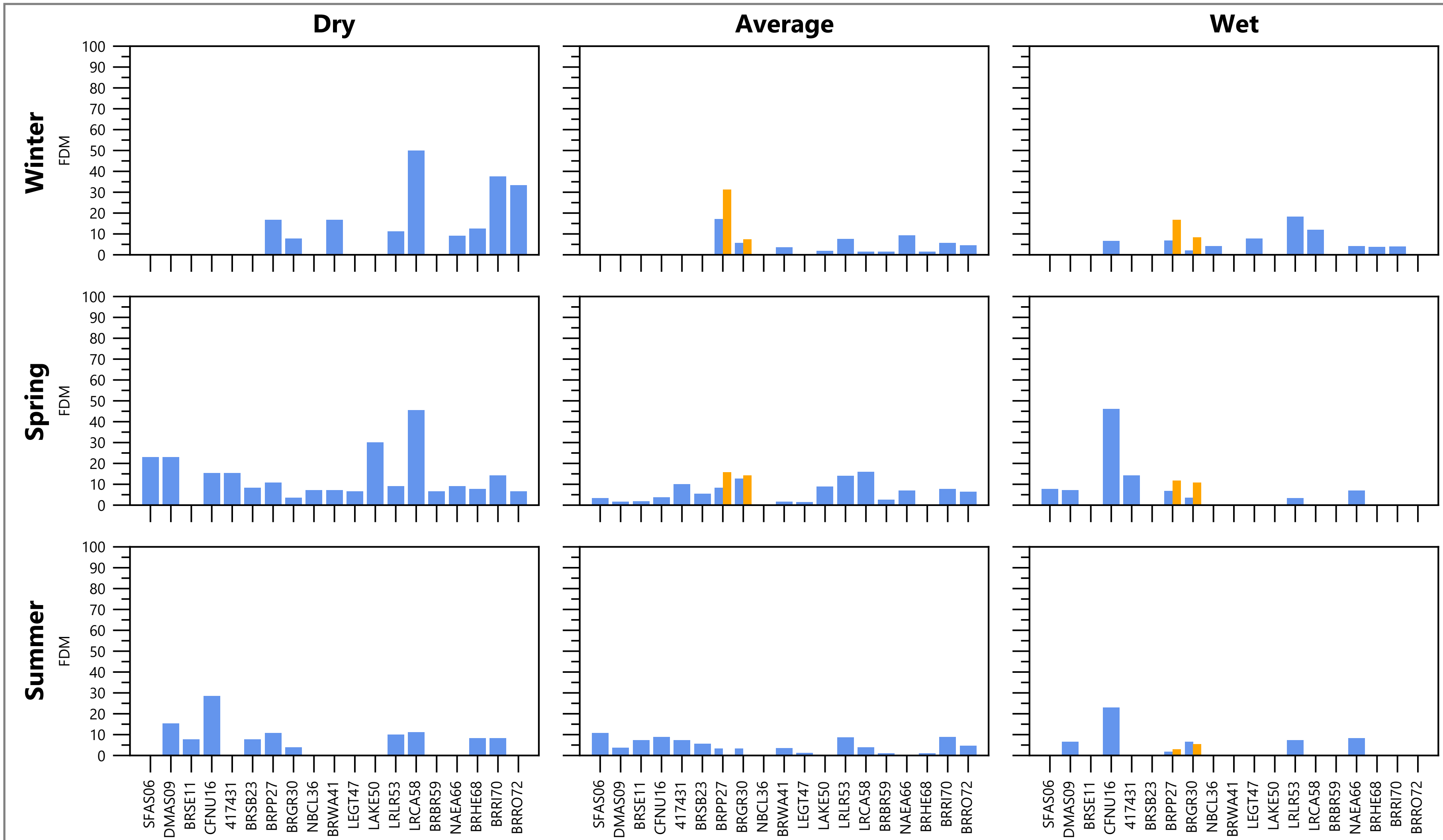
Figure I-51

Frequency Volume Met (FVM) by Season and Hydrologic Condition: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

Tier 1 Pulse

Tier 2 Pulse

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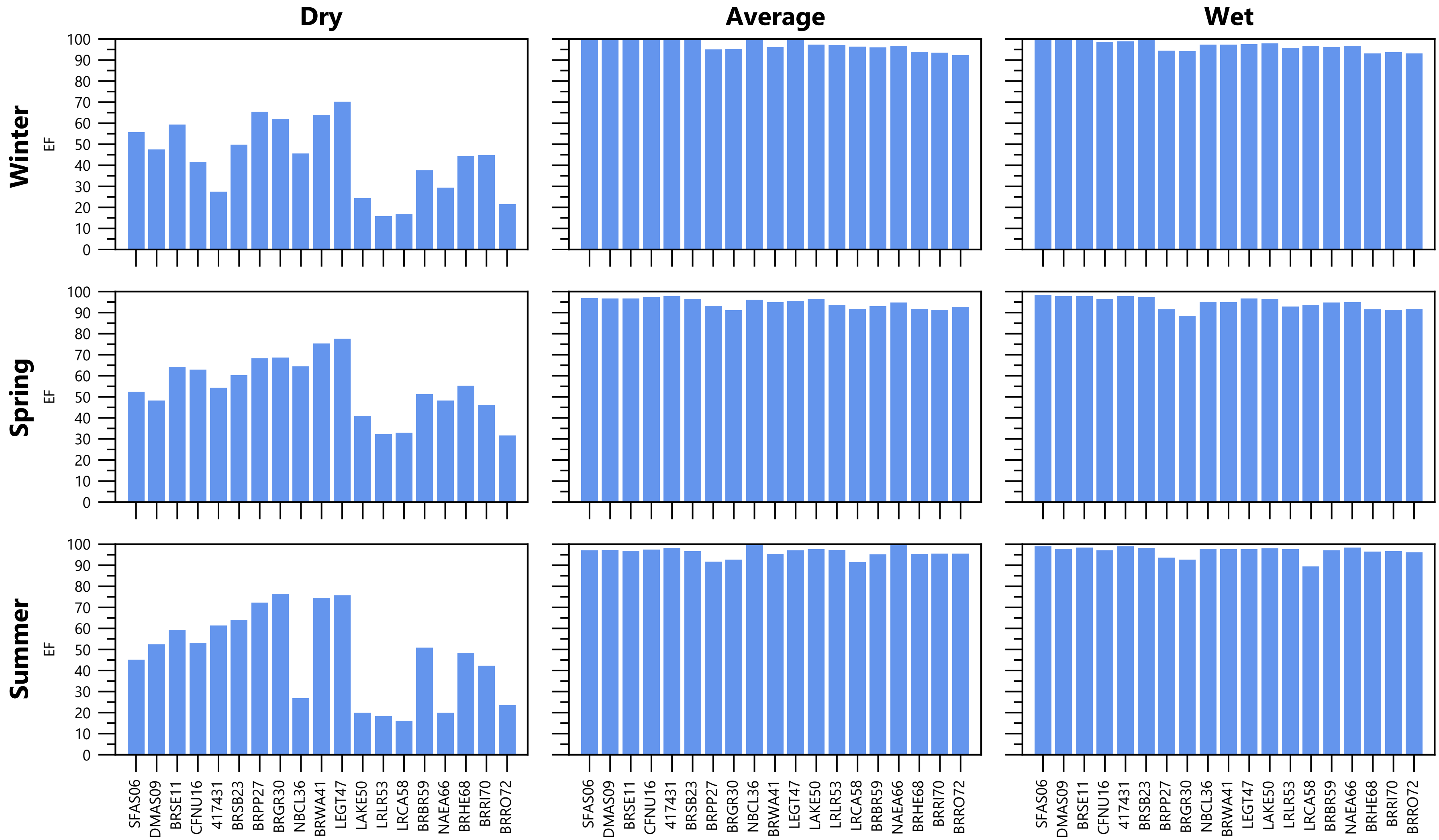
Figure I-52

Frequency Duration Met (FDM) by Season and Hydrologic Condition: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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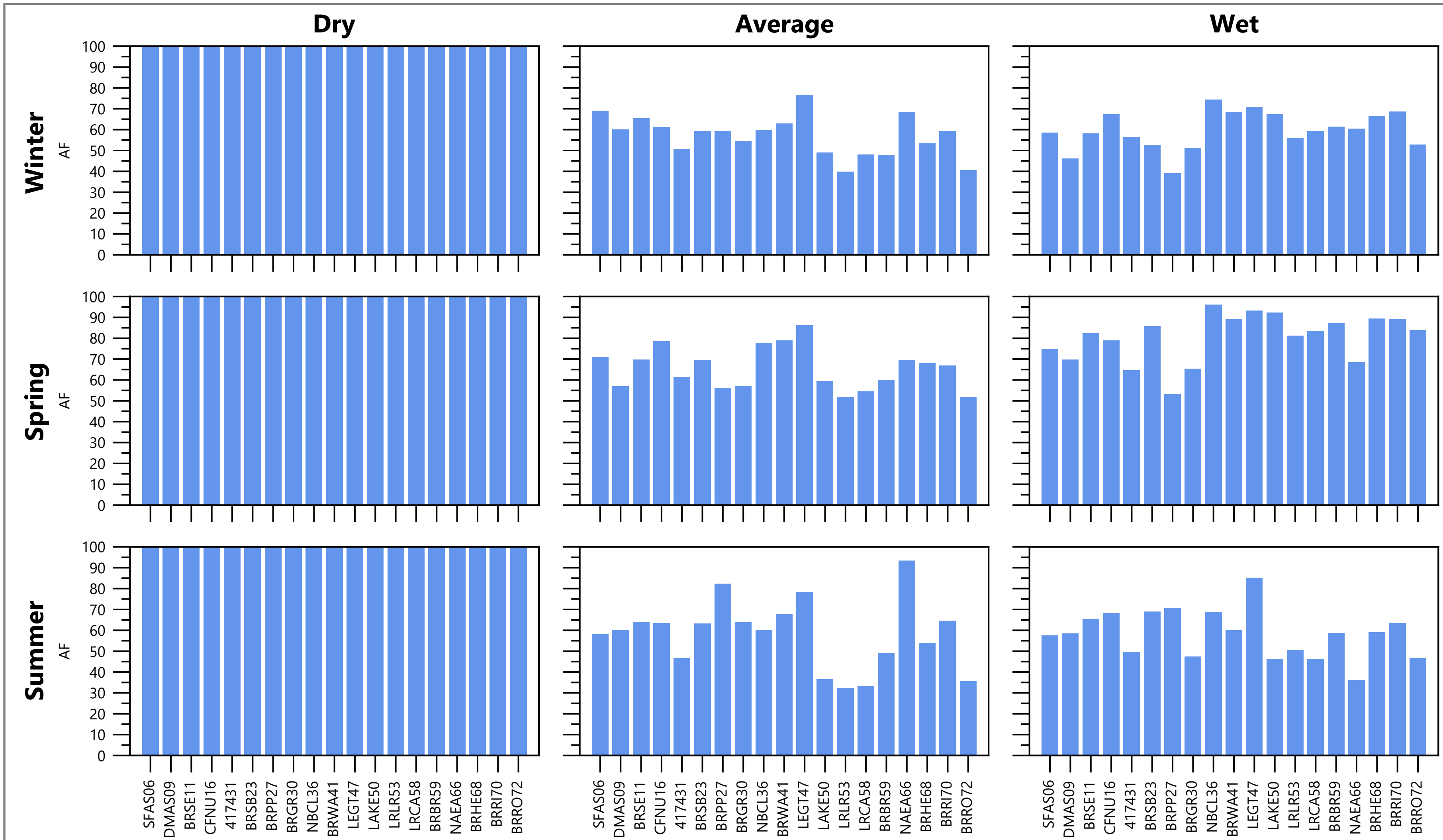
Figure I-53
Base Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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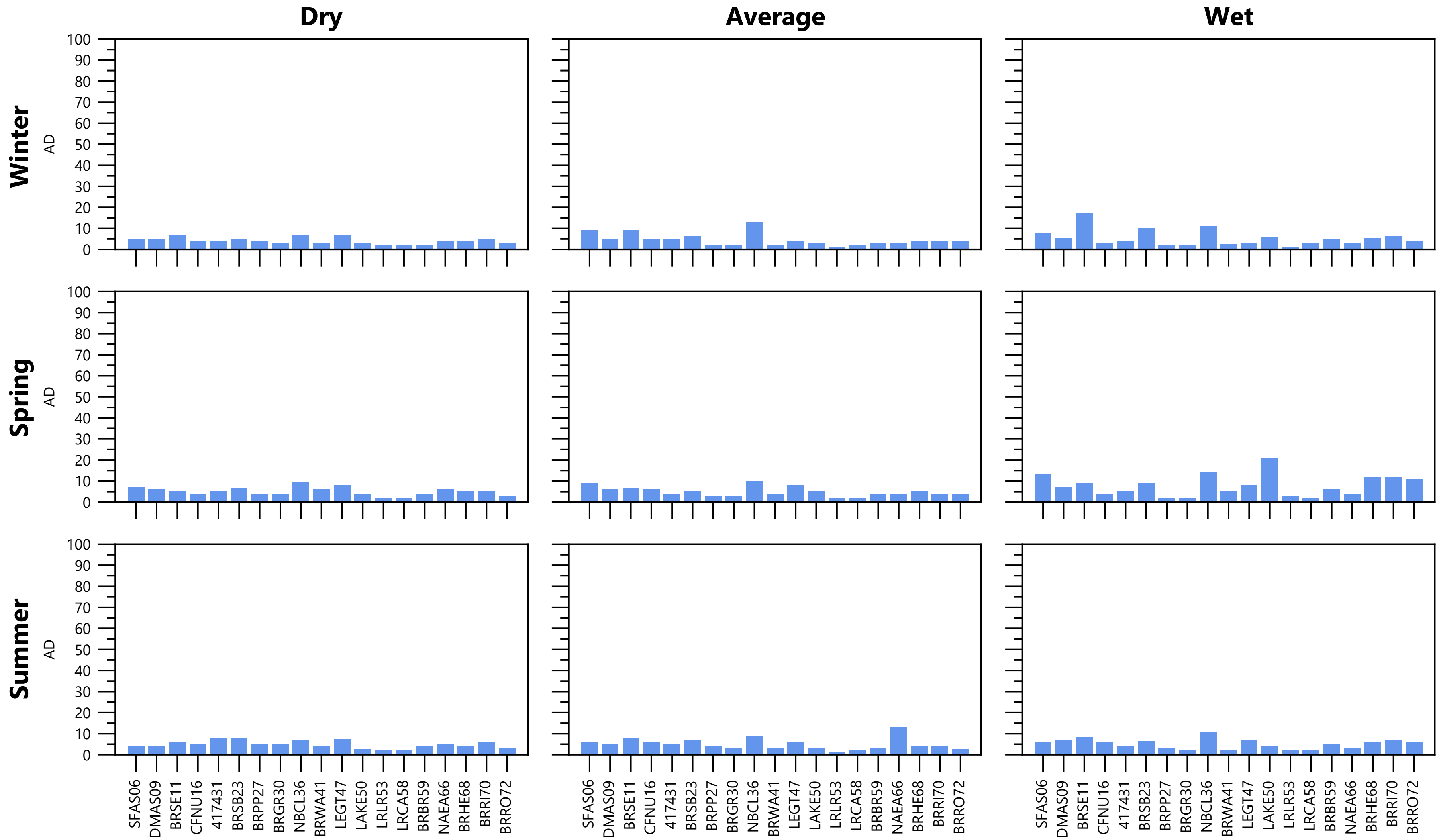
Figure I-54
Base Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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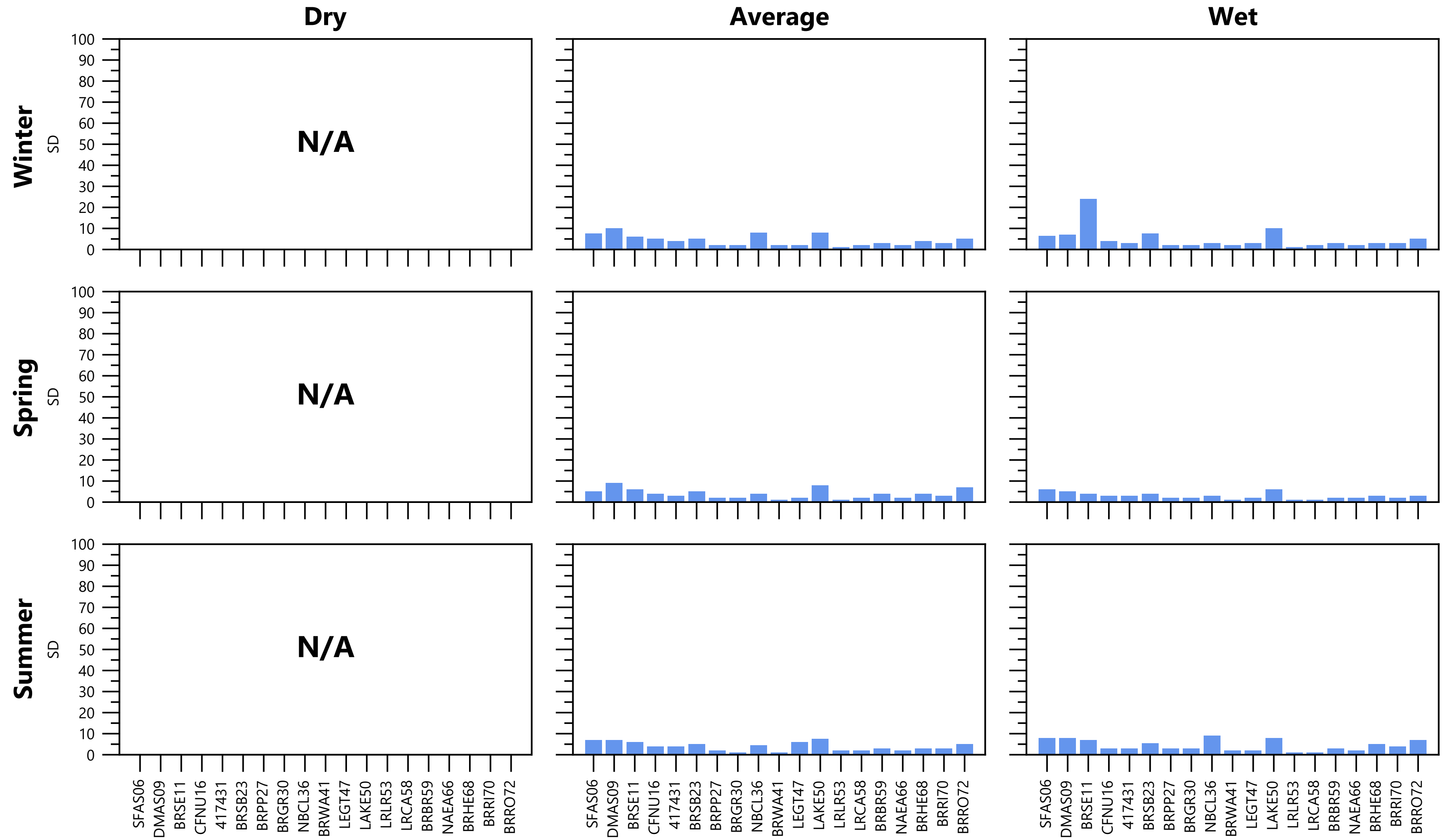
Figure I-55

Base Flow Attainment Duration (AD) by Season and Hydrologic Condition: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Brazos River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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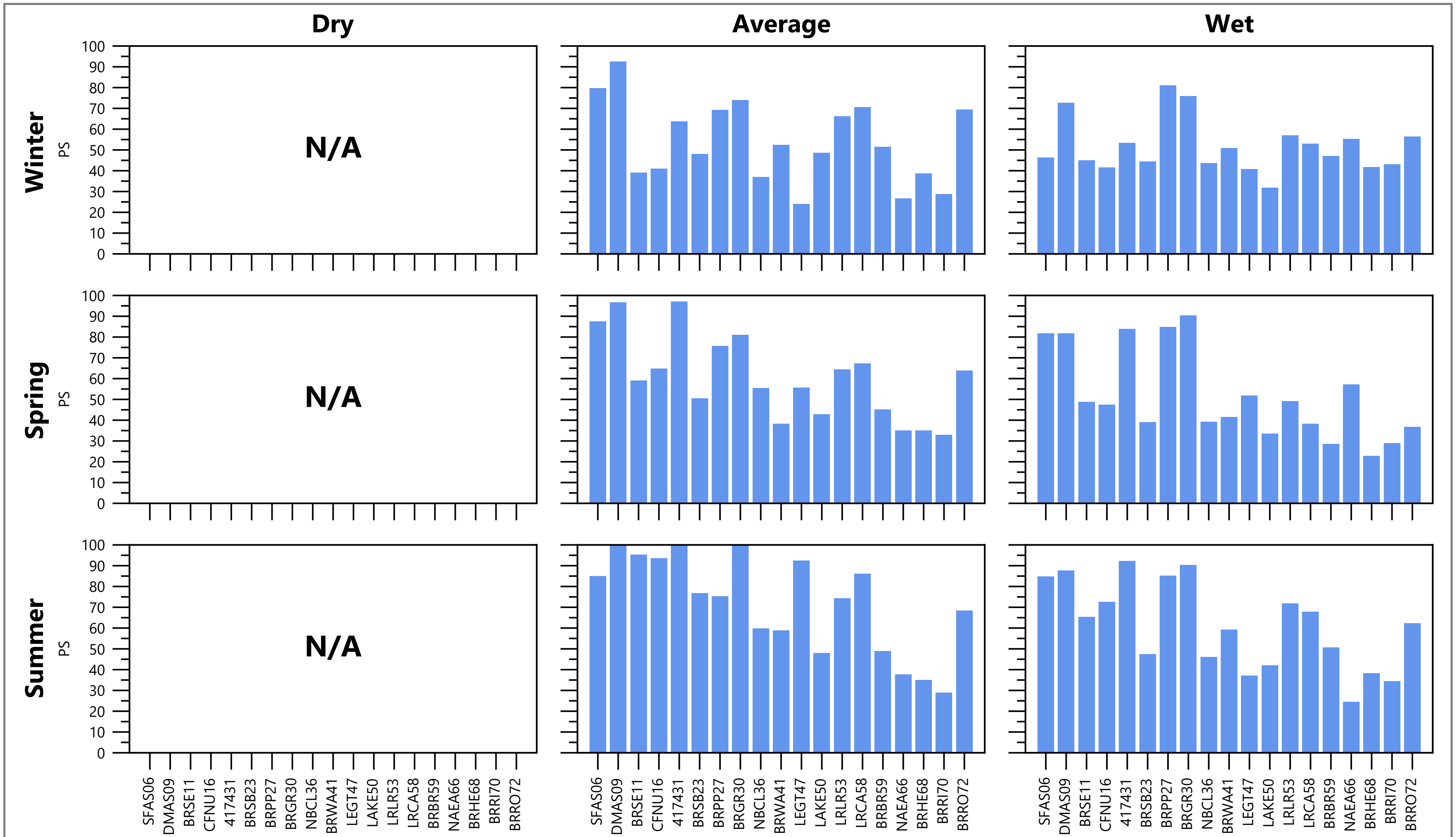
Figure I-56
Base Flow Shortage Duration (SD) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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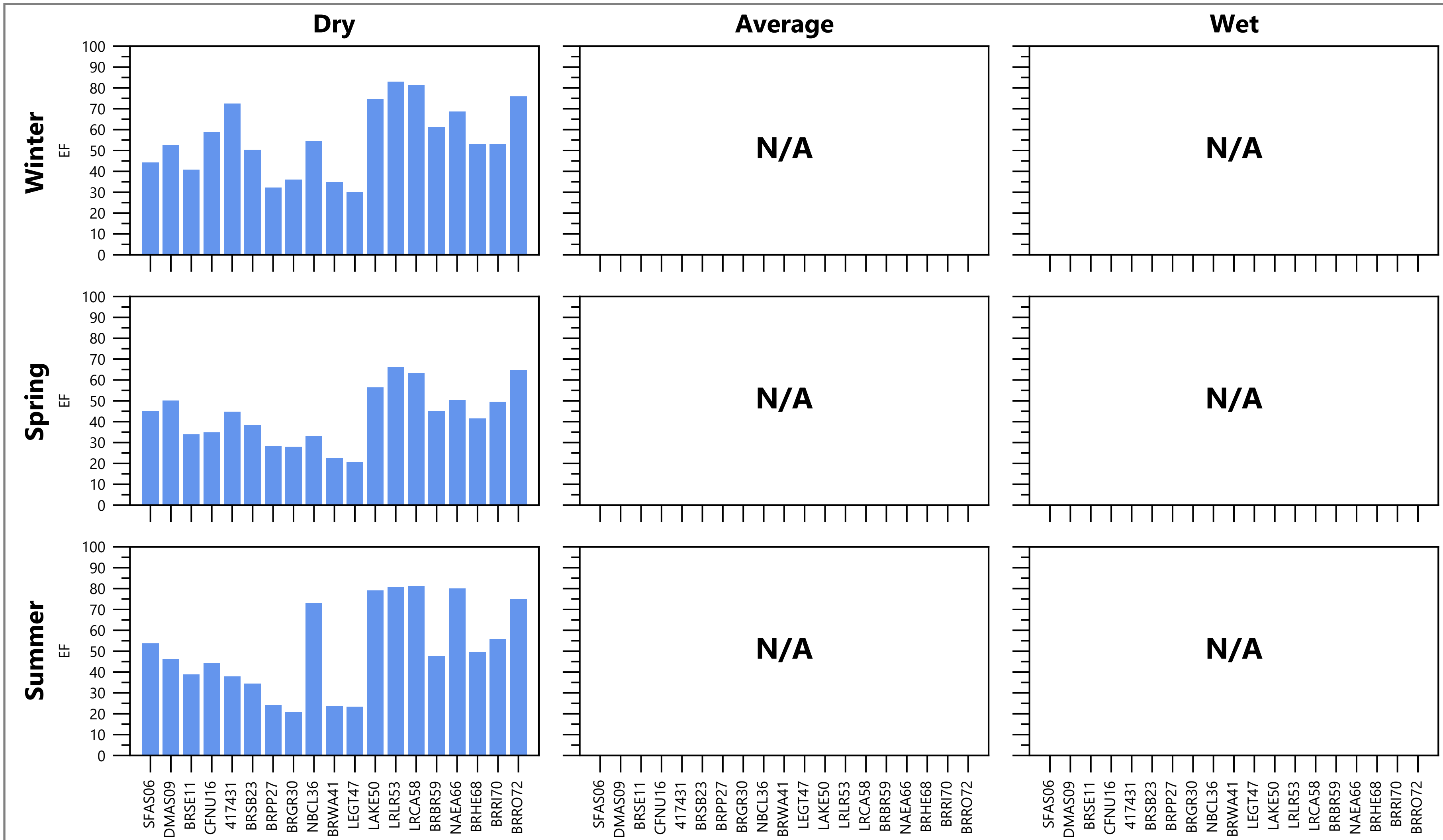
Figure I-57
Base Flow Percent Shortage (PS) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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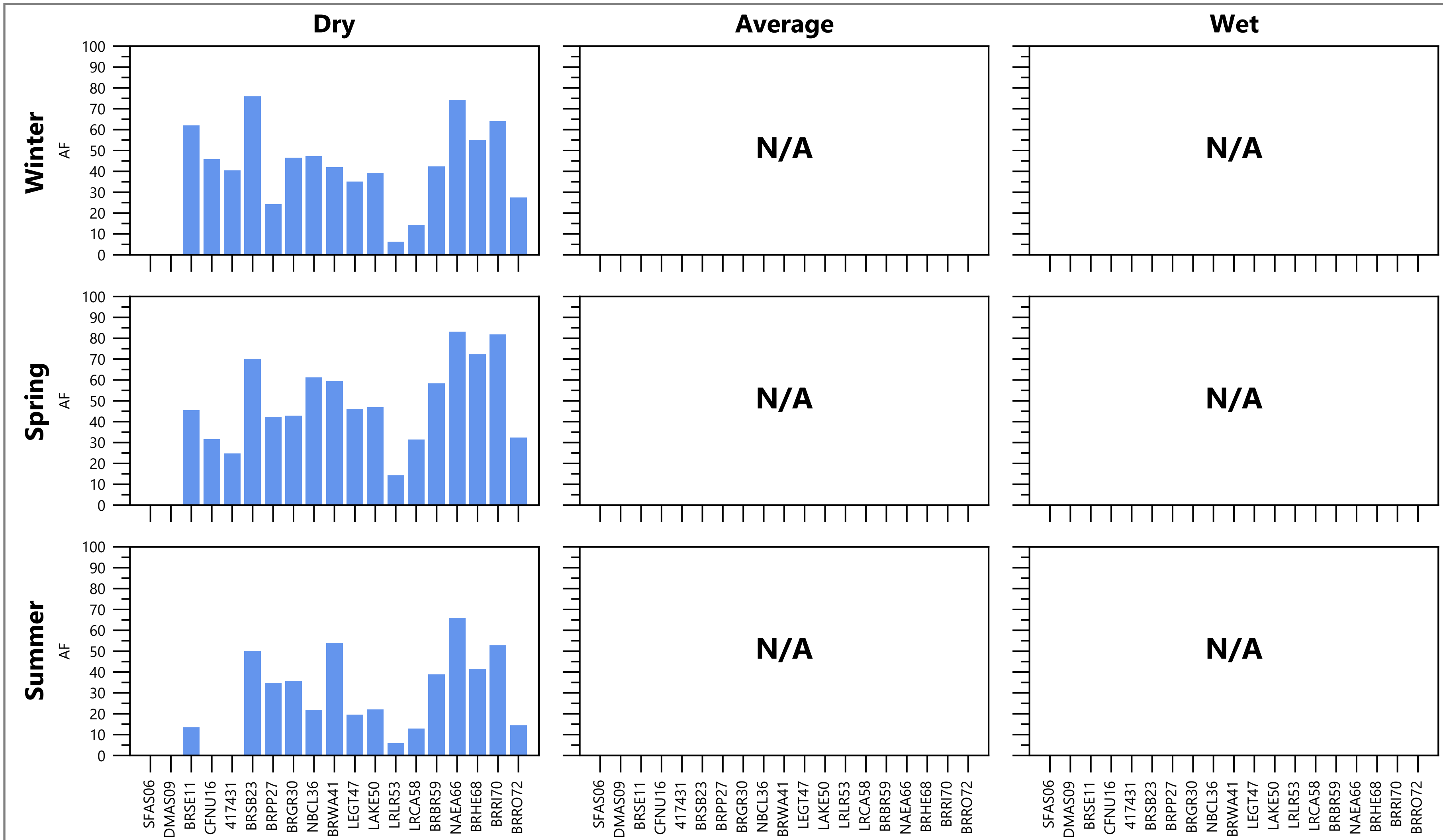
Figure I-58
Subsistence Flow Engagement Frequency (EF) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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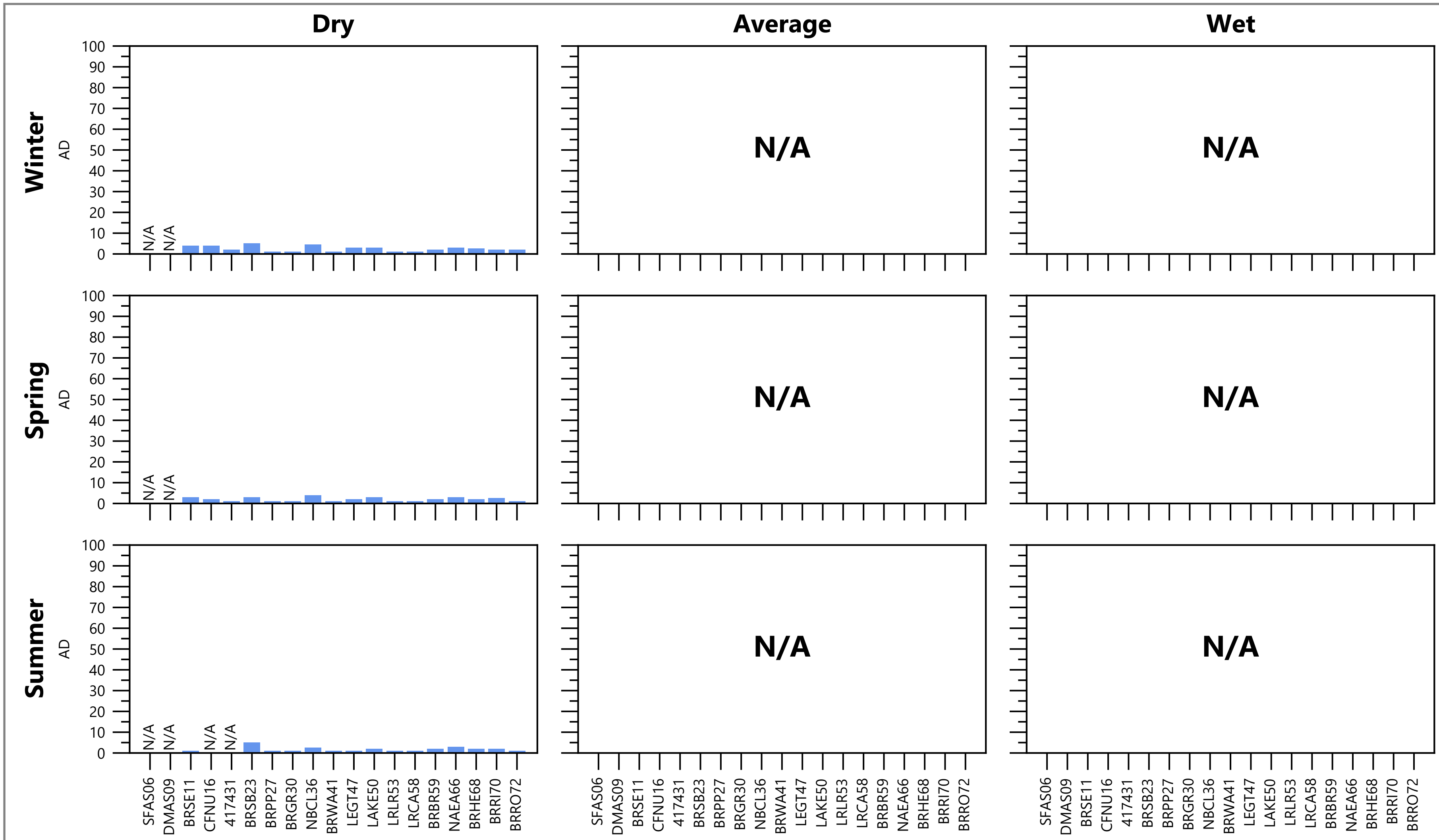
Figure I-59
Subsistence Flow Attainment Frequency (AF) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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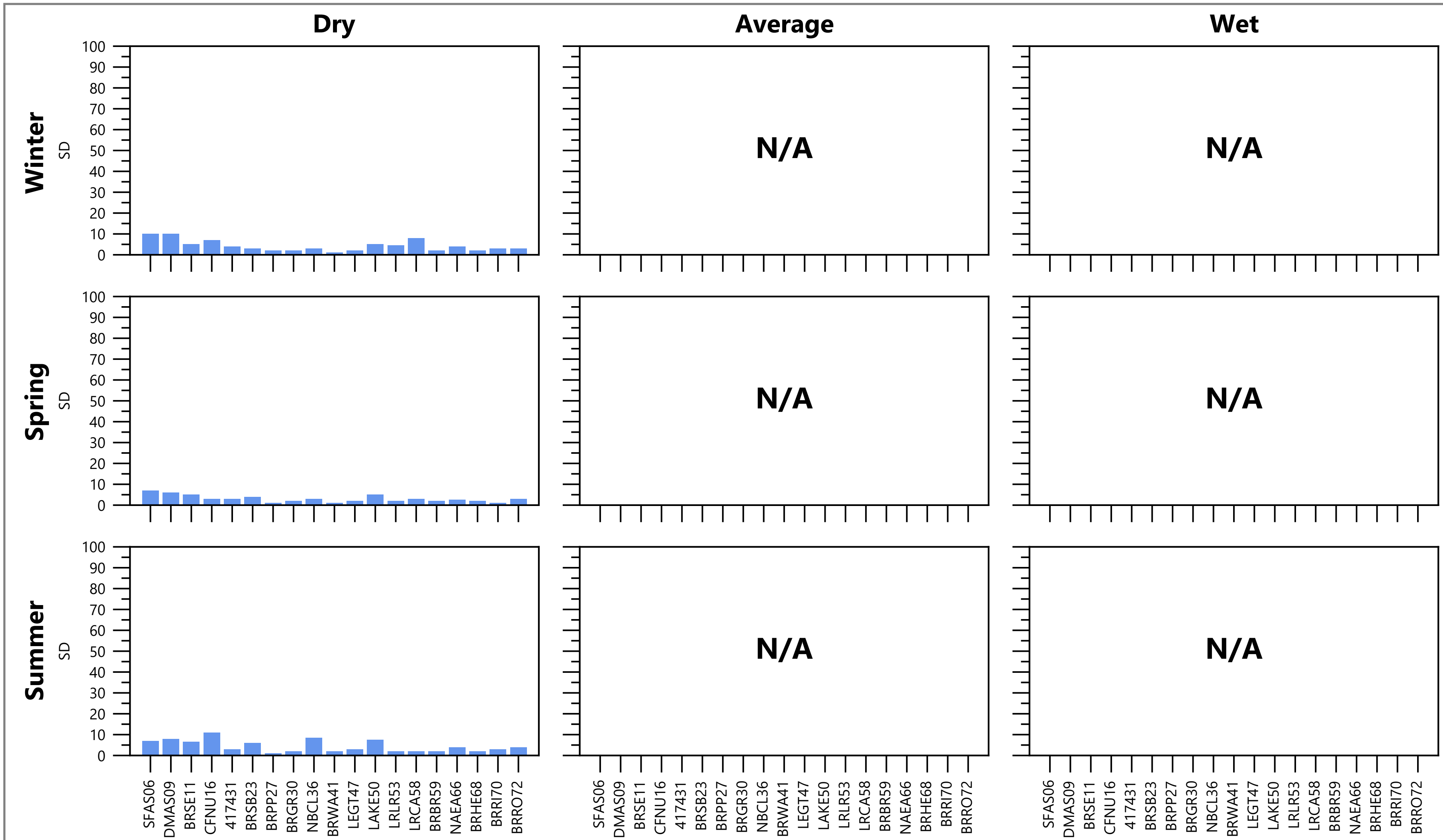
Figure I-60
Subsistence Flow Attainment Duration (AD) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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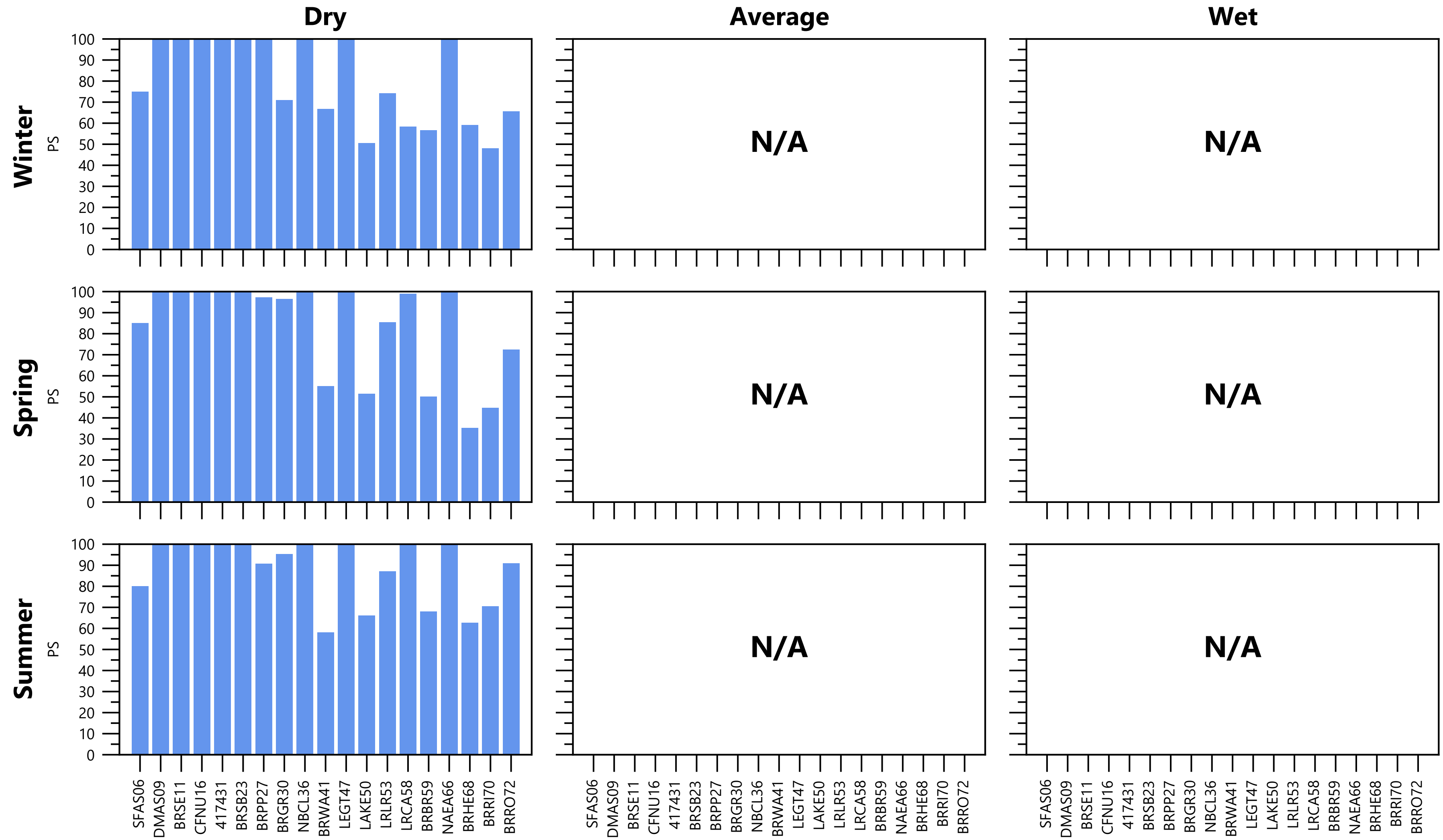
Figure I-61
Subsistence Flow Shortage Duration (SD) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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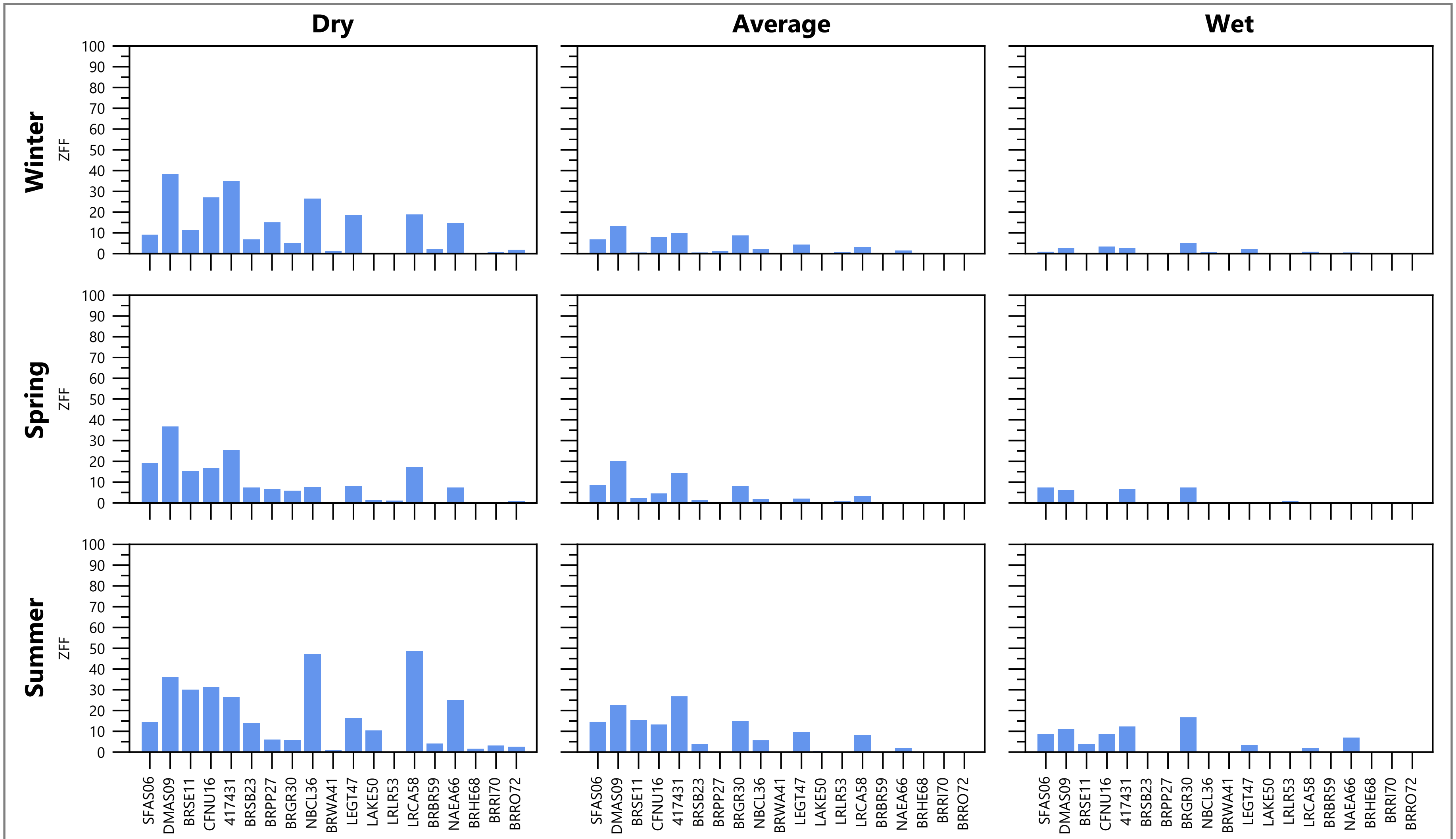
Figure I-62
Subsistence Flow Percent Shortage (PS) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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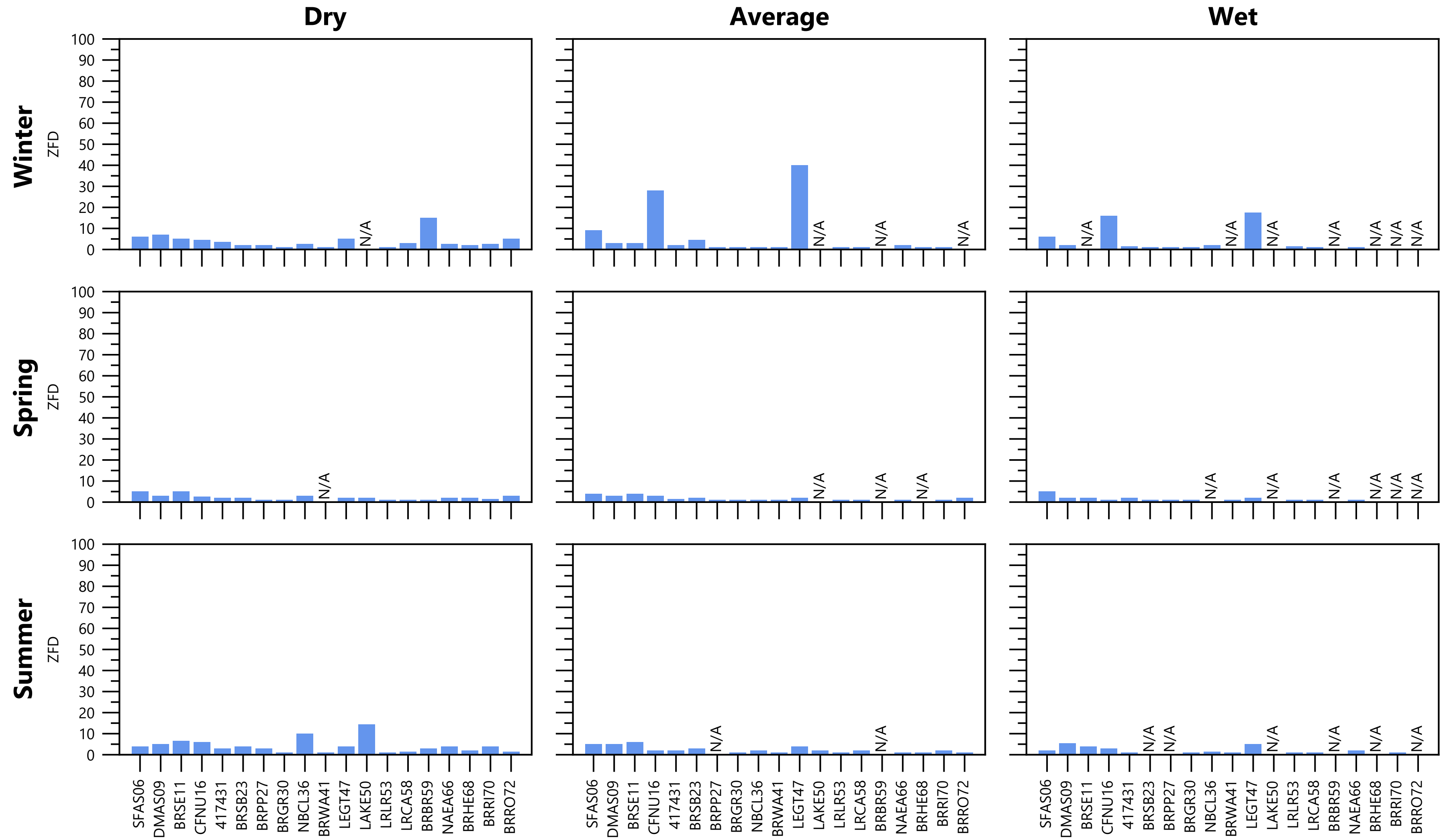
Figure I-63
Zero-Flow Frequencies (ZFF) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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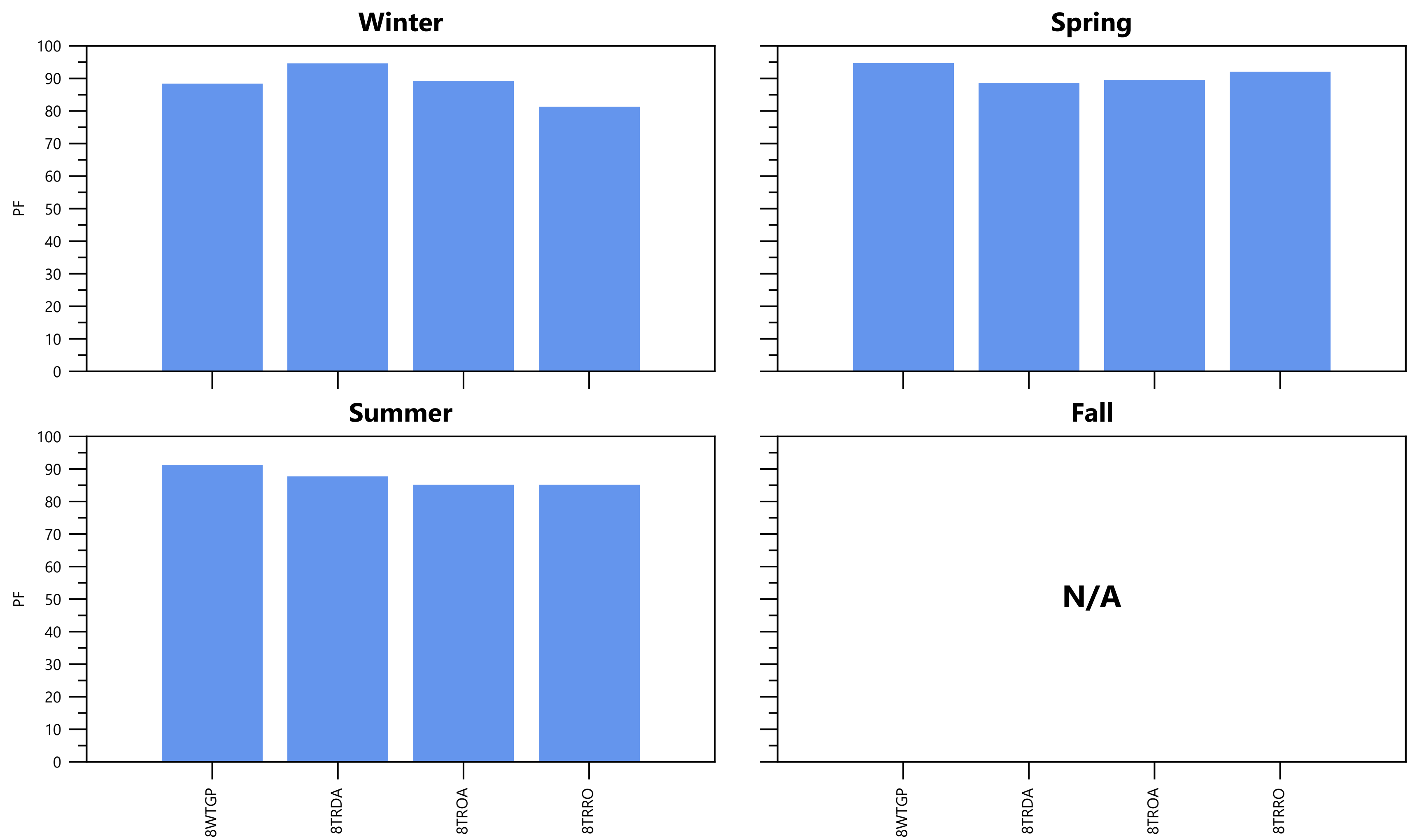
Figure I-64
Zero-Flow Durations (ZFD) by Season and Hydrologic Condition: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Brazos River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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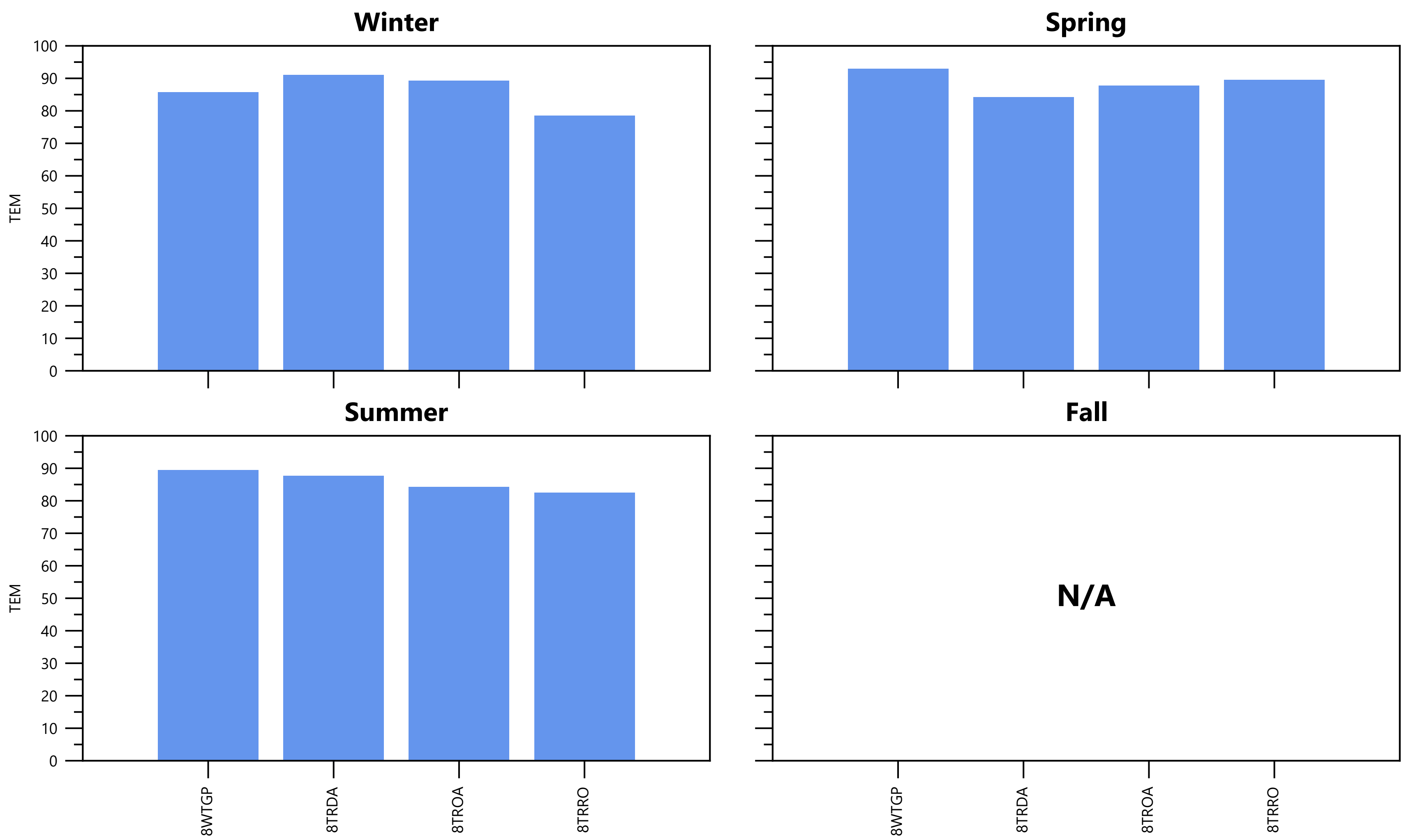
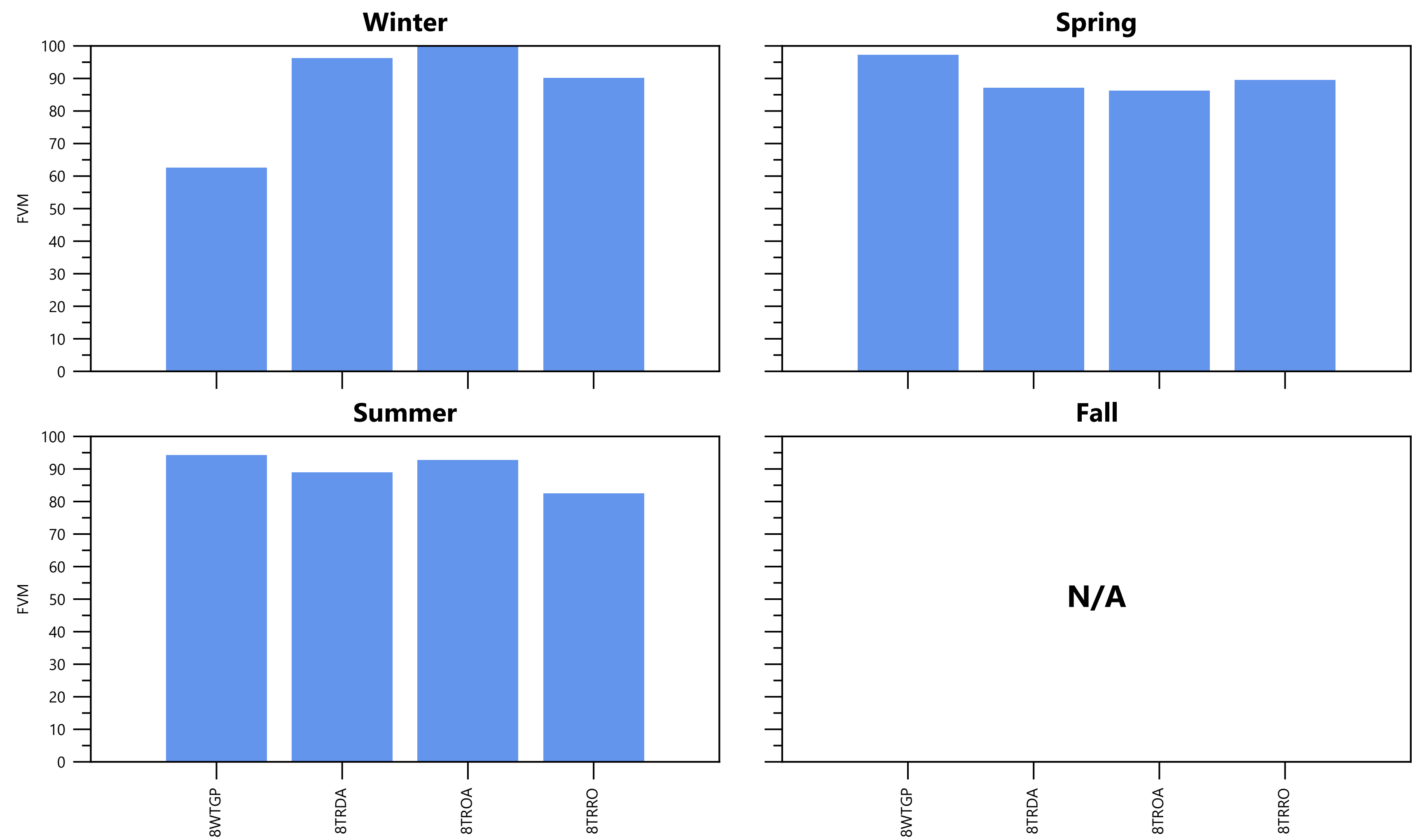
Figure I-65
Pulse Frequencies (PF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

Figure I-66
Target Engagements Met (TEM) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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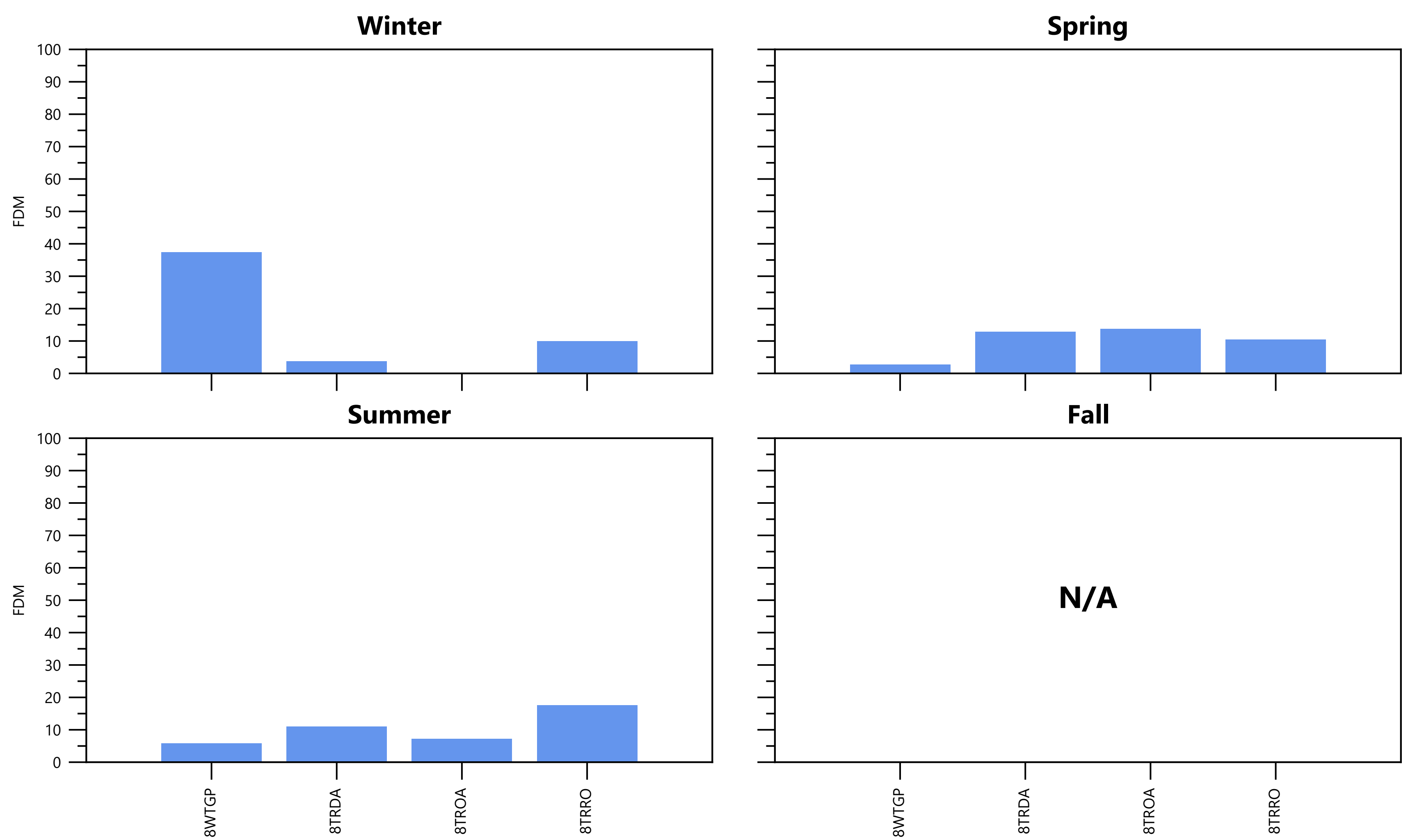
Figure I-67
Frequency Volume Met (FVM) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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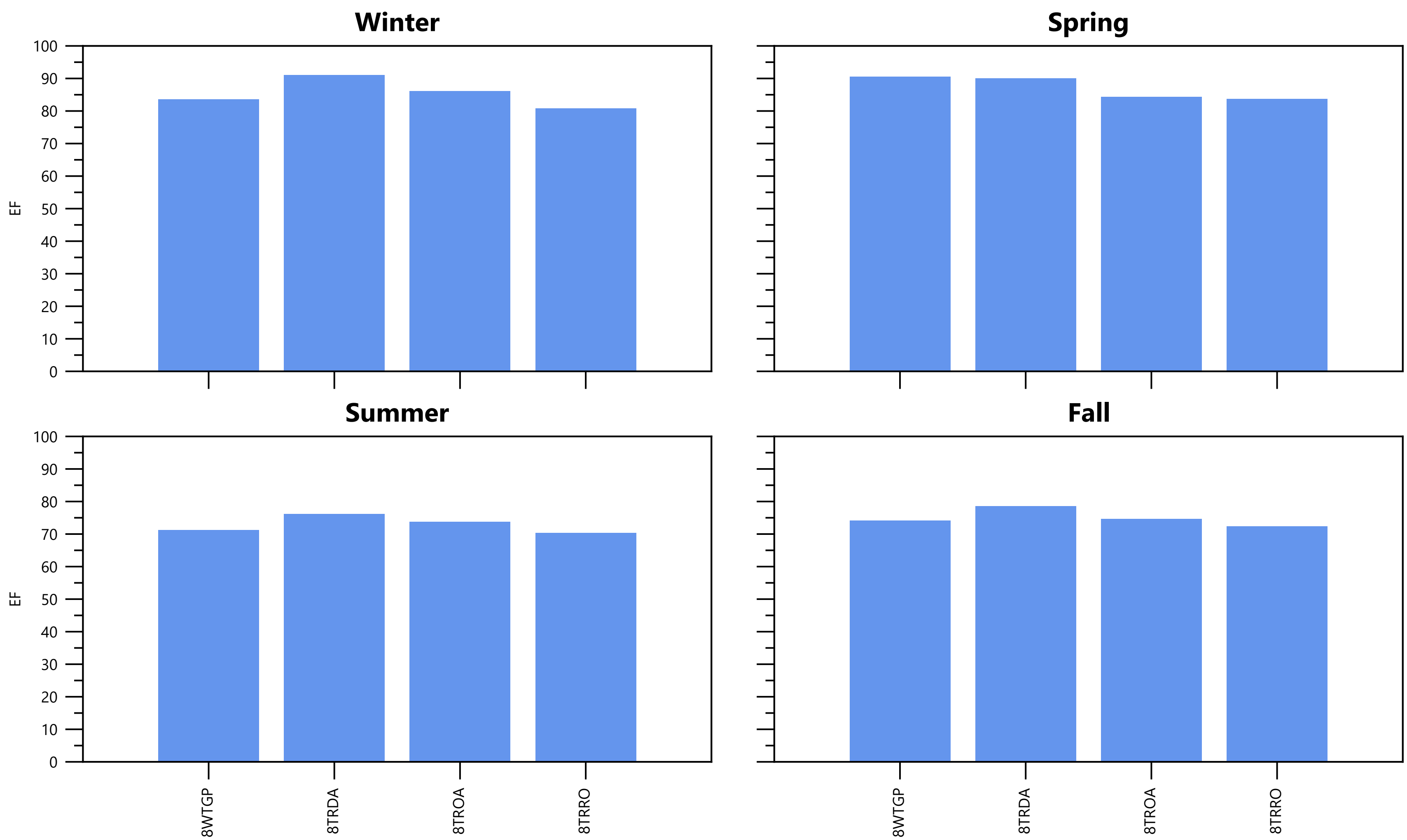
Figure I-68
Frequency Duration Met (FDM) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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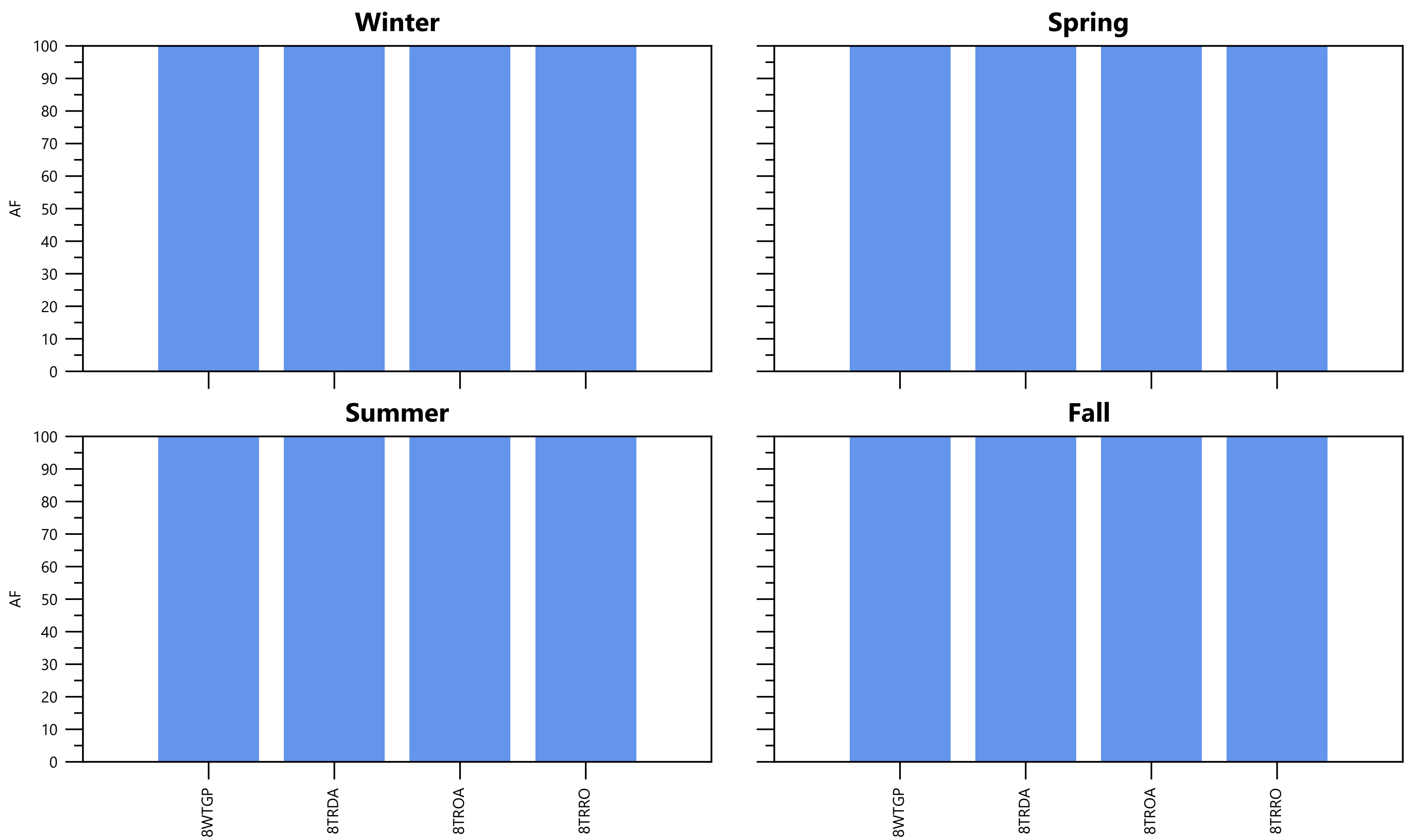
Figure I-69
Base Flow Engagement Frequency (EF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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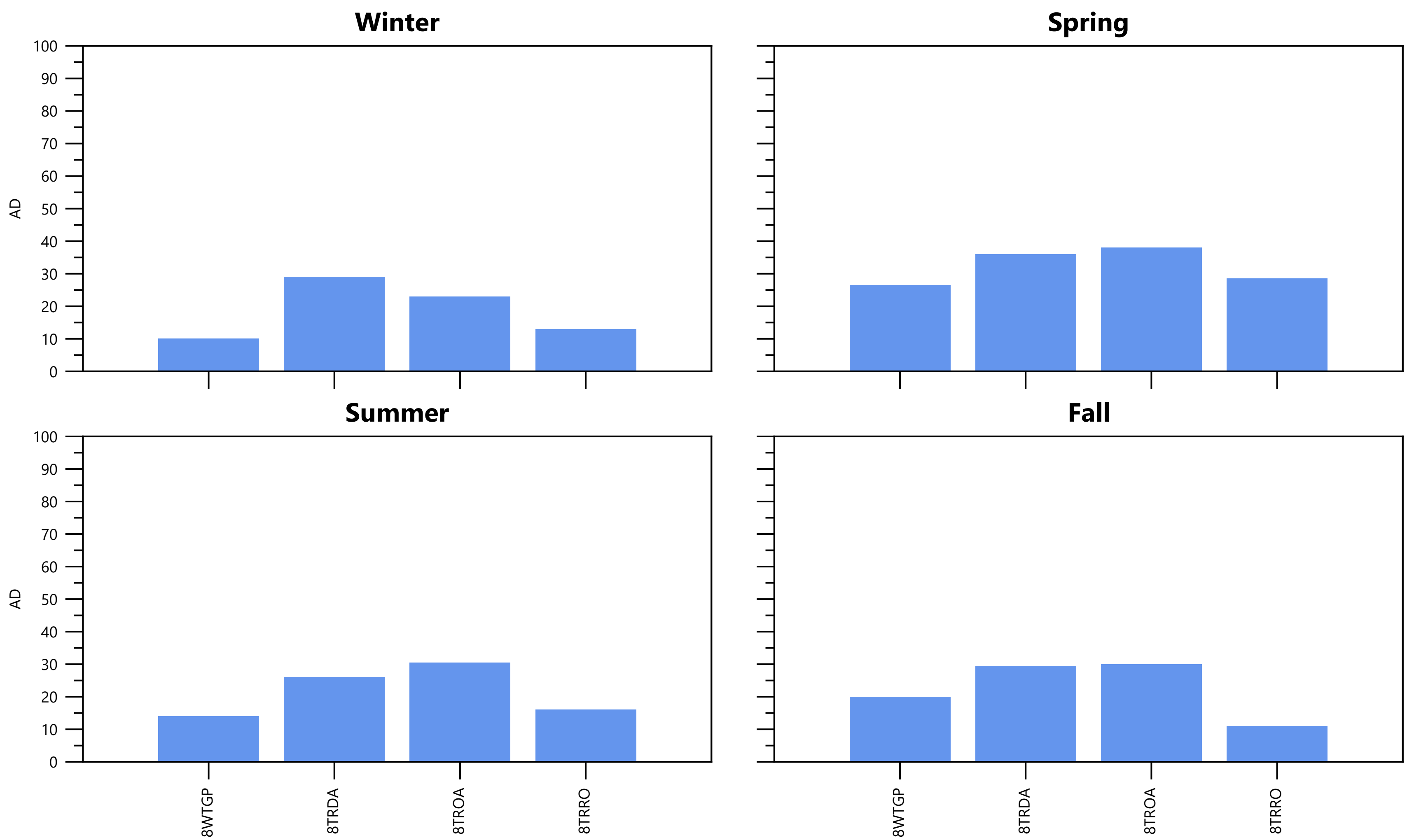
Figure I-70
Base Flow Attainment Frequency (AF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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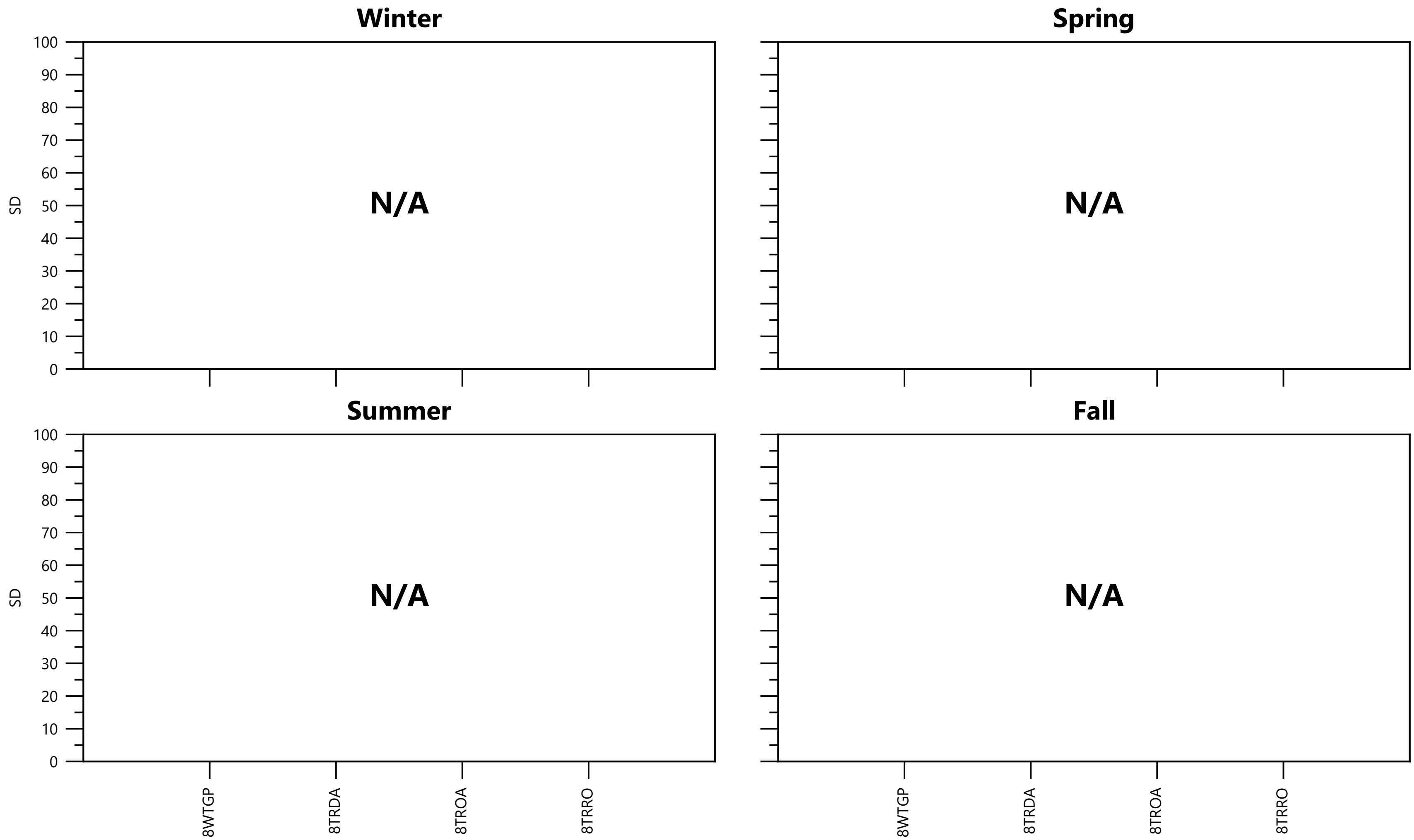
Figure I-71
Base Flow Attainment Duration (AD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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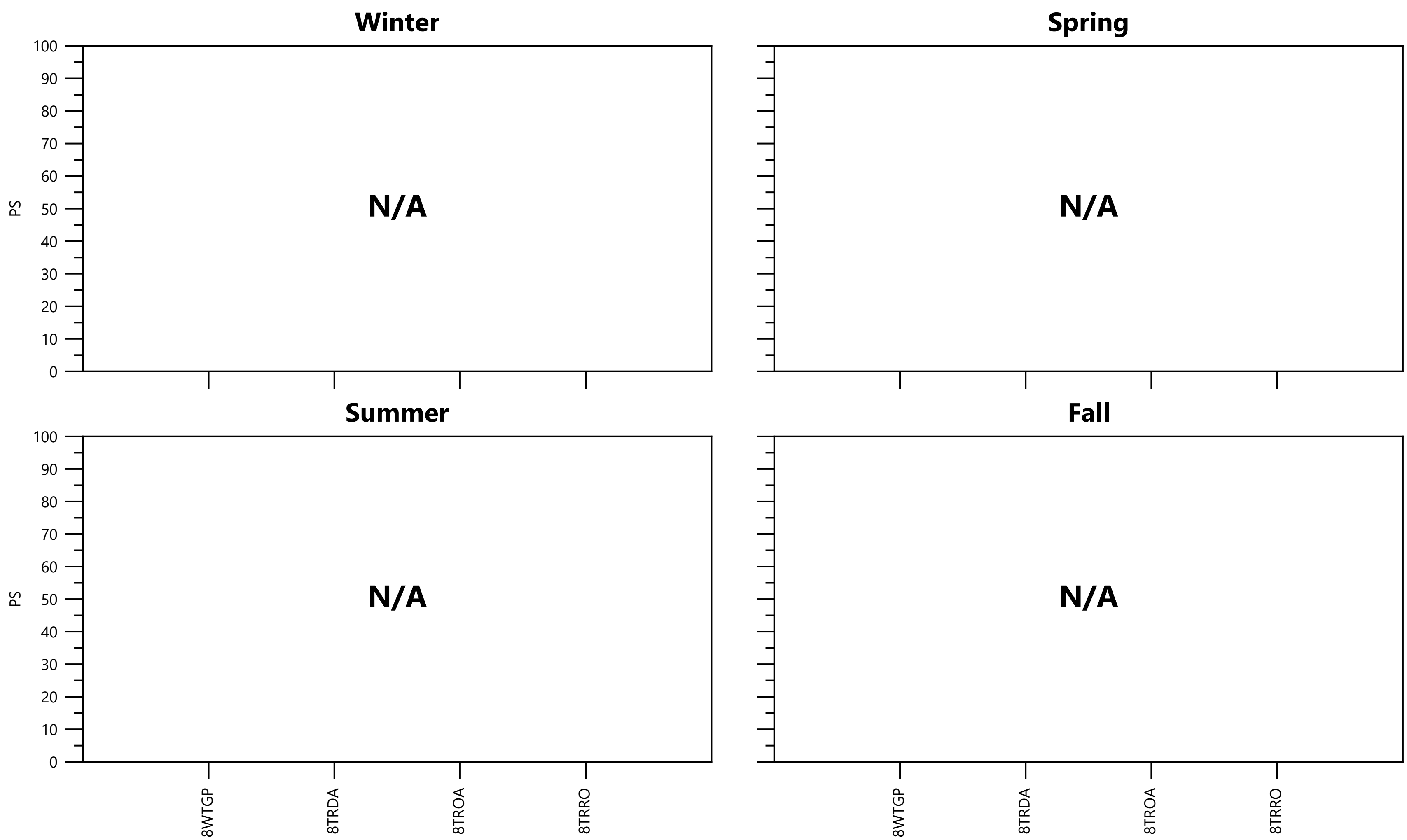
Figure I-72
Base Flow Shortage Duration (SD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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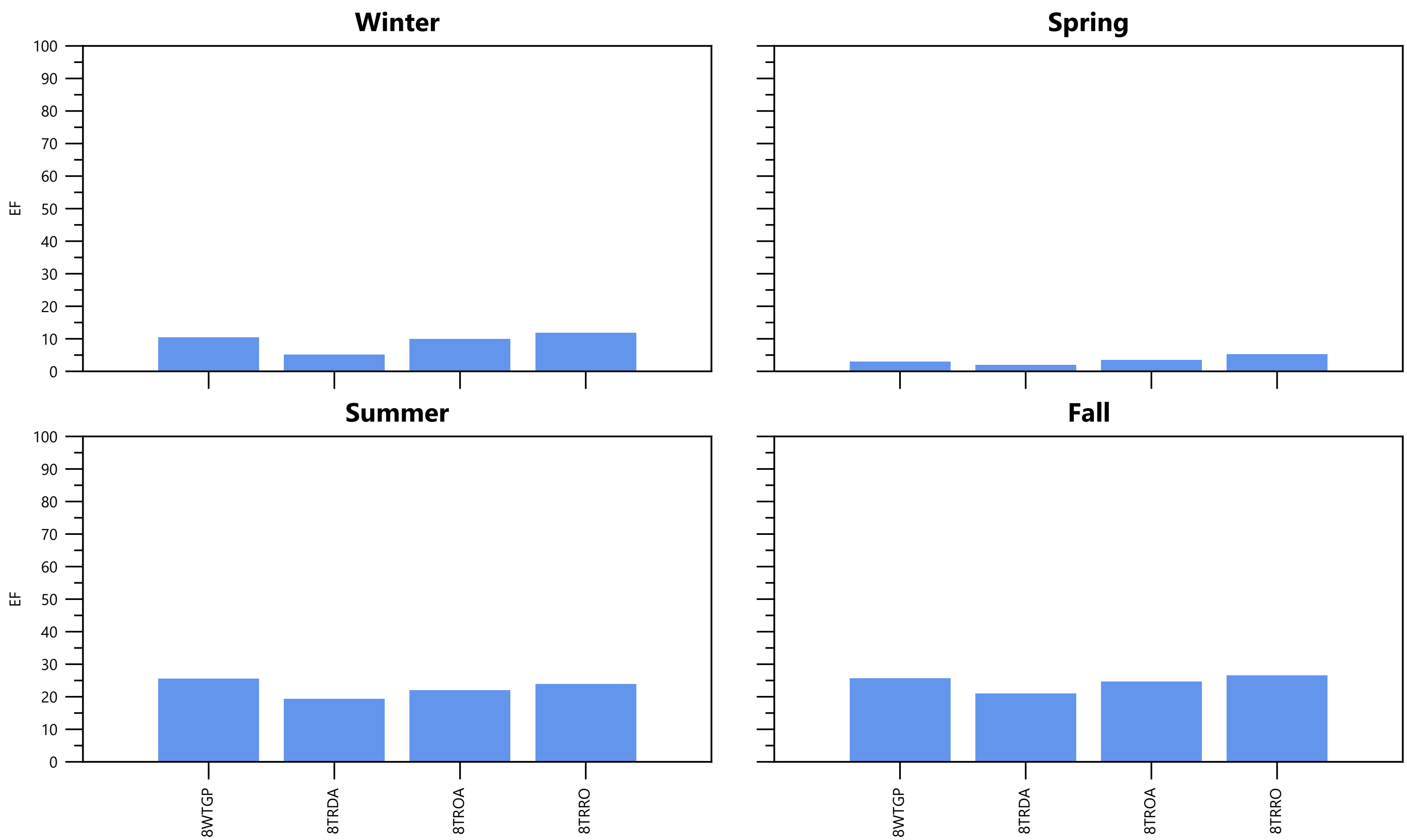
Figure I-73
Base Flow Percent Shortage (PS) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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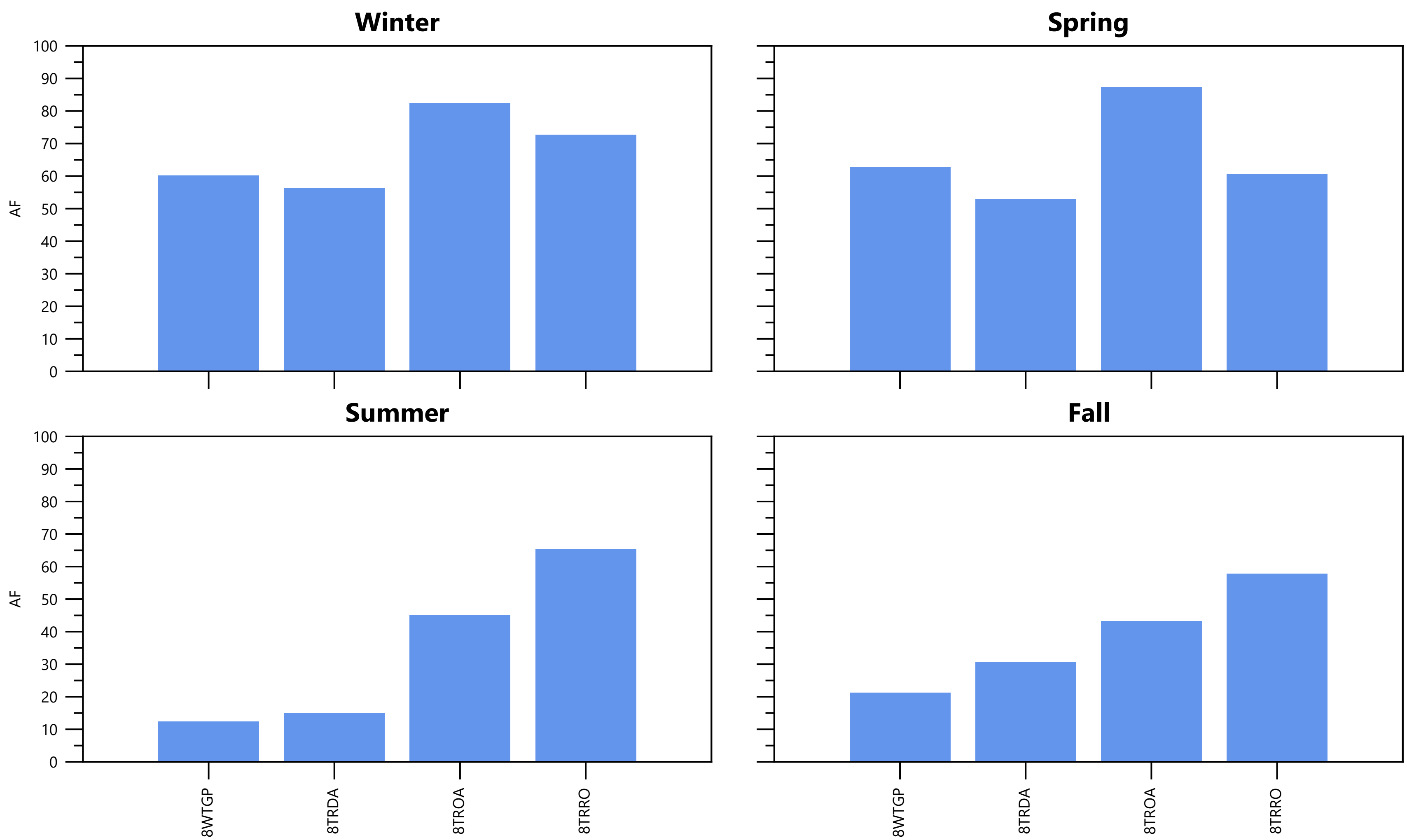
Figure I-74
Subsistence Flow Engagement Frequency (EF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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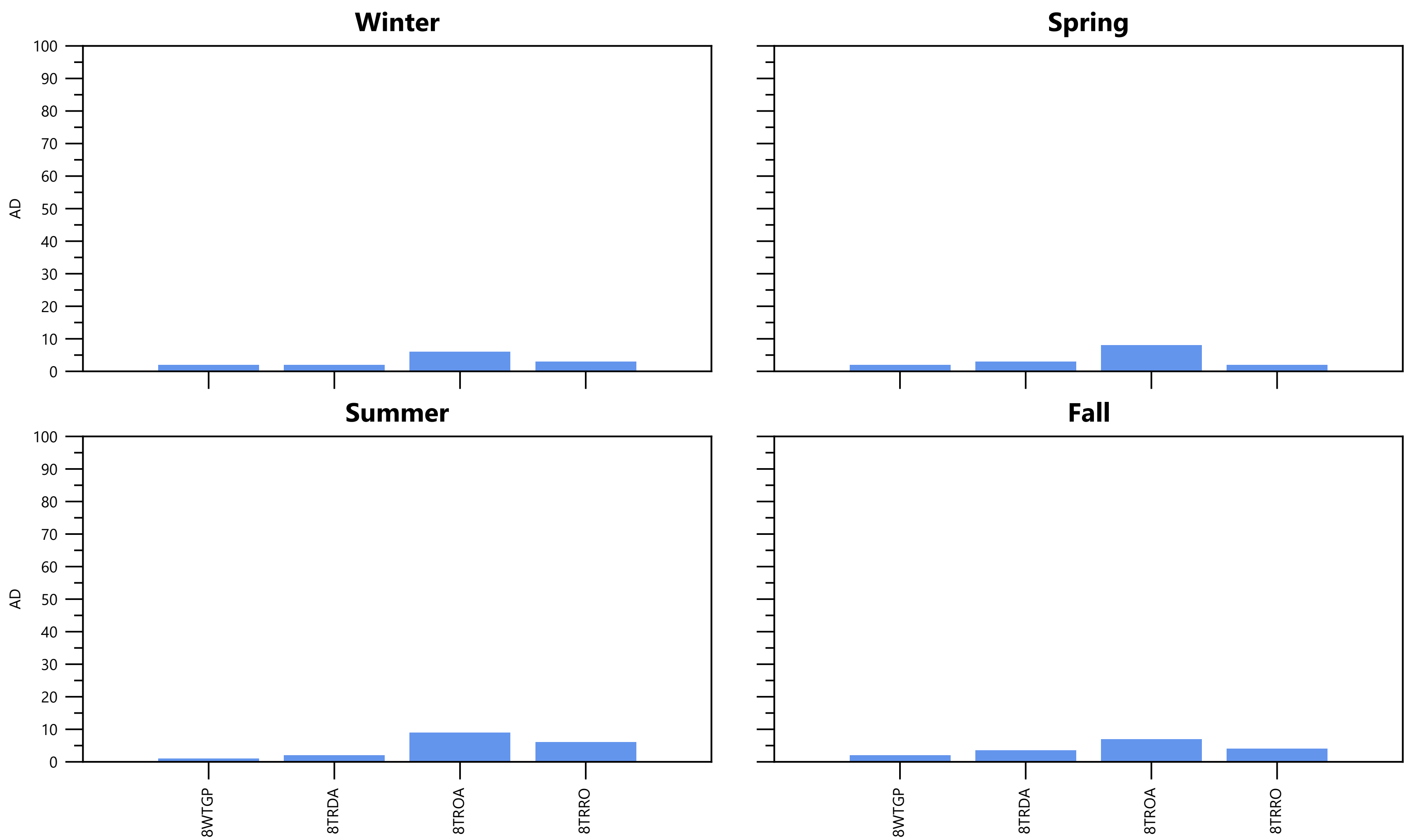
Figure I-75

Subsistence Flow Attainment Frequency (AF) by Season: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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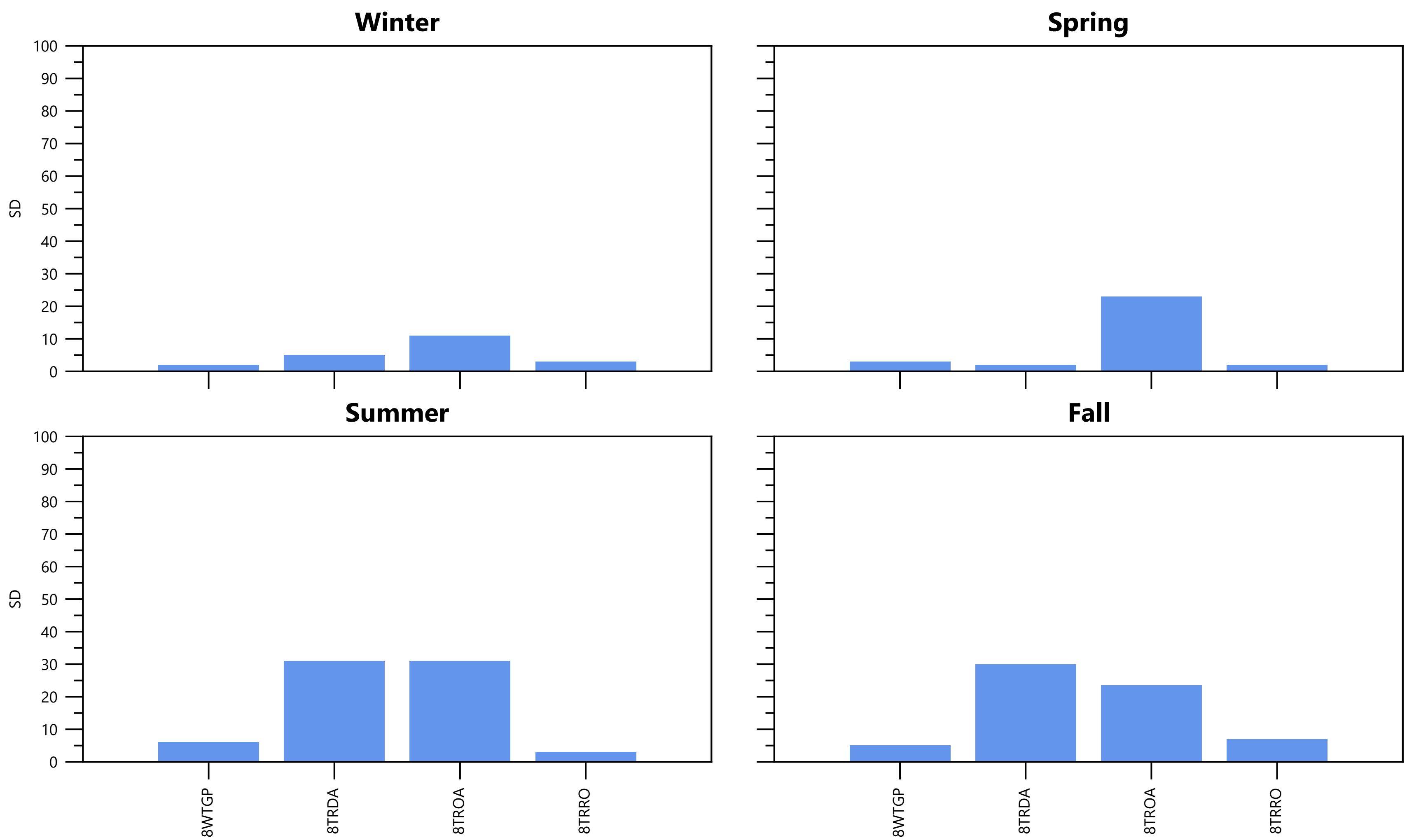
Figure I-76
Subsistence Flow Attainment Duration (AD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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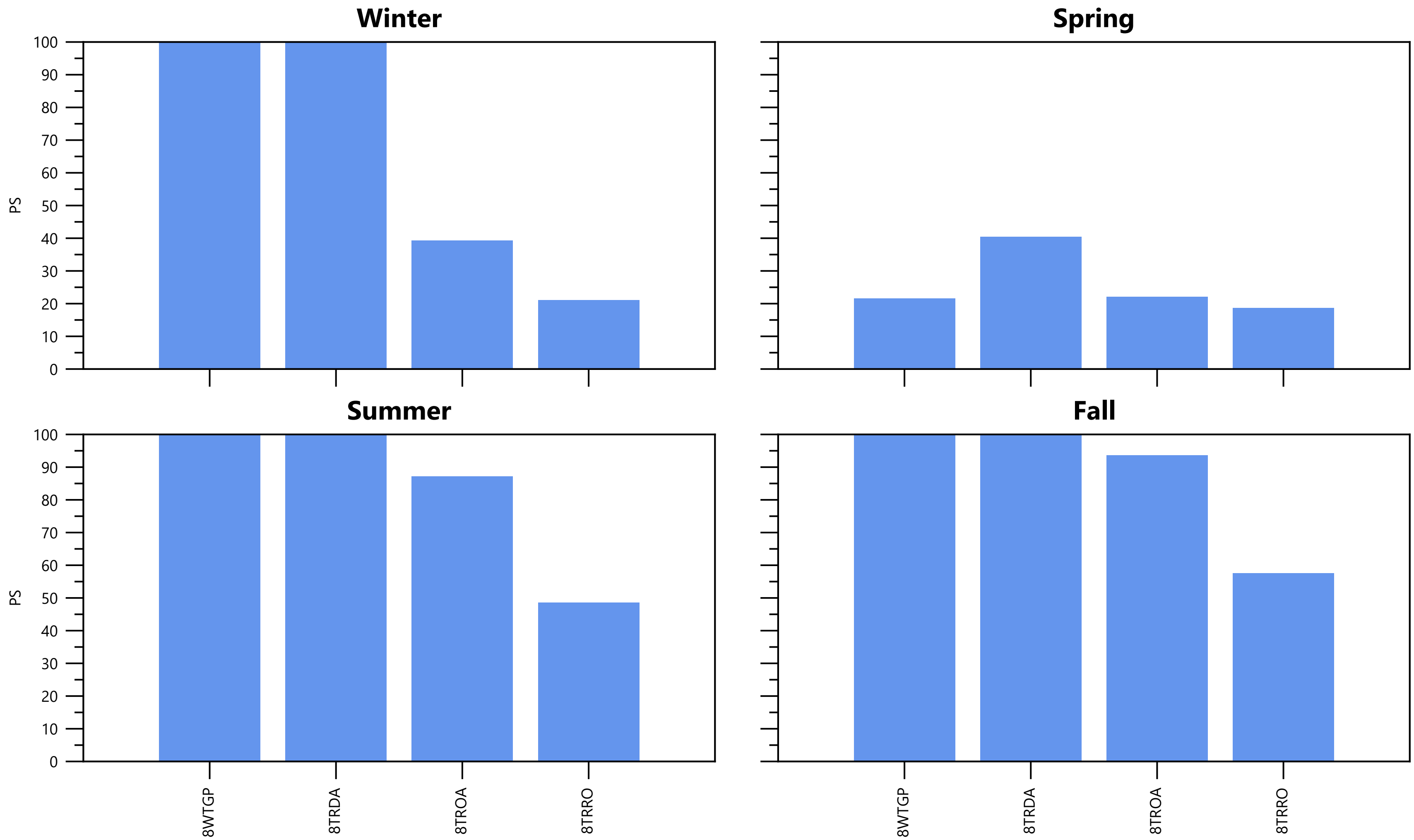
Figure I-77
Subsistence Flow Shortage Duration (SD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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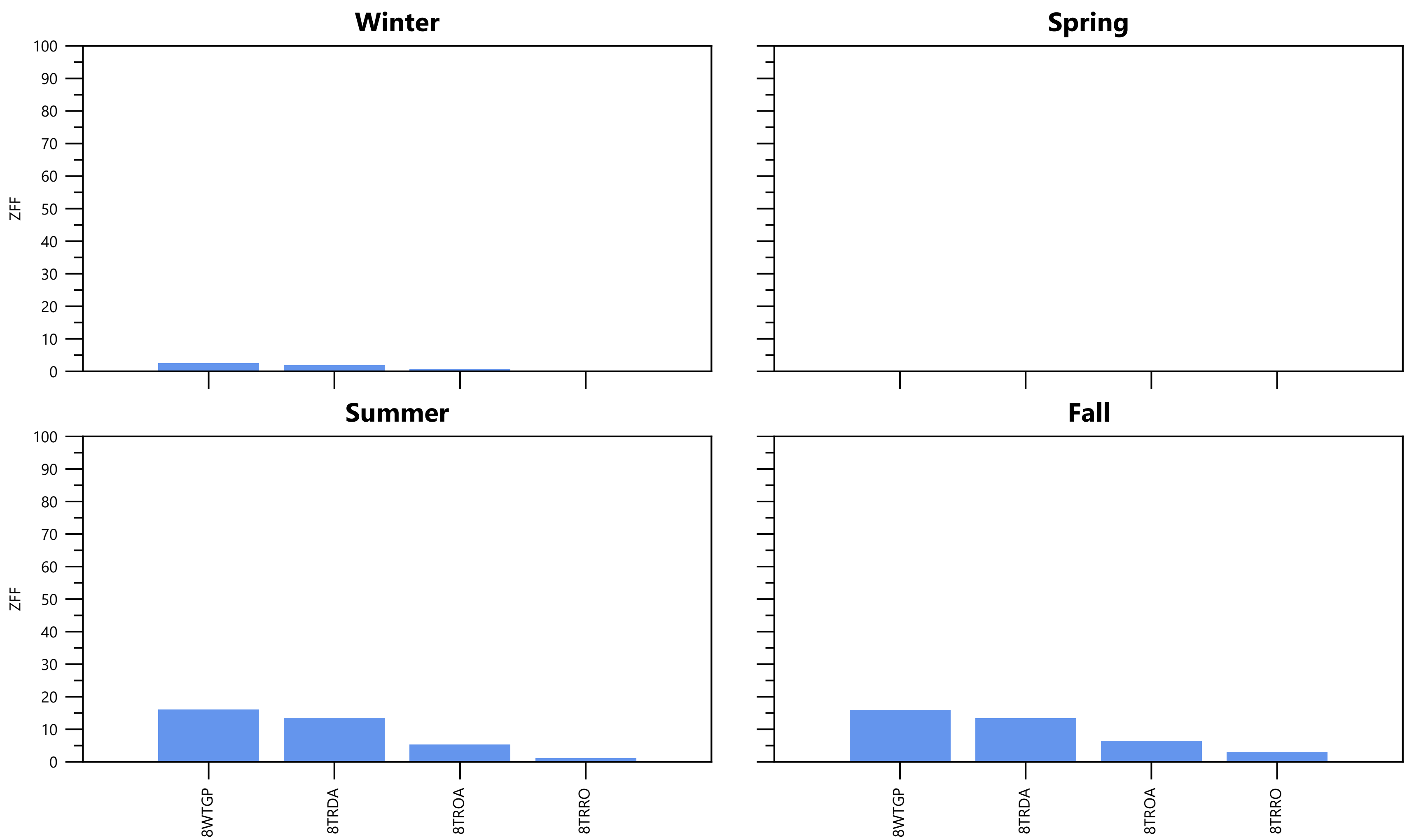
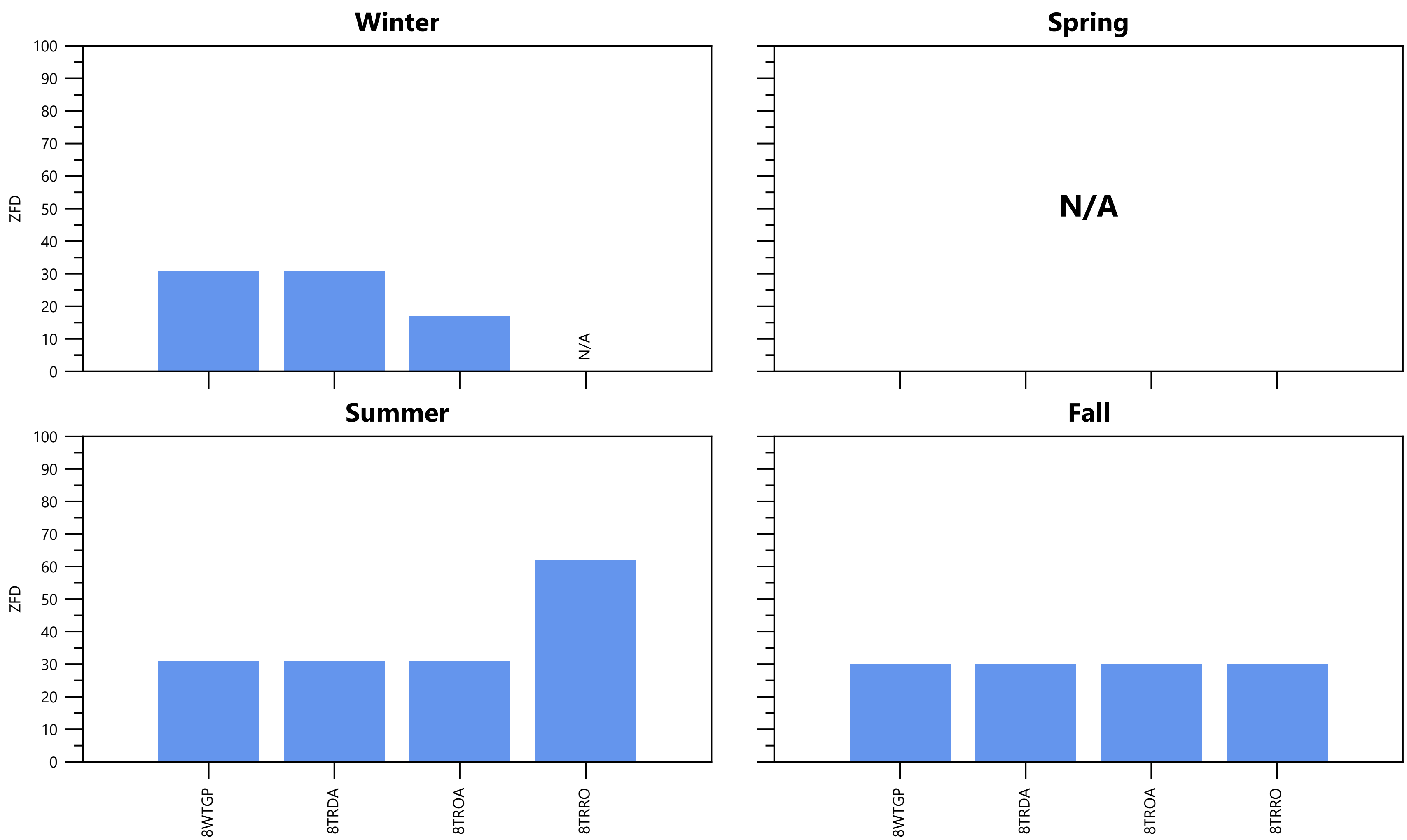
Figure I-78
Subsistence Flow Percent Shortage (PS) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

Figure I-79
Zero-Flow Frequencies (ZFF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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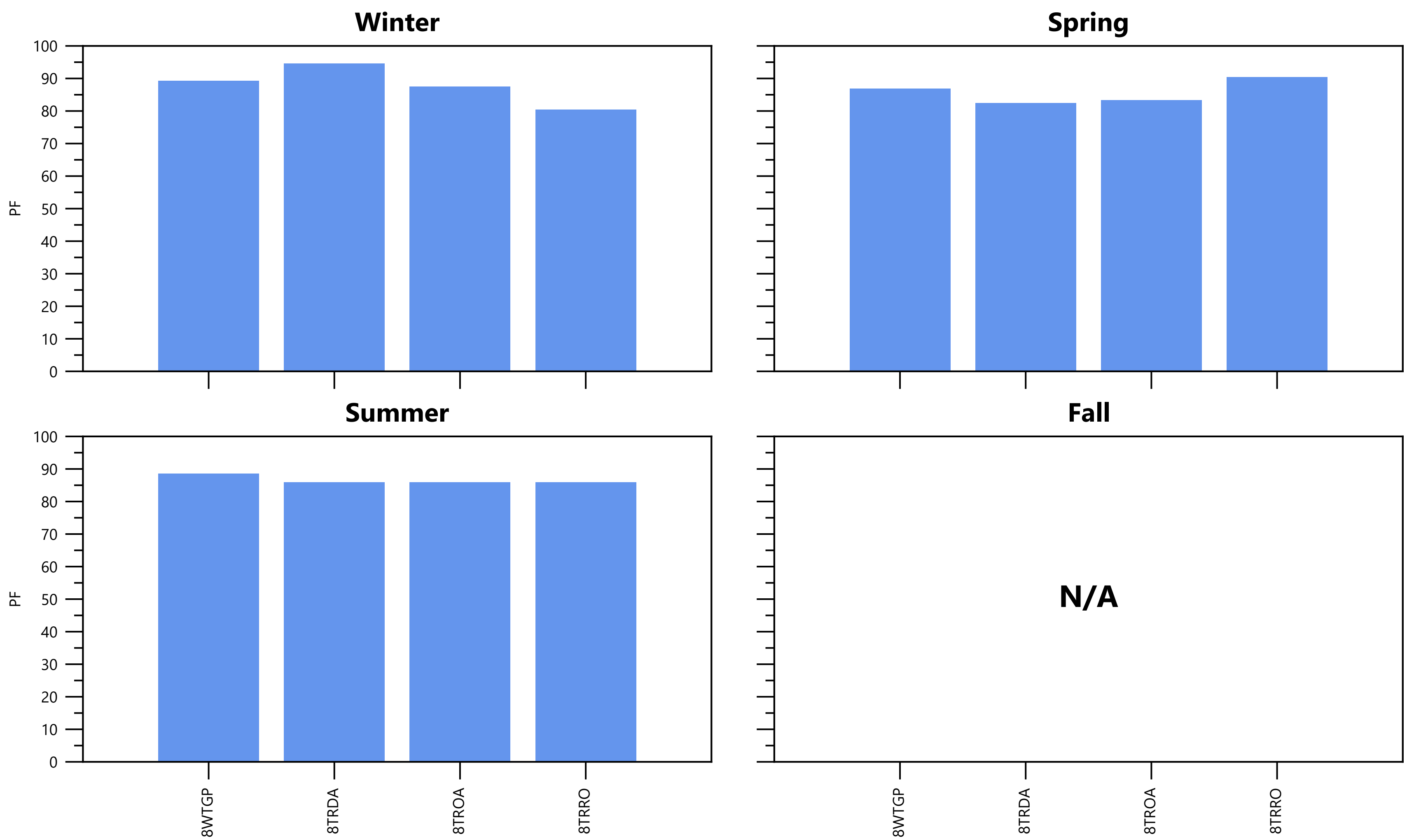
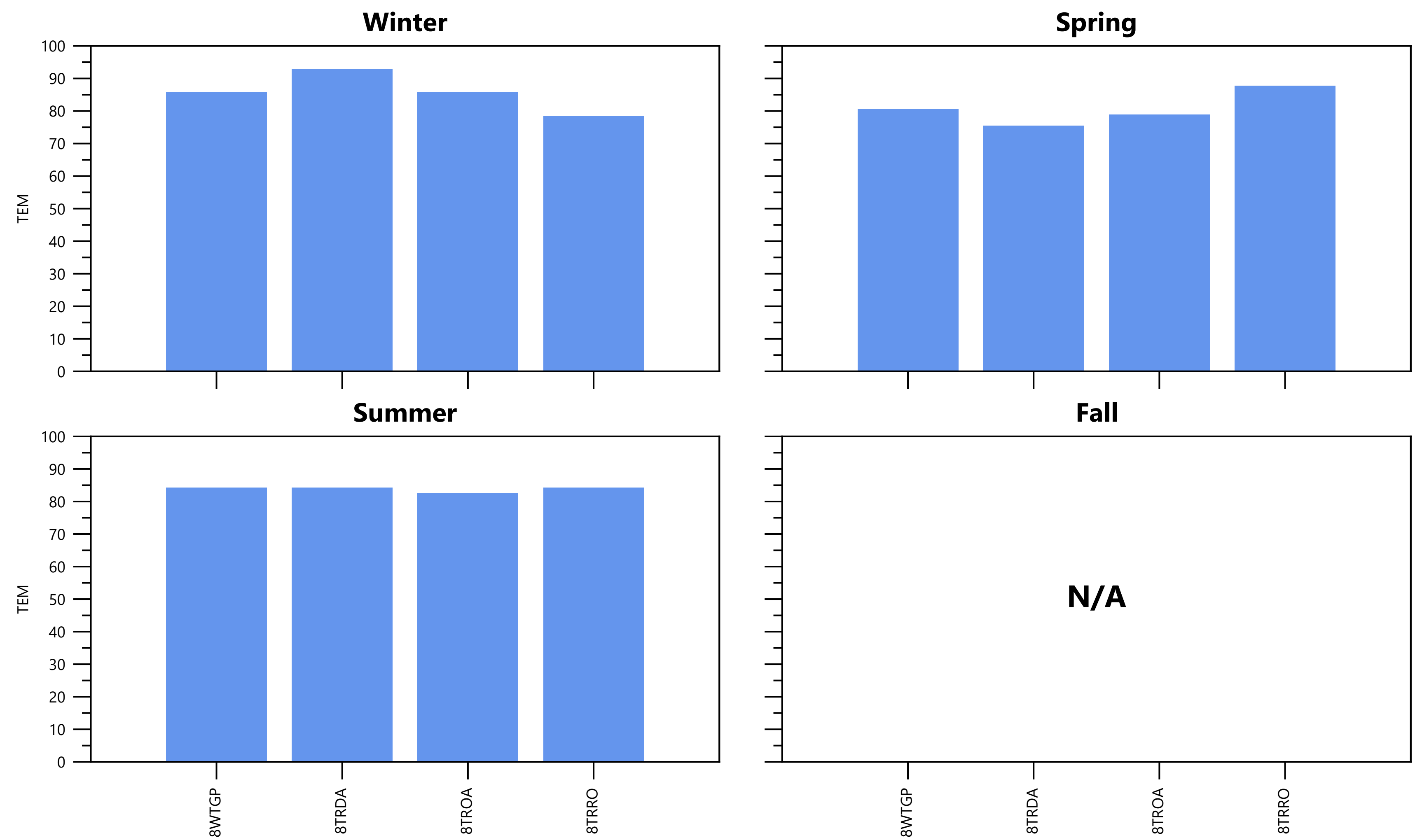
Figure I-80
Zero-Flow Durations (ZFD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

Figure I-81
Pulse Frequencies (PF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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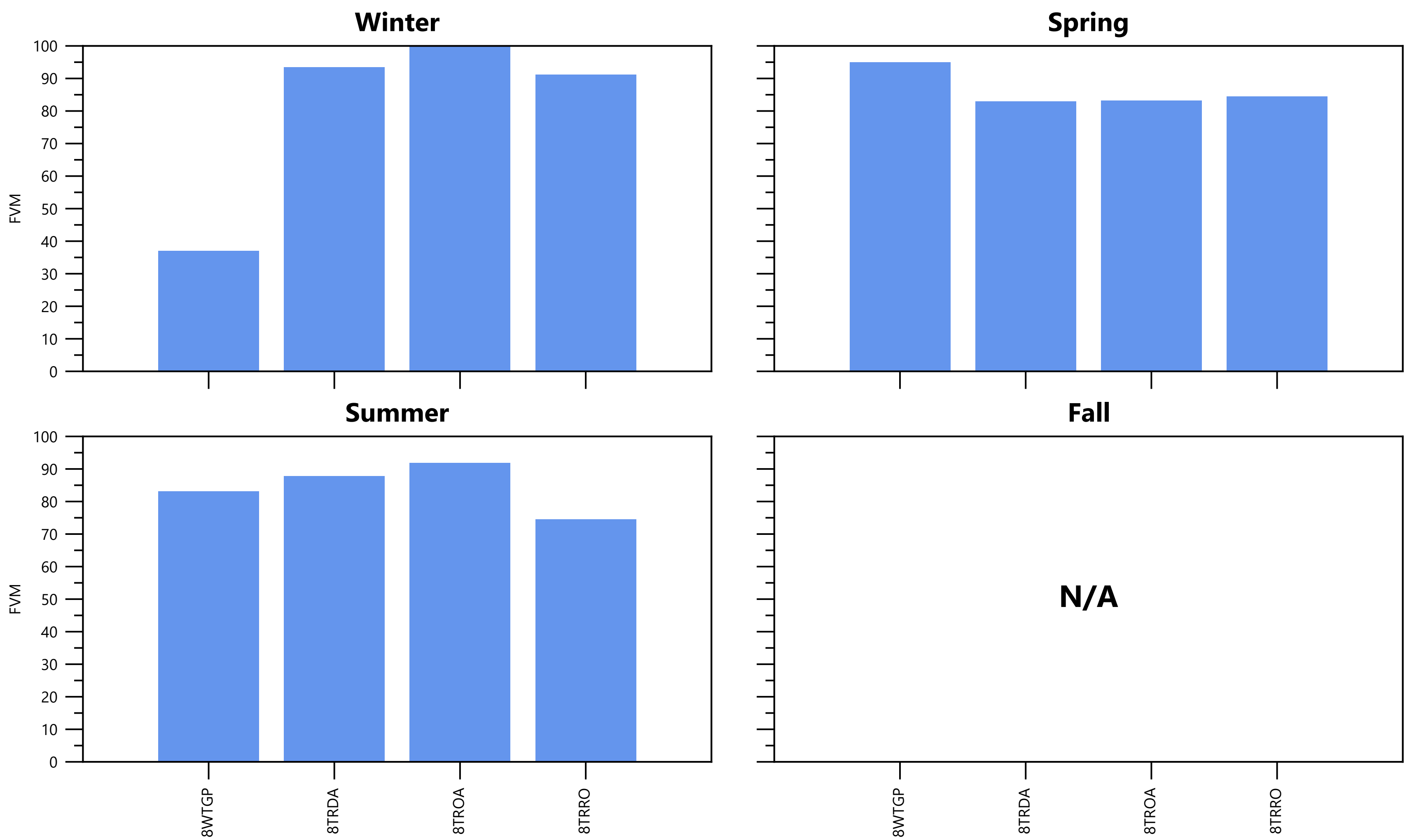
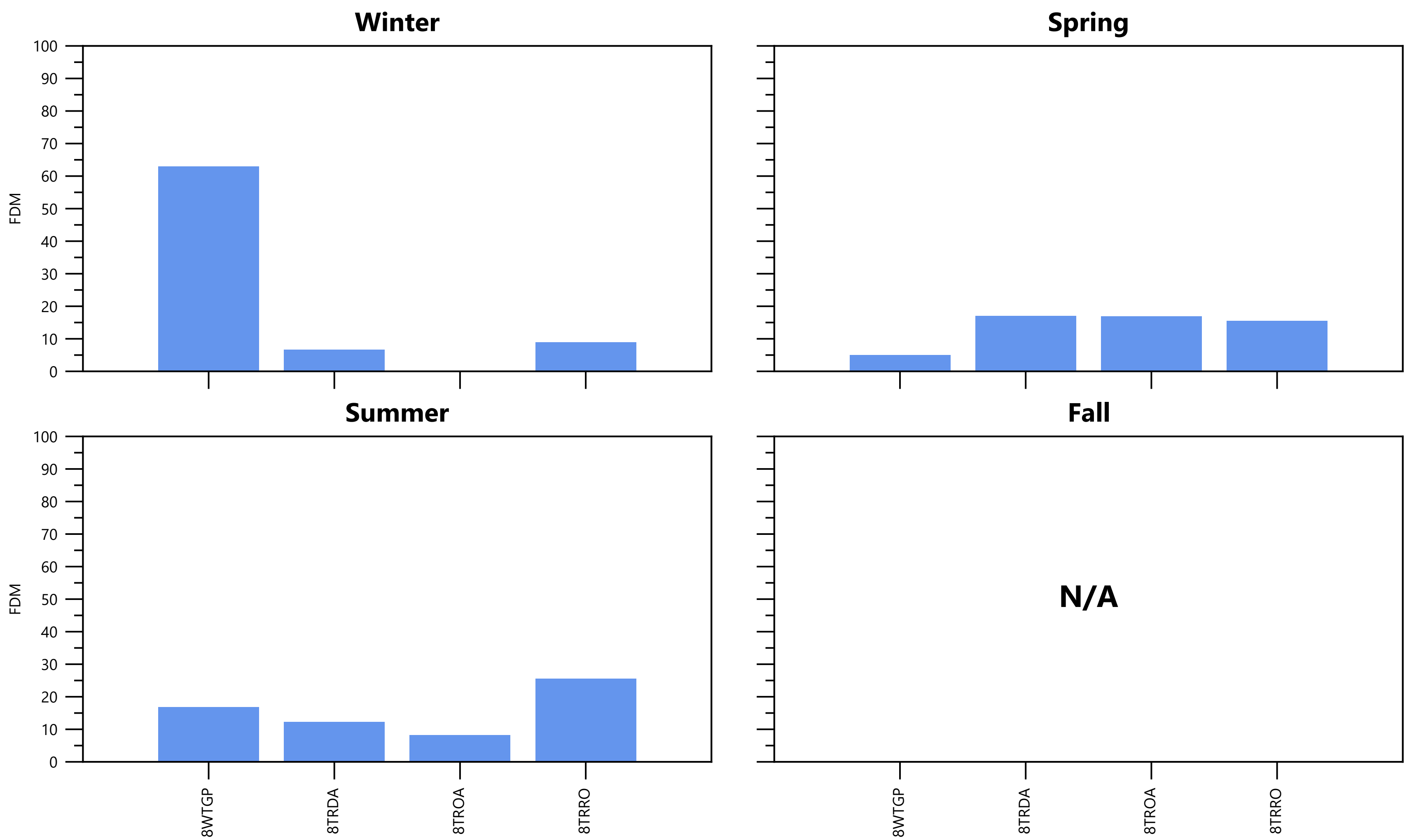
Figure I-82
Target Engagements Met (TEM) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

Figure I-83
Frequency Volume Met (FVM) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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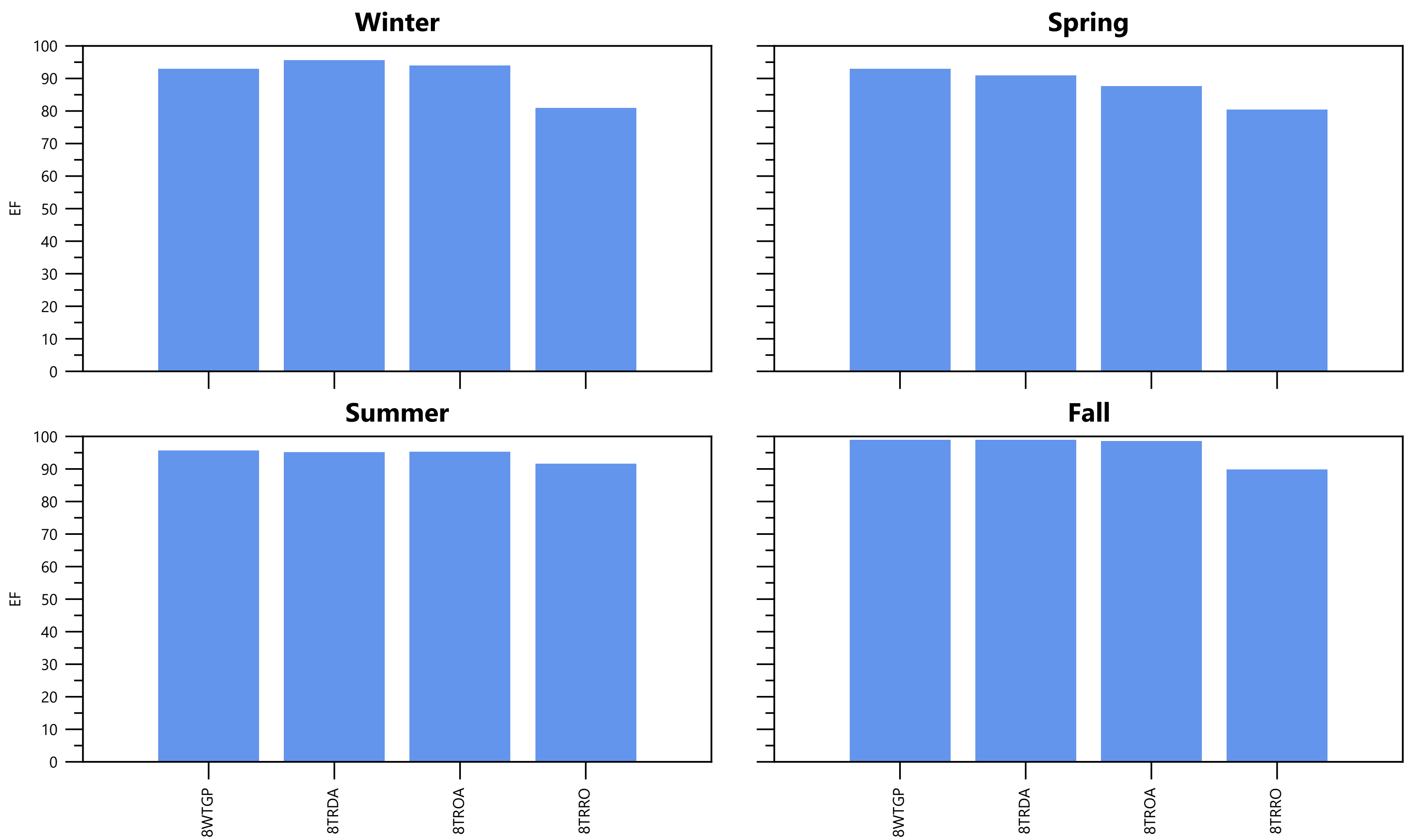

Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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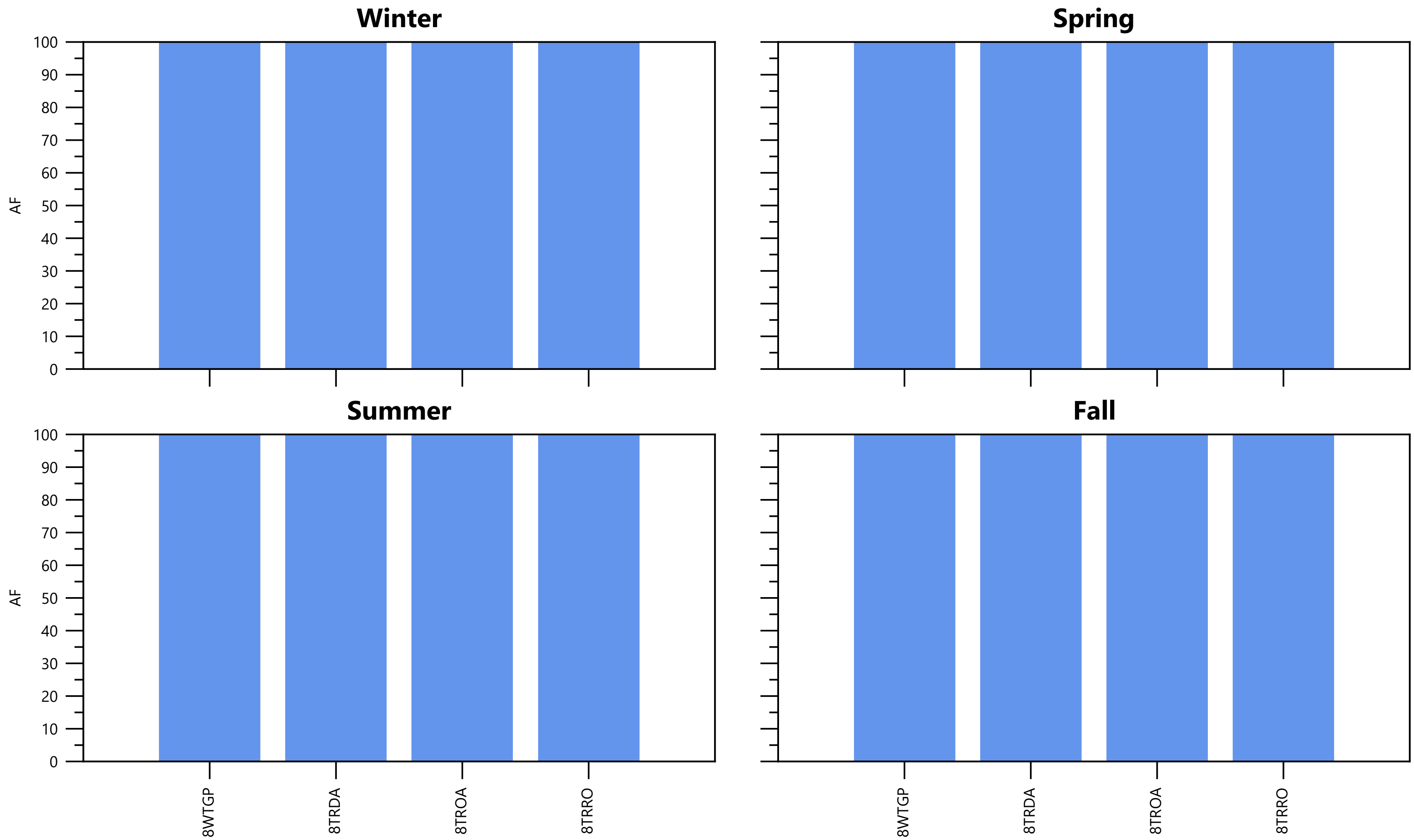
Figure I-85

Base Flow Engagement Frequency (EF) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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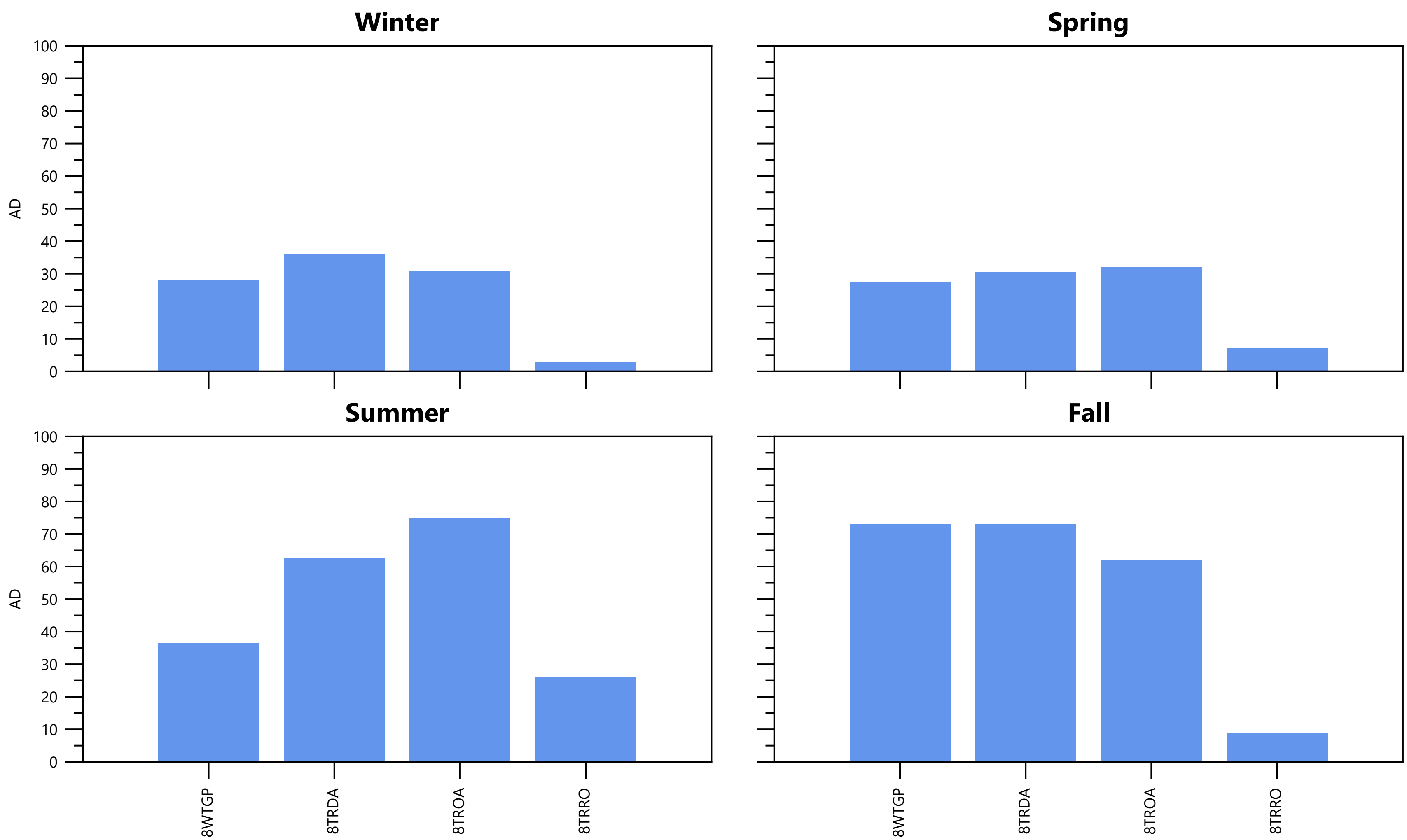
Figure I-86
Base Flow Attainment Frequency (AF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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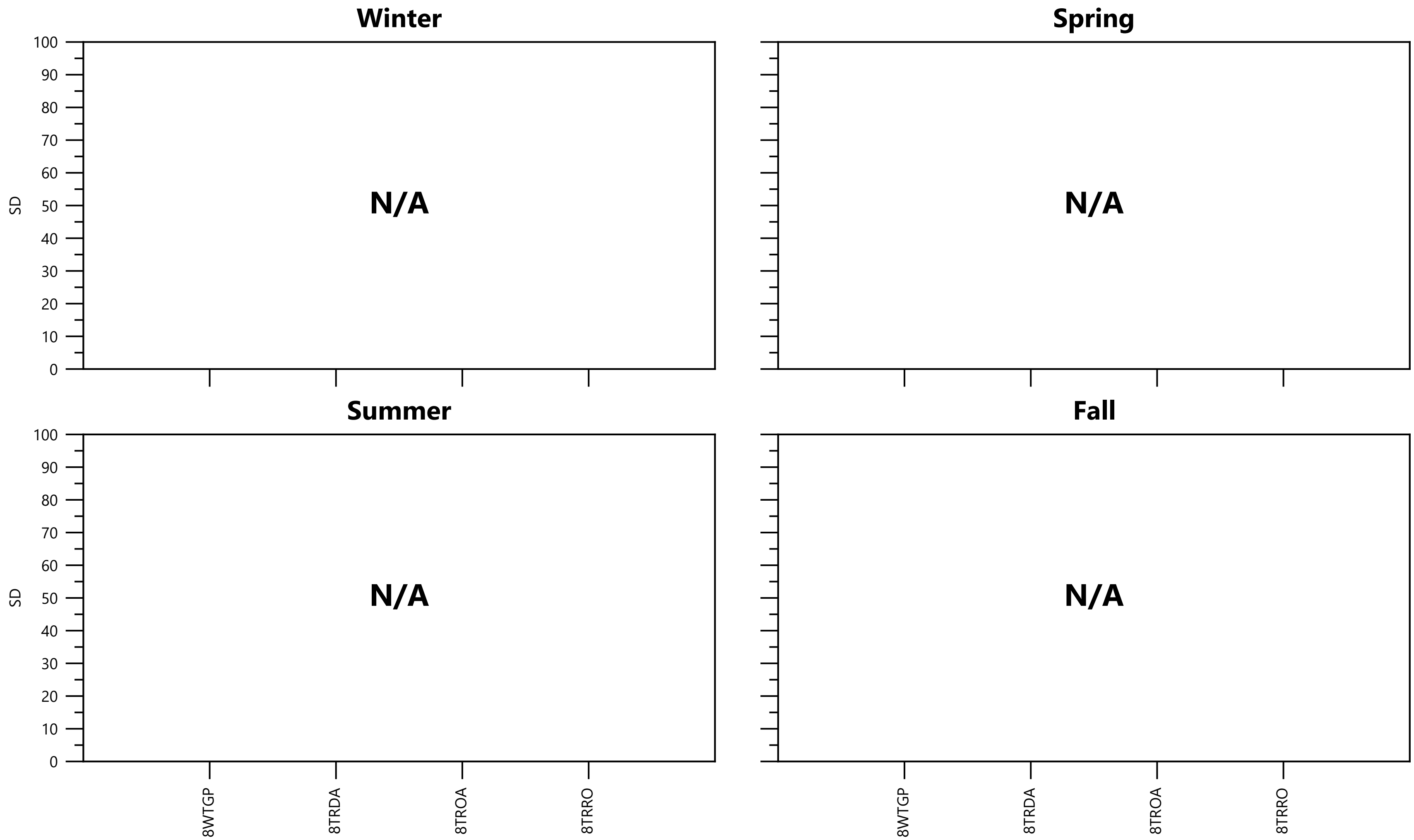
Figure I-87
Base Flow Attainment Duration (AD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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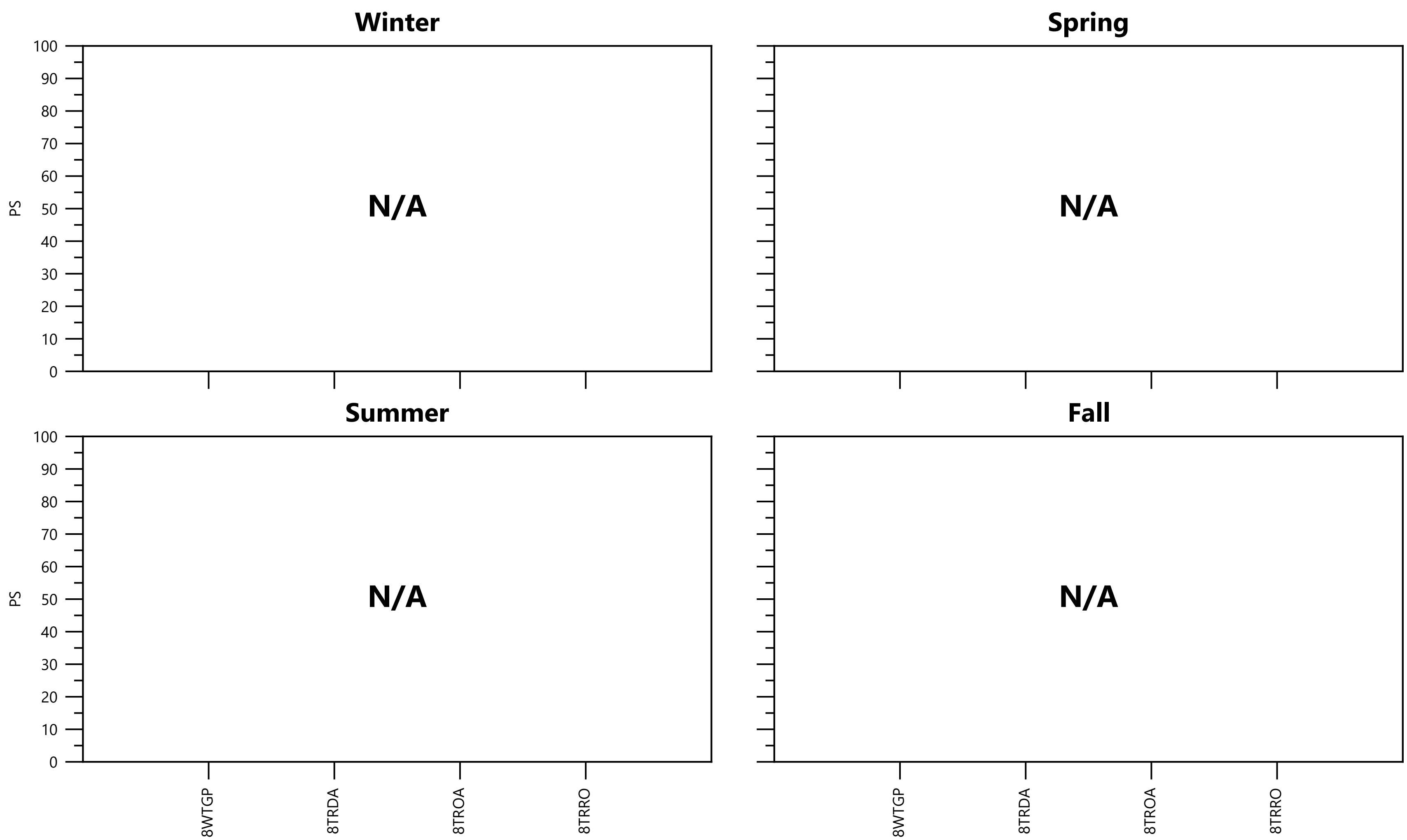
Figure I-88
Base Flow Shortage Duration (SD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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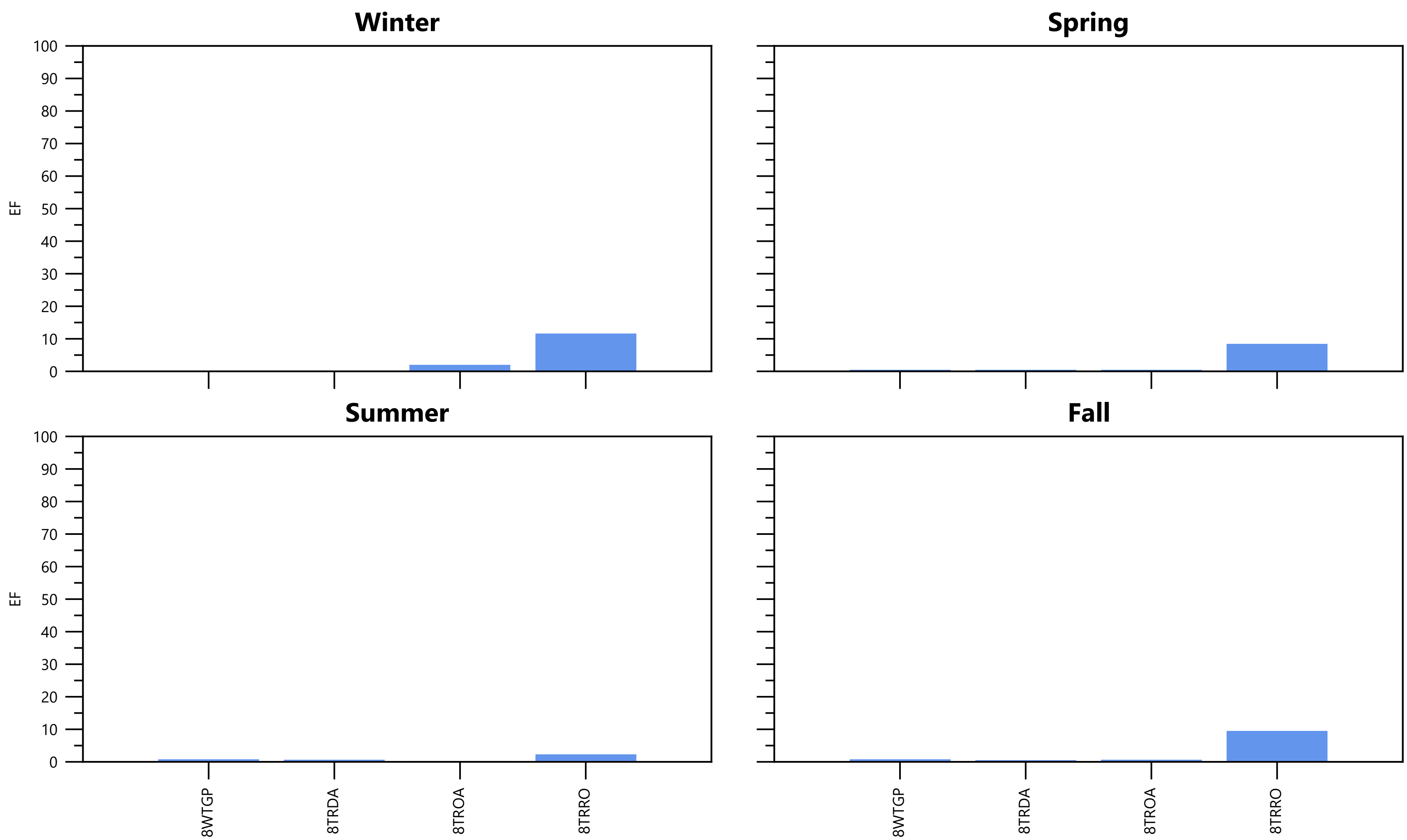
Figure I-89
Base Flow Percent Shortage (PS) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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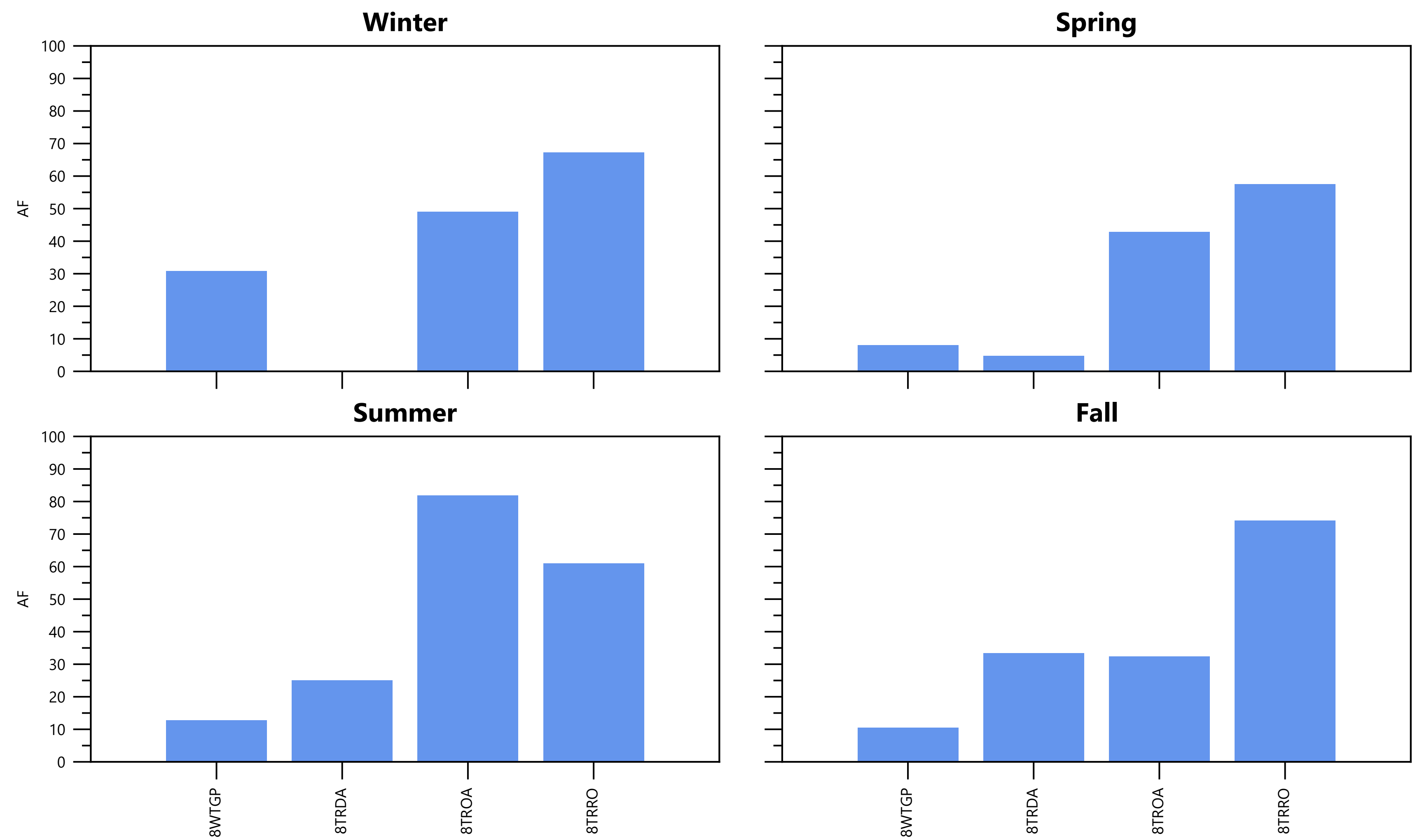
Figure I-90
Subsistence Flow Engagement Frequency (EF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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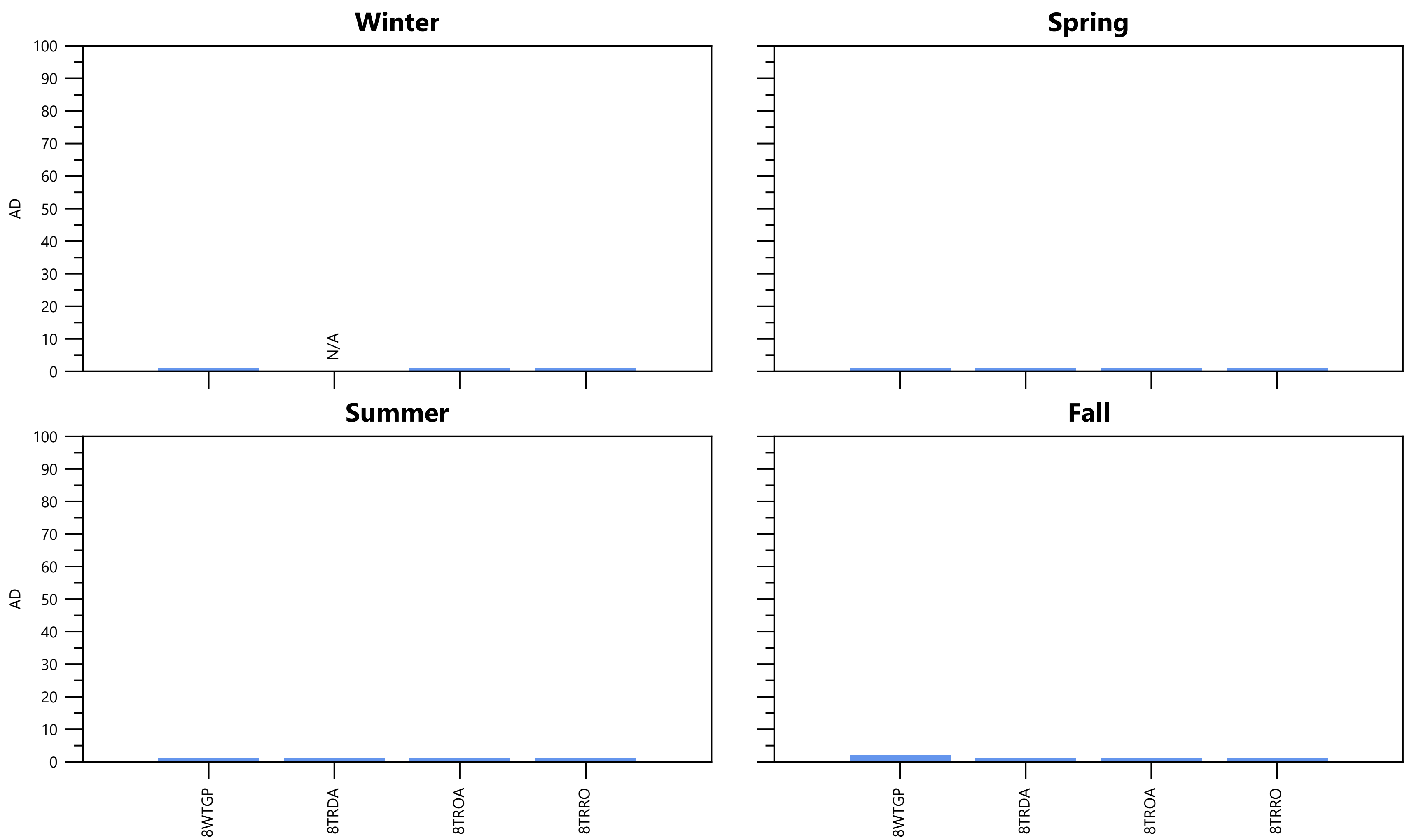
Figure I-91
Subsistence Flow Attainment Frequency (AF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



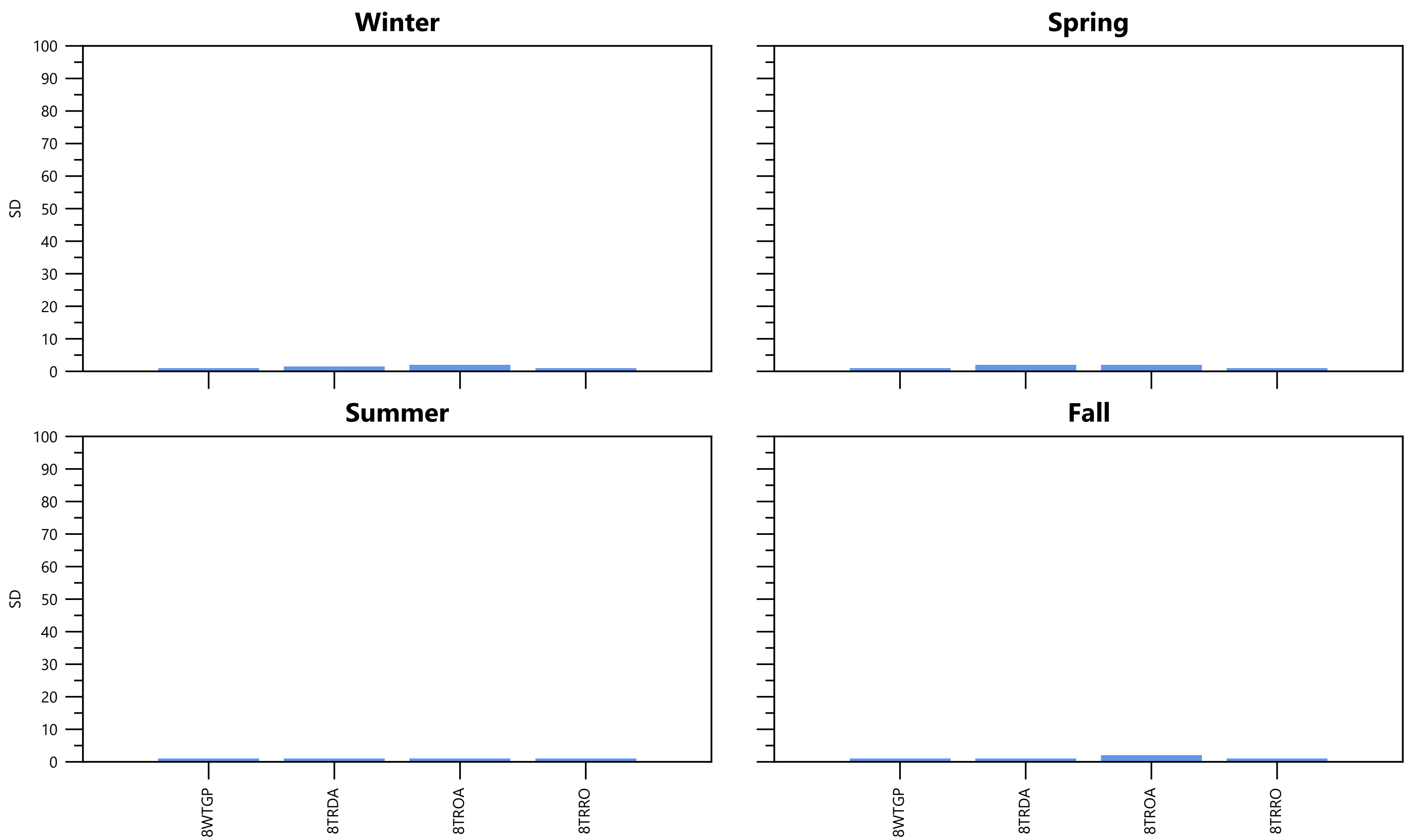
Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

Figure I-92

Subsistence Flow Attainment Duration (AD) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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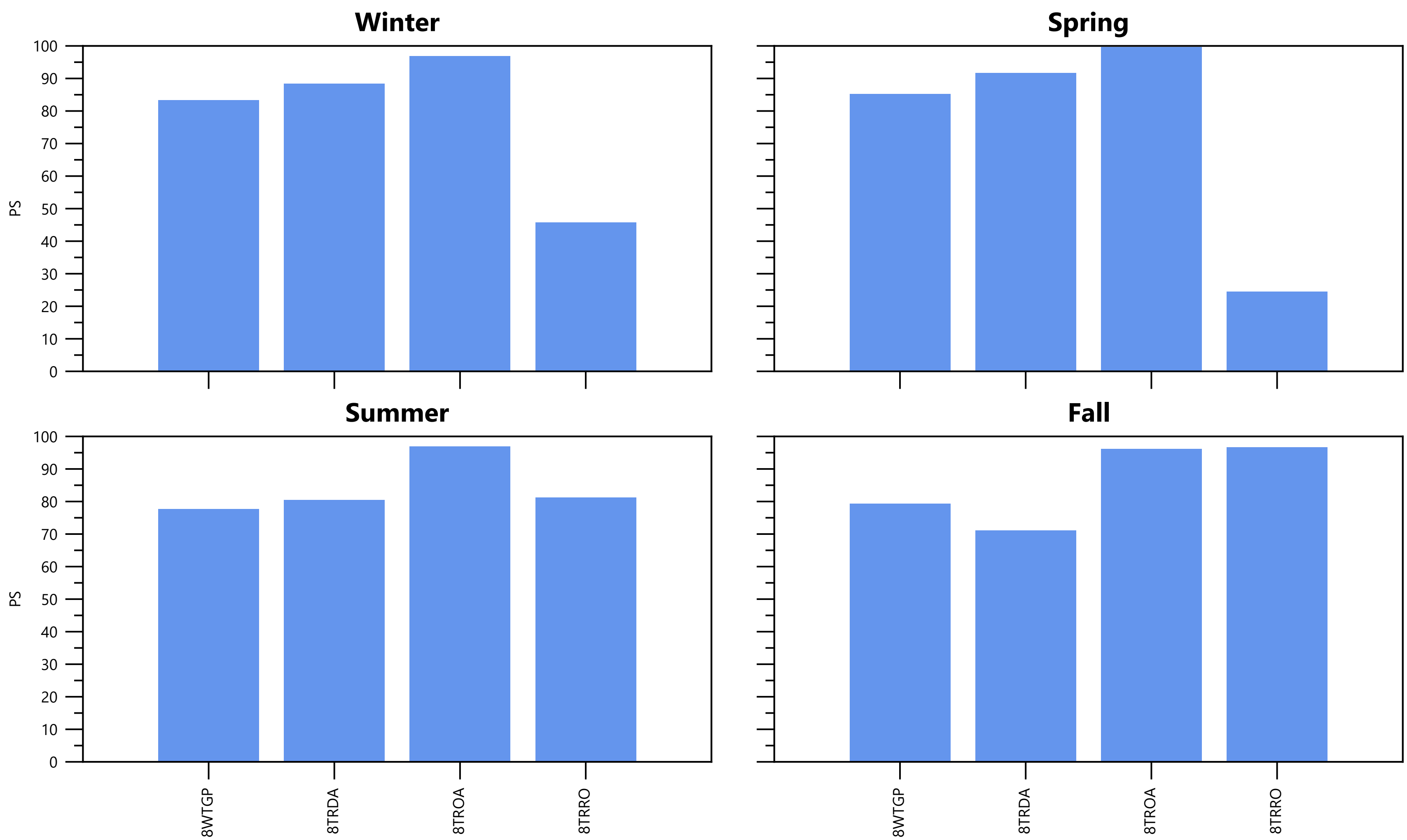
Figure I-93

Subsistence Flow Shortage Duration (SD) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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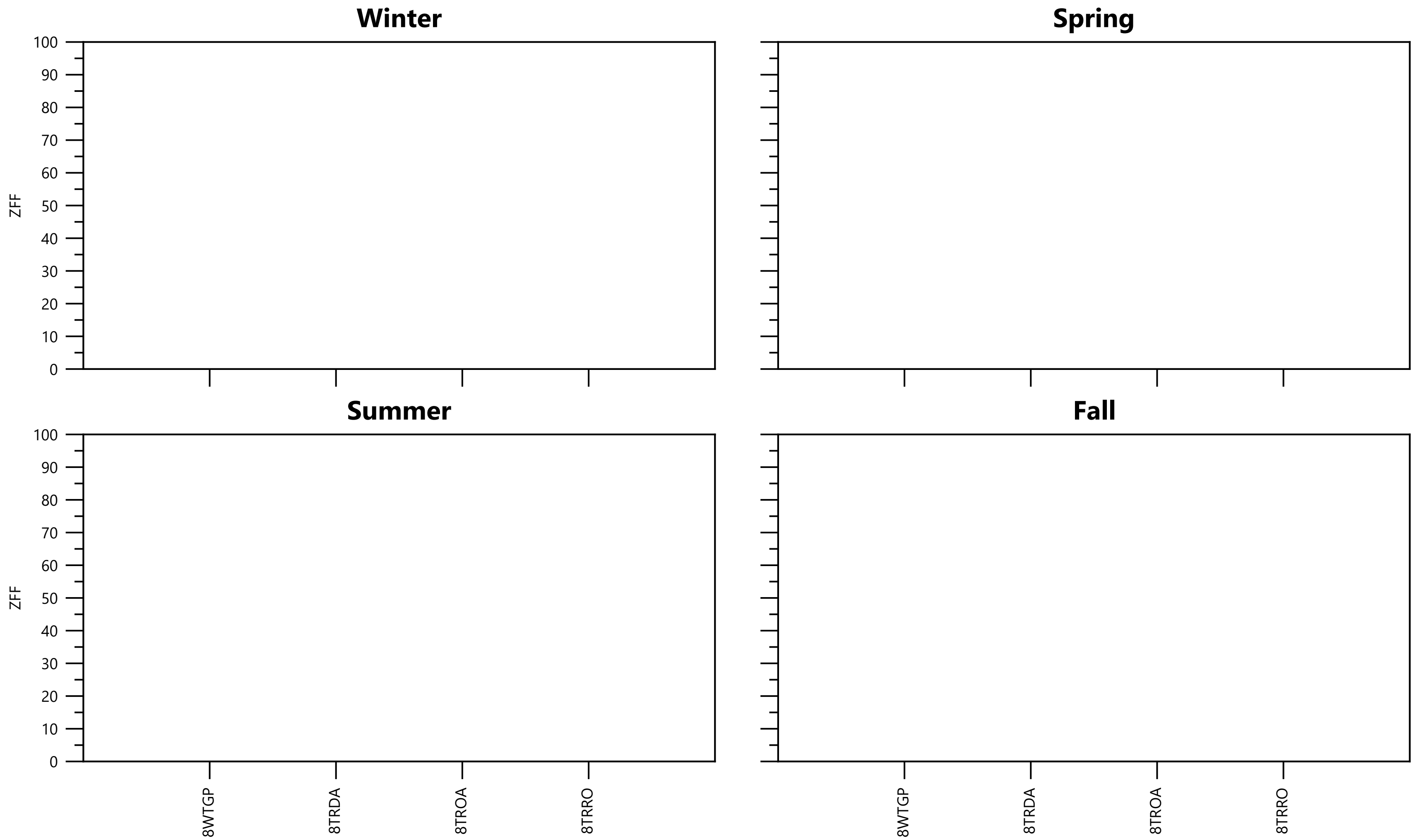
Figure I-94
Subsistence Flow Percent Shortage (PS) by Season: Current Water Use Scenario



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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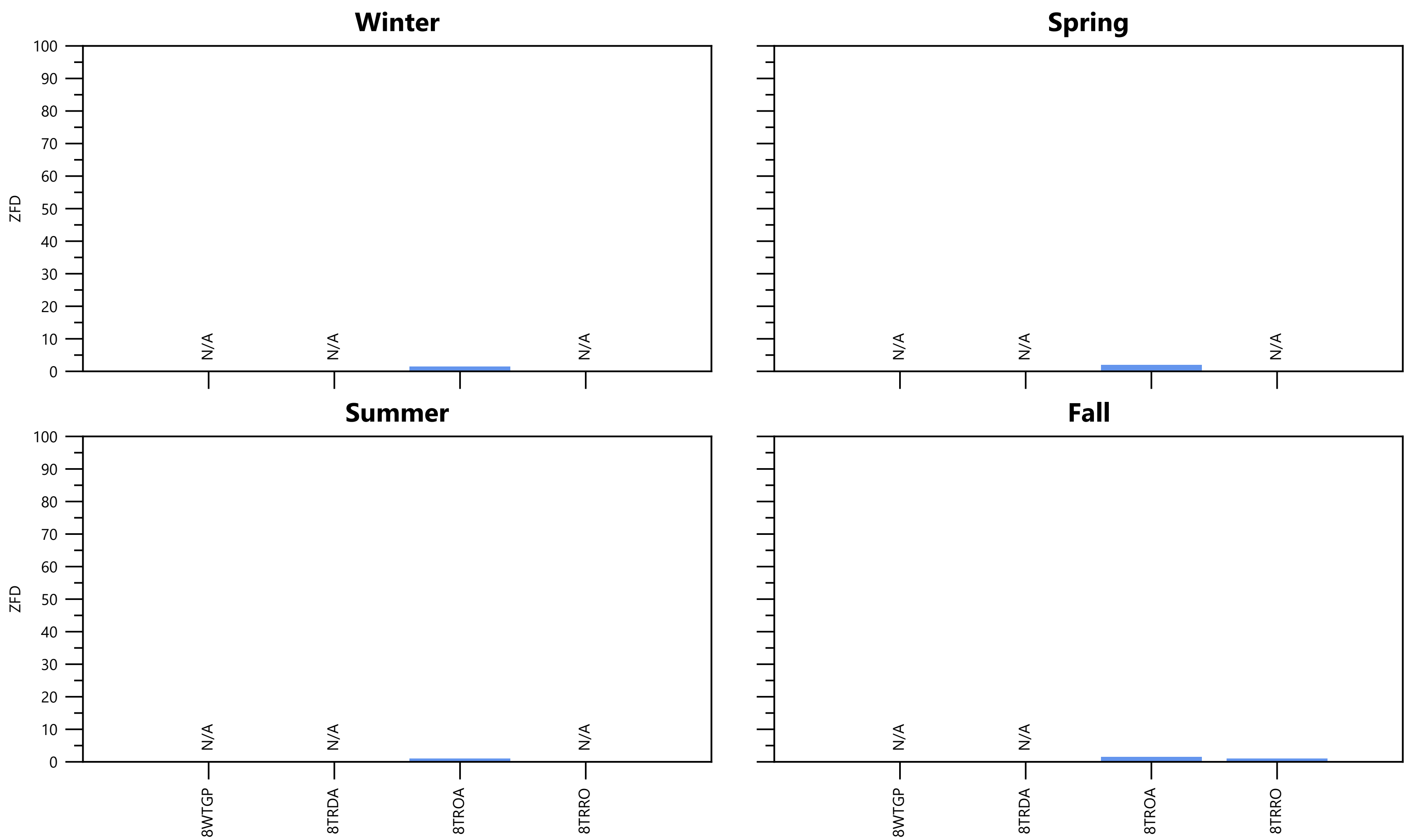
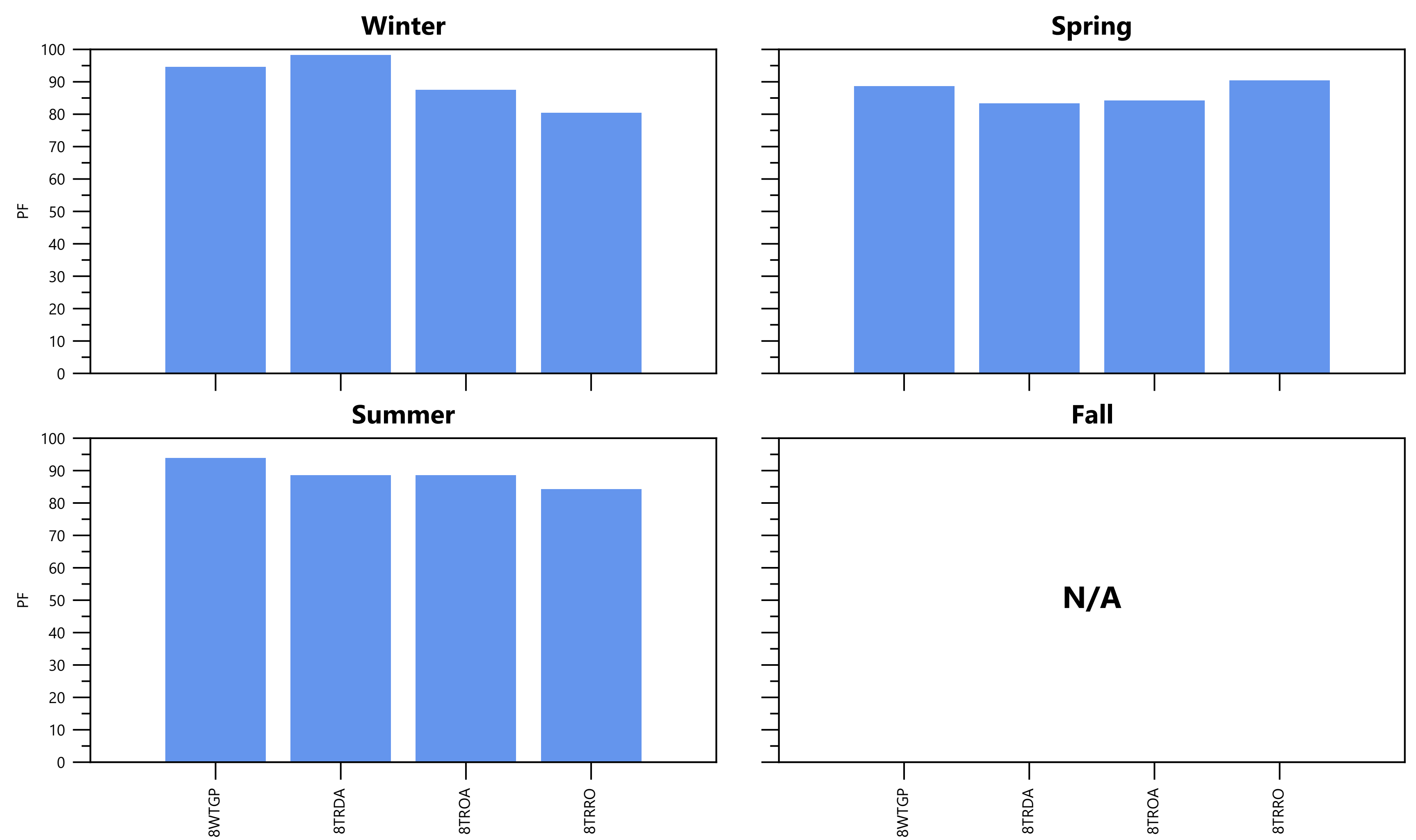
Figure I-95
Zero-Flow Frequencies (ZFF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

Figure I-96
Zero-Flow Durations (ZFD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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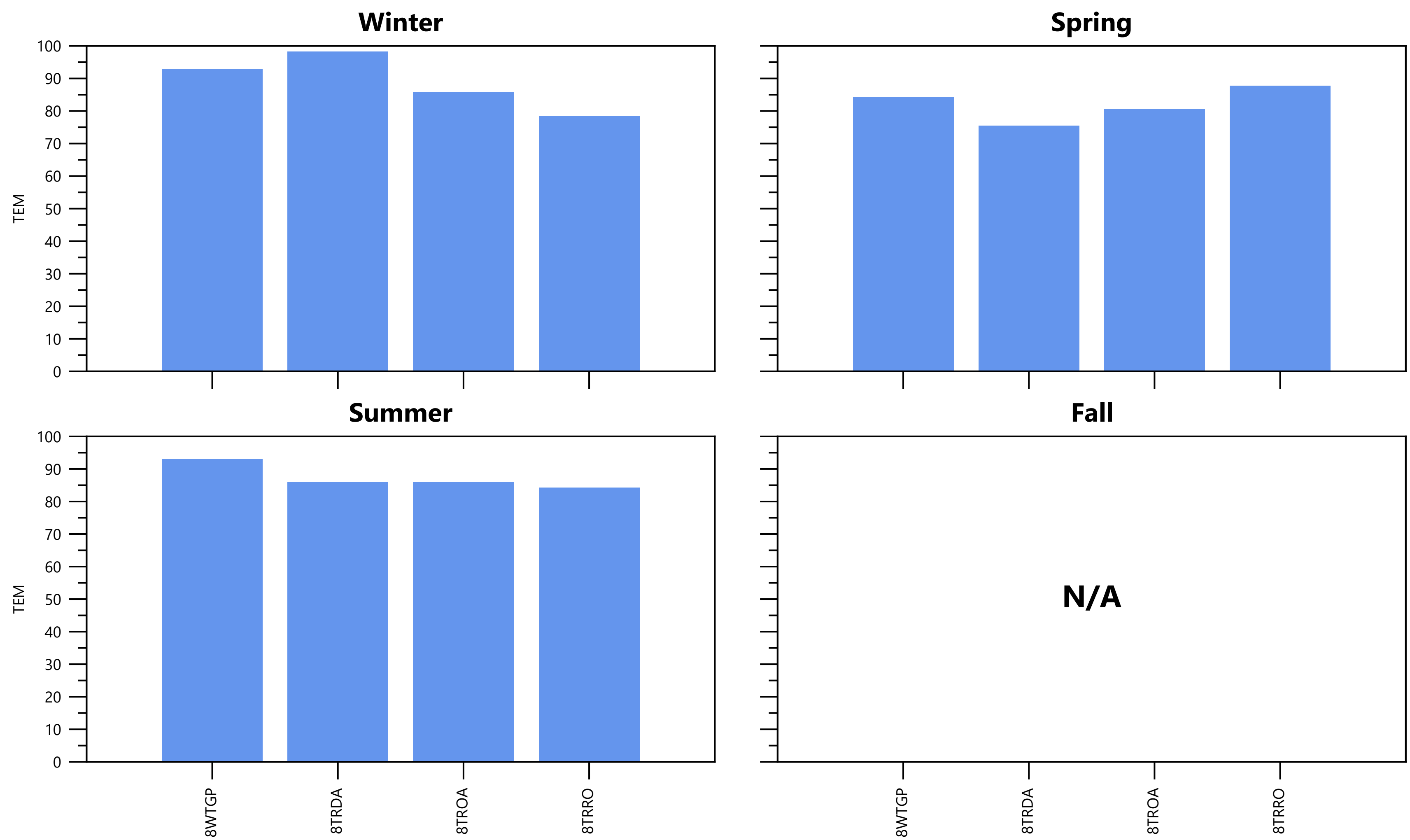
Figure I-97
Pulse Frequencies (PF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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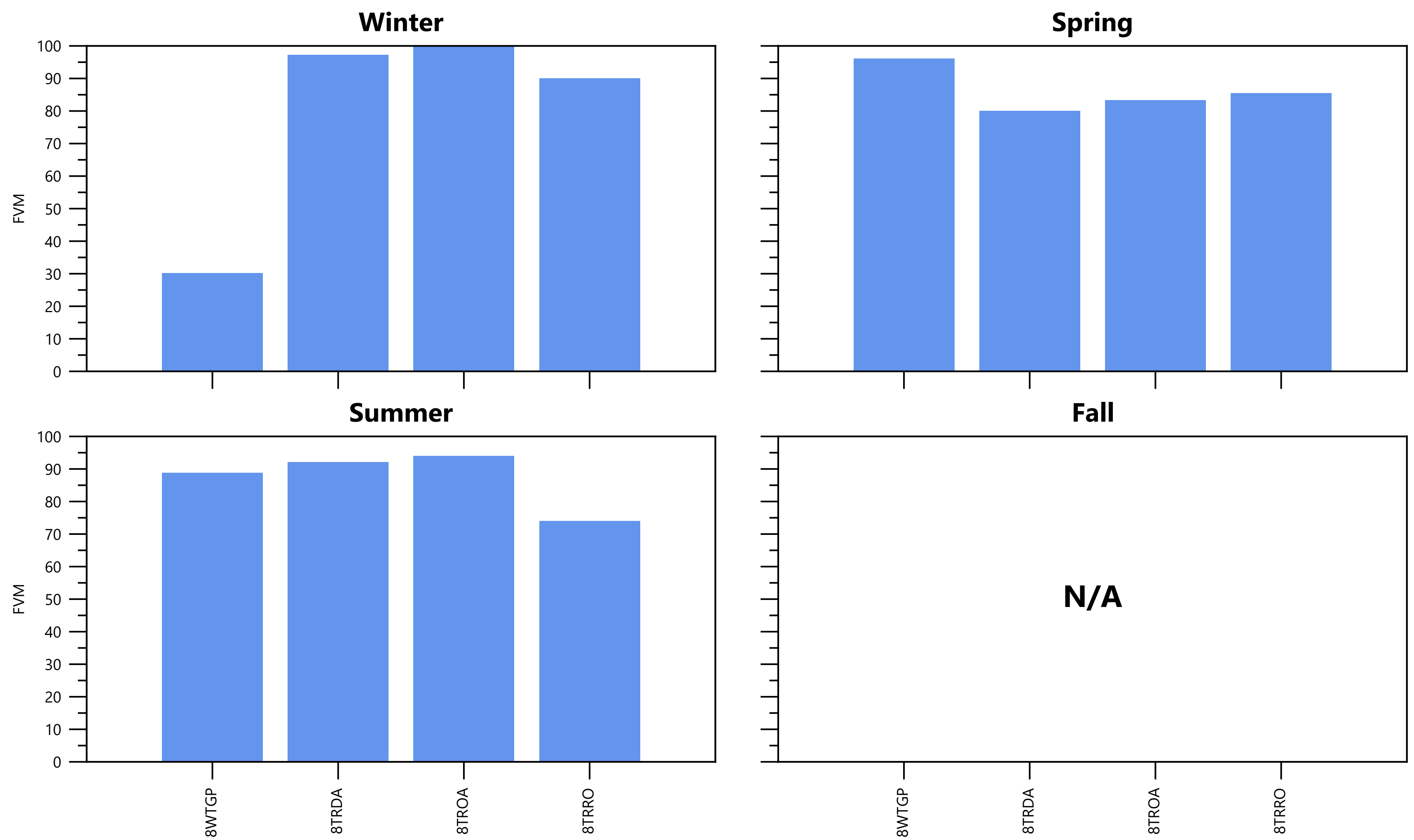
Figure I-98
Target Engagements Met (TEM) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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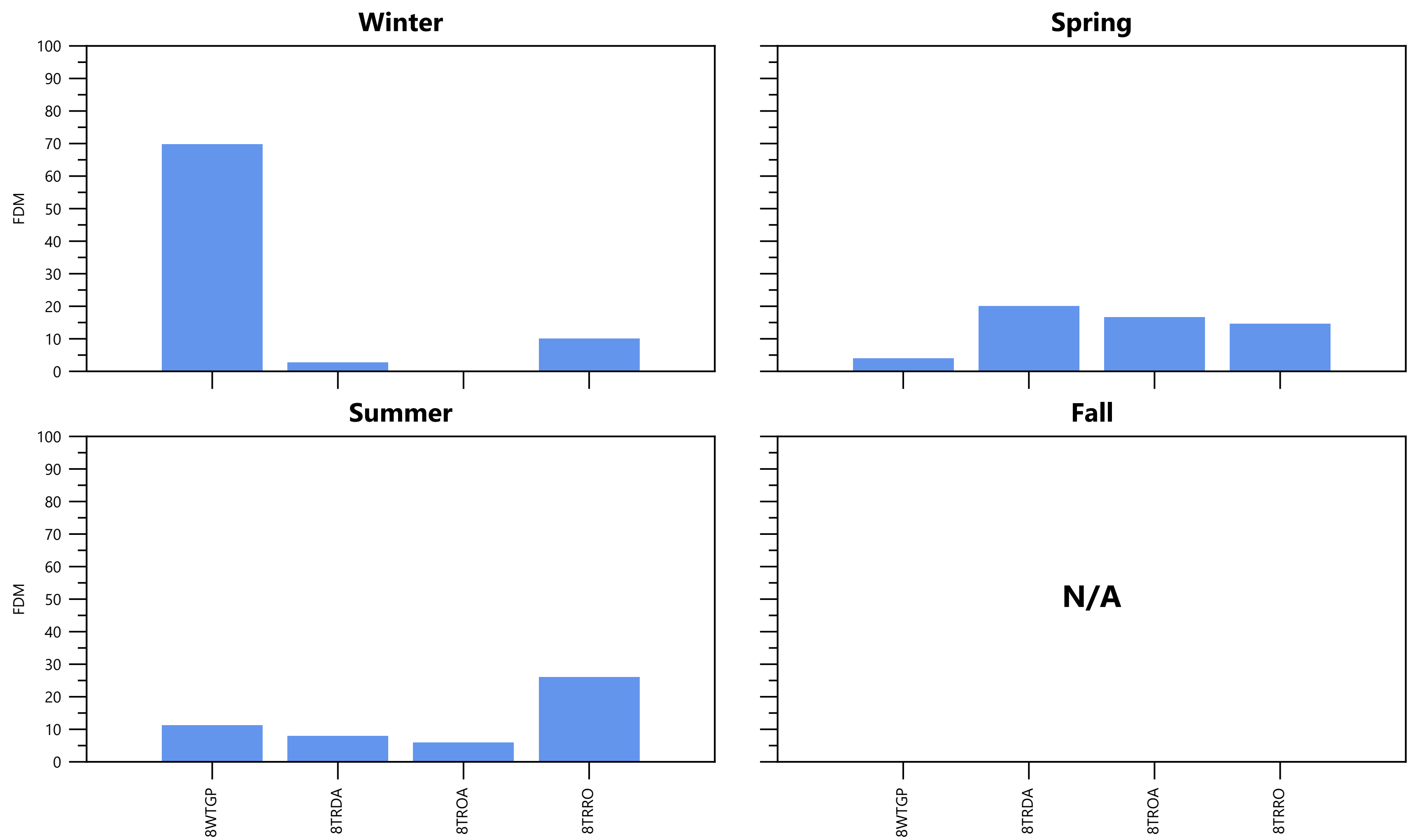

Notes:
The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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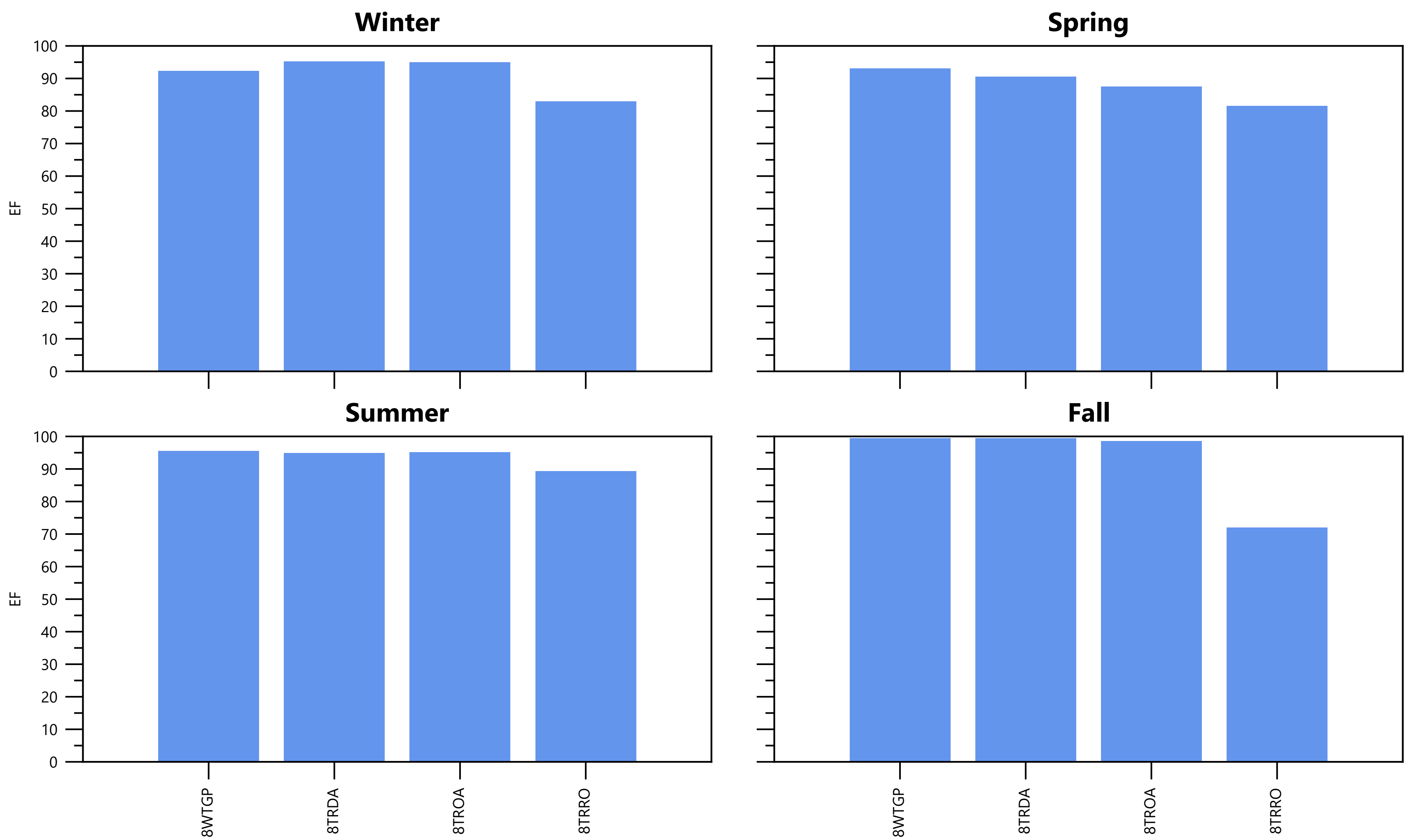
Figure I-100
Frequency Duration Met (FDM) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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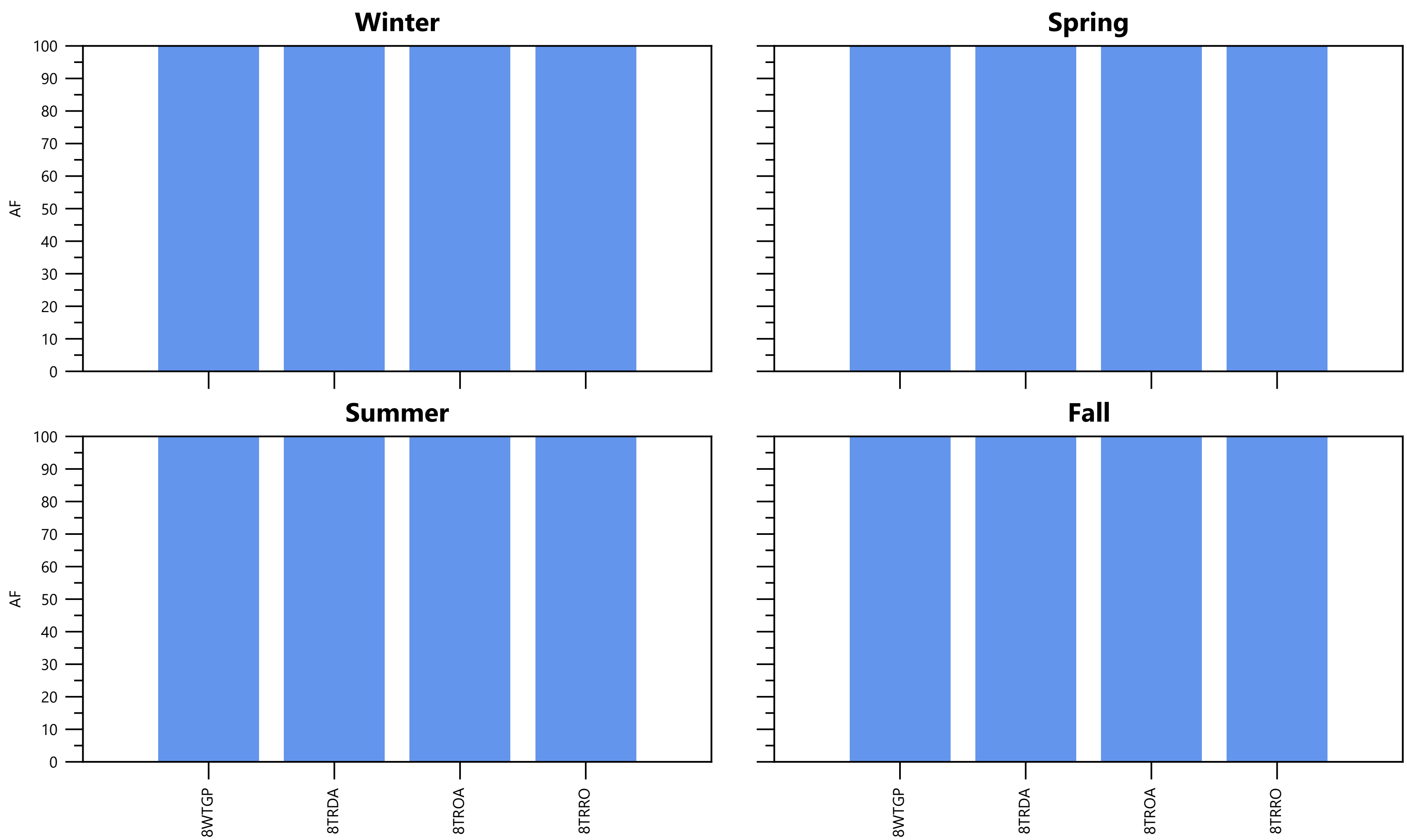
Figure I-101
Base Flow Engagement Frequency (EF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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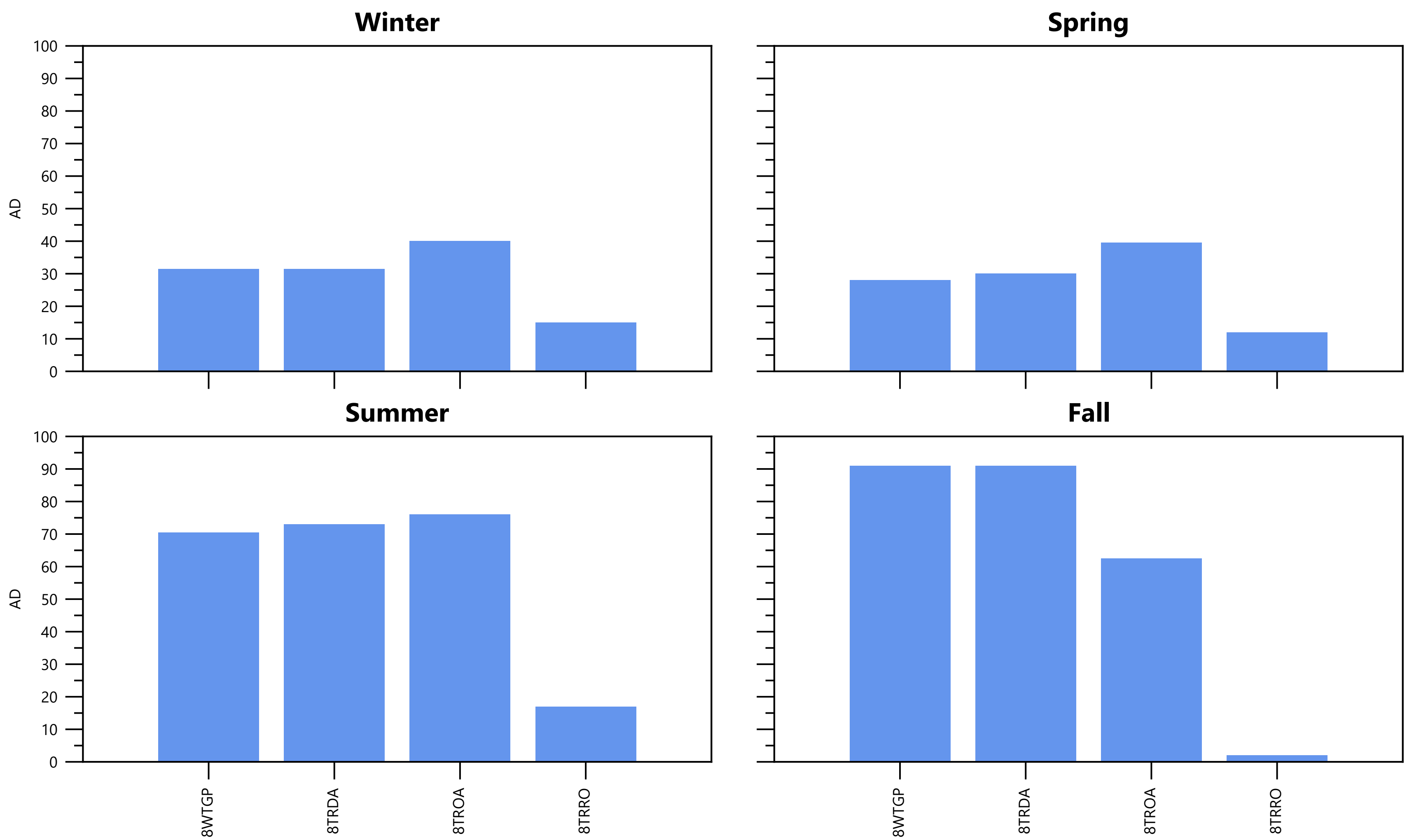
Figure I-102
Base Flow Attainment Frequency (AF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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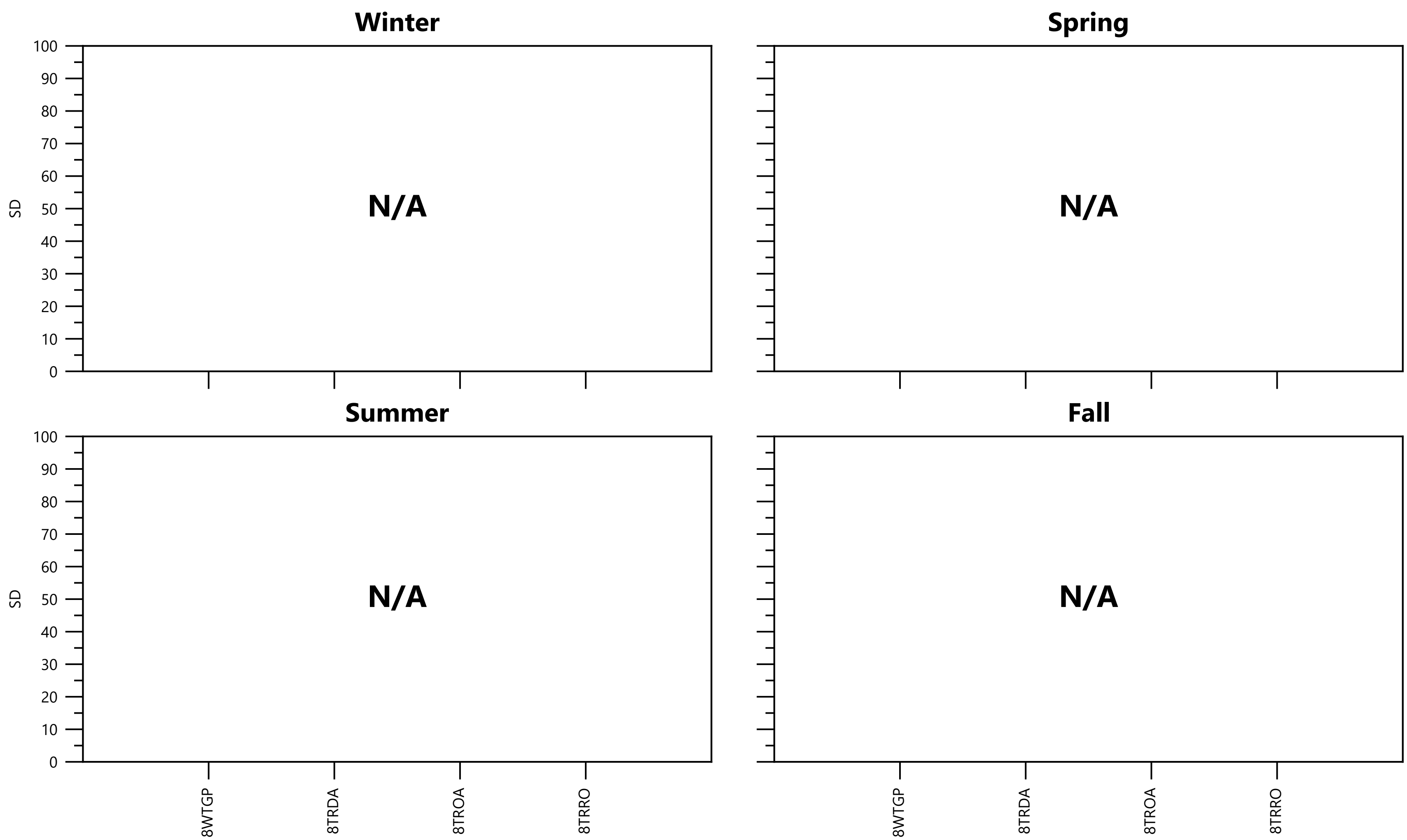
Figure I-103
Base Flow Attainment Duration (AD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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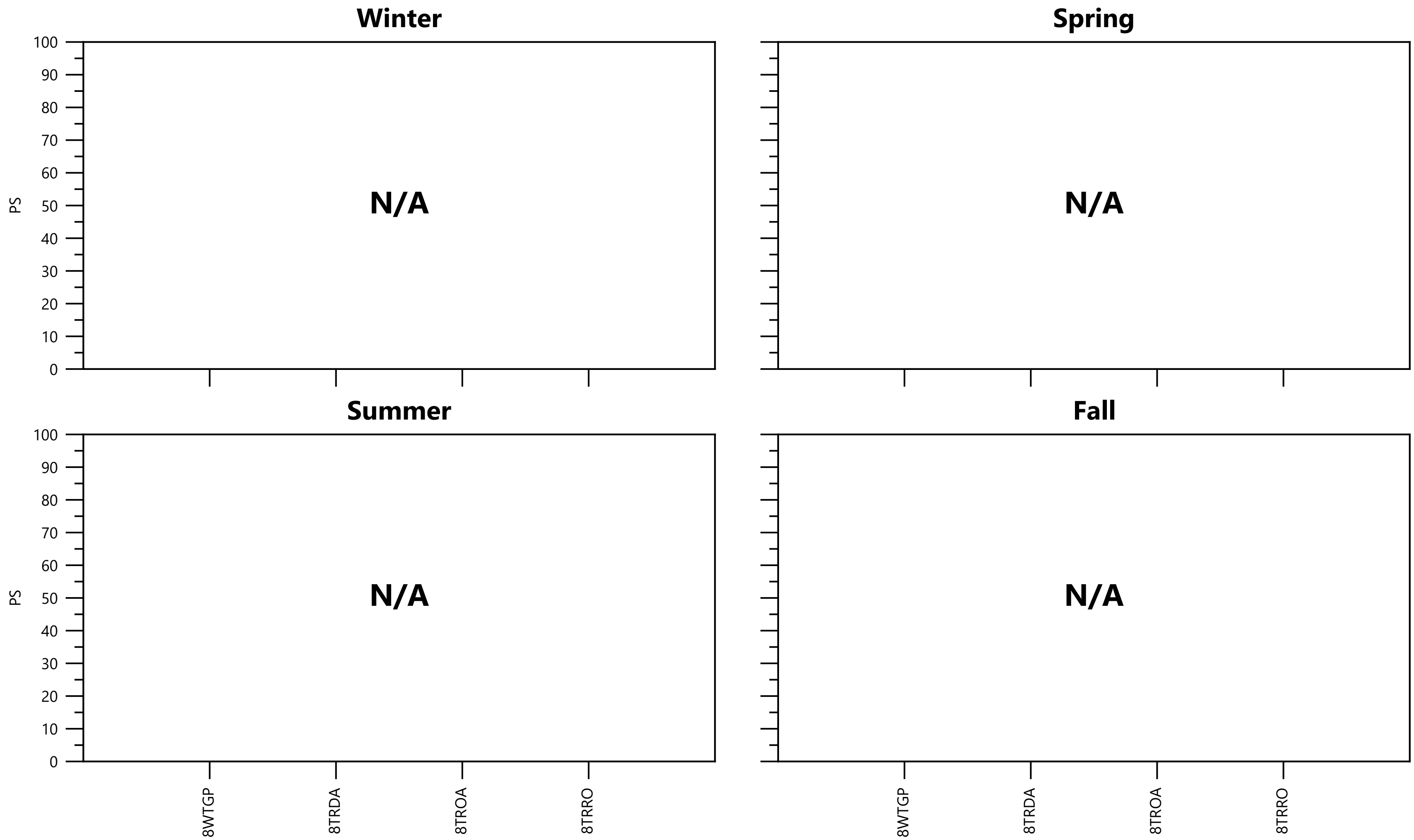
Figure I-104
Base Flow Shortage Duration (SD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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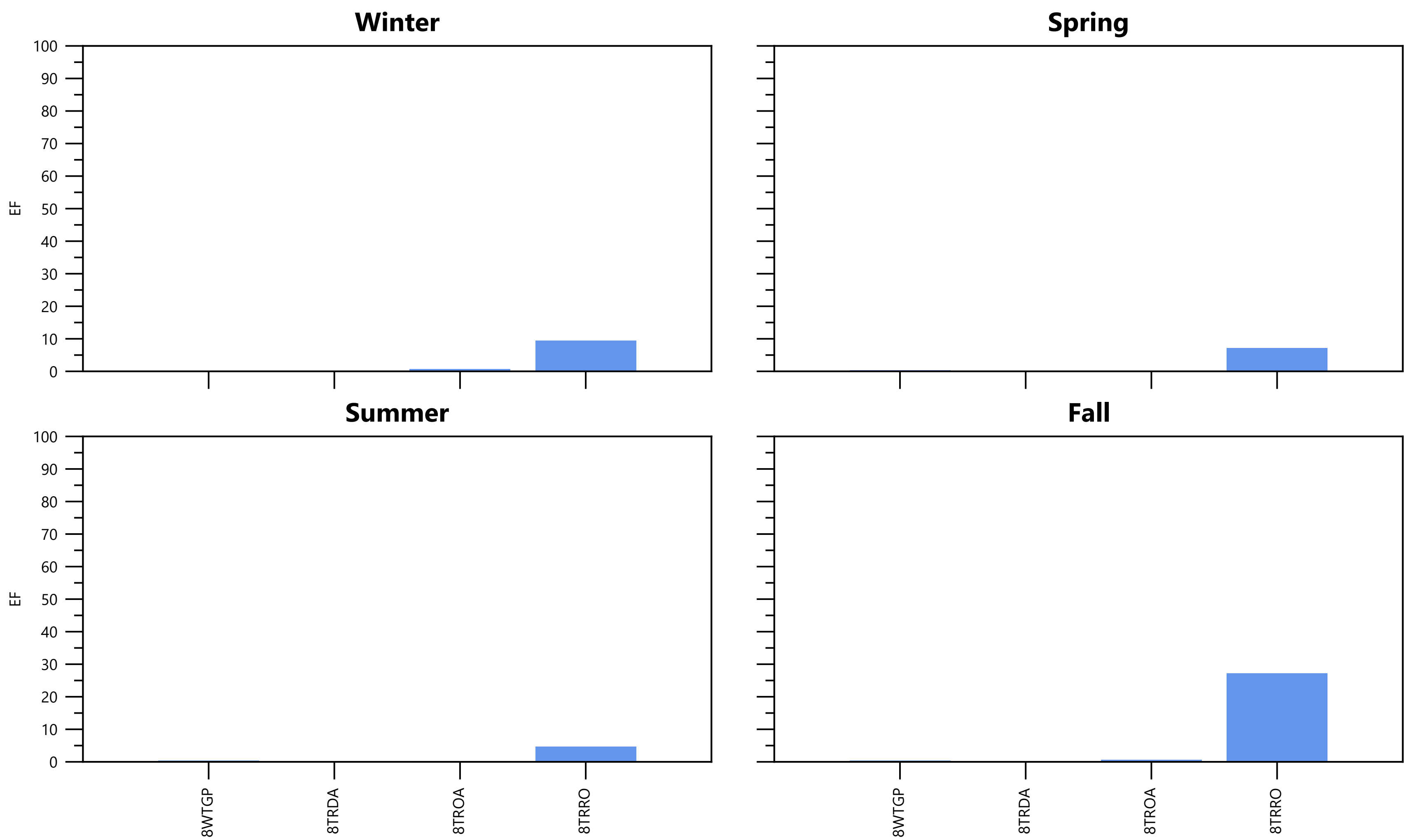
Figure I-105

Base Flow Percent Shortage (PS) by Season: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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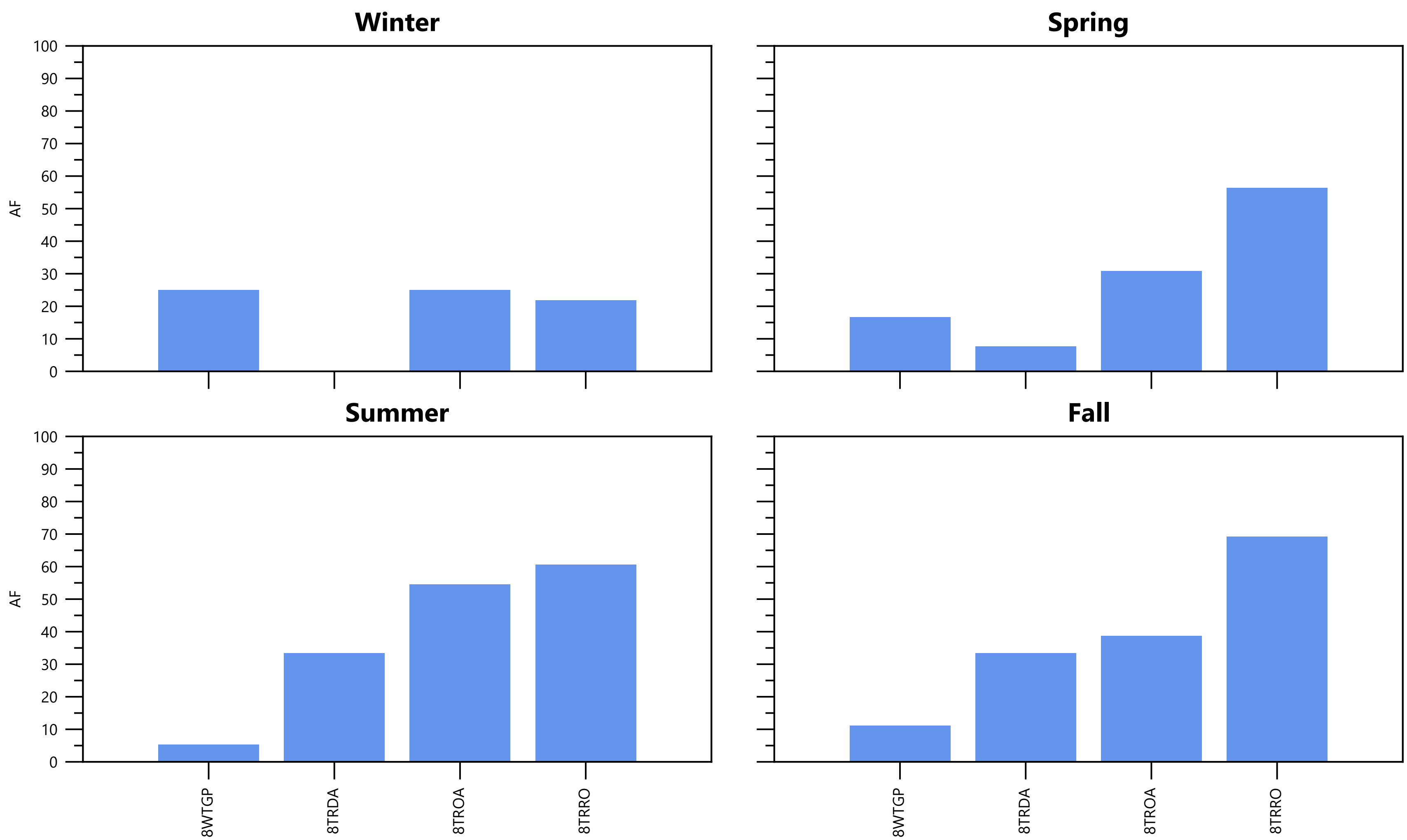
Figure I-106
Subsistence Flow Engagement Frequency (EF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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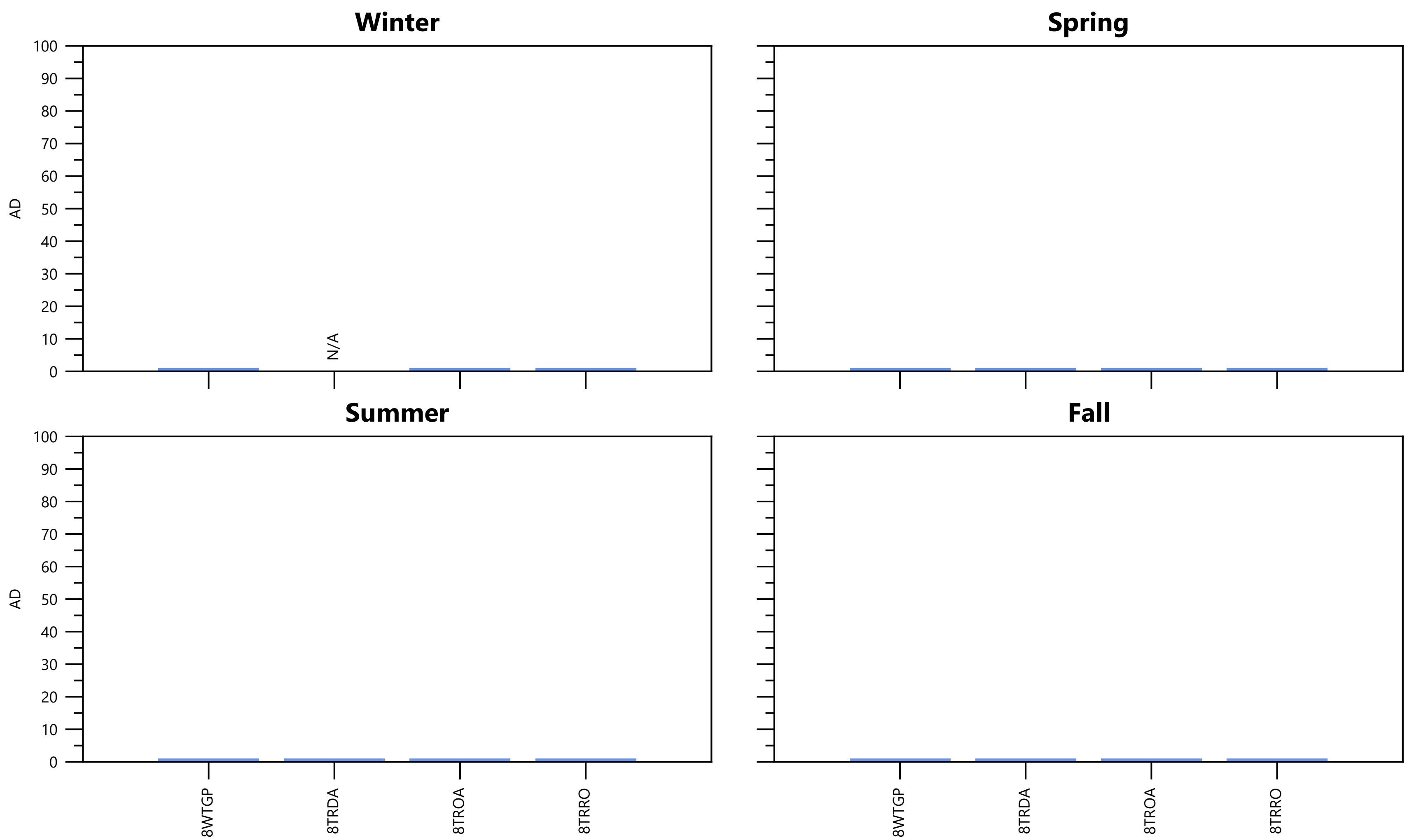
Figure I-107
Subsistence Flow Attainment Frequency (AF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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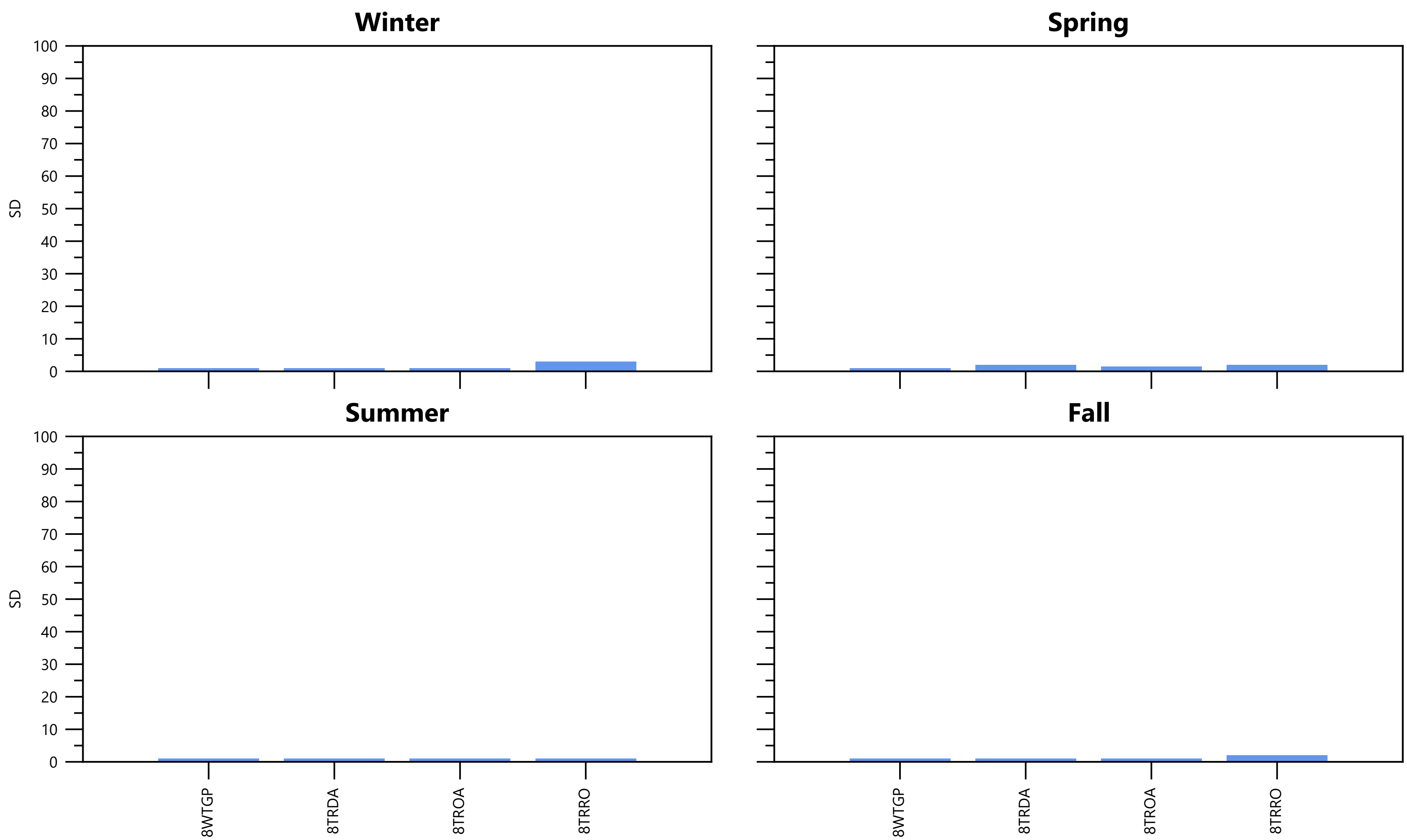
Figure I-108
Subsistence Flow Attainment Duration (AD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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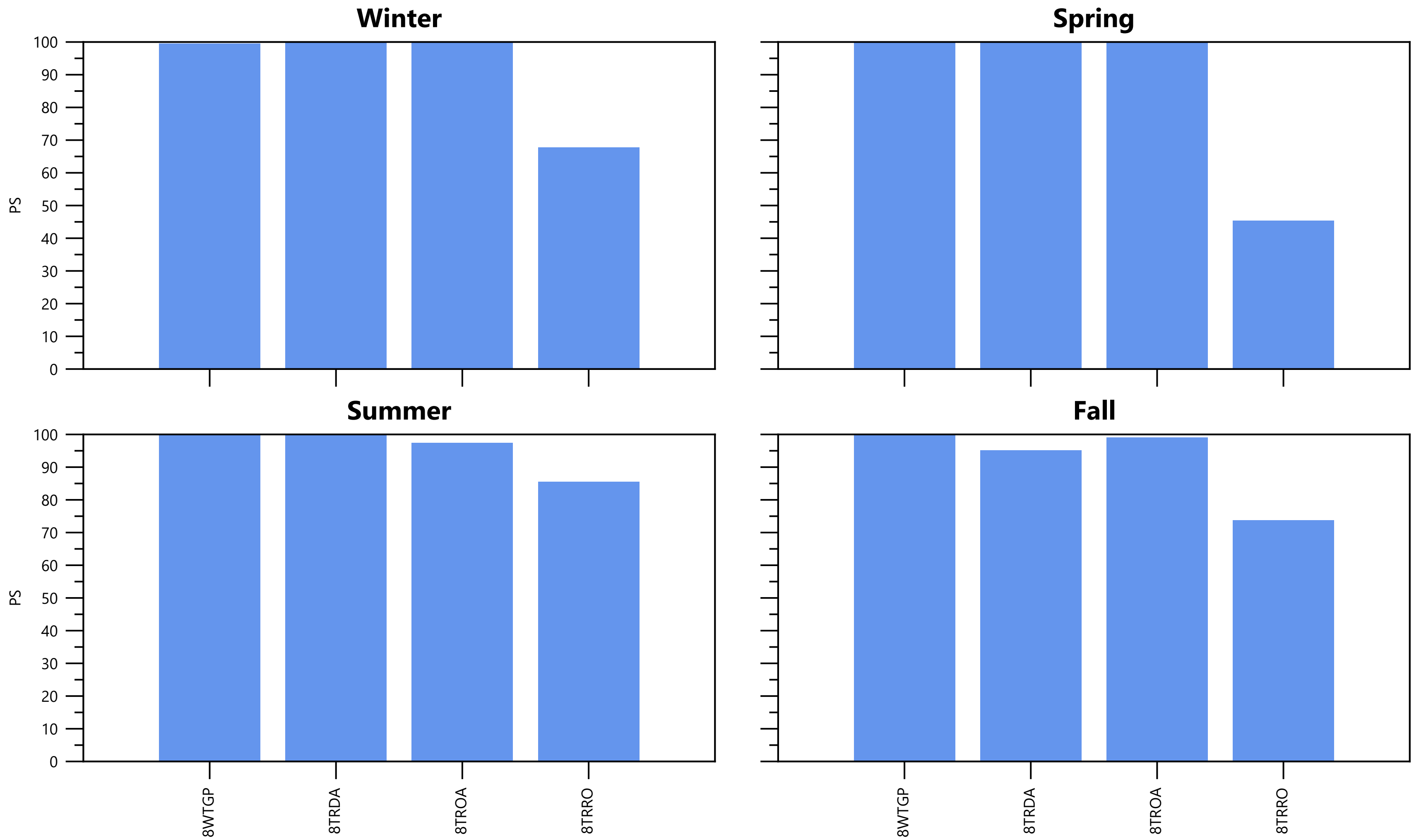
Figure I-109
Subsistence Flow Shortage Duration (SD) by Season: Partial Utilization Scenario



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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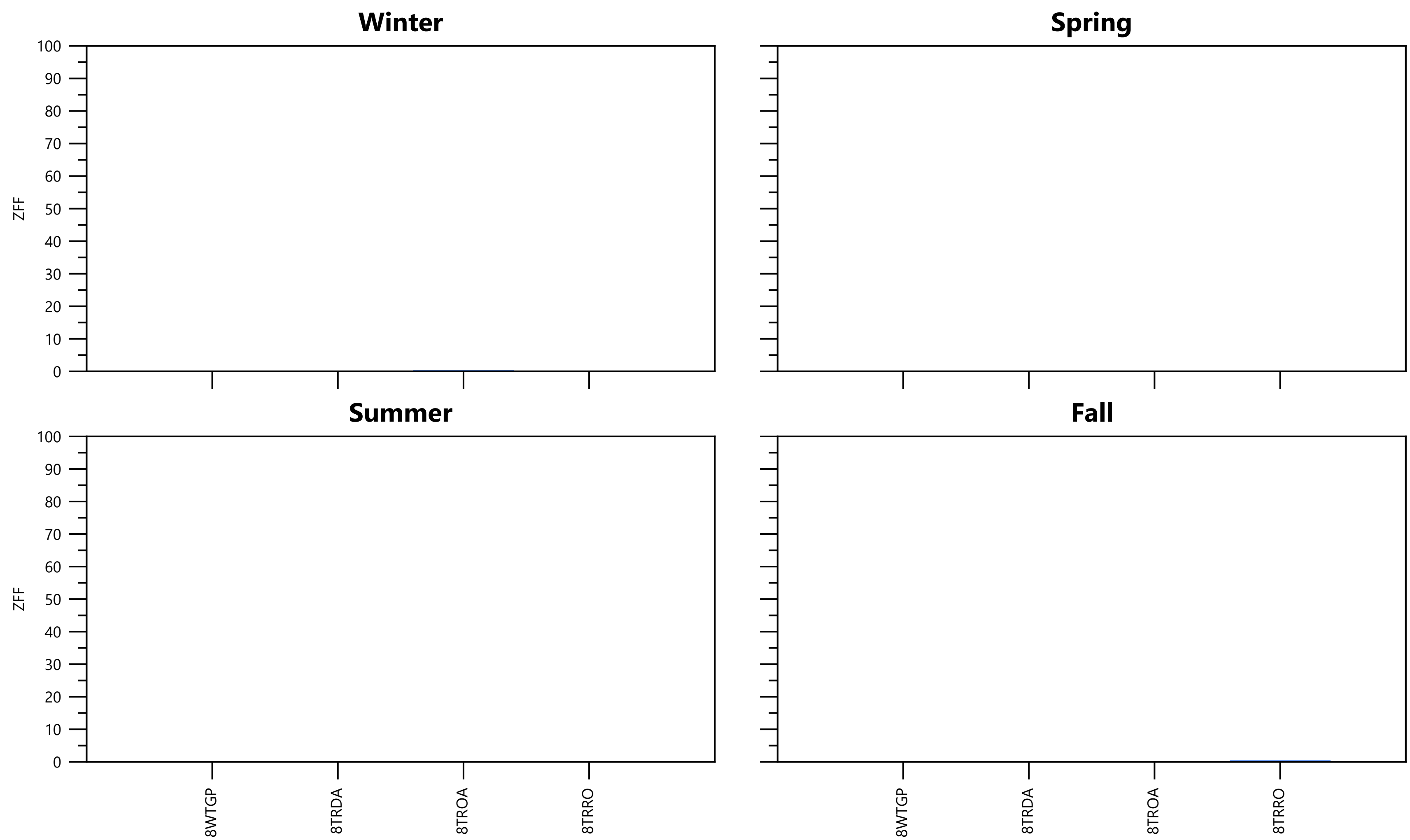
Figure I-110
Subsistence Flow Percent Shortage (PS) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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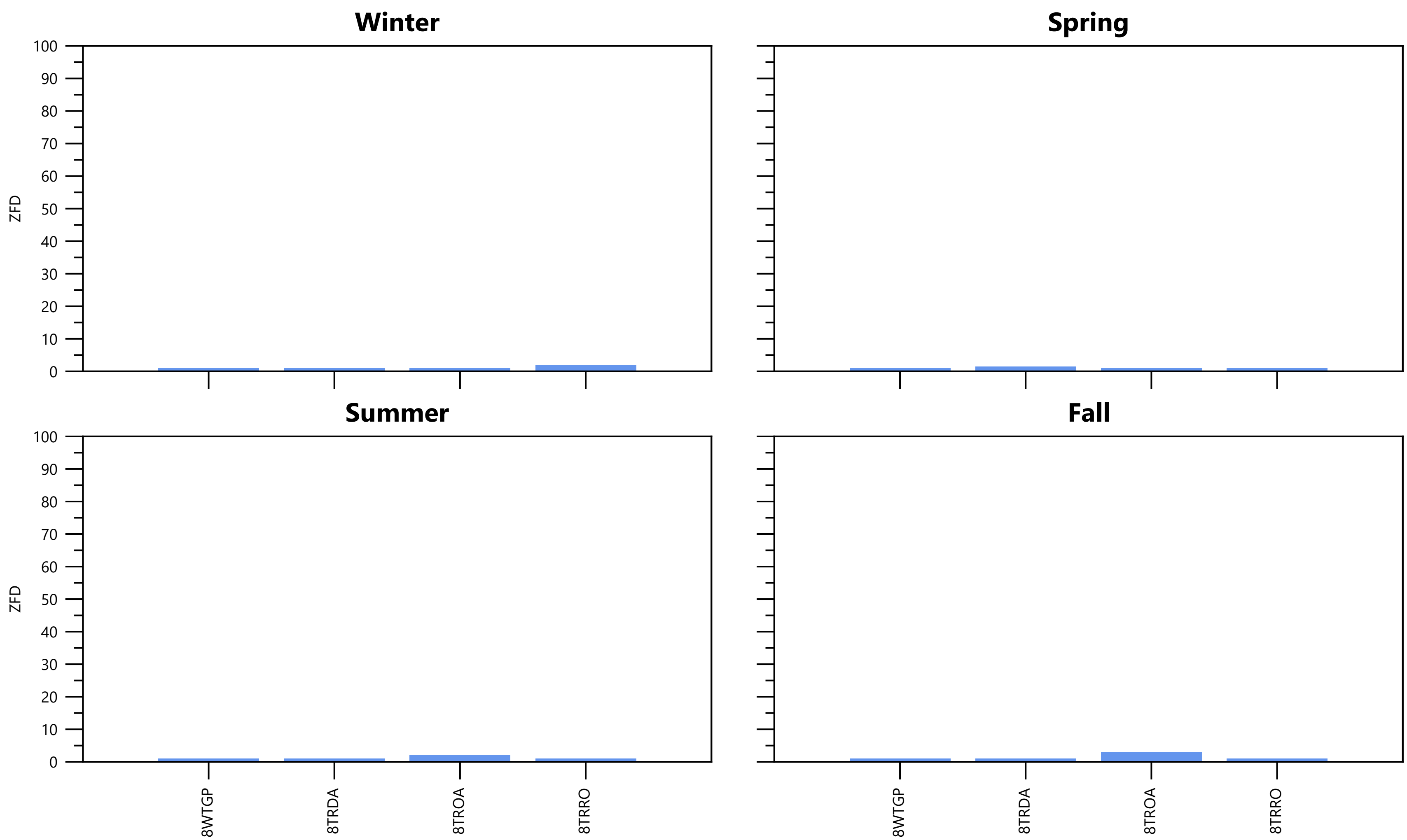
Figure I-111
Zero-Flow Frequencies (ZFF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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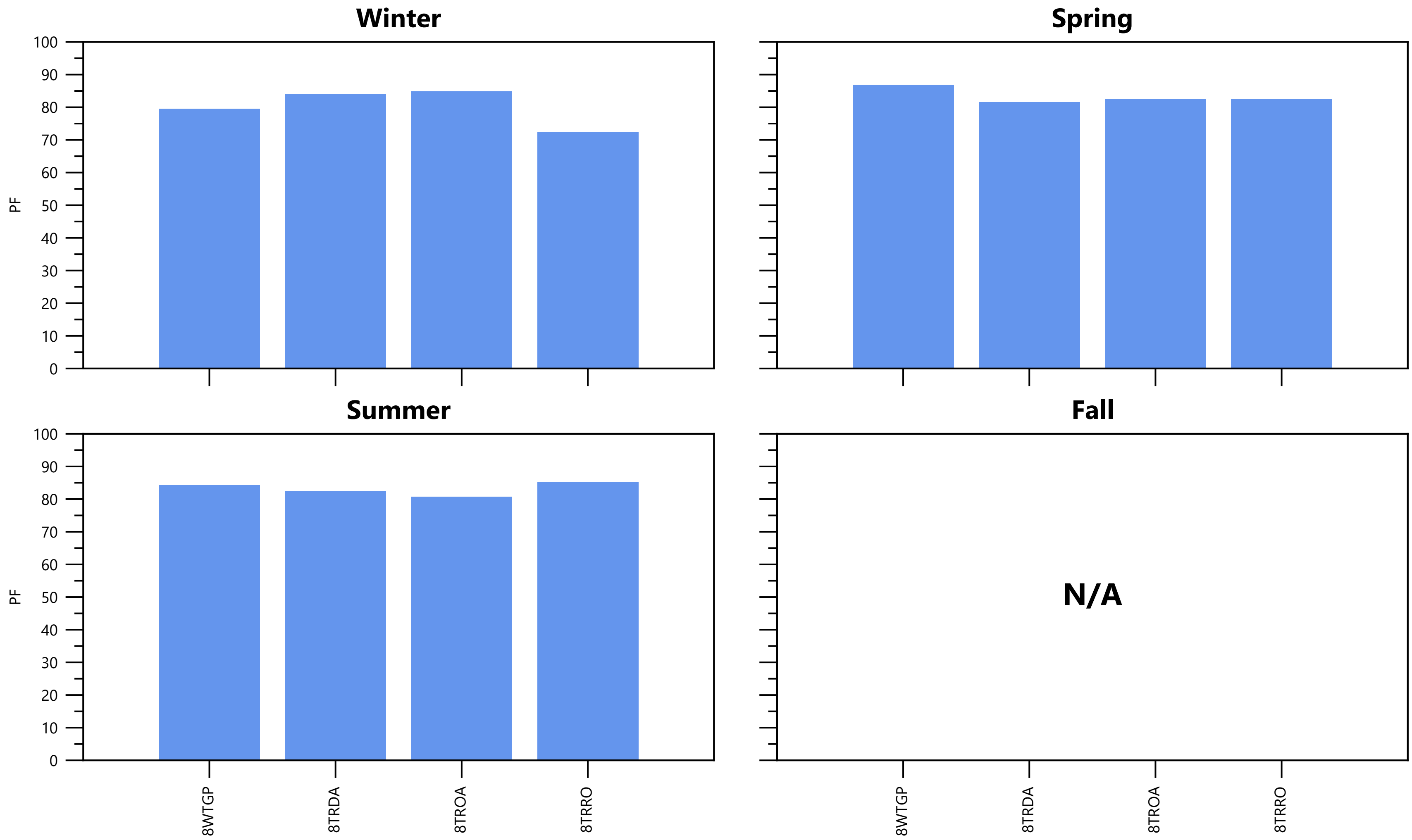
Figure I-112
Zero-Flow Durations (ZFD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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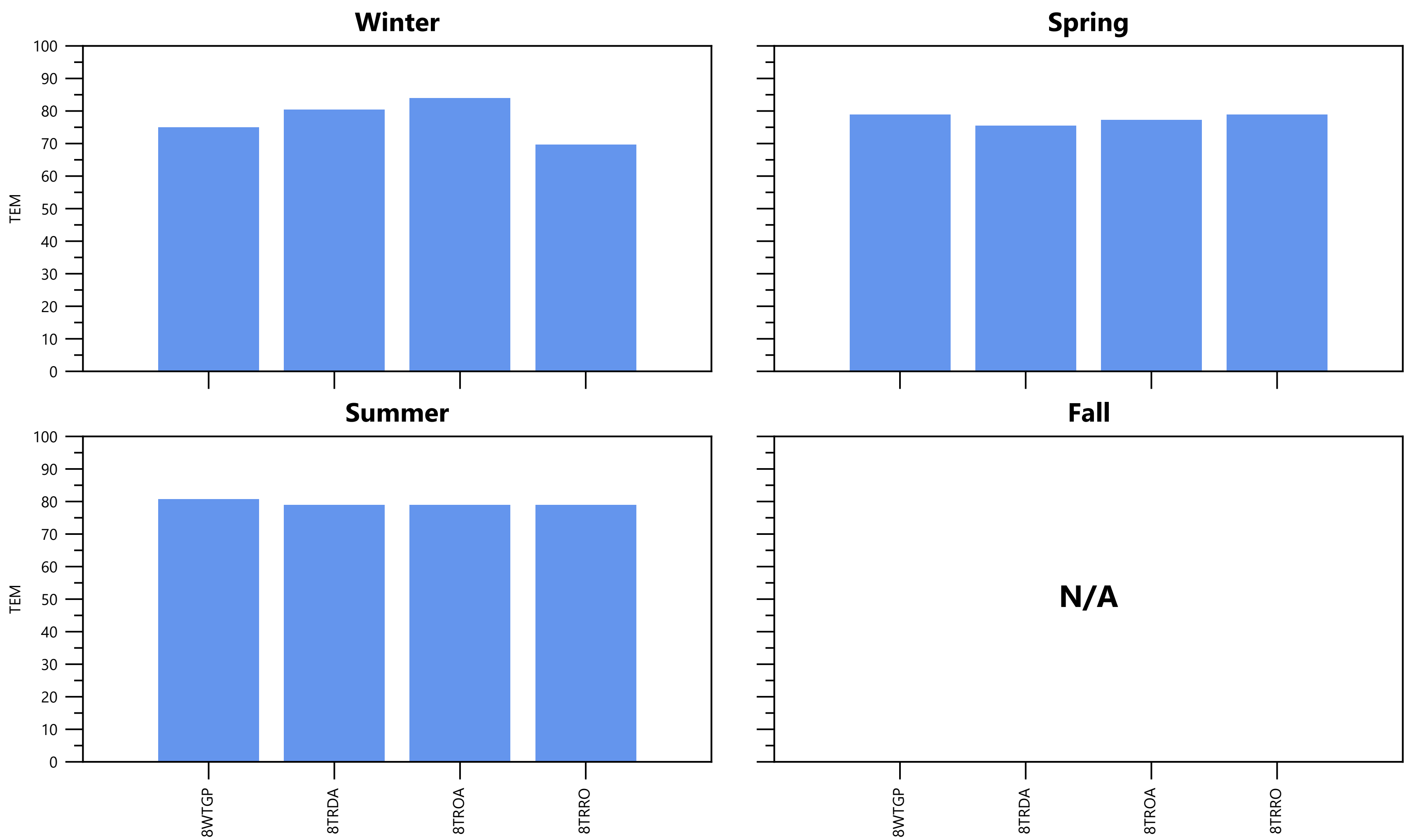
Figure I-113
Pulse Frequencies (PF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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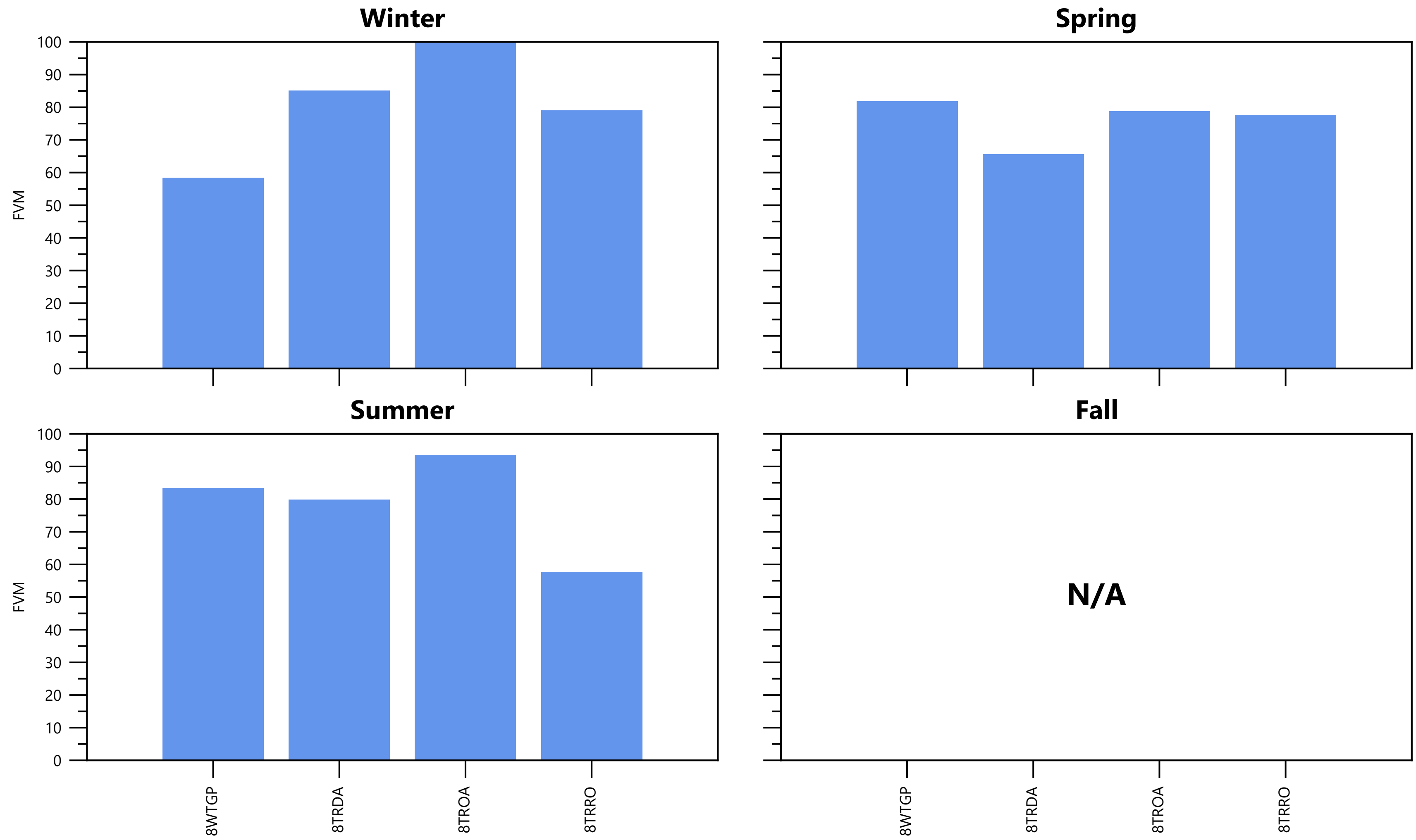
Figure I-114
Target Engagements Met (TEM) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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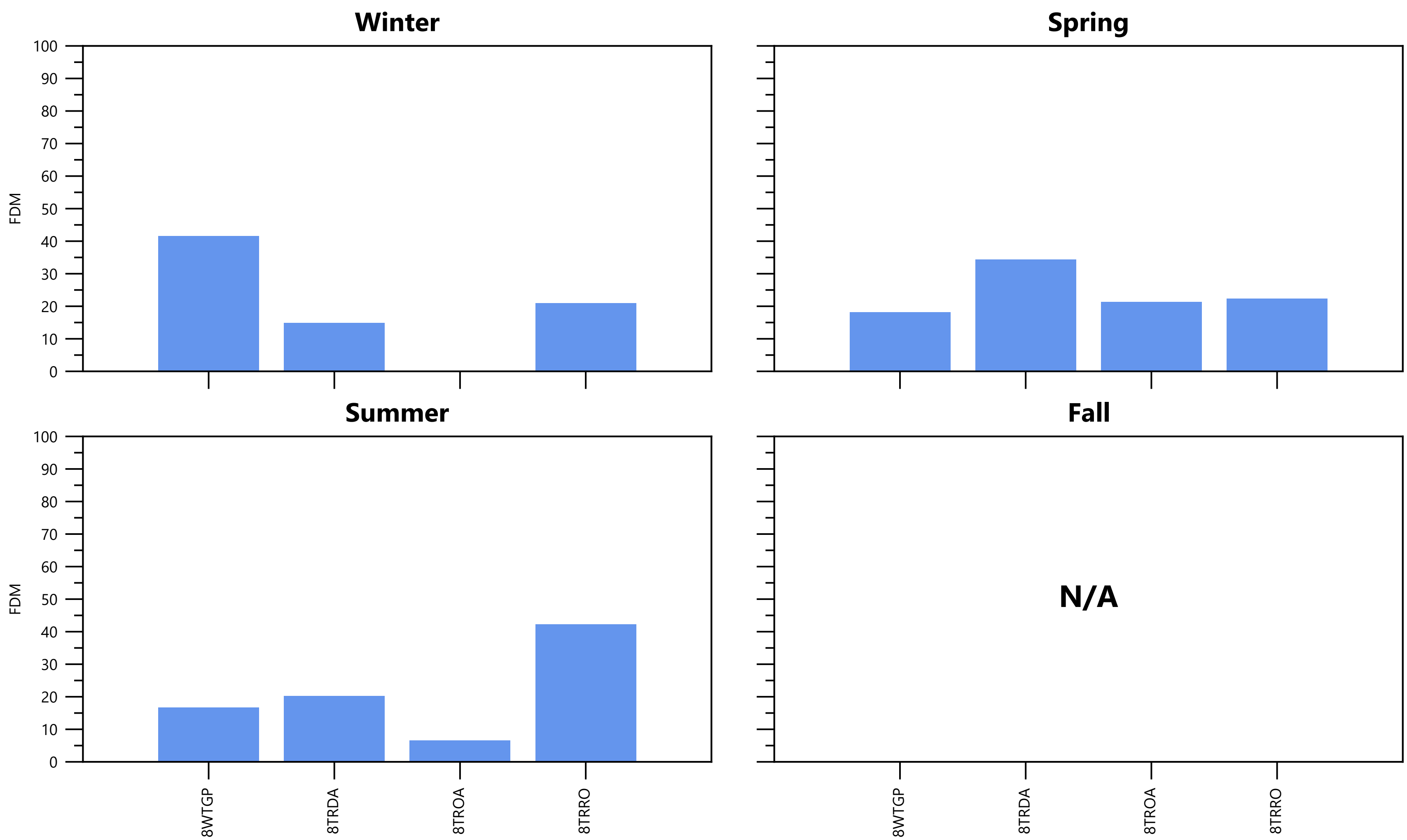
Figure I-115
Frequency Volume Met (FVM) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes:
The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.
For high flow pulses in the Trinity River basin, summer and fall are one season, and the results are shown in the summer.

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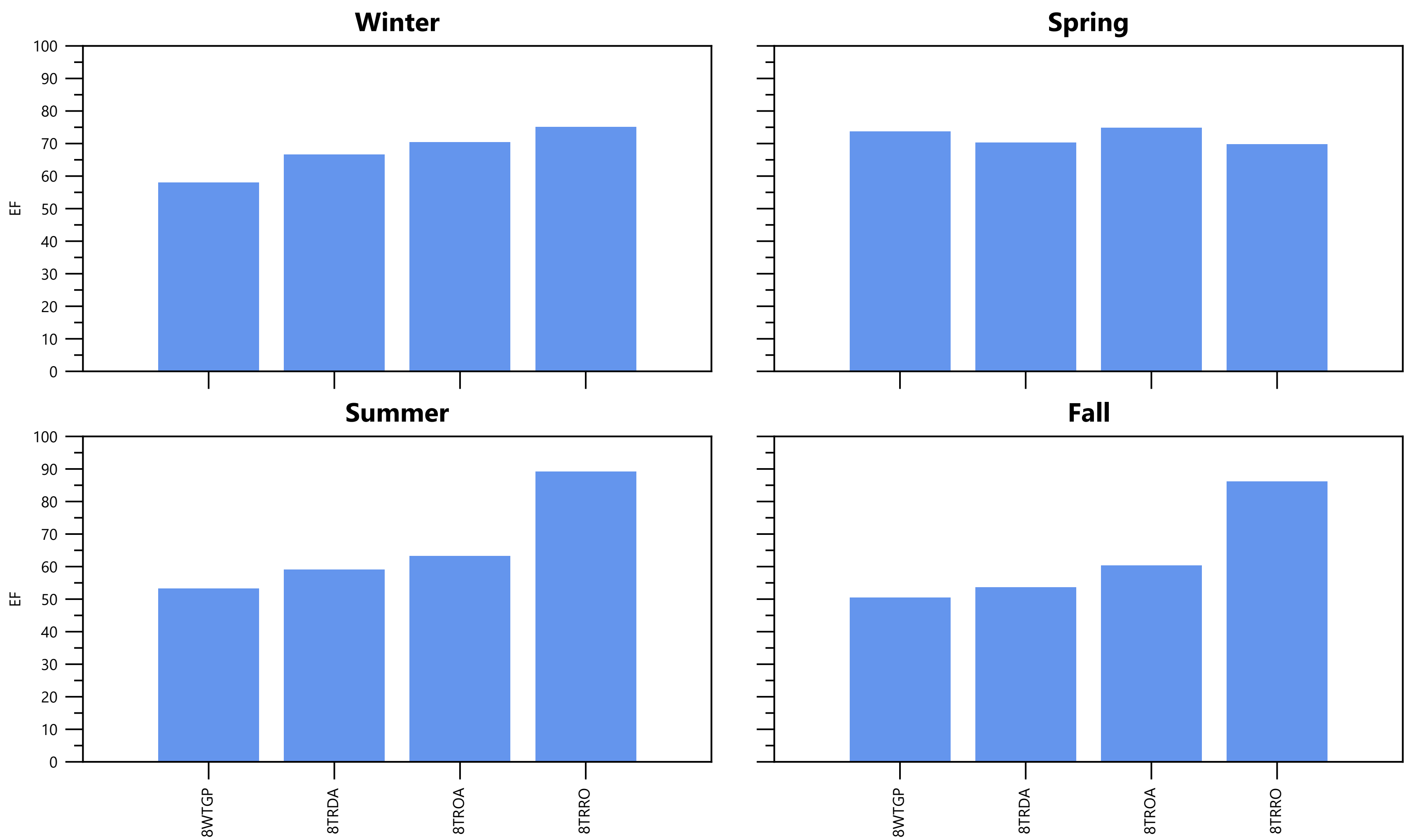
Figure I-116
Frequency Duration Met (FDM) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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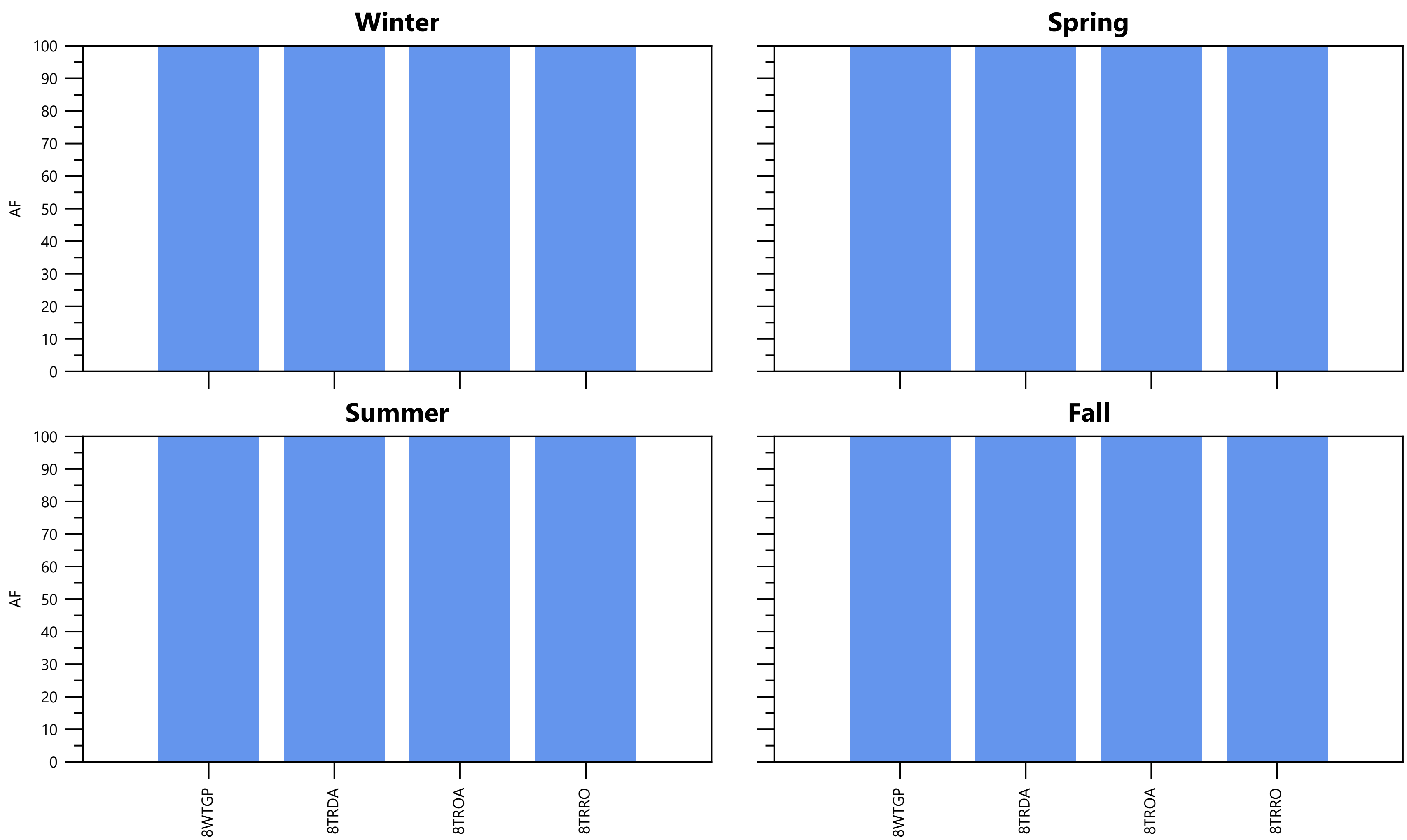
Figure I-117
Base Flow Engagement Frequency (EF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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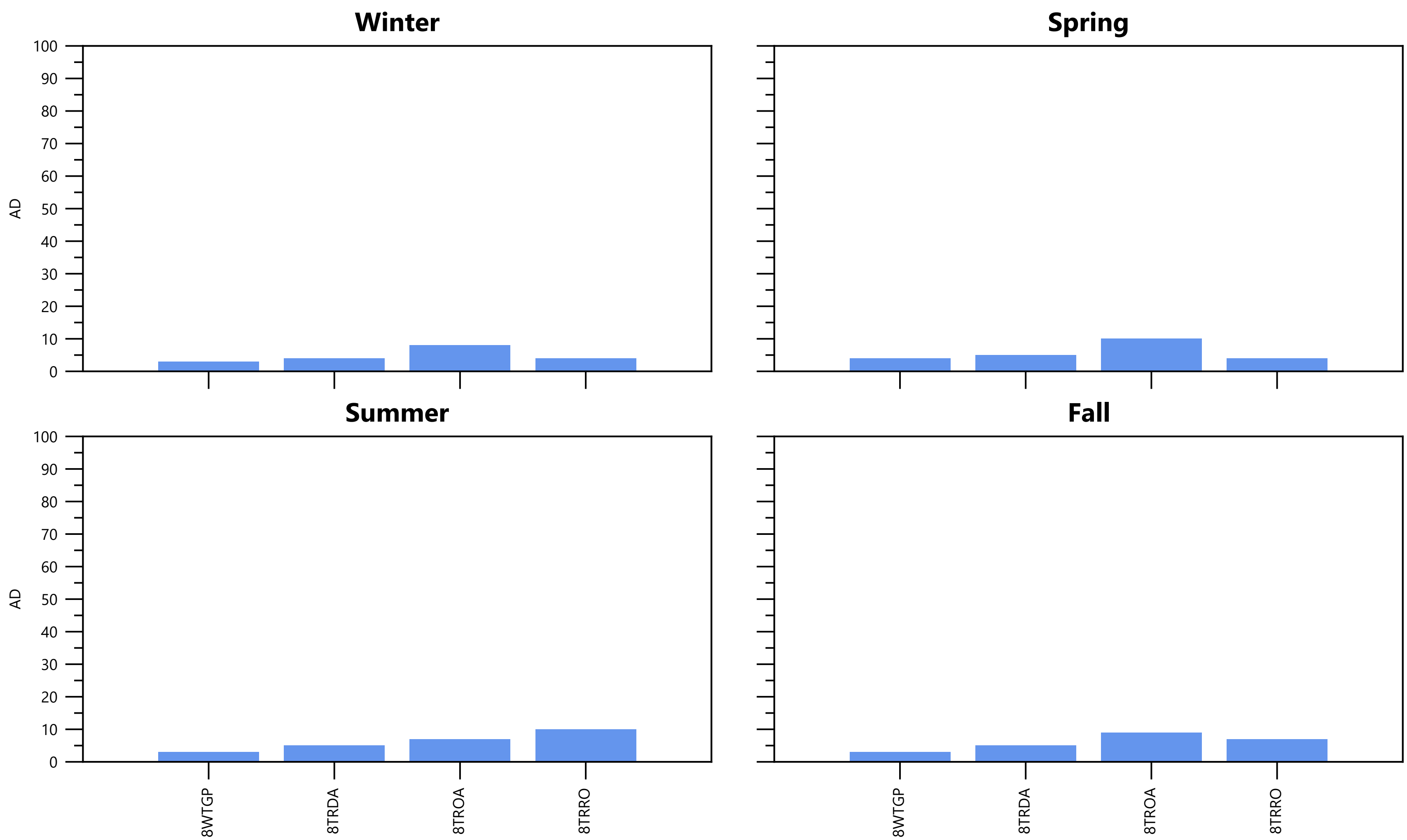
Figure I-118
Base Flow Attainment Frequency (AF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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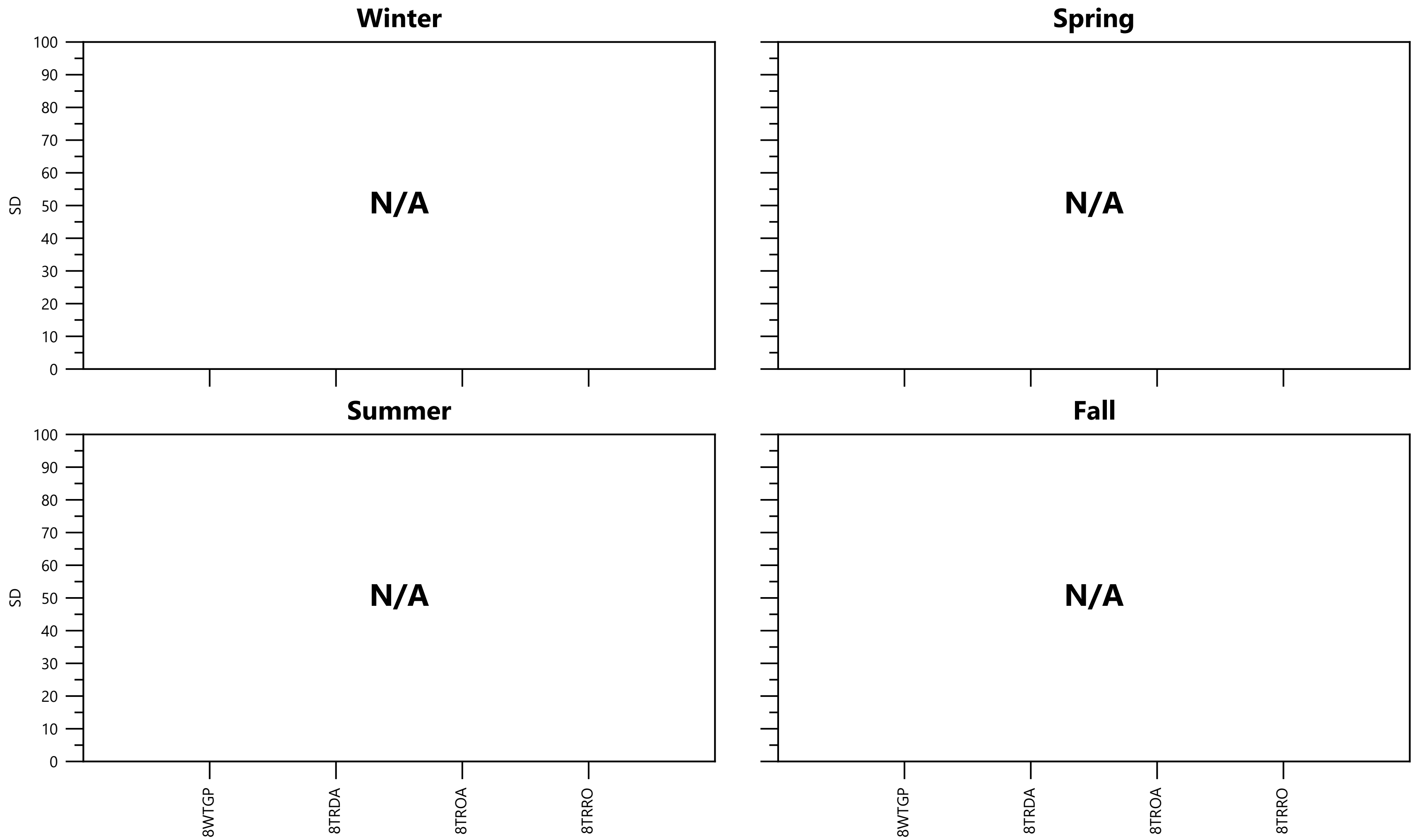
Figure I-119
Base Flow Attainment Duration (AD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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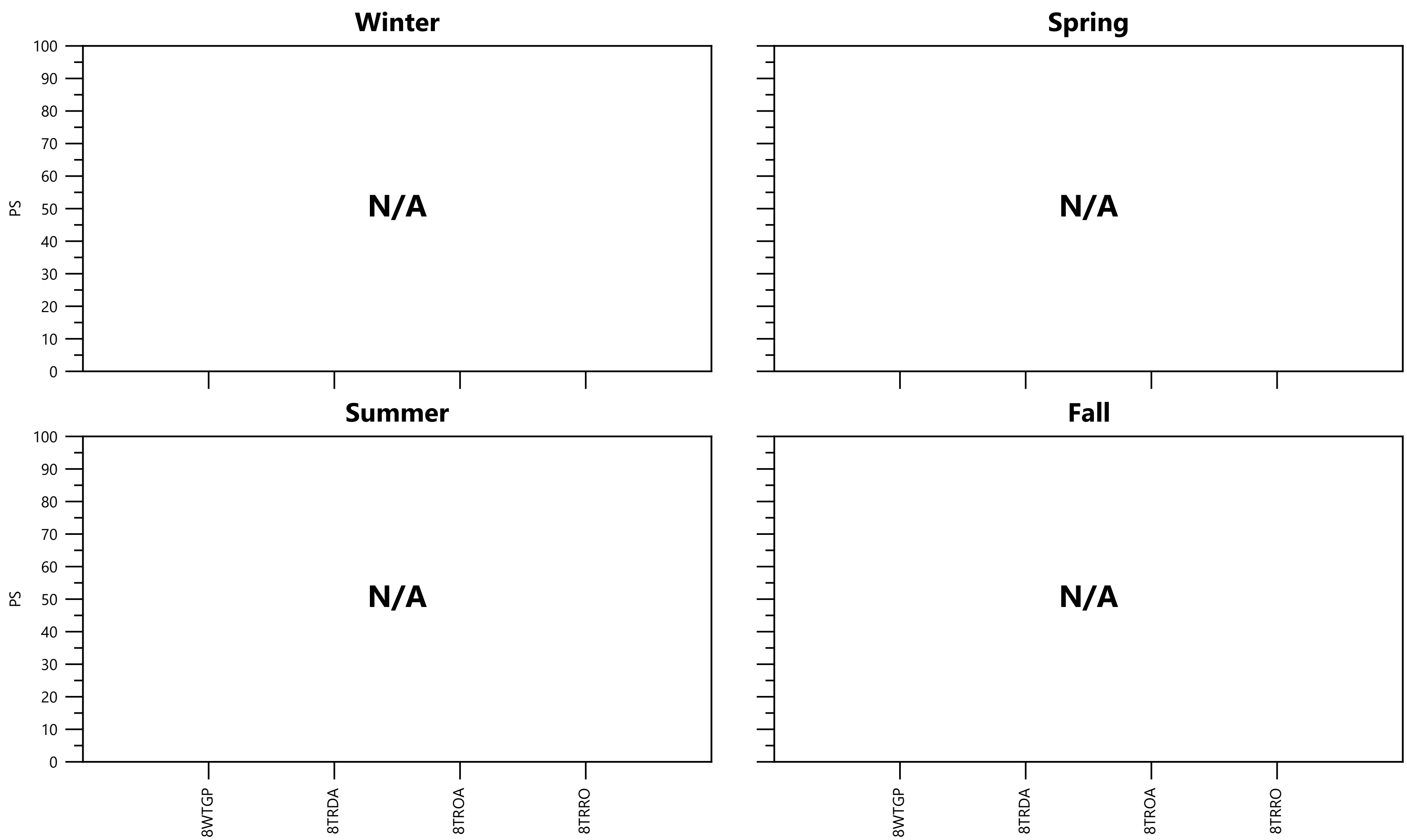
Figure I-120

Base Flow Shortage Duration (SD) by Season: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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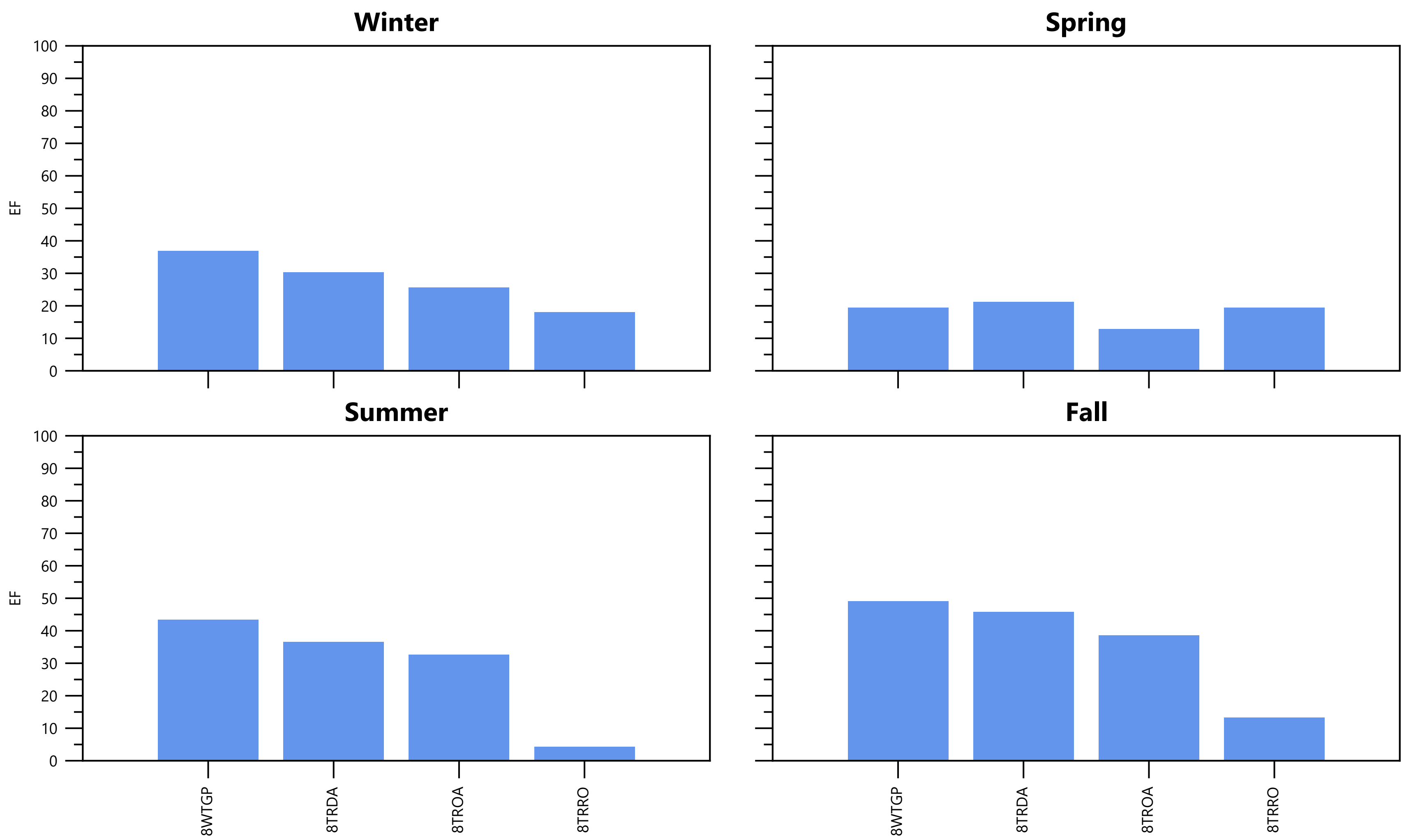
Figure I-121
Base Flow Percent Shortage (PS) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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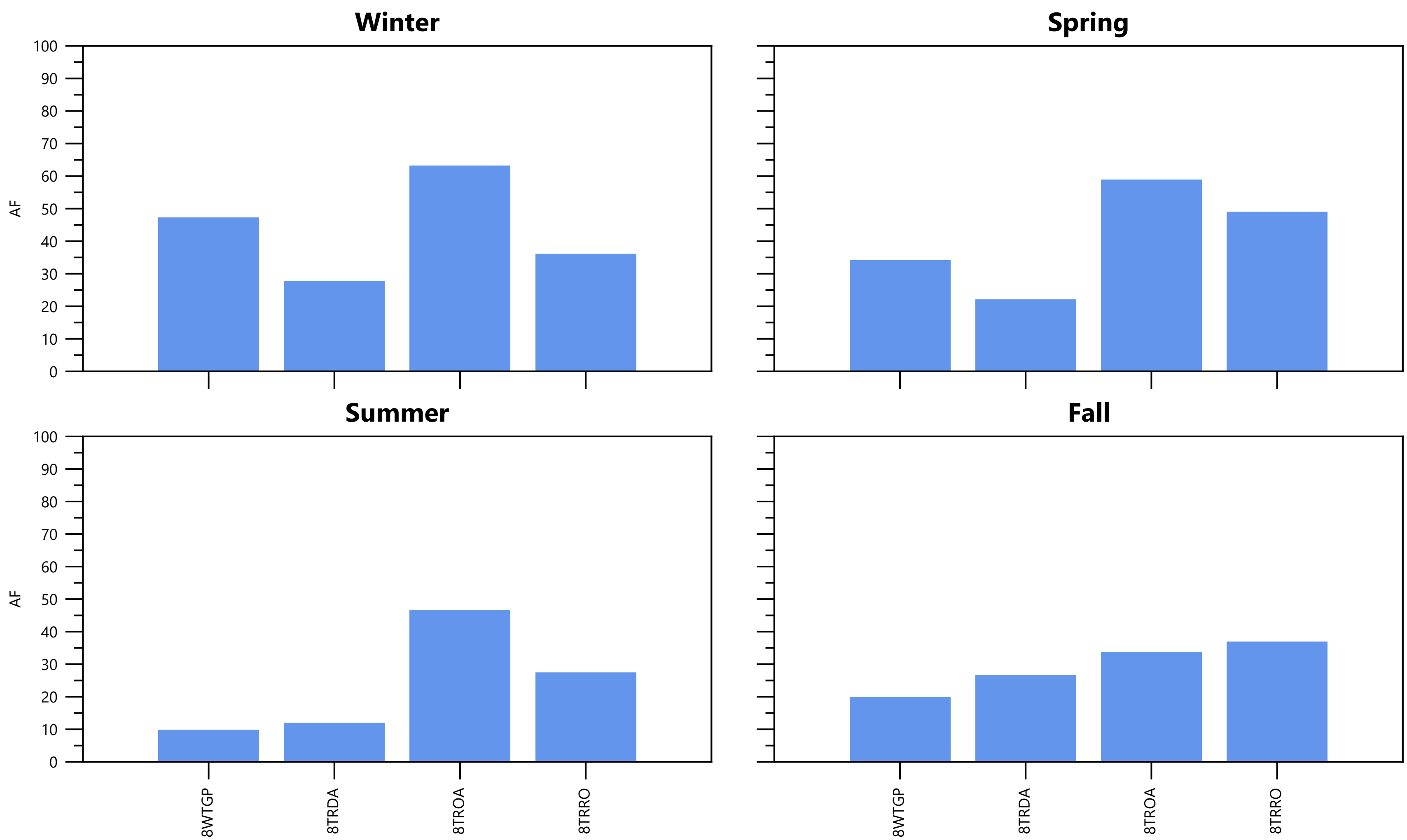
Figure I-122
Subsistence Flow Engagement Frequency (EF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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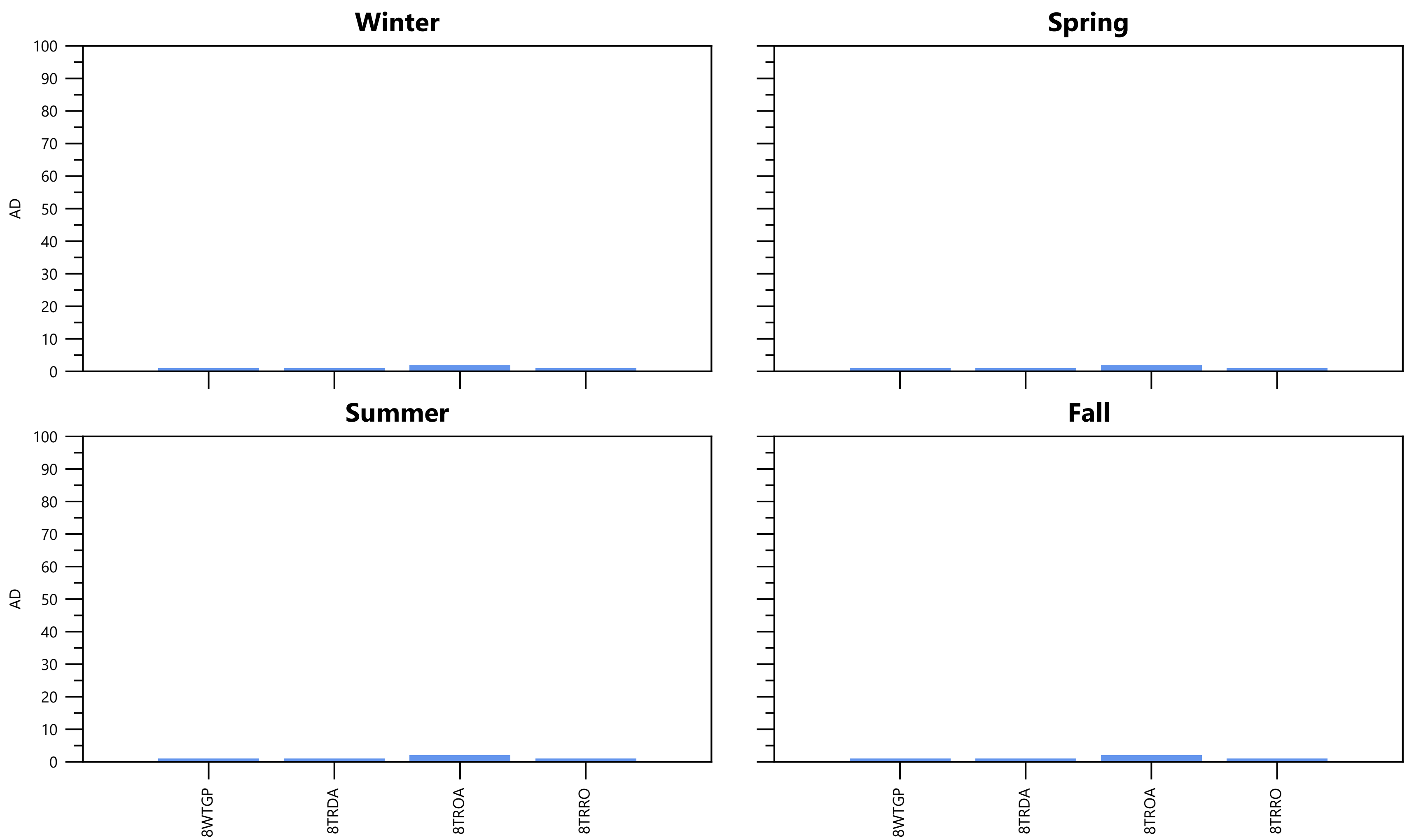
Figure I-123
Subsistence Flow Attainment Frequency (AF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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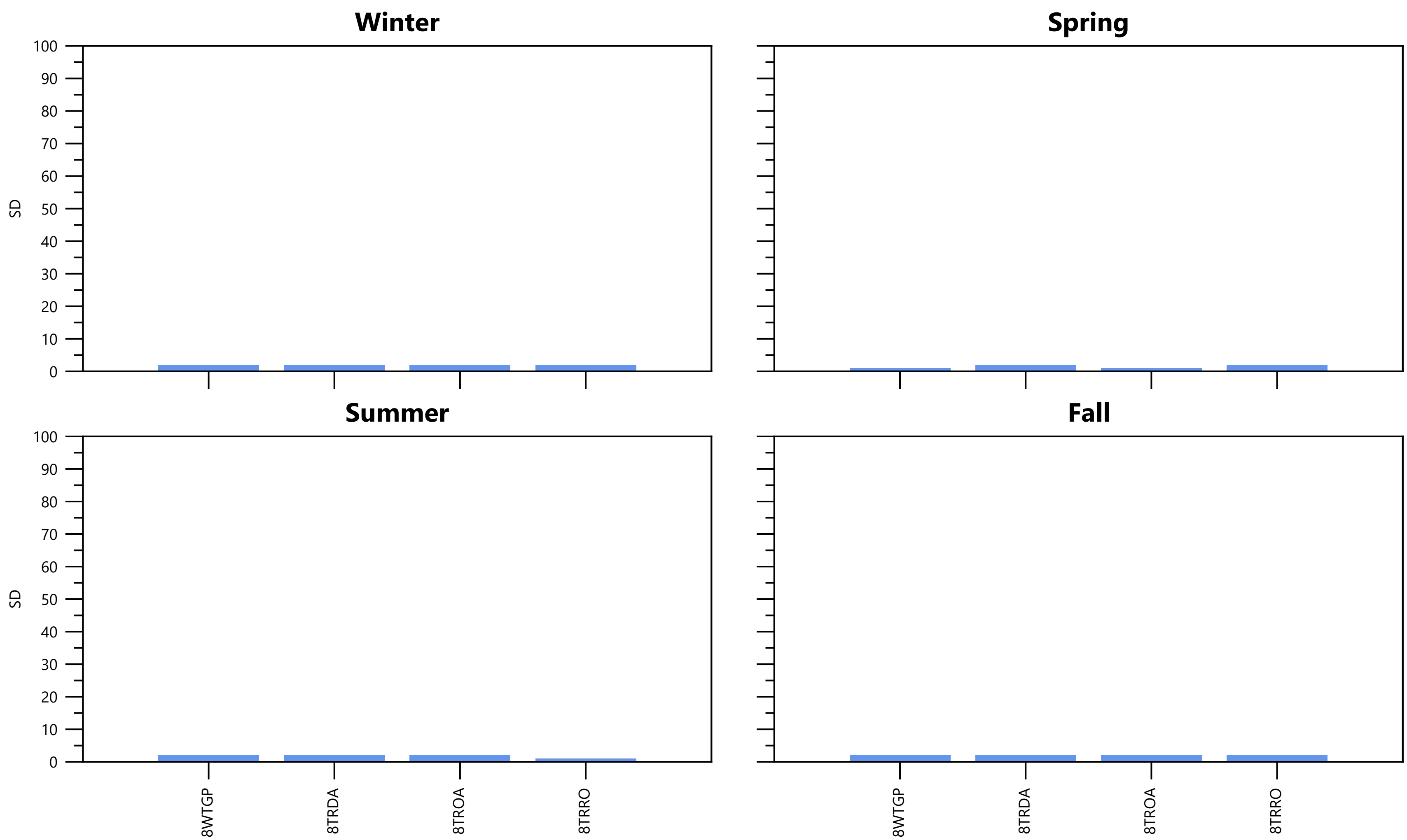
Figure I-124
Subsistence Flow Attainment Duration (AD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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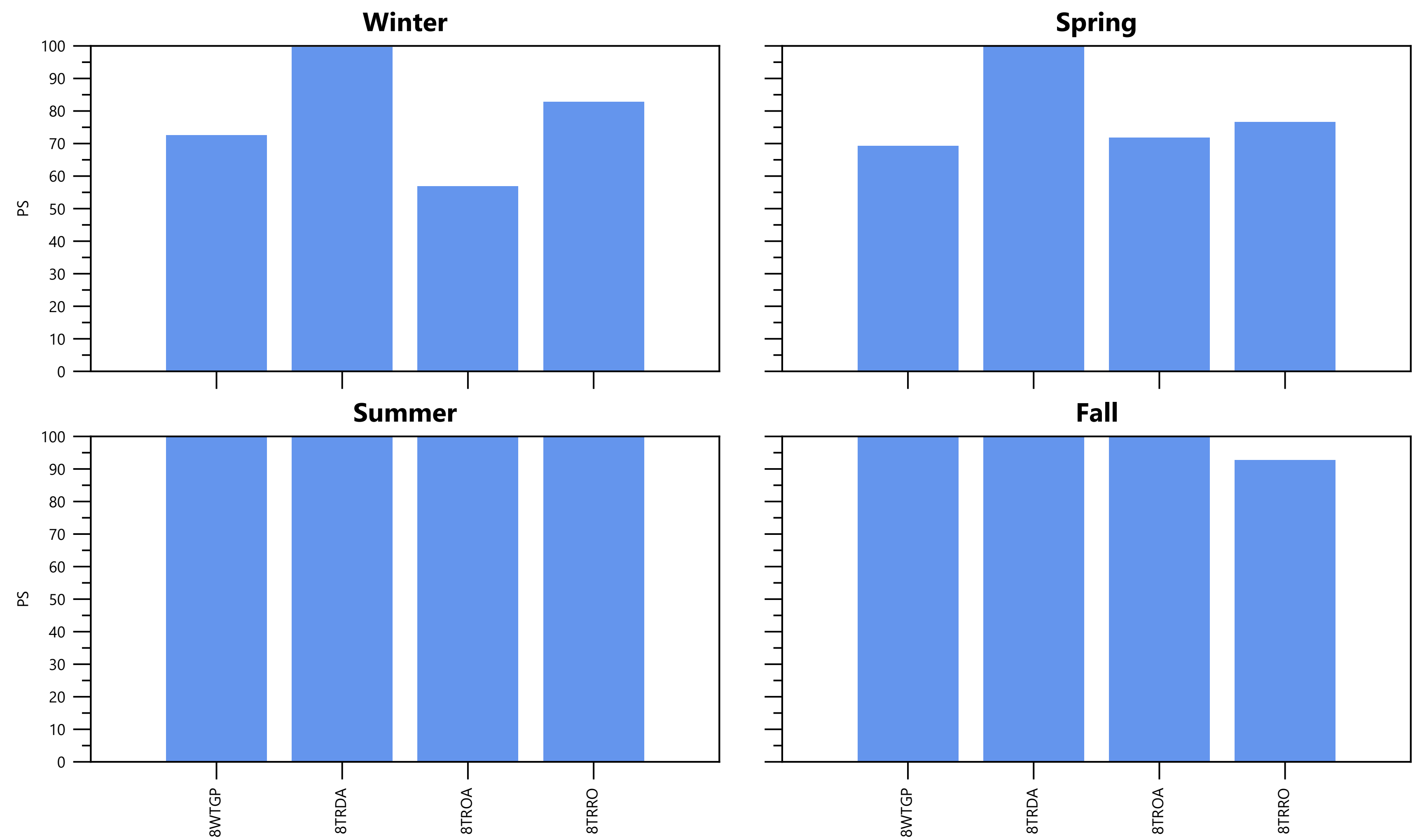
Figure I-125
Subsistence Flow Shortage Duration (SD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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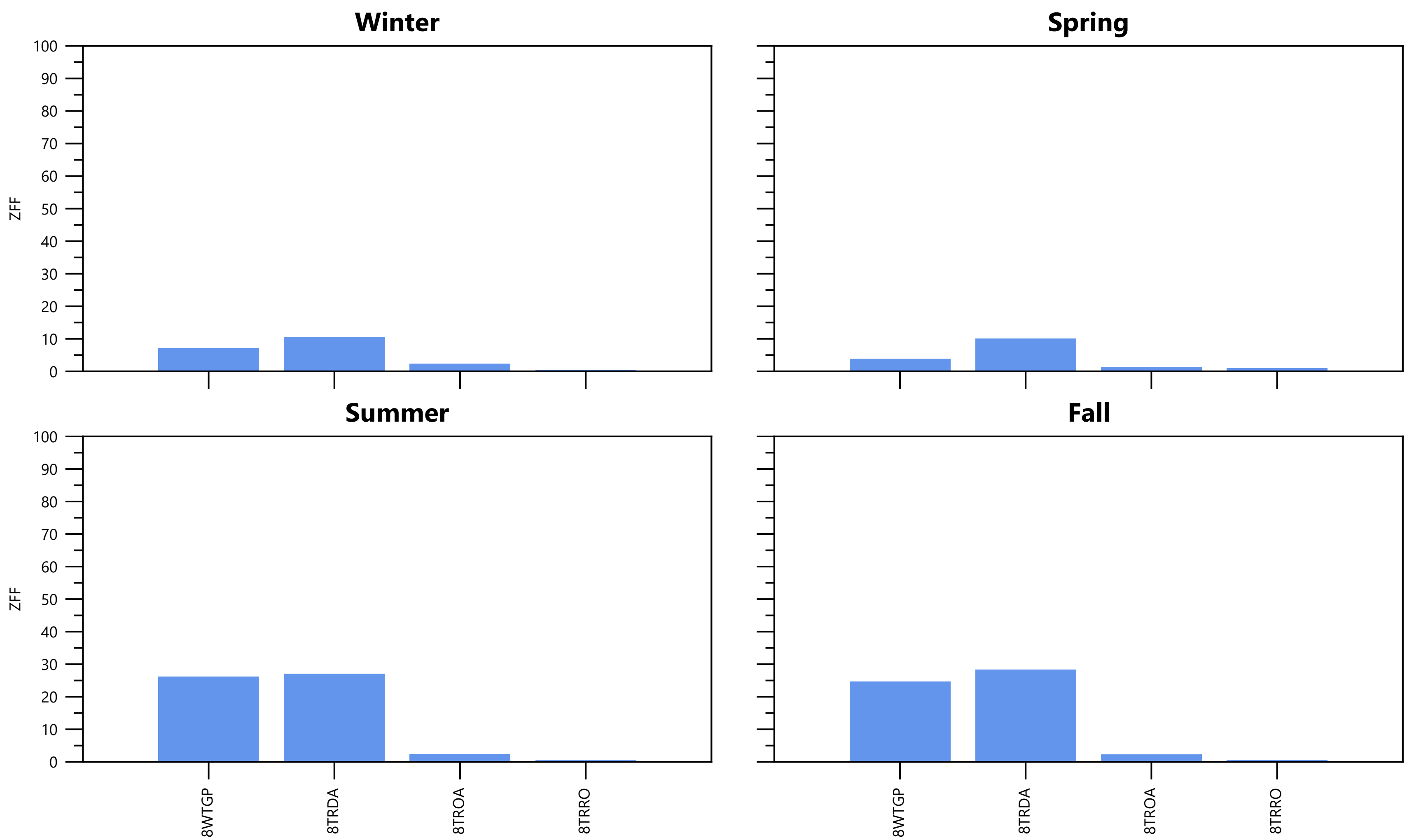
Figure I-126
Subsistence Flow Percent Shortage (PS) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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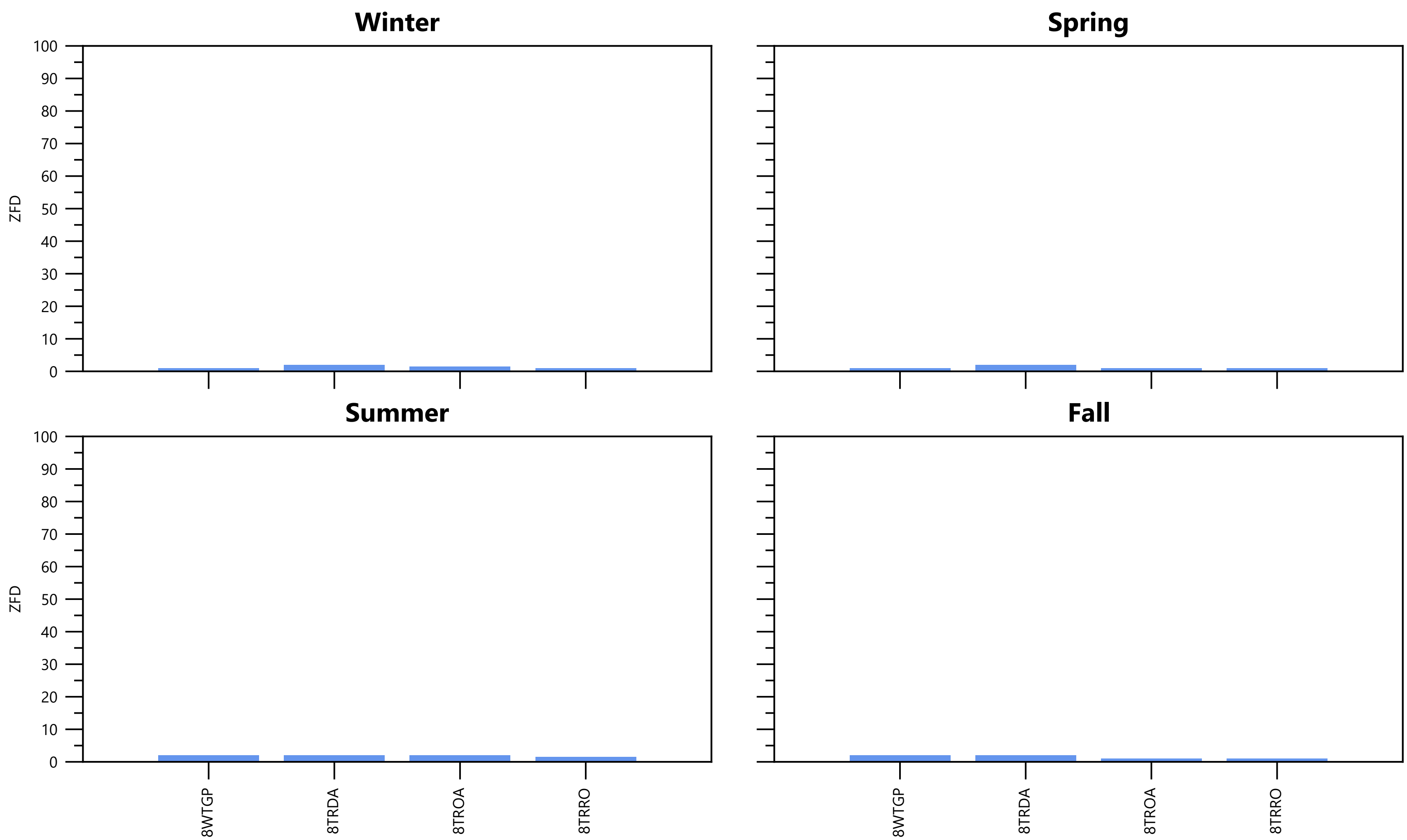
Figure I-127
Zero-Flow Frequencies (ZFF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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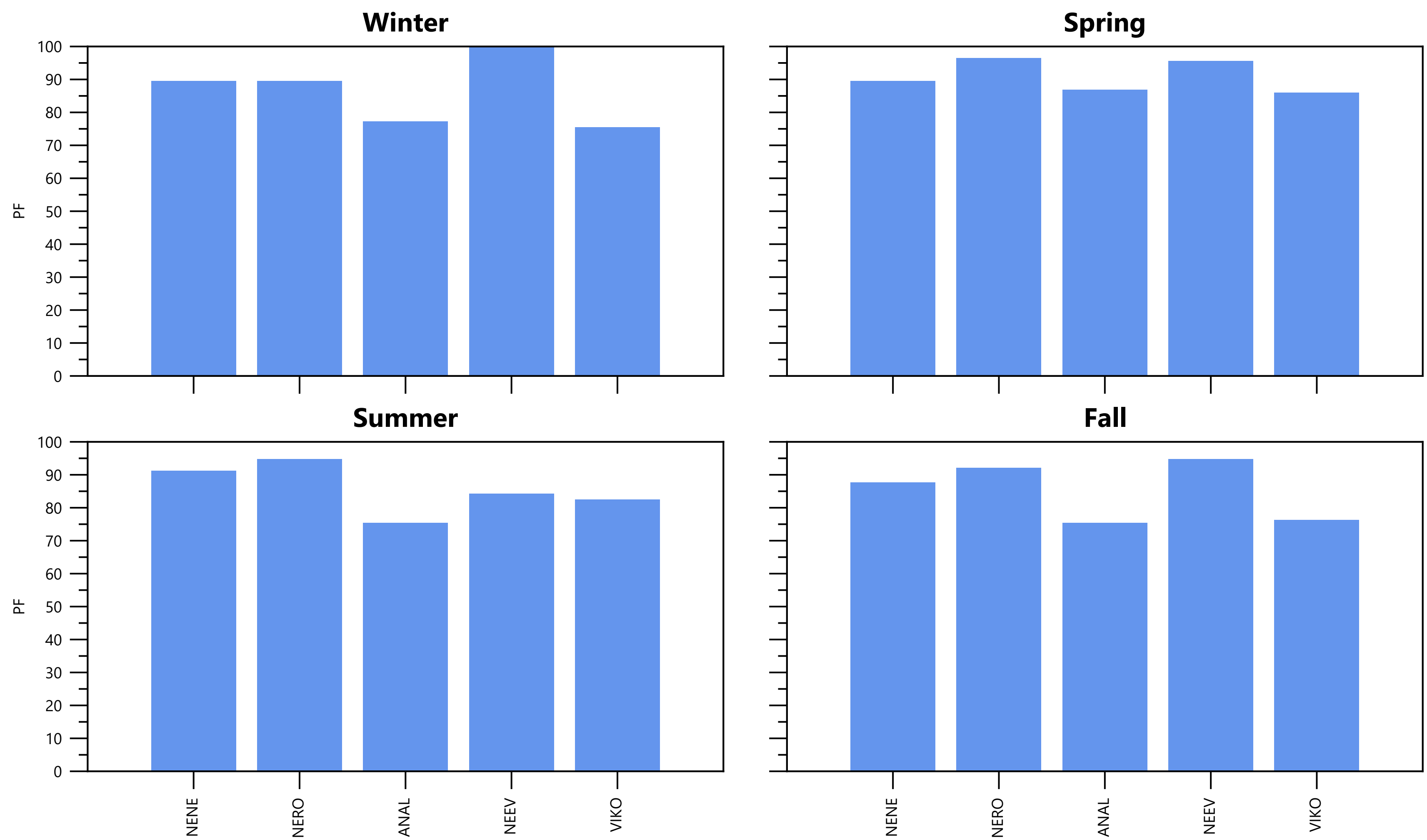
Figure I-128
Zero-Flow Durations (ZFD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

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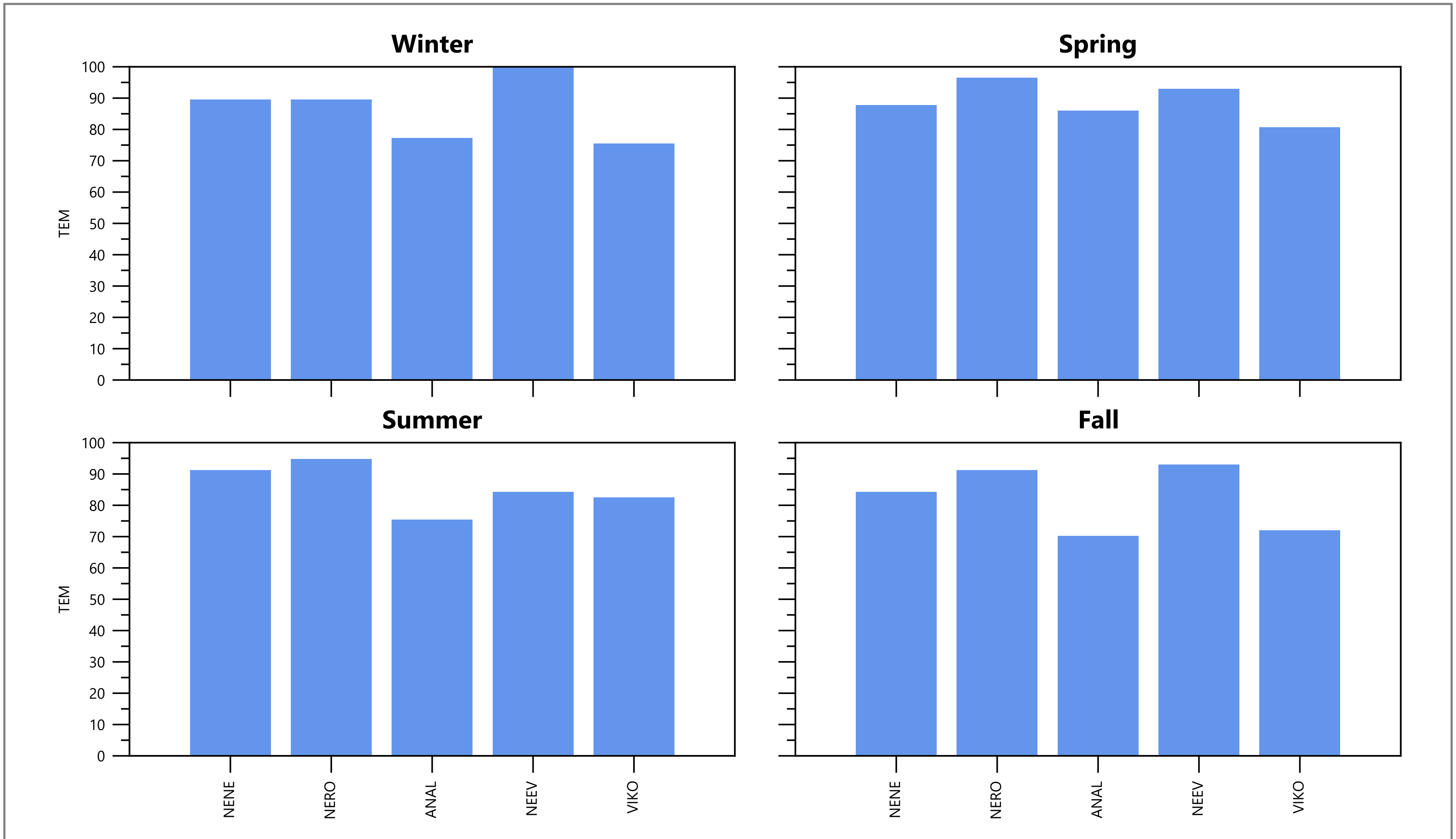
Figure I-129
Pulse Frequencies (PF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

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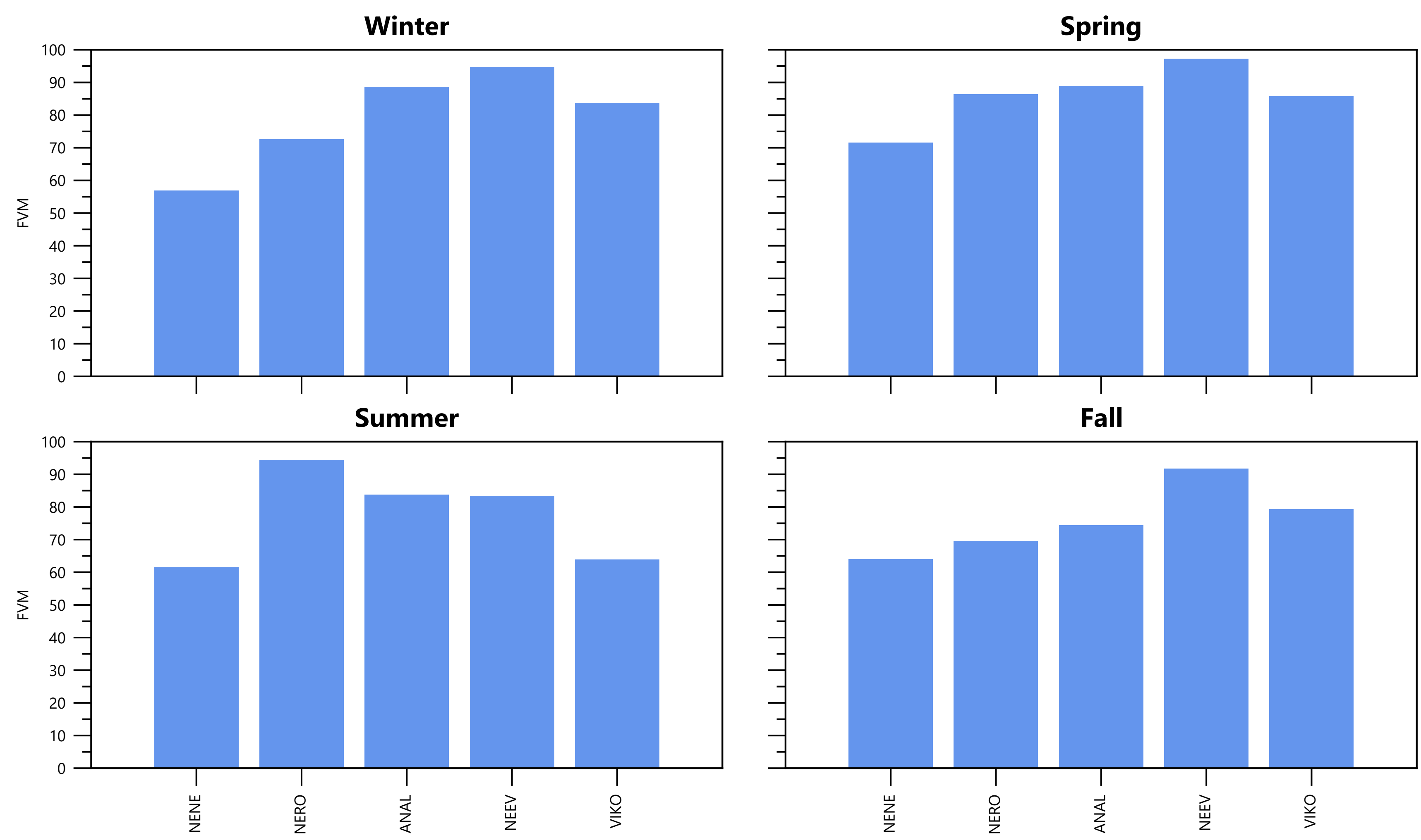
Figure I-130
Target Engagements Met (TEM) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

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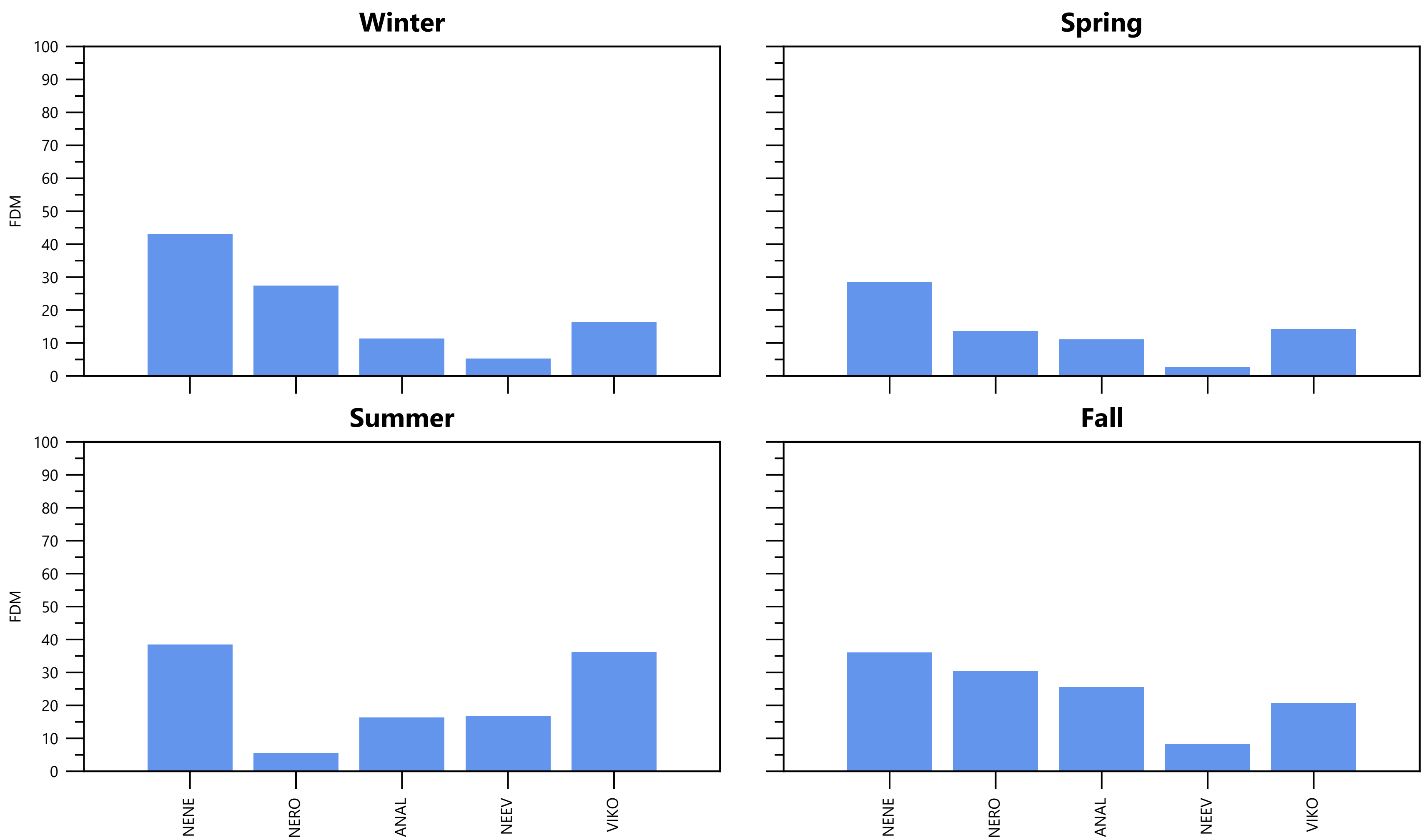
Figure I-131

Frequency Volume Met (FVM) by Season: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

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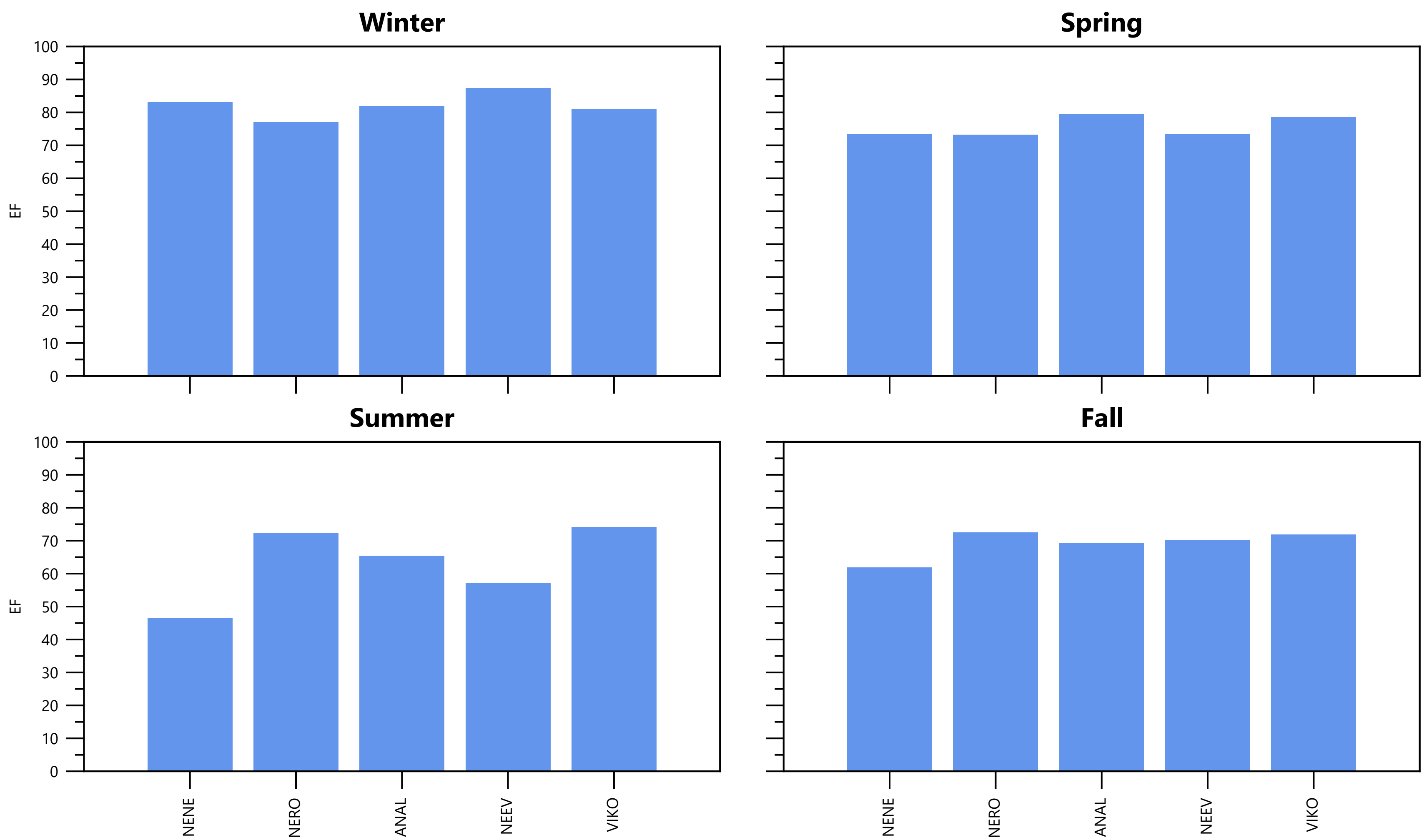
Figure I-132
Frequency Duration Met (FDM) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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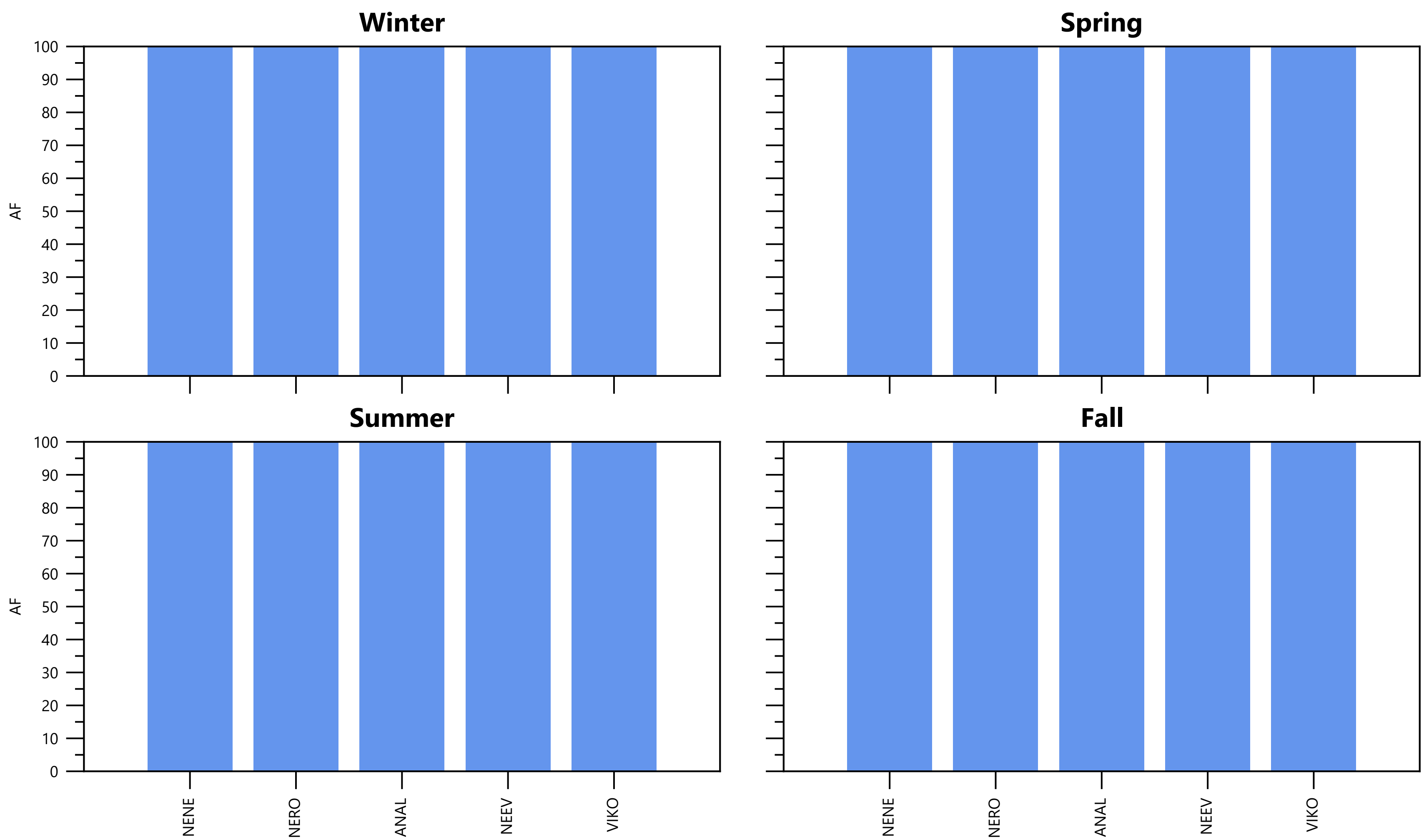
Figure I-133
Base Flow Engagement Frequency (EF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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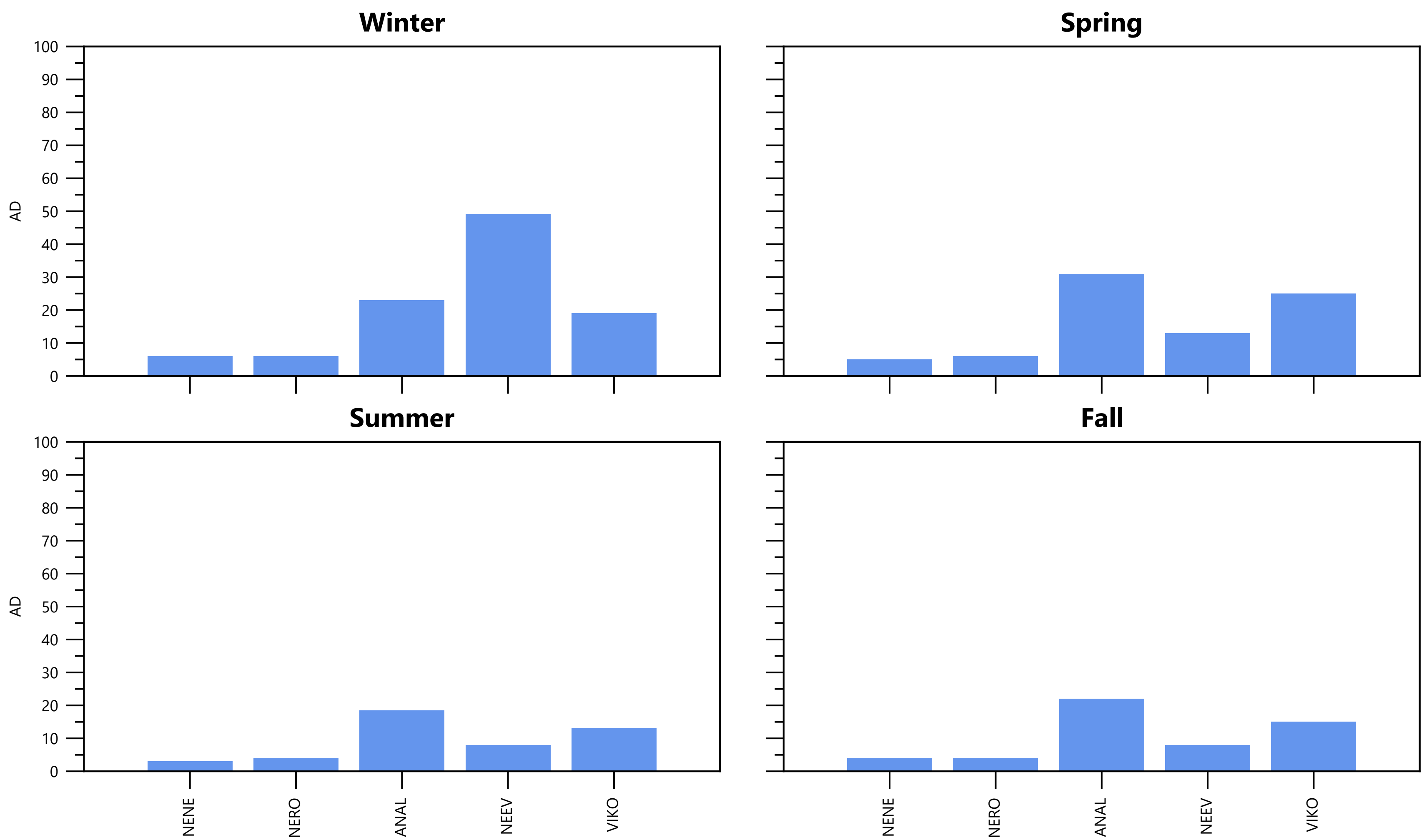
Figure I-134
Base Flow Attainment Frequency (AF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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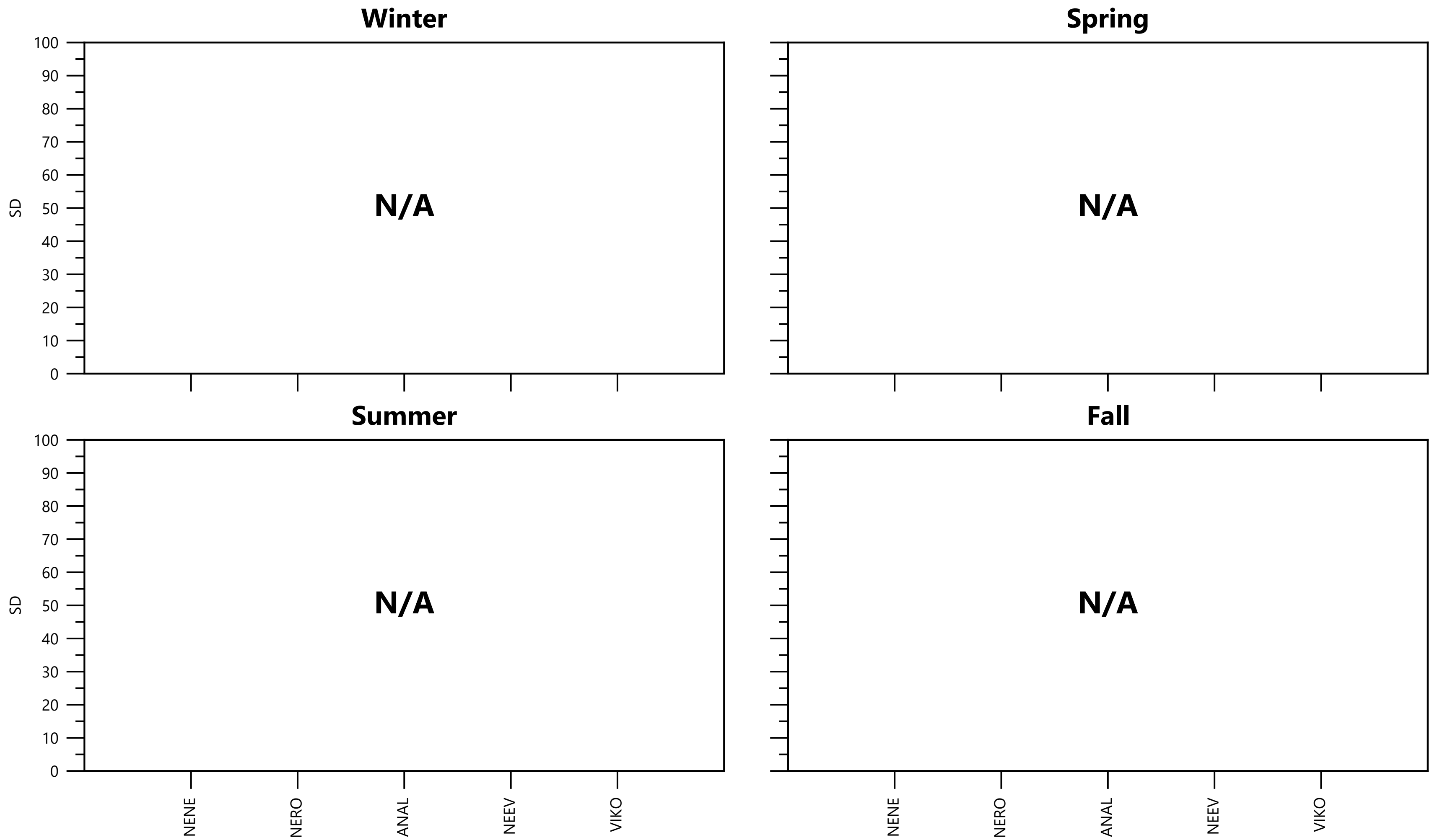
Figure I-135

Base Flow Attainment Duration (AD) by Season: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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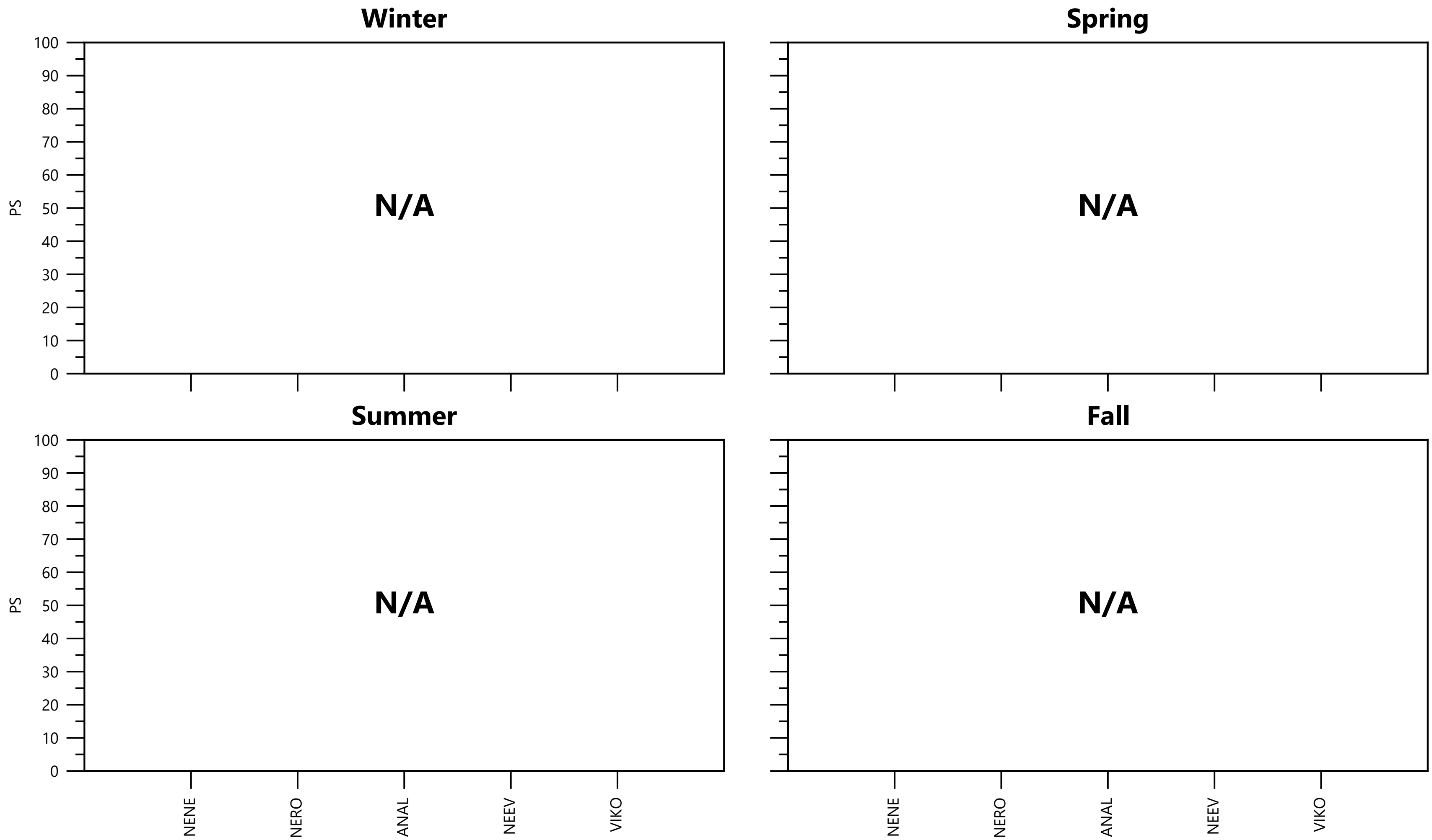
Figure I-136
Base Flow Shortage Duration (SD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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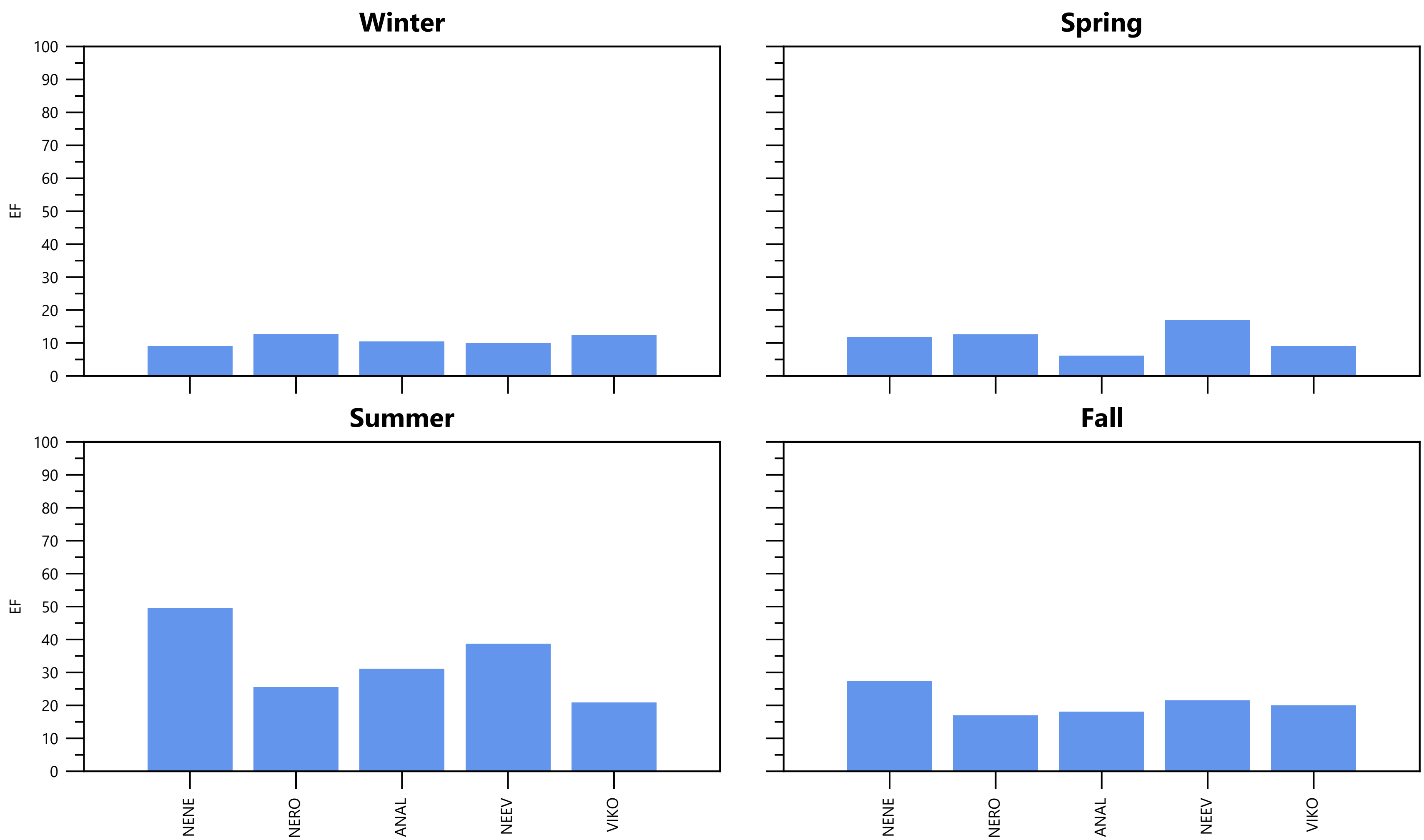
Figure I-137
Base Flow Percent Shortage (PS) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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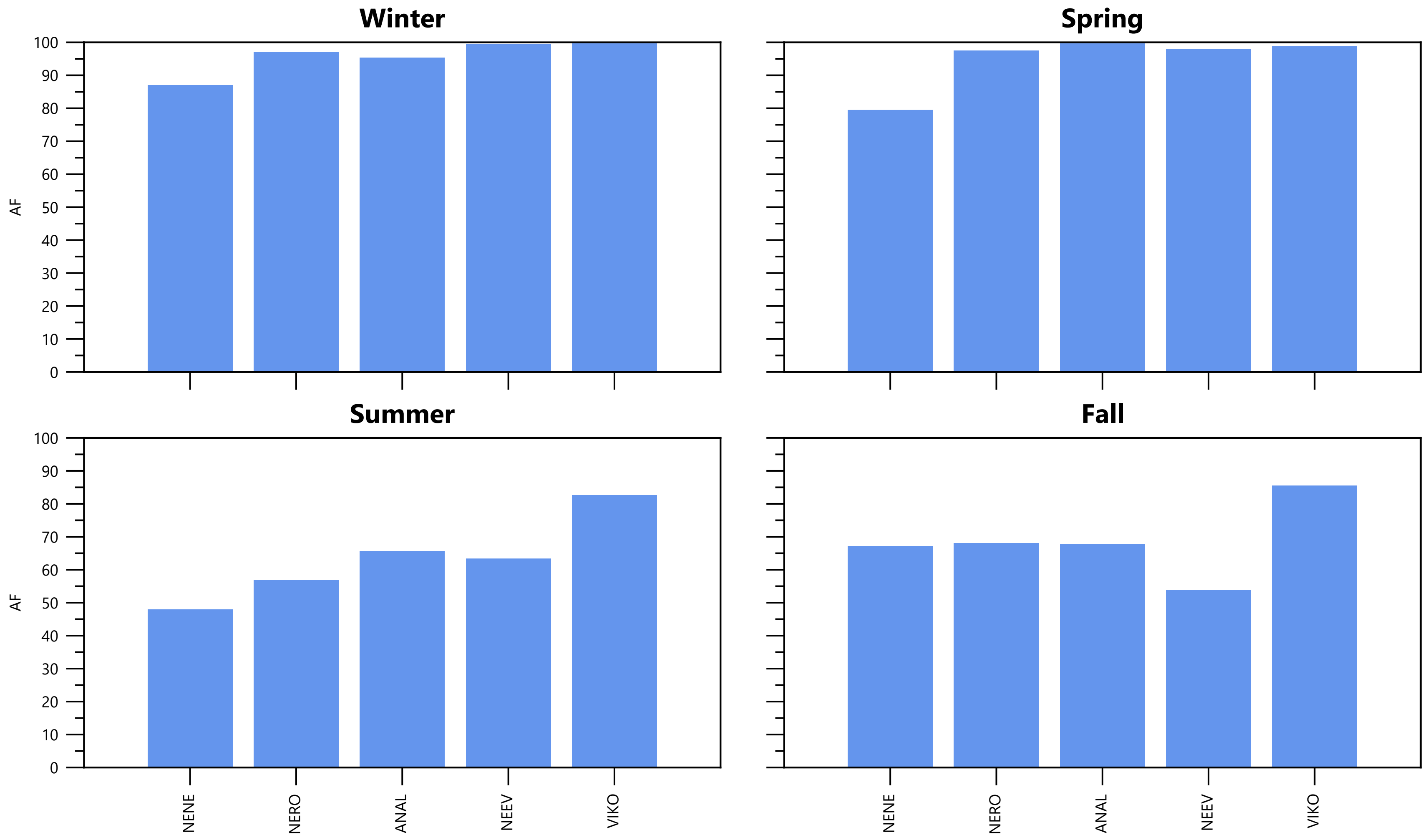
Figure I-138

Subsistence Flow Engagement Frequency (EF) by Season: Naturalized Flow Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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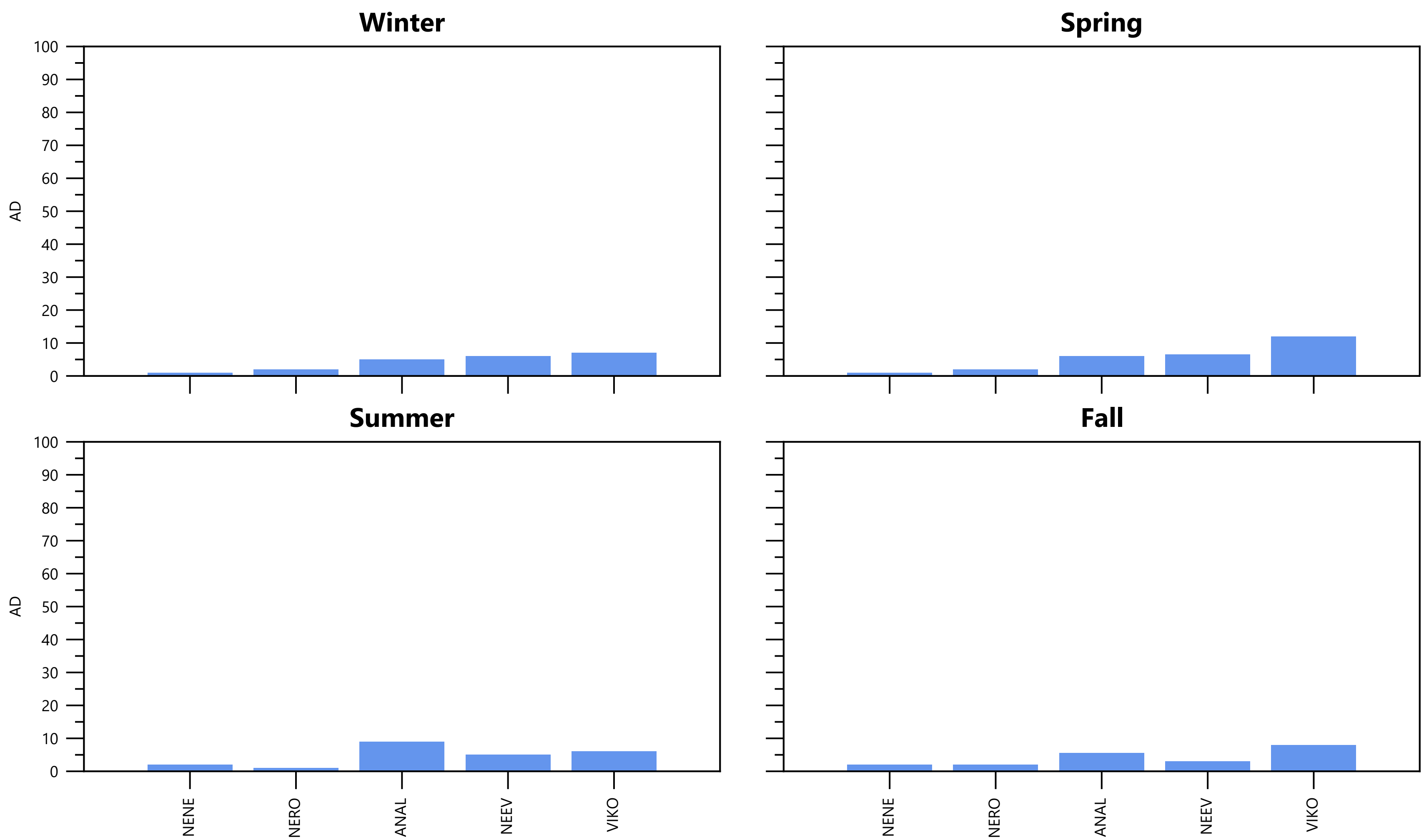
Figure I-139

Subsistence Flow Attainment Frequency (AF) by Season: Naturalized Flow Scenario



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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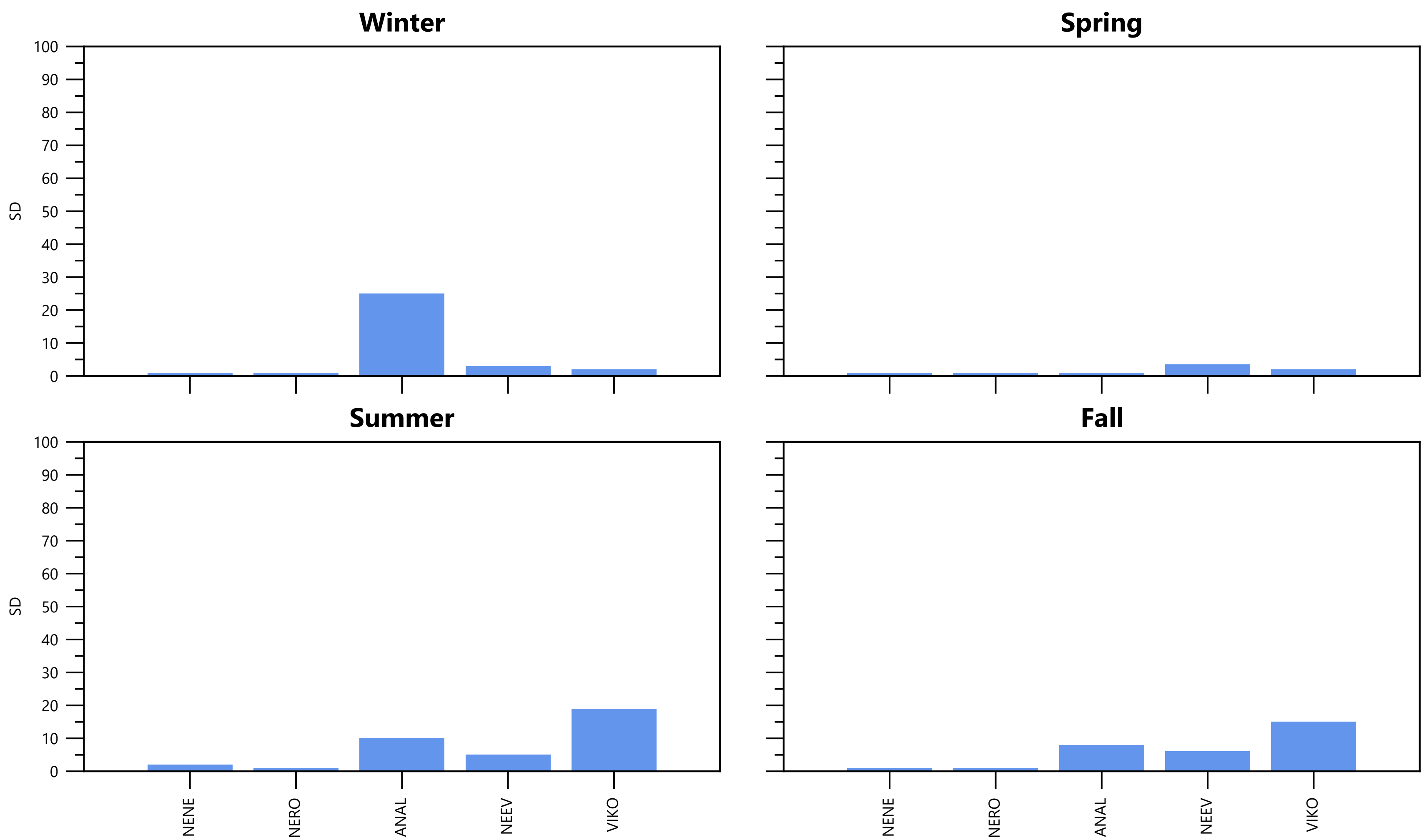
Figure I-140
Subsistence Flow Attainment Duration (AD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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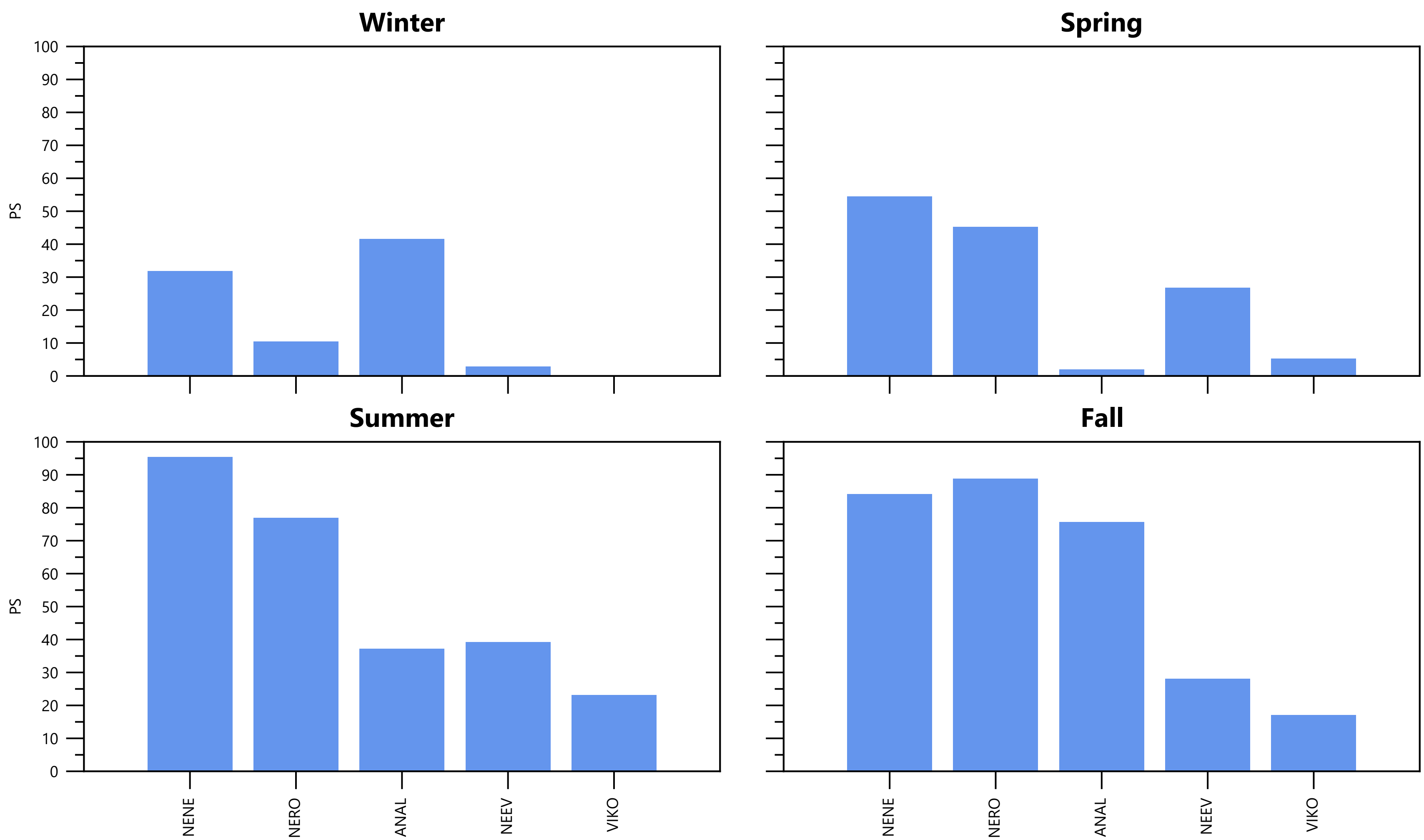
Figure I-141
Subsistence Flow Shortage Duration (SD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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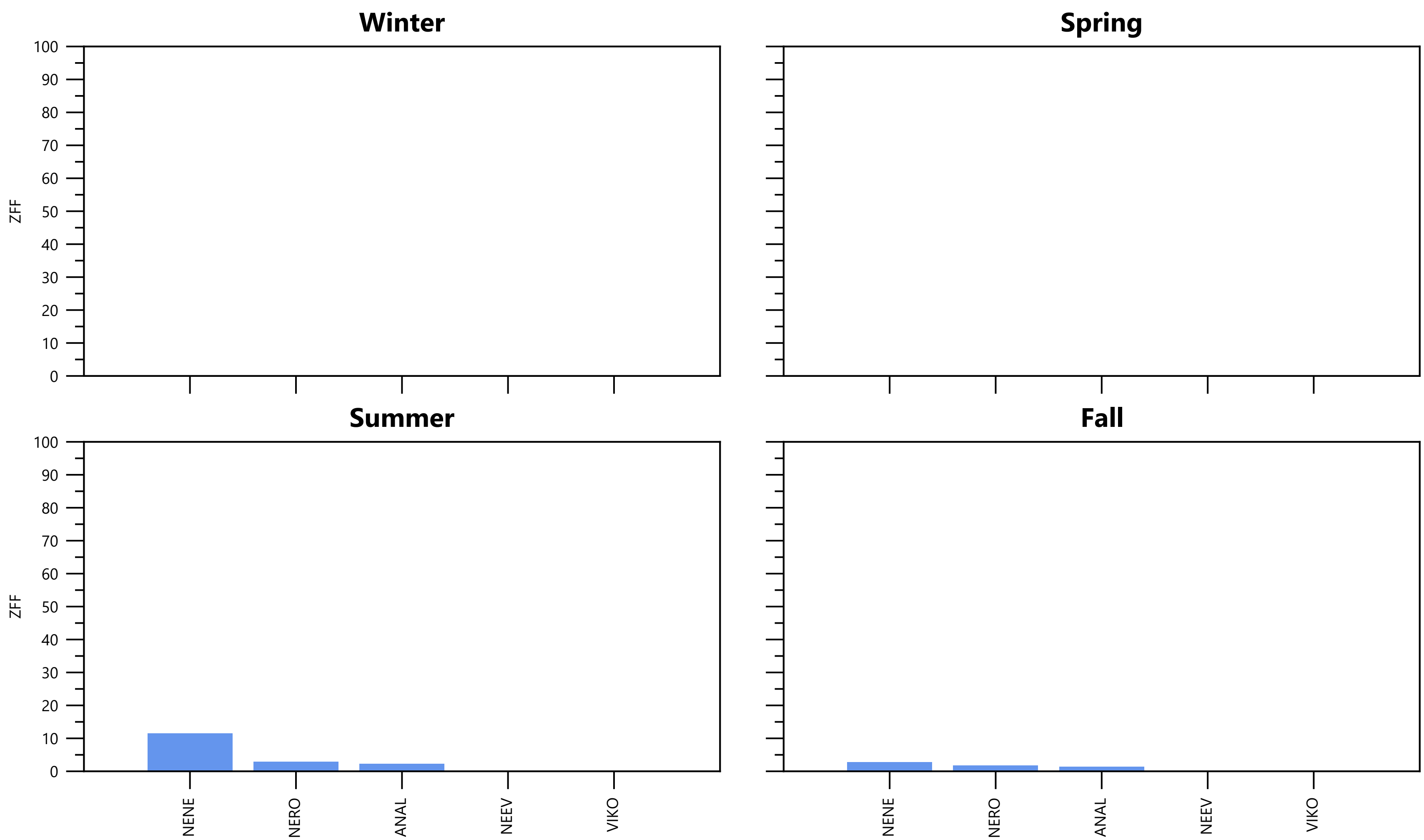
Figure I-142
Subsistence Flow Percent Shortage (PS) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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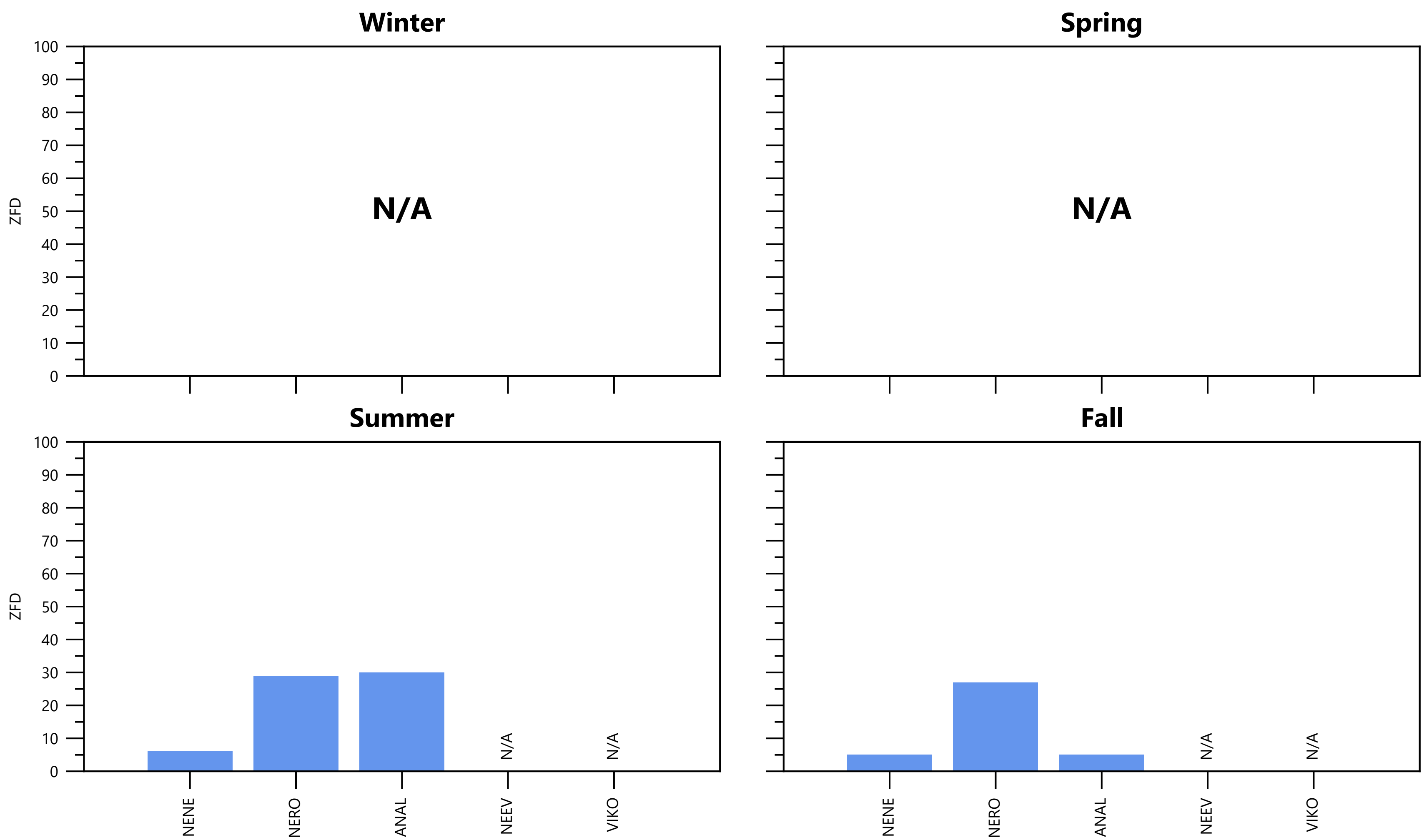
Figure I-143
Zero-Flow Frequencies (ZFF) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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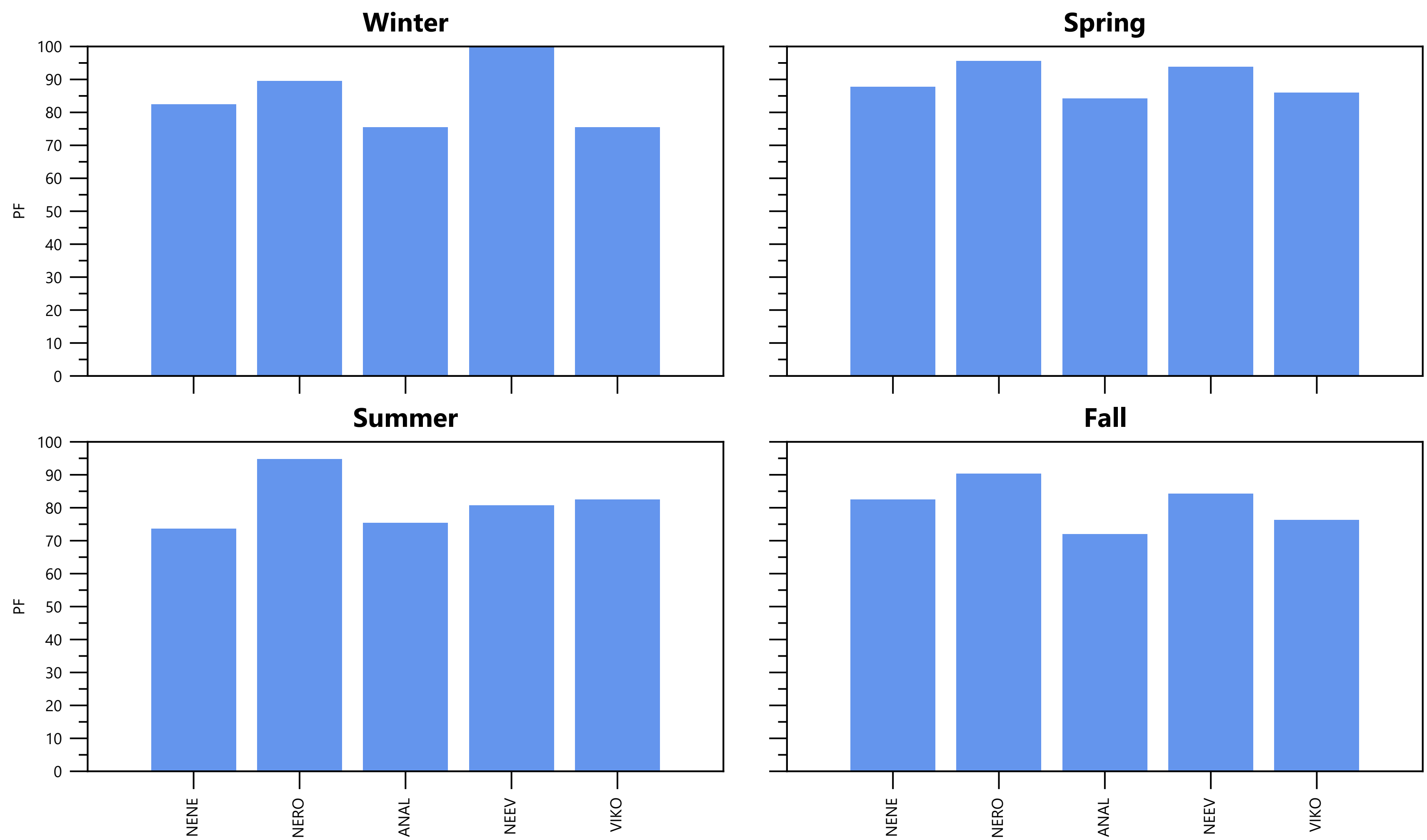
Figure I-144
Zero-Flow Durations (ZFD) by Season: Naturalized Flow Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

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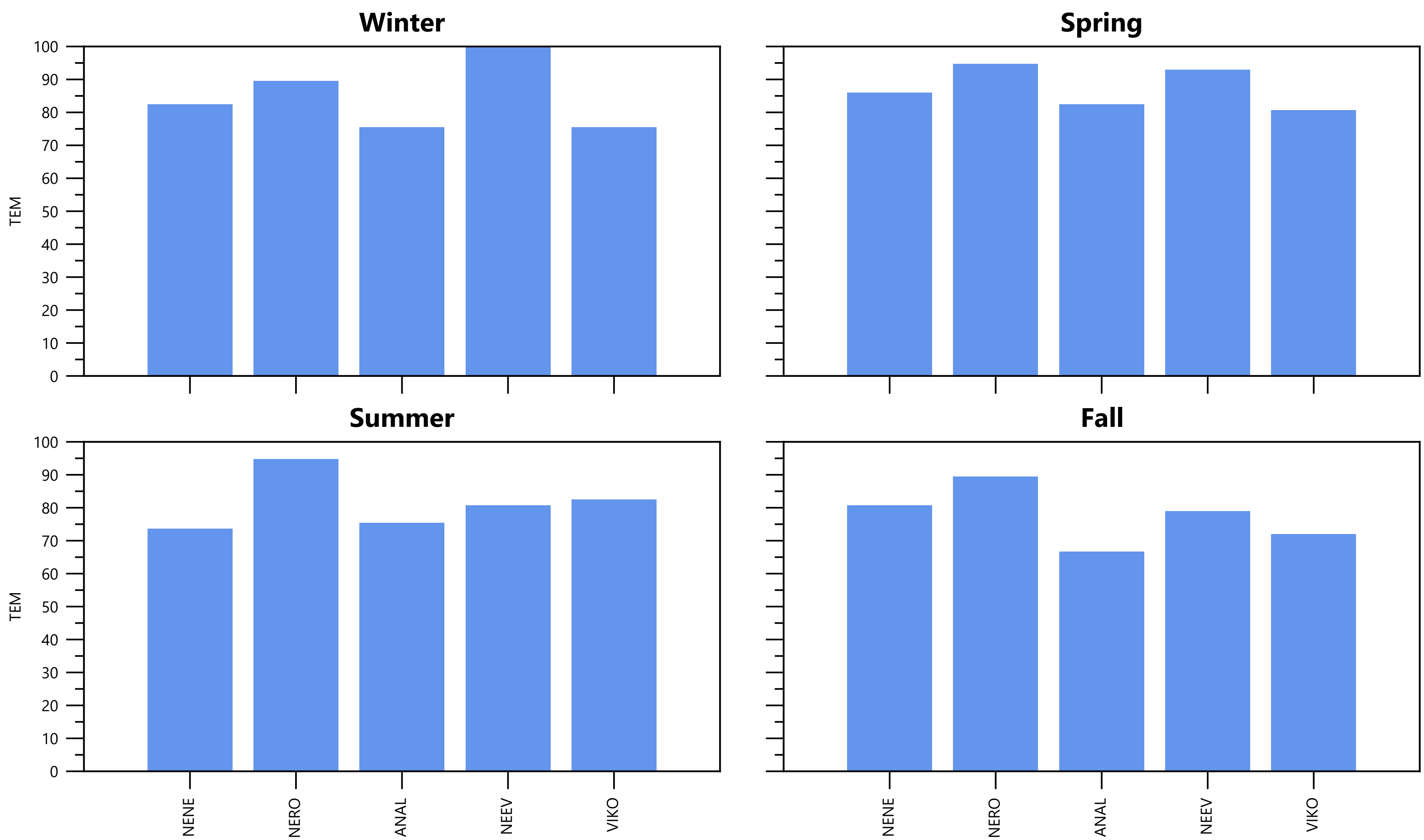
Figure I-145
Pulse Frequencies (PF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

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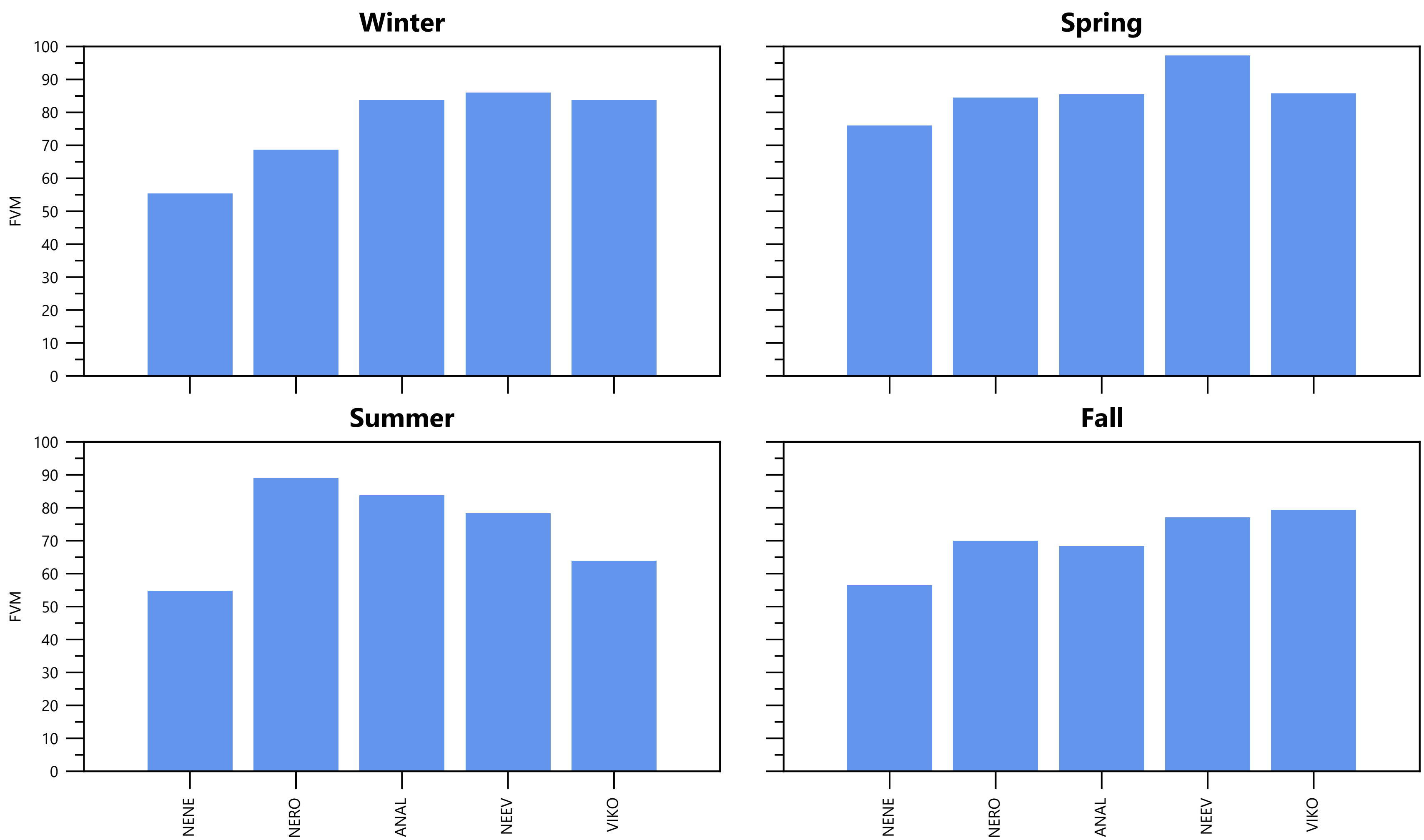
Figure I-146
Target Engagements Met (TEM) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

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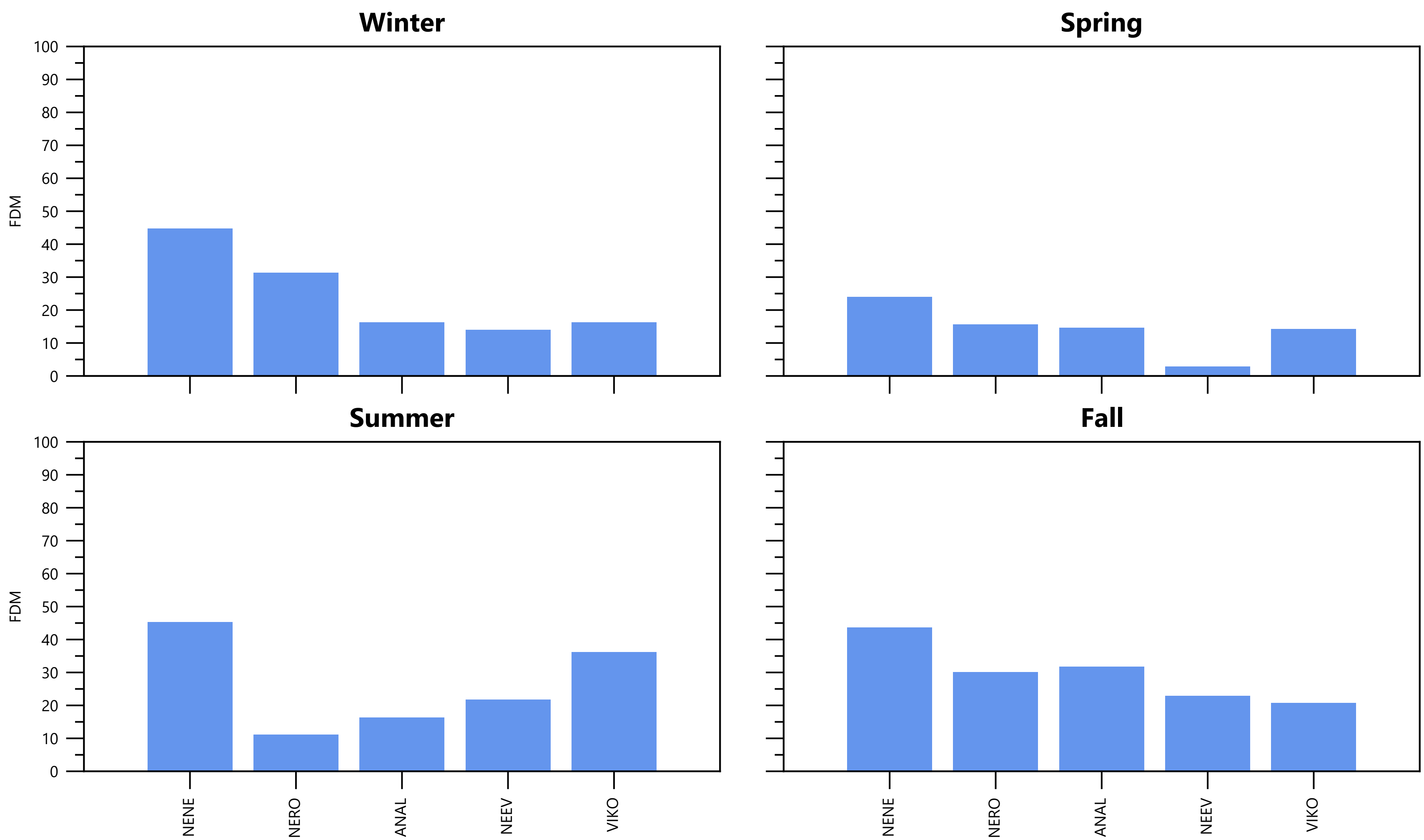
Figure I-147
Frequency Volume Met (FVM) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

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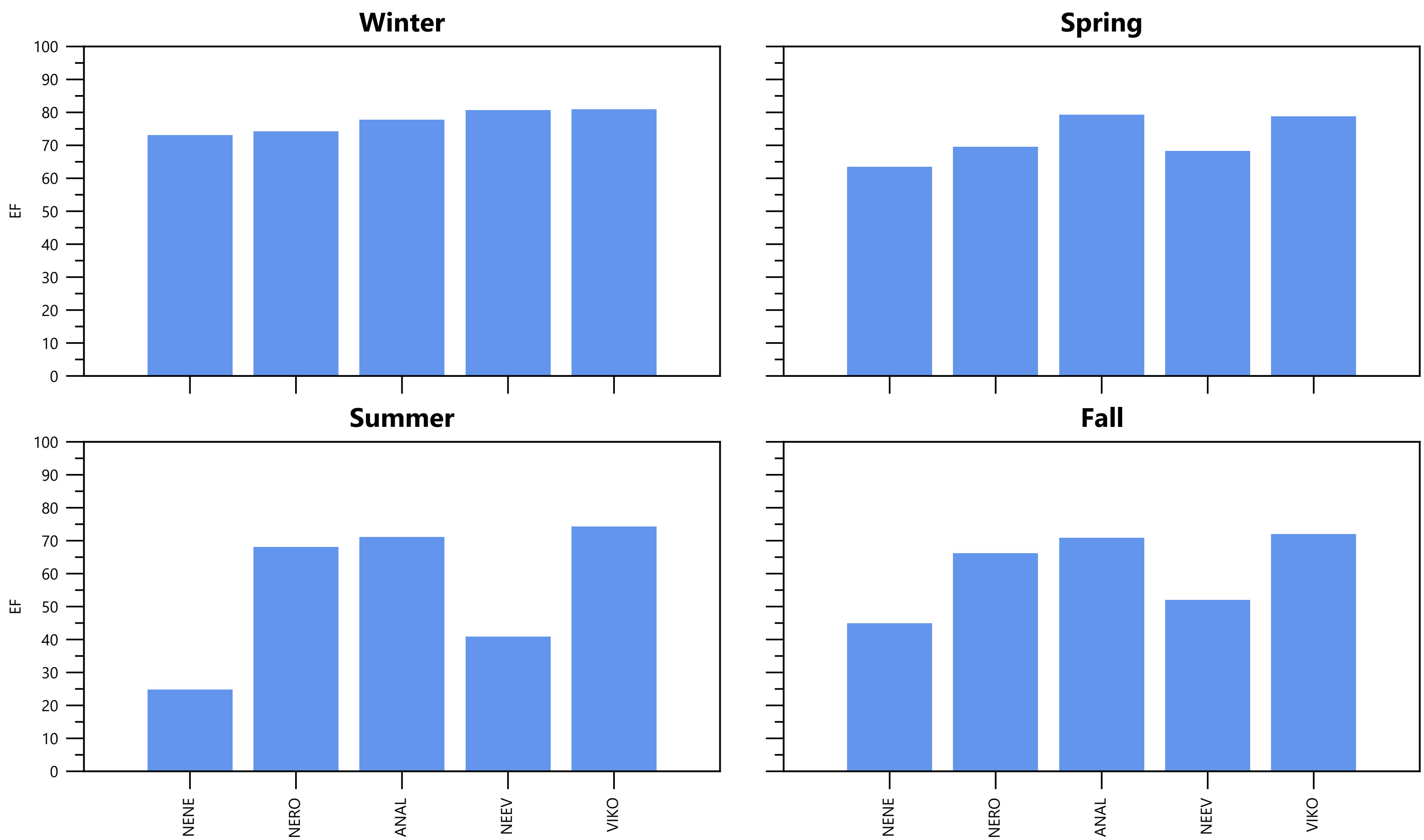
Figure I-148
Frequency Duration Met (FDM) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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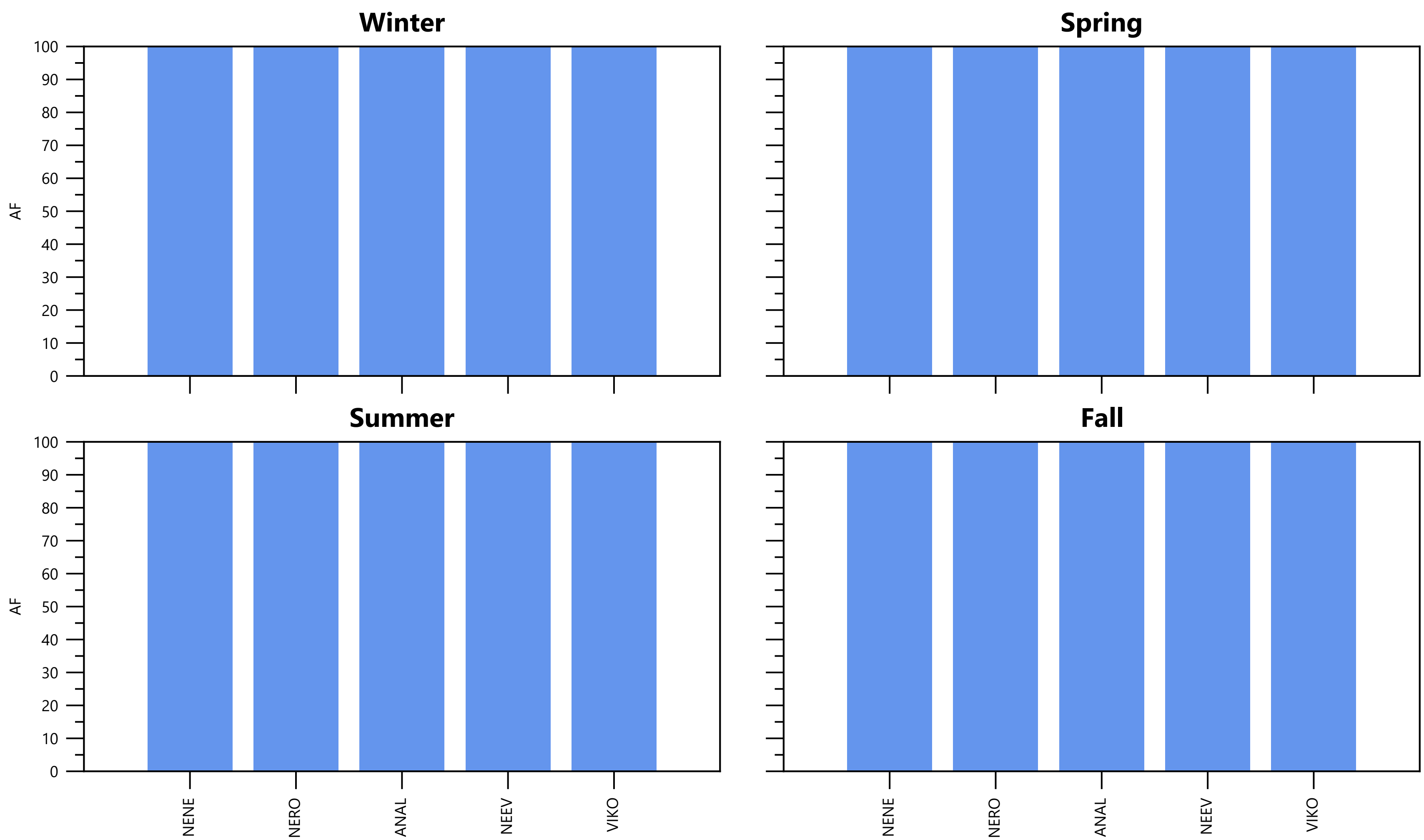
Figure I-149
Base Flow Engagement Frequency (EF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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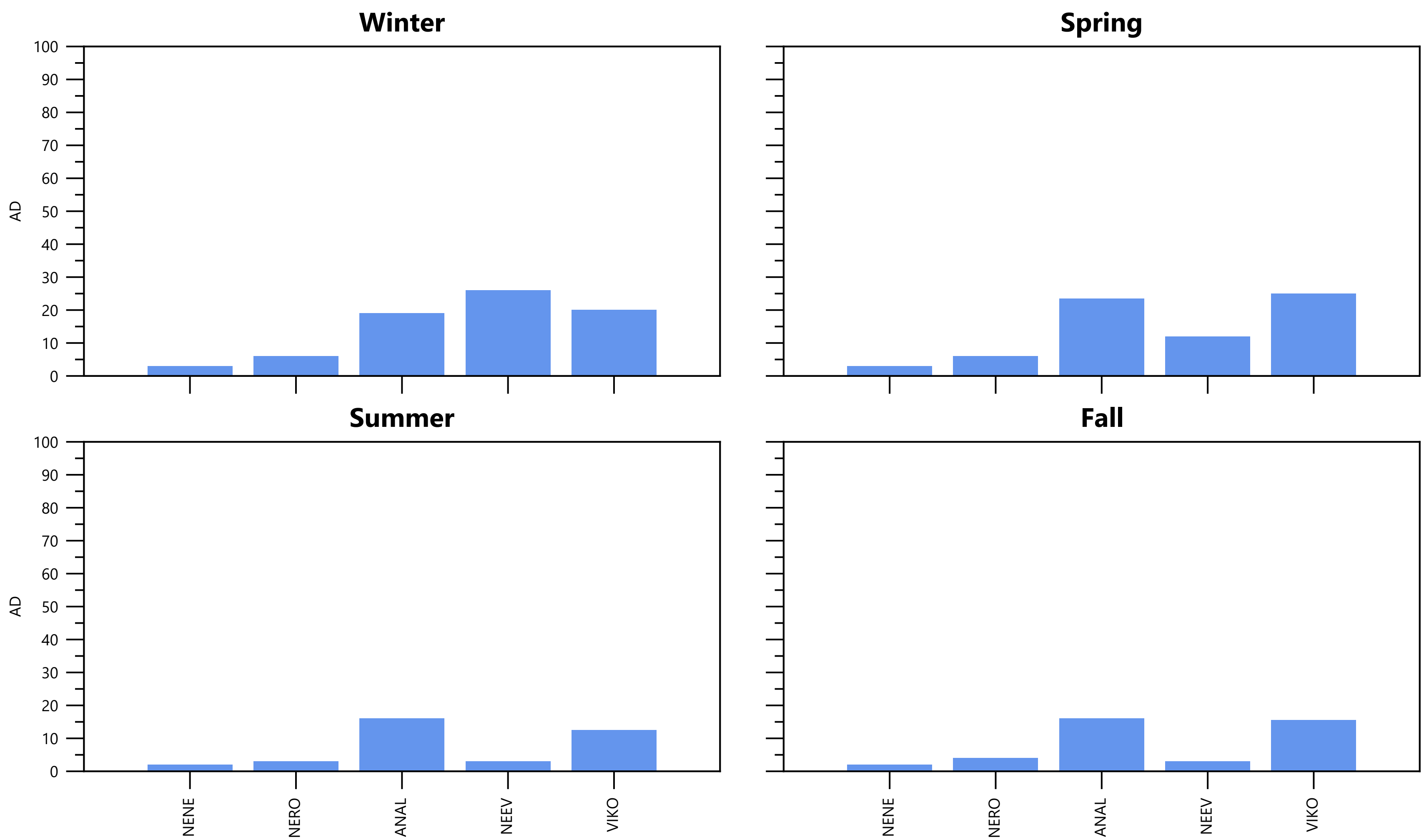
Figure I-150
Base Flow Attainment Frequency (AF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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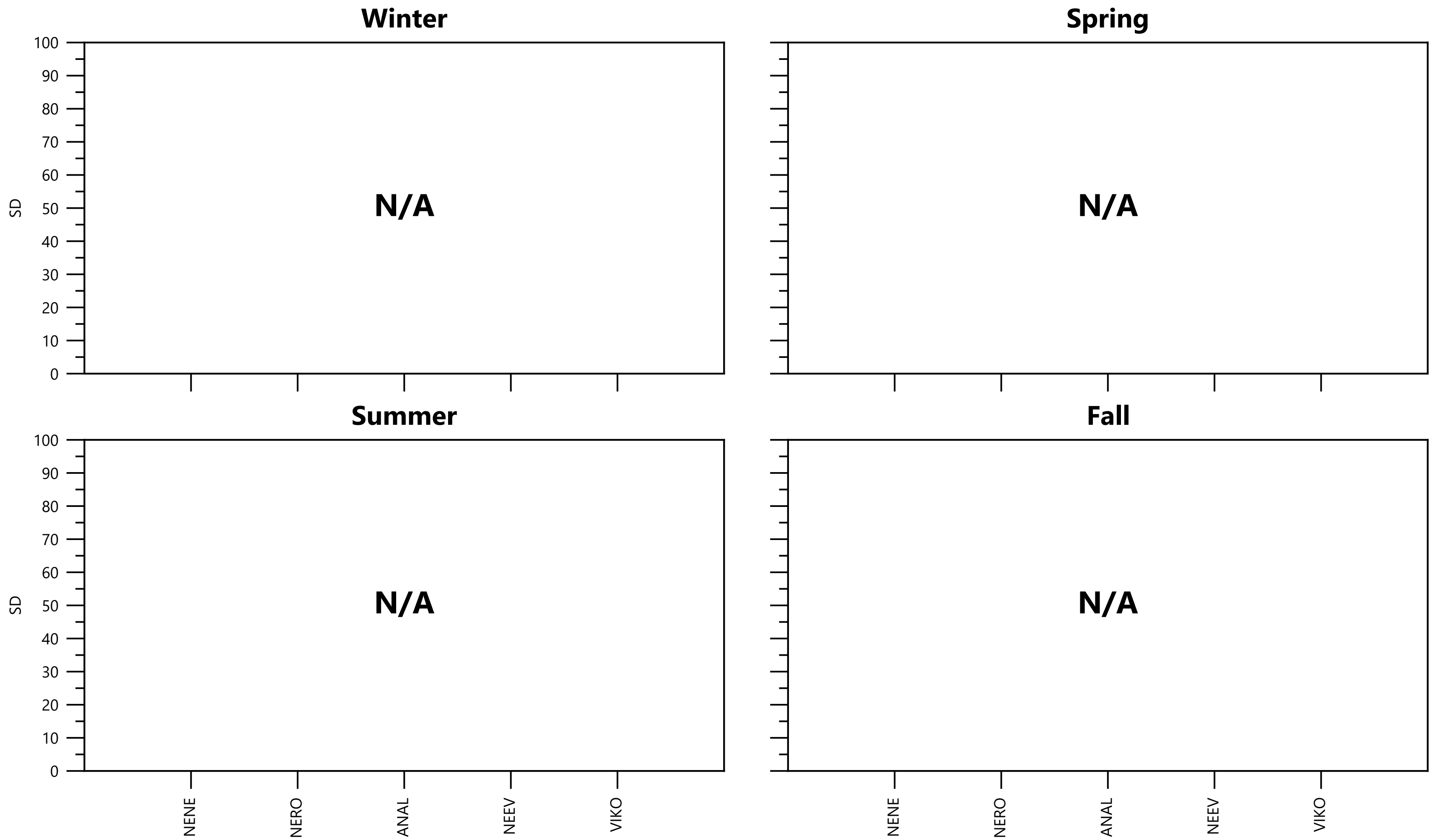
Figure I-151

Base Flow Attainment Duration (AD) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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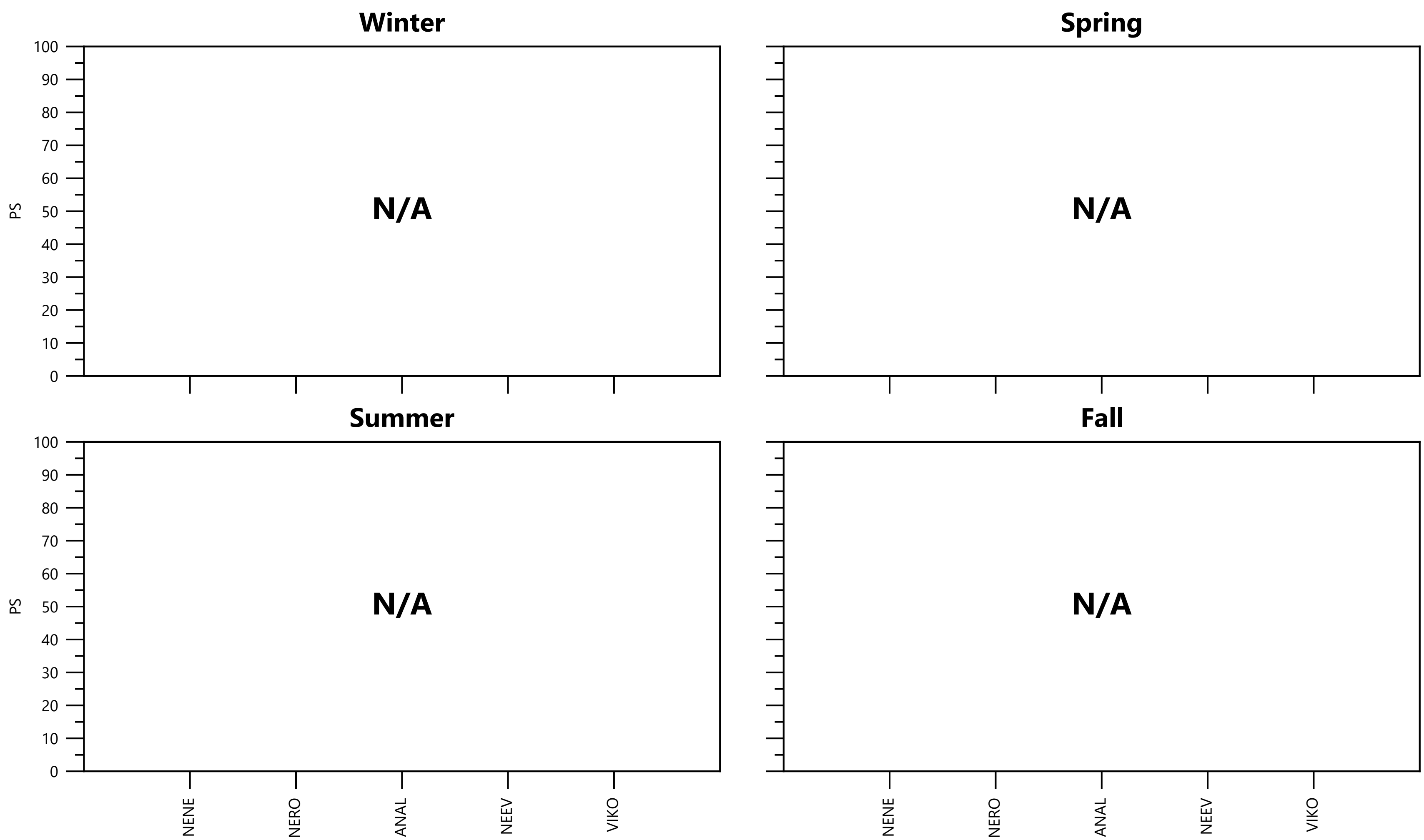
Figure I-152
Base Flow Shortage Duration (SD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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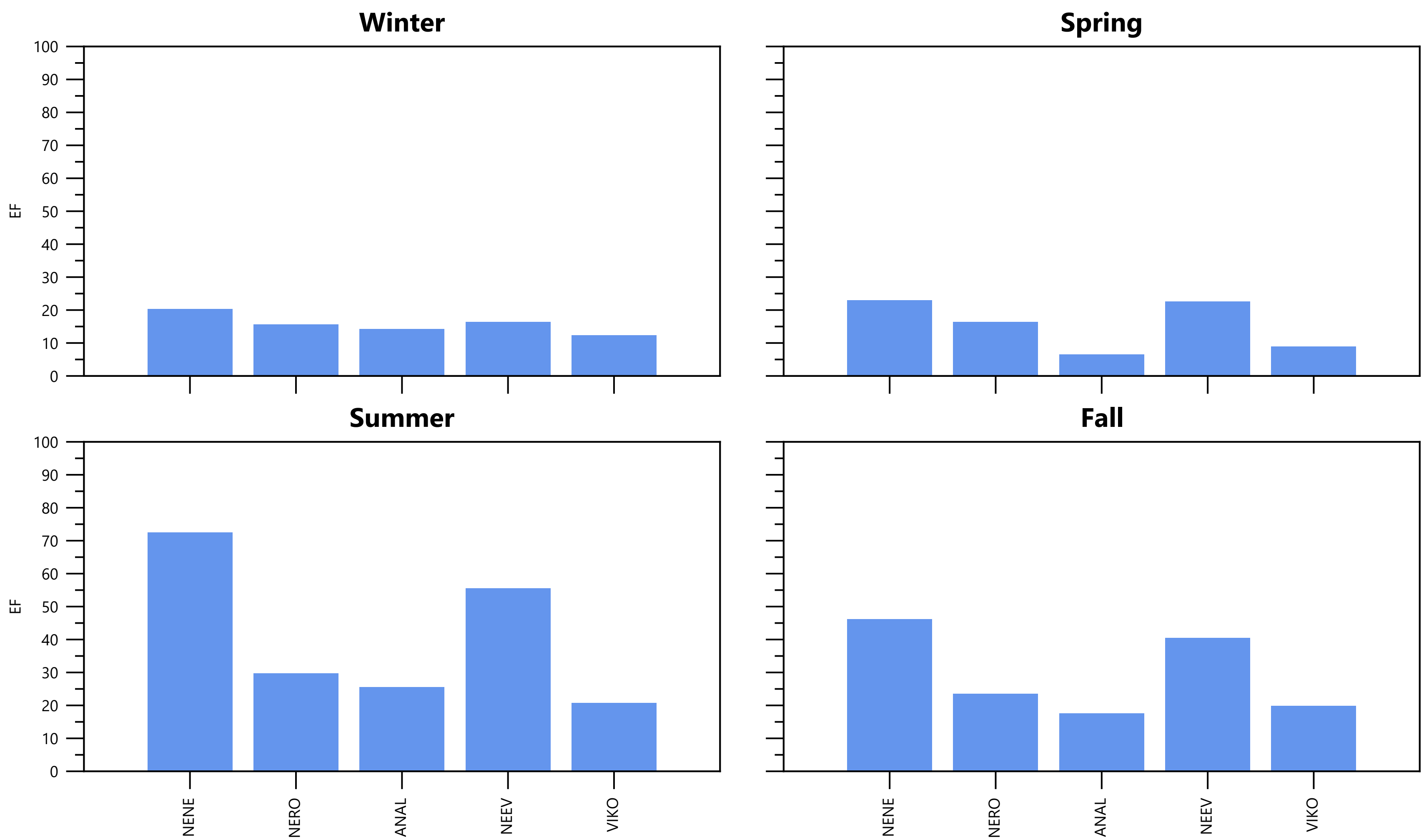
Figure I-153
Base Flow Percent Shortage (PS) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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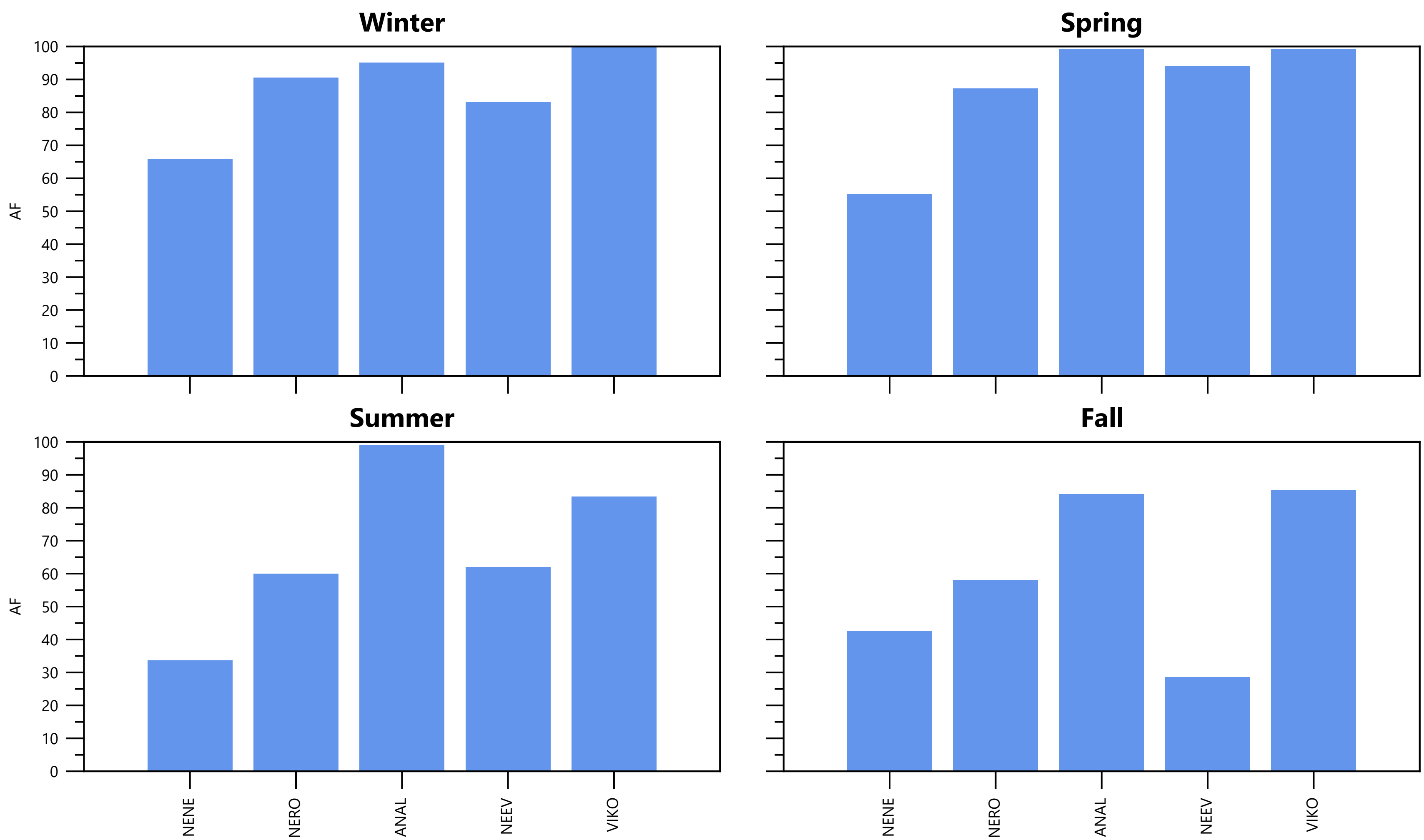
Figure I-154

Subsistence Flow Engagement Frequency (EF) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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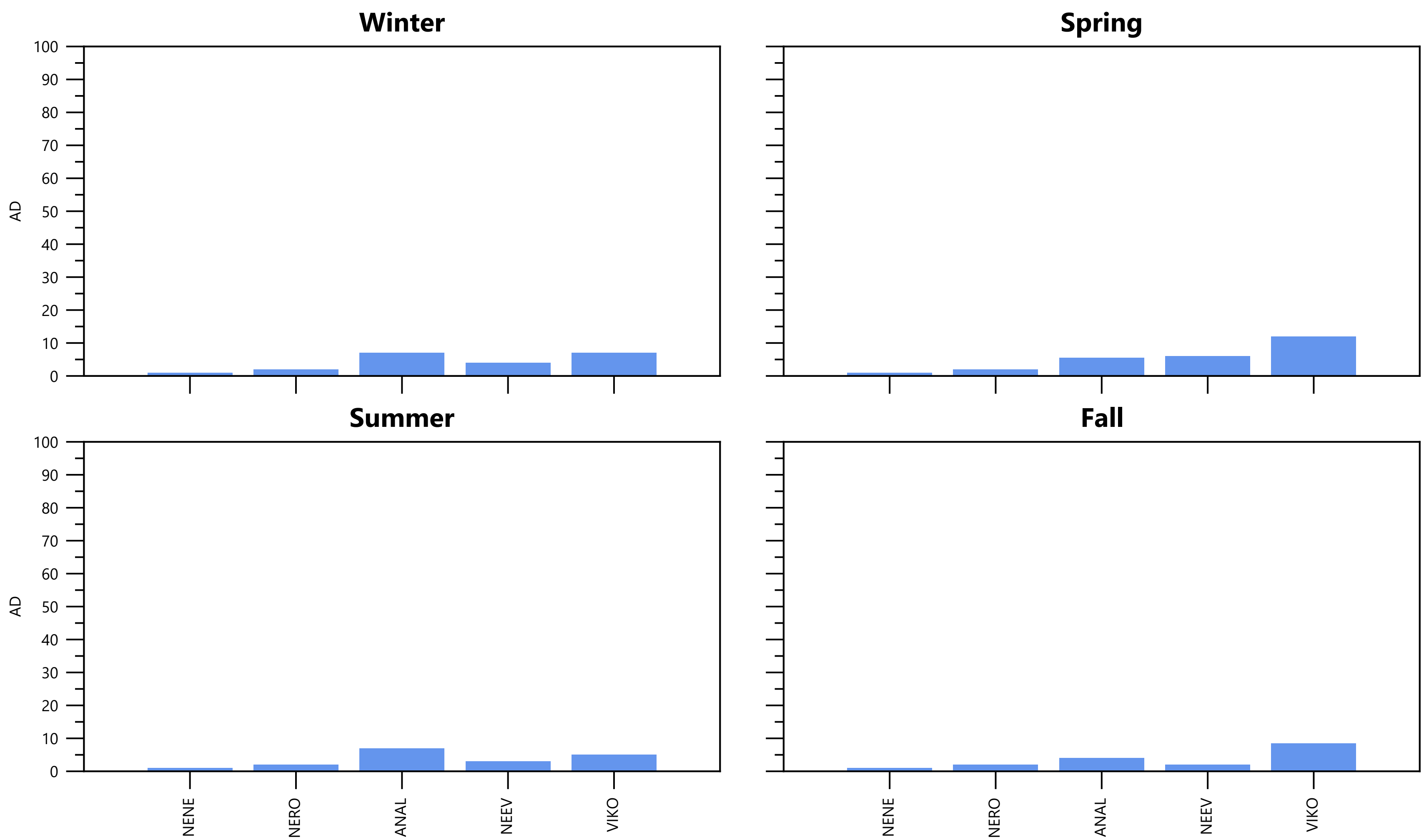
Figure I-155
Subsistence Flow Attainment Frequency (AF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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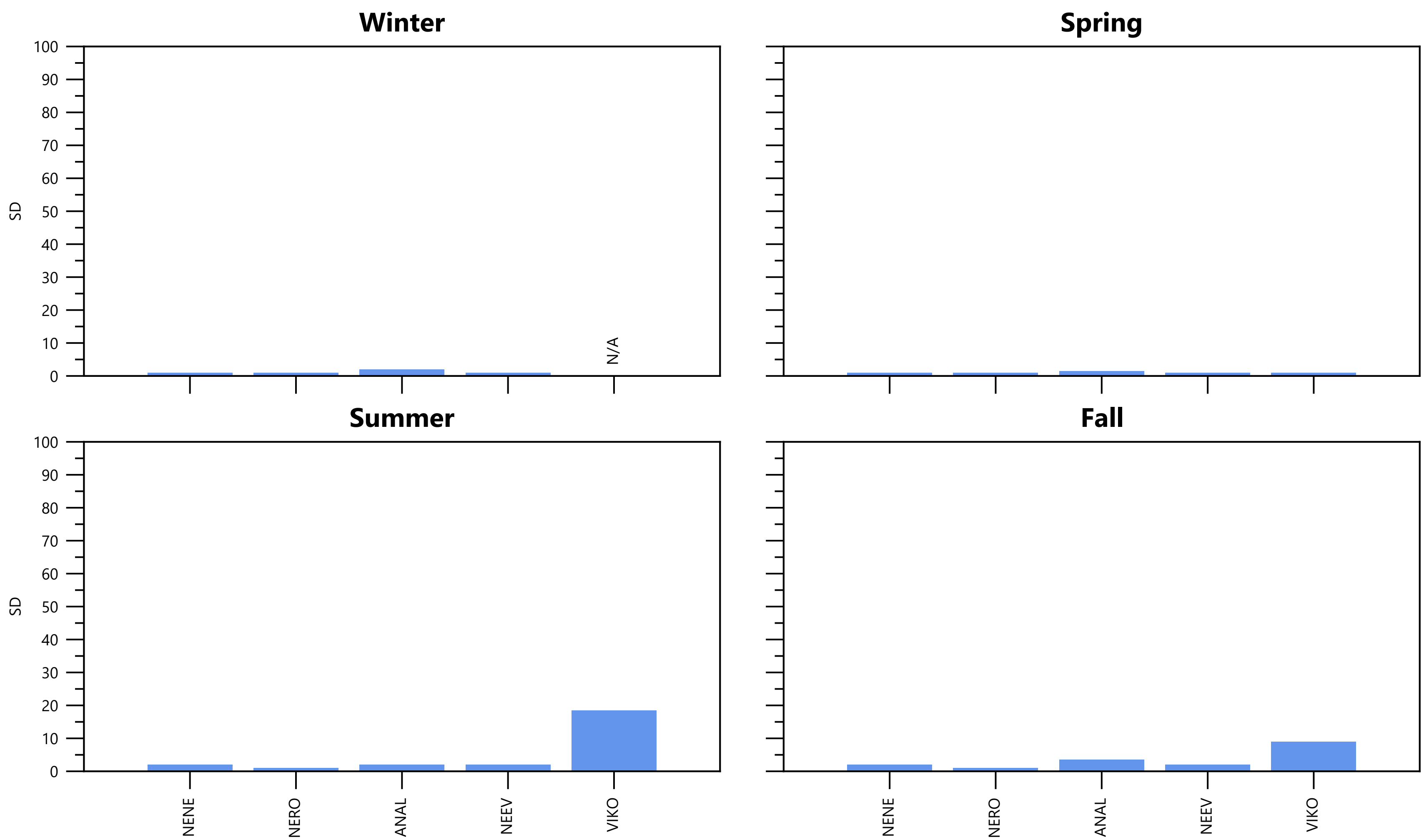
Figure I-156
Subsistence Flow Attainment Duration (AD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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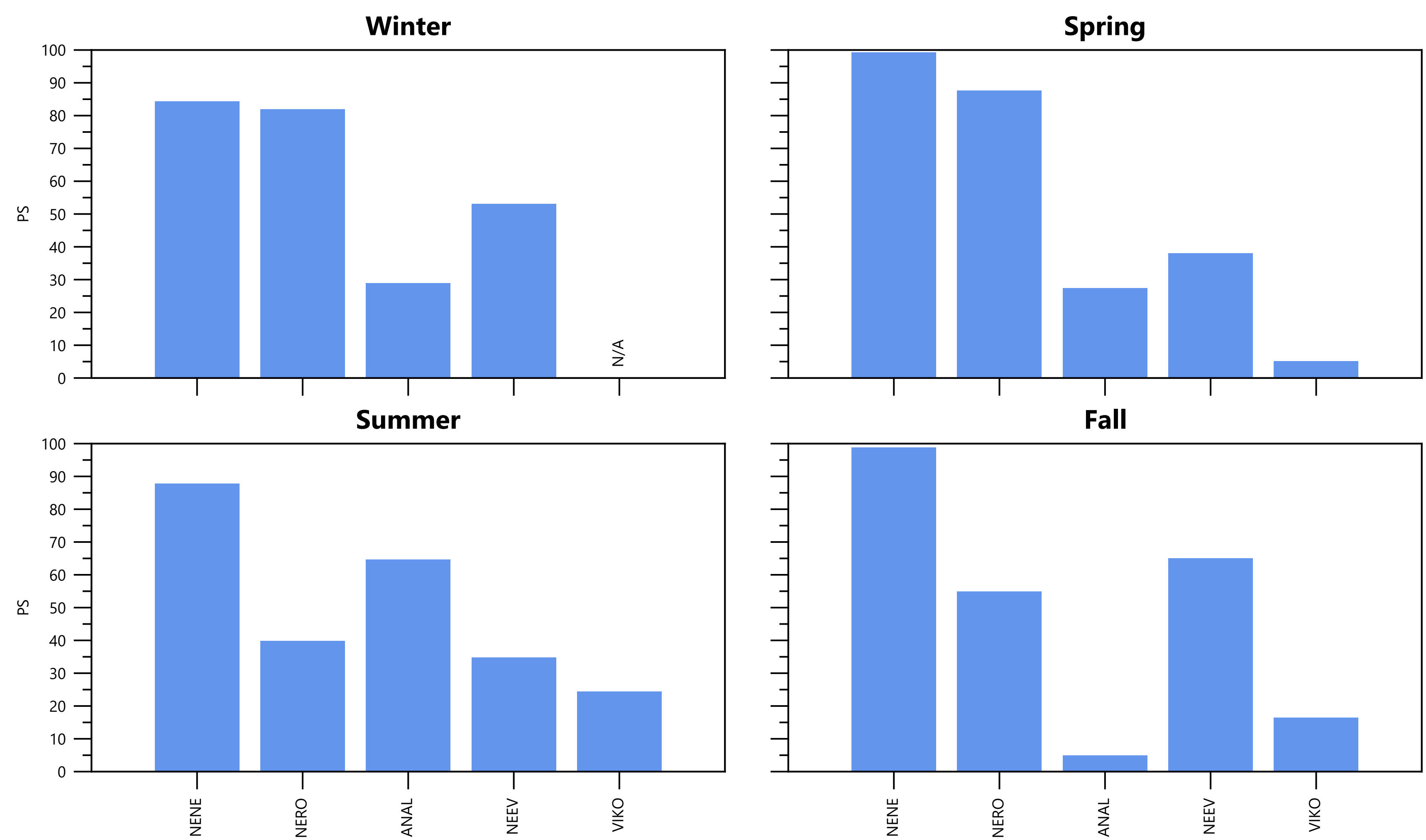
Figure I-157

Subsistence Flow Shortage Duration (SD) by Season: Current Water Use Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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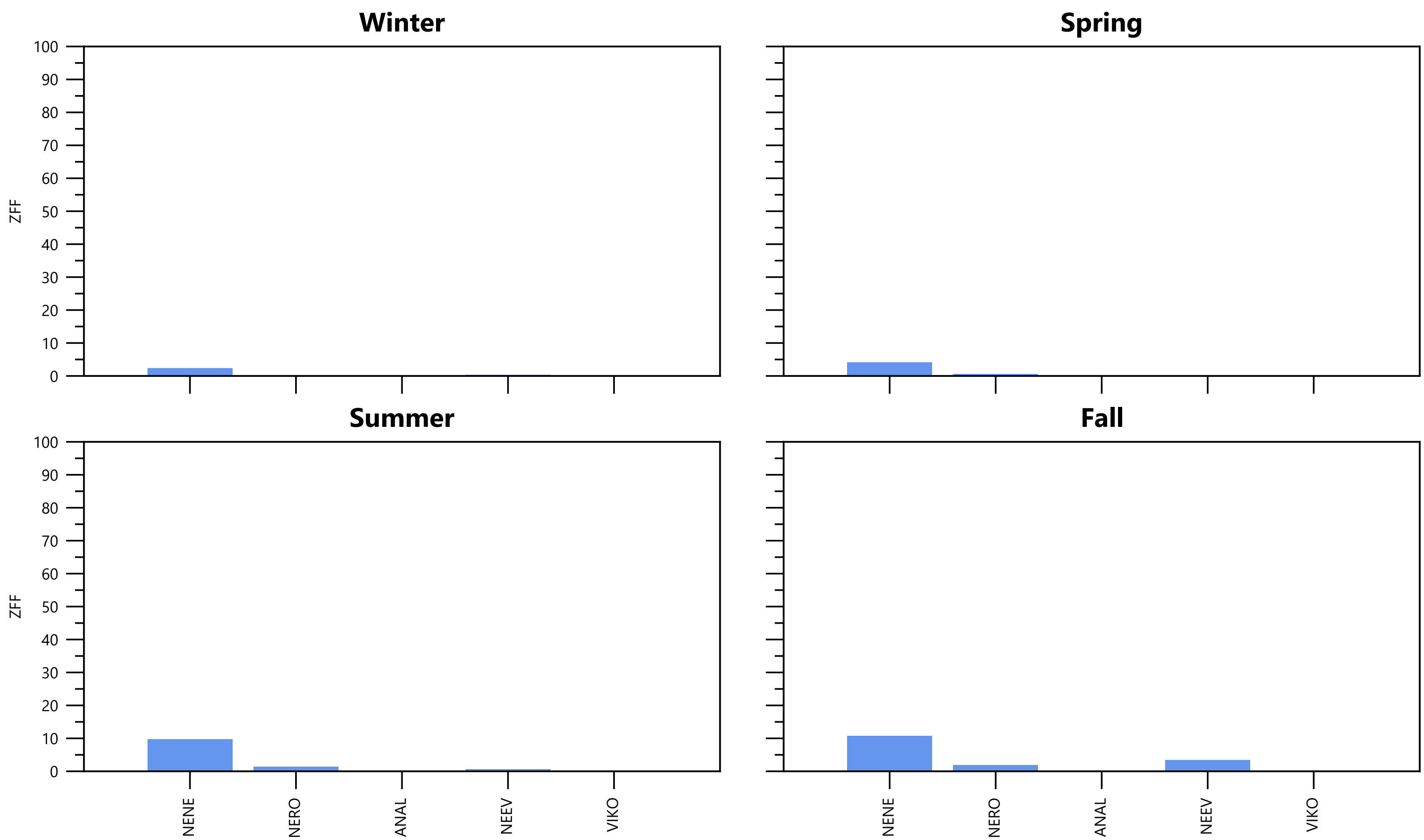
Figure I-158
Subsistence Flow Percent Shortage (PS) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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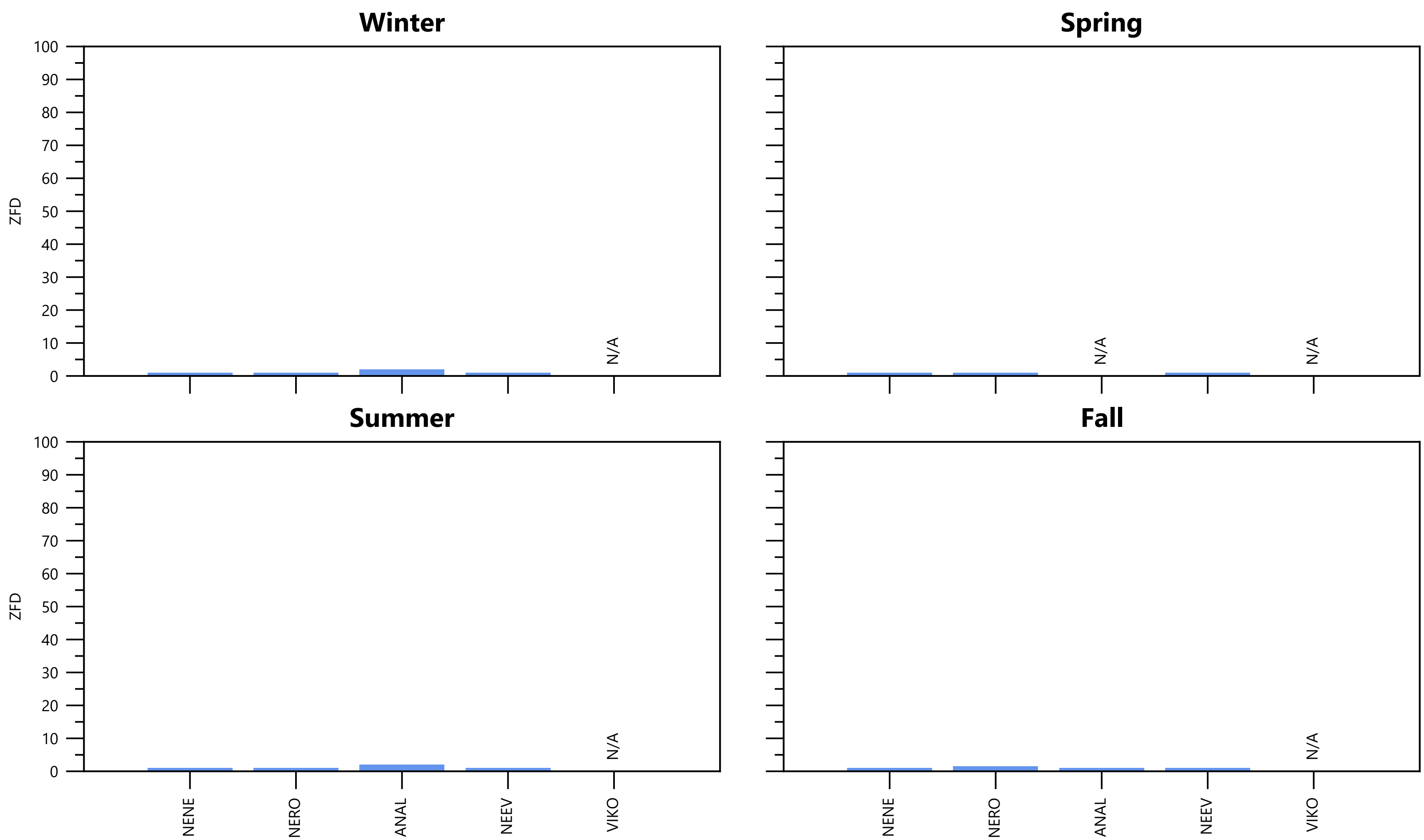
Figure I-159
Zero-Flow Frequencies (ZFF) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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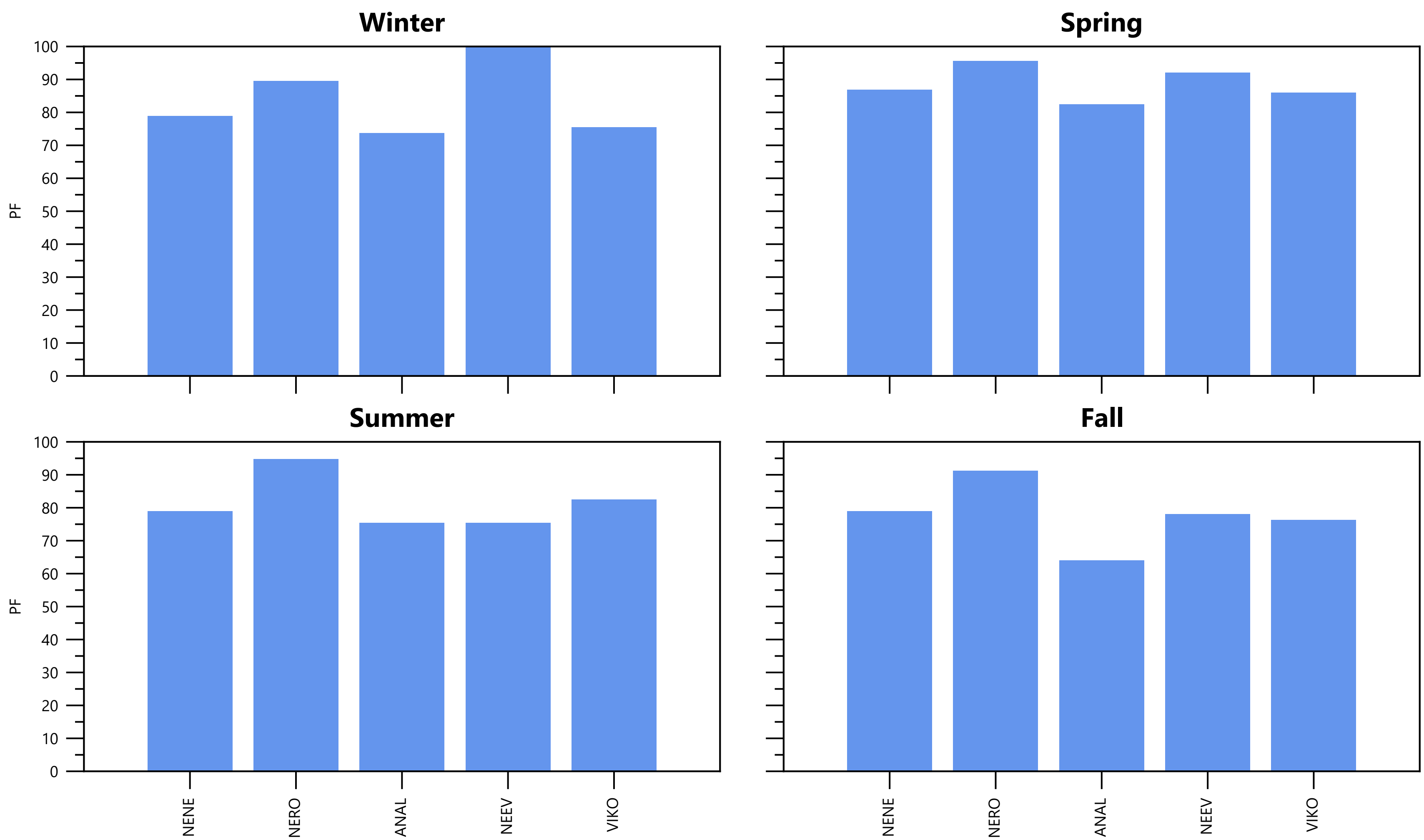
Figure I-160
Zero-Flow Durations (ZFD) by Season: Current Water Use Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

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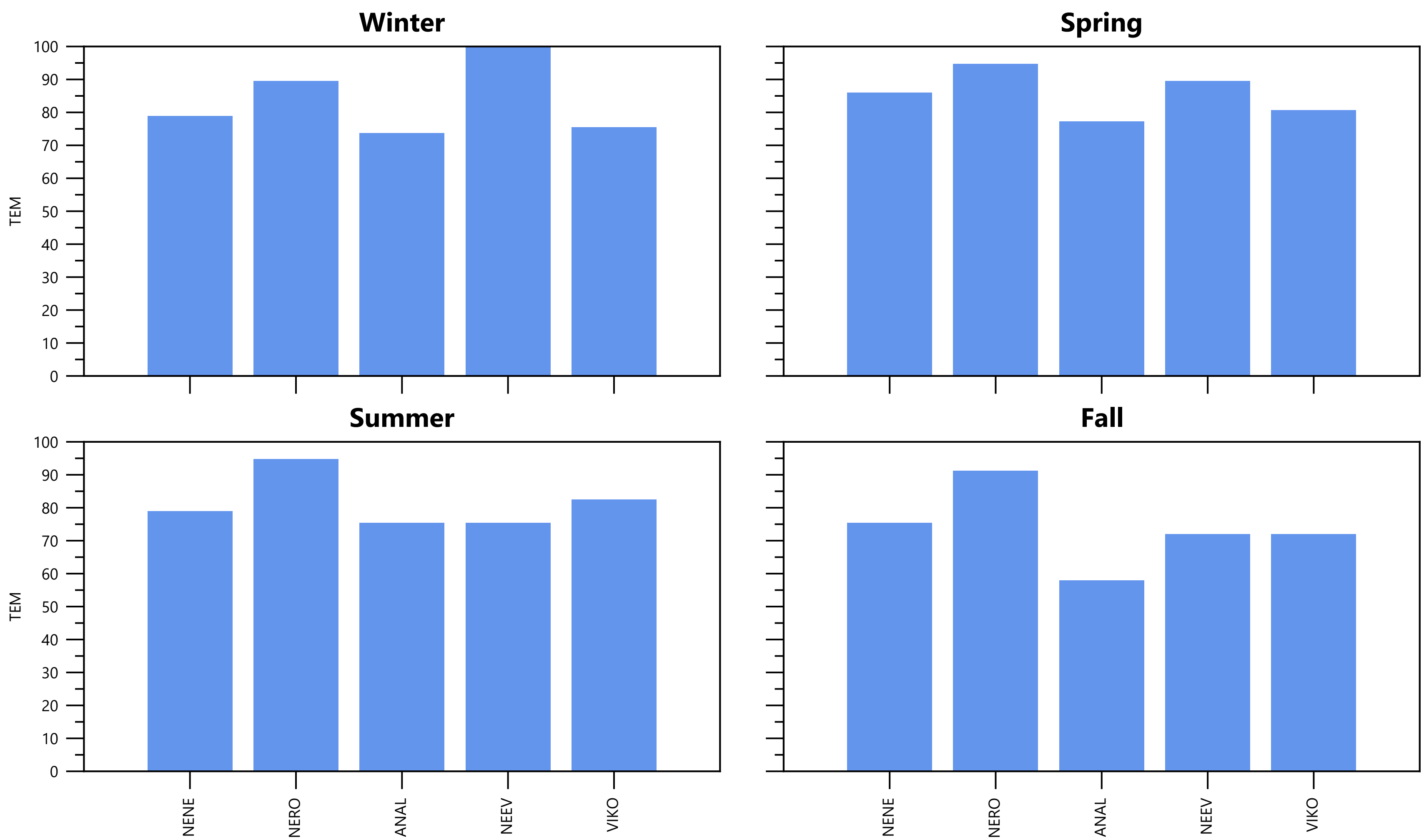
Figure I-161
Pulse Frequencies (PF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

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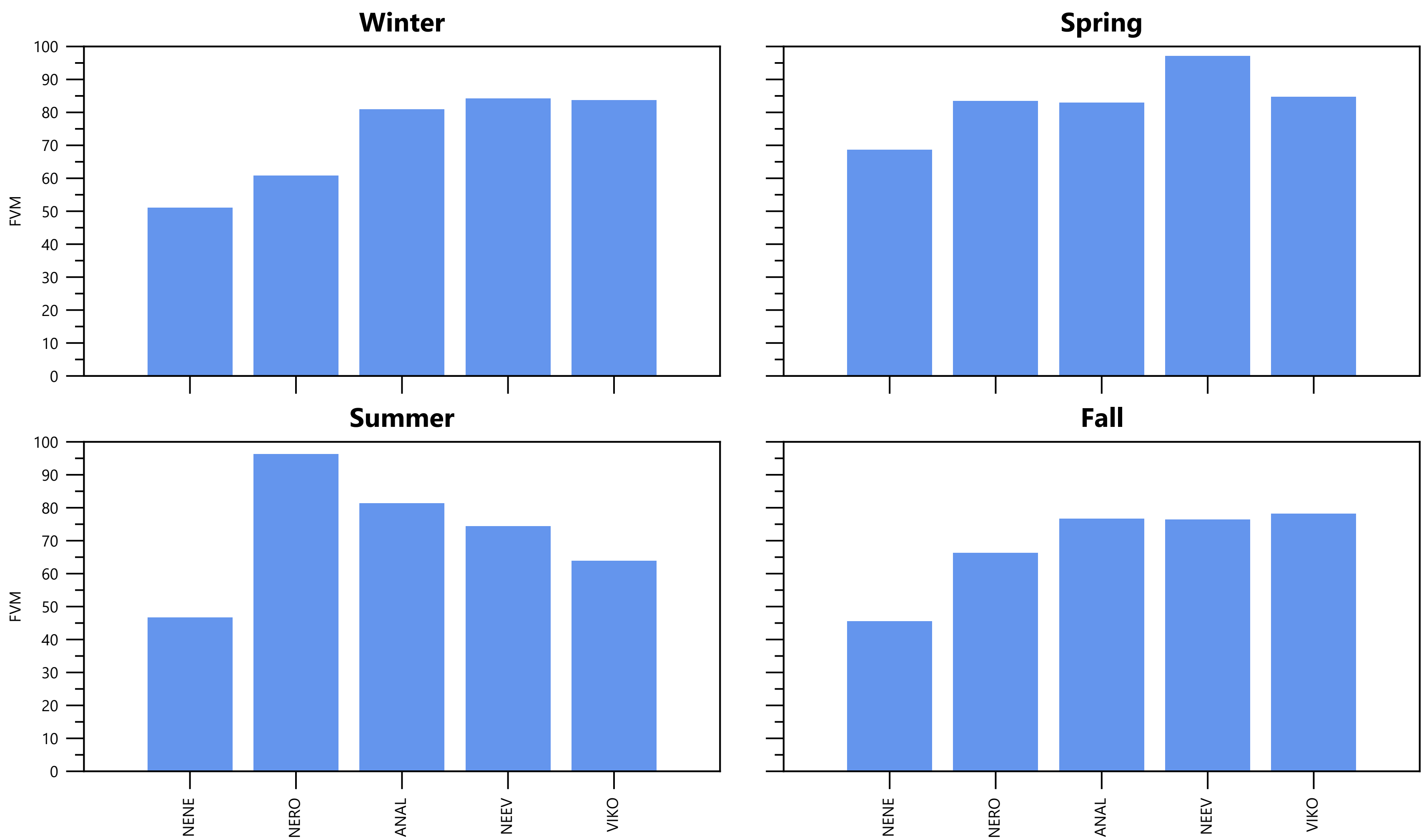
Figure I-162
Target Engagements Met (TEM) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.

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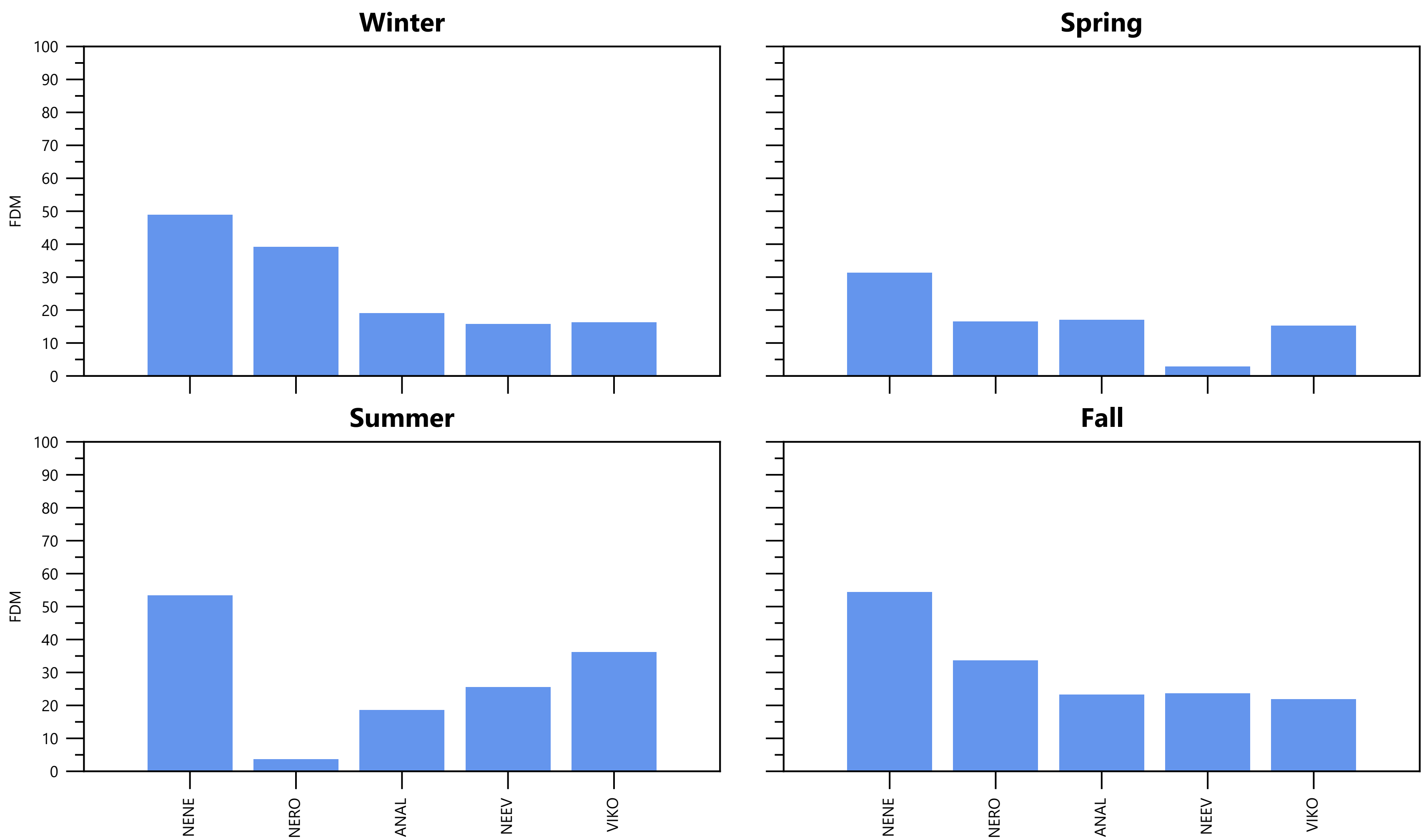
Figure I-163
Frequency Volume Met (FVM) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

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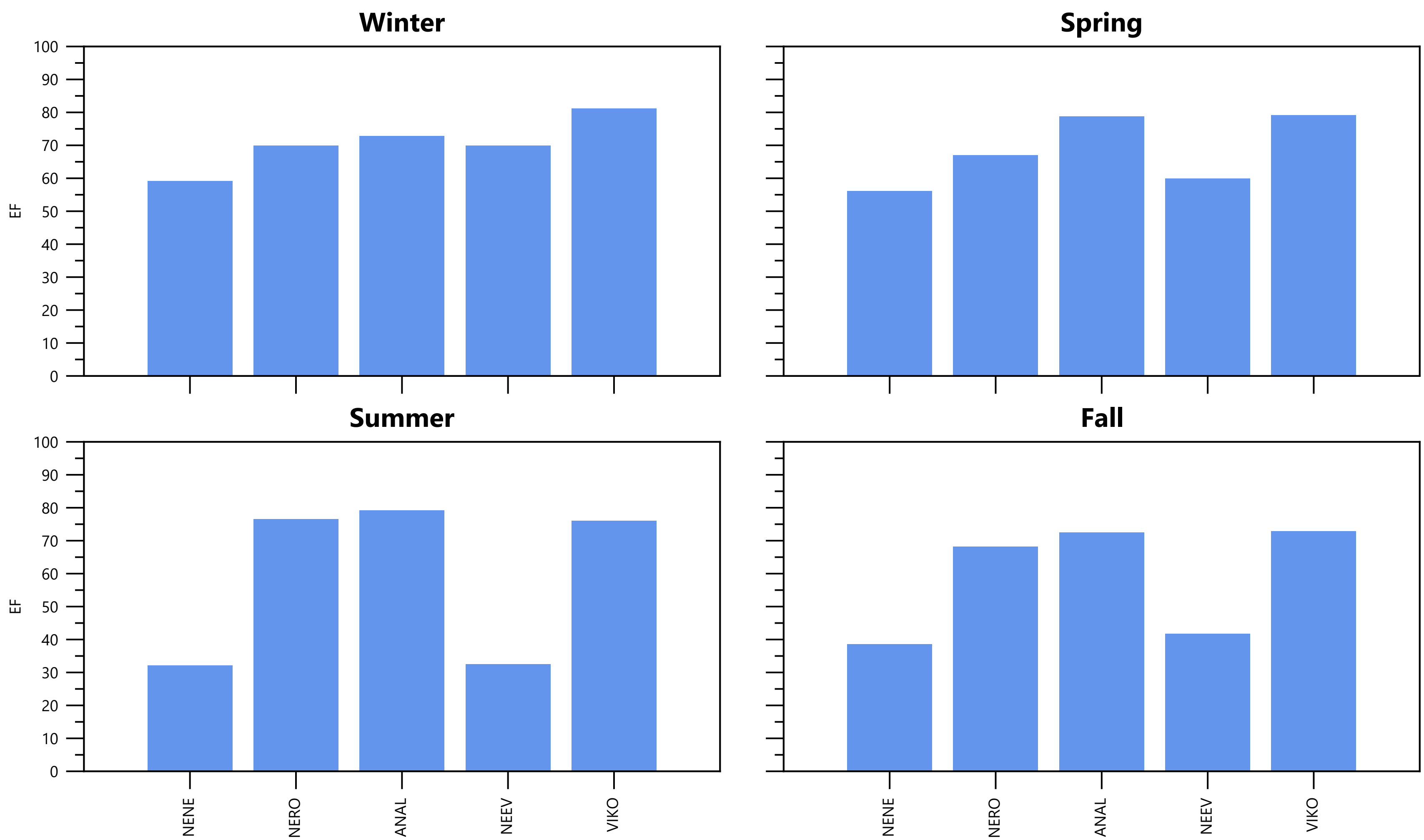
Figure I-164
Frequency Duration Met (FDM) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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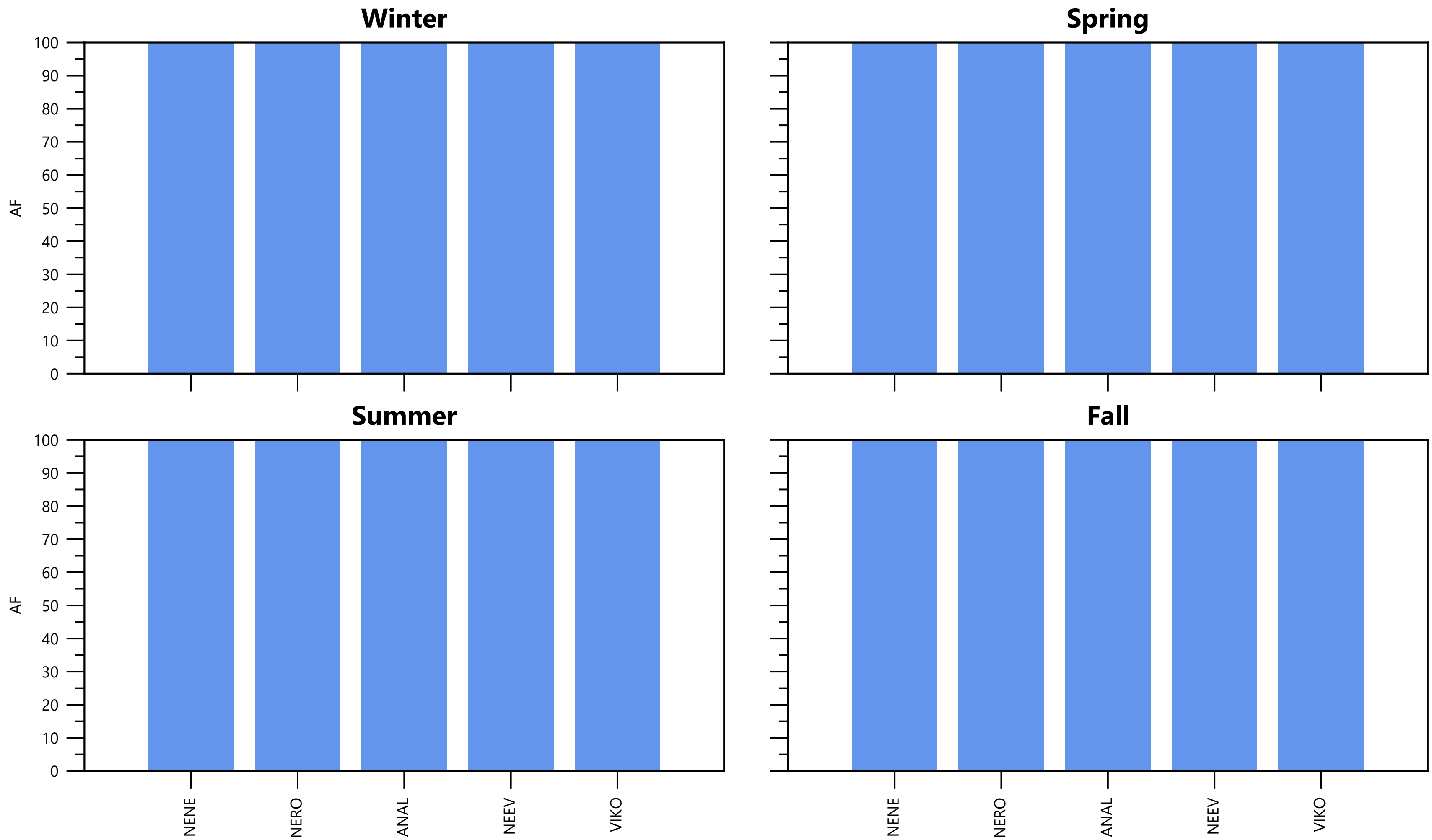
Figure I-165
Base Flow Engagement Frequency (EF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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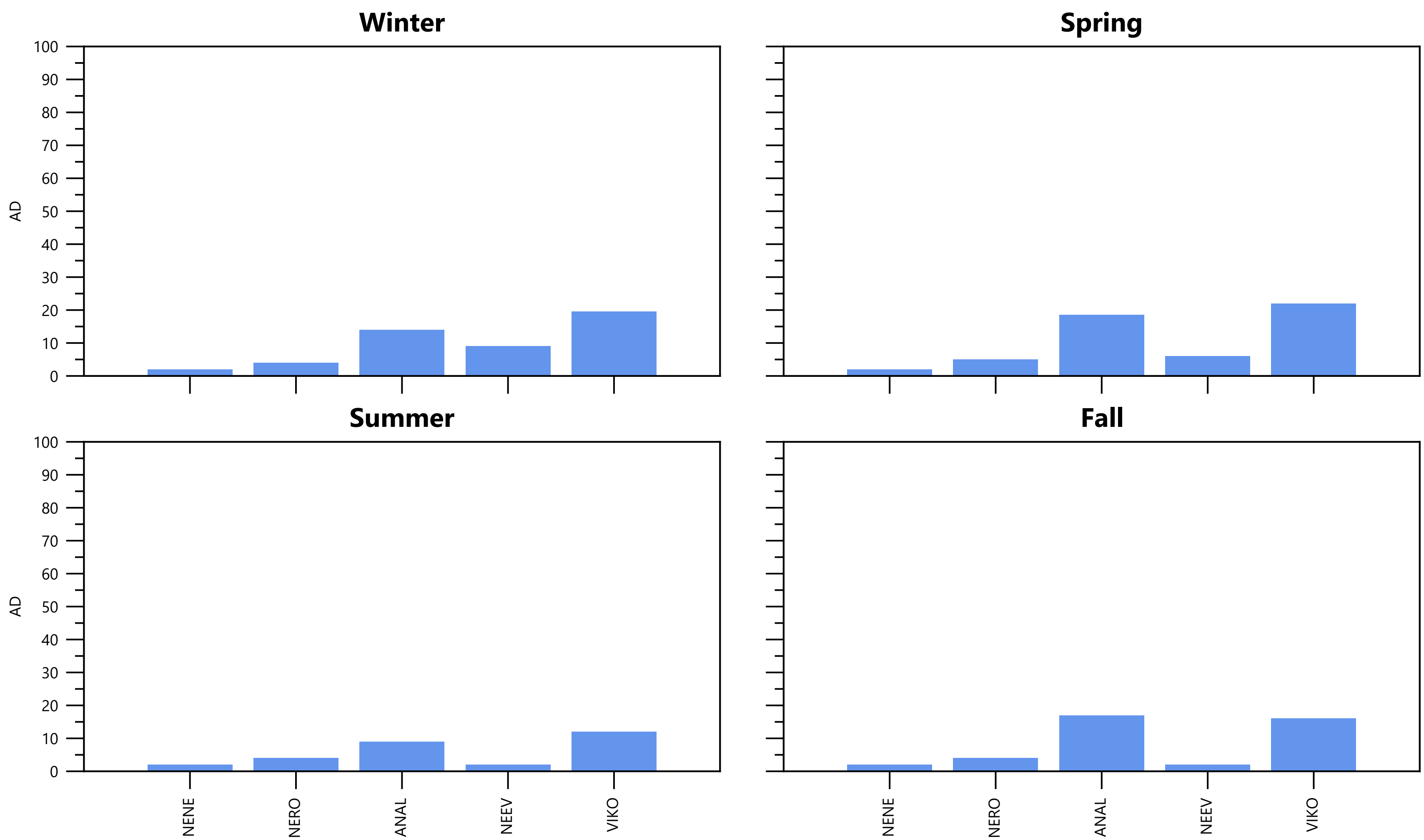
Figure I-166

Base Flow Attainment Frequency (AF) by Season: Partial Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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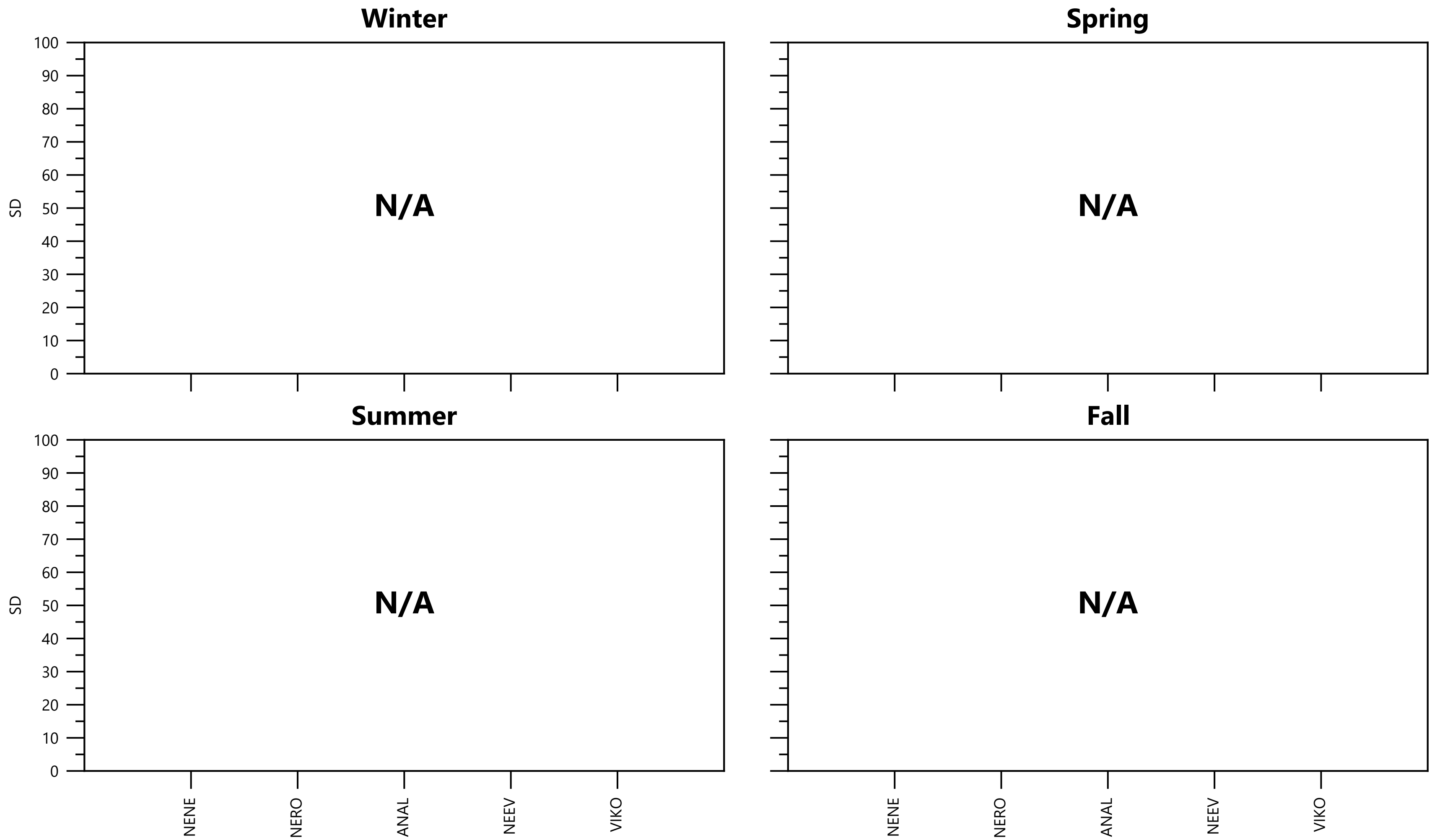
Figure I-167
Base Flow Attainment Duration (AD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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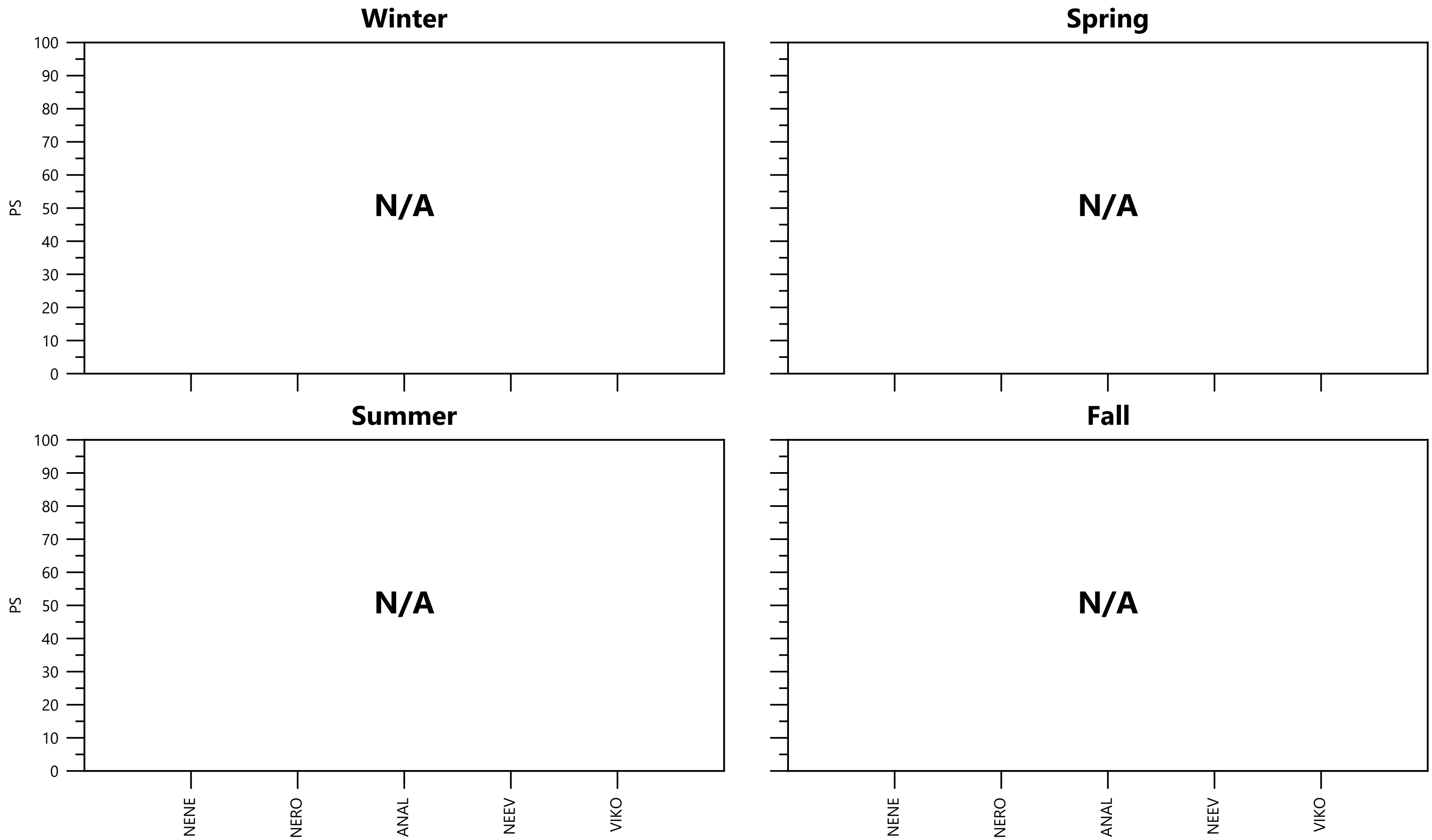
Figure I-168
Base Flow Shortage Duration (SD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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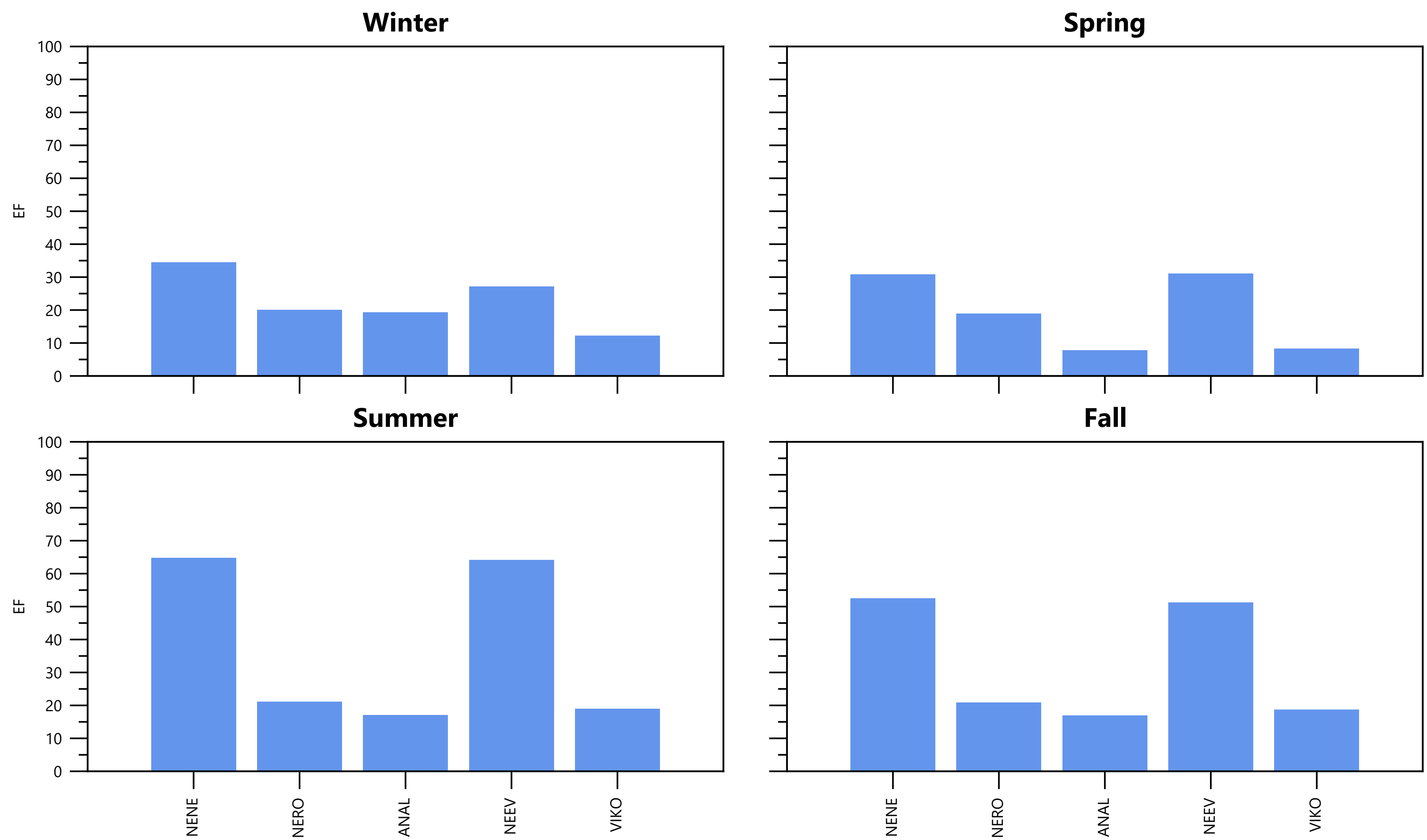
Figure I-169
Base Flow Percent Shortage (PS) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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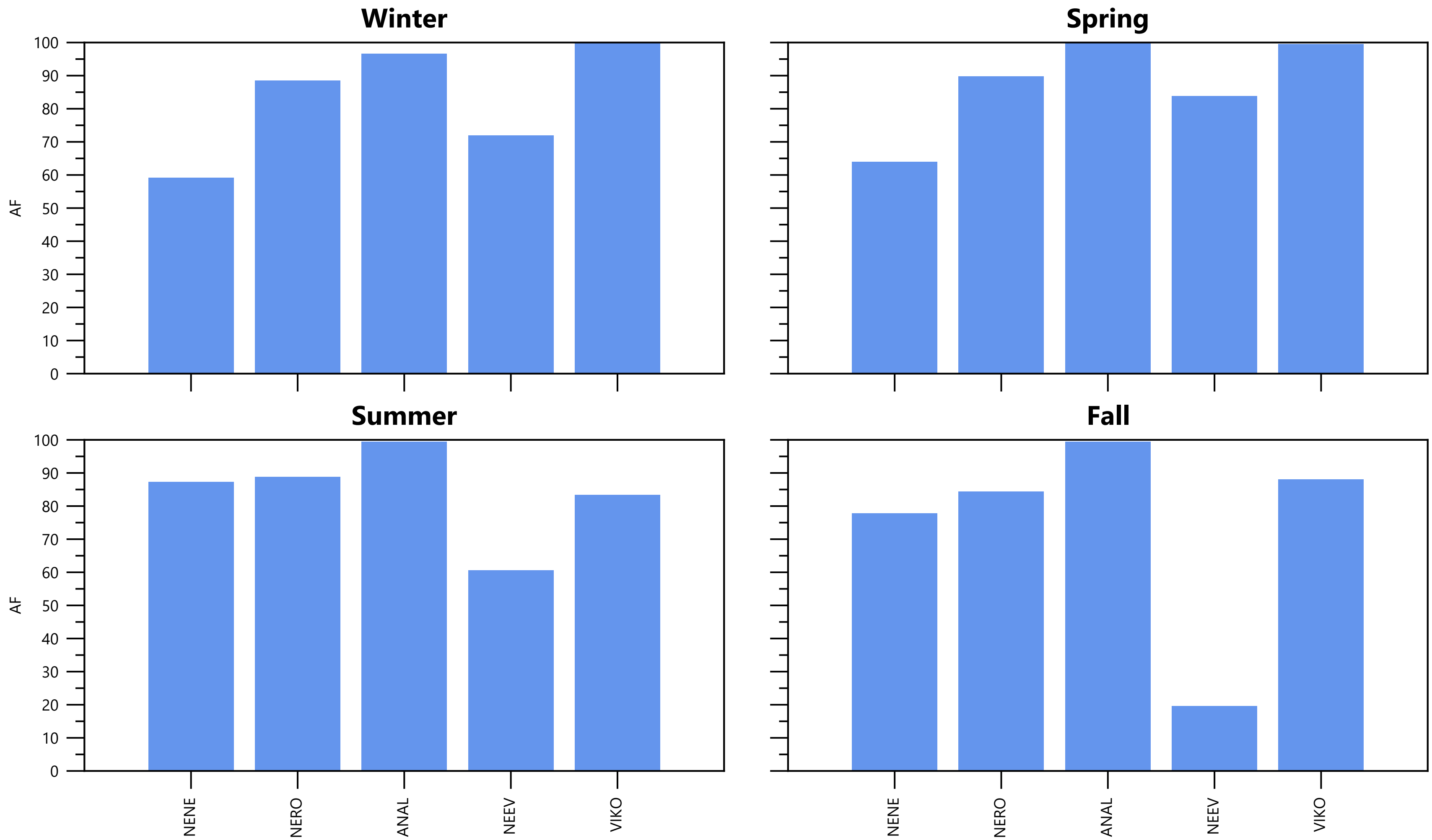
Figure I-170
Subsistence Flow Engagement Frequency (EF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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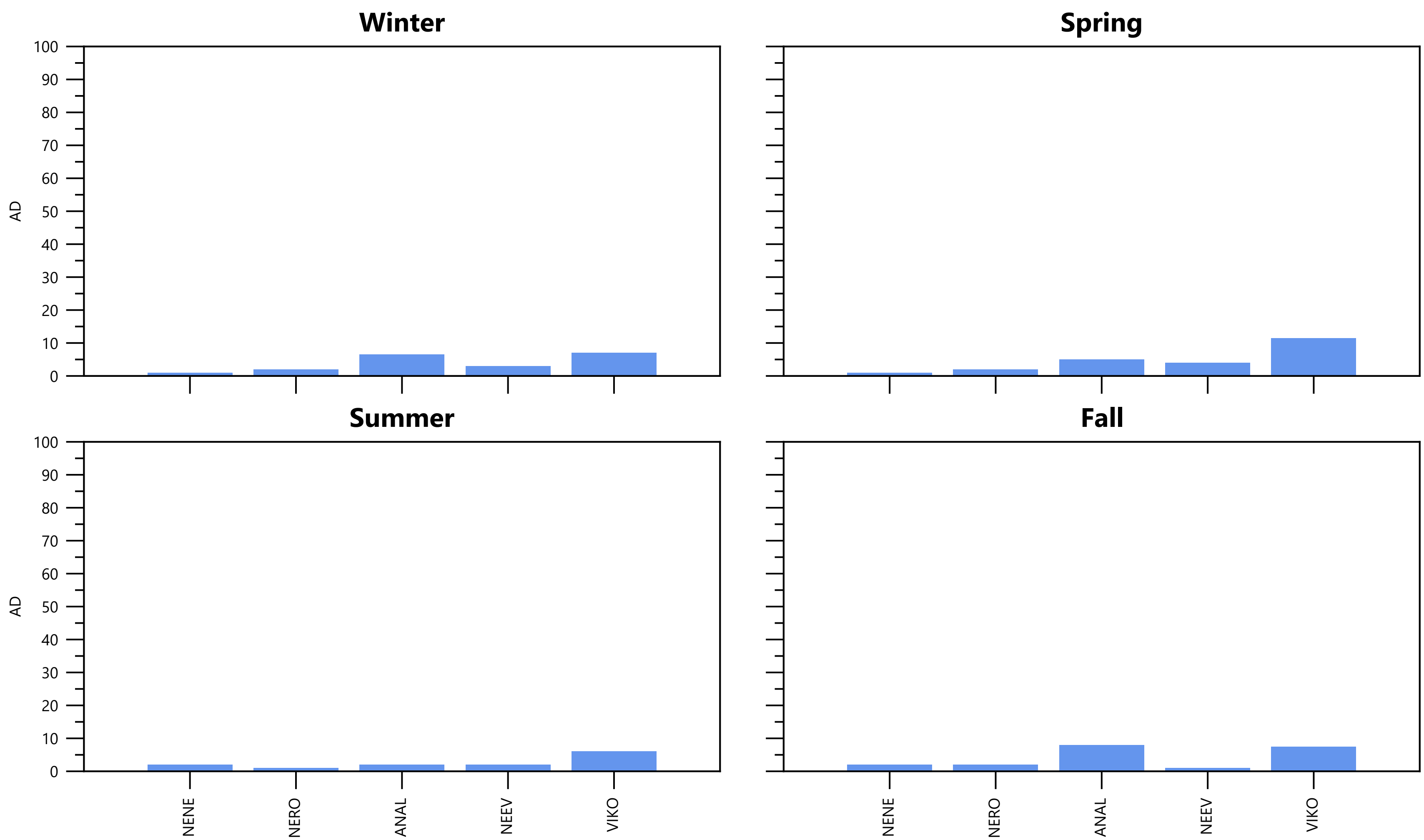
Figure I-171
Subsistence Flow Attainment Frequency (AF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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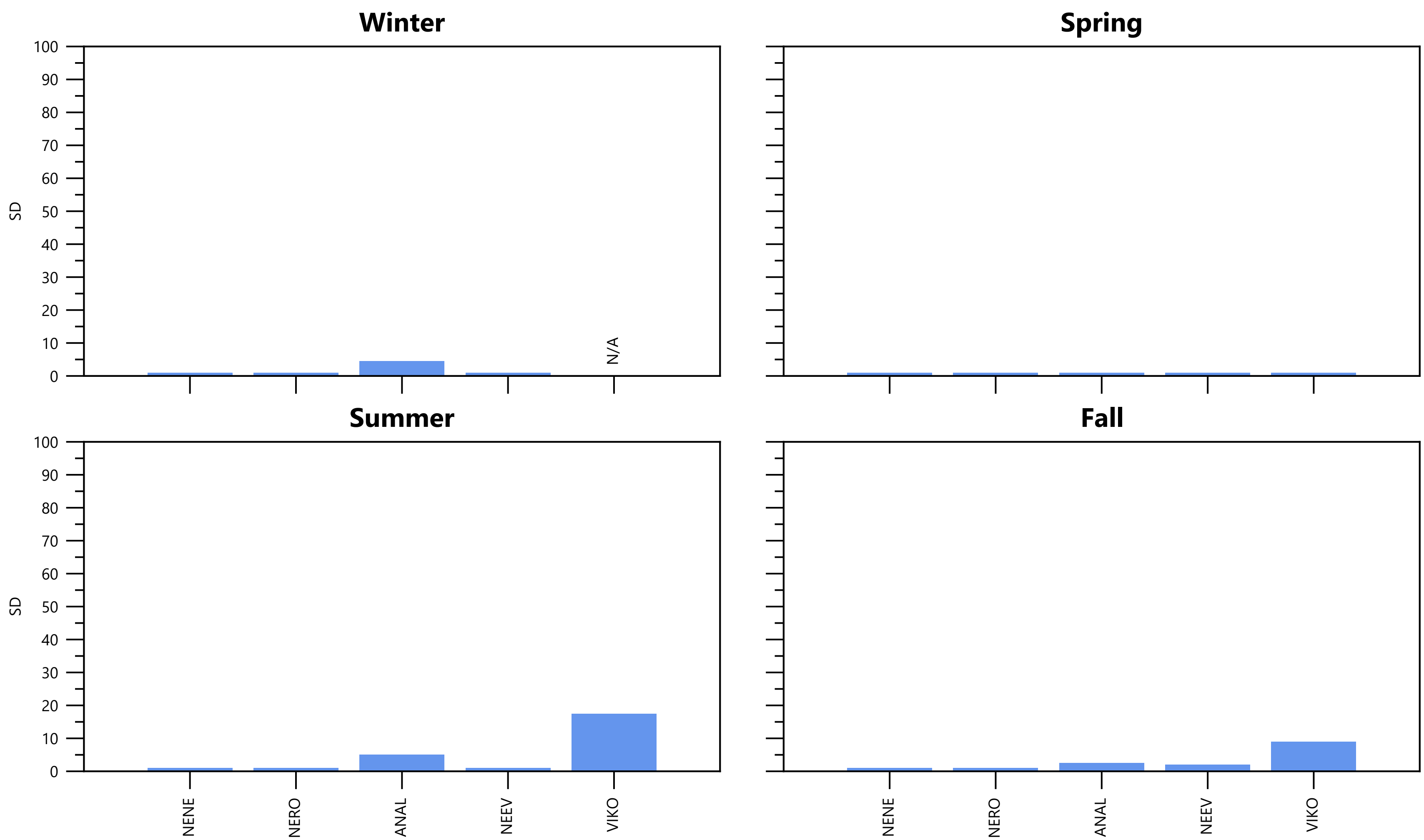
Figure I-172
Subsistence Flow Attainment Duration (AD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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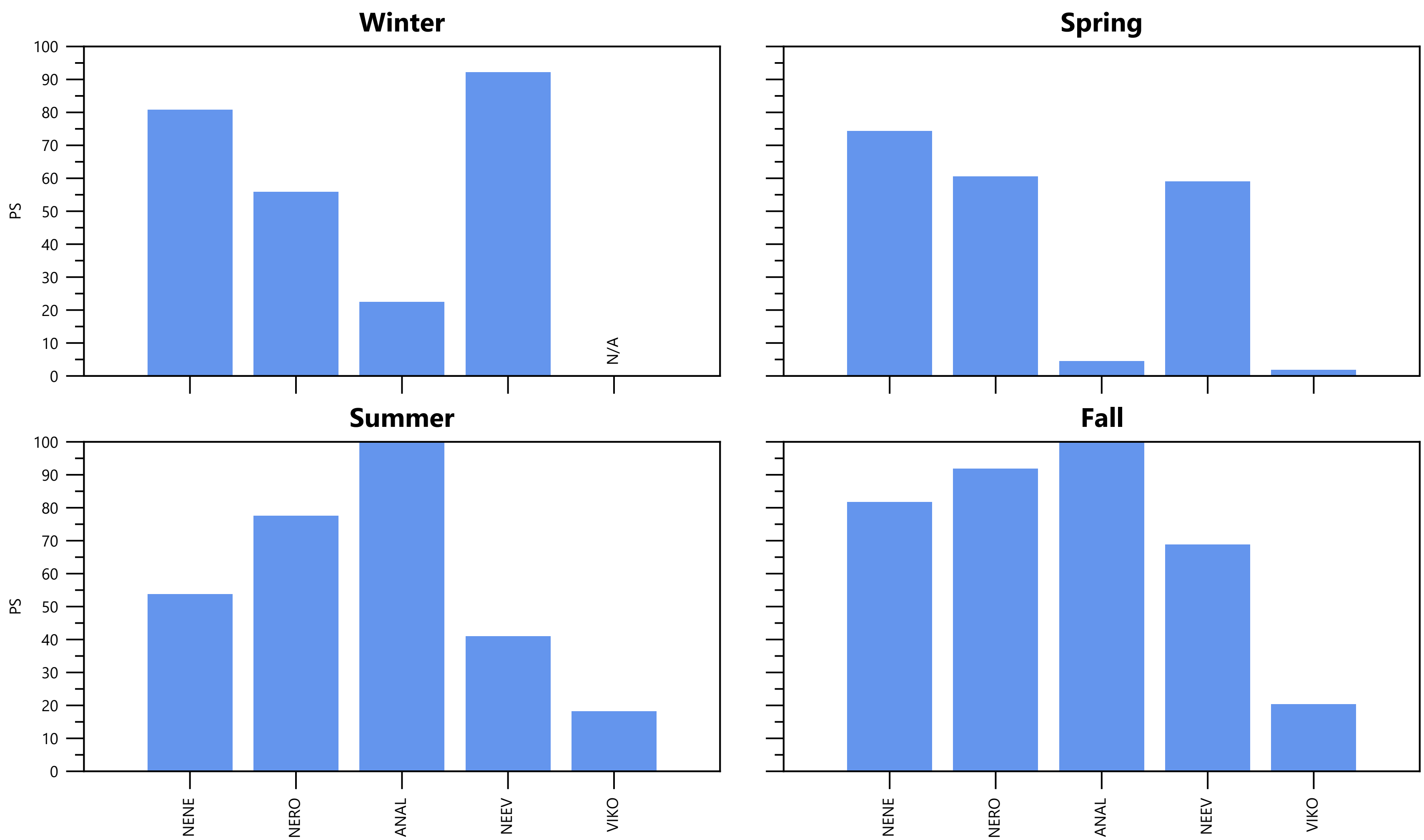
Figure I-173
Subsistence Flow Shortage Duration (SD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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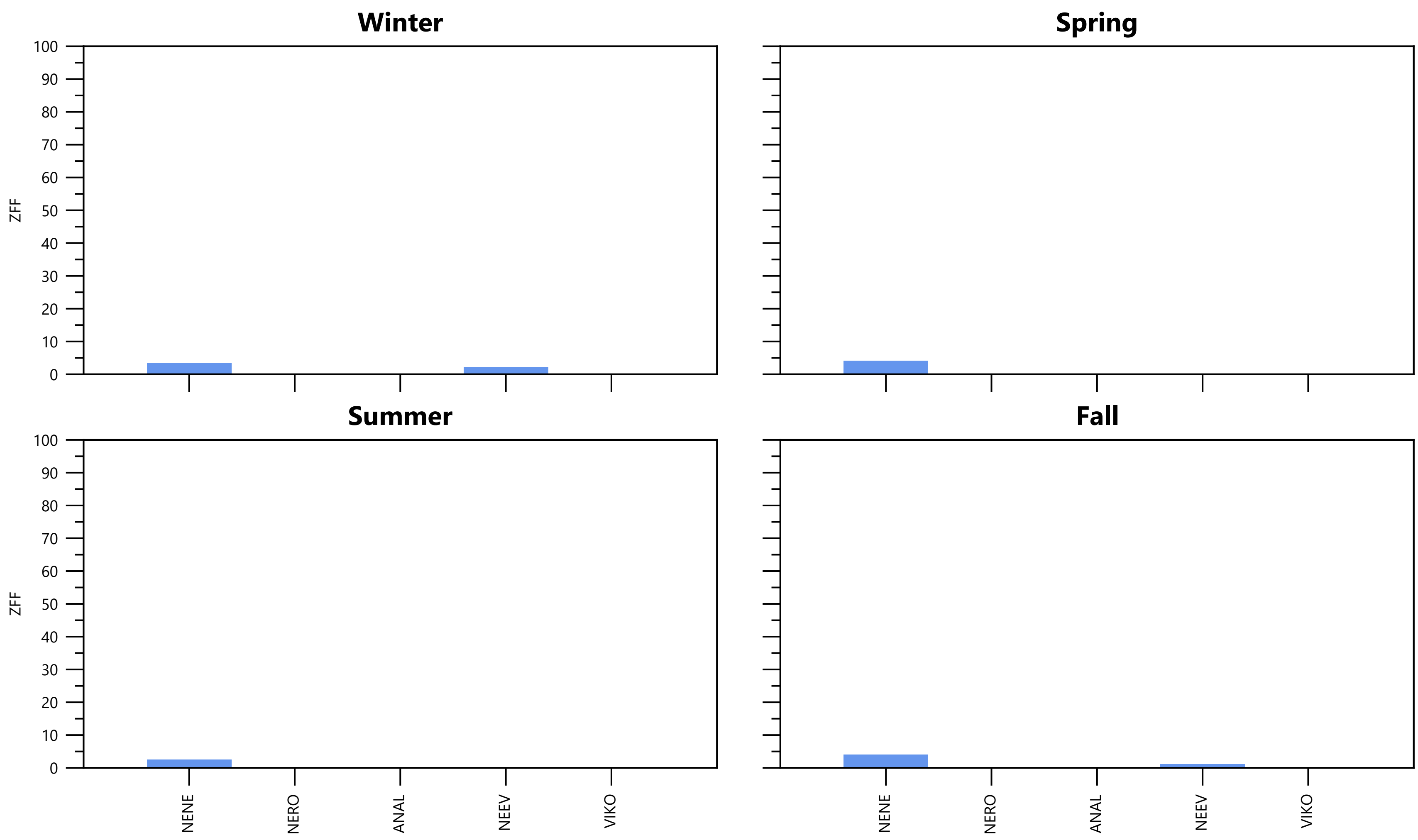
Figure I-174
Subsistence Flow Percent Shortage (PS) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

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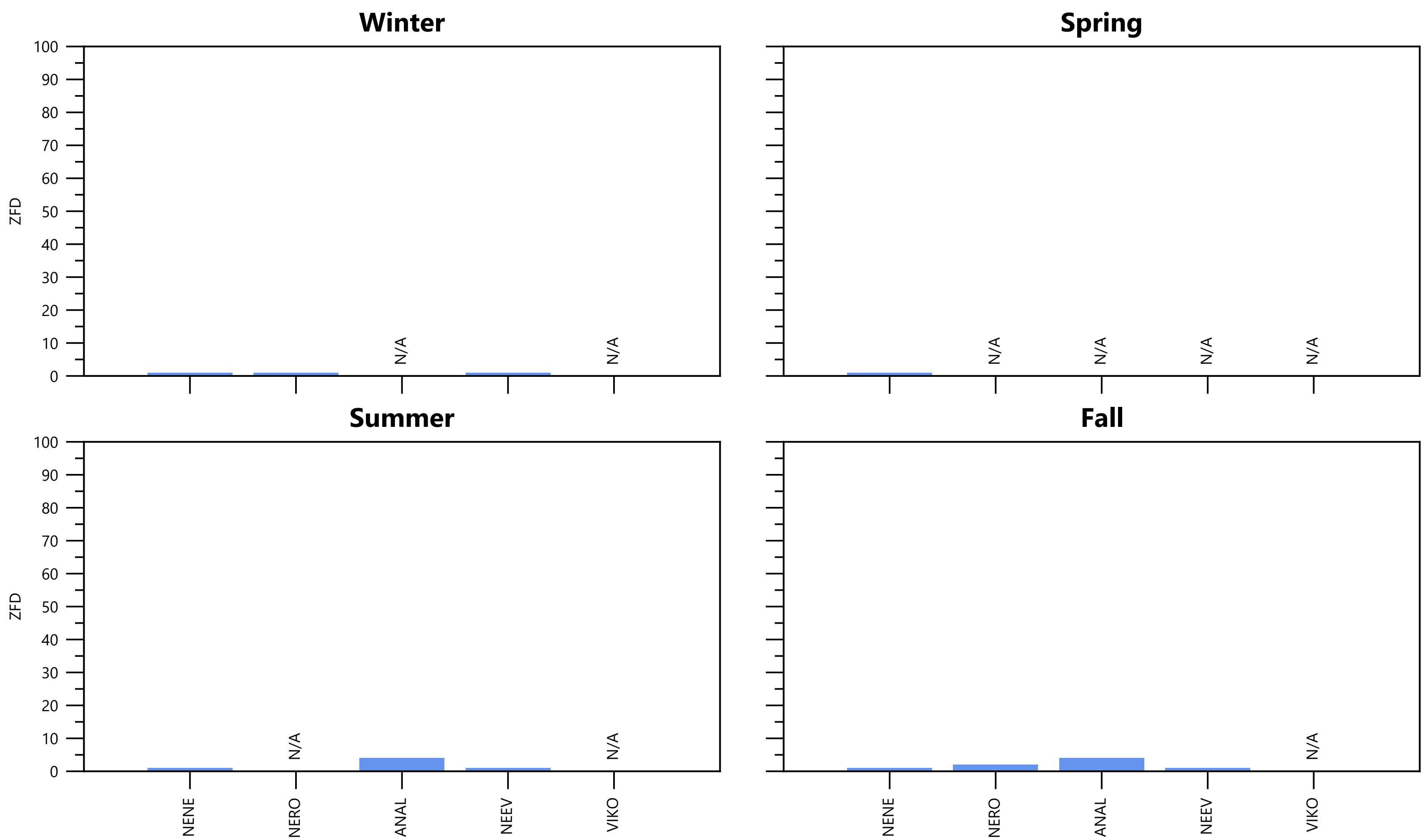
Figure I-175
Zero-Flow Frequencies (ZFF) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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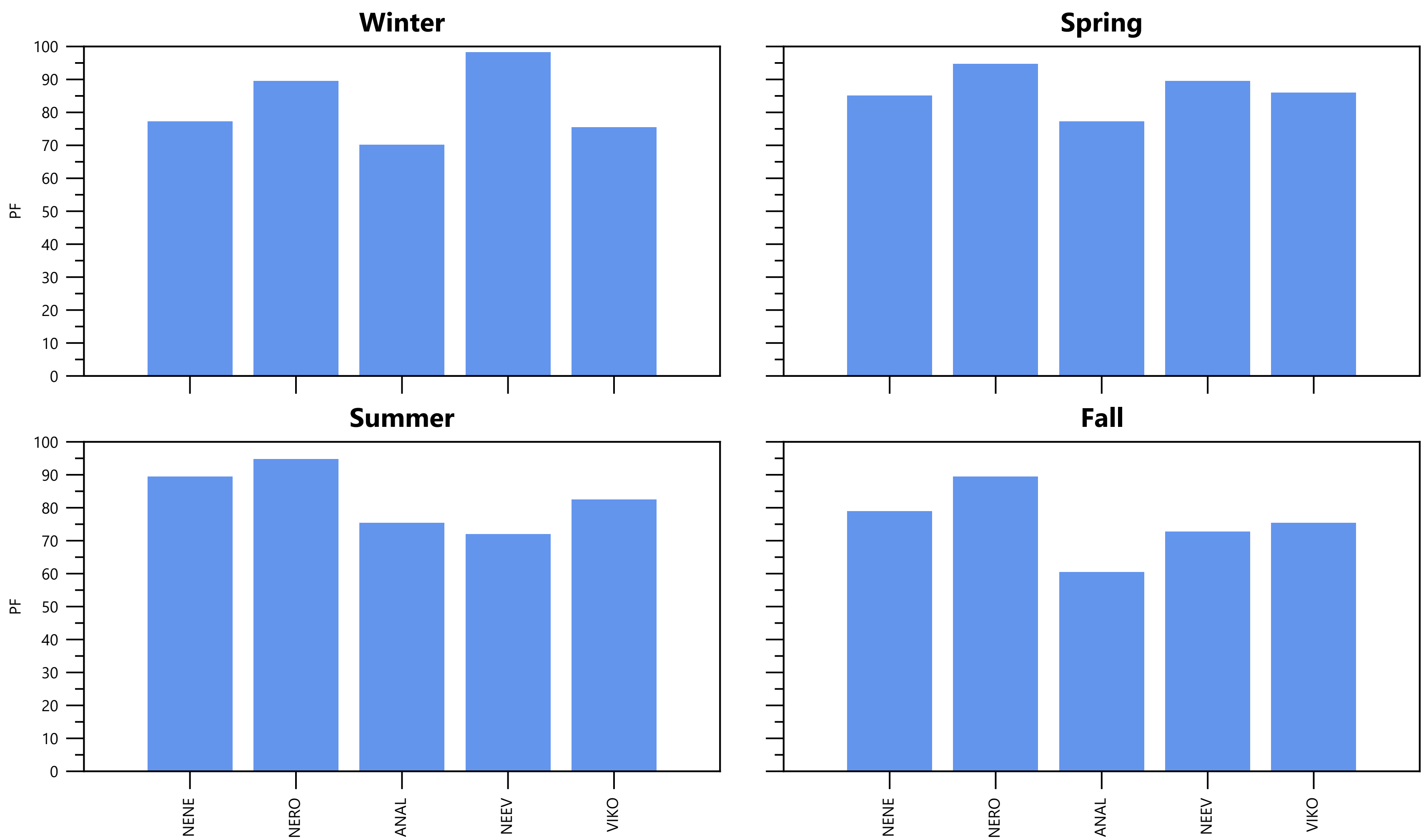
Figure I-176
Zero-Flow Durations (ZFD) by Season: Partial Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PF metric plotted in the charts above is defined as the percentage of high flow pulse engagements, relative to the target number of high flow pulse engagements.

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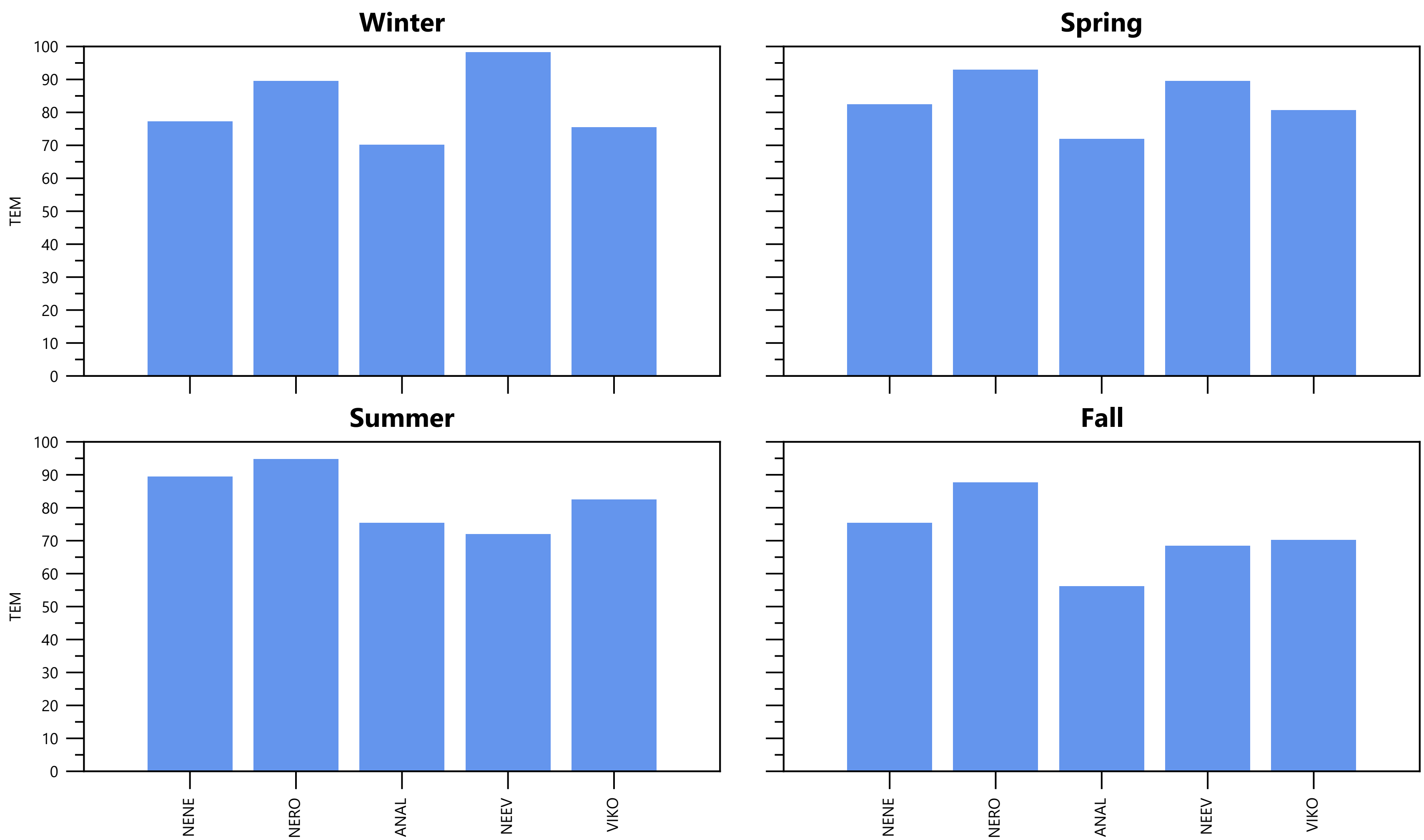
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

Figure I-177
Pulse Frequencies (PF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The TEM metric plotted in the charts above is defined as the percentage of seasons in which all target high flow pulse engagements were met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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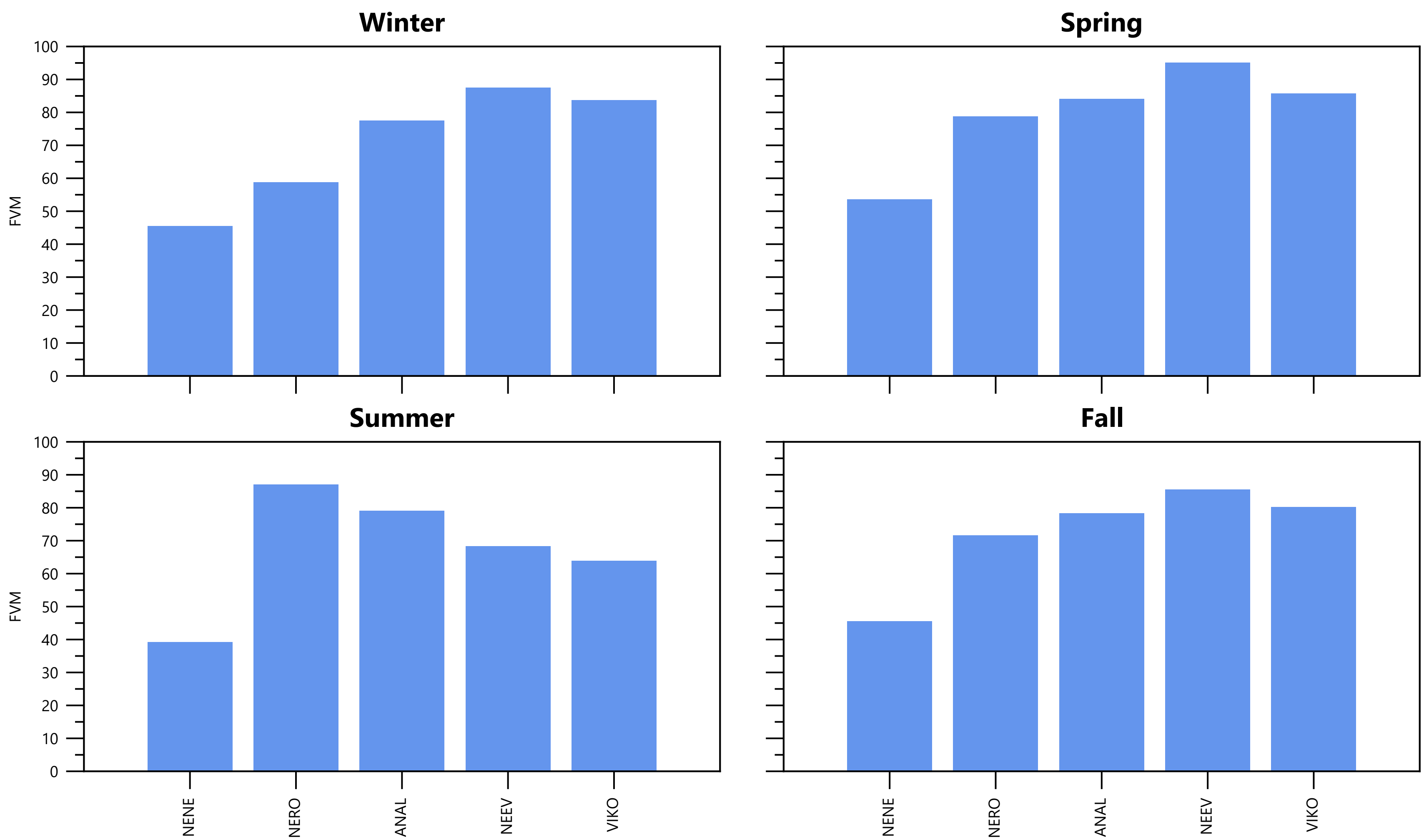
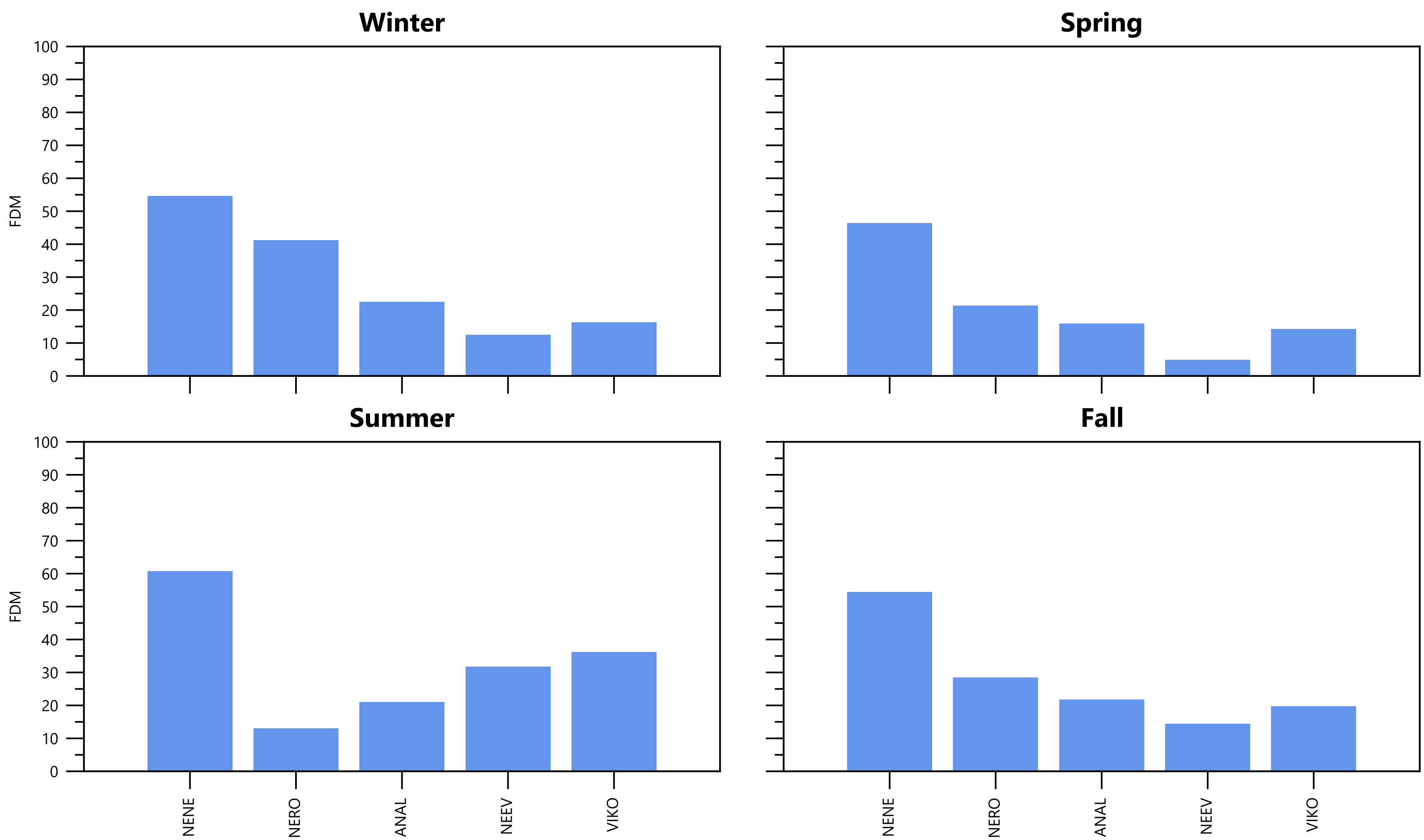
Figure I-178
Target Engagements Met (TEM) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The FVM metric plotted in the charts above is defined as the percentage of high flow pulses that meet volume criteria.



Note: The FDM metric plotted in the charts above is defined as the percentage of high flow pulses that meet duration criteria.

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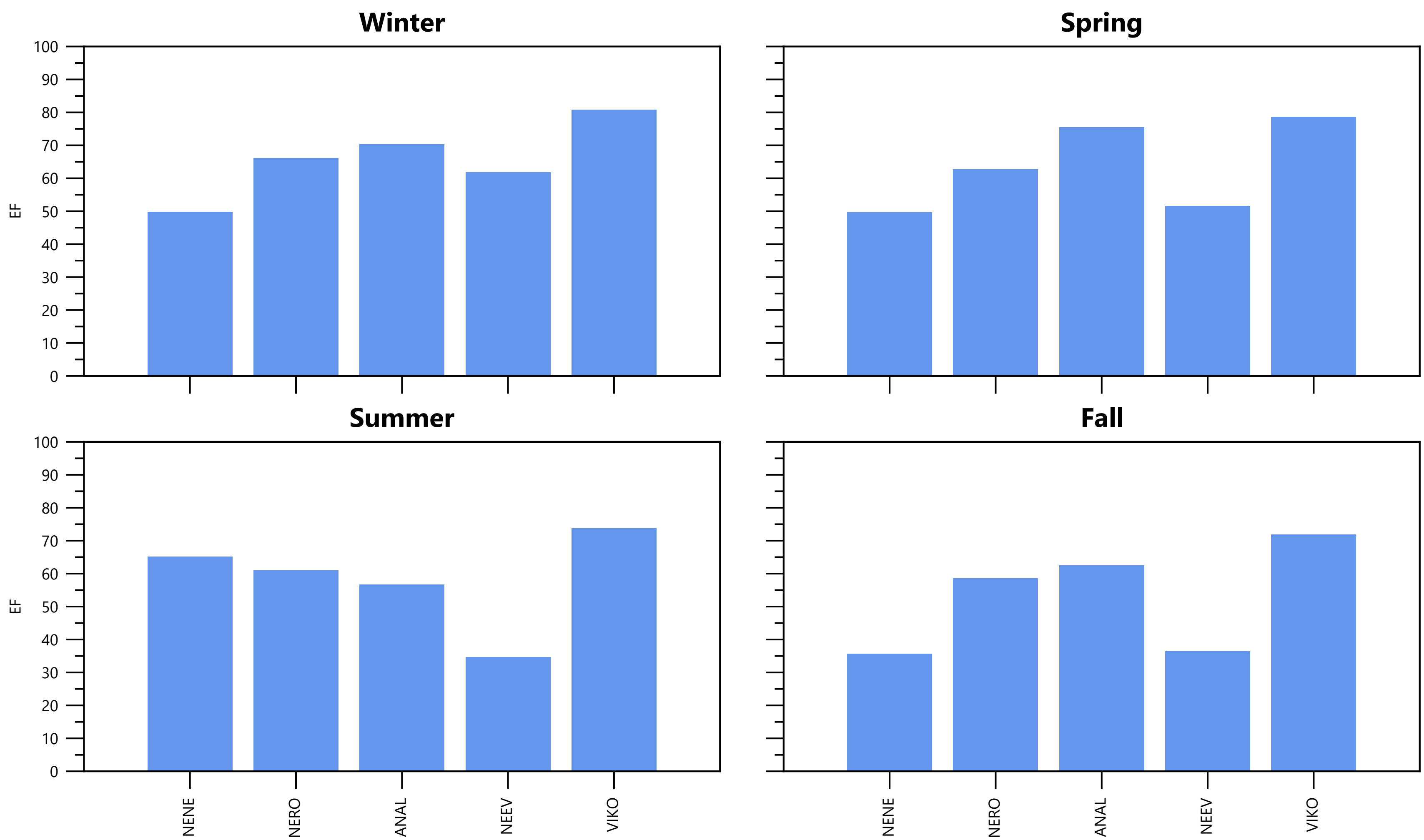
Figure I-180
Frequency Duration Met (FDM) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the base flow standard is engaged.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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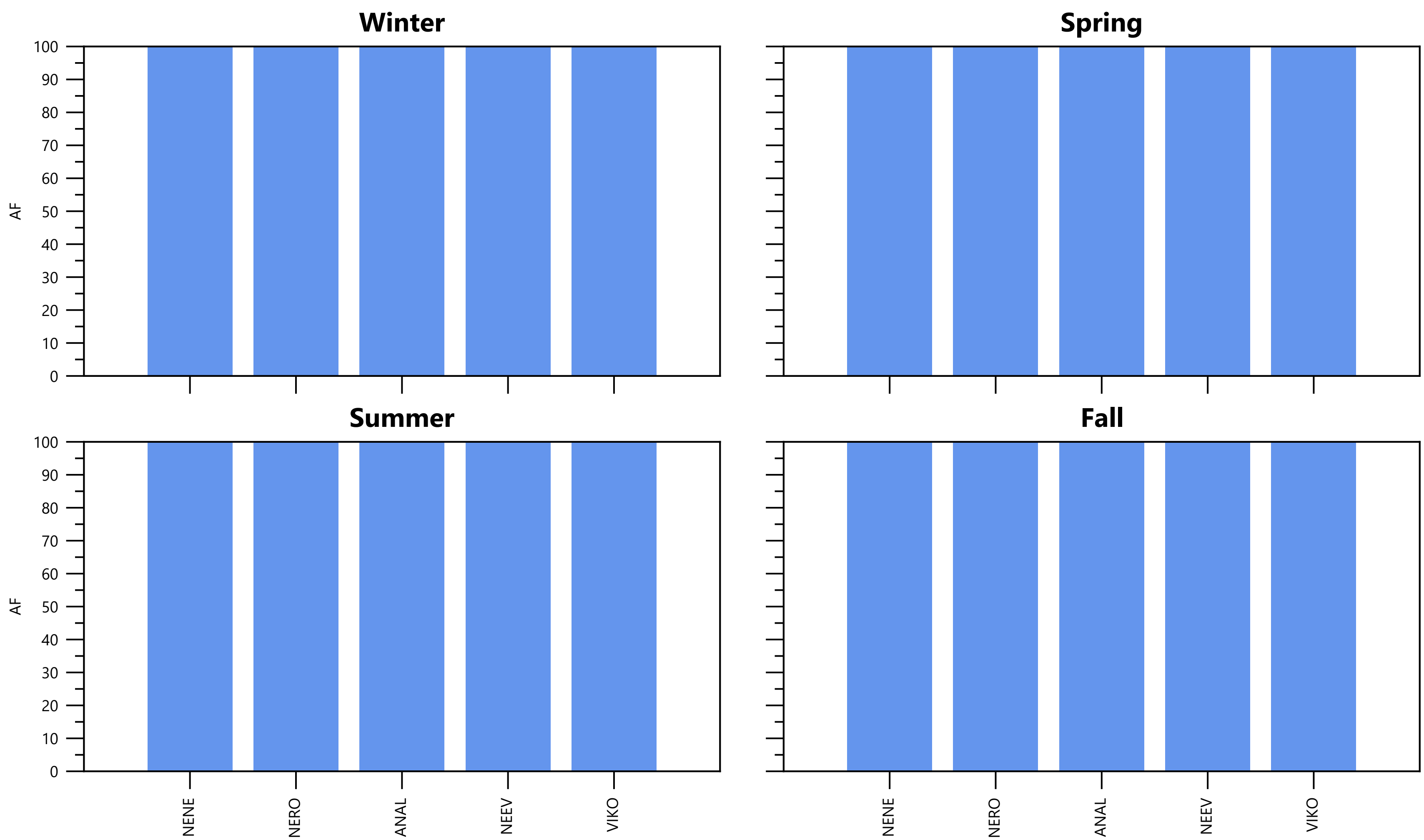
Figure I-181
Base Flow Engagement Frequency (EF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AF metric plotted in the charts above is defined as the percentage of days that the base flow standard is met, relative to the number of days that it is engaged.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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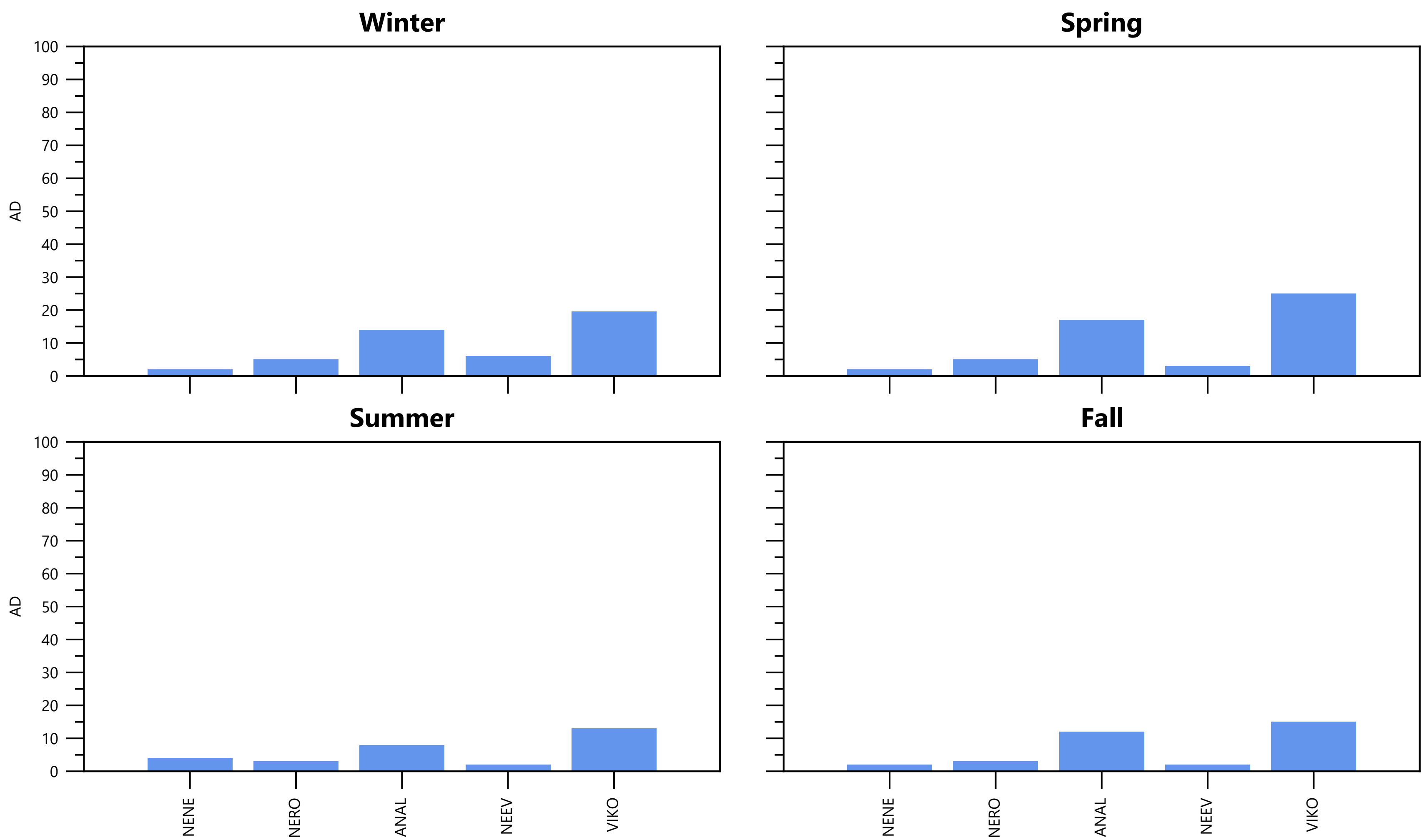
Figure I-182
Base Flow Attainment Frequency (AF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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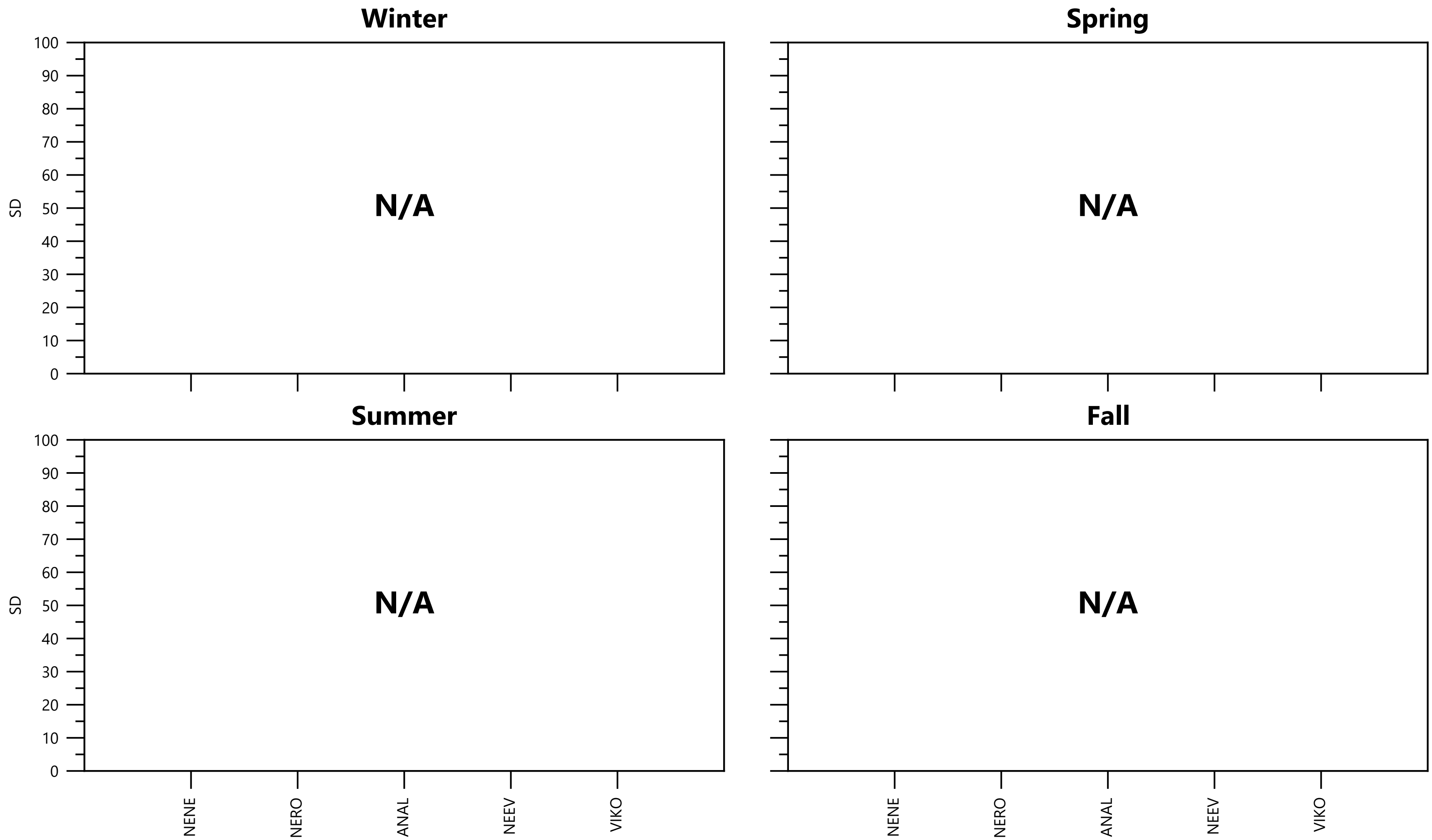
Figure I-183
Base Flow Attainment Duration (AD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the base flow standard is engaged and not met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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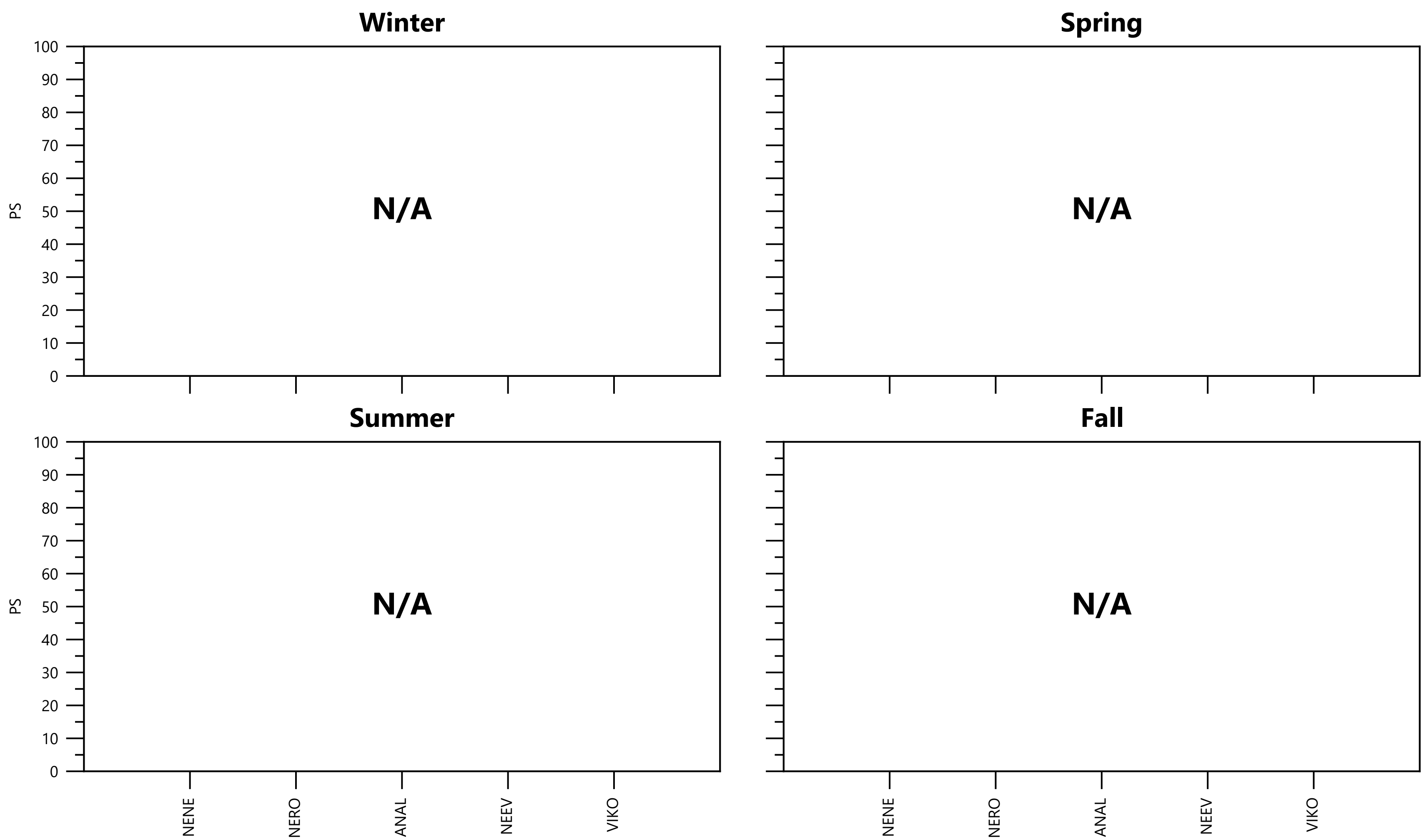
Figure I-184
Base Flow Shortage Duration (SD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the base flow standard is engaged and not met, expressed as a percentage.

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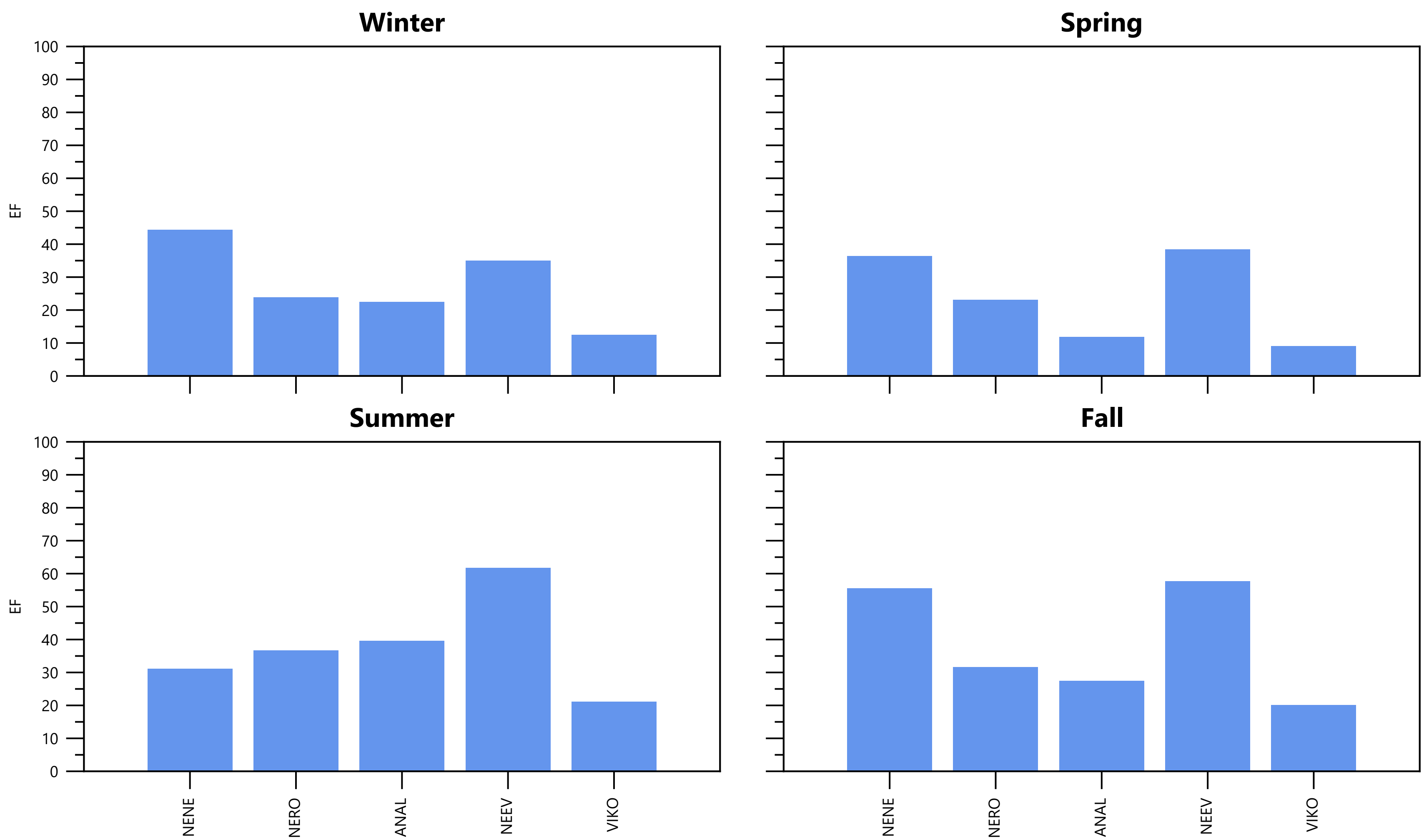
Figure I-185

Base Flow Percent Shortage (PS) by Season: Full Utilization Scenario

Column Plot Matrices of Attainment Metrics for the Neches River Basin

Evaluating the Attainment of Environmental Flow Standards



Note: The EF metric plotted in the charts above is defined as the percentage of time that the subsistence flow standard is engaged.

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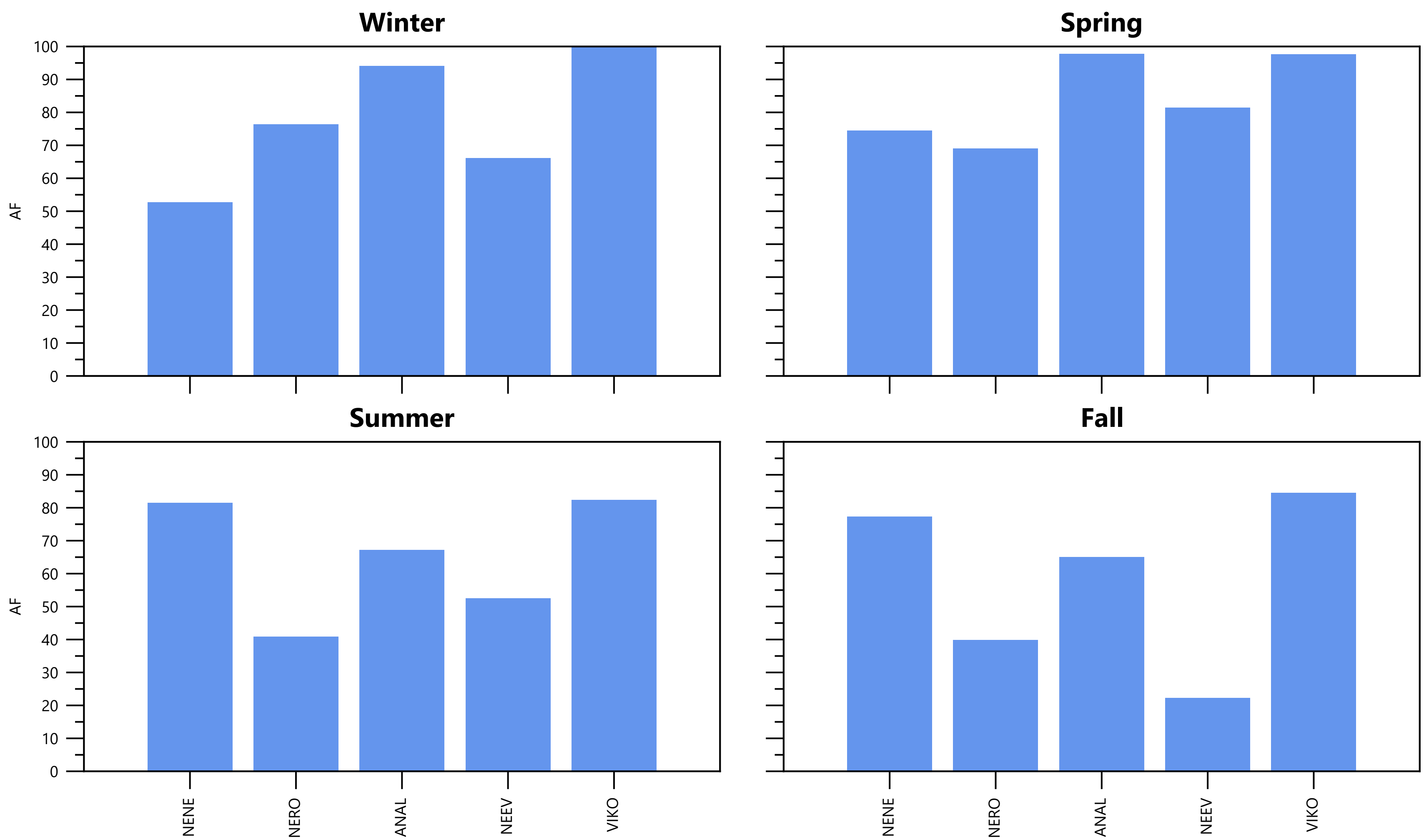
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py



Note: The AF metric plotted in the charts above is defined as the percentage of days that the subsistence flow standard is met, relative to the number of days that it is engaged.

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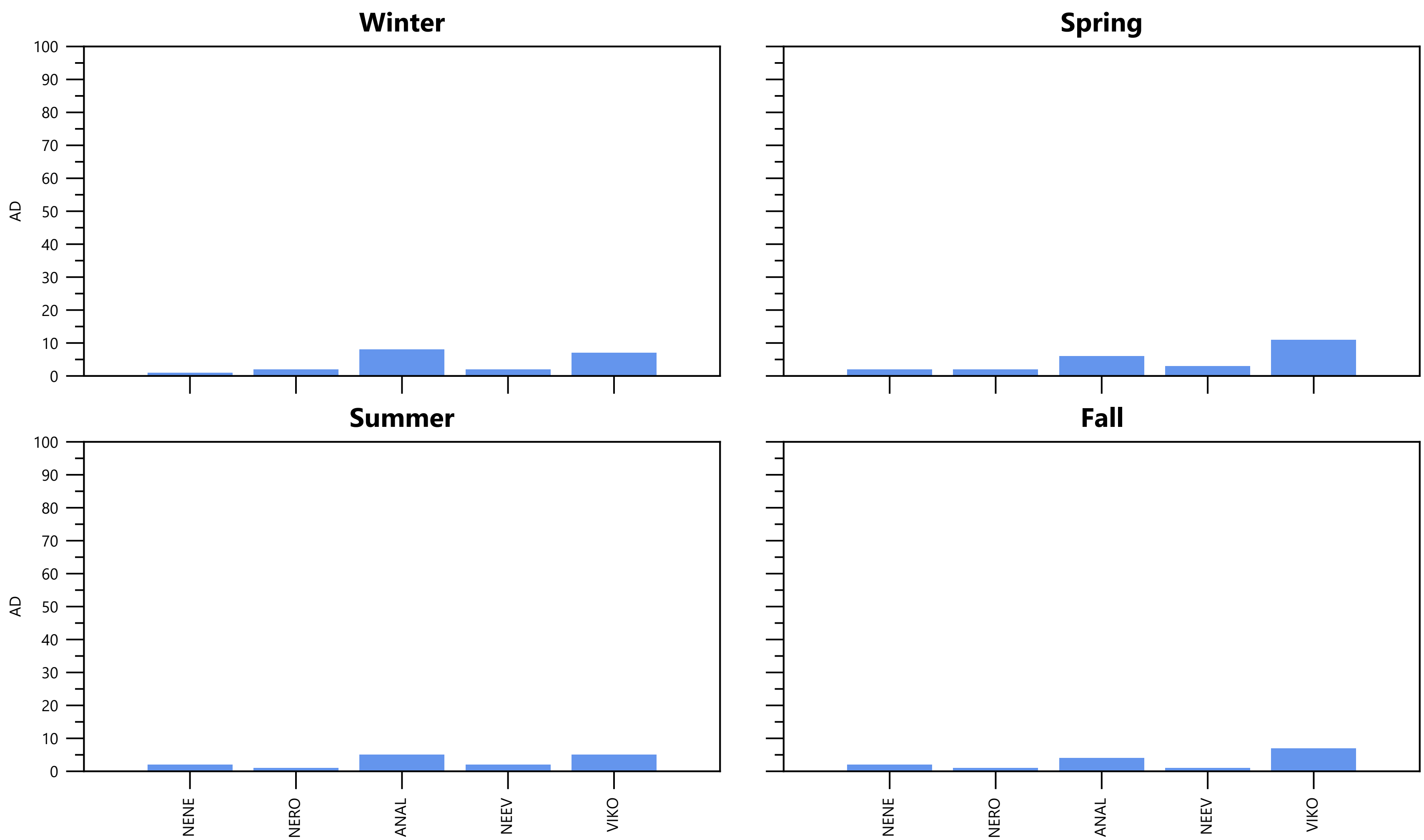
Figure I-187
Subsistence Flow Attainment Frequency (AF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The AD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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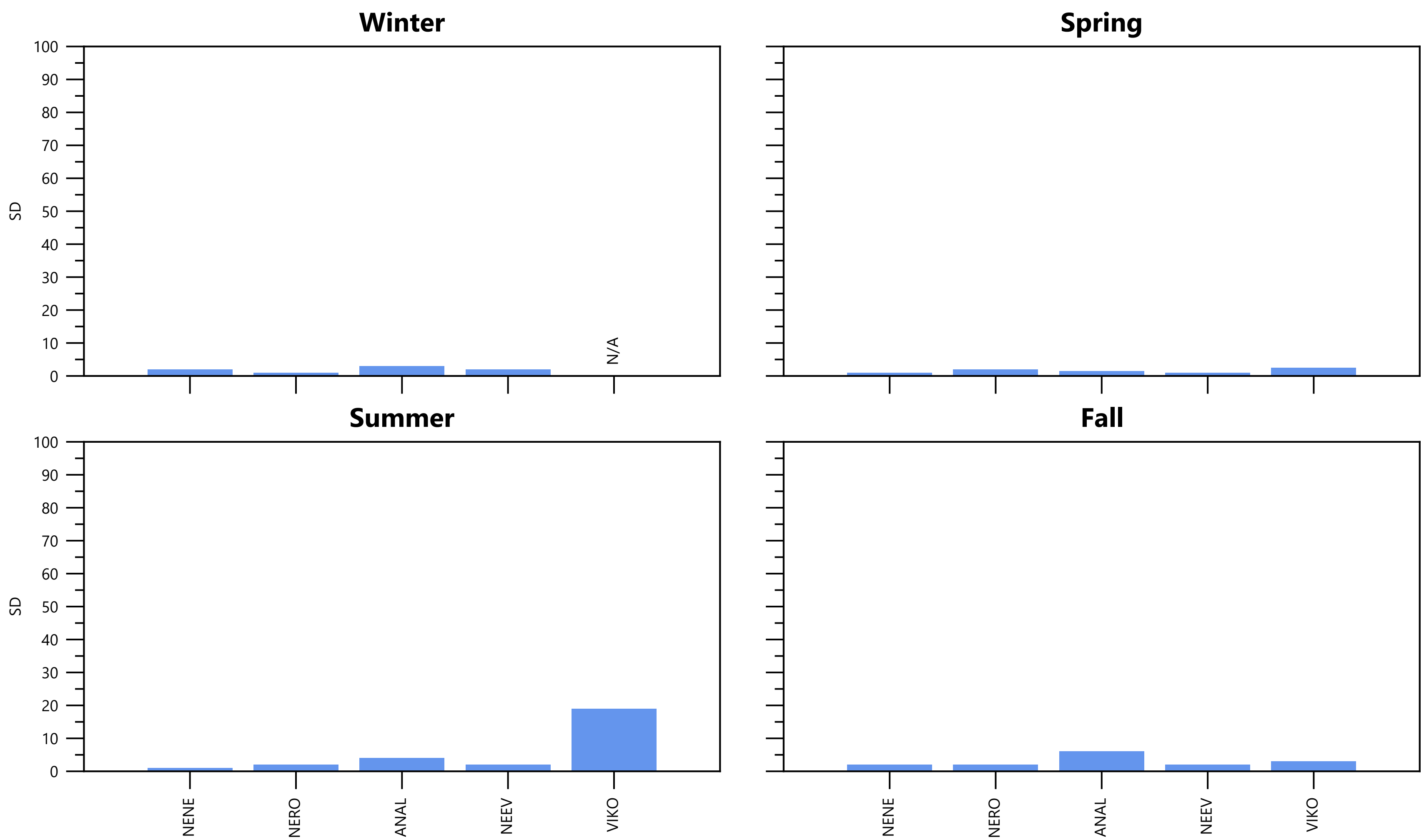
Figure I-188
Subsistence Flow Attainment Duration (AD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The SD metric plotted in the charts above is defined as the median consecutive days that the subsistence flow standard is engaged and not met.

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File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

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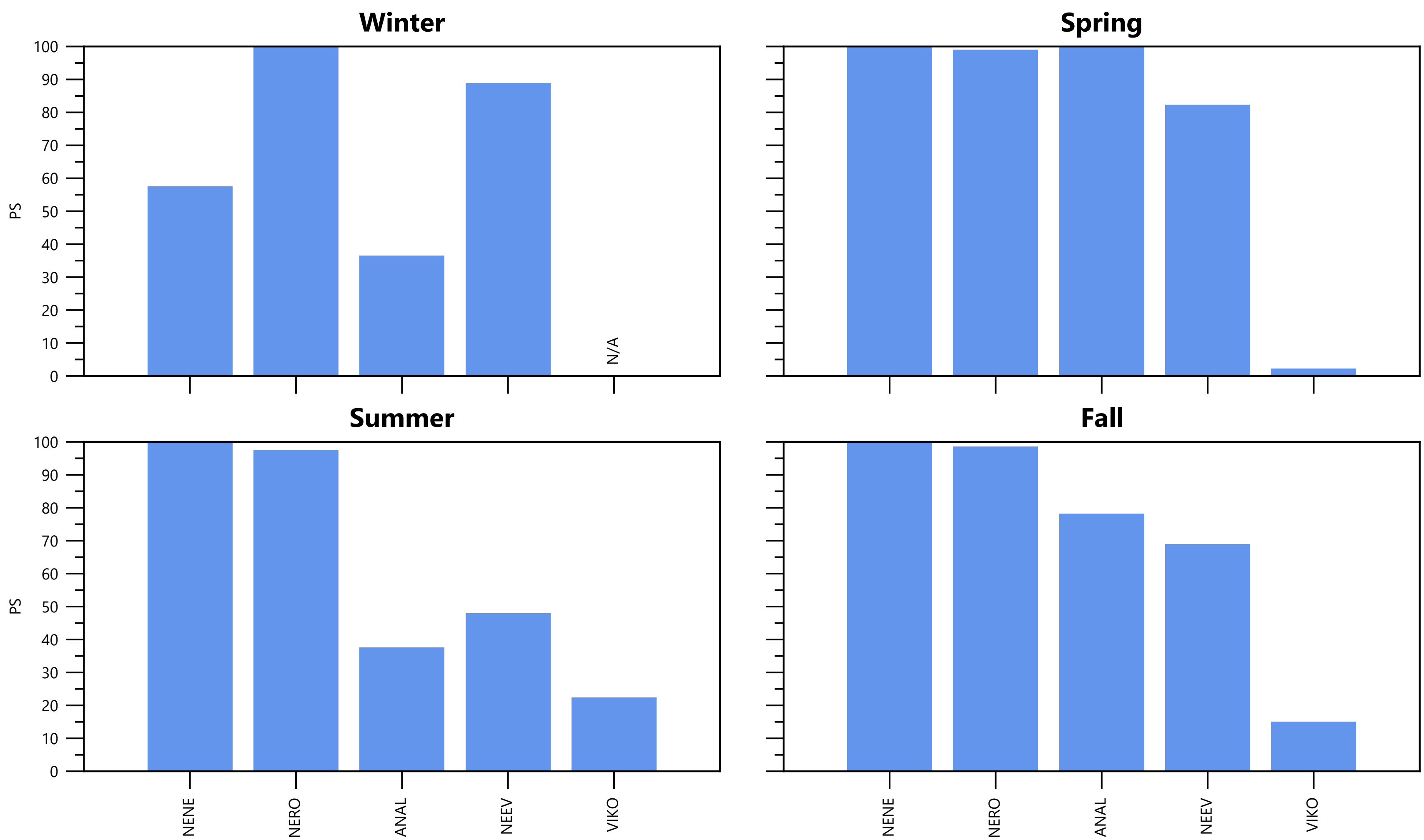
Figure I-189
Subsistence Flow Shortage Duration (SD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The PS metric plotted in the charts above is defined as the median instream flow shortage for days in which the subsistence flow standard is engaged and not met, expressed as a percentage.

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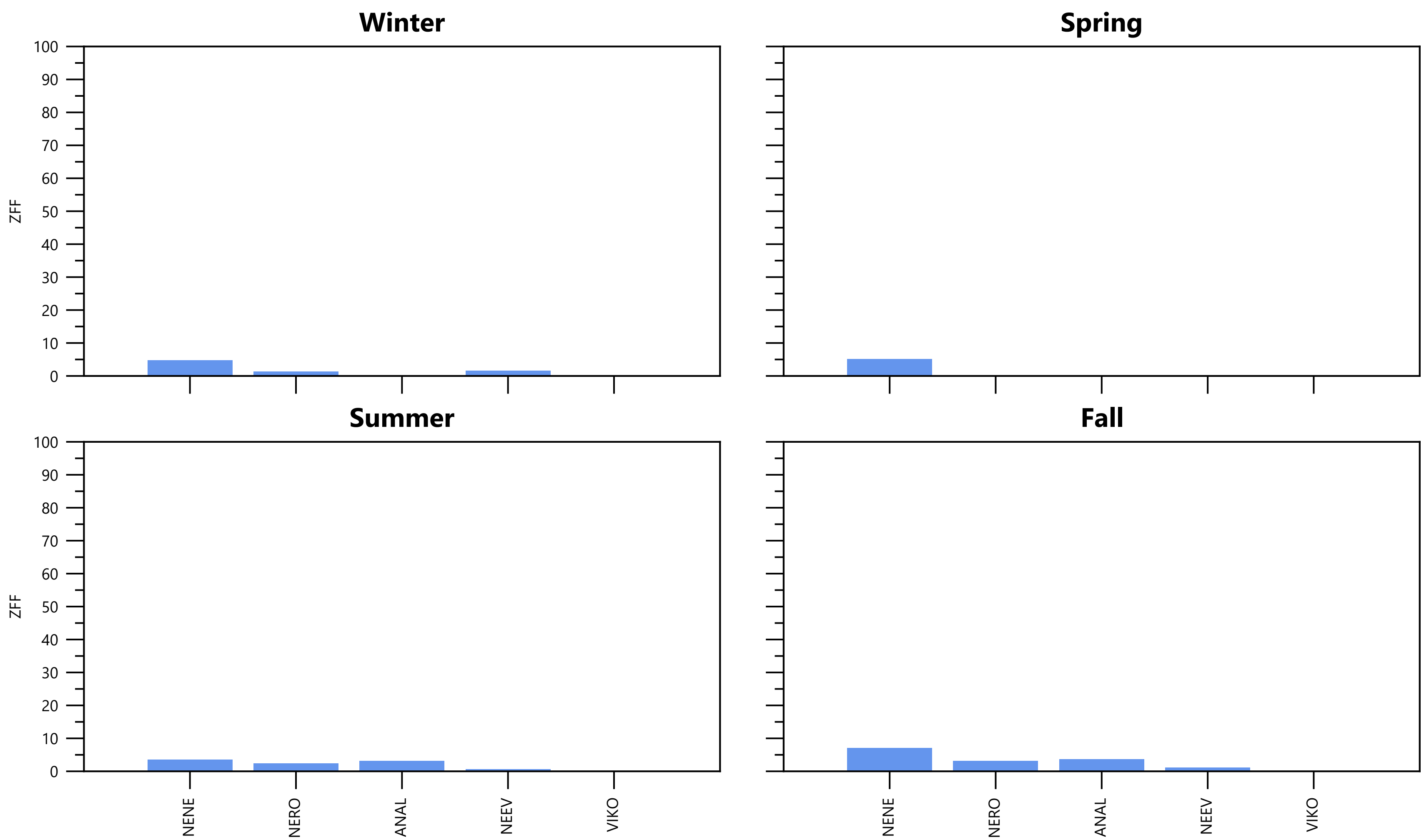
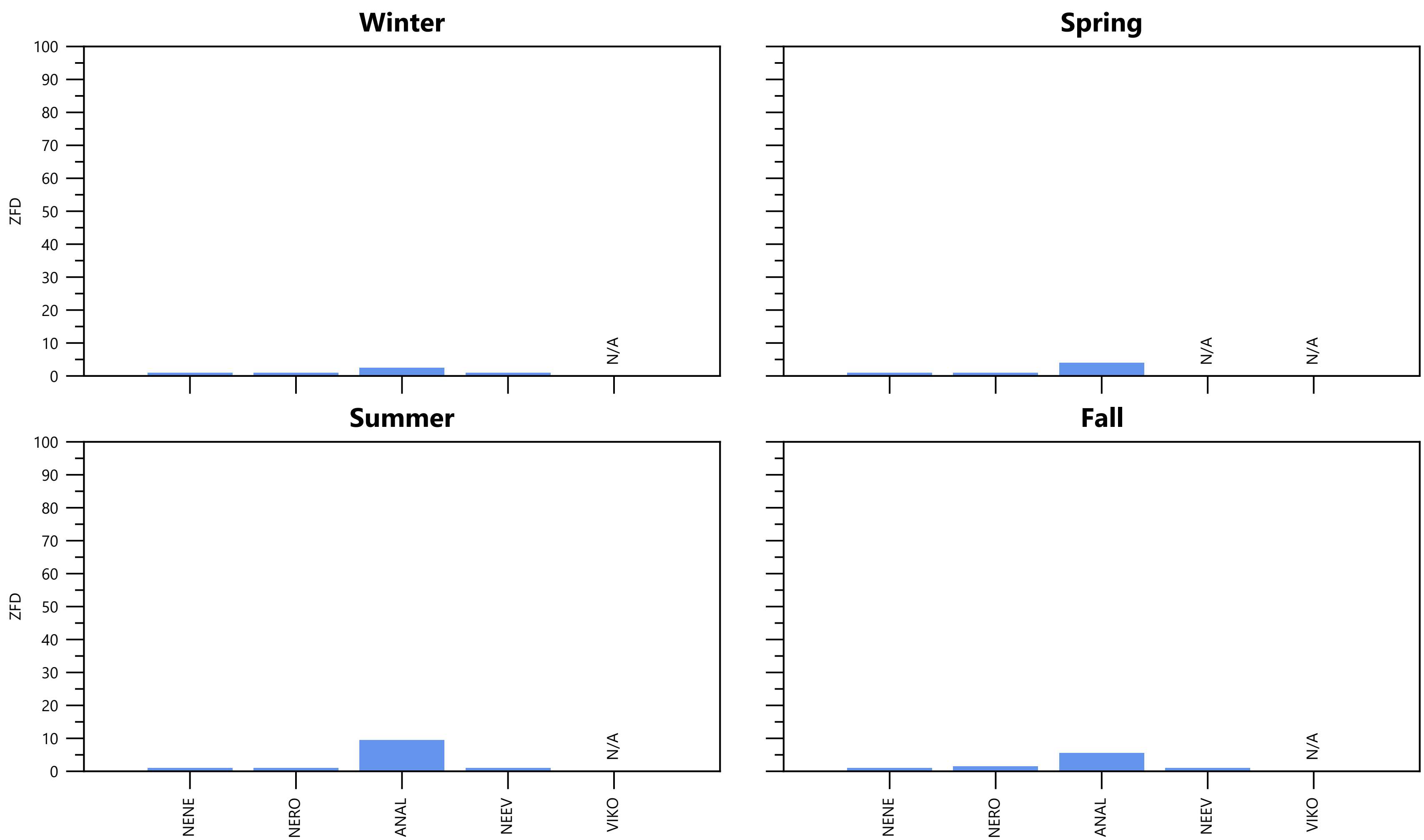
File Path: C:\Users\jhoffmann\OneDrive - ANCHOR QEA\Documents\TWDB Eflows Attain\Processing\plot_column_plot_matrices.py

Figure I-190
Subsistence Flow Percent Shortage (PS) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFF metric plotted in the charts above is defined as the percentage of zero-flow days (≤ 0.1 cubic feet per second).

Figure I-191
Zero-Flow Frequencies (ZFF) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards



Note: The ZFD metric plotted in the charts above is defined as the median consecutive days of zero flow (≤ 0.1 cubic feet per second).

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Figure I-192
Zero-Flow Durations (ZFD) by Season: Full Utilization Scenario
Column Plot Matrices of Attainment Metrics for the Neches River Basin
Evaluating the Attainment of Environmental Flow Standards

Appendix J
Freshwater Inflow Metrics

Introduction

This appendix to the report titled *Evaluating the Attainment of Environmental Flow Standards* (hereafter referred to as the main report) contains summary tables and figures of freshwater inflow metrics for the Trinity River at Galveston Bay, as described in Section 2.5.3.2 of the main report.

This appendix contains two distinct tables and five distinct figures, which are arranged as follows:

- Summary Tables
  - Table J-1: Frequency of attainment of each seasonal flow volume and the annual flow volume, compared to the target attainment frequency of each
  - Table J-2: Durations (i.e., number of consecutive seasons) of flows less than the lowest inflow targets, presented as the median value for each flow scenario, with the minimum and maximum value provided in parentheses
- Figures
  - Figures J-1 through J-4: Exceedance frequency plots of modeled annual and seasonal freshwater inflow volumes for the Trinity River at Galveston Bay; each figure contains four curves—one for each of the modeled flow scenarios—along with the inflow targets and associated frequencies
  - Figure J-5: Exceedance frequency plot of durations (i.e., number of consecutive seasons) of flows less than the lowest inflow targets

For the Trinity River freshwater inflow standards, the fall season does not have an inflow target. For the evaluations in this appendix, the fall season is simply ignored in the calculation of consecutive seasons with a shortage. For example, if a summer inflow is lower than the lowest summer inflow target, and the subsequent winter lowest inflow is lower than the lowest winter inflow target, that is counted as two consecutive seasons below the lowest inflow target.

J-1. Freshwater Inflow Metrics for the Trinity River Basin

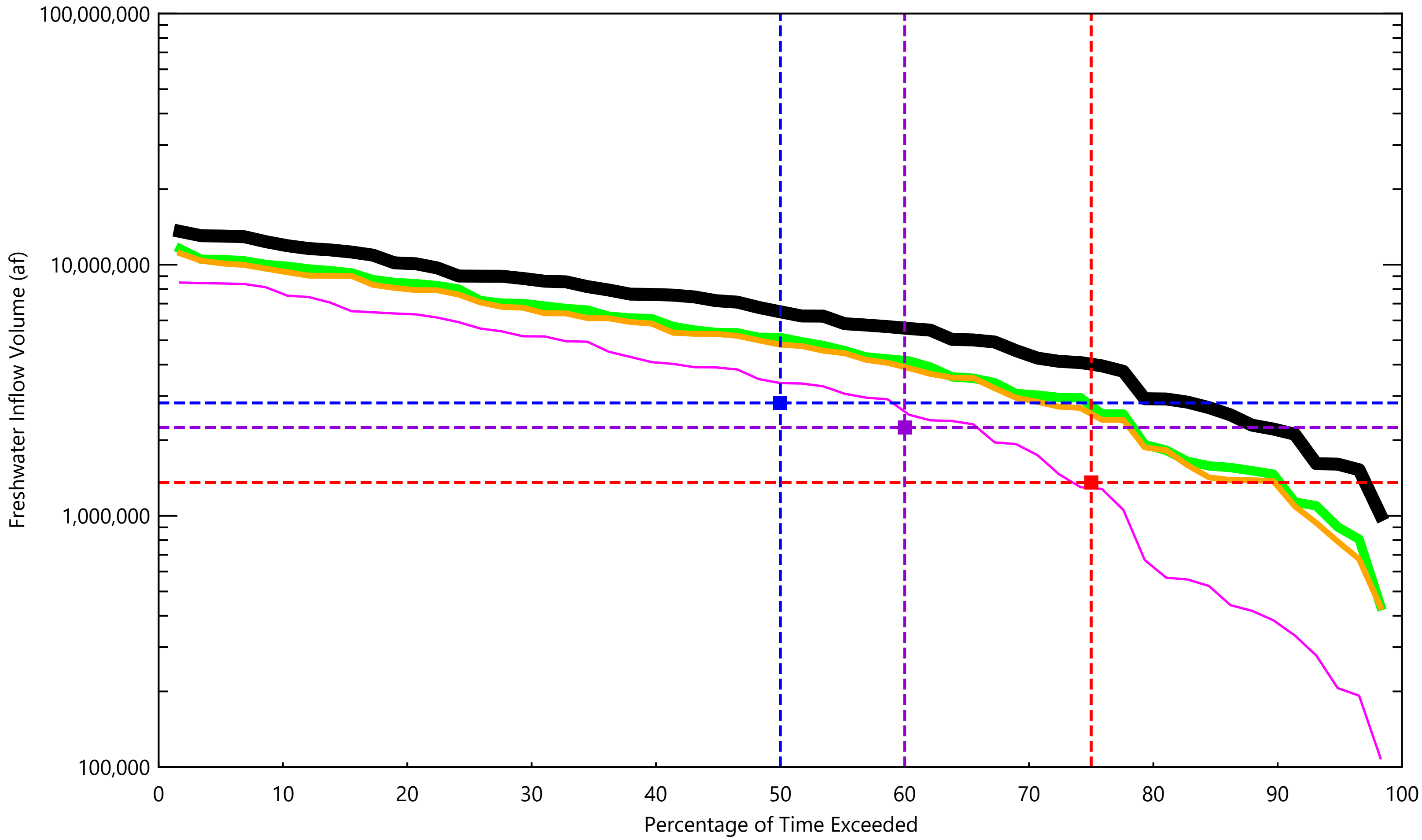
Table J-1
Annual and Seasonal Inflow Standards for the Trinity River Basin
Frequency of Attainment: Trinity River at Galveston Bay

Period	Inflow Quantity (af)	Target Frequency	Frequency of Attainment			
			Naturalized Flow Scenario	Current Water Use Scenario	Partial Utilization Scenario	Full Utilization Scenario
Annual	2,816,532	50%	83%	75%	71%	59%
	2,245,644	60%	89%	78%	78%	66%
	1,357,133	75%	97%	90%	90%	74%
Winter	500,000	40%	82%	73%	75%	52%
	250,000	50%	91%	85%	84%	68%
	160,000	60%	96%	86%	87%	72%
Spring	1,300,000	40%	71%	64%	63%	54%
	750,000	50%	88%	77%	76%	64%
	500,000	60%	94%	87%	85%	72%
Summer	245,000	40%	86%	65%	62%	51%
	180,000	50%	91%	76%	65%	55%
	75,000	60%	98%	97%	78%	69%

Notes: af: acre-feet; red shading denotes instances in which the target frequency is not attained

Table J-2
Seasonal Freshwater Inflow Standards for the Trinity River Basin
Duration of Flows Less Than the Lowest Inflow Targets: Trinity River at Galveston Bay

WAM Scenario	Consecutive Seasons of Flows Less Than the Lowest Inflow Targets
Naturalized Flow Scenario	1 (1, 2)
Current Water Use Scenario	1 (1, 4)
Partial Utilization Scenario	2 (1, 5)
Full Utilization Scenario	2 (1, 6)



Notes: af: acre-feet; vertical dashed lines represent 50th, 60th, 75th percentiles; square symbol denotes the intersection of a freshwater inflow target it its associated target frequency

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
50% Target Frequency (2,816,532 af)
60% Target Frequency (2,245,644 af)
75% Target Frequency (1,357,133 af)

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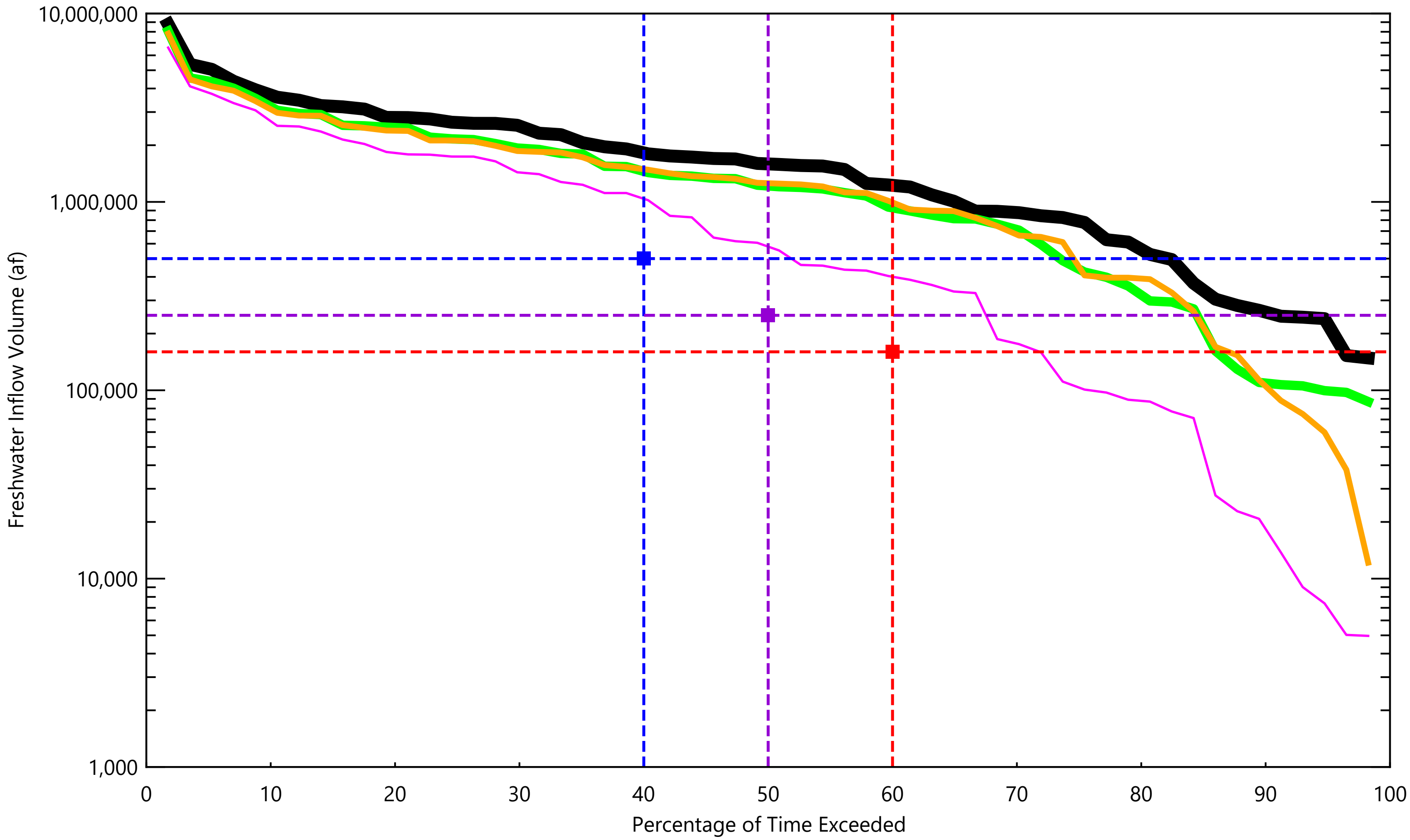
ANCHOR QEA

Figure J-1
Trinity River at Galveston Bay: Annual Inflow Volumes
Freshwater Inflow Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: af: acre-feet; vertical dashed lines represent 40th, 50th, 60th percentiles; square symbol denotes the intersection of a freshwater inflow target it its associated target frequency

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- 40% Target Frequency (500,000 af)
- 50% Target Frequency (250,000 af)
- 60% Target Frequency (160,000 af)

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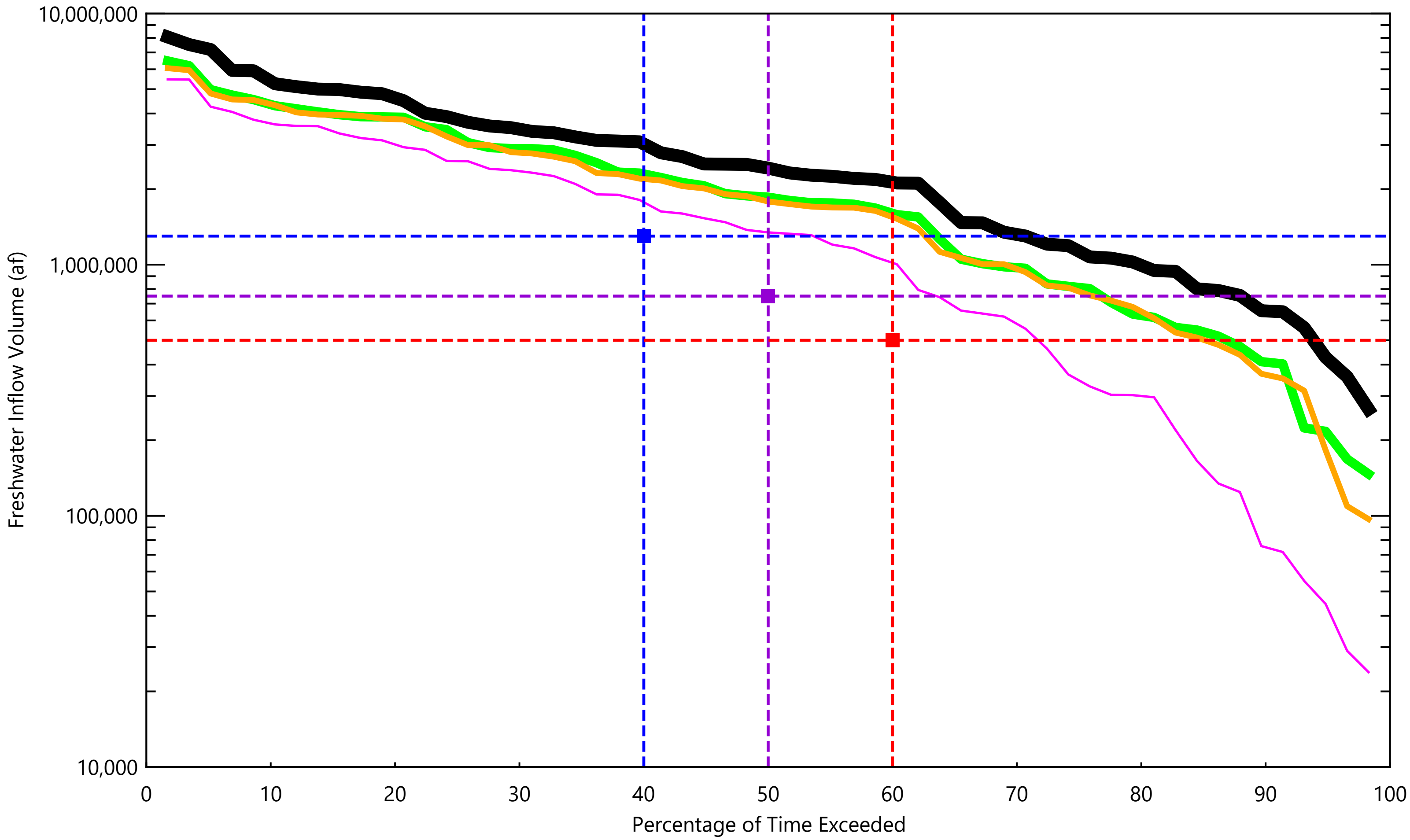
ANCHOR QEA

Figure J-2
Trinity River at Galveston Bay: Winter Inflow Volumes
Freshwater Inflow Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: af: acre-feet; vertical dashed lines represent 40th, 50th, 60th percentiles; square symbol denotes the intersection of a freshwater inflow target it its associated target frequency

Naturalized Flow Scenario
Current Water Use Scenario
Partial Utilization Scenario
Full Utilization Scenario
40% Target Frequency (1,300,000 af)
50% Target Frequency (750,000 af)
60% Target Frequency (500,000 af)

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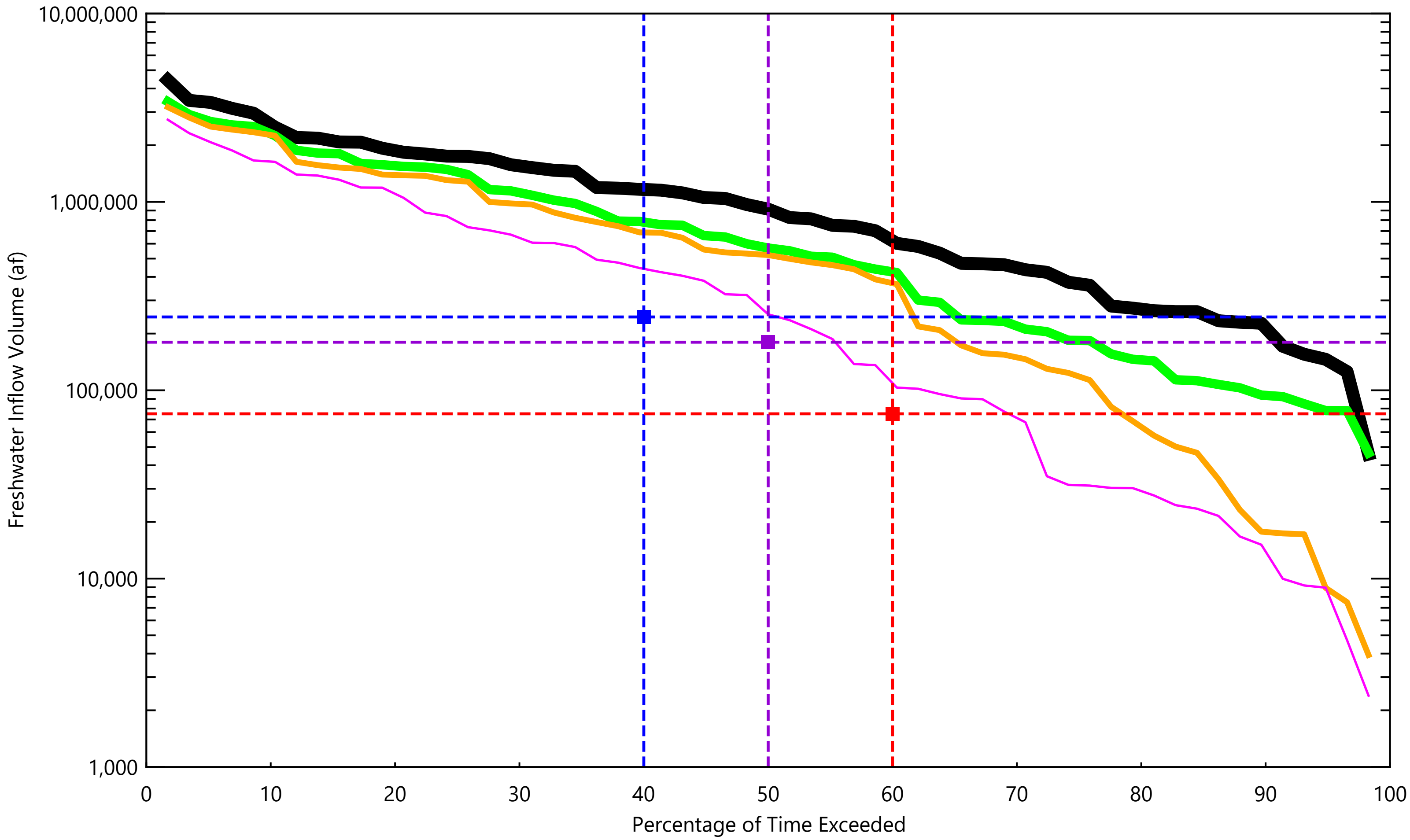
Figure J-3
Trinity River at Galveston Bay: Spring Inflow Volumes
Freshwater Inflow Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: af: acre-feet; vertical dashed lines represent 40th, 50th, 60th percentiles; square symbol denotes the intersection of a freshwater inflow target it its associated target frequency

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario
- 40% Target Frequency (245,000 af)
- 50% Target Frequency (180,000 af)
- 60% Target Frequency (75,000 af)

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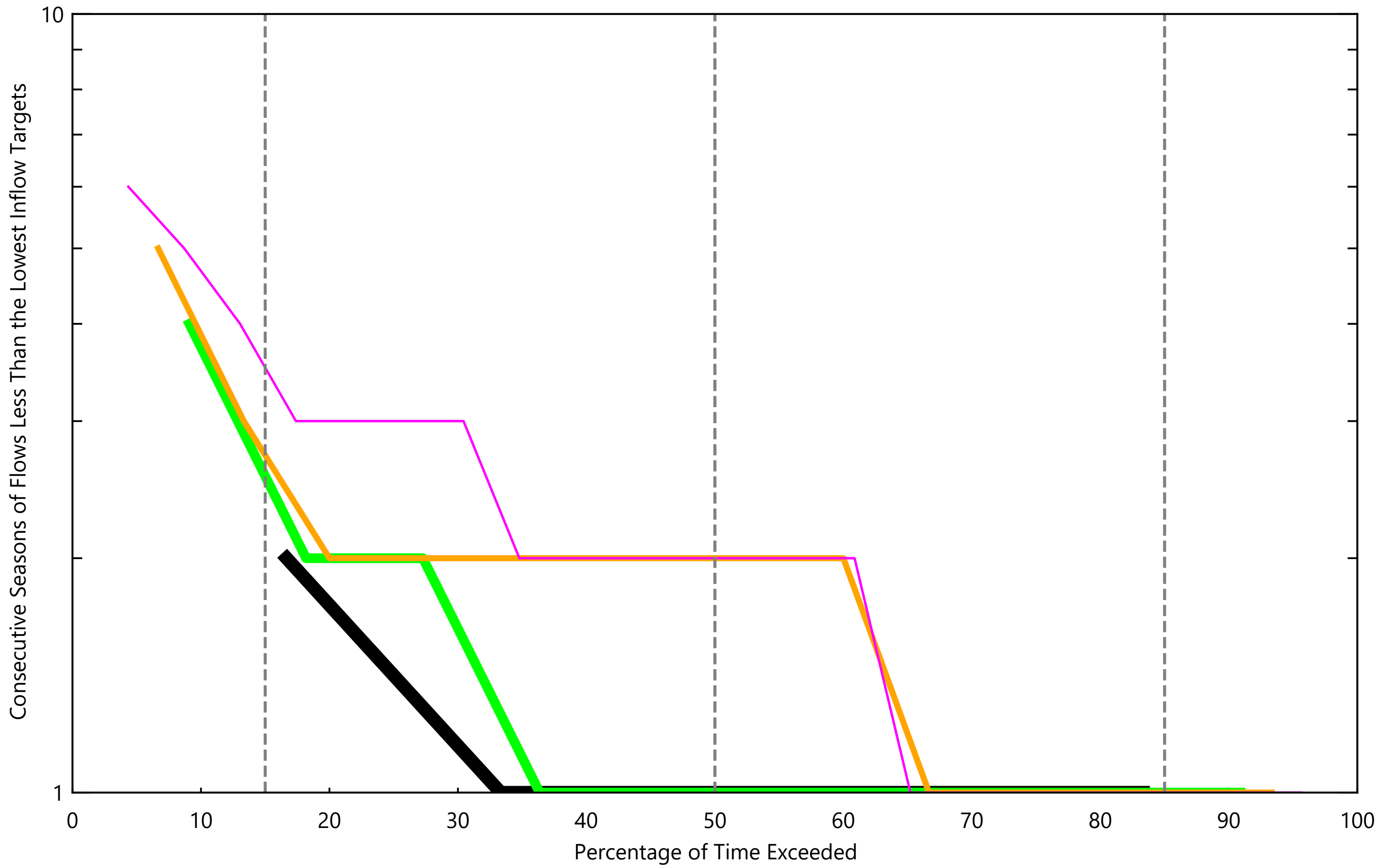
ANCHOR QEA

Figure J-4
Trinity River at Galveston Bay: Summer Inflow Volumes
Freshwater Inflow Metrics for the Trinity River Basin
Evaluating the Attainment of Environmental Flow Standards



Notes: For periods of inflow below the lowest inflow target, this graph illustrates the frequency distribution of consecutive seasons of inflow below the lowest inflow target; vertical dashed lines represent 15th, 50th, and 85th percentiles

- Naturalized Flow Scenario
- Current Water Use Scenario
- Partial Utilization Scenario
- Full Utilization Scenario

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ANCHOR QEA

Figure J-5

Trinity River at Galveston Bay: Durations of Seasonal Flows Less Than the Lowest Inflow Targets

Freshwater Inflow Metrics for the Trinity River Basin

Evaluating the Attainment of Environmental Flow Standards

Appendix K

Draft Report Comments and Responses

901 S. Mopac Expressway, Barton Oaks Plaza V, Suite 150
Austin, Texas 78746
512.306.9221

ANCHOR QEA

Memorandum

August 31, 2021

To: Mark Wentzel, Texas Water Development Board

From: Dan Opdyke and Josef Hoffmann, Anchor QEA, LLC; Richard Hoffpauir, Hoffpauir Consulting

Re: Draft Report Comments and Responses

Introduction

This document includes the following:

- Texas Water Development Board comments on the draft final report entitled *Evaluating the Attainment of Environmental Flow Standards*
- Study team responses

Required Changes

General Draft Final Report Comments

This project made use of recently developed daily Water Availability Models (WAM) to evaluate metrics to assess the attainment of the different elements of the environmental flow standards for three river basins (Brazos, Trinity, and Neches) under four different hydrologic scenarios (naturalized, current water use, partial utilization of water rights, and full utilization of water rights). Overall, the report does an excellent job of documenting the activities and results of the project. Activities related to this project included a literature search of available metrics for evaluating attainment of environmental flow standards; selection of attainment metrics; development of hydrologic scenarios, daily flow models, and model output; application of metrics to model output; analysis of results; and recommendations for future work.

Study Team Response

Noted.

Specific Draft Final Report Comments

1. Title Page. Please update the first sentence of the paragraph on the lower half of the title page: "AS APPROVED BY THE 84TH TEXAS LEGISLATURE" should be "AS APPROVED BY THE 86TH TEXAS LEGISLATURE."

Study Team Response

Change made.

Suggested Changes

Specific Draft Final Report Comments

2. Section 3 and Appendix A do a good job of describing the sources used to develop the daily WAM models for this project. Although it may seem obvious, please consider noting that because the daily WAMs developed for this project rely on specific source models (both daily and monthly WAMs), they incorporate many of the same assumptions and simplifications included in those source models. It may be worth noting that the emphasis of this project was not on improving the performance of a particular WAM model.

Study Team Response

Explanatory text added to Appendix A.

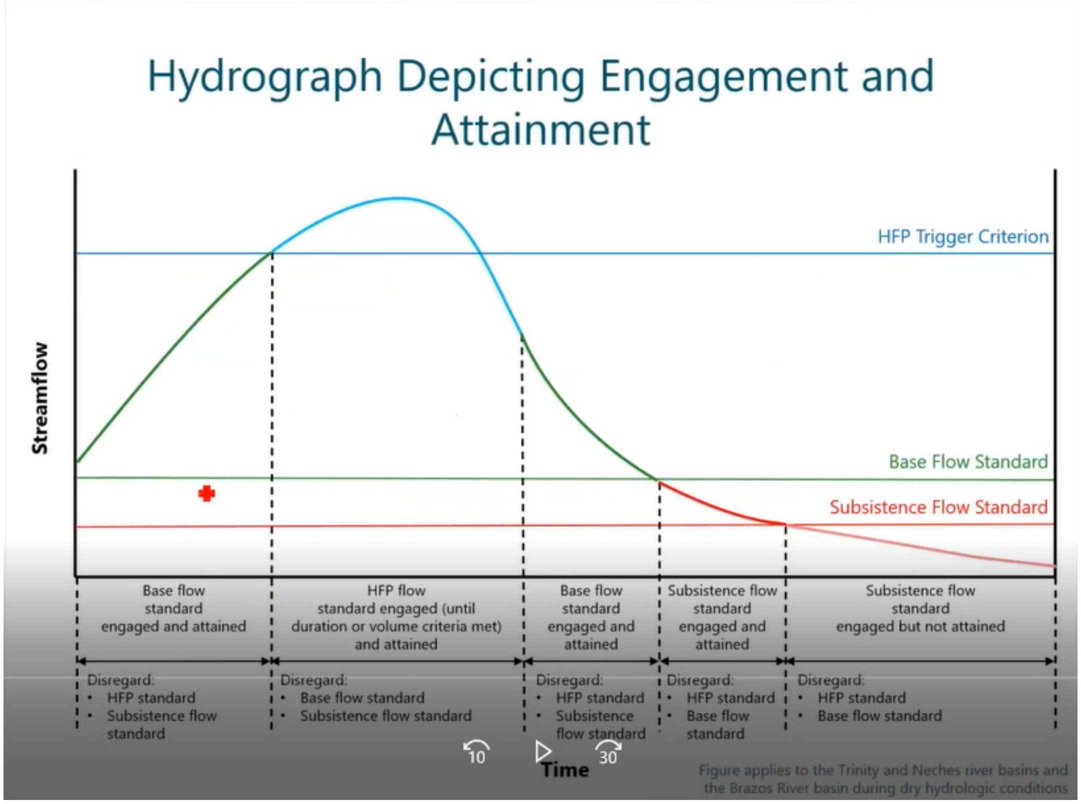
3. Page 83, Section 8.5.6, 1st paragraph, last sentence: The authors refer to Section 2.3.4 of Hardy and others (2021). Because Hardy and others (2021) is a draft report, the section referred to may be omitted or modified in the final version of that report. Please consider not referencing a draft version of a report.

Study Team Response

Sentence, citation, and reference removed.

Figures and Tables Comments

4. "Engagement" and "attainment" of environmental flow standards (introduced in Section 2, page 10, and used throughout the report) are somewhat difficult concepts to grasp. A figure in the report may be helpful for explaining these concepts. Many stakeholders appreciated the figure below, which was presented at the project webinar. Please consider adding this figure (or a similar one) to the body (or an appendix) of the final report.



Study Team Response

Figure and associated text added to Appendix B.