

Environmental Flows Recommendation Report

The Colorado and Lavaca Basin
and Bay Area Stakeholder
Committee

August 2011

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Patrick Brzozowski	August 2011
Chair	The Honorable Troy Fraser, Co-presiding Officer Environmental Flows Advisory Group
Myron Hess	
Vice Chair	The Honorable Allan Ritter, Co-presiding Officer Environmental Flows Advisory Group
Members	Mark R. Vickery, P.G., Executive Director Texas Commission on Environmental Quality
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James Dailey	Dear Senator Fraser, Representative Ritter and Mr. Vickery,
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Carroll Hall	
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Suzanne Zarling	
	For your consideration, the Colorado and Lavaca Rivers Basin and Bay Area Stakeholder Committee (CL-BBASC) hereby submits its final report pursuant to its charge under Senate Bill 3 (80th R, 2007). This charge directed the BBASC to review the Colorado and Lavaca Bay and Basin Expert Science Team (CL-BBEST) recommendation for environmental flows and to weigh the environmental need for water with the need for water for other purposes, including human needs, and to make recommendations on "environmental flow standards" and strategies for the Bay-Basin complex.
	Water evolving in these two river basins satisfies the thirst of Texans and flora and fauna alike from the Texas Hill Country to the coastal plains and prairie of the Gulf of Mexico, ultimately feeding one of the most prolific and profitable bay and estuary systems along the entire Gulf Coast.
	This being said, it is my pleasure to inform you that the BBASC recommendations included in this report are consensus recommendations. This report reflects significant efforts of all BBASC members to seek solutions that addressed their highest concerns, while also finding ways to understand and address the important concerns of the other members, in the true spirit of consensus. It is our expectation that as we now transition to the rules making process, the consensus decisions reported herein are carried forward.
	Respectfully submitted,
	Patrick Brzozowski, P.E. Chair

ACKNOWLEDGMENTS

The Stakeholder Committee wishes to acknowledge the contributions of many people and organizations that made the successful completion of the Committee's task possible. First, and foremost, we want to recognize the dedication and commitment of our fellow Committee members and alternates. The full Committee met on twenty days, with much additional time spent in conference calls and subcommittee meetings, in preparing our recommendations and this report. Many of those members not only contributed their time and energy, but took uncompensated time away from earning their living, to complete this assigned task. In addition, many members absorbed travel costs out of their own pockets.

The Committee is especially grateful to the members of the Bay and Basin Expert Science Team (BBEST) for their diligent efforts in developing and presenting a set of comprehensive recommendations achieved by consensus. In particular, we express our thanks to Dave Buzan, the chair of the BBEST, for his efforts in overseeing the BBEST and in providing unstinting support to the Stakeholder Committee during our learning process and throughout our deliberations in developing these recommendations. We also gratefully acknowledge the great support provided by BBEST members, Bryan Cook, vice-chair, and Kirk Kennedy, throughout this process.

The Committee thanks the staff members of the Texas Commission on Environmental Quality, especially Gregg Easley; the Texas Parks and Wildlife Department; and the Texas Water Development Board for their significant assistance to the Committee.

We owe much of our success to the support of our professional facilitators, Suzanne Schwartz and Margaret Menicucci, with the Center for Public Policy Dispute Resolution at the University of Texas School of Law. Their guidance, advice, and encouragement were instrumental in keeping us moving forward and bringing us to a successful conclusion. Recognizing that our Committee had no state funding available to it, they agreed to provide their services at a significantly reduced rate to make it affordable given our severe budget constraints. On top of that, they then accommodated us as we continued to schedule additional meetings in order to accomplish our task.

Those facilitation services that were so important were available because of the generosity of individual members of the Stakeholder Committee or their sponsoring organizations in contributing funds in the amount of \$29,000 to pay for the facilitation services. Donations were provided by City of Austin; Environmental Stewardship; Formosa Plastics Environmental Endowment Fund Trust; Gertson Farms Partnership; Hickory Underground Water Conservation District No. 1; Lavaca-Navidad River Authority; Lower Colorado River Authority; Menard County Underground Water District; National Wildlife Federation; Rice Belt Warehouse, Inc.; STP Nuclear Operating Company; and Underground Services Markham.

The Stakeholder Committee also benefited greatly from the willingness of organizations to host our meetings. The Lower Colorado River Authority was particularly generous in hosting most of our meetings. The City of Austin, Lavaca-Navidad River Authority, STP Nuclear Operating Company, and National Wildlife Federation also hosted meetings. In addition, the Committee thanks representatives of the Lower Colorado River Authority, Texas Parks and Wildlife Department, the Natural Resources Conservation Service, the Texas State Marine Education Center, and the BBEST for their participation in and invaluable assistance with the Stakeholder Committee tours at Pedernales Falls State Park and in Tres Palacios Bay. These tours were also made possible by generous support from the Reese Foundation. The Lavaca-Navidad River Authority and STP Nuclear Operating Company also provided tours for interested Committee members in association with the meetings they hosted.

The Committee also thanks Patrick Brzozowski and Ronald Gertson for their service, at different times, as the Chair of the Stakeholder Committee. The Committee thanks Myron Hess, Vice Chair, for his adept and thoughtful leadership and participation throughout the process. The Committee benefited greatly from Myron's experiences, familiarity with water rights permitting and environmental flow standards processes, and ability to develop consensus approaches.

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1.0 Introduction

The Colorado is the longest river that begins and ends in Texas.

It is also one of the most managed rivers in America and that is the result of two great forces of nature: Texas weather and Lyndon B. Johnson. The Colorado's reaches in Central Texas are often called "Flash Flood Alley" because of the frequency of intense, often violent storms. Historically, and interspersed with extreme drought such as we are experiencing today, these great storms occur just about every decade including a big one in 1915 that killed 35 people along Waller Creek in Austin. According to the Austin Statesman: "Whole sections of the city were submerged for hours." "Houses were washed away, cows, horses, chickens and other fowl careened down the Shoal and Waller Creeks to join the human corpses that had gone swirling before them to the bosom of the Colorado." In the face of these recurring disasters and following two unsuccessful attempts to tame the river, six reservoirs known as the Highland Lakes were built in the Hill Country in the 1930's and 40's upstream of Austin to stem the floods and Lady Bird Lake in 1960 was the seventh and last.

The Highland Lakes also brought the promise of electric power to the Hill Country which, prior to World War II was one of the poorest regions of the United States. Once a lush savannah, overgrazing by cattle, sheep and goats in less than a century had eroded its soil, destroyed its productivity and exhausted its economy and from its bleak prospects and demoralized citizens arose one of the Nation's most effective politicians, Lyndon Baines Johnson. Johnson graduated in 1930 from Southwest Texas State Teachers' College, now Texas State University. After teaching for a while in South Texas, the young politician joined the New Deal and walked door to door in the Hill Country talking often destitute people into signing up for electric power produced by the Lower Colorado River Authority which was modeled after the Tennessee Valley Authority on another of America's great rivers. Today, the Lower Colorado River Authority is still permeated with the culture of President Johnson and his era and of the seven lakes in the chain, two are named for him and his bride.

Long before Lyndon Johnson grew up on the Pedernales, a tributary of the Colorado, Spanish explorers confused it with the Brazos and named it for the red color of the other river. Later, Stephen F. Austin's first boatload of colonists also confused it with the Brazos and thinking they had arrived at the Colorado, shipwrecked at the mouth of the wrong river. Eventually, many of Austin's "Old Three Hundred" settled along the Lower Colorado and eventually established Austin, on its banks, as the Capitol of Texas. Close by, and just as historic, the Lavaca River was first described by the French Explorer Rene' Robert Cavelier, Sieur de La Salle, who named the river Riviere de Les Veches, or "Cow River," due to his sighting of bison in the river basin. Later, the Spanish translated the name to Lavaca and the Pride, flagship of the pirate Jean Lafitte, was scuttled at the river's mouth, according to legend. Upstream, the old city of Texana docked up to twenty ships a week as one of the busiest ports on the Gulf Coast.

Against the back drop of this rich cultural and natural history, the development and management of these two river basins has given rise to one of America's great regional economic successes by providing water and power for industry, agriculture, and municipal growth while, unfortunately, limiting the amount of water available to meet the environmental flow needs of the rivers themselves. At the same time, the highly controlled nature of the Colorado, the Lavaca and their tributaries may provide the opportunity for water management that can help meet some of those needs in the future.

The push for legal protections for environmental flows also has a long history in Texas starting with the San Marcos River. The San Marcos River Foundation (SMRF) made history in 2000 by applying for a new water right permit to keep water flowing in the San Marcos River and into San Antonio Bay. Several other organizations soon joined SMRF and applied for water rights in other regions of the state. These applications generated vocal opposition from water suppliers, and the TCEQ Commissioners dismissed the applications without a hearing. In response to those applications, the Legislature enacted a temporary moratorium prohibiting any new permits for environmental flow protection and created the Study Commission on Water for Environmental Flows which was charged with considering alternate ways to protect environmental flows.

In February 2003, The Study Commission on Environmental Flows was appointed by the Speaker and Lieutenant Governor and charged to report to the next legislative session by December 1, 2004. With this action, the course was set for environmental flows legislation in Texas. The Study Commission produced the agreement which later formed the basis of Senate Bill 3 introduced in the 80th Legislature. When the bill was not adopted, Governor Perry appointed an Environmental Flows Advisory Committee to continue work on the environmental flows issue that culminated in passage of Senate Bill 3 in 2007 creating the Environmental Flows Allocation Process.

In this spirit and as a direct result of Senate Bill 3, the Colorado/Lavaca Bay and Basin Stakeholder Committee (BBASC) began meeting on December 17, 2009. The BBASC has had 20 meetings from start to finish in La Grange, Bastrop, Austin, Edna, Eagle Lake, Bay City, Johnson City, and Palacios. Field trips included sites such as Lake Texana/lower Lavaca River, Lavaca Bay, the rice-growing region and irrigation systems around Eagle Lake, the South Texas Project facility, Pedernales Falls State Park, and Tres Palacios Bay.

These orientation experiences enabled the Stakeholder Representatives to appreciate the fact that the Texas rice industry, concentrated mainly on the central Gulf Coast, contributes more than \$200 million to the Texas Economy; that the petrochemical industry, centered in the same region produces 40% of all basic petrochemicals manufactured in the United States and that population in the vibrant Austin area alone is expected to double by 2040. The counties along the Colorado and the Lavaca are among the largest cattle producing areas in a state where this industry has an annual economic value in excess of \$6 billion. Finally, the Texas coast is one of the richest systems of bays and estuaries in the world bringing over \$1 billion from recreational and commercial fishing to the Texas economy each year. All these economic sectors are water dependent and anxious about future supplies, particularly the rice industry which has the oldest but least secure commitments for its irrigation needs and the recreational and commercial fishing industries for which very little fresh water is left.

Faced with this diversity of needs and aspirations, the Stakeholders retained Suzanne Schwartz and Margaret Menicucci with the Center for Public Policy Dispute Resolution as facilitators and they were introduced at the March 30, 2011 meeting. The meetings were well attended by BBASC members but enhanced by the active participation of alternate members who contributed very significantly to the process.

From the very beginning, it was the determination of the BBASC to reach consensus on its recommendations and although there were, as expected, significant differences of opinion in discussions, that goal was reached and this report reflects that consensus. Nevertheless, the dialogue over the past two years that produced that consensus reflected, as expected, a wide

diversity of opinion from among the stakeholders. Appropriately, the Stakeholder Committee accepted the report of the Bay Basin Expert Science Team (BBEST) as the framework for its discussions and the following report reflects in many cases, support of the BBEST recommendations. Support for the BBEST recommendations was made challenging by the fact that the precious water resources of the study area, particularly the Colorado Basin are already heavily allocated, leaving little water available to meet environmental flow needs as articulated by the BBEST, particularly those of Matagorda Bay. The fact of the established allocation levels produced the greatest tension in our deliberations.

The BBASC wants to make clear that these flow standards recommendations are not intended to be used beyond the scope set out in Senate Bill 3. As an example, the BBASC does not intend that the environmental flow recommendations should be used in regional planning except, where appropriate, in the evaluation of water management strategies utilizing water rights permits for which these standards would apply, in accordance with Senate Bill 3.

At the same time, from an environmental standpoint, equally strong concerns arose from the fact that, due to the current allocation and use of water in the Colorado Basin, there would seem to be no chance of meeting the recommendations of the BBEST for a sound ecological environment in Matagorda Bay. In the view of some members of the BBASC, this means that the Bay will be imperiled if some additional measures and policy changes are not made. For others, there is acknowledgement that the environmental conditions in the Bay will inevitably change.

Thus, it is important to us, the members of the Bay and Basin Stakeholders Committee, that the Texas Commission on Environmental Quality and all other readers of this report know that, though strong concerns remain among us, what follows represents the result of a very rigorous and good faith effort to present recommendation for these unique and important resources based on a hard won and thoughtful consensus.

2.0 Statutory Background

Senate Bill 3, passed in 2007 by the Texas Legislature, established a science-informed, stakeholder-driven process for developing environmental flow standards across the state. The Colorado and Lavaca Rivers and Matagorda and Lavaca Bays Basin and Bay area is in the second set of areas to undertake this new process. Senate Bill 3 established the Environmental Flows Advisory Group, consisting of three state senators, three state representatives, and three agency representatives, to oversee the process.

In October, 2009, the Environmental Flows Advisory Group appointed the members of the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays Basin and Bay Area Stakeholder Committee (BBASC). The BBASC then had until March 1, 2010, to appoint a Basin and Bay Expert Science Team (BBEST). The BBEST was charged with developing, through a consensus-based process, environmental flow regime recommendations that would be adequate to support a sound ecological environment. The charge of the BBEST was to consider only the best available science in developing those recommendations, without consideration of other needs for water. The BBEST completed its charge within its one-year time period and provided the BBASC with a consensus report.

The BBASC then had six months, from March 1, 2011 to September 1, 2011, to consider those BBEST recommendations in conjunction with competing water needs, both present and future, and other considerations and develop consensus-based recommendations for environmental flow

standards and for strategies to meet those standards. This report presents the Stakeholder Committee's recommendations for standards and strategies, developed by consensus.

The report is being provided to the Environmental Flows Advisory Group and the Texas Commission on Environmental Quality (TCEQ). TCEQ has a one-year period, beginning on September 1, 2011, to adopt rules establishing environmental flow standards for the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays Basin and Bay area. In adopting those rules, TCEQ is directed to consider the BBEST recommendations, the BBASC recommendations, and other appropriate input.

The BBASC also is charged with developing a work plan establishing a periodic review and refinement of the BBEST recommendations, the standards adopted by TCEQ, and the strategies identified for meeting those standards. That review is to occur no less frequently than once every ten years. The work plan also is to include monitoring, studies, and other activities designed to provide for an adaptive management approach to environmental flow protection. Senate Bill 3 did not establish a specific deadline for the submission by the BBASC of the work plan to the Environmental Flows Advisory Group.

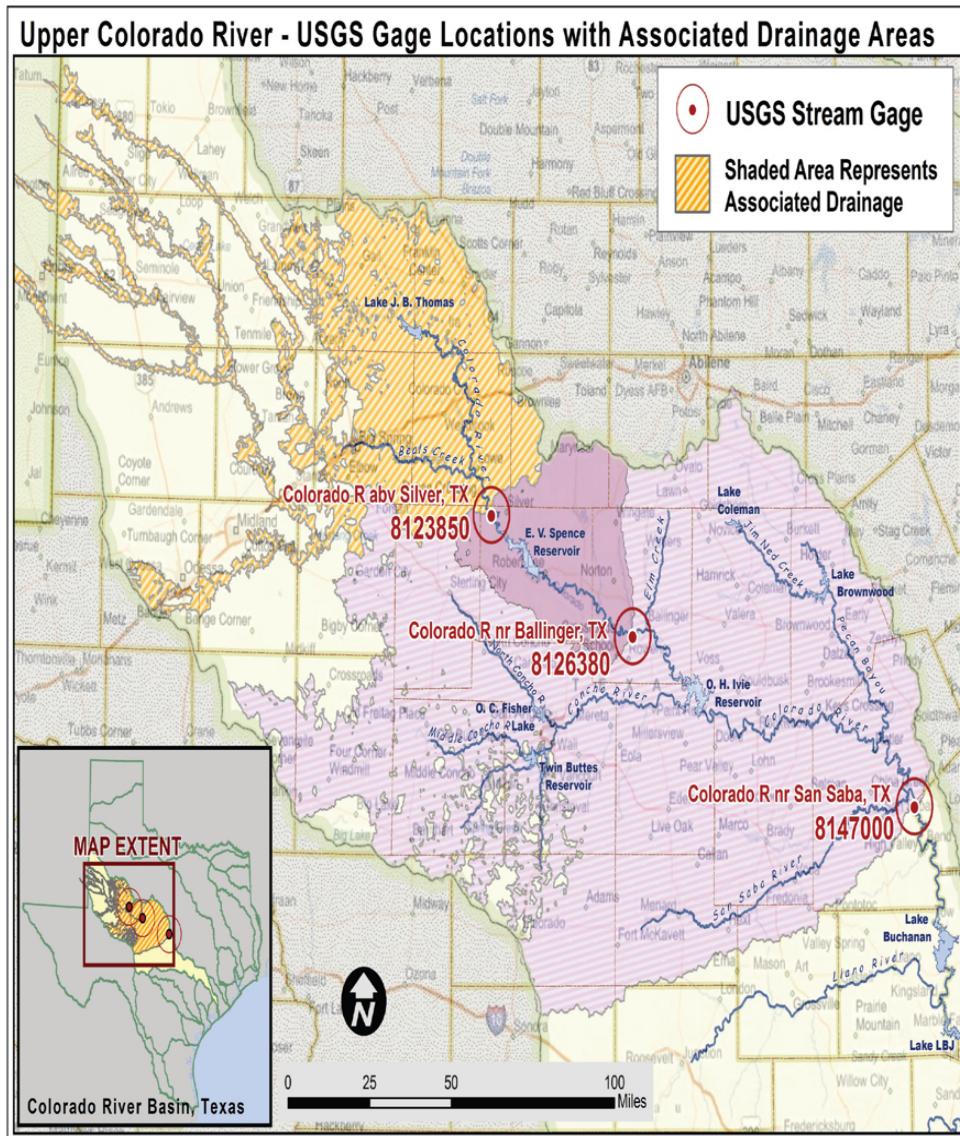
3.0 BBASC Consensus Goal

The BBASC developed the following goal statement to guide the group's deliberative process:

“Develop implementable recommendations that provide for a sound ecological environment in the basins, including the rivers, bays and estuaries, balanced with sufficient water for other beneficial uses and which include an adaptive management process that provides for future sustainability.”

The environmental flow recommendations contained in this report represent the consensus agreements reached by the committee.

4.0 Study Areas



Colorado River above Silver (USGS Gage 8123850)

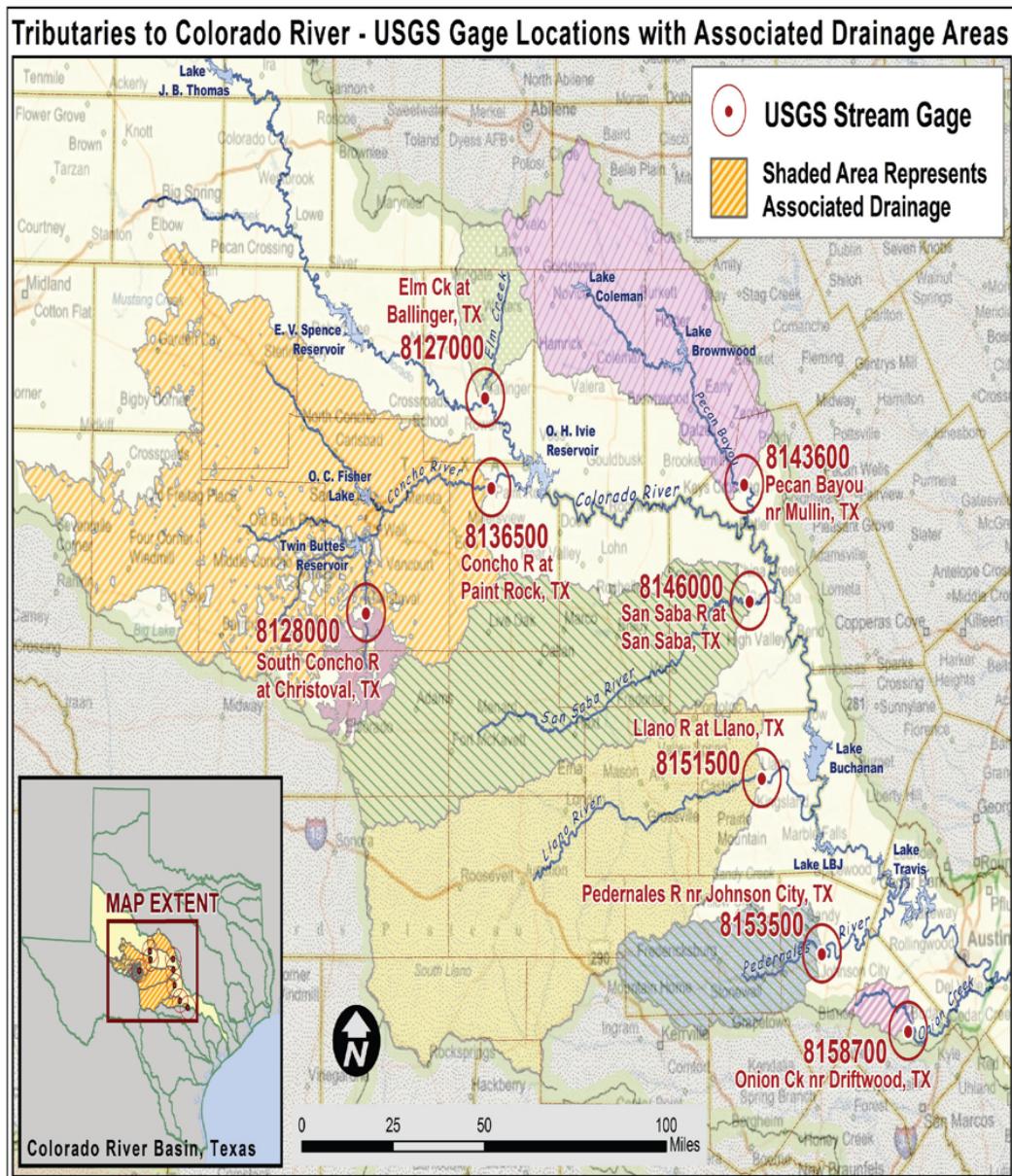
- General area: Semi-arid, primary land use is grazing with some row crops
- Hydrology: River stops flowing at times but maintains perennial pools
- Habitat: Mainly pools and runs, short riffles, relatively straight channel
- Soils: Adjacent to the river, soils flood once every 2 to 20 years. Soils well-drained and unlikely to support wetland development
- Riparian/Floodplain vegetation: Riparian zone sparsely vegetated with few riparian plants, indicating infrequent flooding and water table not elevated adjacent to the river
- Biology: Eight species of fish and several species of aquatic insects present. Concho water snake may be present.
- Water Quality: Supports designated high aquatic life use over a wide range in flow. River is brackish with blooms of toxic golden alga in past.

Colorado River near Ballinger (USGS Gage 8126380)

- General area: Semi-arid, primary land use is cultivation and grazing
- Hydrology: No-flow periods but maintains perennial pools
- Habitat: Long reaches of relatively straight glides and pools
- Soils: Adjacent to the river, soils flood once every 2 to 20 years. Soils well-drained and unlikely to support wetland development
- Wetlands: Some flat areas near the river flood when river rises 3 or more feet
- Riparian/Floodplain vegetation: Riparian zone sparsely vegetated with few riparian plants, indicating infrequent flooding
- Biology: Sixty-one species of fish, several species of aquatic insects and aquatic plants. Concho water snake may be present
- Water Quality: Supports designated high aquatic life use over a wide range in flow. River is brackish with blooms of toxic golden alga in past.

Colorado River near San Saba (USGS Gage 8147000)

- General area: Semi-arid, primary land use is grazing
- Hydrology: River flows perennially. Under low flow conditions, most flow from the San Saba River 5 miles upstream
- Habitat: Mainly pools with riffles, runs, and backwaters
- Soils: Adjacent to the river, soils flood from more than once every 2 years to less than once every 20 years. Soils well-drained with little ability to support wetlands
- Wetlands: Few wetlands near the river
- Riparian/Floodplain vegetation: Some extensive riparian forested areas next to the river
- Biology: 32 species of fish. Fish and aquatic insects demonstrate index of biotic integrity values from intermediate to excellent
- Water Quality: Supports designated high aquatic life use over a wide range in flow.
- Geomorphology: 77% of average annual water yield may protect the channel shape



Elm Creek at Ballinger (USGS Gage 8127000)

- General area: Semi-arid, primary land use is cultivation and grazing
- Hydrology: Does not flow for 36% of the time but maintains perennial pools
- Habitat: Mainly pools behind dams and small pools with runs and short riffles upstream
- Soils: Adjacent to the river, soils flood once every 2 to 20 years; well-drained and unlikely to support wetland development
- Wetlands: Some flat areas near the river with water tolerant plant species; abandoned stream channel parallel to creek with wetland vegetation.
- Riparian/Floodplain vegetation: Patchy forest with typical riparian plant species
- Biology: Twenty species of fish, a state-threatened mussel, and several species of aquatic insects. Concho water snake may be present.
- Water Quality: Supports designated aquatic life use over a wide range in flow.

Concho River at Paint Rock (USGS Gage 8136500)

- General area: Semi-arid, primary land use is cultivation and grazing. 59% of land covered with brush
- Hydrology: Stream flows perennially. Brush infestations, increased groundwater pumping, and upstream reservoirs have reduced base flow.
- Habitat: Mainly pools, some behind dams, separated by rocky riffles
- Soils: Adjacent to the river, some soils flood more than once every two years, other soils flood once every 2 to more than 20 years; well-drained and unlikely to support wetland development
- Wetlands: Small patches of forested wetlands adjacent to the river
- Riparian/Floodplain vegetation: Few typical riparian plants
- Biology: Sixty-one species of fish, a state-threatened mussel, and 79 species of aquatic invertebrates
- Water Quality: Supports designated high aquatic life use over a wide range in flow. A bloom of toxic golden alga was documented as occurring once.

South Concho River at Christoval (USGS Gage 8128000)

- General area: Dry region of the Edwards Plateau, primary land use is ranching.
- Hydrology: Stream flows perennially. Springs which are the source of the river are 4 miles upstream
- Habitat: Short pools and glides separated by riffle-run sequences, 3 low-head dams
- Soils: Adjacent to the river, soils flood once every 2 to 20 years
- Wetlands: Riparian forests extend along both banks in areas. In areas, canopy covers the river.
- Biology: Variety of fish, aquatic insects and plants
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Pecan Bayou near Mullin (USGS Gage 8143600)

- General area: Semi-arid, primary land use is cultivation and grazing.
- Hydrology: Stream flows perennially, however, some periods of no flow exist. Flows influenced by Lake Brownwood releases, treated wastewater and storm water runoff from Brownwood
- Habitat: Mainly pools separated by short runs
- Soils: Adjacent to the river, soils flood every 2 to 20 years. Soils are well-drained and unlikely to support wetland development
- Wetlands: Small patches of forested wetlands adjacent to the river
- Riparian/Floodplain vegetation: Few riparian plants
- Biology: Aquatic plants and 31 species of invertebrates
- Water Quality: Supports designated high aquatic life use over a wide range in flow. Reports of elevated nitrogen, phosphorus and chlorophyll at times

San Saba River at San Saba (USGS Gage 8146000)

- General area: Primary land use is grazing. River originates over Edwards Plateau.
- Hydrology: Stream flows perennially. Has had a few periods of no flow. Edwards-Trinity Aquifer is the source of springs and base flow in the river
- Habitat: Riffles and runs with some pools
- Soils: Adjacent to the river, some soils flood more than once every 2 years, others flood once every 2 to more than 20 years; Soils well-drained and unlikely to support wetland development
- Wetlands: Scattered patches of forested wetlands adjacent to the river

- Riparian/Floodplain vegetation: In areas, the riparian forest canopy obscures the river from view
- Biology: Assessments of the fish and aquatic invertebrate communities indicate they support a high aquatic life use
- Water Quality: Supports designated high aquatic life use over a wide range in flow. Had blooms of toxic golden alga in past

Llano River at Llano (USGS Gage 8151500)

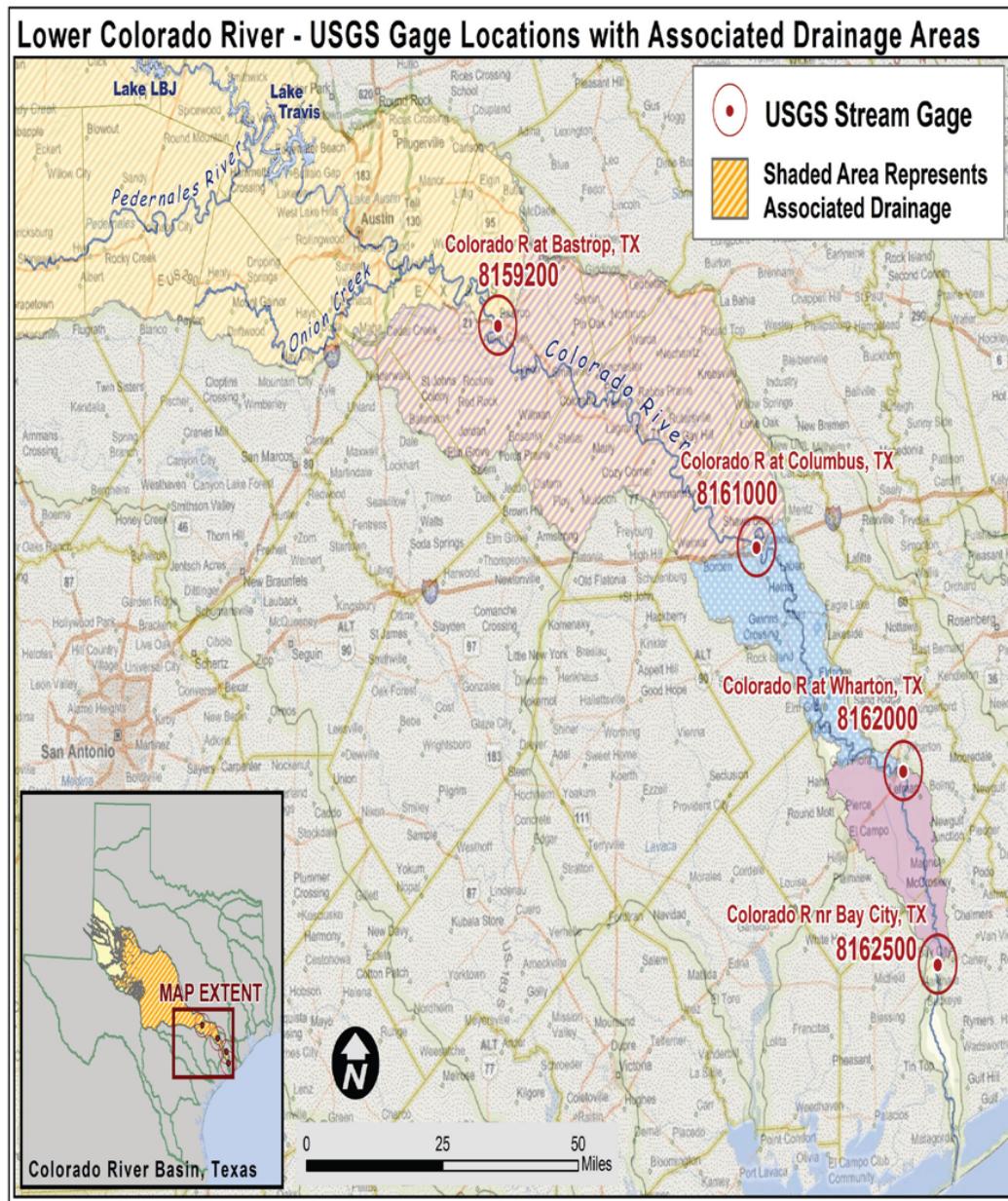
- General area: Primary land use is cattle ranching and crops; River located in the Llano uplift of the Edwards Plateau
- Hydrology: Stream flows perennially; four creeks provide its water. Loses flow as it crosses faults
- Habitat: Primarily long straight reaches of glides and pools
- Soils: Adjacent to the river, some soils flood more than once every 2 years, other soils flood once every 2 to more than 20 years; Soils are well-drained and unlikely to support wetland development
- Wetlands: Channels of tributaries that occasionally flood contain forest wetlands
- Riparian/Floodplain vegetation: Confined to the stream channel and tributary channels with a variety of trees and shrubs found in wetlands
- Biology: Thirty-one species of fish; fish communities support a high to excellent aquatic life use
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Pedernales River at Johnson City (USGS Gage 8153500)

- General area: Primary land use is grazing.; River originates over the Edwards Plateau
- Hydrology: Stream is spring-fed and flows perennially. A few periods of no flow
- Habitat: Long reaches of relatively straight glides separated by pools and occasional riffle-run reaches
- Soils: Adjacent to the river, soils flood more than once every 2 years
- Wetlands: Scattered patches of forested wetlands adjacent to the river
- Riparian/Floodplain vegetation: Riparian vegetation including bald cypress occurs in small pockets along the river and tributary channels
- Biology: Thirty-two species of fish including the state fish, Guadalupe bass
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Onion Creek near Driftwood (USGS Gage 8158700)

- General area: Primary land use is cattle ranching; Originates over the Edwards Plateau
- Hydrology: Perennial pools even though stream has extended periods of no flow; Stream flow infiltrates sinkholes, fissures and caverns of limestone bottom to recharge the Balcones Canyonlands' portion of the Edwards Aquifer
- Habitat: Long, straight reaches of glides and pools with riffle areas
- Soils: Adjacent to the river, soils flood multiple times each year.
- Wetlands: Stream beds of tributaries have forested wetlands
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel. Includes different life stages of typical riparian zone trees
- Biology: Twenty species of fish; fish community supports a high aquatic life use
- Water Quality: Supports designated high aquatic life use over a wide range in flow.



Colorado River at Bastrop (USGS gage 8159200)

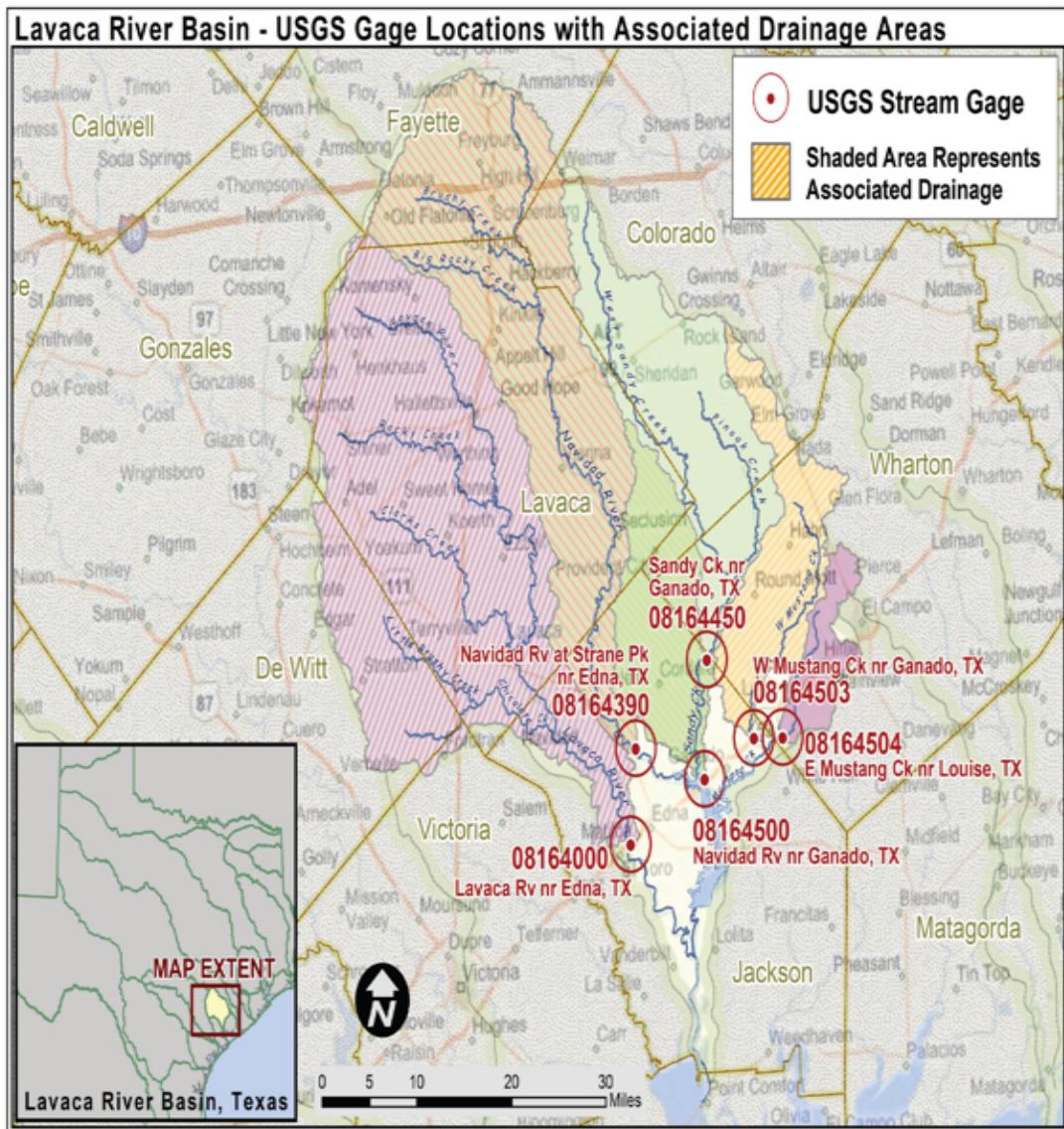
- General area: Primary land uses include grazing, row crop agriculture, urban development
- Hydrology: Perennial flow; Diurnal variations in flows typically over 100 cfs because of diurnal variation in wastewater discharge from Austin; Flow varies because of upstream reservoir releases for power generation and downstream irrigators.
- Habitat: Deep pools, deep runs, and rapids
- Riparian/Floodplain vegetation: riparian areas support mixed bottomland hardwood species
- Water Quality: Supports designated high aquatic life use over a wide range in flow. Had blooms of toxic golden alga in past

Colorado River at Columbus (USGS Gage 8161000)

- General area: Primary land uses include cattle grazing, some gravel mining and suburban development along portions of the river.
- Hydrology: Perennial flow; Diurnal variations in flows typically over 30 cfs because of diurnal variation in wastewater discharge from Austin; Flow varies because of upstream reservoir releases for power generation and downstream irrigators
- Habitat: Primarily long straight runs with in-channel islands and sand bars
- Wetlands: Some oxbows present including one near the river that appears perennial
- Riparian/Floodplain vegetation: Riparian communities relatively wide on both sides of the river
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Colorado River at Wharton (USGS Gage 8162000)

- General area: Primary land uses include farming and grazing with some development on the shore of the river
- Hydrology: Perennial flow; Flow varies because of upstream reservoir releases for power generation and downstream irrigators and slightly because of diurnal variation in Austin wastewater discharges
- Habitat: Primarily long straight runs with in-channel islands and sand bars
- Wetlands: Some oxbows present
- Riparian/Floodplain vegetation: Mix of wooded riparian vegetation and cropland along the banks
- Water Quality: Supports designated high aquatic life use over a wide range in flow.



Lavaca River near Edna (USGS Gage 08164000)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Averages 40 inches of rain per year
- Hydrology: Perennial river in this reach. Has experienced a few periods of no flow
- Habitat: Sequences of runs, pools, and some riffles
- Soils: Adjacent to the river, soils flood more than once every two years
- Wetlands: Forested wetlands along the riparian zone
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel; Presence of American sycamore indicates soils may be saturated for extended periods of time
- Biology: 49 species of fish and 13 species of benthic invertebrates; Fish community is significant fishery and qualifies as a unique fish community
- Water Quality: Supports designated high aquatic life use over a wide range in flow. Upper 29-mile reach of the river near Hallettsville has experienced oxygen levels below the water quality standards

Navidad River at Strane Park (USGS Gage 08164390)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Averages 40 inches of rain per year; Sandy bottom
- Hydrology: Perennial river. Has experienced a few periods of no flow
- Habitat: Sequences of runs, pools, and some riffles
- Soils: Adjacent to the river, soils flood more than once every two years
- Wetlands: Forested wetlands along the riparian zone
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel.
- Biology: 49 species of fish and 11 species of benthic invertebrates
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Sandy Creek near Ganado (USGS Gage 08164450)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Averages 41 inches of rain per year; Sandy bottom
- Hydrology: Perennial stream. Has experienced some periods of no flow; Receives irrigation return flow from rice fields during the summer
- Habitat: Shallow runs and riffles with numerous islands
- Soils: Adjacent to the river, soils flood more than once every two years
- Wetlands: Forested wetlands along the riparian zone
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel
- Biology: 20 species of fish and 11 species of benthic invertebrates
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

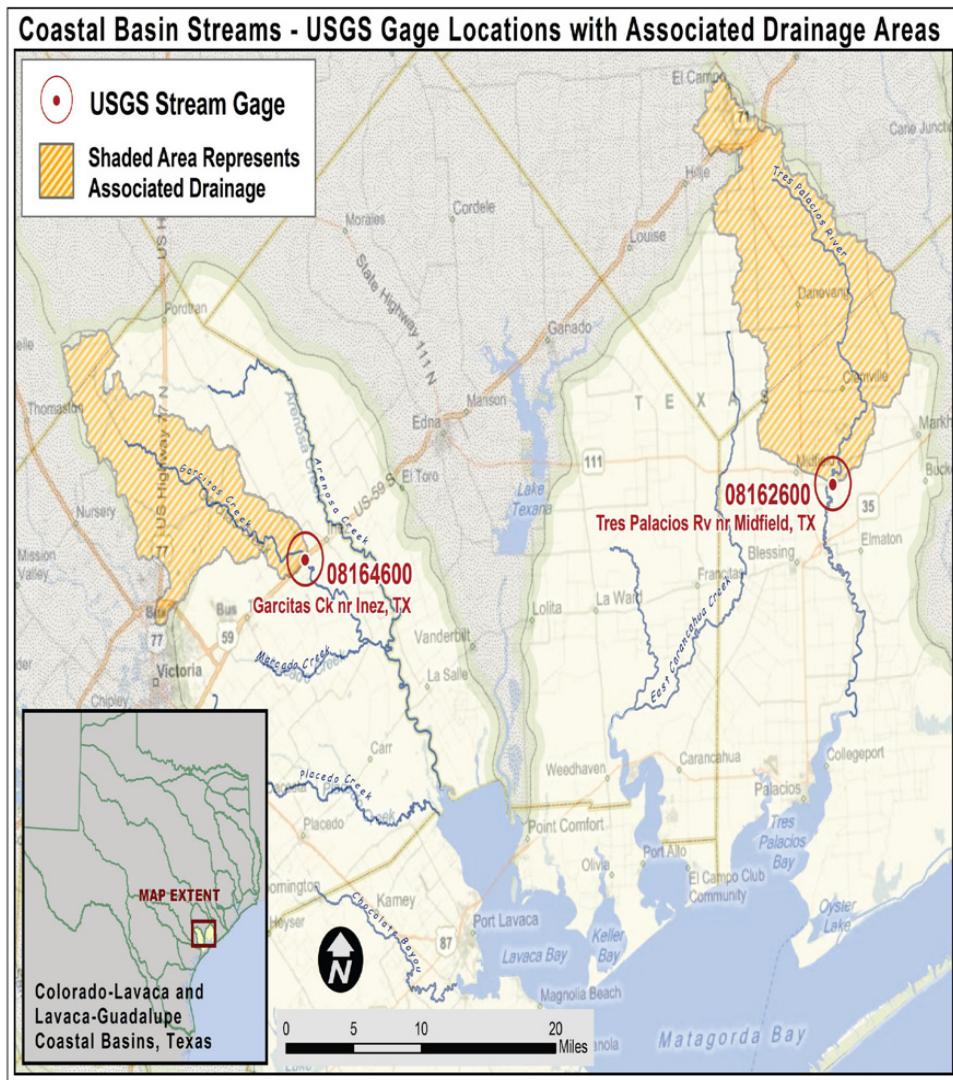
East Mustang Creek near Louise (USGS Gage 08164504)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Higher proportion of agricultural land use than any other watershed in the basin; Sandy bottom
- Hydrology: Creek maintains perennial pools. Has frequent periods of no flow; Receives irrigation return flow from rice fields during the summer
- Habitat: Glides with a few riffles and pools
- Soils: Adjacent to the creek, soils rarely flood
- Wetlands: Forested wetlands along the riparian zone for the lower two stream miles
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel for the lower two stream miles; Upstream of this reach, the channel appears highly modified and channelized with most riparian vegetation removed
- Biology: Fourteen species of fish
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

West Mustang Creek near Ganado (USGS Gage 08164503)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Sandy bottom
- Hydrology: Perennial stream. Has experienced a few periods of no flow; Receives irrigation return flow from rice fields during the summer
- Habitat: Shallow runs and riffles with numerous islands
- Soils: Adjacent to the river, soils flood more than once every two years
- Wetlands: Forested wetlands along the riparian zone
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel

- Biology: Twelve species of fish
- Water Quality: Supports designated high aquatic life use over a wide range in flow.



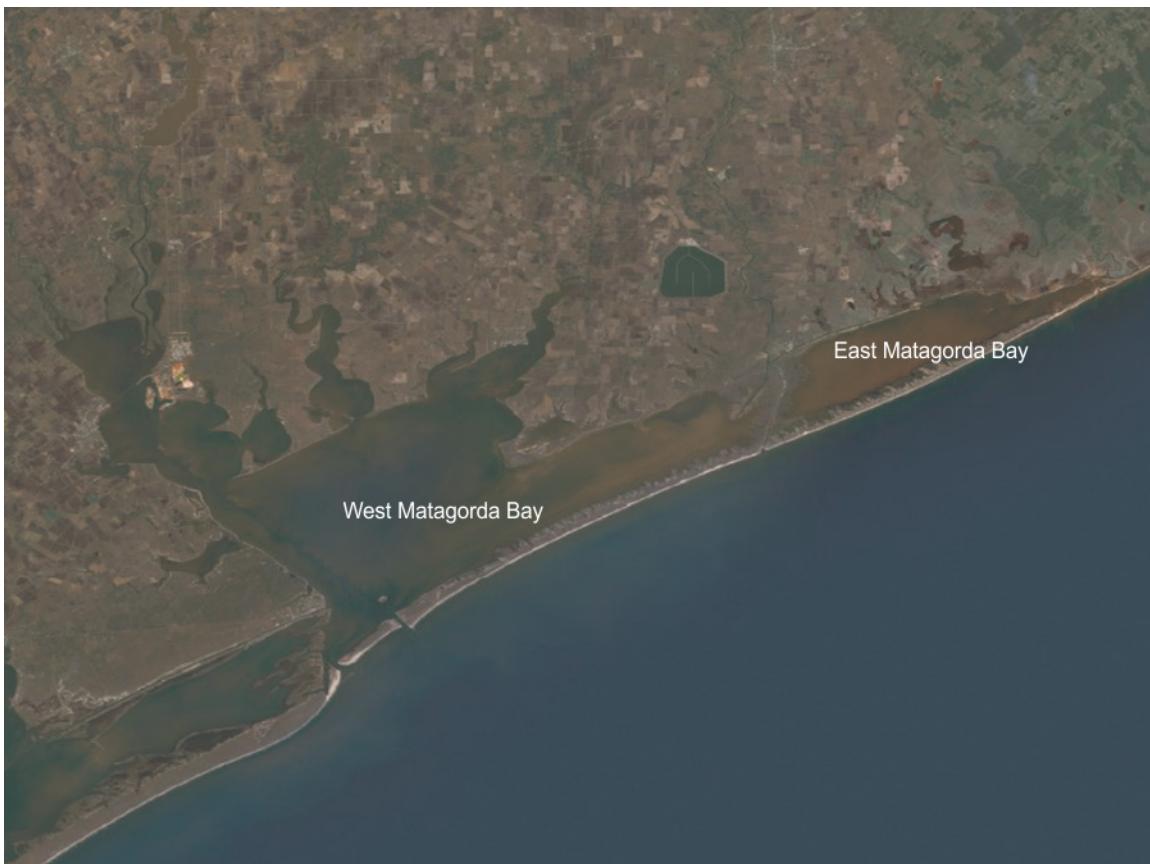
Garcitas Creek near Inez (USGS Gage 08164600)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Averages 37 inches of rain per year; Sandy bottom.
- Hydrology: Creek maintains perennial pools. Has periods of no flow; Receives irrigation return flow from rice fields during the summer
- Habitat: Alternates between small pools and riffles
- Soils: Adjacent to the creek, soils flood more often than once every two years
- Wetlands: Forested wetlands along the riparian zone
- Riparian/Floodplain vegetation: Floodplain hardwood forest lines both sides of channel around the gage
- Biology: 24 species of fish and Index of Biotic Integrity values from intermediate to high
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

Tres Palacios River near Midfield (USGS Gage 08162600)

- General area: Flat coastal plain with croplands and cattle ranching as primary land uses; Averages 42 inches of rain per year
- Hydrology: River has perennial flow. Receives irrigation return flow from rice fields during the summer
- Habitat: Primarily pools and runs upstream of site with riffle/run sequences more frequent downstream of gage
- Soils: Adjacent to the creek, soils rarely flood
- Wetlands: A few scattered freshwater emergent wetlands
- Riparian/Floodplain vegetation: Riparian vegetation appears restricted to immediate vicinity of the channel
- Biology: No biological data available from Tres Palacios Creek above tidal. Wilson Creek, a tributary to Tres Palacios River, had a high Index of Biotic Integrity value for its fish community and an intermediate Index of Biotic Integrity for its benthic invertebrate community
- Water Quality: Supports designated high aquatic life use over a wide range in flow.

MATAGORDA BAYS



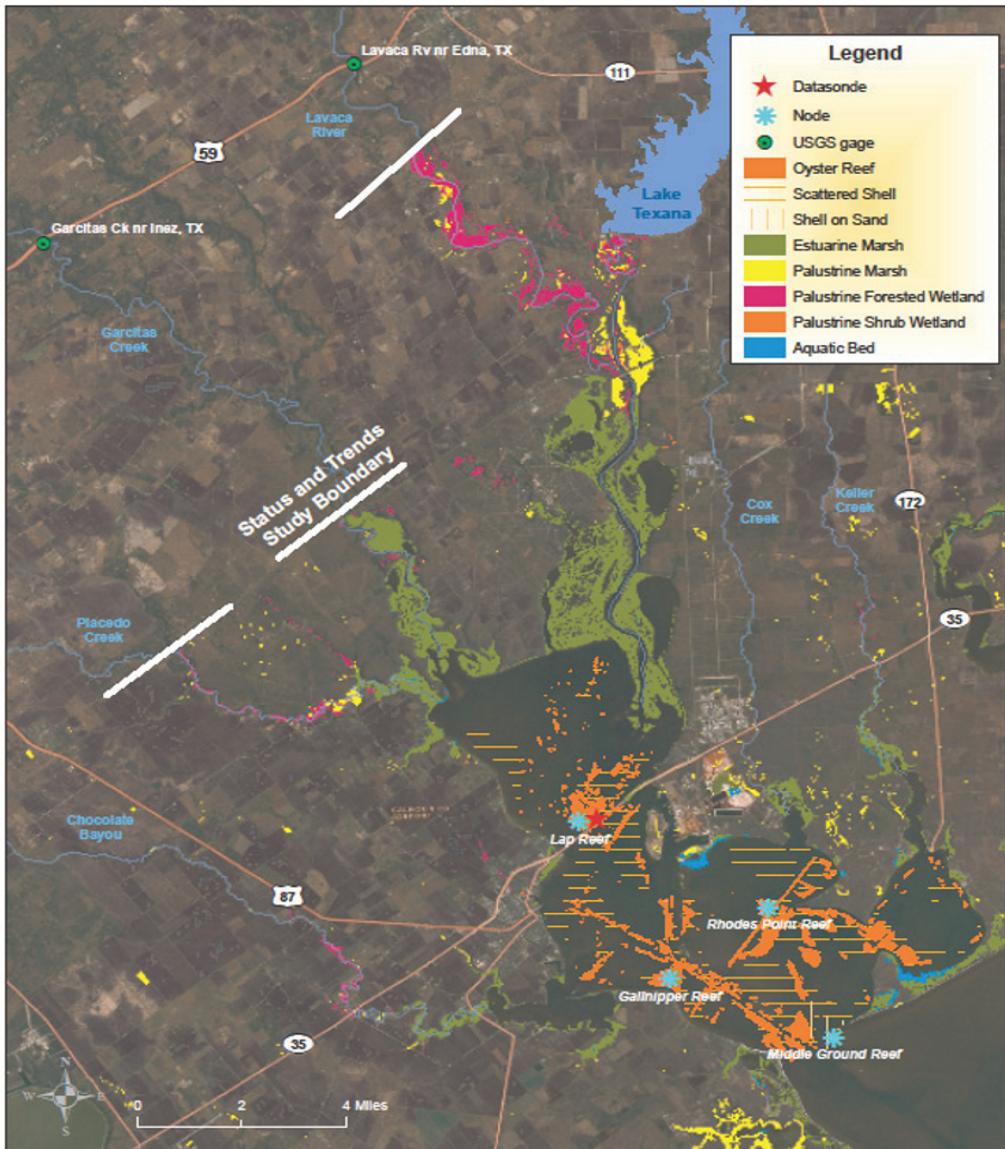
East Matagorda Bay

- Part of the Matagorda Bay system, enclosed by the Matagorda Peninsula and the delta around the former mouth of the Colorado River downstream of the Gulf Intracoastal Waterway (GIWW) to the Gulf of Mexico
- Average width of 3.7 miles and length of about 23 miles
- Depths typically range from 2 to 4 ft
- Caney Creek (flow is not gaged) discharges into the bay at the northeastern border
- Delta around the former Colorado River channel forms the western boundary
- Cut off from Matagorda Bay by a rapidly prograding delta that formed in the 1930s
- Only true opening to the Gulf of Mexico is through Brown Cedar Cut, near the north end of the peninsula
- Extensive marshes occur north of the GIWW and fringing marshes occur within the bay
- Scattered oyster reef and many species of shellfish and finfish occur within the bay
- Compared to other Texas bays, little development has occurred around its periphery
- Primary freshwater inflow sources are localized rainfall and runoff

West Matagorda Bay

- Matagorda Bay system encompasses 352 square-miles, second largest estuary on Texas Coast; the system includes several secondary bays – Lavaca, Tres Palacios, Turtle, Carancahua, Keller, Cox, Chocolate, and Powderhorn
- The Colorado River provides about 45% of the annual average inflow to the bay (since diversion into the bay in 1992); Coastal drainages contribute approximately 29% of annual inflows.
- Matagorda Bay exhibits a wide range of salinity, near 0 after major inflows events to greater than 35 ppt during droughts; Average salinity is around 19 ppt.
- Average Depth is about 6 feet
- Matagorda Bay supports commercial shrimp, oyster, and recreational fisheries.
- Extensive marshes occur north of the GIWW and fringing marsh occurs around the bay. The diversion of the Colorado River in 1992 created significant marsh in the new forming delta
- The marshes and delta in and around Matagorda Bay serve as important finfish and shellfish nursery habitat as well as winter habitat for migratory birds and waterfowl

LAVACA BAY



Sources: Landcover - BEG 2008 Status and Trends (<http://www.glo.state.tx.us/coastal/statusandtrends/matagorabay/index.html>),
 Substrate - TPWD (Simone et al. 2004), Datasonde and TxBLEND nodes - D Buzan (BEBEST/BS&L),
 Hydrography - HNDPlus 2008. Projection: NAD83/UTMZone14N. L. Hamlin Jan. 2011 TPWD Coastal Fisheries - Water Resources

Lavaca Bay

- Lavaca bay is a secondary bay of the Matagorda Bay system.
- Main sources of freshwater: Lavaca River (27.5%), Navidad River via Lake Texana releases (51%), and Garcitas Creek (9.4%): Chocolate Bayou at times is a substantial contributor of freshwater to the lower portion of the bay.
- Lavaca-Navidad watershed contributes approximately 17% of freshwater inflow to the Matagorda Bay system (Sansom 2008)
- Approximately 26 miles from the mouth of Pass Cavallo and the Gulf of Mexico to the bay.
- Mixing occurs from tidal influence (Gulf of Mexico), Keller Creek, Keller Bay, Cox Bay, Cox Creek, and Chocolate Bayou
- Flushes more rapidly than many other Texas secondary bays
- Salinity varies seasonally, ranging from 0 ppt during the spring to 30 ppt in late summer/fall

- Important fishery
 - Important oyster fishery for entire Texas coast. In the late 1800s to the early 1900s, 80% of oyster harvest from coast of Texas occurred here (Doughty 1984)
 - Important green turtle (sea turtle) fishery from the late 1800s to the early 1900s (Doughty 1984)
 - Continues to support important shrimp, oyster and recreational fishing industries
- Diversion from freshwater sources occurred over time for rice field irrigation
- Navidad River was impounded in 1980, creating Lake Texana, approximately 12 miles north east of Lavaca River delta.
- The Navidad and Lavaca Rivers merge south of Lake Texana before flowing into Lavaca Bay. Sandy Creek and East and West Mustang Creeks flow into Lake Texana

5.0 Summary of BBEST Activities and Recommendations Report

The Colorado-Lavaca Expert Science Team (BBEST) delivered a consensus report to the Stakeholder Committee (BBASC) on March 1, 2011, and has continued to support the Stakeholder Committee through completion of this report. The Committee wishes to express its sincere appreciation to the BBEST members for their professional work and for providing an on-time, and high quality consensus report. The report has been a valuable tool for analysis and evaluation. It is anticipated that the well-documented report will be a valuable tool for the Texas Commission on Environmental Quality (TCEQ) as they establish environmental flow standards for the Colorado and Lavaca Basins, including Matagorda and Lavaca bays.

The BBEST was appointed by the Stakeholder Committee on February 24, 2010 after a thorough review of the 20 applicants and the selection of a candidate slate by the Expert Science Team Subcommittee. Candidates were selected based on a decision matrix approved at the January 27, 2010, Stakeholder Committee meeting. The slate met the following criteria:

- Experts in each area of expertise deemed essential by the Stakeholder Group;
- A diverse team, including experts with knowledge of upper and lower Colorado basin and bay and Lavaca basin and bay;
- A team that was small enough to provide a good chance of reaching a consensus recommendation, while managing its work within the limited budget available.

The following consensus slate of ten candidates was presented to, and appointed by, the Stakeholder Committee:

<u>Name</u>	<u>Candidates knowledge base</u>
Bryan Cook	Riverine biology, lower Colorado
Thom Hardy	Flow regime expertise, lower Colorado
David Buzan	Marine biology, Lavaca and lower Colorado
Richard Hoffpauir	Hydrology, lower Colorado
Kirk Kennedy	Hydrology, Lavaca and lower Colorado
Melissa Romigh	Ecology/marine biology, Matagorda Bay
Okla Thornton	Riverine biology/ecology, upper Colorado
Joe Trungale	Flow regime expertise, lower Colorado
Catherine Wakefield	Marine ecology, Matagorda Bay
Steve Watters	Geomorphology, upper Colorado, Lavaca

On March 31, 2010, the Stakeholder Committee also ratified state agency representatives as non-voting members of the BBEST: David Bradsby, representing Texas Parks and Wildlife Department; Kathy Alexander, representing Texas Commission on Environmental Quality; and Nolan Raphelt, representing Texas Water Development Board. David Buzan was elected by the BBEST members to serve as chair, and Bryan Cook as vice-chair. Various Stakeholder Committee members and alternates attended many, if not most, of the BBEST meetings to observe the process and provide input when appropriate.

BBEST Support of BBASC prior to consensus recommendations

The BBEST provided updates on their progress and supported the BBASC WAM subcommittee prior to providing their consensus report as follows (meeting minutes providing details are available at http://www.tceq.texas.gov/permitting/water_rights/eflows/colorado-lavaca-bbasc):

BBASC WAM subcommittee	September 28, 2010
BBASC WAM subcommittee	October 18, 2010
BBEST update	October 28, 2010
BBASC WAM subcommittee	November 23, 2010
BBEST update	December 1, 2010
BBEST update	January 26, 2011
WAM Analysis Examples: Colorado River near San Saba	January 26, 2011
BBEST update	February 9, 2011
BBEST update	February 17, 2011

BBEST Support of BBASC after providing consensus recommendation

The BBEST continued to provide support to the Stakeholder Committee after providing their consensus recommendations. In providing this support the BBEST helped inform the Committee regarding the content and meaning of their recommendations, as well as the environmental implications of “balancing” adjustments being considered by the stakeholders. Based on requests from the stakeholders, the BBEST produced the following presentations and reports (meeting minutes providing details are available at:

http://www.tceq.texas.gov/permitting/water_rights/eflows/colorado-lavaca-bbasc

- BBEST Recommendations Report presentation March 3, 2011
- Q&A discussion to understand BBEST report March 31, 2011
- Previous BBEST Experience: Lessons Learned March 31, 2011
- Basin Literature Review March 31, 2011
- BBASC WAM subcommittee meeting April 21, 2011
- BBEST report discussion – Matagorda & Lavaca Bays April 27, 2011
- WAMS & Other tools April 27, 2011
- Unappropriated Flow Info from TECQ WAM RUN3 All sites with year/month details May 6, 2011
- Discussion of implementation examples May 13, 2011
- Review of potential EFS at selected sites May 13, 2011
- BBASC questions regarding BBEST Report May 13, 2011
- Unappropriated Flow: Graphs Pedernalses, Lavaca, Tres Palacios & Garcitas May 25, 2011
- Unappropriated Flow: Tables - Pedernales, Lavaca, Tres Palacios and Gacitas without & with, BBEST imposed May 25, 2011
- BBEST analysis of Lavaca River Off-Channel Project May 25, 2011
- Lavaca river WAM and Hydrologic Conditions May 25, 2011
- BBASC WAM subcommittee meeting June 1, 2011
- Summary of Compliance Results with EFR June 1, 2011

• Lavaca Bay Frequency of Occurrence Table	June 1, 2011
• Matagorda Bay Attainment Frequency Table	June 1, 2011
• WAM run updates	June 16, 2011
• Develop preliminary bay and estuary standards for Freshwater Inflow Regimes	June 16, 2011
• Develop hydrological conditions triggers	June 16, 2011
• Pulse Flow & Channel Maintenance Components	June 16, 2011
• Possible Recalculated Base Flow Values	June 16, 2011
• Subsistence Flow Questions	June 16, 2011
• DRAFT Work Plan - Adaptive Management Plan	June 29, 2011
• Develop preliminary bay and estuary standard Lavaca-Matagorda	June 29, 2011
• Responses to Stakeholder questions	June 29, 2011
• Continue developing riverine E-Flow standards with example application: Lavaca River at Edna	June 29, 2011

6.0 Water Availability Modeling (WAM) Analysis

6.1 WAM Subcommittee Activities and Analysis

The Stakeholder Committee used Water Availability Modeling (WAM) analyses results to inform decision making regarding the process of making environmental flow recommendations for each site within the basins and bays. The BBEST assisted the Committee by providing modeling results, as requested, to guide decisions.

The Stakeholder Committee established a WAM subcommittee at its August 25, 2010 meeting. The purpose of the subcommittee was to work with BBEST members and state agency representatives to bring recommendations back to the full Stakeholder Committee regarding consideration and evaluation of water availability issues.

SPECIFIC STAKEHOLDER COMMITTEE USE OF WAM MODELS

There were three basic uses of flows generated by the WAM modeling in the formulation of the Committee's recommendations:

- (1) Unappropriated Flows at BBEST Sites
- (2) Regulated flows at Various Other Locations
- (3) New Project Representations

A description of the WAM runs used by the Stakeholder Committee in developing environmental flow recommendations is provided in Appendix 1.

Most analyses went through multiple iterations in order to reach a final consensus result that was reviewed by the full Stakeholder Committee. To avoid confusion, only the final resulting analyses are provided in this report.

UNAPPROPRIATED FLOWS AT BBEST SITES

Unappropriated water, as defined by the TCEQ RUN3 models, is the quantity of water remaining at a location after all upstream and downstream water rights have exercised their rights up to the full amount authorized. Therefore, any unappropriated water remaining at a location can be said to be the maximum amount of water that is available for a new appropriation. The four TCEQ WAM Run3 models for the Stakeholder Committee's area of interest were used to extract unappropriated flows at each location the BBEST made recommendations for. Using this information, numerous statistics were calculated assessing the quantity and frequency of unappropriated water remaining at these sites. This information is included in Appendix 3.

REGULATED FLOWS AT VARIOUS OTHER LOCATIONS

Unlike unappropriated flows, regulated flows from TCEQ's WAM Run3 model represents the quantity of water remaining at a location without regard to what quantities are being reserved for downstream seniors or are in the river as a result stored water traveling from upstream to downstream. Therefore, the regulated flow information from WAM is similar to gaged flow in that it is only reduced by depletions made upstream and thus represents water flowing at a location

without regard to why it is there or who has a right to use it. The WAM regulated flow at the end of the Colorado River Basin was extracted from TCEQ's RUN3 and used by the Stakeholder Committee to formulate its recommendations for inflows to Matagorda Bay (Table 7.8-1).

Similarly, the regulated flow at the end of the Lavaca River Basin along with the regulated flows from the Lavaca/Guadalupe Coastal Basin were extracted and used by the Stakeholder Committee to formulate its recommendations for inflows to Lavaca Bay (Table 7.9-1).

SUBCOMMITTEE MEETINGS

The subcommittee met on the following dates, reviewing presentations and making the noted decisions and recommendations:

September 28, 2010

- Yujuin Yang (TWDB) gave a presentation on Water Availability Models (WAM)
- TWDB indicated that they need input from stakeholders before running the WAM models.
- TCEQ uses a Science Advisory Committee (SAC) guidance document that allows multi-tiered recommendations to be entered into the WAM.
- BBASC WAM subcommittee decided they needed to compile a list of questions in the form of a recommendation to be presented to the full committee.

October 18, 2010

- Discussed use of RUN3 to get a look at impact of BBEST recommendations on projects and unappropriated water.
- Discussed use of Region K cut-off vs. no cut-off model
- Need visual means of presenting.

November 23, 2010

- Kirk Kennedy presented WAM runs on San Saba River @ Colorado River, Colorado River @ Columbus, Tres Palacios River @ Midfield, and Lavaca River @ Edna. Current TCEQ WAM Runs 3 and 8 were used and compared to the HEFR model being used by BBEST (See January 26, 2011 BBASC meeting and Appendix 2).
- A format was agreed upon for BBASC presentations.
- Pulse flows and attainment frequencies were discussed.
- TCEQ indicated it has not incorporated attainment frequencies into the rules as permit conditions.
- TCEQ is looking for flow regime guidelines that are unambiguous, clear and enforceable.
- Kirk Kennedy was asked to give an overview at the next BBASC meeting.
- The subcommittee reached consensus to use TCEQ's updated WAM (cutoff model) if Kirk is able to configure the WAM, otherwise the Region K Cutoff WAM will be used. In either case RUN3 and RUN8 output information will be reviewed before making final decisions.

March 1, 2011

- WAM subcommittee representatives met with TCEQ.
- TCEQ indicated they are looking for a clear approach on implementation of the recommendations; something that can be put into a water right permit.
- TCEQ wants to see the rationale for the recommendations laid out clearly. There is no preferred approach to developing recommendations.

April 7, 2011

- Reached consensus to recommend using the TCEQ WAM's for the Colorado and the Lavaca Basins.
- Agreed that initial BBEST runs include 1) No e-flow restrictions, 2) Consensus criteria, 3) Lyons Method, and 4) Full BBEST recommendations.
- Agreed to 1) Use FRAT to model daily flows for use in WAM, 2) Use WAM RUN3 but incorporate WAM RUN8 into evaluation process, and 3) work with BBEST to evaluate e-flow impacts on projects.

April 21, 2011

- Reviewed initial WAM runs on a potential off-channel project in the Lavaca basin. (Appendix 5)
- Agreed to use same Kirk's presentation except not the entire graphical review of the project.

Additional meetings were held on May 12, 2011, May 23, 2011, and June 16, 2011.

6.2 Stakeholder Committee (BBASC) Discussion of Specific WAM Issues

December 1, 2010 BBASC Meeting: BBEST indicated that the intent is that the BBEST flow regime is implementable and described in a way that facilitates the BBASC's charge. Kirk Kennedy of BBEST was tasked with providing WAM support to the BBASC. The BBASC agreed to set aside ample time at the next meeting to discuss these issues and the BBEST work (see minutes)

January 26, 2011 BBASC Meeting: At the request of the WAM subcommittee, Kirk Kennedy made a presentation of WAM analysis examples for the Colorado River near San Saba, Colorado River near Columbus, Lavaca River near Edna, and Tres Palacios near Midfield (Appendix 2). The various types of WAM models were discussed.

February 17, 2011 BBASC Meeting: BBEST was requested to run WAMs with hypothetical projects that have been selected; the off-channel reservoir in the Lavaca Basin. No project was selected at that time for the Colorado Basin. Kirk Kennedy gave an overview of the different WAMs (TCEQ, Region F & K cutoff model and RUN3 (full water rights utilization)), RUN8 (current conditions), and RUN9 (a proposed TWDB run under future conditions).

April 27, 2011 BBASC Meeting: The BBASC agreed the WAM analyses should focus on sites (gages) where unappropriated water exists. The WAM subcommittee was asked to evaluate the locations and identify those that merit additional analyses.

May 13, 2011 BBASC Meeting: Kirk Kennedy provided a table with unappropriated flow information from WAM RUN3 for all gage sites; with a detailed backup table for each site (Appendix 3). It was clear that unappropriated flows in many (most) sites were available for diversion so infrequently that viable projects at those sites were unlikely. Based on this information the WAM subcommittee recommended to the BBASC that the following sites be grouped as 1) those with potential for a project and a balancing discussion, and 2) those at which availability is so low that there is a low likelihood of a water supply project being viable. Based on the grouping, the following gage sites were selected for additional analysis:

- Site 10: Pedernales at Johnson City
- Site 15: Lavaca near Edna
- Site 20: Tres Palacios
- Site 21: Garcitas Creek

May 25, 2011 BBASC Meeting: Kirk Kennedy provided a table and bar charts showing amounts of unappropriated water at the four (4) sites selected at the previous BBASC meeting (Appendix 4). To demonstrate the impact of the BBEST environmental flows recommendations four scenarios were presented:

- Without the BBEST recommendations imposed
- With the BBEST recommendations imposed
- With the BBEST recommendation but with no high-flow-pulse requirements, and
- With the Lyons recommendations imposed.

June 16, 2011 BBASC Meeting: Kirk Kennedy presented additional information on the Lavaca River at Edna hypothetical off-channel reservoir project evaluation (Appendix 6).

- Members agreed to have BBEST use the following two hypothetical projects to evaluate the impact of the BBEST environmental flow recommendations:
 - Lavaca River off-channel reservoir (OCR) project (which also serves as a representative project for the Garcitas and Tres Palacios Creek sites also)
 - Pedernales River at Johnson City conceptual aquifer storage and recovery project (ASR)

June 29-30, 2011 BBASC Meeting: Kirk Kennedy presented two tables on the hypothetical Pedernales River at Johnson City aquifer storage and recovery project (Appendix 8).

July 20-21, 2011 BBASC Meeting: Kirk Kennedy presented two updated tables on the hypothetical Pedernales River ASR project (Appendix 8) and the hypothetical Lavaca River OCR Project (Appendix 7). Tables and charts provided demonstrated the impact of using various hydrological condition triggers in the Colorado & Lavaca Basins (Appendix 9).

August 2-3, 2011 BBASC Meeting:

The above WAM analyses and BBASC deliberations resulted in the recommendations reflected in this report.

6.3 Stakeholder Committee Evaluation of Hypothetical Water Supply Projects

Two hypothetical projects were analyzed to determine how the environmental flow standard recommendations being considered by the Stakeholder Committee might impact water supply potential and flows in the river; one located in the Lavaca River Basin, and the other in the Colorado River Basin. Each project is described as follows:

(1) Lavaca Off Channel Reservoir Project (LOCR)

Offered to the Committee as a model for a balancing exercise by the Lavaca-Navidad River Authority (LNRA), which might be the potential sponsor of such a project, the Stakeholder Committee, with the support of the BBEST, undertook a specialized water availability evaluation for a hypothetical project. LNRA currently holds a permit authorizing the construction of an on-channel reservoir on the Lavaca River. That permit provides that environmental flow conditions applicable to the on-channel reservoir are to be developed prior to construction. Consistent with LNRA's current management plans for water supply development, an off-channel reservoir is envisioned as a replacement for the on-channel reservoir and, accordingly, the project evaluation for this hypothetical project was undertaken with the existing permit for that on-channel reservoir "coded out" in the water availability model.

This project was represented as diverting water from the Lavaca River in the vicinity of, and immediately downstream of, the Lavaca River near Edna streamflow gage location. As represented for the Stakeholder Committee, the project diverts as much unappropriated water as possible (subject to numerous physical constraints) from the Lavaca River to maintain water levels in a nearby off-channel reservoir (OCR), then diverts water from the OCR to meet a consistent, firm, water demand for municipal purposes. The firm water demand from the OCR is iterated so that the maximum annual demand from the OCR is determined, which directly relates to the amount of water the project can divert from the Lavaca River to refill the OCR. Most of the specific parameters for this project were taken from a RiverWare model and report developed by Freese and Nichols for the Lavaca Navidad River Authority. The parameters, as simulated for the Stakeholder Committee, are summarized as follows:

Inflows to Project:	TCEQ WAM RUN3 with Stage 2 Texana Removed
Pass Throughs for Downstream Rights:	TCEQ WAM RUN3 with Stage 2 Texana Removed
Location:	Downstream of the Lavaca River near Edna gage.
Off-Channel Reservoir Capacity:	25,000 acre-feet.
Water Surface Area at Full:	1,030 acres
Source of Evaporation Information:	Nearby location in TCEQ WAM RUN3.
Maximum Diversion Rate into OCR:	200 mgd (309.45 cfs).
Use Pattern from the OCR:	Uniform.

Monthly flows from the TCEQ WAM RUN3 model were extracted at the project's location and disaggregated into an estimate of daily river flows using the Lavaca River near Edna historical flow as a daily pattern. The FRAT model was used to simulate the project under numerous eflow assumptions and the Firm Annual Yield of the project was determined for each scenario. Flows before and after project diversions under multiple environmental flow scenarios were compared

and a summary of firm yield was developed along with a summary of before and after project river flows. The results are included in Appendix 7. The simulated project depletions from FRAT were then placed back into the RUN3 WAM model and the resulting total flows to Lavaca Bay for several of the modeled environmental flow scenarios were computed and are included in Table 7.8-2

(2) Pedernales Aquifer Storage and Recovery Project (PASR)

This hypothetical project was represented as diverting water at the Pedernales River near the Johnson City streamflow gage location. As represented for the Stakeholder Committee, the project diverts as much unappropriated water as possible (subject to numerous physical constraints) from the Pedernales River to maintain a nearby OCR. Two demands are structured from the OCR: the first attempting to meet a consistent, firm, water demand for municipal purposes; and the second diverting excess water from the OCR (subject to numerous additional physical constraints) for injection into an aquifer. When the amount of water stored in OCR is reduced, the firm water demand is then satisfied by retrieving surface water previously stored in the aquifer.

The firm water for the project was determined by iterating the project demand (which has the ability to be supplied from OCR first and ASR second) so that the a maximum annual demand for the project could be determined which fully utilizes surface water supplies stored in the OCR as well as surface water supplies stored in the ASR. This solution required numerous iterations, taking into consideration (1) the need to meet an annual firm supply, while (2) having enough excess water available in the OCR so that injection into the ASR could occur to the extent required to sustain the project when surface water supplies were exhausted. This process involved multiple iterations between both surface water supplies (OCR and ASR) and culminated in a firm project yield which fully utilizes all surface water from both supplies.

All of the specific parameters for this project were derived by members of the BBEST and the Stakeholder Committee based on what were intended to represent a large, but reasonably, sized project so that additional insight could be provided to the Committee with regard to the proposed environmental flow recommendations and their impact on water supply versus flows in the river. The parameters, as simulated for the Stakeholder Committee, are included in Appendix 8 and summarized as follows:

Inflows to Project:	TCEQ WAM RUN3
Pass Throughs for Downstream Rights:	TCEQ WAM RUN3
Location:	At the Pedernales near Johnson City gage.
Off-Channel Reservoir Capacity:	10,000 acre-feet.
Water Surface Area at Full:	333 acres
Source of Evaporation Information (OCR):	Nearby location in TCEQ WAM RUN3.
ASR Capacity:	100,000 acre-feet
Beginning Capacity in ASR (1):	varies
Maximum Diversion Rate into OCR:	1,000 cfs.
Use Pattern from the OCR:	Uniform.
Maximum Diversion from OCR (use and ASR):	50 cfs

(1) The beginning amount of water in ASR was varied between scenarios so that the ASR did not spill during the first few years of the simulation. Model results indicate that making this parameter different across scenarios does not change the resulting project yields.

Monthly flows from the TCEQ WAM RUN3 model were extracted at the project's location and disaggregated into an estimate of daily river flows using the Pedernales near Johnson City historical flow as a pattern. The FRAT model was modified to include the capability of storing excess diversions from the OCR into a daily accounting process (ASR) by which water stored from previous timesteps could be retrieved and used to satisfy the firm water supply demand when surface water supplies were exhausted. The Firm Annual Yield of the project was determined for each of the environmental flow scenarios. Flows before and after project diversions under the multiple environmental flow scenarios represented were compared and a summary of firm yield and before and after project river flows was made and is included in Appendix 8.

7.0 Environmental Flow Standard Recommendations

This section contains the Stakeholder Committee's (BBASC) consensus environmental flow standard recommendations, which are aimed at meeting the Committee's goal to "Develop implementable recommendations that provide for a sound ecological environment in the basins, including the rivers, bays and estuaries, balanced with sufficient water for other beneficial uses and which include an adaptive management process that provides for future sustainability."

This section organized into two main parts. The first part, Section 7.1, includes descriptions and implementation recommendations for the seven main components of the environmental flow standard recommendations. The second part, Sections 7.2 through 7.8, contains the environmental flow recommendations for the specific riverine and bay locations in the Colorado and Lavaca Basin and Bay areas.

In formulating its recommendations, the Stakeholder Committee considered information about the availability of unappropriated flows on an absolute basis at the various locations throughout the basins. The Committee also chose four locations in the basin and looked at how imposition of the full BBEST recommended flow regime would affect overall water availability at those locations. The four locations chosen were identified as sites with some of the highest availabilities of unappropriated flow. Finally, the Stakeholder Committee also evaluated two specific hypothetical water supply projects as a mechanism for seeing how imposition of all, or a portion, of the BBEST flow regime would affect water availability for such projects. More details about those evaluations are provided in Section 6.2.

7.1 Components of Environmental Flow Standard Recommendations

The Stakeholder Committee recommendations for environmental flow standards include the following components: riverine subsistence flows, base flows, pulse flows, and bay freshwater inflow standards. The Committee also considered overbank flows and channel maintenance flows, as discussed below, but has not included recommendations for incorporating those flow components into the flow standards. In order to implement the multiple levels of base flows included in these recommendations, the Committee has developed specific recommendations for the use of indicators of hydrologic condition. The Stakeholder Committee has not developed specific recommendations for a method of applying the recommended instream flow standards at specific points upstream or downstream of the listed locations, however, the Committee recommends that a method be developed to apply the applicable standards to all of these.

Natural processes can increase reservoir storage by scouring during extreme high flow situations, causing a water right to require amendment to reflect the resulting storage volume. The Stakeholder Committee recommends that such amendments that are solely to increase authorized impoundment capacity to reflect the capacity as it exists on the date that the environmental flow standards for the Colorado Basin are adopted or as it increases after that date resulting solely from natural processes such as scouring be treated as exempt from application of the standards.

1. Subsistence Flows

The Stakeholder Committee recommendations for instream flow locations include a subsistence flow component. The Committee understands subsistence flows to be flow levels that would be experienced very infrequently and thus recommends that the recommended flow standards be applied in a manner to permits subject to the standards in a manner that would prevent use of the permit from causing the flows to fall below subsistence levels. Accordingly, these flow standards recommendations provide that, when considering permits for new appropriations, diversion or impoundment should not be allowed during times when flows are below the subsistence flow levels and also provide that diversion or impoundment that would reduce flow down to subsistence levels should occur only during extremely dry, or severe periods characterized as the driest 5% of time based on hydrologic condition indicators. Furthermore, in order to avoid extended periods of flows at or near subsistence flow levels, these recommendations also provide that, even during severe hydrologic conditions, diversion or impoundment reducing flow down to subsistence flow levels should be allowed only when flows upstream of the diversion or impoundment are below the applicable dry base flow level.

Many of the streams and rivers in these basins have experienced periods of zero flows. Although the Stakeholder Committee acknowledges those periods as part of the natural hydrograph, the Committee recommends that the applicable standards be applied in a manner that would avoid increases in the frequency or duration of periods of zero flows. Accordingly, consistent with the BBEST recommendations, we have chosen 1.0 cfs as the lowest recommended subsistence flow value. Conversely, in our recommendations related to strategies to help achieve compliance with the environmental flow standard recommendations, we do not recommend that strategies be pursued to eliminate periods of zero flows for stream reaches in which such periods are a natural occurrence. Strategies may be appropriate in some locations to reduce the frequency or duration of zero flow periods where human-induced changes have increased the frequency or duration of such periods.

As noted in the discussions of individual locations for flow standard recommendations, the Stakeholder Committee recommendations for subsistence flow levels do differ from the BBEST recommendations for some locations. The BBEST flow regime recommendations for subsistence flows call for basing the subsistence flow recommendation on the highest of three different measurements: (1) 1.0 cfs, (2) the TCEQ critical low flow values from the TCEQ publication entitled *Procedures to Implement the Texas Surface Water Quality Standards*, or (3) the seasonal 95% exceedance flow level as calculated by the BBEST. As explained below, the Stakeholder Committee decided to eliminate the TCEQ critical low flow values from its consideration in establishing subsistence flow recommendations and, instead, chose the higher of 1.0 cfs or the seasonal 95th exceedance flow level.

Various Stakeholder Committee members commented that some of the subsistence flow values that were based on the TCEQ critical low flow values appeared to be high compared to flows commonly observed. In eliminating consideration of the TCEQ critical low flow values, the Stakeholder Committee did solicit input from the BBEST about the likelihood that the resulting subsistence flow value would be adequate to support a sound ecological environment. BBEST members were unanimous in their view that subsistence flow values based on the Stakeholder Committee's approach would be expected to achieve that goal if they were incorporated into an overall comprehensive flow regime in the manner described in the first paragraph of this section. The Stakeholder Committee felt that reducing the subsistence flow values in those instances when

the TCEQ critical low flow values had dictated the selection of a higher subsistence flow level than would otherwise apply represented a reasonable balancing to make more water available for potential water supply development.

Implementation for Subsistence Flows

The Stakeholder Committee recommends that these subsistence flow values be implemented as follows for water right authorizations subject to the environmental flow standards:

- a. Diversion or impoundment would not be allowed when flows at any applicable flow standard measurement point are below the applicable subsistence flow level.
- b. During severe hydrologic conditions, when flows at each applicable flow standard measurement point are above the applicable subsistence flow level but below the applicable dry base flow level, diversion or impoundment would be authorized as long as the flow at any applicable flow standard measurement point does not fall below the applicable subsistence flow level.
- c. During other hydrologic conditions, when flows are below the applicable base flow level for that hydrological condition at any applicable flow standard measurement point, diversion or impoundment would not be authorized.

2. Base Flows

Consistent with the BBEST's environmental flow regime recommendations, the Stakeholder Committee has recommended three levels of base flows for most locations.

As explained by the BBEST, differing levels of base flows are important in protecting variability and providing for a variety of habitat types. For example, low base flows often will favor habitats such as riffles and shallow runs, and the species most associated with those types of habitats, and high base flows often will favor deep pools and fast runs, and the species that do best in those habitat types. Accordingly, the Stakeholder Committee recommends the inclusion of three levels of base flows for most locations. However, consistent with the BBEST recommendations for the three locations in the lower Colorado River, the Committee recommends the use of two levels of base flows for those locations.

Implementation for Base Flows

The stakeholder committee recommends that the base flow values be implemented as follows for water right authorizations subject to the environmental flow standards:

- a. During dry hydrologic conditions, diversion or impoundment would be allowed when flows at each applicable flow standard measurement point are above the applicable dry base flow level and below any applicable pulse flow trigger or magnitude as long as the flow at any applicable flow standard measurement point does not fall below the applicable dry base flow level.
- b. During average hydrologic conditions, diversion or impoundment would be allowed when flows at each applicable flow standard measurement point are above the applicable average base flow level and below any applicable pulse flow trigger or magnitude as long as the flow at any applicable flow standard measurement point does not fall below the applicable average base flow level.

- c. During wet hydrologic conditions, diversion or impoundment would be allowed when flows at each applicable flow standard measurement point are above the applicable wet base flow level and below any applicable pulse flow trigger or magnitude as long as the flow at any applicable flow standard measurement point does not fall below the applicable wet base flow level.

3. Pulse Flows

Consistent with the BBEST's environmental flow regime recommendations, the Stakeholder Committee has recommended protection for multiple levels of pulse flows. However, the Committee's recommendations do provide for a reduced number of pulse levels at many locations compared to the BBEST recommendations and for a simplified implementation approach for protection of large pulses at all locations. The Stakeholder Committee also wants to make clear that it does not intend that the standards should require any permittee to release previously stored water from storage or to take other action to produce a pulse flow event that would not have occurred naturally.

The Stakeholder Committee did evaluate water availability and impacts on potential projects for environmental flow standards both with, and without, protection of pulse flows and recommended that pulse flows should be protected consistent with the implementation approaches set out below. Information about those evaluations is provided in Section 6.2.

The Stakeholder Committee recommended two different basic implementation approaches for pulse flows. Neither of those approaches relies on hydrologic condition for determining applicability of pulse flow requirements. Pulse flow requirements are intended to apply regardless of hydrologic condition.

Generally, for pulses with a recurrence interval of one-year or less (i.e., for seasonal pulses and annual pulses), the Committee recommends that the pulse flow requirement be implemented through permit conditions incorporated into any new appropriation permit issued which would be subject to these standards. By contrast, the Committee recommends, as a general rule, that larger pulses, those with a recurrence interval of greater than one-year, should be evaluated and implemented, if required, primarily through a modeling analysis. If that modeling evaluation indicates that a pulse flow standard is likely to be impaired, then appropriate permit conditions should be developed to avoid the impairment. Conversely, if the modeling evaluation indicates that no impairment is likely, then the permit can be issued without specific permit conditions to protect those larger pulses. As discussed below, there are some exceptions to the general rule.

This differentiation between the two pulse intervals resulted primarily from a concern about the complexity of tracking implementation of pulse flow requirements across multiple years, particularly for entities with smaller permits. In addition to recommending a different implementation approach for large pulses, as an additional consideration in balancing potential impacts on future water rights with environmental flow protection, the Committee also set certain threshold levels below which permit applications need not be assessed for potential impairment of the larger pulses. Generally, those thresholds are set at a diversion rate of 10% of the trigger flow, or magnitude, for the smallest pulse with a recurrence interval of greater than one year or at an impoundment capacity for an on-channel reservoir of 5% of the volume for that pulse. The applicable threshold values are indicated in the tables for the individual flow recommendations and the specific approach for applying those values is described below in the implementation discussion of this section.

Because the BBEST flow regime recommendations for pulses are based on different methodologies for the Colorado River locations below Austin than for other locations, the characterization of the resulting pulse flow recommendations also is different. As a result, the Stakeholder Committee descriptions and recommended implementation approaches for pulses also are different for those locations than for the other locations in the bay and basin area. The specific approaches to implementation of pulse flow components that are included in the recommended environmental flow standards are described below.

Implementation for Pulse Flows with a Recurrence Interval Equal to or Shorter than One-Per-Year

The Stakeholder Committee recommends that the seasonal and annual pulse flows be implemented through permit conditions as follows for water right authorizations subject to the environmental flow standards:

- a. Regardless of hydrologic condition, if flows at any applicable flow standard measurement point are above an applicable pulse flow trigger or magnitude, no diversion or impoundment may occur unless:
 1. the flow at each applicable flow standard measurement point equals or exceeds the corresponding pulse flow trigger or magnitude after accounting for the diversion or impoundment;
 2. the pulse flow requirements for the event that corresponds to the pulse flow trigger or magnitude have been satisfied; or
 3. the required number of pulse flow events for which the trigger or magnitude is exceeded has occurred within the relevant time period.
- b. Pulse flow triggers apply at the riverine flow standard measurement points other than on the Colorado River below the Longhorn Dam. Pulse flow magnitudes only apply for flow standard measurement points on the Colorado River below the Longhorn Dam and for those flow standard measurement points, the pulse flow requirements apply only to applications subject to these standards that seek authorization to:
 1. divert at a rate of 500 cfs or greater, or
 2. impound in a new on-channel impoundment with a capacity of 2,500 acre-feet or more.
- c. If the applicable pulse flow trigger or magnitude does not occur naturally during the relevant accounting period, then the water right holder need not stop diverting or impounding water to protect a pulse flow. The water right holder is not required to release water lawfully stored to produce a flow equal to a pulse flow trigger or magnitude.
- d. Pulse flow requirements for an event are considered to be satisfied if:
 1. for a flow standard measurement point on the Colorado River below Longhorn Dam, the daily average flow equals at least the listed magnitude on consecutive days equaling the listed duration; or
 2. for a flow standard measurement point other than on the Colorado River below Longhorn Dam, the peak flow equals at least the listed trigger level on an instantaneous basis and either the listed volume has passed the measurement point or the listed duration time has elapsed since the trigger level occurred.

- e. Satisfaction of the requirements for a larger pulse flow event would be considered as satisfying the requirements for a smaller pulse event during the same period. (For example, if an annual pulse flow event occurs within the spring season, that event is also considered to satisfy both the one-per-season and one of the two-per-season pulse flow events for the spring season at the same flow standard measurement point.)
- f. Notwithstanding provision b., for the riverine flow standard measurement points on the Colorado River below Longhorn Dam, once authorizations subject to the standards are approved upstream of that measurement point but below Longhorn Dam for diversions in a cumulative amount of greater than 1,250 cfs or for impoundment in new on-channel reservoirs with a cumulative impoundment capacity of greater than 6,750 acre-feet then the pulse flow requirements apply to applications subject to these standards that seek authorization to:
 1. divert at a rate of 250 cfs or greater; or
 2. impound in a new on-channel reservoir with a capacity of 1,250 acre-feet or more.

Implementation for Pulse Flows with a Recurrence Interval Longer than One-Per-Year
For Riverine Locations Other than the Colorado River below Longhorn Dam

For a riverine flow standard measurement point other than on the Colorado River below Longhorn Dam, the Stakeholder Committee recommends that pulse flows with a recurrence interval longer than one-per-year (i.e., larger than the annual pulse) should be implemented as follows for water right authorizations subject to the environmental flow standards:

- a. Those pulse flow requirements apply only to applications subject to these standards that seek the right to divert at a rate equal to or greater than 10% of the trigger level for the smallest applicable one-per-two-year pulse flow standard or to impound in an on-channel reservoir at least 5% of the volume of smallest applicable one-per-two-year pulse flow standard. Subject to provision f., smaller applications, as defined in the previous sentence, can ignore the pulse flow requirements for pulses with a recurrence interval of longer than one-per-year.
- b. Even for applications to which this provision applies, no conditions imposing any restrictions on operations to meet the flow standard for any pulses with a recurrence interval of longer than one-per-year would be required unless the evaluation described here indicates the need for such restrictions.
- c. Applications to which this provision applies would be evaluated to see if an applicable pulse flow standard with a recurrence interval of longer than one-per-year might be impaired:
 1. A pulse flow standard with a recurrence interval of longer than one-per-year would be considered impaired if the permit, in combination with other permits subject to the standards, would reduce the frequency of attainment for an applicable pulse by 10% or more or would reduce the average volume of protected pulses by 10% or more; and
 2. The baseline for comparison would be permits in effect at the time of adoption of the standards and the analysis would consider the full WAM period of record.
- d. If an impairment is indicated, any permit issued would include appropriate permit conditions to avoid the impairment, which should be flexible enough to allow the applicant to incorporate mitigation measures that contribute to avoiding the impairment.

- e. A cumulative impacts provision would apply once permits subject to the standards have been issued, upstream of the flow standard measurement location, that collectively authorize:
 - 1. Diversions at a cumulative diversion rate equal to or greater than 25% of the trigger level for the applicable one-per-two-year pulse; or
 - 2. Impoundment in on-channel reservoirs with a cumulative volume equal to or greater than 15% of the volume for the one-per-two-year pulse.
- f. Once the cumulative impacts provision applies (see e. above), future applications would be evaluated pursuant to provision c. to see if an applicable pulse flow standard with a recurrence interval of longer than one-per-year might be impaired if the application seeks to:
 - 1. divert at a rate greater than 5% of the smallest trigger level for any pulse with a recurrence interval of longer than one-per-year for that location; or
 - 2. impound in an on-channel reservoir more than 3% of the volume of any pulse with a recurrence interval of longer than one-per-year for that location.
- g. Satisfaction of the requirements for a larger pulse flow event would be considered as satisfying the requirements for a smaller pulse event during the same period. (For example, if a one-per-two-year pulse flow event occurs within the spring season, that event is also considered to satisfy the annual pulse requirement along with the one-per-season and one of the two-per-season pulse flow events for the spring season for the same flow standard measurement location.)

Implementation for Pulse Flows with a Recurrence Interval Longer than One-Per-Year For Riverine Locations on the Colorado River below Longhorn Dam

For a flow standard measurement point on the Colorado River below Longhorn Dam, the Stakeholder Committee recommends that pulse flows with a recurrence interval of one-per-eighteen-months should be implemented as follows for water right authorizations subject to the environmental flow standards:

- a. Except as provided in provision e., the one-per-eighteen month pulse flow requirement would apply only to applications subject to these standards that seek authorization to:
 - 1. Divert at a rate of 800 cfs or greater; or
 - 2. Impound in a new on-channel reservoir with a capacity of 2,500 acre-feet or more.
- b. For applications to which the one-per-eighteen-month pulse flow requirement applies, no conditions imposing any restrictions on operations to meet the flow standard for the one-per-eighteen-month pulse flow requirement would be required unless the evaluation described here indicates the need for such restrictions.

- c. Applications to which this provision applies would be evaluated to see if the one-per-eighteen-month pulse flow standard might be impaired as follows:
 - 1. The standard would be considered to be impaired if the permit, in combination with other permits subject to the standards, would reduce the frequency of attainment for the one-per-eighteen-month pulse flow standard by 10% or more or would reduce the average volume of the pulses protected by that standard by 10% or more; and
 - 2. The baseline for comparison would be permits in effect at the time of adoption of the standards and the analysis would consider the full WAM period of record.
- d. If an impairment is indicated, any permit issued would include appropriate permit conditions to avoid the impairment, which should be flexible enough to allow the applicant to incorporate mitigation measures that contribute to avoiding the impairment.
- e. Notwithstanding provision a., for any flow standard measurement point on the Colorado River below Longhorn Dam, once authorizations subject to the standards upstream of that measurement point but below Longhorn Dam are approved for diversions at a cumulative rate equal to or greater than 2,000 cfs or for impoundment in new on-channel reservoirs with a cumulative impoundment capacity of 7,500 acre-feet or more, the one-per-eighteen-month pulse flow requirement would apply to applications subject to these standards that seek authorization to:
 - 1. Divert at a rate greater than 400 cfs; or
 - 2. Impound in a new on-channel reservoir with a capacity of 1,250 acre-feet or more.
- f. Satisfaction of the requirements for a one-per-two-year pulse flow requirement during the compliance period for the one-per-eighteen-month pulse would also be considered as satisfying those requirements for the same flow standard measurement location.

For a flow standard measurement point on the Colorado River below Longhorn Dam, the stakeholder committee recommends that pulse flows with a recurrence interval of 1-per-2-years should be implemented as follows for water right authorizations subject to the environmental flow standards:

- a. Except as provided in provision c. of this section, the 1-per-2-year pulse flow requirement would apply only to applications subject to these standards that seek authorization to:
 - 1. divert at a rate of 2,700 cfs or greater; or
 - 2. impound in a new on-channel reservoir with a capacity of 2,500 acre-feet or more.
- b. For applications to which this provision applies, any permits issued should contain a permit provision providing protections equivalent to the following:

“A qualifying channel maintenance flow event is defined as an event that begins with a flow of at least 27,000 cfs, as measured at USGS Gage 08161000, Colorado River at Columbus, Texas, has a duration of 48 hours, and includes flows below 27,000 cfs that occur within the 48-hour period following the initial 27,000 cfs flow. If a qualifying channel maintenance flow event has not occurred within the last 24 months, and has not

been allowed to pass the diversion points, Permittee's diversions during the first 48 hours after the qualifying channel maintenance flow event has reached the diversion point shall not reduce streamflow below the applicable diversion point to less than the equivalent of 27,000 cfs at USGS Gage 08161000, Colorado River at Columbus, Texas.”

- c. Notwithstanding provision a., for any flow standard measurement point on the Colorado River below Longhorn Dam, once authorizations subject to the standards are approved upstream of that measurement point but below Longhorn Dam for diversions at a cumulative rate of 6,750 cfs or greater or for impoundment in new on-channel reservoirs with a cumulative impoundment capacity of 7,500 acre-feet or greater, then the one-per-two-year pulse flow requirement would apply to applications subject to these standards that seek authorization to:
 1. divert at a rate of 1,350 cfs or greater; or
 2. impound in a new on-channel reservoir with a capacity of 1,250 acre-feet or more.

4. Overbank Flows

The Stakeholder Committee acknowledges the importance of overbank flows, which are considered here to be those naturally-occurring flows that exceed the National Weather Service flood stage, in supporting a sound ecological environment. Although the Committee acknowledges that overbank flows play an important ecological role, the Committee is not recommending the imposition of permit conditions to protect overbank flows.

As noted by the BBEST, overbank flows provide important ecological functions, such as clearing large or accumulated in-channel debris, allowing access to the flood plain for organisms and seeds, and providing energy of the upper range of geomorphic activity. The Texas Environmental Flows Science Advisory Committee (SAC) also noted the importance of overbank flows in providing connections for aquatic organisms to move into floodplain areas and in maintaining the balance and diversity of organisms in riparian zones along rivers and streams. Similarly, the Stakeholder Committee recognizes that overbank flow events provide important inputs of sediment and nutrients to estuaries.

The Committee also believes that overbank flows are likely to continue to occur with relatively little impact from the types of future water development projects that are expected to occur in the Colorado and Lavaca River basins. Finally, the Committee also acknowledges that overbank flows can result in damage or harm to critical infrastructure and buildings and can imperil human life. Accordingly, the Committee is not recommending specific restrictions on diversion or impoundment that would apply to protect overbank flows. As is true for all other pulse-type flows, the Stakeholder Committee also is not recommending that any permittee should be required to make releases from storage or to otherwise seek to create an overbank flow that would not occur naturally.

The Committee urges public and private entities to consider the ecological benefits of overbank flows in developing policies and taking actions that might adversely impact riparian communities and channel structure in the Colorado and Lavaca River Basins. Further we believe that, as part of adaptive management activities in these river basins, the frequency, magnitude, and volume of overbank flows should be monitored and compared to the overbank flow recommendations of the BBEST to determine if significant changes in such flows are occurring over time and, if so, how such changes might be affecting the ecology of the river basins.

Where the BBEST environmental flow regime recommendations included pulse flow levels that were expected to produce overbank flows, the Stakeholder Committee requested that the BBEST recalculate pulse flows to identify a flow level below the overbank designation. A summary of the BBEST pulse flow recommendations expected to result in overbank flows and of the calculations provided by the BBEST in response to the Stakeholder Committee's request is included as Appendix 10. Based on those calculations, the Committee's pulse flow recommendations differ significantly from the BBEST recommendations. The specific recommendations are described by location in Sections 7.2-7.6. In general, however, the Committee made the following adjustments.

For six locations, none of the pulse flows recommended by the BBEST were indicated as producing overbank flows. The Stakeholder Committee recommendations include all of the pulses recommended by the BBEST for those locations, but subject to the implementation approaches described in Section 7.1, Subsction 4, above. For three locations, the one-per-five-year pulse was indicated as producing an overbank pulse and that pulse was simply removed from the recommendations because the one-per-two-year pulse, as recommended by the BBEST, came close to achieving a bank-full level without an indication of creating an overbank flow. For three locations, a pulse flow value between the one-per-five-year and the one-per-two-year pulse flow levels was added in an attempt to achieve as much of the ecological function as possible of the largest pulse but without recommending permit conditions to protect overbank flows.

For six locations, both the one-per-five-year and the one-per-two-year pulses were indicated as producing overbank flows. For two of those locations, the trigger level for the one-per-two-year pulse was reduced downward to avoid a recommendation indicated as producing an overbank flow. For the other four of those locations, both the one-per-five-year and the one-per-two-year pulses were eliminated from the recommendations because the annual pulse was viewed as achieving the bank-full function. In three instances, in addition to eliminating the two pulses, the trigger level for the annual pulse also was reduced downward to avoid a recommendation indicated as producing an overbank flow. In one instance, the trigger level for the one-per-season pulse flow in the spring also was adjusted downward to avoid an overbank flow.

The BBASC requested feedback from the BBEST regarding the potential for those changes to impact the likelihood that the environmental flow standard recommendations would support a sound ecological environment. In response to this request, the BBEST Chairman provided the following summary statement based on feedback received from several of the BBEST committee members:

A sound environment is likely to be maintained in these streams because in part, a pulse up to the flood stage (referred to in this context as a bankfull pulse) will provide some of the ecological services provided by overbank flows and in part because overbank flows are likely to continue to occur at these sites in the near future. If a water supply project could be constructed which could prevent overbank flows, it is possible the soundness of the environment could degrade as a result.

For the three locations on the Colorado River below Longhorn Dam, the BBEST recommendations describe a magnitude for overbank flows and simply describe those flows as having a frequency and duration that are naturally driven. Consistent with our approach for other locations, the Stakeholder Committee has acknowledged the importance of those flows but has not recommended any specific restrictions on diversion or impoundment to protect overbank flows.

5. Channel Maintenance Flows

The BBEST recommendations for all locations other than those in the Lower Colorado included a narrative channel maintenance flow component. The narrative recommendation provides as follows:

A quantity of flow in addition to flows provided by subsistence, base, pulse, and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.

The Stakeholder Committee discussed the implications of the BBEST recommendation regarding the inclusion of the channel maintenance flow component and considered a proposal that would have required project-specific reviews to consider channel morphology implications for large projects. Although the ecological significance of channel morphology was acknowledged, the Committee was not able to reach consensus on including any specific recommendations with respect to additional protection of channel morphology beyond the protection that is inherent in the other flow components that the Stakeholder Committee has recommended for inclusion. Accordingly, no such specific channel maintenance flow recommendation is included in this report.

The BBEST recommendations for the three locations in the Lower Colorado River do include a pulse flow component described as a “channel maintenance flow”. The study underlying the development of these particular pulse flows did consider channel maintenance issues. Although for these locations that particular pulse flow component was renamed by the Stakeholder Committee as a one-per-two-year pulse, the Committee’s decision to rename it is not intended to reflect any judgment that it does not serve channel maintenance functions.

The Stakeholder Committee acknowledges the role of channel morphology in an environmental flow regime. Because of a lack of sufficient data, at this juncture, the Committee is able to agree that further scientific analysis should be undertaken to help inform an understanding of how channel morphology in the Colorado and Lavaca Rivers and Matagorda and Lavaca Bays Basin and Bay area may be affected by various changes in flow and of the significance of the effects of those changes. The Committee anticipates addressing those issues in the development of a work plan so that additional information might be available for consideration in future revisions to environmental flow standards.

6. Hydrologic Condition

An indicator of hydrologic condition is recommended for use in determining when a particular level of base flow limits on diversion or impoundment in on-channel reservoirs should apply and when the diversion or impoundment of flows down to subsistence levels should be authorized. Pulse flow requirements and freshwater inflow requirements are intended to be applied at all times, regardless of hydrological condition. The Stakeholder Committee recommends that a hydrologic condition determination should be made at the beginning of a season and should control diversions for the remainder of that season. Because of the size of the bay and basin area and because of the differences in precipitation across the area, the Committee recommends that different hydrologic condition indicators should be used for different areas.

The Stakeholder Committee's goal in developing hydrologic condition indicators, for all locations except those on the Lower Colorado, is to create a mechanism that will result in engaging wet hydrologic conditions, with the corresponding high base flow requirements, about 25% of the time; average hydrologic conditions, with the corresponding medium base flow requirements, about 50% of the time; dry hydrologic conditions, with the corresponding low base flow requirements, about 20% of the time; and severe hydrologic conditions, with the corresponding combination of low base flow and subsistence flow requirements, about 5% of the time. For the three locations on the Lower Colorado River, the goal in developing hydrologic condition indicators is to have the average conditions indicator, with the corresponding average base flow requirements, engaged about 50% of the time; the dry conditions indicator, with the corresponding dry base flow requirements, engaged about 45% of the time; and the severe conditions indicator, with the corresponding combination of dry base flow and subsistence flow requirements, engaged about 5% of the time. Thus, the hydrologic indicator is intended to reasonably reflect climatic conditions and to align flow protections with those conditions.

The Stakeholder Committee recommends that permits subject to the standards should be issued with a requirement for ultimately complying with environmental flow standards using an implementation approach based on hydrologic condition indicators at least as protective as those resulting from a WAM RUN3 analysis. However, the Stakeholder Committee also recommends that hydrologic conditions based on other assumptions would be appropriate for use in implementation for some interim period of time until conditions come close to reaching the levels reflected in WAM RUN3. The over-riding principle in selecting appropriate assumptions for use in establishing hydrologic conditions is to achieve compliance with the goals for engagement set out above.

Due to time and resource limitations, the Stakeholder Committee did not analyze potential mechanisms other than the types selected here. For most locations, the Committee recommends use of cumulative flow calculated for the preceding 12-month period at a particular location and compared to the indicator values for that location. For the three lower Colorado River locations, the Committee recommends use of combined reservoir storage levels in Lakes Buchanan and Travis. For the locations on the Lavaca River, Navidad River, East and West Mustang Creek, and Sandy Creek, the Committee recommends use of storage levels in Lake Texana. The Committee's recommendations should not be construed as eliminating the possibility that there may exist, or may come into existence, some other more appropriate trigger mechanism for each or all stream segments. Again, the Committee's primary goal in selecting hydrologic condition indicators is to achieve compliance with the goals for engagement frequencies.

Accordingly, the Stakeholder Committee recommends implementation of the hydrologic condition aspect of the instream flow standards as follows:

1. Permits should be issued with conditions adequate to ensure compliance with environmental flow conditions and engagement frequencies using hydrological condition indicators based on WAM RUN3 calculated cumulative flows or reservoir storage/elevations, as applicable.
2. Permits should also include conditions requiring operation on an interim basis using an interim approach for determination of hydrological conditions. The operative principle in determining what interim approach would be appropriate is an attempt to achieve compliance with the goals for engagement frequency set out above during approximately the first ten years that the permit is in effect.
3. The interim hydrological condition indicators should be recalculated and adjusted on an ongoing basis for use in permits to which they apply at least once every ten years, including upon any amendment of the applicable environmental flow standards, in order to achieve compliance with the goals for engagement frequency set out above, or in any amended standards, on a continuing basis.
4. Table 7.1-1 sets out the recommended indicator type, the data set recommended for use in establishing hydrologic condition triggers on an interim basis, and the reservoir levels or cumulative flow totals calculated for interim use by the Stakeholder Committee in achieving a reasonable level of compliance with the goals for engagement for an initial, interim period.

The interim values stated in Table 7.1-1 are derived from the calculations set out in Appendices 11 through 16. Most of the values have been rounded to the nearest multiple of ten for simplicity. The rounding rule used was that values ending in 1 through 4 were rounded down and values ending in 5 through 9 were rounded up. Values stated in elevation above mean sea level were not rounded.

Table 7.1-1

Hydrologic Condition Interim Indicators						
Location	Indicator Type	Data Used	Indicator For Wet Conditions	Indicator For Avg. Conditions	Indicator For Dry Conditions	Indicator For Severe Conditions
Colorado River Above Silver	12-month cumulative flow	Hist. 1980-2010	>57,490 af	≤57,490 af and >16,600 af	≤16,600 af and >4,090 af	≤4,090 af
Colorado River near Ballinger	12-month cumulative flow	Hist. 1980-2010	>67,700 af	≤67,700 af and >11,150 af	≤11,150 af and >3,120 af	≤3,120 af
Elm Creek At Ballinger	12-month Cumulative Flow	Hist. 1980-2010	>46,560 af	≤46,560 af and >4,990 af	≤4,990 af and >820 af	≤820 af

Table 7.1-1 (cont.)

Hydrologic Condition Interim Indicators						
Location	Indicator Type	Data Used	Indicator For Wet Conditions	Indicator For Avg. Conditions	Indicator For Dry Conditions	Indicator For Severe Conditions
South Concho River at Christoval	12-month cumulative flow	Hist. 1980-2010	>21,660 af	≤21,660 af and >7,380 af	≤7,380 af and >5,270 af	≤5,270 af
Concho River at Paint Rock	12-month cumulative flow	Hist. 1980-2010	>49,900 af	≤49,900 af and >17,000 af	≤17,000 af and >7,110 af	≤7,110 af
Pecan Bayou near Mullin	12-month cumulative flow	Hist. 1980-2010	>187,740 af	≤187,740 af And >26,700 af	≤26,700 af and >11,860 af	≤11,860 af
San Saba River at San Saba	12-month cumulative flow	Hist. 1980-2010	>149,890 af	≤149,890 af and >61,100 af	≤61,100 af and >40,550 af	≤40,550 af
Colorado River near San Saba	12-month cumulative flow	Hist. 1980-2010	>568,970 af	≤568,970 af and >205,110 af	≤205,110 af and >80,510 af	≤80,510 af
Llano River At Llano	12-month cumulative flow	Hist. 1980-2010	>364,540 af	≤364,540 af and >145,660 af	≤145,660 af and >90,810 af	≤90,810 af
Pedernales River near Johnson City	12-month cumulative flow	Hist. 1980-2010	>222,700 af	≤222,700 af and >70,210 af	≤70,210 af and >27,710 af	≤27,710 af
Onion Creek near Driftwood	12-month cumulative flow	Hist. 1980-2010	>59,610 af	≤59,610 af and >10,460 af	≤10,460 af and >810 af	≤810 af

Table 7.1-1 (cont.)

Hydrologic Condition Interim Indicators						
Location	Indicator Type	Data Used	Indicator For Wet Conditions	Indicator For Avg. Conditions	Indicator For Dry Conditions	Indicator For Severe Conditions
Colorado River at Bastrop	Combined Storage, Travis and Buchanan	Hist. 1980-2010	N/A	>1,737,460 af	≤1,737,460af and >1,103,700af	≤1,103,700 af
Colorado River at Columbus	Combined Storage, Travis and Buchanan	Hist. 1980-2010	N/A	>1,737,460 af	≤1,737,460af and >1,103,700af	≤1,103,700 af
Colorado River at Wharton	Combined Storage, Travis and Buchanan	Hist. 1980-2010	N/A	>1,737,460 af	≤1,737,460af and >1,103,700af	≤1,103,700 af
W. Mustang near Ganado	Lake Texana elevation	Hist. 1983-2010	>44.00 msl	≤44.00 msl and >43.00 msl	≤43.00 msl and >39.95 msl	≤39.95 msl
E. Mustang near Louise	Lake Texana elevation	Hist. 1983-2010	>44.00 msl	≤44.00 msl and >43.00 msl	≤43.00 msl and >39.95 msl	≤39.95 msl
Navidad River near Edna	Lake Texana elevation	Hist. 1983-2010	>44.00 msl	≤44.00 msl and >43.00 msl	≤43.00 msl and >39.95 msl	≤39.95 msl
Sandy Creek near Ganado	Lake Texana elevation	Hist. 1983-2010	>44.00 msl	≤44.00 msl and >43.00 msl	≤43.00 msl and >39.95 msl	≤39.95 msl

Table 7.1-1 (cont.)

Hydrologic Condition Interim Indicators						
Location	Indicator Type	Data Used	Indicator For Wet Conditions	Indicator For Avg. Conditions	Indicator For Dry Conditions	Indicator For Severe Conditions
Lavaca River near Edna	Lake Texana elevation	Hist. 1983-2010	>44.00 msl	≤44.00 msl and >43.00 msl	≤43.00 msl and >39.95 msl	≤39.95 msl
Tres Palacios Creek near Midfield	12-month cumulative flow	Hist. 1980-2010	>158,630 af	≤158,630 af and >62,920 af	≤62,920 af and >31,940 af	≤31,940 af
Garcitas Creek near Inez	12-month cumulative flow	Hist. 1980-2010	>62,460 af	≤62,460 af and >10,790 af	≤10,790 af and >1,880 af	≤1,880 af

af = acre-feet

msl = mean sea level

N/A = not applicable

7. Freshwater Inflows

Freshwater inflow recommendations are included for three bay systems: East Matagorda Bay, Matagorda Bay, and Lavaca Bay. For the Tres Palacios Creek Coastal Basin, because there is no specific freshwater inflow recommendation, protection of instream flows, including large pulses, all the way to the coast will be even more important for that system than for the others.

Protection of adequate freshwater inflows is a high priority for many members of the Stakeholder Committee. The Committee acknowledged the importance of those inflows in supporting economically important commercial and recreational fishing and nature tourism.

For East Matagorda Bay, the freshwater inflow recommendation is in a narrative form because there are no gaged inflows to East Matagorda Bay. Specific quantitative freshwater inflow recommendations are included for contributions from the Colorado River Basin to Matagorda Bay and from the Lavaca River Basin and Garcitas Creek to Lavaca Bay.

7.2 Environmental Flow Standard Recommendations – Upper Colorado River

The Upper Colorado River is described as those locations on the Colorado above Lake Travis including the tributaries to the river from the confluence with the Pedernales River. And for the purposes of this report, locations upstream and including Onion Creek are also included in this section. (See maps on pages 1-8 and 1-12 of the BBEST Colorado-Lavaca BBEST Environmental Flow Regimes Report.)

STAKEHOLDER CONSIDERATIONS GENERALLY APPLICABLE TO ALL SITES

The Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations for locations on the Upper Colorado. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water throughout the upper Colorado and found it generally to be very limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Because water availability is similar throughout the Upper Colorado River Basin, the Committee, again with the assistance of the BBEST, evaluated a hypothetical aquifer storage and recovery project at a single location upstream of the Highland Lakes in order to gain a better understanding of the potential impact of recommended flow standards on water availability in this portion of the basin. That evaluation is discussed in the Section 6.2 of this report. The evaluation indicated that imposition of the full environmental flow regime, as recommended by the BBEST, would have little impact on water availability.

For several Upper Colorado locations, the Committee adjusted the subsistence flows downward from the TCEQ critical low flow levels recommended by the BBEST to the 95th percentile flows. The Committee considered that adjustment based on observations by some individual members that the critical low flow values at various locations seemed quite high when compared to conditions commonly observed. The Committee sought feedback from the BBEST about the implications of that adjustment and, specifically, about the potential impact on the likelihood of having flow recommendations that would protect a sound ecological environment. The BBEST indicated that, if the Stakeholder Committee used an implementation approach that allowed diversions down to, but not lower than, subsistence levels only during the hydrological condition designed to represent the driest 5% of the time and only at times during that hydrological condition when flows were below the corresponding dry base flow level, those adjusted subsistence levels were likely to support a sound ecological environment. The Committee decided to recommend the use of the 95th percentile flow levels with the implementation approach as suggested by the BBEST. That adjustment was made at the following Upper Colorado locations because the BBEST subsistence values at those locations were based on TCEQ critical low flow levels: Llano River at Llano, Pecan Bayou near Mullin, San Saba River at San Saba, and Pedernales River near Johnson City.

The Committee adopted the BBEST subsistence (as adjusted), base low, base medium and base high flow recommendations and the two-per-season, one-per-season and one-per-year pulse flow recommendations for all sites on the Upper Colorado. However, the one-per-two year and one-per-five year pulse flow values recommended by the BBEST were adjusted. Specifically, in various locations, the one-per-two-year and the one-per-five-year pulse flows were identified as overbank

flows. The Stakeholder Committee did not include recommendations for developing permit conditions or evaluations that would restrict diversion or impoundment of overbank flows.

The respective pulse flow values, and adjustments to those values, will be discussed in the specific location reports. As discussed above, in the section of the report dealing with overbank flows, the Stakeholder Committee believes that overbank flows play an important ecological function but decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a peak flow that does not produce overbank conditions.

The BBEST recommendations also included an unquantified channel maintenance flow component for all Upper Colorado locations. In the absence of more definitive information and after significant discussion, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER ABOVE SILVER

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Colorado River above Silver location. That BBEST recommendation, as summarized in a table on page 1-9 of the BBEST Report, is reproduced immediately below.

Colorado River above Silver, USGS Gage 08123850, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1957-2009	7 periods Max duration: 31 days	45 periods Max duration: 110 days	35 periods Max duration: 56 days	16 periods Max duration: 70 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	2 cfs	2 cfs	1 cfs	1 cfs
Base Medium	4 cfs	5 cfs	3 cfs	4 cfs
Base High	7 cfs	12 cfs	8 cfs	10 cfs
2 Pulses per season	Trigger: 18 cfs Volume: 120 af Duration: 11 days	Trigger: 600 cfs Volume: 2,500 af Duration: 9 days	Trigger: 100 cfs Volume: 350 af Duration: 6 days	Trigger: 100 cfs Volume: 400 af Duration: 6 days
1 Pulse per season	Trigger: 42 cfs Volume: 300 af Duration: 15 days	Trigger: 1,800 cfs Volume: 7,900 af Duration: 11 days	Trigger: 330 cfs Volume: 1,400 af Duration: 9 days	Trigger: 430 cfs Volume: 1,800 af Duration: 9 days
1 Pulse per year	Trigger: 3,000 cfs Volume: 13,600 af Duration: 17 days			
1 Pulse per 2 years	Trigger: 4,500 cfs Volume: 20,400 af Duration: 18 days			
1 Pulse per 5 years (Overbank)	Trigger: 8,100 cfs Volume: 36,700 af Duration: 21 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a trigger level larger than the one-per-two-year pulse because of the desire to avoid recommending specific protection of pulses producing overbank flows.
- b) The Stakeholder Committee decided not to include specific recommendations for addressing channel maintenance issues at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08123850, Colorado River Above Silver

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	1	2	Trigger: 18 cfs Volume: 120 af Duration: 13 days	Trigger: 42 cfs Volume: 300 af Duration: 15 days	Trigger: 3,000 cfs Volume: 13,600 af Duration: 17 days
Winter	Dry	N/A	2			
Winter	Average	N/A	4			
Winter	Wet	N/A	7			
Spring	Severe	1	2			
Spring	Dry	N/A	2			
Spring	Average	N/A	5			
Spring	Wet	N/A	12			
Summer	Severe	1	1			
Summer	Dry	N/A	1			
Summer	Average	N/A	3			
Summer	Wet	N/A	8			
Fall	Severe	1	1	Trigger: 100 cfs Volume: 400 af Duration: 6 days	Trigger: 330 cfs Volume: 1,400 af Duration: 9 days	Trigger: 430 cfs Volume: 1,800 af Duration: 9 days
Fall	Dry	N/A	1			
Fall	Average	N/A	4			
Fall	Wet	N/A	10			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Colorado above Silver; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	4,500	20,400	18	450	1,020

The value of a 1-per-5-year pulse with a trigger of 8,100 cfs, a volume of 36,700 af, and a duration of 21 days is recognized as creating an overbank condition, but no permit review or conditions to protect such pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER NEAR BALLINGER

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Colorado River near Ballinger location. That BBEST recommendation, as summarized in a table on page 1-10 of the BBEST Report, is reproduced immediately below.

Colorado River near Ballinger, USGS Gage 08126380, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1908-2009	14 periods Max duration: 86 days	41 periods Max duration: 83 days	32 periods Max duration: 107 days	13 periods Max duration: 69 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	4 cfs	3 cfs	2 cfs	4 cfs
Base Medium	9 cfs	9 cfs	6 cfs	9 cfs
Base High	14 cfs	19 cfs	14 cfs	17 cfs
2 Pulses per season	Trigger: 27 cfs Volume: 180 af Duration: 11 days	Trigger: 1,300 cfs Volume: 5,300 af Duration: 9 days	Trigger: 130 cfs Volume: 490 af Duration: 6 days	Trigger: 250 cfs Volume: 950 af Duration: 8 days
1 Pulse per season	Trigger: 96 cfs Volume: 660 af Duration: 17 days	Trigger: 3,200 cfs Volume: 13,700 af Duration: 10 days	Trigger: 630 cfs Volume: 2,600 af Duration: 9 days	Trigger: 1,500 cfs Volume: 5,700 af Duration: 10 days
1 Pulse per year	Trigger: 4,500 cfs Volume: 18,300 af Duration: 13 days			
1 Pulse per 2 years (Overbank)	Trigger: 7,400 cfs Volume: 29,800 af Duration: 14 days			
1 Pulse per 5 years (Overbank)	Trigger: 12,300 cfs Volume: 49,000 af Duration: 15 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The Stakeholder Committee decided not to recommend a one-per-two-year or a one-per-five-year pulse or any pulse with a trigger level larger than the one-per-year pulse at this location. The one-per-year pulse trigger level at this location is very close to the bankfull level.
- c) The Stakeholder Committee decided not to include specific recommendations for addressing channel maintenance issues at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08126380, Colorado near Ballinger

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	1	4	Trigger: 27 cfs Volume: 180 af Duration: 11 days	Trigger: 96 cfs Volume: 660 af Duration: 17 days	Trigger: 4,500 cfs Volume: 18,300 af Duration: 13 days
Winter	Dry	N/A	4			
Winter	Average	N/A	9			
Winter	Wet	N/A	14			
Spring	Severe	1 cfs	3			
Spring	Dry	N/A	3			
Spring	Average	N/A	9			
Spring	Wet	N/A	19			
Summer	Severe	1	2			
Summer	Dry	N/A	2			
Summer	Average	N/A	6			
Summer	Wet	N/A	14			
Fall	Severe	1	4	Trigger: 250 cfs Volume: 950 af Duration: 8 days	Trigger: 1,500 cfs Volume: 5,700 af Duration: 10 days	
Fall	Dry	N/A	4			
Fall	Average	N/A	9			
Fall	Wet	N/A	17			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

The value of a 1-per-2-year pulse with a trigger of 7,400 cfs, a volume of 29,800 af, and a duration of 14 days and a 1-per-5-year pulse with a trigger of 12,200 cfs, a volume of 49,000 af, and a duration of 15 days are recognized as creating an overbank condition, but no permit review or conditions to protect such pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER NEAR SAN SABA

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Colorado River near San Saba location. That BBEST recommendation, as summarized in a table on page 1-11 of the BBEST Report, is reproduced immediately below.

Colorado River near San Saba, USGS Gage 08147000, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1923-2009	0 periods Max duration: 0 days	0 periods Max duration: 0 days	4 periods Max duration: 24 days	0 periods Max duration: 0 days
Subsistence	50 cfs	50 cfs	30 cfs	30 cfs
Base Low	95 cfs	120 cfs	72 cfs	95 cfs
Base Medium	150 cfs	190 cfs	120 cfs	150 cfs
Base High	210 cfs	360 cfs	210 cfs	210 cfs
2 Pulses per season	Trigger: 520 cfs Volume: 3,100 af Duration: 9 days	Trigger: 5,800 cfs Volume: 31,300 af Duration: 9 days	Trigger: 510 cfs Volume: 1,900 af Duration: 4 days	Trigger: 890 cfs Volume: 3,500 af Duration: 6 days
1 Pulse per season	Trigger: 1,600 cfs Volume: 11,100 af Duration: 15 days	Trigger: 11,000 cfs Volume: 70,200 af Duration: 13 days	Trigger: 1,400 cfs Volume: 6,500 af Duration: 7 days	Trigger: 3,800 cfs Volume: 19,200 af Duration: 12 days
1 Pulse per year	Trigger: 18,900 cfs Volume: 129,100 af Duration: 23 days			
1 Pulse per 2 years	Trigger: 30,400 cfs Volume: 222,200 af Duration: 28 days			
1 Pulse per 5 years	Trigger: 39,600 cfs Volume: 300,500 af Duration: 31 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows do not differ from the BBEST recommended levels.

The Stakeholder Committee decided not to include specific recommendations for addressing channel maintenance issues at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08147000, Colorado near San Saba

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*	
Winter	Severe	50	95	Trigger: 520 cfs Volume: 3,100 af Duration: 9 days	Trigger: 1,600 cfs Volume: 11,100 af Duration: 15 days	Trigger: 18,900 cfs Volume: 129,100 af Duration: 23 days	
Winter	Dry	N/A	95				
Winter	Average	N/A	150				
Winter	Wet	N/A	210				
Spring	Severe	50	120	Trigger: 5,800 cfs Volume: 31,300 af Duration: 9 days	Trigger: 11,000 cfs Volume: 70,200 af Duration: 13 days		
Spring	Dry	N/A	120				
Spring	Average	N/A	190				
Spring	Wet	N/A	360				
Summer	Severe	30	72	Trigger: 510 cfs Volume: 1,900 af Duration: 4 days	Trigger: 1,400 cfs Volume: 6,500 af Duration: 7 days		
Summer	Dry	N/A	72				
Summer	Average	N/A	120				
Summer	Wet	N/A	210				
Fall	Severe	30	95	Trigger: 890 cfs Volume: 3,500 af Duration: 6 days	Trigger: 3,800 cfs Volume: 19,200 af Duration: 12 days		
Fall	Dry	N/A	95				
Fall	Average	N/A	150				
Fall	Wet	N/A	210				

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Colorado River near San Saba; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	30,400	222,200	28	3,040	11,110
1 per 5 years	39,600	300,500	31	3,040	11,110

The Stakeholder Committee made a 1-per-5-year pulse environmental flow value recommendation for this location because overbank flows are not attained on a frequency of once per five years.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR ELM CREEK AT BALLINGER

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Elm Creek at Ballinger location. That BBEST recommendation, as summarized in a table on page 1-13 of the BBEST Report, is reproduced immediately below.

Elm Creek at Ballinger, USGS Gage 08127000, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1933-2009	Average number of days each year with no flow = 130			
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	1 cfs	1 cfs	1 cfs	1 cfs
Base Medium	1 cfs	1 cfs	1 cfs	1 cfs
Base High	4 cfs	5 cfs	1 cfs	1 cfs
2 Pulses per season	Trigger: 10 cfs Volume: 71 af Duration: 10 days	Trigger: 380 cfs Volume: 1,400 af Duration: 10 days	Trigger: 6 cfs Volume: 25 af Duration: 6 days	Trigger: 10 cfs Volume: 46 af Duration: 9 days
1 Pulse per season	Trigger: 40 cfs Volume: 270 af Duration: 16 days	Trigger: 1,000 cfs Volume: 3,800 af Duration: 12 days	Trigger: 74 cfs Volume: 300 af Duration: 10 days	Trigger: 190 cfs Volume: 850 af Duration: 15 days
1 Pulse per year	Trigger: 1,900 cfs Volume: 7,200 af Duration: 18 days			
1 Pulse per 2 years	Trigger: 3,500 cfs Volume: 13,100 af Duration: 20 days			
1 Pulse per 5 years (Overbank)	Trigger: 6,300 cfs Volume: 22,700 af Duration: 22 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) Overbank levels are attained at this gage at the one-per-five-year pulse level. However, a one-per-four-year pulse event is below the level identified as producing an overbank flow and the Stakeholder Committee recommended including a 1-per-4-year pulse flow value.
- b) The Stakeholder Committee decided not to recommend a one-per-five-year pulse value.
- c) The Stakeholder Committee decided not to include specific recommendations for addressing channel maintenance issues at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08127000, Elm Creek at Ballinger

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	1	1	Trigger: 10 cfs Volume: 71 af Duration: 10 days	Trigger: 40 cfs Volume: 270 af Duration: 16 days	Trigger: 1,900 cfs Volume: 7,200 af Duration: 18 days
Winter	Dry	N/A	1			
Winter	Average	N/A	1			
Winter	Wet	N/A	4			
Spring	Severe	1	1			
Spring	Dry	N/A	1			
Spring	Average	N/A	1			
Spring	Wet	N/A	5			
Summer	Severe	1	1			
Summer	Dry	N/A	1			
Summer	Average	N/A	1	Trigger: 6 cfs Volume: 25 af Duration: 6 days	Trigger: 74 cfs Volume: 300 af Duration: 9 days	
Summer	Wet	N/A	1			
Fall	Severe	1	1	Trigger: 10 cfs Volume: 46 af Duration: 9 days	Trigger: 190 cfs Volume: 850 af Duration: 15 days	
Fall	Dry	N/A	1			
Fall	Average	N/A	1			
Fall	Wet	N/A	1			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Elm Creek at Ballinger; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	3,500	13,000	20	350	650
1 per 4 years	6,100	21,909	21	350	650

The Stakeholder Committee made a 1-per-4-year pulse flow recommendation for this location because overbank flows occur at the trigger for a pulse frequency of once per five years. The value of a 1-per-5-year pulse with a trigger of 6,300 cfs, a volume of 22,700 af, and a duration of 22 days is recognized as creating an overbank condition, but no permit review or conditions to protect such pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR CONCHO RIVER AT PAINT ROCK

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Concho River at Paint Rock location. That BBEST recommendation, as summarized in a table on page 1-14 of the BBEST Report, is reproduced immediately below.

Concho River at Paint Rock, USGS Gage 08136500, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1916-2009	5 periods Max duration: 42 days	40 periods Max duration: 78 days	40 periods Max duration: 316 days	18 periods Max duration: 154 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	8 cfs	4 cfs	1 cfs	5 cfs
Base Medium	20 cfs	14 cfs	4 cfs	16 cfs
Base High	36 cfs	27 cfs	12 cfs	29 cfs
2 Pulses per season	Trigger: 61 cfs Volume: 400 af Duration: 10 days	Trigger: 500 cfs Volume: 2,000 af Duration: 8 days	Trigger: 32 cfs Volume: 140 af Duration: 6 days	Trigger: 74 cfs Volume: 330 af Duration: 7 days
1 Pulse per season	Trigger: 160 cfs Volume: 1,200 af Duration: 16 days	Trigger: 1,400 cfs Volume: 5,700 af Duration: 11 days	Trigger: 110 cfs Volume: 520 af Duration: 8 days	Trigger: 300 cfs Volume: 1,300 af Duration: 10 days
1 Pulse per year	Trigger: 3,000 cfs Volume: 13,500 af Duration: 19 days			
1 Pulse per 2 years	Trigger: 5,200 cfs Volume: 23,400 af Duration: 23 days			
1 Pulse per 5 years	Trigger: 12,300 cfs Volume: 55,300 af Duration: 29 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The Committee did include a recommendation for protection of one-per-five-year pulse flows at this gauge, where the one-per-five-year pulse trigger is substantially below the overbank flow level.
- b) The Stakeholder Committee decided not to include specific recommendations for addressing channel maintenance issues at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08136500, Concho River at Paint Rock

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*	
Winter	Severe	1	8	Trigger: 61 cfs Volume: 400 af Duration: 10 days	Trigger: 160 cfs Volume: 1,200 af Duration: 16 days	Trigger: 3,000 cfs Volume: 13,500 af Duration: 19 days	
Winter	Dry	N/A	8				
Winter	Average	N/A	20				
Winter	Wet	N/A	36				
Spring	Severe	1	4	Trigger: 500 cfs Volume: 2,000 af Duration: 8 days	Trigger: 1,400 cfs Volume: 5,700 af Duration: 11 days		
Spring	Dry	N/A	4				
Spring	Average	N/A	14				
Spring	Wet	N/A	27				
Summer	Severe	1	1	Trigger: 32 cfs Volume: 140 af Duration: 6 days	Trigger: 110 cfs Volume: 520 af Duration: 8 days	Trigger: 300 cfs Volume: 1,300 af Duration: 10 days	
Summer	Dry	N/A	1				
Summer	Average	N/A	4				
Summer	Wet	N/A	12				
Fall	Severe	1	5	Trigger: 74 cfs Volume: 330 af Duration: 7 days	Trigger: 300 cfs Volume: 1,300 af Duration: 10 days	Trigger: 3,000 cfs Volume: 13,500 af Duration: 19 days	
Fall	Dry	N/A	5				
Fall	Average	N/A	16				
Fall	Wet	N/A	29				

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Concho River at Paint Rock; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	5,200	23,400	23	520	1170
1 per 5 years	12,300	55,300	29	520	1170

The Stakeholder Committee made a 1-per-5-year pulse environmental flow regime recommendation for this location because overbank flows are not attained once in five years.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR SOUTH CONCHO RIVER AT CHRISTOVAL

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the South Concho River at Christoval location. That BBEST recommendation, as summarized in a table on page 1-15 of the BBEST Report, is reproduced immediately below.

South Concho River at Christoval, USGS Gage 08128000, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1931-1994	0 days with no flow during period of record			
Subsistence	2 cfs	3 cfs	2 cfs	2 cfs
Base Low	9 cfs	9 cfs	7 cfs	7 cfs
Base Medium	15 cfs	15 cfs	12 cfs	12 cfs
Base High	22 cfs	22 cfs	22 cfs	22 cfs
2 Pulses per season	Not applicable	Not applicable	Not applicable	Not applicable
1 Pulse per season	Not applicable	Not applicable	Not applicable	Trigger: 45 cfs Volume: 190 af Duration: 7 days
1 Pulse per year	Trigger: 420 cfs Volume: 1,400 af Duration: 9 days			
1 Pulse per 2 years	Trigger: 930 cfs Volume: 2,800 af Duration: 10 days			
1 Pulse per 5 years	Trigger: 2,600 cfs Volume: 6,800 af Duration: 11 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) No change was made from the BBEST pulse recommendations up through the one-per-five year level at this location.
- b) The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08128000, South Concho River at Christoval

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	2	9	N/A	N/A	Trigger: 420 cfs Volume: 1,400 af Duration: 9 days
Winter	Dry	N/A	9			
Winter	Average	N/A	15			
Winter	Wet	N/A	22			
Spring	Severe	3	9			
Spring	Dry	N/A	9			
Spring	Average	N/A	15			
Spring	Wet	N/A	22			
Summer	Severe	2	7			
Summer	Dry	N/A	7			
Summer	Average	N/A	12			
Summer	Wet	N/A	22			
Fall	Severe	2	7	N/A	Trigger: 45 cfs Volume: 190 af Duration: 7 days	
Fall	Dry	N/A	7			
Fall	Average	N/A	12			
Fall	Wet	N/A	22			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

South Concho River at Christoval ; Pulse larger than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	930	2,800	10	93	140
1 per 5 years	2,600	6,800	11	93	140

The Stakeholder Committee made a 1-per-5-year pulse environmental flow regime recommendation for this location because overbank levels are not attained once in five years.

**ENVIRONMENTAL FLOW STANDARD RECOMMENDATION
FOR PECAN BAYOU NEAR MULLIN**

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Pecan Bayou near Mullin location. That BBEST recommendation, as summarized in a table on page 1-16 of the BBEST Report, is reproduced immediately below.

Pecan Bayou near Mullin, USGS Gage 08143600, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1968-2009	0 periods Max duration: 0 days	2 periods Max duration: 69 days	7 periods Max duration: 54 days	1 periods Max duration: 9 days
Subsistence	2 cfs	2 cfs	2 cfs	2 cfs
Base Low	3 cfs	3 cfs	2 cfs	3 cfs
Base Medium	7 cfs	9 cfs	4 cfs	7 cfs
Base High	12 cfs	19 cfs	8 cfs	12 cfs
2 Pulses per season	Trigger: 52 cfs Volume: 230 af Duration: 7 days	Trigger: 710 cfs Volume: 3,600 af Duration: 10 days	Trigger: 21 cfs Volume: 73 af Duration: 4 days	Trigger: 36 cfs Volume: 110 af Duration: 3 days
1 Pulse per season	Trigger: 250 cfs Volume: 1,500 af Duration: 14 days	Trigger: 2,100 cfs Volume: 13,200 af Duration: 17 days	Trigger: 100 cfs Volume: 440 af Duration: 7 days	Trigger: 250 cfs Volume: 1,200 af Duration: 9 days
1 Pulse per year	Trigger: 3,500 cfs Volume: 25,800 af Duration: 26 days			
1 Pulse per 2 years	Trigger: 6,700 cfs Volume: 54,100 af Duration: 33 days			
1 Pulse per 5 years	Trigger: 13,900 cfs Volume: 124,900 af Duration: 43 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

Except for subsistence flow values, the BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee. For the subsistence flow recommendation, the Stakeholder Committee substituted the greater of 1 cfs or the 95th percentile flow levels for the TCEQ critical low flow values at this location.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The Committee made a one-per-five year pulse flow recommendation at this gauge, where the trigger level for the one-per-five year pulse is substantially below the overbank flow.
- b) The Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08143600, Pecan Bayou near Mullin

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	1	3	Trigger: 52 cfs Volume: 230 af Duration: 7 days	Trigger: 250 cfs Volume: 1,500 af Duration: 14 days	Trigger: 3,500 cfs Volume: 25,800 af Duration: 26 days
Winter	Dry	N/A	3			
Winter	Average	N/A	7			
Winter	Wet	N/A	12			
Spring	Severe	1	3			
Spring	Dry	N/A	3			
Spring	Average	N/A	9			
Spring	Wet	N/A	19			
Summer	Severe	1	2			
Summer	Dry	N/A	2			
Summer	Average	N/A	4			
Summer	Wet	N/A	8			
Fall	Severe	1	3	Trigger: 36 cfs Volume: 110 af Duration: 3 days	Trigger: 250 cfs Volume: 1,200 af Duration: 9 days	Trigger: 100 cfs Volume: 440 af Duration: 7 days
Fall	Dry	N/A	3			
Fall	Average	N/A	7			
Fall	Wet	N/A	12			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pecan Bayou near Mullin; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	6,700	54,100	33	670	2,705
1 per 5 years	13,900	124,900	43	670	2,705

The Stakeholder Committee makes a 1-per-5-year pulse environmental flow regime recommendation for this location because overbank levels are not attained once in five years.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR SAN SABA RIVER AT SAN SABA

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the San Saba River at San Saba location. That BBEST recommendation, as summarized in a table on page 1-17 of the BBEST Report, is reproduced immediately below.

San Saba River at San Saba, USGS Gage 08146000, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1916-1992	0 periods Max duration: 0 days	2 periods Max duration: 3 days	13 periods Max duration: 46 days	0 periods Max duration: 0 days
Subsistence	29 cfs	22 cfs	22 cfs	22 cfs
Base Low	56 cfs	56 cfs	32 cfs	40 cfs
Base Medium	81 cfs	81 cfs	46 cfs	64 cfs
Base High	110 cfs	110 cfs	62 cfs	87 cfs
2 Pulses per season	Trigger: 150 cfs Volume: 980 af Duration: 14 days	Trigger: 810 cfs Volume: 3,600 af Duration: 9 days	Not applicable	Trigger: 150 cfs Volume: 600 af Duration: 8 days
1 Pulse per season	Trigger: 330 cfs Volume: 2,300 af Duration: 18 days	Trigger: 2,000 cfs Volume: 9,200 af Duration: 12 days	Trigger: 210 cfs Volume: 1,100 af Duration: 9 days	Trigger: 500 cfs Volume: 2,300 af Duration: 12 days
1 Pulse per year	Trigger: 5,500 cfs Volume: 27,400 af Duration: 21 days			
1 Pulse per 2 years	Trigger: 9,000 cfs Volume: 45,300 af Duration: 24 days			
1 per 5 years (Overbank)	Trigger: 14,900 cfs Volume: 75,500 af Duration: 27 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

With the exception of the subsistence flow values, the BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee. For the subsistence flow recommendation, the Stakeholder Committee substituted the greater of 1 cfs or the 95th percentile flow levels for the TCEQ critical low flow values at this location.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) A one-per-three-year pulse was substituted for the one-per-five-year pulse recommended by the BBEST in order to define a pulse flow level that is not an overbank flow.
- b) The Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a trigger value larger than the one-per-three-year pulse.
- c) The Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08146000, San Saba River at San Saba

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*	
Winter	Severe	29	56	Trigger: 150 cfs Volume: 980 af Duration: 14 days	Trigger: 330 cfs Volume: 2,300 af Duration: 18 days	Trigger: 5,500 cfs Volume: 27,400 af Duration: 21 days	
Winter	Dry	N/A	56				
Winter	Average	N/A	81				
Winter	Wet	N/A	110				
Spring	Severe	22	56	Trigger: 810 cfs Volume: 3,600 af Duration: 9 days	Trigger: 2,000 cfs Volume: 9,200 af Duration: 12 days		
Spring	Dry	N/A	56				
Spring	Average	N/A	81				
Spring	Wet	N/A	110				
Summer	Severe	3	32	N/A	Trigger: 210 cfs Volume 1,100 af Duration: 9 days	Trigger: 210 cfs Volume 1,100 af Duration: 9 days	
Summer	Dry	N/A	32				
Summer	Average	N/A	46				
Summer	Wet	N/A	62				
Fall	Severe	13	40	Trigger: 150 cfs Volume: 600 af Duration: 8 days	Trigger: 500 cfs Volume: 2,300 af Duration: 12 days	Trigger: 500 cfs Volume: 2,300 af Duration: 12 days	
Fall	Dry	N/A	40				
Fall	Average	N/A	64				
Fall	Wet	N/A	87				

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

San Saba River at San Saba; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	9,000	45,300	24	900	2265
1 per 3 years	10,500	53,032	25	900	2265

The Stakeholder Committee decided not to make environmental flow regime recommendations for overbank flows. At this location, pulses with a trigger level above the one-per-three-year pulse value are overbank flows, so a once-per-three year pulse flow recommendation was adopted in lieu of a once-per five-year pulse.

The value of a one-per-five-year pulse flow with a trigger level of 14,900 cfs, a volume of 75,500 af, and a duration of 27 days is recognized as creating an overbank condition, but no permit review or conditions to protect streamflows.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR LLANO RIVER AT LLANO

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Llano River at Llano location. That BBEST recommendation, as summarized in a table on page 1-18 of the BBEST Report, is reproduced immediately below.

Llano River at Llano, USGS Gage 08151500, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1923-2009	0 periods Max duration: 0 days	2 periods Max duration: 67 days	5 periods Max duration: 31 days	0 periods Max duration: 0 days
Subsistence	55 cfs	55 cfs	55 cfs	55 cfs
Base Low	100 cfs	100 cfs	67 cfs	87 cfs
Base Medium	150 cfs	150 cfs	92 cfs	120 cfs
Base High	190 cfs	190 cfs	130 cfs	190 cfs
2 Pulses per season	Trigger: 390 cfs Volume: 2,500 af Duration: 13 days	Trigger: 1,800 cfs Volume: 8,500 af Duration: 10 days	Not applicable	Trigger: 370 cfs Volume: 1,600 af Duration: 8 days
1 Pulse per season	Trigger: 1,100 cfs Volume: 6,800 af Duration: 16 days	Trigger: 4,800 cfs Volume: 23,200 af Duration: 13 days	Trigger: 560 cfs Volume: 2,600 af Duration: 9 days	Trigger: 1,400 cfs Volume: 6,300 af Duration: 11 days
1 Pulse per year	Trigger: 9,100 cfs Volume: 46,100 af Duration: 18 days			
1 Pulse per 2 years (Overbank)	Trigger: 17,400 cfs Volume: 89,300 af Duration: 22 days			
1 Pulse per 5 years (Overbank)	Trigger: 41,100 cfs Volume: 214,000 af Duration: 27 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

With the exception of the subsistence flow values, the BBEST recommendations for flow recommendations up through the one-per-year pulse flows were adopted by the Stakeholder Committee. For the subsistence flow recommendation, the Stakeholder Committee substituted the greater of 1 cfs or the 95th percentile flow levels for the TCEQ critical low flow values at this location.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The one-per-two-year pulse trigger value was adjusted downward from the 17,400 cfs level recommended by the BBEST to 15,000 cfs in order to define a pulse flow level that is not an overbank flow. The other aspects of the one-per-two-year pulse flow continue to reflect the BBEST recommendations.
- b) The Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a trigger value larger than the one-per-two-year pulse, as adjusted.
- c) The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08151500, Llano River at Llano

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*	
Winter	Severe	44	100	Trigger: 390 cfs Volume: 2,500 af Duration: 13 days	Trigger: 1,100 cfs Volume: 6,800 af Duration: 16 days	Trigger: 9,100 cfs Volume: 46,100 af Duration: 18 days	
Winter	Dry	N/A	100				
Winter	Average	N/A	150				
Winter	Wet	N/A	190				
Spring	Severe	35	100	Trigger: 1,800 cfs Volume: 8,500 af Duration: 10 days	Trigger: 4,800 cfs Volume: 23,200 af Duration: 13 days		
Spring	Dry	N/A	100				
Spring	Average	N/A	150				
Spring	Wet	N/A	190				
Summer	Severe	3	67	N/A	Trigger: 560 cfs Volume: 2,600 af Duration: 9 days	Trigger: 9,100 cfs Volume: 46,100 af Duration: 18 days	
Summer	Dry	N/A	67				
Summer	Average	N/A	92				
Summer	Wet	N/A	130				
Fall	Severe	20	87	Trigger: 370 cfs Volume: 1,600 af Duration: 8 days	Trigger: 1,400 cfs Volume: 6,300 af Duration: 11 days		
Fall	Dry	N/A	87				
Fall	Average	N/A	120				
Fall	Wet	N/A	190				

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Llano River at Llano; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	15,000	89,300	22	1,500	4,465

The value of a 1-per-5-year pulse with a trigger of 41,100 cfs, a volume of 214,000 af, and a duration of 27 days is recognized as creating an overbank condition, but no permit review or conditions to protect those pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR PEDERNALES RIVER NEAR JOHNSON CITY

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Pedernales River near Johnson City location. That BBEST recommendation, as summarized in a table on page 1-19 of the BBEST Report, is reproduced immediately below.

Pedernales River near Johnson City, USGS Gage 08153500, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1939-2009	0 periods Max duration: 0 days	3 periods Max duration: 37 days	15 periods Max duration: 88 days	3 periods Max duration: 33 days
Subsistence	7 cfs	4 cfs	4 cfs	4 cfs
Base Low	23 cfs	29 cfs	16 cfs	16 cfs
Base Medium	45 cfs	60 cfs	29 cfs	29 cfs
Base High	80 cfs	110 cfs	49 cfs	49 cfs
2 Pulses per season	Trigger: 270 cfs Volume: 1,300 af Duration: 9 days	Trigger: 1,700 cfs Volume: 6,300 af Duration: 8 days	Not Applicable	Trigger: 160 cfs Volume: 620 af Duration: 6 days
1 Pulse per season	Trigger: 860 cfs Volume: 4,700 af Duration: 15 days	Trigger: 3,700 cfs Volume: 14,400 af Duration: 10 days	Trigger: 290 cfs Volume: 1,100 af Duration: 7 days	Trigger: 860 cfs Volume: 3,000 af Duration: 8 days
1 Pulse per year	Trigger: 7,000 cfs Volume: 28,400 af Duration: 15 days			
1 Pulse per 2 years	Trigger: 10,900 cfs Volume: 44,600 af Duration: 17 days			
1 Pulse per 5 years	Trigger: 26,300 cfs Volume: 107,900 af Duration: 21 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

With the exception of the Subsistence flow values, the BBEST recommendations for flow levels up through the one-per-year pulse flows were adopted by the Stakeholder Committee. For the subsistence flow recommendation, the Stakeholder Committee substituted the greater of 1 cfs or the 95th percentile flow levels for the TCEQ critical low flow values at this location.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The one-per-two-year pulse trigger value was adjusted downward from the 10,900 cfs level recommended by the BBEST to 10,000 cfs in order to define a pulse flow level that is not an overbank flow. The other aspects of the one-per-two-year pulse flow continue to reflect the BBEST recommendations.
- b) The Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a magnitude larger than the one-per-two-year pulse, as adjusted.
- c) The Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08153500, Pedernales River near Johnson City

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*
Winter	Severe	7	23	Trigger: 270 cfs Volume: 1,300 af Duration: 9 days	Trigger: 860 cfs Volume: 4,700 af Duration: 15 days	Trigger: 7,000 cfs Volume: 28,400 af Duration: 15 days
Winter	Dry	N/A	23			
Winter	Average	N/A	45			
Winter	Wet	N/A	80			
Spring	Severe	4	29			
Spring	Dry	N/A	29			
Spring	Average	N/A	60			
Spring	Wet	N/A	110			
Summer	Severe	1	16			
Summer	Dry	N/A	16			
Summer	Average	N/A	29			
Summer	Wet	N/A	49			
Fall	Severe	1	16	Trigger: 160 cfs Volume: 620 af Duration: 6 days	Trigger: 860 cfs Volume: 3,000 af Duration: 8 days	Trigger: 290 cfs Volume: 1,100 af Duration: 7 days
Fall	Dry	N/A	16			
Fall	Average	N/A	29			
Fall	Wet	N/A	49			

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pedernales near Johnson City; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	10,000	44,600	17	1,000	2,230

The value of a 1-per-5-year pulse with a trigger of 26,300 cfs, a volume of 107,900 af, and a duration of 21 days is recognized as creating an overbank condition, but no permit review or conditions to protect those pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR ONION CREEK NEAR DRIFTWOOD

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections for the Onion Creek near Driftwood location. That BBEST recommendation, as summarized in a table on page 1-20 of the BBEST Report, is reproduced immediately below.

Onion Creek near Driftwood, USGS Gage 08158700, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1992-2010	0 periods Max duration: 0 days	4 periods Max duration: 245 days	3 periods Max duration: 453 days	1 periods Max duration: 182 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	2 cfs	4 cfs	1 cfs	1 cfs
Base Medium	6 cfs	12 cfs	3 cfs	3 cfs
Base High	26 cfs	34 cfs	7 cfs	7 cfs
2 Pulses per season	Not applicable	Trigger: 200 cfs Volume: 1,100 af Duration: 11 days	Not applicable	Trigger: 18 cfs Volume: 70 af Duration: 5 days
1 Pulse per season	Trigger: 170 cfs Volume: 1,900 af Duration: 20 days	Trigger: 620 cfs Volume: 3,700 af Duration: 19 days	Not applicable	Trigger: 120 cfs Volume: 560 af Duration: 11 days
1 Pulse per year	Trigger: 1,200 cfs Volume: 8,700 af Duration: 34 days			
1 Pulse per 2 years	Trigger: 2,400 cfs Volume: 18,900 af Duration: 45 days			
1 Pulse per 5 years	Trigger: 3,600 cfs Volume: 29,600 af Duration: 53 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The BBEST recommendations for flow levels up through the one-per-year pulse flows were adopted by the Stakeholder Committee.

The Stakeholder Committee recommendations for one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows:

- a) The Committee made a one-per-five year pulse flow recommendation at this gauge, where the trigger level for the one-per-five year pulse is substantially below the overbank flow.
- b) The Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08158700, Onion Creek near Driftwood

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse*	
Winter	Severe	1	2	N/A	Trigger: 170 cfs Volume: 1,900 af Duration: 20 days	Trigger: 1,200 cfs Volume: 8,700 af Duration: 34 days	
Winter	Dry	N/A	2				
Winter	Average	N/A	6				
Winter	Wet	N/A	26				
Spring	Severe	1	4	Trigger: 200 cfs Volume: 1,100 af Duration: 11 days	Trigger: 3,700 cfs Volume: 14,400 af Duration: 10 days		
Spring	Dry	N/A	4				
Spring	Average	N/A	12				
Spring	Wet	N/A	34				
Summer	Severe	1	1	N/A	N/A		
Summer	Dry	N/A	1				
Summer	Average	N/A	3				
Summer	Wet	N/A	7				
Fall	Severe	1	1	Trigger: 18 cfs Volume: 70 af Duration: 5 days	Trigger: 120 cfs Volume: 560 af Duration: 11 days		
Fall	Dry	N/A	1				
Fall	Average	N/A	3				
Fall	Wet	N/A	7				

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Onion Creek near Driftwood; Pulses Larger Than Annual Pulse					
Frequency	Trigger (cfs)	Volume (af)	Duration (days)	Ten Percent of Trigger Value (cfs)	On-channel Impoundment Capacity (af)
1 per 2 years	2,400	18,900	45	240	945
1 per 5 years	3,600	29,600	53	240	945

7.3 Environmental Flow Standard Recommendations – Lower Colorado River

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER AT BASTROP

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Colorado River at Bastrop location. That BBEST recommendation, as summarized in a table on page 1-22 of the BBEST Report, is set out immediately below.

Colorado River at Bastrop, USGS Gage 08159200, Recommended Environmental Flow Regime

Flow	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Subsistence (cfs)	208	274	274	184	275	202	137	123	123	127	180	186
Base – Dry (cfs)	313	317	274	287	579	418	347	194	236	245	283	311
Base – Average (cfs)	433	497	497	635	824	733	610	381	423	433	424	450
Pulse flow - Base	Magnitude (2,000 to 3,000 cfs); Frequency (8-10 times annually); Duration (3-5 days)											
Pulse flow - High	Magnitude (8,000 cfs); Frequency (2 events in a 3-year period); Duration (2-3 days)											
Channel Maintenance	Magnitude (27,000 to 30,000 cfs); Frequency (1 event in 3 yr period); Duration (3 days)											
Overbank	Magnitude (>30,000 cfs); Frequency and Duration (naturally driven)											

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The Committee decided to utilize the basic components of the BBEST flow regime recommendations in its own recommendations. However, based on a balancing of various factors, the Committee's recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found it to be extremely limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Generally, water is available at this location only during brief periods of very high flows. Because water availability is so low, no specific evaluation of a hypothetical project at this location was undertaken.

At this location, the Committee's recommendations do not deviate from the recommendations of the BBEST for the subsistence or base flow categories.

The Committee's recommendations for pulse flows do vary somewhat from the BBEST recommendations for pulse flows. First, with respect to the BBEST Base Pulse Flow, for consistency across other locations, the Committee has renamed those pulses as seasonal pulses. The Committee also has assigned specific values to define the pulses rather than maintaining the ranges provided in the BBEST recommendations. For the seasonal pulses, which are the renamed

BBEST base pulses, the Committee elected to use the high end of the magnitude range (3,000 cfs), the low end of the frequency range (8 occurrences per year), and a middle value for the duration range (4 days). Those decisions were made as part of the consideration of all of the pulse flows as a package for the lower Colorado River locations. In an attempt to achieve a reasonable distribution of protected pulses across the year, the Committee also decided to distribute the eight seasonal pulses by assigning two to each season.

Second, with respect to the BBEST's recommendation for High Pulse Flows, the Committee elected to rename them as the one-per-eighteen-month pulses. In addition, to provide for more predictability, the Committee decided to describe the recommended frequency as one-per-eighteen-months rather as two-per-three-years. The Committee also chose to set the duration at two days.

Finally, with respect to the channel maintenance pulse flow, the Committee decided to rename it as the one-per-two-year pulse. Although this pulse flow is recommended to achieve various channel maintenance-related functions, the changed nomenclature is intended to distinguish this pulse recommendation from the broader category of channel maintenance flow issues discussed in Section 7.1, Sub-section 5 of this report. The Committee also decided to define the magnitude as 27,000 cfs in order to keep the recommendation below the level of creating an overbank event. The duration of the one-per-two-year pulse recommendation was set at two days. Part of the rationale for selecting the shorter duration for this pulse was the recognition that a large part of the reduced volume could be made up through choosing a mid-range duration, rather than the shorter duration, for the seasonal pulses. Because this component of the pulse flow recommendations already has been incorporated into a water rights permit, the Committee recommended that future permits to which this aspect of the recommendations would apply should include language essentially equivalent to the provision used in that existing permit. (Permit 5731)

It is important to note that the durations for the recommended seasonal and one-per-18-month pulses on the Colorado River below Austin are not directly comparable to the durations for recommended pulses in other areas. As explained further in Section 7.1, Subsection 3 above, describing pulse flow recommendations generally, the durations for these pulses in the river below Austin are only satisfied if the recommended magnitudes are met as a daily average flow for each day of the pulse event. That differs from other pulse flow recommendations in this report for which a trigger level is defined and for which a pulse flow recommendation is considered to be satisfied if the trigger level is met on an instantaneous basis and flows at or below that trigger level are passed downstream until either the associated volume or duration have been achieved.

Although the Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee is not recommending the imposition of permit conditions to protect overbank flows.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08159200, Colorado River at Bastrop

Season	Month	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Seasonal Pulse
Winter	December	Severe	186	311	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	December	Dry	N/A	311	
	December	Average	N/A	450	
	January	Severe	208	313	
	January	Dry	N/A	313	
	January	Average	N/A	433	
	February	Severe	274	317	
	February	Dry	N/A	317	
	February	Average	N/A	497	
Spring	March	Severe	274	274	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	March	Dry	N/A	274	
	March	Average	N/A	497	
	April	Severe	184	287	
	April	Dry	N/A	287	
	April	Average	N/A	635	
	May	Severe	275	579	
	May	Dry	N/A	579	
	May	Average	N/A	824	
	June	Severe	202	418	
	June	Dry	N/A	418	
	June	Average	N/A	733	
Summer	July	Severe	137	347	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	July	Dry	N/A	347	
	July	Average	N/A	610	
	August	Severe	123	194	
	August	Dry	N/A	194	
	August	Average	N/A	381	
Fall	September	Severe	123	236	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	September	Dry	N/A	236	
	September	Average	N/A	423	
	October	Severe	127	245	
	October	Dry	N/A	245	
	October	Average	N/A	433	
	November	Severe	180	283	
	November	Dry	N/A	283	
	November	Average	N/A	424	

cfs = cubic feet per second

N/A = not applicable

Colorado River at Bastrop; Pulses Larger Than Annual Pulse				
Frequency	Magnitude (cfs)	Duration (days)	Ten Percent of Magnitude (cfs)	On-channel Impoundment Capacity (af)
1 per 18 months*	8,000	2	800	2,500
1 per 2 years**	27,000	2	2,700	2,500

*Although not necessarily imposed as a permit limit, compliance with pulse flow standards for the 1-per-18-months pulse would be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

**In order to comply with the recommended pulse flow requirement, the Stakeholder Committee recommends that a permit subject to this pulse flow requirement should contain language providing protections equivalent to the following provision recently included in Permit 5731:

“A qualifying channel maintenance flow event is defined as an event that begins with a flow of at least 27,000 cfs, as measured at USGS Gage 08161000, Colorado River at Columbus, Texas, has a duration of 48 hours, and includes flows below 27,000 cfs that occur within the 48-hour period following the initial 27,000 cfs flow. If a qualifying channel maintenance flow event has not occurred within the last 24 months, and has not been allowed to pass the diversion points, Permittee’s diversions during the first 48 hours after the qualifying channel maintenance flow event has reached the diversion point shall not reduce streamflow below the applicable diversion point to less than the equivalent of 27,000 cfs at USGS Gage 08161000, Colorado River at Columbus, Texas.”

The value of an overbank pulse with a magnitude of greater than 30,000 cfs and with a frequency and duration that are naturally driven is recognized, but no permit review or conditions to protect such a pulse are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER AT COLUMBUS

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Colorado River at Columbus location. A corrected version of the BBEST recommendation, as summarized in a table on page 1-22 of the BBEST Report, is set out immediately below. This version reflects corrected Base-Average flow values from those shown in the BBEST report.

Colorado River at Columbus, USGS Gage 08161000, Recommended Environmental Flow Regime

Flow	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Subsistence (cfs)	340	375	375	299	425	534	342	190	279	190	202	301
Base – Dry (cfs)	487	590	525	554	966	967	570	310	405	356	480	464
Base – Average (cfs)	828	895	1,020	977	1,316	1,440	895	516	610	741	755	737
Pulse flow -Base	Magnitude (2,000 to 3,000 cfs); Frequency (8-10 times annually); Duration (3-5 days)											
Pulse flow - High	Magnitude (8,000 cfs); Frequency (2 events in a 3-year period); Duration (2-3 days)											
Channel Maintenance	Magnitude (27,000 to 30,000 cfs); Frequency (1 event in 3 yr period); Duration (3 days)											
Overbank	Magnitude (>30,000 cfs); Frequency and Duration (naturally driven)											

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The Committee decided to utilize the basic components of the BBEST flow regime recommendations in its own recommendations. However, based on a balancing of various factors, the Committee's recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found it to be extremely limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Generally, water is available at this location only during brief periods of very high flows. Because water availability is so low, no specific evaluation of a hypothetical project at this location was undertaken.

At this location, the Committee's recommendations do not deviate from the recommendations of the BBEST for the subsistence category and only deviate from the base flow category to account for a publication error in the BBEST report related to the Base-Average flow regime recommendations at this location.

The Committee's recommendations for pulse flows do vary somewhat from the BBEST recommendations for pulse flows. First, with respect to the BBEST Base Pulse Flow, for consistency across other locations, the Committee has renamed those pulses as seasonal pulses. The Committee also has assigned specific values to define the pulses rather than maintaining the

ranges provided in the BBEST recommendations. For the seasonal pulses, which are the renamed BBEST base pulses, the Committee elected to use the high end of the magnitude range (3,000 cfs), the low end of the frequency range (8 occurrences per year), and a middle value for the duration range (4 days). Those decisions were made as part of the consideration of all of the pulse flows as a package for the lower Colorado River locations. In an attempt to achieve a reasonable distribution of protected pulses across the year, the Committee also decided to distribute the eight seasonal pulses by assigning two to each season.

Second, with respect to the BBEST's recommendation for High Pulse Flows, the Committee elected to rename them as the one-per-eighteen-month pulses. In addition, to provide for more predictability, the Committee decided to describe the recommended frequency as one-per-eighteen-months rather as two-per-three-years. The Committee also chose to set the duration at two days.

Finally, with respect to the channel maintenance pulse flow, the Committee decided to rename it as the one-per-two-year pulse. Although this pulse flow is recommended to achieve various channel maintenance-related functions, the changed nomenclature is intended to distinguish this pulse recommendation from the broader category of channel maintenance flow issues discussed in Section 7.1, Subsection 5 of this report. The Committee also decided to define the magnitude as 27,000 cfs in order to keep the recommendation below the level of creating an overbank event. The duration of the one-per-two-year pulse recommendation was set at two days. Part of the rationale for selecting the shorter duration for this pulse was the recognition that a large part of the reduced volume could be made up through choosing a mid-range duration, rather than the shorter duration, for the seasonal pulses. Because this component of the pulse flow recommendations already has been incorporated into a water rights permit, the Committee recommended that future permits to which this aspect of the recommendations would apply should include language equivalent to the provision used in that existing permit. (Permit 5731)

It is important to note that the durations for the recommended seasonal and one-per-18-month pulses on the Colorado River below Austin are not directly comparable to the durations for recommended pulses in other areas. As explained further in Section 7.1, Subsection 3 above, describing pulse flow recommendations generally, the durations for these pulses in the river below Austin are only satisfied if the recommended magnitudes are met as a daily average flow for each day of the pulse event. That differs from other pulse flow recommendations in this report for which a trigger level is defined and for which a pulse flow recommendation is considered to be satisfied if the trigger level is met on an instantaneous basis and flows at or below that trigger level are passed downstream until either the associated volume or duration have been achieved.

The BBEST recommendations also include an overbank flow component. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee is not recommending the imposition of permit conditions to protect overbank flows.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08161000, Colorado River at Columbus

Season	Month	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Seasonal Pulse
Winter	December	Severe	301	464	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	December	Dry	N/A	464	
	December	Average	N/A	737	
	January	Severe	340	487	
	January	Dry	N/A	487	
	January	Average	N/A	828	
	February	Severe	375	590	
	February	Dry	N/A	590	
	February	Average	N/A	895	
Spring	March	Severe	375	525	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	March	Dry	N/A	525	
	March	Average	N/A	1,020	
	April	Severe	299	554	
	April	Dry	N/A	554	
	April	Average	N/A	977	
	May	Severe	425	966	
	May	Dry	N/A	966	
	May	Average	N/A	1,316	
	June	Severe	534	967	
	June	Dry	N/A	967	
	June	Average	N/A	1,440	
Summer	July	Severe	342	570	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	July	Dry	N/A	570	
	July	Average	N/A	895	
	August	Severe	190	310	
	August	Dry	N/A	310	
	August	Average	N/A	516	
Fall	September	Severe	279	405	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	September	Dry	N/A	405	
	September	Average	N/A	610	
	October	Severe	190	356	
	October	Dry	N/A	356	
	October	Average	N/A	741	
	November	Severe	202	480	
	November	Dry	N/A	480	
	November	Average	N/A	755	

cfs = cubic feet per second

N/A = not applicable

Colorado River at Columbus; Pulses Larger Than Annual Pulse				
Frequency	Magnitude (cfs)	Duration (days)	Ten Percent of Magnitude (cfs)	On-channel Impoundment Capacity (af)
1 per 18 months*	8,000	2	800	2,500
1 per 2 years**	27,000	2	2,700	2,500

*Although not necessarily imposed as a permit limit, compliance with pulse flow standards for the 1-per-18-months pulse would be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

**In order to comply with the recommended pulse flow requirement, the Stakeholder Committee recommends that a permit subject to this pulse flow requirement should contain language providing protections equivalent to the following provision recently included in Permit 5731:

“A qualifying channel maintenance flow event is defined as an event that begins with a flow of at least 27,000 cfs, as measured at USGS Gage 08161000, Colorado River at Columbus, Texas, has a duration of 48 hours, and includes flows below 27,000 cfs that occur within the 48-hour period following the initial 27,000 cfs flow. If a qualifying channel maintenance flow event has not occurred within the last 24 months, and has not been allowed to pass the diversion points, Permittee’s diversions during the first 48 hours after the qualifying channel maintenance flow event has reached the diversion point shall not reduce streamflow below the applicable diversion point to less than the equivalent of 27,000 cfs at USGS Gage 08161000, Colorado River at Columbus, Texas.”

The value of an overbank pulse with a magnitude of greater than 30,000 cfs and with a frequency and duration that are naturally driven is recognized, but no permit review or conditions to protect such a pulse are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR COLORADO RIVER AT WHARTON

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Colorado River at Wharton location. That BBEST recommendation, as summarized in a table on page 1-22 of the BBEST Report, is set out immediately below.

Colorado River at Wharton, USGS Gage 08162000, Recommended Environmental Flow Regime

Flow	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Subsistence (cfs)	315	303	204	270	304	371	212	107	188	147	173	202
Base – Dry (cfs)	492	597	531	561	985	984	577	314	410	360	486	470
Base – Average (cfs)	838	906	1,036	1,011	1,397	1,512	906	522	617	749	764	746
Pulse flow - Base	Magnitude (2,000 to 3,000 cfs); Frequency (8-10 times annually); Duration (3-5 days)											
Pulse flow - High	Magnitude (8,000 cfs); Frequency (2 events in a 3-year period); Duration (2-3 days)											
Channel Maintenance	Magnitude (27,000 to 30,000 cfs); Frequency (1 event in 3 yr period); Duration (3 days)											
Overbank	Magnitude (>30,000 cfs); Frequency and Duration (naturally driven)											

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found it to be extremely limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Generally, water is available at this location only during brief periods of very high flows. Because water availability is so low, no specific evaluation of a hypothetical project at this location was undertaken.

At this location, the Committee's recommendations do not deviate from the recommendations of the BBEST for the subsistence or base flow categories. The table on page 2-148 of the BBEST report is mis-titled and, although labeled as Colorado River at Columbus, actually reflects environmental flow regime recommendations for the Wharton Gage, 08162000.

The Stakeholder Committee recommendations for pulse flows do vary somewhat from the BBEST recommendations for pulse flows. First, with respect to the BBEST Base Pulse Flow, for consistency across other locations, the Committee has renamed those pulses as seasonal pulses.

The Committee also has assigned specific values to define the pulses rather than maintaining the ranges provided in the BBEST recommendations. For the seasonal pulses, which are the renamed BBEST base pulses, the Committee elected to use the high end of the magnitude range (3,000 cfs), the low end of the frequency range (8 occurrences per year), and a middle value for the duration range (4 days). Those decisions were made as part of the consideration of all of the pulse flows as a package for the lower Colorado River locations. In an attempt to achieve a reasonable distribution of protected pulses across the year, the Committee also decided to distribute the eight seasonal pulses by assigning two to each season.

Second, with respect to the BBEST's recommendation for High Pulse Flows, the Committee elected to rename them as the one-per-eighteen-month pulses. In addition, to provide for more predictability, the Committee decided to describe the recommended frequency as one-per-eighteen-months rather as two-per-three-years. The Committee also chose to set the duration at two days.

Finally, with respect to the channel maintenance pulse flow, the Stakeholder Committee decided to rename it as the one-per-two-year pulse. Although this pulse flow is recommended to achieve various channel maintenance-related functions, the changed nomenclature is intended to distinguish this pulse recommendation from the broader category of channel maintenance flow issues discussed in Section 7.1, Subsection 5 of this report. The Committee also decided to define the magnitude as 27,000 cfs in order to keep the recommendation below the level of creating an overbank event. The duration of the one-per-two-year pulse recommendation was set at two days. Part of the rationale for selecting the shorter duration for this pulse was the recognition that a large part of the reduced volume could be made up through choosing a mid-range duration, rather than the shorter duration, for the seasonal pulses. Because this component of the pulse flow recommendations already has been incorporated into a water rights permit, the Stakeholder Committee recommended that future permits to which this aspect of the recommendations would apply should include language equivalent to the provision used in that existing permit. (Permit 5731)

It is important to note that the durations for the recommended seasonal and one-per-18-month pulses on the Colorado River below Austin are not directly comparable to the durations for recommended pulses in other areas. As explained further in Section 7.1, Subsection 3 above, describing pulse flow recommendations generally, the durations for these pulses in the river below Austin are only satisfied if the recommended magnitudes are met as a daily average flow for each day of the pulse event. That differs from other pulse flow recommendations in this report for which a trigger level is defined and for which a pulse flow recommendation is considered to be satisfied if the trigger level is met on an instantaneous basis and flows at or below that trigger level are passed downstream until either the associated volume or duration have been achieved.

The BBEST recommendations also include an overbank flow component. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee is not recommending the imposition of permit conditions to protect overbank flows.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08162000, Colorado River at Wharton

Season	Month	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Seasonal Pulse
Winter	December	Severe	202	470	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	December	Dry	N/A	470	
	December	Average	N/A	746	
	January	Severe	315	492	
	January	Dry	N/A	492	
	January	Average	N/A	838	
	February	Severe	303	597	
	February	Dry	N/A	597	
	February	Average	N/A	906	
Spring	March	Severe	204	531	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	March	Dry	N/A	531	
	March	Average	N/A	1,036	
	April	Severe	270	561	
	April	Dry	N/A	561	
	April	Average	N/A	1,011	
	May	Severe	304	985	
	May	Dry	N/A	985	
	May	Average	N/A	1,397	
	June	Severe	371	984	
	June	Dry	N/A	984	
	June	Average	N/A	1,512	
Summer	July	Severe	212	577	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	July	Dry	N/A	577	
	July	Average	N/A	906	
	August	Severe	107	314	
	August	Dry	N/A	314	
	August	Average	N/A	522	
Fall	September	Severe	188	410	Magnitude: 3,000 cfs Duration: 4 days (2 per season)
	September	Dry	N/A	410	
	September	Average	N/A	617	
	October	Severe	147	360	
	October	Dry	N/A	360	
	October	Average	N/A	749	
	November	Severe	173	486	
	November	Dry	N/A	486	
	November	Average	N/A	764	

cfs = cubic feet per second

N/A = not applicable

Colorado River at Wharton; Pulses Larger Than Annual Pulse				
Frequency	Magnitude (cfs)	Duration (days)	Ten Percent of Magnitude (cfs)	On-channel Impoundment Capacity (af)
1 per 18 months*	8,000	2	800	2,500
1 per 2 years**	27,000	2	2,700	2,500

*Although not necessarily imposed as a permit limit, compliance with pulse flow standards for the 1-per-18-months pulse would be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

**In order to comply with the recommended pulse flow requirement, the Stakeholder Committee recommends that a permit subject to this pulse flow requirement should contain language providing protections equivalent to the following provision recently included in Permit 5731:

“A qualifying channel maintenance flow event is defined as an event that begins with a flow of at least 27,000 cfs, as measured at USGS Gage 08161000, Colorado River at Columbus, Texas, has a duration of 48 hours, and includes flows below 27,000 cfs that occur within the 48-hour period following the initial 27,000 cfs flow. If a qualifying channel maintenance flow event has not occurred within the last 24 months, and has not been allowed to pass the diversion points, Permittee’s diversions during the first 48 hours after the qualifying channel maintenance flow event has reached the diversion point shall not reduce streamflow below the applicable diversion point to less than the equivalent of 27,000 cfs at USGS Gage 08161000, Colorado River at Columbus, Texas.”

The value of an overbank pulse with a magnitude of greater than 30,000 cfs and with a frequency and duration that are naturally driven is recognized, but no permit review or conditions to protect such a pulse are recommended.

7.4 Environmental Flow Standard Recommendations – Lavaca/Navidad Rivers

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR THE LAVACA RIVER NEAR EDNA

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Lavaca River near Edna location. That BBEST recommendation, as summarized in a table on page 1-24 of the BBEST Report, is reproduced immediately below.

Lavaca River near Edna, USGS Gage 08164000, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1938-2010	3 periods Max duration: 26 days	3 periods Max duration: 7 days	4 periods Max duration: 9 days	6 periods Max duration: 53 days
Subsistence	16 cfs	16 cfs	16 cfs	16 cfs
Base Low	30 cfs	30 cfs	20 cfs	20 cfs
Base Medium	55 cfs	55 cfs	33 cfs	33 cfs
Base High	94 cfs	94 cfs	48 cfs	58 cfs
2 Pulses per season	Trigger: 2,000 cfs Volume: 8,000 af Duration: 8 days	Trigger: 4,600 cfs Volume: 17,800 af Duration: 8 days	Trigger: 88 cfs Volume: 370 af Duration: 6 days	Trigger: 1,600 cfs Volume: 6,100 af Duration: 7 days
1 Pulse per season	Trigger: 4,500 cfs Volume: 18,400 af Duration: 10 days	Trigger: 6,800 cfs Volume: 26,600 af Duration: 8 days	Trigger: 420 cfs Volume: 1,800 af Duration: 9 days	Trigger: 4,500 cfs Volume: 18,000 af Duration: 9 days
1 Pulse per year (Overbank)	Trigger: 11,400 cfs Volume: 46,100 af Duration: 10 days			
1 Pulse per 2 years (Overbank)	Trigger: 15,700 cfs Volume: 64,100 af Duration: 11 days			
1 Pulse per 5 years (Overbank)	Trigger: 22,800 cfs Volume: 94,100 af Duration: 12 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Stakeholder Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found that a fairly large volume of water was available on a consistent basis. An overview of the availability of unappropriated water, by location, is included as Appendix 3. As a means of analyzing the effect of the imposition of environmental flow standards on a potential water supply project, the Committee, again with the assistance of the BBEST, evaluated a hypothetical off-channel reservoir project at a location near the gage site. Given that the analysis was conducted using a variety of diversion rates, environmental flow regimes and flow conditions, the results of the group's evaluation indicated that, while the application of environmental flow standards did impact the hypothetical yield of the project, a meaningful volume of water could be developed on a reliable basis for future use. At this location, the Committee adjusted the subsistence flows downward from the TCEQ critical low flow levels recommended by the BBEST to the 95th percentile flows. The Committee considered that adjustment based on observations by some individual members that the critical low flow values at various locations seemed quite high when compared to conditions commonly observed. The Committee sought feedback from the BBEST about the implications of that adjustment and, specifically, about the potential impact on the likelihood of having flow recommendations that would protect a sound ecological environment. The BBEST indicated that, if the Stakeholder Committee used an implementation approach that allowed diversions down to, but not lower than, subsistence levels only during the hydrological condition designed to represent the driest 5% of the time and only at times during that hydrological condition when flows were below the corresponding base low flow level, those adjusted subsistence levels were likely to support a sound ecological environment. The Committee decided to recommend the use of the 95th percentile flow levels with the implementation approach as suggested by the BBEST.

The Committee also adjusted some of the pulse flow values recommended by the BBEST for this location. Specifically, the one-per-year, one-per-two-year and the one-per-five-year pulse flows, as recommended by the BBEST, were identified as overbank flows. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a pulse flow that does not produce overbank conditions. Based on that input, the Stakeholder Committee recommendations for one-per-year, one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows.

The one-per-season "Spring" pulse trigger was adjusted downward from 6,800 cfs to 6,000 cfs and the one-per-year pulse trigger was adjusted downward from 11,400 cfs to 6,000 cfs. The Stakeholder Committee decided not to recommend a one-per-two-year or a one-per-five-year pulse or any pulse with a magnitude that created an overbank flow condition.

The Committee also adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion among the BBASC members, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08164000 Lavaca River near Edna

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)
Winter	Severe	8.5	30	Trigger: 2000 cfs Volume: 8,000 af Duration: 6 days	Trigger: 4,500 cfs Volume: 18,400 af Duration: 7 days	Trigger: 6,000 cfs Volume: 26,600 af Duration: 6 days
Winter	Dry		30			
Winter	Average		55			
Winter	Wet		94			
Spring	Severe	10	30	Trigger: 4,600 cfs Volume: 17,800 af Duration: 6 days	Trigger: 6,000 cfs Volume: 26,600 af Duration: 6 days	Trigger: 6,000 cfs Volume: 26,600 af Duration: 6 days
Spring	Dry		30			
Spring	Average		55			
Spring	Wet		94			
Summer	Severe	1.3	20	Trigger: 88 cfs Volume: 370 af Duration: 4 days	Trigger: 420 cfs Volume: 1,800 af Duration: 6 days	Trigger: 420 cfs Volume: 1,800 af Duration: 6 days
Summer	Dry		20			
Summer	Average		48			
Summer	Wet		33			
Fall	Severe	1.2	20	Trigger: 1,600 cfs Volume: 6,100 af Duration: 5 days	Trigger: 4,500 cfs Volume: 18,000 af Duration: 6 days	Trigger: 4,500 cfs Volume: 18,000 af Duration: 6 days
Fall	Dry		20			
Fall	Average		33			
Fall	Wet		58			

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years *	N/A	N/A	N/A
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-2 year with a trigger of 15,700 cfs, a volume of 64,100 af and a duration of 11 days and a 1-per-5-year pulse with a trigger of 2,800 cfs, a volume of 94,100 af, and a duration of 12 days is recognized, but no permit review or conditions to protect such a pulse are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR THE NAVIDAD RIVER NEAR STRANE PARK

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Navidad River near Strane Park location. That BBEST recommendation, as summarized in a Table on page 1-25 of the BBEST Report, is reproduced immediately below.

Navidad River at Strane Park near Edna, USGS Gage 08164390, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1996-2010	0 periods Max duration: 0 days	0 periods Max duration: 0 days	3 periods Max duration: 11 days	2 periods Max duration: 3 days
Subsistence	4 cfs	4 cfs	4 cfs	4 cfs
Base Low	14 cfs	18 cfs	24 cfs	17 cfs
Base Medium	35 cfs	35 cfs	47 cfs	35 cfs
Base High	71 cfs	71 cfs	84 cfs	71 cfs
2 Pulses per season	Trigger: 2,000 cfs Volume: 9,000 af Duration: 8 days	Trigger: 3,900 cfs Volume: 17,300 af Duration: 8 days	Trigger: 200 cfs Volume: 1,000 af Duration: 7 days	Trigger: 2,000 cfs Volume: 8,700 af Duration: 8 days
1 Pulse per season	Trigger: 3,800 cfs Volume: 17,000 af Duration: 9 days	Trigger: 4,900 cfs Volume: 22,100 af Duration: 8 days	Trigger: 610 cfs Volume: 3,400 af Duration: 9 days	Trigger: 3,800 cfs Volume: 18,800 af Duration: 10 days
1 Pulse per year (Overbank)	Trigger: 7,100 cfs Volume: 34,400 af Duration: 10 days			
1 Pulse per 2 years (Overbank)	Trigger: 10,200 cfs Volume: 50,000 af Duration: 11 days			
1 Pulse per 5 years (Overbank)	Trigger: 15,500 cfs Volume: 77,600 af Duration: 12 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Stakeholder Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found that a fairly small volume of water was available but not on a consistent or reliable basis that would necessitate a more comprehensive evaluation such as done on the Lavaca River near Edna location. An overview of the availability of unappropriated water, by location, is included as Appendix 3.

At this location, the Committee adjusted the subsistence flows downward from the TCEQ critical low flow levels recommended by the BBEST to the 95th percentile flows. The Committee considered that adjustment based on observations by some individual members that the critical low flow values at various locations seemed quite high when compared to conditions commonly observed. The Committee sought feedback from the BBEST about the implications of that adjustment and, specifically, about the potential impact on the likelihood of having flow recommendations that would protect a sound ecological environment. The BBEST indicated that, if the Stakeholder Committee used an implementation approach that allowed diversions down to, but not lower than, subsistence levels only during the hydrological condition designed to represent the driest 5% of the time and only at times during that hydrological condition when flows were below the corresponding base low flow level, those adjusted subsistence levels were likely to support a sound ecological environment. The Committee decided to recommend the use of the 95th percentile flow levels with the implementation approach as suggested by the BBEST.

The Committee also adjusted some of the pulse flow values recommended by the BBEST for this location. Specifically, the one-per-year, one-per-two-year and the one-per-five-year pulse flows, as recommended by the BBEST, were identified as overbank flows. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a pulse flow that does not produce overbank conditions. Based on that input, the Stakeholder Committee recommendations for one-per-year, one-per-two-year and the one-per-five-year pulse flows differ from the BBEST recommended levels as follows.

The one-per-year pulse trigger was adjusted downward from 7,100 cfs to 4,900 cfs. The Stakeholder Committee decided not to recommend a one-per-two-year or a one-per-five-year pulse or any pulse with a magnitude that created an overbank flow condition.

The Committee also adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the

implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion among the BBASC members, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08164390, Navidad River at Strane Park

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)
Winter	Severe	1	14	Trigger: 2000 cfs Volume: 9,000 af Duration: 6 days	Trigger: 3,800 cfs Volume: 17,000 af Duration: 7 days	
Winter	Dry		14			
Winter	Average		35			
Winter	Wet		71			
Spring	Severe	2.8	18	Trigger: 3,900 cfs Volume: 17,300 af Duration: 6 days	Trigger: 4,900 cfs Volume: 22,100 af Duration: 6 days	Trigger: 4,900 cfs Volume: 22,100 af Duration: 6 days
Spring	Dry		18			
Spring	Average		35			
Spring	Wet		71			
Summer	Severe	1.2	24	Trigger: 200 cfs Volume: 1,000 af Duration: 5 days	Trigger: 610 cfs Volume: 3,400 af Duration: 6 days	
Summer	Dry		24			
Summer	Average		47			
Summer	Wet		84			
Fall	Severe	2.2	17	Trigger: 2,000 cfs Volume: 8,700 af Duration: 6 days	Trigger: 3,800 cfs Volume: 18,800 af Duration: 7 days	
Fall	Dry		17			
Fall	Average		35			
Fall	Wet		71			

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years *	N/A	N/A	N/A
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-2 year with a trigger of 10,200 cfs, a volume of 50,000 af and a duration of 11 days and a 1-per-5-year pulse with a trigger of 15,500 cfs, a volume of 77,600 af, and a duration of 12 days is recognized, but no permit review or conditions to protect such a pulses are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR SANDY CREEK NEAR GANADO

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Sandy Creek near Ganado location. That BBEST recommendation, as summarized in a table on page 1-26 of the BBEST Report, is reproduced immediately below.

Sandy Creek near Ganado, USGS Gage 08164450, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1977-2010	4 periods Max duration: 9 days	8 periods Max duration: 20 days	3 periods Max duration: 11 days	0 periods Max duration: 0 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	5 cfs	5 cfs	9 cfs	9 cfs
Base Medium	14 cfs	14 cfs	21 cfs	21 cfs
Base High	30 cfs	30 cfs	39 cfs	39 cfs
2 Pulses per season	Trigger: 800 cfs Volume: 4,000 af Duration: 7 days	Trigger: 1,400 cfs Volume: 7,300 af Duration: 9 days	Trigger: 91 cfs Volume: 500 af Duration: 6 days	Trigger: 630 cfs Volume: 3,100 af Duration: 8 days
1 Pulse per season	Trigger: 1,800 cfs Volume: 10,000 af Duration: 10 days	Trigger: 3,100 cfs Volume: 17,800 af Duration: 11 days	Trigger: 260 cfs Volume: 1,600 af Duration: 9 days	Trigger: 1,800 cfs Volume: 9,200 af Duration: 10 days
1 Pulse per year	Trigger: 4,500 cfs Volume: 26,700 af Duration: 14 days			
1 Pulse per 2 years	Trigger: 5,800 cfs Volume: 35,400 af Duration: 15 days			
1 Pulse per 5 years (Overbank)	Trigger: 8,300 cfs Volume: 52,900 af Duration: 17 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Stakeholder Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found that a fairly small volume of water was available but not on a consistent or reliable basis that would necessitate a more comprehensive evaluation such as done on the Lavaca River near Edna location. An overview of the availability of unappropriated water, by location, is included as Appendix 3.

The Committee adjusted some of the pulse flow values recommended by the BBEST for this location. Specifically, the one-per-year, one-per-two-year and the one-per-five-year pulse flows, as recommended by the BBEST, were identified as overbank flows. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a pulse flow that does not produce overbank conditions. Based on that input, the Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a magnitude that created an overbank flow condition.

The Committee also adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion among the BBASC members, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08164450, Sandy Creek near Ganado

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)
Winter	Severe	1	5			
Winter	Dry		5			
Winter	Average		14			
Winter	Wet		30			
Spring	Severe	1	5			
Spring	Dry		5			
Spring	Average		14			
Spring	Wet		30			
Summer	Severe	1	9			
Summer	Dry		9			
Summer	Average		21			
Summer	Wet		39			
Fall	Severe	1	9			
Fall	Dry		9			
Fall	Average		21			
Fall	Wet		39			

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years	5,800	35,400	11
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-5-year pulse with a trigger of 8,300 cfs, a volume of 52,900 af, and a duration of 17 days is recognized, but no permit review or conditions to protect such a pulse are recommended.

**ENVIRONMENTAL FLOW STANDARD RECOMMENDATION
FOR EAST MUSTANG CREEK NEAR LOUISE**

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the East Mustang Creek near Louise location. That BBEST recommendation, as summarized in a table on page 1-27 of the BBEST Report, is reproduced immediately below.

East Mustang Creek near Louise, USGS Gage 08164504, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1996-2010	10 periods Max duration: 83 days	17 periods Max duration: 20 days	14 periods Max duration: 53 days	17 periods Max duration: 42 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	1 cfs	1 cfs	2 cfs	1 cfs
Base Medium	2 cfs	3 cfs	5 cfs	3 cfs
Base High	6 cfs	6 cfs	8 cfs	8 cfs
2 Pulses per season	Trigger: 150 cfs Volume: 680 af Duration: 7 days	Trigger: 280 cfs Volume: 1,400 af Duration: 9 days	Trigger: 20 cfs Volume: 100 af Duration: 7 days	Trigger: 150 cfs Volume: 650 af Duration: 8 days
1 Pulse per season	Trigger: 340 cfs Volume: 1,700 af Duration: 10 days	Trigger: 550 cfs Volume: 3,000 af Duration: 11 days	Trigger: 60 cfs Volume: 310 af Duration: 9 days	Trigger: 430 cfs Volume: 2,100 af Duration: 10 days
1 Pulse per year	Trigger: 1,200 cfs Volume: 6,400 af Duration: 14 days			
1 Pulse per 2 years (Overbank)	Trigger: 1,500 cfs Volume: 8,600 af Duration: 16 days			
1 Pulse per 5 years (Overbank)	Trigger: 2,200 cfs Volume: 12,500 af Duration: 17 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology and sound ecological environment. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Stakeholder Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found that a fairly small volume of water was available but not on a consistent or reliable basis that would necessitate a more comprehensive evaluation such as done on the Lavaca River near Edna location. An overview of the availability of unappropriated water, by location, is included as Appendix 3.

The Committee adjusted some of the pulse flow values recommended by the BBEST for this location. Specifically, the one-per-five-year pulse flows, as recommended by the BBEST, was identified as creating an overbank flow. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a pulse flow that does not produce overbank conditions. Based on that input, the Stakeholder Committee decided not to recommend a one-per-five-year pulse or any pulse with a magnitude that created an overbank flow condition.

The Committee adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion among the BBASC members, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08164504, East Mustang Creek near Louise

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)	
Winter	Severe	1	1	Trigger: 150 cfs Volume: 680 af Duration: 5 days	Trigger: 340 cfs Volume: 1700 af Duration: 8 days	Trigger: 1200 cfs Volume: 6400 af Duration: 11 days	
Winter	Dry		1				
Winter	Average		2				
Winter	Wet		6				
Spring	Severe	1	1	Trigger: 280 cfs Volume: 1400 af Duration: 7 days	Trigger: 550 cfs Volume: 3000 af Duration: 9 days		
Spring	Dry		1				
Spring	Average		3				
Spring	Wet		6				
Summer	Severe	1	2	Trigger: 20 cfs Volume: 100 af Duration: 5 days	Trigger: 60 cfs Volume: 310 af Duration: 6 days		
Summer	Dry		2				
Summer	Average		5				
Summer	Wet		8				
Fall	Severe	1	1	Trigger: 150 cfs Volume: 650 af Duration: 6 days	Trigger: 430 cfs Volume: 2100 af Duration: 7 days		
Fall	Dry		1				
Fall	Average		3				
Fall	Wet		8				

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years	1500	8,600	12
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-5-year pulse with a trigger of 2,200 cfs, a volume of 12,500 af, and a duration of 17 days is recognized, but no permit review or conditions to protect such a pulse are recommended.

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR WEST MUSTANG CREEK NEAR GANADO

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the West Mustang Creek near Ganado. That BBEST recommendation, as summarized in a table on page 1-28 of the BBEST Report, is reproduced immediately below.

West Mustang Creek near Ganado, USGS Gage 08164503, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1977-2010	3 periods Max duration: 82 days	0 periods Max duration: 0 days	0 periods Max duration: 0 days	0 periods Max duration: 0 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	4 cfs	5 cfs	10 cfs	6 cfs
Base Medium	9 cfs	11 cfs	18 cfs	14 cfs
Base High	20 cfs	20 cfs	32 cfs	26 cfs
2 Pulses per season	Trigger: 470 cfs Volume: 2,400 af Duration: 7 days	Trigger: 810 cfs Volume: 4,400 af Duration: 8 days	Trigger: 75 cfs Volume: 420 af Duration: 6 days	Trigger: 470 cfs Volume: 2,200 af Duration: 8 days
1 Pulse per season	Trigger: 1,000 cfs Volume: 5,600 af Duration: 10 days	Trigger: 1,500 cfs Volume: 9,400 af Duration: 11 days	Trigger: 190 cfs Volume: 1,200 af Duration: 9 days	Trigger: 1,300 cfs Volume: 7,100 af Duration: 11 days
1 Pulse per year	Trigger: 2,800 cfs Volume: 17,800 af Duration: 15 days			
1 Pulse per 2 years	Trigger: 4,700 cfs Volume: 31,900 af Duration: 18 days			
1 Pulse per 5 years	Trigger: 6,700 cfs Volume: 46,900 af Duration: 21 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Stakeholder Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found that a fairly small volume of water was available but not on a consistent or reliable basis that would necessitate a more comprehensive evaluation such as done on the Lavaca River near Edna location. An overview of the availability of unappropriated water, by location, is included as Appendix 3.

The Committee adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion among the BBASC members, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 08164503, West Mustang Creek near Ganado

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)	
Winter	Severe	1	4	Trigger: 470 cfs Volume: 2400 af Duration: 6 days	Trigger: 1000 cfs Volume: 5600 af Duration: 8 days	Trigger: 2800 cfs Volume: 17800 af Duration: 12 days	
Winter	Dry		4				
Winter	Average		9				
Winter	Wet		20				
Spring	Severe	1	5	Trigger: 810 cfs Volume: 4400 af Duration: 6 days	Trigger: 1500 cfs Volume: 9400 af Duration: 9 days		
Spring	Dry		5				
Spring	Average		11				
Spring	Wet		20				
Summer	Severe	1	10	Trigger: 75 cfs Volume: 420 af Duration: 4 days	Trigger: 190 cfs Volume: 1200 af Duration: 6 days		
Summer	Dry		10				
Summer	Average		18				
Summer	Wet		32				
Fall	Severe	1	6	Trigger: 470 cfs Volume: 2200 af Duration: 6 days	Trigger: 1300 cfs Volume: 7100 af Duration: 8 days		
Fall	Dry		6				
Fall	Average		14				
Fall	Wet		26				

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years	4,700	31,900	14
One (1) per five (5) years	6,700	46,900	16

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

7.5 Environmental Flow Standard Recommendations – Coastal Streams

ENVIRONMENTAL FLOW STANDARD RECOMMENDATION FOR GARCITAS CREEK NEAR INEZ

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Garcitas Creek near Inez location. That BBEST recommendation, as summarized in a table on page 1-30 of the BBEST Report, is reproduced immediately below.

Garcitas Creek near Inez, USGS Gage 08164600, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1970-2010	0 periods Max duration: 0 days	13 periods Max duration: 59 days	5 periods Max duration: 190 days	7 periods Max duration: 34 days
Subsistence	1 cfs	1 cfs	1 cfs	1 cfs
Base Low	2 cfs	2 cfs	1 cfs	1 cfs
Base Medium	4 cfs	4 cfs	2 cfs	2 cfs
Base High	7 cfs	7 cfs	3 cfs	5 cfs
2 Pulses per season	Trigger: 110 cfs Volume: 520 af Duration: 8 days	Trigger: 380 cfs Volume: 1,500 af Duration: 10 days	Trigger: 8 cfs Volume: 28 af Duration: 4 days	Trigger: 110 cfs Volume: 420 af Duration: 8 days
1 Pulse per season	Trigger: 410 cfs Volume: 1,800 af Duration: 12 days	Trigger: 1,100 cfs Volume: 4,400 af Duration: 13 days	Trigger: 36 cfs Volume: 150 af Duration: 8 days	Trigger: 510 cfs Volume: 2,000 af Duration: 11 days
1 Pulse per year	Trigger: 2,000 cfs Volume: 8,900 af Duration: 17 days			
1 Pulse per 2 years	Trigger: 3,100 cfs Volume: 13,600 af Duration: 19 days			
1 Pulse per 5 years (Overbank)	Trigger: 5,400 cfs Volume: 24,200 af Duration: 22 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found it to be limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Generally, water is available at this location only during brief periods of very high flows.

The Committee adjusted some of the pulse flow values recommended by the BBEST. Specifically, the one-per-five-year pulse flow, as recommended by the BBEST, was identified as an overbank flow. As discussed in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a peak flow that did not produce overbank conditions. Based on this input, the Stakeholder Committee decided not to recommend a one-per-five-year pulse at this location but did adopt a one-per-three-year pulse as a substitution.

The other aspects of the one-per-year and one-per-two-year pulse flow continue to reflect the BBEST recommendations, with the exception of duration. The Committee adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST. The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 8164600, Garcitas Creek near Inez

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)
Winter	Severe	1	2			
Winter	Dry		2	Trigger: 110 cfs Volume: 9,000 af Duration: 6 days	Trigger: 410 cfs Volume: 1,800 af Duration: 9 days	
Winter	Average		4			
Winter	Wet		7			
Spring	Severe	1	2			
Spring	Dry		2	Trigger: 380 cfs Volume: 17,300 af Duration: 7 days	Trigger: 1,100 cfs Volume: 4,400 af Duration: 9 days	
Spring	Average		4			
Spring	Wet		7			
Summer	Severe	1	1			
Summer	Dry		1	Trigger: 8 cfs Volume: 1,000 af Duration: 3 days	Trigger: 36 cfs Volume: 150 af Duration: 6 days	
Summer	Average		2			
Summer	Wet		3			
Fall	Severe	1	1			
Fall	Dry		1	Trigger: 110 cfs Volume: 8,700 af Duration: 6 days	Trigger: 510 cfs Volume: 2,000 af Duration: 8 days	
Fall	Average		2			
Fall	Wet		5			

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years	3,100	13,600	14
One (1) per three (3) years	3,700	16,304	15
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-5-year pulse with a trigger of 5,400 cfs, a volume of 24,200 af, and a duration of 22 days is recognized, but no permit review or conditions to protect such a pulse are recommended.

**ENVIRONMENTAL FLOW STANDARD RECOMMENDATION
FOR TRES PALACIOS CREEK NEAR MIDFIELD**

A. BBEST RECOMMENDATION

The Stakeholder Committee carefully considered the recommendations from the BBEST regarding instream flow protections at the Tres Palacios near Midfield location. That BBEST recommendation, as summarized in a table on page 1-31 of the BBEST Report, is reproduced immediately below.

Tres Palacios Creek near Midfield, USGS Gage 08162600, Recommended Environmental Flow Regime

	Winter	Spring	Summer	Fall
No-flow periods 1970-2010	No periods of no flow			
Subsistence	7 cfs	7 cfs	7 cfs	7 cfs
Base Low	9 cfs	9 cfs	7 cfs	7 cfs
Base Medium	13 cfs	13 cfs	13 cfs	13 cfs
Base High	18 cfs	22 cfs	22 cfs	18 cfs
2 Pulses per season	Trigger: 650 cfs Volume: 2,500 af Duration: 8 days	Trigger: 1,200 cfs Volume: 4,400 af Duration: 8 days	Trigger: 75 cfs Volume: 360 af Duration: 7 days	Trigger: 800 cfs Volume: 3,200 af Duration: 8 days
1 Pulse per season	Trigger: 1,300 cfs Volume: 4,900 af Duration: 9 days	Trigger: 1,900 cfs Volume: 7,100 af Duration: 8 days	Trigger: 280 cfs Volume: 1,300 af Duration: 9 days	Trigger: 1,900 cfs Volume: 7,700 af Duration: 10 days
1 Pulse per year (Overbank)	Trigger: 3,500 cfs Volume: 13,800 af Duration: 10 days			
1 Pulse per 2 years (Overbank)	Trigger: 4,600 cfs Volume: 18,200 af Duration: 11 days			
1 Pulse per 5 years (Overbank)	Trigger: 6,700 cfs Volume: 26,100 af Duration: 11 days			
Channel Maintenance Flow	A quantity of flow in addition to flows provided by subsistence, base, pulse and overbank flows proposed here would be needed to maintain channel morphology. Analysis by the BBEST at 3 sites across the basins (upper Colorado, lower Colorado, and Lavaca) and within the bounds of the analysis in this report indicates a range of average annual flows on the order of 77-93% of the average annual flow from 1940-1998 with the variability characteristic of the period of record maintains existing channel morphology. The specific flow needed to maintain the channel and its ecological functions will need to be determined on a project and site-specific basis.			
Long-term Engagement Frequencies	Base-high 25%, Base-medium 50%, Base-low 25%, Subsistence 100%, and Pulses 100%. The goal of the engagement frequencies is to produce an instream flow regime that mimics natural patterns by providing the target base flows at frequencies which closely approximate historical occurrences.			

cfs = cubic feet per second

af = acre-feet

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

As discussed further below, the Committee generally decided that, to the extent reasonably possible, it would include the basic components of the BBEST flow regime recommendations in the stakeholder committee recommendations. However, based on a balancing of various factors, the Stakeholder Committee recommendations do vary from the BBEST recommendations in a number of ways, as described below.

The Stakeholder Committee, with the assistance of the BBEST, evaluated the availability of unappropriated water at this location and found it to be extremely limited. An overview of availability of unappropriated water, by location, is included as Appendix 3. Generally, water is available at this location only during brief periods of very high flows.

At this location, the Committee evaluated adjusting the subsistence flows downward from the TCEQ critical low flow levels recommended by the BBEST to the 95th percentile flows. The Committee considered that adjustment based on observations by some individual members that the critical low flow values at various locations seemed quite high when compared to conditions commonly observed. The Committee sought feedback from the BBEST about the implications of that adjustment and, specifically, about the potential impact on the likelihood of having flow recommendations that would protect a sound ecological environment. The BBEST indicated that, if the Stakeholder Committee used an implementation approach that allowed diversions down to, but not lower than, subsistence levels only during the hydrological condition designed to represent the driest 5% of the time and only at times during that hydrological condition when flows were below the corresponding dry base flow level, those adjusted subsistence levels were likely to support a sound ecological environment. The Committee decided to recommend the use of the 95th percentile flow levels with the implementation approach as suggested by the BBEST. As with the other sites evaluated, the Committee concluded that the minimum value for subsistence flow would be set at 1.0 cfs.

The Committee adjusted the pulse flow duration as recommended by the BBEST for each of the given pulse flow conditions. In considering its recommendation of pulse flows, the group observed that the HEFR model output provided three different flow durations; low and high and central tendency. The BBEST recommendation called for the highest of the three. The Committee concluded that altering the duration would allow for additional flexibility in the implementation process and opted to modify the BBEST recommendation using a duration equal to the midpoint between the central tendency and the larger value recommended by the BBEST.

The Committee also adjusted some of the pulse flow values recommended by the BBEST. Specifically, the one-per-one-year, one-per-two-year and the one-per-five-year pulse flows, as recommended by the BBEST, were identified as overbank flows. As discussed above, in the section of the report dealing with overbank flows, although the Stakeholder Committee acknowledges that naturally-occurring overbank flows play an important ecological role, the Committee decided not to recommend flow conditions to protect overbank flows. Accordingly, the Stakeholder Committee requested input from the BBEST in evaluating pulse flow levels that would achieve as much of the value of the BBEST recommendations for pulse flows above overbank levels as could be reasonably achieved with a peak flow that does not produce overbank conditions. Based on that input, the Stakeholder Committee recommendations for one-per-one-year pulse flows differ from the BBEST recommended levels as follows. The Stakeholder Committee decided not to recommend a one-per-two-year or a one-per-five-year pulse or any pulse with a magnitude larger than the one-per-one-year pulse, as adjusted.

The one-per-one-year pulse trigger value was adjusted downward from the 3,500 cfs level recommended by the BBEST to 2,400 cfs in order to define a pulse flow level that is not an overbank flow.

The BBEST recommendations also included an unquantified channel maintenance flow component for this location. In the absence of more definitive information and after significant discussion, the Stakeholder Committee decided not to include specific recommendations for addressing the channel maintenance issue at this location.

C. BBASC ENVIRONMENTAL FLOW STANDARD CONSENSUS RECOMMENDATION

USGS Gage 8162600, Tres Palacios River near Midfield

Season	Hydrologic Condition	Subsistence (cfs)	Base (cfs)	Small Seasonal Pulse (2 per season)	Large Seasonal Pulse (1 per season)	Annual Pulse (1 per year)	
Winter	Severe	2	9	Trigger: 650 cfs Volume: 2,500 af Duration: 6 days	Trigger: 1,300 cfs Volume: 4,900 af Duration: 6 days	Trigger: 2,400 cfs Volume: 13,800 af Duration: 7 days	
Winter	Dry		9				
Winter	Average		13				
Winter	Wet		18				
Spring	Severe	2.5	9	Trigger: 1,200 cfs Volume: 4,400 af Duration: 6 days	Trigger: 1,900 cfs Volume: 7,100 af Duration: 6 days		
Spring	Dry		9				
Spring	Average		13				
Spring	Wet		22				
Summer	Severe	1	7	Trigger: 75 cfs Volume: 360 af Duration: 5 days	Trigger: 280 cfs Volume: 1,300 af Duration: 6 days		
Summer	Dry		7				
Summer	Average		13				
Summer	Wet		22				
Fall	Severe	1	7	Trigger: 800 cfs Volume: 3,200 af Duration: 6 days	Trigger: 1,900 cfs Volume: 7,700 af Duration: 7 days		
Fall	Dry		7				
Fall	Average		13				
Fall	Wet		18				

Although not necessarily imposed as a permit limit, compliance with pulse flow standards for pulses larger than the annual pulse, as set out in the table immediately below, shall be ensured prior to approval of a permit or permit amendment to which that requirement applies as described above in Section 7.1, Subsection 3.

Pulse Flows Larger Than Annual Pulses			
Frequency	Trigger (cfs)	Volume (af)	Duration (days)
One (1) per two (2) years *	N/A	N/A	N/A
One (1) per five (5) years *	N/A	N/A	N/A

cfs = cubic feet per second

af = acre-feet

N/A = not applicable

* The value of an overbank flow equal to a 1-per-2 year with a trigger of 4,600 cfs, a volume of 18,200 af and a duration of 11 days and a 1-per-5-year pulse with a trigger of 6,700 cfs, a volume of 26,100 af, and a duration of 11 days is recognized, but no permit review or conditions to protect such a pulses are recommended.

7.6 Environmental Flow Standard Recommendations – East Matagorda Bay

EAST MATAGORDA BAY INFLOW STANDARD

A. BBEST RECOMMENDATION

The BBEST did not make a specific inflow recommendation for East Matagorda Bay. The BBEST report notes that there are no gaged inflows to East Matagorda Bay. Generally, the BBEST concluded that localized rainfall and runoff would continue to provide inflows to the bay system. Although noting that freshwater inflows to East Matagorda Bay have been reduced through various actions, the BBEST concluded that the system, although changing, likely represented a sound ecological environment.

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The Stakeholder Committee expressed strong concerns about the reductions of freshwater inflows to East Matagorda Bay. The Committee noted some fairly recent actions that have contributed to those reductions including the diversion of the mouth of the Colorado River into Matagorda Bay, which, coupled with the operation of the locks at the confluence of the Colorado River and the Intracoastal Waterway (ICWW), has reduced overall inflows into East Matagorda Bay. Mitchell's Cut also was identified as another recent contributor to reduced inflows. In addition, Committee members noted that the ICWW also intercepts local drainage that would otherwise enter East Matagorda Bay.

Strong concerns were expressed about the decline in the commercial fishery in East Matagorda Bay and about the continuing loss of shrimp and oyster production there. In general, however, the Stakeholder Committee noted that it was unlikely that future diversions of water would result in significant reductions of freshwater inflows to East Matagorda Bay and that, instead, the focus would need to be on identifying appropriate strategies that could be implemented to increase inflows.

C. STAKEHOLDER COMMITTEE CONSENSUS RECOMMENDATION FOR ENVIRONMENTAL FLOW STANDARD

The Stakeholder Committee adopted the following statement by consensus:

Strategies to maintain and increase freshwater inflows should be pursued to support a sound ecological environment within East Matagorda Bay.

That statement includes the concept of not allowing further reductions of freshwater inflows as a result of human-induced changes. However, the Committee recognizes that inflows may continue to decline as a result of changes such as reduced return flows from irrigation. Nonetheless, the Committee does recommend that other reductions of inflows that can be avoided should be avoided. The other important concept is that affirmative action should be taken in the form of strategies to provide increased freshwater inflows to East Matagorda Bay. Those strategies are addressed in Section 8.0.

7.7 Environmental Flow Standard Recommendations – Matagorda Bay

MATAGORDA BAY INFLOW STANDARD

A. BBEST RECOMMENDATION

The Stakeholder Committee extensively discussed the recommendations from the BBEST regarding inflows to Matagorda Bay from the Colorado River basin. That recommendation, as summarized in Table 2.7.4 of the BBEST Report, is reproduced immediately below.

Table 2.7.4 Recommended freshwater inflow regime for Matagorda Bay

	Flow Volumes (acre-feet)			Achievement Guideline ^t
Threshold	Maintain 15,000 acre-feet per month			100%
Regime:	Spring	Fall	Intervening	
MBHE 1	114,000	81,000	105,000	90%*
MBHE 2	168,700	119,900	155,400	75%*
MBHE 3	246,200	175,000	226,800	60%*
MBHE 4	433,200	307,800	399,000	35%*
Long-term Volume and Variability	Average at least 1.4 to 1.5 million acre-feet per year [#]			100%

^tAchievement guidelines refer to the amount of time that the flow volumes should be met or exceeded. *Based on historical frequency of occurrence.

[#]Recommend projected long-term annual average flow is maintained at a level of at least 1.4 to 1.5 million acre-feet, with a coefficient of variation (CV) value above 0.8.

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The Committee generally agreed that, if reasonably possible, it would be desirable to see inflows to Matagorda Bay from the Colorado River basin continue to occur at the levels recommended by the BBEST. However, information available to the Committee about the expected levels of inflows resulting from the full exercise of existing water rights raised concerns that the potential impacts to the ecological environment in the future would be significant.. The corresponding values for attainment frequencies and long-term average inflows based on TCEQ's most current WAM RUN3 model are set out in Table 7.7-1, below. That stark comparison provoked pointed discussions among the Stakeholder Committee members about a reasonable path forward. The feedback received from BBEST members was that inflows at the WAM RUN3 frequencies would not be expected to support a sound ecological environment.

Table 7.7-1

Comparison of BBEST Recommendations for Matagorda Bay Inflows from Colorado River Basin to WAM Run3 Values		
Regime Title	BBEST Recommended Value	WAM Run3 Calculated Value
Attainment Frequency for Threshold Regime	100%	65.5%
Attainment Frequency for MBHE 1 Regime	90%	35.6%
Attainment Frequency for MBHE 2 Regime	75%	16.9%
Attainment Frequency for MBHE 3 Regime	60%	11.9%
Attainment Frequency for MBHE 4 Regime	35%	8.5%
Long-Term Average Volume	1.4 to 1.5 million acre-feet	877,000 acre-feet
Coefficient of Variation for long-term volume	Above 0.8	1.3

Some Committee members felt that the WAM RUN3 results demonstrated that large-scale changes to inflows to Matagorda Bay, and to certain aspects of the bay system, are inevitable and felt that the flow standard recommendations should reflect that. Other members felt that the recommendations should reflect an effort to maintain the inflow levels that the best available science indicates are needed to support a sound ecological environment and the commercial and recreational fishing dependent on it. The Committee as a whole was not comfortable with accepting the WAM RUN3 values as the only recommended flow standard. The Committee did acknowledge that the WAM RUN3 values are, in some sense, a worst case scenario because they assume full use of all existing rights at all times, including an assumption of no return flows.

Recognizing the dual role of environmental flow standards as governing the issuance of permits for new appropriations of water and as establishing the targets for use in selecting and implementing affirmative strategies to be used to help improve substandard environmental flow levels, the Committee reached consensus on a set of dual recommendations. The Committee agreed to recommend that the BBEST recommended values, with certain limited adjustments, should be included in the environmental flow standards as the targets that should be achieved, if possible, through the use of environmental flow strategies. Conversely, the Committee agreed that it would be appropriate not to preclude the possibility for some additional permitting to allow the capture of limited amounts of water during periods that inflows comply with the inflow regime levels recommended for protection by the BBEST. In order to accommodate that potential, the Committee agreed to recommend the use of the WAM RUN3 calculated values as the permitting environmental flow standards, with certain limited adjustments, for use in evaluating permit applications for new water rights and, where applicable, for amendments that are subject to the environmental flow standards.

The agreement, representing a balancing of the goal of protecting a sound ecological environment with the goal of recognizing potential future needs for water, to use a dual set of recommendations in the actual environmental flow standard recommendations was essential to achieving consensus in the Stakeholder Committee.

The Stakeholder Committee made two adjustments to the BBEST recommendations in incorporating them into the recommended flow standards as the targets for use in considering strategies. First, the Committee chose not to include the coefficient of variation parameter for the long-term average volume because it was not clear how it could be used effectively. Second, the Committee also agreed to use 1.4 million acre-feet, which is the lower end of the range, as the target for the long-term average volume.

The Stakeholder Committee also made two adjustments to the calculated WAM RUN3 values in incorporating them into the recommended flow standards for use in evaluating applications. First, the Committee chose not to include the coefficient of variation parameter for the long-term average volume because it was not clear how it could be used effectively. Second, the Committee adjusted the long-term average volume downward in order to accommodate the potential for a limited amount of additional permitting during periods when the inflow regimes are met. The Stakeholder Committee was advised that if it used the value of 877,000 acre-feet, as derived from WAM RUN3, as the long-term average inflow value, no future permits could be authorized, regardless of flow condition. Accordingly, the Committee agreed, after significant discussion of the need to strike a balance between potential impacts to the environment and the potential to develop additional water supplies under certain circumstances, to adjust that value downward by 5% in order to allow for the potential of authorizing some limited new diversions during periods that inflows exceed the specified inflow regime levels. The intent of the Stakeholder Committee recommendations is to avoid allowing new authorizations subject to the flow standards to cause any worsening of compliance with the Annual Frequency for Permitting values in Table 7.7-2.

The Stakeholder Committee recognizes that the inclusion of specific values from WAM RUN3 in the recommendations present some challenges because potential changes to modeling code or to the period of record could produce different results, such as lower attainment frequencies, even without any new authorizations being issued or included in the modeling. Similarly, the Committee recognizes that amendments to some existing rights that would not be subject to the standards could result in somewhat different results for the WAM RUN3 modeling even without the addition of new authorizations subject to the standards. Accordingly, the Stakeholder Committee has incorporated a footnote to its recommendations with the intention of allowing adjustments to WAM RUN3 results to be made based on those specific changes and to be used in determining compliance with the recommended standards.

The Stakeholder Committee recommendations are also intended to ensure that, as strategies to achieve compliance with the recommended target levels are implemented, future water right authorizations subject to the standards are not allowed to make diversions that would impair the contributions of those strategies.

C. STAKEHOLDER COMMITTEE CONSENSUS RECOMMENDATION FOR ENVIRONMENTAL FLOW STANDARD

In order to communicate its intentions as clearly as possible, the Stakeholder Committee has proposed draft language that the Committee believes could be incorporated into rules to establish environmental flow standards for inflows from the Colorado River Basin to Matagorda Bay.

PROPOSED ENVIRONMENTAL FLOW STANDARD FOR INFLOWS TO MATAGORDA BAY FROM THE COLORADO RIVER BASIN

- (a) The granting of a water right application in the Colorado River basin, which seeks to increase the amount of water authorized to be stored, taken or diverted as described in §298.10 of this title (relating to Applicability), shall not cause or contribute to an impairment of the Long-Term Annual Quantity for Permitting value or of any Annual Frequency for Permitting value listed in Table 7.7-2, as adjusted in accordance with the footnote to that table. For purposes of this subsection, the granting of an application would cause or contribute to an impairment if the resulting authorization, subject to any applicable special conditions and considered in combination with any prior authorizations subject to this Subchapter, when modeled over the WAM period of record under full use assumptions is simulated to:
 - 1. decrease the annual average inflow level below the Long-Term Annual Quantity for Permitting value listed in Table 7.7-2;
 - 2. decrease the frequency of compliance for any inflow regime below the accompanying Annual Frequency for Permitting value in Table 7.7-2, as adjusted in accordance with the footnote to that table; or
 - 3. result in diversions during a month that the monthly minimum quantity of the monthly threshold inflow regime is not achieved.
- (b) To the extent that strategies to help meet these environmental flow standards are implemented and simulations in the modeling indicate an increase in the frequency of attainment for any inflow regime listed in Table 7.7-2 above the Annual Frequency for Permitting value, but not above the accompanying Annual Target Frequency for that inflow regime, the granting of a water right application also shall not reduce the annual frequency for that inflow regime below the level simulated to occur for the inflow regime with the strategy or strategies incorporated into the WAM model.
- (c) To the extent that strategies to help meet these environmental flow standards are implemented and simulations in the modeling indicate an increase in the long-term annual average inflow value above the Long-Term Annual Quantity for Permitting value listed in Table 7.7-2, but not above the accompanying Long-Term Annual Target Quantity, the granting of a water right application also shall not reduce the long-term annual average inflow level below the level simulated to occur with the strategy or strategies incorporated into the WAM model.

(d) For Table 7.7-2, entitled Matagorda Bay Inflows from Colorado River Basin, the following definitions apply:

- (1) “Spring season quantity” refers to the maximum inflow quantity occurring during any three consecutive months during the period from January through July.
- (2) “Fall season quantity” refers to the maximum inflow quantity occurring during any three consecutive months during the period from August through December.
- (3) “Intervening season quantity” refers to the quantity of inflows occurring during the remaining six months of any calendar year that are not included in the spring or fall season quantities for that year.
- (4) “Level 1 inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring season quantity, a fall season quantity, and an intervening season quantity that each meets the specified values for that regime.
- (5) “Level 2 inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring season quantity, a fall season quantity, and an intervening season quantity that each meets the specified values for that regime.
- (6) “Level 3 inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring season quantity, a fall season quantity, and an intervening season quantity that each meets the specified values for that regime.
- (7) “Level 4 inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring season quantity, a fall season quantity, and an intervening season quantity that each meets the specified values for that regime.
- (8) “Annual average inflow regime” refers to the long-term average amount, as calculated over the WAM period of record, of total inflow in a calendar year.
- (9) “Monthly threshold inflow regime” refers to the total inflow in any calendar month.

Table 7.7-2

MATA GORDA BAY INFLOWS FROM COLORADO RIVER BASIN						
Inflow Regime	Monthly Minimum Quantity (af)	Spring Season Quantity (af)	Fall Season Quantity (af)	Intervening Season Quantity (af)	Annual Target Quantity (af)	Long-Term Annual Quantity For Permitting (af)
Monthly Threshold	15,000	N/A	N/A	N/A	N/A	N/A
Level 1	N/A	114,000	81,000	105,000	N/A	N/A
Level 2	N/A	168,700	119,900	155,400	N/A	N/A
Level 3	N/A	246,200	175,000	226,800	N/A	N/A
Level 4	N/A	433,200	307,800	399,000	N/A	N/A
Annual Average	N/A	N/A	N/A	1,400,000	833,000	N/A

af = acre-feet
N/A = not applicable

* The listed frequencies are the WAM RUN3 results as calculated based on the most current version of the TCEQ WAM RUN3 (received from TCEQ staff on 3/17/2011) available to the Stakeholder Committee with water rights authorized as of that date. The Stakeholder Committee recognizes that updates to the WAM to extend the hydrologic period of record or incorporate new model code or software for simulating those same water rights may occur and may result in the calculation of different WAM RUN3 frequencies. Similarly, the Committee recognizes that updates to the WAM model to reflect permit amendments that are not subject to the flow standards also may, in some circumstances, result in the calculation of different WAM RUN3 frequencies. It is the intent of the Stakeholder Committee to have values reflected in this column that provide an accurate starting point for modeling to ensure that permits or permit amendments subject to the standards do not worsen conditions, either singly or collectively, beyond the starting point for that analysis. For this reason, the Committee recommends that, as those specific updates occur, the corresponding values as calculated with the updated WAM model be substituted for the values in the referenced column in performing permit reviews.

7.8 Environmental Flow Standard Recommendations – Lavaca Bay

LAVACA BAY INFLOW STANDARD

A. BBEST RECOMMENDATION

The Stakeholder Committee extensively discussed the recommendations from the BBEST regarding inflows to Lavaca Bay from the Lavaca River Basin and Garcitas Creek Basin. That recommendation, as summarized in Table 2.8.8 and 2.8.9 of the BBEST Report, is reproduced immediately below.

Table 2.8.8 Recommended Lavaca Bay Freshwater Inflow regime (acre-feet) for gaged inflows from the Lavaca River, Lake Texana releases, and Garcitas Creek

Freshwater Inflow Regime (Acre-Feet)				
Onset Month	Subsistence	Base Low	Base Medium	Base High
Spring February March April May	13,500 3 consecutive months	55,080 3 consecutive months	127,980 3 consecutive months	223,560 3 consecutive months
Fall August September October	9,600 3 consecutive months	39,168 3 consecutive months	91,080 3 consecutive months	158,976 3 consecutive months
Intervening Six Months	6,900 Total for 6 month period	28,152 Total for 6 month period	65,412 Total for 6 month period	114,264 Total for 6 month period

Table 2.8.9 Historic occurrence of flow regime components

Regime Component	Historical Occurrence (%)
Subsistence	97
Base Low	86
Base Medium	56
Base High	37

The BBEST recommendations also include a high flow pulse inflow designed to reduce bay salinities to below five parts-per-thousand for a period of about two weeks with a recurrence frequency of every five to ten years. The volume associated with that pulse recommendation is 450,000 acre-feet within a one-month period during any season of the year.

B. STAKEHOLDER COMMITTEE CONSIDERATION OF BBEST RECOMMENDATION

The Committee generally agreed that, if reasonably possible, it would be desirable to see inflows to Lavaca Bay from the Lavaca River Basin, inclusive of flows from Lake Texana, and Garcitas Creek Basin continue to occur at the levels and frequencies recommended by the BBEST. However, information available to the Committee about the expected levels of inflows resulting from the full exercise of existing water rights indicates that those levels are not attainable without the implementation of significant strategies to increase inflows. In order to have a direct comparison of comparable attainment frequencies between historical frequencies and WAM simulations, the Stakeholder Committee first had to obtain historical frequencies calculated for the same period of record as is used in the TCEQ WAM. As explained to the Committee by members of the BBEST, the historical occurrence information in Table 2.8.9 of the BBEST report, as reproduced above, does not reflect a comparable time period to that reflected in WAM simulations. Comparable historical occurrence information was calculated for the Committee by the BBEST and is reflected in Table 7.8-1 below. The use of a different period of record resulted in fairly different historical occurrence frequencies from those set out in the BBEST report. The corresponding values for attainment frequencies based on TCEQ's most current WAM RUN3 model are set out in that same table.

Table 7.8-1

Comparison of BBEST Recommendations for Lavaca Bay Inflows from Colorado River Basin to WAM RUN3 Values		
Regime Title	BBEST Recommended Frequency with Period of Record to Match WAM	WAM RUN3 Calculated Frequency
Subsistence Regime	96%	72%
Base Low Regime	82%	54%
Base Medium Regime	46%	28%
Base High Regime	28%	21%
High Flow Pulse	Every 5 to 10 years	-

The Stakeholder Committee determined that the approach it had adopted for dealing with freshwater inflow recommendations for Matagorda Bay should also be used in developing recommendations for Lavaca Bay inflows.

Again, recognizing the dual role of environmental flow standards as governing the issuance of permits for new appropriations of water and as establishing the targets for use in selecting and implementing affirmative strategies to be used to help improve substandard environmental flow levels, the Committee reached consensus on a set of dual recommendations. The Committee agreed to recommend that the BBEST recommended values, as adjusted to correspond with the WAM period of record and with certain additional limited adjustments, should be included in the environmental flow standards as the targets that should be achieved, if possible, through the use of strategies. Conversely, the Committee agreed that it would be appropriate not to preclude the possibility for some additional permitting to allow the capture of water during periods that inflows comply with the inflow regime levels recommended for protection by the BBEST. In order to accommodate that potential, the Committee agreed to recommend the use of the WAM RUN3

calculated values for use in evaluating applications for new water rights and for amendments that are subject to the environmental flow standards.

The agreement, representing a balancing of the goal of protecting a sound ecological environment with the goal of recognizing potential future needs for water, to use a dual set of recommendations in the actual environmental flow standard recommendations was essential to achieving consensus in the Stakeholder Committee.

The Stakeholder Committee made two adjustments to the BBEST recommendations in incorporating them into the recommended flow standards as the targets for use in considering strategies. First, as noted above, the Committee used occurrence information for the historical period that corresponds to the WAM period of record. Second, the Committee chose ten years as the recurrence frequency for the high flow pulse rather than the range of five to ten years, as recommended by the BBEST and prescribed that as a criterion to be met on a long-term average basis.

The Stakeholder Committee did not make any specific adjustments to the calculated WAM RUN3 values in incorporating them into the recommended flow standards for use in evaluating applications. However, the Committee did incorporate compliance with the high flow pulse criterion into the permitting requirements to be assessed for future permitting. The intent of the Stakeholder Committee recommendations is to avoid allowing new authorizations subject to the flow standards to cause any worsening of compliance with the Annual Frequency for Permitting values in Table 7.8-2.

The Stakeholder Committee recognizes that the inclusion of specific values from WAM RUN3 in the recommendations present some challenges because potential changes to modeling code or to the period of record could produce different results, such as lower attainment frequencies, even without any new authorizations being issued or included in the modeling. Similarly, the Committee recognizes that amendments to some existing rights that would not be subject to the standards could result in somewhat different results for the WAM RUN3 modeling even without the addition of new authorizations subject to the standards. Accordingly, the Stakeholder Committee has incorporated a footnote to its recommendations with the intention of allowing adjustments to WAM RUN3 results to be made based on those specific changes and to be used in determining compliance with the recommended standards.

The Stakeholder Committee recommendations are also intended to ensure that, as strategies to achieve compliance with the recommended target levels are implemented, future water right authorizations subject to the standards are not allowed to make diversions that would impair the contributions of those strategies.

C. STAKEHOLDER COMMITTEE CONSENSUS RECOMMENDATION FOR ENVIRONMENTAL FLOW STANDARD

In order to communicate its intentions as clearly as possible, the Stakeholder Committee has proposed draft language that the Committee believes could be incorporated into rules to establish environmental flow standards for inflows from the Lavaca River Basin and Garcitas Creek to Matagorda Bay.

PROPOSED ENVIRONMENTAL FLOW STANDARD FOR INFLOWS TO LAVACA BAY FROM THE LAVACA RIVER BASIN AND GARCITAS CREEK

- (a) The granting of a water right application in the Lavaca River basin or Garcitas Creek basin, which seeks to increase the amount of water authorized to be stored, taken or diverted as described in §298.10 of this title (relating to Applicability), shall not contribute to an impairment of any value listed in the Frequency for Permitting column of Table 7.8-2. For purposes of this subsection, an application would contribute to an impairment if the authorization, subject to any applicable special conditions and considered in combination with any prior authorizations subject to this Subchapter, when modeled over the WAM period of record under full use assumptions is simulated to decrease the frequency of compliance for any listed inflow regime below the accompanying Frequency for Permitting value listed in Table 7.8-2, as adjusted in accordance with the footnote to that table.
- (b) To the extent that strategies to help meet these environmental flow standards are implemented and simulations in the modeling indicate an increase in the frequency of attainment for any inflow regime listed in Table 7.8-2 above the Frequency for Permitting value, but not above the accompanying Target Frequency value, the granting of a water right application also shall not reduce the frequency of achievement simulated to occur for that particular inflow regime with the strategy or strategies included in the model or models.
- (c) For Table 7.8-2, entitled Lavaca Bay Inflows from the Lavaca River Basin and Garcitas Creek Basin, the following definitions apply:
 - (1) “Spring inflow” refers to the inflows during any period of three consecutive months that begins in February, March, April, or May.
 - (2) “Fall inflow” refers to the inflows during any period of three consecutive months that begins in August, September, or October.
 - (3) “Intervening inflow” refers to inflows during the remaining six months of any calendar year that are not included in the spring or fall inflow for that year.
 - (4) “Subsistence inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring inflow, a fall inflow, and an intervening inflow that each meet the specified quantities.

(5) “Base low inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring inflow, a fall inflow, and an intervening inflow that each meet the specified quantities.

(6) “Base medium inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring inflow, a fall inflow, and an intervening inflow that each meet the specified quantities.

(7) “Base high inflow regime” refers to an annual inflow pattern in any calendar year that includes a spring inflow, a fall inflow, and an intervening inflow that each meet the specified quantities.

(8) “Flushing flow inflow regime” refers to the total inflow in any 30-day period.

Table 7.8-2

Lavaca Bay Inflows From The Lavaca River Basin and Garcitas Creek Basin						
Inflow Regime	Spring Inflow Quantity (af)	Fall Inflow Quantity (af)	Intervening Inflow Quantity (af)	30-day Inflow Quantity (af)	Target Frequency	Frequency For Permitting*
Subsistence	13,500	9,600	6,900	N/A	96%	72%
Base Low	55,080	39,168	28,152	N/A	82%	54%
Base Medium	127,980	91,080	65,412	N/A	46%	28%
Base High	223,650	158,976	114,264	N/A	28%	21%
Flushing Flow	N/A	N/A	N/A	450,000	1 year in 10, on average**	1 year in 10, on average**

af = acre-feet

N/A = not applicable

*The listed frequencies are the WAM RUN3 results as calculated based on the most current version of the TCEQ WAM Run3 (Lavaca WAM received from TCEQ staff on 3/17/2011 and Lavaca/Guadalupe WAM downloaded from TCEQ site on 12/8/2010) available to the Stakeholder Committee with water rights authorized as of that date. The Stakeholder Committee recognizes that updates to the WAM to extend the hydrologic period of record or incorporate new model code or software for simulating those same water rights may occur and may result in the calculation of different WAM Run3 frequencies. Similarly, the Committee recognizes that updates to the WAM model to reflect permit amendments that are not subject to the flow standards also may, in some circumstances, result in the calculation of different WAM Run3 frequencies. It is the intent of the Stakeholder Committee to have values reflected in this column that provide an accurate starting point for modeling to ensure that permits or permit amendments subject to the standards do not worsen conditions, either singly or collectively, beyond the starting point for that analysis. For this reason, the Committee recommends that, as those specific updates occur, the corresponding values as calculated with the updated WAM model be substituted for the values in the referenced column in performing permit reviews.

**As calculated over the full WAM period-of-record.

8.0 Implementation Strategies

8.1 Statutory Requirements for Implementation Strategies in Stakeholder Committee Report

Section 11.02362 (o) Texas Water Code: Each basin and bay area stakeholders committee shall review the environmental flow analyses and environmental flow regime recommendations submitted by the committee's basin and bay expert science team and shall consider them in conjunction with other factors, including the present and future needs for water for other uses related to water supply planning in the pertinent river basin and bay system. The basin and bay area stakeholders committee shall develop recommendations regarding environmental flow standards and strategies to meet the environmental flow standards and submit those recommendations to the commission ...*(Emphasis Stakeholder Committee)*

(p) In recognition of the importance of adaptive management, after submitting its recommendations regarding environmental flow standards and strategies to meet the environmental flow standards to the commission, each basin and bay area stakeholders committee, with the assistance of the pertinent basin and bay expert science team, shall prepare and submit for approval by the advisory group a work plan. The work plan must...

(3) establish a schedule for continuing the validation or refinement of the basin and bay environmental flow analyses and environmental flow regime recommendations, the environmental flow standards adopted by the commission, and the strategies to achieve those standards. *(Emphasis Stakeholder Committee)*

8.2 Further Development Through Work Plan Process.

The Stakeholder Committee has identified various categories and approaches for strategies to meet the environmental flow standards recommended. The Committee recognizes that much more work is needed to develop specific strategies that are ready for implementation. The Committee acknowledges the importance of strategies in meeting the environmental flow standards being recommended and intends to continue work in refining these strategy recommendations, including by identifying potential approaches for implementing the recommendations, through the work plan process.

8.3 Regulatory Strategies:

- A. A set standard of net benefit to environmental flows in basin of origin should be applied to inter-basin transfers to include potential return of return flows. Flexibility should be authorized to allow project participants to achieve the net benefit through a variety of mechanisms, including, for example, the purchase and conversion of other water rights to environmental protection purposes.
- B. Explore methods for increasing reliability, using firm yield concepts, for voluntary implementation strategies to meet environmental needs.
- C. Consider ways to dedicate cancelled water rights to environmental flows.
- D. Consider ways to use tax incentives to encourage donation of water rights

- E. Consider ways to encourage local governments to require developers to coordinate with local entities and perform pre-development studies to determine that sufficient water is available for proposed development projects.
- F. Consider creating incentives that apply to future new appropriation authorizations, to the extent that they do not involve an interbasin transfer to dedicate a reasonable portion of resulting return flows to environmental flow protection. Incentives should be available if an appreciable amount of return flows could be generated.

8.4 Voluntary Strategies

SB 3 Legislative Findings Supporting the Use of Voluntary Strategies

11.0235(b) TWC. Maintaining the biological soundness of the state's rivers, lakes, bays, and estuaries is of great importance to the public's economic health and general well-being. The legislature encourages voluntary water and land stewardship to benefit the water in the state, as defined by Section 26.001.

11.0235(d-3)(2)TWC. In those basins in which the unappropriated water that will be set aside for instreamflow and freshwater inflow protection is not sufficient to fully satisfy the environmental flow standards established by the commission, a variety of market approaches, both public and private, for filling the gap must be explored and pursued. *(Emphasis ours)*

Since there is very little unappropriated water in the Colorado River that could be reliably developed, there may rarely be new permits issued in that basin to which the environmental flow regime standards adopted by the Colorado and Lavaca Rivers and Matagorda and Lavaca Bay and Basin Stakeholder Committee will apply. Consequently, strategies to implement the recommended flow regimes in the Colorado Basin will necessarily have to focus primarily on voluntary activities funded privately or through grants.

8.5 Strategies Applicable Throughout the Colorado and Lavaca River Basins

- A. Donation, Purchase or Lease of Existing Water Permits - Current Texas law does not permit the issuance of new permits for instream flows dedicated to environmental needs or bay and estuary inflows, but does authorize amendments to existing permits or certificates of adjudication to change the use to, or add a use for, instream flows dedicated to environmental needs or bay and estuary inflows.
 - Willing water rights holders should be encouraged to donate, sell or lease all or part of their permitted or adjudicated water rights to the Texas Water Trust or to private 501 (C)(3)water trusts which would:
 1. Receive and hold tax-deductible donations of water rights and obtain monetary donations for the purchase or lease of water rights .
 2. Purchase water rights to be to be amended to add instream uses.
 3. Pay irrigators for forbearance from irrigating during drought years to compensate for crop loss.

4. Lease rights on a long-term basis for instream flows
5. File the water right amendment with the TCEQ for the permit holders, do the accounting and maintain records.

This strategy may be most suited to specific locations where recreational use, habitat preservation or esthetics are of special concern to the local or regional community.

- Obtain grants, donations or state or federal funding for purchase or lease of water rights for environmental flows and for riparian restoration projects.

B. Promote Water Stewardship Practices to Qualify for Appraisal as Open-Space Land

- Look for opportunities to promote and encourage those landowner water stewardship practices, including the holding of a water right that authorizes the use of a specified minimum amount of water for instream flows for environmental needs or bay and estuary, which shall make the landowner eligible for appraisal open-space land for purposes of *ad valorem* property tax exemption.
- Develop an educational program to inform landowners of this new opportunity for open-space exemption.

C. Conservation

Incentives for water users to use good management practices:

- Surface water saved through installation of more efficient equipment or management practices should not be subject to cancellation for non-use
- BBASC should work with NRCS to give priority to EQIP contract awards for water conservation practices including brush control and laser leveling.
- Obtain grants, donations or state or federal funding for riparian restoration projects.
- Development of various incentive programs, for example, funding for an entity to promote conservation, with a portion of conserved water dedicated to environmental flow protection.
- Public relations program to encourage municipalities to adopt water –use rate structures that will encourage conservation.

D. Explore ways to improve water availability information for prospective land purchasers.

E. Alternative Water Supplies

- Explore potential for substituting treated effluent (e.g., direct reuse) for surface water supplies in some areas of the basins, where there is a net benefit to environmental flows.
- Explore potential, incentives, and grants or state funding for household graywater use.
- Explore potential for conjunctive use to help protect environmental flows during dry periods.

F. Groundwater Management for Springflow Protection

- Participate in Groundwater Management Area meetings and support the adoption of Desired Future Conditions and groundwater management approaches which will protect key springflows and groundwater-derived base flows.
- Encourage the TWDB to perform or fund studies - especially co-operative studies among multiple groundwater districts -which determine levels of pumping and aquifer drawdown that impair flows from key springs.

G. Diversion Point Management

Opportunities may exist for conservation groups to work with a number of water right holders along a river segment to relocate water right diversion points or use older rights in conjunction with newer rights to improve delivery efficiencies. This has been done in the Entiat River in Washington State.

(See <http://www.warivers.org/entiat.html>)

H. Voluntary Dedication of Wastewater Return Flows

8.6 Site Specific Implementation Strategies

Generally, all implementation strategies are considered to be applicable for all locations unless the general discussion indicates otherwise. Where certain strategies are considered to be particularly appropriate for a given area, those specific strategies are listed below.

Upper Colorado

- State funding or tax incentives for brush control of cedar and mesquite
- State funding or tax incentives for salt clean-up on land
- State funding for studies determining reasons for downward trends in streamflow in the Upper Colorado

Lower Colorado

- State funding or tax incentives for nuisance vegetation control including noxious, invasive plants and establishment of native vegetation

Lavaca-Navidad River

- State funding for sediment control

Coastal Streams

- Add stream gages

Matagorda Bay

- Install gages on Turtle and Keller Creeks.

East Matagorda Bay

- Conduct study of the needs of East Matagorda Bay, including the feasibility of directing additional flows to the bay.
- Redirect flood flows from in Brazoria County to East Matagorda Bay
- Build small channels without boat access to improve circulation in East Matagorda Bay
- Evaluate reasonableness of pumping groundwater into East Matagorda Bay
- Build siphons or pipelines under the intracoastal waterway to ensure that local inflows actually reach the bay.
- Assure that strategies chosen are not impaired by the intracoastal waterway
- Explore the feasibility and efficacy of using various cuts to increase freshwater inflows to the bay- e.g., St. Mary's Bayou and Caney Creek

Lavaca Bay

- Add salinity monitoring sites

9.0 Lessons Learned

The CL BBASC has been fortunate to follow on the heels of two stakeholder groups who were completing their initial tasks at about the same time the Stakeholder Committee was being formed. This enabled the Committee to glean considerable information regarding procedures and processes from these initial SB3 groups allowing for a greater likelihood of successfully completing required tasks in the specified time frame.

What follows is a compilation of lessons learned by the Stakeholder Committee both during their stakeholder process and from other BBASCs:

- Potential stakeholders must understand in advance and be committed to the burdensome time commitment the process requires.
- Each stakeholder should designate an appropriate alternate who is equally committed to the process.
- Alternates should attend all meetings if at all possible in order to be fully versed and able to dialogue when filling in for the member.
- Having frequent (every 1 to 2 months) meetings of the Stakeholder Committee after its formation and prior to receipt of the BBEST report was beneficial.
- Stakeholders should be educated on the needs and expectations of all other stakeholders. This was effectively accomplished by the Stakeholder Committee through educational presentations given by each stakeholder group during early meetings in the process.
- The selection by the Stakeholder Committee of several scientists who had previous BBEST experience was very helpful in expediting both BBEST and Stakeholder Committee tasks.
- The attendance of the chair and vice-chair of the BBEST at Stakeholder Committee meetings proved essential in the transfer of knowledge essential to the Committee's tasks.
- Educational presentations by various BBEST members and other members of the scientific community during the first twelve months of the process were essential for providing the knowledge base the Stakeholder Committee members needed to comprehend the various elements of environmental flow regimes.
- SAC with support from TCEQ, TPWD, and TWDB, should present the process to the Stakeholder Committee when the committee is formed. This should include an introduction to terminology, analysis, and lessons learned from all the agencies. This should also include advice/lessons learned regarding the selection of the BBEST members. TCEQ should also provide a substantial description of the their evaluation processes and results and what has and has not worked.

- Sub-committees were and should be utilized to enable progress on the more technical issues like the establishment of modeling parameters between regular Stakeholder Committee meetings.
- Identify members who will be drafting the report language early in the process, so these members can begin formulating an outline and compiling desired information that will expedite report completion in later stages.
- The Stakeholder Committee utilized professional meeting facilitators for approximately the last seven months prior to the completion of its recommendations. This proved to be essential in keeping the group on task, focused and progressing toward goals.
- Professional facilitation is an expensive undertaking and should be provided by the state as a means of assuring the best chance of reaching consensus on an implementable outcome.
- The BBEST's budgeting of available funds should provide for appropriate interaction with the Stakeholder Committee both before and after the completion of the BBEST report and through the completion of a work plan. BBEST input during this time, including the utilization of WAM experts for modeling purposes, proved invaluable to the Stakeholder Committee.
- While completion of the work plan is not required until after the Stakeholder Committee's recommendations for environmental flow standards, it was found to be expeditious to enumerate and begin fleshing out items to be included in the work plan as those items arose during the Stakeholder Committee's discussions of the various elements of its recommendations.
- If at all possible, the final stage of Stakeholder Committee work on its recommendations should be timed in such a way that it does not coincide with the intense work seasons of the various stakeholders. It was extremely difficult for members whose livelihoods depended on the harvest of agricultural goods to be properly involved at this late stage due to the simultaneous occurrence of harvest with the latter stages of report development.
- It was found that two-day Stakeholder Committee meetings during the last several months of completing the recommendations were helpful, if not essential, in providing the level of intense and pointed discussion necessary to reach understanding and consensus on very technical and complicated issues.
- Some reasonable level of state funding to support the Stakeholder Committee process would be extremely helpful, for example in helping to defray travel costs borne by individual stakeholders.
- Additional guidance about how work plans are likely to be used and considered would be helpful in informing the Stakeholder Committee's deliberations.
- Waiting until the BBEST report is submitted to learn a new science and its language made it difficult to produce a well thought out report. More focus on education in the year prior to BBEST report submission could have resulted in better recommendations in the six month time period allotted for the Stakeholder Committee deliberations.

10.0 List of Appendices

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- 10.2 Appendix 2 - Example of BBEST Results for TCEQ's WAM RUNS 3 and 8 for Four Selected Sites
- 10.3 Appendix 3 - Colorado BBEST/BBASC Unappropriated Flow Info at BBEST Sites From TCEQ WAM RUN3
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- 10.5 Appendix 5 - Colorado/Lavaca BBEST/BBASC Lavaca Project Analysis
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- 10.9 Appendix 8 - Parameters Proposed For ASR Project on Pedernales
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- 10.12 Appendix 9 - Colorado/Lavaca BBEST/BBASC Hydrologic Condition Analysis
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- 10.15 Appendix 12 – Summary of Hydrologic Conditions Engagement Analysis For Onion Creek Near Driftwood
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Appendix 1

WAM MODEL DETAILS

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

WAM MODEL DETAILS

OVERVIEW

The TCEQ maintains water availability models (WAM) for the entire state of Texas, primarily to support their responsibility of evaluating new water right permits or amendments of existing water rights requesting changes in authorization. All of these models use a monthly hydrologic timestep and naturalized flows as input to the model. Output of the WAM models include river flows (unappropriated and regulated), reservoir storage, and many other time series information simulated over a long period of hydrologic record, typically on the order of 50 or 60 years. Numerous simulated flow and reservoir information can be extracted from WAM which enable the user to gain understanding of the impacts of existing water rights on river flows during known periods of extended low and high flow periods.

The area of the Stakeholder Committee's concern is represented by four separate WAM models which cover the Colorado River Basin, Colorado/Lavaca Coastal Basin, Lavaca River Basin, and the Lavaca/Guadalupe Coastal Basin. Generally, two different versions of WAM models were used to assess the impacts of the Stakeholder Committee's recommendations under a wide range of water utilization assumptions. Since one of the main uses of the Committee's SB3 flow recommendations will be to evaluate new water right applications, the primary focus of the analysis was based upon TCEQ RUN3 versions of the WAM models. However, in some cases, RUN8 model results were also viewed along side RUN3 results to provide additional understanding of likely future river flows. Both versions are summarized as follows:

TCEQ WAM RUN3

- All water rights are represented as diverting the full amount their water rights entitle them to divert.
- All reservoirs are assumed to be operated at their fully authorized capacity, without regard to how much of their capacity may have been reduced due to sedimentation.
- Return flows are assumed to be zero.
- Prior Appropriation is fully implemented, which means that water rights are satisfied in priority order, based on priority date, thus junior water rights cannot impound or divert water until downstream senior water rights are fully satisfied.

TCEQ WAM RUN8

- All water rights are represented as diverting their current demand, generally based on their maximum annual reported water use for the past 10 years.
- All reservoirs are assumed to be operated at their current capacity, acknowledging the reduced capacity due to sedimentation.
- Return flows are included where applicable, generally based on the minimum observed return flow occurring over the past five years.
- Prior Appropriation is fully implemented.

The specific dates in which each of the WAM models were received from the TCEQ, or downloaded off of their website, is summarized below:

BASIN	RUN3	RUN8
(1) Colorado	3/17/2011 (a)	11/15/2010 (b)
(2) Colorado/Lavaca	11/15/2010 (b)	11/15/2010 (b)
(3) Lavaca	3/17/2011 (a)	3/17/2011 (a)
(4) Lavaca/Guadalupe	12/8/2010 (b)	12/8/2010 (b)

(a) Received directly from TCEQ staff.

(b) Downloaded from TCEQ's site.

For many of the Stakeholder Committee uses of WAM derived flows, monthly results from the WAM models were disaggregated into a daily time series so that detailed analysis of daily flows could be made to better understand how recommended flow regimes would impact proposed project deliveries as well as flows to the environment. In these cases, the WAM monthly flows were disaggregated into daily flows based on observed (historical) daily flow information. The resulting daily flow estimates were input into the Flow Regime Analysis Tool (FRAT), an Excel spreadsheet maintained by Texas Parks and Wildlife built specifically for analyzing SB3 type flow regimes.

With the exception of the analysis of the Lavaca River Off-Channel Reservoir Project (LOCR), no changes were made to any of the WAM models received or downloaded from TCEQ to develop any of the information used by the Stakeholder Committee to reach their recommendations. For the LOCR, the RUN3 version of the Lavaca TCEQ WAM model was altered by removing the authorization for Texana Stage 2, a large on-channel project that has not been built and was authorized along with Lake Texana's (existing) Stage 1 water right. This change was suggested by the BBASC based on information from the regional water plan as well as specific Stakeholder Committee opinions founded on the likelihood that the LOCR might be pursued as a replacement for Texana Stage 2.

Appendix 2

Example of BBEST Results for TCEQ's WAM RUNS 3 and 8
for Four Selected Sites

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

EXAMPLE OF BBEST RESULTS FOR TCEQ'S WAM RUNS 3 AND 8 FOR FOUR SELECTED SITES

FOR DEMOSTRATION PURPOSES ONLY
DOES NOT REFLECT FINAL BBEST RECOMMENDATIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)												
COLORADO RIVER NEAR COLUMBUS - BBEST FLOW RECOMMENDATIONS																													
SEASON	SUBSISTENCE AND BASEFLOW REQUIREMENTS								HIGH PULSE REQUIREMENTS																				
	SUBSISTENCE		BASELOW		BASEMED		BASEHIGH		#1 (2 per season)			#2 (1 per season)			#3 (1 per 2 years)														
	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)												
WINTER	328	95.2%	628	72.5%	895	56.7%	1,248	40.9%	5,800	4	40,791	13,200	7	111,268															
SPRING	317	95.1%	808	75.7%	1,340	61.3%	2,098	46.7%	21,000	5	111,722	32,000	6	182,959	55,900	8	451,296												
SUMMER	226	95.0%	705	69.8%	1,060	55.6%	1,710	40.5%	6,550	4	45,217	15,600	6	150,724															
FALL	207	95.1%	610	71.4%	928	59.2%	1,400	46.8%	14,500	5	85,850	41,600	6	270,798															
RESULTS WITH TCEQ WAM RUN3																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	75.2%		51.2%		37.7%		28.7%		1.7%			6.8%																	
SPRING	95.2%		70.4%		50.3%		31.5%		5.1%			16.9%			0														
SUMMER	100.0%		98.1%		92.3%		52.7%		6.8%			5.1%																	
FALL	95.3%		63.5%		47.7%		27.2%		15.3%			10.2%																	
RESULTS WITH TCEQ WAM RUN8																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	84.4%		57.5%		45.4%		34.9%		6.8%			11.9%																	
SPRING	95.6%		71.2%		52.2%		34.7%		8.5%			16.9%			3														
SUMMER	100.0%		98.9%		84.7%		38.1%		8.5%			5.1%																	
FALL	98.2%		67.1%		49.7%		28.7%		20.3%			18.6%																	

EXAMPLE OF BBEST RESULTS FOR TCEQ'S WAM RUNS 3 AND 8 FOR FOUR SELECTED SITES

FOR DEMOSTRATION PURPOSES ONLY
DOES NOT REFLECT FINAL BBEST RECOMMENDATIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)												
COLORADO RIVER NEAR SAN SABA - BBEST FLOW RECOMMENDATIONS																													
SEASON	SUBSISTENCE AND BASEFLOW REQUIREMENTS								HIGH PULSE REQUIREMENTS																				
	SUBSISTENCE		BASELOW		BASEMED		BASEHIGH		#1 (2 per season)			#2 (1 per season)			#3 (1 per 2 years)														
	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)												
WINTER	58	95.0%	107	78.4%	163	60.6%	226	42.9%	436	3	2,606	1,400	6	12,650															
SPRING	41	95.1%	122	75.9%	198	58.9%	354	41.9%	3,640	4	21,072	9,250	6	59,235	32,300	12	204,993												
SUMMER	10	95.1%	101	66.7%	179	52.7%	332	38.8%	2,790	4	16,926	7,850	6	48,565															
FALL	28	95.1%	102	72.8%	163	56.8%	262	40.9%	1,550	3	15,217	6,300	6	38,763															
RESULTS WITH TCEQ WAM RUN3																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	96.0%		84.7%		67.0%		47.2%		23.7%			22.0%																	
SPRING	96.8%		82.0%		65.2%		42.9%		22.0%			28.8%			4														
SUMMER	98.0%		83.6%		66.6%		47.3%		27.1%			28.8%																	
FALL	97.0%		78.4%		60.3%		40.7%		42.4%			25.4%																	
RESULTS WITH TCEQ WAM RUN8																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	96.6%		82.4%		59.1%		40.8%		23.7%			18.6%																	
SPRING	96.4%		76.3%		58.8%		39.5%		22.0%			27.1%			2														
SUMMER	97.9%		79.7%		60.8%		39.6%		28.8%			27.1%																	
FALL	96.2%		72.1%		51.6%		33.9%		33.9%			23.7%																	

EXAMPLE OF BBEST RESULTS FOR TCEQ'S WAM RUNS 3 AND 8 FOR FOUR SELECTED SITES

FOR DEMOSTRATION PURPOSES ONLY
DOES NOT REFLECT FINAL BBEST RECOMMENDATIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)												
LAVACA RIVER NEAR EDNA - BBEST FLOW RECOMMENDATIONS																													
SEASON	SUBSISTENCE AND BASEFLOW REQUIREMENTS								HIGH PULSE REQUIREMENTS																				
	SUBSISTENCE		BASELOW		BASEMED		BASEHIGH		#1 (2 per season)			#2 (1 per season)			#3 (1 per 2 years)														
	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)												
WINTER	9	95.1%	29	77.1%	51	59.8%	89	42.4%	1,990	4	7,906	4,490	5	16,473															
SPRING	12	95.4%	31	79.5%	58	61.1%	95	43.1%	3,610	3	13,667	5,700	4	21,698	15,700	5	69,343												
SUMMER	2	95.1%	21	71.7%	36	56.0%	61	40.4%	973	4	4,669	3,210	5	14,792															
FALL	1	95.1%	20	69.5%	32	55.2%	53	40.1%	1,600	4	6,314	4,570	4	21,193															
RESULTS WITH TCEQ WAM RUN3																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	92.9%		74.3%		56.9%		39.4%		24.6%			35.1%																	
SPRING	93.6%		76.2%		58.3%		40.9%		22.8%			31.6%			9														
SUMMER	92.8%		68.9%		53.3%		37.7%		22.8%			28.1%																	
FALL	92.3%		65.9%		51.3%		36.6%		24.6%			29.8%																	
RESULTS WITH TCEQ WAM RUN8																													
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																				
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)														
WINTER	93.7%		75.3%		57.8%		40.0%		22.8%			36.8%																	
SPRING	93.9%		76.5%		58.5%		41.1%		22.8%			31.6%			9														
SUMMER	95.1%		66.3%		51.1%		36.7%		22.8%			28.1%																	
FALL	95.1%		67.3%		52.1%		37.1%		24.6%			31.6%																	

EXAMPLE OF BBEST RESULTS FOR TCEQ'S WAM RUNS 3 AND 8 FOR FOUR SELECTED SITES

FOR DEMOSTRATION PURPOSES ONLY
DOES NOT REFLECT FINAL BBEST RECOMMENDATIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)																
TRES PALACIOS NEAR MIDDLEFIELD - BBEST FLOW RECOMMENDATIONS																																	
SEASON	SUBSISTENCE AND BASEFLOW REQUIREMENTS								HIGH PULSE REQUIREMENTS																								
	SUBSISTENCE		BASELOW		BASEMED		BASEHIGH		#1 (2 per season)			#2 (1 per season)			#3 (1 per 2 years)																		
	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	FREQ (%)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)	FLOW (cfs)	DUR (days)	VOL (af)																
WINTER	6	95.1%	11	72.3%	15	56.5%	24	39.8%	1,050	3	3,938	1,870	3	6,544	6,020	4	26,397																
SPRING	7	95.1%	13	75.7%	17	61.4%	25	43.0%	1,320	3	3,795	2,180	3	6,434																			
SUMMER	9	95.3%	16	80.3%	23	62.0%	33	43.5%	605	4	2,615	1,580	4	6,220																			
FALL	6	95.2%	12	78.3%	18	58.9%	29	41.7%	1,370	4	5,669	2,240	4	9,673																			
RESULTS WITH TCEQ WAM RUN3																																	
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																								
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)																		
WINTER	80.3%		67.6%		59.0%		47.5%		15.8%			22.8%			5																		
SPRING	74.5%		57.9%		49.5%		36.4%		10.5%			19.3%																					
SUMMER	48.9%		39.4%		32.6%		26.3%		5.3%			26.3%																					
FALL	64.5%		52.6%		44.9%		36.6%		17.5%			28.1%																					
RESULTS WITH TCEQ WAM RUN8																																	
SEASON	SUBSISTENCE AND BASEFLOW RESULTS								HIGH PULSE RESULTS																								
	SUBSISTENCE FREQ (%)		BASELOW FREQ (%)		BASEMED FREQ (%)		BASEHIGH FREQ (%)		% OF YEARS REQ #1 MET FREQ (%)			% OF YEARS REQ #2 MET FREQ (%)			% OF YEARS REQ #3 MET FREQ (%)																		
WINTER	84.1%		70.8%		61.9%		49.5%		15.8%			26.3%			5																		
SPRING	78.9%		61.7%		52.9%		39.1%		14.0%			19.3%																					
SUMMER	70.7%		50.4%		39.4%		30.7%		7.0%			26.3%																					
FALL	75.5%		58.0%		48.3%		38.7%		17.5%			28.1%																					

Appendix 3

Colorado BBEST/BBASC Unappropriated Flow Info at BBEST Sites From TCEQ WAM RUN3

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

COLORADO BBEST/BBASC UNAPPROPRIATED FLOW INFO FROM TCEQ WAM RUN3

C:\KRC\Active\COL BBASC\05052011-TCEQ RUN3 UNAP AT BBEST SITES.XLS]SUMMARY

5/6/2011 1:20 PM

SITE#	PAGE #	WAM ID	COLORADO BBEST SITES	FLOW STATISTICS (ACRE-FEET)						FREQUENCY STATISTICS				PERCENT OF TIME	
				ANNUAL DRT AVG AF/Y	ANNUAL POR AVG AF/Y	ANNUAL MAX AMT AF/Y	ANNUAL MIN AMT AF/Y	MONTH MIN AMT AF	MONTH MAX AMT AF	YEARS WITH ZERO	MONTHS WITH ZERO	NUMBER YEARS	CONSC YEARS	NUMBER MONTHS	CONSC MONTHS
1	1	B20000	COLORADO ABOVE SILVER	0	2,989	176,356	0	0	69,005	58	57	705	686	1.7%	0.4%
2	2	D40000	COLORADO NEAR BALINGER	0	4,290	211,232	0	0	87,683	57	41	704	494	3.4%	0.6%
3	3	D30000	ELM CREEK NEAR BALINGER	0	1,917	71,801	0	0	41,318	57	41	704	494	3.4%	0.6%
4	4	C30000	SOUTH CONCHO AT CHRISTOVAL	0	526	6,305	0	0	2,133	45	24	662	298	23.7%	6.5%
5	5	C10000	CONCHO AT PAINT ROCK	0	519	23,358	0	0	11,490	57	41	704	494	3.4%	0.6%
6	6	F20000	PECAN BAYOU NEAR MULLIN	757	49,222	521,798	0	0	254,860	31	9	614	122	47.5%	13.3%
7	7	E10000	SAN SABA AT SAN SABA	2,328	39,182	266,255	0	0	128,276	31	9	613	122	47.5%	13.4%
8	8	F10000	COLORADO NEAR SAN SABA	7,722	118,431	1,189,907	0	0	603,485	31	9	613	122	47.5%	13.4%
9	9	G10000	LLANO AT LLANO	8,463	82,876	505,209	0	0	274,118	30	9	611	122	49.2%	13.7%
10	10	H10000	PEDERNALES NEAR JOHNSON CITY	4,721	54,173	370,035	0	0	192,213	30	9	611	122	49.2%	13.7%
11	11	J50000	ONION NEAR DRIFTWOOD	8,011	16,990	103,705	0	0	47,173	12	3	486	53	79.7%	31.4%
12	12	J30000	COLORADO AT BASTROP	29,701	363,099	3,485,790	0	0	1,526,149	28	9	592	122	52.5%	16.4%
13	13	J10000	COLORADO AT COLUMBUS	42,313	482,682	4,504,329	0	0	1,789,100	28	9	586	122	52.5%	17.2%
14	14	K20000	COLORADO NEAR WHARTON	43,425	501,804	4,752,955	0	0	1,882,364	26	9	576	122	55.9%	18.6%
15	15	GS300	LAVACA RIVER NEAR EDNA	60,964	201,454	848,439	0	0	428,297	6	1	386	26	89.5%	43.6%
16	16	WGS800	WEST MUSTANG CREEK NEAR GANADO	20,950	58,757	192,780	0	0	105,382	9	4	479	51	84.2%	30.0%
17	17	GS1000	SANDY CREEK NEAR GANADO	27,968	84,218	384,196	0	0	145,100	9	4	480	51	84.2%	29.8%
18	18	EDV712	EAST MUSTANG CREEK NEAR LOUISE (APPROX)	4,963	15,701	62,252	0	0	28,561	9	4	479	51	84.2%	30.0%
19	19	DV501	NAVIDAD RIVER NEAR EDNA (STRANE PARK) (APPROX)	48,876	163,232	601,777	0	0	265,411	9	4	479	51	84.2%	30.0%
20	20	GS1300	TRES PALACIOS NEAR MIDFIELD	29,770	65,813	229,902	0	0	83,510	0	0	213	7	100.0%	68.9%
21	21	GS1200	GACITAS CREEK NEAR INEZ	15,150	32,107	93,428	0	0	46,926	0	0	32	3	100.0%	95.3%
15A	22	GS300-ALT	LAVACA RIVER NEAR EDNA (STAGE 2 REMOVED)	107,634	243,983	884,440	0	0	437,495	0	0	62	8	100.0%	90.9%

COLORADO BASIN WAM (1940-1998)
LAVACA BASIN WAM (1940-1996)
COLORADO/LAVACA COASTAL WAM (1940-1996)
LAVACA/GUADALUPE COASTAL WAM (1940-1996)

NOTE 1: HIGH CONSECUTIVE MONTHS OF NO UNAPPROPRIATED WATER INDICATES LITTLE OR NO POSSIBILITY OF RELIABLE WATER SUPPLY, EVEN WITH LARGE RESERVOIR.

NOTE 2: LARGE ANNUAL AVERAGE AMOUNT OF UNAPPROPRIATED WATER AND LOWER NUMBER OF CONSECUTIVE MONTHS WITH NO UNAPPROPRIATED WATER INDICATES POSSIBLE RELIABLE WATER SUPPLY WITH LARGE RESERVOIR.

NOTE 3: UNRELIABLE WATER SUPPLY CAN BE CONSIDERED FOR WATER RIGHTS PERMIT IF ALTERNATIVE WATER SUPPLY IS AVAILABLE; OR, PROPOSED USE IS NOT MUNICIPAL.

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT B20000 COLORADO ABOVE SILVER												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	0 annualized	0	0
units are acre-feet												MAX DURING DROUGHT			0
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC				
1940	0	0	0	0	0	0	0	0	0	0	0				
1941	0	0	0	0	66,964	69,005	0	0	0	0	0				
1942	0	0	0	0	0	0	0	0	0	0	0				
1943	0	0	0	0	0	0	0	0	0	0	0				
1944	0	0	0	0	0	0	0	0	0	0	0				
1945	0	0	0	0	0	0	0	0	0	0	0				
1946	0	0	0	0	0	0	0	0	0	0	0				
1947	0	0	0	0	0	0	0	0	0	0	0				
1948	0	0	0	0	0	0	0	0	0	0	0				
1949	0	0	0	0	0	0	0	0	0	0	0				
1950	0	0	0	0	0	0	0	0	0	0	0				
1951	0	0	0	0	0	0	0	0	0	0	0				
1952	0	0	0	0	0	0	0	0	0	0	0				
1953	0	0	0	0	0	0	0	0	0	0	0				
1954	0	0	0	0	0	0	0	0	0	0	0				
1955	0	0	0	0	0	0	0	0	0	0	0				
1956	0	0	0	0	0	0	0	0	0	0	0				
1957	0	0	0	0	0	0	0	0	0	0	0				
1958	0	0	0	0	0	0	0	0	0	0	0				
1959	0	0	0	0	0	0	0	0	0	0	0				
1960	0	0	0	0	0	0	0	0	0	0	0				
1961	0	0	0	0	0	0	0	0	0	0	0				
1962	0	0	0	0	0	0	0	0	0	0	0				
1963	0	0	0	0	0	0	0	0	0	0	0				
1964	0	0	0	0	0	0	0	0	0	0	0				
1965	0	0	0	0	0	0	0	0	0	0	0				
1966	0	0	0	0	0	0	0	0	0	0	0				
1967	0	0	0	0	0	0	0	0	0	0	0				
1968	0	0	0	0	0	0	0	0	0	0	0				
1969	0	0	0	0	0	0	0	0	0	0	0				
1970	0	0	0	0	0	0	0	0	0	0	0				
1971	0	0	0	0	0	0	0	0	0	0	0				
1972	0	0	0	0	0	0	0	0	0	0	0				
1973	0	0	0	0	0	0	0	0	0	0	0				
1974	0	0	0	0	0	0	0	0	0	0	0				
1975	0	0	0	0	0	0	0	0	0	0	0				
1976	0	0	0	0	0	0	0	0	0	0	0				
1977	0	0	0	0	0	0	0	0	0	0	0				
1978	0	0	0	0	0	0	0	0	0	0	0				
1979	0	0	0	0	0	0	0	0	0	0	0				
1980	0	0	0	0	0	0	0	0	0	0	0				
1981	0	0	0	0	0	0	0	0	0	0	0				
1982	0	0	0	0	0	0	0	0	0	0	0				
1983	0	0	0	0	0	0	0	0	0	0	0				
1984	0	0	0	0	0	0	0	0	0	0	0				
1985	0	0	0	0	0	0	0	0	0	0	0				
1986	0	0	0	0	0	0	0	0	0	0	0				
1987	0	0	0	0	0	0	0	0	0	0	0				
1988	0	0	0	0	0	0	0	0	0	0	0				
1989	0	0	0	0	0	0	0	0	0	0	0				
1990	0	0	0	0	0	0	0	0	0	0	0				
1991	0	0	0	0	0	0	0	0	0	0	0				
1992	0	0	0	0	0	0	0	0	0	0	0				
1993	0	0	0	0	0	0	0	0	0	0	0				
1994	0	0	0	0	0	0	0	0	0	0	0				
1995	0	0	0	0	0	0	0	0	0	0	0				
1996	0	0	0	0	0	0	0	0	0	0	0				
1997	0	0	0	0	0	0	0	0	0	0	0				
1998	0	0	0	0	0	0	0	0	0	0	0				
Avg	0	0	0	0	1,135	1,170	0	0	0	685	0	0	0	0	2,989
Max	0	0	0	0	66,964	69,005	0	0	0	40,387	0	0	0	0	176,356
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT D40000 COLORADO NEAR BALINGER												# of months in drought	144 months	12.0 years	46-56
units are acre-feet												total depletion in drought	0	0 annualized	0
												MAX DURING DROUGHT			0
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	85,736	87,683	0	0	0	0	0	0	0	0	211,232
1942	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	41,889	0	0	41,889
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg	0	0	0	0	1,453	1,486	0	0	0	1,351	0	0	0	0	4,290
Max	0	0	0	0	85,736	87,683	0	0	0	41,889	0	0	0	0	211,232
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT D30000 ELM CREEK NEAR BALINGER												# of months in drought	144 months	12.0 years	46-56
units are acre-feet												total depletion in drought	0	0 annualized	0
												MAX DURING DROUGHT			0
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	26,896	28,755	0	0	0	0	0	0	0	0	71,801
1942	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	41,318	0	0	41,318
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg	0	0	0	0	456	487	0	0	0	0	0	974	0	0	1,917
Max	0	0	0	0	26,896	28,755	0	0	0	0	0	41,318	0	0	71,801
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT C30000 SOUTH CONCHO AT CHRISTOVAL												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	0	0 annualized	0
												MAX DURING DROUGHT			0
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	0	0	1,159	0	302	0	0	1,461			
1941	0	0	0	0	0	2,133	0	0	0	0	0	2,133			
1942	0	0	0	0	0	508	325	0	0	0	0	833			
1943	0	0	0	0	0	426	557	479	270	375	308	2,415			
1944	0	0	0	762	398	0	492	0	0	0	0	1,652			
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	401	0	767	0	1,168		
1958	816	0	0	0	0	0	0	0	0	1,402	0	0	2,218		
1959	0	0	441	460	365	0	0	478	0	0	0	0	1,744		
1960	0	0	0	0	0	625	0	709	798	1,071	666	0	3,869		
1961	0	0	0	737	739	0	0	0	0	0	0	0	1,476		
1962	0	0	0	1,079	1,112	411	903	753	455	527	477	588	6,305		
1963	0	558	0	723	504	749	568	0	0	0	0	0	3,102		
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	771	0	0	0	0	0	0	771		
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	1,032	0	850	0	0	0	0	0	1,882
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg	14	9	7	64	53	95	85	41	47	62	38	10	526		
Max	816	558	441	1,079	1,112	2,133	1,159	753	850	1,402	767	588	6,305		
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT C10000 CONCHO AT PAINT ROCK												# of months in drought	144 months	12.0 years	46-56
units are acre-feet												total depletion in drought	0	0 annualized	0
												MAX DURING DROUGHT			0
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1941	0	0	0	0	9,823	11,490	0	0	0	0	0	0	0	0	23,358
1942	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	7,290	0	0	7,290
1958	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg	0	0	0	0	166	195	0	0	0	158	0	0	0	0	519
Max	0	0	0	0	9,823	11,490	0	0	0	7,290	0	0	0	0	23,358
Min	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT F20000 PECAN BAYOU NEAR MULLIN												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	9,081	757 annualized	826
units are acre-feet												MAX DURING DROUGHT			5,938
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	25,130	0	0	0	0	12,434	61,464			
1941	2,015	27,975	26,102	75,425	203,978	73,316	0	0	0	10,548	0	419,359			
1942	0	0	0	71,731	45,457	0	0	0	0	49,549	11,476	0	178,213		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	13,897	24,286	0	0	0	0	0	0	0	0	38,183		
1946	0	0	0	0	1,123	0	0	0	0	0	0	0	1,123		
1947	2,020	0	5,938	0	0	0	0	0	0	0	0	0	7,958		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	69,594	0	0	0	47,098	31,598	7,734	156,024		
1958	4,429	20,896	29,198	1,109	38,499	7,648	0	0	0	0	0	0	101,779		
1959	0	0	0	0	0	0	0	0	0	91,700	0	5,853	97,553		
1960	42,944	11,064	0	4,297	0	0	0	0	0	0	0	0	4,613	62,918	
1961	13,200	25,506	0	0	0	85,509	25,568	0	0	0	0	0	0	149,783	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,821	19,985	76,244	10,114	0	0	0	0	0	0	0	117,164	
1969	0	0	0	0	0	0	0	0	0	0	0	0	12,134	12,134	
1970	4,774	8,020	44,041	11,010	21,504	0	0	0	0	0	0	0	0	89,349	
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951		
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	13,090	677	0	13,767		
1974	625	0	0	0	0	0	0	0	0	9,852	62,654	32,520	4,221	109,872	
1975	4,054	28,400	2,240	10,070	14,819	2,922	0	0	0	0	0	0	0	62,505	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	578	0	19,897	4,943	0	0	0	0	0	0	0	0	25,418	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	837	0	0	0	16,861	0	0	0	17,698	
1982	0	0	0	0	6,193	0	0	0	0	0	0	0	0	6,193	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	17,249	19,715	
1987	6,900	11,399	43,502	0	26,012	39,814	0	0	0	0	0	0	0	127,627	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	239,015	239,015	
1992	79,841	254,860	143,384	21,929	11,830	9,954	0	0	0	0	0	0	0	521,798	
1993	0	0	4,222	1,755	0	0	0	0	0	0	0	0	0	5,977	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	17,865	22,828	137,461	13,886	0	0	0	0	0	0	215,420	
1998	0	237	32,528	348	0	0	0	0	0	0	0	0	0	33,113	
AVG	2,725	6,592	6,428	4,741	8,024	7,815	1,095	0	167	5,136	1,335	5,164	49,222		
MAX	79,841	254,860	143,384	75,425	203,978	137,461	25,568	0	9,852	91,700	32,520	239,015	521,798		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT E10000 SAN SABA AT SAN SABA												# of months in drought	144 months	12.0 years	46-56	
												total depletion in drought	2,328 annualized		2,540	
units are acre-feet												MAX DURING DROUGHT				
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC				TOTAL	
1940	0	0	0	0	23,900	9,818	0	0	0	0	15,664		49,382			
1941	8,851	14,005	22,536	55,244	59,915	49,628	0	0	0	0	0		266,255			
1942	0	0	0	15,425	11,732	0	0	0	0	35,373	11,097	0	73,627			
1943	0	0	0	0	0	0	0	0	0	0	0		0			
1944	0	0	0	0	0	0	0	0	0	0	0		0			
1945	0	0	22,357	26,326	0	0	0	0	0	0	0		48,683			
1946	0	0	0	0	12,901	0	0	0	0	0	0		12,901			
1947	5,877	0	9,160	0	0	0	0	0	0	0	0		15,037			
1948	0	0	0	0	0	0	0	0	0	0	0		0			
1949	0	0	0	0	0	0	0	0	0	0	0		0			
1950	0	0	0	0	0	0	0	0	0	0	0		0			
1951	0	0	0	0	0	0	0	0	0	0	0		0			
1952	0	0	0	0	0	0	0	0	0	0	0		0			
1953	0	0	0	0	0	0	0	0	0	0	0		0			
1954	0	0	0	0	0	0	0	0	0	0	0		0			
1955	0	0	0	0	0	0	0	0	0	0	0		0			
1956	0	0	0	0	0	0	0	0	0	0	0		0			
1957	0	0	0	0	0	17,507	0	0	0	115,245	16,208	9,865	158,825			
1958	14,539	34,341	23,400	1,109	14,258	35,377	0	0	0	0	0		123,024			
1959	0	0	0	0	0	0	0	0	0	61,210	0	10,084	71,294			
1960	24,903	16,604	0	4,297	0	0	0	0	0	0	0		15,467	61,271		
1961	21,808	14,669	0	0	0	47,298	15,010	0	0	0	0		98,785			
1962	0	0	0	0	0	0	0	0	0	0	0		0			
1963	0	0	0	0	0	0	0	0	0	0	0		0			
1964	0	0	0	0	0	0	0	0	0	0	0		0			
1965	0	0	0	0	0	0	0	0	0	0	0		0			
1966	0	0	0	0	0	0	0	0	0	0	0		0			
1967	0	0	0	0	0	0	0	0	0	0	0		0			
1968	0	0	10,821	19,985	31,905	18,935	0	0	0	0	0		81,646			
1969	0	0	0	0	0	0	0	0	0	0	0		12,134	12,134		
1970	4,774	14,742	33,388	14,472	17,857	0	0	0	0	0	0		85,233			
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951			
1972	0	0	0	0	0	0	0	0	0	0	0		0			
1973	0	0	0	0	0	0	0	0	0	103,670	12,517	0	116,187			
1974	6,894	0	0	0	0	0	0	0	0	128,276	22,475	21,627	18,099	197,371		
1975	18,301	21,634	16,091	20,890	32,888	14,159	0	0	0	0	0		0	123,963		
1976	0	0	0	0	0	0	0	0	0	0	0		0			
1977	0	8,324	0	46,510	21,502	0	0	0	0	0	0		76,336			
1978	0	0	0	0	0	0	0	0	0	0	0		0			
1979	0	0	0	0	0	0	0	0	0	0	0		0			
1980	0	0	0	0	0	0	0	0	0	0	0		0			
1981	0	0	0	0	0	1,865	0	0	0	12,860	1,502	0	16,227			
1982	0	0	0	0	6,193	0	0	0	0	0	0		6,193			
1983	0	0	0	0	0	0	0	0	0	0	0		0			
1984	0	0	0	0	0	0	0	0	0	0	0		0			
1985	0	0	0	0	0	0	0	0	0	0	0		0			
1986	0	0	0	0	0	0	0	0	0	0	2,466	14,934	17,400			
1987	10,898	10,310	12,737	0	15,958	41,349	0	0	0	0	0		91,252			
1988	0	0	0	0	0	0	0	0	0	0	0		0			
1989	0	0	0	0	0	0	0	0	0	0	0		0			
1990	0	0	0	0	0	0	0	0	0	0	0		0			
1991	0	0	0	0	0	0	0	0	0	0	0		50,766	50,766		
1992	17,158	86,171	37,315	26,440	19,644	46,499	0	0	0	0	0		0	233,227		
1993	0	0	4,222	9,689	0	0	0	0	0	0	0		0	13,911		
1994	0	0	0	0	0	0	0	0	0	0	0		0			
1995	0	0	0	0	0	0	0	0	0	0	0		0			
1996	0	0	0	0	0	0	0	0	0	0	0		0			
1997	0	0	23,380	20,125	15,264	100,378	10,362	0	0	0	0		169,509			
1998	0	7,395	20,583	348	0	0	0	0	0	0	0		0	28,326		
AVG	2,271	3,868	4,000	4,421	4,407	6,727	596	0	2,174	7,092	1,109	2,516	39,182			
MAX	24,903	86,171	37,315	55,244	59,915	100,378	15,010	0	128,276	115,245	21,627	50,766	266,255			
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0			

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT F10000 COLORADO NEAR SAN SABA												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	92,669	7,722 annualized	8,424
units are acre-feet												MAX DURING DROUGHT			77,089
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	25,130	0	0	0	0	29,434	78,464			
1941	8,851	50,708	51,198	188,085	448,141	363,617	0	0	0	56,076	0	0	1,166,676		
1942	0	0	0	78,384	45,457	0	0	0	0	49,549	11,476	0	184,866		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	34,552	66,471	0	0	0	0	0	0	0	0	101,023		
1946	0	0	0	0	77,089	0	0	0	0	0	0	0	77,089		
1947	5,877	0	9,703	0	0	0	0	0	0	0	0	0	15,580		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	117,095	0	0	0	357,900	56,637	16,228	547,860		
1958	16,982	60,439	56,128	1,109	49,310	35,377	0	0	0	0	0	0	219,345		
1959	0	0	0	0	0	0	0	0	0	192,044	0	0	16,322	208,366	
1960	83,875	28,741	0	4,297	0	0	0	0	0	0	0	0	17,774	134,687	
1961	36,736	46,650	0	0	0	164,236	44,298	0	0	0	0	0	0	291,920	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,821	19,985	141,304	34,672	0	0	0	0	0	0	0	206,782	
1969	0	0	0	0	0	0	0	0	0	0	0	0	12,134	12,134	
1970	4,774	14,785	104,529	18,750	27,975	0	0	0	0	0	0	0	0	170,813	
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	0	12,951	
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	112,585	12,517	0	0	125,102	
1974	6,894	0	0	0	0	0	0	0	0	205,624	106,209	78,340	23,395	420,462	
1975	26,397	58,961	19,602	39,771	73,076	14,159	0	0	0	0	0	0	0	231,966	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	8,324	0	141,581	49,332	0	0	0	0	0	0	0	0	199,237	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	1,865	0	0	0	24,831	1,502	0	0	28,198	
1982	0	0	0	0	6,193	0	0	0	0	0	0	0	0	6,193	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	40,698	43,164	
1987	22,332	22,480	75,771	0	26,012	146,465	0	0	0	0	0	0	0	0	293,060
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	329,117	329,117	
1992	153,363	603,485	266,647	64,235	27,157	75,020	0	0	0	0	0	0	0	1,189,907	
1993	0	0	4,222	9,689	0	0	0	0	0	0	0	0	0	13,911	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	63,031	40,365	406,180	26,703	0	0	0	0	0	0	559,659	
1998	0	18,193	100,356	348	0	0	0	0	0	0	0	0	0	0	118,897
AVG	6,205	15,471	12,829	11,792	17,143	23,434	1,629	0	3,485	15,436	2,762	8,246	118,431		
MAX	153,363	603,485	266,647	188,085	448,141	406,180	44,298	0	205,624	357,900	78,340	329,117	1,189,907		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT G10000 LLANO AT LLANO												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	101,560	8,463 annualized	9,233
units are acre-feet												MAX DURING DROUGHT			
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC				TOTAL
1940	0	0	0	0	23,900	25,130	0	0	0	0	45,272			94,302	
1941	12,784	26,440	37,158	68,820	64,187	24,287	0	0	0	46,987	0		0	280,663	
1942	0	0	0	38,816	23,640	0	0	0	0	35,711	11,476	0	0	109,643	
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	19,563	28,251	0	0	0	0	0	0	0	0	0	47,814	
1946	0	0	0	0	42,824	0	0	0	0	0	0	0	0	42,824	
1947	40,520	0	18,216	0	0	0	0	0	0	0	0	0	0	58,736	
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	79,803	0	0	0	218,130	46,858	21,854		366,645	
1958	28,309	93,135	51,786	1,109	36,547	40,829	0	0	0	0	0	0	0	251,715	
1959	0	0	0	0	0	0	0	0	0	102,580	0	14,847	0	117,427	
1960	27,275	28,504	0	4,297	0	0	0	0	0	0	0	0	0	31,696	
1961	37,633	47,916	0	0	0	190,813	32,478	0	0	0	0	0	0	308,840	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,821	19,985	73,957	23,579	0	0	0	0	0	0	0	128,342	
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	12,134	
1970	4,774	14,785	94,203	18,750	62,994	0	0	0	0	0	0	0	0	195,506	
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	0	12,951	
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	112,585	14,145	0	0	126,730	
1974	6,894	0	0	0	0	0	0	0	0	100,718	39,020	59,839	33,141	239,612	
1975	25,526	54,696	21,031	28,151	124,408	50,814	0	0	0	0	0	0	0	304,626	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	18,217	0	184,597	78,677	0	0	0	0	0	0	0	0	281,491	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	58,712	0	0	0	0	0	0	0	58,712	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	135,412	0	0	0	85,275	1,502	0	0	222,189	
1982	0	0	0	0	6,193	0	0	0	0	0	0	0	0	6,193	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	50,809	53,275	
1987	33,073	27,992	31,210	0	26,012	171,376	21,458	0	0	0	0	0	0	311,121	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	190,035	190,035	
1992	51,794	215,967	75,333	40,863	40,756	80,496	0	0	0	0	0	0	0	505,209	
1993	0	0	4,222	9,689	0	0	0	0	0	0	0	0	0	13,911	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	50,118	18,058	274,118	33,014	0	0	0	0	0	0	398,688	
1998	0	20,002	38,252	348	0	0	0	0	0	0	0	0	0	58,602	
AVG	4,552	9,282	7,206	8,369	10,140	19,562	1,900	0	1,707	11,048	2,310	6,800	82,876		
MAX	51,794	215,967	94,203	184,597	124,408	274,118	33,014	0	100,718	218,130	59,839	190,035	505,209		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT H10000 PEDERNALES NEAR JOHNSON CITY												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	56,653	4,721 annualized	5,150
units are acre-feet												MAX DURING DROUGHT			29,917
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	7,355	0	0	0	0	37,612	68,867			
1941	8,055	29,632	34,789	55,018	49,951	12,595	0	0	0	13,184	0	0	203,224		
1942	0	0	0	5,792	1,115	0	0	0	0	38,912	3,124	0	48,943		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	36,100	33,006	0	0	0	0	0	0	0	0	69,106		
1946	0	0	0	0	17,992	0	0	0	0	0	0	0	17,992		
1947	29,917	0	8,744	0	0	0	0	0	0	0	0	0	38,661		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	28,426	0	0	0	24,072	13,834	7,250	73,582		
1958	9,171	25,369	17,437	1,109	21,272	40,829	0	0	0	0	0	0	115,187		
1959	0	0	0	0	0	0	0	0	0	123,673	0	0	17,276	140,949	
1960	15,951	24,975	0	4,297	0	0	0	0	0	0	0	0	19,344	64,567	
1961	14,008	38,954	0	0	0	18,832	2,940	0	0	0	0	0	0	74,734	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,821	12,905	20,056	3,519	0	0	0	0	0	0	0	47,301	
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	12,134	12,134
1970	4,774	8,531	29,748	9,205	69,015	0	0	0	0	0	0	0	0	0	121,273
1971	0	0	0	0	0	0	0	0	0	11,534	0	0	1,417	12,951	
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	13,971	5,889	0	0	19,860	
1974	2,632	0	0	0	0	0	0	0	0	20,983	62,074	34,583	12,423	132,695	
1975	13,423	62,045	13,579	10,389	99,317	39,075	0	0	0	0	0	0	0	0	237,828
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	7,508	0	137,791	20,456	0	0	0	0	0	0	0	0	165,755	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	83,723	0	0	0	0	0	0	0	83,723	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	109,769	0	0	0	44,875	1,502	0	0	156,146	
1982	0	0	0	0	6,193	0	0	0	0	0	0	0	0	6,193	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	51,539	54,005	
1987	23,808	19,620	18,901	0	26,012	168,896	21,458	0	0	0	0	0	0	0	278,695
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	192,213	192,213	
1992	36,169	158,889	76,072	33,118	44,354	21,433	0	0	0	0	0	0	0	0	370,035
1993	0	0	3,876	9,689	0	0	0	0	0	0	0	0	0	13,565	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	70,672	44,068	152,376	23,103	0	0	0	0	0	0	0	313,599
1998	0	13,701	48,355	348	0	0	0	0	0	0	0	0	0	0	62,404
AVG	2,676	6,597	5,454	6,497	7,115	11,922	930	0	356	5,632	1,041	5,953	54,173		
MAX	36,169	158,889	76,072	137,791	99,317	168,896	23,103	0	20,983	123,673	34,583	192,213	370,035		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT J50000 ONION NEAR DRIFTWOOD												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	96,131	8,011 annualized	8,384
units are acre-feet												MAX DURING DROUGHT			
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC				TOTAL
1940	0	0	1,384	0	0	2,509	3,187	0	0	2,604	3,554				13,238
1941	2,010	1,844	2,479	2,402	5,055	6,550	2,507	0	0	1,688	0				24,535
1942	1,369	0	1,376	1,915	1,381	1,355	0	1,237	0	1,661	1,509				11,803
1943	1,384	1,384	1,390	1,374	1,375	1,354	1,335	1,276	1,331	1,328	1,385	1,394			16,310
1944	0	0	0	0	0	0	0	0	0	0	0	0			0
1945	0	0	2,137	2,385	0	0	1,268	0	1,236	0	0	0			7,026
1946	0	0	0	0	2,639	0	0	0	0	1,339	3,751	2,104			9,833
1947	2,932	0	2,305	0	0	0	0	0	0	0	0	0			5,237
1948	0	0	1,250	1,380	1,376	1,347	1,329	1,303	0	0	0	0			7,985
1949	0	0	0	0	0	0	0	1,177	0	0	1,383	1,394			3,954
1950	1,392	0	0	0	0	0	0	0	0	1,154	1,381	1,383			5,310
1951	1,387	0	1,472	1,380	1,382	0	1,282	1,268	0	0	0	0			8,171
1952	0	0	0	0	0	1,336	1,327	1,264	1,345	0	0	0			5,272
1953	1,388	0	0	0	1,354	1,339	1,317	1,299	0	0	0	0			6,697
1954	1,394	1,391	1,385	1,382	1,376	1,347	1,321	1,283	1,323	1,351	0	0			13,553
1955	0	0	0	1,359	0	1,359	1,389	1,300	1,330	0	1,327	1,586			9,650
1956	1,461	1,557	1,404	1,376	1,377	1,349	1,320	1,284	1,317	1,336	1,390	1,395			16,566
1957	1,399	0	0	0	0	6,170	0	0	2,440	5,041	2,698	2,130			19,878
1958	2,671	5,827	3,212	2,741	3,196	1,827	0	0	0	0	0	0			19,474
1959	1,397	0	0	2,329	0	0	1,362	0	0	2,107	0	1,612			8,807
1960	1,753	1,886	0	2,311	1,374	0	0	0	0	14,640	4,899	6,810			33,673
1961	6,388	8,133	0	0	0	13,982	9,021	0	4,529	0	0	0			42,053
1962	0	0	0	0	0	0	1,264	0	0	0	0	0			1,264
1963	0	0	0	0	0	0	0	0	0	0	0	0			0
1964	0	0	1,676	1,380	0	0	0	0	0	0	0	0			3,056
1965	0	0	0	0	0	0	0	0	0	0	0	0			0
1966	0	0	0	0	0	1,353	1,293	1,882	0	0	0	0			4,528
1967	1,592	1,390	1,544	1,380	2,059	1,523	1,321	0	0	0	0	0			10,809
1968	0	0	5,180	4,658	10,293	5,833	0	0	0	0	0	0			25,964
1969	0	0	4,490	6,682	0	0	0	0	0	0	0	0			3,920
1970	3,082	5,872	7,941	5,046	11,112	0	0	0	0	0	0	0			33,053
1971	0	1,575	1,377	1,552	0	0	0	0	0	1,350	0	5,731			11,585
1972	0	0	0	0	0	0	0	0	0	0	0	0			0
1973	0	0	0	0	0	0	0	0	0	19,759	3,570	0			23,329
1974	4,197	2,231	1,472	1,372	0	1,640	1,428	0	2,925	4,818	14,010	6,901			40,994
1975	5,251	7,292	4,783	3,916	16,366	10,359	0	0	0	0	0	0			47,967
1976	0	0	0	0	0	0	0	0	0	0	0	3,004			3,004
1977	0	4,948	0	11,852	3,690	0	0	0	0	0	0	0			20,490
1978	0	0	0	0	0	0	0	0	0	0	0	0			0
1979	0	0	0	0	0	3,166	0	0	0	0	0	0			3,166
1980	0	0	0	0	0	0	0	0	0	0	0	0			0
1981	0	0	0	0	0	26,568	0	0	0	3,849	1,481	0			31,898
1982	0	0	0	0	7,275	0	0	0	0	0	0	0			7,275
1983	0	0	0	0	0	0	0	0	0	0	0	0			0
1984	0	0	0	0	0	0	0	0	0	0	0	0			0
1985	0	0	0	0	0	0	0	0	0	0	0	0			0
1986	0	0	0	0	0	0	0	0	0	0	4,047	19,176			23,223
1987	9,137	4,756	9,593	0	3,038	47,173	5,966	0	0	0	0	0			79,663
1988	0	0	0	0	0	0	0	0	0	0	0	0			0
1989	0	0	0	0	0	0	0	0	0	0	0	12			12
1990	19	0	0	0	0	0	0	0	0	0	0	0			19
1991	0	0	0	0	0	0	0	0	0	0	0	33,435			33,435
1992	19,432	29,117	21,916	5,947	12,429	14,864	0	0	0	0	0	0			103,705
1993	0	0	4,261	2,936	0	0	0	12	27	0	0	0			7,236
1994	0	0	0	0	0	0	0	0	0	0	0	0			0
1995	0	0	2,632	0	0	13,602	0	0	0	0	0	0			16,234
1996	0	0	0	0	0	0	0	0	0	0	0	0			0
1997	0	0	3,924	13,758	10,818	45,563	6,606	0	0	0	0	0			1,859
1998	6,589	10,352	13,868	4,346	0	0	0	0	0	23,670	19,020	6,003			83,848
AVG	1,316	1,518	1,770	1,477	1,677	3,618	777	247	302	1,442	1,092	1,753			16,990
MAX	19,432	29,117	21,916	13,758	16,366	47,173	9,021	1,882	4,529	23,670	19,020	33,435			103,705
MIN	0	0	0	0	0	0	0	0	0	0	0	0			0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT J30000 COLORADO AT BASTROP												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	356,409	29,701 annualized	32,401
units are acre-feet												MAX DURING DROUGHT			126,101
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	94,842	0	0	46,096	157,146		321,984			
1941	25,380	144,622	193,041	418,036	757,719	599,180	40,588	0	0	56,076	0	0	2,234,642		
1942	0	0	0	78,384	45,457	0	0	0	0	49,549	11,476	0	184,866		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	94,359	234,154	0	0	0	0	0	0	0	0	328,513		
1946	0	0	0	0	90,570	0	0	0	0	0	80,235	36,845	207,650		
1947	126,101	0	22,658	0	0	0	0	0	0	0	0	0	148,759		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	117,095	0	0	17,078	791,962	242,453	60,635	1,229,223		
1958	135,021	497,614	158,672	1,109	105,756	40,829	0	0	0	0	0	0	939,001		
1959	0	0	0	25,229	0	0	0	0	0	0	248,107	0	41,819	315,155	
1960	107,484	146,336	0	4,297	0	0	0	0	0	0	119,881	31,297	127,788	537,083	
1961	175,026	272,836	0	0	0	483,397	153,974	0	31,189	0	0	0	0	1,116,422	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	10,821	19,985	235,024	118,751	0	0	0	0	0	0	0	384,581	
1969	0	0	11,185	41,231	0	0	0	0	0	0	0	0	0	12,134	64,550
1970	4,774	14,785	404,282	18,750	326,499	0	0	0	0	0	0	0	0	0	769,090
1971	0	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951	
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	307,619	33,138	0	340,757	
1974	32,871	0	0	0	0	0	0	0	0	0	225,484	226,104	385,831	117,745	988,035
1975	31,128	343,022	36,865	39,771	657,964	230,208	0	0	0	0	0	0	0	0	1,338,958
1976	0	0	0	0	0	0	0	0	0	0	0	0	33,288	33,288	
1977	0	71,507	0	855,534	78,677	0	0	0	0	0	0	0	0	1,005,718	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	204,762	0	0	0	0	0	0	0	0	204,762
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	233,713	0	0	0	85,275	1,502	0	0	0	320,490
1982	0	0	0	0	37,291	0	0	0	0	0	0	0	0	0	37,291
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	183,400	185,866	
1987	128,757	120,767	143,352	0	26,012	1,134,779	21,458	0	0	0	0	0	0	0	1,575,125
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	642,832	642,832	
1992	437,344	1,526,149	718,940	185,897	284,010	333,450	0	0	0	0	0	0	0	0	3,485,790
1993	0	0	4,222	9,689	0	0	0	0	0	0	0	0	0	0	13,911
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	18,881	0	0	59,753	0	0	0	0	0	0	0	0	78,634
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	23,380	251,594	175,233	1,134,003	157,802	0	0	0	0	0	18,077	1,760,089	
1998	7,262	38,679	264,231	348	0	0	0	0	0	0	210,339	86,669	9,282	616,810	
AVG	20,528	53,836	35,676	37,017	47,800	79,895	7,943	0	4,640	35,702	15,613	24,448	363,099		
MAX	437,344	1,526,149	718,940	855,534	757,719	1,134,779	157,802	0	225,484	791,962	385,831	642,832	3,485,790		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT J10000 COLORADO AT COLUMBUS												# of months in drought	144 months	12.0 years	46-56	
												total depletion in drought	507,750	42,313 annualized	46,159	
	units are acre-feet											MAX DURING DROUGHT				
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC					
1940	0	0	0	0	23,900	422,548	0	0	0	479,202	435,739	1,361,389				
1941	106,190	182,387	322,363	538,205	1,026,292	789,635	157,190	0	0	56,076	11,538	0	3,189,876			
1942	0	0	0	177,294	45,457	0	0	0	0	49,549	11,476	0	283,776			
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1945	0	0	94,359	408,149	0	0	0	0	0	0	0	0	0	0	0	502,508
1946	0	0	0	0	90,570	86,046	0	0	0	0	80,235	38,187	295,038			
1947	190,054	0	22,658	0	0	0	0	0	0	0	0	0	0	0	0	212,712
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	117,095	0	0	17,078	990,937	242,453	60,635	1,428,198			
1958	149,481	525,734	158,672	1,109	105,756	40,829	0	0	0	0	0	0	0	981,581		
1959	0	0	0	172,355	0	0	0	0	0	0	248,107	0	41,819	462,281		
1960	107,484	155,780	0	61,764	0	111,888	0	0	0	119,881	195,738	160,986	913,521			
1961	250,359	328,416	0	0	0	510,803	176,810	0	299,539	0	0	0	0	1,565,927		
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	10,821	19,985	235,024	303,310	0	0	0	0	0	0	0	569,140		
1969	0	0	48,720	55,318	0	0	0	0	0	0	0	0	0	12,134	116,172	
1970	4,774	14,785	404,282	18,750	346,623	0	0	0	0	0	0	0	0	0	789,214	
1971	0	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951		
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	307,619	46,207	0	353,826			
1974	176,766	0	0	0	0	0	0	0	0	225,484	226,104	472,218	136,255	1,236,827		
1975	31,128	349,104	36,865	39,771	716,709	261,211	0	0	0	0	0	0	0	1,434,788		
1976	0	0	0	0	0	0	0	0	0	0	0	0	141,182	141,182		
1977	0	155,274	0	966,493	78,677	0	0	0	0	0	0	0	0	1,200,444		
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	0	0	0	0	0	211,916	0	0	0	0	0	0	0	0	211,916	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	233,713	0	0	15,903	85,275	235,884	0	570,775			
1982	0	0	0	0	37,291	0	0	0	0	0	0	0	0	37,291		
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	183,400	185,866		
1987	137,006	193,506	153,856	0	26,012	1,397,534	21,458	0	0	0	0	0	0	0	1,929,372	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	642,832	642,832		
1992	566,312	1,789,100	900,986	248,335	497,216	502,380	0	0	0	0	0	0	0	4,504,329		
1993	0	0	4,222	9,689	62,663	143,588	0	0	0	0	0	0	0	0	220,162	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	40,536	0	0	68,472	0	0	0	0	0	0	0	0	109,008	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	23,380	251,594	175,233	1,134,003	176,026	0	0	0	0	0	27,738	1,787,974		
1998	7,262	88,469	264,231	348	0	0	0	0	0	382,421	430,180	54,468	1,227,379			
AVG	29,268	64,111	42,135	50,325	58,365	100,616	16,170	0	9,458	41,992	37,417	32,827	482,682			
MAX	566,312	1,789,100	900,986	966,493	1,026,292	1,397,534	422,548	0	299,539	990,937	479,202	642,832	4,504,329			
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT K20000 COLORADO NEAR WHARTON												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	521,098	43,425 annualized	47,373
units are acre-feet												MAX DURING DROUGHT			193,725
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	422,548	0	0	0	510,792	500,988	1,458,228			
1941	125,780	182,387	322,363	538,205	1,026,292	789,635	157,190	0	0	56,076	16,136	0	3,214,064		
1942	0	0	0	177,294	45,457	0	0	0	0	49,549	11,476	0	283,776		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1944	0	0	21,961	0	0	0	0	0	0	0	0	0	21,961		
1945	6,706	0	94,359	422,656	0	0	0	0	0	0	0	0	523,721		
1946	0	9,677	0	0	90,570	86,046	0	0	0	0	80,235	38,187	304,715		
1947	193,725	0	22,658	0	0	0	0	0	0	0	0	0	216,383		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	117,095	0	0	17,078	990,937	242,453	60,635	1,428,198		
1958	149,481	525,734	158,672	1,109	105,756	40,829	0	0	0	0	0	0	981,581		
1959	0	0	0	178,890	0	0	0	0	0	248,107	0	41,819	468,816		
1960	107,484	155,780	0	61,764	0	111,888	0	0	0	119,881	210,647	160,986	928,430		
1961	262,185	347,206	0	0	0	510,803	176,810	0	299,539	0	0	0	1,596,543		
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1968	0	0	10,821	19,985	235,024	303,310	0	0	0	0	0	0	569,140		
1969	0	0	48,720	55,318	0	0	0	0	0	0	0	0	12,134	116,172	
1970	4,774	14,785	404,282	18,750	346,623	0	0	0	0	0	0	0	0	789,214	
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951		
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1973	0	0	0	11,422	0	0	0	0	0	307,619	50,823	0	369,864		
1974	176,766	0	0	0	0	0	0	0	225,484	226,104	472,218	147,300	1,247,872		
1975	31,128	349,104	36,865	39,771	716,709	261,211	0	0	0	0	0	0	0	1,434,788	
1976	0	0	0	0	0	0	0	0	0	0	0	0	159,119	159,119	
1977	0	155,274	0	966,493	78,677	0	0	0	0	0	0	0	0	1,200,444	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1979	6,503	0	0	0	0	211,916	0	0	5,359	0	0	0	0	223,778	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	233,713	0	0	15,903	85,275	243,821	0	578,712		
1982	0	0	0	0	37,291	0	0	0	0	0	0	0	0	37,291	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	2,466	183,400	185,866		
1987	137,006	193,506	153,856	0	26,012	1,427,566	21,458	0	0	0	0	0	0	1,959,404	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	642,832	642,832	
1992	613,868	1,882,364	969,225	268,835	516,283	502,380	0	0	0	0	0	0	0	4,752,955	
1993	0	0	4,222	9,689	62,663	192,743	0	0	0	0	0	0	0	269,317	
1994	0	0	0	0	0	0	0	0	0	49,317	1,040	0	50,357		
1995	16,363	0	40,536	0	0	68,472	0	0	0	0	0	0	0	125,371	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	108,075	274,000	175,233	1,134,003	176,026	0	0	14,298	0	29,758	1,911,393		
1998	7,262	88,469	264,231	348	0	0	0	0	0	544,206	552,526	86,134	1,543,176		
AVG	31,170	66,174	45,099	51,602	58,688	101,958	16,170	0	9,549	45,812	40,587	34,995	501,804		
MAX	613,868	1,882,364	969,225	966,493	1,026,292	1,427,566	422,548	0	299,539	990,937	552,526	642,832	4,752,955		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300 LAVACA RIVER NEAR EDNA												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	731,567	60,964 annualized	60,365
units are acre-feet												MAX DURING DROUGHT			92,242
GS300	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1940	0	7,031	0	0	0	4,183	238,897	0	0	0	204,178	102,514	556,803		
1941	35,107	23,724	80,969	72,699	166,448	114,829	19,517	5,430	0	5,134	11,099	2,143	537,099		
1942	653	822	153	50,808	0	0	63,212	0	9,547	0	1,422	1,028	127,645		
1943	3,106	0	9,006	0	0	0	1,959	0	0	0	0	0	13,416	27,487	
1944	41,417	8,663	78,205	705	44,952	0	0	464	0	0	0	1,950	7,975	184,331	
1945	20,128	3,958	4,964	32,169	0	0	0	0	0	0	0	0	0	61,219	
1946	0	12,500	12,561	1,392	2,573	42,282	0	39,050	92,242	82,640	37,358	7,681	330,279		
1947	37,336	2,939	9,218	4,665	29,130	0	0	0	0	0	0	0	0	83,288	
1948	0	0	0	0	59,106	0	0	0	0	0	0	0	0	59,106	
1949	0	0	0	44,635	438	0	0	0	0	0	12,834	0	22,928	80,835	
1950	3,749	3,001	0	0	0	0	0	0	0	0	0	0	0	6,750	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	37,215	2,017	0	0	0	0	0	0	18,751	57,983	
1953	0	0	0	0	31,621	0	0	0	0	0	0	0	0	31,621	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	14,149	0	0	0	0	0	0	0	0	14,149	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	45,030	22,526	9,808	0	0	0	0	111,168	68,504	3,964	261,000	
1958	40,135	65,502	6,309	0	16,185	0	0	0	0	10,610	10,223	772	4,379	154,115	
1959	588	64,395	1,471	75,496	13,479	0	0	0	0	0	8,958	11,485	8,297	184,169	
1960	8,957	10,141	1,195	958	0	58,007	4,405	34,771	0	223,167	48,820	35,451	425,872		
1961	56,316	61,950	5,289	0	0	76,192	29,666	0	117,576	4,314	64,498	4,446	420,247		
1962	3,079	1,360	0	32,157	0	5,886	0	0	0	0	0	0	0	42,482	
1963	0	12,826	0	0	0	0	0	0	0	0	0	0	0	12,826	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	10,677	55,787	792	0	95,237	31,857	0	0	0	0	0	37,255	16,542	248,147	
1966	5,215	14,566	5,101	29,919	38,821	0	0	0	0	0	0	0	0	93,622	
1967	0	0	0	0	0	0	0	0	74,295	46,705	2,546	0	123,546		
1968	61,258	6,005	6,029	7,961	77,518	110,518	5,051	0	0	0	0	0	9,418	283,758	
1969	3,797	62,045	41,531	79,200	81,155	0	0	0	0	0	0	0	0	13,213	280,941
1970	14,490	1,782	19,574	0	71,883	16,292	0	0	9,142	11,322	0	0	0	144,485	
1971	0	0	0	0	0	0	0	13,531	79,464	17,026	1,088	32,653	143,762		
1972	19,670	23,075	9,055	0	188,071	14,469	0	343	0	0	0	0	0	254,683	
1973	0	7,370	62,967	151,011	25,306	295,770	16,630	4,055	9,196	109,889	9,320	3,922	695,436		
1974	67,327	9,021	3,007	0	24,691	41,001	0	0	86,568	3,609	37,111	14,754	287,089		
1975	6,898	6,656	1,361	30,565	103,481	21,148	21,159	0	0	0	0	8,692	199,960		
1976	0	0	0	26,490	44,995	6,991	13,240	0	0	51,531	20,708	147,442	311,397		
1977	19,210	57,985	6,834	52,809	4,839	8,246	0	0	0	0	0	0	0	149,923	
1978	3,098	6,995	1,854	8,554	0	0	0	0	157,982	789	6,986	2,052	188,310		
1979	96,023	43,042	20,826	60,483	146,173	81,435	4,630	0	41,963	0	0	0	0	494,575	
1980	29,988	10,619	497	0	46,519	0	0	0	0	0	0	0	0	87,623	
1981	0	0	0	0	0	130,328	16,398	2,836	134,629	13,978	101,638	5,238	405,045		
1982	2,906	30,666	5,965	0	194,999	0	0	0	0	0	52,646	8,303	295,485		
1983	10,409	45,218	49,246	0	14,601	0	48,714	1,752	3,445	7,555	25,799	610	207,349		
1984	17,904	2,321	2,515	0	0	0	0	0	0	0	0	1,284	24,024		
1985	19,705	17,941	38,156	108,938	4,758	0	3,777	0	0	0	0	43,755	4,513	241,543	
1986	0	220	0	0	0	49,725	0	0	0	0	0	0	59,490	109,435	
1987	15,395	53,141	12,532	0	117	286,524	4,941	0	0	0	0	2,503	14,575	389,728	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	18	0	0	0	18	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	66,710	1,902	0	3,397	0	0	0	0	0	126,150	198,159	
1992	92,347	299,709	39,270	160,847	147,787	96,914	0	0	0	0	0	0	11,565	848,439	
1993	14,528	18,801	41,099	22,851	134,338	231,215	1,556	0	0	0	0	0	0	464,388	
1994	0	0	0	0	81,255	0	0	0	0	428,297	3,962	17,535	531,049		
1995	33,492	3,481	34,969	29,540	4,023	8,784	0	0	0	0	0	0	0	114,289	
1996	0	0	0	0	0	0	0	0	7,088	0	0	256	0	7,344	
AVG	13,946	18,513	10,746	20,993	34,567	30,604	8,722	1,794	14,627	20,161	13,954	12,828	201,454		
MAX	96,023	299,709	80,969	160,847	194,999	295,770	238,897	39,050	157,982	428,297	204,178	147,442	848,439		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT WGS800 WEST MUSTANG CREEK NEAR GANADO												# of months in drought	144 months	12.0 years	46-56
WGS800	units are ac											total depletion in drought	251,398	20,950 annualized	19,840
	2											MAX DURING DROUGHT			27,317
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1940	0	0	0	0	0	0	101,052	0	0	0	54,304	37,424	192,780		
1941	13,143	6,450	12,335	23,891	28,160	18,331	9,881	1,624	0	0	6,941	3,421	124,177		
1942	0	0	0	14,522	0	0	26,743	0	0	0	0	0	41,265		
1943	0	0	4,452	0	0	0	0	0	0	0	0	0	9,068		13,520
1944	24,854	4,750	20,630	0	14,505	0	0	0	0	0	0	0	11,703		76,442
1945	9,578	3,341	0	21,879	0	0	0	0	0	0	0	0	0		34,798
1946	0	11,759	5,174	0	0	21,619	0	8,437	20,974	14,596	12,418	3,678			98,655
1947	18,880	0	2,070	0	0	0	0	0	0	0	0	0			20,950
1948	0	0	3,496	0	0	0	0	0	0	0	0	0			3,496
1949	0	0	0	19,205	0	0	0	0	0	0	27,317	0	12,435		58,957
1950	6,236	4,394	0	0	0	0	0	0	0	0	0	0			10,630
1951	0	0	0	0	0	0	0	0	0	0	0	0			0
1952	0	0	0	0	15,438	0	0	0	0	0	0	0	10,118		25,556
1953	0	0	0	0	0	0	0	0	0	0	0	0			0
1954	0	0	0	0	0	0	0	0	0	0	0	0			0
1955	0	0	0	0	0	0	0	0	0	0	0	0			0
1956	0	0	0	0	0	0	0	0	0	0	0	0			0
1957	0	0	0	20,033	13,121	11,818	0	0	0	8,279	15,488	0			68,739
1958	15,190	15,764	0	0	0	0	0	0	0	0	0	0	6,012		36,966
1959	2,876	22,435	0	28,097	0	0	0	0	0	12,551	7,186	9,066			82,211
1960	7,779	7,476	0	0	0	34,875	3,898	7,456	0	37,962	14,930	15,018			129,394
1961	22,587	29,816	0	0	0	23,706	13,557	0	26,737	0	10,951	0			127,354
1962	0	0	0	0	0	0	0	0	0	0	0	0			0
1963	0	0	0	0	0	0	0	0	0	0	0	0			0
1964	0	0	0	0	0	0	0	0	0	0	0	0			0
1965	0	8,653	0	0	23,498	0	0	0	0	0	14,029	3,706			49,886
1966	4,720	7,896	2,860	9,248	16,880	0	0	0	0	0	0	0			41,604
1967	0	0	0	0	0	0	0	0	24,294	14,321	0	0			38,615
1968	40,582	3,314	1,914	0	18,900	49,945	4,529	0	0	0	0	0			125,756
1969	3,850	20,671	9,314	16,863	19,974	0	0	0	0	0	0	0			70,672
1970	6,566	0	8,171	0	18,675	0	0	0	0	0	18,102	0			51,514
1971	0	0	0	0	0	0	0	0	0	18,005	13,349	0			12,917
1972	6,813	10,839	2,171	0	37,707	0	0	0	0	0	0	0			57,530
1973	0	0	12,975	39,649	0	4,570	9,025	0	3,039	29,135	5,669	2,056			106,118
1974	28,902	3,520	0	0	0	0	0	0	19,559	0	15,228	7,798			75,007
1975	3,993	1,831	0	0	23,916	2,811	10,541	0	0	0	0	1,050			44,142
1976	0	0	0	0	0	0	0	0	0	0	0	4,152			4,152
1977	5,667	15,265	0	17,424	0	0	0	0	0	0	0	0			38,356
1978	13,324	7,557	0	0	0	0	0	0	0	43,968	0	5,380			70,229
1979	31,528	16,316	7,062	26,959	14,480	0	0	0	0	60,815	0	0			157,160
1980	54,087	4,053	0	0	0	0	0	0	0	0	0	0			58,140
1981	0	0	0	0	40,648	12,600	1,353	10,394	12,801	20,188	289				98,273
1982	0	8,004	0	0	40,965	0	0	0	0	0	22,879	0			71,848
1983	5,750	21,525	14,929	0	0	0	0	0	24,255	32,588	6,749	0			105,796
1984	5,343	1,673	0	0	0	0	0	0	0	29,784	2,292	1,286			40,378
1985	7,704	5,328	21,848	26,453	0	0	0	0	0	0	0	23,695	6,661		91,689
1986	0	0	0	0	20,883	0	0	0	0	0	0	0	21,864		42,747
1987	7,043	12,818	2,776	0	0	33,179	3,194	0	0	0	12,486	11,074			82,570
1988	0	0	0	0	0	0	0	0	0	0	0	0			0
1989	17,598	0	0	0	12,970	0	0	0	0	0	0	0			30,568
1990	0	0	5,035	0	0	0	0	0	0	0	0	0			5,035
1991	24,336	5,900	0	32,309	0	0	0	0	0	0	0	0			36,098
1992	33,898	71,383	5,505	21,041	28,533	7,514	0	0	0	0	10,873	7,050			185,797
1993	7,895	16,968	8,299	9,384	41,841	54,412	0	0	0	0	0	0			138,799
1994	0	0	0	0	10,036	0	0	0	0	0	105,382	0			21,422
1995	13,895	0	7,961	0	3,959	0	0	0	0	0	0	0			13,308
1996	0	0	0	0	0	2,019	0	0	0	0	0	0			39,123
	AVG	7,800	6,135	2,789	5,736	6,729	5,725	3,421	331	4,422	6,249	4,591	4,829		58,757
	MAX	54,087	71,383	21,848	39,649	41,841	54,412	101,052	8,437	60,815	105,382	54,304	37,424		192,780
	MIN	0	0	0	0	0	0	0	0	0	0	0	0		0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1000 SANDY CREEK NEAR GANADO												# of months in drought	144 months	12.0 years	46-56	
												total depletion in drought	335,613	27,968 annualized	26,304	
GS1000	units are ac											MAX DURING DROUGHT	37,656			
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
	2	8														
1940	0	0	0	0	0	0	47,284	0	0	0	94,700	47,823	189,807			
1941	26,594	9,905	21,975	25,704	51,517	36,391	8,429	448	0	0	6,828	4,598	192,389			
1942	0	0	0	19,059	0	0	20,616	0	0	0	0	0	39,675			
1943	0	0	6,782	0	0	0	0	0	0	0	0	0	16,332			
1944	36,521	6,730	37,890	0	19,722	0	0	0	0	0	0	0	14,161	115,024		
1945	13,622	4,126	0	12,529	0	0	0	0	0	0	0	0	0	30,277		
1946	0	19,757	8,234	0	0	11,570	0	4,352	35,170	25,162	37,656	3,980	145,881			
1947	27,583	0	2,070	0	0	0	0	0	0	0	0	0	0	29,653		
1948	0	0	4,995	0	0	0	0	0	0	0	0	0	0	4,995		
1949	0	0	0	21,381	0	0	0	0	0	0	26,440	0	12,268	60,089		
1950	8,609	6,098	0	0	0	0	0	0	0	0	0	0	0	14,707		
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1952	0	0	0	0	22,038	0	0	0	0	0	0	0	11,984	34,022		
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1957	0	0	0	28,950	17,316	12,223	0	0	0	33,481	47,614	0	139,584			
1958	21,980	27,178	0	0	0	0	0	0	0	0	0	6,929	56,087			
1959	3,574	39,591	0	26,792	0	0	0	0	0	5,080	11,867	10,964	97,868			
1960	10,937	11,805	0	0	0	66,608	3,664	18,034	0	63,568	16,799	18,716	210,131			
1961	33,084	53,256	0	0	0	44,559	9,405	0	44,549	0	9,095	0	193,948			
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1965	0	13,993	0	0	29,932	0	0	0	0	0	20,099	9,675	73,699			
1966	6,364	12,588	3,756	11,885	24,139	0	0	0	0	0	0	0	58,732			
1967	0	0	0	0	0	0	0	0	40,313	15,212	0	0	55,525			
1968	59,908	3,849	1,960	0	27,655	34,390	2,754	0	0	0	0	6,572	137,088			
1969	5,033	36,308	16,158	28,338	29,734	0	0	0	0	0	0	0	115,571			
1970	9,117	0	13,921	0	27,238	0	0	0	0	5,072	0	0	55,348			
1971	0	0	0	0	0	0	0	0	30,016	6,875	0	15,920	52,811			
1972	9,497	18,013	2,451	0	61,678	0	0	0	0	0	0	0	91,639			
1973	0	0	23,190	52,120	0	145,100	1,923	0	26,290	31,762	11,841	2,056	294,282			
1974	42,462	3,520	0	0	0	0	0	0	32,682	0	26,217	9,298	114,179			
1975	5,253	1,831	0	0	36,706	2,811	2,337	0	0	0	0	1,050	49,988			
1976	0	0	0	0	0	0	0	0	0	0	0	60,212	60,212			
1977	7,773	26,231	0	18,787	0	0	0	0	0	0	0	0	52,791			
1978	13,755	10,108	0	0	0	0	0	0	73,538	0	5,308	0	102,709			
1979	57,322	24,098	5,670	22,239	44,386	0	0	0	44,695	0	0	0	198,410			
1980	42,752	4,903	0	0	0	0	0	0	0	0	0	0	47,655			
1981	0	0	0	0	0	57,722	11,820	0	25,042	9,376	32,924	1,337	138,221			
1982	0	11,969	0	0	31,799	0	0	0	0	0	14,666	0	58,434			
1983	11,366	35,466	22,412	0	0	0	0	0	14,525	14,837	9,654	0	108,260			
1984	9,296	4,646	0	0	0	0	0	0	0	16,350	728	611	31,631			
1985	14,919	9,732	24,435	29,435	0	0	0	0	0	0	56,985	7,090	142,596			
1986	0	0	0	0	0	25,172	0	0	0	0	0	34,142	59,314			
1987	8,002	18,015	6,062	0	0	71,026	7,045	0	0	0	3,924	11,777	125,851			
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1989	25,287	0	0	0	12,970	0	0	0	0	0	0	0	38,257			
1990	0	0	4,162	0	0	0	0	0	0	0	0	0	4,162			
1991	29,547	7,224	0	25,857	0	0	0	0	0	0	0	45,500	108,128			
1992	58,658	133,856	24,058	60,694	65,834	19,655	0	0	0	0	12,536	8,905	384,196			
1993	14,570	20,889	13,461	17,573	67,735	105,422	0	0	0	0	0	0	239,650			
1994	0	0	0	0	23,539	0	0	0	0	122,963	0	18,410	164,912			
1995	28,042	0	26,209	0	17	0	0	0	0	0	0	0	11,458	65,726		
1996	0	0	0	0	0	6	0	0	0	0	0	0	0	6		
AVG	11,253	10,100	4,734	7,041	10,420	11,099	2,022	401	6,435	6,600	7,359	6,754	84,218			
MAX	59,908	133,856	37,890	60,694	67,735	145,100	47,284	18,034	73,538	122,963	94,700	60,212	384,196			
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT EDV712 EAST MUSTANG CREEK NEAR LOUISE (APPROX)												# of months in drought	144 months	12.0 years	46-56
EDV712	units are ac											total depletion in drought	59,558	4,963 annualized	4,632
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV				
1940	0	0	0	0	0	0	14,585	0	0	0	18,078	8,590	41,253		
1941	2,879	1,694	5,431	6,306	10,266	6,134	2,032	549	0	0	1,507	506	37,304		
1942	0	0	0	3,914	0	0	4,108	0	0	0	0	0	8,022		
1943	0	0	1,308	0	0	0	0	0	0	0	0	0	1,755		3,063
1944	4,709	968	7,571	0	3,732	0	0	0	0	0	0	0	1,880		18,860
1945	1,945	562	0	4,814	0	0	0	0	0	0	0	0	0	0	7,321
1946	0	2,770	1,608	0	0	4,672	0	1,423	5,520	4,494	3,512	686	24,685		
1947	3,760	0	833	0	0	0	0	0	0	0	0	0	0	0	4,593
1948	0	0	1,006	0	0	0	0	0	0	0	0	0	0	0	1,006
1949	0	0	0	4,989	0	0	0	0	0	0	4,617	0	2,517		12,123
1950	1,019	751	0	0	0	0	0	0	0	0	0	0	0	0	1,770
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	4,758	0	0	0	0	0	0	0	2,020		6,778
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	5,790	2,813	2,014	0	0	0	8,807	5,075	0	24,499		
1958	3,281	4,609	0	0	0	0	0	0	0	0	0	944	0	8,834	
1959	437	5,848	0	7,205	0	0	0	0	0	2,132	1,544	1,521	18,687		
1960	1,367	1,529	0	0	0	7,571	382	2,724	0	11,959	4,424	3,197	33,153		
1961	4,845	7,215	0	0	0	5,971	1,708	0	11,447	0	3,891	0	35,077		
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	2,976	0	0	7,151	0	0	0	0	0	4,117	1,431	15,675		
1966	814	1,702	827	2,337	4,140	0	0	0	0	0	0	0	0	9,820	
1967	0	0	0	0	0	0	0	0	9,689	3,450	0	0	0	13,139	
1968	7,529	627	605	0	5,662	11,836	377	0	0	0	0	0	1,202	27,838	
1969	669	5,451	3,538	5,180	6,043	0	0	0	0	0	0	0	0	20,881	
1970	1,337	0	2,615	0	5,422	0	0	0	0	2,986	0	0	0	12,360	
1971	0	0	0	0	0	0	0	0	5,893	2,460	0	0	2,795	11,148	
1972	1,526	2,555	780	0	12,952	0	0	0	0	0	0	0	0	0	17,813
1973	0	0	5,082	11,545	0	22,985	414	0	3,102	7,391	1,156	472	52,147		
1974	6,008	794	0	0	0	0	0	0	10,004	0	4,126	1,514	22,446		
1975	789	600	0	0	7,432	1,956	558	0	0	0	0	0	1,050	12,385	
1976	0	0	0	0	0	0	0	0	0	0	0	0	10,147	10,147	
1977	1,339	4,365	0	4,488	0	0	0	0	0	0	0	0	0	0	10,192
1978	1,669	1,047	0	0	0	0	0	0	0	12,447	0	718	0	15,881	
1979	8,108	3,737	1,832	5,122	8,805	0	0	0	0	6,589	0	0	0	34,193	
1980	5,244	804	0	0	0	0	0	0	0	0	0	0	0	6,048	
1981	0	0	0	0	0	9,264	461	719	11,771	1,903	8,578	545	33,241		
1982	0	1,949	0	0	12,287	0	0	0	0	0	4,658	0	18,894		
1983	1,717	5,031	4,513	0	0	0	0	0	3,059	4,359	2,795	0	21,474		
1984	1,726	602	0	0	0	0	0	0	0	5,069	380	268	8,045		
1985	2,312	1,447	4,871	7,339	0	0	0	0	0	0	5,696	1,233	22,898		
1986	0	0	0	0	0	4,389	0	0	0	0	0	4,981	9,370		
1987	1,450	3,580	1,038	0	0	14,850	350	0	0	0	2,141	2,092	25,501		
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	2,632	0	0	0	2,517	0	0	0	0	0	0	0	5,149		
1990	0	0	1,472	0	0	0	0	0	0	0	0	0	0	1,472	
1991	4,123	1,410	0	7,115	0	0	0	0	0	0	0	0	9,265	21,913	
1992	8,269	22,014	3,218	10,056	10,731	5,000	0	0	0	0	1,549	1,415	62,252		
1993	1,904	3,001	3,025	2,328	10,603	15,739	0	0	0	0	0	0	0	36,600	
1994	0	0	0	0	5,209	0	0	0	0	28,561	0	2,798	0	36,568	
1995	3,115	0	4,949	0	2,370	0	0	0	0	0	0	0	1,494	11,928	
1996	0	0	0	0	0	531	0	0	0	0	0	0	0	531	
AVG	1,518	1,573	985	1,553	2,156	1,981	438	95	1,395	1,547	1,297	1,163	15,701		
MAX	8,269	22,014	7,571	11,545	12,952	22,985	14,585	2,724	12,447	28,561	18,078	10,147	62,252		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT DV501 NAVIDAD RIVER NEAR EDNA (STRANE PARK) (APPROX)												# of months in drought	144 months	12.0 years
												total depletion in drought	586,515	48,876 annualized

46-56
44,328

units are acre-feet

MAX DURING DROUGHT 77,272

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT DV501 NAVIDAD RIVER NEAR EDNA (STRANE PARK) (APPROX)												# of months in drought	144 months	12.0 years
												total depletion in drought	586,515	48,876 annualized
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
1940	0	0	0	0	0	91,659	0	0	0	184,235	86,900			362,794
1941	30,271	20,273	60,871	78,507	100,558	60,418	37,173	6,038	0	0	17,218	5,248		416,575
1942	0	0	0	35,776	0	0	59,348	0	0	0	0	0		95,124
1943	0	0	12,965	0	0	0	0	0	0	0	0	0		27,638
1944	45,246	9,871	88,505	0	27,077	0	0	0	0	0	0	0		191,169
1945	28,963	4,479	0	65,306	0	0	0	0	0	0	0	0		98,748
1946	0	30,253	22,007	0	0	67,706	0	9,220	34,325	31,191	28,855	8,167		231,724
1947	37,200	0	2,070	0	0	0	0	0	0	0	0	0		39,270
1948	0	0	10,642	0	0	0	0	0	0	0	0	0		10,642
1949	0	0	0	62,734	0	0	0	0	0	48,408	0	27,924		139,066
1950	10,578	10,216	0	0	0	0	0	0	0	0	0	0		20,794
1951	0	0	0	0	0	0	0	0	0	0	0	0		0
1952	0	0	0	0	24,268	0	0	0	0	0	0	21,849		46,117
1953	0	0	0	0	0	0	0	0	0	0	0	0		0
1954	0	0	0	0	0	0	0	0	0	0	0	0		0
1955	0	0	0	0	0	0	0	0	0	0	0	0		0
1956	0	0	0	0	0	0	0	0	0	0	0	0		0
1957	0	0	0	77,272	21,630	12,223	0	0	0	94,444	37,187	0		242,756
1958	31,537	51,300	0	0	0	0	0	0	0	0	0	7,472		90,309
1959	3,912	43,109	0	91,042	0	0	0	0	0	26,006	16,952	16,484		197,505
1960	15,796	18,173	0	0	0	79,869	14,419	39,497	0	82,868	43,295	33,151		327,068
1961	42,216	75,783	0	0	0	63,717	29,313	0	172,160	0	35,354	0		418,543
1962	0	0	0	0	0	0	0	0	0	0	0	0		0
1963	0	0	0	0	0	0	0	0	0	0	0	0		0
1964	0	0	0	0	0	0	0	0	0	0	0	0		0
1965	0	36,082	0	0	94,315	0	0	0	0	0	70,553	20,742		221,692
1966	9,233	21,668	12,447	13,527	48,274	0	0	0	0	0	0	0		105,149
1967	0	0	0	0	0	0	0	0	120,233	31,365	0	0		151,598
1968	80,928	3,849	3,073	0	57,052	166,058	13,501	0	0	0	0	6,572		331,033
1969	7,672	61,037	46,661	57,271	70,043	0	0	0	0	0	0	0		242,684
1970	11,578	0	35,793	0	62,470	0	0	0	0	31,961	0	0		141,802
1971	0	0	0	0	0	0	0	0	52,138	24,102	0	28,300		104,540
1972	13,806	22,324	4,732	0	153,835	0	0	0	0	0	0	0		194,697
1973	0	0	48,028	131,595	0	265,411	14,046	0	36,409	65,475	11,318	2,056		574,338
1974	65,649	3,520	0	0	0	0	0	0	184,457	0	48,659	16,440		318,725
1975	9,951	1,831	0	0	96,852	2,811	14,503	0	0	0	0	1,050		126,998
1976	0	0	0	0	0	0	0	0	0	0	0	111,844		111,844
1977	12,782	46,746	0	72,448	0	0	0	0	0	0	0	0		131,976
1978	11,894	8,952	0	0	0	0	0	0	92,837	0	5,380	0		119,063
1979	76,304	35,840	20,479	62,953	112,429	0	0	0	43,609	0	0	0		351,614
1980	37,659	5,329	0	0	0	0	0	0	0	0	0	42,988		
1981	0	0	0	0	75,804	8,205	24,577	174,724	13,743	99,466	4,673			401,192
1982	0	14,476	0	0	115,368	0	0	0	0	0	37,099	0		166,943
1983	19,862	47,887	52,918	0	0	0	0	0	31,910	50,564	33,144	0		236,285
1984	19,166	4,646	0	0	0	0	0	0	0	63,402	2,292	1,513		91,019
1985	27,109	21,631	51,641	60,247	0	0	0	0	0	0	64,775	15,967		241,370
1986	0	0	0	0	25,172	0	0	0	0	0	0	52,896		78,068
1987	13,708	34,743	10,482	0	0	125,098	9,605	0	0	0	26,655	23,426		243,717
1988	0	0	0	0	0	0	0	0	0	0	0	0		0
1989	27,358	0	0	0	12,970	0	0	0	0	0	0	0		40,328
1990	0	0	11,451	0	0	0	0	0	0	0	0	0		11,451
1991	40,021	16,603	0	82,504	0	0	0	0	0	0	0	93,317		232,445
1992	70,540	181,886	49,448	93,511	133,454	42,054	0	0	0	0	16,318	14,566		601,777
1993	26,513	30,653	35,420	17,573	91,571	125,868	0	0	0	0	0	0		327,598
1994	0	0	0	0	32,556	0	0	0	0	231,858	0	24,841		289,255
1995	19,267	0	62,785	0	17,909	0	0	0	0	0	0	0		14,193
1996	0	0	0	0	0	2,019	0	0	0	0	0	0		2,019

AVG	14,855	15,143	11,270	17,584	22,327	19,548	5,119	1,392	16,540	13,954	13,662	11,837	163,232
MAX	80,928	181,886	88,505	131,595	153,835	265,411	91,659	39,497	184,457	231,858	184,235	111,844	601,777
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1300 TRE PALACIOS NEAR MIDFIELD												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	357,238	29,770 annualized	28,676
units are acre-feet												MAX DURING DROUGHT			29,759
GS1300	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1940	798	4,166	238	0	0	0	647	0	0	8,425	36,104	20,732	71,110		
1941	10,546	7,257	13,791	17,108	29,666	8,048	0	0	383	12,881	2,559	726	102,965		
1942	1,437	3,723	1,004	12,332	0	0	8,119	0	2,632	5,890	791	720	36,648		
1943	3,505	3,365	4,785	0	0	0	0	0	0	5,086	1,199	1,758	19,698		
1944	18,941	5,907	23,265	810	6,244	0	0	1,833	2,145	5,289	892	1,560	66,886		
1945	7,745	4,805	1,172	7,926	0	0	0	0	0	6,523	161	375	28,707		
1946	5,902	11,304	5,611	495	9	9,315	0	1,904	17,081	17,747	6,970	4,003	80,341		
1947	14,494	3,542	2,576	1,409	3,354	0	0	0	0	4,768	355	982	31,480		
1948	3,082	7,090	3,691	0	10,596	0	0	0	0	4,726	84	166	29,435		
1949	889	6,810	2,486	14,155	0	0	0	0	0	29,759	352	3,776	58,227		
1950	5,215	5,498	387	561	0	1,394	0	0	0	4,764	0	232	18,051		
1951	706	2,638	532	0	0	1,806	0	0	984	5,664	73	327	12,730		
1952	690	3,319	323	2,419	11,984	0	0	0	0	4,675	2,937	2,617	28,964		
1953	1,554	3,620	228	0	4,543	0	0	0	618	5,097	129	222	16,011		
1954	725	2,598	0	153	0	0	0	0	0	4,864	0	0	8,340		
1955	726	8,806	0	0	4,384	0	0	0	4	6,670	0	0	20,590		
1956	689	3,155	0	0	0	0	0	0	0	4,524	0	2,901	11,269		
1957	624	3,404	9,778	19,120	1,815	4,612	0	0	1,309	45,236	12,207	902	99,007		
1958	11,787	14,579	1,241	7	920	0	0	0	3,889	7,739	675	312	41,149		
1959	2,750	19,827	1,094	17,855	403	1,870	0	0	191	15,738	2,440	4,342	66,510		
1960	6,377	8,062	1,121	594	0	16,165	0	2	227	39,632	8,970	5,902	87,052		
1961	17,279	25,638	1,652	587	0	10,324	0	0	21,631	6,119	11,554	1,253	96,037		
1962	1,580	3,776	614	7,999	0	0	0	0	1,122	5,117	339	402	20,949		
1963	3,032	4,996	272	0	0	0	0	0	0	4,810	165	101	13,376		
1964	944	4,745	1,311	0	0	0	0	0	1,591	6,060	49	102	14,802		
1965	6,573	8,856	397	0	15,938	795	0	0	0	7,619	8,601	6,192	54,971		
1966	4,100	8,265	2,970	7,445	5,156	0	0	0	0	5,619	127	274	33,956		
1967	892	2,695	71	3	0	0	0	0	19,836	17,488	859	380	42,224		
1968	30,348	4,653	1,886	2,145	12,781	24,598	0	0	612	7,504	480	3,153	88,160		
1969	3,465	18,339	10,329	18,820	13,551	0	0	0	0	7,272	616	1,069	73,461		
1970	5,432	3,218	9,029	86	11,443	27	0	0	3,635	21,052	394	372	54,688		
1971	223	325	130	0	0	0	0	3,781	14,611	16,309	778	21,169	57,326		
1972	3,764	2,915	2,180	0	33,120	866	0	0	0	5,600	397	343	49,185		
1973	2,672	9,406	14,515	34,225	2,957	48,473	0	0	2,175	31,469	2,259	1,110	149,261		
1974	10,658	3,120	1,489	342	2,336	2,000	0	214	15,830	8,153	6,667	11,091	61,900		
1975	2,615	940	723	7,460	17,248	3,609	2,823	0	205	6,600	472	18,282	60,977		
1976	679	305	508	302	0	6,025	0	0	2,212	1,772	11,883	24,501	48,187		
1977	2,808	3,060	846	4,462	0	0	0	0	4,474	6,337	6,586	511	29,084		
1978	9,073	10,067	771	1,134	0	809	0	0	9,478	463	4,739	4,582	41,116		
1979	31,972	18,777	19,100	8,234	12,936	572	16,528	82	76,151	774	795	4,724	190,645		
1980	13,199	3,650	3,159	0	32,309	0	0	0	4,147	6,164	284	359	63,271		
1981	877	648	340	0	18,269	20,983	32,269	2,305	19,386	3,577	24,842	1,013	124,509		
1982	670	12,071	1,420	0	64,751	0	0	0	0	498	17,966	1,629	99,005		
1983	11,928	25,326	14,184	0	0	19,532	0	0	38,275	69,093	4,390	911	183,639		
1984	4,365	744	491	0	9,830	0	0	0	0	83,510	4,958	2,636	106,534		
1985	5,916	3,281	35,779	19,498	0	10,741	5,924	0	325	4,774	923	8,587	95,748		
1986	597	343	512	0	0	0	0	0	729	21,089	9,037	23,729	56,036		
1987	7,976	19,241	1,890	0	0	22,276	0	0	590	0	11,206	4,752	67,931		
1988	1,271	563	1,223	0	0	0	0	0	340	1,332	265	963	5,957		
1989	15,883	806	702	0	2,835	0	0	0	0	0	180	345	20,751		
1990	768	15,008	7,921	7,936	3,025	0	0	0	0	0	0	91	34,749		
1991	32,884	13,115	5,593	37,659	1,089	0	0	0	2,551	95	2,178	34,759	129,923		
1992	29,647	56,007	3,158	34,149	57,337	3,421	0	0	0	5,517	34,177	6,489	229,902		
1993	14,378	20,874	13,330	3,395	24,034	22,139	0	0	0	533	5,742	726	105,151		
1994	940	2,450	3,198	0	4,039	15,319	0	3,056	5,397	82,729	692	18,108	135,928		
1995	13,189	921	14,724	22,577	16,927	5,396	0	0	0	0	2,097	27,880	103,711		
1996	760	332	354	0	0	37,507	0	3,350	17,050	2,334	5,373	6,041	73,101		
AVG	6,887	7,771	4,388	5,498	7,646	4,791	1,612	290	5,120	12,159	4,543	5,108	65,813		
MAX	32,884	56,007	35,779	37,659	64,751	48,473	32,269	3,781	76,151	83,510	36,104	34,759	229,902		
MIN	223	305	0	0	0	0	0	0	0	0	0	0	5,957		

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1200 GACITAS CREEK NEAR INEZ												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	181,796	15,150 annualized	14,643
units are acre-feet												MAX DURING DROUGHT			11,133
GS1200	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1940	214	1,464	223	152	391	973	22,352	394	198	1,921	22,913	10,921	62,116		
1941	4,538	2,955	9,250	8,461	23,895	16,123	8,304	1,354	589	1,704	1,637	998	79,808		
1942	620	714	524	6,139	797	620	9,977	399	1,869	1,249	582	831	24,321		
1943	800	604	1,434	391	1,006	1,264	55	371	236	920	889	2,452	10,422		
1944	5,083	1,445	8,988	866	7,066	1,261	0	332	1,379	967	678	1,410	29,475		
1945	2,780	918	875	4,120	524	1,236	0	288	105	1,010	132	596	12,584		
1946	695	3,214	1,671	713	1,460	6,695	1,263	4,913	10,836	9,159	4,418	1,501	46,538		
1947	4,742	969	1,416	1,136	5,056	741	0	172	106	860	230	671	16,099		
1948	528	1,338	1,063	274	10,230	759	0	65	118	820	82	486	15,763		
1949	353	1,298	484	6,965	1,357	676	51	580	222	3,047	246	3,172	18,451		
1950	929	873	290	736	714	1,248	0	28	32	782	27	452	6,111		
1951	189	345	124	94	134	2,719	0	0	930	924	83	472	6,014		
1952	160	465	155	1,594	11,133	1,772	0	119	100	776	1,909	2,819	21,002		
1953	445	585	213	323	5,881	403	0	1,582	732	904	109	487	11,664		
1954	198	318	72	557	628	237	0	17	35	760	0	384	3,206		
1955	150	4,086	96	201	5,986	1,050	0	1,022	276	780	3	413	14,063		
1956	120	350	33	17	104	195	0	0	0	756	0	588	2,163		
1957	79	729	3,070	9,500	3,977	2,620	0	14	1,112	12,076	7,720	1,139	42,036		
1958	4,973	7,274	1,134	493	3,348	429	0	81	2,570	2,112	433	1,117	23,964		
1959	519	7,169	710	8,856	2,964	1,289	0	468	484	2,324	1,549	1,455	27,787		
1960	1,445	1,603	555	758	764	8,694	3,074	4,389	509	22,346	5,676	4,131	53,944		
1961	7,046	7,046	1,112	760	833	10,893	5,704	547	13,825	1,685	7,312	1,174	57,937		
1962	780	808	489	4,156	861	2,061	229	125	1,010	1,100	225	762	12,606		
1963	686	2,123	330	188	291	414	966	33	29	782	118	627	6,587		
1964	344	686	602	484	293	2,503	0	161	1,272	994	59	475	7,873		
1965	4,436	6,203	559	463	13,915	5,568	0	202	124	1,270	5,452	2,140	40,332		
1966	980	1,954	1,025	3,902	6,322	1,302	393	289	224	864	113	520	17,888		
1967	258	365	174	487	357	278	0	110	12,567	5,750	549	674	21,569		
1968	7,386	1,181	1,124	1,471	11,688	15,333	2,654	406	719	1,018	309	1,658	44,947		
1969	905	6,938	4,951	9,355	12,237	1,075	0	232	334	1,482	417	2,257	40,183		
1970	2,054	669	2,507	527	10,751	3,646	56	0	2,755	990	49	43	24,047		
1971	42	22	47	52	13	1,402	292	464	13,995	9,416	657	3,002	29,404		
1972	4,016	1,332	111	55	17,920	284	1,397	2,362	168	139	234	83	28,101		
1973	638	3,271	1,414	12,573	527	20,728	293	282	3,204	10,202	416	235	53,783		
1974	1,782	312	222	107	8,920	5,772	262	310	5,210	242	3,734	2,086	28,959		
1975	840	188	140	89	8,708	2,759	886	210	486	169	131	12,906	27,512		
1976	437	141	184	7,386	10,267	768	1,806	130	2,510	8,214	4,453	16,198	52,494		
1977	2,566	6,099	484	1,307	289	9,534	260	150	305	706	926	222	22,848		
1978	1,352	2,933	173	872	199	3,495	49	24	46,926	416	502	225	57,166		
1979	12,266	5,811	560	3,866	30,934	6,563	2,337	287	20,043	655	267	236	83,825		
1980	7,771	1,117	281	202	18,869	277	21	7	378	474	74	52	29,523		
1981	131	79	85	89	3,580	44,315	1,895	171	145	1,227	4,169	171	56,057		
1982	134	4,697	651	641	29,449	426	67	0	54	1,159	17,318	1,462	56,058		
1983	635	6,516	4,036	293	212	57	13,388	1,097	1,471	9,877	3,127	281	40,990		
1984	3,312	1,094	254	142	264	50	8	38	67	2,137	669	570	8,605		
1985	3,239	1,493	12,455	16,981	810	665	1,878	129	96	386	343	389	38,864		
1986	261	117	91	89	624	4,981	62	0	63	1,101	462	9,682	17,533		
1987	2,960	5,707	1,076	136	684	43,543	1,180	164	283	153	4,533	1,422	61,841		
1988	368	163	150	201	164	9	19	0	0	16	14	32	1,136		
1989	1,224	492	40	33	3	0	14	0	0	2	1	2	1,811		
1990	2	8	450	986	89	0	7,660	189	279	17	12	4	9,696		
1991	4,212	3,674	920	39,124	515	156	2,601	190	1,021	246	335	11,840	64,834		
1992	13,550	32,076	1,047	21,892	17,806	5,390	261	135	160	63	660	388	93,428		
1993	2,195	3,819	9,863	2,013	24,746	40,565	670	86	69	92	130	109	84,357		
1994	187	155	3,303	220	9,332	440	58	161	1,788	42,716	414	2,012	60,786		
1995	3,403	163	3,501	412	376	726	48	70	166	29	434	896	10,224		
1996	139	47	32	18	2	2,151	83	897	5,193	99	46	71	8,778		
AVG	2,142	2,600	1,523	3,227	5,794	5,073	1,624	460	2,796	3,019	1,894	1,954	32,107		
MAX	13,550	32,076	12,455	39,124	30,934	44,315	22,352	4,913	46,926	42,716	22,913	16,198	93,428		
MIN	2	8	32	17	2	0	0	0	0	2	0	2	1,136		

WAM RUN3 UNAPPROPRIATED FLOW AT BBEST SITES

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300												# of months in drought	144 months	12.0 years	46-56
LAVACA RIVER NEAR EDNA (ALTERNATE - STAGE 2 TEXANA OUT)												total depletion in drought	1,291,605	107,634 annualized	103,183
units are acre-feet												MAX DURING DROUGHT			
GS300	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL		
1940	1,014	11,377	1,959	330	1,112	4,275	244,457	2,150	1,013	11,986	204,146	102,495	586,314		
1941	37,209	25,347	82,414	74,588	170,117	119,272	23,886	10,747	4,512	9,748	14,582	5,882	578,304		
1942	4,270	4,341	4,643	53,820	4,042	1,527	64,375	2,380	15,934	5,045	5,186	4,257	169,820		
1943	5,717	3,302	12,759	2,448	5,558	6,415	6,260	2,226	1,356	1,629	7,917	20,037	75,624		
1944	41,511	11,200	80,072	6,701	49,179	6,378	1,363	1,942	11,551	2,123	6,046	9,890	227,956		
1945	22,075	6,270	7,790	35,850	2,051	6,207	274	1,569	192	2,561	1,177	1,963	87,979		
1946	4,587	27,764	14,890	5,375	8,845	47,754	4,799	42,807	95,949	86,822	39,358	10,780	389,730		
1947	38,552	6,726	12,604	9,133	34,688	2,421	310	514	196	1,013	2,043	2,699	110,899		
1948	3,171	10,201	9,450	1,420	71,845	2,557	1,232	0	305	598	726	893	102,398		
1949	1,706	9,840	4,289	61,240	8,062	1,949	2,271	4,144	1,239	23,633	2,192	27,051	147,616		
1950	6,534	5,839	2,546	5,568	3,437	6,344	0	0	0	211	240	568	31,287		
1951	782	790	800	0	0	17,440	0	0	7,044	1,631	735	758	29,980		
1952	569	1,970	1,351	13,249	78,360	10,271	0	0	53	145	16,739	23,611	146,318		
1953	2,784	3,147	1,871	1,870	40,629	0	0	12,564	5,564	1,475	969	909	71,782		
1954	819	643	637	3,893	2,825	0	0	0	0	0	0	0	8,817		
1955	486	35,437	827	756	41,349	4,797	0	7,720	1,726	197	22	184	93,501		
1956	228	762	288	0	0	0	0	0	0	0	0	0	2,682		
1957	0	4,469	27,356	83,846	26,981	16,777	0	0	8,709	116,984	68,799	7,240	361,161		
1958	40,985	65,802	10,086	3,374	22,393	72	5,475	0	21,891	13,963	3,855	7,038	194,934		
1959	3,469	64,818	6,296	78,123	19,635	6,642	1,638	2,942	3,577	16,152	13,800	10,328	227,420		
1960	11,137	12,677	4,925	5,765	3,810	62,993	9,305	38,055	3,804	223,168	50,570	36,386	462,595		
1961	58,111	63,646	9,879	5,751	4,281	79,636	32,760	3,786	122,743	9,551	65,145	7,592	462,881		
1962	5,432	5,217	4,322	36,093	4,484	12,489	1,445	89	8,261	3,491	2,005	3,579	86,907		
1963	4,497	17,548	2,895	646	385	0	2,706	0	0	203	1,048	2,260	32,188		
1964	1,634	4,089	5,344	3,296	411	15,825	0	69	10,608	2,407	522	792	44,997		
1965	36,015	55,787	4,954	3,114	98,427	39,100	1,173	770	367	5,249	48,574	17,007	310,537		
1966	6,974	15,982	9,107	33,838	43,836	6,719	3,516	1,558	1,256	1,051	1,004	1,224	126,065		
1967	907	1,072	1,514	3,322	879	0	0	0	111,021	51,565	4,886	2,717	177,883		
1968	61,258	8,721	9,994	12,131	82,382	113,452	10,849	2,212	5,684	2,652	2,758	12,305	324,398		
1969	6,746	62,654	44,103	82,503	86,330	4,967	1,003	766	2,235	7,454	3,713	18,140	320,614		
1970	16,286	3,941	22,328	3,686	75,672	24,495	1,771	1,360	21,001	16,110	2,347	2,012	191,009		
1971	1,568	1,932	2,127	649	35	3,598	0	37,977	82,459	22,023	4,687	33,970	191,025		
1972	21,507	26,446	13,822	2,669	190,055	21,963	4,600	5,332	1,982	2,283	2,287	2,033	294,979		
1973	3,830	9,391	65,207	152,808	32,763	296,733	21,783	8,733	13,616	110,071	12,778	7,734	735,447		
1974	67,587	13,159	7,405	4,777	29,562	49,137	2,031	5,321	89,756	8,807	37,729	17,133	332,404		
1975	9,819	9,513	5,786	33,918	104,946	27,229	25,548	4,828	3,691	3,395	2,707	12,619	243,999		
1976	2,456	2,322	3,142	30,458	49,411	15,318	16,267	1,318	3,224	54,968	22,417	147,442	348,743		
1977	20,629	60,582	11,233	54,598	11,545	15,890	2,167	1,077	3,134	1,529	9,401	2,786	194,571		
1978	8,699	9,178	6,353	14,095	1,148	6,646	872	27	168,490	7,568	7,802	4,372	235,250		
1979	95,534	44,824	23,951	62,967	150,052	88,404	8,371	3,312	48,717	3,907	2,805	3,490	536,334		
1980	31,279	13,588	4,725	2,988	51,462	1,779	22	21	1,324	1,892	1,251	1,551	111,882		
1981	1,775	1,497	1,971	8,682	12,970	136,468	21,163	3,365	140,694	16,448	103,561	8,561	457,155		
1982	5,513	32,875	10,009	5,290	198,058	7,545	2,126	702	2,685	2,986	64,093	11,112	342,994		
1983	12,347	46,771	50,941	6,081	20,619	3,906	52,550	7,206	8,140	12,715	28,025	3,855	253,156		
1984	19,328	5,796	6,846	2,159	3,040	2,388	0	0	0	20,411	3,593	3,485	67,046		
1985	21,497	20,281	40,563	112,170	11,852	3,967	9,280	0	1,664	3,455	49,339	7,269	281,337		
1986	2,747	3,487	2,243	432	1,136	60,891	0	0	1,778	6,726	1,908	64,216	145,564		
1987	17,731	53,362	16,786	2,398	6,513	286,524	9,857	2,157	1,361	1,444	13,067	16,332	427,532		
1988	2,537	2,169	3,063	1,072	3,884	3,311	1,892	0	0	105	202	528	18,763		
1989	9,641	3,860	2,051	32	8,536	705	0	0	0	18	66	193	25,102		
1990	510	791	5,766	7,757	2,705	0	0	0	138	0	17	0	17,684		
1991	34,480	11,501	1,944	81,622	8,491	2,589	7,985	0	1,568	646	4,417	133,099	288,342		
1992	92,356	299,709	42,019	163,749	150,313	103,115	4,801	1,347	1,082	1,858	6,656	17,435	884,440		
1993	16,855	20,675	43,391	27,801	137,426	235,216	8,832	2,057	1,053	2,081	1,730	2,633	499,750		
1994	2,171	1,739	6,724	1,950	94,578	4,611	0	0	4,253	437,495	8,179	18,433	580,133		
1995	35,416	5,985	37,641	34,509	8,861	16,405	1,100	1,054	221	595	3,300	4,889	149,976		
1996	876	851	1,134	0	0	5,963	0	3,954	38,634	1,616	1,848	3,954	58,830		
AVG	16,915	21,994	14,371	25,392	40,034	35,457	10,914	4,038	19,078	23,576	16,929	15,283	243,983		
MAX	95,534	299,709	82,414	163,749	198,058	296,733	244,457	42,807	168,490	437,495	204,146	147,442	884,440		
MIN	0	643	288	0	0	0	0	0	0	0	0	0	2,682		

Appendix 4

Colorado BBEST/BBASC Unappropriated Flow Info From
TCEQ WAM RUN3 For Selected Sites Flow Statistics (Acre-
Feet) Frequency Statistics Water Available Percent Of Time
Without BBEST Recommendations And With Various Levels
Of CL BBEST And Lyons Requirements Imposed

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

COLORADO BBEST/BBASC UNAPPROPRIATED FLOW INFO FROM TCEQ WAM RUN3 FOR SELECTED SITES

WITHOUT BBEST RECOMMENDATIONS AND WITH VARIOUS LEVELS OF CL BBEST AND LYONS REQUIREMENTS IMPOSED

C:\KRC\Active\COL_BBASC\WAM FROM TCEQ 03172011\STAGE2-04152011\REVISED FRATITASK2\05242011-TCEQ RUN3 UNAP AT SELECTED BBEST SITES.xls|SUMMARY

5/24/2011 9:50 AM

WITHOUT CL BBEST RECOMMENDATIONS IMPOSED	FLOW STATISTICS (ACRE-FEET)						FREQUENCY STATISTICS				PERCENT OF TIME WATER AVAILABLE	
	ANNUAL DRT AVE AF/Y	ANNUAL POR AVG AF/Y	ANNUAL MAX AMT AF/Y	ANNUAL MIN AMT AF/Y	MONTH MIN AMT AF	MONTH MAX AMT AF	YEARS WITH ZERO NUMBER YEARS	MONTHS WITH ZERO CONSC YEARS	NUMBER MONTHS	CONSC MONTHS	YEARS %	MONTHS %
SITE# PAGE #	WAM ID	BBEST SITES										
10 3	H10000	PEDERNALES NEAR JOHNSON CITY	4,721	54,173	370,035	0	0	192,213	30	9	611	122
15 6	GS300	LAVACA RIVER NEAR EDNA	60,964	201,454	848,439	0	0	428,297	6	1	386	26
20 10	GS1300	TRES PALACIOS NEAR MIDFIELD	29,770	65,813	229,902	5,957	0	83,510	0	0	213	7
21 13	GS1200	GACITAS CREEK NEAR INEZ	15,150	32,107	93,428	1,136	0	46,926	0	0	32	3

WITH CL BBEST RECOMMENDATIONS IMPOSED

SITE# PAGE #	WAM ID	BBEST SITES										
10 4	H10000-BBEST	PEDERNALES NEAR JOHNSON CITY-BBEST	3,739	34,263	304,765	0	0	129,913	30	9	611	122
15 7	GS300-BBEST	LAVACA RIVER NEAR EDNA-BBEST	36,663	135,156	751,366	0	0	318,738	7	3	388	39
20 11	GS1300-BBEST	TRES PALACIOS NEAR MIDFIELD-BBEST	19,023	40,997	181,973	2,768	0	68,294	0	0	243	7
21 14	GS1200-BBEST	GACITAS CREEK NEAR INEZ-BBEST	10,004	20,327	76,057	186	0	40,154	0	0	99	11

WITH CL BBEST RECOMMENDATIONS IMPOSED BUT NO HIGH FLOW PULSE REQUIREMENT

SITE# PAGE #	WAM ID	BBEST SITES										
10 5	H10000-BBEST-NHFP	PEDERNALES NEAR JOHNSON CITY-BBEST-NHFP	4,131	50,153	351,201	0	0	190,319	30	9	611	122
15 8	GS300-BBEST-NHFP	LAVACA RIVER NEAR EDNA-BBEST-NHFP	58,009	192,199	828,243	0	0	427,092	7	3	388	39
20 12	GS1300-BBEST-NHFP	TRES PALACIOS NEAR MIDFIELD-BBEST-NHFP	26,746	61,119	222,144	2,768	0	83,080	0	0	242	7
21 15	GS1200-BBEST-NHFP	GACITAS CREEK NEAR INEZ-BBEST-NHFP	13,654	30,080	90,782	186	0	46,868	0	0	98	11

WITH LYONS RECOMMENDATIONS IMPOSED

SITE# PAGE #	WAM ID	BBEST SITES										
15 9	GS300-BBEST-LYONS	LAVACA RIVER NEAR EDNA-LYONS	59,789	198,227	838,999	0	0	427,758	7	3	387	39

PERIOD OF RECORD FOR THE VARIOUS TCEQ WAM MODELS			
COLORADO BASIN WAM (1940-1998)			
LAVACA BASIN WAM (1940-1996)			
COLORADO/LAVACA COASTAL WAM (1940-1996)			
LAVACA/GUADALUPE COASTAL WAM (1940-1996)			

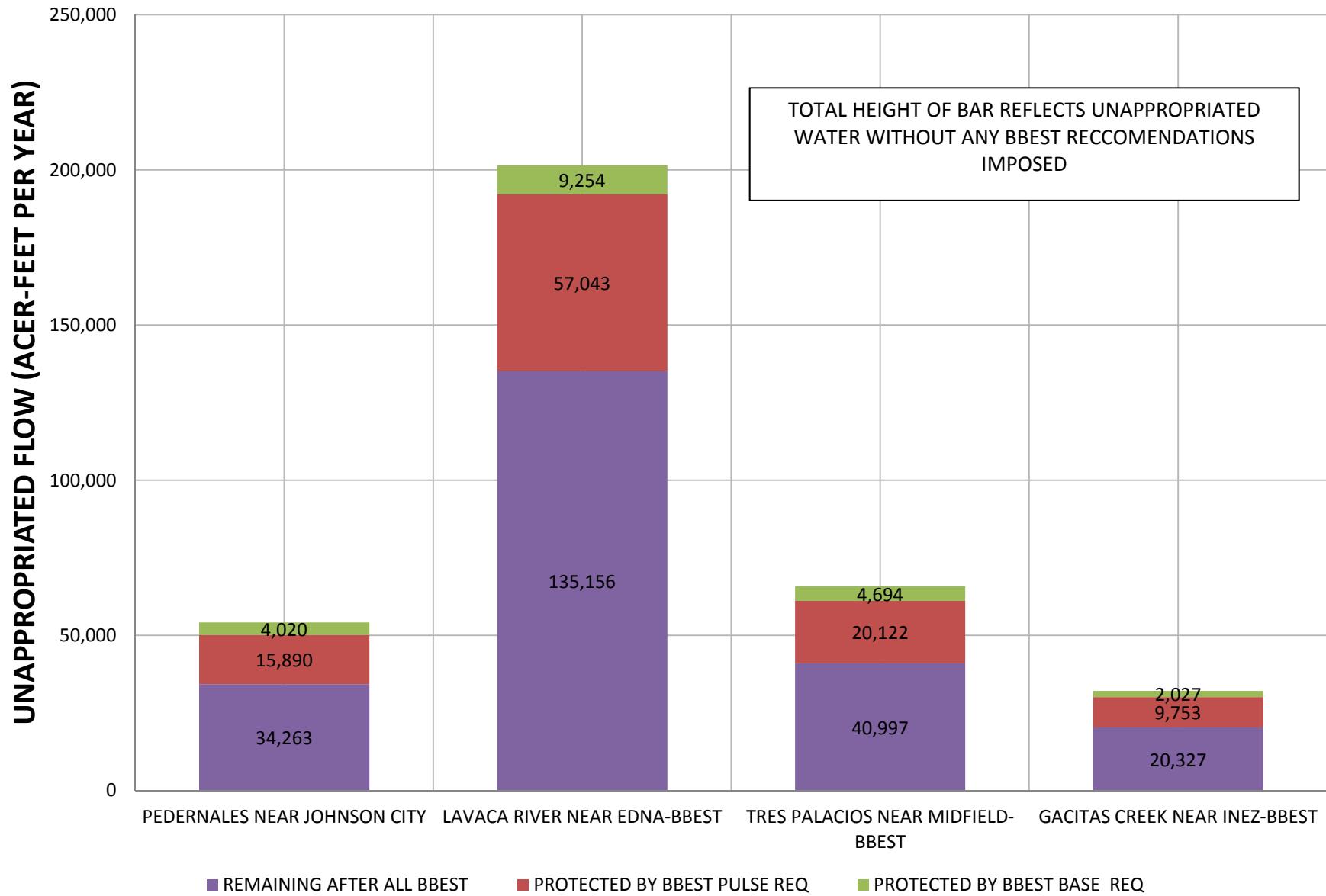
ABBREVIATIONS USED IN ABOVE INFORMATION	
POR	ENTIRE PERIOD OF RECORD, WHICH VARIES DEPENDING ON BASIN WAM MODEL.
DRT	CRITICAL DROUGHT PERIOD, THE 10 YEAR PERIOD BEGINNING IN JUNE 1945 AND ENDING IN MAY 1957.
AF/Y	ANNUAL VOLUME OF WATER IN UNITS OF ACRE-FEET.
CONSC	CONSECUTIVE.
BBEST	CL BBEST'S RECOMMENDATIONS, AS SPECIFIED IN BBEST REPORT.
NHFP	NO HIGH FLOW PULSE RECOMMENDATIONS.

PAGE #
1
2

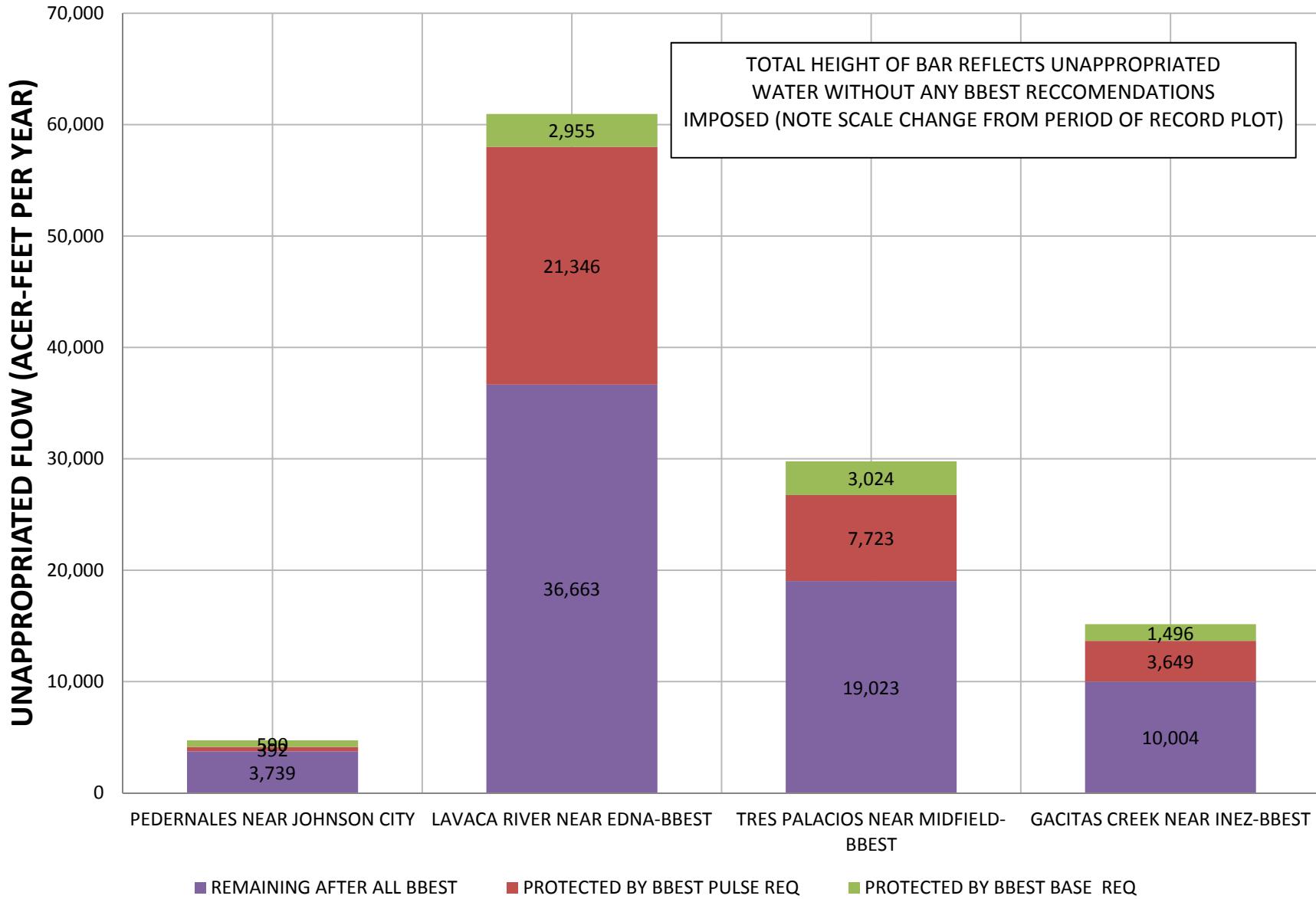
STACKED BAR PLOT FOR EACH SITE SHOWING TOTAL UNAPPROPRIATED WATER REAMAINING WITH NO BBEST, WITH FULL BBEST, AND WITH FULL BBEST BUT NHFP RECOMMENDATIONS FOR POR.

STACKED BAR PLOT FOR EACH SITE SHOWING TOTAL UNAPPROPRIATED WATER REAMAINING WITH NO BBEST, WITH FULL BBEST, AND WITH FULL BBEST BUT NHFP RECOMMENDATIONS FOR DRT.

UNAPPROPRIATED WATER REMAINING AFTER BBEST COMPONENTS IMPOSED ANNUAL AVERAGE AMOUNT FOR PERIOD OF RECORD



UNAPPROPRIATED WATER REMAINING AFTER BBEST COMPONENTS IMPOSED ANNUAL AVERAGE AMOUNT FOR DROUGHT OF RECORD



UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT H10000 PEDERNALES NEAR JOHNSON CITY												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	56,653	4,721 annualized	5,150
units are acre-feet												MAX DURING DROUGHT			29,917
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	23,900	7,355	0	0	0	0	37,612	68,867			
1941	8,055	29,632	34,789	55,018	49,951	12,595	0	0	0	13,184	0	0	203,224		
1942	0	0	0	5,792	1,115	0	0	0	0	38,912	3,124	0	48,943		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	36,100	33,006	0	0	0	0	0	0	0	0	69,106		
1946	0	0	0	0	17,992	0	0	0	0	0	0	0	17,992		
1947	29,917	0	8,744	0	0	0	0	0	0	0	0	0	38,661		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	28,426	0	0	0	24,072	13,834	7,250	73,582		
1958	9,171	25,369	17,437	1,109	21,272	40,829	0	0	0	0	0	0	115,187		
1959	0	0	0	0	0	0	0	0	0	123,673	0	17,276	140,949		
1960	15,951	24,975	0	4,297	0	0	0	0	0	0	0	0	19,344	64,567	
1961	14,008	38,954	0	0	0	18,832	2,940	0	0	0	0	0	0	74,734	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,821	12,905	20,056	3,519	0	0	0	0	0	0	0	47,301	
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	12,134	12,134
1970	4,774	8,531	29,748	9,205	69,015	0	0	0	0	0	0	0	0	121,273	
1971	0	0	0	0	0	0	0	0	0	11,534	0	1,417	12,951		
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	13,971	5,889	0	19,860		
1974	2,632	0	0	0	0	0	0	0	0	20,983	62,074	34,583	12,423	132,695	
1975	13,423	62,045	13,579	10,389	99,317	39,075	0	0	0	0	0	0	0	237,828	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	7,508	0	137,791	20,456	0	0	0	0	0	0	0	0	165,755	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	83,723	0	0	0	0	0	0	0	83,723	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	109,769	0	0	0	44,875	1,502	0	0	156,146	
1982	0	0	0	0	6,193	0	0	0	0	0	0	0	0	6,193	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	51,539	54,005	
1987	23,808	19,620	18,901	0	26,012	168,896	21,458	0	0	0	0	0	0	278,695	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	192,213	192,213	
1992	36,169	158,889	76,072	33,118	44,354	21,433	0	0	0	0	0	0	0	370,035	
1993	0	0	3,876	9,689	0	0	0	0	0	0	0	0	0	13,565	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	70,672	44,068	152,376	23,103	0	0	0	0	0	0	313,599	
1998	0	13,701	48,355	348	0	0	0	0	0	0	0	0	0	62,404	
AVG	2,676	6,597	5,454	6,497	7,115	11,922	930	0	356	5,632	1,041	5,953	54,173		
MAX	36,169	158,889	76,072	137,791	99,317	168,896	23,103	0	20,983	123,673	34,583	192,213	370,035		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT H10000-B PEDERNALES NEAR JOHNSON CITY [BBEST]												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	44,872	3,739 annualized	4,079
units are acre-feet												MAX DURING DROUGHT			28,381
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	19,835	4,835	0	0	0	0	35,505	60,175			
1941	6,993	28,255	17,942	23,094	43,803	8,549	0	0	0	8,457	0	0	137,093		
1942	0	0	0	1,128	507	0	0	0	0	9,083	101	0	10,819		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0		
1944	0	0	0	0	0	0	0	0	0	0	0	0	0		
1945	0	0	19,836	15,057	0	0	0	0	0	0	0	0	34,893		
1946	0	0	0	0	11,565	0	0	0	0	0	0	0	11,565		
1947	28,381	0	4,926	0	0	0	0	0	0	0	0	0	33,307		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0		
1949	0	0	0	0	0	0	0	0	0	0	0	0	0		
1950	0	0	0	0	0	0	0	0	0	0	0	0	0		
1951	0	0	0	0	0	0	0	0	0	0	0	0	0		
1952	0	0	0	0	0	0	0	0	0	0	0	0	0		
1953	0	0	0	0	0	0	0	0	0	0	0	0	0		
1954	0	0	0	0	0	0	0	0	0	0	0	0	0		
1955	0	0	0	0	0	0	0	0	0	0	0	0	0		
1956	0	0	0	0	0	0	0	0	0	0	0	0	0		
1957	0	0	0	0	0	27,746	0	0	0	22,841	8,449	3,354	62,390		
1958	5,997	18,447	13,682	1,109	4,064	27,977	0	0	0	0	0	0	71,277		
1959	0	0	0	0	0	0	0	0	0	78,708	0	9,156	87,864		
1960	12,776	21,736	0	2,606	0	0	0	0	0	0	0	0	12,722	49,840	
1961	12,907	37,691	0	0	0	3,193	1,007	0	0	0	0	0	54,797		
1962	0	0	0	0	0	0	0	0	0	0	0	0	0		
1963	0	0	0	0	0	0	0	0	0	0	0	0	0		
1964	0	0	0	0	0	0	0	0	0	0	0	0	0		
1965	0	0	0	0	0	0	0	0	0	0	0	0	0		
1966	0	0	0	0	0	0	0	0	0	0	0	0	0		
1967	0	0	0	0	0	0	0	0	0	0	0	0	0		
1968	0	0	8,591	11,509	13,223	2,364	0	0	0	0	0	0	35,687		
1969	0	0	0	0	0	0	0	0	0	0	0	0	10,216	40,216	
1970	3,195	5,803	20,347	5,669	23,181	0	0	0	0	0	0	0	58,195		
1971	0	0	0	0	0	0	0	0	0	8,745	0	1,218	9,963		
1972	0	0	0	0	0	0	0	0	0	0	0	0	0		
1973	0	0	0	0	0	0	0	0	0	9,788	2,152	0	11,939		
1974	260	0	0	0	0	0	0	0	0	15,800	8,016	3,618	8,527	36,220	
1975	10,248	31,582	9,823	6,641	75,913	35,440	0	0	0	0	0	0	0	169,646	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0		
1977	0	6,754	0	85,952	16,692	0	0	0	0	0	0	0	109,398		
1978	0	0	0	0	0	0	0	0	0	0	0	0	0		
1979	0	0	0	0	0	55,024	0	0	0	0	0	0	55,024		
1980	0	0	0	0	0	0	0	0	0	0	0	0	0		
1981	0	0	0	0	0	49,851	0	0	0	40,800	1,502	0	92,154		
1982	0	0	0	0	2,219	0	0	0	0	0	0	0	2,219		
1983	0	0	0	0	0	0	0	0	0	0	0	0	0		
1984	0	0	0	0	0	0	0	0	0	0	0	0	0		
1985	0	0	0	0	0	0	0	0	0	0	0	0	0		
1986	0	0	0	0	0	0	0	0	0	0	0	1,755	47,589	49,345	
1987	20,634	16,789	15,145	0	16,193	88,243	21,446	0	0	0	0	0	0	178,450	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0		
1989	0	0	0	0	0	0	0	0	0	0	0	0	0		
1990	0	0	0	0	0	0	0	0	0	0	0	0	0		
1991	0	0	0	0	0	0	0	0	0	0	0	0	83,344	83,344	
1992	34,881	129,913	52,708	29,569	39,799	17,897	0	0	0	0	0	0	0	304,765	
1993	0	0	519	6,034	0	0	0	0	0	0	0	0	0	6,553	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0		
1995	0	0	0	0	0	0	0	0	0	0	0	0	0		
1996	0	0	0	0	0	0	0	0	0	0	0	0	0		
1997	0	0	16,602	41,894	42,674	54,896	11,885	0	0	0	0	0	0	167,951	
1998	0	7,701	18,382	348	0	0	0	0	0	0	0	0	0	26,430	
AVG	2,310	5,164	3,364	3,909	4,912	6,627	664	0	268	3,160	298	3,587	34,263		
MAX	34,881	129,913	52,708	85,952	75,913	88,243	21,446	0	15,800	78,708	8,449	83,344	304,765		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0		

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT H10000-B PEDERNALES NEAR JOHNSON CITY [BBEST-NHFP]												# of months in drought	144 months	12.0 years	46-56
												total depletion in drought	49,577	4,131 annualized	4,507
units are acre-feet												MAX DURING DROUGHT			28,381
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL			
1940	0	0	0	0	22,537	5,573	0	0	0	0	35,505	63,616			
1941	6,993	28,255	30,310	50,500	45,624	8,549	0	0	0	0	0	181,193			
1942	0	0	0	4,349	507	0	0	0	0	37,594	150	0	42,599		
1943	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1944	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1945	0	0	34,007	31,508	0	0	0	0	0	0	0	0	65,515		
1946	0	0	0	0	16,270	0	0	0	0	0	0	0	16,270		
1947	28,381	0	4,926	0	0	0	0	0	0	0	0	0	33,307		
1948	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1949	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1950	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1952	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1957	0	0	0	0	0	27,746	0	0	0	22,880	10,097	3,354	64,076		
1958	5,997	22,015	13,682	1,109	16,541	39,530	0	0	0	0	0	0	98,874		
1959	0	0	0	0	0	0	0	0	0	122,178	0	0	13,304	135,482	
1960	12,776	21,736	0	2,606	0	0	0	0	0	0	0	0	17,434	54,552	
1961	12,907	37,691	0	0	0	15,354	1,007	0	0	0	0	0	0	66,958	
1962	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1963	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1964	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1965	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1968	0	0	10,471	11,509	18,495	2,364	0	0	0	0	0	0	0	42,839	
1969	0	0	0	0	0	0	0	0	0	0	0	0	0	10,216	10,216
1970	3,195	5,803	25,594	5,669	64,589	0	0	0	0	0	0	0	0	104,850	
1971	0	0	0	0	0	0	0	0	0	11,493	0	0	1,389	12,882	
1972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1973	0	0	0	0	0	0	0	0	0	13,025	2,152	0	0	15,176	
1974	260	0	0	0	0	0	0	0	0	18,874	59,242	30,846	8,527	117,749	
1975	10,248	59,016	9,823	6,641	94,927	35,440	0	0	0	0	0	0	0	216,095	
1976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1977	0	6,754	0	132,951	16,692	0	0	0	0	0	0	0	0	156,397	
1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1979	0	0	0	0	0	81,725	0	0	0	0	0	0	0	81,725	
1980	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1981	0	0	0	0	0	105,084	0	0	0	43,598	1,502	0	0	150,183	
1982	0	0	0	0	4,520	0	0	0	0	0	0	0	0	4,520	
1983	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1985	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1986	0	0	0	0	0	0	0	0	0	0	0	2,466	47,589	50,055	
1987	20,634	16,789	15,145	0	24,530	164,802	21,458	0	0	0	0	0	0	263,359	
1988	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1991	0	0	0	0	0	0	0	0	0	0	0	0	190,319	190,319	
1992	34,881	157,312	71,744	29,569	39,799	17,897	0	0	0	0	0	0	0	351,201	
1993	0	0	519	6,034	0	0	0	0	0	0	0	0	0	6,553	
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	0	0	23,380	68,748	42,674	150,185	21,113	0	0	0	0	0	0	306,100	
1998	0	12,644	43,361	348	0	0	0	0	0	0	0	0	0	56,353	
AVG	2,310	6,238	4,796	5,958	6,528	11,376	833	0	320	5,440	800	5,553	50,153		
MAX	34,881	157,312	71,744	132,951	94,927	164,802	21,458	0	18,874	122,178	30,846	190,319	351,201		
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300
LAVACA RIVER NEAR EDNA

of months in drought
total depletion in drought 731,567

144 months
12.0 years
46-56
60,365

MAX DURING DROUGHT 92,242

units are acre-feet

GS300

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	7,031	0	0	0	4,183	238,897	0	0	0	204,178	102,514	556,803
1941	35,107	23,724	80,969	72,699	166,448	114,829	19,517	5,430	0	5,134	11,099	2,143	537,099
1942	653	822	153	50,808	0	0	63,212	0	9,547	0	1,422	1,028	127,645
1943	3,106	0	9,006	0	0	0	1,959	0	0	0	0	13,416	27,487
1944	41,417	8,663	78,205	705	44,952	0	0	464	0	0	1,950	7,975	184,331
1945	20,128	3,958	4,964	32,169	0	0	0	0	0	0	0	0	61,219
1946	0	12,500	12,561	1,392	2,573	42,282	0	39,050	92,242	82,640	37,358	7,681	330,279
1947	37,336	2,939	9,218	4,665	29,130	0	0	0	0	0	0	0	83,288
1948	0	0	0	0	59,106	0	0	0	0	0	0	0	59,106
1949	0	0	0	44,635	438	0	0	0	0	12,834	0	22,928	80,835
1950	3,749	3,001	0	0	0	0	0	0	0	0	0	0	6,750
1951	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	37,215	2,017	0	0	0	0	0	18,751	57,983
1953	0	0	0	0	31,621	0	0	0	0	0	0	0	31,621
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	14,149	0	0	0	0	0	0	0	14,149
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	45,030	22,526	9,808	0	0	0	111,168	68,504	3,964	261,000
1958	40,135	65,502	6,309	0	16,185	0	0	0	10,610	10,223	772	4,379	154,115
1959	588	64,395	1,471	75,496	13,479	0	0	0	0	8,958	11,485	8,297	184,169
1960	8,957	10,141	1,195	958	0	58,007	4,405	34,771	0	223,167	48,820	35,451	425,872
1961	56,316	61,950	5,289	0	0	76,192	29,666	0	117,576	4,314	64,498	4,446	420,247
1962	3,079	1,360	0	32,157	0	5,886	0	0	0	0	0	0	42,482
1963	0	12,826	0	0	0	0	0	0	0	0	0	0	12,826
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	10,677	55,787	792	0	95,237	31,857	0	0	0	0	37,255	16,542	248,147
1966	5,215	14,566	5,101	29,919	38,821	0	0	0	0	0	0	0	93,622
1967	0	0	0	0	0	0	0	0	74,295	46,705	2,546	0	123,546
1968	61,258	6,005	6,029	7,961	77,518	110,518	5,051	0	0	0	0	9,418	283,758
1969	3,797	62,045	41,531	79,200	81,155	0	0	0	0	0	0	0	13,213
1970	14,490	1,782	19,574	0	71,883	16,292	0	0	9,142	11,322	0	0	144,485
1971	0	0	0	0	0	0	0	13,531	79,464	17,026	1,088	32,653	143,762
1972	19,670	23,075	9,055	0	188,071	14,469	0	343	0	0	0	0	254,683
1973	0	7,370	62,967	151,011	25,306	295,770	16,630	4,055	9,196	109,889	9,320	3,922	695,436
1974	67,327	9,021	3,007	0	24,691	41,001	0	0	86,568	3,609	37,111	14,754	287,089
1975	6,898	6,656	1,361	30,565	103,481	21,148	21,159	0	0	0	0	8,692	199,960
1976	0	0	0	26,490	44,995	6,991	13,240	0	0	51,531	20,708	147,442	311,397
1977	19,210	57,985	6,834	52,809	4,839	8,246	0	0	0	0	0	0	149,923
1978	3,098	6,995	1,854	8,554	0	0	0	0	157,982	789	6,986	2,052	188,310
1979	96,023	43,042	20,826	60,483	146,173	81,435	4,630	0	41,963	0	0	0	494,575
1980	29,988	10,619	497	0	46,519	0	0	0	0	0	0	0	87,623
1981	0	0	0	0	0	130,328	16,398	2,836	134,629	13,978	101,638	5,238	405,045
1982	2,906	30,666	5,965	0	194,999	0	0	0	0	0	52,646	8,303	295,485
1983	10,409	45,218	49,246	0	14,601	0	48,714	1,752	3,445	7,555	25,799	610	207,349
1984	17,904	2,321	2,515	0	0	0	0	0	0	0	0	1,284	24,024
1985	19,705	17,941	38,156	108,938	4,758	0	3,777	0	0	0	43,755	4,513	241,543
1986	0	220	0	0	0	49,725	0	0	0	0	0	59,490	109,435
1987	15,395	53,141	12,532	0	117	286,524	4,941	0	0	0	2,503	14,575	389,728
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	18	0	0	18
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	66,710	1,902	0	3,397	0	0	0	0	126,150	198,159
1992	92,347	299,709	39,270	160,847	147,787	96,914	0	0	0	0	0	11,565	848,439
1993	14,528	18,801	41,099	22,851	134,338	231,215	1,556	0	0	0	0	0	464,388
1994	0	0	0	0	81,255	0	0	0	0	428,297	3,962	17,535	531,049
1995	33,492	3,481	34,969	29,540	4,023	8,784	0	0	0	0	0	0	114,289
1996	0	0	0	0	0	0	0	0	7,088	0	0	256	7,344

AVG	13,946	18,513	10,746	20,993	34,567	30,604	8,722	1,794	14,627	20,161	13,954	12,828	201,454
MAX	96,023	299,709	80,969	160,847	194,999	295,770	238,897	39,050	157,982	428,297	204,178	147,442	848,439
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300-BB
LAVACA RIVER NEAR EDNA [BBEST]

of months in drought
total depletion in drought

46-56
34,475

144 months
36,663 annualized

12.0 years
MAX DURING DROUGHT

80,652

units are acre-feet

WGS800

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	3,448	0	0	0	216	142,155	0	0	0	177,845	71,518	395,181
1941	30,650	20,060	14,981	68,798	163,278	111,636	13,304	5,347	0	4,203	3,916	538	436,711
1942	0	216	106	23,486	0	0	34,444	0	9,384	0	1,422	494	69,552
1943	2,143	0	3,236	0	0	0	1,679	0	0	0	0	7,368	14,427
1944	23,713	4,806	43,727	479	42,138	0	0	233	0	0	1,693	1,294	118,083
1945	11,485	3,037	2,588	15,913	0	0	0	0	0	0	0	0	33,022
1946	0	5,445	4,886	784	1,874	21,059	0	10,342	41,123	80,652	35,227	4,740	206,131
1947	17,775	1,506	7,943	4,445	22,185	0	0	0	0	0	0	0	53,853
1948	0	0	0	0	14,000	0	0	0	0	0	0	0	14,000
1949	0	0	0	27,487	438	0	0	0	0	10,481	0	8,614	47,020
1950	2,691	2,055	0	0	0	0	0	0	0	0	0	0	4,746
1951	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	17,157	738	0	0	0	0	0	10,836	28,731
1953	0	0	0	0	12,101	0	0	0	0	0	0	0	12,101
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	12,639	0	0	0	0	0	0	0	12,639
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	38,516	22,218	9,626	0	0	0	37,586	66,830	1,543	176,319
1958	12,308	24,486	2,587	0	4,905	0	0	0	8,983	5,186	771	3,504	62,730
1959	325	29,291	711	41,034	11,339	0	0	0	0	8,904	4,680	5,520	101,803
1960	5,587	7,393	215	647	0	36,548	1,269	13,554	0	139,016	46,606	23,045	273,880
1961	29,198	58,177	4,053	0	0	21,686	12,751	0	95,146	4,314	62,991	1,818	290,134
1962	350	398	0	14,786	0	3,364	0	0	0	0	0	0	18,898
1963	0	7,343	0	0	0	0	0	0	0	0	0	0	7,343
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	5,440	54,121	207	0	68,144	28,913	0	0	0	0	16,132	11,395	184,352
1966	1,879	11,049	3,008	11,589	30,234	0	0	0	0	0	0	0	57,759
1967	0	0	0	0	0	0	0	0	31,310	46,353	2,546	0	80,209
1968	28,872	5,049	3,330	5,926	25,035	106,901	5,051	0	0	0	0	7,608	187,772
1969	2,396	33,832	16,889	26,627	78,196	0	0	0	0	0	0	6,632	164,572
1970	5,843	830	17,926	0	42,733	15,580	0	0	7,929	5,139	0	0	95,980
1971	0	0	0	0	0	0	0	12,084	22,457	16,759	1,088	22,742	75,130
1972	9,334	13,480	1,722	0	135,505	12,913	0	343	0	0	0	0	173,298
1973	0	5,911	16,012	25,103	24,814	293,178	11,465	4,055	9,176	78,617	9,320	1,919	479,569
1974	37,131	7,255	1,625	0	3,630	33,130	0	0	24,873	3,609	35,626	11,069	157,947
1975	4,205	3,744	192	14,847	82,188	19,625	14,610	0	0	0	0	2,994	142,407
1976	0	0	0	15,542	40,673	6,594	13,145	0	0	26,726	19,738	85,941	208,360
1977	17,566	56,323	5,453	20,659	4,514	6,862	0	0	0	0	0	0	111,378
1978	2,565	5,534	932	3,492	0	0	0	0	83,331	789	6,399	75	103,116
1979	57,588	39,022	10,409	32,635	142,825	78,665	4,630	0	18,344	0	0	0	384,117
1980	7,151	9,163	42	0	22,596	0	0	0	0	0	0	0	38,952
1981	0	0	0	0	0	58,808	15,473	1,523	43,345	11,926	98,914	2,612	232,601
1982	275	8,424	3,843	0	131,542	0	0	0	0	0	32,267	5,032	181,383
1983	1,154	20,390	20,685	0	11,777	0	22,203	1,726	3,037	2,629	7,721	98	91,420
1984	7,598	824	992	0	0	0	0	0	0	0	0	604	10,017
1985	16,120	8,712	21,088	26,821	4,015	0	1,502	0	0	0	21,959	2,216	102,433
1986	0	76	0	0	0	29,616	0	0	0	0	0	35,046	64,738
1987	13,675	50,349	10,049	0	87	205,722	4,941	0	0	0	1,252	5,176	291,250
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	50,318	1,423	0	3,168	0	0	0	0	57,820	112,729
1992	90,502	252,063	15,513	150,002	143,870	93,941	0	0	0	0	0	5,475	751,366
1993	11,328	8,005	13,723	19,500	92,554	225,984	1,556	0	0	0	0	0	372,650
1994	0	0	0	0	59,087	0	0	0	0	318,738	3,962	14,993	396,780
1995	14,444	2,724	17,616	23,398	3,138	8,123	0	0	0	0	0	0	69,444
1996	0	0	0	0	0	0	0	0	4,685	0	0	169	4,854

AVG	8,268	13,413	4,672	11,629	25,840	25,078	5,322	863	7,072	14,064	11,560	7,376	135,156
MAX	90,502	252,063	43,727	150,002	163,278	293,178	142,155	13,554	95,146	318,738	177,845	85,941	751,366
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300-BB
LAVACA RIVER NEAR EDNA [BBEST-NHFP]

of months in drought 144 months 12.0 years
total depletion in drought 696,110 58,009 annualized

46-56
57,188

units are acre-feet

MAX DURING DROUGHT 90,693

WGS800

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	5,874	0	0	0	3,332	238,251	0	0	0	202,214	96,734	546,405
1941	30,650	20,060	76,289	68,798	163,278	111,636	19,145	5,347	0	4,203	9,646	538	509,590
1942	0	216	106	48,788	0	0	61,844	0	9,384	0	1,422	494	122,254
1943	2,143	0	7,211	0	0	0	1,679	0	0	0	0	12,297	23,330
1944	38,366	7,523	73,882	479	42,138	0	0	233	0	0	1,693	5,761	170,076
1945	17,774	3,037	2,588	28,874	0	0	0	0	0	0	0	0	52,272
1946	0	12,335	9,116	784	1,874	39,851	0	37,801	90,693	80,652	35,227	4,740	313,073
1947	32,867	1,506	7,943	4,445	27,503	0	0	0	0	0	0	0	74,263
1948	0	0	0	0	58,136	0	0	0	0	0	0	0	58,136
1949	0	0	0	43,907	438	0	0	0	0	12,561	0	21,414	78,320
1950	2,691	2,055	0	0	0	0	0	0	0	0	0	0	4,746
1951	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	36,925	2,017	0	0	0	0	0	17,159	56,101
1953	0	0	0	0	30,344	0	0	0	0	0	0	0	30,344
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	14,088	0	0	0	0	0	0	0	14,088
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	44,821	22,218	9,626	0	0	0	110,087	66,830	1,543	255,125
1958	35,351	60,582	4,229	0	13,724	0	0	0	10,477	9,948	771	3,504	138,585
1959	325	61,763	711	72,147	11,339	0	0	0	0	8,904	10,961	5,520	171,670
1960	5,587	7,393	215	647	0	56,878	3,863	33,251	0	220,391	46,606	30,606	405,436
1961	52,211	58,177	4,053	0	0	72,887	28,619	0	116,417	4,314	62,991	1,818	401,486
1962	350	398	0	30,384	0	5,192	0	0	0	0	0	0	36,324
1963	0	12,017	0	0	0	0	0	0	0	0	0	0	12,017
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	10,497	54,121	207	0	92,470	28,913	0	0	0	0	36,813	11,395	234,417
1966	1,879	11,049	3,008	26,736	35,769	0	0	0	0	0	0	0	78,441
1967	0	0	0	0	0	0	0	0	74,101	46,353	2,546	0	123,000
1968	58,079	5,049	3,330	5,926	73,499	106,901	5,051	0	0	0	0	7,608	265,443
1969	2,396	59,582	37,213	75,101	78,196	0	0	0	0	0	0	11,565	264,053
1970	12,289	830	17,926	0	70,032	15,580	0	0	9,113	10,737	0	0	136,506
1971	0	0	0	0	0	0	0	13,495	78,462	16,759	1,088	30,246	140,050
1972	17,352	21,604	6,083	0	184,527	12,913	0	343	0	0	0	0	242,822
1973	0	5,911	60,304	148,615	24,814	293,178	16,569	4,055	9,176	108,042	9,320	1,919	681,902
1974	62,127	7,255	1,625	0	21,324	38,458	0	0	85,631	3,609	35,626	11,069	266,724
1975	4,205	3,744	192	27,262	99,602	19,625	20,550	0	0	0	0	7,206	182,387
1976	0	0	0	25,390	43,953	6,594	13,145	0	0	50,717	19,908	144,060	303,767
1977	17,566	56,323	5,453	48,755	4,514	6,862	0	0	0	0	0	0	139,473
1978	2,565	5,534	932	7,017	0	0	0	0	157,671	789	6,399	75	180,981
1979	90,243	39,022	16,961	56,811	142,825	78,665	4,630	0	41,062	0	0	0	470,219
1980	27,351	9,163	42	0	43,884	0	0	0	0	0	0	0	80,440
1981	0	0	0	0	0	129,879	15,473	1,523	132,215	11,926	98,914	2,612	392,542
1982	275	26,978	3,843	0	191,546	0	0	0	0	0	51,773	5,032	279,448
1983	7,258	41,318	44,656	0	11,777	0	47,588	1,726	3,037	6,953	24,524	98	188,935
1984	14,362	824	992	0	0	0	0	0	0	0	0	604	16,781
1985	16,120	15,447	34,418	105,407	4,015	0	3,565	0	0	0	43,031	2,216	224,219
1986	0	76	0	0	0	49,030	0	0	0	0	0	58,333	107,439
1987	13,675	50,349	10,049	0	87	281,595	4,941	0	0	0	2,323	12,098	375,116
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	65,094	1,423	0	3,168	0	0	0	0	125,552	195,237
1992	90,502	297,984	35,436	157,228	143,870	93,941	0	0	0	0	0	9,283	828,243
1993	11,328	15,064	37,560	19,645	130,558	227,857	1,556	0	0	0	0	0	443,570
1994	0	0	0	0	80,190	0	0	0	0	427,092	3,962	14,993	526,237
1995	31,036	2,724	33,113	27,932	3,138	8,123	0	0	0	0	0	0	106,067
1996	0	0	0	0	0	0	0	0	7,088	0	0	169	7,257

AVG	12,446	17,244	9,468	20,017	33,404	29,816	8,590	1,715	14,465	19,895	13,589	11,548	192,199
MAX	90,502	297,984	76,289	157,228	191,546	293,178	238,251	37,801	157,671	427,092	202,214	144,060	828,243
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS300-BB
LAVACA RIVER NEAR EDNA [LYONS]

of months in drought
total depletion in drought

144 months

12.0 years

46-56
59,210

MAX DURING DROUGHT 92,018

units are acre-feet

WGS800

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	6,348	0	0	0	3,403	237,845	0	0	0	203,155	101,235	551,986
1941	34,246	22,910	78,835	71,045	165,138	113,758	19,503	5,430	0	5,134	11,099	2,143	529,241
1942	653	822	147	49,083	0	0	62,083	0	9,534	0	1,422	1,028	124,772
1943	3,104	0	7,482	0	0	0	1,757	0	0	0	0	13,408	25,751
1944	39,948	8,436	76,224	705	44,030	0	0	430	0	0	1,950	7,491	179,215
1945	19,084	3,858	3,527	30,757	0	0	0	0	0	0	0	0	57,225
1946	0	12,236	10,834	1,110	2,245	41,507	0	38,304	92,018	82,561	37,163	7,681	325,659
1947	36,385	2,939	8,310	4,652	27,825	0	0	0	0	0	0	0	80,111
1948	0	0	0	0	58,145	0	0	0	0	0	0	0	58,145
1949	0	0	0	43,798	409	0	0	0	0	12,687	0	22,395	79,289
1950	3,685	2,787	0	0	0	0	0	0	0	0	0	0	6,472
1951	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	0	0	0	0	36,694	1,908	0	0	0	0	0	18,426	57,028
1953	0	0	0	0	30,521	0	0	0	0	0	0	0	30,521
1954	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	0	0	0	0	14,088	0	0	0	0	0	0	0	14,088
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	44,583	21,579	9,228	0	0	0	110,771	67,696	3,964	257,820
1958	38,897	63,852	6,217	0	14,943	0	0	0	10,465	10,117	772	3,924	149,187
1959	442	62,895	1,448	73,847	13,143	0	0	0	0	8,958	11,100	7,847	179,679
1960	8,395	9,530	1,131	680	0	57,125	4,321	34,423	0	222,306	48,563	34,744	421,218
1961	55,533	60,923	5,289	0	0	74,286	29,403	0	116,974	4,314	63,832	4,446	415,000
1962	3,079	1,360	0	30,707	0	5,380	0	0	0	0	0	0	40,526
1963	0	11,917	0	0	0	0	0	0	0	0	0	0	11,917
1964	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	10,506	53,877	792	0	93,717	31,174	0	0	0	0	37,153	15,698	242,916
1966	5,084	13,611	4,786	28,431	37,933	0	0	0	0	0	0	0	89,845
1967	0	0	0	0	0	0	0	0	74,101	46,583	2,546	0	123,229
1968	59,487	5,923	5,513	7,423	75,878	109,299	5,051	0	0	0	0	9,242	277,816
1969	3,600	60,597	39,766	77,513	80,097	0	0	0	0	0	0	12,809	274,382
1970	13,623	1,514	18,246	0	70,162	15,882	0	0	9,142	11,276	0	0	139,844
1971	0	0	0	0	0	0	0	13,509	78,924	17,026	1,088	32,006	142,553
1972	18,735	22,502	8,331	0	186,389	14,436	0	343	0	0	0	0	250,737
1973	0	6,612	60,623	149,037	24,991	293,663	16,630	4,055	9,196	109,173	9,320	3,922	687,223
1974	66,008	9,021	3,007	0	23,339	40,309	0	0	86,107	3,609	36,458	14,723	282,581
1975	6,898	6,568	1,361	29,360	101,868	21,076	21,051	0	0	0	0	8,361	196,543
1976	0	0	0	25,636	44,203	6,807	12,948	0	0	51,328	20,545	146,163	307,631
1977	18,961	57,235	6,834	51,107	4,839	8,245	0	0	0	0	0	0	147,222
1978	3,058	6,395	1,383	7,419	0	0	0	0	157,661	789	6,535	2,052	185,292
1979	94,252	41,905	19,419	58,969	144,832	80,563	4,630	0	41,579	0	0	0	486,149
1980	28,769	10,147	497	0	44,955	0	0	0	0	0	0	0	84,367
1981	0	0	0	0	0	129,417	16,103	2,415	134,024	13,953	101,038	5,238	402,188
1982	2,906	29,527	5,860	0	193,447	0	0	0	0	0	52,269	8,289	292,298
1983	9,726	43,990	47,210	0	13,847	0	47,812	1,752	3,424	7,555	25,288	610	201,215
1984	16,936	2,321	2,408	0	0	0	0	0	0	0	0	991	22,656
1985	18,928	16,873	36,612	107,339	4,758	0	3,644	0	0	0	43,488	4,513	236,154
1986	0	220	0	0	0	49,252	0	0	0	0	0	58,922	108,394
1987	14,855	51,452	12,098	0	97	284,462	4,941	0	0	0	2,479	13,883	384,267
1988	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	65,982	1,762	0	3,215	0	0	0	0	125,609	196,568
1992	90,576	297,730	37,881	159,384	146,113	95,890	0	0	0	0	0	11,424	838,999
1993	13,824	17,801	39,464	21,939	132,748	229,895	1,556	0	0	0	0	0	457,227
1994	0	0	0	0	80,444	0	0	0	0	427,758	3,962	16,849	529,013
1995	32,491	3,481	33,479	28,339	3,373	8,274	0	0	0	0	0	0	109,436
1996	0	0	0	0	0	0	0	0	7,088	0	0	233	7,321

AVG	13,556	18,072	10,263	20,506	34,010	30,267	8,640	1,766	14,566	20,103	13,841	12,636	198,227
MAX	94,252	297,730	78,835	159,384	193,447	293,663	237,845	38,304	157,661	427,758	203,155	146,163	838,999
MIN	0	0	0	0	0	0	0	0	0	0	0	0	0

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1300
TRE PALACIOS NEAR MIDFIELD

of months in drought
total depletion in drought

357,238

144 months

12.0 years

46-56
28,676

units are acre-feet

MAX DURING DROUGHT

29,759

GS1300

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	798	4,166	238	0	0	0	647	0	0	8,425	36,104	20,732	71,110
1941	10,546	7,257	13,791	17,108	29,666	8,048	0	0	383	12,881	2,559	726	102,965
1942	1,437	3,723	1,004	12,332	0	0	8,119	0	2,632	5,890	791	720	36,648
1943	3,505	3,365	4,785	0	0	0	0	0	0	5,086	1,199	1,758	19,698
1944	18,941	5,907	23,265	810	6,244	0	0	1,833	2,145	5,289	892	1,560	66,886
1945	7,745	4,805	1,172	7,926	0	0	0	0	0	6,523	161	375	28,707
1946	5,902	11,304	5,611	495	9	9,315	0	1,904	17,081	17,747	6,970	4,003	80,341
1947	14,494	3,542	2,576	1,409	3,354	0	0	0	0	4,768	355	982	31,480
1948	3,082	7,090	3,691	0	10,596	0	0	0	0	4,726	84	166	29,435
1949	889	6,810	2,486	14,155	0	0	0	0	0	29,759	352	3,776	58,227
1950	5,215	5,498	387	561	0	1,394	0	0	0	4,764	0	232	18,051
1951	706	2,638	532	0	0	1,806	0	0	984	5,664	73	327	12,730
1952	690	3,319	323	2,419	11,984	0	0	0	0	4,675	2,937	2,617	28,964
1953	1,554	3,620	228	0	4,543	0	0	0	618	5,097	129	222	16,011
1954	725	2,598	0	153	0	0	0	0	0	4,864	0	0	8,340
1955	726	8,806	0	0	4,384	0	0	0	4	6,670	0	0	20,590
1956	689	3,155	0	0	0	0	0	0	0	4,524	0	2,901	11,269
1957	624	3,404	9,778	19,120	1,815	4,612	0	0	1,309	45,236	12,207	902	99,007
1958	11,787	14,579	1,241	7	920	0	0	0	3,889	7,739	675	312	41,149
1959	2,750	19,827	1,094	17,855	403	1,870	0	0	191	15,738	2,440	4,342	66,510
1960	6,377	8,062	1,121	594	0	16,165	0	2	227	39,632	8,970	5,902	87,052
1961	17,279	25,638	1,652	587	0	10,324	0	0	21,631	6,119	11,554	1,253	96,037
1962	1,580	3,776	614	7,999	0	0	0	0	1,122	5,117	339	402	20,949
1963	3,032	4,996	272	0	0	0	0	0	0	4,810	165	101	13,376
1964	944	4,745	1,311	0	0	0	0	0	1,591	6,060	49	102	14,802
1965	6,573	8,856	397	0	15,938	795	0	0	0	7,619	8,601	6,192	54,971
1966	4,100	8,265	2,970	7,445	5,156	0	0	0	0	5,619	127	274	33,956
1967	892	2,695	71	3	0	0	0	0	19,836	17,488	859	380	42,224
1968	30,348	4,653	1,886	2,145	12,781	24,598	0	0	612	7,504	480	3,153	88,160
1969	3,465	18,339	10,329	18,820	13,551	0	0	0	0	7,272	616	1,069	73,461
1970	5,432	3,218	9,029	86	11,443	27	0	0	3,635	21,052	394	372	54,688
1971	223	325	130	0	0	0	0	3,781	14,611	16,309	778	21,169	57,326
1972	3,764	2,915	2,180	0	33,120	866	0	0	0	5,600	397	343	49,185
1973	2,672	9,406	14,515	34,225	2,957	48,473	0	0	2,175	31,469	2,259	1,110	149,261
1974	10,658	3,120	1,489	342	2,336	2,000	0	214	15,830	8,153	6,667	11,091	61,900
1975	2,615	940	723	7,460	17,248	3,609	2,823	0	205	6,600	472	18,282	60,977
1976	679	305	508	302	0	6,025	0	0	2,212	1,772	11,883	24,501	48,187
1977	2,808	3,060	846	4,462	0	0	0	0	4,474	6,337	6,586	511	29,084
1978	9,073	10,067	771	1,134	0	809	0	0	9,478	463	4,739	4,582	41,116
1979	31,972	18,777	19,100	8,234	12,936	572	16,528	82	76,151	774	795	4,724	190,645
1980	13,199	3,650	3,159	0	32,309	0	0	0	4,147	6,164	284	359	63,271
1981	877	648	340	0	18,269	20,983	32,269	2,305	19,386	3,577	24,842	1,013	124,509
1982	670	12,071	1,420	0	64,751	0	0	0	0	498	17,966	1,629	99,005
1983	11,928	25,326	14,184	0	0	19,532	0	0	38,275	69,093	4,390	911	183,639
1984	4,365	744	491	0	9,830	0	0	0	0	83,510	4,958	2,636	106,534
1985	5,916	3,281	35,779	19,498	0	10,741	5,924	0	325	4,774	923	8,587	95,748
1986	597	343	512	0	0	0	0	0	729	21,089	9,037	23,729	56,036
1987	7,976	19,241	1,890	0	0	22,276	0	0	590	0	11,206	4,752	67,931
1988	1,271	563	1,223	0	0	0	0	0	340	1,332	265	963	5,957
1989	15,883	806	702	0	2,835	0	0	0	0	0	180	345	20,751
1990	768	15,008	7,921	7,936	3,025	0	0	0	0	0	0	91	34,749
1991	32,884	13,115	5,593	37,659	1,089	0	0	0	2,551	95	2,178	34,759	129,923
1992	29,647	56,007	3,158	34,149	57,337	3,421	0	0	0	5,517	34,177	6,489	229,902
1993	14,378	20,874	13,330	3,395	24,034	22,139	0	0	0	533	5,742	726	105,151
1994	940	2,450	3,198	0	4,039	15,319	0	3,056	5,397	82,729	692	18,108	135,928
1995	13,189	921	14,724	22,577	16,927	5,396	0	0	0	0	2,097	27,880	103,711
1996	760	332	354	0	0	37,507	0	3,350	17,050	2,334	5,373	6,041	73,101

AVG	6,887	7,771	4,388	5,498	7,646	4,791	1,612	290	5,120	12,159	4,543	5,108	65,813
MAX	32,884	56,007	35,779	37,659	64,751	48,473	32,269	3,781	76,151	83,510	36,104	34,759	229,902
MIN	223	305	0	0	0	0	0	0	0	0	0	0	5,957

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1300-B
TRE PALACIOS NEAR MIDFIELD [BBEST]

of months in drought 144 months 12.0 years
total depletion in drought 228,275 19,023 annualized

46-56
18,056

units are acre-feet

MAX DURING DROUGHT 13,111

UNAPPROPRIATED FLOWS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	1,657	9	0	0	0	633	0	0	4,510	7,174	11,906	25,889
1941	9,439	6,257	5,469	11,530	28,313	7,733	0	0	93	7,130	177	45	76,187
1942	330	2,723	261	4,790	0	0	7,579	0	2,114	5,091	200	101	23,190
1943	2,706	2,643	3,986	0	0	0	0	0	0	4,656	842	1,179	16,012
1944	8,654	5,159	9,502	646	5,801	0	0	1,833	1,529	4,490	427	956	38,997
1945	2,097	4,083	536	7,082	0	0	0	0	0	5,724	0	43	19,566
1946	5,349	4,669	4,260	300	6	6,105	0	1,832	13,111	9,047	5,899	2,896	53,474
1947	8,530	2,542	1,777	1,389	3,135	0	0	0	0	4,346	98	429	22,246
1948	2,529	6,572	2,892	0	4,415	0	0	0	0	4,296	0	0	20,703
1949	424	1,464	1,933	10,519	0	0	0	0	0	9,302	37	1,649	25,328
1950	4,416	4,776	0	398	0	601	0	0	0	4,367	0	2	14,560
1951	153	2,138	112	0	0	1,774	0	0	881	2,189	13	14	7,273
1952	137	2,801	97	2,262	3,758	0	0	0	0	3,916	2,580	2,032	17,583
1953	755	2,898	0	0	4,308	0	0	0	511	4,298	0	3	12,773
1954	172	2,098	0	143	0	0	0	0	0	1,991	0	0	4,404
1955	377	2,249	0	0	1,552	0	0	0	2	6,240	0	0	10,420
1956	274	2,637	0	0	0	0	0	0	0	4,265	0	2,678	9,854
1957	535	3,100	9,250	9,213	1,791	4,599	0	0	1,241	13,228	11,433	48	54,439
1958	3,494	13,505	137	6	775	0	0	0	1,067	4,410	304	124	23,822
1959	1,951	9,627	191	7,487	325	1,870	0	0	132	9,047	2,024	877	33,531
1960	2,842	7,027	47	401	0	8,207	0	2	89	19,097	7,899	4,795	50,405
1961	9,058	24,638	308	509	0	5,649	0	0	8,840	5,320	10,780	180	65,281
1962	473	2,776	0	5,013	0	0	0	0	970	1,933	5	110	11,280
1963	2,479	2,034	0	0	0	0	0	0	0	4,401	56	6	8,975
1964	623	4,227	891	0	0	0	0	0	1,520	2,499	0	0	9,759
1965	3,682	2,221	0	0	11,394	710	0	0	0	3,723	4,778	5,085	31,593
1966	2,993	6,012	1,617	3,956	4,468	0	0	0	0	4,820	0	0	23,866
1967	339	2,195	0	2	0	0	0	0	3,093	16,896	442	0	22,968
1968	10,952	3,905	742	1,669	3,589	20,462	0	0	349	6,705	19	2,354	50,747
1969	2,666	10,320	4,707	10,498	12,835	0	0	0	0	3,351	192	762	45,331
1970	2,287	2,496	8,230	86	11,112	26	0	0	3,034	8,083	9	0	35,364
1971	0	8	0	0	0	0	0	3,165	7,618	15,510	405	13,095	39,801
1972	3,079	2,263	1,168	0	20,454	866	0	0	0	4,801	112	0	32,743
1973	1,944	3,915	4,390	8,440	2,736	47,699	0	0	1,922	18,500	1,780	320	91,648
1974	7,225	2,204	724	254	2,144	1,997	0	202	11,934	7,354	5,953	7,591	47,580
1975	1,644	108	45	6,865	9,855	1,089	2,500	0	112	5,801	169	10,436	38,625
1976	101	0	27	264	0	0	5,912	0	1,765	1,047	2,099	15,141	26,356
1977	2,009	2,338	0	3,763	0	0	0	0	4,149	2,749	3,011	65	18,084
1978	5,911	6,948	0	811	0	717	0	0	9,061	303	4,383	1,374	29,509
1979	25,965	17,846	884	3,989	12,180	512	15,450	82	40,231	223	214	1,679	119,256
1980	7,658	2,904	2,154	0	12,978	0	0	0	3,842	2,575	7	0	32,117
1981	422	227	10	0	8,983	17,303	17,814	1,991	10,722	2,529	20,745	245	80,990
1982	40	4,103	456	0	38,702	0	0	0	0	366	6,834	793	51,294
1983	5,108	21,918	6,092	0	0	18,663	0	20,058	68,294	3,616	84	143,833	
1984	3,441	18	0	0	2,203	0	0	0	57,995	4,541	1,814	70,012	
1985	4,810	2,375	12,739	18,345	0	10,303	5,797	0	241	1,472	315	1,788	58,185
1986	31	0	11	0	0	0	0	0	451	8,057	8,341	15,659	32,550
1987	7,180	2,145	0	0	0	11,844	0	0	380	0	7,428	1,454	30,431
1988	468	0	613	0	0	0	0	0	299	902	24	461	2,768
1989	7,099	85	258	0	2,638	0	0	0	0	0	93	12	10,184
1990	376	2,551	3,035	2,937	2,732	0	0	0	0	0	0	22	11,652
1991	16,147	12,615	1,495	7,049	905	0	0	0	2,065	0	1,517	26,896	68,689
1992	29,094	41,725	1,938	19,318	55,985	3,133	0	0	0	1,997	25,781	3,002	181,973
1993	7,277	6,165	12,001	2,896	14,407	15,603	0	0	0	303	2,349	225	61,226
1994	483	2,003	2,542	0	3,848	11,774	0	2,572	4,623	60,659	77	10,096	98,677
1995	12,390	200	5,618	5,332	16,304	5,279	0	0	0	0	1,462	19,960	66,546
1996	207	0	18	0	0	10,598	0	2,894	5,596	1,732	4,873	385	26,303
AVG	4,225	5,020	1,985	2,775	5,344	3,447	1,304	256	2,871	7,939	2,834	2,998	40,997
MAX	29,094	41,725	12,739	19,318	55,985	47,699	18,663	3,165	40,231	68,294	25,781	26,896	181,973
MIN	0	0	0	0	0	0	0	0	0	0	0	0	2,768

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1300-B
TRE PALACIOS NEAR MIDFIELD [BBEST-NHPF]

46-56
25,624

units are acre-feet

MAX DURING DROUGHT 29,329

												144 months	12.0 years	
												# of months in drought	total depletion in drought	
												320,947	26,746 annualized	
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
1940	0	3,437	9	0	0	633	0	0	7,632	35,354	19,625		66,692	
1941	9,439	6,257	12,438	15,799	28,313	7,733	0	0	93	11,774	1,538	45	93,430	
1942	330	2,723	261	11,733	0	0	7,955	0	2,114	5,091	200	101	30,510	
1943	2,706	2,643	3,986	0	0	0	0	0	0	4,656	842	1,179	16,012	
1944	18,142	5,159	21,912	646	5,801	0	0	1,833	1,529	4,490	427	956	60,894	
1945	6,946	4,083	536	7,082	0	0	0	0	0	5,724	0	43	24,414	
1946	5,349	10,804	4,260	300	6	9,045	0	1,832	16,010	16,640	5,899	2,896	73,041	
1947	13,387	2,542	1,777	1,389	3,135	0	0	0	0	4,346	98	429	27,103	
1948	2,529	6,572	2,892	0	10,406	0	0	0	0	4,296	0	0	26,694	
1949	424	6,310	1,933	13,727	0	0	0	0	0	29,329	37	3,215	54,974	
1950	4,416	4,776	0	398	0	1,290	0	0	0	4,367	0	2	15,249	
1951	153	2,138	112	0	0	1,774	0	0	881	5,234	13	14	10,318	
1952	137	2,801	97	2,262	11,797	0	0	0	0	3,916	2,580	2,032	25,622	
1953	755	2,898	0	0	4,308	0	0	0	511	4,298	0	3	12,773	
1954	172	2,098	0	143	0	0	0	0	0	4,502	0	0	6,915	
1955	377	8,385	0	0	4,315	0	0	0	2	6,240	0	0	19,319	
1956	274	2,637	0	0	0	0	0	0	0	4,265	0	2,678	9,854	
1957	535	3,100	9,250	18,640	1,791	4,599	0	0	1,241	44,503	11,433	48	95,140	
1958	10,680	13,579	137	6	775	0	0	0	3,658	7,309	304	124	36,573	
1959	1,951	19,105	191	16,662	325	1,870	0	0	132	15,308	2,024	3,270	60,838	
1960	5,270	7,027	47	401	0	15,921	0	2	89	38,895	7,899	4,795	80,345	
1961	16,172	24,638	308	509	0	9,939	0	0	20,917	5,320	10,780	180	88,762	
1962	473	2,776	0	7,521	0	0	0	0	970	4,687	37	110	16,575	
1963	2,479	4,498	0	0	0	0	0	0	0	4,401	56	6	11,440	
1964	623	4,227	891	0	0	0	0	0	1,520	5,630	0	0	12,890	
1965	6,147	8,356	0	0	15,372	710	0	0	0	6,820	7,901	5,085	50,390	
1966	2,993	7,265	1,617	6,618	4,656	0	0	0	0	4,820	0	0	27,970	
1967	339	2,195	0	2	0	0	0	0	19,631	17,058	442	0	39,668	
1968	29,549	3,905	742	1,669	11,890	24,066	0	0	349	6,705	19	2,354	81,248	
1969	2,666	17,617	8,976	17,511	12,835	0	0	0	0	6,473	193	762	67,032	
1970	4,633	2,496	8,230	86	11,112	26	0	0	3,034	20,253	9	0	49,879	
1971	0	8	0	0	0	0	0	3,742	13,837	15,510	405	20,392	53,894	
1972	3,079	2,263	1,168	0	31,779	866	0	0	0	4,801	112	0	44,068	
1973	1,944	8,760	13,716	33,479	2,736	47,699	0	0	1,922	30,670	1,780	320	143,027	
1974	9,653	2,204	724	254	2,144	1,997	0	202	15,056	7,354	5,953	9,984	55,524	
1975	1,644	108	45	6,865	16,370	3,417	2,823	0	112	5,801	169	17,707	55,060	
1976	101	0	27	264	0	6,019	0	1,765	1,047	11,179	23,702	44,104		
1977	2,009	2,338	0	3,763	0	0	0	4,149	5,907	6,169	65	24,400		
1978	8,334	9,345	0	811	0	717	0	9,061	303	4,383	3,695	36,649		
1979	30,865	17,846	18,156	7,429	12,180	512	16,442	82	75,377	223	214	4,101	183,429	
1980	12,506	2,904	2,154	0	31,003	0	0	0	3,842	5,734	7	0	58,149	
1981	422	227	10	0	17,944	20,871	31,557	1,991	18,315	2,529	23,847	245	117,957	
1982	40	11,396	456	0	63,464	0	0	0	0	366	17,365	793	93,879	
1983	11,190	24,347	13,061	0	0	19,224	0	37,549	68,294	3,616	84	177,365		
1984	3,441	18	0	0	9,304	0	0	0	0	83,080	4,541	1,814	102,199	
1985	4,810	2,375	34,445	18,345	0	10,303	5,822	0	241	4,068	315	7,798	88,522	
1986	31	0	11	0	0	0	0	0	451	20,337	8,341	22,930	52,101	
1987	7,180	18,524	928	0	0	21,800	0	0	380	0	10,550	3,740	63,102	
1988	468	0	613	0	0	0	0	299	902	24	461	2,768		
1989	15,330	397	258	0	2,638	0	0	0	0	0	93	12	18,726	
1990	376	14,617	7,384	7,650	2,924	0	0	0	0	0	0	22	32,974	
1991	32,339	12,615	4,774	36,568	905	0	0	0	2,065	0	1,517	34,207	124,991	
1992	29,094	55,489	1,938	32,849	55,985	3,133	0	0	0	4,822	33,403	5,431	222,144	
1993	13,323	19,874	12,001	2,896	22,902	21,509	0	0	0	303	5,060	225	98,093	
1994	483	2,003	2,542	0	3,848	15,140	0	2,963	4,623	81,930	77	17,315	130,925	
1995	12,390	200	13,925	21,803	16,304	5,279	0	0	0	0	1,462	27,231	98,595	
1996	207	0	18	0	0	36,985	0	3,148	16,277	1,732	4,873	5,329	68,569	
AVG	6,163	7,104	3,666	5,194	7,356	4,688	1,587	277	4,877	11,591	4,097	4,519	61,119	
MAX	32,339	55,489	34,445	36,568	63,464	47,699	31,557	3,742	75,377	83,080	35,354	34,207	222,144	
MIN	0	0	0	0	0	0	0	0	0	0	0	0	2,768	

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1200
GACITAS CREEK NEAR INEZ

46-56
14,643

units are acre-feet

MAX DURING DROUGHT 11,133

GS1200

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	214	1,464	223	152	391	973	22,352	394	198	1,921	22,913	10,921	62,116
1941	4,538	2,955	9,250	8,461	23,895	16,123	8,304	1,354	589	1,704	1,637	998	79,808
1942	620	714	524	6,139	797	620	9,977	399	1,869	1,249	582	831	24,321
1943	800	604	1,434	391	1,006	1,264	55	371	236	920	889	2,452	10,422
1944	5,083	1,445	8,988	866	7,066	1,261	0	332	1,379	967	678	1,410	29,475
1945	2,780	918	875	4,120	524	1,236	0	288	105	1,010	132	596	12,584
1946	695	3,214	1,671	713	1,460	6,695	1,263	4,913	10,836	9,159	4,418	1,501	46,538
1947	4,742	969	1,416	1,136	5,056	741	0	172	106	860	230	671	16,099
1948	528	1,338	1,063	274	10,230	759	0	65	118	820	82	486	15,763
1949	353	1,298	484	6,965	1,357	676	51	580	222	3,047	246	3,172	18,451
1950	929	873	290	736	714	1,248	0	28	32	782	27	452	6,111
1951	189	345	124	94	134	2,719	0	0	930	924	83	472	6,014
1952	160	465	155	1,594	11,133	1,772	0	119	100	776	1,909	2,819	21,002
1953	445	585	213	323	5,881	403	0	1,582	732	904	109	487	11,664
1954	198	318	72	557	628	237	0	17	35	760	0	384	3,206
1955	150	4,086	96	201	5,986	1,050	0	1,022	276	780	3	413	14,063
1956	120	350	33	17	104	195	0	0	0	756	0	588	2,163
1957	79	729	3,070	9,500	3,977	2,620	0	14	1,112	12,076	7,720	1,139	42,036
1958	4,973	7,274	1,134	493	3,348	429	0	81	2,570	2,112	433	1,117	23,964
1959	519	7,169	710	8,856	2,964	1,289	0	468	484	2,324	1,549	1,455	27,787
1960	1,445	1,603	555	758	764	8,694	3,074	4,389	509	22,346	5,676	4,131	53,944
1961	7,046	7,046	1,112	760	833	10,893	5,704	547	13,825	1,685	7,312	1,174	57,937
1962	780	808	489	4,156	861	2,061	229	125	1,010	1,100	225	762	12,606
1963	686	2,123	330	188	291	414	966	33	29	782	118	627	6,587
1964	344	686	602	484	293	2,503	0	161	1,272	994	59	475	7,873
1965	4,436	6,203	559	463	13,915	5,568	0	202	124	1,270	5,452	2,140	40,332
1966	980	1,954	1,025	3,902	6,322	1,302	393	289	224	864	113	520	17,888
1967	258	365	174	487	357	278	0	110	12,567	5,750	549	674	21,569
1968	7,386	1,181	1,124	1,471	11,688	15,333	2,654	406	719	1,018	309	1,658	44,947
1969	905	6,938	4,951	9,355	12,237	1,075	0	232	334	1,482	417	2,257	40,183
1970	2,054	669	2,507	527	10,751	3,646	56	0	2,755	990	49	43	24,047
1971	42	22	47	52	13	1,402	292	464	13,995	9,416	657	3,002	29,404
1972	4,016	1,332	111	55	17,920	284	1,397	2,362	168	139	234	83	28,101
1973	638	3,271	1,414	12,573	527	20,728	293	282	3,204	10,202	416	235	53,783
1974	1,782	312	222	107	8,920	5,772	262	310	5,210	242	3,734	2,086	28,959
1975	840	188	140	89	8,708	2,759	886	210	486	169	131	12,906	27,512
1976	437	141	184	7,386	10,267	768	1,806	130	2,510	8,214	4,453	16,198	52,494
1977	2,566	6,099	484	1,307	289	9,534	260	150	305	706	926	222	22,848
1978	1,352	2,933	173	872	199	3,495	49	24	46,926	416	502	225	57,166
1979	12,266	5,811	560	3,866	30,934	6,563	2,337	287	20,043	655	267	236	83,825
1980	7,771	1,117	281	202	18,869	277	21	7	378	474	74	52	29,523
1981	131	79	85	89	3,580	44,315	1,895	171	145	1,227	4,169	171	56,057
1982	134	4,697	651	641	29,449	426	67	0	54	1,159	17,318	1,462	56,058
1983	635	6,516	4,036	293	212	57	13,388	1,097	1,471	9,877	3,127	281	40,990
1984	3,312	1,094	254	142	264	50	8	38	67	2,137	669	570	8,605
1985	3,239	1,493	12,455	16,981	810	665	1,878	129	96	386	343	389	38,864
1986	261	117	91	89	624	4,981	62	0	63	1,101	462	9,682	17,533
1987	2,960	5,707	1,076	136	684	43,543	1,180	164	283	153	4,533	1,422	61,841
1988	368	163	150	201	164	9	19	0	0	16	14	32	1,136
1989	1,224	492	40	33	3	0	14	0	0	2	1	2	1,811
1990	2	8	450	986	89	0	7,660	189	279	17	12	4	9,696
1991	4,212	3,674	920	39,124	515	156	2,601	190	1,021	246	335	11,840	64,834
1992	13,550	32,076	1,047	21,892	17,806	5,390	261	135	160	63	660	388	93,428
1993	2,195	3,819	9,863	2,013	24,746	40,565	670	86	69	92	130	109	84,357
1994	187	155	3,303	220	9,332	440	58	161	1,788	42,716	414	2,012	60,786
1995	3,403	163	3,501	412	376	726	48	70	166	29	434	896	10,224
1996	139	47	32	18	2	2,151	83	897	5,193	99	46	71	8,778

AVG	2,142	2,600	1,523	3,227	5,794	5,073	1,624	460	2,796	3,019	1,894	1,954	32,107
MAX	13,550	32,076	12,455	39,124	30,934	44,315	22,352	4,913	46,926	42,716	22,913	16,198	93,428
MIN	2	8	32	17	2	0	0	0	0	2	0	2	1,136

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1200-B
GACITAS CREEK NEAR INEZ [BBEST]

46-56
9,428

units are acre-feet

GS300

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	718	38	2	229	69	8,673	333	79	1,386	20,818	7,968	40,313
1941	4,108	2,566	3,367	8,044	14,620	15,706	7,973	1,170	291	798	1,148	568	60,359
1942	190	325	278	2,364	551	382	9,687	276	1,338	726	463	585	17,165
1943	554	382	1,188	153	760	1,026	5	110	176	859	829	1,315	7,357
1944	3,247	968	5,613	449	6,636	844	0	142	1,260	844	559	708	21,270
1945	774	696	465	2,495	149	902	0	135	9	887	13	473	6,998
1946	572	1,109	1,243	358	1,038	3,362	922	4,751	7,818	8,852	4,120	1,071	35,214
1947	3,355	580	1,170	898	3,326	503	0	49	46	799	170	548	11,445
1948	405	719	817	54	4,244	492	0	0	60	759	24	363	7,937
1949	230	699	361	3,862	1,234	557	13	321	167	2,571	186	1,167	11,370
1950	683	651	0	436	379	953	0	0	0	721	0	329	4,152
1951	66	234	51	38	43	2,606	0	0	460	450	29	349	4,325
1952	37	352	80	1,483	2,075	204	0	21	30	653	813	2,085	7,833
1953	199	363	11	160	4,171	170	0	1,353	626	781	19	364	8,217
1954	75	207	0	462	505	123	0	0	20	342	0	261	1,995
1955	83	1,984	4	105	4,396	931	0	814	216	719	0	290	9,542
1956	35	235	0	0	72	88	0	0	0	712	0	541	1,683
1957	59	661	2,949	6,397	3,854	2,501	0	0	654	1,867	7,601	709	27,253
1958	2,319	6,885	704	85	1,450	32	0	2	356	1,809	373	672	14,688
1959	31	4,682	282	5,514	2,534	873	0	221	424	1,436	1,489	586	18,074
1960	540	1,201	132	443	368	2,406	2,743	4,205	239	11,075	5,378	2,744	31,473
1961	4,913	6,657	682	343	403	1,330	5,212	363	11,302	1,562	7,193	744	40,703
1962	350	419	243	2,434	615	799	86	10	534	622	165	639	6,918
1963	563	680	85	4	108	236	742	1	1	721	73	505	3,718
1964	23	293	484	371	171	930	0	64	807	518	2	352	4,015
1965	1,823	6,092	133	105	7,729	5,151	0	79	20	736	3,131	789	25,788
1966	550	1,565	595	2,013	4,419	885	230	166	105	741	1	397	11,668
1967	135	254	51	369	247	168	0	59	3,795	5,251	489	428	11,247
1968	4,613	951	694	1,056	1,873	14,916	2,323	222	600	895	190	924	29,256
1969	228	4,963	3,048	3,150	11,807	658	0	109	215	947	298	352	25,776
1970	1,312	447	2,261	289	7,545	3,431	13	0	1,055	879	8	0	17,239
1971	0	0	0	0	0	1,322	222	285	11,490	9,293	538	651	23,801
1972	3,770	1,138	0	0	1,929	60	1,153	2,239	79	72	121	0	10,560
1973	417	2,062	1,187	2,926	286	19,036	101	116	950	10,079	297	0	37,458
1974	1,050	44	2	0	4,232	3,939	139	150	2,889	122	3,615	1,178	17,360
1975	522	0	0	0	2,223	845	537	76	390	73	30	3,471	8,167
1976	210	0	35	3,505	7,866	553	1,576	69	722	7,393	4,334	13,845	40,109
1977	2,320	5,877	67	940	10	457	137	37	245	232	866	38	11,227
1978	635	2,216	0	647	0	1,762	2	0	17,797	223	442	0	23,726
1979	9,818	5,436	251	2,789	20,950	6,176	2,056	165	17,520	532	148	39	65,880
1980	5,440	887	1	0	6,954	0	0	0	326	413	19	0	14,039
1981	39	0	1	8	2,246	30,941	1,552	19	1	80	2,524	0	37,410
1982	0	2,500	329	368	12,036	147	7	0	3	655	15,219	613	31,877
1983	332	4,372	2,133	21	22	0	4,331	974	941	7,762	3,008	11	23,907
1984	915	706	0	0	109	0	0	1	18	1,245	609	194	3,799
1985	2,056	1,155	5,473	6,475	27	409	1,609	48	54	278	224	92	17,901
1986	0	0	0	0	462	3,261	0	0	14	1,008	359	1,972	7,077
1987	2,714	5,500	706	0	473	12,448	831	39	209	57	2,025	594	25,597
1988	47	0	1	67	60	0	3	0	0	6	0	3	186
1989	350	234	0	0	0	0	0	0	0	0	0	0	583
1990	0	1	410	905	50	0	7,430	119	225	0	1	0	9,140
1991	1,944	3,573	740	25,011	261	67	2,320	77	903	163	258	9,426	44,741
1992	13,427	23,093	652	15,645	17,376	4,973	73	34	54	0	555	174	76,057
1993	1,381	1,697	1,507	1,616	2,365	40,154	353	0	3	13	39	19	49,146
1994	75	44	1,608	32	3,988	281	14	79	1,315	33,332	295	1,291	42,355
1995	1,411	3	1,826	193	236	538	0	3	100	0	345	761	5,415
1996	41	0	0	0	0	1,025	29	728	4,250	26	1	14	6,115

AVG	1,421	1,914	771	1,844	3,012	3,362	1,107	355	1,635	2,193	1,605	1,109	20,327
MAX	13,427	23,093	5,613	25,011	20,950	40,154	9,687	4,751	17,797	33,332	20,818	13,845	76,057
MIN	0	0	0	0	0	0	0	0	0	0	0	0	186

UNAPPROPRIATED FLOWS (AC-FT) AT CONTROL POINT GS1200-B
GACITAS CREEK NEAR INEZ [BBEST-NHFP]

46-56
13,135

of months in drought
total depletion in drought

144 months
163,845 13,654 annualized

12.0 years

MAX DURING DROUGHT

11,028

units are acre-feet

GS300

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1940	0	1,197	38	2	229	815	22,291	333	79	1,798	22,794	10,491	60,066
1941	4,108	2,566	8,820	8,044	23,465	15,706	8,120	1,170	291	1,397	1,339	568	75,593
1942	190	325	278	5,901	551	382	9,854	276	1,750	1,126	463	585	21,681
1943	554	382	1,188	153	760	1,026	21	248	176	859	829	2,206	8,403
1944	4,837	1,215	8,558	449	6,636	844	0	209	1,260	844	559	1,164	26,575
1945	2,534	696	465	3,703	149	902	0	175	9	887	13	473	10,007
1946	572	3,103	1,243	358	1,038	6,278	1,079	4,751	10,538	8,852	4,120	1,071	43,003
1947	4,312	580	1,170	898	4,810	503	0	49	46	799	170	548	13,885
1948	405	1,223	817	54	10,023	521	0	0	60	759	24	363	14,249
1949	230	1,187	361	6,846	1,234	557	13	480	167	2,986	186	2,935	17,182
1950	683	651	0	436	379	953	0	0	0	721	0	329	4,152
1951	66	234	51	38	43	2,606	0	0	872	863	29	349	5,150
1952	37	352	80	1,483	11,028	1,653	0	41	30	653	1,821	2,573	19,751
1953	199	363	11	160	5,655	170	0	1,524	626	781	19	364	9,872
1954	75	207	0	462	505	123	0	0	20	705	0	261	2,358
1955	83	3,983	4	105	5,888	931	0	977	216	719	0	290	13,196
1956	35	235	0	0	72	88	0	0	0	712	0	541	1,683
1957	59	661	2,949	9,381	3,854	2,501	0	0	1,063	11,953	7,601	709	40,731
1958	4,543	6,885	704	85	2,922	32	0	2	2,511	2,051	373	882	20,991
1959	285	6,947	282	8,445	2,534	873	0	345	424	2,263	1,489	1,054	24,941
1960	1,015	1,201	132	443	368	8,474	2,890	4,205	239	22,094	5,378	3,701	50,137
1961	6,616	6,657	682	343	403	10,486	5,520	363	13,706	1,562	7,193	744	54,273
1962	350	419	243	3,918	615	1,823	106	10	950	1,039	165	639	10,278
1963	563	2,012	85	4	108	236	905	1	1	721	73	505	5,212
1964	237	578	484	371	171	2,402	0	84	1,223	933	2	352	6,836
1965	4,313	6,092	133	105	13,504	5,151	0	79	20	1,147	5,333	1,710	37,587
1966	550	1,565	595	3,485	5,892	885	270	166	105	741	1	397	14,652
1967	135	254	51	369	247	168	0	83	12,517	5,689	489	428	20,430
1968	7,140	951	694	1,056	11,258	14,916	2,470	222	600	895	190	1,412	41,803
1969	659	6,716	4,521	8,938	11,807	658	0	109	215	1,359	298	2,012	37,292
1970	1,808	447	2,261	289	10,505	3,431	25	0	2,641	879	8	0	22,294
1971	0	0	0	0	0	1,322	263	429	13,894	9,293	538	2,758	28,497
1972	3,770	1,138	0	0	17,571	60	1,308	2,239	79	72	121	0	26,358
1973	417	3,054	1,187	12,335	306	20,520	117	132	3,088	10,079	297	0	51,534
1974	1,529	44	2	0	8,590	5,412	139	190	5,091	122	3,615	1,656	26,389
1975	522	0	0	0	8,374	2,415	702	76	390	73	30	12,776	25,357
1976	210	0	35	7,163	10,021	553	1,745	69	2,408	8,091	4,334	15,952	50,581
1977	2,320	5,877	67	940	10	9,218	137	37	245	645	866	38	20,400
1978	1,131	2,713	0	647	0	3,193	2	0	46,868	355	442	0	55,351
1979	11,836	5,436	251	3,529	30,526	6,176	2,214	165	19,924	532	148	39	80,776
1980	7,546	887	1	0	18,551	19	0	0	326	413	19	0	27,762
1981	39	0	1	8	3,501	44,196	1,711	19	1	1,081	3,902	0	54,460
1982	0	4,507	329	368	29,053	147	7	0	3	1,059	17,211	1,067	53,753
1983	332	6,130	3,606	21	22	0	13,294	974	1,353	9,754	3,008	11	38,505
1984	2,951	706	0	0	109	0	0	1	18	2,076	609	398	6,869
1985	2,809	1,155	12,029	16,564	447	409	1,764	48	54	278	224	92	35,874
1986	0	0	0	0	462	4,745	0	0	14	1,008	359	9,481	16,070
1987	2,714	5,500	706	0	473	43,126	996	39	209	57	4,429	1,045	59,294
1988	47	0	1	67	60	0	3	0	0	6	0	3	186
1989	1,159	421	0	0	0	0	0	0	0	0	0	0	1,580
1990	0	1	410	905	50	0	7,597	119	225	0	1	0	9,307
1991	4,117	3,573	740	38,753	261	67	2,478	77	903	163	258	11,767	63,155
1992	13,427	31,961	652	21,475	17,376	4,973	89	44	54	0	555	174	90,782
1993	1,860	3,455	9,490	1,632	24,316	40,154	500	0	3	13	39	19	81,480
1994	75	44	3,084	32	9,110	281	33	93	1,723	42,620	295	1,787	59,179
1995	3,158	3	3,278	193	236	538	0	3	100	0	345	761	8,615
1996	41	0	0	0	0	2,111	43	861	5,074	26	1	14	8,172

AVG	1,916	2,395	1,277	2,999	5,545	4,837	1,556	377	2,709	2,923	1,800	1,745	30,080
MAX	13,427	31,961	12,029	38,753	30,526	44,196	22,291	4,751	46,868	42,620	22,794	15,952	90,782
MIN	0	0	0	0	0	0	0	0	0	0	0	0	186

Appendix 5

Colorado/Lavaca BBEST/BBASC Lavaca Project Analysis

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

**COLORADO/LAVACA
BBEST/BBASC
LAVACA PROJECT ANALYSIS**

4/20/2010

Kirk Kennedy

OVERVIEW

- TCEQ LAVACA RUN3 WAM USED AS BASE MODEL WITH FOLLOWING MODIFICATIONS
 - TEXANA STAGE II REMOVED FROM MODEL
 - CONTROL POINT FOR PROPOSED PROJECT INSERTED
- WAM PERIOD OF RECORD: 1940-1996
- WAM FLOWS FOR PROJECT LOCATION EXTRACTED FROM BASELINE MODEL
- MONTHLY WAM FLOWS DISTRIBUTED TO DAILY FLOWS USING GAGED DAILY FLOW
- RESULTING DAILY FLOWS INPUT INTO DAILY PROCESS (FRAT)
- FIRM YIELD OF PROJECT DETERMINED FOR 4 SCENARIOS
 - 1- No Environmental Requirements
 - 2- TCEQ Modified Lyons Instream Flow Requirements
 - 3- TWDB Consensus Planning Instream Flow Criteria
 - 4-CL BBEST Recommendations for Lavaca near Edna Location
- DAILY RESULTS USED TO PRODUCE PLOTS FOR BBASC AND AFTER PROJECT FLOWS FOR BBEST
- DEPLETIONS FROM DAILY PROCESS PLACED BACK IN WAM

INPUTS FOR STUDY

- CL BBEST Recommendations for Edna Location
- Hydrologic Condition
- Daily Pattern of Flow
- Project Configuration (FNI Study)
 - Area / Capacity Relationship
 - Pump Rate
- WAM Model (TCEQ)
 - Total Flow
 - Flow Required for Downstream Seniors
 - Evaporation Rate

FLOWS PLOTTED

- NATURAL
- CURRENT
- BASELINE (before project diverts)
 - TCEQ RUN3 with noted changes
- PROJECT (after project diverts)
 - BASELINE with Lavaca Off-Channel Reservoir diverting water subject to no or various instream flow requirements.
- HISTORICAL
- FLOW PROTECTED BY FLOW REGIME

NATURAL

Input Flow Associated with all WAM Models

- No Surface Water Rights Exercised
- No Return Flows Entering the Water Courses
- For Comparison Purposes Only

CURRENT

TCEQ RUN8

- Approximation of Current Demands for All Water Rights of Record
- Return Flows Reflecting Current Use Levels
- Major Reservoirs Represented with Current Sedimentation Conditions
- For Comparison Purposes Only

BASELINE

TCEQ RUN3, with noted changes

- Full Authorized Demands for All Water Rights of Record
- No Assumed Return Flows
- Major Reservoirs Represented with Authorized Capacities
- Output of this model used as Input to all Project Scenarios

PROJECT

BASELINE model used for Hydrology Inputs.

- Off-Channel reservoir project diverting water (by pump) from the Lavaca River
- Represented as most Junior Right in Basin
- General Magnitude of Off-Channel Reservoir Project
 - Capacity = 25,000 acre-feet conservation capacity
 - Area = 1,030 acres
 - Pump Rate from Lavaca = 200 MGD (309.44 cfs)

HISTORICAL

USGS Observed Flow

- Lavaca River near Edna
- Same Information Used by BBEST in HEFR Analysis

FLOW PROTECTED BY FLOW REGIME

Flow Reserved by Flow Recommendation

Considers:

- Applicable Hydrologic Condition
- All Tiers of Flow Recommendation
- Has been called “Infinite Infrastructure” line

HYDROLOGIC CONDITION

AS SUGGESTED IN BBEST REPORT, BASED ON LAKE TEXANA SIMULATED STORAGE IN
BASELINE WAM

BBEST DIRECTION

Percent of time condition expected to be applied

Subsistence	5
Dry	25
Average	50
Wet	25

RESULT USING BASELINE WAM

Percent of time conditions actually applied in BBEST scenario

Subsistence	5.3
Dry	20.7
Average	45.5
Wet	30.5

ONLY APPLIES TO BBEST SCENARIO

CORRESPONDING TRIGGERS

SUBSISTENCE

- BELOW 93,298 af (54% CAPACITY)

DRY

- BETWEEN 93,298 af (54%) AND 132,460 af (77%)

AVERAGE

- BETWEEN 132,460 af (77%) AND 170,300 af (FULL)

WET

- TEXANA FULL (170,300)

FRAT (FLOW REGIME ANALYSIS TOOL)

- DEVELOPED BY HDR AND REFINED BY TPWD (DAN OPDYKE)
- COMPLEX EXCEL SPREADSHEET
- INPUTS
 - DAILY FLOWS
 - HYDROLOGIC CONDITION
 - FLOW RECOMMENDATIONS
 - Specifically Designed to Test SB3 Type Recommendations
 - PROJECT CONFIGURATION, IF APPLICABLE
- OUTPUTS
 - DAILY REPRESENTATION OF PROJECT, IF APPLICABLE
 - DAILY FLOWS AFTER PROJECT
 - NUMEROUS CHARTS
 - FLOW FREQUENCY CURVES
 - TIME SERIES PLOTS
 - FLOW PROTECTED (RESERVED) BY FLOW RECOMMENDATIONS

PRODUCT OF ANALYSIS

- Firm Annual Yield of Project Subject to Various Environmental Flow Concepts.
- Daily Flows for Project Site for all Scenarios.
- Monthly Flows for Lavaca Bay for all Scenarios.
- Charts of Daily Flows for all Scenarios.
- All information made available (site to be determined).

FIRM YIELD RESULTS

- (1) No EFLOW Req: 15,875 af/y.
- (2) Lyons EFLOW Req: 9,775 af/y.
- (3) Consensus EFLOW Req: 9,610 af/y.
- (4) FULL BBEST EFLOW: 10,300 af/y.
- (5) BBEST EFLOW; no Pulse: 10,675 af/y.

ADDITIONAL NEEDS

- FLOW TO BAY FOR EACH PROJECT SCENARIO
- FREQUENCY OF EACH PROJECT SCENARIO MEETING CL BBEST RECOMMENDATIONS
- BBEST REVIEW OF AFTER PROJECT FLOWS FOR SELECTED SCENARIOS
- DISCUSSION OF HYDROLOGIC CONDITION USED AND IMPLEMENTATION ISSUES

FUTURE TOPICS

- ADDITIONAL IDEAS FROM BBASC ON SCENARIOS TO BE TESTED
- OTHER IDEAS OF MEANINGFUL OUTPUT
- OTHER BASELINE CONSIDERATIONS
- OTHER?

DESCRIPTION OF CHARTS

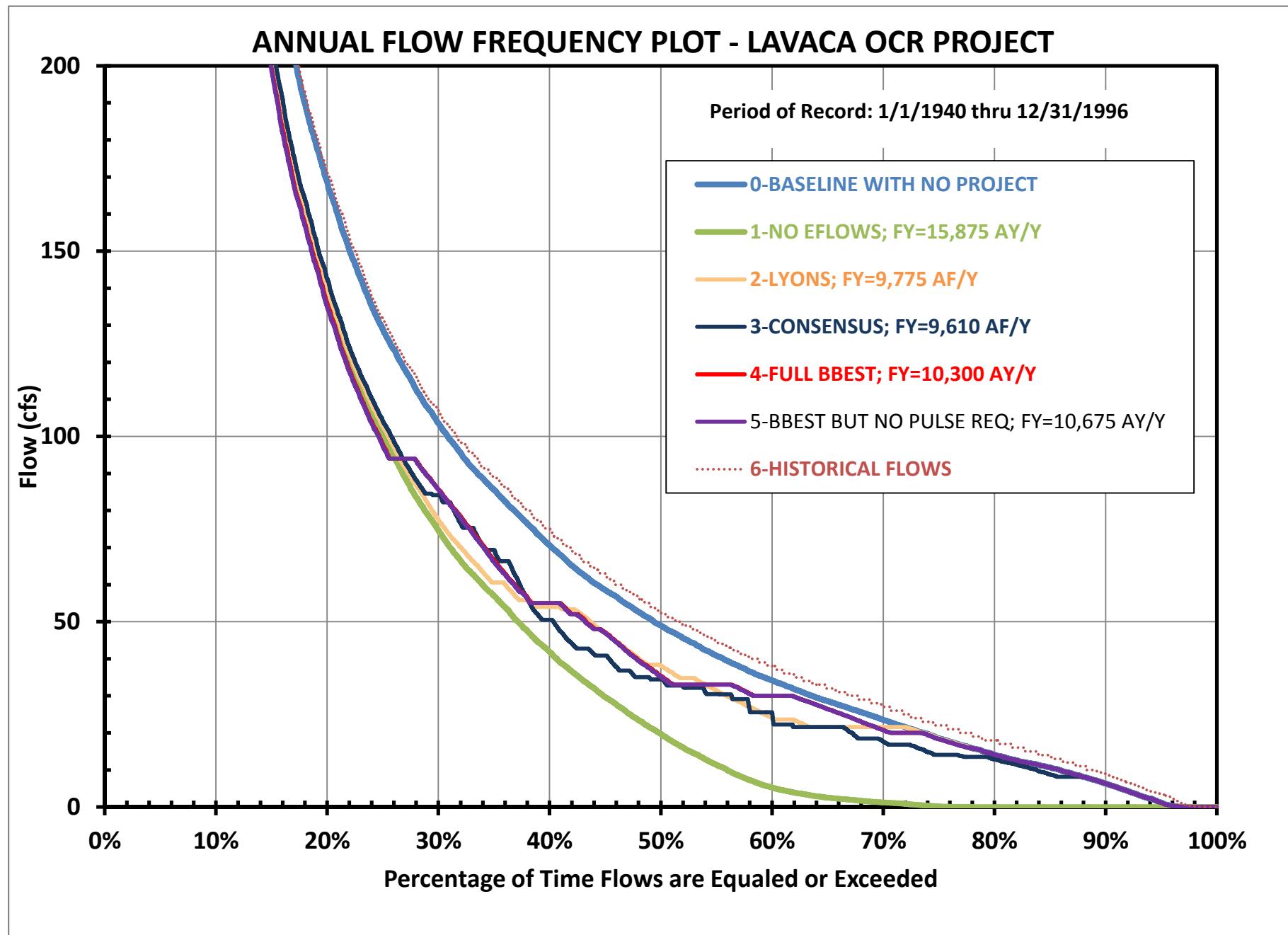
- DAILY TIME SERIES CHART FOR EXAMPLE DRY,
AVERAGE AND WET YEAR
- DAILY FLOW FREQUENCY CHARTS FOR PERIOD
OF RECORD
- DAILY FLOW FREQUENCY FOR EACH OF THE
FOUR SEASONS

Appendix 5a

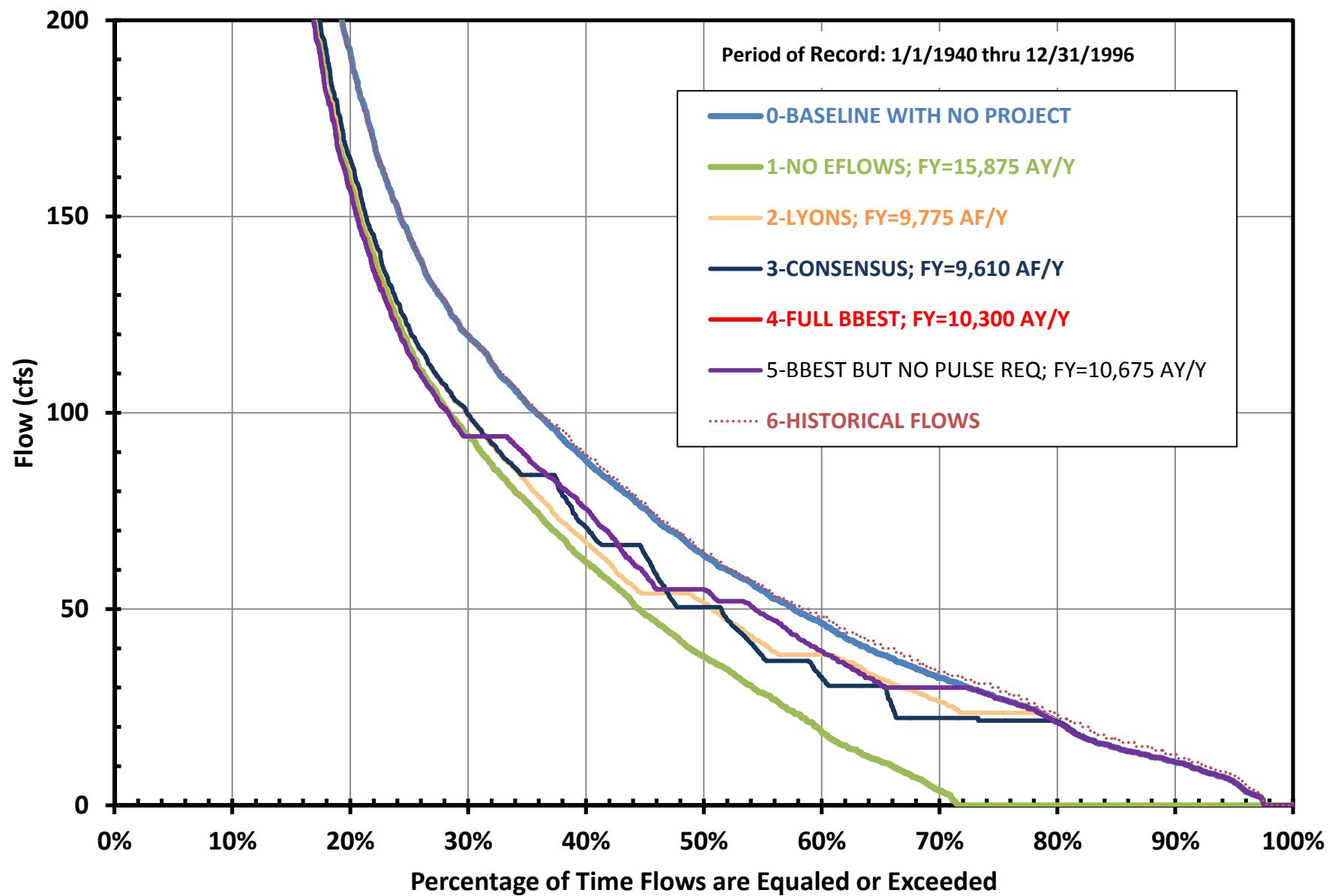
Flow Frequency Plots (5) - Lavaca OCR Project

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

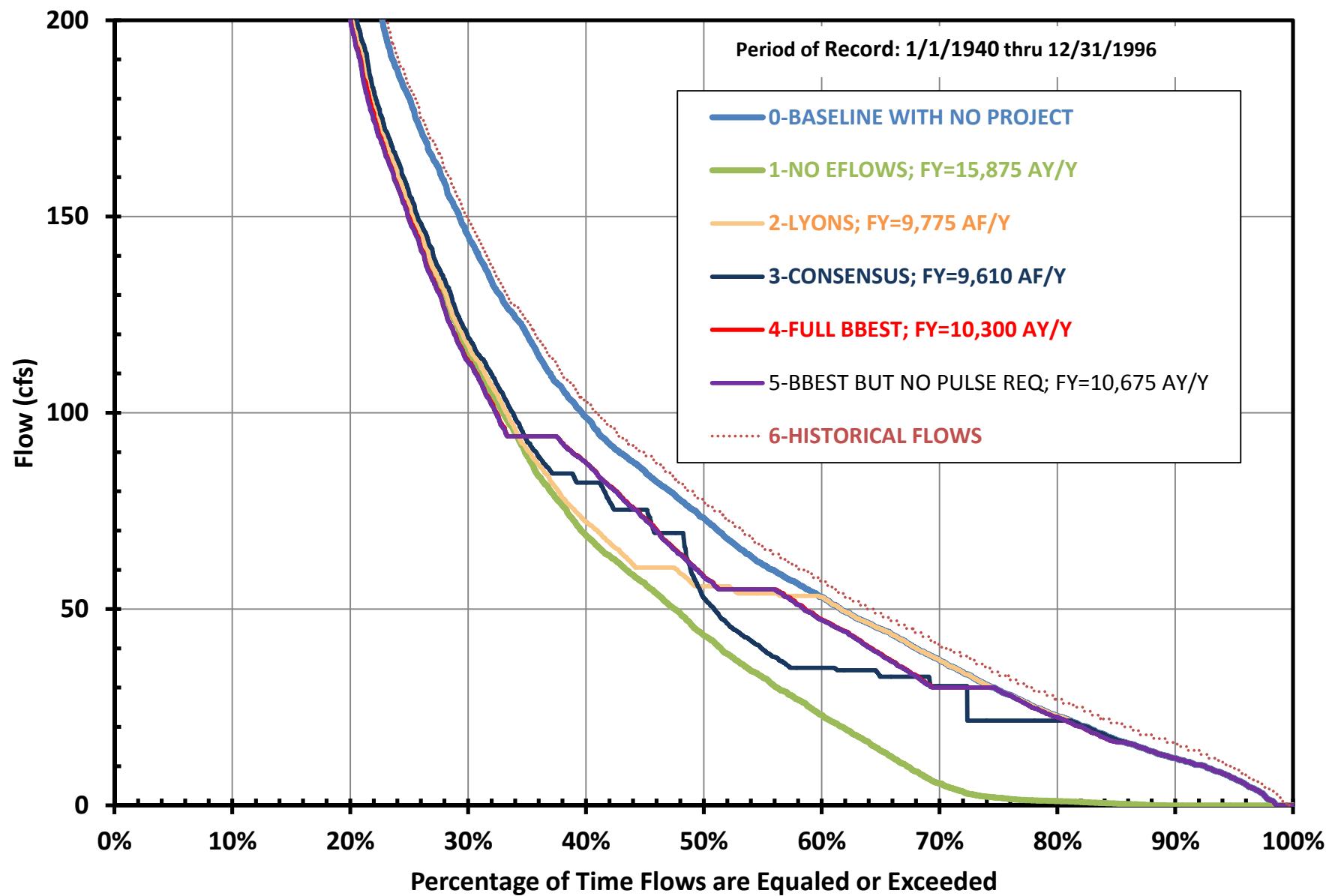
August 2011



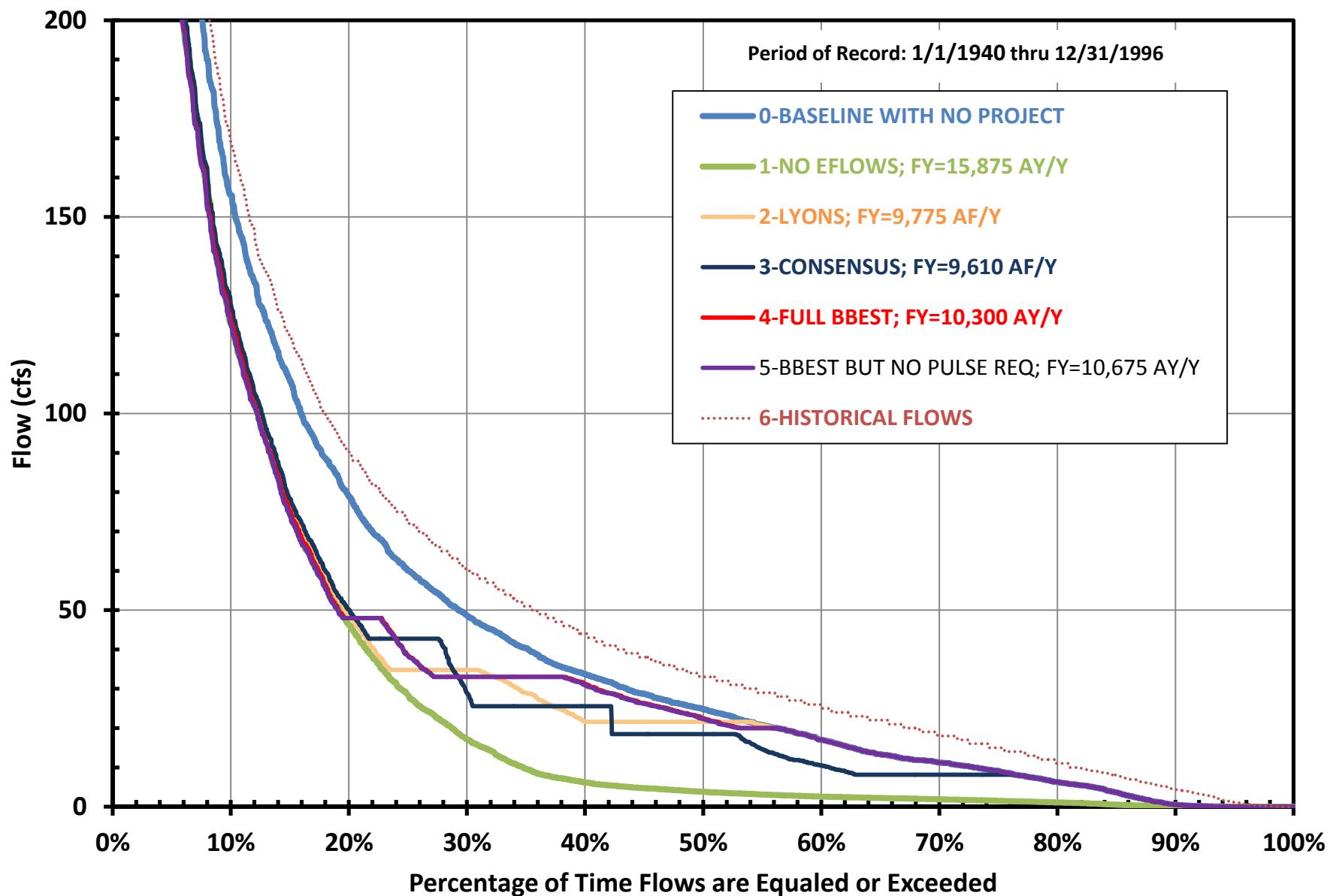
WINTER FLOW FREQUENCY PLOT - LAVACA OCR PROJECT



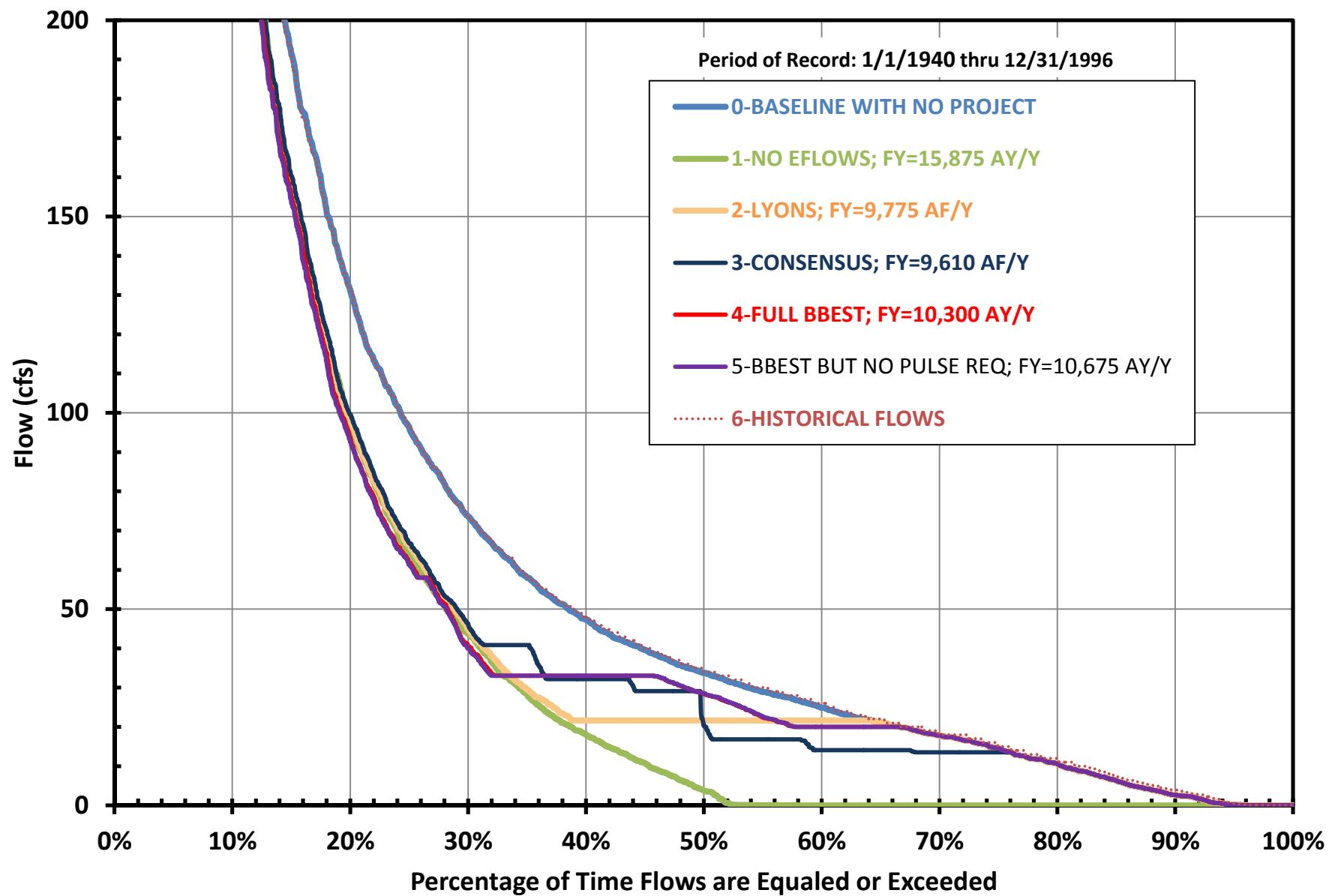
SPRING FLOW FREQUENCY PLOT - LAVACA OCR PROJECT



SUMMER FLOW FREQUENCY PLOT - LAVACA OCR PROJECT



FALL FLOW FREQUENCY PLOT - LAVACA OCR PROJECT



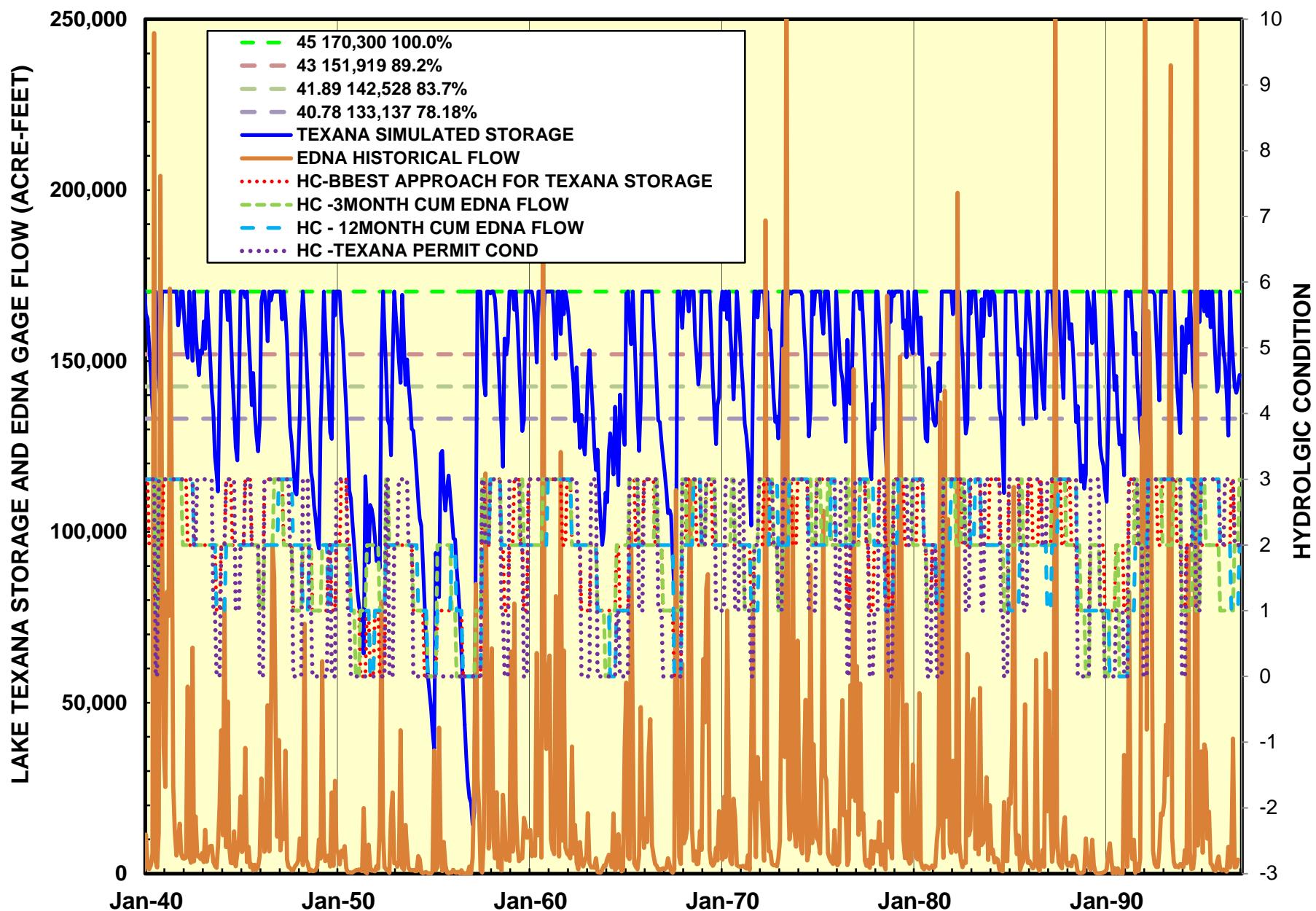
Appendix 6

Simulated Storage for Lake Texana, Gaged Edna Flow, and Various Techniques for Determining Hydrologic Conditions

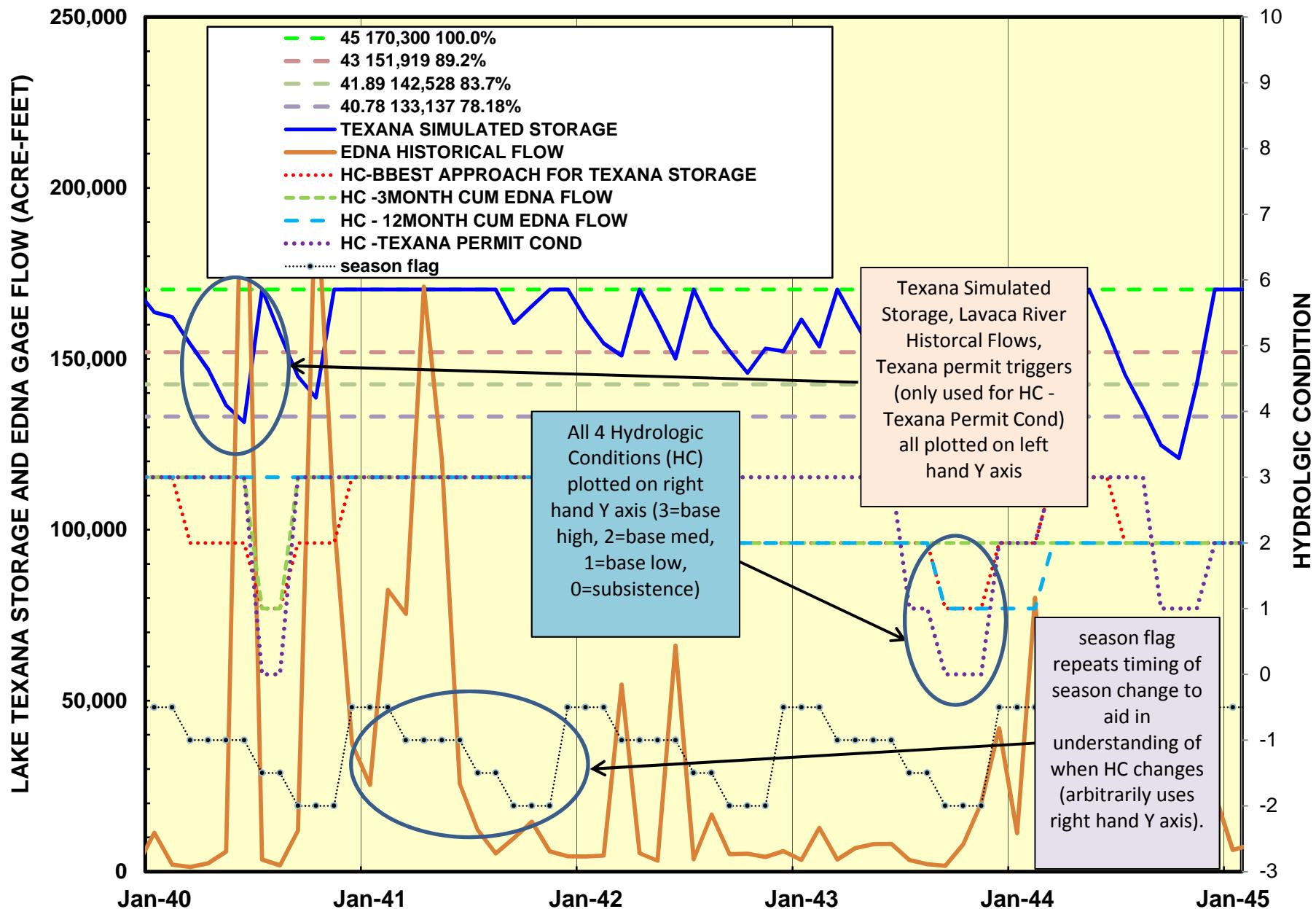
Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

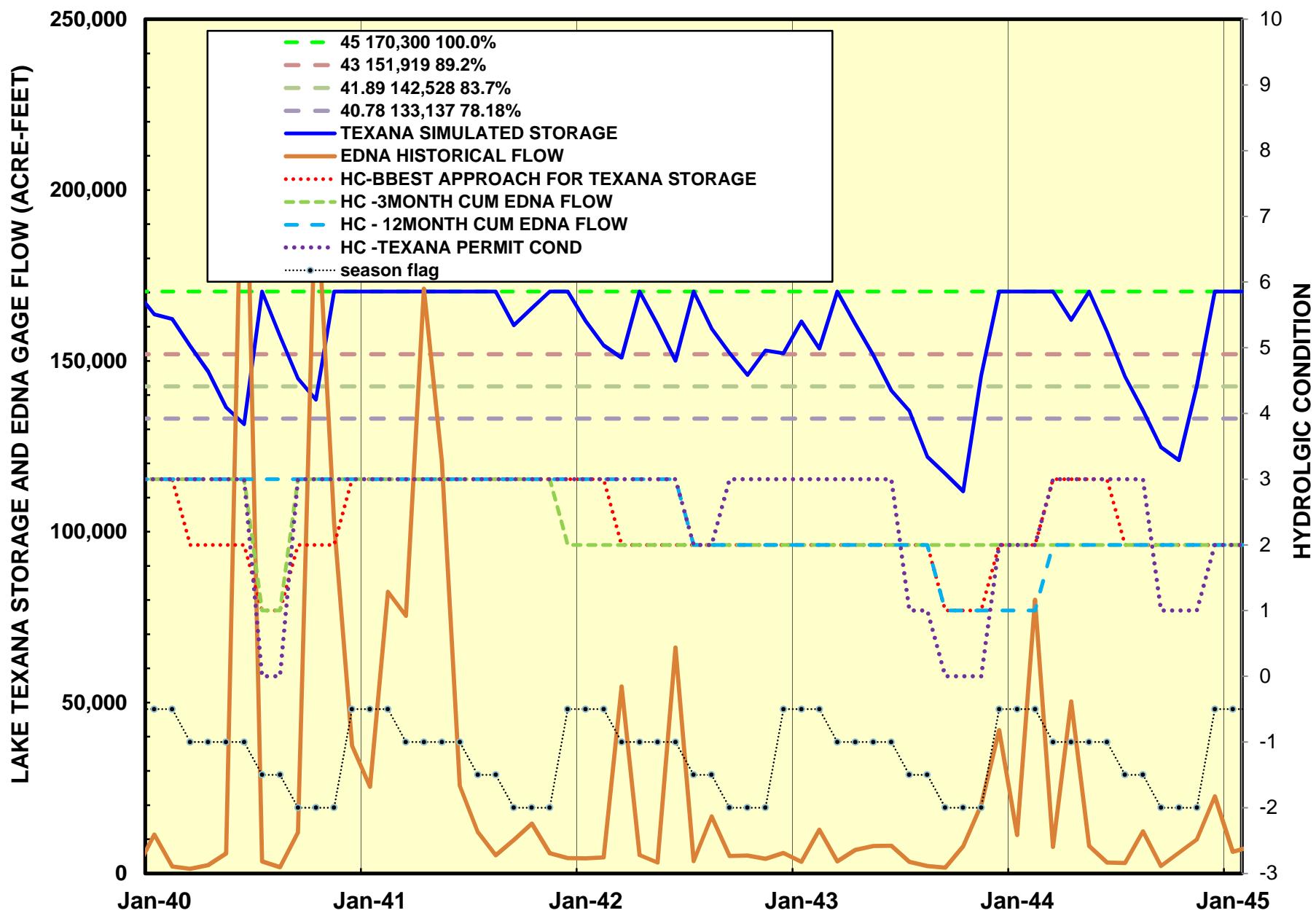
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



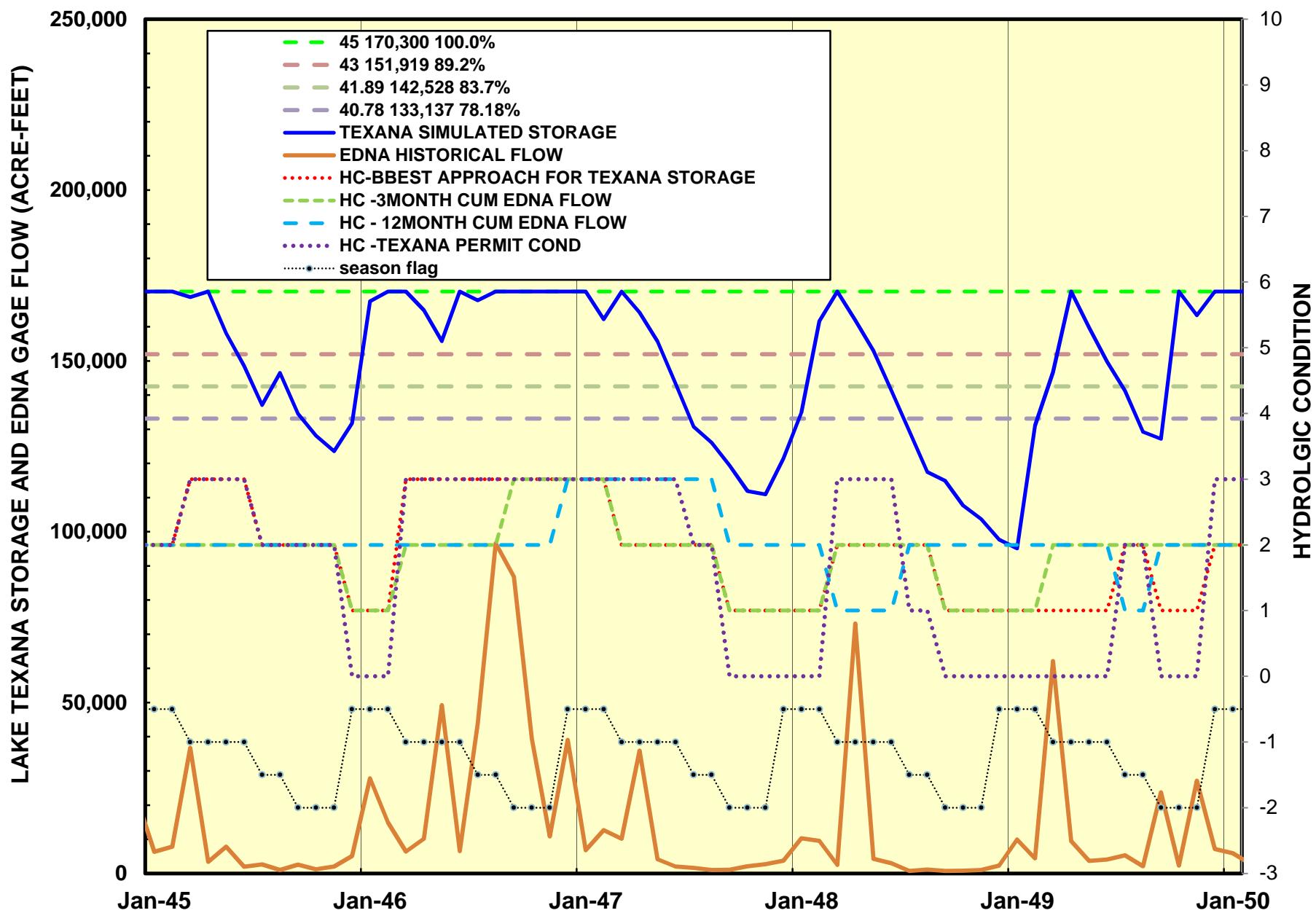
EXAMPLE OF HOW TO READ PLOTS



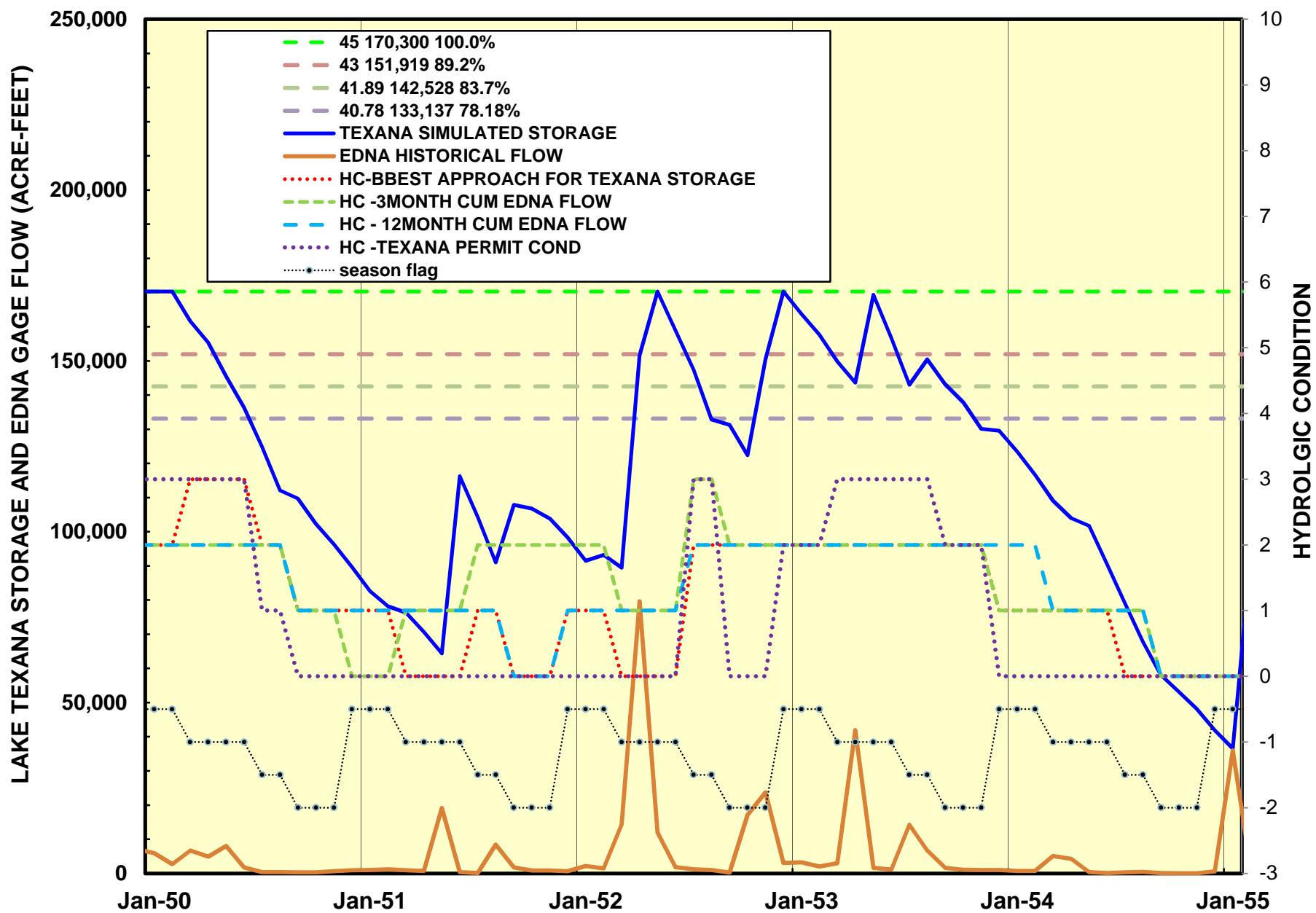
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



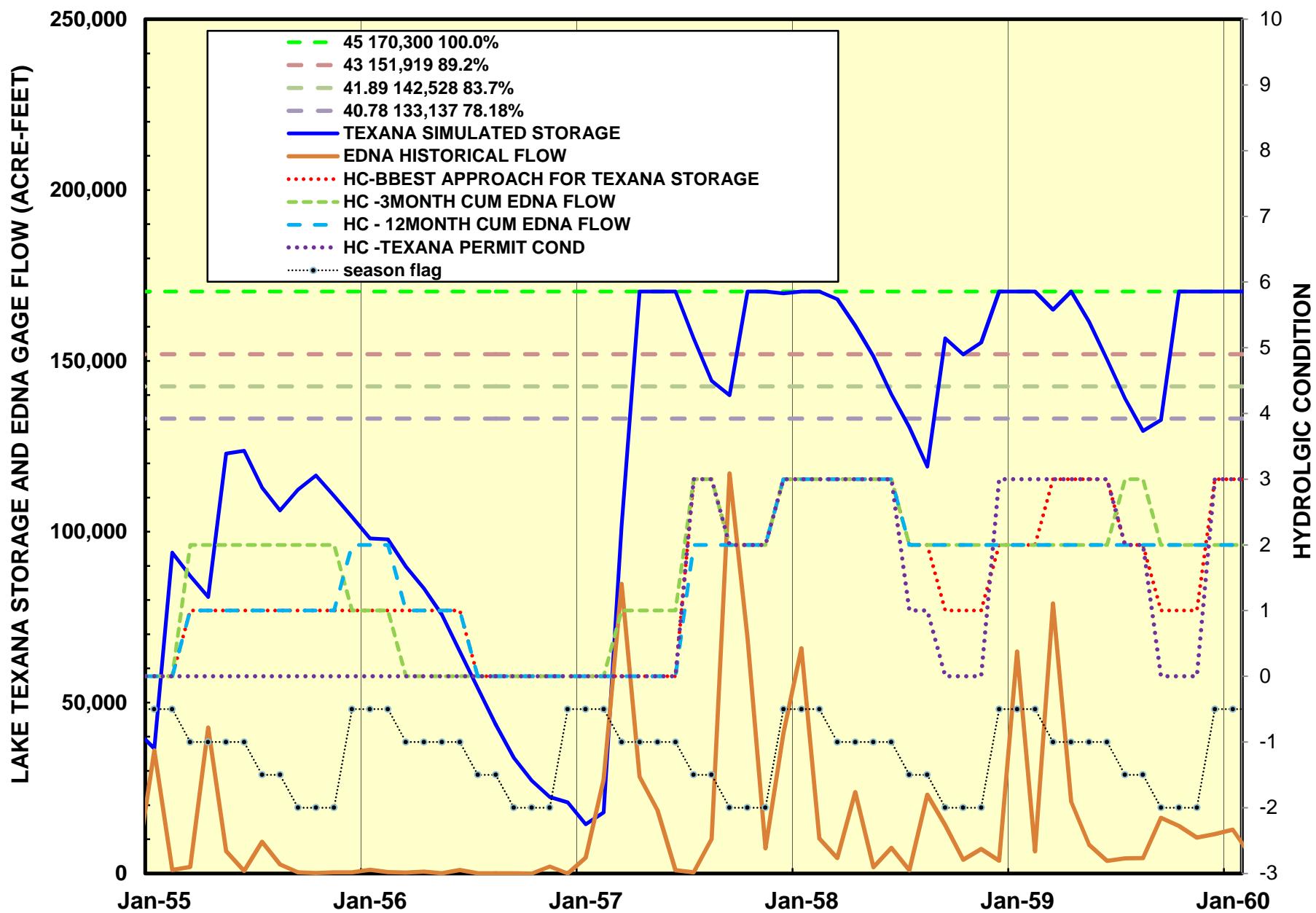
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



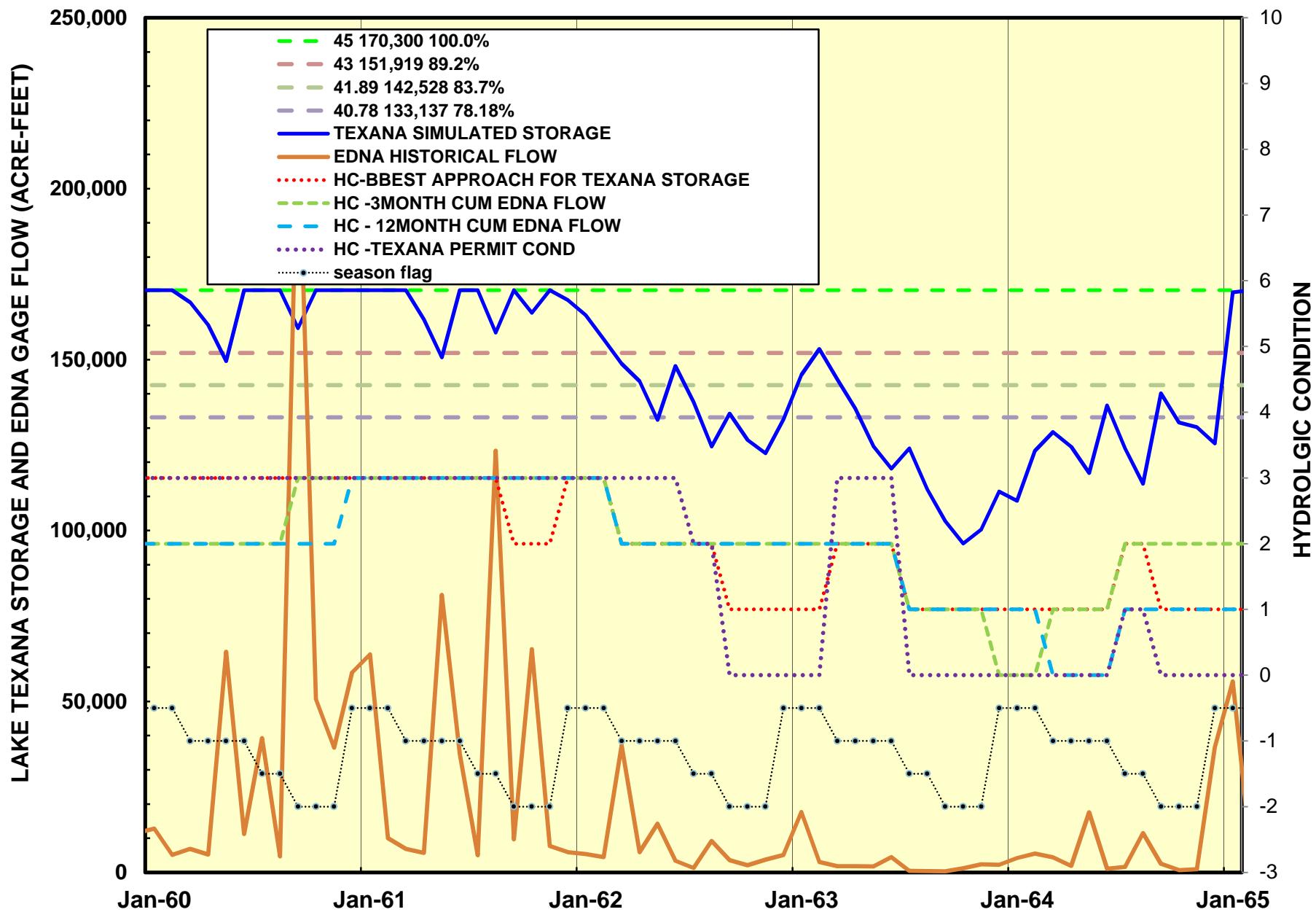
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



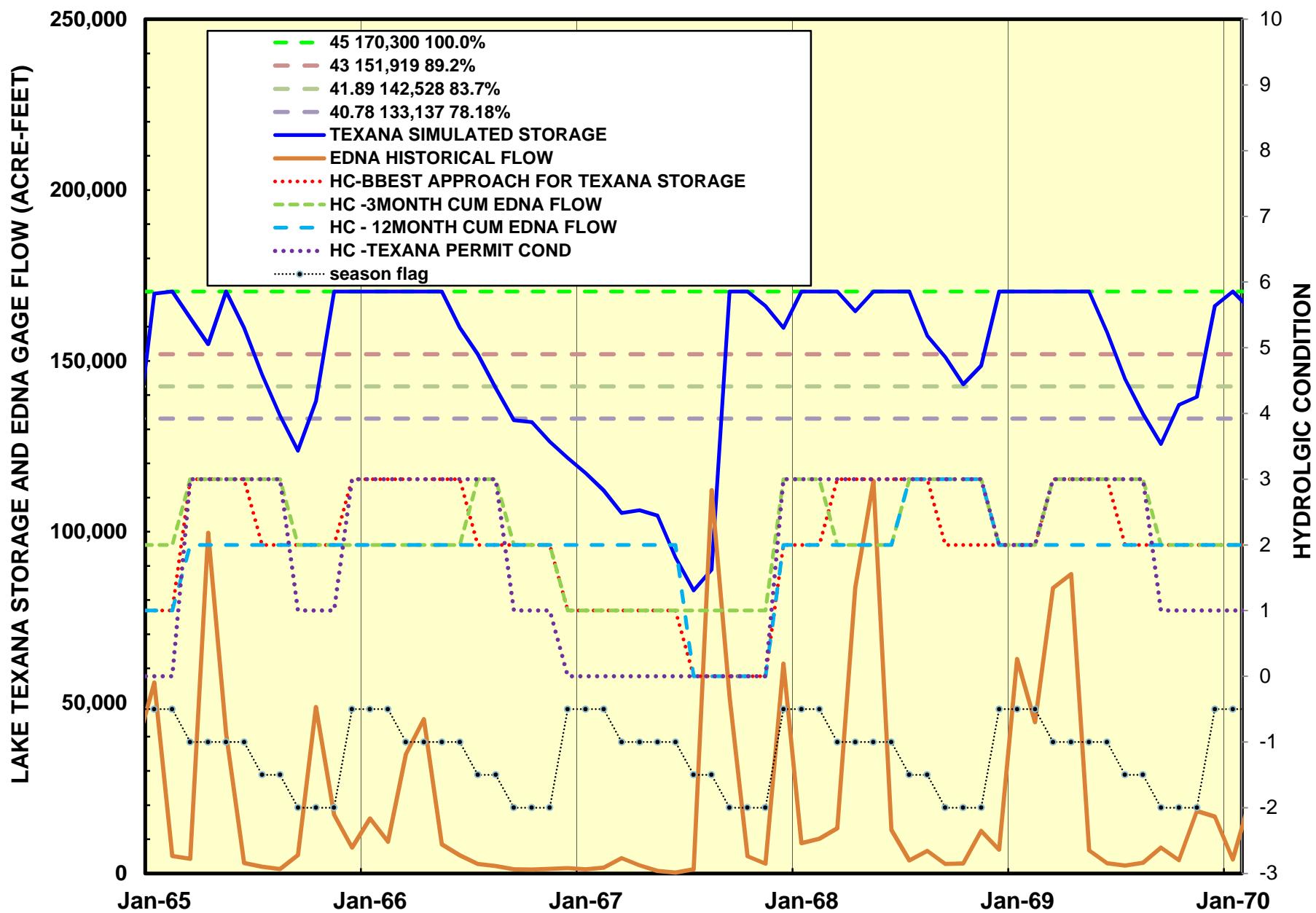
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



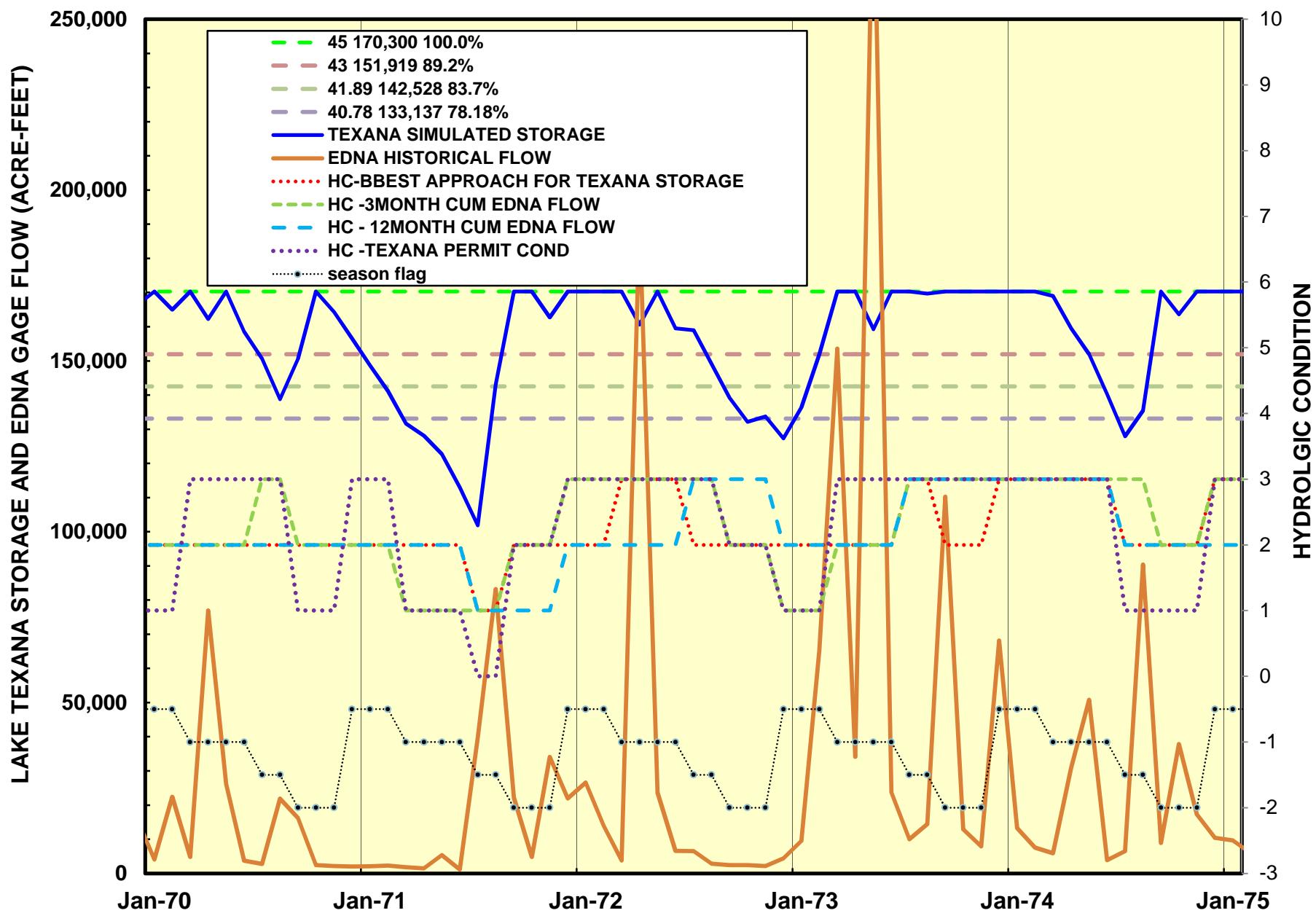
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



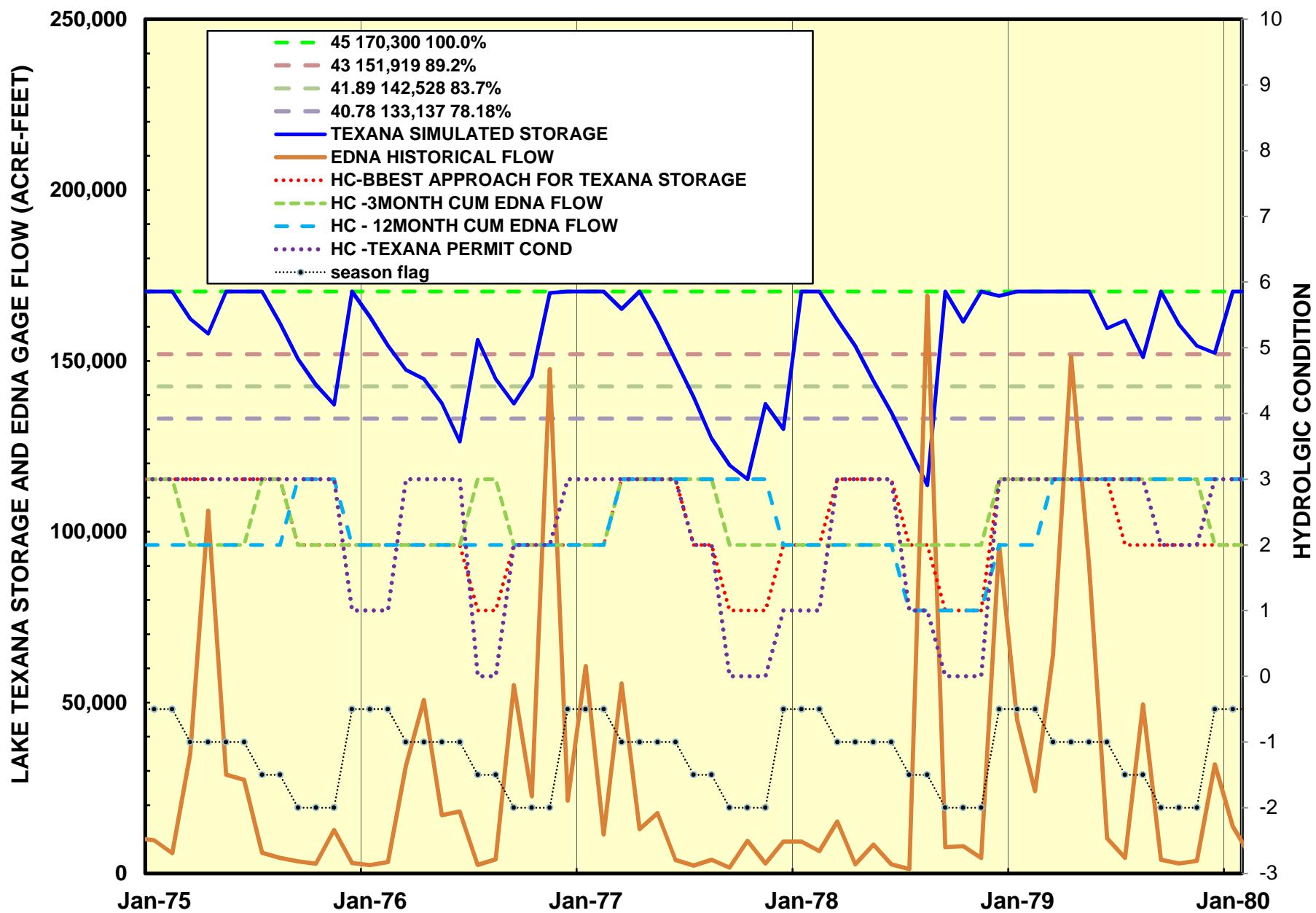
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



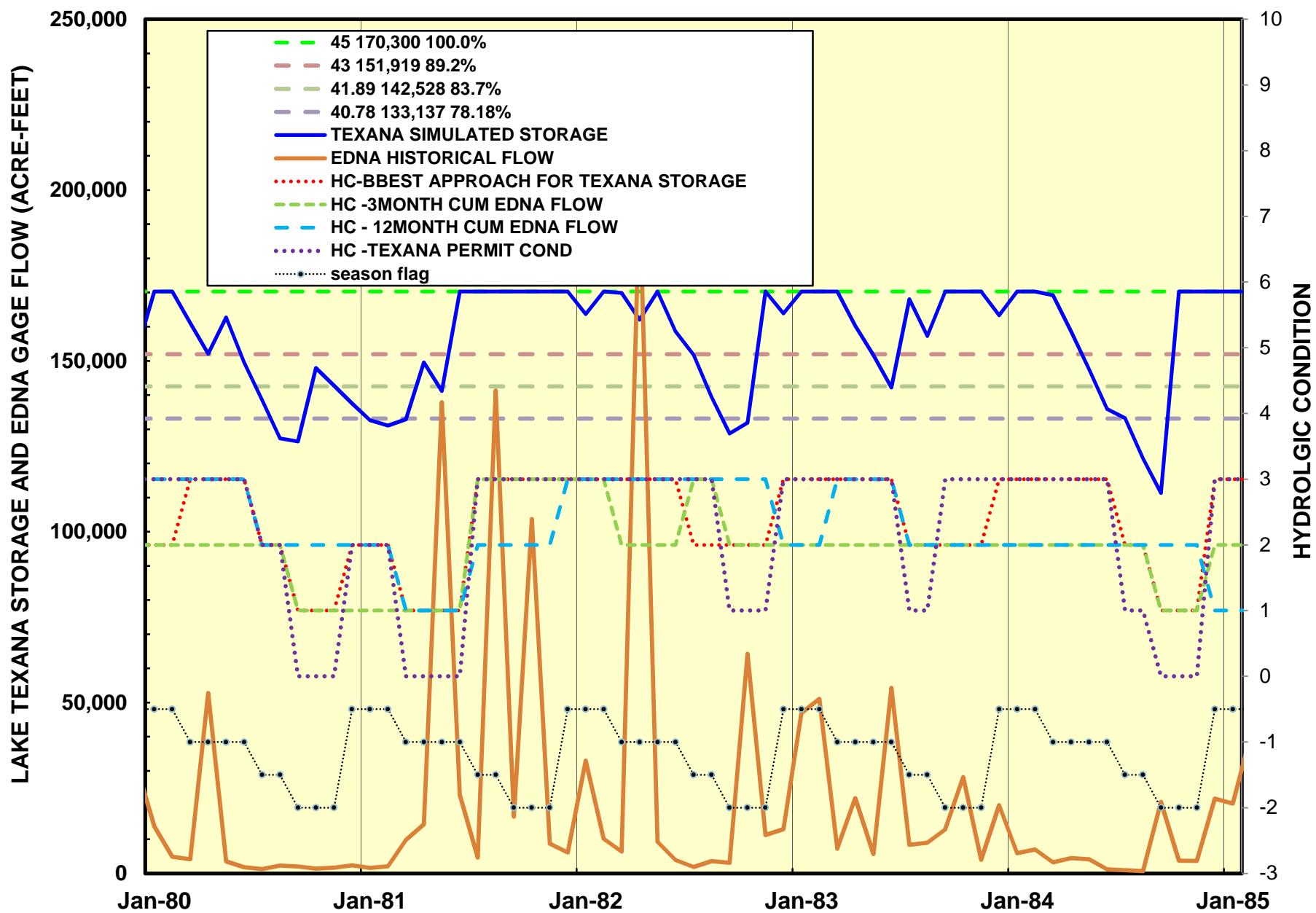
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



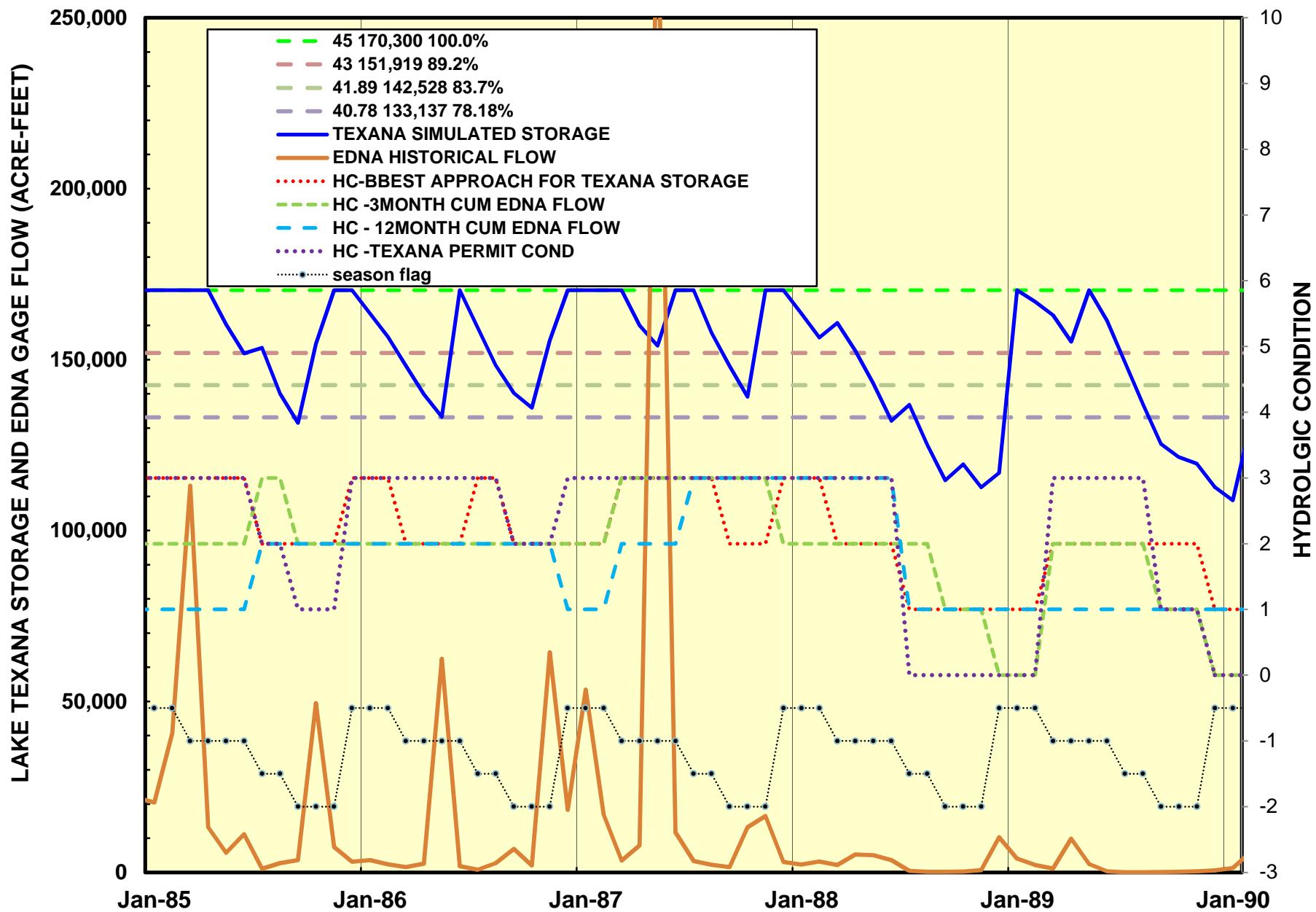
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



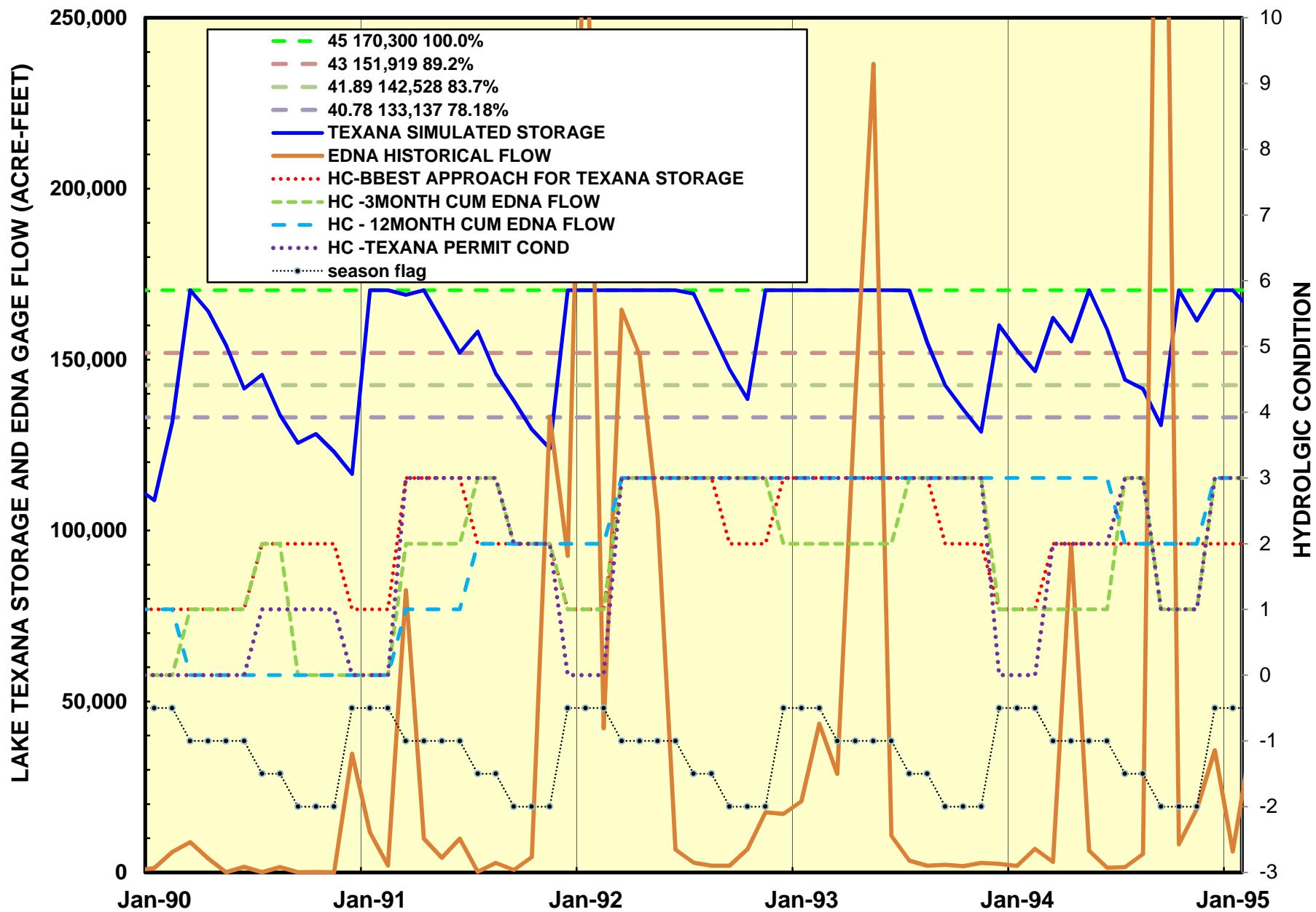
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



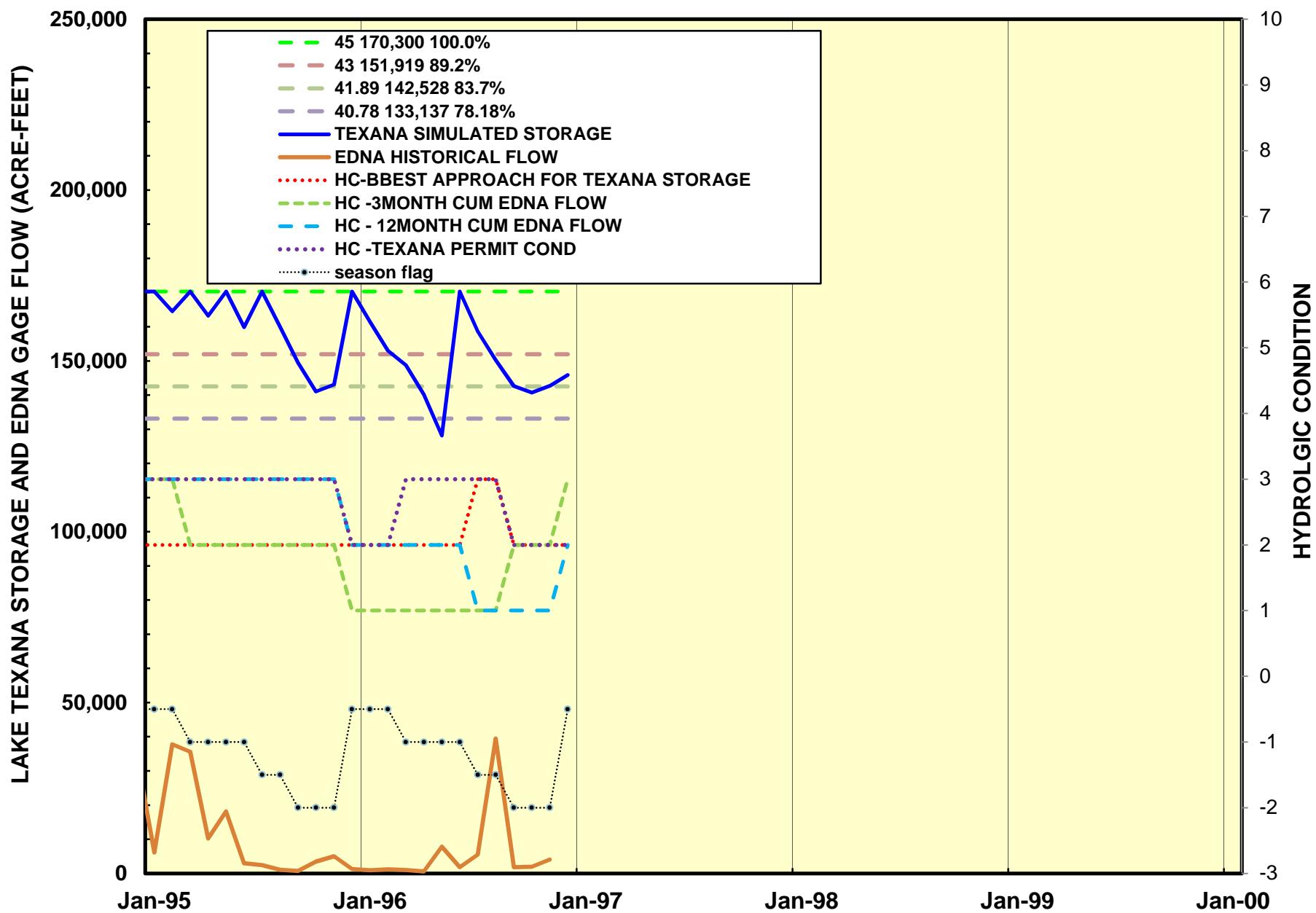
SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



SIMULATED STORAGE FOR LAKE TEXANA, GAGED EDNA FLOW, AND VARIOUS TECHNIQUES FOR DETERMINING HYDROLOGIC CONDITIONS



Appendix 7

Summary Of Compliance Results With CL BBEST eFlow
Recommendations Lavaca River Near Edna Site For Various
BBASC Analyses Lavaca River OCR Project Q95 Substituted
For BBEST Threshold Used For Compliance Comparison

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

SUMMARY OF COMPLIANCE RESULTS WITH CL BBEST EFLOW RECOMENDATIONS

LAVACA RIVER NEAR EDNA SITE FOR VARIOUS BBASC ANALYSES

LAVACA RIVER OCR PROJECT - Q95 SUBSTITUTED FOR BBEST THRESHOLD USED FOR COMPLIANCE COMPARISON

7/20/2011

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) FIRM YIELD (AF/Y)	NA	NA	NA	15,875	10,240	9,900	10,075	10,125	10,725
(2) PROJECT IN / OUT	NO PROJECT			WITH PROJECT IN PLACE (RUN NUMBER - SEE BELOW)					
(3) EFLOW COMPONENT	HISTORICAL	WAM RUN3 USED FOR BBEST REPORT	WAM RUN3 USED FOR PROJECT	1	2	3	4	4A	4B
(4) NON-PULSE FLOWS (PERCENT OF TIME FLOW EQUALS OR EXCEEDS BBEST RECOMMENDATIONS.									
(5) SUBSISTENCE	94%	na *	91%	66%	91%	91%	91%	91%	91%
(6) BASE LOW	73%	70%	67%	44%	57%	57%	67%	67%	67%
(7) BASE MEDIUM	55%	53%	51%	36%	38%	41%	48%	48%	48%
(8) BASE HIGH	39%	37%	36%	28%	28%	28%	30%	30%	30%
(9) PULSE FLOWS (NUMBER OF QUALIFYING PULSE EVENTS PASSED.									
(10) 2PER SEASON (HFP1)	66	63	63	58	58	57	62	62	56
(11) 1PER SEASON (HFP2)	38	36	37	35	35	35	37	37	35
(12) 1 PER YEAR (HFP3)	44	43	44	44	44	43	44	44	43
(13) 1 PER 2 YEARS (HFP4)	22	21	22	22	22	22	22	22	22
(14) 1 PER 5 YEARS (HFP5)	7	6	7	7	7	7	7	7	7

RUN NUMBER	DESCRIPTION OF EFLOW REQUIREMENTS PROJECT SUBJECT TO.
1	NO EFLOW REQUIREMENTS.
2	TCEQ LYONS EFLOW REQUIREMENTS.
3	TWDB CONSENSUS PLANNING EFLOW REQUIREMENTS.
4	FULL CL BBEST RECOMMENDATIONS
4A	CL BBEST RECOMMENDATIONS EXCEPT Q95 SUBSTITUTED FOR RECOMMENDED SUBSISTENCE FLOW REQUIREMENTS.
4B	CL BBEST RECOMMENDATIONS EXCEPT NO HIGH FLOW PULSE RECOMMENDATIONS IMPOSED.

NOTE 1: ATTAINMENT FREQUENCIES FOR SEASONAL RECOMENDATIONS (ALL NON-PULSE RECOMMENDATIONS AND FIRST 2 PULSE RECOMMENDATIONS) SUMMARIZED BY AVERAGING RESULTS FOR ALL FOUR SEASONS INTO SINGLE VALUE FOR ALL COMPARISONS.

NOTE 2: INFORMATION IN COLUMNS 1 AND 2 ARE REPORTED IN BBEST REPORT, PAGES 5-6 AND 5-10. INFORMATION IN COLUMN 3 WAS DETERMINED USING A MORE RECENT VERSION OF THE TCEQ RUN3 WAM MODEL AND WITH THE STAGE 2 TEXANA WATER RIGHT REMOVED.

NOTE 3: ALL BBEST SCENARIOS (COLUMNS 8,9,10) USE LAKE TEXANA STORAGE AS SIGNAL TO DESIGNATE WHICH NON-PULSE LEVEL OF FLOW IS REQUIRED TO BE PASSING PROJECT LOCATION BEFORE DIVERSION CAN OCCUR. PULSE RECOMMENDATIONS ARE APPLIED AT FOR ALL CONDITIONS.

Appendix 8

Parameters Proposed For ASR Project on Pedernales

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

PARAMETERS PROPOSED FOR ASR PROJECT ON PEDERNALES				
CL BBEST / BBASC				
6/20/2011				
PARAMETERS / STEPS	DESCRIPTION	QUANTITY	UNIT	EVAP
(1)	RIVER PUMP RATE	1,000	CFS	NO
(2)	INTERMEDIATE RESERVOIR SIZE (PRE TREATMENT)	10,000	AF	YES
(3)	TREATMENT AND INJECTION RATE	50	CFS	NO
(4)	MAX TERMINAL RESERVOIR SIZE (AQUIFER SPACE)	100,000	AF	NO
(5)	BEGINNING TERMINAL RESERVOIR SIZE (AQUIFER SPACE)	100,000	AF	NO
MODEL PROCESS				
STEP 1	WATER DIVERTED FROM RIVER INTO REGULAR OCR WHENEVER PROJECT IS ABLE TO DIVERT FROM RIVER (Daily Basis).	1,000	CFS	NO
STEP 2	DIVERT WATER FROM OCR WHENEVER POSSIBLE, TREAT, AND INJECT INTO AQUIFER (Daily Basis).	50	CFS	YES
STEP 3	DIVERT FROM AQUIFER WITH MUNICIPAL PATTERN. ITERATE DEMAND UNTIL DIVERSIONS ARE FIRM FROM AQUIFER WITH SPACE DESIGNATED (ITEM #4 ABOVE) BEING FULLY UTILIZED. (Monthly Basis).	TO BE DETERMINED	AF	NO

Appendix 8a

Pedernales near Johnson City Summary of Results For BBEST Application of ASR Project

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

PEDERNALES NEAR JOHNSON CITY

SUMMARY OF RESULTS FOR BBEST APPLICATION OF ASR PROJECT

D:\COL_BBASC\WAM FROM TCEQ 03172011\STAGE2-04152011\FRAT V3.4\TASK2\PRnrJC\ASR SUMMARY-07212011.xls]ASR DETAILS

7/21/2011

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INPUT PARAMETERS		SCENARIO			
		1-NO EFLows	2-FULL BBEST EFLows	3-BBEST BUT NO HFP'S	4-BBEST WITH SEASONAL PULSES ONLY
(1)	RIVER PUMP RATE INTO TREATMENT RESERVOIR (OCR)		1,000 CFS (60,330 AC-FT/MONTH)		
(2)	SIZE OF TREATMENT RESERVOIR		10,000 ACRE-FEET		
(3)	PUMP RATE FROM TREATMENT RESERVOIR (used to meet project demand then inject the balance)		50 CFS (3,016 AC-FT/MONTH or 36,198 AC-FT/YR)		
(4)	AVAILABLE SPACE IN AQUIFER TO STORE WATER		100,000 ACRE-FEET		
SIMULATION RESULTS		SCENARIO			
		1-NO EFLows	2-FULL BBEST EFLows	3-BBEST BUT NO HFP'S	4-BBEST WITH SEASONAL PULSES ONLY
(5)	Beginning Storage in Aquifer	35,000	52,000	42,000	46,600
	Diversions from River into OCR (1000 cfs diversion trying to keep the treatment reservoir full)				
(6)	Maximum Annual Diversion (ac-ft/yr)	31,292	30,268	30,268	30,268
(7)	Average Annual Diversion (ac-ft/yr)	9,223	8,289	8,650	8,382
(8)	Minimum Annual Diversion (ac-ft/yr)	0	0	0	0
	Diversions from OCR to Meet Demand then Inject Balance into ASR (50 cfs diversion from treatment reservoir to be used or injected)				
(9)	Annual Demand from OCR (ac-ft/yr)	36,198	36,198	36,198	36,198
(10)	Percent of Years Full Demand Met	1.7%	0.0%	0.0%	0.0%
(11)	Percent of Years at least 75% of Full Annual Demand Met	10.2%	8.5%	8.5%	8.5%
(12)	Percent of Months Full Monthly Demand Met	23.4%	20.5%	21.3%	20.8%
(13)	Percent of Months any Water Pumped	28.2%	25.8%	26.8%	26.1%
(14)	Maximum Annual Diversion (ac-ft/yr)	36,198	34,306	35,507	34,306
(15)	Average Annual Diversion (ac-ft/yr)	9,232	8,318	8,670	8,409
(16)	Minimum Annual Diversion (ac-ft/yr)	0	0	0	0
(17)	Firm Yield of ASR Project (af-ft/yr)	9,420	8,770	8,960	8,770
(18)	Firm Yield of ASR Project (cfs)	13.0	12.1	12.4	12.1
(19)	Maximum Rate Water Injected into ASR (cfs)	37.0	37.9	37.6	37.9
(20)	Minimum Storage in ASR (ac-ft)	277	502	399	502
	Maximum Storage in ASR (ac-ft)	97,635	98,172	97,716	98,173

OCR = Off-Channel Reservoir

ASR = Aquifer Storage and Recovery

ac-ft = acre-feet

SUMMARY OF COMPLIANCE RESULTS WITH CL BBEST EFLOW RECOMMENDATIONS

PEDERNALES NEAR JOHNSON CITY SITE FOR VARIOUS BBASC ANALYSES

PEDERNALES ASR PROJECT (SUBSISTENCE CHANGED TO Q95)

7/21/2011

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) FIRM YIELD (AF/Y)	NA	NA	NA	9,420	8,770	8,960	8,770
(2) PROJECT IN / OUT	NO PROJECT			WITH PROJECT IN PLACE (RUN NUMBER - SEE BELOW)			
(3) EFLOW COMPONENT	HISTORICAL	WAM RUN3 USED FOR BBEST REPORT	WAM RUN3 USED FOR PROJECT	RUN 1	RUN 2	RUN 3	RUN 4
(4) NON-PULSE FLOWS (PERCENT OF TIME FLOW EQUALS OR EXCEEDS BBEST RECOMMENDATIONS.							
(5) SUBSISTENCE	92%	na (3)	93%	92%	93%	93%	93%
(6) BASE LOW	72%	71%	71%	69%	71%	71%	71%
(7) BASE MEDIUM	55%	54%	54%	51%	54%	54%	54%
(8) BASE HIGH	37%	37%	37%	34%	36%	35%	36%
(9) PULSE FLOWS (NUMBER OF QUALIFYING PULSE EVENTS PASSED.							
(10) 2PER SEASON (HFP1)	92	93	93	88	90	87	91
(11) 1PER SEASON (HFP2)	46	46	45	44	45	44	45
(12) 1 PER YEAR (HFP3)	46	46	46	46	46	46	46
(13) 1 PER 2 YEARS (HFP4)	27	27	24	24	24	24	24
(14) 1 PER 5 YEARS (HFP5)	11	10	10	10	10	10	10

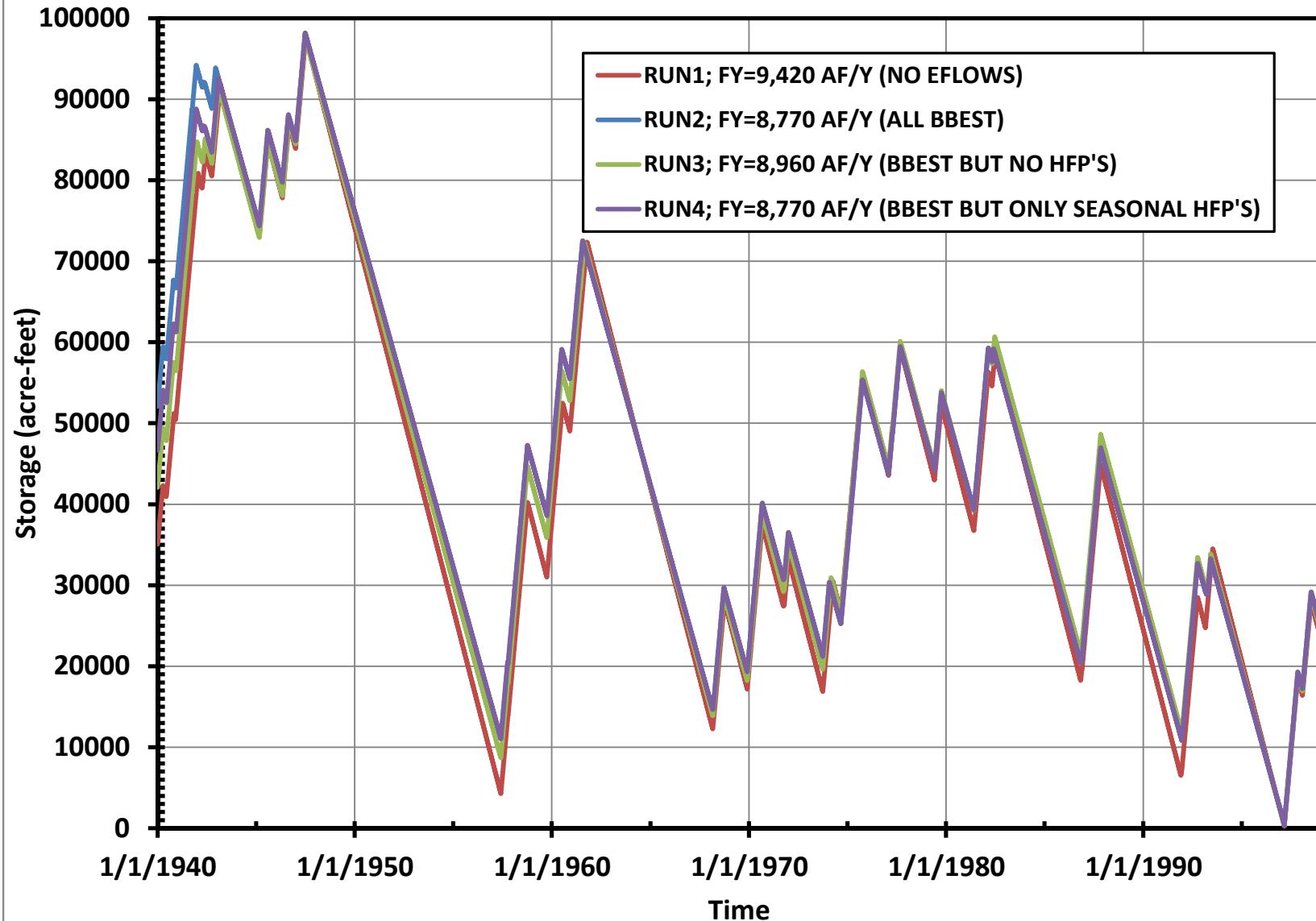
RUN NUMBER	DESCRIPTION OF EFLOW REQUIREMENTS IMPOSED ON PROJECT
1	NO EFLOW REQUIREMENTS.
2	CL BBEST RECOMMENDATIONS.
3	CL BBEST RECOMMENDATIONS BUT NONE OF THE HIGH FLOW PULSE RECOMMENDATIONS IMPOSED.
4	CL BBEST RECOMMENDATIONS BUT ONLY SEASONAL PULSES IMPOSED.

NOTE 1: ATTAINMENT FREQUENCIES FOR SEASONAL RECOMMENDATIONS (ALL NON-PULSE RECOMMENDATIONS AND FIRST 2 PULSE RECOMMENDATIONS) SUMMARIZED BY AVERAGING RESULTS FOR ALL FOUR SEASONS INTO SINGLE VALUE FOR ALL COMPARISONS.

NOTE 2: INFORMATION IN COLUMNS 2 AND 3 ARE REPORTED IN BBEST REPORT (PAGES 5-6 AND 5-10). NOTE THAT SUBSISTENCE COMPLIANCE FROM BBEST REPORT NOT STATED BECAUSE BBEST REPORT STATISTICS WERE NOT BASED ON Q95 VALUE. INFORMATION IN COLUMN 4 WAS DETERMINED USING A MORE RECENT VERSION OF THE TCEQ RUN3 WAM MODEL AND WITH LCRA'S PERMIT 5731 INCLUDED.

NOTE 3: ALL BBEST SCENARIOS (COLUMNS 6,7,8) USE HIGHLAND LAKES SYSTEM STORAGE AND BBEST PROPOSED IMPLEMENTATION PLAN AS SIGNAL TO DESIGNATE WHICH NON-PULSE LEVEL OF FLOW IS REQUIRED TO BE PASSING PROJECT LOCATION BEFORE DIVERSION CAN OCCUR. PULSE RECOMMENDATIONS ARE APPLIED AT TIMESFOR ALL CONDITIONS.

DAILY SIMULATED STORAGE IN PEDERNALES ASR USING FRAT BASED MODEL FOR VARIOUS EFLOW CONDITIONS



Appendix 8b

Hydrologic Triggers Used For Pedernales Analysis Using LCRA System Storage from TCEQ RUN3 (1940-1998)

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

**HYDROLOGIC TRIGGERS USED FOR PEDERNALES ANALYSIS
USING LCRA SYSTEM STORAGE FROM TCEQ RUN3 (1940-1998)**

	% OF TIME ENGAGED		TRIGGER IN WHICH ENGAGED	% OF SYSTEM STORAGE
BASE HIGH	23.8%	100.0%	2,163,227	100.0%
BASE MED	50.5%	76.2%	2,122,659	98.1%
BASE LOW	20.4%	25.7%	1,446,423	66.9%
SUBSISTENCE	5.3%	5.3%	720,800	33.3%

100.0%

Appendix 9

Colorado/Lavaca BBEST/BBASC Hydrologic Condition Analysis

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

**COLORADO/LAVACA
BBEST/BBASC
HYDROLOGIC CONDITION ANALYSIS**

7/20/2011

Kirk Kennedy

WHY WE ARE DOING THIS?

- Stakeholders asked.
- Hydrologic Condition has not made it into any of the adopted SB3 basins, so no goby exists.
- Past SB3 efforts did not have enough direction for the TCEQ to implement; thus the coming analysis presents numerous options.

WHY WERE DIFFERENT MODELS AND HISTORICAL FLOWS USED?

- To give Stakeholders feel for the model results verses what has actually occurred in recent history.
- Might offer reason to come up with 2 sets of triggers for each site:
 - 1 set for evaluating new water right applications – based on RUN3.
 - 1 set for placing in any new permit that gets issued – based on more current conditions (RUN8 or recent historical).

WHAT'S WRONG WITH USING RUN3 TO DEVELOP TRIGGERS?

- Triggers based on RUN3 conditions could be inappropriate until basin conditions actually get to RUN3 condition.
- Triggers based on RUN3 condition where actual conditions are not as “bad” as RUN3 can result in new permits being subjected to higher efflows standards more of the time in the real world.
- RUN3 based triggers would be required, since RUN3 is the TCEQ’s test for new water right applications. More relaxed triggers, based on more current condition, could be considered and possibly tied to the work plan.

LOOK AT PLOTS FROM BOTTOM UP

- As good example, go through all aspects of the plotted information on Page 1 first (LCRA System – RUN3). Note the following:
 - Percent of time engagement is stated in legend and rationalize this time on X scale.
 - Left Y scale is storage in acre-feet and right Y scale is % full.
 - Area between triggers represents zone in which the applicable base flow would be engaged.
 - For many of the other plots, the top tier of base flow would only be applied when reservoir at or above full.
- None of this speaks to how often any of the recommended flow regimes will be met. Instead, the hydrologic condition triggers dictate how often the recommended flow regimes will be engaged.

OTHER ISSUES TO NOTE

- WAM Models do not store water above the conservation capacity.
- The RUN 8 WAM model for Colorado Basin has different operating rules for the LCRA System than the comparable RUN3 (updated RUN8 not available at this time).
- Each of the three sets of storage (RUN3, RUN8, Historical) have their own conservation capacity associated:
 - RUN3 - full authorized amount of storage without consideration of sedimentation.
 - RUN8 – reflects recent TCEQ estimate of current sedimentation.
 - Historical – Taken from information provided by reservoir owner.
- For the 12 month cumulative flow analysis, the San Saba @ San Saba gage was missing information for the period 10/1/1993-9/30/1997.
- None of the legend in the WAM plots express reservoir triggers in terms of elevation. This is simply because elevation is not needed or contained in the WAM models; however, corresponding elevation trigger could be calculated.

Appendix 10

Overbank Summary of High Flow Pulse Recommendations for CL BBEST Sites

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

FROM RECOMMENDATIONS IN THE CL BBEST REPORT
OVERBANK SUMMARY OF HIGH FLOW PULSE RECOMMENDATIONS FOR CL BBEST SITES
(EXCLUDES SITES ON COLORADO RIVER BELOW MANSFIELD DAM)

SITE INFORMATION		MAGNITUDE DEEMED TO BE OVERBANK	ORIGINAL BBEST RECOMMENDATION									
USGS No.	Name		ONCE PER YEAR			ONCE PER 2 YEARS			ONCE PER 5 YEARS			
			MAG	VOL	DUR	MAG	VOL	DUR	MAG	VOL	DUR	
8123850	Colorado Rv abv Silver	4,600	3,000	13,600	17	4,500	20,400	18	8,100	36,700	21	
8126380	Colorado Rv nr Ballinger	4,900	4,500	18,300	13	7,400	29,800	14	12,300	49,000	15	
8127000	Elm Ck at Ballinger	6,100	1,900	7,200	18	3,500	13,100	20	6,300	22,700	22	
8128000	S Concho Rv at Christoval	8,400	420	1,400	9	930	2,800	10	2,600	6,800	11	
8136500	Concho Rv at Paint Rock	35,450	3,000	13,500	19	5,200	23,400	23	12,300	55,300	29	
8143600	Pecan Bayou nr Mullin	32,700	3,500	25,800	26	6,700	54,100	33	13,900	124,900	43	
8146000	San Saba Rv at San Saba	10,500	5,500	27,400	21	9,000	45,300	24	14,900	75,500	27	
8147000	Colorado Rv nr San Saba	43,000	18,900	129,100	23	30,400	222,200	28	39,600	300,500	31	
8151500	Llano Rv at Llano	15,000	9,100	46,100	18	17,400	89,300	22	41,100	214,000	27	
8153500	Pedernales Rv nr Johnson City	10,000	7,000	28,400	15	10,900	44,600	17	26,300	107,900	21	
8158700	Onion Ck nr Driftwood	6,500	1,200	8,700	34	2,400	18,900	45	3,600	29,600	53	
8164000	Lavaca Rv nr Edna	6,000	11,400	46,100	10	15,700	64,100	11	22,800	94,100	12	
8164390	Navidad Rv at Strane Pk nr Edna	5,000	7,100	34,400	10	10,200	50,000	11	15,500	77,600	12	
8164450	Sandy Ck nr Ganado	5,900	4,500	26,700	14	5,800	35,400	15	8,300	52,900	17	
8164503	W Mustang Ck nr Ganado	7,400	2,800	17,800	15	4,700	31,900	18	6,700	46,900	21	
8164504	E Mustang Ck nr Louise	1,500	1,200	6,400	14	1,500	8,600	16	2,200	12,500	17	
8162600	Tres Palacios Rv nr Midfield	2,400	3,500	13,800	10	4,600	18,200	11	6,700	26,100	11	
8164600	Garcitas Ck nr Inez	3,700	2,000	8,900	17	3,100	13,600	19	5,400	24,200	22	

Recommendation labeled as "Overbank" in CL BBEST report.

Recommendation not labeled as "Overbank" in CL BBEST report although recommended magnitude was greater than the overbank magnitude.

MODIFIED RECOMMENDATION INFORMATION BASED ON CL BBASC'S REQUEST/CONCERN TO AVOID OVERBANK RECOMMENDATIONS

OVERBANK SUMMARY OF HIGH FLOW PULSE RECOMMENDATIONS FOR CL BBEST SITES

(EXCLUDES SITES ON COLORADO RIVER BELOW MANSFIELD DAM)

SITE INFORMATION		MAGNITUDE DEEMED TO BE OVERBANK	MODIFIED VALUES BASED ON BBASC REQUEST /CONCERN REGARDING OVERBANK RECOMMENDATIONS												
USGS No.	Name		ONCE PER YEAR			ONCE PER 2 YEARS			ONCE PER 3 YEARS			ONCE PER 4 YEARS			
			MAG	VOL	DUR	MAG	VOL	DUR	MAG	VOL	DUR	MAG	VOL	DUR	
8123850	Colorado Rv abv Silver	4,600	3,000	13,600	17	4,500	20,400	18							
8126380	Colorado Rv nr Ballinger	4,900	4,500	18,300	13	7,400	29,800	14							
8127000	Elm Ck at Ballinger	6,100	1,900	7,200	18	3,500	13,100	20				6,100	21,909	21	
8128000	S Concho Rv at Christoval	8,400	420	1,400	9	930	2,800	10				2,600	6,800	11	
8136500	Concho Rv at Paint Rock	35,450	3,000	13,500	19	5,200	23,400	23				12,300	55,300	29	
8143600	Pecan Bayou nr Mullin	32,700	3,500	25,800	26	6,700	54,100	33				13,900	124,900	43	
8146000	San Saba Rv at San Saba	10,500	5,500	27,400	21	9,000	45,300	24	10,500	53,032	25				
8147000	Colorado Rv nr San Saba	43,000	18,900	129,100	23	30,400	222,200	28				39,600	300,500	31	
8151500	Llano Rv at Llano	15,000	9,100	46,100	18	15,000	89,300	22				41,100	214,000	27	
8153500	Pedernales Rv nr Johnson City	10,000	7,000	28,400	15	10,000	44,600	17				26,300	107,900	21	
8158700	Onion Ck nr Driftwood	6,500	1,200	8,700	34	2,400	18,900	45				3,600	29,600	53	
8164000	Lavaca Rv nr Edna	6,000	6,000	26,600	8	15,700	64,100	11				22,800	94,100	12	
8164390	Navidad Rv at Strane Pk nr Edna	5,000	4,900	22,100	8	10,200	59,000	11				15,500	77,600	12	
8164450	Sandy Ck nr Ganado	5,900	4,500	26,700	14	5,800	35,400	15				8,300	52,900	17	
8164503	W Mustang Ck nr Ganado	7,400	2,800	17,800	15	4,700	31,900	18				6,700	46,900	21	
8164504	E Mustang Ck nr Louise	1,500	1,200	6,400	14	1,500	8,600	16				2,200	12,500	17	
8162600	Tres Palacios Rv nr Midfield	2,400	2,400	13,800	10	4,600	18,200	11				6,700	26,100	11	
8164600	Garcitas Ck nr Inez	3,700	2,000	8,900	17	3,100	13,600	19	3,700	16,304	20				

removed Recommendation goes away, based on CL BBASC's request.

green Magnitude Values shifted down to stay within overbank value; no change made to volume or duration recommendations.

yellow All pulse parameters copied from Spring 2 per season recommendation to stay within overbank value.

red Reduction made to Spring 2 per season recommendation to stay within overbank value and duplicated all resulting spring 2 per season parameters to 1 per year parameter.

Appendix 11

Summary of Hydrologic Conditions Engagement Analysis Colorado at Silver – Pedernales near Johnson City

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO AT SILVER SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER	BASE MEDIUM TRIGGER	BASE LOW TRIGGER	SUBSISTENCE TRIGGER					
						GOAL; 25% OF TIME	GOAL; 50% OF TIME	GOAL; 20% OF TIME	GOAL; 5% OF TIME					
COLORADO AT SILVER														
(1)	TCEQ RUN3	FLOW	315,926	SIM	1940-1998	125,009	26.1%	125,009 AND 37,410	49.1%	37,410 AND 14,063	19.3%	14,063	5.5%	
(2)	TCEQ RUN8	FLOW	329,015	SIM	1940-1998	101,438	25.0%	101,438 AND 25,918	49.4%	25,918 AND 8,183	20.1%	8,183	5.5%	
(3)	USGS	FLOW	686,983	HIST	1957-1998	91,538	27.2%	91,538 AND 27,013	49.6%	27,013 AND 10,665	18.3%	10,665	4.9%	
(4)	USGS	FLOW	266,337	HIST	1980-2010	57,491	23.7%	57,491 AND 16,597	49.5%	16,597 AND 4,094	21.0%	4,094	5.9%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

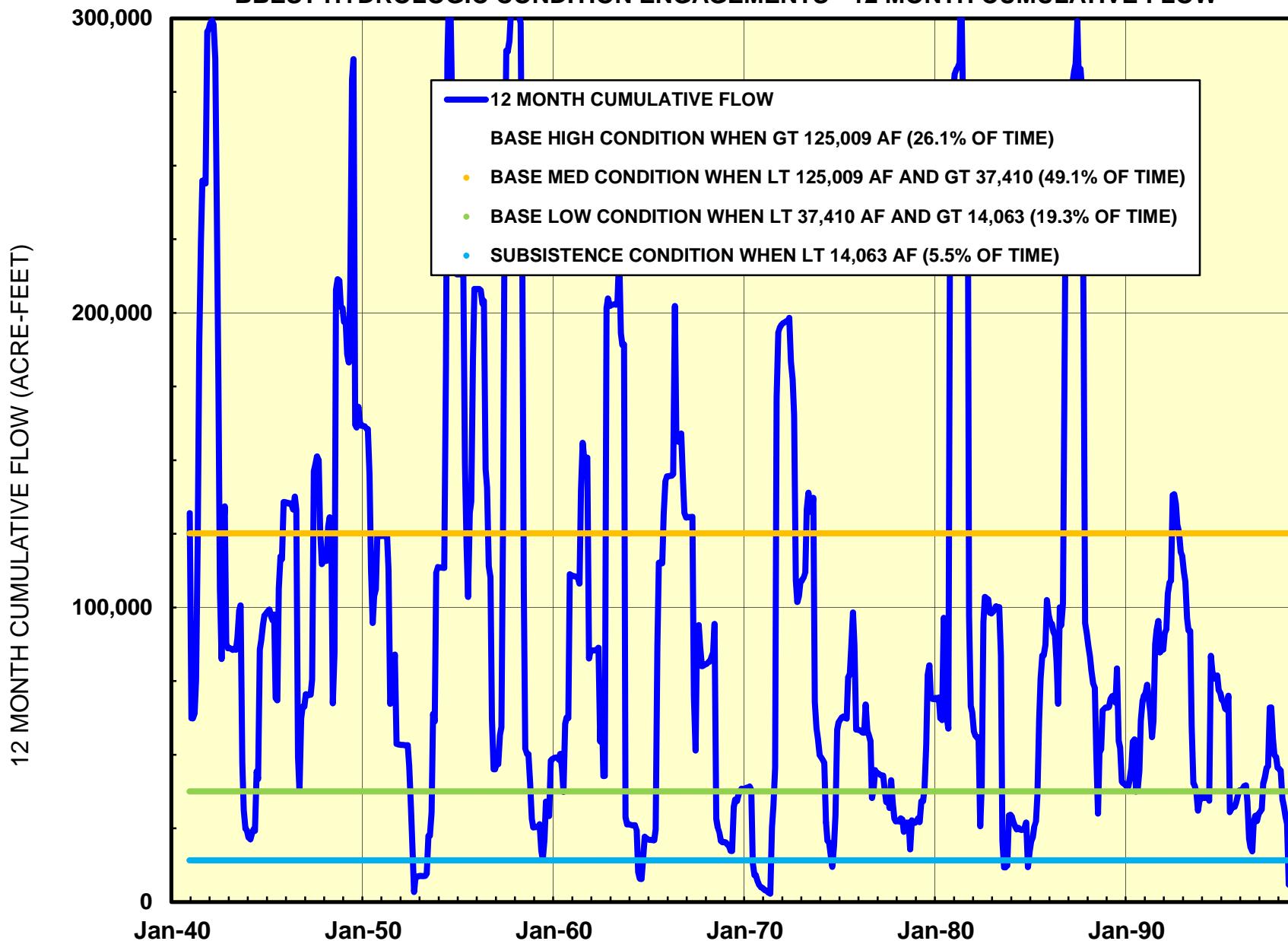
STO Storage

ELEV Elevation

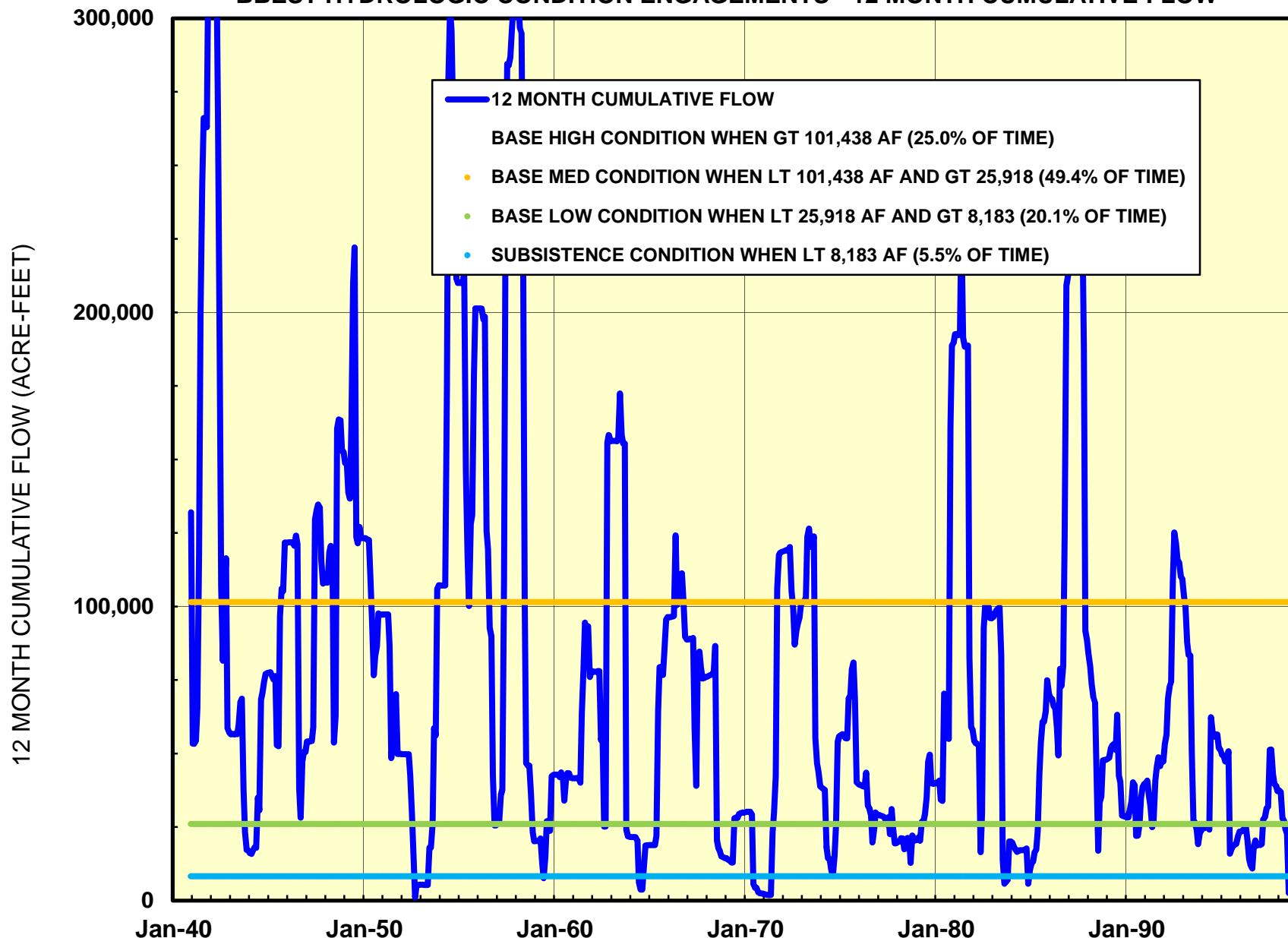
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

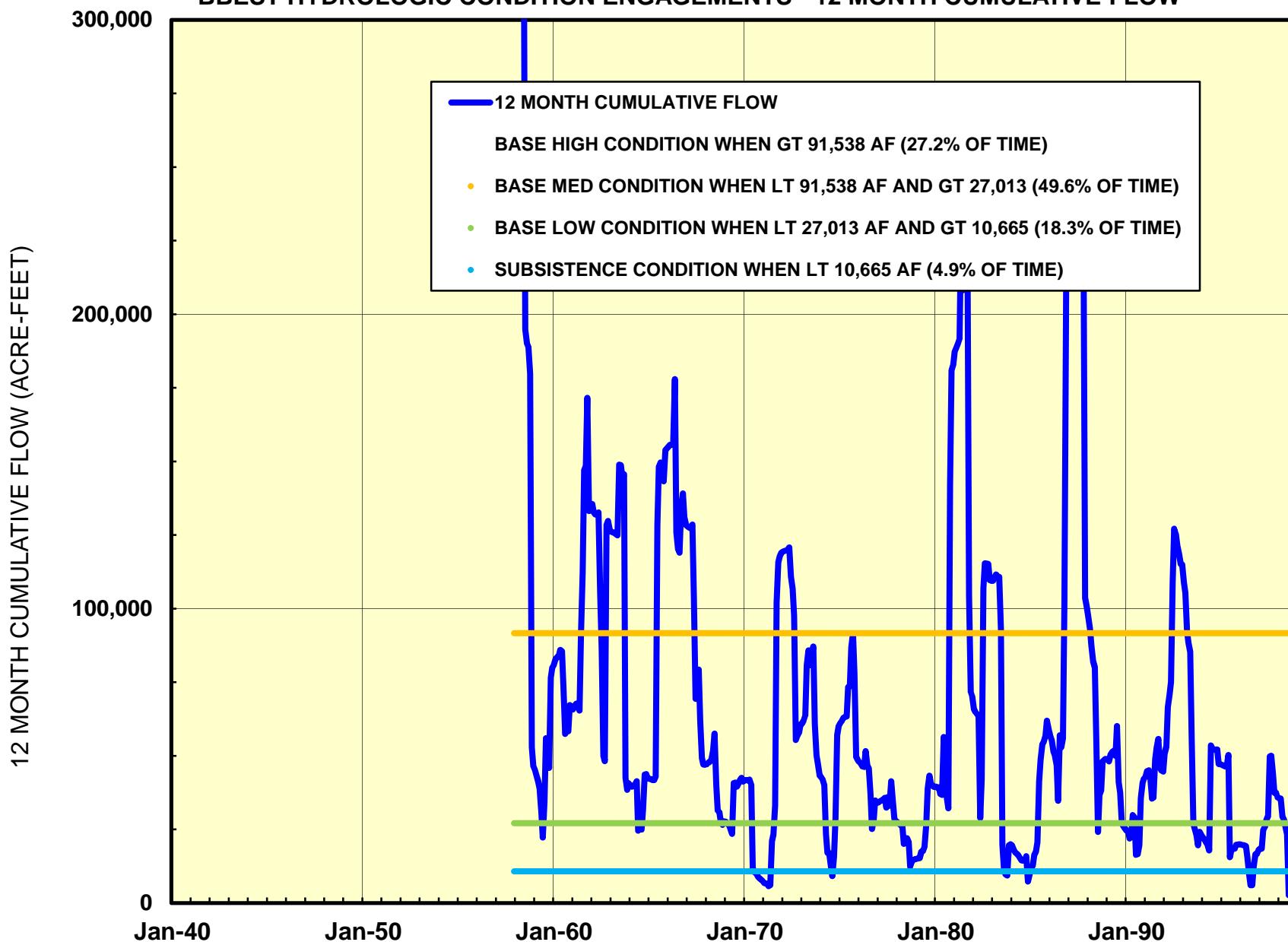
COLORADO AT SILVER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



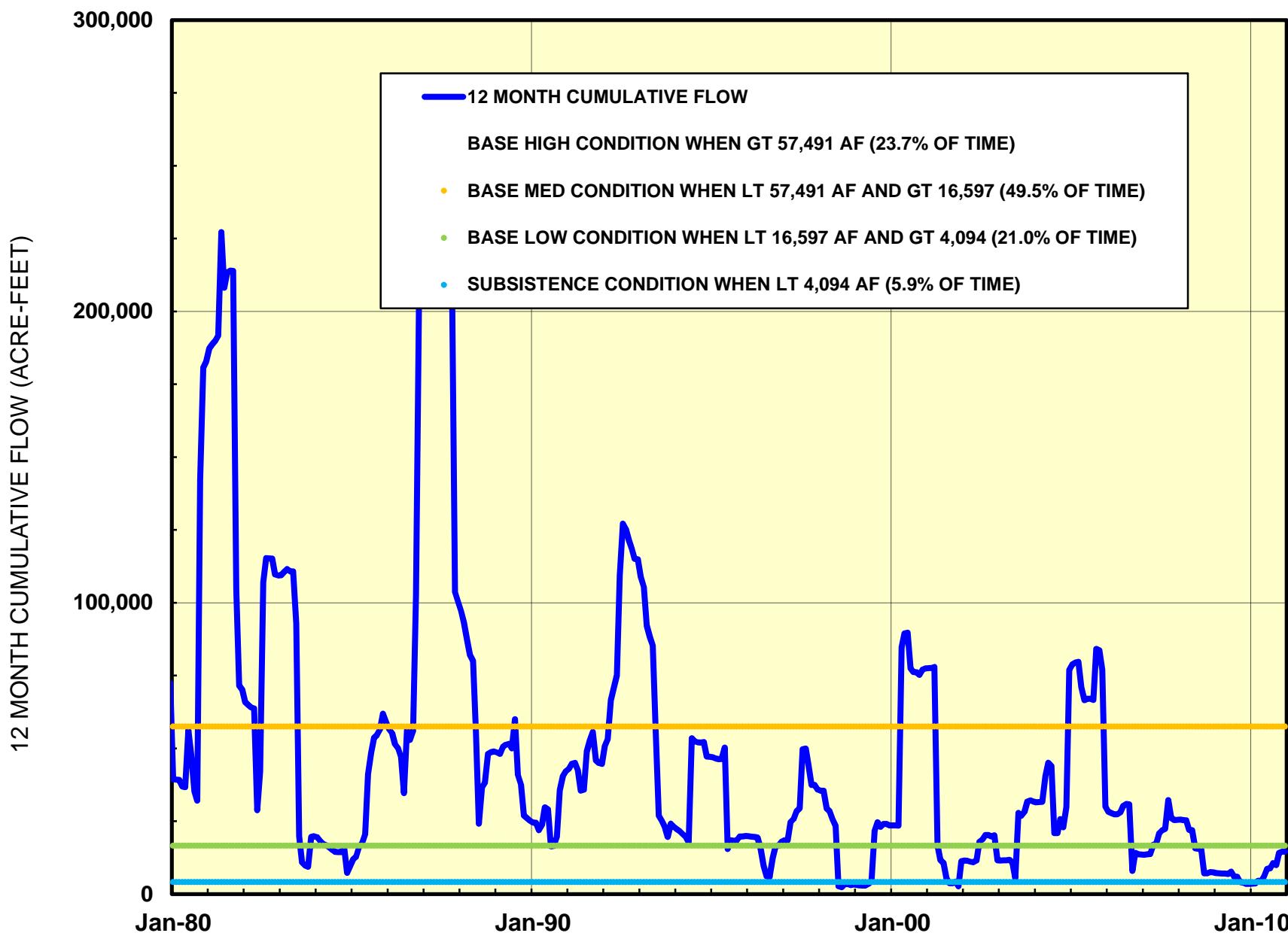
COLORADO AT SILVER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



**COLORADO AT SILVER HISTORICAL FLOW FOR 1957-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW**



COLORADO AT SILVER HISTORICAL FLOW FOR 1980-2010 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO NEAR NEAR BALLINGER SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
COLORADO NEAR BALLINGER														
(1)	TCEQ RUN3	FLOW	469,291	SIM	1940-1998	158,824	25.0%	158,824 AND 55,994	50.0%	55,994 AND 25,593	20.1%	25,593	4.9%	
(2)	TCEQ RUN8	FLOW	463,037	SIM	1940-1998	120,115	25.9%	120,115 AND 41,395	49.7%	41,395 AND 20,677	19.0%	20,677	5.5%	
(3)	USGS	FLOW	688,381	HIST	1940-1998	135,078	24.4%	135,078 AND 30,887	50.3%	30,887 AND 10,358	20.1%	10,358	5.2%	
(4)	USGS	FLOW	326,983	HIST	1980-2010	67,703	24.2%	67,703 AND 11,154	53.2%	11,154 AND 3,117	17.2%	3,117	5.4%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

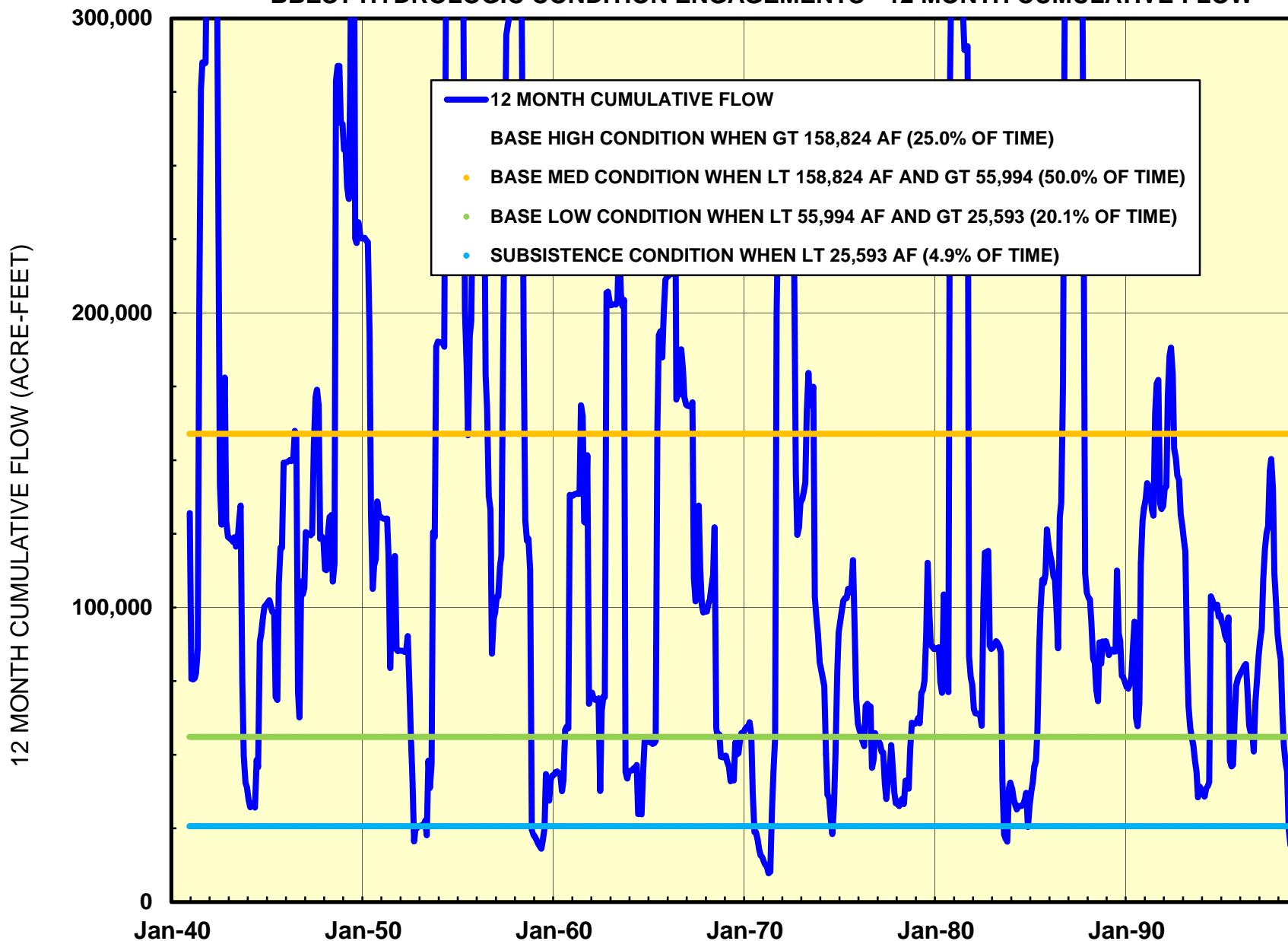
STO Storage

ELEV Elevation

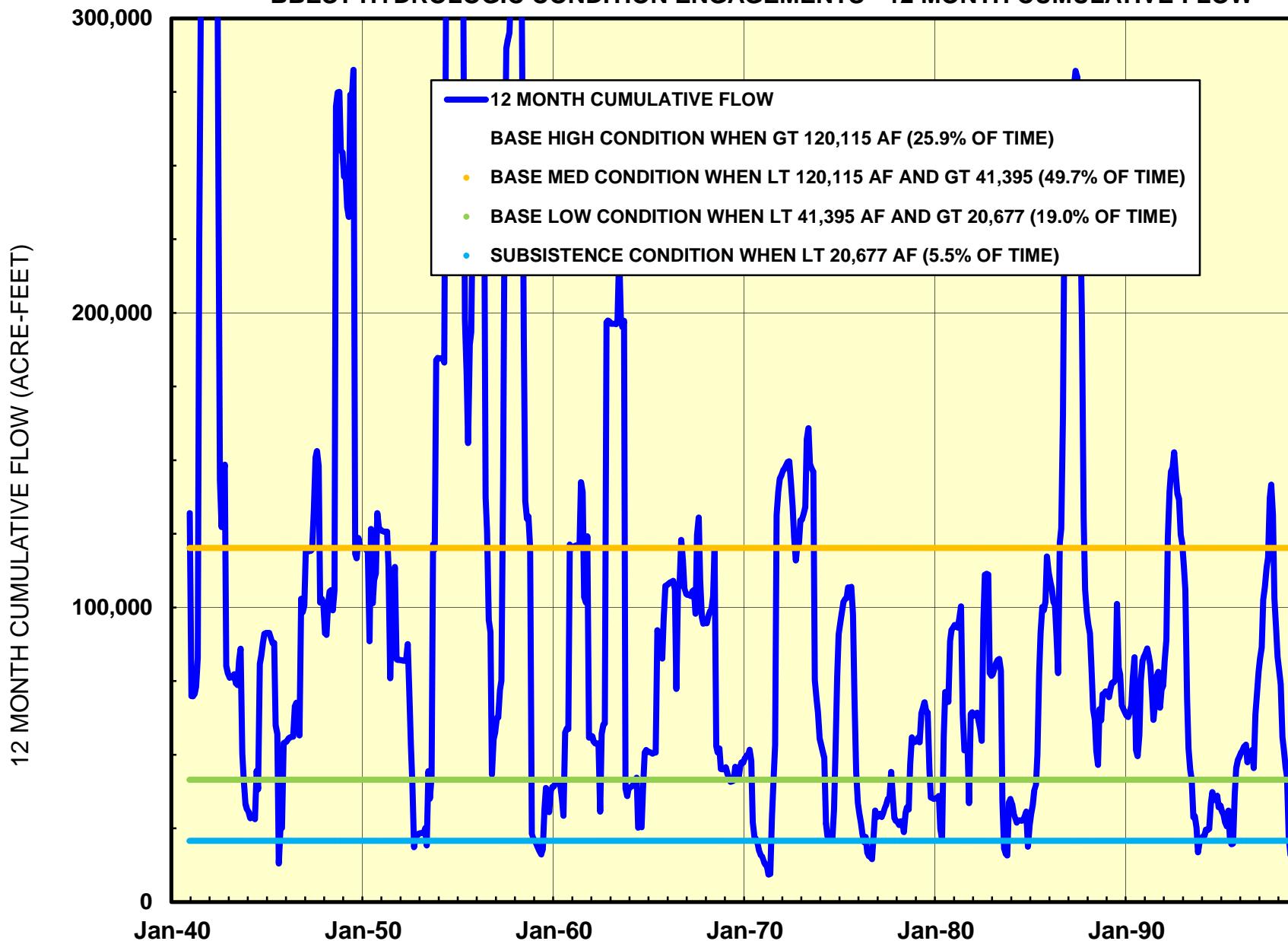
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

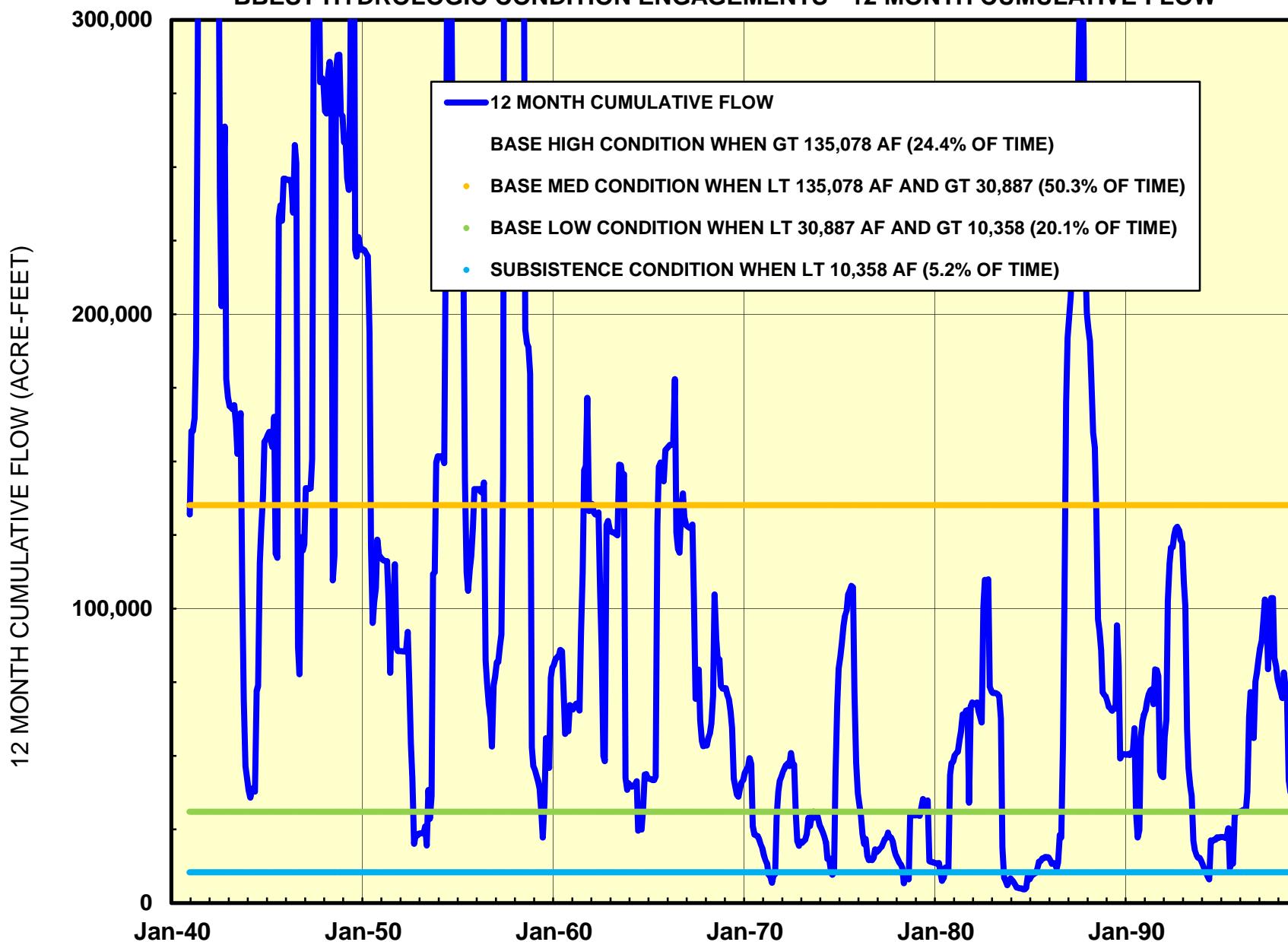
COLORADO NR BALLINGER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



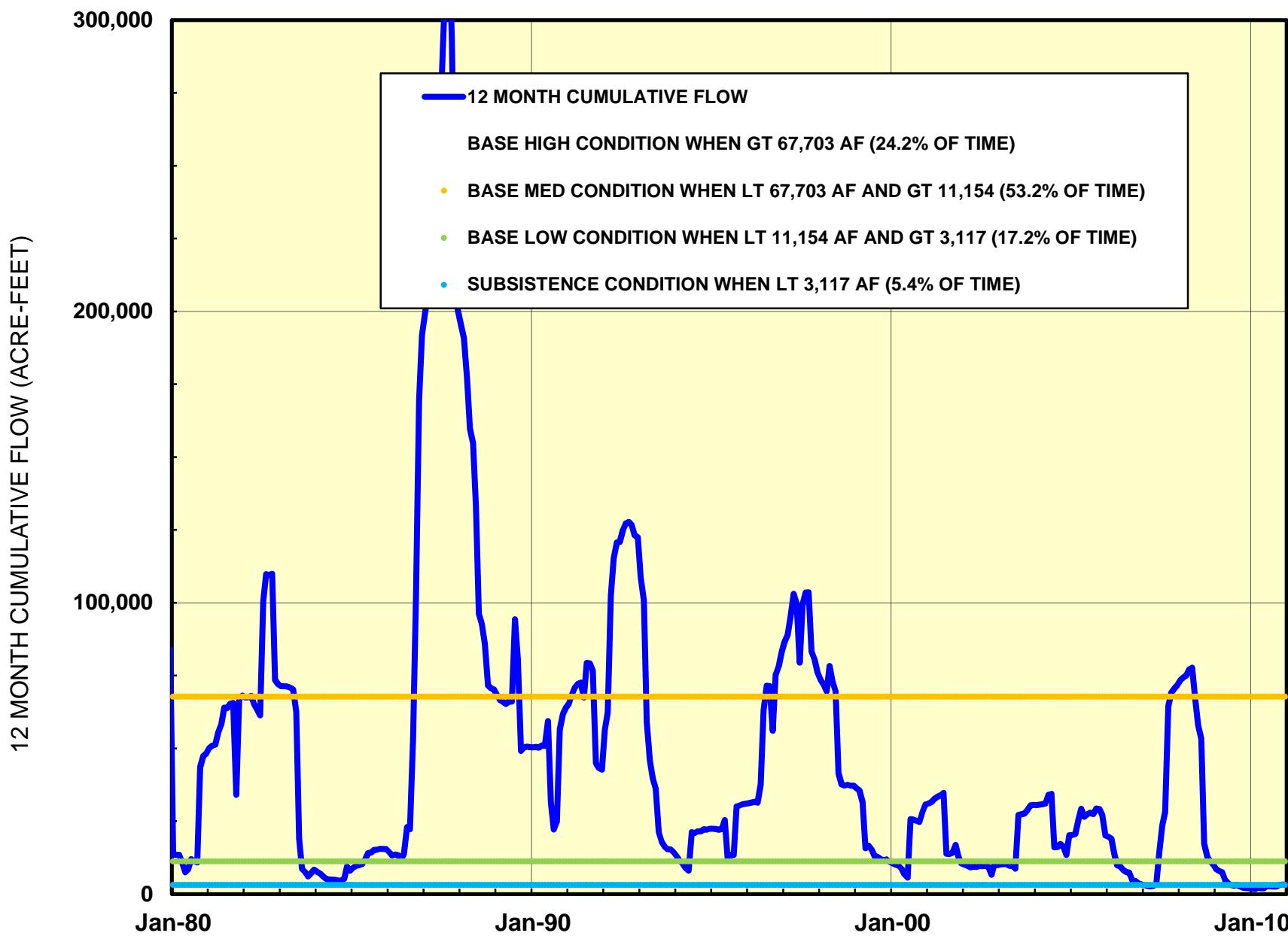
COLORADO NR BALLINGER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



COLORADO NR BALLINGER HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



COLORADOR NR BALLINGER HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR ELM CREEK NEAR BALLINGER SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
ELM CREEK NEAR BALLINGER														
(1)	TCEQ RUN3	FLOW	139,464	SIM	1940-1998	47,952	25.3%	47,952 AND 12,271	50.6%	12,271 AND 4,924	19.3%	4,924	4.9%	
(2)	TCEQ RUN8	FLOW	135,521	SIM	1940-1998	46,139	25.6%	46,139 AND 11,945	49.4%	11,945 AND 4,853	20.1%	4,853	4.9%	
(3)	USGS	FLOW	141,315	HIST	1940-1998	48,239	24.7%	48,239 AND 11,568	51.4%	11,568 AND 2,951	19.0%	2,951	4.9%	
(4)	USGS	FLOW	141,315	HIST	1980-2010	46,564	24.7%	46,564 AND 4,989	49.5%	4,989 AND 820	22.0%	820	3.8%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

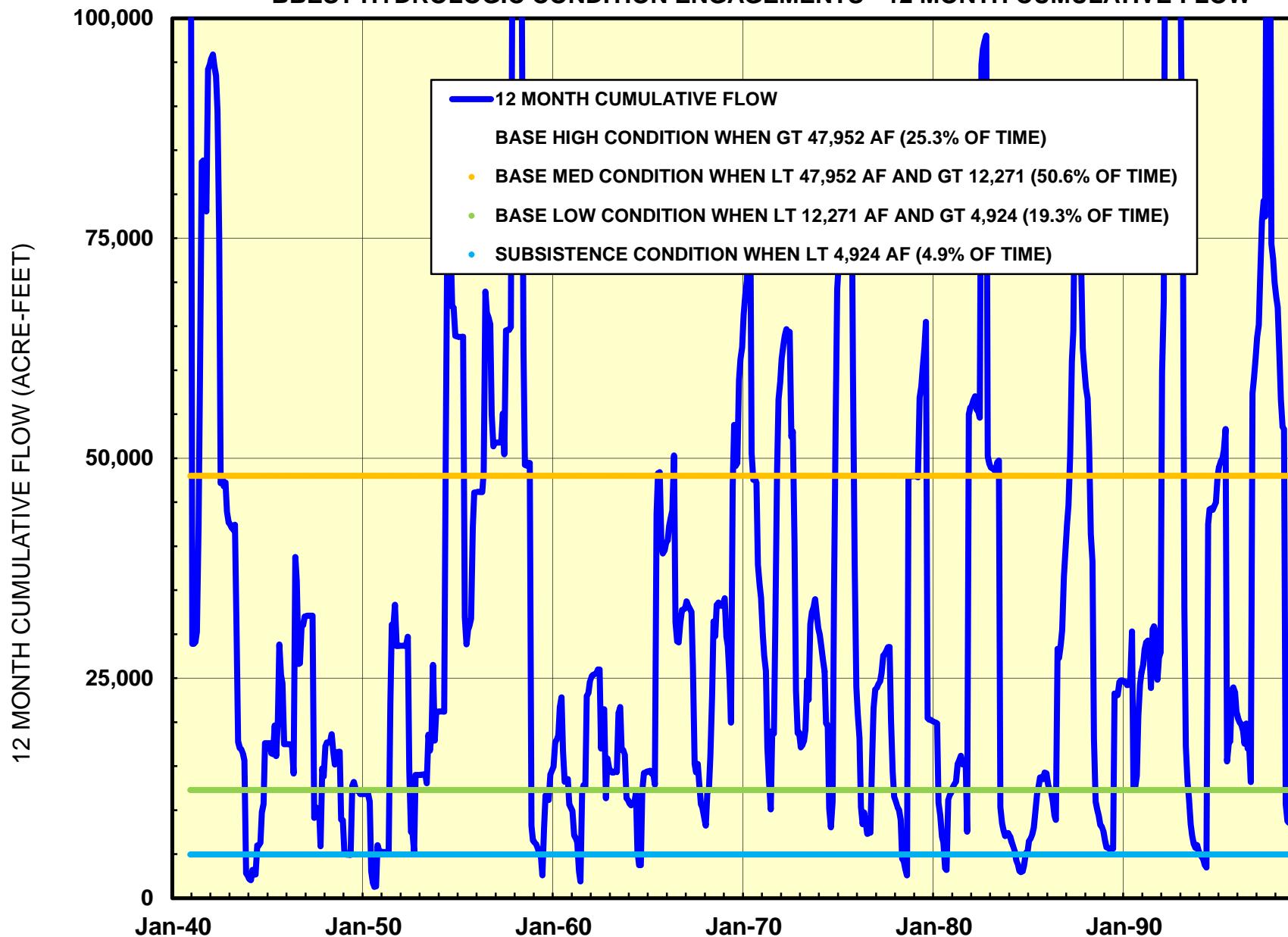
STO Storage

ELEV Elevation

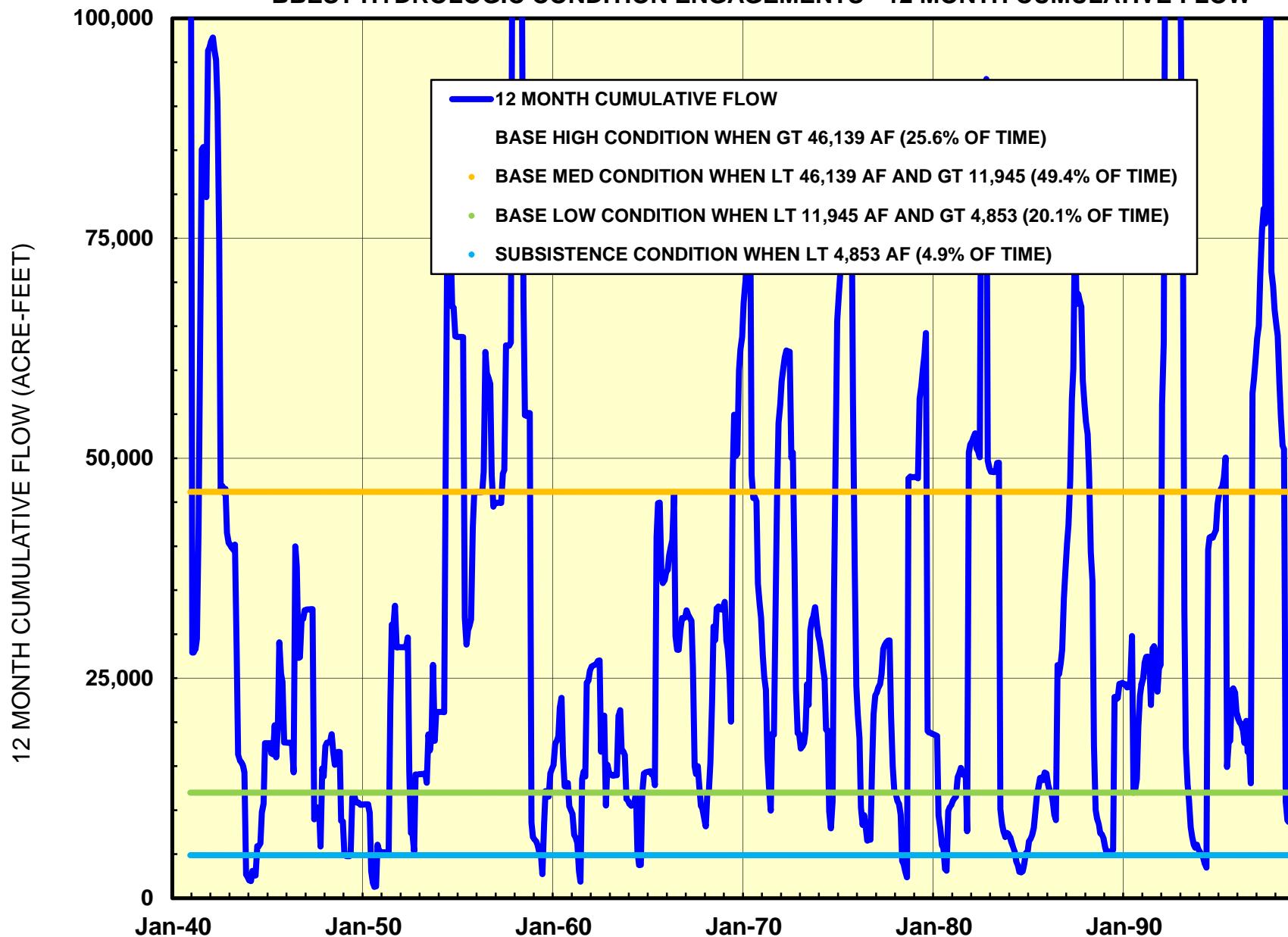
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

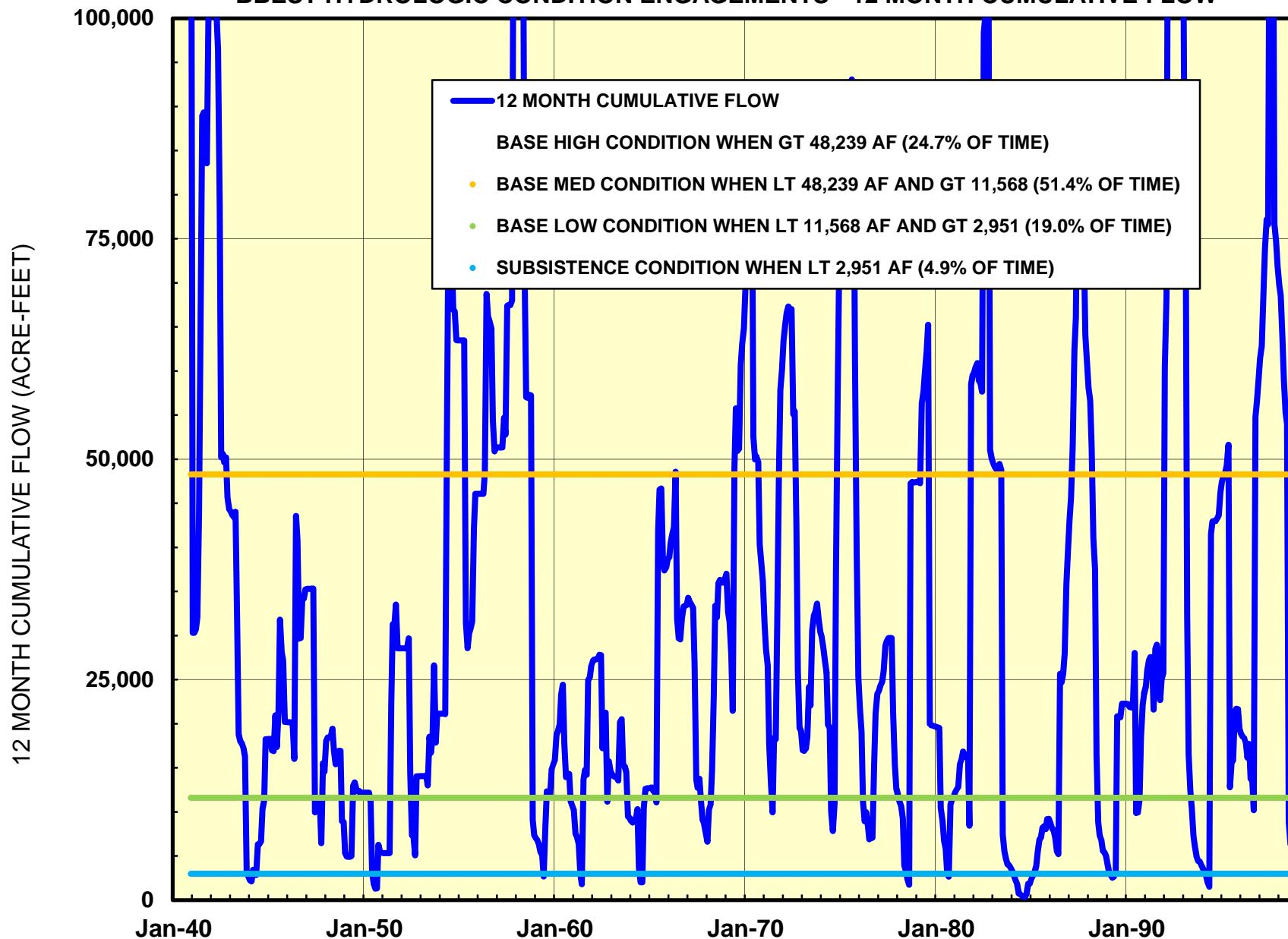
ELM CREEK NR BALLINGER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



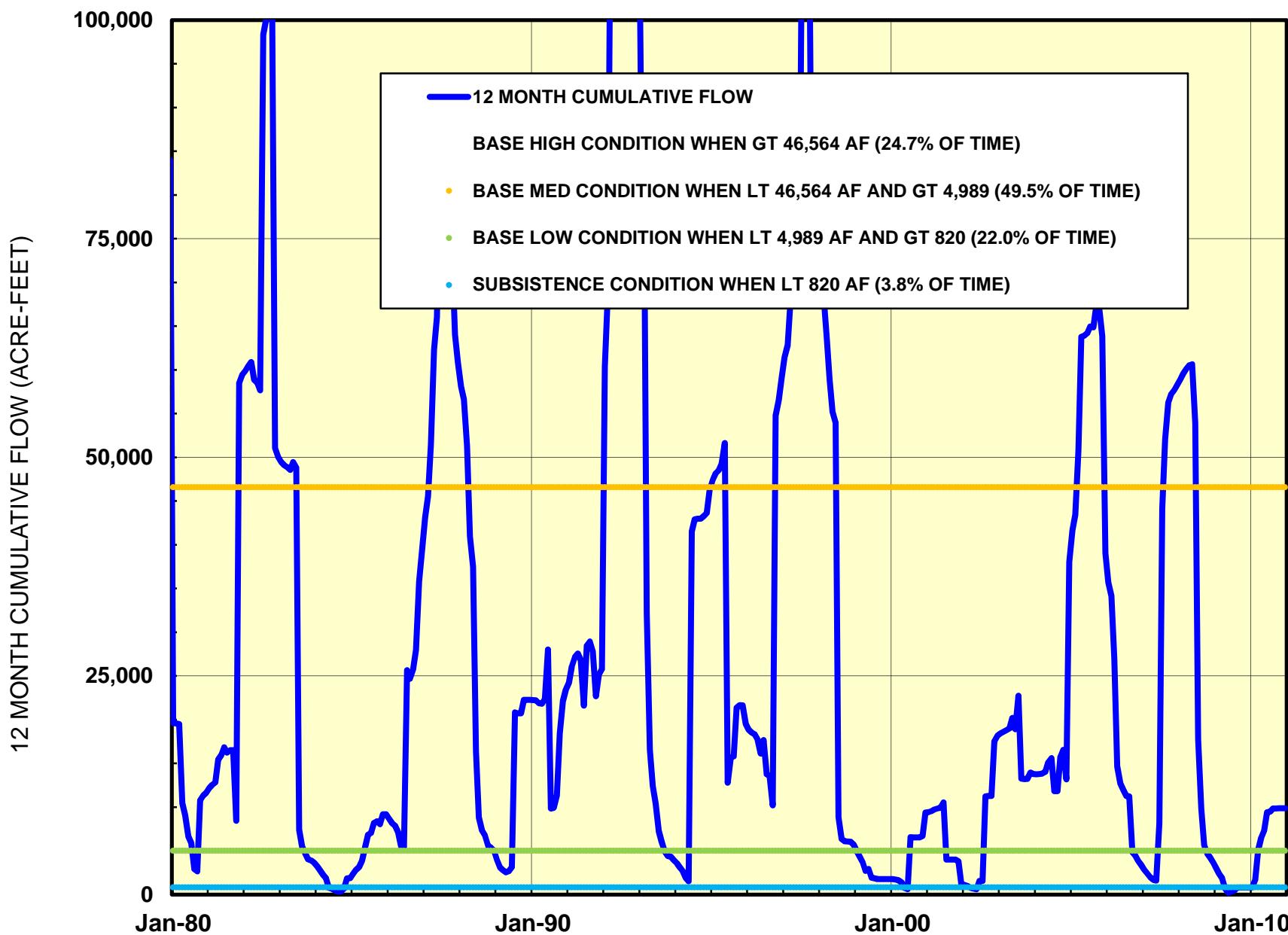
ELM CREEK NR BALLINGER SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



ELM CREEK NR BALLINGER HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



ELM CREEK NR BALLINGER HISTORICAL FLOW FOR 1980-2010 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SOUTH CONCHO AT CHRISTOVAL

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
SOUTH CONCHO AT CHRISTOVAL														
(1)	TCEQ RUN3	FLOW	113,035	SIM	1940-1998	22,635	24.1%	22,635 AND 6,607	50.9%	6,607 AND 3,111	19.5%	3,111	5.5%	
(2)	TCEQ RUN8	FLOW	113,198	SIM	1940-1998	23,002	23.6%	23,002 AND 6,717	50.9%	6,717 AND 3,183	19.8%	3,183	5.7%	
(3)	USGS	FLOW	114,223	HIST	1940-1995	24,788	23.7%	24,788 AND 6,915	51.3%	6,915 AND 3,489	19.2%	3,489	5.8%	
(4)	USGS	FLOW	34,512	HIST	2002-2010	21,655	20.8%	21,655 AND 7,376	50.0%	7,376 AND 5,267	18.8%	5,267	10.4%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

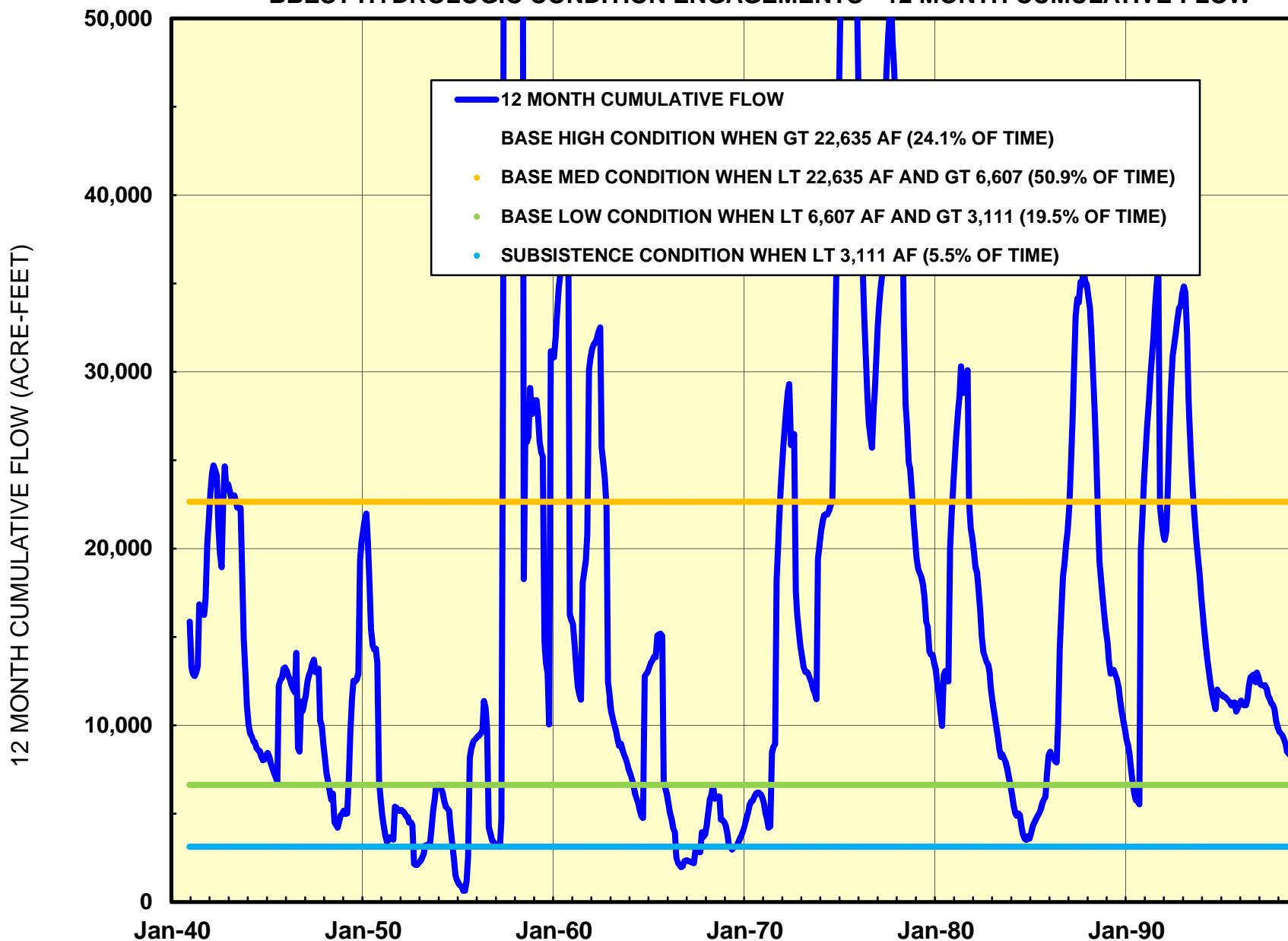
STO Storage

ELEV Elevation

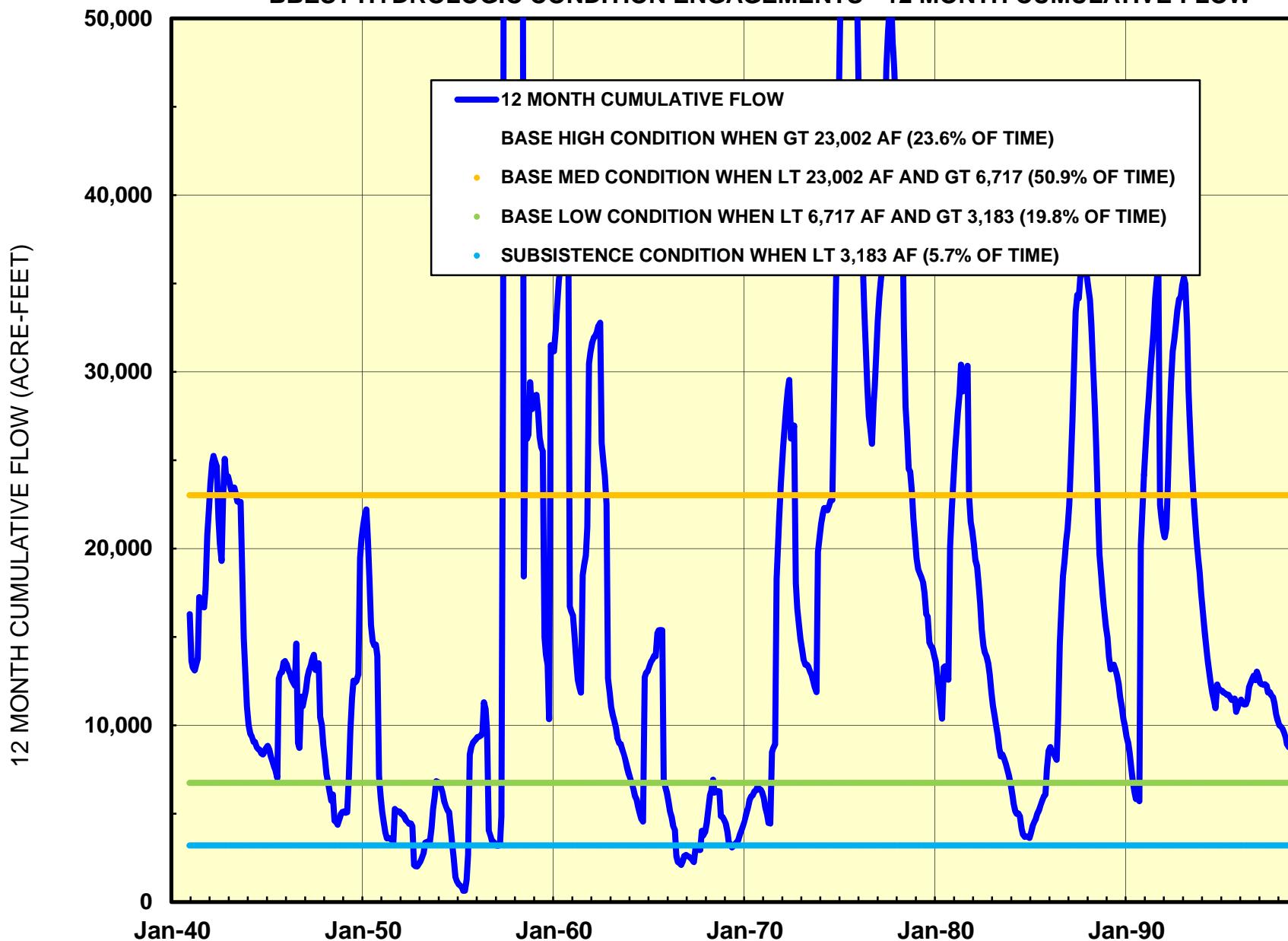
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

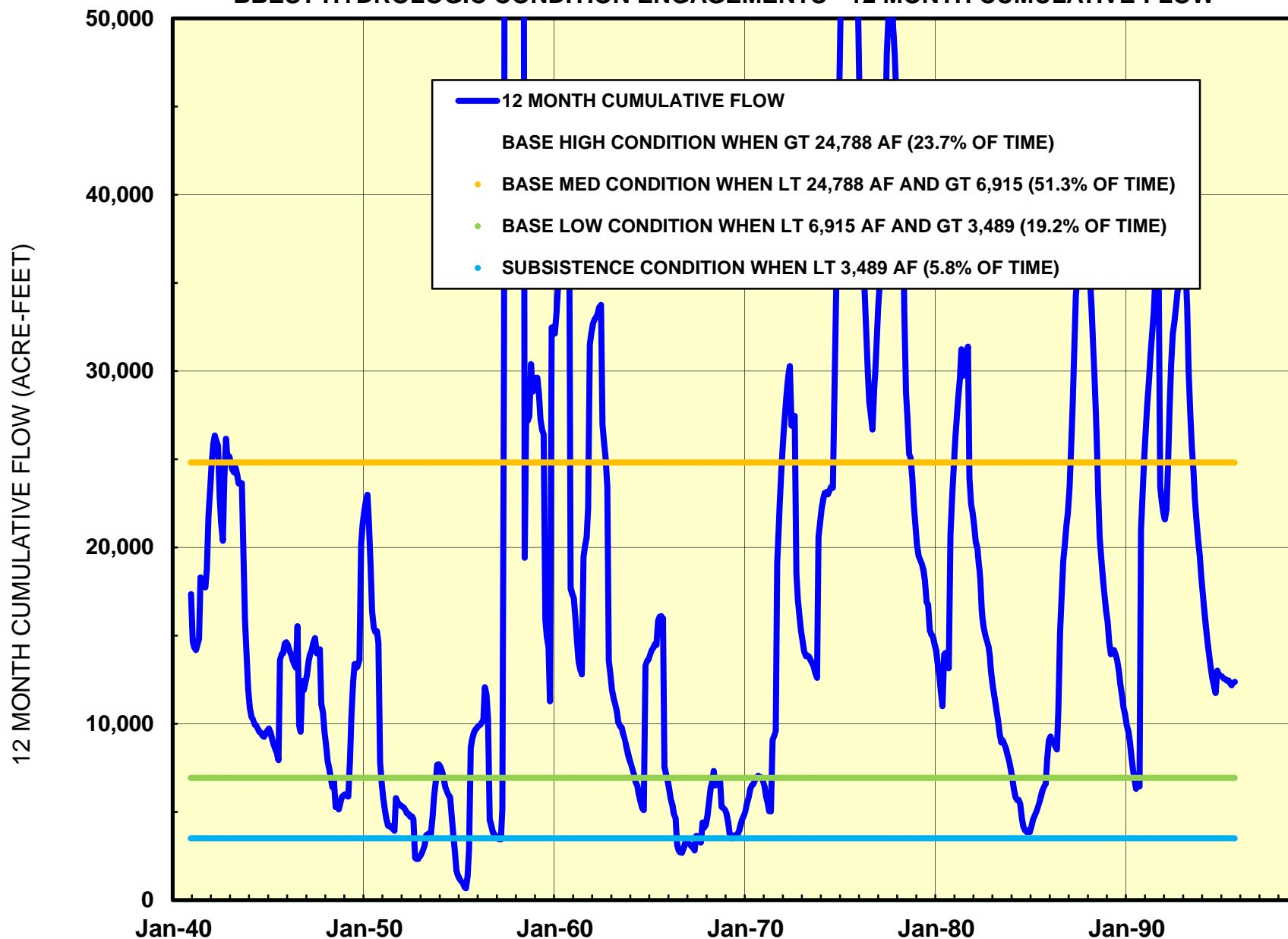
S CONCHO AT CHRISTOVAL SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



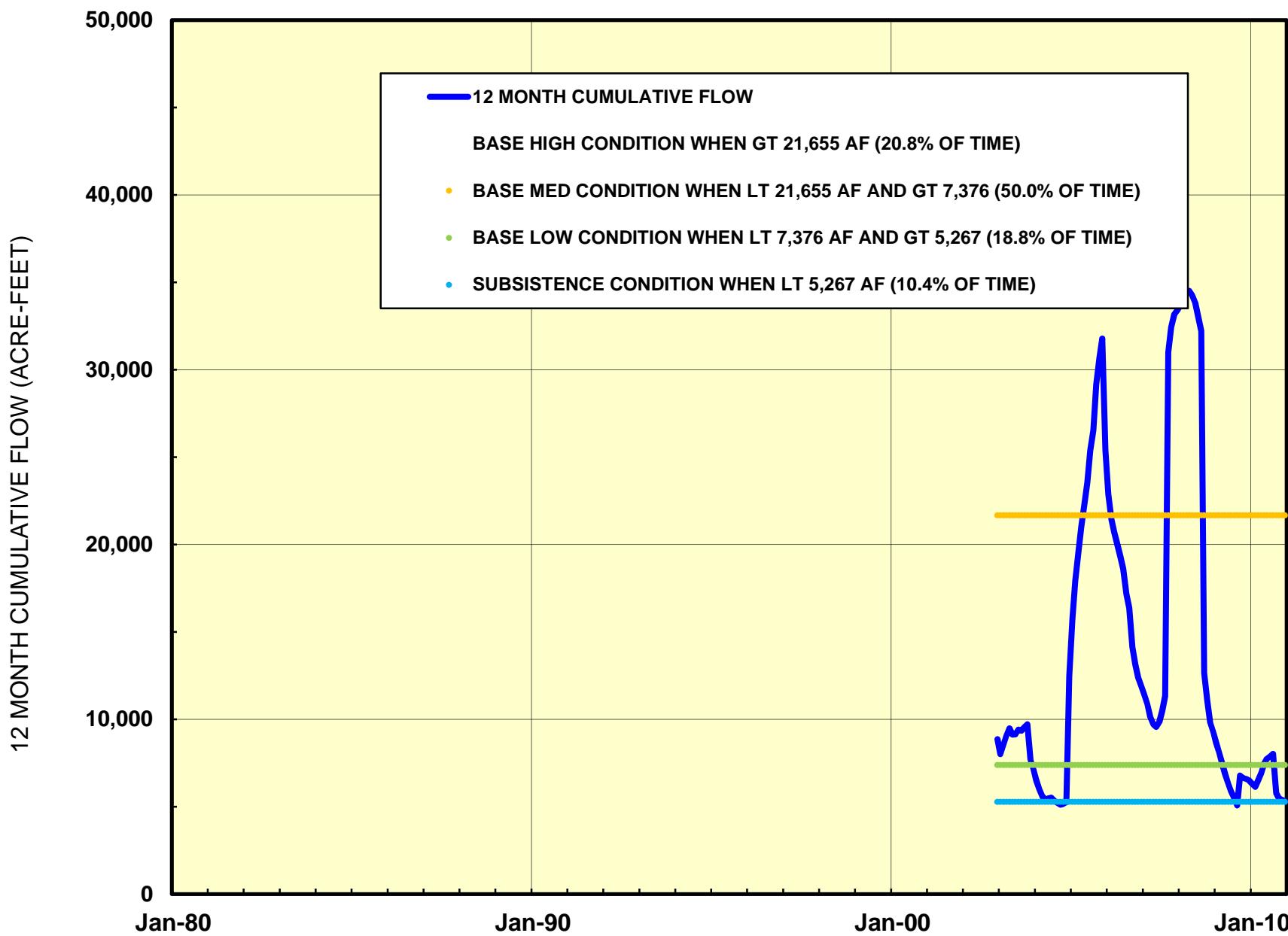
S CONCHO AT CHRISTOVAL SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



S CONCHO AT CHRISTOVAL HISTORICAL FLOW FOR 1940-1995 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



**S CONCHO AT CHRISTOVAL HISTORICAL FLOW FOR 2003-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW**



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR CONCHO AT PAINT ROCK SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					SOURCE DATA	RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD			BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
							ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
CONCHO AT PAINT ROCK															
(1)	TCEQ RUN3	FLOW	351,903	SIM	1940-1998		93,783	24.7%	93,783 AND 36,914	51.1%	36,914 AND 19,648	19.3%	19,648	4.9%	
(2)	TCEQ RUN8	FLOW	317,672	SIM	1940-1998		88,123	23.9%	88,123 AND 34,448	51.7%	34,448 AND 18,566	19.3%	18,566	5.2%	
(3)	USGS	FLOW	555,764	HIST	1940-1998		83,100	25.9%	83,100 AND 24,163	48.0%	24,163 AND 11,048	21.3%	11,048	4.9%	
(4)	USGS	FLOW	194,844	HIST	1980-2010		49,899	25.8%	49,899 AND 17,003	48.9%	17,003 AND 7,110	18.3%	7,110	7.0%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

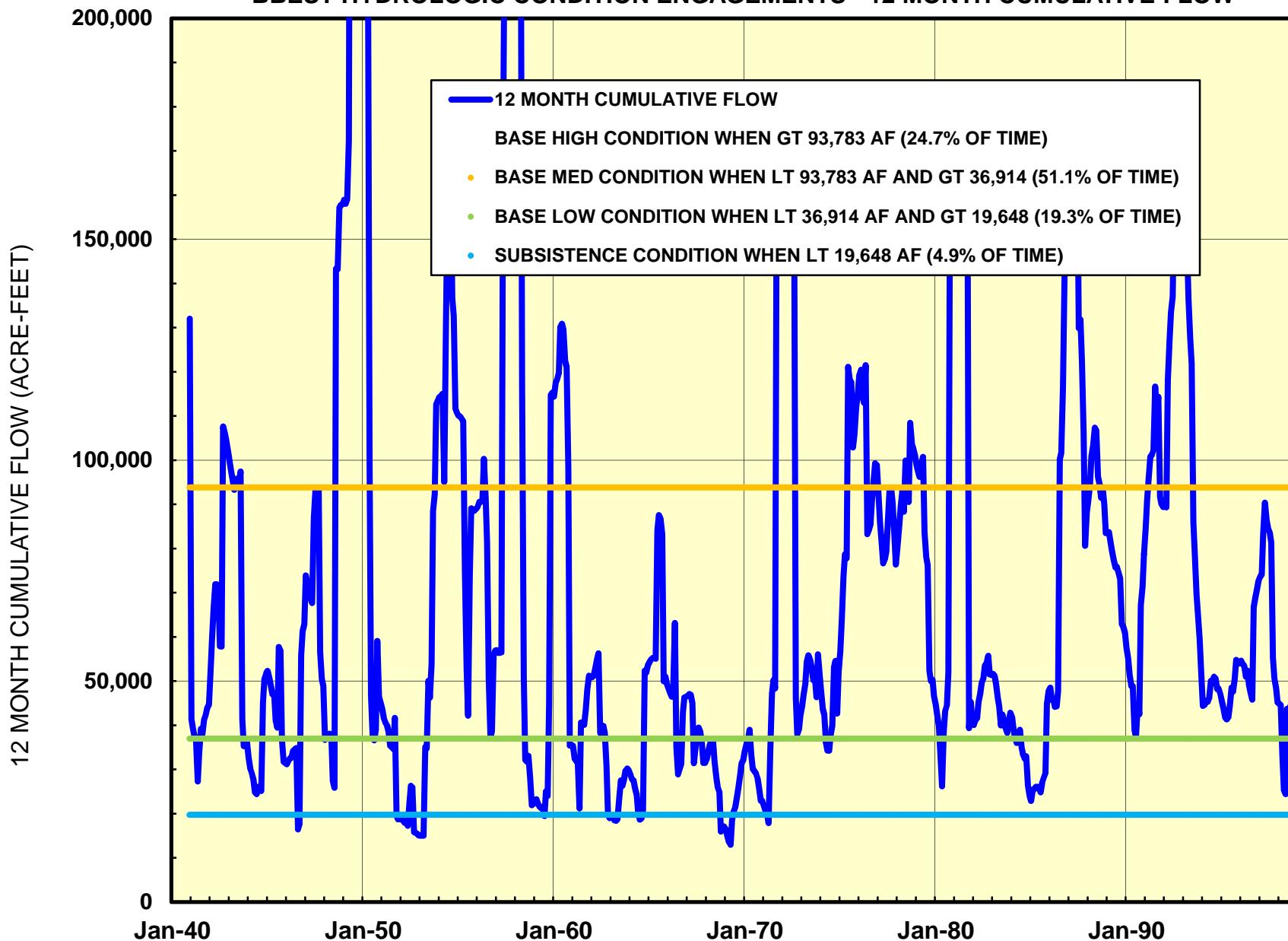
STO Storage

ELEV Elevation

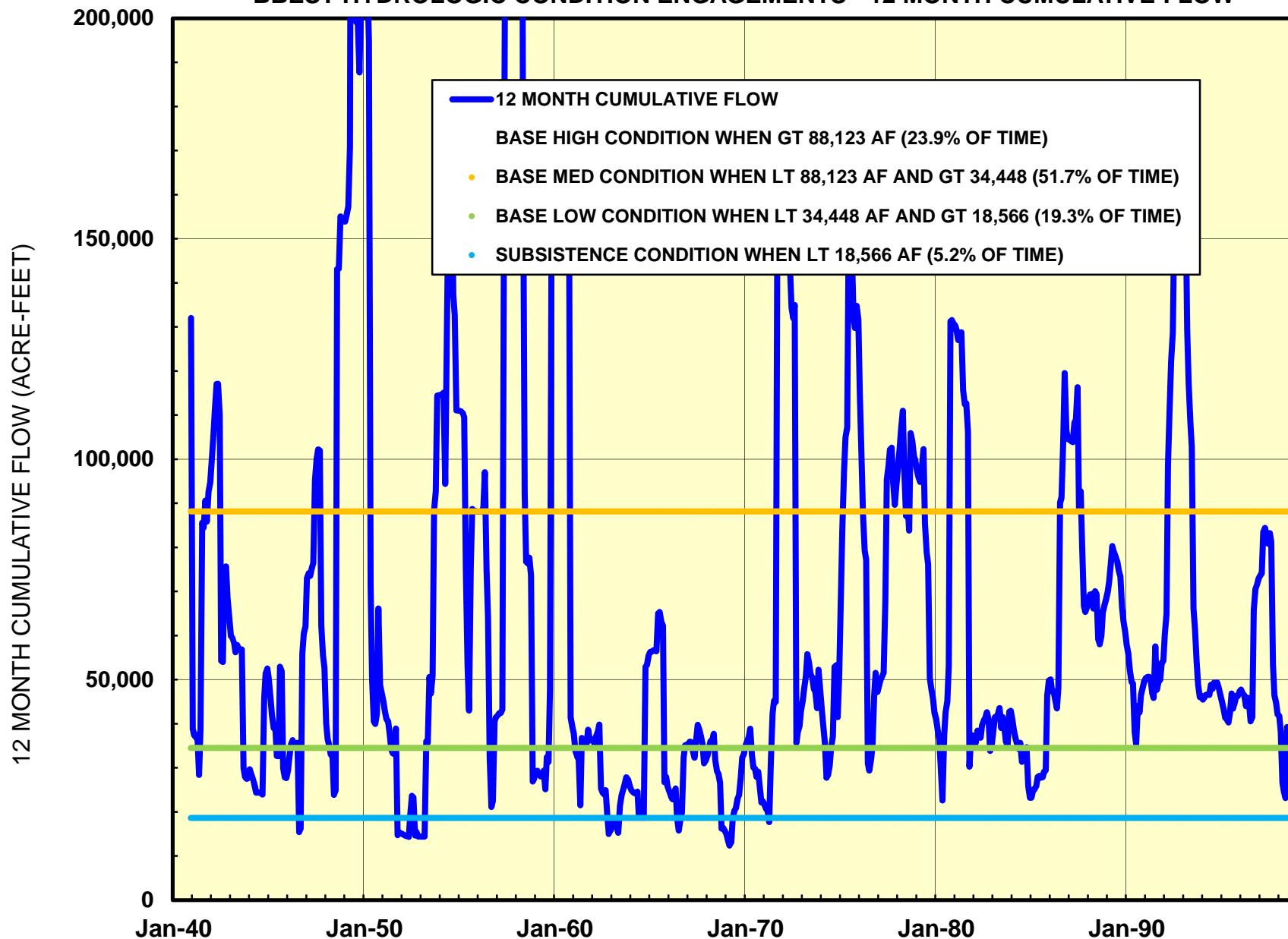
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

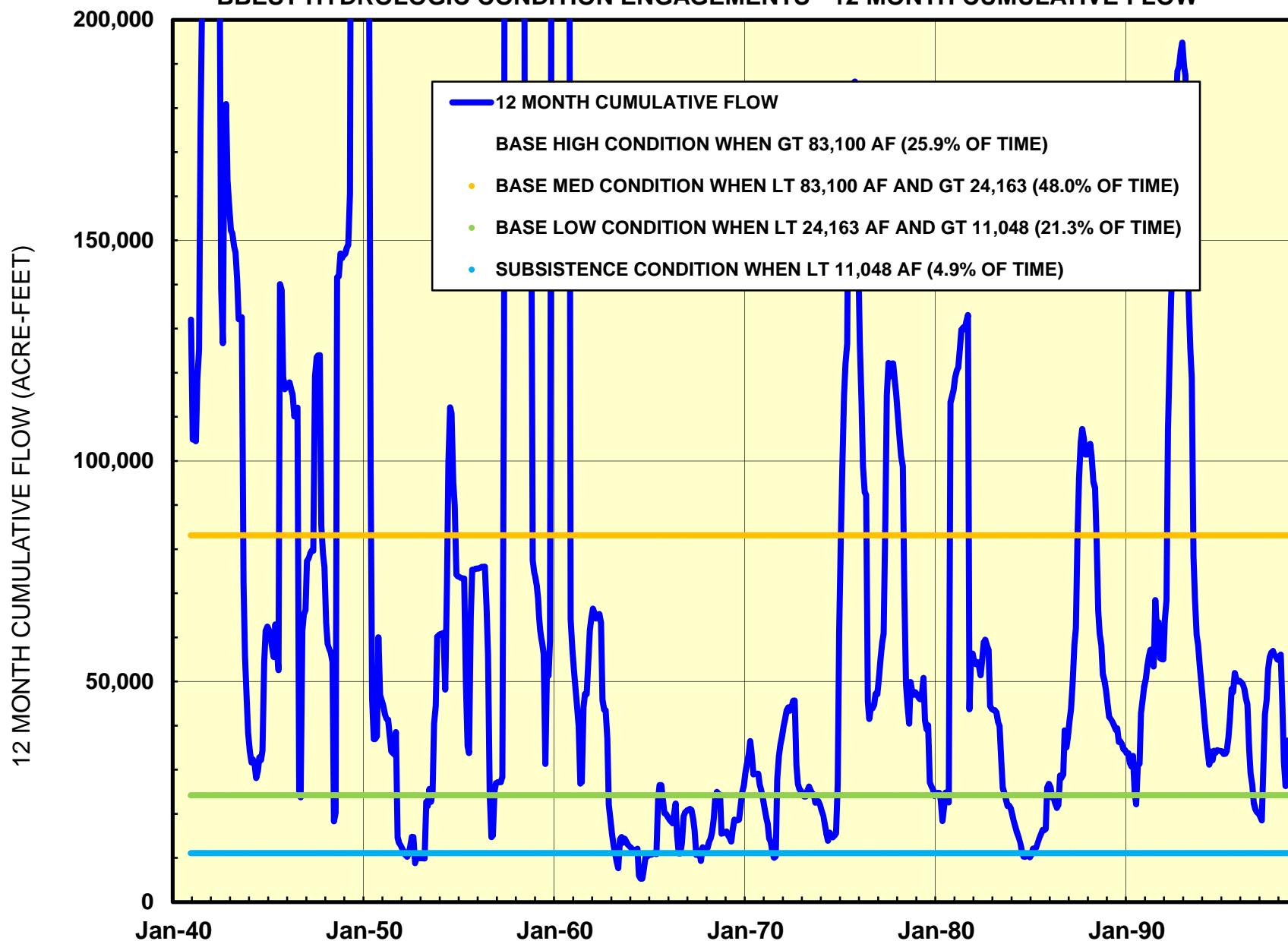
CONCHO AT PAINT ROCK SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



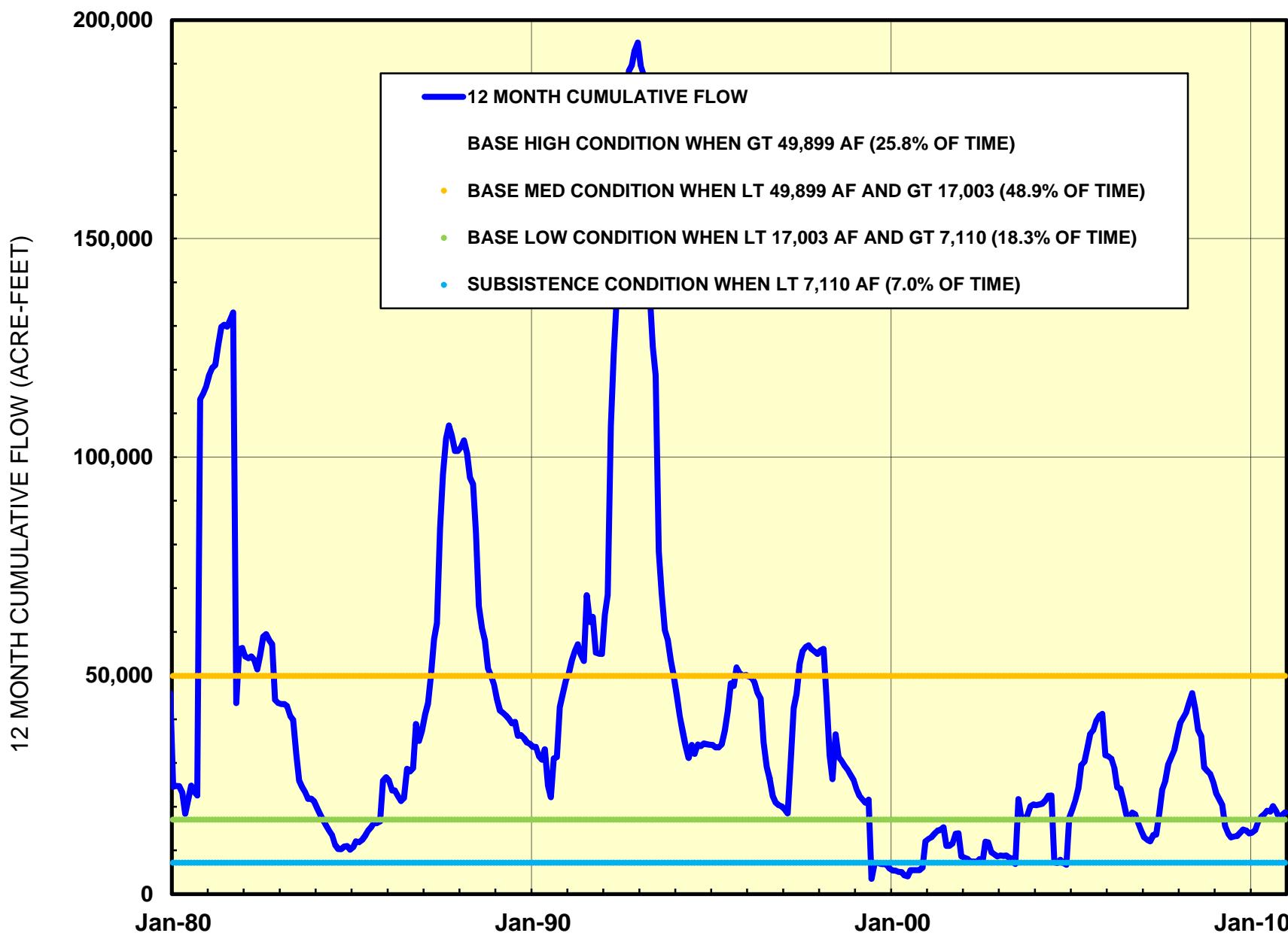
CONCHO AT PAINT ROCK SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



CONCHO AT PAINT ROCK HISTORICAL FLOW FOR 1940-1998 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



CONCHO AT PAINT ROCK HISTORICAL FLOW FOR 1980-2010 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR PECAN BAYOU NEAR MULLIN SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
PECAN BAYOU NEAR MULLIN														
(1)	TCEQ RUN3	FLOW	898,155	SIM	1940-1998	168,768	25.3%	168,768 AND 40,218	50.6%	40,218 AND 16,693	17.8%	16,693	6.3%	
(2)	TCEQ RUN8	FLOW	959,412	SIM	1940-1998	184,850	26.1%	184,850 AND 51,224	48.9%	51,224 AND 20,903	19.0%	20,903	6.0%	
(3)	USGS	FLOW	961,724	HIST	1940-1998	155,135	23.9%	155,135 AND 29,979	50.6%	29,979 AND 7,837	20.7%	7,837	4.9%	
(4)	USGS	FLOW	961,724	HIST	1980-2010	187,741	25.3%	187,741 AND 26,695	48.9%	26,695 AND 11,864	19.4%	11,864	6.5%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

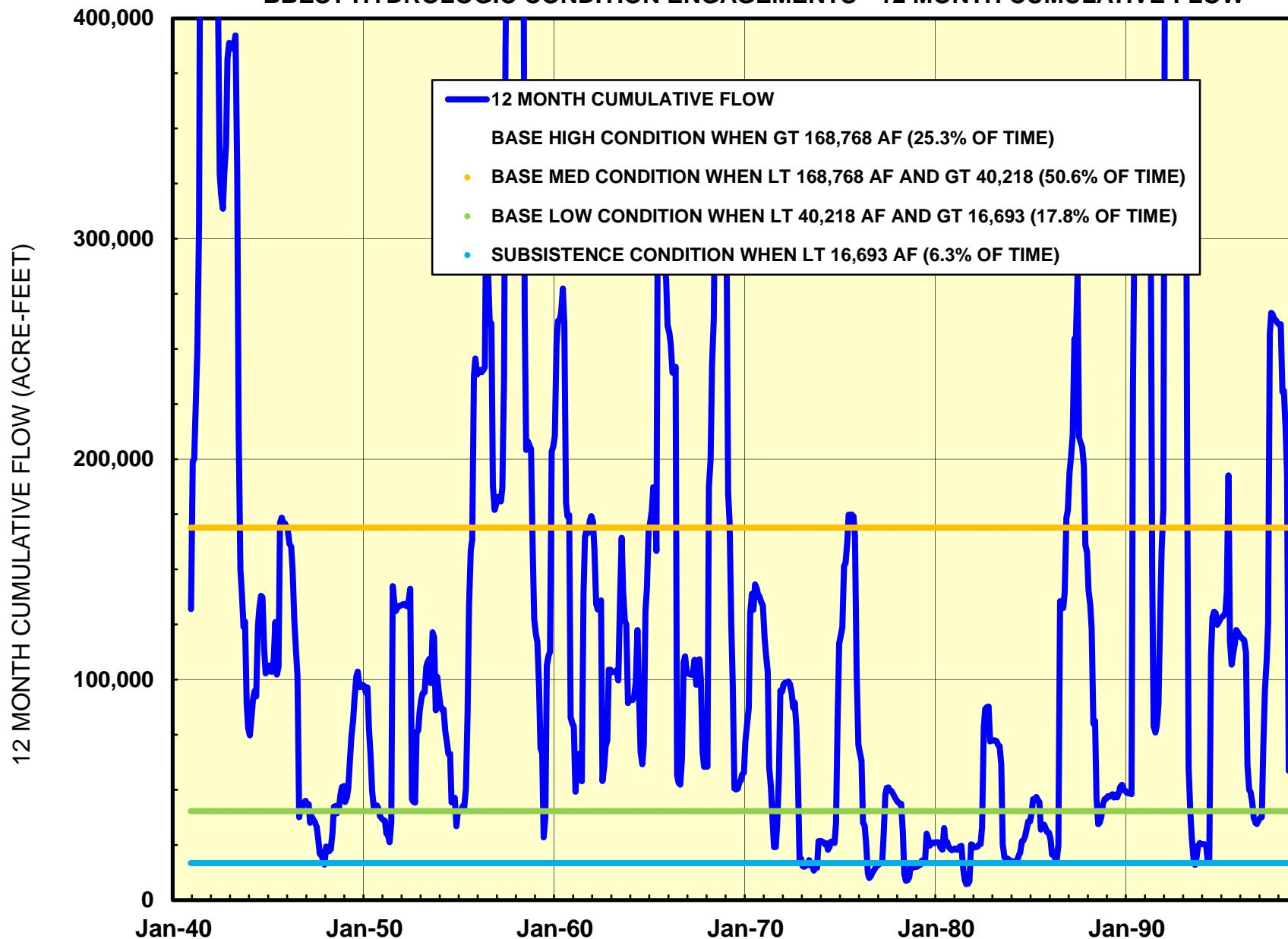
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ELEV Elevation

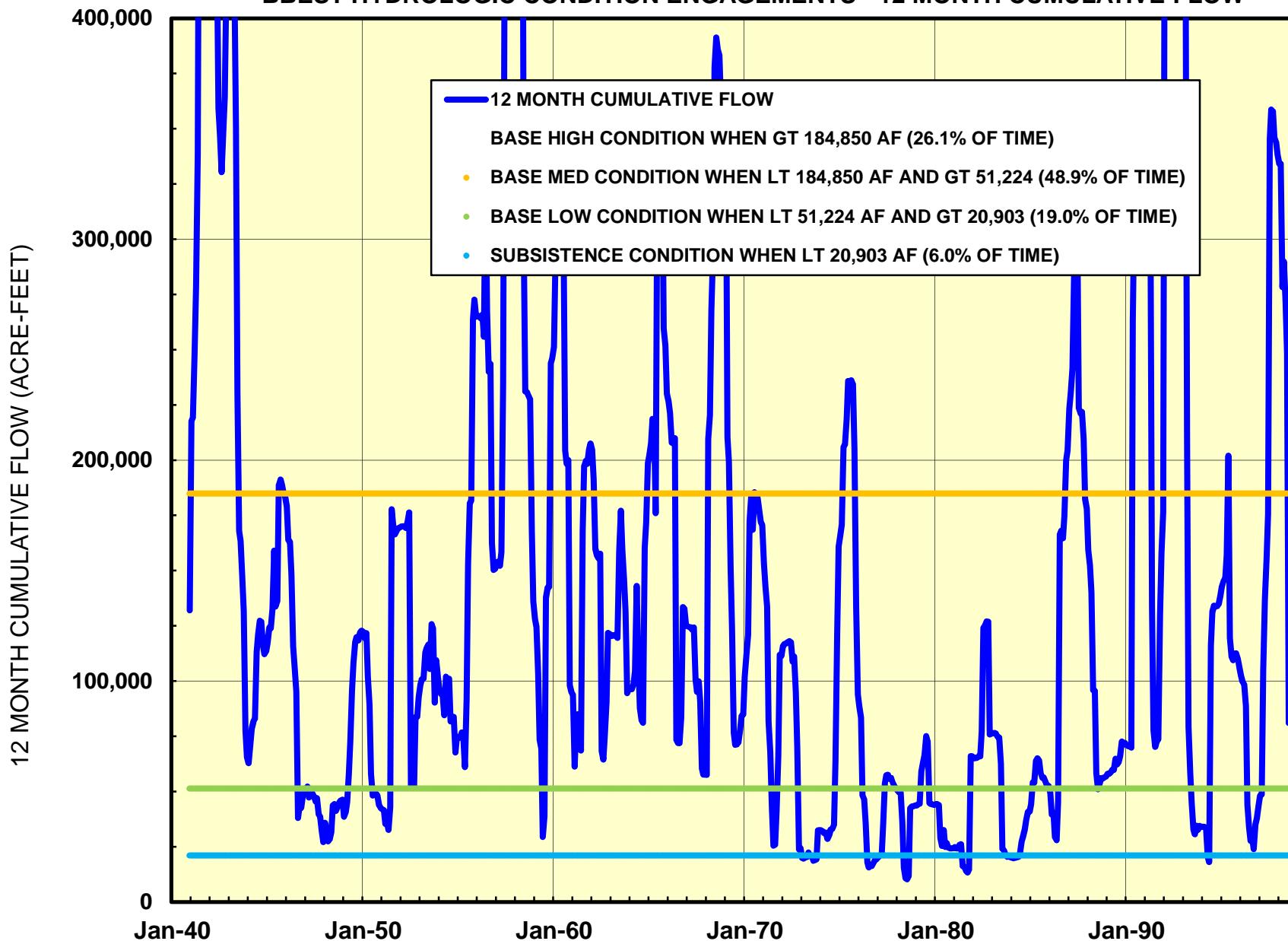
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

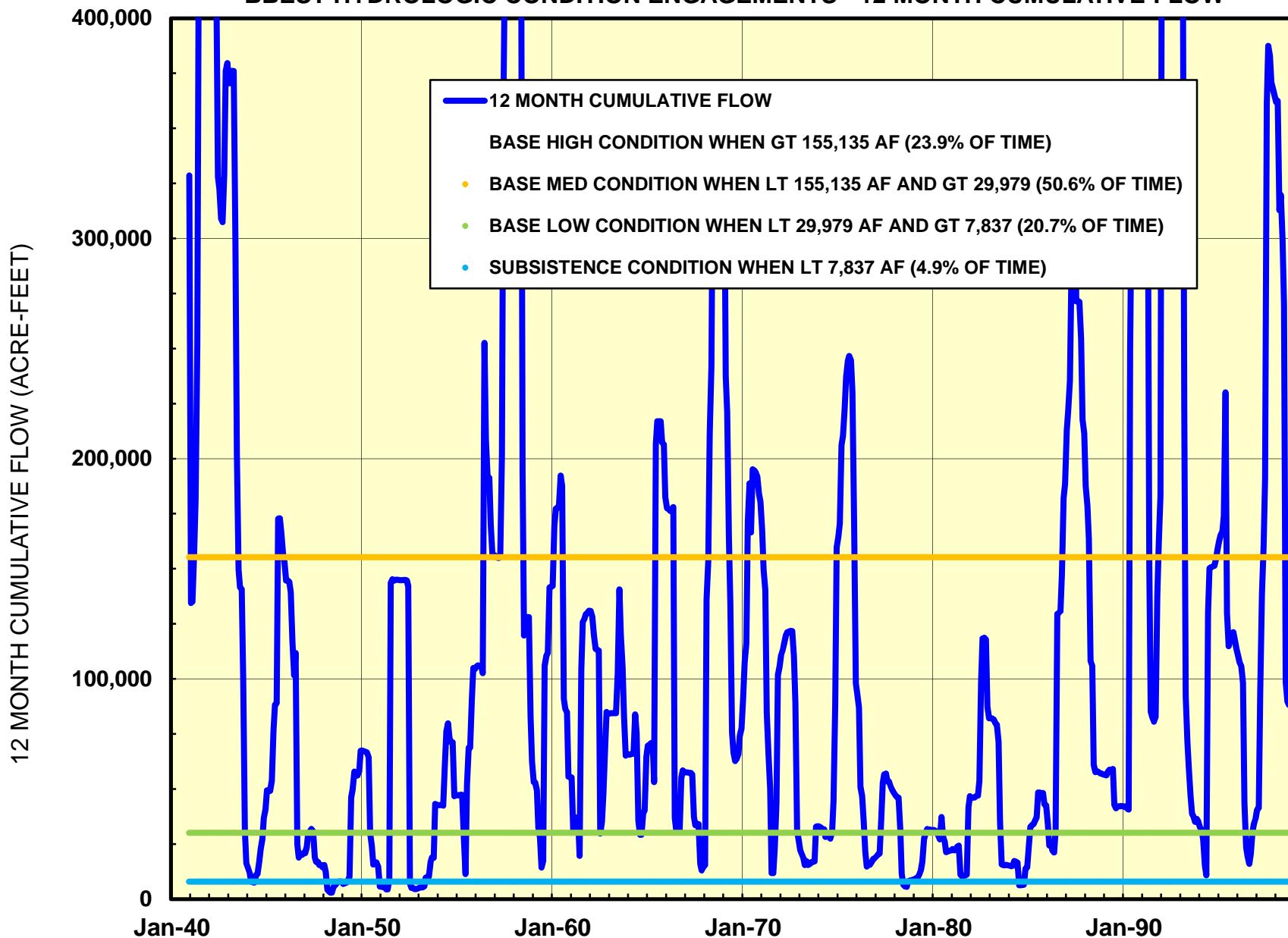
PECAN BAYOU NR MULLIN SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



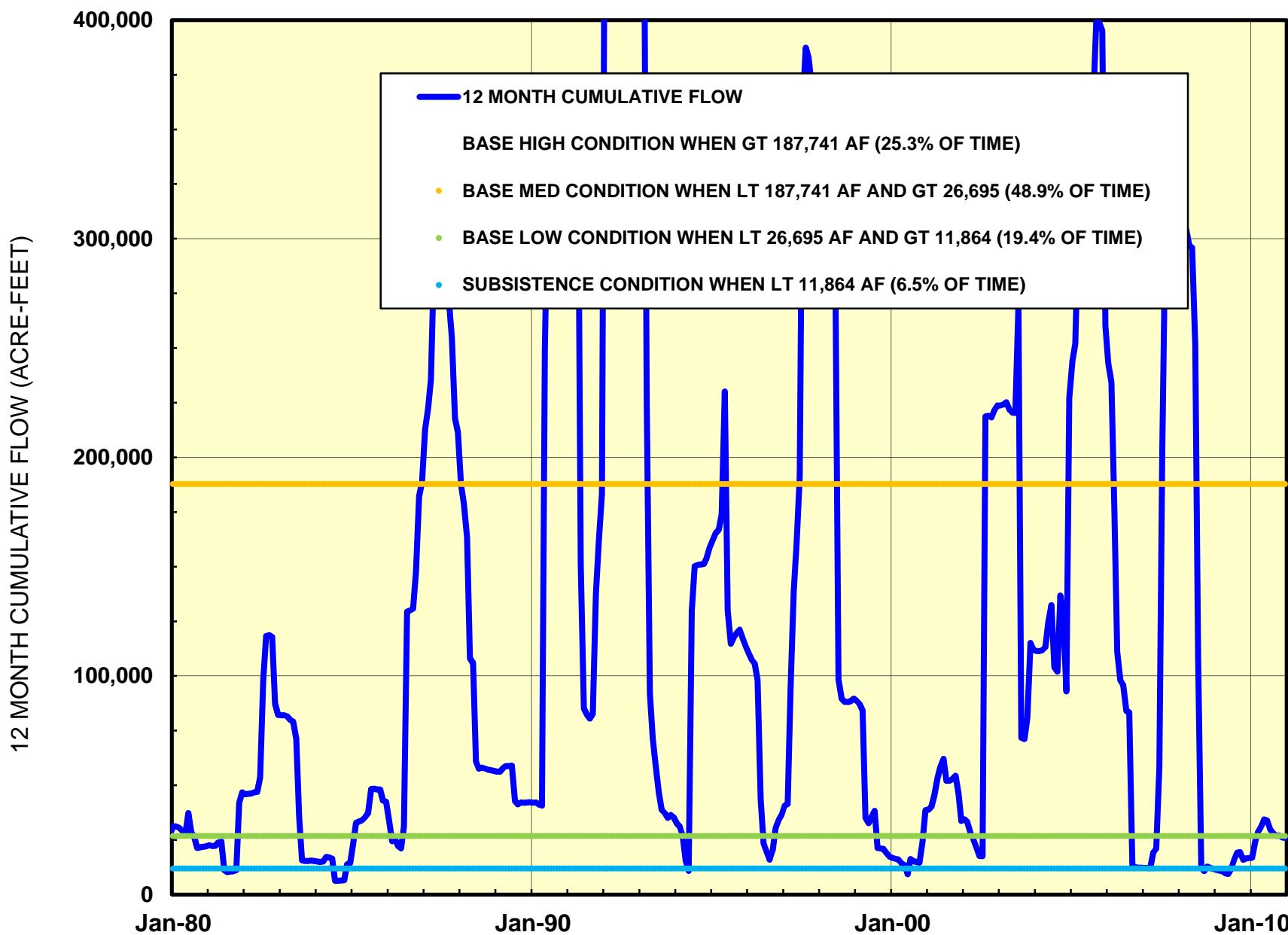
PECAN BAYOU NR MULLIN SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



PECAN BAYOU NEAR MULLIN HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



PECAN BAYOU NR MULLIN HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SAN SABA AT SAN SABA SITE

CL BBEST / BBASC August 24, 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
SAN SABA RIVER AT SAN SABA														
(1)	TCEQ RUN3	FLOW	503,703	SIM	1940-1998	185,982	24.7%	185,982 AND 70,219	50.6%	70,219 AND 48,662	20.1%	48,662	4.6%	
(2)	TCEQ RUN8	FLOW	516,567	SIM	1940-1998	187,923	25.0%	187,923 AND 71,593	50.3%	71,593 AND 49,164	21.0%	49,164	3.7%	
(3)	USGS (1)	FLOW	700,994	HIST	1940-1998	177,516	24.4%	177,516 AND 66,369	50.6%	66,369 AND 39,761	20.7%	39,761	4.3%	
(4)	USGS (1)	FLOW	700,994	HIST	1980-2010	149,890	23.7%	149,890 AND 61,099	51.6%	61,099 AND 40,545	19.4%	40,545	5.4%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

STO Storage

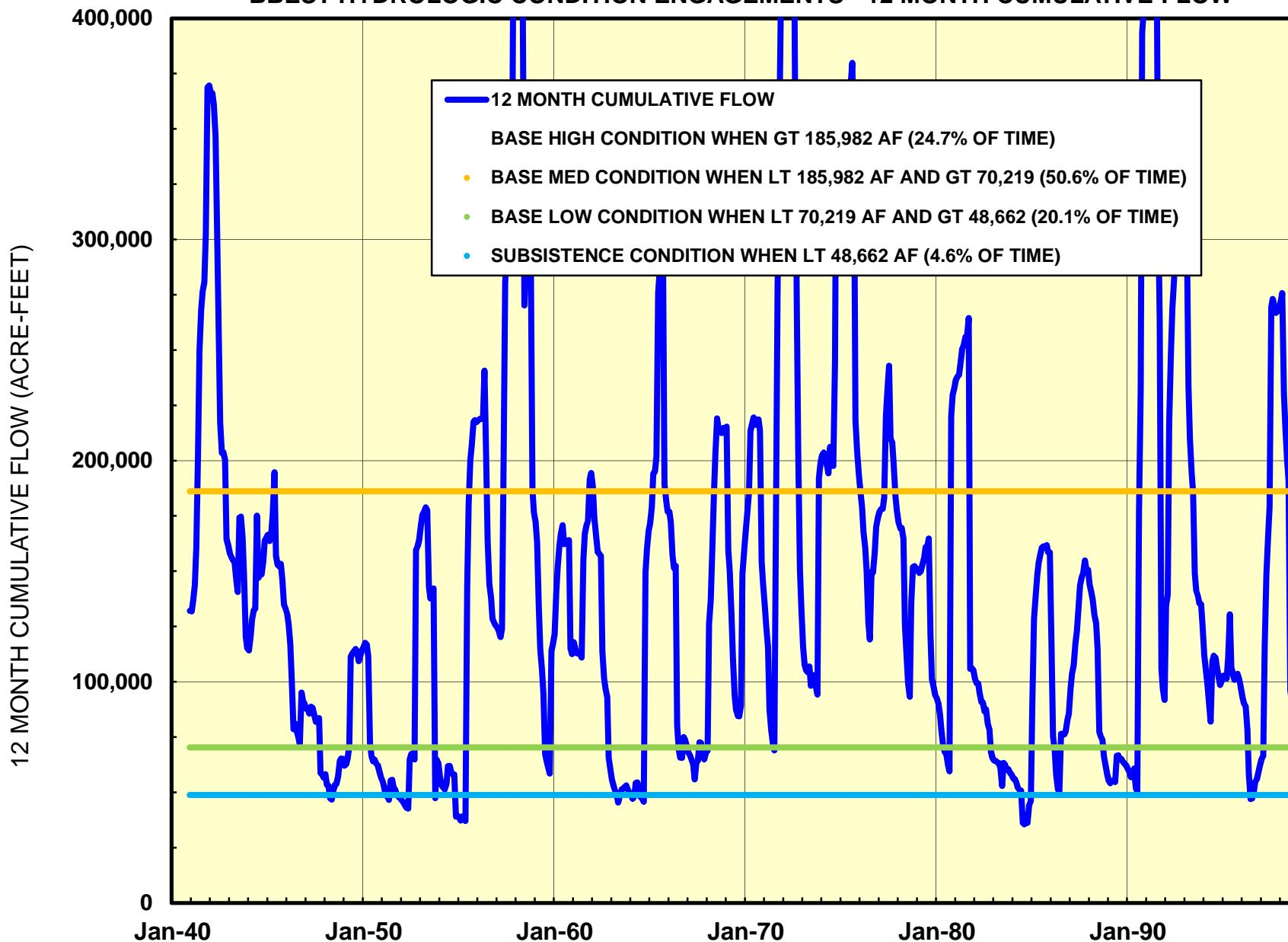
ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

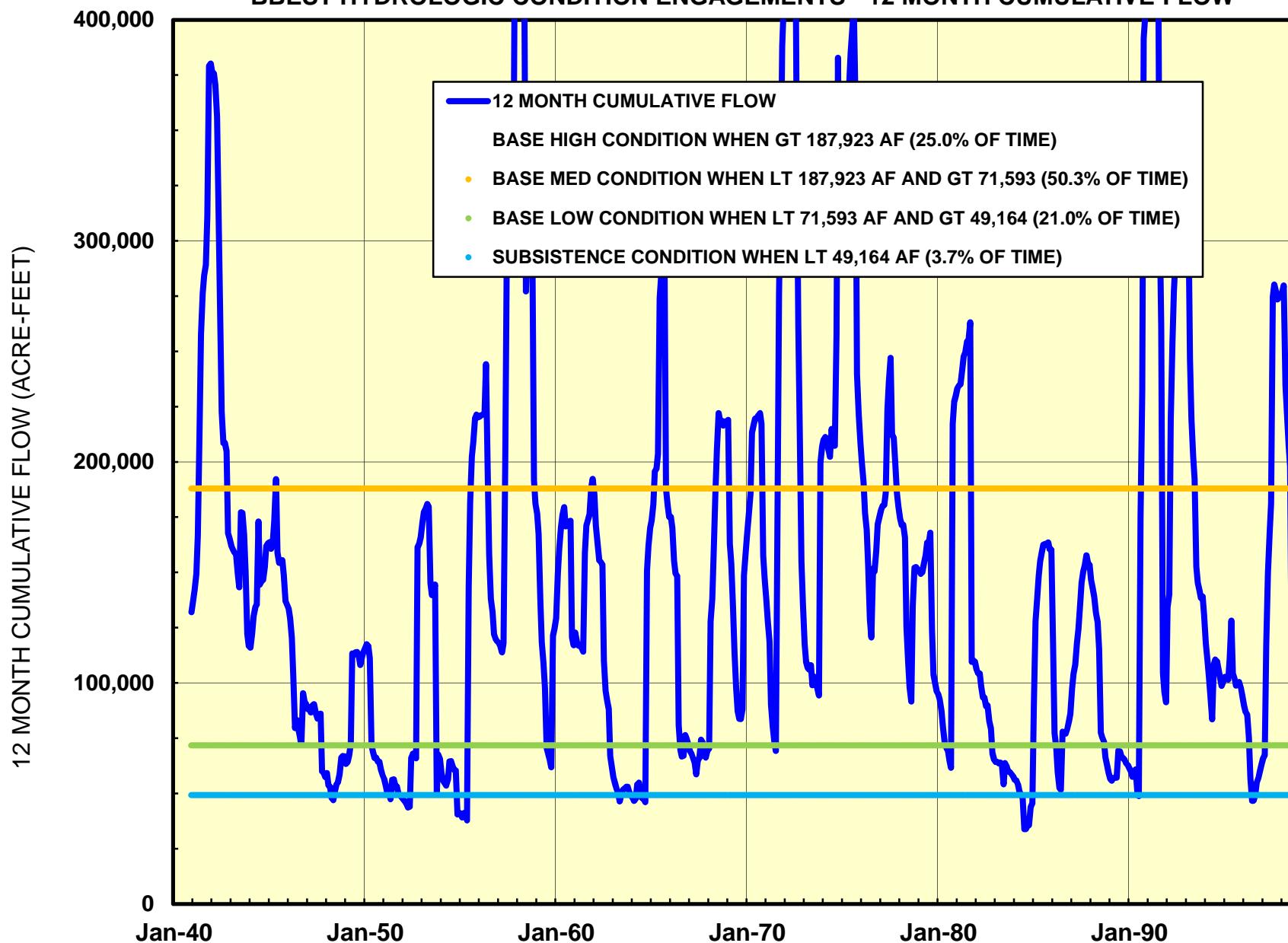
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

(1) Period from 10/1/93-9/30/97 not available, used Llano @ Llano to estimate flows.

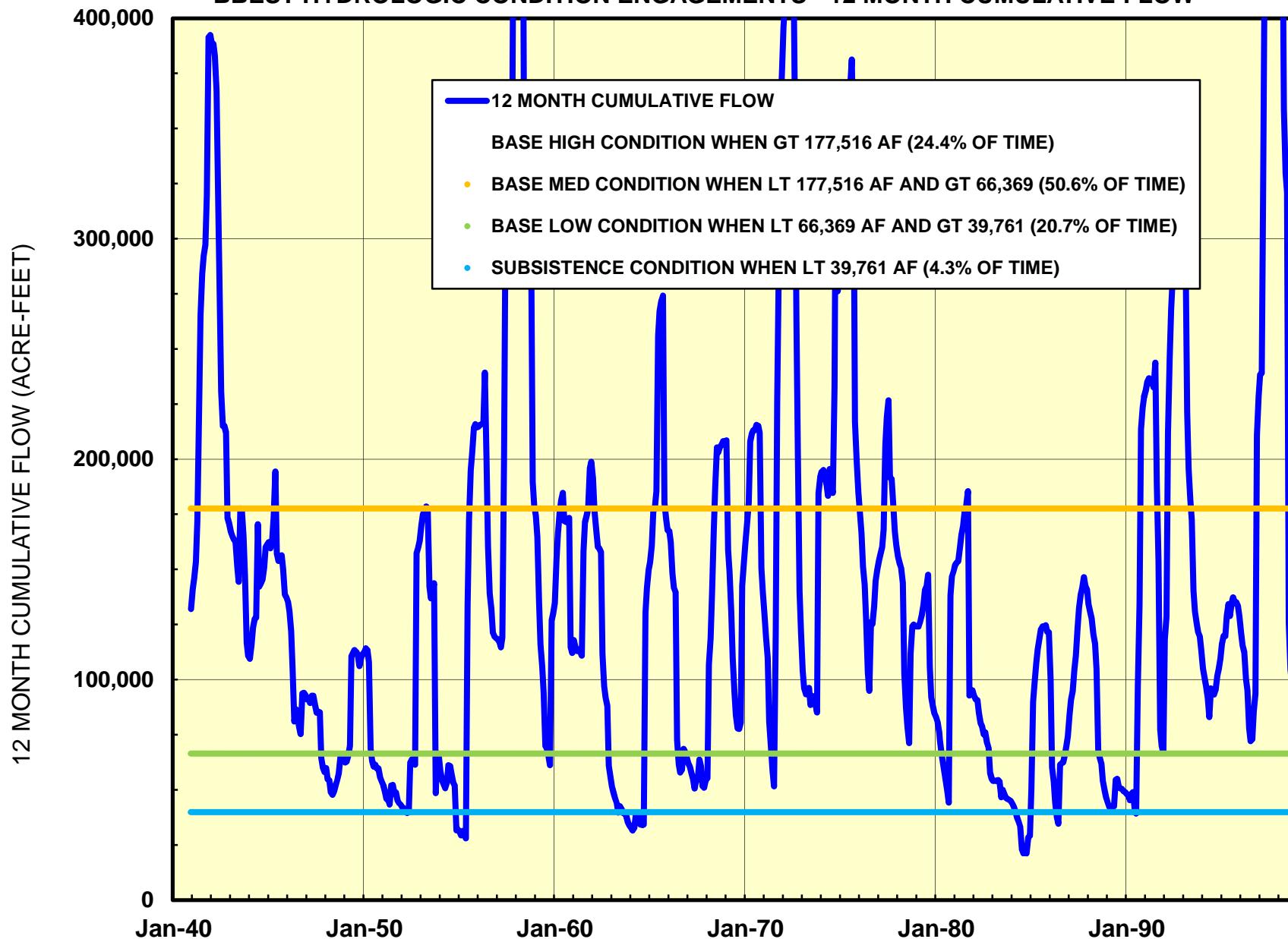
SAN SABA AT SAN SABA SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



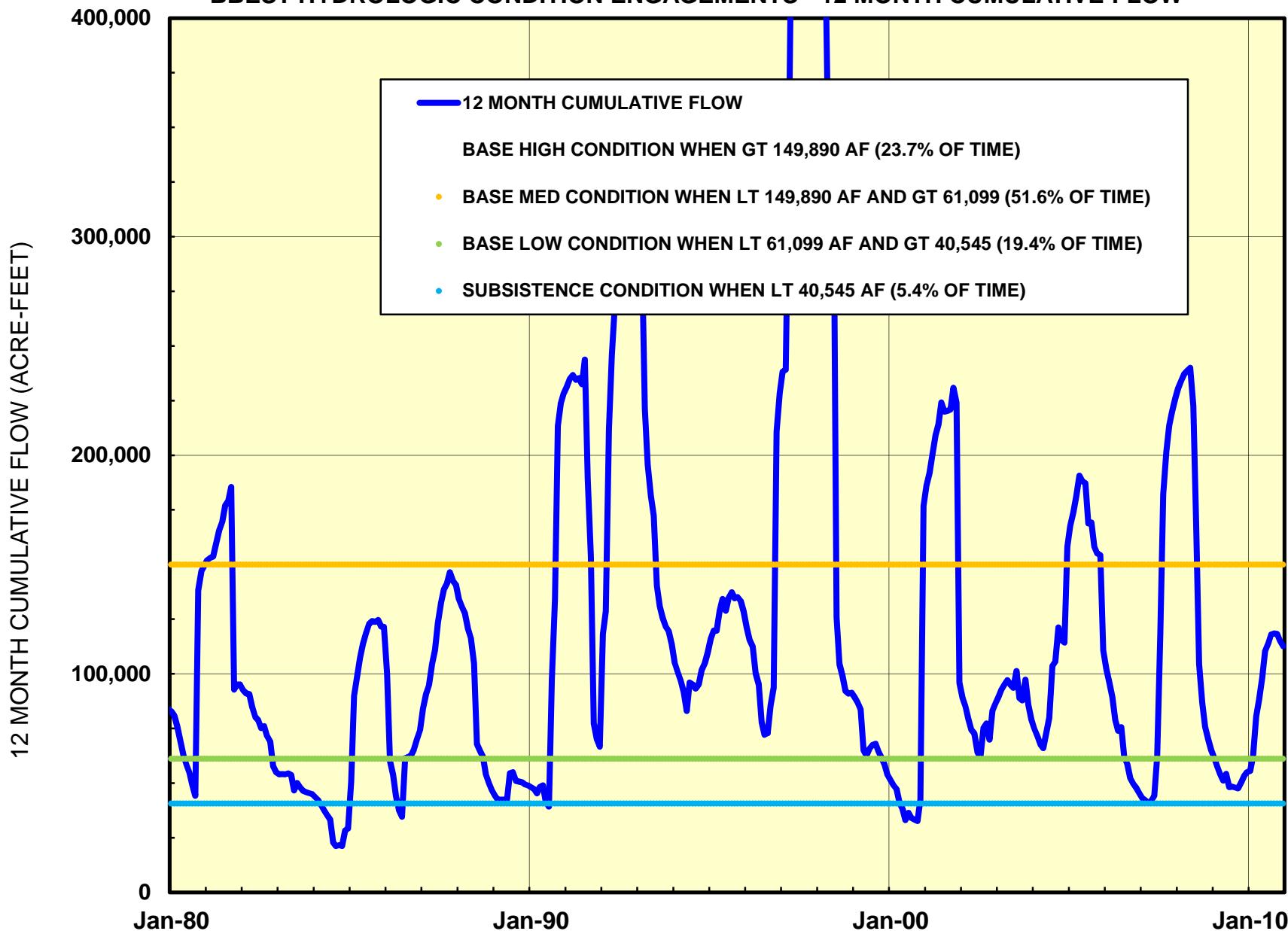
SAN SABA AT SAN SABA SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SAN SABA AT SAN SABA HISTORICAL FLOW FOR 1940-1998 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



**SAN SABA AT SAN SABA HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW**



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO NEAR SAN SABA SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
						ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	ENGAGED % OF TIME ENGAGED	% OF TIME ENGAGED
	COLORADO NEAR SAN SABA													
(1)	TCEQ RUN3	FLOW	2,121,360	SIM	1940-1998	677,930	25.3%	677,930 AND 315,820	49.4%	315,820 AND 205,942	20.4%	205,942		4.9%
(2)	TCEQ RUN8	FLOW	2,584,411	SIM	1940-1998	637,722	25.6%	637,722 AND 285,601	48.9%	285,601 AND 179,400	20.7%	179,400		4.9%
(3)	USGS	FLOW	3,083,742	HIST	1940-1998	806,041	25.6%	806,041 AND 330,965	49.1%	330,965 AND 192,824	20.7%	192,824		4.6%
(4)	USGS	FLOW	2,300,694	HIST	1980-2010	568,972	24.2%	568,972 AND 205,106	52.2%	205,106 AND 80,507	17.2%	80,507		6.5%

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

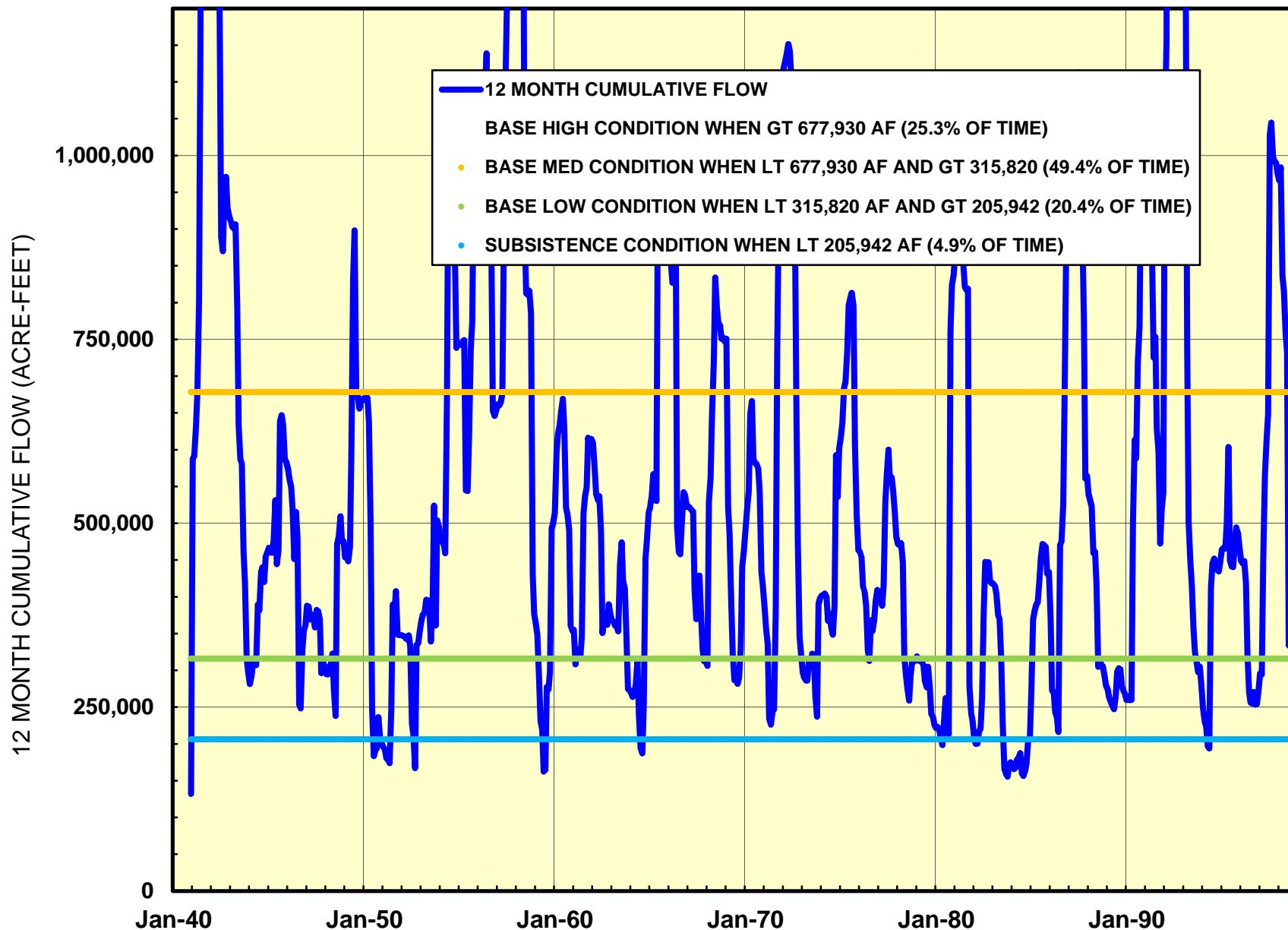
STO Storage

ELEV Elevation

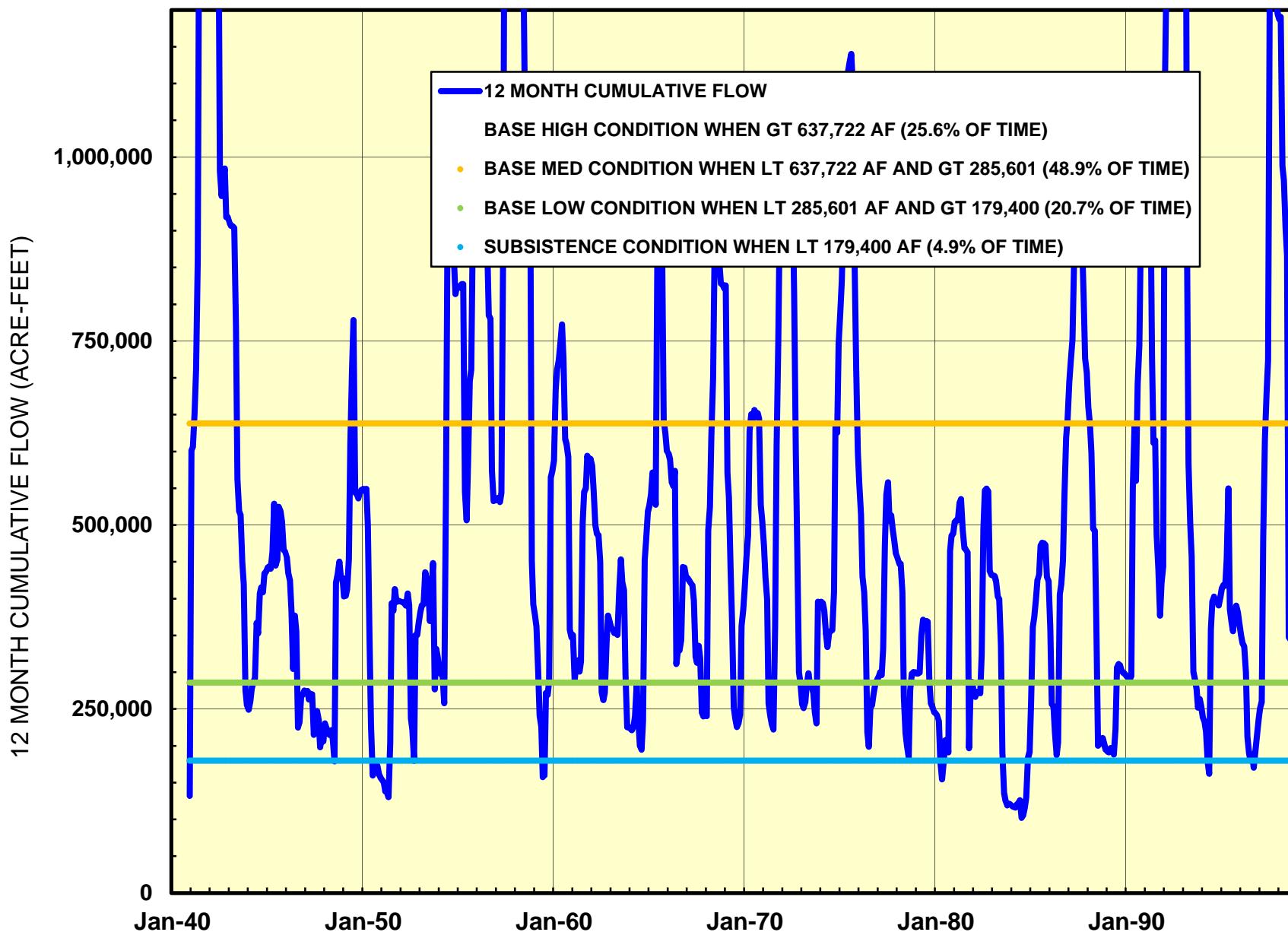
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

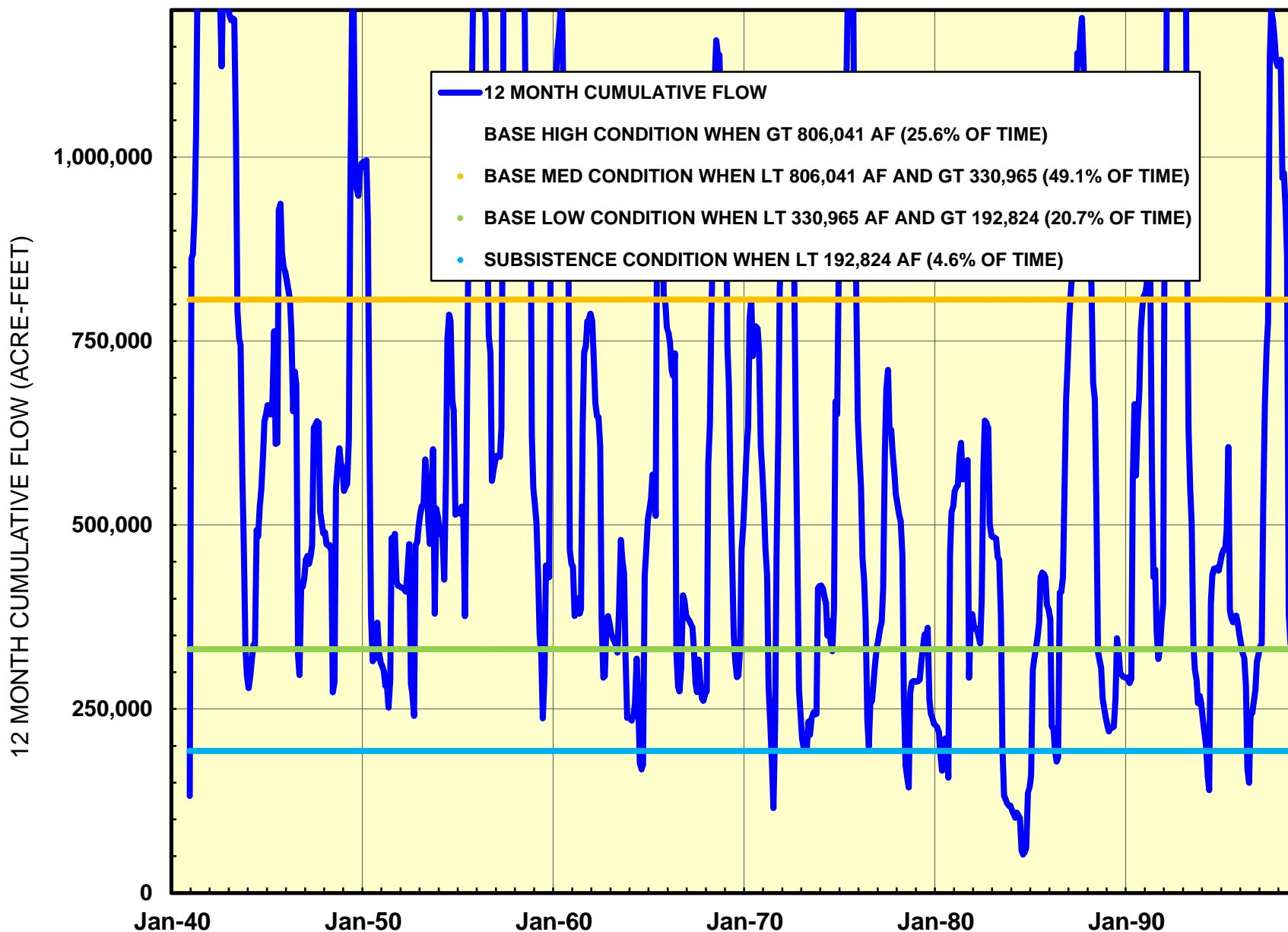
COLORADO NR SAN SABA SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



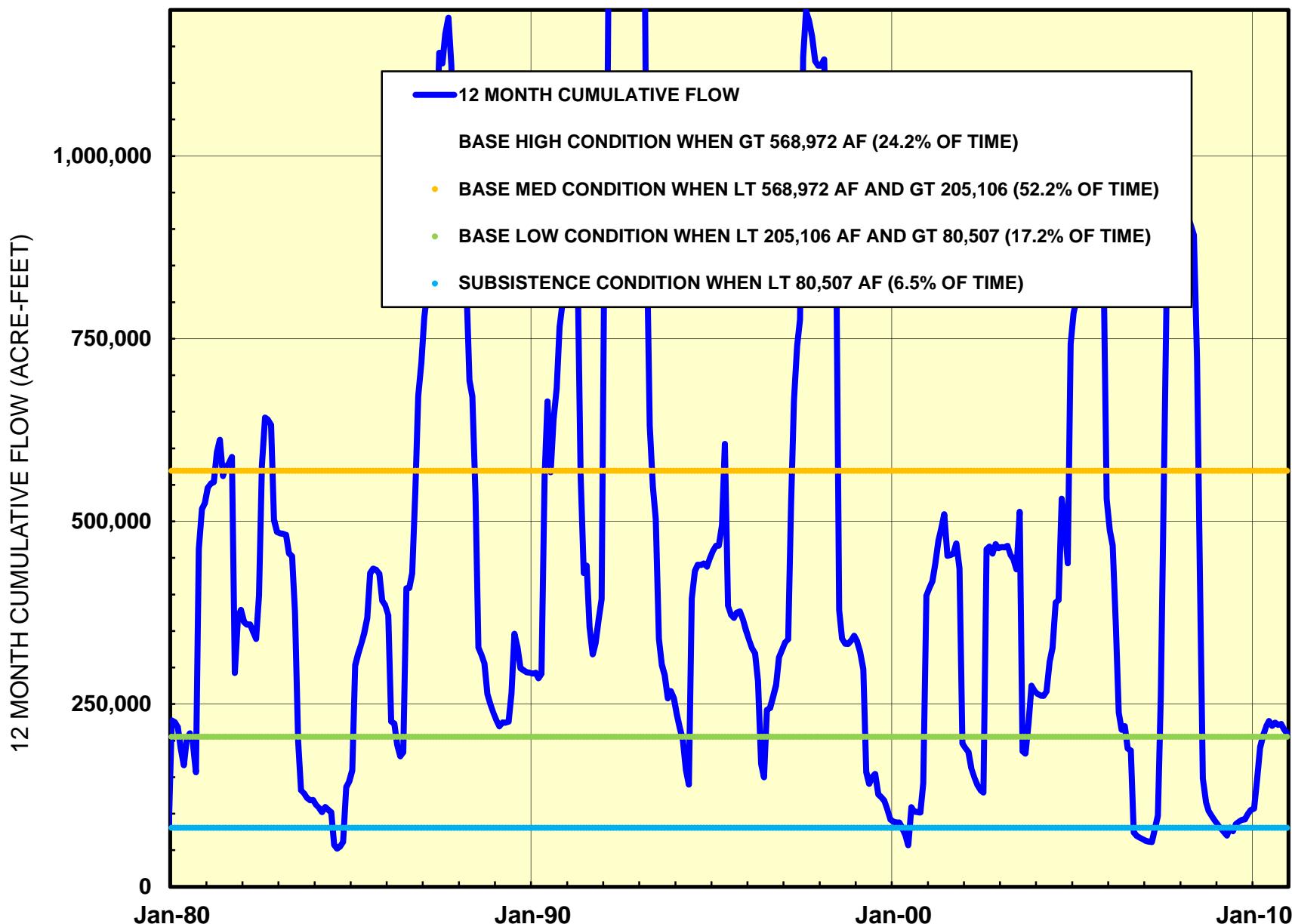
COLORADO NR SAN SABA SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



COLORADO NR SAN SABA HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



COLORADO NR SAN SABA HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR LLANO AT LLANO SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
LLANO AT LLANO														
(1)	TCEQ RUN3	FLOW	961,451	SIM	1940-1998	358,826	25.0%	358,826 AND 142,110	49.1%	142,110 AND 64,208	20.1%	64,208	5.7%	
(2)	TCEQ RUN8	FLOW	966,182	SIM	1940-1998	360,065	25.0%	360,065 AND 144,293	49.1%	144,293 AND 64,243	20.1%	64,243	5.7%	
(3)	USGS	FLOW	968,106	HIST	1940-1998	361,107	25.6%	361,107 AND 143,127	47.7%	143,127 AND 60,035	21.3%	60,035	5.5%	
(4)	USGS	FLOW	968,106	HIST	1980-2010	364,535	23.7%	364,535 AND 145,657	50.0%	145,657 AND 90,810	20.4%	90,810	5.9%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

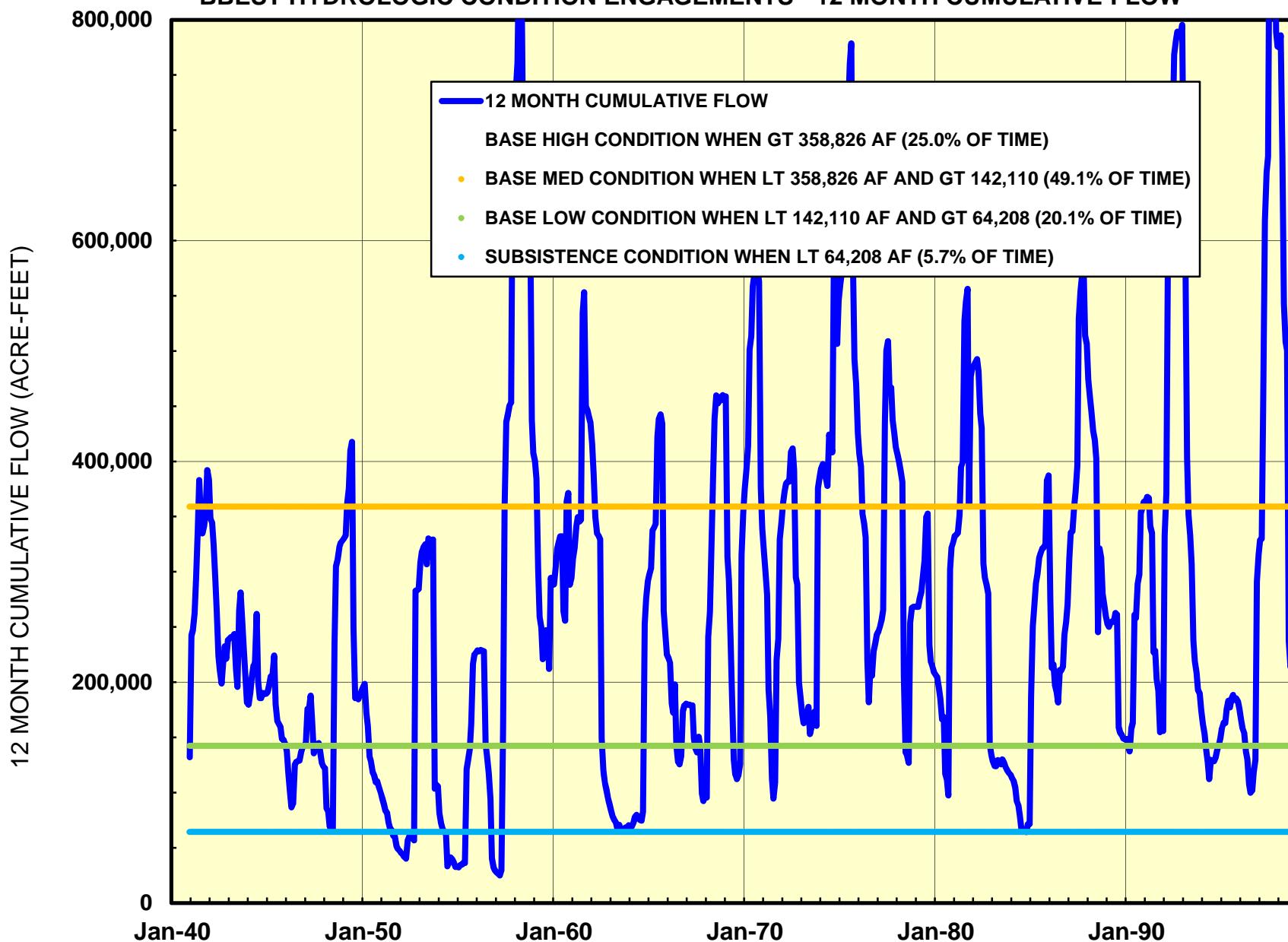
STO Storage

ELEV Elevation

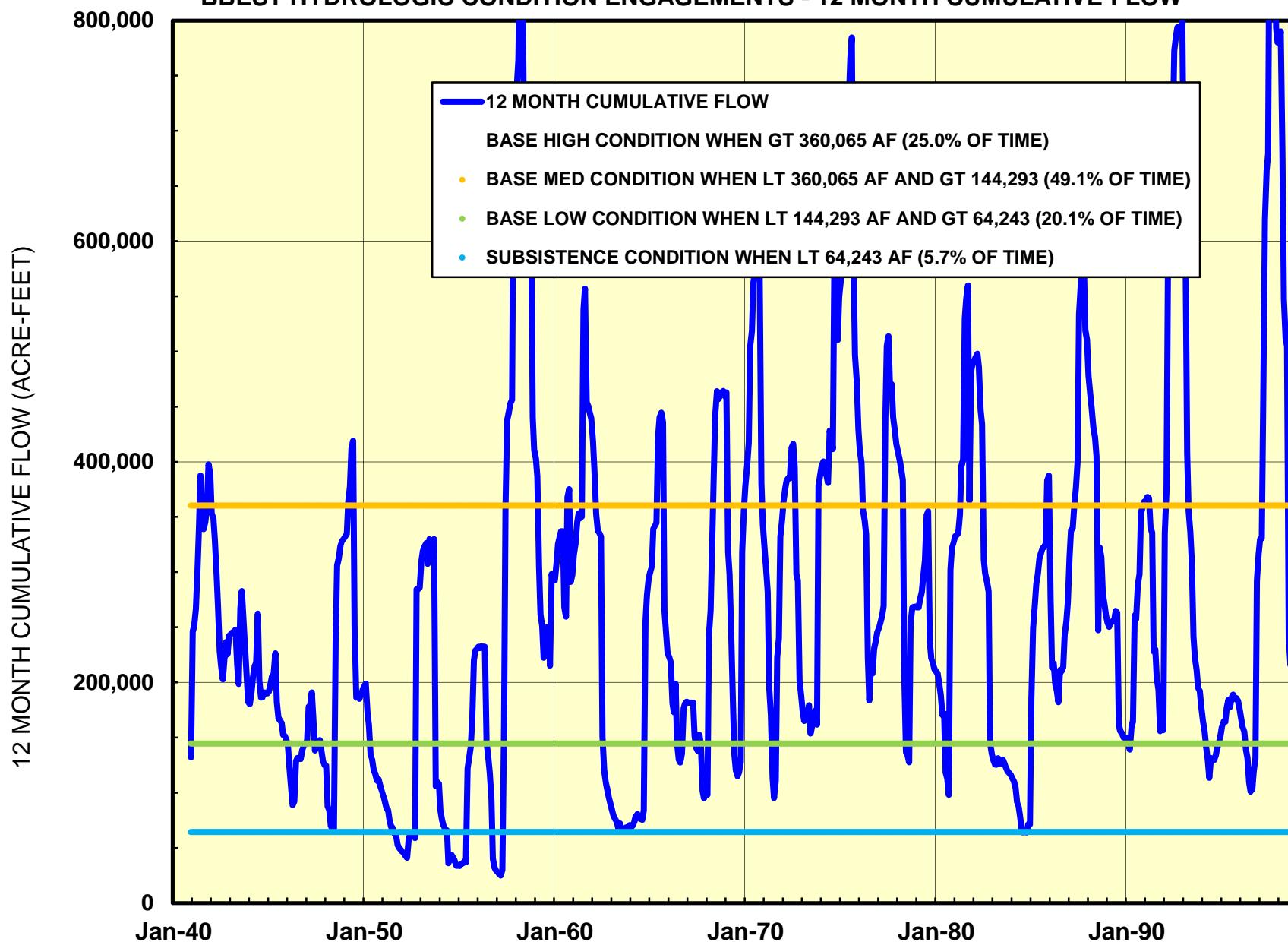
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

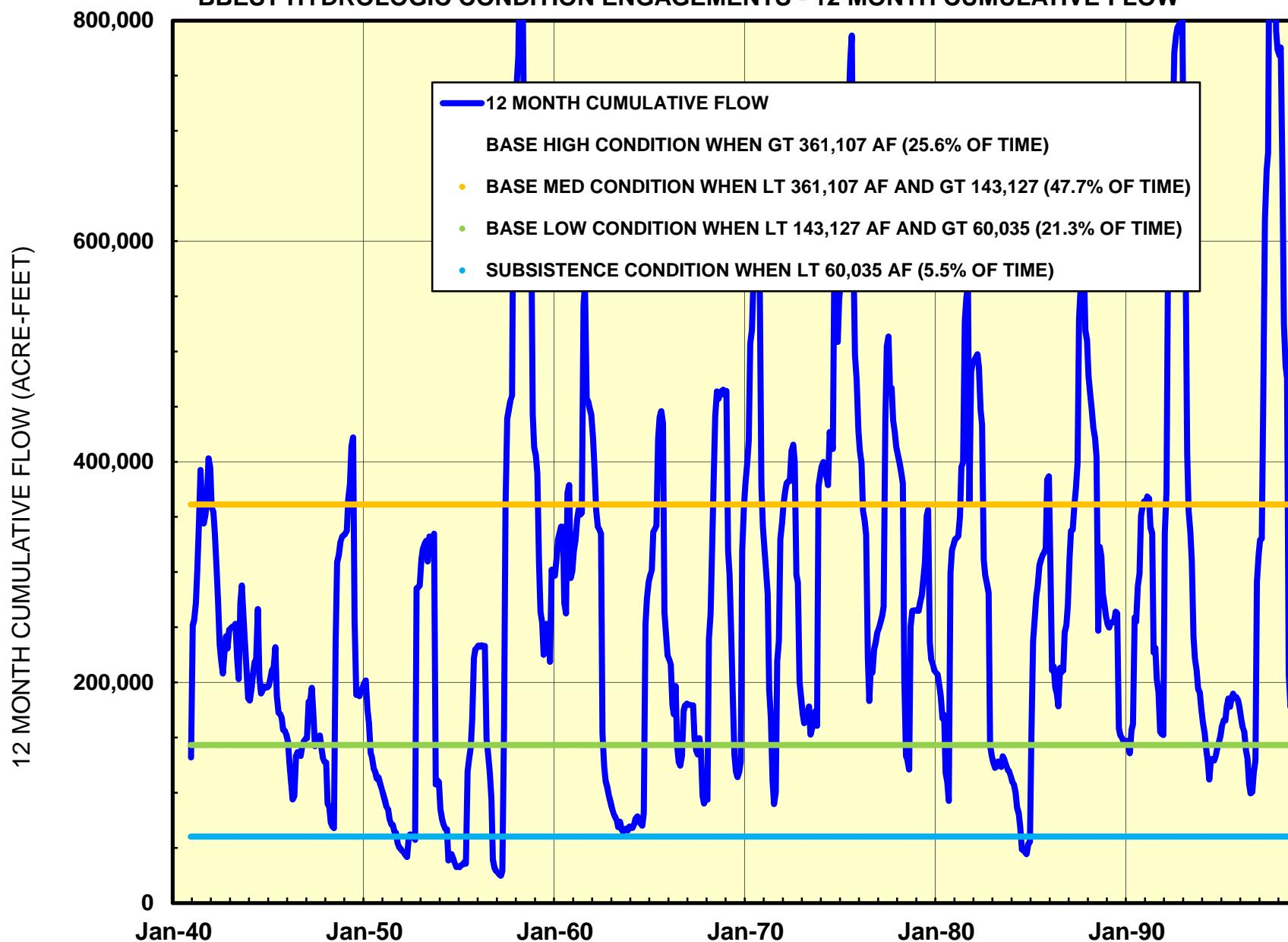
LLANO AT LLANO SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



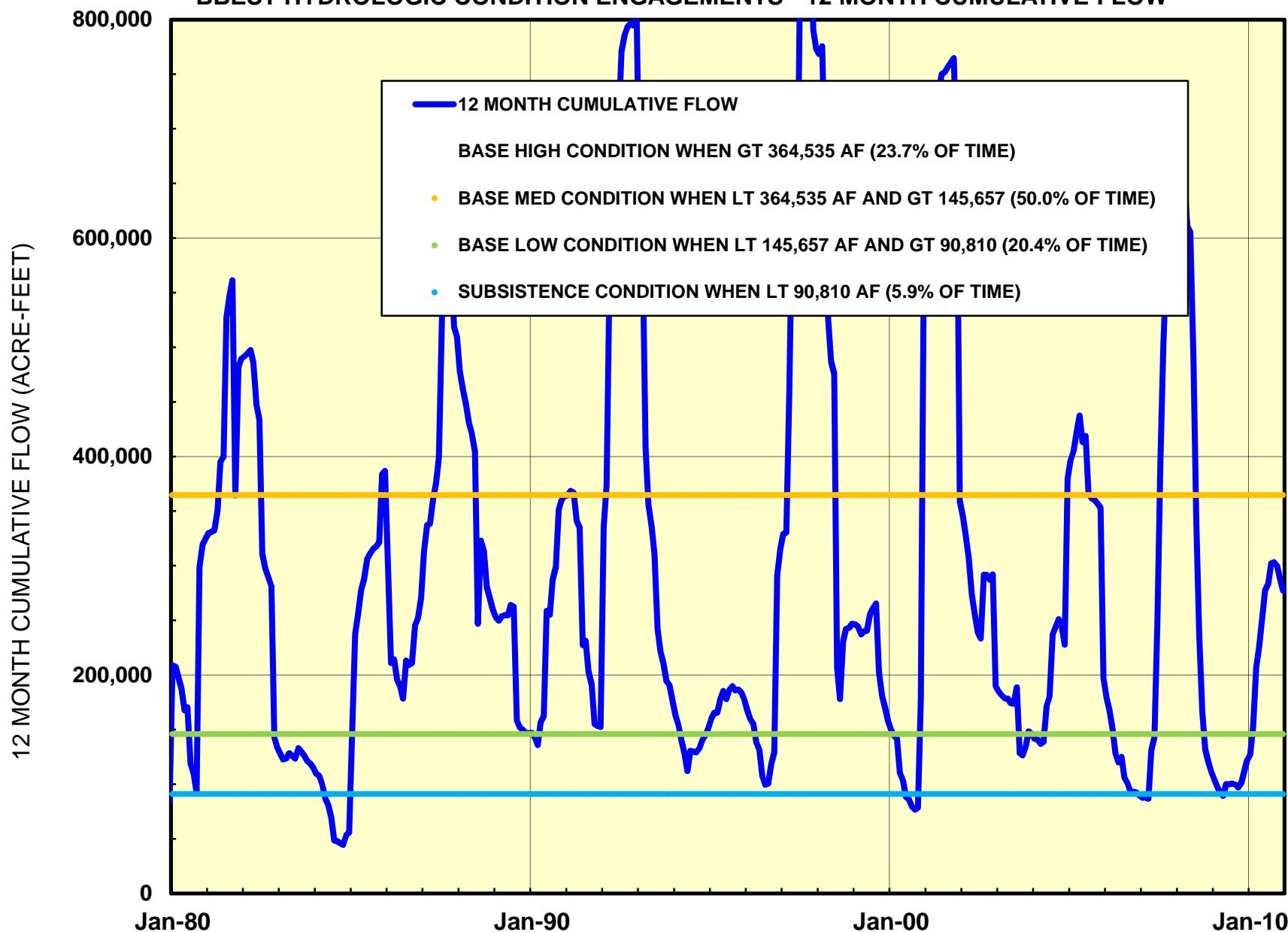
LLANO AT LLANO SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



LLANO AT LLANO HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



LLANO AT LLANO HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR PEDERNALES NEAR JOHNSON CITY SITE

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
PEDERNALES NEAR JOHNSON CITY														
(1)	TCEQ RUN3	FLOW	609,317	SIM	1940-1998	192,804	25.0%	192,804 AND 46,923	49.7%	46,923 AND 16,569	20.4%	16,569	4.9%	
(2)	TCEQ RUN8	FLOW	611,178	SIM	1940-1998	193,834	25.3%	193,834 AND 48,685	49.4%	48,685 AND 17,534	20.1%	17,534	5.2%	
(3)	USGS	FLOW	613,315	HIST	1940-1998	194,514	25.0%	194,514 AND 48,241	49.7%	48,241 AND 16,770	19.5%	16,770	5.7%	
(4)	USGS	FLOW	613,315	HIST	1980-2010	222,698	25.3%	222,698 AND 70,206	49.5%	70,206 AND 27,707	17.7%	27,707	7.5%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

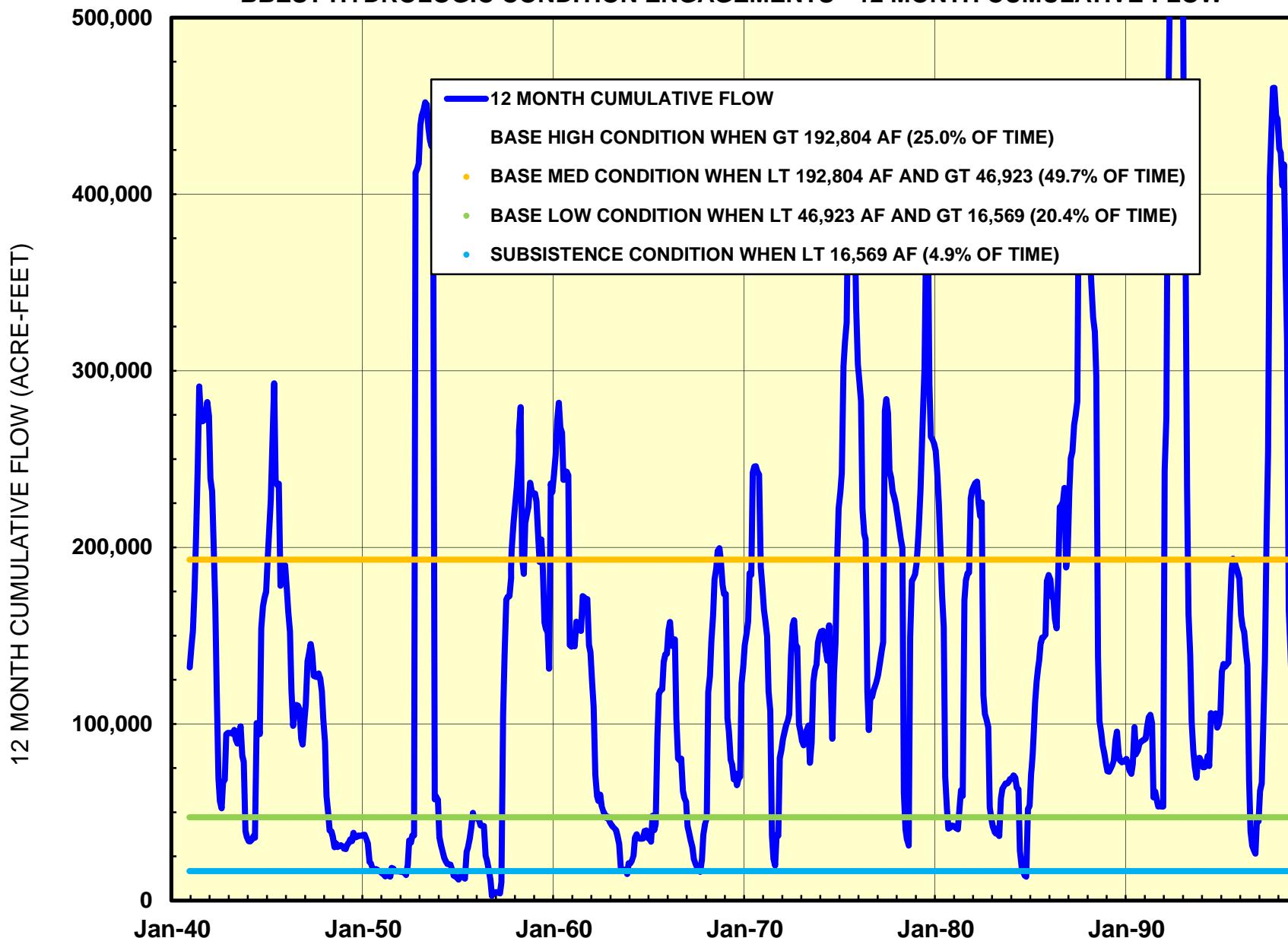
STO Storage

ELEV Elevation

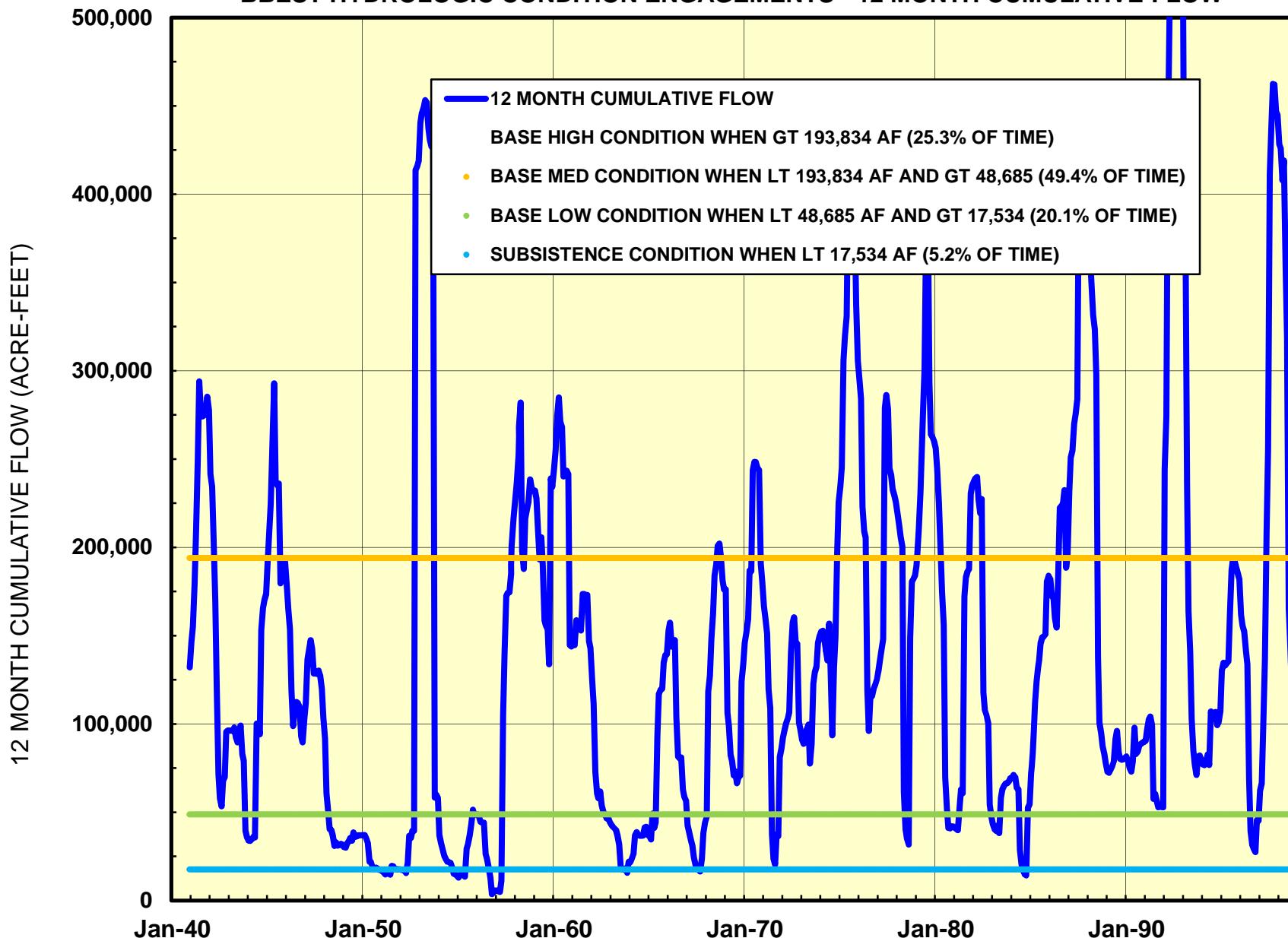
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

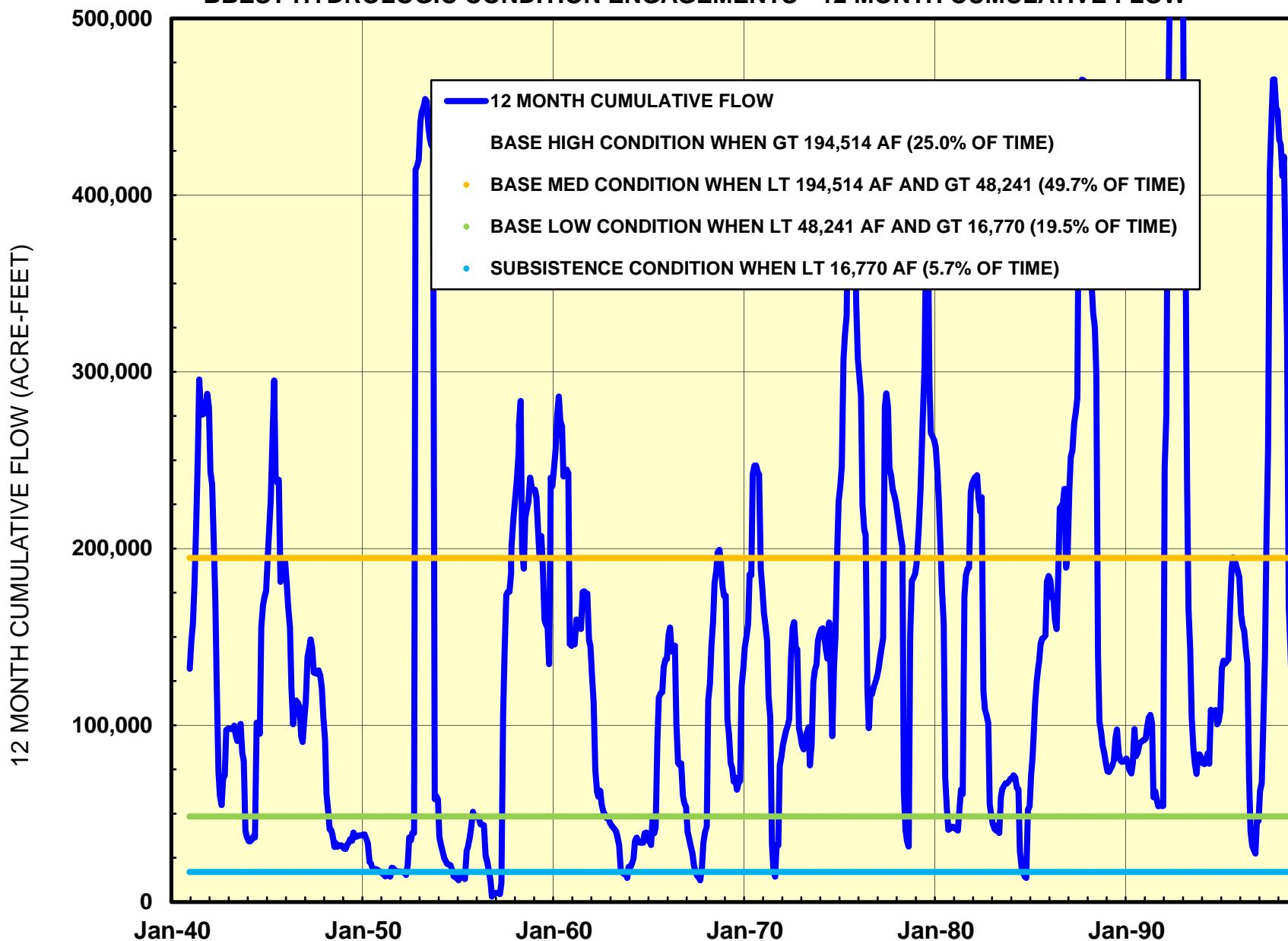
PED NR JOHNSON CITY SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



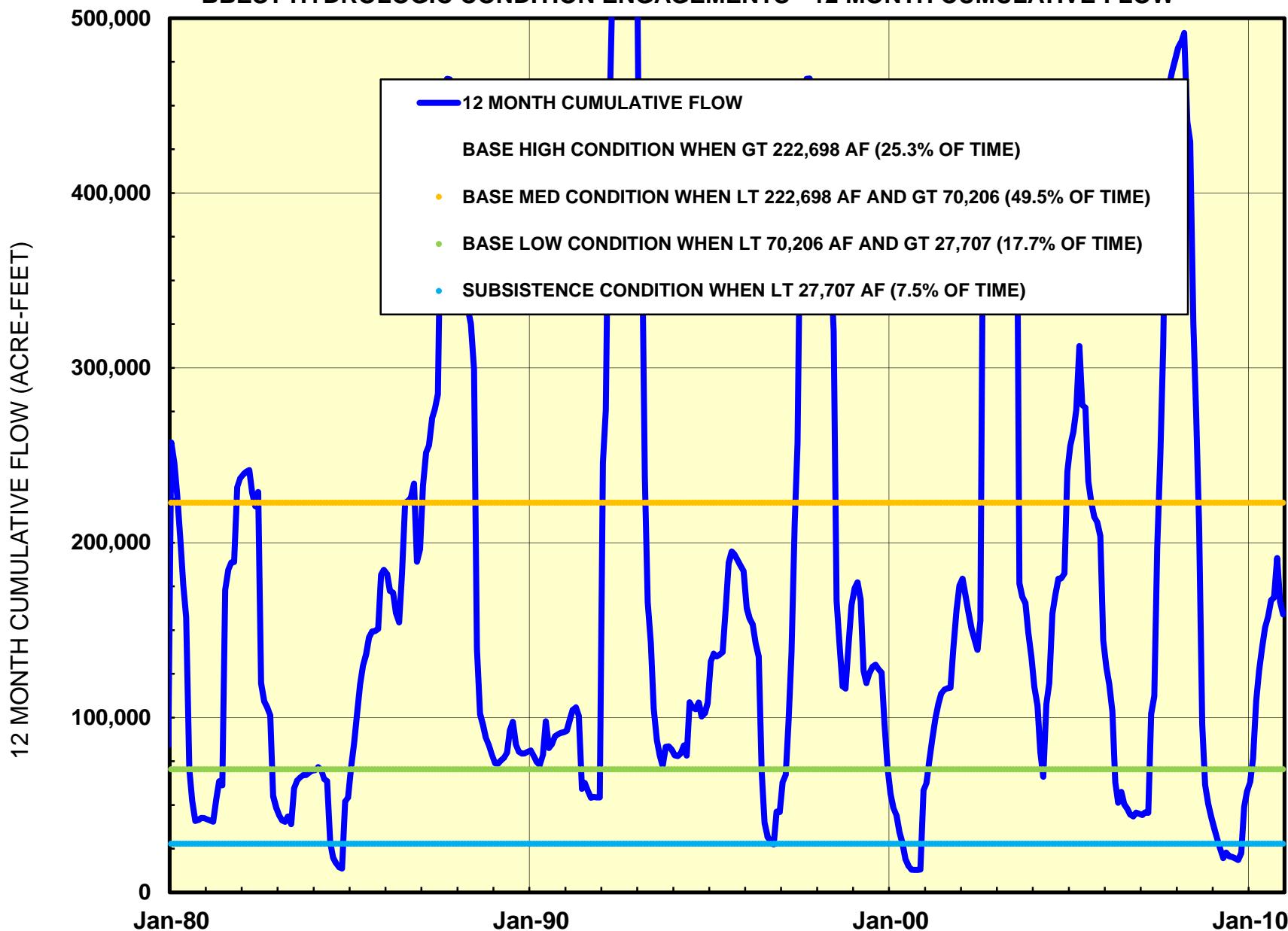
PED NR JOHNSON CITY SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



**PED NR JOHNSON CITY HISTORICAL FLOW FOR 1940-1998 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW**



**PED NR JOHNSON CITY HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW**



Appendix 12

Summary of Hydrologic Conditions Engagement Analysis For Onion Creek Near Driftwood

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR ONION CREEK NEAR DRIFTWOOD

CL BBEST / BBASC August 18, 2011

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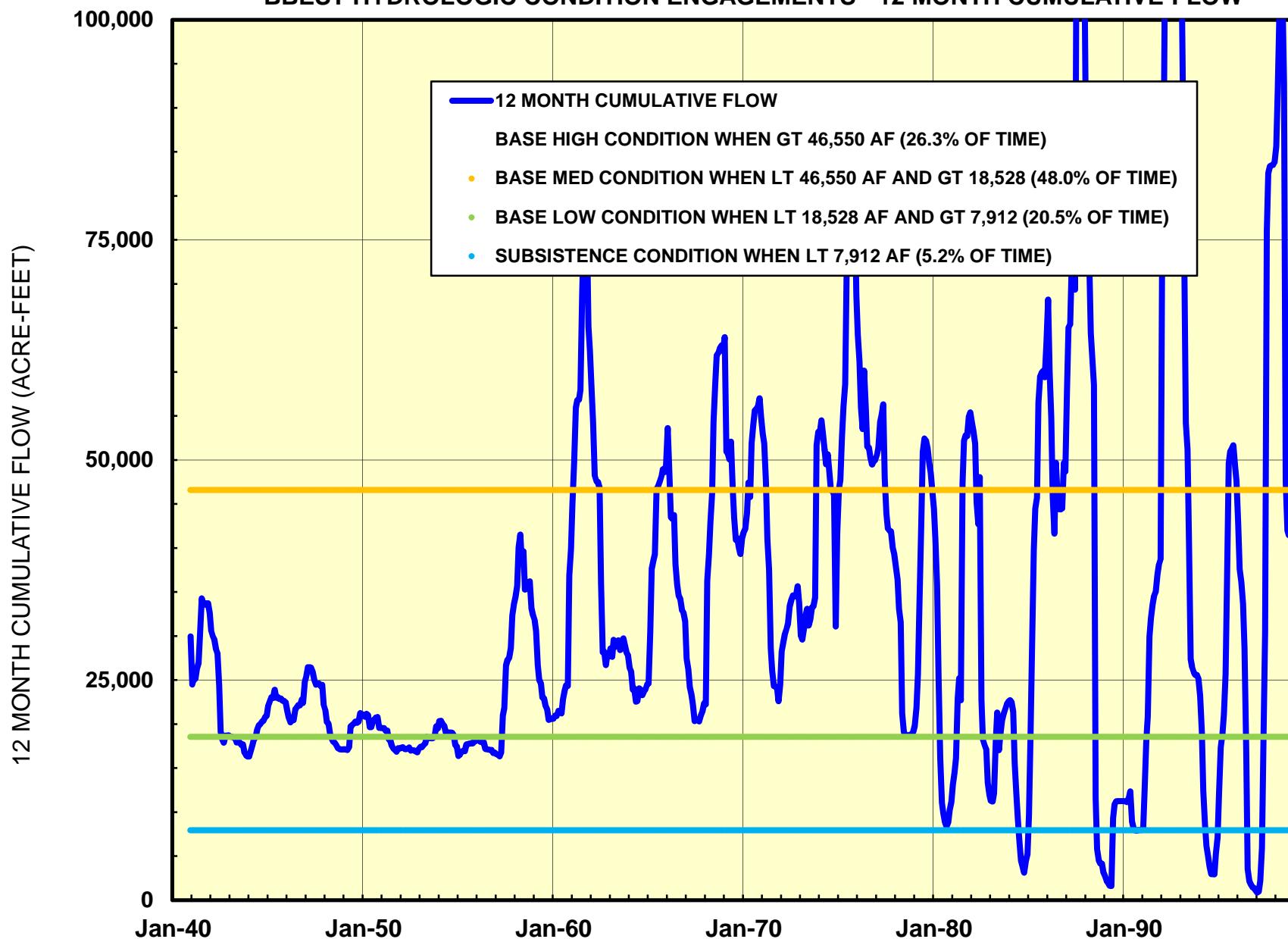
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DATA USED TO DEVELOP FLOW TRIGGERS													RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)	
PAGE #	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD		BASE HIGH TRIGGER GOAL; 25% OF TIME	BASE MEDIUM TRIGGER GOAL; 50% OF TIME	BASE LOW TRIGGER GOAL; 20% OF TIME	SUBSISTENCE TRIGGER GOAL; 5% OF TIME				
							ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
	ONION CREEK NEAR DRIFTWOOD													
(1)	TCEQ RUN3	FLOW	143,514	SIM	1940-1998		46,550	26.3%	46,550 AND 18,528	48.0%	18,528 AND 7,912	20.5%	7,912	5.2%
(2)	USGS	FLOW	143,770	HIST	1981-2010		59,613	25.6%	59,613 AND 10,456	50.3%	10,456 AND 805	18.6%	805	5.6%

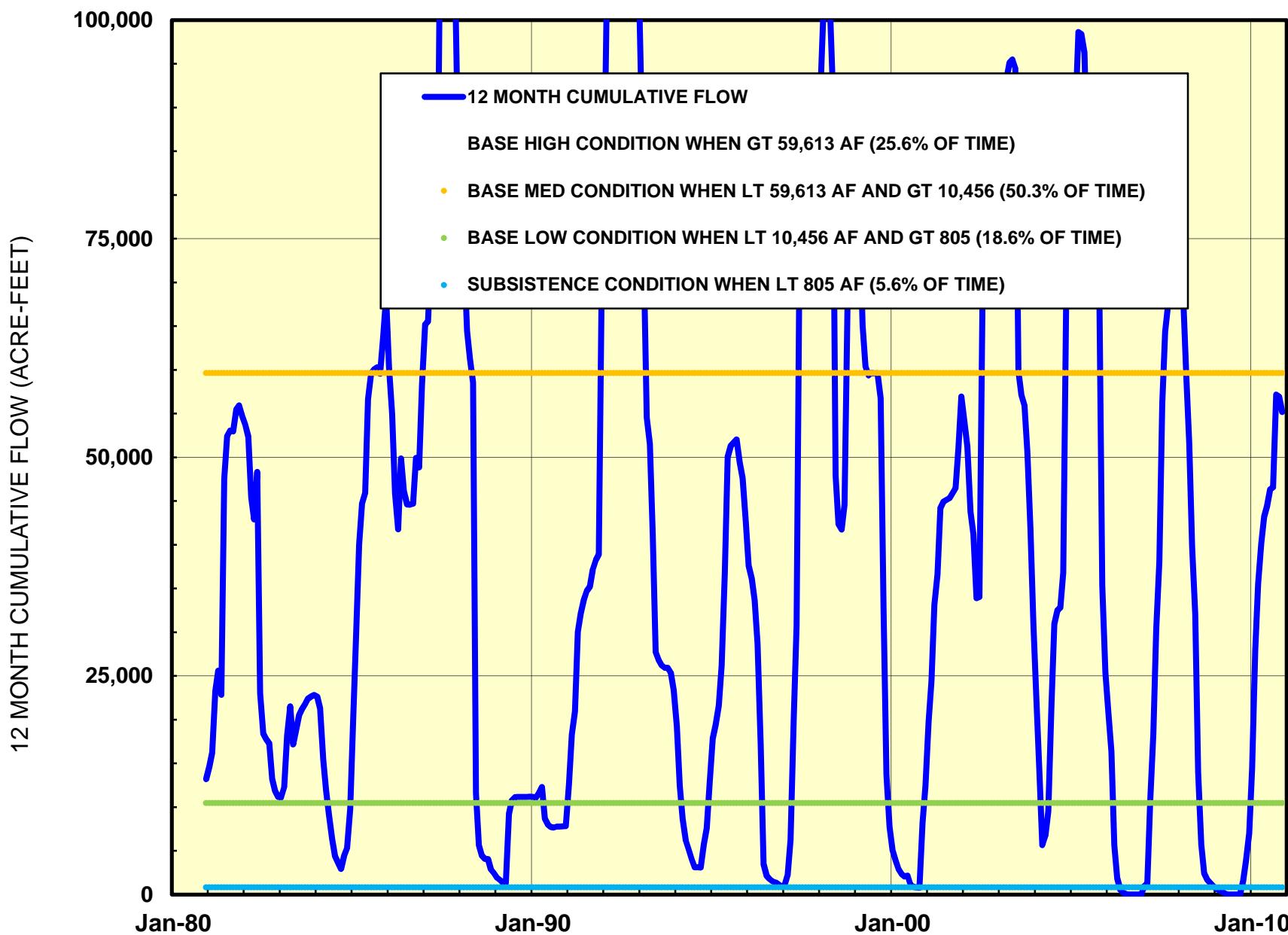
KAF Volume in Thousand Acre-Feet
 MSL Elevation Referenced to Mean Sea Level
 STO Storage
 ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

ONION CR NR DRIFTWOOD SIMULATED FLOW FOR 1940-1998 (TCEQ WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



ONION CREEK NEAR DRIFTWOOD HISTORICAL FLOW FOR 1980-2010 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



Appendix 13

Summary of Hydrologic Conditions Engagement Analysis LSWP (Bastrop, Columbus, Wharton)

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SITES WITH LSWP BASED RECOMMENDATIONS (BASTROP, COLUMBUS, WHARTON)

CL BBEST / BBASC August 9, 2011

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
PAGE #	DATA USED TO DEVELOP STORAGE TRIGGERS					RESULTING TRIGGERS (BASED CONTENT IN LCRA SYSTEM FOR PREVIOUS MONTH; IN ACRE-FEET)						
	SOURCE DATA	HYDRO CONCEPT	CONSERV. STORAGE (acre-feet)	TYPE	PERIOD OF RECORD	BASE AVERAGE TRIGGER		BASE DRY TRIGGER		SUBSISTENCE TRIGGER		
							GOAL; 50% OF TIME		GOAL; 45% OF TIME		GOAL; 5% OF TIME	
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
LCRA SYSTEM STORAGE (BUCHANAN + TRAVIS)												
(1)	TCEQ RUN3	STORAGE	2,163,227	SIM	1940-1998	1,807,791	54.0%	1,807,791 AND 720,800	41.0%	720,800	5.1%	
(2)	TCEQ RUN8	STORAGE	2,021,037	SIM	1940-1998	1,896,735	52.1%	1,896,735 AND 1,353,538	42.9%	1,353,538	4.9%	
(3)	LCRA-WMP WAM (2010 BL)	STORAGE	1,964,429	SIM	1940-2009	1,672,179	54.5%	1,672,179 AND 782,878	39.6%	782,878	5.8%	
(4)	LCRA-WMP WAM (2010 BL)	STORAGE	1,964,429	SIM	1980-2009	1,662,436	54.8%	1,662,436 AND 1,109,594	40.7%	1,109,594	4.4%	
(5)	LCRA STAFF	STORAGE	2,010,544	HIST	1980-2010	1,737,462	52.5%	1,737,462 AND 1,103,702	41.8%	1,103,702	5.6%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

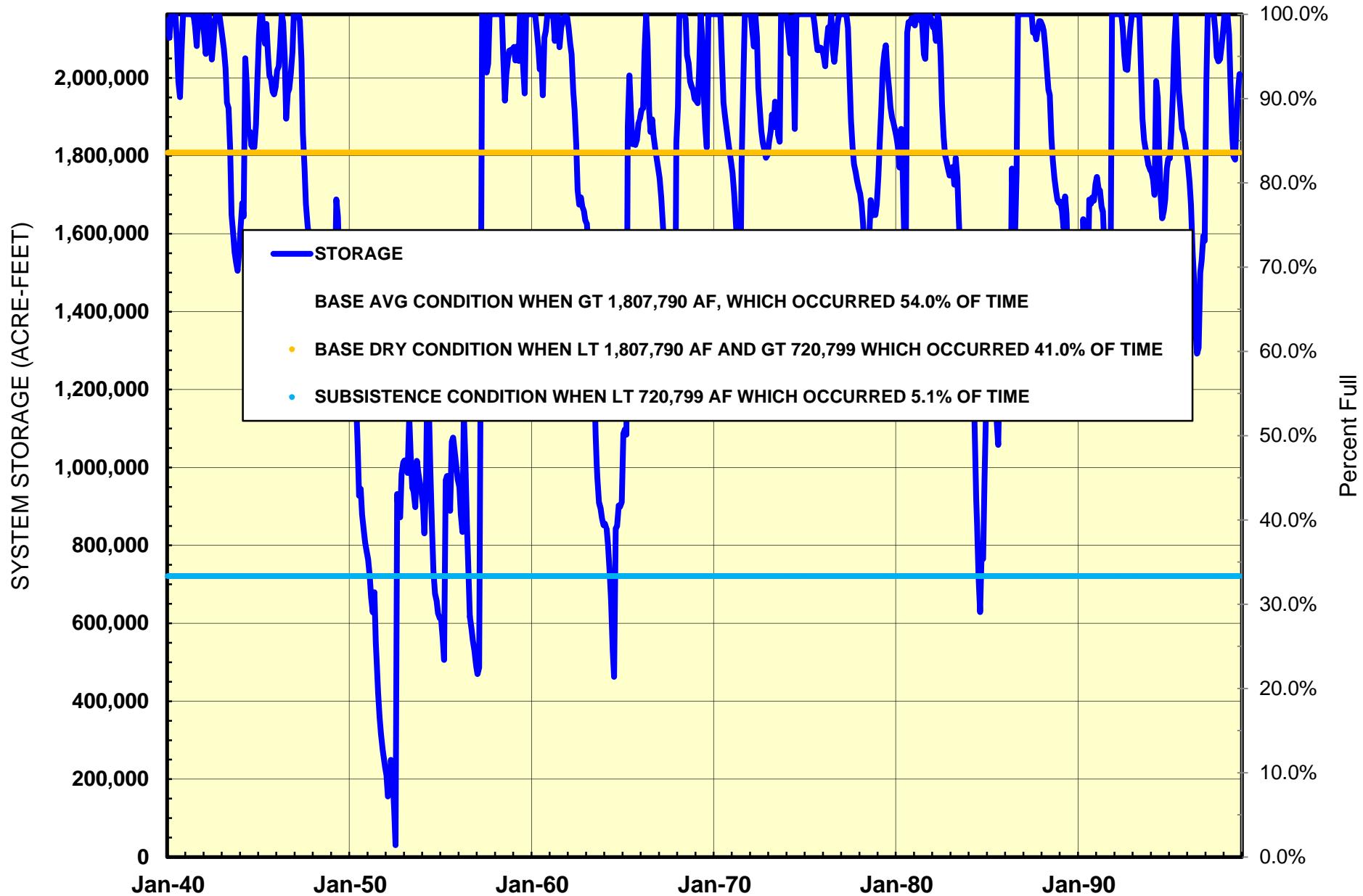
STO Storage

ELEV Elevation

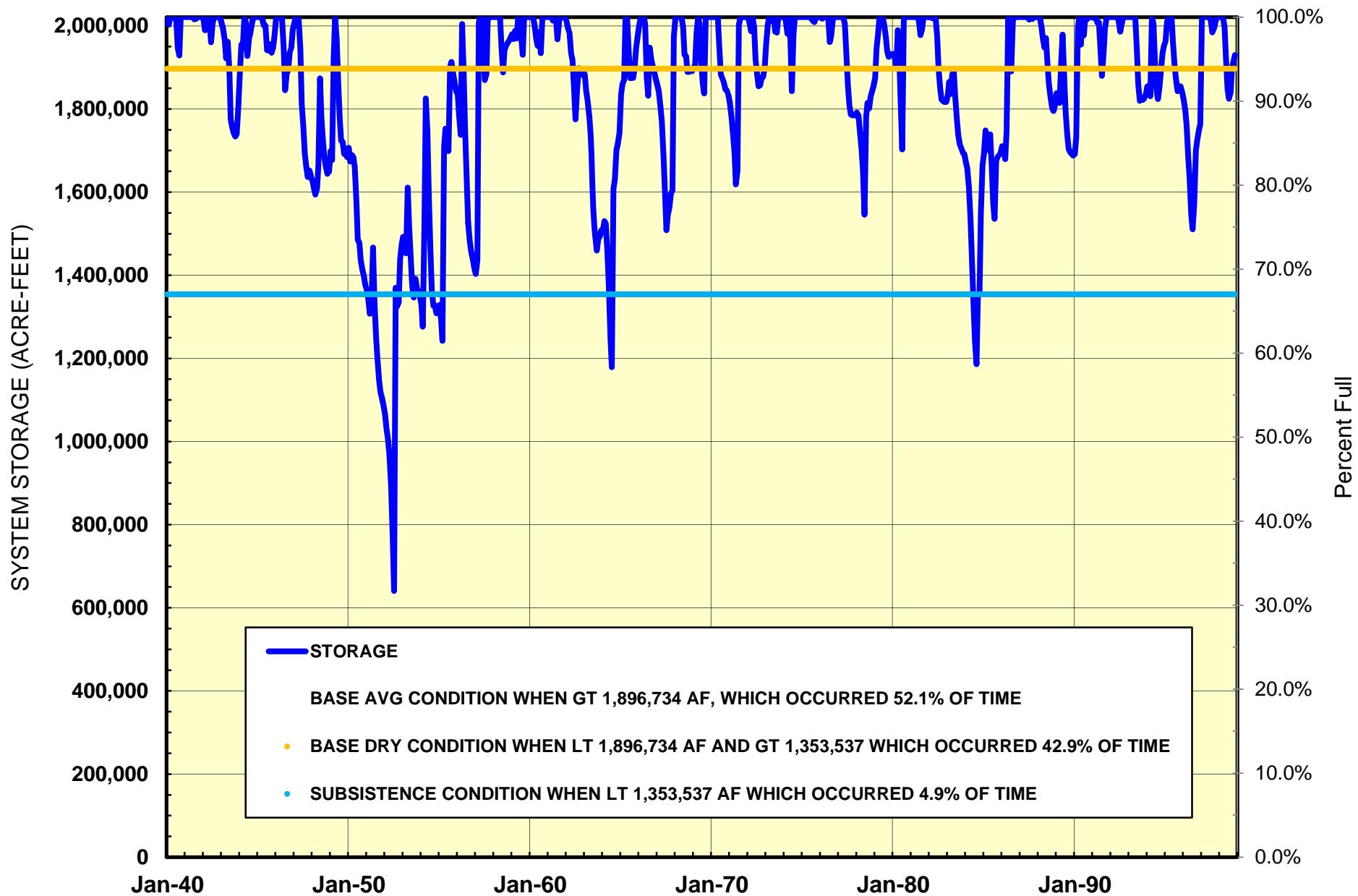
SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

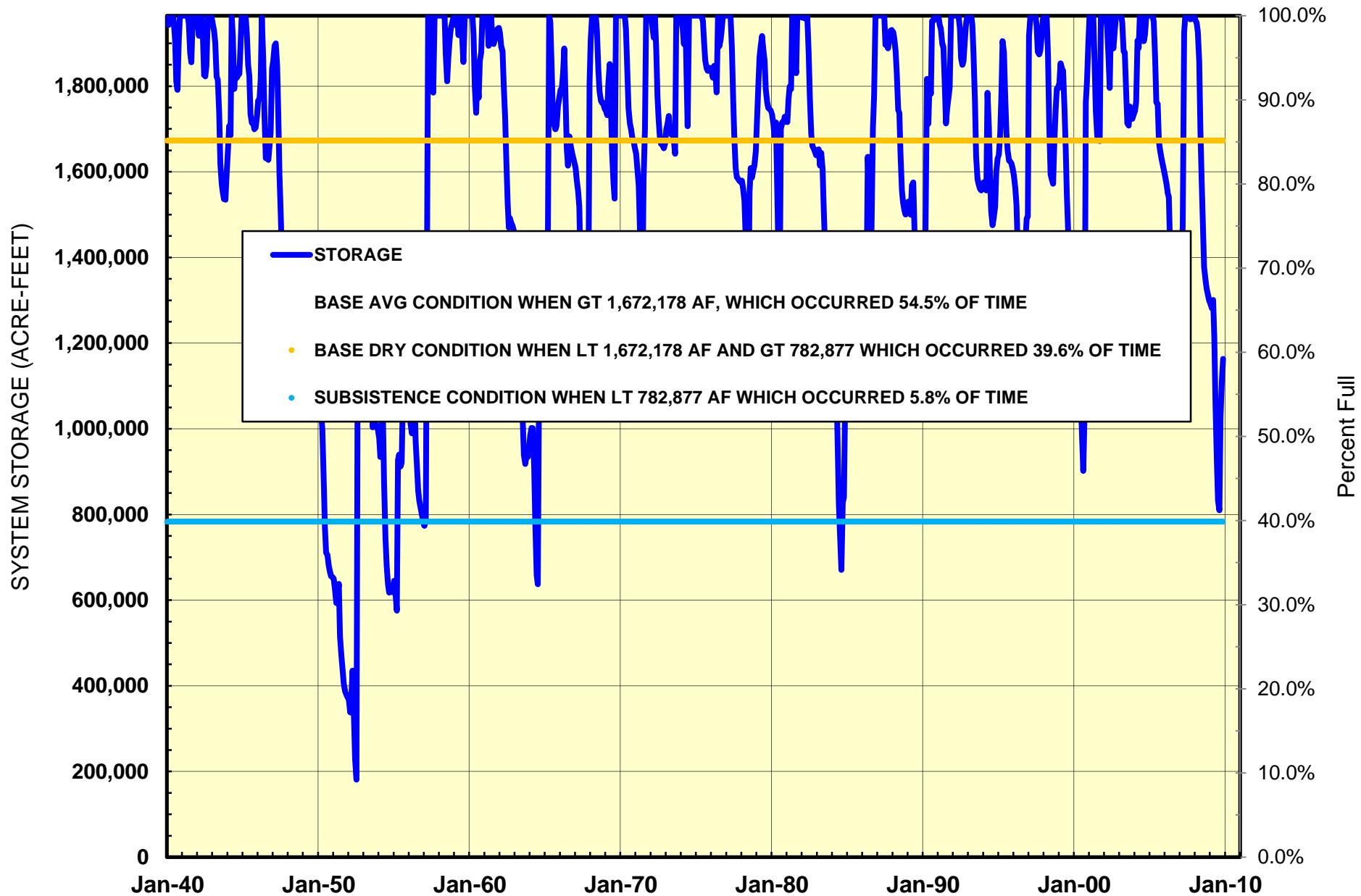
LCRA SYSTEM SIMULATED STORAGE FOR 1940-1998 (TCEQ RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS FOR LSWP BASED FLOWS



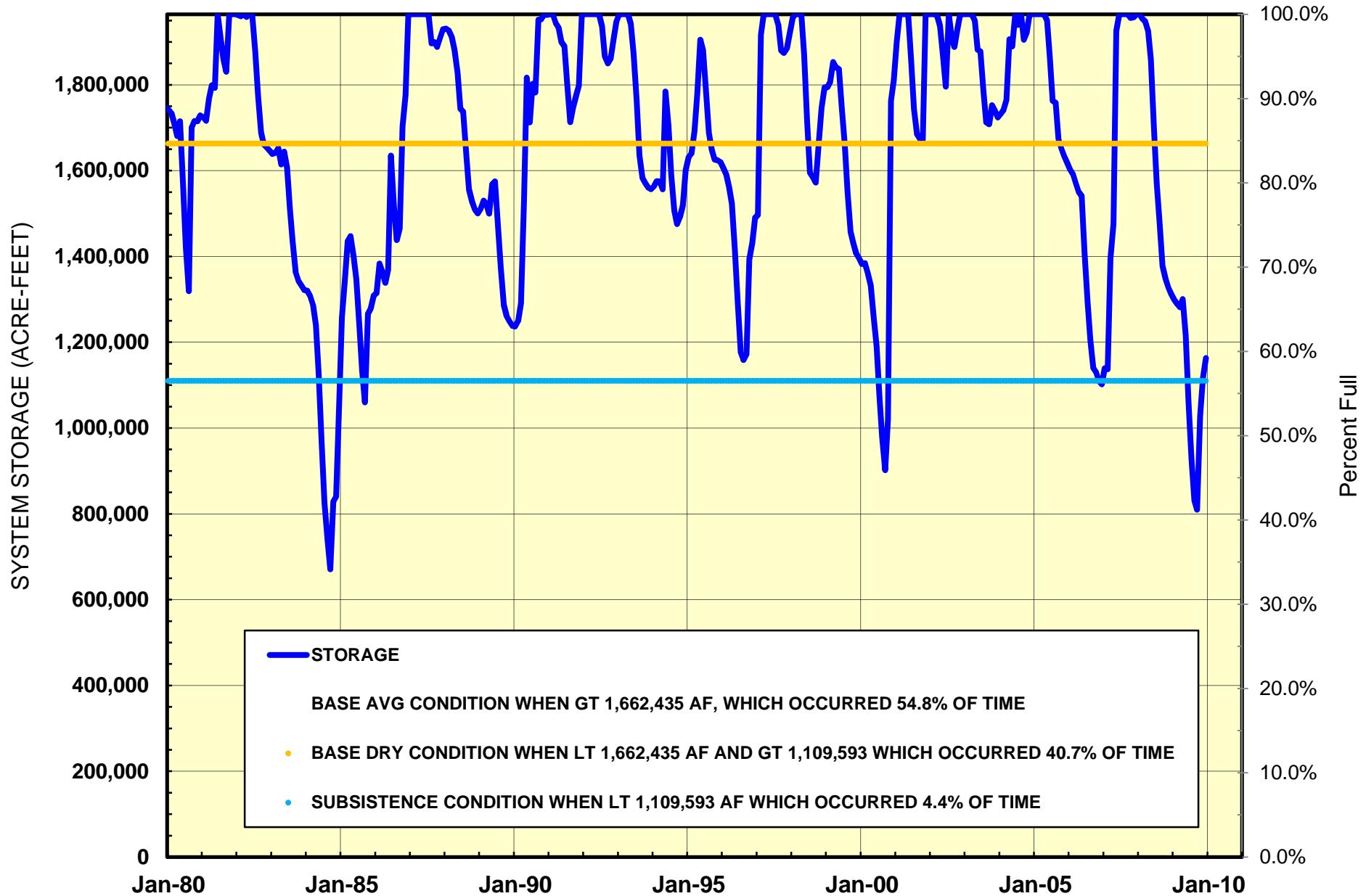
LCRA SYSTEM SIMULATED STORAGE FOR 1940-1998 (TCEQ RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS FOR LSWP BASED FLOWS



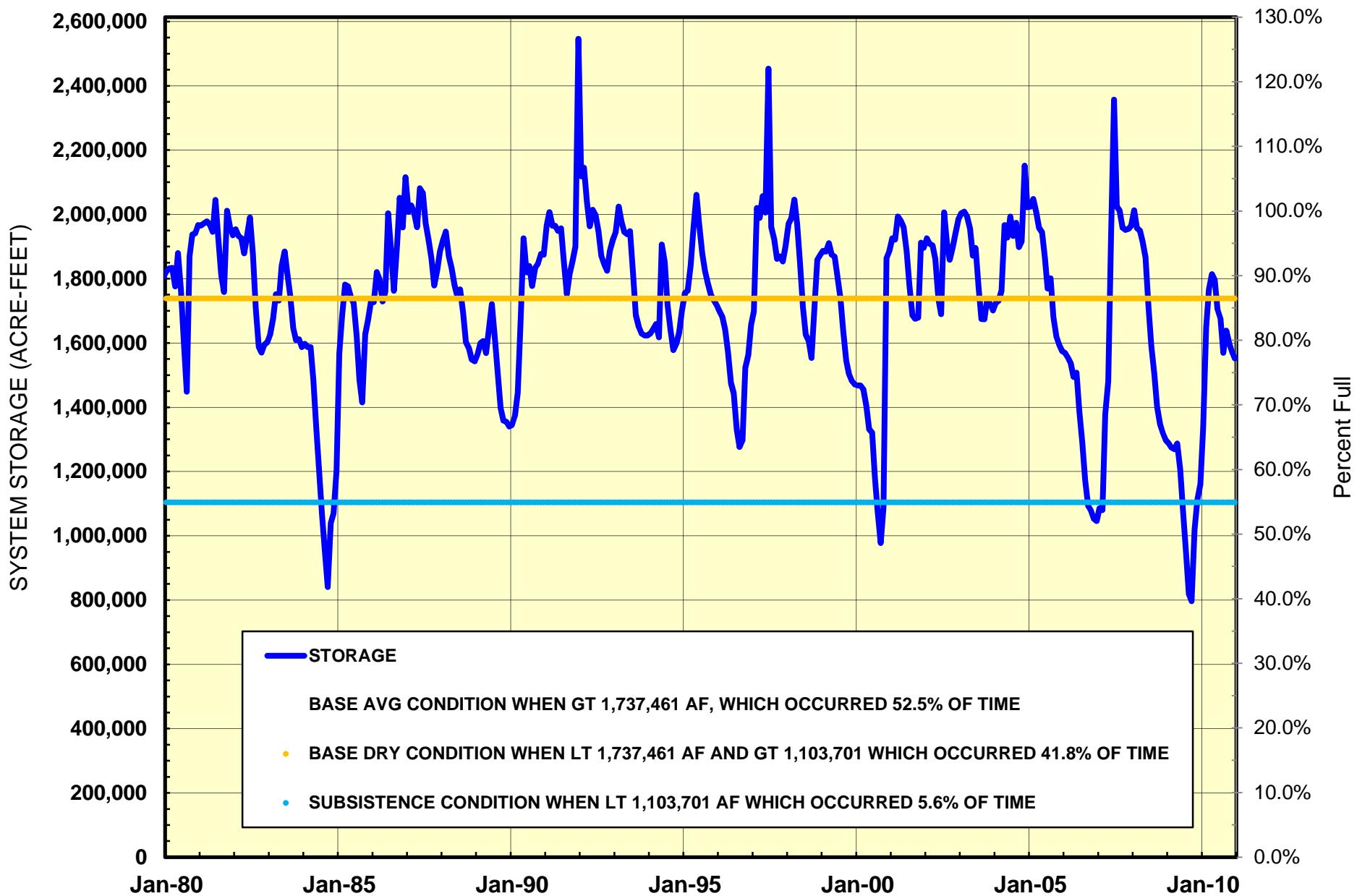
LCRA SYSTEM SIMULATED STORAGE FOR 1940-2009 (LCRA WMP WAM-2010 BL)
 BBEST HYDROLOGIC CONDITION ENGAGEMENTS FOR LSWP BASED FLOWS



LCRA SYSTEM SIMULATED STORAGE FOR 1980-2009 (LCRA WMP WAM-2010 BL)
 BBEST HYDROLOGIC CONDITION ENGAGEMENTS FOR LSWP BASED FLOWS



LCRA SYSTEM HISTORICAL STORAGE FOR 1980-2010 (LCRA STAFF)
 BBEST HYDROLOGIC CONDITION ENGAGEMENTS FOR LSWP BASED FLOWS



Appendix 14

Summary of Hydrologic Conditions Engagement Analysis Lake Texana

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST APPROACH AND LNRA EXISTING TRIGGERS FOR LAKE TEXANA

TO BE USED FOR THE FOLLOWING SITES: EAST MUSTANG, WEST MUSTANG, NAVIDAD, SANDY CREEK, AND LAVACA

CL BBEST / BBASC August 10, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
DATA USED TO DEVELOP STORAGE/ELEVATION TRIGGERS						RESULTING TRIGGERS (BASED CONTENT OR ELEVATION IN LAKE TEXANA FOR PREVIOUS MONTH)								
SOURCE DATA	HYDRO CONCEPT	CONSERVATION (storage in AF; elevation in msl)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER			
					GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME			
					ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED		
LAKE TEXANA														
(1)	TCEQ RUN3	STORAGE	170,300	SIM	1940-1996	170,300	30.5%	170,300 AND 132,460	43.5%	132,460 AND 93,298	20.7%	93,298	5.3%	
(2)	TCEQ RUN8	STORAGE	165,692	SIM	1940-1996	165,692	36.2%	165,692 AND 146,264	36.8%	146,264 AND 125,470	22.8%	125,470	4.2%	
(3)	LNRA	ELEVATION: BBEST APPROACH	161,065 / 44.00	HIST	1983-2010	44.01	25.8%	44.01 AND 42.97	51.3%	42.97 AND 40.09	17.2%	40.09	5.6%	
(4)	LNRA	ELEVATION: LNRA EXISTING TRIGGERS	161,065 / 44.00	HIST	1983-2010	44.00	26.4%	44.00 AND 43.00	50.7%	43.00 AND 39.95	18.1%	39.95	4.7%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

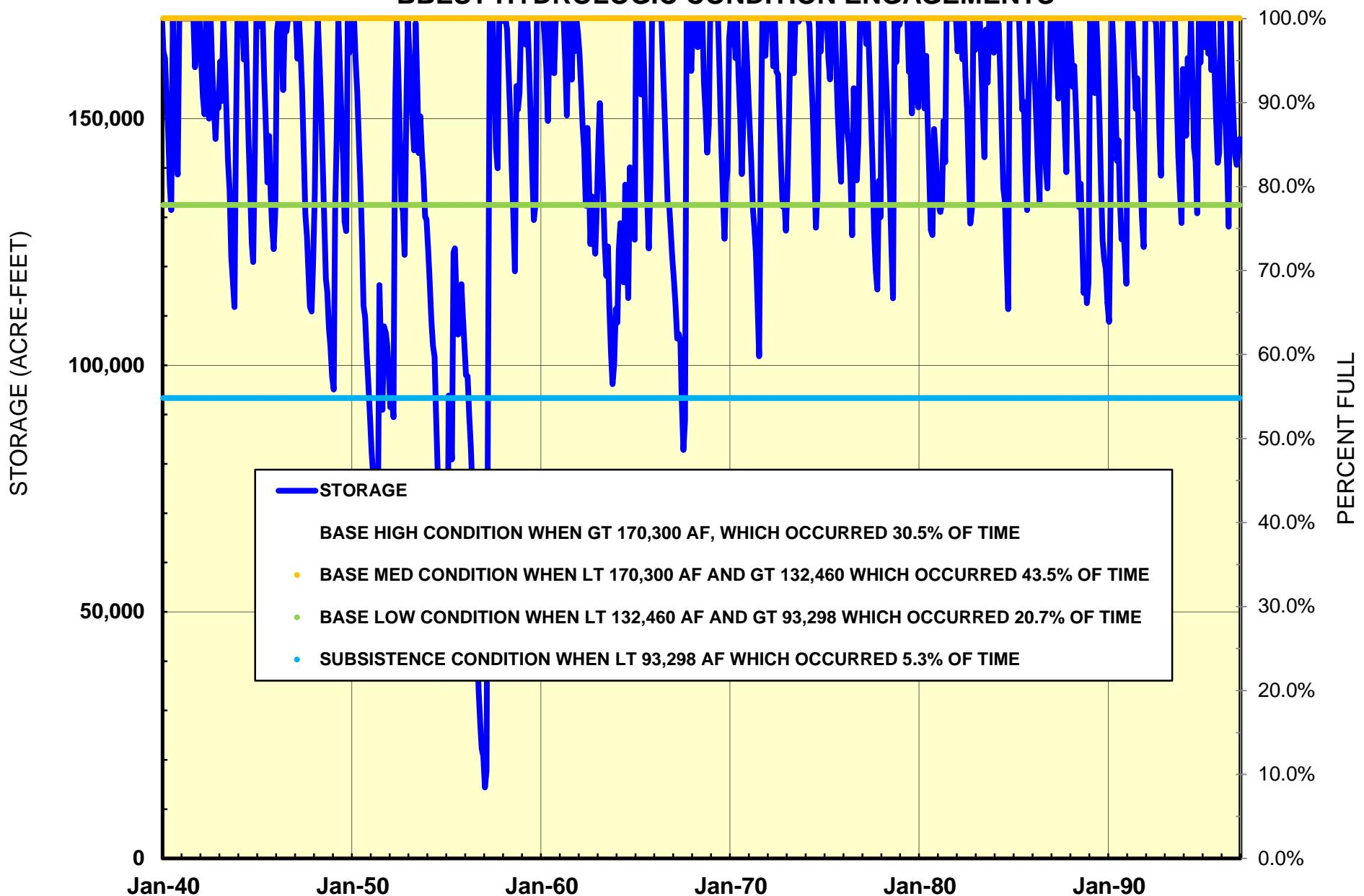
ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

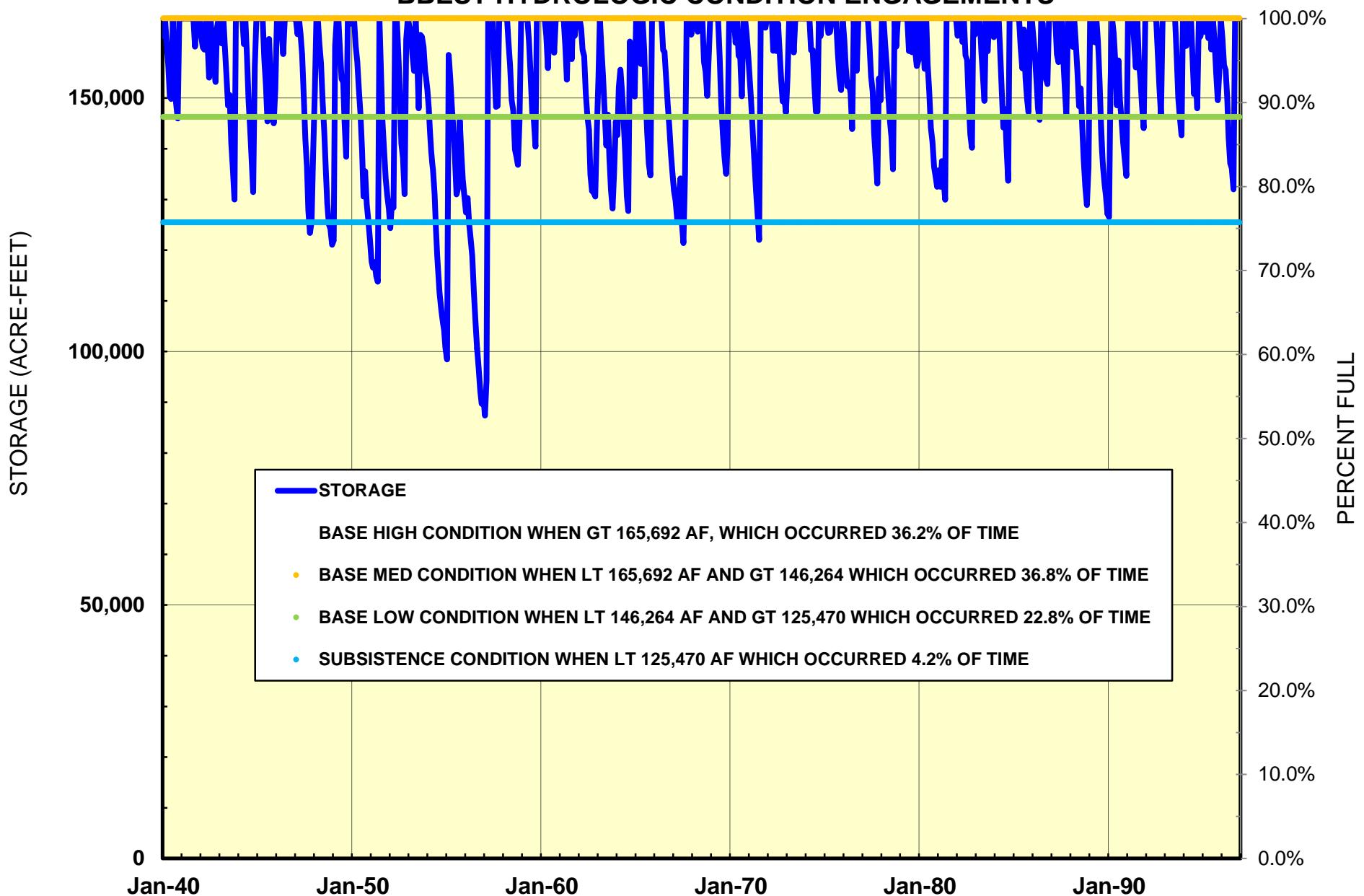
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

TRIGGERS PROVIDED BY LNRA STAFF (BASED ON EXISTING PERMIT CONDITIONS) AND STYLED TO FIT INTO BBEST FRAMEWORK.

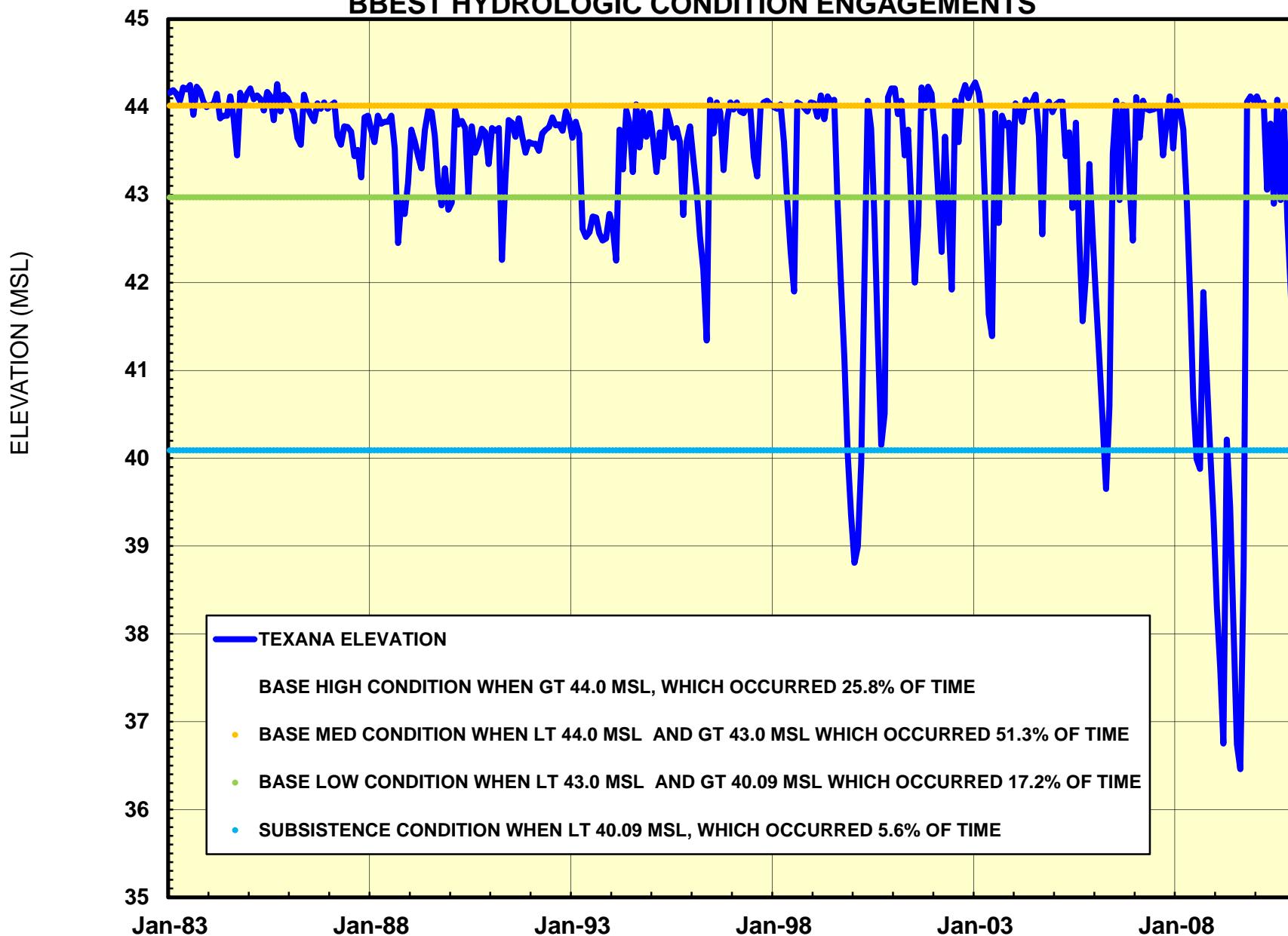
LAKE TEXANA SIMULATED STORAGE FOR 1940-1996 (TCEQ WAM RUN3) BBEST HYDROLOGIC CONDITION ENGAGEMENTS



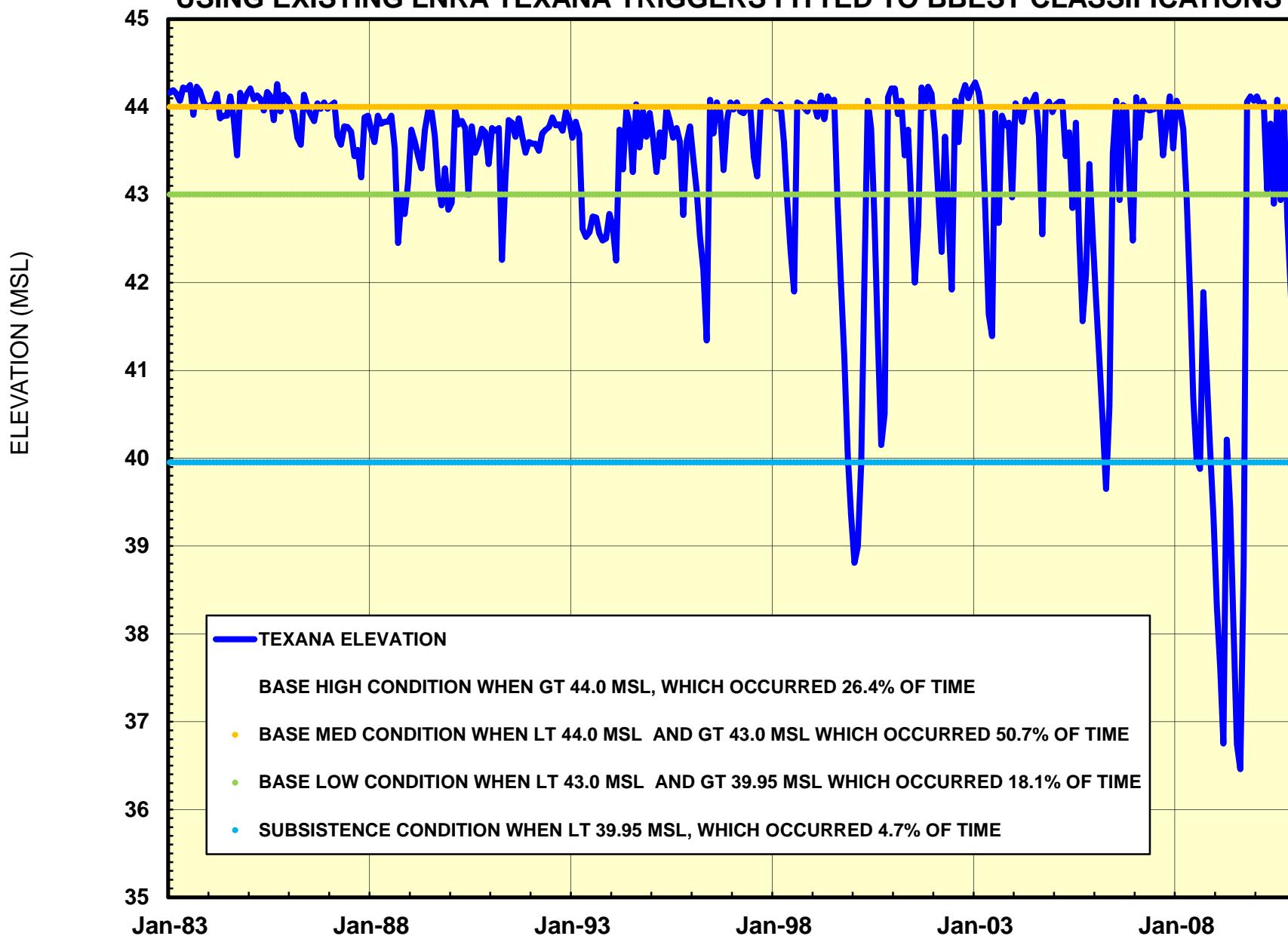
LAKE TEXANA SIMULATED STORAGE FOR 1940-1996 (TCEQ WAM RUN8) BBEST HYDROLOGIC CONDITION ENGAGEMENTS



LAKE TEXANA HISTORICAL ELEVATION FOR 1983-2010 (LNRA) BBEST HYDROLOGIC CONDITION ENGAGEMENTS



LAKE TEXANA HISTORICAL ELEVATION FOR 1983-2010 (LNRA)
USING EXISTING LNRA TEXANA TRIGGERS FITTED TO BBEST CLASSIFICATIONS



Appendix 15

Summary of Hydrologic Conditions Engagement Analysis Tres Palacios Near Midfield – Garcitas Creek Near Inez

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area
Stakeholder Committee

August 2011

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR TRES PALACIOS NEAR MIDFIELD

CL BBEST / BBASC August 11, 2011

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
TRES PALACIOS NEAR MIDFIELD														
(1)	TCEQ RUN3	FLOW	265,073	SIM	1940-1998	101,114	25.0%	101,114 AND 36,920	50.0%	36,920 AND 18,435	19.2%	18,435	5.8%	
(2)	TCEQ RUN8	FLOW	269,765	SIM	1940-1998	105,483	25.0%	105,483 AND 40,458	50.0%	40,458 AND 21,817	18.8%	21,817	6.3%	
(3)	USGS (1)	FLOW	273,898	HIST	1940-1998	104,851	25.6%	104,851 AND 24,186	48.8%	24,186 AND 6,364	19.6%	6,364	6.0%	
(4)	USGS	FLOW	288,968	HIST	1980-2010	158,629	22.6%	158,629 AND 62,915	52.2%	62,915 AND 31,939	20.7%	31,939	4.6%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Le

STO Storage

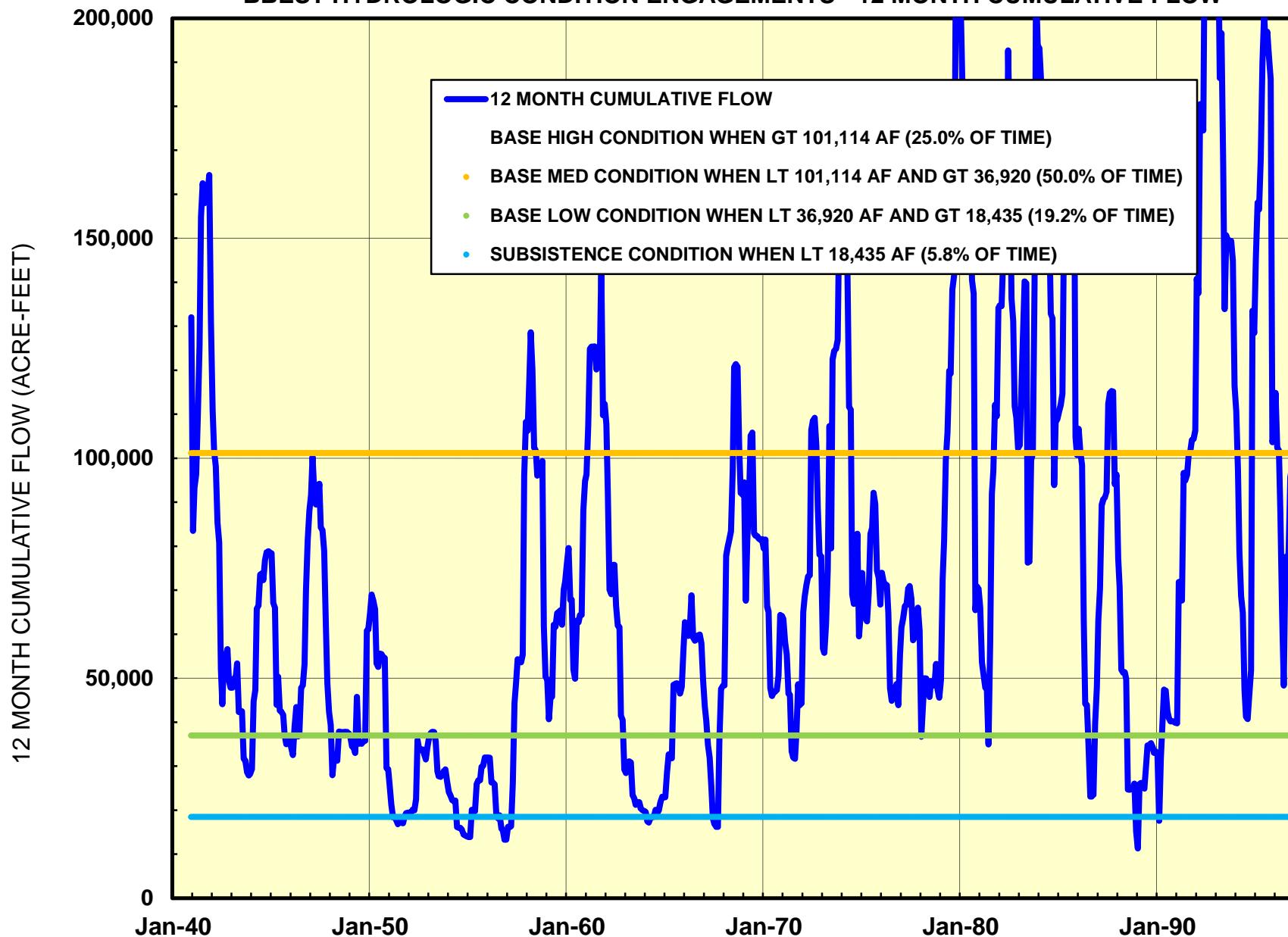
ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

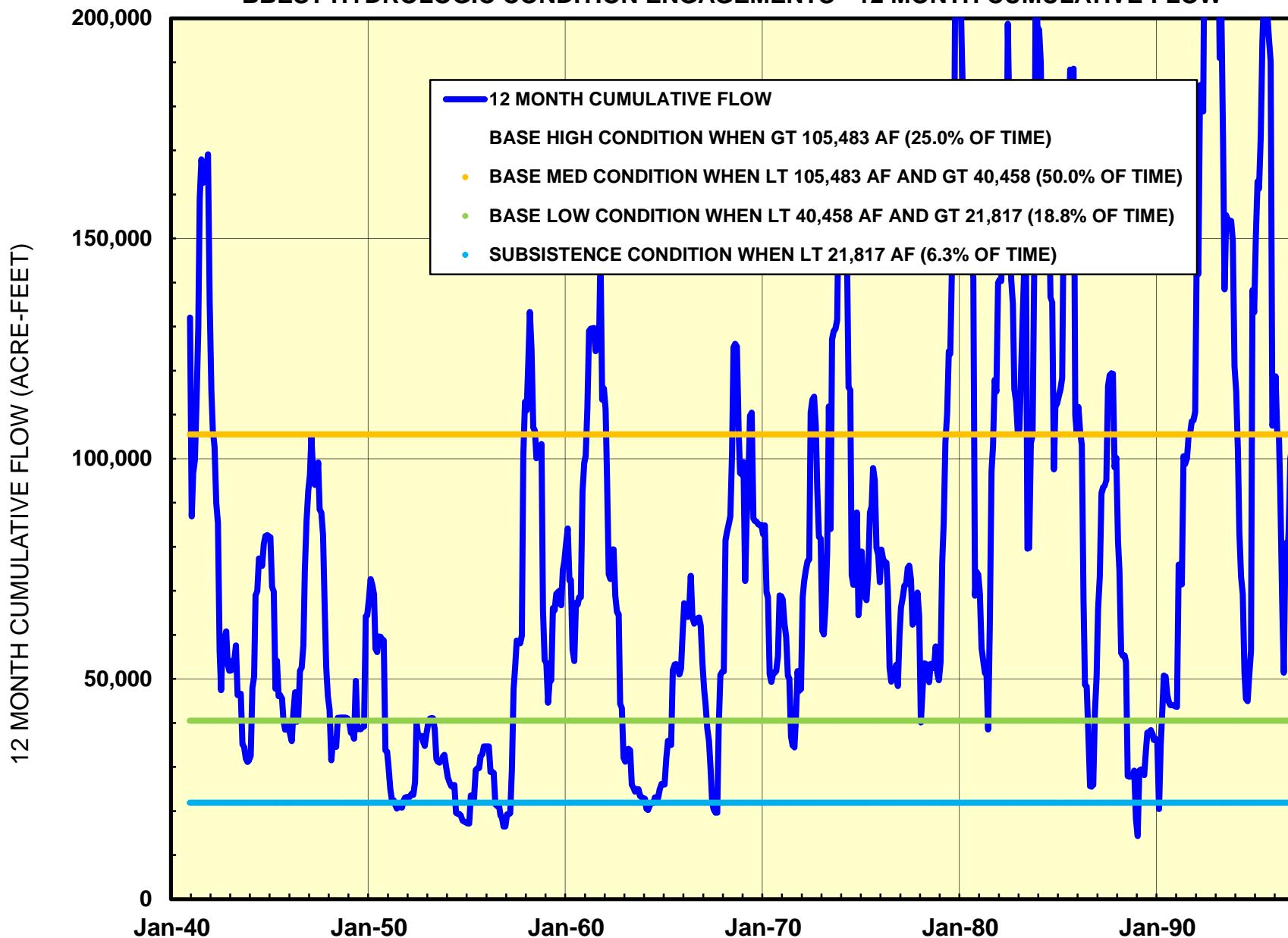
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

(1) Period before 1970 estimated based on Lavaca River near Edna gage.

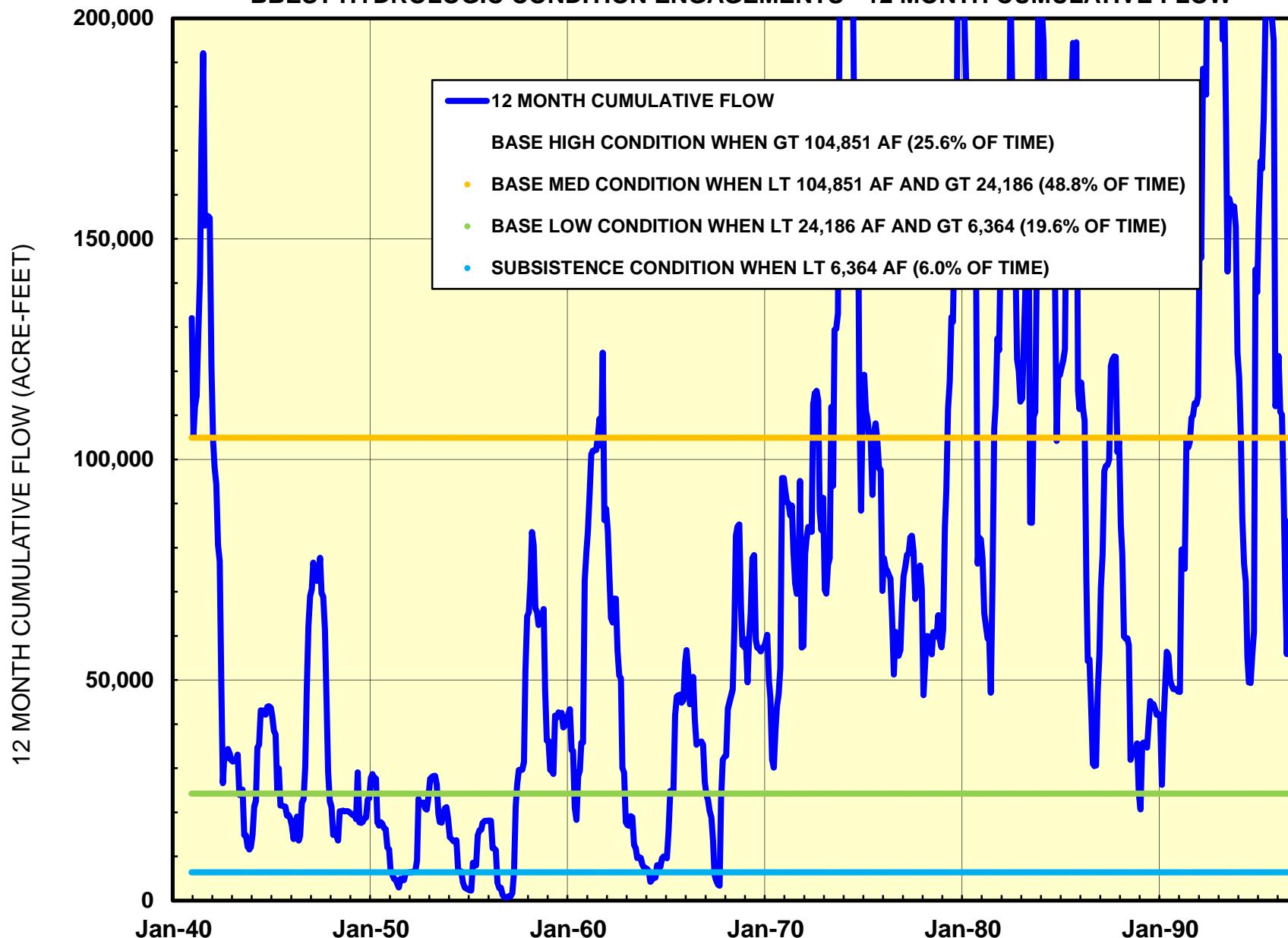
TRES PALACIOS NR MIDFIELD SIMULATED FLOW FOR 1940-1996 (WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



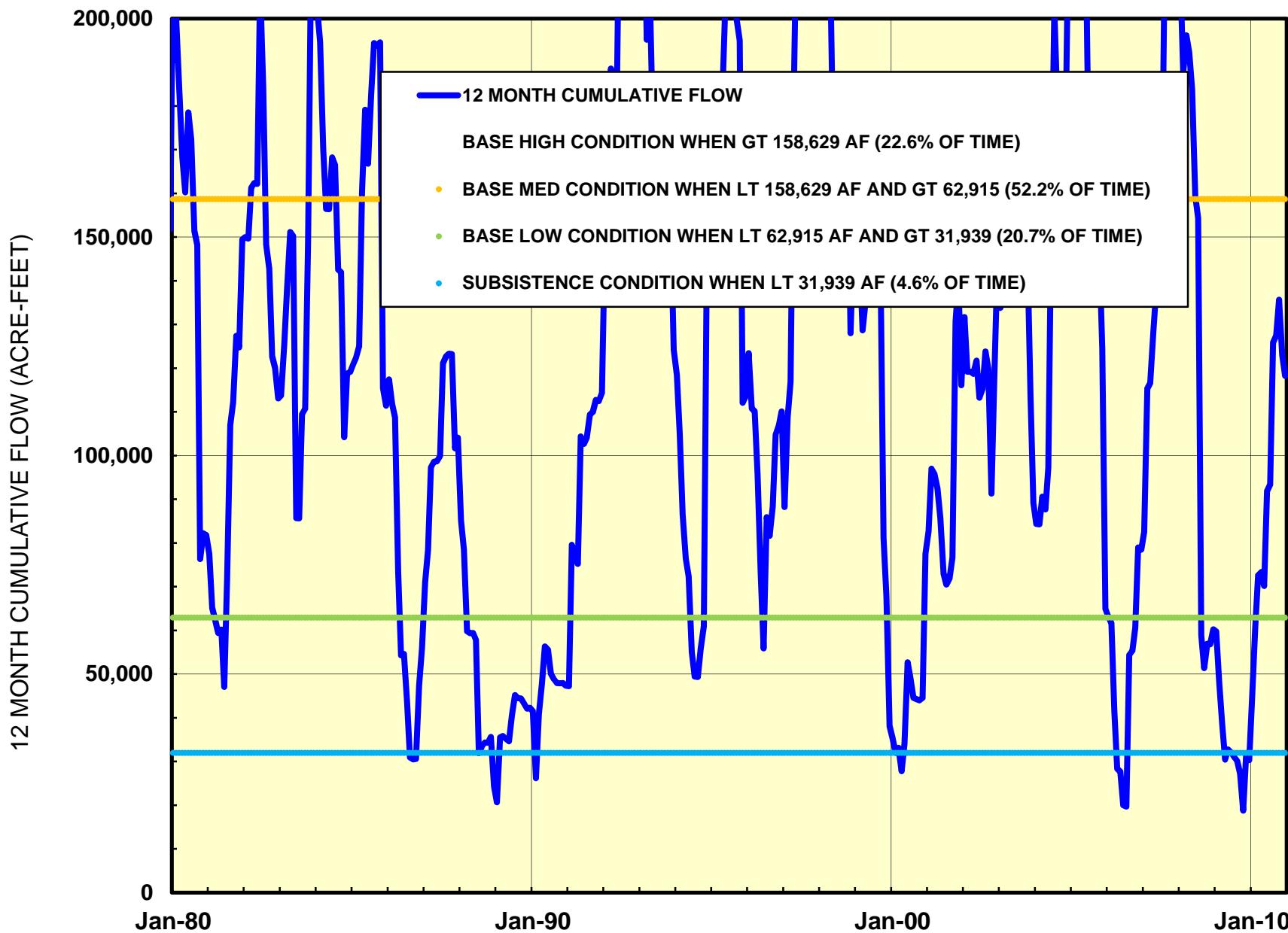
TRES PALACIOS NR MIDFIELD SIMULATED FLOW FOR 1940-1996 (WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



TRES PALACIOS NR MIDFIELD HISTORICAL FLOW FOR 1940-1996 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



TRES PALACIOS NR MIDFIELD HISTORICAL FLOW FOR 1980-2010 (OBSERVED)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR GARCITAS CREEK NEAR INEZ

CL BBEST / BBASC August 11, 2011

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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
GARCITAS CREEK NEAR INEZ														
(1)	TCEQ RUN3	FLOW	132,000	SIM	1940-1998	48,260	24.9%	48,260 AND 12,741	49.1%	12,741 AND 3,346	20.7%	3,346	5.4%	
(2)	TCEQ RUN8	FLOW	132,000	SIM	1940-1998	48,260	24.9%	48,260 AND 12,741	49.1%	12,741 AND 3,346	20.7%	3,346	5.4%	
(3)	USGS (1)	FLOW	132,000	HIST	1940-1998	45,995	25.1%	45,995 AND 11,151	48.8%	11,151 AND 2,285	20.2%	2,285	5.8%	
(4)	USGS	FLOW	130,053	HIST	1980-2010	62,464	23.7%	62,464 AND 10,791	52.2%	10,791 AND 1,878	18.8%	1,878	5.4%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

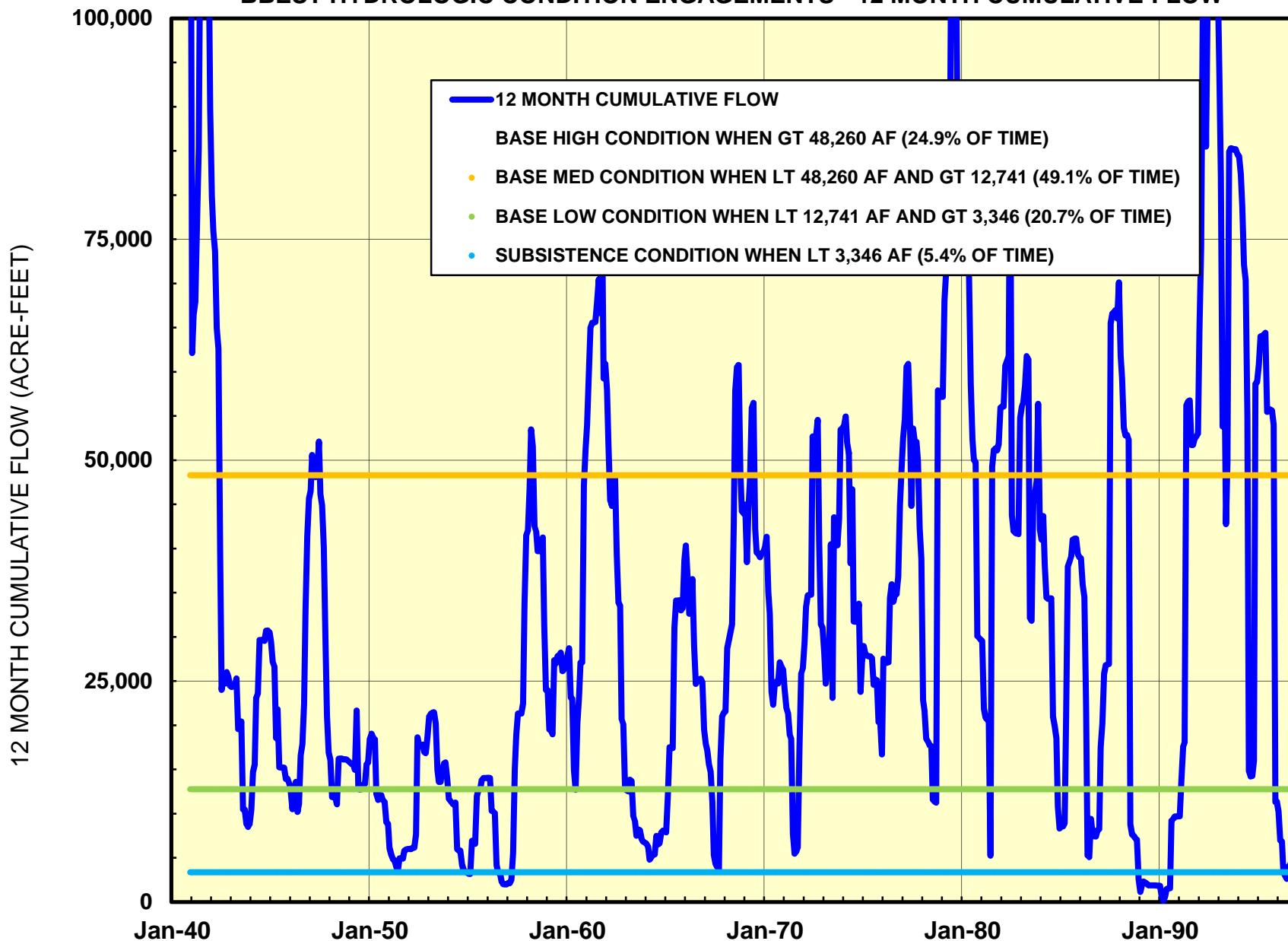
ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

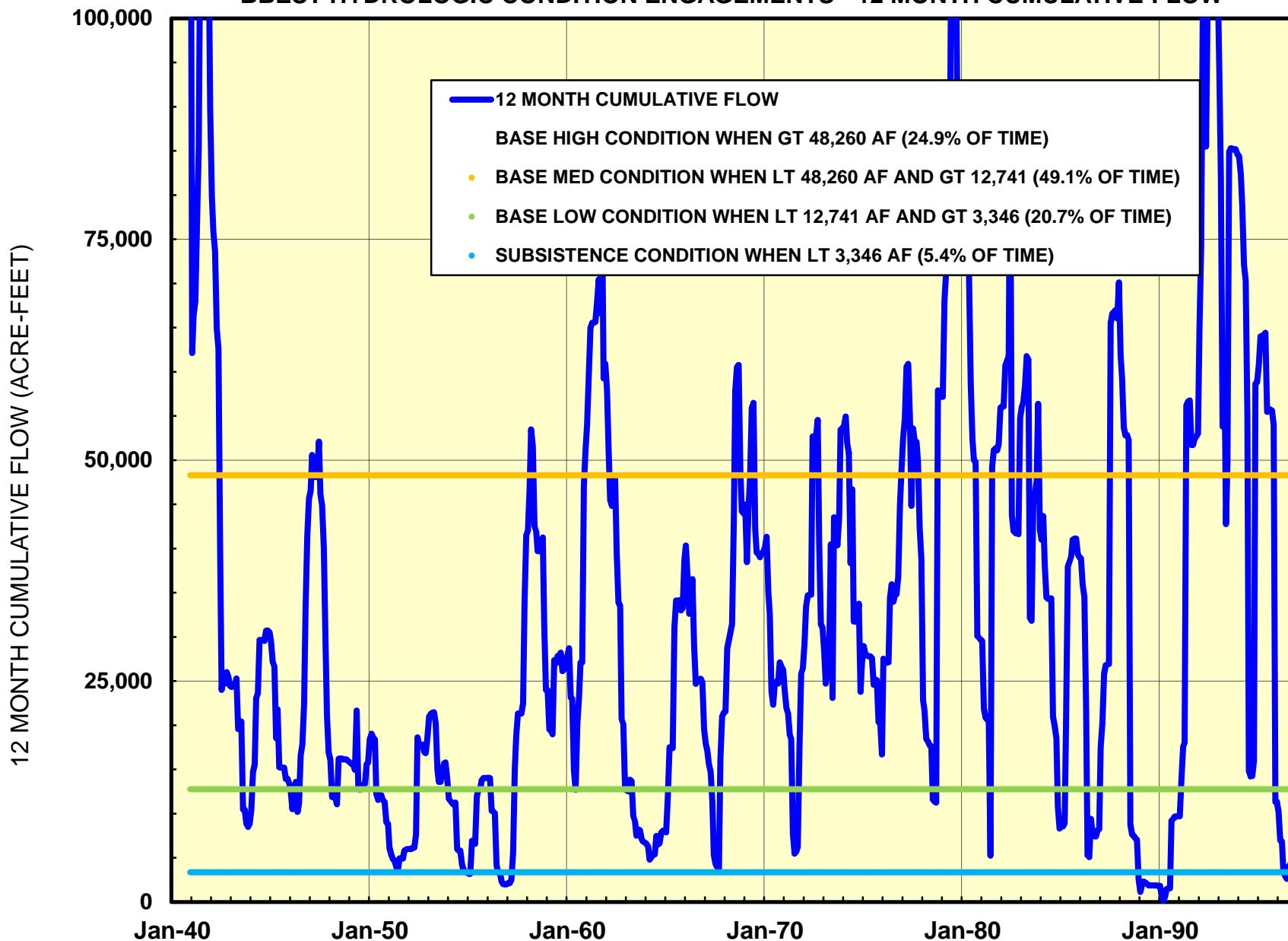
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

(1) Period before 1970 estimated based on Lavaca River near Edna gage.

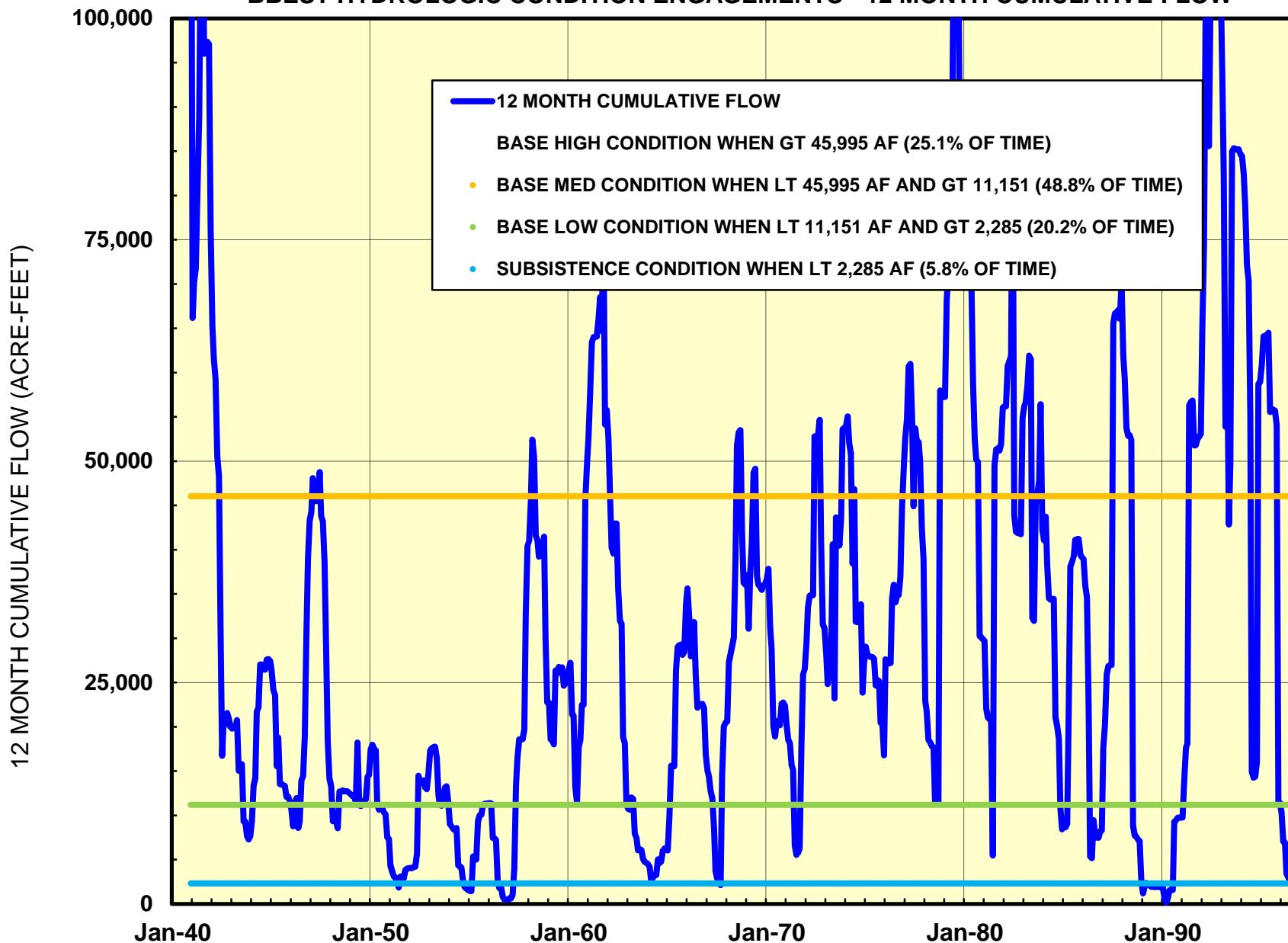
GARCITAS CREEK NEAR INEZ SIMULATED FLOW FOR 1940-1996 (WAM RUN3)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



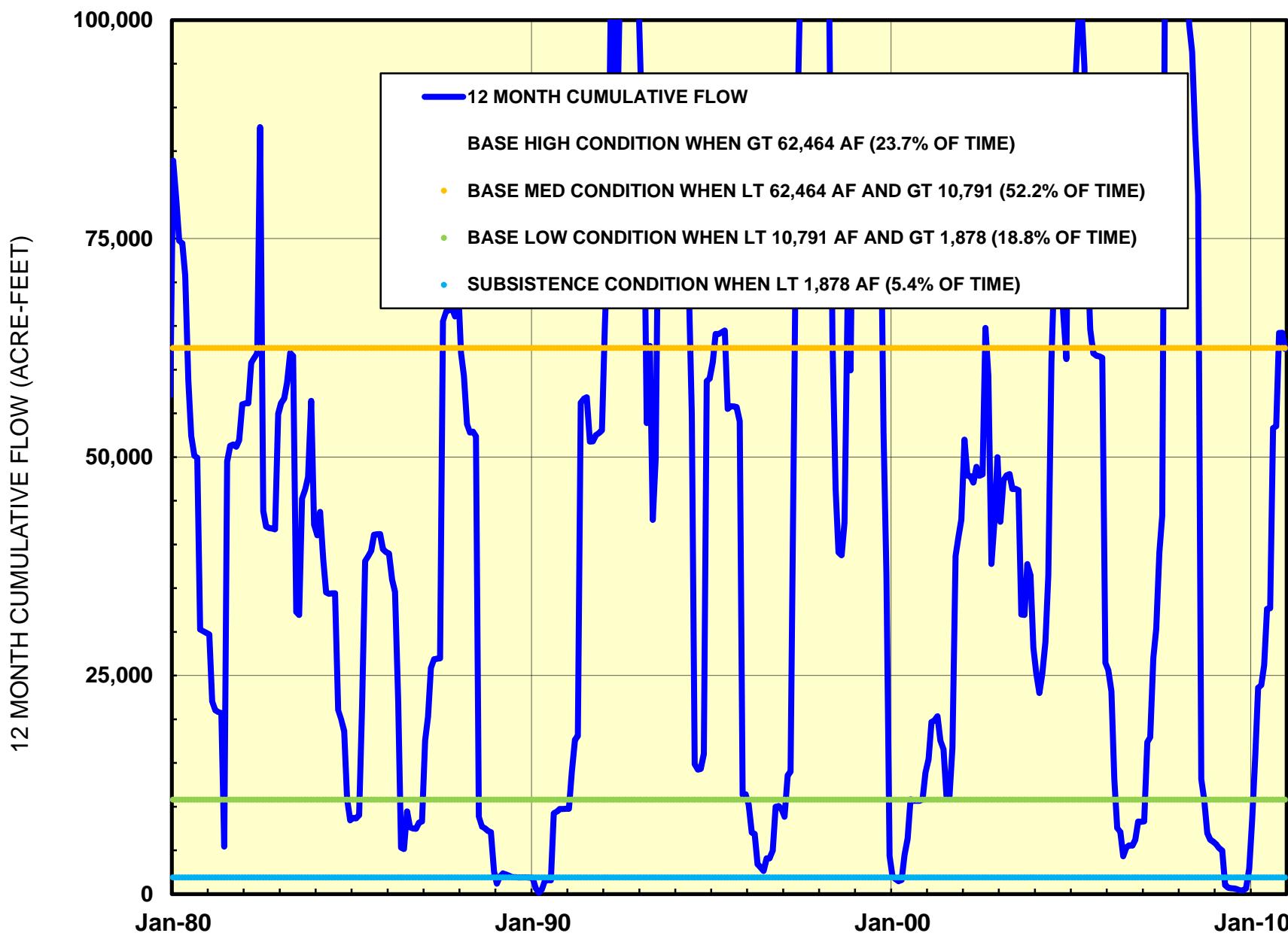
GARCITAS CREEK NEAR INEZ SIMULATED FLOW FOR 1940-1996 (WAM RUN8)
BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



GARCITAS CREEK NEAR INEZ HISTORICAL FLOW FOR 1940-1996 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



GARCIRAS CREEK NEAR INEZ HISTORICAL FLOW FOR 1980-2010 (OBSERVED) BBEST HYDROLOGIC CONDITION ENGAGEMENTS - 12 MONTH CUMULATIVE FLOW



Appendix 16

Summary of C/L BBASC Hydrologic Condition Assumptions

Environmental Flows Recommendation Report - The Colorado and Lavaca Basin and Bay Area Stakeholder Committee

August 2011

SUMMARY OF C/L BBASC HYDROLOGIC CONDITION TRIGGERS														
CL BBASC / BBEST														
AUGUST, 2011														
BBEST SITE ID INFORMATION			BASIS			TRIGGERS RECOMMENDED BY BBASC								
ID	SITE NAME	BASIN	CUMULATIVE FLOW	12 MONTH	LAKE TEXANA SYSTEM STORAGE HIGHLAND LAKES	PERMIT EVALUATION TRIGGERS (TCEQ WAM RUN3) [1]		INTERIM TRIGGERS (HISTORICAL FLOWS) [1]						
						BASE HIGH when above	BASE MED when between	BASE LOW when between	SUBSIST ENCE when below	BASE HIGH when above	BASE MED when between	BASE LOW when between	SUBSIST ENCE when below	
1	Colorado R abv Silver	COL	✓			125,009	125,009 AND 37,410	37,410 AND 14,063	14,063	57,491 AND 16,597	57,491 AND 16,597	16,597 AND 4,094	4,094	
2	Colorado R nr Ballinger	COL	✓			158,824	158,824 AND 55,994	55,994 AND 25,593	25,593	67,703 AND 11,154	67,703 AND 11,154	11,154 AND 3,117	3,117	
3	Elm Ck at Ballinger	COL	✓			47,952	47,952 AND 12,271	12,271 AND 4,924	4,924	46,564 AND 4,989	46,564 AND 4,989	4,989 AND 820	820	
4	South Concho R at Christov	COL	✓			22,635	22,635 AND 6,607	6,607 AND 3,111	3,111	21,655 AND 7,376	21,655 AND 7,376	7,376 AND 5,267	5,267	
5	Concho R at Paint Rock	COL	✓			93,783	93,783 AND 36,914	36,914 AND 19,648	19,648	49,899 AND 17,003	49,899 AND 17,003	17,003 AND 7,110	7,110	
6	Pecan Bayou nr Mullin	COL	✓			168,768	168,768 AND 40,218	40,218 AND 16,693	16,693	187,741 AND 26,695	187,741 AND 26,695	26,695 AND 11,864	11,864	
7	San Saba R at San Saba	COL	✓			185,982	185,982 AND 70,219	70,219 AND 48,662	48,662	149,890 AND 61,099	149,890 AND 61,099	61,099 AND 40,545	40,545	
8	Colorado R nr San Saba	COL	✓			677,930	677,930 AND 315,820	315,820 AND 205,942	205,942	568,972 AND 205,106	568,972 AND 205,106	205,106 AND 80,507	80,507	
9	Llano R at Llano	COL	✓			358,826	358,826 AND 142,110	142,110 AND 64,208	64,208	364,535 AND 145,657	364,535 AND 145,657	145,657 AND 90,810	90,810	
10	Pedernales R. nr Johnson C	COL	✓			192,804	192,804 AND 46,923	46,923 AND 16,569	16,569	222,698 AND 70,206	222,698 AND 70,206	70,206 AND 27,707	27,707	
11	Onion Ck near Driftwood	COL	✓			46,550	46,550 AND 18,528	18,528 AND 7,912	7,912	59,613 AND 10,456	59,613 AND 10,456	10,456 AND 805	805	
12	Colorado R at Bastrop	COL		✓								1,737,462 AND 1,103,702		
13	Colorado R at Columbus	COL		✓										
14	Colorado R at Wharton	COL		✓										
15	West Mustang nr Ganado	LAV			✓									
16	East Mustang nr Louise	LAV			✓									
17	Navidad nr Edna	LAV			✓									
18	Sandy Creek nr Ganado	LAV			✓									
19	Lavaca nr Edna	LAV			✓									
20	Tres Palacios nr Midfield	COLLAV	✓			101,114	101,114 AND 36,920	36,920 AND 18,435	18,435	158,629 AND 62,915	158,629 AND 62,915	62,915 AND 31,939	31,939	
21	Garcitas Creek nr Inez	LAVGUAD	✓			48,260	48,260 AND 12,741	12,741 AND 3,346	3,346	62,464 AND 10,791	62,464 AND 10,791	10,791 AND 1,878	1,878	

[1] For sites number 12,13,14 there are only three 2 base flow regimes, which are called Base Average and Base Dry.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO AT SILVER SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
COLORADO AT SILVER														
(1)	TCEQ RUN3	FLOW	315,926	SIM	1940-1998	125,009	26.1%	125,009 AND 37,410	49.1%	37,410 AND 14,063	19.3%	14,063	5.5%	
(2)	USGS	FLOW	266,337	HIST	1980-2010	57,491	23.7%	57,491 AND 16,597	49.5%	16,597 AND 4,094	21.0%	4,094	5.9%	

KAF Volume in Thousand Acre-Feet
 MSL Elevation Referenced to Mean Sea Level
 STO Storage
 ELEV Elevation

 SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR ELM CREEK NEAR BALLINGER SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME		
ELM CREEK NEAR BALLINGER														
(1)	TCEQ RUN3	FLOW	139,464	SIM	1940-1998	47,952	25.3%	47,952 AND 12,271	50.6%	12,271 AND 4,924	19.3%	4,924	4.9%	
(2)	USGS	FLOW	141,315	HIST	1980-2010	46,564	24.7%	46,564 AND 4,989	49.5%	4,989 AND 820	22.0%	820	3.8%	

KAF
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Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level
Storage
Elevation



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO NEAR NEAR BALLINGER SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME		
COLORADO NEAR BALLINGER														
(1)	TCEQ RUN3	FLOW	469,291	SIM	1940-1998	158,824	25.0%	158,824 AND 55,994	50.0%	55,994 AND 25,593	20.1%	25,593	4.9%	
(2)	USGS	FLOW	326,983	HIST	1980-2010	67,703	24.2%	67,703 AND 11,154	53.2%	11,154 AND 3,117	17.2%	3,117	5.4%	

KAF Volume in Thousand Acre-Feet
 MSL Elevation Referenced to Mean Sea Level
 STO Storage
 ELEV Elevation

 SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SOUTH CONCHO AT CHRISTOVAL

CL BBEST / BBASC August 18, 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
<u>SOUTH CONCHO AT CHRISTOVAL</u>														
(1)	TCEQ RUN3	FLOW	113,035	SIM	1940-1998	22,635	24.1%	22,635 AND 6,607	50.9%	6,607 AND 3,111	19.5%	3,111	5.5%	
(2)	USGS	FLOW	34,512	HIST	2002-2010	21,655	20.8%	21,655 AND 7,376	50.0%	7,376 AND 5,267	18.8%	5,267	10.4%	

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Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level
Storage
Elevation



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.



HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR CONCHO AT PAINT ROCK SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
CONCHO AT PAINT ROCK														
(1)	TCEQ RUN3	FLOW	351,903	SIM	1940-1998	93,783	24.7%	93,783 AND 36,914	51.1%	36,914 AND 19,648	19.3%	19,648	4.9%	
(2)	USGS	FLOW	194,844	HIST	1980-2010	49,899	25.8%	49,899 AND 17,003	48.9%	17,003 AND 7,110	18.3%	7,110	7.0%	

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Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level
Storage
Elevation



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.



HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR PECAN BAYOU NEAR MULLIN SITE

CL BBEST / BBASC August 18 2011

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PAGE #	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME		GOAL; 50% OF TIME		GOAL; 20% OF TIME		GOAL; 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
PECAN BAYOU NEAR MULLIN														
(1)	TCEQ RUN3	FLOW	898,155	SIM	1940-1998	168,768	25.3%	168,768 AND 40,218	50.6%	40,218 AND 16,693	17.8%	16,693	6.3%	
(2)	USGS	FLOW	961,724	HIST	1980-2010	187,741	25.3%	187,741 AND 26,695	48.9%	26,695 AND 11,864	19.4%	11,864	6.5%	

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Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.



HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SAN SABA AT SAN SABA SITE

CL BBEST / BBASC August 24, 2011

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	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL: 25% OF TIME		GOAL: 50% OF TIME		GOAL: 20% OF TIME		GOAL: 5% OF TIME		
SAN SABA RIVER AT SAN SABA														
(1)	TCEQ RUN3	FLOW	503,703	SIM	1940-1998	185,982	24.7%	185,982 AND 70,219	50.6%	70,219 AND 48,662	20.1%	48,662	4.6%	
(2)	USGS (1)	FLOW	700,994	HIST	1980-2010	149,890	23.7%	149,890 AND 61,099	51.6%	61,099 AND 40,545	19.4%	40,545	5.4%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

(1) Period from 10/1/93-9/30/97 not available, used Llano @ Llano to estimate flows.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR COLORADO NEAR SAN SABA SITE

CL BBEST / BBASC August 18, 2011

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	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
COLORADO NEAR SAN SABA														
(1)	TCEQ RUN3	FLOW	2,121,360	SIM	1940-1998	677,930	25.3%	677,930 AND 315,820	49.4%	315,820 AND 205,942	20.4%	205,942	4.9%	
(2)	USGS	FLOW	2,300,694	HIST	1980-2010	568,972	24.2%	568,972 AND 205,106	52.2%	205,106 AND 80,507	17.2%	80,507	6.5%	

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Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level
Storage
Elevation



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.



HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR LLANO AT LLANO SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
LLANO AT LLANO														
(1)	TCEQ RUN3	FLOW	961,451	SIM	1940-1998	358,826	25.0%	358,826 AND 142,110	49.1%	142,110 AND 64,208	20.1%	64,208	5.7%	
(2)	USGS	FLOW	968,106	HIST	1980-2010	364,535	23.7%	364,535 AND 145,657	50.0%	145,657 AND 90,810	20.4%	90,810	5.9%	

KAF Volume in Thousand Acre-Feet
 MSL Elevation Referenced to Mean Sea Level
 STO Storage
 ELEV Elevation

 SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR PEDERNALES NEAR JOHNSON CITY SITE

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 25% OF TIME	ENGAGED WHEN GREATER THAN:	GOAL; 50% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 20% OF TIME	ENGAGED WHEN BETWEEN:	GOAL; 5% OF TIME	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED
PEDERNALES NEAR JOHNSON CITY														
(1)	TCEQ RUN3	FLOW	609,317	SIM	1940-1998	192,804	25.0%	192,804 AND 46,923	49.7%	46,923 AND 16,569	20.4%	16,569	4.9%	
(2)	USGS	FLOW	613,315	HIST	1980-2010	222,698	25.3%	222,698 AND 70,206	49.5%	70,206 AND 27,707	17.7%	27,707	7.5%	

KAF
MSL
STO
ELEV

Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level



SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.



HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR ONION CREEK NEAR DRIFTWOOD SITE

CL BBEST / BBASC August 18, 2011

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PAGE #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL: 25% OF TIME		GOAL: 50% OF TIME		GOAL: 20% OF TIME		GOAL: 5% OF TIME		
ONION CREEK NEAR DRIFTWOOD														
(1)	TCEQ RUN3	FLOW	143,514	SIM	1940-1998	46,550	26.3%	46,550 AND 18,528	48.0%	18,528 AND 7,912	20.5%	7,912	5.2%	
(2)	USGS	FLOW	143,770	HIST	1981-2010	59,613	25.6%	59,613 AND 10,456	50.3%	10,456 AND 805	18.6%	805	5.6%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

ELEV Elevation

 SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR SITES WITH LSWP BASED RECOMMENDATIONS (BASTROP, COLUMBUS, WHARTON)

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PAGE #	DATA USED TO DEVELOP STORAGE TRIGGERS					RESULTING TRIGGERS (BASED CONTENT IN LCRA SYSTEM FOR PREVIOUS MONTH; IN ACRE-FEET)						
	SOURCE DATA	HYDRO CONCEPT	CONSERV. STORAGE (acre-feet)	TYPE	PERIOD OF RECORD	BASE AVERAGE TRIGGER		BASE DRY TRIGGER		SUBSISTENCE TRIGGER		
						GOAL; 50% OF TIME		GOAL; 45% OF TIME		GOAL; 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
LCRA SYSTEM STORAGE (BUCHANAN + TRAVIS)												
(1)	TCEQ RUN3	STORAGE	2,163,227	SIM	1940-1998	1,807,791	54.0%	1,807,791 AND 720,800	41.0%	720,800	5.1%	
(2)	LCRA STAFF	STORAGE	2,010,544	HIST	1980-2010	1,737,462	52.5%	1,737,462 AND 1,103,702	41.8%	1,103,702	5.6%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST APPROACH AND LNRA EXISTING TRIGGERS FOR LAKE TEXANA

TO BE USED FOR THE FOLLOWING SITES: EAST MUSTANG, WEST MUSTANG, NAVIDAD, SANDY CREEK, AND LAVACA

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	DATA USED TO DEVELOP STORAGE/ELEVATION TRIGGERS					RESULTING TRIGGERS (BASED CONTENT OR ELEVATION IN LAKE TEXANA FOR PREVIOUS MONTH)								
	SOURCE DATA	HYDRO CONCEPT	CONSERVATION (storage in AF; elevation in msl)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER GOAL; 25% OF TIME	BASE MEDIUM TRIGGER GOAL; 50% OF TIME	BASE LOW TRIGGER GOAL; 20% OF TIME	SUBSISTENCE TRIGGER GOAL; 5% OF TIME					
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
LAKE TEXANA														
(1)	TCEQ RUN3	STORAGE	170,300	SIM	1940-1996	170,300	30.5%	170,300 AND 132,460	43.5%	132,460 AND 93,298	20.7%	93,298	5.3%	
(2)	LNRA	ELEVATION : LNRA EXISTING TRIGGERS	161,065 / 44.00	HIST	1983-2010	44.00	26.4%	44.00 AND 43.00	50.7%	43.00 AND 39.95	18.1%	39.95	4.7%	

KAF Volume in Thousand Acre-Feet

MSL Elevation Referenced to Mean Sea Level

STO Storage

ELEV Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.

TRIGGERS PROVIDED BY LNRA STAFF (BASED ON EXISTING PERMIT CONDITIONS) AND STYLED TO FIT INTO BBEST FRAMEWORK

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR TRES PALACIOS NEAR MIDFIELD

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL: 25% OF TIME		GOAL: 50% OF TIME		GOAL: 20% OF TIME		GOAL: 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
TRES PALACIOS NEAR MIDFIELD														
(1)	TCEQ RUN3	FLOW	265,073	SIM	1940-1998	101,114	25.0%	101,114 AND 36,920	50.0%	36,920 AND 18,435	19.2%	18,435	5.8%	
(2)	USGS	FLOW	288,968	HIST	1980-2010	158,629	22.6%	158,629 AND 62,915	52.2%	62,915 AND 31,939	20.7%	31,939	4.6%	

KAF Volume in Thousand Acre-Feet
 MSL Elevation Referenced to Mean Sea Level
 STO Storage
 ELEV Elevation

 SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.

SUMMARY OF HYDROLOGIC CONDITION ENGAGEMENT ANALYSIS

USING BBEST IMPLEMENTATION APPROACH FOR GARCITAS CREEK NEAR INEZ

CL BBEST / BBASC August 18, 2011

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	DATA USED TO DEVELOP FLOW TRIGGERS					RESULTING TRIGGERS (BASED ON FLOW FOR PREVIOUS 12 MONTH PERIOD IN ACRE-FEET)								
	SOURCE DATA	HYDRO CONCEPT	MAXIMUM CUMULATIVE 12 MONTH FLOW (acre-feet)	TYPE	PERIOD OF RECORD	BASE HIGH TRIGGER		BASE MEDIUM TRIGGER		BASE LOW TRIGGER		SUBSISTENCE TRIGGER		
						GOAL: 25% OF TIME		GOAL: 50% OF TIME		GOAL: 20% OF TIME		GOAL: 5% OF TIME		
						ENGAGED WHEN GREATER THAN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN BETWEEN:	% OF TIME ENGAGED	ENGAGED WHEN LESS THAN:	% OF TIME ENGAGED	
GARCITAS CREEK NEAR INEZ														
(1)	TCEQ RUN3	FLOW	132,000	SIM	1940-1998	48,260	24.9%	48,260 AND 12,741	49.1%	12,741 AND 3,346	20.7%	3,346	5.4%	
(2)	USGS	FLOW	130,053	HIST	1980-2010	62,464	23.7%	62,464 AND 10,791	52.2%	10,791 AND 1,878	18.8%	1,878	5.4%	

KAF
MSL
STO
ELEV

Volume in Thousand Acre-Feet
Elevation Referenced to Mean Sea Level
Storage
Elevation

SIMULATED RESULTS FROM WAM USED TO DEVELOP TRIGGERS.
 HISTORICAL INFORMATION USED TO DEVELOP TRIGGERS.