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BELCOR RHCP TECHNICAL MEMORANDUM

EXISTING HYDROLOGIC CONDITIONS AND MODELING NEEDS

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March 2024

Executive Summary

The BELCOR RHCP Technical Consultant Team has been tasked with determining the extent to which RHCP covered activities (defined in Section 1 below) may impact those species proposed for coverage under the incidental take permit (ITP) being sought by the BELCOR RHCP Plan Participants (listed on Figure 1). With specific relation to aquatic covered species, this task necessitates an understanding of existing and potential future hydrologic conditions within the BELCOR RHCP area (Plan Area). In support of this task, the Technical Consultant Team collected and reviewed publicly available data and information needed to document existing surface water and groundwater conditions and develop a proposed approach for modeling future hydrologic conditions. Public data was derived from numerous relevant sources including, but not limited to, Brazos River Authority (BRA), Texas A&M University, Texas Commission on Environmental Quality (TCEQ), Texas Water Development Board (TWDB), and United States Geologic Service (USGS). This technical memorandum serves to document general Plan Area hydrologic conditions and provides the hydrologic modeling options/ methods and a recommended approach for consideration by the BELCOR RHCP Plan Participants and the permitting agency (U.S. Fish and Wildlife Service).

This technical memorandum discusses the aquatic species of concern (three freshwater mussels [listed in Section 2 below] and the Salado salamander) for which impacts related to RHCP implementation will need to be determined, details the Plan Area hydrology by water type (surface water versus groundwater), describes the data and analysis that will be used to document existing conditions, outlines potential hydrologic modeling (of future conditions) resources and approaches, and proposes a preferred hydrologic modeling approach (including proposed modeling scenarios) based on key considerations (Plan Area, data available, expected inputs and outputs, and applicability to modeling purpose/need). This technical memorandum also proposes up to six hydrologic modeling scenarios including reference condition, modified existing condition, and four future condition scenarios (see Section 3.2.3 for additional details).

The surface water assessment and modeling, described in this memo, will support the impact assessment for the freshwater mussels proposed for RHCP coverage. The assessment of surface water conditions is described in terms of two key factors: flow data (quantity) and water quality parameters (quality). The water quantity assessment includes water flows and/or levels for key waterbodies in the Plan Area obtained from USGS gage stations, reservoir storage measurements, water usage information (from water rights/contracts), and wastewater treatment plant return flow data. The water quality assessment involves the measurement of key water quality parameters such as dissolved oxygen (DO), temperature, and ammonia-nitrogen obtained from Plan Area Surface Water Quality Monitoring (SWQM) stations and wastewater treatment plant return flow data.

This technical memorandum outlines the surface water modeling approach proposed for the BELCOR RHCP which includes the use of TCEQ's Water Availability Model (WAM) and Water Quality Model (QUAL-TX), both of which were developed to aid Texas regulatory agencies in ensuring sound water management. A summary of the state mandated surface water flow and water quality standards are also included in this memo because they will be used as a potential

point of reference/comparison for the modeled future surface water conditions. Additionally, the model outputs will be reviewed in consideration of habitat requirements for the freshwater mussels of concern to best inform on potential future habitat impacts under RHCP implementation.

The groundwater assessment and modeling will support the impact assessment for the Salado salamander (which is a spring/cave dwelling species) proposed for RHCP coverage. The assessment of groundwater conditions recognizes that there are two primary sources of groundwater in the Plan Area: the Edwards Balcones Fault Zone (BFZ) Aquifer and the Trinity Aquifer (both of which are described in detail in Section 4 below). The assessment of groundwater conditions specifically focuses on information pertaining to water level and water quality. Within the Plan Area, relevant groundwater data is available from several entities namely Groundwater Conservation Districts (GCDs), such as the Clearwater Underground Water Conservation District (CUWCD) and the Middle Trinity Groundwater Conservation District (MTGCD), as well as the TWDB. All of these entities are responsible for monitoring BFZ and/or Trinity Aquifer wells.

This technical memorandum outlines the groundwater modeling approach proposed for the BELCOR RHCP which includes use of the TWDB's Northern Edwards Groundwater Availability Model (NEGAM) to simulate the Edwards BFZ Aquifer in the Plan Area. Though the Trinity Aquifer occurs within the Plan Area, modeling will not focus on the Trinity Aquifer because Plan Area springs supporting the Salado salamander are not associated with this aquifer. The NEGAM will simulate hydrologic (e.g., recharge, surface-groundwater interactions, springs, and cross-formational flow) and anthropogenic processes (e.g., pumping) for each of the six simulation scenarios (listed in Section 3.5.1 below).

This technical memorandum also includes a summary of the Desired Future Conditions (DFCs) that the have been established for the Edwards BFZ Aquifer and Trinity Aquifer. These DFCs refer to the minimum acceptable spring flow for the Edwards BFZ and the water-level drawdowns for the Trinity Aquifer which may occur without impairing the aquifer. The DFCs for each aquifer were determined through joint planning with GCDs within the Groundwater Management Area 8 (GMA 8) and through the use of GAM simulations (additional detail included in Section 4.3). DFCs will be used as potential points of reference/comparison for the modeled future groundwater conditions. Additionally, the model outputs will be reviewed in consideration of habitat requirements for the Salado salamander to best inform on potential future habitat impacts (under RHCP implementation) specifically related to those springs associated with the Edwards BFZ Aquifer.

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Acronyms and Abbreviations

BELCOR RHCP	Bell and Coryell Counties Regional Habitat Conservation Plan
BFZ	Balcones Fault Zone
BRA	Brazos River Authority
CUWCD	Clearwater Underground Water Conservation District
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
Counties	Bell and Coryell Counties
DFC	Desired Future Conditions
DO	Dissolved oxygen
GAM	Groundwater Availability Models
GCD	Groundwater Conservation District
HCP Handbook	Habitat Conservation Planning and Incidental Take Permit Processing Handbook
ITP	incidental take permit
MAG	modeled available groundwater
NEGAM	Northern Edwards Groundwater Availability Model
Plan Area	BELCOR RHCP Plan Area
QUAL-TX	Water Quality Model
RHCP	Regional Habitat Conservation Plan
TCEQ	Texas Commission on Environmental Quality
Technical Consultant Team	BELCOR RHCP Technical Consultant Team
TPDES	Texas Pollutant Discharge Evaluation System
TPWD	Texas Parks and Wildlife Department
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAM	Water Availability Model
WWTP	Wastewater Treatment Plant

1. Introduction

The Existing Hydrologic Conditions and Modeling Needs Technical Memorandum (Hydrologic Technical Memo) was prepared to support the planning and development of the Bell and Coryell Counties Regional Habitat Conservation Plan (BELCOR RHCP or RHCP). As the project name implies, the area of focus for this memorandum is the jurisdictional boundaries of Bell and Coryell counties (Plan Area). This Hydrologic Technical Memo includes hydrologic information for surface water and groundwater resources within the Plan Area and recommendations for hydrologic modeling needed to support the impact assessment for RHCP proposed covered aquatic species - the freshwater mussels[1] and Salado salamander for which impacts will be covered by the Incidental Take Permit [ITP].

Specifically, surface water and groundwater modeling will support the impact assessments (and ultimately the Take estimates) for the covered aquatic species as related to the RHCP covered activities (defined as those activities to be undertaken by the Plan Participants[2]). Hydrologic modeling will also aid in the development of the BELCOR RHCP conservation strategy by determining the habitat areas and conditions which may be key to the conservation of the freshwater mussels and Salado salamander.

The overall purpose of the Hydrologic Technical Memo is to compile and evaluate the following information:

- Existing hydrologic conditions including relevant studies pertaining to the Plan Area hydrology specifically pertaining to hydrogeology, surface water quantity, and surface water quality; and
- The existing framework for surface water and groundwater management.

Additionally, this Hydrologic Technical Memo describes a recommended approach for hydrologic modeling and analysis including the following:

- Models to be used to predict the quantity and quality of surface water and groundwater conditions for the 30-year term of the ITP.
- Additional data needs related to the hydrologic evaluation of the Plan Area including any needs for additional modeling/research strategies.

[1] Freshwater mussels proposed to be a covered by the BELCOR RHCP include the Texas Fawnsfoot *(Truncilla macrodon)*, Balcones spike *(Fusconaia iheringi*), and the Brazos heelsplitter *(Potamilusstreckersoni*).

[2] Covered activities in this Technical Memorandum includes the water usage and wastewater discharge activities of the Plan Participants.

2. Aquatic Species of Concern

As stated above, this Hydrologic Technical Memo includes recommendations for the surface water and groundwater modeling needed to assess and predict future hydrologic conditions (for the 30-year ITP duration) associated with covered activities which may impact distribution and habitat of the aquatic species of concern. These aquatic species include three freshwater mussels: Texas Fawnsfoot *(Truncilla macrodon)*, Balcones spike *(Fusconaia iheringi*), and the Brazos heelsplitter *(Potamilusstreckersoni*) and the Salado salamander (*Eurycea chisholmensis)*. **Figure 1** illustrates the potential habitat for the aquatic species of concern in the Plan Area.

As summarized in the Technical Memorandum on *Existing Information on Species, Data Gaps, and Preliminary Species Accounts for the BELCOR RHCP,* the Texas fawnsfoot and Balcones spike are proposed for federal listing while the Brazos heelsplitter is not currently federally listed or proposed for listing. All species may occur in the Plan Area based on historical data and/or recent survey information. Specifically, the Balcones spike has five historic occurrences in the Plan Area on the Leon River; three in Coryell County and two in Bell County in Belton on both sides of Interstate 35 (Mussels of Texas 2023). There is a reported observation for Texas fawnsfoot (unknown date) along the Leon River west of Gatesville in Coryell County (Mussels of Texas 2023). The Brazos heelsplitter has not been observed in the Plan Area, but there have been four recent (Mussels of Texas 2023) observations downstream on the Little River and Brushy Creek in Milam County, which are hydrologically connected to the Leon River (Mussels of Texas 2023). Given the historic and/or recent observations of all three species along the Leon and Little Rivers, there is potential for all three species to be present in the Plan Area. Primary threats to these species include habitat loss and degradation due to urbanization, acute drought, and water alteration. If development and water related activities occur in or near occupied streams, all three species have the potential to be impacted.

The Salado salamander is federally listed as threatened. These salamanders are restricted to aquatic habitats including seeps, springs, spring-fed creeks, and subterranean water in alluvium and the pores, conduits, and caves of eroded karst limestone (Sweet 1982, Devitt et al. 2019). They are known to occur in southern Bell County but are not documented from northern Bell County or Coryell County (Sweet 1982, Chippindale et al. 2000, Devitt et al. 2019) and may not occur in these areas because the northern segment of the Edwards Aquifer does not extend north of the Lampasas River (Jones 2003). There are springs in the Plan Area (Downtown Salado Springs complex, Robertson Springs complex, and Solana Ranch springs) that are known to support the species and other springs that have potential to support the species but have not been surveyed adequately or at all. Development and water related activities in or near occupied habitat could directly impact salamanders through habitat destruction and removal or through impacts to water quality or quantity.

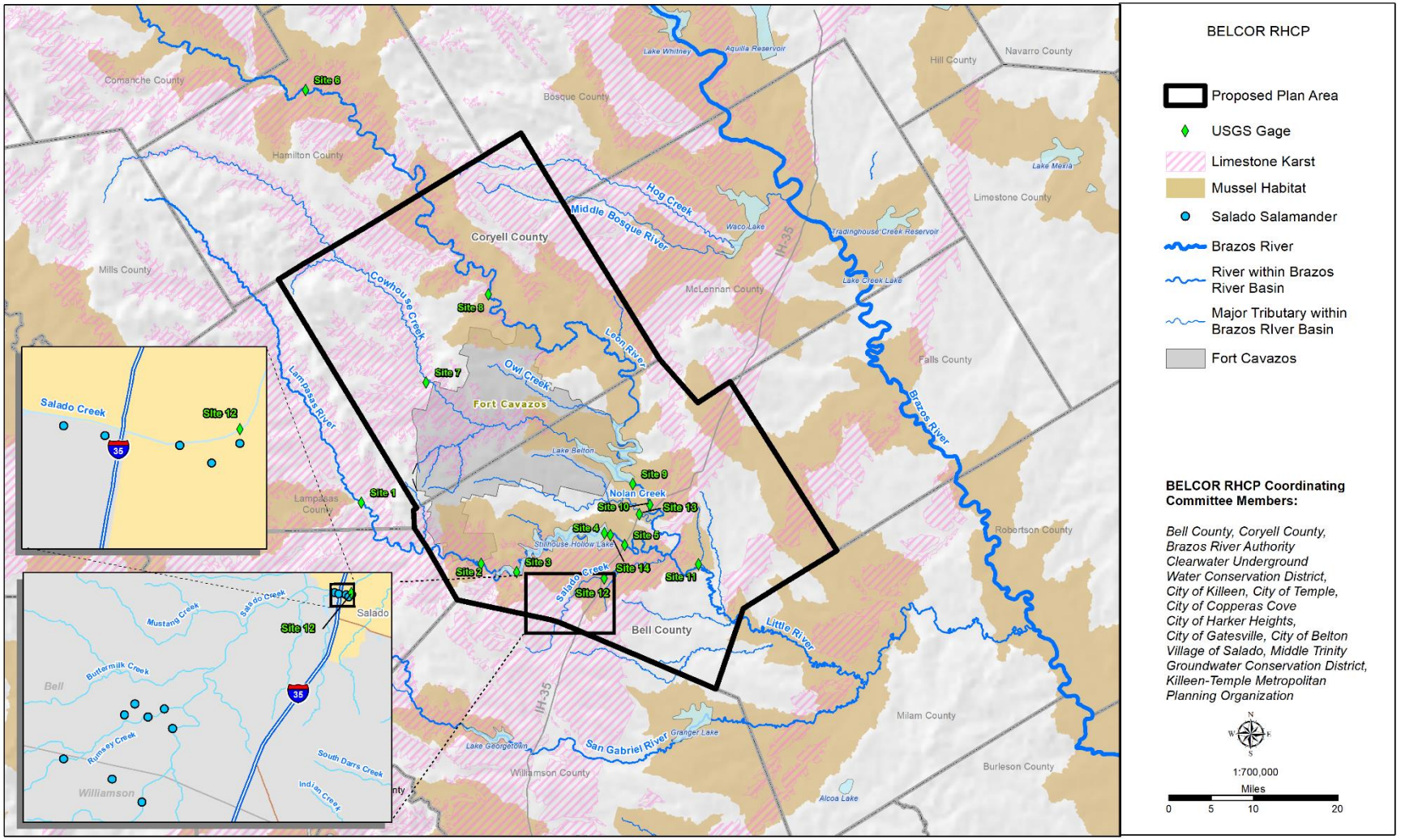

Figure 1. Map of Aquatic Covered Species Habitats in the BELCOR RHCP Plan Area.

3. Surface Water

3.1 Hydrology

Located in the central portion of the Brazos River basin, the hydrologic conditions in the Plan Area encompass various creeks, rivers, and reservoirs that contribute to the overall water flow. **Figure 2** shows the most notable water bodies in Bell County include the following rivers and reservoirs: **Leon River**, which flows through Bell County providing water for irrigation, recreation, and wildlife habitat; **Belton Lake**, which is formed by the Belton Dam on the Leon River and serves as a water supply reservoir that offers recreational opportunities and is designated[3] by the Texas Council on Environmental Quality (TCEQ) as a public water supply and a high aquatic life use waterbody; **Stillhouse Hollow Lake,** which is formed by the Stillhouse Hollow Lake Dam on the Lampasas River and serves as a water supply reservoir, offers recreational opportunities, and is designated by the TCEQ as a public water supply and an exceptional aquatic life use waterbody; **Lampasas River below Stillhouse Hollow Lake**, which commences at Stillhouse Hollow Lake Dam and flows to the confluence with the Leon River; and **Little River**, which although primarily located in Milam County, flows through the southern part of Bell County.

The most notable water bodies in Coryell County include the following rivers and creeks: **Cowhouse Creek**, which flows through Coryell County and eventually joins the Leon River; and a portion of the **Leon River**, which flows from the confluence with Plum Creek in Coryell County into Bell County and Belton Lake.

3.2 Surface Water Modeling

This section outlines the surface water modeling approach proposed for the BELCOR RHCP. This approach will be a comprehensive predictive modeling process to assess the potential impacts that current and future covered activities may have on the BELCOR RHCP freshwater mussels and their habitats. This approach includes an assessment of surface water conditions – conditions that are characterized by both water quantity data and water quality data. The presence or absence of the freshwater mussels depends on both water availability and water quality.

Figure 3 is a simplified diagram of the approach and components of the BELCOR RHCP Hydrologic Surface Water modeling. The diagram illustrates the surface water quantity and surface water quality modeling processes including information on the data inputs and expected outputs. The approach includes the use of TCEQ's Water Availability Model (WAM) and Water Quality Model (QUAL-TX) which were both developed to aid Texas regulatory agencies in ensuring sound water management.

[3] Texas Administrative Code, Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality, Chapter 307, Texas Surface and Water Quality Standards, (30 TAC 307).

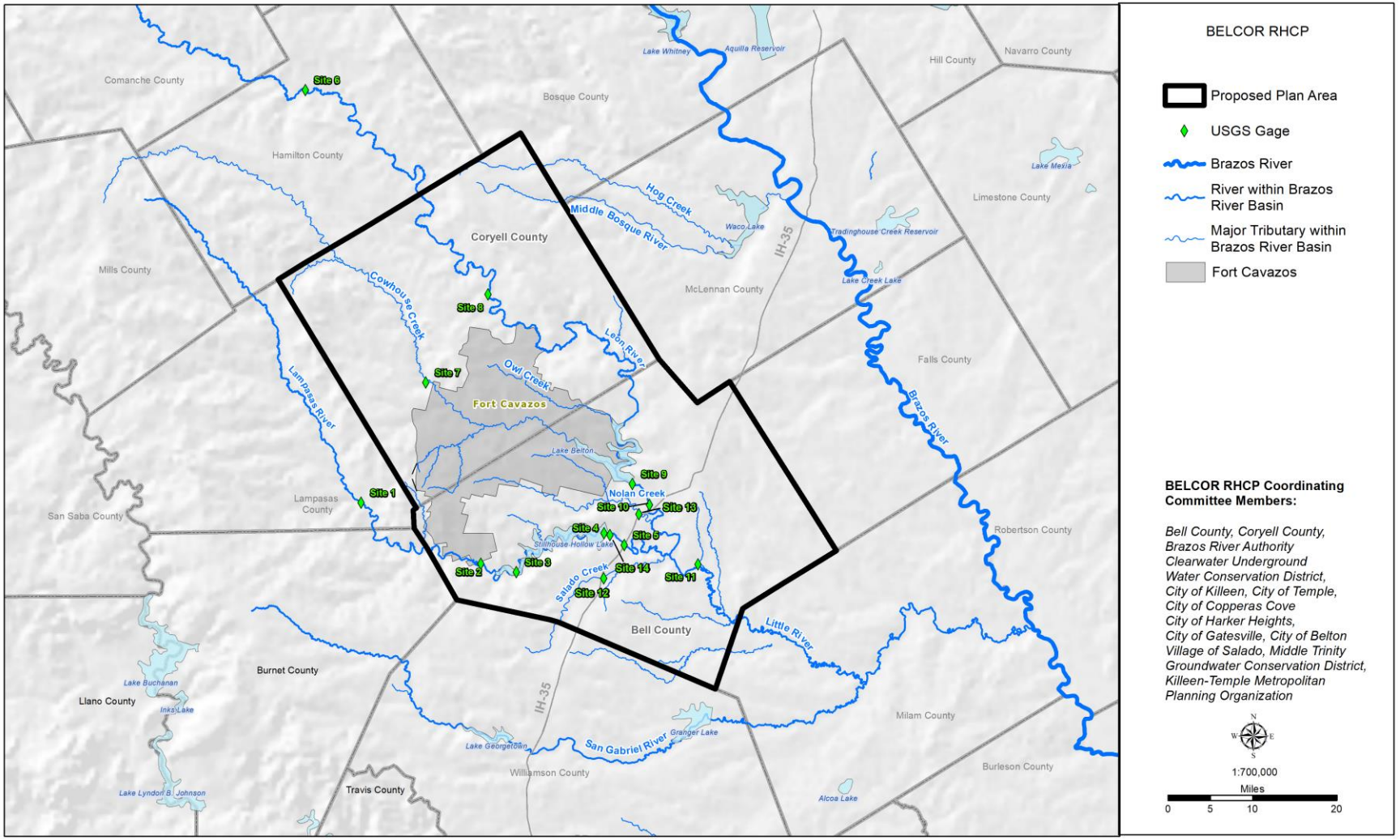

Figure 2. Map of the Surface Water Hydrology in the BELCOR RHCP Plan Area.

The WAM model is a computer-based simulation predicting the amount of water that would be in a river or stream under a specified set of conditions. WAMs are the backbone of the TCEQ water rights permitting program and are used to determine whether water is available for new permits or whether changing an existing permit would affect other water rights. Using the TCEQ WAM allows us to model future conditions under different scenarios to better understand how covered activities may impact water resources and species inhabiting these resources under differing future conditions.

TCEQ's QUAL-TX model is a steady-state surface water quality model that was developed for Texas to evaluate Texas Pollutant Discharge Evaluation System (TPDES) permit effluent limits. Entities that release point source pollutants to Texas waterbodies are modeled using QUAL-TX to evaluate the impact from oxygen-demanding constituents on predicted in-stream dissolved oxygen concentrations. QUAL-TX modeling results help regulatory agencies determine if permitted entities will maintain compliance with the water quality standards, or if more stringent permit conditions are required.

The QUAL-TX model will also include factors such as ambient water temperature, the permitted discharge quality of the WWTP return flows to estimate the in-stream concentrations of dissolved oxygen, ammonia-nitrogen (NH3-N), and biological oxygen demand within each model domain.

3.2.1 Sources of Water Quantity Data

For the WAM (water quantity model), **Figure 3** illustrates the various sources of data and information including historical stream flow, WWTP return flows, water usage (water rights permits and water contracts) and sediment in reservoirs as inputs into the water quantity model. The WAM uses this information to estimate in-stream flows at critical conditions under different scenarios at USGS gage stations, which in turn, will be used as input into TCEQ's QUAL-TX water quality model.

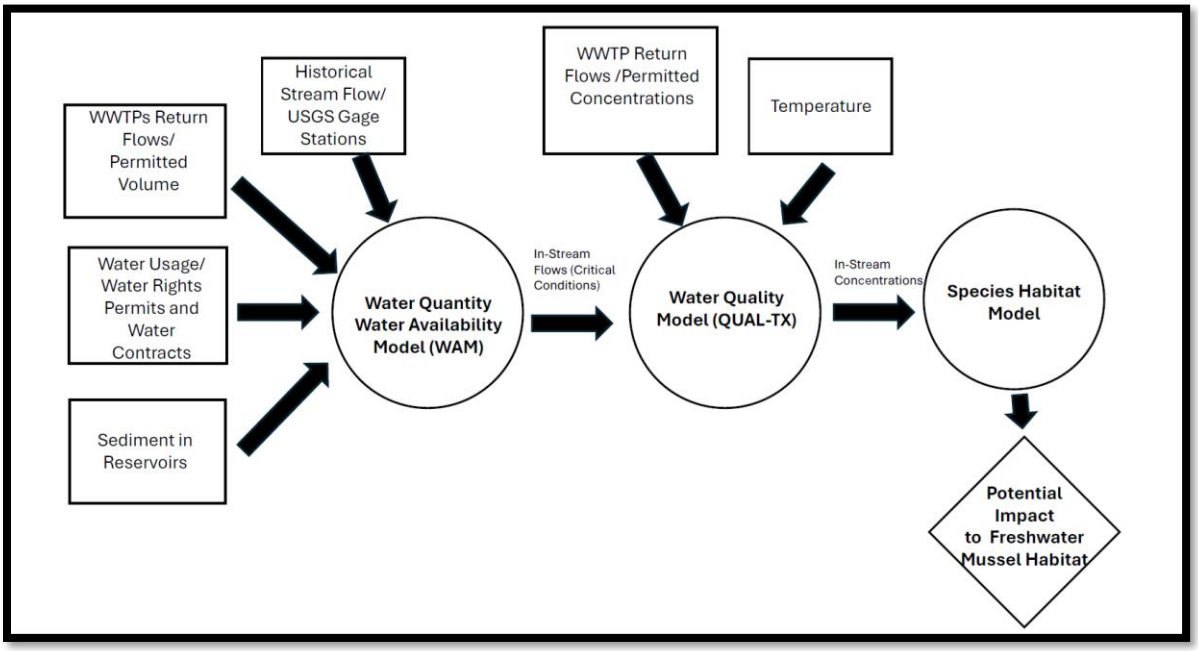

Figure 3. Proposed Approach to the BELCOR RHCP Surface Water Modeling

The following sections further describe the sources of data and information on surface water quantity that will be used in the BELCOR RHCP Surface Water Model:

Data from Gage Stations: Streamflow or discharge data measured at gage stations, is crucial for understanding overall surface water quantity flow. It provides information about the volume of water flowing through a river or creek. These stations continuously monitor water levels (gage height) and calculate flow/discharge in cubic feet per second (cfs). All gages in Bell and Coryell counties are operated by the U.S. Geological Survey (USGS)**.**

There are 14 USGS gage stations within or near Bell and Coryell counties that will be used to assess impacts of current and future conditions on the freshwater mussels. Refer to **Figure 2**: **Surface Water Hydrology in the BELCOR RHCP Plan Area** for the map depicting the locations of these 14 USGS gage stations in the Plan Area. **Table 1** on the following page includes basis information on of these gage stations including the each station's available period of record and their hydrologic significance. With the exception of Sites 3[4], 4, and 9 (shown on Figure 2), all of these gage stations are currently operating and provide daily quantities of flow available from the USGS website (USGS 2024).

Historical streamflow information from all gage stations listed in **Table 1** will be used to make comparisons of historical flow and reservoir storage quantities with the simulated future conditions (Refer to Section 3.2.3). **Attachment 1** contains plots for each of the 14 gage stations which depict the magnitude of flow in annual flow volume that was observed for each gage station over its period of record.

Table 1. USGS Gage Stations where surface water information is available for the Plan Area

Site #	USGS Gage Name and Number	Period of Record	Drainage Area (sq.mi)	Hydrologic Significance
1	Lampasas River at Kempner (08103800)	10/1962 through Current	818	Upstream of Stillhouse Hollow. Has a fairly long period of record and is the most upstream gage on the Lampasas River. This site is also one of the sites that has TCEQ SB3 environmental flow standards, and the gage has current daily flow observations available through USGS's website.

[4] The Site No. 3 gage station was discontinued in the 1980's; however, because of its close proximity to the Site No. 2 gage, which has current observations but a short historical period of record, Site No. 3 was included in the list.

Table 1. USGS Gage Stations where surface water information is available for the Plan Area

Site #	USGS Gage Name and Number	Period of Record	Drainage Area (sq.mi)	Hydrologic Significance
2	Lampasas River at Ding Dong	12/2015-Current	1,195	Upstream of Stillhouse Hollow Reservoir. Although this gage has a short period of record (less than 10 years) it is the closest operating gage upstream of Stillhouse Hollow Reservoir and has current daily flow observations available through USGS's website.
3	Lampasas River at Youngsport	1/1940-8/1980	1,240	Upstream of Stillhouse Hollow Reservoir. Although observations are no longer made at this site, its long-term period of observations (before 1980) and its close proximity to Site #2 offer insight, as well as daily flow patterns, at site #2 before flow observations were actually recorded for site #2.
4	Stillhouse Reservoir	Closed 2/19/1968	1,313	One of the major water supply reservoirs within the BELCOR geographic area. This reservoir is operated by the US Army Corps of Engineers, and the BRA has water rights that authorize the impoundment and use of water for various beneficial uses.
5	Lampasas River near Belton	2/1963 - 10/1989 4/1999-Current	1,321	Immediately Downstream of Stillhouse Hollow Reservoir and thus represents spills and releases from Stillhouse Hollow Reservoir.
6	Leon River near Hamilton	10/2007 - Current with missing data	1,891	Upstream of Lake Belton and downstream of Lake Proctor. This gage is the most upstream gage on the Leon River used in the BELCOR HCP.
7	Cowhouse Creek at Pidcoke	10/1950 - Current	455	On tributary of Leon River upstream of Lake Belton. Unlike site #6, flows at this site are not influenced by releases or spills from Lake Proctor and thus are representative of natural hydrologic conditions within the upper extent of the BELCOR HCP area.

Table 1. USGS Gage Stations where surface water information is available for the Plan Area

Site #	USGS Gage Name and Number	Period of Record	Drainage Area (sq.mi)	Hydrologic Significance
8	Leon River at Gatesville	10/1950 - Current	2,342	Upstream of Lake Belton. This site is also one of the sites TCEQ has established SB3 environmental flow standards at and the gage has current daily flow observations available through USGS's website.
9	Belton Reservoir	Closed 3/8/1954	3,570	One of the major water supply reservoirs within the BELCOR geographic area. This reservoir is operated by the US Army Corps of Engineers and the BRA has water rights that authorize the impoundment and use of water for various beneficial uses.
10	Leon River near Belton	1/1940 - Current	3,582	Immediately Downstream of Lake Benton and thus represents spills and releases from Lake Belton.
11	Little River near Little River	8/1962 - Current	5,228	Downstream of the confluence of the Lampasas and Leon Rivers, downstream of Belton and Stillhouse Reservoirs, and near the most southeast extent of the BELCOR HCP. In addition, this site is one of the sites TCEQ has established SB3 environmental flow standards. The gage also has current daily flow observations available through USGS's website.
12	Salado Creek at Salado	3/2013 - Current	136	On large tributary of Lampasas River that enters the Lampasas River downstream of Lake Stillhouse. Several WWTP's are located in this watershed. Daily flow observations are available through USGS's website.
13	Nolan Creek at S Penelope, Belton	3/2018 - Current	112	On large tributary of Leon River that enters the Leon River downstream of Lake Belton. Receives runoff from heavily urbanized area of Nolanville, Harker Heights, and Killeen with headwaters in Fort Hood (Cavazos). Daily flow observations are available through USGS's website.

Table 1. USGS Gage Stations where surface water information is available for the Plan Area

Site #	USGS Gage Name and Number	Period of Record	Drainage Area (sq.mi)	Hydrologic Significance
14	Chalk Ridge Falls Spings near Belton	10/2017 - Current	None	This site measures spring discharge from the Austin Chalk, Edwards and Associated Limestones, and Other aquifers.

Reservoir Storage and Inflow/ Outflow Measurements: Sites #4 and #9 (see **Figure 2**) include elevation measurements of reservoir levels used to determine sedimentation rates in Stillhouse Hollow Reservoir and Lake Belton, respectively. These reservoirs are the only major reservoirs in the Plan Area and are both operated by the U.S. Army Corps of Engineers (Corps).

Water Usage (Water Rights Permits and Water Contracts): Since surface water in Texas is publicly owned, the TCEQ will grant a water right permit which allows the entity the legal authority to impound or divert surface water for its own beneficial uses or another entities' beneficial use. The amount of water that is impounded or diverted – or water usage - will include the amount of surface water authorized in a current TCEQ water rights permit or surface water allowed in a water contract. For example, the Brazos River Authority (BRA) owns the water rights that authorizes the storage and diversion of water from Stillhouse Hollow Reservoir and Lake Belton for multiple beneficial uses . **Attachment 2** contains the approved Water Right information for the Plan Area, as identified in the 2021 Region G Water Plan and TCEQ's Water Rights Masterfile and **Attachment 3** contains the water source supply of the BELCOR RHCP Plan Participants

Wastewater Treatment Plants Return Flow Volume: The volume of discharge from Wastewater Treatment Plants (WWTPs) is also referred to as return flows because it contributes to overall streamflow at the location of the WWTP outfall. Actual measurements of return flows are provided to the TCEQ by the owner or operator of a WWTP as a part of that WWTP's self-reporting data. This data is included as input into the WAM model resulting in predictive streamflow values that will vary daily. This data is maintained by the TCEQ through the TPDES program.

3.2.2 Sources of Water Quality Data

Water quality parameters such as dissolved oxygen (DO) and temperature are essential to assess current and future surface water conditions to be able to measure the potential impacts that covered activities may have on the freshwater mussels and their habitats. Types of surface water quality data and information that will be used in the BELCOR RHCP Surface Water Modeling include surface water temperature and the permitted effluent concentrations from wastewater treatment plants. The sources of this data include the following:

Surface Water Quality Monitoring (SWQM) Stations: Surface water temperature is recognized as an input variable to the QUAL-TX model and is collected by both the TCEQ and the BRA at Surface Water Quality Monitoring Stations in the Plan Area. **Table 2** lists the locations of the

SWQM Stations with the nearest USGS gage station. Surface water temperature data is available on both the TCEQ and BRA websites.

Wastewater Treatment Plants Return Flow Quality: The quality of return flow is established by the TCEQ TPDES permit program and includes limits on the concentrations of NH3-N, total suspended solids, 5-day carbonaceous biochemical oxygen demand (CBOD5), and minimum concentrations for DO. Permit effluent limits are available from the TCEQ for each WWTP in the Plan Area.

Table 2. Surface Water Quality Monitoring and Standards in the BELCOR RHCP Plan Area

Site No.	USGS Gage Station	Segment ID	Surface Water Quality Monitoring Station	Period with Temp and D.O. Observations	Measured Flow (% Period)	Numeric Criteria Temp (°F)	Numeric Criteria Dissolved Oxygen (mg/l)
1	Lampasas River at Kempner 08103800	1217	Lampasas River At US 190	1981-2023	13%	91	6.5-9.0
5	Lampasas River nr Belton 08104100	1215	Lampasas River @ Dice Cove Rd (10 miles downstream)	1996-2023	67%	91	6.5-9.0
7	Cowhouse Creek at Pidcoke 08101000	1220A	Cowhouse Creek @ FM 116	1989-2023	13%	93	6.5-9.0
8	Leon River at Gatesville 08100500	1259	Leon River @FM 1829 (20 miles downstream)	1988-2023	93%	90	6.5-9.0
10	Leon River near Belton 08102500	1219	Leon River At Fm 436 (30 miles downstream)	1981-2023	13%	91	6.5-9.0
11	Little River near Little River 08104500	1213	Little River @ SH 95	2014-2023	0%	90	6.5-9.0
12	Salado Creek at Salado 08104300	1243	Salado Creek Downstream of FM 2268	1978-2023	32%	90	6.5-9.0
13	Nolan Ck at S Penelope, Belton 08102595	1218	Nolan Creek At Sh 93 In Belton	1994-2018	0%	93	6.5-9.0

3.2.3 Proposed Modeling Scenarios

Based on current understanding of the factors/conditions that may impact the freshwater mussels now and in the future (2060) as related to BELCOR RHCP covered activities, the following scenarios are proposed for the BELCOR RHCP Surface Water Modeling:

1. **Reference Condition (2020 Conditions without Covered Activities)**: Current water management in the Plan Area without Plan Participants' covered activities to be used as a comparison to the other scenarios.
2. **2020 Conditions with Covered Activities:** Current water management in the Plan Area with Plan Participants' covered activities to be used to determine the impact on the freshwater mussels under current conditions.
3. **2060 Conditions with Covered Activities:** Future water management with Plan Participants covered activities, such as projected 2060 water usage to be used to determine the impact on the freshwater mussels under future conditions.
4. **2060 Conditions with Covered Activities and Conservation Measures:** Future water management with Plan Participants covered activities, such as projected 2060 water usage, with proposed conservation measures to be used to assess the extent to which the RHCP conservation strategy mitigates the impact on the freshwater mussels under future conditions.
5. **2060 Conditions with Covered Activities and Conservation Measures and climate change factors:** Future water management with Plan Participants covered activities, such as projected 2060 water usage, with estimated changes in evaporation rates and streamflows due to climate changes and proposed conservation measures to be used to assess the extent to which the RHCP conservation strategy mitigates the impact on the freshwater mussels from climate change factors.
6. **Additional Scenario (details to be determined):** Future water management with Plan Participants covered activities, such as projected 2060 water usage, with alternative conservation measures, proposed by the USFWS, to be used to assess the extent to which the alternative conservation strategy mitigates the impact on the freshwater mussels under future conditions.

3.2.4 Surface Water Quantity Modeling - Water Availability Model (WAM)

For evaluating how streamflows may change within the BELCOR RHCP area under different prescribed scenarios, the Technical Consultant Team will use the TCEQ WAM as mentioned previously. Specifically, the WAM simulates the available supply of water for each water right under the prior appropriation doctrine[5] in the Brazos River Basin based on a long period of monthly flows.

[5] The prior appropriation doctrine provides that senior water rights get priority over junior water rights in times of shortage. The concept is often also referred to "First in time, first in right".

These monthly flows were derived from gage flows with naturalized flow adjustments to remove the effects of historical diversions, wastewater return flows, and reservoirs. Use of this naturalized flow dataset allows assumed future water use conditions and different modeling scenarios to be analyzed based on the same common hydrologic regime.

Several versions of the Brazos WAM are available from various entities, each representing different future water use conditions. The following describes the WAMs that have been acquired and are available for simulating the surface water flow conditions for the Plan Area:

(1) TCEQ Brazos WAM Run 3. This model represents all water rights in the Brazos River basin at their full authorized diversion amounts and reservoir capacities and assumes no discharge of return flows within the basin. This version of the WAM is used by TCEQ for evaluating new water right applications and water right amendments.

(2) TCEQ Brazos WAM Run 8. This model represents all water rights in the Brazos River basin with their demands set to the maximum amount that has been reported for the last 10 years, with return flows set to the minimum amount discharged for a recent five-year period, and with storage in all major reservoirs adjusted to reflect recent sedimentation conditions. Current versions of this model are no longer maintained by TCEQ; however, some older versions are still available offline. The purpose of this version of the WAM originally was to provide a means for TCEQ to evaluate water availability for term water right applications, but the model has also been used extensively to gain insight to water availability conditions without the full, and often times under-utilized, authorized demands and reservoir capacities for all water rights.

(3) Region G Brazos WAM. This model suite includes two separate models, both of which are modified versions of the TCEQ Brazos WAM Run 3. One, referred to as the Supply model, is used to: (1) establish the quantity of surface water supply available in the region, and (2) determine the extent there are shortages in supplies based on realistic water demands. Once shortages in supply are noted, a second version of the model is created, called the Strategy model, in which a wide range of recommended strategies are applied to determine the extent the shortages can be mitigated or eliminated. The most recent Region G Regional Plan was completed in 2021, with results incorporated into the 2022 State Water Plan. Both the Supply and Strategy versions of the Region G model assess water availability for the 2020-2070 time period, using one model per decade, and these models are available from the TWDB Regional Water Planning Program.

(4) Brazos River Authority Operational WAM (River Operations Analysis). Although the current BRA operational model does not fully use the WAM approach to simulate river operations, some recent older versions of BRA's previous approach do use WAM information, and these models are still available offline. The purpose of these models is to implement and test various reservoir operating rules, and thus, they contain meaningful near and far term input parameters that represent expected water demands and reservoir sedimentation conditions.

(5) Brazos River Authority 2060 WAM Model used for development of the Candidate Conservation Agreement with Assurances (CCAA). In 2021, the BRA developed an agreement with the U.S. Fish and Wildlife Service in 2021 where several WAM models were

used to assess various low flow conditions in the Brazos River Basin for the purposes of assessing how future flow conditions might impact the habitat needs of two freshwater mussels (Balcones Spike and Texas Fawnsfoot) (BRA 2021). Because one of the future conditions assessed by the CCAA was the 2060 condition, the Technical Consulting Team will use this model to determine the 2060 streamflow conditions.

Preferred Model

The latest TCEQ Brazos WAM Run 3 is the preferred base model for the BELCOR RHCP analyses. Review of numerous input parameters from the other WAM's will be made, and relevant model parameters/inputs that best represent the future conditions envisioned for use in the RHCP will be extracted and incorporated into the base model to develop the necessary hydrologic inputs for the assessment of river flows in the BELCOR RHCP Plan Area[6]. The changes will result in two versions of the WAM, one that represents 2020 (current) water use and storage conditions and the other representing 2060 conditions.

Information will be extracted from the WAM simulation under each scenario as related to for the 14 USGS gage station locations. The model results will be analyzed through a variety of result comparisons for each of the scenarios. WAM's simulated monthly flows for each gage station will be converted into daily flows using the historical daily flow data available for each gage. For gage stations that do not have historical daily flows for the entire WAM period of record, historical daily flow patterns from nearby and relevant gage stations that have data for the missing period will be used.

Development of the WAM Scenarios

Assuming the use of the TCEQ Brazos WAM Run 3 model (described above), under the six modeling scenarios listed in section 3.4.1, the scenarios for the WAM will be developed as follows:

1. **Reference Condition (2020 Conditions without Covered Activities) -** Using the current versions of TCEQ's Brazos WAM 3 Run, modifications will be made to remove the water usage of the Plan Participants[7] in the proposed Plan Area. For the WAM, all water right activities in the Brazos River Basin will be modified to represent 2020 conditions. Water usage is the water supply source (water rights and or contracts) for each of the Plan Participants. The changes to be made to the base model are the following:

    - All water rights and contracts in the Brazos River Basin with authorized or contracted diversions greater than 1,000 acre-feet per year will be set equal to their maximum annual

[6] The WAM structure already contains control points at most of the proposed locations in Table 1.

[7] The following thirteen entities are the Plan Participants in the BELCOR HCP: Bell County, Coryell County, Clearwater Underground Water Conservation District, Brazos River Authority, City of Belton, City of Copperas Cove, City of Gatesville, City of Harker Heights, City of Killeen, City of Temple, Kileen-Temple Metropolitan Organization, Middle Trinity Groundwater Conservation District, Village of Salado. These entities' sources of water are summarized in Attachment 3.

use for the last 10 years. Water rights with authorized or contracted diversions less than 1,000 acre-feet per year will be set at their authorized or contracted amounts.

- Conservation storage capacity for all major reservoirs in the basin will be set equal to the estimated 2020 storage capacity. Any currently authorized major reservoirs that have not been constructed will be removed from the model.

- All permitted wastewater discharges located in the Lampasas and Leon River watersheds in and upstream of Bell and Coryell counties and downstream of Lake Proctor in the Leon watershed will be set equal to their minimum annual discharge for the last 5 years. For permitted dischargers in the remainder of the Brazos River basin, permitted dischargers with maximum permitted discharge amounts greater than or equal to 1.0 MGD will be included with their discharge set to their minimum annual discharge for the last 5 years and dischargers with maximum permitted discharge amounts less than 1.0 MGD will not be included.

The information required to make these model modifications will be obtained from available sources including the BRA, TCEQ, Texas Water Development Board (TWDB), and U.S. Environmental Protection Agency (USEPA). In the event this information is not readily available, the necessary information will be developed or extrapolated from previous WAM data files representing similar modeling conditions or based on estimated historical information.

2. **2020 Conditions with Covered Activities -** This version of the WAM is the same as that described above, but with the Covered Activities of the Plan Participants included in the model.

3. **2060 Conditions with Covered Activities -** Using the WAM for the **2020 Conditions with Covered Activities**, modifications will be made to incorporate the following:

   - All water rights and contracts in the Brazos River Basin with authorized or contracted diversions for over 1,000 acre-feet per year will be set equal to their estimated annual use for the year 2060. Water rights with authorized or contracted diversions less than 1,000 acre-feet per year will be set at their authorized or contracted amounts.

   - Conservation storage capacity for all major reservoirs in the basin will be set equal to the estimated capacity for the year 2060. Any currently authorized major reservoirs that have not been constructed will be included in the model.

   - All permitted wastewater discharges located in the Lampasas and Leon River watersheds in and upstream of Bell and Coryell counties and downstream of Lake Proctor in the Leon watershed will be set equal to their estimated quantity of return flow for the year 2060. For permitted dischargers in the remainder of the Brazos River Basin, permitted dischargers with maximum permitted discharge amounts greater than or equal to 1.0 MGD will be set to their estimated quantity of return flow for the year 2060 and dischargers with maximum permitted discharge amounts less than 1.0 MGD will not be included.

   The information to make these changes will be based on review of documents from Region G for 2060 and from BRA, TCEQ, TWDB, and USEPA. The WAM modeling will not include any of the recommended water strategies from Region G unless they are currently authorized (permitted).

4. **2060 Condition with Covered Activities and Conservation Measures -** Once the appropriate changes are made to WAM for the **2060 Conditions with Covered Activities**, it will be used, after further modifications, to represent up to five proposed conservation measures that are considered likely to impact surface water flows in the Plan Area.

5. **2060 Condition with Covered Activities, Conservation Measures and Climate Change Factors -** For developing this version of the WAM, readily available information from the most recent climate change sources will be reviewed to identify the range of expected changes in climate factors for the two-county area by the year 2060. The 75th percentile ranking of all available data from this review will be used to formulate estimated 2060 changes in the evaporation rates and streamflows that are inputs to the WAM. These changes will be made to the input data for the version of the WAM described above.

6. **2060 Conditions with Covered Activities and USFWS Conservation Measures** - The WAM described above in Scenario #4 (2060 Conditions with Covered Activities and Conservation Measures) will be modified to represent alternative conservation measures proposed by the USFWS.

Model Output

For each scenario, the WAM generated streamflows will be extracted for each of the 14 USGS gage stations listed in **Table 1.** These generated streamflows will be compared to the historical distributions of daily to monthly flows, in order to convert the WAM simulations into daily flows. Using these converted daily flow values, various statistics, such as the critical low-flow condition flows (7Q2[8]) will be calculated and used by the surface water quality model as input variables.

3.2.5 Surface Water Quality Model (QUAL-TX)

The goal of the water quality modeling is to provide concentration estimates of key water quality constituents of concern (dissolved oxygen, temperature, and NH3-N) under the six different scenarios to be able to assess potential future changes in water quality. Simulated water quality changes under future conditions will be used to assess potential impacts to the freshwater mussels). The water quality modeling will use critical-condition flows (7Q2) developed from the WAM runs and the return flow estimates from the WAM that reflect future human population increases, conservation, and wastewater reuse in Bell and Coryell counties.

Preferred Model

Through the TPDES program, the TCEQ has developed multiple QUAL-TX models for the Brazos River Basin to evaluate wastewater from existing permitted discharges under low-flow conditions (typically 7Q2). These QUAL-TX models have reasonably extensive coverage of the streams within

[8] 7Q2 is the seven-day, two-year low-flow, or the lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data. (2022 TWSQS 30 TAC §307.1-307.10)

Bell and Coryell counties and have been set up to simulate critical low-flow conditions and is therefore the preferred water quality model for the BELCOR RHCP

While coverage of the QUAL-TX models developed for the Brazos River Basin may not be available for all streams or stream reaches in the Plan Area, it is anticipated that models have been developed for the main segments[9] and streams that have major wastewater treatment plants. In addition, the location of covered species play a role in determining where water quality modeling will be conducted. The water quality modeling will focus on segments where there are wastewater discharges that overlap with or may otherwise impact freshwater mussel habitat. **Figure 4** illustrates the freshwater mussel habitat, limestone karst (potential salamander habitat), and the location of the TPDES permitted outfalls of the Plan Participants in the Plan Area. **Figure 5** illustrates the locations of all TPDES permitted outfalls in the Plan Area.

[9] TCEQ designates rivers, major reservoirs, and streams with numeric segments. These segments characterize the water quality for a portion or the entirety of a waterbody. The segments considered herein are 1213, 1215, 1216, 1217, 1218, 1219, 1220, 1221, 1225, 1242, 1243, and 1246.

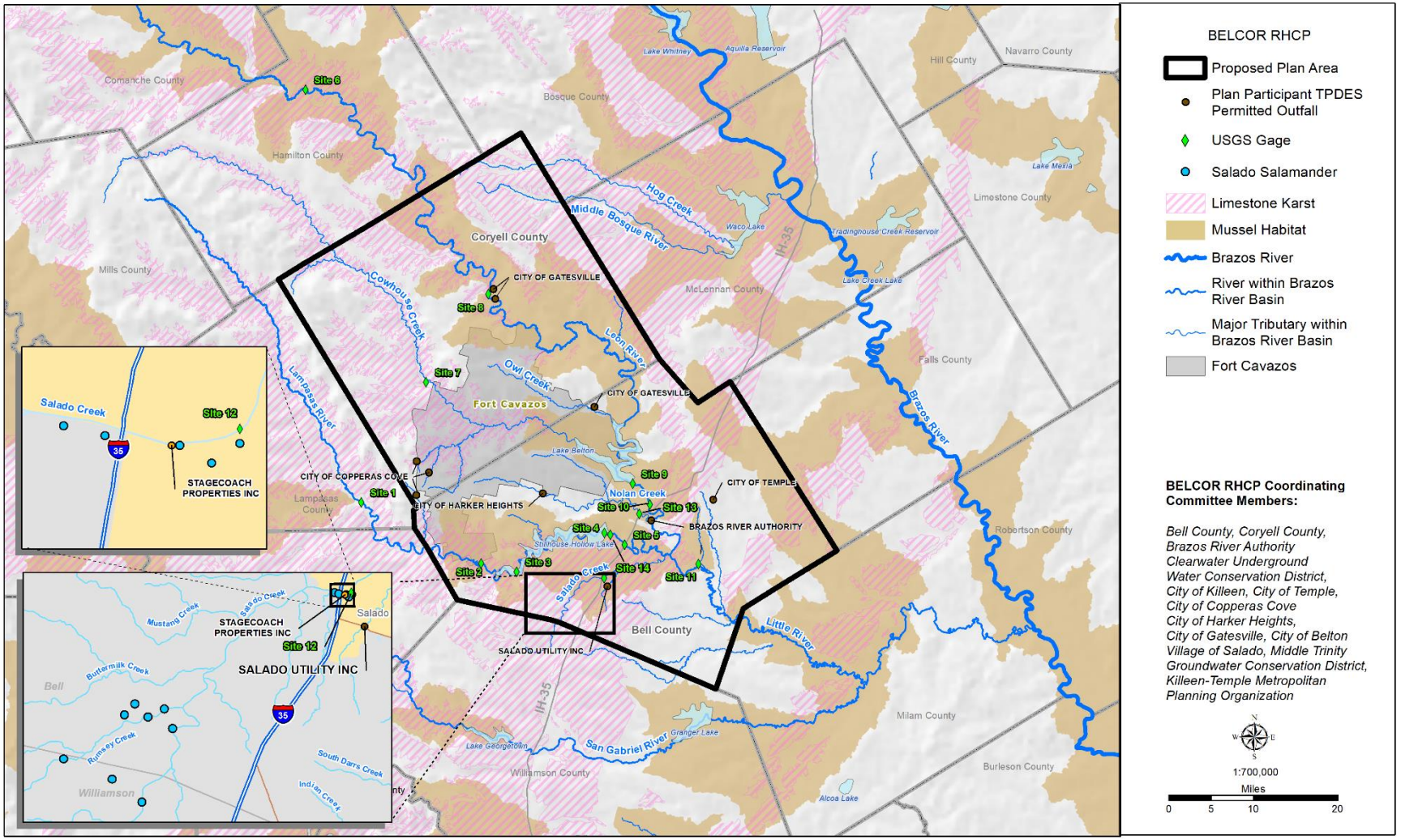

Figure 4. Map of Freshwater Mussel Habitat and Limestone Karst (Potential Salamander Habitat) with TPDES Permitted Outfalls of Plan Participants in the Plan Area.

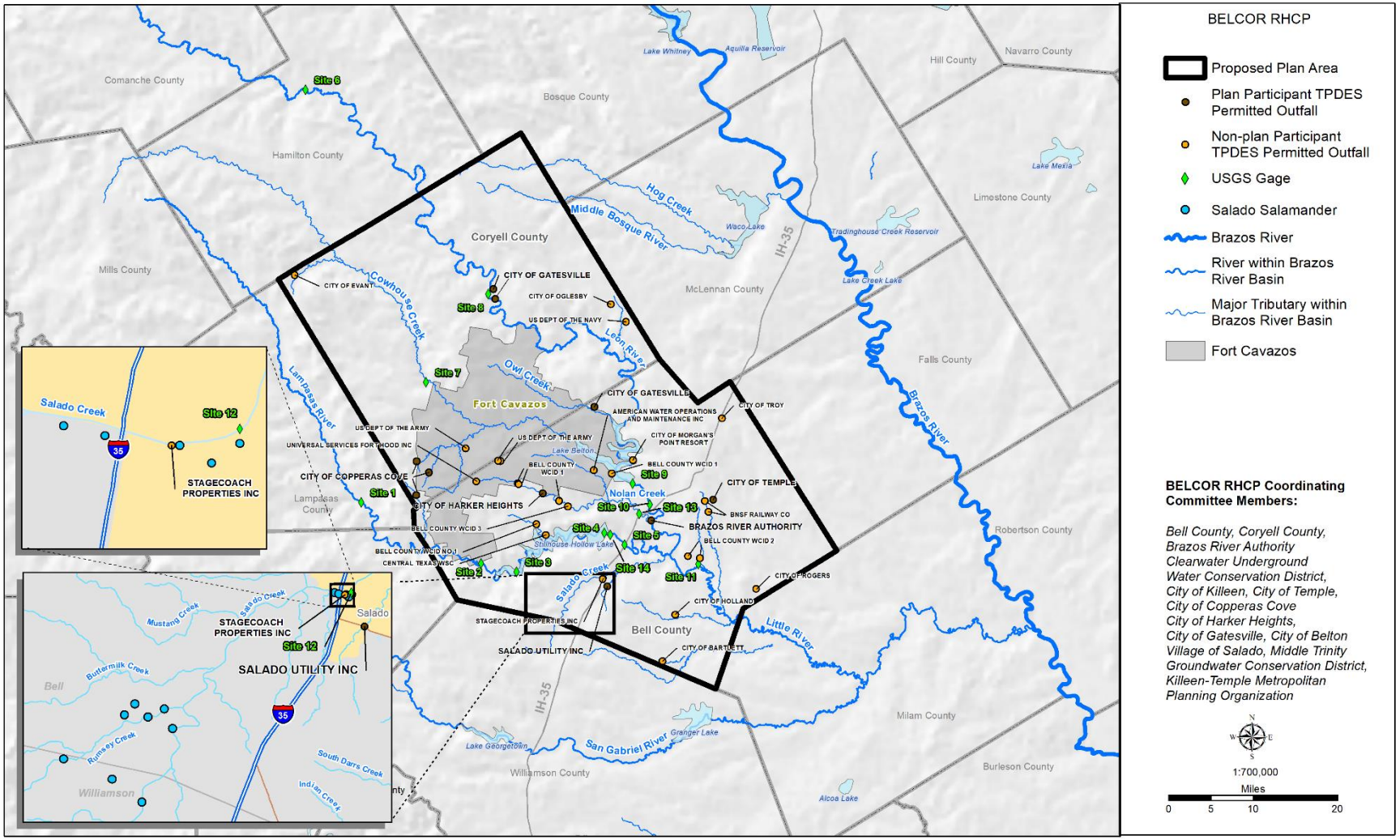

Figure 5. Map of all TPDES Permitted Outfalls in the Plan Area

Model Inputs and Limitations

The water quality modeling will incorporate inputs from both the WAM model and permitted effluent concentrations from wastewater plants to simulate in-stream concentrations of DO, NH3-N, and CBOD5 - as illustrated in **Figure 3** – the proposed approach to the BELCOR RHCP surface water modeling. Additionally, water temperature is recognized as an input variable to the QUAL-TX model. This means the user will have to develop the temperature conditions for input.

To develop these temperature conditions for the BELCOR RHCP water quality model, the Technical Consulting Team matched surface water temperature data collected at a SWQM monitoring stations with the nearest USGS gage station in the Plan Area. At these locations, the Team analyzed stream flow data and temperature and streamflow verses dissolved oxygen. In cases where the observed streamflow was not included with either temperature or dissolved oxygen data, the discharge from the nearby USGS gage site was used. Graphs were created depicting the water temperature and dissolved oxygen data for most of the USGS locations listed in **Table 1.** These plots show meaningful trendlines for (a) all data and (b) summer data separately.

As mentioned previously, TCEQ QUAL-TX models are steady-state models, which means they require inputs that are constant over time but allow for modeling within a larger watershed with inputs from publicly available data. Because WAM flow estimates are time-variable, they will need to be processed to develop representative critical low flows for input into the QUAL-TX models. For instance, monthly flow estimates from WAM will be converted into daily flows to calculate the 7Q2 critical flow.

Additionally, the QUAL-TX model will not be able to account for changes in dissolved oxygen within the duration of the day, and therefore cannot predict the impacts based on daily variations in dissolved oxygen. However, the QUAL-TX model will provide a dissolved oxygen prediction for a general time period over space.

Model Outputs

From each modeling scenario, QUAL-TX will generate predictions of in-stream concentrations of water quality constituents along the longitudinal extent of each modeled stream. **Figure 6** shows a hypothetical example of a modeled stream reach – which is depicted by the green highlighting. The figure shows an example of the predicted streamflow and concentrations for DO, NH_3-N and $CBOD_5$. It can be observed that streamflow increases where return flows enter via TPDES outfalls. Concentrations of NH_3-N and $CBOD_5$ also tend to increase near the outfalls and decline further downstream due to natural assimilation. For each of the permitted outfalls along the modeled reach, the QUAL-TX model will use return flows and effluent limits dictated by the applicable scenario to determine the pollutant load and resulting stream water quality.

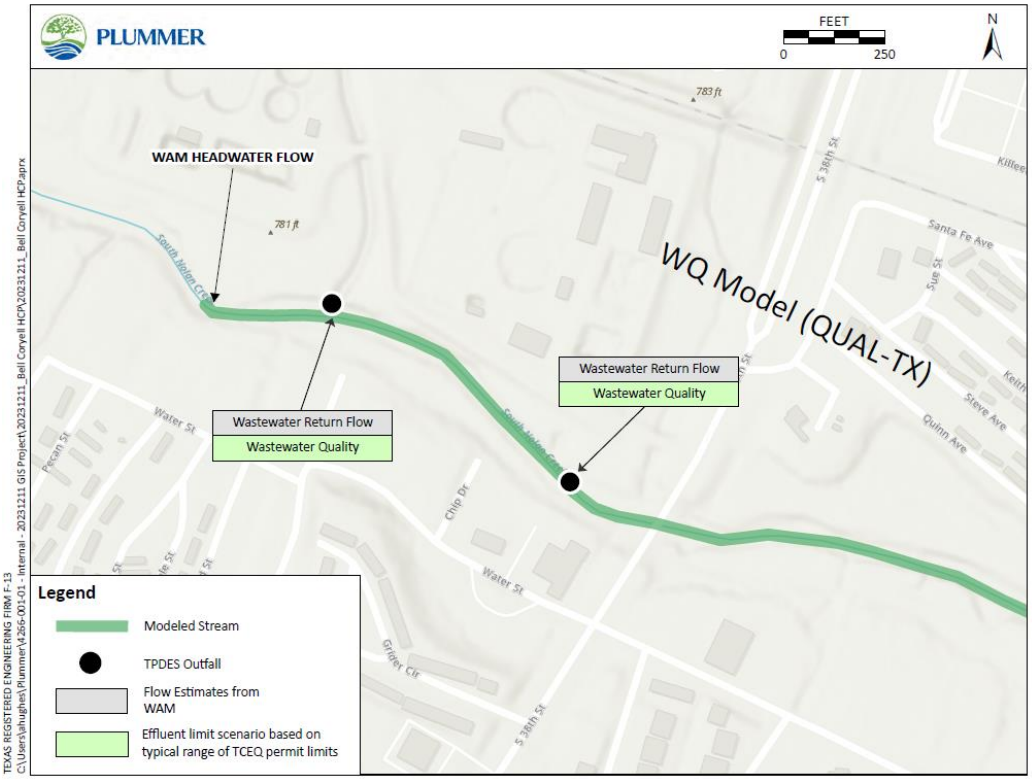

Figure 6. Simulation Example Using WAM flow estimates and TCEQ effluent limits in QUAL-TX Model.

Model outputs can be mapped to stream locations so that water quality predictions can be viewed spatially (see **Figure 7**). The maps of predicted water quality concentrations will be overlaid with species habitat/distribution map layers to be used in the development of the impacts to the freshwater mussels and their habitats.

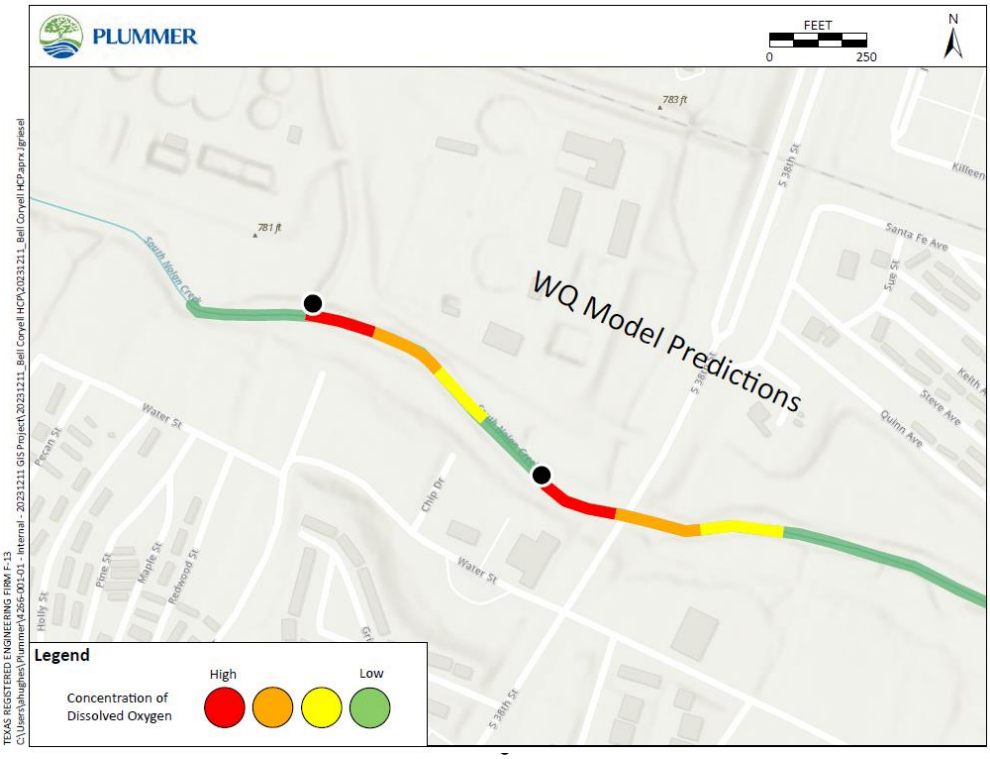

Figure 7. Conceptual illustration of mapping of predicted concentrations of water quality constituents from QUAL-TX.

3.3 Surface Water Management

3.3.1 Environmental Flow Standards

In 2007, the Texas Legislature passed Senate Bill 3 (SB3) in order to determine environmental flow standards for all of the major river basins and bay systems in Texas. In response to SB3, the TCEQ promulgated rules[10] to establish environmental flow standards throughout the Brazos River Basin, which specify hydrologic criteria associated which subsistence, base, and various high flow pulses for dry, average, and wet hydrologic conditions at each site. In Bell and Coryell counties, the TCEQ established environmental flow standards at three of the 14 gage stations which are included in Tables 3, 4, and 5 below. These three gages include: Site#1 - Lampasas River near Kempner, Site#8 - Leon River at Gatesville, and Site#11 - Little River near Little River (Refer to Figure 2 for the locations of these USGS gage stations in the Plan Area). It should be noted that these three gage stations measure the flows entering and exiting the two major water supply reservoirs located in the BELCOR RHCP Plan Area.

Table 3. Environmental Flow Standards for the Lampasas River near Kempner

Season*	Subsistence (cfs)	Hydrologic Condition	Base (cfs)	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	10			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	18	Trigger: 78 cfs	Trigger: 78 cfs	Trigger: 190 cfs
		Average	27	Volume: 430 af	Volume: 430 af	Volume: 1,150 af
		Wet	39	Duration: 8 days	Duration: 8 days	Duration: 11 days
Spring	10			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	21	Trigger: 780 cfs	Trigger: 780 cfs	Trigger: 1,310 cfs
		Average	29	Volume: 4,020 af	Volume: 4,020 af	Volume: 6,860 af
		Wet	43	Duration: 13 days	Duration: 13 days	Duration: 16 days
Summer	10			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	16	Trigger: 77 cfs	Trigger: 77 cfs	Trigger: 190 cfs
		Average	23	Volume: 270 af	Volume: 270 af	Volume: 680 af
		Wet	32	Duration: 4 days	Duration: 4 days	Duration: 6 days

* Seasons are defined as follows: Spring (March through June); Summer (July through October); and Winter (November through February).

[10] 30 Texas Administrative Code, Part 1 TCEQ, Chapter 298 Environmental Flow Standards for Surface Water, Subchapter G: Brazos River and Its Associated Bay and Estuary System.

Table 4. Environmental Flow Standards for the Leon River at Gatesville

Season*	Subsistence (cfs)	Hydrologic Condition	Base (cfs)	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	1			NA	NA	2 Per Season.
		Dry	9			Trigger: 100 cfs
		Average	20			Volume: 540 af
		Wet	52			Duration: 6 days
Spring	1			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	10	Trigger: 340 cfs	Trigger: 340 cfs	Trigger: 630 cfs
		Average	24	Volume: 1,910 af	Volume: 1,910 af	Volume: 4,050 af
		Wet	54	Duration: 10 days	Duration: 10 days	Duration: 13 days
Summer	1			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	4	Trigger: 58 cfs	Trigger: 58 cfs	Trigger: 140 cfs
		Average	12	Volume: 220 af	Volume: 220 af	Volume: 600 af
		Wet	27	Duration: 4 days	Duration: 4 days	Duration: 6 days

* Seasons are defined as follows: Spring (March through June); Summer (July through October); and Winter (November through February).

Table 5. Environmental Flow Standards for the Little River near Little River

Season*	Subsistence (cfs)	Hydrologic Condition	Base (cfs)	Dry Condition Seasonal Pulse	Average Condition Seasonal Pulse	Wet Condition Seasonal Pulse
Winter	55			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	82	Trigger: 520 cfs	Trigger: 520 cfs	Trigger: 1,600 cfs
		Average	110	Volume: 2,350 af	Volume: 2,350 af	Volume: 11,800 af
		Wet	190	Duration: 5 days	Duration: 5 days	Duration: 11 days
Spring	55			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	95	Trigger: 1,420 cfs	Trigger: 1,420 cfs	Trigger: 3,290 cfs
		Average	150	Volume: 9,760 af	Volume: 9,760 af	Volume: 32,200 af
		Wet	340	Duration: 10 days	Duration: 10 days	Duration: 17 days
Summer	55			1 Per Season.	3 Per Season.	2 Per Season.
		Dry	84	Trigger: 430 cfs	Trigger: 430 cfs	Trigger: 1,060 cfs
		Average	120	Volume: 1,560 af	Volume: 1,560 af	Volume: 5,890 af
		Wet	200	Duration: 4 days	Duration: 4 days	Duration: 8 days

* Seasons are defined as follows: Spring (March through June); Summer (July through October); and Winter (November through February).

3.3.2 Texas Surface Water Quality Standards

Under the authority of the Federal Clean Water Act and Texas Water Code, the TCEQ develops and maintains the Texas Surface Water Quality Standards (TSWQS)[11] for every water body segment in the state. **Figure 8** below identifies eight segments in the BELCOR RHCP Plan Area. As stated, **Table 2** lists the locations of the SWQM Stations with the nearest USGS gage station for each segment in the Plan Area. **Table 2** also identifies the water quality standards - numeric criteria for temperature and dissolved oxygen – for each segment in the Plan Area.

[11] 30, TAC Chapter 307

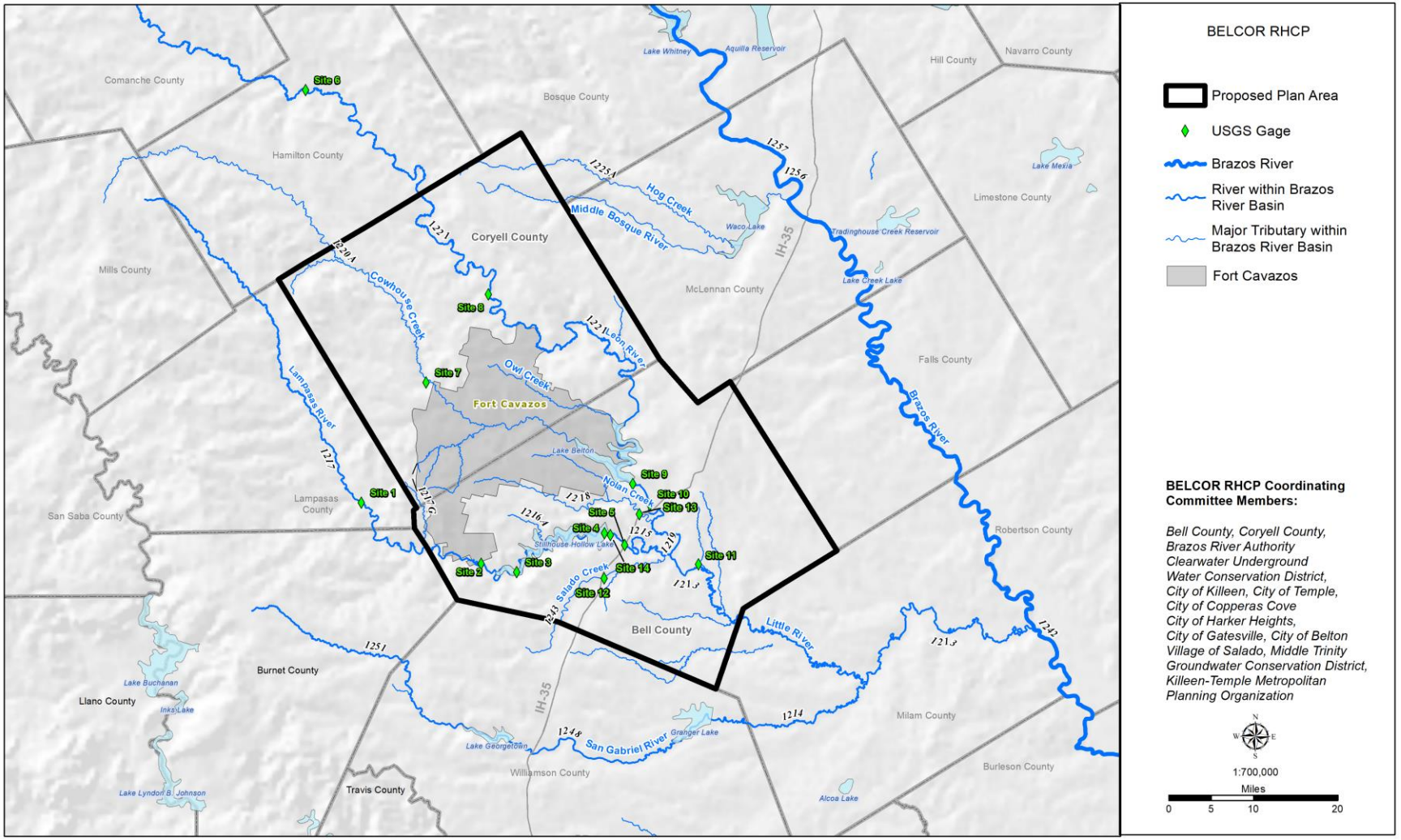

Figure 8. Map of the Water body Segments in the BELCOR RHCP Plan Area

4. Groundwater

4.1 Hydrology

The two primary sources of groundwater in the Plan Area are the Edwards Balcones Fault Zone (BFZ) Aquifer and the Trinity Aquifer with the latter being the main source of groundwater for Coryell County. Because these aquifers provide large quantities of water to a large area in Texas, they are recognized as major aquifers by the TWDB. Both Counties contain some groundwater in shallow alluvial aquifers that are generally associated with streams and tributaries as well as other water bearing formations on the eastern side of Bell County. **Figure 9** shows the extent of the outcrops (exposed layer) and subcrops (buried layer) of the Edwards BFZ Aquifer and Trinity Aquifer in the BELCOR RHCP Plan Area.

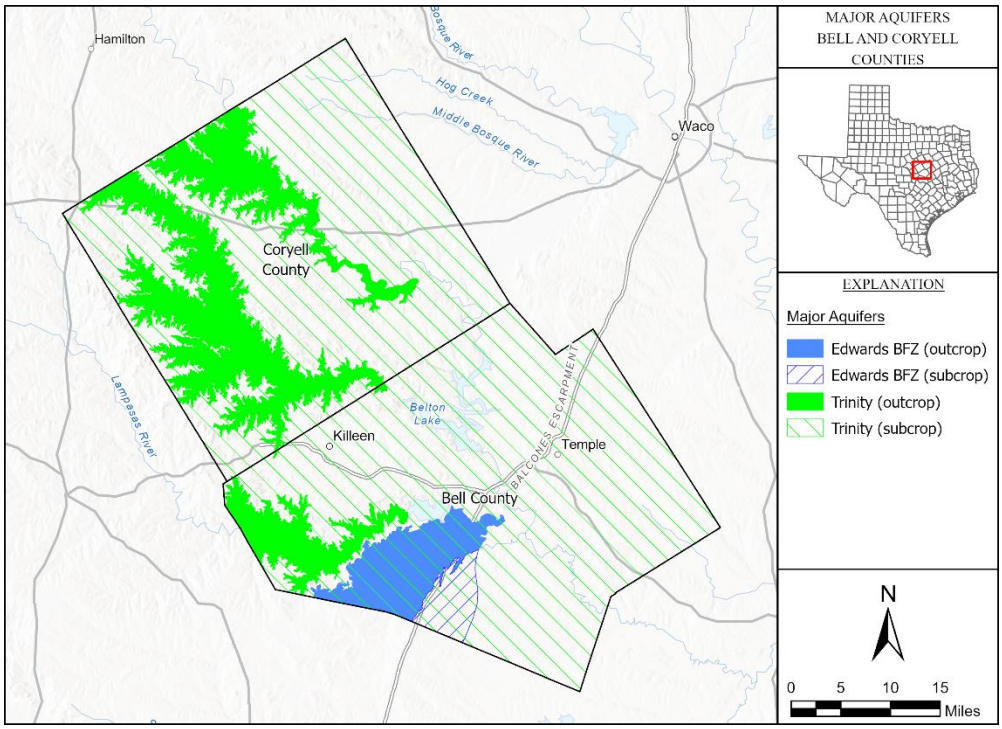

Figure 9. Map of the Edwards Balcones Fault Zone (BFZ) and the Trinity Aquifers in the Plan Area.

4.1.1 Edwards Aquifer

Figure 10 shows the extent of the Edwards BFZ Aquifer in Texas, including the northernmost extent in Bell County. It consists primarily of partially dissolved limestone that creates a highly permeable karst aquifer. Heavy precipitation events can provide significant recharge to the aquifer very quickly. Recharge in higher elevations of the aquifer outcrop move through the aquifer to springs at lower elevations. Historically, the recharge and discharge dynamics have generally resulted in oscillating water levels in the aquifer, but pumping from the aquifer does reduce water levels and spring discharge. Water from the aquifer is primarily used for municipal, irrigation, and

recreational purposes (George et al. 2011). The discharge from the Edwards BFZ Aquifer is the source for Salado Springs in Salado, Texas, located in Bell County and is a critical consideration in the Plan Area. The Edwards BFZ Aquifer is the primary source of water supply for the City of Salado and is used throughout its extent in Bell County.

In 2012, the Clearwater Underground Water Conservation District (CUWCD) initiated a study of the Edwards BFZ. The study is summarized below:

- Synoptic water levels measured in 2013 revealed little change from 2010 synoptic levels.
- The Edwards BFZ Aquifer did not experience significant change in water levels during 2011 drought.
- Springs in downtown Salado (referred to as the Salado Springs Complex), Texas are part of an integrated fracture system as documented by dye tracer tests with springs north and south of Salado Creek connected through fractures.
- Connectivity of springs through the fracture system implies that aquatic organisms such as the Salado salamander should hypothetically be able to move around the springs.
- Salado Springs Complex are connected under both high and low flow conditions.
- Under higher flow conditions, groundwater flow velocities of approximately 350 feet per hour.
- Measured nitrogen concentrations were slightly elevated above the expected background levels with higher values found in more developed areas, but no nitrate values observed over the drinking water limit.
- Dataloggers at cave well and several springs indicated rapid groundwater response to large rainfall events, with recharge response time varying between locations.
- Groundwater modeling conducted on the Edwards BFZ Aquifer indicates for most of the area west of Salado Creek, on average, at least 50% of groundwater pumping originates as captured potential outflow.

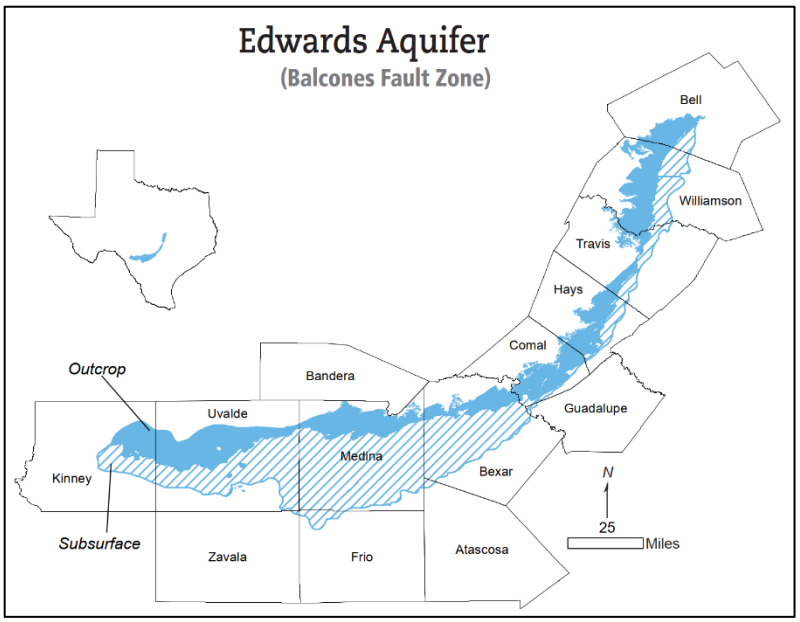

Figure 10. Map of Edwards Aquifer (Balcones Fault Zone) in Texas. (modified from George et al. 2011)

4.1.2 Trinity Aquifer

The Trinity Aquifer extends across much of the central and northeastern part of Texas (as shown in **Figure 11**). It is composed of several smaller aquifers contained within the Trinity Aquifer group. Hydrogeologic names of the productive aquifer zones in the Trinity vary across the state, but in the BELCOR RHCP Plan Area, the main aquifers are Glen Rose, Paluxy, Travis Peak, Hensell, and Hosston aquifers. These aquifers consist of limestones, sands, clays, gravels, and conglomerates. Their combined freshwater saturated thickness averages about 600 feet in North Texas and over 1,500 feet in central Texas (George et al. 2011). It is the primary source of groundwater in much of western Bell County and all of Coryell County.

Groundwater in the Trinity Aquifer is in hydraulic communication with surface water when the water table in the outcrop meets surface water systems. Surface water/groundwater interactions represent a small but significant portion of the water budget (a hydrological tool used to quantify the flow of water in and out of a system) of the Trinity Aquifer in the Plan Area. In wet seasons, the shallower portions of each aquifer that are not normally saturated with groundwater can produce local seeps and small springs that are sourced by precipitation that recently infiltrated in the aquifer outcrop areas and moves through permeable portions of the rock. Because some of these local seeps and springs are not sourced from deeper portions of the aquifer, they may cease to flow in dry seasons. shows the extent of the Trinity Aquifer in Texas as related to the Plan Area.

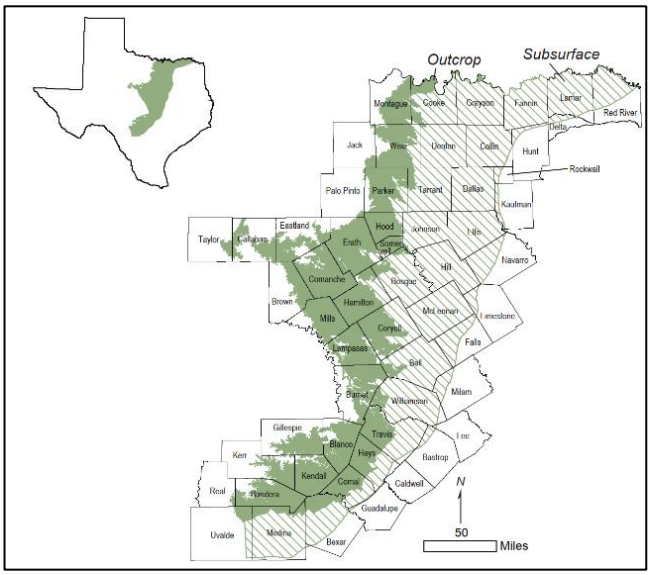

Figure 11. Trinity Aquifer extent in Texas with relation to the Plan Area.
(modified from George et al. 2011)

Surface water and groundwater interactions occur primarily at springs, streams, rivers, and surface water reservoirs. The Trinity Aquifer can directly gain water from, or lose water to, surface water bodies in the outcrop area. When the water table is above the streambed or water surface the stream receives water from the aquifer and is called a gaining reach, (i.e., it gains flow from groundwater discharge as it moves through the reach.) When the water table is below the streambed or water surface the stream is losing water to the aquifer and is called a losing reach (Bene and Hardin 2004).

4.1.3 Other Aquifers

East of Interstate Highway 35, Bell County also has a number of groundwater sources that are not widely recognized as aquifers outside of the County but are important local water sources. Approximately 40 percent of the wells registered within the CUWCD are located in eastern Bell County and produce water from alluvium, the Lake Waco Formation the Kemp Formation, the Ozan Formation, the Pecan Gap Formation, the Austin Chalk, or the Buda Limestone (CUWCD 2023).

4.2 Groundwater Modeling

4.2.1 Sources of Groundwater Data

Several entities collect groundwater data in the Plan Area. The CUWCD monitors wells and some springs in Bell County. The Middle Trinity Groundwater Conservation District (MTGCD) monitors wells and groundwater quality in Coryell County. CUWCD has conducted numerous surface water and groundwater studies related to the BFZ and Trinity aquifers and has focused significant effort on monitoring Salado Springs since 2013. These two groundwater conservation districts collect water level measurements and water quality information in the Plan Area. The TWDB, CUWCD, and the MTGCD maintain databases of groundwater level measurements and groundwater quality information in Edwards BFZ Aquifer and Trinity Aquifer wells.

4.2.2 Proposed Modeling Scenarios

Based on current understanding of the factors/conditions that may impact the Salado salamander now and in the future (2060) as related to BELCOR RHCP covered groundwater activities, the following scenarios are proposed for the BELCOR RHCP groundwater modeling of the Edwards BFZ Aquifer:

1. **Reference Condition (2020 Conditions without Covered Activities)**: 2020 pumping volumes without Plan Participants' pumping and 2020 recharge volumes.
2. **2020 Conditions with Covered Activities:** 2020 pumping volumes with Plan Participants' pumping and 2020 recharge volumes.
3. **2060 Conditions with Covered Activities:** 2060 pumping volumes including Plan Participants' pumping and projected recharge volumes.
4. **2060 Conditions with Covered Activities and Conservation Measures:** 2060 pumping volumes including Plan Participants' pumping and projected recharge volumes with proposed conservation measures to assess the extent the RHCP conservation strategy mitigates the impact on the Salado salamander.
5. **2060 Conditions with Covered Activities and Conservation Measures and climate change factors:** 2060 pumping volumes including Plan Participants' pumping with estimated changes in recharge volumes due to climate changes and proposed conservation measures to be used to assess the extent to which the RHCP conservation strategy mitigates the impact on the Salado salamander.

6. **Additional Scenario (details to be determined):** 2060 pumping volumes including Plan Participants' pumping with alternative conservation measures, proposed by the USFWS, to be used to assess the extent to which the alternative conservation strategy mitigates the impact on the Salado salamander.

4.2.3 Trinity Aquifer Modeling

Groundwater modeling will not be implemented for the Trinity Aquifer. There are no Trinity Aquifer groundwater models that appropriately simulate gravity springs and groundwater/surface water interaction for the Trinity Aquifer.

4.2.4 Edwards Aquifer Modeling

Figure 12 illustrates the proposed approach to groundwater modeling for the BELCOR RHCP and how groundwater availability modeling informs species habitat assessments, focusing on the habitat of the Salado salamander using the Northern Edwards BFZ Groundwater Availability Model. This model will use recharge and pumping data as factors influencing the availability of groundwater in the aquifer and as inputs to the model. In turn, a species habitat model for the Salado salamander will use output from the model– aquifer conditions and spring flow –to determine the potential impacts to the Salado salamander and its habitat.

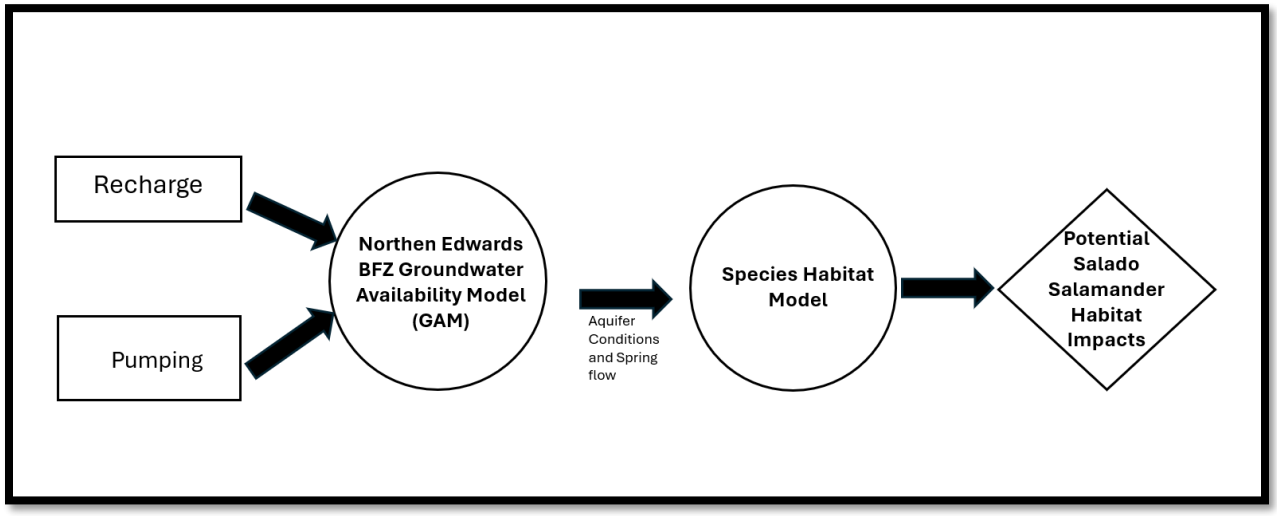

Figure 12. Proposed Approach to the BELCOR RHCP Groundwater Modeling.

Preferred Model

In 2023, the TWDB released a new Northern Edwards Groundwater Availability Model (NEGAM) (Jones 2023). However, the newly released NEGAM has not reviewed by CUWCD and will not be used to develop the desired future conditions and the modeled available groundwater for groundwater management area 8 (GMA 8)- refer to Section 4.3. Therefore, the updated 2023 NEGAM will not be used for this assessment. The TWDB NEGAM (Jones 2003) will be used to assess impact of covered activities on spring flow at Salado Springs.

The northern segment of the Edwards Aquifer covers an area from Austin, Texas, located in Travis County to Salado, Texas, located in Bell County **(Figure 13).** As a result of rapid population growth, demand for water in this region is also rising. Travis and Williamson Counties do not have Groundwater Conservation Districts (GCDs) and do not limit production of groundwater from wells. Therefore, the Clearwater UWCD, which only has regulatory authority in Bell County, does not regulate pumping in Travis and Williamson Counties. This means that groundwater conditions and springflow at Salado Springs are not under full regulatory authority of the CUWCD and therefore, the CUWCD only regulates a portion of the source aquifer from which Salado Springs originates.

The NEGAM was developed to simulate flow through this segment of the Edwards aquifer and was constructed as a groundwater resource management tool. The purpose of this tool is to aid groundwater conservation districts, regional water planning groups, and others in evaluating groundwater resource management strategies to meet projected groundwater demands (Jones 2003). The NEGAM was constructed by calibrating to steady-state water level conditions in 1980 and historical transient conditions for the period 1980-2000. The calibrated model can be used to predict future water-level changes and spring flow that may result from projected pumping rates and/or climatic conditions.

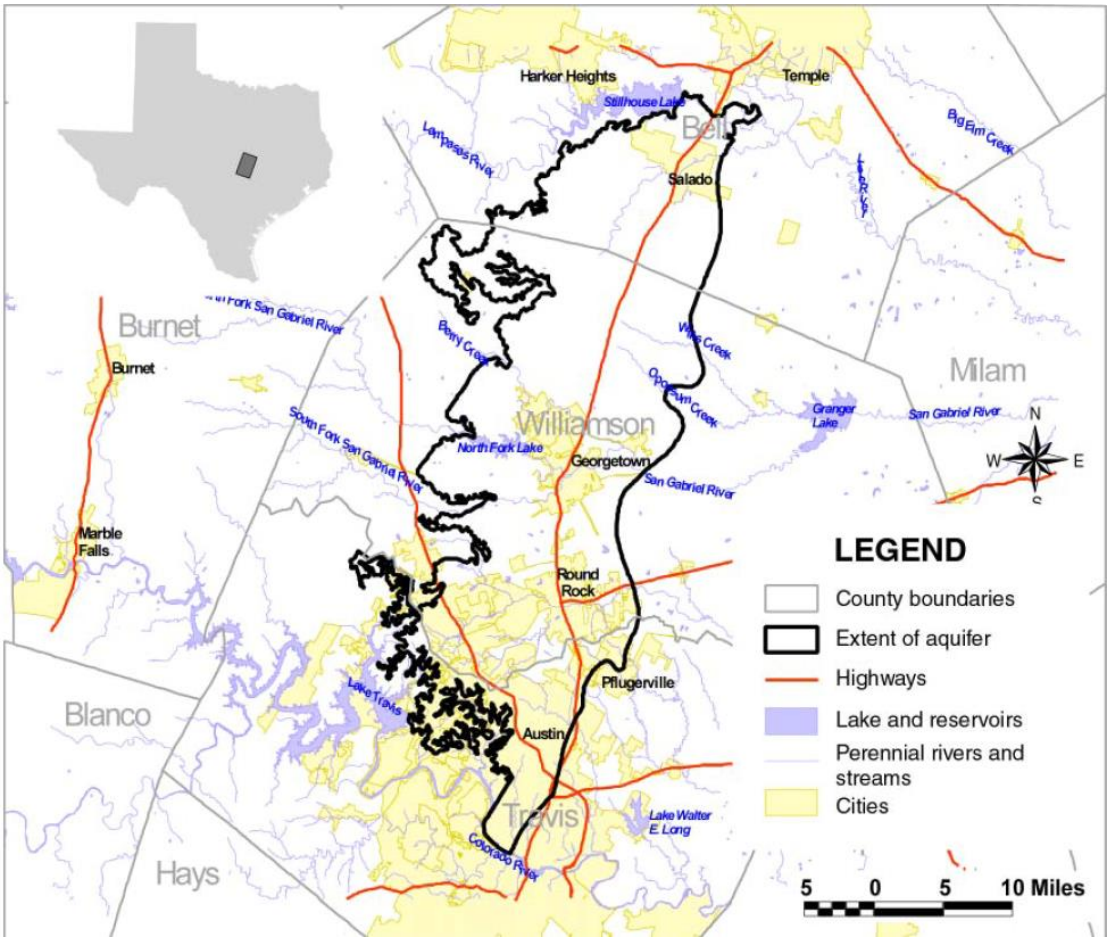

Figure 13. Extent of the Northern Edwards Aquifer in Travis, Williamson, and Bell Counties. Salado Springs, an important discharge point for the Northern Edwards Aquifer in Bell County, discharges in the town of Salado.

The Northern Edwards BFZ GAM simulates hydrologic (e.g., groundwater flow in the aquifer, recharge, surface-groundwater interactions, and springs) and anthropogenic processes (e.g., pumping) using the United State Geologic Survey (USGS) MODFLOW-96 finite-difference flow code (Harbaugh and McDonald 1996).

Model boundary conditions were assigned to represent recharge, pumping and streams and springs. The Drain package in MODFLOW was used to simulate groundwater discharge to seeps, springs, and perennial streams **(Figure 14**). Discharge from the aquifer takes place only when simulated water levels in the drain cells exceed set elevations that represent streambed or spring orifice elevations.

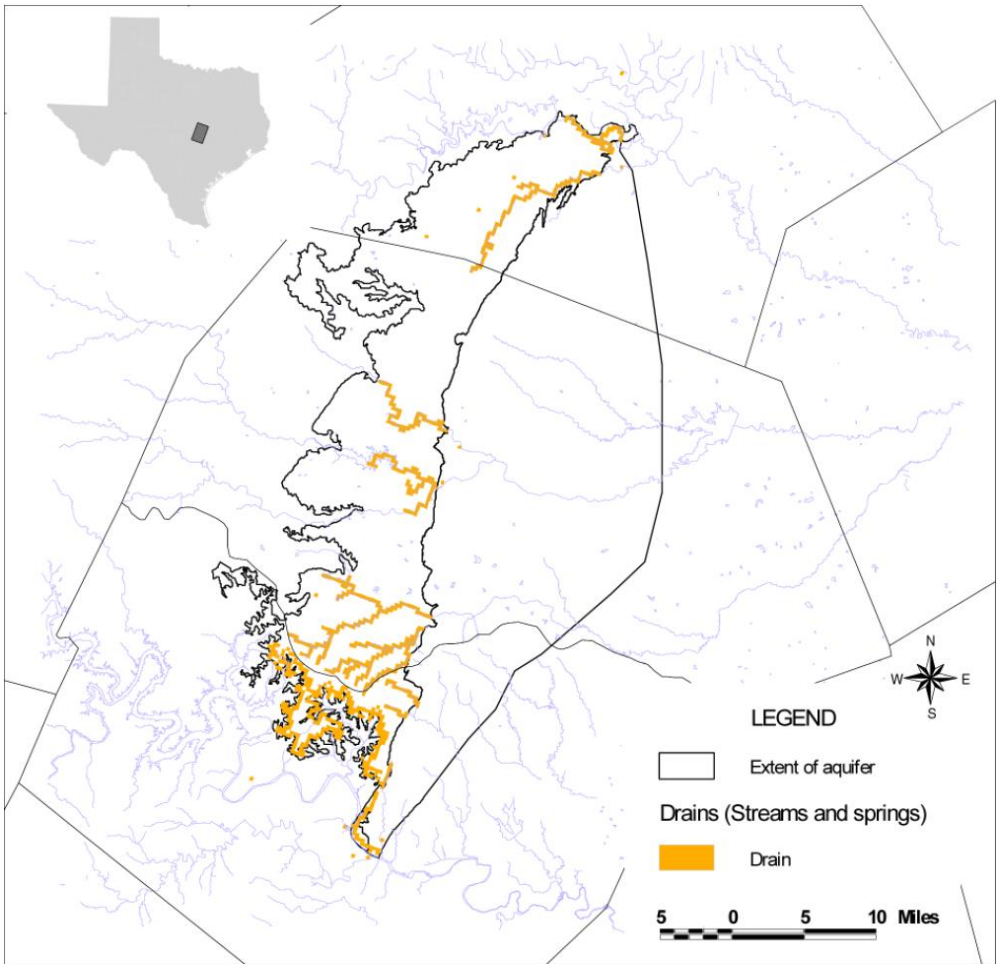

Figure 14. Distribution of drain cells in the model. Salado Creek and springs are shown in Bell County.

Figure 6 represents the conceptual model and boundary conditions for the NEGAM. Figure x shows the distribution of pumping in Edwards based on 1980 data.

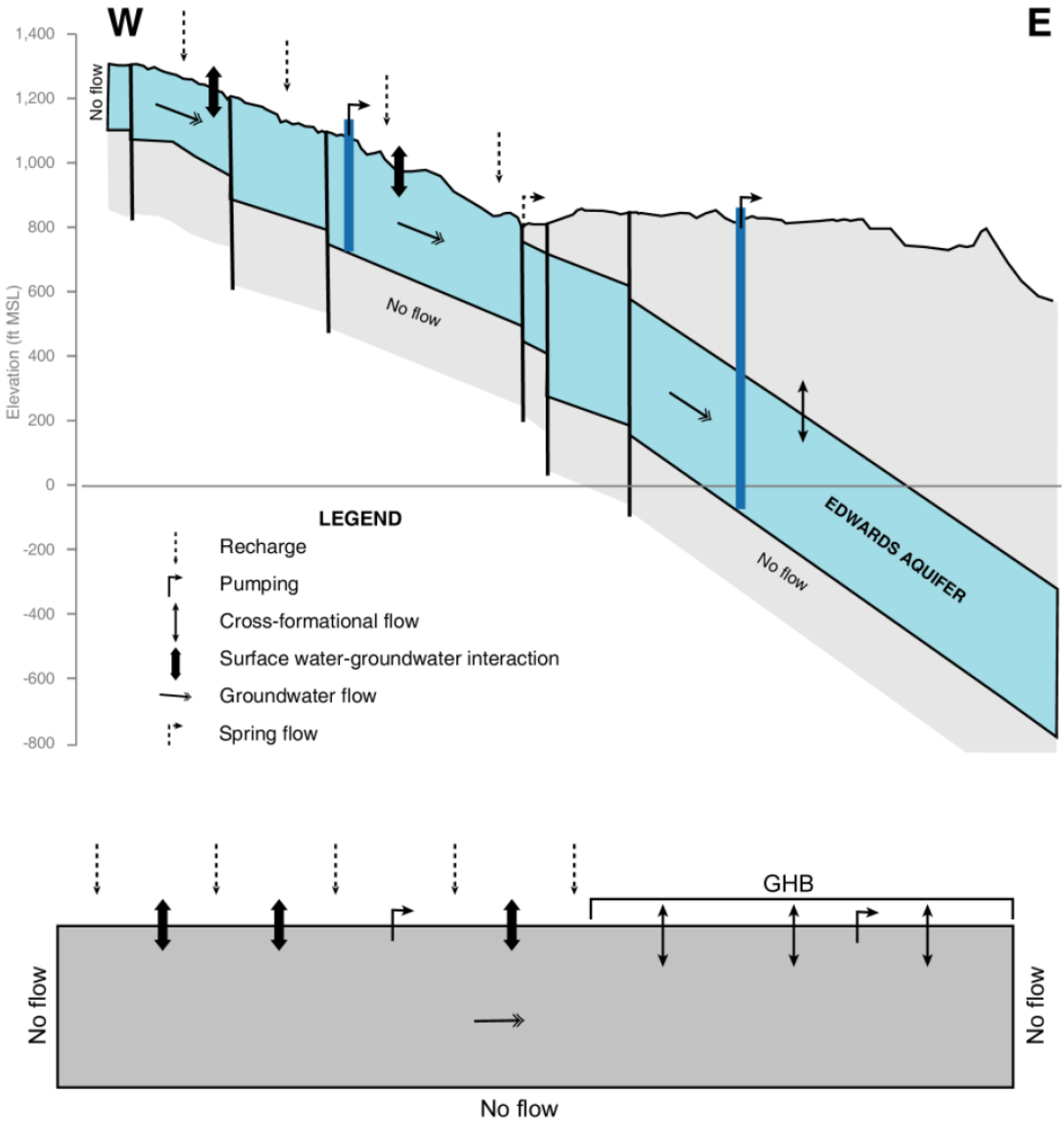

Figure 15. Schematic cross section and conceptual groundwater flow model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer GAM (Jones 2003).

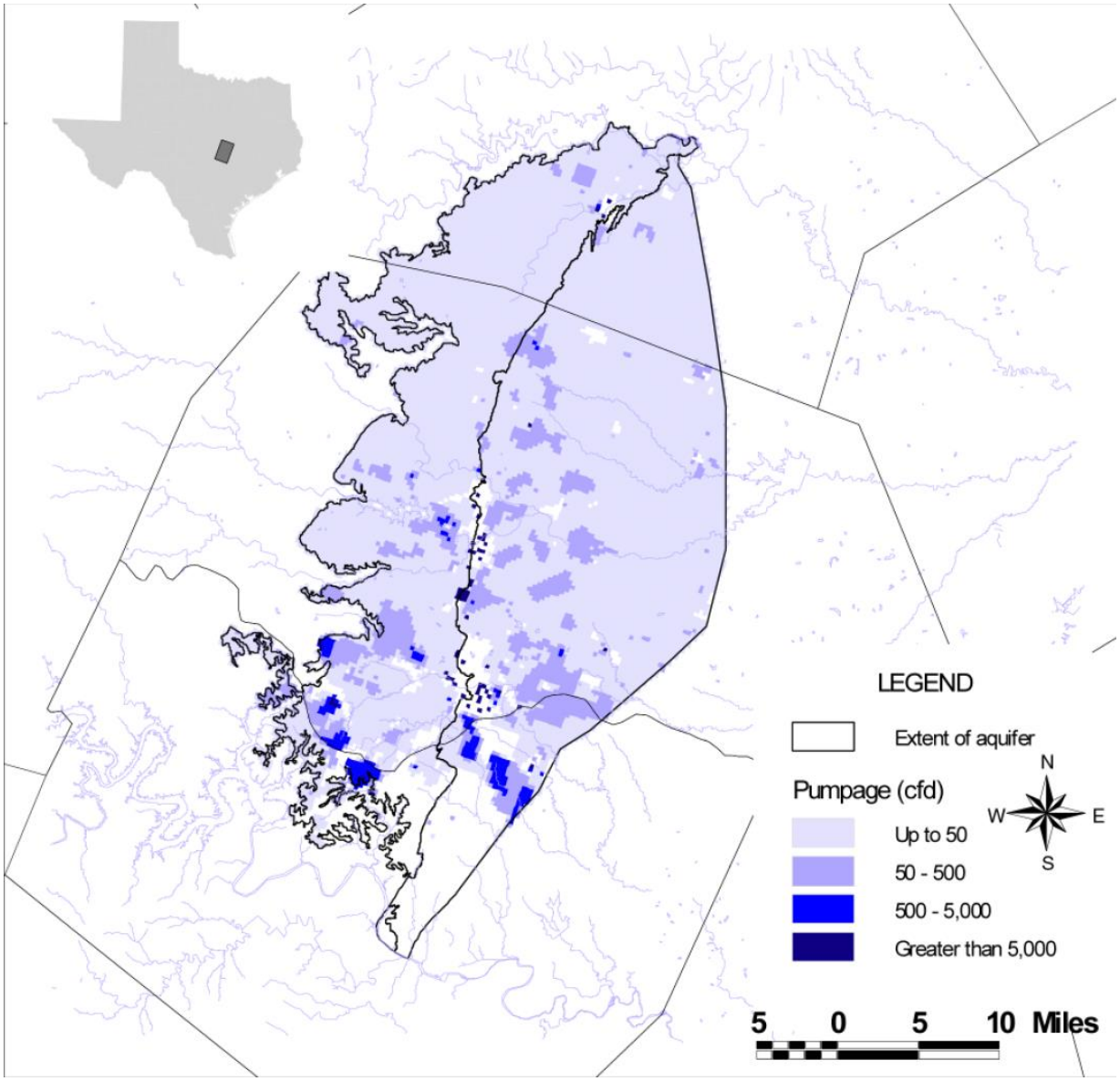

Figure 16. Distribution of pumping in the model based on 1980 information

Model Inputs and Limitations

Predictive modeling scenarios will require appropriate ranges of pumping from the Edwards Aquifer in Bell County. This data will be obtained from CUWCD and based on their regulatory framework. A sensitivity analysis will be completed to address the impact of potential pumping increases in Williamson County on Salado Springs. Williamson County pumping would not be a covered activity, but the analysis would provide insight into the ability of CUWCD pumping limits to maintain flow in Salado Springs.

Numerical groundwater flow models are simplified representations of aquifer systems (Anderson and Woessner 2002) and have limitations. Jones (2003) identifies limitations are usually associated with (1) the purpose for the groundwater flow model, (2) the extent of the understanding of the

aquifer(s), (3) the quantity and quality of data used to constrain parameters in the groundwater flow model, and (4) assumptions made during model development. The National Research Council (2007) concluded that scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or be able to prove that a given model is correct in all respects for a particular application. However, models can be helpful as tools to help inform decision makers about complex aquifer systems based on the best available science.

Model Outputs

The NEGAM will be used to simulate the reference scenario consistent with 2020 and 2060 conditions. The scenarios will include a wide range of hydrologic conditions and assess the most critical factors in determining water levels and spring discharge in the Edwards Aquifer. Those factors are the pumping volumes and the recharge to the aquifer. Therefore, the model will be used to predict impacts to water levels and spring discharge (e.g., Salado Springs) based on various drought and pumping conditions. The model will be extended for the predictive scenarios will incorporate a drought-of-record period. It is assumed that the only covered activity will be regulatory control of pumping in Bell County. Therefore, multiple predictive pumping scenarios will be used to develop a relationship between water levels, spring discharge and pumping from the aquifer and will be used to estimate the impact of conservation measures.

4.3 Groundwater Management: Desired Future Conditions

Groundwater Management Area 8 (GMA 8), which encompasses Bell and Coryell counties, has set Desired Future Conditions (DFCs) for the Edwards BFZ and Trinity aquifers. Modeled available groundwater is defined as the amount of water the TWDB Executive Administrator determines may be produced on an average annual basis to achieve a desired future condition.[12] The DFC of the aquifer may only be determined through joint planning with other groundwater conservation districts (GCDs) in the same groundwater management area (CUWCD 2023). The GCDs of GMA 8 have completed the joint planning process to determine the desired future conditions of the aquifers in GMA 8.

To determine the desired future conditions, the GCDs in GMA 8 conducted a series of simulations using the TWDB's Groundwater Availability Models (GAMs) for the Northern BFZ and the Northern Trinity/Woodbine aquifers. Each series of GAM simulations was conducted by iteratively applying varying amounts of simulated groundwater pumping from the aquifer over a predictive period that included a simulated repeat of the drought of record. Pumping was increased until the amount of pumping that could be sustained by the aquifer without impairing the aquifer conditions selected for consideration as the indicator of the aquifer desired future condition was identified (CUWCD, 2023).

[12] TWC §36.001 section 36.108.

4.3.1 Edwards Aquifer Desired Future Conditions

The desired future condition of the BFZ Aquifer is based on maintaining Salado Spring discharge into Salado Creek during a repeat of conditions like those in the 1950's drought of record. Under the drought of record conditions, a spring discharge of 200 acre-feet per month is preferred and 100 acre-feet per month is the minimum acceptable spring flow.

The modeled available groundwater (MAG) value for the BFZ Aquifer in Bell County, as given in TWDB GAM Run 21-013 MAG for the decades 2020-2080, is 6,469 acre-feet per year, and is based on the desired future condition discussed above. CUWCD estimates that by year 2070, exempt use of the BFZ Aquifer may reach approximately 825 acre-feet per year and that volume of water is allocated for exempt well users on an annual basis. This leaves approximately 5,644 acre-feet per year as the volume of groundwater available for permitting in the BFZ Aquifer. This information will be used as a basis for potential future conditions in the BFZ Aquifer and the discharge at Salado Springs.

4.3.2 Trinity Aquifer Desired Future Conditions

There are three recognized subdivisions in the Trinity Aquifer: the Upper, Middle and Lower Trinity aquifers. In the Plan Area, the three subdivisions of the Trinity Aquifer are made up of several geologic units. The geologic units are the Paluxy Sand; the Glen Rose Limestone and; the Hensell Sand and Hosston Conglomerate of the Travis Peak Formation. GMA 8 developed a desired future condition for each of the water-bearing geologic units which make up the Trinity Aquifer in Bell and Coryell County. The DFCs for the several water-bearing units describe the amount of water-level drawdown which may occur after 70 years when the draw down is averaged across the area of occurrence of the water bearing unit in the CUWCD. The amount of drawdown described in the DFCs is indexed to year 2010 water levels. The DFCs in Bell and Coryell Counties are summarized below.

Table 6. Summary of Desired Future Conditions for the Trinity Aquifer in Bell and Coryell County

Aquifer	Bell County DFC drawdown (feet)	Coryell County DFC drawdown (feet)
Paluxy Aquifer	0	5
Glen Rose Aquifer	83	15
Hensell Aquifer	145	70
Hosston Aquifer	375	141

The total of modeled available groundwater values for the Trinity Aquifer in Bell and Coryell County is summarized in Table 2. The MAG estimates are based on the amounts of groundwater that could be pumped while maintaining the desired future conditions in each aquifer.

Table 7. Summary of Modeled Available Groundwater for the Trinity Aquifer in Bell and Coryell County

Aquifer	Bell County MAG (ac-ft/yr)	Coryell County MAG (ac-ft/yr)
Paluxy Aquifer	0	0
Glen Rose Aquifer	275	120
Hensell Aquifer	1,100	2,197
Hosston Aquifer	7,900	2,163

GAM Run 21-013 MAG 2020

5. References

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Ridgeway, C., and H. Petrini, H. 1999. Changes in groundwater conditions in the Edwards and Trinity aquifers, 1987-1997, for portions of Bastrop, Bell, Burnet, Lee, Milam, Travis, and Williamson Counties. KIP Articles. 943. Available at: https://digitalcommons.usf.edu/kip_articles/943.

Sweet, S. S. 1982. A distributional analysis of epigean populations of Eurcyea netones in central Texas, with comments on the origin of troglobitic populations. Herpetologica, 38:430-444. Available at: https://www.jstor.org/stable/3892428.

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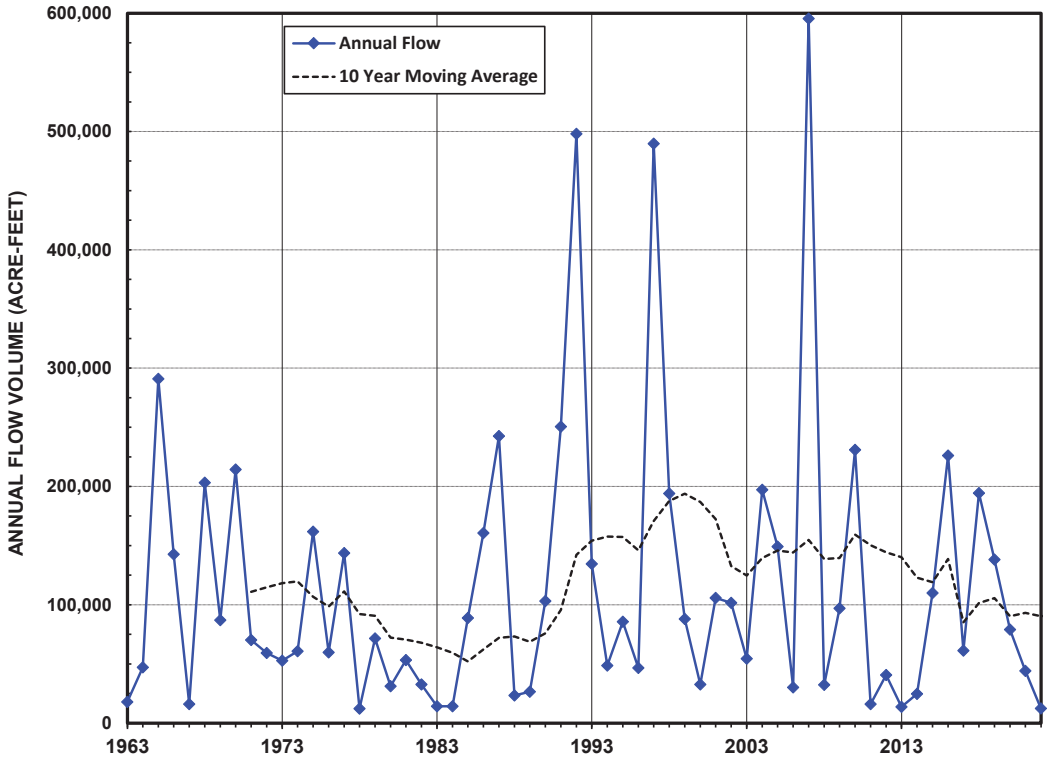
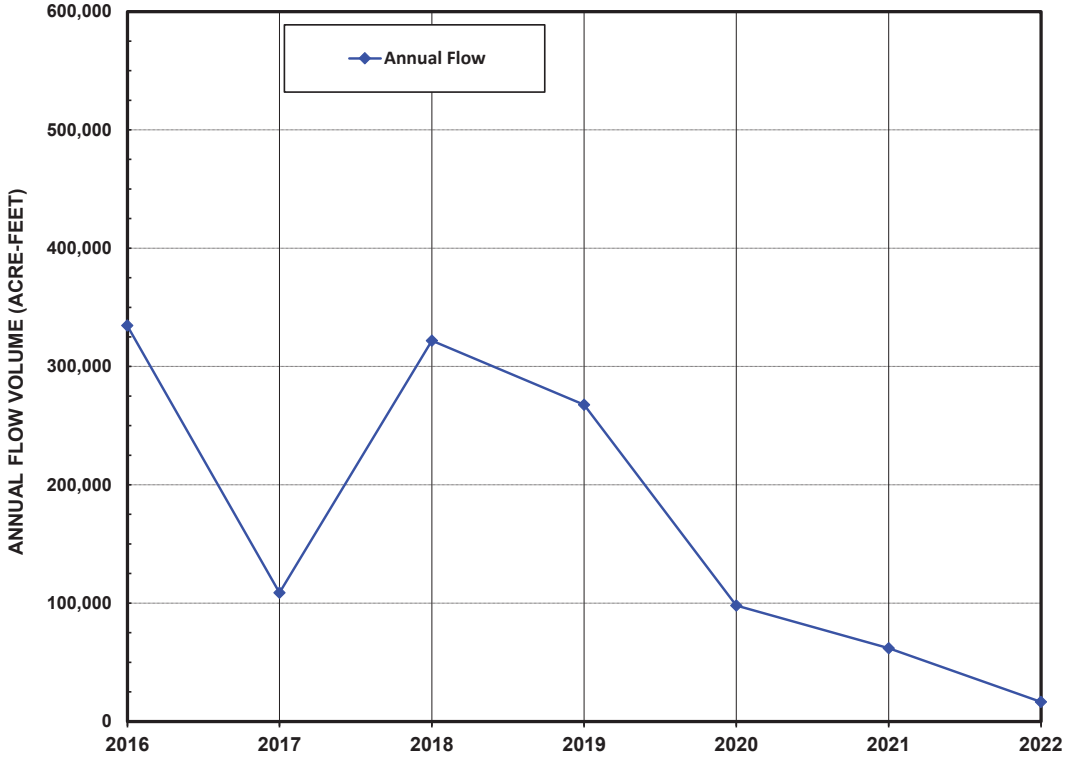
Attachment 1

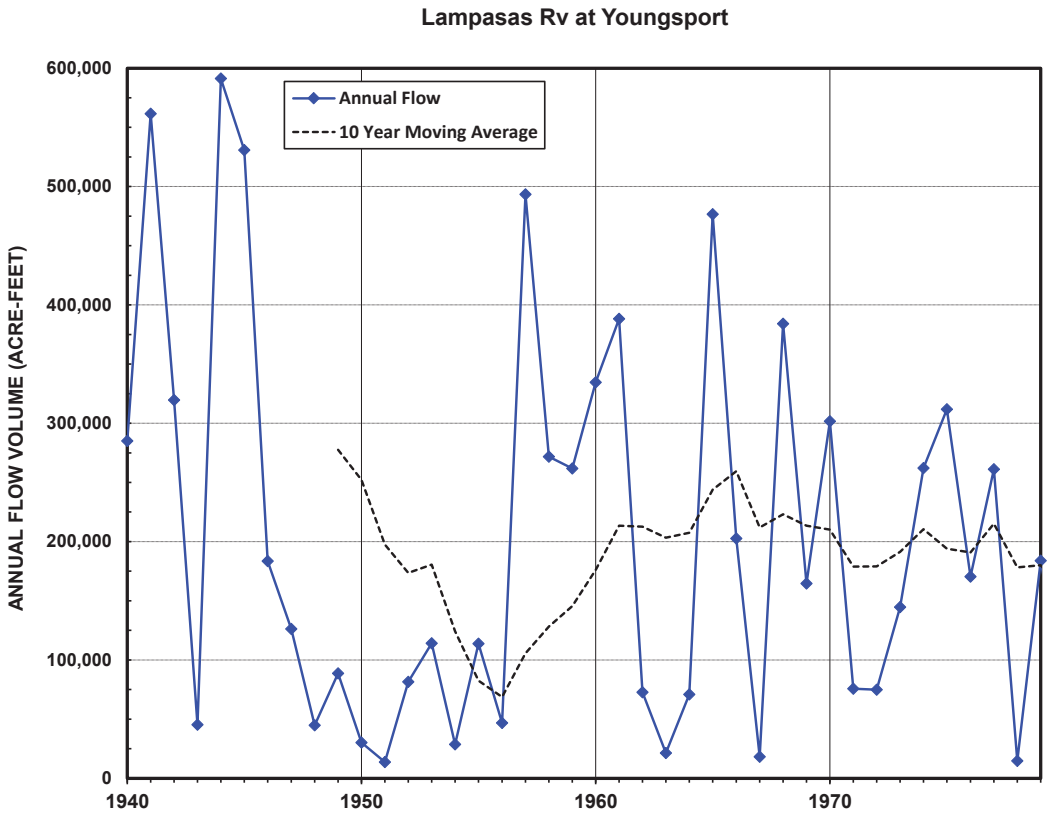
Plots of Annual Flow Volume at USGS Gage Stations in the Plan Area

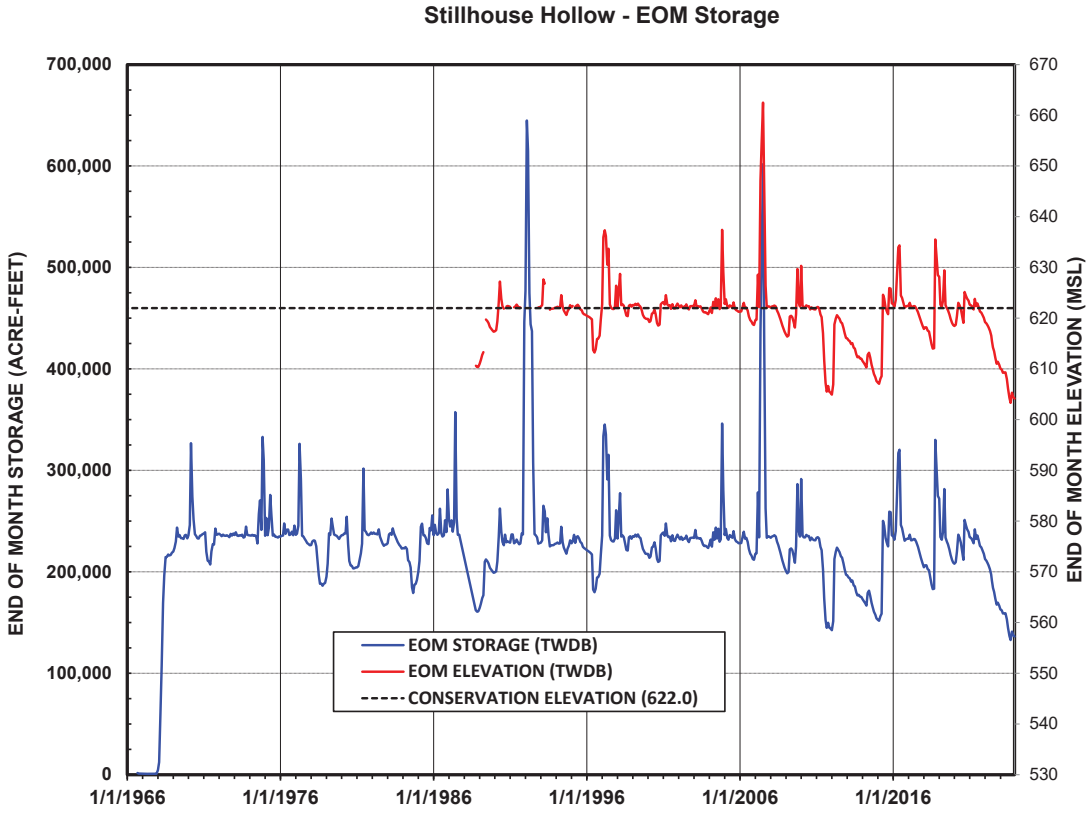
Lampasas Rv nr Kempner



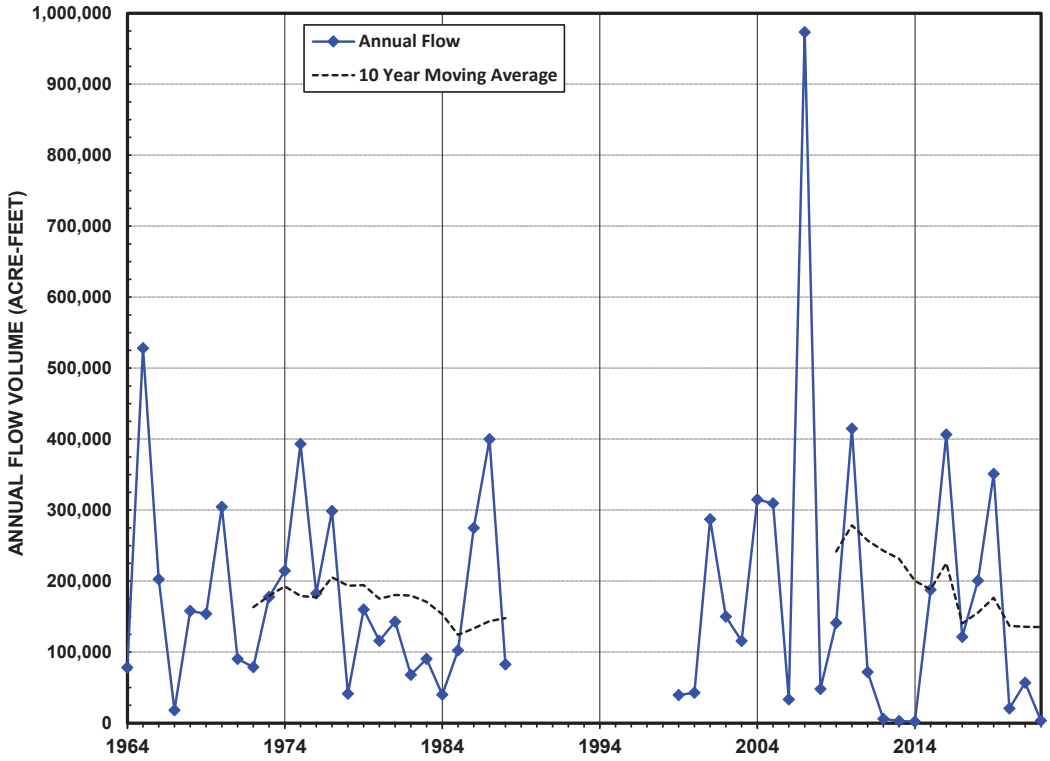
Lampasas Rv at Ding Dong



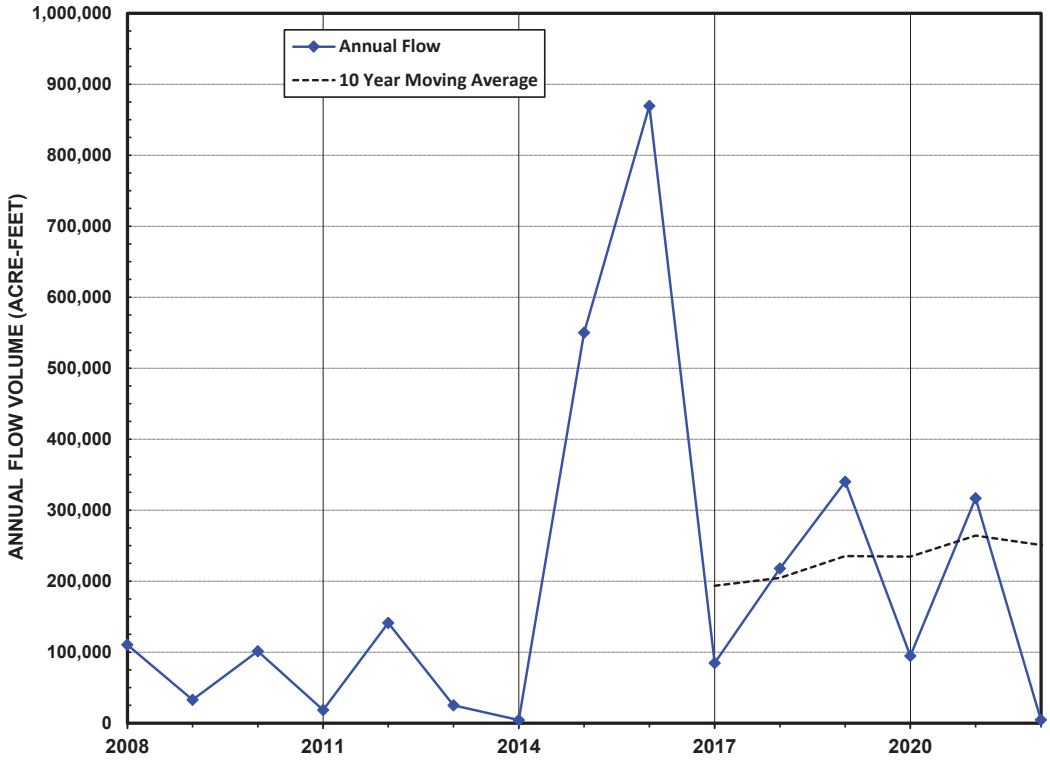

Lampasas Rv at Youngsport
Annual Flow
10 Year Moving Average
ANNUAL FLOW VOLUME (ACRE-FEET)
600,000
500,000
400,000
300,000
200,000
100,000
0
1940
1950
1960
1970


Stillhouse Hollow - EOM Storage
END OF MONTH STORAGE (ACRE-FEET)
END OF MONTH ELEVATION (MSL)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
670
660
650
640
630
620
610
600
590
580
570
560
550
540
530
1/1/1966
1/1/1976
1/1/1986
1/1/1996
1/1/2006
1/1/2016
EOM STORAGE (TWDB)
EOM ELEVATION (TWDB)
CONSERVATION ELEVATION (622.0)

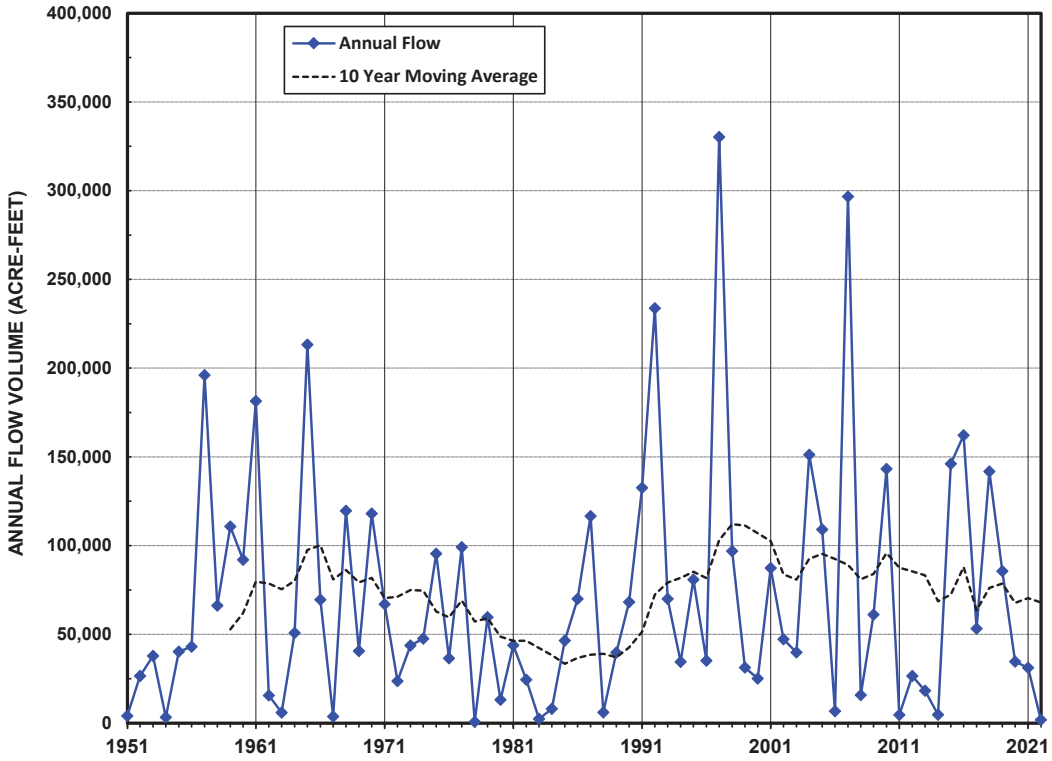
Lampasas Rv nr Belton



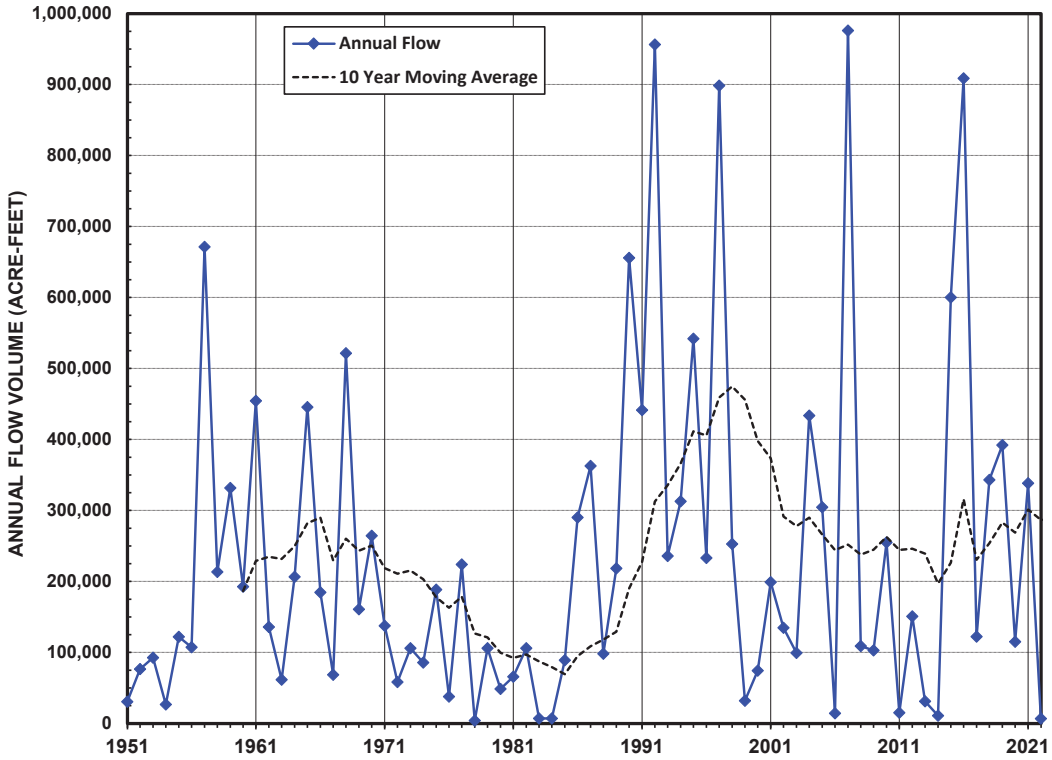
Leon Rv nr Hamilton



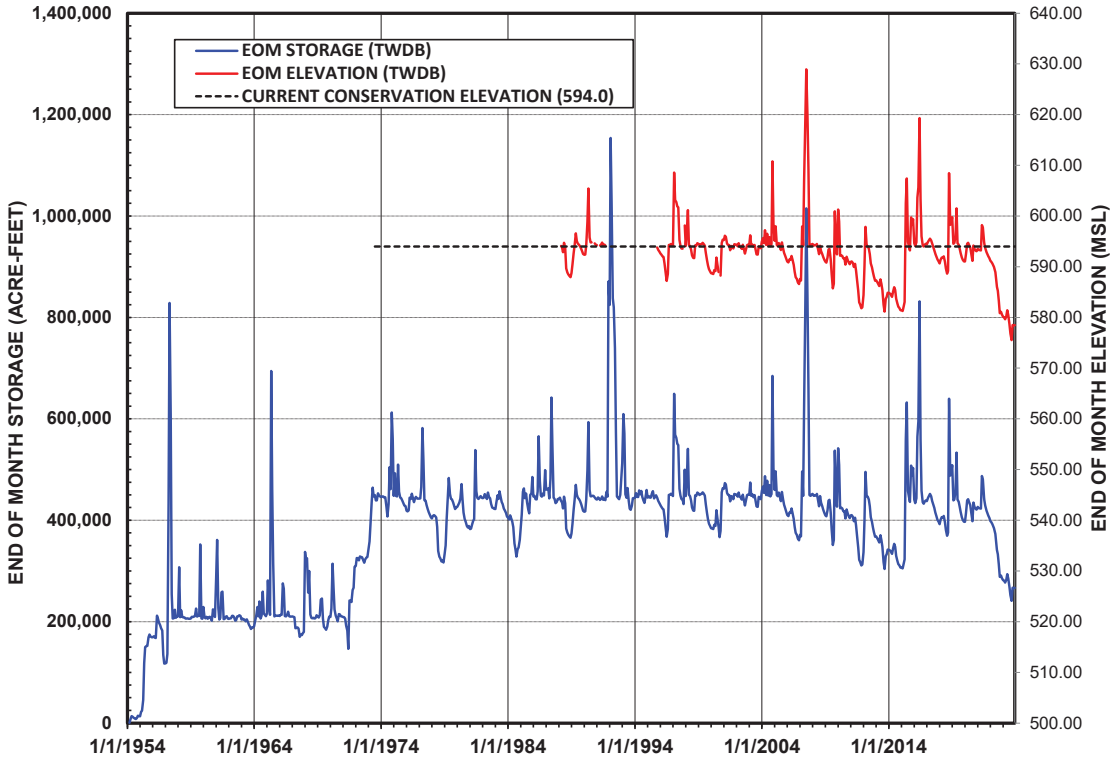
Cowhouse Ck at Pidcoke



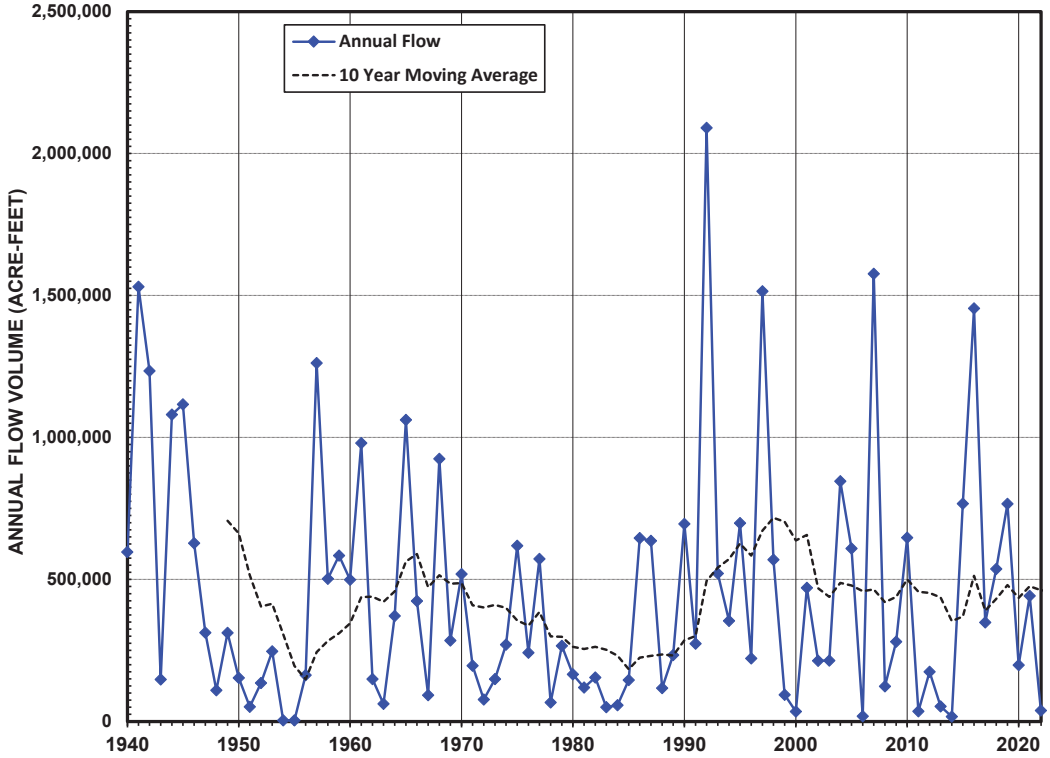
Leon Rv at Gatesville

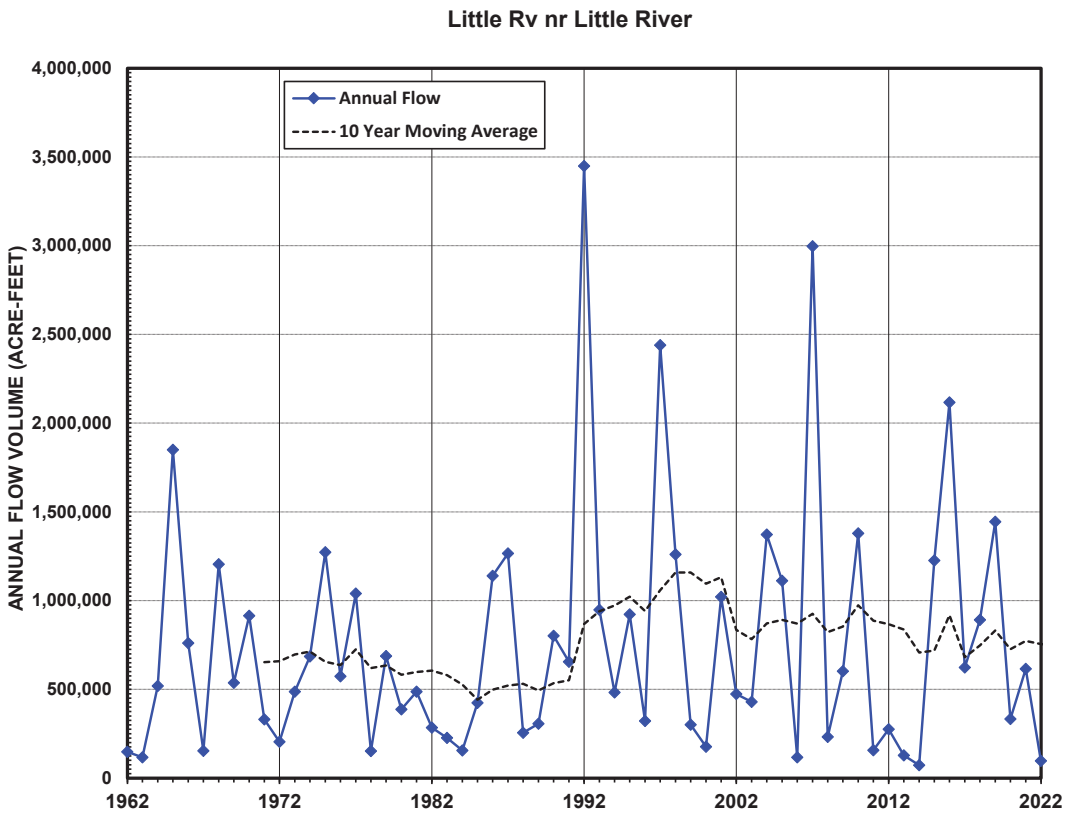


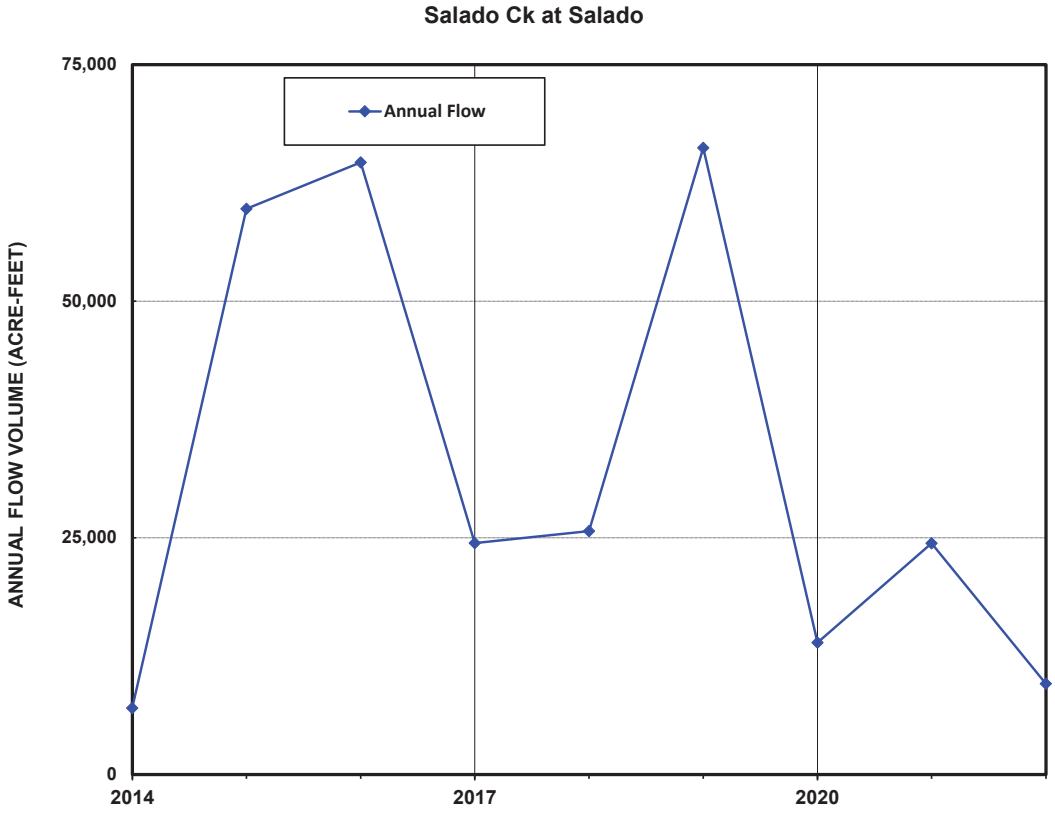
Lake Belton - EOM Storage



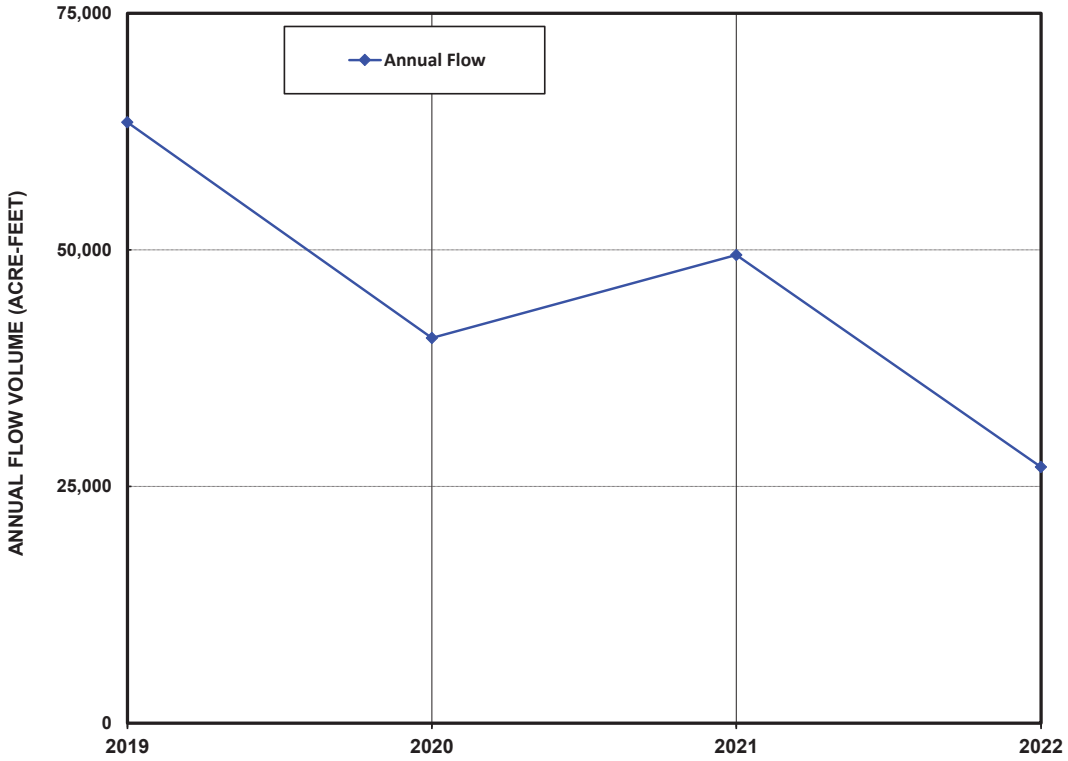
Leon Rv nr Belton



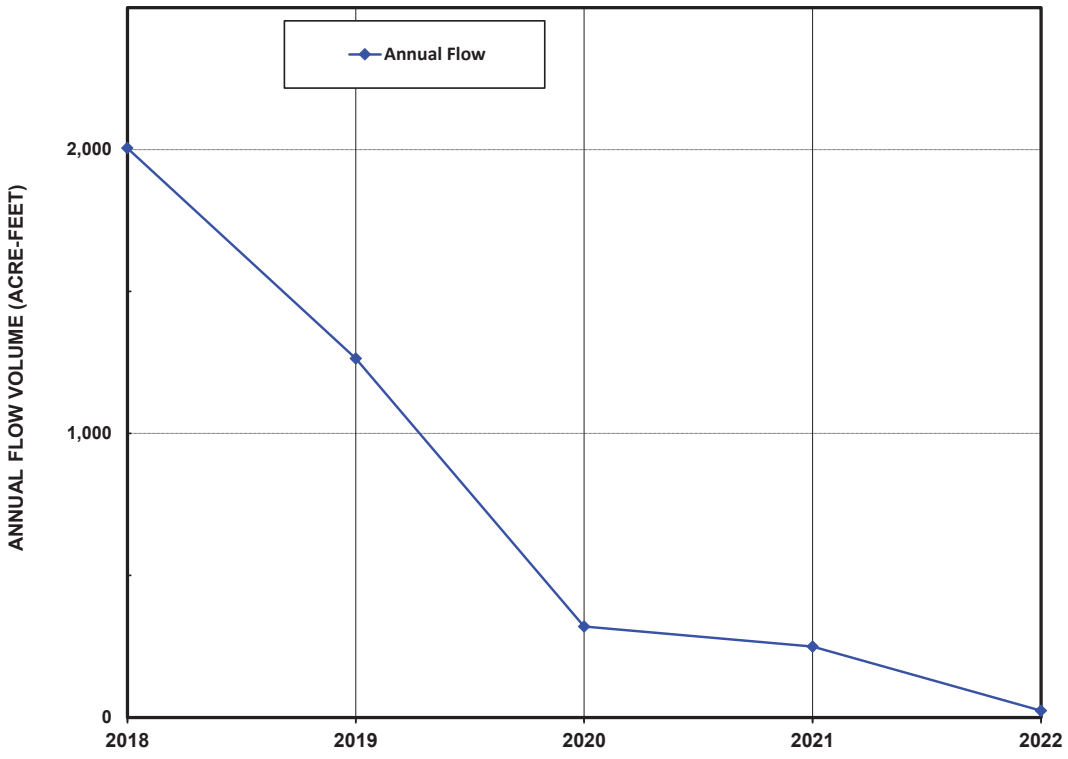

Little Rv nr Little River
Annual Flow
10 Year Moving Average
ANNUAL FLOW VOLUME (ACRE-FEET)
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1962
1972
1982
1992
2002
2012
2022


Salado Ck at Salado
Annual Flow
ANNUAL FLOW VOLUME (ACRE-FEET)
75,000
50,000
25,000
0
2014
2017
2020

Nolan Ck at S Penelope, Belton



Chalk Ridge Falls Spgs nr Belton



Attachment 2

TCEQ Approved Water Right Information

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(1)	5076	WRPERM	A & H DEVELOPERS, INC.	25.00	AGRICULTURE - IRRIGATION		BELL	
(2)	2894	ADJ	Aaron BedellELAINE BEDELLDiane DePrang	0.27	AGRICULTURE - IRRIGATION		CORYELL	
(3)	2906	ADJ	Amanda K. Wolff Judson F. Wolff	10.00	AGRICULTURE - IRRIGATION		CORYELL	
(4)	3726	ADJ	ANNE BUTLER COWANMH Cowan III	5.00	AGRICULTURE - IRRIGATION		BELL	
(5)	3726	ADJ	ANNE BUTLER COWANMH Cowan III	5.00	AGRICULTURE - IRRIGATION	12	BELL	
(6)	2997	ADJ	ANNE PAREKEVIN PARE	4.39	AGRICULTURE - IRRIGATION		BELL	
(7)	2893	ADJ	ASHBY, SEABORN L	10.00	AGRICULTURE - IRRIGATION		CORYELL	
(8)	2945	ADJ	BAIRD, ROGER C	0.32	AGRICULTURE - IRRIGATION		BELL	
(9)	2937	ADJ	Barge Ranch, Ltd.	59.00	AGRICULTURE - IRRIGATION		BELL	
(10)	13561	WRPERM	Bell County Water Control & Improvement District No. 1	2,240.00	MUNICIPAL/DOMESTIC		BELL	X
(11)	2950	ADJ	Belton Independent School District	18.90	AGRICULTURE - IRRIGATION		BELL	
(12)	2997	ADJ	Ben K. PhillipsNancy Z. Phillips	6.38	AGRICULTURE - IRRIGATION		BELL	
(13)	3003	ADJ	Bennie Gibbs Ranch, LP	32.00	AGRICULTURE - IRRIGATION		BELL	
(14)	2907	ADJ	Bernard MillerLinda Miller	75.00	AGRICULTURE - IRRIGATION		CORYELL	
(15)	4002	WRPERM	BERT A. HUNTERLINDA D. HUNTER	11.34	AGRICULTURE - IRRIGATION		BELL	
(16)	4012	WRPERM	Betsy N. Curry Billy G. Curry W.L. Curry MILDRED CURRY KAISER BETTY ANN CURRY LEWIS	440.00	AGRICULTURE - IRRIGATION		BELL	
(17)	3015	ADJ	BOSTON, MARY JEAN The Boston Living Trust	36.00	AGRICULTURE - IRRIGATION		BELL	
(18)	2997	ADJ	Bradley B. Ware	3.89	AGRICULTURE - IRRIGATION		BELL	
(19)	2999	ADJ	Bradley B. Ware	3.00	AGRICULTURE - IRRIGATION		BELL	
(20)	2996	ADJ	Bradley B. Ware	100.00	AGRICULTURE - IRRIGATION		BELL BURNET	

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(21)	5160	ADJ	Brazos River Authority	100,257.00	AGRICULTURE - IRRIGATION INDUSTRIAL MINING MUNICIPAL/DOMESTIC RECREATION	457,600	BELL	X
(22)	5161	ADJ	Brazos River Authority	67,768.00	AGRICULTURE - IRRIGATION INDUSTRIAL MINING MUNICIPAL/DOMESTIC RECREATION	235,700	BELL	X
(23)	3014	ADJ	Brittany Anne Bailey Edwn A. Bailey III Edwin A. Bailey Jr. Elizabeth Bailey Geyer	63.00	AGRICULTURE - IRRIGATION	6	BELL	
(24)	3014	ADJ	Brittany Anne Bailey Edwn A. Bailey III Edwin A. Bailey Jr. Elizabeth Bailey Geyer	2.00	INDUSTRIAL		BELL	
(25)	3004	ADJ	BRUCE FLANIGANKATHRYN FLANIGAN	2.10	AGRICULTURE - IRRIGATION		BELL	
(26)	2998	ADJ	C W DUNCAN IIIG LARRY ALLEN 2007 TRUST	157.00	AGRICULTURE - IRRIGATION		BELL	
(27)	2896	ADJ	CALLAWAY, MARGARET	30.00	AGRICULTURE - IRRIGATION		CORYELL	
(28)	3004	ADJ	CARLA J HARMONRAYFORD HARMON	1.60	AGRICULTURE - IRRIGATION		BELL	
(29)	4002	WRPERM	CHARLES BURTONYE POM BURTON	0.55	AGRICULTURE - IRRIGATION		BELL	
(30)	2997	ADJ	Charles M. Stockton	2.90	AGRICULTURE - IRRIGATION		BELL	
(31)	2997	ADJ	Christa G. ArmantroutJesse P. Armantrout	3.24	AGRICULTURE - IRRIGATION		BELL	
(32)	2907	ADJ	CHRISTI L. BLAKKOLBJOHN W. MUNZ	112.58	AGRICULTURE - IRRIGATION		CORYELL	
(33)	4024	WRPERM	City of Belton	185.70	AGRICULTURE - IRRIGATION	15	BELL	X
(34)	2943	ADJ	City of KilleenKilleen Willows, Inc.	0.00	RECREATION	10	BELL	X
(35)	2943	ADJ	City of KilleenKilleen Willows, Inc.	20.00	AGRICULTURE - IRRIGATION	36	BELL	X

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(36)	2938	ADJ	City of Temple	20,000.00	MUNICIPAL/DOMESTIC		BELL	X
(37)	2938	ADJ	City of Temple	15,804.00	INDUSTRIALMUNICIPAL/DOMESTIC	500	BELL	X
(38)	2938	ADJ	City of Temple	0.00	INDUSTRIALMUNICIPAL/DOMESTIC		BELL	X
(39)	2938	ADJ	City of Temple	0.00	INDUSTRIALMUNICIPAL/DOMESTIC		BELL	X
(40)	5226	WRPERM	City of Temple	0.00	RECREATION	3	BELL	X
(41)	5330	WRPERM	City of Temple	187.00	AGRICULTURE - IRRIGATION RECREATION	210.5	BELL	X
(42)	2952	ADJ	Cloud Construction Co., Inc.	16.00	AGRICULTURE - IRRIGATION	37	BELL	
(43)	2946	ADJ	Cody Wayne SulakJacqueline Jorgette Sulak	24.00	AGRICULTURE - IRRIGATION		BELL	
(44)	2934	ADJ	David BarberStacey Barber	18.76	AGRICULTURE - IRRIGATION		CORYELL	
(45)	2906	ADJ	David E. CarterSamuel R. Carter	26.00	AGRICULTURE - IRRIGATION		CORYELL	
(46)	2951	ADJ	DAVID EGGERSheila G. Egger	2.00	AGRICULTURE - IRRIGATION		BELL	
(47)	2903	ADJ	David Hopson	530.00	AGRICULTURE - IRRIGATION		CORYELL	
(48)	2951	ADJ	David L. Reddell, IIJo F. Reddell	2.08	AGRICULTURE - IRRIGATION		BELL	
(49)	2897	ADJ	David William JennyDorothy Ann Jenny	8.00	AGRICULTURE - IRRIGATION		CORYELL	
(50)	2948	ADJ	DICKSON, CHESTER EDICKSON, LINDA DIANE	278.00	AGRICULTURE - IRRIGATION		BELL	
(51)	2949	ADJ	DICKSON, CHESTER EDICKSON, LINDA DIANE	37.00	AGRICULTURE - IRRIGATION		BELL	
(52)	2935	ADJ	EL PASO TABLEROCK RANCH PROPERTIES LLC	38.00	AGRICULTURE - IRRIGATION	190	CORYELL	
(53)	2887	ADJ	Elizabeth A. TaylorJohn Taylor	30.00	AGRICULTURE - IRRIGATION		CORYELL	
(54)	3762	WRPERM	Ellis G. MarshallJean M. Marshall	100.00	AGRICULTURE - IRRIGATION		BELL	
(55)	2905	ADJ	Estate of Dan G Davidson	14.00	AGRICULTURE - IRRIGATION		CORYELL	
(56)	2908	ADJ	Estate of Dan G Davidson	22.00	AGRICULTURE - IRRIGATION		CORYELL	
(57)	3004	ADJ	Estate of Dr Jamie W Barton	4.80	AGRICULTURE - IRRIGATION		BELL	
(58)	3006	ADJ	Estate of Karl B. Wagner	48.00	AGRICULTURE - IRRIGATION		BELL	
(59)	3004	ADJ	ESTHER L. MUNSONMUNSON, MARK H	10.10	AGRICULTURE - IRRIGATION		BELL	
(60)	3767	ADJ	Five Wells Ranch Company	120.00	AGRICULTURE - AQUACULTURE AGRICULTURE - IRRIGATION	358	BELL	
(61)	5227	WRPERM	Five Wells Ranch Company	0.00	DOMESTIC AND LIVESTOCK	295	BELL	
(62)	4024	WRPERM	Gated River One, LLC	114.30	AGRICULTURE - IRRIGATION		BELL	

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(63)	2888	ADJ	George T. ReynoldsJocelyn Adams Reynolds	2.00	AGRICULTURE - IRRIGATION		CORYELL	
(64)	2997	ADJ	GERALD BROWNNADENE BROWN	2.50	AGRICULTURE - IRRIGATION		BELL	
(65)	2914	ADJ	GRIMES, MABEL RUTHGRIMES, PAT	18.00	AGRICULTURE - IRRIGATION		CORYELL	
(66)	3011	ADJ	HANSEN, JEFFHANSEN, SHANNON	0.46	AGRICULTURE - IRRIGATION		BELL	
(67)	4002	WRPERM	Helene C. MorrowJoseph B. Morrow	13.12	AGRICULTURE - IRRIGATION		BELL	
(68)	2896	ADJ	HILSBERG, DAVID	94.00	AGRICULTURE - IRRIGATION		CORYELL	
(69)	2997	ADJ	Holly D. ThomsonJohn C. Thomson III	1.65	AGRICULTURE - IRRIGATION		BELL	
(70)	2813	ADJ	HOLLY RAE SOHNSRYAN MICHAEL SOHNS	153.00	AGRICULTURE - IRRIGATION		CORYELL	
(71)	4003	WRPERM	ITHA LYNNE BERRYMike H. Berry	29.70	AGRICULTURE - IRRIGATION		BELL	
(72)	3000	ADJ	James L. Shepherd	105.00	AGRICULTURE - IRRIGATION		BELL	
(73)	3004	ADJ	Jencer Investments, Inc.	24.50	AGRICULTURE - IRRIGATION		BELL	
(74)	2898	ADJ	Jennifer J. WoodNathanial D. Wood	0.30	AGRICULTURE - IRRIGATION		CORYELL	
(75)	2934	ADJ	JoAnn CollierMichael L. Collier	15.30	AGRICULTURE - IRRIGATION		CORYELL	
(76)	2934	ADJ	John Wilson Roberts, Jr. Wanda Brown Roberts	4.09	AGRICULTURE - IRRIGATION		CORYELL	
(77)	2953	ADJ	JONATHAN TSAIMANDOLYN TSAI	6.39	AGRICULTURE - IRRIGATION		BELL	
(78)	3010	ADJ	JONES, CLIFFORD D	10.00	AGRICULTURE - IRRIGATION		BELL	
(79)	2997	ADJ	Jude P. CoeMegan E. Vavir Coe	6.31	AGRICULTURE - IRRIGATION		BELL	
(80)	2953	ADJ	Julia Y. HindsRoger W. Hinds	35.46	AGRICULTURE - IRRIGATION		BELL	
(81)	4002	WRPERM	KAREN P. MILLERRICKY D. MILLER	14.48	AGRICULTURE - IRRIGATION		BELL	
(82)	2904	ADJ	Karen S. Barnard Jones Estate of Sterlin J. Barnard	40.00	AGRICULTURE - IRRIGATION		CORYELL	
(83)	2997	ADJ	Karl ThomasPeggy Thomas	5.13	AGRICULTURE - IRRIGATION		BELL	
(84)	2951	ADJ	KATHY DENTONTODD DENTON	2.17	AGRICULTURE - IRRIGATION		BELL	
(85)	2951	ADJ	KERRI COSTASteven M. Costa	1.51	AGRICULTURE - IRRIGATION		BELL	
(86)	2950	ADJ	KRAUSS, DAVID RKRAUSS, DORCAS A	0.08	AGRICULTURE - IRRIGATION		BELL	
(87)	2895	ADJ	LAXSON, WILLIAM TRAVIS	29.00	AGRICULTURE - IRRIGATION		CORYELL	
(88)	2886	ADJ	Leon Bend Ranch, LLC	10.00	AGRICULTURE - IRRIGATION		CORYELL	
(89)	3009	ADJ	LEWIS, JOSEPHLEWIS, SARA C	81.00	AGRICULTURE - IRRIGATION		BELL	

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(90)	2944	ADJ	Lhoist North America of Texas, Ltd.	138.00	MINING	28	BELL	
(91)	3005	ADJ	LOGSDON, BETTYLOGSDON, VAIL E	5.00	AGRICULTURE - IRRIGATION		BELL	
(92)	2951	ADJ	LORI L. MAEDGENWILLIAM O. MAEDGEN III	1.43	AGRICULTURE - IRRIGATION		BELL	
(93)	2911	ADJ	LUEDTKE, DENNES CHARLES	74.00	AGRICULTURE - IRRIGATION		CORYELL	
(94)	2953	ADJ	LYNCH, DENNIS JLYNCH, MARY H	69.65	AGRICULTURE - IRRIGATION		BELL	
(95)	2951	ADJ	LYNDA STOKESWILLIAM STOKES	0.83	AGRICULTURE - IRRIGATION		BELL	
(96)	2933	ADJ	M. J. Hanna Foundation	46.00	AGRICULTURE - IRRIGATION		CORYELL	
(97)	2898	ADJ	MACKIE, DONALD JMACKIE, SARA L	6.88	AGRICULTURE - IRRIGATION		CORYELL	
(98)	4218	WRPERM	Margaret Diane Connell Non-exempt Trust TEXAS SUNFLOWER, LTD.	172.00	AGRICULTURE - IRRIGATION		BELL	
(99)	2934	ADJ	MARTHA JEAN JACKSON-HARRIS JOHN S KOPEC	27.86	AGRICULTURE - IRRIGATION		CORYELL	
(100)	2940	ADJ	Mary Ann Cosper	63.00	AGRICULTURE - IRRIGATION		BELL	
(101)	3013	ADJ	MCCC, LLC	168.00	AGRICULTURE - IRRIGATION	10	BELL	
(102)	2902	ADJ	MCCORKLE, ELIZABETH C MCCORKLE, QUENTIN G	18.00	AGRICULTURE - IRRIGATION		CORYELL	
(103)	3001	ADJ	MELTON, EDD	12.00	AGRICULTURE - IRRIGATION		BELL	
(104)	2945	ADJ	MESSER, ANN WHITWORTH	33.58	AGRICULTURE - IRRIGATION		BELL	
(105)	2945	ADJ	MESSER, JOHN B SR	2.10	AGRICULTURE - IRRIGATION		BELL	
(106)	3763	WRPERM	MEYER, ALICE JANE	122.98	AGRICULTURE - IRRIGATION	20	BELL	
(107)	3004	ADJ	MICHAEL A. ANDERSONSUSAN L. ELROD	3.00	AGRICULTURE - IRRIGATION		BELL	
(108)	2951	ADJ	MONTGOMERY, MICHAEL ANDREW	13.62	AGRICULTURE - IRRIGATION		BELL	
(109)	2915	ADJ	MOORE, ROBERT L	38.00	AGRICULTURE - IRRIGATION		BELL	
(110)	2901	ADJ	Morse Family Partnership, Ltd.	100.00	AGRICULTURE - IRRIGATION		CORYELL	
(111)	4000	WRPERM	Odessa J. LovelaceThomas E. Lovelace	20.00	AGRICULTURE - IRRIGATION		BELL	
(112)	3725	ADJ	Olin Teague Veterans Center	0.00	RECREATION	96	BELL	
(113)	2900	ADJ	PAMELA SUZANNE PARKER TROY WADE PARKER, JR	13.87	AGRICULTURE - IRRIGATION		CORYELL	
(114)	2898	ADJ	Patricia I. JohnsonTim Franklin Orwig	0.87	AGRICULTURE - IRRIGATION		CORYELL	

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(115)	2947	ADJ	Phillip E. PowellSharon L. Powell	11.00	AGRICULTURE - IRRIGATION		BELL	
(116)	2941	ADJ	PINCHE CHINGALE RANCH - BUCKHOLTS, LLC	36.00	AGRICULTURE - IRRIGATION		BELL	
(117)	2900	ADJ	POWELL, CHARLES C	0.13	AGRICULTURE - IRRIGATION		CORYELL	
(118)	2942	ADJ	Pyle Brothers, Inc.	5.14	AGRICULTURE - IRRIGATION		BELL	
(119)	3004	ADJ	RANDALL S. HOUSTON	0.40	AGRICULTURE - IRRIGATION		BELL	
(120)	3002	ADJ	RAY, GENERAY, NELDA FAYE	150.00	AGRICULTURE - IRRIGATION		BELL	
(121)	2997	ADJ	Remy BeherecRobin E. Beherec	1.98	AGRICULTURE - IRRIGATION		BELL	
(122)	2997	ADJ	Ricky LynchSarah Ann Lynch	3.99	AGRICULTURE - IRRIGATION		BELL	
(123)	3007	ADJ	River Farm, Ltd.	48.00	AGRICULTURE - IRRIGATION		BELL	
(124)	3007	ADJ	River Farm, Ltd.	192.00	AGRICULTURE - IRRIGATION		BELL	
(125)	2953	ADJ	Robert Alan ProbeBarbara Weiss	47.23	AGRICULTURE - IRRIGATION		BELL	
(126)	2890	ADJ	ROGERS, DON THOMAS	8.00	AGRICULTURE - IRRIGATION		CORYELL	
(127)	2894	ADJ	San Pablo Corporation	1.73	AGRICULTURE - IRRIGATION		CORYELL	
(128)	3011	ADJ	SCHOEPF, RONALD G JRSCHOEPF, STACI R	16.55	AGRICULTURE - IRRIGATION		BELL	
(129)	2898	ADJ	Sharon Egger Paxton	14.95	AGRICULTURE - IRRIGATION		CORYELL	
(130)	2950	ADJ	Shine Branch, LLC	6.03	AGRICULTURE - IRRIGATION		BELL	
(131)	4095	WRPERM	Sidney Kacir	240.00	AGRICULTURE - IRRIGATION		BELL	
(132)	4095	WRPERM	Sidney Kacir	308.00	AGRICULTURE - IRRIGATION		BELL	
(133)	3763	WRPERM	SM Retreat, Ltd.	327.02	AGRICULTURE - IRRIGATION		BELL	
(134)	2909	ADJ	SOHNS, TIMMY RALPH	26.00	AGRICULTURE - IRRIGATION		CORYELL	
(135)	2910	ADJ	SOHNS, TIMMY RALPH	77.00	AGRICULTURE - IRRIGATION		CORYELL	
(136)	3012	ADJ	Stagecoach 1943, LP	0.00	RECREATION	9	BELL	
(137)	2997	ADJ	Stephen G Suttles	9.24	AGRICULTURE - IRRIGATION		BELL	
(138)	2997	ADJ	Suntex Fuller Corporation	12.40	AGRICULTURE - IRRIGATION		BELL	
(139)	4002	WRPERM	TAMMY BURTON CEHAND	0.51	AGRICULTURE - IRRIGATION		BELL	
(140)	2996	ADJ	TAYLOR, JOHN	56.00	AGRICULTURE - IRRIGATION		BELL BURNET	
(141)	2899	ADJ	Texas Department of Criminal Justice	0.00	AGRICULTURE - IRRIGATION		CORYELL	
(142)	2907	ADJ	THRASHER LEON RIVER RANCH, LLC	199.43	AGRICULTURE - IRRIGATION		CORYELL	

TCEQ Water Rights Masterfile, Brazos River Basin

Water Rights Located in BELCOR Area (Bell and Coryell Counties), Sorted by Owner Name

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Water Right Number	Water Right Type	Owner	Diversion Amount (AF/Y)	Type of Use	Storage Amount (AF)	County	BELCOR Participant
(143)	3008	ADJ	TUTTLE, ELEANOR B	61.00	AGRICULTURE - IRRIGATION		BELL	
(144)	2936	ADJ	U.S. Department of the Army	2,000.00	MUNICIPAL/DOMESTIC		BELL CORYELL	
(145)	2936	ADJ	U.S. Department of the Army	10,000.00	MUNICIPAL/DOMESTIC	12,000	BELL CORYELL	
(146)	2936	ADJ	U.S. Department of the Army	0.00	RECREATION	14.4	BELL CORYELL	
(147)	2936	ADJ	U.S. Department of the Army	0.00	RECREATION	18	BELL CORYELL	
(148)	2936	ADJ	U.S. Department of the Army	0.00	RECREATION	1	BELL CORYELL	
(149)	2936	ADJ	U.S. Department of the Army	300.00	AGRICULTURE - IRRIGATION		BELL CORYELL	
(150)	4130	WRPERM	United States Army Corps of Engineers	5.00	RECREATION	5	BELL	
(151)	2953	ADJ	VERHEYDEN, CHARLES NVERHEYDEN, GALE	75.27	AGRICULTURE - IRRIGATION		BELL	
(152)	2891	ADJ	W. Moreland By Pass Trust	57.00	AGRICULTURE - IRRIGATION		CORYELL	
(153)	3004	ADJ	WBW DEVELOPMENT GROUP, LLC	3.50	AGRICULTURE - IRRIGATION		BELL	
(154)	2892	ADJ	WHISENHUNT, MARY JANE WHISENHUNT, W N	32.00	AGRICULTURE - IRRIGATION		CORYELL	
(155)	2942	ADJ	WRIGHT DOUBLE J RANCH INC.	194.87	AGRICULTURE - IRRIGATION AGRICULTURE - WILDLIFE MANAGEMENT		BELL	

Attachment 3

BELCOR Participants and Apparent Water Supply Source

ATTACHMENT 3

BELCOR Participants and Apparent Water Supply Source

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BELCOR Participant	SOURCE OF INFORMATION (1)						
	2021 Region G Water Plan				TCEQ Water Rights Masterfile		
	Brazos River Authority (Little River - Lake/River System)	Ground Water	Direct Reuse	Aquifer	Water Right (YES or NO)	Associated Water Right Number (WRPERM or ADJ)	Water Supply Contract with Other (WSC)
Bell County	Y	Y	N	Trinity	NO	-	-
Coryell County	Y	Y	N	Trinity	NO	-	WSC 2334
Clearwater Underground Water Conservation District	N	Y	N	Edwards BFZ	NO	-	-
Brazos River Authority	Y	N	N	-	YES	WRPERM 5851 (SYSTEM Permit) ADJ 5160 (Belton) & ADJ 5161 (Stillhouse Hollow)	SOURCE FOR OTHER CONTRACTS (2)
City of Belton	Y	N	N	-	YES	WRPERM 4024	WSC 1891
City of Copperas Cove	Y	N	N	-	NO	-	-
City of Gatesville	Y	N	N	-	NO	-	WSC 1039 WSC 1897 WSC 2012 WSC 12601
City of Harker Heights	Y	N	N	-	NO	-	WSC 12060 WSC 12061
City of Killeen	Y	N	Y	-	YES	ADJ 2943	-
City of Temple	Y	N	N	-	YES	ADJ 2938 & WRPERM 5226 & WRPERM 5330	WSC 1893
Killeen-Metropolitan Organization	UK	UK	UK	-	UK	-	-
Middle Trinity Groundwater Conservation Disctrict	N	Y	N	Trinity	NO	-	-
Village of Salado	Y	Y	N	Edwards BFZ	NO	-	WSC 1040 WSC 2054

WRPERM = Water Right Permit; **ADJ** = Certificate of Adjudication; **WSC** = Water Supply Contract

(1) The information presented was obtained from the 2021 Region G Water Plan documents and the TCEQ's Water Rights Masterfile and will be refined after more water source details are obtained from the BELCOR participants.

(2) The Brazos River Authority is the water source for most of the water supply contracts with the other BELCOR participants.