

November 7, 2023

Kelly Keel
Interim Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, Texas 78711-3087

Re: 2024-2025 biennial report to the Environmental Flows Advisory Group

Dear Ms. Keel,

Pursuant to Texas Water Code § 11.1471(g)(2), the Texas Water Development Board (TWDB) provides the following input to the Texas Commission on Environmental Quality (TCEQ) for their biennial report to the Environmental Flows Advisory Group (Advisory Group). Herein, the TWDB includes a list of its activities during the past biennium that are related to the adaptive management of environmental flow standards established following Senate Bill 3 (2007) and one recommendation for consideration. Additionally, the TWDB respectfully includes, as Attachment 1, a summary of relevant environmental flow studies completed since adaptive management efforts began in 2013.

Activities during fiscal years 2022 – 2023

During the most recent biennium, TWDB staff participated in the following Senate Bill 3 (2007) meetings, including:

- June 30, 2022 – A discussion of scientific studies with a member of the Guadalupe-San Antonio Basin and Bay Expert Science Team and other interested stakeholders.
- October 26, 2022 – A public meeting of the Brazos Basin and Bay Area Stakeholder Committee

In November 2021, the TWDB provided an opportunity for Basin and Bay Area Stakeholder Committees to propose studies that (1) validate or refine the environmental flow analyses, flow regime recommendations, or adopted flow standards for instream flows and freshwater inflows or that (2) evaluate strategies to achieve environmental flow protection. The TWDB received requests from the Guadalupe-San Antonio Basin and Bay Area Stakeholder Committee and from several individual participants of the Senate Bill 3 process. As a result of the requests, the TWDB funded the following studies:

- Guadalupe Blanco River Authority. *Seasonal ecological assessment in the upper Guadalupe Estuary: Phase 3*. Texas Water Development Board Contract #2300012700.

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- Texas A&M University – Corpus Christi, Harte Research Institute. *Focused flows to protect estuarine nursery habitats*. Texas Water Development Board Contract #2300012670.

Additionally, the TWDB funded the following data collection and study analyses which are supportive of Senate Bill 3 (2007) environmental flow adaptive management efforts.

- U.S. Geological Survey. *Coastal water quality monitoring and data collection*. Texas Water Development Board Contract #2200012610.
- Texas A&M University. *Evaluate geomorphic change of the Little River, Texas*. Texas Water Development Board Contract #2300012679.
- The University of Texas – Arlington. *Investigating streamflow drivers in the Brazos River Basin*. Texas Water Development Board Contract #2200012624.
- 2023. Texas A&M Engineering Experiment Station. *Development of a daily and fine-resolution (4km x 4km) gridded reservoir evaporation database for Texas*. Texas Water Development Board Contract #2200012601.
- Texas A&M Engineering Experiment Station. *Assessment of Subseasonal-to-Seasonal (S2S) streamflow, reservoir storage, and freshwater inflow forecast skills in the Trinity River Basin*. Texas Water Development Board Contract #2300012701.
- The University of Texas – Arlington. *Enhancing the data to advance Forecast-Informed Reservoir Operations (FIRO) for operational water management in Texas*. Texas Water Development Board Contract #2300012685.
- Texas A&M University – Galveston. *Development of a 3D cross-scale hydrodynamic model for Texas coastal waters*. Texas Water Development Board Contract #2300012715.
- The University of Texas Rio Grande Valley. *Coastal sediment porewater salinity monitoring methods for Texas*. Texas Water Development Board Contract #2300012739.

Recommendation

The TWDB requests that the Advisory Group consider the applicable agencies' staff resource availability in developing the biennial statewide workplan for review of environmental flow standards. To ensure adequate resources to support these efforts, the TWDB requests that the basins be scheduled on a staggered timeline.

The TWDB appreciates this opportunity to provide input to the TCEQ's biennial report and looks forward to continued assistance to the TCEQ and the Senate Bill 3 (2007) statewide environmental flows process.

Attachment 1. Environmental flow studies 2013 – 2021

The Texas Water Development Board (TWDB) has provided technical and financial support to the adaptive management process since Fiscal Year 2013. Below is a bibliography, organized by basin, of studies conducted that are relevant to environmental flows in Texas. Many studies were funded to support the needs of basin and bay stakeholder committees.

Statewide/Multi-Basin

- 2023. U.S. Geological Survey. *Continuation of suspended sediment sampling at TCEQ environmental flows measurement points in seven river basins: Neches, Trinity, Brazos, Lavaca, Colorado, Guadalupe-San Antonio, and Nueces*. Texas Water Development Board Contract #2000012412; data only.
- 2022. Montagna, P.A. [*Long-term benthic data: adaptive management of three basins*](#). Texas Water Development Board, Contract #2000012436.
- 2022. Winemiller, K., J. Trungale, A. Schwalb, T. Hardy, G. Moore, J. Perkin, D. Hoenighaus, and D. Buzan. [*Environmental flow regime assessment and development of a monitoring framework*](#). Texas Water Development Board Contract #1800012317.
- 2021. Dunn, D., S. Schnier, C. Corso, and J. Walker. [*Effects of recommended reuse strategies on Brazos basin streamflow*](#). Texas Water Development Board Contract #2100012470.
- 2021. Anchor QEA, LLC and Hoffpauir Consulting. [*Evaluating the attainment of environmental flow standards*](#). Texas Water Development Board Contract #2100012465.
- 2021. Hardy, T., K. Winemiller, E. Buskey, G. Guillen, J. Trungale, D. Opdyke, T. Annear, A. Locke, and C. Estes. [*Statewide synthesis of environmental flow studies \(2014-2017\)*](#). Texas Water Development Board Contract #1900012284.
- 2021. Lee, M. and Z. Lucena. *Freshwater, nutrient, and sediment monitoring in four lower river basins: Trinity-San Jacinto, Colorado-Lavaca, Guadalupe-San Antonio, and Nueces*. Texas Water Development Board Contract #1900012323; data only.
- 2020. U.S. Geological Survey. *Suspended sediment sampling at TCEQ environmental flows measurement points in four river basins: Trinity, Brazos, San Antonio, and Guadalupe*. Texas Water Development Board Contract #1800012253; data only.
- 2020. Wetz, M.S. and T. Chin. [*Influence of freshwater inflow gradients on estuarine nutrient-phytoplankton dynamics*](#). Texas Water Development Board, Contract #1800012228.
- 2020. Montagna, P.A., P.M. Cockett, and M. Rohal. 2020. [*Using comparative long-term benthic data for adaptive management of freshwater inflow to three basins*](#). Texas Water Development Board, Contract #1800012223.
- 2019. Hayes, T., and D. Baker. [*Riparian productivity in the Brazos, Guadalupe, and Trinity River Basins, Texas*](#). Texas Water Development Board Contract #1600011933.

- 2019. Lee, M., R. Banta, Z. Lucena, C. Crow, and D. Okerman. *Freshwater, nutrient, and sediment monitoring in four lower river basins: Trinity-San Jacinto, Colorado-Lavaca, Guadalupe-San Antonio, and Nueces*. Texas Water Development Board Contract #1600011927; data only.
- 2017. Montagna, P.A., M. Wetz, and X. Hu. [Monitoring mid-coastal estuaries - 2016](#). Texas Water Development Board, Contract #1600011924.
- 2013 – 2021. *Coastwide bay and estuary water quality monitoring: Sabine-Neches, Trinity-San Jacinto, Colorado-Lavaca, Guadalupe-San Antonio, Nueces, and Laguna Madre*. Texas Water Development Board Contracts #1348311519, 1448311634, #1548311784, #1600011925, #1600011927, #1800012170, #1900012323, #2000012381, #2100012460, #2200012610; data only.

Sabine-Neches Basin and Sabine Lake

Note: The Sabine-Neches Basin and Bay Area Stakeholder Committee did not request adaptive management studies.

Trinity-San Jacinto Basin and Galveston Bay

- *In Progress*. Trinity River Authority. *Evaluation of adopted flow standards for the Trinity River: Phase 4*. Texas Water Development Board Contract #2000012407.
- 2023. Tull, N., P. Passalacqua, and B. Hodges. [Quantifying hydrological connectivity in the Trinity River Delta](#). Texas Water Development Board Contract #2000012435.
- 2023. Bare, R., S. Glenn, and K. Vernin. [The assimilative capacity of Lake Livingston: nutrients, sediments, and high flow events](#). Texas Water Development Board Contract #2000012458.
- 2022. Mangham, W., K. McKnight, T. Osting, P. Southard, and D. Flores. [Evaluation of adopted flow standards for the Trinity River, phase 3](#). Texas Water Development Board Contract #1800012226.
- 2020. Li, Z., B. Hodges, and P. Passalacqua. [Building the Trinity River Delta hydrodynamic model](#). Texas Water Development Board Contract #1800012195.
- 2019. Quigg, A. and J. Steichen. [Defining bioindicators for freshwater inflow needs studies, phase 2: defining a sound ecological environment for Galveston Bay](#). Texas Water Development Board Contract #1600011941.
- 2018. Li, Z., P. Passalacqua, and B. Hodges. [Hydrodynamic model development for the Trinity River Delta](#). Texas Water Development Board Contract #1600011928.
- 2017. Mangham, W., T. Osting, and D. Flores. [Evaluation of adopted flow standards for Trinity River, phase 2](#). Texas Water Development Board Contract #1600011940.
- 2015. U.S. Geological Survey. [Determination of freshwater inflow volume from the Trinity River into Galveston Bay, May 2014 – August 2015](#). Texas Water Development Board Contract #1400011697.

- 2015. Mangham, W., T. Osting, and D. Flores. [Lidar acquisition and flow assessment for the middle Trinity River](#). Texas Water Development Board Contract #1400011696.
- 2015. Quigg, A. and J. Steichen. [Defining bioindicators for freshwater inflow needs studies](#). Texas Water Development Board Contract #1400011695.

Brazos River Basin and Riverine Estuary

- 2022. Guillen, G., J. Oakley, and M. Mokrech. *Baseline research studies in support of validation or refinement of the adopted Texas Commission on Environmental Quality Environmental flow standards for the Brazos River Estuary: methods summary*. Texas Water Development Board Contract #1800012239; available upon request.
- 2021. Schnier, S. [Assessment of how trends in the Brazos River basin may affect surface water availability and attainment of environmental flow standards](#). Texas Water Development Board Contract #2100012466.
- 2017. Bonner, T., J. Duke, G. Guillen, and BIO-WEST, Inc. [Instream flows research and validation methodology framework 2016-2017: Brazos River and Associated Bay and Estuary System](#). Texas Water Development Board Contract #1600012009.
- 2015. Bonner, T., J. Duke, G. Guillen, K. Winemiller, and BIO-WEST, Inc. [Instream flows research and validation methodology framework and Brazos Estuary characterization](#). Texas Water Development Board Contract #1400011722.

Colorado-Lavaca River Basin and Matagorda and East Matagorda Bays

- 2023. Hayes, T.D., Z. Chi, and H. Valencia. [Hydraulic connectivity to riparian habitats in the Colorado and Lavaca basins](#). Texas Water Development Board Contract #2000012438.
- 2022. Batterton, B.E. and K.H. Dunton. [Lavaca River Delta marsh assessment](#). Texas Water Development Board Contract #2000012439.
- 2021. Madewell, M.J., R.A. Feagin, T.P. Huff, and B. Balboa. [Informing environmental flow protection efforts for the sustainability of wetlands in East Matagorda Bay: phase I Big Boggy](#). Texas Water Development Board Contract #2000012414.
- 2021. Bene, J., T. Fenstemaker, and S. Young. [Surface water-groundwater interaction pilot study](#). Texas Water Development Board Contracts #1900012305, #2000012350, and #2000012349.
- 2020. Zhang, Y., M.A. Rahman, M. Ghazvinian, and D.J. Seo. [Developing a multi-model simulation system for estimation and prediction of freshwater inflow to Matagorda Bay](#). Texas Water Development Board Contract #1800012276.
- 2020. Montagna, P.A., P.M. Cockett, E.M. Kurr, and J. Trungale. [Assessment of the relationship between freshwater inflow and biological indicators in Lavaca Bay](#). Texas Water Development Board, Contract #1800012268.
- 2019. Furnans, J., M. Keester, and K. Kennedy. [Evaluation of rainfall-runoff trends in the upper Colorado River basin \(phase two\)](#). Texas Water Development Board Contract #1800012283.

- 2017. Kennedy Resource Company, R.J. Brandes Consulting, and Crespo Consulting Services, Inc. [Evaluation of rainfall-runoff patterns in the upper Colorado River basin](#). Texas Water Development Board Contract #1600012011.
- 2017. Bonner, T., J. Duke, and BIO-WEST, Inc. [Instream flows research and validation methodology framework 2016-2017, Colorado and Lavaca Rivers](#). Texas Water Development Board Contract #1600012010.
- 2015. Austin, B., A. Kennedy, T. Osting, and C. Walker. [Evaluation of freshwater delivery alternatives to East Matagorda Bay](#). Texas Water Development Board Contract #1400011759.
- 2015. Anchor QEA, BIO-WEST, Inc., J.F. Trungale Engineering and Science, and T. Soniat. [Studies to evaluate achievement of freshwater inflow standards and ecological response](#). Texas Water Development Board Contract #1400011715.

San Antonio-Guadalupe River Basin and San Antonio Bay

- 2023. Goldsmith, A. M., M. DeMoulpied, X. Rangaswami, A. Kiser, and C. Randklev. [Literature review to evaluate mussel-flow ecology in the lower Guadalupe River basin](#). Texas Water Development Board Contract #2100012464.
- 2022. Jenkerson, J. T., Sullivan, K.T., B.M. Littrell, and E.L. Oborny. [Seasonal ecological assessment in the upper Guadalupe Estuary](#). Texas Water Development Board Contract #2100012475.
- 2020. Sullivan, K., C. Williams, B.M. Littrell, and E. L. Oborny. [Seasonal ecological assessment in the upper Guadalupe Estuary](#). Texas Water Development Board Contract #1800012267.
- 2019. Scheef, L.P. and E.J. Buskey. [Assessing the effects of freshwater inflows and other key drivers on the population dynamics of blue crab and white shrimp using a multivariate time series modeling framework: phase 2](#). Texas Water Development Board Contract #1600011966.
- 2017. San Antonio River Authority, T. Bonner, J. Duke, BIO-WEST, Inc. [Instream flows research and validation methodology framework 2016-2017: Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin](#). Texas Water Development Board Contract #1600011937.
- 2017. Guadalupe Blanco River Authority. *San Antonio Bay water circulation monitoring and data collection*. Texas Water Development Board Contract #1600011930; data only.
- 2015. San Antonio Bay Partnership, Inc., Trungale Engineering & Science, and ASR Systems, LLC. [Strategy options for meeting attainment frequencies for the estuaries](#). Texas Water Development Board Contract #1400011713.
- 2015. Buskey, E.J., L.P. Scheef, and J. Xue. [Assessing the effects of freshwater inflows and other key drivers on the population dynamics of blue crab and white shrimp using a multivariate time series modeling framework](#). Texas Water Development Board Contract #1400011712.

- 2015. Black, B.A. and M. Heaney. [Rangia clam investigations](#). Texas Water Development Board Contract #1400011711.
- 2015. Carothers, R., Hodges, B., and P. Passalacqua. [Guadalupe bayou flow and inundation study](#). Texas Water Development Board Contract #1400011710.
- 2015. San Antonio River Authority, T. Bonner, J. Duke, BIO-WEST, Inc. [Instream flows research and validation methodology framework: Guadalupe, San Antonio, Mission, and Aransas Rivers and Mission, Copano, Aransas, and San Antonio Bays Basin](#). Texas Water Development Board Contract #1400011709.

Nueces River Basin and Mission-Aransas and Corpus Christi Bays

- 2019. Dunton, K.H., T. Whiteaker, and M.K. Rasser. [Patterns in the emergent vegetation of the Rincon Bayou Delta, 2005-2016](#). Texas Water Development Board Contract #1600011971.
- 2019. Scheef, L.P. and E.J. Buskey. *Nueces Bay circulation assessment using tilt current meters*. Texas Water Development Board Contract #1600011935; available upon request.
- 2018. Saylam, K., J.R. Hupp, J.R. Andrews, and A.R. Averett. [Airborne lidar survey of the Frio River, Texas](#). Texas Water Development Board Contract #1800012220.
- 2017. Buzan, D. and E. To. [Alternative methods to add freshwater to the Nueces Delta](#). Texas Water Development Board Contract #1600012016.
- 2017. Anchor QEA, LLC. [Nutrient budget for Nueces Bay](#). Texas Water Development Board Contract #1600012015.
- 2017. Shockley, A.C. and Z. Stein. [Nueces BBASC work plan study: re-examination of the 2001 Agreed Order monthly targets: phase 2](#). Texas Water Development Board Contract #1600012014.
- 2017. Dodson, J., G. Jackson, C. Koester, M.E. Vega, K. Thompson, H. McNeil, B. Hodges, C. Jalbert, A. Gilmer. [Using landform and hydraulic modifications to increase the benefit of freshwater inflows to Nueces Bay and Nueces Delta – phase II: verification and feasibility assessment for landform modifications in the Nueces Delta](#). Texas Water Development Board Contract #1600012013.
- 2016. Dodson, J., K. Dunton, E. Hill, B. Hodges, G. Jackson, B. Nicolau, M.K. Skoruppa, D. Sullivan, K. Thompson, and G. Ward. [Using landform and hydraulic modifications to increase the benefit of freshwater inflows to Nueces Bay and Nueces Delta](#). Texas Water Development Board Contract #1400011717.
- 2015. Li, Z. and B.R. Hodges. [Modeling salinity fluxes in the Nueces Delta](#). Texas Water Development Board Contract #1400011719.
- 2015. Lemonds, P.J. [Nueces BBASC work plan study no. 3: Nueces watershed pre- and post-development nutrient budgets](#). Texas Water Development Board Contract #1400011718.

- 2015. Shockley, A.C. [*Nueces BBASC work plan study no.1: re-examination of the 2001 Agreed Order monthly targets and safe yield versus current demand evaluations.*](#) Texas Water Development Board Contract #1400011716.

Rio Grande Basin and Laguna Madre Estuary

- 2023. *Lower Rio Grande Valley: Stream and estuary observational monitoring.* Texas Water Development Board Contract #2100012462; data only.