



5

Water Management Strategies

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Chapter 5: Water Management Strategies

Section 5A Identification of Potentially Feasible Water Management Strategies

The Coastal Bend Regional Water Planning Group (CBRWPG) identified and evaluated potentially feasible water management strategies for each water user group (WUG) and wholesale water provider (WWP) in the region, particularly for those WUGs with shortages projected during the planning period. As required by Texas Water Code, the CBRWPG considered the following potential feasible water management strategies for inclusion in the *2026 Coastal Bend Regional Water Plan*:

- Conservation
- Aquifer Storage and Recovery
- Desalination
- Reuse
- Management of Existing Supplies
- Conjunctive Use
- Acquisition of Available Existing Water Supplies
- Development of New Water Supplies
- Development of Regional Water Supply Projects or Facilities
- Voluntary Transfer of Water Within the Region
- Emergency Transfers of Water

The CBRWPG considered a complete list of potentially feasible water management strategies based on previous plans, local on-going studies, and feedback from local sponsors. These potentially feasible strategies included all water management strategy types referenced in the Texas Water Code as presented above. On January 26, 2023, the CBRWPG reviewed the status of recommended strategies and projects with an online decade of 2030 from the 2021 regional water plan to determine relevance for the 2026 regional water plan. At their regular public meeting on October 12, 2023, the CBRWPG approved their process for identifying and evaluating potentially feasible water management strategies for the Coastal Bend Region, which is provided in Figure 5A.1. Additionally, at the same meeting, the CBRWPG determined infeasible water management strategies from the previous 2021 regional water plan. A CBRWPG subcommittee¹ was formed at the same October 12 CBRWPG meeting to consider potentially feasible water management strategies for evaluation in the 2026 regional water plan. Emails were sent to WUGs and WWPs in November 2023, January 2024, and February 2024 with follow-up phone calls to gather information on potentially feasible water management strategies to evaluate for the 2026 regional water plan. On January 25, 2024, the CBRWPG identified potentially feasible water management strategies. Additional input on potentially feasible water management strategies was received at a WWP and WUG workshop on January 26, 2024. A CBRWPG subcommittee met on April 9, 2024, to review the list of potentially

¹¹ The subcommittee consisted of Joe Almaraz, Carl Crull, Andy Garza, John Marez, Lonnie Stewart, and Esteban Ramos.

feasible water management strategies and prioritized those to evaluate in the 2026 regional water plan. On May 16, 2024, the CBRWPG adopted the water management strategies for evaluation in the 2026 regional water plan, as summarized in Table 5A.1. Water management strategies from previous plans considered no longer relevant for active evaluation in the 2026 regional water plan were summarized and are included in Chapter 9.3. Subsequent to adoption of a list of water management strategies at the May 16, 2024, CBRWPG meeting, HDR Engineering, Inc. (HDR) received requests from the City of Corpus Christi, Port of Corpus Christi Authority (PCCA), and City of Mathis on new water management strategies that they would like considered in the Coastal Bend regional water plan. In response to this, the CBRWPG agreed on an approach at the December 12, 2024, meeting that placeholders for new water management strategies in the early stages of development would be included in the Initially Prepared Plan if full evaluations could not be completed in time. In January and February 2025, additional request of four new water management strategies were received, which included one new water management strategy for the City of Corpus Christi, one new strategy by the City of Beeville, and two new water management strategies for the South Texas Water Authority (STWA). In February 2025, the City of Corpus Christi requested the evaluation of two additional water management strategies in response to ongoing drought affecting the Coastal Bend Region and interest by the executive team and City Council to evaluate projects that could be expedited amid growing water supply needs. Following submittal of the Initially Prepared Plan (IPP) to TWDB in early March 2025, preliminary evaluation was shared during a special, public meeting called on June 19, 2025. Draft strategy write-ups for these strategies were provided at that time to stakeholders for comment during the public review and comment period.

A total of 12 water management strategies were investigated during the development of the Coastal Bend regional water plan. Many of these strategies include several water supply options within the main strategy. These strategies are summarized in Table 5A.1.

All potentially feasible water management strategy evaluations in the 2026 regional water plan included in Section 5B were evaluated under drought of record conditions and in accordance with 31 Texas Administrative Code (TAC) 357.34 requirements and the Texas Water Development Board (TWDB) guidelines. Water management strategies from previous plans that were identified as relevant by the CBRWPG for the 2026 regional water plan were updated to reflect new costs, redeveloped to meet current rule requirements, revised for changed physical or socioeconomic conditions, and/or updated to reflect current project configuration information based on the level of detail requested by project sponsors or CBRWPG members. Water losses associated with recommended water management strategies are anticipated to be negligible with routine, standard maintenance performed to extend project life. In accordance with TWDB guidance, water plans should not include project costs associated with maintenance of replacing existing infrastructure. Reliability must be considered in the water management strategy evaluations. Quantifiably, the water volumes presented in this plan for recommended strategies are firm supplies that are 100 percent reliable during drought of record conditions per TWDB planning guidelines.

**Proposed Process to Identify Potentially Feasible Water Management
Strategies for the 2026 Coastal Bend (Region N) Regional Water Plan**
Adopted by CBRWPG, Oct 12, 2023

The process of identifying potentially feasible water management strategies outlined below is proposed for development of the 2026 Region N Regional Water Plan (2026 Plan)¹:

- 1) The Coastal Bend Regional Water Planning Group (RWPG) recognizes that regional water planning is an evolving process and draws upon results obtained from previous planning efforts. A summary of water management strategies (WMSs) from the five previous planning cycles (2001, 2006, 2011, 2016, 2021 Plans) will be discussed at a Region N meeting for consideration for the 2026 Plan. The Texas Water Code list of WMSs eligible for consideration in the Plan will be discussed, including TWDB Water Loss Audit Report, conservation best management practices, and drought management as required by TWDB guidance.
- 2) The Nueces River Authority will host a workshop for water utilities located within the 11-county Region N area to discuss local plans and assess potential regional collaboration opportunities. Current local, on-going studies and future water plans, including specific WMSs of interest, will be solicited from Water User Groups (WUGs) and Wholesale Water Providers (WWPs).
- 3) Considering information compiled from outreach, a draft list of potentially feasible WMSs will be discussed at a Coastal Bend RWPG meeting for public comment.
- 4) HDR, technical consultant, will follow-up with WUGs and WWPs to confirm the list of water management strategies for development of the 2026 Plan.
- 5) The Coastal Bend RWPG will consider forming a subcommittee to review potentially feasible strategies and prepare a draft scope of work for strategies to evaluate for the 2026 Plan. The scope of work subcommittee will review a preliminary list of potentially feasible WMSs and prepare a recommendation for Coastal Bend RWPG consideration given TWDB funding allocations.
- 6) A scope of work for strategies to be evaluated will be considered and adopted at a RWPG meeting after receiving public comment. Subsequently, the Nueces River Authority will submit a letter request for TWDB consideration and approval.
- 7) Based on the adopted list of potentially feasible water management strategies, potential water management strategies will be identified to meet needs for all WUGs and WWPs with identified needs. If no potentially feasible strategy can be identified for a WUG or WWP with a need, the reason for this will be documented in the Technical Memorandum, IPP and Final Plan.
- 8) The list of potentially feasible water management strategies will be included in the Technical Memorandum, IPP, and Final Plan.
- 9) After TWDB approval of the scope of work for water management strategy evaluations, additional water management strategies may be considered and approved for inclusion in the 2026 Plan at WUG sponsor request and expense. These strategies will be brought to the Coastal Bend RWPG for consideration as potentially feasible WMSs and if approved will be included in the Initially Prepared Plan and Final Plan.

¹ Pursuant to Texas Administrative Code Title 31 Part 10 Chapter 357.5(e)(4) of the Regional Water Planning Guidelines which states: "Before a regional water planning group begins the process of identifying potentially feasible water management strategies, it shall document the process by which it will list all possible water management strategies and identify the water management strategies that are potentially feasible for meeting a need in the region."

Figure 5A.1.
**Region N-Adopted Process for Identification of Potentially Feasible Water Management
Strategies for Development of the 2026 Coastal Bend Regional Water Plan**

Table 5A.1.
Potentially Feasible Water Management Strategies Selected by the CBRWPG for
Evaluation in the 2026 Plan

5B.1	Municipal Water Conservation
5B.2	Manufacturing Water Conservation
5B.3	Mining Water Conservation
5B.4	Reuse
5B.5	Aquifer Storage and Recovery
5B.6	Seawater Desalination
5B.7	Brackish Groundwater Desalination
5B.8	Local Balancing Storage Reservoir
5B.9	Groundwater Supplies- Rural and Non-Municipal Water Systems
5B.10	Regional Water Supply Management and Treatment Facilities
5B.11	Nueces River Diversion to Choke Canyon Reservoir
5B.12	Lake Corpus Christi Sediment Removal

Section 5B Water Management Strategy Evaluations and Recommended Water Management Strategies

Table 5B.1 summarizes strategies that were selected for inclusion as recommended or alternative strategies in the plan for WWPs in the Coastal Bend Region and Table 5B.2 shows potential strategies for other local service areas. Each water management strategy category identified in Table 5A.1 has included projects evaluated in accordance with regional water planning guidance and included in Sections 5B.1 through 5B.12. The regional water plan does not include any retail distribution-level infrastructure or associated costs, except those associated with municipal water conservation-related strategies such as pipeline and meter replacement programs (Section 5B.1). Strategies related to water treatment plant improvements (Section 5B.10) rely on development of new raw water supplies to fully deliver at treated capacity. Without new raw water supplies, the treated water available with these strategies declines as existing raw water supplies become utilized by industrial customers to meet growing water demands. There are no Coastal Bend Region strategies that mutually exclude another recommended strategy.

Several water management strategies could potentially provide flood mitigation benefits, which include: 5B.8 Local Balancing Storage Reservoir project to firm up run-of-river supplies for possible co-location with Nueces County Drainage District No. 2 flood detention basins; 5B.11 Nueces River Diversion to Choke Canyon Reservoir, and 5B.12 Lake Corpus Christi Sediment Removal. The latter two projects were identified in the Nueces Basin (Region 13) Regional Flood Plan as flood mitigation strategies (FMSs).



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Table 5B.1.
Potential Water Management Strategies to Meet Long-Term Needs for Wholesale Water Providers

WMS ID	Water Management Strategy	Additional Water Supply (ac-ft/yr)	Total Project Cost (\$)	Annual Cost (\$)	Unit Cost of Additional Treated Water (\$ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5B.1	Municipal Water Conservation	up to 18,108	Variable, Regional Cost up to \$891,455,536	Variable	\$577-\$583	No change	Possible reduction in return flows to bay and estuary
5B.2	Manufacturing Water Conservation	up to 17,689	Highly variable	Highly variable	Variable	Variable. Depends on BMP. Low to significant improvement.	Possible reduction in return flows to bay and estuary
5B.4	Reuse						
	Petronila Regional WWTP Reuse	1,120	\$13,228,000	\$1,554,000	\$1,388	Improves quality	Potential reduction of freshwater inflows to bay and estuary; construction and maintenance of pipeline corridors
	Corpus Christi Greenwood WWTP Direct Potable Reuse	5,381	\$78,008,000	\$12,323,000	\$2,290	Improves quality	Reduction of freshwater inflows to intermittent, local streams. Possible reduction in return flows to bay and estuary; construction and maintenance of pipeline corridors
	Oso Regional WWTP Reuse	11,209	\$614,038,000	\$53,871,000	\$4,806	Improves quality	Reduction in return flows to bay and estuary; construction and maintenance of pipeline corridors
5B.5	City of Corpus Christi Aquifer Storage and Recovery						
	Non-Potable Phase 1 and 2	20,178	\$196,981,000 to \$237,314,000	\$18,731,000 to \$22,280,000	\$928 to \$1,104	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
	ASR with IPR	8,070	\$204,207,000	\$24,231,000	\$3,003	Improves effluent and groundwater quality	Possible reduction in return flows to bay and estuary
5B.6	Seawater Desalination						
	City of Corpus Christi- Inner Harbor (30 MGD)	33,604	\$1,233,812,000	\$127,217,000	\$3,786	Variable. Low to significant improvement.	Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands. NRA Basin Highlights report has identified constituents of concern for Corpus Christi and Nueces Bay to consider during treatment based on end-user goal.
	City of Corpus Christi- La Quinta (40 MGD)	44,806	\$1,141,000,000	\$155,000,000	\$3,460	Variable. Low to significant improvement.	
	City of Corpus Christi Barney Davis Desalination (20 MGD)	33,627	\$582,000,000	\$83,000,000	\$3,705	Variable. Low to significant improvement.	Threatened and endangered species habitat identified near project site.
	Port of Corpus Christi Authority- Harbor Island (100 MGD)	112,014	\$3,456,000,000	\$405,000,000	\$3,616	Variable. Low to significant improvement.	Threatened and endangered species habitat identified near project site.
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	33,627	\$844,000,000	\$116,000,000	\$3,452	Variable. Low to significant improvement.	
5B.7	Brackish Groundwater Desalination						
	Evangeline Laguna Treated Groundwater	25,637	\$486,499,000	\$104,738,000	\$4,085	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Driscoll Brackish Groundwater Treatment Project	1,513	\$36,289,885	\$4,353,679	\$2,878	Significant improvement	Construction and maintenance of pipeline corridors. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
	Nueces River Brackish Wells Reverse Osmosis Facility	12,331	\$268,029,000	\$38,859,000	\$3,151	Significant improvement	Construction and maintenance of pipeline corridors and wellfield.



WMS ID	Water Management Strategy	Additional Water Supply (ac-ft/yr)	Total Project Cost (\$)	Annual Cost (\$)	Unit Cost of Additional Treated Water (\$ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
	EV Ranch Brackish Groundwater Desalination	32,000	\$1,102,285,000	\$142,655,000	\$4,458	Significant improvement	Construction and maintenance of pipeline corridors and wellfield. Disposal of concentrated brine created from process may impact sensitive species.
5B.8	Local Balancing Storage	3,827	\$26,014,000	\$2,035,000	\$904	No Change	Construction and maintenance of pipeline corridors and terminal storage
5B.9	Groundwater Supplies - Rural and Non-Municipal Water Systems						
	Ricardo Well Project	560	\$10,977,100	\$1,183,941	\$2,114	No to low degradation	Minor Impacts
	Regional Water Supply Management and Treatment Facilities						
	ON Stevens WTP Improvements	25,637	\$82,753,000	\$7,502,000	\$665	No Change	None
	Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability	25,637	\$1,236,419,000	\$112,506,000	\$4,760	No Change	None
5B.10	SPMWD Project No. 1 - New WTP (20 MGD) at Plant D	22,418	\$69,048,000	\$18,349,000	\$819	No Change	None
	SPMWD Project No. 2 - New Intake, PS and Raw Transmission on Nueces	69,495	\$223,595,000	\$44,271,000	\$637	No Change	None
	SPMWD Project No. 3 - New PS at MR & Transmission Rehab	33,627	\$40,249,000	\$16,204,000	\$482	No Change	None
5B.11	Nueces River Diversion to Choke Canyon Reservoir	2,939	\$417,731,000	\$35,037,000	\$11,923	No to low degradation	Possible reduction in return flows to bay and estuary
5B.12	Lake Corpus Christi Sediment Removal	2,000	\$2,672,649,000	\$228,009,000	\$114,005	No to low degradation	Temporary degradation to wildlife habitat and wetlands.

*Note: This project does not produce a supply yield, but rather increases infrastructure capacity for the transmission system and WTP. The source of the supply is the Evangeline Laguna Treated Groundwater (5B.7).

Table 5B.2.
Potential Water Management Strategies to Meet Long-Term Needs for
Local Service Areas

WMS ID	Water Management Strategy	Water Supply (ac-ft/yr)	Total Project Cost (\$)	Annual Cost (\$)	Unit Cost of Treated Water (\$ per ac-ft/yr)	Degree of Water Quality Improvement	Environmental Issues/Special Concerns
5B.1	Municipal Water Conservation	up to 18,108	Variable, Regional Cost up to \$891,455,536	Variable	\$577-\$583	No change	Possible reduction in return flows to bay and estuary
5B.2	Manufacturing Water Conservation	up to 17,689	Highly variable	Highly variable	Variable	Variable. Depends on BMP. Low to significant improvement.	Possible reduction in return flows to bay and estuary
5B.3	Mining Water Conservation	up to 882	Highly variable	Highly variable	Variable	No change	Possible reduction in return flows to bay and estuary
5B.7	Brackish Groundwater Desalination						
	City of Beeville	4,204	\$100,904,000	\$16,342,000	\$3,887	Variable. Low to significant improvement.	Possible reduction in return flows to bay and estuary. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5B.9	Groundwater Supplies - Rural and Non-Municipal Water Systems						
	Bee County-Other (Municipal)	1,426	\$5,421,000	\$567,000	\$398	No to low degradation	Minor Impacts
	Bee County-Mining	25	\$1,024,000	\$80,000	\$3,200	No to low degradation	Minor Impacts
	Skidmore WSC	44	\$1,067,000	\$101,000	\$2,295	No to low degradation	Minor Impacts
	TDCJ Chase Field	5	\$1,067,000	\$100,000	\$20,000	No to low degradation	Minor Impacts
	Brooks County-Other (Municipal)	281	\$1,089,000	\$127,000	\$452	No to low degradation	Minor Impacts
	Duval County-Other (Municipal)	253	\$1,496,000	\$158,000	\$625	No to low degradation	Minor Impacts
	San Diego MUD 1	131	\$817,000	\$92,000	\$702	No to low degradation	Minor Impacts
	Jim Wells County- Other (Municipal)	1,621	\$8,763,000	\$846,000	\$522	No to low degradation	Minor Impacts
	Jim Wells County- Manufacturing	25	\$747,000	\$75,000	\$3,000	No to low degradation	Minor Impacts
	Live Oak County- Other (Municipal)	202	\$1,317,000	\$139,000	\$688	No to low degradation	Minor Impacts
	Nueces County-Mining	101	\$752,000	\$60,000	\$594	No to low degradation	Minor Impacts
	City of Mathis	560	\$2,177,000	\$238,000	\$425	No to low degradation	Minor Impacts



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All strategies are compared with respect to four areas of interest: 1) additional water supply; 2) unit cost of treated water; 3) degree of water quality improvement; and 4) environmental issues and special concerns. A graphical comparison of how each significant strategy compares to the others with respect to unit cost and water supply quantity is shown in Figure 5B.1. A detailed analysis of each strategy is included in Section 5B (refer to Sections 5B.1 through 5B.12). In these detailed descriptions, each strategy was evaluated with respect to 11 impact categories, as required by TWDB rules. These categories are shown in Table 5B.3. An evaluation summary is included at the end of each water management strategy description, which summarizes how each strategy relates to the 11 impact categories.

Each strategy includes a separate environmental issues discussion, which describes environmental factors, including impacts to agricultural resources. In the evaluation summaries, some impacts are qualitatively discussed. According to TAC Chapter 357.34(e)(3), quantitative reporting is required for quantity (yield), cost, environmental factors, and impacts to agricultural resources. Table 5B.4 and Table 5B.5 include the keys to the environmental issues and impacts to agricultural resources descriptors, respectively, presented in the evaluation summaries.

Recommended plans to meet the specific needs of the cities and other WUGs during the planning period (2030 through 2080) are presented in the following sections. The plans are organized by county and WUG in the following sections (Sections 5B.2 to 5B.13). Annual and unit costs are shown for each water management strategy and decline after debt service is paid, which generally occurs after 20 years. A new balance is shown in each water supply plan calculated after recommended water management strategy yields have been applied to shortages. Water supply plans for WUGs and major water providers (MWP) frequently include multiple recommended water management strategies that when totaled, sum up to more than the volume needed to meet a water supply shortage. This additional supply accounts for uncertainties in population projections, future demands, climate variability, yield of recommended water management strategies, permitting challenges, and other uncertainties. The TWDB calculates management supply factors for each decade by WUG. Using this information, management supply factors were summarized for MWP and are presented in Table 5B.6.

According to the TWDB, regional planning is a reconnaissance-level effort and a detailed investigation of project impacts is beyond the scope and mandate of this effort. The impacts, costs, and benefit of large-scale projects such as reservoirs or major diversions would, if implemented, undergo additional and extensive evaluation during permitting under Section 404 of the Clean Water Act, the National Environmental Policy Act, and any other applicable federal, state, or local regulations.

Water conservation is recommended based on per capita rates, described below in Section 5C. Drought management is not a recommended water management strategy to meet projected water needs in the Coastal Bend Region, in part because it cannot be demonstrated to be an economically feasible strategy. However, a safe yield reserve of 75,000 acre-feet (ac-ft) is included as a drought management measure when evaluating regional surface water supplies from the Choke Canyon Reservoir/Lake Corpus Christi System/Texana/Mary Rhodes Pipeline (CCR/LCC/Texana/MRP Phase II) System, as discussed in Chapter 7.

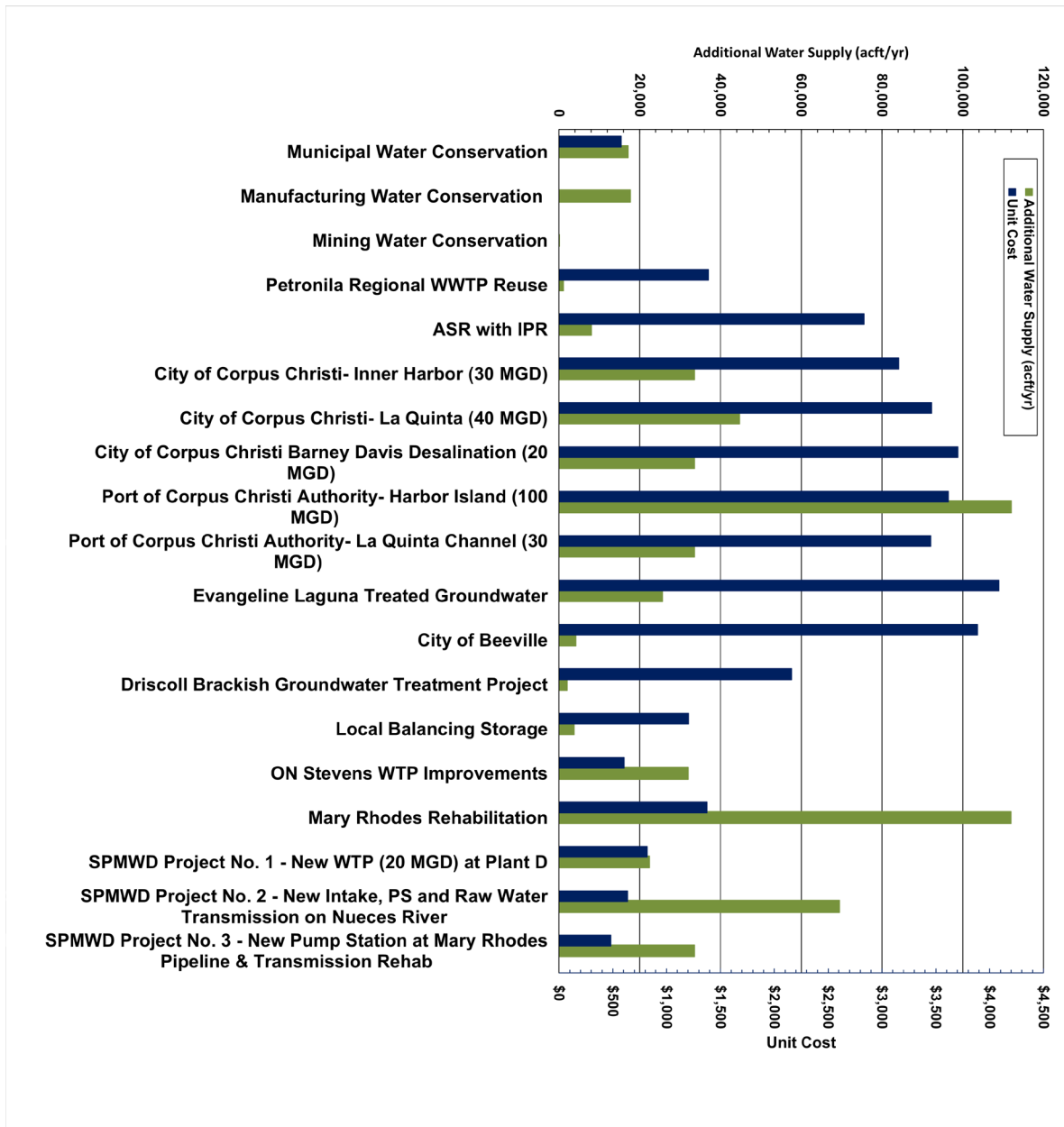


Figure 5B.1.
Unit Cost and Water Supply Comparison for Selected Water Management Strategies

Table 5B.3.
Summary of Impact Categories for Evaluation of Water Management Strategies

a. Water Supply
1. Quantity
2. Reliability
3. Cost of Treated Water
b. Environmental factors
1. Instream flows
2. Bay and Estuary Inflows and arms of the Gulf of Mexico
3. Wildlife Habitat
4. Wetlands
5. Threatened and Endangered Species
6. Cultural Resources
7. Water Quality (Key Parameters Identified by Region N)
a. dissolved solids
b. salinity
c. bacteria
d. chlorides
e. bromide
f. sulfate
g. uranium
h. arsenic
i. other water quality constituents
c. Impacts to agricultural resources and State water resources
d. Threats to agriculture and natural resources in region
e. Recreational impacts
f. Equitable comparison of strategies
g. Interbasin transfers
h. Third party social and economic impacts from voluntary redistribution of water
i. Efficient use of existing water supplies and regional opportunities
j. Effect on navigation
k. Impacts on water pipelines and other facilities currently used for water conveyance

Table 5B.4.
Impacts to Environmental Factors Key

Impacts to Environmental Factors Key	Criteria
None or Low; Negligible	Reduction in environmental flows with implementation of the strategy is indiscernible (less than 1%) using the approved surface water availability model, as compared to instream, Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Wildlife habitat is not expected to be altered by the project. Wetlands are not expected to be altered (less than 1% alteration) with project implementation. Threatened and endangered species habitat are not expected to be altered (less than 1% alteration) with project implementation. Cultural resources are not expected to be altered with project implementation. .
Moderate; Some	Reduction in environmental flows with implementation of the strategy is expected to range from 1% to 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Due to the nature of the strategy, localized impacts to small creeks or on-site tanks may be noticed (up to 10%). Wildlife habitat may be temporarily impacted during project construction (less than 10% area), but long-term impacts to wildlife habitat are not expected. Wetlands may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Threatened and endangered species habitat may be temporarily impacted during construction (less than 10% area) but long-term impacts with project implementation are not expected. Cultural resources are not expected to be altered with project implementation.
High	Reduction in environmental flows with implementation of the strategy is expected to exceed 10% using the approved surface water availability model, as compared to instream and Bay and Estuary flows and arms of the Gulf of Mexico flows without the project. Long-term wildlife habitat alteration (of 10% or greater) is highly likely with project. Permanent wetlands (of 20% or more current wetland area) is highly likely with project implementation. Threatened and endangered species habitat is highly likely (20% or more of habitat area) with project implementation. Cultural resources are highly likely to be altered with project implementation. .

Table 5B.5.
Impacts to Agricultural Resources Key

Impacts to Agricultural Resources Key	Criteria
None or Low; Negligible	Temporary impacts to agricultural land during project construction. Occasional disturbances due to maintenance on right of way for pipelines. Less than 5 irrigated acres permanently affected due to repurposing of land to support the project.
Moderate; Some	Loss of up to 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).
High	Loss of more than 50 irrigated acres permanently due to repurposing of land to support the project (i.e. impoundment).

Table 5B.6.
Region N Major Water Providers Management Supply Factor

Major Water Provider	MWP Management Supply Factor					
	2030	2040	2050	2060	2070	2080
City of Alice	1.1	1.2	1.2	1.2	1.2	1.2
City of Corpus Christi	1.1	1.6	1.7	1.7	1.7	1.7
San Patricio Municipal Water District	1.3	3.9	3.8	3.8	3.8	3.8
South Texas Water Authority	1.0	1.0	1.0	1.0	1.0	1.0

The TWDB socioeconomic impact analysis of water needs in Coastal Bend Region will be conducted by the TWDB between the Initially Prepared Plan and Final Plan.

Future projects involving authorization from either the TCEQ and/or TWDB that are not specifically addressed in the plan are considered to be consistent with the plan under the following circumstances:

1. TWDB receives applications for financial assistance for many types of water supply projects, including water conservation, and when appropriate, wastewater reuse strategies. Other projects involve repairing, replacing, or expanding treatment plants, pump stations, pipelines and water storage facilities. The regional water planning group considers projects that do not involve the development of or connection to a new water source to be consistent with the regional water plan even though not specifically recommended in the plan.
2. TCEQ considers water rights applications for various types of uses (e.g., recreation, navigation, irrigation, hydroelectric power, industrial, recharge, municipal and others). Many of these applications are for small amounts of water, some are temporary, and some are even non-consumptive. Because waters of the Nueces River Basin are fully appropriated to the City of Corpus Christi and others, any new water rights application for consumptive water use from this Basin will need to protect the existing water rights or provide appropriate mitigation to existing water right owners. Throughout the Coastal Bend Region, the types of small projects that may arise are so unpredictable that the regional water planning group is of the opinion that each project should be considered by the TWDB and Texas Commission on Environmental Quality (TCEQ) on their merits, and that the Legislature foresaw this situation and provided appropriate language for each agency to deal with it.

(Note: The provision related to TCEQ is found in Texas Water Code §11.134. It provides that the Commission shall grant an application to appropriate surface water, including amendments, only if the proposed appropriator addresses a water supply need in a manner consistent with an approved regional water plan. TCEQ may waive this requirement if conditions warrant. For TWDB funding, Texas Water Code §16.053(j) states that after January 5, 2002, TWDB may provide financial assistance to a water supply project only after the Board determines that the needs to be addressed by the project will be addressed in a manner that is consistent with that appropriate regional water plan. The TWDB may waive this provision if conditions warrant.)



5B.1

*Municipal Water
Conservation*

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Section 5B.1 Municipal Water Conservation

5B.1.1 Description of Strategy

Water conservation is typically a low-capital intensive alternative that water supply entities can pursue to extend the life of current water supplies and can even defer development of new water supplies. Water conservation refers to those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply or use facilities so that existing supply is conserved and made available for future use. Water supply entities and major water right holders are required by Senate Bill 1 regulations to submit a Water Conservation Plan to the TCEQ for approval. These plans must be updated every five years and detail the water supply entities' plans to reduce water demand, including 5-year and 10-year goals. Reference Chapter 5C.1 – Conservation Recommendations for additional information regarding the current list of water utilities/entities in Region N that have submitted their Water Conservation Plans to TCEQ and provided copies to TWDB.

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily used for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter of municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The primary objective of water conservation is to decrease the amount of water, which is measured in gallons per person per day (gpcd), a typical person uses on a daily basis.

Regional Water Planning Groups have been required to consider water conservation and drought management measures for each water user group with a need (projected water shortage) since the Texas Legislature amended the Texas Water Code in 2001. Subsequently, the Water Conservation Implementation Task Force (Task Force) was created by Senate Bill 1094 to identify and describe Water Conservation Best Management Practices (BMPs) and provide a BMP Guide¹ that has been used by Regional Water Planning groups for development of the Regional Water Plans from 2006 to present. The Task Force recommended that a standardized methodology be used for determining municipal water use based on gallons per capita per day (gpcd) to allow consistent evaluations of effectiveness of water conservation measures adopted among Texas cities located in the various climates and regions of Texas.

Municipal WUGs with per capita rates exceeding 140 gallons per person per day (gpcd) are recommended to voluntarily reduce per capita consumption by 1 percent annually through 2080 until a 140 gpcd rate is attained. This recommendation from the CBRWPG applies to all municipal WUGs with and without projected water supply needs (or shortage). Although the CBRWPG considered the recommendations of the Water Conservation Advisory Council

¹ Texas Water Development Board, Water Conservation Implementation Task Force, Water Conservation Best Management Practices Guide, November 2004.

http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R362_BMPGuide.pdf?d=1581280795628

(WCAC) report to the 88th Texas Legislature²; however, the WCAC methodology of calculating the estimated dry-year planning gpcd resulted in a projected gpcd reduction in the later planning decades that might not be realistic for some of the municipal WUGs.

Since the last planning cycle, TWDB has continued the work of the Task Force and WCAC by updating the previous resources for municipal water users to assist water utilities with water conservation, including:

- Water Conservation Best Management Practice Guides
 - [Municipal Users, February 2020](#)
 - [Wholesale Water Providers, October 2017](#)
- Water Conservation Plan Guidance for Utilities, developed in September 2020
 - [Water Conservation Plan Checklist](#)
 - [What is a Water Conservation Plan](#)
 - [Identifying Water Conservation Targets and Goals](#)

TWDB provided additional tools for Regional Water Planning Groups to consider during the development of the municipal water conservation recommendations for the 2026 Regional Water Plans. The following TWDB resources were considered during the development of the 2026 Region N Regional Water Plan:

- [Conservation Resource Guide for the Development of the 2026 Regional Water Plan](#)
- [Uniform Costing Model and Drought Management Costing Tool](#)
- [Hidden Reservoirs: Addressing Water Loss in Texas, National Wildlife Federation Report, 2022.](#)
 - Report provides an in-depth analysis of water loss in Texas and concludes that utilities are losing approximately 572,000 ac-ft of water per year.
- [Interregional Planning Council Report \(2024\) to TWDB.](#)
 - Report recommends decreasing water loss for utilities through improving infrastructure and water resources management.
- [Municipal Water Conservation Planning Tool](#)
 - The Municipal Water Conservation Planning Tool was developed by the TWDB to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs and produces the expected annual conservation savings and associated capital and annual costs.

² Progress Made in Water Conservation in Texas: Report and Recommendations to the 88th Texas Legislature, Water Conservation Advisory Council, December 2022.

Per capita water use for 2026 Regional Water Planning purposes was based on population and water demand projections provided and approved by the TWDB for each municipal WUG in Region N; the water demand projections incorporated water efficiency savings for each decade from 2030 to 2080). The TWDB provided this information for WUGs based on county, so in some instances one WUG is represented multiple times (i.e., Aransas Pass has two entries for portions located in Aransas and San Patricio Counties). For consistency, Chapter 5B.1 presents information in this way for each WUG and county combination for a total of 55 municipal WUG entries rather than the 52 WUGs reported for Region N, including 41 discrete WUGs (i.e., Aransas Pass located in multiple counties counted as one) and 11 County-Other.

The base year per capita water use³ (primarily from 2020) was used as a basis for projected per capita water use in decades from 2030 to 2080 that might be expected with implementation of low flow plumbing fixtures. For WUGs with per capita rates lower than 60 gpcd, the TWDB applied a minimum of 60 gpcd in the draft water demand projections and no water efficiency savings were applied to them both in the 2022 State Water Plan and the 2026 draft demand projections. Per capita water use is shown for 55 municipal entities located in the Coastal Bend Region in Table 5B.1.1

Table 5B.1.1.
Municipal Water User Groups Projected Per Capita Water Use
(Based on approved Region N—TWDB Population & Water Demand Projections)

No.	County	Water User	Base Year 2020 gpcd	2030	2040	2050	2060	2070	2080
1	Jim Wells	Jim Wells FWSD 1	60	60	60	60	60	60	60
2	Jim Wells	Premont	218	213	213	213	213	213	213
3	San Patricio	Ingleside	95	90	90	90	90	90	90
4	Bee	Pettus MUD	132	129	127	127	128	128	127
5	Nueces	Bishop	155	150	150	150	150	150	150
6	Nueces	Violet WSC	79	74	73	74	73	74	73
7	San Patricio	Portland	148	144	143	143	143	143	143
8	Nueces	Driscoll	116	111	111	111	111	111	112
9	San Patricio	Rincon WSC	90	86	85	85	85	85	85
10	Nueces	River Acres WSC	144	139	139	139	139	139	139
11	Kleberg	Kingsville	131	126	126	126	126	126	126
12	Kleberg	Ricardo WSC	108	104	103	103	103	103	103
13	Aransas	County-Other	100	94	94	94	94	94	94
14	Aransas	Aransas Pass	128	123	123	123	123	123	123
15	Duval	Duval County CRD	126	121	121	121	121	121	121
16	Live Oak	County-Other	111	106	106	106	106	106	106
17	San Patricio	Gregory	151	147	146	146	146	146	146
18	Live Oak	McCoy WSC	111	101	106	108	103	89	112
19	Duval	County-Other	114	109	108	108	108	108	108

³ Based on water user surveys provided voluntarily by water provider to the TWDB.

No.	County	Water User	Base Year 2020 gpcd	2030	2040	2050	2060	2070	2080
20	Brooks	County-Other	114	109	109	109	108	109	109
21	McMullen	County-Other	119	115	114	113	113	114	114
22	Nueces	County-Other	118	112	112	112	112	112	112
23	Duval	San Diego MUD 1	166	162	161	161	161	161	161
24	San Patricio	Mathis	114	110	109	109	109	109	109
25	Aransas	Rockport	162	157	157	157	157	157	157
26	Bee	County-Other	125	120	120	120	120	120	120
27	Jim Wells	San Diego MUD 1	166	161	161	161	160	161	160
28	Jim Wells	County-Other	128	123	123	123	123	123	123
29	San Patricio	County-Other	128	123	123	123	123	123	123
30	San Patricio	Odem	134	129	129	129	129	129	129
31	Kleberg	Baffin Bay WSC	147	143	142	141	142	142	142
32	Duval	Freer WCID	203	198	198	198	198	198	198
33	Nueces	Corpus Christi	173	168	168	168	168	168	168
34	Live Oak	Old Marbach School WSC ¹	136	131	131	131	131	130	131
35	Bee	Skidmore WSC ¹	146	142	141	140	141	141	141
36	Bee	Beeville	194	189	189	189	189	189	189
37	Jim Wells	Alice	179	174	173	174	174	174	174
38	Kleberg	County-Other	151	146	145	145	145	145	145
39	Nueces	Nueces WSC	151	147	147	147	147	147	147
40	Live Oak	George West	164	159	158	158	159	158	158
41	San Patricio	Aransas Pass	128	123	123	123	123	123	123
42	San Patricio	Taft	129	124	124	124	124	124	124
43	San Patricio	Sinton	209	204	204	204	204	204	204
44	Jim Wells	Orange Grove	232	227	226	226	226	226	226
45	Kleberg	Riviera Water System	142	138	137	137	137	137	137
46	Nueces	Nueces Co. WCID 3	264	260	259	259	259	259	259
47	Live Oak	El Oso WSC	183	178	178	178	178	178	178
48	Brooks	Falfurrias	244	240	239	239	239	239	239
49	Live Oak	Three Rivers	156	151	150	150	150	150	151
50	Bee	El Oso WSC	183	178	178	178	178	178	178
51	Bee	TDCJ Chase Field	268	265	264	264	264	264	264
52	Nueces	Nueces Co. WCID 4	455	450	449	449	449	449	449
53	Kenedy	County-Other	471	465	467	467	467	466	466
54	Nueces	Corpus Christi Naval Air Station	1371	1364	1362	1361	1362	1362	1361
55	Kleberg	Naval Air Station Kingsville	4306	4285	4276	4267	4274	4265	4268

¹ Base year per capita water use is from 2018.

The purpose of a municipal water conservation WMS is to evaluate the potential of additional municipal water conservation beyond low flow plumbing code for inclusion in the Regional Water Plan to meet a part of the projected water needs (shortages) as required by 31 TAC Chapter 357.22.

The City of Corpus Christi, the largest water user in the Coastal Bend Region, has demonstrated significant water savings attributable to conservation efforts over the past decades. The City's municipal water use was nearly 220 gpcd in 1990⁴ and was reduced to 173 gpcd by 2020 (Table 5B.1.1).

During development of this plan, the CBRWPG gathered and reviewed water conservation plans submitted to the Nueces River Authority and TCEQ by municipal WUGs (and some smaller utilities included in County-Other) in the 11-county Region N. The water conservation plans for Region N municipal WUGs are summarized in Table 5B.1.2 and include 4 wholesale water providers (City of Corpus Christi, SPMWD, STWA, and Nueces County WCID 3) and 20 municipal water user groups. The purpose of reviewing these plans was to gather information regarding preferred voluntary water conservation BMPs in the Coastal Bend Region and success of the ongoing programs originally identified by the CBRWPG in 2009.⁵ Additionally, information on goals that water user groups in the region have in the next five and ten years was gathered from the water conservation plans. Based on the most current plans on record from 2011 to 2024, local water conservation programs in the Coastal Bend Region have utilized leak detection, water conservation pricing measures, reuse, meter replacement programs, retrofit programs, public education, xeriscaping and other BMPs as shown in Table 5B.1.2 to reduce water use.

The 5-year and 10-year goals identified in the water conservation plans for Region N municipal WUGS are shown in Table 5B.1.3. Some user groups want to maintain their current per capita use, some have identified 1 percent, 2.5 percent, 3 percent or 5 percent reductions over various time periods, and one WUG plans to have a gpcd 10 percent below the state average. This information was used by the Coastal Bend Regional Water Planning Group to develop municipal water conservation goals and prepare a list of most-practical BMPs for voluntary implementation in the region. Additional details on the impact of municipal water conservation BMPs that were implemented based on information provided to the TWDB by the Cities of Alice, Aransas Pass, Beeville, Corpus Christi, Kingsville, Portland, Rockport, Three Rivers, Nueces County WCID 3, Nueces County WCID 4, and River Acres WSC are included in Chapter 5C discussion summarizing Region N conservation recommendations (Table 5C.1.4. through 5C.1.6).

⁴ City of Corpus Christi Water Conservation Plan, 1999.

⁵ Coastal Bend Regional Water Planning Group, 2011 Regional Water Plan, Study 1 – Region-Specific Water Conservation Best Management Practices (BMPs), April 2009.

Public information and education can work to conserve water by informing water users of ways to manage and operate existing and new fixtures and appliances so that less water is used. This includes ideas and practices such as washing full loads of clothes and dishes; using a pail of water instead of a flowing hose to wash automobiles; turning the water off while brushing one's teeth, washing one's hands, or shaving; and watering lawns, gardens, and shrubs during the evening hours as opposed to daytime.

The Coastal Bend Regional Water Planning Group recommends that water user groups, with and without shortages, above 140 gallons per capita per day (gpcd) reduce consumption by one percent each year until a target per capita rate of 140 gpcd is met and then hold the 140 gpcd rate constant through the remaining planning period. For entities with projected water use equal or less than 140 gpcd in 2030, TWDB projections are recommended. All water user groups in the region are encouraged to voluntarily conserve water.

In 2030, 27 municipal water users in the Coastal Bend Water Planning Region have per capita water use of less than or equal to 140 gpcd. Water users with 140 gpcd or less represent 25 percent of the population of the Region in 2030 and use approximately 17 percent of the total municipal water in the Region (reference Table 5B.1.2). In 2030, 28 municipal water users have per capita water use greater than 140 gpcd. This group represents 75 percent of the region's population in 2030 and accounts for approximately 83 percent of the municipal water used in the Region (reference Table 5B.1.2).

Table 5B.1.2.
Municipal Water User Groups Number, Population, and Water Use by Per Capita Water Use Levels Coastal Bend Water Planning Region

Per Capita Water Use in 2030 (gpcd)	Number of WUGs	Percent of WUGs	Population		Water Use	
			Year 2030	Percent of Total	2030 (ac-ft)	Percent of Total
140 and less	27	49.1%	145,942	24.6%	18,746	17.4%
Greater than 140	28	50.9%	447,245	75.4%	89,071	82.6%
Total	55	100.0%	593,187	100.0%	107,817	100%

5B.1.2 Available Yield

All municipal entities in the Coastal Bend Region are encouraged to conserve water, regardless of per capita consumption. Of the 55 municipal entities in Region N, 28 had per capita water use rates equal to or higher than 140 gpcd, the goal established by the CBRWPG. The CBRWPG recommends a one percent reduction per year in water use for those municipal entities with per capita use greater than 140 gpcd until a target goal of 140 gpcd is reached. This conservation goal was approved by the CBRWPG during their Region N meeting on January 30, 2025, and water loss reduction can be achieved in a variety of ways, including using these BMPs identified by the TWDB⁶:

⁶ <https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp>

1. Utility Water Audit and Water Loss (updated 2020),
2. Water Conservation Pricing,
3. Prohibition on Wasting Water,
4. Conservation Ordinance Planning and Development,
5. Showerhead, Aerator, and Toilet Flapper Retrofit,
6. Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,
7. Residential Clothes Washer Incentive Program,
8. School Education,
9. Water Survey for Single-Family and Multi-Family Customers,
10. Landscape Irrigation Conservation and Incentives,
11. Water-Wise Landscape Design and Conversion Programs,
12. Athletic Field Conservation,
13. Golf Course Conservation,
14. Metering of all New Connections and Retrofitting of Existing Connections,
15. Wholesale Agency Assistance Programs,
16. Conservation Coordinator (updated 2019),
17. Water Reuse⁷,
18. Public Information,
19. Rainwater Harvesting and Condensate Reuse⁸,
20. New Construction Greywater,
21. Park Conservation,
22. Conservation Programs for Industrial, Commercial, and Institutional Accounts,
23. Residential Landscape Irrigation Evaluation,
24. Outdoor Watering Schedule (adopted 2019),
25. Custom Characterization (adopted 2019),
26. Public Outreach and Education (adopted 2019),
27. Partnerships with Nonprofit Organizations,
28. Custom Conservation Rebates (adopted 2019),
29. Plumbing Assistance for Economically Disadvantaged Customers (adopted 2019)
30. Cost Effectiveness Analysis,
31. Enforcement of Irrigation Standards (adopted 2020)

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5B.1.3. Also, the TWDB BMP categories adopted by the Region N municipalities in 2022 are presented in Figure 5B.1.1; Landscaping and Public Education/Awareness are the two most popular water loss reduction categories implemented and comprise approximately 56 percent of the total.

⁷ Water Reuse to read “It is assumed that any savings associated with reuse is a small contribution to the savings identified on Table 5B.1.4 and does not duplicate reuse projects identified in Section 5B.5.

⁸ While the municipal conservation best practices guide includes rainwater harvesting and reuse, for regional water planning purposes these practices are considered separate sources and not classified as ‘conservation’.

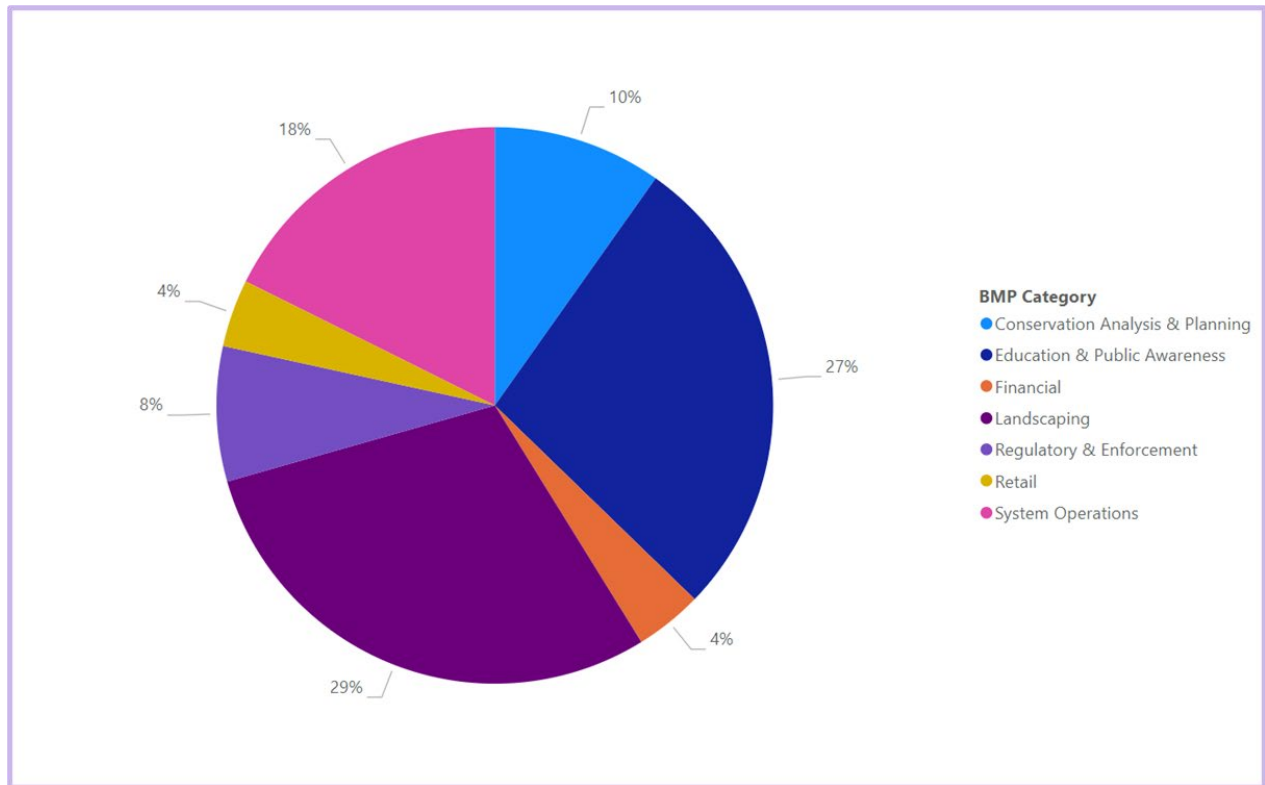


Figure 5B.1.1.
TWDB BMP Category Summary (2022) – Region N Municipalities

Costs and savings presented are general and often sparse, based on a range of variables affecting implementation and level of success. For this reason and others, specific municipal water conservation BMPs are not assigned to municipal entities to provide flexibility for entities to identify practical conservation strategies that fit their individual situation the best.

Water loss mitigation methods (i.e., pipeline and meter replacement, plumbing retrofits) are discussed below to assist municipal entities achieve water conservation savings.

Table 5B.1.3.
Costs and Savings of Possible Municipal Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Water Conservation Pricing/Seasonal or Inverted Block Rates	1	3	2	%	-	-	10	%	Average reduction in water use of 1 to 3% for every 10% increase in the average monthly water bill
2	Metering of All New Connections and Retrofit of Existing Connections	-	-	-	-	-	-	-	-	
3	System Water Audit and Water Loss Control	-	-	-	-	-	-	-	-	
4	Landscape Irrigation Conservation and Incentives	-	-	15	%	-	-	-	-	
5	Athletic Field Conservation	-	-	-	-	-	-	-	-	
6	Golf Course Conservation	15	100	57.5	%	-	-	-	-	Savings and costs highly variable based measures taken - from implementing a CCIS to switching from potable to non-potable water
7	School Education	-	-	-	-	\$1	\$35	\$18	per student	
8	Public Information	-	-	-	-	\$0.50	\$3.00	\$1.75	per customer	
9	Water Reuse	-	100	-	%	-	-	-	-	
10	Prohibitions on Wasting Water	-	-	-	-	-	-	-	-	
11	Residential Toilet Replacement Programs	-	-	10.5	gpcd	\$70	\$100	\$85	per toilet	
12	Showerhead, Aerator, and Toilet Flapper Retrofit	5.5	12.8	9.15	gpd per device	10	50	\$30.00	per customer	5.5 gpd of permanent savings for showerheads and faucet aerators; 12.8 gpd for toilet flapper for 5 years (device life span)
13	Water Wise Landscape Design and Conversion Programs	-	-	-	-	0.05	1	\$0.53	per sq ft	Costs reflect customer rebates - does not include staff labor cost, which ranges between \$50 to \$100 per conversion
14	Custom Conservation Rebates	-	-	-	-	-	-	-	-	

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
15	Plumbing Assistance for Economically Disadvantaged Customers	300	262,080	131,190	gal/yr	-	-	-	-	
16	Rainwater Harvesting and Condensate Reuse	-	-	-	-	-	-	-	-	

Source TWDB: <https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp>

5B.1.2.1 Indoor Water Conservation

During the 2009 Texas Legislature, House Bill (HB) 2667 was enacted to establish new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 also outlines the national standards of the American Society of Mechanical Engineers and American National Standards Institute by which plumbing fixtures are to be produced and tested. Since January 2014, TCEQ has promulgated rules to reflect this change in law that requires all toilets to use no more than 1.28 gallons per flush (20% savings from the 1991 1.6 gallons per flush standard), as shown in Table 5B.1.4.

Table 5B.1.4.
Standards for Plumbing Fixtures

Fixture	Standard
Toilets*	1.28 gallons per flush
Shower Heads	2.75 gallons per minute at 80 psi
Urinals	0.5 gallon per flush
Faucet Aerators	2.20 gallons per minute at 60 psi
Drinking Water Fountains	Shall be self-closing

* House Bill 2667 of the 81st Texas Legislature, 2009

Based upon an average frequency of per-person toilet use of 5.1 and a per-use savings of 0.32 gallons per use, the supplementary savings of adopting high-efficiency toilets is 1.63 gpcd. The water savings potential with the plumbing efficiency program is shown in Table 5B.1.5.

Table 5B.1.5.
Water Conservation Potentials of Low Flow Plumbing Fixtures

Plumbing Fixture	Water Savings (gpcd)
Toilets and Showerheads	16.0
Additional Savings (High Efficiency Toilet)*	1.63
Faucet Aerators – 2.2 gallons per minute	2.0
Urinals – 1.0 gallon per minute	0.3
Drinking Fountains (self-closing)	0.1
Total	20.03 (~20 gpcd)

* TWDB, 2013

The TWDB water demand and per capita projections for the 2026 Region N Water Plan already includes water savings through mandated plumbing fixture replacement programs, and much of the savings reported in Table 5B.1.5 have likely been realized. The target water conservation goals recommended by the Coastal Bend Region for WUGs exceeding 140 gpcd are to be achieved with additional BMPs for the desired water savings above the amount already included in TWDB projections.

5B.1.2.2 Outdoor Water Conservation

In addition to the indoor water conservation measures described above, the water conservation WMS for municipal entities for the Coastal Bend Region includes landscape irrigation and lawn watering. Unlike indoor water conservation, no limit was assumed for the savings potentials associated with outdoor conservation. Instead, outdoor water conservation can be used to meet the projected water savings needed to meet the Region N municipal water goals.

5B.1.2.3 Water Loss Mitigation and Meter Replacement

A municipality can determine unaccounted for water losses by performing a water audit, which includes collecting information that can then be used to calculate unaccounted for water loss using the following equation:

$$\text{Unaccounted for water} = \text{Water production/purchased (gallons)} - \text{Water sales (gallons)}$$

To maximize the benefits of this conservation strategy, the utility uses this audit information to revise meter testing and repairs, reduce unmetered use, improve accuracy of the utility's metering system, and implement effective water loss management strategies. Factors that affect the amount of unaccounted for water include density of the system, age of the system, construction quality of the system, and accuracy of the water metering.

In December 2004, the TWDB adopted rules to require retail public utilities, as defined by Texas Water Code §13.002, to perform a water loss audit and submit water loss audit forms to the TWDB every five years.⁹ Pursuant to TWDB Rules¹⁰ for regional water planning, RWPGs are

⁹ In accordance with Texas Administrative Code §358.6.

¹⁰ In accordance with Texas Administrative Code §357.7(a)(1)(M) and Texas Administrative Code §357.7(a)(7)(a)(iv)

required to include information compiled by the TWDB from water loss audits performed by retail public utilities and consider strategies to address any issues identified in the water loss audit information compiled by the TWDB. The CBRWPG presented this information in Chapter 1.

The TCEQ reports that unaccounted for water losses of 15 percent or less are acceptable for communities greater than 5,000 people. Losses above 15 percent may be an area of concern and provide conservation potentials. Of the 33 entities in the Coastal Bend Region that primarily responded to the 2020-2022 Water Loss Audit (17 from individual municipal entities and 16 from County-Other entities), 13 reported water losses exceeding 15 percent. Based on this information, these utilities may want to consider water loss mitigation activities, such as pipeline replacement programs.¹¹ Pipeline replacement programs are intended to address real losses, that is, those losses primarily associated with breaks, leaks, and unreported losses. Estimated costs for a 10-year pipeline replacement program were prepared for these 13 entities as shown in Table 5B.1.6. Pipeline costs were based on the Unified Costing Model and the following assumptions:

- Entities with less than 32 connections: pipeline costs based on 12" rural, soil environment of \$214 per ft (\$1,129,920 per mile)
- Entities with greater than 32 connections: pipeline costs based on 16" urban, soil environment of \$393 per ft (\$2,075,040 per mile)
- Pipeline replacement of 10 percent each year. Full replacement after 10 years.

For the 2026 Region Water Plan, TWDB uses the American Water Works Association (AWWA) Water Loss Control Committee Report (2020) as an indicator of a utility's performance by evaluating their service connection density (SCD). SCD is calculated by dividing the number of active/inactive retail customer connections by the total length of main lines located within a utility's distribution system. Based on this AWWA Report, retail public utilities are categorized by the following criteria:

- Less dense communities (utilities having less than 32 connections per mile in distribution system) = 57 gallons per connection per day
- More dense communities (utilities having 32 or more connections per mile in distribution system) = 30 gallons per connection per day

Table 5B.1.7 summarizes 10 entities/utilities in Region N that exceed the water loss threshold according to their current water loss audit on file with TWDB. Water loss threshold data has been primarily evaluated by TWDB since July 1, 2023, when a retail public utility requests TWDB funding for a water supply project and may need to mitigate their water loss.

In addition to unaccounted for water losses, public information programs can be an important and key element of water loss mitigation efforts to having water users save water inside homes and commercial structures, in landscaping and lawn watering, and in recreation uses. Public information and education can work in two ways to accomplish water conservation. One way is to

¹¹ Meter retrofits can also achieve water savings, but due to high cost variability based on individual systems this best practice was not explored in detail.

inform and convince water users to obtain and use water-efficient plumbing fixtures and appliances, to adopt low water use landscaping plans and plants, to find and repair plumbing leaks, to use gray water for permissible uses (e.g., lawn and shrubbery watering where regulations allow), and to take advantage of water conservation incentives where available.

The accurate metering of consumed water encourages personal accountability, water conservation and equity in billing rates. Meter replacement programs can be an effective water loss mitigation measure for reducing apparent loss, or water that has been consumed but not properly measured or billed. The 2020-2022 Water Loss Audits (those primarily completed) reported an overall customer meter accuracy of 96.6 percent and apparent loss in the Coastal Bend of 3.4 percent based on responses from 33 entities. Four of the 33 entities in Coastal Bend that responded to the survey reported apparent losses greater than 5 percent. Based on this information, these utilities may want to consider meter replacement programs. Most meters used in residential systems are between 5/8 and 1-inch with ± 1.5 percent accuracy, and the cost averages about \$235 per meter (cost of material only, does not include automatic meter reading)¹². Estimated costs for meter replacement program for entities reporting apparent losses greater than 5 percent are shown in Table 5B.1.8. Summaries of the savings yield (ac-ft/yr) and cost achieved for water loss mitigation strategies (i.e., pipeline and meter replacement) are shown in Table 5B.1.9 and Table 5B.1.10, respectively. After considering demand reductions already incorporated into the TWDB demand projections, a one percent reduction in per capita water use per year for those cities and county-others using greater than 140 gpcd in 2030 results in a water savings (yield) — less water used — of 13,277 ac-ft in 2040 and 17,587 ac-ft in 2080, as seen in Table 5B.1.11. Note: Water savings are only included for 28 of the 55 municipal entities, since 27 of the entities had a water use equal or less than 140 gpcd in 2030.

¹² Seametrics MJN Pulse Water Meter 3/4" \$235/each, internet February 2025.

Table 5B.1.6.
Summary of Estimated Pipeline Replacement Costs for Entities Reporting Losses Greater than 15%

Utility Name & Year of Recent Audit	Retail Pop Served	Main Line Miles	Real Loss/Input Volume*	Total 10 year water savings needed to achieve 5% Real Loss (gallons)	Annual Water Savings Needed to Achieve 5% Real Loss in 10 years (gallons)	Amt of Pipe (miles) replaced annually to achieve 100% in 10 years	Annual Cost	Cost of 10- year Program	Amortized Annual Cost of 10-year Program	Unit Cost (\$ per acft saved)
Aransas Bay Utilities (2015)	600	10	29%	4,880,129	488,013	1	\$2,075,040	\$20,750,400	\$2,752,909	\$1,376,455
Aransas County MUD 1 (2020)	580	15	20%	1,926,434	192,643	2	\$3,112,560	\$31,125,600	\$4,129,364	\$4,129,364
City of Alice (2018)	18,949	100	21%	173,376,449	17,337,645	10	\$20,750,400	\$207,504,000	\$27,529,093	\$519,417
City of Bishop (2020)	3,010	31	43%	67,884,334	6,788,433	3	\$6,432,624	\$64,326,240	\$8,534,019	\$406,382
City of Mathis (2022)	4,150	36	27%	36,328,618	3,632,862	4	\$7,470,144	\$74,701,440	\$9,910,473	\$900,952
City of Sinton (2022)	5,723	60	50%	246,966,279	24,696,628	6	\$12,450,240	\$124,502,400	\$16,517,456	\$217,335
Copano Cove Subdivision (2020)	1,170	20	24%	4,583,552	458,355	2	\$4,150,080	\$41,500,800	\$5,505,819	\$2,752,910
Copano Ridge Subdivision (2020)	580	13	54%	11,491,428	1,149,143	1	\$2,593,800	\$25,938,000	\$3,441,137	\$860,284
Duval County CRD (2015)	2,525	20	17%	7,492,115	749,212	2	\$4,150,080	\$41,500,800	\$5,505,819	\$2,752,910
Freer WCID (2020)	2,689	51	34%	52,797,473	5,279,747	5	\$10,582,704	\$105,827,040	\$14,039,837	\$877,490
Holiday Beach WSC (2019)	2,190	23	23%	4,104,596	410,460	2	\$4,772,592	\$47,725,920	\$6,331,691	\$6,331,691
River Acres WSC (2021)	2,000	18	34%	31,355,848	3,135,585	2	\$3,735,072	\$37,350,720	\$4,955,237	\$495,524
Tynan WSC (2021)	250	8	23%	1,597,923	159,792	1	\$1,660,032	\$16,600,320	\$2,202,327	\$2,202,327

*Note: The percentage shown is attributable to real losses, which can be addressed with pipeline replacement programs. These percentages will differ from water loss audit information, which reports total water loss (apparent and real loss).



Table 5B.1.7.
Summary of Entities Exceeding Water Loss Thresholds Based on Water Loss Audits

Utility Name	Audit Year*	Main Line Miles	Retail Population Served	Retail Connections Served	Real Loss (gallons)	Entity's Service Conn. Density (SCD)	Real Loss Threshold Limit (gal/conn/day) based on Entity's SCD	Entity's Current Real Loss Threshold (gal/conn/day)
Aransas Bay Utilities	2015	10	600	270	5,898,105	27	57	60
City of Bishop	2020	31	3,010	1,232	76,935,042	40	30	171
City of Alice	2018	100	18,949	8,512	227,972,988	86	30	73
City of Corpus Christi	2022	1,810	317,863	97,923	1,135,067,698	55	30	32
City of Mathis	2022	36	4,150	1,670	44,775,468	47	30	73
City of Sinton	2022	60	5,723	2,293	274,628,269	39	30	328
Copano Ridge Subdivision	2020	13	580	232	12,658,697	19	57	149
Duval County CRD	2015	20	2,525	776	10,594,950	41	30	37
Freer WCID	2020	51	2,689	1,212	62,058,526	24	57	140
River Acres WSC	2021	18	2,000	800	36,793,506	45	30	126

*Water loss audit currently on file with TWDB.

Table 5B.1.8.
Summary of Estimated Meter Replacement Costs for Entities Reporting Apparent Losses Greater than 5%

Utility Name & Year of Recent Survey	No. of Retail Service Connections	System Input Volume (gallons)	Total Apparent Loss (gallons)	Apparent Loss (%)	Number of Meters to be Replaced Annually to Achieve 100% replacement in 10 years	Annual Cost (\$235 per meter; 10-year program)	Total 10 Year Program Meter Replacement Cost	Amortized Annual Cost of 10-Year Program	Unit Cost (ac-ft/yr)
Aransas Bay Utilities (2015)	270	20,359,523	3,940,134	19%	27	\$6,345	\$63,450	\$8,418	\$702
City of Alice (2018)	8,512	1,091,930,787	84,663,749	8%	851	\$200,032	\$2,000,320	\$265,378	\$1,021
City of Bishop (2020)	1,232	181,014,167	15,654,122	9%	123	\$28,952	\$289,520	\$38,410	\$800
Copano Heights Water (2020)	108	4,050,452	255,363	6%	11	\$2,538	\$25,380	\$3,367	\$3,367

Table 5B.1.9.
Summary of Water Loss Mitigation Strategies (ac-ft/yr) for Water Loss Mitigation- Pipeline and Meter Replacement

WUG/Utility Name	2030	2040	2050	2060	2070	2080
Pipeline Replacement (Water Savings Needed to Achieve 5% Real Loss)						
Aransas County-Other	0	10	0	0	0	0
Alice	0	53	0	0	0	0
Bishop	0	21	0	0	0	0
Mathis	0	11	0	0	0	0
Sinton	0	76	0	0	0	0
Duval County CRD	0	2	0	0	0	0
Freer WCID	0	16	0	0	0	0
River Acres WSC	0	10	0	0	0	0
Bee County-Other	0	1	0	0	0	0
Meter Replacement for Entities Reporting Apparent Losses Greater than 5%						
Aransas County-Other	0	13	0	0	0	0
Alice	0	260	0	0	0	0
Bishop	0	48	0	0	0	0
TOTAL Annual (AC-FT/YR)	0	521	0	0	0	0

Table 5B.1.10.
Summary of Water Loss Mitigation Strategies (\$) for Water Loss Mitigation- Pipeline and Meter Replacement

WUG/Utility Name	2030	2040	2050	2060	2070	2080
Pipeline Replacement (Based on Annual Water Cost to Achieve 5% Real Loss in 10 years)						
Aransas County-Other	\$0	\$167,040,720	\$0	\$0	\$0	\$0
Alice	\$0	\$207,504,000	\$0	\$0	\$0	\$0
Bishop	\$0	\$64,326,240	\$0	\$0	\$0	\$0
Mathis	\$0	\$74,701,440	\$0	\$0	\$0	\$0
Sinton	\$0	\$124,502,400	\$0	\$0	\$0	\$0
Duval County CRD	\$0	\$41,500,800	\$0	\$0	\$0	\$0
Freer WCID	\$0	\$105,827,040	\$0	\$0	\$0	\$0
River Acres WSC	\$0	\$37,350,720	\$0	\$0	\$0	\$0
Bee County-Other	\$0	\$16,600,320	\$0	\$0	\$0	\$0
Meter Replacement						
Aransas County-Other	\$0	\$88,830	\$0	\$0	\$0	\$0
Alice	\$0	\$2,000,320	\$0	\$0	\$0	\$0
Bishop	\$0	\$289,520	\$0	\$0	\$0	\$0
TOTAL PROGRAM COST (\$)	\$0	\$841,732,350	\$0	\$0	\$0	\$0

Table 5B.1.11.
Potential Additional Water Conservation Savings for Water User Groups Having per Capita Water Use Greater than 140 gpcd

WUG Name	County	Housing Area	2030		2040		2050		2060		2070		2080	
			gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr
Rockport	Aransas	Suburban	11	225	17	348	17	340	17	332	17	325	17	318
Beeville	Bee	Suburban	14	204	30	465	45	736	49	839	49	889	49	945
El Oso WSC	Bee	Rural	12	6	28	19	38	34	38	44	38	58	38	76
Skidmore WSC	Bee	Rural	2	1	1	0	0	0	1	0	1	1	1	0
TDCJ Chase Field	Bee	Rural	23	111	45	221	66	323	85	416	102	500	118	576
Falfurrias	Brooks	Rural	19	91	39	189	58	282	76	370	91	458	99	520
Freer WCID	Duval	Rural	15	37	31	75	47	106	58	123	58	115	58	108
San Diego MUD 1	Duval	Rural	11	48	21	88	21	87	21	88	21	89	21	93
Alice	Jim Wells	Suburban	12	283	27	660	33	856	33	900	33	953	33	1,017
Orange Grove	Jim Wells	Rural	17	27	36	57	55	84	71	107	86	128	86	128
Premont	Jim Wells	Rural	16	42	34	87	52	129	67	164	73	178	73	179
San Diego MUD 1	Jim Wells	Rural	11	9	21	18	21	19	20	19	21	20	20	21
County-Other, Kenedy	Kenedy	Rural	39	15	82	28	118	38	151	45	181	51	208	54
Baffin Bay WSC	Kleberg	Rural	3	3	2	2	1	1	2	2	2	2	2	2
County-Other, Kleberg	Kleberg	Rural	6	9	5	8	5	8	5	8	5	8	5	9
Naval Air Station Kingsville	Kleberg	Rural	391	24	754	48	1082	71	1393	95	1660	117	1912	137
El Oso WSC	Live Oak	Rural	14	11	28	26	38	35	38	35	38	35	38	35
George West	Live Oak	Rural	11	20	18	32	18	29	19	27	18	25	18	23
Three Rivers	Live Oak	Rural	10	30	10	30	10	30	10	31	10	29	11	31
Bishop	Nueces	Rural	10	37	10	37	10	36	10	37	10	36	10	36
Corpus Christi	Nueces	Urban	12	4,164	26	9,338	28	9,883	28	9,823	28	9,765	28	9,706
Corpus Christi Naval Air Station	Nueces	Rural	124	189	240	373	347	539	445	687	532	819	611	936
Nueces County WCID 3	Nueces	Suburban	21	279	43	583	64	863	82	1,109	99	1,328	115	1,522
Nueces County WCID 4	Nueces	Rural	39	118	77	238	112	348	145	446	174	531	200	608
Nueces WSC	Nueces	Rural	7	49	7	45	7	45	7	45	7	45	7	45
Gregory	San Patricio	Rural	7	12	6	10	6	10	6	11	6	11	6	11
Portland	San Patricio	Suburban	4	88	3	83	3	89	3	97	3	105	3	113



WUG Name	County	Housing Area	2030		2040		2050		2060		2070		2080	
			gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr	gpcd	acft/yr
Sinton	San Patricio	Rural	15	80	33	170	49	253	64	332	64	335	64	339
Total			-	6,214	-	13,277	-	15,275	-	16,234	-	16,957	-	17,587

5B.1.3 Environmental Issues

Environmental impacts from water conservation measures in the Coastal Bend Region are not associated with direct physical impacts to the natural environment. Some of the indoor conservation measures recommended could reduce the amount of treated wastewater available to send to the Nueces Bay and Estuary during low flow times, which could be offset by possible positive impact resulting from higher reservoir levels.

Under a 2001 Agreed Order from the TCEQ¹³, the City of Corpus Christi is required to pass specified volumes of inflows to the reservoirs in accordance with a monthly schedule to mitigate the impacts of Choke Canyon Reservoir and maintain the health of the Nueces Estuary. In any month when the System storage is less than 40 percent but greater than 30 percent, the target Nueces Bay inflow requirement may be reduced to 1,200 ac-ft/month when the City of Corpus Christi and its customers implement Condition II of the City's Water Conservation and Drought Contingency Plan (Plan). If System storage drops below 30 percent, bay and estuary releases (except for return flows) may be suspended when the City and its customers implement Condition III of the Plan. The City of Corpus Christi's water conservation and drought contingency plan is summarized in Chapters 5C and 7.

¹³ Texas Commission on Environmental Quality (TCEQ), Agreed Order Establishing Operational Procedures Pertaining to Special Condition B, Certificate of Adjudication No. 21-3214, Held by City of Corpus Christ, et al., April 28, 1995.

5B.1.4 Engineering and Costing

Municipal water conservation costs were based on the TWDB Municipal Water Conservation Planning Tool developed to assist individual water utilities with planning conservation programs. The tool allows the user to select a mix of BMPs, and it then shows the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs. The tool includes the following pre-defined BMPs:

- Bathroom Retrofit
- Showerhead and Aerator Kit
- Clothes Washer Rebate
- Home Water Reports
- Irrigation Audits- High Users
- HE Toilet Rebate
- High Efficiency Sprinkler Nozzle Rebate
- Smart Irrigation Controller Rebate
- WaterWise Landscape Rebate
- Rainwater Harvesting Rebate, and
- Rain Barrel

The costs to implement these BMPs ranges from \$243 to \$1,409 per ac-ft saved, with the showerhead kit being the most economical (\$243 per ac-ft saved) and clothes washer rebates and rain barrels being the most expensive at \$1,220 and \$1,409 per ac-ft, respectively. Three Region N water user groups were selected to represent a range of Small, Medium, and Large utilities for costing purposes.

The City of Taft records in the TWDB tool was considered representative of “Small” Region N municipal water users; the City of Alice was considered representative of “Medium” Region N municipal water users (populations less than 20,000); and the City of Corpus Christi information was obtained from the TWDB tool. As shown in Table 5B.1.12, 22 of the 28 entities with per capita rates exceeding 140 gpcd for which additional conservation is recommended are categorized as “Small”; five entities categorized as “Medium”; and one entity categorized as “Large”. Although the TWDB tool did not present costs for the most common water conservation BMPs from local water conservation plans in the Coastal Bend Region (reference Table 5B.1.3), the following BMPs from the TWDB tool were selected during the 2021 Region N Water Plan to estimate a unit cost for municipal water conservation: HE Toilet Rebate, Bathroom Retrofit, Showerhead and Aerator Kit, Home Water Reports, and WaterWise Landscape Rebate. The costs to implement these BMPs according to the program rates, as well as accounting for inflation this planning cycle, ranged from \$577 to \$583 per ac-ft water saved.

The total program costs for municipal entities having per capita use greater than 140 gpcd are presented in Table 5B.1.12. Total conservation potential costs for Region N are estimated at \$3,613,224 in 2030 and increasing to \$10,217,976 by 2080. The CBRWPG recommends the BMPs listed in Chapter 5B.1.2 to encourage conservation while maintaining flexibility for municipal users to adopt strategies that suit them the best.

These annual costs have been capitalized over a 20-year period at 3.5 percent interest rate by assuming that 70 percent of the annual costs for a municipal water conservation program are associated with repayment of debt issued to fund the initial capital expenditures. Capital costs are also shown in Table 5B.1.12.

5B.1.5 Implementation Issues

There are several issues that may slow down the efforts of water conservation activities. However, the most crucial item is to get water customers to change their water use habits. Effective public outreach and education can go a long way towards reducing water use, but in the end the effectiveness of any program is dependent upon the individual. A key element to the Drought Contingency and Water Conservation Plan that each entity has been required to submit to the TCEQ is the curtailment of water use during drought. Enforcement of these restrictions — typically those that limit lawn watering — is often difficult. Lastly, capital costs for retrofit programs can be expensive depending on the system and may be difficult for cities or rural entities to initially finance.

5B.1.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.1.13.

Table 5B.1.12.
Cost of Water Conservation for Selected Water Conservation Techniques for
Water User Groups Having per Capita Water Use Greater than 140 gpcd

WUG Name	County	Housing Area	Cost per acft	2030	2040	2050	2060	2070	2080
Rockport	Aransas	Suburban	\$577	\$129,826	\$200,661	\$196,011	\$191,703	\$187,338	\$183,584
Beeville	Bee	Suburban	\$577	\$117,897	\$268,292	\$424,598	\$484,051	\$513,049	\$545,171
El Oso WSC	Bee	Rural	\$580	\$3,769	\$11,247	\$19,819	\$25,773	\$33,731	\$44,227
Skidmore WSC	Bee	Rural	\$580	\$710	\$233	\$153	\$234	\$530	\$281
TDCJ Chase Field	Bee	Rural	\$580	\$64,231	\$128,168	\$187,565	\$241,282	\$289,864	\$333,800
Falfurrias	Brooks	Rural	\$580	\$53,046	\$109,680	\$163,359	\$214,388	\$265,660	\$301,625
Freer WCID	Duval	Rural	\$580	\$21,734	\$43,376	\$61,725	\$71,273	\$66,869	\$62,613
San Diego MUD 1	Duval	Rural	\$580	\$27,678	\$50,780	\$50,313	\$50,802	\$51,396	\$53,822
Alice	Jim Wells	Suburban	\$577	\$163,159	\$380,862	\$493,794	\$519,313	\$550,076	\$586,854
Orange Grove	Jim Wells	Rural	\$580	\$15,645	\$32,851	\$48,627	\$62,161	\$74,085	\$74,182
Premont	Jim Wells	Rural	\$580	\$24,411	\$50,589	\$74,830	\$95,382	\$103,351	\$103,658
San Diego MUD 1	Jim Wells	Rural	\$580	\$5,251	\$10,277	\$10,903	\$10,893	\$11,587	\$12,043
County-Other, Kenedy	Kenedy	Rural	\$580	\$8,515	\$16,214	\$21,783	\$26,168	\$29,302	\$31,336
Baffin Bay WSC	Kleberg	Rural	\$580	\$1,510	\$1,067	\$749	\$1,080	\$1,229	\$1,071
County-Other, Kleberg	Kleberg	Rural	\$580	\$5,217	\$4,354	\$4,503	\$4,880	\$4,858	\$5,144
Naval Air Station Kingsville	Kleberg	Rural	\$580	\$13,968	\$27,917	\$41,469	\$55,200	\$67,951	\$79,516
El Oso WSC	Live Oak	Rural	\$580	\$6,657	\$15,280	\$20,480	\$20,480	\$20,480	\$20,480
George West	Live Oak	Rural	\$580	\$11,833	\$18,519	\$17,037	\$15,897	\$14,427	\$13,208
Three Rivers	Live Oak	Rural	\$580	\$17,365	\$17,647	\$17,545	\$17,715	\$17,032	\$17,816
Bishop	Nueces	Rural	\$580	\$21,650	\$21,394	\$21,121	\$21,291	\$21,063	\$20,654
Corpus Christi	Nueces	Urban	\$583	\$2,427,398	\$5,444,195	\$5,761,681	\$5,726,939	\$5,692,849	\$5,658,428
Corpus Christi Naval Air Station	Nueces	Rural	\$580	\$109,695	\$216,104	\$312,435	\$398,608	\$475,247	\$543,170
Nueces County WCID 3	Nueces	Suburban	\$577	\$161,022	\$336,495	\$498,110	\$640,064	\$766,287	\$878,476
Nueces County WCID 4	Nueces	Rural	\$580	\$68,235	\$138,022	\$201,891	\$258,506	\$308,141	\$352,568
Nueces WSC	Nueces	Rural	\$580	\$28,238	\$26,068	\$26,318	\$26,341	\$25,874	\$25,897
Gregory	San Patricio	Rural	\$580	\$7,069	\$5,908	\$5,805	\$6,249	\$6,204	\$6,159
Portland	San Patricio	Suburban	\$577	\$50,969	\$47,733	\$51,515	\$56,037	\$60,518	\$65,422
Sinton	San Patricio	Rural	\$580	\$46,529	\$98,489	\$146,590	\$192,708	\$194,416	\$196,771



WUG Name	County	Housing Area	Cost per acft	2030	2040	2050	2060	2070	2080
Total Region N Cost of Water Conservation Programs to Achieve Savings Goals (\$)				\$3,613,224	\$7,722,422	\$8,880,731	\$9,435,419	\$9,853,414	\$10,217,976

Table 5B.1.13.
Evaluation Summary of Municipal Water Conservation

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Firm Yield: 6,214 ac-ft/yr in 2030 to 17,587 ac-ft/yr in Year 2080.
2. Reliability	2. Highly reliable.
3. Cost of Treated Water	3. Unit Cost ranges from \$577 to \$583 per ac-ft water saved for water conservation. Significantly more expensive for pipeline and meter replacement.
4. Estimated Water Losses	4. Varies based on information reported in TWDB Water Loss Audit (includes apparent and real loss)
b. Environmental factors	
1. Effects on Instream flows	1. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
2. Effects on Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
3. Wildlife Habitat	3. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
4. Wetlands	4. Some impact due to decreased return flows, which could be offset by possible positive impact resulting from higher reservoir levels.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids	
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other water quality constituents	
c. Impacts to Agricultural Resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• May be some impact to disinfectant chlorine residuals.



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5B.2

Manufacturing Water Conservation

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5B.2 Manufacturing Water Conservation

5B.2.1 Description of Strategy

Manufacturing is an integral part of the Texas economy, and for many industries, water plays a key role in the manufacturing process. Some of these processes require direct consumption of water as part of the products; others consume very little water but use a large quantity for cleaning and cooling. Over the past two decades, Texas refiners have reduced water usage by as much as 30 percent while output revenue has increased steadily.¹

The manufacturing water demand projections used in this plan for the Coastal Bend Region were provided by the TWDB and differed from those presented in the 2021 Region N Plan. Manufacturing water use for the Coastal Bend Region is projected to be 15 percent greater this planning cycle at 115,120 ac-ft in 2030 compared to 98,480 ac-ft in 2030 in the 2021 Region N Plan. Although the manufacturing industry is projected to grow after 2030, long-term planning assumes continued efficiency from 2030 to 2070, as shown in Figure 5B.2.1. The majority of Region N manufacturing demand occurs in Nueces and San Patricio Counties. Between 2030 and 2080, these two counties account for 96 percent of the total projected manufacturing water use in the region (Figure 5B.2.2). Six of the eleven counties in Region N show manufacturing demands. Manufacturing demands are not projected in Aransas, Bee, Brooks, Duval, or Kenedy Counties.

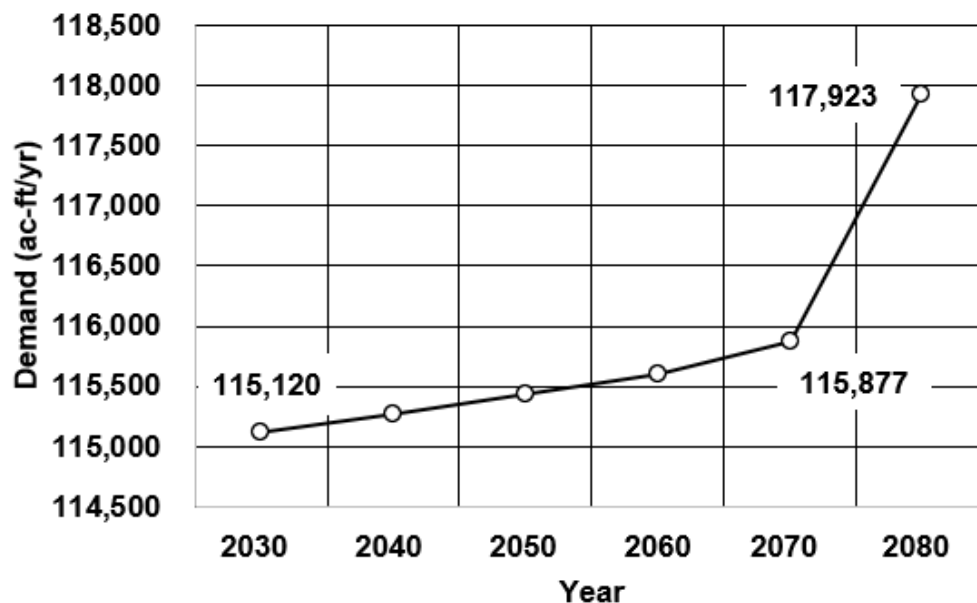


Figure 5B.2.1.
Coastal Bend Region Manufacturing Water Demand Projections

¹ Progress Made in Water Conservation in Texas: Report and Recommendations to the 88th Texas Legislature, Water Conservation Advisory Council, December 1, 2022.

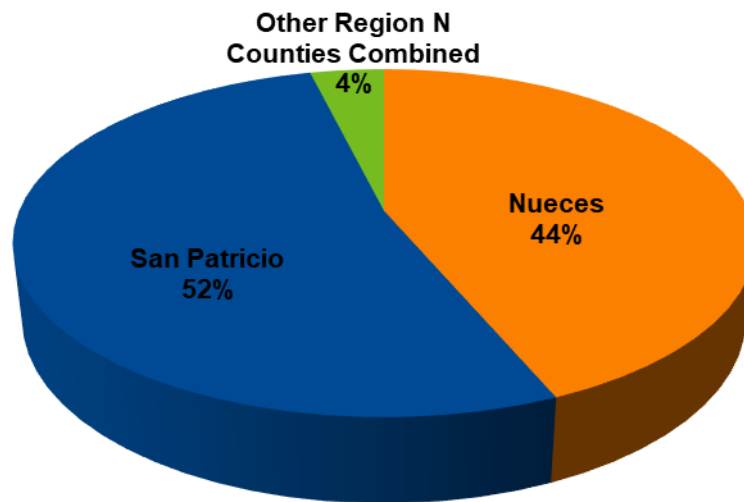


Figure 5B.2.2.
2030-2080 Percentages of Manufacturing Water Demand by County in Coastal Bend

In the Coastal Bend Region, manufacturing supply is obtained from both surface and groundwater sources, as well as reuse or recycling of water. Three of the six counties with manufacturing demands rely solely on groundwater sources for their water supply. San Patricio manufacturing receives nearly all of their water supplies from surface water. Nueces manufacturing receives over 60 percent of their supply from surface water, and a combination of groundwater and reuse supplies make up the remaining difference. Nueces County's total manufacturing water supply is comprised of less than one percent from water reuse. Live Oak manufacturing receives approximately 30 to 40 percent of its surface water through contract with the City of Three Rivers; the county's remaining manufacturing demand is supplied by groundwater.

Six of the eleven counties in the Coastal Bend Region have projected manufacturing needs beginning in 2030: Jim Wells, Kleberg, Live Oak, McMullen, Nueces, and San Patricio Counties, as shown in Table 5B.2.1. A modest shortage is shown for Jim Wells; however, the primary shortage in the region, which steadily increase through 2080, is in Nueces County. The greatest manufacturing shortage (47,971 ac-ft/yr) occurs in 2080 for Nueces County.

TWDB rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The TWDB has provided information on industrial water conservation BMPs, for consideration in the development of the water conservation WMS including a [Best Management Practice Guides for Industrial Water Users](#).

Table 5B.2.1.
Projected Water Demands, Supplies, and Water Needs (Shortages)
for Manufacturing Users in Jim Wells, Kleberg, Live Oak, McMullen, Nueces, and
San Patricio Counties

-	Manufacturing Projections (ac-ft/yr)					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Jim Wells County						
Manufacturing Demand	87	90	93	96	100	104
Manufacturing Existing Supply						
Groundwater	79	79	79	79	79	79
Surface water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Manufacturing Supply	79	79	79	79	79	79
Surplus (Shortage)	(8)	(11)	(14)	(17)	(21)	(25)
Kleberg County						
Manufacturing Demand	1,088	1,128	1,170	1,213	1,258	1,305
Manufacturing Existing Supply						
Groundwater	1,088	1,128	1,170	1,213	1,258	1,305
Surface water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Manufacturing Supply	1,088	1,128	1,170	1,213	1,258	1,305
Surplus (Shortage)	0	0	0	0	0	0
Live Oak County						
Manufacturing Demand	2,843	2,948	3,057	3,170	3,287	3,409
Manufacturing Existing Supply						
Groundwater	2,054	2,054	2,054	2,054	2,054	2,054
Surface water	789	894	1,003	1,116	1,233	1,355
Reuse	0	0	0	0	0	0
Total Manufacturing Supply	2,843	2,948	3,057	3,170	3,287	3,409
Surplus (Shortage)	0	0	0	0	0	0
McMullen County						
Manufacturing Demand	34	34	34	34	34	34
Manufacturing Existing Supply						
Groundwater	34	34	34	34	34	34
Surface water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Manufacturing Supply	34	34	34	34	34	34
Surplus (Shortage)	0	0	0	0	0	0
Nueces County						
Manufacturing Demand	50,363	50,363	50,363	50,363	50,472	52,339
Manufacturing Existing Supply						
Groundwater	3,240	3,240	3,240	3,240	3,240	3,240
Surface water	10,230	7,023	4,607	2,545	376	0
Reuse	1,128	1,128	1,128	1,128	1,128	1,128
Total Manufacturing Supply	14,598	11,391	8,975	6,913	4,744	4,368
Surplus (Shortage)	(35,765)	(38,972)	(41,388)	(43,450)	(45,728)	(47,971)

-	Manufacturing Projections (ac-ft/yr)					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
San Patricio County						
Manufacturing Demand	60,705	60,710	60,715	60,720	60,726	60,732
Manufacturing Existing Supply						
Groundwater	110	110	110	110	110	110
Surface water	69,583	69,194	69,042	69,125	69,203	69,108
Reuse	0	0	0	0	0	0
Total Manufacturing Supply	69,693	69,304	69,152	69,235	69,313	69,218
Surplus (Shortage)	8,988	8,594	8,437	8,515	8,587	8,486

5B.2.2 Available Yield

All manufacturing entities in the Coastal Bend Region are encouraged to conserve water.

Of the six counties in Region N with manufacturing water demands, two counties show shortages (Table 5B.2.1). The CBRWPG recommends that all counties with projected manufacturing water demands (regardless of need or shortage) to target reducing their manufacturing water demands by 15 percent by 2080.

The TWDB lists the following 14 industrial BMPs that may be used to achieve water savings²:

1. Industrial Water Audit
2. Industrial Water Waste Reduction
3. Industrial Submetering
4. Cooling Towers
5. Cooling Systems (other than Cooling Towers)
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water
7. Rinsing/Cleaning
8. Water Treatment
9. Boiler and Steam Systems
10. Refrigeration (including Chilled Water)
11. Once-Through Cooling
12. Management and Employee Programs
13. Industrial Facility Landscaping
14. Industrial Site-Specific Conservation

An additional BMP, Stormwater Runoff, has been added to the list during this planning cycle based on feedback received during a virtual meeting held on September 18, 2024, with Manufacturing Representatives on the CBRWPG. This additional BMP was presented and approved at the Region N meeting on October 17, 2024.

Also, a Region N Survey for Industrial Water Users was conducted during December 2024 and January 2025 to gain additional feedback on effective and voluntary water supply BMPs used.

² TWDB website: <https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp>

Of the four responses received, four different types of industry were represented: Construction, Chemical Manufacturing, Crude Terminal, and Refining. All four industries highlighted eliminating non-essential water use as the primary BMP implemented to reduce water use during a drought, which resulted in approximately 10 percent water savings. Additional voluntary water supply BMPs considered by the industries to reduce water use include:

- Management and employee education programs
- Industrial facility landscaping
- Industrial water audit
- Stormwater runoff (capture onsite)
- Alternative cooling water technologies
- Industrial Alternative Sources, Reuse, and Recirculation of Process Water
- Retrofits and process improvements

Fifty percent of the industries who participated in the survey have developed their own drought contingency plans and target implementing future projects (on-site and/or process related) within the next five years to achieve further water savings and water demand reductions. These future projects include treatment of water supply (such as reverse osmosis) to improve the efficiency of boiler and cooling tower operations while reducing water consumption.

Based on the CBRWPG's recommendation, a 15 percent voluntary reduction in manufacturing water demand by 2080 results in a total savings of 17,689 ac-ft/yr for the region, as shown in Table 5B.2.2. If manufacturing water conservation savings are attained as recommended, shortages would be reduced for all manufacturing counties with needs. New needs after conservation are re-calculated as shown in Table 5B.2.2. The CBRWPG-recommended water conservation goal alone is insufficient to fully address manufacturing shortages in Region N, and additional strategies are considered to address this projected supply deficit (See Chapter 5B).

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5B.2.3. TWDB describes how the BMPs reduce water use; however, information regarding specific water savings and costs to implement conservation programs is generally unavailable since conservation savings and costs are facility and process specific.

Table 5B.2.2.
Projected Water Demands Considering a 15 Percent Reduction by 2080 for All Manufacturing Users; Additional Needs (Shortages) Shown for Jim Wells & Nueces Counties

-	Projections (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Jim Wells County						



-	Projections (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
New Demand (after conservation)	85	85	86	86	87	88
Expected Savings	2	5	7	10	13	16
New Manufacturing Shortage (after recommended conservation)	(6)	(6)	(7)	(7)	(8)	(9)
Shortage Reduction (ac-ft/yr)	25%	45%	50%	59%	62%	64%
Kleberg County						
New Demand (after conservation)	1,061	1,072	1,082	1,092	1,101	1,109
Expected Savings	27	56	88	121	157	196
Balance After Conservation (ac-ft/yr)	27	56	88	121	157	196
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Live Oak County						
New Demand (after conservation)	2,772	2,801	2,828	2,853	2,876	2,898
Expected Savings	71	147	229	317	411	511
Balance After Conservation (ac-ft/yr)	71	147	229	317	411	511
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
McMullen County						
New Demand (after conservation)	33	32	31	31	30	29
Expected Savings	1	2	3	3	4	5
Balance After Conservation (ac-ft/yr)	1	2	3	3	4	5
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Nueces County						
New Demand (after conservation)	49,104	47,845	46,586	45,326	44,163	44,488
Expected Savings	1,259	2,518	3,777	5,037	6,309	7,851
New Manufacturing Shortage (after recommended conservation)	(34,506)	(36,454)	(37,611)	(38,413)	(39,419)	(40,120)
Shortage Reduction (ac-ft/yr)	4%	6%	9%	12%	14%	16%
San Patricio County						
New Demand (after conservation)	59,187	57,674	56,162	54,647	53,135	51,622
Expected Savings	1,518	3,036	4,553	6,073	7,591	9,110
Balance After Conservation (ac-ft/yr)	10,506	11,630	12,990	14,588	16,178	17,596
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Total Manufacturing Savings (Region N)	2,878	5,764	8,657	11,561	14,485	17,689

Table 5B.2.3.
Costs and Savings of Possible Manufacturing Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Industrial Water Audit	10	35	22.5	%	-	-	-	-	
2	Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	
3	Industrial Submetering	-	-	-	-	-	-	-	-	
4	Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
5	Cooling Systems (other than Cooling Towers)	-	90	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
6	Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	
7	Rinsing/Cleaning	-	-	-	-	-	-	-	-	
8	Water Treatment	10	85	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
9	Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
10	Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	
11	Once-Through Cooling	-	-	-	-	-	-	-	-	
12	Management and Employee Programs	-	-	-	-	-	-	-	-	
13	Industrial Facility Landscaping	-	-	15	%	-	-	-	-	
14	Industrial Site Specific Conservation	10	95	52.5	%	-	-	-	-	Savings vary widely based on specific measure - from water audits to changing from potable to recycled water.

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
15	Stormwater Runoff*	-	-	-	%	-	-	-	-	Savings vary depending on size of impervious area, drainage features, and capture ratio of runoff water onsite.

Source: TWDB website: <https://www.twdb.texas.gov/conservation/BMPs/lnd/index.asp>; *BMP No. 15 added to list for 2026 Region Plan based on feedback received from Manufacturing Representatives on the CBRWPG.

5B.2.3 Alternative Cooling Water Technologies

Cooling towers can be among the largest water using systems in the industrial and commercial sector. The most significant opportunity for water savings in cooling tower operation is by reducing the amount of highly concentrated water removed from the system as blowdown.³ The Alliance for Water Efficiency (AWE) developed a tool to assist users to identify water savings opportunities based on source water quality data and to provide potential solutions to improve the Cycles of Concentration to reduce the amount of blowdown lost from system.⁴ AWE also followed up with a pilot study in 2022 to assess several alternative technologies and their effectiveness of meeting a user's cooling demand while providing water savings. Three alternative cooling water technologies recommended from the AWE study include the following: Thermosyphon Cooler Hybrid System, Hygroscopic Cooling Tower, and Thermal Membrane Distillation.

Also, the AWE guide provides information on how to increase water efficiency in cooling towers, including design and operations of cooling towers to achieve additional water savings. Although AWE's pilot study did not include rigorous economic evaluations of the capital cost of the improvements versus the reoccurring operating expenses; however, the tool can be used to help inform industries regarding the life cycle cost analysis and payback period during their evaluation process.

5B.2.3.1 Thermosyphon Cooler Hybrid System

A Thermosyphon Cooler Hybrid System (TCHS) integrates the control of a dry heat rejection device, the thermosyphon cooler (TSC), with an open cooling tower. The TCHS, developed by Johnson Controls, involves placing a dry cooling device, a TSC, upstream and in series with a wet cooling tower. This system uses evaporative cooling when it is most advantageous and then uses dry cooling as system operations and ambient weather conditions permit to save water. In 2016, Johnson Controls partnered with the National Renewable Energy Laboratory (NREL) and Sandia National Laboratories to conduct and model test scenarios using the TCHS. The results

³ *Cooling Systems Management, Report 362*, Texas Water Development Board, 2004.

⁴ *Taking Inventory: A Guide for Identifying Cooling Towers and Estimating Water Use*, Alliance for Water Efficiency, February 2021.

of the pilot study of the hybrid cooling system demonstrated a reduction of annual utility costs by 40% in addition to achieving a significant 56% annualized water savings.⁵

5B.2.3.2 Hygroscopic Cooling Tower

A hygroscopic cooling tower is similar to a conventional wet evaporative cooling system and uses a hygroscopic working fluid as a direct-contact heat-transfer medium between a cooling water loop and the ambient air. The hygroscopic liquid desiccant, a mixture of calcium chloride (CaCl₂) and water, restricts the free evaporation of moisture and results in more heat transfer to the air compared to water. CaCl₂ is the preferred desiccant material since it is widely available, low cost, and has few environmental concerns compared to other desiccants or salts.

In a conventional wet cooling tower, approximately 90% of the energy transfer occurs through evaporation, which is independent on outdoor temperature conditions. With the hygroscopic tower, the amount of heat transfer can be varied to maximize the water savings depending on the air/weather conditions. In 2018, the University of North Dakota conducted a pilot study with grant assistance from the U.S. Department of Defense to test a conventional cooling tower using hygroscopic working fluid to vary the amount of dry versus wet evaporative heat transfer relative to ambient weather conditions.⁶ The results of this study demonstrated the following using hygroscopic cooling towers:

- Allows a full range of wet-to-dry performance using a single air–liquid interface instead of separate wet and dry stages;
- Evaporates all makeup water to provide cooling, which eliminates the need for a wasteful blowdown stream; and,
- Possible annual water savings in the range of 30 to 50 percent.

5B.2.3.3 Thermal Membrane Distillation

Treating and reusing cooling tower blowdown water (CTBD) can achieve additional water efficiency and reduce water demands for manufacturing and industrial users. Thermal membrane distillation (MD) is a thermally driven membrane separation process that creates a vapor pressure generated by a temperature difference between the liquids on both sides of the membrane. The vapor is transported through the membrane from the hot feed liquid side to the condensate side under the effect of the pressure difference.

The School of Energy, Power and Mechanical Engineering at the North China Electric Power University conducted a pilot study and developed a computational model to study the treatment of CTBD by reverse osmosis (RO) and MD to address the issue of cooling tower blowdown

⁵ *Thermosiphon Cooler Hybrid System for Water Savings in an Energy-Efficient HPC Data Center Report: Results of 24 Months and Impact on Water Usage Effectiveness*, National Renewable Energy Laboratory, September 2018.

⁶ *Hygroscopic Cooling Tower for Reduced Water Consumption (ESTCP Project EW-201723)*, University of North Dakota and U.S. Department of Defense, September 2018.

treatment.⁷ During the study, the effects of the main operating parameters on the RO and MD (with/without waste heat utilization) were explored, as well as water-savings and energy consumption. The results showed that MD achieved a water-saving rate of 18.4 percent, and energy consumption was slightly lower than RO. Also, waste heat utilization demonstrated an improvement in the economy of MD.

5B.2.4 Environmental Issues

The TWDB BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been implemented and are not expected to have significant environmental issues associated when in operation. For example, most BMPs improve water use efficiency without making changes to wildlife habitat. Thus, the proposed conservation practices do not have anticipated potential adverse effects, and in fact have potentially beneficial environmental effects.

5B.2.5 Engineering and Costing

The CBRWPG recommends implementing voluntary water conservation for all manufacturing users regardless of need to reduce their water demand by 15 percent by 2080. The Coastal Bend Region can save up to 17,689 ac-ft/yr in 2080 with this approach. Costs to implement BMPs vary from site to site, and the Region recognizes that manufacturing industries will pursue conservation strategies that are economically feasible with water savings benefits. As a result, the assumptions used for the costing methodology are based on the additional guidance provided by TWDB. Cost estimates assume that an average water demand of 1,000 ac-ft/yr equates to a \$10,000 water audit cost, with a minimum cost of \$2,000. In addition, one audit will be conducted every five years, and implementation of these audits will occur by 2030. Estimated total annual costs, based on the projected water demands and expected water conservation savings (Table 5B.2.2), are summarized below in Table 5B.2.4.

Table 5B.2.4.
2026 Total Annual Costs from Implementation of Best Management Practices

WUG	Total Annual Costs (\$/year)					
	2030	2040	2050	2060	2070	2080
Jim Wells County	\$400	\$400	\$400	\$400	\$400	\$400
Kleberg County	\$540	\$1,120	\$1,760	\$2,420	\$3,140	\$3,920
Live Oak County	\$1,420	\$2,940	\$4,580	\$6,340	\$8,220	\$10,220
McMullen County	\$400	\$400	\$400	\$400	\$400	\$400
Nueces County	\$25,180	\$50,360	\$75,540	\$100,740	\$126,180	\$157,020
San Patricio County	\$30,360	\$60,720	\$91,060	\$121,460	\$151,820	\$182,200

⁷ *Performance and Economic Analysis of the Cooling Tower Blowdown Water Treatment System in a Coal-Fired Power Plant*, Institution of Chemical Engineers, Vol. 201, 2023.

5B.2.6 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Coastal Bend Region. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

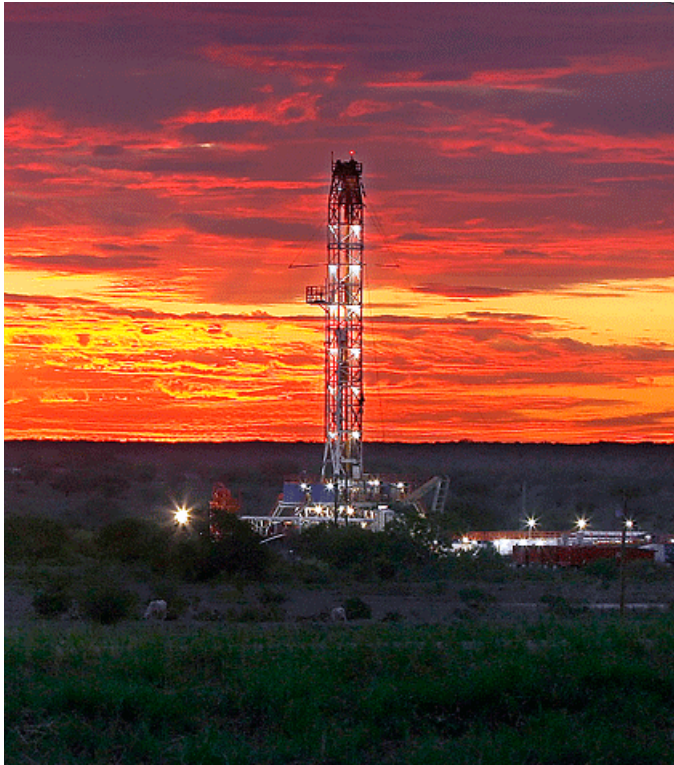
There is public support for manufacturing water conservation, and it is being implemented at a steady pace. As water markets for conserved water expand and the Coastal Bend industrial sector continues to expand, conservation practices will likely reach a greater potential. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of manufacturing conservation.

5B.2.7 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.2.5.

Table 5B.2.5.
Evaluation Summary of Manufacturing Water Conservation

Impact Category	Comment(s)
a. Water Supply 1. Quantity 2. Reliability 3. Cost of Treated Water 4. Estimated Water Losses	1. Firm Yield: Variable; Max of 17,689 ac-ft/yr (2080) 2. Reliable quantity with proven BMPs 3. Cost: Highly variable based on BMP selected and facility specifics. 4. Data unavailable; facility specific.
b. Environmental factors 1. Effects on Instream flows 2. Effects on Bay and Estuary Inflows and arms of the Gulf of Mexico 3. Wildlife Habitat 4. Wetlands 5. Threatened and Endangered Species 6. Cultural Resources 7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	1. None or low impact. 2. None or low impact. 3. None or low impact. 4. None or low impact. 5. None. 6. No cultural resources affected. 7. None or low impact.
c. Impacts to Agricultural Resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None



5B.3

*Mining Water
Conservation*

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5B.3 Mining Water Conservation

5B.3.1 Description of Strategy

Water for mining uses is primarily associated with oil and gas extraction, coal mining, metal mining, and nonmetallic mineral operations. Gross state domestic product data released from the U.S. Department of Commerce showed mining economic outputs of \$152.5 billion for 2018 and \$203.4 billion for 2023.¹ Individual county data for both 2018 and 2023 is presented below in Table 5B.3.1 for comparison purposes.

Table 5B.3.1.
U.S. Department of Commerce Data – Gross State Domestic Product (GDP):
Mining, Quarrying, and Oil and Gas Extraction

Counties in Region N	Gross State Domestic Product	
	2018 (thousands of dollars)	2023 (thousands of dollars)
Aransas	46,896	29,336
Bee	75,234	71,613
Brooks	108,260	*
Duval	132,631	131,116
Jim Wells	785,949	562,049
Kenedy	123,249	*
Kleberg	51,330	38,795
Live Oak	824,939	1,535,180
McMullen	1,736,373	1,823,713
Nueces	762,589	588,191
San Patricio	119,211	166,553

* Data not provided by BEA due to confidentiality; estimates are included in higher-level totals for the state.

The TWDB water demand projections for mining users are generally based on projected economic output, assuming past and current water use trends remain constant over time. The mining water demand projections used in this plan for the Coastal Bend Region were provided by the TWDB and differed from those presented in the 2021 Coastal Bend Regional Water Plan. For 2030, the projected demands in this planning cycle are approximately 30 percent less than those shown in the 2021 Coastal Bend Regional Water Plan (9,821 ac-ft/yr decreased to 6,960 ac-ft/yr in 2030). In the Coastal Bend Region, the trends for mining water demands are projected to increase during 2030 to 2070 with a maximum demand of 7,058 ac-ft and then decrease after 2070 to a minimum of 1,026 ac-ft/yr in 2080 as shown in Figure 5B.3.1. The decrease in water demand is due to the anticipated slowdown of Eagle Ford Shale mining activities in the Coastal Bend Region. Also, McMullen County has the largest projected mining water demands by TWDB, constituting over half of the regional mining water demand during 2030 (Figure 5B.3.2), as well as the highest GDP in the Coastal Bend Region, as shown above in Table 5B.3.1.

¹ Bureau of Economic Analysis, U.S. Department of Commerce.

In the Coastal Bend Region, all counties receive their full mining supply from groundwater sources. Based on a virtual meeting held on September 24, 2024, with Lonnie Stewart (General Manager, Live Oak Underground Water Conservation District), mining companies also construct and operate non-commercial recycling ponds to provide additional water supply; recycled water use from these ponds varies from 15 to 70 percent. Mining activities along with their use of non-commercial recycling ponds are regulated by the Texas Railroad Commission. Existing groundwater supplies were based on TCEQ reported well capacity, when available. In most cases, however, mining well capacity information was not publicly available. For this reason, mining groundwater supplies were calculated based on highest use from recent TWDB historical water use records (2010-2020) subject to MAG (i.e., groundwater availability).

For the 2026 Coastal Bend Regional Water Plan, nine of the eleven counties in the Coastal Bend Region have projected mining needs: Bee, Brooks, Duval, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio counties, as shown in Table 5B.3.2. Overall, shortages in the region peak in 2040 and show a surplus by 2080 due to the reduction in mining water demands expected with reductions in Eagleford shale activities. However, the greatest mining shortage (2,809 ac-ft/yr) is shown for McMullen County during 2030-2070.

TWDB rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The TWDB has provided information on industrial water conservation BMPs, for consideration in the development of the water conservation WMS including a [Best Management Practice Guides for Industrial Water Users](#).

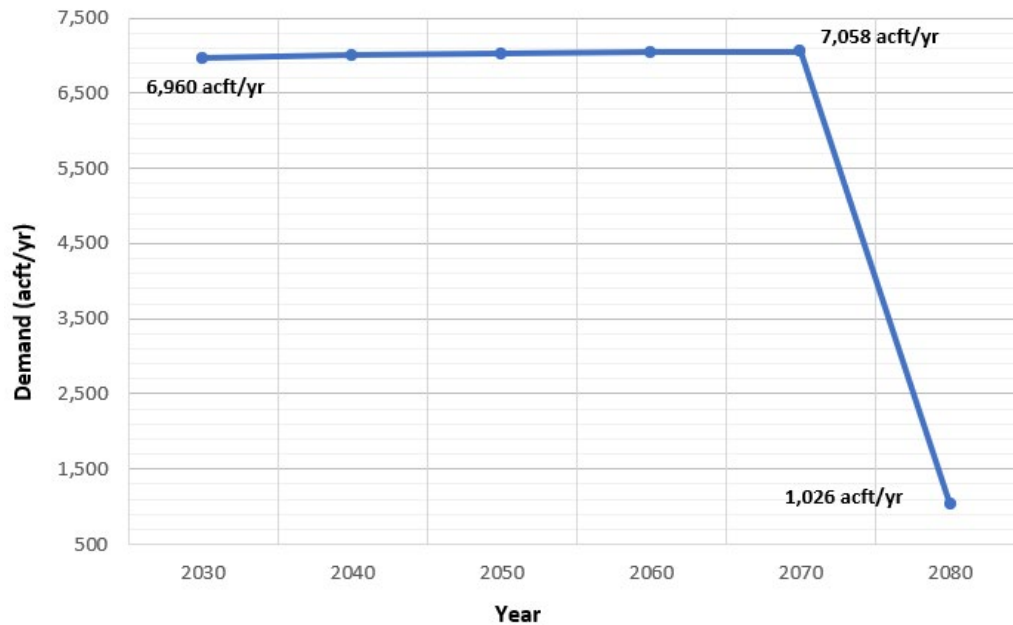


Figure 5B.3.1
Coastal Bend Region Mining Water Demand Projections

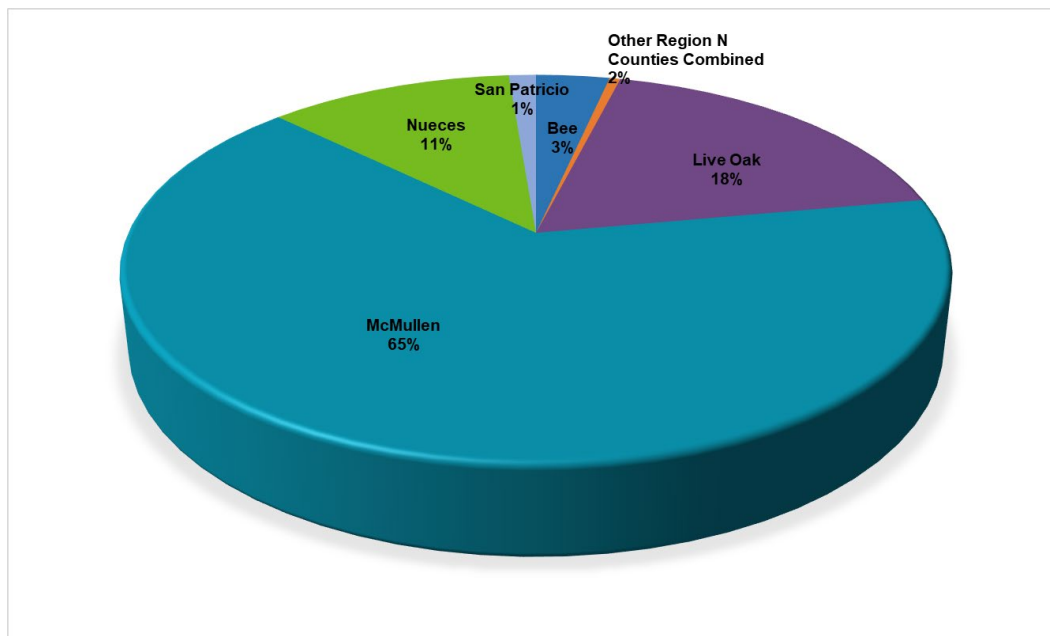


Figure 5B.3.2.
2030 Percentages of Mining Water Demand by County
Total Demand for Coastal Bend Region – 6,960 ac-ft

Table 5B.3.2.
Projected Water Demands, Supplies, and Water Needs (Shortages)
for Mining Users in Bee, Brooks, Duval, Kenedy, Kleberg, Live Oak, McMullen, Nueces,
and San Patricio Counties

-	Mining Projections (ac-ft/yr)					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Bee County						
Mining Demand	239	239	239	239	239	0
Mining Existing Supply						
Groundwater	74	74	74	74	74	0
Surface Water	0	0	0	0	0	0
Reuse	7	7	7	7	7	0
Total Mining Supply	81	81	81	81	81	0
Surplus (Shortage)	(158)	(158)	(158)	(158)	(158)	0
Brooks County						
Mining Demand	16	16	16	16	16	16
Mining Existing Supply						
Groundwater	16	16	16	16	16	16
Surface Water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Mining Supply	16	16	16	16	16	16
Surplus (Shortage)	0	0	0	0	0	0
Duval County						
Mining Demand	6	6	6	6	7	7
Mining Existing Supply						
Groundwater	6	6	6	6	7	7
Surface Water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Mining Supply	6	6	6	6	7	7
Surplus (Shortage)	0	0	0	0	0	0
Kenedy County						
Mining Demand	3	3	3	3	3	3
Mining Existing Supply						
Groundwater	2	2	2	2	2	2
Surface Water	0	0	0	0	0	0
Reuse	1	1	1	1	1	1
Total Mining Supply	3	3	3	3	3	3
Surplus (Shortage)	0	0	0	0	0	0



-	Mining Projections (ac-ft/yr)					
	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	2070 (ac-ft)	2080 (ac-ft)
Kleberg County						
Mining Demand	10	10	10	10	10	10
Mining Existing Supply						
Groundwater	9	9	9	9	9	9
Surface Water	0	0	0	0	0	0
Reuse	1	1	1	1	1	1
Total Mining Supply	10	10	10	10	10	10
Surplus (Shortage)	0	0	0	0	0	0
Live Oak County						
Mining Demand	1,264	1,264	1,264	1,264	1,264	2
Mining Existing Supply						
Groundwater	674	674	674	674	674	674
Surface Water	0	0	0	0	0	0
Reuse	590	590	590	590	590	590
Total Mining Supply	1,264	1,264	1,264	1,264	1,264	1,264
Surplus (Shortage)	0	0	0	0	0	1,262
McMullen County						
Mining Demand	4,538	4,538	4,538	4,538	4,538	1
Mining Existing Supply						
Groundwater	506	506	506	506	506	506
Surface Water	0	0	0	0	0	0
Reuse	1,223	1,223	1,223	1,223	1,223	1,223
Total Mining Supply	1,729	1,729	1,729	1,729	1,729	1,729
Surplus (Shortage)	(2,809)	(2,809)	(2,809)	(2,809)	(2,809)	1,728
Nueces County						
Mining Demand	796	835	858	876	887	893
Mining Existing Supply						
Groundwater	708	737	765	792	792	792
Surface Water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Mining Supply	708	737	765	792	792	792
Surplus (Shortage)	(88)	(98)	(93)	(84)	(95)	(101)
San Patricio County						
Mining Demand	88	90	92	93	94	94
Mining Existing Supply						
Groundwater	88	90	92	93	94	94
Surface Water	0	0	0	0	0	0
Reuse	0	0	0	0	0	0
Total Mining Supply	88	90	92	93	94	94
Surplus (Shortage)	0	0	0	0	0	0

5B.3.2 Available Yield

All mining entities in the Coastal Bend Region are encouraged to conserve water.

Of the nine counties in the Coastal Bend Region with mining water demands, only three counties show shortages (Table 5B.3.2) this planning cycle compared to nine counties showing shortages in the 2021 Coastal Bend Regional Water Plan. The CBRWPG recommends that all counties with projected mining water demands (regardless of need or shortage) to target reducing their mining water demands by 15 percent by 2080. Based on this approach, the region achieves a max savings of 882 ac-ft by 2070 which then declines to 153 ac-ft by 2080, as shown in Table 5B.3.3. The CBRWPG-recommended water conservation goal alone is insufficient to fully address mining shortages in Region N during 2030-2080, and additional strategies are considered to address this projected supply deficit (see Chapter 5B).

Table 5B.3.3.
Projected Water Demands Considering a 15 Percent Reduction by 2080 for All Mining Users; Additional Needs (Shortages) Shown for Bee, McMullen, and Nueces Counties

-	Projections (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Bee County						
New Demand (after conservation)	233	227	221	215	209	0
Expected Savings	6	12	18	24	30	0
New Mining Shortage (after recommended conservation)	(152)	(146)	(140)	(134)	(128)	0
Shortage Reduction (ac-ft/yr)	4%	8%	11%	15%	19%	N/A
Brooks County						
New Demand (after conservation)	16	15	15	14	14	14
Expected Savings	0	1	1	2	2	2
Balance After Conservation (ac-ft/yr)	0	1	1	2	2	2
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Duval County						
New Demand (after conservation)	6	6	6	5	6	6
Expected Savings	0	0	0	1	1	1
Balance After Conservation (ac-ft/yr)	0	0	0	1	1	1
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Kenedy County						
New Demand (after conservation)	3	3	3	3	3	3
Expected Savings	0	0	0	0	0	0
Balance After Conservation (ac-ft/yr)	0	0	0	0	0	0
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Kleberg County						
New Demand (after conservation)	10	9	9	9	9	8
Expected Savings	0	1	1	1	1	2
Balance After Conservation (ac-ft/yr)	0	1	1	1	1	2
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Live Oak County						
New Demand (after conservation)	1,232	1,201	1,169	1,138	1,106	2
Expected Savings	32	63	95	126	158	0
Balance After Conservation (ac-ft/yr)	32	63	95	126	158	1,262
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
McMullen County						
New Demand (after conservation)	4,425	4,311	4,198	4,084	3,971	1
Expected Savings	113	227	340	454	567	0
New Mining Shortage (after recommended conservation)	(2,696)	(2,582)	(2,469)	(2,355)	(2,242)	0
Shortage Reduction (ac-ft/yr)	4%	8%	12%	16%	20%	N/A
Nueces County						
New Demand (after conservation)	776	793	794	788	776	759
Expected Savings	20	42	64	88	111	134
New Mining Shortage (after recommended conservation)	(68)	(56)	(29)	4	16	33

-	Projections (ac-ft/yr)					
	2030	2040	2050	2060	2070	2080
Shortage Reduction (ac-ft/yr)	23%	43%	69%	N/A	N/A	N/A
San Patricio County						
New Demand (after conservation)	86	85	85	84	82	80
Expected Savings	2	5	7	9	12	14
Balance After Conservation (ac-ft/yr)	2	5	7	9	12	14
Shortage Reduction (ac-ft/yr)	N/A	N/A	N/A	N/A	N/A	N/A
Total Mining Savings (Region N)	173	351	526	705	882	153

The TWDB lists the following industrial BMPs that may be used to achieve the recommended water savings²:

1. Industrial Water Audit
2. Industrial Water Waste Reduction
3. Industrial Submetering
4. Cooling Towers
5. Cooling Systems (other than Cooling Towers)
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water
7. Rinsing/Cleaning
8. Water Treatment
9. Boiler and Steam Systems
10. Refrigeration (including Chilled Water)
11. Once-Through Cooling
12. Management and Employee Programs
13. Industrial Facility Landscaping
14. Industrial Site Specific Conservation

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5B.3.4. TWDB describes how the BMPs reduce water use; however, information regarding specific water savings and costs to implement conservation programs is generally unavailable since conservation savings and costs are facility and process specific. .

² TWDB website: <https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp>

Table 5B.3.4.
Costs and Savings of Possible Mining Water Conservation Techniques (BMPs)

Best Management Practices		Water Savings Estimates				Cost Estimates				Assumptions/Notes
		Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
1	Industrial Water Audit	10	35	22.5	%	-	-	-	-	
2	Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	
3	Industrial Sub-metering	-	-	-	-	-	-	-	-	
4	Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
5	Cooling Systems (other than Cooling Towers)	-	90	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
6	Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	
7	Rinsing/Cleaning	-	-	-	-	-	-	-	-	
8	Water Treatment	10	85	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
9	Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
10	Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	
11	Once-Through Cooling	-	-	-	-	-	-	-	-	
12	Management and Employee Programs	-	-	-	-	-	-	-	-	
13	Industrial Facility Landscaping	-	-	15	%	-	-	-	-	
14	Industrial Site Specific Conservation	10	95	52.5	%	-	-	-	-	Savings vary widely - from water audits to changing from potable to recycled water.

5B.3.3 Environmental Issues

The TWDB BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making changes to wildlife habitat. Thus, the proposed conservation practices do not have anticipated potential adverse effects, and in fact have potentially beneficial environmental effects.

5B.3.4 Engineering and Costing

The CBRWPG recommends implementing voluntary water conservation for all mining users regardless of need to reduce their water demand by 15 percent by 2080. The Coastal Bend Region achieves a max savings of 882 ac-ft/yr in 2070 with this approach. Costs to implement BMPs vary from site to site, and the Region recognizes that mining industries will pursue conservation strategies that are economically feasible with water savings benefits. As a result, the assumptions used for the costing methodology are based on the additional guidance provided by TWDB. Cost estimates assume that an average water demand of 1,000 acft/yr equates to a \$10,000 water audit cost, with a minimum cost of \$2,000. In addition, one audit will be conducted every five years, and implementation of these audits will occur by 2030. Estimated total annual costs, based on the projected water demands and expected water conservation savings (Table 5B.3.4), are summarized below in Table 5B.3.5.

Table 5B.3.5.
2026 Total Annual Costs from Implementation of Best Management Practices

WUG	Total Annual Costs (\$/year)					
	2030	2040	2050	2060	2070	2080
Bee County	\$400	\$400	\$400	\$400	\$400	\$0
Brooks County	\$0	\$400	\$400	\$400	\$400	\$400
Duval County	\$0	\$0	\$0	\$400	\$400	\$400
Kenedy County	\$0	\$0	\$0	\$0	\$0	\$0
Kleberg County	\$0	\$400	\$400	\$400	\$400	\$400
Live Oak County	\$640	\$1,260	\$1,900	\$2,520	\$3,160	\$0
McMullen County	\$2,260	\$4,540	\$6,800	\$9,080	\$11,340	\$0
Nueces County	\$400	\$400	\$400	\$400	\$400	\$400
San Patricio County	\$400	\$400	\$400	\$400	\$400	\$400

5B.3.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Coastal Bend Region. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for mining water conservation, and it is being implemented at a steady pace. As water markets for conserved water expand, this practice will likely reach a greater



potential. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

5B.3.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.3.6.

Table 5B.3.6.
Evaluation Summary of Mining Water Conservation

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Firm Yield: Variable; Max of 882 ac-ft/yr (2070)
2. Reliability	2. Reliable quantity with proven BMPs
3. Cost of Treated Water	3. Cost: Highly variable from \$400 to \$11,340 per ac-ft based on BMP selected and facility specifics.
4. Estimated Water Losses	4. Data unavailable; facility specific
b. Environmental factors	
1. Effects on Instream flows	1. None or low impact.
2. Effects on Bay and Estuary Inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids	
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other water quality constituents	
c. Impacts to Agricultural Resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None



5B.4

Reuse

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Section 5B.4 Reuse

5B.4.1 Nueces River Authority Petronila Regional Wastewater Treatment Plant Reuse

5B.4.1.1 Description of Strategy

Water reuse is a strategy that treats wastewater to a safe and suitable extent based on the reuse application, such as potable or non-potable applications. The Nueces River Authority is consolidating local wastewater flows into a regional wastewater treatment plant (WWTP), Petronila Regional WWTP, to replace failing WWTPs and septic systems in Bishop, Driscoll, Banquete, and Robstown.

The Bishop WWTP is permitted to discharge through Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0011541002, an average of 0.32 million gallons per day (mgd) directly to Carreta Creek, which drains to San Fernando Creek, then the Cayo del Grullo portion of Baffin Bay/Alazan Bay/Cayo del Grullo/Laguna Salada in Segment No. 2492 of the Bays and Estuaries. The Driscoll WWTP is permitted to discharge (TPDES Permit No. WQ0010427001) an average of 0.10 mgd directly to Petronila Creek Above Tidal in Segment No. 2204 of the Nueces-Rio Grande Coastal Basin. The Banquete WWTP is permitted to discharge (TPDES Permit No. WQ0011583002) an average of 0.10 mgd directly to Banquete Creek, thence to Petronila Creek Above Tidal in Segment No. 2204 of the Nueces-Rio Grande Coastal Basin. The Robstown WWTP is permitted (TPDES Permit No. WQ0010261001) to not exceed an annual average flow of 2.4 mgd. The discharge flows through an unnamed ditch, to Oso Creek, then Oso Bay in Segment No. 2485 of the Bays and Estuaries.

The Nueces River Authority is considering developing up to 1 mgd from Petronila Creek Regional WWTP as a non-potable Type I reuse supply to serve Nueces County industries. The project layout is shown in Figure 5B.4.1. It is assumed that the source water for the reuse project would originate from Robstown WWTP and a 2.4-mile pipeline would be needed to convey wastewater flow to the proposed Petronila Regional WTP. For this supply option, only the 1 mgd Type I reuse plant is costed. The construction and costing of the total Petronila Regional WWTP and conveyance to associated wetlands are not included in this strategy.

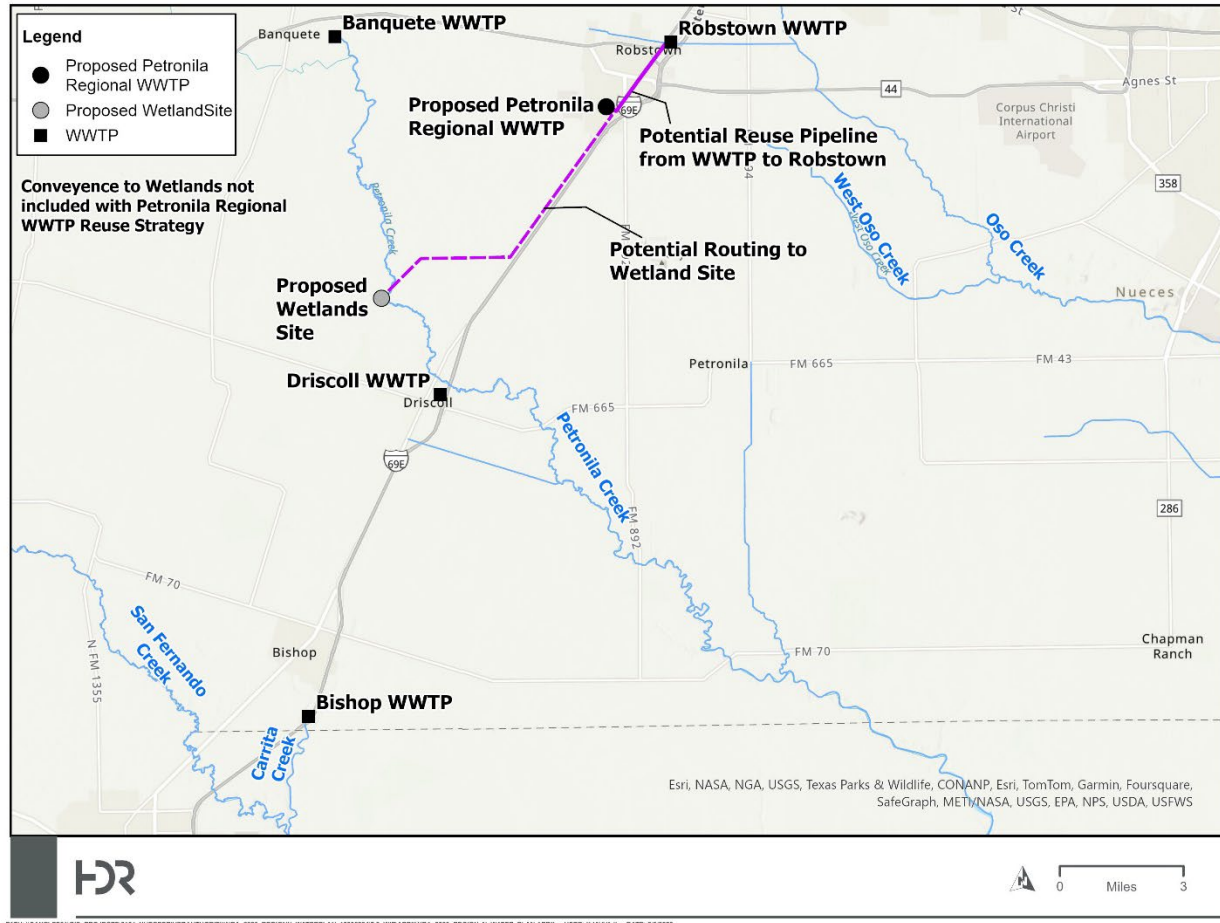


Figure 5B.4.1.
Project Layout of the Petronila Regional Wastewater Reuse Project

5B.4.1.2 Texas Administrative Code, Chapter 210 – Use of Reclaimed Water

There are two general qualities of treated wastewater allowed for reclaimed water use under Texas Commission on Environmental Quality (TCEQ) rules, Chapter 210. These are grouped and defined as Type I and Type II uses.

Broadly defined, Type I reclaimed water quality is required where contact between humans and the reclaimed water is likely. The type of water uses for which Type I reclaimed water could be generally used are:

- Residential irrigation;
- Urban irrigation for public parks, golf courses with unrestricted public access, school yards or athletic fields;
- Fire protection;

- Irrigation of food crops where the reclaimed water may have direct contact with the edible part of the crop;
- Irrigation of pastures for milking animals;
- Maintenance of water bodies where recreation may occur;
- Toilet or urinal flushing; and
- Other similar activities where unintentional human exposure may occur.

Type I water can also be used for all Type II uses listed below.

Type II water quality is where such human contact is unlikely. The type of water uses that would generally be considered as eligible for Type II reclaimed water are:

- Irrigation of sod farms, silviculture, limited access highway rights-of-way, and other areas where human access is restricted (restricted access can include remote sites, fenced or walled borders with controlled access, or the site not being used by the public when normal irrigation operations are in process);
- Irrigation of food crops where the reclaimed water is not likely to have direct contact with the edible part of the crop;
- Irrigation of animal feed crops, other than pasture for milking animals;
- Maintenance of water bodies where direct human contact is unlikely;
- Certain soil compaction or dust control uses;
- Cooling tower makeup water;
- Hydraulic fracking; and
- Irrigation or other non-potable uses of reclaimed water at a wastewater treatment facility; and

At a minimum, the TCEQ requires that the reclaimed water will be of the quality specified in the rules (Table 5B.4.1).

Table 5B.4.1.
Quality Standards for Using Reclaimed Water (30-day Average)

Constituent	Standard
Type I	
BOD ₅ or CBOD ₅	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	75 CFU/100 mL (single grab sample)
Enterococci	4 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	9 CFU/100 mL (single grab sample)
Type II Other than Pond Systems	
BOD ₅	20 mg/L
or CBOD ₅	15 mg/L
Fecal Coliform	200 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	800 CFU/100 mL (single grab sample)
Enterococci	35 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	89 CFU/100 mL (single grab sample)
Type II Pond Systems	
BOD ₅	30 mg/L
Fecal Coliform	200 CFU/100 mL (geometric mean)
Fecal Coliform (not to exceed)	800 CFU/100 mL (single grab sample)
Enterococci	35 CFU/100 mL (geometric mean)
Enterococci (not to exceed)	89 CFU/100 mL (single grab sample)

Source: TAC §210.33 - accessed January 2025

mg/L = milligrams per liter

BOD₅ = Biochemical Oxygen Demand (5-day)

C/BOD₅ = Carbonaceous Biochemical Oxygen Demand (5-day)

CFU/100 ml = Colony Forming Units per 100 milliliter

5B.4.1.3 Available Yield

Nueces River Authority is considering project to generate 1 mgd (1,120 acre-feet per year [ac-ft/yr]) reuse supply from Petronila Regional WWTP for Nueces County-Manufacturing. The reuse water will be non-potable, Type I.

5B.4.1.4 Environmental Issues

The proposed Petronila project would combine four failing WWTPs into one regional facility and would be designed to meet TCEQ reclaimed water regulations along with applicable effluent discharge permit limits. Approximately 1 mgd of the WWTP effluent would be reused for non-potable purposes by Nueces County industries. The remaining approximately 3 mgd would be returned to wetlands that will flow down Petronila Creek into Baffin Bay. Water from the proposed WWTP would discharge to Petronila Creek (TCEQ Segment 2204) and would flow downstream through Petronila Creek Tidal (TCEQ Segment 2203). These segments are both

listed as impaired on the TCEQ 2024 Draft 303(d) List¹ for bacteria in water (recreation use). A study conducted by the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University Corpus Christi indicated that 60 percent of pollutants flowing through Petronila Creek and into Baffin Bay are the direct result of failing municipal WWTPs and failing residential septic systems². Water from Petronila Creek enters Baffin Bay/Alazan Bay/Cayo del Grullo/Laguna Salada (TCEQ Segment 2492) which was not currently listed as impaired³. The proposed project would be expected to improve the water quality in Petronila Creek and downstream by closing failing municipal WWTPs and providing riparian treatment for agricultural and wildlife nutrient loading.

According to the Texas Parks and Wildlife Department's annotated county list of rare species for Nueces County, there is potential for 50 state-listed endangered or threatened species and 28 federally-listed endangered, threatened, proposed endangered, or candidate species to occur within the county. The listed species for Nueces County are included in Table 5B.4.7, located in Section 5B.4.3.3. A field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

Additional studies including a delineation of waters of the United States, a habitat assessment for threatened and endangered species, and cultural resources investigations should be completed early in the design phase to assist with proper siting of WWTP and associated structures and pipelines. Proper siting can avoid and minimize impacts to sensitive resources. Using sites that have previously been disturbed can minimize impacts to wildlife habitat. Coordination with the Texas Historical Commission may be required in accordance with the Texas Antiquities Code and/or Section 106. Studies should be conducted to ensure that adequate water would reach Baffin Bay and water quality would be compatible with maintaining biological processes since estuaries are important as migratory bird use areas, wetlands, and marine fish and invertebrate nursery areas. Impacts to downstream threatened and endangered species should be considered.

5B.4.1.5 Engineering and Costing

The effluent wastewater needs to be treated to reach standards shown in Table 5B.4.1. To estimate the treatment required to reach non-potable Type I reclaimed water, a Level 2 treatment level was utilized in the Uniform Costing Model (UCM). The level 2 treatment process includes alum and polymer addition, rapid mix, flocculation, filtration, and disinfection.

5B.4.1.6 Non-potable Reuse, Type I Cost Estimate

The planning-level cost estimate includes:

¹ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List. Accessed online [2024 Texas IR 303\(d\) List](#) February 5, 2025.

² Partnership for Petronila, 2025. Partnership for Petronila Building a Sustainable Wastewater Treatment Facility . . . Together Brochure.

³ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List. Accessed online [2024 Texas IR 303\(d\) List](#) February 5, 2025.

- Level 2 (Simple Filtration) Treatment
 - Alum and polymer addition
 - Rapid mix
 - Flocculation
 - Filtration
 - Disinfection
- Yield of 1 MGD
- 12,735-foot pipeline and associated pump station to deliver water from Petrolina Regional WWTP to Robstown WWTP

A cost estimate is shown in Table 5B.4.2. The total project cost is approximately \$13,228,000. The annual cost is \$1,554,000. The unit cost of water is estimated to be \$1,388 per acre-foot (ac-ft).

Table 5B.4.2.
Cost Estimate Summary, Petronila WWTP Reuse (Sept 2023 Prices)

Item	Estimated Costs
Booster Pump Station (1 MGD)	\$896,000
Transmission Pipeline (10 in. dia., 2.4 miles)	\$2,411,000
Water Treatment Plant (1 MGD)	\$5,599,000
Integration, Relocations, Backup Generator & Other	\$12,000
Total Cost of Facilities	\$8,918,000
Engineering:	
- Planning (3%)	\$268,000
- Design (7%)	\$624,000
- Construction Engineering (1%)	\$89,000
Legal Assistance (2%)	\$178,000
Fiscal Services (2%)	\$178,000
Pipeline Contingency (15%)	\$362,000
All Other Facilities Contingency (20%)	\$1,301,000
Environmental & Archaeology Studies and Mitigation	\$72,000
Land Acquisition and Surveying (20 acres)	\$63,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$1,175,000
Total Cost of Project	\$13,228,000
Debt Service (3.5 percent, 20 years)	\$930,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$24,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$22,000
Water Treatment Plant	\$560,000
Pumping Energy Costs (198025 kW-hr @ 0.09 \$/kW-hr)	\$18,000
Total Annual Cost	\$1,554,000
Available Project Yield (acft/yr)	1,120
Annual Cost of Water (\$ per acft)	\$1,388
Annual Cost of Water After Debt Service (\$ per acft)	\$557
Annual Cost of Water (\$ per 1,000 gallons)	\$4.26

Item	Estimated Costs
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$1.71

5B.4.1.7 Implementation Issues

No major implementation issues have been identified for the Petronila Regional WWTP Reuse project. TCEQ water quality criteria for reclaimed water will need to be met according to rules. Project implementation will need to be done to meet with public health standards and protection.

Cultural resources will need to be investigated along the pipeline routes and proposed sites and avoided where possible. Implementation of this alternative should be considered in conjunction with local stakeholders.

5B.4.1.8 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.4.3

Table 5B.4.3.
Evaluation Summary of Petronila Regional WWTP Project

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Yield: 1,120 ac-ft/yr
2. Reliability	2. Reliable, based on system operations
3. Cost of Treated Water	3. Non-Potable Type I: \$1,388 per ac-ft
b. Environmental factors	
1. Instream flows	1. Reduced flow in Oso Creek. Potential for environmental impacts to streams currently receiving wastewater effluent.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Environmental impact to estuary in potential reduction of freshwater inflows.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None or low impact.
6. Cultural Resources	6. Cultural resources investigations will be required for all pipeline routes.
7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a. Dissolved solids are estimated to be around 2,000 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. b. Salinity are addressed for non-potable use. If water use needed is potable, additional treatment will be required. c. Bacteria is addressed with treatment process. d. Chlorides are estimated to be around 750 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. e-h. None or low impact i. Nitrate, TSS, TOC, and Mn addressed with treatment processes.
c. Impacts to agricultural resources and State water resources	• No negative impacts on other water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline(s)

Impact Category	Comment(s)
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used for portions
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides reuse opportunities of water supplies
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Additional care should be exercised in construction of pipeline in dense industrial area.

5B.4.2 City of Corpus Christi Greenwood WWTP Direct Potable Reuse

5B.4.2.1 Description of Strategy

In December 2022, City staff initiated a technical study to develop an alternative treatment strategy to treat WWTP effluent for an indirect potable reuse (IPR) system using aquifer storage and recovery (ASR) along with a limited direct potable reuse (DPR) system, included in Section 5B.5 – Aquifer Storage and Recovery. A DPR-only treatment option was also explored to compare the two advanced water supply solutions at the Greenwood WWTP. DPR refers to using treated municipal wastewater and providing additional advanced treatment so that potential chemical and biological contaminants are removed to meet drinking water standards. This alternative was evaluated by (1) developing a layout for a DPR-only system and estimating construction costs, (2) evaluating brine disposal that is generated from reverse osmosis treatment and permitting issues, and (3) preparing a high-level project schedule.

The IPR and DPR-only alternatives differ from the previous 2019 ASR feasibility study in that the reuse goal for this evaluation is to treat the water to potable standards. The City of Corpus Christi continues to face issues with droughts and is evaluating new water supply strategies to address future water demand. The *2021 Coastal Bend Regional Water Plan*⁴ found that the City of Corpus Christi will need to augment their existing water supplies with new water by 2030 to avoid customer shortages. The shortages indicate a need to secure alternative water sources and explore new storage methods such as DPR. Both IPR and DPR are viable options as water supply sources. Environmental permitting is still needed for disposal of waste generated during advanced treatment and will be an important step in implementing either of these strategies.

5B.4.2.2 Available Yield

DPR of Greenwood WWTP effluent has a yield of 4.8 MGD (5,381 ac-ft/yr). The Greenwood WWTP effluent must undergo additional treatment as shown in Figure 5B.4.2. to reach potable standards.

⁴ HDR and Coastal Bend (Region N) Regional Water Planning Group. 2020. 2021 Coastal Bend (Region N) Regional Water Plan, October 2020. Available online: [2021 Regional Water Plans | Texas Water Development Board](#)

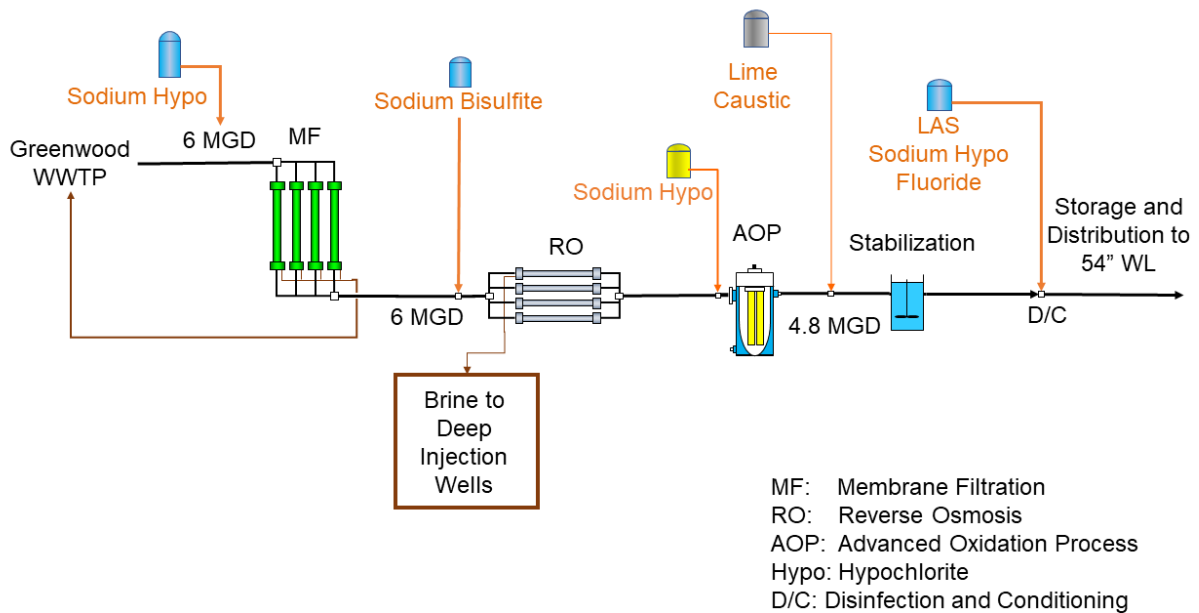


Figure 5B.4.2.

Process flow diagram of aquifer storage and recharge with direct potable reuse treatment

5B.4.2.3 Environmental Issues

The most significant environmental issue associated with the DPR project is repurposing Greenwood WWTP effluent that would otherwise be discharged to Oso Creek. Oso Creek receives treated domestic wastewater from a number of facilities, one industrial facility, three municipal storm sewer systems, four concrete production facilities, and three pesticide plants authorized to discharge. Based on a 3-year average from January 2015 to December 2017, the discharge from Greenwood WWTP was about 5.5 mgd. This represents about 50 percent of discharge to Oso Creek upstream of Davis Power Station. Oso Creek (Segment 2485A), is listed⁵ to have bacteria impairment and water quality concerns of Chlorophyll-a, nitrates, and total P, as shown in Chapter 1, Planning Area Description, Table 1.2. Within the Oso Creek watershed, the most probable sources of bacteria is regulated stormwater, industrial sources, and nonpoint sources.⁶ The Texas A&M University at Corpus Christi Center for Coastal Studies and local stakeholders have formed a group to study Oso Creek and in response, the TCEQ adopted a total maximum daily load⁷ (TMDL) for Oso Creek on July 31, 2019 to monitor and reduce bacterial loads in Oso Creek. The U.S. Environmental Protection Agency (EPA)-approved the TMDL on October 25, 2019, and is now part of the state's Water Quality Management Plan. The Texas State Soil and Water Conservation Board is working to decrease bacterial loads from agriculture by assisting landowners in developing and implementing water quality management plans.

⁵ Nueces River Authority 2019 Basin Highlights Report: San Antonio-Nueces Coastal Basin, Nueces River Basin, Nueces-Rio Grande Coastal Basin. https://www.nueces-ra.org/CP/CRP/pdfs/2019_BHR.pdf

⁶ TCEQ, One Total Maximum Daily Load for Indicator Bacteria in Oso Creek, Adopted July 2019.

⁷ <https://www.tceq.texas.gov/assets/public/waterquality/tmdl/67osocreekbacteria/67-osocreekbacteria.pdf>

Additional studies are needed to evaluate the environmental impact of reducing Greenwood WWTP discharge to use as a supply for DPR.

In addition to diverting flow from Greenwood WWTP, treating the effluent to potable standards requires advanced treatment using reverse osmosis (RO) membranes. RO membranes effectively remove trace contaminants typically found in wastewater effluent as RO separates most dissolved salts, pathogens, and chemicals from the filtered water. Contaminants that may pose risks to aquatic ecosystems or downstream drinking water sources become highly concentrated in the RO brine. The concentration of contaminants increases relative to the amount of water recovered by RO. The estimated composition of the brine exiting the RO membranes for DPR is summarized in Table 5B.4.4. The brine composition was estimated using WWTP effluent data provided by the City and assumed an 80 percent recovery rate in the RO system, resulting in a concentration factor of 5.

Table 5B.4.4.
Estimated Brine Discharge and Total Dissolved Solids (TDS)

Treatment Process	DPR
Brine Flow from Aquifer (MGD)	0
Brine Flow from Direct Reuse (MGD)	1.2
Total (MGD)	1.2
Estimated Total Dissolved Solids (mg/L)	8,555

MGD=million gallons per day; DPR=direct potable reuse

To avoid impacting sensitive ecosystems or nearby drinking water sources, the brine is disposed of in deep injection wells, as shown in Figure 5B.4.3, which requires the City of Corpus Christi to acquire a Class I injection well permit. Disposal of waste by Class I well injection is regulated by TCEQ, and the City of Corpus Christi must obtain the permit, pursuant to the Texas Water Code (TWC), Chapter 27, and the Texas Health and Safety Code (THSC), Chapter 361. As part of construction of the injection well, completion of a well data report also is required.

According to the Texas Parks and Wildlife Department's annotated county list of rare species for Nueces County, there is potential for 50 state-listed endangered or threatened species and 28 federally-listed endangered, threatened, proposed endangered, or candidate to occur within the county. The listed species for Nueces County are included in Table 5B.4.7 located in Section 5B.4.3.3. A field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area for the new brine injection wells or located downstream from the project area in Oso Creek.

Coordination with the Texas Historical Commission may be required in accordance with the Texas Antiquities Code and/or Section 106.

A potential option could include permitting the injection wells under the Class I Underground Injection Code (UIC) General Permit WDWG010000 that provides authorization for use of a Class I injection well to inject nonhazardous brine from a desalination operation or nonhazardous

drinking water treatment residuals. To obtain authorization to construct and operate a Class I well under the General Permit, a Notice of Intent (NOI) is submitted to TCEQ. As part of the general permitting process, TCEQ will review the City of Corpus Christi's compliance history.

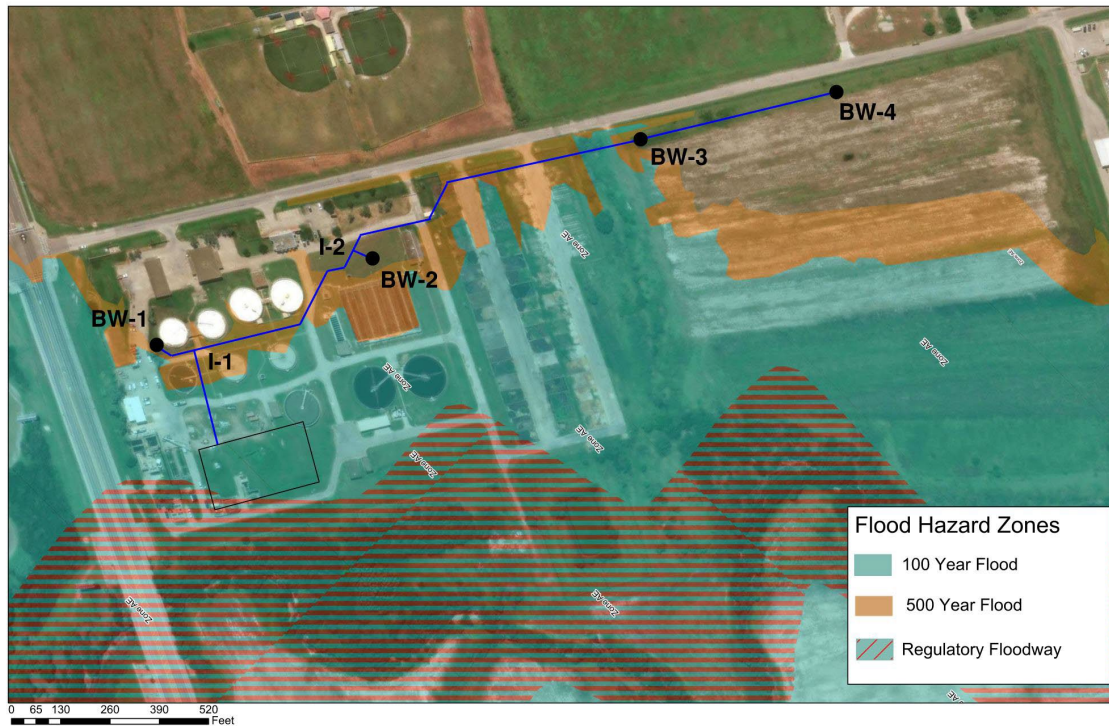


Figure 5B.4.3.
Proposed Reverse Osmosis Brine Well and Piping

If the NOI is administratively complete, TCEQ sends a letter to the City of Corpus Christi acknowledging authorization under the General Permit. The letter would include a unique identification number that has been assigned for each well at the facility that is authorized under the UIC General Permit. If TCEQ denies the City's NOI or authorization to inject waste under the General Permit, TCEQ provides written notice, including a statement of the basis for this decision.

To determine if a general permit or a site-specific permit is most applicable to this project, HDR will communicate further with the City of Corpus Christi regarding items that could affect general permit eligibility, including compliance history.

5B.4.2.4 Engineering and Costing

The effluent wastewater needs to be treated to reach requirements of the Safe Drinking Water Act and TCEQ. The DPR treatment system considers MF, RO, and ultraviolet (UV)/Chlorine advanced oxidation process (AOP). Cost estimates for the advanced treatment technologies (MF, RO, AOP) were provided by Newman Regency Group on March 20, 2023 and April 13, 2023. The cost estimates were evaluated using the Association for the Advancement of Cost Engineering (AACE) Class IV Opinion of Probable Cost level with an expected accuracy of -30

to +50 percent and the Texas Water Development Board's (TWDB) Uniform Costing Model (UCM), using a cost basis for September, 2023. Cost estimates are for review only and are not to be used for any other purpose. Considering recent material shortages and cost volatility, HDR Engineering, Inc. (HDR) cannot guarantee that proposals, bids, or actual construction cost will not vary.

Reverse Osmosis

Reverse osmosis treatment uses high pressure to drive flow through a semipermeable membrane to remove dissolved constituents, like salts and pathogens. RO membranes have a pore size much smaller than MF, at approximately 0.0001 micrometers (μm). As the feed water overcomes the osmotic pressure within the membrane, it produces a filtered flow stream at a recovery rate of 70 to 97 percent depending on operating parameters and the total dissolved solids (TDS) concentration in the feed water. For the analysis in this study a conservative recovery of 80 percent was assumed. The filtered flow stream is nearly devoid of contaminants of concern, making RO membranes highly effective at removing bacteria, viruses, and inorganic contaminants. RO systems have a TDS removal rate of 94 to 98 percent, typically, and produce a concentrated brine stream that can be disposed of through deep injection wells or surface water systems with permit. RO systems are energy intensive systems to operate.

Advanced Oxidation Processes

The AOP system following the RO system uses a high intensity UV light in combination with free chlorine as a chemical oxidant. The oxidant degrades organic compounds and inorganic compounds in the wastewater effluent using highly reactive free radicals produced in the process thus rendering them inactive and incapable of harm.

5B.4.2.5 DPR Cost Estimate

The DPR only configuration planning-level cost estimate includes:

- DPR treatment (6 mgd)
 - MF + RO + UV/Chlorine AOP
- 4.8 MGD pump station at WWTP for potable water distribution
- 1.2 MGD pump station at WWTP for deep well injection
- 4 deep injection wells for reverse osmosis brine
 - 300 gallons per minute (gpm) each injecting to a depth of 3,400 feet
- 18-inch transmission pipeline from potable water pumpstation at WWTP to existing potable water line
- Land acquisition of 10 acres at cost of \$10,000 per acre
- Survey and geotechnical costs estimated at \$55,000 per mile
- Well supervisory control and data acquisition (SCADA) system estimated at 6 percent construction costs

The cost estimate for building treatment facilities, wells, and transmission pipelines to treat 6 mgd of WWTP effluent for DPR is presented in Table 5B.4.5.

The total project cost and annual cost are estimated to be \$78,008,000 and \$12,323,000, respectively. The unit cost of water is estimated to be \$2,290 per ac-ft.

Table 5B.4.5.
Cost Estimate Summary,
City of Corpus Christi – DPR Only Configuration (Sept 2023 Prices)

Item	Estimated Costs
Capital Cost	
Deep Injection Piping (0.5 mi, 8 IN - 12 IN dia.)	\$756,000
Deep Injection Wells (4 wells, 300 gpm, 3,400 ft depth) ¹	\$20,000,000
Potable Water Piping (0.9 mi, 18 IN dia.)	\$2,443,000
DPR Treatment (6 MGD, MF + RO + UV/Chlorine AOP)	\$27,996,000
SCADA	\$1,313,000
Total Cost of Facilities	\$52,508,000
Engineering:	
- Planning (3%)	\$1,575,000
- Design (7%)	\$3,676,000
- Construction Engineering (1%)	\$525,000
Legal Assistance (2%)	\$1,050,000
Fiscal Services (2%)	\$1,050,000
Pipeline Contingency (15%)	\$366,000
All Other Facilities Contingency (20%)	\$10,013,000
Environmental & Archaeology Studies and Mitigation	\$143,000
Land Acquisition and Surveying (18 acres)	\$177,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$6,925,000
Total Cost of Project	\$78,008,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$5,484,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$245,000
Advanced Water Treatment Facility	\$6,455,000
Pumping Energy Costs (1542424 kW-hr @ 0.09 \$/kW-hr)	\$139,000
Total Annual Cost	\$12,323,000
Available Project Yield (acft/yr)	5,381
Annual Cost of Water (\$ per acft)	\$2,290
Annual Cost of Water After Debt Service (\$ per acft)	\$1,271
Annual Cost of Water (\$ per 1,000 gallons)	\$7.03
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$3.90

¹Depth to base of groundwater where total dissolved solids is less than 10,000 mg/L is approximately 2,000 feet, according to *Identification of Potential Brackish Groundwater Production Areas – Gulf Coast Aquifer System* (TWDB Contract Number 1600011947).

5B.4.2.6 Implementation Issues

The deep injection wells required for RO brine disposal will require a Class I injection well permit. Upon receipt of the application for an injection well permit, TCEQ staff date stamp the application and review the application for administrative completeness. The applicant may be contacted by way of an administrative deficiency letter for clarification or additional information at any time during the administrative review.

Within 30 days of the date that the application is determined to be administratively complete, the Chief Clerk mails the Notice of Receipt of Application and Intent to Obtain Permit to the applicant, to potentially affected persons, and to others. The applicant is responsible for newspaper publication of notice of the application in accordance with 30 Texas Administrative Code (TAC) §39.418(b)(1) and §39.651(c). The applicant must also place a copy of the administratively complete application in a public place in accordance with 30 TAC §39.405(g).

TCEQ begins a technical review of the application as soon as the application is administratively complete. As part of the technical review, staff evaluate the applicant's compliance history for the previous 5 years, including the company and facility compliance classification and rating. The applicant may be contacted by way of a technical notice of deficiency letter for clarification or additional information at any time during the technical review. TCEQ will issue no more than two notice of deficiency letters.

After the technical review, TCEQ makes a preliminary decision to issue a permit or recommend denial of the permit. TCEQ delivers the preliminary decision concurrently with the Notice of Application and Preliminary Decision to the applicant, to potentially affected persons, and to others. The applicant is responsible for newspaper publication of the Notice of Application and Preliminary Decision in accordance with 30 TAC §39.419(b) and §39.651(d).

Public comments must be filed with TCEQ within the time period specified in the notice. The public comment period ends 30 days (nonhazardous waste permits) or 45 days (hazardous waste permits) after the last publication of the Notice of Application and Preliminary Decision, except as provided in 30 TAC §55.152. If comments are received, TCEQ prepares a response to comments and files the response to comments with the TCEQ Chief Clerk within 60 days following the close of the comment period in accordance with 30 TAC §55.156. The TCEQ Chief Clerk mails the Executive Director's decision, the Executive Director's response to public comments, instructions for requesting that the Commission reconsider the Executive Director's decision, and instructions for requesting a contested case hearing.

The Executive Director may act on an uncontested application if public notice requirements have been satisfied and the application meets all relevant statutory and administrative criteria in accordance with 30 TAC §50.133. The TCEQ Chief Clerk mails notice of the action and an explanation of the opportunity to file a motion to overturn the Executive Director's action on the application. A motion to overturn must be filed no later than 20 days after the signed permit is mailed to the applicant in accordance with §50.139.

5B.4.2.7 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.4.6.

Table 5B.4.6.
Evaluation Summary of City of Corpus Christi DPR Project

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Yield: 5,381 ac-ft/yr
2. Reliability	2. Reliable, based on system operations
3. Cost of Treated Water	3. \$2,290 per ac-ft
b. Environmental factors	
1. Instream flows	1. Low impact. Reduced flow in Oso Creek.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a. Dissolved solids are estimated to be around 2,000 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. b. Salinity are addressed for non-potable use. If water use needed is potable, additional treatment will be required. c. Bacteria is addressed with treatment process. d. Chlorides are estimated to be around 750 mg/L for non-potable use. If water use needed is potable, additional treatment will be required. - e-h. None or low impact i. Nitrate, TSS, TOC, and Mn addressed with treatment processes.
c. Impacts to agricultural resources and State water resources	• Reduce discharge to Oso Creek.
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Reduce discharge to Oso Creek.
i. Efficient use of existing water supplies and regional opportunities	• Reuses water supply and compatible with regional development.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

5B.4.3 City of Corpus Christi Oso WWTP Reuse

5B.4.3.1 Description of Strategy

The City of Corpus Christi is evaluating alternative water reclamation and reuse applications. DPR could potentially partially satisfy potable water demand increase, especially for manufacturing water use applications, thus minimizing the size and cost of other alternative water supplies that the City of Corpus Christi could add to its portfolio. After evaluating four WWTP sites owned and maintained by the City of Corpus Christi, the City of Corpus Christi determined that Oso WWTP is the most viable location for a DPR plant, as it has the largest volume of effluent available for reuse. The project layout is included in Figure 5B.4.4.

The City of Corpus Christi is in the process of developing a source water characterization report, preparing pilot plant planning and design documents, and summarizing reuse alternatives.

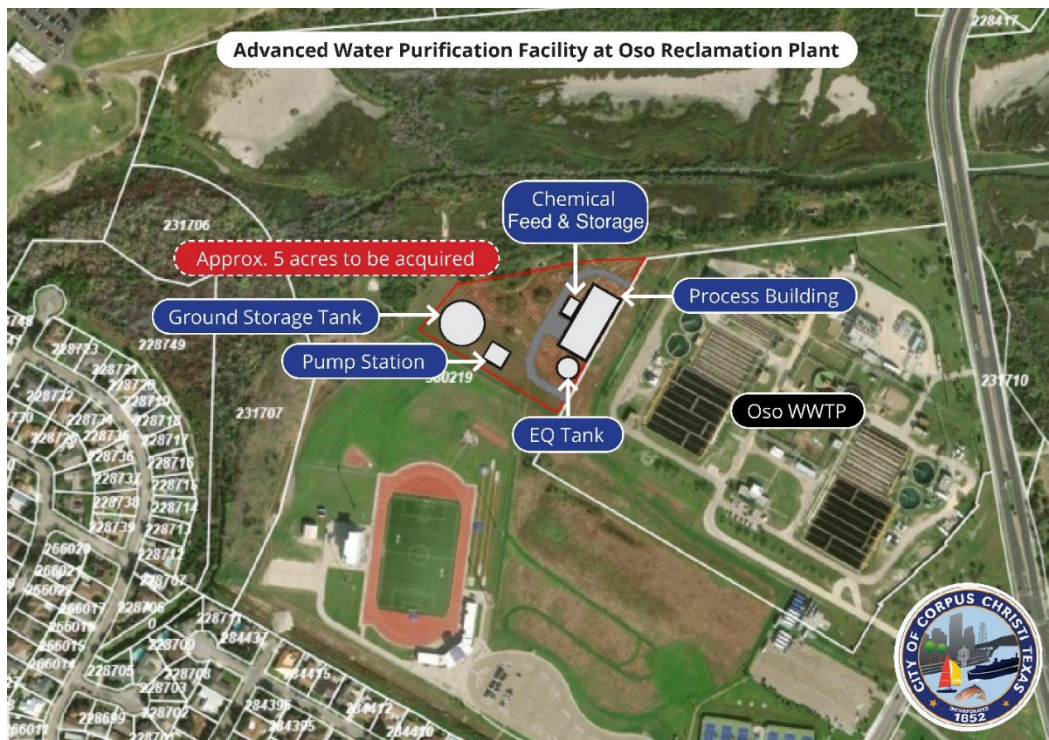


Figure 5B.4.4.
Project layout at Oso WWTP

5B.4.3.2 Available Yield

DPR of Oso WWTP effluent has a yield of 10 MGD (11,201 ac-ft/yr). The Oso WWTP effluent must undergo additional treatment as shown in Figure 5B.4.5. to reach potable standards.

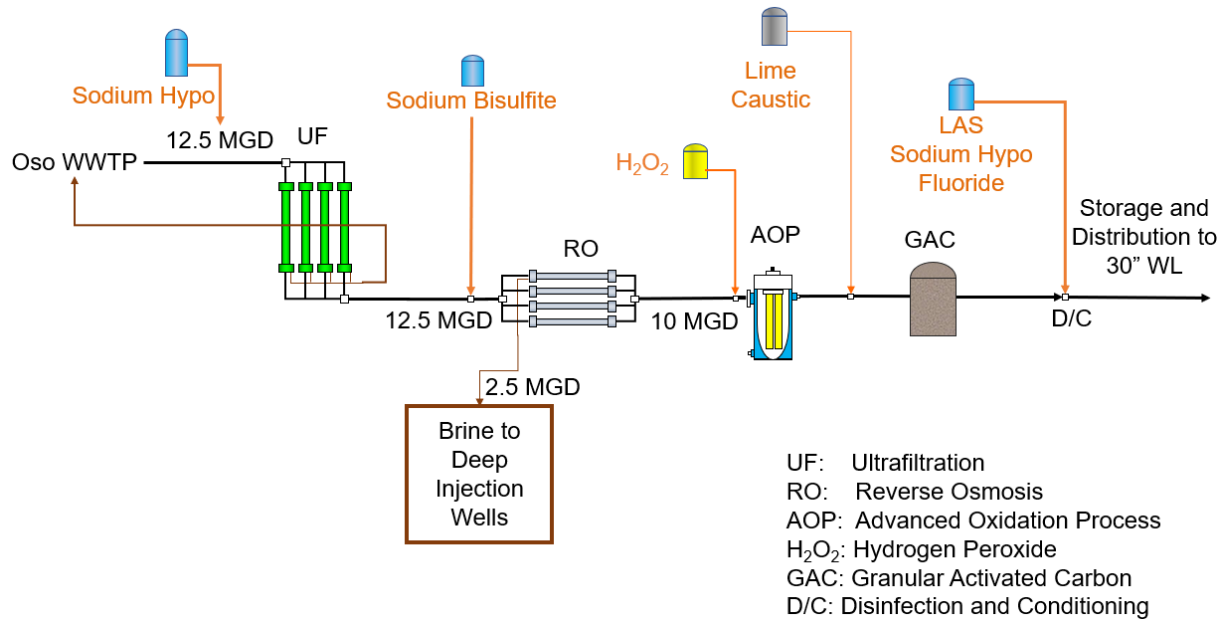


Figure 5B.4.5.
Process flow diagram of DPR treatment at Oso WWTP

5B.4.3.3 Environmental Issues

The proposed Oso Regional WWTP Reuse project would construct an advanced water purification facility with chemical feed and storage, process building, ground storage tank, pump station, and EQ tank on a neighboring 5-acre parcel (to be acquired) to the current Oso WWTP facility. The project would add an approximately 2.3-mile long 30-inch diameter HDPE or PVC pipeline, with connection, to convey treated water to the Ennis Joslin Road and Holly Road intersection. On-site brine disposal is planned to deep injection wells at the treatment facility. Alternatively, discharge to Oso Bay is under evaluation at the time of the writing of this plan. Treatment would be through chemically enhanced ultra-filtration, reverse osmosis, UV-AOP, and peroxide quenching.

The use of deep injection wells for brine disposal would require the City of Corpus Christi to acquire a Class I injection well permit. Disposal of waste by Class I well injection is regulated by TCEQ, and the City of Corpus Christi must obtain the permit, pursuant to the Texas Water Code (TWC), Chapter 27, and the Texas Health and Safety Code (THSC), Chapter 361. As part of construction of the injection well, completion of a well data report also is required.

A potential option could include permitting the injection wells under the Class I Underground Injection Code (UIC) General Permit WDWG010000 that provides authorization for use of a Class I injection well to inject nonhazardous brine from a desalination operation or nonhazardous drinking water treatment residuals. To obtain authorization to construct and operate a Class I well under the General Permit, a Notice of Intent (NOI) is submitted to TCEQ. As part of the general permitting process, TCEQ will review the City of Corpus Christi's compliance history.

Discharge to Oso Bay would require a permit through the Texas Pollutant Discharge Elimination System (TPDES). The Oso WWTP (aka Oso Water Reclamation Plant) is currently permitted to discharge through TPDES Permit No. WQ0010401004, an annual average not to exceed 24 million gallons per day (mgd) directly to Blind Oso Bay (Segment No. 2486 of the Bays and Estuaries). A modification to the permit would likely be necessary to accommodate potential discharge increases from this project.

The majority of the proposed pipeline route runs along Ennis Joslin Road and crosses several potential water features according to the National Wetland Inventory (NWI), including a 4.17-acre freshwater, excavated, permanently flooded pond with a potential perennial channel connection to Oso Bay; and freshwater emergent wetlands with adjacent and connecting to potentially perennial excavated stream. Estuarine and marine intertidal wetland, regularly flooded, and estuarine and marine deepwater subtidal habitats are located adjacent to the north of the Oso WWTP facility.

According to Texas Parks and Wildlife Department's annotated county list of rare species for Nueces County, 50 state-listed endangered or threatened species and 28 federally-listed endangered, threatened, proposed endangered, or candidate species may occur in the county as shown in Table 5B.4.7.

Table 5B.4.7.
Federal- and State-Listed Threatened, and Endangered
Listed for Nueces County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Black rail	<i>Laterallus jamaicensis</i>	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	T	T
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus.	Migrant	E	E
Piping plover	<i>Charadrius melodus</i>	Beaches and flats of coastal Texas.	Migrant	T	T
Reddish egret	<i>Egretta rufescens</i>	Brackish marshes and shallow salt ponds and tidal flats.	Resident	--	T
Red knot	<i>Calidris canutus rufa</i>	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	T	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird. Does nest on sandy beaches and islands.	Migrant	--	T
Swallow-tailed kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
Texas Botteri's Sparrow	<i>Aimophila botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground on low clump of grasses.	Resident	—	T
Tropical parula	<i>Setophaga pitiayumi</i>	Semi-tropical evergreen woodland along rivers and resacas.	Resident	--	T
White-faced ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes.	Resident	--	T
White-tailed hawk	<i>Buteo albicaudatus</i>	Coastal prairies, savannahs and marshes in Gulf Coastal Plain.	Nesting/Migrant	—	T
Whooping crane	<i>Grus Americana</i>	Winters in coastal marshes.	Migrant	E	E
Wood stork	<i>Mycteria Americana</i>	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas.	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time.	Ocean Resident	T	--
Great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Ocean Resident	T	T
Shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico.	Ocean Resident	--	T
Blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, and subpolar waters worldwide, infrequently sighted in the Gulf of Mexico.	Ocean Resident	E	E
Bryde's whale	<i>Balaenoptera iedeni brydei</i>	Habitat description is not available at this time.	Ocean Resident	--	E
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits warm tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide.	Ocean Resident	--	T
False killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics.	Ocean Resident	E	E
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern	Ocean Resident	--	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
		Atlantic Ocean, Gulf of Mexico, and Caribbean.			
Humpback whale	<i>Megaptera novaeangliae</i>	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	E	--
Killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide.	Ocean Resident	--	T
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic.	Ocean Resident	E	E
Ocelot	<i>Leopardus pardalis</i>	Dense chaparral thickets; mesquite-thorn shrub and live oak stands.	Resident	E	E
Pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Rough-toothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters.	Ocean Resident	E	E
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland, and riparian areas are important. Caves are very important.	Resident	PE	--
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters.	Aquatic Resident	T	T
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors and canyons.	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers and marshes, manmade impoundments.	Resident	SAT	--
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Gulf and bay system, warm shallow waters especially in rocky marine environments.	Aquatic Resident	E	E
Green sea turtle	<i>Chelonia mydas</i>	Gulf and bay systems; shallow water seagrass beds.	Aquatic Resident	T	T
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico.	Aquatic Resident	E	E
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Aquatic Resident	E	E
Loggerhead sea turtle	<i>Caretta caretta</i>	Gulf and bay systems for juveniles, adults prefer open waters.	Aquatic Resident	T	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Texas horned lizard	<i>Phrynosoma cornutum</i>	Varied; sparsely vegetated uplands, grass, cactus, brush.	Resident	—	T
Texas scarlet snake	<i>Cemophora coccinea lineri</i>	Mixed hardwood scrub on sandy soils.	Resident	—	T
Texas tortoise	<i>Gopherus berlandieri</i>	Open bush with grass understory; open grass and bare ground avoided.	Resident	—	T
Black lace cactus	<i>Echinocereus reichenbachii var alberti</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy somewhat saline soils on coastal prairie.	Resident	E	E
Slender rush pea	<i>Hoffmanseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes.	Resident	E	E
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils.	Resident	E	E

Source: TPWD, Annotated County List of Rare Species, Nueces County, last updated: January 15, 2025.

PT Proposed Threatened
PE Proposed Endangered
E Endangered

SAT Special Assessment Status
-- Not Listed
T Threatened

Inclusion in Table 5B.4.7 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area counties. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The Hans & Pat Suter Wildlife Refuge is located adjacent to the east of the Oso WWTP. The Texas Historical Commission Historic Sites Atlas lists a historical marker for Karankawa Indians located within the refuge. Via investigations sponsored by the Texas Department of Transportation (TxDOT), extensive archeological deposits and a human burial have been discovered at the Cayo del Oso Site located adjacent to the east of the Oso WWTP, along Ennis Joslin Road, and along the shore of False Oso Bay⁸.

Additional studies including a delineation of waters of the United States, a habitat assessment for threatened and endangered species, and cultural resources investigations should be completed early in the design phase to assist with proper siting of WWTP and associated structures and pipelines. Proper siting can avoid and minimize impacts to sensitive resources. Using sites that have previously been disturbed can minimize impacts to wildlife habitat. Section 404 of the Clean Water Act requires a permit for fill impacts within wetlands and waters of the U.S., and coordination with U.S. Army Corps of Engineers may be required. Coordination with U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department would be required for potential impacts to threatened or endangered species or their habitat. Coordination with Texas

⁸ Jackson, A.T. Et al. 2004. The Cayo del Oso Site (41NU2) Vol. I A Historical Summary of Explorations of a Prehistoric Cemetery on the Coast of False Oso Bay, Nueces County, Texas. Index of Texas Archaeology. TxDOT Report No. 68 and Center for Archeological Research Report No. 350. Accessed online at <https://doi.org/10.21112/ita.2004.1.10>

Historical Commission would be required in accordance with the Texas Antiquities Code and/or Section 106.

Studies should be conducted to ensure that adequate water would reach Oso Bay and water quality would be compatible with maintaining biological processes since estuaries are important as migratory bird use areas, wetlands, and marine fish and invertebrate nursery areas. Impacts to downstream threatened and endangered species should be considered.

5B.4.3.4 Engineering and Costing

The effluent wastewater needs to be treated to reach requirements of the Safe Drinking Water Act and TCEQ. The DPR treatment system considers MF, RO, ultraviolet (UV)/Chlorine advanced oxidation process (AOP), and peroxide quenching. Capital costs were provided by Garver for the advanced treatment facility and potable water pipeline. The total project cost and annual cost were developed using the Texas Water Development Board's (TWDB) Uniform Costing Model (UCM), using a cost basis for September, 2023. Cost estimates are for review only and is not to be used for any other purpose. Considering recent material shortages and cost volatility, HDR Engineering, Inc. (HDR) cannot guarantee that proposals, bids, or actual construction cost will not vary.

Reverse Osmosis

Reverse osmosis treatment uses high pressure to drive flow through a semipermeable membrane to remove dissolved constituents, like salts and pathogens. RO membranes have a pore size of approximately 0.0001 micrometers (μm). As the feed water overcomes the osmotic pressure within the membrane, it produces a filtered flow stream at a recovery rate of 70 to 97 percent depending on operating parameters and the total dissolved solids (TDS) concentration in the feed water. For the analysis in this study a conservative recovery of 80 percent was assumed. The filtered flow stream is nearly devoid of contaminants of concern, making RO membranes highly effective at removing bacteria, viruses, and inorganic contaminants. RO systems have a TDS removal rate of 94 to 98 percent, typically, and produce a concentrated brine stream that can be disposed of through deep injection wells or surface water systems with permit. RO systems are energy intensive systems to operate.

Advanced Oxidation Processes

The AOP system following the RO system uses a high intensity UV light in combination with hydrogen peroxide as a chemical oxidant. The oxidant degrades organic compounds and inorganic compounds in the wastewater effluent using highly reactive free radicals produced in the process thus rendering them inactive and incapable of harm. Following UV/AOP, GAC filtration provides peroxide quenching to prevent interference with downstream processes.

5B.4.3.5 DPR Cost Estimate

The DPR configuration planning-level cost estimate includes:

- DPR treatment (10 MGD treated), including
 - UF + RO + UV/AOP + GAC

- Process building
- Pump station at WWTP for potable water distribution
- Chemical feed and storage equipment
- Storage and equalization tanks
- Land acquisition and improvements
- Brine discharge strategy
- Transmission pipeline from potable water pumpstation at WWTP to existing potable water line
- 89 kW backup generator

The cost estimate for building treatment facilities, wells, and transmission pipelines to treat 10 MGD of WWTP effluent for DPR is presented in Table 5B.4.8. Costs were provided by Garver.

The total project cost and annual cost are estimated to be \$614,038,000 and \$53,871,000, respectively. The unit cost of water is estimated to be \$4,806 per ac-ft.

Table 5B.4.8.
Cost Estimate Summary,
City of Corpus Christi Oso WWTP Reuse (Sept 2023 Prices)

Item	Estimated Costs
Capital Cost	
Potable Water Pipeline*	\$30,000,000
DPR Treatment (10 MGD, UF + RO + UV/Chlorine AOP)* ¹	\$355,000,000
Deep Injection Wells (3 wells, 350 gpm, 5,000 ft depth)	\$30,000,000
Backup Generator	\$48,000
Total Cost of Facilities	\$415,048,000
Engineering:	
- Planning (3%)	\$12,451,000
- Design (7%)	\$29,053,000
- Construction Engineering (1%)	\$4,150,000
Legal Assistance (2%)	\$8,301,000
Fiscal Services (2%)	\$8,301,000
Pipeline Contingency (15%)	\$4,500,000
All Other Facilities Contingency (20%)	\$77,010,000
Environmental & Archaeology Studies and Mitigation ²	\$500,000
Land Acquisition and Surveying (18 acres)	\$178,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$54,546,000
Total Cost of Project	\$614,038,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$43,201,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$600,000
Advanced Water Treatment Facility	\$10,000,000
Pumping Energy Costs (779592 kW-hr @ 0.09 \$/kW-hr), except injection wells	\$70,000
Total Annual Cost	\$53,871,000
Available Project Yield (acft/yr)	11,209
Annual Cost of Water (\$ per acft)	\$4,806
Annual Cost of Water After Debt Service (\$ per acft)	\$952
Annual Cost of Water (\$ per 1,000 gallons)	\$14.75
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$2.92

*Cost provided by Garver

¹Cost includes process building, storage/equalization, pump station, chemical feed and storage, and land acquisition and improvements.

²Cost estimated externally based on nearby wildlife refuge and Cayo del Oso cultural site.

5B.4.3.6 Implementation Issues

The City of Corpus Christi and Nueces River Authority operate Choke Canyon Reservoir and Lake Corpus Christi subject to a 2001 Agreed Order with TCEQ regarding the passage of inflows, releases from the reservoirs, and discharge of return flows to the Nueces Bay and Corpus Christi Bay. The 2001 Agreed Order assumes 54,000 ac-ft of return flows delivered to the Corpus Christi Bay and other receiving estuaries. WWTP discharges contribute to the return

flows, so diverting Oso Creek WWTP effluent may impact bay inflows associated with the Agreed Order.

Table 5B.4.9 shows WWTP effluent flows contributing to the Corpus Christi Bay System and the final receiving water body for each facility. Industrial discharges, not included in Table 5B.4.8, may also be counted as return flows. When considering reported industrial discharges⁹ in the EPA Echo database, the total average effluent discharge from 2022-2025 is estimated at 55,420 ac-ft/yr. Of this amount, approximately 13.39 MGD (or 15,001 ac-ft/yr) is associated with return flows from the Oso WWTP. Additional studies are needed to evaluate the impact of reduced wastewater discharge to the Oso Bay ecosystem.

Table 5B.4.9.
Wastewater Treatment Plant Effluent Flows

WWTP	Receiving Water Body	Average Effluent Discharge ³	
		MGD	Ac-ft/year
Allison ¹	Nueces Bay	3.45	3,866
Broadway ¹	Corpus Christi Bay	3.77	4,227
Greenwood ¹	Oso Bay	5.13	5,748
Oso ¹	Oso Bay	13.39	15,001
Laguna ¹	Corpus Christi Bay	2.08	2,329
Whitecap ¹	Laguna Madre	1.30	1,452
Robstown ²	Oso Bay	0.93	1,041
Mathis ²	Lake Corpus Christi	0.30	336
Portland ²	Nueces Bay	1.67	1,867
Ingleside ²	Corpus Christi Bay	0.67	756
North Mustang Island ²	Corpus Christi Bay	1.00	1,115
Sinton ²	Copano Bay	0.49	549
Beeville ²	Copano Bay	2.07	2,319
Alice ²	Baffin Bay	0.73	819
Kingsville ²	Baffin Bay	1.29	1,446
TOTAL		38.28	42,870

¹Data provided by CCW

²Data accessed via EPA Echo website

³Average effluent flows from May 2022 to May 2025

The deep injection wells required for RO brine disposal will require a Class I injection well permit. Upon receipt of the application for an injection well permit, TCEQ staff date stamp the application and review the application for administrative completeness. The applicant may be contacted by way of an administrative deficiency letter for clarification or additional information at any time during the administrative review.

Within 30 days of the date that the application is determined to be administratively complete, the Chief Clerk mails the Notice of Receipt of Application and Intent to Obtain Permit to the applicant, to potentially affected persons, and to others. The applicant is responsible for

⁹ Includes industrial discharges from the following facilities, averaged over a period from May 2022-May 2025: FHR Corpus Christi West Plant, American Chrome and Chemicals, Buckeye Texas Processing, Citgo Corpus Christi Refinery East Plant, Valero Refining Company East Plant, Equistar Chemicals, Flint Hills Resources Corpus Christi East Refinery, and Valero Corpus Christi Refineries- West Plant.

newspaper publication of notice of the application in accordance with 30 Texas Administrative Code (TAC) §39.418(b)(1) and §39.651(c). The applicant must also place a copy of the administratively complete application in a public place in accordance with 30 TAC §39.405(g).

TCEQ begins a technical review of the application as soon as the application is administratively complete. As part of the technical review, staff evaluate the applicant's compliance history for the previous 5 years, including the company and facility compliance classification and rating. The applicant may be contacted by way of a technical notice of deficiency letter for clarification or additional information at any time during the technical review. TCEQ will issue no more than two notice of deficiency letters.

After the technical review, TCEQ makes a preliminary decision to issue a permit or recommend denial of the permit. TCEQ delivers the preliminary decision concurrently with the Notice of Application and Preliminary Decision to the applicant, to potentially affected persons, and to others. The applicant is responsible for newspaper publication of the Notice of Application and Preliminary Decision in accordance with 30 TAC §39.419(b) and §39.651(d).

Public comments must be filed with TCEQ within the time period specified in the notice. The public comment period ends 30 days (nonhazardous waste permits) or 45 days (hazardous waste permits) after the last publication of the Notice of Application and Preliminary Decision, except as provided in 30 TAC §55.152. If comments are received, TCEQ prepares a response to comments and files the response to comments with the TCEQ Chief Clerk within 60 days following the close of the comment period in accordance with 30 TAC §55.156. The TCEQ Chief Clerk mails the Executive Director's decision, the Executive Director's response to public comments, instructions for requesting that the Commission reconsider the Executive Director's decision, and instructions for requesting a contested case hearing.

The Executive Director may act on an uncontested application if public notice requirements have been satisfied and the application meets all relevant statutory and administrative criteria in accordance with 30 TAC §50.133. The TCEQ Chief Clerk mails notice of the action and an explanation of the opportunity to file a motion to overturn the Executive Director's action on the application. A motion to overturn must be filed no later than 20 days after the signed permit is mailed to the applicant in accordance with §50.139.

5B.4.3.7 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.4.10.

Table 5B.4.10.
Evaluation Summary of City of Corpus Christi Oso WWTP DPR Project

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Yield: 11,209 ac-ft/yr
2. Reliability	2. Reliable, based on system operations
3. Cost of Treated Water	3. \$4,806 per ac-ft
b. Environmental factors	
1. Instream flows	1. Moderate to high impact. Reduced flow in Oso Creek.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Moderate to high impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. Moderate to high impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. Possible impact to Cayo del Oso cultural site.
7. Water Quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. a. Dissolved solids are addressed with treatment processes. b. Salinity is addressed with treatment processes. c. Bacteria is addressed with treatment process. d. Chloride is addressed with treatment process. - e-h. None or low impact i. Nitrate, TSS, TOC, and Mn addressed with treatment processes.
c. Impacts to agricultural resources and State water resources	• Reduce discharge to Oso Creek.
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Reduce discharge to Oso Creek.
i. Efficient use of existing water supplies and regional opportunities	• Reuses water supply and compatible with regional development.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None



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5B.5

Aquifer Storage and Recovery

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Section 5B.5 Aquifer Storage and Recovery

5B.5.1 Description of Strategy

Aquifer storage and recovery (ASR) is a process whereby water is placed into an aquifer for storage to be recovered for beneficial use during a later time when needed. In Texas, treated water is normally recharged into the aquifer through well(s)¹. During recharge and recovery cycles, well screens placed in productive zones for storage allow water to flow through porous areas of the aquifer. The stored water is then recovered and used when water supplies are constrained, such as during drought, periods of high seasonal demands, or water service interruptions. Monitoring wells are used to help maintain a buffer zone within the aquifer between stored and native groundwater and manage storage for supply system operations. ASR can be readily adapted to current infrastructure, delay costly system improvements, and provide supply system redundancy for reliability.

The City of Corpus Christi, in conjunction with the Corpus Christi Aquifer Storage and Recovery Conservation District (District), completed a Corpus Christi ASR Feasibility Project in August 2019. The project was partially funded by a grant from the Texas Water Development Board (TWDB) to study innovative water solutions to promote long term, cost-effective, reliable water supplies for future growth. The work included (1) developing a field-testing plan (2) conducting an exploratory test drilling and sampling program (3) performing a geochemical analysis for source and groundwater compatibility (4) developing a groundwater model and simulating potential ASR operations for long-term drought and supply augmentation during peaking and (5) evaluating ASR operating policies toward project implementation. The final report is accessible on the TWDB website². During the study, both O.N. Stevens water treatment plant (WTP) and Greenwood wastewater treatment plant (WWTP) effluent were evaluated as potential supplies. Based on City of Corpus Christi staff directives, it was determined that Greenwood WWTP effluent was the preferred recharge source due to less competing needs for its use, native groundwater quality considerations, and more frequent availability for recharge than O.N. Stevens WTP water. A conceptual ASR schematic is shown in Figure 5B.5.1.

The first Corpus Christi ASR alternative, also included previously in the *2021 Coastal Bend Regional Water Plan*, upcycles treated effluent from the Greenwood WWTP for beneficial non-potable, industrial water supply during droughts and/or high seasonal demands. Greenwood WWTP effluent is treated and conditioned prior to recharge for storage in the brackish Gulf Coast Aquifer System. After multiple cycles, water quality improves and stored water takes on the characteristics of the recharge water separated by a buffer zone from native groundwater. Based on exploratory testing results, the most favorable ASR storage zones are located between 350 and 800 feet below ground surface. The recovered water quality is estimated to

¹For most previous ASR applications, TCEQ has required treatment to drinking water standards prior to recharge but newer rules passed in 2015 and described in Section 5 of Exhibit G may give some flexibility since both the quality of the effluent relative to drinking water is considered along with the potential to degrade the native groundwater.

²https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/1600011956_Corpus_Christi_ASR.pdf?d=1581391239865

have total dissolved solids (TDS) and chloride levels around 2,000 and 750 milligrams per liter (mg/L), respectively. Reverse osmosis (RO) treatment can be added to reduce TDS and chloride levels.

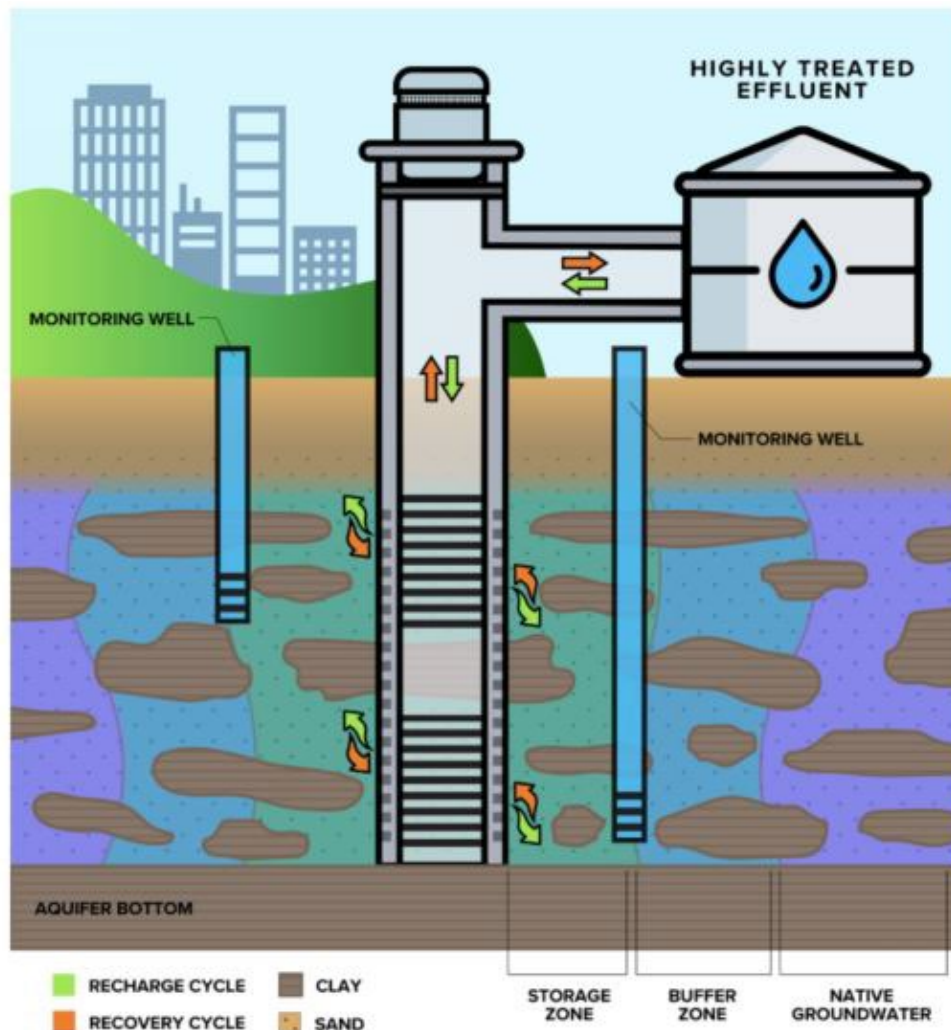


Figure 5B.5.1.
Conceptual ASR Process

For ASR projects, it is important to evaluate source water compatibility with native groundwater and aquifer mineralogy to avoid adverse mechanical and chemical processes with project implementation. The geochemical analysis did not identify any fatal flaws; however, pilot testing of tertiary treatment of WWTP effluent is needed prior to aquifer recharge and monitoring during pilot testing will be critical in proving up geochemical desk-top analyses prior to full scale project implementation and remove suspended materials to avoid clogging the fine sand in aquifer formation for storage. Prior to implementation, a piloting program is needed to verify field tests and confirm water treatment processes necessary to obtain a Texas Commission on Environmental Quality (TCEQ) permit for ASR production, which requires that the source water for recharge to be treated to a sufficient quality so as to not impact or impair the aquifer

formation or groundwater. The Greenwood WWTP effluent will need to be improved with additional treatment upgrades to reduce the following constituents in the existing effluent that could affect operations:

- Total Suspended Solids (TSS)
- Nitrate (NO₃)
- Total Organic Carbon (TOC)
- Manganese (Mn)
- Bacteria

A field-scale groundwater model was constructed using site-specific data collected during the exploratory testing program. The model was then used to simulate most likely ASR operational scenarios³ based on source water availability and future water demands in the vicinity of the project site to determine yield. During scenario development, it was determined that industrial water users in the vicinity of the ASR wellfield would be the most likely customers for recovered water. This determination is based on projected future growth and non-potable needs that could be met with ASR supplies with minimal to no treatment anticipated after recovery.

In December 2022, City of Corpus Christi staff initiated a technical study to develop an alternative treatment strategy to treat WWTP effluent for an indirect potable reuse (IPR) system using ASR along with a limited direct potable reuse (DPR) system. A DPR-only treatment option was also explored, which is included in Chapter 5B.4 - Reuse. IPR is the process of discharging treated municipal wastewater into an environmental buffer, like the Gulf Coast Aquifer, where the treated wastewater will be diluted and undergo additional natural treatment processes before being withdrawn and treated to drinking water standards. DPR refers to using treated municipal wastewater and providing additional advanced treatment so that potential chemical and biological contaminants are removed to meet drinking water standards. The alternative was evaluated by (1) developing layouts for an IPR system using ASR and a limited DPR treatment system and estimating construction costs, (2) evaluating brine disposal that is generated from reverse osmosis treatment and permitting issues, and (3) preparing a high-level project schedule.

The IPR and DPR-only alternatives differ from the previous 2019 ASR feasibility study in that the reuse goal for this evaluation is to treat the water to potable standards. The shortages indicate a need to secure alternative water sources and explore new storage methods such as ASR which can be used along with an IPR treatment strategy for reuse. Both IPR and DPR are viable options as water supply sources. Environmental permitting is still needed for disposal of waste generated during advanced treatment and will be an important step in implementing either of these strategies.

This strategy considers two conceptual alternatives: Option 1- Non-Potable ASR phased for up to 18 million gallons per day (mgd) and Option 2- Potable ASR/IPR with limited DPR.

³ Based on conversations with City Staff and stakeholders

5B.5.2 Available Yield

The Corpus Christi Non-Potable Aquifer Storage and Recovery Project (Option 1) is a phased project, with the initial size based on current Greenwood WWTP capacity and capable of expansion to address industrial growth by providing up to 18 mgd of new water supply.

The non-potable ASR Phase I is focused on 10 wells at the Corpus Christi International Airport site and Phase II adds 5 wells to the east of Phase I. A schematic showing transmission pipelines, Phase I and II wells and associated well field pipeline, and delivery location is shown in Figure 5B.5.2. Phase I and II operated conjunctively would be capable of providing about 10 mgd from ASR well operation, and up to 18 mgd with Greenwood WWTP expansion⁴.

The Phase I and II findings from the Corpus Christi ASR Feasibility Project are as follows:

Phase I

- Phase I limits recharge to 5 mgd, which is based on current available Greenwood WWTP capacity after considering existing contracts to provide treated effluent to golf courses and would be capable of providing up to 8 mgd through recovery at ASR wells.
- If tertiary treated Greenwood WWTP effluent by-passes ASR and is delivered concurrent with ASR recovery, then the combined water supply would be 13 mgd for Phase I.
- Recharge for 5 years and recovery for 2 years would be implemented for the ASR cycle. 5 MGD over 5 years is approximately 28,000 ac-ft recharged to the aquifer. 8 MGD over 2 years is approximately 18,000 ac-ft recovered. The percent recovery is 64%. This assumes a portion of water remains in storage to maintain the buffer zone from native groundwater.

Phase II

- Based on City of Corpus Christi staff input, Greenwood WWTP will likely be expanded to 10 mgd by 2030 to 2035. With tertiary treatment expansion to 10 mgd, it is assumed that up to 8 mgd would be available for ASR project and/or delivery to industrial customers.
- Phase I and II operated conjunctively would provide about 10 mgd from ASR well operation, and up to 18 mgd total by-passed water from Greenwood WWTP expansion⁴.
- Recharge for 5 years and recovery for 2 years would be implemented for the ASR cycle. 7.3 MGD over 5 years is approximately 41,000 ac-ft recharged to the aquifer. 10 MGD over 2 years is approximately 22,500 ac-ft recovered. The percent recovery is 55%. This assumes a portion of water remains in storage to maintain the buffer zone from native groundwater.

⁴ Based on City staff feedback, Greenwood WWTP expansion to 12 MGD by Year 2025-2030 would result in about 8 MGD treated effluent available for potential ASR use.

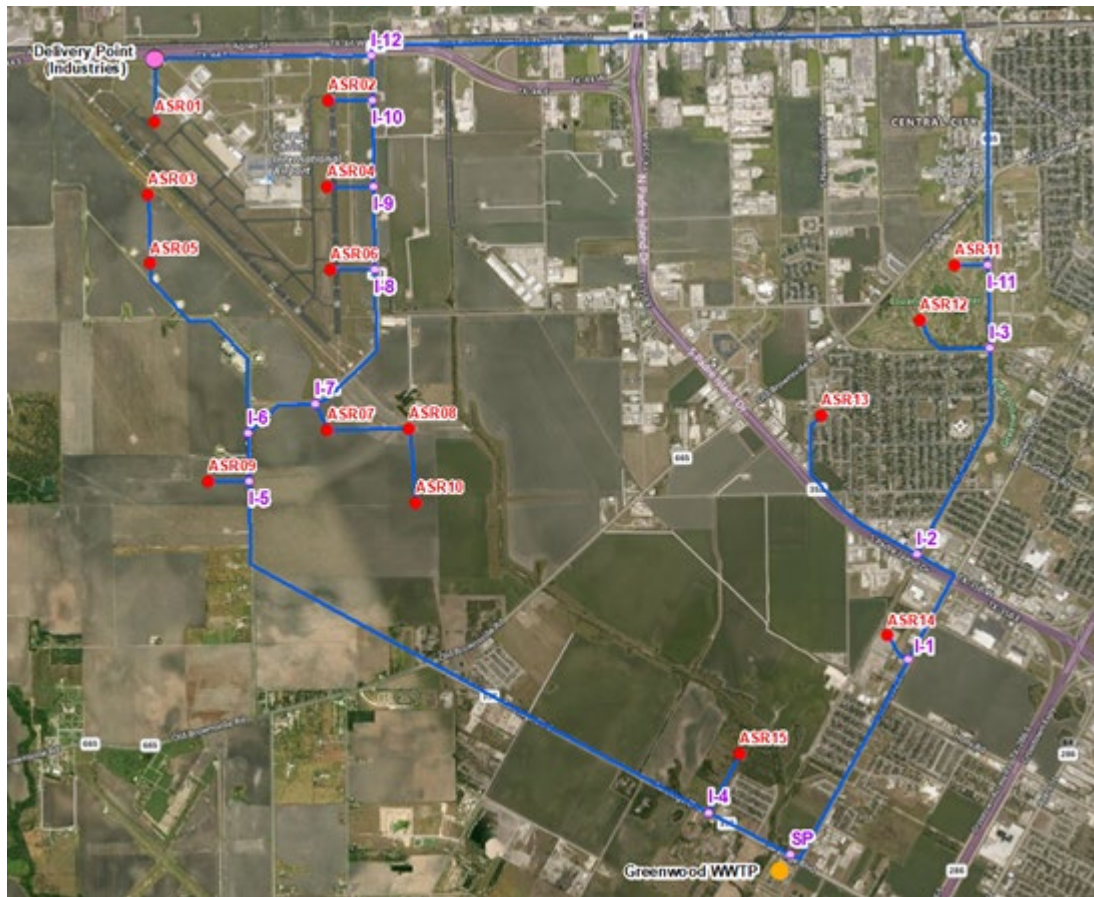


Figure 5B.5.2.
Project Layout of the Corpus Christi ASR Feasibility Project (Phase I and II)

The ASR/IPR with limited DPR reuse strategy (Option 2) treats 6 mgd of Greenwood WWTP effluent with microfiltration (MF), diverting 5 mgd for ASR during seasonal periods of low water demand and further treating 1 mgd with advanced RO processes to meet DPR standards. During periods of high-water demand, 8 mgd of water can be withdrawn from the aquifer, treated through MF/RO, and blended with the DPR water. ASR provides a long-term strategy for the storage of water supply and helps recharge the local aquifer system to improve groundwater quality. The use of ASR requires the installation of nearly 13.4 miles of piping, 10 ASR wells, and a booster pump station at the Corpus Christi International Airport.

5B.5.3 Environmental Issues

The 2001 Agreed Order includes provisions for 151,000 acre-feet per year (ac-ft/yr) of freshwater inflows to the Nueces Bay and Estuary System, made up with a combination of 54,000 acre-feet (ac-ft) return flow credit and remaining 97,000 ac-ft from pass-throughs and controlled releases from the Choke Canyon Reservoir/Lake Corpus Christi System (CCR/LCC System) according to inflow and stored water levels. The actual wastewater discharges in 2017 and 2018 amounted to 84,663 and 92,327 ac-ft, respectively. It is unlikely that use of Greenwood WWTP effluent as a

source water for ASR will have a meaningful impact on achieving freshwater inflow requirements associated with the 2001 Agreed Order.

The most significant environmental issue associated with the ASR project is repurposing Greenwood WWTP effluent that would otherwise be discharged to Oso Creek. Oso Creek receives treated domestic wastewater from a number of facilities, one industrial facility, three municipal storm sewer systems, four concrete production facilities, and three pesticide plants authorized to discharge. Based on a 3-year average from January 2015-December 2017, the discharge from Greenwood WWTP was about 5.5 mgd. This represents about 50 percent of discharge to Oso Creek upstream of Davis Power Station. Oso Creek (Segment 2485A) is listed⁵ to have bacteria impairment and water quality concerns of Chlorophyll-a, nitrates, and total phosphorus, as shown in Chapter 1-Planning Area Description, Table 1.2. Within the Oso Creek watershed, the most probable sources of bacteria are regulated stormwater, industrial sources, and nonpoint sources.⁶ The Texas A&M University at Corpus Christi Center for Coastal Studies and local stakeholders have formed a group to study Oso Creek and in response, the TCEQ adopted a total maximum daily load⁷ (TMDL) for Oso Creek on July 31, 2019, to monitor and reduce bacterial loads in Oso Creek. The U.S. Environmental Protection Agency (EPA)-approved the TMDL on October 25, 2019, and is now part of the state's Water Quality Management Plan. The Texas State Soil and Water Conservation Board is working to decrease bacterial loads from agriculture by assisting landowners in developing and implementing water quality management plans. Additional studies are needed to evaluate the environmental impact of reducing Greenwood WWTP discharge to use as a supply for ASR.

In addition to diverting flow from Greenwood WWTP, treating the effluent to potable standards requires advanced treatment using RO membranes. RO membranes effectively remove trace contaminants typically found in wastewater effluent as RO separates most dissolved salts, pathogens, and chemicals from the filtered water. Contaminants that may pose risks to aquatic ecosystems or downstream drinking water sources become highly concentrated in the RO brine. The concentration of contaminants increases relative to the amount of water recovered by RO. The estimated composition of the brine exiting the RO membranes for DPR is summarized in Table 5B.5.1. The brine composition was estimated using WWTP effluent data provided by the City of Corpus Christi and assumed an 80 percent recovery rate in the RO system, resulting in a concentration factor of 5.

⁵ Nueces River Authority 2019 Basin Highlights Report: San Antonio-Nueces Coastal Basin, Nueces River Basin, Nueces-Rio Grande Coastal Basin. https://www.nueces-ra.org/CP/CRP/pdfs/2019_BHR.pdf

⁶ TCEQ, One Total Maximum Daily Load for Indicator Bacteria in Oso Creek, Adopted July 2019.

⁷ <https://www.tceq.texas.gov/assets/public/waterquality/tmdl/67osocreekbacteria/67-osocreekbacteria.pdf>

Table 5B.5.1.
Estimated Brine Discharge and Total Dissolved Solids (TDS)

Treatment Process	IPR and limited DPR
Brine Flow from Aquifer (MGD)	1.6
Brine Flow from Direct Reuse (MGD)	0.2
Total (MGD)	1.8
Estimated Total Dissolved Solids (mg/L)	9,839

MGD=million gallons per day; DPR=direct potable reuse; IPR=indirect potable reuse

To avoid impacting sensitive ecosystems or nearby drinking water sources, the brine is disposed of in deep injection wells, as shown in Figure 5B.5.3, which requires the City of Corpus Christi to acquire a Class I injection well permit. Disposal of waste by Class I well injection is regulated by TCEQ, and the City of Corpus Christi must obtain the permit, pursuant to the Texas Water Code (TWC), Chapter 27, and the Texas Health and Safety Code (THSC), Chapter 361. As part of construction of the injection well, completion of a well data report also is required.

A potential option could include permitting the injection wells under the Class I Underground Injection Code (UIC) General Permit WDWG010000 that provides authorization for use of a Class I injection well to inject nonhazardous brine from a desalination operation or nonhazardous drinking water treatment residuals. To obtain authorization to construct and operate a Class I well under the General Permit, a Notice of Intent (NOI) is submitted to TCEQ. As part of the general permitting process, TCEQ will review the City of Corpus Christi's compliance history.

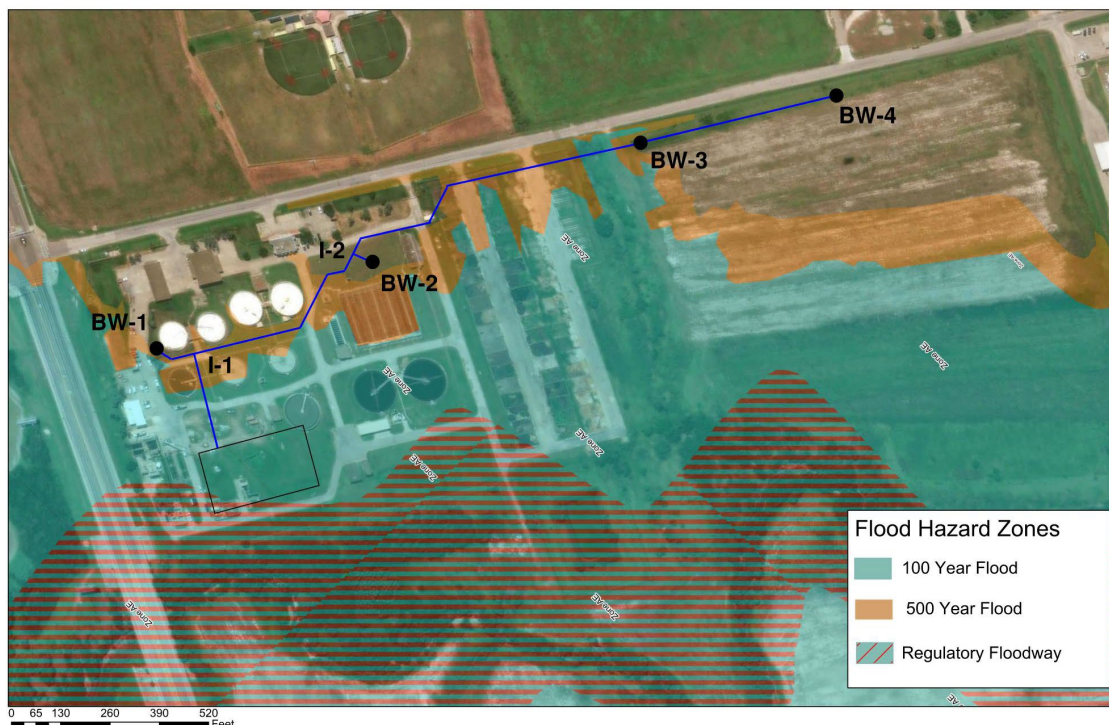


Figure 5B.5.3.
Proposed Reverse Osmosis Brine Well and Piping

If the NOI is administratively complete, TCEQ sends a letter to the City of Corpus Christi acknowledging authorization under the General Permit. The letter would include a unique identification number that has been assigned for each well at the facility that is authorized under the UIC General Permit. If TCEQ denies the City of Corpus Christi's NOI or authorization to inject waste under the General Permit, TCEQ provides written notice, including a statement of the basis for this decision.

To determine if a general permit or a site-specific permit is most applicable to this project, HDR Engineering, Inc. (HDR) will communicate further with the City of Corpus Christi regarding items that could affect general permit eligibility, including compliance history.

5B.5.4 Engineering and Costing

The non-potable ASR project (Option 1) includes two phases (Phase I and II) based on current WWTP treatment capacity and phased according to industrial growth needs. If tertiary treated Greenwood WWTP effluent by-passes ASR and is delivered concurrent with ASR recovery, then the combined water supply would be 13 mgd for Phase I. Phase I and II operated conjunctively would be capable of providing about 10 mgd from ASR well operation, and up to 18 mgd with Greenwood WWTP expansion⁸.

The current secondary treatment process at the Greenwood WWTP consists of a conventional, activated sludge treatment system. The system effectively reduces the biochemical oxygen demand (BOD) and nitrifies the influent ammonia. However, augmentations to the secondary treatment system are required to reduce the effluent nitrate (NO_3). This process will reduce NO_3 to less than 10 mg/L, the maximum contaminant level (MCL). A Modified Ludzack-Ettinger (MLE) process is proposed to complete this treatment. To fully treat the wastewater effluent after the MLE process to sufficient quality to be able to inject it into the aquifer, additional unit processes will likely be required. The main parameters to be reduced or removed in the tertiary system are manganese, TSS, TOC, and bacteria. Three treatment trains are recommended to be compared during the pilot system, which will inform and direct the Phase I and II project construction and later expansion of the treatment plant. The proposed pilot plant arrangement is shown in Figure 5B.5.4.

In the absence of pilot system results, the cost analysis considers secondary treatment improvements and the additional tertiary system considers the following processes:

- Tertiary Membrane Filtration (Microfiltration)
- Ozone and Biologically Active Filter (BAF)
- Ozone and BAF with Microfiltration polishing

5B.5.4.1 Microfiltration

The standard method for removing suspended particles is typically through a membrane filter. Microfiltration, or tertiary membrane filtration (TMF), through hollow fiber membranes is an

⁸ Based on City staff feedback, Greenwood WWTP expansion to 12 MGD by Year 2025-2030 would result in about 8 MGD treated effluent available for potential ASR use.

efficient system to effectively remove particles larger than 1 micrometer (μm), which includes most bacteria. The system will use a submerged membrane configuration and be maintained with an air scouring system with periodic cleaning using acid based cleaners. The physical filtration mechanism should efficiently remove TSS and bacteria once the MLE system removes NO_3 . Microfiltration treatment will likely not sufficiently remove TOC or dissolved manganese.

5B.5.4.2 Ozone and Biologically Active Filters

Biologically active filters operate in a similar way as a traditional slow sand filter. However, a biologically active layer is allowed to develop at the surface of the filter to further treat organic constituents. Ozone is used as an oxidizer before the filter to breakdown recalcitrant TOC that was not available to be processed in the secondary treatment. The biological layer for the BAF will then consume the now biodegradable TOC. An additional benefit of the configuration is that any remaining Mn is expected to be oxidized and removed.

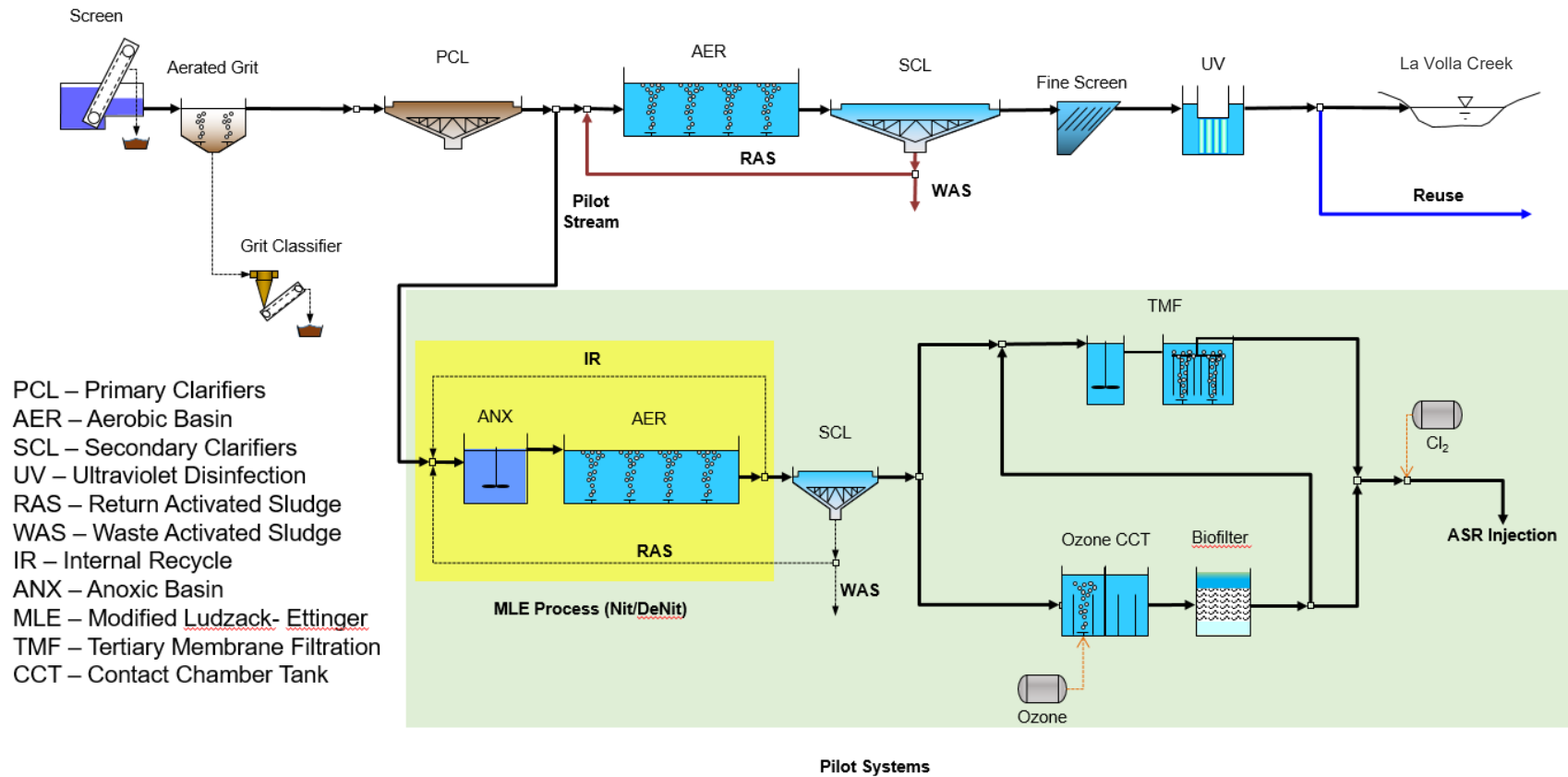


Figure 5B.5.4.
Proposed Pilot System Configuration Process Flow Diagram

Potential inefficiencies of the treatment systems is that the bacteria from the biologically active area may be carried into the effluent and TSS will likely not be sufficiently reduced.

5B.5.4.3 Ozone and BAF with Microfiltration polishing

The combination of the two treatment systems should effectively treat the effluent to a level that will not significantly impact the aquifer environment. All constituents of concern should be removed to meet water quality requirements for ASR injection as detailed previously. This option effectively eliminates individual limitations for the TMF and Ozone/BAF systems.

The IPR and limited DPR project includes 1 mgd for DPR treatment, 5 mgd for recharge, and 8 mgd for recovery. HDR developed cost estimates for the improvements for the additional treatment technologies, ASR wells and piping, brine disposal wells, and transmission line for potable water from the WWTP to an existing water line. Cost estimates for the advanced treatment technologies (MF, RO, advanced oxidative process (AOP)) were provided by Newman Regency Group on March 20, 2023, and April 13, 2023. The cost estimates for both options were evaluated using the Association for the Advancement of Cost Engineering (AACE) Class IV Opinion of Probable Cost level with an expected accuracy of -30 to +50 percent and the TWDB's Uniform Costing Model (UCM), using a cost basis for September 2023. Cost estimates are for review only and is not to be used for any other purpose. Considering recent material shortages and cost volatility, HDR cannot guarantee that proposals, bids, or actual construction cost will not vary.

In the absence of pilot system results, the cost analysis for Potable ASR/IPR and Limited DPR Reuse (Option 2) includes treatment of membrane filtration for recharge and membrane filtration and RO for recovery. The proposed treatment process flow diagram for potable ASR/IPR with limited DPR reuse alternative (Option 2) is shown in Figure 5B.5.7.

5B.5.4.4 Membrane Filtration

Membrane filtration refers to both microfiltration and ultrafiltration, which are low-pressure driven separation processes using a semipermeable membrane. Membrane filtration systems have a pore size ranging from 0.01-10 μm and are effective at removing turbidity, bacteria, fats, oils, colloids, and microparticles. MF is often used as a pretreatment to RO and improves RO performance by increasing flux and reducing membrane fouling.

5B.5.4.5 Reverse Osmosis

RO treatment uses high pressure to drive flow through a semipermeable membrane to remove dissolved constituents, like salts and pathogens. RO membranes have a pore size much smaller than membrane filtration, at approximately 0.0001 μm . As the feed water overcomes the osmotic pressure within the membrane, it produces a filtered flow stream at a recovery rate of 70 to 97 percent depending on operating parameters and the TDS concentration in the feed water. For the analysis in this study a conservative recovery of 80 percent was assumed. The filtered flow stream is nearly devoid of contaminants of concern, making RO membranes highly effective at removing bacteria, viruses, and inorganic contaminants. RO systems have a TDS removal rate of 94 to 98 percent, typically, and produce a concentrated brine stream that can be

disposed of through deep injection wells or surface water systems with permit. RO systems are energy intensive systems to operate.

5B.5.4.6 Ultraviolet Advanced Oxidation Processes (AOP)

The AOP system following the RO system uses a high intensity ultraviolet (UV) light in combination with free chlorine as a chemical oxidant. The oxidant degrades organic compounds and inorganic compounds in the wastewater effluent using highly reactive free radicals produced in the process thus rendering them inactive and incapable of harm.

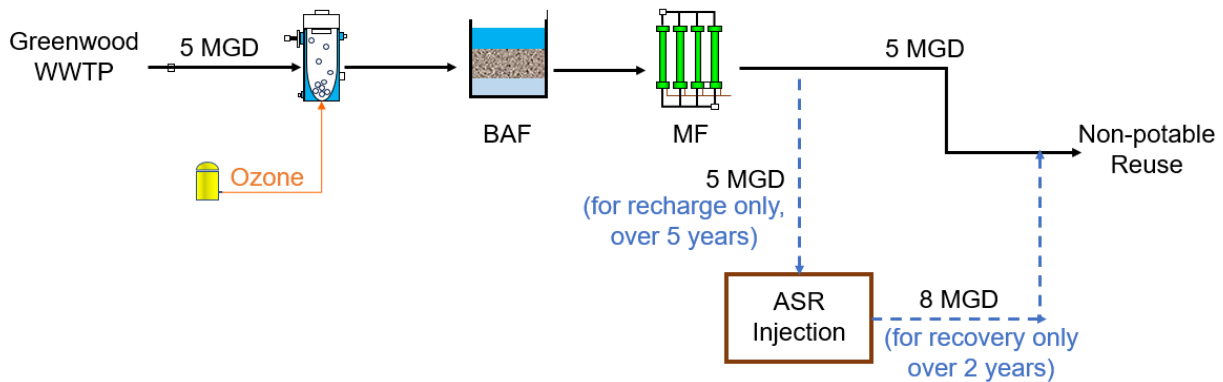
5B.5.4.7 ASR with Non-potable Reuse, Phase I Cost Estimate

The Phase I planning-level cost estimate includes:

- 10 wells constructed and equipped to:
 - Recharge up to 415 gallons per minute (gpm) for each well (about 25 percent extra to account for well downtime and/or maintenance)
 - Recover up to 685 gpm for each well (about 23 percent to account for well downtime and/or maintenance)
- 5 mgd pump station at Greenwood WWTP (for recharge)
- 10.9 mgd booster pump station near Phase I wellfield (for recovery)
- 24-inch transmission pipeline from tertiary treatment facilities at Greenwood WWTP to Phase I well field and 8-inch to 30-inch well field piping
- 30-inch diameter pipe to deliver total Phase I supply produced by 10 wells to a delivery point located to the north west of the Corpus Christi International Airport on Agnes Road, south of the intersection of Bronco Road and Interstate Hwy 44
- 2-million-gallon (MG) terminal storage tank
- Supervisory control and data acquisition system (SCADA) estimated at 3 percent of construction costs
- Easement acquisition of 96 acres at cost of \$10,000 per acre
- Survey and geotechnical costs estimated at \$55,000 per mile
- Tertiary treatment (5 mgd)
 - MLE treatment
 - Additional tertiary treatment (low to high)
 - Alternative 2: Ozone + BAF (low)
 - Alternative 3: Ozone + BAF + Microfiltration (high)
- Yields up to 13 mgd during recovery
 - 8 mgd through ASR wellfield operation plus

- 5 mgd through bypass from tertiary treatment facilities at Greenwood WWTP.

A process flow diagram for the ASR with Non-potable reuse, Phase I, is shown in Figure 5B.5.5



For conceptual application only. No native groundwater will be recovered as a part of this strategy.

MF: Membrane Filtration
BAF: Biologically Active Filter

Figure 5B.5.5.

Process Flow Diagram of Aquifer Storage and Recovery with Non-potable Reuse, Phase I

A cost estimate for Phase I wells and transmission pipelines needed for recharge, recovery, and conveyance is shown in Table 5B.5.2. The costs shown represent a range of treatment processes that will be identified during piloting for subsequent refinement of Phase I costs, accordingly.

The total project cost is expected to range from \$130,002,000 to \$159,141,000 depending on treatment process. The annual cost ranges from \$12,112,000 to \$14,584,000. The unit cost of water is estimated to be \$824 to \$993 per ac-ft during recovery, which is the firm yield expected during drought conditions. After adding recharge operations to replenish storage for later recovery, the energy costs increase by approximately \$100,000. The unit cost increases to \$831 to \$1,001 per ac-ft.

Table 5B.5.2.
Cost Estimate Summary ASR with Non-Potable Reuse (Option 1)- Phase I
Low to High Range Based on Treatment (Sept 2023 Prices)

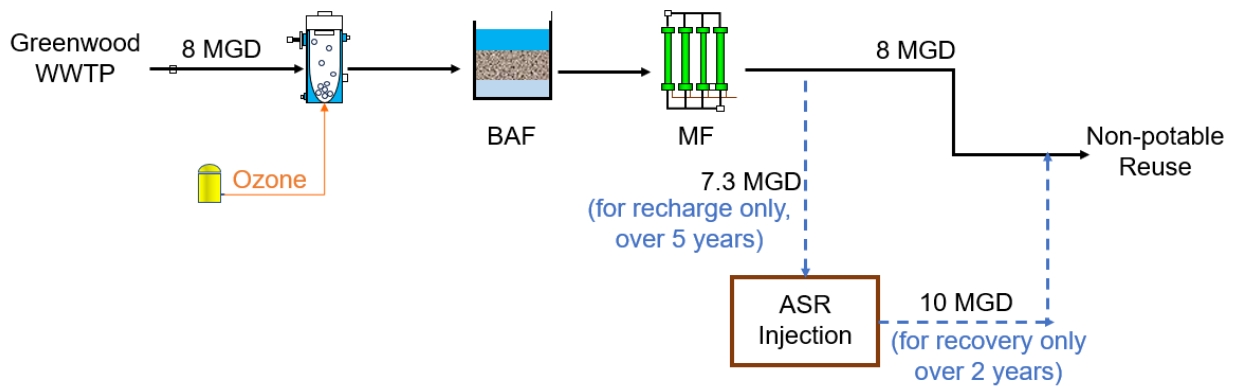
Item	Estimated Costs with Ozone + BAF (Low)	Estimated Costs with Ozone + BAF + Microfiltration (High)
Capital Cost		
Greenwood WWTP Pump Station (5 MGD, 617 HP)	\$5,824,000	\$5,824,000
Booster Pump Station(s) & Storage Tank(s) (10.9 MGD, 390 HP)	\$5,184,000	\$5,184,000
Wellfield Piping (13.4 mi, 8 IN - 30 IN dia.)	\$37,784,000	\$37,784,000
ASR Wells (10 wells, 685 gpm recovery, 800 ft depth)	\$15,150,000	\$15,150,000
Terminal Storage Tank (2 MG)	\$2,545,000	\$2,545,000
Tertiary Treatment and MLE Upgrade (5MGD)	\$14,772,000	\$33,326,000
SCADA	\$4,428,000	\$5,542,000
Total Cost of Facilities	\$85,687,000	\$105,355,000
Engineering:	\$2,571,000	\$3,161,000
- Planning (3%)	\$5,998,000	\$7,375,000
- Design (7%)	\$857,000	\$1,054,000
- Construction Engineering (1%)	\$1,714,000	\$2,107,000
Legal Assistance (2%)	\$1,714,000	\$2,107,000
Fiscal Services (2%)	\$319,000	\$319,000
Pipeline Contingency (15%)	\$16,712,000	\$20,645,000
All Other Facilities Contingency (20%)	\$2,571,000	\$3,161,000
Environmental & Archaeology Studies and Mitigation	\$658,000	\$658,000
Land Acquisition and Surveying (213 acres)	\$2,241,000	\$2,241,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$11,531,000	\$14,119,000
Total Cost of Project	\$130,002,000	\$159,141,000
Annual Cost		
Debt Service (3.5 percent, 20 years)	\$9,132,000	\$11,182,000
Operation and Maintenance	x-	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$620,000	\$631,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$224,000	\$224,000
Tertiary Treatment (Ozone + BAF)	\$1,244,000	\$1,655,000
Pumping Energy Costs (@ 0.08 \$/kW-hr)	\$892,000	\$892,000
Total Annual Cost	\$12,112,000	\$14,584,000
Available Project Yield (acft/yr)	14,573	14,573
Annual Cost of Water (\$ per acft)	\$831	\$1,001
Annual Cost of Water After Debt Service (\$ per acft)	\$204	\$233
Annual Cost of Water (\$ per 1,000 gallons)	\$2.55	\$3.07
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$0.63	\$0.72

5B.5.4.8 ASR with Non-potable Reuse, Phase II Cost Estimate

The Phase II planning-level cost estimate includes:

- 15 wells constructed and equipped to:
 - Recharge up to 415 gpm for each Phase I well and 500 gpm for each Phase II well (about 30 percent for well downtime and/or maintenance)
 - Recover up to 685 gpm each for each Phase I well and 750 gpm for each Phase II well (about 30 percent for well downtime and/or maintenance)
- 10 mgd pump station at Greenwood WWTP (for recharge)
- 17 mgd booster pump station(s) total
- Phase I pipelines + 12-inch transmission pipeline from tertiary treatment facilities at Greenwood WWTP to Phase II well field and well field piping
- 30-inch diameter pipe to deliver total Phase II supply to a delivery point located to the north west of the Corpus Christi International Airport on Agnes Road, south of the intersection of Bronco Road and Interstate Highway 44
- Two 2-MG terminal storage tanks (4 MG total)
- SCADA estimated at 3 percent of construction costs
- Land acquisition of 155 acres at cost of \$10,000 per acre
- Survey and geotechnical costs estimated at \$55,000 per mile
- Tertiary treatment (10 mgd, total)
 - MLE treatment
 - Additional tertiary treatment (low to high)
 - Alternative 2: Ozone + BAF (low)
 - Alternative 3: Ozone + BAF + Microfiltration (high)
- Yields up to 18 mgd during recovery
 - 10 mgd through ASR wellfield operation plus
 - 8 mgd through bypass from tertiary treatment facilities at Greenwood WWTP after expansion.

A process flow diagram for the ASR with Non-potable reuse, Phase II, is shown in Figure 5B.5.6.



For conceptual application only. No native groundwater will be recovered as a part of this strategy.

MF: Membrane Filtration
BAF: Biologically Active Filter

Figure 5B.5.6.
Process Flow Diagram of Aquifer Storage and Recovery with Non-potable Reuse, Phase II

A cost estimate for Phase II wells and transmission pipelines needed for recharge, recovery, and conveyance of water to the delivery point for industrial customer use is shown in Table 5B.5.3. Similar to Phase I, the costs shown represent a range of treatment processes that will be identified during piloting for subsequent refinement of Phase I costs, accordingly.

The total project cost is expected to range from \$196,981,000 to \$237,314,000 depending on treatment process. The annual cost ranges from \$18,731,000 to \$22,280,000. The unit cost of water is estimated to be \$923 to \$1,098 per ac-ft during recovery, which is the firm yield expected during drought conditions. After adding recharge operations to replenish storage for later recovery, the energy costs increase by approximately \$100,000. The unit cost increases to \$928 to \$1,104 per ac-ft.

Table 5B.5.3.
Cost Estimate Summary ASR with Non-Potable Reuse (Option 1)- Phase II
Low to High Range Based on Treatment (Sept 2023 Prices)

Item	Estimated Costs with Ozone + BAF (Low)	Estimated Costs with Ozone + BAF + Microfiltration (High)
Capital Cost		
Greenwood WWTP Pump Station (10 MGD, 907 HP)	\$8,306,000	\$8,306,000
Booster Pump Station(s) & Storage Tank(s) (16.9 MGD, 500 HP)	\$7,108,000	\$7,108,000
Wellfield Piping (24.5mi, 8 IN - 30 IN dia.)	\$60,987,000	\$60,987,000
ASR Wells (15 wells, 685-750 gpm recovery, 800 ft depth)	\$21,453,000	\$21,453,000
Terminal Storage Tank (2 MG)	\$5,091,000	\$5,091,000
Tertiary Treatment (Microfiltration + BAF+Ozone) and MLE Upgrade (10 MGD)	\$20,449,000	\$46,131,000
SCADA	\$6,692,000	\$8,233,000
Total Cost of Facilities	\$130,086,000	\$157,309,000
Engineering:		
- Planning (3%)	\$3,903,000	\$4,719,000
- Design (7%)	\$9,106,000	\$11,012,000
- Construction Engineering (1%)	\$1,301,000	\$1,573,000
Legal Assistance (2%)	\$2,602,000	\$3,146,000
Fiscal Services (2%)	\$2,602,000	\$3,146,000
Pipeline Contingency (15%)	\$1,144,000	\$1,144,000
All Other Facilities Contingency (20%)	\$24,492,000	\$29,937,000
Environmental & Archaeology Studies and Mitigation	\$950,000	\$950,000
Land Acquisition and Surveying (213 acres)	\$3,314,000	\$3,314,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$17,481,000	\$21,064,000
Total Cost of Project	\$196,981,000	\$237,314,000
Annual Cost		
Debt Service (3.5 percent, 20 years)	\$13,845,000	\$16,683,000
Operation and Maintenance	-	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$965,000	\$981,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$327,000	\$327,000
Advanced Water Treatment Facility	\$2,486,000	\$3,181,000
Pumping Energy Costs (12308008 kW-hr @ 0.09 \$/kW-hr)	\$1,108,000	\$1,108,000
Total Annual Cost	\$18,731,000	\$22,280,000
Available Project Yield (acft/yr)	20,178	20,178
Annual Cost of Water (\$ per acft)	\$928	\$1,104
Annual Cost of Water After Debt Service (\$ per acft)	\$242	\$277
Annual Cost of Water (\$ per 1,000 gallons)	\$2.85	\$3.39
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$0.74	\$0.85

5B.5.4.9 Potable ASR/IPR and Limited DPR Reuse Cost Estimate

The IPR and Limited DPR configuration planning-level cost estimate includes:

- DPR treatment (1 mgd)
 - MF + RO + UV/Chlorine AOP
- IPR treatment
 - 5 mgd for recharge
 - MF
 - 8 mgd for recovery
 - MF + RO
- 5 mgd pump station at WWTP (for recharge)
- 8 mgd booster pump station near wellfield (for recovery)
- 7.2 mgd pump station at WWTP for potable water distribution
- 1.8 mgd pump station at WWTP for deep well injection
- 10 ASR wells constructed and equipped to:
 - Recharge up to 415 gpm for each well (approximately 25 percent to account for well downtime and/or maintenance)
 - Recover up to 685 gpm each (approximately 23 percent to account for well downtime and/or maintenance)
- 5 deep injection wells for RO brine
 - 300 gpm each injecting to a depth of 3,400 feet
- 24-inch transmission pipeline from DPR treatment facilities at WWTP to well field and 8-inch to 30-inch well field piping.
- 24-inch transmission pipeline from potable water pumpstation at WWTP to existing potable water line.
- 2-MG terminal storage tank at wellfield
- Well SCADA estimated at 6 percent construction costs
- Easement acquisition of 113 acres at cost of \$10,000 per acre
- Survey and geotechnical costs estimated at \$55,000 per mile

The process flow diagram for Potable ASR/IPR and Limited DPR is shown in Figure 5B.5.7.

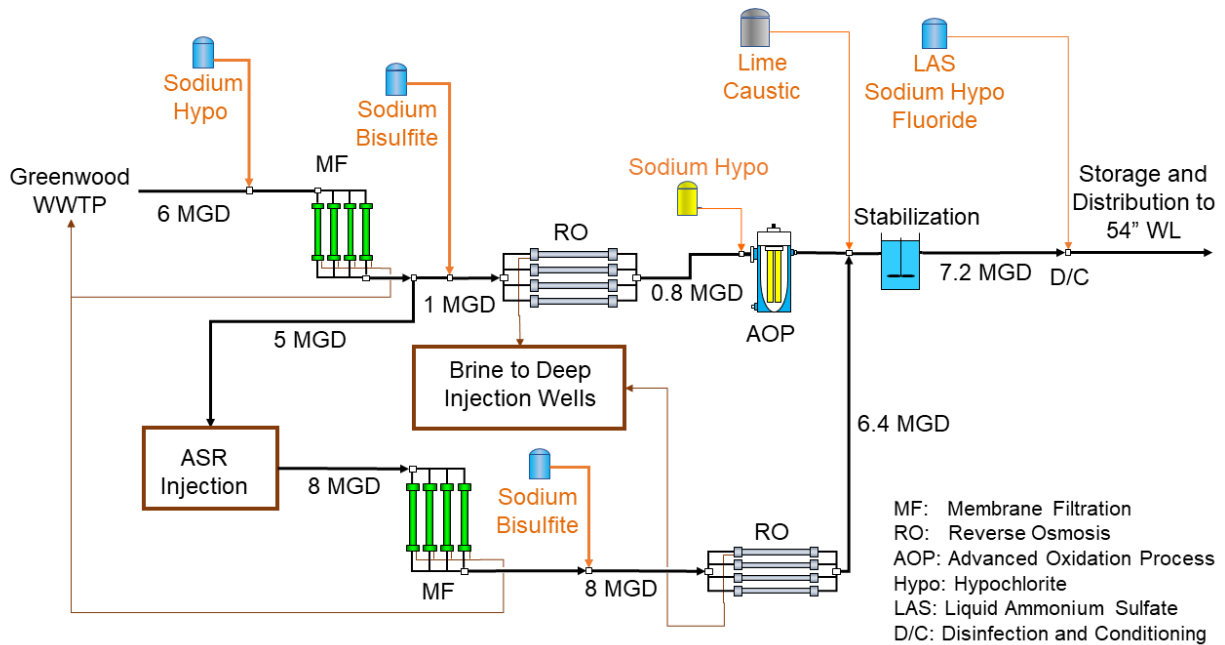


Figure 5B.5.7.
Process Flow Diagram of Aquifer Storage and Recovery with Indirect and Direct Potable Reuse Treatment

The cost estimate for building treatment facilities, wells, and transmission pipelines to treat 6 mgd of WWTP effluent for IPR and Limited DPR is presented in Table 5B.5.4. The total project cost and annual cost are estimated to be \$204,207,000 and \$24,231,000, respectively. The unit cost of water is estimated to be \$2,990 per ac-ft during recovery, which is the firm yield expected during drought conditions. After adding recharge operations to replenish storage for later recovery, the energy costs increase by approximately \$100,000. The unit cost increases to \$3,003 per ac-ft.

Table 5B.5.4
Cost Estimate Summary
Potable ASR/IPR with Limited DPR (Option 2)
(Sept 2023 Prices)

Item	Estimated Costs
Capital Cost	
Booster Pump Station for ASR Recovery (8 MGD)	\$9,833,000
ASR Wellfield Piping (13.4 mi, 8 IN - 30 IN dia.)	\$36,088,000
ASR Wells (10 wells, 685 gpm, 700 ft depth)	\$13,972,000
Deep Injection Piping (0.5 mi, 8 IN - 12 IN dia)	\$926,000
Deep Injection Wells (5 wells, 300 gpm, 3400 ft depth) ¹	\$25,000,000
Potable Water Piping (0.9 mi, 24 IN dia.)	\$3,093,000
Terminal Storage Tank (2 MG)	\$2,545,000
ASR + DPR Treatment	\$39,002,000
ASR Treatment (MF + RO, 8 MGD)	
DPR Treatment (MF + RO, UV/Chlorine AOP, 1 MGD)	
SCADA for Wells	\$5,015,000
Total Cost of Facilities	\$135,474,000
Engineering:	
- Planning (3%)	\$4,058,000
- Design (7%)	\$9,469,000
- Construction Engineering (1%)	\$1,353,000
Legal Assistance (2%)	\$2,705,000
Fiscal Services (2%)	\$2,705,000
Pipeline Contingency (15%)	\$768,000
All Other Facilities Contingency (20%)	\$26,029,000
Environmental & Archaeology Studies and Mitigation	\$1,559,000
Land Acquisition and Surveying (113 acres)	\$1,964,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$18,123,000
Total Cost of Project	\$204,207,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$14,353,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$864,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$246,000
Advanced Water Treatment Facility	\$8,050,000
Pumping Energy Costs (7973120 kW-hr @ 0.09 \$/kW-hr)	\$718,000
Total Annual Cost	\$24,231,000
Available Project Yield (acft/yr)	8,070
Annual Cost of Water (\$ per acft)	\$3,003
Annual Cost of Water After Debt Service (\$ per acft)	\$1,224
Annual Cost of Water (\$ per 1,000 gallons)	\$9.21
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$3.76

¹Depth to base of groundwater where total dissolved solids is less than 10,000 mg/L is approximately 2,000 feet, according to *Identification of Potential Brackish Groundwater Production Areas – Gulf Coast Aquifer System* (TWDB Contract Number 1600011947).

5B.5.5 Implementation Issues

The TCEQ administers state rules governing most facets of ASR project implementation in Texas, which are prescribed in Title 30 of the Texas Administrative Code (TAC), Chapter 331, Underground Injection Control (UIC). The TCEQ has primacy from the EPA to regulate most injection wells through the Texas UIC Program. Since the proposed ASR project does not currently contemplate recovery of water directly to a public water system, rules related to public supply wells and groundwater sources and development, as contained in 30 TAC §290.41 (c), do not apply. Of particular relevance to the proposed ASR project are the requirements in 30 TAC§331.186 (a), which outlines the criteria to be consider by TCEQ in authorizing ASR operations. The effluent from the Greenwood WWTP does not currently meet drinking water standards for chloride, TDS, manganese, and nitrate concentration, or pathogen removal. While it is anticipated that nitrate and manganese will likely be below the drinking water maximum contaminant limit after tertiary treatment, the other parameters will not be significantly altered prior to recharge. As such, the City of Corpus Christi will need to demonstrate to the TCEQ that proposed ASR well operations will not: 1) render the groundwater produced from the receiving formation harmful or detrimental to people, animals, vegetation, or property, or 2) require an unreasonably higher level of treatment of the groundwater produced from the receiving geologic formation than is necessary for the native groundwater in order to render the groundwater suitable for beneficial use.

For most previous ASR applications, TCEQ has required treatment to drinking water standards prior to recharge but newer rules passed in 2015, and described in Section 5 of Exhibit G, may give some flexibility since both the quality of the effluent relative to drinking water is considered along with the potential to degrade the native groundwater. This project would improve the native groundwater for constituents more relevant to Safe Drinking Water Act as a result of the tertiary treatment prior to injection that address the constituents above MCL. Although the storage aquifer is considered brackish it would still be classified as an underground source of drinking water (USDW) per Title 40, Code of Federal Regulations (40 CFR) Section 144.3. It is likely that TCEQ may require additional treatment at the WWTP to meet MCLs and that treatment could be necessary to maintain ASR operations and water compatibility. Treatment may include modifications to the WWTP's treatment process to promote de-nitrification, reduce turbidity, and improve the disinfection system to further inactivate bacteria.

There are several existing wells identified within the ASR study area that will likely be impacted by ASR implementation. Additional efforts to survey unregistered wells in the vicinity of the proposed ASR well field area would be helpful to identify wells to monitor and/or mitigate in advance of commencing ASR operations. Supply protection is within the jurisdictional authority of the District as detailed in the District's 2019 *Groundwater Management Plan*⁹.

5B.5.5.1 Underground Injection Code Permitting Timeframe

The deep injection wells required for RO brine disposal will require a Class I injection well permit. Upon receipt of the application for an injection well permit, TCEQ staff date stamp the

⁹ <http://www.twdb.texas.gov/groundwater/docs/GCD/ccasrcd/CCASRCDMgmtPlan2019.pdf?d=1581392749650>

application and review the application for administrative completeness. The applicant may be contacted by way of an administrative deficiency letter for clarification or additional information at any time during the administrative review.

Within 30 days of the date that the application is determined to be administratively complete, the Chief Clerk mails the Notice of Receipt of Application and Intent to Obtain Permit to the applicant, to potentially affected persons, and to others. The applicant is responsible for newspaper publication of notice of the application in accordance with 30 TAC §39.418(b)(1) and §39.651(c). The applicant must also place a copy of the administratively complete application in a public place in accordance with 30 TAC §39.405(g).

TCEQ begins a technical review of the application as soon as the application is administratively complete. As part of the technical review, staff evaluate the applicant's compliance history for the previous 5 years, including the company and facility compliance classification and rating. The applicant may be contacted by way of a technical notice of deficiency letter for clarification or additional information at any time during the technical review. TCEQ will issue no more than two notice of deficiency letters.

After the technical review, TCEQ makes a preliminary decision to issue a permit or recommend denial of the permit. TCEQ delivers the preliminary decision concurrently with the Notice of Application and Preliminary Decision to the applicant, to potentially affected persons, and to others. The applicant is responsible for newspaper publication of the Notice of Application and Preliminary Decision in accordance with 30 TAC §39.419(b) and §39.651(d).

Public comments must be filed with TCEQ within the time period specified in the notice. The public comment period ends 30 days (nonhazardous waste permits) or 45 days (hazardous waste permits) after the last publication of the Notice of Application and Preliminary Decision, except as provided in 30 TAC §55.152. If comments are received, TCEQ prepares a response to comments and files the response to comments with the TCEQ Chief Clerk within 60 days following the close of the comment period in accordance with 30 TAC §55.156. The TCEQ Chief Clerk mails the Executive Director's decision, the Executive Director's response to public comments, instructions for requesting that the Commission reconsider the Executive Director's decision, and instructions for requesting a contested case hearing.

The Executive Director may act on an uncontested application if public notice requirements have been satisfied and the application meets all relevant statutory and administrative criteria in accordance with 30 TAC §50.133. The TCEQ Chief Clerk mails notice of the action and an explanation of the opportunity to file a motion to overturn the Executive Director's action on the application. A motion to overturn must be filed no later than 20 days after the signed permit is mailed to the applicant in accordance with §50.139.

5B.5.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.5.5.

Table 5B.5.5.
Evaluation Summary of City of Corpus Christi ASR Projects

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Firm Yield: 14,573 ac-ft/yr (Non-potable Phase I); 20,178 ac-ft/yr (Non-potable Phase II); 8,071 ac-ft/yr (ASR with IPR and DPR)
2. Reliability	2. Reliable, based on system operations
3. Cost of Treated Water	3. Non-Potable ASR: \$831- \$1,001 per ac-ft (Phase I) and \$928- \$1,104 per ac-ft (Phase II) ASR with IPR and DPR: \$3,003 per ac-ft
b. Environmental factors	
1. Instream flows	1. Low impact. Reduced flow in Oso Creek.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7.
a. dissolved solids	a. Dissolved solids are estimated to be around 2,000 mg/L for non-potable use. If water use needed is potable, additional treatment will be required.
b. salinity	b. Salinity are addressed for non-potable use. If water use needed is potable, additional treatment will be required.
c. bacteria	c. Bacteria is addressed with treatment process.
d. chlorides	d. Chlorides are estimated to be around 750 mg/L for non-potable use. If water use needed is potable, additional treatment will be required.
e. bromide	e-h. None or low impact
f. sulfate	
g. uranium	
h. arsenic	
i. other water quality constituents	i. Nitrate, TSS, TOC, and Mn addressed with treatment processes.
c. Impacts to agricultural resources and State water resources	• Reduce discharge to Oso Creek.
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• Reduce discharge to Oso Creek.
i. Efficient use of existing water supplies and regional opportunities	• Reuses water supply and compatible with regional development.
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None



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5B.6

Seawater Desalination

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Section 5B.6 Seawater Desalination

5B.6.1 Seawater Desalination Background

Seawater desalination is a process whereby seawater is treated to reduce total dissolved solids, salts, and minerals to make suitable for human consumption and/or high quality industrial/manufacturing purposes. Seawater near Corpus Christi Bay and the Gulf of Mexico, where plants are being considered, is estimated to have total dissolved solids (TDS) content of between 30,000 and 50,000 parts per million.

Commercially available processes that are commonly used to desalt seawater to produce potable water are:

- Distillation (thermal) Processes; and
- Membrane (non-thermal) Processes.

Figure 5B.6.1 shows a process diagram for a typical seawater desalination treatment plant, the percent of water flowing through each component of the system, and the concentration of the TDS. This diagram is intended to serve as an example, recognizing that details and recovery percentages for specific seawater desalination plants may vary.

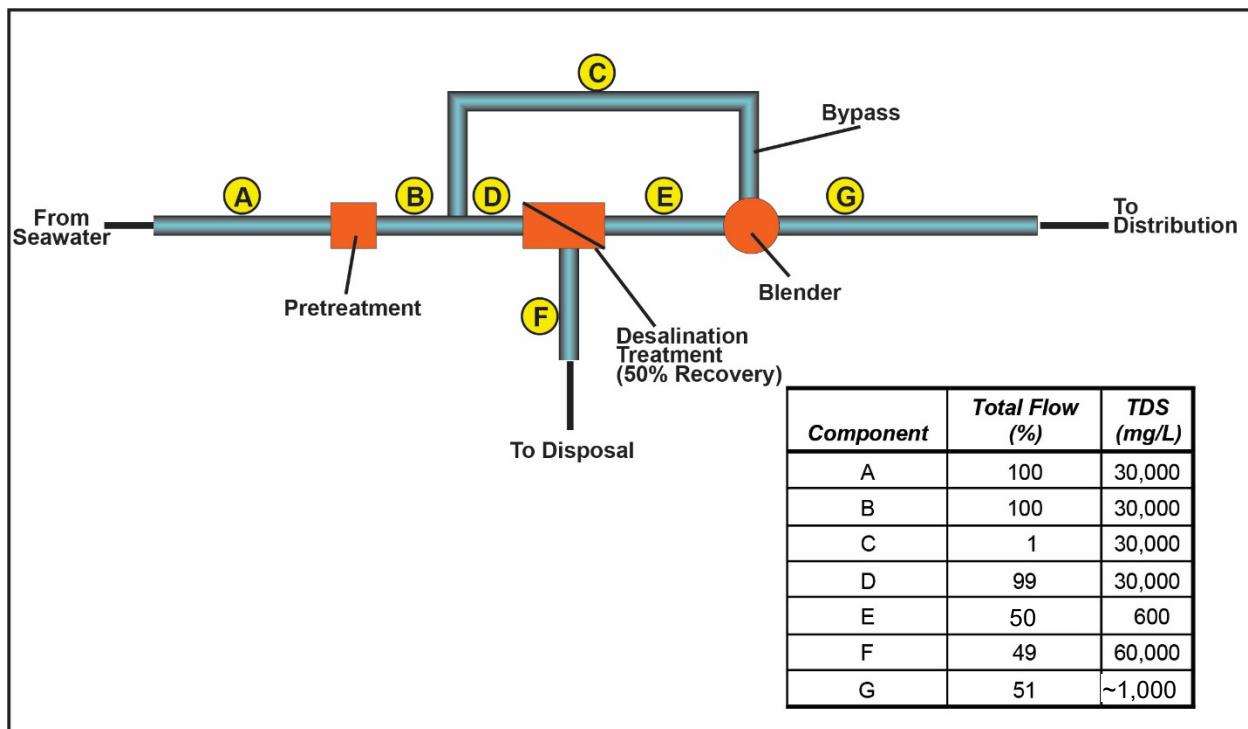


Figure 5B.6.1.
Flow Diagram for a Typical Seawater Desalination Water Treatment Plant

The following section describes distillation and membrane processes and discusses a number of issues that should be considered before selecting a process for desalination of seawater. Coastal seawater desalination projects are either in operation or under construction in Florida and California, but there are no seawater desalination plants operating in Texas.¹

5B.6.1.1 Distillation (Thermal) Processes

Distillation processes produce purified water by vaporizing a portion of the saline feedstock to form steam. Since the salts dissolved in the feedstock are nonvolatile, they remain unvaporized and the steam formed is captured as a pure condensate. Distillation processes are normally very energy-intensive, expensive, and are generally used for large-scale desalination of seawater. Heat is usually supplied by steam produced by boilers or from a turbine power cycle used for electric power generation. Distillation plants are commonly dual-purpose facilities that produce purified water and electricity. According to a recent study by the City of Corpus Christi, geothermal energy is better suited to thermal desalination rather than reverse osmosis membrane processes.²

In general, for a specific plant capacity, the equipment in distillation plants tends to be much larger than membrane desalination equipment. However, distillation plants do not have the stringent feedwater quality requirements of membrane plants. Due to the relatively high temperatures required to evaporate water, distillation plants have high energy requirements, making energy a large factor in their overall water cost. Their high operating temperatures can result in scaling (precipitation of minerals from the feedwater), which reduces the efficiency of the evaporator processes. Once an evaporator system is constructed, the size of the exchange area and the operating profile are fixed, leaving energy transfer as a function of only the heat transfer coefficient. Therefore, any scale that forms on heat exchanger surfaces reduces heat transfer coefficients. Under normal circumstances, scale can be controlled by chemical inhibitors, which inhibit but do not eliminate scale, and by operating at temperatures of less than 200 degrees Fahrenheit.

Distillation product water recoveries normally range from 15 to 45 percent, depending on the process. The product water from these processes is nearly mineral-free, with very low TDS (less than 25 milligrams per liter [mg/L]). However, this product water is extremely aggressive and is too corrosive to meet the Safe Drinking Water Act corrosivity standards without post-treatment. Product water can be stabilized by chemical treatment or by blending with other potable water.

The three main distillation processes in use today are Multistage Flash Evaporation (MSF), Multiple Effect Distillation (MED), and Vapor Compression (VC). All three of these processes utilize an evaporator vessel that vaporizes and condenses the feedstock. The three processes differ in the design of the heat exchangers in the vessels and in the method of heat introduction into the process. Since there are no distillation processes in Texas that can be shown as

¹ City of Corpus Christi website, "Corpus Christi Desalination Demonstration Project", June 2014.
<http://www.cctexas.com/Assets/Departments/Water/Files/DesalFactSheet.pdf>

² City of Corpus Christi, Variable Salinity Desalination Demonstration Project "Technical Memorandum No. 1-Desalination Technology Research Project No. E13063", September 2014.

comparable installations, distillation will not be considered here. However, there are membrane desalination operations in Texas, so the following discussion and analyses are based upon information from the use of membrane technology for desalination.

5B.6.1.2 Membrane (Non-Thermal) Processes

The two types of membrane processes use either pressure — as in reverse osmosis (RO) — or electrical charge — as in electrodialysis reversal (EDR) — to reduce the mineral content of water. Both processes use semi-permeable membranes that allow selected ions to pass-through while other ions are blocked. EDR uses direct electrical current applied across a vessel to attract the dissolved salt ions to their opposite electrical charges. EDR can desalinate brackish water with TDS up to several thousand milligrams per liter, but energy requirements make it economically uncompetitive for seawater, which contains approximately 35,000 mg/L TDS. As a result, only RO is used for seawater desalination.

RO uses a semi-permeable membrane that limits the passage of salts from the saltwater side to the freshwater side of the membrane. Electric motor-driven pumps or steam turbines (in dual-purpose installations) provide the 800 to 1,200 pounds per square inch (psi) pressure to overcome the osmotic pressure and drive the freshwater through the membrane, leaving a waste stream of brine/concentrate. The basic components of an RO plant include pre-treatment, high-pressure pumps, membrane assemblies, and post-treatment. Pretreatment is essential because feedwater must pass through very narrow membrane passages during the process and suspended materials, biological growth, and some minerals can foul the membrane. As a result, virtually all suspended solids must be removed and the feedwater must be pre-treated so precipitation of minerals or growth of microorganisms does not occur on the membranes. This is normally accomplished by using various levels of filtration and the addition of various chemical additives and inhibitors. Post-treatment of product water is usually required prior to distribution to reduce its corrosivity and to improve its aesthetic qualities. Specific treatment is dependent on product water composition.

A "single-pass/stage" seawater RO plant will produce water with a TDS of 300 to 500 mg/L, most of which is sodium and chloride. The product water will be corrosive, but this may be acceptable, if a source of blending water is available. If not, and if post-treatment is required, the various post-treatment additives may cause the product water to exceed the desired TDS levels. In such cases, or when better water quality is desired, a "two-pass/stage" RO system is used to produce water typically in the 200 mg/L TDS range. In a two-pass RO system, the concentrate water from the first RO pass/stage is further desalted in a second RO pass/stage, and the product water from the second pass is blended with product water from the first pass.

Recovery rates up to 45 percent are common for a two-pass/stage seawater RO facility. RO plants, which comprise about 47 percent of the world's desalting capacity, range from a few gallons per day to 35 mgd. The largest RO seawater plant in the United States is the 25 mgd plant in Tampa Bay, Florida. The current domestic and worldwide trend seems to be for the adoption of RO when a single purpose seawater desalting plant is to be constructed. RO membranes have been improved significantly over the past two decades (i.e., the membranes have been improved with respect to efficiency, longer life, and lower prices). Municipal use desalination plants in Texas

that use lake water, river, or groundwater are shown in Table 5B.6.1. As of 2020, The Texas Water Development Desalination Plant database reported 53 public water supply desalination plants currently operating in Texas, greater than 25,000 gallons per day. The plant capacities range from 0.1 mgd (Homestead MUD-EI Paso) to 10 mgd (Lake Granbury).

Table 5B.6.1.
Municipal Use Desalt Plants in Texas (greater than 25,000 gpd)

Location	County	Source	Raw Water TDS (mg/L), estimate	Target TDS for Finished Water (mg/L)	Total Capacity (MGD)	Desalt Capacity (MGD)	Membrane Type ¹	Membrane Recovery (%)
Abilene, City of	Taylor	Surface Water	1500	<500	7.95	3	RO	0.7
Ballinger, City of	Runnels	Surface Water	-	40	-	-	-	0.92
Bardwell, City of	Ellis	Groundwater	-	400	0.252	0.036	RO	0.6
Bayside, City of	Refugio	Groundwater	2500	350	0.045	-	RO	-
Beckville, City of	Panola	Groundwater	1200	100	0.216	0.216	RO	0.75
Benjamin, City of	Knox	Groundwater	-	-	0.072	-	-	0.71
Big Bend Motor Inn	Brewster	Groundwater	1694	300	0.057	0.057	RO	0.75
Bob Elder Water Treatment Plant	Parker	Surface Water	1255	-	-	1	RO	0.68
Brady, City of	McCulloch	Surface Water	1,200 - 1,600	-	3	1.5	RO	0.75
Brazoria County MUD 21	Brazoria	Groundwater	-	-	2.572	2.572	-	-
Clarksville City, City of	Gregg	Groundwater	2600	200	0.288	0.288	RO	0.75
Cypress WTP	Wichita	Surface Water	3500	<100	12	12	RO	0.75
Dell City	Hudspeth	Groundwater	1466	435	0.1	0.1	EDR	0.75
DS Waters of America, LP	Waller	Groundwater	470	36	0.09	-	RO	0.75
Esperanza Fresh Water Supply	Hudspeth	Groundwater	-	-	0.023	-	RO	-
Evant, City of	Coryell	Groundwater	1100	800	0.1	0.08	RO	0.8
Fort Hancock RO Plant 1	Hudspeth	Groundwater	-	-	0.43	0.43	RO	0.78
Ft. Stockton, City of	Pecos	Groundwater	1500	150	7	3	RO	0.8
Granbury, City of (IDLE)	Hood	Surface Water	-	-	0.462	0.35	RO	0.75
H2OAKS Center	Bexar	Groundwater	1160 - 1460	30-50	12	10	RO	0.9
Holiday Beach WSC	Aransas	Groundwater	2000	450	0.15	-	RO	0.7
Horizon Regional MUD RO Plant	El Paso	Groundwater	-	80	6	3.3	RO	0.80
Hubbard, City of	Hill	Groundwater	2793	-	0.648	0.432	RO	0.62
Kay Bailey Hutchison Desalination Plant	El Paso	Groundwater	2500 - 3500	750	27.5	15	RO	0.825
Kenedy, City of	Karnes	Groundwater	1500	-	2.86	0.72	RO	0.67
Brazos Regional Public Utility Agency	Hood	Surface Water	850	150	15	7.5	RO	0.85
Klondike ISD	Dawson	Groundwater	-	-	0.043	-	RO	-
Midland Country Club	Midland	Groundwater	3840	200	0.023	0.11	RO	0.8



Location	County	Source	Raw Water TDS (mg/L), estimate	Target TDS for Finished Water (mg/L)	Total Capacity (MGD)	Desalt Capacity (MGD)	Membrane Type ¹	Membrane Recovery (%)
Military Hwy WSC- Las Rusias	Cameron	Surface Water	-	-	2.1	2.1	RO	-
Military Hwy WSC- Progreso	Cameron	Groundwater	-	-	1	1	RO	-
Millersview-Doole WSC	Concho	Surface Water	800	100	1.53	0.748	RO	0.75
Mitchell County Desal Plant (Idle)	Mitchell	Groundwater	-	-	0.25	-	RO	-
North Alamo WSC (Doolittle)	Hidalgo	Groundwater	2500	500	3.5	3	RO	-
North Alamo WSC (Lasara)	Willacy	Groundwater	-	500	1.2	1	RO	-
North Alamo WSC (Owassa)	Hidalgo	Groundwater	2000	500	2	1.5	RO	-
North Cameron/Hidalgo WA	Cameron	Groundwater	3500	400 uS/cm	2.304	1.152	RO	0.75
Oak Trail Shores	Hood	Surface Water	-	-	1.584	-	RO	-
Possum Kingdom WSC	Palo Pinto	Surface Water	2400	50-100	1	-	RO	0.75
Raw Water Production Facility Big Spring Plant	Howard	Groundwater	2500-3000	<750	2.5	2.5	RO	0.825
River Oaks Ranch	Hays	Groundwater	1500	300	0.1152	0.1152	RO	0.7
Robinson, City of	McLennan	Surface Water	500-900	100-600	2.3	1.6	RO	0.75
Rule, City of	Haskell	Groundwater	-	-	0.864	0.0864	RO	0.68
Seadrift, City of	Calhoun	Groundwater	2200	400	0.61	0.524	RO	0.7
Seymour, City of	Baylor	Groundwater	800	400	3	3	RO	0.81
Sherman, City of	Grayson	Surface Water	-	400-500	10	5	RO	0.80
Southmost Regional Water Authority	Cameron	Groundwater	3500	550	10	8.8	RO	0.75
Sportsmans World MUD	Palo Pinto	Surface Water	-	300	0.083	0.083	RO	0.5
Study Butte Terlingua Water System	Brewster	Groundwater	1425	200	0.144	0.144	RO	0.75
Tatum, City of	Rusk	Groundwater	1200	320	0.324	0.288	RO	0.75
The Cliffs	Palo Pinto	Surface Water	-	400	0.381	0.381	RO	0.8
TPWD Caprock Canyon State Park	Briscoe	Groundwater	-	-	0.54	0.54	RO	-
Valley MUD #2	Cameron	Groundwater	3500	400	1	0.5	RO	0.75
Veolia WTP (Idle)	Jefferson	Surface Water	-	-	0.245	0.066	RO	0.8
Victoria Road Plant	Hidalgo	Groundwater	4000	150	2.25	2	RO	0.75

Source: TWDB Desalination Plant Database, 2020

¹ RO = Reverse Osmosis EDR = Electrodialysis Reversal

5B.6.1.3 Examples of Relevant Existing Desalt Projects

Seadrift, TX: In 1996, Seadrift (retail population 1,890) was dependent on the Gulf Coast Aquifer for its water supply. TDS and chlorides had reached unacceptable levels of 1,592 mg/L and 844 mg/L, respectively. These values exceeded the primary drinking water standard for TDS (1,000 mg/L) and the secondary drinking water standard for chlorides (300 mg/L). Since the community was not located near an adequate quantity of freshwater or a wholesaler of drinking water, the decision was made to install RO to treat this slightly brackish groundwater. The city installed pressure filters, two RO units, anti-scalant chemical feed equipment, and a chlorinator. The capital cost for the system was \$1.2 million and the annual operation and maintenance (O&M) cost is \$56,000, resulting in a total debt service plus O&M cost of about \$0.88 per 1,000 gallons treated by RO. The capital cost included the cost of facilities in addition to the RO units and their appurtenant equipment. Product water from the RO units is blended with groundwater to meet an acceptable quality level. About 60 percent of the total is from the desalt units.

Tampa, FL: The water utility, Tampa Bay Water, selected a 30-year design, build, operate, and own (DBOO) proposal to construct a nominal 25 mgd seawater desalt plant. The plant uses RO as the desalt process. The proposal included total capitalization and operations costs for producing high quality drinking water (chlorides less than 100 mg/L). The total cost to Tampa Bay Water in the original proposal was to be \$2.08 per 1,000 gallons on a 30-year average, with first year cost being \$1.71 per 1,000 gallons. However, subsequent issues with the original design, including significant problems in obtaining adequate pretreatment have increased the projected total cost to Tampa Bay Water by \$0.72 per 1,000 gallons for a total projected cost of \$2.80 per 1,000 gallons on a 30-year average.³ The results of Tampa Bay's competition has attracted international interest in the current cost profile of desalting seawater for drinking water supply, since these costs are only about one-half the levels experienced in previous desalination projects.

Tampa Bay Water selected the winning proposal from four DBOO proposals submitted, which ranged from \$2.08 to \$2.53 per 1,000 gallons. The factors listed below may be all or partially responsible for these seemingly low costs:

- Salinity at the Tampa Bay sites ranges from 25,000 to 30,000 mg/L, lower than the more common 35,000 mg/L for seawater. RO cost is sensitive to salinity.
- The power cost, which is interruptible, is below \$0.04 per kilowatt-hour (kWh).
- Construction cost savings through using existing power plant canals for intake and concentrate discharge.
- Economy of scale at 25 mgd.
- Amortizing over 30 years.
- Use of tax-exempt bonds for financing.

³ Associated Press, "Tampa Bay Water to Hire Group to Fix Desalination Plant," September 21, 2004.

The Tampa Bay Seawater Desalination Plant went on-line in 2007. Information on this project can be found on Tampa Bay Water's website: <https://www.tampabaywater.org/tampa-bay-seawater-desalination>.

The Tampa bids contrast with another current large-scale desalination project in which distillation is proposed. The current desalt project of the Singapore Public Utility Board, which proposes a 36 mgd multi-stage flash distillation plant, will cost an estimated \$5.76 per 1,000 gallons for the first year operation.⁴

Carlsbad Desalination Facility: This 54 mgd desalination plant is located in California and designed by Poseidon with 10 miles of 54-inch pipeline serving San Diego County. It is the largest desalination plan in the Americas. The main technology used for desalination is reverse osmosis. The main delivery method is Design-Build-Finance-Own-Operate-Maintain and Transfer. The total capital cost for the project was around \$922 million, with financing closed in 2012. The project became operational in December 2015 and was delivered on time and on budget. The total water produced to date is greater than 51 billion gallons. The estimated cost is around \$7.82 per thousand gallons, which includes the cost to pump water through the 10-mile pipeline, including a 1,000-foot elevation increase.

5B.6.2 Environmental Issues

House Bill (HB) 2031, passed by the 84th Legislature, requires consultation with Texas Water Development Board (TWDB) and the General Land Office (GLO) regarding siting of marine seawater desalination intakes and discharges to minimize ecological impacts. This legislation created new Texas Water Code (TWC) Chapter 18 addressing marine seawater desalination projects. TWC §18.003 establishes the requirements for obtaining a permit to divert the state's seawater and to discharge brine effluent from desalination projects into the Gulf of Mexico. This legislation applies to desalination plants sited outside the Texas coastal barrier islands.

In the Coastal Bend Region, five proposed desalination plant options are being considered by different entities, including the City of Corpus Christi, the Port of Corpus Christi Authority, and Poseidon/City of Ingleside, as shown in Figure 5B.6.2. Site-specific environmental issues are discussed in the following sections (Sections 5B.6 through 5D.12). This section discusses more general environmental issues associated with seawater desalination plants in the Coastal Bend area.

⁴ Desalination & Water Reuse Quarterly, vol. 7/4, Feb/Mar 1998.

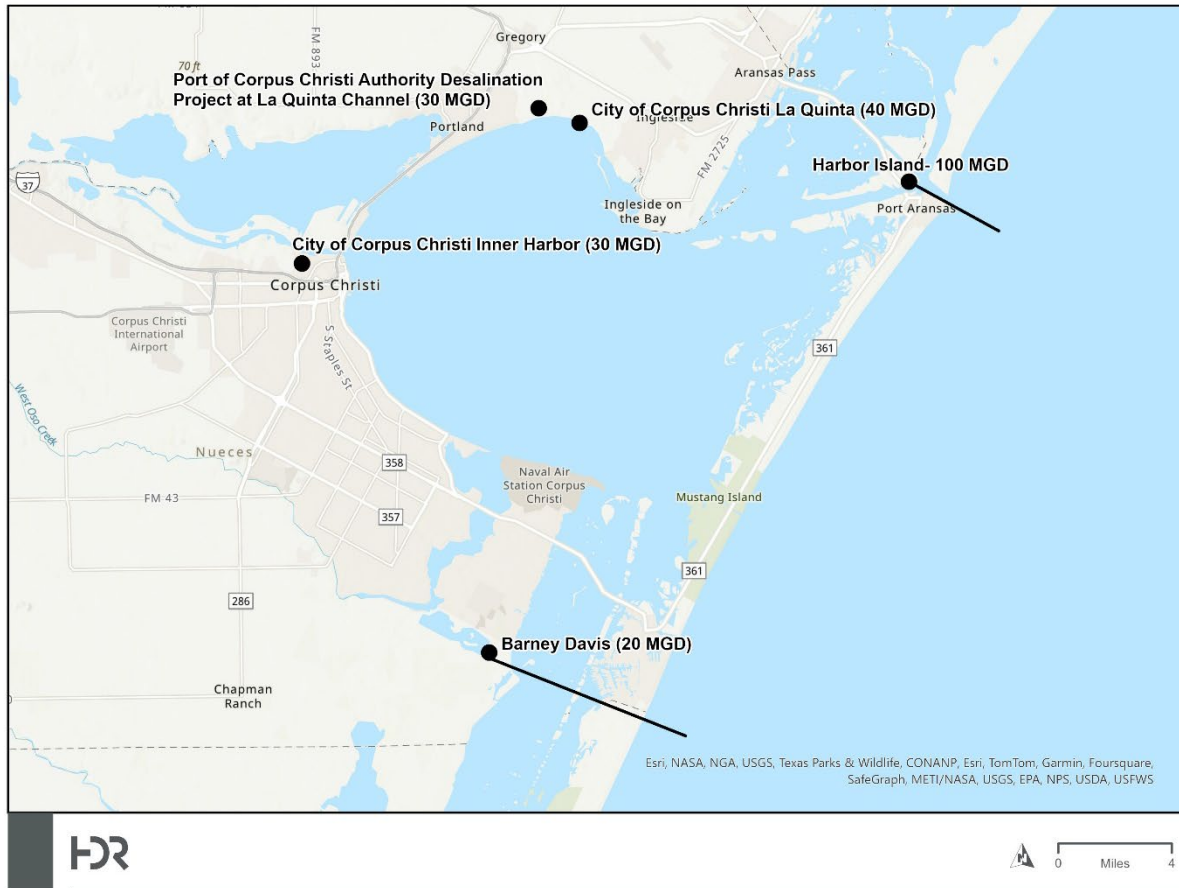


Figure 5B.6.2.
Locations for Proposed Seawater Desalination Plants in Region N

Estuaries and bays serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from the abundance of terrigenous nutrient input, shallow water, and the ability of a few marine species to exploit environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the construction of a desalination plant in the vicinity of Nueces Bay and/or Corpus Christi Bay will be sensitive to the siting of the plant and its appurtenances. Environmental analyses including impingement and entrainment will need to be considered as part of the intake evaluation.

The Texas Parks and Wildlife Department (TPWD) and the GLO conducted a joint agency study⁵, required by House Bill 2031, on marine seawater desalination plants. The study included general recommendations for diversion intake systems to reduce environmental impacts to

⁵ Texas Parks and Wildlife Department and Texas General Land Office, 2018. Marine Seawater Desalination Diversion and Discharge Zones Study. Accessed online <https://tpwd.texas.gov/publications/pwdpubs/media/hb2031dz.pdf?d=462414.3799> December 26, 2019.

marine organisms. While the projects proposed in the following sections are located bayside of the coastal barrier islands and are considered seawater desalination plants, some of the recommendations from the study may be applicable. The recommendations in the study for intake structures included:

- Keeping the flow-through velocity of seawater at the intake structure below 0.5 feet per second;
- Do not co-locate diversions such that combined impacts in the surrounding approach area exceeds 0.5 feet per second;
- Design intake structures to adjust or adaptively manage with varying flows and water quality;
- Design intake structures and reduce velocity so marine organisms can escape the intake;
- Use exclusion devices, such as screens or booms, to exclude organisms from the intake; and
- Conduct a site-specific study of conditions at proposed intake locations to identify marine organisms at risk from intake operations during the design planning process.
- If possible and feasible, the study suggested drawing water down through a sandy bottom to below ground piping which would prevent impingement of marine organisms and entrainment of other organisms on the intake screen.

Concentrated brine effluent is produced during the desalination process. Releasing brine concentrate could potentially affect organisms that are dependent upon a specific range of temperature and salinity. Changes to the ratio and type of salt discharges can cause osmotic imbalances and toxicity. The joint TPWD/GLO study on marine seawater desalination also summarized recommendations on siting discharge locations, from their study and published literature. Site specific studies on the receiving waters and brine discharges should be conducted during project planning and include salinity, types of salts, circulation at the discharge site, other contaminants from the process, maintenance, and pipes that may be discharged to the receiving water. These studies should be conducted to find ways to minimize any potential toxicity and impacts to receiving water chemistry and biota.⁶ Salinity can affect the density of seawater with higher salinity correlating to denser water thereby potentially affecting water movement in the area. The City of Corpus Christi and Port of Corpus Christi Authority (PCCA) have suggested the use of diffusers at the discharge point, or another mechanism, to mix brine discharge effluent with the seawater to reduce these types of impacts⁶. The Gulf of Mexico coastal seawater typically has a concentration of approximately 35 parts sea salt per thousand parts water by weight, where freshwater is near zero. Salinity variations in estuary and

⁶ City of Corpus Christi Seawater Desalination Project (<https://www.cctexas.com/desal>) Accessed December 27, 2019.

bay areas are typically in response to river inflow, evaporation, and mixing by wind and ocean tides.⁷

The proposed projects are located within the Gulf Coast Prairies and Marshes physiographic region of Texas and within the Tamaulipan biotic province.⁸ According to general vegetation data for the state of Texas, several vegetation types occur within the vicinity of the proposed projects, including urban, crops, live oak woods/parks, and marsh barrier island.⁹ Vegetation impacts include clearing areas for the desalination plants and installation of pipelines.

According to Information for Planning and Consultation (IPaC), downloaded from the U.S. Fish and Wildlife Service (USFWS) on January 29, 2025, 15 federally listed threatened or endangered species have the possibility of being in the project area (see Table 5B.6.2). Critical habitat for the threatened piping plover (*Charadrius melodus*) is located on San Jose Island and Mustang Island, and proposed critical habitat for the threatened rufa red knot (*Calidris canutus rufa*) is located on Mustang Island, within the 2 miles of Harbor Island and the proposed PCCA Harbor Island desalination site.¹⁰

Table 5B.6.2 lists federally listed endangered or threatened species occur in the vicinity of the proposed desalination plants. Inclusion in this table does not mean that a species will occur within the project area but only acknowledges the potential for its occurrence in the project area. Because the project will use seawater, no impacts to existing stream flows or stream habitats would be anticipated. Positive impacts to river and stream segments may occur as utilizing treated seawater may reduce or eliminate the water needs from freshwater surface sources. Potential impacts to listed species within the project area could occur due to disturbance associated with intake and discharge structures during operation of the facility. However, proper siting and studies conducted prior to implementation will minimize these impacts.

Impacts to existing habitat resulting from the construction of the desalination plants and their associated pipelines, pump stations and water treatment facilities is a function of facility location and design. Impacts to potential habitat can be avoided by utilizing previously disturbed areas. Site-specific habitat surveys should be conducted prior to project construction to determine whether populations of potential habitats used by listed species occur in the area to be affected. Coordination with TPWD and USFWS regarding threatened and endangered species with potential to occur in the project area should be initiated early in project planning.

⁷ Amec Foster Wheeler, 2017. Process Design Basis and Narrative Port of Corpus Christi Authority Industrial Seawater Desalination Harbor Island. December 2017.

⁸ Blair, W.F., "The Biotic Provinces of Texas," *Tex. J. Sci.* 2:93-117, 1950.

⁹ McMahan, C.A., R.G. Frye, and K.L. Brown, 1984. The Vegetation Types of Texas. Accessed online https://tpwd.texas.gov/publications/pwdpubs/pwd_bn_w7000_0120/ March 22, 2019.

¹⁰ USFWS, 2019. Information for Planning and Consultation (IPaC) resource list. December 18, 2019.

Table 5B.6.2.
Federally-Listed Threatened or Endangered Species in the Vicinity of Proposed Desalination Projects in the Coastal Bend Region

Common Name	Scientific Name	Federal Status	Habitat Requirements
Tricolored bat	<i>Perimyotis subflavus</i>	PE	Forest, woodland and riparian areas are important. Caves are very important to this species.
West Indian manatee	<i>Trichechus manatus</i>	T	Marine, brackish, and freshwater systems in coastal and riverine areas.
Eastern Black Rail	<i>Laterallus jamaicensis jamaicensis</i>	T	Salt, brackish, and freshwater marshes, and borders, wet meadows, and grassy swamps.
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	E	Open country, especially savanna and open woodland, and sometimes in very barren areas.
Piping Plover	<i>Charadrius melodus</i>	T	Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands. Also spoil islands in the Intracoastal Waterway.
Rufa Red Knot	<i>Calidris canutus rufa</i>	T	Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.
Whooping Crane	<i>Grus americana</i>	E	Small ponds, marshes and flooded grain fields for both roosting and foraging.
Green sea turtle	<i>Chelonia mydas</i>	T	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches.
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	E	Gulf and bay system, warm shallow waters especially in rocky marine environments such as coral reefs and jetties. Juveniles found in floating mats of sea plants.
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	E	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico.
Leatherback sea turtle	<i>Dermochelys coriacea</i>	E	Gulf and bay systems, and widest ranging open water reptile.
Loggerhead sea turtle	<i>Caretta caretta</i>	T	Gulf and bay system primarily for juveniles, adults are most pelagic of sea turtles.
Monarch butterfly	<i>Danaus plexippus</i>	PT	Fields, roadsides, wetlands, with milkweed and flowering plants.
Slender rush-pea	<i>Hoffmannseggia tenella</i>	E	Coastal prairie grasslands on level uplands and on gentle slopes along drainages.
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	E	Grasslands and mesquite-dominated shrublands on various soils. Mostly over the Beaumont Formation on the Coastal Plain.

Source: USFWS, 2025. Information for Planning and Consultation Resource List. Downloaded January 29, 2025.

E=Endangered, T=Threatened, PE=Proposed Endangered, PT=Proposed Threatened

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Potential indirect environmental effects include air and greenhouse gas emissions associated with energy usage. These effects could be minimized by incorporating the use of renewable energy sources.

Cultural resource surveys of the plant sites and pipeline routes will need to be performed consistent with requirements of the Texas Antiquities Code. Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by surface infrastructure, changes in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

5B.6.3 Implementation Issues

Permitting of this seawater desalination facilities will require extensive coordination with applicable regulatory entities, including the Texas Commission on Environmental Quality (TCEQ), GLO, and others listed above. Permitting and construction of the intake and concentrate pipeline will be major project components.

The installation and operation of a seawater desalination water treatment plant will likely have to address the following issues.

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and constructing concentrate pipeline through seagrass beds and barrier island;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permits;
- Confirming that blending desalted seawater with other water sources in the municipal demand distribution system can be successfully accomplished;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

5B.6.4 City of Corpus Christi Seawater Desalination- Inner Harbor and La Quinta Channel Projects

5B.6.4.1 Description of Strategy

Desalting seawater from the Gulf of Mexico is a potential source of freshwater supplies for municipal and industrial uses. In August 2004, the City of Corpus Christi conducted a feasibility

study¹¹ funded by the TWDB of a large-scale seawater desalination facility in the Region N area. For the 2006 and 2011 regional water plans, a large-scale 25 to 100 mgd seawater desalination facility co-sited with the Barney M. Davis Power Station in Corpus Christi near Laguna Madre, Oso Bay, and Corpus Christi Bay was considered. Favorable factors for the Barney Davis power station location include use of cooling plant effluent for diluting concentrate, ability to use the existing seawater intake infrastructure at the power plant, and close proximity to the water distribution system. The desalination concentrate was considered to be piped out to the open Gulf of Mexico to be discharged in waters over 30 feet deep. The 2011 regional water plan estimated the cost of a 25 mgd seawater desalination facility at Barney M. Davis Power Station with 5-mile pipeline delivery to proposed distribution center on the south side of town at \$1,696 per ac-ft (or \$5.21 per 1,000 gallons) based on September 2008 dollars. Blending with brackish groundwater, previously evaluated in the 2006 regional water plan, was eliminated from further consideration based on the lack of availability of groundwater at suitable quality (summarized in Chapter 9). The seawater desalination facility co-sited with Barney M. Davis Power Station was included as an alternate strategy in the 2011 regional water plan at the 25 mgd size, which was subsequently updated through amendment in August 2014 to be listed as a recommended strategy for the 2011 regional water plan to meet needs beginning in 2020.

The City of Corpus Christi, as a wholesale water provider (WWP), continues to evaluate seawater desalination options, including variable desalination programs and combinations with brackish groundwater resources to address future industrial development and anticipated population growth associated with new industry and Eagle Ford Shale production. In April 2014, the Corpus Christi City Council voted to accept a federal, U.S. Bureau of Reclamation grant and transfer funds from the City's Raw Water Supply Development Fund for a City of Corpus Christi Desalination Program Pilot Study. In July 2014, Corpus Christi City Council considered and subsequently adopted a resolution to the 84th Texas Legislature to appropriate funding for FY 16-17 biennium and partnering with local sponsors to implement desalination projects.

The City of Corpus Christi conducted a \$3 million demonstration program with support from the U.S. Bureau of Reclamation to design, construct, and operate a demonstration desalination plant for industrial and drinking water purposes. The objectives of the program are to evaluate the feasibility of seawater desalination and develop cost estimates, to test emerging technologies, and to identify and assess site options and requirements for a full-scale facility.¹² With the results of the study, the City of Corpus Christi will consider moving forward with a full-scale desalination project. As of November 2019, the City of Corpus Christi is considering two potential sites to provide additional supplies of 30 mgd for Nueces County industries and municipal customers and 40 mgd for San Patricio County: Inner Harbor and La Quinta Channel. These locations are shown in Figure 5B.6.3, with the aerial photograph showing the most current location.

¹¹ City of Corpus Christi, Draft Report "Large Scale Demonstration Desalination Feasibility Study," August 2004.

¹² City of Corpus Christi website, "Corpus Christi Desalination Demonstration Project", June 2014.
<http://www.cctexas.com/Assets/Departments/Water/Files/DesalFactSheet.pdf>



Figure 5B.6.3.
Proposed Location for Inner Harbor and La Quinta Seawater Desalination Programs

The Inner Harbor Desalination site in Nueces County would be constructed to treat 30 mgd and La Quinta Channel Desalination site in San Patricio County would treat 40 mgd. The treatment efficiency of the desalination plant is estimated to be 45 percent. The finished water quality is targeted to be approximately 500 mg/L. The Inner Harbor Plant will treat all of its product water to potable standards and send it through the City of Corpus Christi distribution system. The La Quinta Channel Plant will treat the product water to potable water standards and deliver it to San Patricio Municipal Water District (SPMWD). The SPMWD will deliver this water to industrial customers, but they may adjust water quality to meet the needs of different customers.

The Inner Harbor water use permit was granted on October 10, 2022, for diversions not to exceed 93,148 ac-ft/yr with a maximum diversion of 129 cubic feet per second (57,708 gallons per minute). The discharge and the U.S. Army Corps of Engineers (USACE) permits are in progress. The La Quinta water use permit was granted on April 17, 2024, for diversions not to exceed 186,295 ac-ft/yr with a maximum diversion of 257 cubic feet per second (115,349 gallons per minute). The discharge and USACE permits are in progress.

An industrial wastewater permit application was filed by the City of Corpus Christi on January 22, 2020. TCEQ Executive Director decided on December 19, 2024, that the permit application meets the requirements of applicable law for discharge permit, TPDES Permit No. WQ0005289000, for effluent discharged directly to Corpus Christi Inner Harbor in Segment No. 2484 of the Bays and Estuaries. The designated uses for Segment No. 2484 are non-contact

recreation and intermediate aquatic life use. TCEQ commissioners have set a public meeting on March 13, 2025, to consider the permit and request for hearing.

5B.6.4.2 Available Yield- Inner Harbor

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The City of Corpus Christi and port industries are currently considering a finished desalination supply of 30 mgd (33,604 ac-ft/yr) at the Inner Harbor facility. A map is shown in Figure 5B.6.4.



Figure 5B.6.4.
Proposed Location for Inner Harbor Seawater Desalination Programs

5B.6.4.3 Engineering and Costing- Inner Harbor

Based on information provided by City of Corpus Christi staff and its consultant, the following costs were identified for the Inner Harbor seawater desalination project as shown in Table 5B.6.3:

- Total estimated construction costs for a 30 mgd Inner Harbor facility \$1.2 billion.
- Lifecycle water production costs, at the fence, are estimated to be \$11.62 per 1,000 gallons with debt service for a plant located at the 30 mgd Inner Harbor facility.

Details regarding desalination process and site-specific environmental impacts for transmission and delivery are unavailable at this time. A 3,500-foot raw water pipeline, 2,300-foot concentrate discharge pipeline, and 500-foot product water delivery line are included in the cost estimate, based on information provided by Freese and Nichols.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the Unified Costing Model (UCM) tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance than is expected by the City of Corpus Christi and their consultant results in an annual cost around \$127,217,000 for the 30 mgd plant. This results in a unit cost of water of \$3,786 per ac-ft with debt service for the Inner Harbor site. Private industry partnerships and funding structures may be considered to help reduce costs and minimize treatment plant operation and maintenance risks assumed by City of Corpus Christi operators, which may account for costing differences as compared to information shown in Table 5B.6.3. The information was developed based on capital costs, project costs, and annual water productions costs provided by Kiewit, updated using the UCM and is relevant for desalination distribution near the facility. Delivery costs to specific industries or municipal distribution system are not included.

Table 5B.6.3.
Cost Estimate Summary,
City of Corpus Christi- Inner Harbor 30 mgd Desalination Project (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Marine Work (Intake Line and Discharge Line)	\$141,798,211
Treatment Plant Labor and Construction Equipment (Civil, Structural, Piping, Process Equipment, Electrical and Instrumentation, Buildings)	\$566,087,279
Product Waterline	\$65,485,252
Navigation Pump Station Improvements	\$24,023,623
Total Cost of Facilities^a	\$797,394,365
Escalation	\$47,277,800
Contingency	\$43,650,000
Bonds and Builders Risk Insurance	\$8,749,934
General Conditions	\$64,112,464
Base Design Services	\$60,890,373
Engineering Services During Construction	\$42,985,957
Vendor Engineering	\$11,303,888
Estimating	\$4,539,600
Procurement	\$1,134,900
Constructability	\$10,781,550
Management and Planning	\$9,143,632
Demonstration Plant	\$11,640,000
Freese and Nichols Administration Services	\$33,950,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$86,258,000
Total Cost of Project^a	\$1,233,812,464
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$68,317,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$2,000,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$1,000,000
Water Treatment Plant ^b	\$55,000,000
Pumping Energy Costs (10079868 kW-hr @ 0.09 \$/kW-hr) ^c	\$900,000
Total Annual Cost^b	\$127,217,000
Available Project Yield (acft/yr)	33,604
Annual Cost of Water (\$ per acft)	\$3,786
Annual Cost of Water After Debt Service (\$ per acft)	\$1,753
Annual Cost of Water (\$ per 1,000 gallons)	\$11.62
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$5.38

^a Costs provided by Kiewit Infrastructure South Co. and presented to the City of Corpus Christi City Council on July 29th, 2025.

Costs were assumed to be provided in June 2025 dollars and were scaled down to September 2023 dollars using the TWDB uniform costing model Construction Cost Index and Producer Price Index values. The "General Conditions" are assumed to include legal assistance and fiscal services. Planning, design, and construction engineering are assumed to be included in "Base Design Services", "Engineering Services During Construction", and "Freese and Nichols Administration Services." Interest During Construction was added to the Kiewit cost based on the TWDB uniform costing model.

^b Annual cost estimated by the TWDB uniform costing model. The water treatment plant annual costs from the TWDB uniform costing model include energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

^c The pumping energy cost is calculated by the uniform costing model based on pipeline diameter and length, flowrate, and elevation data. This cost accounts for pumping raw water from the intake, brine discharge to the outfall, and treated water to the delivery point.

5B.6.4.4 Available Yield- La Quinta

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The City of Corpus Christi and port industries are currently considering a finished desalination supply of 40 mgd (44,806 ac-ft/yr).

5B.6.4.5 Engineering and Costing- La Quinta

Based on information provided by City of Corpus Christi staff and its consultant, the following costs were identified for the La Quinta Channel seawater desalination project as shown in Table 5B.6.4:

- Total estimated construction costs for a 40 mgd La Quinta facility \$1,141,000,000.
- Lifecycle water production costs, at the fence, are estimated to be \$10.62 per 1,000 gallons with debt service for a plant located at the 40 mgd La Quinta facility.

Details regarding desalination process and site-specific environmental impacts for transmission and delivery are unavailable at this time. A 11,800-foot raw water pipeline, 14,500-foot concentrate discharge pipeline, and 2,000-foot product water delivery line are included in the cost estimate, based on information provided by Freese and Nichols. The brine discharge outfall structure was assumed to cost the same as an intake structure for the designated flow rate based on 45 percent RO recovery.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the UCM tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around \$155,000,000. This results in a unit cost of water of \$3,460 per ac-ft with debt service for the La Quinta site with plant size of 40 mgd. Private industry partnerships and funding structures may be considered to help reduce costs and minimize treatment plant operation and maintenance risks assumed by City of Corpus Christi operators, which may account for costing differences as compared to information shown in Table 5B.6.4. The information presented in the tables was developed based on capital costs, project costs, and annual water productions costs provided by Freese and Nichols, updated using the UCM and is relevant for desalination distribution near the facility. Delivery costs to specific industries or municipal distribution system are not included.

Table 5B.6.4.
Cost Estimate Summary,
City of Corpus Christi- La Quinta 40 mgd Desalination Project (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Intake Structure and Pump Station (89 MGD)	\$60,000,000
Water Treatment Plant (40 MGD)	\$614,000,000
Transmission Pipeline (48" - 2,000 ft)	\$3,000,000
Raw Water Pipeline (72" - 11,800 ft)	\$31,000,000
Brine Pipeline (54" - 14,500 ft)	\$28,000,000
Brine Discharge Outfall and Pump Station	\$23,000,000
Treated Water Booster Pump Station	\$7,000,000
Substation and Transmission lines ^a	\$8,000,000
Total Cost of Facilities	\$774,000,000
- Planning (3%)	\$23,000,000
- Design (7%)	\$54,000,000
- Construction Engineering (1%)	\$8,000,000
Legal Assistance (2%)	\$15,000,000
Fiscal Services (2%)	\$15,000,000
Pipeline Contingency (15%)	\$9,000,000
All Other Facilities Contingency (20%)	\$142,000,000
Environmental & Archaeology Studies and Mitigation	\$161,000
Land Acquisition and Surveying (39 acres)	\$240,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$101,000,000
Total Cost of Project	\$1,141,000,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$80,000,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$706,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$2,000,000
Water Treatment Plant ^b	\$71,000,000
Pumping Energy Costs (12816026 kW-hr @ 0.09 \$/kW-hr) ^c	\$1,450,000
Total Annual Cost	\$155,000,000
Available Project Yield (acft/yr)	44,804
Annual Cost of Water (\$ per acft)	\$3,460
Annual Cost of Water After Debt Service (\$ per acft)	\$1,677
Annual Cost of Water (\$ per 1,000 gallons)	\$10.62
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$5.15

^a Cost estimated by HDR, externally from the UCM.

^b The water treatment plant annual costs from the TWDB uniform costing model includes energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

^c The pumping energy cost is calculated by the uniform costing model based on pipeline diameter and length, flowrate, and elevation data. This cost accounts for pumping raw water from the intake, brine discharge to the outfall, and treated water to the delivery point.

5B.6.4.6 Environmental Issues

The two project areas being considered by the City of Corpus Christi for the proposed desalination plant are the Inner Harbor and La Quinta sites. The La Quinta option is located on Corpus Christi Bay, east of the inlet to Nueces Bay; the Inner Ship Channel option is located along the Main Turning Basin, near the outlet to Corpus Christi Bay. The specific siting information is still to be determined, but each proposed desalination plant site would be approximately 10 acres in size. Key factors considered in the selection of these two locations are the availability of power, proximity to the water transmission system, the character of the source water, location of a suitable concentrate discharge location, among other environmental considerations.¹³

Specific siting information for the discharge of desalination concentrate will be determined during project design. Since the desalination concentrate will be saltier than the receiving waters, the City of Corpus Christi has stated that a diffusing system would be desirable to remix the concentrate with the source water. Additional chemicals, which may be used during the filtering/treating process, may be present in the concentrate. The outfall for brine concentrate will need to consider impacts to the estuary and bay system. Prior to construction, site specific environmental studies will need to be conducted to evaluate all potential impacts to the environment and identify best management practices to eliminate or reduce adverse impacts.¹⁴ As of 2024, the City of Corpus Christi has received the TCEQ water rights permit and has submitted the discharge permit application.

Inner Harbor Desalination Site

The TPWD maintains the Texas Natural Diversity Database (TXNDD), which documents the occurrence of endangered, threatened and rare species, natural communities, and animal aggregations. The TXNDD data was reviewed for recorded occurrences of listed or rare species or natural communities, near the proposed project. The plains spotted skunk (*Spilogale putorius interrupta*), a rare species has been documented at the project site. The West Indian manatee (*Trichechus manatus*), a federally-listed threatened species, and a marine mammal with protections under the Marine Mammal Protection Act has been documented within two miles of the proposed project site. Three rare species, the Texas diamondback terrapin (*Malaclemys terrapin littoralis*), Texas stonecrop (*Lenophyllum texanum*), and Texas windmill grass (*Chloris texensis*) have also been documented within two miles of the proposed project. The TXNDD data identified a colonial wading bird colony (rookery) on the northeast side of the causeway (US 181) across Nueces Bay.

The intake and discharge locations for Inner Harbor have been studied¹⁵. This study noted that the habitat quality in the intake area has already been impacted by industrialization and it is unlikely that mortality from entrainment would be enough to substantially impact any local

¹³ City of Corpus Christi Desalination Project Frequently Asked Questions (<https://www.cctexas.com/sites/default/files/water-desal-faq-022819.pdf>)

¹⁴ City of Corpus Christi Desalination Project Frequently Asked Questions (<https://www.cctexas.com/sites/default/files/water-desal-faq-022819.pdf>)

¹⁵ Stunz, Greg and Paul Montagna, 2015. Identification and Characterization of Potential Environmental Impacts Mitigation Measures Related to Intake and Discharge Facilities of Seawater Desalination Plants.

populations. The Inner Harbor intake area is also unlikely to have any type of sensitive habitat types (i.e., seagrasses) which would impact benthic communities. Additionally, the area is highly industrialized and any surface housings would be unlikely to impact aesthetics of the area. For potential discharge, the study recommended further studies on the salinity and water chemistry to determine potential impacts, and bringing brine discharge to ambient bay temperatures prior to discharging.

National Wetland Inventory (NWI) maps were reviewed and the proposed Inner Harbor Desalination site may be in close proximity to estuarine and marine deepwater habitat, freshwater ponds, and freshwater emergent wetlands. Coordination with USACE has been initiated for impacts to waters of the United States, and a permit is expected in first quarter of 2025.

The proposed desalination plant would be located on the Inner Harbor. The Corpus Christi Inner Harbor (TCEQ Segment 2484) is listed as impaired on TCEQ's 2024 Draft 303(d) List¹⁶ for copper in the water. Within approximately 5 miles, one Corpus Christi Bay Recreational Beach (TCEQ Segment 2481CB_06) and the Corpus Christi Bay (Oyster Water) (TCEQ Segment 2481OW_01) are listed as impaired for bacteria in water. Additionally, the inlet to Nueces Bay (TCEQ Segment 2482) is likely within 5 miles of the proposed desalination plant and is listed as impaired for copper in water.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PL96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available Geographic Information System (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area. Two cemeteries, New Bayview and Old Bayview, as well as five sites listed on the National Register of Historic Places, the Nueces County Courthouse, Simon Gugenheim House, Charlotte Sidbury House, S. Julius Lichtenstein House, and the U.S.S. Lexington were located within approximately one mile from the project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the proposed project, the City of Corpus Christi, is a political subdivision of the State of Texas they will be required to coordinate with the Texas Historical Commission prior to project construction.

La Quinta Desalination Site

The TXNDD data was reviewed for documented occurrences of listed or rare species or natural communities near the project area. The federally-listed endangered jaguarundi (*Felis yagouaroundi cacomitli*), as well as several rare species or species of greatest conservation need, the keeled earless lizard (*Holbrookia propinqua*), coastal gay-feather (*Liatris bracteata*), threeflower broomweed (*Thurovia triflora*), Indianola beakrush (*Rhynchospora indianolensis*), and

¹⁶ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List (Category 5). Accessed online <https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d> December 4, 2024.

Wright's trichocoronis (*Trichocoronis wrightii* var *wrightii*) have been documented within two miles of the proposed La Quinta site. Additionally, a rookery was documented on the spoil banks in Corpus Christi Bay, located southeast of the project area.

The intake and discharge locations for the La Quinta site have been studied¹⁷. This study noted that mortality of benthic organisms could occur due to disturbance to bottom sediments. This area is known to have some sensitive seagrass habitats and is located adjacent to other sensitive habitats including fish nursery habitat, rookeries, migratory bird feeding and resting areas, and feeding areas for sea turtles. Due to its location near sensitive habitats, there would be potential for more severe environmental impacts due to brine discharge.

National Wetland Inventory (NWI) maps were reviewed and the proposed La Quinta Desalination site may be in close proximity to estuarine and marine deepwater habitat, estuarine and marine wetlands, freshwater ponds, and lakes. A jurisdictional determination of waters should be completed for the proposed project site, during project planning. Coordination with the USACE would be required for impacts to waters of the United States.

The proposed desalination plant would be located on the Corpus Christi Bay (TCEQ Segment 2481OW).¹⁸ This Segment is listed as impaired on the 2024 Draft 303(d) List for bacteria in oyster waters. The Corpus Christi Bay (TCEQ Segment 2481CB_06) is a recreational beach likely located within 5 miles of the proposed project site and listed as impaired for bacteria in water.

Based on the review of publicly available geographic information system (GIS) records obtained from the Texas Historical Commission, there are no State Historic Sites, National Register Properties or Districts, cemeteries or Historical Markers within the project area, or within one mile of the proposed project area. A review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the proposed project, the City of Corpus Christi, is a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission prior to project construction.

5B.6.4.7 Implementation Issues

The installation and operation of a seawater desalination water treatment plant may have to address the following issues.

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and constructing concentrate pipeline through seagrass beds and barrier island, including conforming with applicable laws and regulations including:
 - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)

¹⁷ Stunz, Greg and Paul Montagna, 2015. Identification and Characterization of Potential Environmental Impacts Mitigation Measures Related to Intake and Discharge Facilities of Seawater Desalination Plants.

¹⁸ TCEQ, 2020. Surface Water Quality Viewer. Accessed online tceq.maps.arcgis.com January 13, 2020.

- Endangered Species Act compliance and TPWD coordination, if required
- Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
- TPDES, stormwater, and associated construction permits
- Associated TCEQ registrations
- Local land use and construction permits
- GLO permitting requirements
- Impact on the bays from removing water for consumptive use and altering existing water rights permits;
- Confirming that blending desalted seawater with other water sources in the municipal demand distribution system can be successfully accomplished;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using design, build, operate contract for a desalination water treatment plant.

5B.6.4.8 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5B.6.5.

Table 5B.6.5.
Evaluation Summary of the City of Corpus Christi's Inner Harbor (30 mgd) and La Quinta (40 mgd) Seawater Desalination Projects

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: Inner Harbor: 33,604 ac-ft/yr and La Quinta: 44,804 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Cost for Inner Harbor: \$3,786 and La Quinta \$3,460 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed.
c. Impacts to agricultural resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts to water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.6.5 City of Corpus Christi Barney Davis Desalination

5B.6.5.1 Description of Strategy

The Barney Davis power facility (owned by Talen Energy) uses seawater originating from the Laguna Madre for cooling. The concept of co-locating a seawater desalination facility at Barney Davis power facility was first developed over 20 years ago¹⁹ and was considered in the *2001 Coastal Bend Regional Water Plan*²⁰ as a water management strategy to meet long-term manufacturing water demands in Nueces and San Patricio counties. The Barney Davis site was identified as technically feasible in a seawater desalination feasibility study²¹ and potential implementation challenges were identified. For the 2006 and 2011 regional water plans, a large-scale 25 to 100 mgd seawater desalination facility co-sited with the Barney M. Davis Power Station in Corpus Christi near Laguna Madre, Oso Bay, and Corpus Christi Bay was considered. Favorable factors for the Barney Davis power station location include use of cooling plant effluent for diluting concentrate, ability to use the existing seawater intake infrastructure at the power plant, and close proximity to the water distribution system. The desalination concentrate was considered to be off-shore in the open Gulf of Mexico to be discharged in waters over 30 feet deep. The 2011 regional water plan estimated the cost of a 25 mgd seawater desalination facility at Barney M. Davis Power Station with 5-mile pipeline delivery to proposed distribution center on the south side of town at \$1,696 per ac-ft (or \$5.21 per 1,000 gallons) based on September 2008 dollars. Blending with brackish groundwater, previously evaluated in the 2006 regional water plan, was eliminated from further consideration based on the lack of availability of groundwater at suitable quality (summarized in Chapter 11). The seawater desalination facility co-sited with Barney M. Davis Power Station was included as an alternate strategy in the 2011 regional water plan at the 25 mgd size, which was subsequently updated through amendment in August 2014 to be listed as a recommended strategy in the 2011 regional water plan to meet needs beginning in 2020.

The concept evaluated in the 2026 regional water plan is to have the desalination facility draw raw water from the power facility cooling pond and discharge brine generated by the RO treatment process through a 7.5-mile pipeline to the Gulf of Mexico. The concept of co-locating a desalination facility at the Barney Davis power facility site is of interest since it would potentially allow a desalination facility to benefit from the existing open water intake permit thereby simplifying the permitting and approval process, as well as reducing power costs for treatment by co-locating the desalination facility at the site of a power facility.

¹⁹ HDR Engineering, Inc (HDR), "Desalination for Texas Water Supply," Texas Water Development Board, Nueces River Authority, August 2000.

²⁰ HDR Engineering, Inc (HDR), "Coastal Bend Regional Water Plan," Texas Water Development Board, January 2001

²¹ City of Corpus Christi and Turner Collie Braden, Large Scale Demonstration Desalination Feasibility Study, November 2004.
https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/2004483508_Corpus_Desal.pdf?d=9668.3999999851

The GLO and TPWD prepared a report²² in response to House Bill 2031 directed by the 84th Texas Legislature that identified zones in the Gulf of Mexico appropriate for diversion of marine seawater and discharge of brine concentrate while accounting for protection of marine organisms. The 7.5-discharge pipeline provides the advantage of not impacting environmentally sensitive nearby receiving bodies (Oso Creek and Laguna Madre). The desalination facility is conceptualized, such that it does not impact Talen Energy's existing power facility operations. There appears to be sufficient space at the Barney Davis site for addition of a 20 mgd desalination facility. The proposed desalination site is shown in Figure 5B.6.5.

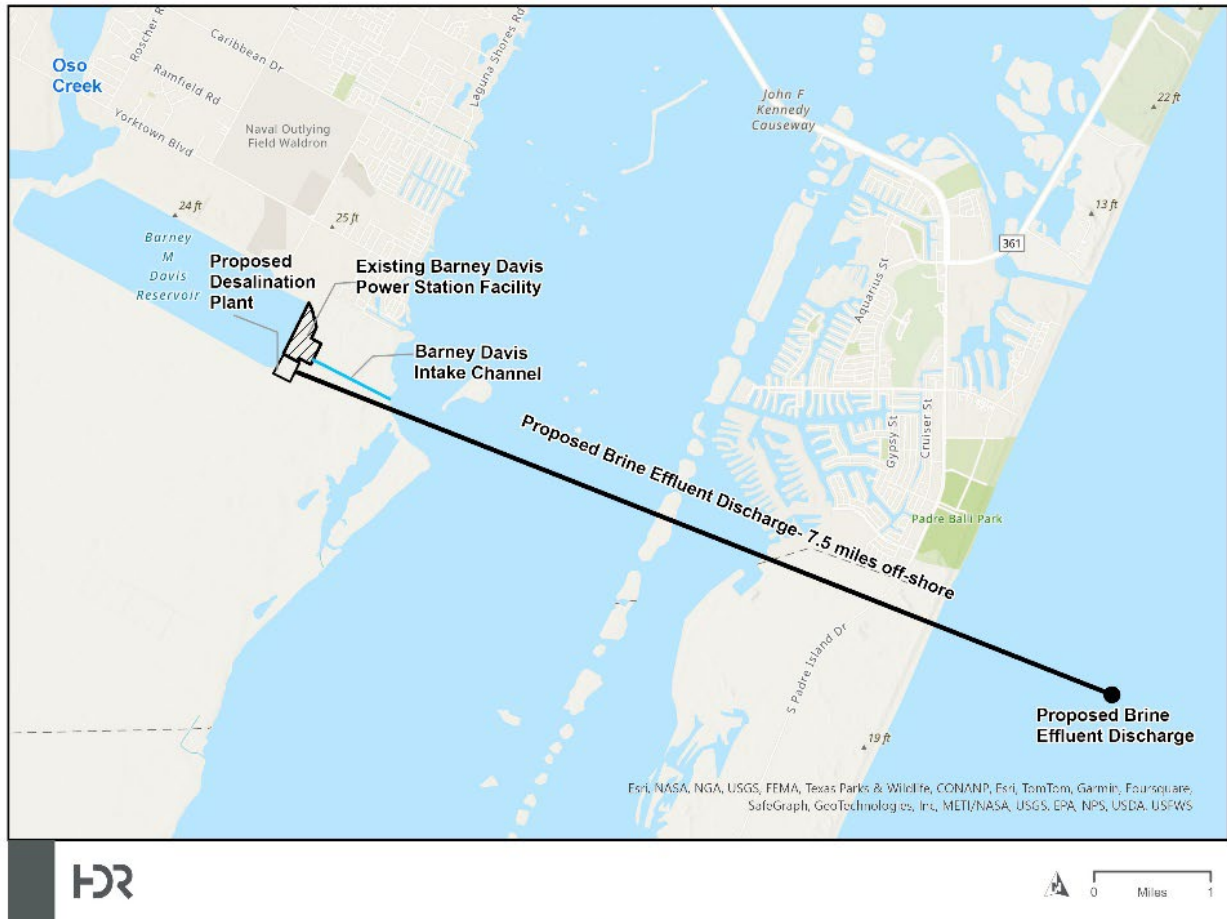


Figure 5B.6.5.
Proposed Location for Seawater Desalination Facility at Barney Davis

5B.6.5.2 Available Yield- Barney Davis

The current Intake Permit at Barney Davis allows for 725,000 acre-feet per year (ac-ft/yr) to be diverted through the intake, or the equivalent of 645 mgd. The current Intake Permit also allows for up to 6,650 ac-ft/yr of consumptive use, or the equivalent of 6 mgd. The consumptive use

²² Texas Parks and Wildlife and Texas General Land Office, 2018, Marine Seawater Desalination Diversion and Discharge Zones Study.

would need to be increased to allow for the operation of a 20 mgd desalination facility. An amendment to the intake permit authorizing a change of use from industrial purposes to public water supply would also be required. The anticipated supply is 33,627 ac-ft/yr (20 mgd).

5B.6.5.3 Environmental Issues- Barney Davis

The USFWS Information for Planning and Consultation (IPaC) Report lists a total of 15 threatened, endangered, and proposed listed species that may be present in the project area (Table 5B.6.6). Coordination with the USFWS and National Marine Fisheries Service (NMFS) is required when there is a federal nexus with the project, with formal consultation required if impacts to listed species are anticipated.

Table 5B.6.6
USFWS listed species with potential to occur within the study area

Species Name	Status	Probability of presence in the Project Area
Tricolored Bat <i>Perimyotis subflavus</i>	Proposed Endangered	The project area may provide habitat for the species. A habitat assessment is recommended.
West Indian Manatee <i>Trichechus manatus</i>	Threatened	The project area may provide habitat for the species. The facility has a controlled access system that prevents the passage of marine species from the Laguna Madre and monitoring protocols in place for aquatic species in the intake channel.
Eastern Black Rail <i>Laterallus jamaicensis ssp. jamaicensis</i>	Threatened	The project area may provide habitat for the species. A habitat assessment is recommended.
Northern Aplomado Falcon <i>Falco femoralis septentrionalis</i>	Endangered	The project area may provide habitat for the species. A habitat assessment is recommended.
Piping Plover <i>Charadrius melodus</i>	Threatened	The project area may provide habitat for the species. A habitat assessment is recommended. Critical habitat for this species is along Mustang Island, potentially within the Study Area.
Rufa Red Knot <i>Calidris canutus rufa</i>	Threatened	The project area may provide habitat for the species. A habitat assessment is recommended. Critical habitat for this species is along Mustang Island, potentially within the Study Area.
Whooping Crane <i>Grus americana</i>	Endangered	The project area may provide habitat for the species. A habitat assessment is recommended. No critical habitat for this species is within the Study Area.
Green Sea Turtle <i>Chelonia mydas</i>	Threatened	The project area may provide habitat for the species. The facility has a controlled access system that prevents the passage of marine species from the Laguna Madre and monitoring protocols in place for aquatic species in the intake channel.
Hawksbill Sea Turtle <i>Eretmochelys imbricata</i>	Endangered	The project area may provide habitat for the species. The facility has a controlled access system that prevents the passage of marine species from the Laguna Madre and monitoring protocols in place for aquatic species in the intake channel.
Kemp's Ridley Sea Turtle <i>Lepidochelys kempii</i>	Endangered	The project area may provide habitat for the species. The facility has a controlled access system that prevents the passage of marine species from the Laguna Madre and monitoring protocols in place for aquatic species in the intake channel.

Species Name	Status	Probability of presence in the Project Area
Leatherback Sea Turtle <i>Dermochelys coriacea</i>	Endangered	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico. The project would be expected to discharge into the Gulf of Mexico using diffusers, studies should be conducted to ensure discharged water chemistry is consistent with the surrounding area.
Loggerhead Sea Turtle <i>Caretta caretta</i>	Threatened	Gulf and bay system primarily for juveniles, adults are most pelagic of sea turtles. The project would be expected to discharge into the Gulf of Mexico using diffusers, studies should be conducted to ensure discharged water chemistry is consistent with the surrounding area.
Monarch Butterfly <i>Danaus plexippus</i>	Proposed Threatened	The project area may provide habitat for the species. A habitat assessment is recommended.
Slender Rush-pea <i>Hoffmannseggia tenella</i>	Endangered	The project area may provide habitat for the species. A habitat assessment is recommended.
South Texas Ambrosia <i>Ambrosia cheiranthifolia</i>	Endangered	The project area may provide habitat for the species. A habitat assessment is recommended.

Generally, habitat may be present for species within the project area, particularly along the coastline and at the point of intake to the power facility in the Laguna Madre and at the discharge point within the Gulf of Mexico. A habitat assessment will be necessary to delineate areas of potential habitat for threatened and endangered species so that siting of the proposed desalination facility can avoid sensitive habitat to the extent practicable.

Barney Davis, LLC received a permit for incidental take for threatened and endangered species on August 3, 2020, under Section 10(a)(1)(B) of the Endangered Species Act. The primary threat to threatened and endangered species from the existing intake, and by extension the proposed desalination facility, is to cold-stunned green and Kemp's ridley sea turtles, which have been documented in the intake canal in recent years. Sea turtles may float into the intake canal and become impinged on the automatic rake before entering the cooling water facility. The facility follows a monitoring and removal plan for cold-stunned sea turtles during the winter months to minimize the number of incidental takes of sea turtles and submits annual reports on the total annual actual take. The permit, which expires August 31, 2030, allows for capture of 206 green sea turtles and 4 Kemp's ridley sea turtles, with mortality and injury take limited to 24 total green sea turtles and 0 Kemp's ridley sea turtles within the 10-year permit period²³. Permitting for the desalination facility will likely require new coordination with NMFS and/or USFWS.

HDR Engineering, Inc. (HDR) conducted a desktop analysis of known and potential cultural resources within and in proximity to the project area in 2023. Staff consulted the Texas Historical Commission Atlas (Atlas), the National Register of Historic Places (NRHP), and the Texas Freedom Colonies Atlas to determine if previously identified archaeological sites, historic architectural resources, and previous cultural resource investigations are located within a one-mile (1.6 kilometer) radius of the project area. Additionally, historical U.S. Geological Survey (USGS) topographic maps and aerial imagery were viewed to identify potential historic-age

²³ National Marine Fisheries Service (NMFS). 2020. Permit to Incidentally Take Endangered/Threatened Species. Issued to Barney Davis, LLC. NOAA, NMFS.

structures within the project area. This section describes known cultural resources and the potential for unidentified cultural resources within the project area and summarizes potential issues that may arise during the proposed project.

HDR's desktop analysis indicated that nine previous cultural resources surveys, nine archaeological sites, and one National Register District (King Ranch) were recorded within 1 mile (1.6 kilometers) of the project area. Of these cultural resources, two archaeological surveys, two archaeological sites, and one National Register District (King Ranch) overlap with the project area. A review of historical aeriels and topographic maps indicated that the project area was historically undeveloped and agricultural land until the development of the coastal residential area in the 1950s and onward (Oso Creek 1925, Oso Creek 1951, Pita Island 1969). The Barney Davis electrical facility and associated cooling pond first appears on the 1975 Pita Island map^{24,25,26, 27}. In 2024, a 7.5-mile pipeline was proposed to discharge water from the facility into the Gulf of Mexico. The exact location of the pipeline is unknown and a desktop analysis of cultural resources has not been completed.

A review of the Texas Department of Transportation's (TxDOT) Potential Archaeological Liabilities Map data revealed that the project area primarily consists of areas of negligible potential for buried cultural deposits in the area of the cooling pond. The areas surrounding the cooling pond contain moderate to high potential for buried deposits, with high potential primarily in the eastern portion of the project area near the coast²⁸. The area for the proposed 7.5-mile discharge pipeline has not been determined and the potential for buried cultural deposits along its length is unknown. The presence of archaeological sites within the project area, as well as large areas of high potential for buried deposits along both stream terraces and near the coastline, indicates that an archaeological survey will likely be necessary for the proposed project. As a political subdivision of the state of Texas, the City of Corpus Christi is required to coordinate with the Texas Historical Commission (THC) under the Antiquities Code of Texas (ACT) (13 TAC 26) regarding this project. The THC will determine whether additional cultural resources work may be required. Should federal funds, property, and/or permits be required to complete the proposed project, further coordination may be required by the State Historic Preservation Office (SHPO) under Section 106 of the National Historic Preservation Act (NHPA), as amended (16 United States Code [USC] § 470).

²⁴ National Register of Historic Places (NRHP). 2023.. Available online: <https://www.nps.gov/maps/full.html?mapId=7ad17cc9-b808-4ff8-a2f9-a99909164466>, accessed January 2023

²⁵ Historic Aeriels. 2023. Historic Aeriels: Viewer, Texas. Available online at <https://www.historicaeriels.com/viewer>, accessed January 2023

²⁶ Texas Historical Commission. 2023. Texas Archeological Sites Atlas. Available online at <https://atlas.thc.texas.gov/>, accessed January 2023.

²⁷ United States Geological Survey (USGS). 2023. USGS Historical Topographic Map Explorer. Available online: <https://livingatlas.arcgis.com/topoexplorer/index.html>, accessed January 2023

²⁸ Texas Department of Transportation (TxDOT). 2023. Potential Archeological Liability Maps. Available online at <https://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/toolkit/archeological-map.html>, accessed January 2023.

NWI-mapped wetlands and National Hydrography Dataset (NHD)-mapped resources in the project vicinity were reviewed for the Barney Davis facility. Preliminary plans estimate the location of a desalination facility generally south of the intake channel and southwest of the existing power plant. A 20-mgd facility would take approximately 12 acres of land. Discharge piping from the facility would extend approximately 7.5 miles into the Gulf of Mexico. There is the likely potential to encounter freshwater emergent wetlands as well as estuarine and marine wetlands along the proposed pipeline route as well as impacts to the bay and gulf. The cooling pond would also be potentially jurisdictional due to the hydrologic connection to Oso Creek. A site delineation of waters of the United States, including wetlands, in accordance with USACE methods and guidelines would be necessary to map and characterize potentially jurisdictional waters in the project area. Further refinement of the site plan would be required to determine impacts to regulated resources and the actual Section 404/10 permitting requirements, but siting of the desalination facility and discharge piping could seek to minimize impacts to existing wetlands and waters of the United States.

If project activities impact jurisdictional waters, a Section 404/10 permit would be required from the USACE. A Nationwide Permit 7 for Outfall Structures and Associated Intake Structures may be used to authorize impacts to waters resulting from construction of the outfall. A Nationwide Permit 39 may be used for the desalination facility as long as the loss of non-tidal waters of the U.S. does not exceed 0.5 acre, and there is no loss of tidal waters or non-tidal wetlands adjacent to tidal waters. A pre-construction notification is required for all activities authorized under Nationwide Permits 7 and 39. If the project will not qualify for a Nationwide Permit, then an Individual Permit would be required. The proposed desalination plant would be located at the Barney Davis power facility. The facility is located on the Laguna Madre (TCEQ Segment 2491). The Laguna Madre is listed as impaired on TCEQ's 2024 303(d) List²⁹ for bacteria in water and depressed dissolved oxygen in water. Within approximately 5 miles, the Oso Bay Oyster Waters and Oso Creek (TCEQ Segments 2485OW and 2485A) are listed as impaired for bacteria in water. The Gulf of Mexico (TCEQ Segment 2501) would be the receiving water for brine discharge and is listed as impaired for mercury in edible tissue.

5B.6.5.4 Engineering and Costing- Barney Davis

Some of the cost associated with the project are summarized below:

- Total estimated costs for a 20 mgd facility located at Barney Davis power facility at \$582,000,000.
- Assumed 0.5-mile 54-inch pipeline for raw water delivery, 3,500-foot 36-inch pipeline for treated water delivery, and 7.5-mile 42-inch brine discharge tunnel system.

Details regarding desalination process, site-specific environmental impacts, and storage needs are unavailable at this time and are not included in the cost estimate other than the 3-mile

²⁹ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List (Category 5). Accessed online <https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d> January 17, 2025.

product delivery pipeline mentioned above. Facility cost estimates were taken from the HDR 2023 Barney Davis Desalination Site Assessment.

Energy is the largest operational cost of a desalination facility. Energy use is directly proportional to salinity of the source water. Using the UCM tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around \$83,000,000. This results in a unit cost of water of \$3,705 per ac-ft with debt service. The capital costs shown presented in Table 5B.6.7 were developed in a 2023 HDR report. The TWDB UCM tool was used to calculate the total cost and annual cost.

Table 5B.6.7.
Cost Estimate Summary 20 mgd Desalination Project at Barney Davis Power Facility
(Sept 2023 Prices)

Item	Estimated Costs for Facilities
Intake Improvements on Laguna Madre ^a	\$20,000,000
Cooling Pond Intake and Raw Water Pumping ^a	\$20,000,000
Water Treatment Plant (20 MGD) ^a	\$240,000,000
Finished Water Line ^a	\$2,500,000
Brine Discharge Outfall and Tunnel System (7.5 miles, 42")	\$114,090,000
Total Cost of Facilities	\$396,590,000
- Planning (3%)	\$11,903,000
- Design (7%)	\$27,773,000
- Construction Engineering (1%)	\$3,968,000
Legal Assistance (2%)	\$7,935,000
Fiscal Services (2%)	\$7,935,000
Pipeline Contingency (15%)	\$15,811,000
All Other Facilities Contingency (20%)	\$58,269,000
Environmental & Archaeology Studies and Mitigation	\$260,000
Land Acquisition and Surveying (12 acres)	\$50,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$52,000,000
Total Cost of Project	\$582,000,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$41,000,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$1,054,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$1,000,000
Water Treatment Plant ^b	\$39,000,000
Pumping Energy Costs (8807756 kW-hr @ 0.09 \$/kW-hr) ^c	\$790,000
Total Annual Cost	\$83,000,000
Available Project Yield (acft/yr)	22,402
Annual Cost of Water (\$ per acft),	\$3,705
Annual Cost of Water After Debt Service (\$ per acft),	\$1,868
Annual Cost of Water (\$ per 1,000 gallons),	\$11.37
Annual Cost of Water After Debt Service (\$ per 1,000 gallons),	\$5.73

^a Capital costs estimated in Site Assessment Report (HDR, 2023).



^b The water treatment plant annual costs from the TWDB uniform costing model include energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

^c The pumping energy cost is calculated by the uniform costing model based on pipeline diameter and length, flowrate, and elevation data. This cost accounts for pumping raw water from the intake, brine discharge to the outfall, and treated water to the delivery point.

5B.6.5.5 Implementation Issues- Barney Davis

Permitting of this facility will require extensive coordination with all applicable regulatory entities.

The proposed brine discharge outfall for the Barney Davis Desalination plant is 7.5 miles off-shore in the Marine Seawater Discharge Zone, and eligible for an alternative expedited permitting process³⁰. On November 6, 2019, TCEQ commissioners adopted the TPWD and GLO's diversion and discharge zones study and codified Section 318.9 of 30 TAC Chapter 318 to expedite permitting for projects within the discharge zone. This is anticipated to save time in permitting the Barney Davis Desalination Project.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues to implementation:

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and construction, which may include:
 - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
 - Endangered Species Act compliance and TPWD coordination, if required
 - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
 - TCEQ Water Right, TPDES, stormwater, and associated construction permits
 - Associated TCEQ registrations
 - Local land use and construction permits
 - Expedited GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- Impact on the bays from removing water for consumptive use and altering existing power plant water rights permit;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline across rivers, highways, and private rural and urban property; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

³⁰ Texas Parks and Wildlife and Texas General Land Office, 2018, Marine Seawater Desalination Diversion and Discharge Zones Study.

5B.6.5.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5B.6.8.

Table 5B.6.8.
Evaluation Summary of the 20 mgd Barney Davis Desalination Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 22,402 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Cost \$3,705 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. Six threatened species and 7 endangered species were identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, dissolved oxygen, pH, and temperature were all identified as constituents of concern for Oso Creek. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	- Impact to Oso Creek will need to be quantified through modeling - Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	Some. Temporary damage due to construction of pipeline
e. Recreational impacts	None
f. Equitable comparison of strategies	- Standard analyses and methods used for portions - Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	Not applicable
i. Efficient use of existing water supplies and regional opportunities	Provides regional opportunities
j. Effect on navigation	None
k. Impacts to water pipelines and other facilities used for water conveyance	Connection to existing 42-inch transmission line is expected to meet hydraulic requirements

5B.6.6 Port of Corpus Christi Authority Seawater Desalination Project- Harbor Island

5B.6.6.1 Description of Strategy

The PCCA has proposed two desalination strategies in Nueces and/or San Patricio counties to meet manufacturing water demands beginning in the 2030 planning decade. PCCA is a political subdivision of the State of Texas and is governed by seven commissioners. It is one of the largest energy hubs with a gateway to global markets. PCCA is the third largest in the world in crude exports, largest in the U.S. in crude exports, and second largest in the U.S. in LNG exports. The port is a multi-billion dollar enterprise with an \$18 billion impact on the State's economy. Although it has the authority to tax, none of its revenue is generated through taxes. All port revenues are generated through tonnage wharfage fees, dockage fees, and land leases. In 2017, PCCA Port Commission directed staff to evaluate two sites for potential future desalination plants on PCCA's property. For the Harbor Island facility, PCCA has received a discharge permit in the Corpus Christi Ship Channel for 50 mgd net production and a GLO easement for the intake structure in the Gulf of Mexico. PCCA's water rights application for 100 mgd net production at Harbor Island is pending with the TCEQ. In May 2024, the PCCA Port Commission again directed staff to complete the remaining permits necessary to construct a desalination facility at Harbor Island with as much optionality as possible, including the potential to scale facility size. PCCA plans to submit in early 2025 a USACE individual permit application, GLO easement amendment for a discharge structure in the Gulf of Mexico, and a discharge permit to TCEQ for a discharge in the Gulf of Mexico to accommodate up to 100 mgd net production for both municipal and industrial use.

The Harbor Island project site is located on the Corpus Christi Ship Channel near Port Aransas as shown in Figure 5B.6.6.



Source: PCCA, via email January 2025

Figure 5B.6.6.
Proposed Location for PCCA Seawater Desalination Project at Harbor Island

5B.6.6.2 Available Yield- PCCA Harbor Island

Seawater from the Gulf of Mexico is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The estimated supply is for 112,014 ac-ft/yr (100 mgd) based on the size of the desalination plant to meet end user customer needs.

5B.6.6.3 Environmental Issues- PCCA Harbor Island

The Harbor Island project site is located on the Corpus Christi Ship Channel across from Port Aransas. Construction of the facility would be located upon approximately 33 acres in a former fuel tank storage area, which has previously been decommissioned and remediated and is currently vacant. The proposed desalination plant would use RO to treat seawater from the Gulf of Mexico and produce up to 100 mgd. The port submitted a discharge permit for the project in 2018; and which was subsequently issued in December 2022 for a discharge in the Corpus Christi Ship Channel (TCEQ Segment 2481) from a net 50 mgd production facility via an HDPE pipeline to a multi-port diffuser approximately 300 feet offshore on the south side of Harbor Island. Both near- and far-field monitoring was completed to determine the ability of the proposed diffuser technology to disperse the brine within the defined mixing zones with a discharge going into the Corpus Christi Ship Channel and adjacent Corpus Christi Bay. The

issued permit established at 2 parts per trillion at 100 meters monitoring requirement to ensure operation within the modeled parameters.

An authorization by TCEQ of a discharge in the Gulf of Mexico for up to 100 mgd net production may supplant the need for a 50 mgd discharge in the Ship Channel. The 100 mgd discharge in the Gulf of Mexico would be 1.8 miles off the shoreline of San Jose Island, following the route of the Bluewater Texas Terminal Single Point Mooring (SPM) pipeline. With both the intake and the discharge located in the Gulf of Mexico, and upland facilities avoiding any permanent impacts to Waters of the U.S., the potential environmental impacts would be limited to salinity in the offshore mixing zone and limited impingement and entrainment issues of an intake structure, similar to a power plant intake. In addition to voluntarily utilizing the best practices for a 301(b) guidelines for power plant intakes, which includes slowing velocity to <0.5 ft/sec and adding screens, the facility proposes the use of a marine life return system to remove any marine life smaller than 3 inches in size that gets into the intake. The location of the intake structure in the Gulf of Mexico has been sited north of the Aransas Channel and designed at an elevation in the water column so as to minimize intake of larval fish and threatened and endangered species and minimize impact to surrounding benthos.

TPWD maintains the TXNDD, which documents the occurrence of endangered, threatened and rare species, natural communities, and animal aggregations. The TXNDD data was reviewed for recorded occurrences of listed or rare species or natural communities, near the proposed project. The West Indian manatee, a federally listed threatened species, and a marine mammal with protections under the Marine Mammal Protection Act, the green sea turtle (*Chelonia mydas*), a federal and state listed threatened species, the Atlantic hawksbill sea turtle (*Eretmochelys imbricata*) a federal and state listed endangered species, the Texas horned lizard (*Phrynosoma cornutum*) a state threatened species, and the piping plover (*Charadrius melodus*) a federal and state listed threatened species have been documented within two miles of the proposed project. The TXNDD data also identified rookeries near the project area on Harbor Island and on Mustang Island. Additionally, critical habitat for the piping plover and proposed critical habitat for the rufa red knot is present on Mustang Island within 2 miles of the project area.

NWI maps were reviewed and the proposed Harbor Island Desalination site may be in close proximity to estuarine and marine deepwater habitat and freshwater emergent wetlands. A jurisdictional determination of Waters of the US has been approved by the USACE for the desalination plant (produced water infrastructure); all impacts to Waters of the United States have been avoided. Permitting and coordination with the USACE for the discharge, intake, and produced water infrastructure is ongoing.

The proposed desalination plant would be located on Harbor Island, which is adjoined to Redfish Bay (Oyster Waters) (TCEQ Segment 2483OW). Redfish Bay (TCEQ Segment 2483_01) and Redfish Bay Oyster Waters (TCEQ Segment 2483OW_01) are listed as impaired

for bacteria on the TCEQ 2024 Draft 303(d) List³¹. The Gulf of Mexico (TCEQ Segment 2501) is located within 5 miles of the proposed Harbor Island desalination site. Segment 2501 is listed on the 2020 Draft 303(d) List as impaired for mercury in edible tissue.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PL96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available GIS records obtained from the Texas Historical Commission, there is potentially one National Register property and one cemetery within one mile of the proposed project area. The Tarpon Inn and Mercer Cemetery are located approximately one mile from the proposed project area in Port Aransas. No State Historic sites, National Register districts, or historical markers were identified within the project area, or within 1 mile of the proposed project area.

Archeological surveys have been conducted in the vicinity of the project area, a review of archaeological resources in the proposed project area should be conducted during the project planning phase. Because the owner or controller of the project will likely be a political subdivision of the State of Texas (i.e., river authority, municipality, county, etc.), they will be required to coordinate with the Texas Historical Commission, under the Texas Antiquities Code, prior to project construction. This coordination will occur as part of the review of the individual permit application to the USACE.

5B.6.6.4 Engineering and Costing- PCCA Harbor Island

Some of the cost associated with the project are summarized below:

- Total estimated costs for a net 100 mgd facility located in Harbor Island at \$3,456,000,000.
- Assumed 2x 30,500-linear feet of up to 54-inch diameter pipe to Aransas Pass area and 16-inch pipe (existing) to Nueces County area (not shown in Figure 5B.6.6)
- For delivery to San Patricio County, assumed three pipe segments: 54-inch diameter 21 miles total from WTP to San Patricio County (which includes the 30,500-linear feet of pipe discussed previously), 14-foot diameter 3.1 miles, and 14-ft diameter 3.6 miles
- Assumed 222 mgd intake and 12-foot diameter intake tunnel system of 3.1 miles.
- Assumed 122 mgd brine discharge outfall and 12-foot diameter effluent outfall tunnel system of 3.6 miles (effluent diffuser located approximately 1.8 miles offshore)

The discharge structure is approximately 500-foot long, 84-inch barrel with 50 6.3-inch ports. Cost estimates for the raw water intake, brine discharge, and substation and transmission line

³¹ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List (Category 5). Accessed online <https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2024/2024-303d> December 4, 2024.

upgrades were provided by PCCA. Details regarding site-specific environmental impacts and storage needs are unavailable at this time and are not included in the cost estimate.

Energy is the largest operational cost of a desalination facility, and energy use is directly proportional to salinity of the source water. Using the UCM tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around \$405,000,000. This results in a unit cost of water of \$3,616 per ac-ft with debt service. The information presented in Table 5B.6.9 was developed based on capital costs, project costs, and annual water productions costs with information provided by PCCA.

Table 5B.6.9.
Cost Estimate Summary of the Port of Corpus Christi Authority's 100 mgd Desalination Project at Harbor Island (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Intake Structure and Pump Station (222 MGD) ^a	\$59,000,000
Water Treatment Plant (100 MGD)	\$1,025,000,000
Treated Water Pump Station	\$49,000,000
Transmission Pipeline (54", 30,300 ft and 54", 110,880 ft)	\$277,000,000
Intake Tunnel System (12', 3.1 miles)	\$367,000,000
Effluent Outfall Tunnel System (12', 3.6 miles)	\$429,000,000
Brine Discharge Outfall and Pump Station ^b	\$126,000,000
Substation and Transmission ^c	\$83,000,000
Total Cost of Facilities	\$2,415,000,000
- Planning (3%)	\$69,000,000
- Design (7%)	\$160,000,000
- Construction Engineering (1%)	\$23,000,000
Legal Assistance (2%)	\$46,000,000
Fiscal Services (2%)	\$46,000,000
Pipeline Contingency (15%)	\$161,000,000
All Other Facilities Contingency (20%)	\$242,000,000
Environmental & Archaeology Studies and Mitigation	\$2,000,000
Land Acquisition and Surveying (268 acres)	\$4,000,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$288,000,000
Total Cost of Project	\$3,456,000,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$228,000,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$12,000,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$3,000,000
Water Treatment Plant ^d	\$154,000,000
Pumping Energy Costs (11835834 kW-hr @ 0.09 \$/kW-hr) ^e	\$8,000,000
Total Annual Cost	\$405,000,000
Available Project Yield (acft/yr)	112,014
Annual Cost of Water (\$ per acft),	\$3,616
Annual Cost of Water After Debt Service (\$ per acft),	\$1,580
Annual Cost of Water (\$ per 1,000 gallons),	\$11.09
Annual Cost of Water After Debt Service (\$ per 1,000 gallons),	\$4.85

^a Cost provided by PCCA for intake structure is \$12,100,000. The cost estimate includes design, construction, and a 30% contingency. The total amount (\$12,100,000) is included in the Cost of Facilities and not included in the contingencies for Total Cost of Project. The intake pump station cost was estimated by the UCM.

^b Cost provided by PCCA for discharge is \$118,230,000. The cost estimate includes design, construction, and a 30% contingency. The total amount (\$118,230,000) is included in the Cost of Facilities and not included in the contingencies for Total Cost of Project. The discharge pump station cost was estimated by the UCM.

^c Costs provided by PCCA. Substation upgrades are approximately \$48,000,000 and transmission line upgrades are approximately \$35,000,000.

^d The water treatment plant annual costs from the TWDB uniform costing model include energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

^e The pumping energy cost is calculated by the uniform costing model based on pipeline diameter and length, flowrate, and elevation data. This cost accounts for pumping raw water from the intake, brine discharge to the outfall, and treated water to the delivery point.

5B.6.6.5 Implementation Issues- PCCA Harbor Island

Permitting of this facility will require extensive coordination with all applicable regulatory entities. The major project components and issues with implementation will be permitting and construction of pipelines.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues to implementation:

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and construction, which may include:
 - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
 - Endangered Species Act compliance and TPWD coordination, if required
 - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
 - TCEQ Water Right, TPDES, stormwater, and associated construction permits
 - Associated TCEQ registrations
 - Local land use and construction permits
 - GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants;
- Permitting of a pipeline in existing right-of-way and across urban property; and
- Possibility of using alternate delivery method contract for a desalination water treatment plant.

5B.6.6.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5B.6.10.

Table 5B.6.10.
Evaluation Summary of the Port of Corpus Christi Authority- Harbor Island 100 mgd Seawater Desalination

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 112,014 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Unit Cost \$3,616 /ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey data from adjacent project informed siting to avoid potential cultural resources.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts of water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.6.7 Port of Corpus Christi Authority Seawater Desalination Project- La Quinta Channel

5B.6.7.1 Description of Strategy

The PCCA has proposed two desalination strategies in Nueces and/or San Patricio counties to meet manufacturing water demands beginning in the 2030 planning decade. PCCA is a political subdivision of the State of Texas and is governed by seven commissioners. It is one of the largest energy hubs with a gateway to global markets, making it the Energy Port of the Americas. PCCA is the third largest in the world in crude exports, largest in the U.S. in crude exports, and second largest in the U.S. in LNG exports. The Port is a multi-billion dollar enterprise with an \$18 billion impact on the state's economy. Although it has the authority to tax, none of its revenue is generated through taxes. All port revenues are generated through tonnage wharfage fees, dockage fees, and land leases. In 2017, PCCA Port Commission directed staff to evaluate two sites for potential future desalination plants on PCCA's property. The sites are on Harbor Island and at the north end of La Quinta Channel. A water rights permit to divert 102,000 ac-ft has been received for the La Quinta plant.

The La Quinta site is located near the La Quinta Ship Channel in San Patricio County. It will produce up to 30 mgd primarily for industrial use, use RO to treat seawater from Corpus Christi Bay, and a proposed diffuser would discharge into the La Quinta Ship Channel. Approximately 3 miles of pipeline will be used to deliver treated water to customers in the area.



Source: PCCA/Naismith/Hanson, 2019 via email December 2019

Figure 5B.6.7.
Proposed Location for Seawater Desalination Program at La Quinta

5B.6.7.2 Available Yield- PCCA La Quinta Channel

Seawater from the Gulf of Mexico and associated bay system is assumed to be available in an unlimited quantity within the context of a supply for the Coastal Bend Region. Also, it is assumed that the cost of Gulf water is zero prior to extraction from the source. The estimated supply is up to 33,627 ac-ft/yr (30 mgd).

5B.6.7.3 Environmental Issues- PCCA La Quinta Channel

On July 16, 2024, TCEQ authorized the water rights for this project and the discharge permit is still pending. This site, located near the La Quinta Ship Channel in San Patricio County, would use RO to treat seawater and produce approximately 30 mgd of treated water for industrial use. This facility has a design intake flow of 90.4 mgd from Corpus Christi Bay.³² This project is expected to discharge through a diffuser into the La Quinta Ship Channel.

The TXNDD data was reviewed for documented occurrences of listed or rare species, or natural communities near the project area. There were no documented occurrences of listed or rare species or communities within two miles of the proposed project area.

³² PCCA, 2019. TCEQ Water Rights Permitting Application Port of Corpus Christi Authority of Nueces County. Proposed Desalination Plant, La Quinta. Dated August 29, 2019.

NWI maps were reviewed and the proposed PCCA La Quinta Desalination site may be in close proximity to estuarine and marine deepwater habitat and freshwater emergent wetlands. A jurisdictional determination of waters on the uplands exists for the proposed project site. Further coordination with the USACE would be required for impacts to waters of the United States for the intake and diffuser.

The proposed desalination plant would be located on the La Quinta Channel. The site would discharge into Corpus Christi Bay (TCEQ Segment 2481OW), which is listed as impaired on TCEQ's 2024 303(d) List for bacteria in oyster water.³³ Within approximately 5 miles, one Corpus Christi Bay Recreational Beach (TCEQ Segments 2481CB_06) is listed as impaired for bacteria in water. Additionally, the inlet to Nueces Bay (TCEQ Segment 2482) is listed as impaired for bacteria in water. The inlet to Corpus Christi Bay Inner Harbor (TCEQ Segment 2484) is within 5 miles of the proposed desalination plant and are listed as impaired for copper in water.

Cultural resources protection on public lands in Texas is afforded by the Antiquities Code of Texas (Title 9, Chapter 191, Texas Natural Resource Code of 1977), the National Historic Preservation Act (PL96-515), and the Archeological and Historic Preservation Act (PL93-291). Based on the review of publicly available GIS records obtained from the Texas Historical Commission, there are no State Historic sites, National Register properties or districts, cemeteries or historical markers within the project area, or within 1 mile of the proposed project area.

Coordination with the Texas Historical Commission, under the Texas Antiquities Code, has already occurred. This information should be reviewed during the design phase for any offsets that might be warranted.

5B.6.7.4 Engineering and Costing- PCCA La Quinta Channel

Some of the cost associated with the project are summarized below:

- Total estimated costs for a 30 mgd net facility located in La Quinta at \$844,000,000.
- Assumed a 3-mile 48-inch pipeline for delivery to industrial complex in San Patricio County.
- Assumed 500-foot 66-inch raw water intake pipeline and 500-foot 48-inch brine discharge pipeline.
- Brine discharge outfall structure was assumed to cost the same as an intake structure for the designated flow rate based on 45 percent RO recovery.

Details regarding desalination process, site-specific environmental impacts, and storage needs are unavailable at this time and are not included in the cost estimate other than the 3-mile product delivery pipeline mentioned above.

³³ TCEQ, 2024. 2024 Texas Integrated Report – Texas 303(d) List (Category 5). Accessed online [2024 Texas IR 303\(d\) List](#) January 29, 2025.



Energy is the largest operational cost of a desalination facility. Energy use is directly proportional to salinity of the source water. Using the UCM tool for regional water planning according to TWDB guidelines, which includes a higher cost for operations and maintenance is expected to result in an annual cost around \$116,000,000. This results in a unit cost of water of \$3,452 per ac-ft with debt service. The information presented in Table 5B.6.11 was developed based on capital costs, project costs, and annual water productions costs with information provided by PCCA.

Table 5B.6.11.
Cost Estimate Summary PCCA - 30 mgd Desalination Project at La Quinta (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Intake Structure and Pump Station (66 MGD)	\$40,000,000
Water Treatment Plant (30 MGD)	\$475,000,000
Treated Water Pump Station	\$6,000,000
Transmission Pipeline (48", 3 miles)	\$28,000,000
Raw Water Pipeline (66", 500 ft)	\$1,000,000
Brine Discharge Pipeline (48", 500 ft)	\$1,000,000
Brine Discharge Outfall and Pump Station	\$13,000,000
Substation and Transmission ^a	\$8,000,000
Total Cost of Facilities	\$572,000,000
- Planning (3%)	\$17,000,000
- Design (7%)	\$40,000,000
- Construction Engineering (1%)	\$6,000,000
Legal Assistance (2%)	\$11,000,000
Fiscal Services (2%)	\$11,000,000
Pipeline Contingency (15%)	\$4,000,000
All Other Facilities Contingency (20%)	\$109,000,000
Environmental & Archaeology Studies and Mitigation	\$96,000
Land Acquisition and Surveying (39 acres)	\$164,000
Interest During Construction (3.5% for 3 years with a 0.5% ROI)	\$74,000,000
Total Cost of Project	\$844,000,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$59,000,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$378,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$1,000,000
Water Treatment Plant ^b	\$55,000,000
Pumping Energy Costs (2593527 kW-hr @ 0.08 \$/kW-hr) ^c	\$932,000
Total Annual Cost	\$116,000,000
Available Project Yield (acft/yr)	33,604
Annual Cost of Water (\$ per acft),	\$3,452
Annual Cost of Water After Debt Service (\$ per acft),	\$1,705
Annual Cost of Water (\$ per 1,000 gallons),	\$10.59
Annual Cost of Water After Debt Service (\$ per 1,000 gallons),	\$5.23

^a Cost estimated by HDR, externally from the UCM.

^b The water treatment plant annual costs from the TWDB uniform costing model include energy costs associated with use of reverse osmosis membrane treatment to desalinate seawater and produce finished water with TDS levels below the TCEQ regulatory limit.

^c The pumping energy cost is calculated by the uniform costing model based on pipeline diameter and length, flowrate, and elevation data. This cost accounts for pumping raw water from the intake, brine discharge to the outfall, and treated water to the delivery point.

5B.6.7.5 Implementation Issues- PCCA La Quinta Channel

Permitting of this facility will require extensive coordination with all applicable regulatory entities. The major project components and issues with implementation will be permitting and construction of pipelines.

The installation and operation of a seawater desalination water treatment plant may have to address the following issues to implementation:

- Disposal of concentrated brine from desalination water treatment plant;
- Permitting and construction, which may include:
 - USACE permitting (including Section 404 Clean Waters Act and Section 10 Rivers & Harbors Act)
 - Endangered Species Act compliance and TPWD coordination, if required
 - Compliance with the Antiquities Code of Texas, the National Historic Preservation Act, and the Archeological and Historic Preservation.
 - TCEQ Water Right, TPDES, stormwater, and associated construction permits
 - Associated TCEQ registrations
 - Local land use and construction permits
 - GLO permitting requirements
- Hydrodynamic Modeling to verify project feasibility;
- Impact on the bays from removing water for consumptive use and altering existing water rights permit;
- High power requirements for desalination process dependent on large, reliable power source;
- Skilled operators of desalination water treatment plants; and
- Possibility of using a design, build, operate contract for a desalination water treatment plant.

5B.6.7.6 Evaluation Summary

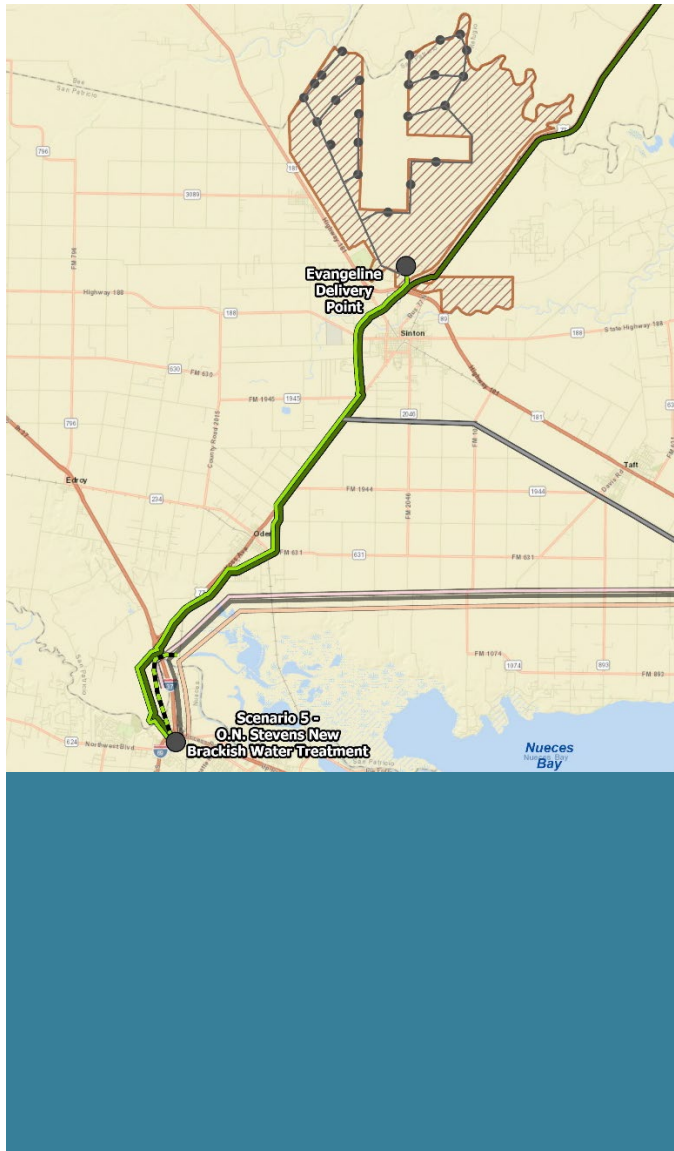
An evaluation summary of this regional water management strategy is provided in Table 5B.6.12.

Table 5B.6.12.
Evaluation Summary of the Port of Corpus Christi Authority- La Quinta Channel 30 mgd Project

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Project size: 33,604 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of treated water	3. Cost \$3,452 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None or low impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some environmental impact to estuary.
3. Wildlife habitat	3. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. Some. Disposal of concentrated brine created from process may impact fish and wildlife habitats or wetlands.
5. Threatened and endangered species	5. None identified. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrate disposal issues will need to be evaluated. 7c-i. Bacteria, chlorides, nitrate, alkalinity, ammonia, and copper were all identified as constituents of concern for the Nueces Bay in the TCEQ and NRA Basin Highlights Report. Additional studies regarding impacts on or as a result of project are needed
c. Impacts to Agricultural Resources and State water resources	• None or low impacts on other water resources • Negligible impacts to agricultural resources
d. Threats to agriculture and natural resources in region	• Some. Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Seawater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities
j. Effect on navigation	• None
k. Impacts to water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor (in future). Possible impact to wildlife habitat along pipeline route and right-of-way.



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5B.7

*Groundwater
Desalination*

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Section 5B.7 Groundwater Desalination

Groundwater desalination is a process whereby pumped groundwater is treated using reverse osmosis (RO), electrodialysis, or similar method to reduce total dissolved solids (TDS), salts, and minerals to make suitable for consumption and/or high quality purposes. Brackish groundwater is defined as groundwater with TDS content of between 1,000 and 10,000 parts per million.

Brackish groundwater is an important water supply source in Texas. The state has more than 3.2 billion acre-feet (ac-ft) of brackish groundwater in 12 of the 31 major and minor aquifers¹. Factors that affect the implementation of desalination include local conditions, permitting, treatment, and concentrate disposal. Groundwater supplies desalinated to potable standards in areas near the Coastal Bend Region are likely to become more prevalent under the compounding pressures of increasing water demands and climate uncertainty.

Figure 5B.7.1 shows a process diagram for a typical groundwater desalination treatment plant, the percent of water flowing through each component of the system, and the concentration of the TDS.

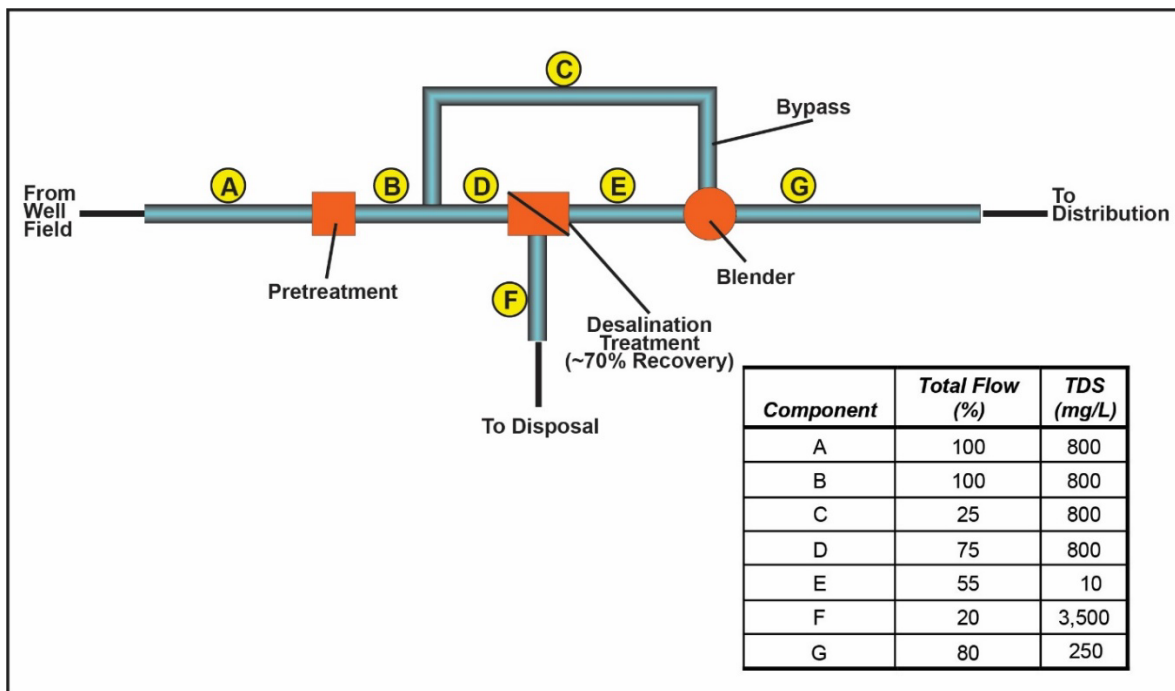


Figure 5B.7.1.
Flow Diagram for a Typical Groundwater Desalination Water Treatment Plant

¹ TWDB, "Desalination: Brackish Groundwater," January 2025

https://www.twdb.texas.gov/publications/shells/doc/Desal_Brackish.pdf

5B.7.1 Evangeline Laguna Groundwater Project

5B.7.1.1 Description of Strategy

The Evangeline Laguna Groundwater Project includes groundwater production of up to 25.4 MGD (28,486 ac-ft/yr) from 23,000+ acres located in San Patricio County for conveyance to a proposed groundwater desalination treatment plant, and delivery to the City of Corpus Christi and/or future industries in San Patricio County. Figure 5B.7.1 shows the approximate location of the project site. Since publication of the *2016 Coastal Bend Regional Water Plan*, project developers have moved this project towards implementation by securing permits from the San Patricio County Groundwater Conservation District (SPCGCD), drilling and collecting data from a test well, and performing a corrosion analysis, as well as a blending analysis. The test well water quality results were all within Texas Commission on Environmental Quality (TCEQ) drinking water standards. TDS and chloride levels measured at the test well were 792 and 269 milligrams per liter (mg/L), respectively. The SPCGCD production permit granted to Evangeline/Laguna LP is for up to 25.4 million gallons per day (mgd) (28,486 acre-feet per year [ac-ft/yr]). After accounting for groundwater production in San Patricio County for current groundwater users, the remaining amount of groundwater available for future projects (based on excess Modeled Available Groundwater (MAG) is 33,783 ac-ft/yr in Year 2030 and increasing to 37,032 ac-ft/yr in Year 2080. Therefore, the unused MAG is sufficient to meet the 25.4 mgd groundwater project contingent on receiving permits from the SPCGCD for the full production amount.

This project was previously evaluated in two ways for the *2021 Coastal Bend Regional Water Plan*: (a) as a raw, groundwater supply with minimal treatment and (b) with groundwater desalination to reduce TDS and chlorides to around 200 mg/L for high water quality use. At the request of project sponsors, the recommended strategy includes groundwater desalination and for this reason it is the only option included in the *2026 Coastal Bend Regional Water Plan*. The strategy presented here is for groundwater desalination for a finished water at a quality around 200 mg/L.

This project does not have a MAG limitation. At full project production, the wellfield consists of approximately 23 wells including contingency. The wells range from 650 feet to 950 feet in depth and have an estimated pumping rate of 1,200 gallons per minute (gpm). The current raw groundwater quality is anticipated to range from 800 mg/L TDS to 1,300 mg/L TDS², and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides. The Evangeline/Laguna group has tested The pumped groundwater would be conveyed to the O.N. Stevens water treatment plant (WTP) and treated to a finished water goal of 200 mg/L TDS based on future industrial water quality needs. The brine concentrate would be disposed of at the Rincon outfall upstream of Nueces Bay. The delivery option selected for evaluation in this water management strategy was previously evaluated by the City of Corpus Christi in 2023/2024 and includes raw water costs provided by Evangeline Laguna

² The broad range is listed here to account for Gulf Coast Aquifer water quality variability that may be experienced across the 23,000 acre+ wellfield site given the heterogeneous nature of the aquifer as well as absence of site-specific information towards the southeast of Evangeline's wellfield.

LLC. The City looked at additional delivery options in their 2023/2024 evaluation, including options to deliver water to San Patricio County near Dressen and raw water integration into the Mary Rhodes Pipeline, deemed viable if Evangeline groundwater supplies were consistently delivered at or below 700 mg/L TDS. Given the project scale and variability in the Gulf Coast/Evangeline aquifer water quality over broad areas in this vicinity, the City of Corpus Christi requested inclusion of Scenario 5 (from their study) with reverse osmosis treatment as a conservative option.

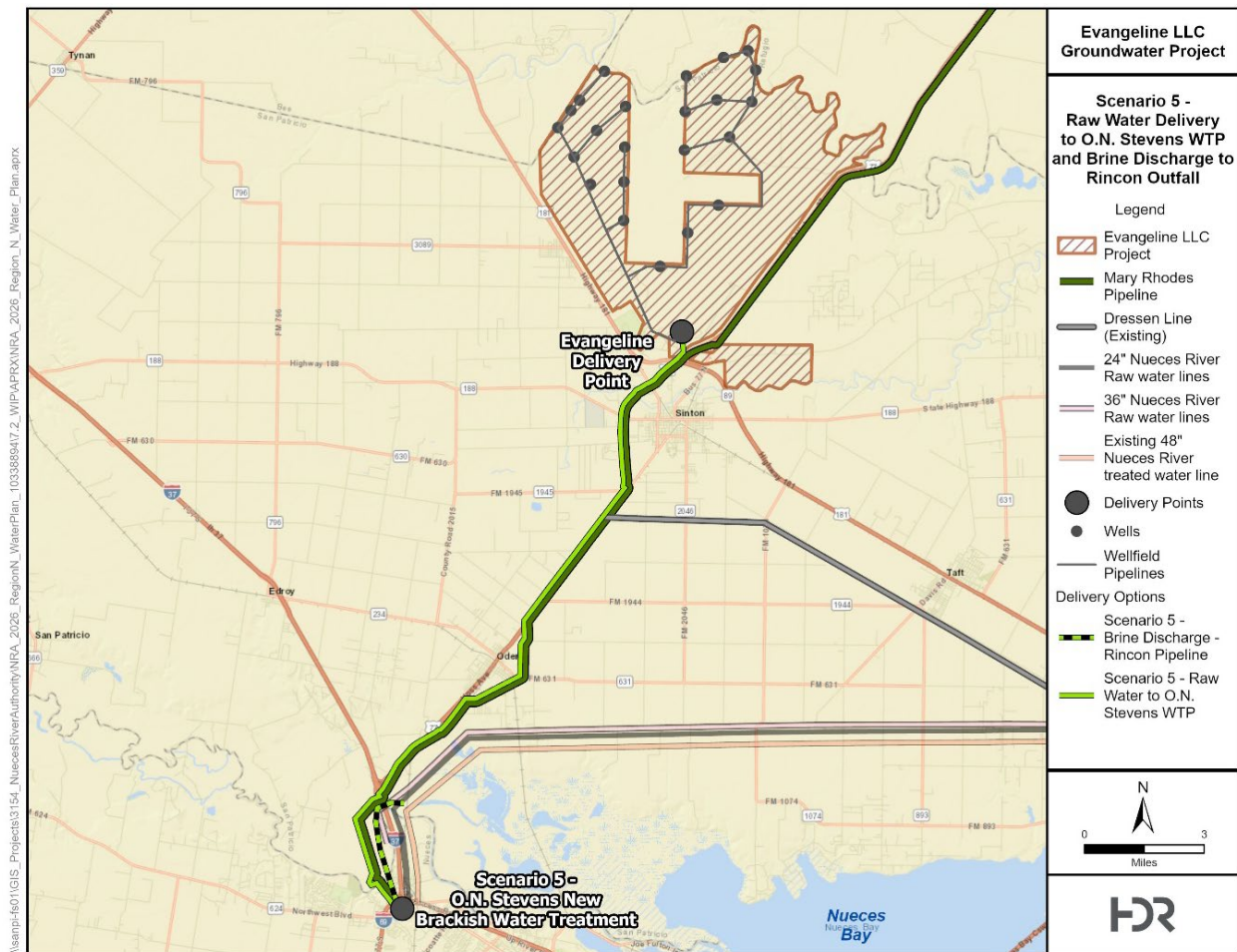


Figure 5B.7.2.
Location of Conceptual Layout of Evangeline Laguna Groundwater Project

5B.7.1.2 Available Yield

In the Coastal Bend region, the Gulf Coast Aquifer System is the primary source of substantial groundwater supplies. The most productive water-bearing zone is the Goliad Sand, also known as the Evangeline Aquifer. The outcrop of the Goliad Sand is about 50 to 75 miles inland. The formation dips toward the coast at about 20 feet per mile. Near the coast, the shallower Chicot Aquifer provides some groundwater supplies. West of the outcrop of the Goliad Sands, the deeper Jasper Aquifer can supply a moderate amount of groundwater in some areas.

Evangeline/Laguna LP secured a water well production permit from SPCGCD on May 16, 2019, which authorizes production of 28,486 ac-ft of water annually at a rate of 1,500 gpm for municipal, industrial, agricultural, irrigation, and wildlife uses. The production permit is expired as of May 16, 2024, and requires renewal with the SPCGCD General Manager or Board representative before any water can be produced from the existing wells. As of July 2024, SPCGCD has issued permits for two testing wells, allowing for current production of 4,840 ac-ft/yr. Additional wells would need to be drilled to reach the full 28,486 ac-ft/yr capacity. Drilling of additional wells would require submittal of water well drilling permit applications to SPCGCD detailing the location of each well, amount of water requested, rate of withdrawal requested, requested well use, a location map, and a \$200 permit fee. The permit application requires submittal of a Notice of Intent (NOI) to drill a well, along with a water conservation plan. Once drilled, a water well registration must be submitted, along with a driller's log, which must be submitted within 90 days of drilling the well.

The full groundwater production equal to the 25.4 mgd permit issued by the SPCGCD is available under regional planning guidelines and within existing MAG availability.

5B.7.1.3 Environmental Issues

The primary environmental issues related to the development of groundwater desalination of water from the Evangeline Aquifer in San Patricio County are the development of the well fields and associated pipelines, development of water treatment facilities, integration into the existing pipeline system and discharge of brine concentrate into the Nueces Delta.

The project is located in the Gulf Coastal Plains of Texas Physiographic Province, specifically in the sub-province of the Coastal Prairies. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than 1 foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

Environmental Considerations Associated with Evangeline Laguna Groundwater Project

The Evangeline Laguna Groundwater project includes a well field of 23 water wells located in San Patricio County near the Bee County line and close to Sinton. Raw water would be delivered from the well field to the desalination facilities at the O.N. Stevens WTP located approximately 17 miles south of the well field, near Calallen. Concentrate disposal for this project would be to the Nueces Delta.

Two new pipelines are proposed, a raw water line from the delivery point at the well field to the O.N. Stevens WTP complex and a brine discharge pipeline from the WTP to the Nueces Delta. Water would be treated at a RO treatment plant, to be co-located near O.N. Stevens WTP, for delivery through existing treated water lines. The proposed raw water pipeline will cross areas previously disturbed by construction of the Mary Rhodes Pipeline (MRP) but may encounter areas primarily used for pasture and crops. The proposed raw water pipeline and the concentrate disposal pipeline would cross possible freshwater emergent and freshwater forested wetland areas associated with the Nueces River. Planning of the pipeline routes should include avoidance of impacts to wetland areas where possible. The potential environmental

effects resulting from the disposal of brine concentrate from the Evangeline/Laguna LP Groundwater project will be sensitive to the siting of the project and its associated pipeline and the concentration and quantity of brine effluent in relation to stream flows. Although the construction of portions of the raw water pipeline may include the clearing and removal of woody vegetation, destruction of potential habitat can generally be avoided by diverting the corridor through previously disturbed areas.

Estuaries such as those found near Nueces Bay serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from their large nutrient input, shallow water, and the ability of a few marine species to thrive in environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the disposal of brine concentrate from the project will be sensitive to the siting of the project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to the Nueces River and the Bay system would need to be performed.

The well field area is primarily located within an area used for crops; however, it also contains smaller portions of Mesquite-Live Oak-Bluewood Parks vegetation areas. Mesquite-Live Oak-Bluewood Parks areas commonly contain plants such as huisache, grajeno, lotebush, pricklypear, agarita, purple threeawn, and Mexican persimmon. Distribution of this vegetation type is found primarily within the South Texas Plains. Site selection for the wells should include the avoidance of impacts to wetland areas.

Appropriate pipeline route selection, construction methods and right-of-way selection should avoid or minimize anticipated impacts to potential wetland areas or other waters of the United States along the proposed raw water pipeline.

Area Vegetation and Wildlife Habitat

The groundwater desalination project area is located within the Gulf Prairies and Marshes Vegetational Area. Gulf Prairies have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally, the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However, tree species such as honey mesquite, and acacia, along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak (*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), blackbrush (*A. rigidula*), and a dwarf shrub; bushy sea-ox-eye (*Borrchia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiagrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Pricklypear (*Opuntia* sp.) are common within this area along with forbs including asters (*Aster* sp.), poppy mallows (*Callirhoe* sp.), bluebonnets (*Lupinus* sp.), and evening primroses (*Oenothera* sp.). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus* sp.), bulrushes (*Scirpus* sp.), rushes (*Juncus* sp.), and grasses. Aquatic forbs found in these

areas generally include pepperweeds (*Lepidium* sp.), smartweeds (*Polygonum* sp.), cattails (*Typha domingensis*) and spiderworts (*Tradescantia* sp.) among others. Game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (ESA), as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the pipeline area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Pipeline construction activities could disturb migratory bird habitats and/or species’ activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project’s activities on threatened and endangered species, as well as bald eagles. Species’ locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service (USFWS) and TPWD recommendations.

In San Patricio and Nueces counties, there may occur 50 state-listed endangered or threatened species and 28 federally listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat and potential occurrence in the two county areas is provided in Table 5B.7.1.

Table 5B.7.1.
Federal- and State-Listed Threatened, and Endangered
Listed for San Patricio and Nueces Counties

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Black rail	<i>Laterallus jamaicensis</i>	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	T	T
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus	Migrant	E	E
Piping plover	<i>Charadrius melodus</i>	Beaches and flats of coastal Texas	Migrant	T	T
Reddish egret	<i>Egretta rufescens</i>	Brackish marshes and shallow salt ponds and tidal flats.	Resident	--	T
Red knot	<i>Calidris canutus rufa</i>	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	T	T
Sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird. Does nest on sandy beaches and islands.	Migrant	--	T
Swallow-tailed kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
Texas Botteri's Sparrow	<i>Aimophila botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses	Resident	—	T
Tropical parula	<i>Setophaga pitiayumi</i>	Semi-tropical evergreen woodland along rivers and resacas	Resident	--	T
White-faced ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes	Resident	--	T
White-tailed hawk	<i>Buteo albicaudatus</i>	Coastal prairies, savannahs and marshes in Gulf Coastal Plain	Nesting/Migrant	—	T
Whooping crane	<i>Grus Americana</i>	Winters in coastal marshes	Migrant	E	E
Wood stork	<i>Mycteria Americana</i>	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time.	Ocean Resident	T	--

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Ocean Resident	T	T
Shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico.	Ocean Resident	--	T
Blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, and subpolar waters worldwide, infrequently sighted in the Gulf of Mexico	Ocean Resident	E	E
Bryde's whale	<i>Balaenoptera iedeni brydei</i>	Habitat description is not available at this time.	Ocean Resident	--	E
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits warm tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide.	Ocean Resident	--	T
False killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters world wide	Ocean Resident	--	T
Finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics.	Ocean Resident	E	E
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern Atlantic Ocean, Gulf of Mexico, and Caribbean.	Ocean Resident	--	T
Humpback whale	<i>Megaptera novaeangliae</i>	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	E	--
Killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide.	Ocean Resident	--	T
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic.	Ocean Resident	E	E
Ocelot	<i>Leopardus pardalis</i>	Dense chaparral thickets; mesquite-thorn shrub and live oak stands	Resident	E	E
Pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Roughtoothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters.	Ocean Resident	E	E
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland, and riparian areas are important. Caves are very important	Resident	PE	--
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters.	Aquatic Resident	T	T
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors and canyons	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers and marshes, manmade impoundments	Resident	SAT	--
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Gulf and bay system, warm shallow waters especially in rocky marine environments	Aquatic Resident	E	E
Green sea turtle	<i>Chelonia mydas</i>	Gulf and bay systems; shallow water seagrass beds	Aquatic Resident	T	T
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico.	Aquatic Resident	E	E
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Aquatic Resident	E	E
Loggerhead sea turtle	<i>Caretta caretta</i>	Gulf and bay systems for juveniles, adults prefer open waters	Aquatic Resident	T	T
Texas horned lizard	<i>Phrynosoma cornutum</i>	Varied; sparsely vegetated uplands, grass, cactus, brush	Resident	—	T
Texas scarlet snake	<i>Cemophora coccinea lineri</i>	Mixed hardwood scrub on sandy soils	Resident	—	T
Texas tortoise	<i>Gopherus berlandieri</i>	Open bush with grass understory; open grass and bare ground avoided	Resident	—	T
Black lace cactus	<i>Echinocereus reichenbachii var alberti</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy somewhat saline soils on coastal prairie.	Resident	E	E
Slender rush pea	<i>Hoffmanseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes.	Resident	E	E
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils.	Resident	E	E

Source: TPWD, Annotated County List of Rare Species, San Patricio County, February 11, 2025

PT Proposed Threatened
PE Proposed Endangered
E Endangered

SAT Special Assessment Status
-- Not Listed
T Threatened

Inclusion in Table 5B.7.1 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed project occurs primarily in areas which have been previously developed and used for farming and pasture for a long period of time. Disturbance within these areas due to construction of the pipeline routes and well field is anticipated to have minimal effect on the existing environment. Impacts from the disposal of saline concentrate into the Nueces River Delta should be carefully monitored in order to minimize any impacts this may have on aquatic species. Suitable habitat for some listed species may exist within the project areas, additional studies would need to be completed to determine potential impacts to listed species. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetland impacts could occur along the pipeline and well field areas located near rivers, streams, or marshy areas. The wells, collection system within the well field, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable and a permit from the U.S. Army Corps of Engineers (USACE) would be required for impacts to waters of the United States.

Cultural Resources

Impacts to National Register of Historic Place (NRHP)-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the well fields and pipeline routes.

A cultural resource survey of the well field and pipeline routes for the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved and the use of the existing O.N. Stevens WTP, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects. Impacts to aquatic species within the Nueces River and the Nueces Bay due to changes from brine concentrate discharge should be studied early in project design.

The pumping of groundwater from the Evangeline Aquifer could cause a slight reduction on baseflow in downstream reaches. However, no measurable impact on wildlife along the streams is anticipated from this project. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent.

5B.7.1.4 Engineering and Costing

Based on data collected and provided by Evangeline Laguna, the key features identified and evaluated for planning and costing purposes for 2026 regional water plan water management strategy are as follows:

- Wells: The well field consists of 23 wells including contingency. Well depth = 650 - 950 feet. Pumping rate = 1,200 gpm each.
- Raw groundwater quality ranging from 800 mg/L TDS to 1,300 mg/L TDS is expected, and wells would be screened and operated in such a manner to target groundwater with lower levels of TDS and chlorides.
- Although test well data shows water quality meets drinking water standards and could be delivered to an industrial customer untreated (Chapter 5B.8.2 includes evaluation of this option), pumped groundwater will be conveyed to the O.N. Stevens WTP along MRP, which is part of the Evangeline/Laguna LP project and treated to a finished water goal of 200 mg/L TDS based on future industrial water quality needs.
- A purchase cost of raw water of \$1,463 per ac-ft (or \$4.49 per 1,000 gallons). This purchase cost of raw water includes construction of all wells and wellfield piping including operations and maintenance and raw water fees. This cost also assumes that Evangeline will build and operate the wells, pumps, and wellfield pipeline, and appurtenances to delivery water up to 25 mgd at the delivery point.
- Transmission and treatment plant costed according to full project build-out: 28,486 ac-ft/yr (25 mgd).
- Treatment plant assumes 800-1,300 mg/l TDS influent, 200 mg/l TDS effluent; plant treats 90 percent of raw groundwater (10 percent bypass) at 90 percent process efficiency.
- Brine concentrate disposal to the Rincon outfall upstream of Nueces Bay.
- Treated water yield: 22,788 ac-ft/yr (20.3 mgd).
- Treated water delivery: delivery is at the fence of the O.N. Stevens complex.

Overall, the project cost is \$486,499,000. Annual cost is \$104,738,000. At a yield of 25,637 ac-ft/yr, the unit cost of water is \$4,085 per ac-ft. The cost table for this project is presented in Table 5B.7.2

Table 5B.7.2.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Evangeline Laguna Treated Groundwater Strategy- Region N Plan

Item	Estimated Costs for Facilities
Intake Pump Stations (26.8 MGD)	\$7,183,000
Transmission Pipeline (18-54 in. dia., 22.2 miles)	\$204,694,000
Water Treatment Plant (25 MGD)	\$143,051,000
Integration, Relocations, Backup Generator & Other	\$258,000
TOTAL COST OF FACILITIES	\$355,186,000
Engineering:	
- Planning (3%)	\$10,700,000
- Design (7%)	\$24,967,000
- Construction Engineering (1%)	\$3,567,000
Legal Assistance (2%)	\$7,134,000
Fiscal Services (2%)	\$7,134,000
Pipeline Contingency (15%)	\$30,928,000
All Other Facilities Contingency (20%)	\$30,098,000
Environmental & Archaeology Studies and Mitigation	\$765,000
Land Acquisition and Surveying (139 acres)	\$667,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$15,353,000
TOTAL COST OF PROJECT	\$486,499,000
Debt Service (3.5 percent, 20 years)	\$34,317,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$2,064,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$180,000
Water Treatment Plant	\$26,119,000
Pumping Energy Costs (4231411 kW-hr @ 0.09 \$/kW-hr)	\$381,000
Purchase of Water (28486 ac-ft/yr @ 1463.06 \$/ac-ft)	\$41,677,000
TOTAL ANNUAL COST	\$104,738,000
Available Project Yield (ac-ft/yr)	25,637
Annual Cost of Water (\$ per ac-ft), based on PF=1	\$4,085
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=1	\$2,747
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$12.54
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$8.43

Note: One or more cost element has been calculated externally.

No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

5B.7.1.5 Implementation Issues

The groundwater availability considered for this water management strategy were based on MAGs adopted by local groundwater conservation district (GCD) and Groundwater Management Areas (GMAs) according to the Texas Water Development Board (TWDB) guidance for regional water planning.

Implementation of the project and the installation and operation of brackish water treatment plant, may have to address the following issues:

- Permitting desalination concentrate discharge to Nueces Estuary;
- Verification of groundwater quality for concentrations of dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Long-term lease of property for well field, and coordination with landowners;
- Competition with others for groundwater in the area;
- Detailed well yield including additional test drilling and aquifer water quality testing;
- Skilled operators of desalination water treatment plants;
- Capital and operations and maintenance costs;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, streamflow, and baseflow in streams;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office (GLO) Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of state-owned lands, if any;
- Cultural resources investigations in accordance with the Texas Historical Commission and the Texas Antiquities Code;
- TPWD Sand, Gravel, and Marl permit.
- Impact on endangered, other wildlife species, and wetlands;
- The potential exceedances in TDS and chloride in the groundwater will require pretreatment to remove TDS or altering the blending ratio to mitigate the impact;
- Incorporating the Evangeline groundwater into the City's water supply will require corrosivity analysis and permitting with TCEQ.

Mitigation requirements may be needed with the City of Sinton depending on long-term groundwater levels. Additional mitigation could include vegetation restoration, wetland creation or enhancement, or additional land acquisition;

5B.7.1.6 Evaluation Summary

An evaluation summary of this regional water management strategy is provided in Table 5B.7.3.

Table 5B.7.3.
Evaluation Summary of the Evangeline Laguna
Treated Groundwater Strategy

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield is 25,637 ac-ft/yr
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate to high cost; \$4,085 per ac-ft
b. Environmental factors:	
1. Instream flows	1. Moderate impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None to low, with discharge location at Rincon outfall upstream of Nueces Bay. Greatest impact is during low-flow conditions.
3. Wildlife habitat	3. Disposal of concentrated brine with bay option may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b,d. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be addressed prior to project implementation. 7c. None or low impact. 7e-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Potential impacts to agricultural or seasonal water users along Chiltipin Creek associated with brine discharge. Discharge is at Rincon outfall upstream of Nueces Bay to reduce environmental impacts. Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Reverse osmosis treatment costs modeled after bid and manufacturers' budgets, but not constructed
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.7.2 City of Beeville

5B.7.2.1 Description of Strategy

The City of Beeville does not show any water supply needs during the planning time period; however, the city is considering the development of additional supplies of up to 5 mgd. Beeville has an existing supply of approximately 1 mgd near Chase Field and receives supplies from the City of Corpus Christi. Beeville has five existing wells that were abandoned in the 1980s. Given the current drought, the City of Beeville is considering these wells for future supply and redundancy. Given the uncertainty in well conditions and production, the assumptions are that the wells need replacement and treatment to provide drought, and long-term water supplies. This 5-mgd project can be developed without violating MAG constraints for Bee County. The proposed 5 mgd wellfield assumes 10 wells at a depth of 450 feet will operate at 350 to 500 gpm. Groundwater will be delivered through a 5-mile transmission pipeline to an existing treatment plant, and it is anticipated to receive brackish groundwater treatment.

5B.7.2.2 Available Yield

The Evangeline Aquifer within the Gulf Coast Aquifer System is the source of groundwater supply. The City of Beeville Brackish Groundwater Treatment Project assumes a 75 percent efficiency for desalination with 25 percent brine concentration. The planned available yield for the Beeville Project is estimated to be 3.75 mgd (4,204 ac-ft/yr). The project can be developed at the requested amount without violating the MAG constraints for Bee County.

The Evangeline Aquifer contains both fresh and brackish water at depths between 200 and 800 feet. The Evangeline Aquifer in the Bee County vicinity is expected to have quality of 500 to 700 mg/L of TDS. The final treated water quality is expected to achieve a TDS range of 400 to 600 mg/L. Test wells should be drilled to confirm geological conditions of the site.

5B.7.2.3 Environmental Issues

The primary environmental issues related to the development of brackish groundwater desalination of water for the City of Beeville in Bee County are the development of 10 brackish water wells (likely replacing 5 abandoned wells and installing 5 new wells), an approximately 5-mile transmission pipeline, and use of an existing treatment plant (unnamed) with additional brine discharge. The conceptual layout has not been developed to identify the locations of the well field, transmission pipelines, or discharge pipelines so the environmental discussion will be general.

Estuaries such as those found near along the Texas Gulf Coast serve as critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from their large nutrient input, shallow water, and the ability of a few marine species to thrive in environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the disposal of brine concentrate from the City of Beeville brackish water project will be sensitive to the siting of the

project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to the receiving creek and the Bay system would need to be performed.

The proposed project area is located within the Coastal Prairies sub-province of the larger Gulf Coastal Plains of Texas Physiographic Province. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than 1 foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

The location of the well field and transmission pipelines have not yet been determined but they may include clearing and removal of vegetation. Potential wildlife habitat impacts can be minimized by siting the corridor within previously disturbed areas where possible. The project would use existing treatment facilities, thereby minimizing impacts.

Threatened and Endangered Species

In Bee County, 16 state-listed endangered or threatened species and 10 federally-listed endangered or threatened wildlife species may occur, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat, and potential occurrence in Bee County is provided in Table 5B.7.4.

Table 5B.7.4.
Federal- and State-Listed Threatened, and Endangered Species
Listed for Bee County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation. Sometimes in wet areas, such as arroyos, canals, ditches or shallow depressions.	Resident	—	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna. Largely fossorial in areas with moist microclimates.	Resident	—	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly in quiet bodies of water, permanent or temporary, with or without submergent vegetation. Wet or sometimes wet areas.	Resident	—	T
Black rail	<i>Laterallus jamaicensis</i>	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	T	T
Interior Least Tern	<i>Sternula antillarum athalassos</i>	Sand and gravel bars within braided streams, rivers or man-made structures.	Resident	E	E
Piping Plover	<i>Charadrius melodus</i>	Beaches, sandflats, and dunes along Gulf Coast beaches.	Transient	LT	T
Rufa Red knot	<i>Calidris canutus rufa</i>	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	T	T
Swallow-tailed Kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland. Marshes, along rivers, lakes and ponds.	Resident	—	T
White-faced Ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats.	Resident	—	T
White-tailed Hawk	<i>Buteo albicaudatus</i>	Near coast on prairies, cordgrass flats, and scrub-live oak. Further inland on prairies, mesquite and oak savannas and mixed savanna-chaparral.	Resident	—	T
Whooping Crane	<i>Grus americana</i>	Small ponds, marshes, and flooded grain fields. Potential migrant via plains through much of state.	Migrant	LE	E
Wood Stork	<i>Mycteria americana</i>	Nests in large tracts of baldcypress or red mangrove. Forages in prairie ponds, flooded pastures or fields, ditches or other shallow standing water.	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Ocelot	<i>Leopardus pardalis</i>	Restricted to mesquite-thorn scrub and live-oak mottes, avoids open areas.	Transient	LE	E

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland and riparian areas. Caves are very important.	Resident	PE	--
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors, and canyons.	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers, swamps and marshes, manmade impoundments.	Resident	SAT	—
Texas horned lizard	<i>Phrynosoma cornutum</i>	Open, arid and semi-arid regions with sparse vegetation.	Resident	—	T
Texas tortoise	<i>Gopherus berlandieri</i>	Open brush with a grass understory is preferred.	Resident	—	T

Source: TPWD, Annotated County List of Rare Species, Bee County, updated January 15, 2025.

PE – Proposed Endangered; PT - Proposed Threatened; E – Endangered; T – Threatened; — - Not Listed

Inclusion in Table 5B.7.4 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

Project details have not been determined to date. Suitable habitat for some listed species may existing within the project area, additional studies would need to be completed to determine potential impacts to listed species. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetlands could occur within the project area, especially near creeks. The wells, collection lines, transmission pipeline, and concentrate discharge lines should be sited in such a way as to avoid or minimize impacts to these sensitive resources, as much as practical. Potential impacts can be minimized by selective property acquisition and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable.

Cultural Resources

Impacts to NRHP-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the well fields and pipeline routes.

A cultural resource survey of the well field and pipeline routes for the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by

infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

The pumping of groundwater from an aquifer could cause a slight reduction on baseflow in downstream reaches. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent. Salinity concentrations in the water receiving the brine discharge and farther downstream should be carefully monitored in order to minimize any impacts this may have on aquatic species.

5B.7.2.4 Engineering and Costing

A few assumptions were made in the cost estimates for the new wells for the City of Beeville. Characteristic well depth and well capacity were developed for costing purposes based on data from existing wells in the vicinity. For the purposes of estimating well pumping power costs, typically a total dynamic head estimate of 300 feet was assumed, to include 200 feet to bring water from pumping levels to the ground surface and 100 feet to pump into a pressurized distribution system maintained at 60 pounds per square inch. This conservative estimate is intended to account for local drawdown and declining water levels with time. Brackish groundwater treatment was the level of treatment assumed for costing purposes. The cost of a 5-mile pipeline to transport groundwater from the wellfield to the existing WTP complex is included in the cost estimate. The total estimated cost of the City of Beeville project is \$100,904,000. Assuming a 20-year debt service at an interest rate of 3.5 percent, the annual cost is projected at \$16,342,000. With a projected treated water yield of 4,204 acre-feet per year (or 3.75 mgd), the unit cost of water supply is calculated at \$3,887 per acre-foot, as detailed in Table 5B.7.5.

The treatment process will involve an advanced brackish desalination facility using RO membranes, capable of processing water with salinity levels up to 3,000 mg/L at a capacity of 5 mgd.

Brine discharge facilities, including injection wells, are not included in the cost estimate. The cost assumes brine discharge for land application or to a local creek near the WTP. If injection wells or brine discharge pipelines are required, this would be an additional cost.

Table 5B.7.5.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies – City of Beeville (Additional 3.75 mgd Supply)

Item	Estimated Costs for Facilities
Intake Pump Stations (5.3 MGD)	\$7,470,000
Transmission Pipeline (24 in. dia., 5 miles)	\$9,459,000
Well Fields (Wells, Pumps, and Piping)	\$7,866,000
Water Treatment Plant (5 MGD)	\$47,475,000
Integration, Relocations, Backup Generator & Other	\$51,000
TOTAL COST OF FACILITIES	\$72,321,000
Engineering:	
- Planning (3%)	\$2,170,000
- Design (7%)	\$5,062,000
- Construction Engineering (1%)	\$723,000
Legal Assistance (2%)	\$1,446,000
Fiscal Services (2%)	\$1,446,000
Pipeline Contingency (15%)	\$1,419,000
All Other Facilities Contingency (20%)	\$12,572,000
Environmental & Archaeology Studies and Mitigation	\$257,000
Land Acquisition and Surveying (46 acres)	\$313,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$3,175,000
TOTAL COST OF PROJECT	\$100,904,000
Debt Service (3.5 percent, 20 years)	\$7,096,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$174,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$187,000
Water Treatment Plant	\$8,632,000
Pumping Energy Costs (2815869 kW-hr @ 0.09 \$/kW-hr)	\$253,000
TOTAL ANNUAL COST	\$16,342,000
Available Project Yield (ac-ft/yr)	4,204
Annual Cost of Water (\$ per ac-ft), based on PF=2	\$3,887
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=2	\$2,199
Annual Cost of Water (\$ per 1,000 gallons), based on PF=2	\$11.93
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=2	\$6.75

5B.7.2.5 Implementation Issues

There are several considerations for the South Texas Water Authority Groundwater Desalination Project to include:

- Permitting desalination concentrate discharge to Petronila Creek.
- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Purchase or lease of property for well field, and coordination with landowners;
- Skilled operators of desalination water treatment plants;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;

- USACE Section 10 and 404 dredge and fill permits for pipelines;
- GLO Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of State-owned lands, if any;
- TPWD Sand, Gravel, and Marl permit;
- Design requirement of new transmission line through the easement of existing 42" line.
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.
- Federal Emergency Management Agency (FEMA) 100-year flood map coming close to the identified well field location.

5B.7.2.6 Evaluation Summary

An evaluation summary of the City of Beeville regional water management strategies is provided in Table 5B.7.6.

Table 5B.7.6.
Evaluation Summary of the City of Beeville Additional 3.75 mgd Supply

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield = 4,204 ac-ft/yr
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate to high cost; \$3,887 per ac-ft
b. Environmental factors:	
1. Instream flows	1. Moderate impact.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None to low. Greatest impact is during low-flow conditions.
3. Wildlife habitat	3. Disposal of concentrated brine with bay option may impact fish and wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b,d. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be addressed prior to project implementation. 7c. None or low impact. 7e-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Potential impacts to agricultural or seasonal water users along waterways associated with brine discharge. Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions • Reverse osmosis treatment costs modeled after bid and manufacturers' budgets, but not constructed
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.7.3 Driscoll Brackish Groundwater Treatment Project

5B.7.3.1 Description of Strategy

The South Texas Water Authority (STWA) is actively pursuing the development of a secondary groundwater source as an independent water supply option, in anticipation of future water scarcity and drought conditions expected in the South Texas region. Currently, STWA relies on purchasing treated surface water from the City of Corpus Christi Water for its distribution. However, with projected growth in Nueces County and within the STWA distribution zone, securing a secondary water source has become a strategic priority.

This evaluation was prepared by International Consulting Engineers (ICE), under the direction of STWA. STWA has been working diligently on this initiative for several years, with key milestones outlined as follows:

- STWA engaged International Consulting Engineers to develop a Water Master Plan, focused on evaluating and strategizing for future growth and ensuring the long-term security of operations.
- STWA has formally expressed its interest in securing an alternative water source to the board members and board has approved for processing the feasibility study.
- A contract was issued to a geology team to conduct a groundwater study, assessing both fresh and brackish water availability within the distribution area for future use.
- Phase 2 of the project involves test drilling and evaluating the water yield at locations identified through the groundwater study.
- Based on the yield results, STWA will conduct a feasibility study for the identified sites to evaluate the potential for a desalination facility.
- The anticipated timeline for the approval and construction of the brackish water treatment plant is three years, including all necessary permits.

STWA has already pinpointed potential drilling sites and locations for the construction of the brackish water treatment plant, as determined by the groundwater study. According to MAG value assessments, the plant's expected capacity will be 1.8 mgd, with an anticipated output of 1.35 mgd. The proposed layout for the brackish groundwater desalination project is shown in Figure 5B.7.3.

The first phase of the project includes drilling tests, followed by analysis of the results and integration with STWA's future water needs. The subsequent phase will focus on developing the treatment facility based on the water quality and suitable locations identified by the STWA Water Master Plan.

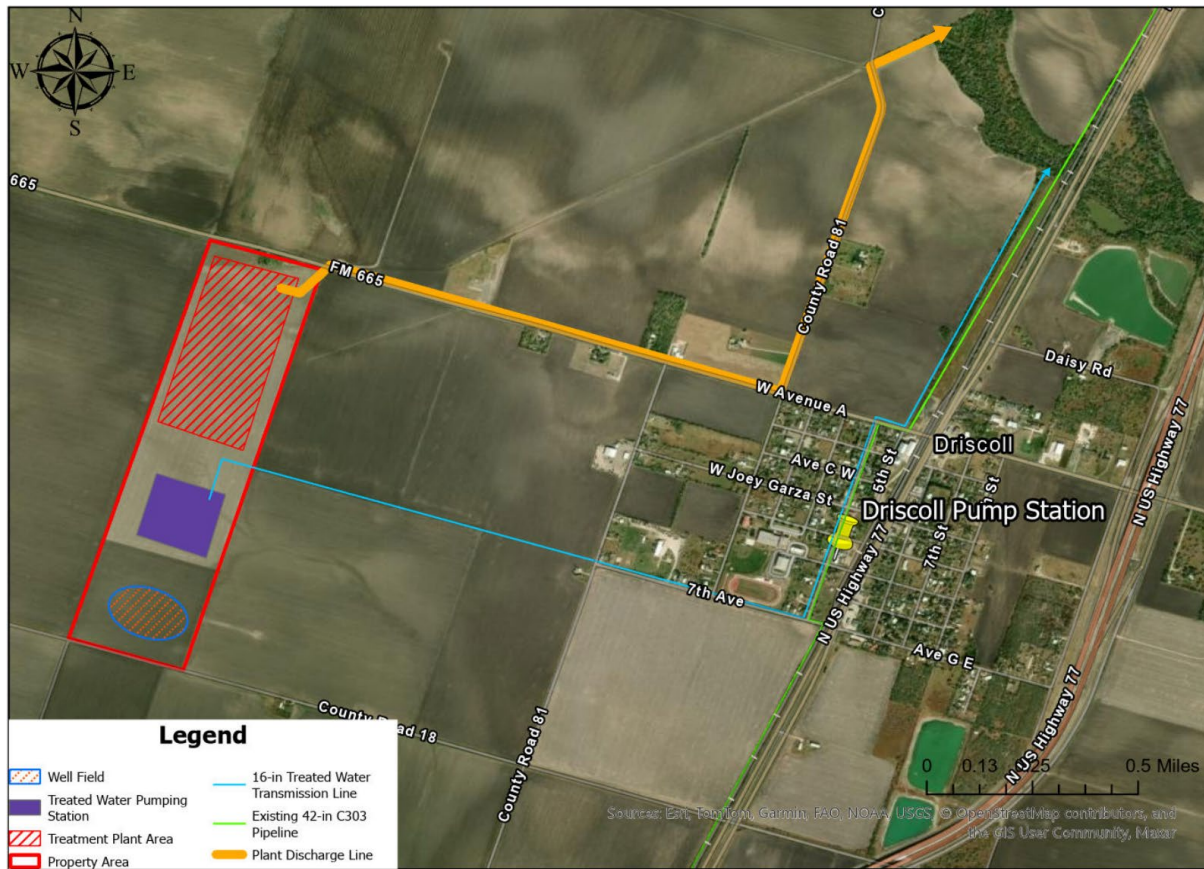


Figure 5B.7.3.
STWA Brackish Desalination Plant Layout

Transmission Strategy

The current water transmission and distribution system primarily relies on the 42-inch AWWA C303 Steel Reinforced Concrete Pipe (SRCP). This pipe serves as the main conduit for transporting water from the Corpus Christi Water source, extending approximately 27 miles southward to Kingsville. Given the pipe's age of 42 years and the external conditions affecting its structural integrity, the STWA has raised concerns regarding its future reliability. To mitigate potential risks and avoid complications from blending different water sources, STWA proposes that the secondary water supply be routed through an independent system, separate from the existing 42-inch line.

The proposed project is strategically located in the heart of the STWA distribution zone and will establish a new transmission line, approximately 6 to 8 miles in length, using a 16-inch pipe. This new line will provide an independent connection to major water user groups within Nueces County. To minimize land acquisition costs and associated expenses, the new 16-inch transmission line will be installed within the easement of the existing 42-inch line.

The new line is designed to interconnect with several key infrastructure points: it will tap into the Tesla water transfer line, the 14-inch line feeding into the Central Pump Station (near the intersection of I-69/E Frontage Road and FM 2826), and the Driscoll Pump Station, which is in

proximity to the proposed brackish water treatment plant. The proposed Transmission line is shown in Figure 5B.7.4. The treatment plant's location is also near the Bishop Pump Station and potential future industrial clients, presenting a viable solution for expansion, contingent on the MAG value and the feasibility of extending the plant's capacity in future.

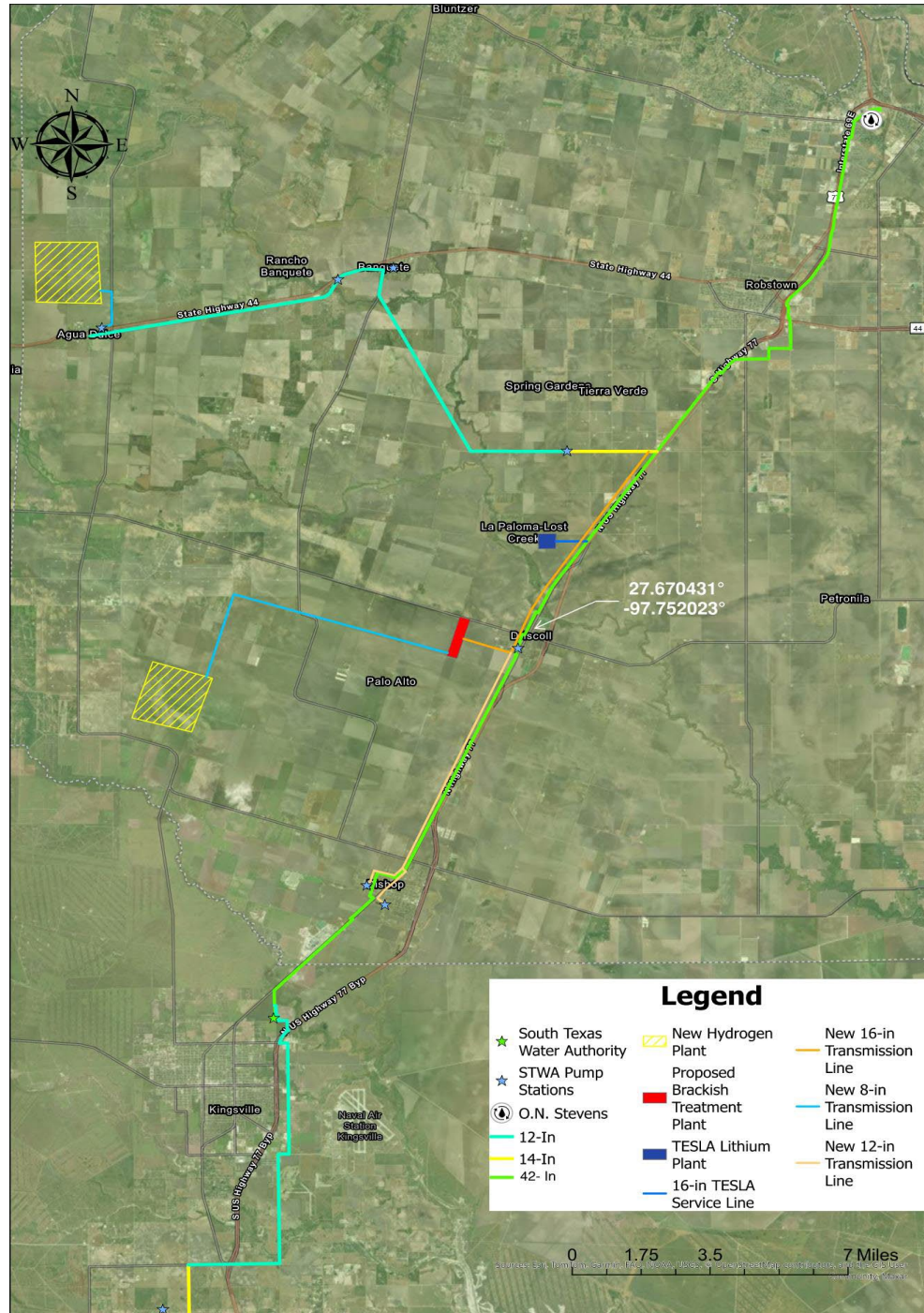


Figure 5B.7.4.
Location of Conceptual Layout of Driscoll Brackish Groundwater Treatment Project

Design and Construction Strategy

According to the TWDB's guidance manual for brackish groundwater desalination, there are standardized strategies for designing and constructing desalination plants in Texas. Desalting systems typically rely on one of two technologies to remove salts from water: evaporation or membrane filtration. For the proposed system, we plan to use a membrane-based system, with the recommended membranes provided by Kovalus Separation Solutions.

STWA will follow a five-phase implementation process to develop the full facility at the identified location, as outlined below:

- Phase 1: Planning
- Phase 2: Permitting
- Phase 3: Design
- Phase 4: Construction
- Phase 5: Operations.

Figure 5B.7.5 illustrates the key process features of a brackish water treatment facility.

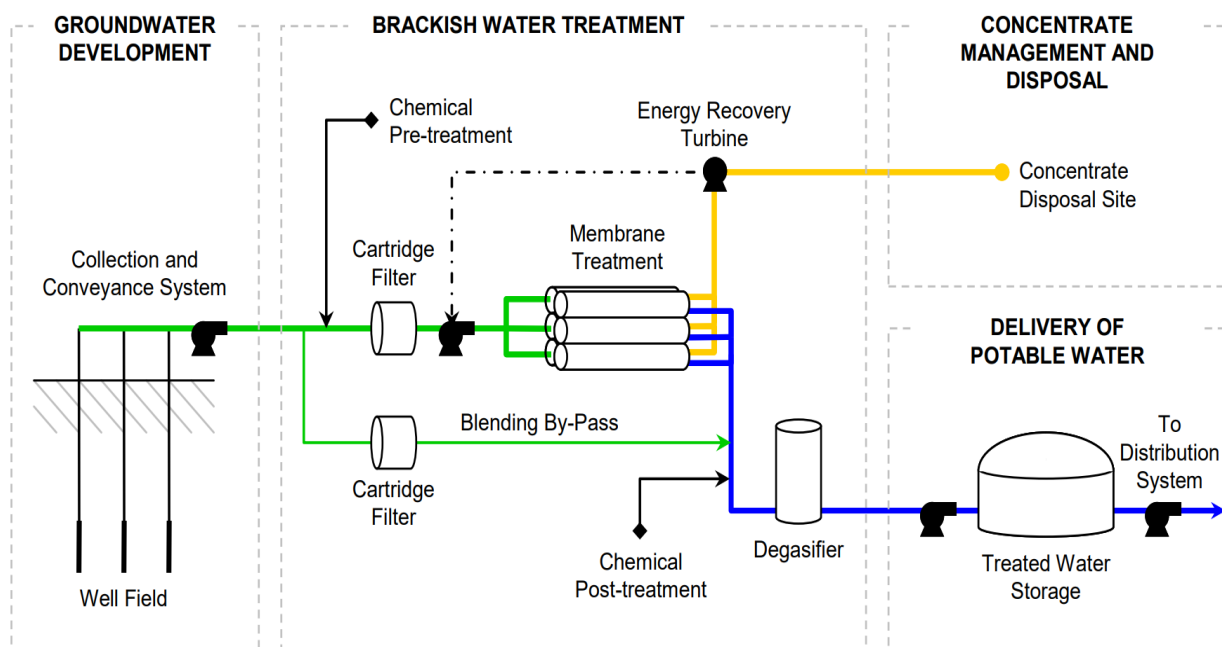


Figure 5B.7.5.
General Flow Process for a Brackish Groundwater Desalination Project³

³https://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0604830581_Brackish_Desal.pdf

5B.7.3.2 Available Yield

The Evangeline Aquifer within the Gulf Coast Aquifer System will be the primary source of groundwater supply for the brackish project in Driscoll. The Driscoll Brackish Groundwater Treatment Project assume a 75 percent efficiency for desalination with 25 percent brine concentration. The Driscoll Brackish Treatment Project will produce groundwater up to 1.8 mgd (2,018 ac-ft/yr), the treated water supply of the project will be 1.35 mgd (1,513 ac-ft/yr) assuming 75 percent water treatment plant efficiency. Approximately 37 percent of the yield (560 ac-ft/yr) is expected to be used by Nueces County Manufacturing, 26 percent of the yield (404 ac-ft/yr) will be used by Nueces County-Other, 15 percent of the yield (224 ac-ft/yr) will be used by Nueces Water Supply Corporation (WSC), 13 percent of the yield (195 ac-ft/yr) will be used by Bishop, and 9 percent of the yield (130 ac-ft/yr) will be used by Driscoll. The project can be developed at requested amounts without violating the MAG constraints for Nueces County.

The STWA contract with the City of Corpus Christi states "Specific written approval by City Council of City will be required before Authority' sells water which Authority has purchased from City to: (f) Any private organization or person not included in the initial water line construction program of Authority within an area where no City has platting jurisdiction, or to governmental unit for resale to such organization." The STWA would need approval to sell City of Corpus Christi purchased water to any private entities.

Based on the STWA Groundwater Study and Evaluation, the proposed site for development is located near the Driscoll Pump Station. Geologically, the area contains brackish water in the Evangeline Aquifer, with a minimum depth of 1,500 feet. According to data from the TWDB, no existing wells have been identified in this area. The study indicates that at a depth of 1,600 feet, the Evangeline Aquifer is expected to provide water with a quality of 2,500 to 3,000 mg/L of TDS. Each well, at this depth, is projected to yield 1 mgd (1,120 ac-ft/yr). The initial project plans call for the installation of three wells, with two operational wells and one reserved for future development, providing a total capacity of at least 2 mgd (2,241 ac-ft/yr) from the two operational wells. The final treated water quality is expected to achieve a TDS range of 400 to 600 mg/L. In line with the available MAG value in Nueces County, the wells are designed to withdraw up to 1.8 mgd (2,016 ac-ft/yr). Test wells will be drilled based on the groundwater study and geological conditions of the site. Additionally, we will assess potential flood impacts on the identified zones as well.

5B.7.3.3 Environmental Issues

The proposal to construct a brackish water treatment plant near the City of Driscoll includes the establishment of the plant and well field area between FM 665 and County Road 18, just outside the city limits. Primary environmental issues related to the extraction of brackish groundwater from the Evangeline Aquifer in Nueces County include the development of a brackish treatment plant, a pumping station for the treated water, a well field from which brackish water would be extracted for treatment, collection pipelines and a concentrate discharge line, and discharge of brine concentrate into Petrolina Creek.

Estuaries and small creek systems like those found near Baffin Bay serve as the critical habitat and spawning grounds for many marine species and migratory birds. Estuaries are marine environments maintained in a brackish state by the inflow of freshwater from rivers and streams. The high productivity characteristic of estuaries arises from their large nutrient input, shallow water, and the ability of a few marine species to thrive in environments continually stressed by low, variable salinities, temperature extremes, and, on occasion, low dissolved oxygen concentrations. The potential environmental effects resulting from the disposal of brine concentrate from the project will be sensitive to the siting of the project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to Petronila Creek and the Bay system would need to be performed.

The proposed project area is located within the Coastal Prairies sub-province of the larger Gulf Coastal Plains of Texas Physiographic Province. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

The proposed project site just outside the City of Driscoll and concentrate disposal pipelines would be within areas characterized primarily as farmland and rural low-intensity areas, with smaller areas of coastal prairie, artificial wetland, a section of Highway 77, and floodplain evergreen woodland and native invasive huisache woodland or shrubland near Petronila Creek. Although the construction of the brine disposal or collection pipelines may include clearing and removal of woody vegetation, destruction of potential habitat can be minimized by siting the corridor within previously disturbed areas, where possible.

Area Vegetation and Wildlife Habitat

The City of Driscoll is located within the South Texas Plains Vegetational Area. The South Texas Plains and brush country averages between 20 and 32 inches of rainfall per year with high summer temperatures and very high evaporation rates. Plains with thorny shrubs and trees dominate the region, with scattered patches of palms and subtropical woodlands in the Rio Grande Valley. Thorny brush, such as mesquite, acacia and prickly pear are the primary vegetation mixed with areas of grassland. Historically, the plains were covered with open grasslands with few trees, and the Valley woodlands covered large areas.

Threatened and Endangered Species

In Nueces County, 50 state-listed endangered or threatened species and 25 federally listed endangered or threatened wildlife species may occur, according to the county lists of rare species published by the TPWD. A list of these species and rare species, their preferred habitat, and potential occurrences in Nueces County is provided in Table 5B.7.7.

Table 5B.7.7.
Federal- and State-Listed Threatened, and Endangered Species
Listed for Nueces County

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
Black-Spotted Newt	<i>Notophthalmus meridionalis</i>	Terrestrial habitats used by adults are typically poorly drained clay soils that allow for the formation of ephemeral wetlands. A wide variety of vegetation associations are known to be used, such as thorn scrub and pasture. Aquatic habitats used for reproduction are a variety of ephemeral and permanent water bodies.	Resident		T
Sheep Frog	<i>hypopachus variolosus</i>	Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.	Resident		T
South Texas siren (Large Form)	<i>Siren sp. 1</i>	Aquatic: Mainly found in bodies of quiet water, permanent or temporary, without submergent vegetation. Wet of sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods but does require some moisture to remain.	Potential Resident		T
black rail	<i>Laterallus jamaicensis</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine the potential presence of this species in a specific county. Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mats of previous years dead grasses. nest usually hidden in marsh grass or at base of Salicornia	Resident	T	T
northern aplomado falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species	Migratory	E	E

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
piping plover	<i>Charadrius melodus</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine the potential presence of this species in a specific county. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands. Also spoil islands in the Intracoastal Waterway. Based on November 30, 1992 Section 6 Job No. 9.1, Piping Plover and Snowy Plover Winter Habitat Status Survey, algal flats appear to be the highest quality habitat. Some of the most important aspects of algae flats are their relative inaccessibility and their continuous availability throughout all tidal conditions. Sand flats often appear to be preferred over algal flats when both are available, but large portions of sand flats along the Texas coast are available only during low-very low tides and are often completely unavailable during extreme high tides or strong north winds. Beaches appear to serve as a secondary habitat to the flats associated with the primary bays, lagoons, and inter-island passes. Beaches are rarely used on the southern Texas coast, where bayside habitat is always available, and are abandoned as bayside habitats become available on the central and northern coast. However, beaches are probably a vital habitat along the central and northern coast (i.e., north of Padre Island) during periods of extreme high tides that cover the flats. Optimal site characteristics appear to be large in area, sparsely vegetated, continuously available or in close proximity to secondary habitat, and with limited human disturbance.	Resident	T	T
reddish egret	<i>Egretta rufescens</i>	Resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear	Resident		T

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
rufa red knot	<i>Calidris canutus rufa</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore. Bolivar Flats in Galveston County, sandy beaches Mustang Island, few on outer coastal and barrier beaches, tidal mudflats and salt marshes.	Resident	T	T
sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird; does nest on sandy beaches and islands, breeding April-July	Transient		T
swallow-tailed kite	<i>Elanoides forficatus</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees	Transient/ Migratory		T
Texas Botteri's sparrow	<i>Peucaea botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses	Resident		T
tropical parula	<i>Setophaga pitiauyumi</i>	Semi-tropical evergreen woodland along rivers and resacas. Texas ebony, anacua and other trees with epiphytic plants hanging from them. Dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July.	Resident		T
white-faced ibis	<i>Plegadis chihi</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; currently confined to near-coastal rookeries in so-called hog-wallow prairies. Nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.			T
white-tailed hawk	<i>Buteo albicaudatus</i>	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May	Resident		T

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
whooping crane	<i>Grus americana</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	Migratory	E	E
wood stork	<i>Mycteria americana</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers to nest in large tracts of baldcypress (<i>Taxodium distichum</i>) or red mangrove (<i>Rhizophora mangle</i>); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	Transient		T
yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, the populations of concern are found breeding in riparian areas in the Trans Pecos (known as part of the Western Distinct Population Segment). It is the Western DPS that is on the U.S. ESA threatened list and includes the Texas counties Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio. Riparian woodlands below 6,000' in elevation consisting of cottonwoods and willows are prime habitat. This species is a long-distant migrant that summers in Texas, but winters mainly in South America. Breeding birds of the Trans Pecos populations typically arrive on their breeding grounds possibly in late April but the peak arrival time is in May. Threats to preferred habitat include hydrologic changes that don't promote the regeneration of cottonwoods and willows, plus livestock browsing and trampling of sapling trees in sensitive riparian areas.	Migratory	T	
giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time	Resident		T
great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Resident	T	

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Resident	T	T
shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Resident		T
migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migratory	C	
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico. Commonly found along the continental shelf and coastal waters that are 65-820 feet deep, usually inside or near 185 m contour (within 250-350 km of coast); occasionally found in deeper waters. Often dive to 30-200 feet preying upon fish, invertebrates, and cephalopods.	Resident		T
blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are infrequently sighted in the Gulf of Mexico. They migrate seasonally between summer feeding grounds and winter breeding grounds, but specifics vary. Commonly observed at the surface in open ocean	Resident	E	E
Bryde's whale	<i>Balaenoptera edeni brydei</i>	Habitat description is not available at this time.	Resident		E
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in water over 3,300 feet deep near the continental shelf near steep slopes or canyons, avoiding coastal areas. Mostly pelagic apparently confined by the 1,00-meter bathymetric contour. frequently make deep dives to capture prey (squids and fishes).	Resident		T
dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide, Commonly found in deep waters near the continental shelf and rarely seen at the surface but may be more coastal than the pygmy sperm whale (<i>Kogia breviceps</i>). Dives to great depths (1,000 feet) to hunt for squid, fish, and crustaceans. Migration patterns are unknown.	Resident		T
false killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in deep, offshore waters deeper than 3,300 feet, making dives of up to 2,000 meters to catch their prey (fishes and squids). Gulf of Mexico distinct population segment is not well studied.	Resident		T

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics preferring cooler water. Commonly found in deep, offshore waters and migrate in the open ocean from the poles (feeding grounds) to warmer waters in the winter to give birth. They feed on krill, squid, and small schooling fish sometimes with other baleen whale species. They are very rare in the Gulf of Mexico and reported sightings are likely vagrants (Witt et al. 2011).	Resident	E	E
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern Atlantic Ocean, Gulf of Mexico, and Caribbean. Commonly found in deep water and open ocean where they prey upon squids. They are difficult to distinguish from others in their family (Mesoplodon) and are cryptic and skittish, but the most commonly stranded species on the US southeastern coast. Migration patterns are unknown.	Resident		T
humpback whale	<i>Megaptera novaeangliae</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide. Migrate up to 5,000 miles between colder water (feeding grounds) and warmer water (calving grounds) each year. They will use both open ocean and coastal waters, sometimes including inshore areas such as bays, and are often found near the surface; however, this species is rare in the Gulf of Mexico. The northwest Atlantic/Gulf of Mexico distinct population segment is not considered at risk of extinction and is not listed as Endangered on the Endangered Species Act.	Resident	E	
killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide. In the Gulf of Mexico, they are commonly found in oceanic waters ranging from 256-2,652 meters deep beyond the 1,000-meter isobath and a very rarely found over the continental shelf and may be entirely absent from nearshore waters. May come in contact with pelagic long line fisheries targeting tunas and billfishes.	Resident		T

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic. Commonly found in coastal waters or close to the continental shelf near the surface. They migrate from feeding grounds in cooler waters (Canada and New England) to warmer waters of the southeast US (South Carolina, Georgia, and Florida) to give birth in the fall/winter - both areas are identified as critical habitat by NOAA-NMFS. Nursery areas are in shallow, coastal waters. This species is very rare in the Gulf of Mexico and the few reported sightings are likely vagrants (Ward-Geiger et al. 2011).	Resident	E	E
ocelot	<i>Leopardus pardalis</i>	Restricted to mesquite-thorn scrub and live-oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.	Resident	E	E
pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico. Commonly found in deeper, offshore waters where they dive for their prey (squids and fishes), but may occasionally occur close to shore. They are very rare and migration patterns are unknown.	Resident		T
pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide. Commonly found in deep water over the continental slope and rarely seen at the surface. Dives to great depths (over 1,000 feet) to hunt for squid, fish, and crustaceans. Migration patterns are unknown.	Resident		T
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Resident	E	E
Rough-toothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Records in Texas are only known from strandings. Commonly found in deep, oceanic water over 1,500-2,000 meters deep and ranging in temperature from 17-25 degrees Celsius. May associate with other cetaceans. Prey on squids and fish. No known migration patterns.	Resident		T
sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Resident	E	E
short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in deeper waters (>1,000 feet) and continental shelf where they make deep dives to capture squid but may come closer to shore. Migration patterns unknown.	Resident		T



Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters. Distribution is highly dependent on their food source (squids, sharks, skates, fish), breeding, and composition of the pod. In general, this species migrates from north to south in the winter and south to north in the summer; however, individuals in tropical and temperate waters don't seem to migrate at all. Routinely dive to catch their prey (2,000-10,000 feet) and generally occupies water at least 3,300 feet deep near ocean trenches.	Resident	E	E
tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland and riparian areas are important. Caves are very important to this species.	Resident	PE	
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters. Warm waters of the tropics, in rivers and brackish bays but may also survive in saltwater habitats. Very sensitive to cold water temperatures. Rarely occurs as far north as Texas. Gulf and bay system; opportunistic, aquatic herbivore.	Resident	T	T
white-nosed coati	<i>Quadrula quadrula</i>	Woodlands, riparian corridors and canyons. Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade	Resident		T
American alligator	<i>Alligator mississippiensis</i>	Aquatic: Coastal marshes; inland natural rivers, swamps and marshes; manmade impoundments.	Resident	SoA, T	
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Inhabits tropical and subtropical waters worldwide, in the Gulf of Mexico, especially Texas. Hatchling and juveniles are found in open, pelagic ocean and closely associated with floating algae/seagrass mats. Juveniles then migrate to shallower, coastal areas, mainly coral reefs and rocky areas, but also in bays and estuaries near mangroves when reefs are absent; seldom in water more than 65 feet deep. They feed on sponges, jellyfish, sea urchins, mollusks, and crustaceans. Nesting occurs from April to November high up on the beach where there is vegetation for cover and little or no sand. Some migrate, but others stay close to foraging areas - females are philopatric.	Resident	E	E

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
green sea turtle	<i>Chelonia mydas</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Adults and juveniles occupy inshore and nearshore areas, including bays and lagoons with reefs and seagrass. They migrate from feeding grounds (open ocean) to nesting grounds (beaches/barrier islands) and some nesting does occur in Texas (April to September). Adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grass and seaweeds.	Resident	T	T
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico. Adults are found in coastal waters with muddy or sandy bottoms. Some males migrate between feeding grounds and breeding grounds, but some don't. Females migrate between feeding and nesting areas, often returning to the same destinations. Nesting in Texas occurs on a smaller scale compared to other areas (i.e., Mexico). Hatchlings are quickly swept out to open water and are rarely found nearshore. Similarly, juveniles often congregate near floating algae/seagrass mats offshore, and move into nearshore, coastal, neritic areas after 1-2 years and remain until they reach maturity. They feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August.	Resident	E	E
leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Nesting is not common in Texas (March to July). Most pelagic of the sea turtles with the longest migration (>10,000 miles) between nesting and foraging sites. Are able to dive to depths of 4,000 feet. They are omnivorous, showing a preference for jellyfish.	Resident	E	E

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
loggerhead sea turtle	<i>Caretta caretta</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. They migrate from feeding grounds to nesting beaches/barrier islands and some nesting does occur in Texas (April to September). Beaches that are narrow, steeply sloped, with coarse-grain sand are preferred for nesting. Newly hatched individuals depend on floating algae/seaweed for protection and foraging, which eventually transport them offshore and into open ocean. Juveniles and young adults spend their lives in the open ocean, offshore before migrating to coastal areas to breed and nest. Foraging areas for adults include shallow continental shelf waters.	Resident	T	T
Texas horned lizard	<i>Phrynosoma cornutum</i>	Terrestrial: Open habitats with sparse vegetation, including grass, prairie, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. Occurs to 6,000 feet but largely limited below the pinyon-juniper zone on mountains in the Big Bend area.	Resident		T
Texas scarlet snake	<i>Cemophora lineri</i>	Terrestrial: Prefers well drained soils with a variety of forests, grassland, and scrub habitats	Resident		T
Texas tortoise	<i>Gopherus berlandieri</i>	Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus, sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.	Resident		T
black lace cactus	<i>Echinocereus reichenbachii</i> var. <i>albertii</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy, somewhat saline soils on coastal prairie, most frequently in naturally open areas sparsely covered with brush of a low stature not resulting from disturbance or along creeks in ecotonal areas between this upland type and lower areas dominated by halophytic grasses and forbs; flowering April-June	Resident	E	E
slender rush-pea	<i>Hoffmannseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes along drainages, usually in areas of shorter or sparse vegetation; soils often described as Blackland clay, but at some of these site's soils are coarser textured and lighter in color than the typical heavy clay of the coastal prairies; flowering April-November	Resident	E	E

Common Name	Scientific Name	Summary of Habitat Preferences	Potential Occurrence in Project Area	Federal Status	State Status
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils ranging from heavy clays to lighter textured sandy loams, mostly over the Beaumont Formation on the Coastal Plain; in modified unplowed sites such as railroad and highway rights-of-way, cemeteries, mowed fields, erosional areas along small creeks; Perennial; Flowering July-November	Resident	E	E

Source: TPWD, Annotated County List of Rare Species, Nueces County, updated January 15, 2025.

PE – Proposed Endangered; PT - Proposed Threatened; E – Endangered; T – Threatened; — - Not Listed, C – Considered, SoA – Similarity of Appearance

Inclusion in Table 5B.7.7 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

Project details have not been determined to date. Suitable habitat for some listed species may existing within the project area, additional studies would need to be completed to determine potential impacts to listed species. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Wetland Areas

Potential wetlands could occur within the project area, especially near creeks. The wells, collection lines, transmission pipeline, and concentrate discharge lines should be sited in such a way as to avoid or minimize impacts to these sensitive resources, as much as practical. Potential impacts can be minimized by selective property acquisition and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable.

Cultural Resources

Impacts to NRHP-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the well fields and pipeline routes.

A cultural resource survey of the well field and pipeline routes for the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by

infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

The pumping of groundwater from an aquifer could cause a slight reduction on baseflow in downstream reaches. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent. Salinity concentrations in the water receiving the brine discharge and farther downstream should be carefully monitored in order to minimize any impacts this may have on aquatic species.

5B.7.3.4 Engineering and Costing

For the Driscoll Brackish Groundwater Treatment Project, the Level 5 engineering cost estimate encompasses the development of a brackish water extraction well field, desalination plant, and treated water transmission infrastructure, designed to establish an independent secondary water source for all major water user groups (WUGs) under the STWA, excluding the City of Kingsville and Ricardo. The system will consist of three wells drilled to a depth of 1,800 feet (Evangeline Aquifer), with a combined average flow rate of 1,249 gpm. A 10-mile long, 16-inch diameter transmission pipeline will transport treated water from the desalination facility to the WUGs, avoiding any tap into the existing 42-inch transmission line to ensure an independent water source.

The total estimated cost of the project is \$36,289,885. Assuming a 20-year debt service at an interest rate of 3.5 percent, the annual cost is projected at \$4,353,679. With a projected treated water yield of 1,513 acre-feet per year, the unit cost of water supply is calculated at \$2,878 per acre-foot, as detailed in Table 5B.7.8.

The treatment process will involve primary treatment followed by an advanced brackish desalination facility, capable of processing water with salinity levels up to 3,000 mg/L at a capacity of 1.8 mgd. The final design will use RO membranes, ensuring a minimum lifespan of 15 years, to produce drinking water with TDS below 500 mg/L. A degasifier system will be employed to remove undesirable gases, such as carbon dioxide and hydrogen sulfide, from the permeate water, reducing chemical usage and lowering operational and maintenance (O&M) costs. As the final step of the treatment process, the water will be chlorinated to a concentration of at least 2 parts per million to ensure effective disinfection. The treated water will be directly transferred to the WUGs, with the transmission line designed to minimize its length to reach all users in Nueces County.

The project estimate also includes the installation of a 6-inch concentrate discharge line to carry the treatment plant's discharge to Petronila Creek. Additionally, an analyzer system will be incorporated to monitor water quality for the end users, and separate magnetic flow meters will be installed to measure water consumption. The selected transmission line route has been determined through comprehensive engineering analysis, ensuring cost efficiency while preventing blending of water from the City of Corpus Christi with the newly sourced water.

5B.7.3.5 Implementation Issues

There are several considerations for the STWA Groundwater Desalination Project to include:

- Permitting desalination concentrate discharge to Petronila Creek.
- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Purchase or lease of property for well field, and coordination with landowners;
- Skilled operators of desalination water treatment plants;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- GLO Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of State-owned lands, if any;
- TPWD Sand, Gravel, and Marl permit;
- Design requirement of new transmission line through the easement of existing 42-inch line.
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.
- FEMA 100-year flood map coming close to the identified well field location.

Table 5B.7.8.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies – City of Driscoll Treatment
(Additional 1.3 mgd Supply)

Item	Estimated Costs for Facilities
Well Fields (Production Wells, Test Well, and Pumps)	\$4,150,000
Transmission Pipeline (16"/8", 10 Miles)	\$14,990,600
Pipelines (Concentrate Disposal, 6" 1.5 Miles)	\$1,071,840
Transmission Pump Stations (2 MGD)	\$250,000
Water Treatment Plant (1.8 MGD)	\$2,218,000
Advanced Water Treatment Facility (1.8 MGD)	\$6,600,000
Integration, Relocation, Backup Generator	\$200,000
SCADA	\$300,000
TOTAL COST OF FACILITIES	\$25,630,440
Engineering:	
* Planning (3%)	\$878,413
* Design (7%)	\$1,974,602
* Construction Engineering (1%)	\$256,304
Legal Assistance (2%)	\$585,609
Fiscal Services (2%)	\$512,609
Pipeline Contingency (15%)	\$2,248,590
All Other Facility Contingency (20%)	\$2,643,600
Compensation for the Farm Land and Facilities	\$200,000
Environmental & Archeological Studies and Mitigation	\$150,000
Land Acquisition and Surveying (45 acres)	\$184,500
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$1,025,218
TOTAL COST OF PROJECT	\$36,289,885
Debt Service (3.5 percent, 20 years)	\$2,553,395
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$204,624
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$110,000
Water Treatment Plant (12% Cost of facility)	\$266,160
Advanced Water Treatment Facility (18% Cost of facility)	\$1,188,000
Pumping Energy Costs (350000 kW-hr @ 0.09 \$/kW-hr)	\$31,500
TOTAL ANNUAL COST	\$4,353,679
Available Project Yield (ac-ft/yr)	1,513
Annual Cost of Water (\$ per ac-ft), based on PF=2	\$2,878
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=2	\$1,190
Annual Cost of Water (\$ per 1,000 gallons), based on PF=2	\$8.83
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=2	\$3.61

Note: One or more cost element has been calculated externally. No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

5B.7.3.6 Evaluation Summary

An evaluation summary of the City of Beeville and the Driscoll Brackish regional water management strategies is provided in Table 5B.7.9.

Table 5B.7.9.
Evaluation Summary of the Driscoll Brackish Groundwater Treatment Project

Impact Category	Comments
a. Water supply:	
1. Quantity	1. Yield: 1,513 ac-ft/yr.
2. Reliability	2. High reliability.
3. Cost of treated water**	3. Generally moderate to high cost; \$2,159 per ac-ft.
b. Environmental factors:	
1. Effects on Instream flows	1. None to low impact. Non-continuous flow in Petronila Creek. Monitor impacts of saline discharge.
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Moderate impact. However, greatest impact is during low flow conditions to Baffin Bay.
3. Wildlife habitat	3. Disposal of concentrated brine may impact wildlife habitats or wetlands.
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7a-b. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be evaluated. 7d-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	- Potential impacts to agricultural or seasonal water use from Petronila Creek associated with brine discharge. These impacts will likely intensify if non-potable reuse project (5B.4) is implemented and WWTP discharge are reduced or eliminated. - Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	Temporary damage due to construction of pipeline
e. Recreational impacts	None
f. Equitable comparison of strategies	- Standard analyses and methods used for portions. - Brackish groundwater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbrain transfers	Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	Not applicable
i. Efficient use of existing water supplies and regional opportunities	Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	None
k. Impacts on water pipelines and other facilities used for water conveyance	Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.7.4 Nueces River Brackish Wells Reverse Osmosis Facility

5B.7.4.1 Description of Strategy

The Nueces River Brackish Wells Reverse Osmosis Facility (Nueces BWROF) includes groundwater production of up to 13 mgd (14,560 ac-ft/yr) for wellfield development along the Nueces River on land owned by the City of Corpus Christi, as part of Phase 1. The Phase 1 wellfield is comprised of eight (8) wells to a depth of 600 or more feet and capable of producing 1.5-2 mgd each from the lower portion of the Chicot Aquifer and upper portion of the Evangeline Formation, collectively part of the Gulf Coast Aquifer system. Phase 1 is considered in this evaluation, also referred to as the Eastern Well Field.

The City of Corpus Christi recently purchased an additional site north of the City of Bluntzer for Phase 2. This additional property will be used to drill up to sixteen (16) wells, referred to as the Western Well Field, to support the next phase of this project (Phase 2). Up to 28 MGD total is estimated to be produced with the Eastern (Phase 1) and Western (Phase 2) wellfield projects.

At the time of development of this strategy, little information was available on the phasing. For this reason, this strategy focuses on Phase 1 only and does not include land purchase costs other than for pipeline right of way. The Phase 1 raw water quality is non-potable with an estimated TDS of 3,000 to 5,000 mg/L, based on typical water quality makeup of the lower Chicot and upper Evangeline members of the Gulf Coast Aquifer in this area. The produced water will be conveyed through a 3.5 mile raw water pipeline to the new Nueces River Park treatment facility located downstream of the wellfield on the Nueces River at the location shown on Figure 5B.7.6. The treatment will involve cartridge filtration, reverse osmosis, and chemical stabilization to produced treated water that meets drinking water requirements. The treated water pipeline is estimated to be 24-inches in diameter, routed approximately 1.5 miles to a 54-inch pipeline tie-in location near Sharpsburg and Up River Road.

Figure 5B.7.6 shows the location of the Eastern Well Field project site and wellfield layout. Communications with the City of Corpus Christi (City) in August 2025, confirmed that all eight (8) wells for Phase 1 had been constructed. Therefore, the cost for the production wells associated with the Eastern Well Field (Phase 1) was not included in this evaluation. Water quality results and permit information was unavailable, at the time of preparing this water management strategy evaluation.

Groundwater availability is estimated based on policy decisions made by groundwater conservation districts, groundwater management areas, and aquifer characteristics. The TWDB uses desired future conditions established by groundwater management areas to determine modeled available groundwater (MAG) for an aquifer or portion of an aquifer.⁴ The TWDB guidance continues by stating that “groundwater availability for existing and future groundwater supplies may not exceed the annual MAG volume unless authorized by the TWDB Executive

⁴ Section 2.3.4 from the TWDB *Second Amended General Guidelines for Development of the 2026 Regional Water Plans*, September 2023.

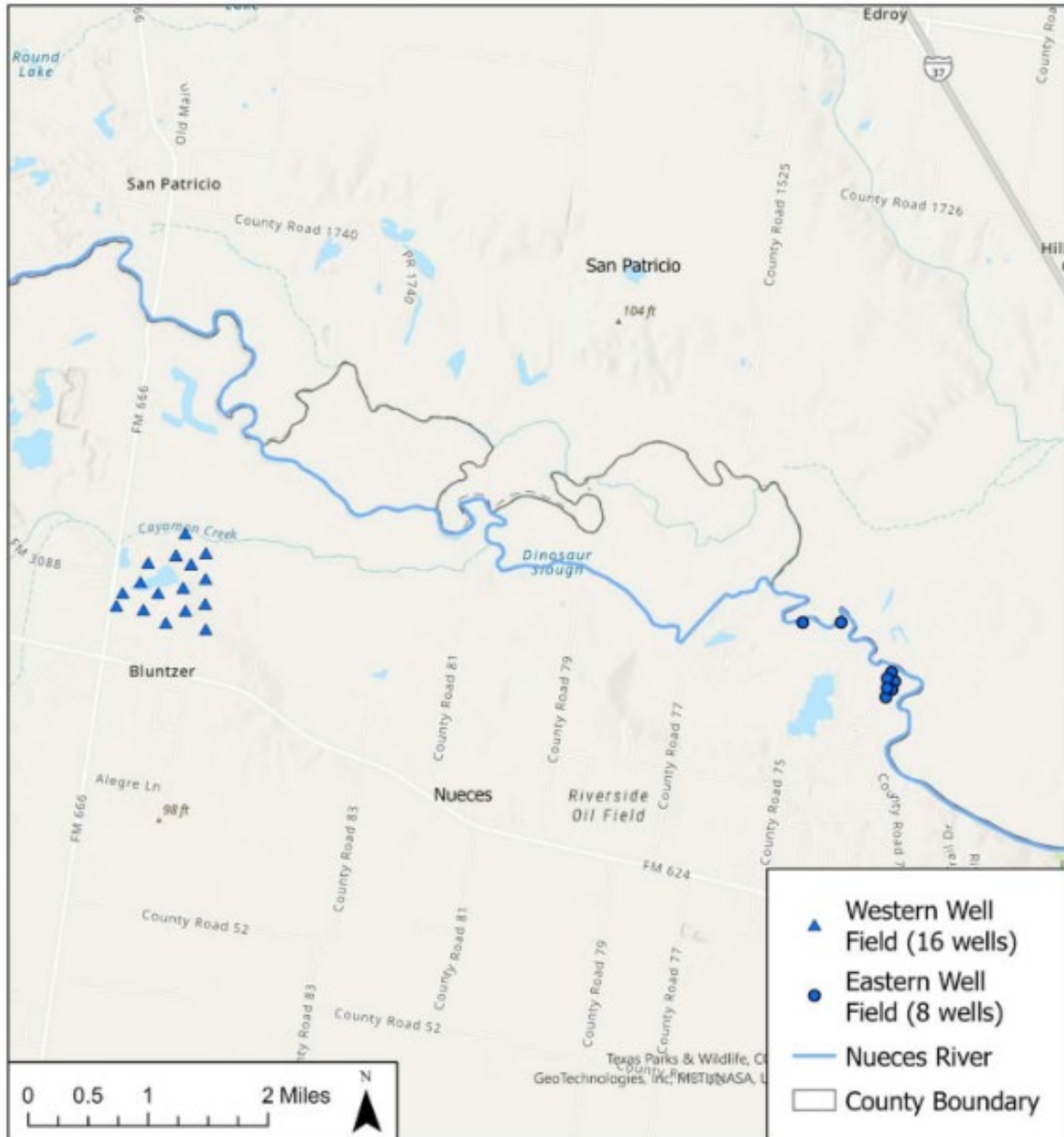
Administrator approval prior to the Initially Prepared Plan through a hydrologic variance request process.”

Nueces County is within GMA 16 and does not have a groundwater conservation district that has jurisdictional authority where the project is located. In November 2021, GMA 16 adopted a desired future condition of 26 feet of drawdown in the Gulf Coast Aquifer System for non-district areas in Nueces County. Using the GMA 16 Groundwater Flow Model for the Coastal Bend Region, the TWDB set a MAG supply of 756 ac-ft/yr (0.67 mgd) in 2030, increasing to 845 ac-ft/yr (0.75 mgd) in 2060 for the Gulf Coast Aquifer system in the Nueces River Basin. This MAG has already been allocated to existing water users in this regional water plan, with 6 to 10 ac-ft/yr unused for the period from 2030 to 2080. Based on a conversation with TWDB on May 30, 2025, the City of Corpus Christi would need to request an update to the GMA 16 desired future conditions and TWDB MAG analysis to provide for the greater groundwater production rates of this project. On August 22, 2025, the City of Corpus Christi sent a letter to GMA 16 requesting the inclusion of this strategy in the desired future condition (DFC) calculations being performed by GMA 16 including background information on the strategy and estimated production from the Gulf Coast Aquifer to achieve the desired yield of this project. Figure 5B.7.7 shows the approximate well locations for Phase 1 and 2 for the purposes of GMA 16 groundwater modeling.



Source: Garver, sent by email on May 24, 2025.

Figure 5B.7.6.
Nueces River Brackish Wells Reverse Osmosis Facility Layout



Source: CCW, sent by email on August 22, 2025.

Figure 5B.7.7.
Eastern (Phase 1) and Western (Phase 2) Wellfields for the Purposes of Future GMA 16 Groundwater Modeling

5B.7.4.2 Available Yield

In the Coastal Bend region, the Gulf Coast Aquifer System is the primary source of groundwater supplies. The most productive water-bearing zone is the Goliad Sand, also known as the Evangeline Aquifer. The outcrop of the Goliad Sand is about 50 to 75 miles inland. The

formation dips toward the coast at about 20 feet per mile. Near the coast, the shallower Chicot Aquifer provides some groundwater supplies. West of the outcrop of the Goliad Sands, the deeper Jasper Aquifer can supply a moderate amount of groundwater in some areas.

The Evangeline Aquifer within the Gulf Coast Aquifer System will be the primary source of groundwater supply for the Nueces River Brackish Wells Reverse Osmosis Facility (Nueces BWROF) project. The Nueces BWROF assumes an 85 percent efficiency for desalination with 15 percent brine concentrate to be disposed of in injection wells. The City of Corpus Christi is currently evaluating phasing opportunities for this project, up to 40 mgd. The first phase of the Nueces River Brackish Wells Reverse Osmosis Facility (Nueces BWROF) project, also considered the Eastern Well Field, includes pumping raw groundwater up to 13 mgd (14,560 ac-ft/yr) from the existing eight (8) wells for a desired treated water supply of 11 mgd (12,331 ac-ft/yr). The project requires updates to the GMA desired future conditions and TWDB MAG analysis to be developed at requested amounts to avoid violating the MAG constraints for this aquifer in Nueces County, as discussed above in sub-section 5B.7.4.1. Table 5B.7.10 compares the amount of unused MAG currently in the Gulf Coast Aquifer in Nueces County and Nueces River Basin to the desired yield for the Nueces BWROF project. The City of Corpus Christi has requested that GMA 16 revisit the DFC and MAG. In order for the desired project yield to be shown in the Plan, GMA 16 will need to formally approve a new MAG showing sufficient availability for the project in the Gulf Coast Aquifer in Nueces County and Nueces River Basin.

Table 5B.7.10.

Comparison between the Envisioned Project Yield and MAG Yield in Acre-Feet per Year

	County	2030	2040	2050	2060	2070	2080
Nueces BWROF-Phase 1	Nueces	14,560	14,560	14,560	14,560	14,560	14,560
Available MAG (Nueces County-Gulf Coast Aquifer)	Nueces	6	8	8	10	10	10

5B.7.4.3 Environmental Issues

The Phase 1 Nueces BWROF, Wellfield, and Pipeline project includes development of 8 water wells in the existing wellfield located in Nueces County along the Nueces River, as of information provided by the City of Corpus Christi on June 4, 2025. Raw water would be collected from the wellfield with a pipeline collection system and conveyed to a proposed reverse osmosis water treatment plant facility at Nueces River Park located approximately 3.5 miles southeast of the well field, near Calallen. Concentrate disposal for this project would be to three on-site deep injection wells at the proposed treatment facility.

Four new pipelines are proposed and included in this water management strategy: a well field collection system, an approximately 3.5-mile raw water conveyance line from the delivery point at the wellfield to the proposed Nueces River Park WT and an approximately 1.5-mile treated water pipeline to tie-in to a location(s) in Nueces County within the City of Corpus Christi's existing distribution system. It is assumed that the injection wells are located at the water treatment plant, therefore no additional piping is needed.

The proposed raw water pipeline would cross areas previously disturbed by oil and gas operations on the Welder Ranch lease, as well as several buried transmission pipelines containing natural gas or highly volatile liquids, but may encounter areas that are predominately undeveloped. The proposed pipelines could cross possible freshwater emergent and freshwater forested wetland areas associated with the Nueces River. The treated water line would likely be routed along roadway rights-of-way and areas primarily considered mixed agricultural/commercial/residential. Planning of the conveyance pipeline routes should include avoidance of impacts to wetland areas where possible. Construction of portions of the pipelines may include clearing and removal of woody vegetation. Destruction of potential wildlife habitat may be minimized or avoided by diverting the corridor through previously disturbed areas.

The potential environmental effects resulting from the disposal of brine concentrate from the project will be sensitive to the siting of the project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to the Nueces River Tidal (Segment 2101) would need to be performed.

The existing wellfield area is located in a primarily residential area along the Nueces River and surrounded by freshwater forested/shrub and freshwater emergent wetlands.

Appropriate pipeline route selection, construction methods and right-of-way selection should avoid or minimize anticipated impacts to potential wetland areas or other waters of the United States for the proposed wellfield collection system, raw water, and treated water pipelines.

Area Vegetation and Wildlife Habitat

The groundwater desalination project area is located within the Gulf Prairies and Marshes Vegetational Area. Gulf Prairies have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally, the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However, tree species such as honey mesquite (*Prosopis glandulosa*), and acacia (*Acacia* sp.), along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak (*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), black-brush (*A. rigidula*), and a dwarf shrub; bushy sea-ox-eye (*Borrchia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiagrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Pricklypear (*Opuntia* sp.) are common within this area along with forbs including asters (*Aster* sp.), poppy mallows (*Callirhoe* sp.), bluebonnets (*Lupinus* sp.), and evening primroses (*Oenothera* sp.). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus* sp.), bulrushes (*Scirpus* sp.), rushes (*Juncus* sp.), and grasses. Aquatic forbs found in these areas generally include pepperweeds (*Lepidium* sp.), smartweeds (*Polygonum* sp.), cattails (*Typha* sp.) and spiderworts (*Tradescantia* sp.) among others. Game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (ESA), as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the pipeline area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Pipeline construction activities could disturb migratory bird habitats and/or species’ activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project’s activities on threatened and endangered species, as well as bald and golden eagles. Species’ locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service (USFWS) and TPWD recommendations.

In San Patricio and Nueces counties, there may occur 50 state-listed endangered or threatened species and 28 federally listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat and potential occurrence in the two county areas is provided in Table 5B.7.11.

Table 5B.7.11.
Federal- and State-Listed Threatened, and Endangered
Listed for San Patricio and Nueces Counties

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Black rail	<i>Laterallus jamaicensis</i>	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	T	T
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus.	Migrant	E	E
Piping plover	<i>Charadrius melodus</i>	Beaches and flats of coastal Texas.	Migrant	T	T
Reddish egret	<i>Egretta rufescens</i>	Brackish marshes and shallow salt ponds and tidal flats.	Resident	--	T
Red knot	<i>Calidris canutus rufa</i>	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	T	T
Sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird. Does nest on sandy beaches and islands.	Migrant	--	T
Swallow-tailed kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
Texas Botteri's Sparrow	<i>Aimophila botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground on low clump of grasses.	Resident	—	T
Tropical parula	<i>Setophaga pitiayumi</i>	Semi-tropical evergreen woodland along rivers and resacas.	Resident	--	T
White-faced ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes.	Resident	--	T
White-tailed hawk	<i>Buteo albicaudatus</i>	Coastal prairies, savannahs and marshes in Gulf Coastal Plain.	Nesting/Migrant	—	T
Whooping crane	<i>Grus Americana</i>	Winters in coastal marshes.	Migrant	E	E
Wood stork	<i>Mycteria Americana</i>	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas.	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time.	Ocean Resident	T	--
Great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Ocean Resident	--	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Ocean Resident	T	T
Shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico.	Ocean Resident	--	T
Blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, and subpolar waters worldwide, infrequently sighted in the Gulf of Mexico.	Ocean Resident	E	E
Bryde's whale	<i>Balaenoptera iedeni brydei</i>	Habitat description is not available at this time.	Ocean Resident	--	E
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits warm tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide.	Ocean Resident	--	T
False killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics.	Ocean Resident	E	E
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern Atlantic Ocean, Gulf of Mexico, and Caribbean.	Ocean Resident	--	T
Humpback whale	<i>Megaptera novaeangliae</i>	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	E	--
Killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide.	Ocean Resident	--	T
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic.	Ocean Resident	E	E
Ocelot	<i>Leopardus pardalis</i>	Dense chaparral thickets; mesquite-thorn shrub and live oak stands.	Resident	E	E
Pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Roughtoothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters.	Ocean Resident	E	E
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland, and riparian areas are important. Caves are very important.	Resident	PE	--
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters.	Aquatic Resident	T	T
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors and canyons.	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers and marshes, manmade impoundments.	Resident	SAT	--
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Gulf and bay system, warm shallow waters especially in rocky marine environments.	Aquatic Resident	E	E
Green sea turtle	<i>Chelonia mydas</i>	Gulf and bay systems; shallow water seagrass beds.	Aquatic Resident	T	T
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico.	Aquatic Resident	E	E
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Aquatic Resident	E	E
Loggerhead sea turtle	<i>Caretta caretta</i>	Gulf and bay systems for juveniles, adults prefer open waters.	Aquatic Resident	T	T
Texas horned lizard	<i>Phrynosoma cornutum</i>	Varied; sparsely vegetated uplands, grass, cactus, brush.	Resident	—	T
Texas scarlet snake	<i>Cemophora coccinea lineri</i>	Mixed hardwood scrub on sandy soils.	Resident	—	T
Texas tortoise	<i>Gopherus berlandieri</i>	Open bush with grass understory; open grass and bare ground avoided.	Resident	—	T
Black lace cactus	<i>Echinocereus reichenbachii var alberti</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy somewhat saline soils on coastal prairie.	Resident	E	E
Slender rush pea	<i>Hoffmanseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes.	Resident	E	E
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils.	Resident	E	E

Source: TPWD, Annotated County List of Rare Species, Nueces and San Patricio Counties, last updated: January 15, 2025.

PT Proposed Threatened
PE Proposed Endangered
E Endangered

SAT Special Assessment Status
-- Not Listed
T Threatened

Inclusion in Table 5B.7.11 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area counties. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed project occurs in areas which are undeveloped, used for oil and gas operations, and residential. Disturbance within these areas due to construction of the pipeline routes and well field is anticipated to have some effect on the existing environment. Impacts from the disposal of brine concentrate into the Nueces River Tidal (Segment 2101) should be carefully monitored in order to minimize any impacts this may have on sensitive aquatic species. Suitable habitat for some listed species may exist within the project areas, additional studies would need to be completed to determine potential impacts to listed species. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Streams and Wetland Areas

Potential stream and wetland impacts could occur along the conveyance pipelines and well field areas located near rivers, streams, or marshy areas. The well field and collection system would be located along the Nueces River (Segment 2102), a perennial freshwater stream. The raw water conveyance pipeline would cross the Nueces River in at least two locations and would also cross several potential freshwater forested/shrub wetlands and emergent wetlands. The wells, collection system within the wellfield, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable and a permit from the U.S. Army Corps of Engineers (USACE) would be required for fill impacts to waters of the United States. The Nueces River Tidal (Segment 2101) is not currently listed as impaired. Water from Segment 2101 enters Nueces Bay (Oyster Waters) (TCEQ Segment 2482OW) which is considered impaired for copper in water according to the TCEQ 2024 303(d) List. Discharge to the Nueces River would require a permit through the Texas Pollutant Discharge Elimination System (TPDES).

Cultural Resources

Impacts to National Register of Historic Place (NRHP)-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be easily avoided through planning associated with the development of the new wells and pipeline routes.

A cultural resource survey of the wellfield and pipeline routes for the proposed project areas will need to be performed consistent with requirements of the Texas Antiquities Code.

Summary of Overall Possible Environmental Impacts

Construction of the water wells, well field collection system, and conveyance pipeline through undeveloped areas characterized as potential wetlands have the greatest possibility of resulting in environmental impacts. Construction of the Nueces BWROF (and maintenance of surface facilities) and treated water pipeline are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, adjustments in facility siting and pipeline

alignment would generally be sufficient to avoid or minimize adverse effects. Impacts to aquatic species within the Nueces River should be studied early in project design.

The pumping of groundwater from the Evangeline Aquifer could cause a slight reduction on baseflow in downstream reaches. However, no measurable impact on wildlife along the streams is anticipated from this project. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent.

5B.7.4.4 Engineering and Costing

Based on data collected and provided by Corpus Christi Water, the key features identified and evaluated for planning and costing purposes are as follows:

- Raw groundwater quality ranging from 3,000 mg/L to 5,000 mg/L TDS is expected. A TDS concentration of 5,000 mg/L was used to determine the cost of treatment.
- Transmission costed according to 14,560 ac-ft/yr (13 mgd) for approximately 3.5 miles of pipeline to the treatment facility and an additional 1.5 miles of pipeline to the tie-in location at Sharpsburg and Up River Road.
- Option A: Brine concentrate disposal in the Nueces River downstream of Calallen Dam transmitted through a 0.3-mile-long transmission pipeline to the river. Assuming 2 mgd of brine solution disposed of in the river.
- Option B: Brine concentrate disposal via three, 0.67 mgd on site deep injection wells planned at the treatment facility with depths of 5,000 to 9,000 feet. An injection well depth of 9,000 feet was used for costing purposes. Injection wells are located adjacent to the reverse osmosis facility, therefore brine is transmitted through a 0.3-mile-long transmission pipeline to the injection wells for disposal. Option B is the preferred brine disposal method for this project.
- Treated water yield: 12,331 ac-ft/yr (11 mgd).
- Treated water delivery: delivery is at tie-in location near Sharpsburg and Up River Road

Option A: (brine disposal to Nueces River) Using the UCM tool including annual operations and maintenance assumptions, the project cost is \$159,584,000. Annual cost is \$30,469,000. At a yield of 12,331 ac-ft/yr (envisioned yield amount), the unit cost of water is \$2,471 per ac-ft. The cost table for this project is presented in Table 5B.7.12.

Option B: (brine disposal via deep injection wells) Using the UCM tool including annual operations and maintenance assumptions, the project cost is \$268,029,000. Annual cost is \$38,859,000. At a yield of 12,331 ac-ft/yr (envisioned yield amount), the unit cost of water is \$3,151 per ac-ft. The cost table for this project is presented in Table 5B.7.13.

The City of Corpus Christi continues to evaluate this strategy and anticipates the annual costs to be less than stated in the cost table (see Table 5B.7.2 note).

Table 5B.7.12.
Desired Project Yield - Cost Estimate Summary Water Supply Project Option A (Brine Disposal to Nueces River),
September 2023 Prices,
Phase 1 Nueces River Brackish Wells Reverse Osmosis Facility Strategy – Region N Plan

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Intake Pump Stations (2.1 mgd)	\$8,344,000
Transmission Pipeline – Wellfield to Treatment and Delivery (24 in. dia., 3.5 miles For transmission line and 1.5 miles for treated water line)	\$13,403,000
Transmission Pipeline – Brine Disposal to River (12 in. diam., 0.3 miles)	\$442,000
Well Fields (Piping Only)	\$2,904,000
Water Treatment Plant (11 mgd)	\$87,205,000
Integration, Relocations, Backup Generator & Other	\$277,000
TOTAL COST OF FACILITIES	\$114,640,000
Engineering:	
- Planning (3%)	\$3,439,000
- Design (7%)	\$8,025,000
- Construction Engineering (1%)	\$1,146,000
Legal Assistance (2%)	\$2,293,000
Fiscal Services (2%)	\$2,293,000
Pipeline Contingency (15%)	\$2,077,000
All Other Facilities Contingency (20%)	\$20,159,000
Environmental & Archaeology Studies and Mitigation	\$245,000
Land Acquisition and Surveying (25 acres)	\$252,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$5,015,000
TOTAL COST OF PROJECT	\$159,584,000
Debt Service (3.5 percent, 20 years)	\$11,229,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$191,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$209,000
Water Treatment Plant	\$17,441,000
Pumping Energy Costs (15526977kW-hr @ 0.09 \$/kW-hr)	\$1,399,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$30,469,000
Available Project Yield (acft/yr)	12,331
Annual Cost of Water (\$ per acft), based on PF=1	\$2,471
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$1,560
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$7.58
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$4.79

Table 5B.7.13.
Desired Project Yield - Cost Estimate Summary Water Supply Project Option B (Brine Disposal via Deep Injection Wells),
September 2023 Prices,
Phase 1 Nueces River Brackish Wells Reverse Osmosis Facility Strategy – Region N Plan

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Intake Pump Stations (2.1 mgd)	\$8,111,000
Transmission Pipeline – Wellfield to Treatment and Delivery (24 in. dia., 3.5 miles Of transmission line and 1.5 miles for treated water line)	\$13,403,000
Transmission Pipeline – Brine Disposal to Injection wells (12 in. diam., 0.3 miles)	\$442,000
Well Fields (Injection Wells, Pumps, and Piping)	\$80,947,000
Water Treatment Plant (11 mgd)	\$87,205,000
Integration, Relocations, Backup Generator & Other	\$268,000
TOTAL COST OF FACILITIES	\$192,441,000
Engineering:	
- Planning (3%)	\$5,773,000
- Design (7%)	\$13,471,000
- Construction Engineering (1%)	\$1,924,000
Legal Assistance (2%)	\$3,849,000
Fiscal Services (2%)	\$3,849,000
Pipeline Contingency (15%)	\$2,077,000
All Other Facilities Contingency (20%)	\$35,719,000
Environmental & Archaeology Studies and Mitigation	\$245,000
Land Acquisition and Surveying (25 acres)	\$252,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$8,429,000
TOTAL COST OF PROJECT	\$268,029,000
Debt Service (3.5 percent, 20 years)	\$18,859,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$971,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$203,000
Water Treatment Plant	\$17,441,000
Pumping Energy Costs (15389423kW-hr @ 0.09 \$/kW-hr)	\$1,385,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$38,859,000
Available Project Yield (acft/yr)	12,331
Annual Cost of Water (\$ per acft), based on PF=1	\$3,151
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$1,622
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$9.67
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$4.98

Table 5B.7.14
MAG Limited Yield - Cost Estimate Summary Water Supply Project Option A (Brine Disposal in Nueces River),
September 2023 Prices,
Phase 1 Nueces River Brackish Wells Reverse Osmosis Facility Strategy – Region N Plan

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Intake Pump Stations (2.1 mgd)	\$8,344,000
Transmission Pipeline – Wellfield to Treatment and Delivery (24 in. dia., 3.5 miles For transmission line and 1.5 miles for treated water line)	\$13,403,000
Transmission Pipeline – Brine Disposal to River (12 in. diam., 0.3 miles)	\$442,000
Well Fields (Piping Only)	\$2,904,000
Water Treatment Plant (11 mgd)	\$87,205,000
Integration, Relocations, Backup Generator & Other	\$277,000
TOTAL COST OF FACILITIES	\$114,640,000
Engineering:	
- Planning (3%)	\$3,439,000
- Design (7%)	\$8,025,000
- Construction Engineering (1%)	\$1,146,000
Legal Assistance (2%)	\$2,293,000
Fiscal Services (2%)	\$2,293,000
Pipeline Contingency (15%)	\$2,077,000
All Other Facilities Contingency (20%)	\$20,159,000
Environmental & Archaeology Studies and Mitigation	\$245,000
Land Acquisition and Surveying (25 acres)	\$252,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$5,015,000
TOTAL COST OF PROJECT	\$159,584,000
Debt Service (3.5 percent, 20 years)	\$11,229,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$191,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$209,000
Water Treatment Plant	\$17,441,000
Pumping Energy Costs (15526977kW-hr @ 0.09 \$/kW-hr)	\$1,399,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$30,469,000
Available Project Yield (acft/yr)	6
Annual Cost of Water (\$ per acft), based on PF=1	\$5,078,167
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$3,206,667
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$15,581.98
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$9,839.42

Table 5B.7.15
MAG Limited Yield - Cost Estimate Summary Water Supply Project Option (Brine Disposal via Deep Injection Wells),
September 2023 Prices,
Phase 1 Nueces River Brackish Wells Reverse Osmosis Facility Strategy – Region N Plan

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Intake Pump Stations (2.1 mgd)	\$8,111,000
Transmission Pipeline – Wellfield to Treatment and Delivery (24 in. dia., 3.5 miles Of transmission line and 1.5 miles for treated water line)	\$13,403,000
Transmission Pipeline – Brine Disposal to Injection wells (12 in. diam., 0.3 miles)	\$442,000
Well Fields (Injection Wells, Pumps, and Piping)	\$80,947,000
Water Treatment Plant (11 mgd)	\$87,205,000
Integration, Relocations, Backup Generator & Other	\$268,000
TOTAL COST OF FACILITIES	\$192,441,000
Engineering:	
- Planning (3%)	\$5,773,000
- Design (7%)	\$13,471,000
- Construction Engineering (1%)	\$1,924,000
Legal Assistance (2%)	\$3,849,000
Fiscal Services (2%)	\$3,849,000
Pipeline Contingency (15%)	\$2,077,000
All Other Facilities Contingency (20%)	\$35,719,000
Environmental & Archaeology Studies and Mitigation	\$245,000
Land Acquisition and Surveying (25 acres)	\$252,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$8,429,000
TOTAL COST OF PROJECT	\$268,029,000
Debt Service (3.5 percent, 20 years)	\$18,859,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$971,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$203,000
Water Treatment Plant	\$17,441,000
Pumping Energy Costs (15389423kW-hr @ 0.09 \$/kW-hr)	\$1,385,000
Purchase of Water (acft/yr @ \$/acft)	\$0
TOTAL ANNUAL COST	\$38,859,000
Available Project Yield (acft/yr)	6
Annual Cost of Water (\$ per acft), based on PF=1	\$6,476,500
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$3,333,333
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$19,872.66
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$10,228.09

5B.7.4.5 Implementation Issues

There are several considerations for the City of Corpus Christi to include:

- TCEQ permitting deep injection wells for brine concentrate (if applicable);
- Permitting brackish water discharge to Nueces River (if applicable)
- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- TCEQ approval after pilot testing of RO treatment process for public supply;
- Skilled operators of desalination water treatment plants;

- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- GLO Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of State-owned lands, if any;
- TPWD Sand, Gravel, and Marl permit;
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.
- Consider FEMA 100-year flood maps related to well field and treatment plant siting

5B.7.4.6 Evaluation Summary

An evaluation summary of the Nueces River Brackish Wells Reverse Osmosis Facility (Nueces BWROF) water management strategy is provided in Table 5B.7.16.

Table 5B.7.16.
Evaluation Summary of Nueces River Brackish Wells Reverse Osmosis Facility

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield is 10 ac-ft/yr (Desired project yield is 12,331 ac-ft/yr)
2. Reliability	2. High reliability.
3. Cost of treated water	3. Generally moderate to high cost; \$2,471 to \$3,151 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None to low impact on water levels at well depths of 600 ft+ in confined units of the Evangeline aquifer. None to low impact on water quality assuming conveyance of raw groundwater through pipeline to the water treatment plant. Monitor Nueces River downstream of project is recommended for impacts of flow and water quality.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Low to moderate.
3. Wildlife habitat	3. Low to moderate.
4. Wetlands	4. Potential stream and wetland impacts could occur along the conveyance pipelines and well field areas located near rivers, streams, or marshy areas. The wells, collection system within the wellfield, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. 7a-b,d. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be addressed prior to project implementation. 7c. None or low impact. 7e-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	Potential impacts to agricultural or seasonal water users along Nueces River associated with brine discharge. Discharge is downstream of Calallen Dam to reduce environmental impacts.
d. Threats to agriculture and natural resources in region	Temporary damage due to construction of pipeline
e. Recreational impacts	None
f. Equitable comparison of strategies	- Standard analyses and methods used for portions of this evaluation. - Brackish groundwater desalination cost modeled after bid and manufacturers' budgets, but not constructed, comparable project
g. Interbasin transfers	Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	Not applicable
i. Efficient use of existing water supplies and regional opportunities	Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	None
k. Impacts on water pipelines and other facilities used for water conveyance	Construction and maintenance of transmission pipeline corridor. Possible impact to wildlife habitat along pipeline route and right-of-way.

5B.7.5 EV Ranch Brackish Groundwater Desalination

5B.7.5.1 Description of Strategy

The EV Ranch Brackish Groundwater Desalination Project is a water supply initiative proposed by a private entity located southeast of Hebbronville, Texas. It aims to develop groundwater supplies from the Catahoula Formation of the Gulf Coast Aquifer in Jim Hogg County and deliver up to 28.5 million gallons per day (MGD) of treated potable water. At the City of Corpus Christi's request, this evaluation includes conveyance of treated water to the O.N Stevens Water Treatment plant in Corpus Christi. The strategy includes a production wellfield, desalination plant, injection wellfield for reject water (concentrate) disposal, and transmission line for treated water transport from Hebbronville to Corpus Christi. A potential route for the transmission line is provided below in Figure 5B.7.8. The City of Corpus Christi would be responsible for project implementation. It is early in negotiations and responsibilities of City of Corpus Christi and EV Ranch Catahoula regarding project construction elements have not been determined. The cost evaluation includes specific project features to estimate project construction and does not include raw water costs, due diligence, or option fees as this information is unavailable at this time. Should the project move forward to construction, the treated water supply is anticipated to be added to the Corpus Christi regional water supply system to benefit multiple MWP/WUGs through their customer relationships.

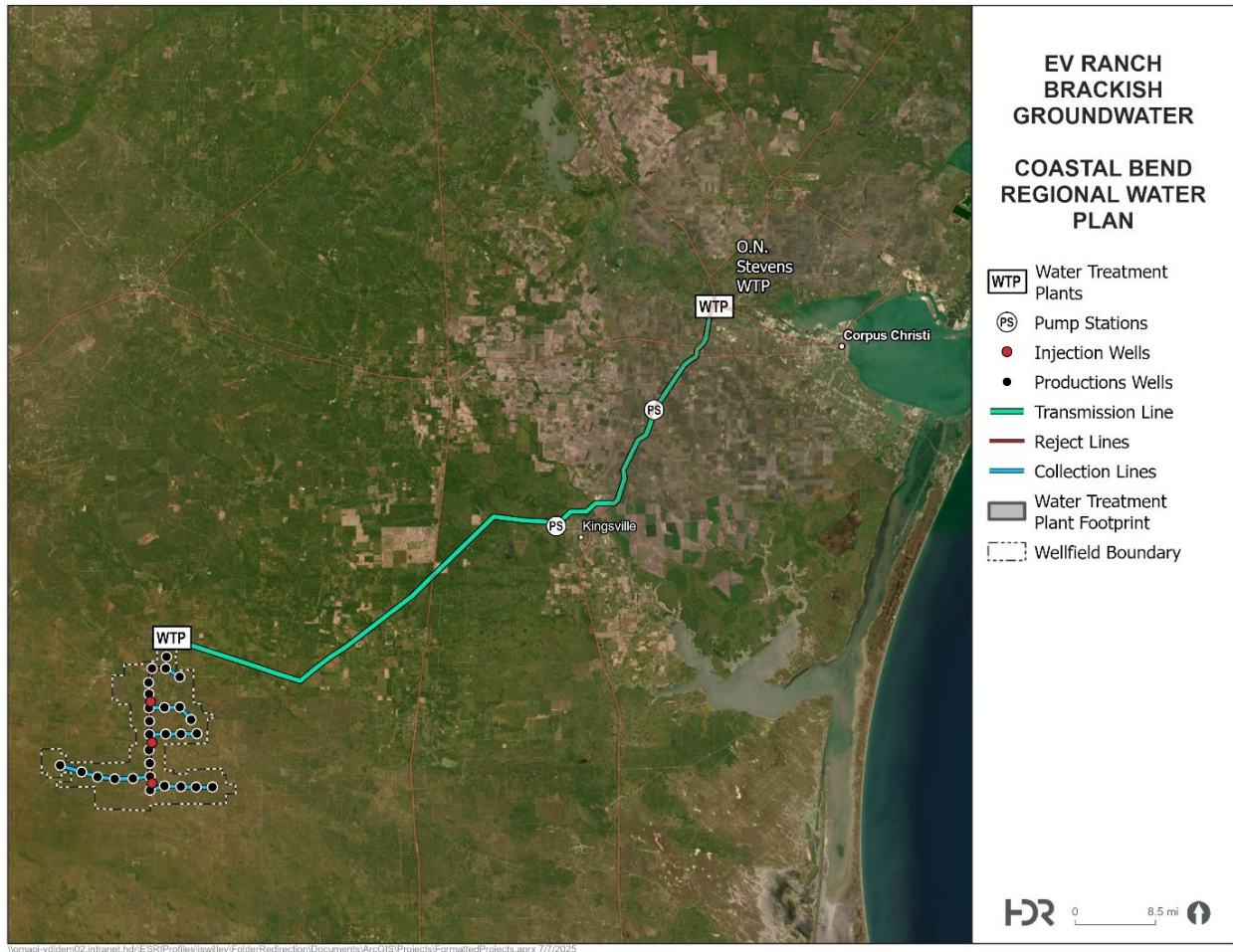


Figure 5B.7.8.
Potential Layout of EV Ranch Transmission Pipeline and Wellfield

5B.7.5.2 Available Yield

The EV Ranch Brackish Groundwater strategy is designed to provide a reliable treated water supply of 32,000 ac-ft/yr (28.5 MGD). This strategy's supply is achieved through the construction of 29 production wells drilled to depths of up to 3500' feet on the EV Ranch property. Of these 29 wells, 27 are assumed to be active at any given time with 2 wells being contingency wells. The assumed average production rate of wells at the site is 864 gpm, for a total raw production of 37,650 ac-ft/yr. Groundwater is sourced from the Catahoula Formation, which is known to be brackish; a conservative 5,000 mg/L TDS is assumed for treatment planning purposes. The proposed water treatment facility is assumed to have a treatment efficiency of 85% and produce 32,000 ac-ft/yr (28.5 MGD). Reject water is produced at a rate of 5.03 MGD and injected into the subsurface at a depth of 9,000 feet using 3 injection wells with an assumed injection rate of 1,166 gpm. Additional studies are needed to verify the formation can accept this injection rate.

This project does not have a MAG limitation⁵, as the Catahoula Formation is not currently used for water supply in the area. MAG quantities for the Gulf Coast Aquifer in Jim Hogg County exclude water stored in the Catahoula formation. Brush Country GCD's TWDB-adopted desired future condition (DFC) is less than 12-ft of drawdown across the district. However, the DCF is largely unaffected by the proposed project due to confining units between the Catahoula and shallower water bearing units in the district including the Chicot and Evangeline.

5B.7.5.3 Environmental Issues

Environmental Considerations Associated with EV Ranch Brackish Groundwater, Wellfield and Pipeline Project

The EV Ranch project includes development of approximately 29 water wells, a raw water wellfield collection system, a water treatment plant, reject water pipeline, and injection wells located on the EV Ranch lease primarily in Jim Hogg County. Raw water would be collected from the wellfield with a pipeline collection system and delivered to a water treatment plant located on the northern end of the EV Ranch. Reject water, a brine with elevated total dissolved solids, would be delivered to one of three injection wells for disposal. A transmission pipeline, approximately 79 miles in length, would deliver the treated water from the treatment plant to the Corpus Christi Stevens Plant near Calallen.

The proposed pipelines would cross areas previously disturbed by oil and gas operations in the Premont and Berregos oil fields, as well as several buried transmission pipelines containing natural gas. Areas within the EV Ranch and along the transmission pipeline corridor could enter areas that are predominately undeveloped. The proposed transmission pipeline route would cross possible freshwater streams. Construction of portions of the wellfield and transmission pipelines may include clearing and removal of woody vegetation. Destruction of potential wildlife habitat may be minimized or avoided by diverting the corridor through previously disturbed areas. Appropriate pipeline route selection, construction methods and right-of-way selection should avoid or minimize anticipated impacts to potential wetland areas or other waters of the United States along the proposed wellfield collection system, raw water, and treated water pipelines.

The wellfield area would be located primarily within the EV Ranch, which is utilized by oil and gas and farming and ranching operations. Site selection for the proposed new wells should include the avoidance of impacts to wetland areas. The potential environmental effects resulting from the disposal of brine concentrate from the project would be sensitive to the siting of the project and its appurtenances. Prior to implementation, water quality studies of discharge impacts to groundwater resources would need to be performed.

The pumping of groundwater from the Catahoula Formation is unlikely to cause impact on baseflow in downstream reaches given the depth of the unit of interest. It is unsure how long-

⁵ Confirmed by the TWDB Groundwater and BRACS data science team. The Catahoula Formation was approved for use as a potential source of brackish groundwater per TWDB email sent to HDR Engineering on August 29, 2025 at 11:49 AM.

term pumping will affect local water levels and/or potential of surface subsidence, which should be considered in future studies.

Area Vegetation and Wildlife Habitat

The majority of the EV Ranch project area is located within the Gulf Prairies and Coastal Plains, and partially within the Texas-Tamaulipan Thornscrub ecoregions. Gulf Prairies and Coastal Plains have slow surface drainage and elevations that range from sea level to 250 feet. These areas include nearly level and virtually undissected plains. Originally, the Gulf Prairies were composed of tallgrass prairie and post oak savannah. However, tree species such as honey mesquite (*Prosopis glandulosa*), and acacia (*Acacia* sp.), along with other trees and shrubs have increased in this area forming dense thickets in many places. Typical oak species found in this area include live oak (*Quercus virginiana*) and post oak (*Q. stellata*), in addition to huisache (*Acacia smallii*), black-brush (*A. rigidula*), and a dwarf shrub, bushy sea-ox-eye (*Borrichia frutescens*). Principal climax grasses of the Gulf Prairies include gulf cordgrass (*Spartina spartinae*), indiagrass (*Sorghastrum nutans*), and big bluestem (*Andropogon gerardii* var. *gerardii*). Pricklypear (*Opuntia* sp.) are common within this area along with forbs including asters (*Aster* sp.), poppy mallows (*Callirhoe* sp.), bluebonnets (*Lupinus* sp.), and evening primroses (*Oenothera* sp.). Gulf Marshes range from sea level to a few feet in elevation, and include low, wet, marshy coast areas commonly covered with saline water. These salty areas support numerous species of sedges (*Carex* and *Cyperus* sp.), bulrushes (*Scirpus* sp.), rushes (*Juncus* sp.), and grasses. Aquatic forbs found in these areas generally include pepperweeds (*Lepidium* sp.), smartweeds (*Polygonum* sp.), cattails (*Typha* sp.) and spiderworts (*Tradescantia* sp.) among others. Game and waterfowl find these low marshy areas to be excellent natural wildlife habitat.

Trees common to the Texas-Tamaulipan Thornscrub region include honey mesquite Texas ebony (*Ebenopsis ebano*), anacahuita (*Cordia boissieri*), and/or Helietta parvifolia (*baretta*). Common shrubs in the Texas-Tamaulipan Thornscrub region include cenizo (*Leucophyllum frutescens*), guajillo (*Acacia berlandieri*), and/or blackbrush (*Acacia rigidula*). Many sites are now dominated by non-native grasses, particularly King Ranch bluestem (*Bothriochloa ischaemum* var. *songarica*) and/or buffelgrass (*Pennisetum ciliare*). Other grasses are often shortgrasses, with species such as Texas grama (*Bouteloua rigidiseta*), hairy grama (*Bouteloua hirsuta*), buffalograss (*Bouteloua dactyloides*), curlymesquite (*Hilaria belangeri*), purple threeawn (*Aristida purpurea*), sideoats grama (*Bouteloua curtipendula*), and plains bristlegrass (*Setaria leucopila*) present. Forbs and subshrubs are conspicuous in the herbaceous layer and include species such as oreja de perro (*Tiquilia canescens*), Texas desert-rue (*Thamnosma texana*), narrowlead thryallis (*Galphimia angustifolia*), Mexican mallow (*Hermannia texana*), and hairy zexmanie (*Wedelia hispida*).

Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (ESA), as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or

degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for the public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the pipeline area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Pipeline construction activities could disturb migratory bird habitats and/or species’ activities.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project’s activities on threatened and endangered species, as well as bald and golden eagles. Species’ locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service (USFWS) and TPWD recommendations.

In Duval, Jim Hogg, Jim Wells, Kleberg, and Nueces counties, there may occur 55 state-listed endangered or threatened species and 30 federally listed endangered or threatened wildlife species, according to the county lists of rare species published by the TPWD. A list of these species, their preferred habitat and potential occurrence in the two county areas is provided in Table 5B.7.17.

Table 5B.7.17.
Federal- and State-Listed Threatened, and Endangered
Species for Duval, Jim Hogg, Jim Wells, Kleberg, and Nueces Counties

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Mexican burrowing toad	<i>Rhinophrynus dorsalis</i>	Terrestrial and aquatic: Low, rolling hills of sand, gravel or thin soil drained by ravines and gullies. Prefers moderate to dense vegetation cover of cactus and thornscrub. Roadside ditches, temporary ponds, arroyos, or wherever loose friable soils are present in which to burrow.	Resident	--	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Black rail	<i>Laterallus jamaicensis</i>	Salt, brackish, and freshwater marshes, pond borders, wet meadows and grassy swamps.	Nesting	T	T
Gray hawk	<i>Buteo plagiatus</i>	Locally and irregularly along U.S.-Mexico border; mature riparian woodlands and nearby semiarid mesquite and scrub grasslands; breeding range formerly extended north to southernmost Rio Grande floodplain of Texas.	Migrant	--	T
Northern Aplomado Falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus.	Migrant	E	E
Piping plover	<i>Charadrius melodus</i>	Beaches and flats of coastal Texas.	Migrant	T	T
Reddish egret	<i>Egretta rufescens</i>	Brackish marshes and shallow salt ponds and tidal flats.	Resident	--	T
Red knot	<i>Calidris canutus rufa</i>	Primarily sea coast on tidal flats and beaches, herbaceous wetland, and tidal flat/shore.	Resident	T	T
Sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird. Does nest on sandy beaches and islands.	Migrant	--	T
Swallow-tailed kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
Texas Botteri's Sparrow	<i>Aimophila botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground on low clump of grasses.	Resident	—	T
Tropical parula	<i>Setophaga pitiayumi</i>	Semi-tropical evergreen woodland along rivers and resacas.	Resident	--	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
White-faced ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes.	Resident	--	T
White-tailed hawk	<i>Buteo albicaudatus</i>	Coastal prairies, savannahs and marshes in Gulf Coastal Plain.	Nesting/Migrant	—	T
Whooping crane	<i>Grus Americana</i>	Winters in coastal marshes.	Migrant	E	E
Wood stork	<i>Mycteria Americana</i>	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas.	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time.	Ocean Resident	T	--
Great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Ocean Resident	T	T
Shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Ocean Resident	--	T
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico.	Ocean Resident	--	T
Coues' rice cat	<i>Oryzomys couesi</i>	Cattail-bulrush marsh with shallower zone of aquatic grasses (Echinochloa, Panicum, Paspalidium) near the shoreline; shade trees around the shoreline are important features. Freshwater marshes.	Resident	--	T
Blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, and subpolar waters worldwide, infrequently sighted in the Gulf of Mexico.	Ocean Resident	E	E
Bryde's whale	<i>Balaenoptera iedeni brydei</i>	Habitat description is not available at this time.	Ocean Resident	--	E
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits warm tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide.	Ocean Resident	--	T
False killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics.	Ocean Resident	E	E
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern Atlantic Ocean, Gulf of Mexico, and Caribbean.	Ocean Resident	--	T
Humpback whale	<i>Megaptera novaeangliae</i>	Open ocean and coastal waters, sometimes including inshore areas such as bays.	Ocean Resident	E	--

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide.	Ocean Resident	--	T
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic.	Ocean Resident	E	E
Ocelot	<i>Leopardus pardalis</i>	Dense chaparral thickets; mesquite-thorn shrub and live oak stands.	Resident	E	E
Pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide.	Ocean Resident	--	T
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Roughtoothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Ocean Resident	E	E
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Ocean Resident	--	T
Sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters.	Ocean Resident	E	E
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland, and riparian areas are important. Caves are very important.	Resident	PE	--
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters.	Aquatic Resident	T	T
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors and canyons.	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers and marshes, manmade impoundments.	Resident	SAT	--
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Gulf and bay system, warm shallow waters especially in rocky marine environments.	Aquatic Resident	E	E
Green sea turtle	<i>Chelonia mydas</i>	Gulf and bay systems; shallow water seagrass beds.	Aquatic Resident	T	T
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico.	Aquatic Resident	E	E
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico.	Aquatic Resident	E	E
Loggerhead sea turtle	<i>Caretta caretta</i>	Gulf and bay systems for juveniles, adults prefer open waters.	Aquatic Resident	T	T
Texas horned lizard	<i>Phrynosoma cornutum</i>	Varied; sparsely vegetated uplands, grass, cactus, brush.	Resident	—	T
Texas scarlet snake	<i>Cemophora coccinea lineri</i>	Mixed hardwood scrub on sandy soils.	Resident	—	T

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Texas tortoise	<i>Gopherus berlandieri</i>	Open bush with grass understory; open grass and bare ground avoided.	Resident	—	T
Ashy dogweed	<i>Thymophylla tephroleuca</i>	Grasslands with scattered shrubs; most sites on sands or sandy loams on level or very gently rolling topography over Eocene strata of the Laredo Formation; flowering March-May depending to some extent on rainfall.	Resident	E	E
Black lace cactus	<i>Echinocereus reichenbachii var alberti</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy somewhat saline soils on coastal prairie.	Resident	E	E
Slender rush pea	<i>Hoffmanseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes.	Resident	E	E
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils.	Resident	E	E
Walker's manioc	<i>Manihot walkerae</i>	Periphery of native brush in sandy loam; also on caliche cuestas; flowering April-September (following rains).	Resident	E	E

Source: TPWD, Annotated County List of Rare Species, Duval, Jim Hogg, Jim Wells, Kleberg, and Nueces Counties, last updated: January 15, 2025.

PT Proposed Threatened
PE Proposed Endangered
E Endangered

SAT Special Assessment Status
-- Not Listed
T Threatened

Inclusion in Table 5B.7.17 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area counties. A more intensive field reconnaissance effort would be necessary to confirm and identify specific species habitat that may be present in the project area.

A desktop review of Texas Natural Diversity Database data indicated occurrences of federal and state listed threatened and endangered species documented within the project area including the Texas scarlet snake within the EV Ranch, the black-spotted newt and black lace cactus near Kingsville, and the South Texas ambrosia and slender rush pea near Bishop and Robstown.

The proposed project occurs in areas which are undeveloped, used for oil and gas operations, and mixed commercial/residential. Disturbance within these areas due to construction of the pipeline routes and wellfield is anticipated to have some effect on the existing environment. Impacts from the disposal of saline concentrate into the deep injection wells should be carefully monitored in order to minimize any impacts this may have on sensitive species. Suitable habitat for some listed species may exist within the project areas; additional studies would need to be completed to determine potential impacts to listed species. The presence or absence of potential habitat within an area does not confirm the presence or absence of a listed species. No species-specific surveys were conducted in the project area for this report.

Streams and Wetland Areas

Potential stream and wetland impacts could occur within the wellfield, along the wellfield collection pipelines, and at the transmission pipelines located near rivers, streams, or marshy areas. The wellfield collection system would potentially cross Arroyo Baluarte, a potentially intermittent stream and Palo Blanco Creek, a potentially ephemeral stream in Jim Hogg County. The transmission line would potentially cross at least two perennial streams, San Fernando Creek (Segment 2492) near Kingsville and Carreta Creek near Bishop, and many potentially intermittent streams including Petronila Creek (Segment 2204) near Driscoll and an unnamed tributary of Oso Creek (Segment 2485C) near Robstown. The wells, collection system within the wellfield, and transmission systems should be sited in such a way as to avoid or minimize impacts to these sensitive resources. Potential impacts can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetland would be required where impacts are unavoidable and a permit from the U.S. Army Corps of Engineers (USACE) would be required for fill impacts to waters of the United States.

Cultural Resources

The transmission pipeline would potentially be routed through King Ranch, a National Register Historic District over 1,000,000 acres in size. Three historical markers are also within 300 feet of study area of the transmission line. Impacts to National Register of Historic Place (NRHP)-listed properties or districts, state historic sites, cemeteries or other cultural resources that are mapped by the Texas Historical Commission should be avoided through planning associated with the development of the new wells and pipeline routes. A cultural resources survey of the wellfield and pipeline routes for the proposed project areas will need to be performed consistent with requirements of the Antiquities Code of Texas.

Summary of Overall Possible Environmental Impacts

Construction of the water wells, wellfield collection system, and conveyance pipeline through undeveloped areas, where there is the potential for suitable habitat for listed species and potential wetlands and streams, has the greatest possibility of resulting in environmental impacts. If constructed in developed areas, the EV Ranch Brackish Groundwater treatment facility (and maintenance of surface facilities) and treated water pipeline could avoid or minimize environmental impacts. Where environmental resources (e.g., endangered species habitat, water resources, and cultural resource sites) could be impacted by infrastructure, adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects. Impacts to potential habitat for listed species and stream crossings should be studied early in project design.

The pumping of groundwater from the Catahoula Formation is not expected to have measurable impact on wildlife along the streams. Minor land surface subsidence could potentially occur as a result of lowering of groundwater levels. As a result, drainage patterns and other habitats might change to a small extent.

5B.7.5.4 Engineering and Costing

The key features of the EV Ranch Brackish Groundwater strategy that were identified for planning and costing for the 2026 Region N Plan are the following:

- 28.5 MGD Advanced Water Treatment Plant
- 79 miles of 42-in transmission pipeline
- 46 miles of collection line varying in size from 6-in to 48-in
- 18 miles of reject lines
- 29 production wells at 3,500 ft deep
- 3 injection wells at 9,000 ft deep

As mentioned previously, option fees are not included in this evaluation as these negotiations are ongoing between EV Ranch Catahoula and the City of Corpus Christi.

It is assumed that the proposed water treatment plant would have a footprint of roughly 120 acres. The proposed pipeline route may change during the design stage of this strategy, pending on the outcome of environmental and other required evaluations. However, the current layout follows existing pipelines as well as major roadways to minimize difficulty in acquiring land for development. A 50-ft permanent right-of-way was assumed for the transmission line's land acquisition cost.

The layout of the wellfield was suggested by the Catahoula Water Company and all associated infrastructure lies within the extent of the EV Ranch. Proposed transmission and wellfield piping is sized to ensure that the velocity in all pipes is less than 5 ft/s. The reject (concentrate) lines are co-located with the collection lines for easier construction, as shown in Figure 5B.7.9.

The proposed well depths represent the deepest reasonable estimates to ensure that the cost estimate for the strategy is conservative. Production wells are assumed to be as deep as 3,500 ft, and injection wells are assumed to be as deep as 9,000 ft. The depth of injection ensures that the concentrate is unable to affect the production wells or other nearby groundwater wells.

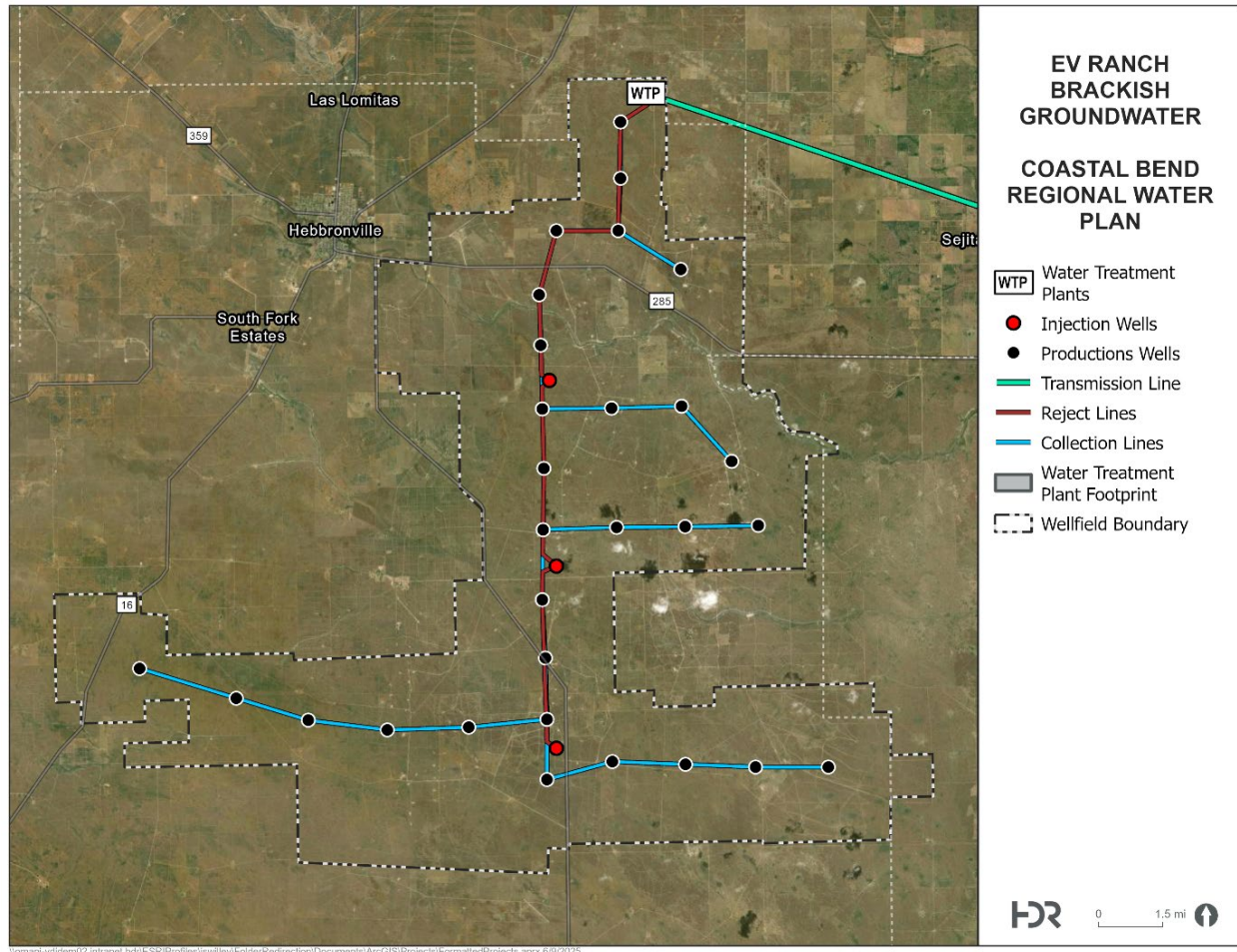


Figure 5B.7.9
Proposed Production and Injection Wellfield Layout for EV Ranch

The estimated cost for EV Ranch Brackish Groundwater infrastructure is \$771,847,000 in September 2023 dollars. The total project cost is estimated to be \$1,102,062,000. The annual cost which includes debt service as well as operation and maintenance costs is \$142,655,000. The assumed yield of 32,000 acft/yr makes the unit cost of water \$4,357 per acft, or \$13.37 per 1,000 gallons. A breakdown of planning level costs is provided in Table 5B.7.18. These estimates include an externally approximated \$10 million unit cost for injection wells based on their depth and their injection rate. A comparable injection well was quoted by drillers for a South Texas municipality at \$6.3 million in 2015 and \$10 million in 2023. A pilot study should be conducted to address uncertainties in costs due to site characteristics.

Table 5B.7.18.
Cost Estimate Summary: EV Ranch Brackish Groundwater Desalination
(Sept 2023 Prices)

<i>Item</i>	<i>Estimated Costs for Facilities</i>
Pump Stations (30.1 MGD)	\$9,339,000
Transmission Pipeline (42 in. dia., 79 miles)	\$302,550,000
Transmission Pump Station(s) & Storage Tank(s)	\$23,014,000
Wellfield Piping (18 mi. Reject; 46 mi. Collection)	\$128,547,000
Production Wells (29 wells)	\$106,558,000
Injection Wells (3 wells)	\$30,000,000
Storage Tanks (Other Than at Booster Pump Stations)	\$3,192,000
Water Treatment Plant (28.5 MGD)	\$167,615,000
Integration, Relocations, Backup Generator & Other	\$1,032,000
TOTAL COST OF FACILITIES	\$771,847,000
Engineering:	
- Planning (3%)	\$23,155,000
- Design (7%)	\$54,029,000
- Construction Engineering (1%)	\$7,718,000
Legal Assistance (2%)	\$15,437,000
Fiscal Services (2%)	\$15,437,000
Pipeline Contingency (15%)	\$45,382,000
All Other Facilities Contingency (20%)	\$93,860,000
Environmental & Archaeology Studies and Mitigation	\$4,354,000
Land Acquisition and Surveying (912 acres)	\$3,643,000
Interest During Construction (3.5% for 2 years with a 0.5% ROI)	\$67,200,000
TOTAL COST OF PROJECT	\$1,102,062,000
Debt Service (3.5 percent, 20 years)	\$77,542,000
Operation and Maintenance:	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$5,719,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$809,000
Water Treatment Plant	\$33,523,000
Pumping Energy Costs (242728956 kW-hr @ 0.09 \$/kW-hr)	\$21,846,000
TOTAL ANNUAL COST	\$139,439,000
Available Project Yield (acft/yr)	32,000
Annual Cost of Water (\$ per acft), based on PF=1	\$4,357
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$1,934
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$13.37
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$5.94

5B.7.5.5 Implementation Issues

There are currently few to no permitted wells in the Catahoula Formation, making the availability and quality of groundwater in the formation challenging to quantify. Modeling approaches use the best available data for parameterization, but uncertainty remains. The production rates of wells and the injection rates of brine disposal wells are an additional source of uncertainty. The rates assumed in this strategy evaluation are based primarily on the desired project yield and number of wells.

Implementation of the project and the installation and operation of brackish water treatment plant, may have to address the following issues:

- Application and issuance of a Brush Country GCD groundwater production permit;

- Export fee for pumping and selling water within Brush Country GCD;
- Verification of groundwater quality for concentrations of dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Long-term lease of property for well field, and coordination with landowners;
- Detailed well yield including additional test drilling and aquifer water quality testing;
- Skilled operators of desalination water treatment plants;
- Capital and operations and maintenance costs;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, streamflow, and baseflow in streams;
- USACE Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office (GLO) Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of state-owned lands, if any;
- Cultural resources investigations in accordance with the Texas Historical Commission and the Texas Antiquities Code;
- Potential impact on endangered, other wildlife species, and wetlands;
- The potential exceedances in TDS and chloride in the groundwater will require pretreatment to remove TDS or altering the blending ratio to mitigate the impact;
- Incorporating Catahoula groundwater will require corrosivity analysis and permitting with TCEQ, including pilot testing of the RO WTP and final approval of the public water supply by TCEQ.

5B.7.5.6 Evaluation Summary

An evaluation summary of this regional water management strategy is in Table 5B.7.19.

Table 5B.7.19
Evaluation Summary of EV Ranch Brackish Groundwater Desalination

Impact Category	Comments
a. Water supply:	
1. Quantity	1. 32,000 acft/yr
2. Reliability	2. Firm
3. Cost of raw water**	3. \$4,357 per acft
4. Estimated Water Losses	4. 5,728 acft/yr (RO concentrate)
b. Environmental factors:	
1. Effects on Instream flows	1. None
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. None
3. Wildlife habitat	3. 143 miles of collection, reject, and transmission pipelines; 120 acres for WTP.
4. Wetlands	4. Six or more stream crossings
5. Threatened and endangered species	5. The presence of T&E species would need to be identified during NEPA process.
6. Cultural resources	6. Impacts to cultural resources would primarily be due to construction of pipelines and the WTP. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Water quality 7a-b, d. Total dissolved solids and salinity of water is removed with reverse osmosis treatment. Brine concentrated disposal issues will need to be addressed prior to project implementation. 7c. None or low impact. 7e-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	c. No state-level impacts to agricultural or natural resources
d. Threats to agriculture and natural resources in region	d. Pipeline construction in rangeland
e. Recreational impacts	e. No expected recreational impacts
f. Equitable comparison of strategies	f. Not included in initially prepared plan due to late submission
g. Interbasin transfers	g. No interbasin transfer of surface water
h. Third party social and economic impacts from voluntary redistribution of water	h. No redistribution of water
i. Efficient use of existing water supplies and regional opportunities	i. Makes use of currently underutilized source of water
j. Effect on navigation	j. No effect on navigation
k. Impacts on water pipelines and other facilities used for water conveyance	k. Infrastructure would need to avoid existing water conveyance facilities.



5B.8

*Local Balancing
Storage Reservoir*

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Section 5B.8 Local Balancing Storage Reservoir

5B.8.1 Description of Water Management Strategy

The 2026 Coastal Bend Regional Water Plan water management strategies are sized and scheduled to meet seasonal and daily variations of demand. According to the Texas Water Development Board (TWDB) rules, run of the river availability, evaluated for a municipal sole-source water user must be based on a minimum monthly diversion amount that is available 100 percent of the time during a repeat of the drought of record. Without storage, some current and proposed water supplies may not be fully reliable during extended droughts. In such cases, local balancing reservoirs can store surplus surface water flow that is available during high flow events subject to diversion rates specified in the water rights. This allows a water user to get through drought of record conditions while meeting its water needs. This local balancing storage reservoir WMS involves implementing a surface storage facility for Nueces County Water Control and Improvement District #3 (WCID 3).

Nueces County WCID 3 has four permits for a combined total of 11,546 acre-feet per year (ac-ft/yr)¹. Nueces County WCID 3 is a wholesale water provider (WWP) and provides treated water supplies to the City of Robstown and River Acres Water Supply Corporation (WSC). While Nueces County WCID 3 has senior water rights, some dating back to February 1909, it does not have storage provisions. The water right will have to be amended to include the off-channel storage, however the existing authorized diversions from the river will not have to be amended, and since they are already authorized, they are not subject to Texas Commission on Environmental Quality (TCEQ) flow standards. During the worse month of the drought of record (DOR), the flow available for diversion is only available to the district's most senior water right², CoA 2466_1. In this month, 28 acre-feet (ac-ft) out of a 259 ac-ft monthly target for CoA 2466_1 (or 11 percent of the monthly supply target) is available for diversion resulting in an annual firm supply of 384 ac-ft/yr (11 percent x 3,500 = 384 ac-ft/yr). No water was available for any of the other Nueces County WCID 3 water rights for diversion during the minimum month during the drought of record when flow conditions were at a minimum.

For the planning period through 2080, the maximum water demand for Nueces County WCID 3 and its municipal customers is 3,827 ac-ft/yr in 2050 and declines slightly to 3,754 ac-ft/yr by 2080. With a firm yield of 384 ac-ft/yr, Nueces County WCID 3 and its customers have a maximum shortage of 3,443 ac-ft/yr in 2050 calculated based on minimum flow conditions in the Nueces Basin Water Availability Model (WAM)³.

¹ Certificate of Adjudication 2466_1 through 2466_4 for municipal (4,246 ac-ft/yr) and irrigation (7,300 ac-ft/yr) purposes. In 2001, the District amended the water rights to use up to 11,546 ac-ft/yr for municipal purposes.

² Certificate of Adjudication 2466_1 is permitted for 3,500 ac-ft/yr and has a priority date of February 7, 1909. It is the only one of the four water rights for which water is available for diversion during the minimum month of the drought of record. During the worse month of the drought of record (August 1995), the flow available for diversion during the minimum month is 10% of the total supply needed to meet 2030 water demands.

³ Based on TWDB rules, run of the river availability was evaluated using the Nueces Basin WAM Run 3 with no return flows. The hydrologic period of the Nueces Basin WAM is from 1934 to 1996.

This local balancing storage reservoir water management strategy is recommended for the purpose of storing and recovering surplus supply to meet demands during times of low availability. A balancing storage component that is integrated into the water production and water treatment system has the potential to reduce costs and increase reliability and efficiency of the water management strategies necessary to meet projected need.

Currently, Nueces County is considering flood mitigation projects in the area and have identified a 600 ac-ft pond east of the City of Robstown near U.S. Highway 77. There may be potential opportunities for co-location of the local balancing storage and flood mitigation detention pond that could open new low-interest funding opportunities. The amount of land needed for the local balancing storage is less than 35 acres, whereas the amount of land for the detention pond is about 60 acres. So, a 100-acre parcel is expected to be adequate for both projects provided that Nueces County WCID 3 and Nueces County Drainage District No. 2 deem this to be a favorable for both projects. A map showing this concept is provided in Figure 5B.8.1.

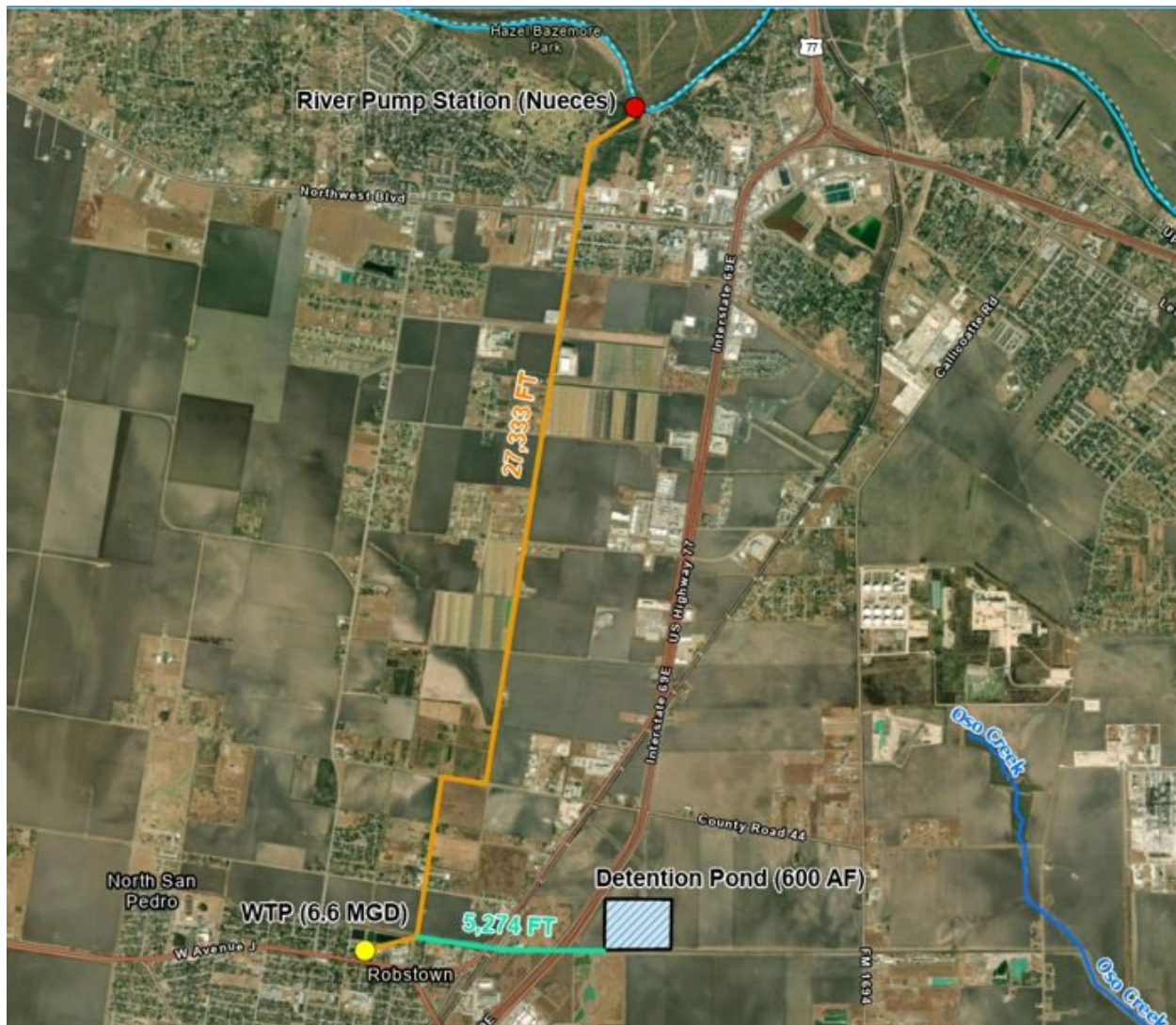


Figure 5B.8.1.
Conceptual Layout for Local Balancing Storage Reservoir (Potential Co-Location Opportunity with Near Nueces County Drainage Project)

5B.8.2 Available Yield

Available yield associated with the local balancing storage was determined using the Nueces River Basin WAM to simulate operations of the run of river rights and water management strategies. The results of the water availability modeling suggested that the minimum month of availability requires an additional 368 ac-ft of supply that could be provided by the balancing reservoir. To address the greatest annual shortage, stored water in an amount of 603 ac-ft is required. Considering evaporative losses, a 650 ac-ft capacity local balancing storage reservoir is needed. The projected yield of the strategy is 3,827 ac-ft/yr.

5B.8.3 Environmental Issues

Potential environmental issues associated with implementation of the local balancing storage reservoir includes consideration of impacts to affected aquatic and terrestrial habitats, cultural resources, and threatened and endangered species, in accordance with applicable state and federal requirements. It is likely that waters of the U.S. could be avoided when siting this project, thereby avoiding the need for a Section 404 Permit.

5B.8.4 Engineering and Costing

Estimated costs for development of balancing storage assume that 650 ac-ft of storage is needed to meet projected water needs and to overcome evaporative losses during this time. The 650 ac-ft storage reservoir is assumed to be approximately 20 feet deep with intake structure sized to refill in one month and infrastructure from storage to the water treatment sized to meet the largest monthly shortage. The pumps are sized based on total storage needed and includes a 7.1-million-gallons-per-day (mgd) pump station and 20-inch diameter pipeline to terminal storage, and a 4.0-mgd pump station and 16-inch piping from terminal storage to the water treatment plant. Cost estimates were computed for capital costs, annual debt service, operation and maintenance, power, and land. These costs are summarized in Table 5B.8.1. The project costs, including capital, are estimated to be \$26,014,000. As shown, the annual costs, including debt service, operation and maintenance, and power are estimated to be \$2,035,000. This option produces raw water at a unit cost of \$532 per ac-ft (\$1.63 per 1,000 gallons) and treated water⁴ at an estimated cost of \$904 per ac-ft (\$2.77 per 1,000 gallons).

⁴ The treatment costs are based on cost estimates for treatment at O.N. Stevens WTP at \$372 per ac-ft from February 12, 2025, correspondence with Corpus Christi Water.

Table 5B.8.1.
Cost Estimate Summary for Local Balancing Storage Reservoir

Item	Estimated Costs for Facilities
Off-Channel Storage/Ring Dike (Conservation Pool 650 acft, 32.5 acres)	\$6,305,000
Intake Pump Stations (7.1 MGD)	\$7,732,000
Transmission Pipeline (16-20 in. dia., 2 miles)	\$4,360,000
Integration, Relocations, Backup Generator & Other	\$63,000
Total Cost of Facilities	\$18,460,000
- Planning (3%)	\$554,000
- Design (7%)	\$1,292,000
- Construction Engineering (1%)	\$185,000
Legal Assistance (2%)	\$369,000
Fiscal Services (2%)	\$369,000
Pipeline Contingency (15%)	\$654,000
All Other Facilities Contingency (20%)	\$2,820,000
Environmental & Archaeology Studies and Mitigation	\$241,000
Land Acquisition and Surveying: Local Balancing Storage Reservoir(33 acres)	\$257,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$818,000
Total Cost of Project	\$26,019,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$1,181,000
Reservoir Debt Service (3.5 percent, 40 years)	\$429,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$44,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$193,000
Dam and Reservoir (1.5% of Cost of Facilities)	\$95,000
Water Treatment Plant	\$0
Advanced Water Treatment Facility	\$0
Pumping Energy Costs (1029764 kW-hr @ 0.09 \$/kW-hr)	\$93,000
Purchase of Water (acft/yr @ \$/acft)	\$0
Total Annual Cost	\$2,035,000
Available Project Yield (ac-ft/yr)	3,827
Annual Cost of Water (\$ per ac-ft), based on PF=1	\$532
Annual Cost of Water After Debt Service (\$ per acft), based on PF=1	\$111
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$1.63
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$0.34
Annual Cost of Treated Water (\$ per ac-ft), with treatment costs of \$372 ac-ft	\$904

Costs for this strategy only include facilities needed for the local balancing storage reservoir strategy, but does not include costs for the detention pond, as this is included in Nueces County Drainage District No. 2's project for flood control.

5B.8.5 Implementation Issues

Potentially significant implementation issues associated with a balancing reservoir include the following:

- Quantification and consideration of any potential effects on water rights, streamflows, and freshwater inflows to bays and estuaries to the extent required by TCEQ rules and applicable state and federal law.
- Run-of-river water rights often require surface storage and/or groundwater to firm up supply for municipal water use and a determination as to the most economically feasible of these is necessary.
- Acquisition of State, Federal, and Local permits.
- Environmental studies.
- Relocations of affected roads, railroads, utilities, and cultural resources.

5B.8.6 Evaluation Summary

It is assumed that Nueces County WCID #3 will implement this strategy to reliably meet the needs of its water supply customers. An evaluation summary of this water management option is provided in Table 5B.8.2.

Table 5B.8.2.
Evaluation Summary of Nueces County WCID #3 Local Balancing Storage Reservoir

Impact Category	Comment(s)
a. Water Supply	
1. Quantity	1. Firm Yield: 3,827 ac-ft/yr
2. Reliability	2. Highly reliable quantity.
3. Cost of Treated Water	3. Cost: \$904 per ac-ft. Moderate cost as compared to other strategies.
b. Environmental factors	
1. Instream flows	1. Some impact due to increased diversions from the Nueces River, when available, for terminal storage needs.
2. Bay and Estuary Inflows and arms of the Gulf of Mexico	2. Some impact due to increased diversions from the Nueces River, when available, for terminal storage needs.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None or low impact.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
a. dissolved solids	-
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other water quality constituents	
c. Impacts to agricultural resources and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable Comparison of Strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• None
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None



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5B.9

*Gulf Coast Aquifer
Supplies- Rural Water
Systems*

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Section 5B.9 Gulf Coast Aquifer Supplies for Rural Water Systems

The Gulf Coast Aquifer underlies all 11 counties within the Coastal Bend Region and yields moderate to large amounts of fresh and slightly saline water. The Gulf Coast Aquifer, extending from Northern Mexico to Florida, is comprised of five water-bearing formations: Catahoula, Jasper, Burkeville Confining System, Evangeline, and Chicot. The Evangeline and Chicot Aquifers are the uppermost water-bearing formations, are the most productive and, consequently, are the formations used most commonly. The Evangeline Aquifer of the Gulf Coast Aquifer System features the highly transmissive Goliad Sands. The Chicot Aquifer is comprised of many different geologic formations; however, the Beaumont and Lissie Formations are predominant in the Coastal Bend Area. The Burkeville Confining System is a limited water-bearing formation and characterized as containing substantial amounts of clay.

The Gulf Coast Aquifer is the primary groundwater resource in the Coastal Bend Region and estimated to constitute 97 percent of the region's groundwater availability according to Modeled Available Groundwater (MAG) values developed by the Texas Water Development Board (TWDB). The MAGs used to define groundwater availability for regional water planning were developed based on desired future conditions adopted by local groundwater conservation districts represented in Groundwater Management Area (GMA) 13, GMA 15, and GMA 16.¹ Table 5B.9.1 shows the Gulf Coast Aquifer groundwater availability, projected use by current groundwater users, and estimates on remaining groundwater available for water management strategies. This information serves as a basis for recommended water management strategies which must be limited to MAG values developed by TWDB and approved through the GMA process, according to TWDB guidelines for regional water planning.

¹ McMullen County is located in GMA 13. Aransas and a portion of Bee County are located in GMA 15. The remaining Region N counties (Bee, Brooks, Duval, Jim Wells, Kenedy, Kleberg, Live Oak, McMullen, Nueces, and San Patricio) are located in GMA 16.

Table 5B.9.1.
Summary of Gulf Coast Aquifer Supplies in the Coastal Bend Region¹

County Name	Basin Name	MAG (ac-ft/yr)		Groundwater Use (ac-ft/yr) ²		Amount Available for WMS (ac-ft/yr)	
		2030	2080	2030	2080	2030	2080
Aransas	San Antonio-Nueces	1,547	1,547	505	453	1,042	1,094
Bee	San Antonio-Nueces	18,869	20,029	5,769	5,795	13,100	14,234
Bee	Nueces	1,007	1,115	352	217	655	898
Brooks	Nueces-Rio Grande	5,123	6,437	2,150	2,244	2,973	4,193
Duval	Nueces	351	428	141	141	210	287
Duval	Nueces-Rio Grande	21,818	26,535	3,787	3,653	18,031	22,882
Jim Wells	Nueces	593	681	406	406	187	275
Jim Wells	Nueces-Rio Grande	8,802	11,368	4,664	4,609	4,138	6,759
Kenedy	Nueces-Rio Grande	10,104	15,421	808	754	9,296	14,667
Kleberg	Nueces-Rio Grande	9,039	12,142	6,137	7,022	2,902	5,120
Live Oak	San Antonio-Nueces	68	61	0	0	68	61
Live Oak	Nueces	11,326	10,233	4,730	4,612	6,596	5,621
McMullen ³	Nueces	510	510	4	4	506	506
Nueces	San Antonio-Nueces	0	0	0	0	0	0
Nueces	Nueces	756	845	750	835	6	10
Nueces	Nueces-Rio Grande	6,031	6,818	3,926	3,926	2,105	2,892
San Patricio	San Antonio-Nueces	40,514	43,615	6,731	6,583	33,783	37,032
San Patricio	Nueces	<u>4,502</u>	<u>5,619</u>	776	776	3,726	4,843
Region N Gulf Coast Aquifer Availability (ac-ft/yr)		140,960	163,404	41,636	42,030	99,324	121,374
Total Region N Groundwater Availability (includes McMullen County- Carrizo and Minor Aquifer)^{1,3,4}		148,731	168,261	44,442	42,135	104,289	126,126

¹ Additional groundwater is available (MAG) for the Carrizo Aquifer and Minor Aquifer Systems (Queen City and Sparta) in McMullen County. These MAGs represent less than 5% of the groundwater supply in the region.

² Groundwater use is based on well capacity, infrastructure limits, projected demand, and other factors limited by MAG as discussed in Chapter 3.

³ Not included in table above- McMullen County has MAG of 7,768 ac-ft/yr from the Carrizo Aquifer and 3 ac-ft/yr from minor aquifers in McMullen County (Queen City and Sparta) in 2030. The MAG for the Carrizo in McMullen County declines to 4,854 ac-ft/yr and remains constant at 3 ac-ft/yr for minor aquifers through 2080. The Yegua Jackson Aquifer, minor aquifer, is present in McMullen County but MAG was not identified for this aquifer by the TWDB. Groundwater use in 2030 is 2,803 ac-ft/yr for the Carrizo Aquifer in and declines to 102 ac-ft/yr by 2080. Groundwater use in 2030 is approximately 3 ac-ft/yr for Queen City and Sparta Aquifers and stays constant through 2080. No WMS are recommended for the Carrizo, Queen City, or Sparta Aquifers.

⁴ Groundwater use from McCoy WSC and El Oso WSC are not included because the WUGs well systems are located in Region L and therefore, not taking from the Region N MAG. Total groundwater use from McCoy WSC and El Oso WSC is 252 ac-ft/yr in 2030 and 526 ac-ft/yr in 2080. When combined with the total groundwater use shown in the table, the amount of groundwater use is 44,694 ac-ft/yr in 2030 and 42,661 ac-ft/yr consistent with Chapter 4A.

5B.9.1 Description of Strategy

Rural municipal water systems and other non-municipal water user groups (WUGs), such as irrigation, manufacturing, and mining interests in the Coastal Plains area of the Coastal Bend Water Planning Region, commonly use the Gulf Coast Aquifer for their supply. These sources may be a strong preference because the water is usually readily available, inexpensive, and often suitable for public water supplies with minimal treatment, although elevated concentrations of total dissolved solids (TDS) are present in some areas.

The purposes of this option are to:

- Evaluate aquifers and existing well field(s) of each WUG to meet projected water supply requirements through the year 2080, based on groundwater supply estimates derived from reported well capacity for other wells in the area.
- If additional supplies are needed, identify if additional wells are the most likely water management strategy, or whether an alternative strategy, such as purchase from a wholesale water provider, is recommended.
- If the water needs to be treated, estimate when the expansion is needed and how much the facilities will cost.

The evaluation of individual WUG systems is at a reconnaissance level and does not include:

- An engineering analysis of the water system as to the current condition or adequacy of the wells, transmission system, and storage facilities;
- A projection of maintenance costs or replacement costs of existing wells and facilities;
- The potential interference of new wells installed by others near the WUG's wells or at locations identified for new well fields;
- Impact of potential changes in groundwater use patterns in the vicinity of the WUG's well field and the county;
- Changes in rules and regulations that may be developed and implemented by a groundwater conservation district or the State; nor
- Consideration of additional wells or water treatment for local purposes such as reliability, water pressure, peaking capacity, and localized growth.

The evaluation of each WUG consists of the following steps:

1. Compiling information prepared by TWDB for Coastal Bend Regional Water Planning Group (CBRWPG) on current and projected population and water demand for each of the WUGs;
2. Estimated well depth and capacity for each WUG based on publicly available information for the water system from published groundwater reports and the Texas Commission on Environmental Quality (TCEQ) Public Water System (PWS) and TWDB records. For non-municipal groundwater users with groundwater capacities not readily obtained from

publicly available resources, the groundwater supply was calculated based on TWDB historical water use records. The final step in determining groundwater supplies was to compare the MAG-preserved well capacities for each WUG that has historically relied on groundwater to meet projected demands. Groundwater supply was set equal to the amount of capacity or water demand, whichever is lower;

3. If the estimated groundwater supply after adjustments was greater than the estimated groundwater demand in the year 2080 and within the MAG, the evaluation concludes that the existing water supply is adequate;
4. If the estimated supply after adjustments was less than the estimated groundwater demand in the year 2080 and within the MAG, the evaluation concluded that an additional water supply would be needed and that supplies up to the MAG are available to meet needs; and
5. If new wells are the most feasible water management strategy, estimated at what decade it is needed and the capital cost of adding the new wells to the water system.

5B.9.1.1 Evaluation of Additional Groundwater for Water Users with Reported Needs

The following rural municipal water systems rely completely on local groundwater supplies and report a water need during the 2030 to 2080 planning period:

- Bee County- Other (Municipal)
- Bee County- Mining
- TDCJ Chase Field
- Brooks County- Other (Municipal)
- Duval County- Other (Municipal)
- Jim Wells County- San Diego MUD 1
- Jim Wells County- Other (Municipal)
- Jim Wells County- Manufacturing
- Live Oak County- Other (Municipal)
- Nueces County- Mining
- Skidmore WSC

5B.9.1.2 Evaluation of Groundwater for Entities that Do Not Report a Water Supply Need

During development of the *2026 Coastal Bend Regional Water Plan*, the City of Mathis and South Texas Water Authority (STWA) reached out to HDR Engineering, Inc. (HDR) to request groundwater strategies to be shown in the plan for long-term supply reliability and redundancy amid drought uncertainty consistent with Chapter 7-Drought Response approach. Both currently rely on surface water supplies. For purposes of this alternative, additional groundwater development for WUGs are considered in strict accordance with groundwater availability (MAG) and assumes minimal treatment, if any, is required.

Because no specific project data regarding any of the local groundwater supply water management strategies is available, it is necessary to make a number of assumptions for costing and evaluation purposes. For WUGs with needs to be met and/or recommended groundwater projects from local Gulf Coast Aquifers, characteristic well depth and well capacity (gallons per minute [gpm]) estimates were developed for costing purposes based on data from existing wells in the vicinity and by using the TCEQ Source Water Assessment & Protection Viewer² and TWDB Groundwater Data Viewer³.

Key assumptions for this evaluation include:

- For mining groundwater use, it was assumed that groundwater would be supplied at a constant annual rate and that the water would be usable without treatment.
- For irrigation and municipal groundwater use, a peaking factor of two was used in estimating the number of wells necessary for cost estimation.
- It is assumed that irrigation and mining water would not require any treatment.
- No pipelines or pump stations were assigned for costing purposes. It was assumed that these proposed wells would connect directly to the demand center or local distribution system and that the cost of any associated piping would be covered in the 35 percent project cost contingency factor.
- For the purposes of estimating well pumping power costs, typically, a total dynamic head estimate of 300 feet was assumed - 200 feet to bring water from pumping levels to the ground surface and 100 feet to pump into a pressurized distribution system maintained at 60 pounds per square inch (psi). This conservative estimate is intended to account for local drawdown and declining water levels with time.
- For municipal users, including county-other, it was also assumed, in the absence of any specific information to the contrary, that disinfection would be the only treatment needed for the groundwater supply to meet water quality standards, and that adequate treatment capacity would exist to meet peak demand rates.

All cost estimates were performed according to the TWDB's unified costing tool methodology for regional water planning. Costs were amortized over a 20-year loan period, with debt service and annualized operations and maintenance (O&M) often being a significant proportion of costs. In addition, wells are costed according to September 2023 pricing, even if they are not scheduled to be needed until later decades. This is to maintain consistency in cost estimates with other projects. However, it should be noted that individual wells are not usually financed in this manner, and managers of affected WUGs may be more interested simply in the estimated capital cost for the wells. Also, cost estimates for new wells serving economic activities such as mining or irrigation are presented as a group with a single unit cost, although in reality these

² [Source Water Assessment & Protection Viewer - Texas Commission on Environmental Quality - www.tceq.texas.gov](http://www.tceq.texas.gov)

³ [Groundwater Data Viewer | Texas Water Development Board](http://www.twdb.org)

costs will be borne individually by multiple independent parties (farmers, mining operations, manufacturing plants, etc.) when and where the wells are needed and constructed.

5B.9.2 Available Yield

All groundwater development alternatives for municipal and non-municipal rural water systems, in the Coastal Bend Region were deemed to be available based on adopted MAGs after considering historical use presented above in Table 5B.9.1. It assumes voluntary groundwater transfers are available and local GCD continues to issue permits. Table 5B.9.2 displays the projected needs, by decade, for each of these entities, project yield, and number of wells estimated to be needed to meet shortages identified. The Ricardo WSC and the City of Mathis are included in Table 5B.9.2 as additional groundwater entities that do not report a water supply need but are developing an additional groundwater supply.

Table 5B.9.2.
Region N Local Needs and Gulf Coast Aquifer Supply Yield Summary

Water User Group	County	Projected Needs (ac-ft/yr)						Maximum Shortage (2030-2080) (acft/yr)	Project Yield Needed to Address Shortage (acft/yr)	Total Wells
		2030	2040	2050	2060	2070	2080			
Groundwater for Water User Groups with Reported Needs										
County-Other	Bee	(1,426)	(1,337)	(1,181)	(984)	(765)	(518)	(1,426)	1,426	5*
Mining	Bee	(25)	(25)	(25)	(25)	(25)	-	(25)	25	1
TDCJ Chase Field*	Bee	(5)	(2)	(2)	(2)	(2)	(2)	(5)	5	1
Skidmore WSC	Bee	(22)	(24)	(27)	(32)	(38)	(44)	(44)	44	1
County-Other	Brooks	(281)	(262)	(234)	(198)	(155)	(101)	(281)	281	1
County-Other	Duval	(253)	(223)	(199)	(179)	(151)	(113)	(253)	253	2
County-Other	Jim Wells	(1,621)	(1,409)	(1,159)	(840)	(484)	(82)	(1,621)	1,621	12*
Manufacturing	Jim Wells	(8)	(11)	(14)	(17)	(21)	(25)	(25)	25	1
San Diego MUD 1	Jim Wells	(102)	(106)	(111)	(116)	(123)	(131)	(131)	131	1
County-Other	Live Oak	(198)	(173)	(164)	(178)	(191)	(202)	(202)	202	2
Mining-Nueces	Nueces	(88)	(98)	(93)	(84)	(95)	(101)	(101)	101	1
Groundwater Strategy Requested by Water User Groups that Do Not Report a Water Supply Need										
City of Mathis	San Patricio	0	0	0	0	0	0	0	561	2
Ricardo Well Project	Kleberg	0	0	0	0	0	0	0	561	2

*Note: Garza East Transfer facility, one of two units on former Chase Field, closed in May 2020. The projected needs shown above may be based on TWDB adopted water demands and current supplies and do not take into consideration the closure of the Garza East facility which formerly housed approximately 2,000 inmates.

**Note: Although the amount of shortage for Bee County-Other and Jim Wells County-Other are similar in magnitude, the assumed well production rates are different and therefore are anticipated to have significantly different well count. For Bee County a rate of 400 gpm was assumed and for Jim Wells County a rate of 160 gpm was assumed. The production rates from TCEQ's [Source Water Assessment & Protection Viewer](#) are higher in Bee County as compared to Jim Wells County. Existing wells for Bee County had an average rate of 300 gpm and Jim Wells County had an average rate of 60 gpm.

5B.9.2.1 City of Mathis

The City of Mathis in San Patricio County does not have any needs identified during the planning period but is considering creating an additional groundwater supply of up to 0.5 mgd with the ability to peak at 1 mgd. Mathis currently receives supplies from the City of Corpus Christi. This project can be developed at requested amounts without violating the MAG constraints for San Patricio County. The 1-mgd wellfield assumes 2 wells at a depth of 550 feet will operate at 400 gpm, and it is anticipated that no advanced treatment is needed other than chlorine disinfection.

5B.9.2.2 Ricardo Well Project

The STWA provides water supplies to several rural water users in Nueces and Kleberg counties. STWA and its customers receive treated water supplies through contract from the City of Corpus Christi and do not have any needs identified during the planning period. Based on information provided by STWA, they are considering creating additional groundwater supply of up to 0.5 mgd in Kleberg County in the vicinity of Ricardo in the Nueces- Rio Grande Basin.

International Consulting Engineers (ICE) prepared the following evaluation of the Ricardo Well Project. STWA considers the Ricardo well project a fresh water well (total dissolved solids (TDS)<800), with expected recovery of 100 percent. Ricardo Water Supply Corporation (WSC) is expected to use approximately 90 percent of the yield (505 acre-feet per year [ac-ft/yr]) with the remaining 10 percent for Kingsville (56 ac-ft/yr).

Ricardo WSC has a history of relying on municipal wells as its primary source of drinking water, although these wells are currently plugged and non-operational. The nearest city, Kingsville, has been effectively using fresh groundwater wells to supply its water needs. At present, Ricardo WSC receives water from STWA, which is a blend of treated surface water from Corpus Christi Water and fresh water from the City of Kingsville.

In response to anticipated water scarcity and drought conditions in South Texas, STWA is actively working on developing a secondary groundwater source as an independent water supply option. While STWA currently depends on purchasing treated surface water from Corpus Christi Water, securing a secondary water source for Ricardo has become a strategic priority, given the increasing demand.

- STWA has made significant progress in this initiative over the past few years, with several key milestones achieved:
- STWA engaged ICE to develop a comprehensive water master plan, aimed at evaluating future growth needs and ensuring the long-term security of operations.
- The STWA board has formally expressed interest in securing an alternative water source, and the board has approved the initiation of a feasibility study for this purpose.
- A contract was awarded to a geological team to conduct a groundwater study, assessing the availability of both fresh and brackish water within the service area for potential future use.

- Phase 2 of the project includes test drilling at selected locations identified through the groundwater study, with the goal of evaluating the water yield.
- Based on the results of these tests, STWA will conduct a feasibility study to assess the potential for developing fresh groundwater extraction and pre-treatment facilities if necessary.
- The anticipated timeline for approval and construction of the municipal freshwater wells is 24 months, which includes obtaining all required permits.

STWA has already identified potential drilling sites for municipal wells based on the findings of the groundwater study. Given the projected population growth in Ricardo by 2080, the planned capacity for the new system will be 1 mgd, with 100 percent recovery efficiency from the production wells. The proposed layout for the municipal groundwater project can be found in Figure 5B.9.1.



Figure 5B.9.1.
STWA Ground Water Well Project Proposed Layout

Transmission Strategy

The city is currently receiving water through a 14-inch pipeline. Ricardo WSC owns the infrastructure and operates three pump stations within the city, including the identified location.

The proposed test well site is located at Pump Station #3 (0.93 acres), owned by Ricardo WSC, which will serve as the potential area for water extraction. To facilitate water transfer, the existing 6-inch incoming water line at FM 2140, which feeds into Pump Station #3, must be upgraded to a 14-inch line, extending up to the main central trunk line (14 inches), in order to meet the required design capacity. This upgrade will optimize the use of the existing transmission system for distributing water from the new well, significantly reducing the costs associated with water transmission. The proposed transmission line connection strategy is shown in Figure 5B.9.2.

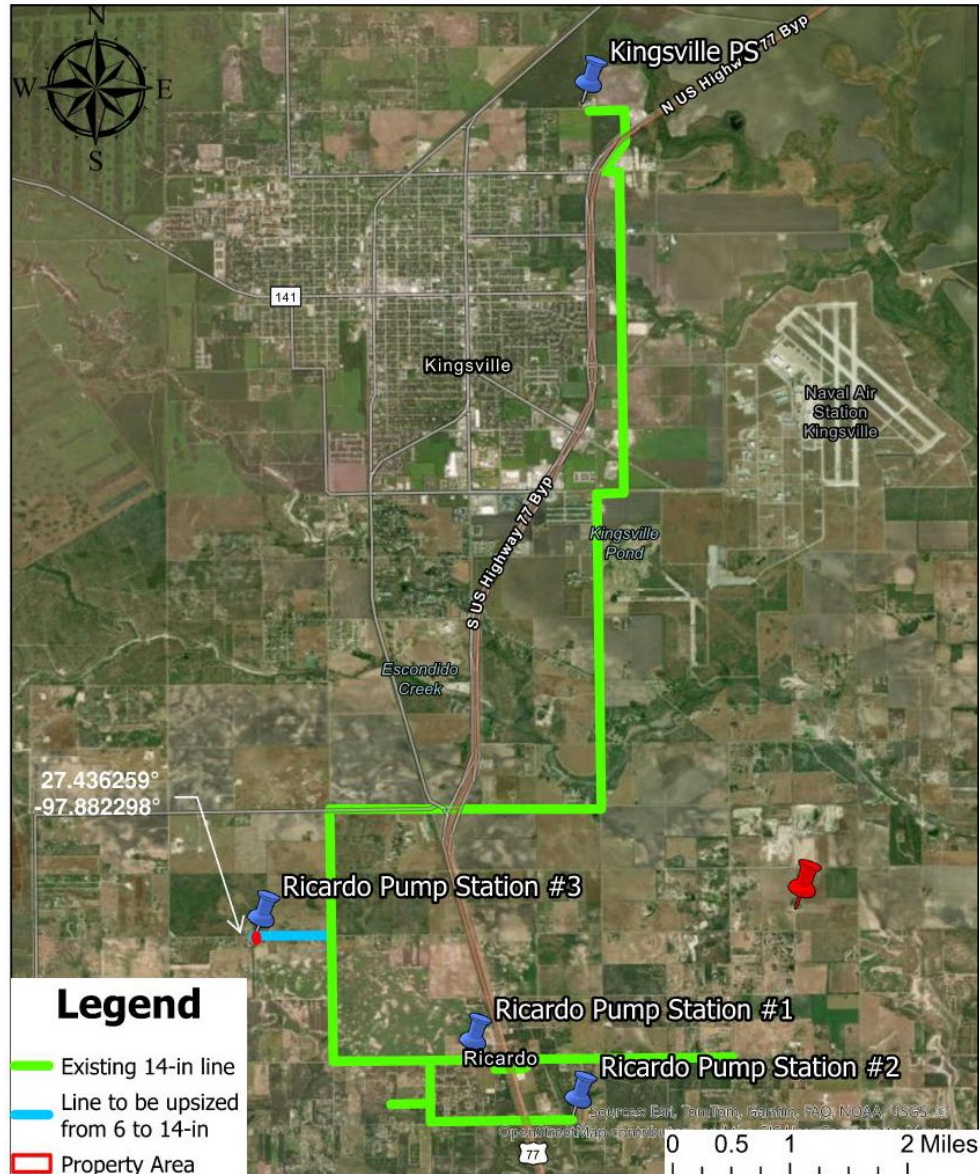


Figure 5B.9.2.
Location of Conceptual Layout of Ricardo Well Project

5B.9.3 Environmental Issues

The pumping of groundwater from the Gulf Coast Aquifer could have a slight negative impact on baseflow in the downstream reaches of streams in these areas. However, many of the streams are dry most all the time; thus, no measurable impact on wildlife along streams is expected.

Although minimal treatment is anticipated for groundwater quality to meet standards of use, the desalination of slightly saline groundwater produces a concentrate of salts in water that requires disposal. Depending upon location, environmental concerns can be addressed by discharging to a saline aquifer by deep well injection, discharging to a salt-water body, or blending with wastewater.

Habitat studies and surveys for protected species may need to be conducted at the proposed well field sites and along any pipeline routes. When potential protected species' habitats or other significant resources cannot be avoided, additional studies would have to be conducted to evaluate habitat use or eligibility for inclusion in the National Register for Historic Places (NRHP), respectively. Wetland impacts and primary pipeline stream crossings can be minimized by right-of-way selection and appropriate construction methods, including erosion controls and revegetation procedures. Compensation for net losses of wetlands may be required where impacts are unavoidable.

With regard to the Ricardo Well Project, the proposal to construct additions to Ricardo WSC Pump Station #3 near the City of Ricardo and the City of Kingsville includes the establishment of a proposed well location, a new pumping station, and a new line connection at the Pump Station site at 350 FCC Monitoring Road in Kleberg County, in the outer areas of the census-designated area of Ricardo itself. Primary environmental issues related to the expansion of the Ricardo WSC Pump Station #3 include upsizing the existing 6-inch transmission line and the development of a new well and pumping station on the property.

The proposed project area is located within the Coastal Prairies sub-province of the larger Gulf Coastal Plains of Texas Physiographic Province. This area is locally characterized as a nearly flat prairie composed of deltaic sands and muds which terminates at the Gulf of Mexico and includes topography changes of less than one foot per mile. Elevation levels in the Coastal Prairies range from 0 to 300 feet above mean sea level.

Although the upsizing of transmission pipelines may include clearing and removal of woody vegetation, destruction of potential habitat can be minimized by siting the corridor within previously disturbed areas, as should be possible given the existing path of the pipeline.

5B.9.3.1 Area Vegetation and Wildlife Habitat

The City of Ricardo is located within the South Texas Plains Vegetational Area. The South Texas Plains and brush country averages between 20 to 32 inches of rainfall per year with high summer temperatures and very high evaporation rates. Plains with thorny shrubs and trees dominate the region, with scattered patches of palms and subtropical woodlands in the Rio Grande Valley. Thorny brush, such as mesquite, acacia and prickly pear are the primary

vegetation mixed with areas of grassland. Historically, the plains were covered with open grasslands with few trees, and the Valley woodlands covered large areas.

5B.9.3.2 Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (ESA), as amended, prohibits the “take” of any threatened or endangered species. The term “take” under the ESA means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” The term “harm” was further defined to include “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.” Designation of critical habitat areas has been established for public knowledge where the publishing of such information would not cause harm to the species. Additional federal protection is extended to migratory birds, and bald and golden eagles under the Migratory Bird Treaty Act (MBTA) as amended, and the Bald and Golden Eagle Protection Act. Protection is also afforded to Texas state-listed species. The Texas Parks and Wildlife Department (TPWD) enforces the state regulations.

The MBTA protects most bird species, including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds. Migratory bird pathways, stopover habitats, wintering areas, and breeding areas may occur within and adjacent to the project area, and may be associated with wetlands, ponds, shorelines, riparian corridors, fallow fields and grasslands, and woodland and forested areas. Construction activities could disturb migratory bird habitats and/or species’ activities, and care should be taken to avoid impacts to migratory birds and active nests.

Reasonable and prudent measures should be taken to avoid and minimize the potential effects of the proposed project’s activities on threatened and endangered species, as well as bald eagles. Species’ locations, activities, and habitat requirements should be considered based on U.S. Fish and Wildlife Service (USFWS) and TPWD recommendations.

In Kleberg County, 54 state-listed endangered or threatened species and 26 federally-listed endangered or threatened wildlife species may occur, according to the county lists of rare species published by the TPWD. A list of these species and rare species, their preferred habitat, and potential occurrences in Nueces County is provided in Table 5B.9.3

Table 5B.9.3.
Federal- and State-Listed Threatened, Endangered, and Species of Concern Listed for Kleberg County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-Spotted Newt	<i>Notophthalmus meridionalis</i>	Terrestrial habitats used by adults are typically poorly drained clay soils that allow for the formation of ephemeral wetlands. A wide variety of vegetation associations are known to be used, such as thorn scrub and pasture. Aquatic habitats used for reproduction are a variety of ephemeral and permanent water bodies.	Resident		Threatened
Sheep Frog	<i>hypopachus variolosus</i>	Terrestrial and aquatic: Predominantly grassland and savanna; largely fossorial in areas with moist microclimates.	Resident		Threatened
South Texas siren (Large Form)	<i>Siren sp. 1</i>	Aquatic: Mainly found in bodies of quiet water, permanent or temporary, with or without submergent vegetation. Wet of sometimes wet areas, such as arroyos, canals, ditches, or even shallow depressions; aestivates in the ground during dry periods but does require some moisture to remain.	Transient		Threatened
black rail	<i>Laterallus jamaicensis</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous years dead grasses. nest usually hidden in marsh grass or at base of Salicornia	Resident	Threatened	Threatened
gray hawk	<i>Buteo plagiatus</i>	Locally and irregularly along U.S.-Mexico border; mature riparian woodlands and nearby semiarid mesquite and scrub grasslands; breeding range formerly extended north to southernmost Rio Grande floodplain of Texas	Resident		Threatened
northern aplomado falcon	<i>Falco femoralis septentrionalis</i>	Open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species	Migratory	Endangered	Endangered

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
piping plover	<i>Charadrius melodus</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Beaches, sandflats, and dunes along Gulf Coast beaches and adjacent offshore islands. Also spoil islands in the Intracoastal Waterway. Based on the November 30, 1992 Section 6 Job No. 9.1, Piping Plover and Snowy Plover Winter Habitat Status Survey, algal flats appear to be the highest quality habitat. Some of the most important aspects of algal flats are their relative inaccessibility and their continuous availability throughout all tidal conditions. Sand flats often appear to be preferred over algal flats when both are available, but large portions of sand flats along the Texas coast are available only during low-very low tides and are often completely unavailable during extreme high tides or strong north winds. Beaches appear to serve as a secondary habitat to the flats associated with the primary bays, lagoons, and inter-island passes. Beaches are rarely used on the southern Texas coast, where bayside habitat is always available, and are abandoned as bayside habitats become available on the central and northern coast. However, beaches are probably a vital habitat along the central and northern coast (i.e., north of Padre Island) during periods of extreme high tides that cover the flats. Optimal site characteristics appear to be large in area, sparsely vegetated, continuously available or in close proximity to secondary habitat, and with limited human disturbance.	Resident	Threatened	Threatened
reddish egret	<i>Egretta rufescens</i>	Resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear	Resident		Threatened

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
rufa red knot	<i>Calidris canutus rufa</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore. Bolivar Flats in Galveston County, sandy beaches Mustang Island, few on outer coastal and barrier beaches, tidal mudflats and salt marshes.	Resident	Threatened	Threatened
sooty tern	<i>Onychoprion fuscatus</i>	Primarily an offshore bird; does nest on sandy beaches and islands, breeding April-July	Transient		Threatened
swallow-tailed kite	<i>Elanoides forficatus</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees	Transient/ Migratory		Threatened
Texas Botteri's sparrow	<i>Peucaea botterii texana</i>	Grassland and short-grass plains with scattered bushes or shrubs, sagebrush, mesquite, or yucca; nests on ground of low clump of grasses	Resident		Threatened
tropical parula	<i>Setophaga pitiayumi</i>	Semi-tropical evergreen woodland along rivers and resacas. Texas ebony, anaqua and other trees with epiphytic plants hanging from them. Dense or open woods, undergrowth, brush, and trees along edges of rivers and resacas; breeding April to July.	Resident		Threatened
white-faced ibis	<i>Plegadis chihi</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; currently confined to near-coastal rookeries in so-called hog-wallow prairies. Nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats.	Transient		Threatened



Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
white-tailed hawk	<i>Buteo albicaudatus</i>	Near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May	Resident		Threatened
whooping crane	<i>Grus americana</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Small ponds, marshes, and flooded grain fields for both roosting and foraging. Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	Migratory	Endangered	Endangered
wood stork	<i>Mycteria americana</i>	The county distribution for this species includes geographic areas that the species may use during migration. Time of year should be factored into evaluations to determine potential presence of this species in a specific county. Prefers to nest in large tracts of baldcypress (<i>Taxodium distichum</i>) or red mangrove (<i>Rhizophora mangle</i>); forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	Transient		Threatened

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, the populations of concern are found breeding in riparian areas in the Trans Pecos (known as part of the Western Distinct Population Segment). It is the Western DPS that is on the U.S. ESA threatened list and includes the Texas counties Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio. Riparian woodlands below 6,000' in elevation consisting of cottonwoods and willows are prime habitat. This species is a long-distant migrant that summers in Texas, but winters mainly in South America. Breeding birds of the Trans Pecos populations typically arrive on their breeding grounds possibly in late April but the peak arrival time is in May. Threats to preferred habitat include hydrologic changes that don't promote the regeneration of cottonwoods and willows, plus livestock browsing and trampling of sapling trees in sensitive riparian areas.	Migratory	Threatened	
giant manta ray	<i>Manta birostris</i>	Habitat description is not available at this time	Resident		Threatened
great hammerhead	<i>Sphyrna mokarran</i>	Habitat description is not available at this time.	Resident	Threatened	
oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Habitat description is not available at this time.	Resident	Threatened	Threatened
shortfin mako shark	<i>Isurus oxyrinchus</i>	Habitat description is not available at this time.	Resident		Threatened
migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migratory	Considered	
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Inhabits warm tropical, subtropical, and temperate waters throughout the Atlantic Ocean, including the Gulf of Mexico. Commonly found along the continental shelf and coastal waters that are 65-820 feet deep, usually inside or near 185 m contour (within 250-350 km of coast); occasionally found in deeper waters. Often dive to 30-200 feet preying upon fish, invertebrates, and cephalopods.	Resident		Threatened
blue whale	<i>Balaenoptera musculus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are infrequently sighted in the Gulf of Mexico. They migrate seasonally between summer feeding grounds and winter breeding grounds, but specifics vary. Commonly observed at the surface in open ocean	Resident	Endangered	Endangered
Bryde's whale	<i>Balaenoptera edeni brydei</i>	Habitat description is not available at this time.	Resident		Endangered

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Coues' rice rat	<i>Oryzomys couesi</i>	Cattail-bulrush marsh with shallower zone of aquatic grasses (Echinochloa, Panicum, Paspalidium) near the shoreline; shade trees around the shoreline are important features. Freshwater marshes.	Resident		Threatened
Coues' rice rat	<i>Oryzomys couesi aquaticus</i>	Cattail-bulrush marsh with shallower zone of aquatic grasses near the shoreline; shade trees around the shoreline are important features; prefers salt and freshwater, as well as grassy areas near water; breeds April-August	Resident		Threatened
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in water over 3,300 feet deep near the continental shelf near steep slopes or canyons, avoiding coastal areas. Mostly pelagic apparently confined by the 1,00 meter bathymetric contour. frequently make deep dives to capture prey (squids and fishes).	Resident		Threatened
dwarf sperm whale	<i>Kogia simus</i>	Inhabits tropical and temperate waters worldwide, Commonly found in deep waters near the continental shelf and rarely seen at the surface, but may be more coastal than the pygmy sperm whale (<i>Kogia breviceps</i>). Dives to great depths (1,000 feet) to hunt for squid, fish, and crustaceans. Migration patterns are unknown.	Resident		Threatened
false killer whale	<i>Pseudorca crassidens</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in deep, offshore waters deeper than 3,300 feet, making dives of up to 2,000 meters to catch their prey (fishes and squids). Gulf of Mexico distinct population segment is not well studied.	Resident		Threatened
finback whale	<i>Balaenoptera physalus</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide, but are less common in the tropics preferring cooler water. Commonly found in deep, offshore waters and migrate in the open ocean from the poles (feeding grounds) to warmer waters in the winter to give birth. They feed on krill, squid, and small schooling fish sometimes with other baleen whale species. They are very rare in the Gulf of Mexico and reported sightings are likely vagrants (Witt et al. 2011).	Resident	Endangered	Endangered

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Gervais's beaked whale	<i>Mesoplodon europaeus</i>	Inhabits tropical, subtropical, and temperate waters of the northern Atlantic Ocean, Gulf of Mexico, and Caribbean. Commonly found in deep water and open ocean where they prey upon squids. They are difficult to distinguish from others in their family (Mesoplodon) and are cryptic and skittish, but the most commonly stranded species on the US southeastern coast. Migration patterns are unknown.	Resident		Threatened
humpback whale	<i>Megaptera novaeangliae</i>	Inhabits tropical, subtropical, temperate, and subpolar waters worldwide. Migrate up to 5,000 miles between colder water (feeding grounds) and warmer water (calving grounds) each year. They will use both open ocean and coastal waters, sometimes including inshore areas such as bays, and are often found near the surface; however, this species is rare in the Gulf of Mexico. The northwest Atlantic/Gulf of Mexico distinct population segment is not considered at risk of extinction and is not listed as Endangered on the Endangered Species Act.	Resident	Endangered	
killer whale	<i>Orcinus orca</i>	Inhabits tropical, subtropical, temperate, and polar waters worldwide. In the Gulf of Mexico, they are commonly found in oceanic waters ranging from 256-2,652 meters deep beyond the 1,000 meter isobath and a very rarely found over the continental shelf and may be entirely absent from nearshore waters. May come in contact with pelagic longline fisheries targeting tunas and billfishes.	Resident		Threatened
North Atlantic right whale	<i>Eubalaena glacialis</i>	Inhabits subtropical and temperate waters in the northern Atlantic. Commonly found in coastal waters or close to the continental shelf near the surface. They migrate from feeding grounds in cooler waters (Canada and New England) to warmer waters of the southeast US (South Carolina, Georgia, and Florida) to give birth in the fall/winter - both areas are identified as critical habitat by NOAA-NMFS. Nursery areas are in shallow, coastal waters. This species is very rare in the Gulf of Mexico and the few reported sightings are likely vagrants (Ward-Geiger et al. 2011).	Resident	Endangered	Endangered

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
ocelot	<i>Leopardus pardalis</i>	Restricted to mesquite-thorn scrub and live-oak mottes; avoids open areas. Dense mixed brush below four feet; thorny shrublands; dense chaparral thickets; breeds and raises young June-November.	Resident	Endangered	Endangered
pygmy killer whale	<i>Feresa attenuata</i>	Inhabits tropical and subtropical waters worldwide, including the Gulf of Mexico. Commonly found in deeper, offshore waters where they dive for their prey (squids and fishes), but may occasionally occur close to shore. They are very rare and migration patterns are unknown.	Resident		Threatened
pygmy sperm whale	<i>Kogia breviceps</i>	Inhabits tropical, subtropical, and temperate waters worldwide. Commonly found in deep water over the continental slope and rarely seen at the surface. Dives to great depths (over 1,000 feet) to hunt for squid, fish, and crustaceans. Migration patterns are unknown.	Resident		Threatened
Rice's whale	<i>Balaenoptera ricei</i>	Habitat description is not available at this time.	Resident	Endangered	Endangered
Rough-toothed dolphin	<i>Steno bredanensis</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Records in Texas are only known from strandings. Commonly found in deep, oceanic water over 1,500-2,000 meters deep and ranging in temperature from 17-25 degrees Celsius. May associate with other cetaceans. Prey on squids and fish. No known migration patterns.	Resident		Threatened
sei whale	<i>Balaenoptera borealis</i>	Habitat description is not available at this time.	Resident	Endangered	Endangered
short-finned pilot whale	<i>Globicephala macrorhynchus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Commonly found in deeper waters (1,000 feet) and continental shelf where they make deep dives to capture squid, but may come closer to shore. Migration patterns unknown.	Resident		Threatened
sperm whale	<i>Physeter macrocephalus</i>	Inhabits tropical, subtropical, and temperate waters worldwide, avoiding icy waters. Distribution is highly dependent on their food source (squids, sharks, skates, and fish), breeding, and composition of the pod. In general, this species migrates from north to south in the winter and south to north in the summer; however, individuals in tropical and temperate waters don't seem to migrate at all. Routinely dive to catch their prey (2,000-10,000 feet) and generally occupies water at least 3,300 feet deep near ocean trenches.	Resident	Endangered	Endangered

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland and riparian areas are important. Caves are very important to this species.	Resident	Proposed Endangered	
West Indian manatee	<i>Trichechus manatus</i>	Large rivers, brackish water bays, coastal waters. Warm waters of the tropics, in rivers and brackish bays but may also survive in salt water habitats. Very sensitive to cold water temperatures. Rarely occurring as far north as Texas. Gulf and bay system; opportunistic, aquatic herbivore.	Resident	Threatened	Threatened
white-nosed coati	<i>Quadrula quadrula</i>	Woodlands, riparian corridors and canyons. Most individuals in Texas probably transients from Mexico; diurnal and crepuscular; very sociable; forages on ground and in trees; omnivorous; may be susceptible to hunting, trapping, and pet trade	Resident		Threatened
American alligator	<i>Alligator mississippiensis</i>	Aquatic: Coastal marshes; inland natural rivers, swamps and marshes; manmade impoundments.	Resident	Similarity of Appearance, Threatened	
Atlantic hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Inhabits tropical and subtropical waters worldwide, in the Gulf of Mexico, especially Texas. Hatchling and juveniles are found in open, pelagic ocean and closely associated with floating algae/seagrass mats. Juveniles then migrate to shallower, coastal areas, mainly coral reefs and rocky areas, but also in bays and estuaries near mangroves when reefs are absent; seldom in water more than 65 feet deep. They feed on sponges, jellyfish, sea urchins, mollusks, and crustaceans. Nesting occurs from April to November high up on the beach where there is vegetation for cover and little or no sand. Some migrate, but others stay close to foraging areas - females are philopatric.	Resident	Endangered	Endangered
green sea turtle	<i>Chelonia mydas</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Adults and juveniles occupy inshore and nearshore areas, including bays and lagoons with reefs and seagrass. They migrate from feeding grounds (open ocean) to nesting grounds (beaches/barrier islands) and some nesting does occur in Texas (April to September). Adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds.	Resident	Threatened	Threatened

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Kemp's Ridley sea turtle	<i>Lepidochelys kempii</i>	Inhabits tropical, subtropical, and temperate waters of the northwestern Atlantic Ocean and Gulf of Mexico. Adults are found in coastal waters with muddy or sandy bottoms. Some males migrate between feeding grounds and breeding grounds, but some don't. Females migrate between feeding and nesting areas, often returning to the same destinations. Nesting in Texas occurs on a smaller scale compared to other areas (i.e., Mexico). Hatchlings are quickly swept out to open water and are rarely found nearshore. Similarly, juveniles often congregate near floating algae/seagrass mats offshore, and move into nearshore, coastal, neritic areas after 1-2 years and remain until they reach maturity. They feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August.	Transient	Endangered	Endangered
leatherback sea turtle	<i>Dermochelys coriacea</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. Nesting is not common in Texas (March to July). Most pelagic of the sea turtles with the longest migration (>10,000 miles) between nesting and foraging sites. Are able to dive to depths of 4,000 feet. They are omnivorous, showing a preference for jellyfish.	Transient	Endangered	Endangered
loggerhead sea turtle	<i>Caretta caretta</i>	Inhabits tropical, subtropical, and temperate waters worldwide, including the Gulf of Mexico. They migrate from feeding grounds to nesting beaches/barrier islands and some nesting does occur in Texas (April to September). Beaches that are narrow, steeply sloped, with coarse-grain sand are preferred for nesting. Newly hatched individuals depend on floating algae/seaweed for protection and foraging, which eventually transport them offshore and into open ocean. Juveniles and young adults spend their lives in open ocean, offshore before migrating to coastal areas to breed and nest. Foraging areas for adults include shallow continental shelf waters.	Resident	Threatened	Threatened
northern cat-eyed snake	<i>Leptodeira septentrionalis</i>	Terrestrial: Thorn scrub and deciduous woodland; dense thickets bordering ponds and streams.	Resident	Threatened	
speckled racer	<i>Drymobius margaritiferus</i>	Terrestrial: Dense thickets near water, palm groves, riparian woodlands; often in areas with much vegetation litter on ground.	Resident		Threatened

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Texas horned lizard	<i>Phrynosoma cornutum</i>	Terrestrial: Open habitats with sparse vegetation, including grass, prairie, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive. Occurs to 6000 feet, but largely limited below the pinyon-juniper zone on mountains in the Big Bend area.	Resident		Threatened
Texas scarlet snake	<i>Cemophora lineri</i>	Terrestrial: Prefers well drained soils with a variety of forest, grassland, and scrub habitats	Resident		Threatened
Texas tortoise	<i>Gopherus berlandieri</i>	Terrestrial: Open scrub woods, arid brush, lomas, grass-cactus association; often in areas with sandy well-drained soils. When inactive occupies shallow depressions dug at base of bush or cactus; sometimes in underground burrow or under object. Eggs are laid in nests dug in soil near or under bushes.	Resident		Threatened
black lace cactus	<i>Echinocereus reichenbachii</i> var. <i>albertii</i>	Grasslands, thorn shrublands, mesquite woodlands on sandy, somewhat saline soils on coastal prairie, most frequently in naturally open areas sparsely covered with brush of a low stature not resulting from disturbance or along creeks in ecotonal areas between this upland type and lower areas dominated by halophytic grasses and forbs; flowering April-June	Transient	Endangered	Endangered
slender rush-pea	<i>Hoffmannseggia tenella</i>	Coastal prairie grasslands on level uplands and on gentle slopes along drainages, usually in areas of shorter or sparse vegetation; soils often described as Blackland clay, but at some of these sites soils are coarser textured and lighter in color than the typical heavy clay of the coastal prairies; flowering April-November	Resident	Endangered	Endangered
South Texas ambrosia	<i>Ambrosia cheiranthifolia</i>	Grasslands and mesquite-dominated shrublands on various soils ranging from heavy clays to lighter textured sandy loams, mostly over the Beaumont Formation on the Coastal Plain; in modified unplowed sites such as railroad and highway rights-of-way, cemeteries, mowed fields, erosional areas along small creeks; Perennial; Flowering July-November	Resident	Endangered	Endangered

5B.9.3.3 Wetland Areas

No wetland areas are known to exist in the immediate vicinity of the project area; the closest aquatic area is the Escondido Creek, approximately 2.25 miles to the north of the Ricardo WSC

Pump Station #3. Due to the lack of discharge infrastructure and the direction of the proposed upsized pipeline, it is unexpected that any negative impact will occur to any wetland area.

5B.9.3.4 Cultural Resources

A review of the Texas Historical Commission Texas Historic Sites Atlas database indicated that there are no National Register properties, historical markers, or cemeteries located near the proposed or alternate project areas. A cultural resource survey of the upsized pipeline route for the proposed project area will need to be performed consistent with requirements of the Texas Historical Commission.

5B.9.3.5 Summary of Overall Possible Environmental Impacts

Because of the relatively small areas involved, construction and maintenance of surface facilities are not expected to result in substantial environmental impacts. Where environmental resources (e.g., endangered species habitat and cultural resource sites) could be impacted by infrastructure, minor adjustments in facility siting and pipeline alignment would generally be sufficient to avoid or minimize adverse effects.

5B.9.4 Engineering and Costing

Cost estimates for new wells were prepared according to the assumptions discussed in Section 5B.9.1. The capital cost, project cost, annual cost, yield, and unit cost (in \$/ac-ft and \$/1,000 gallons) for water obtained under this strategy are presented in Table 5B.9.4 through Table 5B.9.15 for each entity county.

The cost estimate for the Ricardo Well Project, presented in Table 5B.9.16, includes the construction of a groundwater extraction well, a pre-treatment plant, and a 0.6-mile-long treated water transmission line, all designed to provide an independent secondary water source for Ricardo WSC. The system will feature a single well, drilled to a depth of 700 to 1,000 feet (Evangeline and Chicot aquifers), with a combined average flow rate of 348 gpm. A 14-inch diameter transmission pipeline will deliver treated water from the facility to the two existing Ricardo WSC pump stations, tapping into the current 14-inch central line. The total estimated cost of the project is \$10,977,100. With a 20-year debt service at a 3.5 percent interest rate, the projected annual cost is \$1,183,941. Given an anticipated water yield of 1,120 ac-ft/yr, the unit cost of water supply is calculated to be \$2,114.18 per acre-foot (ac-ft), as outlined in Table 5B.9.16. The treatment process will include a primary treatment facility capable of handling water with salinity levels below 1,000 milligrams per liter (mg/L) at a capacity of 1 mgd. The use of a pre-treatment facility will depend on water quality and O&M costs will likely be lower due to the high-water quality in the identified zone. Additionally, the pumping and transfer of treated water will be easier thanks to the existing pump stations and storage tank, though these may be modified to accommodate the new strategy. As the final step in the treatment process, the water will be chlorinated to a minimum concentration of 2 parts per million for effective disinfection. The treated water will be directly delivered to users, with the transmission line designed to minimize length while ensuring all users in Ricardo are reached. Additionally, an analyzer system will be installed to monitor water quality for end users, and separate magnetic flow

meters will be used to measure water consumption. The design, based on preliminary engineering analysis, ensures both cost-efficiency and safe operation.

Table 5B.9.4.
Cost Estimate Summary Water Supply Project Option September 2023 Prices
Region N Local Gulf Coast Supplies – County Other Bee County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$3,645,000
Water Treatment Plant (2.6 MGD)*	\$206,000
TOTAL COST OF FACILITIES	\$3,851,000
Engineering:	
- Planning (3%)	\$116,000
- Design (7%)	\$270,000
- Construction Engineering (1%)	\$39,000
Legal Assistance (2%)	\$77,000
Fiscal Services (2%)	\$77,000
All Other Facilities Contingency (20%)	\$770,000
Environmental & Archaeology Studies and Mitigation	\$24,000
Land Acquisition and Surveying (3 acres)	\$26,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$171,000
TOTAL COST OF PROJECT	\$5,421,000
Debt Service (3.5 percent, 20 years)	\$381,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$36,000
Water Treatment Plant	\$124,000
Pumping Energy Costs (293689 kW-hr @ 0.09 \$/kW-hr)	\$26,000
TOTAL ANNUAL COST	\$567,000
Available Project Yield (ac-ft/yr)	1,426
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$398
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$130
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.22
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.40

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.5.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies – Bee County - Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$729,000
TOTAL COST OF FACILITIES	\$729,000
Engineering:	
- Planning (3%)	\$22,000
- Design (7%)	\$51,000
- Construction Engineering (1%)	\$7,000
Legal Assistance (2%)	\$15,000
Fiscal Services (2%)	\$15,000
All Other Facilities Contingency (20%)	\$146,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (1 acres)	\$3,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$33,000
TOTAL COST OF PROJECT	\$1,024,000
Debt Service (3.5 percent, 20 years)	\$72,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Pumping Energy Costs (32541 kW-hr @ 0.09 \$/kW-hr)	\$1,000
TOTAL ANNUAL COST	\$80,000
Available Project Yield (ac-ft/yr)	25
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$3,200
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$320
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$9.82
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.98

Table 5B.9.6.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies – TDCJ Chase Field

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$729,000
Water Treatment Plant (0.1 MGD)*	\$31,000
TOTAL COST OF FACILITIES	\$760,000
Engineering:	
- Planning (3%)	\$23,000
- Design (7%)	\$53,000
- Construction Engineering (1%)	\$8,000
Legal Assistance (2%)	\$15,000
Fiscal Services (2%)	\$15,000
All Other Facilities Contingency (20%)	\$152,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (1 acres)	\$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$34,000
TOTAL COST OF PROJECT	\$1,067,000
Debt Service (3.5 percent, 20 years)	\$75,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Water Treatment Plant	\$18,000
TOTAL ANNUAL COST	\$100,000
Available Project Yield (ac-ft/yr)	5
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$20,000
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$5,000
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$61.37
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$15.34

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.7.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies – Skidmore WSC

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$729,000
Water Treatment Plant (0.1 MGD)*	\$31,000
TOTAL COST OF FACILITIES	\$760,000
Engineering:	
- Planning (3%)	\$23,000
- Design (7%)	\$53,000
- Construction Engineering (1%)	\$8,000
Legal Assistance (2%)	\$15,000
Fiscal Services (2%)	\$15,000
All Other Facilities Contingency (20%)	\$152,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (1 acres)	\$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$34,000
TOTAL COST OF PROJECT	\$1,067,000
Debt Service (3.5 percent, 20 years)	\$75,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Water Treatment Plant	\$18,000
Pumping Energy Costs (9062 kW-hr @ 0.09 \$/kW-hr)	\$1,000
TOTAL ANNUAL COST	\$101,000
Available Project Yield (ac-ft/yr)	44
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$2,295
Annual Cost of Water After Debt Service (\$ per acft), based on PF=0	\$591
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$7.04
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$1.81

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.8.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies – County Other- Brooks County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$712,000
Water Treatment Plant (0.5 MGD)*	\$63,000
TOTAL COST OF FACILITIES	\$775,000
Engineering:	
- Planning (3%)	\$23,000
- Design (7%)	\$54,000
- Construction Engineering (1%)	\$8,000
Legal Assistance (2%)	\$15,000
Fiscal Services (2%)	\$15,000
All Other Facilities Contingency (20%)	\$155,000
Environmental & Archaeology Studies and Mitigation	\$4,000
Land Acquisition and Surveying (1 acres)	\$5,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$35,000
TOTAL COST OF PROJECT	\$1,089,000
Debt Service (3.5 percent, 20 years)	\$77,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,000
Water Treatment Plant	\$38,000
Pumping Energy Costs (57873 kW-hr @ 0.09 \$/kW-hr)	\$5,000
TOTAL ANNUAL COST	\$127,000
Available Project Yield (ac-ft/yr)	281
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$452
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$178
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.39
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.55

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.9.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies –County Other- Duval County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$997,000
Water Treatment Plant (0.5 MGD)*	\$63,000
TOTAL COST OF FACILITIES	\$1,060,000
Engineering:	
- Planning (3%)	\$32,000
- Design (7%)	\$74,000
- Construction Engineering (1%)	\$11,000
Legal Assistance (2%)	\$21,000
Fiscal Services (2%)	\$21,000
All Other Facilities Contingency (20%)	\$212,000
Environmental & Archaeology Studies and Mitigation	\$8,000
Land Acquisition and Surveying (1 acres)	\$9,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$48,000
TOTAL COST OF PROJECT	\$1,496,000
Debt Service (3.5 percent, 20 years)	\$105,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$10,000
Water Treatment Plant	\$38,000
Pumping Energy Costs (52106 kW-hr @ 0.09 \$/kW-hr)	\$5,000
TOTAL ANNUAL COST	\$158,000
Available Project Yield (ac-ft/yr)	253
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$625
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$209
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.92
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.64

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.10.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies –County Other- Jim Wells County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$5,983,000
Water Treatment Plant (3 MGD)*	\$232,000
TOTAL COST OF FACILITIES	\$6,215,000
Engineering:	
- Planning (3%)	\$186,000
- Design (7%)	\$435,000
- Construction Engineering (1%)	\$62,000
Legal Assistance (2%)	\$124,000
Fiscal Services (2%)	\$124,000
All Other Facilities Contingency (20%)	\$1,243,000
Environmental & Archaeology Studies and Mitigation	\$47,000
Land Acquisition and Surveying (8 acres)	\$51,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$276,000
TOTAL COST OF PROJECT	\$8,763,000
Debt Service (3.5 percent, 20 years)	\$617,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$60,000
Water Treatment Plant	\$139,000
Pumping Energy Costs (333850 kW-hr @ 0.09 \$/kW-hr)	\$30,000
TOTAL ANNUAL COST	\$846,000
Available Project Yield (ac-ft/yr)	1,621
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$522
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$141
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.60
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.43

* Water treatment plant capacity is based on peak well production capacity

Table 5B. 9.11.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies – Jim Wells County – Manufacturing

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$499,000
Water Treatment Plant (0.1 MGD)*	\$31,000
TOTAL COST OF FACILITIES	\$530,000
Engineering:	
- Planning (3%)	\$16,000
- Design (7%)	\$37,000
- Construction Engineering (1%)	\$5,000
Legal Assistance (2%)	\$11,000
Fiscal Services (2%)	\$11,000
All Other Facilities Contingency (20%)	\$106,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (1 acres)	\$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$24,000
TOTAL COST OF PROJECT	\$747,000
Debt Service (3.5 percent, 20 years)	\$52,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$5,000
Water Treatment Plant	\$18,000
TOTAL ANNUAL COST	\$75,000
Available Project Yield (ac-ft/yr)	25
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$3,000
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$920
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$9.21
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$2.82

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.12.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies– San Diego MUD 1

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$532,000
Water Treatment Plant (0.3 MGD)*	\$47,000
TOTAL COST OF FACILITIES	\$579,000
Engineering:	
- Planning (3%)	\$17,000
- Design (7%)	\$41,000
- Construction Engineering (1%)	\$6,000
Legal Assistance (2%)	\$12,000
Fiscal Services (2%)	\$12,000
All Other Facilities Contingency (20%)	\$116,000
Environmental & Archaeology Studies and Mitigation	\$4,000
Land Acquisition and Surveying (1 acres)	\$4,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$26,000
TOTAL COST OF PROJECT	\$817,000
Debt Service (3.5 percent, 20 years)	\$57,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$5,000
Water Treatment Plant	\$28,000
Pumping Energy Costs (26980 kW-hr @ 0.09 \$/kW-hr)	\$2,000
TOTAL ANNUAL COST	\$92,000
Available Project Yield (ac-ft/yr)	131
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$702
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$267
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$2.15
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.82

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.13.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies – County Other-Live Oak County

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$878,000
Water Treatment Plant (0.4 MGD)*	\$55,000
TOTAL COST OF FACILITIES	\$933,000
Engineering:	
- Planning (3%)	\$28,000
- Design (7%)	\$65,000
- Construction Engineering (1%)	\$9,000
Legal Assistance (2%)	\$19,000
Fiscal Services (2%)	\$19,000
All Other Facilities Contingency (20%)	\$187,000
Environmental & Archaeology Studies and Mitigation	\$7,000
Land Acquisition and Surveying (1 acres)	\$8,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$42,000
TOTAL COST OF PROJECT	\$1,317,000
Debt Service (3.5 percent, 20 years)	\$93,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$9,000
Water Treatment Plant	\$33,000
Pumping Energy Costs (41603 kW-hr @ 0.09 \$/kW-hr)	\$4,000
TOTAL ANNUAL COST	\$139,000
Available Project Yield (ac-ft/yr)	202
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$688
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$228
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$2.11
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.70

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.14.
Cost Estimate Summary Water Supply Project Option,
September 2023 Prices,
Region N Local Gulf Coast Supplies – Nueces-County Mining

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$535,000
TOTAL COST OF FACILITIES	\$535,000
Engineering:	
- Planning (3%)	\$16,000
- Design (7%)	\$37,000
- Construction Engineering (1%)	\$5,000
Legal Assistance (2%)	\$11,000
Fiscal Services (2%)	\$11,000
All Other Facilities Contingency (20%)	\$107,000
Environmental & Archaeology Studies and Mitigation	\$3,000
Land Acquisition and Surveying (1 acres)	\$3,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$24,000
TOTAL COST OF PROJECT	\$752,000
Debt Service (3.5 percent, 20 years)	\$53,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$5,000
Pumping Energy Costs (20801 kW-hr @ 0.09 \$/kW-hr)	\$2,000
TOTAL ANNUAL COST	\$60,000
Available Project Yield (ac-ft/yr)	101
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$594
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$69
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.82
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.21

Table 5B.9.15.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies – City of Mathis (Additional 0.5 MGD Supply)

Item	Estimated Costs for Facilities
Well Fields (Wells, Pumps, and Piping)	\$1,446,000
Water Treatment Plant (1 MGD)*	\$102,000
TOTAL COST OF FACILITIES	\$1,548,000
Engineering:	
- Planning (3%)	\$46,000
- Design (7%)	\$108,000
- Construction Engineering (1%)	\$15,000
Legal Assistance (2%)	\$31,000
Fiscal Services (2%)	\$31,000
All Other Facilities Contingency (20%)	\$310,000
Environmental & Archaeology Studies and Mitigation	\$9,000
Land Acquisition and Surveying (2 acres)	\$10,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$69,000
TOTAL COST OF PROJECT	\$2,177,000
Debt Service (3.5 percent, 20 years)	\$153,000
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$14,000
Water Treatment Plant	\$61,000
Pumping Energy Costs (230873 kW-hr @ 0.09 \$/kW-hr)	\$10,000
TOTAL ANNUAL COST	\$238,000
Available Project Yield (ac-ft/yr)	560
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$425
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$152
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$1.30
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$0.47

* Water treatment plant capacity is based on peak well production capacity

Table 5B.9.16.
Cost Estimate Summary Water Supply Project Option, September 2023 Prices,
Region N Local Gulf Coast Supplies– Ricardo WSC (Additional 0.5 MGD Supply)

Item	Estimated Costs for Facilities
Well Fields (Production Wells, Test Well, and Pumps)	\$2,300,000
Treatment System (1 MGD)	\$2,375,000
Pump Station Upgrades	\$2,250,000
Transmission Pipeline (14 ", 0.8 Miles)	\$952,500
TOTAL COST OF FACILITIES	\$7,877,500
Engineering:	
- Planning (3%)	\$236,325
- Design (7%)	\$551,425
- Construction Engineering (1%)	\$78,775
Legal Assistance (2%)	\$157,550
Fiscal Services (2%)	\$157,550
Pipeline Contingency (15%)	\$142,875
All Other Facilities Contingency (20%)	\$1,385,000
Environmental & Archaeology Studies and Mitigation	\$75,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$315,100
TOTAL COST OF PROJECT	\$10,977,100
Debt Service (3.5 percent, 20 years)	\$772,361
Operation and Maintenance	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$40,500
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$13,750
Water Treatment Plant	\$356,250
Pumping Energy Costs (41603 kW-hr @ 0.09 \$/kW-hr)	\$1,080
TOTAL ANNUAL COST	\$1,183,941
Available Project Yield (ac-ft/yr)	560
Annual Cost of Water (\$ per ac-ft), based on PF=0	\$2,114
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=0	\$735
Annual Cost of Water (\$ per 1,000 gallons), based on PF=0	\$6.49
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=0	\$2.23

Note: One or more cost element has been calculated externally. No land acquisition costs, except for transmission pipeline and brine concentrate disposal ROW.

5B.9.4.1 Implementation Issues

The groundwater supply analyses considered for this water management strategy were based on MAGs adopted by local groundwater control districts (GCDs) and GMAs according to TWDB guidance for regional water planning. For future planning efforts, new MAGs provided by GCDs and GMAs located in the Coastal Bend Region need to be considered when determining available groundwater supplies.

Local groundwater districts or GMAs should be consulted for well permit requirements and in accordance with MAG conditions. The potential for regulations by groundwater conservation districts in the future is likely based on future MAGs identified by local districts or Groundwater Management Area, including the renewal of pumping permit at periodic intervals in counties where districts have been organized.

Implementation of aquifer supply projects should consider the following:

- Verification of the Gulf Coast Aquifer water quality for concentrations of the dissolved constituents such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic;
- Impact of water levels in the aquifer, potential intrusion of saline groundwater, land surface subsidence, and streamflow;
- U.S. Army Corps of Engineers (USACE) Section 10 and 404 dredge and fill permits for pipelines;
- General Land Office (GLO) Sand and Gravel Removal permit for pipeline and crossings of streams and roads;
- GLO Easement for use of State-owned lands, if any;
- Cultural resources investigations in accordance with the Texas Historical Commission and the Texas Antiquities Code;
- TPWD Sand, Gravel, and Marl permit; and
- Mitigation requirements would vary depending on impacts, but could include vegetation restoration, wetland creation or enhancement, or additional land acquisition.

If the TDS content in the water is found to be high, treatment to reduce TDS levels will be necessary, along with applying for a Discharge Permit. In this scenario, the following permits will be required to consider:

- USACE Section 10 and 404 dredge and fill permits for pipeline installation.
- GLO Sand and Gravel Removal permit for pipeline installation and stream/road crossings.
- GLO Easement for the use of state-owned lands (if applicable).
- TPWD Sand, Gravel, and Marl permit.

STWA has expressed concerns regarding key elements of the proposed freshwater well project in Kleberg County. These concerns are outlined in the evaluation summary, as follows:

- Verification of water quality from the Gulf Coast Aquifer, specifically testing for concentrations of dissolved constituents, such as TDS, chloride, sulfate, iron, manganese, radium, uranium, and arsenic.
- Assessment of potential impacts on aquifer water levels, risks of freshwater intrusion, land subsidence, and streamflow alterations.
- Compliance with TCEQ permit requirements for a municipal well.
- Mitigation measures, which will vary based on the identified impacts, could include vegetation restoration, wetland creation or enhancement, or the acquisition of additional land.

5B.9.4.2 Evaluation Summary

An evaluation summary of this regional water management option is provided in Table 5B.9.17.

Table 5B.9.17.
Evaluation Summary for Drilling Wells to Provide Additional Groundwater Supply for Municipal and Non-Municipal Rural Water Users

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Firm Yield: Varies from 5 to 2,809 ac-ft.
2. Reliability	2. Good reliability if adequate water quality.
3. Cost of treated water	3. Cost: \$398 to \$20,000 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Some. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Some. May slightly decrease instream flow and discharge of freshwater into coastal estuaries due to local groundwater-surface water interaction.
3. Wildlife habitat	3. Negligible impacts.
4. Wetlands	4. Negligible impacts.
5. Threatened and endangered species	5. Negligible impacts.
6. Cultural resources	6. Cultural resources will need to be surveyed and avoided.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Negligible impacts. a. Low to moderate impact. b. Low to moderate impact. c. No impact. d. Low to moderate impact. e. Low to moderate impact. f. Low to moderate impact. - g-h. Low to moderate impact associated with mining. i. Boron may be a potential water quality concern.
c. Impacts to agricultural resources and State water resources	• Low impacts. No negative impacts on water resources other than slight lowering of Gulf Coast Aquifer levels.
d. Threats to agriculture and natural resources in region	• May slightly increase pumping costs for agricultural users in the area due to localized drawdowns
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• None
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities with local resources
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

Table 5B.9.18.
Evaluation Summary of the STWA Ricardo Well Project

Impact Category	Comments
a. Water supply:	
1. Quantity	1. Yield: 560 ac-ft/yr.
2. Reliability	2. Moderate reliability.
3. Cost of treated water**	3. Generally low to moderate cost; \$2,114 per ac-ft.
b. Environmental factors:	
1. Effects on Instream flows	1. None to low impact.
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Moderate impact.
3. Wildlife habitat	3. None
4. Wetlands	4. None to low.
5. Threatened and endangered species	5. None identified. Project can be adjusted to bypass sensitive areas. Endangered species survey will be needed to identify impacts.
6. Cultural resources	6. Cultural resources survey will be needed to identify any significant sites.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7a-b. Total dissolved solids and salinity of water is expected to be below 1000mg/L 7d-i. Chloride, sulfate, uranium and arsenic concentrations in groundwater will need to be considered prior to implementation of project.
c. Impacts to Agricultural Resources or State water resources	• Little to minor negative impacts on surface water resources
d. Threats to agriculture and natural resources in region	• Temporary damage due to construction of pipeline
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used for portions.
g. Interbrain transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• Not applicable
i. Efficient use of existing water supplies and regional opportunities	• Provides regional opportunities for water that would otherwise be unused
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• Construction and maintenance of transmission pipeline corridor. Possible short-term impact to wildlife habitat along pipeline route and right-of-way.



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5B.10

*Regional Water Supply
Management and
Treatment Facilities*



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Section 5B.10 Regional Water Supply Management and Treatment Facilities

The City of Corpus Christi and San Patricio Municipal Water District (SPMWD) supply over 80 percent of the municipal and industrial water demand in the region. Treated water supply availability is limited by existing water treatment plant (WTP) capacity, as well as raw water availability. Water treatment plant and raw transmission system improvements are necessary for the City of Corpus Christi and San Patricio Municipal Water District to fully use existing water supplies available from the Choke Canyon Reservoir/Lake Corpus Christi System (CCR/LCC)/Lake Texana/ Mary Rhodes Pipeline (MRP) Phase II System (CCR/LCC/Texana/MRP Phase II System or Corpus Christi Regional Water Supply System).

Improvements are underway at the O.N. Stevens WTP improvements to remove bottlenecks and increase treatment capacity to the rated capacity. Beyond these improvements scheduled to be completed by the end of the year, O.N Stevens WTP will need a facility expansion to treat existing¹ and future water supplies and meet treated water needs for planning period from 2030 to 2080. The City of Corpus Christi is currently conducting a condition assessment of the MRP, the sole transmission pipeline delivering the City's existing supplies from Lake Texana and the Colorado River. Preliminary information from ongoing City studies suggest that transmission system improvements are needed for the pipeline to deliver additional, current supplies and future supplies.

The SPMWD is considering replacement of the Nueces River raw water transmission pipeline and pump station on the MRP at Dressen to meet future customer water demands and fully and reliably utilize contracted water supplies from the City of Corpus Christi. Furthermore, SPMWD is planning microfiltration improvements at their water treatment plant to provide treated water to meet customer demands.

5B.10.1 O.N. Stevens WTP Improvements

5B.10.1.1 Description of Strategy

The O.N. Stevens WTP provides treated water supplies to the City of Corpus Christi and its customers. As shown in the City of Corpus Christi's needs analysis in Chapter 4A, additional treatment capacity is needed at the city's water treatment plant to fulfill future treated water supplies to SPMWD and projected industrial water needs.

The City of Corpus Christi expects to experience increasing municipal and industrial water demands due to a growing population, enterprise, and commerce. Despite the successful water conservation efforts of the City's industrial customers, raw and treated water demand is increasing due to increased manufacturing. Not only have manufacturers indicated that they will need increasing amounts of water in the coming years, other water users have approached the

¹ In excess of those included in the safe yield, the basis for existing available supplies from the CCR/LCC/Texana/Colorado System.

City of Corpus Christi about various efforts slated to come online in the next several years with increasing rates of water consumption over a 10-year period. The projected growth in manufacturing and steam-electric demand, in combination with municipal demand, requires that the City of Corpus Christi develop additional treated water supply over the next few years.

Although the O.N. Stevens WTP is currently rated at 167 million gallons per day (mgd) by the Texas Commission on Environmental Quality (TCEQ), the City of Corpus Christi currently can produce only 160 mgd of treated water through the O.N. Stevens WTP (the sole source of treated water for the City of Corpus Christi municipal supply, various large industrial users, and the South Texas Water Authority [STWA])² due to a hydraulic bottleneck at the front end of the O.N. Stevens WTP. The City of Corpus Christi is in the process of O.N. Stevens WTP expansions to increase treatment plant capacity from 160 mgd to 200 mgd and construction activities are underway for an estimated time of completion of 2026. Re-designing the influent end of the plant will allow the plant, operating under acceptable TCEQ detention rates, to produce 200 mgd, which would increase the amount of treated water supplies needed to meet increasing water demands for City of Corpus Christi customers and improve supply reliability. Additional system improvements to the WTP will provide operational cost savings from increased reliability and functionality. The proposed O.N. Stevens WTP Improvements are as follows:

- Raw Water Influent Improvements – these improvements will address the current hydraulic bottleneck at the O.N. Stevens WTP front end that limits total plant capacity to 159 mgd. This project, in combination with uprating the current filter system through TCEQ, will increase total plant capacity to 200 mgd.
- Nueces River Raw Water Intake Pump Station Improvements – these improvements will increase the reliability of water delivery to O.N. Stevens from the Calallen Pool.

The Raw Influent Improvements would allow for blending and pre-sedimentation of 100 percent of the source water which would increase finished water quality, as well as allow for a more uniform treatment regimen which would save operational costs. Full blending and full pre-sedimentation will also accomplish the goal of increasing the quality of the partially treated water that is provided to local industry. Raw Influent Improvements will also increase security at the O.N. Stevens WTP as currently the influent pipelines emerge in an open top meter vault only a few feet from a major road, which is a security concern.

The Nueces River Raw Water Intake Pump Station Improvements will upgrade the pump station in order to increase the reliability of water delivery to O.N. Stevens WTP. The upgrades will also increase the operational capability of the pump station and provide operational cost savings from the increased reliability and capabilities of the improved pump station, including new pump motors and motor starters to be installed.³

² The City of Corpus Christi, STWA, and some industrial users rely solely on the O.N. Stevens WTP for treated water supplies, and do not have backup treatment plants or treated water furnished from other sources.

³ The O.N. Stevens WTP currently contains emergency generators. Proposed water treatment improvements would be added to the existing electrical distribution system.

In addition to the projects detailed above, the City of Corpus Christi is also in the process of adding water treatment plant improvements to the chemical feed system, electrical distribution system, process monitoring instrumentation and automation system, and residual solids handling and water recovery facilities. Such improvements are not fully discussed in this water management strategy and are not included in the cost estimate.

5B.10.1.2 Available Yield

The City of Corpus Christi currently can produce only 160 mgd of treated water due to a hydraulic bottleneck at the front end of the O.N. Stevens WTP treatment train that limits water treatment plant production. With raw water influent improvements, the O.N. Stevens WTP capacity will increase to 200 mgd (peak day).

At a current peak water treatment capacity of 160 mgd, the City is able to produce on average 114.3 mgd⁴ (or 128,104 acre-feet per year [ac-ft/yr]) which adequately treats existing safe yield supplies after considering contract limits with customers. Assuming the same peak to average day ratio, increasing the O.N. Stevens WTP capacity to 200 mgd will produce 142.9 mgd, on average, (or 160,134 ac-ft/yr) which is 32,030 acre-feet (ac-ft) more than the amount that can be currently produced.⁵ The supply for this strategy is expected to originate from the Evangeline Laguna Groundwater Strategy discussed in Chapter 5B.7 which will be conveyed through the Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability (see Chapter 5B.10.2). The yield of the O.N. Stevens WTP treatment improvements, therefore, is limited to 25,637 ac-ft/yr, equal to the future supply from the Evangeline Laguna Groundwater Strategy (discussed in Chapter 5B.7).

5B.10.1.3 Environmental Issues

A summary of environmental issues by water treatment plant improvement component is included in Table 5B.10.1. There is little to no environmental impact from the proposed O.N. Stevens WTP projects. The majority of the work will be on existing facilities and structures.

Table 5B.10.1.
Environmental Issues City of Corpus Christi Water Supply Improvements

Water Management Strategy/Component	Environmental Impact
Raw Influent Improvements	Negligible impact. Possibility of processing more water daily by the WTP could allow for increased consumption if the demand manifests itself, but also increased B&E inflows possible as well.
Nueces River Raw Water Pump Station Improvements	Negligible impact. Upgrades to existing facility will not involve construction in river or alteration of flows, excavation, or dredging.

5B.10.1.4 Engineering and Costing

Figure 5B.10.1 shows the facilities required to develop the Raw Influent Improvements. The improved headworks piping at O.N. Stevens will also allow for 100 percent blending and pre-

⁴ Assumes a peak to average day rate of 1.4: 1 comparable with recent water use records.

⁵ Assumes no raw water shortage.

sedimentation of source waters which will affect water quality improvements and chemical cost savings per unit.

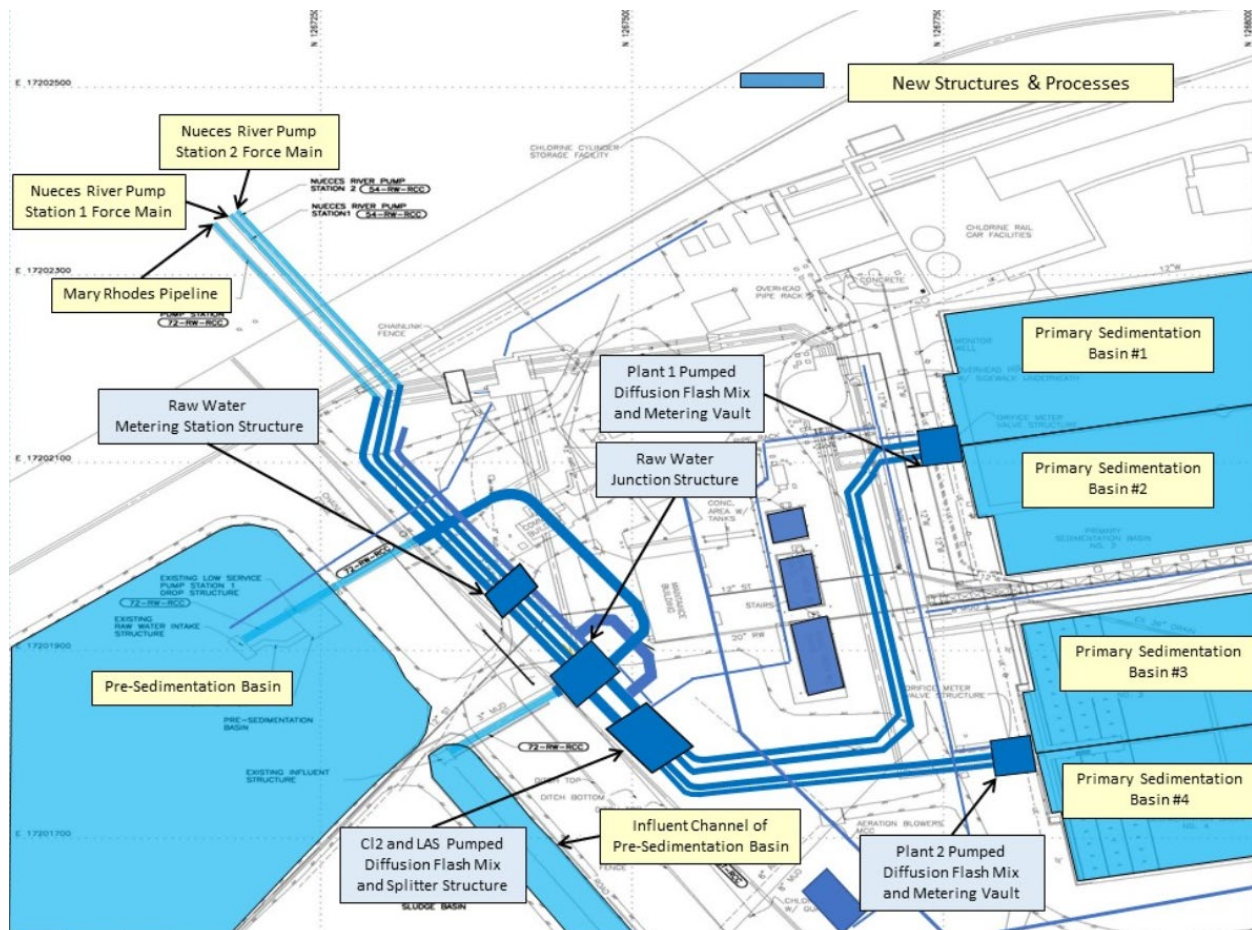


Figure 5B.10.1.
O.N. Stevens Water Treatment Plant Raw Water Influent Improvements

Table 5B.10.2 summarizes the capital and annual costs for the City of Corpus Christi's O.N Stevens WTP improvements, while Table 5B.10.3 summarizes the available project yield subject to raw water constraints and the annual cost of water, including treated water costs with assumption of \$369 per ac-ft used for other water management strategies. It is important to note that yield declines in decades subsequent to 2020 due to the need to maintain raw water supplies up to safe yield capacity constraints. With addition of new raw water supplies during the projection period, the supplies generated by O.N. Stevens WTP improvements will amount to 28,025 ac-ft/yr or raw water project yield whichever is the smaller amount.

Table 5B.10.2.
Cost Estimate Summary, ON Stevens WTP Improvements (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Primary Pump Station	\$16,799,000
Water Treatment Plant Improvements	\$42,570,000
Total Cost of Facilities	\$59,369,000
- Planning (3%)	\$1,781,000
- Design (7%)	\$4,156,000
- Construction Engineering (1%)	\$594,000
Legal Assistance (2%)	\$1,187,000
Fiscal Services (2%)	\$1,187,000
All Other Facilities Contingency (20%)	\$11,874,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$2,605,000
Total Cost of Project	\$82,753,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$5,823,000
Operation and Maintenance	-
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$420,000
Pumping Energy Costs (13987500 kW-hr @ 0.09 \$/kW-hr)	\$1,259,000
Total Annual Cost	\$7,502,000
Available Project Yield (ac-ft/yr)	25,637
Annual Cost of Water (\$ per ac-ft)	\$293
Annual Cost of Water After Debt Service (\$ per ac-ft)	\$65
Annual Cost of Water (\$ per 1,000 gallons)	\$0.90
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$0.20

Table 5B.10.3.
Unit Cost of Water Summary

Yield/Cost	Year					
	2030	2040	2050	2060	2070	2080
Available Project Yield (ac-ft/yr)	25,637	25,637	25,637	25,637	25,637	25,637
Annual Cost of Raw Water (\$ per ac-ft)	\$293	\$293	\$65	\$65	\$65	\$65
Annual Cost of Treated Water (\$ per ac-ft) ^a	\$665	\$665	\$437	\$437	\$437	\$437

^a The cost of treating water is \$372 per ac-ft (from the City of Corpus Christi via email, February 2025).

5B.10.1.5 Implementation Issues

Implementation of these water management strategies will require a National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan Permit.

There are limited chances for participation by partners. To the extent these improvements will provide improvements in water quality or supply for wholesale finished or wholesale partially treated or wholesale raw water customers, there may be partnership opportunities with the wholesale customers.

The sequencing of construction will have to take into account the fact that the O.N. Stevens WTP is the City of Corpus Christi's only water treatment plant, so it has to keep operating throughout the construction process. There is detention time of only a few hours in the

clearwells to allow for switching over to the new hydraulic structures near the end of construction. The Raw Influent Improvements Component is the only portion of the proposed improvements that will require special sequencing consideration.

5B.10.1.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.10.4.

Table 5B.10.4.
Evaluation Summary of O.N. Stevens Water Treatment Plant Improvements

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield: 25,637 ac-ft/yr, with no raw water constraints.
2. Reliability	2. High reliability.
3. Cost of treated water	3. Raw: \$293 per ac-ft. Treated: \$665 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will reduce demand on river water.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities may have minor reduction in inflows to tidal portion of the Nueces River.
3. Wildlife habitat	3. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will preserve minimum water levels in the Audubon Society Rookery.
4. Wetlands	4. Low or no impact.
5. Threatened and endangered species	5. Negligible impact. The O.N. Stevens WTP Solids Handling Facilities will preserve minimum water levels in the Audubon Society Rookery.
6. Cultural resources	6. Negligible impact. All work on O.N. Stevens WTP property should be no impact.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Low or no impact. The O.N. Stevens WTP Solids Handling Facilities will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
c. Impacts to agricultural and State water resources	No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	None
e. Recreational impacts	None
f. Equitable comparison of strategies	Standard analyses and methods used
g. Interbasin transfers	Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	None
i. Efficient use of existing water supplies and regional opportunities	Improvement over current conditions
j. Effect on navigation	None
k. Impacts on water pipelines and other facilities used for water conveyance	None

5B.10.2 Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability

5B.10.2.1 Description of Strategy

The MRP Phase I conveys raw water from an intake pump station at Lake Texana southwest approximately 101 miles to the O.N. Stevens WTP in Corpus Christi, Texas. The MRP Phase I consists of approximately 99 miles of 64-inch diameter B303 Bar-Wrapped Pipe (BWP) and approximately 2 miles of 72-inch Prestressed Concrete Cylinder Pipe (PCCP) in four pressure ratings 100, 125, 150 and 175 pounds per square inch. Construction of the pipeline began in 1997 and was completed by 1998. Figure 5B.10.2 shows the existing MRP Phase I area, which is anticipated to be collocated with all pipe and pump station improvements described in this planning document.

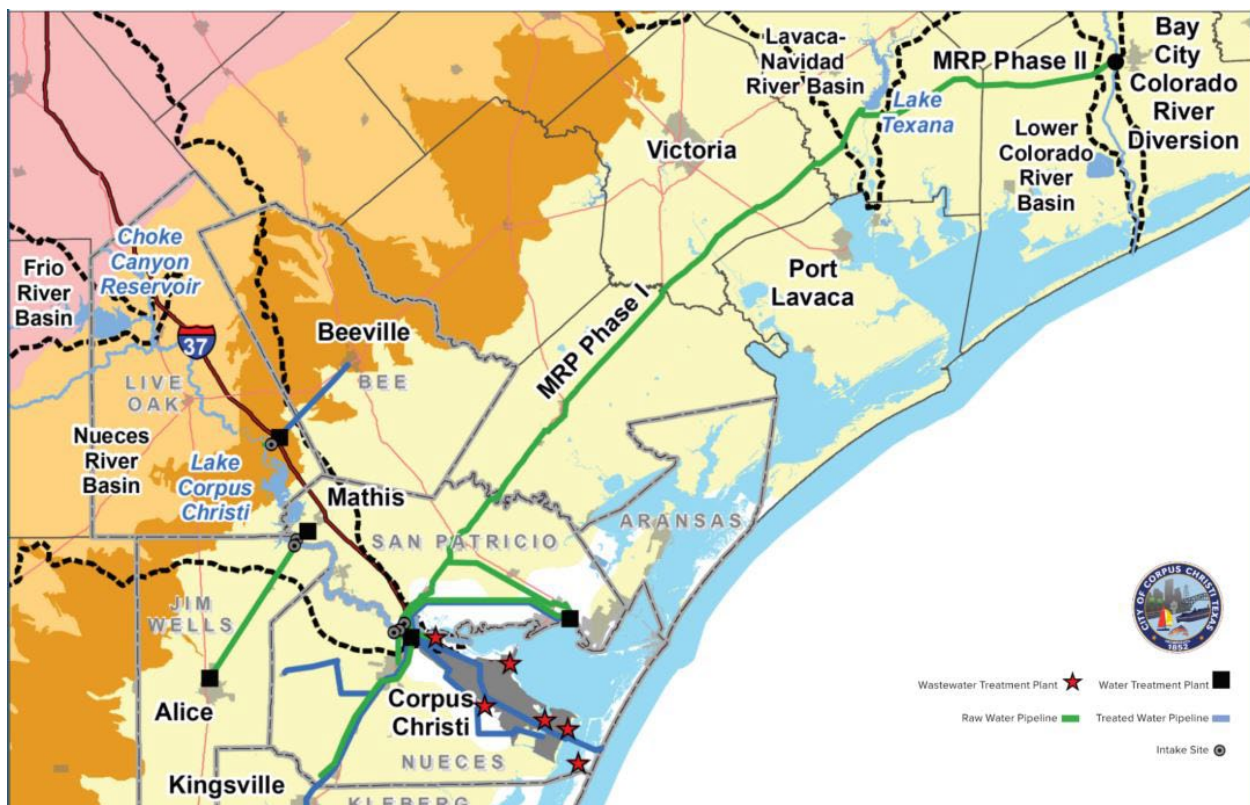


Figure 5B.10.2.
Mary Rhodes Pipeline Phase I Area

The reliability of the MRP is critical since it supplies over half of the City of Corpus Christi's raw water as well as the SPMWD and an industrial customer, Steel Dynamics Incorporated (SDI).

A pumping schedule used by Corpus Christi Water and Lavaca-Navidad River Authority shows that the MRP was designed to convey a variety of flows ranging from 11.5 to 79 mgd in the following scenarios (pumping schedules):

Schedule 1A

Flows ranging from 11.5 to 24.4 mgd are conveyed through the use of one of two variable frequency drive pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana.

Schedule 1B

Flows ranging from 25 to 32.4 mgd are conveyed through the use of both variable frequency drive pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana.

Schedule 2A

Flows ranging from 34 to 40 mgd are conveyed through the use of one constant speed and one variable frequency drive pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana.

Schedule 2B

Flows ranging from 40 to 46 mgd are conveyed through the use of two constant speed and one variable frequency drive pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana.

Schedule 3

Flows ranging from 55 to 58 mgd are conveyed through the use of various pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana and the use of all four pumps at the Bloomington Booster Pump Station.

Schedule 4

Flows ranging from 72 to 79 mgd are conveyed through the use of various pumps at the Lavaca-Navidad River Authority intake pump station at Lake Texana, the use of all four pumps at the Bloomington Booster Pump Station, and the use of all four pumps at the Woodsboro Booster Pump Station.

Corpus Christi Water typically operates the MRP Phase I under Schedule 2B, which meets customer demands and does not require the use of the Bloomington and Woodsboro Booster Pump Stations.

However, a condition assessment that was performed on the MRP Phase I in 2023-2024 identified operating pressures that exceeded the pipeline design pressure ratings in approximately 9 miles of the MRP Phase I pipeline during Schedule 2B pumping. Investigation and resolution of the 9 miles of pressure exceedance area will require the MRP to be taken out of service. Unfortunately, because the MRP has no redundancy it cannot be taken out of service. The Mary Rhodes Pipeline Phase I improvements described in this strategy will increase conveyance capacity for additional source water supply projects, like the Evangeline Laguna Groundwater Project and others. The City of Corpus Christi is beginning a study to evaluate if reconstruction of portions of the MRP are needed to accommodate future water supplies and to what extent.

The pressure exceedance areas are shown in Figure 5B.10.3 through Figure 5B.10.5.

The identification of this pressure exceedance condition has the following impacts on Corpus Christi Water:

1. Decreased operational flexibility by effectively removing schedule 2B from use.
2. Decreased reliability and increased risk of pipeline failure in MRP Phase I when operating under Schedules 2B.
3. Increased dependence on Schedule 3 which requires the use of the Bloomington Booster Pump Station.
4. Inability to convey the upper range of Schedule 4 flow without pressure exceedances.
5. Limited ability to convey flows from new water supply sources without pressure exceedances.

To date, the MRP Phase I has experienced over 34 pipe leaks/failures. Each leak/failure requires the MRP to be taken out of service while the source of the leak is confirmed and repair made. In addition to increasing the conveyance capacity, the MRP improvements described in this strategy would also reduce water loss and improve service reliability.

Increasing customer water needs also require improvements to the booster pump stations in order to increase the pumping capacity of the MRP.

The City of Corpus Christi expects to experience increasing municipal and industrial water demands due to a growing population, enterprise, and commerce. Despite the successful water conservation efforts of the City of Corpus Christi's industrial customers, raw and treated water demand is increasing due to increased manufacturing. Not only have manufacturers indicated that they will need increasing amounts of water in the coming years, other water users have approached the City of Corpus Christi about various efforts slated to come online in the next several years with increasing rates of water consumption over a 10-year period. The projected growth in manufacturing demand, in combination with municipal demand, requires that the City of Corpus Christi improve the reliability and conveyance capacity of its primary water conveyance system in the coming years.

Although the MRP Ph I was designed to convey a maximum of 100 MGD, the City of Corpus Christi currently can only pump 79 MGD of raw water due to pumping limitations and pressure exceedances in a 9-mile section of pipeline. The City of Corpus Christi is in the process of construction activities to add and replace a total of seven combination air vacuum valves to better protect the MRP from transient events. The City of Corpus Christi is also in the process of making various piping, valve, pump, instrumentation, and electrical improvements at the Bloomington and Woodsboro booster pump stations to improve the reliability and capacity of these stations. Both projects have an estimated time of completion of early 2025 and are not detailed and their costs are not included in this document.

Installing new pipe and adding a pump to each of 3 pump stations will allow the MRP Phase I to convey 100 MGD, up from the current 79 MGD. This strategy would increase the amount of

water supplies delivered to meet increasing water demands for City of Corpus Christi customers and improve supply reliability. Additional system improvements to the MRP Phase I will provide increased reliability, conveyance capacity, and functionality. The proposed MRP Phase I Improvements are presented as two options as follows:

Option 1

- New Pipeline at high-risk locations – these improvements will address the current pressure exceedances in approximately 9 miles of the MRP Phase I and allow the City of Corpus Christi to pump at Schedule 2B without exceeding the pipeline pressure capacity.
- Pump Station Improvements – the addition of a pump to each of the three pump stations will increase the conveyance of water through the MRP Phase I from Lake Texana to the O.N. Stevens WTP.
- New Pipeline at remaining locations – these improvements will provide redundancy and improve reliability by allowing the MRP to remain in service when the existing pipeline fails or requires maintenance.

Option 2

- Full replacement of the existing MRP Phase I pipeline and pump stations.

The MRP Phase I Improvements will improve the pipeline reliability, improve operational flexibility, and increase pumping capacity. These improvements will reduce operational and repair costs by allowing the City of Corpus Christi to take pumps and sections of the MRP out of service with minimal to no impact to the City of Corpus Christi's water supply. The improvements will also accomplish the goal of increasing the reliability of the raw water that is provided to local industry.

The Pump Station Improvements will increase the capacity and reliability of the pump stations to deliver raw water to the O.N. Stevens WTP. The upgrades will also increase the operational capability of the pump station and provide operational cost savings from the increased reliability and capabilities of the improved pump station, including new pump motors and motor starters to be installed.

5B.10.2.2 Available Yield

The MRP currently can produce only convey 79 mgd of raw water due to pumping limitations and pipeline pressure exceedances, which is adequate to convey current safe yield. With pipeline, balancing tank, and pump station improvements, the MRP Phase I capacity will increase to 100 mgd (peak day). If Option 2 is implemented it will increase the overall MRP Ph I capacity by allowing new water sources to be tied into either the existing or proposed pipeline.

The supply for this strategy is expected to originate from the Evangeline Laguna Groundwater Strategy discussed in Chapter 5B.7 which will be conveyed through the Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability to O.N. Stevens WTP treatment improvements (see Chapter 5B.10.1). The yield of the Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability, therefore, is limited to 25,637 ac-ft/yr, equal to the future supply from the Evangeline Laguna Groundwater Strategy (discussed in Chapter 5B.7).

5B.10.2.3 Environmental Issues

A summary of environmental issues by pipeline improvement component is included in Table 5B.10.5. There is little to no environmental impact from the proposed projects. The majority of the work will be on existing facilities and structures.

Table 5B.10.5.
Environmental Issues Mary Rhodes Pipeline Phase I Improvements

Water Management Strategy/Component	Environmental Impact
Pipeline Improvements	Negligible impact. New pipeline construction should be performed in previously disturbed areas. Water crossings will be performed using tunneled construction to minimize impacts at those locations.
Pump Station Improvements	Negligible impact. Upgrades to existing facilities will not involve construction in river or alteration of flows, excavation, or dredging.

5B.10.2.4 Engineering and Costing

Figure 5B.10.3 through Figure 5B.10.5 show the new pipe locations for the MRP Phase I Improvements- Option 1.

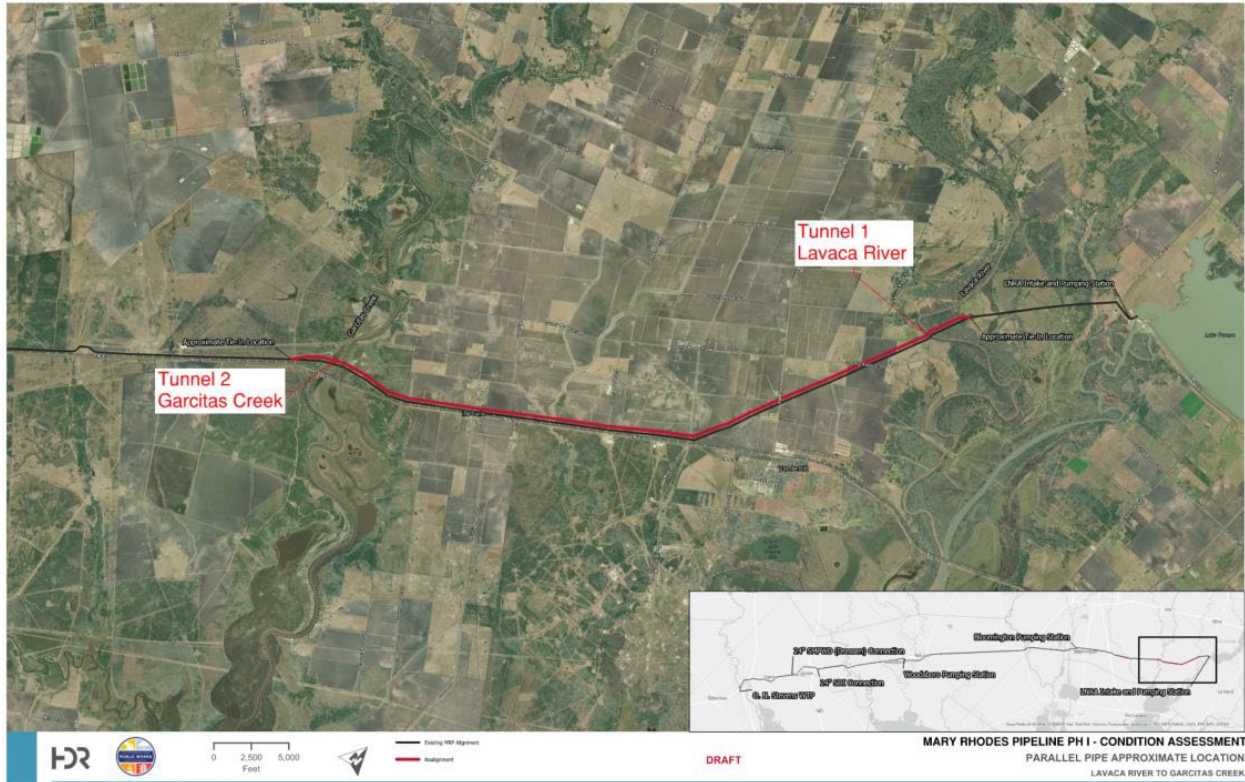


Figure 5B.10.3.
Mary Rhodes Pipeline Phase I Improvements
High Risk Section 1

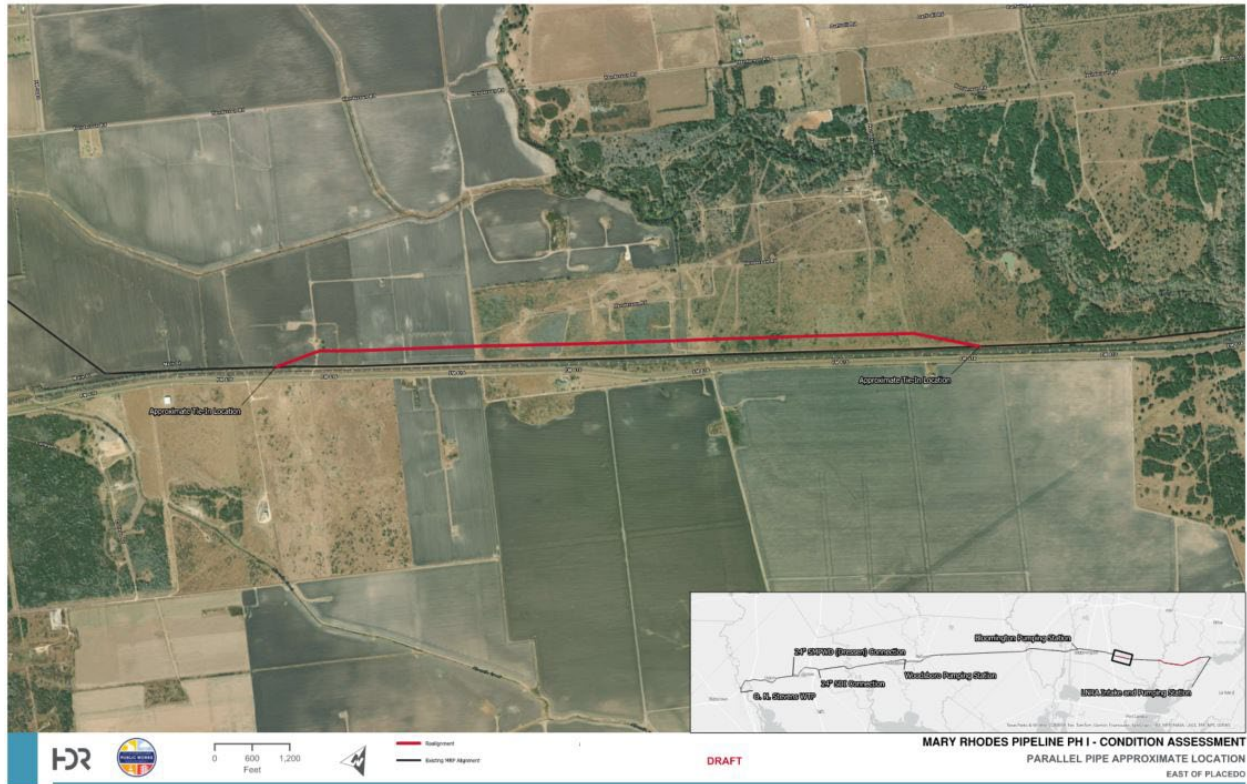


Figure 5B.10.4.
Mary Rhodes Pipeline Phase I Improvements
High Risk Section 2

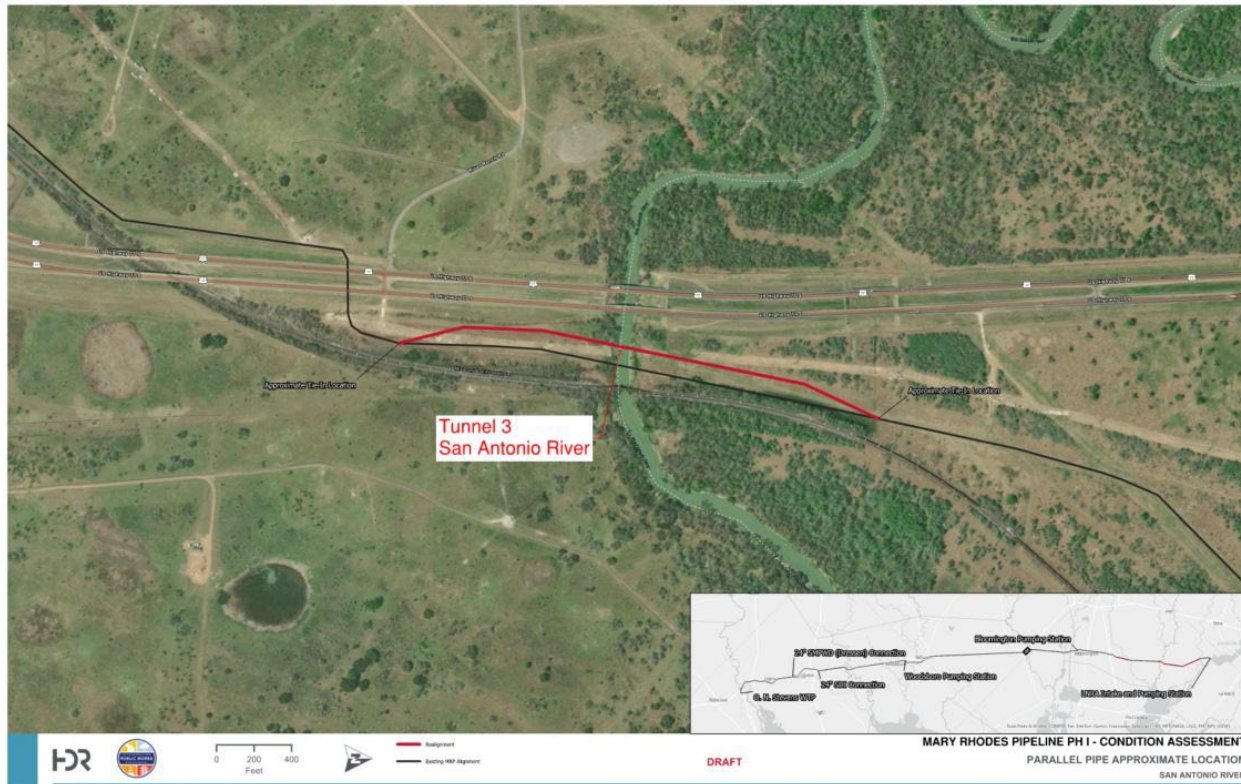


Figure 5B.10.5.
Mary Rhodes Pipeline Phase I Improvements
High Risk Section 3

Table 5B.10.6 summarizes the capital and annual costs for the MRP Phase I Improvements Option 1, while Table 5B.10.7 summarizes the available project yield for Option 1 subject to raw water constraints and the annual cost of water, including treated water costs with assumption of \$372 per ac-ft used for other water management strategies.

Table 5B.10.6.
Cost Estimate Summary for Mary Rhodes Pipeline Phase I Improvements Option 1 (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Capital Cost	
Transmission Pipeline	\$890,000,000
Transmission Pump Station(s) & Storage Tank(s)	\$30,000,000
Total Cost of Facilities	\$920,000,000
- Planning (3%)	\$27,600,000
- Design (7%)	\$64,400,000
- Construction Engineering (1%)	\$9,200,000
Legal Assistance (2%)	\$18,400,000
Fiscal Services (2%)	\$18,400,000
Pipeline Contingency (15%)	\$133,500,000
All Other Facilities Contingency (20%)	\$6,000,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$38,919,000
Total Cost of Project	\$1,236,419,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$86,996,000
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$8,900,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$750,000
Pumping Energy Costs (176223811 kW-hr @ 0.09 \$/kW-hr)	\$15,860,000
Total Annual Cost	\$112,506,000
Available Project Yield (ac-ft/yr)	25,637
Annual Cost of Water (\$ per ac-ft)	\$4,388
Annual Cost of Water After Debt Service (\$ per ac-ft)	\$995
Annual Cost of Water (\$ per 1,000 gallons)	\$13.47
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$3.05

Table 5B.10.7.
Unit Cost of Water Summary Option 1

Yield/Cost	Year					
	2030	2040	2050	2060	2070	2080
Available Project Yield (ac-ft/yr)	25,637	25,637	25,637	25,637	25,637	25,637
Annual Cost of Raw Water (\$ per ac-ft)	\$4,388	\$4,388	\$995	\$995	\$995	\$995
Annual Cost of Treated Water (\$ per ac-ft) ^a	\$4,760	\$4,760	\$1,367	\$1,367	\$1,367	\$1,367

^a The cost of treating water is \$372 per ac-ft (from the City of Corpus Christi via email, February 2025).

Table 5B.10.8 summarizes the capital and annual costs for the MRP Phase I Improvements Option 2, while Table 5B.10.9 summarizes the available project yield for Option 2 subject to raw water constraints and the annual cost of water, including treated water costs with assumption of \$372 per ac-ft used for other water management strategies.

Table 5B.10.8.
Cost Estimate Summary for Mary Rhodes Pipeline Phase I Improvements
Option 2- With Full Replacement (Sept 2023 Prices)

Item	Estimated Costs for Facilities
Capital Cost	
Primary Pump Station (9177 HP)	\$77,560,000
Transmission Pipeline (Lake Texana to brackish WTP: 66 in dia., 100.88 mi.)	\$763,538,000
Transmission Pump Station & Storage Tank (2)	\$108,604,000
Integration, Relocations, Backup Generator & Other	\$10,741,000
Total Cost of Facilities	\$960,443,000
- Planning (3%)	\$28,813,000
- Design (7%)	\$67,231,000
- Construction Engineering (1%)	\$9,604,000
Legal Assistance (2%)	\$19,209,000
Fiscal Services (2%)	\$19,209,000
Pipeline Contingency (15%)	\$114,531,000
All Other Facilities Contingency (20%)	\$39,381,000
Environmental & Archaeology Studies and Mitigation	\$3,026,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$40,648,000
Total Cost of Project	\$1,302,095,000
Annual Cost	
Debt Service (3.5 percent, 20 years)	\$90,861,000
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$7,778,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$4,565,000
Pumping Energy Costs (176224100 kW-hr @ 0.09 \$/kW-hr)	\$15,860,000
Total Annual Cost	\$119,064,000
Available Project Yield (ac-ft/yr)	112,000
Annual Cost of Water (\$ per ac-ft)	\$1,063
Annual Cost of Water After Debt Service (\$ per ac-ft)	\$252
Annual Cost of Water (\$ per 1,000 gallons)	\$3.26
Annual Cost of Water After Debt Service (\$ per 1,000 gallons)	\$0.77

Table 5B.10.9.
Unit Cost of Water Summary Option 2

Yield/Cost	Year					
	2030	2040	2050	2060	2070	2080
Available Project Yield (ac-ft/yr)	112,000	112,000	112,000	112,000	112,000	112,000
Annual Cost of Raw Water (\$ per ac-ft)	\$1,063	\$1,063	\$252	\$252	\$252	\$252
Annual Cost of Treated Water (\$ per ac-ft) ^a	\$1,435	\$1,435	\$624	\$624	\$624	\$624

^a The cost of treating water is \$372 per ac-ft (from the City of Corpus Christi via email, February 2025).

5B.10.2.5 Implementation Issues

Implementation of these pipeline reliability improvement strategies will require an NPDES Stormwater Pollution Prevention Plan Permit.



To the extent these improvements will provide improvements in water supply for wholesale raw water customers, there may be partnership opportunities with the wholesale customers.

The sequencing of construction will have to consider the fact that the MRP has no redundancy and has to keep operating throughout the construction process. Connections between proposed pipeline sections and the existing MRP will likely need to be performed while the MRP is operating.

5B.10.2.6 Evaluation Summary

An evaluation summary of this water management option is provided in Table 5B.10.10.

Table 5B.10.10.
Evaluation Summary of Mary Rhodes Pipeline Phase I Improvements (Options 1 & 2)

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. Yield: Variable
2. Reliability	2. High reliability.
3. Cost of treated water	3. Raw: \$1,063 to \$4,388 per ac-ft. Treated: \$1,435 to \$4,760 per ac-ft.
b. Environmental factors:	
1. Instream flows	1. None anticipated. The new pipe and air valve repairs should not impact instream flows.
2. Bay and estuary inflows and arms of the Gulf of Mexico	2. None anticipated. The new pipe and air valve repairs should not impact bay and estuary inflows and arms of the Gulf of Mexico.
3. Wildlife habitat	3. Minimal impact. The new pipe and air valve repairs should not impact wildlife habitat.
4. Wetlands	4. None anticipated. Waters of the U.S. (WOTUS) including wetlands would be field delineated and trenchless construction methods would be used to avoid impacts to WOTUS.
5. Threatened and endangered species	5. No adverse effects anticipated at this preliminary stage although a habitat assessment would be required during design; No critical habitat or documented occurrences of state or federally listed threatened or endangered species.
6. Cultural resources	6. Subject to the Antiquities Code of Texas and coordination with the Texas Historical Commission would be required.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. No impacts anticipated; erosion and sediment control best management practices would be utilized during construction and new pipes would be constructed to minimize/avoid water quality impacts.
c. Impacts to agricultural and State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

5B.10.3 SPMWD Increase Contracted Water Supply from the City of Corpus Christi

5B.10.3.1 Description of Strategy

San Patricio Municipal Water District (SPMWD) serves as a major wholesale water provider in the Coastal Bend Region providing potable water supplies to municipalities in San Patricio and Aransas counties; these municipal customers include the Cities of Odem, Taft, Portland, Gregory, Ingleside, Ingleside on the Bay, Aransas Pass, Rockport, and Fulton, as well as Nueces County WCID No. 4 and two rural water supply corporations in central and eastern San Patricio County. In addition, SPMWD provides raw and treated water supplies to industries located in San Patricio County.

San Patricio County is expecting significant industrial water demand increases in the future based on industrial growth with current manufacturing users and interest by new customers. TWDB's approved projections for this planning cycle for San Patricio County-Manufacturing show water demands of 60,705 ac-ft/yr (54.0 MGD) in 2030 with a slight increase to 60,732 ac-ft/yr by 2080.

SPMWD has a water supply agreement with the City of Corpus Christi to receive up to 46,800 ac-ft/yr (41.8 MGD) of raw water and 34,760 ac-ft/yr (31.0 MGD) of treated water from the regional CCR/LCC/Texana/MRP Phase II multi-basin water supply system. Depending on SPMWD's customer raw vs treated water needs, a surplus of existing raw water may be available within the existing contract with the City of Corpus Christi or shortage may be experienced due to WTP capacity if additional treated water supplies are needed by San Patricio County- manufacturing water users. However, as noted in previous Region N Water Plans, SPMWD will still need to develop additional new water supplies beginning in 2030 to meet projected municipal and industrial water demands through 2080.

SPMWD's water management strategy (WMS) for this planning cycle focuses on increasing the amount of their raw water contract with the City of Corpus Christi to support three water system capacity projects. These three projects include constructing new conveyance system improvements for improved efficiency and constructing a new water treatment plant to address projected municipal and industrial water demands, and rely on existing and future water supplies being developed by the City of Corpus Christi.

Table 5B.10.11 highlights the three water system capacity projects, which include the treatment and delivery of additional water supply volumes to SPMWD's customers (WUGs). Although the additional raw water supply needed to support these three projects is shown as 80.2 MGD, SPMWD would need to negotiate approximately 73.2 MGD based on the remaining amount of their current raw water contract with the City of Corpus Christi.

Table 5B.10.11.
SPMWD Water System Capacity Summary

SPMWD - Proposed Water System Capacity Projects	Total Supply Volume Needed		Raw Water Contract Used		Treated Water Contract Used		New Raw Water Supply Contract from Corpus Christi	
	ac-ft/yr	MGD	ac-ft/yr	MGD	ac-ft/yr	MGD	ac-ft/yr	MGD
Water Capacity Project #1	65,460	58.4	-	-	-	-	-	-
-- Construct new WTP at Plant D							22,418	20.0
-- Existing SPMWD Plant A	-	-	-	-	10,088	9.0	-	-
-- Existing SPMWD Plant B	-	-	8,967	8.0	-	-	-	-
-- Existing SPMWD Plant C	-	-	-	-	23,987	21.4	-	-
Water Capacity Project #2	69,495	62.0	-	-	-	-	-	-
-- Construct new intake, pump station and 60" transmission line							49,543	44.2
-- Existing intake, PS, and 36" pipeline	-	-	19,952	17.8	-	-	-	-
Water Capacity Project #3	28,022	25.0	-	-	-	-	-	-
-- Construct new pump station and construct new 36" transmission line with PVC material under road crossings							17,934	16.0
-- Existing 36" HDPE pipeline and pump station	-	-	10,088	9.0	-	-	-	-
Total	162,977	145.4	39,007	34.8	34,075	30.4	89,895	80.2
Amt. to Increase Contract Supply							82,049	73.2

The three water system capacity projects identified for SPMWD and included with this WMS are detailed below including evaluation summaries for each.

5B.10.3.1.1 SPMWD WTP Complex: Construct New Water Treatment Plant (20 MGD) at Plant D Site

The SPMWD Water Treatment Plant complex includes municipal and industrial WTPs (Plants A through C) to provide treated water supplies for its customers with a total treatment capacity of 38.4 MGD (or 43,154 ac-ft/yr). The water plant at Plant C has a peak capacity of 21.4 MGD and is capable of delivering 10.7 MGD average day (or 11,994 ac-ft/yr) assuming a 2:1 peak to average day ratio based on historical use.

In order to meet TWDB's water demand projections for San Patricio County in 2030, SPMWD proposes to construct a new 20 MGD (or 22,418 ac-ft/yr) membrane filtration WTP at Plant D, an existing site at the SPMWD Water Treatment Plant complex that currently does not have a treatment facility. This new 20 MGD WTP will increase the total treatment capacity available for SPMWD's municipal and industrial customers from 38.4 to 58.4 MGD according to the 2023 *SPMWD Facility Sequencing Study*. As noted in SPMWD's study, industrial companies have expressed a preference of receiving membrane filtered water (ion exchange or reverse osmosis treatment) versus conventionally treated water for their process needs due to the elimination of chemical addition after the filtration process. Also, industrial users outline a specific type of

treatment needed for manufacturing operations in their contractual agreements with SPMWD, which is then incorporated into the cost of service for the industrial user.

5B.10.3.1.2 Nueces River Improvements: Construct New Raw Water Intake, Pump Station and 60-inch Raw Water Transmission Pipeline

SPMWD currently accesses raw water supply from the Nueces River via the Calallen Pool, a shallow reservoir formed by the Calallen Saltwater Barrier Dam alongside Interstate 37. SPMWD's existing pump station and intake structure, both located along the Nueces River near Labonte Park in the City of Corpus Christi, are used to deliver raw water supplies through a 36-inch pipeline from the Nueces River Calallen Pool to the SPMWD Water Treatment Plant complex, located southeast of the City of Gregory. Proposed improvements include constructing a new intake and pump station (62 MGD) with more than double the capacity at the existing site on the Nueces River and constructing a new 60-inch transmission pipeline alongside the right-of-way in order to deliver greater water supply volume to SPMWD's customers (WUGs).

5B.10.3.1.3 Lake Texana/Lower Colorado River Improvements: Construct New Pump Station and New 36-inch Raw Water Transmission Pipeline

SPMWD has an existing 36-inch HDPE pipeline from the Mary Rhodes Pipeline to deliver raw supplies to the SPMWD Water Treatment Plant complex, located southeast of the City of Gregory. However, a new pump station (25 MGD) is needed along with constructing a new 36-inch PVC transmission pipeline to fully deliver supplies from Lake Texana/Lower Colorado River to the treatment plant complex to provide the additional raw water needed to meet demands through 2080. SPMWD has already purchased land for the pump station and improvements will be constructed within existing right-of-way.

5B.10.3.2 Available Yield

SPMWD has a water supply agreement with the City of Corpus Christi to receive up to 46,800 ac-ft/yr (41.8 MGD) of raw water and 34,760 ac-ft/yr (31.0 MGD) of treated water from the regional CCR/LCC/Texana/MRP Phase II multi-basin water supply system.

5B.10.3.2.1 SPMWD WTP Complex: Construct New Water Treatment Plant (20 MGD) at Plant D Site

An additional WTP is needed at the Plant D site to increase treatment capacity by 20 MGD (or 22,418 ac-ft/yr) to meet current and projected San Patricio County municipal and industrial water needs. Currently, the Plant D Site does not have a treatment facility. The cost estimate provided below in Table 5B.10.12 includes constructing a new 20 MGD membrane filtration WTP to address the capacity required; Plant A will continue to operate as a conventional treatment facility for potable (municipal) water. This new 20 MGD WTP will increase the total treatment capacity of the SPMWD Water Treatment Plant complex from 38.4 to 58.4 MGD according to the *2023 SPMWD Facility Sequencing Study*.

Table 5B.10.12.
Cost Estimate Summary for New WTP at Plant D Site

<i>Item</i>	<i>Estimated Costs for Facilities</i>
CAPITAL COST	
Water Treatment Plant (20 MGD)	\$49,500,000
TOTAL COST OF FACILITIES	\$49,500,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (35% for WTP)	\$17,325,000
Environmental & Archaeology Studies and Mitigation	\$50,000
Land Acquisition and Surveying	\$0
Interest During Construction (3.5% for 1 year with a 0.5% ROI)	\$2,173,000
TOTAL COST OF PROJECT	\$69,048,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$4,858,000
Operation and Maintenance	
Water Treatment Plant (10% Cost of Facilities)	\$4,950,000
Purchase of Raw Water (22,418 ac-ft/yr @ 381 \$/ac-ft)	\$8,541,000
TOTAL ANNUAL COST	\$18,349,000
Available Project Yield (ac-ft/yr)	22,418
Annual Cost of Water (\$ per ac-ft)	\$819
Annual Cost of Water (\$ per 1,000 gallons)	\$2.51

5B.10.3.2.2 Nueces River Improvements: Construct New Raw Water Intake, Pump Station and 60-inch Raw Water Transmission Pipeline

Conveyance system improvements, which include constructing a new intake, new pump station (62 MGD) and new 60-inch transmission pipeline, are necessary in order for SPMWD to deliver the additional raw water to the SPMWD WTP complex for treatment and distribution. SPMWD previously purchased the existing site for the new intake and new pump station; transmission pipeline improvements will be constructed alongside the right-of-way. The new pump station (62 MGD) will be sized for 5-1000 hp pumps. The cost estimate provided below in Table 5B.10.13 includes the proposed new conveyance system improvements to meet SPMWD's projected water demands and customer needs through 2080.

Table 5B.10.13.
Cost Estimate Summary for Nueces River Improvements: Conveyance and Transmission

<i>Item</i>	<i>Estimated Costs for Facilities</i>
CAPITAL COST	
Intake and Pump Station (62 MGD)	\$27,050,000
Raw Water Transmission Pipeline (60-inch)	\$138,415,000
TOTAL COST OF FACILITIES	\$165,465,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$50,992,000
Environmental & Archaeology Studies and Mitigation	\$100,000
Land Acquisition and Surveying	\$0
Interest During Construction (3.5% for 1 year with a 0.5% ROI)	\$7,038,000
TOTAL COST OF PROJECT	\$223,595,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$15,732,000
Operation and Maintenance	
Intake and Pump Station (2.5% of Cost of Facilities)	\$676,300
Raw Water Transmission Pipeline (1% of Cost of Facilities)	\$1,384,200
Purchase of Raw Water (69,495 ac-ft/yr @ 381 \$/ac-ft)	\$26,478,000
TOTAL ANNUAL COST	\$44,271,000
Available Project Yield (ac-ft/yr)	69,495
Annual Cost of Water (\$ per ac-ft)	\$637
Annual Cost of Water (\$ per 1,000 gallons)	\$1.96

5B.10.3.2.3 Lake Texana/Lower Colorado River Improvements: Construct New Pump Station and New 36-inch Raw Water Transmission Pipeline

Pump station improvements are needed for the existing transmission lines to fully deliver supplies up to the contracted amount and additional raw water needed to meet demands through 2080. By constructing a new 25 MGD pump station and new 36-inch pipeline of PVC material, SPMWD will be able to maximize the capacity of the delivery of treated water to their customers (WUGs). SPMWD has already purchased land for the pump station and improvements will be constructed within existing right-of-way. The cost estimate provided below in Table 5B.10.14 includes constructing a new pump station to deliver adequate raw water from Lake Texana/Lower Colorado River to the treatment plant complex to meet needs through 2080. Proposed transmission pipeline improvements include constructing a new 36-inch PVC pipeline, especially under the roadway crossings, to allow for additional pressures from the new 25 MGD pump station.

Table 5B.10.14.
Cost Estimate Summary for Lake Texana/Lower Colorado River Improvements:
Conveyance and Transmission

<i>Item</i>	<i>Estimated Costs for Facilities</i>
CAPITAL COST	
Pump Station (25 MGD)	\$17,850,000
Transmission Pipeline Improvements (new 36-inch)	\$11,411,000
TOTAL COST OF FACILITIES	\$29,261,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	\$9,670,800
Environmental & Archaeology Studies and Mitigation	\$50,000
Land Acquisition and Surveying	\$0
Interest During Construction (3.5% for 1 year with a 0.5% ROI)	\$1,267,000
TOTAL COST OF PROJECT	\$40,249,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$2,832,000
Operation and Maintenance	
Pump Station (2.5% of Cost of Facilities)	\$446,300
Transmission Pipeline Improvements (1% of Cost of Facilities)	\$114,100
Purchase of Raw Water (33,627 ac-ft/yr @ 381 \$/ac-ft)	\$12,812,000
TOTAL ANNUAL COST	\$16,204,000
Available Project Yield (ac-ft/yr)	33,627
Annual Cost of Water (\$ per ac-ft)	\$482
Annual Cost of Water (\$ per 1,000 gallons)	\$1.48

5B.10.3.3 Environmental Issues

The environmental impact of the conveyance improvements and new water treatment plant improvements is estimated to be negligible for the first project (Section 5B.10.3.1.1) and third project (Section 5B.10.3.1.3). The processing of more water daily by the new WTP could allow for increased consumption if demand estimates materialize, which may increase B&E inflows. Also, the new WTP would likely produce water of higher quality than the original source. The new pump stations, new pipelines and new WTP will not involve construction in undeveloped areas or excavation outside of existing pipeline right-of-way.

However, low to moderate environmental impact is estimated for the second project (Section 5B.10.3.1.2) identified in the overall SPMWD WMS. Construction of a new intake and upgrading the 36-inch pipeline with a 60-inch pipeline could cause low to moderate impact to wildlife habitat and wetlands.

5B.10.3.4 Engineering and Costing

The capital/construction cost estimates for each of the three individual projects presented in Section 5B.10.3.1.1 through Section 5B.10.3.1.3 were provided by SPMWD. The 2025 raw water rate from the City of Corpus Christi to SPMWD is currently \$381 per acre-ft (\$1.17 per 1,000 gallons). Table 5B.10.3.2 through Table 5B.10.3.4 summarize the capital and annual costs for the three individual projects of the overall SPMWD WMS. The *TWDB Uniform Costing Model User Guide* for the 2026 regional water plans was utilized regarding general guidelines.

5B.10.3.5 Implementation Issues

Implementation of this overall SPMWD water management strategy will require a National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan Permit. The sequencing of construction will have to consider that the SPMWD water system will need to continue operating throughout the construction process due to sensitive industrial processes which rely on continuous treatment operation. Modular improvements should be considered, when at all possible, to avoid potential service interruptions.

5B.10.3.6 Evaluation Summary

An evaluation summary of each of the three individual projects identified for the overall SPMWD WMS is provided below in Table 5B.10.15 through Table 5B.10.17. The evaluation criteria are based on TWDB requirements for the 2026 regional water plans.

Table 5B.10.15.
Evaluation Summary for New WTP at Plant D Site

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. 22,418 ac-ft/yr (20 MGD).
2. Reliability	2. High reliability.
3. Cost of treated water	3. \$819 per ac-ft
4. Estimated water losses	4. None – new construction
b. Environmental factors:	
1. Effects on Instream flows	1. Negligible impact.
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Negligible impact. The SPMWD new WTP may have minor increases in return flows to Nueces Bay and Estuary.
3. Wildlife habitat	3. Negligible impact. The SPMWD new WTP at Plant D Site will not disturb unaltered and/or new land.
4. Wetlands	4. Negligible impact.
5. Threatened and endangered species (TES)	5. Negligible impact. The SPMWD new WTP at Plant D Site will not disturb unaltered and/or new land or known TES critical habitat.
6. Cultural resources	6. Negligible impact. All work on existing SPMWD property or existing right-of-way should have no impact.
7. Water quality (WQ)	7. Low or no impact. The SPMWD new WTP will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
a. dissolved solids	
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other WQ constituents	
c. Impacts to Agricultural Resources or State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

Table 5B.10.16.
Evaluation Summary for Nueces River Improvements: Conveyance and Transmission

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. 69,495 ac-ft/yr (62 MGD).
2. Reliability	2. High reliability.
3. Cost of treated water	3. \$637 per ac-ft
4. Estimated water losses	4. None – new construction
b. Environmental factors:	
1. Effects on Instream flows	1. Low impact. Water would be released from Choke Canyon Reservoir into the Nueces River to maintain stream flows. Raw water that would be removed through the Nueces River intake would minimally change instream flows, if at all.
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Low impact. Water would be released from Choke Canyon Reservoir to replace raw water which would be removed from the Nueces River. Therefore, only minor impacts to freshwater flows entering Rincon Bayou would be anticipated.
3. Wildlife habitat	3. Low to Moderate impact. New areas would be disturbed for the installation of the transmission pipeline and new intake facility. Some impacts to wildlife habitat, especially within and along the Nueces River and its floodplain.
4. Wetlands	4. Low to Moderate impact. Wetlands are likely present along the intake area and portions of the pipeline route. Delineation and avoidance would be recommended where possible.
5. Threatened and endangered species (TES)	5. Low impact. No known impacts to listed species or critical habitats. Habitat assessment would be recommended during design.
6. Cultural resources	6. Unknown impact. The project would be a new alignment, and it is anticipated that a cultural resources survey would be required.
7. Water quality (WQ)	7. Low or no impact. The Nueces River Improvements will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
a. dissolved solids	
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other WQ constituents	
c. Impacts to Agricultural Resources or State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None



<i>Impact Category</i>	<i>Comment(s)</i>
k. Impacts on water pipelines and other facilities used for water conveyance	• None

Table 5B.10.17.
Evaluation Summary for Lake Texana/Lower Colorado River Improvements: Conveyance and Transmission

Impact Category	Comment(s)
a. Water supply:	
1. Quantity	1. 33,627 ac-ft/yr (25 MGD).
2. Reliability	2. High reliability.
3. Cost of treated water	3. \$482 per ac-ft.
4. Estimated water losses	4. None – new construction
b. Environmental factors:	
1. Effects on Instream flows	1. Negligible impact.
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Negligible impact. The new pump station and new pipeline will have minor impacts to flows to bays and estuaries.
3. Wildlife habitat	3. Low impact. This project will not disturb previously undisturbed areas.
4. Wetlands	4. Negligible impact. Pump station could be sited to avoid wetland impacts and the new pipeline would be along the existing pipeline route.
5. Threatened and endangered species (TES)	5. Low impact. No known impacts to listed species or critical habitats. No unaltered land would be disturbed.
6. Cultural resources	6. Negligible to Low impact. It is anticipated this project would take place within areas previously surveyed for cultural resources and then disturbed for pipeline use.
7. Water quality (WQ)	7. Low or no impact. The new pump station and new pipeline will likely produce water of higher quality than the original source water (including lowered TDS), as the facility would remove solids.
a. dissolved solids	
b. salinity	
c. bacteria	
d. chlorides	
e. bromide	
f. sulfate	
g. uranium	
h. arsenic	
i. other WQ constituents	
c. Impacts to Agricultural Resources or State water resources	• No apparent negative impacts on water resources
d. Threats to agriculture and natural resources in region	• None
e. Recreational impacts	• None
f. Equitable comparison of strategies	• Standard analyses and methods used
g. Interbasin transfers	• Not applicable
h. Third party social and economic impacts from voluntary redistribution of water	• None
i. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions
j. Effect on navigation	• None
k. Impacts on water pipelines and other facilities used for water conveyance	• None

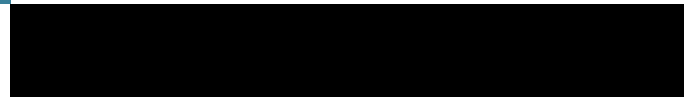


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5B.11

*Diversion to Choke
Canyon Reservoir*



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Section 5B.11 Diversion to Choke Canyon Reservoir

5B.11.1 Description of Water Management Strategy

The Diversion to Choke Canyon Reservoir strategy diverts unappropriated flows in the Nueces River to Choke Canyon Reservoir (CCR) when Lake Corpus Christi (LCC) is full and unable to store them downstream. Diverting flows in the Nueces River during high-flow events offers mitigation for flood impacts downstream in addition to the water supply that the strategy provides. The diversion leverages two parallel, 2.4-mile, 144-inch pipelines to convey a peak capacity of 731.6 million gallons per day (mgd) (1,132 cubic feet per second) at a velocity of 5 feet per second.

CCR is located on the Frio River upstream of the confluence with the Nueces River. LCC is located on the Nueces River, downstream of the confluence. The City of Corpus Christi operates these two reservoirs as a system and inflows are passed in accordance with the agreed order¹ set by the Texas Commission on Environmental Quality (TCEQ) (formerly TRNCC) in 2001. The agreed order defines required in-stream environmental flow requirements for the purpose of maintaining healthy ecosystems in the Nueces Estuary and Corpus Christi Bay. Passthrough requirements for environmental flows are based on the combined storage of the CCR-LCC system at thresholds of 70 percent, 40 percent, and 30 percent of storage capacity. The strategy would divert water from the Nueces River for subsequent discharge and storage in CCR when environmental flow requirements and downstream water rights have been satisfied and LCC is unable to store additional water.

5B.11.2 Available Yield

The firm yield of the project was assessed using the TCEQ's Nueces Basin Run 3 Water Availability Model (WAM). A firm yield was computed for the CCR-LCC system for two scenarios: one representing current conditions and one with the strategy in place. To do this, monthly available flows from the WAM were disaggregated to daily flows using nearby historical data from U.S. Geological Survey (USGS) streamflow gages. The amount of available flow diverted was determined using the strategy's capacity and the daily available streamflows. The WAM was then re-run with targets set to the diversion amounts calculated in the daily analysis.

Results of the modeling indicate the strategy does not increase the firm yield of the system due to no availability of unappropriated flows during the critical drawdown period of the system. Prior to the critical drawdown period (July 1992-August 1996), both reservoirs were full, meaning that no previous diversions would affect the firm yield. However, the strategy does increase the average annual supply from the CCR-LCC system by approximately 2,939 acre-feet per year

¹ Texas Natural Resource Conservation Commission. 2001. An Agreed Order: Amending the operational procedures and continuing an Advisory Council Pertaining to Special Condition 5.B., Certificate of Adjudications No. 21-3214; Docket No. 2001-0230-WR

(ac-ft/yr). This means that existing water rights that draw from the CCR-LCC system could expect to see a combined 2,393 ac-ft/yr of additional water on average.

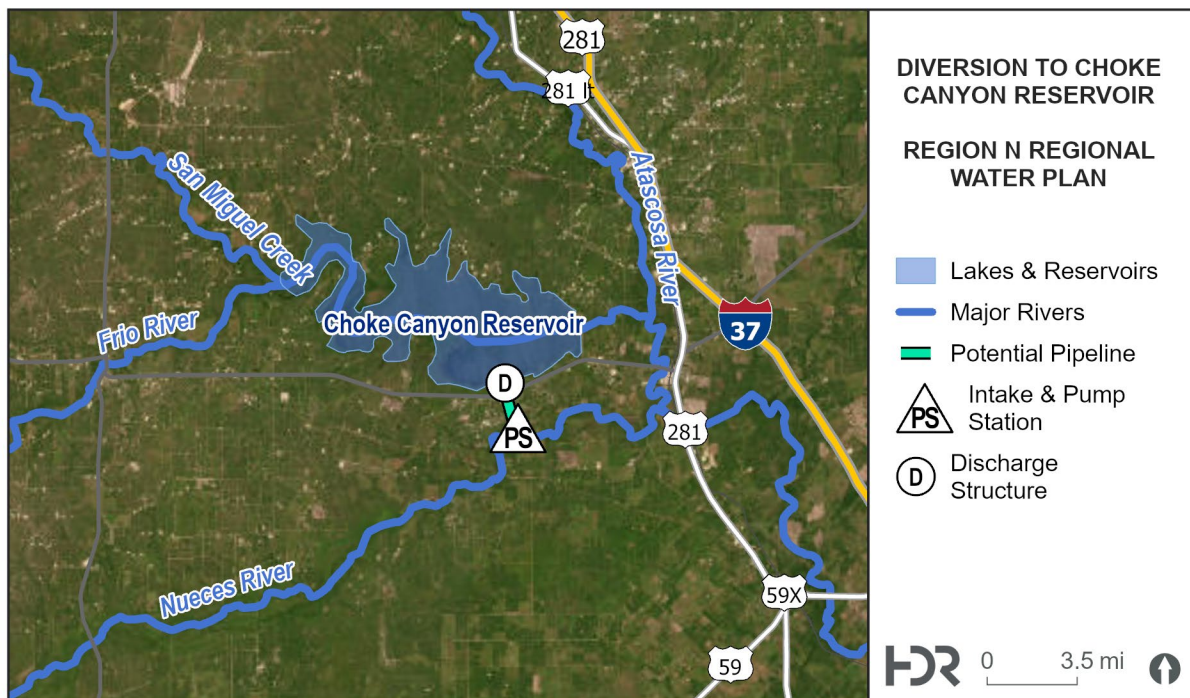


Figure 5B.11-1
Diversion to Choke Canyon Reservoir: Strategy Layout

As shown in Figure 5B.11-2 and Figure 5B.11-3, unappropriated flows are available less than 4 percent of the time (at a daily interval). While there is frequently available storage in CCR (see Figure 5B.11-4), there is also available storage in LCC roughly 90 percent of the time (Figure 5B.11-5), limiting the efficacy of a diversion. Additionally, flows in the Frio River allocated to downstream water rights can be stored in CCR without the use of the diversion (see the map in Figure 5B.11-1). This approach is already being implemented and is improving the efficiency of the CCR-LCC system in the same way that the diversion might.

Diversions made during high flow events do not affect the simulated firm yield of the reservoir system. In the firm yield analysis, there is no available flow for diversion during the critical drawdown period of CCR and LCC, and both reservoirs were full at the onset of the drought. This can be seen in Figure 5B.11-6 and Figure 5B.11-7.

A diversion capacity was determined for two parallel 144-inch pipelines with a peak flow velocity of 5.0 feet per second and applied to the available flows. This pipeline capacity represents the upper bound of common pipelines for water supply projects and was selected because it has lower unit cost of water than smaller projects.

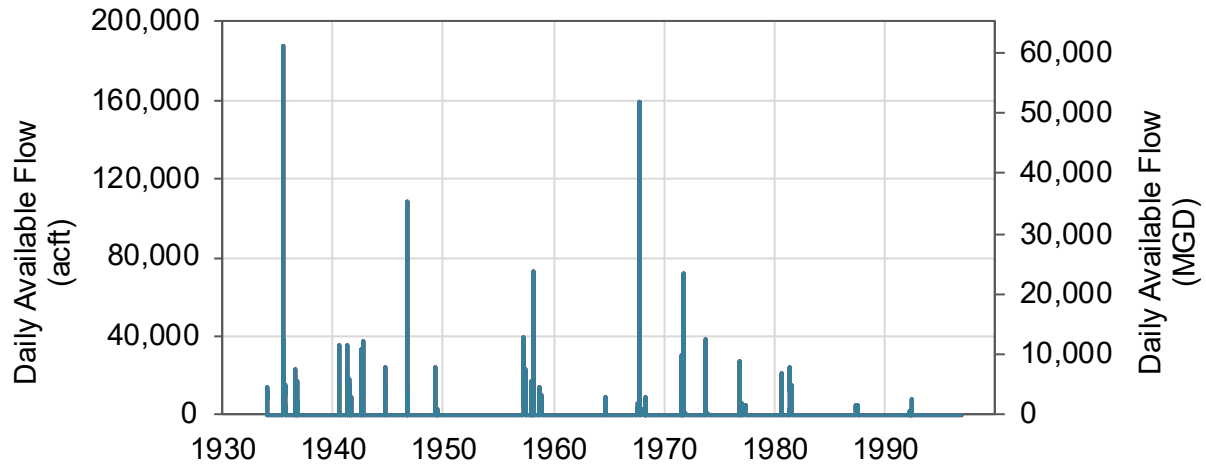


Figure 5B.11-2.

Daily Available Flow in the Nueces River Near Tilden After Senior Water Rights and Environmental Flows Have Been Accounted For

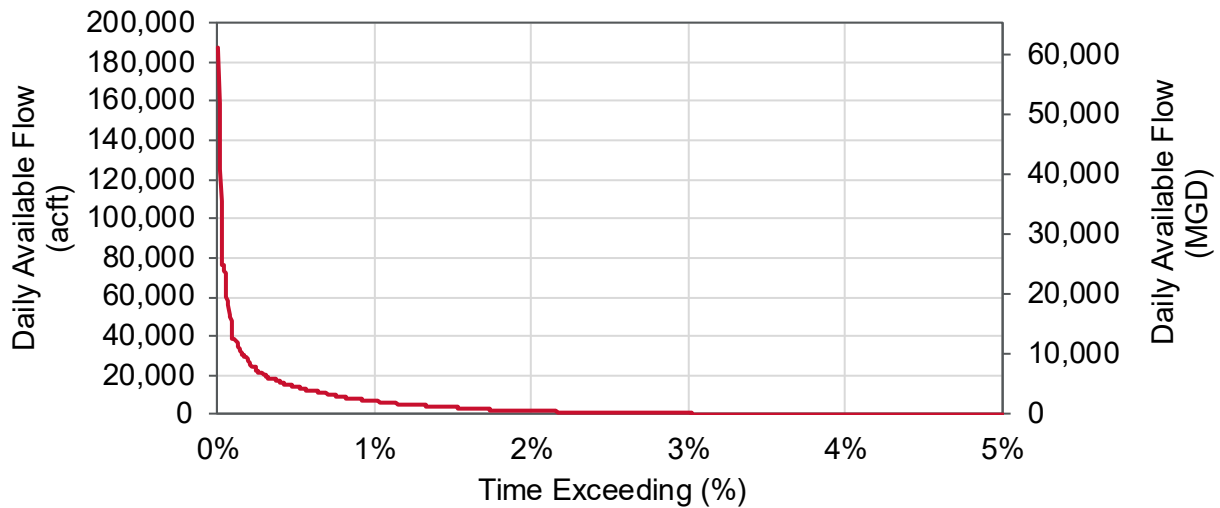


Figure 5B.11-3.

Frequency of Available Flows in the Nueces River Near Tilden After Senior Water Rights and Environmental Flows Have Been Accounted For

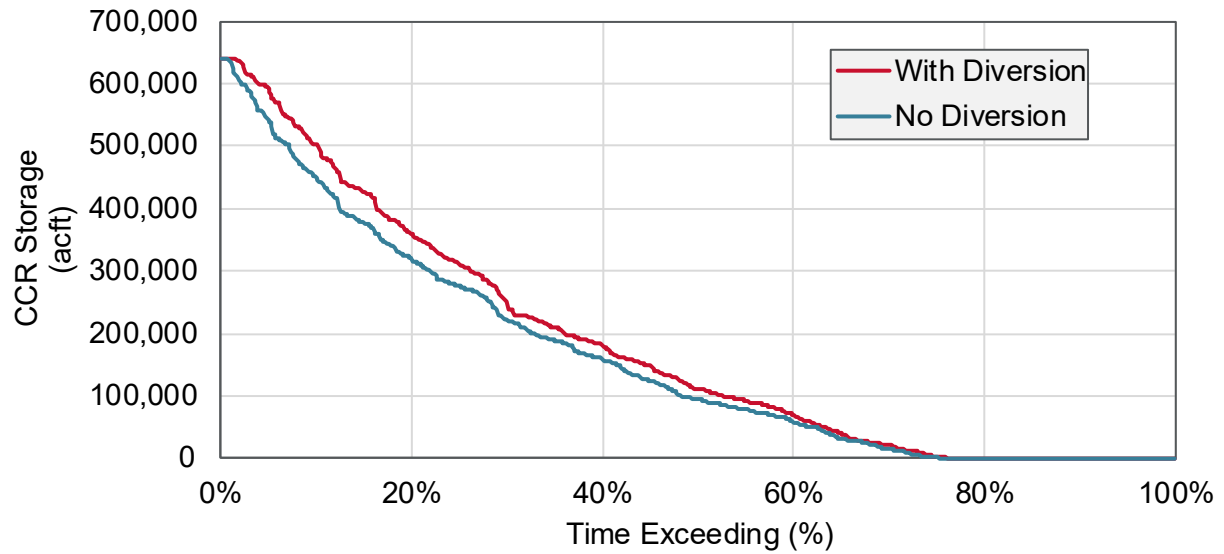


Figure 5B.11-4
Storage Versus Frequency Relationship for CCR

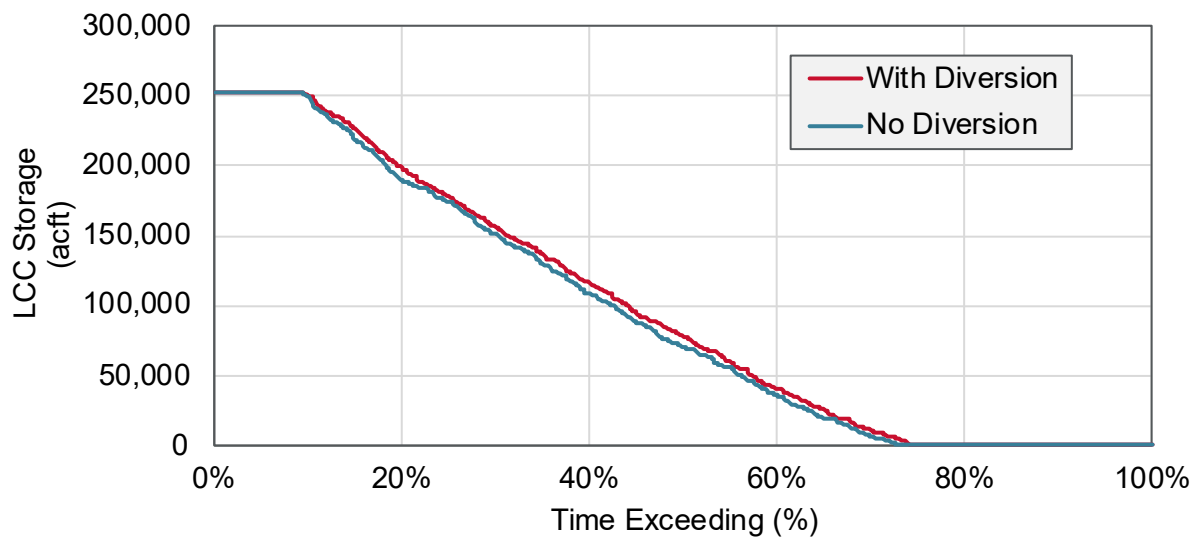


Figure 5B.11-5.
Storage Versus Frequency Relationship for LCC

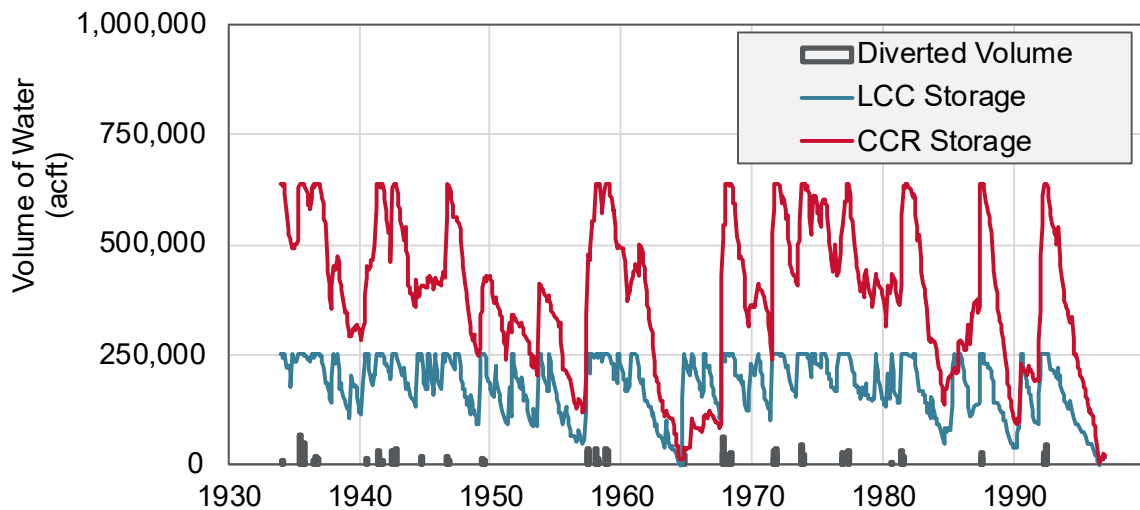


Figure 5B.11-6.
Firm Yield Analysis for CCR-LCC System

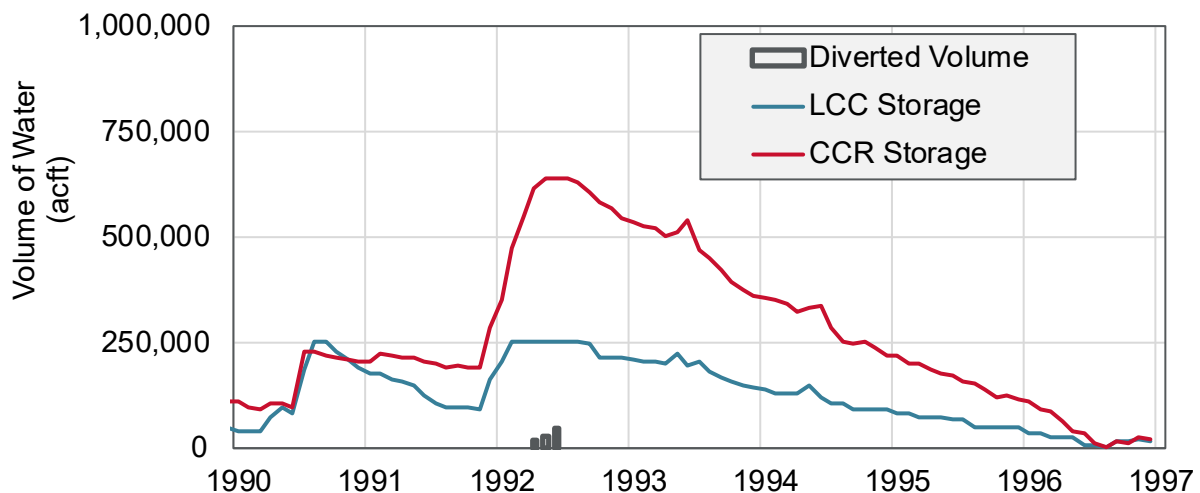


Figure 5B.11-7.
Firm yield Analysis for CCR-LCC System: Critical Drawdown Period

5B.11.3 Environmental Issues

The key environmental consideration to be made for the Diversion to CCR is in-stream environmental flow requirements. The Nueces River is the primary source of Freshwater to the Corpus Christi Bay and surrounding coastal ecosystems. These ecosystems rely on both large pulses of freshwater as well as more consistent lower flows. The environmental flow needs of downstream ecosystems have been addressed by using the TCEQ's Nueces Basin WAM.. The WAM computes environmental flows to the Nueces Bay in accordance with the 2001 Agreed

Order². Post-processing was performed to evaluate the availability of freshwater inflows to the bay and estuary and compare the effect that the project would have on those freshwater inflows. Table 5B.11.1 provides the TCEQ's Environmental Flow Standards for the Nueces River and Corpus Christi and Baffin Bay³ as well as the simulated freshwater inflows to the Nueces Bay. Both the baseline scenario and the with-project scenario miss freshwater inflow goals. However, the Diversion to Choke Canyon Reservoir increases the storage in the CCR-LCC system, triggering more pass-throughs to the bay in some months and marginally improving the frequency with which some of the inflow targets are met. The project decreases the years in which the Level 1 goal for November-February is met by 2%. Figure 5B.11-8 shows these results graphically.

Table 5B.11.1.
Freshwater Inflow Frequency Targets, Goals, and Performance⁴

-	November-February	March-June	July-October	Annual
Targets				
Level 1	125,000	250,000	375,000	750,000
Level 2	22,000	88,000	56,000	166,000
Level 3	5,000	10,000	15,000	30,000
Goals				
Level 1	11%	11%	12%	16%
Level 2	23%	30%	40%	47%
Level 3	69%	88%	74%	95%
Baseline				
Level 1	5%	5%	8%	6%
Level 2	34%	17%	41%	35%
Level 3	65%	70%	71%	83%
With Project				
Level 1	3%	5%	8%	6%
Level 2	34%	21%	43%	40%
Level 3	68%	70%	71%	83%
Change Due to Project				
Level 1	-2%	0%	0%	0%
Level 2	0%	3%	2%	5%
Level 3	3%	0%	0%	0%

² Texas Natural Resource Conservation Commission. 2001. An Agreed Order: Amending the operational procedures and continuing an Advisory Council pertaining to Special Condition 5.B., Certificate of Adjudication No. 21-3214; Docket No. 2001-0230WR

³ Texas Commission of Environmental Quality. 2014. Chapter 298 – Environmental Flow Standards for Surface water: Nueces River and Corpus Christi and Baffin Bays.

⁴ Texas Commission of Environmental Quality. 2014. Chapter 298 – Environmental Flow Standards for Surface water: Nueces River and Corpus Christi and Baffin Bays.

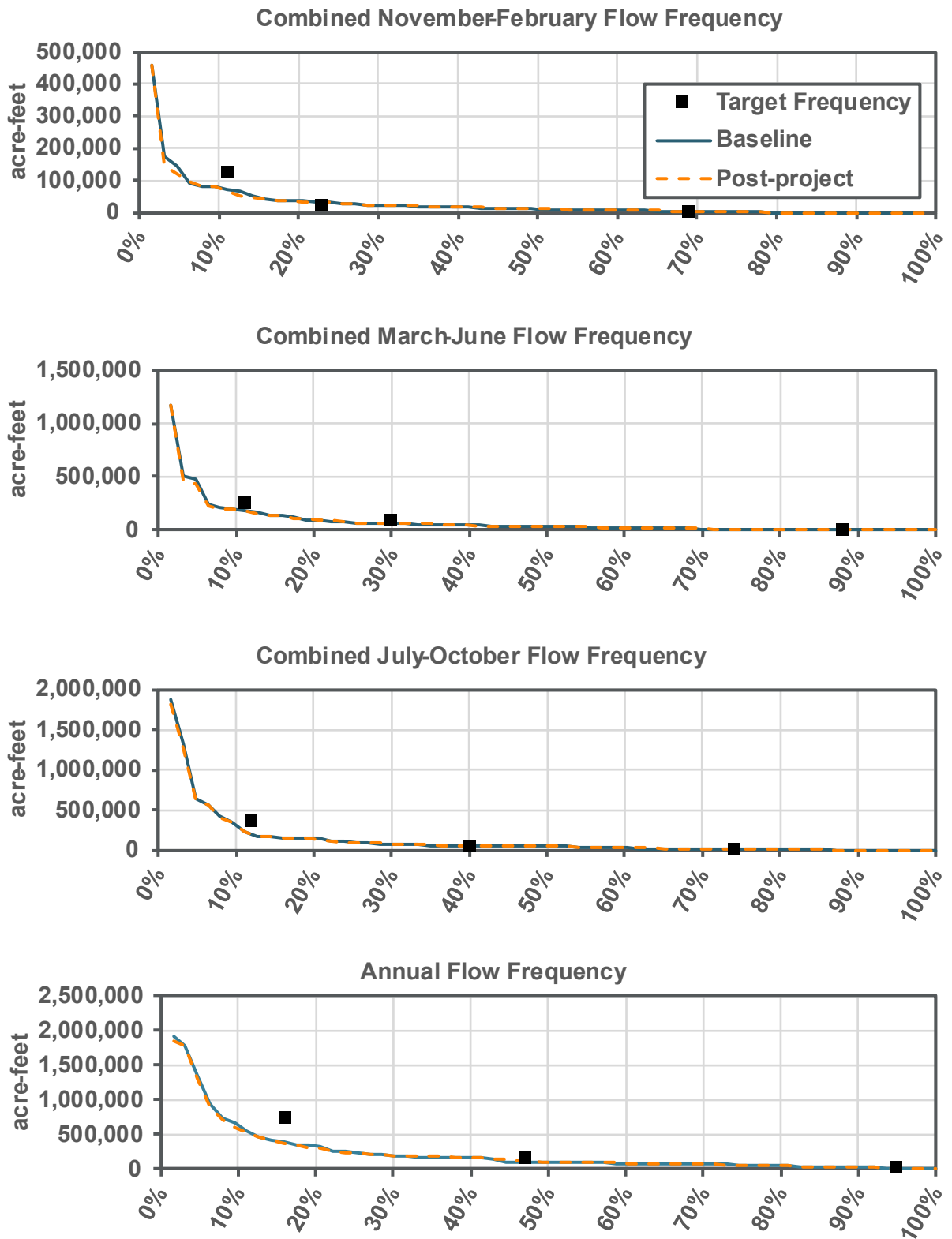


Figure 5B.11-8.
Freshwater Inflow Frequency Targets, Goals, and Performance

The project infrastructure possesses less potential for negative environmental impacts. The largest of these impacts would likely be from the channel dam, which is part of the intake structure. The channel dam would create a small permanent impoundment that the pump station could draw from. The proposed location of the 2.4-mile pipeline follows an existing road and runs through an area that has experienced at least some level of human disturbance previously. Temporary disruption of water quality in the Nueces River during construction of the intake structure may be a concern.

High levels of suspended solids are common during high flow events. Diverting water from the Nueces River into CCR may negatively affect the water quality of CCR because of suspended solids in the Nueces. Adding a sedimentation facility such as a ring dike to the proposed project could mitigate negative water quality effects due to suspended solids if they prove to be an issue.

According to Texas Parks and Wildlife Department's annotated county list of rare species for Live Oak County, 14 state-listed endangered or threatened species and seven federally-listed endangered, threatened, proposed endangered, or candidate species may occur in the county as shown in Table 5B.11.2.

Table 5B.11.2
Federal- and State-Listed Threatened, and Endangered Listed for Live Oak County

Common Name	Scientific Name	Summary of Habitat Preference	Potential Occurrence in Project Area	Federal Status	State Status
Black-spotted newt	<i>Notophthalmus meridionalis</i>	May be found in resacas and bodies of water with firm bottoms and little or no vegetation.	Resident	--	T
Sheep frog	<i>Hypopachus variolosus</i>	Predominantly grassland and savanna.	Resident	--	T
South Texas siren (large form)	<i>Siren sp. 1</i>	Mainly found in bodies of quiet water, permanent or temporary, with or without submerged vegetation.	Resident	--	T
Interior Least Tern	<i>Sternula antillarum athalassos</i>	Sand beaches, flats, bays, inlets, lagoons, islands. Subspecies is listed only when inland (more than 50 miles from a coastline).	Resident	--	E
Piping plover	<i>Charadrius melodus</i>	Beaches and flats of coastal Texas.	Migrant	T	T
Swallow-tailed kite	<i>Elanoides forficatus</i>	Lowland forested regions, especially swampy areas, ranging into open woodland.	Resident	—	T
White-faced ibis	<i>Plegadis chihi</i>	Prefers freshwater marshes.	Resident	--	T
White-tailed hawk	<i>Buteo albicaudatus</i>	Coastal prairies, savannahs and marshes in Gulf Coastal Plain.	Nesting/Migrant	—	T
Whooping crane	<i>Grus Americana</i>	Winters in coastal marshes.	Migrant	E	E
Wood stork	<i>Mycteria Americana</i>	Forages in prairie ponds, ditches and shallow standing water; formerly nested in Texas.	Migrant	—	T
Yellow-billed cuckoo	<i>Coccyzus americanus</i>	In Texas, populations of concern are found breeding in riparian areas in the Trans Pecos.	Migrant	T	--
Migratory monarch butterfly	<i>Danaus plexippus plexippus</i>	Habitat description is not available at this time.	Migrant	PT	--
Ocelot	<i>Leopardus pardalis</i>	Dense chaparral thickets; mesquite-thorn shrub and live oak stands.	Resident	E	E
Tricolored bat	<i>Perimyotis subflavus</i>	Forest, woodland, and riparian areas are important. Caves are very important.	Resident	PE	--
White-nosed coati	<i>Nasua narica</i>	Woodlands, riparian corridors and canyons.	Transient	—	T
American alligator	<i>Alligator mississippiensis</i>	Coastal marshes, inland natural rivers and marshes, manmade impoundments.	Resident	SAT	--
Texas horned lizard	<i>Phrynosoma cornutum</i>	Varied; sparsely vegetated uplands, grass, cactus, brush.	Resident	—	T
Texas tortoise	<i>Gopherus berlandieri</i>	Open bush with grass understory; open grass and bare ground avoided.	Resident	—	T

Source: TPWD, Annotated County List of Rare Species, Live Oak County, last updated: January 15, 2025.

PT Proposed Threatened
PE Proposed Endangered
E Endangered

SAT Special Assessment Status
-- Not Listed
T Threatened

Inclusion in Table 5B.11.2 does not imply that a species will occur within the project area but only acknowledges the potential for occurrence in the project area county. A more intensive field reconnaissance would be necessary to confirm and identify specific species habitat that may be present in the project area.

The proposed pipeline and channel dam have potential to cross rivers and streams which could be considered waters of the U.S. A delineation of waters should be conducted early in the design phase to assist with proper siting to avoid or minimize impacts to waters of the U.S. Section 404 of the Clean Water Act regulates the discharge of dredge or fill material in jurisdictional waters. Impacts within the ordinary high water mark of a jurisdictional water would require a Section 404 permit and coordination with the U.S. Army Corps of Engineers may be required.

Additional studies including a habitat assessment for threatened and endangered species and cultural resources investigations should be completed early in the design phase to assist with siting. Proper siting can avoid and minimize impacts to sensitive resources. Using sites that have previously been disturbed, such as roads and agricultural land, can minimize impacts to wildlife habitat along the pipeline route. Coordination with U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department would be required for potential impacts to threatened or endangered species or their habitat. Coordination with Texas Historical Commission would be required in accordance with the Texas Antiquities Code and/or Section 106.

5B.11.4 Engineering and Costing

The facility cost for the Diversion to Choke Canyon Reservoir is estimated to be \$310,566,000. The total cost of the project is estimated to be \$427,712,000. Annually, that equates to \$12,188 per acft of increased average supply. The increased supply is an average over the simulation and is not a firm supply.

The key features identified for costing and planning during the 2026 cycle of regional water planning include the following items:

- Intake on the Nueces River
- Roughly 2.4 miles of pipeline and associated right-of-way
- Pumps and lift station, etc.
- Outfall into Choke Canyon Reservoir



Figure 5B.11-9.
Diversion to Choke Canyon Reservoir Infrastructure

Table 5B.11.3.
Cost Estimate Summary: Diversion to Choke Canyon Reservoir

Table Units: September 2023 Dollars

Item	Estimated Costs for Facilities
CAPITAL COST	
Intake Structure Including Channel Dam	\$12,609,000
Intake Pump Stations (731.7 MGD)	\$166,657,000
Transmission Pipeline (144 in. dia., 4.8 miles)	\$131,300,000
TOTAL COST OF FACILITIES	\$310,566,000
Engineering:	
- Planning (3%)	\$9,317,000
- Design (7%)	\$21,740,000
- Construction Engineering (1%)	\$3,106,000
Legal Assistance (2%)	\$6,211,000
Fiscal Services (2%)	\$6,211,000
Pipeline Contingency (15%)	\$17,445,000
All Other Facilities Contingency (20%)	\$38,853,000
Environmental & Archaeology Studies and Mitigation	\$394,000
Land Acquisition and Surveying (25 acres)	\$405,000
Interest During Construction (3.5% for 1 years with a 0.5% ROI)	\$13,464,000
TOTAL COST OF PROJECT	\$427,712,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$30,094,000
Operation and Maintenance:	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$1,313,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	\$4,166,000
Dam and Reservoir (1.5% of Cost of Facilities)	\$189,000
Pumping Energy Costs (614050 kW-hr @ 0.09 \$/kW-hr)	\$55,000
TOTAL ANNUAL COST	\$35,817,000
Additional Annual Supply (non-firm) (acft/yr)	2,939
Annual Cost of Water (\$ per acft), based on PF=279	\$12,188
Annual Cost of Water After Debt Service (\$ per acft), based on PF=279	\$1,948
Annual Cost of Water (\$ per 1,000 gallons), based on PF=279	\$37.40
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=279	\$5.98

5B.11.5 Implementation Issues

Constructing an intake, pump station, and outfall will require a U.S. Army Corps of Engineers (USACE) Section 404 permit for modification to a navigable US waterway. Additionally, the TCEQ may need to issue a new water right for the diversion to provide any new supply. This may not be required if City of Corpus Christi only intends to use this project as a method for capturing water allocated by existing water rights. However, this additional diversion point would need to be added to the water rights by amendment. Additionally, adjusting existing water rights associated with the CCR-LRR system might affect the agreed upon order and could entail a renegotiation of environmental flows and passthrough requirements.

5B.11.6 Evaluation Summary

Table 5B.11.4 offers a summary of the Diversion to Choke Canyon Reservoir strategy.

Table 5B.11.4.
Evaluation Summary of Diversion to Choke Canyon Reservoir

Impact Category	Comments
a. Water supply:	
1. Quantity	1. 2,939 acft/yr
2. Reliability	2. Non-firm
3. Cost of treated water**	3. \$12,188 per acft
4. Estimated Water Losses	4. Decrease in water losses to evaporation
b. Environmental factors:	
1. Effects on Instream flows	1. Only used during highwater events
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Only used to capture unappropriated flow
3. Wildlife habitat	3. Low to moderate impact
4. Wetlands	4. Moderate impact
5. Threatened and endangered species	5. Low to moderate impact
6. Cultural resources	6. Cultural resource investigations would be required to determine potential impact
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Water quality i. Potential increase of suspended solids in CCR when operated
c. Impacts to Agricultural Resources or State water resources	c. 25 acres of rural land acquired for ROW
d. Threats to agriculture and natural resources in region	d. Possible oil and gas pipeline crossings; 25 acres of rural land acquired for ROW
e. Recreational impacts	e. No Impact
f. Equitable comparison of strategies	f. Followed RWP guidelines
g. Interbasin transfers	g. No interbasin transfer
h. Third party social and economic impacts from voluntary redistribution of water	h. No redistribution of water
i. Efficient use of existing water supplies and regional opportunities	i. Improves efficiency by storing water higher in the watershed
j. Effect on navigation	j. Intake structure may impede navigation of the Nueces River
k. Impacts on water pipelines and other facilities used for water conveyance	k. No known effect on water pipelines or other facilities

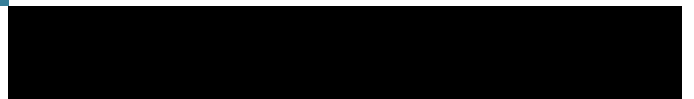


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5B.12

*Lake Corpus Christi
Sediment Removal*



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Section 5B.12 Lake Corpus Christi Sediment Removal

5B.12.1 Description of Water Management Strategy

The Lake Corpus Christi Sediment Removal strategy would increase the storage capacity of Lake Corpus Christi (LCC) providing additional water supply and flood protection in the southern Nueces River Basin. The strategy also offers a sediment source for coastal restoration projects in the Nueces Delta and other areas in the nearby Corpus Christi Bay.

Lake Corpus Christi Sediment Removal was evaluated during the 2001 regional water planning cycle. The strategy was not considered in subsequent regional water plans due to its high cost and low supply it would develop. New interest in Lake Corpus Christi Sediment Removal has been spurred by recent successful projects undergone by the General Land Office (GLO) that were able to use dredged material for beneficial use in costal restoration projects. Figure 5B.12.1 shows the proposed trucking route and alternative rail route to transport the dredged sediment from LCC to the Nueces Bay, where it could be carried by barge and applied to the Nueces Delta to mitigate the effects of land subsidence and sea level rise. It should be noted that dredging would produce much more sediment than could be put to beneficial use and that a large quantity of sediment would need to be disposed of.

5B.12.2 Available Yield



Figure 5B.12.1.
Potential Routes to Disposal Sites for Lake Corpus Christi Sediment Removal

The Lake Corpus Christi Sediment Removal strategy could potentially increase the firm yield of the Choke Canyon Reservoir-Lake Corpus Christi system (CCR-LCC System) by an estimated 2,000 acre-feet per year (ac-ft/yr). This estimate was calculated using the Texas Commission on Environmental Quality (TCEQ) Nueces Basin RUN 3 Water Availability Model (WAM) with current and proposed area-capacity relationships for the LCC-CCR System.

A sedimentation rate of 445 ac-ft/yr was applied to LCC to estimate volume lost to sedimentation by 2024. Because sedimentation in CCR also affects the yield of the system, a corresponding sedimentation rate of 944 ac-ft/yr was applied to CCR. The LCC sedimentation rate was determined from the two most recent TWDB bathymetric surveys, as shown in Table 5B.12.1. Figure 5B.12.2 displays the projected sedimentation in LCC.

Table 5B.12.1.
Sedimentation Estimates for LCC¹

Survey	Volume at conservation pool elevation 94.0 feet (acft)					
	1948	1957	1972	1987	2002	2016
Year of Survey	1948	1957	1972	1987	2002	2016
1948	292,758	<>	<>	<>	<>	<>
1957 re-calculated by McCaughan & Etheridge	<>	297,776	<>	<>	<>	<>
McCaughan & Etheridge 1972	<>	<>	272,352	<>	<>	<>
USGS 1987	<>	<>	<>	266,832	<>	<>
TWDB 2002 re-calculated	<>	<>	<>	<>	262,564	<>
2016 volumetric survey	256,339	256,339	256,339	256,339	256,339	256,339
Volume difference (acre-feet)	36,419 (12.4%)	41,437 (13.9%)	16,013 (5.9%)	10,493 (3.9%)	6,225 (2.4%)	<>
Number of years	68	59	44	29	14	<>
Capacity loss rate (acft/yr)	536	702	364	362	445	

¹ TWDB. 2017. Volumetric Survey of Lake Corpus Christi. February 2016 Survey. Table 3.

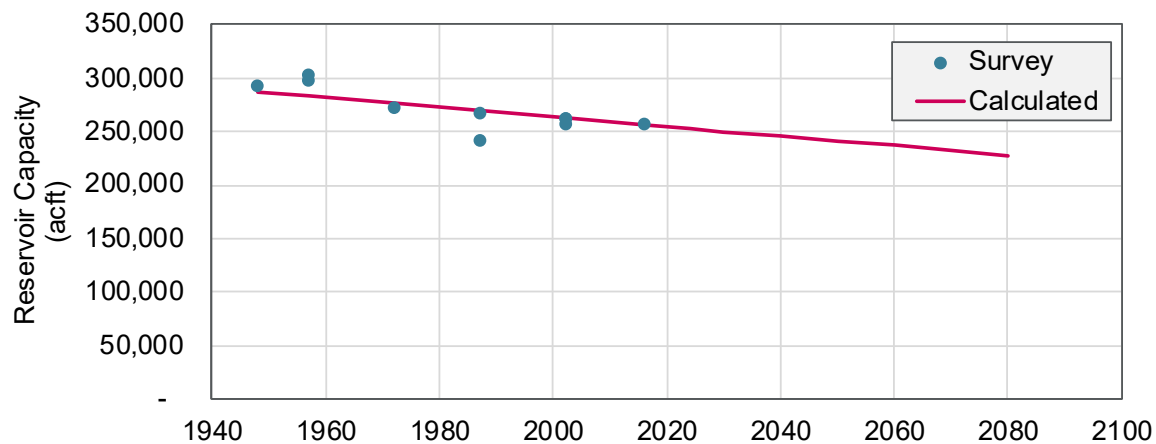


Figure 5B.12.2.
LCC Available Reservoir Storage and Decline Due to Sedimentation

Using updated, 2024 storage capacities, the firm yield of the LCC-CCR System was approximated at 173,000 ac-ft/yr using the TCEQ Nueces Basin RUN 3 WAM. A post-implementation firm yield of 175,000 ac-ft/yr was estimated by restoring LCC's storage capacity to its permitted volume of 300,000 acft in the WAM and performing the same firm yield analysis. The difference, 2,000 acre-feet (ac-ft), represents the yield of the strategy.

5B.12.3 Environmental Issues

Hydraulic dredging would likely increase the total suspended solids in LCC. In doing so, it would also increase the chance for contaminants in the sediment such as heavy metals to become biologically available. For similar reasons, sediments to be applied in beneficial use zones may be screened by comparison with TCEQ Human Health Protective Concentration Levels (PCLs). The chemical makeup of LCC sediment has been tested in the past; however, the current PCLs for many constituents such as mercury and silver are lower than the detection limits of those studies. Therefore, additional testing would be necessary to determine any hazard posed by contaminants in LCC's sediment. Remediation is not included in the estimated cost of this strategy. For this evaluation, it has been assumed that sediment could be dredged and placed without causing water quality issues.

How to dispose of sediment not applied in beneficial use zones is another environmental consideration to be made. This evaluation has assumed that dewatered sediment could be land applied up to 10 feet high. Several thousand acres would be required to store the volume of sediment removed from LCC. This would alter the landscape and drainage of a large area. To minimize the impact of sediment disposal, previously disturbed habitat, such as agricultural land or similar could be prioritized for site selection.

5B.12.4 Engineering and Costing

Cost estimates for Lake Corpus Christi Sediment Removal are based on a 2024 study performed for the GLO by Anchor QEA. This report assesses the feasibility of removing 100,000 cubic yards (CY) (62.0 ac-ft) of sediment from LCC for beneficial use. In comparison, an estimated 76 million CY (47,107 ac-ft) of sediment would need to be removed from LCC to return LCC to its permitted volume of 300,000 ac-ft. This is magnitudes larger than the Anchor QEA evaluation and other projects common in the U.S., and economies of scale may emerge that are specific to this project that might reduce the costs. To model this effect, only the costs of dredging, transporting, and contingencies were scaled up from the smaller project's cost estimates. Costs such as mobilization, access road construction, etc. were left unchanged from Anchor QEA's estimate. The total unit cost of removing sediment is assumed to be \$35/CY versus the Anchor QEA's estimate of \$55/CY. For an additional reference, the recent expansion of the Suez Canal, completed in 2015, dredged nearly \$259 million/CY at an overall unit cost of \$43/CY in September 2023 dollars²³.

Sediment would need to be dewatered and transported overland by truck or train to a disposal area or pumped via a slurry pipeline to a dewatering and disposal area. In the case of a slurry pipeline, water would then need to be pumped back to LCC. Alone, hydraulically dredging 76 million CY of sediment would cost \$528,937,000 before dewatering, transportation, application, or contingencies at an assumed unit cost of \$6.94 per CY⁴. The cost to remove 445 ac-ft of sediment per year to prevent future sedimentation has been included in the annual maintenance cost. If this strategy is implemented, further work may be needed to determine the most economical way to remove sediment after the initial dredging project. In this study, it is assumed that preventative sediment removal for maintenance would cost the same per CY as the initial project.

The largest cost associated with the strategy is transportation of the dredged material. It is assumed for this evaluation that sediment would be trucked 28 miles from LCC to the Nueces Delta for beneficial use or would be trucked a comparable distance for disposal. The trucking cost is estimated at \$1,461,239,000 in September 2023 dollars, which is equivalent to \$4.84 million 20-ton dump truck trips (15.7 CY capacity) over the duration of the project. This number could vary if a different mode of transportation were selected.

More sediment would be removed than can be utilized for beneficial use in the Nueces-Corpus Christi Bay area. This evaluation assumes that 25% of the removed sediment could be put to beneficial use. Land for disposal of the remaining 57 million CY is assumed to be available in

² Suez Canal Authority. 2019. New Suez Canal. Facts and Figures. <https://www.suezcanal.gov.eg/English/About/SuezCanal/Pages/NewSuezCanal.aspx>

³ NCESC. 2024. How much did new Suez Canal cost? <https://www.ncesc.com/geographic-faq/how-much-did-new-suez-canal-cost/>

⁴ The unit cost provided here comes from the 2024 Anchor QEA report for the GLO but has been indexed to September 2023 dollars

Live Oak County at the cost of \$5,800 per acre. Assuming that dewatered sediment could be stored up to 10 feet tall, roughly 3,542 acres would be required for disposal.

The total project cost is estimated to be \$2.67 billion, costing \$228 million annually. With a firm yield of 2,000 ac-ft/yr, the unit cost of water is \$114,005 per ac-ft, or \$349.81 for one thousand gallons.

The key features of the Lake Corpus Christi Sediment Removal strategy that were identified for planning and costing for the 2026 Coastal Bend Regional Water Plan are the following:

- Dredging
- Transport of dredged material
- Dewatering and staging
- Site construction for staging
- Land acquisition for disposal
- Sediment distribution

Table 5B.12.2.
Cost Estimate Summary: Lake Corpus Christi Sediment Removal

Table Unit: September 2023 Dollars

Item	Estimated Costs for Facilities
CAPITAL COST	
Land Acquisition for Terminal Storage of Sediment	\$19,479,000
Dredging and Transportation of Sediment	\$1,652,934,000
TOTAL COST OF FACILITIES	\$1,672,413,000
Engineering:	
- Planning (3%)	\$50,172,000
- Design (7%)	\$117,069,000
- Construction Engineering (1%)	\$16,724,000
Legal Assistance (2%)	\$33,448,000
Fiscal Services (2%)	\$33,448,000
All Other Facilities Contingency (20%)	\$334,483,000
Environmental & Archaeology Studies and Mitigation	\$20,541,000
Land Acquisition and Surveying (3542 acres)	\$20,754,000
Interest During Construction (3.5% for 5 years with a 0.5% ROI)	\$373,597,000
TOTAL COST OF PROJECT	\$2,672,649,000
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	\$182,522,000
Reservoir Debt Service (3.5 percent, 40 years)	\$3,679,000
Operation and Maintenance:	-
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	\$41,516,000
Dam and Reservoir (1.5% of Cost of Facilities)	\$292,000
TOTAL ANNUAL COST	\$228,009,000
Available Project Yield (ac-ft/yr)	2,000
Annual Cost of Water (\$ per ac-ft), based on PF=1	\$114,005
Annual Cost of Water After Debt Service (\$ per ac-ft), based on PF=1	\$20,904
Annual Cost of Water (\$ per 1,000 gallons), based on PF=1	\$349.81
Annual Cost of Water After Debt Service (\$ per 1,000 gallons), based on PF=1	\$64.14

5B.12.5 Implementation Issues

Dredging projects in navigable waters of the United States such as this require a Clean Water Act, Section 404 permit from the U.S. Army Corps of Engineers (USACE). Additionally, distribution of removed sediment for coastal restoration would likely require USACE authorization under Section 10 of the Rivers and Harbors Act of 1899, as structure is being constructed in navigable waters of the US. Water quality impacts from the dredging and distribution of sediment may warrant a Section 401 permit from the USACE under the Clean Water Act. The above permitting requirements would require a National Environmental Policy Act (NEPA) environmental assessment (EA) and potentially a biological assessment (BA). The results of those assessment determine if an environmental impact statement (EIS) will be required for the Section 404 permit. The removal of Sediment from LCC may require a Sand and Gravel Permit from the Texas Parks and Wildlife Department (TPWD). Coordination with the Texas Historical Commission will likely be required but will be performed during the permitting process with the USACE. Compliance is required with water quality regulation set by the Lower Nueces River Watershed Partnership (LNRWP), the City of Corpus Christi, and the Nueces River Authority.

5B.12.6 Evaluation Summary

Lake Corpus Christi Sediment Removal would improve the storage capacity of LCC, which would offer additional water supply as a well as provide improved floodwater mitigation. However, the strategy would be expensive, with a total project cost of \$2.7 billion. It would offer 2,000 ac-ft/yr of additional water supply at the price of \$114,005 per ac-ft, or \$228 million annually. Sediment removal would more than meet the needs of all beneficial use projects in the area, meaning that a great deal of sediment would need to be disposed of in other locations. Further investigation would need to be performed on sediment to ensure that no harmful chemicals would be released by dredging. Table 5B.12.3 provides a breakdown of the strategy's notable elements and considerations.

Table 5B.12.3.
Evaluation Summary of Lake Corpus Christi Sediment Removal

Impact Category	Comments
a. Water supply:	
1. Quantity	1. 2,000 ac-ft/yr
2. Reliability	2. Firm
3. Cost of raw water**	3. \$ 114,005 per ac-ft
4. Estimated Water Losses	4. Decrease in water losses to evaporation
b. Environmental factors:	
1. Effects on Instream flows	1. Mitigated by system operations
2. Effects on Bay and estuary inflows and arms of the Gulf of Mexico	2. Mitigated by system operations
3. Wildlife habitat	3. Temporary degradation; long-term improvement
4. Wetlands	4. Temporary degradation, long-term improvement
5. Threatened and endangered species	5. The presence of T&E species would need to be identified during NEPA process.
6. Cultural resources	6. Impacts to cultural resources would primarily due to construction of transportation and disposal facilities and would be mitigated during project execution.
7. Water quality a. dissolved solids b. salinity c. bacteria d. chlorides e. bromide f. sulfate g. uranium h. arsenic i. other water quality constituents	7. Water quality i. Temporary increase in suspended solids during dredging ii. Potential release of heavy metals and other contaminants during dredging, dewatering, and disposal.
c. Impacts to Agricultural Resources or State water resources	c. No state-level impacts to agricultural or natural resources. Potential improvement to agricultural lands if sediment is land-applied.
d. Threats to agriculture and natural resources in region	d. No regional threat to agriculture or natural resources
e. Recreational impacts	e. Temporary impact only
f. Equitable comparison of strategies	f. Followed RWP guidelines
g. Interbasin transfers	g. No interbasin transfer
h. Third party social and economic impacts from voluntary redistribution of water	h. No redistribution of water
i. Efficient use of existing water supplies and regional opportunities	i. Improves efficiency by creating more storage per surface area
j. Effect on navigation	j. No effect on navigation
k. Impacts on water pipelines and other facilities used for water conveyance	k. No effect on water pipelines or other facilities



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Section 5C Conservation Recommendations

Regional water planning guidelines require each region to consider water conservation to meet projected shortages, although funding to implement such water conservation programs is limited. Conservation is shown as a recommended strategy for all water user groups with needs identified for the planning period. The CBRWPG adopted the following conservation recommendations for the 2026 Coastal Bend Regional Water Plan during their meeting on January 30, 2025:

- Manufacturing water user groups with water demands in their respective categories were recommended to voluntarily reduce water use by 15 percent by 2080 regardless of need. These WUGs report the largest identified needs in the region by category and were recommended to continue to pursue best management practices to reduce water consumption.

Industries in the Coastal Bend Region have a good history of implementing water conservation practices, and report some of the lowest water use in the state per barrel of crude produced. The City of Corpus Christi directly, and indirectly through SPMWD, provides most water for manufacturing WUGs with identified needs during the projection period.

- Mining water user groups with water demands in their respective categories were recommended to voluntarily reduce water use by 15 percent by 2080 regardless of need. Mining companies are continuing to make advancements in water conservation into their processes by constructing and operating non-commercial recycling ponds to provide additional water supply. These activities are regulated by the Texas Railroad Commission, and recycled water use from these ponds varies from 15 percent to 70 percent.
- Conservation recommendations were not made for livestock water user groups, similar to the previous planning cycles.
- Additional conservation for irrigation water user groups was not requested for this planning cycle, as a result of the region showing a decline in water needs (approximately 50 percent less) due to field efficiency achieved with saving water. Although irrigated acreage declined statewide by approximately 2.3 million acres in 2021, the agricultural census indicates that irrigated acreage in the 11-county Coastal Bend area totaled 26,010 acres, with 82 percent of the regional total occurring in Bee, Duval, and San Patricio counties. Table 5C.1 summarizes the variety of crops grown in the Coastal Bend Region and number of irrigated acres for each county in 2021.

Table 5C.1.
Irrigated Acres by Crop (2021) Coastal Bend Region

County	Corn	Cotton	Hay	Sorghum	Vegetables	Other*	Total Acres
Aransas	0	0	0	0	0	0	0
Bee	2,130	2,610	60	2,050	0	250	7,100
Brooks	0	0	440	0	160	50	650
Duval	0	0	3000	0	750	600	4,350
Jim Wells	0	0	550	0	650	530	1,730
Kenedy	0	0	0	0	0	0	0
Kleberg	0	0	330	0	0	0	330
Live Oak	550	470	360	110	0	0	1,490
McMullen	0	0	120	0	0	0	120
Nueces	0	10	40	30	0	410	490
San Patricio	1,880	4,180	20	3,510	160	0	9,750
Total Acres	4,560	7,270	4,920	5,700	1,720	1,840	26,010
Percent	17.53%	27.95%	18.92%	21.91%	6.61%	7.07%	

Source: TWDB Historical Agricultural Irrigation Water Use Estimates, 2021

*Other Category: represents crops not captured in an existing TWDB crop category; the "Other" crop category historically includes greenhouse and nursery operations.

- Municipal WUGs with per capita rates exceeding 140 gallons per person per day (gpcd) were recommended to voluntarily reduce per capita consumption by 1 percent annually through 2080 until a 140 gpcd rate is attained. This recommendation from the CBRWPG applies to all municipal WUGs with and without projected water supply needs (or shortage). Although the CBRWPG considered the recommendations of the Water Conservation Advisory Council (WCAC) report to the 88th Texas Legislature²; however, the WCAC methodology of calculating the estimated dry-year planning gpcd resulted in a projected gpcd reduction in the later planning decades that might not be realistic for some of the municipal WUGs.

A summary was prepared of common municipal water conservation best management practices appropriate for the region (Table 5C.2) and recommended 5- and 10-year water conservation targets (Table 5C.3). TWDB-provided information on implemented municipal water conservation programs in the Coastal Bend Region based on annual reports submitted by water user groups to TWDB is presented in Table 5C.4 through Table 5C.6. The CBRWPG recommends that water user groups in the region review the list and look to identify water user groups of a relevant size with similar water supply type and consider voluntary implementation of those best management practices, if applicable.

A Coastal Bend Region-specific model water conservation plan for municipal water users is included in Appendix C. These model plans include a list of best management practices in the region, to supplement TCEQ model water conservation plans found on TCEQ's website:

https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/conserv.html

² *Progress Made in Water Conservation in Texas: Report and Recommendations to the 88th Texas Legislature*, Water Conservation Advisory Council, December 2022.

Table 5C.2.
Summary of Water Conservation BMPs in the Coastal Bend Region

Wholesale Water Provider	WCP Available	Date	Best Management Practices							
			Reduce Water Losses/Unaccounted for Water/Leak Detection	Water Conservation Pricing/Seasonal or Inverted Block Rates	Reuse	Improve Meter Accuracy	Toilet Replacement/Retrofit Programs	Public/School Education	Landscape Conservation/Xeriscape	Others
City of Corpus Christi ¹	Y	2020	√	√	√	√		√	√	√
San Patricio Municipal Water District ¹	Y	2019	√	√	√	√		√	√	√
South Texas Water Authority ¹	Y	2018	√	√		√		√		
Nueces County WCID 3 ^{1,2}	Y	2019	√	√	√	√	√	√		
Port of Corpus Christi Authority	Y	2025	√			√				√
Water User Group										
Alice ¹	Y	2024	√	√	√	√		√	√	
Aransas Pass	Y	2019	√	√		√	√	√	√	
Beeville ¹	Y	2024	√	√	√	√		√		
El Oso WSC	Y	2008	√	√		√		√		√
Falfurrias ¹	Y	1999	√	√		√		√	√	
Holiday Beach WSC ¹	Y	2018	√	√	√	√	√		√	
Ingleside ¹	Y	2018	√	√	√	√		√	√	√
Kingsville ¹	Y	2018	√	√	√	√		√	√	
Lamar Improvement District ¹	Y	2024	√	√		√		√		
McCoy WSC ^{1,2}	Y	2014	√	√		√		√		
Nueces County WCID 4 ¹	Y	2019	√	√	√	√		√	√	
Nueces WSC ¹	Y	2018	√	√		√		√		
Odem ¹	Y	2013	√	√		√		√	√	√
Portland ¹	Y	2022	√	√	√	√	√	√	√	
Ricardo WSC ¹	Y	2018	√	√		√		√		
River Acres WSC ^{1,2}	Y	2021	√	√		√		√		
Robstown ²	Y	2011						√		
Rockport ²	Y	2015	√	√	√	√				
Taft ¹	Y	2013	√	√	√	√	√	√	√	
Three Rivers ²	Y	2019	√	√	√	√		√	√	√

¹ Water Conservation Plan on-file with the Nueces River Authority.

² Water Conservation Plan provided by the TWDB.

Table 5C.3.
Summary of 5- and 10-Year Water Conservation Goals in the Coastal Bend Region

Wholesale Water Provider	5-Year Goal		10-Year Goal	
	GPCD Target	General	GPCD Target	General
City of Corpus Christi ^{1,2,3}	195 ²	1% annual reduction over next decade & reduce summertime peak demand	184 ²	1% annual reduction over next decade & reduce summertime peak demand
San Patricio Municipal Water District ¹	141	1% annual reduction over next decade	134	1% annual reduction over next decade
South Texas Water Authority ¹	140-145	Not Available	140-145	Not Available
Nueces County WCID 3 ^{1,2}	103	Not Available	108	Not Available
Port of Corpus Christi Authority	N/A	Each customer to attain 90% of its five-year target(s) and/or goal(s)	N/A	Each customer to attain 95% of its ten-year target(s) and/or goal(s)
Water User Group				
Alice ¹	145	Reduce per capita use by 3%	141	Reduce per capita use by 3%
Aransas Pass ²	225	2.5% per capita	260	5% per capita
Beeville ¹	161	1% annual reduction over next decade	160	1% annual reduction over next decade
Corpus Christi ^{1,2,3}	195	1% annual reduction over next decade	184	1% annual reduction over next decade
El Oso WSC	N/A	Reduce water loss	N/A	Reduce water loss
Falfurrias ¹	N/A	Not Available	N/A	Not Available
Holiday Beach WSC ¹	58	Reduce water loss	56	Reduce water loss
Ingleside ¹	106	1% reduction in water loss and usage within the next 5 years	105	2% within the next 10 years
Kingsville ^{1,2}	130	1% annual reduction	125	1% annual reduction
Lamar Improvement District ¹	150	Reduce water loss	145	Reduce water loss
McCoy WSC ¹	115	Maintain current per capita usage; Reduce water loss to 4% of water pumped, line flushing/fire fighting	110	Reduce usage by 4.5%; Reduce water loss to 2% of water pumped, not including line flushing/fire fighting
Nueces County WCID 4 ^{1,2}	396	1% annual reduction over next decade	376	1% annual reduction over next decade
Nueces WSC ¹	118	Maintain current per capita usage	118	Maintain current per capita usage
Odem ¹	149	5% over the next 10 years	146	7% reduction in unaccounted-for water over the next 10 years
Portland ¹	88	5% reduction	84	10% reduction
Ricardo WSC ¹	95	Maintain current per capita usage	95	Maintain current per capita usage
River Acres WSC ¹	100	1% annual reduction	99	1% annual reduction
Robstown ²	N/A	Not Available	N/A	Not Available
Rockport	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands	107	Maintain unaccounted water in the system below 12% annually in 2016 and subsequent years and reduce other water demands
Taft ¹	147	Reduce per capita use by 3%	140	Reduce per capita use by 3%
Three Rivers ³	386	0.5% annual reduction	377	0.5% annual reduction

¹ Water Conservation Plan on-file with the Nueces River Authority.

² Information is from the 2019/2020 Water Conservation Plans, Target and Goal Table, provided by the TWDB.

³ Calculated by taking volume of treated water, excluding water sold to wholesale customers, and dividing by permanent population, divided by 365. Because industrial use is close to 40% of treated water, the per capita rate is higher.

N/A = Not Available

Table 5C.4.
Summary of Water Conservation Implementation Results (2023 Water Use Survey and 2022 Annual Report sent by Utility to TWDB)

Utility Name	Retail Populations	Gallons Saved	Gallons Reused
City of Alice	17,891	0	66,702,930
City of Aransas Pass	10,651	6,000,000	0
City of Beeville	15,612	3,500,000	0
City of Corpus Christi	325,406	*	52,787,862
City of Kingsville	26,213	100,000	0
City of Portland	23,046	160,530,000	10,500,000
City of Rockport	38,269	155,000,000	98,445,000
City of Three Rivers	4,411	0	13,966,575
Nueces County WCID 3	19,000	7,000,000	0
Nueces County WCID 4	3,024	485,000	0
River Acres WSC	2,500	330,000	0

*Data not included in City's 2022 TWDB Annual Report or 2023 TWDB Water Use Survey



Table 5C.5.
Details on BMPs Implemented

Utility Provider	Total Estimated Gallons Reused	Total Estimated Gallons Saved	Best Management Practices Category							
			Landscaping	Conservation Technology & Reuse	Financial	System Operations	Education and Public Awareness	Regulatory and Enforcement	Retail	Conservation Analysis and Planning
City of Alice	66,702,930	0	Golf Course Conservation and Park Conservation	Reuse for Plant Washdown	Water Conservation Pricing	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	School Education; Public Information	-	Other	-
City of Aransas Pass	0	6,000,000	-	-	-	Metering New Connections and Retrofitting Existing Connections	School Education; Public Information	-	-	-
City of Beeville	0	3,500,000	Golf Course Conservation and Park Conservation; Outdoor Watering Schedule	Reuse for On-site Irrigation, Plant Washdown, Chlorination/Dechlorination	Water Conservation Pricing	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	School Education; Public Information	-	-	-
City of Corpus Christi	52,787,862	*	Irrigation Consultation Program; Golf Course and Park Conservation	-	Water Conservation Pricing	System Water Audit and Loss Control	School Education	Prohibition on Wasting Water	-	-



Utility Provider	Total Estimated Gallons Reused	Total Estimated Gallons Saved	Best Management Practices Category							
			Landscaping	Conservation Technology & Reuse	Financial	System Operations	Education and Public Awareness	Regulatory and Enforcement	Retail	Conservation Analysis and Planning
City of Kingsville	0	100,000	-	-	-	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	School Education; Public Information	-	-	-
City of Portland	10,500,000	160,530,000	Landscape Irrigation Conservation and Incentives	Reuse for Chlorination /Dechlorination	Water Conservation Pricing	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	Public Information	Prohibition on Wasting Water	-	-
City of Rockport	98,445,000	155,000,000	Golf Course Conservation	Reuse for Chlorination /Dechlorination ; Reuse for On-site Irrigation; Reuse for Plant Washdown	Water Conservation Pricing	System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water	-	-
City of Three Rivers	13,966,575	0	-	Reuse for Plant Washdown	-	-	School Education; Public Information	-	Other	Conservation Coordinator
Lamar Improvement District	-	Not listed	-	-	Water Conservation Pricing	System Water Audit and Loss Control	School Education; Public Information	-	-	-



Utility Provider	Total Estimated Gallons Reused	Total Estimated Gallons Saved	Best Management Practices Category							
			Landscaping	Conservation Technology & Reuse	Financial	System Operations	Education and Public Awareness	Regulatory and Enforcement	Retail	Conservation Analysis and Planning
Nueces County WCID 3	0	0	Golf Course Conservation; Outdoor Watering Schedule	-	Water Conservation Pricing	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water	-	Cost Effective Analysis
Nueces County WCID 4	0	485,000	Athletic Fields and Golf Course Conservation; Outdoor Watering Schedule	-	-	Metering New Connections and Retrofitting Existing Connections; System Water Audit and Loss Control	Public Information	-	Other	Cost Effective Analysis; Conservation Coordinator
Nueces WSC	-	Not listed	-	-	Water Conservation Pricing	Metering of All Connections; System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water	-	-
Ricardo WSC	-	Not listed	-	-	Water Conservation Pricing	Metering of All Connections; System Water Audit and Loss Control	School Education; Public Information	Prohibition on Wasting Water	-	-
River Acres WSC	-	330,000	Golf Course Conservation; Landscape Irrigation Conservation and Incentives	-	-	New AMR metering for all Connections; System Water Audit and Loss Control	Public Information	Enforcement of Irrigation Standards	-	Conservation Coordinator

*Data not included in City's 2022 TWDB Annual Report or 2023 TWDB Water Use Survey

Table 5C.6.
Summary of Rate Structures Implemented to Encourage Conservation

Utility Name	Summary of Implemented Rate Structures
City of Alice	Non-promotional Rates
City of Beeville	Non-promotional Rates
City of Corpus Christi	Uniform Rates, Water Budget Based Rates, Other
City of Portland	Excess Use Rates, Drought Demand Rates (updated January 2020)
City of Rockport	Inclining/Inverted Block Rates, Drought Demand Rates
City of Taft	Uniform Rates
City of Three Rivers	Water Budget Based Rates
Lamar Improvement District	Inclining Block Rates, Drought Demand Rates
Nueces County WCID 3	Uniform Rates
Nueces WSC	Inclining Block Rates, Drought Demand Rates
Ricardo WSC	Inclining Block Rates, Drought Demand Rates
River Acres WSC	Uniform Rates



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Section 5D Water Supply Plans

5D.1 Coastal Bend Water Supply Plan

This section includes water supply plans for each of the 11-counties in the Coastal Bend Region, as well as wholesale water providers (Section 5D.14) for the planning period from 2030 to 2080. Section 5D.15 discusses Implementation Status and Timeline for Selected Projects, a new provision for 2026 Regional Water Plans.

5D.2 Aransas County Water Supply Plan

Table 5D.1 lists each water user group in Aransas County and their corresponding surplus or shortage in years 2050 and 2080. For each WUG, a water supply plan is presented in the following subsections. There are no projected shortages for Aransas County water user groups.

Table 5D.1.
Aransas County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Aransas Pass	0	0	Supply equals demand
Rincon WSC	0	0	Supply equals demand
City of Rockport	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	none	none	No demands projected
Irrigation	none	none	No demands projected
Livestock	0	0	Supply equals demand

¹ From Tables 4A.2 and 4A.3, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.2.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties. Aransas Pass contracts with the San Patricio Municipal Water District (SPMWD) to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties.

5D.2.3 City of Rockport

The City of Rockport has a contract with the SPMWD to purchase treated water. The contract allows the City of Rockport to purchase only the water that it needs. No shortages in annual water supplies are projected for the City of Rockport; however, additional water conservation is a recommended water management strategy for the city (Table 5D.2).

Table 5D.2.
Recommended Water Supply Plan for the City of Rockport

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	225	348	340	332	325	318
New Balance	225	348	340	332	325	318

Estimated costs of the recommended plan for the City of Rockport are shown in Table 5D.3.

Table 5D.3.
Recommended Plan Costs by Decade for the City of Rockport

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$129,826	\$200,661	\$196,011	\$191,703	\$187,338	\$183,584
Unit Cost (\$/ac-ft)*	\$577	\$577	\$577	\$577	\$577	\$577

* Unit costs for this plan element are rounded.

5D.2.4 County-Other

County-Other in Aransas County obtains water from the SPMWD and a small amount from the Gulf Coast Aquifer (approximately 10 percent demand). No shortages in annual water supplies are projected for Aransas County-Other and no changes in water supply are recommended.

There are several small municipal entities in Aransas County-Other with recommended pipeline and meter replacement (Table 5B.1.9 and 5B.1.10). Up to 9 acft water savings is expected in Year 2040 at a cost of \$167,040,720 for pipeline replacement. Up to 13 acft water savings is expected in Year 2040 at a cost of \$88,830.

5D.2.5 Manufacturing

No manufacturing demand exists or is projected for the county.

5D.2.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.2.7 Mining

No mining demand exists or is projected for the county.

5D.2.8 Irrigation

No irrigation demand exists or is projected for the county.



5D.2.9 Livestock

The livestock water demands in Aransas County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.3 Bee County Water Supply Plan

Table 5D.4 lists each water user group in Bee County and their corresponding surplus or shortage in years 2050 and 2080. For each WUG with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.4.
Bee County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Beeville	0	0	Supply equals demand
El Oso WSC	0	0	Supply equals demand
Pettus MUD	0	0	Supply equals demand
Skidmore WSC	(27)	(44)	Projected Shortage – see plan below
TDCJ Chase Field	(2)	(2)	Projected shortage – see plan below
County-Other	(1,181)	(518)	Projected shortage – see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	(25)	(79)	Projected shortage – see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.4 and 4A.5, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.3.1 City of Beeville

The City of Beeville obtains water from contracts with the City of Corpus Christi to purchase raw water from the Choke Canyon Reservoir/Lake Corpus Christi System (CCR/LCC System) water supply and from the Gulf Coast Aquifer. The contract with the City of Corpus Christi allows the City of Beeville to purchase only the water that it needs. No shortages are projected for the City of Beeville; however, additional water conservation is a recommended water management strategy for the city (Table 5D.5).

Table 5D.5.
Recommended Water Supply Plan for the City of Beeville

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	204	465	736	839	889	945
Brackish Groundwater Desalination	4,204	4,204	4,204	4,204	4,204	4,204
New Balance	4,408	4,669	4,940	5,043	5,093	5,149

Estimated costs of the recommended plan for the City of Beeville are shown in Table 5D.6.

Table 5D.6.
Recommended Plan Costs by Decade for the City of Beeville

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$117,897	\$268,292	\$424,598	\$484,051	\$513,049	\$545,171
Unit Cost (\$/ac-ft)*	\$577	\$577	\$577	\$577	\$577	\$577
City of Beeville Brackish Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$16,340,948	\$16,340,948	\$9,244,596	\$9,244,596	\$9,244,596	\$9,244,596
Unit Cost (\$/ac-ft)*	\$3,887	\$3,887	\$2,199	\$2,199	\$2,199	\$2,199

* Unit costs for this plan element are rounded.

5D.3.2 El Oso Water Supply Corporation

El Oso Water Supply Corporation (WSC) is located in Bee and Live Oak counties, with the majority of demand located in Live Oak County. See Live Oak County for the El Oso WSC plan.

5D.3.3 Pettus Municipal Utility District

Pettus Municipal Utility District (MUD) demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for Pettus MUD and no changes in water supply are recommended.

5D.3.4 Skidmore Water Supply Corporation

Skidmore WSC obtains water from the Gulf Coast Aquifer. Shortages are projected as early as 2030 with the current supply capacity being just under 81 acre-feet per year (ac-ft/yr) and projected 2030 demand being 103 ac-ft/yr. The following water management strategies are recommended for Skidmore WSC.

Table 5D.7.
Recommended Water Supply Plan for Skidmore WSC

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(22)	(24)	(27)	(32)	(38)	(44)
Recommended Plan						
Municipal Water Conservation	1	0	0	0	1	0
Drill New Well	44	44	44	44	44	44
Total New Supply	45	44	44	44	45	44
New Balance	23	20	17	12	7	0

Estimated costs of the recommended plan for County-Other entities are shown in Table 5D.8.

Table 5D.8.
Recommended Plan Costs by Decade for the City of Beeville

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$710	\$233	\$153	\$234	\$530	\$281
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Drill New Well (Chapter 5B.9.1)						
Annual Cost (\$/yr)	\$100,980	\$100,980	\$26,004	\$26,004	\$26,004	\$26,004
Unit Cost (\$/ac-ft)*	\$2,295	\$2,295	\$591	\$591	\$591	\$591

* Unit costs for this plan element are rounded.

5D.3.5 TDCJ Chase Field

TDCJ Chase Field obtains water supply from the Gulf Coast Aquifer. Shortages are projected for the entity beginning in 2030 and continuing through 2080. The following water management strategies are recommended for TDCJ Chase Field (Table 5D.9).

Table 5D.9.
Recommended Water Supply Plan for TDCJ Chase Field

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(5)	(2)	(2)	(2)	(2)	(2)
Recommended Plan						
Municipal Water Conservation	111	221	323	416	500	576
Drill New Well	5	5	5	5	5	5
Total New Supply	116	226	328	421	505	581
New Balance	111	224	326	419	503	579

Estimated costs of the recommended plan for County-Other entities are shown in Table 5D.10.

Table 5D.10.
Recommended Plan Costs by Decade for TDCJ Chase Field

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$64,231	\$128,168	\$187,565	\$241,282	\$289,864	\$333,800
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$100,000	\$100,000	\$25,000	\$25,000	\$25,000	\$25,000
Unit Cost (\$/ac-ft)*	\$20,000	\$20,000	\$5,000	\$5,000	\$5,000	\$5,000

* Unit costs for this plan element are rounded.

5D.3.6 County-Other

Bee County-Other entities obtain water supply from the Gulf Coast Aquifer. Shortages are projected beginning in 2030 and continuing through 2080. The following water management strategies are recommended for County-Other entities (Table 5D.11).

Table 5D.11.
Recommended Water Supply Plan for Bee County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(1,426)	(1,337)	(1,181)	(984)	(765)	(518)
Recommended Plan						
Drill New Well	1,426	1,426	1,426	1,426	1,426	1,426
Municipal Water Conservation- Pipeline Replacement		1				
Total New Supply	1,426	1,427	1,426	1,426	1,426	1,426
New Balance	0	90	245	442	661	908

Estimated costs of the recommended plan for County-Other entities are shown in Table 5D.12.

Table 5D.12.
Recommended Plan Costs by Decade for Bee County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9.)						
Annual Cost (\$/yr)	\$567,548	\$567,548	\$185,380	\$185,380	\$185,380	\$185,380
Unit Cost (\$/ac-ft)*	\$398	\$398	\$130	\$130	\$130	\$130
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1.)						
Capital Cost (\$/ac-ft)		\$16,600,320				

* Unit costs for this plan element are rounded.

5D.3.7 Manufacturing

No manufacturing demand exists or is projected for the county.

5D.3.8 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.3.9 Mining

Mining supply in Bee County is obtained through groundwater from the Gulf Coast Aquifer. Shortages are projected for mining throughout the planning period. The following water management strategies are recommended for mining entities in Bee County (Table 5D.13).

Table 5D.13.
Recommended Water Supply Plan for Bee County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(25)	(25)	(25)	(25)	(25)	-
Recommended Plan						
Mining Water Conservation	6	12	18	24	30	0
Drill New Well	25	25	25	25	25	25
Total New Supply	31	37	43	49	55	25
New Balance	6	12	18	24	30	25

Estimated costs of the recommended plan for mining entities are shown in Table 5D.14.

Table 5D.14.
Recommended Plan Costs by Decade for Bee County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$400	\$400	\$400	\$400	\$400	\$0
Unit Cost (\$/ac-ft)	\$67	\$33	\$22	\$17	\$13	\$0
\$Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$80,000	\$80,000	\$8,000	\$8,000	\$8,000	\$8,000
Unit Cost (\$/ac-ft)*	\$3,200	\$3,200	\$320	\$320	\$320	\$320

* Unit costs for this plan element are rounded.

5D.3.10 Irrigation

Irrigation supply in Bee County is obtained through groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5D.3.11 Livestock

The livestock water demands in Bee County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for livestock and no changes in water supply are recommended.

5D.4 Brooks County Water Supply Plan

Table 5D.15 lists each water user group in Brooks County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.15.
Brooks County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Falfurrias	0	0	Supply equals demand
County-Other	(234)	(101)	Projected shortage – see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.6 and 4A.7, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.4.1 City of Falfurrias

The City of Falfurrias receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the City of Falfurrias; however, additional water conservation is a recommended water management strategy (Table 5D.16).

Table 5D.16.
Recommended Water Supply Plan for the City of Falfurrias

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	91	189	282	370	458	520
New Balance	91	189	282	370	458	520

Estimated costs of the recommended plan for the City of Falfurrias are shown in Table 5D.17.

Table 5D.17.
Recommended Plan Costs by Decade for the City of Falfurrias

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$53,046	\$109,680	\$163,359	\$214,388	\$265,660	\$301,625
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.4.2 County-Other

The Brooks County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Brooks County-Other throughout the planning period. The following water management strategy is recommended (Table 5D.18).

Table 5D.18.
Recommended Water Supply Plan for Brooks County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(281)	(262)	(234)	(198)	(155)	(101)
Recommended Plan						
Drill New Well	281	281	281	281	281	281
Total New Supply	281	281	281	281	281	281
New Balance	0	19	47	83	126	180

Estimated costs of the recommended plan for County-Other users are shown in Table 5D.19.

Table 5D.19.
Recommended Plan Costs by Decade for Brooks County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$127,012	\$127,012	\$50,018	\$50,018	\$50,018	\$50,018
Unit Cost (\$/ac-ft)*	\$452	\$452	\$178	\$178	\$178	\$178

* Unit costs for this plan element are rounded.

5D.4.3 Manufacturing

The manufacturing water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for manufacturing users and no changes in water supply are recommended.

5D.4.4 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.4.5 Mining

Brooks County mining users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for mining users throughout the planning period. The following water management strategies are recommended (Table 5D.20).

Table 5D.20.
Recommended Water Supply Plan for Brooks County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Mining Water Conservation	0	1	1	2	2	2
Total New Supply	0	1	1	2	2	2
New Balance	0	1	1	2	2	2

Estimated costs of the recommended plan for irrigation users are shown in Table 5D.21.

Table 5D.21.
Recommended Plan Costs by Decade for Brooks County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$0	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$0	\$400	\$200	\$200	\$200	\$200

* Unit costs for this plan element are rounded.

5D.4.6 Irrigation

The irrigation water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5D.4.7 Livestock

The livestock water demands in Brooks County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.5 Duval County Water Supply Plan

Table 5D.22 lists each water user group in Duval County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.22.
Duval County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
Duval County CRD	0	0	Supply equals demand
Freer WCID	0	0	Supply equals demand
San Diego MUD 1	0	0	Supply equals demand
County-Other	(199)	(113)	Projected shortage – see plan below
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.8 and 4A.9, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.5.1 Duval County Conservation and Reclamation District

Duval County Conservation and Reclamation District (CRD) receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Duval County CRD and no changes in water supply are recommended.

Duval County CRD is recommended for pipeline replacement (Table 5B.1.9 and 5B.1.10). Up to 2 acft water savings is expected in Year 2040 at a cost of \$41,500,800 for pipeline replacement.

5D.5.2 Freer Water Control and Improvement District

Freer Water Control and Improvement District (WCID) receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Freer WCID; however, additional water conservation is a recommended water management strategy for the WCID (Table 5D.23). See Section 5C for more details.

Table 5D.23.
Recommended Water Supply Plan for Freer WCID

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	37	75	106	123	115	108
Municipal Water Conservation- Pipeline Replacement	-	16	-	-	-	-
New Balance	37	91	106	123	115	108

Estimated costs of the recommended plan for Freer WCID are shown in Table 5D.24.

Table 5D.24.
Recommended Plan Costs by Decade for Freer WCID

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$21,734	\$43,376	\$61,725	\$71,273	\$66,869	\$62,613
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1.)						
Capital Cost (\$)	-	\$105,827,040	-	-	-	-

* Unit costs for this plan element are rounded.

5D.5.3 San Diego Municipal Utility District 1

San Diego MUD 1 is located in Duval and Jim Well counties; however, its water supply plan is presented here. The City of San Diego obtains groundwater supplies from the Goliad Sands of the Gulf Coast Aquifer.

Shortages are projected for San Diego MUD 1. There are sufficient Gulf Coast Aquifer supplies to drill an additional well without exceeding Modeled Available Groundwater (MAG) constraints. The recommended water supply management plan for the MUD is shown in Table 5D.25.

Table 5D.25.
Recommended Water Supply Plan for San Diego MUD 1

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(102)	(106)	(111)	(116)	(123)	(131)
Recommended Plan						
Municipal Water Conservation	57	106	106	107	109	114
Gulf Coast Aquifer Supplies	131	131	131	131	131	313
Total New Supply	188	237	237	238	240	245
New Balance	86	131	126	122	117	114

Estimated costs of the recommended plan for San Diego MUD 1 are shown in Table 5D.26.

Table 5D.26.
Recommended Plan Costs by Decade for San Diego MUD 1

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$32,929	\$61,057	\$61,216	\$61,695	\$62,983	\$65,865
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$91,962	\$91,962	\$34,977	\$34,977	\$34,977	\$34,977
Unit Cost (\$/ac-ft)	\$702	\$702	\$267	\$267	\$267	\$267

* Unit costs for this plan element are rounded.

The City of Alice has run a 16-inch water transmission line to Highway 281 bypass, approximately 8 to 9 miles from the City of San Diego. This pipeline could be extended to provide water supply from the City of Alice to San Diego. Although this is not a recommended strategy, it could provide an alternative supply to the City of San Diego.

5D.5.4 County-Other

Shortages are projected for Duval County-Other municipal users beginning in 2030. The recommended water supply management plan for County-Other is shown in Table 5D.27. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5D.27.
Recommended Water Supply Plan for Duval County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(253)	(223)	(199)	(179)	(151)	(113)
Recommended Plan						
Gulf Coast Aquifer Supplies	253	253	253	253	253	253
Total New Supply	253	253	253	253	253	253
New Balance	0	30	54	74	102	140

Estimated costs of the recommended plan for Duval County-Other are shown in Table 5D.28.

Table 5D.28.
Recommended Plan Costs by Decade for Duval County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$158,125	\$158,125	\$52,877	\$52,877	\$52,877	\$52,877
Unit Cost (\$/ac-ft)	\$625	\$625	\$209	\$209	\$209	\$209

* Unit costs for this plan element are rounded.

5D.5.5 Manufacturing

No manufacturing demand exists or is projected for the county.

5D.5.6 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.5.7 Mining

No shortages are projected for Duval County mining; however, mining conservation is recommended.

Table 5D.29.
Recommended Water Supply Plan for Duval County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Mining Water Conservation	0	0	0	1	1	1
Total New Supply	0	0	0	1	1	1
New Balance	0	0	0	1	1	1

Estimated costs of the recommended plan for Duval County Mining are shown in Table 5D.30.

Table 5D.30.
Recommended Plan Costs by Decade for Duval County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$0	\$0	\$0	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$0	\$0	\$0	\$400	\$400	\$400

* Unit costs for this plan element are rounded.

5D.5.8 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5D.5.9 Livestock

The livestock water demands in Duval County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.6 Jim Wells County Water Supply Plan

Table 5D.31 lists each water user group in Jim Wells County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.31.
Jim Wells County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Alice	0	0	Supply equals demand
Jim Wells County FWSD 1	0	0	Supply equals demand
City of Orange Grove	0	0	Supply equals demand
City of Premont	0	0	Supply equals demand
San Diego MUD 1			See Duval County
County-Other	(1,159)	(82)	Projected shortage – see plan below
Manufacturing	(14)	(25)	Projected shortage – see plan below
Steam-Electric	none	none	No demands projected
Mining	none	none	No demands projected
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.10 and 4A.11, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.6.1 City of Alice

The City of Alice has a contract to purchase water from the City of Corpus Christi via Lake Corpus Christi. The City also maintains a small reservoir in town, Lake Findley, which serves as temporary storage of waters from Lake Corpus Christi. This reservoir is fed naturally by a small watershed and has no effective firm yield. No shortages are projected for the City of Alice; however, additional water conservation is a recommended water management strategy for the city (Table 5D.32).

Table 5D.32.
Recommended Water Supply Plan for the City of Alice

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	283	660	856	900	953	1,017
Municipal Water Conservation- Pipeline Replacement	-	53	-	-	-	-
Municipal Water Conservation- Meter Replacement	-	260	-	-	-	-
New Balance	283	973	856	900	953	1,017

Estimated costs of the recommended plan for the City of Alice are shown in Table 5D.33.

Table 5D.33.
Recommended Plan Costs by Decade for the City of Alice

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$163,159	\$380,862	\$493,794	\$519,313	\$550,076	\$586,854
Unit Cost (\$/ac-ft)*	\$577	\$577	\$577	\$577	\$577	\$577
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$207,504,000	-	-	-	-
Municipal Water Conservation- Meter Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$2,000,320	-	-	-	-

* Unit costs for this plan element are rounded.

5D.6.2 City of Orange Grove

The City of Orange Grove's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Orange Grove; however, additional water conservation is a recommended water management strategy for the city (Table 5D.34).

Table 5D.34.
Recommended Water Supply Plan for the City of Orange Grove

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	27	57	84	107	128	128
New Balance	27	57	84	107	128	128

Estimated costs of the recommended plan for the City of Orange Grove are shown in Table 5D.35.

Table 5D.35.
Recommended Plan Costs by Decade for the City of Orange Grove

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$15,645	\$32,851	\$48,627	\$62,161	\$74,085	\$74,182
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.6.3 City of Premont

The City of Premont's water supply is from the Gulf Coast Aquifer. No shortages are projected for the City of Premont; however, additional water conservation is a recommended water management strategy for the city (Table 5D.36).

Table 5D.36.
Recommended Water Supply Plan for the City of Premont

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	47	87	129	164	178	179
New Balance	47	87	129	164	178	179

Estimated costs of the recommended plan for the City of Premont are shown in Table 5D.37.

Table 5D.37.
Recommended Plan Costs by Decade for the City of Premont

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$24,411	\$50,589	\$74,830	\$95,382	\$103,351	\$103,658
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.6.4 City of San Diego

The City of San Diego is in both Duval and Jim Wells Counties. See Duval County for the city's water management plan.

5D.6.5 County-Other

Jim Wells County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Jim Wells County-Other beginning in 2030. The recommended water supply management plan for County-Other municipal users is shown in Table 5D.38. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5D.38.
Recommended Water Supply Plan for Jim Wells County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(1,621)	(1,409)	(1,159)	(840)	(484)	(82)
Recommended Plan						
Gulf Coast Aquifer Supplies	1,621	1,621	1,621	1,621	1,621	1,621
New Balance	0	212	462	781	1,137	1,539

Estimated costs of the recommended plan for Jim Wells County-Other are shown in Table 5D.39.

Table 5D.39.
Recommended Plan Costs by Decade for Jim Wells County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$846,162	\$846,162	\$228,561	\$228,561	\$228,561	\$228,561
Unit Cost (\$/ac-ft)*	\$522	\$522	\$141	\$141	\$141	\$141

* Unit costs for this plan element are rounded.

5D.6.6 Manufacturing

Jim Wells manufacturing users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for manufacturing entities beginning in 2030. The recommended water supply management plan for Jim Wells manufacturing is shown in Table 5D.40. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5D.40.
Recommended Water Supply Plan for Jim Wells County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(8)	(11)	(14)	(17)	(21)	(25)
Recommended Plan						
Manufacturing Water Conservation	2	5	7	10	13	16
Gulf Coast Aquifer Supplies	25	25	25	25	25	25
Total New Supply	27	30	32	35	38	41
New Balance	19	19	18	18	17	16

Estimated costs of the recommended plan for Jim Wells County Manufacturing are shown in Table 5D.41.

Table 5D.41.
Recommended Plan Costs by Decade for Jim Wells County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$400	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$200	\$80	\$57	\$40	\$31	\$25
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$75,000	\$75,000	\$23,000	\$23,000	\$23,000	\$23,000
Unit Cost (\$/ac-ft)*	\$3,000	\$3,000	\$920	\$920	\$920	\$920

* Unit costs for this plan element are rounded.

5D.6.7 Steam-Electric

No steam-electric demand exists or is projected for the county.



5D.6.8 Mining

No mining demand exists in Jim Wells County..

5D.6.9 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5D.6.10 Livestock

The livestock water demands in Jim Wells County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.7 Kenedy County Water Supply Plan

Table 5D.42 lists each water user group in Kenedy County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.42.
Kenedy County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
County-Other	0	0	Supply equals demand
Manufacturing	none	none	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	none	none	No demands projected
Livestock	0	0	Supply equals demand

¹ From Tables 4A.12 and 4A.13, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.7.1 County-Other

The Kenedy County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Kenedy County-Other entities; however, additional water conservation is a recommended water management strategy for the entity (Table 5D.43).

Table 5D.43.
Recommended Water Supply Plan for Kenedy County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	15	28	38	45	51	54
New Balance	15	28	38	45	51	54

Estimated costs of the recommended plan for Kenedy County-Other are shown in Table 5D-44.

Table 5D-44.
Recommended Plan Costs by Decade for Kenedy County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$8,515	\$16,214	\$21,783	\$26,168	\$29,302	\$31,336
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.7.2 Manufacturing

No manufacturing demand exists or is projected for the county.

5D.7.3 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.7.4 Mining

Kenedy County mining users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for mining and no changes in water supply are recommended.

5D.7.5 Irrigation

No irrigation demand exists or is projected for the county.

5D.7.6 Livestock

The livestock water demands in Kenedy County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.8 Kleberg County Water Supply Plan

Table 5D.45 lists each water user group in Kleberg County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.45.
Kleberg County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
Baffin Bay WSC	0	0	Supply equals demand
City of Kingsville	0	0	Supply equals demand
Naval Air Station Kingsville	0	0	Supply equals demand
Ricardo WSC	0	0	Supply equals demand
Riviera Water System	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	0	0	Supply equals demand
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.14 and 4A.15, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.8.1 Baffin Bay Water Supply Corporation

Baffin Bay WSC's water supply is from the Gulf Coast Aquifer. No shortages are projected for the WSC and no changes in water supply are recommended.

5D.8.2 City of Kingsville

The City of Kingsville has a contract with the STWA to purchase treated surface water from the CCR/LCC/Texana/MRP Phase II System. The city also has five wells with a combined capacity of 3.7 million gallons per day (mgd) (or 4,130 ac-ft/yr) that pump groundwater from the Gulf Coast Aquifer. No shortages are projected for Kingsville; however, the City of Kingsville will receive 10 percent of the Ricardo Well Project's yield.

Table 5D.46.
Recommended Water Supply Plan for City of Kingsville

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Gulf Coast Aquifer Supplies	505	505	505	505	505	505
New Balance	505	505	505	505	505	505

Estimated costs of the recommended plan for City of Kingsville are shown in Table 5D.47.

Table 5D.47.
Recommended Plan Costs by Decade for City of Kingsville

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$11,838	\$11,838	\$4,116	\$4,116	\$4,116	\$4,116
Unit Cost (\$/ac-ft)*	\$2,114	\$2,114	\$735	\$735	\$735	\$735

5D.8.3 Naval Air Station Kingsville

The Naval Air Station in Kingsville obtains water supply from the Gulf Coast Aquifer. No shortages are projected for the air station; however, additional water conservation is a recommended water management strategy (Table 5D.48).

Table 5D.48.
Recommended Water Supply Plan for Naval Air Station Kingsville

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	24	48	71	95	117	137
New Balance	24	48	71	95	117	137

Estimated costs of the recommended plan for the Naval Air Station in Kingsville are shown in Table 5D.49.

Table 5D.49.
Recommended Plan Costs by Decade for Naval Air Station Kingsville

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$13,968	27,917	41,469	55,200	67,951	79,516
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.8.4 Ricardo WSC

STWA provides water to the Ricardo Water Supply Corporation via a direct 12-inch transmission line that became operational in December 2013. Ricardo WSC demands are met with surface water supplies. No shortages are projected for Ricardo WSC; however, Ricardo WSC is diversifying their water supply with groundwater resources.

Table 5D.50.
Recommended Water Supply Plan for Ricardo WSC

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Gulf Coast Aquifer Supplies	505	505	505	505	505	505
New Balance	505	505	505	505	505	505

Estimated costs of the recommended plan for Ricardo WSC are shown in Table 5D.51.

Table 5D.51.
Recommended Plan Costs by Decade for Ricardo WSC

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$1,065,456	\$1,065,456	\$370,440	\$370,440	\$370,440	\$370,440
Unit Cost (\$/ac-ft)*	\$2,114	\$2,114	\$735	\$735	\$735	\$735

* Unit costs for this plan element are rounded.

5D.8.5 Riviera Water System

The Riviera Water System obtains groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for the water system and no changes in water supply are recommended.

5D.8.6 County-Other

Kleberg County-Other receives groundwater supplies from the Gulf Coast Aquifer and some surface water supplies from nearby water providers, including the City of Kingsville. No shortages are projected for the Kleberg County-Other; however, additional water conservation is a recommended water management strategy for this entity (Table 5D.52).

Table 5D.52.
Recommended Water Supply Plan for Kleberg County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	15	28	38	45	51	54
New Balance	15	28	38	45	51	54

Estimated costs of the recommended plan for Kleberg County-Other are shown in Table 5D.53.

Table 5D.53.
Recommended Plan Costs by Decade for Kleberg County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$5,217	\$4,354	\$4,503	\$4,880	\$4,858	\$5,144
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.8.7 Manufacturing

Kleberg County manufacturing use, identified by the TWDB, is supplied by groundwater from the Gulf Coast Aquifer. Shortages are projected for manufacturing users beginning in 2040. The recommended water supply management plan is shown in Table 5D.54.

Table 5D.54.
Recommended Water Supply Plan for Kleberg County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Manufacturing Water Conservation	27	56	88	121	157	196
Total New Supply	27	56	88	121	157	196
New Balance	27	56	88	121	157	196

Estimated costs of the recommended plan for Kleberg County Manufacturing are shown in Table 5D.55.

Table 5D.55.
Recommended Water Supply Plan for Kleberg County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$540	\$1,120	\$1,760	\$2,240	\$3,140	\$3,920
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$20

5D.8.8 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.8.9 Mining

Mining water demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for Kleberg County Mining; however, mining water conservation is recommended. The recommended water supply management plan is shown in Table 5D.56.

Table 5D.56.
Recommended Water Supply Plan for Kleberg County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Mining Water Conservation	0	1	1	1	1	2
Total New Supply	0	1	1	1	1	2
New Balance	0	1	1	1	1	2

Estimated costs of the recommended plan for Kleberg County Mining are shown in Table 5D.57.

Table 5D.57.
Recommended Water Supply Plan for Kleberg County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$0	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$0	\$400	\$400	\$400	\$400	\$200

5D.8.10 Irrigation

Irrigation demands are met by groundwater from the Gulf Coast Aquifer. No shortages are projected for irrigation and no changes in water supply are recommended.

5D.8.11 Livestock

The livestock demands in Kleberg County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.9 Live Oak County Water Supply Plan

Table 5D.58 lists each water user group in Live Oak County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.58.
Live Oak County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
El Oso WSC	0	0	Supply equals demand
City of George West	0	0	Supply equals demand
McCoy WSC	0	0	Supply equals demand
Old Marbach School WSC	0	0	Supply equals demand
City of Three Rivers	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	(28)	(28)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	0	0	Supply equals demand
Irrigation	(534)	(534)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

¹ From Tables 4A.16 and 4A.17, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.9.1 El Oso Water Supply Corporation

El Oso Water Supply Corporation is located in both Bee and Live Oak counties, with the majority of demand located in Live Oak County. The El Oso Water Supply Corporation receives groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for El Oso WSC in Bee County during the planning period; however, municipal water conservation is recommended. The recommended water supply management plan is shown in Table 5D.59.

Table 5D.59.
Recommended Water Supply Plan for El Oso WSC

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	17	45	69	79	93	111
Total New Supply	17	45	69	79	93	111
New Balance	17	45	69	79	93	111

Estimated costs of the recommended plan for El Oso WSC are shown in Table 5D.60.

Table 5D.60.
Recommended Water Supply Plan for El Oso WSC

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$10,426	\$26,527	\$40,299	\$46,253	\$54,211	\$64,707
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.9.2 City of George West

The City of George West's demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for George West; however, additional water conservation is a recommended water management strategy for the City (Table 5D.61).

Table 5D.61.
Recommended Water Supply Plan for the City of George West

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	20	32	29	27	25	23
New Balance	20	32	29	27	25	23

Estimated costs of the recommended plan for the City of George West are shown in Table 5D.62.

Table 5D.62.
Recommended Plan Costs by Decade for the City of George West

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$11,833	18,519	\$17,037	\$15,897	\$14,427	\$13,208
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.9.3 McCoy WSC

McCoy WSC's demands are met with groundwater from the Carrizo-Wilcox Aquifer. No shortages are projected for McCoy WSC and no changes in water supply are recommended.

5D.9.1 Old Marbach School WSC

Old Marbach School WSC's demands are met with groundwater from the Gulf Coast Aquifer. No shortages are projected for Old Marbach School WSC and no changes in the water supply are recommended.

5D.9.4 City of Three Rivers

The City of Three Rivers' demands are met with stored water from Choke Canyon Reservoir through contract with the City of Corpus Christi. No shortages are projected for Three Rivers; however, additional water conservation is a recommended water management strategy for the City (Table 5D.63). Note that numbers shown below are positive and represent surpluses.

Table 5D.63.
Recommended Water Supply Plan for the City of Three Rivers

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	2,184	2,089	1,983	1,873	1,760	1,639
Recommended Plan						
Municipal Water Conservation	30	30	30	31	29	31
New Balance	2,214	2,119	2,013	1,904	1,789	1,670

Estimated costs of the recommended plan for the City of Three Rivers are shown in Table 5D.64.

Table 5D.64.
Recommended Plan Costs by Decade for the City of Three Rivers

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$17,365	\$17,647	\$17,545	\$17,715	\$17,032	\$17,816
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.9.5 County-Other

Live Oak County-Other municipal users receive groundwater supplies from the Gulf Coast Aquifer. Shortages are projected for Live Oak County-Other throughout the planning period. The recommended water supply management plan for County-Other municipal users is shown in Table 5D.65. There are sufficient Gulf Coast Aquifer supplies to meet shortages without exceeding MAG constraints.

Table 5D.65.
Recommended Water Supply Plan for Live Oak County-Other

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(198)	(173)	(164)	(178)	(191)	(202)
Recommended Plan						
Gulf Coast Aquifer Supplies	202	202	202	202	202	202
New Balance	4	29	38	24	11	0

Estimated costs of the recommended plan for Live Oak County-Other are shown in Table 5D.66.

Table 5D.66.
Recommended Plan Costs by Decade for Live Oak County-Other

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$138,976	\$138,976	\$46,056	\$46,056	\$46,056	\$46,056
Unit Cost (\$/ac-ft)*	\$688	\$688	\$228	\$228	\$228	\$228

* Unit costs for this plan element are rounded.

5D.9.6 Manufacturing

Live Oak County manufacturing users receive groundwater supplies from the Gulf Coast Aquifer and surface water supplies from run-of-river rights in the Nueces Basin. There are no shortages projected for Live Oak County manufacturing; however, manufacturing conservation is a recommended strategy. The recommended water supply management plan is shown in Table 5D.67.

Table 5D.67.
Recommended Water Supply Plan for Live Oak County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Manufacturing Water Conservation	71	147	229	317	411	511
Total New Supply	71	147	229	317	411	511
New Balance	71	147	229	317	411	511

Estimated costs of the recommended plan for Live Oak County Manufacturing are shown in Table 5D.68.

Table 5D.68.
Recommended Water Supply Plan for Live Oak County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$1,420	\$2,940	\$4,580	\$6,340	\$8,220	\$10,220
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$20

5D.9.7 Steam-Electric

No steam-electric demand exists or is currently projected for the county.

5D.9.8 Mining

Live Oak County mining users receive groundwater supplies from the Gulf Coast Aquifer. No shortages are projected for Live Oak Mining and no changes in water supply are recommended; however, surpluses are projected by 2080.

Table 5D.69.
Recommended Water Supply Plan for Live Oak County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	1,262
Recommended Plan						
Mining Water Conservation	32	63	95	126	158	0
Total New Supply	32	63	95	126	158	0
New Balance	32	63	95	126	158	1,262

Estimated costs of the recommended plan for Live Oak County Mining are shown in Table 5D.70.

Table 5D.70.
Recommended Water Supply Plan for Live Oak County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$640	\$1,260	\$1,900ND	\$2,520	\$3,160	\$0
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$0

5D.9.9 Irrigation

Live Oak County irrigation users receive groundwater supplies from the Gulf Coast Aquifer and surface water supplies in 2030. No shortages are projected for Live Oak County Irrigation and no changes in water supply are recommended.

5D.9.10 Livestock

The livestock demands in Live Oak County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.10 McMullen County Water Supply Plan

Table 5D.71 lists each water user group in McMullen County and their corresponding surplus or shortage in years 2050 and 2080. No water supply shortages are projected for McMullen County throughout the planning period.

Table 5D.71.
McMullen County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
County-Other	0	0	Supply equals demand
Manufacturing	0	0	No demands projected
Steam-Electric	none	none	No demands projected
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.18 and 4A.19, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.10.1 County-Other

The McMullen County-Other municipal users receive groundwater supplies from the Carrizo Aquifer. No shortages are projected for McMullen County-Other entities and no changes in water supply are recommended.

5D.10.2 Manufacturing

Manufacturing users in McMullen County obtain groundwater from the Gulf Coast Aquifer. No shortages are projected for McMullen County Manufacturing entities; however, manufacturing water conservation is a recommended water management strategy. The recommended water supply management plan is shown in Table 5D.72.

Table 5D.72.
Recommended Water Supply Plan for McMullen County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Manufacturing Water Conservation	1	2	3	3	4	5
Total New Supply	1	2	3	3	4	5
New Balance	1	2	3	3	4	5

Estimated costs of the recommended plan for McMullen County Manufacturing are shown in Table 5D.73.

Table 5D.73.
Recommended Water Supply Plan for McMullen County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$400	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$400	\$200	\$133	\$133	\$100	\$80

5D.10.3 Steam-Electric

No steam-electric demand exists or is projected for the county.

5D.10.4 Mining

Mining users in McMullen County obtain water from the Carrizo, Gulf Coast, Queen City, and Sparta aquifers. No shortages are projected for McMullen County Mining entities; however, surpluses are projected by 2080. The recommended water supply management plan is shown in Table 5D.74.

Table 5D.74.
Recommended Water Supply Plan for McMullen County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	1,262
Recommended Plan						
Mining Water Conservation	32	63	95	126	158	0
Total New Supply	32	63	95	126	158	0
New Balance	32	63	95	126	158	1,262

Estimated costs of the recommended plan for McMullen County Mining are shown in Table 5D.75.

Table 5D.75.
Recommended Water Supply Plan for McMullen County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$2,260	\$4,540	\$6,800	\$9,080	\$11,340	\$0
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$0

5D.10.5 Irrigation

No irrigation demand exists or is projected for the county.



5D.10.6 Livestock

The livestock water demands in McMullen County are met by groundwater from the Carrizo Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.11 Nueces County Water Supply Plan

Table 5D.76 lists each water user group in Nueces County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.76.
Nueces County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Aransas Pass	0	0	Supply equals demand
City of Bishop	0	0	Supply equals demand
City of Corpus Christi	0	(5,158)	Projected shortage – see plan below
Corpus Christi Naval Air	0	0	Supply equals demand
City of Driscoll	0	0	Supply equals demand
Nueces County WCID 3	(3,443)	(3,370)	Projected shortage – see plan below
Nueces County WCID 4	0	0	Supply equals demand
Nueces WSC	0	0	Supply equals demand
River Acres WSC	0	0	Supply equals demand
Violet WSC	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	(11,685)	(16,587)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	(93)	(101)	Projected shortage – see plan below
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.20 and 4A.21, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.11.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties, with the majority of demand lying in San Patricio County. Aransas Pass contracts with SPMWD to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties, and no changes in water supply are recommended.

5D.11.2 City of Bishop

The City of Bishop has a contract with STWA to purchase treated surface water. Additionally, the City pumps groundwater from the Gulf Coast Aquifer. No shortages are projected for the City of Bishop; however, additional water conservation is a recommended water management strategy for the city (Table 5D.77).

Table 5D.77.
Recommended Water Supply Plan for the City of Bishop

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	37	37	36	37	36	36
Driscoll Groundwater Desalination	195	195	195	195	195	195
Municipal Water Conservation- Pipeline Replacement	-	21	--		-	-
Municipal Water Conservation- Meter Replacement	-	48	-	-	-	-
Total New Supply	232	333	231	232	231	231
New Balance	232	333	231	232	231	231

Estimated costs of the recommended plan for the City of Bishop are shown in Table 5D.78.

Table 5D.78.
Recommended Plan Costs by Decade for the City of Bishop

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$21,650	\$21,394	\$21,121	\$21,291	\$21,063	\$20,654
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Driscoll Groundwater Desalination						
Annual Cost (\$/yr)	\$566,074	\$566,074	\$234,061	\$234,061	\$234,061	\$234,061
Unit Cost (\$/ac-ft)*	\$2,878	\$2,878	\$1,190	\$1,190	\$1,190	\$1,190
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$64,326,240	-	-	-	-
Municipal Water Conservation- Meter Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$289,520	-	-	-	-

* Unit costs for this plan element are rounded.

5D.11.3 City of Corpus Christi

The City of Corpus Christi meets demands with its own water rights in the CCR/LCC System, through a contract with the Lavaca-Navidad River Authority that provides water from Lake Texana, and supplies associated with water rights in the Colorado River Basin delivered through the MRP-Phase II project. Municipal water supply shortages are projected for the City of Corpus Christi in 2080. The city also provides surface water to SPMWD, STWA, various nearby cities, and manufacturing and steam-electric water user groups in Nueces and San Patricio counties. Shortages are assigned to manufacturing water user groups in Nueces and San Patricio counties. The recommended water supply management plan is shown in Table 5D.79. The total project yield for the seawater desalination project is larger than shown in the table below. The Corpus Christi Inner Harbor seawater desalination project yield is 33,604 ac-ft/yr. Supplies were divided equally between the City of Corpus Christi and Nueces County-Manufacturing for the Inner Harbor seawater desalination project.

Table 5D.79.
Recommended Water Supply Plan for the City of Corpus Christi

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	(5,158)
Recommended Plan						
Municipal Water Conservation	4,164	9,338	9,883	9,823	9,765	9,706
O.N. Stevens WTP Improvements*	0	0	0	0	0	0
Oso Regional WWTP Reuse	0	3,737	3,737	3,737	3,737	3,737
Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability*	0	0	0	0	0	0
Aquifer Storage and Recovery	0	4,035	4,035	4,035	4,035	4,035
Evangeline/Laguna LP Groundwater Desalination*	8,546	8,546	8,546	8,546	8,546	8,546
Seawater Desalination – Corpus Christi (Inner Harbor)	16,802	16,802	16,802	16,802	16,802	16,802
Seawater Desalination – Barney Davis	0	11,201	11,201	11,201	11,201	11,201
Seawater Desalination – Port Harbor Island	28,003	28,003	28,003	28,003	28,003	28,003
Brackish Groundwater Desalination – EV Ranch	6,400	6,400	6,400	6,400	6,400	6,400
Nueces River Brackish Well Reverse Osmosis Facility	2	3	3	4	4	4
Total New Supply	63,917	88,065	88,610	88,551	88,493	88,434
New Balance	63,917	88,065	88,610	88,551	88,493	83,276

*Note: These projects increase infrastructure capacity to serve existing and future customers, and are anticipated to come on-line in 2030. The source water is associated with the Evangeline/Laguna Groundwater project, but could include other recommended WMS projects that the City of Corpus Christi are also considering. The supply is set to zero as to not double count with water source strategies.

Estimated costs of the recommended plan for the City of Corpus Christi are shown in Table 5D.80.

Table 5D.80.
Recommended Plan Costs by Decade for the City of Corpus Christi

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$2,427,398	5,444,195	\$5,761,681	\$5,726,939	\$5,692,849	\$5,658,428
Unit Cost (\$/ac-ft)	\$583	\$583	\$583	\$583	\$583	\$583
O.N. Stevens WTP Improvements (Chapter 5B.10)						
Annual Cost (\$/yr)	\$7,502,000	\$7,502,000	\$1,679,000	\$1,679,000	\$1,679,000	\$1,679,000
Unit Cost (\$/ac-ft)*	\$665	\$665	\$437	\$437	\$437	\$437
Oso Regional WWTP Reuse (Chapter 5B.4)						
Annual Cost (\$/yr)	\$0	\$53,871,000	\$53,871,000	\$10,670,000	\$10,670,000	\$10,670,000
Unit Cost (\$/ac-ft)	\$0	\$4,806	\$4,806	\$952	\$952	\$952
Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability (Chapter 5B.10)						
Annual Cost (\$/yr)	\$112,506,000	\$112,506,000	\$25,510,000	\$25,510,000	\$25,510,000	\$25,510,000
Unit Cost (\$/ac-ft)	\$4,760	\$4,760	\$1,367	\$1,367	\$1,367	\$1,367
Aquifer Storage and Recovery (Chapter 5B.5)						
Annual Cost (\$/yr)	\$0	\$11,435,190	\$11,435,190	\$4,878,315	\$4,878,315	\$4,878,315
Unit Cost (\$/ac-ft)	\$0	\$2,834	\$2,834	\$1,209	\$1,209	\$1,209
Evangeline/Laguna LP Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$34,909,048	\$34,909,048	\$23,474,946	\$23,474,946	\$23,474,946	\$23,474,946
Unit Cost (\$/ac-ft)	\$4,085	\$4,085	\$2,747	\$2,747	\$2,747	\$2,747
Seawater Desalination – Corpus Christi (Inner Harbor) 10 MGD** (Chapter 5B.6)						
Annual Cost (\$/yr)	\$52,993,508	\$52,993,508	\$29,957,966	\$29,957,966	\$29,957,966	\$29,957,966
Unit Cost (\$/ac-ft)	\$3,154	\$3,154	\$1,783	\$1,783	\$1,783	\$1,783
Seawater Desalination – Corpus Christi (Barney Davis) 20 MGD (Chapter 5B.6)						
Annual Cost (\$/yr)	\$0	\$124,588,035	\$124,588,035	\$62,815,236	\$62,815,236	\$62,815,236
Unit Cost (\$/ac-ft)	\$0	\$3,705	\$3,705	\$1,868	\$1,868	\$1,868
Seawater Desalination – PCCA Harbor Island 50 MGD*** (Chapter 5B.6)						
Annual Cost (\$/yr)	\$101,260,656	\$101,260,656	\$44,245,530	\$44,245,530	\$44,245,530	\$44,245,530
Unit Cost (\$/ac-ft)	\$3,616	\$3,616	\$1,580	\$1,580	\$1,580	\$1,580
Brackish Groundwater Desalination – EV Ranch (Chapter 5B.7)						
Annual Cost (\$/yr)	\$142,655,000	\$142,655,000	\$65,097,000	\$65,097,000	\$65,097,000	\$65,097,000
Unit Cost (\$/ac-ft)	\$4,458	\$4,458	\$2,034	\$2,034	\$2,034	\$2,034
Brackish Groundwater Desalination – Nueces River Brackish Wells Reverse Osmosis Facility (Chapter 5B.7)						
Annual Cost (\$/yr)	\$38,859,000	\$38,859,000	\$20,000,000	\$20,000,000	\$20,000,000	\$20,000,000
Unit Cost (\$/ac-ft)	\$6,476,500	\$6,476,500	\$3,333,333	\$3,333,333	\$3,333,333	\$3,333,333

* Note: Seawater Desalination costs do not include transmission pipelines for delivery to point of use.

5D.11.4 Corpus Christi Naval Air Station

The Corpus Christi Naval Air Station obtains treated surface water from the City of Corpus Christi. No shortages are projected for the air station; however, additional water conservation is a recommended water management strategy (Table 5D.81).

Table 5D.81.
Recommended Water Supply Plan for the Corpus Christi Naval Air Station

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	189	373	539	687	819	936
New Balance	189	373	539	687	819	936

Estimated costs of the recommended plan for the Corpus Christi Naval Air Station are shown in Table 5D.82.

Table 5D.82.
Recommended Plan Costs by Decade for the Corpus Christi Naval Air Station

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$109,695	216,104	312,435	398,608	475,247	543,170
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.11.5 City of Driscoll

The City of Driscoll purchases treated surface water from STWA, which originates from the CCR/LCC/Texana/MRP Phase II System. No shortages are projected for the City of Driscoll; however, the city of Driscoll is to receive 12 percent of the Driscoll Groundwater Desalination Plant's yield. The recommended water supply management plan is shown in Table 5D.83.

Table 5D.83.
Recommended Water Supply Plan for City of Driscoll

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Driscoll Groundwater Desalination	130	130	130	130	130	130
Total New Supply	130	130	130	130	130	130
New Balance	130	130	130	130	130	130

Estimated costs of the recommended plan for City of Driscoll are shown in Table 5D.84.

Table 5D.84.
Recommended Water Supply Plan for City of Driscoll

Plan Element	2030	2040	2050	2060	2070	2080
Driscoll Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$391,897	\$391,897	\$162,042	\$162,042	\$162,042	\$162,042
Unit Cost (\$/ac-ft)	\$2,878	\$2,878	\$1,190	\$1,190	\$1,190	\$1,190

5D.11.6 Nueces County Water Control and Improvement District #3

Nueces County WCID 3 has a water right to divert supply from the Nueces River. Shortages are projected for Nueces County WCID 3 throughout the planning period. The total project yield for the local balancing storage is larger than shown in the table below. The local balancing storage yield is 4,058 ac-ft/yr. Supplies were divided between Nueces County WCID 3 and River Acres WSC and assigned based on need.

The recommended water supply management plan is shown in Table 5D.85.

Table 5D.85.
Recommended Water Supply Plan for Nueces County WCID 3

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(3,383)	(3,439)	(3,443)	(3,419)	(3,395)	(3,370)
Recommended Plan						
Municipal Water Conservation	279	583	863	1,109	1,328	1,522
Local Balancing Storage	3,827	3,827	3,827	3,827	3,827	3,827
Total New Supply	4,106	4,153	4,458	4,727	4,967	5,181
New Balance	723	714	1,015	1,308	1,572	1,811

Estimated costs of the recommended plan for Nueces County WCID 3 are shown in Table 5D.86.

Table 5D.86.
Recommended Water Supply Plan for Nueces County WCID 3

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$161,022	336,495	498,110	640,064	766,287	878,476
Unit Cost (\$/ac-ft)*	\$577	\$577	\$577	\$577	\$577	\$577
Local Balancing Storage (Chapter 5B.8)						
Annual Cost (\$/yr)	\$2,035,000	\$2,035,000	\$854,000	\$854,000	\$854,000	\$854,000
Unit Cost (\$/ac-ft)	\$904	\$904	\$483	\$483	\$483	\$483

* Unit costs for this plan element are rounded.

5D.11.7 Nueces County Water Control and Improvement District #4

Nueces County WCID 4 obtains treated surface water supply from the City of Corpus Christi. No shortages are projected for Nueces County WCID 4; however, additional water conservation is a recommended water management strategy for the WCID (Table 5D.87).

Table 5D.87.
Recommended Water Supply Plan for Nueces County WCID 4

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	118	238	348	446	531	608
New Balance	118	238	348	446	531	608

Estimated costs of the recommended plan for Nueces County WCID 4 are shown in Table 5D.88.

Table 5D.88.
Recommended Plan Costs by Decade for Nueces County WCID 4

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$68,235	\$138,022	\$201,891	\$258,506	\$308,141	\$352,568
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.11.8 Nueces Water Supply Corporation

Nueces WSC has a contract with the STWA to purchase treated surface water from the CCR/LCC/Texana/MRP Phase II System. No shortages are projected for Nueces WSC; however, additional water conservation is a recommended water management strategy for the WSC (Table 5D.89).

Table 5D.89.
Recommended Water Supply Plan for Nueces WSC

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	49	45	45	45	45	45
Driscoll Groundwater Desalination	224	224	224	224	224	224
New Balance	273	269	269	269	269	269

Estimated costs of the recommended plan for Nueces WSC are shown in Table 5D.90.

Table 5D.90.
Recommended Plan Costs by Decade for Nueces WSC

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$28,238	\$26,068	\$26,318	\$26,341	\$25,874	\$25,897
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580
Driscoll Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$653,162	\$653,162	\$270,071	\$270,071	\$270,071	\$270,071
Unit Cost (\$/ac-ft)*	\$2,878	\$2,878	\$1,190	\$1,190	\$1,190	\$1,190

* Unit costs for this plan element are rounded.

5D.11.9 River Acres Water Supply Corporation

River Acres WSC obtains its water from Nueces County WCID 3. No shortages are projected for River Acres WSC during the planning period and no changes to water supply management are recommended.

River Acres WSC is recommended for pipeline replacement (Table 5B.1.9 and 5B.1.10). Up to 10 acft water savings is expected in Year 2040 at a cost of \$37,350,720 for pipeline replacement.

5D.11.10 Violet Water Supply Corporation

Violet WSC obtains treated surface water supply from the City of Corpus Christi. No shortages are projected for the WSC and no changes in water supply are recommended.

5D.11.11 County-Other

Nueces County-Other entities obtain surface water from various water providers, including STWA, and groundwater from the Gulf Coast Aquifer. No shortages are projected for Nueces County-Other entities during the planning period; however, Nueces County-Other entities will receive 27 percent of the Driscoll Groundwater Desalination Project's yield. The recommended water supply management plan is shown in Table 5D.91.

Table 5D.91.
Recommended Water Supply Plan for Nueces County-Other

Plan Element	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Driscoll Groundwater Desalination	404	404	404	404	404	404
New Balance	404	404	404	404	404	404

Estimated costs of the recommended plan for Nueces County-Other are shown in Table 5D.92.

Table 5D.92.
Recommended Plan Costs by Decade for Nueces County-Other

Plan Element	2020	2030	2040	2050	2060	2070
Driscoll Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$1,175,692	\$1,175,692	\$486,127	\$486,127	\$486,127	\$486,127
Unit Cost (\$/ac-ft)*	\$2,878	\$2,878	\$1,190	\$1,190	\$1,190	\$1,190

* Unit costs for this plan element are rounded.

5D.11.12 Manufacturing

The City of Corpus Christi provides treated and raw surface water for manufacturing in Nueces County from the CCR/LCC/Texana/MRP Phase II System. Additional manufacturing supplies are from the Gulf Coast Aquifer and reuse supplies. The City of Corpus Christi also provides surface water for manufacturing in San Patricio County. A shortage in manufacturing supply occurs beginning in 2040. The recommended water supply plan for Nueces County Manufacturing is shown below (Table 5D.93). The recommended strategies Seawater Desalination- Corpus Christi (Inner Harbor) and Evangeline/Laguna LP Groundwater Desalination project shown would likely be jointly developed by the City of Corpus Christi and the SPMWD.

Note: The total project yield for O.N. Stevens Water Treatment Plant (WTP) improvement, Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability, Aquifer Storage and Recovery, Evangeline/Laguna LP Groundwater Desalination project, Corpus Christi Inner Harbor seawater desalination, Barney Davis seawater desalination, and PCCA Harbor Island seawater desalination project is larger than shown Table 5D.93.

The Corpus Christi Inner Harbor seawater desalination project yield is 33,604 ac-ft/yr, the Port Harbor Island seawater desalination project yield is 112,014 ac-ft/yr, the O.N. Stevens WTP Improvement project yield is 25,637 ac-ft/yr, the Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability project yield is 25,637 ac-ft/yr, Aquifer Storage and Recovery project yield is 8,070 ac-ft/yr, the Evangeline Laguna Treated Groundwater project yield is 25,637 ac-ft/yr, and the Barney Davis seawater desalination project yield is 33,627 ac-ft/yr. Supplies were divided equally between Nueces County-Manufacturing and the City of Corpus Christi for the Corpus Christi Inner Harbor seawater desalination project, PCCA Harbor Island seawater desalination project, and the Aquifer Storage and Recovery project. Supplies were divided equally between Nueces County-Manufacturing, San Patricio County-Manufacturing, and the City of Corpus Christi for the O.N. Stevens WTP Improvement, Evangeline/Laguna LP Groundwater Desalination Project, and Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability project. The PCCA Harbor Island seawater desalination project yield is allocated 25 percent to Nueces County-Manufacturing and 75 percent to San Patricio County-Manufacturing. The manufacturing water conservation yield for Nueces County is 1,259 ac-ft/yr in 2030 and increases to 7,851 ac-ft/yr by 2080.

Table 5D.93.
Recommended Water Supply Plan for Nueces County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(33,672)	(36,879)	(39,295)	(41,356)	(43,635)	(45,731)
Recommended Plan						
Manufacturing Water Conservation	1,259	2,518	3,777	5,037	6,309	7,851
O.N. Stevens WTP Improvements*	0	0	0	0	0	0
Petronila Regional WWTP Reuse	1,120	1,120	1,120	1,120	1,120	1,120
Oso Regional WWTP Reuse	0	3,736	3,736	3,736	3,736	3,736
Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability*	0	0	0	0	0	0
Aquifer Storage and Recovery	0	4,035	4,035	4,035	4,035	4,035
Evangeline/Laguna LP Groundwater Desalination	8,546	8,546	8,546	8,546	8,546	8,546
Driscoll Groundwater Desalination	560	560	560	560	560	560
Seawater Desalination – Corpus Christi (Inner Harbor)	16,802	16,802	16,802	16,802	16,802	16,802
Seawater Desalination – Barney Davis	0	11,201	11,201	11,201	11,201	11,201
Seawater Desalination – Port Harbor Island	28,003	28,003	28,003	28,003	28,003	28,003
Brackish Groundwater Desalination – EV Ranch	6,400	6,400	6,400	6,400	6,400	6,400
Nueces River Brackish Well Reverse Osmosis Facility	2	3	3	3	3	3
Total New Supply	62,692	82,924	84,183	85,443	86,715	88,257
New Balance (Treated)	29,020	46,045	44,888	44,087	43,080	42,526

*Note: These projects increase infrastructure capacity to serve existing and future customers, and are anticipated to come on-line in 2030. The source water is associated with the Evangeline/Laguna Groundwater project, but could include other recommended WMS projects that the City of Corpus Christi are also considering. The supply is set to zero as to not double count with water source strategies.

Estimated costs of the recommended plan for Nueces County Manufacturing are shown in Table 5D.94.

Table 5D.94.
Recommended Plan Costs by Decade for Nueces County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$25,180	\$50,360	\$75,540	\$100,740	\$126,180	\$157,020
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$20
O.N. Stevens WTP Improvements (Chapter 5B.10)						
Annual Cost (\$/yr)	\$7,502,000	\$7,502,000	\$1,679,000	\$1,679,000	\$1,679,000	\$1,679,000
Unit Cost (\$/ac-ft)*	\$665	\$665	\$437	\$437	\$437	\$437
Petronila Regional WWTP Reuse (Chapter 5B.4)						
Annual Cost (\$/yr)	\$1,554,560	\$1,554,560	\$623,840	\$623,840	\$623,840	\$623,840
Unit Cost (\$/ac-ft)	\$1,388	\$1,388	\$557	\$557	\$557	\$557
Oso Regional WWTP Reuse (Chapter 5B.4)						
Annual Cost (\$/yr)	\$0	\$53,871,000	\$53,871,000	\$10,670,000	\$10,670,000	\$10,670,000
Unit Cost (\$/ac-ft)	\$0	\$4,806	\$4,806	\$952	\$952	\$952
Mary Rhodes Improvements (Chapter 5B.10)						
Annual Cost (\$/yr)	\$112,506,000	\$112,506,000	\$25,510,000	\$25,510,000	\$25,510,000	\$25,510,000
Unit Cost (\$/ac-ft)*	\$4,760	\$4,760	\$1,367	\$1,367	\$1,367	\$1,367
Aquifer Storage and Recovery (Chapter 5B.5)						
Annual Cost (\$/yr)	\$0	\$11,435,190	\$11,435,190	\$4,878,315	\$4,878,315	\$4,878,315
Unit Cost (\$/ac-ft)	\$0	\$2,834	\$2,834	\$1,209	\$1,209	\$1,209
Evangeline/Laguna LP Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$34,909,048	\$34,909,048	\$23,474,946	\$23,474,946	\$23,474,946	\$23,474,946
Unit Cost (\$/ac-ft)	\$4,085	\$4,085	\$2,747	\$2,747	\$2,747	\$2,747
Driscoll Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$1,611,133	\$1,611,133	\$666,174	\$666,174	\$666,174	\$666,174
Unit Cost (\$/ac-ft)	\$2,878	\$2,878	\$1,190	\$1,190	\$1,190	\$1,190
Seawater Desalination – Corpus Christi (Inner Harbor) 10 MGD** (Chapter 5B.6)						
Annual Cost (\$/yr)	\$52,993,508	\$52,993,508	\$29,957,966	\$29,957,966	\$29,957,966	\$29,957,966
Unit Cost (\$/ac-ft)	\$3,154	\$3,154	\$1,783	\$1,783	\$1,783	\$1,783
Seawater Desalination – Corpus Christi (Barney Davis) 20 MGD (Chapter 5B.6)						
Annual Cost (\$/yr)	\$0	\$124,588,035	\$124,588,035	\$62,815,236	\$62,815,236	\$62,815,236
Unit Cost (\$/ac-ft)	\$0	\$3,705	\$3,705	\$1,868	\$1,868	\$1,868
Seawater Desalination – PCCA Harbor Island 50 MGD*** (Chapter 5B.6)						
Annual Cost (\$/yr)	\$101,260,656	\$101,260,656	\$44,245,530	\$44,245,530	\$44,245,530	\$44,245,530
Unit Cost (\$/ac-ft)	\$3,616	\$3,616	\$1,580	\$1,580	\$1,580	\$1,580
Brackish Groundwater Desalination – EV Ranch (Chapter 5B.7)						
Annual Cost (\$/yr)	\$142,655,000	\$142,655,000	\$65,097,000	\$65,097,000	\$65,097,000	\$65,097,000
Unit Cost (\$/ac-ft)	\$4,458	\$4,458	\$2,034	\$2,034	\$2,034	\$2,034
Brackish Groundwater Desalination – Nueces River Brackish Wells Reverse Osmosis Facility (Chapter 5B.7)						
Annual Cost (\$/yr)	\$38,859,000	\$38,859,000	\$20,000,000	\$20,000,000	\$20,000,000	\$20,000,000
Unit Cost (\$/ac-ft)	\$6,476,500	\$6,476,500	\$3,333,333	\$3,333,333	\$3,333,333	\$3,333,333

* Unit cost for Regional WTP upgrades includes treatment of \$369 per ac-ft.

** Note: Seawater Desalination costs do not include transmission pipelines for delivery to point of use.

***Note: Seawater Desalination costs estimate 2 mile line for delivery to point of use.

5D.11.13 Steam-Electric

The steam-electric users in Nueces County are provided water by City of Corpus Christi. No shortages are projected for steam-electric users and no changes in water supply are recommended.

5D.11.14 Mining

Nueces County Mining users obtain water supplies from the Gulf Coast Aquifer. Shortages are projected for mining users throughout the planning period. The recommended water supply management plan is shown in Table 5D.95.

Table 5D.95.
Recommended Water Supply Plan for Nueces County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	(88)	(98)	(93)	(84)	(95)	(101)
Recommended Plan						
Mining Water Conservation	20	42	64	88	111	134
Gulf Coast Aquifer Supplies	101	101	101	101	101	101
Total New Supply	121	143	165	189	212	235
New Balance	33	45	72	105	117	134

Estimated costs of the recommended plan for Nueces County Mining are shown in Table 5D.96.

Table 5D.96.
Recommended Water Supply Plan for Nueces County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.3)						
Annual Cost (\$/yr)	\$400	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$20	\$10	\$6	\$5	\$4	\$3
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$59,994	\$59,994	\$6,969	\$6,969	\$6,969	\$6,969
Unit Cost (\$/ac-ft)	\$594	\$594	\$69	\$69	\$69	\$69

5D.11.15 Irrigation

Irrigation users in Nueces County obtain water supplies from the Gulf Coast Aquifer. No shortages are projected for irrigation users during the planning period and no changes to water supply management are recommended.

5D.11.16 Livestock

The livestock demands in Nueces County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.12 San Patricio County Water Supply Plan

Table 5D.97 lists each water user group in San Patricio County and their corresponding surplus or shortage in years 2050 and 2080. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5D.97.
San Patricio County Surplus/(Shortage)

Water User Group	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Aransas Pass	0	0	Supply equals demand
City of Gregory	0	0	Supply equals demand
City of Ingleside	0	0	Supply equals demand
City of Mathis	0	0	Supply equals demand
City of Odem	0	0	Supply equals demand
City of Portland	0	0	Supply equals demand
Rincon WSC	0	0	Supply equals demand
City of Sinton	0	0	Supply equals demand
City of Taft	0	0	Supply equals demand
County-Other	0	0	Supply equals demand
Manufacturing	6,240	6,289	Supply equals demand
Steam-Electric	0	0	Supply equals demand
Mining	0	0	Supply equals demand
Irrigation	0	0	Supply equals demand
Livestock	0	0	Supply equals demand

¹ From Tables 4A.22 and 4A.23, Chapter 4A – Comparison of Water Demands with Water Supplies to Determine Needs.

5D.12.1 City of Aransas Pass

The City of Aransas Pass is located in Aransas, Nueces, and San Patricio Counties, with the majority of demand lying in San Patricio County. Aransas Pass contracts with SPMWD to purchase treated water. The contract allows the City of Aransas Pass to purchase only the water that it needs. No shortages are projected for the City of Aransas Pass across all three counties, and no changes in water supply are recommended.

5D.12.2 City of Gregory

The City of Gregory has a contract with the SPMWD to purchase treated water. The contract allows the city to purchase only the water that it needs. No shortages are projected for the City of Gregory; however, additional water conservation is a recommended water management strategy for the city (Table 5D.98).

Table 5D.98.
Recommended Water Supply Plan for the City of Gregory

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	12	10	10	11	11	11
New Balance	12	10	10	11	11	11

Estimated costs of the recommended plan for the City of Gregory are shown in Table 5D.99.

Table 5D.99.
Recommended Plan Costs by Decade for the City of Gregory

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$7,069	\$5,908	\$5,805	\$6,249	\$6,204	\$6,159
Unit Cost (\$/ac-ft)*	\$580	\$580	\$580	\$580	\$580	\$580

* Unit costs for this plan element are rounded.

5D.12.3 City of Ingleside

The City of Ingleside has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Ingleside and no changes in water supply are recommended.

5D.12.4 City of Mathis

The City of Mathis has a contract with the City of Corpus Christi to purchase raw water from the CCR/LCC/Texana/MRP Phase II System. The contract allows the city to purchase only the water that it needs. No shortages are projected for the City of Mathis; however, the city is diversifying its water supply with the addition of groundwater supplies.

Table 5D.100.
Recommended Water Supply Plan for City of Mathis

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Gulf Coast Aquifer Supplies	560	560	560	560	560	560
Municipal Water Conservation- Pipeline Replacement	-	11	-	-	-	-
New Balance	560	571	560	560	560	560

Estimated costs of the recommended plan for City of Mathis are shown in Table 5D.101.

Table 5D.101.
Recommended Plan Costs by Decade for City of Mathis

Plan Element	2030	2040	2050	2060	2070	2080
Drill New Well (Chapter 5B.9)						
Annual Cost (\$/yr)	\$238,000	\$238,000	\$85,120	\$85,120	\$85,120	\$85,120
Unit Cost (\$/ac-ft)*	\$425	\$425	\$152	\$152	\$152	\$152
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$74,701,440	-	-	-	-

* Unit costs for this plan element are rounded.

5D.12.5 City of Odem

The City of Odem has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Odem and no changes in water supply are recommended.

5D.12.6 City of Portland

The City of Portland has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Portland and no changes in water supply are recommended; however, additional water conservation is a recommended water management strategy for the city (Table 5D.102).

Table 5D.102.
Recommended Water Supply Plan for the City of Portland

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	88	83	89	97	105	113
New Balance	88	83	89	97	105	113

Estimated costs of the recommended plan for the City of Portland are shown in Table 5D.103.

Table 5D.103.
Recommended Plan Costs by Decade for the City of Portland

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$50,969	\$47,733	\$51,515	\$56,037	\$60,518	\$65,422
Unit Cost (\$/ac-ft)	\$577	\$577	\$577	\$577	\$577	\$577

5D.12.7 Rincon Water Supply Corporation

Rincon WSC has a contract with the SPMWD to purchase treated water. The contract allows the WSC to purchase only the water that it needs. No shortages are projected for Rincon WSC and no changes in water supply are recommended.

5D.12.8 City of Sinton

The City of Sinton meets its demands with groundwater pumped from the Gulf Coast Aquifer. No shortages are projected for the City of Sinton; however, additional water conservation is a recommended water management strategy for the city (Table 5D.104).

Table 5D.104.
Recommended Water Supply Plan for the City of Sinton

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Municipal Water Conservation	80	170	253	332	335	339
Municipal Water Conservation- Pipeline Replacement	-	77	-	-	-	-
New Balance	80	247	253	332	335	339

Estimated costs of the recommended plan for the City of Sinton are shown in Table 5D.105.

Table 5D.105.
Recommended Plan Costs by Decade for the City of Sinton

Plan Element	2030	2040	2050	2060	2070	2080
Municipal Water Conservation (Chapter 5B.1)						
Annual Cost (\$/yr)	\$46,529	98,489	146,590	192,708	\$194,416	\$196,771
Unit Cost (\$/ac-ft)	\$580	\$580	\$580	\$580	\$580	\$580
Municipal Water Conservation- Pipeline Replacement (Chapter 5B.1)						
Capital Cost (\$)	-	\$124,502,400	-	-	-	-

5D.12.9 City of Taft

The City of Taft has a contract with the SPMWD to purchase treated water. The contract allows the City to purchase only the water that it needs. No shortages are projected for the City of Taft and no changes in water supply are recommended.

5D.12.10 County-Other

County-Other demands are met with surface water from the CCR/LCC/Texana/MRP Phase II System provided by the SPMWD and groundwater from the Gulf Coast Aquifer. No shortages are projected for County-Other entities and no changes in water supply are recommended.

5D.12.11 Manufacturing

The City of Corpus Christi provides the surface water for manufacturing in San Patricio County through the SPMWD from the CCR/LCC/Texana/MRP Phase II System. A small amount of manufacturing supplies are from the Gulf Coast Aquifer and reuse supplies. The city also provides surface water for manufacturing in Nueces County. SPMWD shows a raw water surplus ranging from 6,791 to 6,289 acft/yr during the 2030-2080 period based on TWDB

approved water demands. However, a shortage in manufacturing supply occurs beginning in 2030 due to treatment plant constraints assuming 80 percent of SPMWD supplies to industries are treated. The recommended water supply plan for San Patricio County Manufacturing is shown below (Table 5D.106). The recommended Seawater Desalination- Corpus Christi (La Quinta) project shown would likely be jointly developed by the City of Corpus Christi and the SPMWD. Note: The total project yield for O.N. Stevens WTP improvement, Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability , Evangeline/Laguna LP Groundwater Desalination project, and PCCA Harbor Island seawater desalination project is larger than shown in Table 5D.106. The Port Harbor Island seawater desalination project yield is 112,014 ac-ft/yr, the O.N. Stevens WTP Improvement project yield is 25,637 ac-ft/yr, the Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability project yield is 25,637 ac-ft/yr, and the Evangeline Laguna Treated Groundwater project yield is 25,637 ac-ft/y. Supplies were divided equally between Nueces County-Manufacturing, San Patricio County-Manufacturing, and the City of Corpus Christi for the O.N. Stevens WTP Improvement, Evangeline/Laguna LP Groundwater Desalination Project, and Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability project. The PCCA Harbor Island seawater desalination project yield is allocated 25 percent to Nueces County-Manufacturing and 75 percent to San Patricio County-Manufacturing. The manufacturing water conservation yield for San Patricio Counties is 1,518 ac-ft/yr in 2030 and increases to 9,110 ac-ft/yr by 2080.

Table 5D.106.
Recommended Water Supply Plan for San Patricio County Manufacturing

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage) – WTP Capacity Constrained	(1,454)	(1,847)	(2,003)	(1,924)	(1,851)	(1,951)
Recommended Plan						
Manufacturing Water Conservation	1,518	3,036	4,553	6,073	7,591	9,110
O.N. Stevens WTP Improvements*	0	0	0	0	0	0
Oso Regional WWTP Reuse	3,736	3,736	3,736	3,736	3,736	3,736
Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability*	0	0	0	0	0	0
SPMWD Project No. 1 - New WTP (20 MGD) at Plant D**	0	0	0	0	0	0
SPMWD Project No. 2 - New Intake, PS and Raw Water Transmission on Nueces River**	0	0	0	0	0	0
SPMWD Project No. 3 - New Pump Station at Mary Rhodes Pipeline & Transmission Rehab**	0	0	0	0	0	0
Evangeline/Laguna LP Groundwater Desalination	8,545	8,545	8,545	8,545	8,545	8,545
Seawater Desalination – Corpus Christi (La Quinta)	0	44,806	44,806	44,806	44,806	44,806
Seawater Desalination – Port La Quinta	0	33,604	33,604	33,604	33,604	33,604
Seawater Desalination – Port Harbor Island	84,011	84,011	84,011	84,011	84,011	84,011
Brackish Groundwater Desalination – EV Ranch	19,200	19,200	19,200	19,200	19,200	19,200
Nueces River Brackish Well Reverse Osmosis Facility	2	2	2	3	3	3
Total New Supply	117,012	196,940	198,457	199,978	201,496	203,015
New Balance (Treated)	115,558	195,093	196,454	198,054	199,645	201,064

*Note: These projects increase infrastructure capacity to serve existing and future customers and are anticipated to come on-line in 2030. The source water is associated with the Evangeline/Laguna Groundwater project, but could include other recommended WMS projects that the City of Corpus Christi are also considering. The supply is set to zero as to not double count with water source strategies.

**Note: The SPMWD infrastructure projects is anticipated to be needed by Year 2030 and is focused on treatment and delivery of additional water supply volumes to SPMWD's customers. It assumes increased contracted water supplies from the City of Corpus Christi in an amount up to 82,049 ac-ft/yr (or 73.2 MGD). The supply is set to zero as to not double count with water source strategies. For additional information, see Chapter 5B.10.3.

Estimated costs of the recommended plan for San Patricio County Manufacturing are shown in Table 5D.107.

Table 5D.107.
Recommended Plan Costs by Decade for San Patricio County Manufacturing

Plan Element	2030	2040	2050	2060	2070	2080
Manufacturing Water Conservation (Chapter 5B.2)						
Annual Cost (\$/yr)	\$30,360	\$60,720	\$91,060	\$121,460	\$151,820	\$182,200
Unit Cost (\$/ac-ft)	\$20	\$20	\$20	\$20	\$20	\$20
O.N. Stevens WTP Improvements (Chapter 5B.10)						
Annual Cost (\$/yr)	\$7,502,000	\$7,502,000	\$1,679,000	\$1,679,000	\$1,679,000	\$1,679,000
Unit Cost (\$/ac-ft)*	\$665	\$665	\$437	\$437	\$437	\$437
Oso Regional WWTP Reuse (Chapter 5B.4)						
Annual Cost (\$/yr)	\$53,871,000	\$53,871,000	\$10,670,000	\$10,670,000	\$10,670,000	\$10,670,000
Unit Cost (\$/ac-ft)	\$4,806	\$4,806	\$952	\$952	\$952	\$952
Mary Rhodes Improvements (Chapter 5B.10)						
Annual Cost (\$/yr)	\$112,506,000	\$112,506,000	\$25,510,000	\$25,510,000	\$25,510,000	\$25,510,000
Unit Cost (\$/ac-ft)*	\$4,760	\$4,760	\$1,367	\$1,367	\$1,367	\$1,367
SPMWD Project No. 1 - New WTP (20 MGD) at Plant D (Chapter 5B.10)						
Annual Cost (\$/yr)	\$18,360,342	\$18,360,342	\$13,450,800	\$13,450,800	\$13,450,800	\$13,450,800
Unit Cost (\$/ac-ft)*	\$819	\$819	\$600	\$600	\$600	\$600
SPMWD Project No. 2 - New Intake, PS and Raw Water Transmission on Nueces River (Chapter 5B.10)						
Annual Cost (\$/yr)	\$44,268,315	\$44,268,315	\$44,268,315	\$44,268,315	\$28,562,445	\$28,562,445
Unit Cost (\$/ac-ft)*	\$637	\$637	\$411	\$411	\$411	\$411
SPMWD Project No. 3 - New Pump Station at Mary Rhodes Pipeline & Transmission Rehab (Chapter 5B.10)						
Annual Cost (\$/yr)	\$16,208,214	\$16,208,214	\$13,383,546	\$13,383,546	\$13,383,546	\$13,383,546
Unit Cost (\$/ac-ft)*	\$482	\$482	\$398	\$398	\$398	\$398
Evangeline/Laguna LP Groundwater Desalination (Chapter 5B.7)						
Annual Cost (\$/yr)	\$34,909,048	\$34,909,048	\$23,474,946	\$23,474,946	\$23,474,946	\$23,474,946
Unit Cost (\$/ac-ft)	\$4,085	\$4,085	\$2,747	\$2,747	\$2,747	\$2,747
Seawater Desalination – Corpus Christi (La Quinta) 20 MGD (Chapter 5B.6)						
Annual Cost (\$/yr)	\$0	\$155,028,760	\$155,028,760	\$75,139,662	\$75,139,662	\$75,139,662
Unit Cost (\$/ac-ft)	\$0	\$3,460	\$3,460	\$1,677	\$1,677	\$1,677
Seawater Desalination – Port La Quinta 30 MGD (Chapter 5B.6)						
Annual Cost (\$/yr)	\$0	\$116,080,404	\$116,080,404	\$57,334,035	\$57,334,035	\$57,334,035
Unit Cost (\$/ac-ft)	\$0	\$3,452	\$3,452	\$1,705	\$1,705	\$1,705
Seawater Desalination – Port Harbor Island 100 MGD (Chapter 5B.6)						
Annual Cost (\$/yr)	\$303,781,968	\$303,781,968	\$132,736,590	\$132,736,590	\$132,736,590	\$132,736,590
Unit Cost (\$/ac-ft)	\$3,616	\$3,616	\$1,580	\$1,580	\$1,580	\$1,580
Brackish Groundwater Desalination – EV Ranch (Chapter 5B.7)						
Annual Cost (\$/yr)	\$142,655,000	\$142,655,000	\$65,097,000	\$65,097,000	\$65,097,000	\$65,097,000
Unit Cost (\$/ac-ft)	\$4,458	\$4,458	\$2,034	\$2,034	\$2,034	\$2,034
Brackish Groundwater Desalination – Nueces River Brackish Wells Reverse Osmosis Facility (Chapter 5B.7)						
Annual Cost (\$/yr)	\$38,859,000	\$38,859,000	\$20,000,000	\$20,000,000	\$20,000,000	\$20,000,000
Unit Cost (\$/ac-ft)	\$6,476,500	\$6,476,500	\$3,333,333	\$3,333,333	\$3,333,333	\$3,333,333

* Unit cost for Regional WTP upgrades includes treatment of \$369 per ac-ft.

***Note: Seawater Desalination costs estimate 2 mile line for delivery to point of use.

5D.12.12 Steam-Electric

Steam-electric demands in San Patricio County are met by water from the SPMWD. No shortages are projected for steam-electric users and no changes in water supply are recommended.

5D.12.13 Mining

Mining users in San Patricio County obtain water supply from the Gulf Coast Aquifer. No shortages are projected for mining during the planning period; however, mining water conservation is a recommended water management strategy for the county. The recommended water supply management plan is shown in Table 5D.108.

Table 5D.108.
Recommended Water Supply Plan for San Patricio County Mining

Plan Element	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)	2080 (ac-ft/yr)
Projected Need (Shortage)	0	0	0	0	0	0
Recommended Plan						
Mining Water Conservation	2	5	7	9	12	14
Total New Supply	2	5	7	9	12	14
New Balance	2	5	7	9	12	14

Estimated costs of the recommended plan for San Patricio County Mining are shown in Table 5D.109.

Table 5D.109.
Recommended Plan Costs by Decade for San Patricio County Mining

Plan Element	2030	2040	2050	2060	2070	2080
Mining Water Conservation (Chapter 5B.4)						
Annual Cost (\$/yr)	\$400	\$400	\$400	\$400	\$400	\$400
Unit Cost (\$/ac-ft)	\$200	\$80	\$57	\$44	\$33	\$29

ND = Not Determined due to high variability in costs associated with mining BMPs.

5D.12.14 Irrigation

Irrigation users in San Patricio County obtain water from the Gulf Coast Aquifer. No shortages are projected for irrigation users during the planning period and no changes to water supply are recommended.

5D.12.15 Livestock

The livestock water demands in San Patricio County are met by groundwater from the Gulf Coast Aquifer and surface water from local on-farm sources. No shortages are projected for livestock and no changes in water supply are recommended.

5D.13 Wholesale Water Provider Water Supply Plans

Table 5D.110 lists each Wholesale Water Provider and their corresponding surplus or shortage in years 2050 and 2080. For each Wholesale Water Provider with a projected shortage, a water supply plan has been developed.

Table 5D.110.
Wholesale Water Provider Surplus/(Shortage)

Wholesale Water Provider	Surplus/(Shortage) ¹		Comment
	2050 (ac-ft/yr)	2080 (ac-ft/yr)	
City of Corpus Christi ²	(39,295)	(50,889)	Projected shortage – see plan below
San Patricio MWD	(2,003)	(1,951)	Projected shortage – see plan below
South Texas Water Authority	0	0	Supply equals demand
Nueces County WCID 3	(3,443)	(3,370)	Projected shortage – see plan below

¹ Surplus/(Shortage) for each Wholesale Water Provider calculated by taking total surface water availability (constrained by water treatment plant capacity) less municipal retail and wholesale demands, steam-electric demands, manufacturing demands, and/or other water supply contracts (Table 4A.24).

² The City of Corpus Christi provides water supplies to SPMWD to meet San Patricio County-Manufacturing demands. The total shortages shown for the City of Corpus Christi include both the needs of Nueces County-Manufacturing and those required by SPMWD to meet San Patricio County-Manufacturing demands (i.e. San Patricio MWD shortage).

5D.13.1 City of Corpus Christi

As the primary provider of surface water to the Coastal Bend Region, the City of Corpus Christi is the major WWP in the region. Corpus Christi has 157,000 ac-ft in available safe yield supply in 2080 through its own water right in the CCR/LCC/Texana/MRP Phase II System. This includes contracted supplies with Lavaca-Navidad River Authority from Lake Texana, after exercising Lavaca-Navidad River Authority's call-back provision for Jackson County users in addition to up to 35,000 ac-ft/yr from the Garwood water rights located on the Colorado River.

The city provides treated and raw water from the CCR/LCC/Texana/MRP Phase II System to the WUGs and other entities shown in Table 5D.111.

Table 5D.111.
Purchasers of Water from the City of Corpus Christi

Water User Group / Entity	County
San Patricio MWD	San Patricio
South Texas Water Authority	Kleberg, Nueces
City of Alice	Jim Wells
City of Beeville	Bee
Corpus Christi Naval Air Station	Nueces
City of Mathis	San Patricio
City of Three Rivers	Live Oak
Nueces County WCID 4 (Port Aransas)	Nueces
Violet WSC	Nueces
Steam-Electric	Nueces
Manufacturing	Nueces

The shortage listed in Table 5D.112 reflects the entire city's demands — both municipal retail and wholesale, as well as steam-electric and manufacturing demands, taking water treatment plant constraints into consideration. The shortage spans the entire 50-year planning period and is due to large manufacturing demands in Nueces and San Patricio counties. For a list of the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in Nueces County in Section 5D.11.12.

5D.13.2 San Patricio Municipal Water District

The SPMWD is the second largest Wholesale Water Provider in the region. SPMWD has a contract with the City of Corpus Christi to purchase water from the CCR/LCC/Texana/MRP Phase II System. SPMWD treats this water and provides it to the water user groups and other entities shown in Table 5D.112.

Table 5D.112.
Purchasers of Water from San Patricio MWD

Water User Group / Entity	County
City of Aransas Pass	Aransas, Nueces, San Patricio
City of Gregory	San Patricio
City of Ingleside	San Patricio
City of Ingleside on the Bay	San Patricio
City of Odem	San Patricio
City of Portland	San Patricio
City of Rockport	Aransas
City of Taft	San Patricio
Rincon WSC	San Patricio
Nueces WCID 4 (Port Aransas)	Nueces
Seaboard WSC	San Patricio
Steam- Electric	San Patricio
Manufacturing	San Patricio

The shortage listed in Table 5D.110 reflects all of SPMWD's demands — both municipal retail and wholesale, as well as manufacturing demands. The shortage also accounts for water availability constraints in the CCR/LCC/Texana/MRP Phase II. SPMWD has adequate contracts in place with the City of Corpus Christi to meet demands through 2080. However, the treated water needs exceed treatment capacity with contracted treated water from the City of Corpus Christi, therefore SPMWD is showing a shortage across the entire 50-year planning period. For the water management strategies available to meet these shortages, refer to the water supply plan for manufacturing in San Patricio County in Section 5D.12.11.

5D.13.3 South Texas Water Authority

The South Texas Water Authority (STWA) is the third largest Wholesale Water Provider in the region. STWA has a contract with the City of Corpus Christi to purchase treated water from the CCR/LCC/Texana/MRP Phase II System. STWA provides this water to the water user groups and other entities shown in Table 5D.113.

Table 5D.113.
Purchasers of Water from South Texas Water Authority

Water User Group / Entity	County
City of Bishop	Nueces
City of Driscoll	Nueces
Nueces County-Other ¹	Nueces
Nueces WSC	Nueces
City of Kingsville	Kleberg
Ricardo WSC	Kleberg

¹ Includes City of Agua Dulce and Nueces County WCID #5.

There are no shortages listed in Table 5D.110 for South Texas Water Authority.

5D.13.4 Nueces County Water Control and Improvement District #3

The Nueces County WCID 3 is the smallest WWP in the region. Nueces County WCID 3 receives a firm yield of 324 ac-ft/yr from its Nueces Basin run-of-river rights. Nueces County WCID 3 provides this water to the water user groups and other entities shown in Table 5D.114.

Table 5D.114.
Purchasers of Water from Nueces County WCID 3

Water User Group / Entity	County
City of Robstown	Nueces
River Acres WSC	Nueces

Nueces County WCID 3 is projected to have a water shortage throughout the planning period. The plan for Nueces County WCID 3 is shown in Chapters 5D.11.6 and 5D.11.9.

5D.14 Summary of Recommended Water Management Strategies by Water User Group

A summary of recommended water management strategies for all WUGs is shown in Table 5D.115.

5D.15 Implementation Status and Timeline for Selected Projects in the 2026 Plan

TWDB guidance for 2026 Regional Water Plans includes a new provision that requires Chapter 5 to include a sub-section documenting the implementation status of certain WMSs that are recommended in the plan. The implementation status must be provided for the following types of recommended WMSs with any online decade, based on House Bill 1565, 88th Texas Legislature:

- All reservoir strategies (including major and minor reservoirs);
- All seawater desalination strategies;

- Direct potable reuse strategies that provide greater than 5,000 acft/yr of supply in any planning decade;
- Brackish groundwater strategies that provide greater than 10,000 acft/yr of supply in any planning decade;
- Aquifer storage and recovery strategies that provide greater than 10,000 acft/yr in any decade;
- All water transfers from out of state; and
- Any other innovative technology projects the RWPG considers appropriate.

This provision is relevant to the City of Corpus Christi's desalination and groundwater strategies, Port of Corpus Christi Authority's desalination projects, and Nueces County WCID 3's local balancing reservoir. HDR obtained implementation status information from the City of Corpus Christi, Port of Corpus Christi Authority, and Nueces County WCID 3, which is attached in TWDB requested format. The seven recommended water management strategies with implementation status and timelines for the *2026 Coastal Bend Regional Water Plan* are shown in Table 5D.120. The project sponsor, region, online decade, capital cost, and anticipated footprint are included in the table. Additionally, the permitting status, design/construction status, and total funds expected to date. Following Table 5D.116 are Figure 5D.1 through Figure 5D.11 showing schedules and major milestones for each recommended water management strategy.



Table 5D.115.
Summary of Recommended Water Management Strategies in the Coastal Bend Region

WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost (\$/ac-ft/yr)	Last Decade Estimated Unit Cost (\$/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2030	2040	2050	2060	2070	2080
5B.1	Municipal Water Conservation	<i>Variable, Regional Cost up to \$49,723,186</i>	\$577 - \$583	\$577 - \$583	6,214	13,277	15,275	16,234	16,957	17,587
	Rockport	\$1,089,123	\$577	\$577	225	348	340	332	325	318
	Beeville	\$2,353,058	\$577	\$577	204	465	736	839	889	945
	El Oso WSC	\$138,566	\$580	\$580	6	19	34	44	58	76
	Skidmore WSC	\$2,141	\$580	\$580	1	0	0	0	1	0
	TDCJ Chase Field	\$1,244,910	\$580	\$580	111	221	323	416	500	576
	Falfurrias	\$1,107,758	\$580	\$580	91	189	282	370	458	520
	Freer WCID	\$327,590	\$580	\$580	37	75	106	123	115	108
	San Diego MUD 1	\$284,791	\$580	\$580	48	88	87	88	89	93
	Alice	\$2,694,058	\$577	\$577	283	660	856	900	953	1,017
	Orange Grove	\$307,551	\$580	\$580	27	57	84	107	128	128
	Premont	\$452,221	\$580	\$580	42	87	129	164	178	179
	San Diego MUD 1	\$60,954	\$580	\$580	9	18	19	19	20	21
	County-Other, Kenedy	\$133,318	\$580	\$580	15	28	38	45	51	54
	Baffin Bay WSC	\$6,706	\$580	\$580	3	2	1	2	2	2
	County-Other, Kleberg	\$28,956	\$580	\$580	9	8	8	8	8	9
	Naval Air Station Kingsville	\$286,021	\$580	\$580	24	48	71	95	117	137
	El Oso WSC	\$103,857	\$580	\$580	11	26	35	35	35	35
	George West	\$90,921	\$580	\$580	20	32	29	27	25	23
	Three Rivers	\$105,120	\$580	\$580	30	30	30	31	29	31
	Bishop	\$127,173	\$580	\$580	37	37	36	37	36	36
	Corpus Christi	\$30,711,490	\$583	\$583	4,164	9,338	9,883	9,823	9,765	9,706
	Corpus Christi Naval Air Station	\$2,055,259	\$580	\$580	189	373	539	687	819	936
	Nueces County WCID 3	\$3,280,454	\$577	\$577	279	583	863	1,109	1,328	1,522
	Nueces County WCID 4	\$1,327,363	\$580	\$580	118	238	348	446	531	608
	Nueces WSC	\$158,736	\$580	\$580	49	45	45	45	45	45
	Gregory	\$37,394	\$580	\$580	12	10	10	11	11	11
	Portland	\$332,194	\$577	\$577	88	83	89	97	105	113
	Sinton	\$875,503	\$580	\$580	80	170	253	332	335	339



WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost (\$/ac-ft/yr)	Last Decade Estimated Unit Cost (\$/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2030	2040	2050	2060	2070	2080
5B.1	Municipal Water Conservation- Pipeline Replacement	Capital Cost= \$839,353,680	-	-		521				
	Aransas County-Other	\$167,040,720	-	-		9				
	Alice	\$207,504,000	-	-		53				
	Bishop	\$64,326,240	-	-		21				
	Mathis	\$74,701,440	-	-		11				
	Sinton	\$124,502,400	-	-		77				
	Duval County CRD	\$41,500,800	-	-		2				
	Freer WCID	\$105,827,040	-	-		16				
	River Acres WSC	\$37,350,720	-	-		10				
	Bee County-Other	\$16,600,320	-	-		1				
	Municipal Water Conservation- Meter Replacement	Capital Cost= \$2,378,670	-	-						
	Aransas County-Other	\$88,830	-	-		13				
	Alice	\$2,000,320	-	-		260				
	Bishop	\$289,520	-	-		48				
5B.2	Manufacturing Water Conservation	-	-	-	2,878	5,764	8,657	11,561	14,485	17,689
	Jim Wells County	\$2,400	\$200	\$25	2	5	7	10	13	16
	Kleberg County	\$12,900	\$20	\$20	27	56	88	121	157	196
	Live Oak County	\$33,720	\$20	\$20	71	147	229	317	411	511
	McMullen County	\$2,400	\$400	\$80	1	2	3	3	4	5
	Nueces County	\$535,020	\$20	\$20	1,259	2,518	3,777	5,037	6,309	7,851
	San Patricio County	\$637,620	\$20	\$20	1,518	3,036	4,553	6,073	7,591	9,110
5B.3	Mining Water Conservation	-	-	-	173	351	526	705	882	153
	Bee County	\$2,000	\$67	\$0	6	12	18	24	30	0
	Brooks County	\$2,000	\$0	\$2400	0	1	1	2	2	2
	Duval County	\$1,200	\$0	\$400	0	0	0	1	1	1
	Kleberg County	\$2,000	\$0	\$2400	0	1	1	1	1	2
	Live Oak County	\$9,480	\$20640	\$0	32	63	95	126	158	0
	McMullen County	\$34,020	\$20,260	\$0	113	227	340	454	567	0
	Nueces County	\$2,400	\$20400	\$3400	20	42	64	88	111	134
	San Patricio County	\$2,400	\$200400	\$29	2	5	7	9	12	14
5B.4	Reuse	-	-	-	-	-	-	-	-	-
	Petronila Regional WWTP Reuse	\$13,228,000	\$1,388	\$557	1,120	1,120	1,120	1,120	1,120	1,120
	Oso Regional WWTP Reuse	\$614,038,000	\$4,806	\$952	11,209	11,209	11,209	11,209	11,209	11,209
5B.5	Aquifer Storage and Recovery	-	-	-	-	-	-	-	-	-



WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost (\$/ac-ft/yr)	Last Decade Estimated Unit Cost (\$/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2030	2040	2050	2060	2070	2080
	ASR with IPR	\$204,207,000	\$3,003	\$1,224	8,070	8,070	8,070	8,070	8,070	8,070
5B.6	Seawater Desalination	-	-	-	-	-	-	-	-	-
	City of Corpus Christi- Inner Harbor (30 MGD)	\$1,233,812,000	\$3,786	\$1,753	33,604	33,604	33,604	33,604	33,604	33,604
	City of Corpus Christi- La Quinta (40 MGD)	\$1,141,000,000	\$3,460	\$1,677	0	44,806	44,806	44,806	44,806	44,806
	City of Corpus Christi Barney Davis Desalination (20 MGD)	\$582,000,000	\$3,705	\$1,868	0	22,402	22,402	22,402	22,402	22,402
	Port of Corpus Christi Authority- Harbor Island (100 MGD)	\$3,456,000,000	\$3,616	\$1,580	112,014	112,014	112,014	112,014	112,014	112,014
	Port of Corpus Christi Authority- La Quinta Channel (30 MGD)	\$844,000,000	\$3,452	\$1,705	0	33,604	33,604	33,604	33,604	33,604
5B.7	Brackish Groundwater Desalination	-	-	-	-	-	-	-	-	-
	Evangeline Laguna Treated Groundwater	\$486,499,000	\$4,085	\$2,747	25,637	25,637	25,637	25,637	25,637	25,637
	City of Beeville	\$100,904,000	\$3,887	\$2,199	4,204	4,204	4,204	4,204	4,204	4,204
	Driscoll Brackish Groundwater Treatment Project	\$36,289,885	\$2,878	\$1,190	1,513	1,513	1,513	1,513	1,513	1,513
	Nueces River Brackish Wells Reverse Osmosis Facility	\$268,029,000	\$3,151	\$1,622	12,331	12,331	12,331	12,331	12,331	12,331
	EV Ranch Brackish Groundwater Desalination	\$1,102,285,000	\$4,458	\$2,034	32,000	32,000	32,000	32,000	32,000	32,000
5B.8	Local Balancing Storage	\$26,019,000	\$904	\$483	3,827	3,827	3,827	3,827	3,827	3,827
5B.9	Groundwater Supplies - Rural and Non-Municipal Water Systems	-	-	-	-	-	-	-	-	-
	Bee County-Other (Municipal)	\$5,421,000	\$398	\$130	1,426	1,426	1,426	1,426	1,426	1,426
	Bee County-Mining	\$1,024,000	\$3,200	\$320	25	25	25	25	25	25
	Skidmore WSC	\$1,067,000	\$2,295	\$591	44	44	44	44	44	44
	TDCJ Chase Field	\$1,067,000	\$20,000	\$5,000	5	5	5	5	5	5
	Brooks County-Other (Municipal)	\$1,089,000	\$452	\$178	281	281	281	281	281	281
	Duval County-Other (Municipal)	\$1,496,000	\$625	\$209	253	253	253	253	253	253
	San Diego MUD 1	\$817,000	\$702	\$267	131	131	131	131	131	131
	Jim Wells County- Other (Municipal)	\$8,763,000	\$522	\$141	1,621	1,621	1,621	1,621	1,621	1,621
	Jim Wells County- Manufacturing	\$747,000	\$3,000	\$920	25	25	25	25	25	25
	Live Oak County- Other (Municipal)	\$1,317,000	\$688	\$228	202	202	202	202	202	202
	Nueces County-Mining	\$752,000	\$594	\$69	101	101	101	101	101	101
	City of Mathis	\$2,177,000	\$425	\$152	560	560	560	560	560	560
	Ricardo Well Project	\$10,977,100	\$2,114	\$735	560	560	560	560	560	560



WMS ID	Recommended WMS	Total Project Cost	First Decade Estimated Unit Cost (\$/ac-ft/yr)	Last Decade Estimated Unit Cost (\$/ac-ft/yr)	Water Yield (ac-ft/yr)					
					2030	2040	2050	2060	2070	2080
5B.10	Regional Water Supply Management and Treatment Facilities	-	-	-	-	-	-	-	-	-
	ON Stevens WTP Improvements	\$82,753,000	\$665	\$437	-	-	-	-	-	-
	Mary Rhodes Pipeline Phase I Improvements to Increase Capacity and Reliability	\$1,236,419,000	\$4,760	\$1,367	-	-	-	-	-	-
	SPMWD Project No. 1 - New WTP (20 MGD) at Plant D	\$69,048,000	\$819	\$600	-	-	-	-	-	-
	SPMWD Project No. 2 - New Intake, PS and Raw Water Transmission on Nueces River	\$223,595,000	\$637	\$411	-	-	-	-	-	-
	SPMWD Project No. 3 - New Pump Station at Mary Rhodes Pipeline & Transmission Rehab	\$40,249,000	\$482	\$398	-	-	-	-	-	-

*Note: These projects increase infrastructure capacity to serve existing and future customers and are anticipated to come on-line in 2030. The source water is associated with the Evangeline/Laguna Groundwater project and/or increases in contracted water supplies. The supply is set to zero, so as to not double count with water source strategies.



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Table 5D.116.
Recommended WMS Implementation Status

WMS/ Project Name	Project Sponsor	WMS Project Sponsor Region	Online Decade	Capital Cost	Anticipated Footprint Acreage (acres)	SPONSOR AUTHORIZATION Date(s) that the sponsor took an affirmative vote or other action to make expenditures necessary to construct or file applications for state or federal permits (date(s))	PERMITTING STATUS (as applicable)								PLANNING, DESIGN, AND CONSTRUCTION STATUS							TOTAL FUNDS EXPENDED TO DATE	Other significant activities completed (summary)	
							STATE WATER RIGHT STATUS				FEDERAL 404 PERMIT STATUS (if applicable)		DESALINATION PERMIT STATUS		OTHER KEY PERMITS	GEOTECH/DESIGN	LAND ACQUISITION		CONSTRUCTION					
							Anticipated (or actual) TCEQ application filed (date)	Anticipated (or actual) State Water Right Permit Administratively Complete (date)	Anticipated (or actual) Draft State Water Right Permit Issued (date)	Anticipated (or actual) Date Final State Water Right Permit Issued (date)	Anticipated (or actual) application for permit filed (date)	Anticipated (or actual) permit issuance (date)	Anticipated (or actual) diversion permit issued (date)	Anticipated (or actual) Discharge/ Disposal Permit Issued (date)	Summary of other permits and status (summary)	Generally describe the types and amount (as %) of geotechnical/ reconnaissance/ engineering feasibility or other technical, testing, and/or design work etc. performed to date (summary)	Percent Land Acquisition Completed (%)	Anticipated land acquisition completion (date)	Anticipated start of construction (Date)	Percent construction completed (%)	Anticipated construction completion (date)	Rough approximation of the total expenditures, to date, on ALL activities related to project implementation to date (millions of \$s)		
Local Balancing Storage	Nueces County WCID 3	N	2030	\$18,460,000	33	NCWCID3 has been in communication with Nueces County Commissioner Joe Gonzales in regard to potentially utilizing the large storm water detention reservoirs that they will be constructing with General Land Office Mitigation Funds to serve as all or part of our Local Balancing Storage Reservoir needs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Corpus Christi Inner Harbor (30 MGD)	City of Corpus Christi	N	2030	\$797,394,365	10	Most recently, 6/25/2024, City Council authorized the City Manager to execute a contract with the design-build team for the Inner Harbor Project.	-	-	-	-	Submitted 5/10/2023. USACE review in progress.	-	Granted October 10, 2022 for diversions not to exceed 93,148 ac-ft/year with a maximum diversion of 129 cfs	In progress; to be considered on March 13,2025 (TPDES Permit No. WQ0005289000)	-	20% Geotechnical Investigation 15% Topographic Survey 5% Preliminary Engineering 25% Water Quality Characterization	-	-	26-Mar	-	28-Jul	13M	The City of Corpus Christi is moving forward with a 30MGD seawater desalination treatment plant to be designed, built and commissioned along the Inner Harbor via a progressive design-build project delivery method. The City has chosen Kiewit as the progressive design-builder. The City will use existing infrastructure to deliver water to all customers and intends to operate and maintain the plant by 2028.	
Corpus Christi La Quinta Channel (40 MGD)	City of Corpus Christi	N	2050	\$774,000,000	10	12/17/2019 City Council authorized the development and submission of both diversion and discharge permit applications for the project.	-	-	-	-	-	-	Filed 5/5/2020. Granted 3/28/2024 for diversions not to exceed 186,295 acre-feet per year with a maximum diversion rate of 257 cfs	Application filed 1/22/2020. TCEQ review in progress.	-	-	-	-	-	-	-	.7M	The City is working with the TCEQ to complete the discharge permitting process and review.	
Corpus Christi Barney Davis (20 MGD)	City of Corpus Christi	N	2040	\$396,590,000	12	-	-	-	-	-	-	-	725,000 ac-ft/year with up to 6,650 ac-ft/year of consumptive use	-	Permit for incidental take for threatened and endangered species on August 3, 2020	-	-	-	-	-	-	-	-	The City is reviewing the feasibility and future demand needed.



WMS/ Project Name	Project Sponsor	WMS Project Sponsor Region	Online Decade	Capital Cost	Anticipated Footprint Acreage (acres)	SPONSOR AUTHORIZATION	PERMITTING STATUS (as applicable)									PLANNING, DESIGN, AND CONSTRUCTION STATUS						TOTAL FUNDS EXPENDED TO DATE	Other significant activities completed (summary)
							STATE WATER RIGHT STATUS				FEDERAL 404 PERMIT STATUS (if applicable)		DESALINATION PERMIT STATUS		OTHER KEY PERMITS	GEOTECH/DESIGN	LAND ACQUISITION		CONSTRUCTION				
						Date(s) that the sponsor took an affirmative vote or other action to make expenditures necessary to construct or file applications for state or federal permits (date(s))	Anticipated (or actual) TCEQ application filed (date)	Anticipated (or actual) State Water Right Permit Administratively Complete (date)	Anticipated (or actual) Draft State Water Right Permit Issued (date)	Anticipated (or actual) Date Final State Water Right Permit Issued (date)	Anticipated (or actual) application for permit filed (date)	Anticipated (or actual) permit issuance (date)	Anticipated (or actual) diversion permit issued (date)	Anticipated (or actual) Discharge/ Disposal Permit Issued (date)	Summary of other permits and status (summary)	Generally describe the types and amount (as %s) of geotechnical/ reconnaissance/ engineering feasibility or other technical, testing, and/or design work etc. performed to date (summary)	Percent Land Acquisition Completed (%)	Anticipated land acquisition completion (date)	Anticipated start of construction (Date)	Percent construction completed (%)	Anticipated construction completion (date)	Rough approximation of the total expenditures, to date, on ALL activities related to project implementation to date (millions of \$s)	
Harbor Island (100 MGD)	Port of Corpus Christi Authority	N	2030	\$2,415,000,000	31	Initially April 2017 and direction from Port Commission 5/21/2024 to pursue remaining permits.	2/13/2023	3/14/2023	~Fall 2025	~Q2 2026	To be submitted in early 2025; pre-app meeting with USACE Jan 17, 2025.	~Q2 2026	50 MGD rec'd 12/22/22; anticipate filing GOM outfall application in Mar 2025	Offshore discharge permit application under development	GLO easement for intake/intake pipe approved by Port Commission on 10/2024; GLO easement amendment for discharge structure to be submitted in early 2025	Some geotechnical complete for Blue Water Texas Terminal project and supporting infrastructure follows this route.	NA	NA	~Q2 2027		2030	~\$9MIL	Offshore lease and easement approved by Port Commission Oct '24; pending GLO execution.
PCCA- La Quinta Channel (30 MGD)	Port of Corpus Christi Authority	N	2050	\$572,000,000	40	Initially April 2017.				6/26/2024	TBD	TBD	7/16/2024 (102,000 ac-ft)	Pending	NA		NA	NA	TBD	TBD	TBD	\$2.6MIL	-
Evangeline Laguna Treated Groundwater*	City of Corpus Christi	N	2030	\$204,000,000	23,000	3/14/2023 and 10/13/2023 (Expenditures by City of Corpus Christi to Evaluate Strategy and Negotiations with Project Owner)	-	-	-	-	-	-	-	-	4/18/2019 (San Patricio County Groundwater Conservation District Water Well Production Permit)	-	-	-	-	-	-	Consulting services (CCW): \$230,400	Constructed and tested two wells for water quality and production rate. Water quality analysis, identified regulatory considerations, evaluated five project configuration/delivery options, stakeholder coordination with municipal and industrial stakeholders to identify water quality needs and constituents of interest, raw water rate evaluation, performed blending evaluation to identify integration considerations for raw water.
City of Corpus Christi Oso WWTP Reuse	City of Corpus Christi	N	2040	-	20 acres	9/16/2024	NA	NA	NA	NA	NA	NA	NA	NA	Ch. 210, UIC, TXDOT	\$1M +	50%	TBD	Q2 - 2028	0%	Q2-2030	\$1.4M	Feasibility and modeling in progress; City Council presentations and discussions

WMS/ Project Name	Project Sponsor	WMS Project Sponsor Region	Online Decade	Capital Cost	Anticipated Footprint Acreage (acres)	SPONSOR AUTHORIZATION	PERMITTING STATUS (as applicable)									PLANNING, DESIGN, AND CONSTRUCTION STATUS						TOTAL FUNDS EXPENDED TO DATE	Other significant activities completed (summary)
							STATE WATER RIGHT STATUS				FEDERAL 404 PERMIT STATUS (if applicable)		DESALINATION PERMIT STATUS		OTHER KEY PERMITS	GEOTECH/DESIGN	LAND ACQUISITION		CONSTRUCTION				
						Date(s) that the sponsor took an affirmative vote or other action to make expenditures necessary to construct or file applications for state or federal permits (date(s))	Anticipated (or actual) TCEQ application filed (date)	Anticipated (or actual) State Water Right Permit Administratively Complete (date)	Anticipated (or actual) Draft State Water Right Permit Issued (date)	Anticipated (or actual) Date Final State Water Right Permit Issued (date)	Anticipated (or actual) application for permit filed (date)	Anticipated (or actual) permit issuance (date)	Anticipated (or actual) diversion permit issued (date)	Anticipated (or actual) Discharge/ Disposal Permit Issued (date)	Summary of other permits and status (summary)	Generally describe the types and amount (as %s) of geotechnical/ reconnaissance/ engineering feasibility or other technical, testing, and/or design work etc. performed to date (summary)	Percent Land Acquisition Completed (%)	Anticipated land acquisition completion (date)	Anticipated start of construction (Date)	Percent construction completed (%)	Anticipated construction completion (date)	Rough approximation of the total expenditures, to date, on ALL activities related to project implementation to date (millions of \$s)	
EV Ranch Brackish Groundwater Desalination	City of Corpus Christi	N	2040	-	101000 acres	NA	NA	NA	NA	NA	NA	NA	NA	NA	UIC, GCD Production, GCD Transport, TXDOT	NA	0%	NA	NA	0%	NA	\$1M +	City Council presentations and discussions
Nueces River Brackish Wells Reverse Osmosis Facility	City of Corpus Christi	N	2030	-	380 acres	4/30/2025	NA	NA	NA	NA	NA	NA	NA	NA	UIC, TXDOT	\$1M +	90%	NA	Q3 - 2026	0%	Q4-2027	\$16M	Conceptual Design, installation of wells, TCEQ permitting process, hydrogeologic evaluations, and City Council presentations and discussions

*Note: The ON Stevens WTP Improvements and Mary Rhodes Mary Rhodes Pipeline Phase 1 Improvements to Increase Capacity and Reliability (Chapter 5D.10) infrastructure projects are anticipated to be needed to convey this new source water. Both infrastructure projects are anticipated to be completed and online by Year 2030.



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Local Balancing Storage	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
ANTICIPATED														
Project to come online														2030-2040

Figure 5D.1.
Local Balancing Storage Schedule

Corpus Christi Inner Harbor (30 MGD)	2022				2023				2024				2025				2026				2028				2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
COMPLETED																												
(Desalination) 93,148 AFY diversion permit, granted																												
Federal 404 permit, applied [USACE review in progress]																												
Authorized by City Council to execute a contract with the Inner Harbor Project design-build team																												
ANTICIPATED																												
(Desalination) discharge/ disposal permit under consideration																												
Start of construction																												
Construction completion																												
City to take over plant operation and maintenance																												
Project to come online																												

Figure 5D.2.
Corpus Christi Inner Harbor Schedule

Corpus Christi La Quinta Channel (40 MGD)	2019				2020				2021				2022				2024				2040				2080			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
COMPLETED																												
Authorized by City Council to develop and submit diversion and discharge permit applications																												
(Desalination) discharge permit, applied [TCEQ review in progress]																												
(Desalination) 186,295 AFY diversion permit, applied																												
(Desalination) 186,295 AFY diversion permit, issued																												
ANTICIPATED																												
Project to come online																												

Figure 5D.3.
Corpus Christi La Quinta Channel Schedule



Corpus Christi Barney Davis (20 MGD)	2020	2030	2040	2050	2060	2070	2080
COMPLETED							
Incidental take for threatened and endangered species permit	◆ 8/3/2020						
ANTICIPATED							
Project to come online							

Figure 5D.4.
Corpus Christi Barney Davis Schedule

Harbor Island (100 MGD) START: 2017	2022				2023				2024				2025				2026				2027				2030				2080			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
COMPLETED																																
(Desalination) 50 MGD diversion permit issued	◆ 12/22																															
TCEQ application filed	◆ 2/13																															
State water right permit (administratively complete)	◆ 3/14																															
GLO intake/ intake pipe easement approved (by Port Commission)	◆ Oct. 2024																															
Federal 404 permit application filed	◆ 1/17																															
ANTICIPATED																																
GLO discharge structure easement	◆ Early 2025																															
(Desalination) GOM outfall application filed	◆ Mar. 2025																															
Draft state water right permit issue	◆ Fall 2025																															
Final state water right permit issued	◆ Q2 2026																															
Federal 404 permit issued	◆ Q2 2026																															
Start of construction	Q2 2027 ◆																															
Construction completion																								◆ 2030								
Project to come online																																
UNDER DEVELOPMENT																																
(Desalination) offshore discharge permit application																																

Figure 5D.5.
Harbor Island Schedule

PCCA La Quinta Channel (30 MGD) START: APRIL 2017	2024	2030	2040	2050	2060	2070	2080
ANTICIPATED							
Final state water wight permit, issued	◆ 6/26						
(Desalination) 102,000 AFY diversion permit, issued	◆ 7/16						
Project to come online							
PENDING							
(Desalination) discharge/ disposal permit, issued							
UNDER DEVELOPMENT							
Federal 404 permit application, filed							
Federal 404 permit application, issued							
Start of construction							
Construction checkpoint							
Construction completion							

Figure 5D.6.
PCCA La Quinta Channel Schedule

Evangeline Laguna Treated Groundwater	2019				2020				2021				2022				2023				2030				2040			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
COMPLETED																												
San Patricio County GCD water well production permit																												
City expenditure to evaluate strategy																												
Project owner negotiations																												
ANTICIPATED																												
Project to come online																												

Figure 5D.7.
Evangeline Laguna Treated Groundwater Schedule

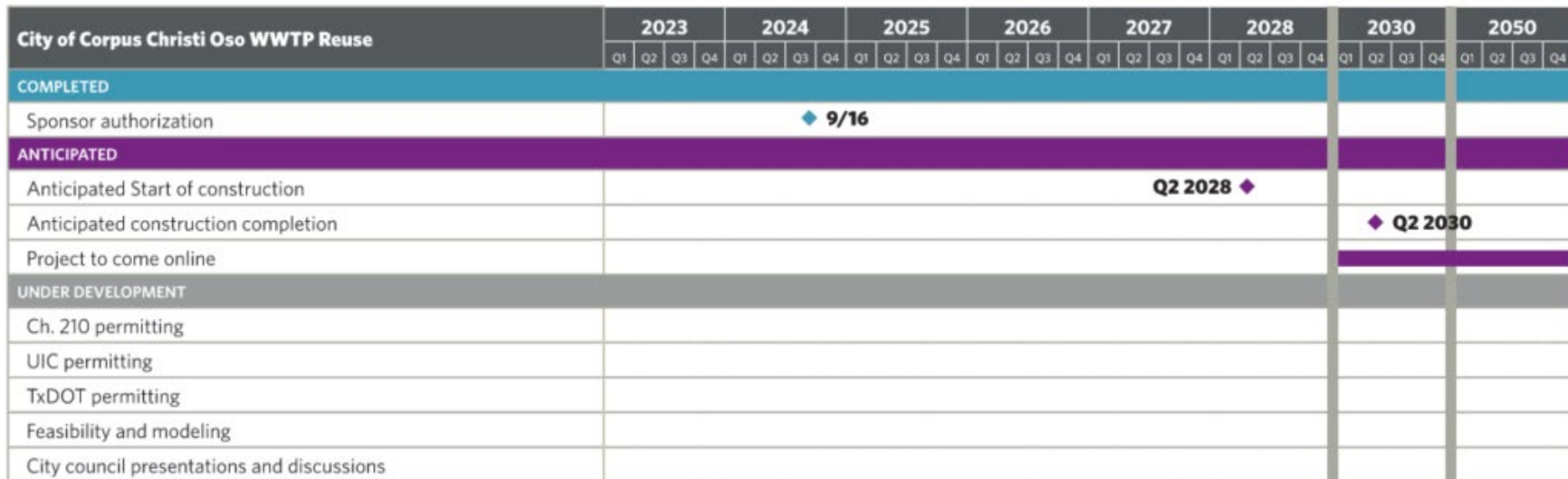


Figure 5D.8.
City of Corpus Christi Oso WWTP Reuse Schedule



Figure 5D.9.
EV Ranch Brackish Groundwater Desalination Schedule

Nueces River Brackish Wells Reverse Osmosis Facility	2023				2024				2025				2026				2027				2028				2030				2040							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								
COMPLETED																																				
Sponsor authorization																									◆ 4/30											
ANTICIPATED																																				
Anticipated Start of construction																									Q3 2026 ◆											
Anticipated construction completion																													◆ Q4 2027							
Project to come online																																				
UNDER DEVELOPMENT																																				
UIC permitting																																				
TxDOT permitting																																				

Figure 5D.10.
Nueces River Brackish Wells Reverse Osmosis Facility Schedule

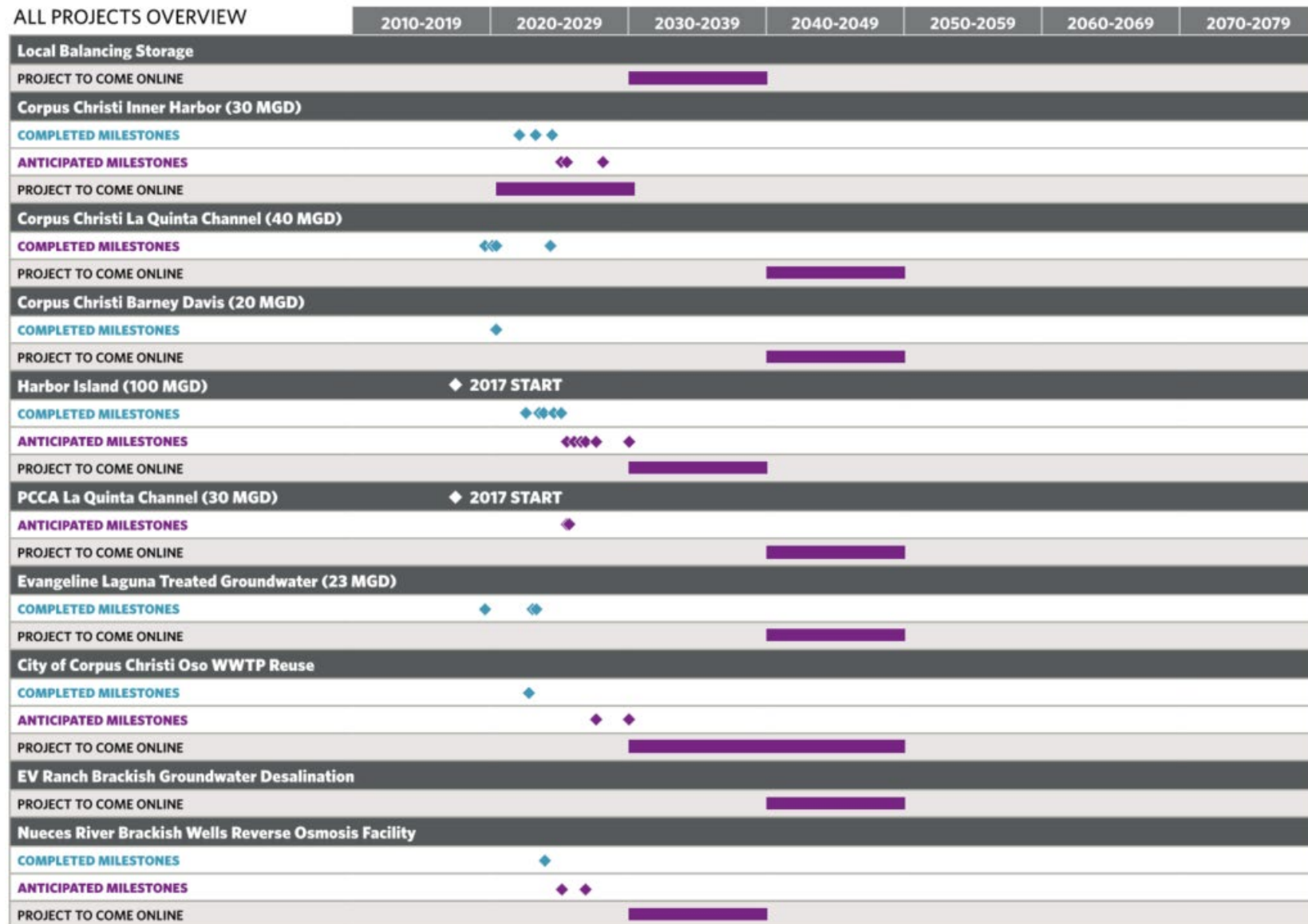


Figure 5D.11.
All Projects Schedule Overview