SUPPLEMENTAL APPENDIX J

Data Requirements for Water Right Application for New or Additional State Water – Reuse of Discharges from Sabine Creek Wastewater Treatment Facility

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DATA REQUIREMENTS FOR WATER RIGHT APPLICATION FOR NEW OR ADDITIONAL STATE WATER – REUSE OF DISCHARGES FROM SABINE CREEK WASTEWATER TREATMENT FACILITY

Texas Administrative Code (TAC) Title 30, Part 1, Rule 288.7(a) addresses water conservation plans that accompany a water right application for new or additional state water:

§288.7. Plans Submitted With a Water Right Application for New or Additional State Water.

(a) A water conservation plan submitted with an application for a new or additional appropriation of water must include data and information which:

(1) supports the applicant's proposed use of water with consideration of the water conservation goals of the water conservation plan;

(2) evaluates conservation as an alternative to the proposed appropriation; and

(3) evaluates any other feasible alternative to new water development including, but not limited to, waste prevention, recycling and reuse, water transfer and marketing, regionalization, and optimum water management practices and procedures.

The North Texas Municipal Water District (NTMWD or District) currently has multiple applications for the reuse of treated wastewater discharges in technical review by TCEQ. NTMWD is now filing a reuse application for the Sabine Creek Wastewater Treatment Plant (Sabine Creek WWTP). NTMWD also has other potential sources of reuse water that the District intends to develop at a later time when feasible. **Table J-1** provides basic information on the discharges from Sabine Creek WWTP for the new reuse application. The plant's current TPDES permit allows for a discharge of up to 7.0 MGD, and NTMWD is currently seeking an increased TPDES permit to expand the WWTP to 20.0 MGD. Concurrently, NTMWD is seeking authorization to reuse the discharges from the expanded Sabine Creek WWTP.

TABLE J-1: SUMMARY OF POTENTIAL REUSE SOURCE

Facility	Existing or New	Facility Owner	Permitted Discharge (MGD)	River Basin	Watershed
Facilities with Current or Imminent Reuse Applications					
Sabine Creek WWTP	Existing	NTMWD	20.0	Sabine	Lake Tawakoni

Fully developing available reuse is a primary goal of the NTMWD Water Conservation Plan (the Plan). As acknowledged by the Water Conservation Implementation Task Force, water reuse is considered a component of water conservation and as such, should not be viewed as an alternative to conservation. While conservation does not typically require a water right, water reuse does. Therefore, this appendix addresses the requirements of TAC §288.7(a) for the Sabine Creek WWTP reuse application. In considering the requirements of TAC §288.7(a)(2) and TAC §288.7(a)(3), this appendix looks at alternatives based on information from two sources:

1. The approved *2021 Region C Water Plan* and the approved *2022 State Water Plan*

2. The *2026 Initially Prepared (Draft) Region C Water Plan*, currently under review by the Texas Water Development Board and the public.

J.1 CONSIDERATION OF WATER CONSERVATION GOALS - 288.7(a)(1)

NTMWD provides wholesale treated water to customers in a ten-county area in North-Central Texas. The area served by NTMWD is one of the fastest growing regions in the country. The population served by NTMWD has increased from 32,000 when NTMWD was formed in 1951 to over 2.2 million as of 2024, and this growth is expected to continue. To meet the anticipated growth and increased water demands, NTMWD is actively promoting water conservation measures with its Member Cities and Customers, and NTMWD is currently implementing the largest wastewater reuse program in the state, and potentially the largest in the U.S. NTMWD's larger reuse projects include reuse from the Wilson Creek Regional WWTP (RWWTP) that discharges directly to Lavon Lake. This RWWTP is permitted to discharge up to 64 MGD. NTMWD's other large current reuse project is the East Fork Water Supply Project (the East Fork Wetland). This project diverts wastewater return flows from the East Fork Trinity River and the Trinity River Mainstem to a constructed wetland in Kaufman County. From there, the water is pumped to Lavon Lake for subsequent diversion and use. Collectively, these two projects can provide 175,000 acre-feet per year of supply. NTMWD has also applied to reuse up to 64 MGD of return flows from the proposed Sister Grove Water Resource Recovery Facility, and that application is in technical review by TCEQ. If the Sabine Creek WWTP reuse authorization is granted the reuse supplies would increase by up to 22,420 acre-feet per year (20.0 MGD). This section describes NTMWD's conservation activities and the resulting water savings.

The Plan includes a variety of conservation measures that are actively implemented and monitored by NTMWD. This suite of water conservation measures goes well beyond the minimum requirements for conservation plans for wholesale providers. In accordance with the Texas Administrative Code, Title 30, § 288.5, the minimum requirements for wholesale providers are:

- Description of the wholesaler's service area;
- Specification of quantifiable conservation goals;
- Description of the means to measure the amount of water from a source;
- Monitoring and record managing program;
- Metering, leak detection and repair program;
- Requirement that wholesale customers must develop and implement a water conservation plan that incorporates the measures in the wholesale water provider plan;
- Reservoir systems operation plan;
- Means for implementing and enforcing the plan; and
- Documentation of coordination with associated regional water planning groups.

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The Plan meets these minimum requirements and specifies other conservation activities that NTMWD and/or its Member Cities and Customers are undertaking to achieve water conservation and efficiency. These other measures include:

- Water conservation workshops for wholesale customers;
- Model Water Conservation and Drought Contingency / Water Resource Emergency Management Plans for Member Cities and Customers, including compulsory landscape and water management measures to conserve water;
- Annual reports and tracking of customer water use;
- Reuse and recycling of wastewater;
- Public education and outreach programs;
- Technical assistance to customers;
- Zero discharge from water treatment plants;
- In-house conservation efforts; and
- Landscape water management measures, including developing the Water My Yard program and the installation of weather stations to assess outdoor irrigation needs.

Each of these measures is described elsewhere in the Plan. As noted above, reuse and recycling of wastewater is a major part of the Plan. NTMWD has the largest reuse program in the state with plans for further development. This intent is captured in the goals of the Plan. NTMWD's Water Conservation Plan goals include maximizing the level of the reuse of discharges from wastewater facilities within NTMWD's service area. **Figure J-1** shows NTMWD's historical water supplies from reuse.

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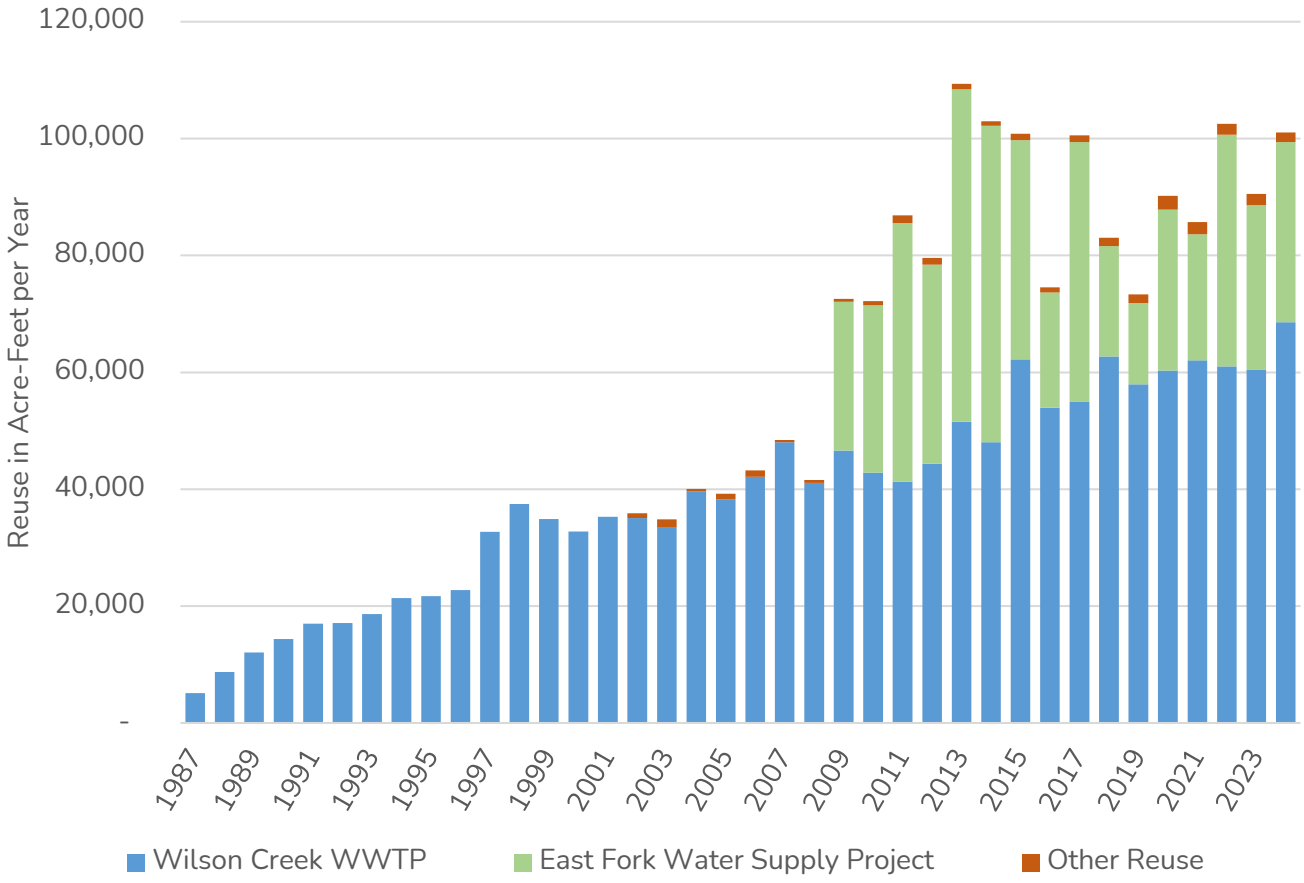
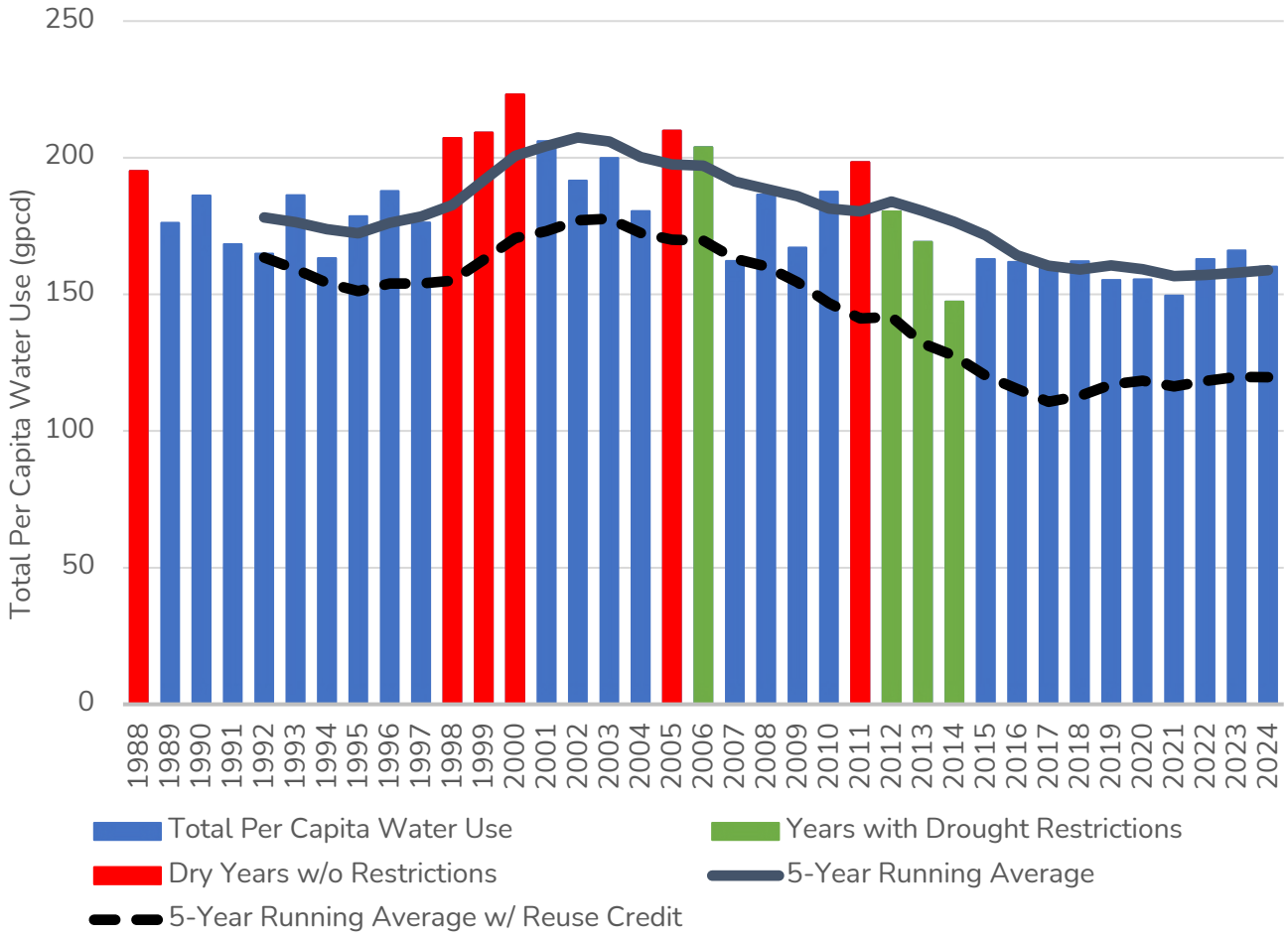
FIGURE J-1: NTMWD REUSE



Conservation Water Savings Realized by NTMWD

NTMWD collects water use data annually from its Member Cities and Customers and uses this information to track per capita water use. **Figure J-2** shows the annual and five-year running average total per capita use for Member Cities and Customers from 1988 to 2024. Consistent with the Plan, total per capita use is defined as the amount of water used divided by the population served. As shown in this figure, the average per capita water use peaked during the early 2000s and has declined substantially since then. NTMWD's total per capita use in 2000 (the year of highest historical per capita use) was 223 gallons per person per day. The 2020 dry year use for NTMWD in the *2021 Region C Water Plan* is 185.7 gallons per person per day, a reduction of 15 percent from the year 2000 level. The 2030 dry year use for NTMWD in the *2026 Initially Prepared Region C Water Plan* is 178 gallons per person per day, a reduction of 20 percent from the year 2000 level. This shows the success of the conservation efforts of NTMWD, its Member Cities, and its Customers. When considering credit for reuse, there is an even greater decline in per capita water use since the early 2000s. This reflects NTMWD's robust reuse program.

FIGURE J-2: TOTAL RAW WATER PER CAPITA USE



J.2 CONSERVATION AS AN ALTERNATIVE TO THE PROPOSED APPROPRIATION – 288.7 (a)(2) - BASED ON THE 2022 STATE WATER PLAN

NTMWD water use in 2024 totaled approximately 401,400 acre-feet. 2024 was not a dry year, and demands would be higher in a dry year. The projected dry year demands for NTMWD in 2030 in the *2021 Region C Water Plan* are over 467,800 acre-feet per year. The *2021 Region C Water Plan* and *2022 State Water Plan* project that these demands will increase to nearly 770,000 acre-feet by the year 2070. Based on existing water supplies, NTMWD will need to develop an additional 369,000 acre-feet of supply to meet the 2070 demands projected in the *2021 Region C Water Plan*. NTMWD expects to meet a portion of this demand via conservation. The *2022 State Water Plan* indicates that additional water conservation efforts (beyond what NTMWD has already accomplished) will provide 26,000 acre-feet per year of NTMWD's total water supplies by 2030 and approximately 44,400 acre-feet per year by 2070.

NTMWD also plans to meet a significant part of its projected demands by reuse. Reuse comprises 43 percent of NTMWD's existing 2030 water supply in the *2021 Region C Water Plan*. Increases in

available reuse due to population growth and the development of specific reuse projects are expected to provide up to 76,300 acre-feet of additional reuse supplies by 2070. Combined, conservation and reuse are estimated to provide over 299,400 acre-feet of water supplies by 2070, which represents approximately 29 percent of NTMWD's projected total water demand in 2070.

Both conservation and reuse are integral strategies in NTMWD's plans to meet projected water demands. The reuse of wastewater discharges associated with current and future water supplies developed by NTMWD will provide supplies to help meet projected water demands. However, in light of NTMWD's projected total demand of 769,200 acre-feet of water by 2070, intensified conservation and reuse alone cannot provide enough water to address all demands. Thus, conservation and reuse strategies are part of the portfolio of strategies that will be pursued by NTMWD to meet the rapidly rising demand for municipal water supplies in the NTMWD service area.

J.3 FEASIBLE ALTERNATIVES TO NEW WATER DEVELOPMENT – 288.7(a)(3) – BASED ON THE 2021 REGION C WATER PLAN

The 2021 regional water planning process identified and evaluated many potential water management strategies for NTMWD. The *2021 Region C Water Plan* considered 17 different water management strategies to meet the projected water supply shortages for NTMWD through 2070. Of these considered strategies, the Region C and State Water Plan recommended ten strategies for implementation by NTMWD.

NTMWD has or is currently implementing some of these strategies, including:

- Water Conservation (implemented)
- Bois d'Arc Lake (implemented)
- Additional Lavon Watershed Reuse (in progress)
- Additional Lake Texoma Blend Phase I (blended with supplies from Bois d'Arc Lake) (in progress)

The other strategies recommended in the *2021 Region C* and *2022 State Water Plan* for implementation include:

- Additional Measures to Access Full Lavon Lake Yield
- Expanded wetland reuse
- Additional Lake Texoma water with blending with new fresh water supply Phase II
- Marvin Nichols Reservoir
- Wright Patman Reallocation
- Oklahoma water supply

Each of these strategies is scheduled for implementation based on the projected water needs and the time to implement the strategy, including considerations for planning and permitting.

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Potential alternatives considered for NTMWD but not recommended for implementation in the *2021 Region C Water Plan* include developing other new reservoirs (George Parkhouse North and George Parkhouse South), transporting water from existing reservoirs (Toledo Bend and Lake O' the Pines), development of new groundwater supplies, aquifer storage and recovery, and desalination of Lake Texoma water. Most of these alternative strategies will require water rights for new appropriations and/or interbasin transfers, and they all will require the construction of infrastructure to store and transport water supplies to the NTMWD service area.

To continue its water supply development, NTMWD is applying for a water right from the TCEQ for reuse of wastewater discharges from the Sabine Creek WWTP. The Sabine Creek WWTP discharges to the Lake Tawakoni watershed. NTMWD has an intake on Lake Tawakoni, which could be used to divert the return flows.

This discussion focuses on alternatives to the Sabine Creek WWTP reuse application in the *2021 Region C Water Plan* and *2022 State Water Plan*. Only projects that have not been implemented and are not currently in progress are discussed here. Descriptions of potential project alternatives are presented below. **Table J-2** presents a synopsis of the applicability of these potential strategies as feasible alternatives to reuse.

Each potential project alternative was vetted through the state water planning process and the discussions herein are consistent with the *2021 Region C Water Plan* and the *2022 State Water Plan*. Strategies that are recommended for implementation by NTMWD are part of a suite of strategies to meet NTMWD's water needs. As such, these strategies are not alternatives to reuse but rather complement this supply. For completeness, a full range of potential alternatives is discussed in this appendix, including strategies that are recommended for implementation after reuse.

NTMWD's evaluation of the potential alternatives considered many factors, including cost of the water, quantity, reliability, the potential impacts of developing the project on the environment, natural resources and other water users, timing to develop the strategy, and potential implementation issues. **Table J-3** and **Figure J-3** show a comparison of the unit costs for the alternative strategies.

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TABLE J-2: 2021 REGION C WATER PLAN LIST OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR NTMWD

Strategy[1]	Feasible Alternative (Yes/No)	Comment
Additional Measure to Access Full Lavon Yield	No	This strategy is considered an emergency supply during times of drought and not a significant source of long-term supply. It is not an alternative to long-term supplies from reuse.
Expanded Wetland Reuse	No	The source of water for this strategy is not available until population grows and generates more return flows.
New Lake Texoma Blend (Phase II)	No	Requires additional new source of fresh water to blend to meet drinking water quality standards.
Marvin Nichols Reservoir	No	Has greater environmental impacts than reuse. Significantly higher costs than the Sabine Creek WWTP reuse. Could take between 30 and 40 years to implement. Cannot be implemented within the timeframe water is needed.
Wright Patman Reallocation	No	Has greater environmental impacts than the Sabine Creek WWTP reuse. Could take between 30 and 40 years to implement. This is not an alternative for the Sabine Creek WWTP reuse due to the online date.
Oklahoma Water	No	Current political and legal impediments.
Toledo Bend Reservoir	No	High costs and energy use. Requires agreements with other providers. Cannot be implemented within the timeframe water is needed.
New Lake Texoma (Desalinate)	No	High costs and energy use. Cannot be implemented within the timeframe water is needed.
Lake O' the Pines	No	Development of this source would require contracts with NETMWD and other suppliers. Agreements have not been reached to purchase this water. Due to uncertainty and expected time to develop, this is not a feasible alternative to the Sabine Creek WWTP reuse applications.
Carrizo-Wilcox Groundwater	No	Supply uncertainty and competing local interests for water.
Aquifer Storage and Recovery	No	Suitable geologic formation to store water has not been identified. Quantity is small. Unproven for size and location. Cannot be implemented within the timeframe water is needed.
George Parkhouse (North)	No	Has greater environmental impacts than reuse. Yield is impacted by potential upstream reservoirs. Cannot be implemented within the timeframe water is needed.
George Parkhouse (South)	No	Has greater environmental impacts than reuse of discharges. Yield is impacted by upstream reservoir. Cannot be implemented within the timeframe water is needed.

1. Each of these strategies was vetted through the state water planning process. Strategies that are recommended for implementation by NTMWD are part of a suite of strategies to meet NTMWD's water needs. Some strategies that are identified as not feasible at this time may be a feasible water supply project in the future.

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TABLE J-3: 2021 REGION C WATER PLAN COSTS FOR POTENTIAL SUPPLY ALTERNATIVES

Strategy	Costs Reported in the 2021 Region C Water Plan[1]		
	Capital Cost for NTMWD	Unit Cost for NTMWD ($/kGal.)	
		Pre-Amortization	Post-Amortization
Proposed Projects			
Sabine Creek WWTP Reuse	$517,000[2]	$0.01	$0.00
Potential Alternatives			
Additional Measure to Access Full Lavon Yield	$32,753,000	$0.76	$0.23
Expanded Wetland Reuse	$625,891,000	$5.03	$2.30
Lake Texoma Blend - Phase II	$346,367,000	$1.04	$0.32
Marvin Nichols Reservoir	$1,702,936,000	$2.17	$0.43
Toledo Bend Reservoir	$1,663,942,000	$4.15	$1.26
Oklahoma Water	$259,924,000	$1.30	$0.43
Lake O' the Pines	$567,896,000	$2.83	$0.94
Wright Patman Reallocation	$730,827,000	$2.56	$0.63
George Parkhouse Reservoir (North)	$930,193,000	$2.20	$0.50
George Parkhouse Reservoir (South)	$1,176,874,000	$2.41	$0.46
Lake Texoma Desalinate	$880,563,000	$8.01	$3.65
Carrizo-Wilcox Groundwater	$607,023,000	$3.60	$1.19
Aquifer Storage and Recovery	$6,041,000	$1.00	$0.48

1. Only projects considered in the *2021 Region C Water Plan* are included in Table J-3 and Figure J-3. Costs in Table J-3 are reported in 2021 dollars. Costs are for raw water only and do not include cost for treatment and treated water system distribution.
2. The cost is from the *2026 Initially Prepared Region C Water Plan* and reported in 2023 dollars. There are no capital costs estimated for the Sabine Creek WWTP reuse project. This facility is currently discharging to water bodies from which NTMWD has existing facilities for diversion and use. Only permitting costs are considered which is represented under the capital cost column.

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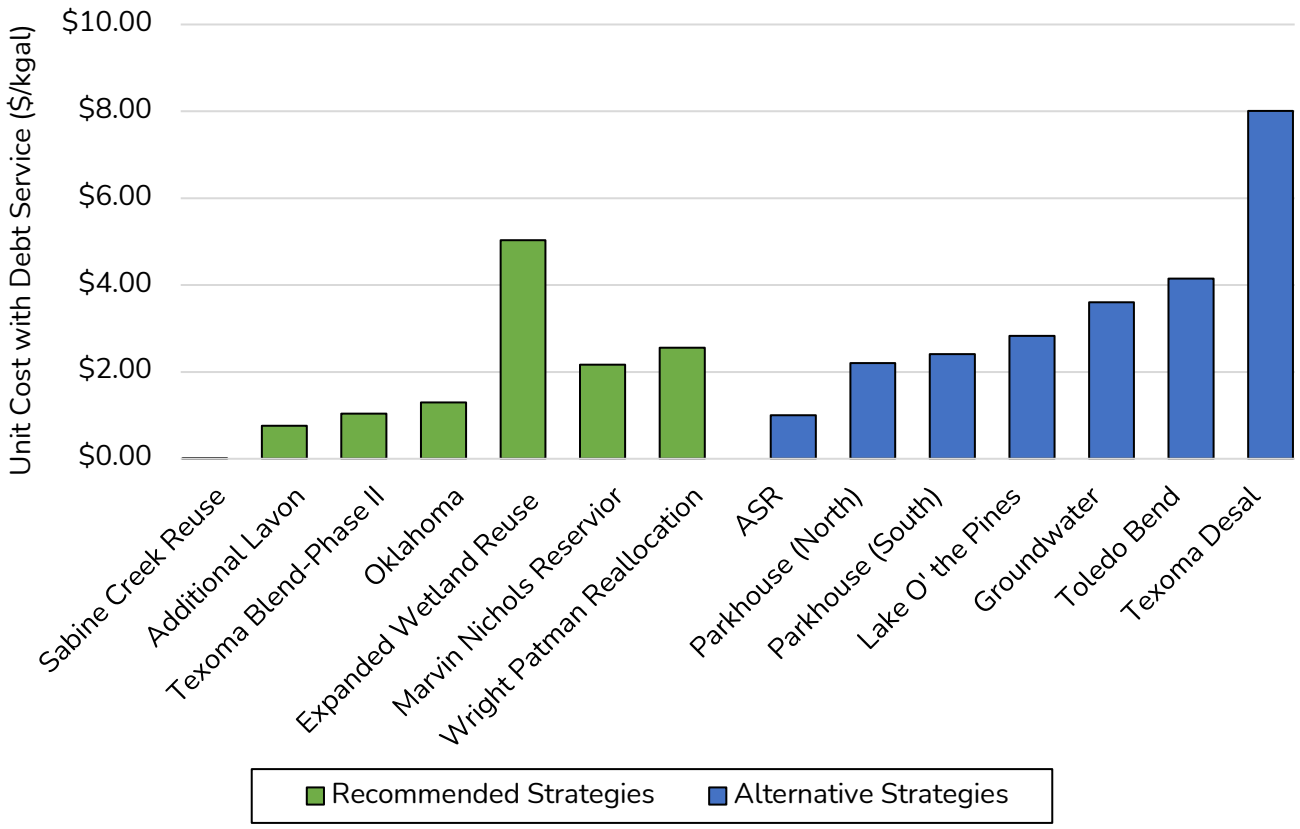
FIGURE J-3: 2021 REGION C WATER PLAN COST COMPARISON OF POTENTIAL ALTERNATIVES TO REUSE PROJECT



The *2021 Region C Water Plan* and the *2022 State Water Plan* project that NTMWD will have water shortages of approximately 82,300 acre-feet per year by 2030, increasing to nearly 369,000 acre-feet per year by 2070. The near-term shortage is expected to be met through conservation and Bois d'Arc Lake. Expanded reuse through NTMWD's existing reuse projects and new reuse projects could provide up to nearly 76,300 acre-feet per year by 2070. However, to provide this level of reuse, authorizations for reuse from new or expanded WWTPs will be needed. As shown, additional reuse is a critical component of the District's water supply portfolio and conservation program.

Supply from Other Reuse Projects

Expanded Wetland Reuse

NTMWD currently diverts return flows from the East Fork Trinity River and Trinity River Mainstem to a constructed wetland facility in Kaufman and Ellis counties (East Fork Wetland). The return flows are conveyed through the constructed wetland facility before being blended in Lavon Lake for diversion and use. With the population growth and an agreement with Dallas Water Utilities (DWU) for access to these return flows, the quantity of return flows available from these sources will exceed the treatment capacity of the existing East Fork Wetland. This project proposes to expand the diversion

and treatment capacity of the return flows through the development of new constructed wetlands followed by membrane treatment. The level of treatment proposed would allow NTMWD to transport the treated return flows either to Lavon Lake or directly to a water treatment plant.

This project is part of NTMWD's long-term reuse program and is a recommended strategy in the *2021 Region C Water Plan* and *2022 State Water Plan*. Due to the required infrastructure for this project, the costs are higher and the time to implement is longer than the reuse of discharges from the Sabine Creek WWTP.

Supply from New (Undeveloped) Reservoirs

Marvin Nichols Reservoir

Marvin Nichols Reservoir is a proposed reservoir in the Sulphur River Basin in Titus and Red River Counties, about 45 miles west of Texarkana. It is a recommended strategy in the *2021 Region C Water Plan* and *2022 State Water Plan* for NTMWD, the Tarrant Regional Water District (TRWD), and the Upper Trinity Regional Water District (UTRWD). The total available supply from the Marvin Nichols Reservoir to Region C providers is 361,200 acre-feet per year.

At the recommended conservation pool elevation of 328 feet MSL, the reservoir would inundate approximately 66,100 acres. Approximately 31,600 acres are classified as bottomland hardwoods or forested wetlands. The U.S. Fish and Wildlife Service (USFWS) has classified some of this acreage as Priority 1 bottomland hardwoods, which is the highest quality classified by USFWS (USFWS, 1984). Additional studies are needed to confirm the quality and extent of these resources.

The Marvin Nichols Reservoir would provide considerable amounts of new water supply to the North Texas area at a relatively low unit cost compared to some other strategies. However, the development of this strategy would have greater environmental impacts than the Sabine Creek WWTP reuse. Environmental impacts of the reuse of discharges are negligible, as there is an existing Texas Pollutant Discharge Elimination System permit authorizing the discharge of return flows. The reuse of this treated wastewater after it is discharged will have negligible impacts on the environment.

The development of the Marvin Nichols Reservoir as proposed in the *2021 Region C Water Plan* and *2022 State Water Plan* also requires multiple participants to effectively achieve the cost benefits and full utilization of the available supply. As a result, the timing for this strategy is dependent upon the needs of other participants. In addition, development of this project could take between 30 and 40 years due to the permitting requirements and current opposition.

The Marvin Nichols Reservoir is not a feasible alternative to the reuse of discharges from the Sabine Creek WWTP because it has greater environmental impacts and cannot be implemented within the proposed timeframe to satisfy the purpose and need of this project.

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George Parkhouse Reservoir (South)

George Parkhouse Reservoir (South) is a potential reservoir located on the South Sulphur River in Hopkins and Delta Counties. It is located immediately downstream from Jim Chapman Lake and would yield 116,000 acre-feet per year. At conservation elevation 401 feet MSL, George Parkhouse Lake (South) would inundate approximately 29,000 acres and store 652,000 acre-feet. The yield of George Parkhouse Lake (South) would be reduced substantially by the development of Marvin Nichols Reservoir. The yield studies conducted as part of the Reservoir Site Protection Studies indicate the yield of this lake would be reduced by up to 60 percent (46,400 acre-feet per year) if constructed after Marvin Nichols (HDR *et al*, 2007). The lake, as currently configured, would abut the dam for Jim Chapman Lake, and over fifty percent of the land impacted would be bottomland hardwood forest or marsh (HDR *et al*, 2007).

The proposed George Parkhouse Reservoir (South) is an alternative strategy in the *2021 Region C Water Plan*. This strategy is not a feasible alternative due to the uncertainty of the reliable supply with the development of other reservoirs in the river basin and the environmental impacts. Also, the project probably could not be implemented within the timeframe needed for additional water for NTMWD.

George Parkhouse Reservoir (North)

George Parkhouse Reservoir (North) is a potential reservoir located on the North Sulphur River in Lamar and Delta Counties, about 15 miles east of the City of Paris. At a proposed conservation elevation of 410.0 feet MSL, the reservoir would store 331,000 acre-feet of water and inundate 14,400 acres. The firm yield would be 106,500 acre-feet per year, but its yield would be reduced substantially by the development of the Marvin Nichols Reservoir (HDR *et al*., 2007).

The reservoir site is located upstream of a designated Priority 1 bottomland hardwood preservation site known as Sulphur River Bottoms West. Most of the land impacted by this alternative is grassland or agricultural lands. Only about 1,200 acres are classified as wetlands. However, the acreage of affected wetlands would require field surveys and verification.

The proposed George Parkhouse Reservoir (North) is an alternative strategy in the *2021 Region C Water Plan*. Similar to the George Parkhouse Reservoir (South) alternative, the economic viability of the project is dependent upon the ultimate yield of the project. The proposed reservoir is not a feasible alternative to the Sabine Creek WWTP reuse due to the uncertainty of the reliable supply with the development of other reservoirs in the river basin. Also, the project probably could not be implemented within the timeframe needed for additional water for NTMWD.

Transporting Water From Existing Reservoirs

Transporting water from existing reservoirs to NTMWD's service area requires agreements with the owner of the existing water supplies and often long transmission pipelines. Existing reservoirs that

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may have uncommitted supplies are commonly located in the eastern part of the state where there is more available surface water. However, most of these sources would require transporting the water over long distances with substantial vertical lift. NTMWD considered the following alternatives:

Additional Measures to Access Full Lavon Lake Yield

Currently, NTMWD does not have access to the full storage volume in Lavon Lake due to limitations of its diversion facilities. During most times these facilities provide the full authorized diversion from the lake. This strategy would provide for emergency measures to be taken during drought conditions when access to the full storage volume is limited. These measures may include, but are not limited to, development of raw water pump station #4 with a deep-water intake, extension and/or dredging intake channels to the pumping facilities, and floating barges equipped with pumps.

This strategy would provide access to existing supplies only during periods of drought and does not provide significant supply to help meet growing demands associated with population growth. It is a recommended strategy in the *2021 Region C Water Plan* and *2022 State Water Plan*. This strategy is considered an emergency supply rather than an alternative to the Sabine Creek WWTP reuse.

Lake Texoma Alternatives

Lake Texoma is an existing U.S. Army Corps of Engineers (USACE) reservoir on the Red River on the border between Texas and Oklahoma. NTMWD has water rights to divert up to 197,000 acre-feet per year of water from Lake Texoma. Water from Lake Texoma is relatively high in dissolved salts and does not meet secondary drinking water standards. Until 2009, NTMWD diverted up to 84,000 acre-feet of Lake Texoma water and blended the water in Lavon Lake for subsequent use. With the detection of zebra mussels in Lake Texoma, this practice has ceased. NTMWD now transports water from Lake Texoma directly to the Wylie Treatment Plant and blends the water with supplies from Lavon Lake, but the amount of water that can be blended and still provide drinking water of acceptable quality is limited. NTMWD intends to blend Texoma water with water from Bois d'Arc Lake at the Leonard Water Treatment Plant. NTMWD also plans to make additional supplies available from Lake Texoma either through blending with new fresh water sources or desalination.

Blending and desalination are very different and are considered two different alternatives to reuse projects. Each alternative is discussed below.

Transport and Blend Lake Texoma Water with New Fresh Water Supplies (Phase II)

Due to environmental concerns and additional costs associated with large desalination projects, NTMWD's preferred use of this water source is to blend the Lake Texoma water with new fresh water supplies. It is anticipated that Lake Texoma water would be blended in a constructed balancing reservoir near a treatment facility and not in an existing lake or stream. This would reduce potential impacts of added dissolved solids to local lakes or streams and reduce concerns with possible transfer of invasive species.

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Texoma Blending Phase II would increase the use of water from Lake Texoma by blending with new fresh water supplies. Aside from Bois d'Arc Lake (Texoma Blending Phase I), there are no other readily available fresh water supplies in the amount needed to blend with the new water supply from Lake Texoma and existing supplies are not sufficient to provide a blended water of acceptable quality for municipal use. Therefore, the Phase II blended alternative cannot be implemented without also implementing another water supply alternative to provide fresh water to NTMWD. NTMWD does plan to make use of water supplies from this source and it is a recommended strategy in the *2021 Region C Water Plan* and *2022 State Water Plan*, but only after development of other significant fresh water sources (such as Marvin Nichols Reservoir or other fresh water source). Blending (Phase II) cannot be considered an alternative to reuse without implementation of another water supply source and cannot not be developed in time to meet the projected needs; thus, blending Lake Texoma water with existing fresh water supplies is not a feasible alternative to the Sabine Creek WWTP reuse.

Transport and Desalinate Lake Texoma Water

One option to use Lake Texoma water for municipal purposes is to desalinate the water using reverse osmosis water treatment or another similar treatment method. Desalination can result in the loss of up to one fourth of the raw supply to the treatment process. Lake Texoma with desalination is an alternative strategy in the *2021 Region C Water Plan*. For this strategy, it was assumed that 40,000 acre-feet per year of source water would result in a treated water supply of approximately 33,600. This strategy assumes a new desalination facility would be constructed at the Leonard Water Treatment Plant. Lake Texoma water would be transported directly to the Leonard Water Treatment Plant through a new pipeline and the desalination waste would be discharged to the Red River.

Desalination is a much more expensive strategy than blending, and there are considerable uncertainties in the operation and long-term costs of a large-scale desalination facility. The estimated costs for desalination of water from Lake Texoma are based on current cost information for large desalination facilities. However, they are more uncertain than other cost estimates developed for the potential alternatives because few large inland desalination facilities have been built to date. The Fort Bliss/ El Paso Water Utilities desalination facility, which is the largest inland desalination plant in the United States, produces 27.5 MGD. The technology for desalination is improving but it is still costly.

Desalination is also an energy intensive process, and as energy costs continue to increase, these costs are expected to increase. Large scale desalination of Lake Texoma water (>50 MGD) is not a feasible alternative to the Sabine Creek WWTP reuse due to the cost uncertainty, the greater energy usage associated with large-scale brine operations, and the time it would take to implement the project.

Toledo Bend Reservoir

Toledo Bend Reservoir is a 181,600-acre lake located in East Texas on the Texas-Louisiana state line. The total permitted supply from this source for Texas is 970,067 acre-feet per year (including the additional authorization of 220,067 acre-feet per year granted in August 2019). The Sabine River

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Authority (SRA) of Texas operates the Texas portion of this lake. In the *2021 Region C Water Plan* the transport of water from Toledo Bend Reservoir to the North Texas area is an alternative joint strategy for NTMWD, TRWD, DWU, and UTRWD. This project, as presented in the *2021 Region C Water Plan*, could deliver a total of 650,000 acre-feet per year, with 200,000 acre-feet per year for NTMWD, in two phases.

This alternative will require multiple transmission pipelines to transport the water approximately 200 miles to North Texas. The current concept for this project includes the use and storage of existing reservoirs as part of the transmission system. This transfer of water is anticipated to have a low to medium low impact on the receiving reservoirs.

This strategy requires cooperation with other water providers and an agreement with the Sabine River Authority to purchase the water. The high capital costs for Phase 1 and energy usage associated with the long transmission pipelines result in a unit cost of over $4.00 per 1000 gallons for raw water delivered to NTMWD. Costs for the other partners are higher. This project requires multiple agreements, which have not been reached, and an interbasin transfer to use the water in the North Texas area. Considering the costs, time to implement, and uncertainty of agreements, this strategy is not a feasible alternative to the Sabine Creek WWTP reuse.

Water from Oklahoma

Another potential alternative is the use of water from Oklahoma. At the present time, the Oklahoma Legislature has established a moratorium on the export of water from the state. Assuming the moratorium may be lifted in the future, the *2021 Region C Water Plan* and *2022 State Water Plan* recommends that NTMWD develop a project to use water from Oklahoma. It is an alternate strategy for the City of Irving and UTRWD. The recommended project is for 50,000 acre-feet per year and is planned for 2070.

NTMWD has applied for Oklahoma water rights to use water from the Kiamichi River, Muddy Boggy Creek, and stored water in Lake Hugo. At this time, the state cannot act upon these permits without further direction from the Oklahoma Legislature.

The challenges with this strategy are the development issues, including the legal moratorium on out-of-state water sales and the Lacey Act. Under the Lacey Act, it is unlawful to transport invasive species across state lines. Since there is considerable uncertainty as to when these obstacles could be overcome, this strategy cannot be counted on for near-term water supplies. Thus, it is not a feasible alternative to the Sabine Creek WWTP reuse.

Lake O' the Pines

Lake O' the Pines is an existing USACE reservoir in the Cypress River Basin with Texas water rights held by the Northeast Texas Municipal Water District (NETMWD). NTMWD has explored the

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possibility of purchasing supplies in excess of local needs from the Cypress River Basin and it is an alternative strategy in the *2021 Region C Water Plan*. According to the *2021 Region D Water Plan*, there is no water available for export from the basin. However, there may be excess supplies from existing contracts.

Lake O' the Pines is about 120 miles from the Metroplex, and the distance and limited supply make this a relatively expensive water management strategy. Development of this source would require contracts with NETMWD and other Cypress River Basin suppliers with excess supplies. At this time, agreements have not been reached to purchase this water. Due to this uncertainty and expected time to develop, Lake O' the Pines is not a feasible alternative to the Sabine Creek WWTP reuse.

Wright Patman Lake

The Wright Patman Reallocation strategy involves development of new surface water supplies from the Sulphur River Basin through a reallocation of storage at Wright Patman Lake from its current purpose, flood control, to water conservation storage. The supply quantity and cost identified above are for a specific reallocation of Wright Patman at elevation 235 feet MSL. At that conservation pool elevation, the pool raise at Wright Patman Lake would inundate an additional 14,372 acres above the permitted conservation pool elevation (ultimate rule curve). Infrastructure would be developed to transport the water to the Region C water providers.

The Wright Patman Reallocation strategy is considered for NTMWD, UTRWD, TRWD, DWU, and the City of Irving in the *2021 Region C Water Plan* and recommended for NTMWD, TRWD and UTRWD in the *2021 Region C Water Plan* and *2022 State Water Plan*.

The firm yield with reallocation of Wright Patman to elevation 235 feet MSL, above the 180,000 acre-feet per year permitted to Texarkana, would be 122,200 acre-feet per year. It is assumed that all the reallocation supplies would be available to Region C providers. These quantities assume that Marvin Nichols is senior to the Wright Patman Lake reallocation. However, the City of Texarkana has applied for a new water right from Wright Patman. If this right is granted, the amount of supply available to Region C providers would be less.

Reallocation to elevation 235 feet MSL was selected to minimize impacts to the White Oak Creek Wildlife Management Area (WOCWMA). This site is located upstream of Wright Patman Lake and is designated as mitigation for the construction of Jim Chapman Reservoir. At elevation 235 feet MSL, the increase in the conservation pool at Wright Patman Lake would increase water levels on approximately 450 acres of the WOCWMA and affect some riparian bottomland hardwoods. However, reallocation at this elevation would not affect the functioning of constructed wetland structures and would still allow the wetland structures to function as designed. Also, the USACE owns property up to the 235 feet MSL elevation, which simplifies additional land acquisition.

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Reallocation of Wright Patman Lake would be sponsored by USACE, would require additional environmental studies, and would require congressional approval. Further study would be needed to ensure that there is no increase in flooding risks after reallocation.

Due to the uncertainty of authorizing reallocation of flood storage, reaching agreements with strategy partners, and higher costs, this strategy is not a feasible alternative to the Sabine Creek WWTP reuse.

New Groundwater Supplies

There are limited new groundwater sources that could supply the quantity of water needed by NTMWD. The Ogallala aquifer in the Texas Panhandle has large quantities of water, but much of this supply is committed to users in the area, including agricultural users and local municipalities. Another potential source is the Carrizo-Wilcox aquifer. This aquifer is also heavily used by local entities.

Carrizo-Wilcox Aquifer Groundwater

The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. Organizations and individuals have been studying the development of water supplies in Anderson County and surrounding counties for export. Anderson County is about 100 miles from NTMWD's service area and this strategy is an alternative strategy for NTMWD in the *2021 Region C Water Plan*. There are some uncertainties about developing such a large quantity of groundwater and exporting this water to North Texas. Based on the *2021 Regional* and *2022 State Water Plans*, the Modeled Available Groundwater (MAG) values for the Carrizo-Wilcox in Anderson County are less than 25,000 acre-feet per year. Some of this groundwater is currently used by local producers. Due to the uncertainty of available supply and competition for this water source, the Carrizo-Wilcox groundwater alternative is not a feasible alternative to the Sabine Creek WWTP reuse.

Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is a water management approach that stores surplus water in local aquifers during periods of excess water availability and withdraws the stored water later during periods of drought or peak demands. This strategy can provide additional supply during drought. It requires a suitable aquifer formation and excess supplies that have been treated to a level that will not degrade existing water quality in the aquifer. ASR is an alternative strategy for NTMWD in the *2021 Region C Water Plan*. The small-scale ASR strategy considered for NTMWD assumes a suitable formation can be identified near an existing water treatment facility, and the operations could provide up to 2,500 acre-feet per year during drought.

This quantity of water could help with peak demands but would not provide a significant source of new water. Further study is needed to determine if there are suitable geologic formations that are economically feasible for ASR, and the operation of the system may pose challenges for infrastructure

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that may not be used regularly. ASR is a not a feasible alternative to the Sabine Creek WWTP reuse due to the technical uncertainties with implementation and time to implement.

Conclusion

Based upon the aforementioned information and analysis, there are no feasible alternatives to the Sabine Creek WWTP reuse in the *2021 Region C* or *2022 State Water Plan* at this time. Furthermore, this project type is consistent with NTMWD's conservation goals to fully develop its available reuse to meet its future water needs.

J.2 CONSERVATION AS AN ALTERNATIVE TO THE PROPOSED APPROPRIATION – 288.7 (a)(2) – BASED ON THE 2026 INITIALLY PREPARED REGION C WATER PLAN

NTMWD water use in 2024 totaled approximately 401,400 acre-feet. 2024 was not a dry year, and demands would be higher in a dry year. The projected dry year demands for NTMWD in 2030 in the *2026 Initially Prepared Region C Water Plan* are over 520,100 acre-feet per year, including 5% losses for treatment and delivery. The *2026 Initially Prepared Region C Water Plan* projects that these demands will increase by about 63% by 2080, to approximately 847,200 acre-feet per year. Based on current water supplies, NTMWD will need to develop over 417,300 acre-feet per year of additional supply to meet the 2080 demands projected in the *2026 Initially Prepared Region C Water Plan*. NTMWD expects to meet a portion of this demand via conservation. The *2026 Initially Prepared Region C Water Plan* indicates that additional water conservation efforts (beyond what NTMWD has already accomplished) will provide nearly 22,900 acre-feet per year of NTMWD's total water supplies by 2030 and about 78,600 acre-feet per year by 2080.

NTMWD plans to meet a significant part of its projected demands by reuse. Reuse comprises 37 percent of NTMWD's existing 2030 water supply in the *2026 Initially Prepared Region C Water Plan*. Increases in available reuse due to population growth and the development of specific reuse projects are expected to provide up to 89,500 acre-feet of additional reuse supplies by 2080. Combined, conservation and reuse (existing and new) are estimated to provide nearly 347,800 acre-feet of water supplies by 2080, which represents approximately 35 percent of NTMWD's projected total water demand in 2080.

Both conservation and reuse are integral strategies in NTMWD's plans to meet projected water demands. The reuse of wastewater discharges associated with current and future water supplies developed by NTMWD will provide supplies to help meet projected water demands. However, in light of NTMWD's projected total demand of nearly 847,200 acre-feet per year of water by 2080, intensified conservation and reuse alone cannot provide enough water to address all demands. Thus, conservation and reuse strategies are part of the portfolio of strategies that will be pursued by NTMWD to meet the rapidly rising demand for municipal water supplies in the NTMWD service area.

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J.3 FEASIBLE ALTERNATIVES TO NEW WATER DEVELOPMENT – 288.7(a)(3) – BASED ON THE 2026 INITIALLY PREPARED REGION C WATER PLAN

The 2026 regional water planning process identified and evaluated many potential water management strategies for NTMWD. The *2026 Initially Prepared Region C Water Plan* considered 18 different water management strategies to meet the projected water supply shortages for NTMWD through 2080. Of these considered strategies, the *2026 Initially Prepared Region C Water Plan* recommended 11 strategies for implementation by NTMWD, including Sabine Creek WWTP reuse.

NTMWD has or is currently implementing some of these strategies, including:

- Water Conservation (implemented)
- Interim Upper Sabine Basin (implemented)
- Additional Lavon Watershed Reuse (in progress)
- Additional Lake Texoma Blend Phase I (blended with supplies from Bois d'Arc Lake) (in progress)
- Sabine Creek WWTP Reuse (in progress)

The other strategies recommended in the *2026 Initially Prepared Region C Water Plan* for implementation include:

- Additional Measures to Access Full Lavon Lake Yield
- Expanded wetland reuse
- Lake O' the Pines
- Marvin Nichols Reservoir
- Wright Patman
- Additional Lake Texoma Blend Phase II (blended with new fresh water supply)

Each of these strategies is scheduled for implementation based on the projected water needs and the time to implement the strategy, including considerations for planning and permitting.

Potential alternatives considered for NTMWD but not recommended for implementation in the *2026 Initially Prepared Region C Water Plan* include developing other new reservoirs (George Parkhouse North and George Parkhouse South), transporting water from existing reservoirs (Toledo Bend), development of new groundwater supplies (Carrizo-Wilcox), aquifer storage and recovery, out of state water (Oklahoma), and desalination of Lake Texoma water. Most of these strategies will require water rights for new appropriations and/or interbasin transfers, and they all will require the construction of infrastructure to store and transport water supplies to the NTMWD service area.

To continue its water supply development, NTMWD is applying for a water right from the TCEQ for reuse for wastewater discharges from the Sabine Creek WWTP. The Sabine Creek WWTP discharges to the Lake Tawakoni watershed. NTMWD has an intake on Lake Tawakoni, which could be used to divert the return flows.

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This discussion focuses on alternatives to the Sabine Creek WWTP reuse application in the *2026 Initially Prepared Region C Water Plan*. Only alternative projects that have not been implemented and are not currently in progress are discussed here. Descriptions of potential project alternatives are presented below. **Table J-4** presents a synopsis of the applicability of these potential strategies as feasible alternatives to reuse.

Each potential project alternative is being vetted through the state water planning process and the discussions herein are consistent with the *2026 Initially Prepared Region C Water Plan*. Strategies that are recommended for implementation by NTMWD are part of a suite of strategies to meet NTMWD's water needs. As such, these strategies are not alternatives to reuse but rather complement this supply. For completeness, a full range of potential alternatives is discussed in this appendix, including strategies that are recommended for implementation after reuse.

NTMWD's evaluation of the potential alternatives considered many factors, including cost of the water, quantity, reliability, the potential impacts of developing the project on the environment, natural resources and other water users, timing to develop the strategy, and potential implementation issues. **Table J-5** and **Figure J-4** show a comparison of the unit costs for the alternative strategies.

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TABLE J-4: 2026 INITIALLY PREPARED REGION C WATER PLAN LIST OF POTENTIAL WATER SUPPLY ALTERNATIVES FOR NTMWD

Strategy[1]	Feasible Alternative (Yes/No)	Comment
Additional Measure to Access Full Lavon Yield	No	This strategy is considered an emergency supply during times of drought and not a significant source of long-term supply. It is not an alternative to long-term supplies from reuse.
Expanded Wetland Reuse	No	The source of water for this strategy is not available until population grows and generates more return flows. Requires new infrastructure.
Lake O' the Pines	No	Development of this source would require contracts with NETMWD and other suppliers. Agreements have not been reached to purchase this water. Due to uncertainty and expected time to develop, this is not a feasible alternative to the Sabine Creek WWTP reuse application.
Marvin Nichols Reservoir	No	Has greater environmental impacts than reuse. Significantly higher costs than the Sabine Creek WWTP reuse. Could take between 30 and 40 years to implement. Cannot be implemented within the timeframe water is needed.
Wright Patman	No	Has greater environmental impacts than the Sabine Creek WWTP reuse. Could take between 30 and 40 years to implement. This is not an alternative for the Sabine Creek WWTP reuse due to online date.
Additional Lake Texoma Blend Phase II	No	Requires additional new sources of fresh water to blend to meet drinking water quality standards.
Lake Texoma - Desalinate at Leonard	No	High costs and energy use. Cannot be implemented within the timeframe water is needed.
Carrizo-Wilcox Groundwater	No	Supply uncertainty and competing local interests for water.
George Parkhouse Reservoir (North)	No	Has greater environmental impacts than reuse. Yield is impacted by potential upstream reservoirs. Cannot be implemented within the timeframe water is needed.
George Parkhouse Reservoir (South)	No	Has greater environmental impacts than reuse of discharges. Yield is impacted by upstream reservoir. Cannot be implemented within the timeframe water is needed.
Aquifer Storage and Recovery	No	Suitable geologic formation to store water has not been identified. Unproven for size and location. Cannot be implemented within the timeframe water is needed.
Toledo Bend Reservoir	No	High costs and energy use. Requires agreements with other providers. Cannot be implemented within the timeframe water is needed.
Oklahoma	No	Current political and legal impediments.

1. Each of these strategies was vetted through the state regional water planning process. Strategies that are recommended for implementation by NTMWD are part of a suite of strategies to meet NTMWD's water needs. Some strategies that are identified as not feasible at this time may be a feasible water supply project in the future.

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TABLE J-5: 2026 INITIALLY PREPARED REGION C WATER PLAN COSTS FOR POTENTIAL SUPPLY ALTERNATIVES

Strategy	Costs Reported in 2026 Initially Prepared Region C Water Plan[1]		
	Capital Cost for NTMWD	Unit Cost for NTMWD ($/kGal.)	
		Pre-Amortization	Post-Amortization
Proposed Projects			
Sabine Creek Reuse	$517,000[2]	$0.01	$0.00
Potential Alternatives			
Additional Measure to Access Full Lavon Yield	$209,348,000	$3.76	$1.00
Expanded Wetland Reuse	$686,489,000	$5.05	$0.73
Lake O' the Pines	$1,345,792,000	$4.05	$1.07
Marvin Nichols Reservoir	$2,559,708,000	$3.39	$0.70
Wright Patman	$1,632,513,500	$4.82	$0.91
Lake Texoma Blend - Phase II	$997,393,000	$2.63	$0.43
Lake Texoma Desalinate	$1,198,976,000	$13.22	$5.58
Carrizo-Wilcox Groundwater	$1,253,455,000	$6.23	$1.25
George Parkhouse Reservoir (North)	$1,762,143,000	$3.56	$0.65
George Parkhouse Reservoir (South)	$1,976,311,000	$3.23	$0.56
Aquifer Storage and Recovery	$332,260,000	$5.02	$2.93
Toledo Bend Reservoir	$2,930,008,000	$6.43	$1.43
Oklahoma	$1,075,067,000	$4.39	$0.84

1. Only projects considered in the *2026 Initially Prepared Region C Water Plan* are included in Table J-4 and Figure J-4. Costs in Table J-5 are reported in 2023 dollars. Costs are for raw water only and do not include cost for treatment and treated water system distribution (except for the Lake Texoma desalination project which includes a desalination plant).
2. There are no capital costs estimated for the Sabine Creek WWTP reuse project. This facility is currently discharging to water bodies from which NTMWD has existing facilities for diversion and use. Only permitting costs are considered which is represented under the capital cost column.

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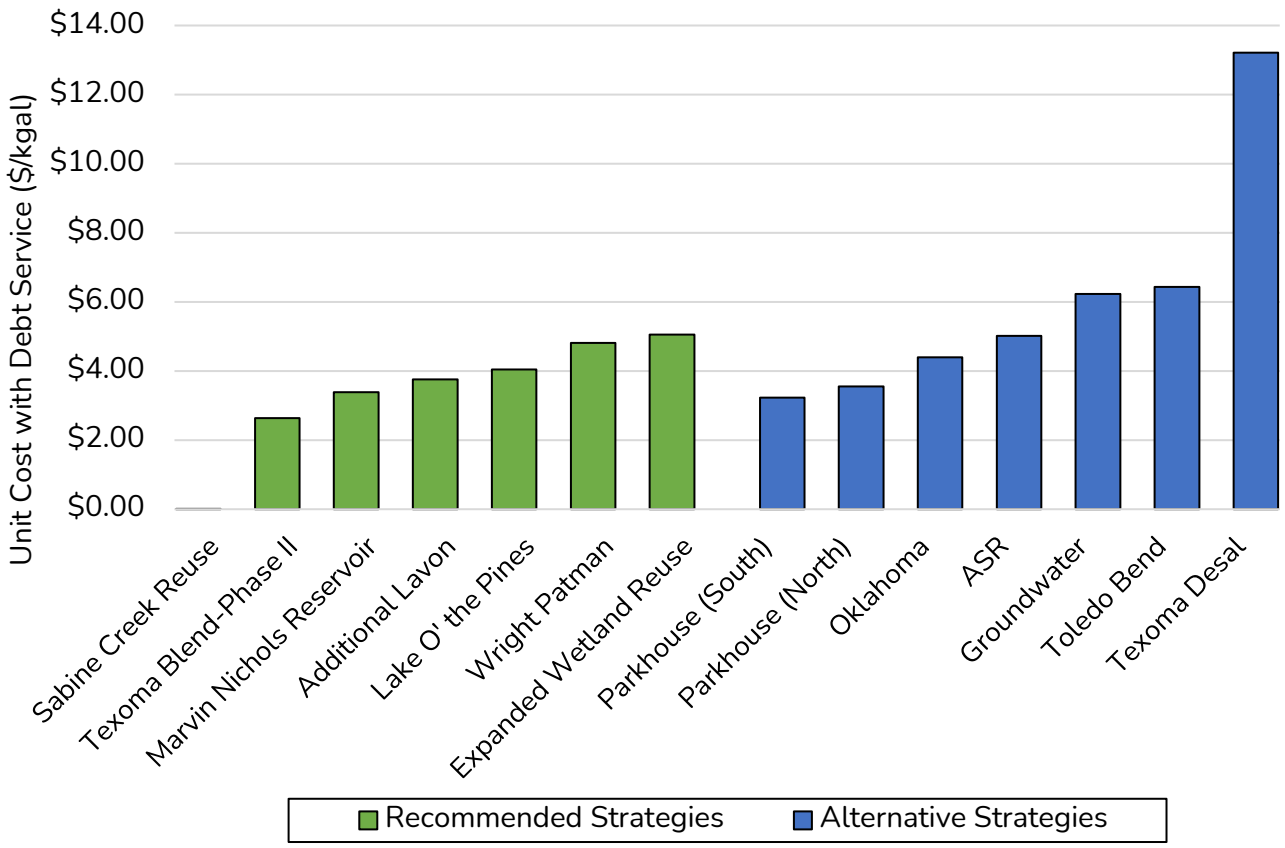
FIGURE J-4: 2026 INITIALLY PREPARED REGION C WATER PLAN COST COMPARISON OF POTENTIAL ALTERNATIVES TO REUSE PROJECT



The *2026 Initially Prepared Region C Water Plan* projects that NTMWD will have water shortages of approximately 45,100 acre-feet per year by 2030, increasing to nearly 417,300 acre-feet per year by 2080. The near-term shortage is expected to be met through conservation, additional Lake Texoma blend phase I, and interim upper Sabine basin supplies. Expanded reuse through NTMWD's existing reuse projects and new reuse projects could provide over 10,000 acre-feet per year in 2030 and 89,500 acre-feet per year by 2080. However, to provide this level of reuse, authorizations for reuse from new or expanded WWTPs will be needed. As shown, additional reuse is a critical component of the District's water supply portfolio and conservation program.

Supply from Other Reuse Projects

Expanded Wetland Reuse

NTMWD currently diverts return flows from the East Fork Trinity River and Trinity River Mainstem to a constructed wetland facility in Kaufman and Ellis counties (East Fork Wetland). The return flows are conveyed through the constructed wetland facility before being blended in Lavon Lake for diversion and use. The proposed expanded wetland reuse project would treat return flows from WWTPs owned and operated by NTMWD and DWU. With population growth and an agreement with DWU

for access to these return flows, the quantity of return flows available from these sources will exceed the treatment capacity of the existing East Fork Wetland. This project proposes expanding the diversion and treatment capacity of the return flows through the development of new constructed wetlands for nutrient removal. The level of treatment proposed would allow NTMWD to transport the treated return flows to Lake Tawakoni for blending with other sources.

This project is part of NTMWD's long-term reuse program and is a recommended strategy in the *2026 Initially Prepared Region C Water Plan*. Due to the required infrastructure for this project, the costs are higher and the time to implement is longer than the reuse of discharges from the Sabine Creek WWTP.

Supply from New (Undeveloped) Reservoirs

Marvin Nichols Reservoir

Marvin Nichols Reservoir is a proposed reservoir in the Sulphur River Basin in Titus and Red River Counties, about 45 miles west of Texarkana. It is a recommended strategy in the *2026 Initially Prepared Region C Water Plan* for NTMWD, the Tarrant Regional Water District (TRWD), and the Upper Trinity Regional Water District (UTRWD). The total available supply from the Marvin Nichols Reservoir to Region C providers is 320,160 acre-feet per year.

At the recommended conservation pool elevation of 328 feet MSL, the reservoir would inundate approximately 66,100 acres. Approximately 31,600 acres are classified as bottomland hardwoods or forested wetlands. The U.S. Fish and Wildlife Service (USFWS) has classified some of this acreage as Priority 1 bottomland hardwoods, which is the highest quality classified by USFWS (USFWS, 1984). Additional studies are needed to confirm the quality and extent of these resources.

The Marvin Nichols Reservoir would provide considerable amounts of new water supply to the North Texas area at a relatively low unit cost compared to some other strategies. However, the development of this strategy would have greater environmental impacts than the Sabine Creek WWTP reuse. Environmental impacts of the reuse of discharges are negligible, as there is an existing Texas Pollutant Discharge Elimination System permit authorizing the discharge of return flows. The reuse of this treated wastewater after it is discharged will have negligible impacts on the environment.

The development of the Marvin Nichols Reservoir as proposed in the *2026 Initially Prepared Region C Water Plan* also requires multiple participants to effectively achieve the cost benefits and full utilization of the available supply. As a result, the timing for this strategy is dependent upon the needs of other participants. In addition, development of this project could take between 30 and 40 years due to the permitting requirements and current opposition.

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The Marvin Nichols Reservoir is not a feasible alternative to the reuse of discharges from the Sabine Creek WWTP because it has greater environmental impacts and cannot be implemented within the proposed timeframe to satisfy the purpose and need of this project.

George Parkhouse Reservoir (South)

George Parkhouse Reservoir (South) is a potential reservoir located on the South Sulphur River in Hopkins and Delta Counties. It is located immediately downstream from Jim Chapman Lake and would yield approximately 115,000 acre-feet per year. At conservation elevation 401 feet MSL, George Parkhouse Lake (South) would inundate approximately 29,000 acres and store 652,000 acre-feet. The yield of George Parkhouse Lake (South) would be reduced substantially by the development of Marvin Nichols Reservoir. The yield studies conducted as part of the Reservoir Site Protection Studies indicate the yield of this lake would be reduced by up to 60 percent (46,400 acre-feet per year) if constructed after Marvin Nichols (HDR *et al*, 2007). The lake, as currently configured, would abut the dam for Jim Chapman Lake, and over fifty percent of the land impacted would be bottomland hardwood forest or marsh (HDR *et al*, 2007).

The proposed George Parkhouse Reservoir (South) is an alternative strategy in the *2026 Initially Prepared Region C Water Plan*. This strategy is not a feasible alternative due to the uncertainty of the reliable supply with the development of other reservoirs in the river basin and the environmental impacts. Also, the project probably could not be implemented within the timeframe needed for additional water for NTMWD.

George Parkhouse Reservoir (North)

George Parkhouse Reservoir (North) is a potential reservoir located on the North Sulphur River in Lamar and Delta Counties, about 15 miles southeast of the City of Paris. At a proposed conservation elevation of 410.0 feet MSL, the reservoir would store 331,000 acre-feet of water and inundate 14,400 acres. The firm yield would be approximately 94,500 acre-feet per year, but its yield would be reduced substantially by the development of the Marvin Nichols Reservoir (HDR *et al*., 2007).

The reservoir site is located upstream of a designated Priority 1 bottomland hardwood preservation site known as Sulphur River Bottoms West. Most of the land impacted by this alternative is grassland or agricultural lands. Only about 1,200 acres are classified as wetlands. However, the acreage of affected wetlands would require field surveys and verification.

The proposed George Parkhouse Reservoir (North) is an alternative strategy in the *2026 Initially Prepared Region C Water Plan*. Similar to the George Parkhouse Reservoir (South) alternative, the economic viability of the project is dependent upon the ultimate yield of the project. The proposed reservoir is not a feasible alternative to the Sabine Creek WWTP reuse due to the uncertainty of the

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reliable supply with the development of other reservoirs in the river basin. Also, the project probably could not be implemented within the timeframe needed for additional water for NTMWD.

Transporting Water From Existing Reservoirs

Transporting water from existing reservoirs to NTMWD's service area requires agreements with the owner of the existing water supplies and often long transmission pipelines. Existing reservoirs that may have uncommitted supplies are commonly located in the eastern part of the state where there is more available surface water. However, most of these sources would require transporting the water over long distances with substantial vertical lift. NTMWD considered the following alternatives:

Additional Measures to Access Full Lavon Lake Yield

Currently, NTMWD does not have access to the full storage volume in Lavon Lake due to limitations of its diversion facilities. During most times these facilities provide the full authorized diversion from the lake. This strategy would provide for emergency measures to be taken during drought conditions when access to the full storage volume is limited. These measures may include, but are not limited to, development of raw water pump station #4 with a deep-water intake, extension and/or dredging intake channels to the pumping facilities, and floating barges equipped with pumps.

This strategy would provide access to existing supplies only during periods of drought and does not provide significant supply to help meet growing demands associated with population growth. It is a recommended strategy in the *2026 Initially Prepared Region C Water Plan*. This strategy is considered an emergency supply rather than an alternative to the Sabine Creek WWTP reuse.

Lake Texoma Alternatives

Lake Texoma is an existing U.S. Army Corps of Engineers (USACE) reservoir on the Red River on the border between Texas and Oklahoma. NTMWD has water rights to divert up to 197,000 acre-feet per year of water from Lake Texoma. Water from Lake Texoma is relatively high in dissolved salts and does not meet secondary drinking water standards. Until 2009, NTMWD diverted up to 84,000 acre-feet of Lake Texoma water and blended the water in Lavon Lake for subsequent use. With the detection of zebra mussels in Lake Texoma, this practice has ceased. NTMWD now transports water from Lake Texoma directly to the Wylie Treatment Plant and blends the water with supplies from Lavon Lake, but the amount of water that can be blended and still provide drinking water of acceptable quality is limited. NTMWD intends to blend Texoma water with water from Bois d'Arc Lake at the Leonard Water Treatment Plant. NTMWD also plans to make additional supplies available from Lake Texoma either through blending with new fresh water sources or desalination.

Blending and desalination are very different and are considered two different alternatives to reuse projects. Each alternative is discussed below.

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Transport and Blend Lake Texoma Water with New Fresh Water Supplies (Phase II)

Due to environmental concerns and additional costs associated with large desalination projects, NTMWD's preferred use of this water source is to blend the Lake Texoma water with new fresh water supplies. It is anticipated that Lake Texoma water would be blended in a constructed balancing reservoir near a treatment facility and not in an existing lake or stream. This would reduce potential impacts of added dissolved solids to local lakes or streams and reduce concerns with possible transfer of invasive species.

Texoma Blending Phase II would increase the use of water from Lake Texoma by blending with new fresh water supplies. Aside from Bois d'Arc Lake (Texoma Blending Phase I), there are no other readily available fresh water supplies in the amount needed to blend with the new water supply from Lake Texoma and existing supplies are not sufficient to provide a blended water of acceptable quality for municipal use. Therefore, the Phase II blended alternative cannot be implemented without also implementing another water supply alternative to provide fresh water to NTMWD. NTMWD does plan to make use of water supplies from this source and it is a recommended strategy in the *2026 Initially Prepared Region C Water Plan*, but only after development of other significant fresh water sources (such as Lake O' the Pines, Marvin Nichols Reservoir, or other fresh water sources). Blending (Phase II) cannot be considered an alternative to reuse without implementation of another water supply source and cannot not be developed in time to meet the projected needs; thus, blending Lake Texoma water with existing fresh water supplies is not a feasible alternative to the Sabine Creek WWTP reuse.

Transport and Desalinate Lake Texoma Water

One option to use Lake Texoma water for municipal purposes is to desalinate the water using reverse osmosis water treatment or another similar treatment method. Desalination can result in the loss of up to one fourth of the raw supply to the treatment process. Lake Texoma with desalination is an alternative strategy in the *2026 Initially Prepared Region C Water Plan*. For this strategy, it was assumed 40,000 acre-feet per year of source water would result in a treated water supply of approximately 33,600 acre-feet per year. This strategy assumes a new desalination facility would be constructed at the Leonard Water Treatment Plant. Lake Texoma water would be transported directly to the Leonard Water Treatment Plant through a new pipeline and the desalination waste would be discharged to the Red River.

Desalination is a much more expensive strategy than blending, and there are considerable uncertainties in the operation and long-term costs of a large-scale desalination facility. The estimated costs for desalination of water from Lake Texoma are based on current cost information for large desalination facilities. However, they are more uncertain than other cost estimates developed for the potential alternatives because few large inland desalination facilities have been built to date. The Fort Bliss/ El Paso Water Utilities desalination facility, which is the largest inland desalination plant in the United States, produces 27.5 MGD. The technology for desalination is improving but it is still costly.

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Desalination is also an energy intensive process, and as energy costs continue to increase, these costs are expected to increase. Large scale desalination of Lake Texoma water (>50 MGD) is not a feasible alternative to the Sabine Creek WWTP reuse due to the cost uncertainty, the greater energy usage associated with large-scale brine operations, and the time it would take to implement the project.

Toledo Bend Reservoir

Toledo Bend Reservoir is a 181,600-acre lake located in East Texas on the Texas-Louisiana state line. The total permitted supply from this source for Texas is 970,067 acre-feet per year (including the additional authorization of 220,067 acre-feet per year granted in August 2019). The Sabine River Authority (SRA) of Texas operates the Texas portion of this lake. In the *2026 Initially Prepared Region C Water Plan* the transport of water from Toledo Bend Reservoir to the North Texas area is an alternative joint strategy for NTMWD, TRWD, DWU, and UTRWD. This project, as presented in the *2026 Initially Prepared Region C Water Plan*, could deliver a total of 650,000 acre-feet per year, with 200,000 acre-feet per year for NTMWD, in two phases.

This alternative will require multiple transmission pipelines to transport the water approximately 200 miles to North Texas. The current concept for this project includes the use and storage of existing reservoirs as part of the transmission system. This transfer of water is anticipated to have a low to medium low impact on the receiving reservoirs.

This strategy requires cooperation with other water providers and an agreement with SRA to purchase the water. The high capital costs for Phase 1 and energy usage associated with the long transmission pipelines result in a unit cost of over $6.00 per 1000 gallons for raw water delivered to NTMWD. Costs for the other partners are higher. This project requires multiple agreements, which have not been reached, and an interbasin transfer to use the water in the North Texas area. Considering the costs, time to implement, and uncertainty of agreements, this strategy is not a feasible alternative to the Sabine Creek WWTP reuse.

Water from Oklahoma

Another potential alternative is the use of water from Oklahoma. At the present time, the Oklahoma Legislature has established a moratorium on the export of water from the state. Assuming the moratorium may be lifted in the future, water from Oklahoma is listed as an alternative strategy for NTMWD in the *2026 Initially Prepared Region C Water Plan*. It is also an alternate strategy for DWU, UTRWD, and the City of Irving. The project is for 50,000 acre-feet per year and is planned for 2080.

NTMWD has applied for Oklahoma water rights to use water from the Kiamichi River, Muddy Boggy Creek, and stored water in Lake Hugo. At this time, the state cannot act upon these permits without further direction from the Oklahoma Legislature.

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The challenges with this strategy are the development issues, including the legal moratorium on out-of-state water sales and the Lacey Act. Under the Lacey Act, it is unlawful to transport invasive species across state lines. Since there is considerable uncertainty as to when these obstacles could be overcome, this strategy cannot be counted on for near-term water supplies. Thus, it is not a feasible alternative to the Sabine Creek WWTP reuse.

Lake O' the Pines

Lake O' the Pines is an existing USACE reservoir in the Cypress River Basin with Texas water rights held by the Northeast Texas Municipal Water District (NETMWD). NTMWD has explored the possibility of purchasing supplies in excess of local needs from the Cypress River Basin and it is a recommended strategy in the *2026 Initially Prepared Region C Water Plan*. Lake O' the Pines is about 120 miles from the Metroplex, and the distance and limited supply make this a relatively expensive water management strategy. The development of this source would require contracts with NETMWD and other Cypress River Basin suppliers with excess supplies. The *2026 Initially Prepared Region C Water Plan* shows supplies from Lake O' the Pines coming online in 2040.

At this time, agreements have not been reached to purchase this water. Due to this uncertainty and expected time to develop, Lake O' the Pines is not a feasible alternative to the Sabine Creek WWTP reuse.

Wright Patman Lake

The Wright Patman Reallocation strategy involves development of new surface water supplies from the Sulphur River Basin through a reallocation of storage at Wright Patman Lake from its current purpose, flood control, to water conservation storage. The supply quantity and cost identified above are for a specific reallocation of Wright Patman at elevation 235 feet MSL. At that conservation pool elevation, the pool raise at Wright Patman Lake would inundate up to 15,100 acres above the permitted conservation pool elevation (ultimate rule curve). Infrastructure would be developed to transport the water to the Region C water providers. The Wright Patman Reallocation strategy is considered for NTMWD, UTRWD, TRWD, DWU, and the City of Irving, and recommended for NTMWD and TRWD.

The firm yield with reallocation of Wright Patman to elevation 235 feet MSL, above the 180,000 acre-feet per year permitted to Texarkana, would be 125,000 acre-feet per year. It is assumed that all the reallocation supplies would be available to Region C providers. These quantities assume that Marvin Nichols is senior to the Wright Patman Lake reallocation. However, the City of Texarkana has applied for a new water right from Wright Patman. If this right is granted, the amount of supply available to Region C providers would be less.

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Reallocation to elevation 235 feet MSL was selected to minimize impacts to the White Oak Creek Wildlife Management Area (WOCWMA). This site is located upstream of Wright Patman Lake and is designated as mitigation for the construction of Jim Chapman Reservoir. At elevation 235 feet MSL, the increase in the conservation pool at Wright Patman Lake would increase water levels on approximately 450 acres of the WOCWMA and affect some riparian bottomland hardwoods. However, reallocation at this elevation would not affect the functioning of constructed wetland structures and would still allow the wetland structures to function as designed. Also, the USACE owns property up to the 235 feet MSL elevation, which simplifies additional land acquisition.

Reallocation of Wright Patman Lake would be sponsored by USACE, would require additional environmental studies, and would require congressional approval. Further study would be needed to ensure that there is no increase in flooding risks after reallocation.

Due to the uncertainty of authorizing reallocation of flood storage, reaching agreements with strategy partners, and higher costs, this strategy is not a feasible alternative to the Sabine Creek WWTP reuse.

New Groundwater Supplies

There are limited new groundwater sources that could supply the quantity of water needed by NTMWD. The Ogallala aquifer in the Texas Panhandle has large quantities of water, but much of this supply is committed to users in the area, including agricultural users and local municipalities. Another potential source is the Carrizo-Wilcox aquifer. This aquifer is also heavily used by local entities.

Carrizo-Wilcox Groundwater

The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. Organizations and individuals have been studying the development of water supplies in Anderson County and surrounding counties for export. Anderson County is about 100 miles from NTMWD's service area and this strategy is an alternative strategy in the *2026 Initially Prepared Region C Water Plan*. There are some uncertainties about developing such a large quantity of groundwater and exporting this water to North Texas. Based on Modeled Available Groundwater (MAG) values adopted through the Groundwater Joint Planning Process for the 2026 Initially Prepared Regional Water Plans for the Carrizo-Wilcox in Anderson County are approximately 27,000 acre-feet per year. Some of this groundwater is currently used by local producers. Due to the uncertainty of available supply and competition for this water source, the Carrizo-Wilcox groundwater alternative is not a feasible alternative to the Sabine Creek WWTP reuse.

Aquifer Storage and Recovery

Aquifer Storage and Recovery (ASR) is a water management approach that stores surplus water in local aquifers during periods of excess water availability and withdraws the stored water later during periods of drought or peak demands. This strategy can provide additional supply during drought. It

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requires a suitable aquifer formation and excess supplies that have been treated to a level that will not degrade existing water quality in the aquifer. ASR is an alternative strategy for NTMWD in the *2026 Initially Prepared Region C Water Plan*. The ASR strategy considered for NTMWD assumes a suitable formation can be identified near an existing water treatment facility, and the operations could provide up to 26,000 acre-feet per year during drought.

Further study is needed to determine if there are suitable geologic formations that are economically feasible for ASR, and the operation of the system may pose challenges for infrastructure that may not be used regularly. ASR is not a feasible alternative to the Sabine Creek WWTP reuse due to the technical uncertainties with implementation and time to implement.

Conclusion

Based upon the aforementioned information and analysis, there are no feasible alternatives to the Sabine Creek WWTP reuse in the *2026 Initially Prepared Region C Water Plan* at this time. Furthermore, this project type is consistent with NTMWD's conservation goals to fully develop its available reuse to meet its future water needs.

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