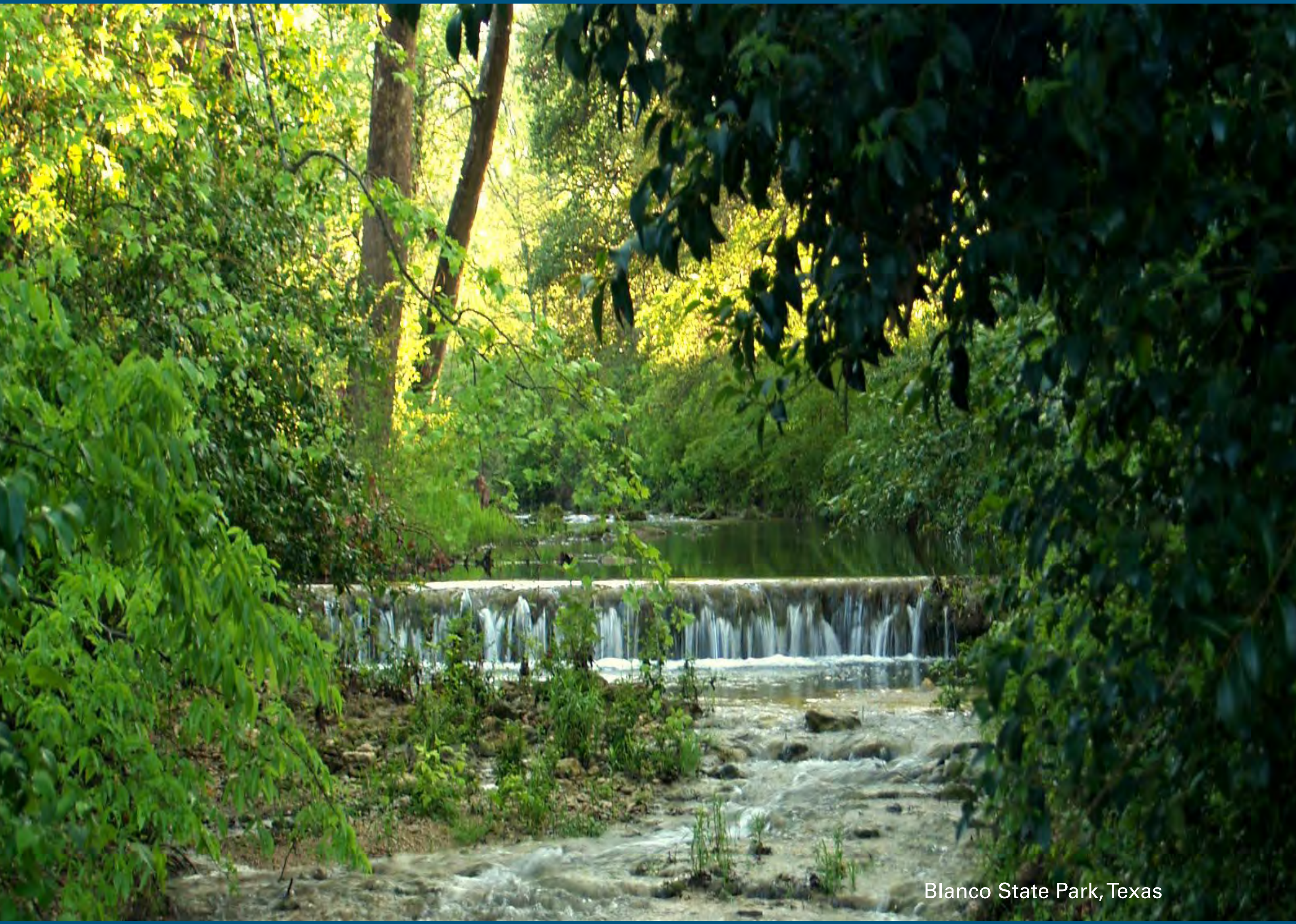
Blanco TPDES Refinement Study

Report: 2021-05
June 2021



THE MEADOWS CENTER
FOR WATER AND THE ENVIRONMENT
TEXAS STATE UNIVERSITY

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The Meadows Center for Water and the Environment

Blanco TPDES Refinement Study

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TEXAS STATE UNIVERSITY

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Water Planning, Science & Engineering

Table of Contents

Background, Summary and Recommendations

Background

The City of Blanco (City) has alternated between discharging and irrigation with its treated effluent many times over the past few years. Its current TPDES permit allows it to discharge and irrigate, with the balance between the two up to the City's discretion. However, in 2019 the City utilized its permit to discharge treated wastewater into the Blanco River for several months while it refurbished the holding ponds adjacent to the wastewater treatment plant (WWTP). Within a short period of time the river turned green with algae below the discharge point, due to the high nutrient load the treated effluent carried with it. There was significant public interest in this event and public opposition to the draft permit, which TCEQ issued in 2019. In September 2020, the Blanco Water Reclamation Task Force (Task Force) was set up and charged with finding cost effective solutions to avoid having to discharge to the river at all in the future, thereby helping preserve the unique nature of the river.

The Blanco River is a pristine Hill Country stream, offering a variety of recreational opportunities and supporting a vast and diverse ecosystem, as well as water supply needs throughout the basin. The value of this resource was recognized with the broad, bipartisan support and passage of House Bill 4146 in the 2021 legislative session, which seeks to eliminate discharge of wastewater effluent into Texas' 22 most pristine waterways, including the Blanco.

The population of the City of Blanco currently stands at about 2,710 people and is projected to grow to about 3,520 people by the year 2040, an increase of about 30 percent. Current water use is about 120 million gallons per year (MGY) and is expected to grow with the population increase, up to about 170 MGY by the year 2040. Wastewater production is about 50 percent of water supplied and would therefore be around 85 MGY (0.23 MGD) by the year 2040, up from 51 MGY (0.14 MGD) being treated by the wastewater treatment plant currently. City administrators and their engineers usually plan more conservatively in order to make sure that their facilities have the capacity to handle unexpected growth, such as the formation of a new Municipal Utility District in Blanco, and so planning for 124 MGY (0.340 MGD) of wastewater treatment need by 2040, as suggested in the City's TPDES permit renewal application, is probably a good, conservative, planning number. The first of the two figures at the end of Executive Summary shows the City of Blanco and surrounding area, including the location of the WWTP.

The City discharges its treated effluent to a set of five interconnected ponds (total capacity just under 29 acre-feet) and pumps from them to irrigate some 26 acres of hay fields on City-owned land adjacent to the WWTP under their existing permit, that allows land application. During normal weather conditions, the amount of water used for irrigation keeps the pond levels low enough such that no treated effluent needs to be discharged to the river. However, during prolonged wet periods and the current configuration, the City would be required to discharge to prevent the ponds from overtopping. The City is allowed to discharge under their existing TPDES permit, which they have applied to amend.

The Texas Commission on Environmental Quality (TCEQ) allows a variety of options for disposal of wastewater. Discharge to a water body (i.e. lake, river, or stream) is very common, but many smaller towns and cities in the drier parts of the state are able to use exclusively lagoons (where the treated wastewater is evaporated) and/or land application. Discharge to surface water bodies is generally accomplished through Texas Pollution Discharge Elimination System (TPDES) permitting and approval. Water quality requirements for discharge to a surface waterbody depend on several factors that include flow, receiving body water quality, outfall location, etc. Other disposal options that have been allowed include land application (TLAP), deep well injection, and Type 1 water reuse (described in Title 30 Texas Administrative Code, Chapter 210). Land application is usually applied as spray or drip irrigation. Deep well injection can also be used, but the quality of the underground aquifers being discharged into will dictate discharge water quality requirements. Water reuse is a more recent method of wastewater disposal and is a greener option to replace other sources of water for needs such as irrigation, amenity ponds and industrial uses. Water quality requirements for reuse vary based on the end use. Where public contact is likely, the wastewater must meet the higher Type 1 standards. The Blanco WWTP currently produces Type 1 effluent, but those standards are not met once the effluent is discharged into the holding ponds adjacent to the plant because of the additional suspended sediment.

The City of Blanco's WWTP TPDES permit WQ0010549-002, issued in April 2015, was set to expire in 2018, and, pending approval of a new permit, TCEQ has currently authorized continued operation under the expired permit. The City's permit included, beginning in April 2018, more stringent water quality effluent limits that would be placed on discharges entering the Blanco River. While the existing wastewater treatment plant had the ability to continue meeting permit requirements using the land application approach, the old WWTP's treatment technology was no longer suitable to meet the more stringent requirements to discharge into the river, even during rare instances when that would occur. An initial application for permit amendment was submitted by the City in 2018. The application sought to increase the permitted outflow from 0.225 MGD to 1.6MGD, and to reconfigure the WWTP to meet the more stringent effluent requirements. The reconfigurations involved decommissioning the old facility and constructing new facilities, which were completed in 2019. However, when the ponds were being refurbished wastewater was discharged into the river for several months, resulting in significant algal growth below the outfall.

In January 2019, the City of Blanco executed an agreement with the Meadows Center for Water and the Environment to work with the research institution on water conservation and One Water strategies (see Memorandum of Understanding and associated extension through 12/31/21 in the Addendum). After public meetings and comments on the draft permit continued through 2019, including scheduling of a contested case hearing, an interim order was issued in January 2020 to cancel the hearing and to remand the amendment application back to the TCEQ. In October 2020 the City submitted a revised TPDES permit application to TCEQ. The revised application seeks to increase the permitted discharge from 0.225 MGD to 0.45 MGD, to reconfigure the WWTP and alter the route between the plant and the river, and to reconfigure stabilization ponds to augment ongoing reuse of reclaimed water. The stated purpose of the discharge permit is to only discharge treated effluent into the Blanco River during "last resort" conditions, during periods when plant operations or capacity for reuse dictates the need to discharge.

Summary

A simple water balance model was developed based on numbers provided by the City that showed that the most cost-effective short-term strategy to reduce the likelihood of having to discharge reclaimed water to the river is to increase the storage capacity of the ponds AND increase the area of irrigated land. The trade-off between area of irrigation and storage in order to avoid future discharge to the river is shown in later sections of this report. The spreadsheet uses daily weather data to show how discharge could be completely avoided in 40 years of historical weather under existing effluent production rates.

Executing agreements with adjacent landowners for use of the reclaimed water would result in relatively little cost, especially if the landowners would cover some or all of the cost of extending the distribution lines to their property. It is expected that at least 100 acres of additional land could be made available in the near future. The City has already executed an agreement with an adjacent landowner to irrigate 48 acres of land and is negotiating agreements with other landowners.

Doubling the capacity of the storage ponds (an additional 9.2 MG, or 28 ac-ft) would cost approximately $500,000. It is likely that the City will be able maintain Type 1 standards in its new pond, which is required in order to secure a permit to reuse the water under Chapter 210 of the Texas Water Code, but that has not yet been confirmed. Doubling the capacity of the holding ponds and increasing the area of land available for irrigation would ensure that the City does not have to discharge to the Blanco River under current effluent production rates, but both storage and irrigation area would need to be expanded to handle expected growth in effluent production in the future.

The City owns land adjacent to the wastewater treatment plant that would likely be suitable for construction of a new pond. Combined, the increased irrigated land and additional storage described above would reduce the probability of having to discharge to less than once every 40 years (equivalent to a less than 2.5 percent chance on an annual basis). This configuration would require the City to expand the acreage for TLAP in its permit, with TCEQ approval, and discontinue the discharge provision. The second figure in the Executive Summary shows the WWTP facility site and adjacent lands, including location of potential new storage pond. It should be noted that the City has identified a piece of land south of their current irrigation fields that should also be investigated for feasibility.

Even though the expansion of the ponds and area under irrigation would allow the City to handle all of its wastewater through a TLAP permit, the City is committed to continuing to find ways to reduce the nutrient load, thereby expanding the possibilities for reuse, and sale, of that reclaimed water. The new WWTP already has the ability to pump a coagulant into the secondary clarifier and this past week has initiated a study to try to optimize the dosing of alum (aluminum sulphate), to reduce the Total Phosphorus down from the current levels of approximately 1 mg/l. An October 2020 report by Dr. Ryan King after the 2019 algal bloom in the Blanco River indicated that major algal blooms can occur in the river when Total Phosphorus levels are as low as 15 µg/l (0.015 mg/l).

Biological Nutrient Removal (BNR) is another method commonly used to reduce nutrients in wastewater treatment plant facilities. A new system integrated into an aeration unit would cost somewhere between $150,000 and $200,000. Annual operating costs of the BNR facility would be low, mainly electricity. An advantage of the BNR system is that it reduces the need for the coagulant and therefore some savings are returned to the operator of the facility when both systems are in place. Very high-level calculations indicate that both systems (optimized use of coagulant and BNR facility) could lower Total Phosphorus down to 0.1 mg/l (and possibly much lower) at an operating cost of approximately $10,000 per year.

Running a water line from the WWTP up to highway 281, in order to sell Chapter 210, Type 1 reclaimed water to future industrial customers would be fairly expensive if storage tanks were built at each end. The pipeline itself would cost around $1 million, with pump station and chlorine injection facilities expected to cost a similar amount. The total costs of the facilities would be around $5 million, with considerable annual O&M costs as well. The idea might be feasible, from a cost perspective, if there were enough customers for the water and if the cost of building the pipeline could be shared with others. Costs would be further reduced if the proposed new storage pond could be used, rather than a tank. This remains a long-term goal of the City and could be funded and constructed in phases.

Recommendations:

1. The City has the ability to avoid discharge to the Blanco River under current effluent production rates by increasing the capacity of its storage ponds and irrigation of nearby hay fields. As such, the City is encouraged to **abandon its request to be able to discharge to the Blanco River** and instead focus on TLAP on its land and Chapter 210 reuse to convey excess reclaimed water to neighboring properties. Exact quantities needed for TLAP and/or Chapter 210 Type 1 reuse should be discussed with TCEQ in the second phase of this work, as a top priority.
2. The City should move forward with plans to **double the size of onsite storage ponds** as soon as possible. Furthermore, the City should consider options to preserve the Type I water quality standards of the pond water by using a geotextile lining, to reduce Total Suspended Solids (TSS), and possibly the use of a chemical to maintain low Biological Oxygen Demand and TSS in the effluent. The total cost of the new pond will be around $500,000, based on information from similar-sized projects.
3. The Task Force members should coordinate with the City to **approach all potential customers of the reclaimed water**. As soon as possible, the City should execute agreements with nearby land owners interested in using reclaimed water for irrigation, and build infrastructure to convey the water to the point of use. It is possible that the landowners will pay for, or at least share the cost, of the purple pipe needed to convey the reclaimed water to their properties. Since the City would not own the land that is being irrigated, it needs to ensure that the agreements are (1) highly reliable and account for contingencies should leases fall through or not be renewed; and (2) contain provisions to ensure that irrigation practices are environmentally sound and subject to strict oversight; (3) require irrigation during winter months to minimize the need for additional storage; and (4) make sure they meet all TCEQ requirements.
4. The City should **consider the possibility of consolidating the debt on existing loans and refinancing** at a lower rate to save the City money. At the same time, this re-structuring of debt could allow the City to finance the construction of the infrastructure described in this report. Rebecca Trevino, CFO of the Texas Water Development Board has offered to sit down with the City financial advisors to discuss scenarios and possibilities.
5. The City should continue its recent initiative to **optimize the use of alum** at the wastewater treatment plant to reduce the total phosphorous in the effluent. Furthermore, the City is encouraged to integrate **Biological Nutrient Removal (BNR**) into the wastewater treatment process, which would dramatically reduce the nutrient load (and need for alum). Capital costs of inserting BNR into the aeration unit of the treatment plant are estimated to be below $200,000, with operating costs expected to be around $10,000 when factoring in the reduced need for alum. Lowering the nutrient load and further improving the quality of the effluent is relatively inexpensive and opens up more options for beneficial use of the reclaimed water in the future.
6. As the population of Blanco grows, so will the need to increase the capacity of the ponds further. The City should continue to **seek other uses for the reclaimed water**. Longer term

strategies, to be explored in the next phase of this work, include the possibility of conveyance of reclaimed water to the Rocking J development and associated golf course in exchange for potable groundwater (of which it has plenty). Another intriguing option is the implementation of a decentralized approach for the management of future wastewater, which would reduce the need to expand the ponds and irrigation fields near the wastewater treatment plant, while also presenting the possibility of reducing costs. The City should also consider pursuing the idea of conveying this reclaimed water north to highway 281, where there is likely a need for the water from industrial customers.

7. The **Task Force and the City should continue to form consensus** on overall goals and near- and long-term actions to develop One Water Pathways for regional water management. Messaging to the community should be coordinated through Task Force recommendations, press releases and utility bill inserts to inform the community, get feedback, and seek agreement.

The information summarized in this memo was obtained from email and in-person communication with City of Blanco staff and the Blanco Water Reclamation Task Force, as well as publicly available documents such as the City's permit renewal application and documents produced by the Freeland Turk Engineering Group, the City of Blanco, and the Region K Regional Water Planning Group.

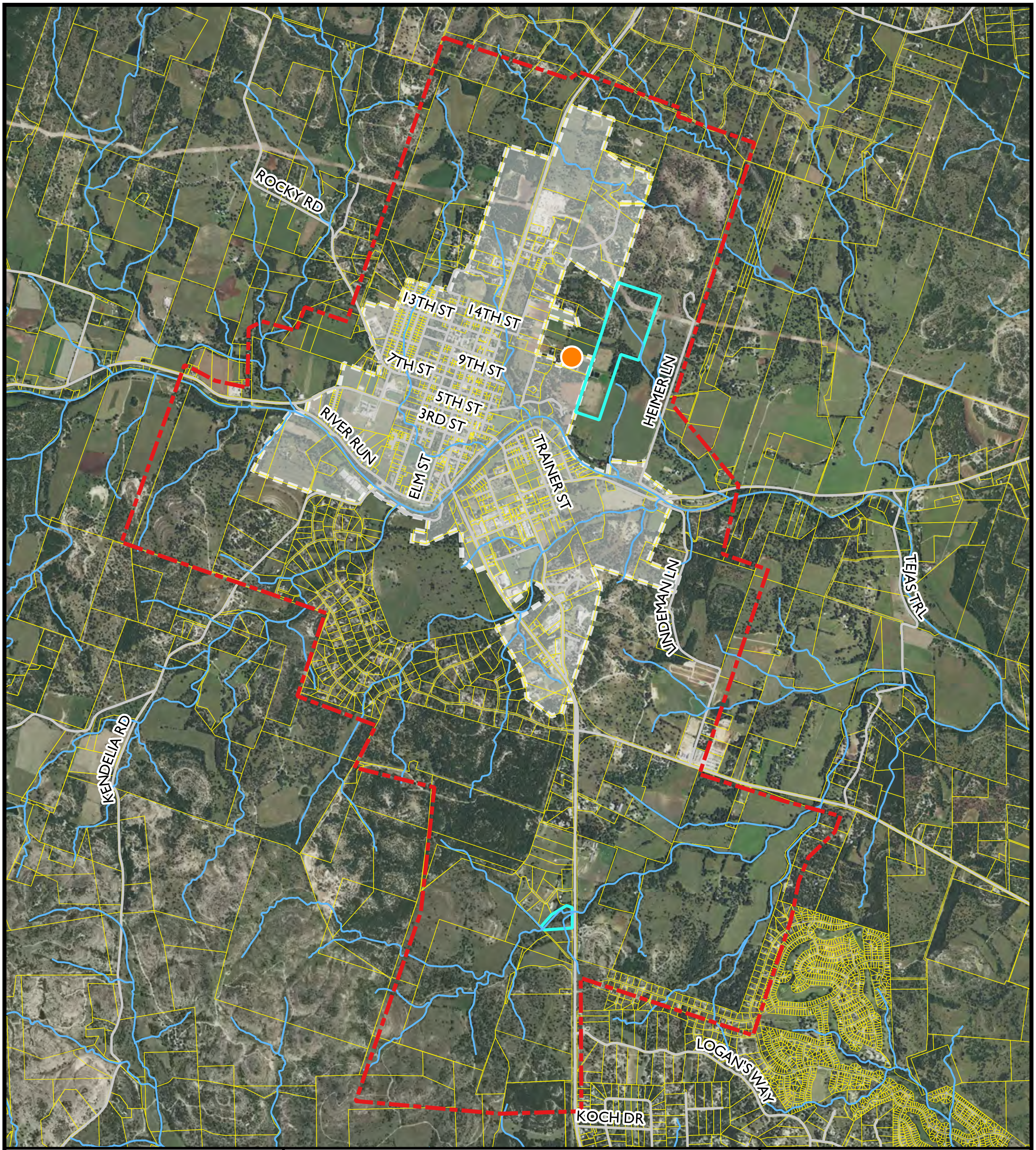

FIGURE 1
City of Blanco
Area Map

06/14/2021

For Planning Purposes Only
Not for Construction

Legend

- Wastewater Treatment Plant
- Roads
- Streamlines
- Approximate Wastewater Service Area
- Land Parcels
- City-owned Land
- City Limits (white dash)

Projection: Texas State Plane Central
Imagery: NAIP 2020

N 0 0.2 0.4 0.6 0.8 1 mi

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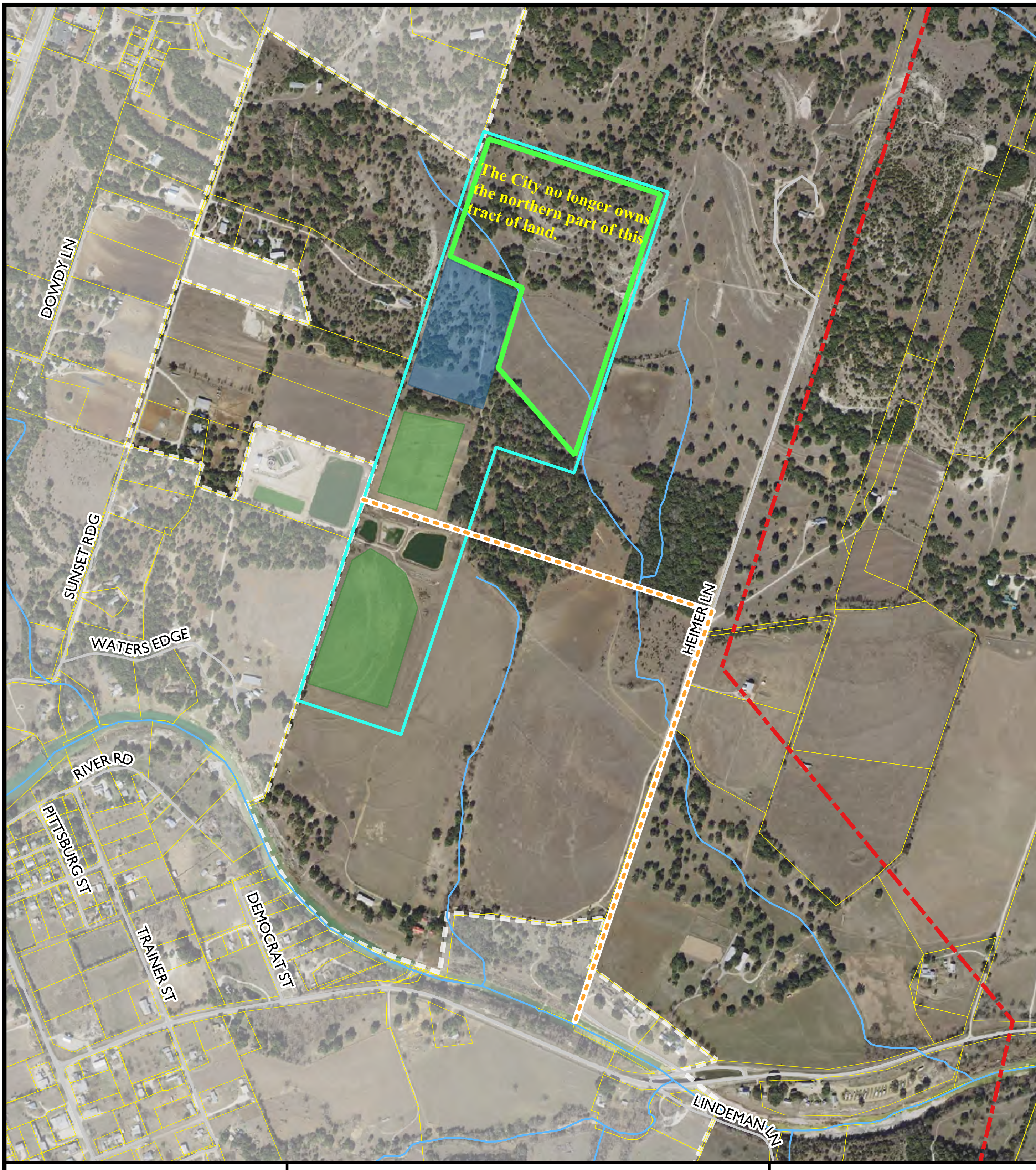

FIGURE 2
City of Blanco
Wastewater Treatment Plant & Adjacent Area

06/14/2021

For Planning Purposes Only
Not for Construction

Legend

- Proposed Wastewater Discharge Route
- Irrigated Areas (current)
- Potential Irrigation Area
- Potential Additional Effluent Pond
- Approximate Wastewater Service Area
- Land Parcels
- City-owned Land

Projection: Texas State Plane Central
Imagery: Stratmap20 (12-in)

N 0 0.1 0.2 mi

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1. Population, Water Supply and Wastewater Treatment Needs

The City of Blanco serves approximately 1,023 connections, but has raw water supplies capable of serving at least 3,000 connections. The City currently receives treated water from Canyon Lake through an MOU with the Canyon Lake Water Service Company (CLWSC), in the amount of up to 0.5 MGD (560 ac-ft/year).[1] The City is currently upgrading its existing water treatment plant, located on the Blanco River, for which it has a water right for 600 ac-ft/year[2]. In the meantime, sufficient treated water is provided to the City by CLWSC.

The City does not currently have or use any groundwater supplies. The major groundwater aquifer in the vicinity of the City of Blanco is the Lower Cretaceous Trinity Aquifer, specifically the units of the Middle Trinity. Though referred to by different names in various parts of Hill Country, in the Blanco are three units that make up the Middle Trinity Aquifer: Lower Glen Rose, Hensel and Cow Creek. These units are carbonates consisting primarily of flat lying limestones and dolomites and are roughly 400 feet in total thickness. Most of the permeability of the carbonates is via karst features, fractures and occasional faulting. Given the nature of the permeability, production from water wells is quite variable. Overlying the Middle Trinity Aquifer is the Upper Trinity Aquifer with the Lower Trinity Aquifer underlying the Middle Trinity Aquifer. Due to low yields and/or poor water quality, neither of these aquifers are widely used for municipal or domestic well production.

During the period 1996 -1999, the City drilled seven wells to access groundwater resources for potential municipal supply (TWDB, 2021 and confirmed by the City). The wells were completed in the Middle Trinity Aquifer. Estimated well yields ranged from 10 to 74 gpm (TWDB, 2021). None of the wells were completed as water supply wells. The wells were either plugged/destroyed, remain unused or are currently being monitored for water levels by the Blanco Pedernales Groundwater Conservation District.

To further illustrate the variability of wells yields in the area, an aquifer test at Brushy Top, just north of the City of Blanco, was performed in the Middle Trinity. Pumping the well at 12gpm for 24 hours resulted in a decline in water level (drawdown) of 79 feet (Hunt, 2010). Another aquifer test was performed at the Rocking J development (just south of the City of Blanco) yielding 155 gpm with 1.9 feet of drawdown in a 36-hour test. The driller's estimate of yield at the well was 500+ gpm (TWDB, 2021). The high yields and low drawdown at the Rocking J well may be related to faulting in the aquifer in the vicinity (Wierman, et al, 2010). The well is currently used for golf course irrigation and municipal use. An idea that has been explored by the City and the developer is a strategy whereby treated wastewater would be provided to the golf club for use on the fairways, in exchange for groundwater. It is likely that the cost of this strategy will be prohibitively high, especially considering both lines would have to go under the Blanco River and water conveyed some 5+ miles, but it will be investigated further in the later stages of this project.

1.1 Existing Water Demand

The water demand at present for the City is approximately 113.9 million gallons per year (MGY) or 349.8 ac-ft/year (average from 2016-2020). Over the last five years, demand has increased by an average of 1.2 MGY (11.5 ac-ft/year) or 2.9 percent per year, as shown in Table 1.1.

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[1] This water is treated and conveyed by Canyon Lake Water Supply Company, but the City of Blanco has a separate water right for the diversion of this water.

[2] The reliability of this water right has not been verified, but the two impoundments on the Blanco River have recently been dredged, maximizing capacity.

Table 1.1: Reported Water Use from 2016 – 2020 for the City of Blanco.

Year	Demand (MGY)	Increase from Previous Year (%)
2020	120*	0.0%
2019	120.0**	5.4%
2018	113.8**	3.0%
2017	110.5**	5.2%
2016	105.1***	1.0%
Average	**113.9**	**2.9%**

**Approximate demand*
*** Reported by the City of Blanco*
**** Reported in the City of Blanco Water Conservation Plan*

1.2 Projected Population and Water Demands

Population projections indicate similar growth to the previous five years is likely for the City in the future, as shown in Figure 1.1. While the City Comprehensive Master Plan timeline does not extend beyond the year 2020, Texas Water Development Board Planning Group Region K (Region K), in which the City of Blanco is located, projects a population growth for the City of approximately 30 percent from 2020 through 2040, based on its 2021 plan.[3] This projected growth is downscaled from the Blanco County projection, using a simple proportion method. The City of Blanco Water Conservation and Drought Contingency Plan (WCDCP) employs the same percentage growth rate as the Region K plan but makes use of a higher base population in 2020, based on assumed per capita consumption by connection. The Region K and WCDCP population projections are used as the basis for the water demand scenarios presented in Tables 1.2 and Figure 1.2.

[3] The same population projections are used in the 2021 Region K plan. Data from the 2020 Census will be used to update population projections for the 2026 Region K plan.

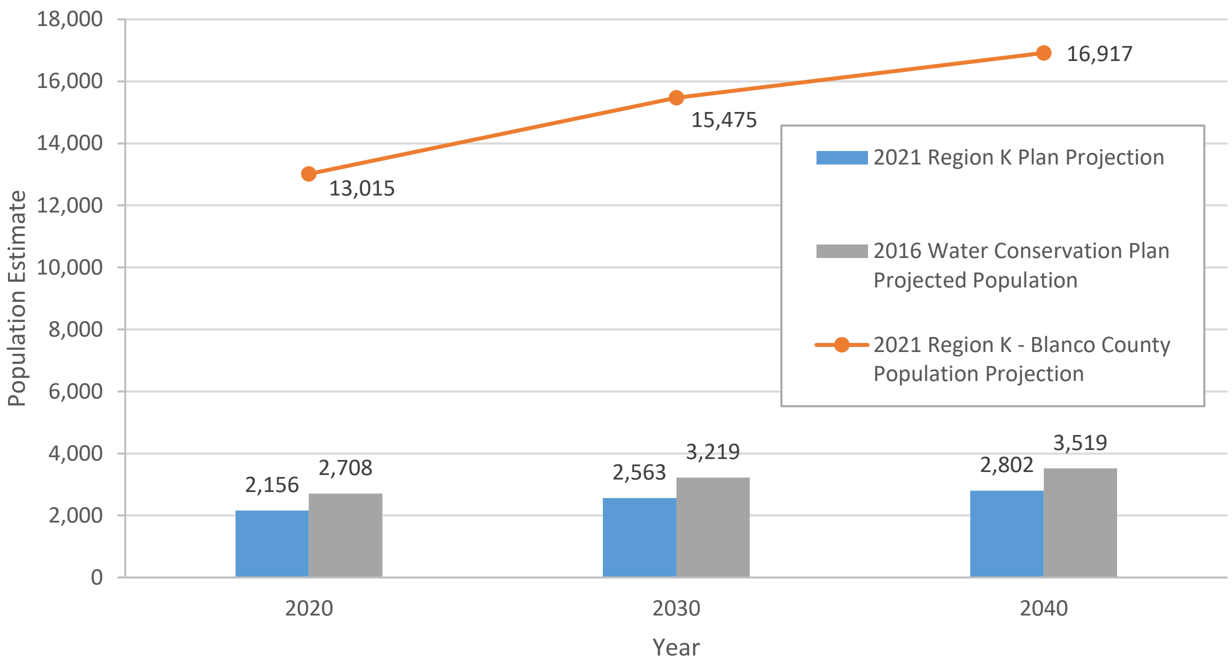


Figure 1.1: Population Projections for the City of Blanco and Blanco County, 2020 through 2040.

Based on these population projections, information obtained from the City, and demand reductions proposed in the 2017 WCDCP, seven water demand scenarios were compared, through 2040.[4] The 2017 WCDCP proposes water conservation and non-revenue water (NRW) reduction goals, including reducing per capita consumption to below 100 gallons per day and NRW to 14 gallons per day, in an overall effort to reduce water consumption by one percent per year (through 2026, the timeline of the plan). It also provides various strategies to be implemented to achieve these goals, including universal metering, record management, and public outreach efforts. It is important to note that the conservation goals outlined in the WCDCP are significantly more stringent than the reductions incorporated in the Region K plan.

1. **Region K 2016.** Using a base population of 2,156 in 2020, this projection assumes some demand reduction due to conservation efforts.
2. **Region K 2021.** Using a base population of 2,156 in 2020, this projection assumes some demand reduction due to conservation efforts. The baseline demand and therefore all projected future values in the 2021 regional plan were revised downwards from the 2016 regional water plan (by approximately 14 percent), reflecting a change in the assumed baseline volume of water used per capita per day.[5]
3. **2021 City of Blanco (5 million gallons per year increase).** This scenario is based on information provided by the City. Uses the reported demand in 2020 as the base demand.

[4] These scenarios do not incorporate refined data on water use by sector, (i.e. residential, commercial, industrial, etc.). The WCDCP notes only one industrial customer; all remaining water is classified as residential.

[5] https://static1.squarespace.com/static/601d9dd86690083c71aedc59/t/6035533f41f5ac22bedc8f00/1614107455425/2018_1_10_Region_K_Municipal_Projection_Revision_Memo.pdf

4. **Water Conservation Plan (No Demand Reduction).** This scenario is based on the WCDCP projected population, with a constant daily per capita demand of 130 gallons, as assumed in the WCDCP without conservation measures applied or reductions in unaccounted for water.
5. **Water Conservation Plan (With Demand Reduction).** This scenario is based on the WCDCP projected population, with a decreasing daily per capita demand, as proposed in the WCDCP, due to conservation measures and reductions in unaccounted for water.
6. **Region K Population Basis with Demand Reduction.** This scenario is based on the Region K population projections, with WCDCP conservation measures and reductions in unaccounted for water applied.
7. **5-Year Average Growth Scenario.** This scenario assumes a constant growth rate per year of 2.9%/year, based on the average growth rate reported by the City from 2016-2020.

The scenarios described above provide a wide range of water demands, ranging from below current demand levels in 2030 (2021 Region K Plan) to 220 MGY in 2040 (approximately 83% above current demand levels). Because the 2021 Region K Plan projections (both with and without demand reduction) have 2020 base values well below existing water use, these should be considered more unlikely than the remaining five scenarios. While the largest projections (5 MGY increase and the previous 2016-2020 average growth rate scenario) can be considered conservative, demands in this range may not be unreasonable due to potential growth within the HWY 281 corridor, especially if additional water supply is secured for the region. It should also be noted that a new Municipal Utility District (MUD No. 1) is planned for development near the City, and it remains to be determined how this MUD will obtain its water and treat its wastewater. The population and demand projections presented in this memo do not take this potential new source of growth into account, but should be taken under consideration in future planning efforts.

Table 1.2: Water Demand Projections through 2040

Water Demand Scenario	Base Population Scenario	2020	2025	2030	2040
TWDB-Region K 2016	Region K	119	128	138	149
TWDB-Region K 2021	Region K	103	111	119	128
2021 City of Blanco (5 MGY Increase)	2020 Reported Water Use	120	145	170	220
Water Conservation Plan (No Demand Reduction)	WCDCP	128	137	153	167
Water Conservation Plan (With Demand Reduction)	WCDCP	124	129	134	146
Region K Population Basis (With Demand Reduction)	Region K	99	103	107	117
5-Year Average Growth (2.9%/year)	2020 Reported Water Use	120	139	160	214

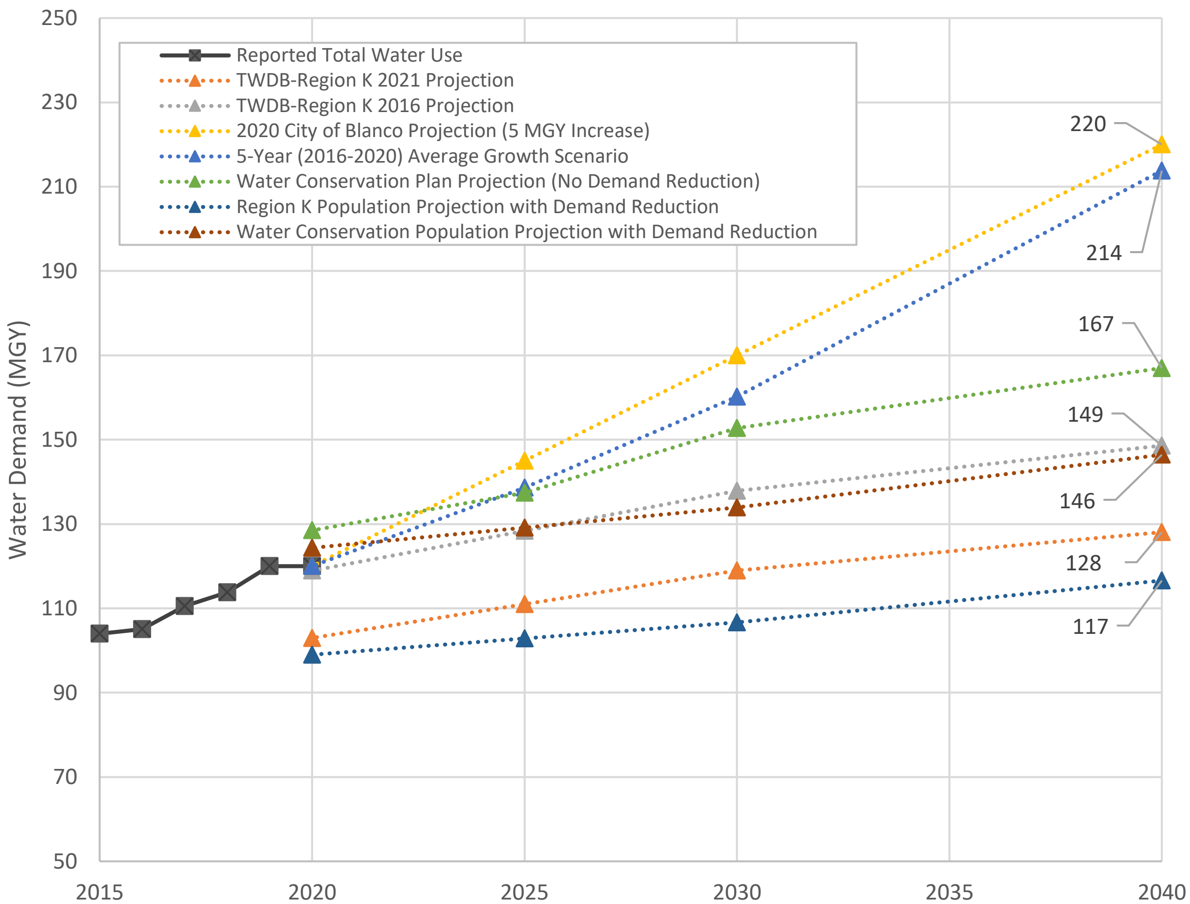


Figure 1.2: Existing and Projected Water Demands

1.3 Existing Wastewater Production and Treatment

The City of Blanco wastewater production and treatment averaged approximately 0.140 MGD over the past 12 months. Wastewater effluent is currently used to irrigate approximately 26 acres of hay adjacent to the WWTP under an existing TPDES permit[6], supplemented with direct discharges to the Blanco River when required due to maintenance or wet conditions. There is also a set of five adjacent ponds that allows the City to retain treated wastewater during wet conditions when the water is not needed (or desired) on the hay fields.

The City has preliminary plans underway to extend a treated wastewater line “purple pipe” from the WWTP north to Highway 281, serving customers for irrigation water along the way. A standpipe would be constructed at the purple pipe terminus, to serve industrial customers including TxDOT. Seeking easements for the pipeline and proceeding with design, permitting and construction of this pipeline, and executing agreements with nearby landowners is probably the best course of action to reduce the likelihood of having to discharge into the Blanco River. This strategy has already been initiated by the City. It should be noted that an agreement is already in place to provide treated wastewater to one of the adjacent landowners, who owns 48 acres of land, and another landowner has requested bids for pumps and pipes in order to accept treated wastewater too.

1.4 Projected Wastewater Treatment

Based on the production values reported in the City Water Conservation plan, wastewater produced ranges from 37.9% to 52.5% of the total water supplied by the City. Applying a fairly conservative 50% number to three scenarios from those described above in the section on water demand (assumed to be low, average, and high future demand estimates) produces a range of potential future wastewater volumes needing treatment, ranging from 60 MGY in 2020 (current condition) to possibly as much as 141.9 MGY in 2040. These scenarios are shown in both Table 1.3 and Figure 1.3, on the following page. For comparison purposes, the low and high wastewater production projections noted in the City’s recent permit renewal application are also shown, in the last two rows of the table.[7]

[6] TCEQ Permit Number 54623.

[7] TCEQ Domestic Wastewater Permit Renewal/Major Amendment Application. Prepared by Freeland Turk Engineering Group for the City of Blanco, Texas. October 2020.

Table 1.3: Wastewater Production (MGY).

Wastewater Production Scenario	Base Population Scenario	2020	2025	2030	2040
50% of 2021 City of Blanco (5 MGY Increase)	2020 Reported Water Use	60	73	85	110
50% of Water Conservation Plan (No Demand Reduction)	WCDCP	64	69	76	84
50% of Water Conservation Plan (With Demand Reduction)	WCDCP	62	65	67	73
City of Blanco Discharge Permit Application (LOW)	N/A	60.7	71.1	83.4	106.4
City of Blanco Discharge Permit Application (HIGH)	N/A	81	94.9	111.2	141.9

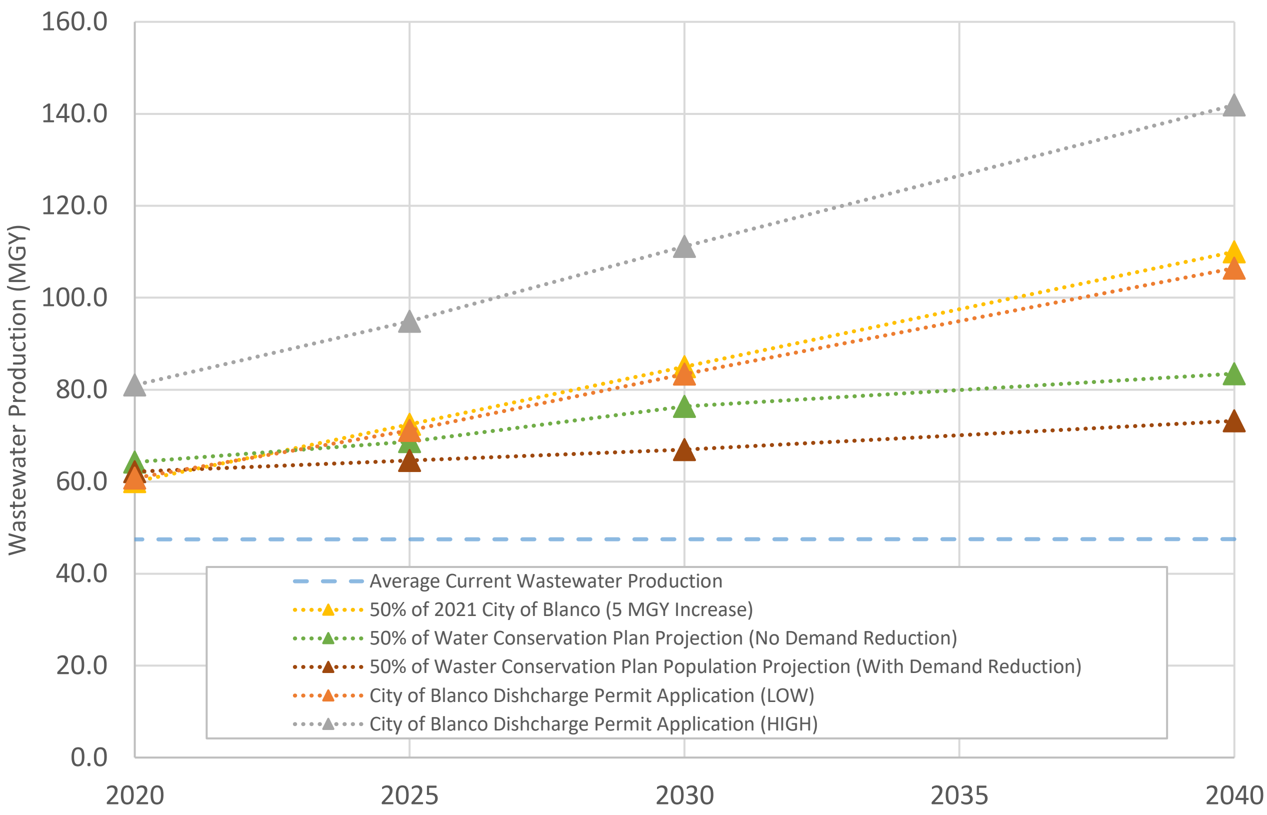


Figure 1.3: Low, Medium, and High Wastewater Production Scenarios

1.5 Water and Wastewater Management Strategies and Opportunities

The Region K plan notes several recommended water management strategies for the City, including water conservation, advanced metering, and direct wastewater reuse. On the latter, the plan notes 146 ac-ft/yr (47.6 MGY) of wastewater to be treated for irrigation use by the year 2030. Water conservation strategies could include water loss control, meter replacements, improved monitoring technology, etc.; many of these are already described in the existing WCDCP. Non-revenue water (NRW) has been estimated to be approximately 18 percent by the City.

There exists a significant opportunity for the City to use its treated effluent for beneficial use, initially through land application and Chapter 210 reuse for irrigation of hay fields, but later for industrial purposes and eventually for potable reuse, potentially, thereby reducing the need for water from nearby aquifers or surface water sources. The concept of One Water encourages examination of all aspects of water resources management, including treatment and disposal or reuse of treated wastewater. Longer term, specific ideas will be explored in more detail in the next phase of this study.

2. Water Quality in the Treated Effluent and TPDES Permit

The City of Blanco's WWTP TPDES permit WQ0010549-002, issued in April 2015, was set to expire in 2018, and, pending approval of a new permit, TCEQ has currently authorized continued operation under the expired permit. The City's permit included, beginning in April 2018, more stringent water quality effluent limits that would be placed on discharges entering the Blanco River receiving water via Outfall Number 001. While the existing WWTP has ability to continue meeting permit requirements using the land application approach via Outfall 002, the old WWTP's treatment technology was no longer suitable to meet the more stringent requirements for Outfall 001 to discharge into the river, even during rare instances when that would occur.

An initial application for permit amendment was submitted by the City in 2018. The application sought to increase the permitted outflow from 0.225 MGD to 1.6MGD, and to reconfigure the WWTP to meet the more stringent effluent requirements. The reconfigurations involved decommissioning the old facility and constructing new facilities. After public meetings and comments continuing through 2019, including scheduling of a contested case hearing, an interim order was issued in January 2020 to cancel the hearing and to remand the amendment application back to the TCEQ. In October 2020 the City submitted a revised TPDES permit application to TCEQ. The revised application seeks to increase the permitted discharge from 0.225 MGD to 0.45 MGD, to reconfigure the WWTP, to alter the route between Outfall 003 and the river, and to reconfigure stabilization ponds to augment ongoing reuse of reclaimed water. The stated purpose of the discharge permit is to only discharge treated effluent into the Blanco River during "last resort" conditions during periods when plant operations or capacity for reuse dictates the need to discharge.

Effluent limitations for the Blanco River outfall vary by time period for the existing permit (Table 2.1). For example the ammonia limit gets more stringent from 3mg/L to 2 mg/L. The 2019 draft permit from TCEQ maintained the more stringent concentration limits and additionally included a new total phosphorus (TP) concentration limit. The TP limit was added because algae growth in natural waters are often limited by the amount of available phosphorus, and because WWTP discharges have the potential to contribute a large load of phosphorus that could contribute to excess algae growth.

Table 2.1. TPDES Effluent Limits for the Blanco River Outfall, existing permit and proposed amendments

	Flow	CBOD5	TSS	Ammonia	TP
Existing - Outfall 001					
Existing until Apr 2018	0.225 MGD	30 mg/L	90 mg/L	3 mg/L	n/a
Existing after Apr 2018	0.225 MGD	7 mg/L	15 mg/L	2 mg/L	n/a
Proposed - Outfall 003					
2018 permit application					
2019 TCEQ draft permit (revised 2019-11-25, 2019-09-17, 2018-03-29, 2017-06-21)					
Interim I	0.225 MGD	10 mg/L	15 mg/L	2 mg/L	0.5 mg/L
Interim I	0.225 MGD	10 mg/L	15 mg/L	2 mg/L	0.25 mg/L
Interim III	0.95 MGD	7 mg/L	15 mg/L	2 mg/L	0.25 mg/L
Final	1.6 MGD	5 mg/L	5 mg/L	1.9 mg/L	0.15 mg/L
2018 application withdrawn and draft permit remanded.					
Proposed - Outfall 003					
2020 revised permit application (concentrations proposed in application)					
Interim I	0.225 MGD	10 mg/l	15 mg/L	2 mg/L	n/a
Final	0.45 MGD	10 mg/l	15 mg/L	2 mg/L	n/a
TCEQ permit limits not yet set.					

During maintenance of the storage ponds, treated wastewater effluent was discharged via Outfall 001 into the Blanco River for a few months in the period from November 2018 through November 2019. No apparent exceedance of the permit effluent limits for nitrogen, cBOD5, or TSS concentration in the effluent are apparent in available EPA Echo[1] data. For the last nine months of the discharge, the effluent concentrations would appear to comply with the more stringent limits (CBOD: 5 mg/l, TSS: 15 mg/l and Ammonia: 2 mg/l), though the first four months reflect higher concentrations with improving trend, and only two samples for TSS that would have exceeded the more stringent permit limits (Figure 2.1). Dissolved Oxygen concentration (Figure 2.2) in the effluent were lower than the proposed 6.0 mg/L; the permit amendment application indicates installation of an improved aeration unit. Phosphorus is not reported because no TP limit is part of the permit.

[1] EPA ECHO - https://echo.epa.gov/effluent-charts#TX0054623

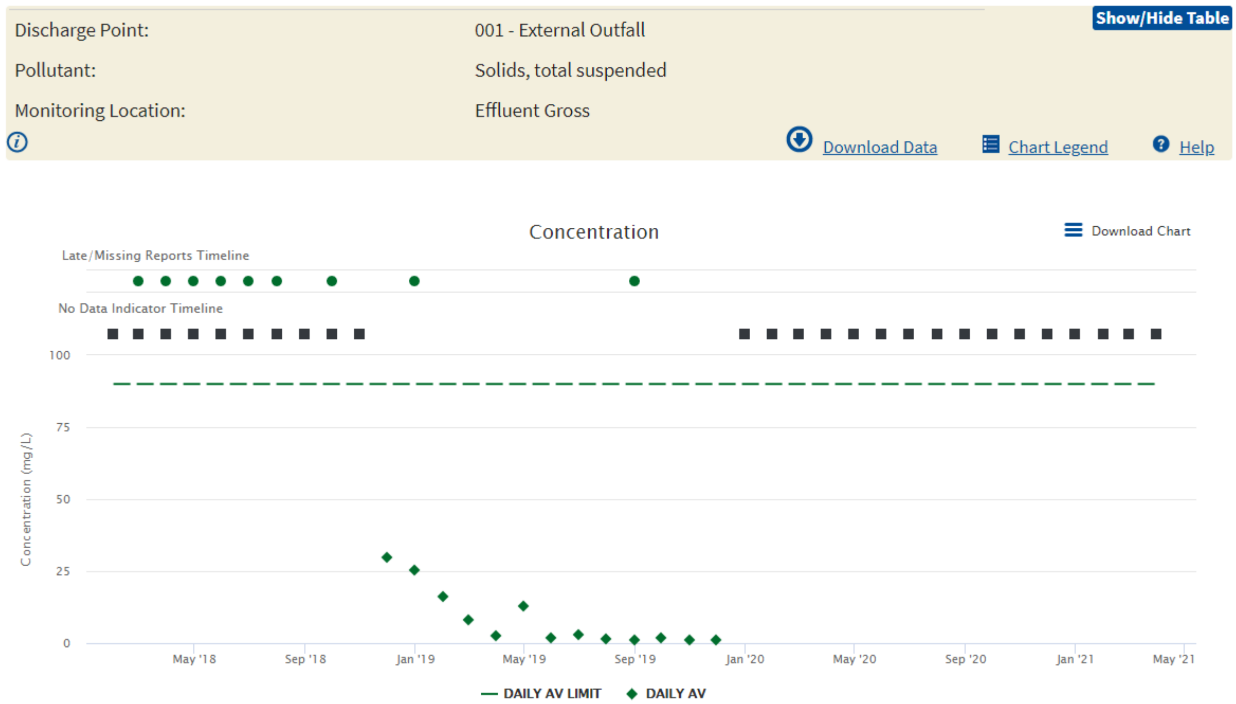


Figure 2.1. EPA Echo discharge data, TSS concentration

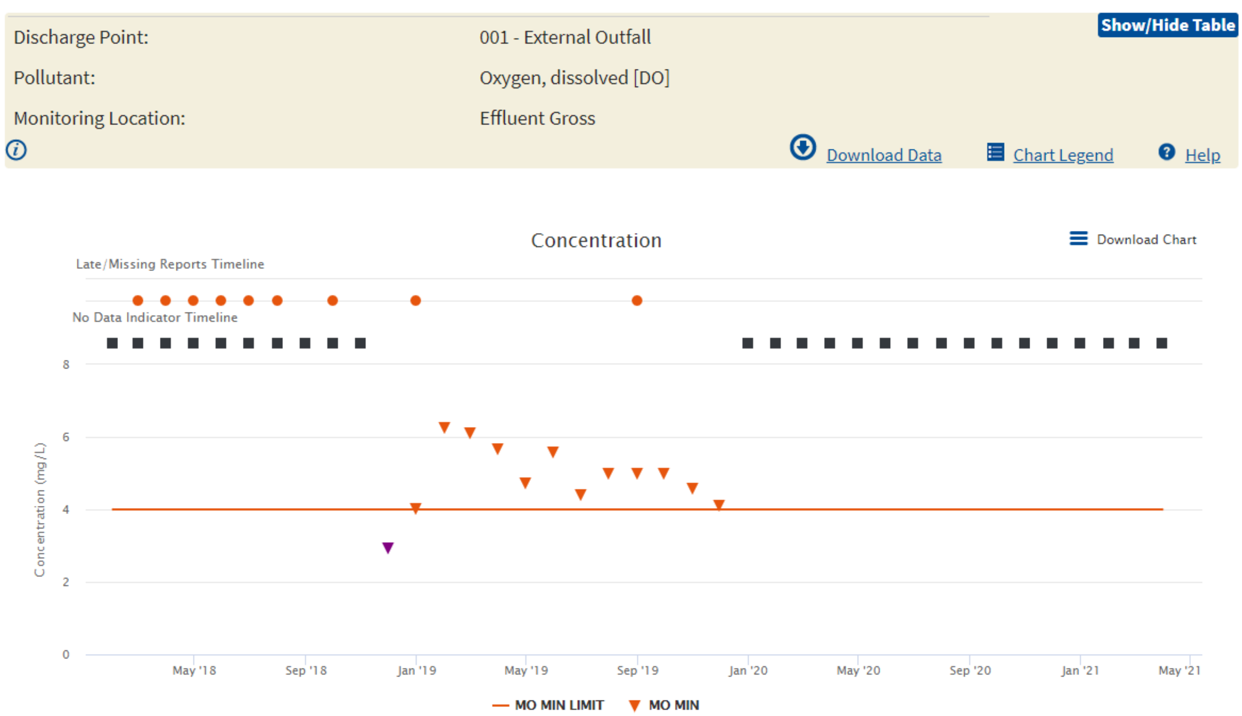


Figure 2.2. EPA Echo discharge data, DO concentration

Despite no significant permit concentration exceedances, river conditions exhibited significant algal mat growth downstream of the discharge location beginning at the time discharge began. A field study performed by Baylor University scientists April through September 2019 comparing segments upstream and downstream of the discharge location[2], indicated notable increase in benthic algae biomass, and concentration of nitrogen, phosphorus, chlorophyll-a and TSS. One notable trend is that, while at times the upstream site exhibited nitrogen concentrations comparable to the downstream site, the phosphorus concentration at the site downstream of the discharge was at all times significantly higher than at the upstream site. The concentration of total phosphorus is sufficient, when combined with the nitrogen concentration contributed by the treatment plant, and when combined with other natural sources, to promote an increase in aquatic vegetation and algal mats that can impact the existing recreation use.

While the phosphorus concentration in the 2019 discharge was unknown, a TP concentration of 4 mg/L is consistent with secondary treated effluent, and a TP concentration of 8 mg/L or higher is possible with less treatment. TP concentration of 4mg/L during the 2019 discharge at 0.13mgd contains similar phosphorus load as a proposed discharge of 0.45mgd and with TP effluent limit of 1mg/L. With a TP limit of 1 mg/L, no greater load of TP would be imparted to the Blanco River, and therefore an argument could be made that a worse algae bloom would not be expected compared to 2019. However, experiencing the same bloom again is not desirable and maintaining background levels of TP and nitrogen is the only way to be sure to prevent another algae bloom in the river should discharge occur again.

In addition to setting appropriate effluent concentration limits, an operational measure to minimize river water quality problems would be to release only when Blanco River flow is higher than a flow threshold, like median flow. An argument may be that chances of algae blooms and other water quality problems may be reduced because of the concentration of phosphorus and other effluent constituents would be diluted by higher flow. Unfortunately, the operational success is difficult to guarantee that a plant malfunction or a maintenance event would coincide with appropriate river flow levels. Further, the Baylor study showed equal or higher algal and effluent-related impacts during the high flow April-May 2019 study period compared to the low flow August-September 2019 period (Figure 2.3). It is unclear without further analysis whether using Outfall 003 during strong baseflow conditions, rather than during low river flow conditions, will reduce water quality problems in the Blanco River.

[2] King, RS, JA Back. 2020. Bioassessment of four Hill Country streams threatened by proposed municipal wastewater discharges. Center for Reservoir and Aquatic Systems Research, Baylor University, Waco, TX

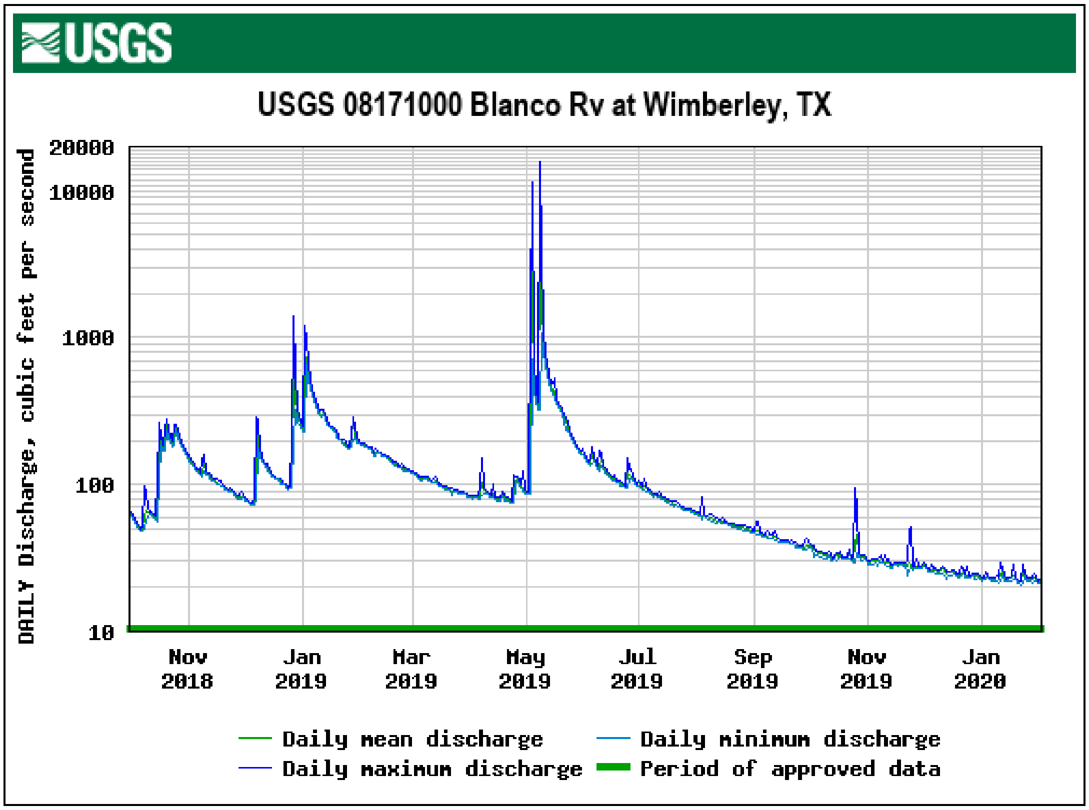


Figure 2.3. USGS Blanco River flow data during discharge event.

3. Water Balance

The purpose of the water balance analysis is to estimate the existing ability of the Blanco WWTP to avoid discharging into the Blanco River by using local water storage ponds and surface irrigation. To this end, a time-series water balance model was employed, in which the WWTP effluent storage ponds are treated as a control volume, with inflows of wastewater effluent and outflows due to irrigation and evaporation, as shown in Figure 3.1. The model makes use of forty years of historical rainfall and evaporation data at a daily time-step, outputting an estimated storage volume for each day. From these historical data, current and future storage needs are estimated, under the assumption that the City of Blanco will continue to see similar rainfall and evaporation in the future.[1] Data sources are detailed in the following below.

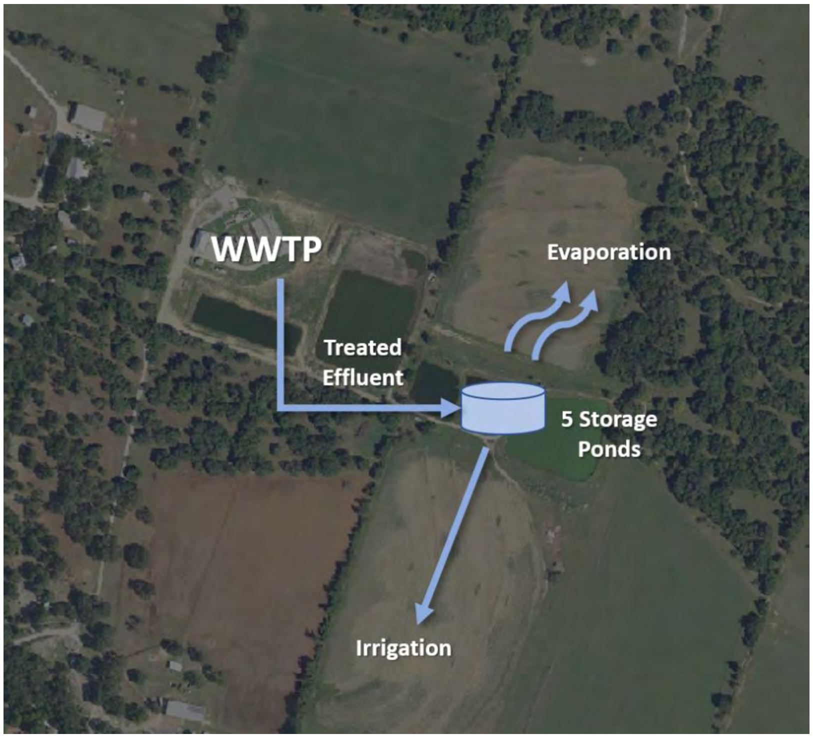


Figure 3.1: Water balance model schematic

[1] Other model assumptions include:

1. WWTP effluent is constant, on a daily basis. No seasonal variation is included.
2. Evaporation is directly proportional to the area of storage ponds within a given scenario.
3. Time-series evaluations begin with storage ponds half-full.

Wastewater data

These data were obtained from email and in-person communication with City of Blanco staff, for present and recent values (shown in Table 3.1), and from the permit application for projected values.[2]

Table 3.1: Wastewater Influent, Effluent, and Irrigation from 2019 – 2021 for the City of Blanco.

Year	WW Influent	WW Effluent	WW Irrigation
Jan-19	6.016	5.83	0.408
Feb-19	4.192	4.105	0.052
Mar-19	4.739	4.198	0.11
Apr-19	4.713	4.132	0
May-19	7.308	6.919	0.917
Jun-19	4.652	4.191	0.532
Jul-19	4.309	3.551	1.34
Aug-19	4.392	3.591	0
Sep-19	4.055	3.271	0
Oct-19	4.325	3.332	0
Nov-19	4.36	3.238	0
Dec-19	4.179	3.056	0
Jan-20	4.226	3.647	0
Feb-20	4.324	3.821	1.527
Mar-20	4.278	4.056	1.503
Apr-20	4.368	3.533	2.283
May-20	4.958	4.293	2.393
Jun-20	4.443	3.714	2.748
Jul-20	4.336	3.693	2.948
Aug-20	4.088	3.579	3.164
Sep-20	4.134	3.373	0.897
Oct-20	4.142	3.115	4.26
Nov-20	3.888	2.819	1.201
Dec-20	4.127	2.83	0.646
Jan-21	4.185	2.903	0.723
Feb-21	2.127	1.58	0.337
Mar-21	4.393	3.228	1.1

Rainfall Data

Obtained from the National Centers for Climatic Information (NCEI). Forty years of daily rainfall (January 1st, 1981 through December 31st, 2020) were considered in this analysis.[3]

[2] TCEQ Domestic Wastewater Permit Renewal/Major Amendment Application. Prepared by Freeland Turk Engineering Group for the City of Blanco, Texas. October 2020.

[3] https://www.ncdc.noaa.gov/cdo-web/datatools/findstation; Station USC00410832.

Evaporation Data

Obtained from the NCEI for Canyon Dam. These pan evaporation data were adjusted by the standard coefficient of 1.3.[4]

3.1 Irrigation Distribution Scenarios

Preventing effluent discharges greatly depends on the ability of the City of Blanco to irrigate consistently throughout the year. For this analysis, three irrigation distribution scenarios were assessed, as described below and presented in Table 3.2. Three different scenarios were explored in order to set bounds on the likely additional storage required to avoid discharge into the Blanco River.

1. **Permit Application Scenario.** This distribution was obtained from the analysis carried out by Turk Engineers and provided with the discharge permit application to TCEQ. This scenario is the most conservative scenario evaluated under this analysis, as it does not allow any irrigation during the winter months of November, December, January, and February.
2. **Golf Course Irrigation Scenario.** This scenario was created by distributing the average volume of water reported for irrigation (per acre) by the Quicksand Golf Course in Wimberley, TX, according to the average monthly water use of Lantana Golf Course in Lantana, TX.
3. **Recent Use Scenario.** This distribution was taken directly from the February 2020 to January 2021 monthly irrigation data provided by the City of Blanco (provided in Table 1).

In addition to incorporating the monthly distribution of irrigation effluent described above, the model was built such that no irrigation was allowed on days following 0.25 inches of rain or more, to account for wet conditions on the irrigated fields.

Table 3.2. Irrigation Distribution Scenarios used in the water model under this analysis.

Month	Irrigation Distribution (in/day)		
	Permit Application Scenario	Golf Course Irrigation Scenario	Recent Use Scenario
January	0.00	0.01	0.03
February	0.00	0.02	0.08
March	0.06	0.06	0.07
April	0.10	0.11	0.11
May	0.22	0.20	0.11
June	0.26	0.30	0.13
July	0.27	0.33	0.13
August	0.15	0.20	0.14
September	0.18	0.20	0.04
October	0.11	0.11	0.19
November	0.02	0.04	0.06
December	0.00	0.03	0.03

[4] https://www.ncdc.noaa.gov/cdo-web/datatools/findstation; Station USC00411429.

3.2 Model Results

Based on the three irrigation distributions described above, the water balance model was used to simulate storage volumes and/or irrigation areas required to meet various existing and future scenarios from the City's TPDES permit renewal application. These are summarized in Table 3.3 and described in more detail in the sections below.

Table 3.3. Projected Effluent production, storage, pond area, and irrigation area for Phases I – IV.

Phase	Effluent Flow (MGD)	Storage Capacity (MG)	Storage Pond Area (acres)	Irrigation Area (acres)
Existing Conditions	0.145	9.08	7.1	26.1
Phase I (2022)	0.145*	19.55	15	26.1
Phase II (2030)	0.225	29.98	20	60
Phase III (2040)	0.340	36.50	25	260
Phase IV (2050)**	0.450	45.62	30	400
Existing Conditions, with Additional Irrigation (42 acres)	0.145*	9.08	7.1	68

*Though the recent permit application provides a flow lower than this value, the current City-reported average flow is used here.
**Phase IV is included for reference, but was not evaluated further in the water balance model.

3.3 Existing Conditions

Based on model results for existing conditions (i.e. current wastewater production rate, available storage and irrigation area), all irrigation distributions show that current storage volumes and irrigation areas are inadequate under the simulated period, with discharge regularly needed during prolonged wet conditions.

3.4 Future Conditions

Conditions for Phases I, II, and III were also evaluated for their ability to avoid discharge to the Blanco River. These phases are described in more detail within the permit amendment application and Table 3.3. Based on these results, under Phases I and II additional irrigation area would be required (i.e. above that listed in the permit application), though Phase III requirements can be met with a slightly higher storage volume than planned. It should be emphasized that these proposed phases build in substantial additional storage volumes and areas of irrigation, and the additional storage volumes presented in Table 3.4 are *above* these planned amounts.

Table 3.4. Water balance model results for each Phase and irrigation scenario evaluated.

Scenario	Required Additional Storage to prevent discharge (MG)		
	Phase I (0.145 MGD)	Phase II (0.225 MGD)	Phase III (0.340 MGD)
Golf Course Demand	28.5	5.9	None
Permit Application	Additional Irrigation Area Required*	18.7	1.1
Recent Use	Additional Irrigation Area Required*	Additional Irrigation Area Required*	None

A higher rate of effluent disposal is required to balance the wastewater effluent.

3.5 Existing Conditions with Additional Irrigation Area

Because the existing infrastructure is likely to allow conditions under which frequent discharges would occur, an additional scenario was modeled in which additional irrigation area (for a total of 68 acres) was assumed.[5] Water balance model results for this scenario show that additional storage volume would be required to avoid discharge under all irrigation application scenarios evaluated, varying from 0.6 MG for the 'Recent Use' distribution, to 5.4 MG for the 'Golf Course Demand' distribution, to 9.2 MG for the 'Permit Application' distribution. As shown in Figure 3.2, the 'Permit Application' scenario, because of the lack of irrigation in the winter months, extra effluent storage is required in nearly all years, which occurs in the fall and spring months. The 'Golf Course Demand' scenario shows a similar pattern, with smaller volume requirements. The 'Recent Use' scenario is adequate in all evaluated years except one. Overall, implementing this scenario (i.e. adding additional irrigation area) along with doubling the available storage volume will allow the City to not need a TPDES permit at all. The City will, however, need a TLAP permit and should pursue a Chapter 210 reuse permit as well.

[5] The City of Blanco used to irrigate approximately 68 acres of Bermuda grass under a previous TLAP permit. This scenario assumes that the City will be able to secure the ability to irrigate this same area.

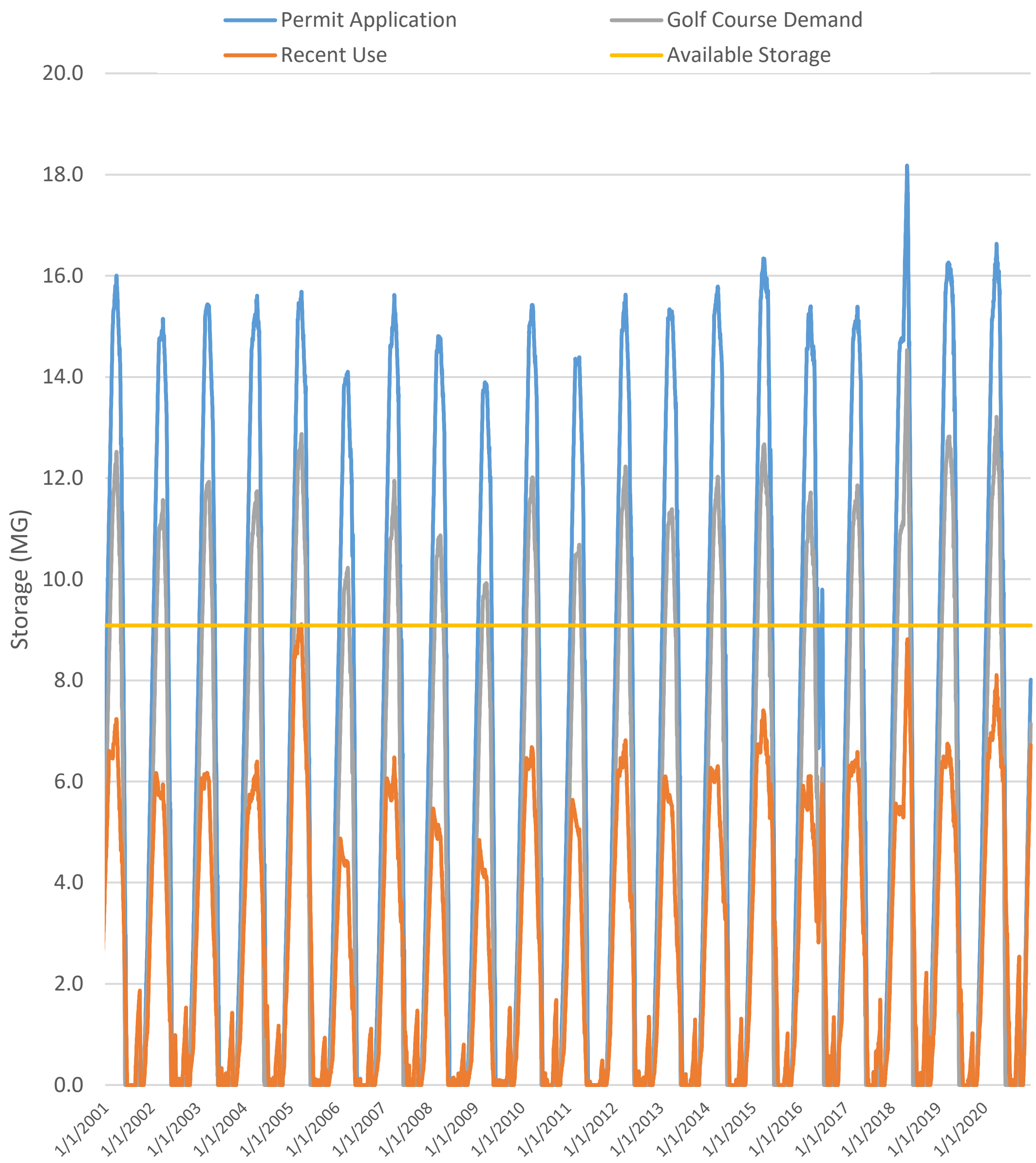


Figure 3.2. Required Pond Storage Volume over time for each irrigation distribution under the 'Existing Conditions with Additional Storage' scenario (only years 2001 through 2020 shown for clarity).

Based on these results, a storage requirement versus percent exceedance relationship for this scenario was developed, and is shown in Figure 3.3. This chart shows that under the 'Golf Course Demand' distribution, additional storage of approximately 2.7 MG would be adequate to avoid discharge for approximately 50% of the years evaluated, whereas 6.3 MG would be required to achieve the same results under the 'Permit Application' scenario.

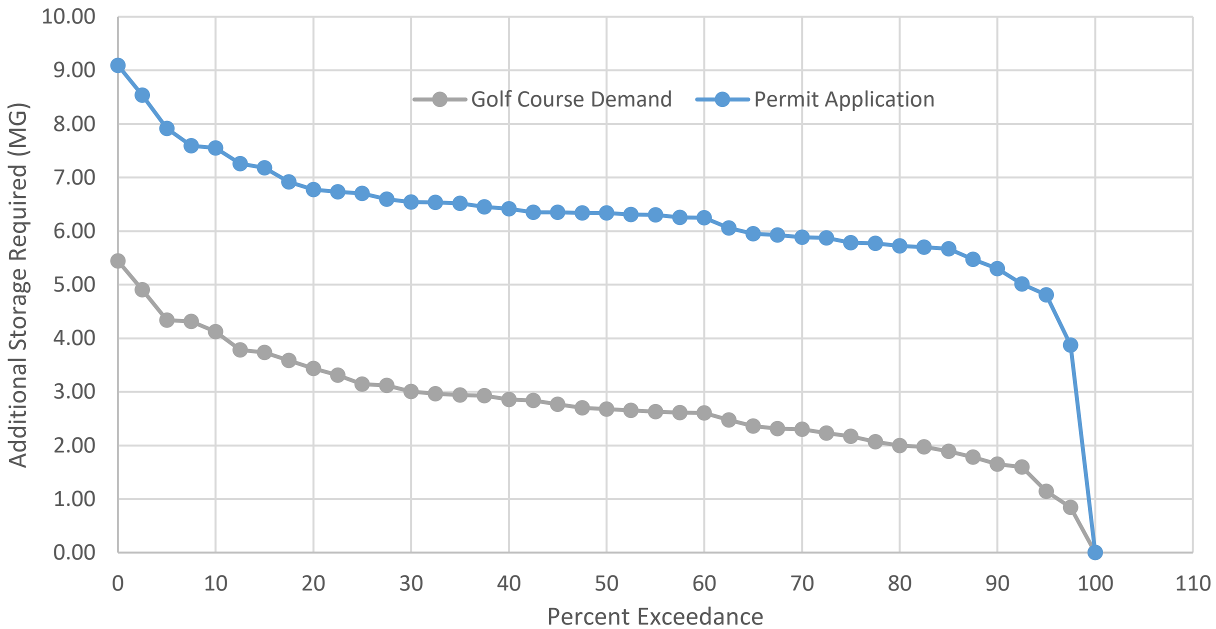


Figure 3.3. Additional Storage required versus percent exceedance by year

3.6 Storage and Irrigated Area Needs

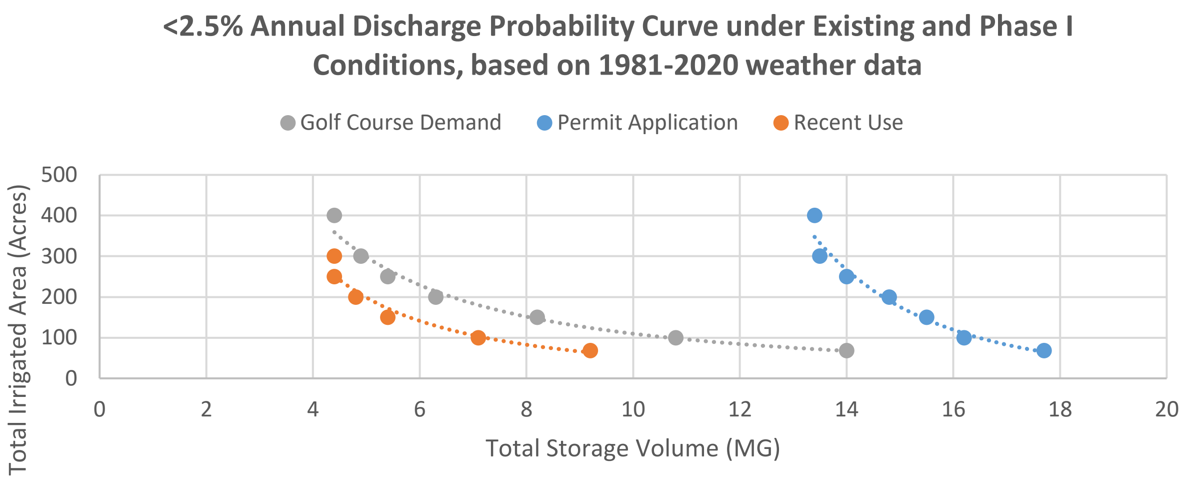
Combinations of irrigated areas and storage volumes that result in no discharge over the simulation period were extracted from the water model for existing, Phase I, Phase II, and Phase III conditions. These are shown in Figure 3.4, and demonstrate the potential tradeoff possible between storage and irrigation area for these scenarios.

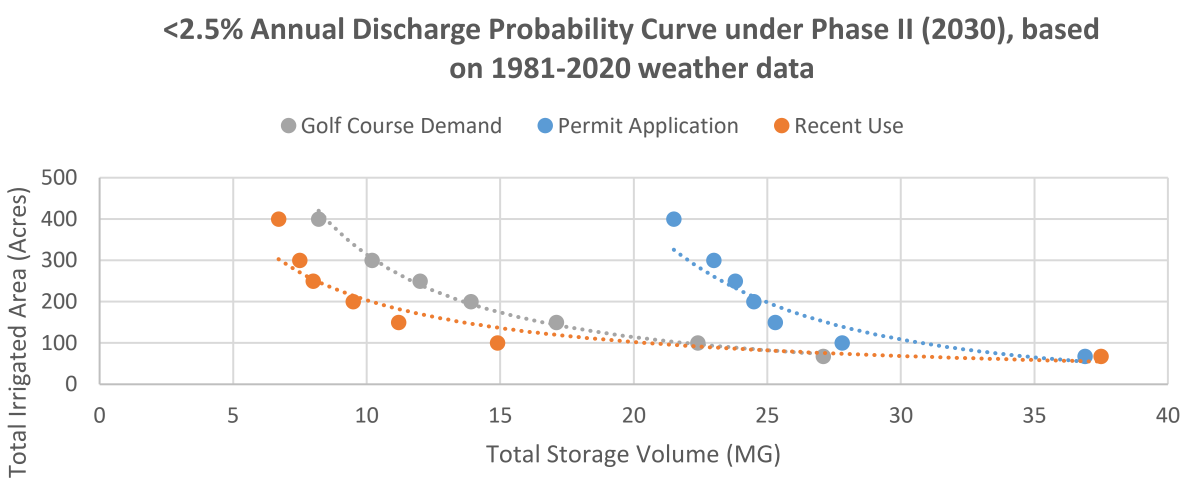
3.7 Cost of Additional Storage

Based on the findings presented above, construction costs for the additional storage required were estimated. A range of costs, along with the associated percent of years that storage is exceeded under the potential 68-acre irrigation area and current WWTP effluent flows for the 'Permit Application' distribution (i.e. the most conservative scenario), are presented in Table 3.5. The other irrigation scenarios do not show any discharges under these additional storage volumes. The largest additional storage volume output for this proposed phase is 9.2 MG (28.2 ac-ft), which has an associated cost estimate of $438,000. These costs, which include construction contingency, permitting and legal fees, and management/inspection components, should be considered preliminary, and updated based on future designs and site conditions.

Table 3.5. Proposed costs and percent of years storage exceeded in water balance model.

Additional Storage Pond Volume (MG)	Additional Storage Pond Volume (ac-ft)	Approximate Cost*	Percent of Time Storage Exceeded in Permit Application Irrigation Scenario
9.2	28.2	$438,000	0%
6.7	20.6	$332,000	25%
6.3	19.5	$316,000	50%
5.3	16.7	$277,000	90%





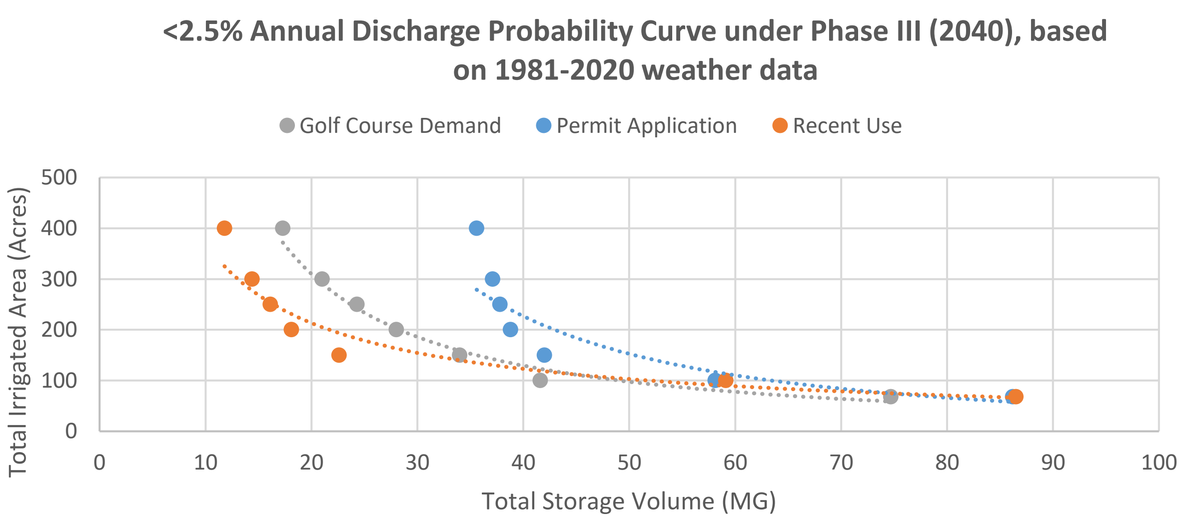


Figure 3.4. Storage and irrigated area to avoid discharge for existing, Phase I, II, and III conditions.

4. Costs to Convey Reclaimed Water to Highway 281

The City is proposing to construct a pipeline from the WWTP to a point north on Highway 281 in order to sell reclaimed water at some future date. The capital cost of construction and estimated O&M were developed for this project and are presented in this section. The proposed route travels from the City of Blanco wastewater treatment plant (WWTP) north approximately 1.4 miles to an end point adjacent to Highway 281. A summary of the proposed route is listed in Table 4.1 and shown in Figure 4.1.

KIT Professionals recommended a pipe diameter of 8 inches, being able to convey 1.12 million gallons per day (MGD) assuming a maximum flow velocity of 5 feet per second. This flow rate is equivalent to 1.74 cubic feet per second (cfs) or 1,260 acre-feet per year (AFY). Due to the increase in pipeline elevation a pump station at the beginning of the pipeline is likely needed and was assumed when estimating cost.

Table 4.1. Proposed pipeline details.

Pipeline Detail	**Value**	**Notes**
Total Length (ft)	7,450	From WWTP start point to end point, see Figure 1
Total Length (miles)	1.41	
Gross Elevation Change (ft)	100	Positive indicates an increase in elevation from start to end location.
Private Property Right of Way Length (ft)	920	Private property crossing south and southwest of WWTP
Pipeline Diameter (inches)	8	
Required Roadway crossings	1	

Figure 4.1. Proposed reclaimed pipeline route, Blanco, Texas.

4.1 Cost Estimate

A single demand, equal to the design capacity of the 8-inch pipeline (1.12 MGD; 1,260 AFY), was used to estimate the cost of the pipeline system and cost per 1,000 gallons.

To determine the cost of implementing the proposed pipeline, the Texas Water Development Board's Uniform Cost Model[1] (UCM) was used as a framework for a cost assessment. The UCM is often used by Texas Regional Water Planning Groups to generate cost estimates for potential water supply projects in a standardized and consistent format. This costing model was last revised at the end of 2018 and does not consider the large amount of price variability that has occurred in the past year. When available,

[1] *Uniform Costing Model User's Guide, v 2.0*. HDR & Freese and Nichols. November 2018. Available at: https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2021/doc/current_docs/project_docs/UCM_User Guide_NOV2018.pdf

updated and more recent cost data were included. The major cost components for this reclaimed pipeline system are the pipeline, pump station, and ground storage tank.

Pipeline costs include the cost of the pipe, appurtenances (e.g. values, markers, thrust restraint systems, air and vacuum values), installation, and one roadway crossing. Pump station costs include the cost of the pumps, housing, motors, materials, and the electrical connection. A residual pressure of 5 psi at the end of the pipe was assumed when sizing the pump's horsepower needs. Basic hydraulic calculations were used to estimate a pump size of 60 horsepower. A covered ground storage tank at the receiving end of the pipeline was included and sized to 100,000 gallons.

According to City of Blanco Staff[2] the wastewater effluent is of TCEQ Type 1 standard. To maintain the Type 1 standard the effluent would need to be stored in a covered ground storage tank before being pumped to its final place of use. A covered ground storage tank cost is included at the WWTP property and is sized to 1,000,000 gallons. Chlorine disinfection was also added to the cost at the WWTP site. It was assumed no additional chlorine disinfection would be needed at the receiving end of the pipeline. Both ground storage tank sizes were estimated, and a more thorough analysis will need to be completed for both tanks once more information on demand and customers becomes available.

The pump station, ground storage tank, and chlorine disinfection system were assumed to be installed on existing WWTP property and would not require any land acquisition costs. A right-of-way land acquisition cost was assumed for approximately 920 ft of pipeline across private property located south-southwest of the WWTP. For the costing estimate it was assumed no booster pumps along the pipeline route would be needed.

Unit costs for these components and other assumptions are shown in Table 4.2.2. Other cost assumptions are also summarized in the table, including engineering and legal services, environmental studies and mitigation associated with the pipeline installation, and annual loan payments. Power costs for pump station operation were assumed at $0.08/KWh.

The cost estimates are summarized in Table 4.3 with a total project cost of $5.942 million.

[2] Personal communications with Ronnie Rodriguez, May 24,2021.

Table 4.2. Unit costs and major project assumption costs.

Unit Cost Assumptions

Pipeline Costs

	Cost per linear foot	
Diameter	soil	crossings
8"	$150	$450

Pump Station Costs

HP	10	20	60
Conveyance (MGD)	0.33	0.57	1.12
Cost:	$720,090	$756,540	$841,680

* Specific to conveyance, dynamic head and pump efficiency (70%)

** Additional cost for power connection

*** Power costs assumed at $0.08/KWh

Ground Storage Tank Costs

Volume (gal)	Cost
100,000	$901,492
500,000	$1,077,270
1,000,000	$1,296,813

Project Cost Assumptions

Engineering, Legal, and Contingency Costs

Pipeline project	30% of pipeline cost
All other facilities	35% of costs for other facilities (tanks, pumps)

Environmental Studies and Mitigation

Pipeline	$25,000 per mile

Annual Costs

Debt Service	3.0% over 20 years
Pipeline, Tank O&M	1% of capital costs of facilities
Pump Station O&M	2.5% of capital costs of facilities

Land Cost for pipeline right of way

Assumed width of right of way	20 ft
Assumed cost of land	$10,561/acre, TAMU Real Estate Research Center for Blanco County (LMA 17)

Table 4.3. Cost estimate. Cost values include capital costs and miscellaneous costs (e.g. engineering, legal, environmental and mitigation). Debt service is estimated at 3.0% over 20 years. Total Annual cost is annual debt service, and annual O&M and pumping costs.

Item	***Estimated Costs***
CAPITAL COST	
Pump Station (60 HP)	$892,000
Transmission Pipeline (8 in dia., 1.41 miles)	$1,169,000
Ground Storage Tanks (110,000 gallons, 1 million gallons)	$2,198,000
Chlorine Disinfection (1.12 MGD)	$96,000
TOTAL COST OF FACILITIES	**$4,355,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, Contingencies (30% for pipes & 35% for all other facilities)	$1,466,000
Environmental & Archaeology Studies and Mitigation	$35,000
ROW Land Acquisition and Surveying	$5,000
Interest During Construction (3% for 0.5 years with a 0.5% ROI)	$81,000
TOTAL COST OF PROJECT	**$5,942,000**
ANNUAL COST	
Debt Service (3%, 20 years)	$399,000

Operation and Maintenance	
Pipeline, and Storage Tanks (1% of Cost of Facilities)	$34,000
Pump Station (2.5% of Cost of Facilities)	$22,000
Chlorine Disinfection Costs	$57,000
Pumping Energy Costs (0.08 $/kW-hr)	$31,000
TOTAL ANNUAL COST	**$543,000**
Available Project Yield (acre-feet / year)	1,264
Annual Cost of Water ($ per 1,000 gallons)	$1.32
Annual Cost of Water After Debt Service ($ per 1,000 gallons)	$0.35

4.2 Conclusions

For the 8-inch reclaimed pipeline route suggested, Aqua Strategies has provided a planning cost estimate of the pipeline system, which includes a ground storage tank, pump station and pipeline. Total project costs are estimated at $5.942 million, with the cost of $1.32 per 1,000 gallons during the first 20 years of debt service.

It was assumed a single pump station at the WWTP could provide sufficient pipeline pressure but further analysis on the need for a booster pump and pipeline modeling will need to be completed. The cost estimates provided are for planning purposes only and are based on the best resources available at the time of this analysis. Due to the increased variability in pricing data over the past year cost estimates should be further reviewed during system design. This assessment is not a pipeline system design and further analysis, including pipeline, pump station, chlorine disinfection, and ground storage tank design will be required to develop the most accurate cost assessment and prior to project implementation.

5. Biological Nutrient Removal

Preliminary numbers were assembled on capital and O&M costs for BNR with chemical polishing. At the time of publication, no data was available on the existing plant performance so assumptions on wastewater characteristics would need to be vetted.

The team evaluated two options for phosphorous removal: Alternative 1 is chemical polishing only; Alternative 2 is for Biological Nutrient Removal (BNR) and chemical polishing. The following assumptions were made:

- Assumed influent concentration of 10 mg/l TP to remove down to 0.1 mg/L.
- Calculations are based upon flow of 0.45 MGD.
- For Alternative 2, it was assumed that dosing would be based on post-BNR reduction from 1 mg/L down to 0.1 mg/L.
- The 0.1 mg/L discharge targets are based on an assumed TPDES limit of 0.15 – 0.25 mg/L, as discussed in the June 2021 Task Force meeting. Under a hybrid TLAP/TPDES permit where discharges only occurred under wet weather conditions, higher Total Phosphorus limits may be acceptable, resulting in lower alum dosing/costs. However, the lower target was retained in the calculations.
- Energy usage calcs for BNR assume mixers for anaerobic zones and recycle nitrate pumps so horsepower addition only.
- Costs are for liquid alum chemical only, and do not include chemical feed facilities (storage, pumping, etc.), any necessary WWTP modifications, energy, or sludge disposal.
- Capital costs assume converting the aeration zone in the WWTP to BNR. There are some tricky construction logistics that need to occur so a lot of assumptions on pricing were necessary. Capital costs are based upon converting the 0.225 MGD train to BNR, however the operational costs assume the two trains produce 0.45 MGD. These are based on the permit amounts. The plant is currently processing around 0.13 MGD so the actual costs today would be lower.

Alternative	Description	Annual Alum Cost ($)	Alum Cost ($/MG)	Alum Cost ($/kgal)	BNR Energy Costs	Capital Costs	Chemical Sludge Production (lb/day)
Alt 1	Chemical Treatment Only (Alum + Filtration)	$26,362	$160.50	$0.16	-	-	287
Alt 2	Post-BNR Polishing (BNR + Alum + Filtration)	$2,397	$0.17	$0.0002	$8,807	$150,000 -- $200,000	26

The suggestion is Alternative 2 since BNR can operate minimal costs. This is the normal way BNR plants operate. No need to spend additional money on chemical and sludge if you can remove the phosphorous biologically. It is hard to turn the BNR "process" on and off the same way you can easily turn on alum dosing due to the operation, so preferably it would run continuously. It should be much easier for the operator to set the BNR and not mess with it too much once it is in operation. By contrast, the alum addition can be more readily throttled up and down to meet intended targets.

Addendum

Memorandum of Understanding
Between
Texas State University
And
City of Blanco, TX

This Memorandum of Understanding (MOU) is hereby entered into by **Texas State University** (hereafter referred to as "Texas State"), a governmental body of the state whose primary place of business is located at 601 University Dr., San Marcos, TX 78666, by and through its duly authorized representative, and the **City of Blanco**, Texas, a type A general law municipal corporation (hereafter referred to as "City") whose primary place of business is located at 300 Pecan St., Blanco, TX 78606, by and through its duly authorized Mayor. Texas State and City may be referred to herein individually as a "Party" or collectively as the "Parties."

PREAMBLE

WHEREAS, the governing bodies of each party find that the subject of this MOU is necessary for the benefit of the public and that the performance of this MOU is in the common interest of both parties; and

WHEREAS, Texas State and the City find that collaboration to identify sustainable water management solutions for the City may have far reaching impacts across the Texas Hill Country; and

WHEREAS, Texas State and the City find that the development of an effective organizing framework to enhance cooperation and coordination among regional stakeholders is in the common interest of both parties; and

WHEREAS, Texas State's University Center called "The Meadows Center for Water and Environment" (Meadows Center) shall be the lead in the activities of Texas State; and

WHEREAS, Texas State and the City find that the efforts undertaken through this MOU will serve to fulfill the four pillars of The Meadows Center's mission of "Inspiring research and leadership that ensures clean, abundant water for the environment and all humanity."

NOW THEREFORE, Texas State and the City, hereby mutually agree to:

I. TEXAS STATE RESPONSIBILITIES

1. Texas State, through its Meadows Center, will coordinate directly with the City to review planning, governing and permitting documents related to water and wastewater management as mutually agreed to by Texas State and the City.

2. Texas State, through its Meadows Center, will provide technical assistance to identify opportunities for sustainable water management solutions for the City as mutually agreed to by Texas State and the City.

3. Texas State, through its Meadows Center, will host meetings and/or conference calls among Texas State staff, the City and regional stakeholders at times and locations mutually agreed to by Texas State and the City.

4. Texas State, through its Meadows Center, will deliver workshops and/or presentations to the City at times and locations mutually agreed to by Texas State and the City.

5. Texas State, through its Meadows Center, will seek to engage outside partners with expertise in sustainable water management solutions as mutually agreed to by Texas State and the City.

II. CITY RESPONSIBILITIES

1. City will host one or more water/wastewater planning sessions with Texas State (Meadows) and City of Blanco staff and/or council over a 12-month period at times mutually agreed to by Texas State and the City and as the City budget allows.

2. City will provide publicly available water/wastewater related materials that will aid in the evaluation or development of future water or wastewater projects, upon request.

3. City will evaluate existing funding measures that the City could leverage to enhance water/wastewater infrastructure, water conservation, and/or water quality protection.

4. City will evaluate water/wastewater management strategies for future development, including One Water concepts such as rainwater harvesting, green stormwater infrastructure, onsite treatment and reuse systems as City funding permits.

III. MISCELLANEOUS

1. Amendments. This MOU may be amended by mutual written agreement signed by the parties hereto.

2. The Parties agree that they may engage in exchanges of activities of mutual interest and benefit including but not limited to the following:
   a) sharing research project ideas and data for research purposes;
   b) sharing of tools, techniques, and methodologies developed for research purposes;

c) undertaking specific, parallel funded research projects; and
d) undertaking staff or student research exchange programs.

3. The Parties agree to cooperate to the extent mutually convenient in identifying potential collaborative projects of mutual benefit and in finding appropriate resources and funding for such projects.

4. Each party shall make reasonable efforts to respect the objectives of the other Party and to accommodate such objectives in the design of any collaborative project.

5. Neither Party shall be required to collaborate with the other on any specific project.

6. Relationship of Parties. Nothing contained in this MOU shall be deemed to create a partnership, joint venture, or relationship of employment between the Parties. Neither Party shall have the authority to act on behalf of the other Party, or to commit any other Party in any manner or cause whatsoever, or to use any other Party's name in any way not specifically authorized by this MOU.

7. Liability. Neither Party shall be liable for any act, omission, representation, obligation or debt of the other Party.

8. Legal Effect of MOU. Texas State and City understand and agree that this MOU constitutes only an expression of intent and shall have no legal or binding effect on the parties.

9. Information and Confidentiality

   9.1. Before commencing any research project or exchanging any data, the Parties will seek all necessary approvals for the sharing of information, complete a research agreement and, where applicable, execute a mutual non-disclosure agreement for the sharing of confidential information.

   9.2. Research agreements between the Parties will also stipulate, on a project by project basis, the terms and conditions pertaining to timelines, funding agreements, resource arrangements, intellectual property rights, copyright and the publication of research findings associated with each collaborative research project.

10. Term and Termination

   10.1 This MOU is effective upon signatures by both parties and shall terminate on December 31, 2020.

   10.2 Either party may terminate this agreement upon 30 days written notice to the other party.

10.3 In the event of termination the Parties shall take the following steps:

a) Any ongoing projects shall be completed or terminated in accordance with the terms and conditions stipulated in the research agreement; and,

b) Any equipment, software, data, or materials acquired in connection with collaborative projects or activities shall be distributed between the Parties in accordance with the terms and conditions of the research agreement.

11. Contact information

Notices and correspondence concerning this MOU shall be sent to

For Texas State:
Nick Dornak
Director of Watershed Services, The Meadows Center
601 University Dr.
San Marcos, TX 78666
Phone: 512-245-7389
Fax: 512-245-7371
nickdornak@txstate.edu

With copy to:
Dr. Reddy Venumbaka
Director, Office of Technology Commercialization
601 University Dr., JCK 489
San Marcos, TX 78666
Phone: 512-245-2314
Fax: 512-245-3847
reddy@txstate.edu

For City of Blanco, TX:
Martha Herden
Mayor
P.O. Box 750
Blanco, TX 78606
Phone: 830-833-4525
Fax: 830-833-4121
mayor@cityofblanco.com

With copy to:
Alan Bojorquez
City Attorney
Bojorquez Law Firm
12325 Hymeadow Dr.
Austin, Texas 78750
alan@texasmunicipallawyers.com

IN WITNESS WHEREOF, the Parties hereto have executed this Memorandum of Understanding to be effective as of the Effective Date.

Texas State University	**City of Blanco, TX**
By: ____________________	By: ____________________
Dr. Walter E. Horton	Martha Herden
Chief Research Officer	Mayor
Date: 1-16-2019	Date: 01-10-2019

Memorandum of Understanding
Amendment 1
Between
Texas State University
And
City of Blanco, TX

This Memorandum of Understanding (MOU) Amendment is to amend the MOU between Texas State University (Texas State) and the City of Blanco (City) with reference to Texas State #A 2019-0048 and executed on January 16, 2019.

It is mutually understood and agreed by and between the undersigned to amend this MOU effective upon signatures of both parties.

Article III, Section 10.1 shall be replaced in its entirety with the following:

10.1 This MOU is effective upon signatures by both parties and shall terminate on **December 31, 2021.**

All other terms and conditions of the above numbered Memorandum of Understanding not hereby amended remain in full force and effect.

Texas State University

By: [signature]

Dr. Walter E. Horton
Chief Research Officer

Date: 12/7/20

City of Blanco, TX

By: Martin Sauceda

Martin Sauceda
Mayor Pro Tem

Date: 12/08/2020