City of Runaway Bay
Water Distribution System Master Plan

1248321465_Final Report

Final Report

May 2, 2013

Prepared by:

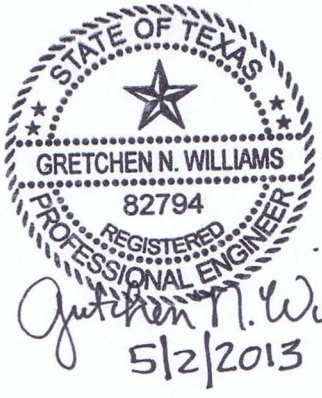
BLACKSTONE
ENGINEERING PLLC
TBPE Firm - 10218

In association with,
Collier Consulting, Inc

City of Runaway Bay
Water Distribution System Master Plan

Final Report

May 2, 2013



Prepared by:

BLACKSTONE
ENGINEERING PLLC
TBPE Firm - 10218

In association with,
Collier Consulting, Inc

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

Section 1 - Introduction

1.1 Background

The City of Runaway Bay is in Wise County, lying at the southern end of Lake Bridgeport. Lake Bridgeport is a man-made freshwater reservoir located in Wise and Jack Counties and is owned by Tarrant Regional Water District. Lake Bridgeport is the City of Runaway Bay's primary source of raw water. The 2010 US Census Bureau reported a population for Runaway Bay of 1,286, and it covers 2.3 square miles of land and 4.2 square miles of water.

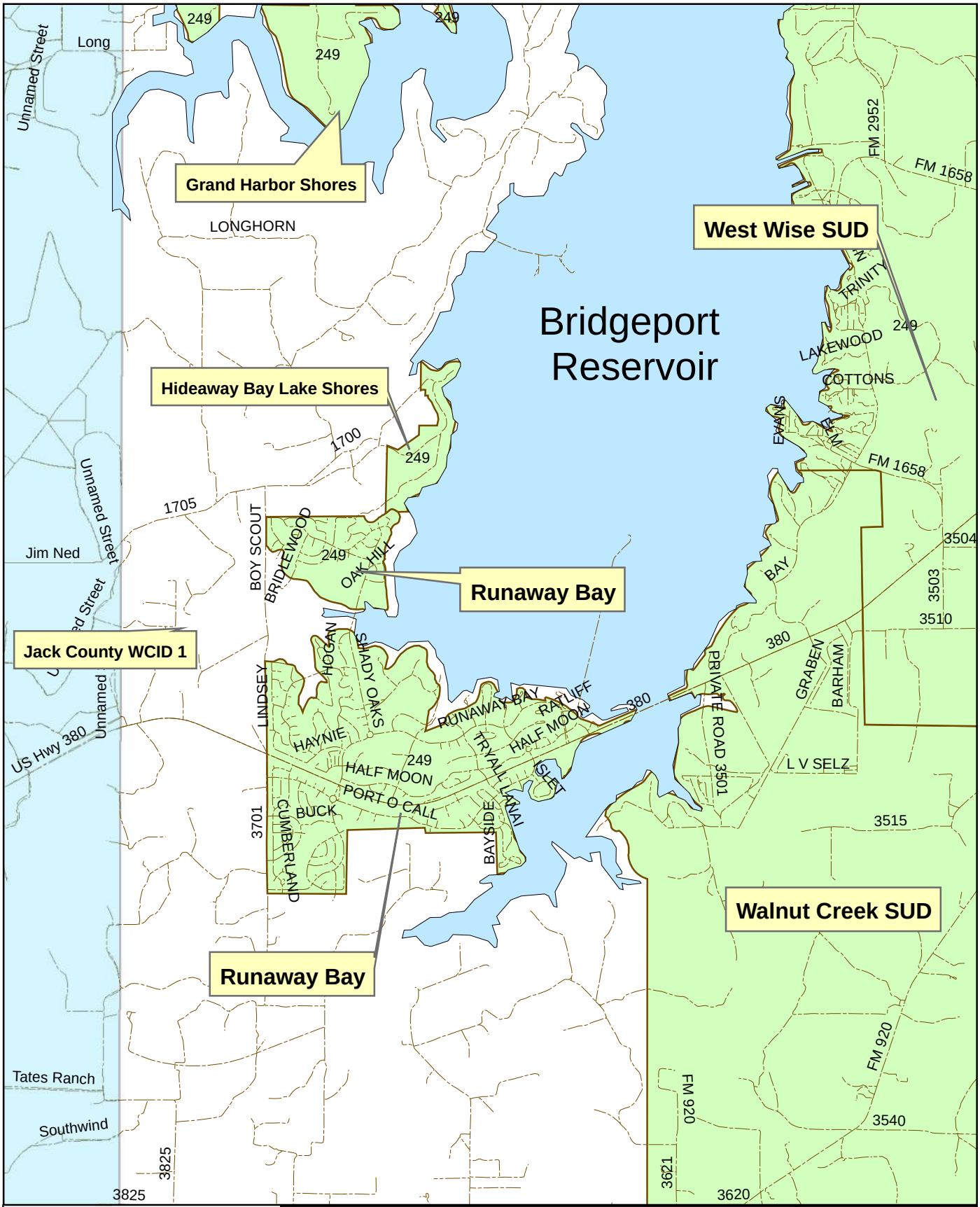
Blackstone Engineering PLLC was retained by the Collier Consulting, Inc. to develop a Water System Hydraulic Model for evaluation of the water system and recommendation of improvements. The model serves as a planning tool for current and future conditions and design improvements to assure adequate water and pressure within the service area.

1.2 Scope of Work

The purpose of this study is to perform a water system evaluation and develop phased improvements for the City of Runaway Bay water service area. The water model was built from data collected from the City of Runaway Bay, North Central Council of Governments (NCTCOG), Texas Water Development Board (TWDB) and Texas Commission on Environmental Quality (TCEQ). To evaluate existing water needs, historical water usage data and water billing data were gathered and evaluated. Future growth of Runaway Bay's service area was established from TWDB Region 3 State Water Plan projections of municipal water usage. Planning periods for years 2012, 2017, 2027 and 2060 (possible built-out conditions) were used to evaluate the system and determine capital improvements. The analysis and results are presented in this report. Due to the timing of the project start, fire flow testing for calibration of the model was not performed, as it was outside the peak day demand periods. It is recommended that the City of Runaway Bay, perform the fire flow testing and calibration of the model in the summer of 2013. The City of Runaway Bay Water System is shown on Figure 1 on the following page.

1.3 Limitations of Study

The findings and recommendations contained in this study are valid as of the date of this report and based on the information referenced herein. Changes in the amount or pattern of growth within the study area, changes in water use patterns, implementation of more detailed investigations or regulatory changes may affect the conclusions and recommendations presented in this report. Water System Evaluations such as this report should be thoroughly reviewed every three to five years to determine if the assumptions and recommendations are still valid.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Location Map - City of Runaway Bay

Figure 1

Section 2 - Existing Water System

2.1 Introduction

Described in this section are the existing water system facilities for the City of Runaway Bay. The water system facilities included in this study are water treatment plant, storage tanks (elevated and ground), pumping facilities and a network of distribution and transmission mains. Each of the facilities are presented in the following sections. The existing water system is shown on Figure 2, located on the following page.

2.2 Water Supply Customers

The City of Runaway Bay currently provides potable water to:

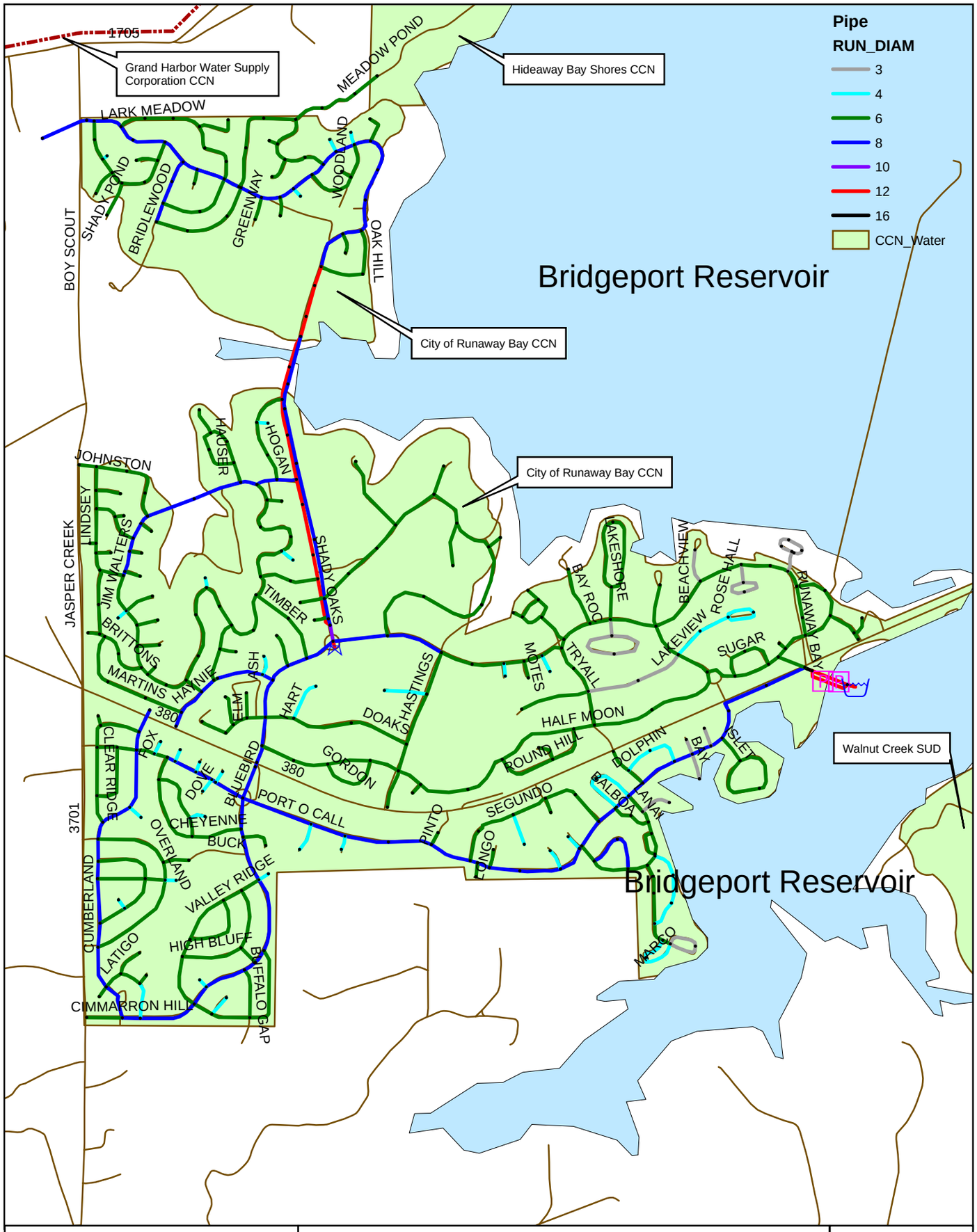
- **Runaway Bay residents,** within the Texas Commission on Environment Quality Certificate of Convenience and Necessity.
- **Shady Oaks Subdivision**, located outside of Runaway Bay incorporated area.
- **Hideaway Bay Lake Shores**, a wholesale customer.
- **Grand Harbor Water Supply Corporation**, a wholesale customer.

In year 2012, Runaway Bay sold 7.1 million gallons of water to West Fork Tanks (tank truck company) that provides water to natural gas fracturing operators. It has been assumed that Runaway Bay will continue to sell water to West Fork Tanks as long as it does not negatively impacted the water system and supply to current customers.

Runaway Bay purchases raw surface water from Tarrant Regional Water District's Lake Bridgeport. Water is treated at the City's water treatment plant (WTP), which is located on the south side of Highway 380. Evaluation of the raw water intake and treatment facilities are not part of the scope of work for this project.

2.3 Water Distribution System

The City of Runaway Bay water distribution system consists of one pressure plane, with ground elevations across the system ranging from approximately 820 feet to 966 feet, which results in 146 feet difference in the elevation. Typically, water pressure planes are established at approximately 100 feet elevation differences to provide more consistent pressures. Raw water is received at the WTP and treated, then stored in the ground storage tanks adjacent to the WTP. Water is pumped out of the ground storage tanks into the system to supply demands and fill the elevated storage tank.



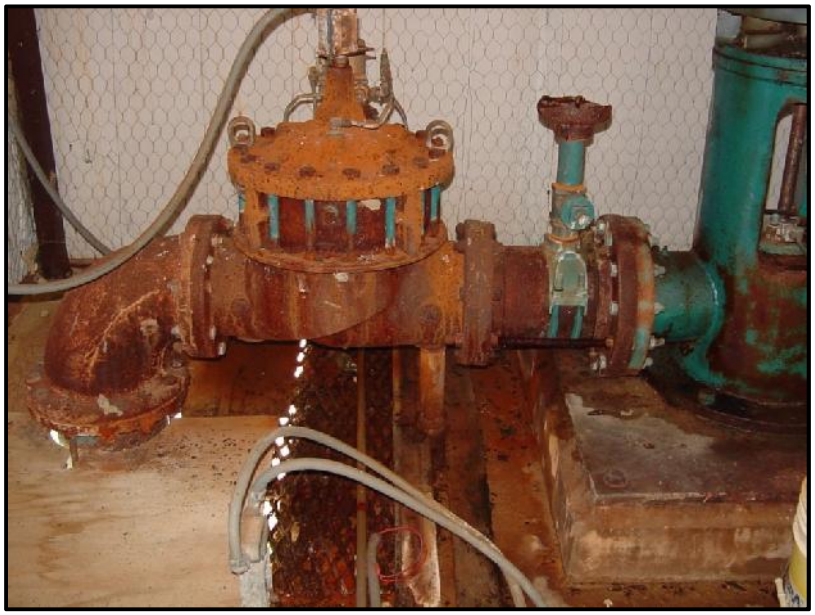
BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Runaway Bay Water Distribution System

Figure 2

2.4 Pumping Facilities

The City of Runaway Bay water pumping facility data is presented in ***Table 2-3***, located on page 2-4. Pumping data was obtained from Smith Pump Company for the existing vertical turbine pumps, manufactured by Byron Jackson. The existing pumps were rated for 600 gallons per minute (gpm) with a head of 279 feet and a horsepower of 75. Below are photos of a pump, piping, valve, motor and fittings at the Water Treatment Plant.



The pumps were installed in 1983, which was 30 years ago. As would be expected the pumps and pipe have considerable corrosion. Output of the pumps could vary from the data supplied from original pump curve due to pump wear.

Table 2-3 Existing Pumping Facilities

Facility	Number of Pumps	Capacity of Pumps (gpm)	Firm Capacity (gpm)
High Service Pump Station at WTP	Pump 1	600	
	Pump 2 (inoperable)		
	Pump 3 (inoperable)		
	Pump 4	600	
	Pump 5 (inoperable)		
		Total Firm Capacity	**600**

The pump station draws water from the ground storage tanks at the water treatment plant and pumps into the distribution system and elevated storage tank. The pump station building was designed for five vertical turbine pump slots, two vertical turbine pumps are operable and three pumps are inoperable. Firm capacity is defined by the total pump capacity with the largest pump out of service. Pump data is presented below.

The location of the Pump Station facilities are shown on Figure 2.

2.5 Water Storage Tanks

Ground storage tanks are located at the Water Treatment Plant. Presented in ***Table 2-4***, below are the existing City of Runaway Bay ground storage facilities with corresponding tank capacities. The City plans to construct a pipeline between the ground storage tanks to equalize flow.

Table 2-4 Existing Ground Storage Facilities

Facility	Capacity of Tank(s) (gallons)
Water Treatment Plant Ground Storage	1 - 300,000
	1 - 100,000
Total Capacity - Ground Storage	**400,000**

Below are photographs of the two storage tanks at the Water Treatment Plant.

300,000 gallons storage tank

100,000 gallons storage tank

In addition to pumping facilities and ground storage tanks, the City of Runaway Bay has one elevated storage tank to maintain pressure in the water system and aid in fire protection. Presented in ***Table 2-5*** is a listing of the existing elevated storage with the corresponding capacity in gallons and the overflow elevations of the tanks in feet.

Table 2-5 Existing Elevated Storage Facilities

Facility	Capacity of Tank (gallons)	Overflow Elevation (feet)
Elevated Storage Tank	100,000	1,071

100,000 gal elevated storage tank

Section 3 - Water Consumption

Municipal water consumption typically varies based on, but not limited to; climate, geography, culture, development character, and system constraints. Municipal water use is typically divided into three major categories: 1) residential or domestic, 2) commercial, and 3) industrial. Some communities may have large institutional or governmental users as well. Residential water consumption is water used by the residents of the community and includes single-family and multi-family dwellings. The water usage varies over any given day, and typically exhibits two peak periods in a day, one in the morning and one in the evening.

Residential water use is also influenced by seasonal variations. Specifically, lawn irrigation in many areas has a significant impact on residential water usage. Residents that reside on the shoreline of Lake Bridgeport, can purchase permits from the Tarrant Regional Water District to use lake water for lawn irrigation. An exact count of the number of permits for Runaway Bay is not available, but is estimated to be 250 lots, based on estimated quantity of shoreline lots.

Commercial water consumers include stores, restaurants, gas stations, warehouses, offices, etc. Typically, the water usage patterns for commercial water use vary with the hours of operation of the business and type of business. Water usage in Runaway Bay is typical of most cities of its size, in that it is predominately residential with a small component of commercial development.

As mention previously, the City of Runaway Bay currently provides potable water to; Runaway Bay residents, Shady Oaks Subdivision (located outside of Runaway Bay incorporated area), Hideaway Bay Lake Shores, Grand Harbor Water Supply Corporation, and West Fork Tank Trucks. In year 2012, Runaway Bay sold 7.1 million gallons of water to West Fork Tank Trucks that provides water to natural gas fracturing operations.

3.1 Historical Population

Historical population for the City of Runaway Bay is presented in ***Table 3-1*** below.

Populations were acquired from North Central Texas Council of Government (NCTCOG) and Texas Water Development Board (TWDB). The population projections for the census years include 1990, 2000, 2010.

Table 3-1 Historical Population

Historical and Projected Populations from Various Sources			
Year	**Census Population**	**NCTCOG Population Estimate**	**TWDB Population Estimate**
1990	700	700	-
2000	1,104	1,104	1,104
2010	1,286	1,286	1,411
2012	-	1,300	1,473[1]

[1] *Includes wholesale customers*

3.2 Historical and Projected Water Demand

The sizing and operation of water system facilities are based on the rate of water consumed and the variation in that rate. In general, seasonal demand peaks in usage are used to size regional supply facilities, while daily and hourly usage rates are used to size distribution system facilities. The variations or fluctuations in water consumption are normally expressed in terms of a peaking factor. A peaking factor represents the peak consumption as a ratio of the average annual demand or other demand components. Peak day consumption is defined as the highest daily usage for a given year. Maximum hour consumption is defined as the highest usage in a given hour during the peak day event.

$$\text{Peak Day Factor} = \frac{\text{Peak Day Usage}}{\text{Average Annual Usage}}$$

$$\text{Maximum Hour Factor} = \frac{\text{Maximum Hour Usage}}{\text{Peak Day Usage}}$$

The average day demands and peak day demands were determined from historical treated water plant production for Year 2008 through 2012, and are presented in ***Table 3-2*** below.

Table 3-2 Historical Water Production

Year	Average Day (MGD)	Peak Day (MGD)	Peak Day Factor
2008	0.293	0.563 (8/9)	1.92
2009	0.261	0.650 (7/12)	2.49
2010	0.288	0.617 (8/27)	2.14
2011	0.354	0.902 (8/31)	2.55
2012	0.316	0.761 (7/30)	2.41

The peak day factor ranges from 1.92 to 2.55. The average peaking factor for the last five years is 2.30, and was used in projecting peak day demand for future years. Water demand projections for current and future years are shown below in ***Table 3-3.*** The populations and average water demand were taken from TWDB projections for the City of Runaway Bay service area. The water demands include wholesale customers.

TWDB demand projections take into account water conservation. Region C (includes Wise County) Regional Water Planning Projections include water conservation of 12% by year 2060 in addition to other water management strategies to meet water demands.

Peak day and maximum hour demand projections are needed to analyze the water distribution system. The planning years of 2017 and 2027 were extrapolated from the TWDB populations, average day and peak day demands.

Table 3-3 Future Water Demand Projections (TWDB)

Year	Population	Average Day (MGD)	Peak Day (MGD)	Maximum Hour (MGD)
2012[1]	*1,473*	*0.316*	*0.761*	*1.218*
2012	1,473	0.270	0.620	0.992
2017	1,548	0.303	0.709	1.134
2027	1,977	0.363	0.849	1.358
2030	2,097	0.384	0.899	1.438
2040	2,400	0.437	1.023	1.637
2060	3,000	0.585	1.369	2.190

[1] *Actual Usage*

Historical water usage for maximum hour conditions was not available. A peak day to maximum hour factor of 1.60 was used. Modeling scenarios for years 2012, 2027 and 2060 were analyzed and results are contained in Section 5 of this report.

3.3 Water Loss

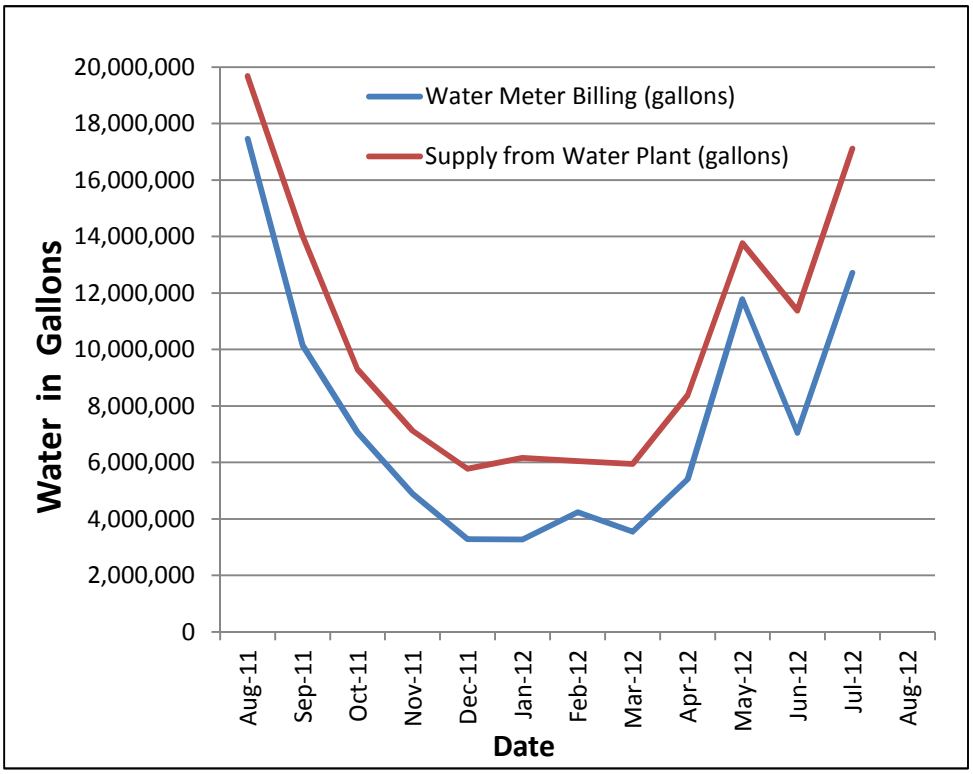
Water billing data from customer water meters were obtained to populate the hydraulic model with water demands. Typically water billing consumption is lower than the total supply. Presented below in ***Table 3-4*** is a comparison of total water supplied (from WTP) and water billing records for the period between August 2011 and July 2012. Also, in the table is a column for the difference in water volumes by month and the percentage of difference.

Table 3-4 Comparison of Total Water Supply and Water Billing Meter Data for the period between August 2011 and July 2012

Month	Total Water Supply (MG)	Water Billing Data (MG)	Difference in Water Supply and Billing (MG)	Difference %
August	19.67	17.46	2.22	11.27
September	14.03	10.14	3.89	27.71
October	9.30	7.07	2.23	23.97
November	7.13	4.89	2.24	31.39
December	5.78	3.28	2.50	43.24
January	6.17	3.28	2.89	46.85
February	6.05	4.24	1.81	29.97
March	5.94	3.55	2.39	40.26
April	8.38	5.41	2.98	35.51
May	13.76	11.78	1.98	14.38
June	11.38	7.05	4.32	38.01
July	17.10	12.71	4.40	25.70
TOTAL	**124.69**	**90.85**	**33.85 MGD**	**37.25**

Below is a graph depicting the amount of water which was billed to customers and the amount of water pumped from the Water Treatment Plant pump station.

Comparison of Water Billed to Water Production



The amount of water loss can vary from system to system. Values ranging from 4% to 30% of the total are found, however values of 10% to 15% are more common, in most cases. The City of Runaway Bay has 37 % water loss based on just the meter data and supply records for mid-year 2011 to mid-year 2012, which is substantial. Water loss in other areas may also be prevalent.

Water loss can be explained as occurring in two fundamental ways:

- Real Losses, considered the physical escape of water, which can include water lost from leaking pipes, joints, fittings, leaks from tanks, overflow from reservoirs, and malfunction of drains or blow-off valves.
- Apparent Losses, signify water that is not physically lost, but does not generate revenue because of inaccuracies. These inaccuracies may include, under recording of customer meters, consumption data handling errors, theft or illegal use.

Cities can also have unbilled authorized consumption in addition to the real apparent losses.

If the City was able to reduce the apparent losses by 10%, the City could see an increase in revenue of over $100,000. Due to the large percentage of water loss, it is recommended that the City of Runaway Bay perform a Water Audit to ascertain areas in which the losses can be reduced.

Section 4 - Water System Modeling

The City of Runaway Bay water distribution system was analyzed using InfoWater Suite 8.5 hydraulic water modeling software package from Innovyze (formerly MWH). For the hydraulic model the Hazen-Williams formula was used to calculate the headloss in the water distribution system. The roughness coefficient (C factor) used for the model was based on the pipe material and year installed.

Water distribution system information regarding piping, pump station, ground storage tanks, and elevated storage tank was provided by the City staff. Junction node demand was imported from the water billing data as provided by the City staff. Ground elevation information was imported into the water modeling software from contour data from North Central Texas Council of Governments (NCTCOG). Pump station information was provided by City staff including number of pumps, capacity, head, and typical operating sequences. Storage tank information included capacity, operating levels, and overflow levels.

The water distribution system was analyzed using extended period simulation model for:

- average day conditions,
- peak day conditions and assumed fire flow, and
- maximum hour.

4.1 Calibration

The purpose of calibration is to create a model that reasonably agrees with observed operating conditions. The calibration process is necessary to provide greater confidence in the model results and offers additional insight into the behavior of the system.

Fire flow tests are typically taken during the high demand period, as it is one of the more severe conditions to meet. Due to the timing of the project start, fire flow tests were not taken for the project. It is recommended that fire flow testing and model calibration be performed in the summer of year 2013.

4.2 Water Demand Allocation

The City staff provided meter-billing records for August 2011 through July 2012. The billing data was then increased to represent production records during this time period.

4.3 Water Modeling Criteria

The hydraulic model for the City of Runaway Bay water system was evaluated as follows for existing and future conditions.

- System Pressure: Junction nodes were evaluated under peak day and maximum hour demand conditions to verify pressures were between 40 pounds per square inch (psi) and 90 psi.

- Fire Flow: Fire Flows were modeled in addition to peak day demands. The junction nodes were evaluated under the following criteria:

Minimum Needed Fire Flow	600 gpm
Upper Fire Flow Limits	800 gpm
Residual Pressure (at fire flow location)	20 psi
Minimum System Pressure	20 psi

- Headloss in Pipelines: Pipelines were evaluated under peak day demand conditions and maximum hour conditions, and pipe segments with friction losses greater than 5 ft per 1000 ft were identified.
- Storage Tanks: Elevated storage tanks were evaluated for time to replenish. Ground storage tanks were evaluated for tank capacity.
- Pump Stations: Pump stations were evaluated for adequate pumping capacities to meet the maximum hour, peak day and peak day with fire flow conditions and have adequate backup.

Section 5 - Water System Analysis

The City of Runaway Bay water distribution system was analyzed utilizing using InfoWater Suite 8.5 hydraulic water modeling software package from Innovyze (formerly MWH). The system was evaluated for average day, peak day and maximum hourly water demands. A fire flow analysis was performed for the current condition and is included in the following section. The peak day and maximum hour scenarios were used to determine the appropriate size of storage tanks, pumping stations and distribution system pipelines. A description of the modeling performed and the results are presented in the following sections.

5.1 Year 2012 Scenario

5.1.1 Water Demand Conditions

The historical water usage for Year 2012 is presented in ***Table 5-1*** below. The average day usage was 0.316 million gallons per day (MGD) or 219 gallons per minute (gpm). The peak day usage was 0.761 MGD or 528 gpm. The estimated maximum hour demand condition for Year 2012 is 1.218 MGD or 845 gpm.

Table 5-1 Year 2012 Water Demand Projections

Demand Condition	Water Demand (MGD)
Average Day Demand	0.316
Peak Day Demand	0.761
Maximum Hour Demand	1.218

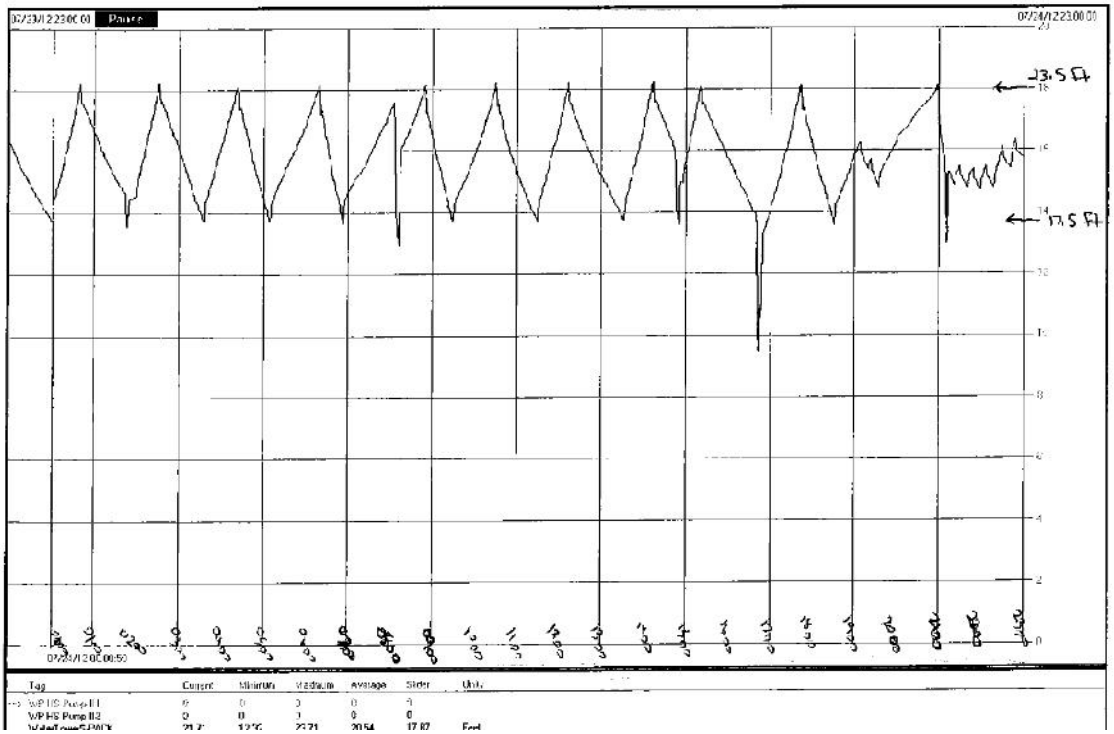
5.1.2 Operational Conditions

The Runaway Bay Water Treatment Plant (WTP) has a treatment capacity of 1 million gallons per day (MGD). The WTP capacity should equal or exceed peak day demands to adequately supply the water system. Since Year 2011 historical peak day water demands were higher than Year 2012, Year 2011 usage was considered. Peak day demand in Year 2011 was 902,000 g/day, which is currently 90% of the WTP capacity. It is recommended that the City of Runaway Bay begin planning now for a WTP expansion as; evaluations, preliminary planning, engineering, funding, bidding process and construction could take up to 5 years to complete.

- The Runaway Bay Elevated Storage Tank and High Service Pump Station (PS) supply water to the customers. When the high service pumps are running, they fill the elevated storage tank and supply water to the customers. When the elevated storage tank level reaches 17.5 feet in the tank bowl, the pumps shut- off until the tank needs to be refilled. This operation, on July 23, 2012, resulted in over eleven (11) fill cycles. Below is a screen capture of the operation on peak-day, July 23, 2012.
- Frequent start and stop cycles of the high service pumps can result in additional wear to the pumps and motor, and can result in increased energy costs. The addition of variable speed drives (VFD) controlling the pump motors can regulate the flowrate to more closely match the water demands, thus reducing the frequent stop-starts, and could

allow the pumps to run while the tank drained and filled. Based on the modeling results, high pressures (above 80 psi) exist in the water system. High pressures can damage plumbing fixtures, waste water and is thought to cause micro water leaks in the pipe seals. The addition of variable speed drives could lower the system pressures, which could reduce the damaging effects of high pressure.

- The frequent fill and drain cycles of the elevated storage is indicative of an insufficient elevated storage capacity. Changing the operation with VFDs would allow the tank to be filled when present demands are less than the pump capacity.



5.1.3 Modeling Results

Presented below is a summary of the modeling results for average day, peak day, peak day with fire flow and maximum hour conditions for the historical demands in Year 2012.

Current Operating Capacity:

- The estimated allowable expansion for the Runaway Bay Water System is 77,760 gallons per day (or 54 gpm), approximately 10% of the total system. The additional 77,760 gpd of capacity equates to approximately 80 additional homes. When the water demand is between peak day (528 gpm) and maximum hour of (845) the demand exceeds the firm capacity of 600 gpm, a second pump would need to be on line. This would result in a condition in which a back up pump is not available. Therefore, it is recommended that minimum growth be allowed until an additional pump(s) are added to the high service pump station.

Average Day Demand Condition:

- Average day demands in Year 2012 were 0.316 MGD or 219 gpm. Only one pump is needed to meet the demands and refill the elevated storage tank during average day conditions. The pumps at the high service pump station are 30 years old. It is likely that the pumps have experienced some wear, which could reduce the flow, head or both. Since that amount of wear is difficult to determine, for modeling purposes it has been assumed that the operation of the pumps are currently operating around 95% of the pump capacity when new.
- In the model scenario for average day conditions for Year 2012, the elevated storage tank drains only when the high service pumps are in the off position. This is due to the system pressures at the tank being greater than the overflow elevation of the tank, thus not allowing water to drain from the tank until the pumps are off. The height of the elevated storage is reported to be 125 feet, which has been assumed to be the height from ground to the top of the elevated storage tank bowl.
- Headlosses in the water distribution system piping are equal to or less than 5 feet per 1,000 feet during average day demands, which indicate that pressures are not substantially lower due to the pipe size during average day demands. Pressures in the distribution system are 44 psi to 120 psi.

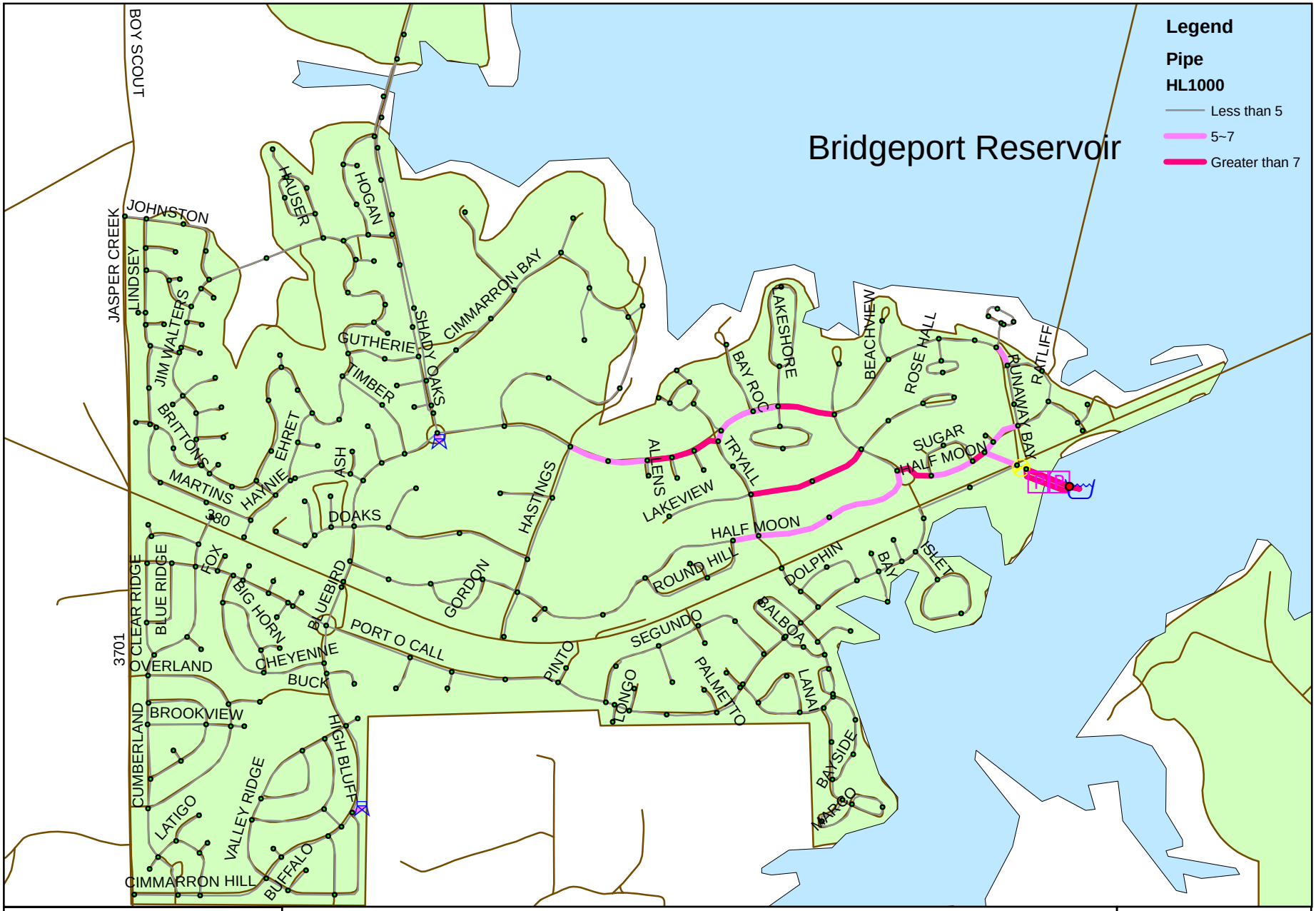
Peak Day Demand Condition:

- Peak day demands for Year 2012 are 0.761 MGD or 528 gpm. The water demand will vary over the entire peak day, causing the demands to be below and above the average peak day demand. During peak day demand model results one pump is running and the elevated storage tank is filling. System pressures for peak day conditions range from are 44 psi to 114 psi.
- The waterline leaving the WTP to Half Moon Way and north and west to the elevated storage tank have head (pressure) losses greater than 7 feet per 1,000 feet. Headlosses greater than 7 feet per 1,000 feet are indicative of pipelines which do not have adequate capacity and can result in reduced system pressures.

Maximum Hour Demand Condition:

- Maximum hour demand conditions for Year 2012 are 1.218 MGD or 846 gpm. Two high service pumps are needed in the model to supply the demand and refill the elevated storage tank. Pressures in the system during maximum hour demand are from 45 psi to 128 psi. Several areas have high headlosses due to the high water demand.
- It is recommended that an additional 600 gpm pump be added to meet TCEQ capacity requirements of maximum hour demand (845 gpm) with the largest pump out of service. The added capacity will also be needed for future demands.
- If one of the current pumps failed during maximum hour conditions, the pressure could drop below the TCEQ minimum pressure of 35 psi, resulting in possible boil water notices to residents. Also, if a fire occurred during peak day demands, the pressure could drop below the TCEQ minimum of 20 psi (during fire flow) resulting in potential loss of property or worse.

Pipelines which are undersized are shown in ***Figure 3*** on the following page.



BLACKSTONE
ENGINEERING PLLC

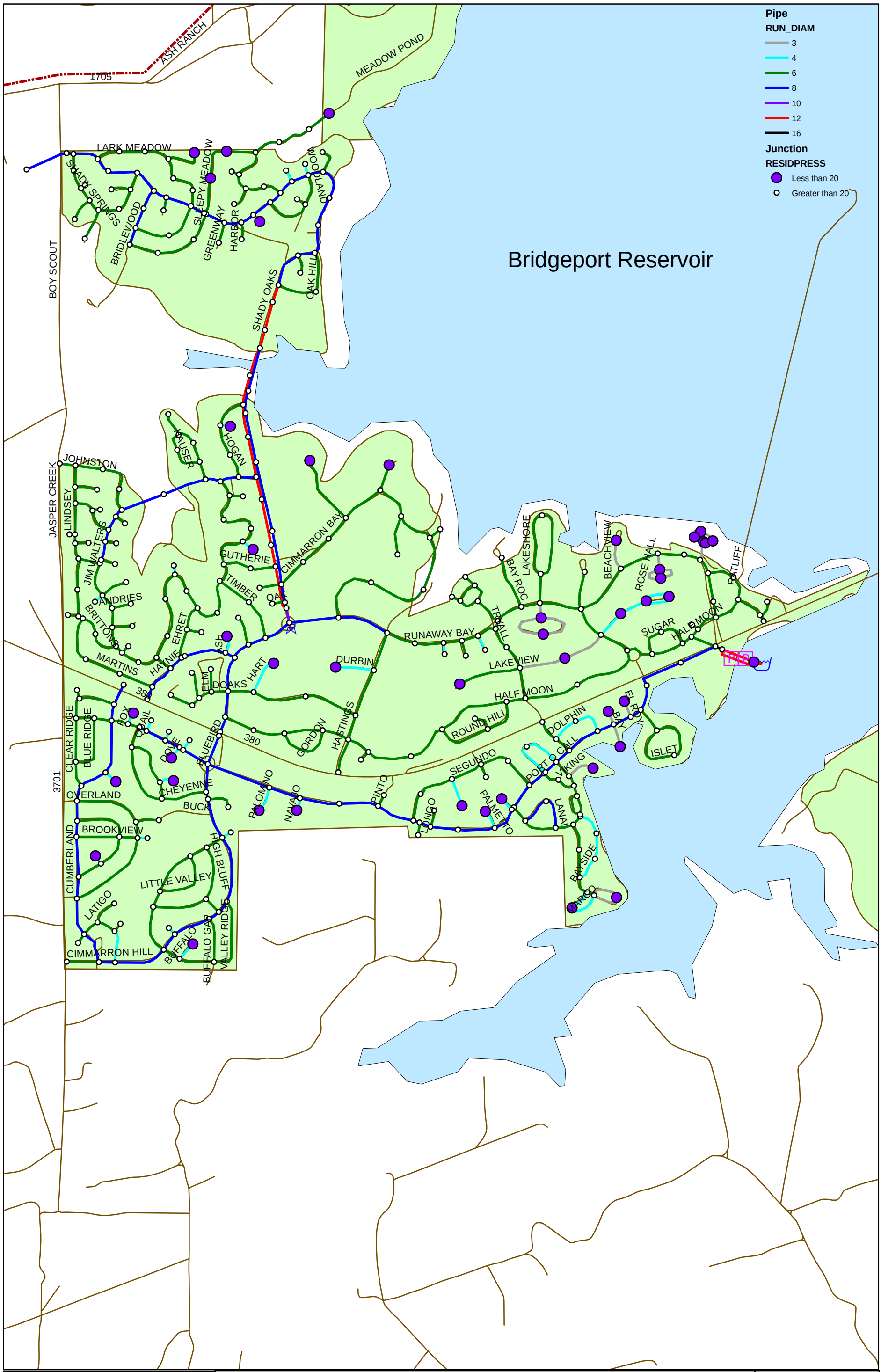
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218
817.899.0656

Waterlines undersized for 2012

Figure 3

Peak Day with Fire Flow:

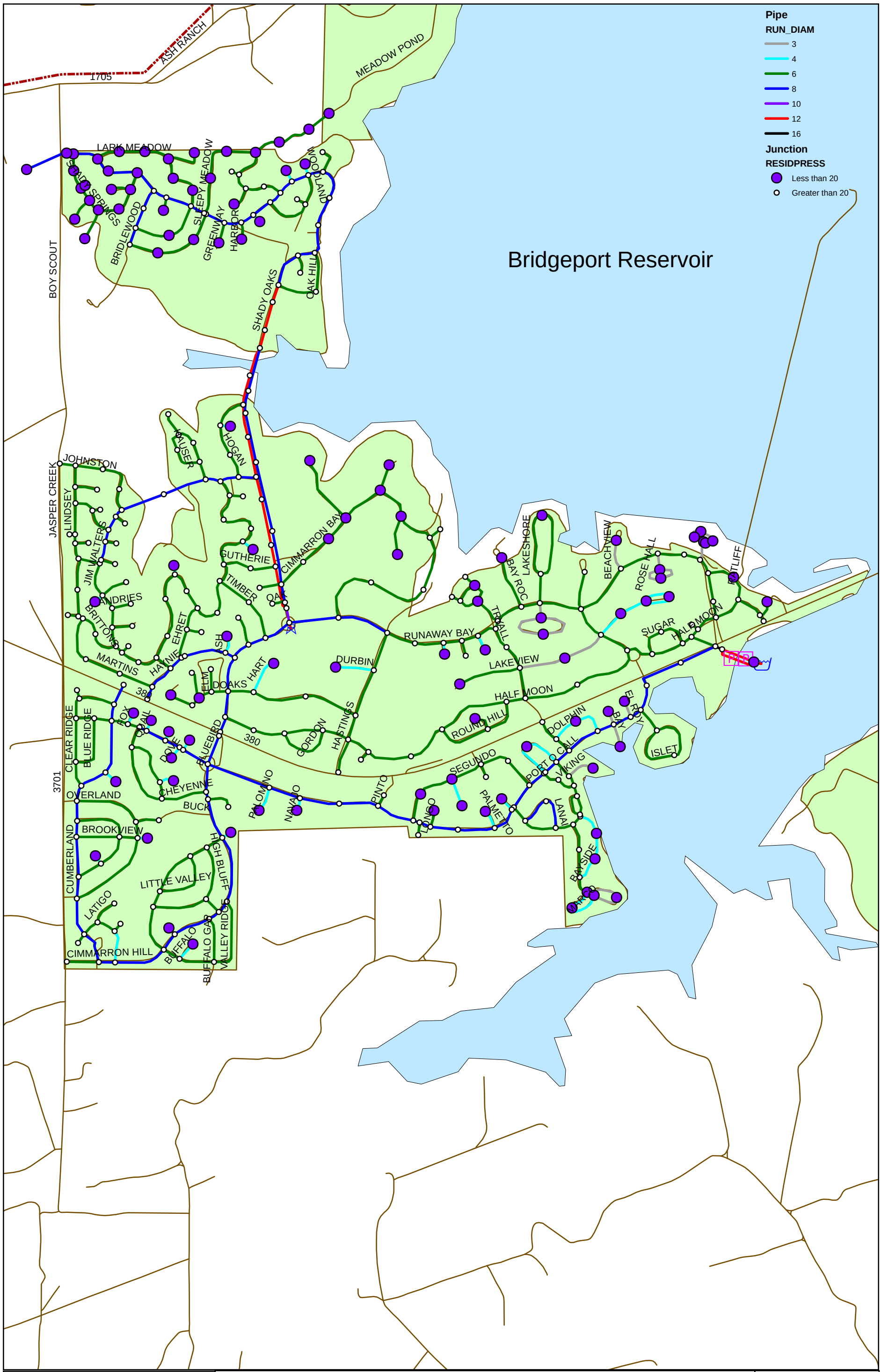
- A fire flow analysis was performed for the City of Runaway Bay's distribution system. A minimum fire flow of 600 gpm and a maximum of 800 gpm were used.
- The following general guidelines can be used for future subdivision and smaller waterlines not addressed specifically in this study.
    - An 800 gpm fire flow requires a minimum of an 8-inch loop system.
    - A 1,200 gpm fire flow requires a minimum of a 10-inch loop system.
    - Fire flows greater than 1,000 gpm would require site specific analysis.
- The minimum system pressure required at the point of assumed fire flow is 20 psi with the system pressure not dropping below 20 psi. The fire flow model runs were not made at every fire hydrant location. However, fire flow calculations are performed by the water model at each junction node, one at a time. Junction nodes located on the suction side of pumps were not included in the fire flow analysis, as those lines typically don't have fire hydrants. Actual fire flow at a specific hydrant could be slightly lower than the flowrate at the model junction node.
- Presented on Figure 4 are results for a fire flow scenario with 600 gpm fire flow needed. The junction nodes color coded in purple (larger junction nodes)shown on Figure 4 indicate the locations where the fire flow residual of 20 psi could not be met. Presented on Figure 4b are results of a fire flow of 800 gpm. The junctions for Figure 4B are color coded as in Figure 4A.



PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2012 Junction Nodes with Fire Flow of 600 gpm

Figure 4a



PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2012 Junction Nodes with Fire Flow of 800 gpm

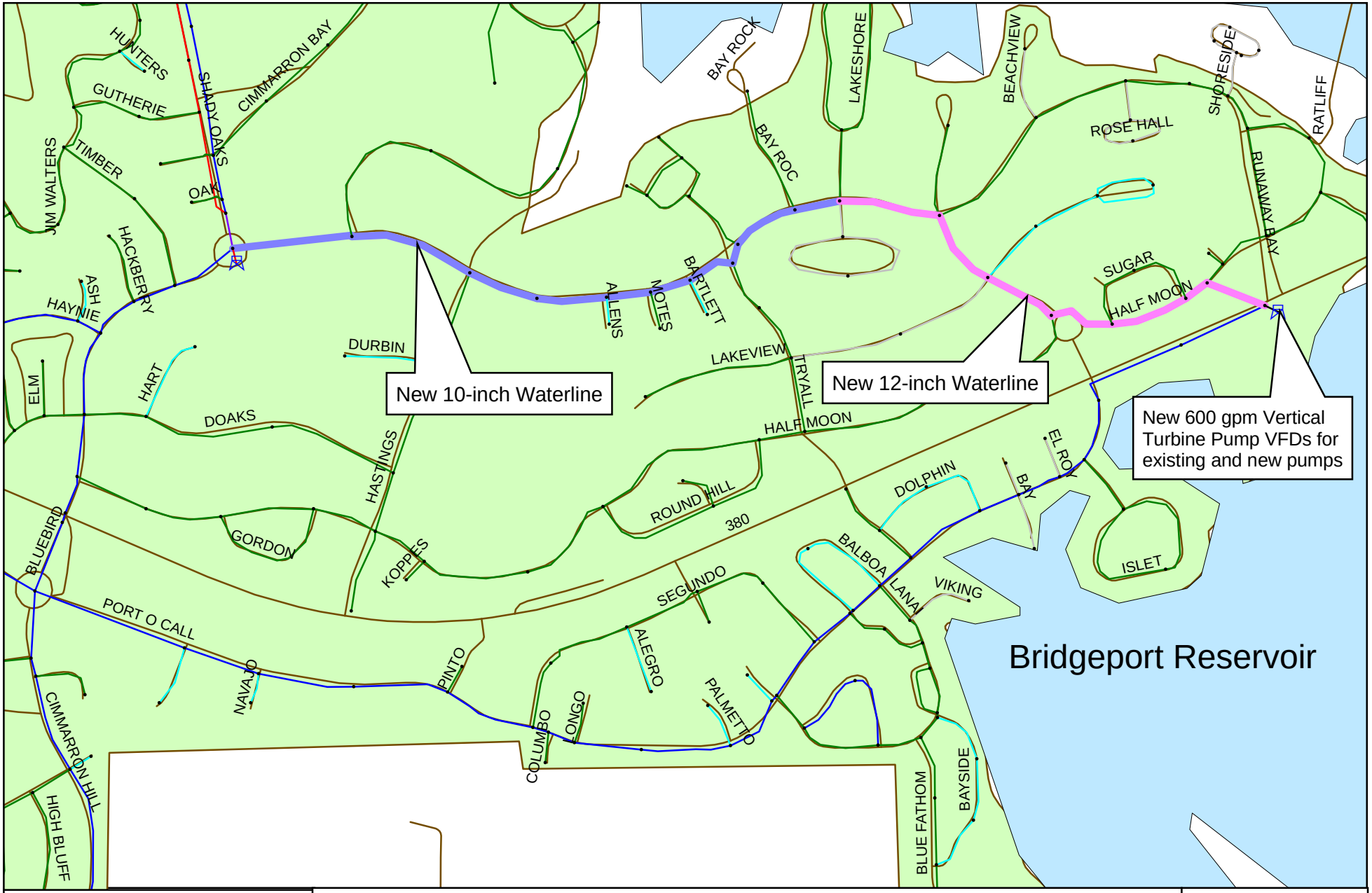
Figure 4b

5.1.4 System Recommendations for Year 2013

Below is a listing of system recommendations that should be addressed immediately. The recommendations are in the order of need, and will most likely take 5 to 7 years to complete, depending on funding sources.

- Add at least one 600 gpm vertical turbine pump to the high service pump station. This will provide a firm capacity of 1,200 gpm at the pump station.
- Consider implementing variable speed drives for the High Service Pump Station.
- A 10-inch and 12-inch waterline replacement is needed from the High Service Pump Station to Half Moon, and traversing Port O Call to Runaway Bay and ending at the existing elevated storage tank.

System Improvements for Year 2013 are shown on ***Figure 5.***



BLACKSTONE
ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2013 - Water System Improvements

Figure 5

5.2 Year 2017 Scenario

5.2.1 Water Demand Conditions

Presented in ***Table* 5-2** below is the projected water demand for Year 2017 for average day, peak day and maximum hour conditions. For this and future scenarios it has been assumed that all recommended improvements have been implemented.

Table 5-2 Year 2017 Water Demand Projections

Demand Condition	Water Demand (MGD)
Average Day Demand	0.303
Peak Day Demand	0.709
Maximum Hour Demand	1.134

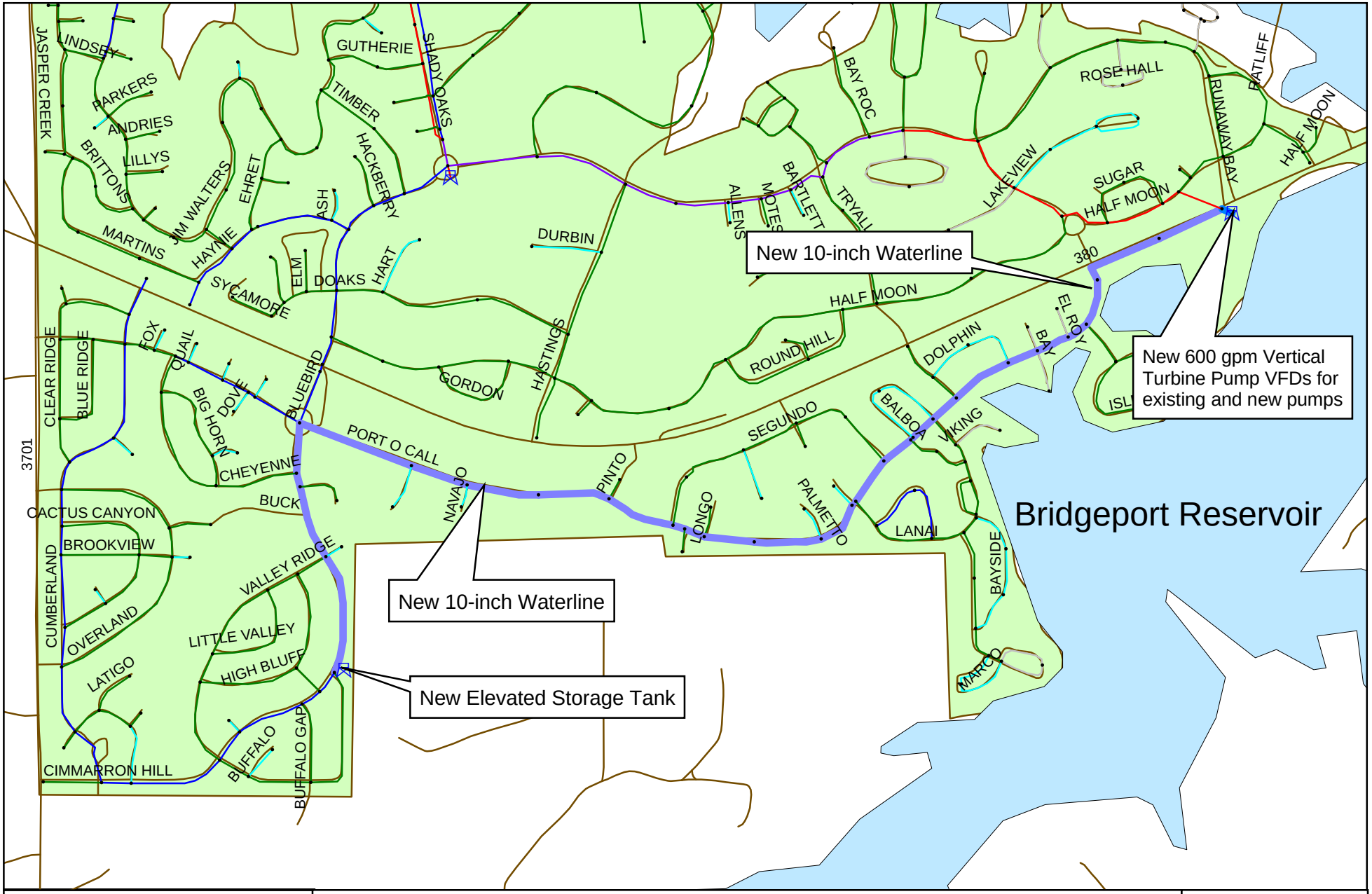
The water demand projections from TWDB for Year 2017 are less than historical water usage for Runaway Bay in Year 2012. The recommended improvements are to enhance operations and provide additional system reliability. The average day usage is 0.303 million gallons per day (MGD) or 210 gallons per minute (gpm). The peak day usage was 0.709 MGD or 492 gpm. The estimated maximum hour demand condition for Year 2012 is 1.134 MGD or 788 gpm.

System Improvements for Year 2017 are shown on ***Figure 6.***

5.2.2 System Recommendations

Complete any of the remaining recommendations from Year 2013 that have not been completed.

- As the existing pumps continue to age and wear, an additional 600 gpm High Service Pump it recommended to provide continued reliability of the pump station.
- The existing elevated storage tank volume is 100,000 gallons. The addition of another elevated storage tank (140,000) would reduce the frequent cycling of the existing tank, provide additional volume to assist with fire protection and future demands.
- Pipeline to the new Elevated Storage Tank is needed to adequately fill the tank and supply the surrounding future demands.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2017 - Water System Improvements

Figure 6

5.3 Year 2027 Scenario

5.3.1 Water Demand Conditions

Presented below in ***Table 5-3*** is the projected water demand for Year 2027 for average day, peak day and maximum hour conditions.

Table 5-3 Year 2027 Water Demand Projections

Demand Condition	Water Demand (MGD)
Average Day Demand	0.363
Peak Day Demand	0.849
Maximum Hour Demand	1.358

The average day usage is 0.363 million gallons per day (MGD) or 252 gallons per minute (gpm). The peak day usage is 0.849 MGD or 590 gpm. The maximum hour water demand projection from TWDB for Year 2027 is 1.358 MGD or 943.0 gpm.

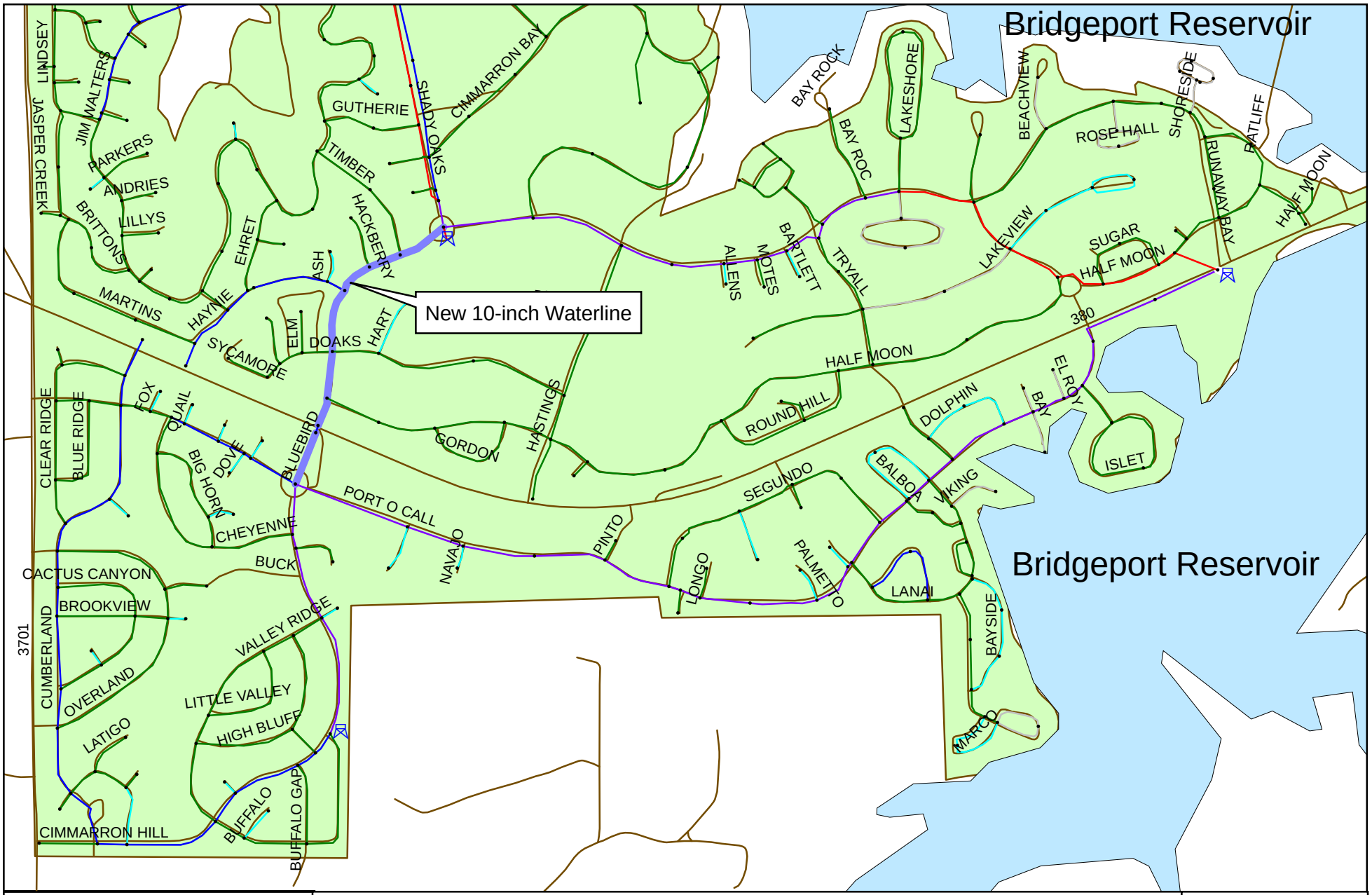
System Improvements for Year 2027 are shown on ***Figure 7.***

5.3.2 Recommendations

Complete any of the remaining recommendations from Year 2012 or 2017 that have not been completed.

- Replace existing waterline from Port O Call and Bluebird to Shady Oaks (Original Elevated Storage Tank) with 10-inch pipe.

This improvement will allow for water demands to be efficiently met throughout the system, and rapid recovery of the elevated storage tanks.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2027 - Water System Improvements

Figure 7

5.4 Year 2060 Scenario

5.4.1 Water Demand Conditions

Based on the current number of vacant lots in the Runaway Bay water service area, Year 2060 may result in build-out of the area. A water system model was prepared and evaluated for future needs in Year 2060. Presented below in ***Table 5-4*** is the projected water demand for Year 2060 for average day, peak day and maximum hour conditions.

Table 5-4 Year 2060 Water Demand Projections

Demand Condition	Water Demand (MGD)
Average Day Demand	0.585
Peak Day Demand	1.369
Maximum Hour Demand	2.190

The average day usage is 0.585 million gallons per day (MGD) or 406 gallons per minute (gpm). The peak day usage is 1.369 MGD or 951 gpm. The maximum hour water demand projection from TWDB for Year 2060 is 2.190 MGD or 1,521 gpm.

5.4.2 Modeling Results

Two junction nodes in The Shady Oaks neighborhood (along Sleepy Meadow) of the water model are below 40 psi, but above the TCEQ requirement of 35 psi. Additional water lines or upsizing of existing waterline may be necessary in this area. Also, if the City of Runaway Bay were to provide more than 60 gpm to Hideaway Bay and/or 58 gpm to Grand Harbor additional piping may be needed to provide adequate volume and pressure needed.

Water modeling of a simulated fire flow was prepared on the Year 2060 system, an estimated 600 gpm hydrant flow and residual pressure of 20 psi was used. Two issues result in fire flow pressures below the standard of 20 psi during the fire flow event.

- The Shady Oaks neighborhood is located at the furthest northern portion of the water system, the furthest distance from the pump station and elevated storage tanks. Pipelines in the Shady Oaks neighborhood are primarily 6-inch and 8-inch in diameter, with several small diameter dead-end lines. If fire protection is desired in this area, upsizing of some of the water lines and additional lines to create looped water lines would be necessary.

- In the remainder of the system, all junction nodes served by dead-end small diameter (2-inch, 3-inch and 4-inch) waterlines could not provide adequate pressure of 20 psi with an assumed hydrant flow of 600 gpm.

5.5 Costs for Recommended Improvements

Table 5-5 Opinion of Probable Construction Costs

YEAR 2013 - 2016					
Item	**Description**		**Units**	**Unit Cost**	**Cost *(yr 2013$)***
1	One 600 gpm vertical turbine pumps with VFD, piping, fittings, valves, etc.	600	gpm		$ 324,000
2	10-inch to 12-inch waterline to existing tank	8,200	ln ft	$80	$ 738,000
3	Bore of HWY 380	80	ln ft	$280	$ 22,400
4	Allowance and Contingencies[1]	20%			$ 216,880
	Grand Total For Year 2013 - 2016				**$ 1,301,280**
YEAR 2017 - 2026					
Item	**Description**		**Units**	**Unit Cost**	**Cost *(yr 2013$)***
1	One 600 gpm vertical turbine pump with VFD, piping, fittings, valves, etc.	600	gpm		$ 125,000
2	New Elevated Storage Tank (160,000 gallons)				$ 600,500
3	10-inch waterline to new EST	11,300	ln ft	$75	$ 960,500
4	Allowance for Engineering and Surveying[1]	20%			$ 337,200
	Grand Total For Year 2017 - 2026				**$ 2,023,200**
YEAR 2027					
Item	**Description**		**Units**	**Unit Cost**	**Cost *(yr 2013$)***
1	10-inch waterline between tanks	3,060	ln ft	$75	$ 260,100
2	Bore of HWY 380	80	ln ft	$280	$ 22,400
3	Allowance for Engineering and Surveying[1]	20%			$ 56,500
	Grand Total For Year 2017 - 2027				**$ 339,000**

[1] *Engineering, Surveying, Environmental Assessments, and Contingencies*

APPENDIX A

Public Meeting Notice
August 28, 2012
Meeting Sign-In Sheet

Water Distribution Model for Runaway Bay

Meeting Agenda

August 28, 2012
9:30-12:00

Type of Meeting: The development and implementation of the Runaway Bay Water Distribution Model. The project is funded in part by Texas Water Development Board

Meeting Facilitator: Oneta Berghoefer, City of Runaway Bay.

Invitees: General Public and other interested parties.

Agenda

I.	Registration	9:30 AM-10:00 AM
II.	Meeting called to order	10:00 AM
III.	Introductions	10:05 AM
	Oneta Berghoefer, City of Runaway Bay	
	Joe Lane, P.E., Collier Consulting	
	Gerry Kendall, E.I.T, Collier Consulting	
	Gretchen Williams, P.E., Blackstone Engineering	
IV.	Overview of Project	
	Gretchen Williams, P.E., Blackstone Engineering	10:30 AM
V.	Question and Answer Session	10:45 AM
VI.	Adjournment	

COLLIER CONSULTING

APPENDIX B

Public Meeting Notice
February 8, 2013
Meeting Sign-In Sheet

PUBLIC MEETING NOTICE
FEBRUARY 8, 2013
1:00 P.M.
101 RUNAWAY BAY DRIVE
RUNAWAY BAY, TEXAS 76426

Notice is hereby given that Collier Consulting, Inc. and the City of Runaway Bay, Texas, will conduct a public meeting on Friday, February 8, 2013, in the Council Chambers at 101 Runaway Bay Drive, Runaway Bay, Texas, at 1:00 p.m. The purpose of the meeting is to discuss the status of the Regional Facility Plan for the City of Runaway Bay, funded in part by a grant from the Texas Water Development Board to support the City of Runaway Bay in their effort to develop a water system model and plan for long term water supply needs.

Public input and comments will be accepted for incorporation in the final report.

Posted this 31st day of January, 2013, at approximately 4:00 P.M. on the official bulletin board at Runaway Bay City Hall, 101 Runaway Bay Drive, a place convenient and readily accessible to the general public at all times.

Oneta Berghoefer

Oneta Berghoefer, City Secretary
City of Runaway Bay

Meeting Sign-In Sheet

Project: Water Model Study
Facilitator: Robert Ryan
Place/Room: Council Chambers

Date: 2/8/13
Time: 1:00 pm

PRINT NAME	ORGANIZATION	TITLE	PHONE	EMAIL
1. Gretchen Williams	Blackstone Engineering	President	817.899.0656	gretchen@blackstoneengineering.com
2. Oneta Berghoefer	City		940-575-4745	oberghoefer@runawaybaytexas.com
3. Robert Ryan	City	Mayor	940-393-5433	rgryan1@yahoo.com
4. Matt Van Hattem	Collier Consulting	Engineer	(254) 968-8728	matt@collierconsulting.com
5. Angela Kennedy	TWDB	Project Mgr	(512)463-1437	angela.kennedy@twdb.texas.gov
6. John Fluharty	US Water	Project Mgr	940-389-7970	jfluharty@uswatercorp.com
7. Randy Searcy	City		940-393-9104	
8. Wayne Owen	TRWD	Planning Mgr.	817 335 2491	Wayne.owen@trwd.com
9. Lauren Brown	TRWD	Analyst-Planning	8) 335-2491	lauren.brown@trwd.com
10. Jerry St. John	City	Mayor Pro Tem	940 575-4745	jstjohn@runawaybaytexas.com
11.				
12.				
13.				
14.				
15.				
16.				

APPENDIX C

Regional Water Supply Facility Plan

Regional Water Supply Facility Plan

The purpose of the Regional Water Supply Facility Plan is to evaluate and determine the most feasible alternatives to meet regional water supply needs for the area surrounding the City of Runaway Bay. This study area covers a portion of Wise County. This study has been funded in part by the Texas Water Development Board Regional Planning Grant Program.

Listed below are the developed tasks for the Regional Water Supply Facility Plan:

A. Establish the area(s) of need outside of the Runaway Bay Service Area.

B. Identify potential water systems which can reasonably supply water to the areas of need.

C. Evaluate potential water systems.

D. Develop planning level cost estimates for the options selected.

1.1 Regional Planning Participants

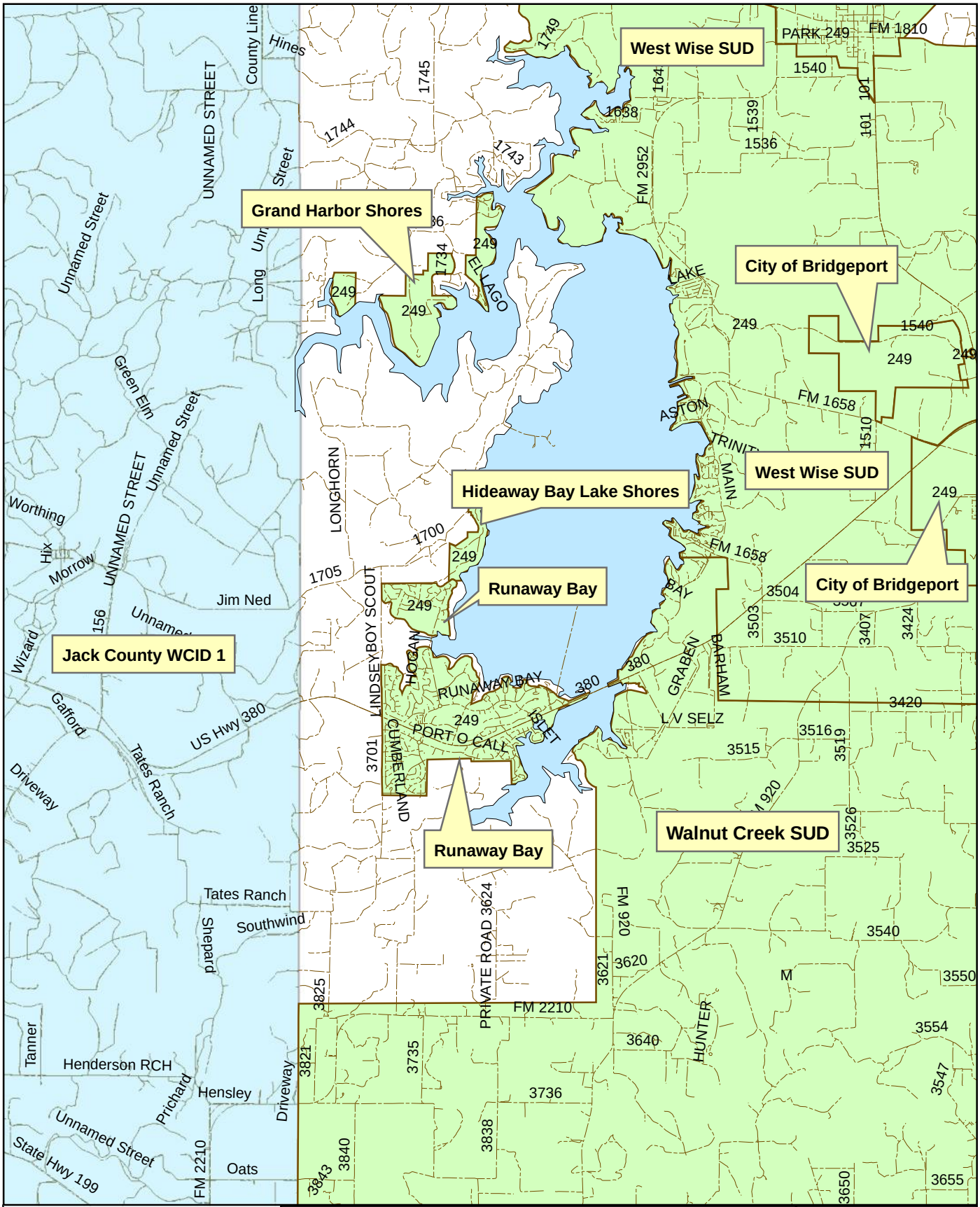
The following utilities are either adjacent or near the City of Runaway Bay service area.

A. West Wise Special Utility District (WWSUD)
B. City of Bridgeport (COB)
C. Walnut Creek Special Utility District (WCSUD)
D. East Keechi Creek Water Control and Improvement District #1
E. Jack County Water Control and Improvement District #1

The City of Runaway Bay service area and regional planning participants are shown on ***Figure 1***.

Hideaway Bay Lake Shores and Grand Harbor Shores are located on the far northern portion of the City of Runaway Bay service area and have been eliminated from consideration as a regional provider. Both utilities purchase all their water from Runaway Bay and would require extensive improvements to have adequate facilities for the regional plan. The Texas Commission on Environmental Quality (TCEQ) estimated populations and number of meters for Hideaway Bay Lake Shores and Grand Harbor Shores are presented below.

- Grand Harbor Shores - population 75, number of meters 25
- Hideaway Bay Shores- population 158, number of meters 53



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218
817.899.0656

Regional Plan

Figure 1

The area to the west of the City of Runaway Bay, and to the north and south is an area that is not a designated Certificate of Convenience and Necessity (CCN). The area to the south of Hwy 380 and west of Walnut Creek SUD is also not designated as a CCN. Below is a listing of each potential water providers within a reasonable range from the service area:

A. West Wise Special Utility District (WWSUD)

WWSUD is located across Lake Bridgeport, north and east of the City of Runaway Bay. The WWSUD 's water supply consists of treated water from their water plant and wholesale water from Walnut Creek Special Utility District. Raw water supply for WWSUD is Lake Bridgeport. TCEQ reports the population served by WWSUD is over 3,400 persons, with approximately 1,107 water meters, and the average day consumption for WW SUD is 0.350 MGD.

B. City of Bridgeport (COB)

The City of Bridgeport is located east of the City of Runaway Bay, across Lake Bridgeport. TCEQ data shows that the City of Bridgeport has a population of just over 5,600 persons, with 1,900 water meters, and the average daily water consumption is 1.065 MGD. The City of Bridgeport staff has indicated they do not any anticipate any plans to expand their water system to the west.

C. Walnut Creek Special Utility District (WCSUD)

WCSUD is located east and south of the City of Runaway Bay. It is a fairly large special utility district, with over 17,000 residents and over 5,800 water meters as documented by TCEQ. The WCSUD also provides potable water to City of Reno, City of Boyd, City of Rhome, City of Paradise and West Wise SUD. The estimated population served to the wholesale customers is 8,865. Mr. Jerry Holsomback, General Manager of WCSUD has indicated any expansion of their system would be a result of interested developers. The WCSUD 's water supply consists of raw water from Lake Bridgeport treated at their water plant.

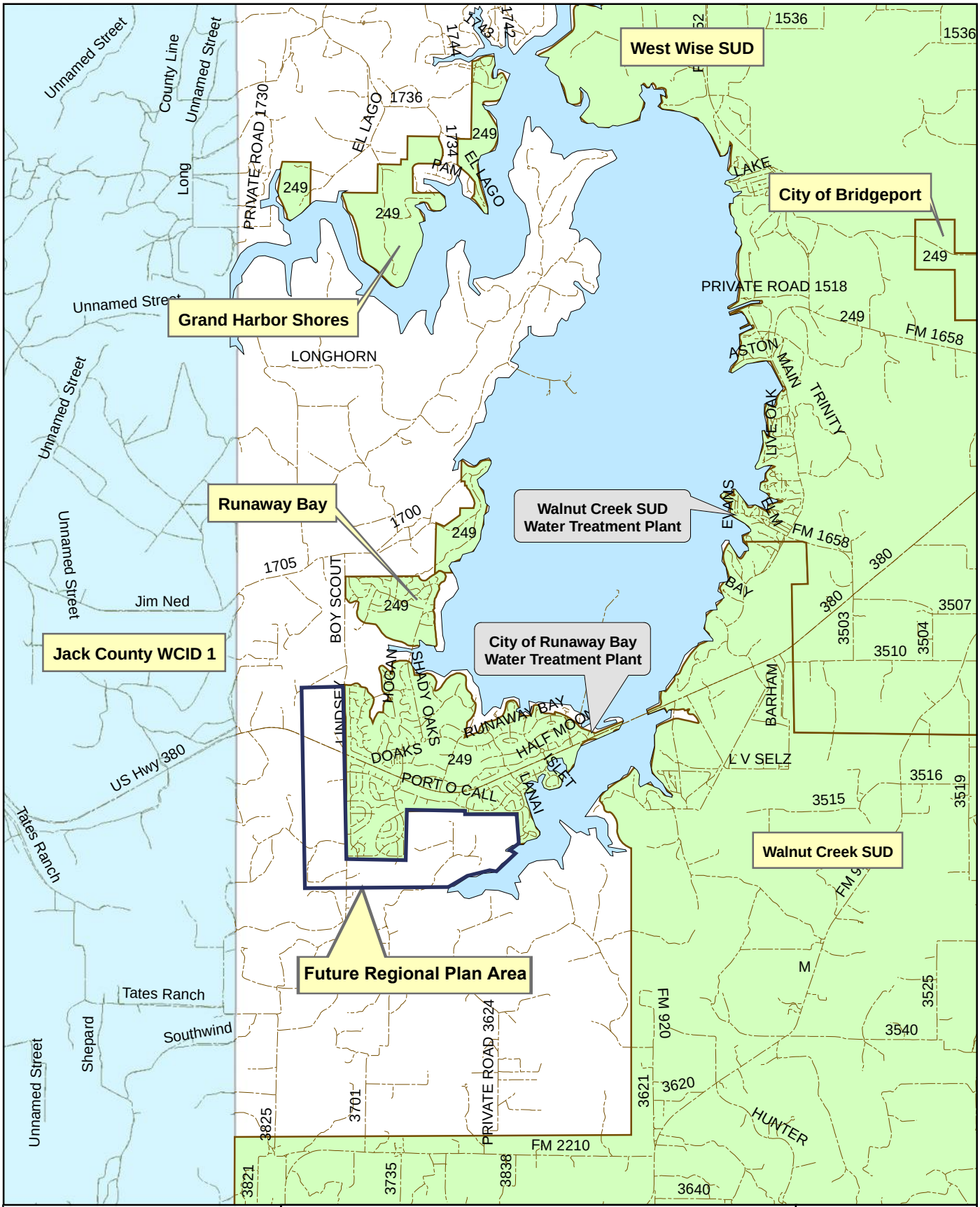
D. East Keechi Creek Water Control Improvement District #1 (EKC WCID#1)

The function of EKC WCID #1 includes drainage, flood control, irrigation and untreated water. Mr. Darrel Francis (Secretary of the East Keechi Creek WCID #1) indicated that the East Keechie Creek WCID #1 supply is primarily stock tank and ponds. This source would not be adequate for municipal water usage.

E. Jack County WCID #1

Jack County WCID #1 is located west of the City of Runaway Bay. The function of the JC WCID #1 includes drainage, flood control, irrigation and untreated water. JC WCID #1 does not have treated water facilities or pipelines in their system.

The future Regional Plan area is shown on ***Figure 2*** on the following page.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Regional Plan - Year 2030

Figure 2

1.2 Evaluation of Regional Planning Participants

Below is a description of the evaluation of the Regional Planning Participants. West Wise SUD and City of Bridgeport are not feasible water suppliers for the regional water supply plan on the west side of the City of Runaway Bay, due to the amount and cost of infrastructure to treat and move the water.

East Keechi Creek WCID1 and Jack County WCID 1 are water control and improvement districts, which have broad authority to supply and store water for domestic, commercial, and industrial use and provide irrigation, drainage and water quality services. The East Keehi Creek WCID1 and Jack County WCID1 currently does not provide water for domestic, commercial or industrial use. Therefore, these WCID's would require extensive infrastructure to provide water to the Regional Planning area.

Therefore two options are feasible for the Regional Planning area, Walnut Creek SUD and the City of Runaway Bay service area.

Below is a listing of each potential water provider within a reasonable range from the service area:

A. Walnut Creek Special Utility District (WCSUD)

WCSUD is located east and south of the City of Runaway Bay. The WCSUD 's water supply consists of raw water from Lake Bridgeport treated at their water plant. WCSUD current facilities include;

Table 1 - Walnut Creek SUD Facilities

Storage		
1	Total Storage	5.672 MG
2	Elevated Storage	2.422 MG
Production		
1	Total Production	6.048 MGD
2	Service Pump Capacity	28.950 MGD

B. City of Runaway Bay

The City of Runaway Bay has 1,473 residents and over 800 water meters, and provides water to;

1. Runaway Bay residents,
2. Shady Oaks Subdivision (located outside the Runaway Bay incorporated area),
3. Hideaway Bay Lake Shores,
4. Grand Harbor Water Supply Corporation and
5. West Fork Tanks.

Runaway Bay's water supply consists of raw water from Lake Bridgeport treated at their water plant. The City of Runaway Bay's current facilities include;

Table 2 - City of Runaway Bay Facilities

Storage		
1	Total Storage	500,000 gal
2	Elevated Storage	100,000 gal
Production		
1	Total Production	1.0 mgd
2	Service Pump Capacity	600 gpm (firm capacity)

1.3 Estimated Populations for Regional Water Plan

The growth of the regional water planning area from year 2013 to 2030 is an estimated 750 acres of land on the west and south sides of City of Runaway Bay service area. It has been assumed that of the 750 acres of raw land, approximately 488 acres are available for home sites. Facilities and structures other than homes would take-up land including; roadways, utility corridors (gas, electrical, drainage, water, sewer, fiber optics, cable, telephone, etc.) drainage areas, floodplains, wetlands, parks and open space.

The current population of the regional planning area is anticipated to be small, as typical utilities are not widely available, and a large amount of the area currently is being used for natural gas recovery. For purposes of this study, it is assumed that no population exists currently in the Regional Water Plan area. It is anticipated that future development of the area would consist primarily of residential homes sites of 1 to 3 acres, with 3 persons per home. For purposes of determining an estimate population, home sites of an average of 2 acres was used. A water demand of 189 gallons per capita was used to estimate future water demands. The City of Runaway Bay peak day demand factor of 2.3 was used in determining the peak day water demands.

Table 3 - Year 2030 Regional Water Supply

Regional Water Supply	Year 2030 Populations	Year 2030 Water Demands
Regional Water Supply		
Populations	732	
Water Demands Existing & Future:		
Average Day (MGD)		0.138
Peak Day (MGD)		0.317

Table 4 - Comparison of City of Runaway Bay and Walnut Creek SUD

Regional Water Supply	City of Runaway Bay	Walnut Creek SUD
Year 2030 Population Estimates	2,097	50,123
Additional Populations for Regional Needs	732	732
Total Population	**2,829**	**50,855**
Year 2030 Average Day Demands (MGD)	0.384	7.660
Additional Water Demands for Regional Needs	0.138	0.138
Total Average Day Demands	**0.522**	**7.798**
Year 2030 Peak Day Demands (MGD)	0.899	17.620
Additional Water Demands for Regional Needs	0.317	0.317
Total Peak Day Demands	**1.216**	**17.937**

1.4 Available Facilities

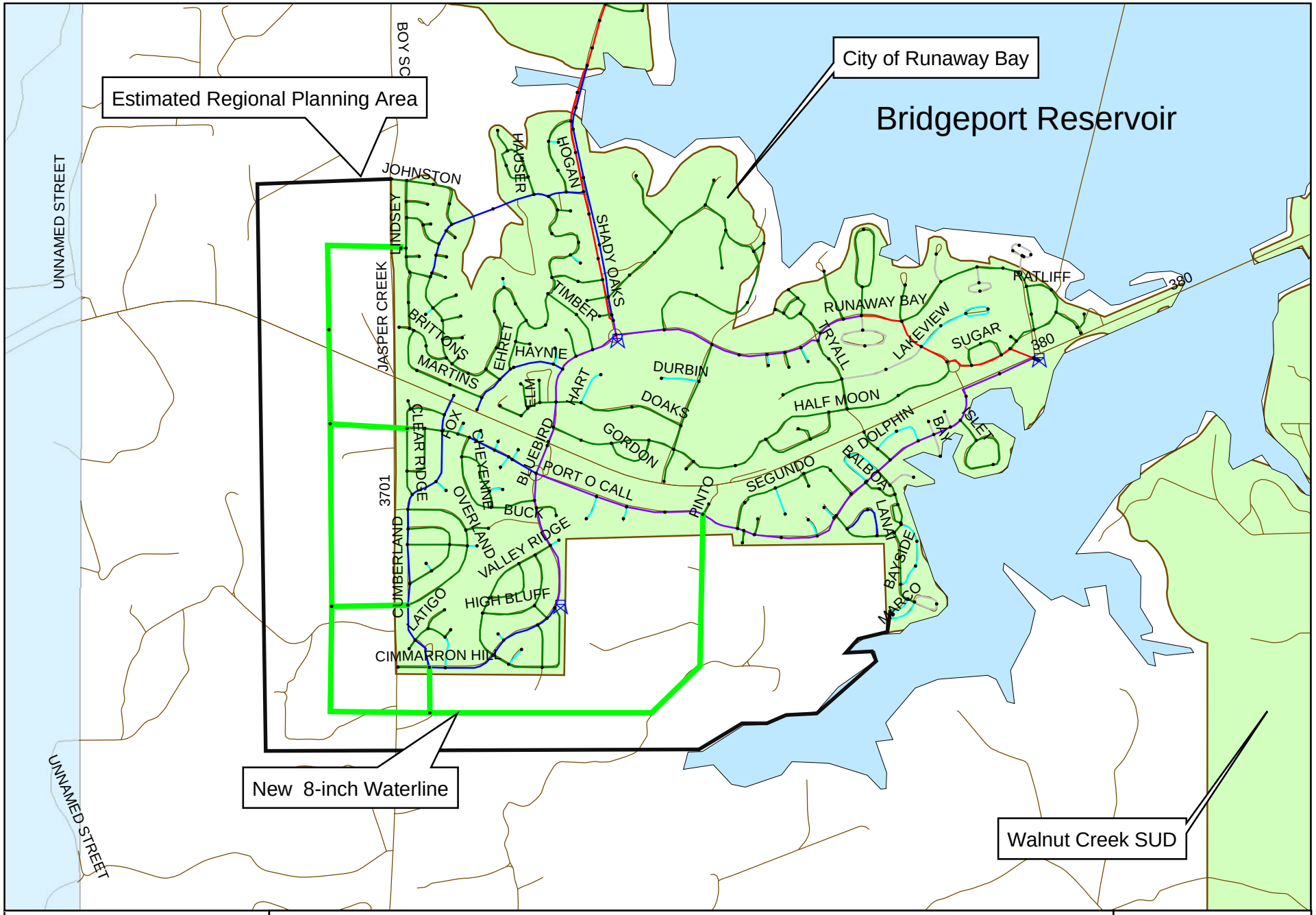
The City of Runaway Bay and Walnut Creek SUD both utilize Lake Bridgeport raw water. Based on the estimated location for growth outside the City of Runaway Bay service area could be served by Runaway Bay or Walnut Creek SUD.

Water System improvements needed for the City of Runaway Bay system to serve the regional water supply area include;

Facilities upgrades include

Plant capacity - 0.317 MGD
Pumping capacity - 352 gpm
Water Pipelines - 315,700 gallons per day (PD)

The waterline route for the regional planning area for service from the City of Runaway Bay is shown on ***Figure 3*** on the following page.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2030 Regional Water Plan
Supply from Runaway Bay

Figure 3

Water System improvements needed for the Walnut Creek SUD system to serve the regional water supply area include;

Plant capacity - 0.317 MGD
Pumping capacity - 352 gpm
Water Pipelines - 315,700 gallons per day (PD)

The waterline route for the regional planning area for service from the City of Runaway Bay is shown on ***Figure 4*** on the following page.

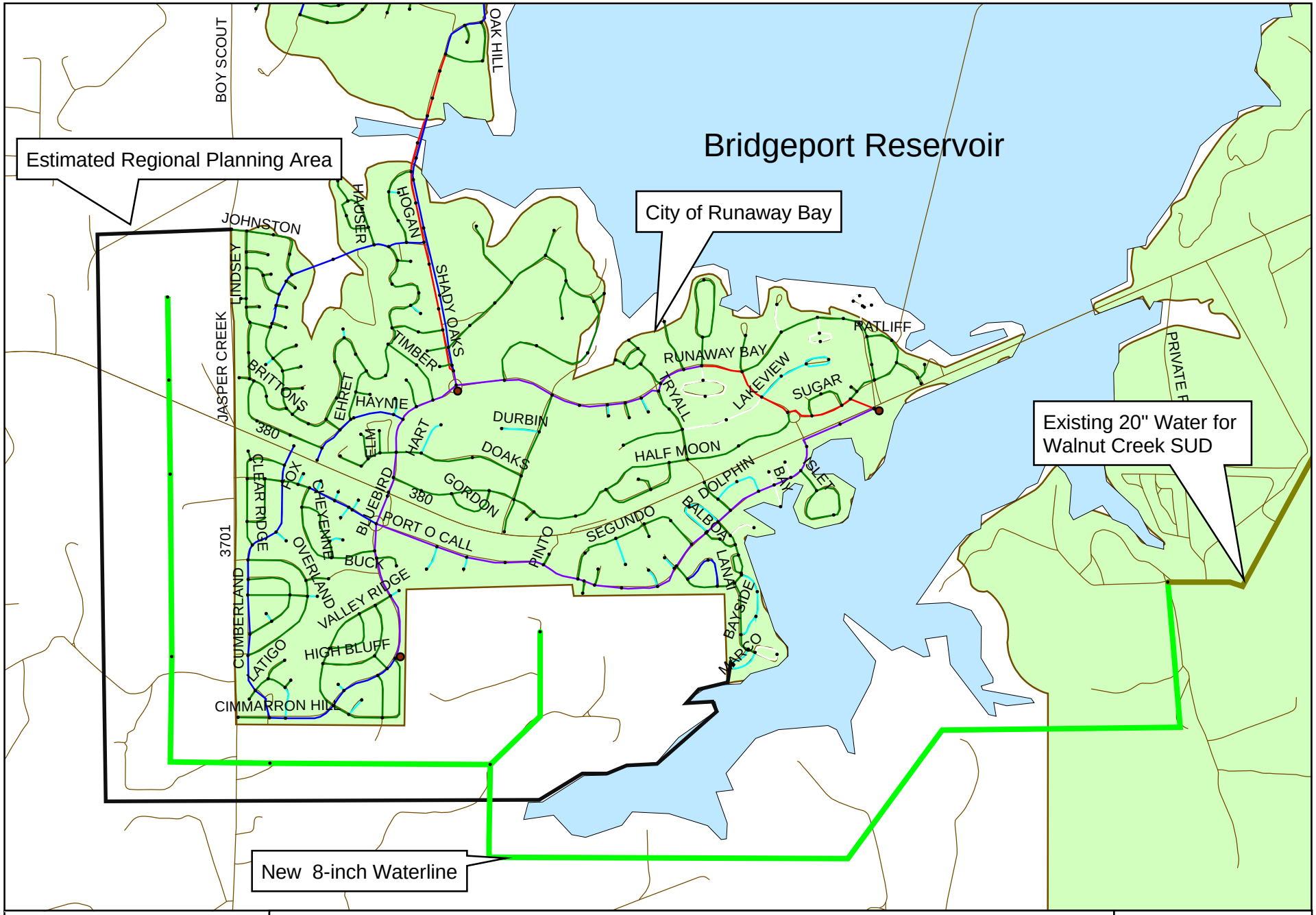
6.5 Opinion of Probable Costs

Below is an opinion of probable project costs for expansion of the Runaway Bay System and the Walnut Creek SUD. The costs are based on the improvements needed for the regional planning area. It is assumed that each potential water provider's water system is up to data and adequately sized for existing Year 2030 water demands.

Runaway Bay Supply					
Item	Description		Units	Unit Cost	Cost *(yr 2013$)*
1	Additional Plant Capacity		0.317 MGD	$1,000,000	$ 317,000
2	Additional Pumping Capacity		353 gpm	$ 100	$ 35,300
3	Water lines		22,500 feet	$ 110	$ 2,475,000
Grand Total					$ 2,827,300

Walnut Creek Special Utility District					
Item	Description		Units	Unit Cost	Cost *(yr 2013$)*
1	Additional Plant Capacity		0.317 MGD	$1,000,000	$ 317,000
2	Additional Pumping Capacity		353 gpm	$ 100	$ 35,300
3	Water lines		33,900 feet	$ 110	$ 3,729,000
Grand Total					$ 4,081,300

It is recommended that the City of Runaway Bay consider expanding their service area to meet the needs of the Year 2030 regional planning area. City of Runaway Bay system would be more reliable, with the additional connections to their existing system. Also, the overall system costs are less for the City of Runaway Bay.



BLACKSTONE ENGINEERING PLLC
PO BOX 2099
MANSFIELD, TEXAS 76063
TBPE F-10218 817.899.0656

Year 2030 Regional Water Plan
Supply from Walnut Creek SUD

Figure 4

APPENDIX D

Pipe Life Expectancy

Pipe Life Expectancy

The majority of water pipe in the Runaway Bay water service area is Asbestos-cement (AC) pipe and Polyvinyl Chloride pipe (PVC). Most of the pipe was installed between the late 1960's and early 1970's.

The "Water Main Break Rates in the USA and Canada: A Comprehensive Study" (Study), finds that the average age of failing water mains is 47 years old. The percent of common failure provided in the Study is 7.1% (per 100 miles/year) for AC pipe and 2.6% for PVC pipe.

AC pipe was used extensively in the mid-1900s in potable water distribution systems, particularly in the Western United States. The Chrysotile Institute estimates AC pipe lifespan at 70 years. Over time, AC pipe undergoes gradual degradation in the form of corrosion. Accordingly, as the water distribution system ages, the number of AC pipe failures increases with time.

Estimating the remaining life of distribution system piping is depending on many factors that are costly to determine. The remaining service life depends largely on the following items;

1. Quality of the pipe installation,
2. Correct pipe trench and backfill for the specific pipe,
3. Presence of Corrosion (not a factor with PVC)
4. Working environment. (such as working pressures)

The estimated life expectancy of PVC pipe is estimated to be 110 years. PVC

It is clear that pipe age has an effect on the failure rate of pipe.

The Environmental Protection Agency information states that pipes have life cycles that can range from 15 to over 100 years, depending on the type of material and where they are laid. With pipes, the material used and proper installation of the pipe can be a greater indicator of failure than age.

To accurately estimate the remaining life of the Runaway Bay water system, detailed investigations are needed. It is clear that the AC pipe is most likely to be problematic, due to corrosion and age.