

WATER AND SEWER SYSTEM MASTER PLAN



FOR THE
TOWN OF ELIZABETH

FEBRUARY 2020

WATER AND SEWER SYSTEM MASTER PLAN

FOR THE

TOWN OF ELIZABETH

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JVA Project No. 1052.1e

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APPENDICES

- APPENDIX A – WATER RIGHTS SUMMARY
- APPENDIX B – WELL DRILLING COST ESTIMATES

ABBREVIATIONS

Abbreviations used in this report are defined below:

ac-ft	acre feet
CIP	Capital improvements plan
FAR	Floor area ratio
ft	feet
gpm	gallons per minute
hp	horsepower
I&I	Infiltration and Inflow
LF	linear feet
LS	Lift Station
LIRF	Lawn Irrigation Return Flows
mgd	million gallons per day
mg	million gallons
RAS	return activated sludge
SCADA	Supervisory Control and Data Acquisition
SF	Square Feet
SFE	Single Family Equivalent
TDH	Total dynamic head
WAS	waste activated sludge
WWTP	wastewater treatment plant
UV	Ultraviolet

SECTION 1 – INTRODUCTION

The background and purpose for this Water and Sewer System Master Plan are described in this section.

BACKGROUND

The Town of Elizabeth (Town) and surrounding Elbert County area are predicted to see substantial growth over the next 20 years. In preparation for this potential growth, the Town has coordinated the development of three key planning documents including the Comprehensive Plan (adopted in December 2019), Transportation Plan and this Water and Sewer Master Plan.

This Master Plan builds on previous planning documents including the 1997 Water and Sanitary Sewer Master Plan Update, 2006 201-Facilities Plan, 2007 Confluence Wastewater Treatment Plant Evaluation, and 2009 Water Master Plan. In these previous plans, development densities and areas are different than currently planned and hence an updated review of proposed water and sewer facilities is presented in this document.

A key element of this Master Plan is the water supply. Supply options are limited, and the Town is essentially relying upon Denver Basin aquifers, specifically the Lower Dawson, Denver, Arapahoe and Laramie Fox Hills. These aquifers are non-renewable and therefore the Town is adopting a conservative approach in managing this valuable water resource, including:

- 300-yr supply. Essentially planning to use only one third of the State appropriated 100-yr aquifer resource.
- Reduce water consumption with the adoption of water conservation measures and xeriscaping requirements for commercial and multifamily developments
- Minimize use of the Upper Dawson aquifer and preserve this water resource for surrounding private residents.
- Integrate future water reclamation facilities for irrigation and indirect potable reuse.

MASTER PLAN PURPOSE AND GOALS

The overall purpose of this Water and Sewer System Master Plan is to provide a holistic and fresh overview of the current and future water and sewer infrastructure needs based on surrounding development impacts. The document is divided into the following sections:

- Existing Facilities
- Existing Water Supply
- Land Use & Water Resources
- Demand & Flow Projections
- Future Infrastructure
- Conclusions, Recommendations & Capital Improvements Plan

The review of water resources, flow projections, and future infrastructure is divided into With-In Town Boundary and Outside Town Boundary. The purpose of this division is to define infrastructure needs to serve the current community and differentiate this from the facilities needed for future Town annexations. There are pending developments in the Town boundary, and hence near-term capital improvement plans are focused on proposed facilities to serve these areas. The infrastructure and budgetary costs to serve potential annexations is also presented, but without an improvement plan since the timeline is unknown.

SECTION 2 – EXISTING FACILITIES

WATER SYSTEM

The Town water system is depicted in Figure 1. The major components of wells, tanks and distribution system are described in the following. Well water is chlorinated and pumped to the tanks and the disinfected water is then distributed to the community.

WELLS

The Town currently operates three Denver Basin wells to meet the Town’s potable water supply demands. These wells are referred to as the Dawson, Denver and Arapahoe wells. The Town also owns an additional two wells (Dawson & Denver) that are leased and operated by the School District to irrigate the Elizabeth High School and Middle School. Specific well data is provided in Table 1.

Table 1 – Denver Basin Wells

Well	Permit No.	Year Constructed	Total Depth (ft)	Approx. Depth to Water (ft)	100-Yr Annual Appropriation (ac-ft/yr)	Pumping Rate (gpm)
Dawson	15617-FR	2012	526	136	50	100
Denver	16210-FR	2009	1,591	216	150	150
Arapahoe	44454-FR	1995	2,149	1,831	132	200
School – Lower Dawson	52512-F	1977	564	106	21	20*
School – Denver	52511-F	1995	1,010	605	39.7	70*

* Estimate

The Arapahoe and Dawson wells are located on a site at the intersection of CR 136 and Pine Ridge Road and the Denver well is located at the Town’s tank farm. The irrigation wells are located near the schools. The Denver and Dawson wells have been replaced in the last 10 years, with the Arapahoe being the oldest, having been drilled 25 years ago. The Arapahoe well pump was replaced in the last five years. There are well houses at each of the two sites, utilized for chlorine dosing, tank level and flow monitoring. The Town has a Supervisory Control and Data Acquisition (SCADA) system which monitors tank levels and controls well pump operation.

TANKS

The Town owns three ground steel tanks with all tanks located at a single site on Pine Ridge Road. The tank capacities are 1.0 mg, 0.25 mg and 0.30 mg, for a total storage volume of 1.5 mg. The 1.0 mg tank was constructed in 2001 and is about 20 years old. The smaller two tanks are over 30 years old. The wall height for all three tanks is 32 feet. A master flow meter was installed as part of the Denver well replacement project and total demand for the Town is monitored in SCADA.

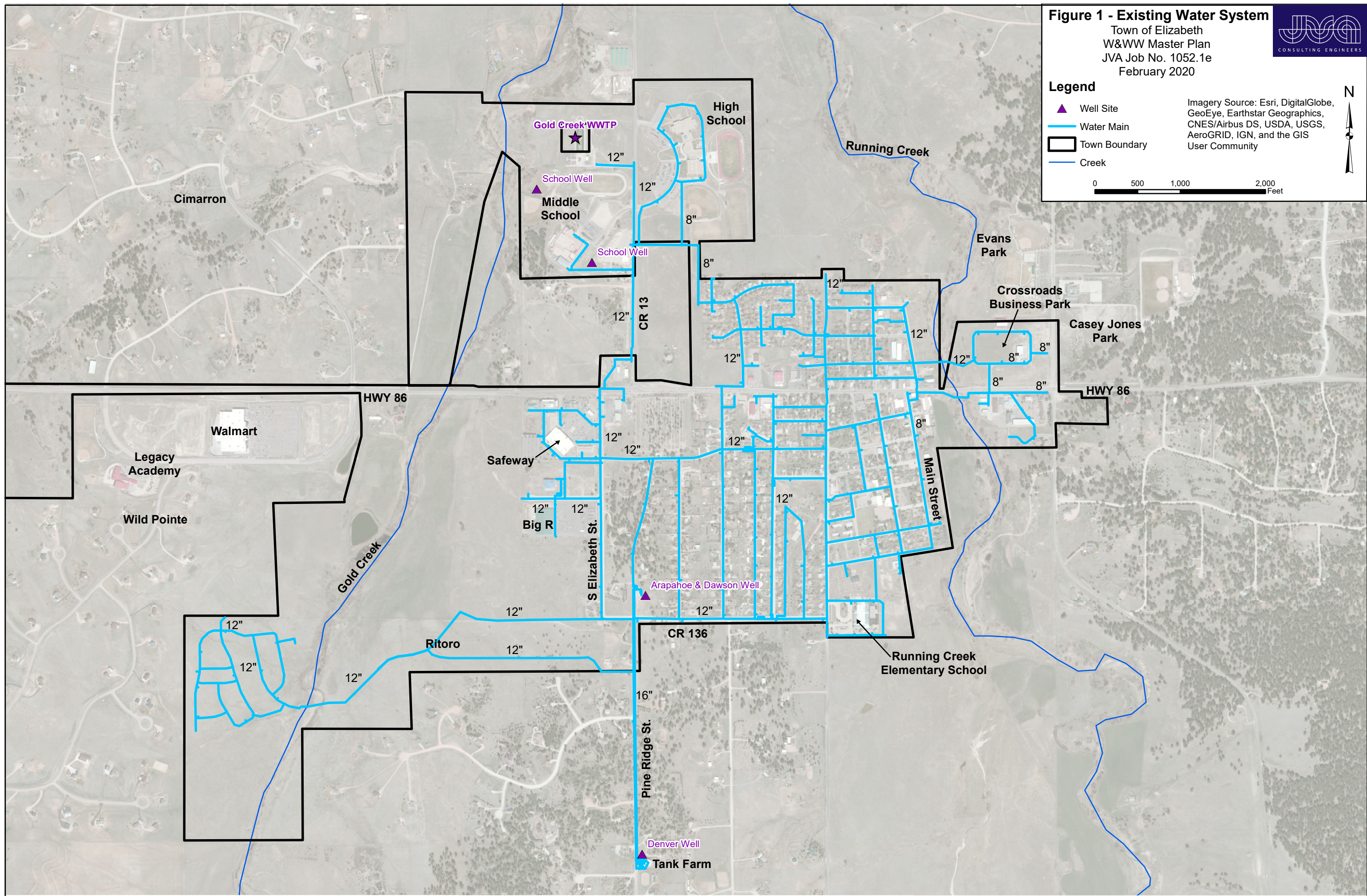
Figure 1 - Existing Water System

Town of Elizabeth
W&WW Master Plan
JVA Job No. 1052.1e
February 2020



Legend

- Well Site
 - Water Main
 - Town Boundary
 - Creek
- Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
- 0 500 1,000 2,000 Feet



DISTRIBUTION

The Town water distribution system consists of 12-inch, 8-inch, 6-inch and 4-inch main lines totaling about 19 miles in length. The entire Town is on a single pressure zone. Originally, a second lower pressure zone was created in the old Town area (Main Street), with pressure reducing valve (PRV) stations. These stations are bypassed, and Town residents are required to have individual PRVs to control pressures. These old PRV stations should be removed eventually, to maintain good transmission through the community which is required for serving developments east of Town.

SEWER SYSTEM

The Town sewer system consists of gravity sewer collection, lift stations and wastewater treatment. The overall system is depicted in Figure 2. Each element is described below.

COLLECTION SYSTEM

The Town sewer system consists of 15-inch, 12-inch and 10-inch trunk sewers and 8-inch and 4-inch sewer laterals. The entire sewer system is approximately 15 miles in length. Two 10-inch mains serve the Gold Creek drainage area, an upper and lower main. The upper 10-inch main flows by gravity to the Gold Creek WWTP and serves the current Safeway area and properties along Elizabeth Street. The lower 10-inch main feeds the Gold Creek Lift Station and serves the Wild Pointe commercial properties and the Ritoro development. Most of the Town flows by gravity, in the Running Creek drainage, down to a 12-inch trunk sewer in Garland St that feeds the Running Creek Lift Station.

LIFT STATIONS

Running Creek Lift Station

The Running Creek Lift Station is a wet well/dry well arrangement with three 35 hp submersible pumps located in the wet well (each pump is rated at 370 gpm at a TDH of 140 ft). Discharge piping from each pump enters the dry well where individual ball check valves and manual isolation valves are located. The three discharge pipes converge into a single 8-inch forcemain. Total pumped flow is monitored utilizing an 8-inch magnetic flow meter located in a dedicated metering vault. The pumps are equipped with variable frequency drives (VFDs) and are controlled based on wet well level and speed selection. Flow, wet well level, and pump speed are monitored in the Town SCADA system. The facility includes a back-up power diesel generator and emergency overflow storage.

Gold Creek Lift Station

The Gold Creek Lift Station consists of two 6 hp submersible pumps located in a wet well. Capacity of each pump is 124 gpm (staff have estimated the actual pumping rate at 80 gpm). The pump discharge lines pass through a valve vault housing check valves, isolation valves and a quick connect for emergency bypass purposes. The two discharge lines converge into a single 4-inch forcemain passing under Gold Creek and discharging into the Gold Creek 10-inch trunk sewer. The pumps are constant speed and operate based on wet well level. Pump operation times and approximate volume are monitored in the Town SCADA system. The system also includes a propane driven generator utilized for back-up power.

Crossroads Lift Station

The Crossroads Lift Station was originally constructed and operated by the Crossroads Development entity. In last five years, the State of Colorado requested that the Town take over operations and hence the Town now owns and operates this lift station. The lift station only serves the Crossroads commercial parcels and has sufficient capacity for build-out of the area. The lift station is a package Smith & Loveless system consisting of a wet well and dry well. Two pumps are in the drywell and can be accessed from a manway at ground level. The capacity of each pump is 100 gpm. The system also includes a diesel generator for backup power.

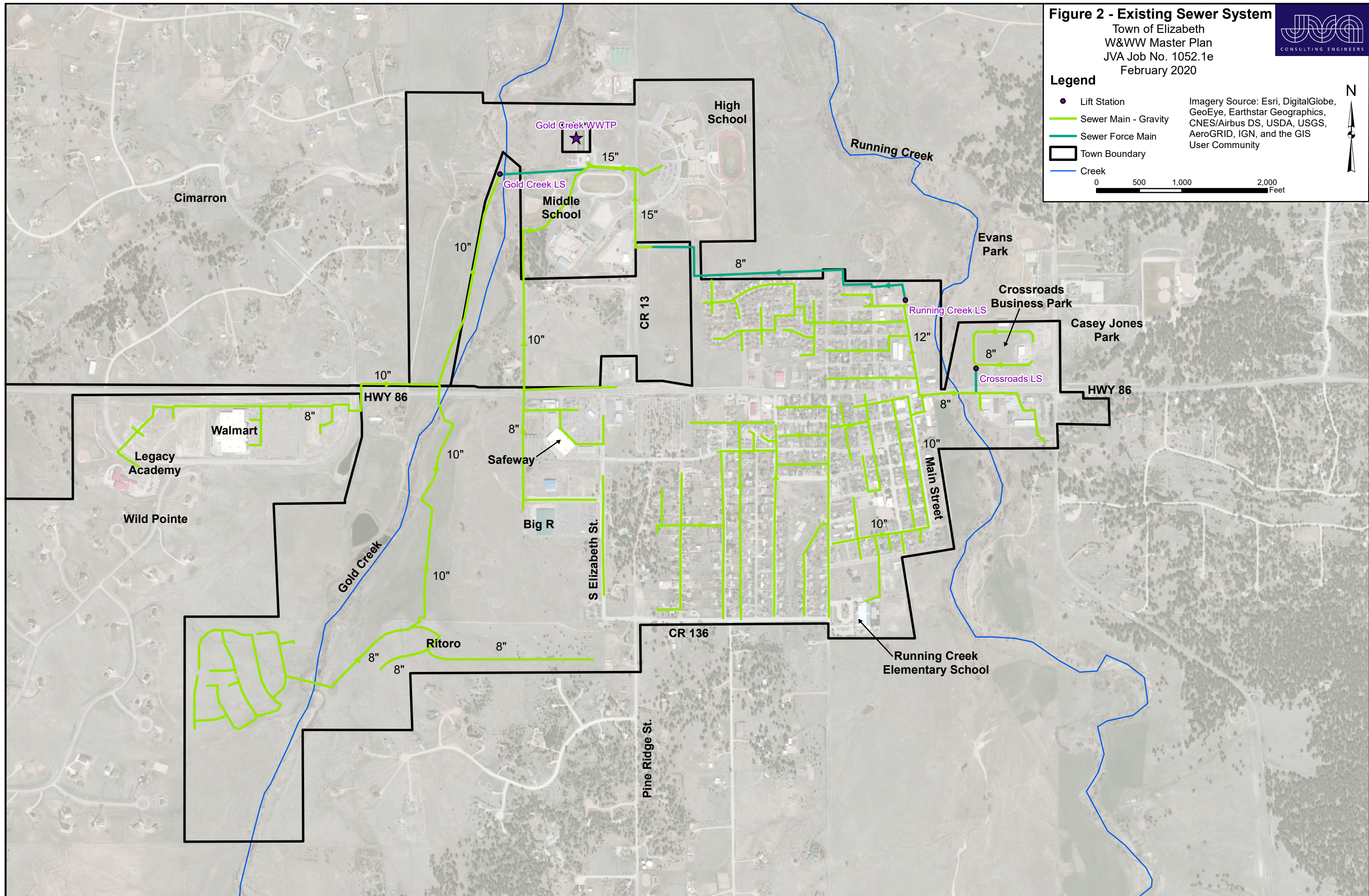
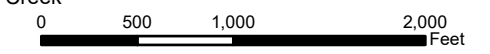
Figure 2 - Existing Sewer System

Town of Elizabeth
W&WW Master Plan
JVA Job No. 1052.1e
February 2020



Legend

- Lift Station
 - Sewer Main - Gravity
 - Sewer Force Main
 - ▭ Town Boundary
 - Creek
- Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



WASTEWATER TREATMENT PLANT

Prior to 2007 the Town operated two lagoon treatment systems one at Running Creek and one at Gold Creek. With the construction of the new mechanical wastewater treatment facility in 2008, the lagoon treatment systems were eliminated. The mechanical treatment facility was constructed at the Gold Creek site and a lift station was constructed at the Running Creek site to convey sewage to the centralized treatment facility. The Gold Creek WWTP has a rated capacity of 0.5 mgd. The facility is a nitrifying activated sludge facility and includes the following major components:

Headworks

Outside open channel headworks (with channel covers) including influent flow monitoring, fine screen (including screening washer and compactor) and bypass manual screen. Flow from the headworks is directed to a flow split structure prior to primary treatment.

Activated Sludge Treatment

The flow from the headworks can be split into two treatment trains consisting of mechanically mixed anoxic cells for denitrification followed by aerobic treatment for BOD and ammonia reduction. The mixed liquor feeds two 38-ft diameter clarifiers operated in parallel. The clarified effluent is combined into a common chamber for gravity conveyance to the UV disinfection system. The clarifiers are equipped with scum collection and bottom sludge removal. The scum and a portion of the Waste Activated Sludge (WAS) is pumped to the aerobic digesters and Return Activated Sludge (RAS) is recycled to the front end of the treatment train.

UV Disinfection

The clarified effluent is directed to the Ultraviolet (UV) disinfection channel. Two UV modules are arranged in series providing system redundancy. The UV system has been designed with a second, parallel channel to allow for future expansion. A fixed weir provides a controlled water surface over the UV bulbs. Flow from the UV channel is directed to an old chlorine contact channel and then out to the Gold Creek discharge.

Solids Handling System

Each process train has dedicated aerobic digesters. The WAS and scum are conveyed to the digesters for aerobic treatment. Sludge pumps are used to move digested solids to either digester or to a truck for offsite disposal. The digester solids are thickened using a decant system. Periodically, the blowers are shut down, allowing for digester settling. Supernatant is mechanically drawn at the water surface where it is discharged into an adjacent decant chamber. Decant pumps draw from the chamber and convey the flow to the front end of the treatment train. The digesters have been planned for conversion to aerobic treatment trains when the plant is expanded in the future.

SECTION 3 – EXISTING WATER SUPPLY

The Town's current water supply, well monitoring program and a synopsis of the recent Elbert County Rural Water Supply Study are described in this section.

CURRENT WATER RIGHTS

The Town's water supplies are from the Denver Basin aquifers which lie beneath the Town's property. All the Denver Basin aquifers exist beneath the Town. Those aquifers are the Upper Dawson, Lower Dawson, Denver, Arapahoe, and Laramie-Fox Hills. The Upper Dawson is the shallowest aquifer and the Laramie-Fox Hills is the deepest aquifer.

The Town's annual appropriations by Water Court decree and aquifer are provided in Appendix A and summarized in Table 2 below. The annual appropriation values are acre-feet per year (ac-ft/yr). The annual appropriation values are based on the presumed 100-year aquifer life from Colorado water law. The legal entitlement of this ground water is that one one-hundredth of the total original amount of ground water in storage can be withdrawn annually. However, in recognition of the valuable nature of this ground water resource the Town has voluntarily opted to follow a 300-year aquifer life standard. This standard means that the most ground water withdrawn in any year will be one three-hundredth of the total original amount of ground water in storage.

Municipal pumping from the Upper Dawson aquifer is tributary and municipal pumping from the remaining aquifers is non-tributary. Tributary groundwater means it is connected to local surface water supplies and therefore use of the water requires a plan for augmentation before groundwater can be pumped (augmentation plans establish replacements for stream depletions from well pumping). Non-tributary groundwater is not connected to surface supplies and therefore the amount pumped can be used to extinction, except for a two percent relinquishment requirement. For the Town, this means water reclamation can be employed by reuse for irrigation and/or for indirect potable reuse.

This plan shows that all future property annexations into the Town will not include municipal wells in the Upper Dawson aquifer. The purpose of this is to limit withdrawal from the Upper Dawson aquifer. Many of the surrounding Elbert County property owners use the Upper Dawson aquifer for their water supply.






The limits of the Town's Denver Basin ground water are shown in Figure 3. The total 100-year annual appropriation amounts by aquifer are summarized in Table 2.

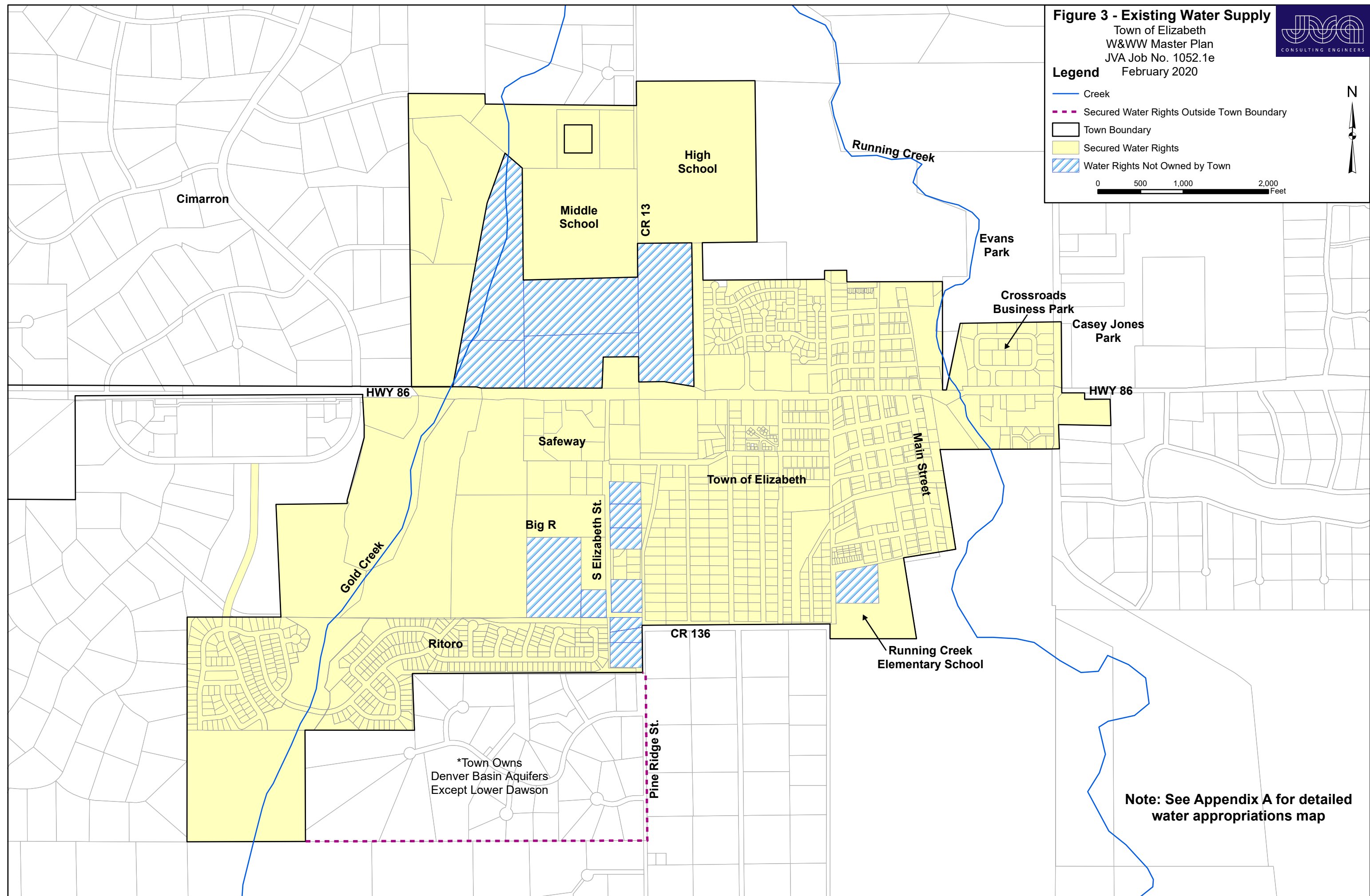
Figure 3 - Existing Water Supply

Town of Elizabeth
W&W Master Plan
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February 2020



Legend

-  Creek
 -  Secured Water Rights Outside Town Boundary
 -  Town Boundary
 -  Secured Water Rights
 -  Water Rights Not Owned by Town
- 0 500 1,000 2,000 Feet



*Town Owns
Denver Basin Aquifers
Except Lower Dawson

**Note: See Appendix A for detailed
water appropriations map**

Table 2 – Denver Basin Aquifers – 100-year Annual Appropriations Summary

Aquifer	Annual Appropriation (ac-ft/yr)
Upper Dawson	290.6
Lower Dawson	242.1
Denver	459.1
Arapahoe	380.6
Laramie-Fox Hills	341.4
Total	1,713.8
Total – Without Upper Dawson	1,423.2

As discussed above, the Town follows a standard that replaces the Colorado water law 100-year appropriation period with a 300-year appropriation period. The ground water supply standard means that the Town will base its annual pumping on a 300-year appropriation period. Table 3 lists the 300-year annual appropriation amounts.

Table 3 – Denver Basin Aquifers – 300-yr Annual Appropriations Summary

Aquifer	Annual Appropriation (ac-ft/yr)
Upper Dawson	96.9
Lower Dawson	80.7
Denver	153.0
Arapahoe	126.9
Laramie-Fox Hills	113.8
Total	571.3
Total – without Upper Dawson	474.4

The Town’s 300-yr appropriation totals 571.3 ac-ft/yr and 474.4 ac-ft/yr excluding the Upper Dawson aquifer. This 300-yr appropriation is compared to projected Town demands in Section 5 of this report.

CURRENT WELL MONITORING

The Town’s wells are equipped with pressure transducers that continuously measure the water level in the three municipal wells. The water level data and pumping rate data are monitored. This data can be used to evaluate groundwater level fluctuations overtime and the effects of water level decline on well production. The Town should institute a new program to tabulate, graph, and analyze the well water data. The water level analyses should be summarized in annual reports.

The adjacent Gold Creek Meadows Homeowner’s Association (south of the Town boundary) collects well water level data quarterly on 14 of their wells. Additionally, the United States Geological Survey (“USGS”) collects water levels on Elbert County wells. In conjunction with the proposed Town well level tracking/reporting program, the Town should also obtain the Gold Creek Meadows and USGS ground-water level data and include it in the proposed annual summary reporting. A yearly analysis of this comprehensive Elbert County well data will provide a holistic understanding of groundwater level changes.

Forsgren and Associates prepared a report for Elbert County entitled “Elbert County Rural Water Supply” in June 2018. The Town of Elizabeth is the largest water provider in Elbert County. However, development and ground water use outside of the Town’s water service area is of interest for planning purposes. The Town’s water supply planning is aligned with the water supply results presented in the Forsgren report. The Town and Elbert County acknowledge that the Denver Basin aquifers are their primary water supply. Both entities also acknowledge that ground-water levels and well pumping rates will decline over time and that the cost of ground water production will increase overtime. A 300-year ground water supply criteria, conservation, reuse, ground-water level and production monitoring, and the evaluation of renewable water supply alternatives are highlighted in the Elbert County report and are either current policies of the Town or recommendations of this Master Plan. The Town follows a 300-year ground water supply standard and will adjust its conservation ordinance to further reduce demands.

SECTION 4 – LAND USE & WATER RESOURCES

The Town Comprehensive Plan (Comp Plan) was recently adopted in December 2019. In the Comp Plan future development parcels and densities are defined. These designated parcels and densities are used in this section to predict future water use (i.e. water resources) for the projected Town build-out. In this section, the water resource calculation assumptions and unit demands are defined. In addition, a summary of the projected demands and groundwater supply are presented for areas “Within the Town Boundary” and areas “Outside the Town Boundary”.

WATER RESOURCE CALCULATIONS

The two key components for the water resources plan are predicted water supply and estimated demands. The supply and the demand must balance for the resource plan to be viable.

A typical 100-yr appropriation for the Lower Dawson, Denver, Arapahoe, and Laramie Fox Hills aquifers is 1.3 ac-ft/yr/acre (note: Upper Dawson is excluded). The supply is estimated based on the gross parcel area being developed. The 300-yr supply is approximately one third of the projected appropriation or 0.43 ac-ft/yr/acre. Return flow from the use of this non-tributary Denver Basin groundwater can be used to extinction and therefore, conservatively we have assumed an additional 50 percent can be reclaimed and reused adding an additional 0.22 ac-ft/yr/acre to the projected supply. For planning purposes, a total supply estimate of 0.65 ac-ft/yr/acre is used.

The following criteria are use in estimating future demands.

- 70% of the gross area is developable
- Estate Residential density – 1.3 dwelling units/acre
- Low Density Residential – 3.0 dwelling units/acre
- Medium Density Residential – 7.0 dwelling units/acre
- High Density Residential – 16.0 dwelling units/acre
- Average number of people/dwelling unit – 2.79
- Mixed Use – 30% of developable area – Residential
- Mixed Use – 70% of developable area – Commercial
- 40% FAR for Mixed Use
- 25% FAR Retail/Commercial/Business
- Retail – 0.3 SFE /1,000 sf
- Mixed Use Commercial – 0.4 SFE/1,000 sf
- Business - 0.5 SFE/1,000 sf
- Multifamily – 0.75 SFE per unit
- Demand
 - 0.35 ac-ft/yr/SFE – Low density & Estate Residential
 - 0.25 ac-ft/yr/SFE – Commercial, Retail, Multifamily & Business

The development areas of the Comp Plan are presented in Figure 4. We have provided a letter nomenclature (A) to designate parcel clusters. The current Evans and Casey Jones Parks are also shown. These parks are served with individual wells and it is assumed that this supply and irrigation

plan will not be changed. In addition, the proposed Confluence Park is shown to the north. The Confluence Park area is a proposed site for future Town infrastructure and demands are assumed to be minimal.

WITHIN TOWN BOUNDARIES

We have divided projections into “Within” and “Outside” the current Town boundary. The estimated demands for potential developments within the Town boundary can be added with existing demands for comparison to actual appropriated groundwater supplies. The estimated demands for potential properties within the Town boundary are summarized in Table 4 below. Projected population additions are also provided.

Table 4 – Annual Demands – Projected Additions in Town Boundary

Development Designation	Development Type	Gross Area (acre)	Population Addition	Total SFE	Avg. Annual Demand (ac-ft/yr)
G	Mixed Use & Retail	57	253	262	65
J	Mixed Use & Retail	47	162	191	48
W	Low Density Res & Retail	98	516	208	70
X	Low Density Res	42	246	88	31
Total		244	1,177	749	214

Figure 4 - Water Resources

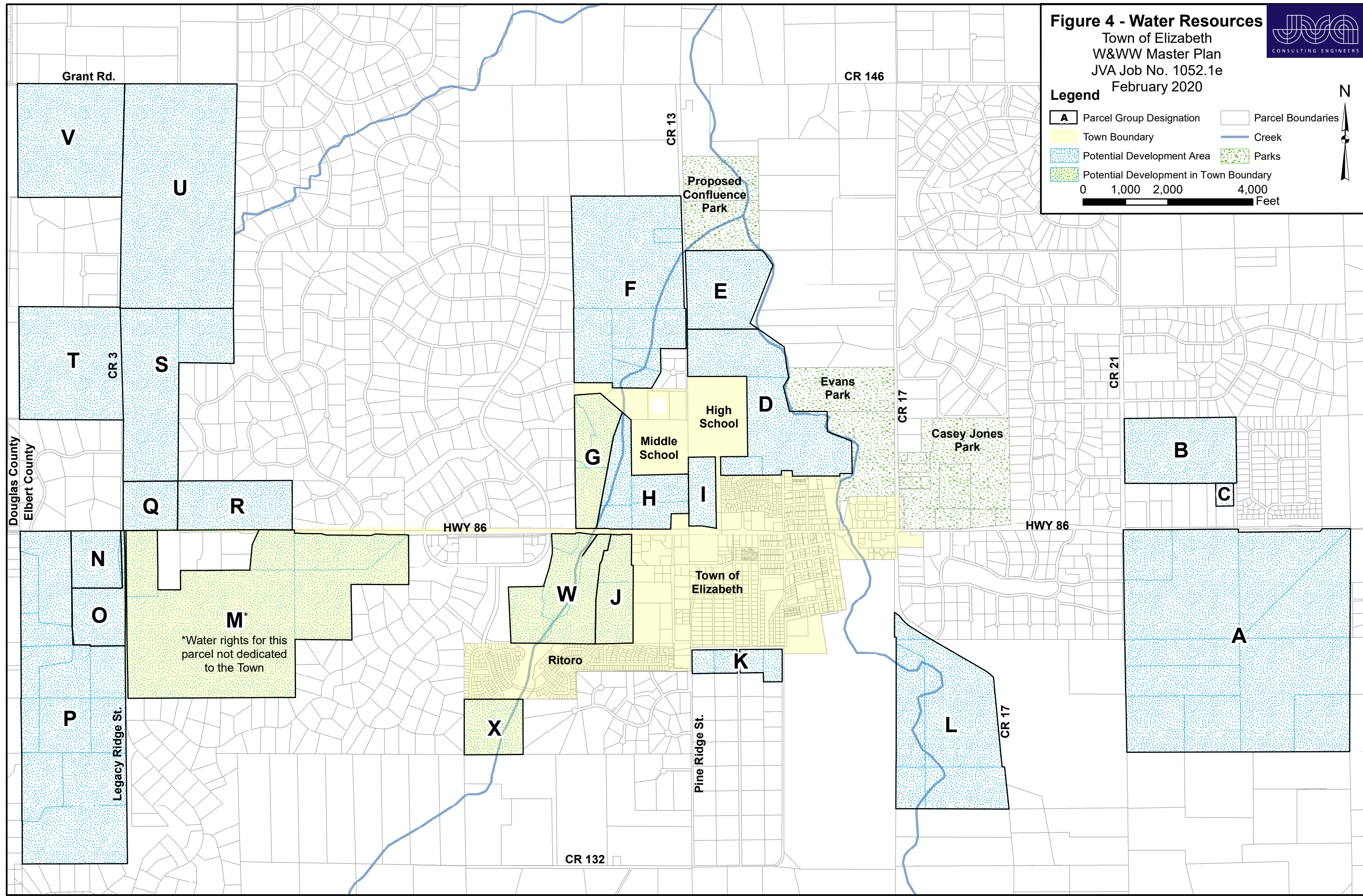
Town of Elizabeth
W&WW Master Plan
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February 2020



Legend

Parcel Group Designation	Parcel Boundaries
Town Boundary	Creek
Potential Development Area	Parks
Potential Development in Town Boundary	

0 1,000 2,000 4,000 Feet



OUTSIDE TOWN BOUNDARY – POTENTIAL ANNEXATIONS

Areas outside the Town boundary have not yet been annexed; therefore, an estimate of the potential groundwater supply and demand must be prepared. As detailed in Table 5 below, the overall estimated demand of all the potential parcels closely approximates the projected 300-year supply. Some of the individual parcels do show an imbalance in the demand/supply ratio, but the varying projected densities offset each other for an overall balanced plan.

Table 5 – Annual Demands – Projections Outside Town Boundary

Development Designation	Development Type	Gross Area (acre)	Population Addition	Total SFE	Avg. Annual Demand (ac-ft/yr)	300 year Supply (ac-ft/yr)
A	Low Density Res Mixed Use Business Park	640	2,580	1,812	537	416
B	Low Density Res	94	551	197	69	61
C	Business Park	5	0	19	5	3
D	Medium Density Res	157	1,610	577	144	102
E	Low Density Res	76	445	160	56	49
F	Low Density Res	256	1,500	538	188	166
H	Mixed Use & Retail	72	387	365	91	47
I	Medium Density Res	24	246	88	22	16
K	Mixed Use	28	197	166	42	18
L	Low Density Res	214	1,254	449	157	139
M ⁽¹⁾	Estate Res Low Density Res Retail	418	1,377	699	224	272
N	Mixed Use	37	260	220	55	24
O	Low Density Res	38	223	80	28	25
P	Estate Res	366	929	333	117	238
Q	Mixed Use	34	239	202	50	22
R	Low Density Res	72	422	151	53	47
S	Low Density Res	162	949	340	119	105
T	Estate Res	148	376	135	47	96
U	Estate Res	324	823	295	103	211
V	Estate Res	153	388	139	49	99
Total		3,318	14,756	6,965	2,156	2,156

(1) Area “M” “Elizabeth West” is annexed into the Town; however, water rights have not been dedicated, and therefore we have included this area as outside the Town Boundary.

SECTION 5 – DEMAND & FLOW PROJECTIONS

In this section the potable water demand and wastewater flow projections are defined, use of the hydraulic model is summarized, and estimates for “Within” and “Outside” the Town boundary are presented.

DEMAND AND FLOW CALCULATION FACTORS

Potable water demands and sewage flow estimates are based on the following factors.

1. Peak Month Wastewater Flow = 240 gal/day/SFE (includes I&I)
2. Peak Day Wastewater Flow = 270 gal/day/SFE (includes I&I)
3. Wastewater Flow - peak hour to peak day factor (2.5)
4. Maximum Day Potable Water Demand – Max Day to Yearly Average factor (1.7)
5. Peak Hour Potable Water Demand – Peak Hr to Max Day factor (2.0)

The peak month wastewater flow factor is consistent with previous sewer planning studies for the Town and the peak day and peak hour wastewater flows are a conservative estimate based on industry standards. The 1.7 maximum day to yearly average potable water demand factor is based on actual Town of Elizabeth operations data and the peak hour potable water factor of 2 is common for a community similar in size to the Town.

Peak month wastewater flows are commonly used for sizing treatment facilities and peak hour flows are used for lift station sizing. The maximum day potable water value is used to size infrastructure such as wells, booster pumps and tanks. The peak hour potable water figure is used for main line and booster pump sizing.

HYDRAULIC MODEL

The Town water distribution system was modeled in the 2009 Water Master Plan using WaterCAD. As part of this Master Plan, the original model has been upgraded and expanded into a new WaterGEMS program. Peak hour demand and fire flow modeling scenarios were used to verify that the existing water main infrastructure consisting of a 16-inch main line from the tanks, in combination with 12-inch mains within the community are of sufficient size to meet current and future demands. In addition, the model showed 12-inch mains at the Ritoro development and in potential future parcels such as Legacy Village (area W) are also of sufficient size to meet the future demands and fire flows.

WITHIN TOWN BOUNDARIES

In this section the wastewater flows and potable water demands are estimated for the buildout of the current Town boundary. The wastewater flow is divided into the Gold Creek drainage and Running Creek drainage with total flow monitored at the Gold Creek WWTP influent flow meter.

The Gold Creek drainage includes two 10-inch sewer mains (upper and lower). The upper sewer main flows by gravity to the Gold Creek WWTP and serves areas such as Safeway and areas along Elizabeth Street. The lower 10-inch sewer serves the Wild Pointe commercial site, Ritoro and development infill in the Gold Creek basin, with all flow feeding the Gold Creek Lift Station. The Running Creek drainage includes most of the Town with all wastewater flow feeding the Running Creek Lift Station. Wastewater flow projections in Running Creek included Town infill, infill at the Crossroads Business Park, Main street redevelopment and the proposed assisted living medical center.

Wastewater flow projections for buildout of the current Town boundary are presented in Table 6. Projected peak hour flows at the Gold Creek and Running Creek Lift Stations are also shown for estimating future sizing requirements.

Table 6 – Wastewater Flow Projections - Current Town Boundary

Area Designation	Total SFE	Peak Month (gal/day)	Peak Day (gal/day)	Peak Hour (gpm)
Current at Gold Creek WWTP	750 ⁽¹⁾	140,000 ⁽²⁾	160,000 ⁽²⁾	-
Gold Creek Upper – In-fill	30 ⁽³⁾	7,200	8,100	-
Gold Creek Lower to Lift Station				550⁽⁷⁾
Wild Pointe In-fill	50 ⁽⁴⁾	12,000	13,500	-
Ritoro – Phase I In-fill	10	2,400	2,700	-
Ritoro – Phase 2 & 3	210	50,400	56,700	-
Area “G”	262	62,900	70,700	-
Area “J” “Abraham”	191	45,800	51,600	-
Area “W” “Legacy Village”	208	49,900	56,200	-
Area “X”	88	21,100	23,700	-
Running Creek to Lift Station				240⁽⁸⁾
Cross-Roads In-fill	43 ⁽⁵⁾	10,300	11,600	-
Assisted Living/Medical Center	30	7,200	8,100	-
Main Street Redevelopment	20 ⁽⁶⁾	4,800	5,400	-
Town In-fill	70 ⁽⁶⁾	16,800	18,900	-
Projected Total	1,962	430,800	487,200	-

(1) Estimate - includes Wild Pointe commercial

(2) Based on operational data

(3) In-fill along Elizabeth Street – gravity flow to Gold Creek WWTP

(4) Wild Pointe In-fill including, Anytime fitness, and open lots west of Walmart

(5) 17 lots at 2.5 SFE per lot

(6) Estimate

(7) Estimated Peak Hour at the Gold Creek Lift Station – Town Boundary Buildout

(8) Estimated Peak Hour at the Running Creek Lift Station – Town Boundary Buildout

As depicted in Table 6, a total peak month of 430,800 gal/day is estimated for buildout of the Town boundary, which is less than the current WWTP capacity. In addition, peak hour flows of 550 gpm and 240 gpm are estimated for the Gold Creek and Running Creek Lift Stations. These peak hour flows represent the required firm capacity for the station and included current estimated peak day flows of 40,000 gal/day for Gold Creek and 90,000 gal/day for Running Creek. Recommended facility improvements based on these flow rates are detailed in Section 6 of this report.

The projected water demands for the Gold Creek and Running Creek drainages are summarized in Table 7. Note that the total SFE presented is lower than the wastewater estimate shown in Table 6 because the Town only provides sewer service to the Wild Pointe area.

Table 7 – Potable Water Demand Projections - Current Town Boundary

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (gal/day)
Current	650 ⁽²⁾	210 ⁽¹⁾	305,000 ⁽¹⁾
Cross-Roads In-fill	43 ⁽³⁾	11	16,700
Assisted Living/Medical Center	30 ⁽⁴⁾	11	16,700
Main Street Redevelopment	20 ⁽⁶⁾	5	7,600
Town In-Fill	100 ⁽⁵⁾	35	53,100
Ritoro – Phase I In-fill	10 ⁽⁶⁾	4	6,100
Ritoro – Phase 2 & 3	210	74	112,300
Area “G”	262	65	98,600
Area “J” “Abraham”	191	48	72,800
Area “W” “Legacy Village”	208	70	106,000
Area “X”	88	31	47,000
Projected Total	1,812	564	841,900

- (1) Based on operational data
- (2) Estimate – different from Table 6 because Wild Pointe commercial is not included
- (3) 17 lots – at 2.5 SFE per lot
- (4) Based on previous estimates for the property
- (5) Estimate base on properties like Elizabeth 44 Condos and Pine Ride Condos
- (6) Estimate

The projected average annual demand totals 564 ac-ft at buildout of the Town boundary. The Town’s legal 300 yr Denver Basin aquifer appropriations total 474 ac-ft without the Upper Dawson and 571 ac-ft including the Upper Dawson. The annual demand closely approximates the appropriated supply. A groundwater surplus is not predicted at buildout of the Town boundary.

OUTSIDE TOWN BOUNDARY – POTENTIAL ANNEXATIONS

In this section the wastewater flows and potable water demands are estimated for areas outside the current Town boundary. We have divided the discussion into areas; “Central – Adjacent to Town”, “North of Town”, “East of Town” and “West of Town”. These projected flows and demands are used to size the facilities described in Chapter 6

CENTRAL – ADJACENT TO TOWN

The Central areas are properties that can be served with existing Town infrastructure and extensions. The wastewater flow projections are detailed in Table 8.

Table 8 – Wastewater Flow Projections – Central & Adjacent to Town

Area Designation	Total SFE	Peak Month (gal/day)	Peak Day (gal/day)	Peak Hour (gpm)
Area “H” (1)	365	87,600	98,550	171
Area “I” (2)	88	21,120	23,760	41
Area “K” (3)	166	39,840	44,820	- (3)
Area “L” (4)	449	107,760	121,230	210
Projected Total	1,068	256,320	288,360	

- (1) Proposed – gravity sewer connection to existing 10-inch sewer main feeding the Gold Creek WWTP
 (2) Proposed – gravity sewer connection to existing 15-inch sewer main feeding the Gold Creek WWTP
 (3) Proposed – gravity sewer connection to multiple 8-inch sewer mains off CR 136 – feeding Running Creek Lift Station
 (4) Proposed – gravity sewer connection at HWY 86 & CR 17 – feeding Running Creek Lift Station

Note that area “H” does have a portion of the parcel along Gold Creek which could end up feeding the Gold Creek Lift Station. However, this area may be in the floodplain and not developable. The wastewater service will be determined based on actual development plans.

The Central area potable water demand projections are shown in Table 9.

Table 9 – Potable Water Demand Projections – Central & Adjacent to Town

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (gal/day)
Area “H” (1)	365	91	138,100
Area “I” (1)	88	22	33,400
Area “K” (1)	166	42	63,700
Area “L” (2)	449	157	238,200
Projected Total	1,068	312	473,400

- (1) Can be served by adjacent 12-inch water mains – in Town Zone Boundary
 (2) Can be served with 12-inch water main extension – in Town Zone Boundary

NORTH OF TOWN

Potential developments to the North are areas that can be served by water main extensions and the construction of a central lift station at the Confluence Park area. The area is included in the Town Pressure Zone. The wastewater flow projections are detailed in Table 10 and the potable water demand projections are shown in Table 11.

Table 10 – Wastewater Flow Projections – North of Town

Area Designation	Total SFE	Peak Month (gal/day)	Peak Day (gal/day)	Peak Hour (gpm)
Area "D" ⁽¹⁾	577	138,500	155,800	-
Area "E" ⁽¹⁾	160	38,400	43,200	-
Area "F" ⁽¹⁾	538	129,100	145,300	-
Projected Total	1,275	306,000	344,300	600⁽²⁾

(1) Propose - gravity sewer to centralized lift station at the proposed Confluence Park

(2) Projected ultimate peak hour wastewater flow at Confluence Park Lift Station

Table 11 – Potable Water Demand Projections – North of Town

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (gal/day)
Area "D" ⁽¹⁾	577	144	218,500
Area "E" ⁽¹⁾	160	56	85,000
Area "F" ⁽¹⁾	538	188	285,300
Projected Total	1,275	388	588,800

(1) Can be served with 16-inch water main extension – in Town Zone Boundary

EAST OF TOWN

Development areas east and west of Town will require standalone infrastructure including lift stations, wells, water tanks, and pump stations. The East area wastewater flow projections are detailed in Table 12 and the potable water demand projections are shown in Table 13.

Table 12 – Wastewater Flow Projections – East of Town

Area Designation	Total SFE	Peak Month (gal/day)	Peak Day (gal/day)	Peak Hour (gpm)
Area "A" ⁽¹⁾	1,812	434,900	489,200	849 ⁽³⁾
Area "B" ⁽²⁾	197	47,300	53,200	101 ⁽⁴⁾
Area "C" ⁽²⁾	19	4,600	5,100	-
Projected Total	2,028	486,800	547,500	-

- (1) Propose area to be served by Area "A" centralized lift station
- (2) Propose area to be served by Area "B" centralized lift station – also service Area "C"
- (3) Projected ultimate peak hour wastewater flow at Area "A" Lift Station
- (4) Projected ultimate peak hour wastewater flow at Area "B" Lift Station

Table 13 – Potable Water Demand Projections – East of Town

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (gal/day)
Area "A" ⁽¹⁾	1,812	537	814,900
Area "B" ⁽¹⁾	197	69	104,700
Area "C" ⁽¹⁾	19	5	7,600
Projected Total	2,028	611	927,200

- (1) Served with new central water system

WEST OF TOWN

The development area west of Town will require standalone infrastructure including lift stations, wells, water tanks, and pump stations. The West area wastewater flow projections are detailed in Table 14 and the potable water demand projections are shown in Table 15.

Table 14 – Wastewater Flow Projections – West of Town

Area Designation	Total SFE	Peak Month (gal/day)	Peak Day (gal/day)	Peak Hour (gpm)
Area "M" ⁽¹⁾	699	167,800	188,700	624 ⁽²⁾
Area "N"	220	52,800	59,400	-
Area "O"	80	19,200	21,600	-
Area "P"	333	80,000	89,900	156 ⁽³⁾
Area "Q"	202	48,500	54,500	-
Area "R"	151	36,200	40,800	600 ⁽⁴⁾
Area "S"	340	81,600	91,800	-
Area "T"	135	32,400	36,500	63 ⁽⁵⁾
Area "U"	295	70,800	79,700	300 ⁽⁶⁾
Area "V"	139	33,400	37,500	65 ⁽⁷⁾
Projected Total	2,594	622,700	700,200	-

- (1) Also known as Elizabeth West - propose area to be served by Area "M" centralized lift station
- (2) Projected ultimate peak hour wastewater flow at Area "M" Lift Station. Includes gravity flow from Areas "N" & "O" and the pumped flow from Area "P"
- (3) Projected ultimate peak hour wastewater flow at Area "P" Lift Station
- (4) Projected ultimate peak hour wastewater flow at Area "R" Lift Station. Includes gravity flow from Area "Q" and the pumped flows from Areas "T", "U" & "V"
- (5) Projected ultimate peak hour wastewater flow at Area "T" Lift Station
- (6) Projected ultimate peak hour wastewater flow at Area "U" Lift Station. Includes gravity flow from Area "S"
- (7) Projected ultimate peak hour wastewater flow at Area "V" Lift Station

Table 15 – Potable Water Demand Projections – West of Town

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (gal/day)
Area "M" ⁽¹⁾	699	224	340,000
Area "N"	220	55	83,500
Area "O"	80	28	42,500
Area "P"	333	117	177,500
Area "Q"	202	50	75,900
Area "R"	151	53	80,400
Area "S"	340	119	180,600
Area "T"	135	47	71,300
Area "U" ⁽¹⁾	295	103	156,300
Area "V" ⁽¹⁾	139	49	74,300
Projected Total	2,594	845	1,222,300

SUMMARY

A summary of the wastewater flow projections and potable water demands for the full planning area are depicted in Tables 16 and 17. As noted previously, the SFE estimate for the wastewater flow projection is higher than the potable water projections because of the Wild Pointe commercial area, which the Town only provides sewer service.

Table 16 – Wastewater Flow Projections – Summary

Area Designation	Total SFE	Peak Month (mgd)	Peak Day (mgd)
With-In Town Boundary ⁽¹⁾	1,962	0.43	0.49
Central – Adjacent to Town – Potential Development	1,068	0.26	0.29
North of Town – Potential Development	1,275	0.31	0.34
East of Town – Potential Development	2,028	0.49	0.55
West of Town – Potential Development	2,594	0.62	0.70
Projected Total	8,927⁽²⁾	2.11	2.37

(1) Includes Build-out in Gold Creek & Running Creek Drainages, and existing flows

(2) Total projected SFE – includes existing and potential developments

A total projected peak month flow of 2.11 mgd is estimated for the entire planning region. This closely approximates the master planned buildout capacity of 2.0 mgd for the Gold Creek WWTP site.

Table 17 – Potable Water Demand Projections - Summary

Area Designation	Total SFE	Avg. Annual (ac-ft/yr)	Max Day (mgd)
With-In Town Boundary ⁽¹⁾	1,812	564	0.84
Central – Adjacent to Town – Potential Development	1,068	312	0.47
North of Town – Potential Development	1,275	388	0.59
East of Town – Potential Development	2,028	611	0.93
West of Town – Potential Development	2,594	845	1.22
Projected Total	8,777⁽²⁾	2,720	4.05

(1) Includes Build-out in the current Town Boundary and existing

(3) Total projected SFE – includes existing and potential developments

As shown in Table 17, an approximate 4.0 mgd maximum day demand is projected for buildout of the entire planning region. All wells, booster pump stations and tanks must be sized to meet this demand. Required infrastructure is detailed in Section 6.

SECTION 6 – FUTURE INFRASTRUCTURE

In this section the type of water and sewer infrastructure facilities are described along with detailed sizing for specific systems. Listed budgetary costs are full project cost estimates including construction (2020 dollars), engineering and construction administration. Budgetary costs do not include any required land acquisition for siting facilities.

FACILITY TYPES & BUDGETARY COSTS

WELLS

The current Town water supply and all projected development will be served with the Denver Basin wells and reuse. HRS has provided well construction cost estimates (see Appendix B) which have been used to estimate the following budgetary costs. The well construction includes drilling, casing, screen, pump and pitiless adapter.

Lower Dawson Well (100 gpm)	= \$0.7 million
Denver Well (100 gpm)	= \$1.1 million
Arapahoe Well (180 gpm)	= \$1.4 million
Laramie-Fox Hills (180 gpm)	= \$1.7 million

A conservative pumping rate has been used for the wells, assuming a future decline in aquifer levels and pumping rate. For planning purposes, the total estimated pumping volume from a four-well installation cluster is 560 gpm, at a total well completion cost of \$4.9 million. Firm capacity is the pumpable volume with the largest well out of service. The wells must deliver the projected maximum day demands. Due to the water quality of the Laramie-Fox Hills aquifer, it is expected that blending will be required with the groundwater of the other wells. Each well cluster site will also require a well house for monitoring flow, chlorine addition for disinfection and other maintenance items. The well house will also include back-up power.

Well House	= \$1.0 million
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Most well clusters and corresponding well houses will be strategically located near tanks sites, so chlorine contact time can be achieved with the local storage.

TANKS

Three storage volumes are typically considered for tank sizing; operational, fire flow and emergency. These volumes are additive and sizing assumptions are described as follows:

Operational Storage – Storage required to supplement peak hour demands and manage production. This volume is set at 30 percent of the maximum day demand.

Fire Flow Storage – Storage required to accommodate fire flow demands within a respective pressure zone. Typical volumes are:

Residential – 2,500 gpm @ 2 hrs = 300,000 gallons
Commercial – 3,000 gpm @ 3hrs – 540,000 gallons

We have assumed the commercial fire flow will be required for all regions.

Emergency Storage – Storage required for emergency situations where production is limited. This volume is set at 50 percent of the Maximum Day Demand

There are essentially three tank options; elevated, ground steel, and buried concrete. Each option is described below. A budgetary unit cost is also provided for each tank option.

Elevated – elevated tanks are typically provided when local topography is flat and water must be stored at an elevated level to provide normal system pressures and fire flows. The current Town tanks are not elevated, with local hills being used to create pressure boundaries.

Budgetary Cost - \$5/gallon



Ground Steel - ground steel tanks are the most common and the least costly. Ground steel tanks are commonly used in regions with topographic relief, where tanks can be oriented strategically on local hills to provide system pressure. The Town uses similar tanks now.

Budgetary Cost - \$2/gallon



Buried Concrete – similar to ground steel tanks, buried concrete tanks are used in regions with topographic relief and can be sited strategically on local hills. If afforded by surrounding elevations and soil conditions (no bedrock), buried or partially buried tanks can be constructed. These tanks are more costly than ground tanks but have the added benefit of keeping the area more visually pleasing.

Budgetary Cost - \$3/gallon



WATER MAINS

Most water main costs are funded by developers as part of the overall distribution system. However, for interconnecting piping between regions the following budgetary unit costs are used. The unit costs include pavement replacement and Right of Way permits.

12-inch main	- \$250/LF
16-inch main	- \$300/LF

BOOSTER PUMP STATIONS

Currently the Town wells are pumped directly to the tank farm on Pine Ridge St., and therefore booster pumping is not required. However, specifically for future developments to the east and west, due to site topography, booster pumping will be required to maintain system pressures. The booster pump can be a “Type 1” where the volume pumped is simply the maximum day demand lifted to an elevated tank. The “Type 1” pump is conventional and the least costly. A more complicated “Type 2” booster station will be required if elevated storage is not employed. The “Type 2” booster station will draw volume from the local ground tank and provide system pressures along with fire flows. The “Type 2” booster station is larger and requires back-up power.

Booster Station – Type 1 (max day only)	= \$1.0 million
Booster Station – Type 2 (peak hr & fire flow)	= \$2.0 million

SEWER MAINS & FORCEMAINS

Most sewer main costs are funded by developers as part of the overall collection system. Areas specifically east, west and north of Town will require sewer extensions and lift stations to convey the sewage into the Town. Lift stations (described below) pump the sewage through forcemains to gravity conveyance high points. The sewer and forcemain unit budgetary costs are provided below and include pavement replacement where required and Right of Way permitting.

12-inch gravity sewer main	- \$300/LF
4-inch forcemain	- \$100/LF
6-inch forcemain	- \$150/LF
8-inch forcemain	- \$200/LF

LIFT STATIONS

All new developments east, west and north of Town will require sewage lift stations. Based on the estimated sizes, the following budgetary costs have been provided. The smallest lift station would include two (2) 10 hp sewage pumps and the largest is estimated at three (3) 50 hp sewage pumps. Submersible pumps housed in a wet well, a meter vault, back-up power and control system are assumed. There are alternate lift station arrangements such as dry well pumping and suction lift systems. These alternate systems will be reviewed as part of the design phase of the specific future project. Lift station budgetary costs are as follows:

Small Lift Station (2 – 10 hp pumps)	- \$0.5 million
Lift Station (3 – 15 hp pumps)	- \$1.0 million
Lift Station (3 – 25 hp pumps)	- \$1.5 million
Lift Station (3 – 50 hp pumps)	- \$2.0 million

WASTEWATER TREATMENT

The Town currently operates a nitrifying activate sludge treatment facility with a rated capacity of 0.5 mgd. The site is master planned for expansion to the ultimate build-out capacity of 2.0 mgd. The peak month projected flows are used for treatment sizing. Based on JVA's experience with treatment works the budgetary cost for expansion is:

Wastewater Treatment Plant Expansion	- \$10.0/gallon
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WATER PURIFICATION FACILITY & REUSE IRRIGATION

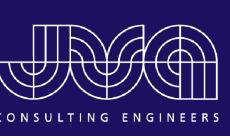
The Denver Basin aquifers are non-tributary and hence the Town water supply can be used to extinction. Currently wastewater effluent is discharged to Gold Creek and the Town has a lease agreement with downstream farmers. However, as part of the Town's water supply plan, this effluent is to be used for reuse irrigation and indirect potable reuse. With the proximity of the high school and middle school to the Gold Creek Wastewater Treatment Plant, the implementation of reuse irrigation at these schools is feasible. The reuse irrigation system would include a filtration unit and booster pumping system, conveying the filtered effluent to the local irrigation storage tank, located at the middle school. Implementation of the reuse system would also reduce the demand on the Denver Basin aquifers which are currently used for the irrigation supply. To fully utilize the Denver Basin supply, an indirect potable reuse facility (Water Purification) must be constructed and is assumed to be sited at Confluence Park. The facility would include an intake on Running Creek (collecting comingled water) and treatment process including oxidation, flocculation, sedimentation, biological media filtration, microfiltration, adsorption, UV oxidation and disinfection. Based on industry standards the budgetary costs are:

Reuse Irrigation (Filtration Plant)	- \$2.0 million
Water Purification Facility	- \$20.0/gallon

BUILDOUT OF CURRENT TOWN BOUNDARY

The proposed water and sewer systems for the current Town boundary are shown in Figure 5 and Figure 6. The facilities required to serve the existing Town at buildout are defined below along with budgetary costs. Project phasing is also described.

Figure 5 - Water System at Buildout
 Town of Elizabeth
 W&WW Master Plan
 JVA Job No. 1052.1e
 February 2020



Legend

Existing Well	Existing Water Main	Town Zone Boundary
Existing Tank	Town Boundary	Creek
Proposed Well Site	Potential Development Area	Major Contour
Proposed Tank	Parks	Minor Contour
Proposed Pump Station	Parcel Group Designation	
Proposed Water Main	Parcel Boundaries	

0 1,000 2,000 4,000 Feet

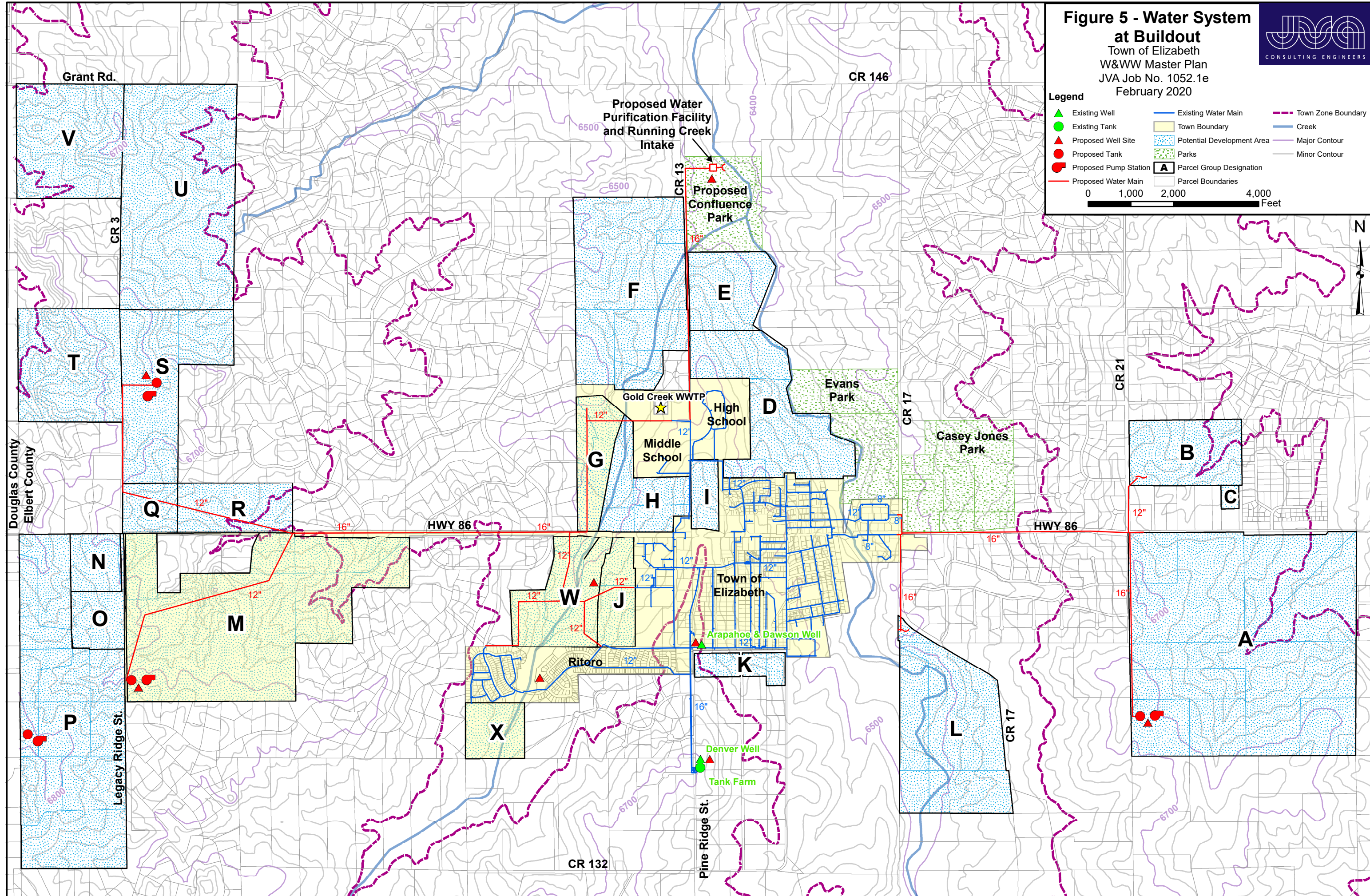


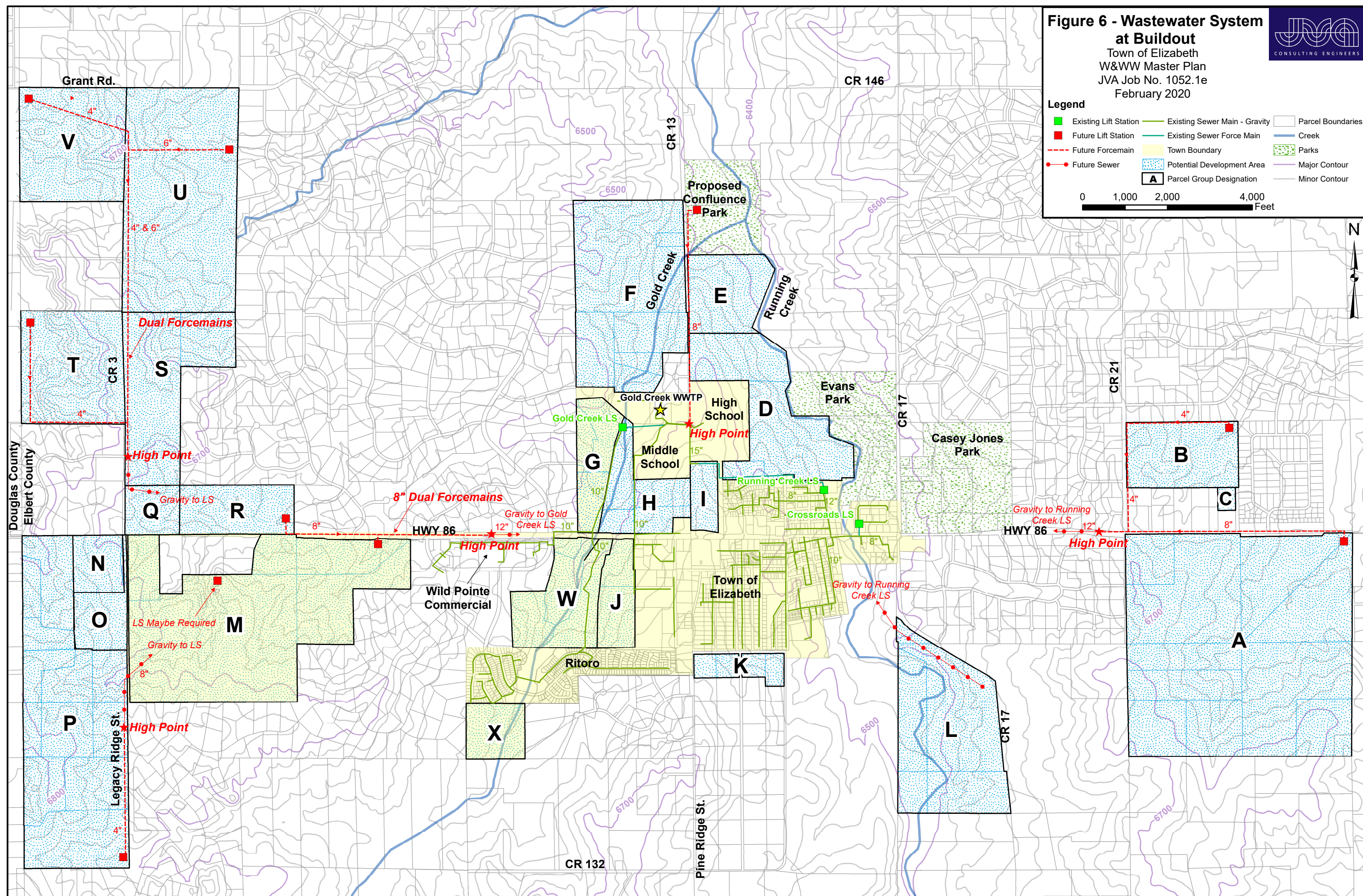
Figure 6 - Wastewater System at Buildout
 Town of Elizabeth
 W&WW Master Plan
 JVA Job No. 1052.1e
 February 2020



Legend

Existing Lift Station	Existing Sewer Main - Gravity	Parcel Boundaries
Future Lift Station	Existing Sewer Force Main	Creek
Future Forcemain	Town Boundary	Parks
Future Sewer	Potential Development Area	Major Contour
Parcel Group Designation	Minor Contour	

0 1,000 2,000 4,000 Feet



WELLS

The Town currently operates three Denver Basin wells (Arapahoe, Denver & Dawson) with a combined planning level capacity of 380 gpm. The current firm capacity with the largest well out of service (Arapahoe) is 200 gpm. The projected maximum day demand for build-out in the current Town Boundary is 841,900 gal/day or about 580 gpm. Additional well pumping at 380 gpm is required at build-out. Development of the Ritoro well site in two phases is recommend. Build-out of the Ritoro development is anticipated in 2020 and the Phase I wells must increase the supply to meet this demand. Adding an Arapahoe and Denver well is recommended for Phase I and the addition of a Lower Dawson well in Phase II. Timing for the Phase II project will be tied to the development schedule for parcels such as Legacy Village (Area W) or Abraham (Area J).

- Phase I - Ritoro Well Site
 - Arapahoe Well (180 gpm) \$ 1.4 million
 - Denver Well (100 gpm) \$ 1.1 million
 - Well House \$ 1.0 million
 - Total** **\$ 3.5 million**
- Phase II - Ritoro Well Site
 - Lower Dawson Well (100 gpm) \$ 1.4 million
 - Miscellaneous Well House Improvement \$ 0.2 million
 - Total** **\$ 1.6 million**

TANKS

The Town currently owns and operates a tank farm on Pine Ridge Road consisting of three ground steel tanks with a total capacity of 1.5 mg. The required volume of storage is based on 80 percent of the maximum day demand plus commercial fire flow at 0.54 mg. The projected maximum day demand for build-out in the current Town Boundary is 841,900 gal/day. Therefore, the required storage is 1.2 mg which is less than the current capacity. Additional storage is not required.

WATER MAINS

Each new development within the current Town boundary is required to provide a piping network with 12-inch looped mains connected into the existing Town distribution system. The combination of 8-inch and 12-inch looped piping is sufficient to meet peak hour and fire flow demands.

BOOSTER PUMP STATIONS

All development within the current Town boundary is in the Town Pressure Zone, with pressure provided by the current tank farm. Booster pumping is not required.

SEWER MAINS

The current sewer system is divided between the Running Creek drainage and Gold Creek drainage. Most of the proposed development within the Town boundary is to occur in the Gold Creek drainage. The current 10-inch and 12-inch sewer main sizing in the Running Creek drainage is more than adequate to serve build-out conditions. There are two 10-inch sewer mains serving the Gold Creek drainage. The upper 10-inch sewer connects by gravity to the Gold Creek WWTP

and has adequate capacity to serve the Safeway commercial area and developments along Elizabeth Street. The lower 10-inch sewer main serves areas such as the Wild Pointe commercial area, Ritoro, Legacy Village “W” and Abraham “J”. The 10-inch sewer main is sized appropriately for buildout within the Town boundary.

LIFT STATIONS

The Town currently operates three lift stations, Running Creek, Cross Roads and Gold Creek. Cross Roads is the smallest lift station and only serves the Cross Roads commercial area. This lift station is sized appropriately to accommodate build-out of the Cross Roads commercial pads. The firm capacity of the Running Creek Lift Station is 625 gpm. Projected build-out peak hour flows for the Running Creek drainage total 240 gpm, substantially lower than the current capacity. Improvements at the Running Creek Lift Station are not required.

The Gold Creek Lift Station was originally constructed to serve the Wilde Point commercial area (Walmart, Taco Bell, etc.). The lift station was designed for expansion, however at buildout a new replacement lift station will be required. The current lift station includes two 6 hp pumps with a firm capacity of approximately 100 gpm. The facility is expandable with the installation of two 15 hp pumps, increasing the firm capacity to approximately 200 gpm. The current peak hour flow is estimated at about 70 gpm, which is about 70 percent of the current capacity. The Gold Creek Lift Station should be expanded in 2020. The expanded firm capacity of 200 gpm is adequate to accommodate the build-out of Wild Point and Ritoro. However, the expanded facility will not have the capacity to serve developments such as Legacy Village “W” or Abraham “J”.

Improvements to the Gold Creek Lift Station should be completed in 2020, with a future replacement lift station constructed in phases. Required preliminary engineering documents and costs are also defined.

- Prepare Preliminary Engineering Report and Site Application for Gold Creek Lift Station Expansion **\$ 30,000**
- Expand Gold Creek Lift Station
 - Emergency Storage \$ 100,000
 - Replace 6 hp pumps with 15 hp pumps \$ 50,000
 - Replace 30 kw propane generator with 85 kw unit \$ 100,000
 - Electrical and I&C Upgrades \$ 30,000
 - Ancillary improvements \$ 20,000
- Total** **= \$ 300,000**
- Preliminary Design for Gold Creek Lift Station Replacement **\$ 50,000**
- Gold Creek Ultimate Lift Station – Phase I
 - Required for Buildout in the current Town boundary
 - Phase I – Lift Station
 - 600 gpm capacity three pumps each rated at about 300 gpm
 - Lift Station - three 15 hp pumps **- \$ 1.0 million**
 - Two 8-inch forcemains crossing Gold Creek
2 x 1,300 LF x \$200/LF **- \$ 0.5 million**
 - Phase II – Lift Station
 - Triggered by developments West of Town (see below)

WASTEWATER TREATMENT

The Town’s current wastewater treatment capacity is 0.5 mgd. The projected peak month sewage flows total 0.43 mgd for build-out within the Town boundary. Technically plant expansion is not required, however CDPHE requires expansion planning when capacities exceed 80 percent of capacity and must be under construction when flows and loading exceed 95% of capacity.

OUTSIDE TOWN BOUNDARY – POTENTIAL ANNEXATIONS

The proposed infrastructure for potential annexations outside the current Town Boundary are described in this section. The regions are divided into “Central – Adjacent to Town”, “North of Town”, “East of Town” and “West of Town”.

CENTRAL – ADJACENT TO TOWN

These are the areas of potential build-out adjacent to Town that can be served with existing infrastructure and extensions. These areas include “H”, “I”, “K” & “L” which are depicted in Figure 5 and Figure 6. Projected infrastructure improvements are described in the following.

Wells (Central)

The water supply firm yield is projected to be 580 gpm at buildout of the current Town boundary. The addition of development areas “H”, “I”, “K” & “L” will increase the maximum day demand to approximately 900 gpm. Additional well pumping at 320 gpm is required. There are a few scenarios for well expansion, but full development of the Ritoro well site and the addition of an Arapahoe well at the existing Tank farm are suggested, providing an additional capacity of 360 gpm.

- Existing Well Site (Tank Farm)
 - Arapahoe Well (180 gpm) \$ 1.4 million
 - Improvements to Existing Well House \$ 0.2 million
 - Total** **\$ 1.6 million**
- Buildout Ritoro Well Site
 - Laramie-Fox Hills Well (180 gpm) \$ 1.7 million
 - Miscellaneous Well House Improvement \$ 0.2 million
 - Total** **\$ 1.9 million**

Tanks (Central)

The Town current storage capacity of 1.5 mg. The required volume of storage is based on 80 percent of the maximum day demand plus fire flow at 0.54 mg. The projected maximum day demand for build-out in the current Town Boundary plus developments “H”, “I”, “K” & “L” is approximately 1.3 mgd. The calculated storage requirement of 1.5 mg matches the current capacity. Additional storage is not required.

Water Mains (Central)

Each new development within the current Town boundary is required to provide a piping network with 12-inch mains looped and connected into the existing Town distribution system. Areas “H” & “I” will loop water from the existing 12-inch in CR 13. Development area “K” will be served with extensions from the mains adjacent to CR 136. An approximate 2,000 LF 12-inch water extension will be required for Area “L”.

Area “L” 2,000 LF 12-inch Water Main Extension - **\$ 0.5 million**

Booster Pump Stations (Central)

These central developments are in the Town Pressure Zone, with pressure provided at the tank farm. Booster pumping is not required.

Sewer Mains (Central)

The central developments can be served with existing infrastructure. Area “H” will connect to the upper Gold Creek 10-inch sewer and Area “I” will connect to the existing 15-inch sewer in CR 13. Area “K” will connect into multiple existing sewer stubs along CR 136 and will feed into the Running Creek Lift Station. Area “L” will also feed into the Running Creek Lift Station, but because of sewer capacity issues east of Running Creek, the proposed 12-inch sewer extension will need to cross Running Creek and connect into the existing 12-inch main on Garland Street.

Area “L” 3,000 LF 12-inch Sewer Main Extension - **\$ 0.9 million**

Lift Stations (Central)

Areas “H” & “I” will connect into the Gold Creek WWTP by gravity. Areas “K” & “L” will feed into the Running Creek Lift Station with an added peak hour volume of approximately 290 gpm. Adding in the projected peak hour flow for build-out in the Town boundary gives a total peak hour flow of 520 gpm. The firm capacity of the Running Creek Lift Station is 625 gpm, which exceeds the projected peak hour flows. Improvements at the Running Creek Lift Station are not required.

Wastewater Treatment (Central)

The Town’s current treatment capacity is 0.5 mgd. The projected peak month sewage flows including Town build-out total approximately 0.70 mgd. Expansion of the treatment facility will be required. Expansion is planned in 0.5 mgd increments.

Expand WWTP from 0.5 mgd to 1.0 mgd - **\$ 5.0 million**

NORTH OF TOWN

The proposed facilities for areas north of Town are described in this section. These areas include “D”, “E” & “F”. Proposed infrastructure is shown in Figure 5 and Figure 6.

Wells (North)

The combined improvements for buildout of the Town boundary and Central developments gives a total firm well capacity of 940 gpm. Including Town buildout, Central developments and Northern development areas “D”, “E” & “F”, the maximum day demand increases to approximately 1,300 gpm. These areas are included in the current Town Pressure zone, so the addition of wells at existing wells sites is feasible. Additional well pumping of at least 360 gpm is required. Expansion at the CR 136 and Tank Farm well sites is suggested providing an additional capacity of 560 gpm. This added capacity exceeds what is needed but is recommended to provide additional water supply redundancy.

- Existing Well Site (CR 136 & Pine Ridge) (280 gpm)
 - Denver Well (100 gpm) \$ 1.1 million
 - Laramie-Fox Hills Well (180 gpm) \$ 1.7 million
 - Replace 8-inch raw water line in Pine Ridge Rd.
 - 3,000 lf – 12-inch raw water main \$ 0.8 million
 - Add second Well House \$ 1.0 million
 - Total** **\$ 4.6 million**
- Existing Well Site (Tank Farm) (280 gpm)
 - Lower Dawson (100 gpm) \$ 0.7 million
 - Laramie-Fox Hills Well (180 gpm) \$ 1.7 million
 - Improvements to Existing Well House \$ 0.3 million
 - Total** **\$ 2.7 million**

As shown in Figure 5, the future Water Purification facility is planned for the northern Confluence Park area. This site is also ideal for establishing an additional well cluster and should be planned and held in reserve for a future back-up water supply.

Tanks (North)

The Town current storage capacity of 1.5 mg. The required volume of storage is based on 80 percent of the maximum day demand plus fire at 0.54 mg. The projected maximum day demand for build-out in the current Town boundary, Central developments; and Northern developments totals approximately 1.9 mgd. The calculated storage requirement is 2.0 mg which is less than the current 1.5 mg capacity. The addition of a fourth tank with storage capacity of 0.5 mg is assumed for the existing tank farm. However, depending on development timing for areas east and west of Town, storage in these regions could also be used for this purpose.

0.5 mg Ground Steel Tank at Existing Tank Farm - **\$ 1.0 million**

Water Mains (North)

New developments are required to provide a piping network with 12-inch mainlines looped and connected into the existing Town distribution system. The Northern areas will be served with a 16-inch water main extension in CR 13. This main will also be used to convey treated water from the future Water Purification Facility. The Northern areas are lower in elevation and system pressures are expected to be higher at 130 psi in some regions.

6,000 LF 16-inch Water Main Extension - **\$ 1.8 million**

Booster Pump Stations (North)

The northern development areas are in the Town Pressure Zone, with pressure provided at the tank farm. Booster pumping is not required.

Sewer Mains (North)

Each of the northern developments will be required to appropriately size sewer mains that will ultimately gravity feed to the centralized lift station, proposed at the Confluence Park area.

Lift Stations (North)

The projected peak hour sewage flow and lift station capacity for the Northern Area is 600 gpm. The northern lift station is proposed to be sited at the proposed Confluence Park area (see Figure 6)

Northern Lift Station

- 600 gpm capacity - three pumps each rated at about 300 gpm
 - Lift Station - three 50 hp pumps - **\$ 2.0 million**
 - 8-inch forcemain along CR 13 – 5,000 LF - **\$ 1.0 million**
- Total = \$ 3.0 million**

Wastewater Treatment (North)

The Town's current treatment capacity is 0.5 mgd and an expansion, doubling the capacity to 1.0 mgd is projected to serve the Central development areas. Including the Northern development areas, the peak month sewage flow is estimated to increase to 1.0 mgd, matching the expanded treatment capacity.

EAST OF TOWN

Areas east and west of Town are isolated developments with localized infrastructure. The existing Town systems will be interconnected providing some redundancy, but most of the facilities in these areas will be stand alone.

Wells (East)

The total maximum day demand for the eastern properties “A”, “B” and “C” is approximately 640 gpm. A four-well cluster is planned and will be sited adjacent to the proposed tank(s) to provide chlorine disinfection contact time.

Well Site (560 gpm)	
○ Lower Dawson Well (100 gpm)	\$ 0.7 million
○ Denver Well (100 gpm)	\$ 1.1 million
○ Arapahoe Well (180 gpm)	\$ 1.4 million
○ Laramie-Fox Hills Well (180 gpm)	\$ 1.7 million
○ Well House	<u>\$ 1.0 million</u>
Total	\$ 5.9 million

The total demand of 640 gpm exceeds the four-well cluster of 560 gpm. It is assumed that the 80 gpm differential will be supplemented from the Town supply, also providing redundancy.

Tanks & Booster Pump Stations (East)

The required volume of storage is based on 80 percent of the maximum day demand plus fire at 0.54 mg. The projected maximum day demand for the eastern developments totals 930,000 gal/day. The calculated storage requirement is 1.3 mg. Due to topography, there are two storage options, elevated or ground steel. Standard (Type 1) booster pump stations can be used with elevated tanks, while more complicated (Type 2) booster stations will be paired with ground storage tanks. The tanks maybe constructed in phases, and a combination of tanks and pump stations are likely. Budgetary costs are provided only for the two base tank options.

Elevated Storage	
○ 1.0 mg of elevated storage	\$ 5.0 million
○ 0.3 mg ground steel storage	\$ 0.6 million
○ Type 1 Booster Pump Station	<u>\$ 1.0 million</u>
Total	\$ 6.6 million
Ground Steel Storage	
○ 1.3 mg of storage	\$ 2.6 million
○ Type 2 Booster Pump Station	<u>\$ 2.0 million</u>
Total	\$ 4.6 million

Water Mains (East)

New developments are required to provide a piping network with 12-inch mains looped and interconnected into the distribution system. The Eastern areas will be interconnected with the Town using a 16-inch water main extension in HWY 86. (see Figure 5). It is assumed that main extensions on the parcel will be funded by the developer.

5,000 LF 16-inch Water Main Extension - **\$1.5 million**

Sewer Mains (East)

Each of the developments will be required to appropriately size sewer mains. However, for the eastern development an off-site 12-inch sewer main will be required to convey sewage to the existing Running Creek Lift Station site where a second lift station must be constructed to serve the Eastern developments (see Figure 6).

8,000 LF 12-inch Sewer Main Extension - **\$2.4 million**

Lift Stations (East)

Three lift stations are required to serve the eastern area. Two lift stations to convey the sewage over the eastern ridge and a third lift station at the Running Creek Site to convey sewage to the Gold Creek Wastewater Treatment.

Eastern Lift Station – Serving Areas “B” & “C”

- 100 gpm capacity two pumps each rated at about 100 gpm
- Lift Station - two 10 hp pumps - **\$ 0.5 million**
- 4-inch forcemain – 5,500 LF - **\$ 0.6 million**

Total = \$ 1.1 million

Eastern Lift Station – Serving Area “A”

- 850 gpm capacity three pumps each rated at about 450 gpm
- Lift Station - three 50 hp pumps - **\$ 2.0 million**
- 8-inch forcemain – 6,000 LF (HWY 86) - **\$ 1.2 million**

Total = \$ 3.2 million

Second Running Creek Lift Station

- 950 gpm capacity three pumps each rated at about 500 gpm
- Lift Station - three 50 hp pumps - **\$ 2.0 million**
- 8-inch forcemain – 4,000 LF - **\$ 0.8 million**

Total = \$ 2.8 million

Wastewater Treatment (East)

A peak month flow of 1.5 mgd is estimated for serving Town buildout, Central, North and East developments. Assuming the 1.0 mgd treatment plant expansion is in place, a second 0.5 mgd expansion would be required.

Expand WWTP from 1.0 mgd to 1.5 mgd - **\$ 5.0 million**

WEST OF TOWN

Areas east and west of Town are isolated developments with localized infrastructure. The existing Town systems will be interconnected providing some redundancy, but most of the facilities in these areas will be standalone.

Wells (West)

The total maximum day demand for the western properties is approximately 850 gpm. Two sites with four-well clusters are planned and will be sited adjacent to the proposed tank(s), to provide chlorine disinfection contact time. The two well clusters are planned for the north and south sides of HWY 86 to provide separation (see Figure 5)

Well Site (560 gpm x 2 = 1,120 gpm)	
○ Lower Dawson Well (100 gpm)	\$ 0.7 million
○ Denver Well (100 gpm)	\$ 1.1 million
○ Arapahoe Well (180 gpm)	\$ 1.4 million
○ Laramie-Fox Hills Well (180 gpm)	\$ 1.7 million
○ Well House	<u>\$ 1.0 million</u>
Total (Well Site 1)	\$ 5.9 million
Total (Well Site 2)	\$ 5.9 million
Total	\$11.8 million

The supply for the two well clusters totals 1,120 gpm, exceeding the projected maximum day demand of 850 gpm. The surplus pumping capacity of 270 gpm will providing redundancy for the western developments.

Tanks & Booster Pump Stations (West)

The required volume of storage is based on 80 percent of the maximum day demand plus fire at 0.54 mg. The projected maximum day demand for the western development's totals 1.2 mgd. The calculated storage requirement is 1.5 mg. The optimum tank site for the western region is the peak elevation of area "P" (see Figure 5). The area "P" tank site can serve the other western parcels, however smaller tanks at the well cluster sites will be required for chlorine contact and for interconnection with the Town distribution system. Because of the local topography, a partially buried concrete storage tank is an option for the area "M" site. Tanks will be constructed in phases, and a combination of tanks and pump stations are likely. Budgetary costs are provided for the preferred option only.

Preferred Option	
○ 1.5 mg of ground steel tank(s) at area "P"	\$ 3.0 million
○ Type 2 Booster Pump Station at Area "P"	\$ 2.0 million
○ 0.1 mg partially buried tank at Area "M"	\$ 0.3 million
○ Type 1 Booster Pump Station at Area "M"	\$ 1.0 million
○ 0.1 mg ground steel tank at Area "S"	\$ 0.2 million
○ Type 1 Booster Pump Station at Area "S"	<u>\$ 1.0 million</u>
Total	\$ 7.5 million

Water Mains (West)

New developments are required to provide a piping network with 12-inch mainlines looped and connected into the existing Town distribution system. The western areas will be interconnected with the Town system by a 16-inch water main extension in HWY 86.

6,000 LF 16-inch Water Main Extension **- \$ 1.8 million**

Sewer Mains (West)

Each of the developments will be required to appropriately size sewer mains. However, for the western development an off-site 12-inch sewer main will be required to convey sewage to the existing Gold Creek Lift Station site where a new lift station must be constructed to serve the western region and Town buildout in the Gold Creek drainage. The sewer is proposed to be aligned in HWY 86 and the use of existing easements along Gold Creek is assumed.

5,000 LF 12-inch Sewer Main Extension **- \$ 1.5 million**

Lift Stations (West)

Seven lift stations are required to serve the western area. Six lift stations to convey the sewage over the western ridge (near Wild Pointe Walmart) and final lift station at the Gold Creek Site to convey sewage to the Gold Creek Wastewater Treatment.

Western Lift Station – Serving Area “T”

- 70 gpm capacity two pumps each rated at about 100 gpm
- Lift Station - two 10 hp pumps **- \$ 0.5 million**
- 4-inch forcemain – 6,000 LF **- \$ 0.6 million**

Total = \$ 1.1 million

Western Lift Station – Serving Area “V”

- 70 gpm capacity two pumps each rated at about 100 gpm
- Lift Station - two 10 hp pumps **- \$ 0.5 million**
- 4-inch forcemain – 10,000 LF **- \$ 1.0 million**

Total = \$ 1.5 million

Western Lift Station – Serving Area “U”

- 300 gpm capacity three pumps each rated at about 160 gpm
- Lift Station - three 15 hp pumps **- \$ 1.0 million**
- 6-inch forcemain – 10,000 LF **- \$ 1.5 million**

Total = \$ 2.5 million

Western Lift Station – Serving Area “P”

- 160 gpm capacity two pumps each rated at about 180 gpm
- Lift Station - two 10 hp pumps **- \$ 0.5 million**
- 4-inch forcemain – 3,000 LF **- \$ 0.3 million**

Total = \$ 0.8 million

Western Lift Station – Serving Area “R”

- Lift station includes pumped flow from areas “T”, “U” & “V”
 - 600 gpm capacity three pumps each rated at about 310 gpm
 - Lift Station - three 15 hp pumps - **\$ 1.0 million**
 - 8-inch forcemain – 5,000 LF - **\$ 1.0 million**
- Total = \$ 2.0 million**

Western Lift Station – Serving Area “M”

- Lift station includes pumped flow from area “P” and gravity flow from areas “O” and “N”
 - 630 gpm capacity three pumps each rated at about 320 gpm
 - Lift Station - three 15 hp pumps - **\$ 1.0 million**
 - 8-inch forcemain – 3,000 LF - **\$ 0.6 million**
- Total = \$ 1.6 million**

Gold Creek Lift Station

- Phase II
 - 1,200 gpm capacity three pumps each rated at about 620 gpm
 - Lift Station - three 50 hp pumps - **\$ 2.0 million**
 - 8-inch forcemains installed in Phase I
- Total = \$ 2.0 million**

Wastewater Treatment (West)

A total projected peak month flow of 2.1 mgd is estimated for the entire planning region. Assuming the 1.5 mgd treatment plant expansion is in place, a second 0.5 mgd expansion would be required.

Expand WWTP from 1.5 mgd to 2.0 mgd **- \$ 5.0 million**

REUSE IRRIGATION FACILITY

Currently wastewater effluent is discharged to Gold Creek and the Town has a lease agreement with downstream farmers. Return flows to the creek are not required and this water can be reused. With the proximity of high school and middle school to the Gold Creek Wastewater Treatment Plant, integrating reuse irrigation is very feasible. The two schools have an approximate irrigation area of 15 acres. In 2019 irrigation volumes total about 17 ac-ft, but in dry years this irrigation volume can more than double. A reuse irrigation facility should be implemented as soon as possible, to reduce demand on the Denver Basin aquifers.

WATER PURIFICATION FACILITY

As noted throughout this report, Denver Basin aquifers are non-tributary, and the water supply can be used to extinction. The wastewater effluent discharged to Gold Creek can be captured and used. The Town's water supply plan is to reuse this water for irrigation and in-direct potable reuse. Implementation of a reuse irrigation facility is the first phase (see above) and the second phase is to develop an in-direct potable reuse plant or Water Purification Facility. The reclaimed component of the Town water supply plan is about 33% or approximately 730 ac-ft/yr at full buildout of the entire Town of Elizabeth planning region. This equates to an approximate 1.0 mgd Water Purification Facility for meeting ultimate maximum day demands at a total budgetary cost of \$20 million. The facility would most likely be constructed in phases and planning should begin when about a quarter of the potential annexations are accepted into the Town. Planning for the Water Purification Facility is likely to exceed the five-year horizon.

SECTION 7 – CONCLUSIONS, RECOMMENDATIONS & CAPITAL IMPROVEMENTS PLAN

In this section the conclusions of the overall assessment of the Elizabeth planning area are detailed. Specific recommendations are also identified as well as a near term Capital Improvements Plan.

CONCLUSIONS

The water and sewer infrastructure have been evaluated for the Town of Elizabeth planning region with the following conclusions:

1. Existing PRV (Pressure Reducing Valve) stations in the water distribution system are not used and should be removed. PRVs are required at individual water services to control pressure.
2. Current 10-inch, 12-inch and 15-inch sewers are adequately sized to serve buildout within the Town boundary
3. The Town has voluntarily opted in to follow a 300-yr aquifer life standard in recognition of the valuable nature of the Denver Basin groundwater supply.
4. The 300 yr water supply estimate for all future annexations excludes the use of the Upper Dawson aquifer. The Upper Dawson aquifer is used by many surrounding Elbert County property owners and the Town is committed to limit withdraws from this aquifer.
5. Water supply planning for future annexations includes the 300-yr water supply policy plus a reclaimed water component. The Lower Dawson, Denver, Arapahoe and Laramie-Fox Hill aquifers are non-tributary and return flows can be used to extinction. With a total supply estimate of 0.65 ac-ft/yr/acre, the supply and demand balances for the overall potential annexations at about 2,200 ac-ft/yr. Each property annexed will be required to provide a water supply adequacy evaluation for review by the Town.
6. The Town currently monitors the groundwater level and flow at each well. In addition, the local Gold Creek Meadows Homeowner's Association collects well water level data and the USGS collects water level data for Elbert County wells. This data should be analyzed yearly to provide a holistic understanding of groundwater level changes for the region.
7. The Town's water supply plan is consistent with the 2018 Elbert County Rural Water Supply Study.

8. The groundwater irrigation supply for the Evans and Casey Jones Parks will remain unchanged.
9. At full buildout of the planning region, an approximate 16,000 population increase projected.
10. Potable water 16-inch and 12-inch main piping with looped 8-inch distribution lines are adequate to serve peak hour and fire flow demands.
11. The demand at buildout of the current Town boundary is estimated 564 ac-ft/yr. This closely approximates the current legal appropriations of 571 ac-ft/yr and 474 ac-ft/yr (excluding Upper Dawson). A surplus in supply is not projected at buildout of the current Town boundary.
12. The peak month wastewater flow at full buildout of the planning region is estimated at 2.11 mgd. This closely approximates the 2.0 mgd capacity master planned for the Gold Creek WWTP site.
13. Due to the anticipated water quality, a blending regime is anticipated when integrating future Laramie-Fox Hills water supply wells.
14. The storage capacity at the current tank farm is adequate to serve buildout of the current Town boundary.
15. The capacity of the Cross-Roads Lift Station is adequate to serve buildout of the Cross-Roads business park.
16. The capacity of the Running Creek Lift Station is adequate to serve buildout of the current Town boundary in the Running Creek drainage.
17. Additional wells are required for buildout of the current Town boundary. Development of the Ritoro well site is recommended in phases. The phase I addition of Arapahoe and Denver wells is planned for 2020 (see CIP). The phase II addition of a Lower Dawson well at \$1.6 million should be implemented based on the development timing of Gold Creek drainage parcels. These improvements would be funded with the tap fees received from the development.
18. Upgrading and replacement of the Gold Creek Lift Station is required at buildout of the current Town boundary. Preparation of a State Site Application and Preliminary Engineering Report for the lift station upgrade and the actual lift station upgrade are planned for 2020 (see CIP). In addition, the preliminary design and construction of the phase I Gold Creek Lift Station replacement is planned for the 5-yr planning horizon (see CIP). These improvements would be funded with the tap fees received from the development.
19. The current Gold Creek WWTP 0.5 mgd capacity is adequate for buildout of the current Town boundary.

20. Infrastructure and budgetary project costs for serving areas Outside the Town Boundary (Annexations) are detailed below. Improvements needed per new development would be funded by the development.

a. Central-Adjacent to Town

- i. Suggest addition of Arapahoe well at the current tank farm (\$1.6 mil) and addition of a Laramie-Fox Hills well at the Ritoro well site (\$1.9 mil)
- ii. Current tank farm storage capacity is adequate
- iii. 12-inch water main extension to area “L” is required (\$0.5 mil)
- iv. Booster pump station not required – in Town Pressure Zone
- v. 12-inch sewer main extension to area “L” is required (\$0.9 mil)
- vi. Lift station improvements are not required
- vii. Gold Creek Wastewater Treatment Plant to be expanded to 1.0 mgd (\$5.0 mil)

b. North Town

- i. Suggest full development of four well cluster at tank farm (\$2.7 mil) and full development of four well cluster at CR 136 well site (\$4.6 mil)
- ii. Well site at Confluence Park area to be held in reserve and used for back-up if required in the future.
- iii. Provide additional 0.5 mg tank at current tank farm (\$1.0 mil). Tank volume for the east or west developments could be used as an option, eliminating the need for a fourth tank at the existing tank farm.
- iv. 16-inch water main extension in CR 13 (\$1.8 mil)
- v. Northern developments are at lower elevations and water main pressures could reach 130 psi. Individual PRVs will be required for services.
- vi. Booster pump station not required – in Town Pressure Zone
- vii. Adequately sized sewer mains will be required and funded by northern developments.
- viii. A Northern Lift Station (\$3.0 mil) will be required to convey sewage south to the Gold Creek WWTP.
- ix. The expanded 1.0 mgd wastewater treatment capacity is adequate.

c. East of Town

- i. New four-well cluster located near the proposed tanks (\$5.9 mil)
- ii. Elevated or ground steel storage tanks paired with Type 1 or 2 booster pump stations (\$6.6 mil to \$4.6 mil). Phased tank construction and combination of arrangements is likely.
- iii. A 16-inch water main extension along HWY 86 is required (\$1.5 mil)
- iv. A 12-inch sewer main along HWY 86 to the Running Creek LS site is required (\$2.4 mil)
- v. Three lift stations (\$7.1 mil) will be required to convey sewage west to the Gold Creek WWTP.
- vi. Gold Creek Wastewater Treatment Plant to be expanded to 1.5 mgd (\$5.0 mil)

d. West of Town

- i. Two four-well clusters located north and south of HWY 86 are planned (\$11.8 mil)
- ii. The preferred tank site is at the high point of Area “P”. Tanks and pump stations are also required at Area “M” and Area “S” (\$7.5 mil). Phased tank construction and combination of arrangements is likely.
- iii. A 16-inch water main extension along HWY 86 is required (\$1.8 mil)
- iv. A 12-inch sewer main along HWY 86 and aligned in an existing easement along Gold Creek is required for conveyance to the Gold Creek LS site (\$1.5 mil)
- v. Seven lift stations (\$11.5 mil) will be required to convey sewage west to the Gold Creek WWTP.
- vi. Gold Creek Wastewater Treatment Plant to be expanded to 2.0 mgd (\$5.0 mil)

21. A reuse irrigation facility should be implemented at the Gold Creek WWTP site to reduce demand on the Denver Basin aquifers. The facility can be designed in 2020 and have a target implementation in 2021 (see CIP).

22. Planning for a Water Purification Facility is likely to exceed the 5 yr horizon. However, with future northern developments and planning for the Confluence Park, land requirements for the facility must be considered. At full buildout of the entire Town of Elizabeth planning region a 1.0 mgd Water Purification Facility is anticipated at a budgetary cost of \$20 million.

23. The budgetary cost (2020 dollars) for the water and sewer infrastructure required to serve full buildout of the entire Town of Elizabeth planning region totals approximately \$120 million.

RECOMMENDATIONS

The following is recommended based on the evaluations of this Water and Sewer Master Plan. The recommendations do not include operational or permitting/compliance impacts and are more focused on facilities required for growth. Permit compliance impacts should be reviewed at the planning and design phase for all future infrastructure projects.

1. Remove/abandon existing PRV stations.
2. Proceed with Ritoro well site development in 2020
3. Proceed with the Gold Creek Lift Station upgrades in 2020
4. Complete the Preliminary Engineering for the Gold Creek Lift Station replacement plan
5. Proceed with the construction of a Reuse Facility for irrigation of the high school and middle school.
6. Require that all new developments include looped water distribution systems with 12-inch transmission mains.
7. The wastewater flow additions to the Gold Creek WWTP have been estimated by region. However, expansion requirements will be based on actual influent flows and loads. The State requires preliminary engineering when flows reach 80 percent of capacity and improvements are to be under construction when flows reach 95 percent of capacity.
8. Prepare plan to implement strategies to limit the use of the Upper Dawson well.
9. Update zoning ordinance to include xeriscaping regulations for new developments.
10. The proposed well site at Legacy Village (area W) will be kept in reserve. Development of the wells at this site may not be required for future demands.
11. Develop a groundwater level monitoring program that includes the Town, Gold Creek Meadows, and USGS groundwater level data. This program would include a quarterly review of groundwater level data and an annual summary report.
12. Investigate the potential lawn irrigation return flows (LIRF) augmentation credit available to the Town.
13. Evaluate renewable water supply alternatives that may include senior rights on Gold Creek and Running Creek, exchange of municipal return flows, aquifer storage and recovery (ASR) and imported water projects

14. The Town should stay informed with respect to the State’s non-potable and potable reuse policies. Changes to these policies in the future may provide direction for additional water supply opportunities.
15. The Town should proceed with a water and sewer rate study using this Master Plan as a starting point in understanding future capital costs.
16. Due to regional and governmental changes, the findings of this Master Plan should be reviewed and updated in five to ten-year increment.
17. Funding for larger, regional utility improvements such as the Water Purification Facility should be considered in future annexation negotiations.

CAPITAL IMPROVEMENTS PLAN

Most of the budgetary costs presented in this Master Plan are related to serving future annexations. The infrastructure costs for these annexations are detailed in the Conclusions portion of this report section but are not part of the Capital Improvements Plan because the timing is unknown. The following near-term (approximate 5 yr horizon) Capital Improvements are recommended and mostly relate to serving developments within the current Town boundary.

Construction of these utility improvements maybe completed using public funding, private funding, or a combination of funding sources. The projects planned for 2020 are anticipated to be funded by tap fees received from developments.

- 2020 Projects
 - Develop Ritoro Well Site **\$ 3.5 million**
 - State Site Application Gold Creek LS Expansion **\$ 30,000**
 - Expand Gold Creek Lift Station **\$ 300,000**
 - Design Reuse Irrigation Facility **\$ 200,000**
- 5-yr Planning Horizon (2021 to 2025)
 - Construct Reuse Irrigation Facility **\$ 1.8 million**
 - Preliminary Engineering for Gold Creek LS Replacement **\$ 50,000**
 - Gold Creek Lift Station Replacement – Phase I **\$ 1.5 million**
 - Well level monitoring plan **\$ 30,000/yr**

APPENDIX A – WATER RIGHTS SUMMARY

HRS Water Consultants has prepared a detailed matrix of the Town of Elizabeth water supply appropriations with corresponding map which is provided in this appendix.

Town of Elizabeth
Denver Basin Ground Water Availability

HRS Water Consultants, Inc.

Preliminary and Subject to Change

January 27, 2020

Denver Basin Ground Water - Previously Decreed and Decreed in Case No. 18CW3073

Bold appropriation values in the aquifer tables below are from the 18CW3073 Exhibits S through W.

Upper Dawson			Arapahoe		
Land	Decree No.	Appropriation (af/yr)	Land	Decree No.	Appropriation (af/yr)
Denver 16210-FR Pre-213 Well	81CW122	51	Arapahoe - 44454-FR Pre 213 Well & Core Town	94CW210	127.40
Parcel H - Very small acreage	94CW190	0.0028	Parcel H - Very small acreage	94CW190	0.33
Ritoro, Parcel K (I)	07CW244	34.9	Ritoro, Parcel K (I)	07CW244	42.1
Core Town	94CW210	35.5	E-86	93CW051	38
E-86	93CW051	31.1	Woodard Abraham Parcel	93CW051	17
Woodard Abraham Parcel	93CW051	14	Nielson, Parcel N	84CW094	46
Woodard, Parcel P	93CW051	1.24	Woodard, Parcel P	93CW051	1.50
Elizabeth Middle & High School	99CW118	27.8	590 Elm/Inter Mt. Church, Parcel Q	09CW058	0.6
Elizabeth School District C-1	90CW102	3.92	Elizabeth Middle & High School	99CW118	39.6
Total		199.44	Elizabeth School District C-1	90CW102	5.24
18CW3073 Determinations previously decreed land (acres).	118.36		Total		317.75
Upper Dawson augmentation plan for 90CW102	96CW108	67.22	18CW3073 Determinations previously decreed land (acres).	319.88	
94CW210 & 99CW118					
Upper Dawson augmentation plan for parcels H, K, & P	18CW3073	36.12			
Augmentation plan needed to withdraw -		96.10			


Lower Dawson			Laramie-Fox Hills		
Land	Decree No.	Appropriation (af/yr)	Land	Decree No.	Appropriation (af/yr)
Denver 16210-FR Pre-213 Well	81CW122	20	Parcel H - Very small acreage	94CW190	0.28
Parcel H - Very small acreage	94CW190	0.18	Ritoro, Parcel K (I)	07CW244	38.99
DA-15617-F - Pre 213 Well	81CW123	50	Core Town	94CW210	112
Ritoro, Parcel K (I)	07CW244	24.2	Nielson, Parcel N	84CW094	48
Core Town	94CW210	59.6	E-86	93CW051	33.7
E-86	93CW051	21.8	Woodard Abraham Parcel	93CW051	15
Woodard Abraham Parcel	93CW051	10	Woodard, Parcel P	93CW051	1.32
Woodard, Parcel P	93CW051	0.84	590 Elm/Inter Mt. Church, Parcel Q	09CW058	0.50
Elizabeth Middle & High School, Well A, 52512-F	99CW118	21	Elizabeth Middle & High School	99CW118	32.5
Elizabeth School District C-1	90CW102	3.1	Elizabeth School District C-1	90CW102	4.77
Total		210.72	Total		287.06
18CW3073 Determinations previously decreed land (acres).	318.16		18CW3073 Determinations previously decreed land (acres).	319.88	

Denver			Total Previously Decree & 18CW3073 Aquifer		
Land	Decree No.	Appropriation (af/yr)	Appropriation (af/yr)	300 Year Approp. (af/yr)	
Parcel H - Very small acreage	94CW190	0.340	Upper Dawson	290.6	96.9
Denver 16210-FR Pre-213 Well	81CW122	79	Lower Dawson	242.1	80.7
Ritoro, Parcel K (I)	07CW244	38.42	Denver	459.1	153.0
Core Town	94CW210	131	Arapahoe	380.6	126.9
Nielson, Parcel N	84CW094	52	Laramie-Fox Hills	341.4	113.8
E-86	93CW051	35.1	Total	1,713.7	571.2
Woodard Abraham Parcel	93CW051	16	Total w/o Upper Dawson	1,423.1	474.4
Woodard, Parcel P	93CW051	1.30			
590 Elm/Inter Mt. Church, Parcel Q	09CW058	0.6			
Elizabeth Middle & High School, Well B, 52511-F	99CW118	39.7			
Elizabeth School District C-1	90CW102	5.55			
Total		399.01			
18CW3073 Determinations previously decreed land (acres).	319.88				









Denver Basin Ground Water in Case No. 18CW3073 Aquifer		
	Classification	Appropriation (af/yr)
Upper Dawson	Actual Replace.	91.16
Lower Dawson	Nontributary	31.38
Denver	Nontributary	60.04
Arapahoe	Nontributary	62.87
Laramie-Fox Hills	Nontributary	54.30
Totals		299.8
Totals w/o Upper Dawson		208.6

Groundwater Appropriations Parcel Map

Map Legend

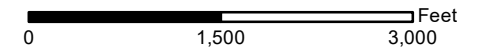
 18CW3073 Town of Elizabeth

Previously Decreed Parcel
(by case number and ownership)

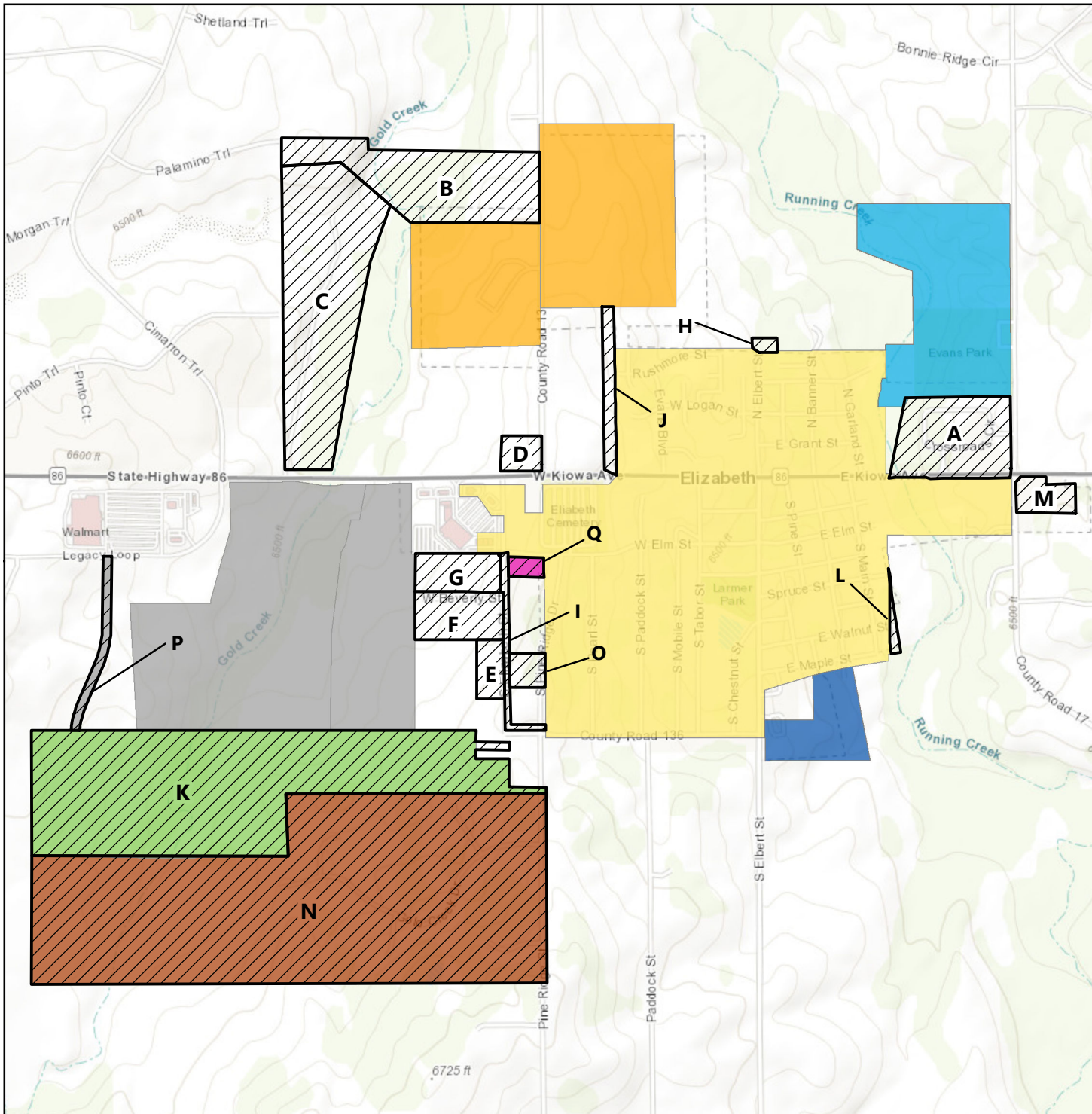
-  84CW94/96CW141, Town of Elizabeth
-  90CW102, Elizabeth Con 1 School District
-  93CW51, Town of Elizabeth
-  94CW190, Elizabeth Parks and Rec District
-  94CW210, Town of Elizabeth
-  99CW118, Elizabeth Con 1 School District
-  07CW244, Town of Elizabeth
-  09CW58, Town of Elizabeth



1 inch = 1,500 feet



Job Number: 86007-11
 Date: February 20, 2020
 Projection: NAD83/UTM
 Zone13N
 File Name: Elizabeth_TOW
 Sources: Elbert County
 Assesor, CDWR



APPENDIX B – WELL DRILLING COST ESTIMATES

HRS Water Consultants prepared well completion cost estimates for specific regions within the Town of Elizabeth planning area. These costs are included in this appendix and were used in estimating the budgetary well costs detailed in Section 6 of this report.

Town of Elizabeth

HRS Water Consultants

86007-14

January, 2020

Well Installation and Equipping Cost Estimates

Name	Aquifer Base (feet)	Well Diameter (inches)	Well Installation Cost (\$/foot)	Installation Cost Per Well (\$)	Equipment Cost Per Well (\$)	Xcel Cost Estimate Per Well (\$)	Total Well Equipment Cost (\$)	Total Cost Per Well (\$)	Total Cost Per Well w/25% Contingency (\$)
Running Creek LS Site									
Lower Dawson	586	8	\$381	\$223,266	\$135,000	\$10,625	\$145,625	\$368,891	\$461,114
Denver	1436	8	\$361	\$518,396	\$200,000	\$10,625	\$210,625	\$729,021	\$911,276
Arapahoe	1,911	10	\$341	\$650,764	\$250,000	\$10,625	\$260,625	\$911,389	\$1,139,236
Laramie-Fox Hills	2,513	10	\$321	\$806,531	\$300,000	\$10,625	\$310,625	\$1,117,156	\$1,396,445
Future Confluence Park									
Lower Dawson	567	8	\$381	\$216,027	\$135,000	\$10,625	\$145,625	\$361,652	\$452,065
Denver	1,436	8	\$361	\$518,396	\$200,000	\$10,625	\$210,625	\$729,021	\$911,276
Arapahoe	1,922	10	\$341	\$654,510	\$250,000	\$10,625	\$260,625	\$915,135	\$1,143,918
Laramie-Fox Hills	2,516	10	\$321	\$807,494	\$300,000	\$10,625	\$310,625	\$1,118,119	\$1,397,649
Ritiro									
Lower Dawson	617	8	\$381	\$235,077	\$135,000	\$10,625	\$145,625	\$380,702	\$475,878
Denver	1,540	8	\$361	\$555,940	\$200,000	\$10,625	\$210,625	\$766,565	\$958,206
Arapahoe	2,038	10	\$341	\$694,012	\$250,000	\$10,625	\$260,625	\$954,637	\$1,193,296
Laramie-Fox Hills	2,665	10	\$321	\$855,315	\$300,000	\$10,625	\$310,625	\$1,165,940	\$1,457,425
"W" Legacy Village									
Lower Dawson	603	8	\$381	\$229,743	\$135,000	\$10,625	\$145,625	\$375,368	\$469,210
Denver	1,509	8	\$361	\$544,749	\$200,000	\$10,625	\$210,625	\$755,374	\$944,218
Arapahoe	2,000	10	\$341	\$681,071	\$250,000	\$10,625	\$260,625	\$941,696	\$1,177,121
Laramie-Fox Hills	2,619	10	\$321	\$840,551	\$300,000	\$10,625	\$310,625	\$1,151,176	\$1,438,970
Existing South Town									
Arapahoe	2,097	10	\$341	\$714,103	\$250,000	\$10,625	\$260,625	\$974,728	\$1,218,410
Laramie-Fox Hills	2,714	10	\$321	\$871,041	\$300,000	\$10,625	\$310,625	\$1,181,666	\$1,477,082
Existing Tank Farm									
Denver	1,650	8	\$361	\$595,650	\$200,000	\$10,625	\$210,625	\$806,275	\$1,007,844
Laramie-Fox Hills	2,763	10	\$321	\$886,767	\$300,000	\$10,625	\$310,625	\$1,197,392	\$1,496,740
Property "A"									
Lower Dawson	869	8	\$381	\$331,089	\$135,000	\$10,625	\$145,625	\$476,714	\$595,893
Denver	1,639	8	\$361	\$591,679	\$200,000	\$10,625	\$210,625	\$802,304	\$1,002,880
Arapahoe	2,126	10	\$341	\$723,979	\$250,000	\$10,625	\$260,625	\$984,604	\$1,230,755
Laramie-Fox Hills	2,701	10	\$321	\$866,869	\$300,000	\$10,625	\$310,625	\$1,177,494	\$1,471,867
"M" Elizabeth West									
Lower Dawson	818	8	\$381	\$311,658	\$135,000	\$10,625	\$145,625	\$457,283	\$571,604
Denver	1,754	8	\$361	\$633,194	\$200,000	\$10,625	\$210,625	\$843,819	\$1,054,774
Arapahoe	2,279	10	\$341	\$776,081	\$250,000	\$10,625	\$260,625	\$1,036,706	\$1,295,882
Laramie-Fox Hills	2,969	10	\$321	\$952,881	\$300,000	\$10,625	\$310,625	\$1,263,506	\$1,579,383