BASIS OF DESIGN REPORT

PANORAMA RANCHES HOMEOWNER'S ASSOCIATION

Revised October 2019

Prepared by

SGM

118 West Sixth Street, Suite 200
Glenwood Springs, CO 81601
970.945.1004
970.945.5948 fax

Basis of Design Report

Panorama Ranches Homeowner's Association Chlorine Contact Improvements

Authored By:

Maggie McHugh, EI

Reviewed By:

Justin Kattnig, PE and Rick Huggins, PE

SGM Project # 2018-245.001

TABLE OF CONTENTS

1.0 Project Information 1-1

1.1 Name and Mailing Address of Owner/Water Supplier 1-1

1.2 Project Description 1-1

2.0 Sources of Potential Contamination 2-1

2.1 100-year Flood Plain Certification 2-1

2.2 Contamination Sources 2-1

2.3 Contamination Mitigation Strategy 2-1

3.0 Water Quality Data 3-1

3.1 Source Data 3-1

3.2 Process Selection Data 3-1

4.0 Process Flow Diagram/Hydraulic Profile 4-1

4.1 Process Flow Diagram and Hydraulic Profile 4-1

5.0 Design Calculations 5-1

5.1 Capacity Summary 5-1

5.2 Water Rights Evaluation 5-1

5.3 Source Evaluation 5-1

5.4 Current and Projected Water Demands 5-2

5.5 Current and Future Capacity of Panorama Ranches System 5-3

5.6 Treatment Goals 5-3

5.6.1 Regulatory Compliance 5-3

5.7 Treatment System Capacity 5-4

5.7.1 Metering Pump and Chemical Storage Sizing 5-4
5.7.2 Chlorine Contact Time 5-5
5.7.2.1 System Characteristics 5-6
5.7.2.2 Minimum Residual 5-6

5.8 System Pumps 5-8

5.9 Distribution System 5-11

6.0 Monitoring and Sampling Evaluation 6-1

6.1 Sampling Locations/Monitored Parameters 6-1
7.0 Geotechnical Report 7-1
8.0 Residuals Handling 8-1
8.1 Residuals Handling Plan 8-1
9.0 Preliminary Plan of Operation 9-1
9.1 Staffing and Operator Certification 9-1
9.2 Operating Considerations 9-1
9.3 Control Strategy 9-1
10.0 Impact to Corrosivity 10-1
11.0 Site Specific Deviations 11-2
12.0 List of Acronyms and Abbreviations 12-3

List of Tables

Table 5-1. Capacity of each existing and proposed unit process. 5-1
Table 5-2. Source Capacity Evaluation. 5-2
Table 5-3 Current and Projected Domestic Water Demands 5-2
Table 5-4 Summary of Key System Capacities 5-3
Table 5-5. Metering Pump Sizing Data. 5-5
Table 5-6. Chemical Storage Sizing Data 5-5
Table 5-7 System Data for CT Calculations 5-6
Table 5-8 CDPHE Baffling Factor Guidance Requirements[1]. 5-7
Table 5-9 Minimum Residual Requirements for 4-log inactivation of Virus 5-8
Table 5-10. Pump Sizing Data. 5-10

LIST OF FIGURES

Figure 5-1. Pump Curve with Throttle Points for Typical (25 gpm) and Emergency Flow (50 gpm). 5-10
Figure 5-2. Pump Curve with Throttle Points for Typical (25 gpm) and Emergency Flow (50 gpm). 5-11

1.0 Project Information

1.1 Name and Mailing Address of Owner/Water Supplier

See AOC Cover Page and Application located under **Tab 1**.
Panorama Ranches HOA is a non-transient public community water system, PWSID CO0123595, located in Carbondale, CO, which serves the area shown in the **Vicinity Map** under **Tab 3**. Operated by Panorama Ranches HOA, the Panorama Ranches community consists of 56 single-family sized lots. Panorama currently has 46 lots occupied, with 10 lots left to develop.

As shown in the **Process Flow Diagram** under **Tab 4**, Panorama system has two active wells, one pump house with a chlorine metering pump, one chlorine contact chamber with one submersible booster pumps, and one stainless steel 100,000-gallon storage tank, on which 4 homes maintain a private pump house to access water from the tank, and 14,916 feet of 6" PVC SDR 26 distribution piping (rated at 160 psig).

The scope of the proposed work includes replacement of both well pumps, elimination of booster pump in current wet well, and replace existing chemical metering pumps to increase the rated capacity of the system to 50 gpm. Each well pump will be sized to produce 50 gpm. This will allow each well to serve as a redundant 50 gpm source in case there is an emergency or failure at one well site. The existing booster pump, which is recorded as producing approximately 30-35 gpm, will be removed from service, and the wet well will be isolated from the system.

The primary goal of this project is to increase the HOA's production capacity in order to increase minimum water levels in the existing 100,000-gallon storage tank during peak demand season. The HOA is concerned about maintaining proper water level in the tank and wants to increase capacity to ensure redundant source of water in the event of a well failure or emergency such as a wildfire. As a result of increasing the system capacity, Panorama Ranches needs to install a new chlorine contact system to meet CDPHE design criteria.

1.2 Project Description

The purpose of this application for construction approval is to seek approval for Panorama Ranches' new chlorine contact configuration (serpentine piping), and increase the rated capacity of the system to 50 gpm, which will provide redundancy at full build out.

This project's scope of work includes the following:

- Replace the following pumps with larger counterparts:
  - 5HP Well Pump No.1R
  - 5HP Well Pump No.2
  - Chemical Metering Pumps
- Eliminate booster pump and isolate wet well from system.
- Install a 12" C900 serpentine pipe loop to provide 4-logs of virus inactivation.
- Install a frost-free yard hydrant downstream of the proposed pipe loop, but prior to the distribution system.

   - The system's entry point sampling location will be relocated from the existing contact tank to this yard hydrant.

Key points regarding the approval of this project include:

- This application seeks approval to increase the rated capacity of Panorama Ranch's system to 50 gpm.
- **Desired system capacity: 50 gpm.**
- Source classification is groundwater, with sodium hypochlorite treatment.
- Source capacity: legal capacity of both wells is 50 gpm each, 100 gpm total. Maximum annual water use is 48 ac-ft, as listed in the well permits under **Tab 6**.
- Treatment capacity: Increase treatment capacity to 50 gpm.

SGM is seeking approval for the scope of work as shown in the **Project Construction Plans** under **Tab 5**, and new equipment specifications listed under **Tab 7.**

2.0 Sources of Potential Contamination

2.1 100-year Flood Plain Certification

See the attached **100-year Floodplain Certification Form** located in the **Application for Construction Approval** under **Tab 1**. A 100-year floodplain map from the Federal Emergency Management Administration (FEMA) shows that the project site lies outside of the 100-year Floodplain as seen in **Tab 9**. This map is used as justification for the corresponding certification.

2.2 Contamination Sources

The location of Wells No. 1 and No. 2 can be seen in the Vicinity Map under **Tab 3**. Review of current conditions shows a road exists approximately 100 ft away from Well 2, and 150 ft from Well 1R, but no irrigation or drainage ditches are located near the roads. A road may be a source of surface runoff high in nitrogen or phosphorus, as well as leaked chemicals such as gasoline or oil. However, well construction of each well was done in accordance with BOE Construction Rules outlined in 2 CC 402-2 from the Division of Water Resources which requires certain control structures to be installed to prevent surface water contamination at well heads, therefore, there is no surface water contamination concern.

Both Well 2 and Well 1R are located near developed homes, which each have a private septic tank and soil treatment area. One septic location is located within 500 ft of Well 1R and two are located within 500 ft of Well 2. All septic systems must be installed in accordance with health and safety standards of Garfield County and State of Colorado as described in the Panorama HOA By-Laws (**Tab 10**).

No sewer main pipes, raw surface water, or petroleum pipelines are known to be present or cross the potable water line in the system. No pipes are known to be laid parallel to the main distribution lines.

2.3 Contamination Mitigation Strategy

As the perforated portion of Well 1R lies near 420 ft below surface, and the existing depth to ground water is approximately 353 feet below the surface it is unlikely that the well would be in the zone of influence of any nearby surface run-off from the road. Similarly, the perforated portion of Well 2 lies between 275 and 335 ft below grade, with a water surface elevation of 290’ therefore no interaction from surface runoff from the roads is anticipated.

The existing **Monitoring Schedule** listed under **Tab 11** requires monitoring of Total Coliform, which would detect any interaction from septic leaks, or other contamination, and should be sufficient to monitor for potential contaminants from both sources. Frequency of monitoring is summarized in **Table 6-1**. Historic sampling results does not indicate any interaction with septic systems, **(Tab 12**).

3.0 Water Quality Data

3.1 Source Data

This project did not involve the collection and evaluation of water quality data to determine project/direction goals. The system has been monitoring water quality in accordance with the Monitoring Schedule located under **Tab 11.** Additionally, a summary of water quality sampling is included in **Tab 12** to reflect most recent results.

3.2 Process Selection Data

Due to a lack of operating data, the following worst-case values were assumed for disinfection and log inactivation calculations (see **Section 5**). In accordance with Design Criteria section 1.2.3 a pH of 8.0 and temperature of 5 degrees were used in all CT calculations.

4.0 Process Flow Diagram/Hydraulic Profile

4.1 Process Flow Diagram and Hydraulic Profile

A hydraulic profile and process flow diagram for the current and proposed Panorama Ranches System can be seen under **Tab 4**.

5.0 Design Calculations

The following paragraphs describe design calculations used to verify the existing system meets CDPHE Design Criteria.

5.1 Capacity Summary

Panorama Ranches system capacity is limited by the booster pump, which delivers water from the pump house and dosing location to the distribution system and storage tank. This design proposed to remove the booster pump and wet well and utilize the pumps directly from the wells to the tank to simplify system operations and maintenance. Proposed rated capacity for the treatment system is the new well pump capacity for each well, **50 gpm.** **Table 5-1** summarizes all maximum capacities calculated in detail in the subsequent sections. Capacity calculations were done for the well pumps, chemical metering pumps, and chlorine contact time for proposed work.

Table 5-1. Capacity of each existing and proposed unit process.

Unit Process	Maximum Capacity (gpm)
Total Water Rights	100
Well Pump #1	50
Well Pump #2	50
Chemical Metering Pumps	62
Serpentine Chlorine Contact Time	50

5.2 Water Rights Evaluation

Panorama Ranches currently has water rights to 48 ac-ft of water per year, with each well limited to a legal pumping capacity of 50 gpm (see Well Permits under **Tab 6**). These rights are conditional, and are available for domestic use for single-family households, as well as limited irrigation use. Based upon current demand, and level of the community developed (82% developed), Panorama Ranches has adequate water supply to serve the entire community at full build out, as summarized under **Table 5-3**. Panorama Ranches is currently in the process of filing for absolute water rights on their groundwater wells.

5.3 Source Evaluation

Sources for Panorama Ranches include two Groundwater wells, filed under permit numbers 47397-F-R and 043581-F. A summary of current pump capacity, legal capacity, and proposed system capacity is shown in **Table 5-2**. Raw water tap is located in the well house to sample both wells in the system as indicated on the 60% Construction Drawings under **Tab 5**. System capacity is defined here as the capacity, which this application seeks approval for, and is used as the basis for all subsequent CT calculations. Maximum well capacity is the legal production rate reported in the well permits (**Tab 6**), and installed pump capacity represents the current pump capacity under typical operational conditions.

Well pumps

Current and future pumping capacities for the wells and booster pump are described in **Table 5-2**. Currently, the Goulds 33GS50 submersible pump in Well 1 has an estimated capacity of 33 gpm, and the Goulds 65GS50 submersible pump in Well 2 has an estimated capacity of 30 gpm. Both pumps are fixed speed pumps and do not contain soft starters. Proposed pump replacement will increase both well pumps to 50 gpm capacity each and include VFDs on each well pump. Flowmeter in the pump house will be replaced on the discharge end of the house such that the meter is sized for new operational flowrate of 50 gpm. Please note that current flowmeters induce a high-pressure loss since maximum operating flow rate is 20 gpm (See **Tab 7**).

Table 5-2. Source Capacity Evaluation.

Facility	Installed Pumping Capacity (gpm)	Proposed Pumping Capacity (gpm)
Well 1R	33	50
Well 2	30	50
Requested System Capacity (gpm)		**50**

5.4 Current and Projected Water Demands

Current and projected domestic water demands for the system are summarized in **Table 5-3.** Existing potable water demands were estimated by processing 5 years of production data, recorded 3-4 times per month from the totalizing flow meters located at the well house. Average daily demand was calculated by summing the total production data between each date recorded, divided by the recording interval. Maximum daily demand was estimated for each year as the largest daily production value, and then averaged over the 5 years of data.

Historic production data were used to derive unit demands on a per-lot basis. Future water demands were estimated by applying this demand to the remaining uninhabited lots (10). This assumes each new developed lot will consume the current average and maximum calculated value. Results are summarized in **Table 5-3**. Under these conditions, Panorama Ranches has access to adequate legal water to supply their community at full build-out. Panorama is planning to file for absolute right of their well water in the next calendar year.

Table 5-3 Current and Projected Domestic Water Demands

Parameter	Current Demand (GPD)	Future Demand (GPD)	Water Rights Capacity (GPD)
Average Demands			
Average Daily Demand	12,875	16,386	Annual Average: 42,851
Maximum Daily Demand[1]	33,667	44,507	
Est. Peak Hourly Demand (gpm)[2]	46.9	59.7	

(1) The annual average value is close to 3 times greater than the future average daily demand, therefore adequate water supply is available for the community.

(2) Estimated PHD was calculated assuming a peaking factor of 3.5. PHD (gpm) =ADD (gpm)*3.5.

(3) Gallons per minute flow is calculated from daily data assuming pumps run 16 hours a day.

5.5 Current and Future Capacity of Panorama Ranches System

Water system capacity should be capable of meeting maximum daily demands. Historical data (past 5 years) of Panorama Ranches suggests a maximum daily demand of 33,667 gpd, and average daily demand of 12,875 gpd, as summarized in **Table 5-3.** The existing system is limited by the submersible booster pump (25 gpm), which is currently unable to meet the maximum daily demand of 35 gpm, and future MDD of 46 gpm. This information is summarized in **Table 5-3**.

Due to inadequate pumping rates to the distribution system and water storage tank Panorama Ranches has observed issues of low water levels in the storage tank during peak demand periods and identified the need to increase pumping rates to remedy this issue. The existing system capacities are summarized in **Table 5-4** with comparison to current and future maximum day demands.

Table 5-4 Summary of Key System Capacities

	Current	Future
Treatment capacity (gpm)[1]	25	50[1]
Maximum Daily Demand[2] (gpm)	35	46
Equalization Storage Needed (gallons)[3]	1320	582[4]

(1) Treatment capacity is limited by the size of the booster pump at the well pump house. To meet current and immediate future demands a 50 gpm pump is proposed.
(2) Maximum daily demands were converted to gpm assuming pumps are on for a total of 16 hours per day.
(3) Equalization storage is calculated as (Peak Demand - Production Capacity) * 60 minutes
(4) Note the equalization storage needed decreases as the production capacity is increased.

Panorama Ranches proposes to install a new booster pump to increase tank infill rate and allow the ability to meet future maximum day demands directly from pumping. This can be accomplished by increasing the booster pump size from 25 gpm to 50 gpm. Additionally, Panorama Ranches proposes installing two new well pumps, 50 gpm each, such that wells can be alternated during operation, and ensure system redundancy if one well is offline. To meet the peak hourly demand, estimated as 3.5 times the current average demand, available storage will be used to meet the deficit between the pumping rate and peak hourly demand. Equalization storage is commonly calculated to meet this deficit and is briefly summarized in **Table 5-4.**

5.6 Treatment Goals

5.6.1 Regulatory Compliance

In accordance with Section 4.0.1.b. of CDPHE's Design Criteria for potable water systems, groundwater systems must be designed to maintain a minimum disinfection residual of 0.2 mg/L throughout the distribution system. Both Well 1R and 2 are not currently considered under the influence of surface water, are not opting for a disinfection wavier, and are not undergoing triggered source water monitoring. As such, the system is not required to continuously demonstrate 4-logs of virus inactivation to remain in compliance with Colorado's Ground Water Rule.

Panorama Ranches doses approximately 1% liquid Sodium Hypochlorite (NSF certified) to achieve minimum residuals and 4-log virus inactivation. 1 gallon of 10% sodium hypochlorite is diluted with 10 gallons of water as described under **Tab 16**. The current defined entry point for the system is located after the chlorine contact tank basin.

The proposed chlorine contact system will require a change of entry point to downstream of the serpentine piping located from a smooth-nosed sample tap which feeds directly from the specified yard hydrant (see Construction Plans under **Tab 5** for more detailed information).

5.7 Treatment System Capacity

5.7.1 Metering Pump and Chemical Storage Sizing

The existing metering pump at the pump house is a Chem Tech Series XP007 peristaltic chemical feed pump, with a maximum output of 0.29 gph, a maximum operating pressure of 125 psig, and a maximum turndown ratio of 20:1. Chemical metering pumps should be designed to provide maximum dosing of 2 mg/L at maximum flow rate, as well as minimum dosing to maintain the minimum residual of 0.2 mg/L in the system. Based upon increased flowrates proposed in the system, the current metering pumps are not adequate to provide proper dosing ranges. It is recommended a Prominent Beta B4 Series solenoid diaphragm pump, Model 0708 is used for future operations, with a nominal capacity of 1.88 gph, and turndown ratio of 100:1. Prominent Beta B4 Series metering pumps are NSF 61 approved pumps, which include auto-degassing valve, integral bleed valve, and ability to control dosing by changing stroke frequency and stroke length. Additionally, each pump will be equipped with prominent supplied anti-siphon/back pressure valve which protects the system from siphoning, allows for pressure relief and venting from the tank, and maintains adequate back-pressure in the system for accurate metering. Pumps will only operate if booster pump is turned on. Information on the pumps and additional valve is located under Project Specifications **Tab 7**.

Two will be purchased so a shelf spare for operation and maintenance is available. **Table 5-4** below summarizes minimum, average, and maximum sodium hypochlorite pumping rates. The metering pump pulls from one 100-gallon double walled storage tank.

Maximum sodium hypochlorite flowrates were determined by considering each well's maximum instantaneous flowrate with a dose of 2 mg/L. Maximum sodium hypochlorite flowrate from each well is limited by the submersible well pump as listed in Error! Reference s ource not found.. Average sodium hypochlorite flow rates were determined by considering each well's instantaneous flow rate with an average dose of 1 mg/L. Minimum sodium hypochlorite flow rates were determined by considering each well's instantaneous flow rate with the metering pump's minimum advisable turndown. Results are summarized in **Table 5-5.**

$$Sodium\ Hypochlorite\ Treatment\ Capacity\ (gpm) = \left(\frac{Active\ Chemical * Max\ Chemical\ Flow}{Dose}\right)$$

$$Maximum\ Metering\ Pump\ Flow\ Rate\ =\ 62\ gpm$$

Table 5-5. Metering Pump Sizing Data.

Parameter	Pump House
Maximum Well Pump Flowrate, (gpm)	50
Max. Sodium Hypochlorite Dose (mg/L)	2.0
Max. Sodium Hypochlorite Flow, (gph)	**0.81**
Well Pump Flowrate, (gpm)	50
Avg. Sodium Hypochlorite Dose (mg/L)	1.0
Avg. Sodium Hypochlorite Flow, (gph)	**0.41**
Well Pump Flowrate, (gpm)	50
Min. Sodium Hypochlorite Dose (mg/L)	0.06
Min. Sodium Hypochlorite Flow, (gph)	**0.081**
Metering Pump Turndown at Min. Flow	**12**

Sodium hypochlorite storage requirements were determined by considering the amount of sodium hypochlorite needed for peak monthly demand. This was determined using the average sodium hypochlorite dose. Results of this analysis are summarized in **Table 5-6.**

Table 5-6. Chemical Storage Sizing Data

Parameter	Pump House
Peak Monthly Demand (gpd)	31,626
Avg. Sodium Hypochlorite Dose (mg/L)	1.0
Max Sodium Hypochlorite Daily Flow, (gpd)	4.3
Current Storage Volume (gal)	100
Days of Storage (days)	**23**

As shown in **Table 5-6**, the sodium hypochlorite storage tank provides 23 days of storage during peak month of the year. This storage is adequate for operator to re-fill the solution every 3 weeks, maintaining solution strength, while also not over burdening the operator with purchase and delivery of sodium hypochlorite. The double walled tank therefore provides appropriate storage of hypochlorite at a low solution strength to prevent chemical decay issues. The frequency of filling the solution every 23 days prevents solution decay.

5.7.2 Chlorine Contact Time

The following section outlines calculations which determine minimum chlorine residuals required to achieve 4-logs of virus activation under different operating conditions. Note that both Well 1R and Well 2 are not currently considered under the influence of surface water, are not opting for a disinfection wavier, and are not undergoing triggered source water monitoring.

5.7.2.1 System Characteristics

Table 5-7 outlines assumed system characteristics used in the determination of contact times under maximum flowrates. Note: the maximum flowrate used here are the maximum legal pumping rate for each well as defined in corresponding well permits.

Table 5-7 System Data for CT Calculations

Parameter	Value
Max. Pump Capacity (gpm)	50
Min. Temperature (°C)[2]	5
Max pH[2]	8
Min CT for 4-log Inactivation (mg/l-min.)[3]	8.00

1. Demand Assumptions are described in Section 1 of this BDR.
2. Due to a lack of pH and temperature data, these worst-case values have been assumed in accordance with Table 1.2 Notes from 2018 Design Criteria.
3. This value was taken from the CT tables of the USEPA's *LT1ESWTR Disinfection Profiling and Benchmarking Technical Guidance Manual*

5.7.2.2 Minimum Residual

Minimum residual is calculated at the booster pump house to meet 4-log inactivation in proposed serpentine piping. The system point of entry is proposed to be at the end of the serpentine piping on a ¾" tap located near the existing pump house.

As shown under **Tab 5, Construction Plans,** the serpentine system consists of 12" C900 DR-18 pipe, with 3 main runs at 45 ft each, resulting in an individual length to diameter ratio (L/D) of 45, and an overall L/D of 110. Following guidelines listed in the CDPHE Baffling Factor Guidance Manual[1], it is assumed that a BF of 0.7 will be awarded to this system as it meets all serpentine piping requirements. **Table 5-8** further lists all requirements in the CDPHE Baffling Factor Guidance Manual.

[1] CDPHE Baffling Factor Guidance Manual. March 2014.

Table 5-8 CDPHE Baffling Factor Guidance Requirements[1].

Baffling Factor Manual Requirements	Proposed System
Each segment of pipe in a serpentine piping system must meet L/D = 40 on a per run basis.	$L/D_{Run} = 45$
Serpentine piping systems can achieve a BF of 1.0 if the overall L/D = 160. If this is not met, then BF = 0.7 is awarded.	$L/D_{Total} = 110$
Flow in serpentine piping contact system should be fully turbulent, and achieve a Reynolds of 4000. For 12" pipe minimum flow rate is 23.4 gpm.	$Q_{min} =$ 50 gpm
The serpentine pipe may not include any contractions or bends along main runs.	(2) 12" Pipe Runs at 55' each.

1. See Construction Plans for more details on pipe length and size.

Minimum flowrate required:

$$Q_{min} = \frac{Re*v*\pi*D}{4} * 448.84\frac{gpm}{cfs}$$

Re = Reynolds Number
V= kinematic viscosity of water at 5 degrees C
D = inner diameter of pipe

$$Q_{min} = 4000 * 1.667 * 10^{-5}\left(\frac{ft^2}{s}\right) * \left(\frac{\pi}{4}\right) * 1.03\,ft * 448.84\frac{gpm}{cfs} = \textbf{23.4 gpm}$$

Total volume of water in pipe:

$$V_{pipe} = \frac{1}{4}\pi D^2 \cdot L \cdot BF$$

D = diameter of pipe
L = total length of pipe (sum of each run)
BF = baffling factor

$$V = \frac{1}{4}\pi\left(\frac{12\text{ in}}{12\frac{\text{in}}{\text{ft}}}\right)^2 (135\text{ ft})\left(\frac{7.48\text{ gal}}{\text{ft}}\right) \cdot 0.7 = 555\text{ Gallons}$$

Each well pump listed in **Table 5-2** has a maximum capacity of 50 gpm, which yields the following contact time:

$$T_{W1} = \frac{V}{Q} = \frac{555\text{ gal}}{50\text{ gpm}} = 11.1\text{ min}$$

Table 5-9 Minimum Residual Requirements for 4-log inactivation of Virus

Maximum Flow (gpm)	Min Chlorine Residual (mg/l)	CT Achieved (mg/l·min)	Log removal of Virus
50	0.54	8.00	4.00

The operator will maintain a minimum of dose of 0.8 mg/L, which is within range of metering pump capacity as discussed **Section 5.5.3** and exceeds CDPHE log-inactivation requirements.

5.8 System Pumps

Booster Pumps

The current booster pump is a submersible fixed-speed Goulds Model 45J approximately 32 gpm pump located in the chlorine contact basin. ~~Proposed booster pump replacement will increase the booster pump capacity to 50 gpm, with a soft-starter and throttle valve for flow control.~~ The booster pump will be removed from service to simplify system operations and reduce ongoing maintenance issues that the booster pump and wet well currently cause for the community.

Both well pumps will be replaced with Goulds 45GS75 pumps and VFDs to offer variable speed control of each well pump. The chosen pumps can operate at two different set points giving the operator control to choose the desired flowrate dependent upon system conditions:

1. 50 gpm from each well with only one well running at a time OR
2. 25 gpm from each well with both wells running in parallel~~The booster will be located in the chlorine contact chamber, which will serve as wet well before entering the serpentine pipe contact chamber. The 25 gpm pump will be plumbed next to the new 50 gpm pump, allowing water to be pumped at 25 gpm, in the event that the 50 gpm is out of service or down for maintenance. The wet well allows all pumps to be fixed speed, providing flexibility in the system as pumps are replaced or repaired. As described previously, the booster pump capacity, 50 gpm, determines the overall system capacity, and is therefore used in all subsequent calculations.~~

Installation of VFDs offers flexibility to choose the desired flowrate. If feasible, Option 1 will be standard system operating duty point. However, this is dependent upon pressure rating of buried pipe from Well 1R to the pump house, which is to be verified at time of Well 1R pump and VFD. If the buried pipe cannot handle pressures of 155 psi at the discharge of Well 1R then the pumps will operate under Option 2 to produce 50 gpm total. The exact breakdown of flow from each well is flexible utilizing the VFDs at each well to choose the best operating flow/pressure at each well.

Valves and Appurtenances

All required valves, pressure gages, and controls are shown on the proposed construction drawings under **Tab 5**. This section briefly describes each proposed installation of valves, pressure gages, and other controls to meet CDPHE Design Criteria.

Pressure gages will be installed on the ~~suction side of the submersible booster pump downstream of each well's discharge pipe, in the pump house~~discharge end of each well pump in the pump house to monitor system pressures. ~~An existing pressure gage on the~~

discharge of the booster pump will remain. Pressure gages will be used to verify TDH of well pumps as assumed and calculated in **Table 5-12**.

Isolation valves will be installed in the wet well on the suction and discharge end of the pump, as required by **Section 6.3.3** and shown in construction plans (**Tab 7**). The isolation valves will allow for maintenance and isolation of each booster pump from the system. Valves will be operated via opening the wet well hatch from above grade. No personnel needs to enter the wet well to operate, remove, or maintain any pumps or appurtenances. The 25 gpm pump will be isolated via gate valve from the system under operating conditions and only used during needed maintenance or emergency.

Check valves will be installed on the discharge pipe of each pump if not included in pump installation design. , both in the well and in the wet well basin. A new flowmeter will be installed on the combined discharge side both well pumps to reduce headloss at new flowrate of 50 gpm. side of the new booster pump to be properly sized for the increased flow and reduce major pressure losseAdditionally, flowmeters will be replaced downstream of each well to reduce pressure loss and accommodate typical flowrates of 25 gpm, and up to 50 gpm during emergencies.

Pump Sizing

After completion of proposed work the Panorama Ranches water system will contain four two total pumps designed to operate under two operation scenarios. : 2 submersible well pumps and 2 submersible booster pumps as summarized in **Table 5-12.** This will allow redundancy in replacement parts and maintenance in their system.simplifies the Panorama HOA system operations. Each new well pump has a variable frequency drive (VFD) to allow for speed control to achieve desired flowrate from each well. More information on the Goulds Model 45GS75 pump is located under **Tab 7**. Sizing calculations and throttling curvesVFD are also located under **Tab 7**. Please note that the due to the similarity of TDH and flow the same pump is used in Well 1R and wet well. Due to the configuration of a wet well a submersible well pump is feasible to operate properly in the well as confirmed by Goulds manufacturer.

Pumps were sized based upon the following calculations:

$$Total\ Dynamic\ Head\ (ft)\ =\ Total\ Static\ Head\ (ft)\ +\ Losses\ (ft)$$

$$TSH\ (ft)\ =\ Elevation\ of\ Wet\ Well - (Top\ of\ Well\ Elevation - Water\ Level\ BG\ (ft))$$

$$Losses\ (ft) = Minor\ Losses + Major\ Losses$$

All loss calculations were done using Hazen-Williams equations. Results are summarized in **Table 5-10** and under **Tab 7**. Pump Curves under **Tab 7** include two duty points of operating with both wells in service and one well in service to meet maximum flowrate of 50 gpm. These are achieved using the VFDs installed at each well. These duty points are summarized **Table 5-10** below.

Table 5-10. Pump Data.

Pump Location	Duty Point	TSH (ft)	Loss (ft)	TDH (ft)
Well 1R	25 gpm 50 gpm	467.5	29.5 56.3	497 524
Well 2	25 gpm 50 gpm	297.5	13.5 10	311 307.5

1. Elevation data and headloss calcs are assumed from previous engineering reports and existing HOA documents. Losses should be verified on site when new pumps are installed.

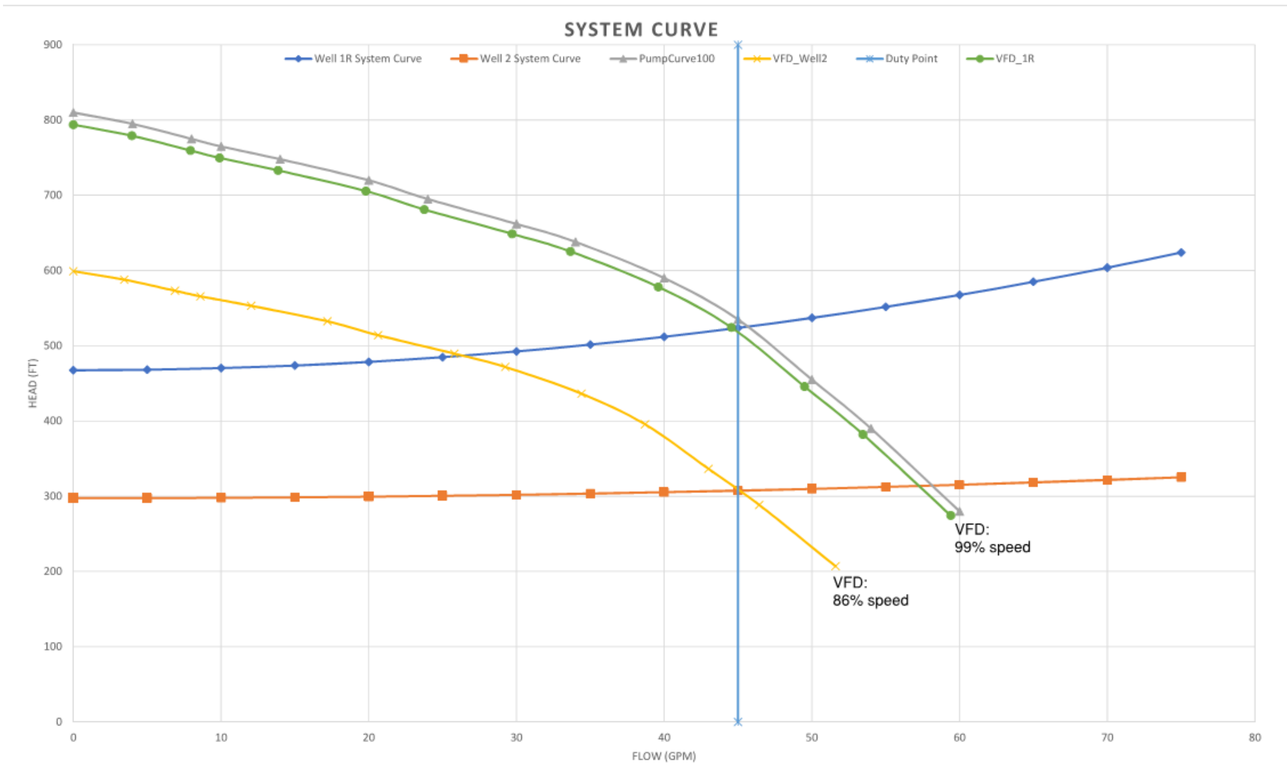

Figure 5-1. Pump Curve for wells operating independently at 45 gpm each.

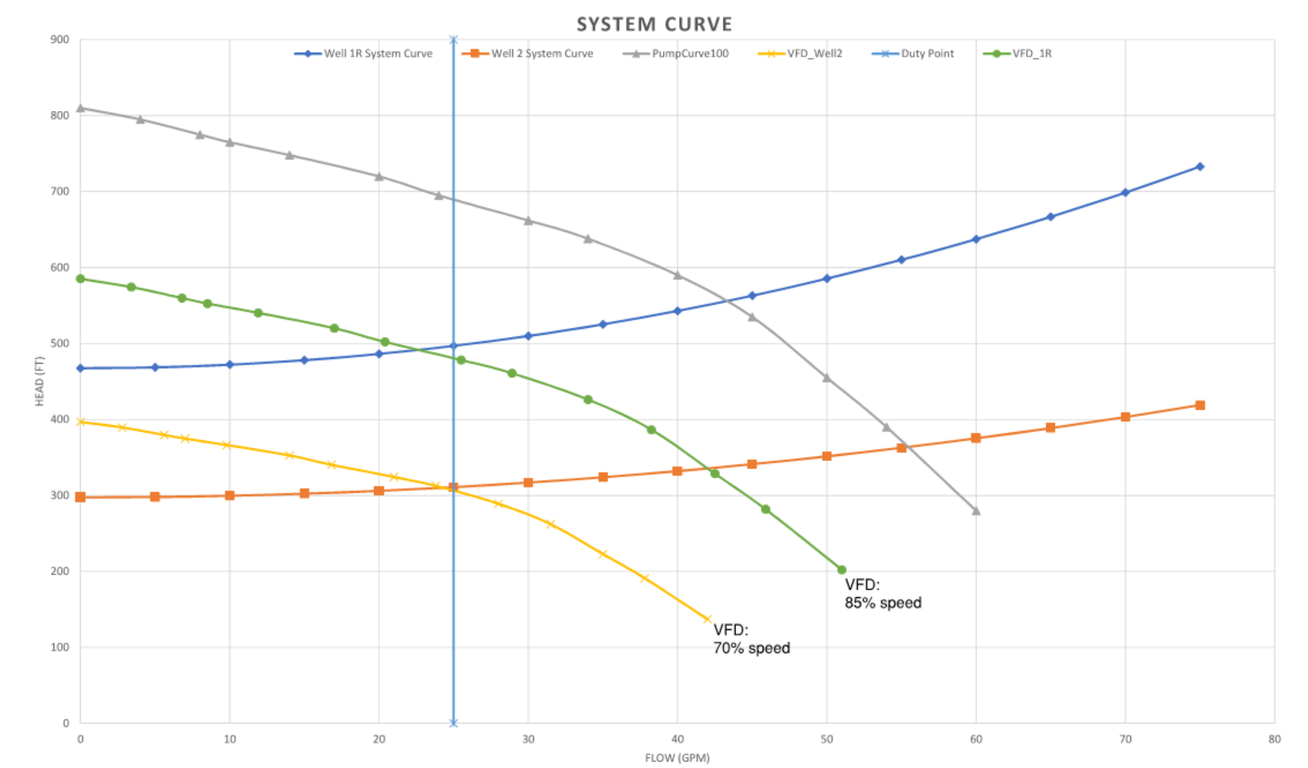

Figure 5-2. Pump Curve for wells operating in parallel at 25 gpm.

5.9 Distribution System

A map of the distribution system is included under **Tab 8**, and Emergency Plan located in the O&M Manual under **Tab 14**. The distribution system is comprised of the following components:

- Estimated 14,916 feet of 6" PVC SDR 26 distribution piping
- (8) 6" Gate Valves
- 12 Hydrants

6.0 Monitoring and Sampling Evaluation

6.1 Sampling Locations/Monitored Parameters

A detailed Sampling Plan is included under **Tab 14** and in the 2018 Monitoring Schedule currently on file with CDPHE located under **Tab 11**. The current point of entry (POE) will be moved downstream of the proposed serpentine piping system as shown in construction drawings under **Tab 5**.

7.0 Geotechnical Report

Per Appendix A of CDPHE's *Design Criteria for Potable Water Systems*, a geotechnical report was not required for this project.

8.0 Residuals Handling

8.1 Residuals Handling Plan

A residuals handling plan was not required for this project as no residuals are produced from operations.

9.0 Preliminary Plan of Operation

9.1 Staffing and Operator Certification

According to the CDPHE Water and Wastewater Facility Operators Certification Requirements Regulation No.100.4.2, Panorama Ranches Subdivision's supply wells are Class D treatment facilities and Class 1 distribution system. As such the system is required to be operated under the direct responsibility of a Class D certified plant operator and a Class 1 certified distribution operator. The plant operator of record is Davis Farrar, whom exceeds all required certifications, whose credentials are listed below

Davis Farrar, Drinking Water Operator:
Water Treatment Class D #12522
Distribution Operator Class 1 #3651

9.2 Operating Considerations

Current operations utilize a booster pump to directly serve chlorinated water to customers. Current residential water demands are described in **Table 5-3**. The existing booster pump is not adequately sized to meet future peak demands and keep tank levels sufficient, and therefore is being removed from service to simplify operations. The new well pumps will directly fill the tank bypassing the current wet well and utilizing new serpentine piping. This change will help increase tank infill rate under average operations and ensure storage levels remain above set minimum during peak demand periods. Therefore, the entry point of the system is upstream of the drinking water storage tank.

It is recommended that the operator increase chlorine residuals to 0.8 mg/L under normal operations, as this will meet to ensure proper dosing of sodium hypochlorite in system given the serpentine piping design.

9.3 Control Strategy

For additional information please see operations details under **Tab 16**.

- The submersible pumps in both wells are controlled by pressure switches at the pump house. The well pumps will either alternate in operation utilizing lead/lag switches or operate in parallel to produce 50 gpm. Desired operations are flexible with VFDs installed at each well.
- Flow is controlled from each well with VFDs. VFD setpoints will produce desired flowrate(s) to increase infill rate to the tank.
- Chlorine metering pump turns on when the well pumps are on via power-based interlocks.
- Water is combined at the pump house in 6" piping, where it will flow through the buried serpentine piping system at 50 gpm.
- Chlorine is injected after the well discharge in the pump house, same as current injection locations.
- Chlorine is sampled at the end of serpentine piping via smooth-nose tap yard hydrant.

- There are visual alarms at the pump house, which will activate under the following scenarios:
  - Tank level exceeds high-water level
  - Tank level is below low-water level

10.0 Impact to Corrosivity

Panorama Ranches chlorine contact improvements project is considered a substantial modification which is classified as Category 1 project and requires no information to impact to corrosivity evaluation as determined under Table A.1. Design Review Matrix.

2018 Monitoring Schedule and HOA developed Plan **(Tab 11/Tab 14, respectively)** includes lead and copper sampling, at a frequency of 5 samples throughout 6 months. Lead and copper sampling locations have been identified in the Monitoring Plan, which was previously submitted to CDPHE.

11.0 Site Specific Deviations

Below is a list of system deviations for the Panorama water treatment system. Please reference Tab 18 for more details.

1. **Design Criteria Section 4.4.1.2** Chemical Metering Pumps Capacity
    a. Section 4.4.1 of the 2018 Design Criteria states systems must have metering pumps with a required 200:1 turndown. Panorama Ranches will replace their existing metering pumps with Prominent Beta metering pumps, which have a 100:1 turndown ratio. A deviation is requested as this pump currently has a turn-down ratio capable of meeting the full range of dosing (0.2 - 2 mg/L) required as described in **Section 5.7.1.**
2. **Section 5.1.10.h. Chemical Tank Venting**
    a. Section 5.1.10.h states that any chemical storage tanks larger than 55 gallons must have proper ventilation. Tank current configuration does not have venting for the tank, but a new proposed valve on the chemical metering pump will allow off-gassing and venting to ensure the system can be de-pressurized as needed.

12.0 List of Acronyms and Abbreviations

ADD	average daily demand
BFV	butterfly valve
$CaCO_3$	calcium carbonate
CDPHE	Colorado Department of Public Health and Environment
CFE	combined filter effluent
CT	product of "residual disinfectant concentration" (C) in milligrams per liter (mg/L) determined before or at the first customer, and the corresponding "disinfectant contact time" (T) in minutes, i.e., "C" x "T"
^{o}C	degrees Celsius
DBP	disinfection byproduct
D/DBP	Disinfectants and Disinfection Byproducts
DOLA	Colorado Department of Local Affairs
EQR	equivalent residential unit
GPD	gallons per day
Fe	iron
ft^2	square feet
ft^3	cubic feet
HAA5	haloacetic acids (sum of regulated five)
HP	horsepower
IDSE	Initial Distribution System Evaluation
IESWTR	Interim Enhanced Surface Water Treatment Rule
IFE	individual filter effluent
in	inch
LCR	Lead and Copper Rule
LRAA	locational running annual average
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MDD	maximum daily demand
MGD	million gallons per day
Min	minute
mg/L	milligrams per liter
μg/L	micrograms per liter
Mn	manganese
ng/L	nanograms per liter
NTU	nephelometric turbidity units
Panorama	Panorama Ranches HOA

PW	potable water
RAA	running annual average
RO	reverse osmosis
RW	raw water
RWPS	raw water pump station
s.u.	standard unit
SWTR	Surface Water Treatment Rule
TCR	Total Coliform Rule
TDS	total dissolved solids
TLECC	Timberline Electrical and Controls Corporation
TOC	total organic carbon
TT	treatment train
TTHM	total trihalomethane
USEPA	Unites States Environmental Protection Agency
USGS	United States Geological Survey
UV	ultraviolet
WTP	water treatment plant