T·O ENGINEERS

Memorandum

PROFESSIONAL ENGINEER REGISTERED 10816 11/15/19 STATE OF IDAHO CARL W. KIPWELL

To: **City of Cascade**
CC: **Paul Scoresby**
From: Jon Duerschner
Date: November 15, 2019
Re: City of Cascade Water Supply and Storage Assessment

This memo is intended to summarize the current state of the City of Cascade's water supply and storage infrastructure and to estimate the impact of the planned Cascade River Ranch development. Information about the water system is largely lacking. However some information regarding well capacity and storage tank size has been provided by the City. Additionally, a Pharmer Engineering PER regarding water supply and storage for Fruitland Idaho has been used as a reference.

1.0 Existing Infrastructure

The City of Cascade currently supplies water via three wells located south of the Cascade Reservoir, just north of West Mountain Road. These wells pump water to three separate storage reservoirs located on the bench between the City and the reservoir. A 300,000 gallon reservoir is located on Bogie Drive and is supplemented by two (2) 500,000 gallon reservoirs located just off Duffer Lane. This information has been provided by the City of Cascade and is summarized in Table 1.

Table 1: Summary of Existing Water Supply and Storage Infrastructure

Wells	Capacity		Comment
Well 1	300 – 350 gpm		0.43 - 0.50 MGD
Well 2	300 – 350 gpm		0.43 - 0.50 MGD
Well 3	600 – 650 gpm		0.86 - 0.94 MGD, Serves as duty well
Reservoirs	**Volume**	**Diameter**	**Comment**
Bogie Reservoir	300,000 gallons	40 ft	
Duffer Reservoir 1	500,000 gallons	40 ft	
Duffer Reservoir 2	500,000 gallons	30 ft	
Total Storage	**1,300,000 gallons**		

2.0 Water Supply and Usage

Currently, the City of Cascade has a population of 1004. The Cascade River Ranch Development is planned in five (5) phases. Additionally there are roughly 50 existing lots in the City which will be expected to be built on during future growth. The projected population after completion of phase 5 and after empty lot fill in is 2,470.

Table 2 provides a summary of the development flows following the completion of each project phase. For the existing construction, a per capita usage of 160 gpcd has been selected. For the new construction, a per capita usage of 120 gpcd is used. This lower number is justified by the facts that, 1) the new construction will have a separate well for lawn irrigation, and 2) that the new construction will be better insulated, requiring taps to be left on overnight less often. A maximum day demand peaking factor of 2.5 has been selected to be conservative, and a peak hour demand peaking factor of 4 has been selected based on population.

From Table 2, the maximum day demand is met by the duty well alone even after full project buildout. The peak hour demand is not met by the duty well alone, however between the assumed operational and standby storage (see Section 3.0), 7.6 hours of storage is available before the fire storage will begin to be depleted. This time should provide ample opportunity for the peak hour flow to reduce below the combined standby well capacity of 1.00 MGD, at which time the City's water storage will begin to be replenished.

Therefore, it is the opinion of T-O Engineers that the City does not require a new well to meet the Cascade River Ranch demand.

Water Summary

Wells			**Comment**
Total Well Capacity	MGD	1.35	
Well Capacity Less Largest	MGD	0.70	
Population			
Current Population		1004	
Cascade River Ranch Addition		1266	
Empty Lot Fill-In		200	50 lots @ 4 people per lot
Projected Population after Phase 1		1622	
Projected Population after Phase 2		1914	
Projected Population after Phase 3		2102	
Projected Population after Phase 4		2318	
Projected Population after Phase 5		2470	
Current Usage			
Average Day Per Capita Usage	gpcd	160	
Average Day Demand (ADD)	MGD	0.16	
MDD/ADD	---	2.5	
PHD/ADD	---	4	
Maximum Day Demand (MDD)	MGD	0.40	
Peak Hour Demand	MGD	2.36	
Projected Average Day Usage			
Per Capita Use for New Development	gpcd	120	
After Phase 1	MGD	0.26	
After Phase 2	MGD	0.30	
After Phase 3	MGD	0.32	
After Phase 4	MGD	0.34	
After Phase 5	MGD	0.36	
Projected Max Day Usage			
After Phase 1	MGD	0.65	Scaled based on 2.5 MDD Peaking Factor
After Phase 2	MGD	0.74	
After Phase 3	MGD	0.79	
After Phase 4	MGD	0.86	
After Phase 5	MGD	0.90	
Projected Peak Hour Usage			
After Phase 1	MGD	1.04	Scaled based on 4.0 PHD peaking factor
After Phase 2	MGD	1.18	
After Phase 3	MGD	1.27	
After Phase 4	MGD	1.37	
After Phase 5	MGD	1.45	

3.0 Determing Water Storage Requirements

Calculation of storage requirements for the City of Cascade is hindered by a large number of unknowns. To fill these unknowns, several assumptions used by a 2008 Pharmer Engineering PER for Fruitland are also assumed for Cascade. The breakdown of the storage requirements for the the City of Cascade are presented in Table 3.

Table 3: Storage Requirements

			Comment
Dead Storage	24,100	gal	Assumes 1 foot freeboard per tank
Operational Storage	72,300	gal	Assumes 3 feet storage per tank
Equilization Storage	0	gal	Assumes less than operational + standby storage
Fire Storage	1,140,000	gal	Assumes school building defines fire flow
Standby Storage	69,700	gal	4 hours per day at ADD
Total	**1,306,100**	**gal**	

Dead storage is assumed to be 1 foot of freeboard per tank. This is the criteria used in the Pharmer PER. Because all three tanks have considerable elevation over the rest of the City, it is assumed the dead space storage is not necessary for the purpose of adding elevation to the operational storage. Thus 1 foot of freeboard is used.

Operational storage is assumed to be 3 feet of storage per tank, equating to 72,300 gallons. This is the value assumed in the Pharmer PER. This value may be conservative as it results in a pump cycle time of 7.5 hours during ADD.

The equilization storage is the largest unknown. Without hourly water usage data it is safest to assume the equilization storage can be accounted for with the sum of the operational and standby storage. The conservative value assumed for the operational storage is in part to account for the omission of equilization storage in this analysis. Additionally, the full capacity of all three wells is greater than the assumed peak hour demand. Thus we can assume that the supply can keep up with even large peaks in usage.

From an inspection of the City on GoogleEarth, the school on N School Street appears to be the largest building, and as such will define the fire flow requirement. The combined floor area of the school is roughly 110,000 ft^2 including three floors (calculted by outlining the building in GoogleEarth). According to the International Building Code, newer schools are commonly type II-A construction. For the given floor area and building type, the Idaho Fire Code prescribes fire storage equalling 4,750 gpm over a 4 hour duration, or 1,140,000 gallons.

Per the Pharmer Engineer PER, the standby storage has been estimated as equal to 4 hours at the average day flow, or 69,700 gallons.

4.0 Conclusion

This analysis does not support the need for additional water supply in the form of another well. However, the City may require additional water storage. The City is only 6,000 gallons over their existing storage, and given the large number of assumptions this analysis is based on, the decision to add additional storage could go either way. Verification of the fire storage requirement would be especially important. It is recommended that the City develop a facility plan in accordance with Idaho DEQ standards to have a complete understanding of the City water system and determine if additional storage is needed to meet the current and future city needs.

5.0 References

Idaho Department of Insurance. (2015). https://doi.idaho.gov/sfm/Prevention/Statutes.

Pharmer Engineering. 2008. Water Treatment Facility Preliminary Engineering Report Volume 1 Fruitland Water Treatment Plant, Fruitland, Idaho

6.0 Attachments

1.0 Selected pages from the Idaho Fire Code and International Building Code
2.0 Selected pages from the 2008 Pharmer Engineering PER for Fruitland

Attachment 1: Selected Pages from the Idaho Fire Code and International Building Code

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION B101 GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102 DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE-FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m^2), used to determine the required fire flow.

SECTION B103 MODIFICATIONS

B103.1 Decreases. The fire chief is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

B103.2 Increases. The fire chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the *fire code official* is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code*.

SECTION B104 FIRE-FLOW CALCULATION AREA

B104.1 General. The fire-flow calculation area shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation. Portions of buildings which are separated by *fire walls* without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate fire-flow calculation areas.

B104.3 Type IA and Type IB construction. The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

> **Exception:** Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

SECTION B105 FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings. The minimum fire-flow and flow duration requirements for one- and two-family *dwellings* having a fire-flow calculation area that does not exceed 3,600 square feet (344.5 m^2) shall be 1,000 gallons per minute (3785.4 L/min) for 1 hour. Fire-flow and flow duration for *dwellings* having a fire-flow calculation area in excess of 3,600 square feet (344.5m^2) shall not be less than that specified in Table B105.1.

> **Exception:** A reduction in required fire-flow of 50 percent, as *approved*, is allowed when the building is equipped with an *approved automatic sprinkler system*.

B105.2 Buildings other than one- and two-family dwellings. The minimum fire-flow and flow duration for buildings other than one- and two-family *dwellings* shall be as specified in Table B105.1.

> **Exception:** A reduction in required fire-flow of up to 75 percent, as *approved*, is allowed when the building is provided with an *approved automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2. The resulting fire-flow shall not be less than 1,500 gallons per minute (5678 L/min) for the prescribed duration as specified in Table B105.1.

SECTION B106 REFERENCED STANDARDS

ICC	IBC—12	International Building Code	B104.2, Table B105.1
ICC	IWUIC—12	International Wildland-Urban Interface Code	B103.3
NFPA	1142—12	Standard on Water Supplies for Suburban and Rural Fire Fighting	B103.3

TABLE B105.1
MINIMUM REQUIRED FIRE-FLOW AND FLOW DURATION FOR BUILDINGS

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	4
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

Construction Types - Definitions

TYPE I-A--Fire Resistive Non-combustible (Commonly found in high-rise buildings and Group I occupancies).

3 Hr. Exterior Walls*
3 Hr. Structural Frame
2 Hr. Floor/Ceiling Assembly
1 ½ Hr. Roof Protection

TYPE I-B--Fire Resistive Non-Combustible (Commonly found in mid-rise office & Group R buildings).

2 Hr. Exterior Walls*
2 Hr. Structural Frame
2 Hr. Ceiling/Floor Separation
1 Hr. Ceiling/Roof Assembly

TYPE II-A--Protected Non-Combustible (Commonly found in newer school buildings).

1 Hr. Exterior Walls
1 Hr. Structural Frame
1 Hr. Floor/Ceiling/Roof Protection

TYPE II-B--Unprotected Non-Combustible (Most common type of non-combustible construction used in commercial buildings).

Building constructed of non-combustible materials but these materials have no fire resistance.

TYPE III-A--Protected Combustible (Also known as "ordinary" construction with brick or block walls and a wooden roof or floor assembly which is 1 hour fire protected).

2 Hr. Exterior Walls*
1 Hr. Structural Frame
1 Hr. Floor/Ceiling/Roof Protection

TYPE III-B--Unprotected Combustible (Also known as "ordinary" construction; has brick or block walls with a wooden roof or floor assembly which is not protected against fire. These buildings are frequently found in "warehouse" districts of older cities.)

2 Hr. Exterior Walls*
No fire resistance for structural frame, floors, ceilings, or roofs.

TYPE IV--Heavy Timber (also known as "mill" construction; to qualify all wooden members must have a minimum nominal dimension of 8 inches.)

2 Hr. Exterior Walls*
1 Hr. Structural Frame or Heavy Timber
Heavy Timber Floor/Ceiling/Roof Assemblies

TYPE V-A--Protected Wood Frame (Commonly used in the construction of newer apartment buildings; there is no exposed wood visible.)

1 Hr. Exterior Walls
1 Hr. Structural Frame
1 Hr. Floor/Ceiling/Roof

TYPE V-B--Unprotected Wood Frame (Examples of Type V-N construction are single family homes and garages. They often have exposed wood so there is no fire resistance.)

- Note exceptions in the building code for fire resistance ratings of exterior walls and opening protection.

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Attachment 2: Selected Pages from the 2008 Pharmer Engineering PER for Fruitland

allow it to refill. The valve will only open if the storage tank is below a set point and the elevated storage tank is above a set point. This valve is currently undersized as it takes a days or even weeks to refill the tank, especially after an extended period of high demand (i.e. a fire or system flushing). Two wells (5 and 10) currently pump directly into the storage tank. The proposed WTP will replace the source water from the wells and be used to fill the tank directly from the system using a pressure reducing valve. The new filling design will allow the tank to be completely re-filled in less than 24 hours at 2026 average daily flows.

The existing tank connection will be modified to add a 8-inch pressure reducing valve (PRV) with a shutoff solenoid to be installed between the existing distribution system and the existing storage tank as shown on Figure ___. The PRV will normally be closed and will require the solenoid to be energized to open the valve. The PRV will be located in a concrete vault just adjacent to the existing booster pump station. The PRV will operate similarly to the existing valve in that it requires the storage tank level to be below a low set point and the elevated storage tank to be above a high set point before it will open. This operational scheme will prevent the booster pumps from pumping water 'in a circle' from the ground storage tank, into the distribution system and back into the tank. The PRV will close when the storage tank level is filled.

5.3 Storage Tank

The new tank will provide adequate storage to accommodate diurnal water demand requirements through year 2026, and provide additional fire suppression storage to meet the City's fire-flow requirements. The new ground storage tank reduces the water treatment plant capacity by providing additional water during peak hour usages, which would be required to be supplied by the treatment plant. The storage tank and pumping station also provides a southern input to the distribution system. The new ground storage tank is to be a 1.2 MG bolted steel tank that is approximately 92 ft in diameter and 24 ft tall. The tank will have a fill line that will be controlled by an electrically operated control valve. The outlet pipe from the tank will be a 16 in. pipe that supplies water to the storage pump system. The outlet and inlet pipes will be located on opposite sides of the tank to encourage mixing of the water within the tank to avoid water stagnation. The 1.2 MG of tank volume is divided up into the following components of storage.

5.3.1 Dead Storage

Dead storage includes the volume of water in a tank/reservoir that is unavailable to the system. The dead storage of the new ground storage tank is approximately 0.10 MG, which provides 1 ft of freeboard below the tank overflow and assumes some unusable water above the tank floor.

5.3.2 Operational Storage

Operational storage is stored water that supplies the system under normal operating conditions when the source supply is off. This volume prevents the source pumps from frequent cycling. In addition, this volume also provides a small safety factor for the other components of storage.

The new ground storage tank is designed to provide approximately 0.15 MG of operational storage that equates to approximately 3 ft of water level in the tank. With this operational volume, the water with in the tank will be turned over approximately every eight days, based on existing usages in the City water system.

5.3.3 Equalization Storage

Equalization storage is stored water that supplies the system when the maximum day diurnal demands exceed the capacity of the source supply. This water must be supplied to the system at pressures above 40 psi at all times.

For the Fruitland water distribution system, this component of storage was determined by analyzing a diurnal curve for a MDD scenario and including the estimated peak-hour demand. The portion of the diurnal curve above the capacity of the source is the required equalization storage. Source capacity is sized for MDD.

The necessary equalization storage for the system is 0.72 MG for the 2026 demand. This volume is generally accounted for in the City's existing storage tanks.

5.3.4 Fire Suppression Storage

Fire suppression storage or flow capabilities are required for public water systems to provide fire protection capabilities while still maintaining adequate system pressures. For the City, the required fire-flow capacity is 4,000 gpm for 4 hours while maintaining a minimum system pressure of 20 psi as identified in the Water Facility Plan (Pharmer 2008b). The City's existing storage tanks are capable of providing 1,000 gpm for 4 hours while maintaining a minimum system pressure of 20 psi.

The new ground storage tank is sized to provide 3,000 gpm fire flow plus 600 gpm of MDD to the upper zone for 4 hours, as required by fire code, while maintaining a minimum system pressure of 20 psi in both pressure zones in accordance with IDAPA 58.01.08.501.17. This requirement equates to a fire suppression volume in the new tank of 0.85 MG.

5.3.5 Standby Storage

The purpose of standby storage is to provide additional reliability to the distribution system should sources fail or if demands are higher than anticipated. Pharmer Engineering recommends 4 hours of average-day demand (ADD) be included as standby. The standby storage based on the 2026 ADD is 0.30MG. This volume is generally accounted for in the City's existing storage facilities.

5.3.6 Storage Summary

Dead Storage	0.10 MG
Fire Suppression Storage	0.71 MG
Operational Storage	0.15 MG
Sub-Total	*0.96 MG (As identified in the facility plan)*
Fire Suppression Storage	0.14 MG[a]
Total Storage	1.10 MG (Use 1.2 MG)

[a] Additional storage for upper zone

5.4 Pump Station

The pump station building is 36 ft x 28 ft with a chemical room, electrical room, and pump room. The chemical room will contain two chemical metering pumps (tube pumps) and two 55 gallon drums of 12% NaOCl. A valve vault will be located beneath the chemical room that will contain a pressure relief valve, an electric actuated control valve, and a surge anticipator valve. The pressure relief valve will provide water flow from the upper pressure zone to the lower pressure zone. The electrically actuated control valve is used to control the flow of water to the new water tank. The surge anticipator valve provides protection to the pump station from pressure surges within the distribution system. The electrical room will house all of the electrical equipment and controls for the pump station and storage tank.

The pump room will house pumps to supply water to the two pressure zones from the storage reservoir as well as a booster pump station to pump water from the lower pressure zone to the upper pressure zone. Pumps will be added to the booster pump station as necessary to meet water demands and fire-flow requirements in the upper zone. As part of the proposed project a 100gpm booster pump will be installed.

During the proposed project, four storage pumps will be installed to pump water from the new ground storage tank to the existing water system (lower zone) to provide fire flow. The pumps will be end suction, centrifugal pumps each sized to provide 1,000 gpm of flow at 185 ft of head. The selected total dynamic head for the pumps will allow the pumps to pump to the upper pressure zone head of 185 ft, which will eliminate the need to have separate fire pumps for each zone. The four storage pumps will provide an additional 1,000 gpm of peak-hour pumping capacity to the lower pressure zone. This additional pumping capacity was identified as necessary in the Water Facility Plan (Pharmer 2008b). The pump station is also designed to provide the additional 3,000 gpm of fire-flow pumping capacity also identified in the facility plan. With three duty pumps and one standby pump, the pump station is capable of supplying 3,000 gpm of fire flow to either pressure zone. The pump station meets the IDAPA requirements for mechanical redundancy with one standby pump. In addition, a 300 KW diesel generator will be provided to provide backup power to the pump station.

5.5 Controls and Electrical

The storage tank and pump station will be connected into the City SCADA system through a