Mountain WATERWORKS

Simplified Engineering Report

Terrace Lakes Water Company

Emergency and Imminent Community Water Assistance Grants Program

August 2020

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Section 1 PROJECT JUSTIFICATION

1.1 Introduction and Justification for ECWAG Funding

On March 31, 2020, a large magnitude 6.5 earthquake struck Central Idaho. The earthquake was the largest in the state of Idaho in over 35 years. Ground shaking was felt throughout Valley and Boise County regions (among many other regions throughout the State). Damage to the Terrace Lakes Water Company public drinking water system was observed by the system's operational staff, members of governing Board, customers, and the system's engineer in the immediate aftermath of the earthquake. Boise County, Idaho, the county in which the Terrace Lakes Water Company (Terrace Lakes) public water system is located, declared an Emergency on June 4, 2020. The Boise County emergency declaration is included as **Appendix A**, and specifically references Terrace Lakes, among other public water systems in the County. Valley County, Idaho, the county in which the Yellow Pine Water Users Association public water system is located declared an Emergency on June 15, 2020. The Valley County emergency declaration is included as **Appendix B**, and specifically references the Yellow Pine Water Users Association public water system. Valley County Emergency Service Manager Juan Bonilla also presented on behalf of the Yellow Pine Water Users Association as an emergency expert witness. Both Valley and Boise counties experienced private, public and municipal damage from the earthquake, with significant damage to public drinking water systems in these adjacent counties.

Terrace Lakes' most productive well (Well No. 5) was drilled in 2006. Following the earthquake, this well has lost significant production capacity due to declining static and pumping water levels. Shortly after the earthquake the submersible pump and motor installed in the well failed, resulting in loss of production capacity. It is likely this failure is associated with the greater pumping water level drawdown observed following the earthquake.

The purpose of this Simplified Engineering Report (SER) is to support an application for a USDA Rural Development Emergency Community Water Assistance Grant (ECWAG) to address the damage to the Terrace Lakes public water system as attributed to the earthquake of March 31, 2020. If approved, the grant would be utilized to construct a new water supply well and well house to supplement the water system's existing sources and provide the community with adequate water supply to maintain public health and safety.

Section 2 EXISTING CONDITIONS

2.1 Terrace Lakes Well No. 5

2.1.1 Well Construction

The well completion report prepared by SPF Water Engineering indicates geologic conditions consisting of Miocene-age sediments of the Payette Formation. The Payette Formation sediments consist of clay interbedded with water-bearing layers of sand and gravel. The Payette Formation sediments are underlain by granitic rocks of the Idaho Batholith.

The well was completed with a single string of 6-inch stainless steel screens and casing to a depth of 410 ft below ground surface (bgs). Screens were placed in water bearing zones from 290 to 300 ft below ground surface (bgs) and 360 to 390 ft bgs. An 8-12 Colorado Silica Sand filter pack was installed from approximately 170 ft bgs to 410 ft bgs. A bentonite chip surface seal extends from ground surface to the top of the sand filter pack at approximately 170 ft bgs. A summary of the completed well is included in **Table 2-1**.

Table 2-1: Well No. 5 Summary

Parameter	Value	Units
Completed Depth	410	ft bgs
Inner Diameter	6	in
Screen Placement	290-300, 360-390	ft bgs
Static Water Level	76	ft bgs
Pump Setting Depth	250	ft bgs
Test Pumping Rate	111	gpm
Drawdown during Test Pumping	72	ft
Specific Capacity during Test Pumping	1.5	gpm/ft drawdown
Design Sustainable Pumping Rate	100	gpm

2.1.2 Reduced Well Capacity

Following the March 31, 2020 earthquake and associated aftershocks, the static water level dropped approximately 50 feet and the aquifer recharge rate decreased. The static water level drop resulted in decreased production capacity that ultimately resulted in a pump and motor failure in April 2020. The reduced static water level results in a pumping water level that approaches the well screen depth, reducing the long-term sustainable well production capacity from 100 gpm to approximately 50 gpm. The original drawdown curve of the well as a function of time during test pumping is shown in **Figure 2-1**. The initial drawdown curve is compared against the drawdown vs. time relationship based on the static water level observed after the March 31st earthquake. Assuming the best-case scenario that the well recharge has remained the same, it is estimated there would be only 60 feet of water over the pump following 24-hours of pumping at 111 gpm. Continuous pumping at approximately 100 gpm would dewater the well to the level of the pump following approximately one week of production. The reduced operating range limits the length of time the well can be utilized during the summer peak demand period at the original 100 gpm

design capacity, or requires a reduction in the sustainable pumping rate to approximately 50 gpm to prevent damage to the pump and motor caused by excessive drawdown.

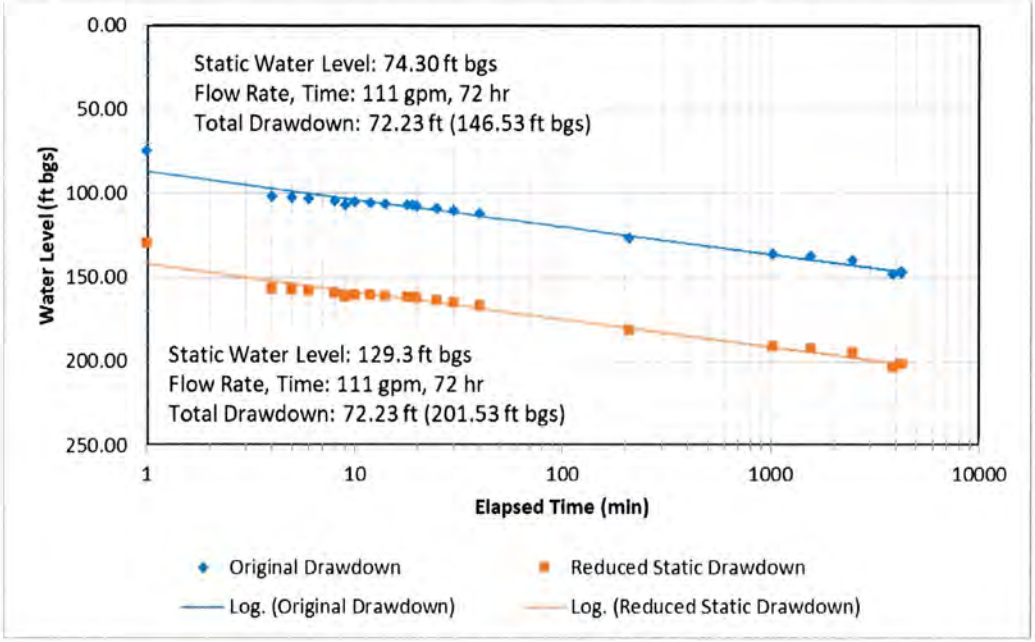


Figure 2-1: Reduced Static Water Level Drawdown Comparison

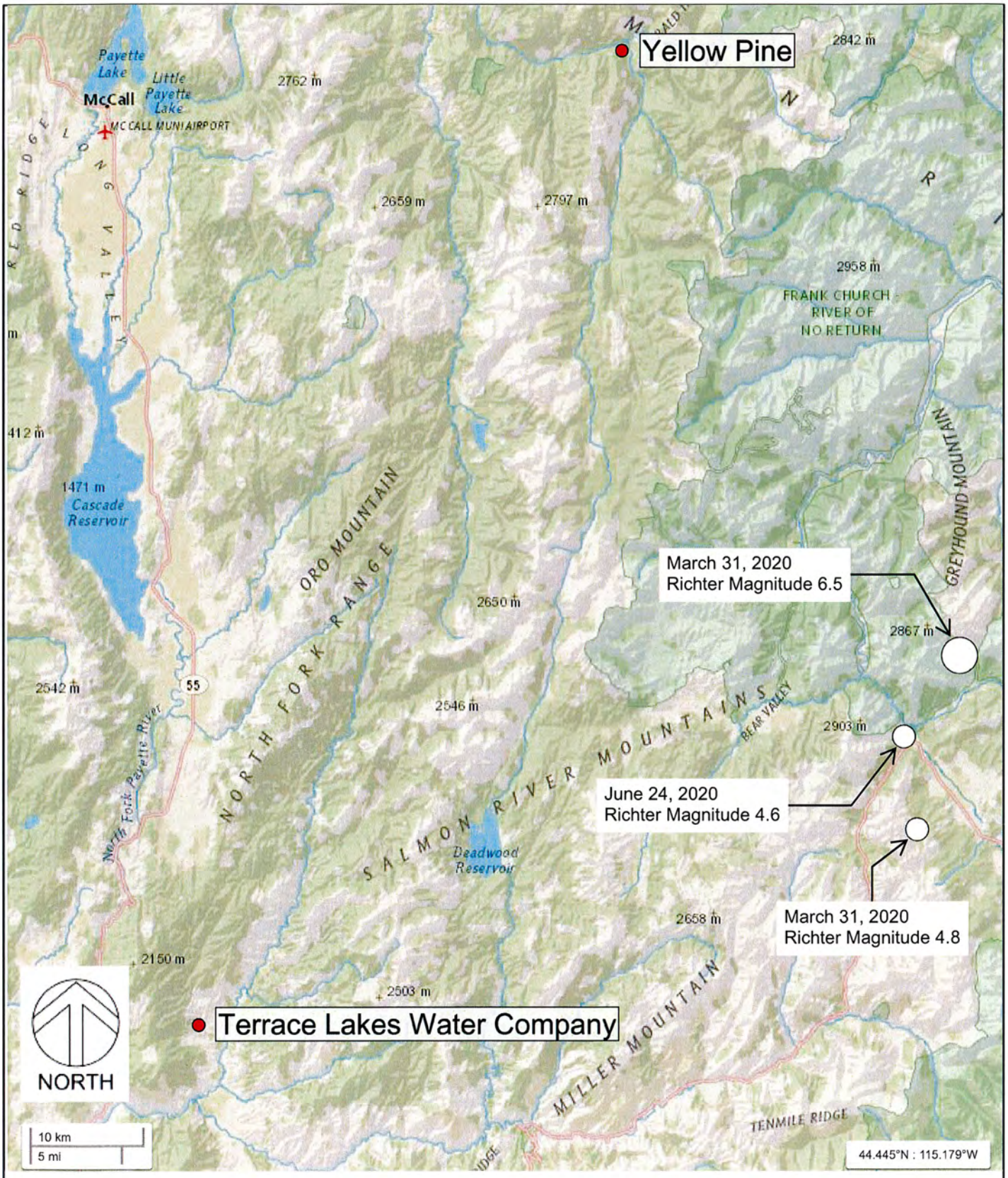
2.1.3 Seismic Activity

The decrease in static water level of 50 ft. and aquifer production capacity of 50 – 60 gpm at Well No. 5 was first observed in April 2020 when the pump/motor failure occurred. Following the Boise County Emergency Declaration, Mountain Waterworks reviewed seismic activity in the region during the period immediately prior to the observed capacity decrease in April 2020. A summary of large seismic events (Richter magnitude 4.5+) in the region between March and June 2020 is included in **Table 2-2,** with events shown graphically in **Figure 2-2.** A Modified Mercalli Intensity map is provided in **Figure 2-3** for the magnitude 6.5 event, which indicates moderate earth shaking would have been observed in the vicinity of Terrace Lakes during the earthquake.

Table 2-2: Large Seismic Event Activity (March - June 2020)

Date	Latitude	Longitude	Depth (km)	Magnitude	Epicenter Location
3/31/2020	44.465°N	115.118°W	12.1	6.5	70km W of Challis, Idaho
3/31/2020	44.323°N	115.167°W	10.0	4.8	72km E of Cascade, Idaho
6/24/2020	44.375°N	115.202°W	10.6	4.6	68km E of Cascade, Idaho

In addition to the large seismic events included in **Table 2-2**, approximately 745 events of Richter magnitude 2.5 and greater have occurred in the region between January and June 2020 (refer to map included in **Appendix C**). These seismic swarms are located approximately 40 and 60 miles northeast of Terrance Lakes and coincide with the observed Well No. 5 static water level decline. While the magnitude of many of the earthquakes are relatively small, ground motions in bedrock from shallow, low-magnitude events can be detected at distances of 100 miles or greater from the epicenter.



SEISMIC ACTIVITY NEAR TERRACE LAKES WATER COMPANY PUBLIC WATER SYSTEM

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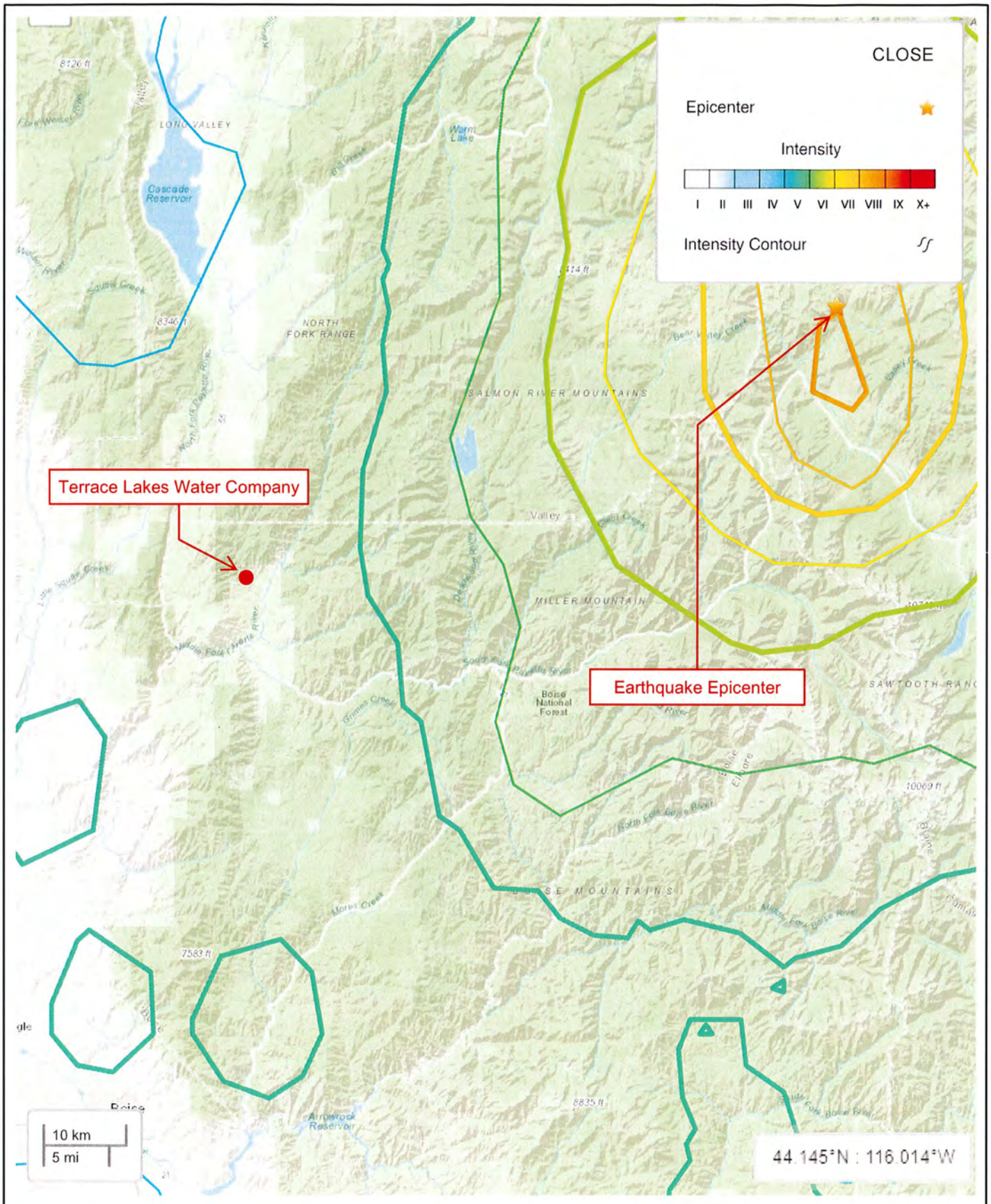
TERRACE LAKES WATER COMPANY	PROJECT NO.: 999.245
VICINITY MAP	SHEET NO. FIGURE 2-2



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TERRACE LAKES WATER COMPANY

MODIFIED MERCALLI INTENSITY MAP

PROJECT NO.: 999.245

SHEET NO. FIGURE 2-3

2.2 Water Supply and Demand

The Terrace Lakes water system is broken into two separate service levels (North and South) of roughly equal size that are separated by Warm Springs Drive. Although the subdivision contains 457 total platted lots, total buildout is estimated at about 380 lots/service connections due to lot constructability constraints and instances of multiple lot ownership where only a single residence is constructed. There are currently 360 active connections in the water system, which are split between the two service levels. Each service level has its own groundwater wells and one storage reservoir, which allows them to function effectively as independent distribution systems. A pressure reducing valve vault is installed at the bottom of both service levels near Warm Springs Drive and allows water to flow from the South service level to the North service level under emergency conditions, such as a fire or supply outage on the north side. Because the North and South reservoirs are at different elevations water can only flow from south to north. Under normal operating conditions, both service levels are separated and function independently.

2.2.1 Sources of Supply

The water system is supplied by four primary wells—Wells 3, 4, 5, and 6. Wells 1 and 2 are inactive and used only as emergency sources due to high fluoride above the maximum contaminant level (Well 1) and low productivity (Well 2), and consequently are not included in the source of supply summary.

Listed in **Table 2-3** are the current capacities of each primary well along with the service level it supplies. As a result of the recent regional seismic events, Well No. 5 is estimated at a reduced sustainable supply capacity of approximately 50 gpm due to significant groundwater level decline. Since both the North and South service levels operate independently, the total system sustainable well production must include 2 wells out of service.

Table 2-3: Source of Supply Summary

Well Information Summary			
Source of Supply	**Capacity**	**Service Area**	**Notes**
Well No. 3	30	South	-
Well No. 4[a]	40	North	-
Well No. 5[a]	50	South	Declining Production
Well No. 6	55	North	-
Well Operating Scenarios			
All Sources Active	175	North and South	Wells 3, 4, 5, and 6 Active
South Production w/o Largest Well	30	South	Well 3 Active Well 5 Inactive
North Production w/o Largest Well	40	North	Well 4 Active Well 6 Inactive
Total Production w/o Largest Wells	70	North and South	Wells 3 and 4 Active

a. *Well 4 and 5 are the respective primary wells for the North and South service levels.*

2.2.2 Current Water System Demands

Per IDAPA 58.01.08, public water systems must be able to meet Maximum Daily Demands (MDD) with the largest source offline, with storage reservoirs required to provide sufficient volume to meet fire flow and peaking demands. As shown in **Table 2-4,** the Terrace Lakes currently serves approximately 360 service connections, with a systemwide maximum day demand of 112 gpm. Per-connection average day demand (AAD) and maximum month, average day demand (MMAD) are assumed to be the same as reported in the 2009 Water Facility Plan Amendment prepared by SPF Water Engineering. Maximum day demands were estimated using MMAD in combination with a 1.3 peaking factor and the current number of service connections in the system and in each service level. Peak hour demands were estimated based on maximum day demand using a peaking factor of 2.

Table 2-4: Water System Demands

Parameter	Value
Current Number of Service Connections in System	360
Number of Connections in North Service Level at Buildout	160
Number of Connections in South Service Level at Buildout	200
Per-Connection Demands	
Average Day Demand[1]	146 gal/day*connection
Maximum Month Average Day Demand[1]	345 gal/day*connection
Maximum Day Demand[2]	448 gal/day*connection
Peak Hour Demand[3]	896 gal/day*connection
Systemwide Demands	
Average Day Demand	52,560 gal/day 36.5 gpm
Maximum Day Demand	161,300 gal/day 112 gpm
Peak Hour Demand	224 gpm
North Service Level Demands	
Average Day Demand	23,360 gal/day 16.2 gpm
Maximum Day Demand	72,000 gal/day 50 gal/min
Peak Hour Demand	100 gpm
South Service Level Demands	
Average Day Demand	29,200 gal/day 20.3 gpm
Maximum Day Demand	90,000 gal/day 62 gal/min
Peak Hour Demand	124 gpm

1. *Source: 2009 Terrace Lakes Facility Plan Amendment, SPF Water Engineering.*
2. *Estimated using peaking factor of 1.3 and maximum month average day demand.*
3. *Estimated using a peaking factor of 2 applied to maximum day demand.*

2.2.3 Fire Flow

The existing distribution system was not originally designed to provide standard residential fire flow of 1,500 gpm. The distribution network is comprised of small diameter (6-inches or less) piping and does not have the hydraulic capacity to convey fire flow at 1,500 gpm. It is assumed that the existing distribution system could provide water for firefighting at a reduced rate of 250 gpm for at least two hours in accordance with NFPA 1142—Standard on Water Supplies for Suburban and Rural Fire Fighting. This water would be delivered through filling stations in the distribution system to fire tanker trucks. The water systems' two reservoirs provide a total of 100,000 gallons of storage, of which 30,000 gallons is intended to supply the fire flow required by NFPA 1142.

2.2.4 Components of Water Storage

The water system includes two storage reservoirs with a combined volume in 102,500 gallons. The North service level storage reservoir holds 50,500 gallons and the South service level reservoir holds 52,000 gallons. **Table 2-5** summarizes the combined components of water storage (operational, standby, equalization, and fire suppression) for both reservoirs. Storage component definitions are as follows:

- **Operational Storage:** Volume used during normal operation to control pump on/off cycling.
- **Standby Storage:** Volume dedicated to maintaining system pressure during a power outage; calculated as 8 hours of average day demand.
- **Equalization Storage:** Volume dedicated to meeting peaking demand above maximum day demand; calculated as 22.5% of maximum day demand per Idaho Dept. of Environmental Quality guidance document "*Guidance for Determining Equalization Water Storage for Public Water Systems.*"
- **Fire Suppression:** Volume dedicated for firefighting operations; calculated as described in **Section 2.2.3**.

Table 2-5: Components of Water Storage

Storage Component	Volume (gallons)
Operational	18,700
Standby	17,500
Equalization	36,300
Fire Suppression	30,000
Total Storage Available (North and South Reservoirs)	**102,500**

2.2.5 South Service Level—Water Supply Versus Demand at Buildout

Because the North service level's reservoir is at a lower elevation than the South service level reservoir, wells in the South service level must be capable of supplying maximum day demand within the South service level. As shown in **Table 2-4**, maximum day demand in this service level is 62 gallons per minute at 448 gallons per day per service connection. Well No. 3 (30 gpm) and Well No. 5 (50 gpm) are the only sources of water available to supply the South service level, with a total capacity of approximately 80 gpm.

The Idaho Department of Environmental Quality (IDEQ) requires a sustainable capacity with the largest well out of service. After the earthquake and with the largest well (Well No. 5) out of service, the South service level has a supply deficiency of approximately 32 gpm, meaning the system would be required to rely on storage to meet maximum day demand. In the event of an outage lasting longer than 2 – 3 days under these conditions, the South service level could experience depressurization and loss of water service. In addition, water from the South service level could not be used to supplement the North service level in the event of a well outage, maintenance, or during a fire. Using a similar analysis, the North service level also lacks capacity to meet maximum day demand with its largest well out of service. However, it is possible to supplement the North service level from the South reservoir provided all wells in the South service level are operating. In the event one well in both service levels was out of service, the overall water system would not have adequate supply to meet maximum day demand.

A summary of service area supply and demands is provided in **Table 2-6**.

Table 2-6: Well Capacity vs. Water System Demands

System Operation	Water Supply Capacity[2,3] (gpm)	Maximum Day Demand[1] (gpm)	Surplus/(Deficit) (gpm)
North Service Area			
All Wells Operational	95	50	45
Largest Well Out of Service	40	50	(10)
South Service Area			
All Wells Operational	80	62	18
Largest Well Out of Service	30	62	(32)
Water System Total			
All Wells Operational	175	112	63
Largest Well(s) Out of Service	70	112	(42)

1. *Demands based on 448 gallons per day per connection peak day*
2. *South service level wells can serve the North service level through the pressure reducing valve (PRV) station intertie.*
3. *North service level wells are unable to supply the South service level.*

Section 3 SCOPE OF WORK

3.1 Construction of New Well in South Service Level

To address the supply deficiency that has developed since the March 2020 earthquake, construction of a new well and well house is proposed to supplement existing sources of supply. The project includes the following elements:

- Secure land and easements to construct a new groundwater well (Well No. 7).
- Drill a 300-foot deep, 6-inch diameter test well, conduct geophysical logging, and confirm available water quantity and quality.
- Apply for and obtain permission from the Idaho Department of Water Resources to add a new point of diversion for a new production well to the water system's existing water rights.
- Drill a new 300-foot deep, 8-inch or 10-inch diameter groundwater production well and install a submersible turbine pump and motor, pump column, and pitless unit or adapter.
- Install 6-inch AWWA C900 PVC water main to connect the new well to the south service level distribution system.
- Construct a well house to contain the mechanical piping, isolation and check valves, air release valve, pressure relief valve, sample taps, pump to waste piping, instrumentation (e.g. flow meter and pressure transducer), control systems, and electrical equipment for the new well.

After the well lot has been secured, a new point of diversion will need to be added to Terrace Lakes' three existing groundwater rights, which allow a combined diversion rate of up to 0.47 cubic feet per second, or 211 gpm. This is about 100 gpm more than the water system's current maximum day demand, so additional water rights will not be required. Copies of the Idaho Department of Water Resources water rights reports for the three water rights are provided in Appendix D.

A new groundwater well is anticipated to be located along Warm Springs Drive or in the vicinity of Well No. 3 as shown in **Figure 3-1,** and will target a production capacity of 100 gpm. The well will be completed in the interbedded sand, gravel, and clay sediments at the valley floor, which are more likely to contain productive water-bearing zones than the granite formations that would be encountered if the well were completed further up in the mountains in the western portion of the development.

A new communications and control system will be installed in to monitor the Well No. 7 pumping water level and alarm system operators in the event of future water level declines. A variable frequency drive will be used to control the well pump motor to allow the pumping rate to be reduced if required to maintain the pumping water level above the pump bowls and protect the pump and motor. This will improve reliability of the system and allow Terrace Lakes Water Company operations staff to respond more rapidly to system emergencies.

Water system capacity vs. demand at buildout following completion of a new 100-gpm well is summarized in **Table 3-1**. Completion of this well would provide the water system with adequate firm capacity from its primary wells to meet maximum day demand through buildout as required by IDAPA 58.01.08 § 501.17, "Idaho Rules for Public Drinking Water Systems." The supply

deficiency in the north service level could be addressed by transferring water from the South reservoir, as the new well would provide adequate surplus capacity in South service level to maintain the water level in the North reservoir.

Table 3-1: Well Capacity vs. Water System Demands after Well No. 7 Completion

System Operation	Water Supply Capacity[b,c] (gpm)	Maximum Day Demand[a] (gpm)	Surplus/(Deficit) (gpm)
North Service Area			
All Wells Operational	95	50	45
Largest Well Out of Service	40	50	(10)
South Service Area			
All Wells Operational	180	62	118
Largest Well Out of Service	80	62	18
Water System Total			
All Wells Operational	275[1]	112	163
Largest Well(s) Out of Service	120	112	8

1. In practice, the maximum pumping rate is limited by Water Right 63-23085 to 211 gpm.

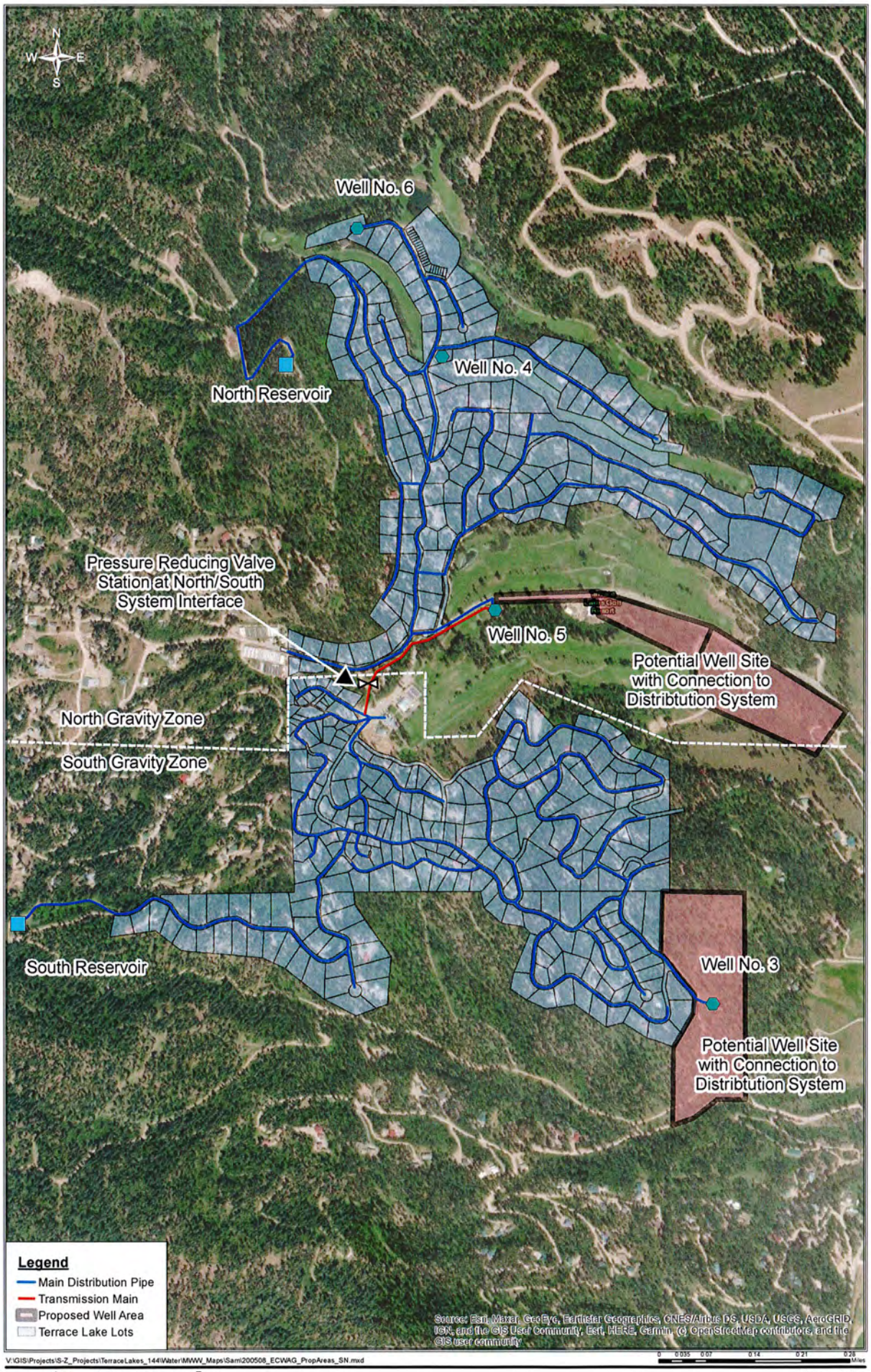

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Figure 3-1
Propsed Project Area
Terrace Lakes

Mountain Waterworks, Inc.

Boise - Lewiston - McCall

TABLE 3-1: ENGINEER'S OPINION OF PROBABLE COST[1]

Terrace Lakes Water Company

Well No.7 Design and Construction

NO.	ACTIVITY		COST
	Construction and Land Aquistion		
1	Land Acquisition, Legal, Easements		$25,000
2	Test Well (300 ft. 6-inch)		$50,000
3	Idaho Power Electrical Service		$25,000
4	Production Well Drilling (8 or 10-inch)		$200,000
5	Well Pump, Motor, and Pitless Unit		$50,000
6	Mechanical Piping (4-inch DI)		$35,000
7	Transmission Piping (6-inch C900 PVC)		$75,000
8	Well House and Site Work		$125,000
9	Communication and Controls System		$50,000
10	Electrical Programming & Integration (Owner Provider Services)		$25,000
11	Survey (Owner Provider Services)		$15,000
12	Well Production & Water Quality Testing (Owner Provider Services)		$20,000
	Construction Subtotal		**$ 695,000**
13	Contingency (16%)		$ 112,000
	Construction Total		**$ 807,000**
14	**Basic Engineeering (18% of Construction)**		$ 152,400
15	**Additional Services**		
	15.a	Pre-Project Development	$5,000
	15.b	Water Right Administration & Application	$7,500
	15.c	O&M Manual	$5,000
	Additional Services Total		**$17,500**
16	**Resident Project Representative - RPR (6%)**		$50,000
	Basic Engineering, Additional Services and RPR Total		**$219,900**
	Project Cost Total		**$1,026,900**

1. The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Mountain Waterworks has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Mountain Waterworks cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.