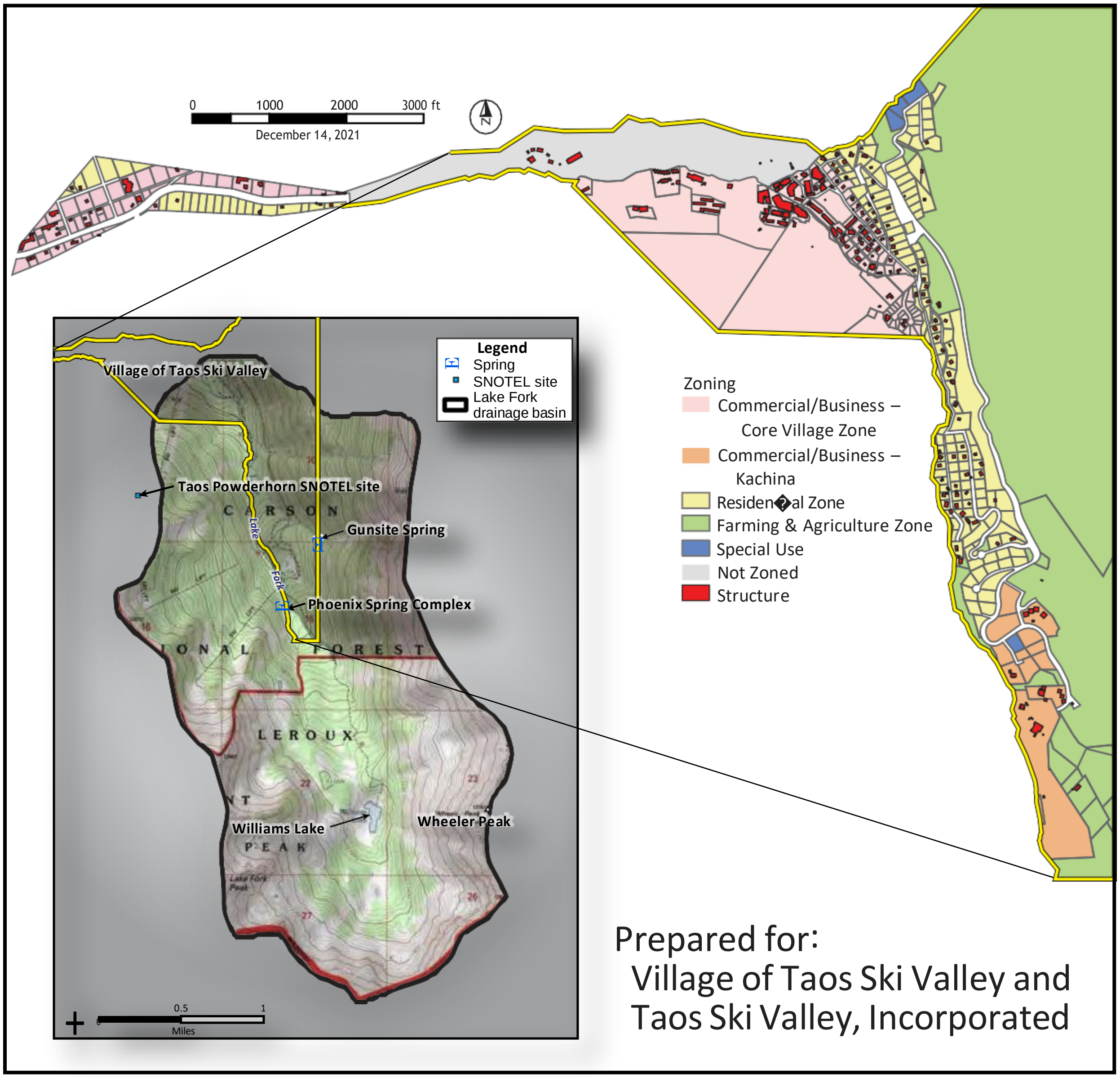
Village of Taos Ski Valley, NM

Water Master Plan



Prepared for:
Village of Taos Ski Valley and
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December 16, 2021

TAOS SKI VALLEY WATER MASTER PLAN EXECUTIVE SUMMARY

Glorieta Geoscience, Inc. (GGI) and Dennis Engineering Company (DEC) have conducted a geohydrologic analysis of the Phoenix Spring and Lake Fork drainage basin (Figure ES1), and an engineering analysis of the Village of Taos Ski Valley (VTSV) water distribution system, respectively.

- The goal of the geohydrology investigation was to evaluate sources and timing of recharge to the Phoenix Spring Complex and develop a methodology for estimating future minimum spring flows based on historic data.
- The focus of the engineering analysis was to evaluate the water distribution system, current and projected system demand and related infrastructure to recommend improvements to provide VTSV with a more reliable water distribution system.
- The overarching goal of the two studies was to evaluate the ability of VTSV to meet future water demands, especially during periods of peak use around the winter holidays and spring break, given natural (spring flow) and engineering (distribution system) constraints.

The primary conclusions of this investigation are presented below. The detailed analysis, methodologies, and conclusions are presented in the attached reports from GGI and DEC.

HYDROLOGY AND WATER SUPPLY SUMMARY (GGI REPORT)

The Phoenix Spring Complex discharges at a bedrock constriction, which reduces cross sectional area of the aquifer in glacial deposits. Winter precipitation contributes ~55-88% of recharge to springs, with the balance coming from (primarily monsoonal) rainfall. Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old).

Based on metering data collected by VTSV over the past eight years from the Phoenix Spring Complex, analysis of data from the Powderhorn Snotel site from 2010 to 2021, and analysis of data from the USGS Rio Hondo at Valdez gage from 1934 to 2021, the following are minimum flows predicted for the Phoenix Spring Complex:

- The lowest projected monthly average flow is 144 gallons per minute (gpm), equivalent to 207,360 gallons per day (gpd)
- The lowest projected 5-day average spring flow is 126 gpm/181,440 gpd
- The lowest monthly average flow will likely occur in March, whereas the lowest 5-day average flow may occur in March or April

These values do not include flow from the Gunsite Spring, which is also a permitted point of diversion for VTSV. Flows were measured by VTSV from Gunsite Spring during Summer and early Fall of 2019 and 2020, and have been measured weekly by GGI beginning in February, 2021. During the period of weekly flow measurements, Gunsite spring discharge ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) in August, 2021.

It is extremely important that the Village continue to carefully monitor (meter) flows from the Phoenix Springs Complex, including tracking the timing and duration of bypass flows, and revisit the baseline flow evaluation every 5 years. Projections of future water supply should be adjusted as appropriate to incorporate continued and improved data collection.

Ongoing statewide water supply and climate change studies being conducted by various state agencies have found that:

1. In the last 20 years there are only 5 years where NM has not been in drought conditions
2. At present, NM is in the deepest drought in the last 20 years
3. In the last 4 decades, temperatures have risen and precipitation has remained about the same State-wide
4. It will get warmer in NM as CO_2 concentrations in the atmosphere increase
5. There will be decreased snowpack but more winter precipitation in the Northern Mountains
6. Snowpack and streamflow will decrease
7. Snow will melt earlier and there will be less runoff

To accommodate potential reductions in spring flows arising from climate change, an annual reduction in spring flows of 0.5% per year was applied to the projected values presented above over a 25-year planning horizon. Incorporating this climate-induced flow reduction results in the following estimated minimum values for discharge from the Phoenix Spring Complex that should be used for planning purposes:

Minimum monthly average flow: 126 gpm / 182,000 gpd
Minimum 5-day average flow: 111 gpm / 159,000 gpd

Applying a 0.5% per year reduction to the measured flow from the Gunsite Spring results in projected minimum flows of 26 gpm / 38,000 gpd. Additional data collection is required to confirm the Gunsite Spring minimum flows. If connected to the VTSV system, the Gunsite Spring has the potential to compensate for most or all of the declines in Phoenix Spring flow arising from the effects of climate change.

WATER DEMAND AND INFRASTRUCTURE NEEDS (DEC REPORT)

The Water Service Area is a defined term referencing that portion of the Village which is serviced by the municipal water system. This area and the corresponding 2019 Metered Gallons establish the Base Line documentation of usage within the Village. Figure ES2 shows the VTSV municipal water service area, as well as those portions of the Village which are not served, and delineates usage by zone and type of dwelling. This is the basis for evaluating existing water consumption, and from which projected growth and future usage are derived. As part of that projected growth, it is assumed that water service will be provided to Amizette in addition to growth in the existing Water Service Area. A detailed assessment of baseline conditions and growth projections can be found in the DEC Water Master Plan Technical Memorandum – Appendix E: TSVI Baseline and Estimated Future Demand, and a summary is provided here in Table ES1.

Peak system demand typically occurs in December through March of each year, with the greatest demand in January. VTSV metered records indicate that, during periods of peak demand, unaccounted water is 74%, meaning that system customers only utilize approximately 26% of the water metered at the Phoenix Spring chlorination station. Approximately 80,000 gpd, or 60% of all unaccounted-for water, is lost between the chlorination station and the 250,000 gallon 'Green Tank'.

The demand analysis, combined with the future water supply projection outlined in the GGI report, indicate that if no improvements are made to the water distribution system, supply could potentially be

Table ES-1. Baseline and estimated future (25-year) water demand and water supply.

Growth Scenario:	**Water Service Baseline**	**Existing + 20%**	**Base Village & Kachina**	**Amizette (existing)**	**Amizette (expansion)**
Land Use Assumption (see note A)					
Single Family Homes	103	-	106	21	41
Hotels	108	-	78	90	-
Multi-Family	276	-	323	36	-
Total Lodging Units	487	-	507	147	41
Total - Cumulative Units	487	487	994	1,141	1,182
Non-Residential Space (SF)	155,272	-	50,300	-	-
Cumulative (SF)	155,272	155,272	205,572	205,572	205,572
Water Demand ('000 gal) (see note B)					
Baseline (2019 data)	1,553	-	-	-	-
Growth	-	311	1,749	223	56
Total Demand (Cumulative)	**1,553**	**1,863**	**3,612**	**3,835**	**3,891**
Water Capacity Scenarios ('000 gal) (see note C)					
1. Current Capacity w/75% leakage	**1,599**	**1,599**	**1,599**	**1,599**	**1,599**
Surplus/(Shortfall) – thousand gallons	*46*	*(264)*	*(2,013)*	*(2,236)*	*(2,292)*
Surplus/(Shortfall) - %	*3%*	*-14%*	*-56%*	*-58%*	*-59%*
2. 50% leakage + 12.5% climate loss	**2,812**	**2,812**	**2,812**	**2,812**	**2,812**
Surplus/(Shortfall) – thousand gallons	*1,259*	*949*	*(800)*	*(1,023)*	*(1,079)*
Surplus/(Shortfall) - %	*81%*	*51%*	*-22%*	*-27%*	*-28%*
3. 35% leakage + 12.5% climate loss	**3,656**	**3,656**	**3,656**	**3,656**	**3,656**
Surplus/(Shortfall) – thousand gallons	*2,103*	*1,793*	*44*	*(179)*	*(235)*
Surplus/(Shortfall) - %	*135%*	*96%*	*1%*	*-5%*	*-6%*
4. 25% leakage + 12.5% climate loss	**4,218**	**4,218**	**4,218**	**4,218**	**4,218**
Surplus/(Shortfall) – thousand gallons	*2,665*	*2,355*	*606*	*383*	*327*
Surplus/(Shortfall) - %	*172%*	*126%*	*17%*	*10%*	*8%*

(A) See Figure ES-2 Land Use Assumption schedule for details.

(B) Based on 2019 data from VTSV with reductions for Pizza Shack, Terry Sports, Phoenix Grill leak and Hotel St. Bernard which are non-recurring or incorporated into the future growth projection.

(C) Climate change is assumed to reduce water capacity by one-half percent (.5%) annually for a 12.5% loss over the next 25 years.

insufficient to meet existing demand in 2022, if in 2022 the Phoenix Springs Complex has historically low flows (equivalent to the lowest projected flow from the GGI report). If no improvements are made to the distribution system to reduce line losses, then it will be impossible to demonstrate that water will be available for any future development, including extending service to Amizette. If, however, system losses are reduced to 25% (a reasonable, but still relatively high number), then the water use projections indicate the VTSV system will be able to provide water for all proposed future development in the Base Area, Kachina Village, and Amizette, with an estimated 8% surplus at full build out. This projection takes into account a 20% increase in visitations/occupancy (relative to 2019 values), a 0.5% per year decline in flow from the Phoenix Springs Complex (relative to the lowest projected flow value), and does not include connecting Gunsite Spring to the VTSV system.

As these numbers indicate, it is critical that VTSV undertake immediate action to reduce water losses in the system to ensure that sufficient supply is available to meet existing and projected future demand.

RECOMMENDED ACTION PLAN

- Continue to carefully monitor (meter) flows from the Phoenix Springs Complex, including the timing and duration of bypass flows.
- Continue to record flows from the Gunsite Spring.
- Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate ongoing and improved spring flow data.
- Bring the Kachina water tank on-line and connect it to the system.
- **Isolate locations and extent of water losses**
    - Replace the mechanical inlet and outlet meters at the Green Tank with electromagnetic flow meters and install in separate vaults to ensure manufacturer clear distances are satisfied. This will confirm the extent of water loss between the chlorination station and the Green tank.
    - Install master meters at strategic locations in the system (delineated in the DEC report) to isolate specific segments of the distribution and pinpoint where water losses are occurring.
    - Target meter installation by summer of 2022 (prior to 2022/2023 peak demand)
- **Replace leaking water lines:** Future line replacement projects should focus on areas of maximum water loss as determined from the master metering program.
- Evaluate areas where 4-inch water mains are utilized for fire protection to determine if these lines are adequate to provide fire protection, and replace these lines if they are not.
- Replace all galvanized water lines in the system with adequately sized ductile iron water lines.
- Replace all customer meters and begin a meter replacement program to ensure that all customer meters are scheduled to be replaced prior to the end of their service life.

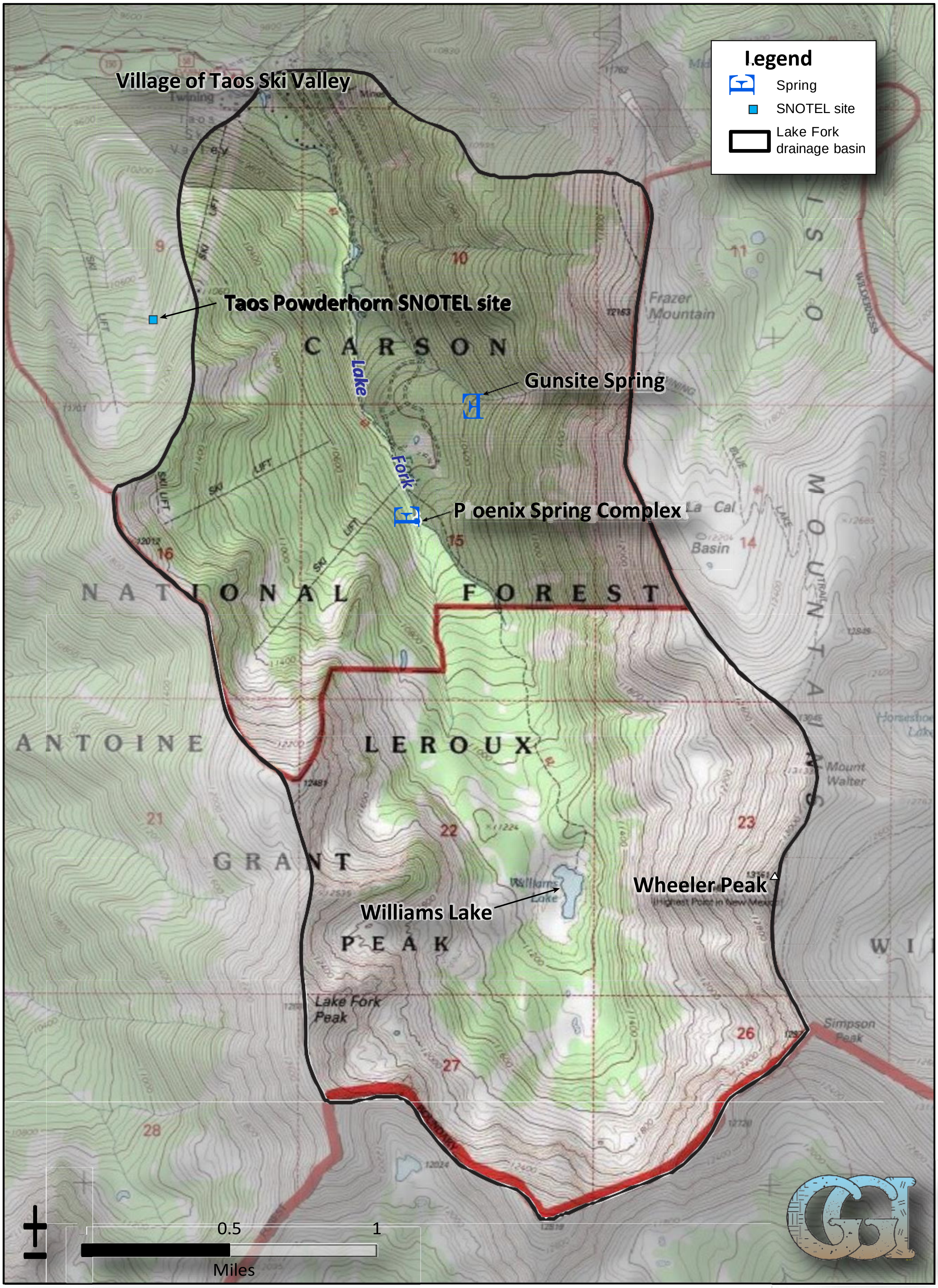

Figure ES1. Map of the Lake Fork drainage basin showing location of the Phoenix Spring Complex, Gunsite Spring, and the Taos Powderhorn SNOTEL site

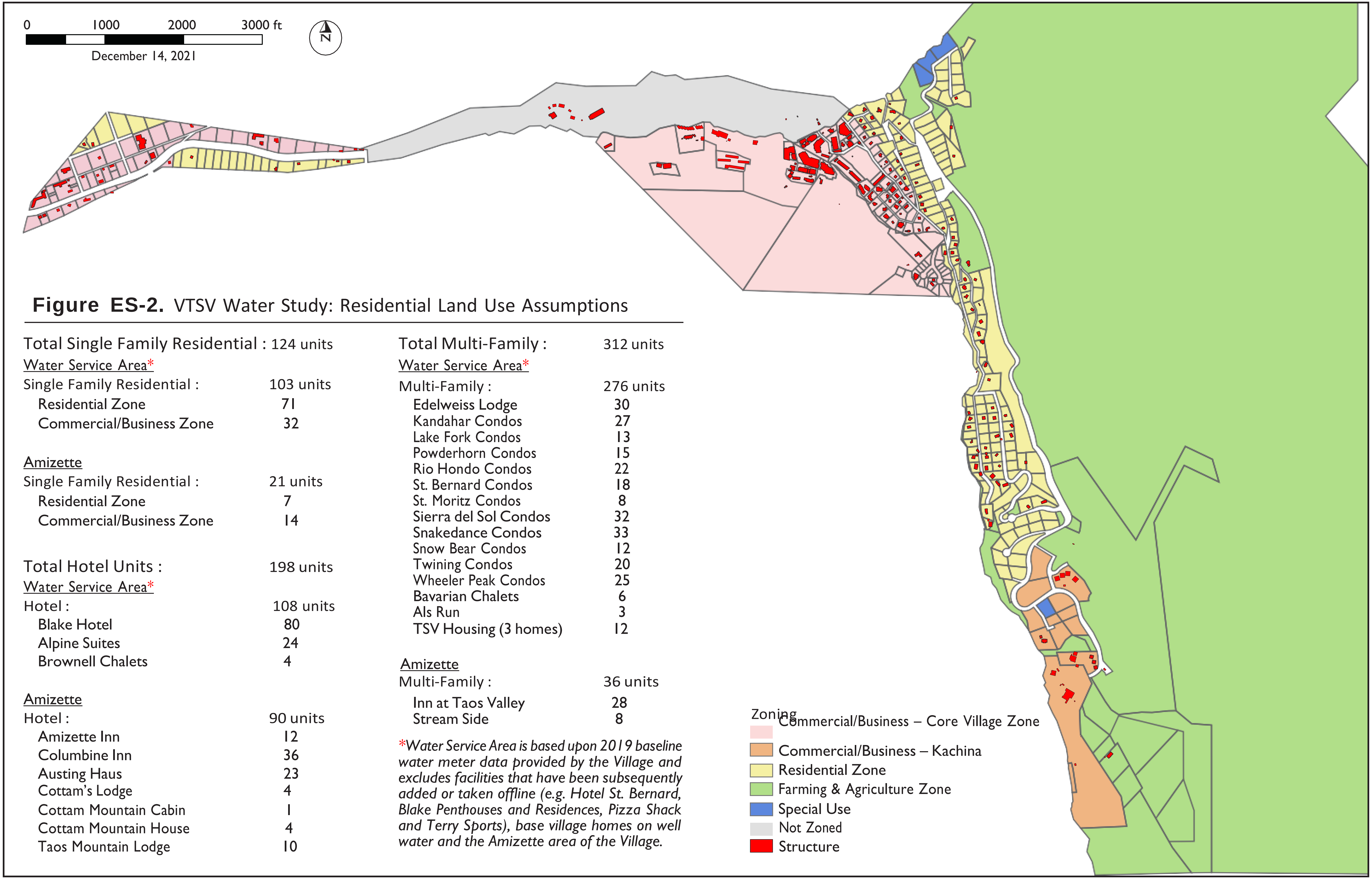

Figure ES-2. VTSV Water Study: Residential Land Use Assumptions

Total Single Family Residential :	124 units
<u>Water Service Area</u>*	
Single Family Residential :	103 units
Residential Zone	71
Commercial/Business Zone	32
<u>Amizette</u>	
Single Family Residential :	21 units
Residential Zone	7
Commercial/Business Zone	14

Total Hotel Units :	198 units
<u>Water Service Area</u>*	
Hotel :	108 units
Blake Hotel	80
Alpine Suites	24
Brownell Chalets	4
<u>Amizette</u>	
Hotel :	90 units
Amizette Inn	12
Columbine Inn	36
Austing Haus	23
Cottam's Lodge	4
Cottam Mountain Cabin	1
Cottam Mountain House	4
Taos Mountain Lodge	10

Total Multi-Family :	312 units
<u>Water Service Area</u>*	
Multi-Family :	276 units
Edelweiss Lodge	30
Kandahar Condos	27
Lake Fork Condos	13
Powderhorn Condos	15
Rio Hondo Condos	22
St. Bernard Condos	18
St. Moritz Condos	8
Sierra del Sol Condos	32
Snakedance Condos	33
Snow Bear Condos	12
Twining Condos	20
Wheeler Peak Condos	25
Bavarian Chalets	6
Als Run	3
TSV Housing (3 homes)	12
<u>Amizette</u>	
Multi-Family :	36 units
Inn at Taos Valley	28
Stream Side	8

**Water Service Area is based upon 2019 baseline water meter data provided by the Village and excludes facilities that have been subsequently added or taken offline (e.g. Hotel St. Bernard, Blake Penthouses and Residences, Pizza Shack and Terry Sports), base village homes on well water and the Amizette area of the Village.*

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Village of Taos Ski Valley, NM

Water Master Plan - Hydrologic Assessment

Historic and Projected Flows from the Phoenix Springs Complex

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Prepared for:

Village of Taos Ski Valley
and
Taos Ski Valley Incorporated

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December 16, 2021

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ACRONYMS AND ABBREVIATIONS

cfs	cubic feet per second
CS	Chlorination Station
DWB	Drinking Water Bureau (NMED)
GGI	Glorieta Geoscience, Inc.
gpd	gallons per day
gpm	gallons per minute
LRE	Leonard Rice Engineers, Inc.
MGD	Million gallons per day
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMED	New Mexico Environment Department
SNOTEL	SNOwpack TELemetry
std dev	Standard Deviation
SWE	Snow Water Equivalent
TSVI	Taos Ski Valley Incorporated
VTSV	Village of Taos Ski Valley
WY	Water Year (October 1 to September 30)

UNIT CONVERSIONS

Multiply	By	**To Get**	**Rule of thumb conversions**
gpm	1440	gpd	1 gpm = 1440 gpd
gpd	0.000694	gpm	
cfs	449.23	gpm	1 cfs ~ 450 gpm
gpm	0.0022	cfs	
cfs	646,891	gpd	1 cfs ~ 650,000 gpd
gpd	1.55×10^{-6}	cfs	

EXECUTIVE SUMMARY

Taos Ski Valley, Inc. (TSVI) and the Village of Taos Ski Valley (VTSV) have undertaken a water master planning effort to quantify future water supply needs and the water available to meet those needs. This report has been prepared by Glorieta Geoscience, Inc. (GGI) as part of the larger water master planning effort and summarizes the results of efforts to quantify current and projected water supply from the springs that are currently the Village's sole source of municipal water supply. The data included in this report build on previous studies of the geology and hydrology of the Taos Ski Valley area conducted by GGI on behalf of both VTSV and TSVI, copies of which are included as appendices to this report. These previous studies found:

- Phoenix spring discharges at a bedrock constriction, which reduces cross sectional area of the aquifer in glacial deposits
- Winter precipitation contributes ~55-88% of recharge to springs, with the balance coming from (primarily monsoonal) rainfall
- Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)
- The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) or 1,950,000 gallons per day (gpd) from Phoenix Spring to the East Fork confluence during low flow conditions

Data and conclusions from these previous studies are updated here with more recent spring flow metering data and additional analyses of the relationships between snow pack, precipitation, stream flows, and spring discharge. These relationships are used to project minimum anticipated future spring flows for utilization as a planning tool by VTSV.

Metered spring flow data, provided by VTSV, are available for the period from February 2014 to April 2021. The lowest monthly average flows occur during March, when demand in VTSV is typically high, and in April. From the available meter data:

- The lowest recorded monthly average flow was 158 gallons per minute (gpm, equivalent to 227,520 gallons per day [gpd]) in March, 2021
- The lowest recorded 5-day average flow was 140 gpm/201,600 gpd from April 11 to April 15, 2014

Stream flow records are available for the Rio Hondo from 1935 to 2021. Using relationships between spring flows and Rio Hondo flows that were established during evaluation of the data, historic spring flows are extrapolated for this entire period. From the projected spring flow data:

- The lowest projected monthly average flow is 144 gpm/207,360 gpd
- the lowest projected 5-day average spring flow is 126 gpm/181,440 gpd

These values are conservative to take into account the uncertainties associated with the relatively short period of spring flow meter data and incomplete records of when the Side Spring and Schreiber Spring were being metered.

These values do not include flow from the Gunsite Spring, which is a permitted point of diversion for VTSV. Flows were measured by VTSV from Gunsite Spring during Summer and early Fall of 2019 and 2020, and have been measured weekly by GGI beginning in February, 2021. During the period of weekly flow measurements, Gunsite spring discharge ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) as of August 19, 2021.

Ongoing statewide water planning studies suggest that climate change impacts in the VTSV planning area will likely include increasing temperatures, decreased snowpack, and earlier runoff, all of which may affect the quantity and timing of discharge from the Phoenix Springs Complex and Gunsite Spring. To account for the potential future decrease in spring flows arising from climate change, the projected low flow values were further reduced by 0.5% per year for a 25-year planning period.

Based on the findings of this study, GGI recommends the following:

1. **For planning purposes, a minimum monthly average flow of 126 gpm / 182,000 gpd and a minimum 5-day average flow of 111 gpm / 159,000 gpd should be used for the Phoenix Springs Complex.** These values incorporate a 0.5% per year decrease in spring flows attributable to effects of climate change.
2. Continue metering flows from the Phoenix Springs complex, including improved record keeping regarding when the Side Spring and Schreiber Spring are turned in to the chlorination station and when they are bypassing the chlorination station meters.
3. Install meters on the bypass pipelines and record bypass flows to allow for a full accounting of all spring discharge, including high flows, that are not currently metered. This metering will allow for better correlation of snowpack (snow water equivalent) to spring flows and could provide a useful future planning tool to allow for early warning of upcoming periods of low spring discharge based on snow water equivalent.
4. Continue monitoring Gunsite Spring flows to better constrain the range of flows that can be expected from this source.
5. Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate continued and improved data collection. The current projections include several assumptions to keep the estimates conservative for planning purposes. Continued collection and re-evaluation of the data will allow projected flow estimates to be adjusted up or down, as appropriate, to assist in ongoing planning efforts.
    a. Once Gunsite Spring flows are better understood, it may be advisable for VTSV to consider connecting Gunsite Spring to the municipal distribution system.
6. Implement policies and practices to reduce the impacts of climate change, including continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses, continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

1 INTRODUCTION

The Village of Taos Ski Valley (VTSV/the Village) utilizes water from the Phoenix Springs Complex, which includes the Phoenix Spring and two nearby hydrologically connected springs ('Side Spring' and 'Schreiber Spring') as its sole sources of municipal water supply. Water from Phoenix Spring is collected in an infiltration gallery and piped into the VTSV chlorination facility (commonly referred to as the chlorination station, CS) before being put into the municipal distribution system. During the low spring-flow period from December/January through March/April (depending on the year), the Side Spring and Schreiber Spring may also be directed into the CS via a system of valves and pipelines, described in section 4 below. Collectively, these three springs will be referred to in this report as the *Phoenix Springs Complex* (Figure 1). VTSV has a second permitted point of diversion, the Gunsite Spring (Figure 1), that is listed on the New Mexico Environment Department (NMED) Drinking Water Bureau (DWB) Drinking Water Watch website. This water source is listed as "Inactive" on the Water Watch Website and is not currently utilized as part of the VTSV water system. The focus of this report is therefore the Phoenix Springs Complex; however, it is GGI's recommendation that VTSV pursue development of the Gunsite Spring as an additional water source.

In order to plan responsibly for future growth in VTSV it is critical for the Village to understand the water supply that can be reliably obtained from these springs. The Village has undertaken a water master planning effort to identify and quantify both the potential future water demand resulting from proposed or potential development and the available water (spring) supply to accommodate that demand. Of specific interest to planning efforts is obtaining a reliable estimate of the minimum flow that can be expected from the Phoenix Springs Complex during peak demand season (December through early April) in future years.

This report has been prepared by GGI to address the spring-supply portion of the water master planning effort and is focused on providing VTSV with a reliable minimum spring flow number to use for future planning efforts. GGI has been conducting hydrogeologic studies in the VTSV area and the surrounding Lake Fork and Rio Hondo watershed since 1990. The studies of springs, groundwater, and surface water resources in this and other watersheds throughout the southwestern US are resources that GGI has drawn upon to better understand the hydrologic system that sustains the Phoenix Springs Complex, and the VTSV water supply.

2 HYDROGEOLOGIC SETTING AND PREVIOUS INVESTIGATIONS

The Phoenix Springs Complex is one of the primary sources of stream flow in the upper reaches of the Lake Fork of the Rio Hondo. Phoenix Spring is situated at an elevation of 10,310 ft in the Lake Fork Valley, a glacial valley draining the Williams Lake cirque and Wheeler Peak in northern New Mexico (Figure 1). The Lake Fork Valley is underlain by rock glaciers and thick valley bottom till. Recharge occurs both in the Williams Lake Cirque and along the Lake Fork Valley, with snowmelt and monsoonal precipitation infiltrating directly into the glacial deposits. No surface water flow leaves the cirque; rather groundwater discharges further down the valley through springs and directly to the Lake Fork. Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss and schist.

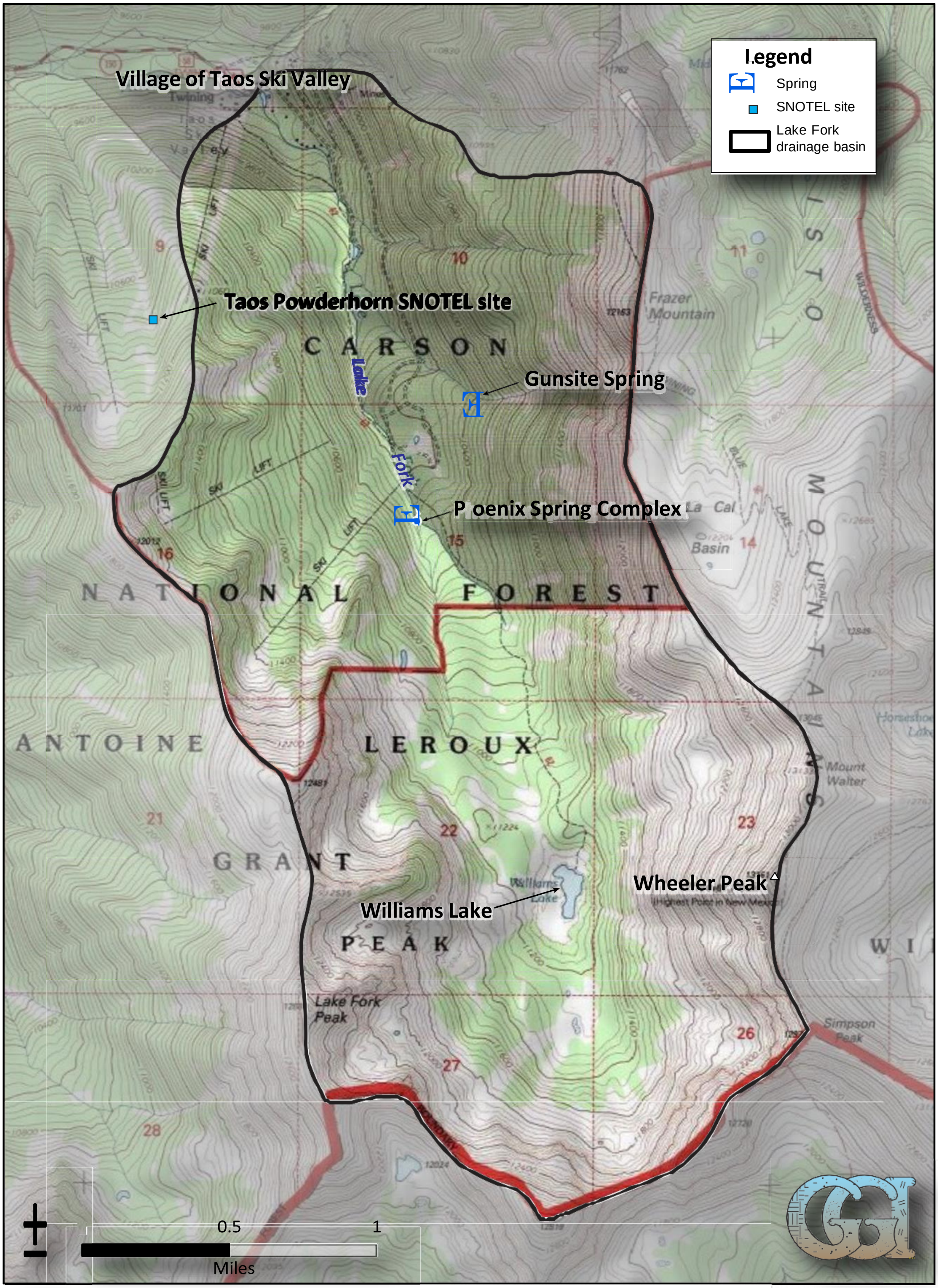

Figure 1. Map of the Lake Fork drainage basin showing location of the Phoenix Springs Complex, Gunsite Spring, and the Taos Powderhorn SNOTEL site

TSVI, VTSV, and GGI conducted a hydrogeologic investigation of Phoenix Spring and the upper Rio Hondo drainage from 2016-2019.[1] This investigation included collection of precipitation and snowpack samples for tritium and stable isotope analyses, piezometer installation and water level monitoring upgradient of the Phoenix Springs Complex, and gaging of stream flows. Significant findings of this investigation included:

- Phoenix spring discharges at bedrock constriction, which reduces cross sectional area of aquifer in glacial deposits
- Stable isotopes show that winter precipitation contributes ~55-88% of recharge to springs[2]
- Shallow groundwater is recharged by monsoonal precipitation with an approximate two-week lag time as seen in piezometer water level data (see piezometer installation report and water level data included in Appendix A)
- Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)[2]
- The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) from Phoenix Spring to the East Fork confluence during low flow conditions (equivalent to approximately 1.94 million gallons per day, MGD)
- Spring discharge is typically highest in May, June, and July, the result of an initial rapid response to snowmelt recharge
- March-April low discharge base flow conditions are controlled by the previous winter's snowpack, or snow water equivalent (SWE). This is consistent with recharge to high-hydraulic conductivity coarse sediments (talus, rock glaciers, and moraines) in the Williams Lake Cirque and Lake Fork Valley above the Phoenix Springs Complex. These types of aquifers have fast responses to snowmelt and storm events, yet they sustain steady discharge for many months (Hayashi, 2020).

The Drakos et al. (2020) presentation summarizing these studies is included in Appendix B.

3 UNCERTAINTIES

As with any hydrogeologic investigation, there are a number of uncertainties associated with the current study. These uncertainties are primarily related to:

1. Limited period of record for metered spring flows (8 years)
2. Gaps in 2020 spring flow records
3. Incomplete records of when the Side Spring and Schreiber Spring were turned into/out of the CS
4. Reliability/accuracy of climate change forecasts
5. Natural variability in a complex hydrogeologic system

While it is not possible to eliminate all uncertainty from an analysis of the factors contributing to spring flow, GGI has attempted to identify and discuss the sources of uncertainty in this report. Where

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[1] The results of these studies and other similar spring investigations have been presented in technical conferences (e.g. Drakos et al., 2020), provided to TSVI, presented to the VTSV Source Water Protection Stakeholders group, and are referenced in the Source Water Protection Plan (SWPP).

[2] Additional isotope samples have been collected from Phoenix Spring, East Fork Lake Fork Spring, Gunsight Spring, and Simpson Spring as part of the current study. Samples have been submitted for laboratory analyses and results are pending.

uncertainty exists, we have taken a conservative approach to the data analysis in order to provide VTSV with a projection of future spring flow that is both defensible and reasonable for planning purposes.

4 SPRING FLOWS

4.1 SPRING FLOW METERING DATA

Spring flow metering records were provided by VTSV for the period covering February 7, 2014 through April 30, 2021. The records include both instantaneous readings and totalizer meter readings for flows into the chlorination chamber and the overflow that is returned to the river. Combined flow from the two meters (overflow + chlorination chamber) represent the total amount of spring production being directed into the CS. This flow does not necessarily represent the total flow being produced by the Phoenix Springs Complex due to controls on the distribution upstream of the chlorination station that may allow some flow to bypass the chlorination station entirely, as described below and shown schematically in Figure 2. Hand-drawn schematics of the spring flow controls, prepared by the former system operator, are included for reference in Appendix C.

4.1.1 Main Bypass Line

The main pipeline from the Phoenix Spring infiltration gallery to the CS includes a 10-inch overflow line that can allow spring flow to be directed into the Lake Fork upstream of the CS (Figure 2). This connection between the overflow line and the main line does not have a valve. Flows are directed to the overflow pipeline by restricting flow into the CS using a valve located at the CS, which creates back-pressure in the main line and forces water out the overflow. During periods of peak flow in the late spring and early to mid-summer, the excess spring flows are discharged directly to the Lake Fork via this 10-inch bypass line, and the meters in the CS only record the portion of total flow that is not bypassed to the Lake Fork. In 2016 VTSV staff identified times in 2015 when the flows were being bypassed, shown in blue text on Figure 3.

4.1.2 Scheiber Spring

Scheiber Spring is located between the main Phoenix Spring and the CS (Figure 2). Flow from Scheiber Spring can be directed to the CS or directly to the Lake Fork via an 8-inch bypass line. This bypass, similar to the upper 10" bypass, is controlled by a valve in the discharge line that can be opened to allow flow to the CS or throttled back to direct flows to the Lake Fork during times of high spring flows. No records have been identified to indicate when this bypass has been opened and closed but, presumably, operation of this bypass would result in the same types of spikes/reductions in metered flows at the CS as are induced by the operation of the upper bypass. Discussions with VTSV staff indicate that flows from Scheiber Spring are always utilized (directed to the CS) during the low flow winter months, typically beginning in December.

4.1.3 Side Spring

In addition to Phoenix and Schreiber Springs, there is a third spring referred to as the Side Spring (formerly known as Mickey's Spring), which can be diverted into the CS when Phoenix Spring flows are low (Figure 2). The Side Spring is owned by Taos Ski Valley, Inc. (TSVI) and flows from the spring can only be utilized by VTSV to augment Phoenix Springs flows with the permission of TSVI. Since 2016 records of when the

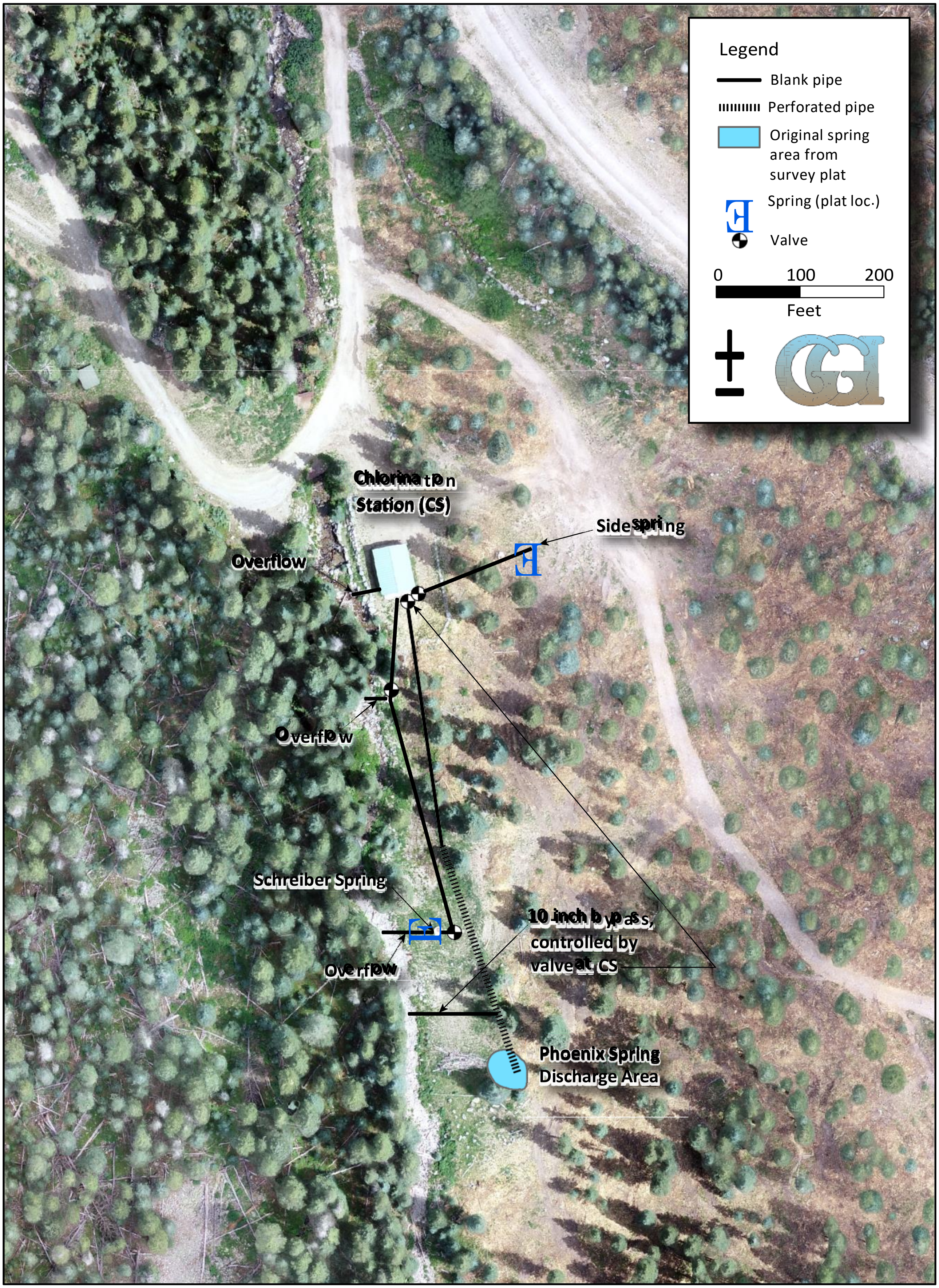

Figure 2. Schematic overview of spring flow collection and control system. Reconstructed from survey plats made prior to chlorination station construction and from schematic drawings of valve controls from VTSV staff (see Appendix C).

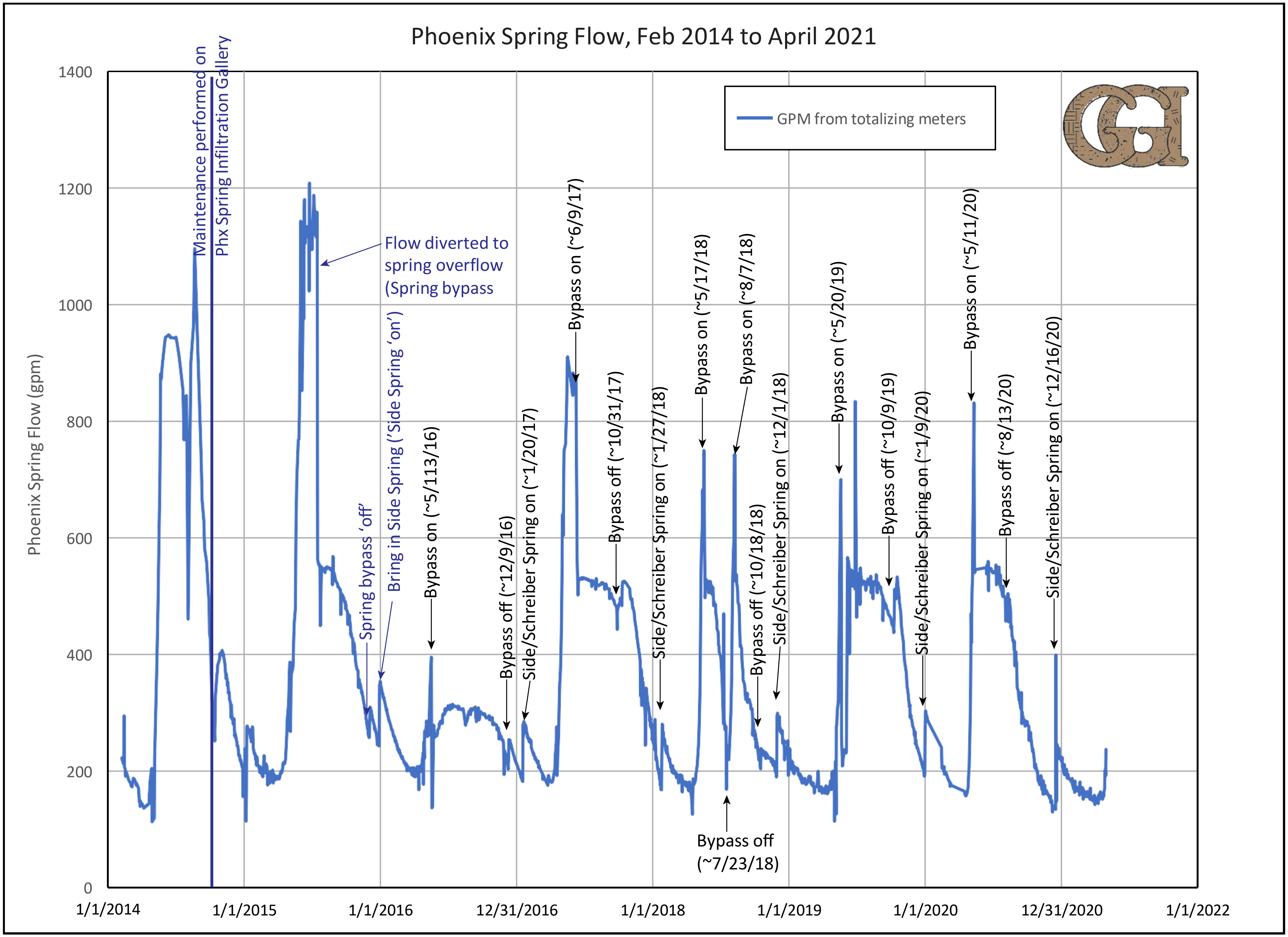

Figure 3. Annotated graph of Phoenix Spring metered flows. Notes in blue text are information provided by Village staff in 2015-2016. Notes in black are GGI' s interpretation of possible operational changes made that influence the spring flow meter readings.

Side Spring was turned in to the system have not been identified by VTSV, but discussions with VTSV staff indicate that the Side Spring is typically turned into the system in January.

In 2016 VTSV staff identified when the Side Spring was turned in to the chlorination station, shown in blue text on Figure 3. Spikes in metered spring flow that likely represent either the Side Spring or Schreiber spring being turned into the CS are labeled in black on Figure 3 for the years after 2016. It is possible that in some years only one of the secondary springs was turned into the system, but lack of records for when the Schreiber and Side Springs have been turned in make it impossible to know for certain. If this has been the case in some years, then the metered flow values under-represent the total flow available from the entire spring complex in those years.

4.2 DATA COMPILATION AND QA/QC

Data provided by VTSV were compiled and assessed to identify and address any apparently erroneous data points. In most cases data entry errors were easily identified by large one-day spikes or drops in recorded spring flows. The meter entries on these days were checked and, in most instances, a numeric transposition error was the cause, resulting in a very high meter reading one day followed by a very low reading the next day (or vice-versa). These entries were manually corrected to eliminate the spikes and troughs. In other instances, there were one-day spikes or drops in the flow data that couldn't be explained by an obvious transposition error in the data entry. In these cases, the values were compared to the instantaneous meter readings and the adjacent totalizer flow values and, where appropriate, a manual adjustment was made to the data to provide a reasonable flow value for the day in question. In relatively rare instances the anomalous data from the totalizer (one-day spikes) matched the instantaneous reads very closely, and no adjustment was made. Overall, from 2014 to 2019 and from June 2020 to April 2021 only a small percentage of the metered values required modification.

4.2.1 2020 DATA

In 2020 there were three large gaps in spring flow data. No data were recorded between January 9 and February 20, between March 11 and April 15, and between May 14 and June 13. The data were apparently measured, but the paper records were incomplete. To adjust for the incomplete data, the days between when the last recorded measurement was taken and the subsequent measurement was recorded were assigned a flow rate equal to the prior days reading plus (or minus) an incremental flow amount equal to the total difference between the two readings and the number of missing days. This results in a smoothed transition of flow between the measurements that provides a good approximation of the natural decline in spring flows that would be expected over the missing time periods. The shape of the interpolated low- flow curve over the period from March 11 to April 15 2020, when daily data are missing, compares favorably to the shape of the continuously recorded flow data from 2014-2019 and 2020 (Figure 4), and the interpolated data are considered useable for inclusion in analysis of the period of record flow data.

4.3 SPRING FLOW DATA EVALUATION

Figure 4 shows year-over-year 5-day average spring flow measurements for each 'water year' from May 1 to April 30. The abrupt and dramatic changes in metered flows during the high-runoff period from May through August or September is indicative of measurements largely controlled by operation of the bypass

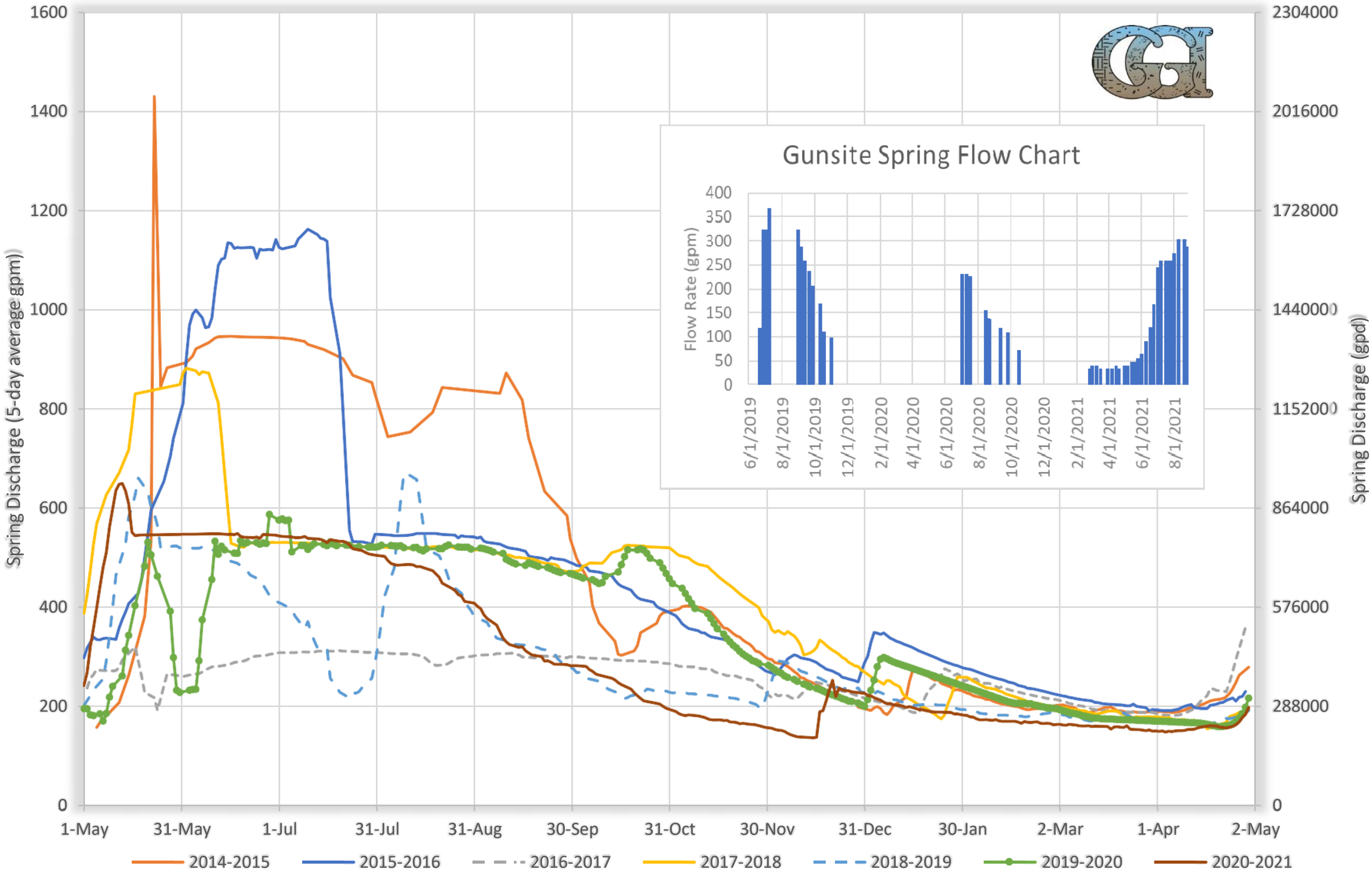

Figure 4. Phoenix Spring Discharge - May 1 to April 30 'water year', 5-day average flow. Inset shows Gunsite Spring flow measurements from 2019, 2020, and 2021

valve(s) as described above. Data from each year also show abrupt increases in metered flows that occur in December or January (depending on the year) that are the result of the Side Spring and/or Schreiber Spring being turned in to the system. It is only after the Side Spring and Schreiber Spring have been turned in to the chlorination station that year-to-year flows can be directly compared because, at that point, everything that is being produced by the spring complex (Phoenix Spring, Schreiber Spring and Side Spring) is measured and no water is being returned to the river prior to metering (see discussion in section 4.4 below).

Figure 5 shows year-over-year 5-day average flows during the low-flow months of December through April, which includes all of the spring flow data during February, March, and April when flows from the entire spring complex are being metered (see discussion in section 4.4 below). Overall, mean monthly flows are lowest in March, but the single lowest flows averaged over a five-day period (five-day trailing average) typically occur in early- to mid-April (Table 1). The discrepancy in mean monthly versus five-day average flows is due to the rapid rise in spring flow that occurs beginning in mid- to late-April (Figure 5). **The lowest recorded 5-day average flow was approximately 140 gpm (201,500 gpd) in April, 2014. The lowest monthly average flow was approximately 158 gpm (227,000 gpd) in March, 2021.**

Table 1. Summary of low-flow measurements

Year	Mean Feb-March flow (gpm/gpd)	Mean March Flow (gpm/gpd)	Lowest 5-day ave. flow (gpm/gpd)	Dates of 5-day ave. low flow
2014	190.4 / 274,200	169.8 / 244,500	**139.9 / 201,500**	4/11-4/15
2015	198.0 / 285,100	191.0 / 275,000	186.7 / 268,800	3/5-3/9
2016	224.1 / 322,700	206.2 / 296,900	191.8 / 276,200	4/2-4/6
2017	215.2 / 309,900	195.1 / 280,900	181.8 / 261,800	4/2-4/6
2018	202.2 / 281,200	186.3 / 268,300	169.3 / 243,800	4/13-4/17
2019	179.2 / 258,000	174.8 / 251,700	165.0 / 237,600	4/13-4/17
2020	192.4 / 277,100	175.9 / 253,300	159.2 / 229,200	4/17-4/21
2021	163.4 / 235,300	**157.8 / 227,200**	148.1 / 213,300	3/31-4/4

4.4 RELIABILITY OF FLOW MEASUREMENTS

The calibration of the meters installed in the chlorination station were checked and validated by Yukon and Associates, Ltd. on 7/19/2021. Because the meters are confirmed to have been reading accurately, the meter values represent the minimum possible flow from the Phoenix Springs Complex at any given time. Because there are no records of when the Side Spring and Schreiber Spring were turned into/out of the CS, it is possible that at certain times the combined flow of the springs was more than the metered amount (if one or both of the ancillary springs was being bypassed). The minimum flow numbers reported in Table 1 assume that both the Side Spring and Schreiber Spring were being directed to the CS during low-flow periods, but the lack of records of when the bypasses were operated after 2016 make it possible that one or both were being bypassed in any given year after 2016. **It is therefore possible that the Phoenix Springs Complex produced more water than is reflected in Table 1, but it is not possible that the combined flow of the springs was less than the metered amount shown in Table 1**. The metered values can be relied upon to provide a conservative estimate of minimum monthly and five-day average flows.

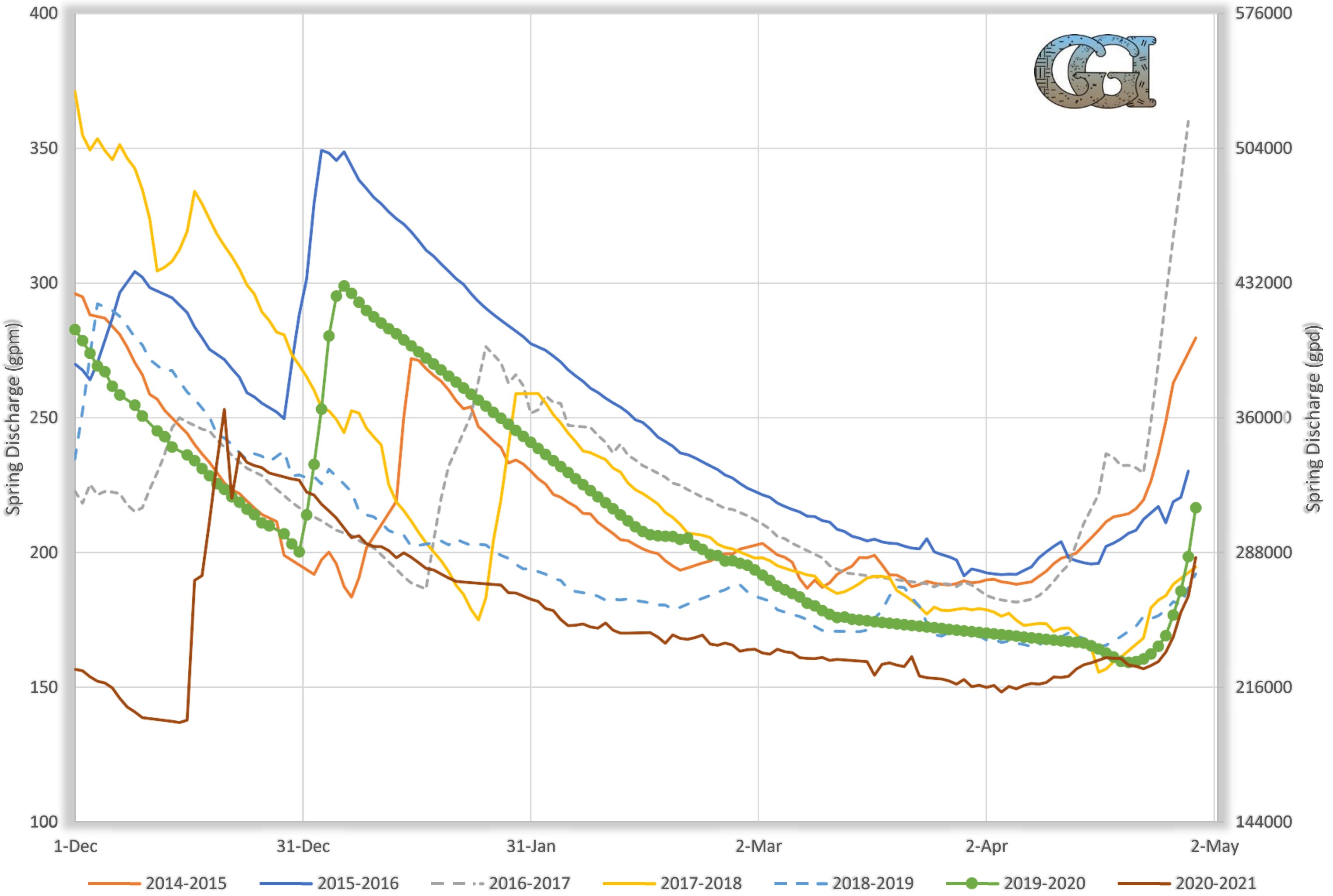

Figure 5. 5-day average discharge from Phoenix Springs Complex during low flow period, Dec 1 to May 1

5 GUNSITE SPRING PRELIMINARY DATA

A 3-inch Parshall flume was installed at Gunsite Spring by VTSV and Leonard Rice Engineers, Inc. (LRE) in June 2019. The flume measures flow from the main Gunsite spring source, but does not measure flow from a significant secondary spring discharge point that is part of the Gunsite spring. VTSV and LRE measured flows during Summer and early Fall 2019 and 2020 (LRE, 2020). Flows measured by LRE ranged from a maximum of 365 gpm (525,600 gpd) on July 19, 2019 to a minimum of 69 gpm (99,360 gpd) on October 10, 2020 (Figure 4). The property where Gunsite Spring is located was subsequently purchased by Mr. Bob Corroon of Taos Land and Cattle Company I, LLC. GGI located and dug out the flume from beneath approximately 5 feet of snow in February, 2021. To determine Gunsite spring flow during low-flow conditions and throughout the year on behalf of Mr. Corroon, GGI has measured spring discharge on a weekly basis beginning on February 24, 2021. During this time period, Gunsite spring discharge (exclusive of the secondary spring discharge source) ranged from a low of 30 gpm (43,200 gpd) in late March and early April to a maximum of 300 gpm (430,200 gpd) as of August 19, 2021 (Figure 4). Although it is not known at present whether this source would be classified by NMED as groundwater or groundwater under the influence of surface water, it is GGI's recommendation that VTSV pursue development of the Gunsite Spring as an additional water source. Continued monitoring of flows is also recommended to better quantify potential flow available from Gunsite Spring.

6 SNOTEL DATA

Climate data (temperature, snow depth, snow water equivalent, and accumulated precipitation) are available from the Powderhorn SNOTEL site from August 8, 2009 to present[3]. Data from the SNOTEL site was downloaded and compiled for comparison to spring flows. Precipitation at the SNOTEL site occurs predominantly as snow from October/November to April/May and as rain for the remainder of the year. From 2011 to 2020 the average precipitation over a water year (WY; October 1 to September 30) has been 36.4 inches, ranging from 19.1 inches in WY 2018 to 47.7 inches in WY 2017. The SNOTEL station records snow depth but, more importantly, records snow water equivalent (SWE) which is the moisture content of the snow recorded as inches of water. The accumulated moisture content of the snow pack is not available as potential recharge to the aquifer/springs until the snow melts and releases the liquid water. To evaluate how the timing of potential recharge corresponds to changes in spring discharge the data were processed to calculate cumulative recharge as the snow pack melts.

Figure 6 is a compilation of total annual precipitation (blue circles), cumulative annual snow (as SWE; grey circles) and total annual potential recharge (purple line). The timing and amount of total annual potential recharge was calculated as the daily decline in SWE (representing melting snow) plus the daily precipitation occurring as rainfall. The resulting value is the amount of liquid water added to the system and is termed potential recharge (rather than actual recharge) because some water may run off as overland flow, evaporate, or be lost through other processes. The maximum potential recharge occurs each year during the spring snowmelt, generally between April and June, resulting in the maximum spring flow during the same period.

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[3] https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=1168

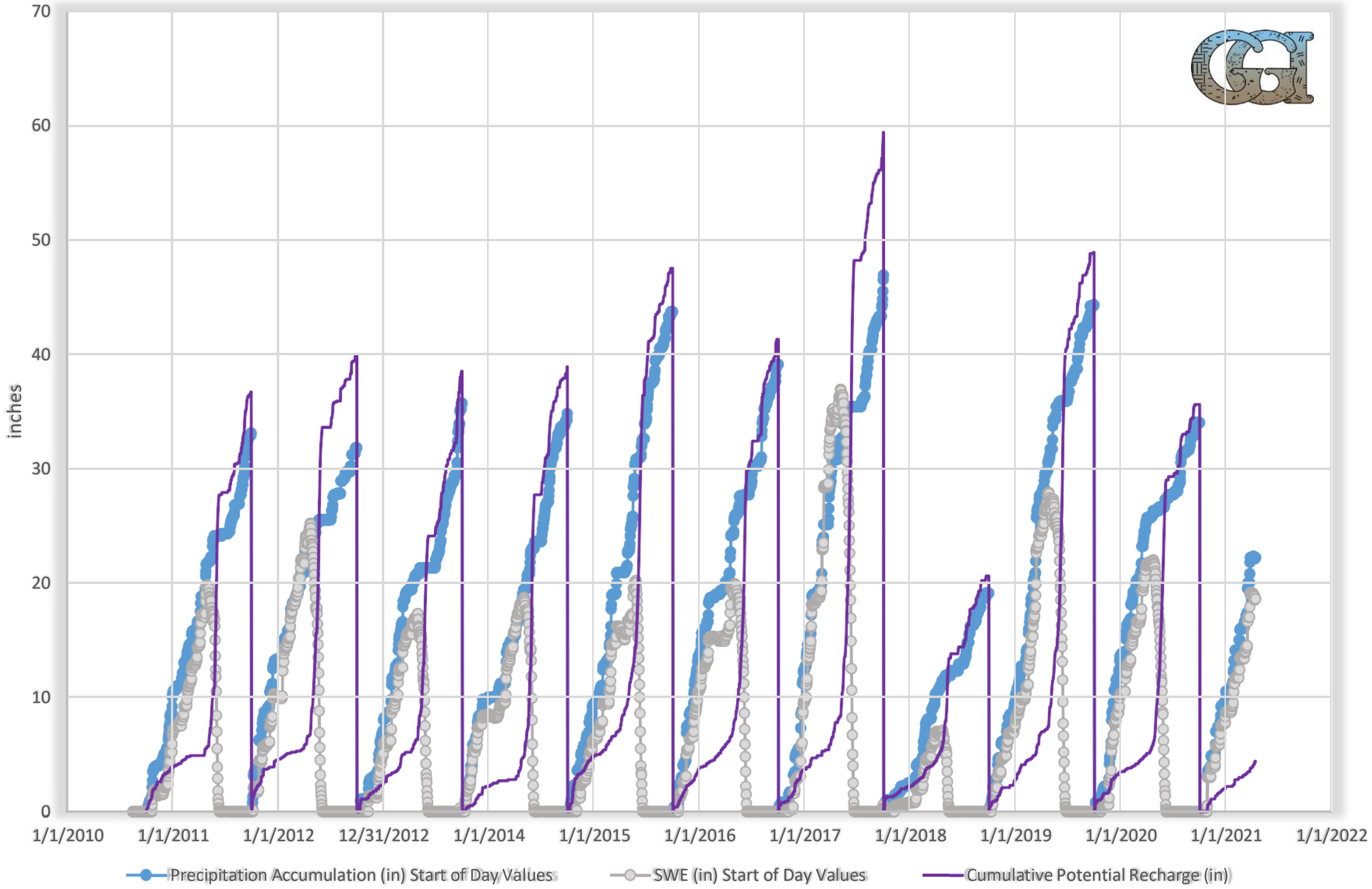

Figure 6. Precipitation, Snow Water Equivalent (SWE) and Cumulative Potential Recharge from the Powderhorn SNOTEL site for the period of record.

7 RECHARGE AND SPRING FLOWS

Figure 7 includes graphs allowing a visual comparison of total annual potential recharge to mean monthly spring flow (February and March combined [top] and just March [bottom]) for 2014 through 2021. Graphs on the left are for the one-year prior recharge and graphs on the right are the cumulative recharge for the previous three years. Note that the potential recharge covers the period from April 1 of the prior year to March 31 of the year in which the spring flows are reported[4]. Similar graphs were created using the prior two and four years of cumulative potential recharge, but the one- and three-year totals provided the closest visual match. As can be seen on Figure 7, there is general agreement between potential recharge and spring flows, with wetter years (greater total potential recharge) corresponding to higher spring discharge. The exceptions to this general correspondence are:

1) 2018, when the high potential recharge, representing primarily melting of the large 2017 snow pack, did not result in a corresponding increase in spring flows
2) 2019, when the extremely low potential recharge, resulting from the historically low snowpack in 2018, did not result in drop in spring flow of a corresponding magnitude, although there was a decline in flow.

While the visual comparison of potential recharge to spring flow suggests a direct relationship between the two, scatter plots of potential recharge vs. spring flow (March and Feb-March combined) show a relatively weak correlation (r^2 ranging between 0.23 and 0.37, depending on the date ranges being compared). There is a slightly better correlation between the three-year cumulative potential recharge and spring flow than the single-year potential recharge and spring flow (Figure 8).

There is clearly a causal relationship between recharge from snowmelt and monsoonal precipitation and spring flow that can be assessed qualitatively with existing data. Spring flows increase as a direct result of snowmelt and large rainfall events (see Appendix B). Although the relationship between SWE from the preceding one to three years' snowpack and Phoenix spring flows cannot be quantified using the existing eight years of spring flow records, continued collection of spring and SNOTEL flow data should allow the relationship between potential recharge and spring flow to be better refined/quantified during low flow periods. Installation of meters on all of the bypass lines shown on Figure 2 is necessary before a quantitative relationship can be established between recharge events and high spring flow rates.

7.1 PIEZOMETER DATA

In addition to the SNOTEL and Spring flow data described above, water level data are available for the period of September 2017 to September 2019 from five piezometers completed in the area above the Phoenix Springs Complex (Figure 9). Data from the piezometers show that the lowest water levels, which correlate with lowest spring flows, were observed in February through April, followed by a period of recharge/higher water levels in May through July and generally declining water levels thereafter (Figure 10). Strong summer or fall monsoonal precipitation events also provide transient recharge to the shallow aquifer and the Phoenix Springs Complex, with an approximately 2-week lag time between precipitation events and groundwater elevation rise/increased spring discharge (e.g. Sept-October 2017). This pattern is similar to displays of fast response to snowmelt and rainfall, followed by much slower, steady groundwater discharge observed in other alpine regions such as the European Alps, North American Cordillera, and Himalayas (Hayashi, 2020).

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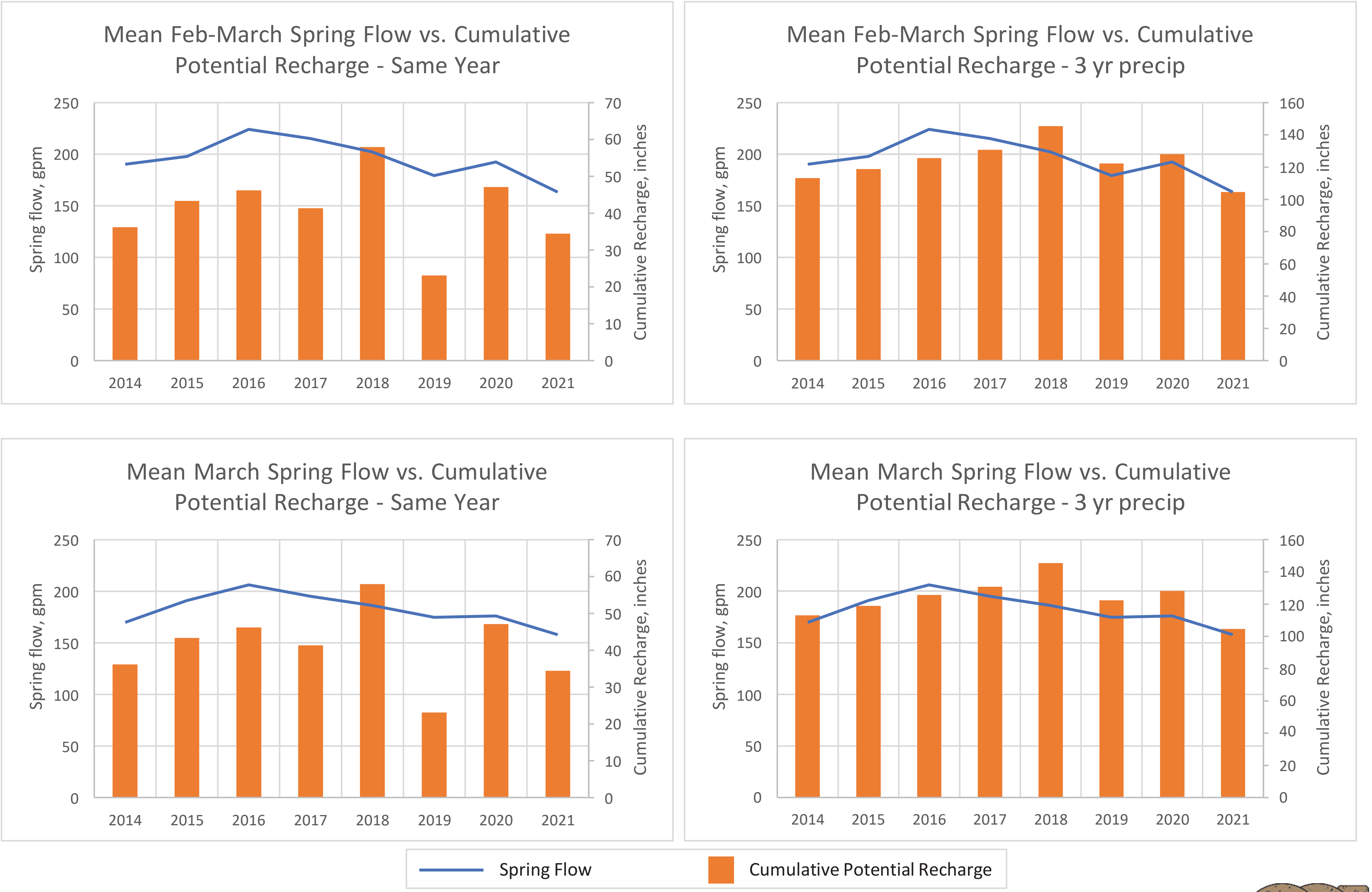
[4] For example, 2014 potential recharge is the total potential recharge from April 1, 2013 to March 31, 2014.



Mean Feb-March Spring Flow vs. Cumulative Potential Recharge - Same Year

Mean Feb-March Spring Flow vs. Cumulative Potential Recharge - 3 yr precip

Mean March Spring Flow vs. Cumulative Potential Recharge - Same Year

Mean March Spring Flow vs. Cumulative Potential Recharge - 3 yr precip

Figure 7. Annual cumulative potential recharge compared to Phoenix Spring flows for February and March combined (top) and March only (bottom), looking at same year potential recharge (left) and three-year cumulative potential recharge (right).

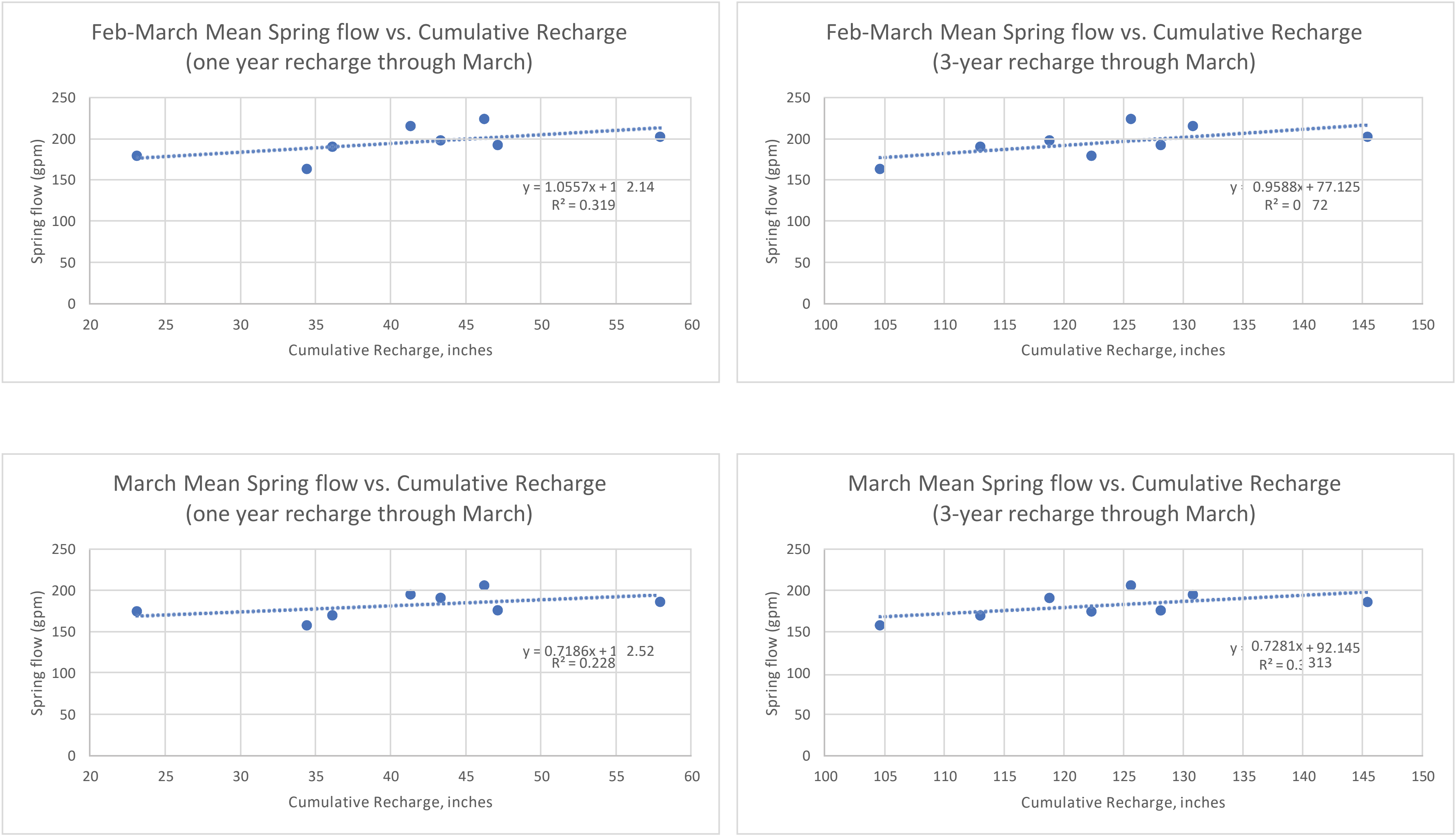


Figure 8. Annual cumulative potential recharge compared to Phoenix Spring flows for February and March combined (top) and March only (bottom), looking at same year potential recharge (left) and three-year cumulative potential recharge (right).

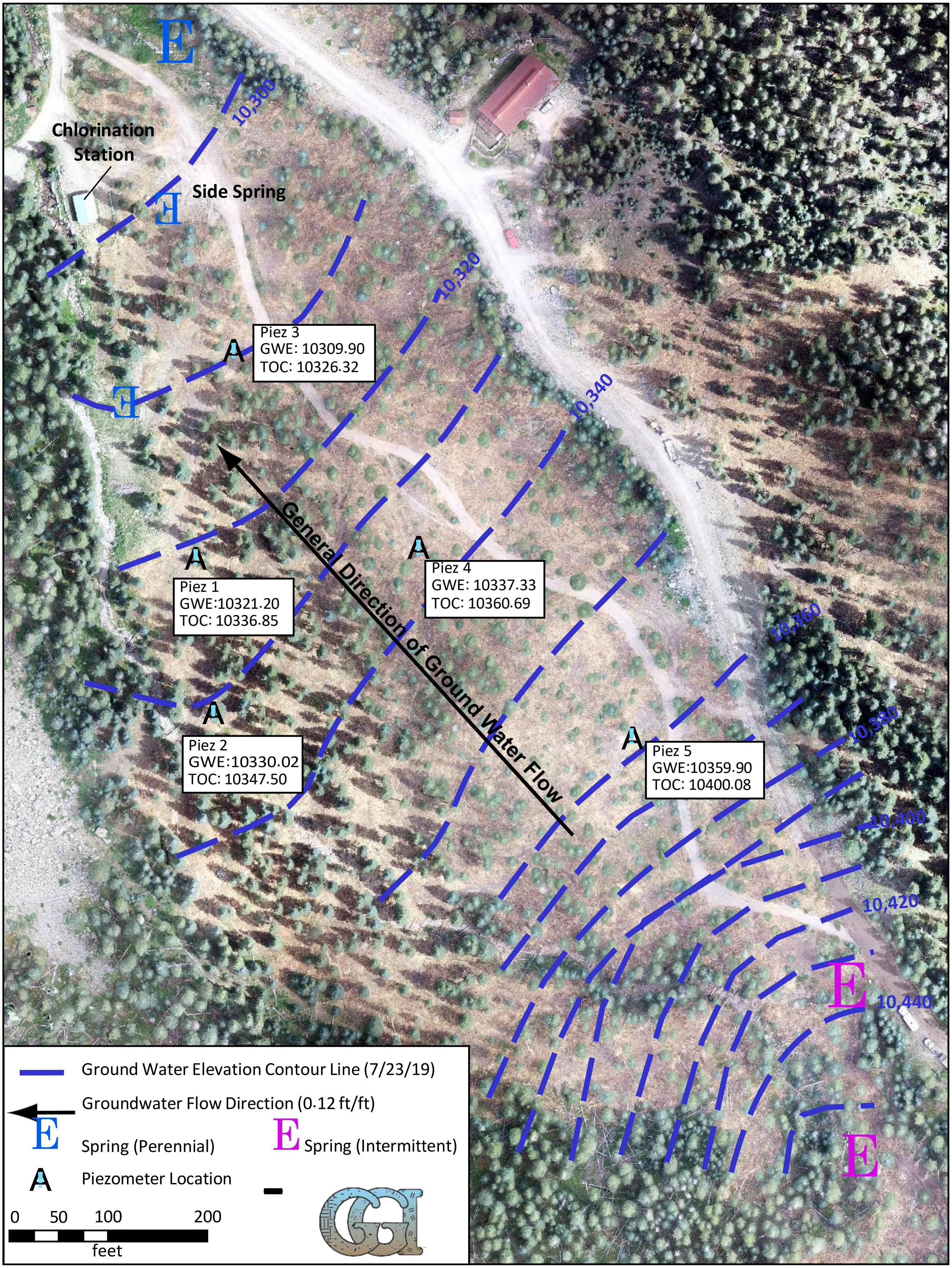


Figure 9. Piezometer locations showing groundwater flow direction measured on 7/23/2019

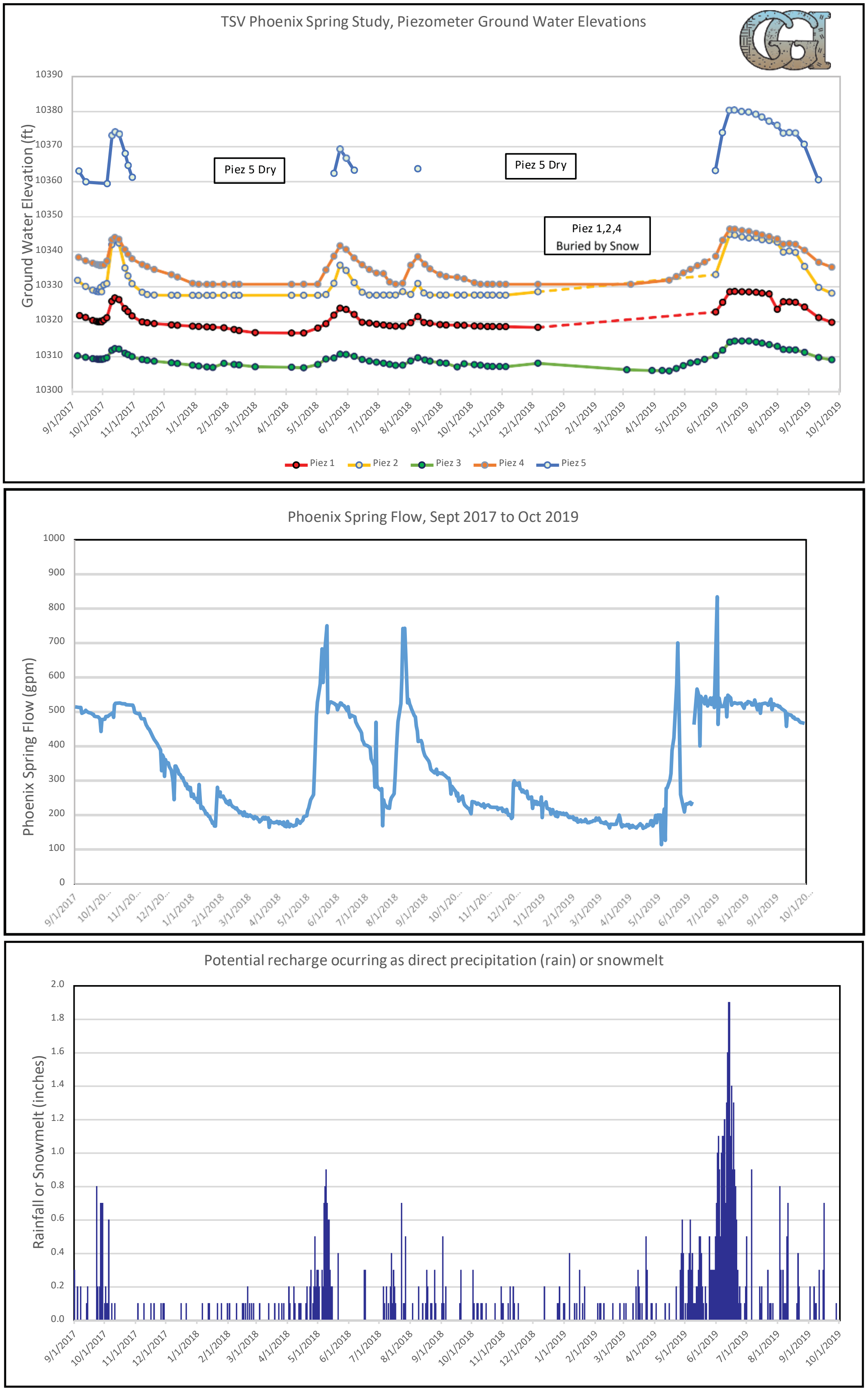


Figure 10. Piezometer water levels (top), Phoenix Springs Complex discharge (middle), and recharge data (bottom) from 9/1/17 to 9/30/19.

8 SPRING FLOW VS. RIO HONDO FLOW

8.1 MONTHLY AVERAGE FLOWS (LOW FLOW PERIODS)

The USGS maintains a gage on the Rio Hondo near Valdez (USGS Site No. 08267500 - Rio Hondo Near Valdez, NM) that has a continuous period of record from 1934 to present. Over the period of record, Hondo flows are lowest, averaging 11 cfs (equivalent to approximately 4,900 gpm or 7.1 MGD), in January and February (Table 2).

Table 2. Mean monthly flows for USGS Site No. 08267500 (Rio Hondo Near Valdez, NM) for the period of record from 1934 to 2001

Month	Mean cfs/MGD	Month	Mean cfs/MGD	Month	Mean cfs/MGD
January	11 / 7.1	May	92 / 59.5	September	21 / 13.6
February	11 / 7.1	June	107 / 69.2	October	18 / 11.6
March	14 / 9.0	July	45 / 29.1	November	14 / 9.1
April	33 / 21.3	August	28 / 18.1	December	12 / 7.8

During the low flow months, the base flow in the Rio Hondo is sustained by groundwater discharge, with little or no snowmelt or direct precipitation runoff contributing significantly to overall flow. The same factors influencing groundwater discharge at the Phoenix Springs Complex (previous years' snowpack, monsoonal precipitation, antecedent soil moisture conditions, etc.) would also influence groundwater-controlled base flow in the Rio Hondo. A comparison of annual low flow (March) from the Phoenix Springs Complex to February low flow in the Rio Hondo shows that there is a moderate correlation (r^2=0.675) between these flows (Figure 11). This relationship suggests that in years when the Rio Hondo flows are relatively low, the Phoenix Springs Complex flows will also be relatively low. This relationship can be utilized to allow historic spring flows to be estimated from the much longer Rio Hondo gage period of record.

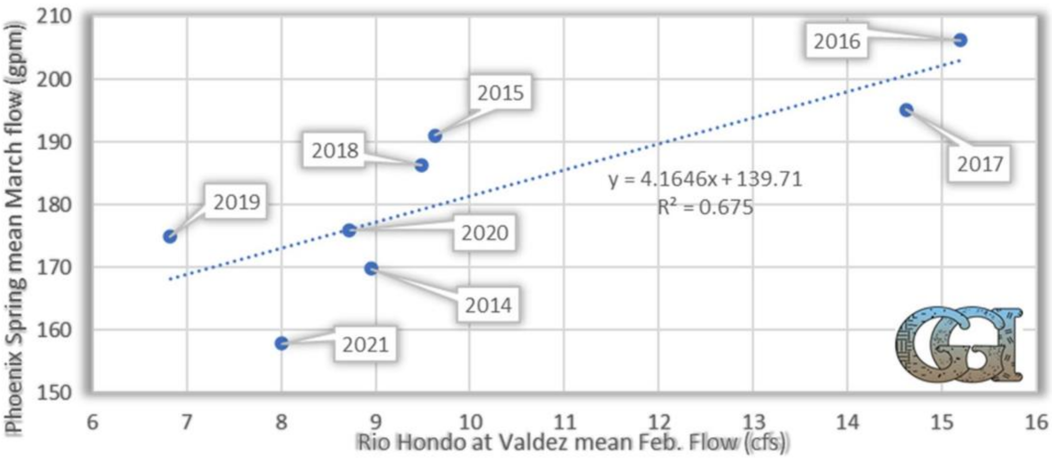


Figure 11. Rio Hondo (Feb) v. Phoenix Spring (March) flows, 2014-2021

Using the relationship shown in Figure 11, spring flows were estimated for the period 1934 to 2013 (Figure 12). In addition to the calculated spring flow value, Figure 12 also shows a range of calculated values representing 2 standard deviations from the trend line shown in Figure 11. These values were calculated by detrending the data shown on Figure 10 and determining the standard deviation of that data variation (std. dev. = 8.8). Therefore, the values shown on Figure 12 as two standard deviations represent the calculated spring flow plus or minus 17.7 gpm, and this range encompasses all of the variability seen in the available data.

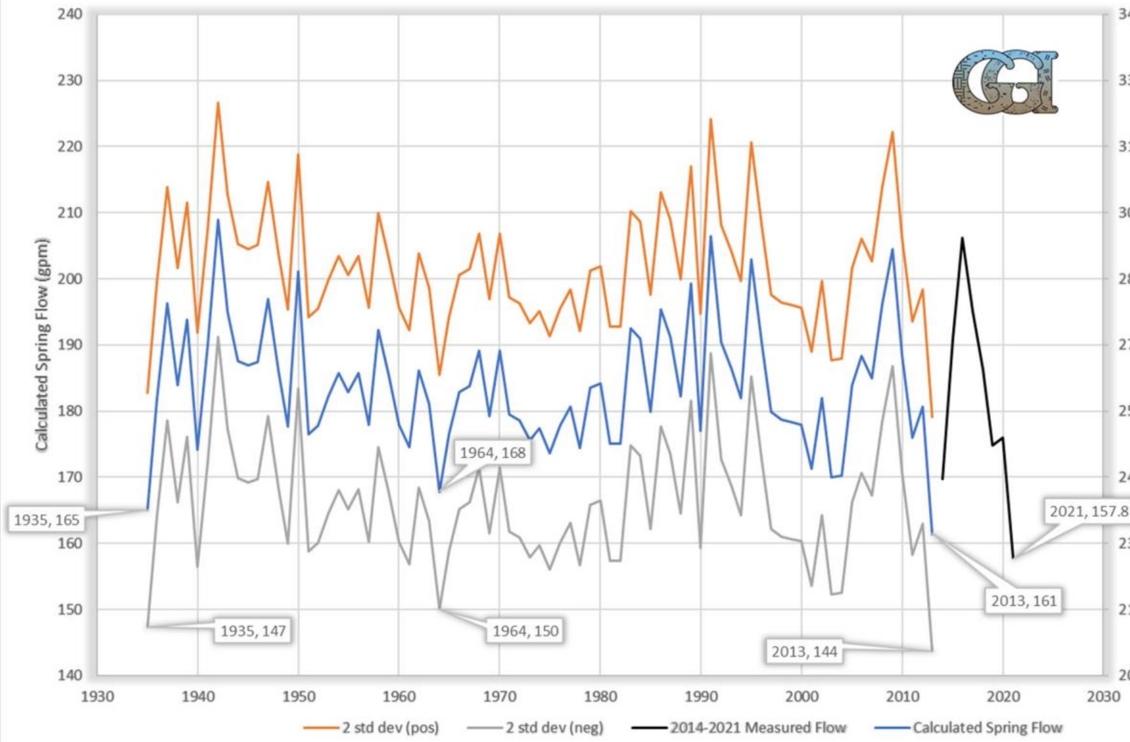


Figure 12. Calculated historic spring flows (March) based on correlation to historic Rio Hondo flows (Feb), showing plus and minus two standard deviations. Callouts show years with minimum flows and the associated low flow in gpm.

8.2 5-DAY AVERAGE FLOWS (LOW FLOW PERIODS)

While the calculated monthly flows are useful, understanding minimal flows that may be expected over a shorter duration is also critical for planning purposes. Figure 13 is a comparison of the lowest 5-day average spring flow to the mean monthly spring flow from 2014 to 2021. There is a good correlation (r^2=0.84) between the mean monthly flow and the 5-day minimum flow for a given year. Using the relationship between mean monthly flow and 5-day minimum flow shown on Figure 13, the 5-day minimum flow that would be associated with the calculated historic low flow values can be approximated. Table 3 provides estimates of the lowest 5-day average flow values that would have been expected in the three calculated lowest flow years of 1935, 1964, and 2013 for both the calculated monthly flow value and the calculated value minus two standard deviations.

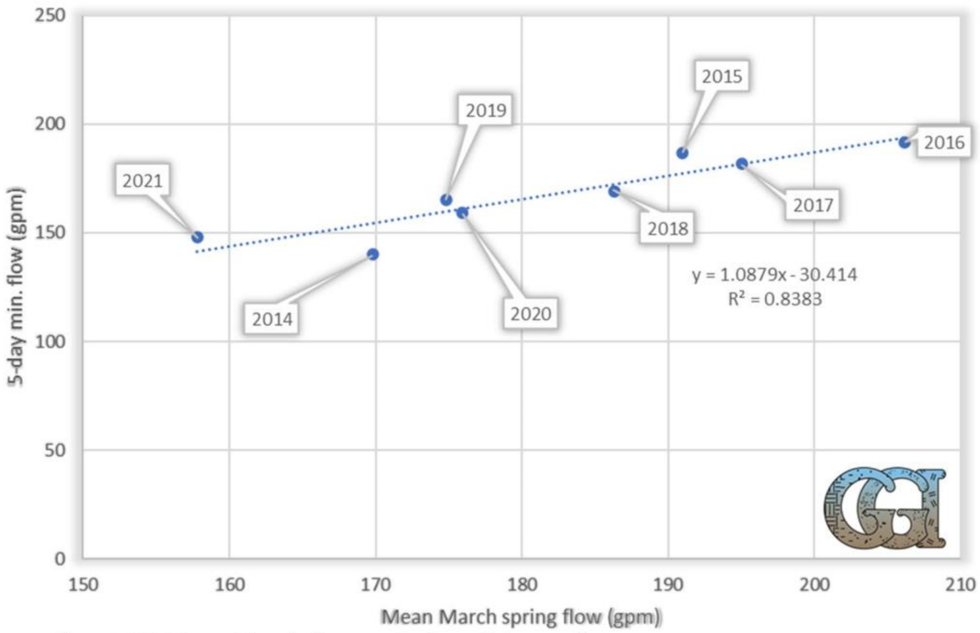


Figure 13. Mean March flow vs. 5-day minimum flow

Table 3. Five-day average spring flow estimated from monthly average flows in low-flow years

Year	Calculated Phoenix Monthly flow (gpm/gpd)	Calculated Phoenix 5-day average flow (gpm/gpd)	Calculated Phoenix Monthly flow minus 2 Std. Dev. (gpm/gpd)	Calculated Phoenix 5-day average flow (gpm/gpd) from 2 Std. Dev. Calc.
1935	165 / 237,600	149 / 214,600	147 / 211,700	130 / 187,200
1964	168 / 241,900	152 / 218,900	150 / 216,000	133 / 191,500
2013	161 / 231,840	145 / 208,800	144 / 207,400	**126 / 181,400**

The lowest estimated monthly average flow projection projected from the historic data is approximately 144 gpm (207,400 gpd) in March, 2013.

The lowest estimated 5-day average flow projected from the historic data is approximately 126 gpm (181,440 gpd) in 2013.

9 CLIMATE FORECAST

The State of New Mexico is in the process of preparing a 50-year water plan to assess projected effects of climate change on water availability. GGI, on behalf on TSVI, is an active participant in the State of New Mexico's 50 Year Water Planning efforts, especially on climate-change related issues. We participate in the Climate and Water Science Advisory Team meetings and webinars and provide input into the State's

Water Resiliency Assessment forum. These studies by our in-State subject matter experts represent the cutting-edge status of climate change research available in New Mexico.

The 50-year water plan is scheduled for completion in April, 2022. A draft report was released for public comment on September 16, 2021. GGI reviewed the public comment draft, and a summary is provided in Appendix D. Interim conclusions of the plan, presented on July 21, 2021 include:

1. In the last 20 years there are only 5 years where NM has not been in drought conditions
2. As of July, 2021, NM was in the deepest drought in the last 20 years
3. In the last 4 decades, temperatures have risen and precipitation has remained about the same State-wide
4. It will get warmer in NM as CO_2 concentrations in the atmosphere increase
5. There will be decreased snowpack but more winter precipitation in the Northern Mountains
6. Snowpack and streamflow will decrease
7. Snow will melt earlier and there will be less runoff

Along with a summary of the climate studies, and potential water supply impacts, Appendix D includes recommendations to both TSVI and VTSV to increase water efficiency, water supply, and reduce carbon footprints. These recommendations included continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses, continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

It remains to be seen how accurate these predictions will be and, assuming they are accurate, how these predicted changes will impact Phoenix Springs Complex flows. While the total snow pack is predicted to be less, the total amount of precipitation is not expected to change. Exactly how the change in the form of winter precipitation (rain vs. snow) will impact Phoenix Springs Complex flows is uncertain. The predicted transition to earlier runoff could result in higher flows from the Phoenix Springs Complex during the high demand period in March. However, planning for lowest predicted flows based on the historic record is prudent, given the predictions of decreased snowpack and stream flows resulting from climate change.

9.1 ESTIMATED REDUCTIONS IN MINIMUM FLOWS ARISING FROM CLIMATE CHANGE EFFECTS

To accommodate potential future reductions in flow arising from climate change, the projected minimum monthly and 5-day average flows presented in Section 8 above have been further adjusted to include a 0.5% annual decline in flows, as summarized in Table 4. The starting values used in the projections of flow reduction for the Phoenix Springs represent an initially conservative value that includes a two standard deviation variation from the minimum projected flow. The added 0.5% per year reduction in projected flows adds an additional layer of conservatism into the Phoenix Springs Complex flow projections for use in future growth planning.

Table 4 also includes flow reductions at the Gunsite Spring projected as a decrease of 0.5% per year as a result of climate change. The starting value for the Gunsite Spring projections is the low flow of 30 gpm observed in late March and early April, 2021. Because there are limited data (less than one year) available from Gunsite Spring, it is not possible to calculate a standard deviation for flow values measured over a longer period of record. However, average Phoenix spring flows measured in March 2021 were the lowest measured over the period of record, and it is reasonable to assume that the lowest 2021 flow values measured at the Gunsite spring are also on the low end of expected flow. Applying a 0.5% per year reduction to the 2021 measured values gives a reasonable approximation of expected low flow values adjusted for climate change. Continued monitoring of flows at Gunsite Spring is required if a better estimate of the expected variability of Gunsite Spring flows is desired for planning purposes.

Table 4. Spring flows projected for 25 years assuming 0.5% per year decrease in flows

	Phoenix Springs Complex				**Gunsite Spring**	
	GPM		**GPD**		**GPM**	**GPD**
Year	Monthly Ave.	5-Day Ave.	Monthly Ave.	5-Day Ave.		
2022	143.3	125.4	206,323	180,533	29.9	42,984
2027	139.7	122.3	201,216	176,064	29.1	41,920
2032	136.3	119.2	196,236	171,707	28.4	40,883
2037	132.9	116.3	191,379	167,457	27.7	39,871
2042	129.6	113.4	186,642	163,312	27.0	38,884
2047	126.4	110.6	182,023	159,270	26.3	37,921

The lowest estimated monthly average flow projection for the Phoenix Springs Complex, projected to the year 2047 from the historic data and incorporating a 0.5% annual decline in flow arising from climate change effects, is approximately 126 gpm (182,000 gpd).

The lowest estimated 5-day average flow projection for Phoenix Springs Complex, projected to the year 2047 from the historic data and incorporating a 0.5% annual decline in flow arising from climate change effects, is approximately 111 gpm (159,000 gpd).

10 VTSV WATER RIGHTS

A summary of VTSV's water rights is provided in Table 5. The diversion amount shown in Table 5 includes return flow credit from the VTSV wastewater treatment plant. Potential treated wastewater reuse will need to be evaluated in the context of the return flow credit currently built in to the Village's water rights.

Table 5. VTSV Water Rights Summary

Permit No.	**Date of Approval**	**Div. AFY**	**C.U. AFY**	**Purpose of Use, Notes**	**Priority Date**	**OSE Filings**
0444-A	March 2002	178.2	8.91 afy	Domestic & sanitary	1808	COO Pattison Trust to VTSV filed March 2004
0444-AA	June 1992	40	2.0 afy	Domestic, residential, municipal, commercial, snowmaking*	1808	COO Twining Water to VTSV filed April 2015
3751 (San Juan Chama)	January 1978	200 Nov 1- Apr 11	15 afy - SJC carriage loss		1978	COO Twining Water to VTSV filed April 2015

**If entire SJC water right is diverted for snowmaking, 41.67 AFY can be diverted (not counting carriage loss).*

11 SUMMARY

- The Phoenix Springs Complex consists of three springs: Phoenix Spring, Schreiber Spring, and Side Spring.
- Previous studies of the Phoenix Spring / Upper Lake Fork drainage have determined that:
    - Phoenix spring discharges at a bedrock constriction, which reduces cross sectional area of aquifer in glacial deposits
    - Winter precipitation contributes ~55-88% of recharge to springs in the Lake Fork basin, with the balance coming from (primarily monsoon) rainfall
    - Tritium isotope data from Phoenix and other springs in the area show modern recharge (water discharging from springs is less than 5-10 years old)
    - The Lake Fork of the Rio Hondo is a gaining stream reach, and gains approximately 3 cubic feet per second (cfs) from Phoenix Spring to the East Fork confluence during low flow conditions
- Phoenix Springs Complex flow data are available from February 2014 to present. Over this period the lowest average monthly flows typically occur in March when demand is historically highest.
    - The lowest recorded monthly average flow was 157.8 gpm (227,200 gpd) in March, 2021
    - The lowest recorded 5-day average flow was 139.9 gpm (201,500 gpd) from April 11 to April 15, 2014
- The Gunsite Spring is a second permitted point of diversion for VTSV, but it is not currently utilized as a municipal water source and lacks infrastructure
- Gunsite spring flow has been measured on a weekly basis beginning in late February, 2021. The flow during this period of measurement has ranged from a minimum of 30 gpm in late March and early April to a maximum of 300 gpm as of August 19, 2021.
- Uncertainties associated with the available data include:
    - Lack of data on when the Side Spring and Schreiber Spring were bypassing the chlorination station
    - Incomplete meter records from 2020
    - Relatively short period of spring flow records (8 years)
- Despite the limitations on the available data, there is sufficient information available to make reasonable and conservative estimates of anticipated low flows for planning purposes
- Available metering data from the springs represent minimum values; it is possible that combined flow from the entire Phoenix Springs Complex was greater than what was recorded if some flows were being bypassed.
- Calibration testing of the meters demonstrates that it is not possible that spring flow was less than was recorded by the meters.
- Available data show that years with low spring flows correlate to years with low flow in the Rio Hondo.
- The relationship established between average flows in the Rio Hondo and average Phoenix Springs Complex flows was used to estimate spring flows from 1935 to 2013.
    - The lowest calculated monthly average spring flow was 161 gpm (231,800 gpd) in March, 2013
        - Subtracting two standard deviations, the lowest monthly average flow in March 2013 was calculated as 144 gpm (207,400 gpd).

    - The lowest 5-day average spring flow in March, extrapolated from historic Rio Hondo data, was approximately 145 gpm (208,800 gpd) in 2013.
        - Subtracting two standard deviations, the lowest 5-day average spring flow in March 2013 was calculated as approximately 126 gpm (181,400 gpd).
- Preliminary results of climate studies and water supply forecasts being undertaken by the State of New Mexico indicate that future snowpack will be less, but total winter precipitation will not change significantly.
    - It is uncertain how the reduction in snow pack/increase in winter rainfall may impact Phoenix Spring flows, and it is possible that the predicted changes could result in higher spring flows in March
- Low-end (conservative) projections of future spring flow should be utilized for planning purposes to accommodate the uncertainties associated with climate change and gaps in the available data.
- To address the potential for reduced flows in March as a result of climate change impacts, projected flows were reduced by 0.5% per year. This results in projected (year 2047) low monthly average flow of 126 gpm (182,000 gpd) and a low 5-day average flow of 111 gpm (159,000 gpd).

12 RECOMMENDATIONS

1) Continue to carefully monitor (meter) Flows from the Phoenix Springs Complex
    a) The timing of when Schreiber Spring and the Side Spring are turned into and out of the chlorination station should be carefully documented to remove uncertainty from the metered flow values.
    b) Install meters on the bypass pipelines and record bypass flows to allow for a full accounting of all spring discharge, including high flows, that are not currently metered. This metering will allow for better correlation of snowpack (snow water equivalent) to spring flows and could provide a useful future planning tool to allow for early warning of upcoming periods of low spring discharge based on snow water equivalent.
2) Continue to monitor Gunsite Spring flows to establish a range of expected flow variability that can be used for future flow estimates.
3) **For planning purposes the following projected flows from Phoenix Spring should be utilized:**
    a) **Low monthly average flow of approximately 126 gpm (182,000 gpd)**
    b) **Low 5-day average flow of 111 gpm (159,000 gpd)**
4) Continue monitoring Gunsite Spring flows to better constrain the range of flows that can be expected from this source.
5) Revisit the baseline flow evaluation every 5 years and adjust the projections as appropriate to incorporate continued and improved data collection.
    a) The current projections include several assumptions to keep the estimates conservative for planning purposes. Continued collection and re-evaluation of the data will allow projected flow estimates to be adjusted up or down, as appropriate, to assist in ongoing planning efforts.
    b) Once Gunsite Spring flows are better understood, it may be advisable for VTSV to consider connecting Gunsite Spring to the municipal distribution system.
6) Implement policies and practices to reduce the impacts of climate change, including continuing efforts to reduce CO_2 emissions, increasing available water storage, reducing distribution system losses,

continuing forest management projects, maximizing snowmaking efforts, and investigating cloud-seeding projects.

13 REFERENCES

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Hayashi, M., 2020, Alpine Hydrology: The critical role of groundwater in sourcing the headwaters of the world: Groundwater, v. 58, no. 4, p. 498-510.

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APPENDIX A. GEOLOGIC AND ISOTOPIC INVESTIGATION OF PHOENIX SPRING, TAOS SKI VALLEY, NM – INTERIM REPORT

GEOHYDROLOGIC AND ISOTOPIC INVESTIGATION OF PHOENIX SPRING, TAOS SKI VALLEY, NM

Interim Report

Prepared for Taos Ski Valley, Inc.

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Introduction

Glorieta Geoscience, Inc. (GGI) has initiated a hydrogeologic investigation of the Phoenix Spring area in the Village of Taos Ski Valley (VTSV), NM, on behalf of Taos Ski Valley, Inc. (TSV). This investigation was undertaken at the request of VTSV as part of an evaluation of a proposed 250,000 gallon water storage tank site proposed by TSV. The investigation conducted thus far has included collection of precipitation samples for tritium and stable isotope analysis, sampling of the Phoenix Spring, the Hillslope Spring, and Williams Lake for general chemistry and stable isotopes, drilling and installation of five piezometers, collection and analysis of geotechnical samples from two piezometers, and sampling of three piezometers for geochemical analysis. Sampling locations, piezometers, and the proposed tank site are shown on Figures 1 and 2. Following installation, piezometers were surveyed Redtail Survey and water levels were measured one to two times each week through September and October 2017. The frequency of water level measurements was reduced to weekly in November and December 2017, and January, 2018.

Hydrogeologic and Isotopic Characterization of Phoenix Springs

Hydrogeologic Setting

Phoenix Spring is situated in the Lake Fork valley, a north-to-northwest-trending glacial valley draining the Williams Lake basin (Figure 1). The Lake Fork valley is underlain by glacial deposits including rock glacier and thick valley bottom till (Lipman and Reid, 1989; Figure 3). Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss (Figure 3). The Lake Fork above Phoenix spring is an intermittent stream that flows during spring runoff in response to discharge from South Fork Lake Fork and East Fork Lake Fork springs (Figure 2a and 2b). These springs both discharge at a rate of several cubic feet per second (cfs) during peak spring runoff, but are typically dry by August of each year.

Drilling Program

Five piezometers (Piez 1 – 5) were drilled and completed by Geomechanics, Southwest at the direction of GGI, using a CME-75 HD drill rig equipped with a 6” Tubex casing advance (rotary percussion) system. This method was selected to drill through coarse, unconsolidated glacial deposits comprising sandy pebble-to-cobble gravel that underlie the site. The piezometers were drilled under New Mexico Office of the State Engineer (OSE) Permit RG-96901 POD1 through POD6. The OSE permits were issued August 29, 2017, and drilling commenced September 6, 2017. Proposed piezometer locations were reviewed by VTSV staff prior to drilling. Two locations were modified in response to a request made by VTSV during a site visit at the start of drilling on September 6, 2017. VTSV requested that the locations of the closest piezometers be moved further from the infiltration galley. In response to this request Piez 3 was moved and original Piez 4 (RG-96901 POD3) was eliminated. One location (Piez 1) was subsequently moved closer to the infiltration gallery due to rig access issues with approval from VTSV staff on September 8, 2017.

Piezometers were installed to total depths (TD) ranging from 18 to 45 ft below ground surface (bgs). Piezometers 1, 2, and 3 were completed with 5 ft of screen and a bottom cap, and piezometers 4 and 5 were completed with 10 ft of screen and bottom caps (Table 1; Appendix A). The annular space was filled with pea gravel from TD to a minimum of 5 ft above the top of the screened interval, and the annular space above the pea gravel was sealed with bentonite grout (hydrated pellets) (Table 1; Appendix A). Where the bentonite seal did not reach the ground surface (Piez 1, 3, and 5) the remaining annular space was sealed with neat cement during the surface completion (Table 1; Appendix A). The surface completion consisted of a 1 ft x 1 ft concrete pad and locking steel shroud.

Table 1. Piezometer completion information, Phoenix Spring Investigation

Well	**TD (Ft)**	**Diameter (in.)**	**Screened Interval (Ft)***	**Gravel Pack (Ft)**	**Bentonite (Ft)**	**Casing Stick-up (Ft)**	**Initial DTW BGS (Ft)**	**DTW Date**
Piez 1	18.6	2.0	13.2-18.2	8.0-18.6	0.5-8	1.6	13.50	9/8/2017
Piez 2	18.0	2.0	13.0-18.0	6.5-18.0	0.0-6.5	1.8	13.93	9/6/2017
Piez 3	19.7	2.0	14.7-19.7	6.5-18.0	0.0-8.0	2.0	14.02	9/6/2017
Piez 4	28.4	2.0	18.0-28.0	8.0-28.4	1.0-8.0	1.8	20.60	9/7/2008
Piez 5	45.0	2.0	29.8-39.8	10.0-45.0	2.0-10.0	1.9	35.20	9/7/2008

* All piezometers completed with 0.010 slot screen

Lithology

All borings encountered coarse, sandy, poorly sorted pebble to boulder gravel consisting of amphibolite, granite, quartzite, vein quartz, and phyllite. Bedrock was not encountered in any of the borings. Lithologic logs and completion diagrams are presented in Appendix A. OSE well records are presented in Appendix B.

Geotechnical Sampling

Geotechnical samples were collected during drilling Piez 1 and Piez 4 from 0-18 in., 5 - 6.5 ft, and 10 - 11.5 ft. Blow counts and lithologic characteristics were recorded, and samples were placed in zip lock plastic bags. Samples were submitted to Geo-Test, Inc., Santa Fe, NM for analysis of moisture content, grain size, and Atterberg limits tests. The geotechnical engineering report prepared by Geo-Test is included in Appendix C.

Water Level and Precipitation Monitoring

Water levels were measured upon completion of drilling, once each week for the next two weeks, and then two times each week for the next four weeks (until the end of October). Water levels have been measured once each week during November, December (2017) and January (2018). Precipitation has been measured manually using a rain gage installed near the base of Strawberry Hill at an elevation of approximately 9360 ft from July 27 through October 6, and precipitation data were downloaded from the Powderhorn Snotel site (https://wcc.sc.egov.usda.gov /nwcc/site?sitenum=1168), at an elevation of 11,057 ft, through January 14.

Precipitation Sampling

A precipitation sampler and rain gage were installed by GGI on July 27 at the Pit House, and moved to the west end of the boardwalk northeast of the Pit House at the base of Strawberry Hill on August 9, 2017 (Figure 1). Precipitation samples were collected from July 27 to October 6, 2017. Eleven samples have been submitted to the University of Arizona Environmental Isotope Laboratory for oxygen ($\delta^{18}O$) and deuterium (δ^2H) analyses, and two of the samples will analyzed for tritium (^3H) (Table 2). These samples will be added to a data set previously compiled for snow samples collected from the Lake Fork and Williams Lake basin, and used to construct a Local Meteoric Water Line (LMWL).

Table 2. Summary of Precipitation, Spring, and Surface Water Samples

Date	Time	Sample Site	Sample Name	Analytes
7/31/2017	7:40	TSV Pit House	Precip07312017	^{18}O, ^2H
8/7/2017	7:30	TSV Pit House	Precip08072017	^{18}O, ^2H
8/15/2017	7:00	TSV Pit House	Precip08152017	^{18}O, ^2H
8/24/2017	16:45	TSV Pit House	Precip08242017	^{18}O, ^2H, ^3H
8/28/2017	7:30	TSV Pit House	Precip08282017	^{18}O, ^2H
9/7/2017	7:00	TSV Pit House	Precip09072017	^{18}O, ^2H
9/15/2017	8:20	TSV Pit House	Precip09152017	^{18}O, ^2H
9/25/2017	7:40	TSV Pit House	Precip09252017	^{18}O, ^2H
9/28/2017	7:00	TSV Pit House	Precip09282017	^{18}O, ^2H, ^3H
10/4/2017	7:00	TSV Pit House	Precip10042017	^{18}O, ^2H
10/6/2017	7:00	TSV Pit House	Precip10062017	^{18}O, ^2H
10/17/2017	13:15	TSV Phoenix	Piez 4	^{18}O, ^2H, cation - anion balance
10/17/2017	15:30	TSV Phoenix	Piez 3	^{18}O, ^2H, cation - anion balance
10/17/2017	16:20	TSV Phoenix	Piez 1	^{18}O, ^2H, ^3H, cation - anion balance
10/26/2016	16:40	TSV	Phoenix Spring	^{18}O, ^2H, ^3H
11/3/2017	17:20	TSV	Hill Slope Spr	^{18}O, ^2H, cation - anion balance
11/3/2017	18:01	Williams Lk	Williams Lk	^{18}O, ^2H, cation - anion balance

Groundwater and Surface Water Sampling

Piezometers 1, 3, and 4 were purged and sampled on October 17, 2017. The informally named Simpson Spring (also known as “Hill Slope Spring”) and Williams Lake were sampled on November 3, 2017. Samples were submitted to Hall Environmental Analysis Laboratory (HEAL) for cation-anion balance and to U of A for isotope geochemistry analyses (Table 2). A sample was collected from the Phoenix Spring overflow on October 26, 2016, and this sample was also submitted for isotope geochemistry analyses. In addition, Phoenix, Blue Jay Ridge, Fraser, Gunsight, East Fork Lake Fork, South Fork Lake Fork, and Side Spring were sampled in June, 2014 as part of an earlier investigation (Drakos and Tafoya, 2016). These data will be included with isotopic and general geochemistry results from the current investigation.

Preliminary Results

Water Level Trends

The shallow aquifer in the vicinity of Phoenix Spring is unconfined. Water levels did not rise above the level at which they were encountered during drilling, except in response to recharge events. The aquifer matrix comprises unconsolidated, poorly sorted coarse sandy gravels that represent Pleistocene glacial deposits.

Water level and precipitation data are shown in Figure 4 (plot of groundwater elevation and precipitation-versus time) and Figure 5 (plot of depth to water and precipitation-versus time). These data show an approximately two-week lag between summer monsoonal precipitation and shallow groundwater recharge. Water levels show a generally declining trend from September 8 through 30, then groundwater recharge (e.g. rise in water levels) was observed October 6 through 20 following a series of 0.5 inch or greater precipitation events from September 22 through October 6. These recharge events were observed as a water level rise ranging from 3 feet (Piez 3) to 16 ft (Piez 2), with a 7 to 8 ft water level rise in Piez 1 and 4. Water levels show a declining trend from October 13, 2018 through January 12, 2018 with the lowest groundwater elevations measured in January for Piez 1 – Piez 4; Piez 5 was unable to be measured as it has been dry since November, 2017.

Water levels fluctuated between 8 and 16 ft bgs in Piez 1, 12 and 17 bgs in Piez 3, 15 and 28 ft bgs in Piez 4, and 24 and >38 ft bgs in Piez 5 (Figure 5). Depth to water in Piez 2, the piezometer located closest to the Lake Fork (20 ft from the stream bank), fluctuated between 2 and 18 ft bgs with the shallowest water levels recorded when the Lake Fork was flowing from October 10-17. The large recharge event observed in Piez 2 is tied to flow in the Lake Fork, whereas recharge to the other piezometers, while coincident with this event, appear to reflect areal recharge to the shallow groundwater system. This recharge may occur in the Williams Lake basin and/or throughout the Lake Fork basin.

Groundwater Flow Direction

Shallow groundwater flows from southeast to northwest, parallel to the trend of the Lake Fork valley in the site vicinity, at a gradient of 0.09 ft/ft (September 14, 2017) to 0.10 ft/ft (October 13, 2017; January 12, 2018) (Figures 2a, 2b and 2c). The gradient apparently steepens during recharge events as a result of the large water level rise observed in the southeastern most piezometer (Piez 5). This larger magnitude recharge in Piez 5 relative to Piez 1, 3, and 4 could be due to the presence of a buried channel at the Piez 5 location, a buried bedrock high in the vicinity of South Fork Lake Fork and East Fork Lake Fork springs that extends toward Piez 5, or recharge from the steep hillslope east of Piez 5.

Geotechnical Investigation

Based on an analysis of geotechnical samples collected by GGI, Geo-Test, Inc. recommended overexcavation of existing soils at the site throughout the area of a proposed 250,000 gallon, 43 ft diameter tank (Appendix C). This overexcavation will provide for at least 2.0 ft of properly compacted, structural fill below a reinforced concrete ring-wall footing (see Appendix C). Additional recommendations for site grading and moisture protection are provided in the Geo-Test, Inc. report in Appendix C.

GGI constructed a cross section through the tank site using water level data from Piezometers 4 and 1, projected onto the line of section (Figure 6). The elevation profile along the line of section was developed using 1-ft contours generated from LiDAR data. The tank location, 93 ft diameter area of disturbance and depth of the excavation were provided by Craig Taggert, Trinchera Ranch (personal communication, 2017). The cross section through the proposed tank site indicates that the highest water level observed during late summer and fall, 2017 (resulting from a 7 to 8 ft water level rise in Piez 1 and 4 following heavy late September/early October precipitation) would result in a water level 3.5 ft below the bottom of the deepest part of the tank excavation (Figure 6). Continued water level monitoring in late spring/summer 2018 will provide additional information on high water table conditions at the proposed tank site.

Excavation and placement of the tank will not affect the hydrogeology of the Phoenix Spring, even in the event that high water table conditions cause water to rise to the base of the proposed excavation. Boulders are present in the glacial deposits underlying the valley floor, and the tank would essentially act as another large boulder sitting at the surface of these deposits. Phoenix Spring discharge would not be affected.

Geochemistry

Analytical results for isotope geochemistry are pending. These results, along with general chemistry data, will be compiled in the final report following 2018 water level monitoring and used to evaluate relative contributions of summer and winter precipitation to Phoenix Spring discharge. Tritium data will be compiled to evaluate the timing of recharge to the shallow aquifer system and Phoenix Spring.

Phoenix Spring Discharge

A plot of Phoenix Spring discharge from September 1 through November 20 is shown in Figure 7. Data were provided by VTSV staff. The plot is “combined flow,” which is the sum of flow into the Village system and flow that is diverted back into the Lake Fork and bypasses the chlorination station. Some additional flow bypasses the collection system, discharging at the spring north of the infiltration gallery (Figure 2). The total volume of flow from the spring north of the infiltration gallery and other seeps below is unknown, but may be in the range of 100 ± 50 gpm during September-November flow conditions. The total flow measured at the chlorination station recorded from September through November, 2017 peaked around October 6 through 20, and shows a two-week time lag following the series of late September precipitation events that is similar to the recharge event observed in the piezometers installed upgradient of the Phoenix spring.

Preliminary Conclusions

- The shallow aquifer in the vicinity of Phoenix Spring is unconfined. The aquifer matrix comprises unconsolidated, poorly sorted coarse sandy gravel that represent Pleistocene glacial deposits. Bedrock was not encountered in any of the borings; therefore, total thickness of glacial deposits is unknown.
- Shallow groundwater measured in piezometers installed south and upgradient of the Phoenix Spring ranged from less than 5 ft (in Piez 2 during the mid-October recharge event) to greater

than 38 ft (in Piez 5 during dry low precipitation periods) below ground surface during late summer-fall, 2017.
- An approximate two-week lag was observed between late summer monsoonal precipitation events and recharge to shallow piezometers (water level rise).
- A similar two-week lag was observed between late summer monsoonal precipitation events and an increase in discharge at Phoenix Spring.
- Water level rises ranging from 3 feet (Piez 3) to 16 ft (Piez 2) were observed in response to the late September/early October recharge event.
- Summer/fall monsoonal precipitation events appear to result in transient recharge events, which temporarily increases the discharge in downgradient springs and ultimately increases flows in the Lake Fork.
- An analysis of the proposed 250,000 gallon tank site indicates that the highest water level observed during the late summer and fall of 2017 would result in a water level 3.5 ft below the bottom of the deepest part of the proposed tank excavation. This relatively high water table condition was a result of a recharge event causing a water level rise of 7 to 8 feet in the vicinity of the proposed tank site.
- The proposed 250,000 gallon tank will not have an effect on Phoenix Spring discharge.
- Phoenix Spring discharges at a location where the width of glacial deposits narrows between a bedrock constriction formed by Precambrian gneiss. The resulting decrease in cross sectional area of the alluvial aquifer underlying the site likely causes groundwater flowing northwest down the Lake Fork Valley to discharge at the land surface.

References

Lipman, P.W., and Reed, J.C., 1989, Geologic map of the Latir Volcanic Field and adjacent areas, northern New Mexico: Map I-1907, USGS Miscellaneous Investigation Series, Scale 1:48,000.

Drakos, P., and Tafoya, A.J., 2016, Village of Taos Ski Valley Snow Sampling Results: Unpublished consulting report to the Village of Taos Ski Valley.

Figures Follow Text

Figure 1. Site location map showing precipitation sampler, piezometers and spring locations.

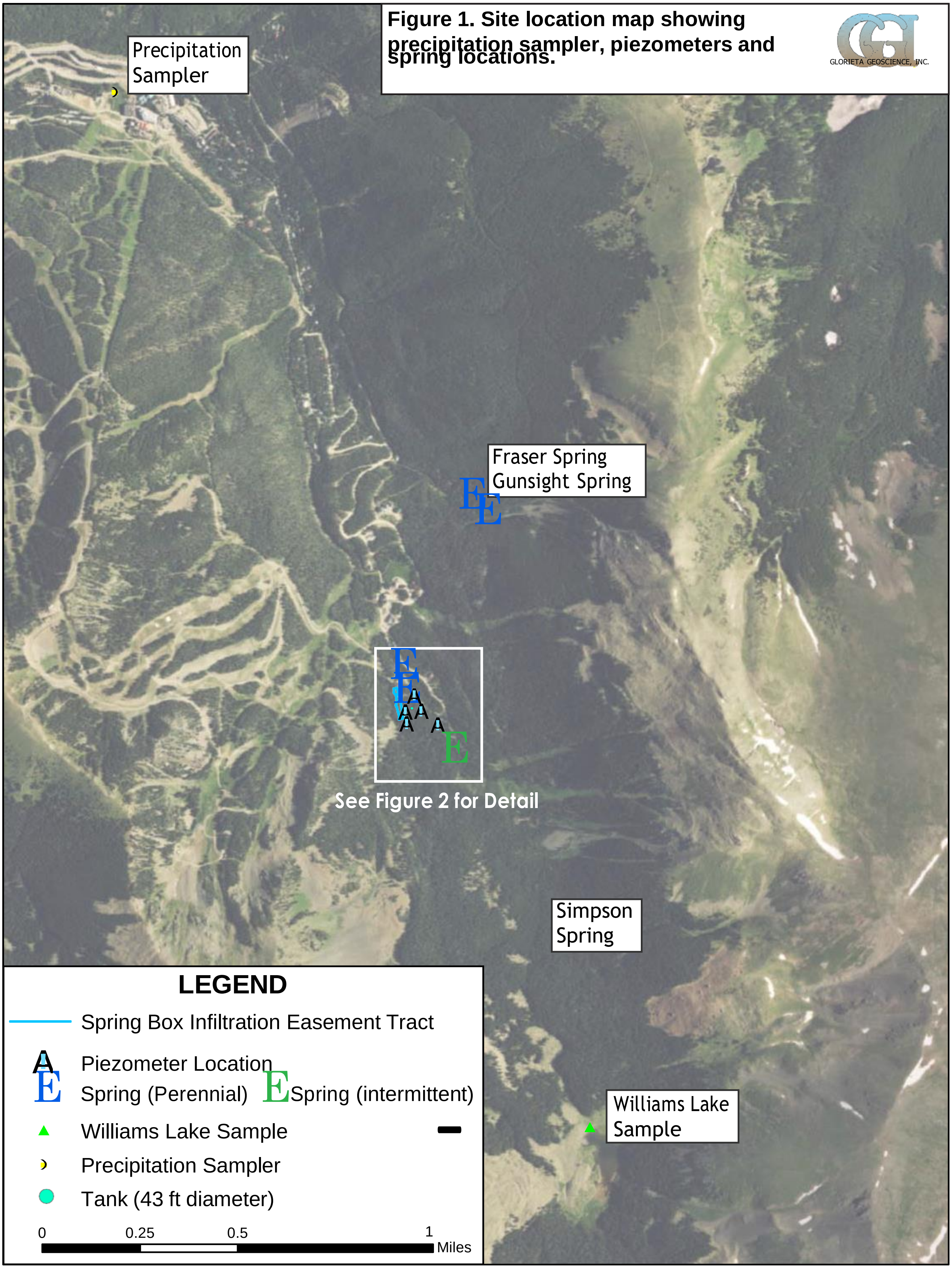


Figure 2a. Phoenix Springs piezometer locations and potentiometric surface map (September 14, 2017)

* GWE = Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data

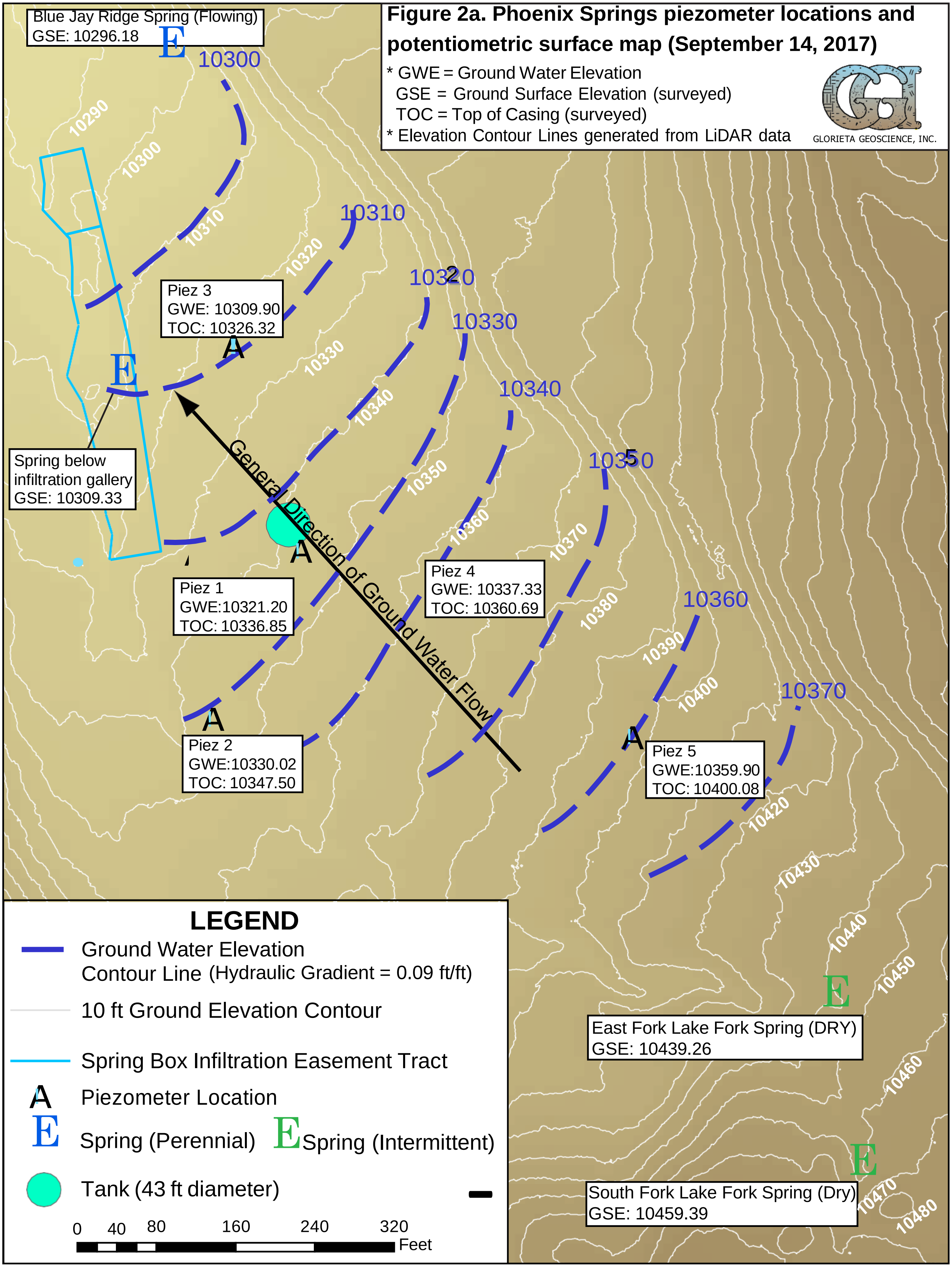


Figure 2b. Phoenix Springs piezometer locations and potentiometric surface map (October 13, 2017)

* GWE = Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data

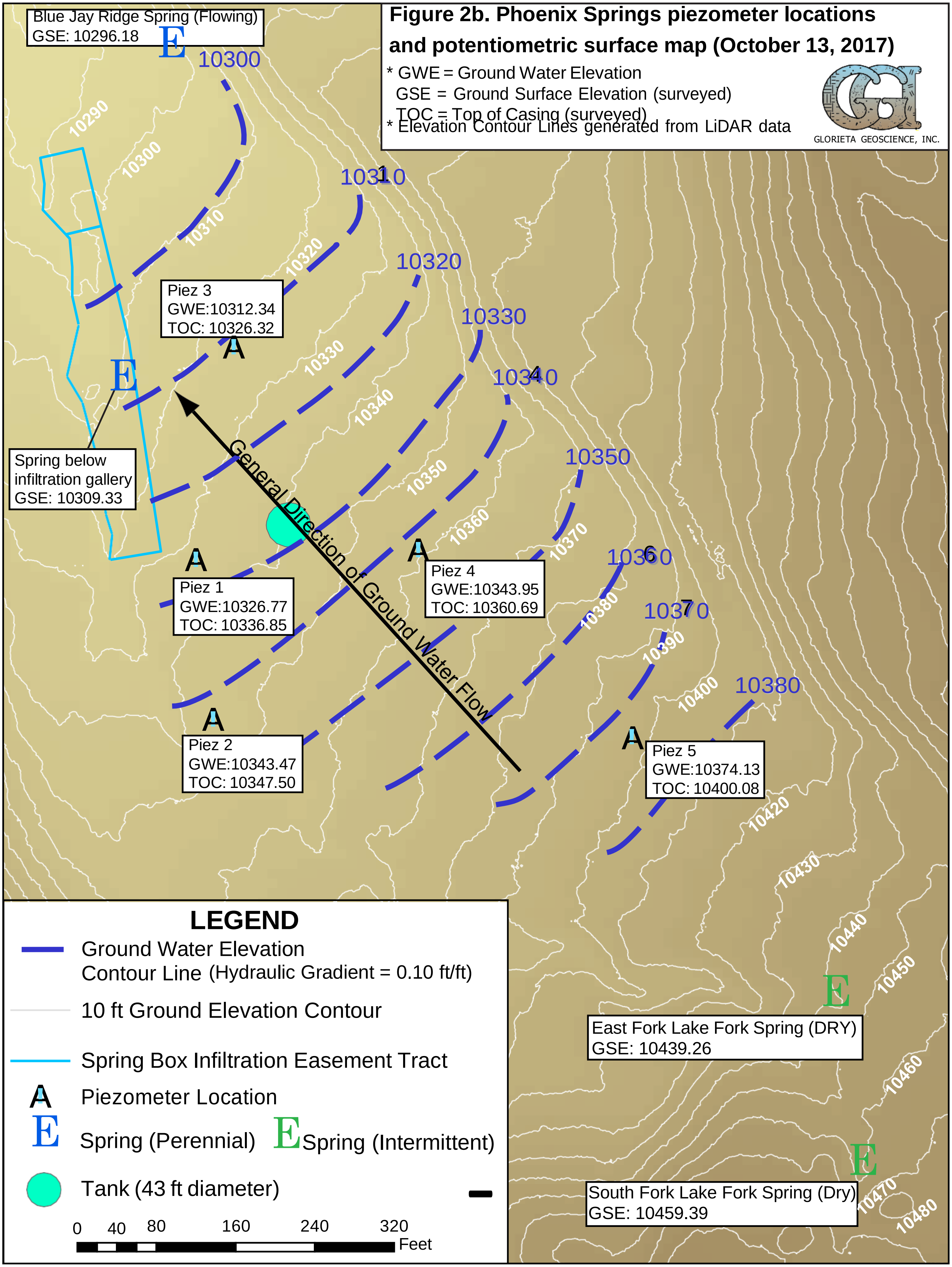


Figure 2c. Phoenix Springs piezometer locations and potentiometric surface map (January 12, 2018)

* GWE = Ground Water Elevation
GSE = Ground Surface Elevation (surveyed)
TOC = Top of Casing (surveyed)
* Elevation Contour Lines generated from LiDAR data

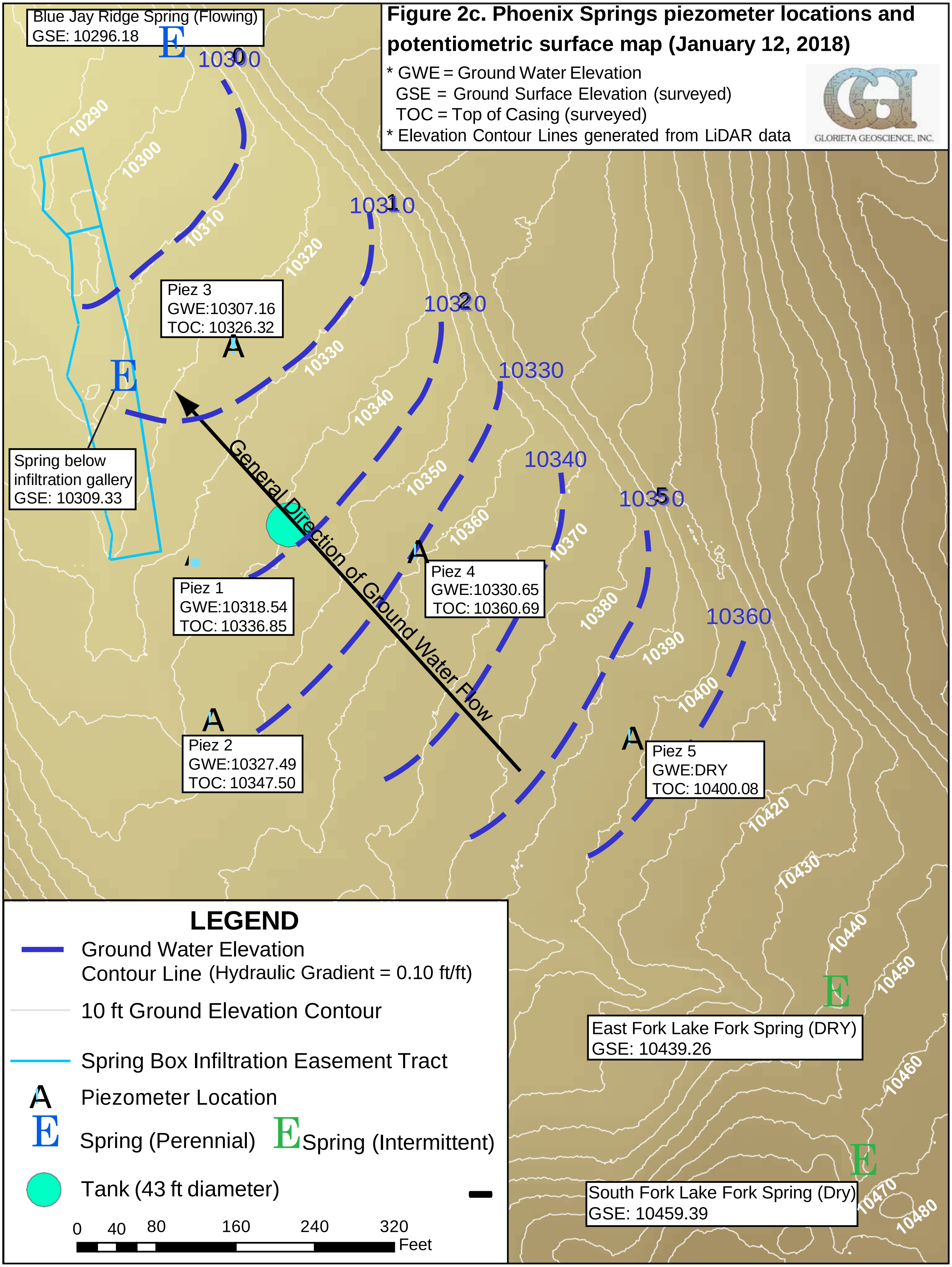
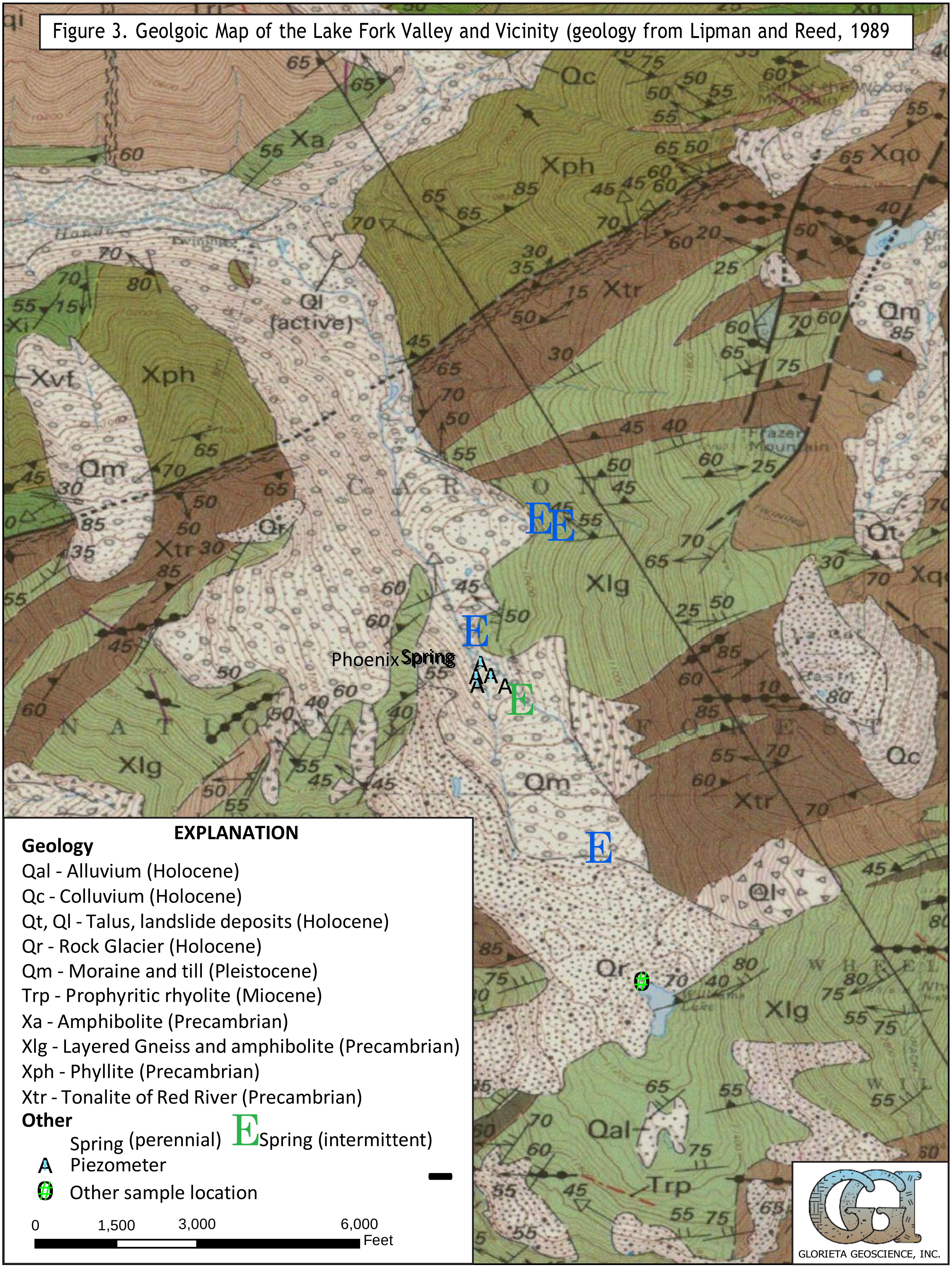


Figure 3. Geolgoic Map of the Lake Fork Valley and Vicinity (geology from Lipman and Reed, 1989



EXPLANATION

Geology

Qal - Alluvium (Holocene)
Qc - Colluvium (Holocene)
Qt, Ql - Talus, landslide deposits (Holocene)
Qr - Rock Glacier (Holocene)
Qm - Moraine and till (Pleistocene)
Trp - Prophyritic rhyolite (Miocene)
Xa - Amphibolite (Precambrian)
Xlg - Layered Gneiss and amphibolite (Precambrian)
Xph - Phyllite (Precambrian)
Xtr - Tonalite of Red River (Precambrian)

Other

Spring (perennial) E Spring (intermittent)
A Piezometer
Other sample location

0 1,500 3,000 6,000 Feet

Figure 4. TSV Phoenix Spring Study, Piezometer Ground Water Elevations and Precipitation Data

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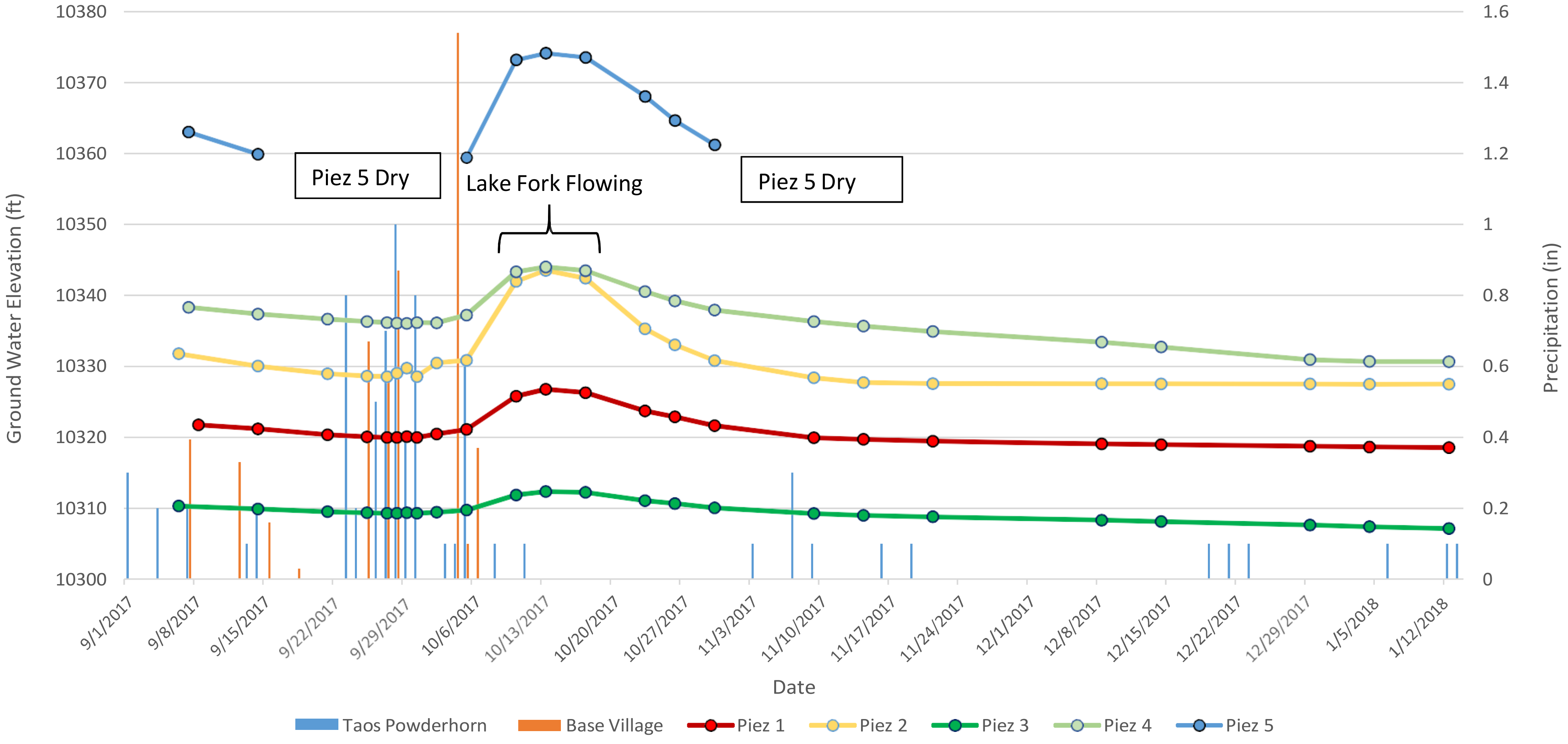

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Figure 5. TSV Phoenix Spring Study, Piezometer Depth to Water Measurements and Precipitation Data

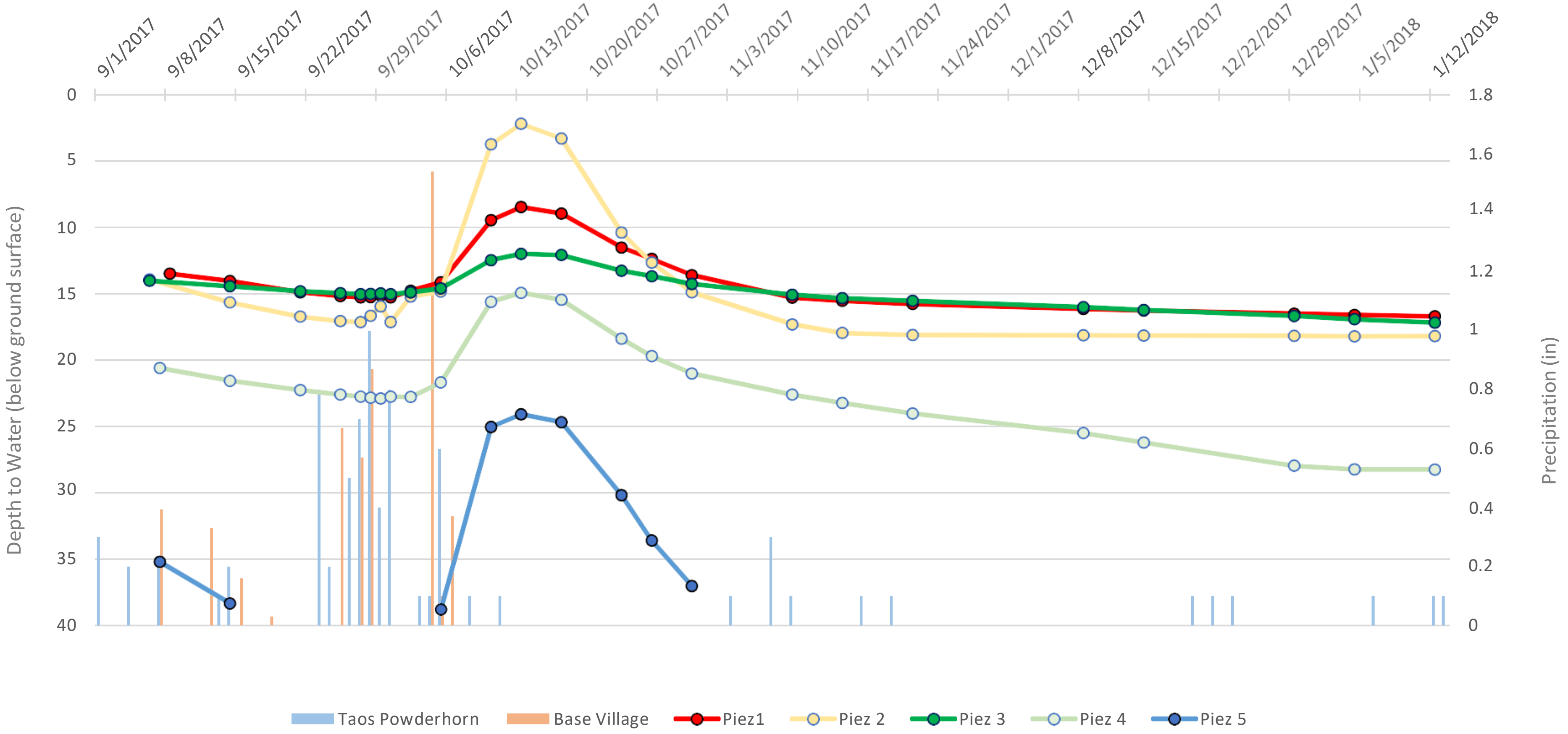

Figure 6. Cross section (A - A') through proposed 250,000 gallon tank site.

Legend

- ▬ Ground Surface derived from 2014 LiDAR
- ▼ Groundwater Elevation (projected) September 14, 2017
- ▼ Groundwater Elevation (projected) October 13, 2017
- ▬ 1' Contour produced from 2014 LiDAR
- ☐ Sandy gravel with minor clay
- ▨ Bedrock, depth unknown
- 🟧 Approximate excavation

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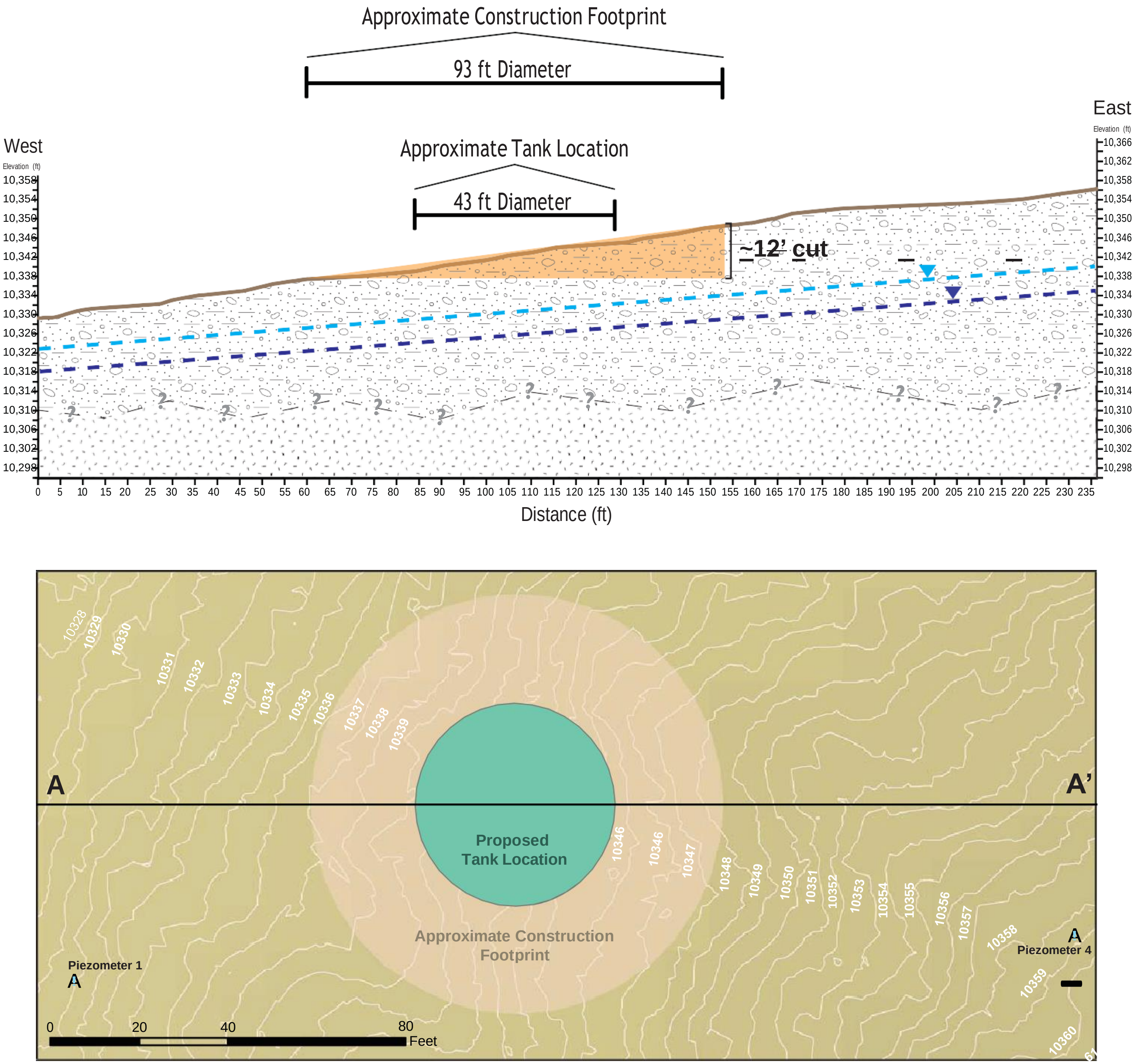

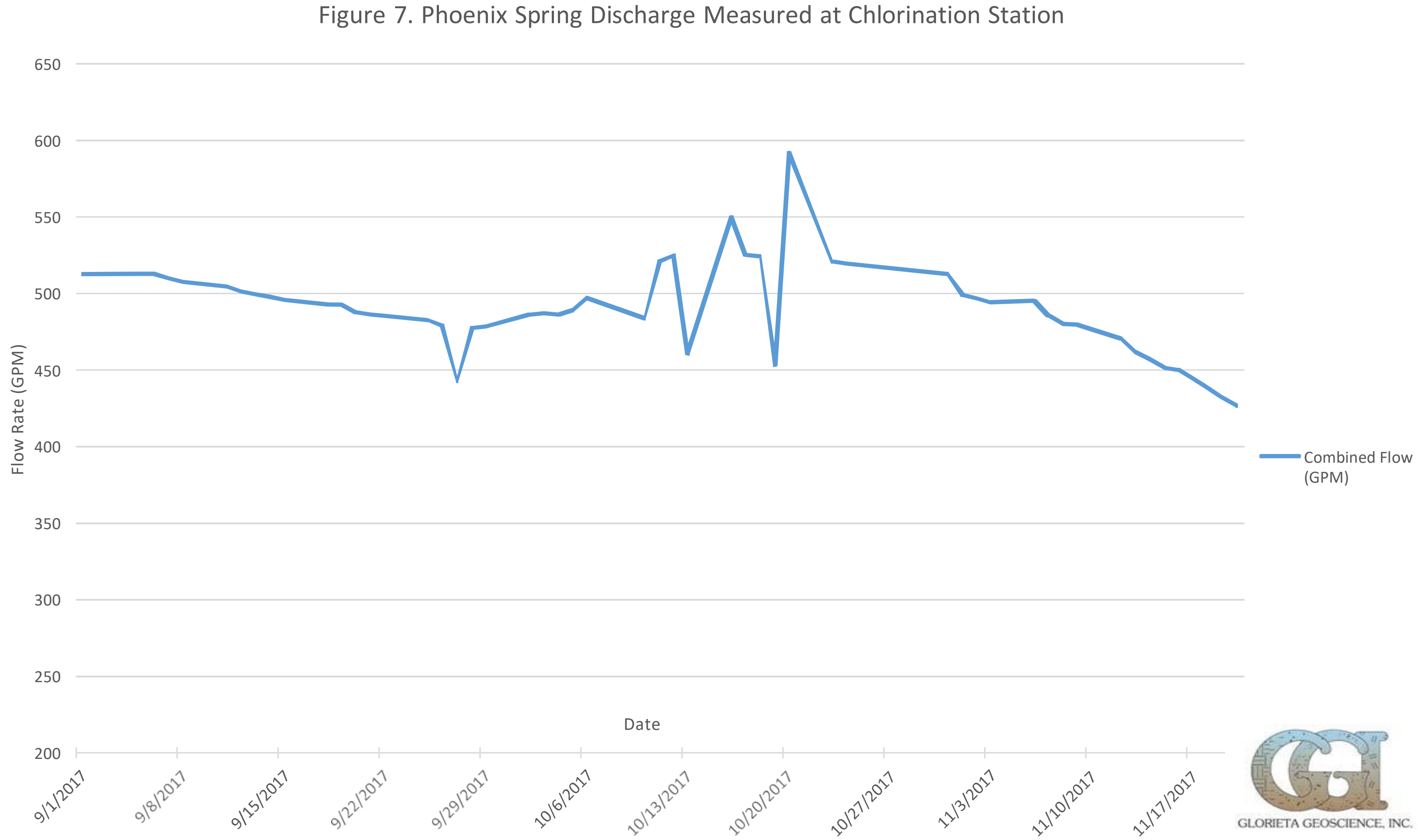

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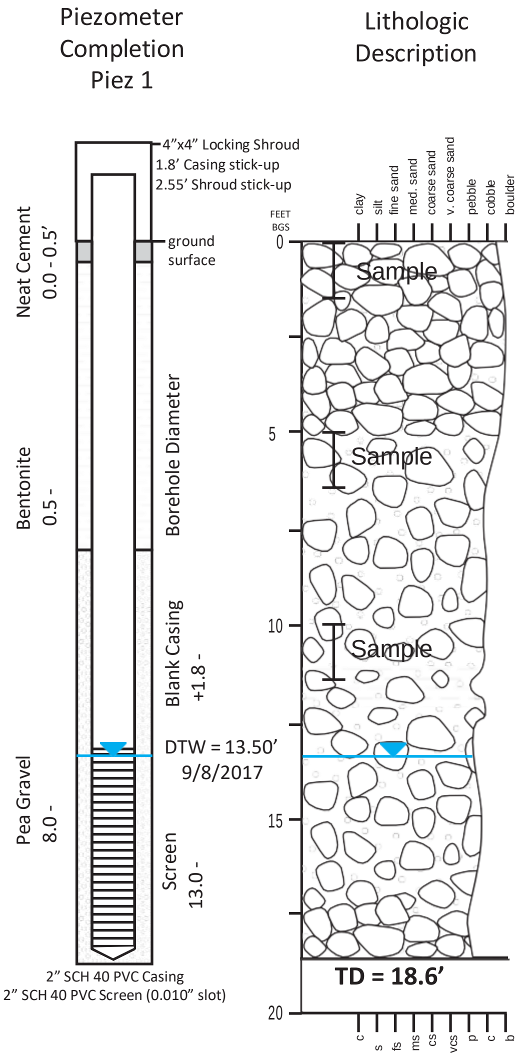
Appendix A: Piezometer Lithologic Logs and Completion Diagrams



Lithologic Log

0-5.0 ft: Angular cobble-boulder gravel composed of granite and amphibolite, minor vein quartz, +/- phyllite; 0-1.5 ft split spoon sample 14" recovery, 0-2" darkened soil horizon, brown, silty fine sand; 2-9" oxidized loose sandy angular gravel; 9-14" granite boulder

5.0-11.0 ft: Loose very coarse sandy, angular pebble-cobble-gravel, composition same as above; 5-6.5 ft split spoon 12" recovery, 0-12" granite and amphibolite cobbles, angular pebbles, coarse to very coarse sand

11.0-11.5 ft: Angular-subangular pebble-cobble-gravel, composed of granite and amphibolite; light brown poorly sorted, slightly clayey medium-very coarse sand; 10-11.5 ft split spoon sample 8" recovery, angular-subangular pebble-cobble, granite and amphibolite gravel, light brown poorly sorted slightly clayey medium-very coarse sand matrix

12.0-15.0 ft: Subrounded-subangular loose sandy pebble-gravel composed of amphibolite, granite, vein quartz, and phyllite. Water at ~13.5 feet

15-17.5 ft: Same as above, poor recovery

17.5-18.6 ft: Amphibolite boulder

Surveyed Location: 460783 mE, 4047592 mN
NAD83 UTM Zone 13S

Piez 1 (RG-96901-POD1): Piezometer Lithology and Completion

Lithologic log and completion schematic of Piez 1 . Logged by Paul Drakos, P.G. on 9/8/2017. Location shown on Figures 1 and 2.

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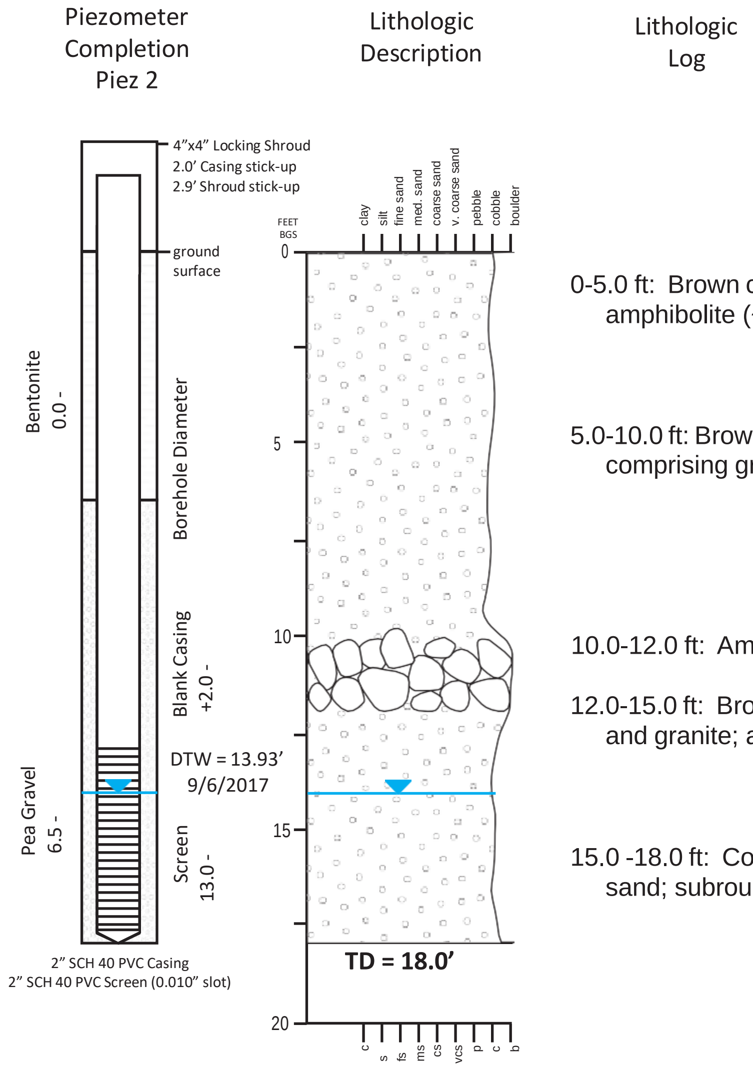


0-5.0 ft: Brown course angular sandy gravel; granite (~80%) and amphibolite (~20%)

5.0-10.0 ft: Brown sandy pebble-cobble-gravel, mostly subrounded, comprising granite, amphibolite and felsic gneiss

10.0-12.0 ft: Amphibolite boulder

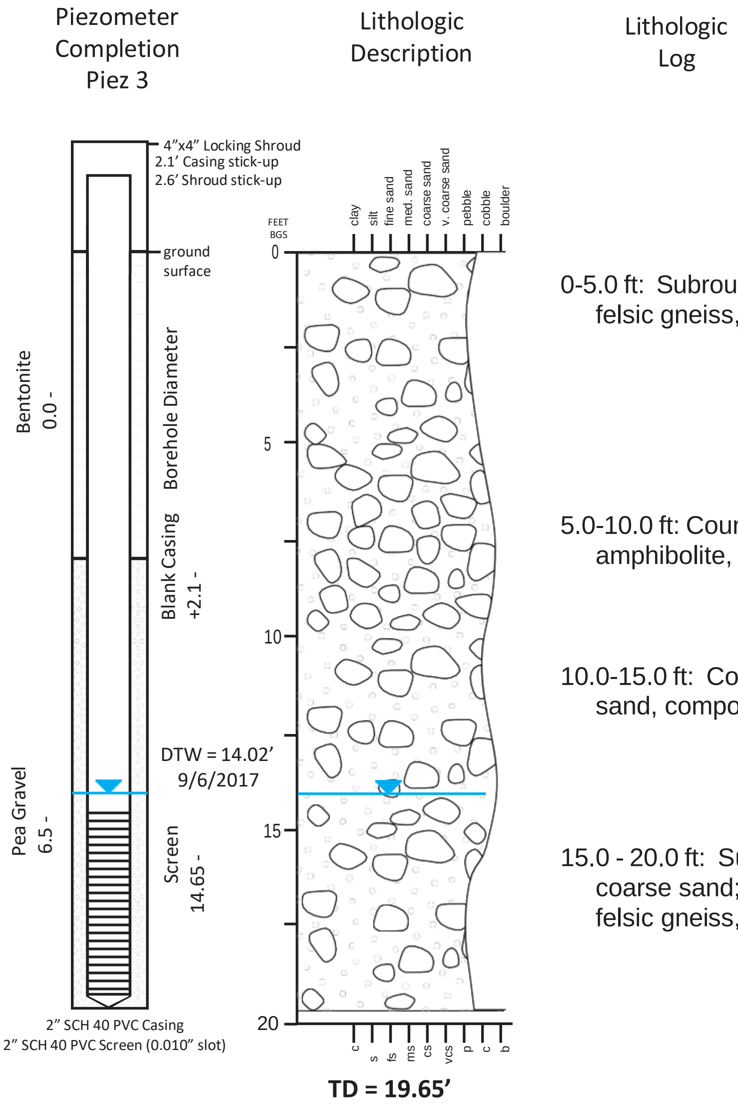
12.0-15.0 ft: Brown sandy gravel comprising felsic gneiss, amphibolite, and granite; angular-subrounded, water at ~14.0'

15.0 -18.0 ft: Course-very coarse, subrounded quartz and K-feldspar sand; subrounded and subangular gravel

Surveyed Location: 460787 mE, 4047542 mN
NAD83 UTM Zone 13S

Piez 2 (RG-96901-POD2): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 2. Logged by Paul Drakos, P.G. on 9/6/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.



0-5.0 ft: Subrounded-subangular pebble-cobble-gravel comprising felsic gneiss, amphibolite, granite and very coase sand

5.0-10.0 ft: Course, angular cobble boulder gravel comprising gneiss, amphibolite, and granite; plus quartzite, vein quartz pebbles

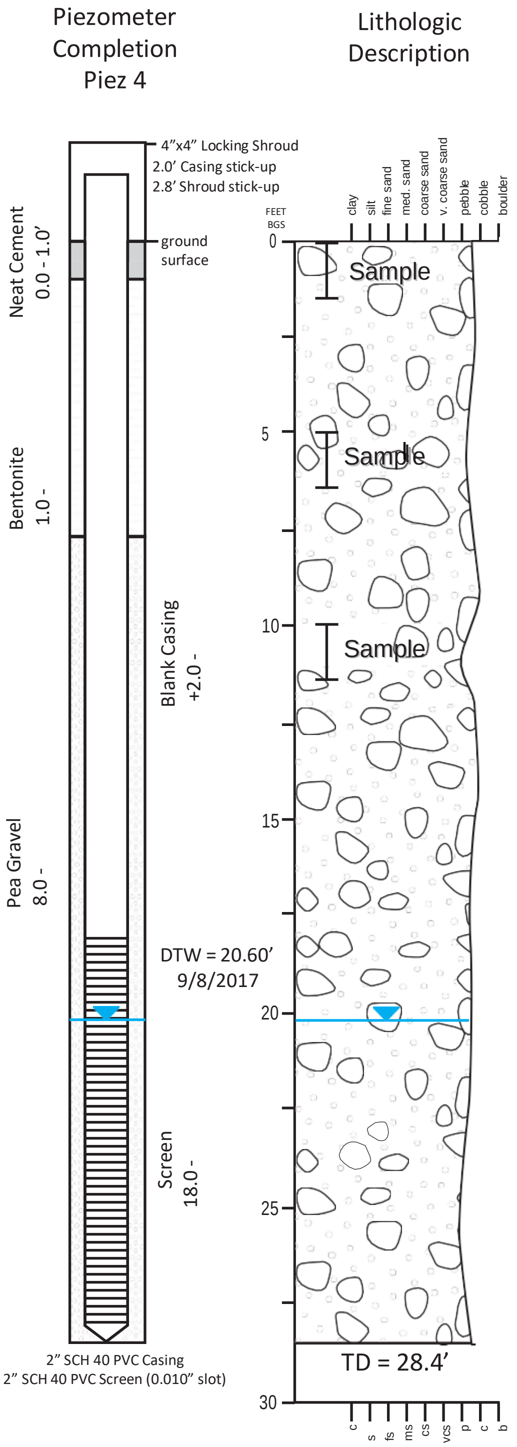
10.0-15.0 ft: Course sandy subrounded-angular gravel and very coarse sand, composition same as above

15.0 - 20.0 ft: Subrounded-angular pebble-cobble-gravel and lithic very coarse sand; gravel composition includes amphibolite, vein-quartz, felsic gneiss, minor granite DTW ~ 15'

Surveyed Location: 460795 mE, 4047655 mN
NAD83 UTM Zone 13S

Piez 3 (RG-96901-POD4): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 3 l. Logged by Paul Drakos, P.G. on 9/6/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.



Lithologic Log

0-5.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite-quartz lithic very coarse send; 0-1.5 ft split spoon sample 12" recovery, 0-6" brown slightly clayey soil horizon, 6-12" brown, loose sand and angular gravel

5.0-10.0 ft: Same as above plus vein-quartz gravel, more very coarse sand than above, 5-6.5 ft split spoon 7" recovery, 0-7" loose angular amphibolite and minor granite gravel

10.0-15.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite-quartz lithic very coarse send; 10-11.5 ft split spoon sample 9" recovery, course, loose granite gravel, 7 - 9" moist, brown, medium to course sand

15.0-20.0 ft: Same as above, slightly more rounded

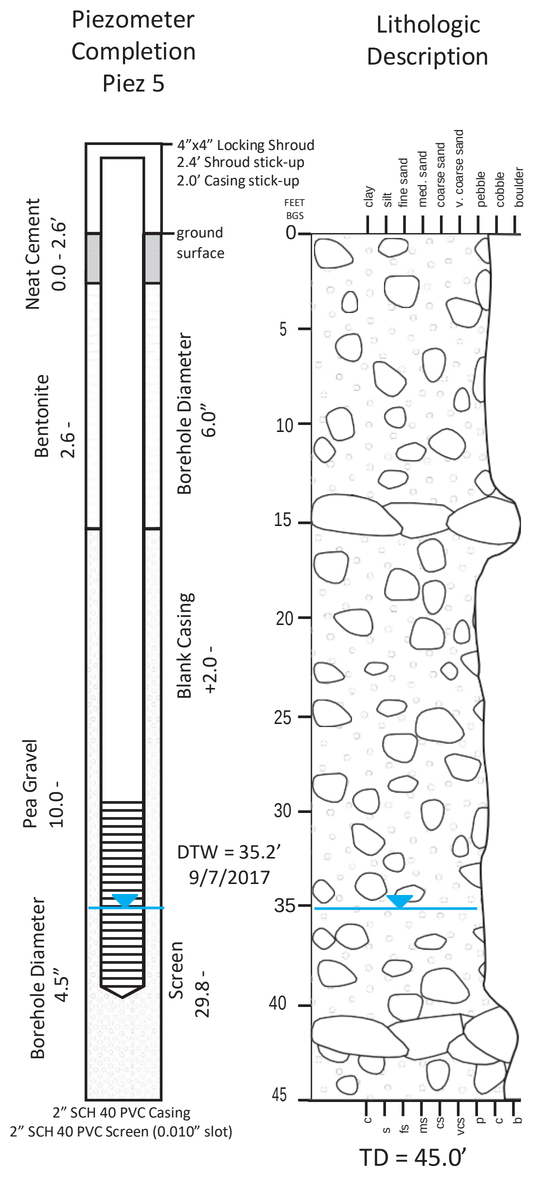
20.0-25.0 ft: Same as above, more amphibolite than granite

25.0-28.4 ft: Same as above

Surveyed Location: 460851 mE, 4047594 mN
UTM NAD83 Zone 13S

Piez 4 (RG-96901-POD5): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 4. Logged by Paul Drakos, P.G. and April Jean Tafoya on 9/7 - 9/8/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.



Lithologic
Log

0-4.0 ft: Loose brown sandy pebble-cobble gravel, composition = angular granite, amphibolite, felsic gneiss, phyllite

4.0-9.0 ft: Same as above, plus quartzite gravel

9.0-14.0 ft: Angular-subrounded granite, amphibolite, felsic gneiss, phyllite pebble-cobble-gravel, slightly clayey brown sand; lesser granite than above
14.0-15.0 ft: Boulder

15.0-19.0 ft: Granite and quartz subrounded lithic very coarse sandy, subrounded pebble gravel; composition = granite, amhibolite, phyllite and minor vein quartz

19.0-24.0 ft: same as above, gravel subangular

24.0-29.0 ft: coarse to very coarse sandy, subrounded pebble gravel and angular cobble fragments comprising granite, amphibolite and phyllite

29.0-30.0 ft: Subrounded-angular granite, amphibolite and vein quartz pebble to cobble gravel

35.0-40.0 ft: Subrounded-angular granite, amphibolite and vein quartz pebble to cobble gravel, DTW ~38'
40.0-41.0 ft: Same as above
41.0-43.0 ft: Amphibolite boulder
43.0-45.0 ft: Subangular-angular course granite, amphibolite, gneiss, vein-quartz pebble to boulder gravel

Surveyed Location: 460917 mE, 4047535 mN
NAD83 UTM Zone 13S

Piez 5 (RG-96901-POD6): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 5. Logged by Paul Drakos, P.G. and April Jean Tafoya on 9/7/2017. Location shown on Figures 1 and 2.

GLORIETA GEOSCIENCE, INC.

Appendix B: OSE Well Logs

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE POD NO. (WELL NO.) POD-I	j WELL TAGID NO	OSE FILE NO(S) RG-96901
WELL OWNER NAME(S) Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL)
WELL OWNER MAILING ADDRESS 200 W. De Vargas St Suite 7, PO Box 8980		CITY Santa Fe — STATE NM — ZIP 87504

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS		
	LATITUDE	36	34	22.1	N	• ACCURACY REQUIRED: ONE TENTH OF A SECOND
	LONGITUDE	105	26	18.3	W	• DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS -PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE
Taos Ski Valley

LICENSE NO	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1522	Branden L. Sanders	Geomechanics Southwest, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
9-6-17	9-6-17	18'	18 ft.	13.2

COMPLETED WELL IS: LJ ARTESIAN 0 DRY HOLE R) SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT) 13.2

DRILLING FLUID: [Z]AIR n MUD ADDITIVES - SPECIFY:

DRILLING METHOD: ☐ ROTARY 0 HAMMER D CABLETOOL 0 OTHER- SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (ndd coupliug diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
0	13	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
13	18	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	,]54"	0.010

DEPTH (feet bgl)		BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	2	6	neet cement	.3	tremmie
2	7	6	3/8" bentonite chips	.8	tremmic
7	I&	6	I/4" fl?." ernvcl	1.8	trcmm1c

FOR OSE INTERNAL USE — WR-20 WELL RECORD & LOG (Version 06/30/17)

FILE NO. — POD NO. — TRNNO.

LOCATION — WELL TAG ID NO — PAGE I OF 2

DEPTH (feet bgl)		THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
FROM	TO				
0	15	15	Sand/Gravel/cobbles	/Y N	
15	18	3	boulders	/Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT ☑ BAILER ☐ OTHER - SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST | TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE

FILE NO POD NO. TRN NO.

LOCATION WELL TAG ID NO.

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www .ose.state.nm.us

OSE POD NO (WELL NO) POD-2
WELL TAG IDNO
OSE FILE NO(S) RG-96901

WELL OWNER NAME(S) Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)
PHONE (OPTIONAL)

WELL OWNER MAILING ADDRESS 200 W. DeVargas St Suite 7, PO Box 8980
CITY Santa Fe
STATE NM
ZIP 87504

WELL LOCATJON (FROMGPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	36	34	23.0	N
	LONGITUDE	105	26	16.2	W

- ACCURACY REQUIRED: ONE TENTH OF A SECOND
- DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS - PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE
Taos Ski Valley

LICENSE NO	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
WD-1522	Branden L. Sanders	Geomechanics Southwest, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
9-8-17	9-8-17	18'	18 ft.	14.2

COMPLETED WELL IS: ☐ ARTESIAN ☐ DRYHOLE ☒ SHALLOW (UNCONFINED)
STATIC WATER LEVEL IN COMPLETED WELL (FT) **14.2**

D.RILLING FLUID: ☐ AIR ☐ MUD ☐ ADDITIVES - SPECIFY:
DRILLING METHOD: ☐ ROTARY ☒ HAMMER ☐ CABLETOOL ☐ OTHER - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (add coupling diameter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
0	13	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
13	18	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	.154"	0.010

DEPTH (feet bgl)		BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	2	6	nect cement	.3	tremmic
2	8	6	3/8" bcntonitc chips	l	tremmic
8	18	6	1/4" pea gravel	1.6	trcmmic

FOR OSE INTERNAL USE
WR-20 WELL RECORD & LOG (Version 06/30/17
FILE NO.
POD NO
TRNNO.
LOCATION
WELL TAG ID NO

DEPTH (feet bgl)		THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED • INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
FROM	TO				
0	IO	IO	Sandy Gravel	y [✓ N]	
IO	12	2	boulder	y [✓ N]	
12	18	6	Sandy Gravel	[✓ Y] N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT ☒ BAILER ☐ OTHER - SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST | TEST RESULTS. ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO POD NO. TRN NO.

LOCATION WELL TAG ID NO.

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE POD NO. (WELL NO) POD-4	WELL TAG ID NO	OSE FILE NO(S) RG-96901
WELL OWNER NAME(S) Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL)
WELL OWNER MAILING ADDRESS 200 W. DeVargas St Suite 7, PO Box 8980		CITY Santa Fe · STATE NM · ZIP 87504

WELL LOCATION (FROM GPS)	DEGREES	MINUTES	SECONDS		
LATITUDE	36	34	25.1	N	• ACCURACY REQUIRED: ONE TENTH OF A SECOND
LONGITUDE	105	26	16.9	W	• DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS - PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE
Taos **Ski** Valley

LICENSE NO. WD-1522	NAME OF LICENSED DRILLER Branden L. Sanders			NAME OF WELL DRILLING COMPANY Geomechanics Southwest, Inc.
DRILLING STARTED 9-6-17	DRILLING ENDED 9-6-17	DEPTH OF COMPLETED WELL (FT) 20'	BORE HOLE DEPTH (FT) 20 ft.	DEPTH WATER FIRST ENCOUNTERED (FT) 14

COMPLETED WELL IS: rJ ARTESIAN n DRYHOLE R) SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT)
14

DRILLING FLUID: (7] AIR Q MUD ADDITIVES -SPECIFY:

DRILLING METHOD: fJ ROTARY 0 HAMMER [J CABLE TOOL 0 OTHER - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE tadd cou11ling dinmc1er)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
0	15	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
15	20	6	Sch 40 PVC screen	flush thread w/ O-l'ing	2"	.154"	0.0IO

DEPTH (feet bgl)		BORE HOLE DIAM, (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	2	6	nect cement	.3	tremmic
2	8	6	3/8" bentonite chips	l	trcmmic
8	20	6	l/4" pea gravel	2	trcmmic

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Ver.don 06/30/17

FILE NO. POD NO. TRNNO.

LOCATION WELL TAG ID NO.

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES **(attach supplemental sheets to fully describe all units)**	WATER BEARING? (YES /NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	20	20	Sand/Gravel/cobbles	[✓ Y] N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	
				Y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIRLIFT ☒ BAILER ☐ OTHER - SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE WR-20 WELL RECORD & LOG (Version 06/30/2011)

FILE NO POD NO. TRN NO.

LOCATION WELL TAG ID NO

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE POD NO (WELL NO): POD-5

WELL TAG ID NO:

OSE FILE NO(S}: RG-96901

WELL OWNER NAME(S): Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)

PHONE (OPTIONAL):

WELL OWNER MAILING ADDRESS: 200 W. DeVargas St Suite 7, PO Box 8980

CITY: Santa Fe

STATE: NM

ZIP: 87504

WELL LOCATION (FROM GPS)	DEGREES	MINUTES	SECONDS	
LATITUDE	36	34	22.9	N
LONGITUDE	105	26	16.1	W

- ACCURACY REQUIRED: ONE TENTH OF A SECOND
- DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS-PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE: Taos Ski Valley

LICENS"; NO: WD-1522

NAME OF LICENSED DRILLER: Branden L. Sanders

NAME OF WELL DRILLING COMPANY: Geomechanics Southwest, Inc.

DRILLING STARTED: 9-7-17

DRILLING ENDED: 9-8-17

DEPTH OF COMPLETED WELL (FT): 28'

BORE HOLE DEPTH (FT): 28 ft.

DEPTH WATER FIRST ENCOUNTERED (FT): 20.6

COMPLETED WELL IS: n ARTESIAN ☐ DRYHOLE (7] SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT): 20.6

DRILLING FLUID: 0 AIR ☐ MUD ADDITIVES - SPECIFY:

DRILLING METHOD: [J ROTARY Ri HAMMER 0 CABLETOOL ☐ OTHER - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing siring, and note sections of screen)	CASING CONNECTION TYPE (11d<l i:ouphnl[diametor)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
0	18	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
18	28	6	Sch 40 PVC screen	flush thread w/ O-ring	2"	.154"	0.010

DEPTH (feel bgl)		BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	2	6	neet cement	.3	tremmie
2	8	6	3/8" benlonitc chips	I	trcmmic
8	28	6	1/4" pea gravel	3.2	trcmmic

FOR OSE INTP.RNAL USE

WR-2() WELL RECORD & LOG (Vcrsio11 06/30/17}

FILE NO

POD NO

TRN NO.

LOCATION

WELL TAG ID NO.

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED - INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES (attach supplemental sheets to fully describe all units)	WATER BEARING? (YES / NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	28	28	Sand/Gravel	Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT ☒ BAILER ☐ OTHER - SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Branden L. Sanders 9-27-17

SIGNATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO POD NO. TRN NO

LOCATION WELL TAG ID NO.

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

OSE POD NO. (WELL NO) POD-6	WELL TAG ID NO	OSE FILE NO(S) RG-96901
WELL OWNER NAME(S) Taos Ski Valley, Inc. - Canepa & Vidal, PA (agent)		PHONE (OPTIONAL)
WELL OWNER MAILING ADDRESS 200 W. De Vargas St Suite 7, PO Box 8980		CITY Santa Fe; STATE NM; ZIP 87504

WELL LOCATION (FROM GPS)		DEGREES	MINUTES	SECONDS	
	LATITUDE	36	34	24.2	N
	LONGITUDE	105	26	12	W

- ACCURACY REQUIRED: ONE TENTH OF A SECOND
- DATUM REQUIRED: WGS 84

_pESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS -PLSS (SECTION, TOWNSHJIP, RANGE) WHERE AVAILABLE

Taos Ski Valley

LICENSE NO WD-1522	NAME OF LICENSED DRILLER Branden L. Sanders	NAME OF WELL DRILLING COMPANY Gcomcchanics Southwest, Inc.

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
9-7-17	9-7-17	40'	45 ft.	35.2

COMPLETED WELL IS: ☐ ARTESIAN [J DRY HOLE f7l SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT) 35.2

DRILLING FLUID: RJ AIR ☐ MUD ADDITIVES - SPECIFY:

DRILLING METHOD: [J ROTARY 0 HAMMER D CABLETOOL [J OTHER - SPECIFY: Hammer - tubex casing advance

DEPTH (feet bgl)		BORE HOLE DIAM (inches)	CASING MATERIAL AND/OR GRADE (include each casing string, and note sections of screen)	CASING CONNECTION TYPE (cld ouu11llng dimneter)	CASING INSIDE DIAM. (inches)	CASING WALL THICKNESS (inches)	SLOT SIZE (inches)
FROM	TO						
0	30	6	Sch. 40 PVC	flush thread w/ O-ring	2"	0.154"	
30	40	6	3d1 40 rvc 5CICC!l	tlu5h thread w/ O-ring		.154"	0.010

DEPTH (feet bgl)		BORE HOLE DIAM. (inches)	LIST ANNULAR SEAL MATERIAL AND GRAVEL PACK SIZE-RANGE BY INTERVAL	AMOUNT (cubic feet)	METHOD OF PLACEMENT
FROM	TO				
0	2	6	ncct cement	.3	tremm1e
2	10	6	3/8" bcntonitc chips	1.3	trcmmic
10	40	6	1/4" pea gravel	5	trcmmic

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/30/17

FILE NO. POD NO. TRNNO,

LOCATION WELL TAG ID NO.

DEPTH (feet bgl) FROM	DEPTH (feet bgl) TO	THICKNESS (feet)	COLOR AND TYPE OF MATERIAL ENCOUNTERED- INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES **(attach supplemental sheets to fully describe all units)**	WATER BEARING? (YES /NO)	ESTIMATED YIELD FOR WATER-BEARING ZONES (gpm)
0	14	14	Sand/Gravel	y {N	
14	15	I	boulder	y {N	
15	40	25	gravel	{Y N	
40	43	3	boulder	{Y N	
43	45	2	gravel	{Y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	
				y N	

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA:

☐ PUMP ☐ AIR LIFT 0BAILER ☐ OTHER-SPECIFY:

TOTAL ESTIMATED WELL YIELD (gpm): 0.00

WELL TEST: TEST RESULTS-ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING DISCHARGE METHOD, START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

MISCELLANEOUS INFORMATION: Bailing was to clean up well after install. Unable to obtain an estimate of well yield.

PRINT NAME(S) OF DRILL RIG SUPERVISOR(S) THAT PROVIDED ONSITE SUPERVISION OF WELL CONSTRUCTION OTHER THAN LICENSEE:

Freland Glenn Sanders

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING JS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WJLL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

Branden L. Sanders 9-27-17

SIONATURE OF DRILLER / PRINT SIGNEE NAME DATE

FOR OSE INTERNAL USE

WR-20 WELL RECORD & LOG (Version 06/30/2017)

FILE NO.

POD NO

TRN NO.

LOCATION

WELL TAG ID NO.

Appendix C: Geo-Test, Inc. Geotechnical Engineering Services Report

GEO-TEST

GEO-TEST, INC.
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SANTA FE,
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FAX (505) 471-2245

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NEW MEXICO
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GEOTECHNICAL ENGINEERING SERVICES REPORT
JOB NO. 1-71005
250,000 GALLON WATER TANK
TAOS SKI VALLEY, NEW MEXICO

PREPARED FOR

TAOS SKI VALLEY, INC.
C/O
GLORIETA GEOSCIENCE, INC.

GEO-TEST

October 31, 2017
Job No. 1-71005

Taos Ski Valley, Inc.
C/o Glorieta Geoscience, Inc.
1723 2nd Street
Santa Fe, New Mexico 87505

Attn: Paul Drakos, P.G.

RE: Geotechnical Engineering Services
250,000 Gallon Water Tank
Taos Ski Valley, New Mexico

Dear Mr. Drakos:

Submitted herein is the Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our laboratory testing, and recommendations for tank foundation design, as well as criteria for site grading.

It has been a pleasure to serve you on this project. If you should have any questions, please contact this office.

Respectfully submitted:

Patrick R. Whorton, EI

Reviewed by:

Robert D Booth, P.E.

5711

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Table of Contents

INTRODUCTION

This report presents the results of the geotechnical engineering services investigation performed by this firm to aid in the design of the proposed 250,000 gallon steel water storage tank to be located near Blue Jay Ridge within the Taos Ski Valley, New Mexico.

The objectives of this investigation were to:

1) Evaluate the nature and engineering properties of the subsurface soils underlying the proposed tank site.

2) Provide recommendations for the design and construction of tank foundations as well as the required site grading.

The investigation includes subsurface exploration, selected soil sampling, laboratory testing of the samples, performing an engineering analysis and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the project consists of the construction of a new 250,000 gallon, welded steel water storage tank 43 feet in diameter and 24 feet in height. Unit loading at the base of the tank will be on the order of 1,500 pounds per square foot.

Should project details vary significantly from those outlined above, this firm should be notified for review and revision of recommendations contained herein.

FIELD EXPLORATION

Two (2) borings were drilled near the proposed location of the water tank to install piezometers. The borings were drilled under the supervision of Glorieta Geoscience, Inc. and logged and sampled by Paul Drakos, P.G. with that firm. This report was prepared using the data gathered from those borings, piezometers 1 and 4. The locations of the borings/piezometers are shown on the Boring Location Map, Figure 1. Standard penetration tests were performed at the surface and at depths of 5 and 10 feet in the borings and the samples were delivered to the Geo-Test, Inc. Santa Fe laboratory by Glorieta Geoscience, Inc. Piezometer/boring lithology logs prepared by Glorieta Geoscience, Inc. are presented in a following section of this report along with logs derived by this firm to present standard penetration data and USCS soil classifications. Geo-Test, Inc. did not perform a field investigation at the proposed tank site.

LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits with depth. The results of these tests are shown on the boring logs.

Sieve analysis and Atterberg limits tests were performed to aid in soil classification. The results of these tests are shown in the Summary of Laboratory Results and on the individual test reports presented in a following section of this report.

SITE CONDITIONS

The tank site is located within an undeveloped area with the Taos Ski Valley. The site is located near the end of Blue Jay Ridge Road and Williams Lake Trail. The site is in a wooded area and generally slopes down from east to west.

SUBSURFACE SOIL CONDITIONS

As indicated by the boring data and laboratory testing, the soils underlying the site consist of a surficial layer of silty sand and gravels with interspersed cobbles and boulders which extends to a depth of approximately 5 feet below existing site grades. Below the surficial layer, well graded gravel with silt, sand and cobbles was encountered to the full depths explored.

Free groundwater was encountered at depths of about 13 to 21 feet below grade. The groundwater level may fluctuate seasonally and could be higher or lower during certain times of the year. Soil moisture contents above the water table were relatively low near the surface but became moist with depth.

CONCLUSIONS AND RECOMMENDATIONS

The subsurface soils encountered at the site vary considerably in both gradation and density. Based on these results and general experience in the area it is believed that the subsurface soils encountered consist of alluvium resulting from higher elevation erosion and possibly landslides or glacial activity. As such, void space and buried debris may exist within the soils. Foundations bearing on these soils would be susceptible to excessive differential settlements. Accordingly, the existing near surface native soils are not considered suitable in their present condition to provide reliable support of the proposed tank.

However, with special site preparation, the proposed tank can be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on properly compacted, non-expansive structural fill. The special site preparation would involve overexcavation of the existing soils throughout the area of the tank to such an extent as to provide for at least 2.0 feet of properly compacted, non-expansive structural fill below the ring-wall footing and the tank bottom. The limits of the overexcavation should also extend laterally from the footing perimeter a distance equal to the depth of fill beneath its base. The exposed native soils at the base of the excavation should be densified prior to placement of structural fill. The overexcavated soils will not be suitable for use as structural fill and should be wasted or placed in non-structural areas of the site or processed to meet the specification for structural fill outlined in the Site Grading section of this report. Detailed recommendations for foundation design, along with the required earthwork, are presented in the following sections of this report.

Post-construction moisture increases in the supporting soils could cause some differential foundation movements. Therefore, moisture protection is considered an important design consideration and should be reflected in overall site grading and drainage details as recommended in the Moisture Protection section of this report.

FOUNDATION

The proposed water tank may be supported on a reinforced concrete ring-wall footing (AWWA Type 1) bearing directly on a minimum of 2.0 feet of properly compacted, non-expansive structural fill. The footing should be designed using an allowable soil bearing pressure not exceeding 3,000 pounds per square foot. The recommended bearing pressure applies to full dead plus live loads and may be increased by one-third for total loads including wind and seismic forces. The ring-wall footing should be established a minimum of 3.0 feet below the lowest adjacent finished grade. The minimum recommended width of the ring-wall footing is 16 inches. The floor of the tank should be supported on a sand cushion at least 3 inches thick placed directly on structural fill.

ESTIMATED SETTLEMENTS

It is estimated that total settlement of the tank and ring-wall footing, designed and constructed as recommended herein, will not exceed about 1.0 inch. Differential movement, or tilt across the entire tank bottom, is estimated to be less than 0.5 inches.

The above settlement estimates are based upon the soil moisture contents encountered during test drilling or moisture contents introduced during construction. Post construction soil moisture increases could create additional movements and, thus, the moisture protection procedures as recommended in a following section of this report are considered important for the satisfactory performance of the tank structure.

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LATERAL LOADS

Resistance to lateral forces will be provided by passive earth resistance against the sides of the ring-wall footing and by soil friction between the base of the footing and the tank and the soil. A coefficient of friction of 0.45 is recommended when calculating lateral resistance between base of the footing and the tank and the soil. A passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis.

SITE GRADING

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site grading. It is recommended that all structural fill and backfill be placed and compacted under engineering observation and in accordance with the following:

1) The existing site soils throughout the tank site should be over-excavated to such an extent as to provide for at least 2.0 feet of properly compacted non-expansive structural fill beneath the ring-wall footing and the tank bottom. The overexcavation limits should extend laterally beyond the footing perimeter equal to the depth of fill beneath the base of the footing.

2) After the required overexcavation, the exposed cut surface should be densified. Densification of the exposed native soils should consist of moisture conditioning to the optimum moisture content or above and compacting the subgrade to a minimum of 95 percent of maximum dry density as determined in accordance with ASTM D-1557. It is anticipated that the bottom of the excavation may be uneven, rocky and difficult to grade and compact. If these conditions exist it is recommended that a thin approximately 2 inch thick layer of structural fill be spread across the bottom of excavation and compacted in order to create a level workable surface prior to the placement structural fill.

3) The results of this investigation indicate that the overexcavated soils will not be suitable for use as structural fill as is and should be wasted or placed in non-structural areas of the site. The onsite material may be processed and used as structural fill provided the processed material meets the specifications for structural fill outlined below. Imported material must also meet the criteria for structural fill outlined below.

4) All structural fill should be free of vegetation and debris, and contain no rocks larger than 3 inches. Gradation of the material, as determined in accordance with ASTM D-422, should be as follows:

Size	Percent Passing
3 inch	100
¾ inch	75 – 100
No. 4	40 – 70
No. 200	5 – 15

5) The plasticity index of the structural fill and backfill should be no greater than 10 when tested in accordance with ASTM D-4318.

6) On site material may be used as general fill within non-foundation areas and as trench backfill. All pipe embedment and bedding materials should conform to the pipe manufacturer specifications.

7) Fill or backfill, consisting of soil approved by the geotechnical engineer, shall be placed in 8 inch loose lifts and compacted with approved compaction equipment. Loose lifts should be reduced to 4 inches if hand held compaction equipment is used. All compaction of structural fill or backfill shall be accomplished to a minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D-1557. The moisture content of the structural fill during compaction should be within 2 percent of the optimum moisture content.

8) Tests for degree of compaction should be determined by the ASTM D-1556 method or ASTM D-6938. Observation and field tests should be performed during fill and backfill placement by the geotechnical engineer to assist the contractor in obtaining the required degree of compaction. If less than 95 percent is indicated, additional compaction effort should be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

MOISTURE PROTECTION

Proper drainage maintenance is required to preclude accumulation of excessive moisture in the soils below the tank. Accumulations of excessive moisture can weaken or cause other changes in the soils supporting the foundations. This can cause differential movement of foundations and can result in structural damage to the tank. Positive drainage should be established away from the exterior walls of the tank. The slope away from the perimeter of the tank should be a minimum of 5 percent for a minimum distance of 10 feet and be sloped to provide positive drainage beyond those points to natural water courses.

All backfill should be well compacted and should meet the specifications outlined in the Site Grading section of this report. All utility trenches leading into the tank should be backfilled with compacted fill. If any water line or tank leaks are detected, they should be promptly repaired. In addition, if any depressions develop from settlement of soils in utility trenches or other areas, they should be backfilled to maintain the grade so that surface water drains rapidly away from the tank.

The foregoing recommendations should only be considered minimum requirements for overall site development. It is recommended that a civil/drainage engineer be consulted to provide more detailed grading and drainage recommendations.

FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the geotechnical engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications should be noted in writing by the geotechnical engineer. Variations from soil conditions presented herein may be encountered during construction of the tank.

In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the geotechnical engineer be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and properly compacted and foundation elements penetrate the recommended soils.

CLOSURE

Our conclusions, recommendations and opinions presented herein are:

1) Based upon our evaluation and interpretation of the findings of the field and laboratory program.

2) Based upon an interpolation of soil conditions between and beyond the explorations.

3) Subject to confirmation of the conditions encountered during construction.

4) Based upon the assumption that sufficient observation will be provided during construction.

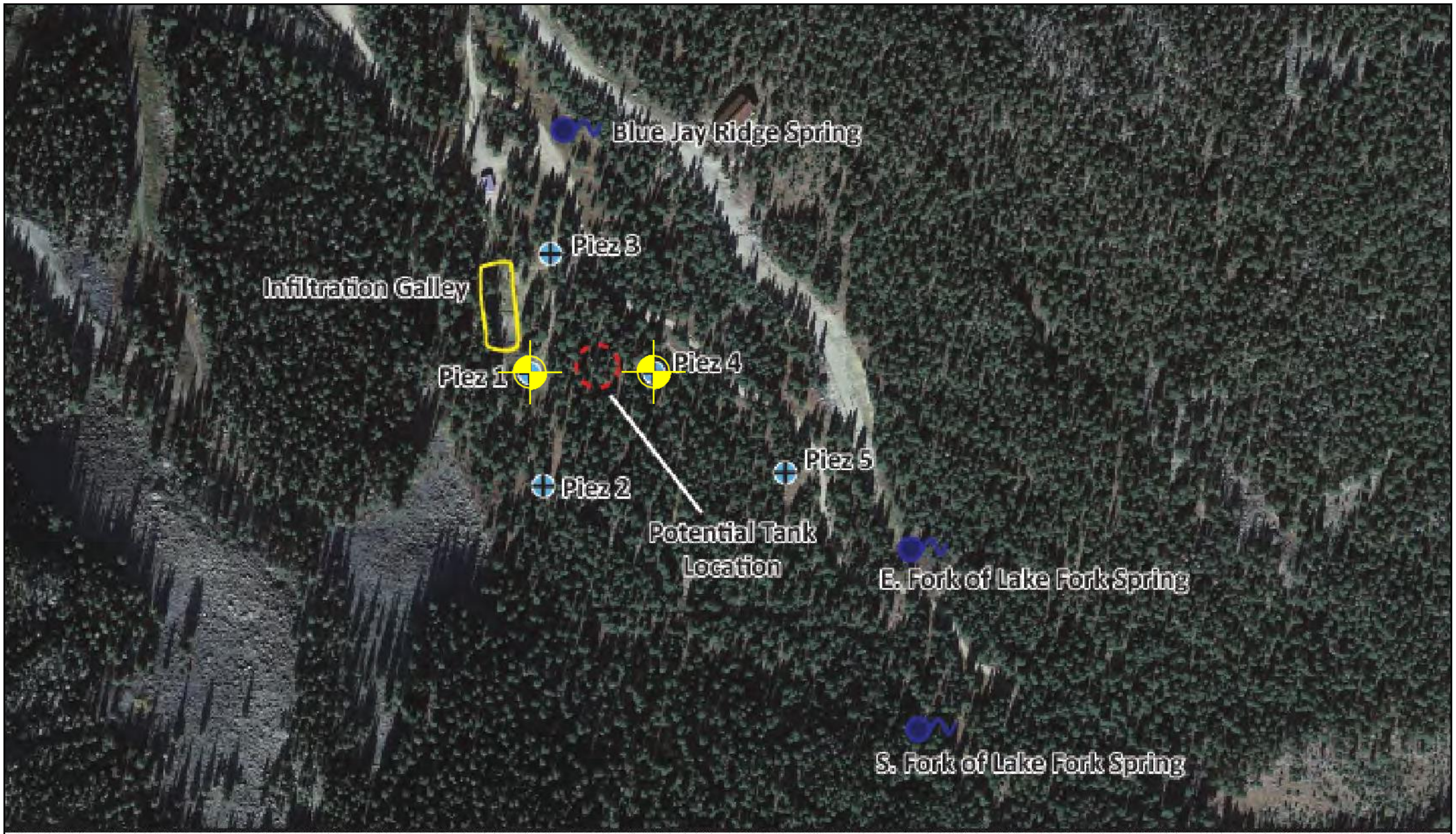
5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

This report has been prepared for the sole use of Taos Ski Valley, Inc., specifically for the design of the 250,000 gallon water storage tank to be located within the Taos Ski Valley, New Mexico and not for the use by any third parties.

We make no other warranty, either expressed or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as they deem necessary to satisfy themselves as to the surface and subsurface conditions to be encountered and the procedures to be used in the performance of work on this project. If conditions encountered during construction appear to be different than indicated by this report, this office should be notified.

All soil samples will be discarded 60 days after the date of this report unless we receive a specific request to retain the samples for a longer period of time.

BORING LOCATION MAP



Piezometer Location Map

Original Piez 3 location moved and Piez 4 eliminated at request of VTSV staff on 9/6/2017.
Piez 1 moved closer to infiltration gallery due to drilling rig access issues. New location approved by VTSV Staff on 9/8/2017.

GLORIETA GEOSCIENCE, INC.

250,000 gallon Water Tank
Taos Ski Valley, New Mexico
Job No. 1-71005

Figure 1

Yellow piezometer borings were utilized in the preparation of this report.

N W E S

GEO-TEST
GEOTECHNICAL ENGINEERING
AND MATERIAL TESTING

GEO-TEST

Project: 250,000 Gallon Water Tank
Date: 09/08/2017
Project No: 1-71005
Elevation:
Type: Tube Ex

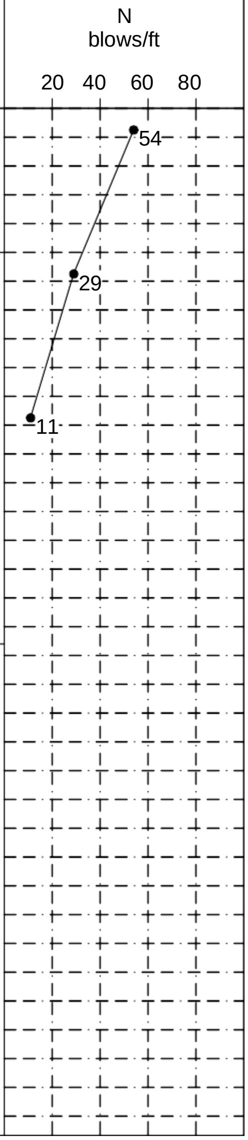
LOG OF TEST BORINGS

NO: Piez 1

GROUNDWATER DEPTH

During Drilling: 13.5
After 24 Hours:

DEPTH (Ft)	LOG	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
		☒	SS	4-6-48 54	4		GM	SILTY GRAVEL with COBBLES and BOULDERS, non-plastic, very dense, slightly moist, brown
5		☒	SS	10-14-15 29	3		GW-GM	WELL GRADED GRAVEL with SILT, SAND and COBBLES, non-plastic, dense to medium dense, slightly moist to wet, light brown
10		☒	SS	11-8-3 11	2			
15								▽
20								Total Depth = 18.6 feet * Note: This boring log was derived in order to show USCS soil classifiactions and SPT counts based on data provided by Glorieta Geoscience. This log does not represent data gathered by Geo-Test, Inc.
25								
30								
35								

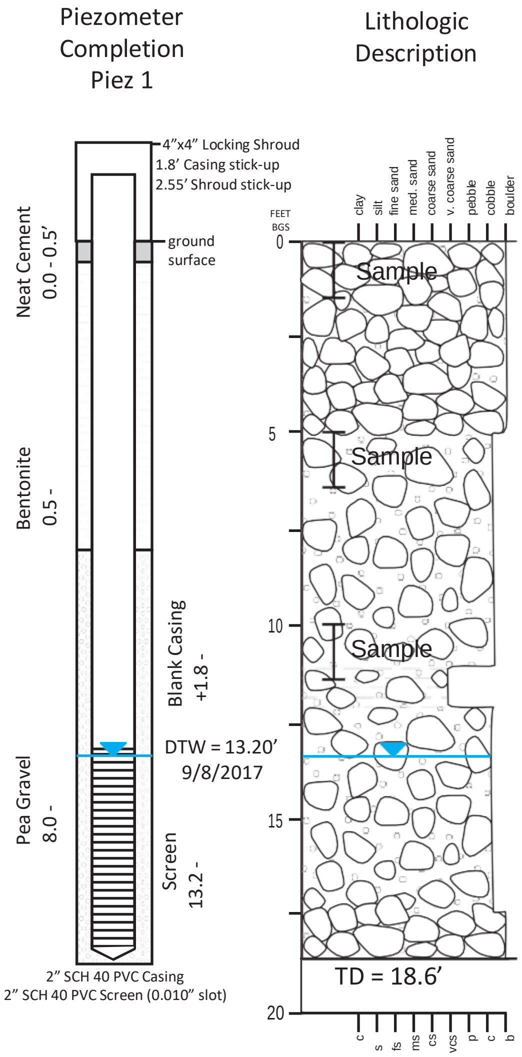


LEGEND

SS - Split Spoon
AC - Auger Cuttings
UD/SL - Undisturbed Sleeve

AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.



0-5.0 ft: Angular course cobble-boulder granite and amphibolite, minor vein quartz, +/- phyllite; 1-1.5 ft split spoon sample 14” recovery, 0-2” darkened soil horizon, brown, silty fine sand, 2-9” oxidized loose sandy angular gravel, 9-14” granite boulder

5.0-11.0 ft: Loose VCS, Angular pebble-cobble-gravel, composition same as above; 5-6.5 ft split spoon 12” recovery, 0-12” granite and amphibolite cobbles, angular pebbles, CS-VCS

11.0-11.5 ft: Angular-subangular pebble-cobble-gravel, composition granite and amphibolite; light brown poorly sorted, slightly clayey MS-VCS; 10-11.5 ft split spoon sample 8” recovery, granite and amphibolite angular-subangular pebble-cobble-gravel, light brown poorly sorted slightly clayey MS-VCS

12.0-15.0 ft: Subrounded-subangular loose sandy pebble-gravel, amphibolite, granite, vein quartz, phyllite. Water at ~13.5 feet

15-17.5 ft: Same as above, poor recovery

17.5-18.6 ft: Amphibolite boulder

Surveyed Location: 460783 mE, 4047592 mN
UTM NAD83 13S

Piez 1 (RG-96901-POD1): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 1 located at Taos Ski Valley, Inc. Logged by Paul Drakos, P.G. on 9/8/2017.

GLORIETA GEOSCIENCE, INC.

GEO-TEST

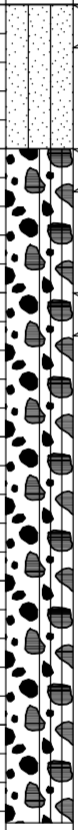
Project: 250,000 Gallon Water Tank
Date: 09/08/2017 Project No: 1-71005
Elevation: Type: Tube Ex

LOG OF TEST BORINGS

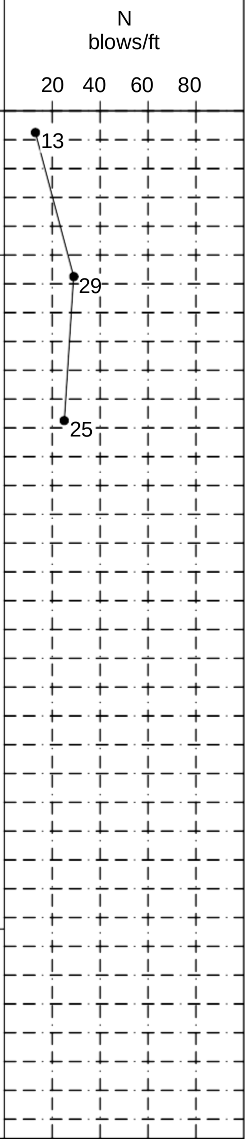
NO: Piez 4

GROUNDWATER DEPTH

During Drilling: 20.6 After 24 Hours:



DEPTH (Ft)	SAMPLE INTERVAL	TYPE	N. BLOWS/FT	MOISTURE %	DRY DENSITY (pcf)	USC	DESCRIPTION
	☒	SS	1-3-10 13	14		SM	SILTY SAND with GRAVEL and COBBLES, non-plastic, medium dense, moist, brown
5	☒	SS	9-14-15 29			GW-GM	WELL GRADED GRAVEL with SILT, SAND, and COBBLES, non-plastic, medium dense, slightly moist to wet, brown
10	☒	SS	9-9-16 25	5			
15							
20							▽
25							
30							Total Depth = 28.4 feet * Note: This boring log was derived in order to show USCS soil classifiactions and SPT counts based on data provided by Glorieta Geoscience. This log does not represent data gathered by Geo-Test, Inc.
35							



LEGEND

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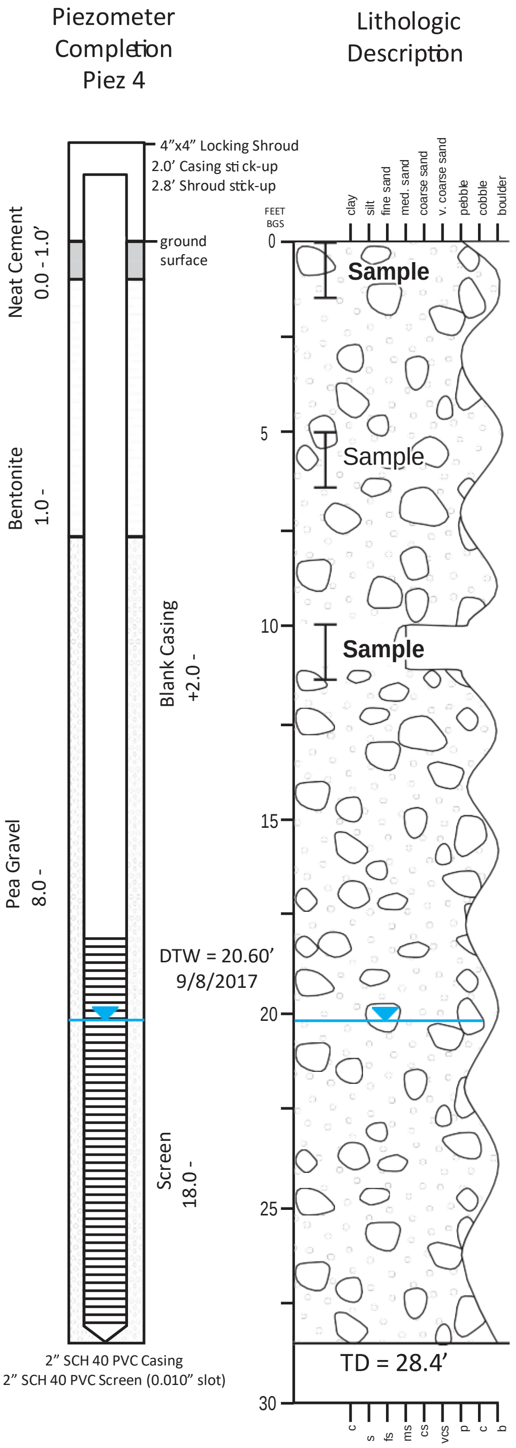
UD/SL - Undisturbed Sleeve
AMSL - Above Mean Sea Level
CS - Continuous Sampler
UD - Undisturbed
ST - Shelby Tube

Stratification lines represent approximate boundaries between soil types. Transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurments were made.



Lithologic Log

0-5.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite-quartz lithic angular to subrounded VCS; 0-1.5 ft split spoon sample 12" recovery, 0-6" brown slightly clayey soil horizon, 6-12" brown, loose sand and angular gravel

5.0-10.0 ft: Same as above, more VCS than above, vein-quartz; 5-6.5 ft split spoon 7" recovery, 0-7" loose angular amphibolite and minor granite gravel

10.0-15.0 ft: Angular-subrounded granite and amphibolite pebble-cobble-gravel, granite-quartz lithic VCS; 10-11.5 ft split spoon sample 9" recovery; 0-7" course, loose granite gravel, 7" - 9" moist, brown, medium course sand

15.0-20.0 ft: Same as above, slightly more rounded

20.0-25.0 ft: Same as above, more amphibolite than granite

25.0-28.4 ft: Same as above

Surveyed Location: 460851 mE, 4047594 mN
UTM NAD83 13S

Piez 4 (RG-96901-POD5): Piezometer Lithology and Completion
Lithologic log and completion schematic of Piez 4 located at Taos Ski Valley, Inc. Logged by Paul Drakos, P.G. and April Jean Tafoya on 9/7 - 9/8/2017.

GLORIETA GEOSCIENCE, INC.

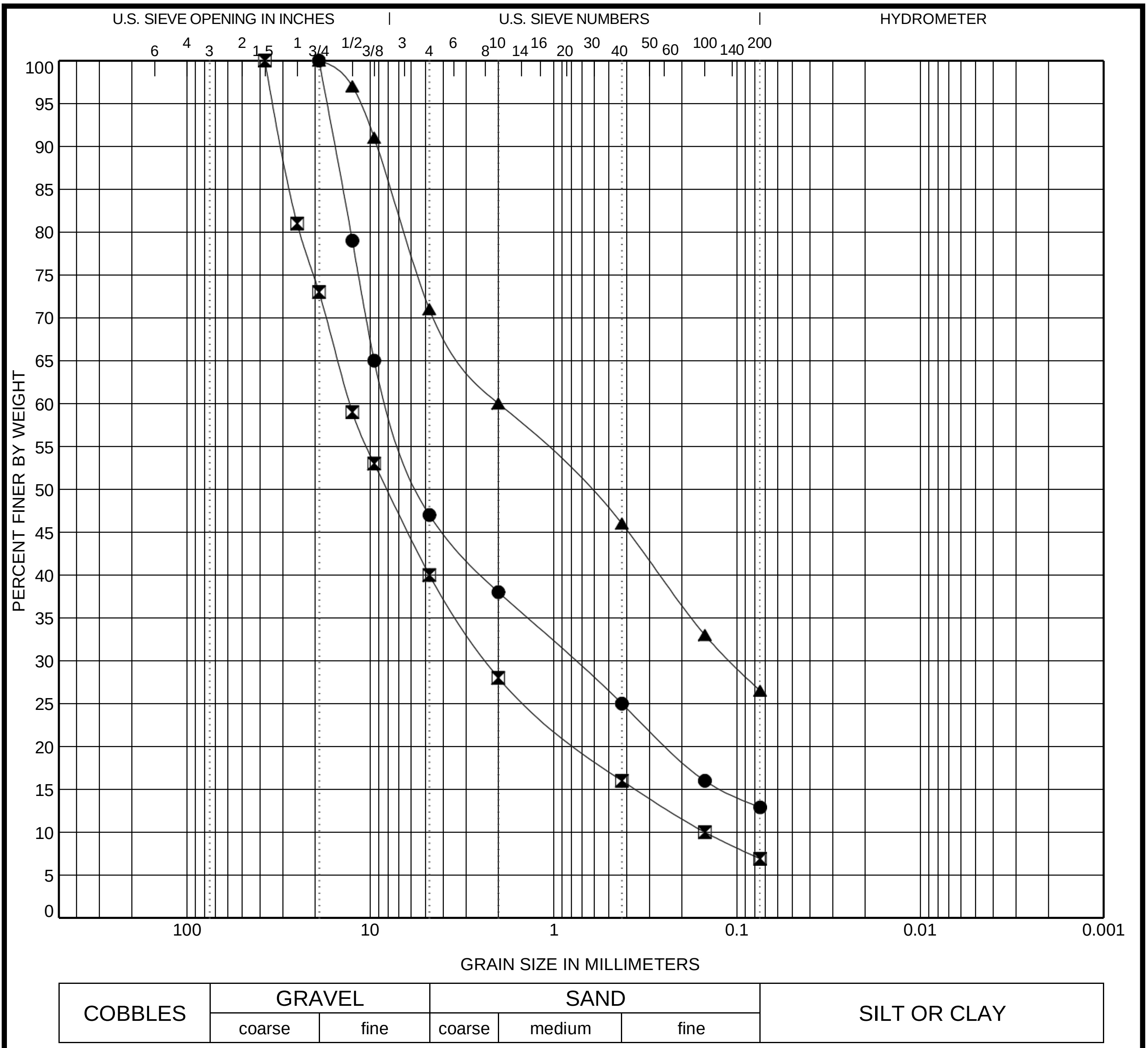
SUMMARY OF LABORATORY RESULTS

						SIEVE ANALYSIS PERCENT PASSING											
TEST HOLE	DEPTH (FEET)	UNIFIED CLASS	(%) MOIST	LL	PI	NO 200	NO 100	NO 40	NO 10	NO 4	3/8"	1/2"	3/4"	1"	1 1/2"	2"	4"
Piez 1	1.0	GM	4.2	NP	NP	13	16	25	38	47	65	79	100				
Piez 1	5.5	GW-GM	3.2	NP	NP	7	10	16	28	40	53	59	73	81	100		
Piez 1	10.5		2.3														
Piez 4	1.0	SM	14.1	NP	NP	27	33	46	60	71	91	97	100				
Piez 4	10.5		4.6														

GEO-TEST

LL = LIQUID LIMIT
PI = PLASTICITY INDEX
NP = NON PLASTIC or NO VALUE

Project: 250,000 Gallon Water Tank
Location: Taos Ski Valley, NM
Number: 1-71005



	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**Piez 1**	**1.0**	**SILTY GRAVEL with SAND(GM)**	**NP**	**NP**	**NP**		
⧗	**Piez 1**	**5.5**	**WELL-GRADED GRAVEL with SILT and SAND(GW-GM)**	**NP**	**NP**	**NP**	**2.76**	**85.86**
▲	**Piez 4**	**1.0**	**SILTY SAND with GRAVEL(SM)**	**NP**	**NP**	**NP**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	Piez 1	**1.0**	**19**	**7.836**	**0.771**		**53.0**	**34.1**	**12.9**	
	Piez 1	**5.5**	**37.5**	**12.879**	**2.31**	**0.15**	**60.0**	**33.1**	**6.9**	
	Piez 4	**1.0**	**19**	**2**	**0.109**		**29.0**	**44.5**	**26.5**	

GEO-TEST

GRAIN SIZE DISTRIBUTION

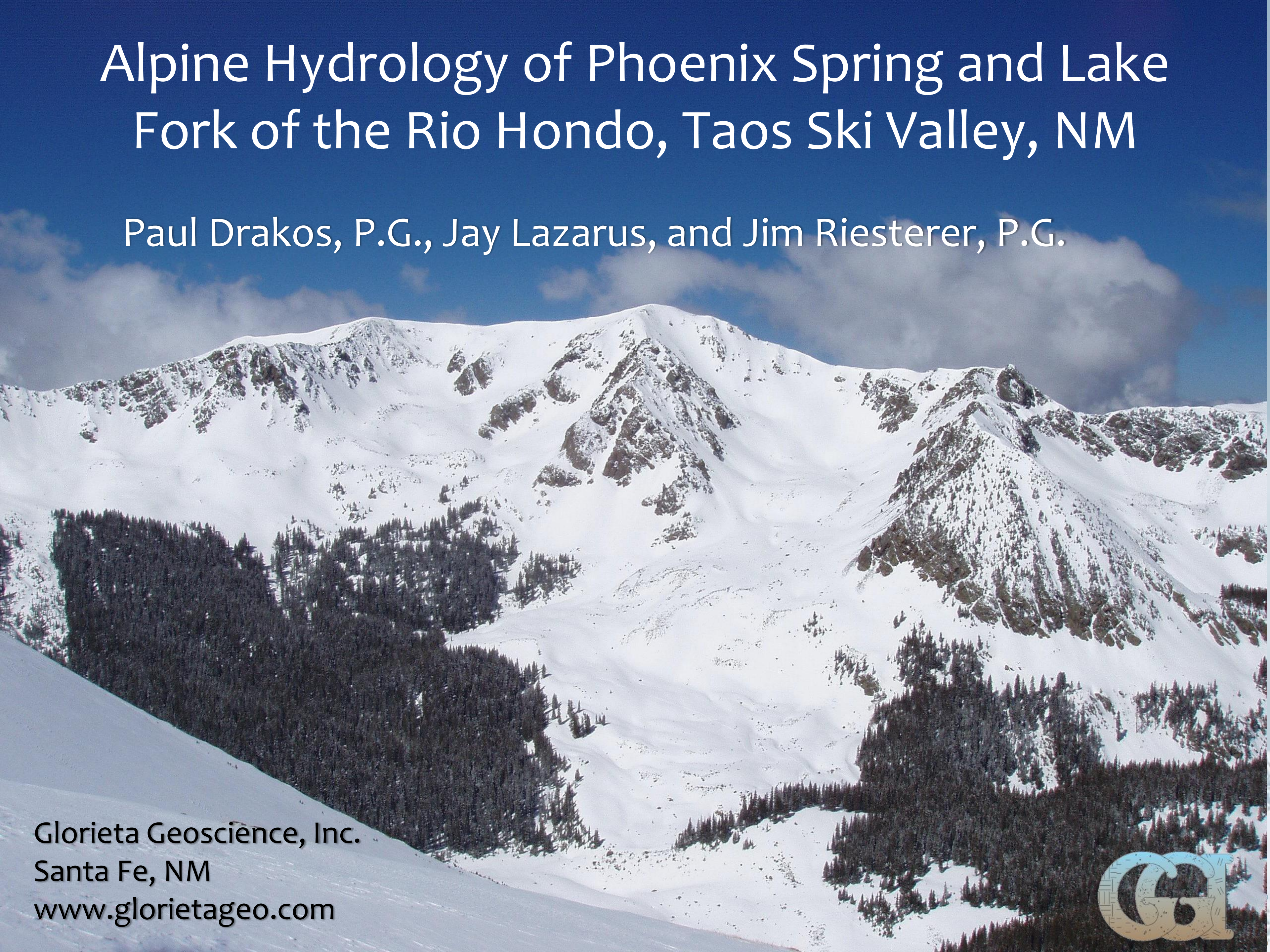
Project: 250,000 Gallon Water Tank

Location: Taos Ski Valley, NM

Number: 1-71005

US GRAIN SIZE 1-71005 250,000 GALLON WATER TANK, TAOS.GPJ GEO TEST.GDT 10/30/17

APPENDIX B. ALPINE HYDROLOGY OF PHOENIX SPRING AND LAKE FORK OF THE RIO HONDO, TAOS SKI VALLEY, NM



Alpine Hydrology of Phoenix Spring and Lake Fork of the Rio Hondo, Taos Ski Valley, NM

Paul Drakos, P.G., Jay Lazarus, and Jim Riesterer, P.G.

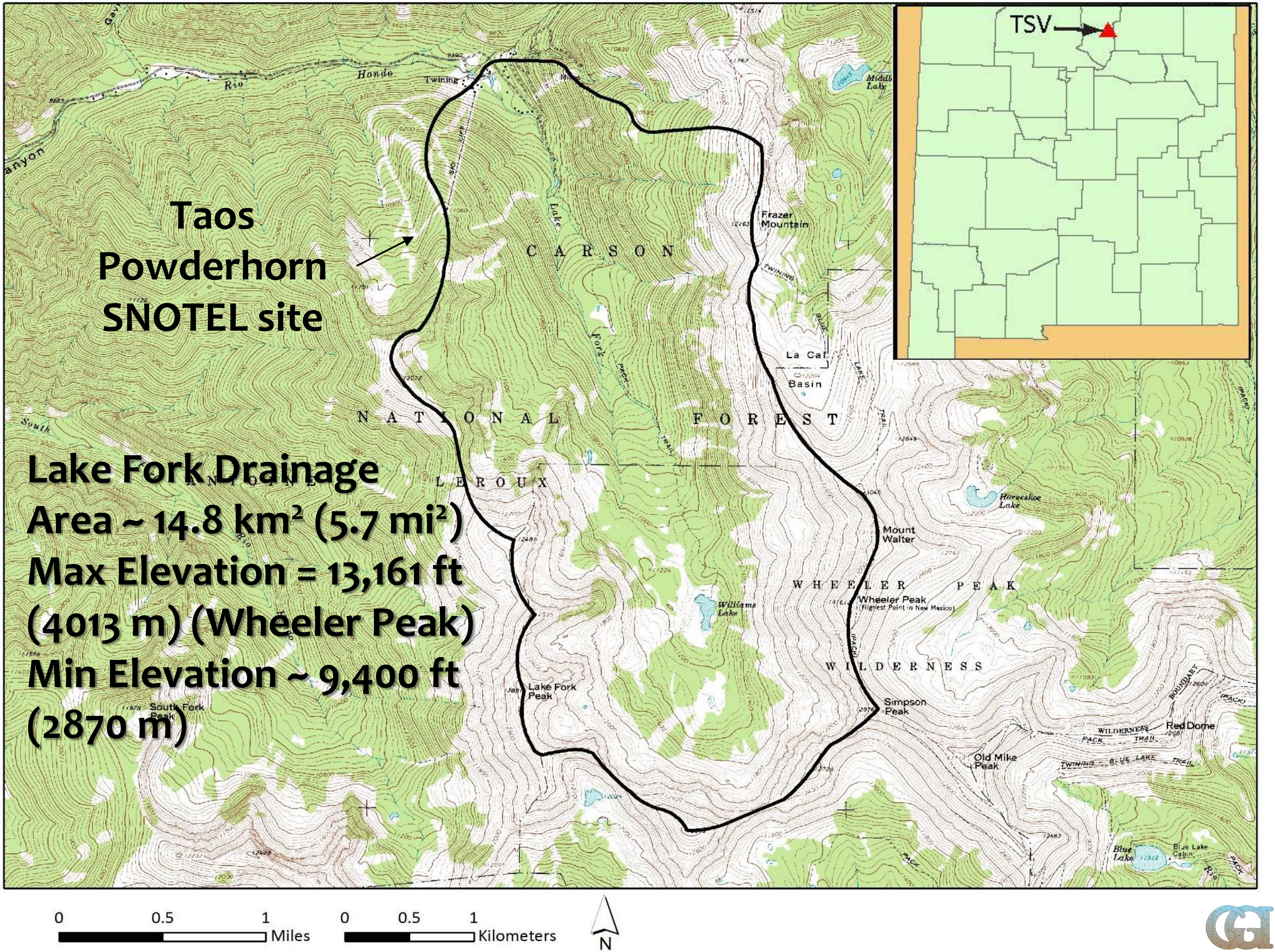
Glorieta Geoscience, Inc.
Santa Fe, NM
www.glorietageo.com

Purpose of Study

- Phoenix Spring is Currently Sole Drinking Water Source for Village of Taos Ski Valley/Taos Ski Area
- Develop a Conceptual Model of the Groundwater and Surface Water hydrology of Lake Fork Basin
- Determine Recharge Sources for Phoenix Spring Complex and Lake Fork of the Rio Hondo
- Collect Stream Flow Data During Low Flow Conditions to Evaluate Storage Needs for Snowmaking for Taos Ski Area
- Provide Hydrogeologic Framework for Source Water Protection

Methodology

- Sample summer (monsoonal) precipitation, winter snowpack for ^{2}H, ^{18}O, ^{3}H (limited subset)
- Install piezometers upgradient of Phoenix Spring
- Collect weekly (summer/fall) to monthly (winter) water level data for two years (September 2017 – September 2019)
- Sample springs, piezometers, Williams Lake for ^{2}H, ^{18}O, ^{3}H (limited subset)
- Conduct stream gaging/seepage runs on Lake Fork and upper Rio Hondo

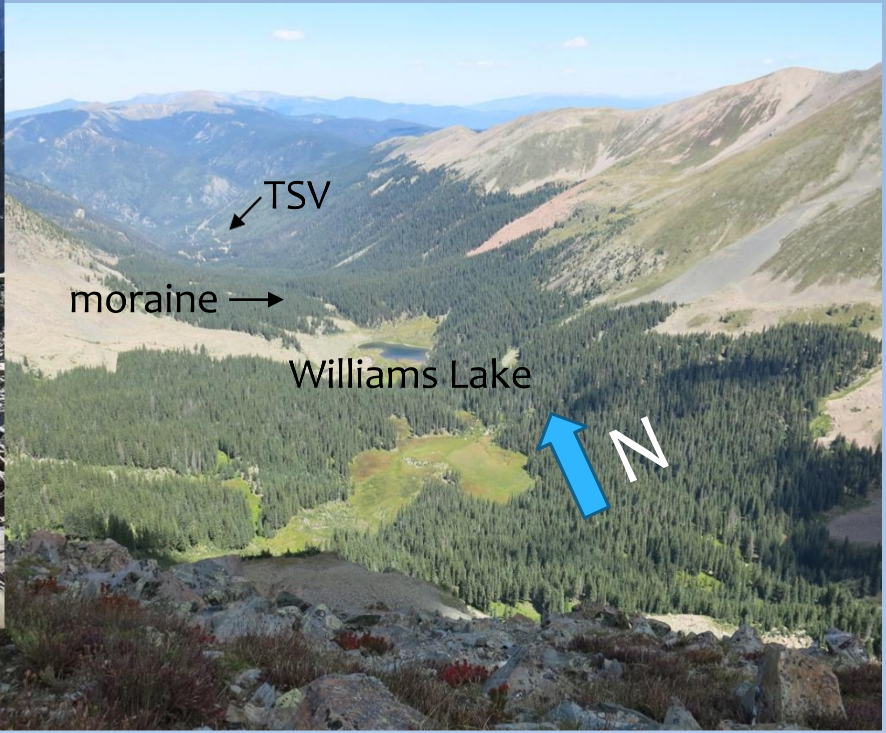


Taos Powderhorn SNOTEL site

Lake Fork Drainage
Area ~ 14.8 km² (5.7 mi²)
Max Elevation = 13,161 ft (4013 m) (Wheeler Peak)
Min Elevation ~ 9,400 ft (2870 m)

Williams Lake Cirque

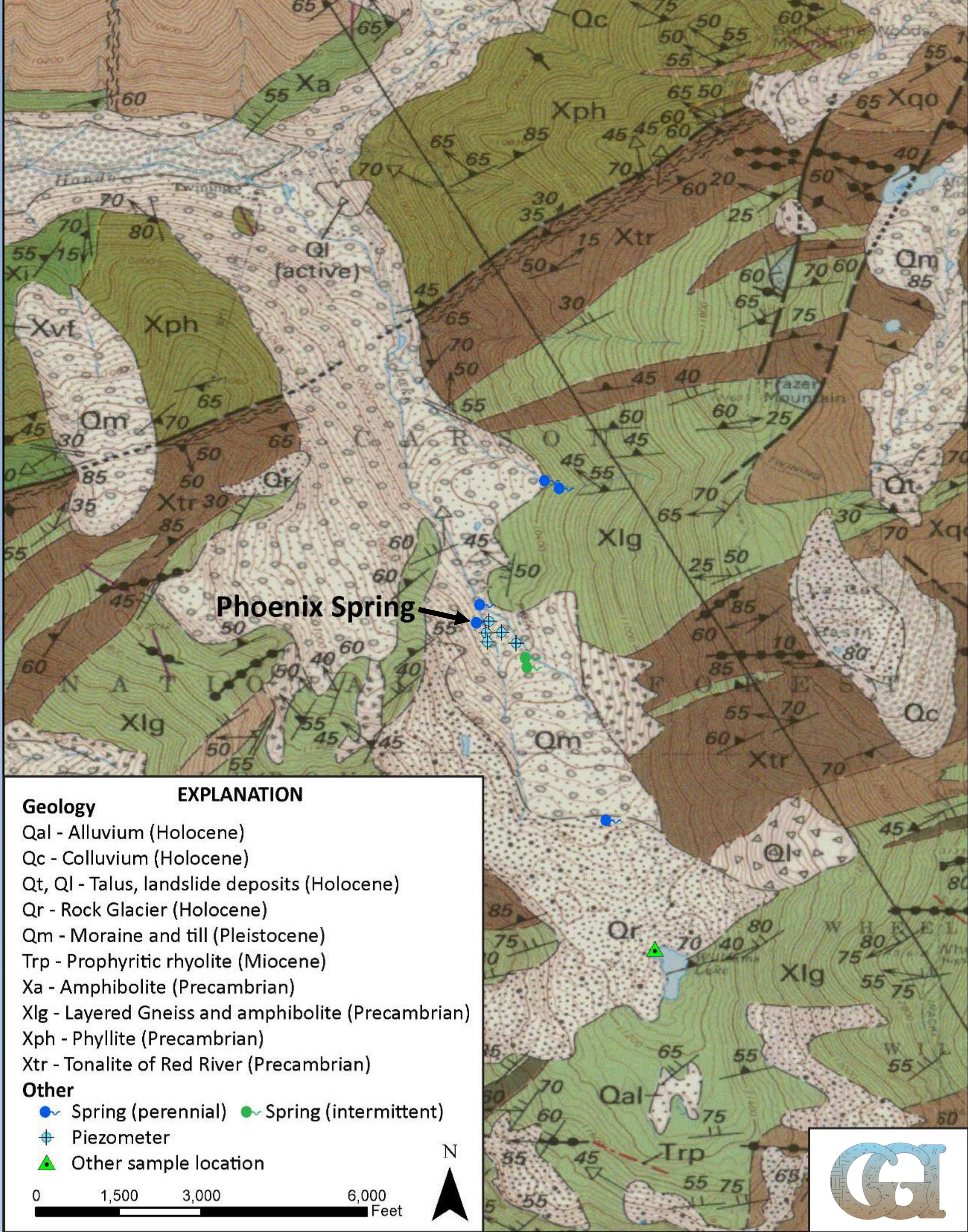
- Dominated by rock glacier, talus deposits and fractured bedrock
- No surface water flow out of cirque



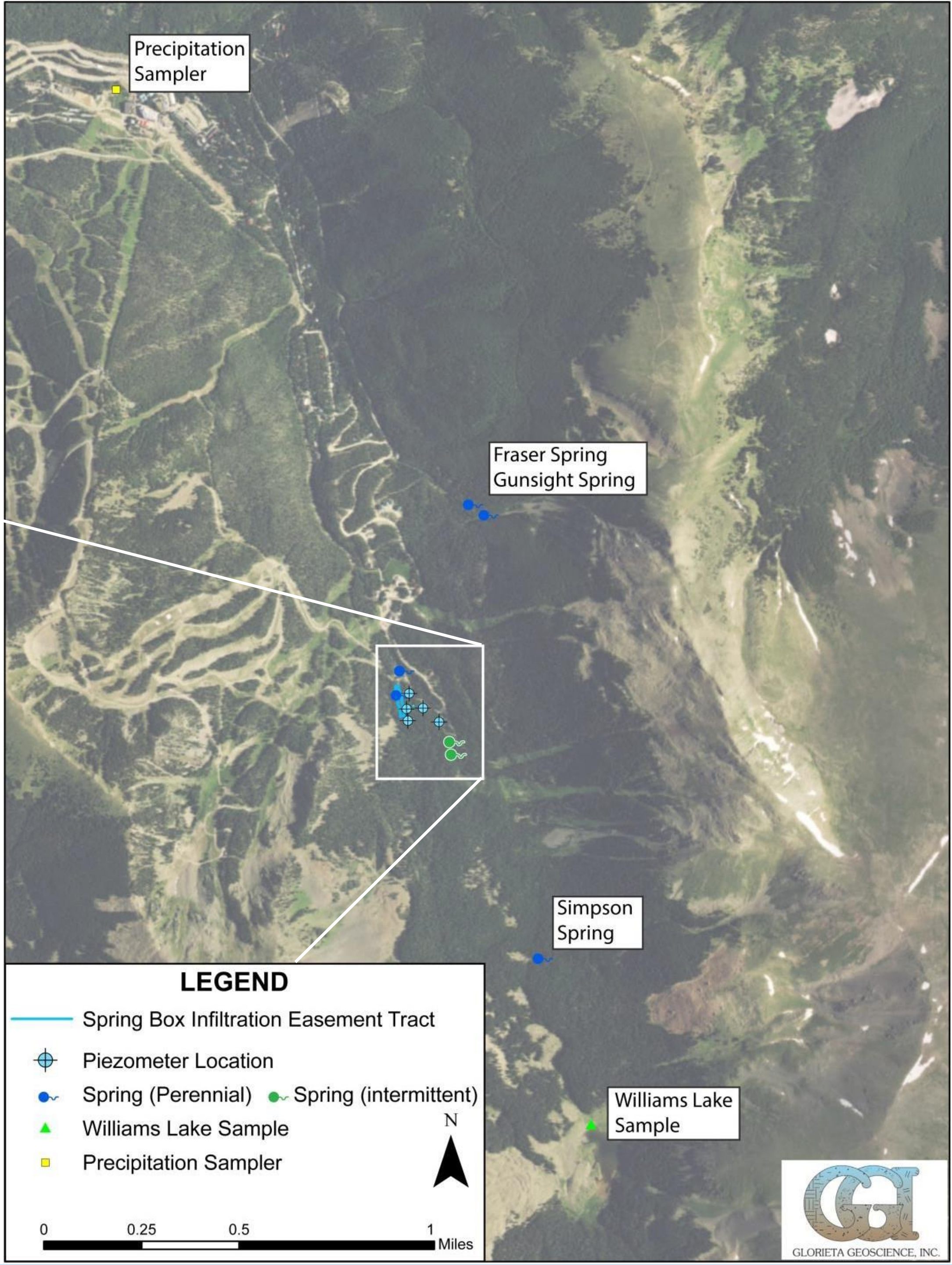
Geologic Setting

- Phoenix Spring discharge controlled by bedrock constriction formed by Precambrian amphibolite and gneiss

Source: Lipman and Reed, 1989

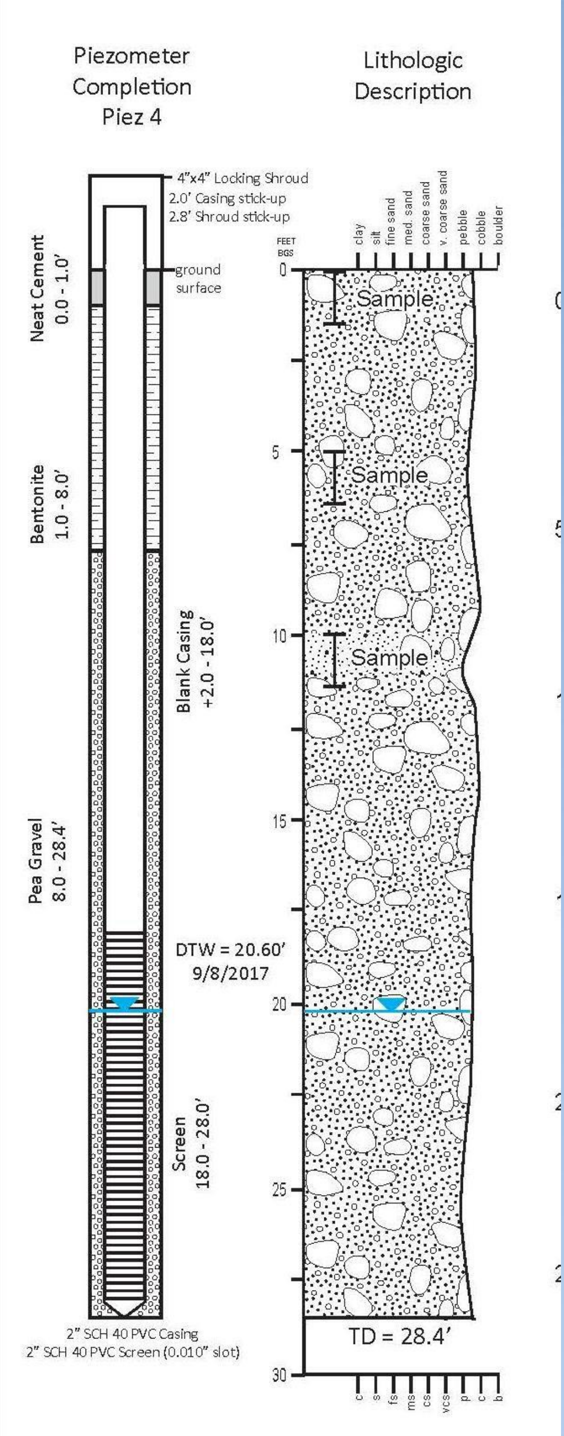


Precipitation sampler, piezometers and spring locations



Drilling Program

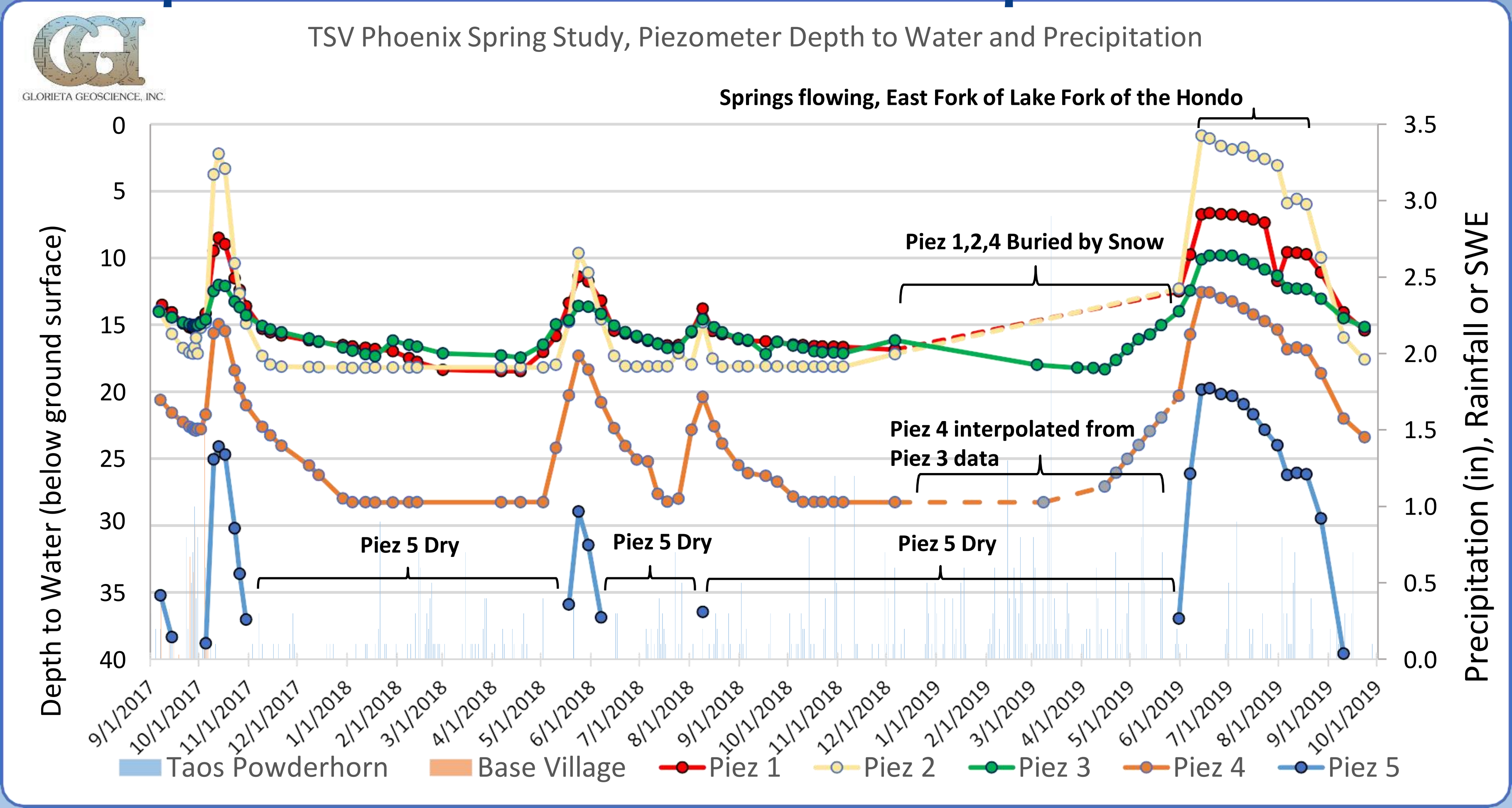
- Five piezometers completed to depths from 18 to 40 ft



Drilling Program

- Piezometers completed into glacial deposits, 5 to 15 ft into unconfined aquifer

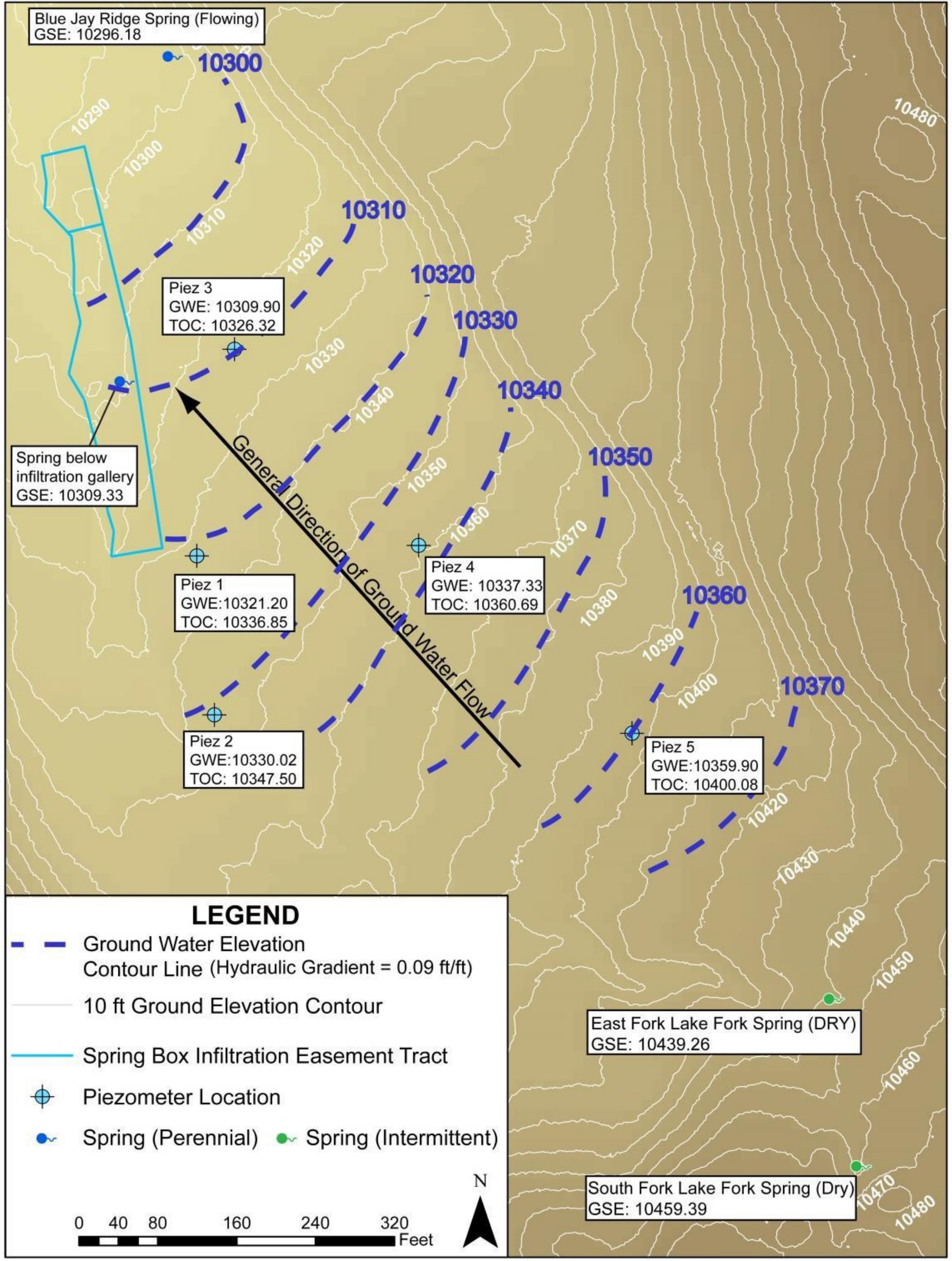
Depth to Water and Precipitation Data



- Approx 2-week lag, late-summer precip and recharge event
- DTW in piezometers upgradient of Spring typically 10-25 ft bgs (late summer/fall)
- Water levels approach “static” conditions during winter

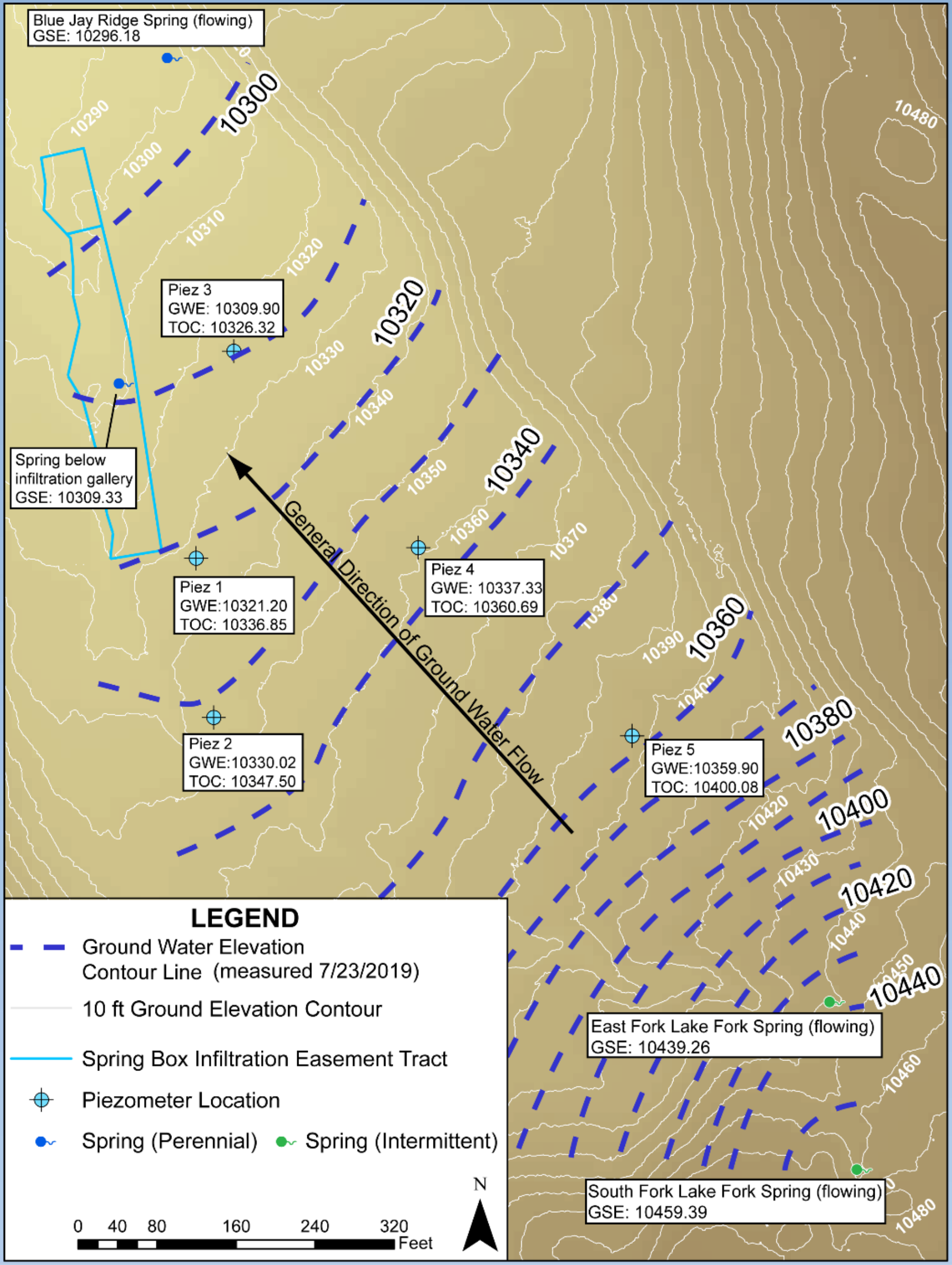
Potentiometric surface map (9/14/2017)

- Intermittent springs not flowing
- GW flow direction NW, 0.09 ft/ft



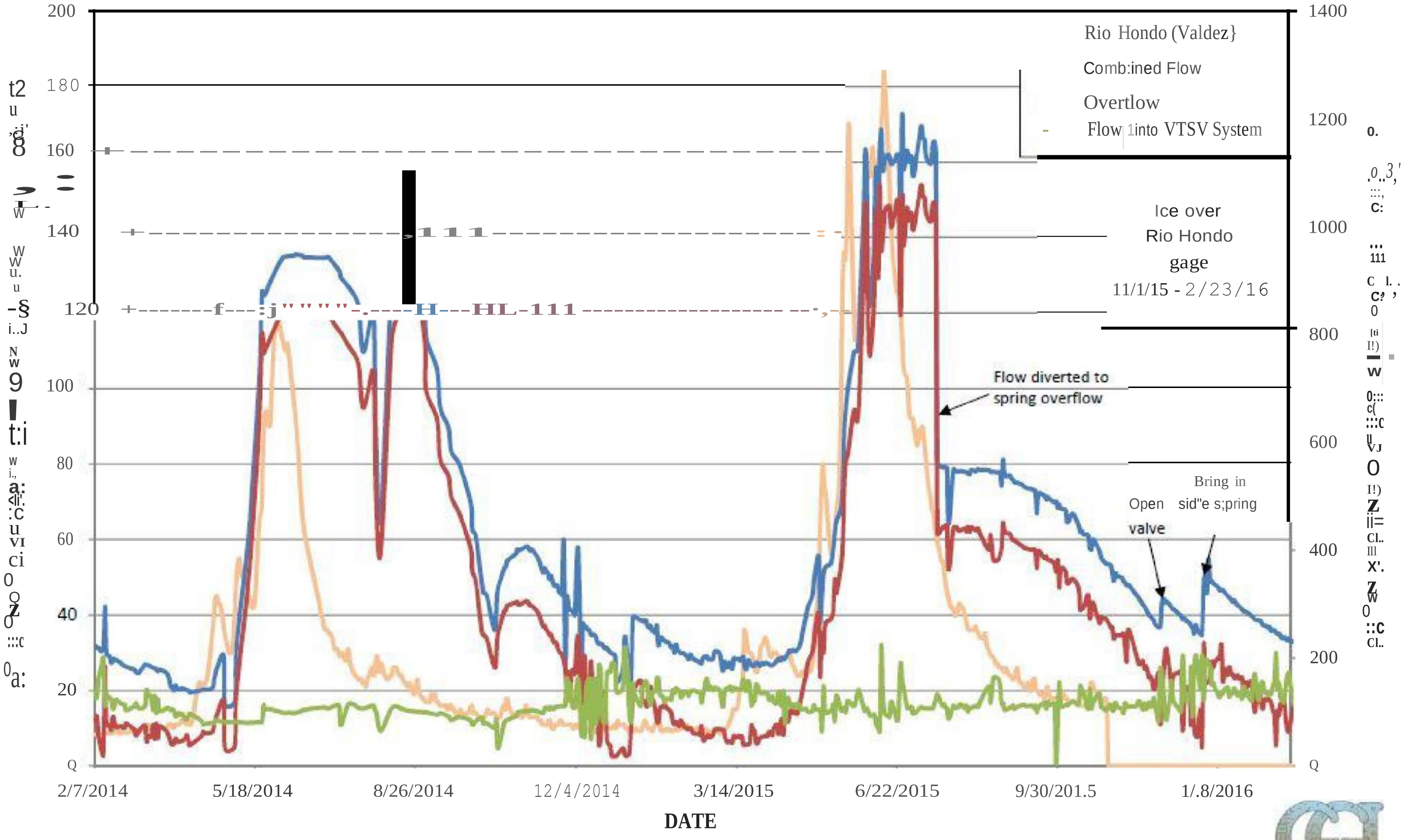
Potentiometric surface map (7/23/2019)

- Intermittent springs flowing
- GW flow direction NW, 0.12 ft/ft



Annual Variation in Phoenix Spring Flow

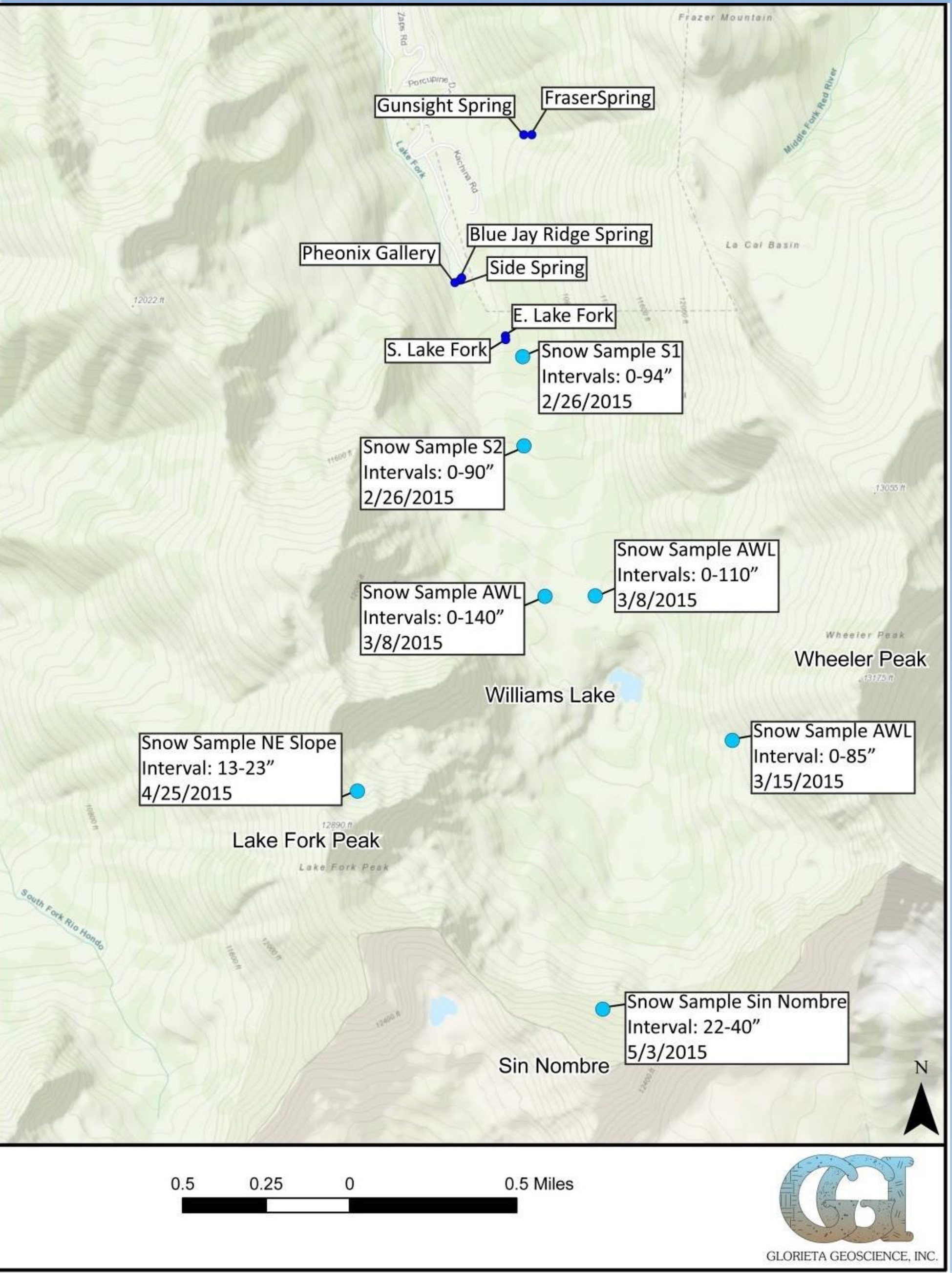
Figure 3. Total Discharge from Phoenix Spring (GPM) and Rio Hondo near Valdez (USGS SITE 08267500, CFS)1



Precipitation and Snow Sampling

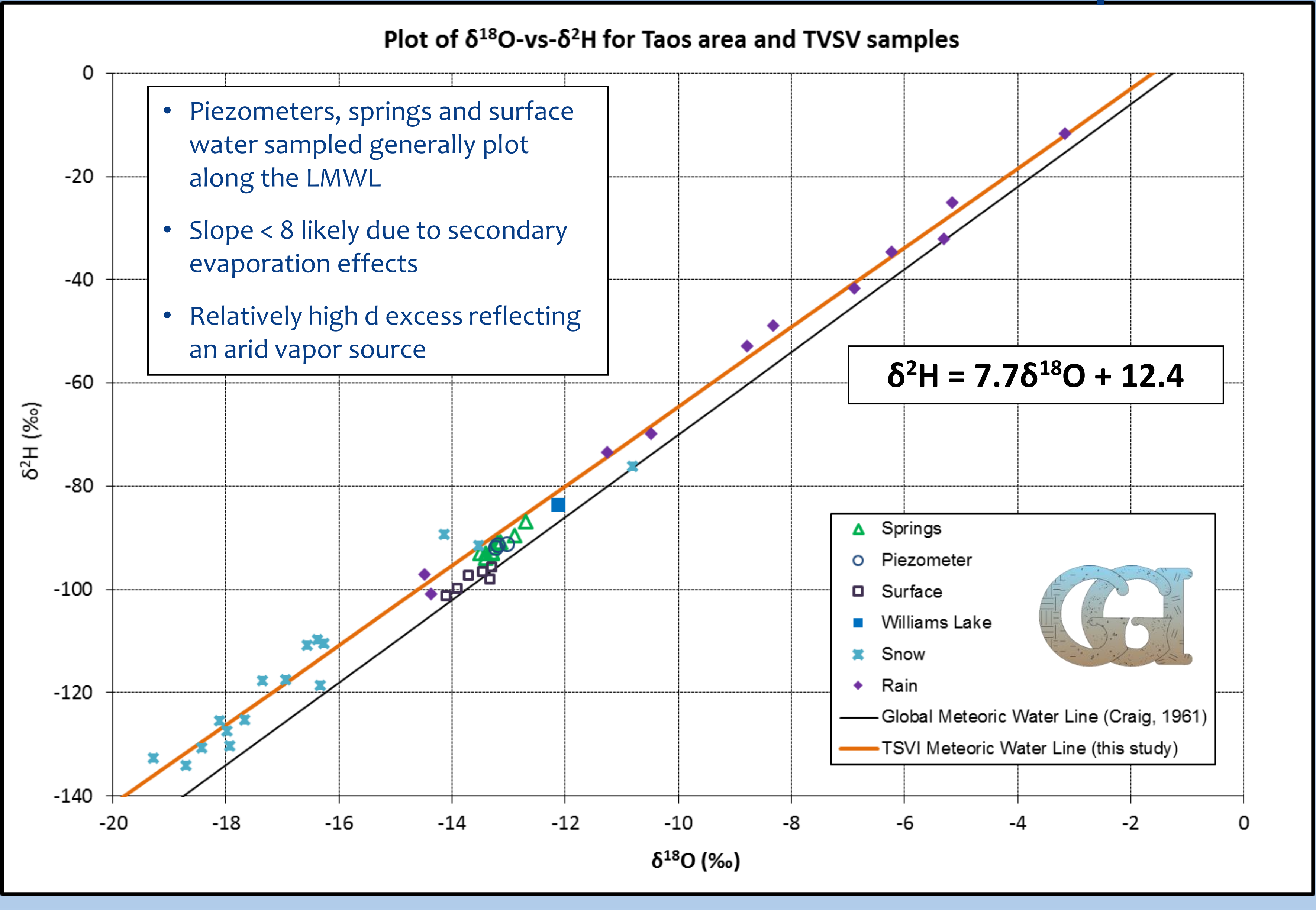
- Precipitation samples collected 7/27/2017 - 10/6/2017
- Snowpack samples collected 2/2/2015 - 5/3/2015


Distribution of Snow Samples



- Snowpack samples from upper Lake Fork and Cirque
- Discrete layers, multiple intervals from most locations

TSV & Taos Area Stable Isotopes



Plot of $\delta^{18}O$-vs-$\delta^{2}H$ for Taos area and TVSV samples

- Piezometers, springs and surface water sampled generally plot along the LMWL
- Slope < 8 likely due to secondary evaporation effects
- Relatively high d excess reflecting an arid vapor source

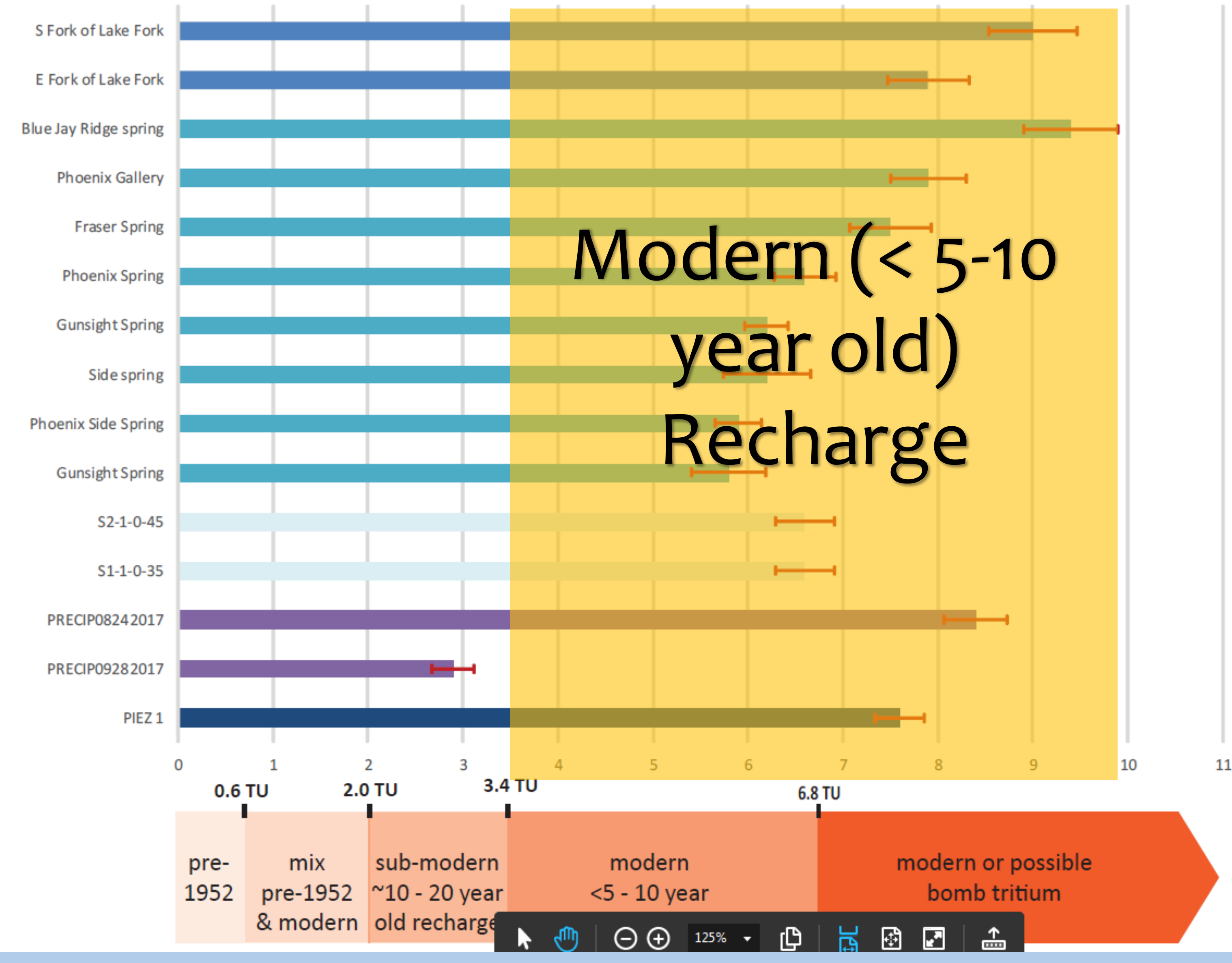
$$\delta^{2}H = 7.7\delta^{18}O + 12.4$$

EMMA: End Member Mixing Analysis Preliminary Results

O^{18}		H^2	
Average Rain	45%	Average Rain	41%
Average Snow	55%	Average Snow	59%

- Two component (1) precipitation as rain, (2) precipitation as snow
- Average of four sampling time periods (February, June, October, November)
- This study Indicates winter precipitation contributes ~55-60% groundwater recharge (possibly skewed by 2017 monsoonal event)
- Tolley et al. (2015) estimate 68% - 88% of groundwater recharge due to winter precipitation

Tritium Data



Modern (< 5-10 year old) Recharge

pre-1952

mix pre-1952 & modern

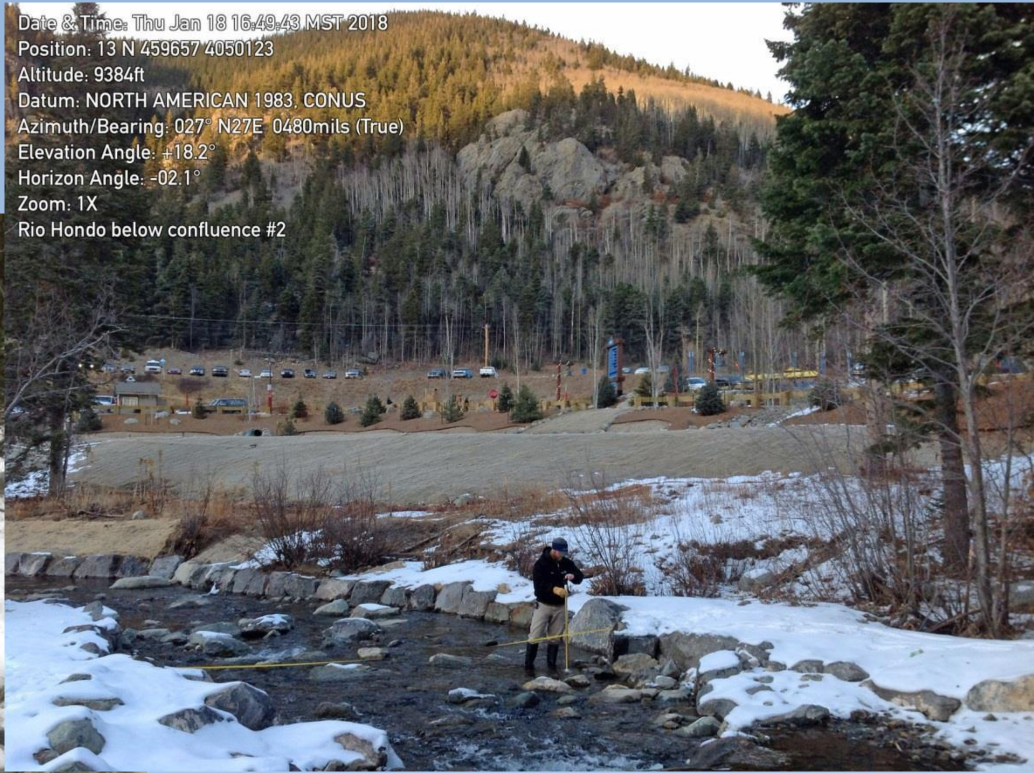
sub-modern ~10 - 20 year old recharge

modern <5 - 10 year

modern or possible bomb tritium

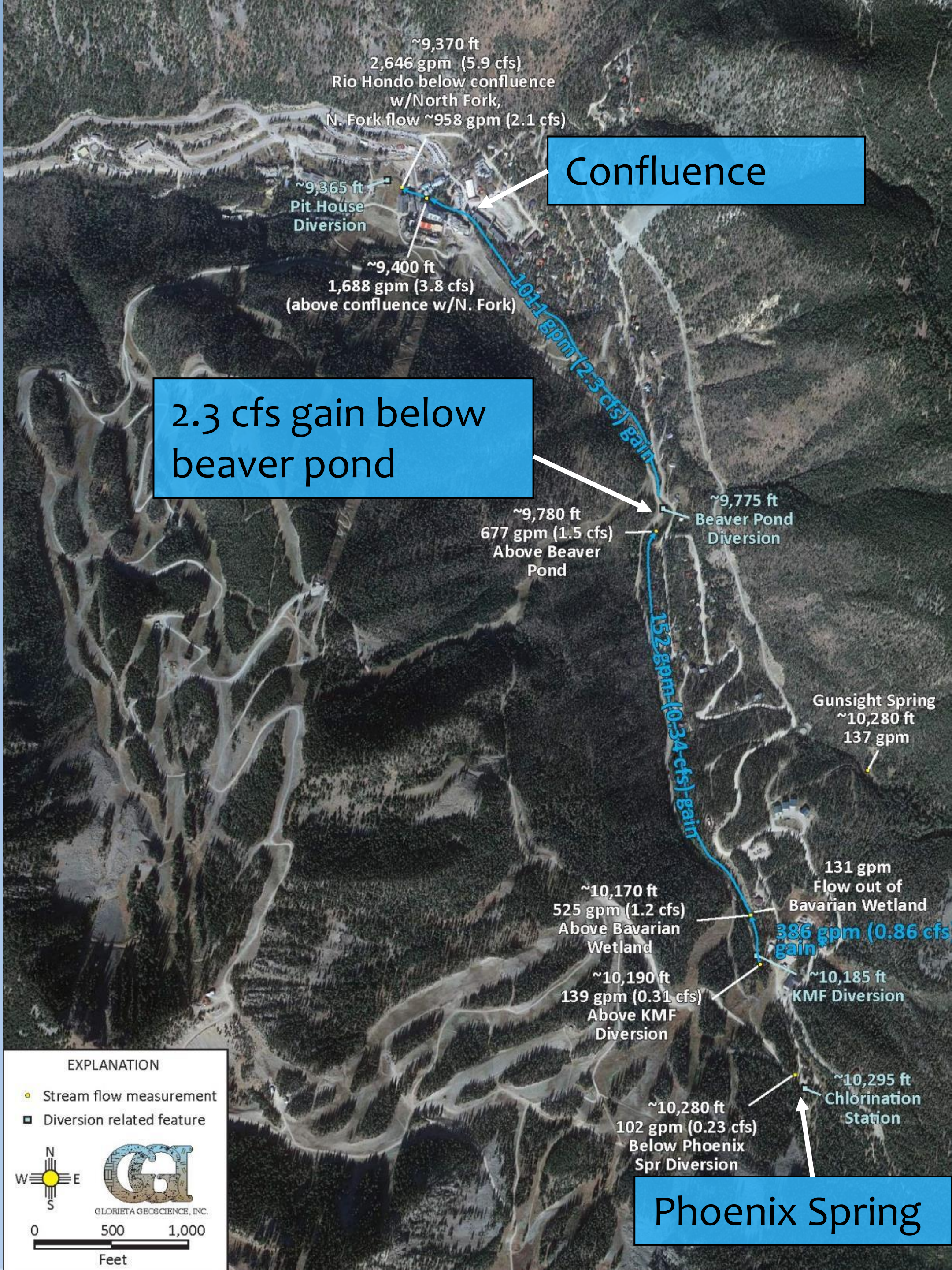
Stream Gaging

- Conduct seepage runs from Lk Fork to upper Rio Hondo
- Weekly flow measurements January-early February, October-December, 2018
- Low Flow conditions

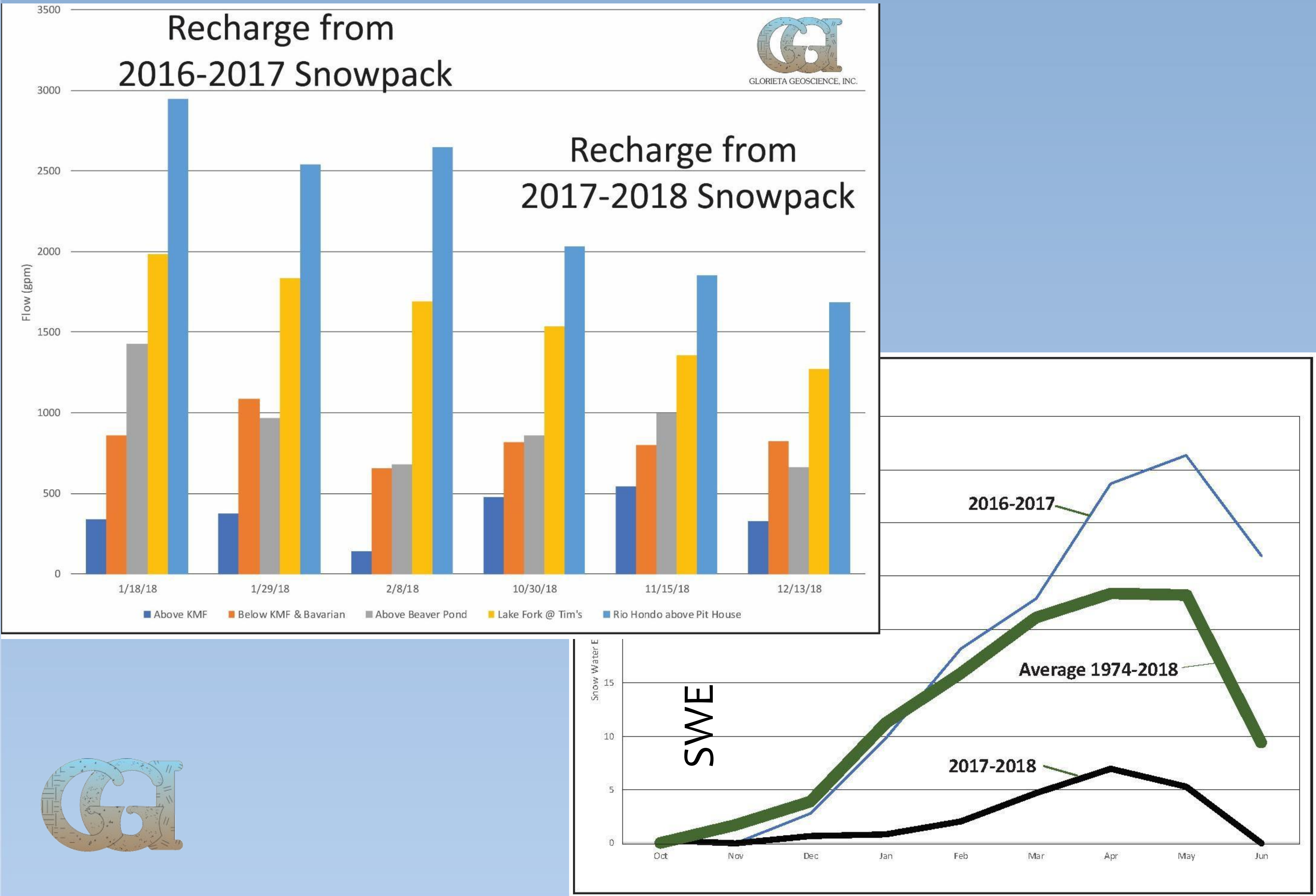


Stream Flow Measurements 2-8-2018

- Lk Fork gains 3.5 cfs in 2.3 km between Phoenix Spring and confluence
- Most of gain (2.3 cfs) is along lower ~3600 ft (1.1 km) of stream
- Spring discharge important source



Stream Flow - ~1 Year Lag from Winter Precipitation



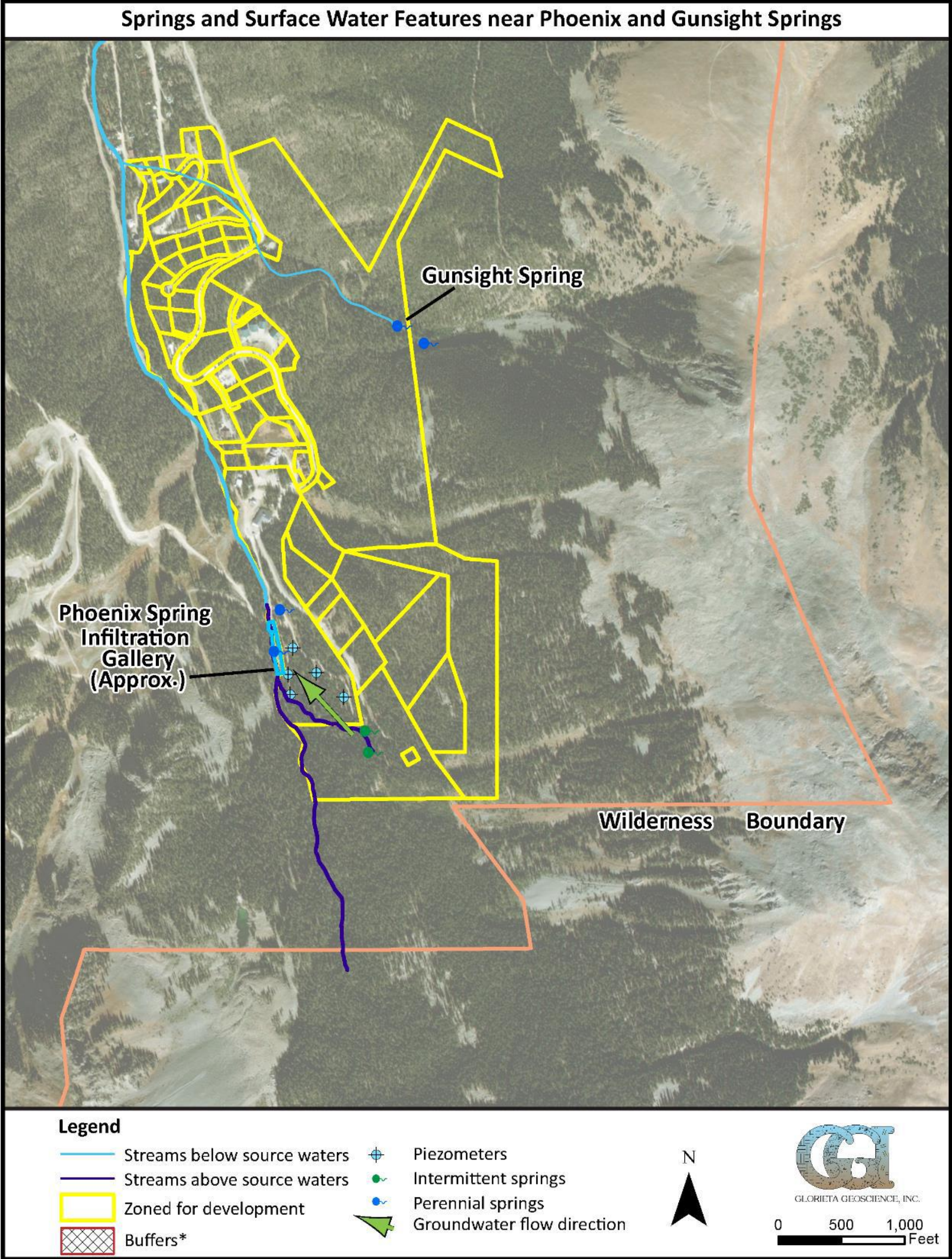
Understanding of Stream Flow Dynamics and Controls on Recharge May be Used to Guide Snowmaking Strategies and Stream Restoration Projects

Snowmaking Strategies and Stream Flow

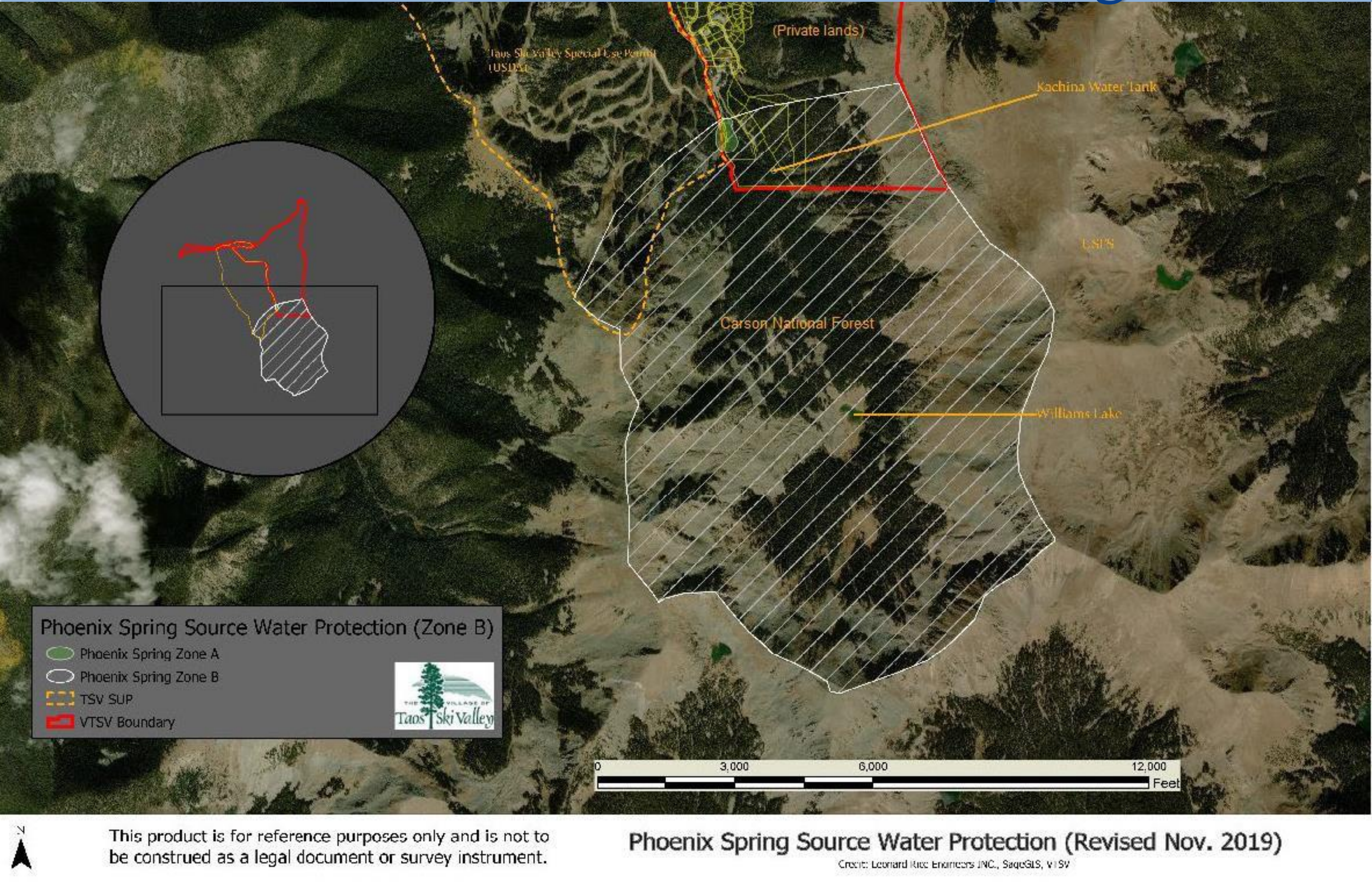
- November-February flow in the Lake Fork and Rio Hondo are controlled primarily by the previous year’s snow pack
- Monsoonal precipitation likely of secondary importance
- The total gain in flow from above the KMF diversion to the Rio Hondo above the Pit House diversion during low flow conditions is approximately 2.9 cfs
- Data used to develop model for sizing storage to balance snowmaking needs with maintaining in-stream flows for fish habitat

Conceptual hydrologic model for SWPP development

- Modern recharge to Phoenix Spring
- Gunsight Spring important second water source for Village



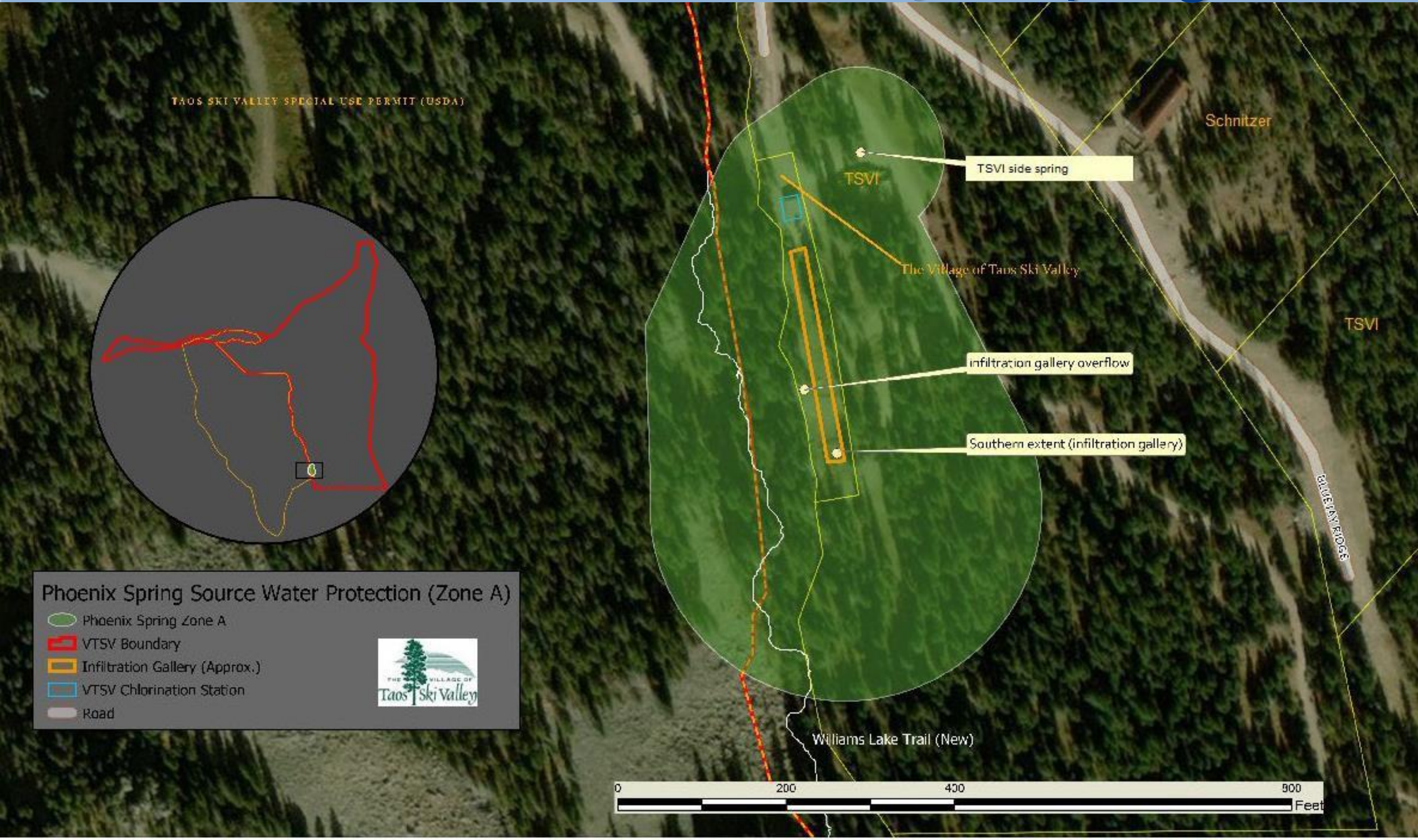
SWP Zones for Phoenix Spring
Zone B is Watershed Above Spring



Phoenix Spring Source Water Protection (Revised Nov. 2019)

Credit: Leonard Rice Engineers INC., SageGIS, VTSV

SWP Zones for Phoenix Spring
Zone A is Immediate Vicinity of Spring



This product is for reference purposes only and is not to be construed as a legal document or survey instrument.

Phoenix Spring Source Water Protection (Revised Nov. 2019)

Credit: Leonard Rice Engineers INC., SageGIS, VTSV

BMPs for Zones A and B Include:

- Fire Management/Forest Thinning
- No Septic Systems
- No USTs
- Construction Practices to Minimize Runoff from Trails
- Human Waste Management in Wilderness Area
- Ski Area, Village, Acequia Association, Taos Pueblo, Amigos Bravos and other Stakeholders participated

Conclusions

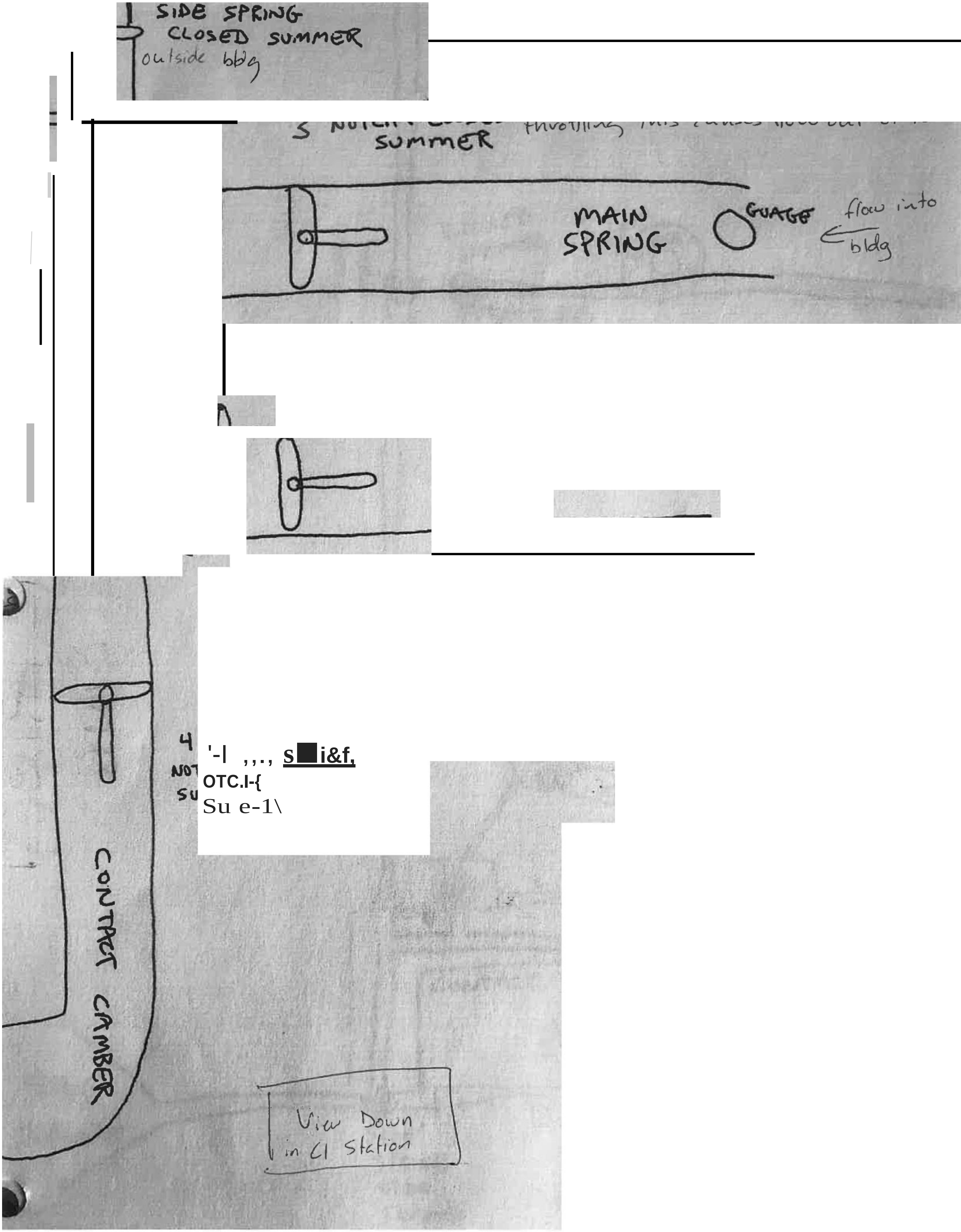
- Phoenix spring discharges at bedrock constriction, which reduces cross sectional area of aquifer in glacial deposits
- Winter precipitation contributes ~55-88% of recharge to springs
- Shallow groundwater is recharged by monsoonal precipitation with an approximate two-week lag time
- Phoenix and other springs in the area show modern recharge
- Lake Fork gains ~ 3 cfs from Phoenix Spring to Confluence during low flow conditions (~7500 ft or 2.3 km)
- Nov-Feb flows in the Lake Fork and Rio Hondo are controlled primarily by the previous year's snow pack
- Study informed SWPP development and allowed development of model for sizing storage to balance snowmaking needs with maintaining in-stream flows for fish habitat

Acknowledgements

- Taos Ski Valley, Inc.
- Village of Taos Ski Valley

APPENDIX C. SCHEMATIC OF SPRING COLLECTION SYSTEM

Provided by VTSV staff, originally drawn by previous system operator


SIDE SPRING
CLOSED SUMMER
outside bldg
5
throttling
SUMMER
MAIN
SPRING
GUAGE
flow into
bldg
4
'-l ,,., s i&f,
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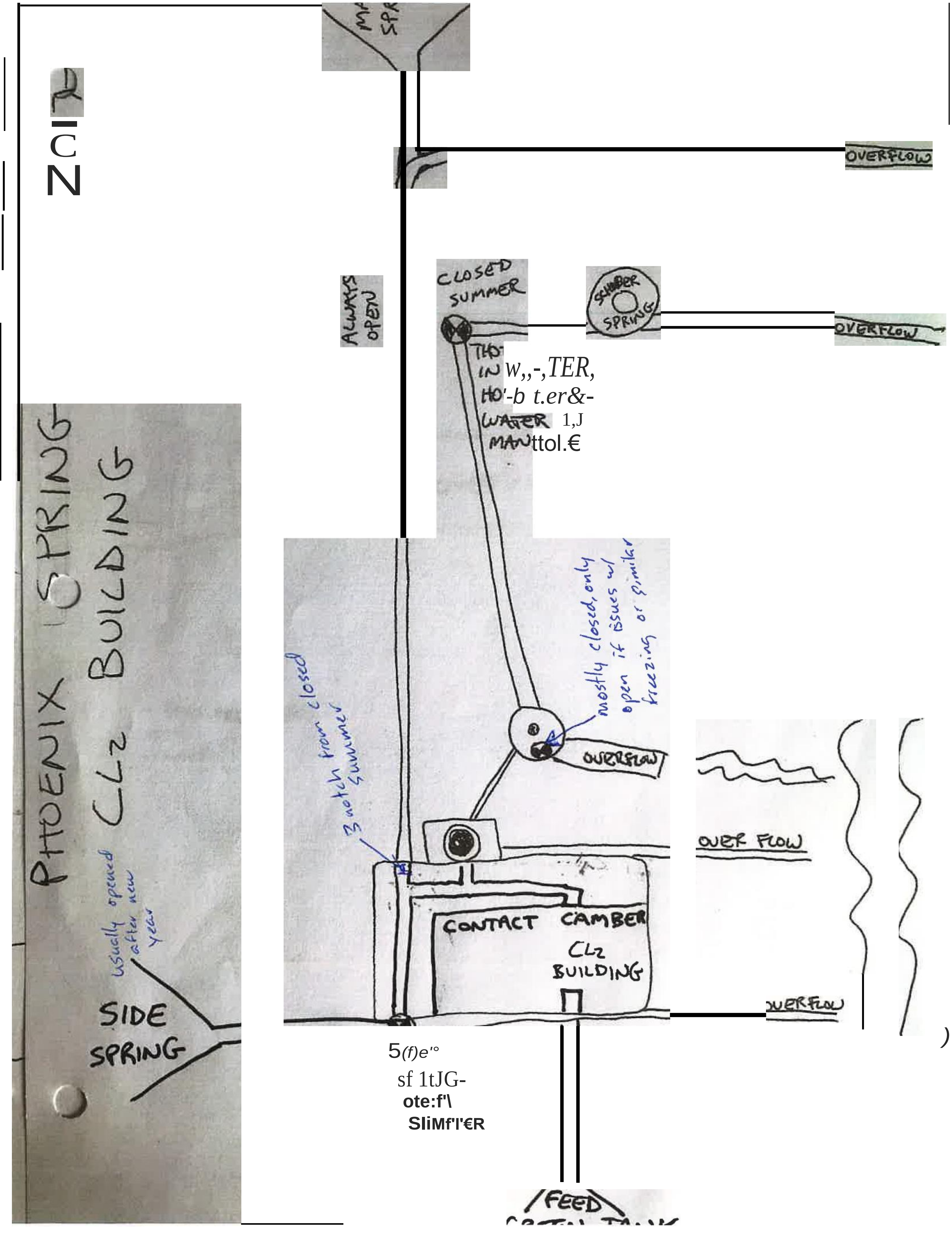
CONTACT CAMBER
View Down
in C1 Station


MA
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CLOSED SUMMER
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MANttol.€
PHOENIX SPRING
CL2 BUILDING
mostly closed, only open if issues w/ freezing or similar
3 notch from closed Summer
OVERFLOW
OVER FLOW
CONTACT CAMBER
CL2 BUILDING
OVERFLOW
usually opened after new year
SIDE SPRING
5(f)e'°
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SliMf'l'€R
FEED

APPENDIX D. GGI Summary of NMBGMR Public Comment Draft entitled "Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources"

Prepared by Jay Lazarus and Paul Drakos

GLORIETA GEOSCIENCE, INC.
P.O. Box 5727 Santa Fe, NM 87502
(505) 983-5446 Fax (505) 983-6482
E-mail: ggi@glorietageo.com
Web Address: www.glorietageo.com

Memo to: Peter Talty, Taos Ski Valley, Inc.
From: Jay Lazarus, Paul Drakos, P.G., GGI
Date: October 25, 2021
Re: Review of Public Comment Draft of “Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources” prepared by the New Mexico Bureau of Geology and Mineral Resources

INTRODUCTION

As requested by Mr. Peter Talty of Taos Ski Valley, Inc. (TSVI), Glorieta Geoscience, Inc. (GGI) has reviewed the Public Comment Draft of “Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources” prepared by the New Mexico Bureau of Geology and Mineral Resources on September 16, 2021. Our review focused on the impact of Climate Change in mountainous regions of New Mexico and specifically how climate change can impact water availability for snow-making and municipal purposes in the Lake Fork and Rio Hondo watersheds. The Draft Report is a comprehensive research document that predicts increasing temperatures and decreasing snowpack in mountainous regions of New Mexico. It is our opinion that the conclusions presented in the report do not compel TSVI to submit Public Comments as the data and conclusions are based on widely accepted scientific research, and other than reducing greenhouse gas emissions, the authors do not make specific recommendations for actions to be taken. The Draft Report is pretty much a compendium of climate research conducted to date in New Mexico with predictions of how climate change will affect specific ecosystems throughout the State.

We present key findings from the Draft Report followed by our conclusions and recommendations. GGI’s conclusions and recommendations in this memo look at the next 50 years of TSVI’s operations with the Draft Report’s predictive climate change scenarios occurring. Additionally, since high-altitude snow pack and precipitation control recharge to the Phoenix Spring complex, TSVI anticipates climate change-related questions from the Village of Taos Ski Valley (Village) as part of the Village’s analysis of TSVI’s Water Master Plan and this memo provides some strategies for collaboration with the Village on climate change.

KEY FINDINGS

Greenhouse gas emissions

All evidence suggests that the average temperature for all parts of New Mexico will increase over the next 50 years. Models indicate that the amount of temperature increase will depend on the amount of greenhouse gasses added to the atmosphere in the future. In a higher- side greenhouse gas emission scenario, the average projected temperature increase across the state is a staggeringly high 7°F over the 70-year period between 2000 and 2070. In lower emission scenarios, temperature will continue to climb at a rate closer to what has been observed during the past 30 years, leading to a lower, but still significant average temperature increases of about 5ºF. In all currently envisioned cases, temperatures state-wide and around all of the southwestern US will rise significantly. A 5ºF temperature increase will have a significant effect on TSVI's snow-making, especially in dry or "late" snow years.

Impacts of Increasing Temperature

- Changes in snowpack elevations and snow water equivalent (SWE)
- Changes in available water volumes and timing of water availability
- Increasing precipitation in the form of rain rather than snow due to increasing temperatures
- Smaller spring runoff volumes and/or earlier runoff that will impact water availability for irrigation and for ecological and species needs
- Milder winters and hotter summers, resulting in longer growing seasons and increased plant and human water use
- Increased evaporative losses from reservoirs, streams, and soils due to hotter, drier conditions
- Increased evapotranspiration by agricultural and riparian plants
- An increase in extreme events, including both droughts and floods

Snow and Snowmelt Runoff

Snowpack at high elevations is projected to decline very substantially by 2070 across the southwestern U.S. (USGCRP, 2017; Mote et al., 2018), continuing a long-term decrease in snowpack that has been observed (including in the Rio Grande headwaters by Chavarria and Gutzler, 2018) over the past half-century. The projected decrease in snowpack occurs as the result of warmer temperature, despite possible increases in total winter precipitation, as estimated for the Rio Grande headwaters. Projections indicate large declines in snowpack in the western United States and shifts to more precipitation falling as rain than snow in the cold season in many parts of the central and eastern United States.

Long-term changes in the snowmelt and snow-water equivalent (SWE) from snow monitoring stations in western North America were researched and 34% of stations exhibit increasing winter snowmelt trends and SWE declines. Snowmelt trends are highly sensitive to temperature and an underlying warming signal, whereas SWE trends are more sensitive to precipitation variability. Thus, continental-scale snow water resources are in steeper decline than inferred from SWE trends alone. More winter snowmelt will complicate future water resource planning and management (Musselman, et al, 2021)

Mountainous regions of New Mexico will be particularly impacted by a warming climate, and these impacts will cause downstream effects in other regions of the state. The atmospheric temperature in mountainous regions will rise over the next 50 years at a rate similar to the rest of the state. The highest elevations are very likely to experience sharp declines in snowpack, which will melt earlier and generate less snowmelt runoff. Higher temperatures will lead to higher levels of evapotranspiration across the state, but the relative increase in evapotranspiration rates over the next 50 years will be higher in New Mexico's mountainous regions. Less snowmelt and higher evapotranspiration lead to proportionally less water available to recharge aquifers and support plant growth

There has been a trend toward earlier snowmelt and a decrease in snowstorm frequency on the southern margins of climatologically snowy areas. Winter storm tracks have shifted northward since 1950 over the Northern Hemisphere. Northern Hemisphere spring snow cover extent, North America maximum snow depth, snow water equivalent in the western United States, and extreme snowfall years in the southern and western United States have all declined, while extreme snowfall years in parts of the northern United States have increased. The effect of windblown dust is also a concern, as dust production associated with lower soil moisture content becomes more prevalent. The primary hydrologic impact of dust-on-snow is an increased rate of snowmelt associated with more extreme dust deposition, producing earlier peak streamflow rates on the order of 1–3 weeks. Snowmelt runoff has been occurring earlier as average spring temperatures rise. The effect of earlier snowmelt has already been evidenced as acequias are cleaning their ditches earlier each spring in anticipation of earlier snowmelt.

Snowpack has been declining over the past several decades in association with warming temperatures and increases in dust blowing onto snow (Livneh, el al, 2015), promoting earlier snowmelt. When snowpack becomes dust-covered, the snow's ability to reflect solar radiation decreases, causing more solar radiation to be absorbed, and therefore more rapid melting. With less water available to acequias, more fields will be fallowed, adding to the potential for more dust to blow off.

Another robustly projected impact of warming temperatures over the next 50 years is that the average snowpack in the mountains on April 1, typically the time of maximum snowpack, will steadily decrease. This effect will likely be exacerbated by increased dustiness in parts of the state, which also promotes early melting of snow. This decreased snowpack will, in turn, impact the timing and quantity of runoff, reducing flow in the Rio Grande and other major snow-fed rivers. Furthermore, increased evaporation and sublimation of snowpack and subsequent runoff in a warmer climate further reduces the amount of snowmelt water that reaches rivers. Also, over the next 50 years, we are likely to experience more variability in precipitation from year to year, including anomalously wet years interspersed with periods of more extreme drought.

Tree-ring studies across southwestern North America have shown that profound droughts lasting multiple decades have occurred once or twice per century for at least a thousand years (Gutzler, 2004; Watkins, 2006). Peak snowmelt runoff occurs earlier in nearly all computer simulations. On a Statewide basis, there will likely be less runoff in the Rio Grande, putting additional pressure on New Mexico to deliver wet water to Texas to comply with the terms of the Rio Grande Compact, and likely less water available to San Juan/Chama Project contractors.

There is general consensus that increasing temperature will reduce snowmelt runoff but quantifying the reduction is difficult at present.

CONCLUSIONS

1. In the next 50 years, Taos Ski Valley will likely experience:
    a. Sharp declines in snowpack, which will melt earlier and generate less snowmelt runoff
    b. Less streamflow in the Lake Fork and Rio Hondo, resulting in less water available for snowmaking
    c. Less San Juan/Chama water available to contracting entities, potentially reducing the Village's municipal and snow-making water supply
    d. Continued increased likelihood of fires
    e. More light-absorbing aerosols being blown onto the snowpack in early spring
    f. Less water for downstream acequias resulting in more land being fallowed and creating more dust that when blown onto snowpack, results in earlier spring snowmelt, and increases the rate at which the snowpack melts
    g. A smaller early-season snow-making window (already decreasing)
2. At current rates of temperature increase, the predicted 5°F to 7°F temperature increase over the next 50 years will have a significant effect on TSVI's snow-making operations, especially in dry or "late" snow years.

RECOMMENDATIONS

Taos Ski Valley, Inc.

1. Focus on how TSVI can continue to reduce its CO_2 emissions
2. Increase TSVI and VTSV water storage
3. Conduct forest thinning/management on private and Forest Service lands
4. Make as much snow as possible for both TSVI needs and spring release to downstream irrigators
5. Continue to add more snow guns
6. Get a better understanding of high mountain precipitation cycles similar to GGI's piezometer/recharge analyses
7. Explore cloud seeding in partnership with VTSV, US Forest Service, Taos Pueblo, NM Interstate Stream Commission, Taos Valley Acequia Association/Rio Hondo acequias and Natural Resources Conservation Service (NRCS)
    a. Not all clouds are suitable for seeding and seeding must be adapted to the cloud conditions
    b. Researchers at the National Center for Atmospheric Research in Boulder state that cloud seeding enhances snowfall under the right conditions
    c. NM has had cloud seeding law on the books that claims its sovereign rights to moisture over its land mass (needs more research)
    d. Cloud seeding has been done for many years in Colorado and California and until COVID, Vail had an annual budget line item for cloud seeding and allegedly increased precipitation in specific clouds by 24%

   e. Cloud seeding will also benefit irrigators and summer recreational activities

Village of Taos Ski Valley

1. Implement GGI and DEC's recommendations in the Water Master Plan
2. Reduce VTSV system losses
3. Develop and connect Gunsite Spring into Village treatment and distribution system
4. Prepare and implement a water conservation plan
5. Reduce its CO_2 emissions
6. More effectively manage runoff, erosion, and sedimentation from Village roads
7. Continue to pursue forest thinning projects
8. Participate as a cloud-seeding partner

REFERENCES (some not specifically cited)

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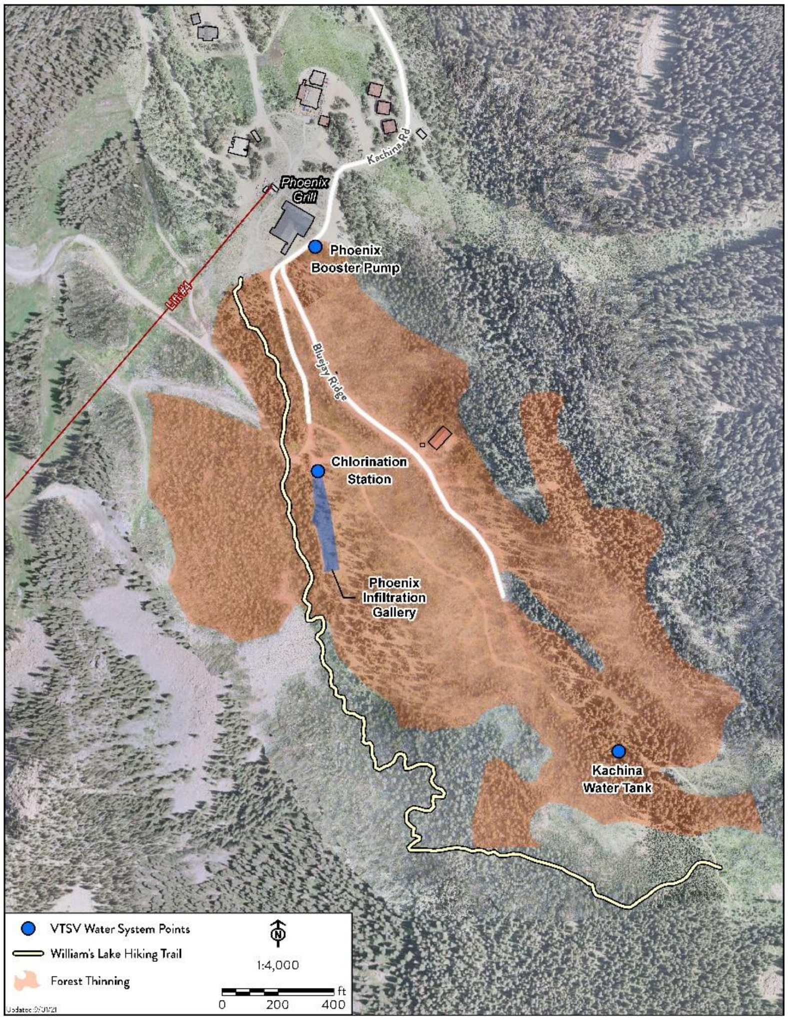
VILLAGE OF TAOS SKI VALLEY

WATER MASTER PLAN
TECHNICAL MEMORANDUM



PREPARED FOR:

VILLAGE OF TAOS SKI VALLEY
TAOS SKI VALLEY, INC.

DECEMBER 2021

PREPARED BY:

DENNIS ENGINEERING COMPANY

Gary H. Bierner, P.E.
Tappan J. Mahoney, P.E.

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VILLAGE OF TAOS SKI VALLEY

WATER MASTER PLAN
TECHNICAL MEMORANDUM

DECEMBER 2021

Prepared by the undersigned, whose seal as a Professional Engineer, licensed to practice as such in the State of New Mexico, is affixed below:

Gary H. Bierner, P.E.
Gary H. Bierner, P.E.

GARY H. BIERNER
26787
12-16-2021

DENNIS ENGINEERING COMPANY

Albuquerque, NM
505-281-2880

www.decnm.com

Socorro, NM
575-835-0604

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APPENDICES

Appendix A: Ultra Mag Electromagnetic Flow Meter
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The Village of Taos Ski Valley (VTSV) is a small community in Taos County located within the Carson National Forest in northcentral New Mexico. This technical memorandum was prepared by Dennis Engineering Company (DEC) with information provided by VTSV, Taos Ski Valley, Inc. (TSVI), and Glorieta Geoscience, Inc. (GGI) to evaluate the existing water distribution system, current and projected system demand and related infrastructure to recommend improvements to provide the community with a more reliable water distribution system. The scope of this technical memorandum includes the following tasks:

- Evaluation of water usage data provided by VTSV.
- Evaluation of the existing water distribution facilities serving the community.
- Evaluation of the water system reliability under the current and future demand conditions and recommend improvements.
- Prioritize recommended improvements.

1.1 NEED FOR THE IMPROVEMENTS

VTSV's water distribution system is supplied by the Phoenix Spring Complex. The existing water distribution system is shown in Figure 3-2. Historically, the Phoenix Spring Complex has provided adequate water to meet system demand; however, it has been observed by VTSV, typically during the week of spring break, that the Phoenix Spring struggles to meet demand in times of high demand and low spring flow. As such, historic and future supply from the Phoenix Spring Complex has been evaluated by GGI in a separate report (Riesterer, Drakos, & Lazarus, 2021). Based on GGI's evaluation of the Phoenix Spring, it is recommended that a low monthly average flow of 144 gallons per minute (gpm) (207,360 gallons per day (gpd)) and a low 5-day average flow of 126 gpm (181,440 gpd)[1] be utilized for planning purposes. Additionally, DEC evaluated flow into the system from the Phoenix Spring Chlorination Station (CS) and total system usage (metered and estimated unmetered usage) from February 2014 to December 2020 to determine the reliability of the water distribution system.

Based on DEC's evaluation, it was determined that peak system demand typically occurs December through March of each year with the greatest demand experienced in January. **During peak demand, it was observed that unaccounted-for water is, on average, 74%, meaning the distribution system customers utilize approximately 26% of the water metered at the Phoenix Spring CS.** EPA has estimated that, on average, water loss in systems throughout the United States is sixteen percent (16%) (U.S. Environmental Protection Agency, 2013). Additionally, per NMAC 17.12.750.15, unaccounted-for water exceeding fifteen percent (15%) of the total production should be given special attention in order to reduce excessive losses of water. It should

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[1] In this technical memorandum, the unit's gpm and gpd are used to identify water flow rate. Traditionally, gpm is used to describe water demands such as average daily demand, max daily demand, and peak hourly demand. For the benefit of VTSV, the unit gpd is utilized for water demand and unaccounted-for water.

be noted that within VTSV's water distribution system the percentage of unaccounted-for water is related to system demand as when demand increases, unaccounted-for water decreases, suggesting that the longer the water remains in the system, the more unaccounted-for water will be experienced. It was observed in January of 2020 when VTSV experienced their highest demand on record (73,639 gpd) for the subject data interval, unaccounted-for water decreased to 63%.

Per discussions with VTSV, TSVI, and GGI, consideration of climate change and based upon improvements proposed within the Village, the following scenarios were analyzed to determine water supply, water demand and minimum unaccounted-for water.

1. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation.
2. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation and incorporation of Amizette into the water system.
3. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation and incorporation of Amizette with growth into the water system.

As shown in Table 4-2, Scenario 3 results in a water demand of 125,000 gpd, requiring unaccounted-for water be decreased to a maximum of 31%. It is recommended that VTSV work towards reducing unaccounted-for water to a maximum of 25% to provide adequate supply contingencies if larger demand is experienced or failures within the distribution system occur.

Considering the estimated low monthly average flow of 207,360 is experienced, VTSV would not be able to satisfy the existing system demand in March of 2022. **As such, VTSV should actively work towards reducing unaccounted-for water within the distribution system to ensure the distribution system can continue to meet existing system demands and permit growth within the Village.**

1.2 RECOMMENDED IMPROVEMENTS

The following is a list of recommended improvements to actively address unaccounted-for water.

1) Install new electromagnetic flow meters in separate vaults to meet manufacturer's recommended clear distances on the Green Tank inlet and outlet. These new meters should be used to verify unaccounted-for water between the Chlorination Station and the Green Tank.
2) Install master meters within the water distribution system at the locations and in the order identified in Figure 5-1 to isolate segments of the water distribution system. The readings provided by the intermediate meters should be analyzed in conjunction with customer meter readings on a monthly basis to identify and document unaccounted-for water. This data should be monitored for a minimum of one year. If after one year it is apparent that a particular isolated segment of the distribution system is responsible for large amounts of

unaccounted-for water, VTSV should consult with a water leak detection specialist to identify the best method to locate the damaged waterlines. Options are available, such as American Leak Detection and GPRS out of Albuquerque, NM. If VTSV suspects that the distribution waterlines within an isolated segment are subject to future leaks, such as segments with thin-walled PVC waterlines or galvanized waterlines, the entire water line within the isolated segment should be replaced.

3) Commence with a meter replacement program for all existing customer meters to ensure that all customer meters are scheduled to be replaced prior to the end of their service life (typically 15 to 20 years).

4) Establish a Water Loss Control Program to monitor and track progress towards decreasing unaccounted-for water. Additional information about AWWA's Water Loss Control Program and their free Water Audit Software can be found at: https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control.

2 INTRODUCTION

2.1 PURPOSE AND SCOPE

This technical memorandum was prepared by Dennis Engineering Company (DEC) for the Village of Taos Ski Valley (VTSV) and Taos Ski Valley, Inc. (TSVI) with information provided by VTSV, TSVI, and Glorieta Geoscience, Inc. (GGI). The purpose of this document is to evaluate the existing water distribution system, current and projected system demand and related infrastructure to recommend improvements to provide the community with a more reliable water distribution system. The scope of this technical memorandum includes the following tasks:

- Evaluation of water usage data provided by VTSV.
- Evaluation of the existing water distribution facilities serving the community.
- Evaluation of the water system reliability under the current and future demand conditions and recommend improvements.
- Prioritize recommended improvements.

2.2 PROJECT AREA

VTSV is located in Taos County in the northcentral part of the State of New Mexico within the Carson National Forest, approximately 19 miles northeast of Taos, NM and approximately 29 miles southeast of Questa, NM along NM State Road 522. Figure 2-1 shows the regional location of VTSV.

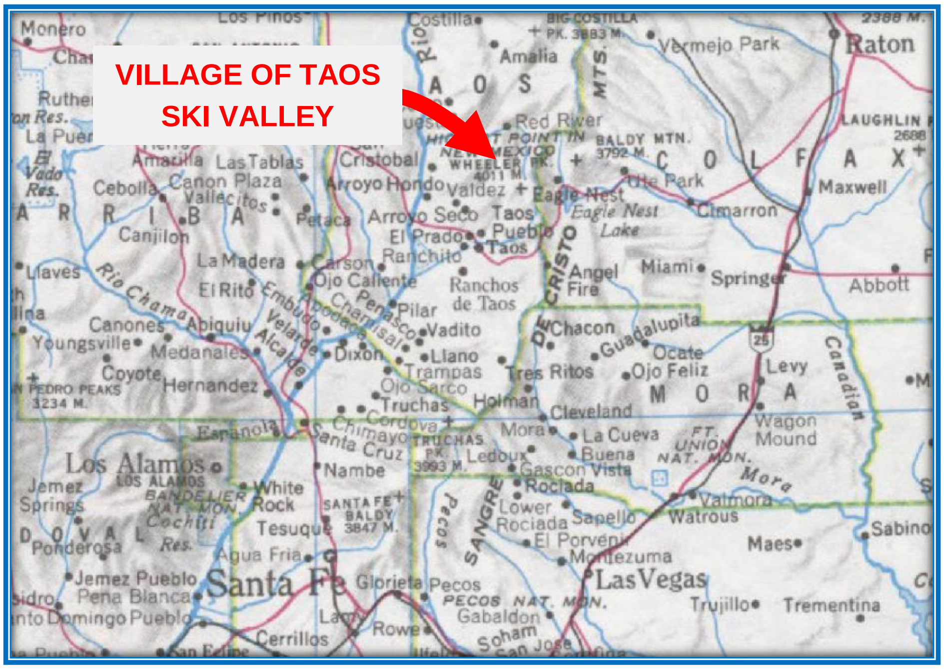


Figure 2-1. Regional Location Map

3 EVALUATION OF THE EXISTING WATER SUPPLY AND DISTRIBUTION SYSTEM

The following sections present an overview of the existing water distribution system. The existing system layout is shown in Figure 3-2.

3.1 EXISTING WATER DISTRIBUTION SUPPLY

3.1.1 PHOENIX SPRING COMPLEX

VTSV's primary source of potable drinking water is provided by the Phoenix Spring Complex as described in the GGI's "Assessment of Historic and Projected Flows from the Phoenix Spring Complex." The infiltration gallery and related infrastructure which collects flow from the Phoenix Spring Complex and transfers the flow to the chlorine contact chamber will not be discussed in-depth in this technical memorandum as this infrastructure is discussed in GGI's referenced water supply report.

3.1.2 CHLORINE CONTACT CHAMBER (CHLORINATION STATION)

Flow from the Phoenix Spring Complex enters the chlorination station (CS) by an 8-inch ductile iron waterline and a 4-inch ductile iron waterline. The flow from the Phoenix Spring Complex is then chlorinated and enters the chlorine contact chamber which discharges into the distribution system, or the flow is directed into an overflow basin which discharges directly into the Lake Fork. Flow directed to the distribution system is metered by an 8-inch Ultra Mag electromagnetic flow meter and flow directed to the overflow is metered by a 10-inch Ultra Mag electromagnetic flow meter (see Appendix A for information on Ultra Mag electromagnetic flow meters). Both meters were installed in 2012 and meter calibration was verified in 2021.

Upon evaluating the metered data from February 2014 to December 2020, it was observed that flow directed to the distribution system and flow directed to the overflow is dependent on water supply and water demand. In times of high demand and low spring flow, a larger percentage of spring flow is diverted into the distribution system and in times of low demand and high spring flow, a larger percentage of spring flow is diverted to the overflow. Based on review of the metered information from 2014 to 2020, it was determined that at no time during this period has 100% of the available spring flow entered the distribution system. This suggests that flow from the Phoenix Spring Complex has adequately met historic water demand. Upon review of the CS design, it was determined that 100% of the Phoenix Spring flow could be diverted to the distribution system, if necessary.

3.2 EXISTING WATER DISTRIBUTION SYSTEM

3.2.1 EXISTING DISTRIBUTION WATERLINES

There are approximately 35,000 LF of distribution waterlines throughout VTSV. These distribution waterlines are comprised of 10-inch, 8-inch, 6-inch, 4-inch and 2-inch ductile iron, PVC, and galvanized waterlines. The VTSV operator has indicated the PVC waterlines within the distribution system are not C-900 PVC and are similar to Sch. 40 PVC. The operator noted that these lines are brittle and subject to damage with movements in the earth. Water systems have moved away from utilizing Sch. 40 PVC for water distribution mains as Sch. 40 PVC is inferior to other products on the market, such as DR 18 C-900 PVC or ductile iron pipe. Based on available GIS data and maps provided by VTSV and TSVI, it is estimated that approximately 35% of the water distribution system is comprised of 12,200 LF of 8-inch, 6-inch, 4-inch and 2-inch PVC waterlines.

Galvanized waterlines are subject to corrosion overtime which can reduce flow through the waterlines and cause pinholes to develop within the waterlines. Currently, 3% of the water distribution system is comprised of 1,200 LF of galvanized 2-inch waterlines.

Ductile iron waterlines are effective in areas of ground movement provided joints are correctly installed and secured. Approximately 27% of the water distribution system is comprised of 9,500 LF of recently installed (2010-2020) 10-inch, 8-inch, and 4-inch ductile iron waterlines. These recently installed ductile iron waterlines are located within the Core Village Base Area, Commercial/ Business Base Area, Kachina Commercial/ Business zone, near the Pioneer Glade Tank and Kachina Water Storage Tank. Each joint of these new ductile iron waterlines was mechanically restrained with joint harnesses and were pressure tested. These lines are considered in good condition and are unlikely to contribute to unaccounted-for water.

The remaining 35% of the water distribution system is comprised of 12,300 LF of 8-inch and 6-inch ductile iron waterlines installed prior to 2010.Depending on when these waterlines were installed and the manner in which they were installed, there is a possibility that these waterlines contribute to unaccounted-for water.

3.2.2 EXISTING WATER DISTRIBUTION STORAGE AND PUMPING FACILITIES

The water storage system is comprised of three storage tanks located in various locations throughout the water system. The three tanks are the Green Tank, Pioneer Glade Tank, and the Kachina Water Storage Tank, which combine for a storage capacity of 750,000 gallons. Currently, there is only one booster station within the distribution system, and it is the Kachina Booster Station, located east of the Phoenix Day Lodge (See Figure 3-2).

3.2.2.1 *Green Tank*

The Green Tank is a round, partially buried 250,000-gallon steel water storage tank with an unknown installation date. A tank inspection was performed in September 2008 and indicated extensive rust spots (<1% of surface is rusted) on the interior roof and walls, few isolated rust spots (<0.3% of surface is rusted) on the interior floor and noted that approximately 33% of the surface was rusted for the perimeter floor welds. The tank inspection report recommended the Green Tank be cleaned and inspected every 3 to 5 years (See Appendix B for complete tank inspection report).

The tank level is controlled by an altitude valve installed on the tank inlet. The inlet and outlet of the tank are metered by 6-inch mechanical Neptune HP Turbine meters of unknown age (see Appendix C for information on Neptune NP Turbine Meter). During a site visit it was observed that the upstream and downstream clear distance between valves and fittings do not appear to meet the manufacturer's recommendations. Considering the size limitations within the existing meter and altitude valve vault, it does not appear that the piping can be reconfigured to provide adequate upstream and downstream clear distances. Meter accuracy can be affected if the recommended upstream and downstream clear distances are not satisfied.

Based on the metered data for the Green Tank inlet and outlet and metered data for the Phoenix Spring Complex inlet, the water distribution system is currently experiencing approximately 80,000 gallons per day (gpd) of unaccounted-for water in this segment, which is approximately 36% of the total water supplied from the Phoenix Spring Complex and approximately 60% of total unaccounted-for water. **Determining the accuracy of the Green Tank meters is essential to determine if this unaccounted-for water is accurate or a result of inaccurate meter readings**.

3.2.2.2 *Pioneer Glade Tank*

The Pioneer Glade Tank is a round, buried 250,000-gallon concrete water storage tank that was constructed in 2010. The tank has one dedicated 4-inch inlet and one common 10-inch inlet/ outlet. A 4-inch altitude valve is installed on the dedicated 4-inch inlet and there is a 10-inch, two-way altitude valve installed on the common 10-inch inlet/outlet. These altitude valves control the water level within the Pioneer Glade Tank. Flow into and out of the Pioneer tank is not metered.

During the construction of the Pioneer Glade Tank, approximately 2,000 LF of 10-inch ductile iron distribution waterline was installed to connect the existing distribution system to the tank outlet.

3.2.2.3 *Kachina Water Storage Tank*

The Kachina Water Storage Tank is a rectangular buried 250,000-gallon concrete water storage tank constructed in 2020. The tank has two 125,000 gallon internal chambers, Chamber 1 and Chamber 2, with individual mixing systems. The chambers have individual common inlet/ outlets. The inlet/outlets are piped outside of the tank through a concrete vault. Within the vault, the common inlet/ outlet for Chamber 1 is metered whereas the common inlet/outlet for Chamber 2 is not metered. The tank is filled and water levels are maintained by the Kachina Booster Station located east of the Phoenix Day Lodge.

During construction of the Kachina Water Storage Tank approximately 960 LF of 8-inch ductile iron distribution waterline was installed to connect the tank outlet line to the portion of the water distribution system previously supplied by the Kachina Booster Station. VTSV is currently locating an 8-inch ductile iron waterline previous installed so that the Kachina Water Storage Tank can provide flow to the Kachina Village. Additionally, VTSV is investigating the need for a pressure reducing/ sustaining valve to connect the Kachina Water Storage Tank to the remainder of the water distribution system. **It is recommended that VTSV pursue all improvements necessary to connect the Kachina Water Storage Tank to both the Kachina Village and the remainder of the water distribution system.**

3.2.2.4 *Kachina Booster Station*

The Kachina Booster Station is located east of the Phoenix Day Lodge and provides water to the Kachina Water Storage Tank and the Schnitzer Cabin. The booster station utilizes two 15hp, vertical multi-stage vertical pumps to provide water to the Kachina Water Storage Tank. The motor and electrical components were upgraded in 2020 as a part of the Kachina Water Storage Tank project. Flow from the booster station is metered by a 2-inch Ultra Mag electromagnetic flow meter.

The meter readings from the Kachina Booster Station were analyzed; however, the meter was not transmitting readings for the years 2019 and 2020; therefore, the data available for outflow from the Kachina Booster Station was limited.

3.2.3 FIRE SUPPRESSION CAPABILITIES

3.2.3.1 *Current Fire Suppression Capabilities*

VTSV provides fire suppression by utilizing fire hydrants located throughout the distribution system. The VTSV fire hydrant flows observed in October 2020 are included in Appendix D. Based on these observed fire hydrant flows, the minimum flow provided by the existing fire hydrants is 448 gpm and the maximum flow provided by the existing fire hydrants is 1,574 gpm. Per the NMED-CPB Recommended Standards for Water Supply Systems, 2006 Edition, typical ranges of fire flow requirements are as follows:

1. Single Family Residential: 500 to 1,500 gpm for at least 2 hours.
2. Apartments/ Condominiums: 2,500 gpm for at least 4 hours
3. Commercial: 4,000 gpm for at least 4 hours

Actual fire protection requirements should be determined based on recommendations from the Insurance Service Office (ISO) working directly with VTSV.

Additionally, upon reviewing the existing fire hydrant layout, it appears that multiple fire hydrants are installed on 4-inch diameter water mains. Per Recommended Standards for Water Works, 2018 Edition, the minimum size of water mains providing fire protection and serving fire hydrants shall be 6-inch diameter. 4-inch water mains within the distribution system which provide fire protection should be evaluated to determine if the 4-inch water mains are capable of providing adequate fire protection.

In this technical memorandum, available fire flow was analyzed for four different scenarios. Scenario 1 is available fire flow for residents and businesses located between the Green Tank and Pioneer Glade Tank, utilizing available fire flow from the Green Tank. Scenario 2 is available fire flow for residents and businesses located between the Green Tank and Pioneer Glade Tank utilizing available fire flow from the Green Tank and Kachina Water Storage Tank. Scenario 3 is available fire flow for residents and businesses located below the Pioneer Glade Tank utilizing available fire flow from the Green Tank and Pioneer Glade Tank. Scenario 4 is available fire flow for residents and businesses located below the Pioneer Glade Tank utilizing available fire flow from the Green Tank, Pioneer Glade Tank and Kachina Water Storage Tank. These four scenarios are based on utilizing only emergency storage and do not account for total available storage (operating storage + emergency storage) The 2-hour and 4-hour available fire storage for each scenario is identified below.

- Scenario 1:
    - 2-hour available fire flow: 1,965 gpm
    - 4-hour available fire flow: 983 gpm
- Scenario 2:
    - 2-hour available fire flow: 2,261 gpm
    - 4-hour available fire flow: 1,131 gpm
- Scenario 3:
    - 2-hour available fire flow: 3,621 gpm
    - 4-hour available fire flow: 1,811 gpm
- Scenario 4:
    - 2-hour available fire flow: 3,917 gpm
    - 4-hour available fire flow: 1,959 gpm

3.2.3.2 *Future TSVI 5MG Snow Making Storage Tank*

TSVI has plans to design and construct a non-potable 5 million gallon (MG) water storage tank to utilize for snow making. TSVI is planning to construct the necessary related infrastructure so that the 5MG storage tank could be used as back-up fire protection against catastrophic issues and forest fires. It should be noted that since it is non-potable water, water from the 5MG storage tank could not be used for or connected directly to the distribution system, but could include fire hydrants and lines through a separate non-potable water system.

3.3 UNACCOUNTED-FOR WATER (WATER LOSS)

EPA has estimated that, on average, water loss in systems throughout the United States is 16 percent (U.S. Environmental Protection Agency, 2013). Per NMAC 17.12.750.15, unaccounted-for water exceeding fifteen percent (15%) of the total production should be given special attention in order to reduce excessive losses of water. As illustrated in Table 3-1, VTSV's annual average unaccounted-for water is eighty percent (80%) of the total water supplied by the Phoenix Spring Complex, not including the Phoenix Spring overflow, from 2014 to 2020. Unaccounted-for water varies seasonally with demand. During peak usage, December through March, unaccounted-for water decreases to an average of seventy-four percent (74%) and during the off-season, unaccounted-for water increases to an average of eighty-three percent (83%). **Unaccounted-for water results in additional expenditures for electrical and chemical costs, which is an unnecessary burden on VTSV and its water consumers. The total unaccounted-for water from February 2014 through December 2020 is approximately 342 million gallons (1,050 acre-feet) or 135,000 gallons per day.**

As noted above, unaccounted-for water is related to system demand, as when demand increases, unaccounted-for water decreases, suggesting that the longer the water remains in the system, the more unaccounted-for water will be recorded. In January 2020, VTSV experienced their highest water demand on record (73,639 gpd) for the subject data interval and unaccounted for water decreased to 63%. The percentage of unaccounted-for water vs water demand from February 2014 through December 2020 was plotted with a trend line. The trend line, as shown in Figure 3-1, indicates that there is a correlation between unaccounted-for water and water demand.

Table 3-1. Historic Unaccounted-for Water

Historic Unaccounted-for Water

Year	Annual	Peak Season*	Off-Season
2014	77%	--	87%
2015	82%	73%	88%
2016	82%	72%	87%
2017	84%	74%	88%
2018	86%	77%	90%
2019	77%	78%	78%
2020	74%	69%	63%
Average	80%	74%	83%

*Peak Season includes usage from December of the previous year.

--Spring flows for December 2013 and January 2014 were unavailable therefore the unaccounted-for water for the 2014 Peak Season is undeterminable.

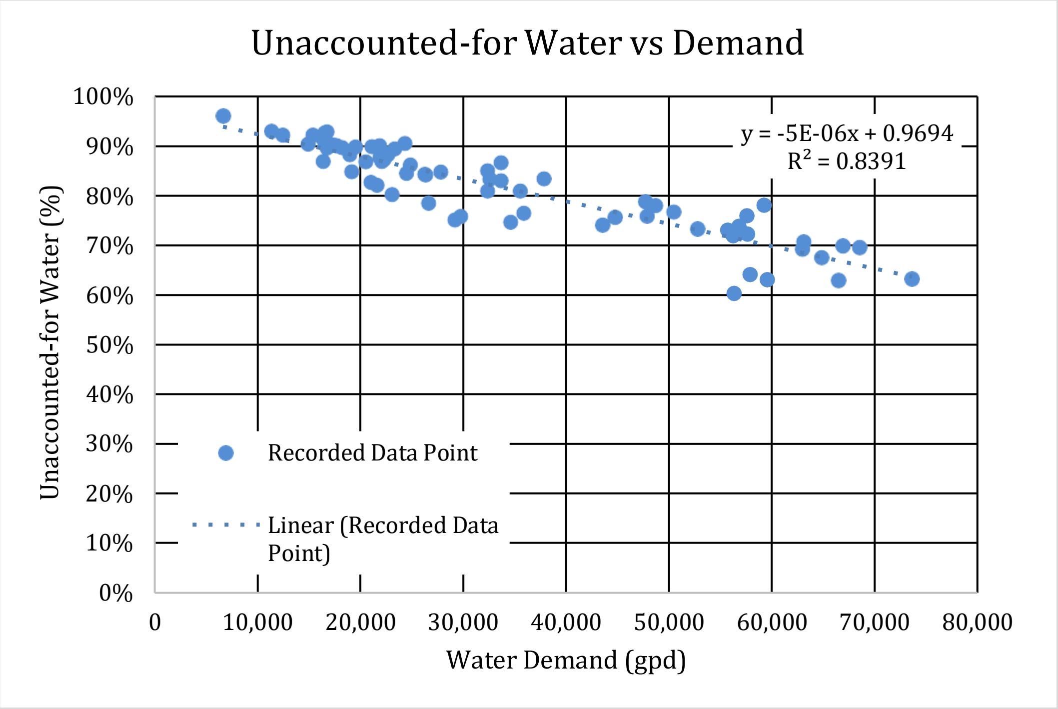
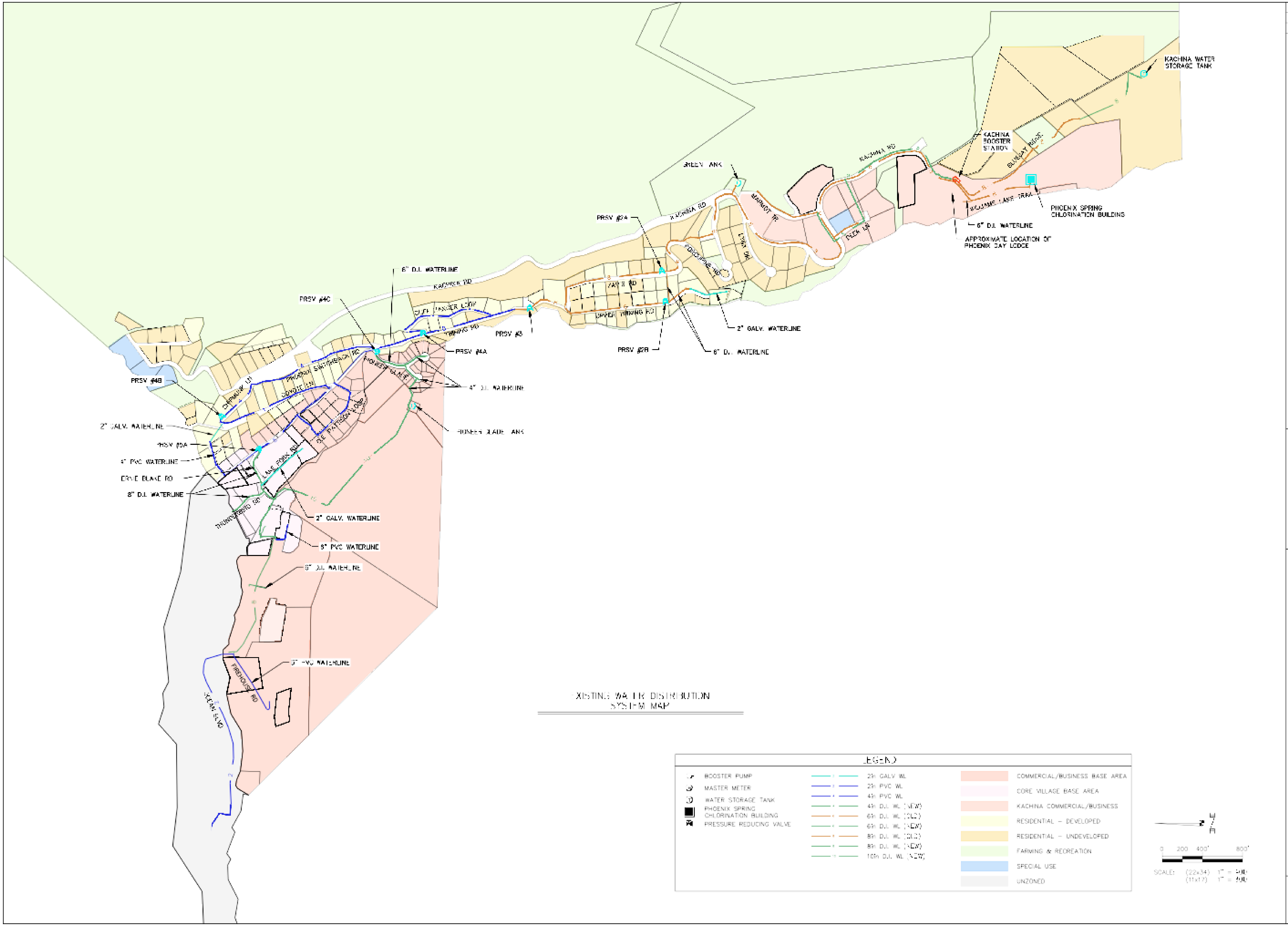


Figure 3-1. Unaccounted-for Water vs. Demand



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PROJECT

VILLAGE OF TAOS SKI VALLEY
WATER MASTER PLAN
TECHNICAL MEMORANDUM

DENNIS ENGINEERING COMPANY

TITLE

EXISTING WATER DISTRIBUTION
SYSTEM MAP

FIGURE

3-2

4 CURRENT AND ESTIMATED FUTURE WATER DEMAND

4.1 CURRENT WATER DEMAND

4.1.1 ANNUAL WATER DEMAND

Water demand within VTSV is highly seasonal with peak demand occurring in December through March. Beginning in April, water demand decreases significantly, rebounds slightly from June through August and then decreases again until demand begins to increase in late November, early December.

Customer usage, metered bypass and unmetered (estimated) bypass provided by VTSV was analyzed from February 2014 to December of 2020. During this period, the average water usage was 12.5 MG per year (38 acre-feet) or 35,000 gpd. On average, 6.7 MG (55,000 gpd) was documented through customer meters, metered bypass, and estimated unmetered bypass during the peak season while 5.8 MG (24,000 gpd) was documented through customer meters, metered bypass, and estimated unmetered bypass during the off-season. It was estimated that the Base Area – Core Village zone utilizes 50% of the total water consumption while the Base Area – Commercial/ Business zone utilizes 25% of the total water consumption. As such, the Base Area – Core Village and Base Area – Commercial/ Business utilize 75% of the total water consumption. The remaining 25% of total water consumption is distributed throughout the Kachina Commercial/ Business, Residential, Farming & Recreation and Special Use zones.

4.1.2 PEAK WATER DEMAND

As identified above, peak water demand occurs from December thru March of any given year. Through examination of VTSV's metered records, coordination with VTSV, TSVI, and GGI, it was determined that peak usage should be evaluated considering low spring flow occurs during the same time of year. In GGI's report, GGI analyzed spring flow to determine when supply from the Phoenix Spring Complex is of greatest concern. **Based on analysis of the water usage, review of GGI's report and discussions with VTSV and TSVI, it was determined the month of March is of greatest concern.**

Table 4-1 identifies the monthly average spring flow, flow to the CS, average daily demand, maximum daily demand and peak hourly demand for peak usage from December 2014 to March 2020. As indicated by Table 4-1, the largest peak demand typically occurs in January with demand in February and March being several thousand gallons per day less. Though, on average, March experiences less demand than January or February, it is estimated that the average maximum daily demand of 100,000 gallons per day is experienced for at least five (5) consecutive days during spring break. **When high demand, storage capacity and unaccounted-for water is considered, and the estimated 5-day average low flow of 181,000 gpd is experienced during spring break, the water system will have difficulty providing flow to the consumers.**

Considering that the Kachina Water Storage Tank is not currently connected to the water distribution system, it is estimated that the Green Tank and Pioneer Glade Tank will utilize all of their available operating storage within 20 hours. Once these tanks drop below operating storage, the storage tanks will require continuous fill to meet system demand until demand drops below the maximum daily demand. Once the Kachina Water Storage Tank is placed into service, and considering both chambers are full, it is estimated that the operating storage will deplete in 48 hours.

Table 4-1. Historic Water Demand

Historic Water Demand

December

	Average Spring Flow (gpd)	Average Spring Flow to CC (gpd)	Average Daily Demand (gpd)	Maximum Daily Demand (gpd)	Peak Hourly Demand (gpd)
2014	344,396	186,420	35,520	63,936	106,560
2015	403,699	208,285	57,026	102,646	171,077
2016	329,373	198,676	47,882	86,187	143,646
2017	449,317	198,289	33,649	60,568	100,947
2018	369,679	252,293	33,649	60,568	100,947
2019	332,223	183,522	44,765	80,576	134,294
Average	372,000	205,000	43,000	76,000	127,000
January					
2015	343,706	199,962	64,854	116,738	194,563
2016	445,685	206,649	55,696	100,252	167,087
2017	327,693	216,666	50,439	90,791	151,318
2018	323,990	221,842	66,935	120,483	200,805
2019	298,332	270,274	59,253	106,655	177,758
2020	387,473	200,397	73,639	132,550	220,917
Average	355,000	220,000	62,000	112,000	186,000
February					
2015	295,492	197,598	52,773	94,992	158,320
2016	351,272	204,846	63,000	113,401	189,001
2017	334,309	215,870	63,136	113,644	189,407
2018	316,627	221,267	48,685	87,632	146,054
2019	264,801	239,536	57,573	103,631	172,718
2020	301,672	179,439	66,466	119,638	199,397
Average	311,000	210,000	59,000	106,000	176,000
March					
2015	275,051	200,564	56,238	101,229	168,714
2016	296,934	207,772	57,642	103,755	172,925
2017	280,909	216,694	56,786	102,214	170,357
2018	268,249	224,764	47,744	85,940	143,233
2019	251,736	224,899	68,518	123,332	205,553
2020	253,356	168,259	43,571	78,428	130,714
Average	272,000	208,000	56,000	100,000	166,000

4.2 ESTIMATED FUTURE WATER DEMAND

4.2.1 BASE LINE WATER DEMAND

This technical memorandum utilized the 2019 VTSV Water Metered log as the last full year of service pre-COVID 19. The Water Metered log has been cross referenced to those properties that were connected to the water system and serviced in 2019. As a consequence, the 2019 Service Area differs from the Land Use Assumptions accepted by Village Council in September 2021 which represents all properties in the Village of Taos Ski Valley.

In aggregate, the 2019 Service Area is comprised of the following:

<u>2019 Service Area:</u>

Multi-Family & Condos	276 units
Hotel rooms	108 units
Single Family Residential	103 units
Commercial Square Footage	155,272 sq. ft.

Additional information relating to the Water System Service Area is identified in Appendix I.

4.2.2 PROJECTED WATER DEMAND

4.2.2.1 *Projected Water Demand Assumptions*

To forecast future demand, this technical memorandum made several assumptions as it relates to the future Service Area. These assumptions are noted below and described further in Section 4.2.2.2.

1. All of Amizette is included within the Service Area.
2. A 100% build-out of all remaining Residential zoned properties in both main Village and Amizette.
3. A 20% growth factor in the existing 2019 Service Area to reflect increased demand.
4. A full build-out of the 2012 Conceptual Master Plan for the Core Village (See Appendix G).
5. A full build-out of the October 2021 Kachina Area Master Plan (See Appendix H)
6. A timeline of a 25-year build-out
7. VTSV remedies the average 74% unaccounted-for water that currently exists within the water distribution system and reduces unaccounted-for water to 25%. Note – NMAC 17.12.750.15 recommends that unaccounted-for water be addressed upon exceeding15% water loss.

8. A 0.5% loss compounded annually to the supply of water from the Chlorination Station to account for impacts from Climate Change.

In aggregate, the Projected Service Area based on VTSV's Land Use Assumptions is comprised of the following:

Projected Service Area:

Multi-Family & Condos	635 units
Hotel Rooms	276 units
Single Family Residential	271 units
Commercial Square Footage	205,572 units

For additional information relating to the Baseline and Projected Water Demand, refer to Appendix E.

4.2.2.2 *Projected Water Demand*

This technical memorandum has identified that water supply in the month of March is of greatest concern as during this month, water supply is at its lowest and water demand is significant as it coincides with Texas spring break. Per GGI's report climate change will result in a further decrease in supply during the month of March. To account for climate change, GGI's estimated low monthly average flow of 207,360 gpd was reduced by 0.5% yearly through the estimated build-out period of 25-years. Considering this reduction in supply due to climate change, and if the estimated low monthly average flow of 207,360 gpd is experienced, if VTSV does not address the unaccounted-for water that the distribution system is currently experiencing, VTSV will no longer be able to meet the existing system demand in March of 2022. **As such, it is recommended that VTSV actively work towards decreasing unaccounted-for water within the distribution system to ensure that VTSV can continue to meet system demand and permit growth within the Village.**

The following Service Area growth scenarios were analyzed to determine the projected system demand and determine the minimum amount of unaccounted-for water to meet system demand:

1. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation.
2. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation and incorporation of Amizette into the water system.
3. Complete build-out of the Core Village Base Area and Kachina with a 20% increase in visitation and incorporation of Amizette with growth into the water system.

Table 4-2 identifies the climate change adjusted low monthly flow, distribution system demand and maximum unaccounted-for water to satisfy system demand for each scenario. The minimum unaccounted-for water to satisfy demand identified in Table 4-2 is the theoretical value based on the assumptions identified in Section 4.2.2.1; however, **it is recommended that VTSV work towards reducing unaccounted-for water to a maximum of 25% to provide adequate supply contingencies if larger demand is experienced or failures within the distribution system occur.**

Table 4-2. Service Area Growth Scenarios

Scenario	Adjusted Estimated Average Water Supply (GPD)	Distribution System Demand (GPD)	Maximum Unaccounted-for Water to Satisfy Demand (%)
Build-out for Base Village and Kachina w/ 20% Increase in Visitation	182,000	116,000	36%
Build-out for Base Village and Kachina w/ 20% Increase in Visitation and Incorporation of Amizette	182,000	123,000	32%
Build-out for Base Village and Kachina w/ 20% Increase in Visitation and Incorporation of Amizette w/ Growth	182,000	125,000	31%

5 RECOMMENDED IMPROVEMENTS TO ADDRESS UNACCOUNTED-FOR WATER

The following sections present proposed improvements to address unaccounted-for water within VTSV. The proposed improvements are identified in Figure 5-1.

5.1 RECOMMENDED IMPROVEMENTS

5.1.1 VERIFY SOURCE AND INTERMEDIATE METER ACCURACY

5.1.1.1 *Phoenix Spring System-in and Overflow Meters*

Per discussions with the VTSV operator, James Kircher with Yukon & Associates, Ltd. was recently on-site and verified that the Phoenix Spring Complex system-in and overflow meters are correctly calibrated. As discussed in Section 3.1.2, these meters were installed in 2012. The expected service life of these meters is 30-years. As such, VTSV should plan to replace these meters within the next 20 years.

5.1.1.2 *Green Tank Inlet and Outlet Meters*

As mentioned in Section 3.2.2.1, the age and accuracy of the Green Tank inlet and outlet mechanical Neptune meters are unknown. Additionally, it appears that the that these meters do not satisfy the upstream and downstream clearance requirements identified in the manufacturer's published installation and maintenance guide.

To ensure accurate flow measurements, the Neptune Meters should be replaced with Ultra Mag electromagnetic flow meters and placed in a separate vault, ensuring that upstream and downstream clearance requirements are satisfied (see Detail A1, Figure 5-1).

5.1.2 INSTALLATION OF MASTER METERS TO ISOLATE DISTRIBUTION SYSTEM

5.1.2.1 *Installation of Intermittent Master Meters*

The installation of additional master meters are necessary to isolate portions of the water distribution system to identify locations of unaccounted-for water. **It is recommended that VTSV install Ultra Mag electronic flow meters in individual vaults with buried gate valves upstream and downstream of the vault to isolate the meters in event that the meters need to be taken off-line for maintenance (See Detail A1, Figure 5-1)**. It is not shown in Detail A1, but it is recommended that bypass piping be installed at each of these locations in the event that the meters need to be taken off-line for an extended period of time. Each master meter location should be evaluated during design to determine the feasibility and necessity of bypass piping. Figure 5-1 identifies the location and proposed priority that master meters be installed.

The data from the master meters should be monitored in conjunction with customer meter readings on a monthly basis to identify potential unaccounted-for water. This data should be analyzed for a minimum of one year to identify and document unaccounted-for water. **If after one**

year it is apparent that an isolated segment of the distribution system is responsible for a large quantity of unaccounted-for water, VTSV should consult with a water leak detection specialist to identify the best method to locate the damaged waterlines. Options are available, such as American Leak Detection and GPRS out of Albuquerque, NM. If VTSV suspects that the distribution waterlines within an isolated segment are subject to future leaks, such as segments with thin-walled PVC waterlines or galvanized waterlines, the entire waterline within the isolated segment should be replaced.

5.1.3 VERIFY CUSTOMER METER ACCURACY

5.1.3.1 *Residential and Commercial Customer Meters*

VTSV does not currently test meters for accuracy or have a meter replacement program to ensure that customer meters are replaced prior to the end of their service life. Depending on the meter manufacturer, meter service life is generally 15 to 20-years. Per discussions with VTSV, customer meters are replaced on an "as needed" basis. Considering the severity of water loss within the water distribution system, **it is recommended that VTSV replace all customer meters within the distribution system and begin a meter replacement program to ensure that all customer meters are scheduled to be replaced prior to the end of their service life.**

If VTSV is aware of new or recently installed meters, VTSV should test these meters for accuracy. Portable water meter test kits, such as the Recordall Portable Small Meter Tester (0.25 – 25 gpm) or Recordall Portable Large Meter Tester (0.5 – 500 gpm) (see Appendix F for product information), are available for purchase. If meter accuracy is confirmed, the meters should be added to the meter replacement program. If meters are inaccurate, the meters should be replaced.

5.1.4 ESTABLISH A WATER LOSS CONTROL PROGRAM

VTSV should establish a Water Loss Control Program, such as the free Water Audit Software provided by AWWA to monitor and track progress towards decreasing unaccounted-for water. Additional information about AWWA's Water Loss Control Program and their free Water Audit Software can be found at: https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control.

5.2 PRIORITY OF RECOMMENDED IMPROVEMENTS

5.2.1 PRIORITY NO. 1

Install new master meters in separate vaults for the Green Tank inlet and outlet to ensure recommended upstream and downstream clear distances are satisfied. By installing these new master meters, the distribution waterline between the CS and Green Tank (~4,600 LF) can be isolated. As identified in Section 3.2.2.1, the meter readings from existing mechanical meters indicate an apparent average unaccounted-for water of 80,000 gpd (60% of the total documented unaccounted-for water).

5.2.2 PRIORITY NO. 2

Install a new master meter at the intersection of Twining Road and Pioneer Glade, prior to the branch line to Pioneer Glade. The installation of this meter along with the installation of the master meter on the Green Tank outlet and customer meters will isolate approximately 3,200 LF of 8-inch ductile iron waterline, 1,600 LF of 6-inch ductile iron waterline, 1,400 LF of 8-inch PVC waterline, and 1,200 LF of 4-inch PVC waterline. All waterlines isolated were installed prior to 2010 and are likely to contribute to unaccounted-for water. **It is important to prioritize this segment as it not only provides water to residential lots but is the only water main that provides water from the Green Tank to the Pioneer Glade Tank and the remainder of the Core Village Base Area and Commercial/ Business Base Area.**

5.2.3 PRIORITY NO. 3

Install four (4) new master meters. One master meter should be installed on the 4-inch inlet to the Pioneer Glade Tank in a separate valve vault. This meter along with customer meters will isolate approximately 400 LF of 8-inch ductile iron waterline and 800 LF of 4-inch ductile iron waterline. All waterlines in this isolated segment were installed after 2010 and are unlikely sources of unaccounted-for water; however, it is necessary to isolate these waterlines in order to evaluate the remainder of the isolated segment.

The remaining three (3) master meters should be installed at the intersection of Twining Road and Ernie Blake Road. One meter should be installed southeast of the intersection along Twining Road, another should be installed northwest of the intersection along Twining Road and the final meter should be installed west of the intersection along Ernie Blake Road. These three master meters, along with customer meters, will isolate approximately 2,000 LF of 8-inch PVC waterline and 4,400 LF of 4-inch PVC waterline. All waterlines isolated in this segment were installed prior to 2010 and are likely to contribute to unaccounted-for water. Additionally, these waterlines supply the Core Village Base Area and Commercial/ Business Base area, which accounts for the majority of water usage within the system.

5.2.4 PRIORITY NO. 4

Install a new master meter on the 6-inch ductile iron waterline installed in 2017 near the Children's Center. This meter, along with customer meters, will isolate approximately 750 LF of 6-inch PVC waterline and 2,200 LF of 2-inch PVC waterline. All waterlines isolated in this segment were installed prior to 2010 and are likely to contribute to unaccounted-for water. The primary users for this isolated segment are those located along Firehouse Rd. and VTSV's wastewater treatment facility.

5.2.5 PRIORITY NO. 5

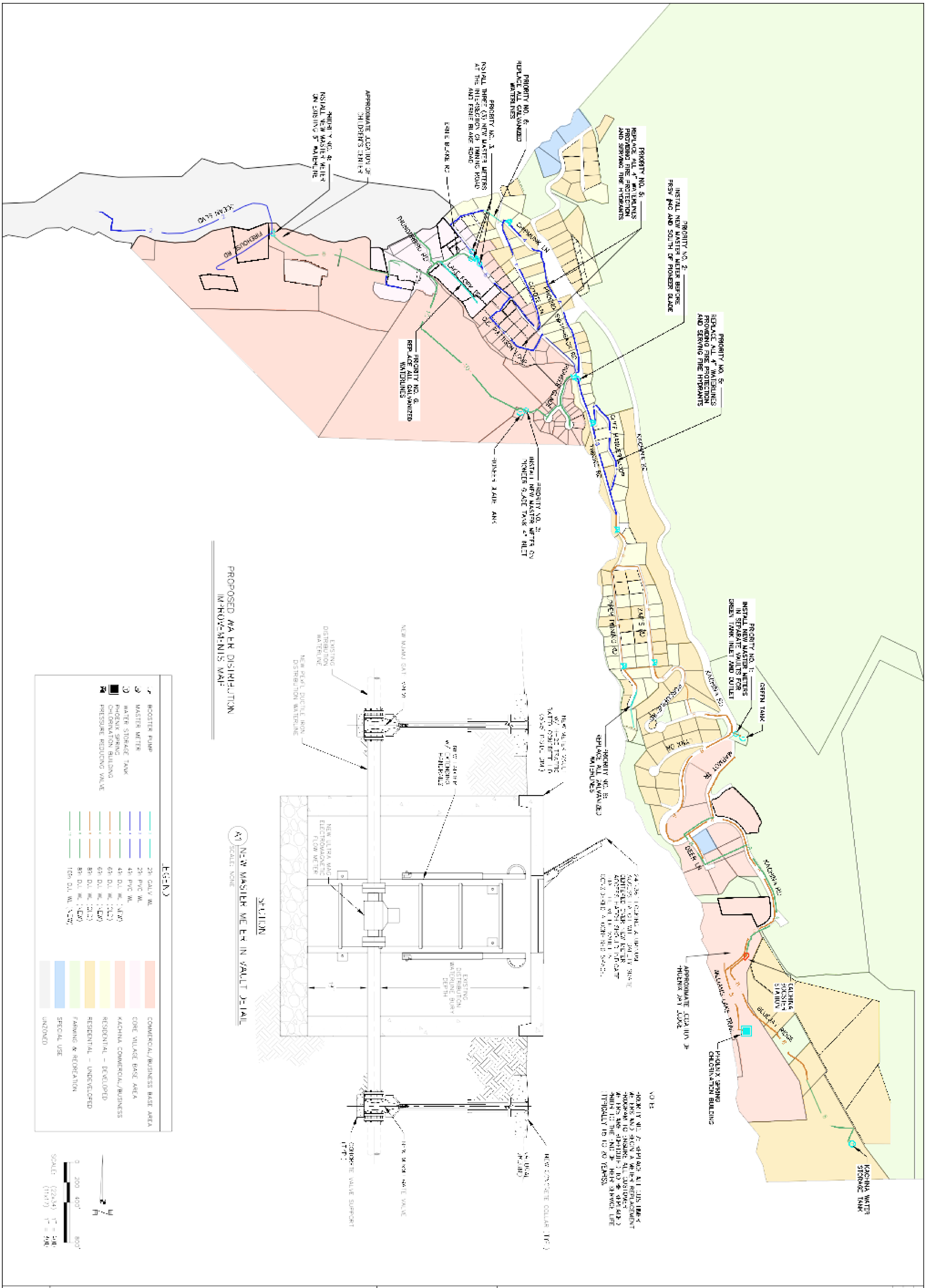
As noted in Section 3.2.3.1, there are locations within the distribution system where 4-inch water mains are utilized for fire protection. There is approximately 1,200 LF of 4-inch PVC water mains in the segment isolated by the master meters identified in Priority No. 3 and 4,400 LF of 4-inch PVC water mains in the segment isolated by the master meters identified in Priority No. 4 utilized for fire protection. These water mains should be thoroughly evaluated to determine fire protection capabilities. If it is determined that these 4-inch water mains are unable to provide adequate fire protection, these water mains should be immediately replaced with adequately sized water mains to satisfy water protection needs.

5.2.6 PRIORITY NO. 6

Based on available mapping, there are approximately 1,200 LF of 2-inch galvanized water lines within the distribution systems. Galvanized waterlines are subject to corrosion overtime which can reduce flow through the waterlines and cause pinholes to develop within the waterline. Galvanized waterlines should be replaced with adequately sized ductile iron waterlines to provide a more reliable water system.

5.2.7 PRIORITY NO. 7

Replace all customer meters and begin a meter replacement program to ensure that all customer meters are scheduled to be replaced prior to the end of their service life (typically 15 to 20 years).



PROJECT

VILLAGE OF TAOS SKI VALLEY
WATER MASTER PLAN
TECHNICAL MEMORANDUM

DEC
DENNIS ENGINEERING COMPANY

TITLE

PROPOSED WATER DISTRIBUTION IMPROVEMENTS MAP

FIGURE

5-1

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 RECOMMENDATIONS

VTSV is currently experiencing excess unaccounted-for water within their water distribution system. It is recommended that VTSV pursue all proposed improvements outlined in this technical memorandum in attempt to reduce unaccounted-for water to twenty-five (25%), or less. By reducing unaccounted-for water to 25% or less, VTSV will be able to utilize a greater amount of water from the Phoenix Spring Complex, thereby allowing VTSV to expand without immediately pursuing a separate water source. Additional benefits to reducing unaccounted-for water is that VTSV will save expenses related to energy and disinfection costs no longer needed for disinfecting water lost to the system.

In general, water systems with more than one source of water supply are more reliable. As noted above, if unaccounted-for water is decreased to 25% or less, VTSV will not have to immediately pursue a separate water source; however, considering the Phoenix Spring Complex is the only water source for VTSV, VTSV should consider the development of Gunsite Spring pending the outcome of the investigations discussed in GGI's report.

6.2 PROJECT FUNDING OPTIONS

The following are known sources of funding in the state for water projects such as those outlined in this report. It should be noted that multiple funding sources require a planning document outlining specific projects with the submission of the funding application.

USDA - Rural Development (RD)	
Water and Environmental Programs (WEP)	The USDA-RD program provides water and wastewater funding to rural areas (with a population of less than 10,000). Applications are accepted year-round. USDA funding is considered a loan first, and then after evaluation of the entity's financial information, the amount of grant is determined. Additional information can be obtained by contacting USDA-RD at 505-761-4955 or visiting their website at www.rd.usda.gov.
New Mexico Legislature	
Capital Outlay	Capital Outlay funding is appropriations made by the New Mexico legislature. The project monies are funded by the General Fund, Capital Projects Fund or by the proceeds generated by the sale of Severance Tax Bonds (STB) and is considered a grant. Applications are submitted in January/February during the legislative session and require the signature of the senator/representatives of the respective area.

	Capital Outlay requests can be for a variety of projects but typically include water, wastewater, solid waste, storm drains, planning/reports and essential community facilities. Additional information can be obtained from the entities legislators or respective Council of Governments.
New Mexico Environment Department (NMED) Programs	
Program Name	*Brief Description*
Rural Infrastructure Program (RIP)	The purpose of this program is to provide financial assistance to local authorities for the construction or modification of water, wastewater or solid waste facilities. RIP may also be used as a bridge loan for other funding sources to provide initial engineering or other services. Eligible projects include: Pollution control projects Water tanks and pipelines New sewer interceptors and collectors, Water and sewer system rehabilitation Infiltration/inflow correction Treatment plant improvements Non-point source projects Septic tanks Solid waste facilities Applications are accepted year-round and are available through NMED's website (https://www.env.nm.gov/forms/). For additional information, contact the RIP Program Administrator at 505-469-3365 or 505-469-3459 or by email at nmenv-cpbinfo@state.nm.us .
New Mexico Finance Authority (NMFA) Programs	
Water Trust Board (WTB)	There are five categories of eligible projects: Water Conservation or Recycling, Treatment or Reuse Flood Prevention Water Storage, Conveyance, and Delivery Watershed Restoration Endangered Species Act. Water Trust Board funding consists of a loan, grant and match and are considered state funding. Per the 2022 Application Overview and Frequently Asked Questions, the interest rate on the loan is 0%. Applications are accepted annually and are typically due in October. For additional information, contact NMFA at 1-877-275-6632 or wtbadmin@nmfa.net.
Drinking Water State Revolving Loan Fund (DWSRLF)	The DWSRLF program provides low cost financing for construction and improvements to drinking water facilities. Eligible projects include:

	New and replacement water sources, treatment, transmission and distribution lines Storage SCADA Infrastructure to interconnect or regionalize Energy efficient and water conservation Installation and replacement of water meters. Applications are accepted throughout the year but are only reviewed in August, November and February. Interest rates vary between 0% and 4%; contingent upon the type of system (public vs. private) and disadvantage status. DWSRLF funding is considered federal funding; it is co-administered by NMFA and NMED – Drinking Water Bureau. Subsidies are available, however, the best chances of receiving subsidies is during the first application period of the year (February). Additional information is available through NMFA DW@nmfa.net or 1-877-275-6632.
Local Government Planning Fund (LGPF)	Eligible projects (planning documents) for NMFA's LGPF program include: Preliminary Engineering Reports Environmental Information Documents that are compliant with the State's Drinking Water Revolving Loan Fund Plans to implement the Local Economic Development Act Water Conservation Plans Comprehensive Plans Priority infrastructure projects identified on the entities Capital Improvement Plans Economic development feasibility studies Asset Management Plans Energy Audits Applications for planning funds are accepted monthly and are considered state funds. LGPF is limited to $50,000 per planning document and $100,000 per entity per 24 month period. The funding consists of a grant and entity match, the percentages of which are contingent upon median household income, local burden ratio and other considerations as identified in the rules government the LGPF. Additional information can be obtained by contacting NMFA at 1-877-275-6632.
Department of Finance and Administration – Local Government Division (DFA-LGD) Programs	
Community Development Block Grant (CDBG)	The CDBG program is administered by the New Mexico Department of Finance Authority. Eligible projects include: Water

	Wastewater Storm water drainage Solid waste Planning reports Essential community facilities The maximum amount that can be applied for is $750,000 and this funding is considered federal funding. Funding from the CDBG program is a grant and there is a matching requirement (either 5% or 10%, contingent upon rural or non-rural status). Applications are accepted annually, usually in the spring; however, in 2021, applications were accepted in September. Additional information can be obtained by call DFA-LGD at 505-827-8051 or at DFA's website (www.nmdfa.state.nm.us).

7 REFERENCES

Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. (2018). *Recommended Standards for Water Works.* St. Paul: Minnesota's Bookstore Communications Media Division.

New Mexico Environmental Department - Construction Programs Bureau. (2006). *Recommended Standards for Water Facilities.*

Riesterer, J., Drakos, P., & Lazarus, J. (2021). *Assessment of Historic and Projected Phoenix Spring Flows.*

U.S. Environmental Protection Agency. (2013, July). *Water Audits and Water Loss Control for Public Water Systems.* Retrieved from https://www.epa.gov/sites/default/files/2015-04/documents/epa816f13002.pdf

APPENDIX A: ULTRA MAG ELECTROMAGNETIC FLOW METER

MODEL UM06 AND UM08

ULTRA MAG® ELECTROMAGNETIC FLOW METER

150 PSI FLANGED TUBE METER, SIZES 2" thru 48"
300 PSI FLANGED TUBE METER, SIZES 2" thru 48"

M-SERIES SIGNAL CONVERTER

DESCRIPTION

MODELS UM06 AND UM08 FLANGED TUBE ULTRA MAG® meters are manufactured to the highest standard available for magmeters. They incorporate microprocessor technology to offer very low flows and broad rangeability. The flanged end tube design permits use in a wide range of applications with up to 300 PSI working pressure. Flanged ends are Class "D" flat face flanges (150 PSI) or Class "F" raised face flanges (300 PSI). The fabricated tube is stainless steel with steel or stainless steel flanges and is lined with UltraLiner™, an NSF approved, fusion bonded epoxy material.

INSTALLATION is made similar to placing a short length of flanged end pipe in the line. The meter can be installed vertically, horizontally, or inclined on suction or discharge lines. The meter must have a full pipe of liquid for proper operation. Fluid must be grounded to the downstream flange of the sensor either via internal grounding electrodes (4 - 12") or using McCrometer 316 SS Grounding Rings. Any 90 or 45 degree elbows, valves, partially opened valves, etc. should not be placed closer than five pipe diameters upstream and two pipe diameters downstream. All blending and chemical injection should be done early enough so the flow media is thoroughly mixed prior to entering the measurement area.

SIGNAL CONVERTER: The M-Series signal converter is the reporting, input and output control device for the sensor. The converter allows the measurements, functional programming, control of the sensor and data recording to be communicated through the display and inputs/outputs. The M-Series microprocessor-based signal converter has a curve-fitting algorithm to improve accuracy, dual 4-20mA analog outputs, an RS485 communication port, an 8 line graphical backlit LCD display with 3-key touch programming, and a rugged enclosure that meets IP67. In addition to a menu-driven self-diagnostic test mode, the converter continually monitors the microprocessor's functionality. The converter will output rate of flow and total volume. The converter also comes standard with password protection and many more features.

OPTIONAL:

DC powered converter (10-35 VDC, 21 W)
Meter mounted converter
Extended warranty
Hastelloy® electrodes
ANSI or DIN flanges
Special lay lengths, including ISO standard lay lengths
Converter sun shield
Modbus Protocol RS485

SPECIFICATIONS

WARRANTY	2 Years
ACCURACY TESTS	3-point wet flow calibration of every complete flow tube with its signal converter. If desired, the tests can be witnessed by the customer. The McCrometer test facilities are traceable to the National Institute of Standards & Technology. Uncertainty relative to flow is ±0.15%
ACCURACY	Plus or minus 0.5% of actual flow
REPEATABILITY	±0.05% or ±.0008ft/s (±0.25mm/s), whichever is greater
HEAD LOSS	None. No obstruction in line and no moving parts
PRESSURE RANGE	150 PSI maximum working pressure (UM06) 300 PSI maximum working pressure (UM08)
TEMPERATURE RANGE	Operating: -10 to 77˚C (14 to 170˚F) Storage: -15 to 77˚C (5 to 170˚ F)
VELOCITY RANGE	.2 to 32 FPS
BI-DIRECTIONAL FLOW	Forward and reverse flow indication and forward, reverse, net totalization are standard with all meters
CONDUCTIVITY	5 µs/cm
LINER	UltraLiner NSF approved, fusion bonded epoxy
ELECTRODES	Type 316 stainless steel, others optional
POWER SUPPLY	AC: 90-265VAC/45-66 Hz (20W/25VA) or DC: 10-35VDC (21W). AC or DC must be specified at time of ordering.
OUTPUTS	Dual 4-20mA Outputs: Galvanically isolated and fully programmable for zero and full scale (0-21mA) Four separate digital programmable outputs: open collector transistor usable for pulse, frequency, or alarm settings. • Volumetric Pulse • Flow Rate (Frequency) • Directional Indication • High/Low Flow Alarms • Hardware Alarm • Empty Pipe • Range Indication
EMPTY PIPE SENSING	Zero return when electrodes are uncovered
ALARMS	Programmable alarm outputs
DIGITAL TOTALIZER	M-Series restrictive based on pipe size. Cubic Meter, Cubic Centimeter, Mililiter, Liter, Cubic Ddecimeter, Decaliter, Hecaliter, Cubic Inches, American Gallons, Imperial Gallons, Cubic Feet, Standard Barrel, Oil Barrel, Cubic Yard, American Kilogallon, Imperial Kilogallon, Acre Feet, Megagallon, Imperial Megagallon
RATINGS	Metering Tube: NEMA 6P/IP68 with remote converter Electronics enclosure: IP67 and CE Certified

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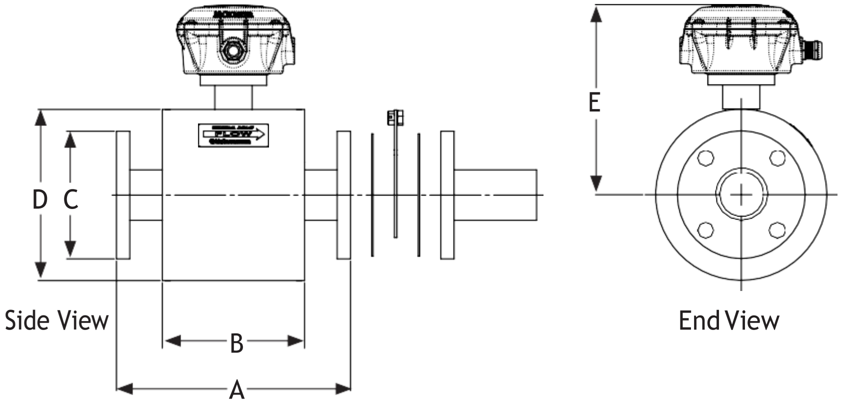
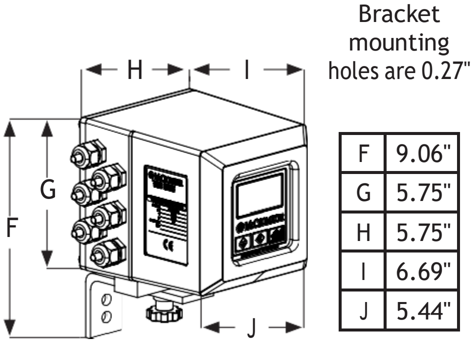
MODEL UM06 AND UM08

ELECTROMAGNETIC FLOW METER

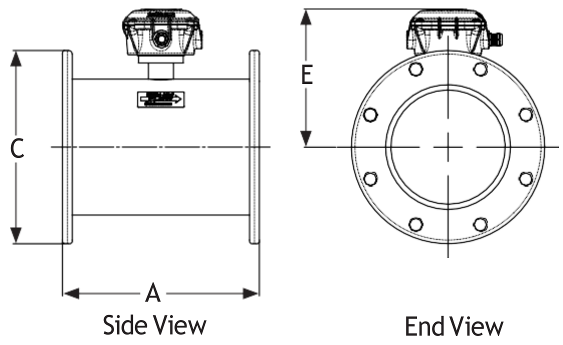


2" and 3" Models Body Style

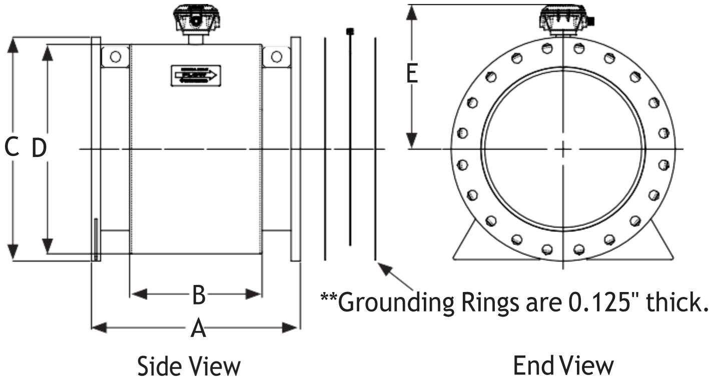


F	9.06"
G	5.75"
H	5.75"
I	6.69"
J	5.44"

Converter Dimensions



4" to 12" Models Body Style



14+" Models Body Style

Pipe Size (Nominal)	Meter Pipe ID	Flow Ranges GPM Standard .2 to 32 FPS Min - Max	DIMENSIONS (Lay Lengths)							Estimated Shipping Weight (lbs.)	
			A*		B	C		D	E	UM06	UM08
			UM06	UM08		UM06	UM08				
2"	2.156	2 - 340	11.00	11.00	6.70	6.00	6.50	7.90	9.26	93	107
3"	3.250	5 - 730	13.40	13.40	6.70	7.50	8.25	9.40	10.01	97	111
4"	3.750	8 - 1,140	13.40	13.40	n/a	9.00	10.00	n/a	8.06	78	108
6"	5.750	19 - 2,660	14.60	14.60	n/a	11.00	12.50	n/a	9.06	82	138
8"	7.375	33 - 4,870	16.10	17.25	n/a	13.50	15.00	n/a	10.06	115	195
10"	9.750	52 - 7,670	18.50	18.50	n/a	16.00	17.50	n/a	10.46	144	247
12"	11.750	74 - 11,180	19.70	19.70	n/a	19.00	20.50	n/a	12.31	193	342
14"	13.625	90 - 16,070	21.70	22.75	12.00	21.00	23.00	20.30	15..46	321	476
16"	15.625	118 - 20,900	23.60	25.25	14.20	23.50	25.50	21.10	16.21	390	645
18"	17.625	150 - 26,480	23.60	25.25	14.20	25.00	28.00	21.10	17.21	446	750
20"	19.563	185 - 32,720	25.60	28.25	16.20	27.50	30.50	24.80	18.26	588	874
24"	23.500	270 - 47,180	30.70	35.75	21.70	32.00	36.00	29.60	20.11	769	1,568
30"	29.250	420 - 73,620	35.80	41.75	26.50	38.75	43.00	35.90	23.26	1,261	2,317
36"	35.250	610 - 105,930	46.10	46.10	28.20	46.00	50.00	42.70	26.66	1,696	2,915
42"	41.250	830 - 144,370	48.05	**	32.10	52.75	**	48.35	29.99	**	**
48"	47.250	1,080 - 188,430	50.00	**	36.00	59.50	**	54.00	33.31	**	**

* Laying lengths for meters with ANSI Class 150 Flanges are equal to UM08 laying lengths

** Consult factory

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APPENDIX B: GREEN TANK INSPECTION REPORT

I iquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report

Job No. ""-'· \,._,,,0,-,<.. _ Utility L.LAS6---Qf"' _Tues Sl:1 VAIU-'(f ank L U:Sc2 IC6-,{J'5-J--

InspectorX M Team Leader 3l:--ce.4..-..c. ----- Dat,eCJ-/")- [Fori!ii)

Complies With: AWWA • OSHA • ANSI • NIOSH • NAVFAC • NFPAC

• Contamination & Health Checklist •

Air Vents	Type: mushroom # 1 Screen Conditions: [✓ Good] Fair Poor
Hatches	Type: square # 1 Secured Properly: [✓ Yes] No Properly Sealed: [✓ Yes] No
Exterior Overflow	Flapper: Yes [✓ No] Screen: [✓ Yes] No Gasket: [✓ Yes] Condition: [✓ Good] Fair Poor
"'~~hodic Cov~~	~~Covers in Place: Yes No Gaskets: Yes No Properly Sealed: Yes No # of Covers~~
Roof to Wall Joint	Welded: [✓ Yes] No Properly Sealed: [✓ Yes] No
Roof Integrity	Holes: Yes [✓ No] Cracking: Yes [✓ No] Standing Water: Yes [✓ No] Other: none
Wall Integrity	Holes: Yes [✓ No] Cracking: Yes [✓ No] Other: none
Manway Integrity	Leaks: Yes [✓ No] Condition: [✓ Good] Fair Poor
Water Clarity	General Appearance: Clear Odor: none Other: none
Floating Surface Debris	Type: None Source: N/A
~~Hypalon Floating Cover~~	~~Condition: Good Fair Poor Holes: Yes No Tears: Yes No~~
~~Telemetry Penetrations~~	~~Properly Sealed: Yes No~~
Other Discrepancies	None

,l,-

• Facility Safety Compliance Checklist •

Exterior Ladder

Overall Ladder	Condition· Fair Poor Offset Landings Yest@# Itl/.,:i_ Height·___ 1 __
Ladder Vandal Guard	Present Yes I No / Vandal Guard Locked: Yes, ·
Ladder Rails & Rungs	Condition: Fair Poor Missing/Damaged Rungs: Yes @
Rung Spacing & Depth	Spacing: 1_. In. (ma). 12') Toe depth.________ m (min 7") r.
Rail Spacing & Size	Width .. _ in. (min 2') Thickness._Ll.(.f_in (mm U,. R ii to Rail. _jJJ_!_ 1n (max 16'J
Safety Climb System	Type. Cage Notched Rail Cable Gr®- Other Condition. Fair Poor
Number & Locations	W all .1.... Leg Roof_____Riser Pipe_____ Other__ _
Ladder Attachments	[✓ Welde] Bolted Other

Manways

Type and Size	Type: oval S Other Size. 5;:.. (24" 1B"X22"mm) # :L -
Support Structure	Dogged Davit Arm Other Condition· Fair Poor
Number & Locations	Wall ..Z. Roof_____Riser Pipe_____ Other__ _

Hatches

Hatch Type and Size	Round R c angle Other (24' 24 X15" min) 0.5
Hatch & Lid Lip Height	Hatch (4"min.) ________11_ led (2 mm.J 2 •.7=,

Balconies & Railing

Deck/Walkways	Condition: Good. fair Poor Width.
Hand Rails	Condition: Goorf\,;\=alr p 1 I'-- __ (42" min.) No. Rails___ (min. 2)
Toe Rail	Co , ,.. r Poor Height (4" min.)
Welds/ ~~Attachments~~	Condition: Good a r Poor
Safety Tie-Off Points	
Antennas	c:Types: Condition: Good F /J. P n · g- PrJiji.1td Poin. ·t _I_O_m_n_iDirectional Receiving #__ -

P-lher D ! screpancies None

Additional Information NONE

DISCLAIMER
Unless otherwise noted. the findings contained in lhis repor1 were neither prepared nor rev)ewed by a licensed Professional Eng1neor. but are based on lhe experience. training and *visual examination* of the inspecting Orve Memtenence Technician

Liquid Engineering Corporation

Circular Tank Diagram / Information Worksheet

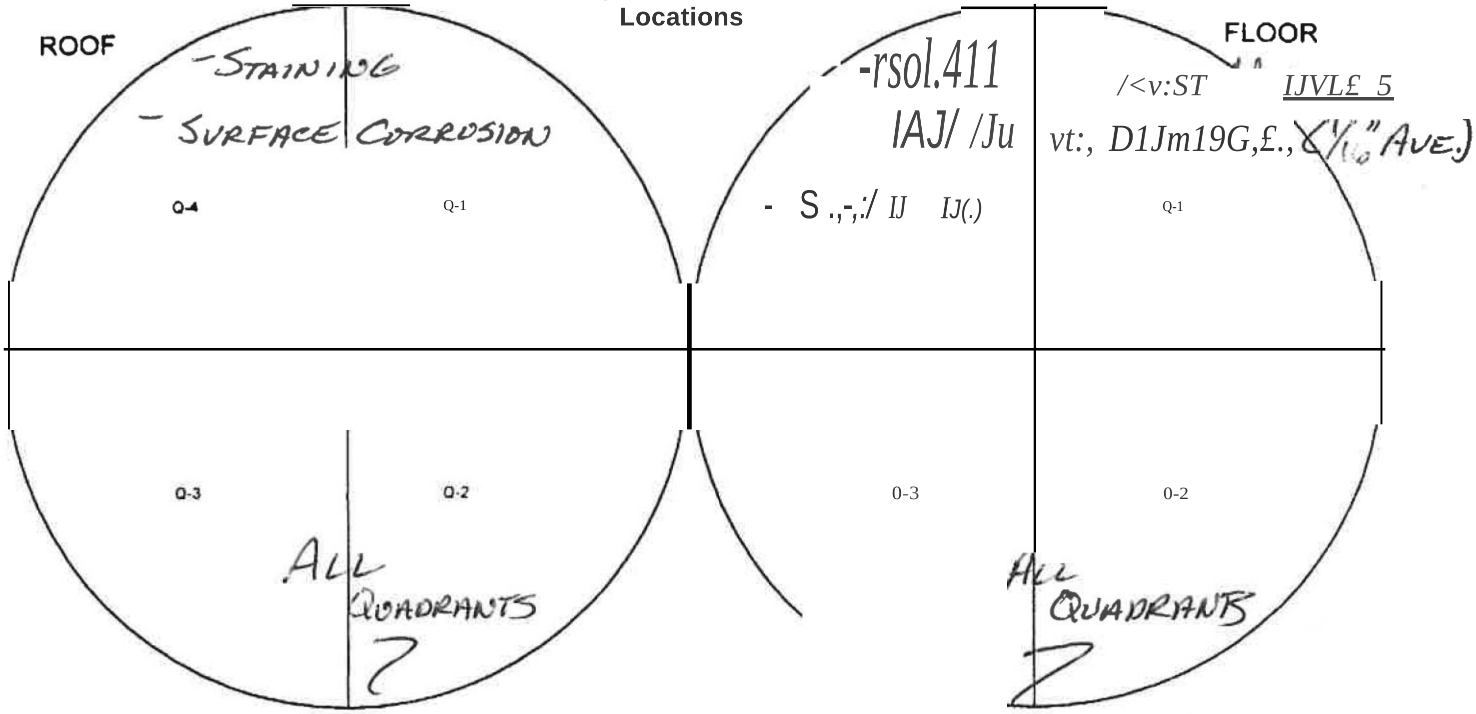
Job# 3Sll10

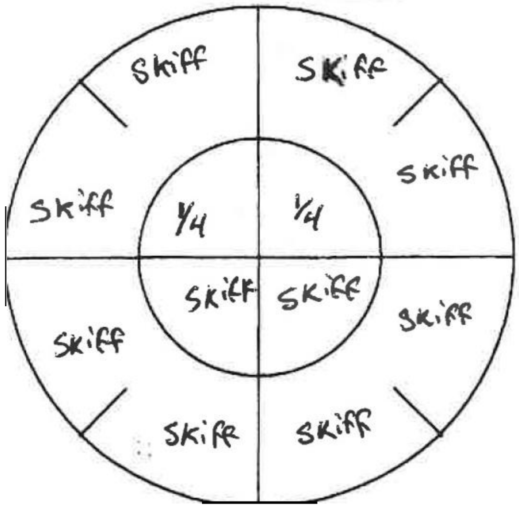
Tank Name:#/ {?SO t6 <:,/& \

Date: 4-lt-z-og

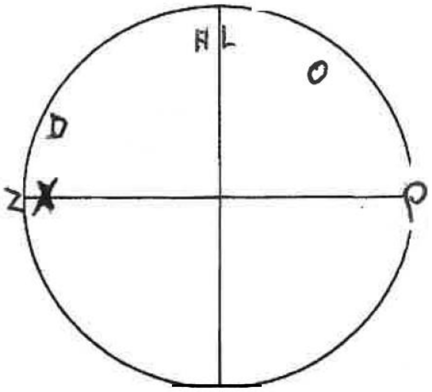
WALLS	Q-4	Q-1	Q-2	Q-3
Roof line	'Srn1ihv'1 $14 5 / ,eVI.J5 - :rsoutT££J l:!v.s:r 1	lJ ovu;;5 {/4,,)/A,/<,)		
Floor line	At.,.t_ aV14/J Mv-rs			

Testing and Discrepancy Locations

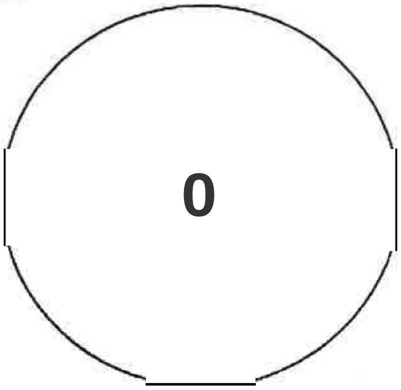




Sediment Depth Meaeurement11



Plumbing & Structure Location



Column Placement =+

Plumbing and Structure **Codes**

O:aOutlet X=lntet **Z=Manway**
V=Vent D=Dre,n S=Sump
L=Ladder H=Hatch P=Overflow
F=Float level Indicator
T=Telemetry

T •um[J
Base Strulcure
I I u (U) I
Top Structure
I_ I I n \ (I

Steel Concrete Other· ________

Average Sediment Depth= The sum of **all measurements taken,** divided by the number of **measurements taken.**

Average Sediment Depth: 5 tFF Cubic Yardage:__ _

Type of Sedim nt: S lt...T,) M/\J VV1AfJG6AlJ

Liquid Engineering Corporation

Steel Potable Water Reservoir Inspection Report

Job No. :-:-64(0 Utility vvLA{-t:; D£1A"!S !:.tz:: VAli{:-'-[Tank :::f::l=-...; ...1.f(.-'? 5.0;:r..............?.:'.......;$.y/;._j&.....:.....)-j----

AMERICAN WATER WORKS ASSOCIATION

ANSI/AWWA M42 / 0101-53 (R86)

SSPC Legend
Society for Protective Coatings

RUST GRADE	DESCRIPTION
1o	No rusting, or< o 01% of surface is rusted
9	Minute rusting, < o 03% of surface is rusted
8	Few isolated rust spots,< O 1% of surface is rusted
7	Few isolated rust spots, < 0.3% of surface is rusted
6	Extensive rust spots, < 1% of surface is rusted
5	Rusting to the extent of 3% of surface area
4	Rusting to the extent of 10% of surface area
3	Approximately 116th of the surface (17%) is rusted
2	Approximately 1/Jrd of the surface (33%) is rusted
1	Approximately½ of the surface (50%) is rusted
o	Approximately 100% of the surface is rusted

NACE Legend
National Association of Corrosion Engineers

CORROSION GRADE	DESCRIPTION
A	None
B	Uniform Surface Corrosion
C	Pitting
D	Concentration Cell
E	Galvanic
F	Stress Corrosion Cracking
G	Erosion Corrosion
H	Intergranular
I	Dealloying

AWS Legend
American Welding Society

WELD GRADE	DESCRIPTION
L	Satisfactory
M	Spatter
N	Porosity
0	Convexity / Concavity
p	Cracks
Q	Inclusions
R	Incomplete Fusion
S	Incomplete Penetration
T	Undercut
U	Underfill
V	Overlap
W	Unable to Evaluate

INTERIOR RESERVOIR ROOF1

	QUADRANT1			QUADRANT 2			QUADRANT3			QUADRANT4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Vents	µ		v...l									
Roof Panels	t,	D	;.J	·c..	1Sb	:...J	!	bD	w	/..	'?::.b	bc:
Roof Support Structure		"l?::>l2	'\	&:,		1 ... L	L	b	)o .!		h	l L
Roof Support Gussets		"f:;,b	2	t.,			c.,	:&1>	(...)	t,.		\v

_;.....,. ....,

Protective Coating **Good Poor:** Blistering - Chalking - Checking - Cracking - Delamination - Growth - Pinholes - Staining - Saggs/Runs

Blisters/ Avg. Size________________ **Pitting /Avg.Size** ________________

INTERIOR RESERVOIR WALLS1

	QUADRANT 1			QUADRANT2			QUADRANT3			QUADRANT4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Wall to Roof Weld		b	L	l.d	.::b	! ; t'		1S.	'IAL	f-:,	0	'vlL
Lower Ring Panels		1?	w	t,	&	vv		i:	c:	cG		W
Middle Ring Panels		'n	vJ	6		"V'		h	L./	6	"15	\
Upper Ring Panels					i::,				'vv	Co		Vv:'.
Interior Ladder	8	-.:	L							R	3::.,	l..

Protective Coating **Good QPoor:** Blistering - Chalking - Checking - Cracking - Delamination - Growth - Pinholes-

Blisters/ Avg. Size________________ Pitting **/Avg.Size** JltL, ________________

INTERIOR RESERVOIR FLOOR1

	QUADRANT 1			QUADRANT 2			QUADRANTJ			QUADRANT4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Perimeter Weld	:2	(3/X ,	L-		B/JC	L	.:;i	./3lJC	L	oZ	-f3t)C	L-
Floor Sketches (Panels)	7	BtJC	L--		8/JC	L	i	BtJC	L	7	L30C	c..,

Protective Coating **Good Poor:** Blistering - Chalking - Checking - Cracking - Delamination - Growth - Pir tes - SaggsIR uns

Blisters/ Avg. Size ________________ **Pitting /Avg.Size** _ .Y'.'-'fl-„ ________________

liquid Engineering Corporation

Section 17: **Immediate Needs Assessment**

Job No.: 35410 Tank Name: -1 Cz-:;o t;.G) Date q-l':,-05

I. Health & Safety Items

O Safety Climb System Installation: Not Recommended (Semi ...) -- ,_--'.,__,._.....,cc...,;:S;C.J ..____,>,,c=-.......................;-..--'"'"-l""-'-L u.o:::-;,1------------

O Vent Screen Repairs: _.s -Si. 1-P. !"1'f____f.J.:i::f 2.....J:;:f!.!l'fd!. ::u:J!J-

II. Testing Items

O Dye Testing For Leak Evaluation: .,v.o , fli.{:) 1--r,i .....–

☐ Presence of Lead Test (Interior/ Exterior): ,Au.l,..n,<,.;A_e=-..&.u.:.::v:;..;11:. C,..I"--

Ill. Destructive Testing Items

O % Of Lead Test (Interior / Exterior)(Coating *samples* /J/9 *removed for laboratory* *anatysis): ...,v,,rl""IJ.,.*

O Coating Adhesion Testing (Interior / Exterior): ....,/1;,.l.,o_iT___,p"";""r--l oF'c=..:;r-'I'>'l--=-fl'I.

Specific written authot1zation required to perform *destructive tasting. Destructive tests include touch-up of coating system.*

IV. Repair Items

O Epoxy Coating Repairs: *lla*li::l *70 Jka&..5*. *i·x.Jt)Q?* *i·?;u Pw,,l?* f *tl-*¹*,tu-5(I r*

O Temporary Leak Repairs: .,v/_,Q,.,

O Float Operated Level Indicator Repairs / Maintenance: AJ/11 *(rx;TE')IZµAL* *7k<NJ1&Zi?lj,)*

O Hypalon Repairs:--

V. Security Related Items *(Critical security upgrade information is immediately available.)*

()!Ptank Vents Are Not Equipped With A Security Vent Shroud.

Tank Hatches Are Not Equipped With A Security Hatch Locking **Device.**

la' Tank Perimeter Not Adequately Secured:

O EPA - Mandated Vulnerability Assessment Not Completed_·

Additional Description of Recommended Work

* CLEAN AND INSPECT EVERY 3 I◊ 5 Yf:..4.RS,

* SECURITY RELATED ITEM LISTED ABOVE

* RECOMEND 16 TO 20 HOURS OF EPOXY

The above noted additional work is considered immediately necessary and recommended to be completed. Some items may be completed in conjunction with work currently being performed while the field crew is on site.

Authorized Utility Signature:

Signing at>ove achkowledgn that recommendation■have been made for additional work that may ba neceaaary and can ba a,mplllad while the LEC etN ii on aita. Signing abO•• doaa not authorize additional work An additional authorization will ba prepared lo IIUlhorlza any additional work deand.

Liquid Engineering Corporation

Steel Potable Water Reservoir Inspection Report

Job No. "55LJl()

Utility i 1-a1 k'--.E-0£ ::r:M,:; ..Stt VAfleY Tank___ ,l .l e,.. :S:::, "--"t'.'.t;'°""- G::::.,,'-1- t:J+---

INTERIOR RESERVOIR SUPPORT COLUMNS,

	QUAORANT1			QUADRANT 2			QUADRANT3			QUADRANT4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Column Structures	Cf	8	L-									
Column Base Structure	q	B	L.									
Column To Roof Stucture	1	B	L									

Protective Coating **Fair** **Poor:** Blistering - Chalking - Checking - Cracking - Delamination - Growth - Pinholes - — Saggs/Runs

Blisters/ Avg. Size tJlA Pitting / Avg. Size ____ _..:,A)::::. /;;q_,

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT1			QUADRANT 2			QUADRANT3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Inlet Plumbing										g	13	C....
Outlet Plumbing	q	fJ.	L									
Manways			———							ci	th	L
Floor Drains										q	l2,	L.
Interior Overflows			———		/;;)	L						

EXTERIOR RESERVOIR ROOF,

	QUADRANT1			QUADRANT 2			QUADRANT3			QUADRANT4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Vents		6	L..									
Roof Panels		(b	L		0	L			L.		r;	L
Access Hatches	q		L.									

Protective Coating ifil1' Poor: Blistering - Cracking - Delamination - Growth - Pinholes - — Saggs/Runs

·Blisters/ Avg. Size .UOne Pitting /Avg.Size ..:.W......,/'-----'-14,,-"'-------------

EXTERIOR RESERVOIR WALLS,

	QUADRANT1			QUADRANT2			QUADRANT3			QUADRANT 4		
	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS	SSPC	NACE	AWS
Wall to Roof Weld	C\	&	l...	c::	lb	'	o'		L-	C\	(Q	L_
Lower Ring Panels Middle Ring Panels	5J:	!;i	f-.	'1	oe	L		a,	'L	6l-	6Ci	L-
Upper Ring Panels	0.	le	L..		5.	L			l,,.		e,	L...
Interior Overflows					-6	L-						

Protective Coating Good Poor: Blistering — - Cracking - Delamination - Growth - Pinholes - — Saggs/Runs

Blisters/ Avg. Size lA **Pitting /Avg.Size** AJ l14

FOOTINGS / FOUNDATION,

Footings / Foundations Satisfactory__________ Cracking l(_) Spalling ~~Erosion/Exposed Agg~~regale___________

Anchor Bolts Satisfacto A- Rusted / Corroded (If Excessive) Diameter=

TOWER SUPPORT STRUCTURES,

Tower Legs/ Columns Satisfactory ___________ Alignment _______________ Settling ______________ ~~Rust / Corrosion~~ __________

Riser Pipe Satisfactory_____________Align_ entl Settling ~~Frost Casing~~ ~~Rusted / Corroded~~ ______

Rods & Turnbuckles Satisfactory Turnlu le Tension ~~Rod Tension~~ _____________ Cotter Pins/Rod Nuts_____________

Leg shoes/ Brackets fi Rusted I Corroded _______________ Pitting / Cracking_____________

Other___ ————:: ═ ' '' —— ══ ——————————————————————————————

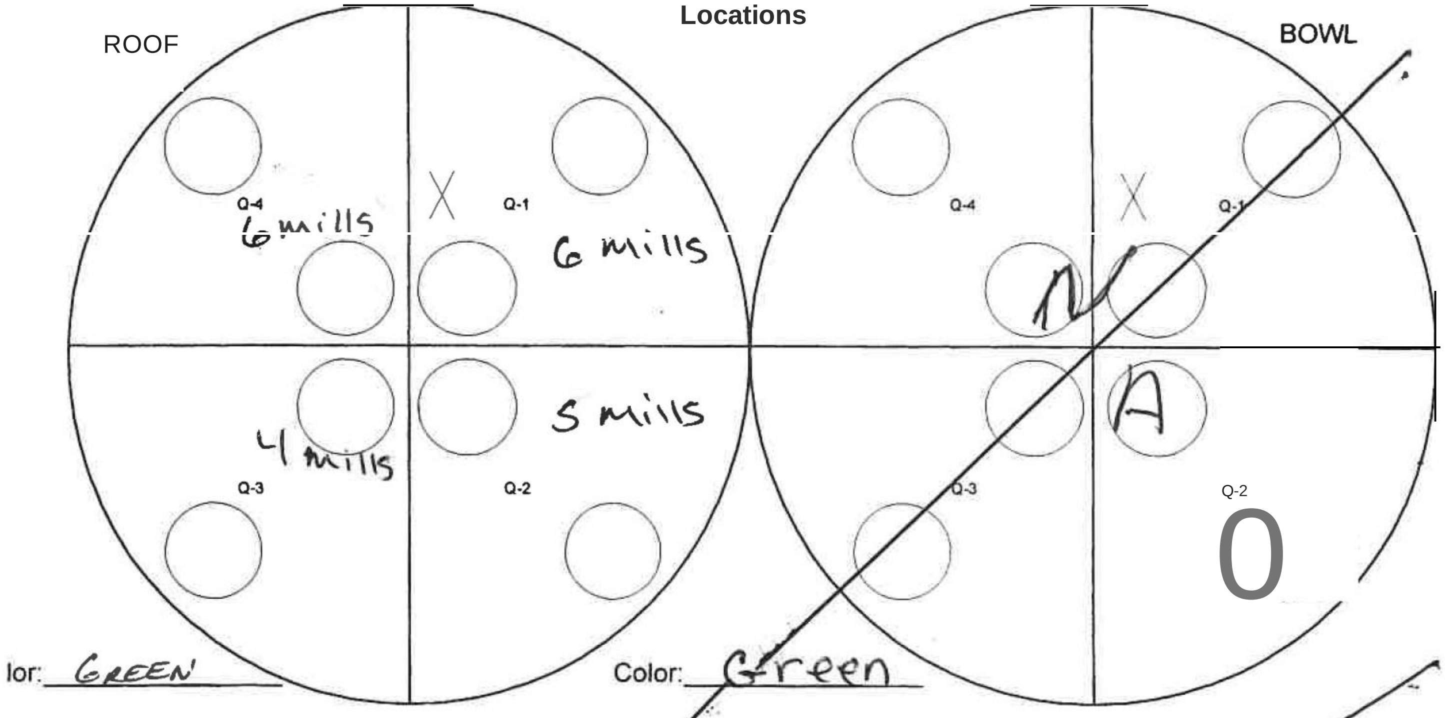
Liquid ering Corporation

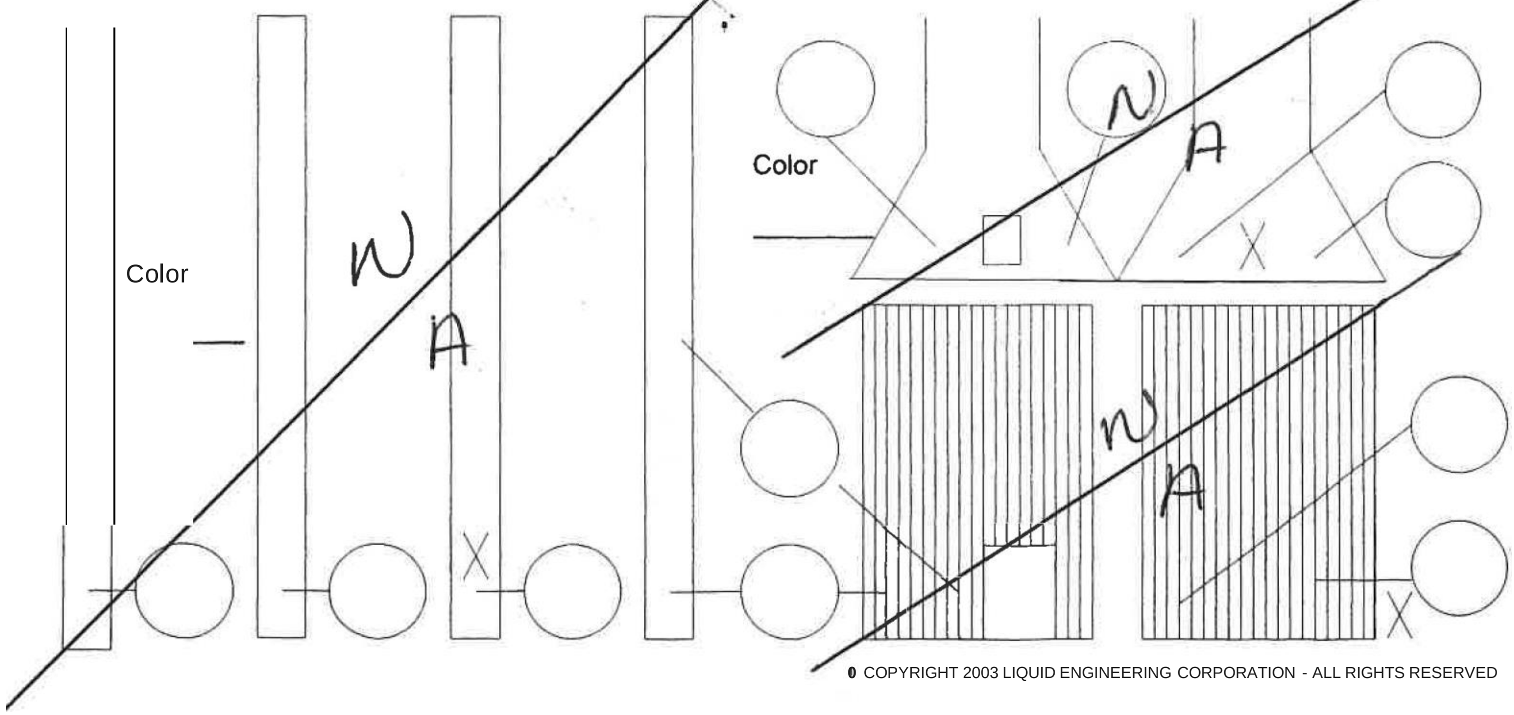
Circular Tank Diagram / NOT ☐ OFT Coating Adhesion ☐ Presence of Lead☐

Job# ·::s,c.,// \f) Tank Name: :µ-) {.?. ") yt;. sltS) Date: g-J'J-08

WALLS	Q-4	Q-1	Q-2	Q-3
of line or line	G)xG)	Color: G-- rei'n (vi - LL<:> 0 0	G)@	0 0

Testing and Discrepancy Locations





Liquid Engineering Corporation

Steel Water Reservoir Exterior Condition Worksheet

Job No.: 3.Slllo

Tank Name: - -• \L---'-(..1..,._S;?....,_ -.-'.-t'.:. c;.. f),. .[{5.) -----

Date 9-tr:>::cg,

Section 9. General Tank Security

Is the tank surrounded by a security fence?	Yes (N)
Are the access gates locked?	Yes (f4
Is the tank equipped with a vandal guard on the primary access ladder?	**Yes**
Is the vandal guard locked?	Yes
Are all of the access hatches equipped with electronic monitoring devices?	**Yes** ®
Are all of the vents equipped with security vent shrouds?	Yes ®
Does the exterior of the tank show signs of trespass?	Yes (N-o)
Does the surrounding geography of the tank obscure it from public **view?**	Yes 0
Are the external plumbing components housed in a secure vault or out building?	es') No
Is the area surrounding the tank well lit?	l(ffi) No
Are there any additional security features associated with this tank or surrounding **area?** If ves describe in additional remark!; section.	Yes (_No)

Additional Remarks and Measurements

APPENDIX C: NEPTUNE HIGH PERFORMANCE TURBINE METER

A PRODUCT SHEET OF NEPTUNE TECHNOLOGY GROUP

High Performance Turbine Meter

Neptune® High Performance (HP) Turbine water meters offer some of the widest flow ranges of any turbine meters on the market.

All HP Turbine water meters meet or exceed the latest performance and accuracy requirements of AWWA C701 and maximum continuous flow rates may be exceeded by as much as 25% for intermittent periods.

Construction

Each HP Turbine consists of a rugged, lead free, high-copper alloy maincase, an AWWA Class II turbine measuring element, and a roll-sealed register. The maincase is corrosion-resistant, lightweight, and compact. Inlet and outlet connections are flanged. Strainers are available to prevent debris from entering the meter and to reduce the effects of uneven water flow due to upstream piping variations.

The unitized measuring element (UME) allows for quick, easy, in-line interchangeability. Water volume is measured accurately at all flows by a specially-designed assembly. The hydrodynamically-balanced, thrust-compensated rotor relieves pressure on the thrust bearings to minimize wear and provide sustained accuracy over an extended operating life. Direct coupling of the rotor to the gear train eliminates revenue loss due to slippage during fast starts and line surges. A calibration vane allows in-field calibration of the UME to lengthen service life and to ensure accurate registration.

The roll-sealed register eliminates leaking and fogging. A magnetic drive couples the register with the measuring element.

Application

The HP Turbine water meter is designed for applications where flow rates are consistently moderate to high.

Systems Compatibility

Adaptability to all present and future systems for flexibility.

Warranty

Neptune provides a limited warranty with respect to its HP Turbine water meters for performance, materials, and workmanship.

When desired, owner maintenance is easily accomplished by in-line replacement of major components.

KEY FEATURES

Roll-Sealed Register

- Magnetic-driven, low-torque registration ensures accuracy
- Impact-resistant register design with flat glass for readability
- 1:1 ratio, low-flow indicator identifies leaks
- Bayonet mount allows in-line serviceability
- Tamperproof seal pin deters theft
- Date of manufacture, size, and model stamped on dial face

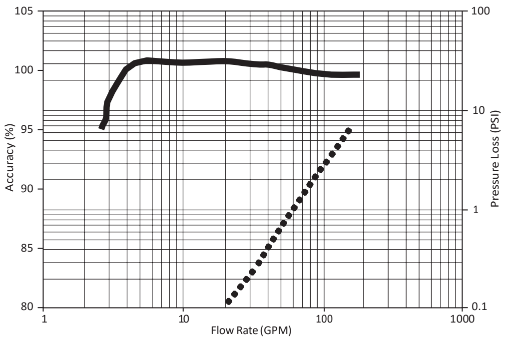
Lead Free Maincase

- Made from lead free, high-copper alloy
- NSF/ANSI 61 and 372 certified
- Compact design is lightweight and easy to handle
- Sturdy, durable, corrosion-resistant
- Resists internal pressure stresses and external damage
- Residual value

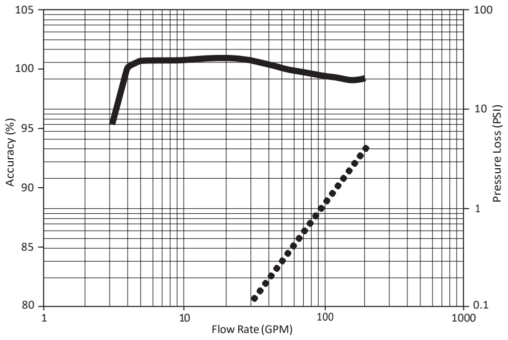
Turbine Measuring Element

- Excellent low-flow sensitivity and wide flow ranges available at 98.5% - 101.5% accuracy
- Direct coupling of rotor to gear train prevents slippage and ensures accurate registration
- Interchangeable measuring element allows for in-line service
- Hydrodynamically-balanced rotor
- Reusable O-ring gasket on 3” - 10” sizes

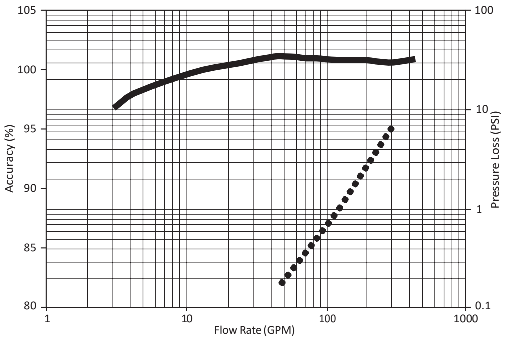
1½” Accuracy



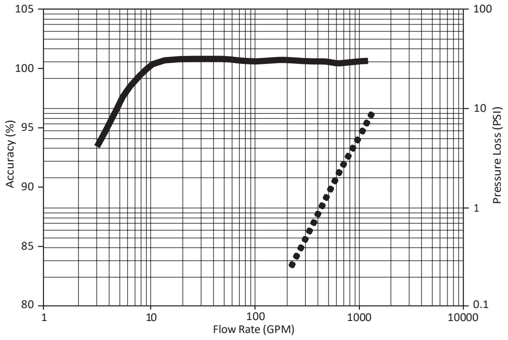
2” Accuracy



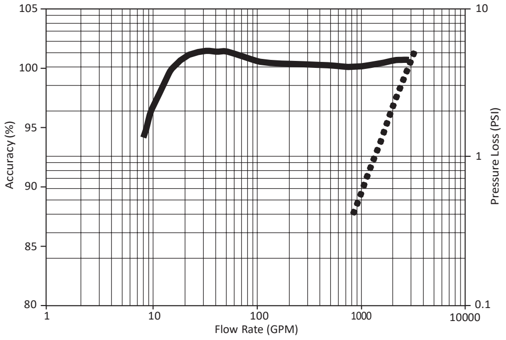
3” Accuracy



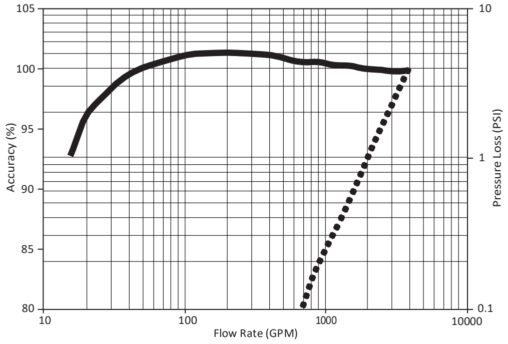
4” Accuracy



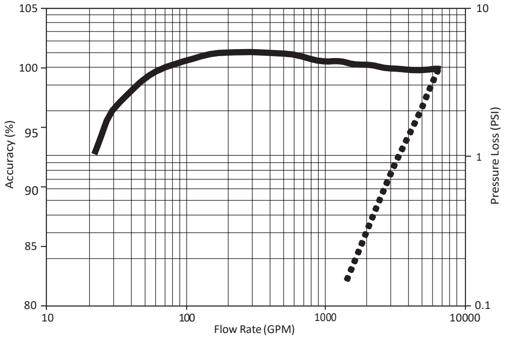
6” Accuracy



8” Accuracy



10” Accuracy



━ Accuracy

⋯ Head Loss

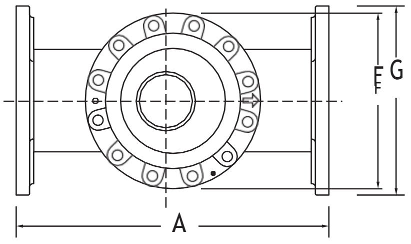
These charts show typical meter performance. Individual results may vary.

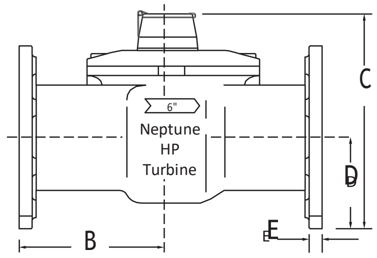
Operating Characteristics

Meter Size	Normal Operating Range @100% Accuracy (±1.5%)	Maximum Intermittent Flow	AWWA Standard
1½”	4 to 160 US gpm 0.91 to 36.3 m^3/h	200 US gpm 45.4 m^3/h	4 to 120 US gpm 0.91 to 27.3 m^3/h
2”	4 to 200 US gpm 0.91 to 45.4 m^3/h	250 US gpm 56.8 m^3/h	4 to 190 US gpm 0.91 to 43.2 m^3/h
3”	5 to 450 US gpm 1.14 to 102.2 m^3/h	560 US gpm 127.2 m^3/h	8 to 435 US gpm 1.8 to 98.8 m^3/h
4”	10 to 1,200 US gpm 2.27 to 272.5 m^3/h	1,500 US gpm 340.7 m^3/h	15 to 750 US gpm 3.4 to 170.3 m^3/h
6”	20 to 2,500 US gpm 4.55 to 567.8 m^3/h	3,100 US gpm 704.1 m^3/h	30 to 1,600 US gpm 6.8 to 306.6 m^3/h
8”	35 to 4,000 US gpm 7.95 to 908.5 m^3/h	5,000 US gpm 1135.6 m^3/h	50 to 2,800 US gpm 11.4 to 635.9 m^3/h
10”	50 to 6,500 US gpm 11.36 to 1476.3 m^3/h	8,000 US gpm 1817 m^3/h	75 to 4,200 US gpm 17.0 to 953.9 m^3/h

Dimensions

Meter Size	A	B	C-STD	C-ProRead™	C-E-CODER®and ProCoder® Products	D	E	F	G	Weight
	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	lbs (kg)
1½”	10 (254)	6½ (165)	7⅛ (181)	7⁹⁄₁₆ (192)	7¾ (197)	1¾ (44)	¾ (19)	4½ (114)	5⅜ (137)	19 (8.6)
2”	10 (254)	6½ (165)	7⅝ (194)	8¹⁄₁₆ (204.8)	8¼ (210)	2⅛ (54)	¹³⁄₁₆ (21)	4½ (114)	5⅜ (137)	20 (9.1)
3”	12 (305)	6 (152)	10 (254)	10⁷⁄₁₆ (265.1)	10⅝ (270)	3¾ (95)	⅝ (16)	6¼ (159)	7½ (191)	40 (18.1)
4”	14 (356)	6½ (165)	10⅞ (276)	11⁵⁄₁₆ (287.3)	11½ (292)	4½ (114)	¾ (19)	8⅛ (206)	9 (229)	52 (23.6)
6”	18 (457)	8⅝ (219)	13 (330)	13⁷⁄₁₆ (341.3)	13⅝ (346)	5½ (140)	1 (25)	10¼ (260)	11 (279)	115 (52.2)
8”	20 (508)	9⅝ (244)	15½ (394)	15¹⁵⁄₁₆ (404.8)	16⅛ (409)	6¾ (171)	1⅛ (29)	10¼ (260)	13½ (343)	195 (88.4)
10”	26 (660)	12⅝ (321)	15½ (394)	15¹⁵⁄₁₆ (404.8)	16⅛ (409)	8 (203)	1¼ (32)	10¼ (260)	16 (406)	275 (124.7)





Specifications

Application

- Cold water measurement of flow in one direction

Maximum operating pressure:

- 175 psi (1206 kPa)

Maximum operating temperature:

- 80°F

Register

- Direct reading, center-sweep, roll-sealed, magnetic drive with low-flow indicator

Measuring element

- AWWA Class II Turbine, hydrodynamically-balanced rotor

Guaranteed Systems Compatibility

All HP Turbine water meters are guaranteed adaptable to our ARB® V, ProRead™ (ARB VI), ProCoder™, E-CODER®, E-CODER®)R900*i*™, E-CODER®)R450*i*™, TRICON®/S, TRICON/E®3, and Neptune meter reading systems without removing the meter from service.

Options

Sizes

- 1½″, 2″, 3″, 4″, 6″, 8″, 10″

Units of measure:

- U.S. gallons, imperial gallons, cubic feet, cubic metres

Register Types

- Remote reading systems*:
  ARB V, ProRead,
  ProCoder, E-CODER,
  E-CODER)R900*i*, E-CODER)R450*i*,
  TRICON/S, TRICON/E3

* *Consult factory for meter performance specifications when fitted with ARB.*

- Reclaim

Companion flanges

- 1½″ and 2″ (oval): bronze
- 3″, 4″, 6″: bronze or cast iron
- 8″ and 10″: cast iron

Strainer

- 1½″- 6″ NSF/ANSI 61 lead free high copper alloy
- 1½″-10″ NSF/ANSI 61 lead free Rilsan® nylon-coated ductile iron

Registration

Registration (6-wheel odometer, per sweep hand revolution)

	1½", 2", 3", 4"	6", 8", 10"
1,000 US Gallons		✓
1,000 Imperial Gallons		✓
100 US Gallons	✓	
100 Imperial Gallons	✓	
100 Cubic Feet		✓
10 Cubic Feet	✓	
10 Cubic Metres		✓
1 Cubic Metre	✓	

Register Capacity (6-wheel odometer)

	1½", 2", 3", 4"	6", 8", 10"
1,000,000,000 US Gallons		✓
1,000,000,000 Imperial Gallons		✓
100,000,000 US Gallons	✓	
100,000,000 Imperial Gallons	✓	
100,000,000 Cubic Feet		✓
10,000,000 Cubic Feet	✓	
10,000,000 Cubic Metres		✓
1,000,000 Cubic Metres	✓	

NEPTUNE
TECHNOLOGY GROUP

#winyourday
neptunetg.com

Neptune Technology Group
1600 Alabama Highway 229
Tallassee, AL 36078
800-633-8754 f 334-283-7293

APPENDIX D:VTSV OBSERVED FIRE HYDRANT FLOWS

Taos Ski Valley Fire Department
2020 Hydrant Testing Report
Testing completed on 10/19/2020

TAG #	Hydrant Dia.	Coeff.	Year	Make	Location	Stat. Press.	Res. Press.	Flow Press.	Total GPM	Flow Hydrant	Notes
BR1	2.5	0.9	1981	Mueller	Bluejay Ridge (Just South of Kachina Rd)	80	22	7	452	BR5	
BR2	2.5	0.9	2008	Mueller	100 Kachina Rd (Bavarian Chalets)	78	21	7	448	BR5	
BR3	2.5	0.9	2012	Mueller	100 Kachina Rd (Bavarian Chalets Entrance)	X	X	X	X	X	OUT OF SERVICE- No water/flow.
BR5	2.5	0.9	UNK	Waterous	91 Kachina Rd	80	29	8	518	BR6	
BR6	2.5	0.9	1981	Mueller	Deer Ln (SW of Williams Lake Trail Head & Parking)	79	38	9	612	BR5	
BR9	2.5	0.9	2005	Mueller	Kachina Rd (NE of Lynx Dr)	X	X	X	X	X	OUT OF SERVICE- No water/flow.
CH2	2.5	0.9	1981	Mueller	61 Cliff Hanger Loop	70	35	20	910	ZAP3	
CH3	2.5	0.9	UNK	Waterous	Phoenix Switchback Rd & Twining Rd	109	35	20	829	ZAP3	
CH4	2.5	0.9	2008	Mueller	Burroughs Rd & Lily Ln	X	X	X	X	ZAP3	OUT OF SERVICE- Once the hydrant was on and water was flowing, a loud POP came from the 3 o'clock outlet and water came pouring out where it meets the barrel.
CH6	2.5	0.9	1981	Mueller	Chipmunk Ln & Coyote Ln	90	15	12	560	CH3	All cap chains broken/missing
EB1	2.5	0.9	UNK	Mueller	5 Thunderbird Rd	X	X	X	X	X	Unable to test due to construction in the area.
EB3	2.5	0.9	UNK	UNKNOWN	116 Sutton Pl	X	X	X	X	X	Unable to test due to construction in the area.
EB5	2.5	0.9	2017	Mueller	106 Sutton Pl	70	24	20	785	EB2	
EB6	2.5	0.9	2001	Mueller	5 Firehouse Rd (Near Lift House)	90	20	10	557	EB5	
EB7	2.5	0.9	1981	Mueller	22 Firehouse Rd	100	18	15	641	EB10	All cap chains broken/missing
EB8	2.5	0.9	UNK	Waterous	22 Firehouse Rd (Condominiums)	80	10	20	696	EB10	
EB9	2.5	0.9	2015	Mueller	2 Ernie Blake Rd (N of The Blake Hotel)	78	25	20	788	EB2	
EB10	2.5	0.9	2017	Mueller	3 Firehouse Rd	108	24	10	544	EB7	
KAC1	2.5	0.9	2002	Mueller	Porcupine Rd (W of Kachina rd)	85	48	15	881	KAC3	
KAC2	2.5	0.9	2004	Mueller	Porcupine Rd (SW of turning into Zap's Rd)	92	78	15	1574	KAC3	
KAC3	2.5	0.9	2004	Mueller	98 Zap's Rd (NW of Porcupine Rd)	85	49	20	1032	ZAP2	
KAC4	2.5	0.9	2011	Mueller	57 Zap's Rd	100	65	15	1015	ZAP2	
KAC5	2.5	0.9	2010	Mueller	165 Twining Rd	115	75	20	1197	ZAP3	
KAC6	2.5	0.9	2005	Mueller	174 Twining Rd	108	70	20	1181	ZAP3	
PHX1	2.5	0.9	1981	Mueller	48 Twining Rd	81	22	20	764	CH3	
PHX2	2.5	0.9	1981	Mueller	35 Twining Rd	98	65	10	844	CH3	
PHX3	2.5	0.9	2013	Mueller	4 O E Pattison Loop	106	20	15	650	PHX1	

Taos Ski Valley Fire Department
2020 Hydrant Testing Report
Testing completed on 10/19/2020

TAG #	Hydrant Dia.	Coeff.	Year	Make	Location	Stat. Press.	Res. Press.	Flow Press.	Total GPM	Flow Hydrant	Notes
PHX4	2.5	0.9	2012	Mueller	10 Ernie Blake Rd (Lake Fork Condos)	118	81	21	1301	PHX2	
PHX5	2.5	0.9	1981	Mueller	15 Twining Rd (St Bernard Condominiums)	107	70	21	1220	PHX2	
PHX6	2.5	0.9	2012	Mueller	1 Wolf Ln	89	51	25	1158	PHX2	
ZAP1	2.5	0.9	UNK	Waterous	23 Zap's Rd	95	45	15	869	ZAP3	
ZAP2	2.5	0.9	2005	Mueller	112 Twining Rd	79	50	21	1128	ZAP3	
ZAP3	2.5	0.9	UNK	Waterous	Twining Rd (N of Zap's Rd)	98	48	16	853	ZAP1	
No M	2.5	0.9	2012	Mueller	Deer Ln (S of Williams Lake Trail Head & Parking)	X	X	X	X	X	OUT OF SERVICE- No water/flow.
Unma	2.5	0.9	UNK	UNKNOWN	154 Twining Rd	X	X	X	X	X	Unable to locate hydrant, fresh pile of dirt/rubble where hydrant used to be.

Total Hydrants Tested **35**

Please note all failed Hydrants should remain out of service until properly repaired and re-tested. Any Hydrants removed from service shall have failed tags attached.

Waterway, Inc. will inspect and service test all Fire Hydrants in accordance to the standard of NFPA 291. It is expressly understood and agreed that Waterway, Inc. shall not be deemed or held liable, obligated or accountable upon or under any guarantees or warranties, express or implied, statutory, by operation of law, or otherwise, relative to the use of any tested fire hydrants after the date of inspection. Furthermore, Waterway, Inc. will not be held liable, obligated or accountable for any fire hydrant that fails during testing under specified conditions.

APPENDIX E:TSVI BASELINE AND ESTIMATED FUTURE DEMAND

RESIDENTIAL				
		Potential Growth		
Type and Location	**Water Service Baseline (2019)**	**Base & Kachina**	**Amizette (existing)**	**Amizette (growth)**
SINGLE FAMILY RESIDENCES				
Base & Kachina				
Residential Zone	71	106		
Commercial/Business Zone	32			
Sub-total	103	106	-	-
Amizette				
Residential Zone			7	17
Commercial/Business Zone			14	24
Sub-total	-	-	21	41
Total	103	106	21	41
Total (cumulative)	***103***	***209***	***230***	***271***
HOTEL ROOMS				
Base & Kachina				
Blake Hotel	80			
Alpine Suites	24			
Hotel St. Bernard		27		
Brownell Chalets	4			
Kachina Lodging Units		51		
Sub-total	108	78	-	-
Amizette				
Amizette Inn			12	
Columbine Inn			36	
Austing Haus			23	
Taos Mountain Lodge			10	
Cottam Mountain Cabin			1	
Cottam Mountain House			4	
Cottam's Lodge			4	
Sub-total	-	-	90	-
Total	108	78	90	-
Total (cumulative)	***108***	***186***	***276***	***276***
MULTI-FAMILY				
Base & Kachina				
Als Run Condo's	3			
Edelweiss Lodge	30			
Kandahar Condo's	27			
Lake Fork Condo's	13			
Powderhorn Condo's	15			
Rio Hondo Condo's	22			
Predock Condo's	18			
St. Moritz Condo's	8			
Sierra del Sol Condo's	32			
Snakedance Condo's	33			
Snow Bear Condo's	12			
Twining Condo's	20			
Wheeler Peak Condo's	25			
Bavarian Chalets	6			
TSV Housing Units	12			
Blake Hotel - Penthouses		9		
Blake Hotel - Residences		24		
Parcel C - Thunderbird		23		
Parcel I - Strawberry Hill*		24		

		Potential Growth		
Type and Location	**Water Service Baseline (2019)**	**Base & Kachina**	**Amizette (existing)**	**Amizette (growth)**
Parcel E - Burroughs*		32		
Parcel H - Mogul Medical*		13		
Parcel F - Resort Center*		10		
Kachina Cabins		47		
TSV Rio Hondo Townhomes		36		
Beausoleil		80		
Other Development		25		
Sub-total	276	323	-	-
Amizette				
Inn at Taos Valley			28	
Stream Side			8	
Sub-total	-	-	36	-
Total	276	323	36	-
Total (cumulative)	***276***	***599***	***635***	***635***
Total Residential Units (cumulative)	**487**	**994**	**1,141**	**1,182**

**Assumes 50% of maximum yield per 2012 Core Village Master Plan*

NON-RESIDENTIAL SPACE (SF)				
		Potential Growth		
Facility	**Water Service Baseline (2019)**	**Base & Kachina**	**Amizette (existing)**	**Amizette (growth)**
TSVI - Rio Hondo Learning Center	31,000			
TSVI - Pit House	3,872			
TSVI - VMF Washbay	7,000			
TSVI - VMF Main	7,000			
TSVI - Little Maintenance Facility	3,000			
TSVI - Resort Center Admin/BOH	30,000			
TSVI - Resort Center F&B	30,000			
TSVI - Donut Shop	200			
Stray Dog Cantina	4,000			
192 Restaurant	5,000			
Hondo Bar Restaurant	5,000			
Blonde Bear/Naranja Rest.	5,000			
TSVI - Public Restrooms (plaza)	200			
TSVI - Public Restrooms (RC)	400			
TSVI - Public Restrooms (Blake)	200			
TSVI - Mogul Medical	4,000			
Blake Pool	800			
Blake Fitness	2,500			
Blake Spa	2,500			
Edelweiss Spa	600			
Bavarian	10,000			
Bavarian Public Restrooms	500			
TSVI - Phoenix Grill Restroom	2,500			
Beausoleil F&B		10,000		
Cid's Market		2,000		
Nitro Fog/Juice Bar		500		
Firehouse/Office		10,000		
Office #2		10,000		
Public Restrooms		400		
Kachina Nordic Spa		7,500		
Pools		2,400		
Fitness Centers		7,500		
Total Commercial SF	155,272	50,300	-	-
Total Cumulative SF (full build)	**155,272**	**205,572**	**205,572**	**205,572**

Village of Taos Ski Valley
Water Capacity & Demand Analysis Summary (March)
December 17, 2021

			Growth Potential			
		Water Service Baseline	Existing + 20%	Base Village & Kachina	Amizette (existing)	Amizette (expansion)
Land Use Assumptions	**(A)**					
Single Family Homes		103	-	106	21	41
Hotels		108	-	78	90	-
Multi-Family		276	-	323	36	-
Total Lodging Units		487	-	507	147	41
Total - Cumulative Units		487	487	994	1,141	1,182
Non-Residential Space (SF)		155,272	-	50,300	-	-
Cumulative (SF)		155,272	155,272	205,572	205,572	205,572
Water Demand ('000 gal)						
Baseline (2019 data)	**(B)**	1,553		-	-	-
Growth		-	311	1,749	223	56
Total Demand (Cumulative)		**1,553**	**1,863**	**3,612**	**3,835**	**3,891**
Water Capacity Scenarios ('000 gal)*	**(C)**					
1. Current Capacity w/75% leakage		**1,599**	**1,599**	**1,599**	**1,599**	**1,599**
Surplus/(Shortfall) - thousand gallons		*46*	*(264)*	*(2,013)*	*(2,236)*	*(2,292)*
Surplus/(Shortfall) - %		*3%*	*-14%*	*-56%*	*-58%*	*-59%*
2. 50% leakage + 12.5% climate loss		**2,812**	**2,812**	**2,812**	**2,812**	**2,812**
Surplus/(Shortfall) - thousand gallons		*1,259*	*949*	*(800)*	*(1,023)*	*(1,079)*
Surplus/(Shortfall) - %		*81%*	*51%*	*-22%*	*-27%*	*-28%*
3. 35% leakage + 12.5% climate loss		**3,656**	**3,656**	**3,656**	**3,656**	**3,656**
Surplus/(Shortfall) - thousand gallons		*2,103*	*1,793*	*44*	*(179)*	*(235)*
Surplus/(Shortfall) - %		*135%*	*96%*	*1%*	*-5%*	*-6%*
4. 25% leakage + 12.5% climate loss		**4,218**	**4,218**	**4,218**	**4,218**	**4,218**
Surplus/(Shortfall) - thousand gallons		*2,665*	*2,355*	*606*	*383*	*327*
Surplus/(Shortfall) - %		*172%*	*126%*	*17%*	*10%*	*8%*

(A) See attached Land Use Assumption schedule for details.

(B) Based on 2019 data from VTSV with reductions for Pizza Shack, Terry Sports, Phoenix Grill leak and Hotel St. Bernard which are non-recurring or incorporated into the future growth projection. March makes up 16% of annual water consumption.

(C) Climate change is assumed to reduce water capacity by one-half percent (.5%) annually for a 12.5% loss over the next 25 years.

Village of Taos Ski Valley
Annual Water Usage Projection

December 17, 2021

EXISTING BASELINE WATER CONSUMPTION*									
					Annual Gallons*				
Type	**Units**	**SF**	**Avg SF**	**Occ % (est)**	**Total**	**Per Unit**	**Per Rm Nt**	**Per SF**	**Note**
Single Family Residential	103	309,000	3,000	30%	1,122,780	10,901	100	4	
Multi-Family Residential	276	297,300	1,077	35%	3,184,676	11,539	90	11	
Hotel	108	73,200	678	40%	1,896,679	17,562	120	26	Alpine Village inflating the avg
F&B	7	88,700	12,671		1,954,140	279,163		22	
TSVI Commercial Ops		55,872			407,930			7	
Public Restrooms	5	4,300	860		888,280	177,656		207	
Pools	1	800	800		50,000	50,000		63	
Fitness Centers	1	2,500	2,500		200,000	200,000		80	
Spa's	2	3,100	1,550		65,000	32,500		21	
Total Current	**503**	**834,772**			**9,769,485**				

*Based on 2019 metered consumption per VTSV adjusted for any non-recurring use (e.g. leaks, discontinued operations)

NEW WATER CONSUMPTION									
		Usable			Annual Gallons				
Type	**Units**	**SF**	**Avg SF**	**Occ %**	**Total**	**Per Unit**	**Per Rm Nt**	**Per SF**	**Note**
Baseline + 20%									
Single Family Residential	-	-			224,556				Assumes 20% visitation bump
Multi-Family Residential	-	-			636,935				Assumes 20% visitation bump
Hotel	-	-			379,336				Assumes 20% visitation bump
F&B	-	-			390,828				Assumes 20% visitation bump
TSVI Commercial Ops	-	-			81,586				Assumes 20% visitation bump
Public Restrooms	-	-			177,656				Assumes 20% visitation bump
Pools	-	-			-				
Fitness Centers	-	-			40,000				Assumes 20% visitation bump
Spa's	-	-			13,000				Assumes 20% visitation bump
Condo (new)									
Blake Penthouses	9	27,000	3,000	36%	347,069	38,563	293	13	Not included in 2019 baseline
Blake Residences	24	35,000	1,458	42%	449,904	18,746	122	13	Not included in 2019 baseline
Parcel C - Thunderbird	23	39,000	1,696	42%	501,321	21,797	142	13	Per CV Master Plan Yield
Parcel I - Strawberry Hill	24	36,000	1,500	42%	462,758	19,282	126	13	Per CV Master Plan Yield
Parcel E - Burroughs	32	48,000	1,500	42%	617,011	19,282	126	13	Per CV Master Plan Yield
Parcel H - Mogul Medical	13	19,500	1,500	42%	250,661	19,282	126	13	Per CV Master Plan Yield
Parcel F - Resort Center	10	15,000	1,500	42%	192,816	19,282	126	13	Per CV Master Plan Yield
Rio Hondo Townhomes	36	63,000	1,750	42%	809,827	22,495	147	13	Placeholder
Beausoleil	80	120,000	1,500	42%	1,542,527	19,282	126	13	Placeholder
Other Development	25	37,500	1,500	42%	482,040	19,282	126	13	Placeholder
Hotel									
HSB (open year round)	27	13,500	500	48%	349,797	12,955	74	26	Backed out of 2019 baseline
Single Family	97	339,500	3,500	35%	1,480,325	15,261	119	4	Baseline rate + 20%
F&B									
Beausoleil F&B	1	10,000			220,309	220,309		22	Placeholder
Cid's Market	1	2,000			44,062	44,062		22	Not included in 2019 baseline
Nitro Fog/Juice Bar	1	500			11,015	11,015		22	Not included in 2019 baseline
TSVI Commercial Ops									
Firehouse/Office	1	10,000			73,012	73,012		7	Baseline rate + 20%
Office #2	1	10,000			73,012	73,012		7	Baseline rate + 20%
Public Restrooms	1	400			82,631	82,631		207	Placeholder - location and need TBD
Pools									
Parcel C	1	800			60,000	60,000		75	Baseline rate + 20%
Parcel I	1	800			60,000	60,000		75	Baseline rate + 20%
Beausoleil	1	800			60,000	60,000		75	Placeholder
Fitness Centers									
Parcel C	1	1,500			144,000	144,000		96	Baseline rate + 20%
Parcel I	1	1,500			144,000	144,000		96	Baseline rate + 20%
Parcel E	1	1,500			144,000	144,000		96	Baseline rate + 20%
Parcel H	1	1,500			144,000	144,000		96	Baseline rate + 20%
Beausoleil	1	1,500			144,000	144,000		96	Placeholder
Kachina									
Kachina Nordic Spa	1	7,500			720,000	720,000		96	Assumes same rate as fitness
Block 2 (Cabins)	17	34,000	2,000	30%	364,208	21,424	196	11	Condo as reference
Block 3, Lot 2-4 ,7 (Cabins)	30	45,000	1,500	30%	482,040	16,068	147	11	Condo as reference
Block 4 (Lodge Units)	12	6,000	500	30%	155,465	12,955	118	26	Hotel as reference

Type	Units	Usable SF	Avg SF	Occ %	Annual Gallons				Note
					Total	Per Unit	Per Rm Nt	Per SF	
Block 3, Lot 6 (Lodge Units)	18	9,000	500	30%	233,198	12,955	118	26	Hotel as reference
Phoenix Lodge (Lodge Units)	21	10,500	500	30%	272,065	12,955	118	26	Hotel as reference
Block 3, Lot 1 (Wild. Homes)	2	10,000	5,000	30%	36,336	18,168	166	4	Single Family as reference
Blue Jay Ridge (Single Fam)	3	15,000	5,000	30%	54,504	18,168	166	4	Single Family as reference
Lake Fork (Single Fam)	4	20,000	5,000	30%	72,672	18,168	166	4	Single Family as reference
Total New Water Usage	**522**	**992,800**			**13,224,480**				
TOTAL (Projected)	**1,025**	**1,827,572**			**22,993,965**				
Increase from baseline	*104%*	*119%*			*135%*				

AMIZETTE

Amizette (existing)	Units	SF	Avg SF	Occ % (est)	Annual Gallons*				
					Total	Per Unit	Per Rm Nt	Per SF	
Single Family	21	42,000	2,000	35%	152,611	7,267	57	4	
Hotel	90	36,000	400	35%	932,793	10,364	81	26	
Multi-Family	36	28,800	800	35%	308,505	8,570	67	11	
Total Increase	**147**	**106,800**			**1,393,909**				
TOTAL w/Amizette (existing)	**1,172**	**1,934,372**			**24,387,875**				
Increase from baseline	*133%*	*132%*			*150%*				
Amizette (growth)									
Single Family	39	97,500	2,500	35%	354,275	9,084	71	4	
Hotel									
Multi-Family									
Total Increase	**39**	**97,500**			**354,275**				
TOTAL w/Amizette (ALL-IN)	**1,211**	**2,031,872**			**24,742,150**				
Increase from baseline	*141%*	*143%*			*153%*				

APPENDIX F: METER TESTING PRODUCT INFORMATION

Portable Small Meter Tester

Model PSMT

DESCRIPTION

The Model PSMT Portable Meter Tester is designed for field testing meters 1/2…1 inch. Tests may be performed without removing the meter from service using a hose connection downstream of the meter. Additionally, adapters are provided for testing meters that have been removed from service.

Through routine testing of meters in service, change-out programs may be developed to aid in ensuring that the installed base of meters is providing accurate measurement to maximize revenue. Additionally, the PSMT may be used to demonstrate meter accuracy during customer inspections.

Construction

The PSMT is a self-contained portable test meter with all control valves, hose connections, fittings, and pressure gauges permanently installed in a rugged, weatherproof plastic portable case. The case is built to MIL-C-4150J specifications for long service life in harsh field conditions. The case may be closed and locked while the tester is in service in the event long-term evaluations are needed.

Accessories included with the tester allow various testing connections for a variety of meter sizes:

- One (1) 2 in. pressure gauge
- Two (2) 3/4 in. × 39 in. reinforced flexible hoses
- Fittings for connection to 1/2 in., 5/8 in., 3/4 in. and 1 in. meters
- Test ring to allow starting all tests at zero
- Complete operating instructions laminated to the case cover

Internal Piping

All internal fittings are soldered brass or copper, except plastic tubing for pressure gauge. Connection to the test meter is made using standard meter connection fittings. The 2 inch pressure gauge provides visual indication of water system pressure. The inlet control valve is a quick acting one-quarter turn ball valve installed upstream of the meter for accurate test starts and stops. The outlet globe valve—located downstream from the meter—allows reliable flow rate adjustment.

Field Connections

External connection to the tester is made using standard 3/4 inch male hose connections located on the exterior of the case. Two (2) 3/4 in. × 39 in. rugged reinforced flexible hoses are provided for field connection of the PSMT.

SPECIFICATIONS

Operating Range	0.25… 25 gpm (1.0…95 lpm)
Overall Accuracy	100% ± 1.5%
Maximum Operating Temperature	80° F (27° C)
Maximum Operating Pressure	100 psi (6.9 bar)
Register Type	Sealed magnetic drive
Units of Measure	Gallons, cubic feet or cubic meters
Test Resolution	0.1 gallons, 0.01 cubic feet, 0.01 cubic meters using a register test ring
Meter Size Test Capacity	1/2 in., 5/8 in., 5/8× 3/4 in., 3/4 in. and 1 in.
Connections	3/4 in. x 39 in. reinforced flexible hose

MATERIALS

Meter	Nutating disc engineering thermoplastic
Case	Weatherproof, high-impact structural copolymer
Overall Size	18-1/2 in. × 14-1/16 in. × 6-1/16 in. (470 mm × 357 mm × 154 mm)
Total Weight	10 lb (4.5 kg)

PART NUMBERS

Part Number	Description
64343-001	Portable small meter tester, gallons
64343-002	Portable small meter tester, cubic feet
64343-004	Portable small meter tester, cubic meters

SMART WATER IS BADGER METER

Badger Meter

Portable Large Meter Tester

Model PLMT

DESCRIPTION

The Badger Meter Portable Large Meter Tester (PLMT) consists of a 5/8 in. Recordall® Model 25 meter for measuring low flows (0.25…25 gpm) and a 3 in. Recordall Turbo Series Fire Hydrant meter for measuring high flows (25…450 gpm).

Applications

The PLMT is used in testing the performance of any make of large potable cold water meter (sizes 1-1/2…10 in.). Testing can be performed without removing the meter from the service line.

Benefits of Testing

The PLMT is an invaluable tool in helping water utilities earn full revenue on all water distributed to customers. By checking the accuracy of meters already in service, the utility can easily determine when under-registration is curtailing water revenue.

Accuracy and revenue performance of meters can be affected by a number of factors, including the length of time in service, overloading and damage from other causes. Because of its one-person portability, the device makes regular testing possible without removing the meter from the line and taking it back to a repair shop.

Small utilities with limited facilities can use the test meter in their own shops to check the performance of meters before and after repair.

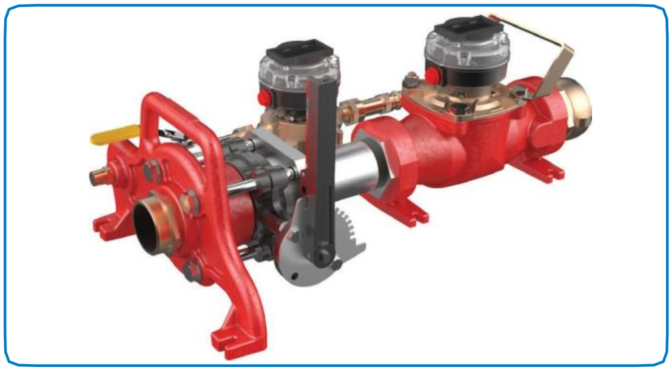
Construction

Flow rates through the PLMT are controlled by two valves.

The high flow side uses a butterfly valve operated with the option of either a detent handle (*Figure 1*) or gear operator (*Figure 2*) depending on your measurement needs.

Figure 1: Detent handle

Figure 2: Gear operator



The low flow side uses a ball valve to control water flow. To better isolate the flow and detect any leaks, the PLMT comes standard with two output paths (high side and low side). An optional flow combiner tee is available to combine low and high side outflow.

Figure 3: Optional flow combiner tee

The assembly also includes a gauge port for a customer supplied pressure gauge/transducer.

The entire assembly is corrosion resistant and is designed for easy operation and handling by one person.

Two 12-1/2 ft sections of fire hose, 1 in., 1-1/2 in. and 2 in. test plug adapters and a spanner wrench are included with the portable tester.

Magnetic Drive

Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling.

Operating Performance

The tester contains all equipment necessary for field testing, including fire hoses and standard adapters. With the accessibility of a test tee on the line, the unit tests all Badger Meter and competitive large meter products.

The 5/8 in. Recordall Model 25 and 3 in. Recordall Turbo Series Fire Hydrant water meters meet or exceed the latest applicable AWWA performance and accuracy standards. A certified accuracy test curve is provided with the assembly.

Sealed Register

The standard registers consist of a straight-reading, odometer-type totalization display, 360° test circle with center sweep hand and flow finder to detect leaks. Permanently sealed, dirt, moisture, tampering and lens fogging problems are eliminated.

(Optional) Resettable Registers

Two (2) electronic resettable registers with ER-9 style single indicators provide rate of flow and totalization for the main line and bypass meters. The totalization resettable function can be disabled. Flow rate function is programmed independently of the totalization. See the ER-9 User Manual for programming details. The flow rate value is approximate and if a more specific value is required, follow the procedure outlined in the PLMT Application Data Sheet for flow rate calculation.

Maintenance

The PLMT is designed and manufactured to provide long-term service with minimal maintenance.

Hose Couplings

The PLMT is equipped with (2-1/2…7-1/2 in. NST) fire hose swivel couplings as standard equipment unless otherwise specified.

MATERIALS

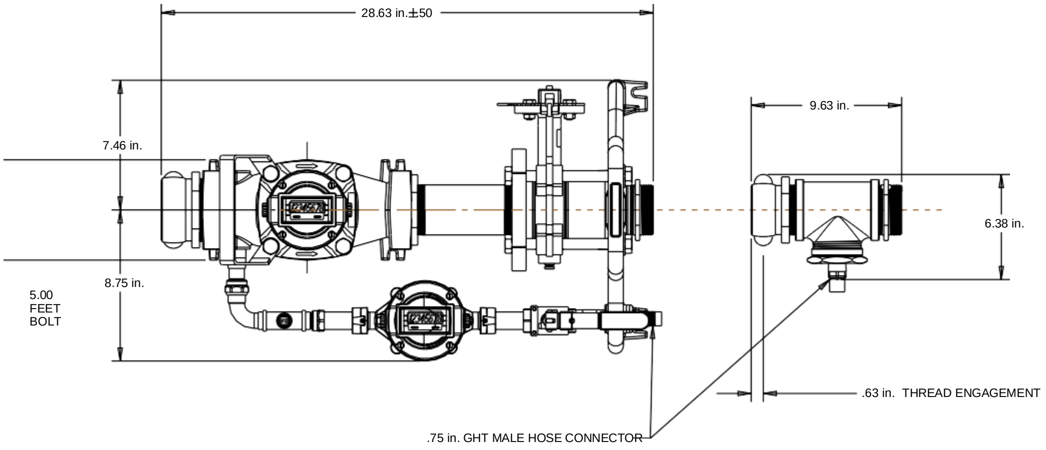
Meter Housing	Disc: Lead-free bronze alloy Turbo: Heat treated aluminum alloy
Housing Cover	Lead-free bronze alloy
Measuring Elements	Thermoplastic
Trim	Stainless steel
Connection Screen	Thermoplastic
Magnets	Ceramic
Magnet Spindles	Stainless steel
Register Cover	Bronze: non-resettable register Thermoplastic: resettable register
Flow Restriction Plate	Stainless steel
Inlet Screen	Stainless steel with elastomer

SPECIFICATIONS

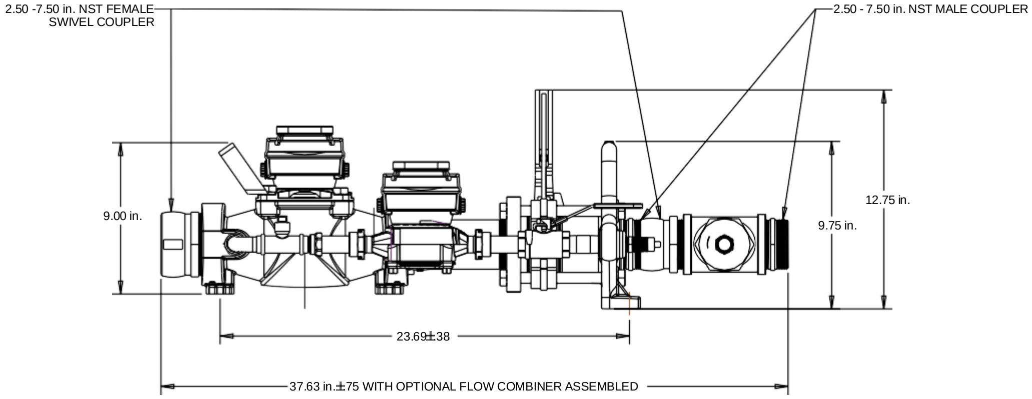
Typical Operating Range (100% ±1.5%)	(0.1…113 m³/h) 1/2…500 gpm	
Typical Low Flow (Min. 95%)	1/4 gpm (0.06 m³/h)	
Maximum Continuous Flow	450 gpm (102.2 m³/h)	
Pressure Loss at Maximum Continuous Operation	45 psi at 450 gpm (3.1 bar @ 102.2 m³/h)	
Max. Operating Temperature	80° F (26° C)	
Max. Operating Pressure	150 psi (10 bars)	
Register Type	Straight reading, permanently sealed magnetic drive (standard)	
Register Capacity	Disc:	10,000,000 gallons 1,000,000 cubic feet 100,000 cubic meters
	Turbo:	100,000,000 gallons 10,000,000 cubic feet 1,000,000 cubic meters
Weight with 10-position Detent Handle	93 lb (includes accessories)	
Weight with Gear Operator	101 lb (includes accessories)	
Shipping Weight with 10-position Detent Handle	104 lb (includes all accessories plus optional flow combiner accessories)	
Shipping Weight with Gear Operator	113 lb (includes all accessories plus optional flow combiner accessories)	
Main Line Valve	Butterfly valve	
Bypass Valve	Ball valve	
Meter Adaptors	1 in., 1-1/2 in. and 2 in. test plug adapters	
Fire Hose	Two 12-1/2 ft lengths	
Test Rings	Two provided	

DIMENSIONS

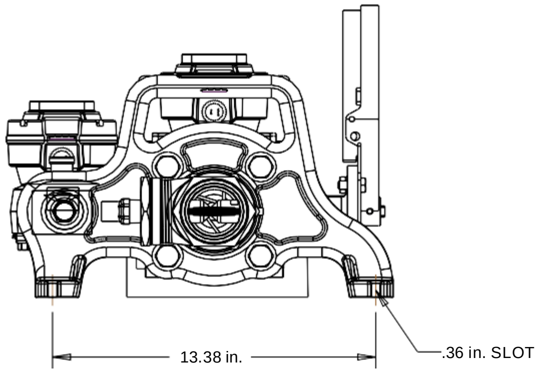
PLMT with Detent Handle



Top view

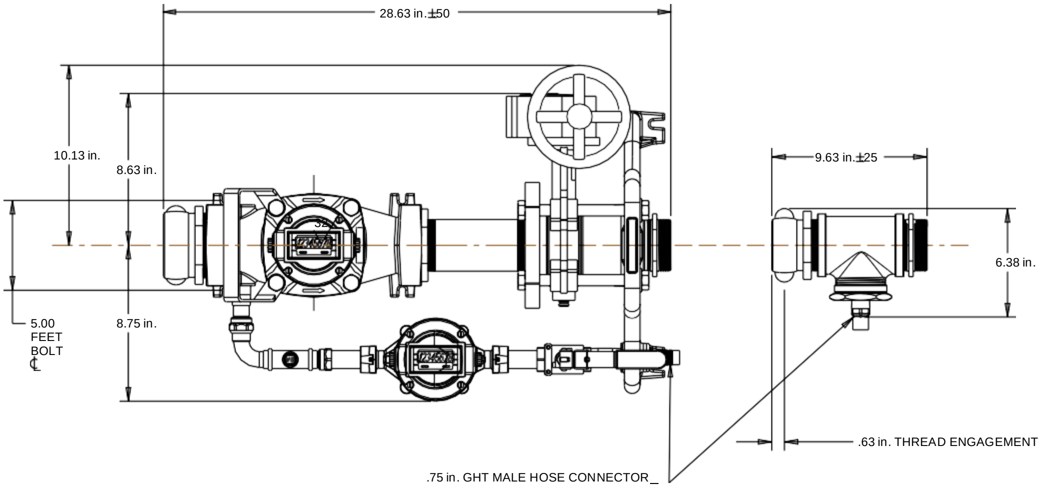


Side view

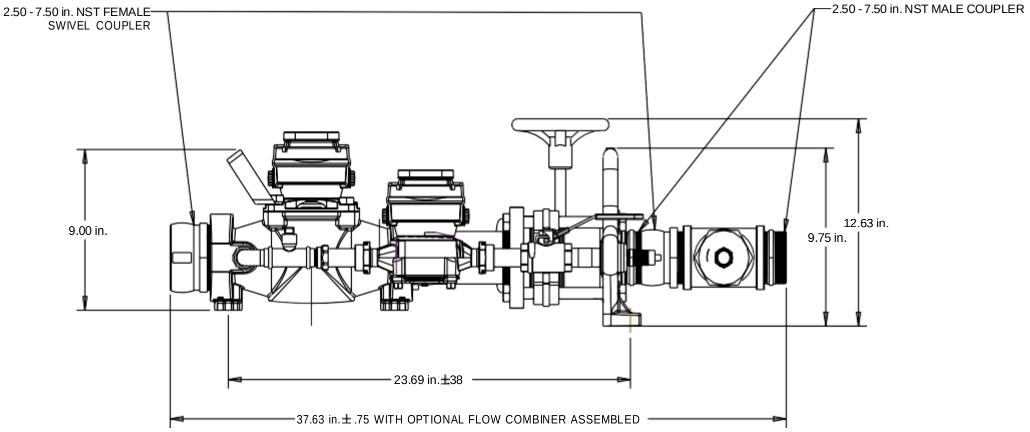


End view

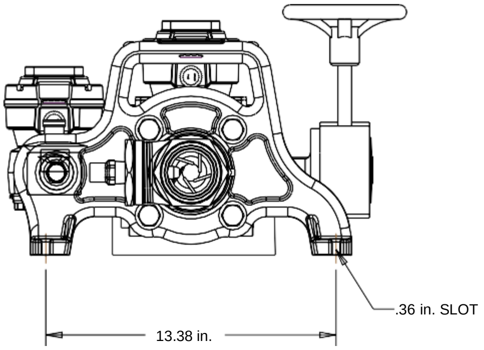
PLMT with Gear Operator



Top view



Side view



End view

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APPENDIX G: CONCEPTUAL MASTER PLAN CORE VILLAGE

CORE VILLAGE LAND USE DIAGRAM

TAOS SKI VALLEY CORE VILLAGE REVITALIZATION (SOUTHERN PORTION)

The proposed land uses and infrastructure improvements depicted on this plan are subject to review and modification by the Village of Taos Ski Valley and the respective property owners … and thus subject to change without notice. This plan should not be relied upon as an accurate depiction of the final development or infrastructure for the Core Village at Taos Ski Valley.

APPENDIX H: KACHINA AREA MASTER PLAN

DEVELOPMENT PROGRAM

A - B - C - D - E

16,000 sf of commercial uses

21 lodge units

accessory staff accommodations (3-5 total)

F - 2 wilderness homes

G - 18 lodge units

H - 17 forest cabins

I - 70 public parking spaces

shuttle drop off

J - 5,000 sf Nordic spa

12 lodge units - Nordic spa

accessory staff accommodations (3-5 total)

K - 14 forest cabins

WINTER PROGRAM

L - lift/gondola access

M - ski core activity area

N - outdoor dining

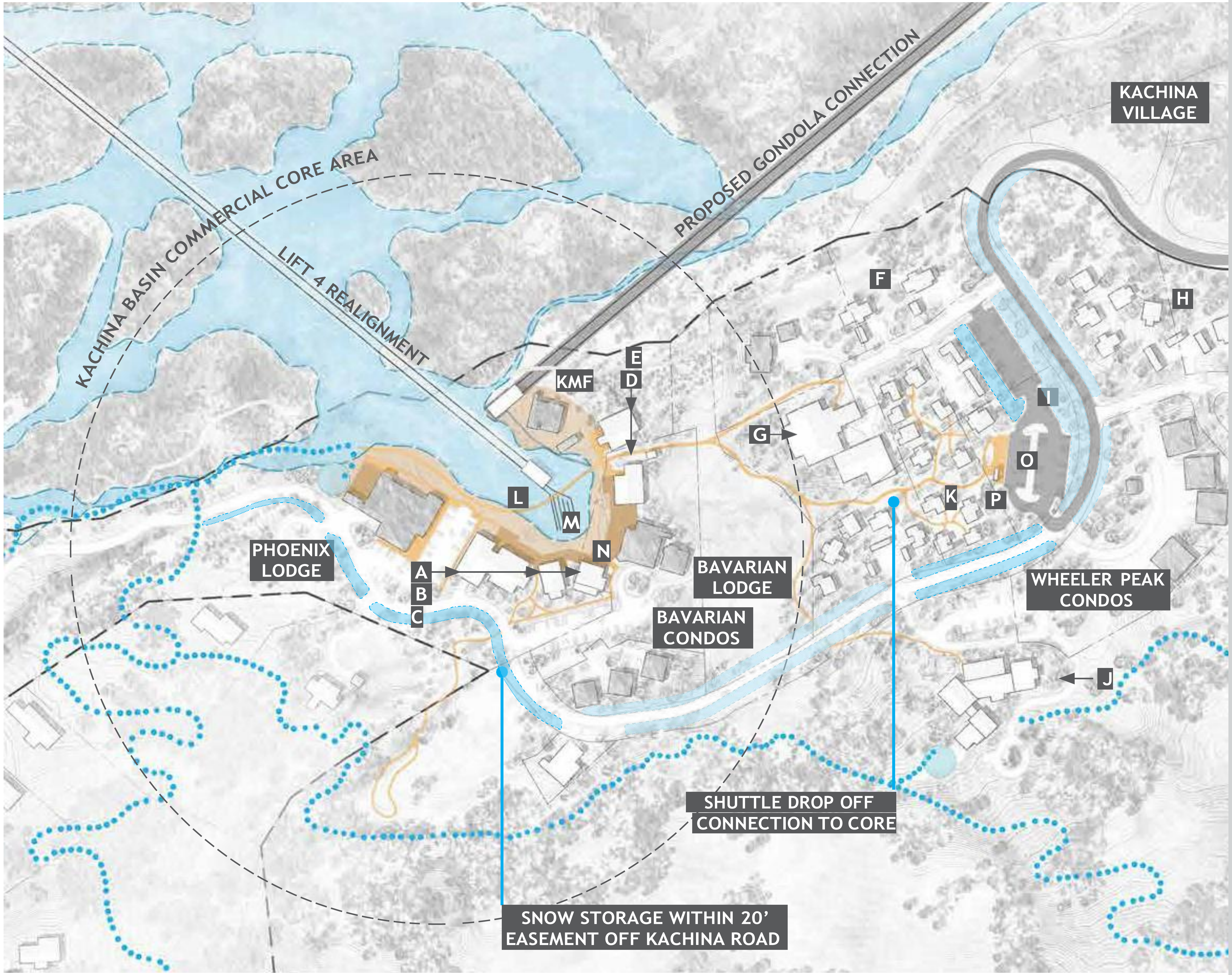
O - shuttle drop off

P - hiker trailhead

Q - future connection to Northside trails

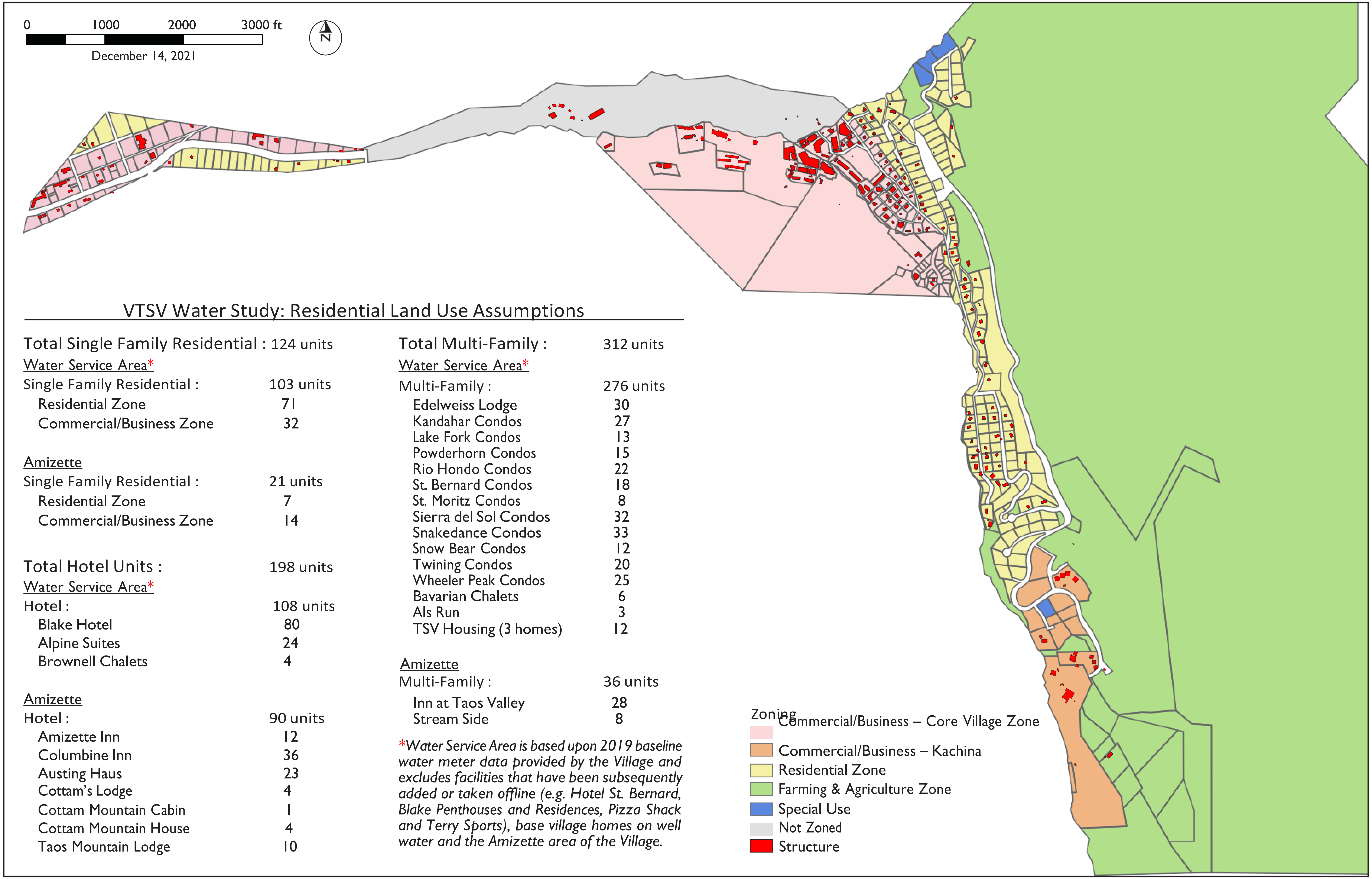
R - future trail connection to Core Village

S - nordic trailhead



N **KACHINA BASE AREA WINTER ILLUSTRATIVE SITE PLAN**

APPENDIX I: FUTURE WATER SYSTEM SERVICE AREA



VTSV Water Study: Residential Land Use Assumptions

Total Single Family Residential :	124 units
<u>Water Service Area</u>*	
Single Family Residential :	103 units
Residential Zone	71
Commercial/Business Zone	32
<u>Amizette</u>	
Single Family Residential :	21 units
Residential Zone	7
Commercial/Business Zone	14

Total Hotel Units :	198 units
<u>Water Service Area</u>*	
Hotel :	108 units
Blake Hotel	80
Alpine Suites	24
Brownell Chalets	4
<u>Amizette</u>	
Hotel :	90 units
Amizette Inn	12
Columbine Inn	36
Austing Haus	23
Cottam's Lodge	4
Cottam Mountain Cabin	1
Cottam Mountain House	4
Taos Mountain Lodge	10

Total Multi-Family :	312 units
<u>Water Service Area</u>*	
Multi-Family :	276 units
Edelweiss Lodge	30
Kandahar Condos	27
Lake Fork Condos	13
Powderhorn Condos	15
Rio Hondo Condos	22
St. Bernard Condos	18
St. Moritz Condos	8
Sierra del Sol Condos	32
Snakedance Condos	33
Snow Bear Condos	12
Twining Condos	20
Wheeler Peak Condos	25
Bavarian Chalets	6
Als Run	3
TSV Housing (3 homes)	12
<u>Amizette</u>	
Multi-Family :	36 units
Inn at Taos Valley	28
Stream Side	8

**Water Service Area is based upon 2019 baseline water meter data provided by the Village and excludes facilities that have been subsequently added or taken offline (e.g. Hotel St. Bernard, Blake Penthouses and Residences, Pizza Shack and Terry Sports), base village homes on well water and the Amizette area of the Village.*