

Olympic Valley Public Service District

Basis of Design Report

Pressure Zone 1A Improvement Project

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EXECUTIVE SUMMARY

The water distribution system analyzed in this report is located in Olympic Valley, California and is ran by the Olympic Valley Public Service District (OVPSD). Olympic Valley resides approximately five miles to the northwest of Tahoe City, California and approximately 10 miles to the south of Truckee, California.

Olympic Valley's water system currently feeds both residential and commercial users. There are currently only three pressure zones within the water system, known as Zones 1, 2, and 3. Zone 1 is the largest zone of the three, and contains all the production wells that supply the system with water, as well as the West Tank storage tank. Zone 1 spans the entire OVPSD service area (east to west), with two main distribution areas on the eastern and western ends of the system connected by a single transmission main in Olympic Valley Road. Zone 2 is located to the south of Olympic Valley Road and to the north of Zone 3. The East Booster Pump Station (BPS) feeds Zone 2 by pumping water from Zone 1. However, water can feed back into Zone 1 through the pressure reducing valve (PRV) located at the East BPS. Zone 3 is located to the southeast of Zone 2 and consists of a distribution main along Sierra Crest Trail from the intersection of Valley View Court to the cul-de-sac at the end of Sierra Crest Trail. The District's low capacity horizontal wells also supply Zone 2. Zone 3 is the smallest pressure zone but does include the Zone 3 tank. Zone 3 is fed from Zone 2 through the Zone 3 BPS. The PRV at the Zone 3 BPS also provides water to Zone 2. Figure 1 shows the extents of Zones 1, 2, and 3 within the overall OVPSD water distribution system.

Olympic Valley is located within the Sierra Nevada Mountain range and has a large variability in elevation from east to west. Since Zone 1 is the largest pressure zone within the water distribution system and spans from one end of Olympic Valley to the other, large elevation differences cause pressures to exceed 150 pounds per square inch (psi) on the east side of the system near Highway 89. To reduce these high pressures, it is proposed to create a new pressure zone that will encompass the distribution area to the east of the Olympic Valley Road and Victor Drive intersection. This new zone, referred to as Pressure Zone 1A (or just Zone 1A), will have less of an elevation differential within the zone and will reduce overall pressures. There are four possible configurations that have been modeled for separating Zone 1A out of Zone 1. All four design alternatives break the pressure zone with the placement of PRVs. PRVs are one-way valves that reduce high incoming water pressure from one pressure zone to another. Separating pressure zones with PRVs is essential for the proper operation of a water distribution system to ensure that home piping and appliances operate under a safe, but adequate, pressure. The purpose of this Basis of Design Report (BDR) is to analyze and select the best design alternative for implementation.

The main benefit of creating Pressure Zone 1A is reducing wear and tear on fittings and valves that are caused by high pressure, leading to fewer maintenance and replacement costs that affect rate payers. Operations and maintenance situations were taken into account in the development of each alternative, such as the proposed future emergency intertie near the intersection of Russell Road and Olympic Valley Road with the Squaw Valley Mutual Water Company's (SVMWC) water system and keeping the Hidden Lake Loop area in water during an emergency repair on the Olympic Valley Road water main west of Russell Road.

Four alternatives were modeled to determine the optimal configuration necessary to create Pressure Zone 1A. In each alternative, Zone 1A is located to the east of the listed PRVs. A brief overview of the proposed changes under each alternative is as follows:

- Alternative 1
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
 - See Figure 4 for alternative layout map
- Alternative 2
 - 2 PRVs (Olympic Valley Road PRV and Tiger Tail West PRV)
 - Closed valve on Victor Place
 - See Figure 7 for alternative layout map

- Alternative 3
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
 - Parallel main on Olympic Valley Road to the East BPS
 - See Figure 10 for alternative layout map
- Alternative 4
 - 3 PRVs (Olympic Valley Road PRV, Victor Drive PRV, and Tiger Tail East Road PRV)
 - See Figure 13 for alternative layout map

Each of the four alternatives was analyzed by modeling pressures during the maximum day demand (MDD) and available fire flows at each hydrant within proposed Zone 1A, creating an Engineer’s Opinion of Probable Cost for the design and construction of each alternative, and performing a non-economic evaluation of each alternative.

The non-economic analysis evaluated each alternative’s ranking for the three main criteria of Operations and Maintenance, Engineering, and Public/Regional Impacts. Each criteria had multiple sub-criteria that were developed to fully analyze the impacts of each alternative on the main criteria. Each alternative was then ranked for each sub-criteria and criteria and given an overall ranking out of 100. Details on the non-economic analysis can be found in Section 3.0. A summary of the alternatives analysis, including the Engineer’s Opinion of Probable Cost, non-economic evaluation scores, and overall alternative ranking, can be found in Table 1 below.

Table 1: Executive Summary Alternative Comparison

Alternative	Cost	Non-Economic Evaluation Score (out of 100)	Ranking
1	\$974,400	74.1	4
2	\$733,400	81.6	3
3	\$2,435,400	55.4	2
4	\$961,300	88.3	1

Details regarding each step of the analysis for each alternative can be found in Sections 2.0 and 3.0, as well as an overall alternative comparison of the analysis results in Section 4.0. Given the results of the analysis performed and the interests of the OVPSD, it was determined that Alternative 4 was the preferred alternative.

Under Alternative 4, Tiger Tail Road to the west of the Tiger Tail East PRV will remain in Zone 1 and the East BPS will be included in Zone 1A. This alternative forms Zone 1A in a way that maintains system pressures in the higher elevation residences along Tiger Tail Road. Houses on the north side of Tiger Tail Road are higher than street level and placing those residences in Zone 1A (as in Alternatives 1-3) leads to lower system pressures (approximately 45 psi to 70 psi at street level). Keeping these residences in Zone 1 will maintain existing system pressure for these homes, which ranges from 98 psi to 120 psi.

Pressures at MDD under Alternative 4 range from 53 to 108 psi, which is approximately 50 psi lower than existing pressure at services within proposed Zone 1A. There was little change in available fire flow within proposed Zone 1A under Alternative 4, and all hydrants within the system meet the requirements set forth by Olympic Valley Fire Department (discussed in Section 1.2.1). A summary of the minimum and maximum pressures at MDD and available fire flows for Pressure Zone 1A under Alternative 4 can be found in Table 2. Figure 14 illustrates the pressure at MDD across Zone 1A under Alternative 4 and Figure 15 illustrates the available fire flow capacity for each hydrant within Zone 1A, with the location of the maximum and minimum producing hydrants called out. Commercial properties are also highlighted in Figure 15, which have a higher minimum flow rate than residential hydrants (see Section 1.2.1).

Table 2: Alternative 4 Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	53	108
Available Fire Flow (gpm)	1,500	>3,000

The creation of Zone 1A presents an operational challenge when repairs need to be performed on the Olympic Valley Road distribution main to the west of Russell Road. Currently, when this distribution main Russell is turned off for repairs, areas to the east in Zone 1 (including Hidden Lake Loop) are back fed through the East BPS PRV. If an emergency repair were necessary west of Russell Road after the formation of Zone 1A, Hidden Lake Loop and upper Tiger Tail Road would be cut off from its main water supply (the Olympic Valley Road main) and would not be able to receive water from the East BPS PRV due to the proposed Zone 1A PRVs. To solve this problem, the following solution is proposed:

- Installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road that connects the OVPSD water system to the SVMWC water system.
 - Intertie would consist of a 6-inch PRV with a 2-inch bypass PRV
 - All Zone 1A PRVs would be closed to prevent SVMWC flow into Zone 1A
 - SVMWC would provide all water to Zone 1 east of Russell Road (this includes daily flows and fire flows if needed) until the Olympic Valley main is fixed and turned back on
 - Valve for meadow line that runs from the Palisades Tahoe parking lot east towards Resort at Squaw Creek would be opened so that Well 5R could feed into Zone 2, which would feed Zone 1A via the East BPS PRV

An in-depth discussion about pressures at MDD and available fire flows to Zone 1 and Zone 1A east of Russell Road during emergency repairs on the Olympic Valley Road transmission main can be found in Section 5.4 of this report.

The engineer's opinion of probable cost for the construction of Alternative 4, which includes the PRV for the SVMWC emergency intertie, can be found in Table 3. Details on the percentages used for the soft costs can be found in Section 1.2.5.

Table 3: Alternative 4 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (NTE 10%)	1	EA	\$57,300.00	\$57,300.00
Traffic Control	1	EA	\$14,300.00	\$14,300.00
East Tiger Tail Road 6" PRV	1	EA	\$90,000.00	\$90,000.00
Victor Drive 8" PRV	1	EA	\$100,000.00	\$100,000.00
Olympic Valley Road 12" PRV	1	EA	\$120,000.00	\$120,000.00
SVMWC Intertie 6" PRV	1	EA	\$90,000.00	\$90,000.00
PRV Electrical and SCADA	3	EA	\$50,000.00	\$150,000.00
Conduit Trench 1" PVC Conduit	125	LF	\$75.00	\$9,375.00
3" Patch Paving	340	SF	\$20.00	\$6,800.00
East BPS Pump Replacement	1	EA	\$25,000.00	\$25,000.00
Construction Subtotal:				\$662,800.00
Contingency:				\$99,500.00
Engineering:				\$66,300.00
Permitting:				\$33,200.00
Inspection and Construction Management:				\$66,300.00
Administration:				\$33,200.00
Estimated Total Project Cost:				\$961,300.00

Once Alternative 4 was chosen as the preferred alternative, certain details of the alternative were analyzed in depth, such as:

- The advantages of replacing the Victor Drive PRV with a closed valve
- The new set point and pump parameters for replacing the East BPS pump
- The new pressure setting for the East BPS PRV
- Operational details for providing Hidden Lake Loop and upper Tiger Tail Road with water in the event of an emergency repair on Olympic Valley Road west of Russell Road
- Anticipated permitting for construction

Specifics for all Alternative 4 considerations mentioned above can be found in Section 5.0.

1.0 DESIGN APPROACH

The configuration of the existing OVPSD water distribution system controlled the design approach of creating Zone 1A since there are limited alternatives that can be created based on the existing system and pressure zones. Three of the main considerations for the creation of Pressure Zone 1A were placing PRVs at appropriate locations that could supply adequate flows during fire events, proximity of the PRV locations to power, and the ability to keep Hidden Lake Loop supplied with water from Zone 2 during emergency repairs on the Olympic Valley Road main west of the Russell Road intersection. Other considerations for PRV placement include keeping PRVs near pavement to increase accessibility during winter months and the proximity of the PRVs to other utilities within the right-of-way.

The chosen locations of PRVs that would separate Zone 1A from Zone 1 were limited to the following locations:

- The south end of Victor Drive near the intersection with Olympic Valley Road (referred to as the Olympic Valley Road PRV)
- The intersection of Victor Place and Victor Drive, located on the Victor Place main (referred to as the Victor Place PRV)
- The intersection of Victor Place and Victor Drive, located on the Victor Drive main (referred to as the Victor Drive PRV)
- The west end of Tiger Tail Road at the intersection with Victor Drive (referred to as Tiger Tail West PRV)
- The east end of Tiger Tail Road near the center of the U-bend (referred to as the Tiger Tail East PRV)

The four alternatives discussed in Section 2.0 are based on different locations and configurations of PRVs to create Zone 1A. A brief overview of the proposed changes under each alternative is as follows:

- Alternative 1
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
- Alternative 2
 - 2 PRVs (Olympic Valley Road PRV and Tiger Tail West PRV)
 - Closed valve on Victor Place
- Alternative 3
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
 - Parallel main on Olympic Valley Road to the East BPS
- Alternative 4
 - 3 PRVs (Olympic Valley Road PRV, Victor Drive PRV, and Tiger Tail East Road PRV)

1.1 EXISTING ZONE 1

Pressure Zone 1 is fed by four wells: Well 1, 2R, 3R, and 5R. Pressure Zone 1 also contains one of three storage tanks in the overall system, referred to as West Tank. The area of Zone 1 that encompasses proposed Zone 1A is fed by the Olympic Valley Road main and mostly consists of pressures exceeding 100 psi at the Maximum Daily Demand (MDD), with pressures reaching over 150 psi on the east end of the zone near Highway 89. Figure 2 illustrates existing pressures at MDD within the proposed Zone 1A area. Existing fire flow availability within proposed Zone 1A is adequate, with all hydrants able to supply more than 1,500 gallons per minute (gpm) of flow to residential areas and more than 2,500 gpm to the hydrants adjacent to commercial areas. Figure 3 illustrates where all existing hydrants within proposed Zone 1A are located, as well as existing available fire flows. The existing minimum and maximum pressures at MDD and available fire flows within proposed Zone 1A are listed in Table 4.

Table 4: Existing Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	97	158
Available Fire Flow (gpm)	1,600	>3,000

The East BPS provides flow from Zone 1 up to Zone 2. Due to the location of the East BPS on the east side of Zone 1, it will be affected by the creation of Zone 1A in three of the four analyzed alternatives (Alternatives 1, 2, and 4). Currently, the East BPS has an operating point of 220 gpm at 60 feet of head. Specifics on how the East BPS will be affected by the creation of Zone 1A will be discussed in the following sections. The East BPS PRV currently operates at a 100-psi setting.

1.2 DESIGN CRITERIA

1.2.1 Regulatory Compliance

Two regulatory compliance criteria were considered when modeling alternatives:

- Minimum pressure under any condition of flow
- Available fire flows at each hydrant

Per the California Fire Code, all hydrants must be able to meet 1,500 gpm for 2 hours for residential buildings and 2,500 gpm for 2 hours for commercial and multi-family residential (Tavern Inn) buildings. There are only three commercial buildings serviced by three fire hydrants located within the proposed Zone 1A, which are:

- OVPSD located at 305 Olympic Valley Road
 - Serviced by fire hydrants H100 and H117
- Lake Tahoe Preparatory School located at 255 Olympic Valley Road
 - Serviced by fire hydrant H135
- 7-11 and Tahoe Dave's located at 3041 River Road
 - Serviced by fire hydrant H126

Each hydrant listed above was analyzed to meet the 2,500 gpm criteria and called out on any figures developed for easy reference. Aside from the three commercial buildings and associated hydrants listed above, the rest of the fire hydrants within proposed Zone 1A service residential buildings and will adhere to the 1,500 gpm criteria. Available fire flows within proposed Zone 1A were analyzed at MDD for each alternative.

For system pressure requirements, the California Code of Regulations 22 CCR § 64602 was followed, which requires that pressures must, at the point of service, be greater than or equal to 20 psi at all times. Pressures within proposed Zone 1A were analyzed at MDD for each alternative.

1.2.2 PRV Sizing

Each PRV location for the chosen alternative will consist of a larger PRV sized to handle fire flow demands during MDD and a bypass line to a smaller PRV for lower flow events, such as Average Day Demand (ADD). A bypass to a smaller PRV will prevent water hammer from a large PRV unnecessarily slamming open and closed and will protect existing infrastructure from damage due to water hammer. Detailed PRV sizes for the chosen alternative will be discussed in Section 5.0.

1.2.3 SCADA and Electrical

Each PRV location was chosen based on its proximity to a power source. Each PRV location will have SCADA instrumentation such as flow meters and pressure transducers, electrical features such as heaters to prevent valve malfunction during winter months, and RTUs.

1.2.4 East BPS

Three of the four alternatives place the East BPS within proposed Zone 1A. Due to the lower hydraulic grade line (HGL) of Zone 1A, the East BPS pump will need to supply more head to the water to pump it into Zone 2. If the current pump were to supply the additional head, it would be running off the designed pump curve causing inefficient use of the pump and an increased rate of degradation to pump parts. Therefore, the increase of head will require a new pump at the East BPS. The new set point of the pump will be discussed for the chosen alternative in Section 5.3.

The East BPS PRV currently operates at a setting of 100 psi. Since the HGL of Zone 1A will be lower than Zone 1, the setting of the East BPS PRV needed to be reduced in order for it to function properly within the new pressure zone (i.e., being in a lag position to the proposed PRVs). Therefore, the East BPS PRV setting was reduced to 72 psi for the modeling of Alternatives 1-4. The East BPS PRV is discussed in detail for the preferred alternative in Section 5.3.2.

1.2.5 Cost Estimates

The cost estimates developed for each alternative are planning level estimates and follow the AACE Level 3 Estimate guidelines. Cost estimates were developed by taking costs from similar jobs within the Lake Tahoe basin that have been constructed within the last two years and applying inflation factors and other adjustments to account for economic variations since those jobs took place. The numbers listed in the cost estimate are simply an Engineer's Opinion of Probable Costs and will vary widely when taken to bid due to many factors, such as supply chain issues, contractor availability, etc.

All soft costs were calculated as a percentage of the construction total. Soft costs include the contingency, engineering services, permitting, inspection and construction management, and administration. The percentage used for each soft cost was consistent across all alternatives. The percentage used for each soft cost is listed in Table 5.

Table 5: Percentage of Construction Total Used for Soft Costs

Soft Cost Description	Percentage of Construction Total
Contingency	15%
Engineering	10%
Permitting	5%
Inspection and Construction Management	10%
Administration	5%

1.3 OPERATIONAL CONSTRAINTS

The creation of Zone 1A presents an operational challenge when repairs need to be performed on the Olympic Valley Road distribution main to the west of Russell Road. Currently, when the Olympic Valley Road main west of Russell Road is turned off for repairs, areas to the east in Zone 1 (including Hidden Lake Loop) are back fed through the East BPS PRV.

If an emergency repair were necessary west of Russell Road after the formation of Zone 1A, Hidden Lake Loop would be cut off from its main water supply (the Olympic Valley Road main) and would not be able

to receive water from the East BPS PRV due to the proposed Zone 1A PRVs. To solve this problem, three Emergency Scenarios were taken into consideration:

1. Installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road that connects the OVPSD water system to the SVMWC water system.
 - All Zone 1A PRVs would be closed to prevent SVMWC flow into Zone 1A
 - SVMWC would provide all water to Zone 1 east of Russell Road (this includes daily flows and fire flows if needed) until the Olympic Valley main is fixed and turned back on
 - Valve for meadow line that runs from the Palisades Tahoe parking lot east to the Resort at Squaw Creek would be opened so that Well 5R could feed into Zone 2, which would feed Zone 1A via the East BPS PRV
2. Reverting Pressure Zone 1A back to Pressure Zone 1 so that Hidden Lake Loop and other areas east of break would be back fed by East BPS PRV
 - Bypasses for all Zone 1A PRVs would be pinned open
 - East BPS PRV setting would be converted back to Zone 1 pressures (100 psi)
 - Valve for meadow line would be opened so that Well 5R could feed into Zone 2, which would then feed Zone 1 via the East BPS PRV
3. Installation of bypass/parallel line between Victor Drive and East BPS
 - Bypass/parallel line would keep East BPS and East BPS PRV in Zone 1
 - East BPS PRV would be able to feed Zone 1 east of Russell Road without needing to pin open Zone 1A PRVs
 - Valve for meadow line would be opened so that Well 5R could feed into Zone 2, which would feed Zone 1 via the East BPS PRV

Although Emergency Scenario 2 (reverting Pressure Zone 1A back to Pressure Zone 1) was initially considered, it was ultimately found to not be a reasonable solution due to the amount of operator attention it would require during an emergency. Having an operator pin open the Zone 1A PRVs, as well as adjust the setting on the East BPS PRV, would be time consuming tasks when the operator should be focusing on how to repair the broken Olympic Valley Road distribution main. Additionally, reverting homes within Zone 1A back to higher Zone 1 pressures may give rise to various operational and customer complaint issues. Therefore, the only options considered for supplying Hidden Lake Loop with water were those that kept Zone 1A functional in the event of a transmission line disruption.

Analysis of the intertie in the following sections was based on a combination of the OVPSD Zone 1A model and the SVMWC model. The SVMWC model was sent to Farr West Engineering by Shaw Engineering which was then combined with the OVPSD model. All modeling was performed with the assumption that the SVMWC model was accurate with up-to-date demands.

Each alternative for the formation of Zone 1A will discuss the preferred solution for keeping Hidden Lake Loop in water during repairs on the Olympic Valley Road distribution main west of Russell Road. A summary of what emergency scenario was considered for each alternative is listed below. Detailed discussion for each alternative can be found within Section 2.0. Operational considerations will need to be taken into account during the design phase to account for all possible emergency situations after the formation of Zone 1A.

- Zone 1A Alternative 1: PRVs on Olympic Valley Road, Victor Place, and West Tiger Tail Road
 - Emergency Scenario 1: Installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road
- Zone 1A Alternative 2: PRV on Olympic Valley Road and west Tiger Tail Road, Closed Gate Valve on Victor Place
 - Emergency Scenario 1: Installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road

- Zone 1A Alternative 3: PRV on Olympic Valley Road, West Tiger Tail Road, and Victor Place; separate Main to Zone 2 Pump Station on Olympic Valley Road
 - Emergency Scenario 3: Installation of bypass/parallel line between Victor Drive and East BPS
- Zone 1A Alternative 4: PRV on Olympic Valley Road, Victor Drive, and Tiger Tail Road
 - Emergency Scenario 1: Installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road

2.0 ALTERNATIVES ANALYSIS

All modeling on the existing system and proposed alternatives was performed in InfoWater Pro. The original water distribution model was developed in 2012 and was updated in 2021 with updated demands for Zone 1. Additionally, fire hydrant flow tests were performed by OVPSD staff in 2021 and the model was calibrated using the flow test results. The model calibration also included updated pump curves for existing wells and booster pump stations, as well as creating extended period simulation (EPS) scenarios. Lidar of Olympic Valley was flown in 2021 and was incorporated into the model in 2022 to update all node elevations for more accurate hydraulic modeling.

Four alternatives were modeled to determine the optimal configuration necessary to create Pressure Zone 1A. In each alternative, Zone 1A is located to the east of the listed PRVs. A brief overview of the proposed changes under each alternative is as follows:

- Alternative 1
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
- Alternative 2
 - 2 PRVs (Olympic Valley Road PRV and Tiger Tail West PRV)
 - Closed valve on Victor Place
- Alternative 3
 - 3 PRVs (Olympic Valley Road, Victor Place PRV, and Tiger Tail West PRV)
 - Parallel main on Olympic Valley Road to the East BPS
- Alternative 4
 - 3 PRVs (Olympic Valley Road PRV, Victor Drive PRV, and Tiger Tail East Road PRV)

All proposed changes under each alternative will be made in existing right-of-way where there are utilities already in place. No significant permitting efforts are anticipated for any of the four alternatives and the permitting effort will not change significantly between alternatives. Permitting specifics for the chosen alternative will be discussed in detail in Section 5.5.

2.1 ALTERNATIVE 1: PRVS ON OLYMPIC VALLEY ROAD, VICTOR PLACE, AND WEST TIGER TAIL ROAD

2.1.1 Alternative Description

For Alternative 1, Zone 1A is formed by adding PRVs on Olympic Valley Road, Victor Place, and the west end of Tiger Tail Road at the intersection of Victor Drive. The Olympic Valley Road PRV was modeled as a 12-inch PRV, the Tiger Tail West PRV was modeled as an 8-inch PRV, and the Victor Place PRV was modeled as a 6-inch PRV. All of the proposed PRVs match the existing pipe diameters for those mains. The modeled PRV sizes are also reflected in the cost estimates. If installed, these PRVs will also have smaller bypass PRVs that will allow lower flows to go from Zone 1 to Zone 1A without causing water hammer.

The PRVs were modeled so that the Olympic Valley Road PRV was in lead position, and Victor Place and Tiger Tail West PRVs were in lag position. The locations of the proposed PRVs, as well as the extents of Zone 1A, are shown in Figure 4. Under this alternative, the East BPS will be included in Zone 1A. For this reason, upgrades to the East BPS will be required.

2.1.2 Modeling Results

The MDD was modeled to determine the lowest possible pressures within the system. At MDD, the Olympic Valley Road PRV was the only PRV letting water into Zone 1A. The minimum and maximum pressures found within Zone 1A are listed in Table 6. The lowest pressures seen in Zone 1A were located along Tiger Tail Road, from the intersection of Victor Drive to the top of hill that loops to the south. There

were also low pressures along the southern end of Broken Arrow Place. The highest pressures in proposed Zone 1A were located at the intersection of Olympic Valley Road and Highway 89. Figure 5 illustrates the pressures at MDD across Zone 1A with pressure gradient contours.

The available fire flow analysis calculated the highest demand a fire hydrant can accommodate while keeping pressures above 20 psi at all other hydrants and services within the pressure zone. Most hydrants were self-limiting (which is ideal), and there was no single problem area that was limiting fire hydrant flow. A self-limiting hydrant is a fire hydrant that will reach 20 psi before any other hydrants in the pressure zone reach 20 psi. Since available fire flow for a fire hydrant is based on the flow of the hydrant when any hydrant in the pressure zone reaches 20 psi, a hydrant is self-limiting when it is releasing flow and is the first hydrant in the pressure zone to reach 20 psi. A summary of the minimum and maximum fire flows within Zone 1A for Alternative 1 can be found in Table 6. Figure 6 illustrates the location of the highest and lowest flows, as well as the fire flow range for each hydrant within proposed Zone 1A.

Under Alternative 1, all residential hydrants meet the 1,500 gpm criteria and all commercial hydrants meet the criteria of 2,500 gpm established by the Olympic Valley Fire Department. The highest and lowest flows came from fire hydrant H081 and hydrant H098, respectively. The location of the hydrants with the highest and lowest flows are called out in Figure 6.

Fire flow events on the east side of the system will mainly draw water through the Olympic Valley Road PRV with a smaller portion of flow coming through the East BPS PRV. Fire flow events on the west side of the system will only utilize the Olympic Valley Road PRV. The Victor Place PRV would only provide water to Zone 1A during a fire flow event when the Olympic Valley Road PRV is out of service during maintenance, repair, or replacement on the Olympic Valley Road distribution main. Since the Victor Place PRV does not regularly provide any water to Zone 1A, it essentially creates a hydraulic dead-end. Operations staff will need to consider this and treat this area like any other dead-end in the system.

It is important to note that available fire flows are higher in Zone 1A than in Zone 1 because hydrants and services at higher elevations in the Granite Chief area (that would hit 20 psi before hydrants and services at lower elevations) were separated by the creation of the new pressure zone.

Table 6: Alternative 1 Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	47	108
Available Fire Flow (gpm)	1,500	>3,000

2.1.3 Emergency Repairs on Olympic Valley Road Main

Under Alternative 1, disruption on the Olympic Valley Road transmission main would leave Zone 1 east of Russell Road without water. In order to provide water to that area of Zone 1 (including Hidden Lake), it was determined that the most feasible solution was to install an emergency intertie to the SVMWC system near the intersection of Russell Road and Olympic Valley Road. The intertie would consist of a 6-inch PRV with a 2-inch bypass and would be the sole source of water to Zone 1 east of the intertie while the Olympic Valley Road transmission main is offline.

During emergency repairs on the Olympic Valley Road transmission main, Zone 1A would be fed by Zone 2 via the East BPS PRV. Zone 2 would receive water from Well 5R through the main that crosses the meadow, which operations staff would need to open. In order to prevent the Intertie PRV from also feeding Zone 1A, all proposed Zone 1A PRVs (Olympic Valley Road PRV, Victor Place PRV, and West Tiger Tail PRV) would need to be manually closed by operations staff.

Pressures at MDD and available fire flows during emergency repairs on the Olympic Valley Road main were only modeled for the Preferred Alternative. An in-depth discussion of the modeling results can be found in Section 5.4.

2.1.4 Cost Estimate

The cost estimate for Alternative 1, including the Intertie PRV for emergency repair situations, is summarized in Table 7. Assumptions for cost estimates are listed in Section 1.2.5.

Table 7: Alternative 1 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (NTE 10%)	1	EA	\$60,000.00	\$60,000.00
Traffic Control	1	EA	\$14,500.00	\$14,500.00
Tiger Tail West 8" PRV	1	EA	\$100,000.00	\$100,000.00
Victor Place 6" PRV	1	EA	\$90,000.00	\$90,000.00
Olympic Valley Road 12" PRV	1	EA	\$120,000.00	\$120,000.00
SVMWC Intertie 6" PRV	1	EA	\$90,000.00	\$90,000.00
PRV Electrical and SCADA	3	EA	\$50,000.00	\$150,000.00
Conduit Trench 1" PVC Conduit	145	LF	\$75.00	\$10,875.00
3" Patch Paving	580	SF	\$20.00	\$11,600.00
East BPS Pump Replacement	1	EA	\$25,000.00	\$25,000.00
Construction Subtotal:				\$672,000.00
Contingency:				\$100,800.00
Engineering:				\$67,200.00
Permitting:				\$33,600.00
Inspection and Construction Management:				\$67,200.00
Administration:				\$33,600.00
Estimated Total Project Cost:				\$974,400.00

2.2 ALTERNATIVE 2: PRV ON OLYMPIC VALLEY ROAD AND WEST TIGER TAIL ROAD, CLOSED GATE VALVE ON VICTOR PLACE

2.2.1 Alternative Description

For Alternative 2, Zone 1A is formed by adding PRVs on Olympic Valley Road and the west end of Tiger Tail Road and adding a closed gate valve on Victor Place. The Olympic Valley Road PRV was modeled as a 12-inch PRV and the Tiger Tail West PRV was modeled as an 8-inch PRV, which both match the existing pipe diameters for those mains. The cost estimates will reflect these modeling assumptions. If installed, these PRVs will also have smaller bypass PRVs that will allow lower flows to go from Zone 1 to Zone 1A without causing water hammer.

The PRVs were modeled so that the Olympic Valley Road PRV was in the lead position and Tiger Tail West PRV was in lag position. This alternative is almost identical to Alternative 1, except the Victor Place PRV was changed to a closed valve to evaluate the effect that would have on Zone 1A. The locations of the proposed PRVs and closed valve, as well as the extents of Zone 1A, are shown in Figure 7. Under this alternative, the East BPS will be included in Zone 1A. For this reason, upgrades to the East BPS will be required.

2.2.2 Modeling Results

Overall, modeling results for Alternative 2 were identical to results for Alternative 1 due to the fact that the Victor Place PRV did not open to allow flow into Zone 1A under any of the modeled scenarios.

The MDD was modeled to determine the lowest possible pressures within the system. At MDD, the Olympic Valley Road PRV was the only PRV letting water into Zone 1A. The minimum and maximum pressures found within Zone 1A are listed in Table 8. The lowest pressures seen in Zone 1A were located along Tiger Tail Road, from the intersection of Victor Drive to the top of hill that loops to the south. There were also low pressures along the southern end of Broken Arrow Place. The highest pressures in proposed Zone 1A were located at the intersection of Olympic Valley Road and Highway 89. Figure 8 illustrates the pressures at MDD across Zone 1A with pressure gradient contours.

The available fire flow analysis calculated the highest demand a fire hydrant can accommodate while keeping pressures above 20 psi at all other hydrants and services within the pressure zone. Most hydrants were self-limiting (which is ideal), and there was no single problem area that was limiting fire hydrant flow. A summary of the minimum and maximum fire flows within Zone 1A for Alternative 2 can be found in Table 8. Figure 9 illustrates the location of the highest and lowest flows, as well as the fire flow range for each hydrant within proposed Zone 1A.

Under Alternative 2, fire hydrant H098 was the lowest flowing hydrant on the southeast end of Broken Arrow Place and fire hydrant H081 was the highest flowing hydrant at the intersection of Olympic Valley Road and Indian Trail Road. Fire flow events on the east side of Zone 1A will mainly draw water through the Olympic Valley Road PRV with a smaller portion of flow coming through the East BPS PRV. Fire flow events on the west side of Zone 1A will only draw water through the Olympic Valley Road PRV.

Table 8: Alternative 2 Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	47	108
Available Fire Flow (gpm)	1,500	>3,000

2.2.3 Emergency Repairs on Olympic Valley Road Main

Under Alternative 2, disruption on the Olympic Valley Road transmission main would leave Zone 1 east of Russell Road without water. In order to provide water to that area of Zone 1 (including Hidden Lake Loop),

it was determined that the most feasible solution was to install an emergency intertie to the SVMWC system near the intersection of Russell Road and Olympic Valley Road. The intertie would consist of a 6-inch PRV with a 2-inch bypass and would be the sole source of water to Zone 1 east of the intertie while the Olympic Valley Road transmission main is offline.

During emergency repairs on the Olympic Valley Road transmission main, Zone 1A would be fed by Zone 2 via the East BPS PRV. Zone 2 would receive water from Well 5R through the main that crosses the meadow, which operations staff would need to open. In order to prevent the Intertie PRV from also feeding Zone 1A, all proposed Zone 1A PRVs (Olympic Valley Road PRV and West Tiger Tail PRV) would need to be manually closed by operations staff.

Pressures at MDD and available fire flows during emergency repairs on the Olympic Valley Road main were only modeled for the Preferred Alternative. An in-depth discussion of the modeling results can be found in Section 5.4.

2.2.4 Cost Estimate

The cost estimate for Alternative 2, including the Intertie PRV for emergency repair situations, is summarized in Table 9. Assumptions for cost estimates are listed in Section 1.2.5.

Table 9: Alternative 2 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (NTE 10%)	1	EA	\$41,600.00	\$41,600.00
Traffic Control	1	EA	\$10,500.00	\$10,500.00
Tiger Tail West 8" PRV	1	EA	\$100,000.00	\$100,000.00
Olympic Valley Road 12" PRV	1	EA	\$120,000.00	\$120,000.00
SVMWC Intertie 6" PRV	1	EA	\$90,000.00	\$90,000.00
PRV Electrical and SCADA	2	EA	\$50,000.00	\$100,000.00
Conduit Trench 1" PVC Conduit	120	LF	\$75.00	\$9,000.00
3" Patch Paving	480	SF	\$20.00	\$9,600.00
East BPS Pump Replacement	1	EA	\$25,000.00	\$25,000.00
Construction Subtotal:				\$505,700.00
Contingency:				\$75,900.00
Engineering:				\$50,600.00
Permitting:				\$25,300.00
Inspection and Construction Management:				\$50,600.00
Administration:				\$25,300.00
Estimated Total Project Cost:				\$733,400.00

2.3 ALTERNATIVE 3: PRV ON OLYMPIC VALLEY ROAD, WEST TIGER TAIL ROAD, AND VICTOR PLACE; SEPARATE MAIN TO ZONE 2 PUMP STATION ON OLYMPIC VALLEY ROAD

2.3.1 Alternative Description

For Alternative 3, Zone 1A is formed by adding PRVs on Olympic Valley Road, Victor Place, and the west end of Tiger Tail Road. The Olympic Valley Road PRV was modeled as a 12-inch PRV, the Tiger Tail West PRV was modeled as an 8-inch PRV, and the Victor Place PRV was modeled as a 6-inch PRV. All of the proposed PRVs match the existing pipe diameters for those mains. The modeled PRV sizes are also reflected in the cost estimate. If installed, these PRVs will also have smaller bypass PRVs that will allow lower flows to go from Zone 1 to Zone 1A without causing water hammer.

The PRVs were modeled so that the Olympic Valley Road PRV was in lead position and the Tiger Tail West PRV and Victor Place PRV were in lag position. A parallel main would be constructed from the intersection of Olympic Valley Road and Victor Drive (upstream of the Olympic Valley PRV) that ties the Zone 1 Olympic Valley Road main directly into the East BPS and East BPS PRV. This alternative was created specifically to keep Hidden Lake in water if the Olympic Valley Road main was shut off for repairs west of Russell Road. In such a situation, water would feed from Well 5R, across the meadow line (which would need to be opened for this scenario) into Zone 2 and would then reach Zone 1 through the East BPS PRV. An additional benefit to Alternative 3 is that it keeps the East BPS in Zone 1 so that no modifications would need to be made to the existing pump. The locations of the proposed PRVs and parallel main, as well as the extents of Zone 1A, are shown in Figure 10.

Alternative 3 is the only alternative that is fully reliant on the OVPSD system during emergency repairs on the Olympic Valley Road transmission main, which was an important consideration during the alternatives analysis discussed in following sections.

2.3.2 Modeling Results

The MDD was modeled to determine the lowest possible pressures within the system. At MDD, only the Olympic Valley Road PRV provides water to Zone 1A. The minimum and maximum pressures found within Zone 1A are listed in Table 10. The lowest pressures seen in Zone 1A were located along Tiger Tail Road, from the intersection of Victor Drive to the top of hill that loops to the south. There were also low pressures along the southern end of Broken Arrow Place. The highest pressures in proposed Zone 1A were located at the intersection of Olympic Valley Road and Highway 89. Figure 11 illustrates the pressures at MDD across Zone 1A with pressure gradient contours.

The available fire flow analysis calculated the highest demand a fire hydrant can accommodate while keeping pressures above 20 psi at all other hydrants and services within the pressure zone. About half of the hydrants were self-limiting (which is ideal) and the hydrants that weren't self-limiting were limited by either the top of Broken Arrow Place or at the top of the hill on the east side of Tiger Tail Road. A summary of the minimum and maximum fire flows within Zone 1A for Alternative 3 can be found in Table 10. Figure 12 illustrates the location of the highest and lowest flows, as well as the fire flow range for each hydrant within proposed Zone 1A.

Fire flows are slightly lower under Alternative 3, with fire hydrant H098 having the lowest flowing hydrant on the southeast end of Broken Arrow Place and fire hydrant H072 being the highest flowing hydrant just downstream of the Olympic Valley Road PRV. Hydrant H098 is the only hydrant that has an available fire flow below the required 1,500 gpm set forth by the Olympic Valley Fire Department, which would need to be addressed if this alternative were to be constructed. Fire flow events across the system will mainly draw water through the Olympic Valley Road PRV with fire flow events on the far west side of the system also drawing water through the Tiger Tail West PRV.

Table 10: Alternative 3 Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	47	108
Available Fire Flow (gpm)	1,200	>3,000

2.3.3 Emergency Repairs on Olympic Valley Road Main

Pressure Zone 1A Alternative 3 was created for the sole purpose of supplying water to Zone 1 east of Russell Road in the event of an emergency repair on the Olympic Valley Road transmission main. The parallel line that runs from the intersection of Olympic Valley Road and Victor Drive to the East BPS would keep the East BPS in Zone 1. In an emergency situation where the Olympic Valley Road transmission main is offline for emergency repairs east of Russell Road, Zone 1 would be supplied water from the East BPS. Zone 2 would receive water from Well 5R through the main that crosses the meadow, which operations staff would need to open.

Since Zone 1 would be fed from Zone 2, Zone 1A would receive water from Zone 1 through the Olympic Valley Road PRV, Victor Drive PRV, and East Tiger Tail PRV. Under this solution for emergency repairs, Zone 1A would remain intact and the only actions required by operations staff would be to open the meadow line so that Well 5R can feed Zone 2.

This solution to the emergency scenario on Olympic Valley Road is a viable solution since it allows the most operational flexibility and does not rely on the SVMWC as the sole source of water for Zone 1 east of Russell Road. However, the high cost of installing 2,000 feet of parallel 12-inch main under Alternative 3 makes this solution the most expensive of the two possible solutions.

Pressures at MDD and available fire flows during emergency repairs on the Olympic Valley Road main were only modeled for the Preferred Alternative. An in-depth discussion of the modeling results can be found in Section 5.4.

2.3.4 Cost Estimate

The cost estimate for Alternative 3 is summarized in Table 11. Assumptions for cost estimates are listed in Section 1.2.5.

Table 11: Alternative 3 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (NTE 10%)	1	EA	\$168,000.00	\$168,000.00
Traffic Control	1	EA	\$42,000.00	\$42,000.00
Olympic Valley Road 12" PRV	1	EA	\$120,000.00	\$120,000.00
Hidden Lakes Loop 8" PRV	1	EA	\$100,000.00	\$100,000.00
Victor Place 6" PRV	1	EA	\$90,000.00	\$90,000.00
PRV Electrical and SCADA	2	EA	\$50,000.00	\$100,000.00
Conduit Trench 1" PVC Conduit	125	EA	\$75.00	\$9,375.00
3" Patch Paving	12,500	SF	\$20.00	\$250,000.00
12" Zone 1 Bypass Line	2,000	LF	\$400.00	\$800,000.00
Construction Subtotal:				\$1,679,400.00
Contingency:				\$252,000.00
Engineering Design:				\$168,000.00
Permitting:				\$84,000.00
Inspection and Construction Management:				\$168,000.00
Administration:				\$84,000.00
Estimated Total Project Cost:				\$2,435,400.00

2.4 ALTERNATIVE 4: PRV ON OLYMPIC VALLEY ROAD, VICTOR DRIVE, AND TIGER TAIL ROAD

2.4.1 Alternative Description

Zone 1A is formed under Alternative 4 by adding PRVs on Olympic Valley Road, Victor Drive, and the east side of Tiger Tail Road near the middle of the U-bend. The Olympic Valley Road PRV was modeled as a 12-inch PRV, the Tiger Tail East PRV was modeled as a 6-inch PRV, and the Victor Drive PRV was modeled as an 8-inch PRV. All of the proposed PRVs match the existing pipe diameters for those mains. The modeled PRV sizes are also reflected in the cost estimate. If installed, these PRVs will also have smaller bypass PRVs that will allow lower flows to go from Zone 1 to Zone 1A without causing water hammer.

The PRVs were modeled so that the Olympic Valley Road PRV was in lead position and the Tiger Tail East PRV and Victor Drive PRV were in lag position. The locations of the proposed PRVs, as well as the extents of Zone 1A, are shown in Figure 13.

Under this alternative, Tiger Tail Road to the west of the PRV will remain in Zone 1. This alternative was created to maintain system pressures in the higher elevation residences along Tiger Tail. Houses on the north side of Tiger Tail Road are higher than street level and placing those residences in Zone 1A (as in Alternatives 1-3) leads to lower system pressures. Keeping these residences in Zone 1 will maintain existing system pressure for these homes. Additionally, Alternative 4 moves the East BPS from Zone 1 to Zone 1A; therefore, upgrades to the East BPS will be required.

2.4.2 Modeling Results

The MDD was modeled to determine the lowest possible pressures within the system. At MDD, the Olympic Valley Road PRV was the only PRV letting water into Zone 1A. The minimum and maximum pressures found within Zone 1A are listed in Table 12. The lowest pressures seen in Zone 1A were located along Tiger Tail Road, just downstream of the Tiger Tail East PRV, and along the southern end of Broken Arrow Place. The highest pressures in proposed Zone 1A were located at the intersection of Olympic Valley Road and Highway 89. Figure 14 illustrates pressures at MDD across Zone 1A with pressure gradient contours. Service pressures along Tiger Tail Road (for the services that are in Zone 1A for Alternatives 1-3 but remain in Zone 1 for Alternative 4) range from 98 to 120 psi at street level under this alternative. In comparison, the same services range in pressure from 45 to 69 psi at street level under Alternatives 1-3.

The available fire flow analysis calculates the highest demand a fire hydrant can accommodate while keeping pressures above 20 psi at all other hydrants and services within the pressure zone. Most hydrants were self-limiting (which is ideal), and there was no single problem area that was limiting fire hydrant flow. A summary of the minimum and maximum fire flows within Zone 1A for Alternative 4 can be found in Table 12. Figure 15 illustrates the location of the highest and lowest flows, as well as the fire flow range for each hydrant within proposed Zone 1A.

Under Alternative 4, fire hydrant H098 was the lowest flowing hydrant, on the southeast end of Broken Arrow Place, and fire hydrant H081 was the highest flowing hydrant, at the intersection of Olympic Valley Road and Indian Trail Road. Fire flow events on the west side of proposed Zone 1A will only draw water through the Olympic Valley Road PRV. For fire flow events on the east side of proposed Zone 1A, the Olympic Valley Road PRV and East BPS PRV will supply most of the flow and the Tiger Tail East PRV will supply a smaller portion of the flow. The Victor Drive PRV would only provide water to Zone 1A during a fire flow event when the Olympic Valley Road PRV is out of service during maintenance, repair, or replacement on the Olympic Valley Road distribution main. Since the Victor Drive PRV does not regularly provide any water to Zone 1A, it essentially creates a hydraulic dead-end. Operations staff will need to consider this and treat this area like any other dead-end in the system.

Table 12: Alternative 4 Pressures and Available Fire Flow within Proposed Zone 1A

Description	Minimum	Maximum
Pressure at MDD (psi)	53	108
Available Fire Flow (gpm)	1,500	>3,000

2.4.3 Emergency Repairs on Olympic Valley Road Main

Under Alternative 4, disruption on the Olympic Valley Road transmission main would leave Zone 1 east of Russell Road without water. In order to provide water to that area of Zone 1 (including Hidden Lake Loop and upper Tiger Tail Road), it was determined that the most feasible solution was to install an emergency intertie to the SVMWC system near the intersection of Russell Road and Olympic Valley Road. The intertie would consist of a 6-inch PRV with a 2-inch bypass and would be the sole source of water to Zone 1 east of the intertie while the Olympic Valley Road transmission main is offline.

During emergency repairs on the Olympic Valley Road transmission main, Zone 1A would be fed by Zone 2 via the East BPS PRV. Zone 2 would receive water from Well 5R through the main that crosses the meadow, which operations staff would need to open. In order to prevent the Intertie PRV from also feeding Zone 1A, all proposed Zone 1A PRVs (Olympic Valley Road PRV, Victor Drive PRV, and East Tiger Tail PRV) would need to be manually closed by operations staff.

Pressures at MDD and available fire flows during emergency repairs on the Olympic Valley Road main were only modeled for the Preferred Alternative. An in-depth discussion of the modeling results can be found in Section 5.4.

2.4.4 Cost Estimate

The cost estimate for Alternative 4, including the Intertie PRV for emergency repair situations, is summarized in Table 13. Assumptions for cost estimates are listed in Section 1.2.5.

Table 13: Alternative 4 Cost Estimate

Description	Quantity	Unit	Unit Cost	Total Cost
Mobilization and Demobilization (NTE 10%)	1	EA	\$57,300.00	\$57,300.00
Traffic Control	1	EA	\$14,300.00	\$14,300.00
East Tiger Tail Road 6" PRV	1	EA	\$90,000.00	\$90,000.00
Victor Drive 8" PRV	1	EA	\$100,000.00	\$100,000.00
Olympic Valley Road 12" PRV	1	EA	\$120,000.00	\$120,000.00
SVMWC Intertie 6" PRV	1	EA	\$90,000.00	\$90,000.00
PRV Electrical and SCADA	3	EA	\$50,000.00	\$150,000.00
Conduit Trench 1" PVC Conduit	125	LF	\$75.00	\$9,375.00
3" Patch Paving	340	SF	\$20.00	\$6,800.00
East BPS Pump Replacement	1	EA	\$25,000.00	\$25,000.00
Construction Subtotal:				\$662,800.00
Contingency:				\$99,500.00
Engineering Design:				\$66,300.00
Permitting:				\$33,200.00
Inspection and Construction Management:				\$66,300.00
Administration:				\$33,200.00
Estimated Total Project Cost:				\$961,300.00

3.0 NON-ECONOMIC EVALUATION OF ALTERNATIVES

The sub-sections below describe the evaluation method, criteria, and sub-criteria that were used to perform the non-economic evaluation of the alternatives. The results from the non-economic evaluation will be paired with the cost-based analysis discussed in Section 2.0 to identify the preferred alternative, which is discussed in Section 4.0.

3.1 CRITERIA AND SUB-CRITERIA WEIGHTS AND PRIORITIES

Alternatives 1-4, discussed in Section 2.0, were evaluated using a matrix comparison. The matrix is a tool used to identify the best alternative relative to the competing alternatives based on direct comparison. This section includes a brief description of the methodology used, including descriptions of the various criteria and the specific weighting assigned to each criterion.

Each alternative under consideration was scored based on specific criteria. The relative value assigned to each criteria determined its weight compared to the other criteria used in the evaluation. The weight was based on the importance to the project, with a maximum of ten (10) representing critical importance, and a minimum of zero (0) representing least importance. Table 14 presents the scale used in the weighting of criteria.

Table 14: Criteria/Sub-Criteria Weighting Scale

Verbal Scale	Numeric Scale
Critical	10
Very Important	7.5
Important	5
Less Important	2.5
Least Important	0

The criteria and sub-criteria used for the non-economic evaluation were developed by carefully considering the goals of the project and the needs of OVPSD. During a workshop on March 9, 2022, OVPSD was asked for review, input, and acceptance of these parameters. The three evaluation criteria that were used to compare the Zone 1A alternatives are:

1. Operations and Maintenance
2. Engineering
3. Public/Regional Impacts

Table 15 applies the weighting scale in Table 14 to each of the three evaluation criteria listed above based on each criteria's relative importance. The "Priority" column in Table 15 represents a normalization of the weighting, which reflects the relative contribution that a particular criterion has on the overall ranking relative to the other criteria. This priority is expressed as a percentage of the sum of all criterion weights. In this case there are three criteria categories that were weighted separately. These priorities reflect the total criteria scoring, equaling 100 percent.

Table 15: Zone 1A Criteria Weights and Priorities

Criteria	Weight	Priority
Operations and Maintenance	7.5	30%
Engineering	10	40%
Public/Regional Impacts	7.5	30%
Total	25	100%

The three main criteria listed above were broken down into a total of 12 sub-criteria, which are specific characteristics used to compare how well each alternative meets each of the main criteria. Similar to the criteria (as described above), each sub-criterion was assigned a weight, which was then used to calculate a priority. Finally, a matrix weight was calculated for each sub-criterion. The matrix weight for each criterion is equal to that criteria's priority multiplied by 100, which brings the weight from a percentage to a whole number that was used for scoring purposes. The criteria's matrix weight is then multiplied by each sub-criteria's priority to determine the highest possible score that each sub-criterion could be worth. The summation of the matrix weights for all the sub-criteria will always equal 100. The chosen sub-criteria, weights, priorities, and matrix weights used for the non-economic analysis of the Zone 1A alternatives are summarized in Table 16.

Table 16: Zone 1A Sub-Criteria Weights, Priorities, and Matrix Weights

Sub-Criteria	Weight	Priority	Matrix Weight
Operation & Maintenance Weight = 7.5, Priority = 30%			
Number of PRVs	10	40.0%	12.0
Emergency Operations During Olympic Valley Rd Repairs	10	40.0%	12.0
Traffic Control During Maintenance/Repair	5	20.0%	6.0
Subtotal	25	100.0%	30.0
Engineering Weight = 10, Priority = 40%			
Traffic Control During Construction	2.5	9.1%	3.6
Additional Assets (e.g.) Piping	10	36.4%	14.5
Proximity to Existing Utilities	7.5	27.3%	10.9
RTU Placement	2.5	9.1%	3.6
Negative Effect on Existing Service During Construction	5	18.2%	7.3
Subtotal	27.5	100.0%	40.0
Public/Regional Impacts Weight = 7.5, Priority = 30%			
Negative Effect on Existing Fire Protection	7.5	27.3%	8.2
System Self-Reliance	10	36.4%	10.9
Proximity to Residences	2.5	9.1%	2.7
Services Changing Pressure Zones	7.5	27.3%	8.2
Subtotal	27.5	100.0%	30.0

After the criteria and sub-criteria were established and weighted, each alternative was ranked within each sub-criterion and a resulting score was calculated. For example, there are four Zone 1A configuration alternatives, so each alternative was ranked relatively from one (1) to four (4) for each sub-criteria, with four representing the highest, and most desirable rank. The score was then calculated by dividing the rank

by the number of alternatives (4) and then multiplying it by the sub-criteria's matrix weight. If two alternatives are tied for a given sub-criteria, each alternative will be ranked as the same higher rank. For example, if two alternatives are tied as the lowest rank for a sub-criterion, both of the alternatives would be given a rank of 2. The scores for each sub-criteria were then summed for each alternative, and the highest overall scoring alternative is considered the most desirable. The highest possible score for any alternative is 100.

3.2 CRITERIA AND SUB-CRITERIA DESCRIPTIONS

The criteria and sub-criteria used for the non-economic evaluation were introduced in Table 15 and Table 16, respectively. Detailed descriptions of what each criterion and sub-criterion represents, as well as the reasoning for the weight assigned to each, are discussed in the following sections.

3.2.1 Operations & Maintenance

The operation and maintenance of PRVs are a significant consideration in the overall project evaluation and preliminary design. Therefore, this criterion was considered "Very Important" and given a high overall weight. The sub-criteria under the Operations and Maintenance criterion attempts to evaluate the degree of maintenance, operator attention, and how well each alternative accommodates long term accessibility for maintenance purposes.

Since all PRVs were located in existing rights-of-way that are regularly plowed in the winter months, snow removal was not considered as a factor that would be different between alternatives. However, snow removal was a main driver in choosing placement of PRV locations.

1. Number of PRVs: PRVs require routine maintenance and an abundance of PRVs in a system can be cumbersome for OVPSD to maintain. For this reason, this sub-criterion was considered "Critical" when applying weights. Due to the large amount of maintenance and operational control that PRVs require, alternatives with fewer PRVs were given a higher score.
2. Emergency Operation During Olympic Valley Road Water Main Repairs: Considered "Critical" since emergency repairs on the Olympic Valley Road main are anticipated to happen periodically and supplying water to Zone 1 east of Russell Road will be essential during repairs. Operators will need to focus on repairing the Olympic Valley Road main, which will be difficult if providing water to Zone 1 requires a large amount of time and attention. Opening and closing isolation valves is to be expected in such a situation but changing PRV settings or manually pinning open PRVs can be a time-consuming process. Alternatives were given a lower score if they require more operator attention to supply water to Zone 1 during emergency repairs on the Olympic Valley Road main.
3. Traffic Control During Maintenance/Repair: Repair and maintenance can often require large equipment that will facilitate traffic control. For these reasons, this sub-criterion was considered "Important". Alternatives with proposed infrastructure (e.g., PRV's, closed valves, pipeline) within areas where access was restricted (i.e., dead-end roads with no alternative routing) were given a lower score than alternatives with infrastructure on thru roads that had more than one way to access them.

3.2.2 Engineering

The design and constructability of an alternative is a "Critical" criterion to consider when selecting a project, since construction challenges have the potential to cause a significant increase in project costs and/or delay in schedule and could impact the feasibility of constructing the project. The engineering criterion considers the potential ease of construction and is evaluated by the following six sub-criteria:

1. Traffic Control: Considered “Less important”, since it would be a part of any alternative considered, to a varying degree. Alternatives with infrastructure on dead-end roads that cannot be accessed by residents via an alternate route were given lower scores.
2. Additional Assets (e.g., piping, PRV stations, etc.): Limiting additional assets when creating Zone 1A was considered “Critical”. Additional assets, such as pipe or PRV stations, will require long-term maintenance, as well as complete replacement (typically around 30 years for PRV stations, for example). Increasing the replacement and maintenance costs for the water distribution system creates a burden to the customers who pay the rates. OVPSD would like to limit required infrastructure, so alternatives with a larger amount of additional assets (piping, PRV stations, etc.) were given lower scores.
3. Proximity to Existing Utilities: Placement of PRVs will require vaults and if PRVs are proposed in an area with a large amount of existing underground utilities, design and construction could be made difficult, resulting in increased costs and delays to project schedule. Increased costs and delays to project schedules could also apply to the installation of new water main crossing existing utilities, such as gas or sanitary sewer. Therefore, this sub-criterion was considered “Very Important”. The alternatives that have PRVs located near an abundance of existing utilities or installation of water main that will require utility crossings were given a lower score.
4. RTU Placement: Considered “Less Important” since all PRVs will have SCADA that will require an RTU box at each site. Alternatives with PRVs in crowded spaces, where RTU placement would be more challenging (such as near residences) were given lower scores.
5. Negative Effect on Existing Service During Construction: Considered “Important”, since Olympic Valley is mainly composed of residences, making interruptions to service especially noticeable. Alternatives that require larger mains to be shut off for installation of proposed infrastructure were given lower scores.

3.2.3 Public/Regional Impacts

With any construction project, there will be impacts to the general population. Creating Zone 1A will also modify water system pressures for existing services and may add above ground infrastructure near these residences. Public/Regional Impacts was considered “Very Important” and was evaluated using three sub-criteria, that are as follows:

1. Negative Effect on Existing Fire Protection: Some residences are located at a higher elevation within proposed Zone 1A. These higher elevation residences have pressures and available fire flows within acceptable ranges as they currently exist in Zone 1. Moving these residences from Zone 1 to Zone 1A may lead to lower pressures, which can lead to issues and customer complaints for residences in these areas that are above road elevation (the elevation that pressures were modeled). Additionally, the higher elevation services may see reduced available fire flows and act as limiting nodes for the entire Pressure Zone 1A, leading to lower available fire flows throughout the entire zone. Since these higher elevation areas can affect the entirety of Pressure Zone 1A, this sub-criterion was considered “Very Important”. Alternatives that had a lower number of higher elevation services moved from Zone 1 to Zone 1A were given a higher score.
2. System Self-Reliance: When emergency repairs are necessary on the Olympic Valley Road transmission main, Zone 1 to the east of Russell Road will be left without water. With the formation of Zone 1A preventing water from backflowing to this area of Zone 1, system reconfiguration was necessary to supply that water. One solution was to rely on an intertie between a neighboring water system (SVMWC) and the other solution was to add piping to allow water to backflow into Zone 1 from the OVPSD system. Since OVPSD has little control over the reliability of the water coming from SVMWC, self-reliance on the OVPSD system was considered “Critical”. Alternatives that

rely solely on the OVPSD system during emergency repairs on the Olympic Valley Road transmission main were given higher scores than alternatives that rely on the SVMWC to provide water to Zone 1 east of Russell Road.

3. Proximity to Residences: Ideally, above ground infrastructure (such as RTUs) will not be located near the front of any residences. This was considered “Less important” since proximity to residences should not negatively affect the daily life of residents and is mainly an aesthetic concern. Alternatives with PRVs closer to residences were scored lower than alternatives that were not.
4. Services Changing Pressure Zones: Residents within proposed Zone 1A have PRVs at the connection location that limit the amount of pressure seen within the residential building. Changing a service from a higher-pressure zone to a lower zone may have unintended consequences on the operation of the on-site PRV if the new system pressures become too low. Additionally, services connected to the system may see a reduction in service pressure leading to public complaints that would require a response from OVPSD. Therefore, this sub-criterion was considered “Very Important”. Alternatives that had a lower number of residences changing pressure zone from Zone 1 to Zone 1A were given higher scores.

3.3 SCORING MATRIX

After each criterion and sub-criterion were determined for the non-economic analysis, as discussed in Section 3.2, and a weight was assigned to each criterion and sub-criterion, as discussed in Section 3.1, each alternative was ranked within each criterion and sub-criterion in a scoring matrix. The full scoring matrix for the Zone 1A alternatives, including each alternative’s determined rank and final score, is summarized in Table 17.

Table 17: Scoring Matrix for Zone 1A Alternatives

							ALTERNATIVES							
Criteria			Sub-Criteria											
Criteria	Weight	Priority (%)	Sub-Criteria	Weight	Priority (%)	Matrix Weight	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
							Rank	Score	Rank	Score	Rank	Score	Rank	Score
Operational Complexity	7.5	30.0%	Number of PRVs	10	40.0 %	12.0	2	6.0	4	12.0	4	6.0	2	6.0
			Emergency Operation During Olympic Valley Rd Repairs	10	40.0 %	12.0	3	9.0	3	9.0	4	12.0	3	9.0
			Traffic Control During Maintenance/Repair	5	20.0 %	6.0	2	3.0	3	4.5	2	3.0	4	6.0
			Sub-total	25	100.0 %	30.0		18.0		25.5		21.0		21.0
Engineering	10	40.0%	Traffic Control During Construction	2.5	9.1 %	3.6	3	2.7	3	2.7	1	0.9	4	3.6
			Additional Assets (e.g. Piping)	10	36.4 %	14.5	4	14.5	4	14.5	1	3.6	4	14.5
			Proximity to Existing Utilities	7.5	27.3 %	10.9	3	8.2	3	8.2	1	2.7	4	10.9
			RTU Placement	2.5	9.1 %	3.6	3	2.7	3	2.7	3	2.7	4	3.6
			Negative Effect on Existing Service During Construction	5	18.2 %	7.3	3	5.5	3	5.5	3	5.5	4	7.3
Sub-total	27.5	100.0 %	40.0		33.6		33.6		15.5		40.0			
Public/Regional Impacts	7.5	30.0%	Negative Effect on Existing Fire Protection	7.5	27.3 %	8.2	3	6.1	3	6.1	3	4.6	4	8.2
			Proximity to Residences	10	36.4 %	10.9	3	8.2	3	8.2	4	8.2	3	8.2
			System Self-Reliance	2.5	9.1 %	2.7	3	2.0	3	2.0	3	1.5	4	2.7
			Services Changing Pressure Zones	7.5	27.3 %	8.2	3	6.1	3	6.1	3	4.6	4	8.2
Sub-total	27.5	100.0 %	30.0		22.5		22.5		18.9		27.3			
Total	25	100%				Total		74.1		81.6		55.4		88.3

4.0 ALTERNATIVES COMPARISON

The detailed evaluation of project alternatives included both non-economic and economic components. The sub-sections below summarize each alternatives pressures and fire flows within the modeled OVPSD system, how the alternatives compare to both the existing system and each other, the cost estimate associated with each alternative, the final scores of the non-economic evaluation, a comparison of solutions to emergency repairs on Olympic Valley Road, and a summary of key information with an overall alternative ranking.

4.1 MODEL COMPARISON

A summary of the minimum and maximum pressures at MDD, as well as the minimum and maximum available fire flows, as discussed in Section 2.0, are summarized in Table 18. A detailed discussion on how the alternatives differ from the existing system, as well as how the alternatives differ from each other can be found in the following sub-sections.

Table 18: Alternative Comparison of Pressures at MDD and Available Fire Flows

Alternative	Min Pressure at MDD (psi)	Max Pressure at MDD (psi)	Min Available Fire Flow (gpm)	Max Available Fire Flow (gpm)
Existing	97	159	1,600	>3,000
Alternative 1	47	108	1,500	>3,000
Alternative 2	47	108	1,500	>3,000
Alternative 3	47	108	1,200	>3,000
Alternative 4	53	108	1,500	> 3,000

4.1.1 Alternatives Compared to Existing

There are several notable differences between the existing system and the proposed alternatives, which is summarized in Table 19. Overall, pressures at MDD are significantly lower than the existing system, which was the goal of creating Zone 1A. Available fire flows only saw significant changes for Alternative 3, which saw overall reduced available fire flows and had one hydrant fall under the minimum required available flow rate of 1,500 gpm.

Table 19: Alternatives Compared to Existing System

Alternative	Pressures at MDD Compared to Existing System	Available Fire Flows Compared to Existing System
1, 2, 4	Significantly lower	Available fire flows do not change significantly from existing. All fire flows meet 1,500 gpm minimum for residential properties and 2,500 gpm for commercial properties.
3	Significantly lower	Most hydrants saw slight decrease in available fire flow 1 hydrant had flow below 1,500 gpm

4.1.2 Alternatives Compared to Each Other

Overall, Alternatives 1-4 have many similarities. Each alternative forms Zone 1A and will see the same HGL when created. However, there are some key differences between alternatives, which are important to consider. Alternative differences are discussed in detail below.

- Key difference in infrastructure/proposed Zone 1A service area
 - Alternative 1 versus Alternative 2
 - In Alternative 1, there is a PRV on Victor Place and in Alternative 2, there is a closed valve on Victor Place
 - PRV on Victor Place provided negligible flows
 - Pressures at MDD and available fire flows for Alternatives 1 and 2 were essentially identical
 - The largest difference between the two alternatives is the cost and operational flexibility associated with having a PRV versus a closed valve
 - Alternative 2 has a lower cost estimate
 - Alternative 1 allows for more operational flexibility for operators
 - Alternative 3
 - Parallel main to the East BPS and in addition to PRV on Olympic Valley Road
 - Cost estimate of the parallel main far exceeded the combined cost of an additional PRV and replacing the pump at the East BPS
 - Alternative 4
 - Tiger Tail West PRV moved to east side of Tiger Tail Road
 - Victor Place PRV moved to Victor Drive
 - North half of Victor Drive and most of Tiger Tail Road will remain in Zone 1 and are no longer a part of Zone 1A
- East BPS
 - Will be in Zone 1A for Alternatives 1, 2, and 4
 - Will require a new pump that delivers more head
 - The required pump parameters for the East BPS pump will be discussed in detail in Section 5.0
 - Will remain in Zone 1 for Alternative 3
 - Will not require a pump replacement
- Pressures for services between East Tiger Tail PRV and West Tiger Tail PRV
 - These services are moved to Zone 1A in Alternatives 1-3 and remain in Zone 1 in Alternative 4
 - Pressures are listed per alternative in Table 20.

- It is important to note that most residences along this segment of road are located at higher elevations than what was modeled at street level. For this reason, pressures experienced by the residences may be lower than what is listed in Table 20.

Table 20: Pressure Comparison for Tiger Tail Road

Alternative	Pressures for Services between East and West Tiger Trail PRVs	
	Minimum	Maximum
1	47	69
2	47	69
3	45	68
4	97	120

4.2 COST COMPARISON

A summary of the estimated construction costs for each alternative, determined in Section 2.0, is shown in Table 21. Overall, Alternative 2 had the lowest estimated cost of construction, due to that alternative only having two PRVs. Alternative 3 consisted of three PRVs and a 2,000-foot section of 12-inch main, which caused Alternative 3 to have the highest estimated cost of construction at over double any of the other alternatives.

Table 21: Alternative Comparison of Cost Estimates

Alternative	Estimated Cost of Construction
1	\$974,400
2	\$733,400
3	\$2,435,400
4	\$961,300

4.3 NON-ECONOMIC EVALUATION COMPARISON

The non-economic evaluation took into consideration the differences in alternative configuration by evaluating the impacts each configuration would have on the operation and maintenance of the system, the engineering and constructability of each configuration, and the public/regional impacts of each configuration. After analyzing each alternative against these three main criteria, as described in Section 3.0, an overall score was determined. Table 22 summarizes the non-economic evaluation score for each alternative. Overall, Alternative 4 had the highest score and Alternative 3 had the lowest score.

Table 22: Alternative Comparison of Non-Economic Evaluation Scores

Alternative	Non-Economic Evaluation Score (out of 100)
1	74.1
2	81.6
3	55.4
4	88.3

4.4 EMERGENCY REPAIR SOLUTION COMPARISON

Supplying water to Zone 1 east of Russell Road during emergency repairs on the Olympic Valley Road transmission main was a large consideration during the creation of alternatives. This emergency scenario was the main driver for consideration of the emergency intertie within this report, as well as the creation of Alternative 3. The proposed solution per alternative for supplying water to Zone 1 east of Russell Road during emergency repairs on the Olympic Valley Road transmission main is listed in Table 23.

Under all the emergency solutions, operators would need to open valves to allow water from Well 5R to travel across the meadow line and feed Zone 2, which would then back feed into Zone 1A (under Alternatives 1, 2, and 4) or Zone 1 (Alternative 3). Alternatives 1, 2, and 4 all rely on the emergency intertie, and thus the SVMWC water system, to supply water to Zone 1 east of Russell Road and would require operators to close isolation valves to all Zone 1A PRVs so that water from SVMWC would not feed into Zone 1A.

Alternative 3 is the only solution that allows OVPSD's water system to be completely self-reliant during emergency repairs, which is a large factor for overall alternative ranking in Section 4.5 due to its high importance. In addition, under Alternative 3, no further actions beyond opening the meadow line are required by operators. Less operator attention needed to supply Zone 1 with water would mean more time for them to focus on repairing the Olympic Valley Road transmission main.

Table 23: Alternative Comparison on Emergency Repair Solutions

Alternative	Olympic Valley Road Main Emergency Repair Solution
1	Emergency intertie near the intersection of Russell Road and Olympic Valley Road
2	Emergency intertie near the intersection of Russell Road and Olympic Valley Road
3	Bypass/parallel line between Victor Drive and East BPS
4	Emergency intertie near the intersection of Russell Road and Olympic Valley Road

4.5 OVERALL ALTERNATIVE RANKING

After taking into consideration both the economic and non-economic evaluations performed for each alternative, it was determined that Alternative 4 was the preferred alternative for the creation of Pressure Zone 1A. Table 24 lists the overall ranking for each alternative, where a ranking of 1 indicates the most desirable alternative and a ranking of 4 indicates the least desirable alternative.

Alternative 4 had the second to lowest estimated cost of construction and scored the highest in the non-economic evaluation and, therefore, was ranked the highest and identified as the alternative most in line with OVPSD's goals. However, Alternative 3 is the only alternative that keeps the system as-is with respect to fully looped supply to all areas of the system under just about any water main disruption and is the only alternative that allows OVPSD's water system to be fully self-reliant in emergency situations. Even though other criteria evaluated in the non-economic evaluation brought the score of Alternative 3 lower than the other alternatives, it is the alternative that is the most hydraulically similar to the system as it exists today. For that reason, Alternative 3 was ranked as the second most desirable alternative for construction, mostly hampered due to the high cost of construction associated with the parallel main.

Table 24: Ranking of Alternatives

Alternative	Cost	Non-Economic Evaluation Score (out of 100)	Ranking
1	\$974,400	74.1	4
2	\$733,400	81.6	3
3	\$2,435,400	55.4	2
4	\$961,300	88.3	1

5.0 PREFERRED ALTERNATIVE DETAILS

Alternative 4 was identified as the preferred alternative, as summarized in Section 4.5. The purpose of this section is to discuss operational subtleties that will need to be taken into consideration when Alternative 4 is implemented.

5.1 PROPOSED PRV SETTINGS

Proposed PRV elevations and settings under Alternative 4 are listed in Table 25. Detailed discussion on the East BPS PRV and the future SVMWC intertie PRV can be found in Section 5.3.2 and 5.4, respectively.

Table 25: Settings and Elevations for Zone 1A PRVs

PRV	Elevation in Model (ft)	Setting (psi)
Olympic Valley Road PRV	6170.11	80
Victor Drive PRV	6187.58	70
Tiger Tail East PRV	6232.78	50
East BPS PRV	6180.97	72
SVMWC Intertie PRV	6183.48	117

5.2 VICTOR DRIVE PRV

Under Alternative 4, the Victor Drive PRV is in lag with the Olympic Valley Road PRV. As discussed in Section 2.4.2, the Victor Drive PRV does not open to allow flow into Zone 1A, even during fire flow events. Therefore, if the Victor Drive PRV were replaced with a closed valve to create Zone 1A, pressures at MDD and available fire flows discussed in Section 2.4 would remain the same. Whether there is a PRV or a closed valve at Victor Drive, it will functionally be a hydraulic dead-end in the system and should be treated as such by operations staff (i.e., scheduling routine flushing, etc.). The Victor Drive PRV was included in Alternative 4 at the request of OVPSD for operational purposes but can easily be replaced with a closed valve if costs become prohibitive. A summary of the pros and cons of replacing the Victor Drive PRV with a closed valve is listed in Table 26.

Table 26: Pros and Cons of Replacing Victor Drive PRV with a Closed Valve

Pros	Cons
Cost of construction will decrease by an estimated \$150,000 (accounts for PRV and SCADA)	Decreased operational flexibility (a PRV at Victor Drive creates more paths to move water from Zone 1 to Zone 1A)
Customer rates will see less of an increase due to lower construction, maintenance, and replacement costs	
The long-term cost of operating and maintaining a closed valve is much lower than a PRV	
Zone 1A will see the same pressures at MDD and available fire flows as with the PRV	

5.3 EAST BOOSTER PUMP STATION

5.3.1 Pump

Currently, the East BPS pumps water from Zone 1, at an HGL of 6,471.6 feet, to Zone 2, at an HGL of 6,507.4 feet. The current operating point of the East BPS pump is 220 gpm at 60 feet of head. After the implementation of Alternative 4, the East BPS will be pumping from Zone 1A, at an HGL of 6,354.9 feet, instead of from Zone 1. Since the Zone 1A HGL is 116.7 feet lower than the Zone 1 HGL, the new operating point of the existing pump will be off the existing pump curve. In order to have the East BPS run efficiently, it is recommended to replace the current pump with a new pump that can provide a total of 153 feet of head.

5.3.2 PRV Setting

Currently, the East BPS PRV is set to 100 psi. Alternatives discussed in Section 2.0 were all modeled in InfoWater with the East BPS PRV set to 72 psi. This was done to accommodate the lower HGL of Zone 1A so that the East BPS PRV was in lag position with the proposed PRVs.

The East BPS PRV was modeled to be in lag with all of the proposed PRVs under Alternative 4 (Olympic Valley Road PRV, Victor Drive PRV, and Tiger Tail East PRV) so that it would not open and provide flow until necessary during a fire flow event. It was determined that a setting of 72 psi for the 6-inch PRV would keep the PRV closed during the MDD but open during a fire flow event. There is an existing 2-inch bypass PRV, which would need to be set to 74 psi so that the 6-inch only opens during high flow events (i.e. fire flow events).

5.4 EMERGENCY REPAIRS ON OLYMPIC VALLEY ROAD MAIN

Alternative 4 provides water to Hidden Lake Loop and upper Tiger Tail Road through the installation of an emergency intertie near the intersection of Russell Road and Olympic Valley Road that connects the OVPSD water system to the SVMWC water system, as discussed previously in Section 2.4.3. Under this emergency scenario solution:

- All Zone 1A PRVs would be closed by operational staff to prevent SVMWC flow into Zone 1A
- SVMWC would provide all water to Zone 1 east of Russell Road (this includes daily flows and fire flows if needed) until the Olympic Valley main is fixed and turned back on
- The valve for meadow line would be opened by operational staff so that Well 5R could feed into Zone 2, which would feed Zone 1A via the East BPS PRV

Once the Zone 1A PRVs are closed and the East BPS PRV is providing water from Zone 2, Zone 1A pressures would range from 49 to 105 psi. If a fire flow event were to happen while the East BPS PRV was the sole source of water, available fire flow in Zone 1A would range from 1,500 to over 3,000 gpm. Overall, pressures and available fire flows throughout Zone 1A during emergency repairs on the Olympic Valley main saw a slight decrease while being back fed by the East BPS PRV. However, pressures and fire flows within Zone 1A still fall within acceptable ranges and still meet local and state regulations.

Under daily operations, pressures supplied to Zone 1 through the Intertie PRV would remain adequate for uninterrupted service. At MDD, pressures range from 39 to 122 psi, with the lowest pressures occurring along the northern side of Hidden Lake Loop. If a fire flow event were to happen while the Intertie PRV was the sole source of water to Zone 1 east of Russell Road, available fire flow in Zone 1 would range from 900 to 2,100 gpm. The lowest available fire flow of 900 gpm would occur at hydrant H086 on the northeast end of Tiger Tail Road, due to the higher elevations in that area. Pressures in Zone 1 meet minimum state requirements (at least 20 psi) but most hydrants fall below the minimum required fire flow of 1,500 gpm (11 hydrants are below 1,500 gpm and 5 hydrants are above 1,500 gpm).

It was assumed that fire flows to Zone 1 from the SVMWC system would be available at flow rates that were provided in the model. Further analysis will be needed during the design of the emergency intertie to confirm that the SVMWC system can provide these flows.

5.5 PERMITTING

This project will require county and state level permitting and clearances. Under California State Water Board requirements, projects which will disturb one (1) or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ. Construction activity subject to this permit includes clearing, grading and disturbances to the ground such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development of a Storm Water Pollution Prevention Plan (SWPPP) by a certified Qualified SWPPP Developer (QSD).

Clearance under the California Environmental Quality Act (CEQA) is required. Efforts for this project may fall under a categorical exclusion or may require more robust environmental review. A biological review of the project area may be necessary due to crucial habitat identified near the project area. Regardless of the level of CEQA review, an emissions plan would be required to ensure the project meets state air quality standards and is in compliance with National Ambient Air Quality Standards (NAAQS) and Placer County air quality plans. In addition, Placer County Miscellaneous Construction Permit Application – Grading, Underground piping, commercial electric is likely required, and public works county encroachment permit may be necessary for work in roadways.

6.0 CONCLUSION

High pressures in certain areas of Pressure Zone 1 of the OVPSD municipal water system have necessitated analyzing the system to determine the best option for reducing pressures. Four alternatives were modeled in InfoWater that separates the area with the highest pressures into its own pressure zone, referred to as Zone 1A. The four alternatives that were modeled are summarized below:

- Alternative 1
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
- Alternative 2
 - 2 PRVs (Olympic Valley Road PRV and Tiger Tail West PRV)
 - Closed valve on Victor Place
- Alternative 3
 - 3 PRVs (Olympic Valley Road PRV, Victor Place PRV, and Tiger Tail West PRV)
 - Parallel main on Olympic Valley Road to the East BPS
- Alternative 4
 - 3 PRVs (Olympic Valley Road PRV, Victor Drive PRV, and Tiger Tail East PRV)

For each alternative, pressures at MDD and available fire flows within Zone 1A were determined to verify that each alternative met design criteria determined by local and state ordinance, as summarized in Table 27. In addition to the modeling effort, a Level 3 AACE cost estimate was developed, and a non-economic evaluation was performed for each alternative. A comparison of estimated construction costs and the final non-economic evaluation scores for each alternative is summarized in Table 28.

Table 27: Alternative Comparison of Pressures at MDD and Available Fire Flows

Alternative	Min Pressure at MDD (psi)	Max Pressure at MDD (psi)	Min Available Fire Flow (gpm)	Max Available Fire Flow (gpm)
Existing	97	159	1,600	>3,000
Alternative 1	47	108	1,500	>3,000
Alternative 2	47	108	1,500	>3,000
Alternative 3	47	108	1,200	>3,000
Alternative 4	53	108	1,500	>3,000

Table 28: Alternative Comparison of Cost Estimates and Non-Economic Evaluation Scores

Alternative	Estimated Cost of Construction	Non-Economic Evaluation Score (out of 100)
Alternative 1	\$974,400	74.1
Alternative 2	\$733,400	81.6
Alternative 3	\$2,435,400	55.4
Alternative 4	\$961,300	88.3

Based on the economic and non-economic analyses that were performed, it was determined that Alternative 4 was the preferred alternative for construction. Additional considerations were discussed for the implementation of Alternative 4, including certain operational details. These key points are summarized below:

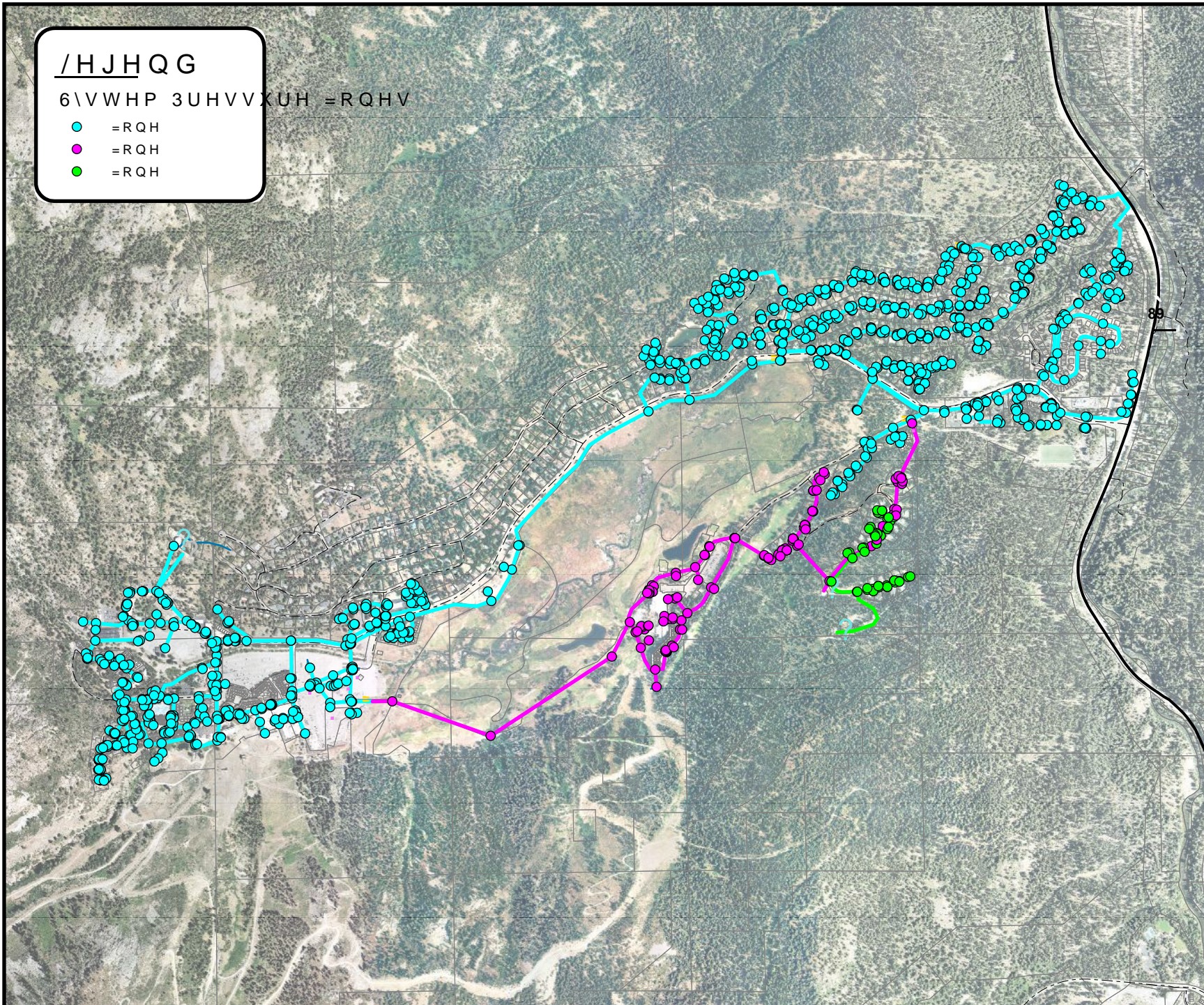
- A closed valve can be installed in place of the Victor Drive PRV without affecting pressures or fire flows within Zone 1A
- A new pump will be required at the East BPS that can provide 153 feet of head
- The setting for the East Booster PRV will need to be changed from 100 psi to 72 psi
- Steps for OVPSD operations were listed for when emergency repairs occur on the Olympic Valley Road water main.
 - These steps will allow Hidden Lake Loop to stay in water without allowing pressures in Zone 1A to increase dramatically.
- Anticipated permitting:
 - Storm water discharge permit
 - Requires the development of a SWPPP
 - CEQA clearance
 - This project may fall under a categorical exclusion
 - Biological review of the area
 - Emissions plan
 - Placer County Miscellaneous Construction Permit
 - For grading, underground piping, and commercial electric
 - Public works county encroachment permit

APPENDIX A: FIGURES

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- =RQH
- =RQH
- =RQH



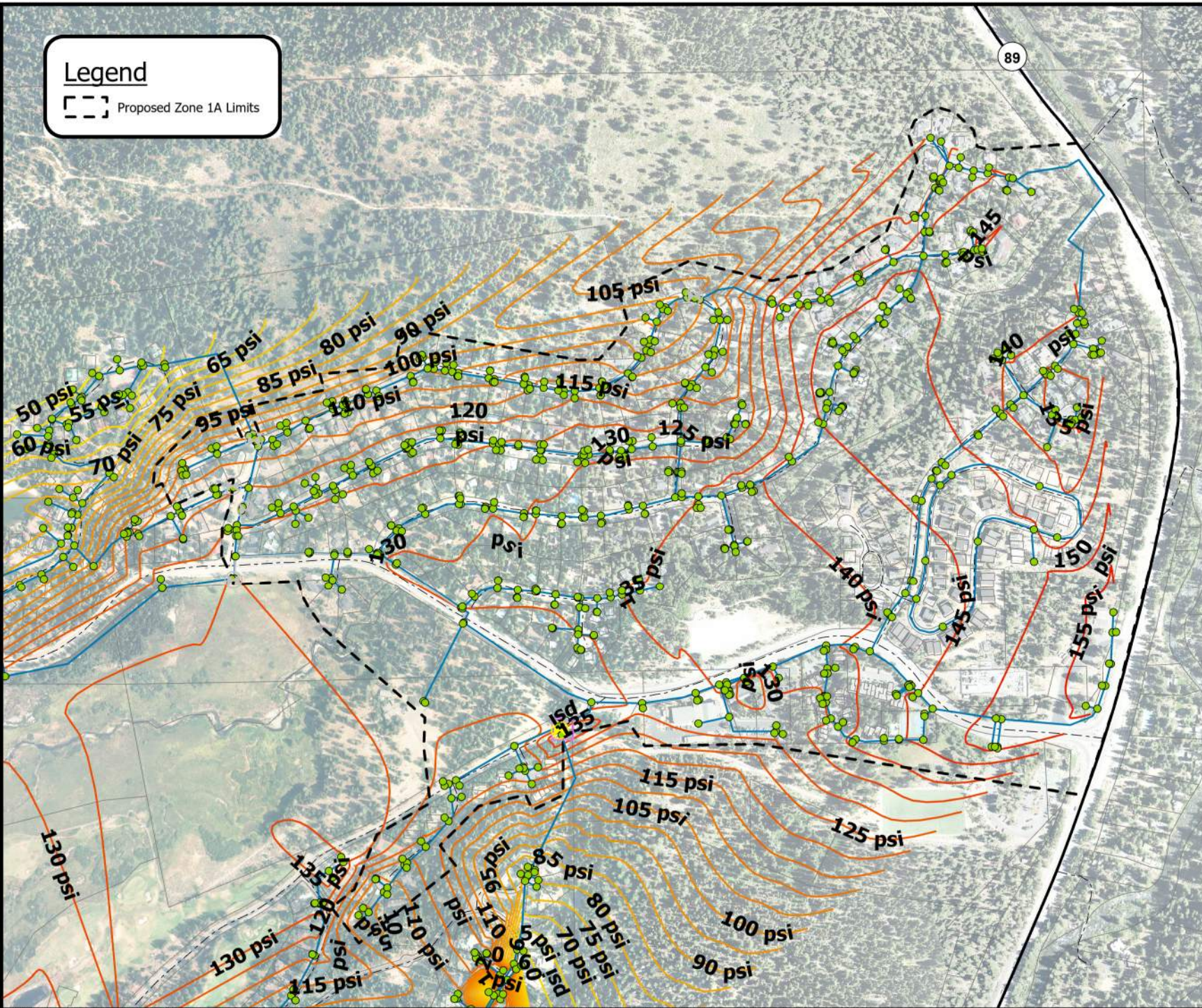
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HULQJ FRP

HG KHUHL
UYH\ GHO
FRQVWUX
WKH DXWK
DLW\ LV D
HHULQJ DV
DFFXUDF

**Figure 2: Existing System Pressures at MDD
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



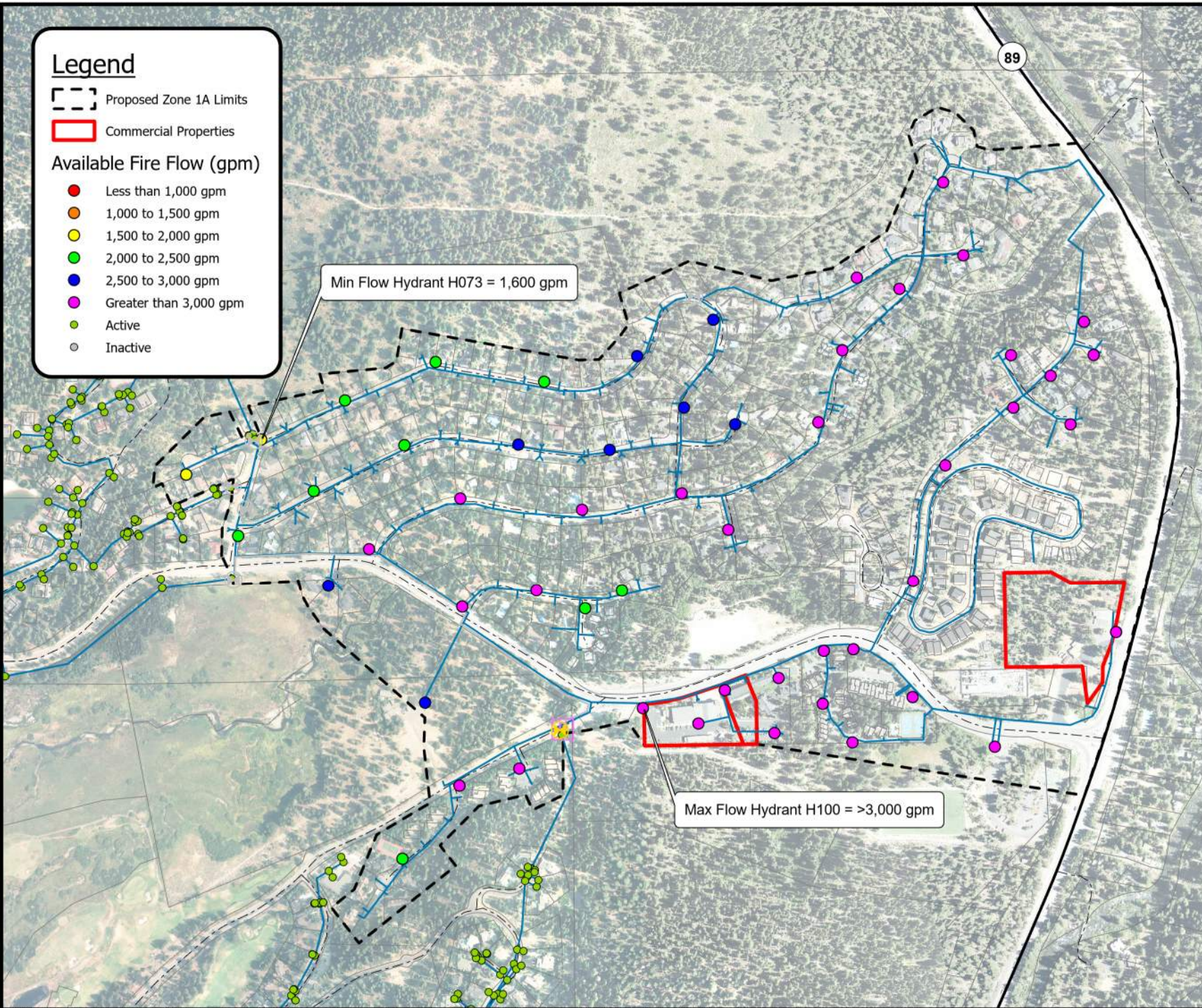
Legend

--- Proposed Zone 1A Limits

**Figure 3: Existing System Available Fire Flows
Pressure Zone 1A**



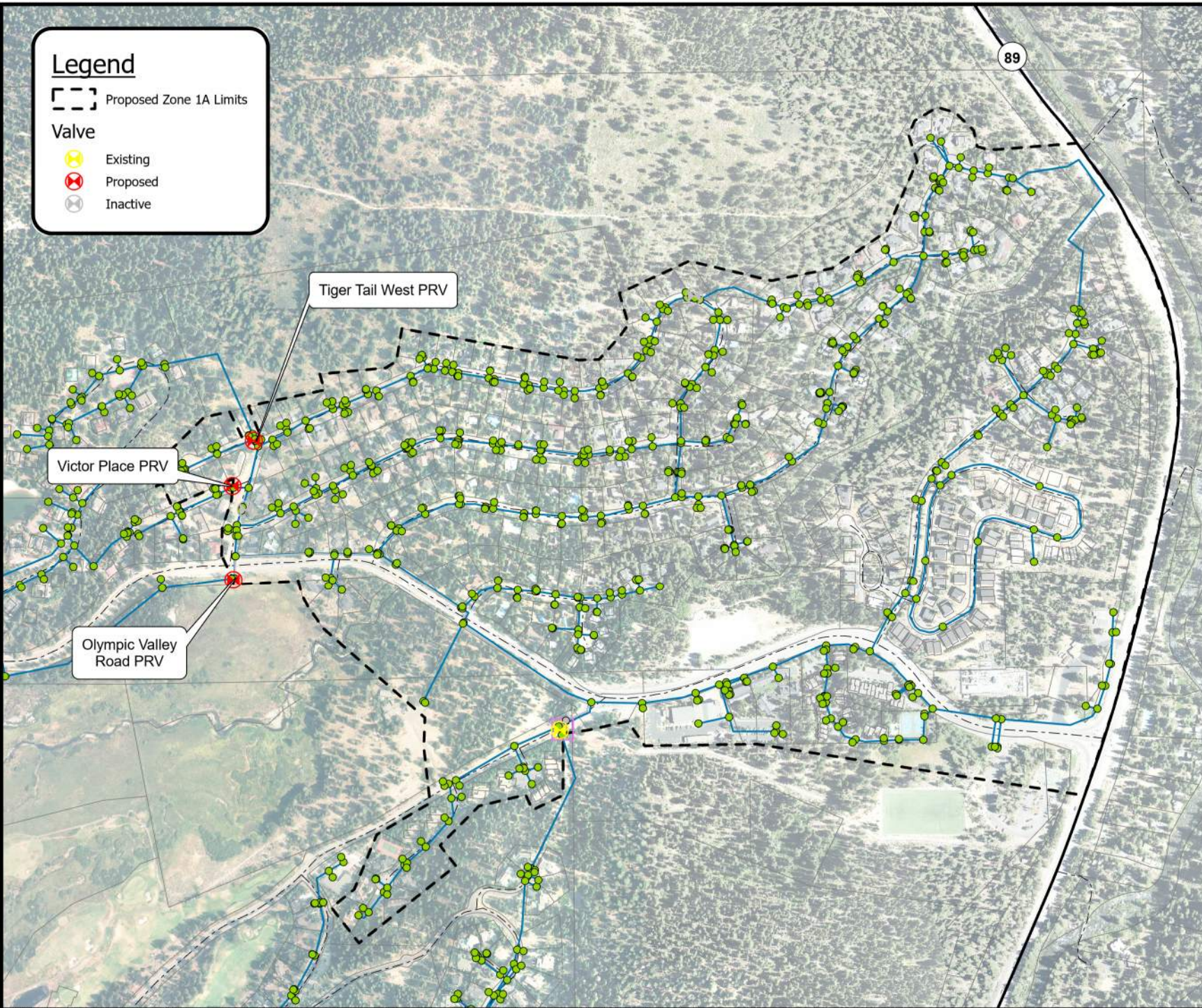
The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



**Figure 4: Alternative 1 Proposed PRV Locations
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



Legend

Proposed Zone 1A Limits

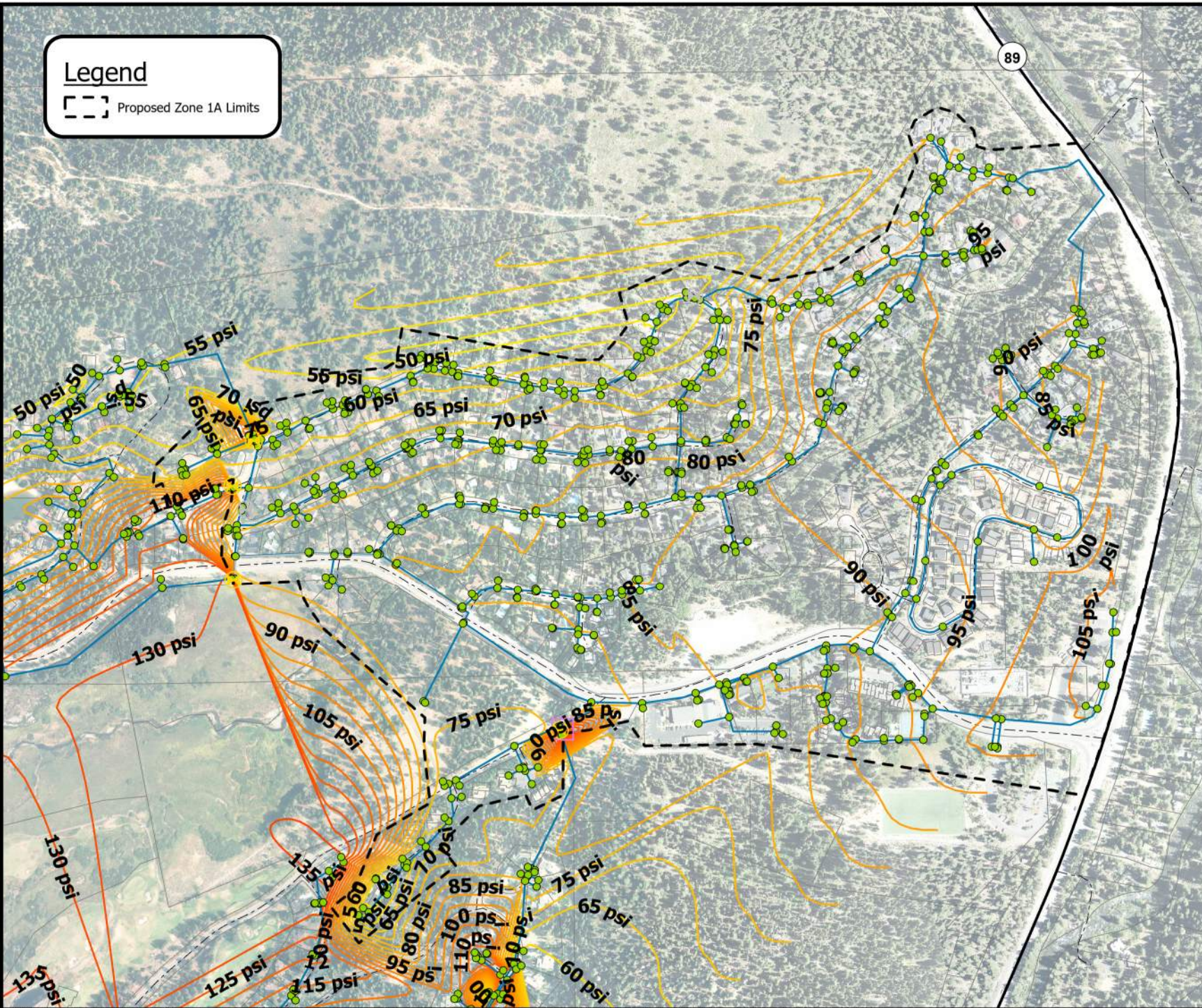
Valve

- Existing (Yellow circle with cross)
- Proposed (Red circle with cross)
- Inactive (Grey circle with cross)

**Figure 5: Alternative 1 Pressures at MDD
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.





Legend

Proposed Zone 1A Limits

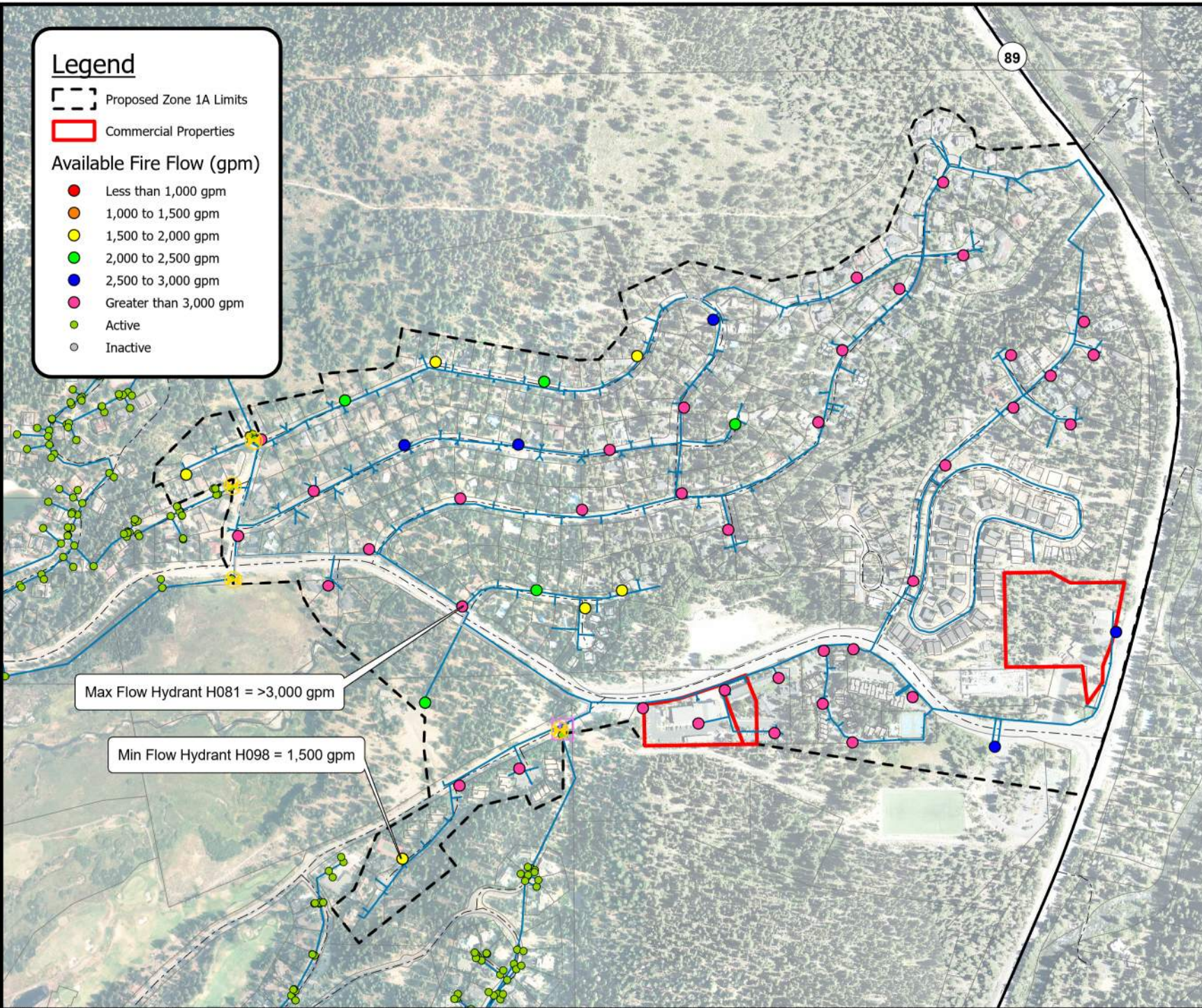
89

Legend

-  Proposed Zone 1A Limits
-  Commercial Properties

Available Fire Flow (gpm)

-  Less than 1,000 gpm
-  1,000 to 1,500 gpm
-  1,500 to 2,000 gpm
-  2,000 to 2,500 gpm
-  2,500 to 3,000 gpm
-  Greater than 3,000 gpm
-  Active
-  Inactive



**Figure 6: Alternative 1 Available Fire Flows
Pressure Zone 1A**

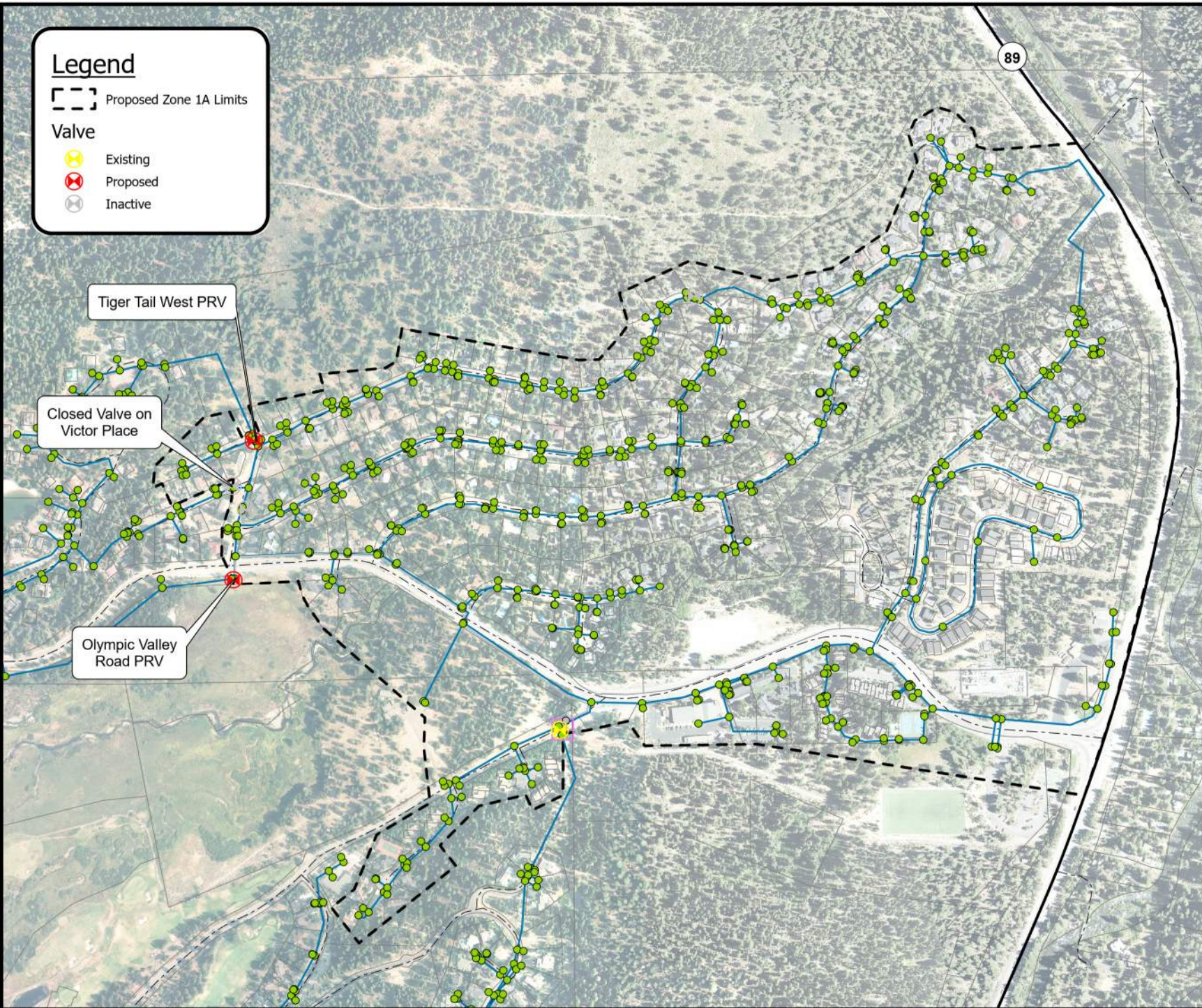


The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

**Figure 7: Alternative 2 Proposed PRV Locations
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



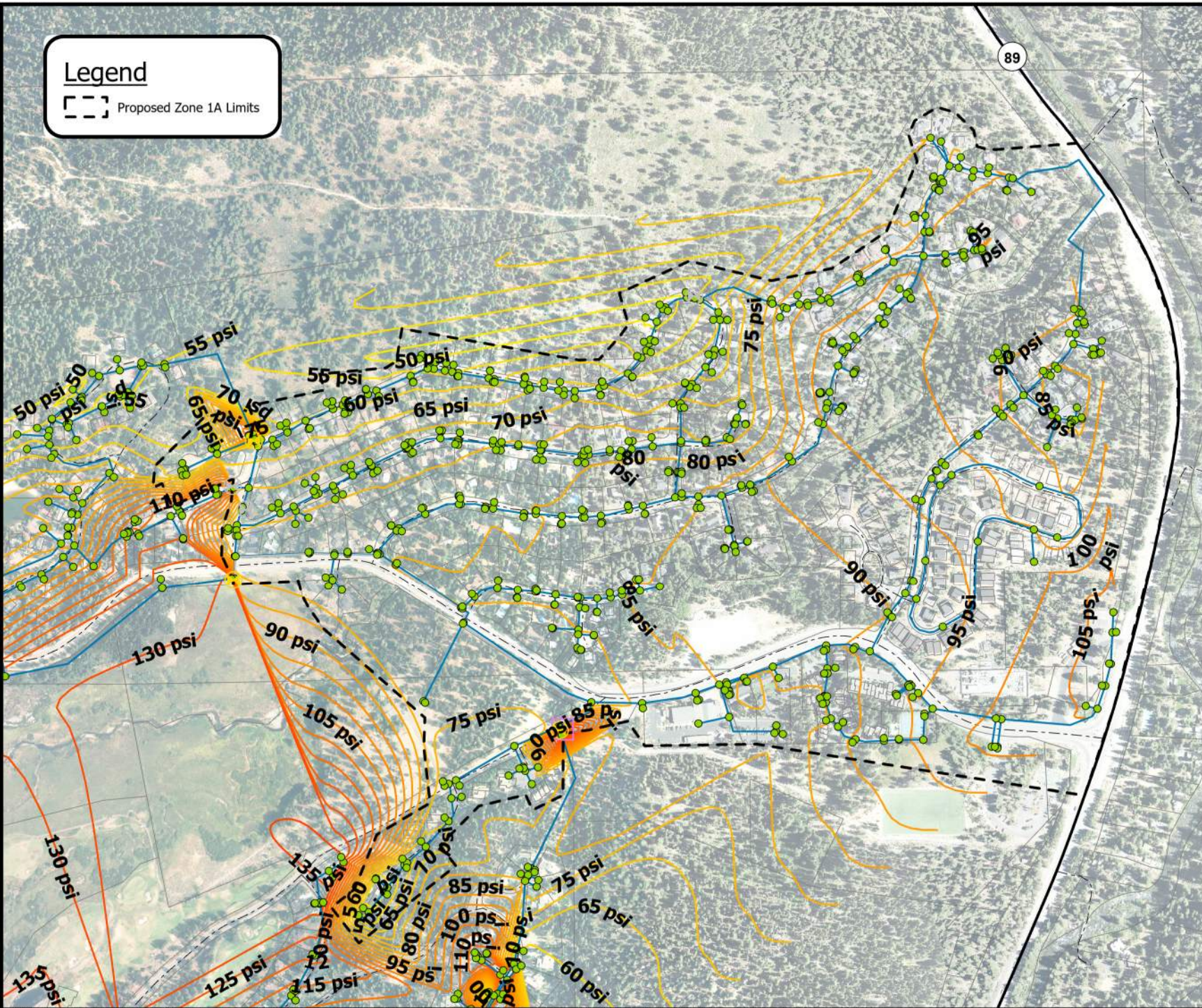
Legend

- Proposed Zone 1A Limits
- Valve**
 - Existing
 - Proposed
 - Inactive

**Figure 8: Alternative 2 Pressures at MDD
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



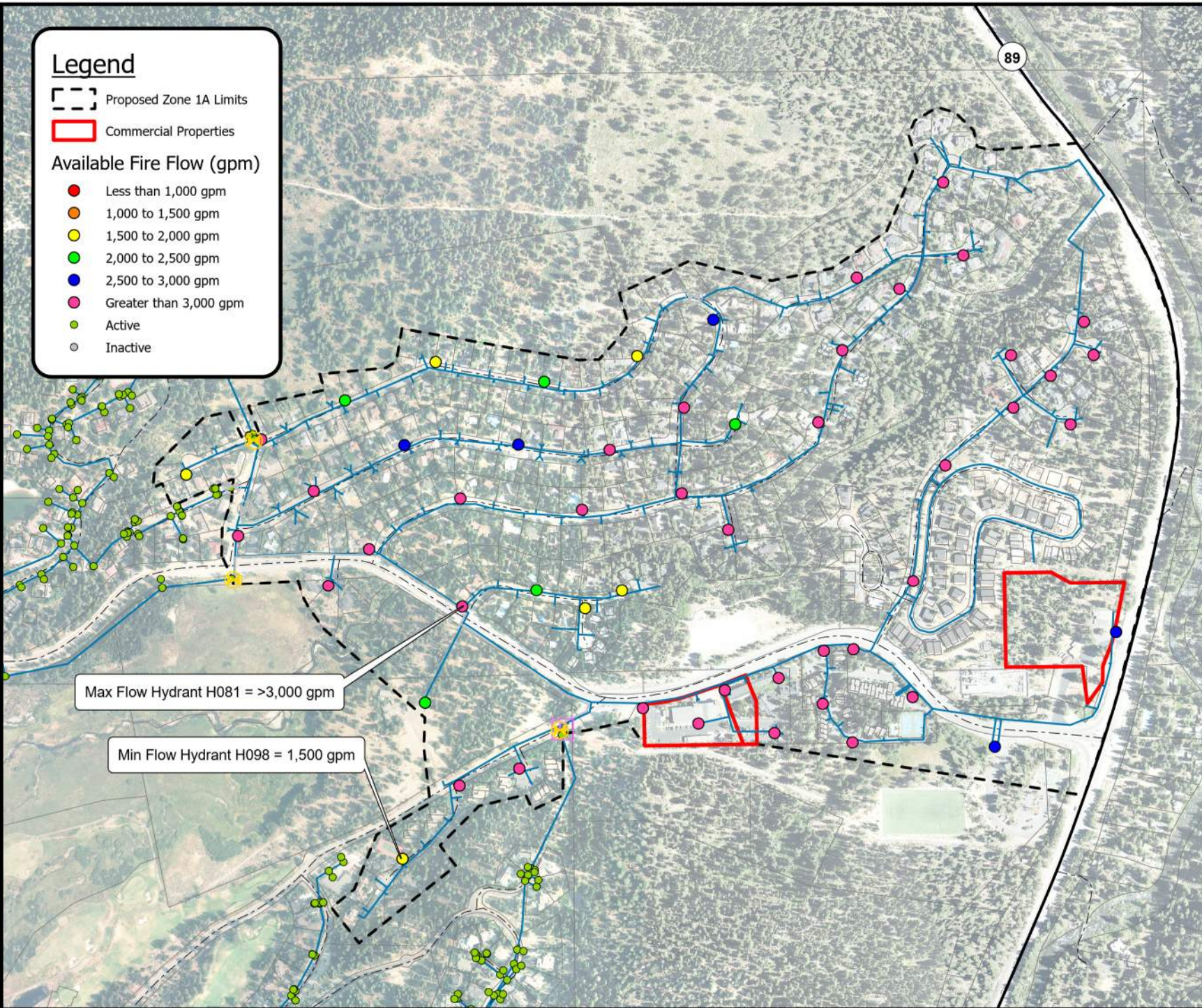
Legend

Proposed Zone 1A Limits

**Figure 9: Alternative 2 Available Fire Flows
Pressure Zone 1A**

N
1" = 600'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



Legend

- Proposed Zone 1A Limits
- Commercial Properties

Available Fire Flow (gpm)

- Less than 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- Greater than 3,000 gpm
- Active
- Inactive

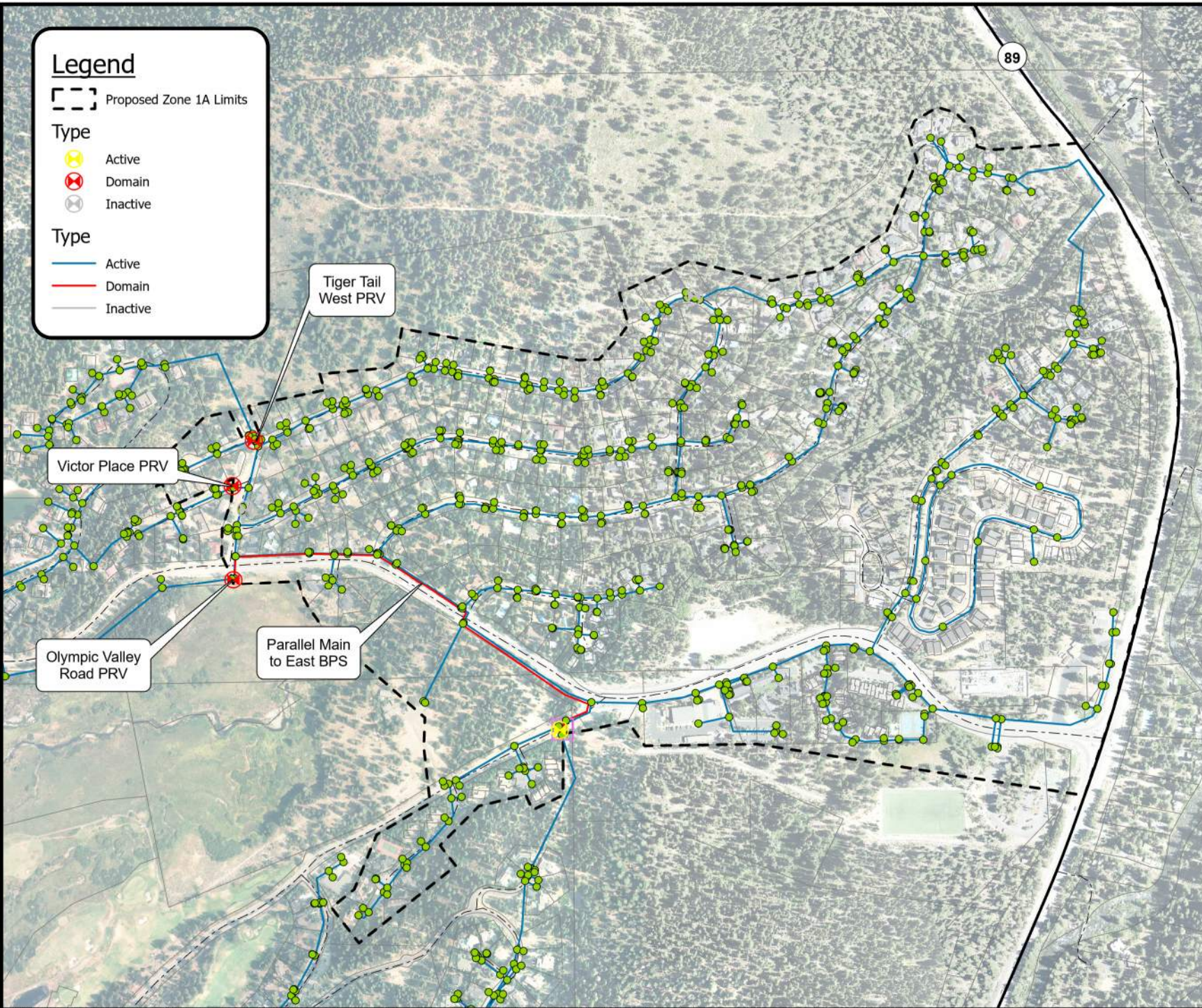
Max Flow Hydrant H081 = >3,000 gpm

Min Flow Hydrant H098 = 1,500 gpm

Figure 10: Alternative 3 Proposed PRV Locations



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



Legend

Proposed Zone 1A Limits

Type

- Active
- Domain
- Inactive

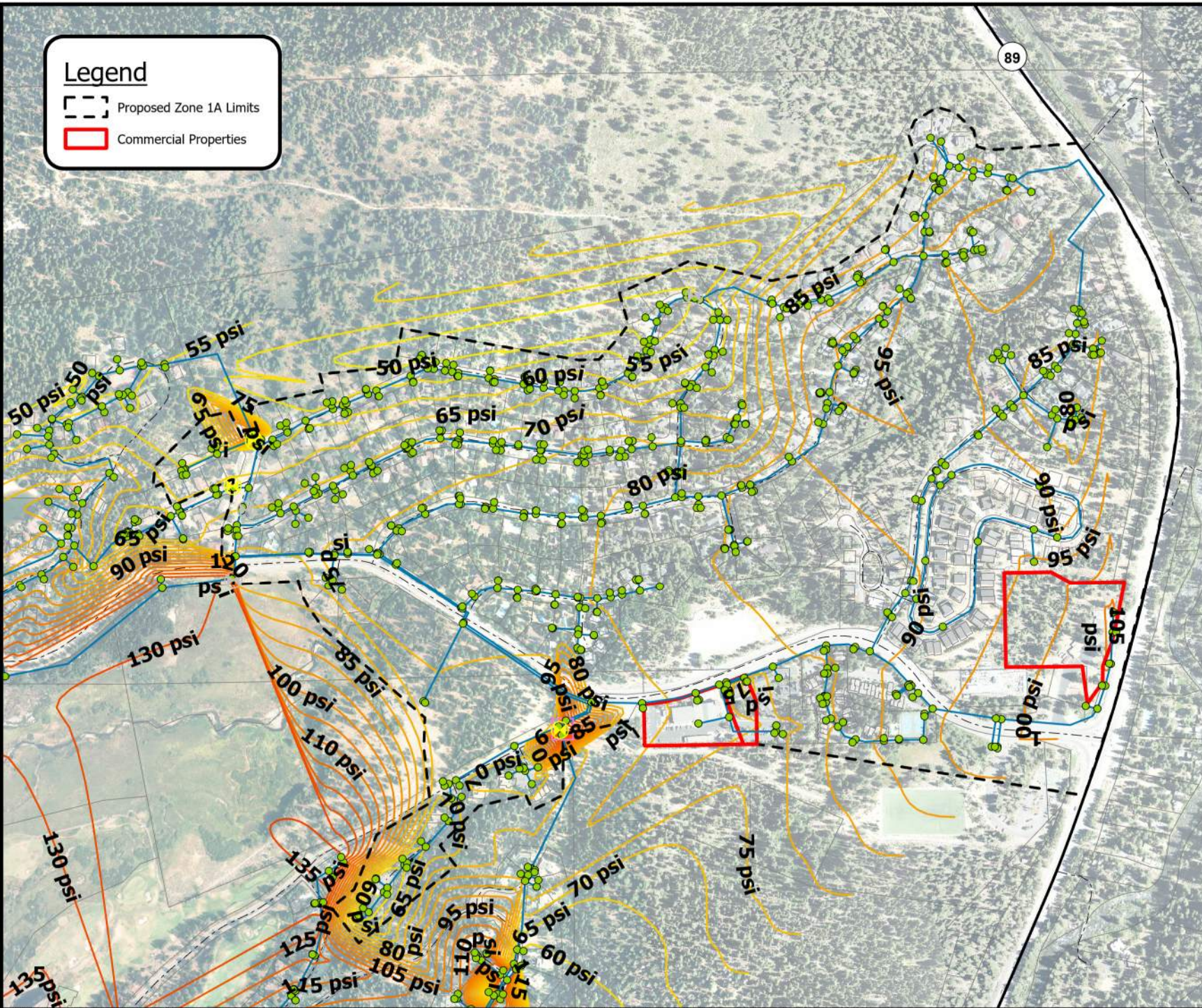
Type

- Active
- Domain
- Inactive

**Figure 11: Alternative 3 Pressures at MDD
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



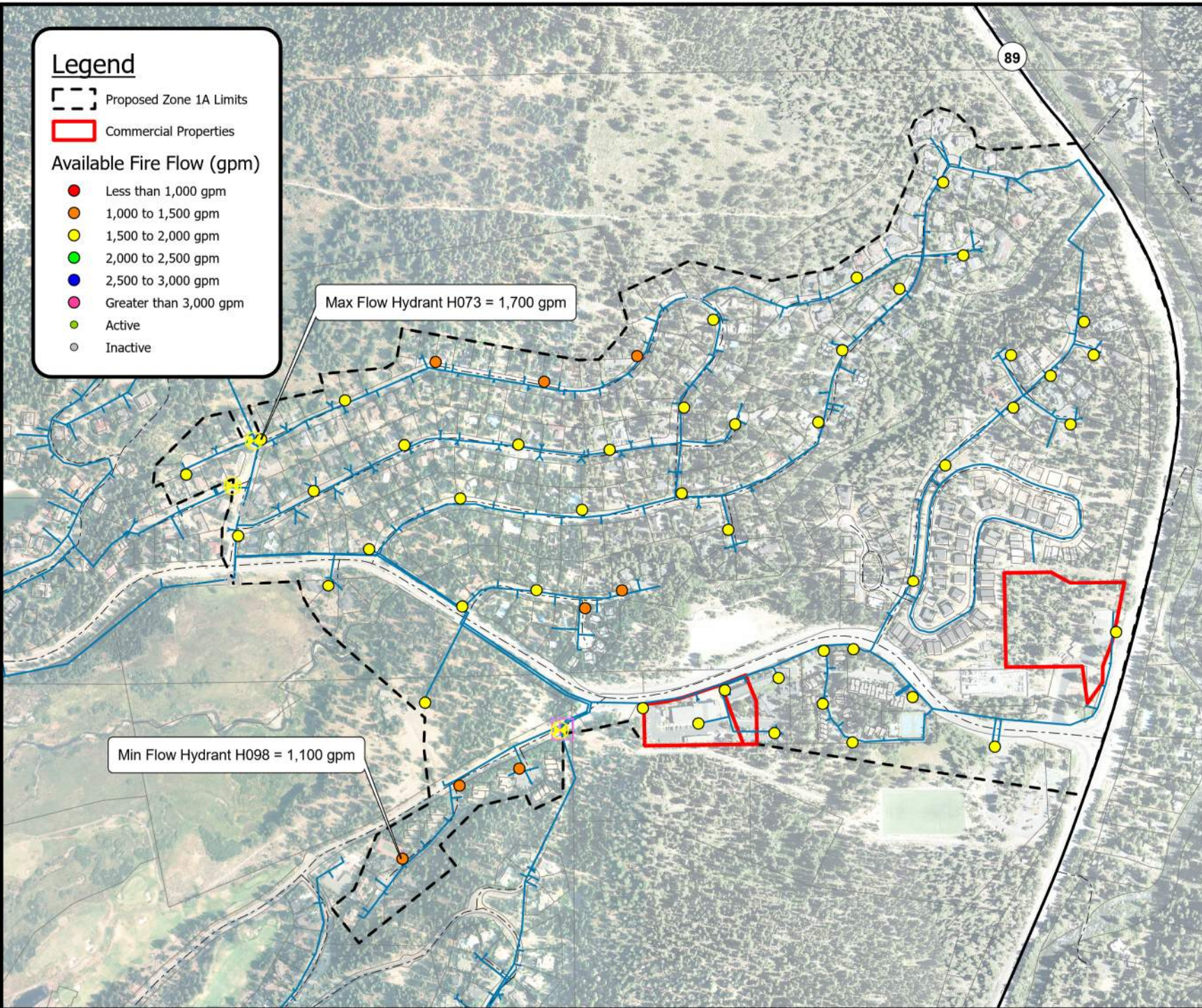
Legend

- Proposed Zone 1A Limits
- Commercial Properties

**Figure 12: Alternative 3 Available Fire Flows
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



Legend

- Proposed Zone 1A Limits
- Commercial Properties

Available Fire Flow (gpm)

- Less than 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- Greater than 3,000 gpm
- Active
- Inactive

Figure 13: Alternative 4 Proposed PRV Locations Pressure Zone 1A



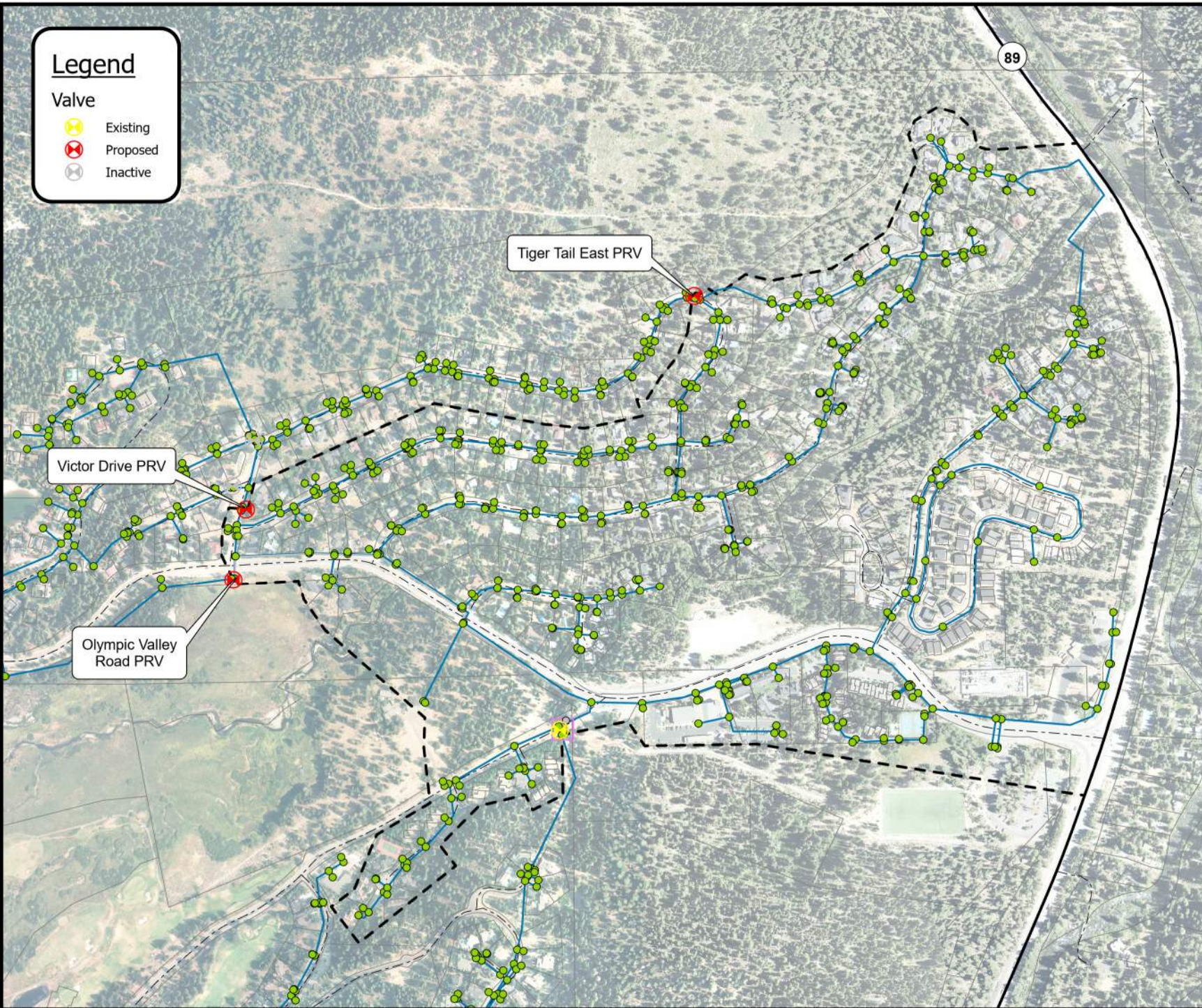
1" = 600'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.

Legend

Valve

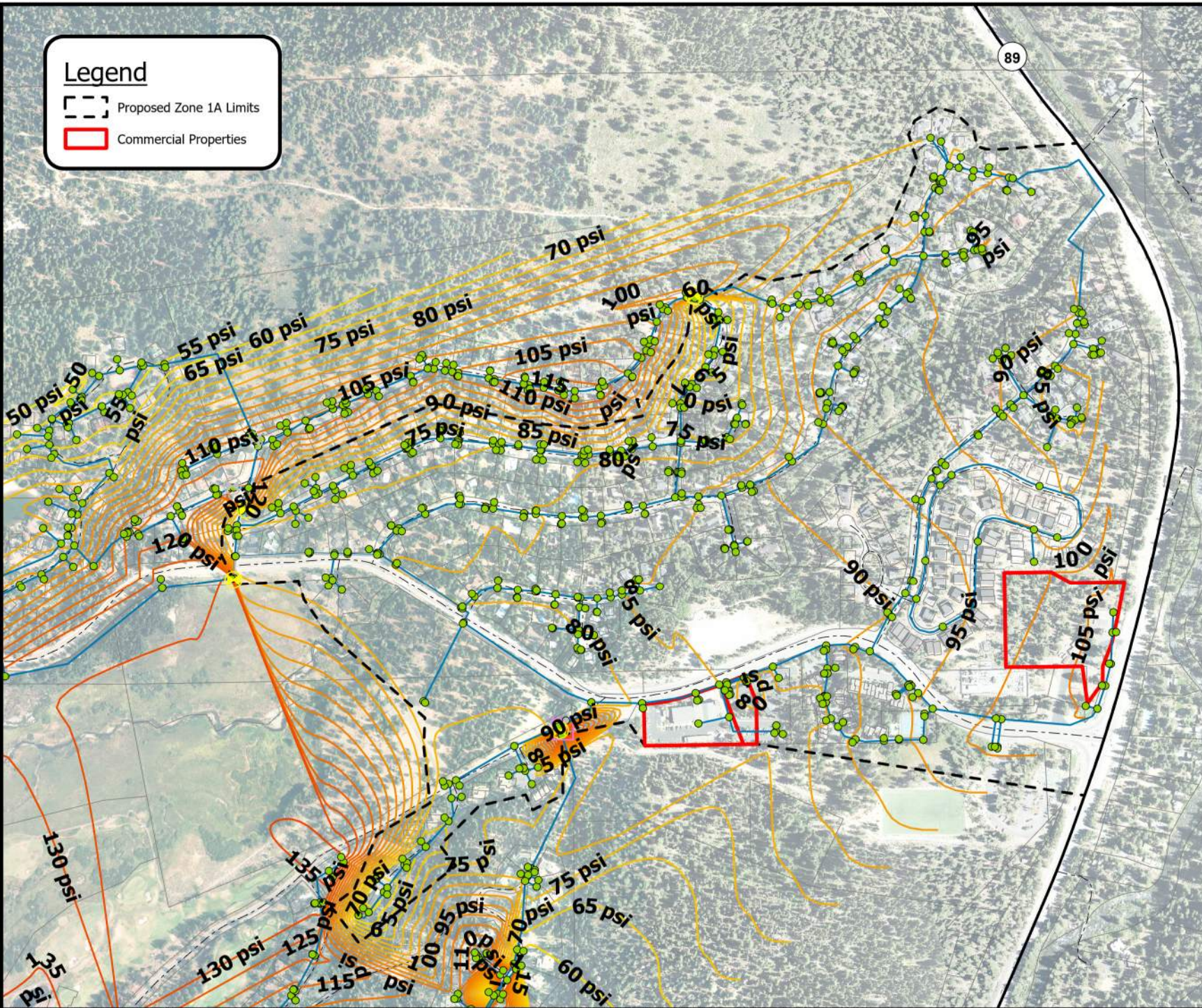
- Existing (Yellow circle with a cross)
- Proposed (Red circle with a cross)
- Inactive (Grey circle with a cross)



**Figure 14: Alternative 4 Pressures at MDD
Pressure Zone 1A**



The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



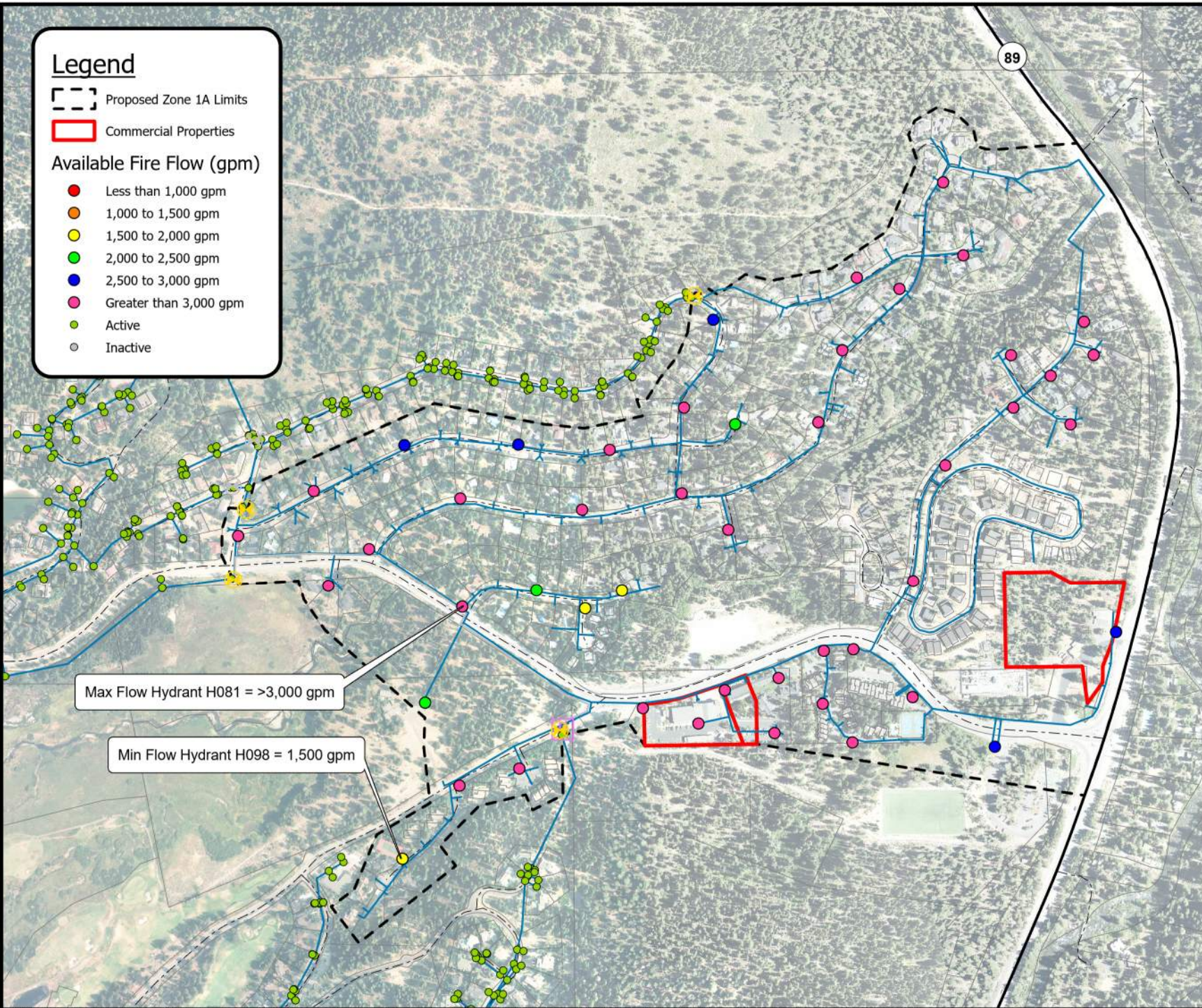
Legend

- Proposed Zone 1A Limits
- Commercial Properties

**Figure 15: Alternative 4 Available Fire Flows
Pressure Zone 1A**

N
1" = 600'

The data contained herein does not represent survey delineation and should not be construed as a replacement for the authoritative source. No liability is assumed by Farr West Engineering as to the sufficiency or accuracy of the data.



Legend

- Proposed Zone 1A Limits
- Commercial Properties

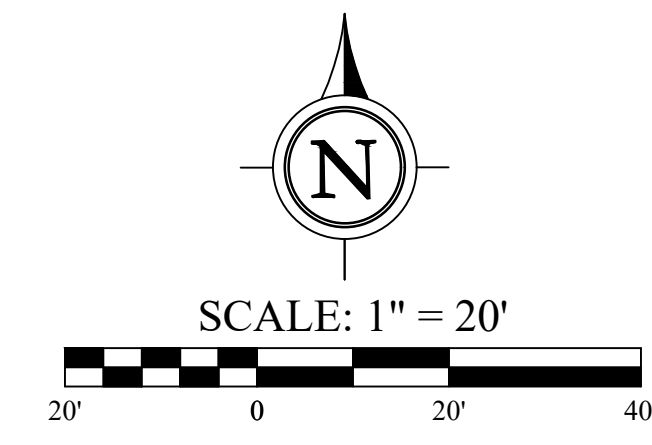
Available Fire Flow (gpm)

- Less than 1,000 gpm
- 1,000 to 1,500 gpm
- 1,500 to 2,000 gpm
- 2,000 to 2,500 gpm
- 2,500 to 3,000 gpm
- Greater than 3,000 gpm
- Active
- Inactive

Max Flow Hydrant H081 = >3,000 gpm

Min Flow Hydrant H098 = 1,500 gpm

FILE SPEC: P:\Client\Projects\Square Valley PSD 136\1830 Pressure Zone 1A Improvements\5.0 Drawings\5.2 DWG\5.2.7 SHEETS\1830_C1-CX_CIVIL.dwg
 PLOT DATE: Oct 17, 2022 - 2:27pm



30% SUBMITTAL
PRELIMINARY
NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	BY	APP	DATE

JOB NO.:	1830
DATE:	MAY 2022
SCALE:	AS SHOWN
DESIGNED:	AS
DRAWN:	MS
CHECKED:	XS

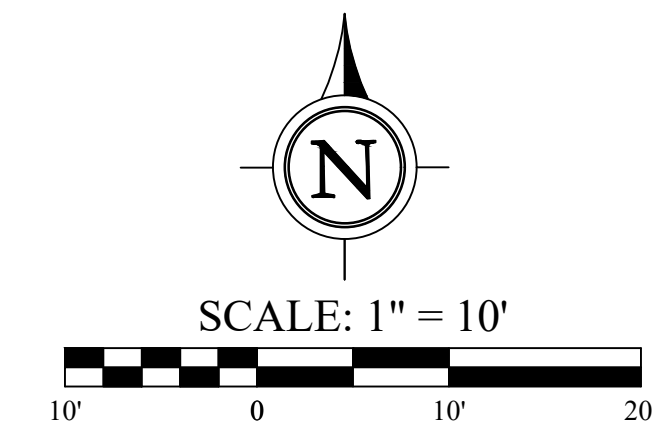
FARR WEST ENGINEERING
 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 FAX: (775) 851-0766
 FARRWESTENGINEERING.COM

OLYMPIC VALLEY PUBLIC SERVICE DISTRICT
 ZONE 1A
 SITE PLAN 1
 CONFORMED SET

PLACER COUNTY
 CALIFORNIA

SHEET NUMBER
C1
 --- OF XX

FILE SPEC: P:\Client\Projects\Square Valley PSD_136\1830 Pressure Zone 1A Improvements\5.0 Drawings\5.2 DWG\5.2.7 SHEETS\1830_CI-CX_CIVIL.dwg
 PLOT DATE: Oct 17, 2022 - 2:28pm



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PRELIMINARY
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<p>OLYMPIC VALLEY PUBLIC SERVICE DISTRICT ZONE 1A SITE PLAN II CONFORMED SET</p>		<p>PLACER COUNTY</p>	<p>CALIFORNIA</p>																									
<p>SHEET NUMBER C2 --- OF XX</p>		<p>ONE INCH AT FULL SCALE:</p> <table border="1"> <thead> <tr> <th>REVISION</th> <th>DESCRIPTION</th> <th>BY</th> <th>APP</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		REVISION	DESCRIPTION	BY	APP	DATE																				
REVISION	DESCRIPTION	BY	APP	DATE																								
<p>JOB NO.: 1830 DATE: MAY 2022 SCALE: AS SHOWN DESIGNED: AS DRAWN: MS CHECKED: XS</p>		<p>FARR WEST ENGINEERING 5510 LONGLEY LANE RENO, NEVADA 89511 PHONE: (775) 851-4788 FAX: (775) 851-0766 FARRWESTENGINEERING.COM</p>																										

FILE SPEC: P:\Client\Projects\Square Valley PSD_136\1830 Pressure Zone 1A Improvements\5.0 Drawings\5.2 DWG\5.2.7 SHEETS\1830_CI-CX_CIVIL.dwg
 PLOT DATE: Oct 17, 2022 - 2:28pm



096-370-015-000
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 EQUITY TRUST COMPANY CUSTODIAN

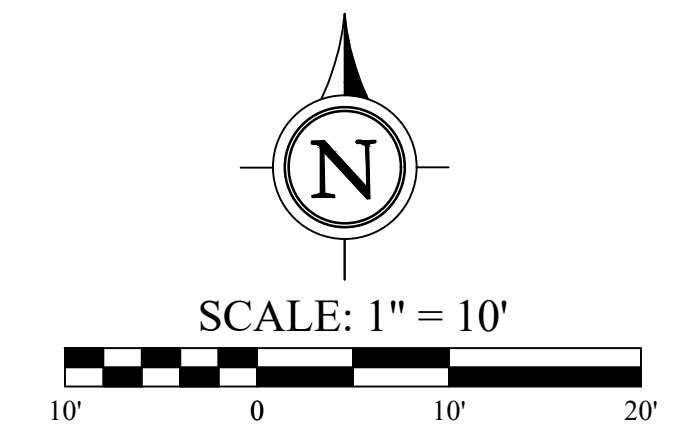
096-370-014-000
 138 TIGER TAIL RD
 REAGAN K & JANET L BAUER

TIGER TAIL RD

PROPOSED RTU
 ENCLOSURE

AC TRENCH PATCH
 FOR ELECTRICAL SERVICE

PROPOSED PRV
 VAULT PER DETAIL



NO.	DATE	BY	APP.	DATE

REVISION	DESCRIPTION

FARR WEST ENGINEERING
 5510 LONGLEY LANE
 RENO, NEVADA 89511
 PHONE: (775) 851-4788
 FAX: (775) 851-0766
 FARRWESTENGINEERING.COM

OLYMPIC VALLEY PUBLIC SERVICE DISTRICT
 ZONE 1A

SITE PLAN III
 CONFORMED SET

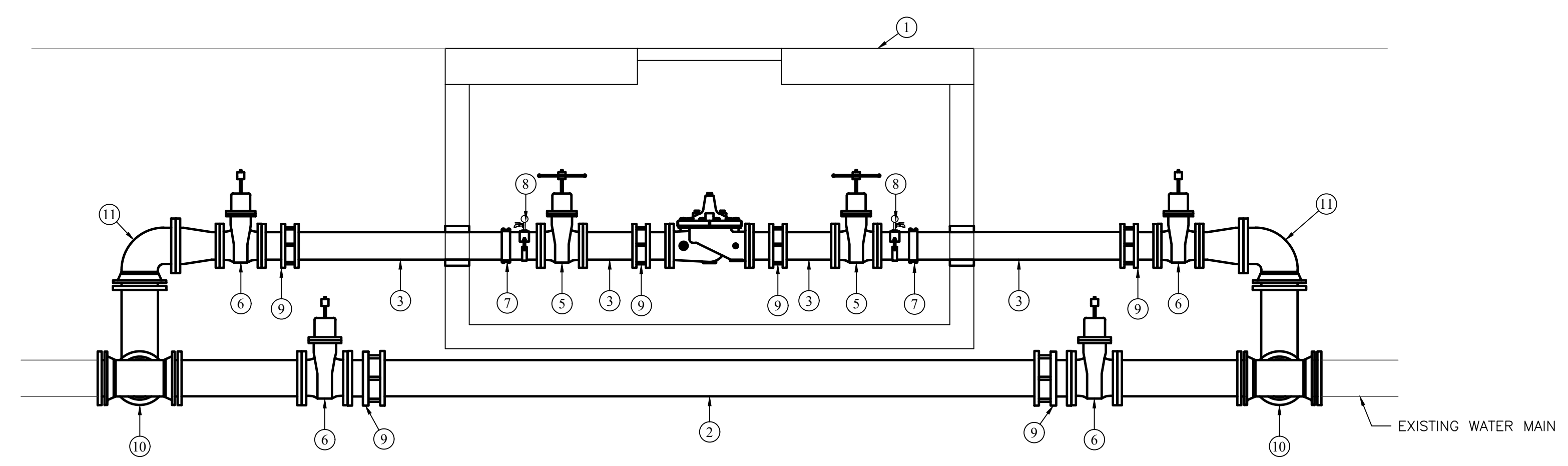
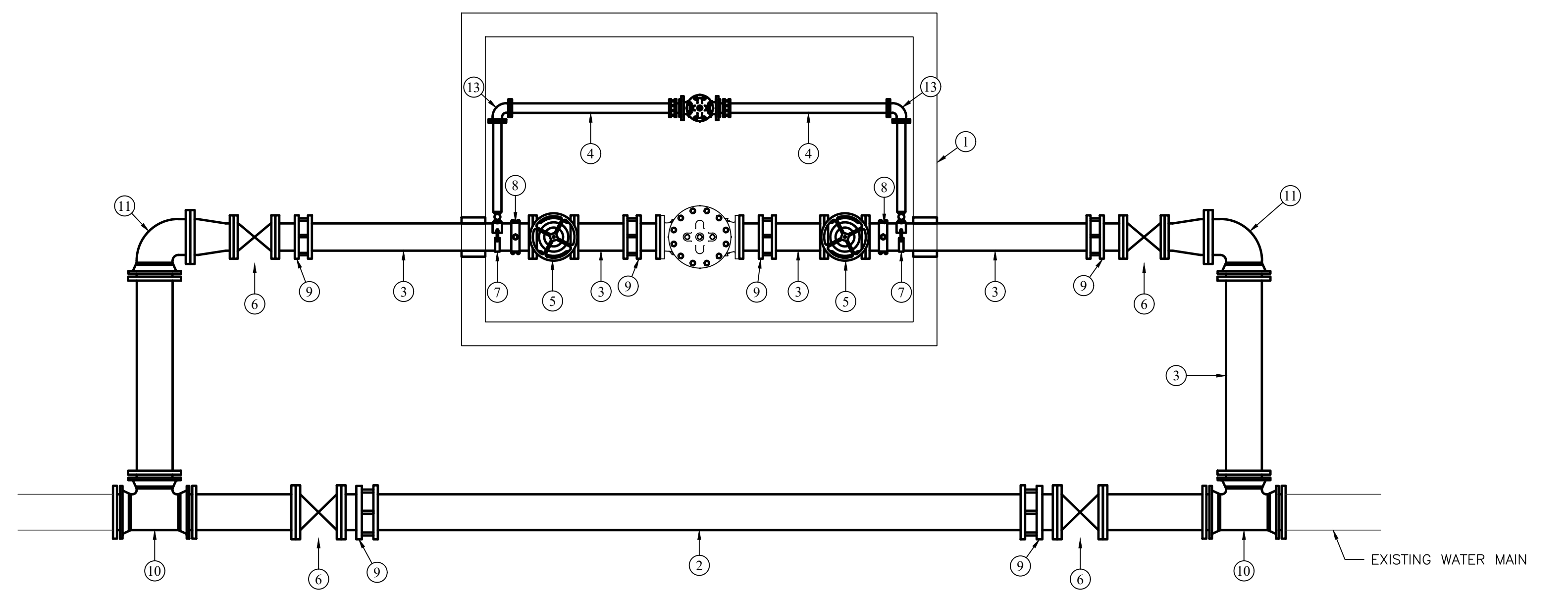
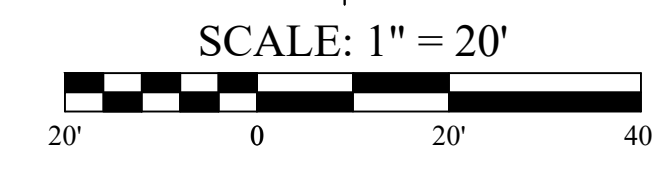
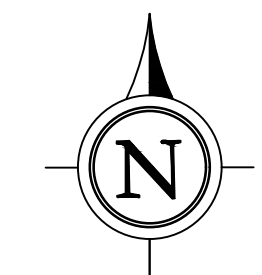
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C3
 --- OF XX

FILE SPEC: P:\Client\Projects\Spokane Valley PSD_136\1830 Pressure Zone 1A Improvements\5.0 Drawings\5.2 DWG\5.2.7 SHEETS\1830_CI-CX_CIVIL.dwg
 PLOT DATE: Oct 17, 2022 - 2:28pm

A B C D E F G H



CONSTRUCTION NOTES:

- ① 10'X7' PRECAST VAULT W/ 36" H20 RATED MANHOLE LID AND ACCESS LADDER.
- ② PROPOSED DI MAIN.
- ③ PROPOSED PRV PIPING
- ④ PROPOSED BYPASS PIPING
- ⑤ PROPOSED GATE VALVE W/ HANDWHEEL
- ⑥ PROPOSED GATE VALVE
- ⑦ PROPOSED SERVICE TAP FOR BYPASS PIPING
- ⑧ PROPOSED SERVICE TAP FOR PRESSURE TRANSDUCER
- ⑨ PROPOSED RFCA
- ⑩ PROPOSED MJ TEE
- ⑪ PROPOSED FLGxMJ 90° BEND
- ⑫ PROPOSED FLG REDUCER
- ⑬ PROPOSED 90° BYPASS ELBOW.
- ⑭ PROPOSED PRV.
- ⑮ PROPOSED PRV FOR BYPASS PUMPING.

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