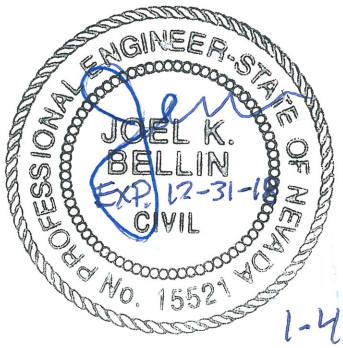
Zephyr Water Utility District – Water System Evaluation

Preliminary Engineering Report

Douglas County, Nevada
January 7, 2016



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1 Executive Summary

The objective of the Zephyr Water Utility District (ZWUD) Preliminary Engineering Report (PER) is to:

- Identify water system deficiencies
- Develop and compare project alternatives to address those deficiencies
- Identify and evaluate environmental impacts of the project alternatives
- Prioritize recommended alternatives
- Provide preliminary costs for the recommended project alternatives

1.1 Need for Project

The system was evaluated based on the following criteria:

- Nevada Administrative Code (NAC) 445A
- Douglas County design standards
- Overall condition of facilities based on previous County reports and field visits

The results of the assessment are summarized in the following general areas.

1.1.1 Marla Bay Pump Station/ Lake Intake

The Lake intake and Marla Bay Pump Station (MBPS) are generally in good condition, however, the following deficiencies were noted:

1. Lake intake pump piping and building paint/coatings are failing.
2. Lake intake pump check valve was leaking, causing air to enter the system. The check valve was replaced in 2015, and the air entering the system has been significantly reduced. Alternatives were evaluated to address the issue if the check valve leaking resumes over time.

1.1.2 Distribution and Storage

The distribution system is somewhat unique in that it uses dedicated high pressure fire lines in certain zones, with smaller lower pressure domestic lines. The approach results in fewer total pressure zones, but a more complex system with parallel distribution lines. Homes in the upper zones near the Lookout Tank and Riven Rock areas have insufficient pressure due to the minimal relative tank elevation. The following deficiencies were noted for the water distribution and storage components:

1. Excessive line leaks due to old piping with poor installation.
2. Insufficient fire flows and system pressures
3. Multiple homes/business served off a single water service
4. Most services are not metered
5. Lack of redundant water source

6. Storage tank coating will require replacement in the near future.

1.1.3 Ozone/UV Water Disinfection Plant

The ZWUD WTP is generally in good condition, and meets all applicable treatment standards. However, a few deficiencies were noted with respect to overall system reliability:

1. Lack of Uninterruptable Power Supply (UPS) for PLCs results in system restarts during power failures and voltage sags.
2. Loss of communications link to Cave Rock results in loss of UV reporting data, which is difficult and costly to retrieve.
3. Aging and proprietary Programmable Logic Controllers (PLC) result in reliance on a single integrator for service.
4. Fluctuations in hypochlorite residual due to potential inefficient mixing and lack of metering pump pacing control.

1.2 Project Alternatives

The following table summarizes the identified water system deficiencies and project alternatives:

No.	Deficiency	Applicable Code	Alt 1	Alt 2	Alt 3
Distribution and Storage					
1	Fire Flow (varies by parcel)	Fire Authority/ NFC County	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
2	20 psi Min Pressure - FF + MDD	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
3	30 psi Min Pressure - Peak Hour Demand	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
4	40 psi Min Pressure - Max Day Demand (MDD)	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
5	8 fps Max Velocity (all conditions except FF)	NAC 445A.6672 County 4.1.4	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
6	10 fps Max Velocity (FF + ADD)	County 4.1.4	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
7	8" Min Line Size (All)	County 4.5	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire Pumps and upsize lines
8	Line Leaks	NAC 445A.6727	Replace lines	Do Nothing	
9	Storage Volume	NAC 445A.6674-66755 County 4.8.2	New Tank	Add Fire & Booster pumps to meet fire and peak hour flows	
10	Storage Tank Coating	NAC 445A.67085 County 4.8.5	Recoat Tank	Do Nothing	
11	Water Supply Redundancy	NAC 445A.6678	Cave Rock Intertie and Booster Station	Do Nothing	

No.	Deficiency	Applicable Code	Alt 1	Alt 2	Alt 3
12	Water Conservation	County 4.5.6	Water Meters & Dedicated Services	Do Nothing	
			Marla Bay Pump Station		
13	Lake Intake Loss of Prime & Reduced Pump Capacity		Install self priming pumps	Install submersible Pumps	
14	MBPS Piping & Building Coatings		Recoat piping and walls	Do Nothing	
			Water Treatment Plant		
15	WTP Electrical		Surge Protection and UPS	Do Nothing	
16	WTP SCADA & Controls		Various	Do Nothing	
17	Unstable Hypochlorite Residual	NAC 445A.6683	Dose pace feed pumps and move injection point to HS pump discharge	Dose pace feed pumps and add mechanical mixers to clearwell	
18	WTP Building Roof		Replace shingles as needed	Do Nothing	

Table 1-1 Summary of Deficiencies and Alternatives

Figure 5-15 shows the proposed water system improvements to address system deficiencies. Figure 5-16 shows the proposed pressure zones.

1.3 Alternatives Analysis

The alternatives (where applicable) were evaluated based on the following weighted criteria, and ranked accordingly.

- Implementation (20%) – Is the alternative feasible to implement? Is the alternative constructible?
- Reliability (25%) – Will the alternative provide reliable results?
- Operability/Maintenance (40%) – Does the alternative require large quantities of time in terms of operator attention? Does the alternative require specialized maintenance requirements that cannot be performed in-house, or does it require frequent calibration, cleaning, tuning, etc. Does it require an ongoing contract for maintenance?
- Environmental Consideration (15%): Will the alternative be difficult to permit? Can TRPA thresholds be met? Are there short-term or long-term effects on the environment?

1.4 Prioritization of Improvements and Cost Summary

The recommended alternatives were prioritized based on the following criteria:

- Priority 1 – These deficiencies represent public health and safety risks. Consequence of failure is includes potential loss of life and property.
- Priority 2 – Represent deficiencies which may result in temporary disruption of water service or compliance, but generally minimal public health and safety impacts.
- Priority 3 – Represent deficiencies which may result in less efficient operations, but are not likely to cause loss or disruption of service or compliance.
- Priority 4 – Represent projects which may result in further gains in efficiency from priority 3, but are not directly needed for operations. Projects in this category represent “wants” more than “needs”, and do not address code violations.

The following table summarizes the overall project priorities and costs.

Deficiency No.	Description	Priority	Recommended Alternative	Capital Cost (x$1,000)
1-4	Fire Flow, & Pressure Criteria	1	3 - Fire & Booster Pumps	$1,643
8	Line Leaks	2	Replace Lines	$195
14	WTP Electrical	2	Surge Protection & UPS	$66
15	WTP SCADA & Controls	2	UPS & SCADA PAK & SCADA LOG	$124
16	Unstable Hypochlorite Residual	2	1 - Dose Pace & Move Injection Point	$28
12	Lake Intake Prime	3	1 - Self-Priming Pumps	$143
9	Storage Tank Coating	3	Recoat Tank	$358
11	Water Conservation	3	Water Meters & Dedicated Services	$1,563
10	Water Supply Redundancy	4	Cave Rock Intertie & Booster Station	$1,723
13	MBPS Piping & Building Coatings	4	Recoat Piping & Building	$29
5, 6	Max Velocity Criteria	4	Upsize Lines	$8,239
			Total	$14,111

Table 1-2 Project Priority and Cost Summary

2 Project Planning

2.1 Location

The Project Planning Area includes the Zephyr Water Utility District (ZWUD) located on the east shore of the Lake Tahoe Basin within Douglas County, Nevada. ZWUD is primarily residential intermixed with undeveloped and Forest Service land.

ZWUD is depicted in the Figure 3-1 Location Map. As shown in the location map, the boundary for ZWUD runs from Lake Tahoe to the west, to Canyon Drive and the end of Inspiration Drive, Lakeview Drive, Lakeview Court, and Hillcrest Drive to the east, and includes some USFS land east of the developed neighborhood. The vertical boundaries of ZWUD include the South Zephyr Creek outlet into Lake Tahoe and Zephyr Cove Resort in the north to Lakeshore Boulevard and Pine Cone Resort in the south. ZWUD is located in Douglas County, Nevada within the Glenbrook, NV United States Geological Survey (USGS) 7.5-minute quadrangle, Township 13 North, Range 18 East, Sections 9 and 10.

2.2 Environmental Resources Present

2.2.1 Geology and Land Capability

Under the Bailey Land Scoring System, soil types are classified into categories 1 through 7, with subcategories 1a, 1b (stream environment zone), and 1c being the most environmentally sensitive and 7 being the least sensitive. Development is prohibited on capability 1 through 3 lands, with allowable base coverage limited to 1% for capability 1 and 2 lands and up to 5% on capability 3 lands. Allowable coverage increases to 20% and 25% for capability 4 and 5 land, respectively, and up to 30% for capability 6 and 7 land.

The majority of ZWUD consists of “other environmentally sensitive areas,” which are low capability lands (Class 1a, 1c, 2 and 3) (Figure 3-1). Most of the area is Land Capability 1A and 2. Small pockets of non-sensitive land capability classes (4 and 7) are located at the southwest corner (4) and northern portion (7) of the ZWUD area. ZWUD also includes 1b SEZ land along South Zephyr Creek and the shoreline at the outlet of the creek and along the shoreline of Zephyr Cove. Another area of 1b SEZ within ZWUD is located west of Lake Shore Boulevard up to Tallac Drive.

According to the NRCS Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov accessed 8/19/15), the soil units in ZWUD include:

Table 2-1. NRCS Soils in the Project Area

Soil Type[1]	Parent Material[2]	Surface Runoff Class[3]	Slowest Permeability[4]	Shrink-Swell Potential[5]	Corrosivity[6]	Drainage Class[7]	Available Water Capacity[8]	Hydrologic Soil Group[9]
Beaches (7011)	Beach sand	Negligible	Rapid	Low	High/High	--	Very Low	--
Cagwin-Rock outcrop complex, 5-15% slopes, extremely stony (7411)	Colluvium over grus derived from granodiorite	Low	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Very Low (2.1 in.)	B
Cagwin-Rock outcrop complex, 15-30% slopes, extremely stony (7412)	Colluvium over grus derived from granodiorite	Medium	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Very Low (2.1 in.)	B
Cagwin-Rock outcrop complex, 30-50% slopes, extremely stony (7413)	Colluvium over grus derived from granodiorite	Medium	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Very Low (2.1 in.)	B
Cassenai gravelly loamy coarse sand, 5-15% slopes, very stony (7421)	Colluvium derived from granodiorite	Low	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Low (4.5 in.)	A
Cassenai gravelly loamy coarse sand, 15-30% slopes, very stony (7422)	Colluvium derived from granodiorite	Medium	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Low (4.5 in.)	A
Cassenai gravelly loamy coarse sand, 30-50% slopes, very stony (7423)	Colluvium derived from granodiorite	Medium	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Low (4.5 in.)	A
Christopher-Gefo complex, 0-5% slopes (7444)	Outwash derived from granodiorite	Very Low	Rapid	Low	Moderate/ Low	Somewhat excessively drained	Moderate (6.6. in.)	A
Jabu coarse sandy loam, 0-9% slopes (7461)	Outwash derived from granodiorite	Low	Rapid	Low	Moderate/ High	Well drained	Low (4.5 in.)	A
Oxyaquic Cryorthents-Aquic Xerothents-Tahoe complex, 0-15% slopes (9011)	Alluvium and/or colluvium derived from mixed	High	Rapid	Low	Moderate/ High	Somewhat poorly drained	Very low (2.5 in.)	A

Source: NRCS 2015 Soil Survey Maps

Table Notes:

1. See Figure 2-1for locations
2. Parent material. The unconsolidated and chemically weathered mineral and organic material in which the solum of a soil is formed as a result of pedogenic processes.
3. Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.
4. Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality.
5. Shrink/Swell Potential provides criteria for determination of expansive soil properties.
6. Ratings are for Concrete/Steel. The ratings provided are the most conservative and based on the highest % representative aggregate. Site-specific soil resistivity analysis will be necessary prior to site development.
7. Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."
8. Available water capacity (AWC) (available moisture capacity). The volume of water that should be available to plants if the soil, inclusive of fragments, were at field capacity. It is commonly estimated as the difference between the amount of water at field capacity and the amount at wilting point with adjustments for salinity, fragments, and rooting depth. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as: Very low 0 to 2.5; Low 2.5 to 5.0; Moderate 5.0 to 7.5; High 7.5 to 10.0; Very high more than 10.0.
9. Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Hydrologic Soils Group Definitions: A =low runoff potential (0.30 to 0.45 in/hr); B=moderate runoff potential (0.15 to 0.30 in/hr); C=moderately high runoff potential (0.05 to 0.5 in/hr); D=high runoff potential (less than 0.05 in/hr)

Geologic hazards in the area include earthquakes, seiche, tsunami, and erosion. The primary north-south fault zone that separates the eastern edge of the Sierra Nevada from the parallel fault block mountains of Nevada and Utah is located about six miles east of the Lake Tahoe Basin. Significant fault movement along the Sierra Nevada frontal fault could occur in the future with resultant ground failure and severe ground shaking within the Lake Tahoe Basin. Fault lines, including the Incline Village Fault, Stateline Fault, East Tahoe Fault, and West Tahoe Fault, traverse the lake and numerous earthquakes have occurred in the Lake Tahoe Basin within the past 100 years. Due to an earthquake in 1966, a seiche occurred on the lake measuring 0.4 feet. Both seiche and tsunami events could occur if triggered by an earthquake event in or near the lake. The Lake Tahoe Basin is classified as Zone III for earthquake intensity, which is the highest intensity zone and one in which structural damage may occur.

Runoff from roadways and urban development, as well as ground disturbance, can result in erosion. Due to the slopes within the area, erosion caused by runoff and storm events can occur. While EIP programs are implemented to address surface runoff in the area and control erosion and siltation, some erosion can continue to occur.

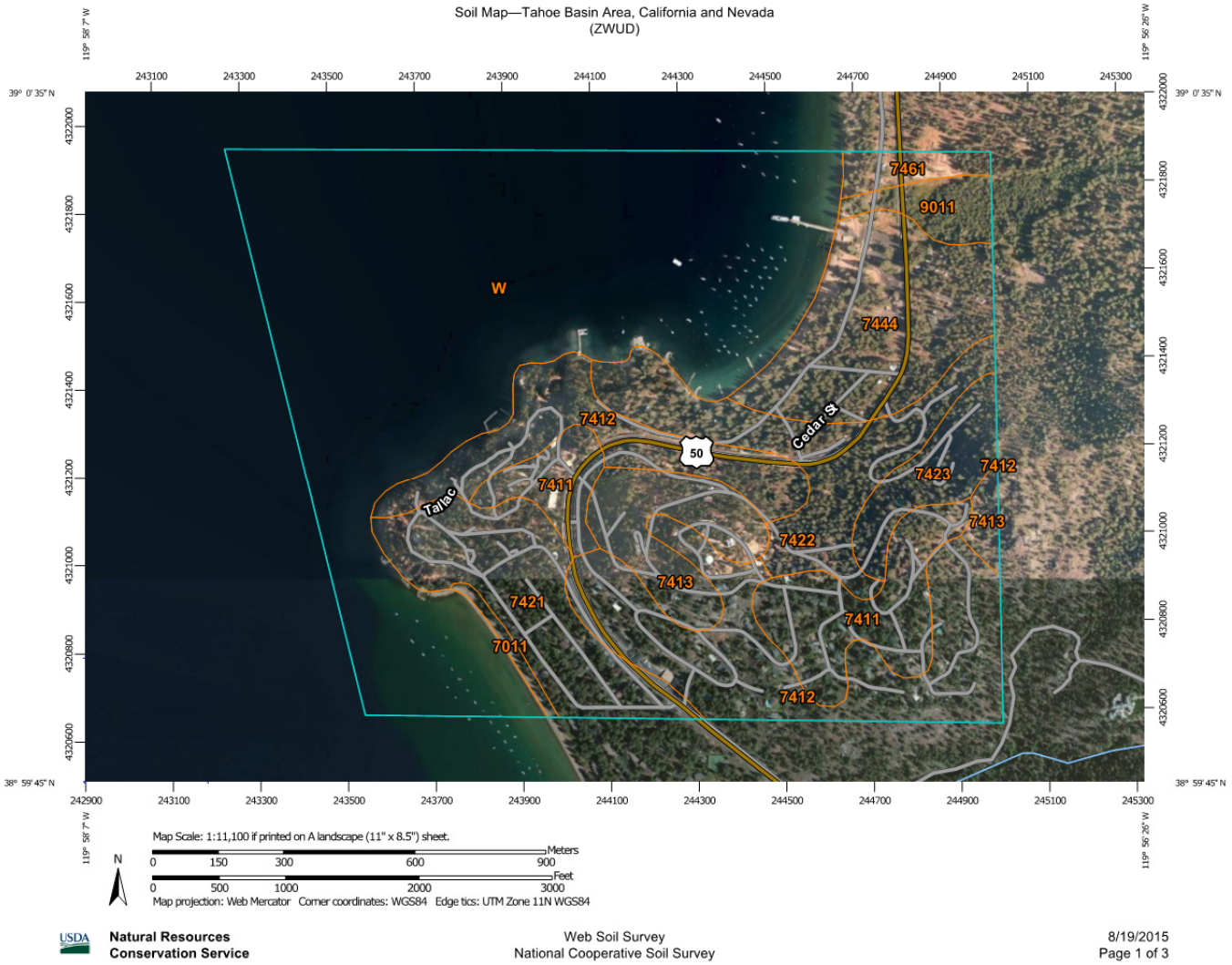


Figure 2-1. ZWUD Soils Map

2.2.2 Air Quality

The only Nevada Division of Environmental Protection air monitoring station in the basin is located in Stateline and monitors only carbon monoxide (CO) emissions. According to the TRPA 2011 Threshold Evaluation, improvements in CO emission reductions result in attainment of threshold standards for 1-hour and 8-hour CO emissions. The region is also in attainment with ozone (O_3), nitrogen oxides (NO_x), and particulate matter (PM_{10} and $PM_{2.5}$). Improvements to the water system may result in a temporary increase in emissions during the active construction period as a result of vehicle and equipment fuel combustion and ground disturbance, but would not affect long-term emissions levels. Likewise odors from construction equipment idling would be temporary and limited to the area of active construction activity.

2.2.3 Water Quality and FEMA Flood Zones

ZWUD primarily includes land within the FEMA Zone X 500-year flood zone; however, the South Zephyr Creek outlet and areas along the shoreline of Lake Tahoe are within FEMA Zone A of the 100-year flood zone. Base flood elevations have not been determined by FEMA within Zone A. A small area south of the South Zephyr Creek outlet down to Church Street is FEMA undetermined flood hazard area. In addition to Lake Tahoe, A portion of South Zephyr Creek is located within the northern boundary of ZWUD.

According to the Draft Tahoe Douglas Area Plan (2014), the Douglas County portion of the basin contributes three percent of the Basin-wide fine sediment particle load. Various water quality and erosion control projects have been completed in the area through the County, NDOT and the TRPA EIP. TMDL reductions are planned through various erosion control and drainage improvement projects in the area, some of which have been completed and some of which are planned for future EIP projects. The Tahoe Douglas Area Plan and 2012 Douglas County Master Plan indicate a number of private parcels in the area have BMP certification. In all of the Tahoe-area of Douglas County in 2012, including areas outside the Water System Areas, there were 946 BMP-certified single-family residential units (36%), 751 BMP-certified multi-family residential units (43%) and 71 BMP-certified commercial units (51%) (Douglas County Master Plan, 2012).

2.2.4 Biological Resources

ZWUD is located within the U.S. Forest Service Carson Range Ecological Subsection. Predominant vegetation types within the Carson Range include Jeffrey pine (*Pinus jeffreyii*) and white fir (*Aibes concolor*) at lower elevations where ZWUD boundaries occur. Sedge meadow communities and willow thickets can occur in wet areas, with lodgepole pine (*Pinus contorta*) occurring around the margins of wet areas. The Carson Range also includes shrubs such as big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), greenleaf manzanita (*Arctostaphylos patula*), rabbitbrush (*Ericameria nauseosa*), and tobacco brush (*Ceanothus velutinus*). In ZWUD, the predominant vegetation communities include Jeffery pine, montane chaparral, Sierran mixed conifer, urban, with wet meadow area in the northern portion where an unnamed creek flows toward Lake Tahoe in the northern portion of the WSA.

Vegetation

According to the TRPA 2011 Threshold Evaluation, the dominant vegetation associations in ZWUD are yellow pine and some areas of shrub. Yellow pine forest typically includes Jeffrey

pine, white fir, incense cedar (), and sugar pine (), and is the most common vegetation association in the basin. Shrub association includes greenleaf and pinemat manzanita (*Arctostaphylos nevadensis*), tobacco brush, Sierra chinquapin (*Chrysolepis sempervirens*), huckleberry oak (*Quercus vacciniifolia*), and mountain whitethorn (*Ceanothus cordulatus*). The WSAs do not provide suitable habitat to support populations of Galena Creek rockcress (*Arabis rigidissima* var. *demota*), Cup Lake draba (*Draba asterophora* var. *macrocarpa)*, Long-petaled lewisia (*Lewisia longipetala*), and Tahoe Draba (*Draba asterophora* var. *asterophora)*, although Tahoe yellow cress is identified along the lake's sandy beaches within the ZWUD boundary.

Wildlife

Species in Douglas County listed by the Nevada Natural Heritage Program (heritage.nv.gov, Accessed 7/16/2015) include the following:

Table 2-2. NNHP Species List for the Project Area

Common Name	Species	G Rank	S Rank	Status (NNHP/Federal/NV Protection/USFS/NNPS)
Amphibian				
northern leopard frog	Lithobates pipiens	G5	S2S3	Watch List/C/PA
Sierra Nevada yellow-legged frog	Rana sierrae	G1G2	SH	At-Risk List/USFS S
Bird				
Tricolored Blackbird	Agelaius tricolor	G2G3	S1B	At-Risk List
Golden Eagle	Aquila chrysaetos	G5	S4	Watch List
Short-eared Owl	Asio flammeus	G5	S4	Watch List
Ferruginous Hawk	Buteo regalis	G4	S2	At-Risk List
Western Snowy Plover	Charadrius nivosus nivosus	G3T3	S3B	Watch List
Olive-sided Flycatcher	Contopus cooperi	G4	S2B	Watch List
Prairie Falcon	Falco mexicanus	G5	S4	Watch List
Peregrine Falcon	Falco peregrinus	G4	S2	At-Risk List/USFS S
Pinyon Jay	Gymnorhinus cyanocephalus	G5	S3S4	Watch List
Loggerhead Shrike	Lanius ludovicianus	G4	S4	Watch List
Lewis's Woodpecker	Melanerpes lewis	G4	S3	Watch List
Mountain Quail	Oreortyx pictus	G5	S3	Watch List/GB/USFS S
Sage Thrasher	Oreoscoptes montanus	G5	S5B	Watch List
American White Pelican	Pelecanus erythrorhynchos	G4	S2B	Watch List
Flammulated Owl	Psiloscops flammeolus	G4	S4B	Watch List/USFS S
Brewer's Sparrow	Spizella breweri	G5	S4B	Watch List
Fish				
mountain whitefish	Prosopium williamsoni	G5	S3	Watch List/GF
Mammal				
mountain beaver	Aplodontia rufa	G5	S1	At-Risk List
big brown bat	Eptesicus fuscus	G5	S4	Watch List
spotted bat	Euderma maculatum	G4	S2	At-Risk List/TM/USFS S
northern flying squirrel	Glaucomys sabrinus	G5	S3	Watch List
silver-haired bat	Lasionycteris noctivagans	G5	S3B	Watch List
hoary bat	Lasiurus cinereus	G5	S3N	Watch List
sagebrush vole	Lemmiscus curtatus	G5	S3	Watch List
Sierra Nevada snowshoe hare	Lepus americanus tahoensis	G5T3T4Q	S3	Watch List/GM
American marten	Martes americana	G5	S2S3	At-Risk List/FM
California myotis	Myotis californicus	G5	S4	Watch List
western small-footed myotis	Myotis ciliolabrum	G5	S3	Watch List
long-eared myotis	Myotis evotis	G5	S4	Watch List
little brown myotis	Myotis lucifugus	G5	S3	Watch List
fringed myotis	Myotis thysanodes	G4	S2	At-Risk List/PM
long-legged myotis	Myotis volans	G5	S4	Watch List

Common Name	Species	G Rank	S Rank	Status (NNHP/Federal/NV Protection/USFS/NNPS)
Yuma myotis	Myotis yumanensis	G5	S3S4	Watch List
Allen's chipmunk	Neotamias senex	G5	S2S3	Watch List
American pika	Ochotona princeps	G5	S2	At-Risk List/PM
American water shrew	Sorex palustris	G5	S2	At-Risk List
Trowbridge's shrew	Sorex trowbridgii	G5	S2	Watch List
Mexican free-tailed bat	Tadarida brasiliensis	G5	S3S4B	Watch List/PM
Douglas's squirrel	Tamiasciurus douglasii	G5	S5	Watch List/PM
mountain pocket gopher	Thomomys monticola	G5	S3	Watch List
western jumping mouse	Zapus princeps	G5	S2	At-Risk List
Reptile				
northern rubber boa	Charina bottae	G5	S3S4	Watch List
Sierra alligator lizard	Elgaria coerulea palmeri	G5T4	S2S3	At-Risk List/PR
Sierra gartersnake	Thamnophis couchii	G4	S3	Watch List
Invertebrate				
endemic Tahoe annelid	Varichaeta nevadana	GNR	SNR	Watch List
Tahoe cave obligate amphipod	Stygobromus lacicolus	G1	SNR	Watch List
Tahoe cave obligate amphipod	Stygobromus tahoensis	G1	SNR	Watch List
Tahoe benthic stonefly	Capnia lacustra	G1	S1	At-Risk List
Carson Valley wood nymph	Cercyonis pegala carsonensis	G5T1T2	S2	At-Risk List
Mono checkerspot	Euphydryas editha monoensis	G5T2T3	S1	At-Risk List
northern Sierra endemic ant	Formica microphthalma	G2?	S1	At-Risk List
Carson Valley sandhill skipper	Polites sabuleti genoa	G5T3T4	S1	At-Risk List
Carson wandering skipper	Pseudocopaeodes eunus obscurus	G3G4T1	S1	At-Risk List/LE
Apache silverspot butterfly	Speyeria nokomis apacheana	G3T2	S2	At-Risk List
Carson Valley silverspot	Speyeria nokomis carsonensis	G3T1	S1	At-Risk List
Nevada water mite	Thermacarus nevadensis	GH	SH	Watch List
western Lahontan pyrg	Pyrgulopsis longiglans	G2G3	S2S3	At-Risk List
Wongs pyrg	Pyrgulopsis wongi	G2G3	S1	At-Risk List
Plant				
Shevock bristlemoss	Orthotrichum shevockii	G2	S1	Watch List/USFS S/NNPS M
Washoe tall rockcress	Arabis rectissima var. simulans	G4G5T1Q	S1	At-Risk List/USFS 4/NNPS T
Margaret's Rushy milkvetch	Astragalus convallarius var. margaretiae	G5T2	S2	At-Risk List/NNPS D
Lavin eggvetch	Astragalus oophorus var. lavinii	G4T2	S2	At-Risk List/USFS S/NNPS W
Nevada suncup	Camissonia nevadensis	G3	S3	Watch List/NNPS D
Steamboat monkeyflower	Diplacus ovatus	G1G2Q	S1S2	At-Risk List/NNPS T
Tahoe draba	Draba asterophora var. asterophora	G2T2	S1S2	At-Risk List/USFS S/NNPS T
Slide Mountain buckwheat	Eriogonum ovalifolium var. eximium	G5T3	S2	At-Risk List/NNPS W
sand cholla	Grusonia pulchella	G4	S2S3	At-Risk List/CY/NNPS D
Webber ivesia	Ivesia webberi	G2	S2	At-Risk List/LT/CE/USFS S/NNPS T
soft lupine	Lupinus malacophyllus	G3?	S3?	Watch List/NNPS D
Wassuk beardtongue	Penstemon rubicundus	G2G3	S3	At-Risk List/USFS S/NNPS D
tuni	Perideridia lemmonii	G4?	S3?	Watch List
Williams combleaf	Polyctenium williamsiae	G2Q	S2	At-Risk List/CE/USFS S/NNPS T
Tahoe yellowcress	Rorippa subumbellata	G1	S1	At-Risk List/C/LTBMU S/NNPS T

Common Name	Species	G Rank	S Rank	Status (NNHP/Federal/NV Protection/USFS/NNPS)
Tiehm peppercress	Stroganowia tiehmii	G2	S2	At-Risk List/NNPS W
Leichtlin mariposa lily	Calochortus leichtlinii	G4	S3	Watch List

G - Refers to the **global** population of a species.
T - Refers to the subspecific or variety **taxonomic** level (used in conjunction with G-rank); uses numeric ranks 1-5 in the same way that G and S ranks are applied.
S - Refers to the **subnational** (state) population of a species, subspecies, or variety.
X - Presumed Extinct or extirpated (S-rank) – Not located despite intensive searches and virtually no likelihood of rediscovery.
H - Possibly Extinct – Known from only historical occurrences but still some hope of rediscovery.
1 - Critically Imperiled – At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
2 - Imperiled – At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
3 - Vulnerable – At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
4 - Apparently Secure – At fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
5 - Secure – At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
S#S# - Range Rank – A numeric range rank (e.g., S2S3 or S1S3) is used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than two ranks (e.g., SU is used rather than S1S4). A range rank could also be applied at the global scale as well (e.g., G2G3).
NR - Taxon **Not Ranked** – rank not yet assessed.
NA - Conservation status rank is **Not Applicable** because element is not a suitable target for conservation activities (often used for non-native species or hybrids).
U - Unrankable – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
Q - Questionable taxonomy – taxonomic distinctiveness of the entity at the current level is questionable or currently being reviewed; resolution of this uncertainty may result in change from a species to a subspecies, variety or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation status.
B - Breeding – Conservation status refers to the breeding population of the element in the nation or state/province.
N - Non-breeding – Conservation status refers to the non-breeding population of the element in the nation or state/province (e.g., wintering bird populations).
M - Migrant – Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the nation or state/province.
C – USFWS Candidate for listing as Threatened or Endangered
LT – USFWS Listed Threatened
LE – USFWS Listed Endangered
CE – Critically Endangered Plant (State of NV Protection and Designation)
CY – Protected as a cactus, yucca, or Christmas tree (State of NV Protection and Designation)
GF – Game Fish (State of NV Protection and Designation)
PA – Protected Amphibian (State of NV Protection and Designation)
PR – Protected Reptile (State of NV Protection and Designation)
GM – Game Mammal (State of NV Protection and Designation)
FM – Fur-bearing Mammal (State of NV Protection and Designation)
PM – Protected Mammal (State of NV Protection and Designation)
TM – Threatened Mammal (State of NV Protection and Designation)
USFS S – Region 4 (Humboldt-Toiyabe National Forest) Sensitive
LTBMU – USFS LTBMU listed species
NNPS M – Marginal/disjunct, rare and/or possibly distinct, and potentially vulnerable in the NV portion of its range, but more widespread and secure outside NV.
NNPS T – Threatened, believed to meet the ESA definition of Threatened but not formally listed.
NNPS D – Delisted, dropped from consideration, no longer of concern.
NNPS W – Watch list species, potentially vulnerable to becoming Threatened or Endangered.

Species listed by the US Fish and Wildlife Service for the project area include:

Table 2-3. USFWS Species List for the Project Area

Type	Species	Federal Status
Fishes	Cui-ui (*Chasmistes cujus*)	Endangered
Fishes	Lahontan cutthroat trout (Oncorhynchus clarkii henshawi)	Threatened
Flowering Plants	Tahoe yellow cress (Rorippa subumbellata)	Candidate

While northern goshawk (*Accipiter gentilis*) are not known to occur in the area the area adjacent to the WSA contains suitable habitat for this species. Additionally, willow flycatcher (*Empidonax traillii*) habitat is present in the wet meadow area in the Zephyr Cove portion of the WSA. Osprey (*Pandion haliaetus*) nests, which are protected under the Migratory Bird Treaty Act, have been recorded in the vicinity (Shay Zanetti, Personal Communication 28 Sept. 2015). Fragmented areas appropriate for mule deer summer fawning and foraging habitat occur in the area.

According to the LTBMU Forest Plan, there are no Protected Activity Centers (California Spotted Owl (*Strix occidentalis*) and Northern goshawk) or Home Range Core Areas (Spotted Owl), Whitebark pine (*Pinus albicaulis*) species refuge area, or species refuge area for Sierra Nevada yellow-legged frog (*Rana sierrae*) or Lahontan cutthroat trout within the ZWUD area. However, there are species refuge areas for Tahoe yellow cress within the ZWUD and Skyland WSA, along the shores of Zephyr Cove.

Pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. As noted above, no known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area, however creation of a new roadway and associated tank site on US Forest Service land would likely require protocol surveys to be performed. Willow flycatcher habitat will also likely require surveys for the presence of this species in the wet meadow area by USFS.

Crossing the wet meadow area in the Zephyr Cove vicinity will also require a wetland delineation. As shown in USFWS Species List for this project, the project contains Freshwater Emergent Wetland. This area is subject to the regulation of US Army Corps of Engineers and would require their review, permitting and concurrence prior to disturbance activities or construction.

2.2.5 Noise

Since ZWUD is a residential and recreation area, the primary noise source is U.S. Highway 50, although some noise may be generated by recreation areas. The maximum community noise equivalent level for PAS 060, 066, and 067 is 50 CNEL, with a maximum of 65 CNEL for the US 50 corridor.

The TRPA 2011 Threshold Evaluation Report indicates that noise levels along U.S. Highway 50 are at or somewhat better than targets. Noise studies indicate that roadway noise levels are below 65 CNEL, ranging between 58 and 65 A-weighted decibels (dBA), for an average of 61 dBA.

2.2.6 Land Use

ZWUD is located within the Tahoe Douglas Area Plan. According to the Area Plan and the Regional Plan Land Use map, land uses in the ZWUD are primarily residential, with some mixed-use commercial and recreation areas, and conservation areas to the east. Douglas County

Zoning in the ZWUD consists of Tourist (PAS 067), Residential (PAS 067), and Commercial (PAS 067 and 066).

ZWUD includes a portion of Plan Area Statement 066 Zephyr Cove, Plan Area Statement 067 Marla Bay/Zephyr Heights, and Plan Area 060 Genoa Peak. Potable water service facilities are considered a special use in each of the Plan Area Statements within ZWUD. Plan Area Statement 067 Marla Bay/Zephyr Heights has a land use classification of residential and management strategy of mitigation with no special designations. According to the Plan Area Statement, "This area should continue to be residential, maintaining the existing character of the neighborhood." The shoreline is privately owned; however, at 80% build out, existing uses in the area includes older low-density residential subdivisions, a condominium development, Presbyterian lodge and cabins, and small commercial and motel establishments. Planning considerations and special policies address water supply issues, building maintenance and improvements, accessibility and scenic issues within the U.S. 50 commercial area, and the commercial area, commercial growth, treatment of runoff, and maintenance of the historical district.

Plan Area Statement 066 Zephyr Cove has a land use classification of recreation, a management strategy of mitigation, and is a TDR receiving area for existing development. According to the Plan Area Statement, "This area should continue to serve as a recreation/education center with limited opportunities for recreation expansion consistent with the need to improve the quality of the recreation experience." At 50% build out, existing uses in this area includes the federally owned Zephyr Cove Resort and Marina (M.S. Dixie Tour Boat), a library, senior citizen center, elementary school, high school, a Douglas County park, and a large estate. Approximately 50% of the shoreline is in public ownership. Planning considerations and special policies address traffic congestion and pedestrian and vehicular safety in relation to the resort, beach accessibility, fish migration barriers on Zephyr Creek, runoff water quality, and protection of Rorippa in certain beach areas. Water intake lines are an allowed use within the shorezone.

Plan Area Statement 060 Genoa Peak has a land use classification of conservation and management strategy of mitigation with no special designations. According to the Plan Area Statement, "This area should be managed for low level resource use with special management emphasis on the protection of water and visual qualities." Most of the Plan Area is managed by the U.S. Forest Service for primitive recreation, including dirt roads for off-highway vehicle use, cross country skiing and hiking access. Planning considerations and special policies address recreation and wilderness management, and watershed protection, among others.

Review of the LTBMU Forest Plan Land Management Plan (2015) indicates that a portion of LTBMU General Conservation Management Area may be within ZWUD, where the management concept includes roaded landscapes, active management, dispersed and developed recreation uses. These areas are actively managed to meet various social, economic, and ecological goals and most uses allowed on Forest Service land may occur in this management area. Recreation in the General Conservation Management Area includes beaches, resorts, historic sites, streams, and trails, among others, although dispersed recreation such as hiking trails, also occurs in this area. Forest management is implemented to enhance watershed conditions, address fire and disease risk, control invasive species, and maintain unique habitat.

Santini-Burton/Urban Forest Parcels Management Area can also be found within ZWUD. These are protected and undeveloped landscapes and active management areas that are generally smaller in size and located in or near urban and suburban areas or adjacent to General

Conservation and Backcountry Management Areas. Santini-Burton lands were acquired under the 1980 Santini-Burton Act and use and development of these lands is restricted to activities that do not compromise the watershed or environmental quality of the area such as dispersed recreation.

- Utilities are considered suitable within the General Conservation Management Area, but face restrictions in Santini-Burton and Urban Forest Management Areas. Soil and Water Restoration activities are considered suitable in these management areas.

2.2.7 Transportation

The primary roadway through the area is U.S. Highway 50, which is a 4 lane rural undivided highway through the WSAs. Nevada Department of Transportation and the 2012 Regional Plan EIR indicate traffic volumes on U.S. 50 range from 15,100 ADT west of Meyers to 12,000 ADT east of SR 28. SR 28 intersects U.S. 50 near Glenbrook. Summer 2010 traffic counts indicate between 27,000 to 33,000 ADT on U.S. 50 between South Stateline and Zephyr Cove, while counts dropped to 14,900 on U.S. 50 at Glenbrook near SR 28. SR 28 experienced an ADT of 7,200, indicating a majority of the trips on U.S. 50 in this area continued on out of the basin and into the Carson Valley.

Transit service is available within the WSAs along U.S. 50 through the Tahoe Transportation District BlueGo/Valley and Lake Express Service that operates one route (Stateline to Carson City) along this stretch of U.S. 50. The nearest transit stops are located in Zephyr Cove near Whittell High School (Skyland WSA), Zephyr Cove Stables, and Zephyr Cove Resort (ZWUD). Although no bike path is located in the area, a bikeway is planned to include this portion of U.S. 50, and encircle the lake.

Water utility system improvements and repair would have no long-term effect on traffic and circulation, although some temporary construction delays on U.S. 50 and neighborhood streets may occur during the active construction period.

2.2.8 Hazards

The nearest active Leaking Underground Storage Tank (LUST) sites are the Round Hill Shell located at 199 U.S. 50 in Zephyr Cove and Zephyr Cove Resort at 760 U.S. 50 in Zephyr Cove, both of which have confirmed release of gasoline and are actively monitored (Nevada Division of Environmental Protection, 7/15/15).

The entire WSA areas are within the Wildland Urban Interface (WUI) as shown in the LTBMU Forest Plan Map (Map 4, Forest Plan, 2015).

U.S. 50 is the primary evacuation route through this area, as well as the Uppaway, Cave Rock, and Skyland WSAs.

2.2.9 Public Utilities and Services

Utility and service providers within the ZWUD include Douglas County, Zephyr Cove General Improvement District (GID), Zephyr Knolls GID, Zephyr Heights GID, Marla Bay GID, Douglas County School District, Douglas County Sewer Improvement District, Douglas County Sheriff's Office, Tahoe Douglas Fire Protection District, South Tahoe Refuse, NV Energy, Southwest Gas, and Frontier Communications (Douglas County Master Plan, 2012).

Douglas County provides water service within the Zephyr Water Utility District as well as Skyland WSA and Uppaway and Cave Rock WSAs. These areas were consolidated under the County. The County is currently evaluating the existing system, planning for repairs and improvements, and assessing future needs. With little growth anticipated, efforts focus on system improvements and repairs.

Area wastewater is pumped out of the basin for reuse and disposal by the Douglas County Sewer Improvement District No.1, which serves all of the Douglas County WSAs. Tahoe Douglas Sewer District provides collection of wastewater and conveys it to DCSID No.1 for treatment and export from the basin.

There are four GIDs within the ZWUD: Zephyr Cove GID, Zephyr Knolls GID, Zephyr Heights GID, and Marla Bay GID. Each of the GIDs manage and maintain infrastructure within their respective subdivision, including roadway maintenance and snow removal, storm drains, curb and gutter, street lighting and safety, street sweeping, among other responsibilities.

South Tahoe Refuse provides solid waste service under a franchise agreement with Douglas County. Refuse and recyclables are transported to a material recovery facility and transfer station in South Lake Tahoe, California, and then transported to the Lockwood Landfill in Storey County.

The Douglas County Sheriff's Office has a substation at Kingsbury Grade and U.S. 50 south of the WSAs, with County law enforcement support services centered in the South Shore area.

The Tahoe Douglas Fire Protection District provides fire protection, emergency response, and rescue services. The nearest fire stations are the Glenbrook Station #25 south of the Uppaway WSA, and the Zephyr Cove Station #24 in the Skyland WSA.

The Douglas County School District operates Zephyr Cove Elementary (K-6) and Whittell High School (7-12) located in the Skyland WSA. Due to declining enrollment, Kingsbury Middle School was closed in 2008 and may be redeveloped into commercial and residential uses. Library services are provided by the County at the Library in Zephyr Cove, located nearby in the Skyland WSA on Warrior Way.

Recreation in the area includes U.S. Forest Service land and trails for hiking, biking, and other recreation activities, while other recreation resources in the vicinity of the WSAs includes the Glenbrook golf course, the Zephyr Cove marina, Spooner Lake, and the Tahoe Rim Trail. Area schools also provide recreational facilities; however few developed recreation facilities are located within or near the WSAs. The LTBMU Forest Plan identifies the ZWUD as an area with both Urban and Rural Recreation Spectrums, with areas west of U.S. 50 being urban due to Zephyr Cove Resort development and beach and marina access.

Nevada Energy and Southwest Gas provide electricity and natural gas services to the area, and Frontier Communications provides communication services. A low-power, non-broadcast LTBMU communications site is located at the Zephyr Heights Lookout within the ZWUD.

2.2.10 Scenic Resources

ZWUD includes Roadway Unit 30 and Scenic Shoreline Unit 29 and a small portion of Unit 28 (Wagstaff and Brady 1983). Views within ZWUD in Scenic Roadway Unit 30 – Zephyr Cove-Lincoln Park include riparian and meadow vegetation around Zephyr Creek, and views of Zephyr Cove and distant mountains to the west, views of Round Mound and Heavenly Valley mountains to the south, as well as forested areas with commercial and residential developments visible in

the foreground. The overall scenic quality is defined as high with a rating of 3; however views within the WSA range from moderate to high quality with ratings ranging from 2 to 3. In 2001, Unit 30 was separated into four units with the portion in the ZWUD being Unit 30C and a small portion of Unit 30B. The TRPA 2011 Threshold Report for Unit 30C indicates a threshold composite rating of 16, with overall ratings of: man-made features – 2.5; roadway distractions – 3; road structure – 3; lake views – 3.5; landscape views – 2; and variety – 2. Clutter around Zephyr Cove resort such as banners and on-street parking detract from the area, although redevelopment of the campground and upgrades to the parking lot and landscaping at Zephyr Cove Resort have improved the manmade feature score in the past. No improvements altered the scores between 2006 and 2011. Unit 30B has a threshold composite rating of 16.5 with overall ratings of: man-made features – 3; roadway distractions – 3.5; road structure – 2; lake views – 2.5; landscape views – 3; and variety – 2.5. Roadside parking near the Zephyr Cove Resort persists and distracts from the visual quality of the area.

Scenic Shoreline Unit 28 – Tahoe School has an overall moderate scenic quality and rating of 2. Background views include forested steep hills, while shoreline views include rocky, forested, natural shore with willows and other vegetation near the creeks. Some housing and roadway are visible. Offshore views include rocks and boulders within the lake. Unit 28 remains at-risk of non-attainment with threshold composite score of 11; man-made features – 4; background views – 4; and variety – 3. Although this unit is in attainment, residential remodeling in the area can threaten the current score.

Most of ZWUD is located within Scenic Shoreline Unit 29 – Zephyr Cove, which has an overall moderate scenic quality and rating of 2. Background views within ZWUD include rugged, rocky hills and trees with houses and condominiums intermixed, stone retaining walls, sandy beaches with willows and other riparian vegetation, views of the paddle steamer M.S. Dixie, Zephyr Cove, Zephyr Point, and roadway development and traffic. Shoreline Unit 29 is not in attainment. 2011 Threshold Ratings for Unit 29 include: Threshold composite – 9; man-made features – 2; background views – 3; and variety – 4. Large piers with boatlifts create distractions and detract from the man-made features, as do large residential remodels.

Scenic Recreation Area 2 – Zephyr Cove is also located within ZWUD. Views from Scenic Recreation Area 2 include views of the lake, distant peaks across the lake, sandy beaches, forests, area streams, the pier and concessions, parking, and picnic areas. Development within the recreation area as well as nearby residential subdivisions affect the scenic value of this area. According to the 2011 Threshold Report, this area is in attainment with ratings of 4 for unity, vividness, and intactness and 3 for variety for a total rating of 15.

The LTBMU Forest Plan indicates USFS portions of ZWUD have a minimum scenic integrity of “high”. The Forest Plan Scenic Stability rating for ZWUD is mostly high, with some area of moderate stability around the residential area southwest of U.S. 50.

U.S. 50 is a National Scenic Byway within each of the Douglas County Water System areas.

2.2.11 Cultural Resources

The ZWUD project area was subjected to a forest service health survey in 1978 by the LTBMU-USFS. That survey entailed a random inventory for cultural resources in a large block area. That undertaking does not appear to have included a pedestrian survey of the ZWUD project area. There are few cultural resources recorded near the project area, however there have not been many cultural resources surveys or inventories.

There are no previously recorded cultural resources within or adjacent to the project area (National Register of Historic Places Research Database, nps.gov/nR/research/index, accessed on 9/23/15). Within ½ mile of the project area there are several historical resources consisting of the Zephyr Point Fire Lookout, the Lincoln Highway (US 50), and The Zephyr Cove Resort. There is also a Zephyr Cove historical district located northwest of the ZWUD area on the lakefront, which includes a number of historic houses and structures associated with Lake Tahoe tourism. None of the sites are listed on the National Register of Historical Places (NRHP) or otherwise protected by the state of Nevada. Historical resources further from the project area include a large historical timber-harvest landscape, and numerous resources associated with historical agricultural practices.

Prehistoric sites would most likely be ethnographically associated with the Washoe Tribe of Nevada and California. The closest archaeological sites to ZWUD are located along the lakeshore. The prehistoric sites are primarily food preparation areas surrounding bedrock mortar (grinding hole) stations.

The ZWUD project area has a medium to low cultural resources sensitivity. Resources would most likely be associated with historical timber harvesting and forestry practices. Large complex prehistoric or historic resources requiring costly mitigation measures are not anticipated. This assessment is based solely on a records search conducted electronically with the Nevada Cultural Resources Information System (nvcris.shpo.nv.gov, accessed on 9/21/15 and 9/23/15). There is always the possibility that previously unrecorded cultural resources are present near and around the ZWUD project area.

2.3 Population Trends

According to the 2011 Douglas County Master Plan, population trends in the Lake Tahoe region of Douglas County indicate the full-time permanent population declined between 2000 and 2010 as a result of an increase in second and vacation home ownership. The number of active vacation home rentals in the area is expected to continue to increase. The population in the Tahoe area decreased between 2000 and 2010 the Zephyr Cove/Roundhill CDP experiencing a population decrease of 373 persons or -20% for a total population of 1,324. Similar trends occurred in other portions of the Lake Tahoe area such as Kingsbury and Stateline, while the portions of Douglas County outside of the Lake Tahoe Basin experienced population growth. TRPA socioeconomic data for 2010 indicates that percentage of primary residences in Douglas County versus secondary residences is 51/49 (TRPA 2011 Threshold Evaluation – Appendix A). Overall, the population increased by 14% between 2000 and 2010 in Douglas County, with a 2010 population of 46,997 persons.

Nevada County Population Projections 2014-2033 prepared by the Nevada State Demographer's Office (October 1, 2014), project the population of Douglas County will be approximately 49,620 persons in 2032, as compared to 48,478 persons in 2013. Overall, population trends indicate a population decrease in Douglas County through 2018, with an average annual increase of 0.3% through 2033. The 2014-2013 Projections also indicate most job growth will occur in the fields of construction (1.2%), accommodation and food services (1.8%), and professional, scientific, and technical services (0.8%), among others.

Redevelopment employment along US 50 is unlikely to result in population growth despite employment gains as workforce housing has not increased. In addition, wages corresponding to the employment growth areas in the Lake Tahoe Basin do not afford employees residence within

the Lake Tahoe area. Those employed by new jobs will continue to commute to the area from more affordable areas in Douglas County. Therefore, population growth trends will continue to decrease or remain stagnant in the Lake Tahoe Basin area.

In 2012, there were 102 vacant developable residential parcels (Individual Parcel Evaluation System [IPES] score above zero) in the Tahoe Planning Area of Douglas County. At a development rate of eight allocations per year, the area would be built-out within 13 years. None of these parcels are located in the Uppaway WSA, but some are located within the Cave Rock, Skyland, and Zephyr WSAs.

2.4 Community Engagement

Community engagement will occur through a series of workshops, where the County will share the findings of the PER, and solicit input from the rate payers. The exact format of the workshops have not been determined at this time, but they will include discussion of the system deficiencies, proposed alternatives, and probable funding sources.

3 Existing Facilities

3.1 Location Map

ZWUD is located on the east shore of Lake Tahoe in Douglas County, and services the Zephyr Cove, Zephyr Heights, Zephyr Knolls and Marla Bay subdivisions as shown in the following location map.

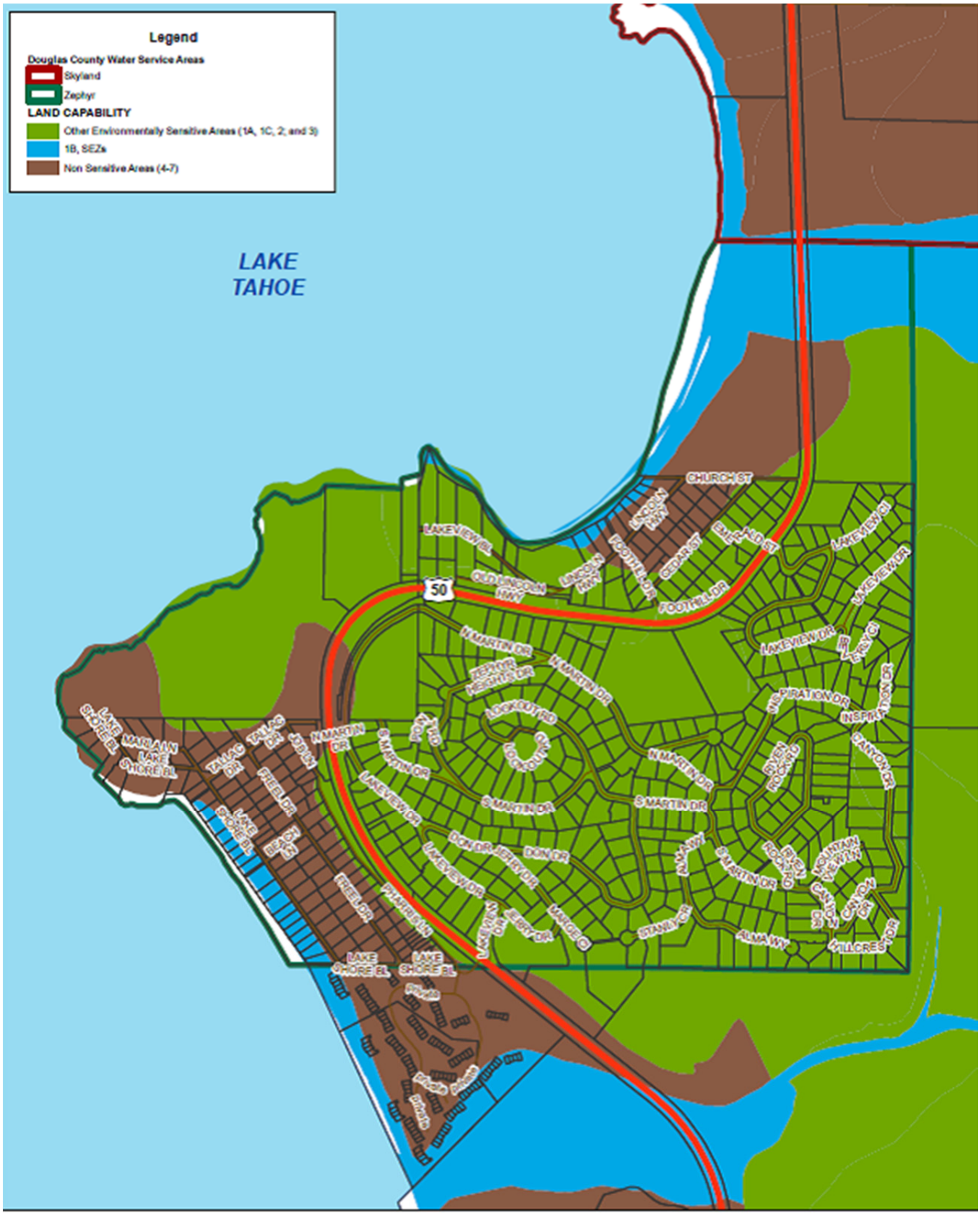


Figure 3-1. Location Map

3.2 History

The water system was originally built for the Marla Bay and Zephyr Cove subdivisions in the 1950s, and has been added to over time as the service area expanded. There are currently 572 Equivalent Dwelling Units (EDUs) served by the system, comprised of a mix of residential and commercial buildings. Most of the residential units are unmetered. A few of the commercial services are metered, and include the Presbyterian Conference Center.

Originally, most homes built in the area were small summer or winter cabins. As real estate prices in the Lake Tahoe area increased over the years, most of the original cabins have been replaced with larger vacation homes, many in excess of 3,500 square feet. The larger homes have increased fixture counts and water usage, although most homes are still primarily summer/winter vacation homes.

ZWUD water system is compromised of the following major system components:

Table 3-1. System Components

Component	Material	Size/Capacity	Year Constructed
Water Tank	Welded Steel	560,000 Gal	1994
Ozone/UV Water Treatment Plant		620 gpm	Original 1999, Upgraded in 2011 & 2014
Lake Intake	HDPE	10-inch	1994
Lake Intake Pump Station		620 gpm	1994[1]
Distribution Piping – Lakeview Dr and Beverley /Circle	Ductile Iron	8-inch	2012
Distribution Piping – Tallac Dr, Job Lane, Lakeview Dr	Ductile Iron	8-inch	1990 - 1994
Distribution Piping - Various	Steel	1-inch to 4 inch	1950s – 1960s

Source: Douglas Co Record Drawings
1 – Pumps replaced in 1996-97

3.3 Lake Intake

Lake Tahoe is the sole source water source for ZWUD. A 10-inch diameter High Density Polyethylene (HDPE) pipeline extends approximately 1,035-feet in Marla Bay. The line is partially buried and partially exposed on the lake floor. The exposed section is weighted down with concrete anchors. The stainless steel intake screen structure is approximately 63-feet deep, based on a lake level of 6,223. The intake is set 6.5-feet above the bottom of the lake. The following figure shows the intake screen detail.

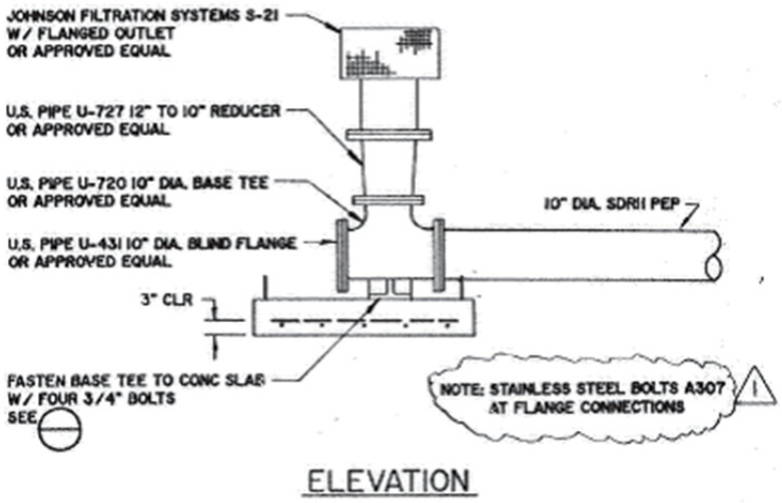


Figure 3-2. Lake Intake Screen

3.3.1 Condition

The intake is inspected every 2-years by a commercial diving company using SCUBA equipment. The last inspection was performed October 17th, 2014 by Blue Locker Commercial Diving Services.

Overall, the intake pipeline is in good condition.

- No visible damage to the pipeline
- Anchor blocks are securely fastened and in place
- Marine growth covers the pipeline

Photo 3-1. Pipeline & Anchor Block

The intake screen was cleaned by the diver to remove marine growth. Asian clams, an invasive species to Lake Tahoe which can clog screens, have not been a problem so far.

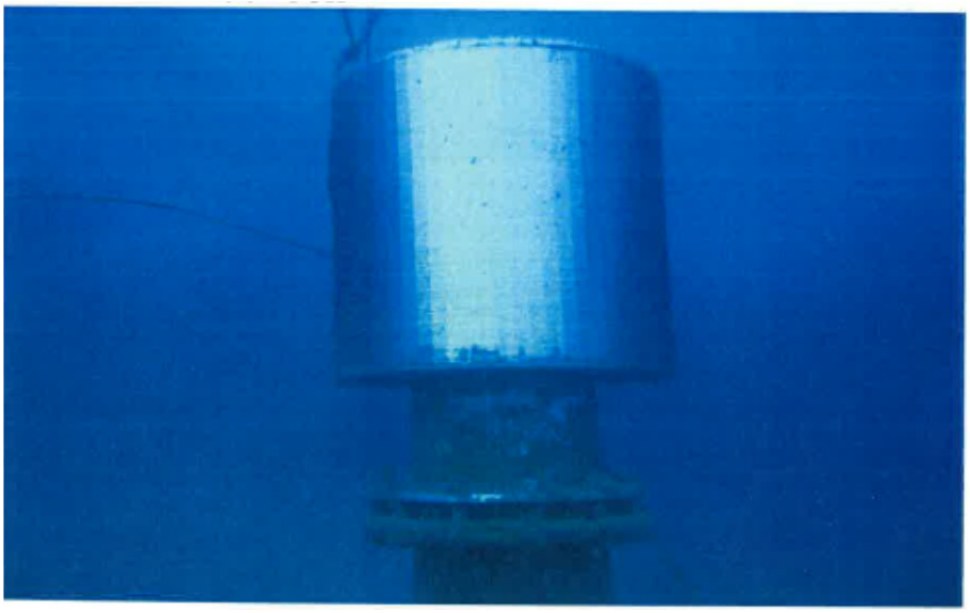


Photo 3-2. Clean Intake Screen

Check Valve

A leaking 10-inch check valve just upstream from the screens was causing problems at the Lake Pump Station and Water Treatment Plant (see respective sections).

As can be seen in the inspection photos, the intake check valve was sitting at an angle, which may have contributed to its leaking. It is not clear if it was originally installed this way, or if the pipe twisted, resulting in the check valve moving. The County replaced this check valve on October 14, 2015, and will be checking to see if it resolves the air entrapment issues in the intake line. Initial results indicate that the air has been significantly reduced.

Photo 3-3. Original Tilted Check Valve

3.3.2 Regulatory Compliance

NAC 445A.6698 and 445A.860 requires the intake to extend 1,000-feet into the Lake, 15-feet below the surface, and 4-feet above the bottom. The intake meets these criteria.

3.4 Marla Bay Pump Station

The intake pump station is located off Lakeshore and Tallac Drive on the beach in Marla Bay. The pump station was constructed in 1994 and houses two centrifugal pumps and associated piping. The pumps lift raw water to the water treatment plant west of Highway 50.

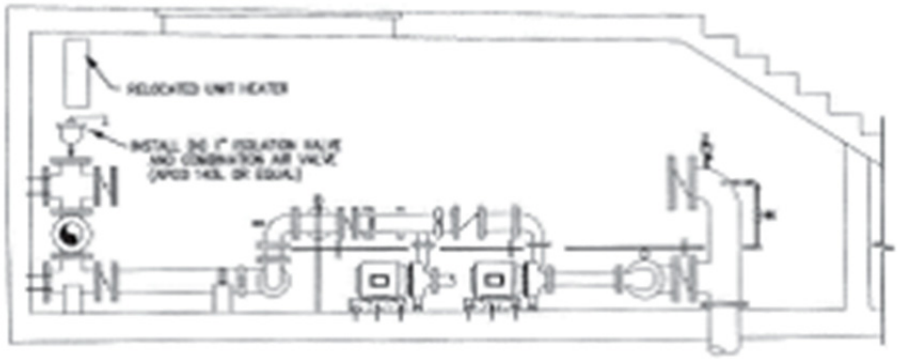


Figure 3-3. Lake Pump Station Elevation

Table 3-2. Intake Pump Station

Component	Value	Units
Pumps		
Flowserve D814-4x3x13F	Qty.2	
Design Flow	420	gpm
Design Head	108	ft
Speed	1760	rpm
Electric Motor	20	Hp
Piping		
Discharge size	8-10	In
Material	Ductile Iron	

Source: Douglas Co Record Drawings

The pump impellers were recently replaced as part of the UV Disinfection upgrades to provide increased head for the UV piping.

3.4.1 Condition

Overall the pump station is in fair condition. The pumps are approximately 20 years old, but appear to be in decent condition, and are relatively simple to rebuild.

The condition of the piping coatings in the pump station building is fair to poor. Corrosion is occurring on sections of the piping where the coatings have failed. This is expected for coatings that are over 20 years old, and is considered routine maintenance to have to recoat piping on a 10 to 15 year basis.

The coating on the building walls is also in fair to poor condition, showing the concrete substrate. The concrete is not susceptible to attack in this environment, but is more of an aesthetics issue.

Photo 3-4. MBPS Intake Piping

Photo 3-5. MBPS Discharge Piping

3.4.2 Operational Issues

Intake Prime and Air Pocket

Since the centrifugal pumps are located above the lake level, the intake pipeline must remain full to maintain the pump prime.

Years ago, the check valve in the Lake started to leak, which allows water to leak back into the lake, and drains the line. To address this, the County installed a small bypass line around the pumps to connect the discharge side to the suction side. The line has a solenoid valve which is open when the pumps are off, closed when the pumps are on. This bypass effectively keeps the pump suction primed.

However, by pulling water from the discharge side to keep the suction primed, an air pocket is formed in the line. When the pumps start, this air pocket is pushed up to the treatment plant, where it is discharged at the air relief valve on the UV reactors. The UV reactors need to be “wet” when operating to maintain cooling for the lamps. Also, air from the line can get into the UVT sample line, which impacts the UVT analyzer readings, which can shut the plant down if artificially low.

To work around this issue, the programming was modified to allow the lake pumps to run for a preset time before the UV reactors are called to run, to allow the system to purge air. This approach has been successful, although it is still a work around to an existing problem. The County replaced the check valve on October 14, 2015.

Pump Capacity

As part of the UV Disinfection Project piping modifications, the UV discharge isolation valve must be throttled to prevent a siphon condition. This resulted in increased head conditions for the pumps, and an approximately 20 gpm decrease in flow.

3.5 Water Treatment Plant

The ZWUD Water Treatment Plant operates under filtration avoidance, which was issued by the state after the raw water sampling for *Giardia* and virus in 1991 and 1992, and the overall high water quality in Lake Tahoe. The original ozone disinfection plant was built in 1999, but did not function correctly due to controls issues. Modifications to the plant in 2001 corrected the control problems. The ozone generators eventually began to fail in 2010 and were replaced in 2011. The promulgation of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) led to a study of compliance alternatives in 2008-2009. UV disinfection was selected as the most cost effective treatment alternative, and was added to the plant in 2014.

Refer to the 2015 Operations Manual for a detailed description of the WTP process and operation.

3.5.1 Condition

Mechanical

Following the 2014 upgrades, the plant is in good condition overall. There are no known issues at this time with mechanical equipment at the plant.

Electrical

The plant electrical system consist of a 400 ampere main 277/480 volt, 3 phase, 4 wire service switchboard/MCC-B with a 277/480 volt, 3 phase, 4 wire distribution panel, DP-1 and a dry transformer feeding a 120/240 volt, single phase panelboard, LP-B. There is also a 120/208 volt, 3 phase, 4 wire panelboard, DP-1L, mounted near the ultra violet (UV) control panels in the treatment room. The plant switchboard and motor control center (MCC) have provided reliable service for 15 years and there are no known current operational issues with this equipment.

The space between the front of the switchboard and MCC to the standby generator is less than required by the National Electrical Code (NEC), but there is no easy or inexpensive solution to this spacing deficiency by simple equipment replacement or relocation. This was an original design deficiency as the 1996 NEC which was in effect at the time of the original plant design requires a 42 inch clearance and the clearance actually provided in the design was about 36 inches. This is adequate working space and does meet NEC as long as the panel doors are not opened while the panel is energized. Major changes to the building structure or a major relocation of this equipment to an outside location would be necessary to meet the full requirements of the NEC and the best solution is to never open the panel doors while the equipment is energized unless performed by a qualified service technician and preferably with a non-conducting barrier like plywood temporarily installed against the grounded parts of the standby generator opposite the panel door to be opened.

The electrical components within the switchboard and MCC are standard field replaceable devices such as circuit breakers, motor starter, relays and control devices (pushbuttons, selector switches, pilot lights) which can easily be replaced by maintenance staff if and when needed.

The basic equipment structure and busing should be serviceable for at least another 20 years. We would not anticipate any major increase in maintenance over the remaining service life of the equipment.

We would recommend periodic inspections and field testing of this equipment about every 3-5 years by a qualified electrical testing firm. They can perform infra-red thermal scans in order to identify hot spots in the equipment which might be due to loose fasteners, poor insulation, failing stab connections or other poor electrical connections. Maintenance staff can also perform these thermal scans. The testing firm can also test the major circuit breakers in place for proper operation and trip function and can test other electrical components such as the automatic transfer switch for proper operation. The current condition of this equipment does not warrant complete replacement at this time.

The existing standby generator is providing reliable service and has low operating hours as is typical for standby generators. The generator engine likely does not meet current air quality standards, but is not required to do so having been installed a number of years ago. This does not impact the generator set's ability to perform its functions properly and this unit can remain in service for the foreseeable future with proper maintenance and service.

During lightning storms, voltage surges and dips can be detrimental to sensitive PLC based controls systems. These voltage fluctuations can cause damage or cause the UV and Ozone equipment to shutdown, which results in the entire plant going into a shutdown sequence. A hard shutdown may require an operator to restart the system manually. This can be remedied by installing surge protection devices in the switchboard and panel boards to help protect against electrical surges and disturbances.

The standby electrical generator starting battery consists of 20 single 1.3 volt cells. These batteries have been in service since the plant was constructed with little or no service and we would recommend that the battery cells be checked for continued serviceability.

Controls/ SCADA

Background

The ZWUD treatment plant control software has gone through 4 upgrade cycles; the initial treatment plant startup in 2000, plant modifications needed after initial startup to correct a number of deficiencies, replacement of the ozone generation equipment in 2011/2012 and the addition of the ultra violet (UV) treatment in 2013. It is not uncommon that there would be considerable field work on the software during each of the 4 startups in order to remove bugs and correct deficiencies that were not apparent or anticipated during design and initial software modification in the office. This not a fault of the PLC system or its basic software, but is a typical phenomenon during process startup. It is, in fact, a testament to the basic software and PLC system that it can be easily field changed for different process needs. There were more than normal field software changes during plant startup in 2000 and many were due to deficiencies in the plant control specifications, lack of knowledge of the plant processes and due to unanticipated process needs identified as startup progressed. These items were resolved and the plant functioned normally for 10 years. A number of software changes were required when the ozone generation equipment was replaced in 2010/2011 because the new equipment differed substantially from the old equipment. This necessitated a number of changes to the plant equipment and to the PLC software which were made and the new equipment was placed into successful operation. The software was again upgraded when the UV system was installed

and started up. The present TESCO hardware and software has been in service since the plant was initially started up and has provided reliable service except for one PLC failure which occurred within the last year. This failure was repaired; the system checked out and placed back in service. The existing TESCO hot standby PLC system is fully capable of automatic switchover to the functioning PLC if a PLC fails, but has always been in manual switchover mode at the request of the plant operations staff. This mode can be field changed. We believe the existing hardware and software is suitable for continued service until the planned retirement of the TESCO PLC system in the future.

Operational Issues

The treatment plant control system consists of local control panels (LCP) for each of the 2 UV treatment units, LCP's for each of the 2 ozone generators, a plant control panel with 2 hot standby configured TESCO Liquitronic 5 PLC's and a Sierra Controls SCADA Pack PLC which provides communications interface from the TESCO PLC's to the radio system for communication to the Cave Rock WTP SCADA.

This total plant control system has been reliable except for one failure of a Liquitronic 5 PLC and the gateway which controls communications between the Liquitronic 5 PLC's and the UV system PLC's. The system was placed back into satisfactory operation by replacing the failed Liquitronic 5 PLC and replacing the failed gateway with a TESCO L1000 G gateway controller. The system is presently in satisfactory operation with manual PLC switchover.

If the communications link between ZWUD and Cave Rock WTP is lost for any reason, UV compliance data that is being transmitted to Cave Rock is disrupted. The data is difficult and costly to retrieve from the ZWUD WTP and requires a TESCO field visit. The Sierra Controls SCADA Pack was slated for Priority 3 replacement with an upgraded SCADA Pack model in the recent SCADA Master Plan. The SCADA Pack has capability for up to several months of data storage. Addition of SCADA LOG software will allow access to the UV data via a laptop, in a format that can be put in a spreadsheet. This would be useful as supplemental information for compliance reporting to the State.

The TESCO Liquitronic 5 PLC's were given a high Priority 1 rating for replacement because of their age, but now one unit is new and may provide satisfactory service for a number of years. Ultimately the PLCs should be replaced with an open source format such as SCADA Pack, so the County isn't reliant on a single integrator for service.

Building

The roof shingles are failing on the WTP building, as was documented in the NDEP Sanitary Survey from September 11, 2014. The problem areas are on the east (Highway 50) side of the roof, and due to snow and ice from Highway 50 being knocked onto the roof by snow plows. The County replaced the shingles on the east side of the roof in October 2015 with asphalt composite shingles, and salvaged slate shingles for use on future repairs on the west side of the roof.

3.5.2 Operational Issues

Generally speaking, the plant is working well operationally and providing the required 3-log *Giardia,* 3-log *Cryptosporidium*, and 4-log virus inactivation for all Surface Water Treatment Rule compliance.

Chemical Feed

The existing chemical feed pumps for sodium hypochlorite and calcium thiosulfate (CT) are fixed speed pumps, which are adjusted manually. The original plant control logic used a flow paced control for sodium hypochlorite, and a flow and ozone residual paced control for the CT pumps. At some point, the chemical feed control was simplified to a manually adjusted constant speed setup.

The plant is experiencing some issues maintaining a proper chlorine residual (approximately 0.5 mg/l) based on varying CT dosage and residual. Calcium thiosulfate, which is used to quench ozone, also quenches sodium hypochlorite, which is used to maintain disinfection residual.

If the CT dosage exceeds the ratio required to quench the ozone residual (0.25 mg CT/mg Ozone), it will then deplete the hypochlorite residual. This causes the operators to increase the hypochlorite dose, which then leads to high hypochlorite residuals when the ozone residuals decrease.

Possible causes of this problem include inadequate mixing at the point of injection. The majority of disinfection effectiveness is at the initial point of contact. Too little mixing will result in inadequate disinfection. The 1998 Record Drawings show the hypochlorite injection point in the last section of the finished water clearwell.

3.5.3 Regulatory Compliance

Currently, the treatment plant meets all applicable state and federal water quality regulations. There is no evidence at this time to suggest regulations will require filtration in the near future.

3.6 Distribution System

The original distribution system built in the 1950s was primarily constructed of unwrapped 2-inch to 4-inch galvanized steel pipes. During the 1990s, a significant portion of the original piping was replaced with 8-inch ductile iron pipe for fire protection.

Due to the large range in elevation of the system, there are currently 5 pressure zones in ZWUD. In addition, primarily on the Lake side of Highway 50, the system is configured as a “dual” system. A high pressure fire system supplies the hydrants and pressure reducing valves (PRVs) drop the pressure below 100 psi to serve a parallel piping system for the domestic demands. The benefit of this dual system approach is it increases the fire flow available from the existing 8-inch pipes. However, the velocities exceed the County and NAC standards. Also, the most of the domestic pipes are old and failing, and will require replacement.

3.6.1 Regulatory Compliance

The distribution system must meet State and Federal regulations, as documented in the Nevada Administrative Code (NAC) section 445A. In addition to the criteria in NAC 445A, Douglas County has its own Design Criteria, some of which are stricter than the NAC. Lastly, fire flow requirements are ultimately governed by the local fire authority, the Tahoe Douglas Fire District.

The following table summarizes the general water distribution requirements for both Douglas County and the State of Nevada. In the few instances where County code criteria were stricter than NAC (as shown in red), the stricter code governs.

Table 3-3. Code Comparison

Criteria	NAC 445A	County
System Residual Pressure		
Fire Flow & Max Day	20 psi	20 psi
Max Day	40 psi	40 psi
Peak Hour	30 psi	30 psi
Max Static	100 psi	100 psi
Pipe Velocity		
All Conditions (except Fire Flow)	8 fps	8 fps
Fire Flow & Ave Day Demand	None	10 fps
Minimum Pipe Size	6-inch	8-inch
Pipe Material	Orange Book/ AWWA	Ductile Iron or C900 PVC

Source: NAC and Douglas County Design Criteria

Fire Flow Requirements

The County met with Tahoe Douglas Fire District (TDFD) on February 25, 2015 to discuss fire flow requirements for ZWUD. The County requirement for fire flow is 1,500 gpm minimum. Historically, this fire flow requirement has been applied “across the board” with respect to residential fire flow requirements for water system modeling and analysis. However, at this meeting, TDFD as represented by Eric Guevin, Fire Marshall, stated that fire flow requirements were governed by the International Fire Code (IFC). In the IFC, fire flow is determined based on building size and construction, as summarized in Table B105.1.

Water line upgrades from the 1990’s were based on the fire flow requirements at that time. When those lines are due for replacement in the future, new code requirements may require them to be upsized.

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

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

For SI: 1 square foot = 0.0929 m2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.
a. Types of construction are based on the *International Building Code*.
b. Measured at 20 psi residual pressure.

Figure 3-4. IFC Table B105.1

The County used building information obtained from County GIS records to determine the fire flow criteria for each parcel in the water system. This information is shown on the following figure. The required parcel fire flows were allocated to nearby hydrants, as indicated by the colored circles on the figure.

These flows were used as the basis for water system modeling to verify the system meets pressure and flows under the various demand scenarios.

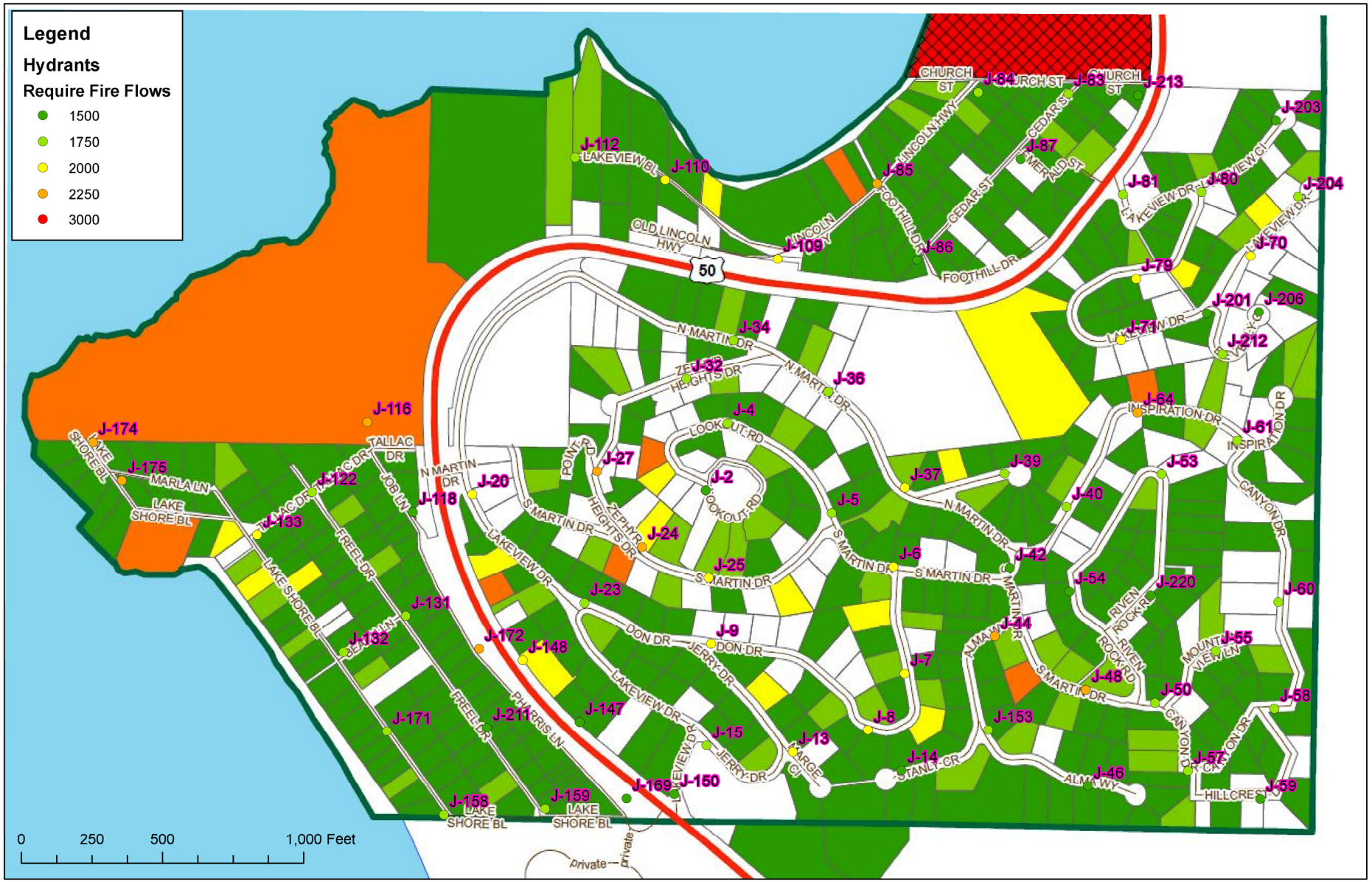


Figure 3-5. Fire Flow Requirements

3.6.2 Water Meters

Currently only about 41 of the 528 services, or 7.7% of the services are metered. Non-metered services are charged a flat rate, which does not promote water conservation. A water conservation plan is required under NRS 540.131. The County has an adopted Water Conservation Plan that needs updating.

3.6.3 Piping Condition

The original remaining distribution piping is in poor condition, as evidenced by the large number of leaks over the last 10 years. Original piping installation was very poor, and likely did not include much, if any, construction inspection. Pipe bedding and backfill was substandard, as it is not uncommon to find large rocks in the pipe bed zone.

Photo 3-6. Failed Pipe Examples

Photo 3-7. Typical Failed Pipes

Also, it has been documented from repair records that the pipe was often bent at angle points instead of using elbows. The areas where the pipe was bend or in contact with rocks damage the thin galvanized coating, leading to galvanic corrosion, and ultimately pipe failure and leaks.

The County has documented the extensive leak history at ZWUD, which is summarized in the following table and map.

Table 3-4. Leak History and Associated Costs

Fiscal Year	No. of Leaks	Contractor Costs	County Labor and OT Costs[1]	Total Cost
2009-2010	7	$10,200	$5,900	$16,100
2010-2011	22	$38,500	$21,300	$59,800
2011-2012	9	$18,000	$10,400	$28,400
2012-2013	4	$2,600	$1,500	$4,100
2013-2014	5	$6,900	$4,000	$10,900
Total				**$119,300**

Source: Douglas Co records
[1]FY 10-11 and 11-12 are actual data. Other years estimated based on 57% of contractor costs.

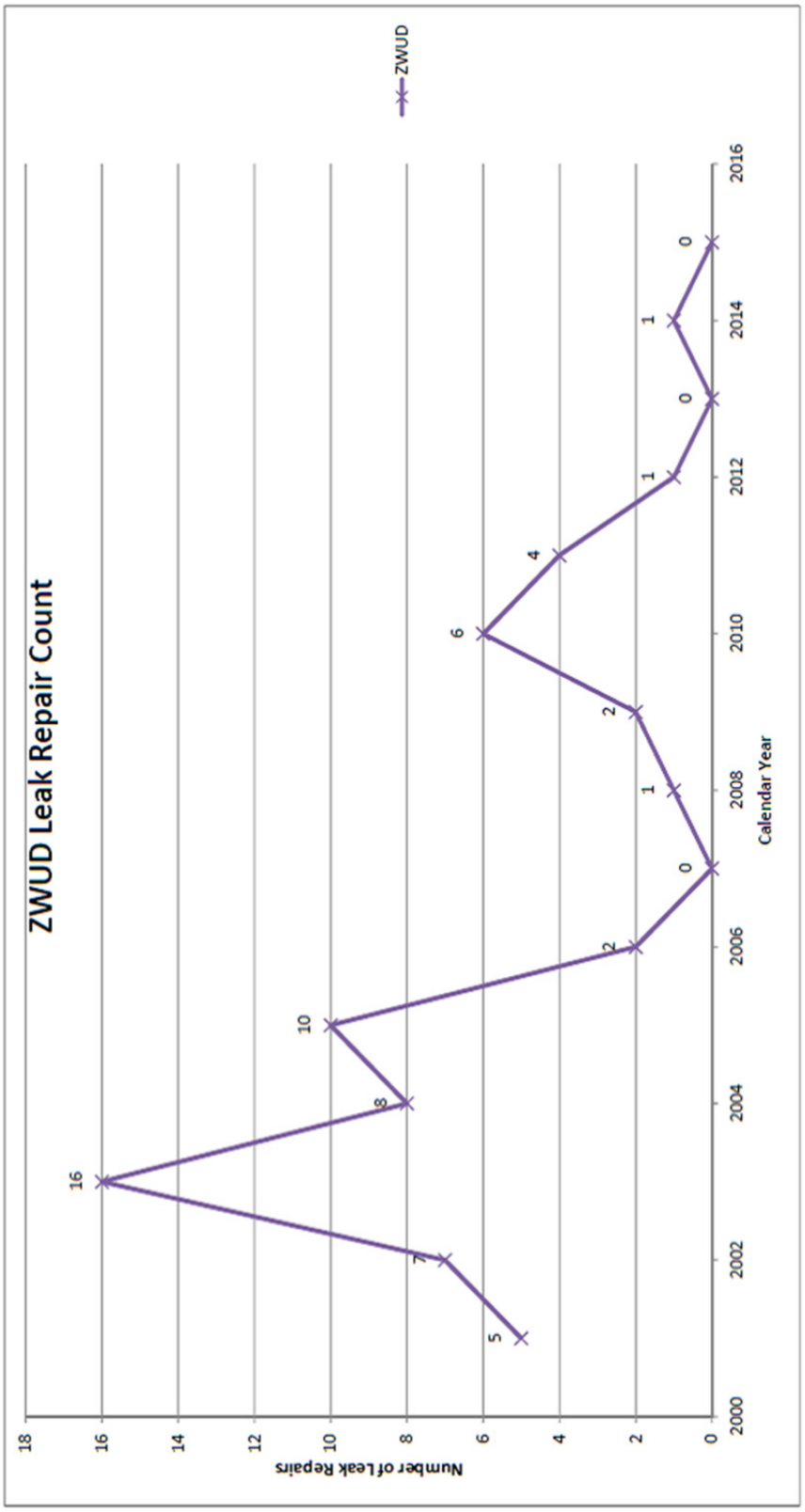


Figure 3-6. System Leaks per Year

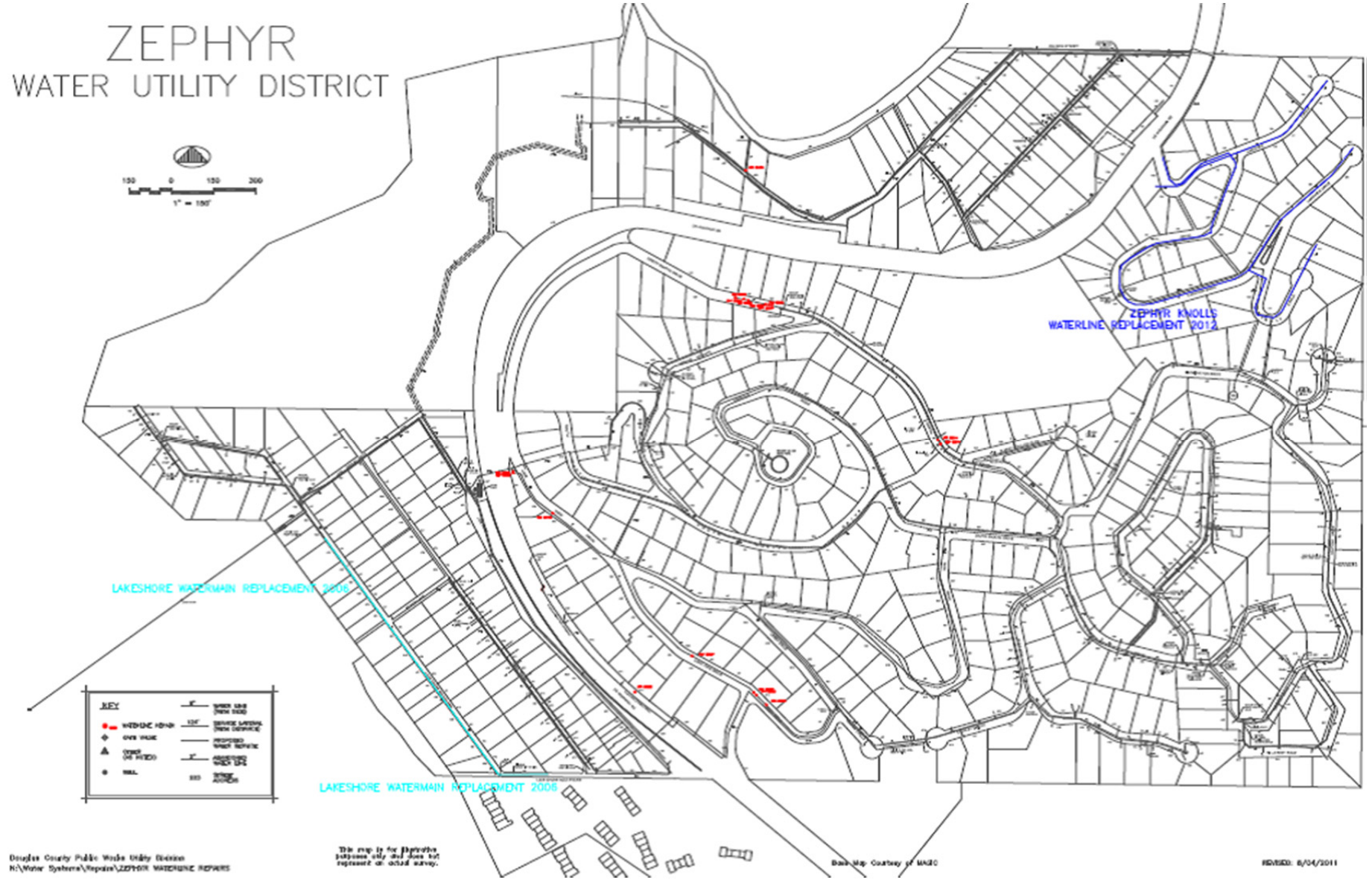


Figure 3-7. Leak Repair Map

3.7 Water System Modeling

Douglas County provided a hydraulic model of the ZWUD water distribution to HDR for modeling fire flows and system pressures. The model was analyzed and updated based on County water distribution system evaluation criteria. The model used of this analysis was provided by Douglas County. The modeling software package Bentley® WaterGEMS® V8i was used for this analysis.

3.7.1 Model Infrastructure

The County model contains the whole ZWUD water system including raw water pumps, treatment facility, and distribution system. The model contains 393 facilities which are summarized Table 3-5. The pipes are summarized in Table 3-6.

Lake Tahoe and the treatment facility clear well are represented with constant head reservoirs. All seven valves in the existing model are pressure reducing valves (PRVs). The one tank in the distribution system is the Lookout Road tank which is 60-ft in diameter and 32-ft high with a base elevation of 6,662 ft.

Table 3-5. Facility Inventory

Facility	Quantity
Pipes	206
Junctions	173
Pumps	4
Pressure Reducing Valves (PRVs)	7
Tanks	1
Reservoirs	2
Total	393

Table 3-6. Pipe Inventory

Material	Diameter (in)	Length (ft)	Quantity
Asbestos Cement	4	267	1
Ductile Iron	1	988	4
Ductile Iron	2	345	3
Ductile Iron	4	6,790	24
Ductile Iron	6	4,001	20
Ductile Iron	8	29,433	121
Ductile Iron	10	29	2
Galvanized Steel	1	193	1
Galvanized Steel	2	5,535	19

Material	Diameter (in)	Length (ft)	Quantity
Galvanized Steel	4	472	1
PEP	10	1,095	2
PVC	4	1,010	4
PVC	6	417	1
Steel	4	406	3
	Total	50,981	206

3.7.2 Demands

The following table summarizes the demands used in the various model scenarios.

Table 3-7. Model Demands

Demand Scenario	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
Total	460.8	654.8	2,304.0
Peaking Factor	1.0	1.4	5.0

Source: County Watercad model

Since growth in the service area is currently negative, current demands were considered adequate for representing future conditions.

3.7.3 Evaluation Criteria

Evaluation criteria for analyzing the model are based on the Nevada Administrative Code Section 445A, and Douglas County Design Standards, and are summarized in Section 3.6.1.

Pressure and Velocity

These criteria include minimum/ maximum pressures and velocities for the following flow conditions:

- Maximum Day Demand (MDD)
- Peak Hour Demand (PHD)
- MDD plus Fire Flow (FF)
- Average Day Demand (ADD)

Table 3-8. Evaluation Criteria

Criteria	Value	Units
MDD Min Pressure	40	Psi
PHD Min Pressure	30	psi
MDD + FF	20	Psi
ADD Max Pressure	100	psi
ADD Max Velocity	8	Ft/s
ADD + FF Max Velocity	10	Ft/s

Fire Flow

Fire flow requirements were determined based on parcel data provided by the County, as summarized in Section 3.6.1. The resulting map and list of fire flow requirements per hydrant and model node are shown in Figure 2.4, Table B105.1.

3.7.4 Existing System Analysis

The existing system was analyzed based on the evaluation criteria. Model simulations were run for ADD, ADD+FF, MDD, MDD+FF, and PHD. Tank levels were adjusted based on the type of analysis being run. For high pressure sensitive simulations, for example, ADD maximum pressure analysis, the level of the Lookout Road tank was set to approximately 74 percent full. For low pressure sensitive simulations, the tank was set to 50 percent full, as shown in the following table.

Distribution pumps were also turned on to test high pressure simulations. All PRVs were allowed to open for fire flow simulations based on the assumption PRVs in the real world system are set to fully open in the event of a major pressure gradient is experienced in the direction of flow.

Table 3-9. Tank Levels During Model Scenarios

Scenario	High Pressure Test (ADD)	Low Pressure Test (MDD, PHD, FF)
Elevation Base	6,626.0	6,626.0
Elevation Minimum	6,627.0	6,627.0
Elevation Initial	6,650.0	6,642.5
Elevation Maximum	6,658.0	6,658.0
% Full	74.2	50.0
Level Minimum	1.0	1.0
Level Initial	24.0	16.5
Level Maximum	32.0	32.0

Results

Average Day Demand

Fifty one (51) model nodes were above 100 psi. Nodes with high pressure were located around the periphery of the system as shown in Figure 3-8.

Average Day Demand & Fire Flow

Seventy (70) fire flow deficiencies located throughout the system as shown in Figure 3-9.

Max Day Demand & Fire Flow

Seventy (70) fire flow deficiencies as shown in Figure 3-10.

Max Day Demand

Six (6) model nodes with less than 40 psi pressure. Three of these nodes are located along Riven Rock Road representing a local high point in the system. Two of these nodes are located on dead end lines as shown in Figure 3-11.

Peak Hour Demand

Forty four (44) model junctions with less than 30 psi pressure as shown in Figure 3-12. These junctions are concentrated near the existing tank in the center of the system and to the south east of the system.

- The model results indicate that the existing system as modeled does not meet the evaluation criteria.

Based on the results of the existing system model simulations, alternatives were developed and modeled to address the hydraulic deficiencies found. The alternatives are discussed in Section 5.

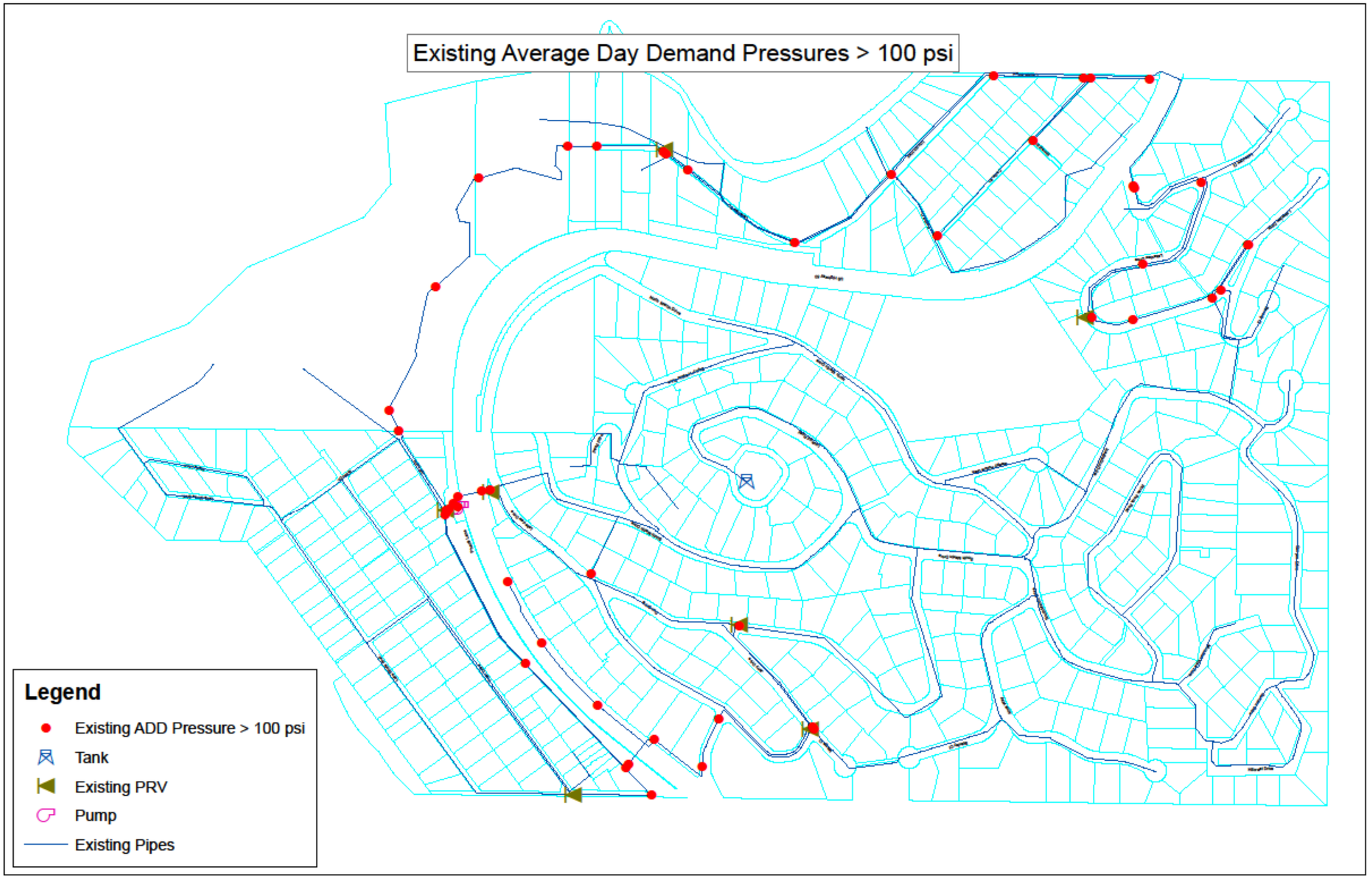


Figure 3-8 ADD High Pressures

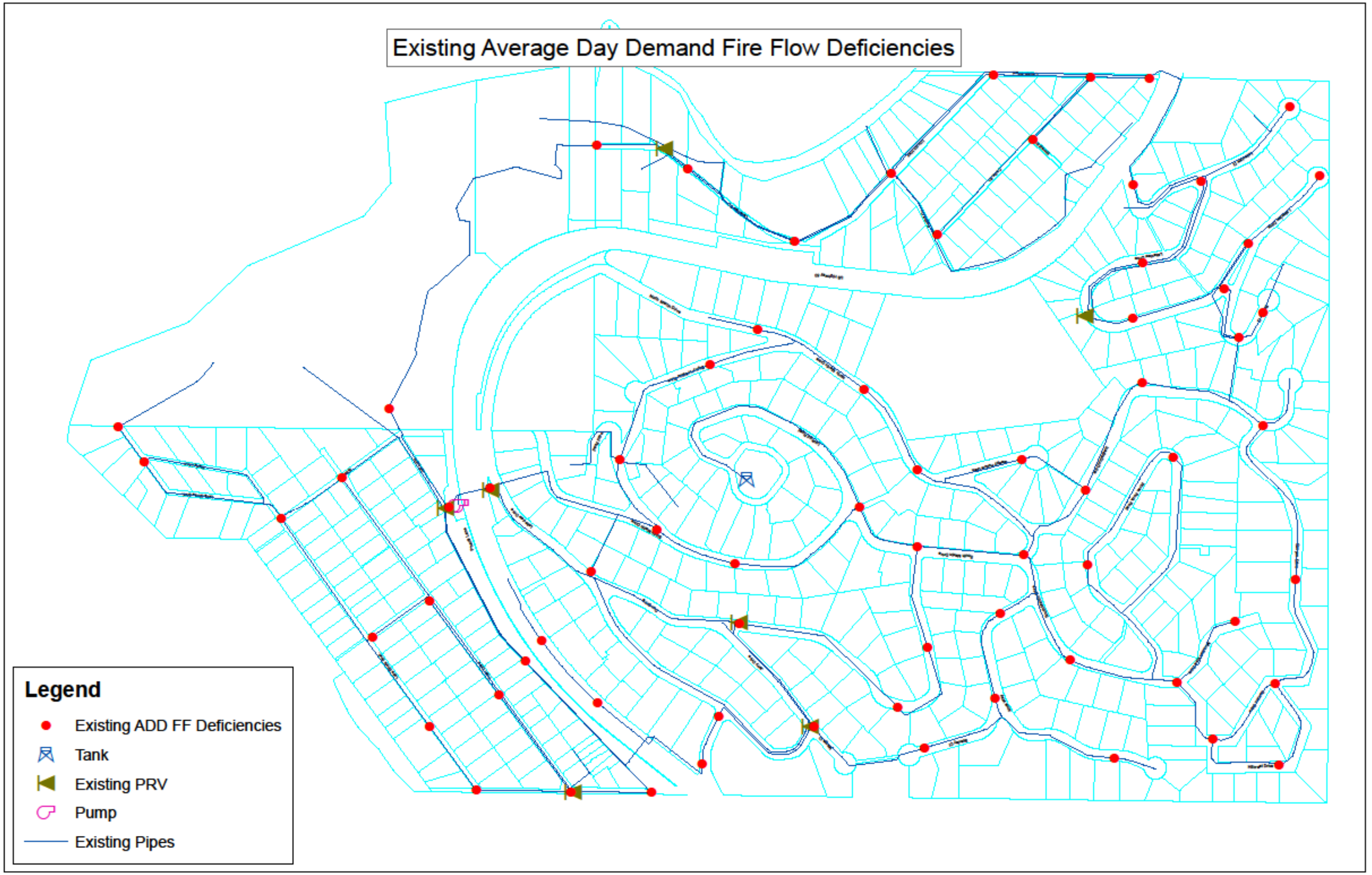


Figure 3-9 ADD Fire Flow Deficiencies

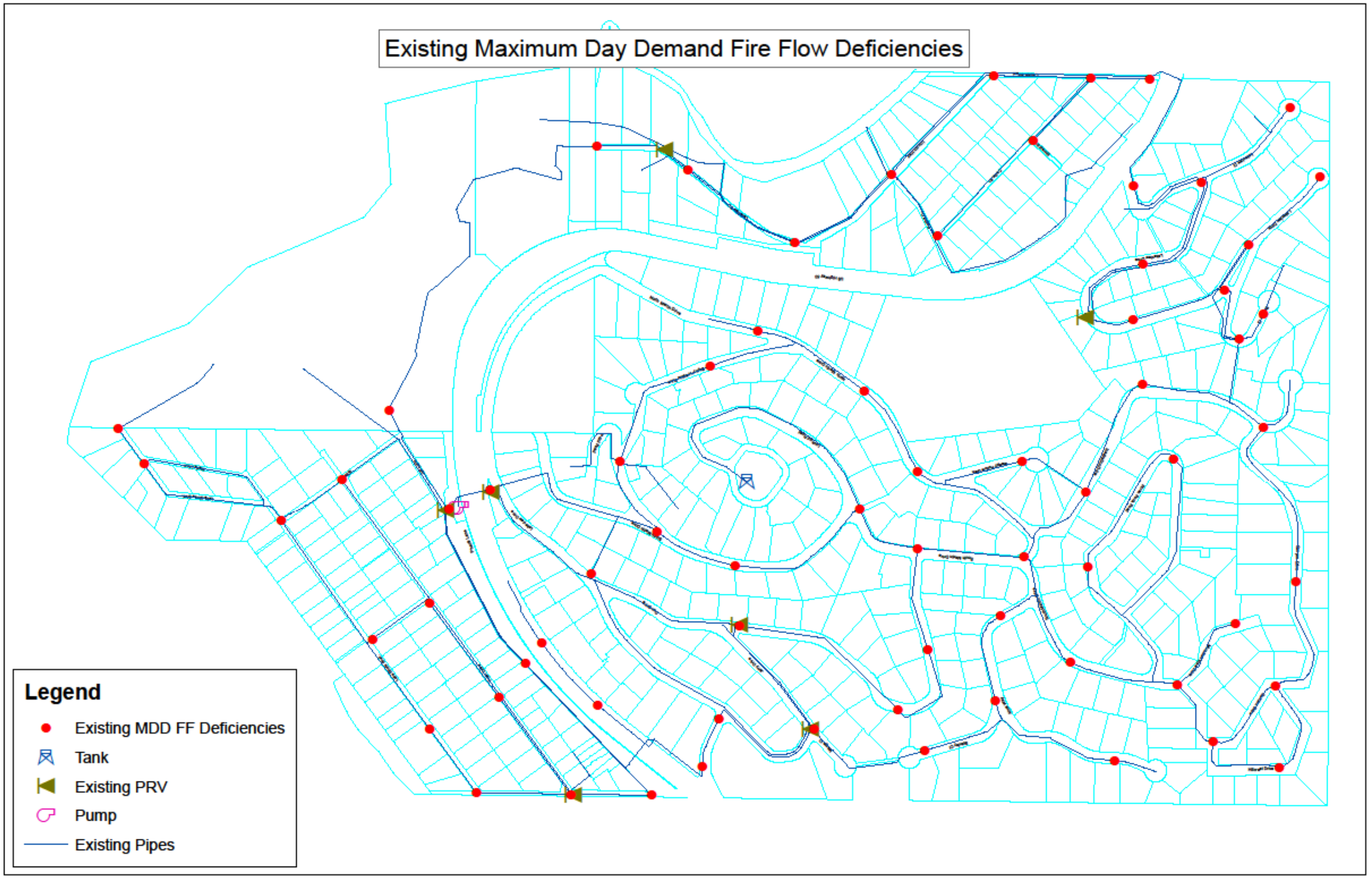


Figure 3-10 MDD Fire Flow Deficiencies

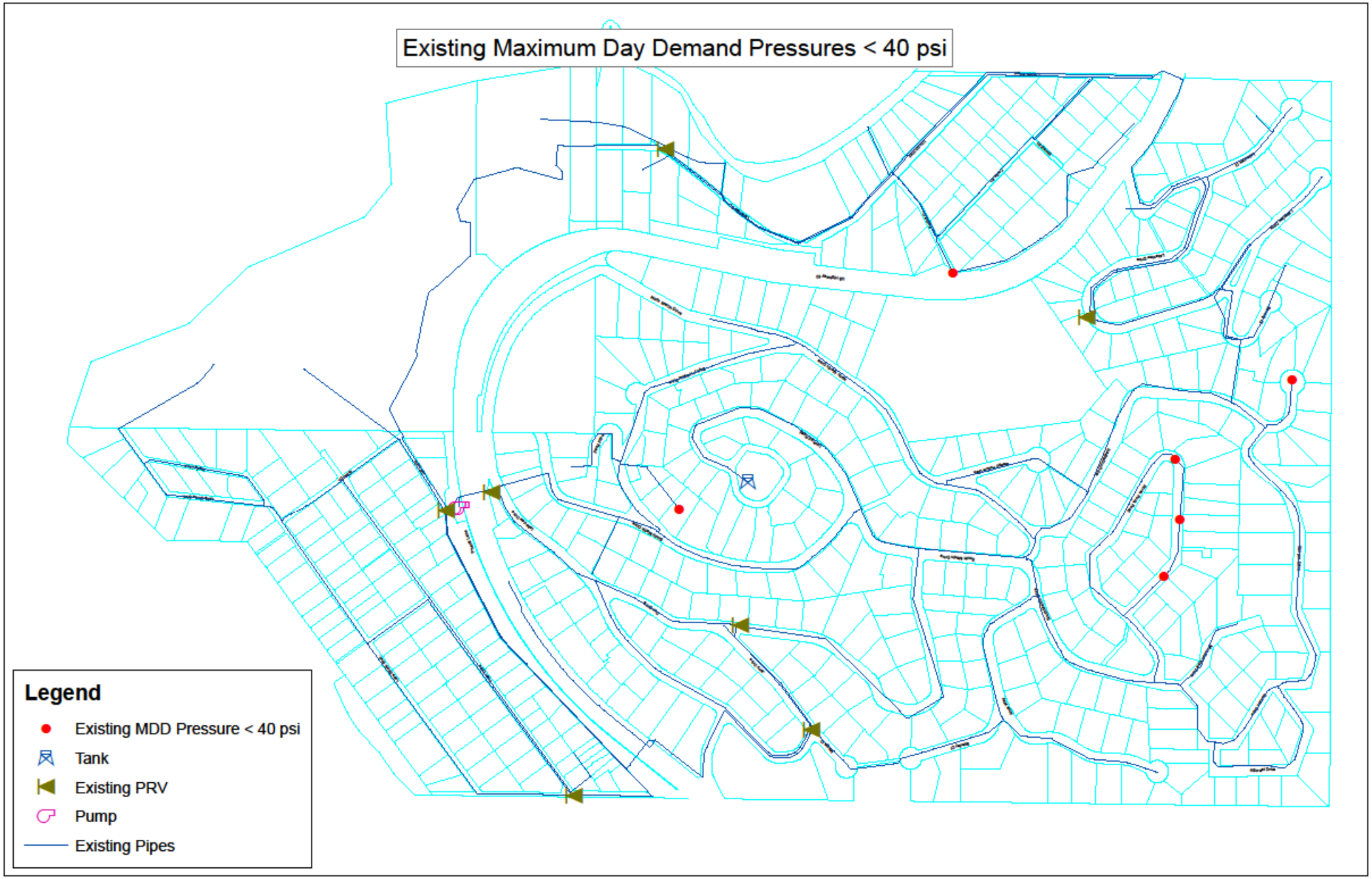


Figure 3-11 MDD Pressure Deficiencies

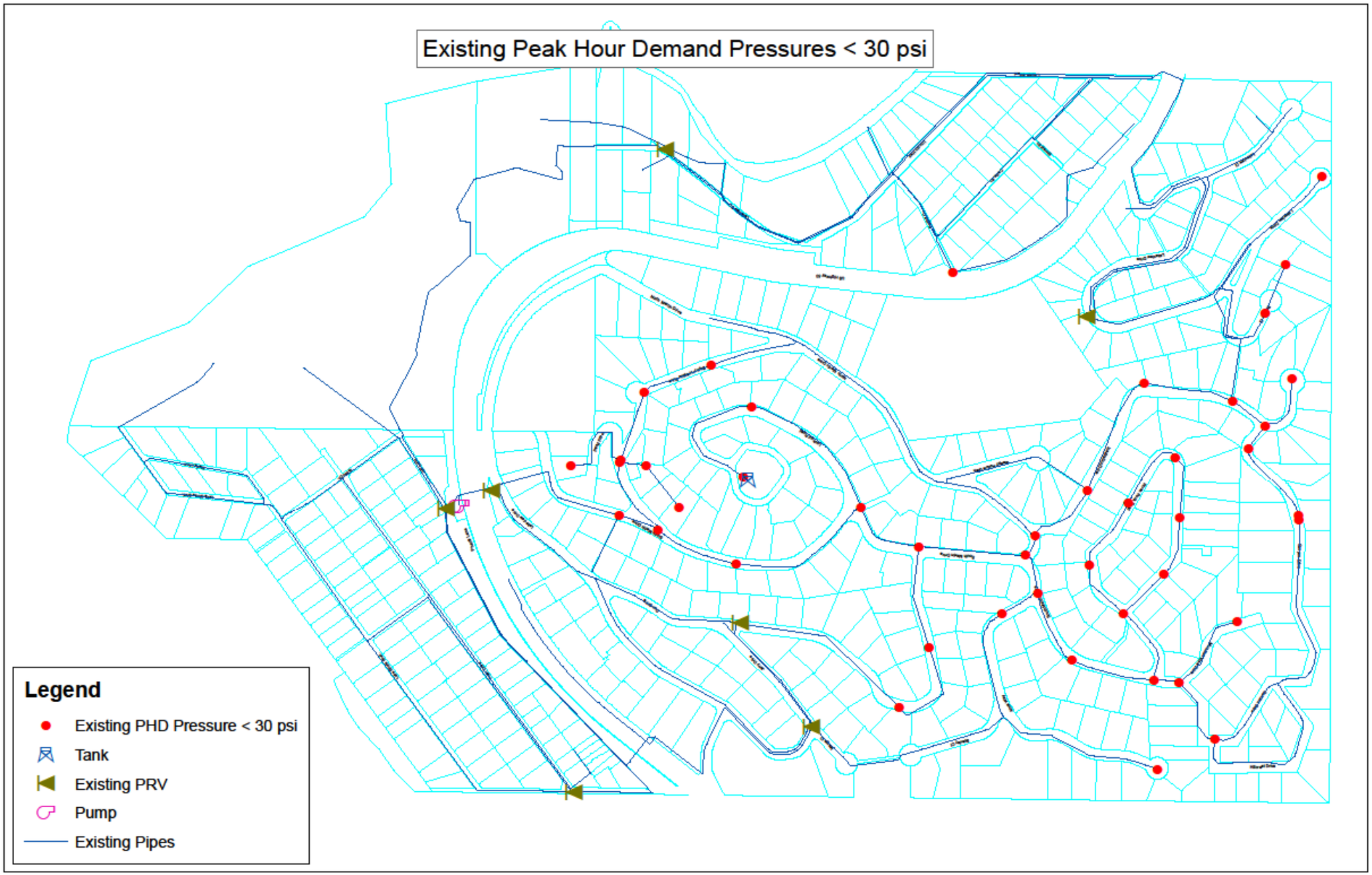


Figure 3-12 PHD Pressure Deficiencies

3.8 Storage Tank

ZWUD has a single 628,174 gallon water storage tank to meet the system demands including required fire flows, and domestic demands. The tank was constructed in 1994 of welded steel, and is located at the end of Lookout Road at elevation 6,628.

Table 3-10. Lookout Tank Summary

Item	Value	Units
Diameter	60	Feet
Height (to overflow)	30	Feet
Volume (to overflow)	634,476	Gallons
Base Elevation	6,626	Feet
Overflow Elevation	6,656	Feet

3.8.1 Condition

Douglas County had this tank inspected on September 9, 2013. The complete inspection report is included in the Appendix. Overall, the coating is fair to good condition. The sections taken from the tank inspection report summarize the coating conditions by area:

Section 1: Interior Shell (Page, 14-16)

- Coating on shell is in Fair condition
- 500+ Unbroken blisters in all 4 quadrants
- Blisters are mainly in Ring #2 but extend to Ring #1

Section 2: Floor (Page, 13, 23-29)

- 1/8''-2'' (At the Shell) of sediment and debris removed prior to inspection
- Coating on floor panels is in good condition with no blisters
- 10+ Rust spots in all 4 quadrants
- Rust staining on inlet/outlet from debris

Section 3: Ceiling (Page, 11-17)

- Coating is in good condition with no blisters observed
- Surface Rust and Rust Staining mostly at seams around beams
- 6'' x 12'' area of peeling was observed above the overflow

Section 4: Support Pole (Page, 21-22)

- Coating is in good condition no blisters observed

- One support pole at the center of the tank.
- Surface Staining and Rust Staining near top hat and fins
- No Flaws observed on pole or base
- Rust seeping out through crevices between base and floor

Section 5: Water Level Indicator (Page, 25-26, 29)

- 2 Water Level Indicators both are in good condition
- Transducer on floor and a high water float
- Both are under the access hatch

Section 6: Roof Vent (Page, 7-9)

- 12'' Center Roof vent is in Good Condition and screens are intact
- 2 x 6'' inch perimeter roof vents, Good Condition
- No flaws observed

Section 7: Exterior Ladder-Climbing Device Present - Device: Cable

- Coating on Safety Cage and Climbing Device are in Good Condition, (Page 1)
- No Flaws observed

Section 8: Access Hatch (Page, 10)

- 30' 'x 30'' coated steel access hatch is in good condition
- No flaws observed

Section 9: Interior Ladder- Interior Safety- Climbing Device Present- Device: Galvanized Pipe-Good Condition, Page, (10-11)

- Coating is in good condition
- No Safety Cage
- Climbing Device present
- 20 + rust spots where rungs meet the runners

Section 10: Inlet/Outlet (Page, 13)

- Coating in Good Condition
- 8'' Inlet/outlet
- Unobstructed
- 4 Rust spots on edge of mudguard
- Sediment and rust staining on the interior

- No other flaws observed

Section 11: Overflow (Page, 3 & 17)

- 6’’exterior overflow pipe is in good condition
- 6’’ Interior overflow Box is in good condition
- Diver could not view interior of overflow
- No Flaws observed

Section 12: Drain (Page, 13)

- Good Condition and unobstructed
- 4-5 Rust Spots on opening edge of drain
- Rust Nodules and Staining on Interior

Section 13: Man Ways (Page, 5,12,22,25)

- 2ft. x 24’’ man ways, coating is in good condition
- 5-8 rust spots on penetration edge repaired

Based on the condition of the tank coating and 24 years of age, the County should plan on recoating the tank within the next 5 to 10 years.

3.8.2 Regulatory Compliance

Tank Volume

Storage volume is covered under the following sections of the NAC 445A:

- 6674 – Storage Capacity
- 66745 – Operating Storage
- 6675 – Emergency Reserve

Douglas County shares the NAC 445A requirements for total storage volume, which is comprised of:

- Total Storage = Operating Storage + Emergency Reserve + Fire Demand.

Where:

- Operating Storage = Max day demand based on historical data, minus the system capacity to treat and pump water. For ZWUD max day demand occurs in July and is approximately 356 gpm (1993 to 2014 data).
- Emergency Reserve = Based on Engineer’s judgment, 50% of max day demand
- Fire Storage = 2,250 gpm for 2 hours

In this case operating storage (356 gpm) is offset by treatment plant capacity (400 gpm), and thus falls out of the equation.

Based on the following table, storage volume requirements are met for ZWUD.

Table 3-11. Storage Volume Requirements

Component	Gallons	Comments
Operating Storage	(64,067)	Offset by WTP capacity
Emergency Reserve	255,967	50% of MDD
Fire Storage	270,000	Section 3.6.1
Total	**461,900**	
Existing Storage	630,000	
Surplus/ (Deficit)	**168,100**	Requirement Met

Photo 3-8. Shell at Chine

Photo 3-9. Shell Exterior

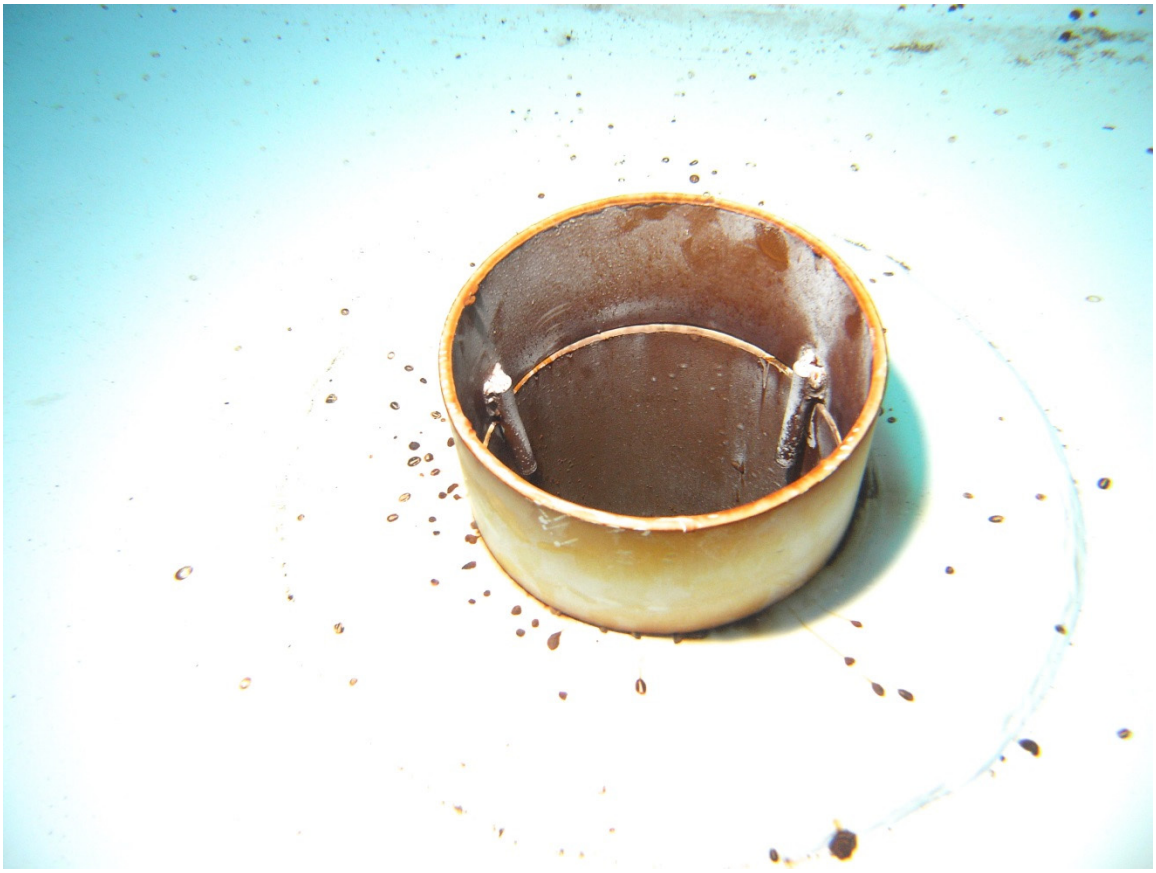


Photo 3-10. Inlet/Outlet

Photo 3-11. Ceiling with Peeling Above Overflow

The existing tank is 516,826 gallons below the required volume by Douglas County and NAC 445A standards.

NAC 445A.66755 provides an exemption for existing systems for the storage volume requirements if the system has sufficient pumping capacity to meet max day and fire flow demands.

> *An existing public water system is not required to comply with the requirements of NAC 445A.6674, 445A.66745 and 445A.6675 if the system has a sufficient alternative pumping capacity to meet requirements for maximum day demand, peak hour demand and fire flow.*

The firm pumping capacity at the ZWUD WTP is approximately 400 gpm, based on the Marla Bay pump station and water treatment plant as the limiting factors. Therefore, ZWUD does not meet the NAC storage exemption criteria.

A second storage tank of approximately 520,000 gallons, or a booster and fire pump sized for fire flow and MDD would satisfy the regulatory criteria.

3.9 Sanitary Surveys

Nevada Division of Environmental Protection (NDEP) last conducted a sanitary survey of the water system on August 28, 2014. A subsequent letter from NDEP dated September 11, 2014 identified 4 items for corrective action, and 1 item as an observation/recommendation. Douglas County responded with a letter dated December 30, 2014. The following table summarizes the deficiencies noted by NDEP and the status of the proposed corrective actions.

Table 3-12. Summary of Sanitary Survey Related Deficiencies

No.	Area	Relevant Codes	Description	Response
1	System Management and Operation	NAC 445A.591-5926	System requires additional manpower to meet maintenance requirements due to recent staffing losses.	County is seeking additional staffing. In the interim, a WWTP operator has been reassigned to potable water.
2	Treatment		Concern over UV reactor sleeve break, and possible release of mercury to the system.	Lamp did not break, so no mercury release. Mercury response plan is included in updated Operations Manual.
3	Intake		Leaking check valve is allowing air into the intake line, causing issues with UV process.	County intends to replace the leaking check valve in 2015.
4	Treatment		Leaking RPP backflow off finished water pumps	Problem has been linked to a leaking relief valve, which has been replaced.

No.	Area	Relevant Codes	Description	Response
5	Treatment		WTP roof deterioration	County repaired the roof in October 2015.

3.10 Financial Status of Existing Facilities

3.10.1 Audit Information

A Comprehensive Annual Financial Report (CAFR) is completed annually for the County which outlines the financial activities over the past fiscal year. The details of the ZWUD financial review are included as part of the CAFR as a major enterprise fund. The CAFR provides a summary of the ZWUD financial position. The full CAFR is available on the County's website. For the review, the FY 13/14 CAFR was chosen which was the most recent year available. Shown below in Table 3-13 is a summary of the FY 13/14 CAFR review for the ZWUD system.

Table 3-13. FY 13/14 CAFR Summary (July1, 2013 – June 30, 2014)

	Budget	Actual	Variance
Operating Revenues	$513,000	$530,883	$17,883
Operating Expenses	$590,220	$558,777	$31,443
Operating Bal/(Def)	-$77,220	-$27,894	$49,326
Plus: Non-Op Rev/(Exp)	-$77,823	-$42,460	$35,363
Plus: Contributed Capital	$0	$10,643	$10,643
Plus: Transfers In	$77,760	$79,254	$1,494
Change in Net Position	-$77,283	$19,543	$96,826

3.10.2 Income

The primary source of income for the ZWUD system is through user rates. The budgeted water user fees are based on the current rate schedules for the ZWUD system and the number of metered and unmetered customers. In addition to user rates additional sources of income include loan proceeds and transfers in along with interest on current investments. Shown below in

Table 3-14 is a summary of ZWUD's current (FY 14/15) budgeted O&M expenses.

Table 3-14. Summary of Annual Income (FY 14/15 Budget)

Account #	Account Description	Adopted Budget
344.850	Water User Fees	$509,264.00
	Charges for Service Totals	**$509,264.00**
360.750	Loan Proceeds	$73,868.00
392.000	Transfers In	77,760.00
	Other Financing Sources Totals	**$151,628.00**
361.200	Interest on Investment	$500.00
	Investment Income Totals	**$500.00**

3.10.3 Rate Schedule

HDR reviewed the current water rate schedule for Zephyr Water Utility District. For the unmetered residential and commercial customers the monthly rate is a flat charge. There are 461 residential unmetered customers and 11 unmetered commercial customers. For metered commercial customers, there is a monthly fixed meter charge and a consumption charge on a per 1,000 gallon basis. There are 46 metered customers with a total 258,000 gallons of annual consumption. Finally, there is an irrigation class of customers that is charge similarly to commercial metered with a fixed monthly charge and a volumetric consumption charge per 1,000 gallons. For irrigation, there is 1 customer with annual consumption of 5.3 million gallons. A summary of the current water rates for ZWUD are shown below in Table 3-15.

Table 3-15. Summary of Current Monthly Water Rates

Meter Size	Residential - Flat	Commercial - Flat	Commercial - Metered	Irrigation - Metered
5/8”	$99.91	$117.49	$117.49	$97.76
3/4”	99.91	117.49	117.49	97.76
1”	249.77	293.71	293.71	180.47
1 ½”	499.54	587.42	587.42	300.79
2”	799.26	939.87	939.87	563.98
3”	N/A	1,879.74	1,879.74	962.53
4”	N/A	2,937.10	2,937.10	1,503.94
Volumetric Charge				
$/1,000 Gallon	N/A	N/A	$2.67	$2.80

Meter Size	Residential - Flat	Commercial - Flat	Commercial - Metered	Irrigation - Metered
# of Customers	464	10	41	1
Consumption (1,000 gallons)	0	0	258	5,265

3.10.4 Metering Customers

A key component of rate setting is the ability to provide the customer with a price signal that reflects the impacts (costs) placed on the system by their consumption. This is typically accomplished through the use of metered rates. However, not all utilities have meters on all customers, and as a result charge a flat rate that reflects the average customer use based on metered customers. Given the recent drought in the western United States, which has highlighted water resource management, a renewed interest in metering customers has been emphasized. Although the transition to metered water service and rates can be strenuous and demanding, it can be a process that ends with the utility and the customer understanding the cost impacts placed on the system during peak use periods and the infrastructure necessary to provide service. Given the increased visibility of metered rates, the County has been considering a transition to metered rates and has started to evaluate the alternatives.

Capital Cost and Rate Adjustments

The first item to consider would be the initial capital investment as it is the first step in implementation and there is a substantial financial burden at onset. Many utilities will be challenged by the cost of the metering program but this can be mitigated by strategic planning. It is most likely to be a phasing in approach where meters are replaced over a period of years, not necessarily all at once.

Also, there would need to be rate adjustments to provide the additional funding to finance the meter purchases and installation. Reserve funds can also play a pivotal role in storing up funds and then dispersing them as the program requires them. The reserves are then typically restored over time to maintain prudent minimum reserve levels.

Conservation

Currently, the amount of water used is not apparent to customers as there is no volumetric component. This can lead to a greater use of water, and some may argue, wasteful use. However, the “waste” may be inadvertent because customers do not have an avenue to monitor their own use.

Reduction in Use

Another key aspect to include in the analysis is the anticipated reduction in per capita water usage as customer’s transition to metered rates and reduces consumption.

This can impact rate revenue but it can also provide for additional available capacity for the District's system which may defer future capital needs for water supply and push them out a number of years which results in cost savings for the utility in the short term. It can also save money in the area of source of supply. The reduced use can result in the delay of source of supply projects or the avoidance of purchasing water from other purveyors, depending on the water supply portfolio of the District.

System Leaks

Another aspect of metering customers is the ability to find leaks in the system. As meters are placed in service the County will be able to compare total production to total metered sales and begin to gain an understanding of the unaccounted for water on the system and develop a plan to minimize the water loss. These losses may occur on the distribution system or on the customer owned facilities.

Funding

Finally, the metering of water customers is becoming a "mandatory" requirement as many grant and low interest loan applications are requesting the utility to note if customers are billed on a metered rate. By metering customers the ability to obtain future low interest loans or grants may be enhanced. It should be noted that there are additional funding sources that may be utilized in order to minimize rate impacts from the cost of metering customers. The lowest cost funding available are grant and low interest loan programs. However, these programs are becoming more difficult to obtain given availability of funds, the 'competition' for them with other utilities, as well as the County's eligibility to meet the requirements. Each program has different eligibility requirements and projects that can be funded from the program. It should also be noted that the full project cost will most likely not be funded through grants or low interest loans and other sources of funding will be necessary. These can be other low interest loan programs, existing reserves, rate funded, or additional long-term debt. Other utilities in the Tahoe Basin have recently been successful in receiving grant and low interest loan funding to assist in funding the installation of meters over the next several years.

3.10.5 Annual O&M Costs

The goal of all utilities is to operate the system in a way that provides service to it's customers into perpetuity. A large component of annual costs to provide service is included in the annual operations and maintenance (O&M) expense. A utility must prudently fund the O&M annually, at a level that is adequate to fund the operation and repair of the water system. O&M costs will typically increase with time due to inflationary measures and may also increase due to additions like additional FTE's, programs, or other requirements. Shown below is a summary of ZWUD's budgeted expenses for FY 14/15.

Table 3-16. Summary of Annual O&M Costs Budgeted Less Energy

	Salaries & Wages	Employee Benefits	Services & Supplies	Total O&M Expenses
O&M Expenses	$119	$48	$186	**$352**

The O&M expenses for the ZWUD system are split into three main categories of Salaries and Wages, Employee Benefits, and Service and Supplies. The above expenses are based on the current budget and are projected annually through the budgeting process. As system infrastructure is added, the O&M expenses are adjusted to reflect the costs associated with operating and maintaining the necessary infrastructure to provide service to customers.

3.10.6 Energy Costs

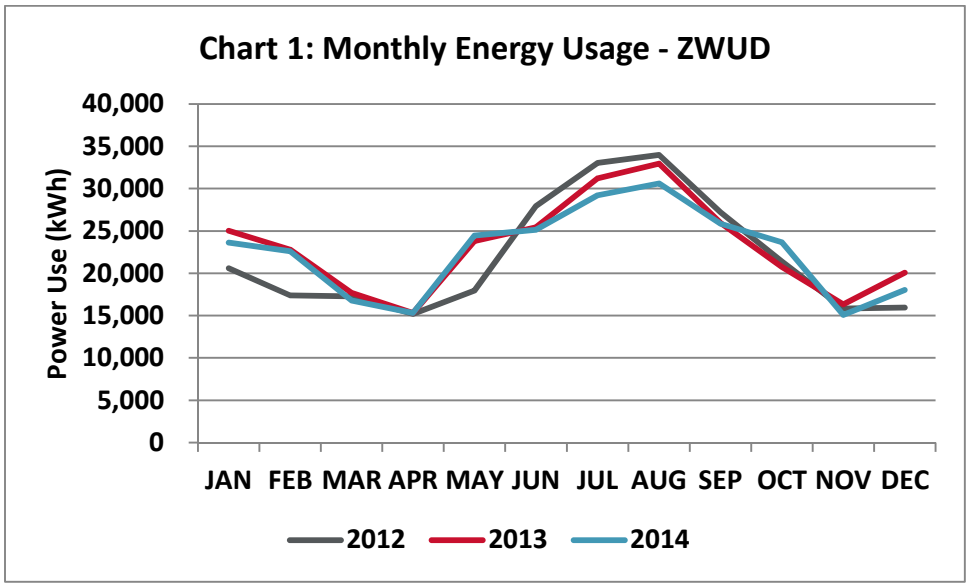
When reviewing the ZWUD's energy costs, it was noted that they had a slight increase in kWh in CY 2013 from CY 2012 but that the 11 months of 2014 are trending down from CY 2013 levels. Shown below in Table 3-17 is a summary of those costs.

Table 3-17. Annual Energy Costs[1]

Year	Annual Usage (kWh)	Annual Energy Costs
CY 2012	263,760	$31,887
CY 2013	277,430	33,092
CY 2014[2]	270,368	31,926

[1] *Data from the NVEnergy billing Jan 2012 – Nov 2014*
[2] *2014 uses the 11 months as provided by the County and the average for December from the previous 2 years*

In additional to the summary shown above, the monthly power usage is illustrated below to further aide in analyzing power costs. Shown in Chart 1 below is a summary of the monthly power use for CY 2012 – 2014.



3.10.7 Capital Improvements Program

The County's ZWUD water system's CIP is summarized in Table 3-18 below.

Table 3-18. Capital Improvement Budget ($000s)

	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20
ZWUD System Improvements	$0	$0	$0	$200	$1,400	$0
Total Capital Projects	**$0**	**$0**	**$0**	**$200**	**$1,400**	**$0**

3.10.8 Debt Repayments

Currently, ZWUD has three debt obligations: 2005 revenue bond, 2011 SRF loan, and 2012 SRF loan. The 2005 revenue bond is retired in FY 2016 which results in a reduction of debt service of roughly $120,000 annually. Table 3-19 below, shows a summary of the current debt service over a five year period.

Table 3-19. Debt Obligations ($000s)

	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20
2005A Water Refunding Bond	$122	$124	$0	$0	$0	$0
2011 SRF Loan	$73	$73	$73	$73	$73	$73
2012 SRF Loan	$26	$50	$73	$73	$73	$73
Total Debt Service	$221	$247	$146	$146	$242	$242

In Table 2-19 above, it can be seen that the 2005A Water Refunding Bond is retired in FY 2016. This would allow the County the ability to fund future capital

improvements through means that the County can add addition new long-term borrowing up to the level that of the annual debt service payment of the 2005A bond, or does not exceed approximately $124,000, with and there would be no impact to current rate levels. However, if additional long-term borrowing is necessary to fund the project(s) in the future and the annual debt service exceeds that amount, the balance would most likely need to be funded through increases in user rates. The County should proactively manage the retirement of the existing long-term debt with regards to timing large capital projects to maximize available funding sources and leverage capital funding prudently.

3.10.9 Reserve Funds

An important component of a utility financial health is maintaining prudent reserve ending balances. There are many different types of reserve funds and numerous objectives that can be accomplished with them. Currently, ZWUD's water system has three reserves: operating, capital, and emergency. The county also has a set of existing financial policies to guide the maintenance of the reserve funds.

For the operating fund, the County currently has a minimum level at 60 days of O&M expenses with a goal of 90 days. This figure is targeted in order to provide funding for the utilities operations, should there be a shortfall due to perhaps a wetter summer than normal and decreased rate revenues for example. Currently, the utility exceeds the target minimum reserve ending balance.

Next is the County's capital reserve, which holds loan and bond proceeds as well as other capital-related revenues such as connection fee revenue. Currently, County's policy for the capital reserve ending balance is 2.0% of the total (original) cost of utility fixed assets. Again this is to provide funding should an anomaly occur for the utility but with regards to capital infrastructure. For instance, if a major water main bursts and a sudden need for a large amount of cash for repairs is required. This allows the utility greater resiliency during those times and to limit the loss of service for the customers as a result of cash flow issues.

The final reserve is the emergency reserve. This reserve, as the name implies is to cover unexpected emergencies and is similar in nature to the objective of the capital fund but is more intended for small scale equipment failures rather than system-wide. The minimum emergency reserve balance is $50,000 with a goal of $75,000. The County is currently meeting the minimum balance.

Shown below is the beginning reserve fund balances from the current FY 14/15 budget (beginning reserve balance July 1 2014):

- Operating Reserve - $159,000
- Capital Reserve - $325,000
- Emergency Reserve - $50,000

4 Need for Project

The evaluation of the existing system in Section 3 identified various needs or deficiencies for the water system. These needs are categorized under the following general categories. Note that some needs could be classified under more than one category.

Health, Sanitation, Code Compliance, and Security

The needs in this section include compliance with relevant regulations and codes, health and sanitation, and security issues that may have been brought to light by state regulatory agencies, such as sanitary surveys.

Aging Infrastructure

While different portions of the water system were constructed at different times, the age of the existing distribution infrastructure is estimated to range from approximately 20 to 60 years. The sections with an age of 60 years have reached or exceeded their lifespan.

Within the ZWUD, the County began replacing the water distribution piping in the 1990s; however not all lines or improvements have been completed. Water line replacement and fire flow improvements have not occurred in: Zephyr Heights #1, Zone 1; Zephyr Cove Properties, Zone 3, or Zephyr Heights #1, Zone 4. There are also areas where one lateral serves multiple properties.

Other items related to aging infrastructure include: treatment, storage, and pumping system needs.

Reasonable Growth

This item includes reasonable growth capacity that is necessary to meet needs during the planning period. The population in Douglas County in Lake Tahoe actually decreased from 2000 to 2010, as documented in the County's 2011 Master Plan. In the Zephyr Cove/ Roundhill area, the population decreased by 19.7%, due to increases in the number of second/vacation home ownership. This trend is expected to continue in the future.

With little to no growth in the area, and slow growth projected in the future, the need for the improvements is primarily a result of aging infrastructure and health, sanitation, and code compliance as discussed above. Increases in distribution pipe size and storage facilities are to meet fire flow and storage volume code requirements, not in relation to population growth projections.

4.2 Distribution and Storage

4.2.1 Summary

Based on the results of the condition assessment, operational issues, and water model results described in Section 3, the distribution and storage systems have the following deficiencies which need to be addressed.

Table 4-1. Summary of Distribution and Storage Related Deficiencies

No.	Deficiency	Relevant Codes	Requirement/ Goal	Existing Condition[1]
1	Fire Flow	Fire Authority/ NFC County 4.1.3	1,500 to 2,250 gpm	<2,250 gpm
2	Min Distribution Pressure – FF + Max Day Demand (MDD)	NAC 445A.6672 County 4.1.1	20 psi	< 20 psi
3	Min Distribution Pressure – Peak Hour Demand	NAC 445A.6672 County 4.1.1	30 psi	< 30 psi
4	Min Distribution Pressure –MDD	NAC 445A.6672 County 4.1.1	40 psi	< 40 psi
5	Max Velocity (All conditions except fire flow)	NAC 445A.6672/ County 4.1.4	8 fps	> 8 fps
6	Max Velocity (Fire flow + ADD)	County 4.1.4	10 fps	> 10 fps
7	Min Main Line Size (All)	County 4.5	8 in	2 in
8	Line Leaks	NAC 445A.6727	Minimize repair costs	47 leaks since 2009
9	Storage Tank Coating	NAC 445A.67085 County 4.8.5	Continuous intact coating	Areas of coating failure
10	Supply Redundancy	NAC 445A.6678	Backup Water Source	Single Water Source
11	Water Conservation	NRS 540.131/ County 4.5.6	100% Metered	8% Metered

Notes:

1 – Refer to modeling results in Section 3.

4.2.2 Fire Flow and Pressure Deficiencies

Fire flow and minimum pressure requirements are the largest drivers for improvements to the distribution and storage system. These requirements result in

increases to the pipe sizes, and increases to the storage and/or pumping requirements. Fire protection is an especially important function of the water system, especially given the drought conditions, and changing climate. Historically, water systems in the Lake Tahoe area have been undersized for fire protection, in large part due to the development of smaller individual water systems to serve general improvement districts, rather than a regional approach to water service.

Increases in fire flow capacity are needed to meet the National Fire Code requirements, which are based on building size and construction. The trend over the last 15 years has been to tear down smaller original structures, and build large homes in Lake Tahoe. This translates directly into increased fire flow and storage requirements the system must provide.

4.2.3 Piping Leaks

Piping leaks need to be addressed to minimize the costs of repairing the original failing distribution system. These should be addressed during line replacements for fire flow requirements wherever possible.

4.2.4 Water Meters

The 1991 Nevada State Legislature passed a law requiring public water systems to adopt a Plan of Water Conservation (NRS 540.131). The Board for Financing Water Projects deems that: “Metering of all water services is an essential element of a water conservation program.” As such, water meters are required for AB198 grant funding, and the Board would likely question the lack of water meters for DWSRF loans. The DWSRF program remains solvent and is planned to disperse approximately $24.2 million in project funding for fiscal year 2015. Grants, as outlined by AB 198 (assembly bill), are available under NRS 349.980 – 349.987 for installation of water meters as part of a water conservation program. The funding source for the grant program is based on property tax revenue and has dwindled in recent years as a result of decreased real estate values and therefore, property tax revenue. The Nevada Division of Environmental Protection reviews the available funding for this program annually and determines if funds will be available.

During this time of sustained drought, water production is impacted as pump heads decrease in response to a lower lake level. Water meters have been proven to reduce water usage in public water systems. Installation of meters ensures that available resources are conserved, which lowers overall operation and maintenance costs.

4.3 Marla Bay Pump Station

4.3.1 Summary

Table 4-2. Summary of Marla Bay Pump Station Related Deficiencies

No.	Deficiency	Category	Requirement/ Goal	Existing Condition
12a	Lake Intake Loss of Prime	Aging Infrastructure	Maintain suction prime without leaking water into the lake.	Requires a prime tap off the raw water main.
12b	Reduced Lake Pump Flow	Aging Infrastructure	Maintain original 1-pump design flow of 430 gpm	Approximately 400 gpm.
13	Pump Station Piping and Building Coatings.	Aging Infrastructure	Maintain original coating condition.	Deteriorating/ failing

4.3.2 Lake Pump Prime

The check valve has been replaced on the intake line. At this point, it is not clear if this will be a long term fix, as the valve may begin to leak again. If this is the case, changes to the pumps may be required to maintain prime and eliminate the air pocket issue at the WTP.

4.4 UV/Ozone Disinfection Plant

Table 4-3. Summary of Disinfection Treatment Plant Related Deficiencies

No.	Deficiency	Category	Requirement/ Goal	Existing Condition
14	WTP Electrical	Aging Infrastructure	Surge Protection	Recent failures.
15	WTP SCADA & Controls	Aging Infrastructure	Improve controls reliability, data Transfer and retrieval to Cave Rock	System shutdowns due to lighting. Periodic data transfer and recovery issues.
16	Unstable Hypochlorite Residual	Health, Sanitation, Code Compliance	Stabilize Residual	Residual varies based on ozone residual.

5 Project Alternatives

The alternatives considered have been broken into the following areas in order to better describe the various project sub-alternatives:

- Storage and Distribution
- Marla Bay Pump Station
- Water Treatment Plant

Figure 5-1 summarizes the project needs and alternatives, as grouped in the previously described areas. The alternatives for each area are described in detail in the following sections.

Only the relevant sub-sections are included in the alternative sections. For example, ‘Land Requirements’ is not included in the Lake Intake Prime Alternatives sections.

No.	Deficiency	Category	Applicable Code	Alt 1	Alt 2	Alt 3
Distribution and Storage						
1	Fire Flow (varies by parcel)	Health, Sanitation, Code Compliance	Fire Authority/ NFC County	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
2	20 psi Min Pressure - FF + MDD	Health, Sanitation, Code Compliance	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
3	30 psi Min Pressure - Peak Hour Demand	Health, Sanitation, Code Compliance	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
4	40 psi Min Pressure - Max Day Demand (MDD)	Health, Sanitation, Code Compliance	NAC 445A.6672 County 4.1.1	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
5	8 fps Max Velocity (all conditions except FF)	Health, Sanitation, Code Compliance	NAC 445A.6672 County 4.1.4	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
6	10 fps Max Velocity (FF + ADD)	Health, Sanitation, Code Compliance	County 4.1.4	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
7	8" Min Line Size (All)	Health, Sanitation, Code Compliance	County 4.5	New Tank, Inspiration Dr Booster, PRVs, & Upsize lines	New Tank, Increased WTP Pumps, PRVs, & Upsize lines	Fire & Booster Pumps and upsize lines
8	Line Leaks	Aging Infrastructure	NAC 445A.6727	Replace lines	Do Nothing	
9	Storage Tank Coating Condition	Aging Infrastructure	NAC 445A.67085 County 4.8.5	Recoat Tank	Do Nothing	
10	Supply Redundancy/ Single Water Source	Health, Sanitation, Code Compliance	NAC 445A.6678	Cave Rock Intertie and Booster Station	Do Nothing	
11	Water Conservation	Aging Infrastructure	County 4.5.6	Water Meters & Dedicated Services	Do Nothing	
Marla Bay Pump Station						
12	Lake Intake Loss of Prime & Reduced Pump Capacity	Aging Infrastructure		Replace leaking check valve & install self priming pumps	Submersible Pumps	
13	PS building and piping corrosion	Aging Infrastructure		Recoat piping and walls	Do Nothing	
Water Treatment Plant						
14	WTP Electrical	Aging Infrastructure		Surge Protection and UPS	Do Nothing	
15	WTP SCADA & Controls	Aging Infrastructure		Various	Do Nothing	
16	Difficulty maintaining hypochlorite residual	Health, Sanitation, Code Compliance	NAC 445A.6683	Dose pace feed pumps and move injection point to HS pump discharge	Dose pace feed pumps and add mechanical mixers to clearwell	

Figure 5-1. Deficiencies and Alternatives Matrix

5.1 Deficiencies 1-8 – Fire Flow, Pressure, Velocity, and Line Size Criteria, and Line Leaks

The following sections address deficiencies 1 through 8 of the Needs and Alternatives Summary Matrix. These alternatives include the new tank, which is needed for additional pressure to provide fire flow in Alternatives 1 and 2.

5.1.1 Alternative 1 – New Tank, Lookout Dr. Booster Station, Inspiration Dr. Booster Station, Up-Size Lines, and New Pressure Reducing Stations

Description

This alternative is based around a new storage tank to create a higher pressure zone, to alleviate the low pressure issues. There are a total of 8 pressure zones in this alternative, which includes a small zone near Lookout Tank pressurized by the Lookout Booster and Pneumatic Tank. The Inspiration Booster Station is required to lift water to the new tank. The dual distribution system is eliminated with fire and domestic demands being served off the same lines.

Tank

A new 500,000 gallon tank is located at an elevation of 6,680 feet on USFS parcel 1-318-10-007 to the east of the subdivision, as shown in Figure 5-2. The tank will be welded steel construction, with a concrete ring foundation, and NSF-61 certified epoxy coating.

The tank will be connected to the existing system with approximately 1,000 lineal feet of 10-inch pipe. The pipeline will connect to the system off Inspiration Court through USFS parcel APN 1-318-103-140-17, and likely require approximately 700 lineal feet of directional drilling through rock to get to the tank.

Table 5-1. Tank Summary

Item	Quantity	Units
Storage Tank – Welded Steel	500,000	Gallon
Diameter	54	Feet
Height	30	Feet
Base Elevation	6,680	Feet
Approximate Coordinates		
Latitude	39° 0'9.35"N	

Item	Quantity	Units
Longitude	119°56'36.74"W	

Tank Access Road

Access to the tank will be from a new road off Lakeview Circle. The road will be approximately 12-feet wide, with a 10-foot paved section. The estimated slope will range between 8% and 25% as shown in the figure. A retaining wall will be required on either side for approximately 900 lineal feet of the alignment. The retaining wall is assumed to be colored and stamped reinforced concrete for cost purposes.

Table 5-2. Tank Access Road Summary

Item	Quantity	Units
Tank Access Road		
Width	12	Ft
Length	1,930	Ft
Area	0.53	Acres
Tank Site		
Tank & 12-ft Ring Road	4,902	Sq. Ft
Total Area Required	0.54	Acres

Tank Figures

The following figures show the proposed tank location and access road alignments.

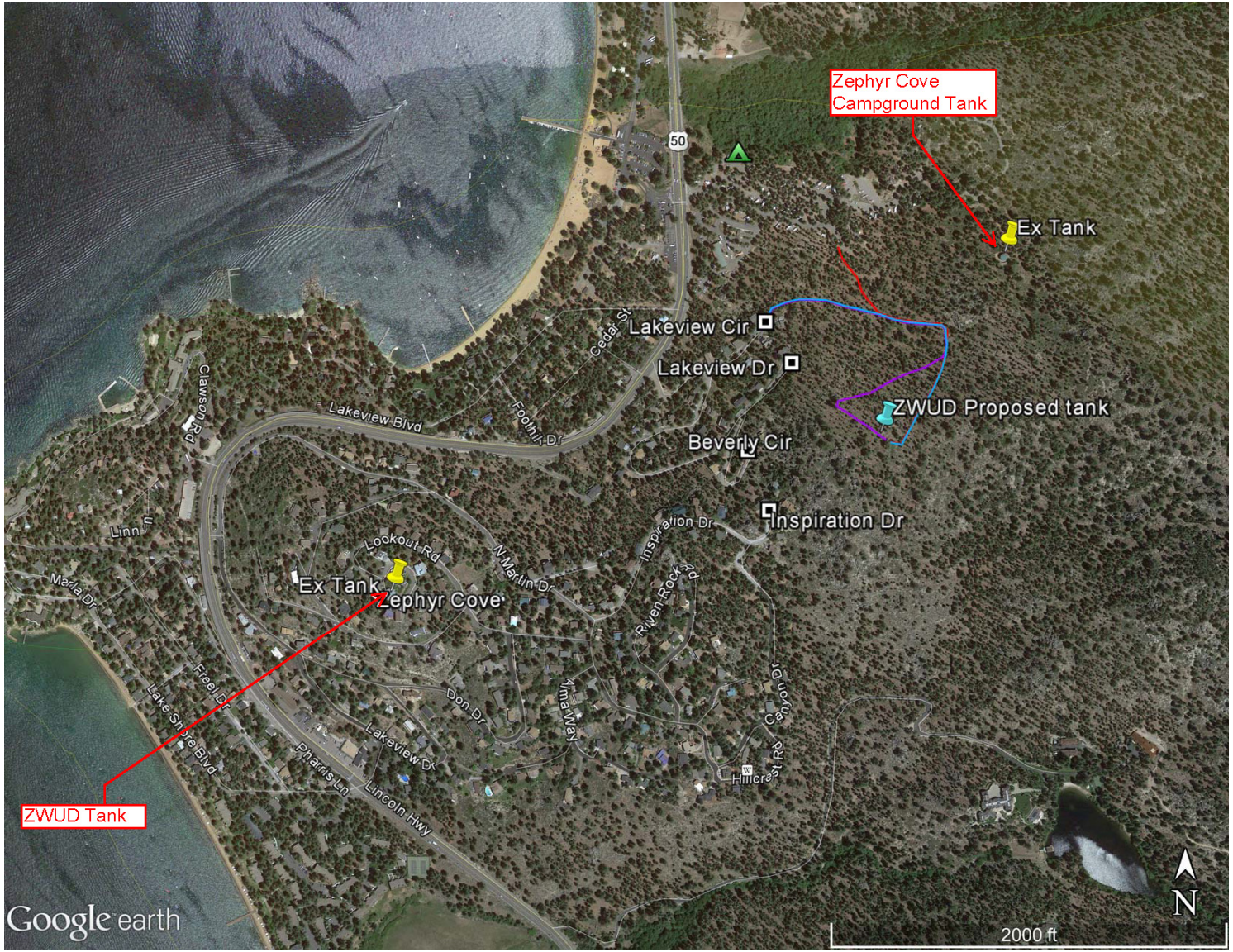


Figure 5-2. Overall Tank Plan

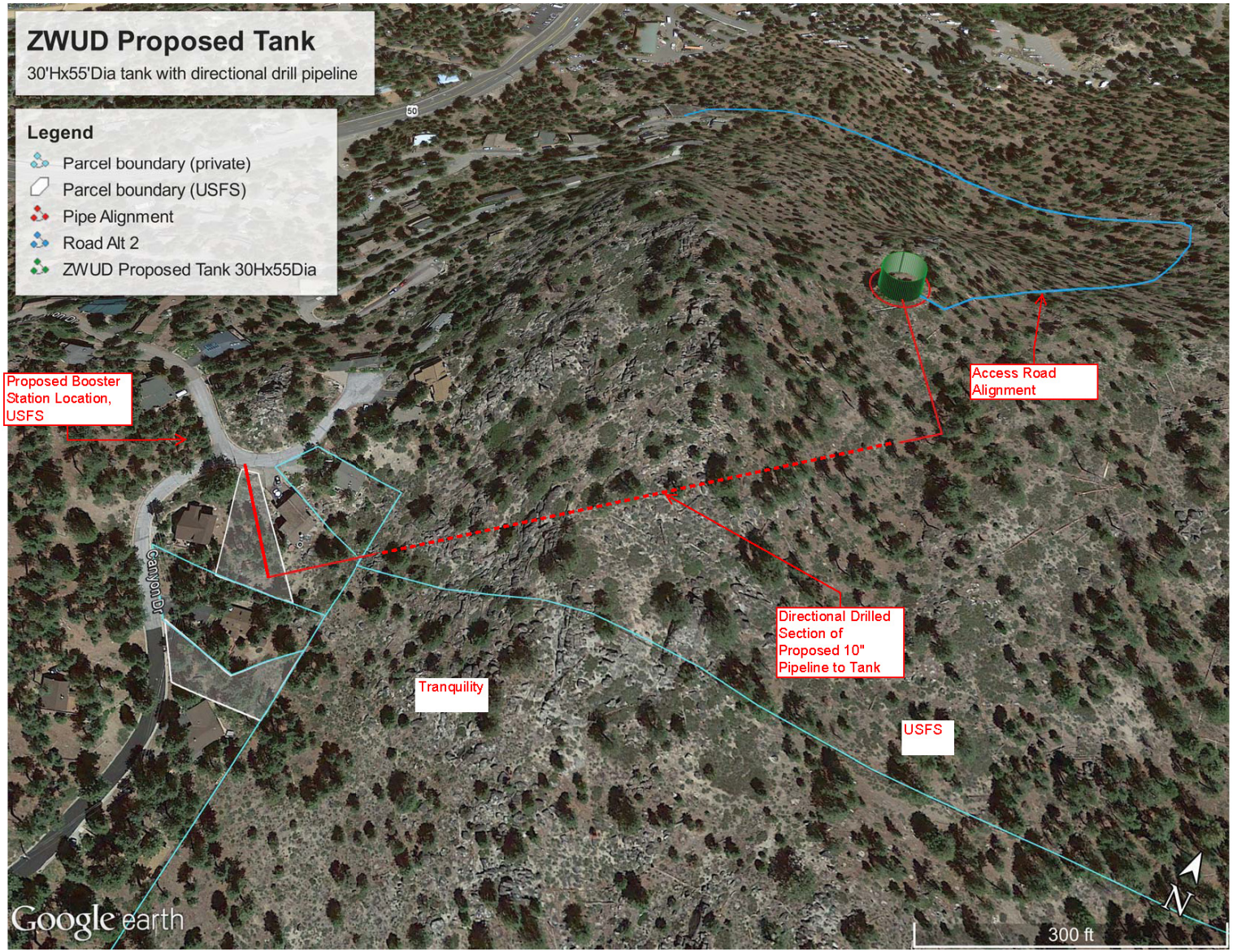


Figure 5-3. Tank Piping and Access Alignments

Figure 5-4. Road Alignment Plan

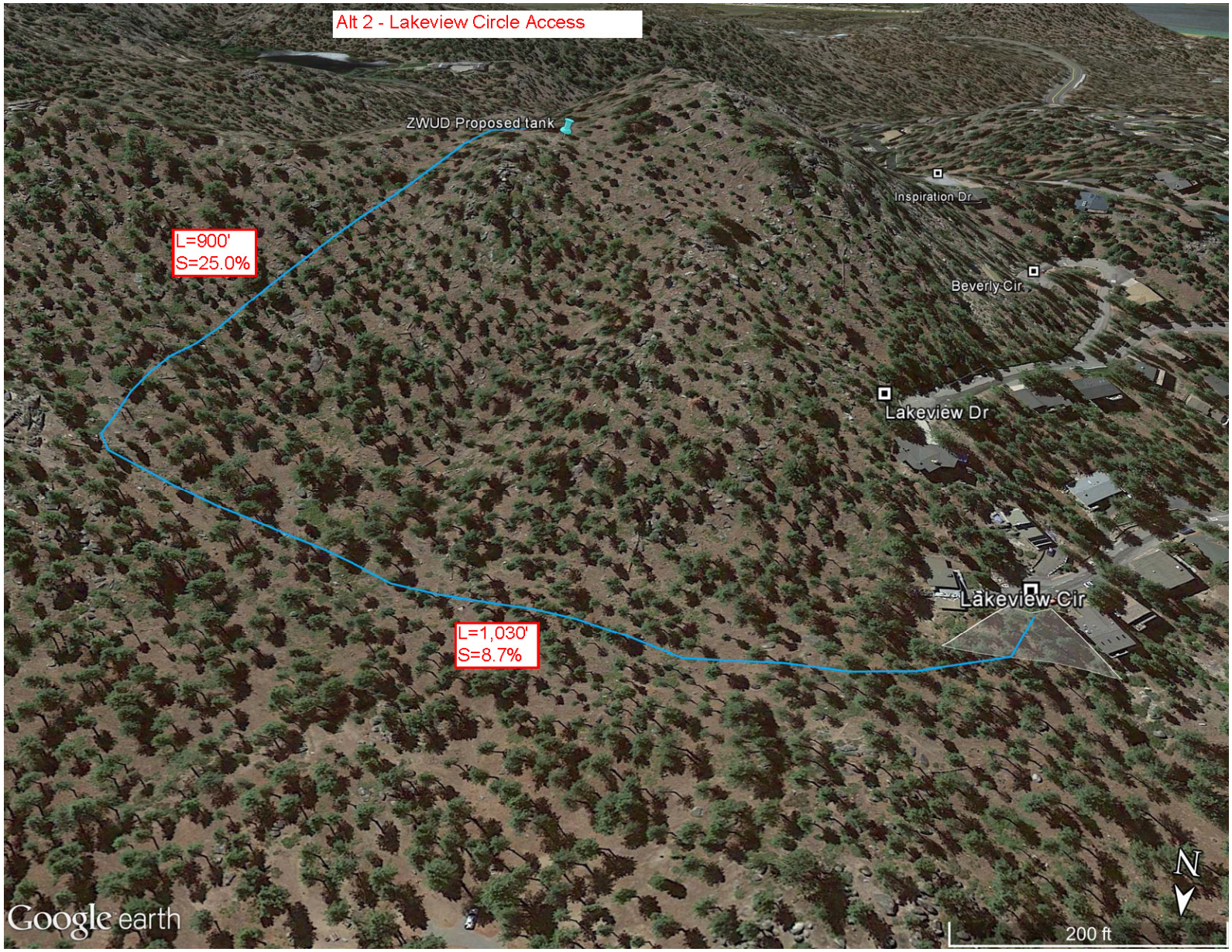


Figure 5-5. Road Alignment Grades

Piping

System improvements include installation of approximately 22,640 lineal feet of new pipe. This includes line upsizing to meet pressure and velocity criteria for the various flow scenarios:

- Fire Flow + ADD
- PHD
- MDD

It also includes replacement of lines in leak prone areas.

As a point of reference, Truckee Meadows Water Authority and Las Vegas Valley Water District utilize a fire flow plus maximum day velocity criteria of 18 and 20 feet per second (fps) respectively. We recommend that the County consider changing the design code to reflect a max velocity of 18 fps. The following table summarizes the line upsizing and replacements required for this alternative.

Table 5-3. Alternative 1 - Pipeline Improvements Summary

	Quantity & Criteria (ft)			
Diameter (in)	Leak Repair	Velocity & Pressure	Additional Infrastructure	Total
8-inch Pipeline	375	13,901	1,200	15,476
10-inch Pipeline	-	5,850	1,314	7,164
Total	375	19,751	2,514	22,640

Booster Stations

To lift water to the new tank, a booster station would be constructed at the intersection of Inspiration Drive and Canyon, on the south west corner. The booster pumps will be located in a new building on a USFS parcel APN #1-318-103-140-19.

The building will be concrete masonry construction (CMU) or steel, with a metal roof, and will meet TRPA standards for appearance.

Table 5-4. Inspiration Drive Booster Station

Item	Quantity	Units	Comments
Pumps	2		1 Duty, 1 Standby
Firm Capacity	600	gpm	
Total Dynamic Head	80	Feet	
Variable Frequency Drive	2		

Item	Quantity	Units	Comments
Building (20'x20')	400	Sq. Feet	

A small booster station and pneumatic tank is required to supply pressure to the homes near the Lookout Tank. Since the tank limits the pressure available off the existing 8-inch line, a new parallel line would be installed, but not connected to the tank. The following table summarizes the design criteria for the Lookout Booster.

Table 5-5. Lookout Booster Station

Item	Quantity	Units	Comments
Pumps	2		1 Duty, 1 Standby
Firm Capacity	20	gpm	
Total Dynamic Head	100	Feet	
Pneumatic Tank	150	Gal	
Building (10'x10')	100	Sq. Feet	

Pressure Reducing Stations

Four additional pressure reducing stations are required for this alternative. New pressure zones are created off the proposed tank, to address low pressures in the upper zones. The existing PRVs remain in place. Alternative 1 Figure shows the additional PRVs needed for this alternative.

Table 5-6. Pressure Reducing Station Summary

PRV Label	Status	Type
2	Existing	Single Direction
3	Existing	Single Direction
4	Existing	Single Direction
5	Existing	Single Direction
1	Existing	Single Direction
11	Existing	Single Direction
Beverly	Existing	Single Direction
Lakeview	Existing	Single Direction

PRV Label	Status	Type
Canyon North	New	Single Direction
Canyon South	New	Bi-Directional
Inspiration BPS	New	Single Direction
South Martin Dr	New	Bi-Directional

Figures

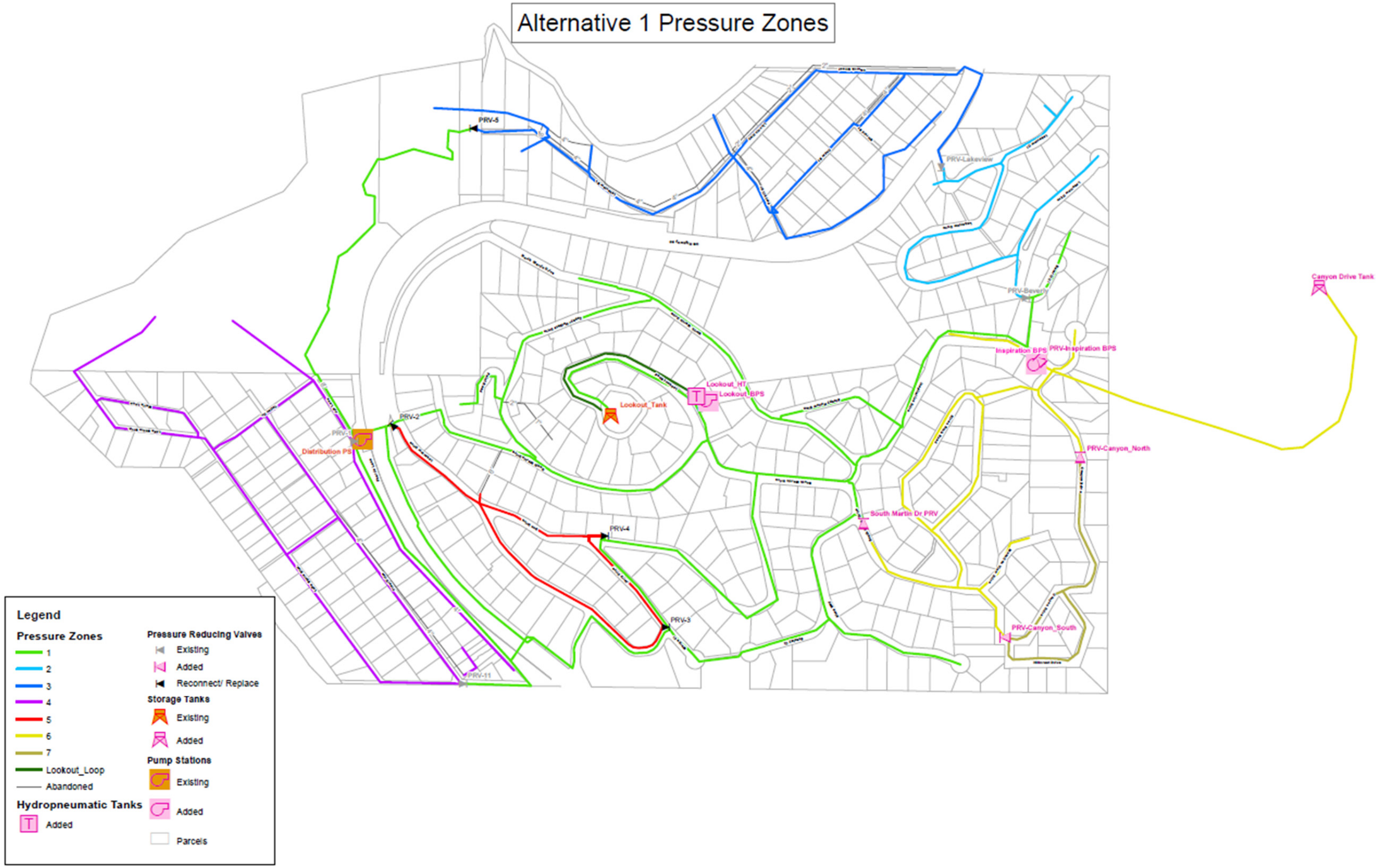


Figure 5-6. Alternative 1 - Pressure Zones

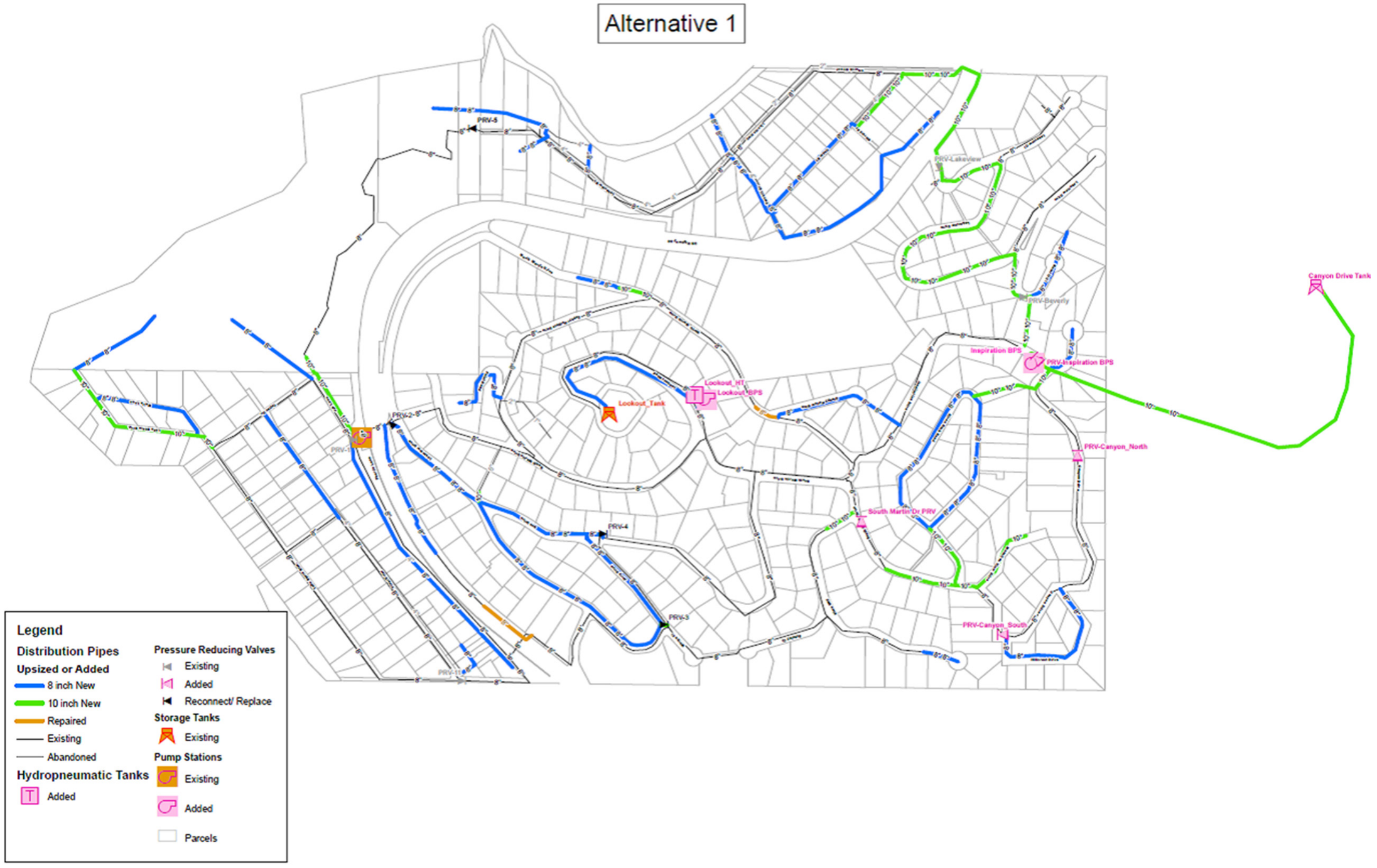


Figure 5-7. Alternative 1 Improvements

Environmental Impacts - Tank

An access road will be constructed from Lakeview Drive to the new water storage tank to allow operation and maintenance access to the storage tank. However, this would not be a public through road and would not generate traffic or serve as neighborhood access.

Construction of the pipelines, storage tank, and access road, and replacement of existing pipeline will result in ground disturbance, which can affect erosion and water quality. In particular, development of the tank access road, and associated pipeline would occur in areas of slopes ranging from 9% to 25% as shown in Table 5-7.

Table 5-7. Storage Tank Access Road Alternatives

Alternative Road or Pipe	Length (lineal feet)	Coverage (sq ft)	Slope
Lakeview Circle Access Alt. 1	2,250	45,000	9% - 24%
Lakeview Circle Access Alt. 2	1,930	38,600	9% - 25%
Zephyr Cove Campground Access Alt. 3	1,760	35,200	15% - 25%
Tank Pipeline – Inspiration and Canyon Drive	1,000	Underground	12%-45%

Best Management Practices (BMPs)

Implementation of BMPs, including those listed in TRPA's Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Best Management Practices (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality impacts and erosion to a less than significant level. These BMPs include, but are not limited to, infiltration devices, slope stabilization, revegetation of disturbed areas, and runoff controls. Permanent BMPs would be included to address runoff from the new storage tank and access road coverage.

The Project will incorporate standard practices to comply with TRPA regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of: an Erosion Control Plan, onsite monitoring, a Storm Water Pollution Prevention Plan (SWPPP), a dewatering plan, tree protection measures, a revegetation plan, and operations BMPs and monitoring.

Stormwater Pollution Prevention Plan (SWPPP)

The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of the State and will require a site-specific SWPPP to prevent debris, soil, silt, oil, or other earthen or construction materials from entering into the SEZ. The SWPPP will describe, locate, and implement the BMPs specific to each area in which

construction and operation occurs, will designate areas for construction staging and access, and will include a spill response and groundwater management plan.

Construction shall also occur in the dry season to minimize siltation. Consultation with the USFS will also occur to ensure the appropriate measures as implemented on USFS property.

Pipeline

Most of the proposed pipeline to the tank (approximately 700 lineal feet) would be directionally drilled through rock, thus minimizing ground disturbance, with the exception of a small 30-ft by 30-ft boring and receiving pit on either side of the pipeline.

The remainder of the pipeline connecting to the proposed tank would result in approximately 300 linear feet of ground disturbance and would not be located underneath existing or proposed roadway pavement until reaching the proposed tank due to engineering limitations.

Coverage and Land Capability

The new storage tank and storage tank access road would result in new coverage. Coverage from the storage tank would vary based on final design, but is anticipated to be between 2,375 sq. ft for a 55-foot diameter storage tank and 3,630 sq. ft for a 68-foot diameter tank. The associated 20-foot wide ring road around the tank would be between 4,710 to 5,526 sq, ft. depending on the diameter of the tank. Additional coverage from the access road is estimated to be between 35,200 sq. ft. to 45,000 sq. ft. depending on which access road alternative is selected, as shown in Table 5-7.

Design of the storage tank and access road will take into account land capability limitations to avoid exceeding coverage limits on the affected parcels, but the location of the proposed facilities is within environmentally sensitive land capability areas 1A and 2. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options.

As stated in TRPA Code of Ordinances Section 30.4.2.D, “The maximum land coverage for linear public facilities and public health and safety facilities is limited to the minimum amount needed to achieve its public purpose.” Section 30.4.2.F states, “The maximum land coverage for other public service facilities located outside of an approved community plan is 50 percent of the project area.” According to Section 30.5.1.C, “Land coverage and disturbance for public service facilities may be permitted in Land Capability Districts 1a. 1c. 2. And 3 if TRPA finds that: The project is necessary for public health, safety…There is no reasonable alternative…The impacts are fully mitigated….”

Since the majority of the ZWUD area is located within land capability 1b and 2, locating the tank and pipelines within a higher land capability is not feasible, particularly given the location of the existing infrastructure. Repair of linear public facilities and minor utility projects (replacement, repair, interconnection of existing utilities) is not subject to excess land coverage mitigation (TRPA Code of Ordinances Section 30.6.2.E and F)

United States Forest Service (USFS) Requirements

Locating the storage tank and associated pipeline and access road on USFS property will require an easement and permit from the USFS. The storage tank would be located on USFS parcel APN 131810000006 (172 acres). Some Santini-Burton parcels are located within the developed subdivision areas, and coordination with the LTBMU is required to address infrastructure improvements on these lands as they are associated with restrictions for such uses.

Scenic Impacts

Since the storage tank will be a large above-ground structure, it will be visible within the area, and may be visible from U.S. 50 and Lake Tahoe, due to the height of the structure and footprint elevation. In addition, the roadway to the storage tank and the pipeline connecting to the tank may create visible linear scarring due to tree removal and the slope of the affected area. Once design is complete, a more detailed plan would need to be prepared to ensure compliance with TRPA height limitations and design standards (TRPA Code of Ordinances Chapters 37 and 36). To ensure no adverse impacts occur, the project may require mitigation in accordance with the height and design standards such as, lowering the height of the tank, landscape screening, color blending, and other methods to reduce visibility and maintain the visual character. No public roadway signage is associated with the structure. New or replaced pipelines and pressure reducing valves would be located below existing pavement and would not result in an aesthetic change.

The following figures show the simulated tank from different vantage points. It should be noted that the trees are flattened in the images. Actual visibility would be significantly reduced by existing tree screening.

Wildlife Resources

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. No known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area, however creation of a new roadway and associated tank site on US Forest Service land would likely require protocol surveys to be performed. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6) and the project will be required to comply with resource protection actions required by the USFS and resource agencies.

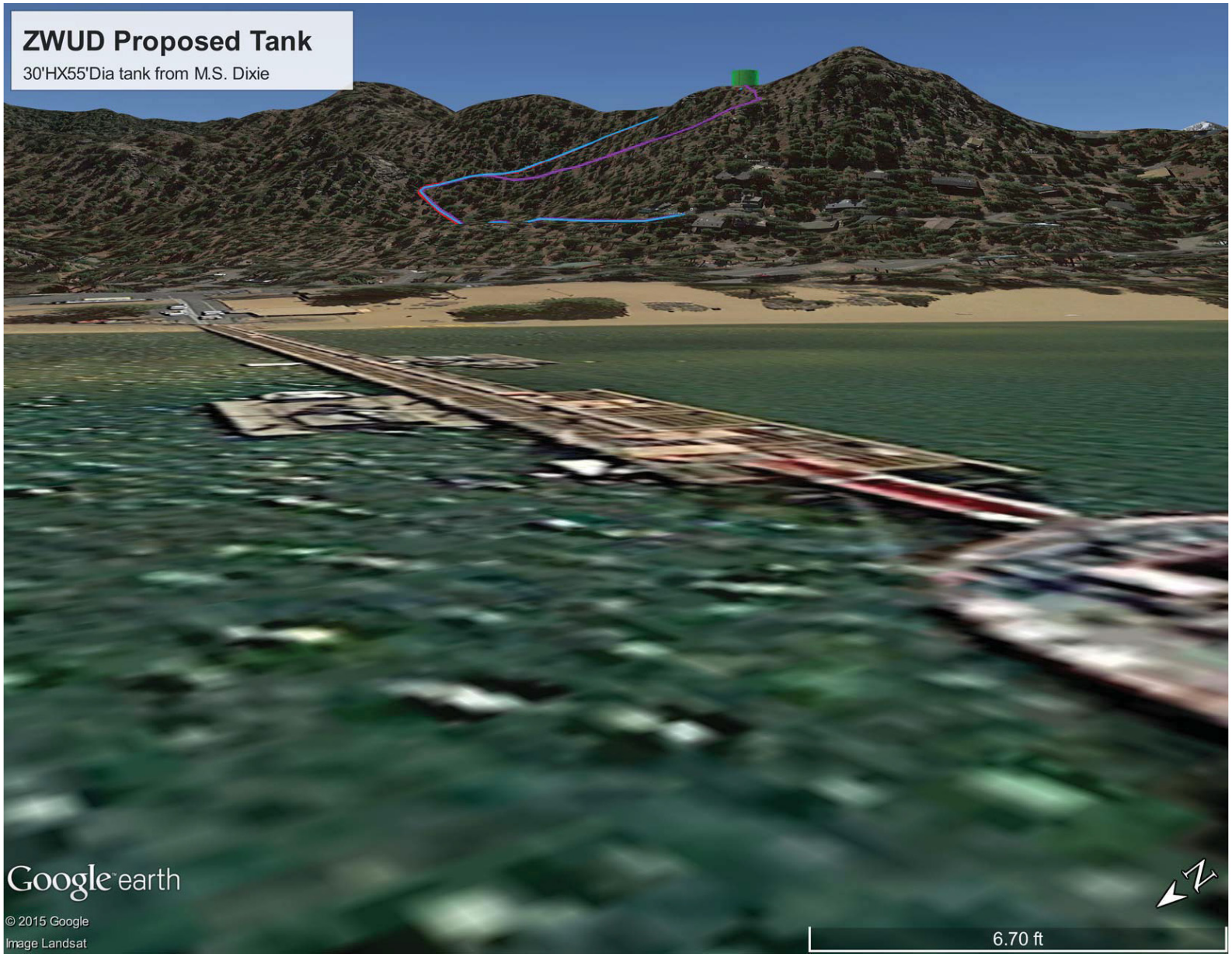


Figure 5-8. Tank and Access Road View from Zephyr Cove

Figure 5-9. Tank and Access Road View from Zephyr Cove Stables

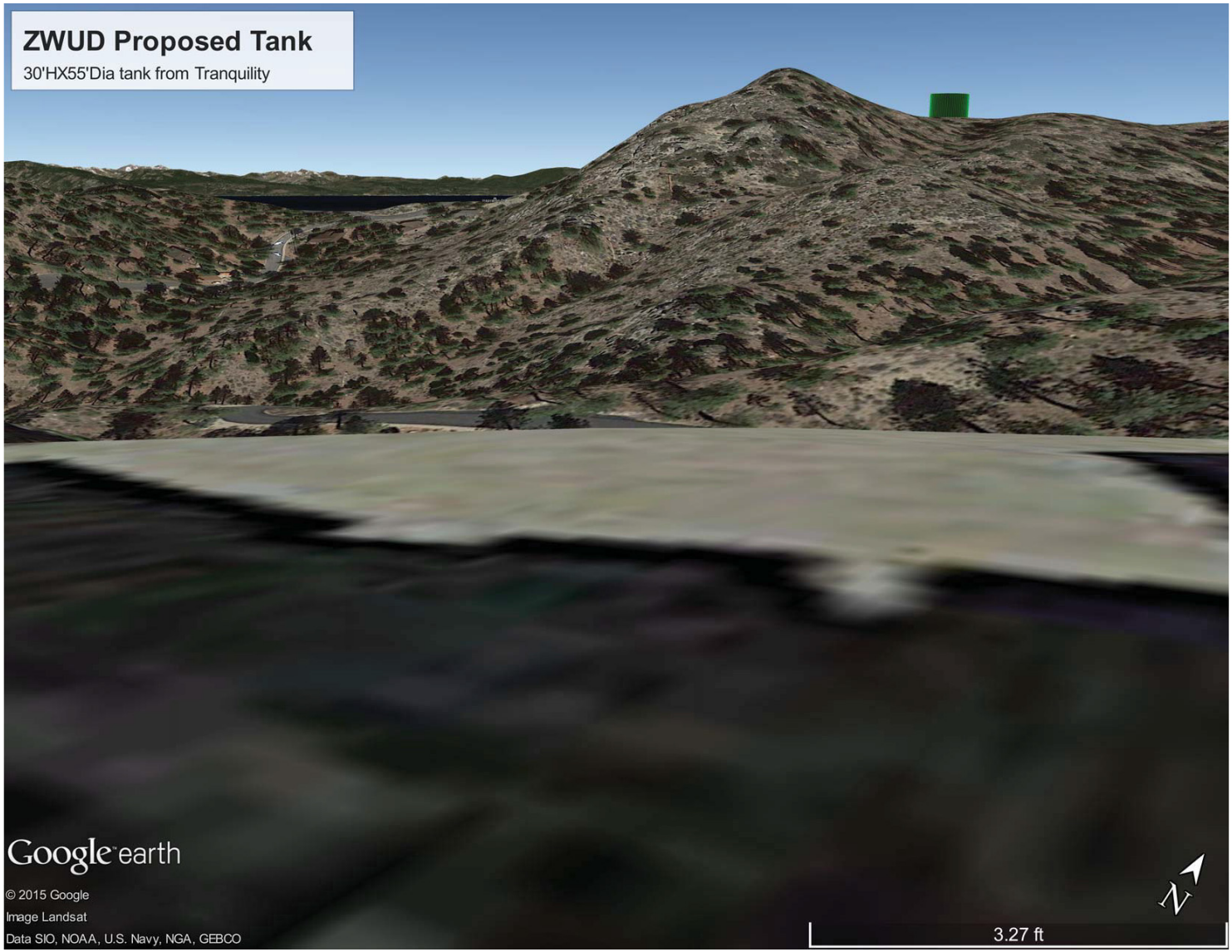


Figure 5-10. Tank View from Tranquility Estates

Cultural Resources

There are no known cultural resources within the area of the water storage tank or affected neighborhood roadways where new or replacement pipeline is proposed. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

Land Requirements

The proposed connection pipeline to the storage tank would begin at Inspiration Drive/Canyon Drive on USFS parcel APN 131810314017 (10,019 sq. ft. lot) and would also cross through a portion of developed private parcel 131810314016 (12,197 sq. ft. lot).

In addition, the access road from Lakeview Circle would commence on USFS parcel APN 131810312010 (6,534 sq. ft. lot) and the alternative tank connection pipeline from Lakeview Drive would commence on USFS parcel APN 131810313019 (13,939,sq. ft. lot), which would require an easement through the affected properties.

USFS parcel 131810414003 (9,583 sq. ft. lot) has also been identified within the project area, and would likewise require an easement should facilities be constructed onsite.

The total easement area required is summarized in the table below.

Table 5-8. Easement Requirements

Item	Dimensions	Area (SF)	Area (Ac)
Water Tank	40-ft Rad	5,026	0.12
Access Road	15-ft width x 1,930-ft	28,950	0.66
Total		33,976	0.78

Environmental Impacts – Other Project Elements

Development of new pipeline and pressure reducing stations, the replacement of existing pipeline, and the development of a new water storage tank will not adversely affect population rates or housing resources, circulation systems, public services, utilities, minerals, agriculture or forestry, or recreation, or create significant hazards. The new pipelines and pressure reducing stations and replacement pipelines would be located beneath existing pavement, where feasible, or in line with existing pipeline. However, a new 10-inch pipe is required across APN 1-318-104-150-009, which is owned by the USFS.

Mitigable impacts may occur in relation to operation noise, construction air emissions, traffic, geology and land coverage, hydrology and water quality, aesthetics, biological resources, and cultural resources.

Noise Thresholds

Operation of the pipelines and water storage tank would not create noise levels that exceed threshold limits. Construction noise is expected to occur; however BMPs such as heavy equipment muffling, limiting construction hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant. Construction of the 10-inch pipeline from the proposed tank to Inspiration Drive/Canyon Drive will require approximately 550 feet of directional drilling through rock for a portion of its length, which may create noise and vibration disturbance to nearby residents on Inspiration Drive and Canyon Drive.

As stated above, construction would be limited to TRPA's construction noise exemption hours and BMPs would be implemented to reduce construction noise disturbance. BMPs may include, but are not limited to equipment muffling, use of temporary sound barriers, alternate backup warning systems, and pre-construction building inspection and monitoring during construction, among other methods. Emergency pressure relief valves and other similar emergency control devices are exempt from noise limitations per TRPA Code of Ordinances (Section 68.9).

Air Emissions

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Tahoe Basin would be employed to limit construction emissions. No long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling, covering exposed soils and stored materials with a chemical dust suppressant or water, removing track out, and limiting construction vehicle speeds, among others. As discussed above, the access to and operation of the storage tank would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is expected to be below threshold limits.

Land Coverage

The new and replacement pipelines would be located below ground, primarily beneath existing area roadway pavement, and would not result in additional coverage.

Traffic Impacts

Pipeline upgrades along U.S. 50 and local roadways may result in temporary traffic events, but construction within the interstate and neighborhood roadways would

meet NDOT and County traffic control requirements including signage, implementation of safety devices and other controls as determined necessary.

Land Requirements

The Inspiration Booster Station will be located on USFS parcel APN #1-318-103-140-19, and will require an easement from the USFS. Based on the estimated building size, a 2,000 square foot easement requirement is anticipated.

A new 10-inch pipe is required across APNs 1318-104-150-009 and 1318-10-314-017 to connect to the new tank. These vacant parcels are owned by the USFS, and will require a Special Use permit. An easement from one of the adjacent parcels (1318-10-414-002 or 1318-10-314-016) is also required to connect to the new tank.

Cost Opinion

The cost opinions provided in the subsequent sections are level 4, or feasibility level cost opinions. The level or accuracy for feasibility level estimates typically ranges between +40% and -20%, with a recommended contingency of 20% to 30%. Administrative costs such as engineering, construction management, and legal are included which typically run about 25% of the construction cost in the Tahoe basin.

Total present worth cost includes the capital, operation and maintenance costs (including annualized equipment replacement costs). The present worth cost is based on a 30 year term and 3.5% discount rate. Present worth costs are used for comparison of alternatives in Section 0. Detailed cost break downs are included in Appendix A.

Table 5-9. Alternative 1 – New Tank, Inspiration & Lookout Boosters, Pipelines, and PRVs

Item	Quantity	Unit Cost	Cost (x$1,000)
Division 1			$1,743
Pipelines (various)	LS		$4,701
PRVs	4	$54,700	$219
500,000 Gal Tank	LS		$917
Tank Access Road	1,930 LF	$361	$697
Inspiration Booster Station	LS		$431
Lookout Booster	LS		$74
Contingency	25%		$845
Administrative	25%		$2,195
Total Capital			**$10,976**

Item	Quantity	Unit Cost	Cost (x$1,000)
Annual O&M [1]			$129
Present Worth (i=3.5%, 30 years)			**$13,356**

Notes:
1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement.
2 – Cost does not include associated easements.

5.1.2 Alternative 2 – New Tank, Upsized ZWUD Booster Pumps, Lookout Booster, Up-Size Lines, and New Pressure Reducing Stations

Description

This alternative uses increased pumping head at the WTP from to lift water to the new tank. The Lookout Tank can be disconnected from the system, and remain as a backup. A Lookout Booster is added to provide pressure for the homes near the Lookout Tank. This alternative results in 12 pressure zones, including the Lookout zone.

Piping

System improvements include installation of approximately 27,564 lineal feet of new pipe. The increased pipe sizes are needed to accommodate fire flows, and meet the minimum system pressures and maximum velocity criteria. The line replacements also address the areas with a history of pipe leaks.

Table 5-10. Alternative 2 - Pipeline Improvements Summary

	Quantity & Criteria (ft)			
Diameter (in)	Leak Repair	Velocity & Pressure	Additional Infrastructure	Total
8-inch Pipeline	112	11,821	1,126	13,059
10-inch Pipeline	-	13,059	69	13,128
12-inch Pipeline	-	377	1,000	1,377
Total	112	25,257	2,195	27,564

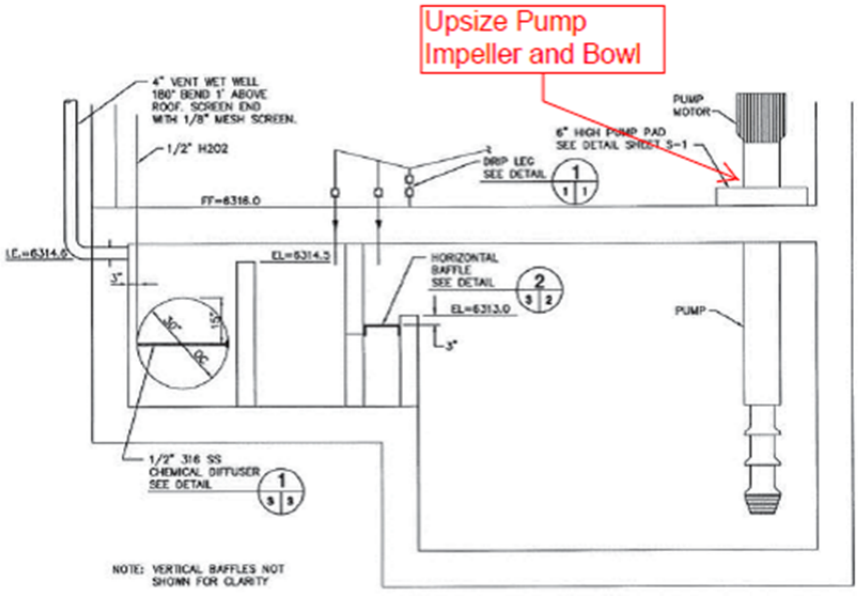
Booster Pumps

Additional pumping head is required to lift water to the new storage tank. Under this alternative, the pump head at the WTP would be increased by adding stages to the existing pump impellers or increasing impeller and bowl size. The existing motors are 75 horsepower and will be sufficient to meet the new design condition.

Table 5-11. WTP Pumping Requirements

Item	Quantity	Units	Comments
Pumps	2		1 Duty, 1 Standby
Firm Capacity	600	gpm	
Total Dynamic Head	400	Feet	
Pump Motor	75	Horsepower	Use Existing motors & VFDs

Figure 5-11. Upsized High Service Pumps



A small booster station and pneumatic tank is required to supplement pressure to the homes near the Lookout Tank from the new Canyon Drive Tank. The booster would be connected to the existing 8-inch line and the Lookout Tank would be isolated from the system. The following table summarizes the design criteria for the Lookout Booster.

Table 5-12. Lookout Booster Station

Item	Quantity	Units	Comments
Pumps	2		1 Duty, 1 Standby
Firm Capacity	20	gpm	
Total Dynamic Head	55	Feet	
Pneumatic Tank	150	Gal	
Building (10'x10')	100	Sq. Feet	

Pressure Reducing Stations

Eight additional pressure reducing stations are required for this alternative. New pressure zones are created off the proposed tank, to address low pressures in the upper zones. The existing PRVs remain in place. Alternative 2 Figure shows the additional PRVs needed for this alternative.

Table 5-13. Pressure Reducing Station Summary

PRV Label	Status	Type
2	Existing	Single Direction
3	Existing	Single Direction
4	Existing	Single Direction
5	Existing	Single Direction
1	Existing	Single Direction
11	Existing	Single Direction
Beverly	Existing	Single Direction
Lakeview	Existing	Single Direction
Canyon North	New	Single Direction
Canyon South	New	Bi-Directional
Don Dr	New	Bi-Directional
Zephyr Heights	New	Bi-Directional
North Martin	New	Bi-Directional
Sleepy Hollow	New	Bi-Directional
Alma	New	Bi-Directional

Figures

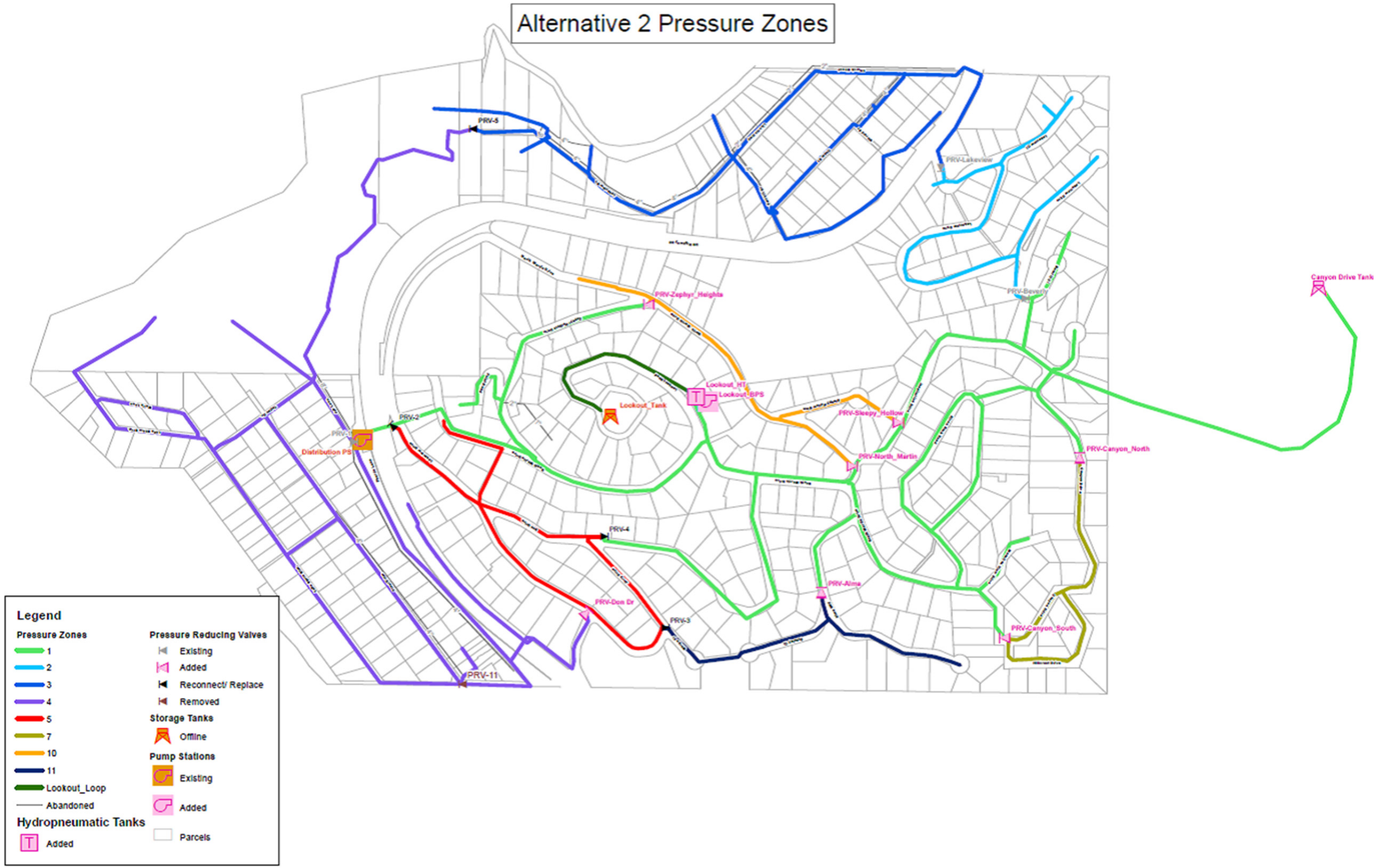


Figure 5-12. Alternative 2 Pressure Zones

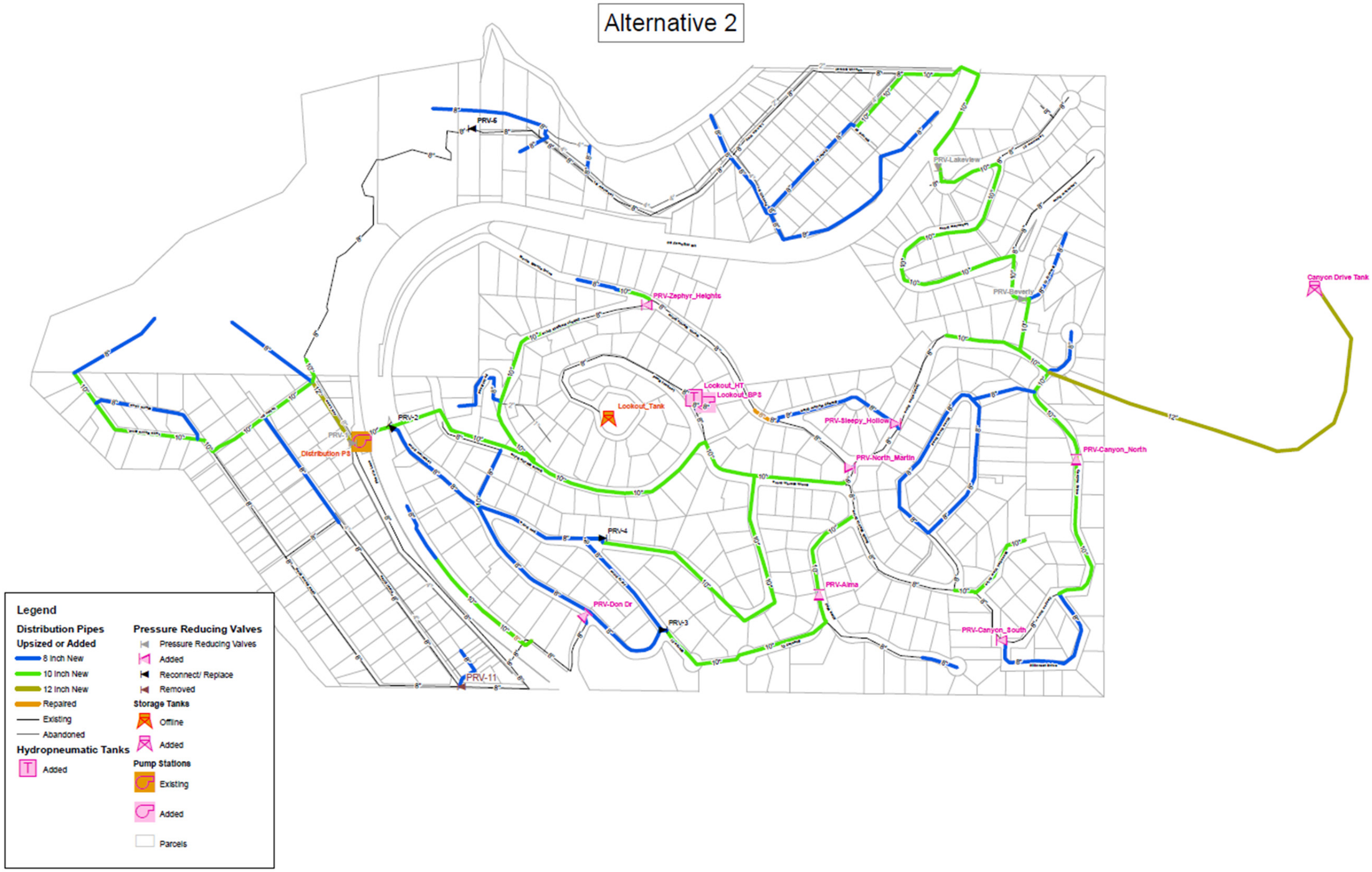


Figure 5-13. Alternative 2 Improvements

Environmental Impacts

Alternative 2 addresses System Deficiencies 1 through 8 in a similar manner to Alternative 1 with existing, below roadway pavement pipeline being replaced with new and larger pipeline to address aging infrastructure and bring the system into compliance with current code requirements. Like Alternative 1, Alternative 2 includes pressure-reducing valves that would be located within existing roadways where pipe upsizing occurs. However, a new 10-inch pipe is required across APN 1-318-104-150-009, which is owned by the USFS.

The storage tank and associated access road and pipeline would be in the same location and of the same size as proposed for Alternative 1. See the previous section for discussion on storage tank impacts.

Please refer to the impact analysis summary for Alternative 1 System Deficiencies 1 through 8 above as the impacts and regulatory compliance actions would be the same due to the location of upsized or new pipeline and pressure reducing stations beneath existing roadways. In Alternative 2, pipe sizes, locations, and pressure release valve quantities differ from Alternative 1. However, this alternative has the same location and sizing of the storage tank and access road.

Under Alternative 2, there would be no adverse impact to population rates or housing resources, transportation and circulation systems, public services, utilities, minerals, agriculture or forestry, recreation, or create hazards. This alternative would also comply with TRPA and USFS BMP requirements for noise, traffic control, air quality, erosion and water quality, land coverage, visual resources, biological resources and cultural resources.

Land Requirements

The primary land requirements associated with this alternative are related to the new storage tank and access road, which are common to Alternative 1 and 2. These items are discussed separately under Section 5.1.1.

A new 10-inch pipe is required across APNs 1318-104-150-009 and 1318-10-314-017 to connect to the new tank. These vacant parcels are owned by the USFS, and will require a Special Use permit. An easement from one of the adjacent parcels (1318-10-414-002 or 1318-10-314-016) is also required to connect to the new tank. No additional land acquisition or easements are anticipated for this alternative.

Cost Opinion

Table 5-14. Alternative 2 – Tank, Upsized WTP Booster, Lookout Booster, Pipelines, and PRVs

Item	Quantity	Unit Cost	Cost (x$1,000)
Division 1			$2,008
Pipelines (various)	LS		$5,993
PRVs	8	$54,700	$383
500,000 Gal Tank	LS		$917
Tank Access Road	1,930 LF	$361	$697
WTP Booster Pump Modifications	LS		$60
Lookout Booster	LS		$74
Contingency	25%		$2,031
Administrative	25%		$3,040
Total Capital			**$15,201**
Annual O&M Cost[1]			$109
Present Worth (i=3.5%, 30 years)			**$17,212**

Notes:
1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement.
2 – Cost does not include associated easements.

5.1.3 Alternative 3 – Fire Pumps, Lookout & Riven Rock Booster Pumps, and Upsized Lines

Description

In lieu of a new tank to provide the required pressure to the upper zones for max day and fire flow demands, this alternative describes a fire and booster pumps to provide the required pressure to meet these demands.

There would be two booster pump stations, one on Lookout Road and one on Riven Rock Road. The Lookout Road Booster will have 3 separate pumps for peak hour, fire, and Lookout Road demands respectively. A new line paralleling the existing is required to provide pressure to the homes on Lookout Road near the tank.

The Riven Rock Road Booster and pneumatic tank is needed to meet the Riven Rock Road zone max day and peak hour demands.

Lookout Booster & Fire Pump

The Lookout booster pumps are required to meet peak hour and fire demands. The booster station is located on a vacant parcel near the tank on Lookout Road. The peak hour booster pump is only needed for peak hour demands. It will be variable speed controlled, with 1 duty and 1 standby pump. Average and max day demands are supplied from the pressure at Lookout Tank. A small booster and pneumatic tank will provide extra pressure for the closed loop up to the Lookout Tank.

The fire pump will be UL listed, with diesel engine driver. The entire assembly will be skid mounted, and be supplied by a vendor with unit responsibility for the pumping system.

The pumps will be housed in a manufactured metal building for cost considerations. A 500 gallon diesel storage tank is required for the fire pump, and will be located on the side of the building. The site will be enclosed by a security fence meeting TRPA visual standards. The site will be paved and include the necessary BMPs.

Table 5-15. Lookout Booster Station and Fire Pump

Item	Quantity	Units	Comments
Peak Hour Booster Pumps	2		1 Duty, 1 Standby
Firm Capacity	1,880	gpm	
Total Dynamic Head	20	Feet	
Variable Frequency Drive	2		
Lookout Booster			
Firm Capacity	20	gpm	1 Duty, 1 Standby
Total Dynamic Head	100	Feet	
Pneumatic Tank	150	Gal	
Fire Pump	1		Diesel Engine Driven
Firm Capacity	2,500	gpm	
Total Dynamic Head	50	Feet	
Diesel Storage Tank	500	Gal	External
Building (50’ x 20’)	1,000	Sq. Feet	

Riven Rock Booster

This pump station is required primarily to increase pressure to the Riven Rock area, which sits at a higher elevation than most of the rest of the system. The pump will run during all demand scenarios, except fire flows, where the larger Fire Pump and

WTP Pump will take over. The booster station is located on the corner of Inspiration and Canyon Drives and will be housed in a small CMU or steel building.

Table 5-16. Riven Rock Booster Station

Item	Quantity	Units	Comments
Booster Pumps	2		1 Duty, 1 Standby
Firm Capacity	83	gpm	
Total Dynamic Head	65	Feet	
Variable Frequency Drive	2		
Building (14’ x 10’)	140	Sq. Feet	

Piping

System improvements include installation of approximately 22,609 lineal feet of new pipe. The increased pipe sizes are needed to accommodate fire flows, and meet the minimum system pressures and maximum velocity criteria. The line replacements also address the areas with a history of pipe leaks.

Table 5-17. Alternative 3 - Distribution Improvements Summary

	Quantity & Criteria (ft)			
Diameter (in)	Leak Repair	Velocity & Pressure	Additional Infrastructure	Total
8-inch Pipeline	375	11,616	850	12,841
10-inch Pipeline	-	8,481	53	8,534
12-inch Pipeline	-	377	857	1,234
Total	375	20,474	1,760	22,609

Pressure Reducing Stations

This alternative does not require additional PRVs and has a total of 7 pressure zones.

Figures

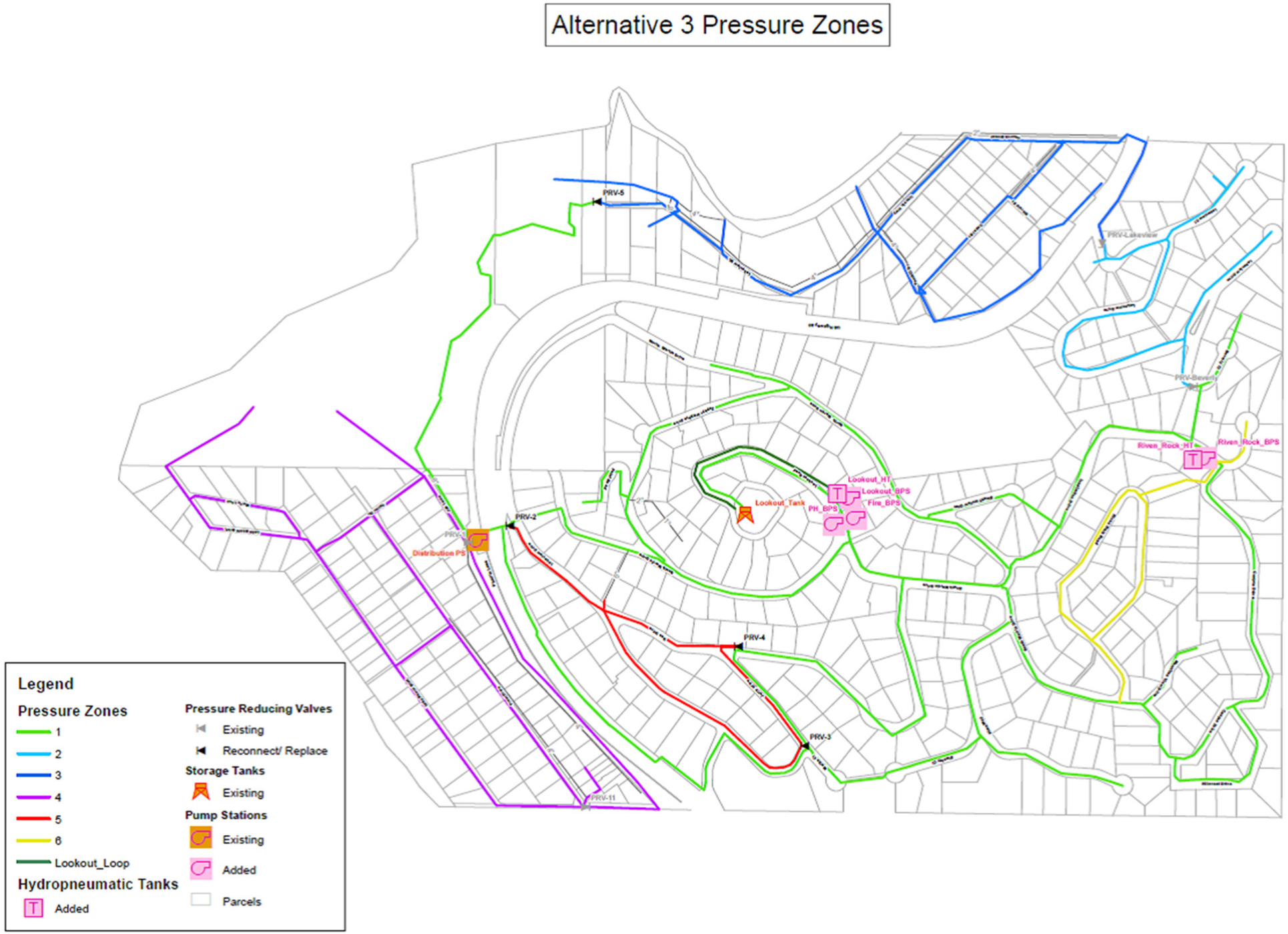


Figure 5-14. Alternative 3 - Pressure Zones

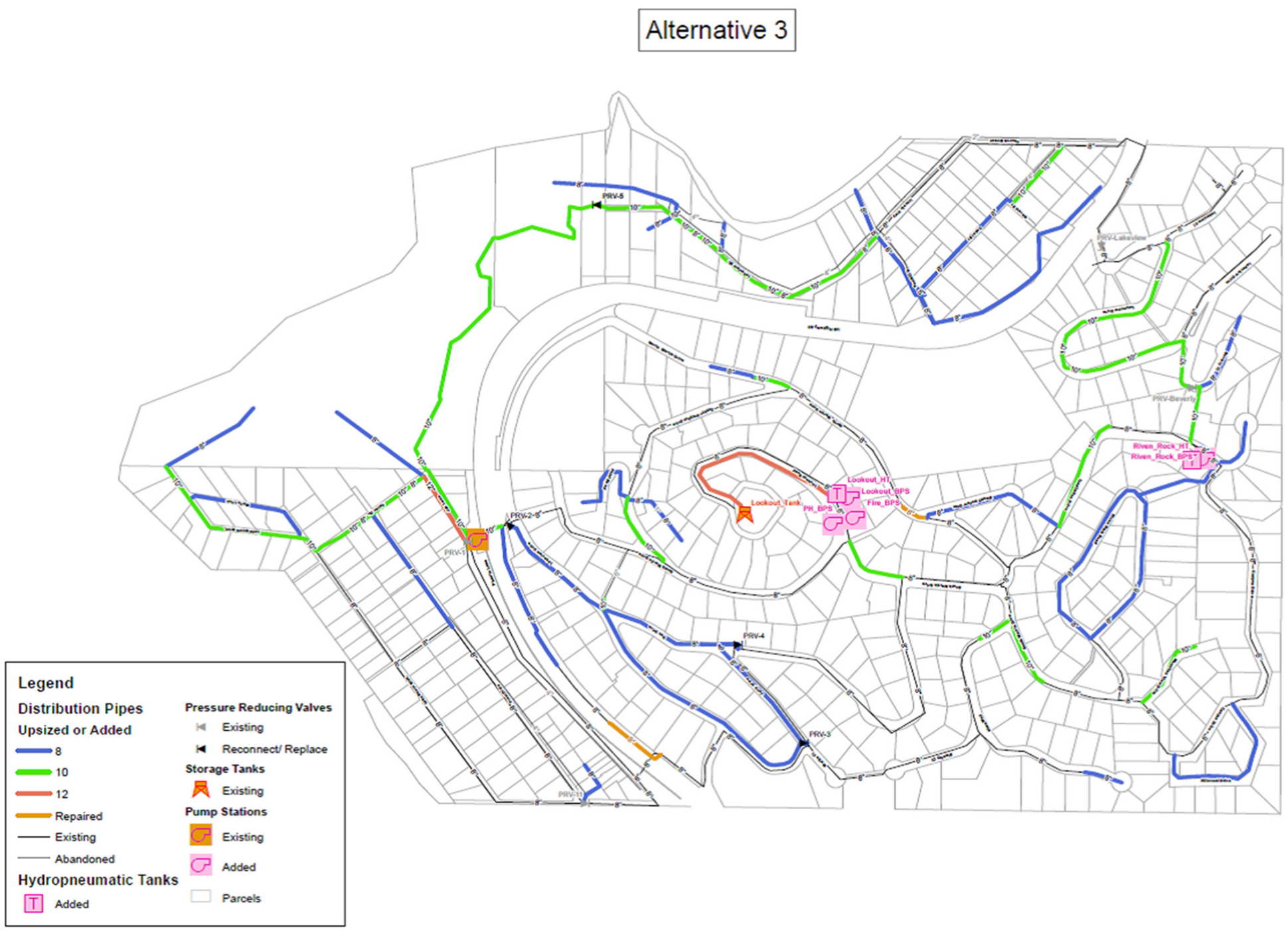


Figure 5-15. Alternative 3 Improvements

Environmental Impacts

Alternative 3 has minimal impacts compared to Alternatives 1 and 2, since there is not a new tank and access road. In addition, Alternative 3 does not include any new pressure reducing stations. However, the remaining common components (pipeline upsizing/ replacement) are very similar to the other alternatives.

This alternative includes below roadway pavement pipeline being replaced with new and larger pipeline to address aging infrastructure and bring the system into compliance with current code requirements. However, a new 10-inch pipe is required across APN 1-318-104-150-009, which is owned by the USFS.

Please refer to the impact analysis summary for Alternative 1 System Deficiencies 1 through 9, as the impacts and regulatory compliance actions would be the same due to the location of upsized or new pipeline beneath existing roadways. In Alternative 3, pipe sizes and locations differ slightly from Alternative 1.

Under this alternative, there would be no adverse impact to population rates or housing resources, transportation and circulation systems, public services, utilities, minerals, agriculture or forestry, recreation, or create hazards. This alternative would also comply with TRPA and USFS BMP requirements for noise, traffic control, air quality, erosion and water quality, land coverage, visual resources, biological resources and cultural resources.

Land Requirements

The proposed site for the Tank Booster Station is Accessor's Parcel Number (APN) 1-318-104-17-013. This parcel is 0.22 acres and is owned by USFS. It is anticipated that Douglas County would need to acquire a 4,000 square foot easement for access and the building on this parcel.

The Riven Rock Road Booster is located on APN 1-318-103-140-19, which is owned by USFS. It is anticipated that Douglas County would need to acquire a 1,400 square foot easement for access and the building on this parcel.

A new 10-inch pipe is required across APN 1318-104-150-009 to loop the Riven Rock Road area. This vacant parcel is owned by the USFS, and will require a Special Use permit.

Noise

Less than significant impacts may occur in relation to operation noise, construction air emissions, geology and water quality, land coverage, aesthetics, biological resources, and cultural resources. Since the pumps would be enclosed within a concrete masonry structure, operational noise levels are not anticipated to exceed threshold limits. Some construction noise may occur; however BMPs such as heavy equipment muffling, limiting construction hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant.

Air Emissions

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Lake Tahoe Basin would be employed to limit construction emissions. No significant long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling, covering exposed soils, and other site maintenance, among other BMPs. As discussed above, the access driveway and operation of the booster pump station would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is expected to be below threshold limits.

The diesel driven fire pump will meet California standards for emissions, and will employ a critical grade exhaust silencer to limit noise emissions.

Land Coverage and Capability

Design of the booster station will take into account land capability limitations (Land Capability 1A) to maintain coverage limits on the affected parcel (USFS 9,583 sq. ft. parcel APN 131810314019); however, most of the existing ZWUD facilities are within low capability lands that cannot be avoided. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options.

BMPs

Construction of the booster pump station would result in ground disturbance and cut and fill, which can affect erosion and water quality; however, implementation of BMPs, including those listed in TRPA BMP Handbook (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality effects and erosion to a less than significant level. These BMPs include, but are not limited to, infiltration devices, slope stabilization, revegetation of disturbed areas, and runoff controls. The Project will incorporate standard practices to comply with TRPA regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of: an erosion control plan, onsite monitoring, a Storm Water Pollution Prevention Plan (SWPPP), a dewatering plan, tree protection measures, a revegatation plan, and operations BMPs and monitoring.

SWPPP

The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of the State and will require a site-specific SWPPP to prevent debris, soil, silt, oil, or other earthen or construction materials from affecting state waters. The SWPPP will describe, locate, and implement the BMPs specific to each area in which construction and operation occurs, will designate areas for construction staging and

access, and will include a spill response and groundwater management plan. Construction shall also occur in the dry season to minimize siltation.

United States Forest Service (USFS) Requirements

Locating the booster station on US Forest Service (USFS) property will require an easement and permit from the USFS. Some Santini-Burton parcels are located within the vicinity, and coordination with the LTBMU is required to address infrastructure improvements on these lands, if affected, as they are associated with restrictions for such uses. The proposed Inspiration Drive Booster Station would be located on USFS parcel APN 131810314019 (9,583 sq. ft. lot). Water tanks, pumps, wells and associated facilities are defined by the TRPA Code of Ordinances as "Local public health and safety facilities" or "Public utility centers" (TRPA Code of Ordinances, Chapter 21). Local public health and safety facilities are considered a special use in each of the TRPA Plan Area Statements (060, 066, and 067) within the ZWUD and will require a special use permit. The Project will be required to comply with the terms of the permit.

Scenic Impacts

Since the booster station will be an above-ground concrete masonry structure with a metal roof, it may be visible within the immediate area, although it is not anticipated to be visible from U.S. 50, the shoreline, or Lake Tahoe. Once design is complete, a more detailed plan would need to be prepared to ensure compliance with TRPA height limitations and design standards (TRPA Code of Ordinances Chapters 37 and 36). To ensure no adverse impacts occur, the project may require mitigation in accordance with the height and design standards such as, lowering the height of the structure, landscape screening, color blending, architectural applications to blend in with the surrounding structures and other methods to reduce visibility and maintain the visual character. No public roadway signage is associated with the structure.

Wildlife Impacts

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6).

Cultural Resources

There are no known cultural resources within the area of the Inspiration Drive Booster Pump Station. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada

SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

Cost Opinion

Table 5-18. Alternative 3 – Fire Pumps, Booster Pumps, and Upsized Lines

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$1,419
Pipelines (various)	LS		$4,849
Tank Booster Station & Fire Pump	LS		$731
Riven Rock Booster Station	LS		$132
Contingency	25%		$1,428
Administrative	25%		$2,140
Total Capital			**$10,698**
Annual O&M Cost[1]			$156
Present Worth (i=3.5%, 30 years)			**$13,576**

Notes:
1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement.
2 – Cost does not include associated easements.

5.2 Deficiency 9 – Storage Tank Coating Condition

5.2.1 Alternative 1 – Recoat Tank

Description

The tank would be recoated with an NSF 61 certified epoxy coating for contact with potable water. Since there is only one tank in the system, a temporary tank will need to be installed in order to take the tank out of service for coating. Fire flow will be limited during the interim period, until the tank is placed back in service.

Cost Opinion

Table 5-19. Tank Coating

Item	Quantity	Unit Cost	Cost (x$1,000)
Division 1			$38
Tank Exterior Coating	8,859 SF	$7.60	$67
Tank Interior Coating	11,687	$12	$117
Temporary Tank			$23
Contingency	20%		$41
Administrative	25%		$72
Total Capital			**$358**

5.3 Deficiency 10 – Supply Redundancy

5.3.1 Alternative 1 – Cave Rock System Intertie and Booster Station

Description

This alternative describes a connection to the Cave Rock water system, which would serve as a backup source to ZWUD. In an emergency such as a large fire or system failure, this would provide a backup source for ZWUD. The intertie can be designed to go both ways, but this alternative describes the infrastructure necessary to boost water to the new ZWUD tank.

A 10-inch pipeline would tie-in to Skyland on Warrior Way, and run south approximately 2,600 lineal feet along the east side of Highway 50 right-of-way to Church Street and Highway 50 in ZWUD. There would be a booster station located between Warrior Way and Church Street along Highway 50. The location will depend on what land is most readily available. The booster station would include a flow meter to track flow in both directions.

Table 5-20. Cave Rock Intertie Summary

Item	Quantity	Units	Comments
Booster Pumps	2		1 Duty, 1 Standby
Firm Capacity	600	gpm	
Total Dynamic Head	350	Feet	
Building (14’ x 18’)	252	Sq. Feet	
10-in Pipeline	2,600	LF	

Map

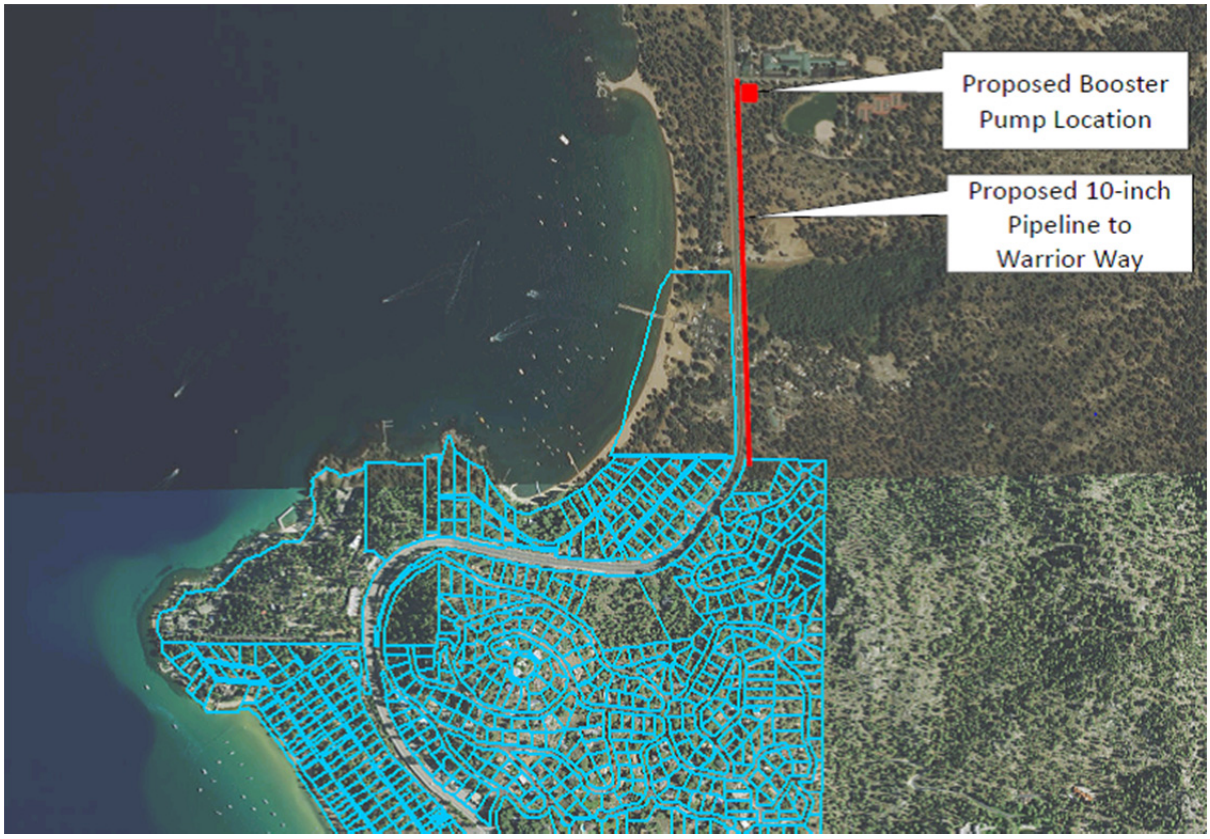


Figure 5-16. Cave Rock System Intertie

Environmental Impacts

This alternative would locate a booster pump station on the south east corner of US 50 and Warrior Way. An intertie pipeline would run under U.S. 50 right-of-way to connect the Cave Rock water system to ZWUD at Highway 50 and Church Street.

Development of the booster station and intertie pipeline will not adversely affect population rates or housing resources, public services, utilities, minerals, agriculture or forestry, hydrology, or recreation, or create hazards. The purpose of the facilities is to provide an emergency connection with the Cave Rock water system, which will provide supply redundancy for both systems.

Noise

Less than significant impacts may occur in relation to operation noise, construction air emissions, traffic, geology and water quality, land coverage, aesthetics, biological resources, and cultural resources. Since the pump would be enclosed within a concrete masonry structure, operational noise levels are not anticipated to exceed threshold limits. Some construction noise may occur; however BMPs such as heavy equipment muffling, limiting construction hours to TRPA's construction noise

exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant.

Air

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Tahoe Basin would be employed to limit construction emissions. No long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling. As discussed above, the access road and operation of the booster pump station would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is expected to be below threshold limits.

Traffic

Although an access driveway will be constructed to allow operation and maintenance access to the booster pump station, this would not be a public through road and would not generate traffic. Minor traffic delays may result during construction of the intertie pipeline within U.S. 50 right-of-way; however NDOT traffic controls would be implemented to ensure safety and manage traffic flow and the delays would be temporary and limited to the construction period of the intertie pipeline. Construction and operation of the intertie would be required to comply with the terms of the encroachment permit, including implementation of mitigation or traffic control measures.

BMPs

Construction of the booster station and intertie will result in ground disturbance and cut and fill, which can cause erosion and siltation and affect water quality, particularly at the SEZ crossing along U.S. 50; however, implementation of BMPs, including those listed in TRPA BMP Handbook (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality effects and erosion to a less than significant level. These BMPs include, but are not limited to, infiltration devices, slope stabilization, revegatation of disturbed areas, and runoff controls. Other options include directional drilling through the SEZ, which would mitigate the disturbance effects.

The Project will incorporate standard practices to comply with TRPA regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of: an erosion control plan, onsite monitoring, a Storm Water Pollution Prevention Plan (SWPPP), a dewatering plan, tree protection measures, a revegatation plan, and operations BMPs and monitoring.

SWPPP

The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of

the State and will require a site-specific SWPPP to prevent debris, soil, silt, oil, or other earthen or construction materials from entering into the SEZ. The SWPPP will describe, locate, and implement the BMPs specific to each area in which construction and operation occurs, will designate areas for construction staging and access, and will include a spill response and groundwater management plan. Construction shall also occur in the dry season to minimize siltation.

Land Coverage and Capability

Design of the booster pump station will take into account land capability limitations to avoid exceeding coverage limits on the affected parcel, which is located on Land Capability 2. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options. The intertie will pass through land capability 1B, 2, 5, and 7, from the booster station to Warrior Way. Placement of the intertie pipeline within U.S. 50 will require the submittal of an encroachment permit application to NDOT for construction within the right-of-way and implementation of permit conditions. Likewise, an easement of undeveloped USFS parcel 1-318-10-000-004 (31 Ac) will be necessary to construct the booster station.

Scenic Impacts

Since the booster station will be an above-ground concrete masonry structure with a metal roof, it may be visible within the immediate area and U.S. 50, although it is not anticipated to be visible from the shoreline or Lake Tahoe. Once design is complete, a more detailed plan would need to be prepared to ensure compliance with TRPA height limitations and design standards (TRPA Code of Ordinances Chapters 37 and 36). To ensure no adverse impacts occur, the project may require mitigation in accordance with the height and design standards such as, lowering the height of the structure, landscape screening, color blending, architectural applications to blend in with the surrounding structures and other methods to reduce visibility and maintain the visual character. No public roadway signage is associated with the structure.

Wildlife Resources

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. Willow flycatcher habitat will also likely require surveys for the presence of this species in the wet meadow area by USFS. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6). As discussed in the Setting, crossing the wet meadow area in the Zephyr Cove vicinity will also require a wetland delineation. The USFWS Species List for this project indicates the project contains Freshwater Emergent Wetland. This area is subject to the regulation of US Army Corps of Engineers and would require their review, permitting and concurrence prior to disturbance activities or construction.

Historic Resources

The intertie pipeline would be located within the U.S. 50 (Lincoln Highway) right-of-way. Portions of the Lincoln Highway are considered historic, with significant features including bridges and the road alignment. Pipes and infrastructure within the corridor would not be considered an adverse effect. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

Land Requirements

An easement will be required for the booster station on undeveloped USFS parcel 1-318-10-000-004 (31 Ac). The size of easement required is approximately 3,000 square feet.

For the pipeline, it is assumed that it can be constructed within the Nevada Department of Transportation (NDOT) right-of-way, but outside of the paved road section. The new pipeline will require an encroachment permit from NDOT, for which the Project will be required to comply the terms and conditions of the permit.

Cost Opinion

Table 5-21. Cave Rock System Intertie

Item	Quantity	Unit Cost	Cost (x$1,000)
Division 1			$234
10-In Pipeline	2,600	$220	$573
Booster Station	LS		$342
Contingency	25%		$229
Administrative	25%		$345
Total Capital			**$1,723**

5.4 Deficiency 11 – Water Conservation

The following sections address deficiency 11 of the Needs and Alternatives Summary Matrix.

5.4.1 Alternative 1 – Water Meters and Dedicated Services

Description

To comply with NRS requirements for a Water Conservation Plan, this alternative includes the installation of approximately 458 water meters throughout the distribution system. As part of this alternative, services that serve multiple properties would be separated into single metered services. These include the following services:

- Marla Bay
    - 8 homes served off a single 2-inch service. The single 2-inch water service lateral branches off to two (2) service laterals. Each of these service laterals serves four (4) homes.
    - Services run underneath the homes
- Zephyr Heights
    - Multiple homes served off single service near the tank
- Highway 50 Corridor
    - Multiple business served off a single service on Lakeview Drive

The services in question will need to be abandoned, and new services installed off the mains. Since these mains were recently replaced, this will likely be a stand-alone project. Detailed cost opinion is included in Appendix A.

Cost Opinion

Table 5-22. Water Meter and Service Relocation

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$131
New Services	18	$11.2	$204
Residential 3/4 & 1 -In Meter Assemblies	419	$1.6	$668
Commercial Meters (various sizes)	12		$23
Contingency	25%		$224
Administrative	25%		$313
Total Capital			**$1,563**

5.5 Deficiency 12 – Lake Pump Station Intake Prime

5.5.1 Alternative 1 –Self Priming Pumps

Description

A new 10-inch swing check valve was installed by the County to replace the existing leaking check valve on October 14, 2015. The check valve was oriented with the swing disk horizontal to the lake bottom, for maximum gravitation force on the disk.

Replacing the leaking check valve should eliminate the priming problem in the near term. However, the check valve seat will likely develop biological and mineral deposits over time which may cause it to leak again.

If the leak re-occurs, the existing end suction centrifugal pumps could be replaced with self priming pumps. Self priming pumps are designed to remove air at the pump volute, thus priming the pump and eliminating air from going to the WTP. It should be noted that self priming pumps still need water in the volute to function; they cannot pump if completely dry. Water to prime the pump is typically provided from a reservoir above the pump.

Figure 5-17. Intake Check Valve Replacement

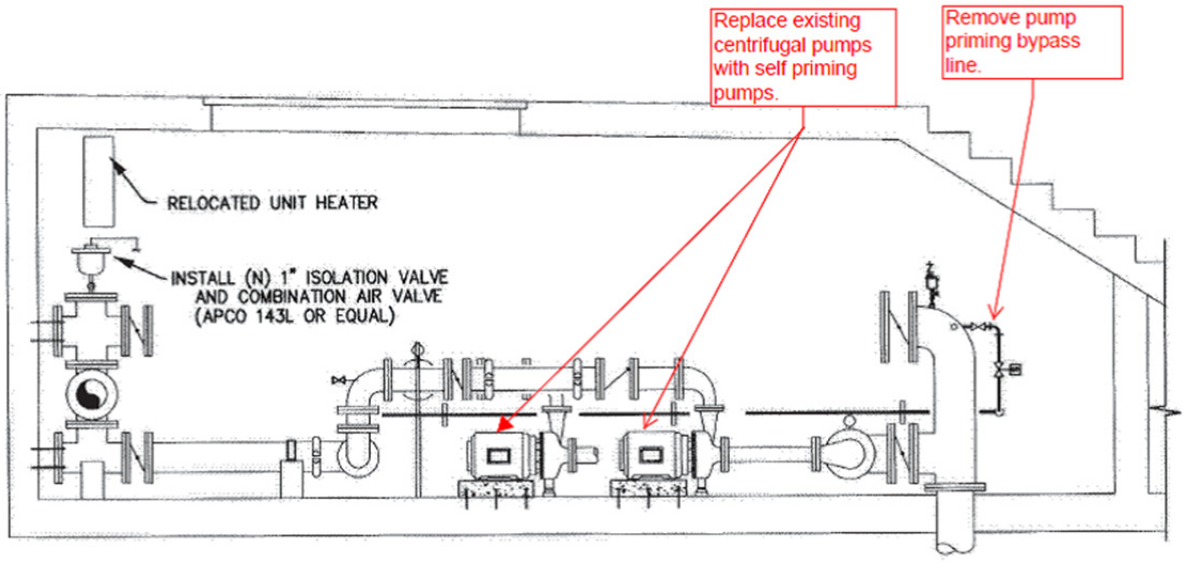


Figure 5-18. MBPS Self Priming Pumps

Environmental Impacts

Certified professional SCUBA divers are required to install the check valve. Removal of the existing check valve may result in minor sediment stirring on the lake bottom. However, this is considered a no impact alternative.

Cost Opinion

Table 5-23. Lake Intake Prime - Alternative 1

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$19
Self Priming Pumps			$76
Contingency	25%		$19
Administrative	25%		$29
Total Capital			**$143**
Annual O&M Cost[1]			$15
Present Worth (i=3.5%, 30 years)			**$420**

1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement costs.

5.5.2 Alternative 2 – Submersible Pumps

Description

This alternative addresses the priming issue by replacing the existing centrifugal pumps in the MBPS with submersible pumps in the lake. Submersible pumps inherently address any priming issues by their nature. A check valve is still required on the discharge of the pump to keep the line full, and thus avoiding air in the line.

As the check valve ages and begins to leak, this alternative is still prone to allow air into the pipeline. However, since air relief valves are located at the high points in the MBPS building piping, air should be removed prior to the WTP.

Figure

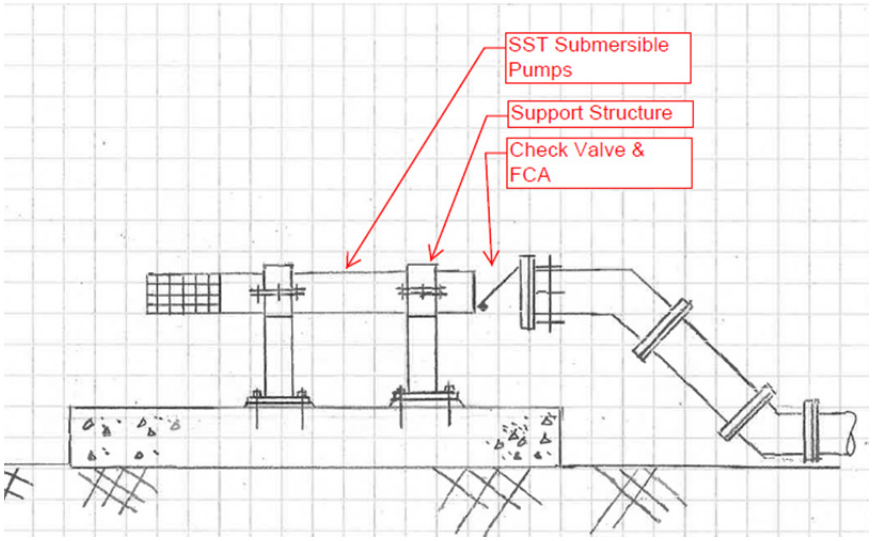


Figure 5-19. Submersible Pump Skid

Environmental Impacts

Certified professional SCUBA divers are required to install the pump skid, connect to the existing line, and remove the existing intake screen. A barge crane would be used to lower and install the pump skid.

Removal of the existing screen may result in minor sediment stirring on the lake bottom. This can be mitigated using silt fencing around the pump skid.

Cost Opinion

Table 5-24. Lake Intake Prime - Alternative 2

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$43
Submersible Pumps			$75
Piping & Misc Mechanical			$49
Electrical			$40
Contingency	25%		$43
Administrative	25%		$65
Total Capital			**$325**
Annual O&M Cost[1]			$15
Present Worth (i=3.5%, 30 years)			**$602**

1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement costs.

5.6 Deficiency 13 – Marla Bay Pump Station Piping Corrosion

The following section addresses deficiency 14 in the Needs and Alternatives Matrix.

5.6.1 Alternative 1 – Replace Coatings

Description

The alternative includes repainting of the existing MBPS piping, and touch up painting of the building.

Cost Opinion

Table 5-25. MBPS Piping Coating

Item	Quantity	Unit Cost	Cost (x$1,000)
Division 1			$3
Epoxy Coating – Piping	LS		$10
Acrylic Coating – Building	768 SF	$8	$6
Contingency	20%		$4
Administrative	25%		$6

Item	Quantity	Unit Cost	Cost (x$1,000)
Total			**$29**

5.7 Deficiency 14 – WTP Electrical

5.7.1 Alternative 1 – Surge Protection and UPS

Description

This alternative includes the following:

1. Addition of surge protection devices (SPD) to the electrical service switchboard and to each of the 2 low voltage panelboards, 3 units total. The installation for each SPD would include the SPD plus a circuit breaker for connection to the panel bus, 3 circuit breakers total.
2. Install an uninterruptible power supply (UPS) in the electrical room to serve the TESCO control panel and the 2 ozone control panels which are served from panelboard LP-B. This UPS should be sized for the combined panel load and at least 15 minutes operation.
3. Install a UPS power supply in the WTP treatment room near panelboard DP-1L to serve the 2 UV control panels and should be sized for the combined load or 2 UPS's could be installed, 1 for each UV panel for redundancy for at least 15 minutes operation.
4. Replace standby generator batteries with 2-12 volt heavy duty diesel starting batteries which are the current standard for such service.

Cost Opinion

Table 5-26. WTP Electrical

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$7
Surge Protection	LS		$18
UPS	2	$10	$20
Contingency	20%		$8
Administrative	25%		$13
Total			**$66**

5.8 Deficiency 15 – WTP Controls/SCADA

5.8.1 Alternative 1 – PLC, UPS Power Supply, and Miscellaneous

PLC

It is desired to replace the TESCO PLC system in the future because the equipment is older, the TESCO PLC system is proprietary and to better fit with the new long range SCADA master plan. The question is primarily one of timing and it is not expected to be upgraded for a few years. The treatment plant process was recently upgraded and it is not expected that another plant process upgrade will be needed for a number of years. The PLC upgrade can be done at any time and independent of any plant treatment process upgrades. The PLC upgrade needs to be carefully planned because of the impact on plant operations.

A similar PLC upgrade was completed at the Glenbrook treatment plant about 2 years ago as part of a plant process upgrade. The PLC and operator interface were changed out within the existing control panel which requires careful planning during design and construction because of the impact on plant operations. This avoided having to physically change out the plant control panel which would have been much more difficult. The following must be considered when the PLC system is upgraded.

The first decision would be whether or not to change out the plant control panel or just modify the existing panel for the new PLC system. There are important operational and physical considerations both ways.

In either case it will be necessary to obtain the latest panel drawings in order to plan the changes to the existing panel or to design a replacement panel. Providing complete modification drawings either as part of the design of the upgrade or as a shop drawing from the upgrade control integrator is necessary so the panel modifications or construction of a new panel can be accomplished.

The TESCO PLC program is not transferrable to any other brand PLC, but can be down loaded from the Liquitronic PLC. The usefulness of this downloaded program to programming the new PLC depends on the control integrator's familiarity with TESCO PLC code. If the control integrator can read the TESCO PLC code it will help in developing the program for the new PLC; if not the new program will have to be developed from scratch. In either case there will be debugging involved in the startup of the new PLC and it could involve considerable effort.

If the Liquitronic 5 is replaced with a SCADA Pak PLC, it would also eliminate the need for the L1000G PLC and existing SCADA Pak RTU. The L1000G is currently required to communicate between the LIQ-5 and UV control panels. This would result in a simpler system. Startup of the new PLC system needs to be carefully planned and allowances made for the field debugging and software development.

UPS

The TESCO L1000G provides a communications protocol interface between the Liquitronic 5 PLC's and the UV system PLC's. This interface is important as the

Liquitronic 5's call for the UV system to start and stop. If the L1000G interface can be backed-up it would be desirable. The cost would likely be about $10,000.

The Liquitronic 5 hot standby system is presently configured to generate an alarm to Cave Rock SCADA if a Liquitronic 5 PLC fails, but the actual switchover is manually initiated by the operator. We recommend that the hot standby PLC system be re-configured to switch over automatically upon a PLC failure and generate an alarm to Cave Rock SCADA in order to place the plant back in normal operation as soon as possible. This re-configuration may require a service visit by TESCO.

SCADA

Certain data is now transmitted from the ZWUD WTP to Cave Rock WTP and can be stored and retrieved at Cave Rock SCADA through the SCADA Pack and radio system. There is other data that is stored in the Liquitronic 5, but not transmitted to Cave Rock SCADA. The data stored in the Liquitronic 5 requires a special TESCO program and site visit for retrieval.

It is recommended that continuous data logging be provided at the ZWUD treatment plant. Performance data must be reported to the state monthly and normally this monthly data is compiled at the Cave Rock Treatment Plant based on data transmitted by radio communication to the Cave Rock Treatment Plant SCADA. If for any reason this communications link is lost, there is no data transmitted from ZWUD to Cave Rock and therefore the missing data is not available for the monthly report. Presently, it is very difficult and costly to retrieve this data from the ZWUD Plant.

The SCADA Pack RTU at ZWUD which transmits the plant data to Cave Rock SCADA does have capability for limited (up to several months) internal data storage.

It is recommended that SCADA Log software be acquired that will allow a laptop or other computer to access this data from the SCADA Pack RTU in such a form that it can be presented in an excel spreadsheet. This spreadsheet could act as an auxiliary report to accompany the monthly state report to fill in missing data from ZWUD plant, in the event there is a lapse in data transmission to Cave Rock SCADA for any reason.

There is no easy way for this missing data to be reentered into the Cave Rock SCADA historian so it would appear on the regular monthly report, but an auxiliary report would be second best to provide complete monthly reporting. The SCADA Log software would allow use of the storage in the SCADA Pack RTU and it is recommended that the ZWUD data be recorded continuously in the SCADA Pack RTU. When the limit of the RTU storage is reached after a few months the system would simply write over a continuous record of data available for download for the previous several months.

Miscellaneous

Assure that the radio antenna masts at each radio are solidly grounded and that each radio lead in cable from the antenna contains a grounded surge suppressor prior to connection to the radio.

There is a keypad in the ZWUD WTP control panel that is used for service work and this keypad should be mounted in a more secure manner in the panel. This could be done at the same time item 4 is performed.

Cost Opinion

Table 5-27. WTP Controls

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$12
PLC	LS		$51
UPS – L1000G	1	$10	$10
Misc Items	LS		$8
Contingency	25%		$17
Administrative	25%		$25
Total			**$124**

5.9 Deficiency 16 – Unstable Hypochlorite Residual

5.9.1 Alternative 1 – Dose Pace Feed Pumps and Move Injection Point

Description

This alternative includes replacement of the chemical feed pumps to implement dose pacing control, and moving the hypochlorite injection point to the high service pump discharge. The hypochlorite pump speed would be controlled in proportion to flow. The calcium thiosulfate feed pump rate would be controlled based on ozone residual. This would help alleviate over and under dosing of CT, which in turn will result in better chlorine residual control.

In addition, the hypochlorite injection would be moved further downstream from the CT injection point, to the high service pump discharge. This would be accomplished with a saddle tap, corporation stop, and PVC injection nozzle on the 8-inch discharge pipe. Moving the injection point from the clearwell to the pump discharge will provide the following benefits to address residual consistency:

- Improved mixing
- Additional ozone quench reaction time and greater separation from the calcium thiosulfate dosing point.

Figure

Figure 5-20. Hypochlorite Injection Point

Cost Opinion

Table 5-28. Hypochlorite Residual – Alternative 1

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$4
Hypochlorite Feed Pumps	2		$12.5
Move Injection Point	LS		$2
Contingency	25%		$4
Administrative	25%		$6
Total Capital			**$28**
Annual O&M Cost[1]			$2
Present Worth (i=3.5%, 30 years)			**$65**

1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement costs.

5.9.2 Alternative 2 – Dose Pace Feed Pumps and Add Mixers to Clear Well

Description

This alternative includes replacement of the chemical feed pumps to implement dose pacing control, as described under Alternative 1. A mechanical mixer would also be installed in the clearwell at the CT and hypochlorite injection points to improve mixing and reaction kinetics.

Figure

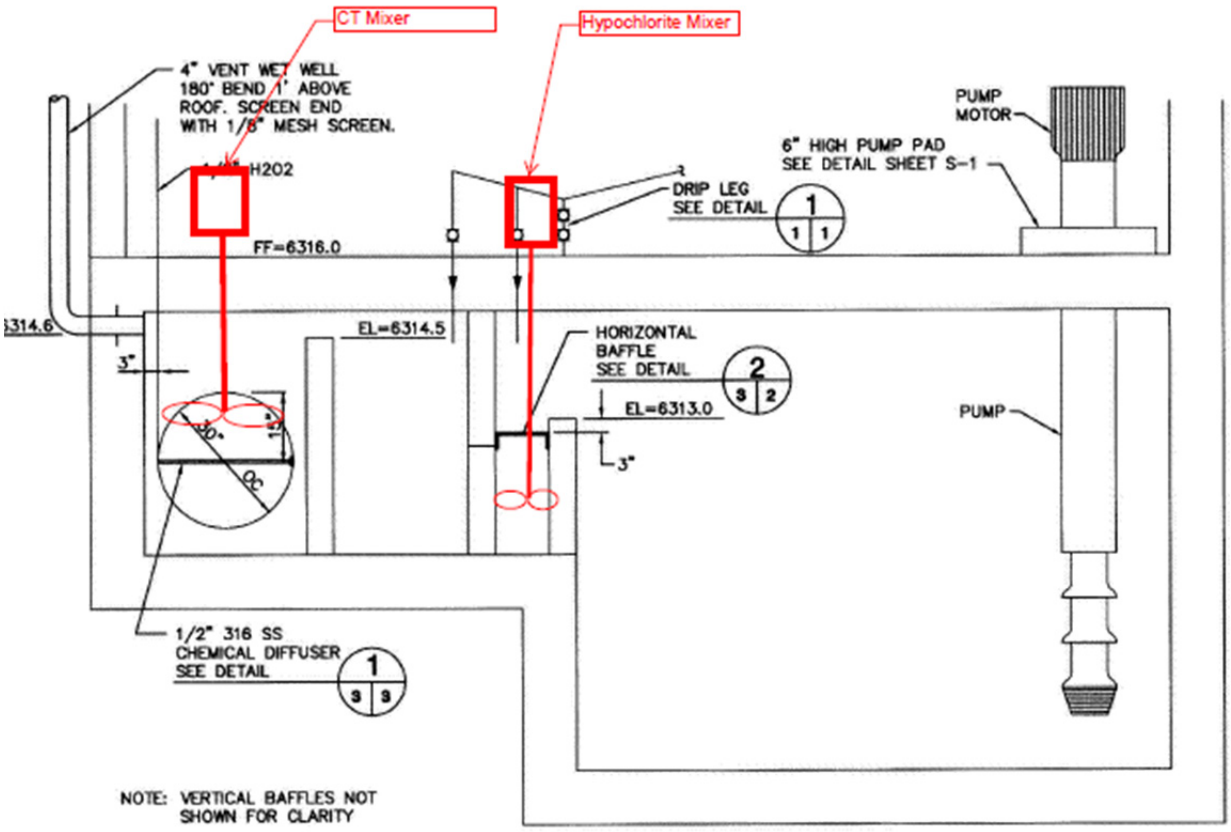


Figure 5-21 Clear Well Mixer Section

Cost Opinion

Table 5-29. Hypochlorite Residual – Alternative 2

Item	Quantity	Unit Cost (x$1,000)	Cost (x$1,000)
Division 1			$7
Hypochlorite Feed Pumps	2		$13
Mixer	LS		$16
Contingency	25%		$7
Administrative	25%		$11
Total Capital			**$54**
Annual O&M Cost[1]			$2
Present Worth (i=3.5%, 30 years)			**$91**

1 – Relative operation & maintenance cost to compare alternatives. Includes equipment replacement costs.

6 Alternatives Analysis

For the purpose of evaluating the alternatives, four weighted criteria will be used to develop an overall score. The criteria will be ranked on a scale of one (1) to four (4), with one being the highest (best) ranking, and 4 being the lowest (worst). The overall lowest score is considered the best alternative. Cost will be a stand alone criterion, which is not factored into the weighted score. The following criteria and weighting will be used to score the alternatives:

- Implementation (20%) – Is the alternative feasible to implement? Is the alternative constructible?
- Reliability (25%) – Will the alternative provide reliable results?
- Operability/Maintenance (40%) – Does the alternative require large quantities of time in terms of operator attention? Does the alternative require specialized maintenance requirements that cannot be performed in-house, or does it require frequent calibration, cleaning, tuning, etc. Does it require an ongoing contract for maintenance?
- Environmental Consideration (15%): Will the alternative be difficult to permit? Can TRPA thresholds be met? Are there short-term or long-term effects on the environment?

6.1 Deficiencies 1-8 – Fire Flow, Pressure, Velocity, Line Size Criteria, and Line Leaks

6.1.1 Rankings Summary

Table 6-1. Summary of Alternatives

Alternative	Description
1	Tank, Inspiration & Lookout Boosters, 4 PRVs, Pipelines
2	Tank, WTP & Lookout Boosters, 7 PRVs, Pipelines
3	Lookout Fire & Booster Pumps, Riven Rock Booster, Pipelines

Table 6-2. Deficiencies 1-8 Alternative Rankings

Criterion	Weight	Alternative Rank			Weighted Score		
Alternative		1	2	3	1	2	3
Implementation	20%	3.5	3	1	0.70	0.60	0.20
Reliability	25%	1	1.5	2.5	0.25	0.38	0.63
Operability/Maintenance	40%	2	2	2.5	0.80	0.80	1.00

Criterion	Weight	Alternative Rank			Weighted Score		
Environmental/Permitting	15%	4	**3.5**	1	0.60	0.53	0.15
				Net Score	2.4	2.3	2.0
				Net Rank	**3**	**2**	**1**

Notes:
Ranking 1 – 4, 1 is highest (best), 4 is lowest (worst).
Lowest net score is considered best alternative.

Life Cycle Cost

Life cycle or present worth costs were calculated for each alternative based on the following formula:

PW Cost = capital cost + annualized O&M Cost

Annualized O&M Cost taken over 30 years, with a discount rate of 3.5%.

The Operations and Maintenance costs used for the comparison were based on relative costs to fairly compare the alternatives. Costs that were the same for each alternative were not necessarily used in the calculation, since they cancel out. The following table summarizes the life cycle costs for each alternative. Detailed cost tables for each alternative are provided in the Appendix.

Table 6-3. Life Cycle Cost Summary

Alternative	PW Cost (x$1,000)
1 - Tank, Inspiration & Lookout Boosters, 4 PRVs, Pipelines	$13,356
2 - Tank, WTP & Lookout Boosters, 7 PRVs, Pipelines	$17,212
3 – Lookout Fire & Booster Pumps, Riven Rock Booster, Pipelines	$6,673

6.1.2 Implementation

Implementation of Alternatives 1 and 2 is difficult due to the several factors including the following:

- USFS easements required for the tank and access roads
- Construction of roads and pipeline up steep terrain, including areas of granite rock
- Pipeline will likely require directional drilling to construct

For these reasons, Alternatives 1 and 2 were ranked lower than Alternative 3, which does not have these issues. Alternative 1 was ranked slightly lower than 2, since it requires an additional booster station.

6.1.3 Reliability

Alternatives 1 and 2 are ranked higher for reliability than Alt 3 due to the fact that fire flows are gravity fed off the tank, which is the more reliable than a pump. Alt 1 is ranked slightly higher than 2 because it has fewer PRVs, which can fail. The fire pump in Alt 3 will be diesel driven and UL listed, which ensures the highest reliability for a pump.

6.1.4 Operability/Maintenance

Alternatives 1 and 2 are scored the same, since they both utilize the tank, and have offsetting values for the other components. Alt 1 has fewer PRVs, but an extra booster station. Alt 2 has just one booster, but more PRVs. It should be noted that will Alt 3 has the most pumps, it has the fewest PRVs.

6.1.5 Environmental/ Permitting

Alternative 3 is ranked the highest since it does not require TRPA permits and USFS easements for the tank and access road. It does, however, require permits and easements for two new booster stations. Alternative 1 is ranked lower than 2 since it requires permits and easements for the Inspiration Booster Station.

6.1.6 Recommended Alternative

Alternative 3 is recommended based on the combination of highest score and lowest life cycle cost. Douglas County does not normally advocate the use of fire pumps. However, in this case, a fire pump should be considered due to the significant implantation, permitting, and costs associated with installing a new tank. Fire pumps are successfully used in many communities where topography prohibits the use of gravity tanks.

6.2 Deficiency 12 – Lake Intake Loss of Prime

6.2.1 Rankings Summary

Table 6-4. Summary of Alternatives

Alternative	Description
1	Self Priming Pumps
2	Submersible Pumps

Table 6-5. Deficiency 12 Alternative Rankings

Criterion	Weight	Alternative Rank		Weighted Score	
Alternative		1	2	1	2
Implementation	20%	1	2	0.20	0.40

Criterion	Weight	Alternative Rank		Weighted Score	
Reliability	25%	1	2	0.25	0.50
Operability/Maintenance	40%	1	4	0.40	1.60
Environmental/Permitting	15%	1	2.5	0.15	0.38
			Net Score	1.0	2.9
			Net Rank	**1**	**2**

Notes:
Ranking 1 – 4, 1 is highest (best), 4 is lowest (worst).
Lowest net score is considered best alternative.

Life Cycle Cost

Alternative	PW Cost (x$1,000)
1 – Self Priming Pumps	$420
2 – Submersible Pumps	$602

6.2.2 Implementation

Alternative 1 easily scores higher for ease of installation, since the pumps can be installed within the existing pump station, versus in the lake for Alt 2, which requires a barge and divers.

6.2.3 Reliability

In theory, each pump alternative is equally reliable, assuming equal quality pumps. However, small submersible pumps tend to be of a lower quality than a self priming centrifugal, so Alt 1 was ranked higher.

6.2.4 Operability/Maintenance

This criterion easily favors the self priming pump, since it is readily accessible for maintenance, unlike a submersible which requires divers to access. If there are problems with the pumps, they must be shipped to the factor for repairs or replaced.

6.2.5 Environmental/ Permitting

This criterion also easily favors Alt 1, since there are no permits needed (outside of the County) for this alternative, whereas submersible pumps may require a TRPA permit to install and definitely require BMPs.

6.2.6 Recommended Alternative

Alternative 1 is recommended based on the combination of highest score and lowest life cycle cost. Douglas County does not typically advocate the use of submersible pumps for critical installations such as this.

6.3 Deficiency 16 – Unstable Hypochlorite Residual

6.3.1 Rankings Summary

Table 6-6 Summary of Alternatives

Alternative	Description
1	Dose Pace Pumps & Move Injection Point
2	Dose Pace Pumps & Mechanical Mixer

Table 6-7. Deficiency 16 Alternative Rankings

Criterion	Weight	Alternative Rank		Weighted Score	
Alternative		1	2	1	2
Implementation	20%	1	2	0.20	0.40
Reliability	25%	1	1.5	0.25	0.38
Operability/Maintenance	40%	1	1.5	0.40	0.60
Environmental/Permitting	15%	NA	NA	-	-
			Net Score	0.9	1.4
			Net Rank	**1**	**2**

Notes:
Ranking 1 – 4, 1 is highest (best), 4 is lowest (worst).
Lowest net score is considered best alternative.

Life Cycle Cost

Alternative	PW Cost (x$1,000)
1 – Move Injection Point	$65
2 – Mechanical Mixer	$91

6.3.2 Implementation

Alternative 1 was ranked higher since it was deemed easier to move the injection point, than to install the wetwell mixer. For Alt 1, a saddle tap and diffuser can easily be installed on the High Service Pump discharge pipe. Installing a wetwell mixer will be more complicated, since it requires coring through the floor, and location is critical.

6.3.3 Reliability

If properly implemented, either alterative should provide a more reliable hypochlorite residual than the current arrangement. A slight edge is given to Alt 1 since it is easier to implement, and thus more likely to work properly.

6.3.4 Operability/Maintenance

Again, these two are close, but a slight edge to Alt 1 since there is really nothing to maintain with respect to the injection point. Alt 2 involves a mechanical mixer, which may require maintenance at some point.

6.3.5 Environmental/ Permitting

This criterion does not really apply, since neither alternative requires a permit outside of the County. It was not used in the weighted ranking of the alternatives.

6.3.6 Recommended Alternative

Alternative 1 is recommended based on the combination of highest score and lowest life cycle cost.

7 Prioritization of Improvements and Cost Summary

7.1 Discussion of Priorities

Prioritization of projects are based on risk. System deficiencies with higher associated risk consequences will be given higher priority. The projects are grouped into four priority categories as follows:

- Priority 1 – These deficiencies represent public health and safety risks. Consequence of failure is includes potential loss of life and property.
- Priority 2 – Represent deficiencies which may result in temporary disruption of water service or compliance, but generally minimal public health and safety impacts.
- Priority 3 – Represent deficiencies which may result in less efficient operations, but are not likely to cause loss or disruption of service or compliance.
- Priority 4 – Represent projects which may result in further gains in efficiency from priority 3, but are not directly needed for operations. Projects in this category represent “wants” more than “needs”, and do not address code violations.

7.1.1 Priority 1 Projects

Priority 1 projects address direct threats to public health and safety.

Fire flow and storage limitations represent potential threats to public health and safety. Potential results of insufficient fire flow and storage include loss of property and life. As such, project(s) that address Deficiencies 1-4 were deemed the only Priority 1 projects.

7.1.2 Priority 2 Projects

Priority 2 project address deficiencies which result in system shutdown downs and minor compliance issues. These deficiencies generally do not pose threats to public health.

Line leaks result in partial system shutdowns, and risk distribution system contamination. Projects that address Deficiency 8 were considered Priority 2 level due to the number and frequency of shutdowns, and associated disinfection of the distribution system.

Electrical surges and voltage fluctuations may result in system shutdowns, and damage to critical controls equipment. Projects that address Deficiencies 14 and 15 were considered Priority 2 level for this reason.

Unstable hypochlorite residual may result in non-compliance due to high or low chlorine residual levels. Projects that address Deficiency 16 were considered Priority 2 level for this reason.

7.1.3 Priority 3 Projects

Priority 3 projects generally address deficiencies which result in less efficient system operation, but no threats to public health or safety. The majority of the deficiencies fall into this category.

7.1.4 Priority 4 Projects

Priority 4 projects are not related directly to code requirements, but may provide benefits to the system reliability and efficiency. These projects are more “wants” than “needs”.

The Cave Rock system intertie to address water supply redundancy was classified as Priority 4, since it is not required by code. However, in an emergency situation such as loss of the tank or water treatment plant, it could provide a valuable backup source for either system.

7.2 Project Priority Summary and Costs

Table 7-1. Project Priority Summary and Costs

Deficiency No.	Description	Priority	Recommended Alternative	Capital Cost (x$1,000)
1-4	Fire Flow, & Pressure Criteria	1	3 - Fire & Booster Pumps	$1,643
8	Line Leaks	2	Replace Lines	$195
14	WTP Electrical	2	Surge Protection & UPS	$66
15	WTP SCADA & Controls	2	UPS & SCADA PAK & SCADA LOG	$124
16	Unstable Hypochlorite Residual	2	1 - Dose Pace & Move Injection Point	$28
12	Lake Intake Prime	3	1 - Self-Priming Pumps	$143
9	Storage Tank Coating	3	Recoat Tank	$358
11	Water Conservation	3	Water Meters & Dedicated Services	$1,563
10	Water Supply Redundancy	4	Cave Rock Intertie & Booster Station	$1,723
13	MBPS Piping & Building Coatings	4	Recoat Piping & Building	$29
5, 6	Max Velocity Criteria	4	Upsize Lines	$8,239

8 References

1. Fluid Dynamics - Water System Evaluation for ZWUD Water System Report, May 08, 2008

2. Blue Locker Commercial Diving Services – Douglas County ZWUD – Steel Reservoir Inspection, September 9, 2013

3. CH2M HILL - SCADA Master Plan Technical Memorandum, June 1, 2015

4. Blue Locker Commercial Diving Services – Douglas County ZWUD Pipeline Inspection, October 17, 201

APPENDIX A – COST OPINIONS

	Job No.			Calc. No.	
Computation					
Project:	Lake Water Preliminary Engineering			***Computed:***	JB
Subject:	Fire Flow, Pressure, and Storage Criteria			***Date:***	1/7/2016
Task:	Deficiency 1-8 Alternative 1			***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1*			***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$217,700
Demobilization	1	LS	1.00%	$71,100
Bonds and Insurance	1	LS	2.50%	$180,500
Construction Facilities/Fencing	1	LS	0.50%	$35,400
General Conditions	1	LS	2.00%	$143,700
Shop Drawings and O&M Manuals	1	LS	2.00%	$143,700
Facilities Start-up & Testing	1	LS	2.00%	$143,700
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$782,100
SUBTOTAL			23.0%	**$1,742,900**
Pipelines *(includes patch paving)*				
8" DIP	15476	LF	$193	$2,987,388
8" Gate Valve	20	EA	$2,900	$58,000
10" DIP	7164	LF	$227	$1,626,933
10" Gate Valve	9	EA	$3,200	$28,800
SUBTOTAL				**$4,701,121**
Pressure Reducing Stations				
8" PRV	4	EA	$54,692	$218,768
SUBTOTAL				**$218,768**
Water Tank				
Welded steel tank	500,000	Gal	$1.00	$500,000
Coating	17,316	SF	$7.00	$121,212
Conc Foundation	96	CY	$400	$38,397
Clearing & Grubing	1	AC	$10,000	$10,000
Site Grading	873	SY	$6.00	$5,236
Backfill, Structural	582	CY	$25.00	$14,544
AC Paving	349	SY	$36	$12,566
Telemetry		LS		$30,000
BMPs		LS		$10,000
Directional Drill Pipeline	700	LF	$250	$175,000
SUBTOTAL				**$916,956**
Tank Access Road				
Clearing & Grubing	1	AC	$20,000	$20,000
Site Grading	3,002	SY	$6.00	$18,013
Backfill, Structural	1,000	CY	$30.00	$30,000
Earthwork Cut	1,000	CY	$35.00	$35,000
AC Paving	2,500	SY	$36	$90,000
5' Reinforced Conc Retaining Wall, 33d Slope Embankment	1800	LF	$280	$504,000
SUBTOTAL				**$697,013**
Inspiration Booster Station				
Turn-key booster skid, 600 gpm firm capacity		LS		$150,000
Installation		LS	50%	$75,000
Yard Piping, 8" DIP	100	LF	$220	$22,000
20 KW Standby Generator		LS		$28,200
Switch Gear & Installation		LS	100%	$28,200
Steel Building, 14'x18'	252	SF	$75	$18,900
Conc Foundation	19	CY	$250	$4,667
Clearing & Grubing	348	SY	$10.00	$3,480
Site Grading	348	SY	$6.00	$2,088
Fencing, 6' chain link, vinyl slats	224	LF	$45	$10,080
Gate, Electric Cantilever	1	EA	$10,000	$10,000
AC Paving	207	SY	$36	$7,440
Electrical		35%		$56,000
Telemetry		LS		$15,000
SUBTOTAL				**$431,055**
Lookout Booster Station				

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
Turn-key booster skid, and pneumatic tank, 20 gpm firm capacity		LS		$15,000
Installation		LS	50%	$7,500
Yard Piping, 4" DIP	50	LF	$100	$5,000
Steel Building	100	SF	$75	$7,500
Conc Foundation	7	CY	$250	$1,852
Clearing & Grubing	278	SY	$10.00	$2,778
Site Grading	278	SY	$6.00	$1,667
Fencing, 6' chain link, vinyl slats	200	LF	$45	$9,000
Gate	1	EA	$2,500	$2,500
AC Paving	167	SY	$36	$6,000
Electrical		35%		$7,875
Telemetry		LS		$7,000
SUBTOTAL				**$73,671**

SUBTOTAL	$7,038,585
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$1,742,900
SUBTOTAL 2	$8,781,485
CONTINGENCY (25%)	$1,759,646
SUBTOTAL 3	$8,781,000
ADMINISTRATIVE (25%)	$2,195,000
TOTAL	**$10,976,000**

Deficiency 1-8 Alt 1 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
500,000 Gal Tank Coating	1	$264,000	20	$13,200
Inspiration Booster Pumps	2	$50,000	15	$6,667
WTP Booster Pumps	2	$100,000	15	$13,333
20 KW Standby Generator	1	$42,000	20	$2,100
Lookout Booster	1	$15,000	15	$1,000
Total ($/yr)				$36,300

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Inspiration Booster Pumps		15	0.9	14	143
WTP Booster Pumps		62	0.9	56	588
Building LVP	30	5	0.9	4.5	108
Lookout Booster		1	0.9	0.57	14
Total (kWhr/day)					853
Total (kWhr/yr)					311241
$/kWhr					$ 0.12
$/yr					$37,400

Labor[2]

Personnel	$/hr[1]	No.	Hr/week	$/yr
Operator	$40	2	8	$33,280
Supervisor	$65	1	2	$6,760
Maintenance	$45	1	4	$9,360
SCADA/Electrical/Instrumentation	$50	1	2	$5,200
Total (4/yr)				$54,600

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	129,000
Present Worth O&M (3.5%, 30 years)	18.446	$	2,380,000
Present Worth Cost		**$**	**13,356,000**

	Job No.			Calc. No.	
Computation					
Project:	Lake Water Preliminary Engineering			***Computed:***	JB
Subject:	Fire Flow, Pressure, and Storage Criteria			***Date:***	1/7/2016
Task:	Deficiency 1-8 Alternative 2			***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1-*			***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$251,300
Demobilization	1	LS	1.00%	$82,100
Bonds and Insurance	1	LS	2.50%	$208,300
Construction Facilities/Fencing	1	LS	0.50%	$40,900
General Conditions	1	LS	2.00%	$165,800
Shop Drawings and O&M Manuals	1	LS	2.00%	$165,800
Facilities Start-up & Testing	1	LS	2.00%	$165,800
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$902,600
SUBTOTAL			23.0%	**$2,007,600**
Pipelines ***(includes patch paving)***				
8" DIP	13059	LF	$193	$2,520,826
8" Gate Valve	17	EA	$2,900	$49,300
10" DIP	13128	LF	$227	$2,981,347
10" Gate Valve	17	EA	$3,200	$54,400
12" DIP	1377	LF	$275	$378,675
12" Gate Valve	2	EA	$4,000	$8,000
SUBTOTAL				**$5,992,549**
Pressure Reducing Stations				
8" PRV	7	EA	$54,700	$382,900
SUBTOTAL				**$382,900**
Water Tank				
Welded steel tank	500,000	Gal	$1.00	$500,000
Coating	17,316	SF	$7.00	$121,212
Conc Foundation	96	CY	$400	$38,397
Clearing & Grubing	1	AC	$10,000	$10,000
Site Grading	873	SY	$6.00	$5,236
Backfill, Structural	582	CY	$25.00	$14,544
AC Paving	349	SY	$36	$12,566
Telemetry		LS		$30,000
BMPs		LS		$10,000
Directional Drill Pipeline	700	LF	$250	$175,000
SUBTOTAL				**$916,956**
Tank Access Road				
Clearing & Grubing	1	AC	$20,000	$20,000
Site Grading	3,002	SY	$6.00	$18,013
Backfill, Structural	1,000	CY	$30.00	$30,000
Earthwork Cut	1,000	CY	$35.00	$35,000
AC Paving	2,500	SY	$36	$90,000
5' Reinforced Conc Retaining Wall, 33d Slope Embankment	1800	LF	$280	$504,000
SUBTOTAL				**$697,013**
Lookout Booster Station				
Turn-key booster skid, and pneumatic tank, 20 gpm firm capacity		LS		$15,000
Installation		LS	50%	$7,500
Yard Piping, 4" DIP	50	LF	$100	$5,000
Steel Building	100	SF	$75	$7,500
Conc Foundation	7	CY	$250	$1,852
Clearing & Grubing	278	SY	$10.00	$2,778
Site Grading	278	SY	$6.00	$1,667
Fencing, 6' chain link, vinyl slats	200	LF	$45	$9,000
Gate	1	EA	$2,500	$2,500
AC Paving	167	SY	$36	$6,000

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
Electrical		35%		$7,875
Telemetry		LS		$7,000
SUBTOTAL				**$73,671**
WTP Booster Station Modifications				
Replace Pump Bowl Assembly for Increased Head	2	EA	$15,000	$30,000
Labor		100%		$30,000
SUBTOTAL				**$60,000**

SUBTOTAL	$8,123,089
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$2,007,600
SUBTOTAL 2	$10,130,689
CONTINGENCY (25%)	$2,030,772
SUBTOTAL 3	$12,161,000
ADMINISTRATIVE (25%)	$3,040,000
TOTAL	**$15,201,000**

Deficiency 1-8 Alt 2 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
500,000 Gal Tank Coating	1	$264,000	20	$13,200
WTP Booster Pumps	2	$100,000	15	$13,333
Lookout Booster	1	$15,000	15	$1,000
Total ($/yr)				$27,600

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
WTP Booster Pumps		69	0.9	62	655
Lookout Booster		1	0.9	0.57	14
Total (kWhr/day)					669
Total (kWhr/yr)					244031
$/kWhr					$ 0.12
$/yr					$29,300

Labor[2]

Personnel	$/hr[1]	No.	Hr/week	$/yr
Operator	$40	2	8	$33,280
Supervisor	$65	1	2	$6,760
Maintenance	$45	1	4	$9,360
SCADA/Electrical/Instrumentation	$50	1	1	$2,600
Total (4/yr)				$52,000

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	109,000
Present Worth O&M (3.5%, 30 years)	18.446	$	2,011,000
Present Worth Cost		**$**	**17,212,000**

	Job No.			Calc. No.	
Computation					
Project:	Lake Water Preliminary Engineering			***Computed:***	JB
Subject:	Fire Flow, Pressure, and Storage Criteria			***Date:***	1/7/2016
Task:	Deficiency 1-8 Alternative 3			***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1-*			***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$176,700
Demobilization	1	LS	1.00%	$57,700
Bonds and Insurance	1	LS	2.50%	$146,500
Construction Facilities/Fencing	1	LS	0.50%	$28,700
General Conditions	1	LS	2.00%	$116,600
Shop Drawings and O&M Manuals	1	LS	2.00%	$116,600
Facilities Start-up & Testing	1	LS	2.00%	$116,600
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$634,600
SUBTOTAL			23.0%	**$1,419,000**
Pipelines ***(includes patch paving)***				
8" DIP	12841	LF	$193	$2,478,745
8" Gate Valve	17	EA	$2,900	$49,300
10" DIP	8534	LF	$227	$1,938,058
10" Gate Valve	11	EA	$3,200	$35,200
12" DIP	1234	LF	$275	$339,350
12" Gate Valve	2	EA	$4,000	$8,000
SUBTOTAL				**$4,848,652**
Tank Booster Station & Fire Pump				
Turn-key booster/fire pump skid, 1700/2300 gpm firm capacity		LS		$315,000
Installation			30%	$94,500
Diesel Storage Tank		LS		$20,000
Yard Piping, 10" DIP	160	LF	$235	$37,600
11.5 KW Standby Generator		LS		$22,500
Switch Gear & Installation		LS	100%	$22,500
Steel Building, 50'x20'	1000	SF	$75	$75,000
Conc Foundation	74	CY	$250	$18,519
Clearing & Grubing	356	SY	$10.00	$3,556
Site Grading	356	SY	$6.00	$2,133
Fencing, 6' chain link, vinyl slats	320	LF	$45	$14,400
Gate, Electric Cantilever	1	EA	$10,000	$10,000
AC Paving	422	SY	$36	$15,200
Electrical		LS	20%	$65,000
Telemetry		LS		$15,000
SUBTOTAL				**$730,907**
Riven Rock Road Booster Station				
Turn-key booster skid, 80 gpm firm capacity		LS		$40,000
Installation		LS	40%	$16,000
Yard Piping, 10" DIP	100	LF	$175	$17,500
Steel Building, 14'x10'	140	SF	$100	$14,000
Conc Foundation	10	CY	$250	$2,593
Clearing & Grubing	300	SY	$10.00	$3,000
Site Grading	300	SY	$6.00	$1,800
Fencing, 6' chain link, vinyl slats	208	LF	$45	$9,360
Swing Gate	1	EA	$800	$800
AC Paving	180	SY	$36	$6,480
Electrical		LS	25%	$10,000
Telemetry		LS		$10,000
SUBTOTAL				**$131,533**

SUBTOTAL $5,711,092

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
			(ADDITIVE FOR) DIVISION 1 (ABOVE)	$1,419,000
			SUBTOTAL 2	$7,130,092
			CONTINGENCY (25%)	$1,427,773
			SUBTOTAL 3	$8,558,000
			ADMINISTRATIVE (25%)	$2,140,000
			TOTAL	$10,698,000

Deficiency 1-8 Alt 3 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
Fire Pump	1	$202,500	20	$10,125
Tank Booster Pumps	2	$50,000	15	$6,667
Riven Rock Booster Pumps	2	$47,250	15	$6,300
WTP Booster Pumps	2	$100,000	15	$13,333
11.5 KW Standby Generator	1	$35,000	20	$1,750
Lookout Booster	1	$15,000	15	$1,000
Total ($/yr)				$39,200

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Tank Booster Pumps		25	0.9	23	84
Riven Rock Pumps		2	0.9	1	15
WTP Booster Pumps		62	0.9	56	588
Building LVP	30	10	0.9	9	216
Lookout Booster		1	0.9	0.57	14
Total (kWhr/day)					917
Total (kWhr/yr)					334537
$/kWhr					$ 0.12
$/yr					$40,200

Labor[2]

Personnel	$/hr[1]	No.	Hr/week	$/yr
Operator	$40	2	12	$49,920
Supervisor	$65	1	2	$6,760
Maintenance	$45	1	6	$14,040
SCADA/Electrical/Instrumentation	$50	1	2	$5,200
Total (4/yr)				$76,000

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	156,000
Present Worth O&M (3.5%, 30 years)	18.446	$	2,878,000
Present Worth Cost		**$**	**13,576,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Fire Flow & Pressure Criteria		***Date:***	1/7/2016
Task:	Deficiency 1-4 Alternative 3		***Reviewed:***	
File Name:	C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$26,700
Demobilization	1	LS	1.00%	$8,800
Bonds and Insurance	1	LS	2.50%	$22,200
Construction Facilities/Fencing	1	LS	0.50%	$4,400
General Conditions	1	LS	2.00%	$17,700
Shop Drawings and O&M Manuals	1	LS	2.00%	$17,700
Facilities Start-up & Testing	1	LS	2.00%	$17,700
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$95,900
SUBTOTAL			23.0%	**$236,100**
Lookout Booster Station & Fire Pump				
Turn-key booster/fire pump skid, 1700/2300 gpm firm capacity		LS		$315,000
Installation			30%	$94,500
Diesel Storage Tank		LS		$20,000
Yard Piping, 10" DIP	160	LF	$235	$37,600
11.5 KW Standby Generator		LS		$22,500
Switch Gear & Installation		LS	100%	$22,500
Steel Building, 50'x20'	1000	SF	$75	$75,000
Conc Foundation	74	CY	$250	$18,519
Clearing & Grubing	356	SY	$10.00	$3,556
Site Grading	356	SY	$6.00	$2,133
Fencing, 6' chain link, vinyl slats	320	LF	$45	$14,400
Gate, Electric Cantilever	1	EA	$10,000	$10,000
AC Paving	422	SY	$36	$15,200
Electrical		LS	20%	$65,000
Telemetry		LS		$15,000
SUBTOTAL				**$730,907**
Riven Rock Road Booster Station				
Turn-key booster skid, 80 gpm firm capacity		LS		$40,000
Installation		LS	40%	$16,000
Yard Piping, 10" DIP	100	LF	$175	$17,500
Steel Building, 14'x10'	140	SF	$100	$14,000
Conc Foundation	10	CY	$250	$2,593
Clearing & Grubing	300	SY	$10.00	$3,000
Site Grading	300	SY	$6.00	$1,800
Fencing, 6' chain link, vinyl slats	208	LF	$45	$9,360
Swing Gate	1	EA	$800	$800
AC Paving	180	SY	$36	$6,480
Electrical		LS	25%	$10,000
Telemetry		LS		$10,000
SUBTOTAL				**$131,533**

SUBTOTAL	$862,440
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$236,100
SUBTOTAL 2	$1,098,540
CONTINGENCY (25%)	$215,610
SUBTOTAL 3	$1,314,000
ADMINISTRATIVE (25%)	$329,000
TOTAL	**$1,643,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Max Velocity Criteria		***Date:***	1/7/2016
Task:	Deficiency 5, 6 Line Upsize Alternative 3		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def S*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$136,000
Demobilization	1	LS	1.00%	$44,400
Bonds and Insurance	1	LS	2.50%	$112,700
Construction Facilities/Fencing	1	LS	0.50%	$22,100
General Conditions	1	LS	2.00%	$89,700
Shop Drawings and O&M Manuals	1	LS	2.00%	$89,700
Facilities Start-up & Testing	1	LS	2.00%	$89,700
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$488,300
SUBTOTAL			23.0%	**$1,097,600**
Pipelines ***(includes patch paving)***				
Tie-Ins	4	EA	$10,000	$40,000
8" DIP	11616	LF	$193	$2,242,279
8" Gate Valve	15	EA	$2,900	$43,500
10" DIP	8481	LF	$227	$1,926,021
10" Gate Valve	11	EA	$3,200	$35,200
12" DIP	377	LF	$275	$103,675
12" Gate Valve	1	EA	$4,000	$4,000
SUBTOTAL				**$4,394,675**

SUBTOTAL	$4,394,675
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$1,097,600
SUBTOTAL 2	$5,492,275
CONTINGENCY (25%)	$1,098,669
SUBTOTAL 3	$6,591,000
ADMINISTRATIVE (25%)	$1,648,000
TOTAL	**$8,239,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Line Leaks		***Date:***	1/7/2016
Task:	Deficiency 8 - Line Leaks Alternative 3		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 8*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$2,700
Demobilization	1	LS	1.00%	$900
Bonds and Insurance	1	LS	2.50%	$2,300
Construction Facilities/Fencing	1	LS	0.50%	$500
General Conditions	1	LS	2.00%	$1,800
Shop Drawings and O&M Manuals	1	LS	2.00%	$1,800
Facilities Start-up & Testing	1	LS	2.00%	$1,800
Traffic Control		LS		$25,000
Contractor Overhead & Profit		LS	10.00%	$9,700
SUBTOTAL			23.0%	**$46,500**
Pipelines ***(includes patch paving)***				
8" DIP	375	LF	$193	$72,388
8" Gate Valve	1	EA	$2,900	$2,900
Tie-Ins	2	EA	$6,000	$12,000
SUBTOTAL				**$87,288**

SUBTOTAL	$87,288
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$46,500
SUBTOTAL 2	$133,788
CONTINGENCY (25%)	$21,822
SUBTOTAL 3	$156,000
ADMINISTRATIVE (25%)	$39,000
TOTAL	**$195,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	***Computed:***	JB
Subject:	Tank Coating	***Date:***	1/7/2016
Task:	Deficiency 9 - Alternative 1	***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 9*	***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$6,400
Demobilization	1	LS	1.00%	$2,100
Bonds and Insurance	1	LS	2.50%	$5,300
Construction Facilities/Fencing	1	LS	0.50%	$1,100
Contractor Overhead & Profit		LS	10.00%	$23,000
SUBTOTAL			17.0%	**$37,900**
Temporary Tank				
100,000 Gal Tank Rental	40	Day	$250	$10,000
Tank Mob/De-mob		LS		$5,000
Temp 8" Piping		LS		$7,500
SUBTOTAL				**$22,500**
Overcoating				
Tank Exterior - Overcoat Existing Coating	8859	SF	$7.6	$67,189
SUBTOTAL				**$67,189**
New Coating				
Tank Interior - 100% Solids Epoxy	11687	SF	$10	$116,867
SUBTOTAL				**$116,867**

SUBTOTAL	$206,556
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$37,900
SUBTOTAL 2	$244,456
CONTINGENCY (20%)	$41,311
SUBTOTAL 3	$286,000
ADMINISTRATIVE (25%)	$72,000
TOTAL	**$358,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	**Computed:**	JB
Subject:	System Redundancy - Cave Rock Intertie	**Date:**	1/7/2016
Task:	Deficiency 10 Alternative 1	**Reviewed:**	
File Name:	C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1	**Date:**	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$28,400
Demobilization	1	LS	1.00%	$9,300
Bonds and Insurance	1	LS	2.50%	$23,500
Construction Facilities/Fencing	1	LS	0.50%	$4,600
General Conditions	1	LS	2.00%	$18,700
Shop Drawings and O&M Manuals	1	LS	2.00%	$18,700
Facilities Start-up & Testing	1	LS	2.00%	$18,700
Traffic Control		LS		$10,000
Contractor Overhead & Profit		LS	10.00%	$101,700
SUBTOTAL			23.0%	**$233,600**
Pipelines				
10" DIP	2,600	LF	$200	$520,000
10" Gate Valve	4	EA	$3,200	$12,800
System Tie-ins	2	EA	$15,000	$30,000
BMPs		LS		$10,000
SUBTOTAL				**$572,800**
Booster Station				
Turn-key booster skid, 600 gpm firm capacity		LS		$150,000
Installation		LS	30%	$45,000
Yard Piping, 8" DIP	100	LF	$220	$22,000
Steel Building, 14'x18'	252	SF	$75	$18,900
Conc Foundation	19	CY	$250	$4,667
Clearing & Grubing	348	SY	$10.00	$3,480
Site Grading	348	SY	$6.00	$2,088
Fencing, 6' chain link, vinyl slats	224	LF	$45	$10,080
Gate, Electric Cantilever	1	EA	$10,000	$10,000
AC Paving	207	SY	$25	$5,167
Electrical		35%		$56,000
Telemetry		LS		$15,000
SUBTOTAL				**$342,381**

SUBTOTAL	$915,181
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$233,600
SUBTOTAL 2	$1,148,781
CONTINGENCY (25%)	$228,795
SUBTOTAL 3	$1,378,000
ADMINISTRATIVE (25%)	$345,000
TOTAL	**$1,723,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	***Computed:***	JB
Subject:	Water Conservation - Water Meters	***Date:***	1/7/2016
Task:	Deficiency 11 - Alternative 1	***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1*	***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$27,700
Demobilization	1	LS	1.00%	$9,100
Bonds and Insurance	1	LS	2.50%	$23,000
Construction Facilities/Fencing	1	LS	0.50%	$4,500
General Conditions	1	LS	2.00%	$18,300
Shop Drawings and O&M Manuals	1	LS	2.00%	$18,300
Traffic Control		LS		$15,000
Contractor Overhead & Profit		LS	10.00%	$15,000
SUBTOTAL			21.0%	**$130,900**
New Services [1]				
Marla Bay - 3/4-in residential	11	EA	$11,200	$123,200
Zephyr Heights - 3/4-in residential	4	EA	$11,200	$44,800
Highway 50 Corridor - 1-in commercial	3	EA	$12,000	$36,000
SUBTOTAL				**$204,000**
Residential Meters				
Install 3/4" Meter, Yolk, and Pit Assembly	422	EA	$1,570	$662,540
Install 1" Meter, Yolk, and Pit Assembly	3	EA	$1,800	$5,400
SUBTOTAL				**$667,940**
Commercial Meters				
Install 3/4" Meter, Yolk, and Pit Assembly	9	EA	$1,570	$14,130
Install 1" Meter, Yolk, and Pit Assembly	1	EA	$2,280	$2,280
Install 2" Meter, Yolk, and Pit Assembly	2	EA	$3,530	$7,060
SUBTOTAL				**$23,470**

1 - Based on assumed 80-foot service length

SUBTOTAL	$895,410
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$130,900
SUBTOTAL 2	$1,026,310
CONTINGENCY (25%)	$223,853
SUBTOTAL 3	$1,250,000
ADMINISTRATIVE (25%)	$313,000
TOTAL	**$1,563,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Intake Prime - Self Priming Pumps		***Date:***	1/7/2016
Task:	Deficiency 12 Alternative 1		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$2,400
Demobilization	1	LS	1.00%	$800
Bonds and Insurance	1	LS	2.50%	$2,000
Construction Facilities/Fencing	1	LS	0.50%	$400
General Conditions	1	LS	2.00%	$1,600
Shop Drawings and O&M Manuals	1	LS	2.00%	$1,600
Facilities Start-up & Testing	1	LS	2.00%	$1,600
Contractor Overhead & Profit		LS	10.00%	$8,500
SUBTOTAL			23.0%	**$18,900**
MBPS				
Self Priming Pumps, 450 gpm @115' TDH	2	EA	$20,000	$40,000
Installation		LS	40%	$16,000
Misc Piping/ Mechanical		LS		$12,000
Electrical		LS	20%	$8,000
SUBTOTAL				**$76,000**

SUBTOTAL	$76,000
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$18,900
SUBTOTAL 2	$94,900
CONTINGENCY (25%)	$19,000
SUBTOTAL 3	$114,000
ADMINISTRATIVE (25%)	$29,000
TOTAL	**$143,000**

Deficiency 12 Alt 1 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
Pumps	2	$27,000	20	$2,700
Total ($/yr)				$2,700

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Self Priming Pumps		17	0.9	16	230

Total (kWhr/day)		230
Total (kWhr/yr)		84070
$/kWhr	$	0.12
$/yr		$10,100

Labor[2]

Personnel	$/hr[1]	No.	Hr/Year	$/yr	
Operator	$40	2	8	$640	
Supervisor	$65	1	2	$130	
Maintenance	$45	1	24	$1,080	
SCADA/Electrical/Instrumentation	$50	1	2	$100	
Total					$2,000

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	15,000
Present Worth O&M (3.5%, 30 years)	18.446	$	277,000
Present Worth Cost		**$**	**420,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Intake Prime - Submersible Pumps		***Date:***	1/7/2016
Task:	Deficiency 12 Alternative 2		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$5,400
Demobilization	1	LS	1.00%	$1,800
Bonds and Insurance	1	LS	2.50%	$4,500
Construction Facilities/Fencing	1	LS	0.50%	$900
General Conditions	1	LS	2.00%	$3,600
Shop Drawings and O&M Manuals	1	LS	2.00%	$3,600
Facilities Start-up & Testing	1	LS	2.00%	$3,600
Contractor Overhead & Profit		LS	10.00%	$19,300
SUBTOTAL			23.0%	**$42,700**
Demo				
Pipe and Anchors		LS		$10,000
MBPS				
Submersible Pumps	2	EA	$25,000	$50,000
Installation			50%	$25,000
Concrete/SST Support Structure		LS		$15,000
Check Valve	2	EA	$7,000	$14,000
Misc Piping/ Mechanical		LS		$20,000
SUBTOTAL				**$124,000**
Electrical				
Electrical Pump Lead	1100	LF	$20	$22,000
Electiral General			35%	$17,500
SUBTOTAL				**$39,500**

SUBTOTAL	$173,500
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$42,700
SUBTOTAL 2	$216,200
CONTINGENCY (25%)	$43,375
SUBTOTAL 3	$260,000
ADMINISTRATIVE (25%)	$65,000
TOTAL	**$325,000**

Deficiency 12 Alt 2 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
Pumps	2	$24,000	20	$2,400
Total ($/yr)				$2,400

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Submersible Pumps		15	0.9	14	202
Total (kWhr/day)					202
Total (kWhr/yr)					73562

$/kWhr	$	0.12
$/yr		$8,900

Labor[2]

Personnel	$/hr[1]	No.	Hr/Year	$/yr	
Operator	$40	2	8	$640	
Supervisor	$65	1	4	$260	
Maintenance	$45	1	36	$1,620	
SCADA/Electrical/Instrumentation	$50	1	4	$200	
Total					$2,800

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	15,000
Present Worth O&M (3.5%, 30 years)	18.446	$	277,000
Present Worth Cost		**$**	**602,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	***Computed:***	JB
Subject:	MBPS Piping Corrosion	***Date:***	1/7/2016
Task:	Deficiency 13 - Alternative 1	***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1.*	***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$500
Demobilization	1	LS	1.00%	$200
Bonds and Insurance	1	LS	2.50%	$500
Contractor Overhead & Profit		LS	10.00%	$1,800
SUBTOTAL			16.5%	**$3,000**
MBPS Piping Coating				
Epoxy		LS		$10,000
SUBTOTAL				**$10,000**
MBPS Building Coating				
Acrylic	768	SF	$8	$6,144
SUBTOTAL				**$6,144**

SUBTOTAL	$16,144
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$3,000
SUBTOTAL 2	$19,144
CONTINGENCY (25%)	$4,036
SUBTOTAL 3	$23,000
ADMINISTRATIVE (25%)	$6,000
TOTAL	**$29,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	***Computed:***	JB
Subject:	WTP Electrical	***Date:***	1/7/2016
Task:	Deficiency 14 - Alternative 1	***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1.*	***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$1,200
Demobilization	1	LS	1.00%	$400
Bonds and Insurance	1	LS	2.50%	$1,000
Contractor Overhead & Profit		LS	10.00%	$4,300
SUBTOTAL			16.5%	**$6,900**
Surge Protection				
Surge Protection at Switchboard		LS		$12,000
Installation		LS	50%	$6,000
SUBTOTAL				**$18,000**
UPS				
UV Control Panels		LS		$10,000
Tesco PLC		LS		$10,000
SUBTOTAL				**$20,000**

SUBTOTAL	$38,000
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$6,900
SUBTOTAL 2	$44,900
CONTINGENCY (20%)	$7,600
SUBTOTAL 3	$53,000
ADMINISTRATIVE (25%)	$13,000
TOTAL	**$66,000**

	Job No.			Calc. No.

Computation

Project:	Lake Water Preliminary Engineering	**Computed:**	JB
Subject:	WTP Controls	**Date:**	1/7/2016
Task:	Deficiency 15 - Alternative 1	**Reviewed:**	
File Name:	C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1	**Date:**	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$2,200
Demobilization	1	LS	1.00%	$700
Bonds and Insurance	1	LS	2.50%	$1,800
Contractor Overhead & Profit		LS	10.00%	$7,700
SUBTOTAL			16.5%	**$12,400**
SCADA PAK				
RTU to replace LIQ-5 and L1000 PLCs	2	EA	$3,000	$6,000
SCADA LOG Software		LS		$5,000
Installation, programming, commissioning		LS		$40,000
SUBTOTAL				**$51,000**
UPS				
L1000G		LS		$10,000
Misc Items		LS		$8,000

SUBTOTAL	$69,000
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$12,400
SUBTOTAL 2	$81,400
CONTINGENCY (25%)	$17,250
SUBTOTAL 3	$99,000
ADMINISTRATIVE (25%)	$25,000
TOTAL	**$124,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Hypochlorite Residual - Dose Pace and Move Injection Point		***Date:***	1/7/2016
Task:	Deficiency 16 Alternative 1		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1(*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$500
Demobilization	1	LS	1.00%	$200
Bonds and Insurance	1	LS	2.50%	$400
Construction Facilities/Fencing	1	LS	0.50%	$100
General Conditions	1	LS	2.00%	$300
Shop Drawings and O&M Manuals	1	LS	2.00%	$300
Facilities Start-up & Testing	1	LS	2.00%	$300
Contractor Overhead & Profit		LS	10.00%	$1,700
SUBTOTAL			23.0%	**$3,800**
Hypochlorite Feed Pumps				
Peristalltic Feed Pumps w/ Pacing Control	2	EA	$2,500	$5,000
Installation			30%	$1,500
Pump Programming		LS		$6,000
SUBTOTAL				**$12,500**
Move Hypo Injection Point				
PE Tubing		LS		$500
Tap 8" Pipe & Saddle	1	EA	$700	$700
Injection Diffuser	1	EA	$800	$800
SUBTOTAL				**$2,000**

SUBTOTAL	$14,500
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$3,800
SUBTOTAL 2	$18,300
CONTINGENCY (25%)	$3,625
SUBTOTAL 3	$22,000
ADMINISTRATIVE (25%)	$6,000
TOTAL	**$28,000**

Deficiency 16 Alt 1 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
Metering Pumps	2	$3,375	15	$450
Total ($/yr)				$500

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Self Priming Pumps		0	0.9	0	0

Total (kWhr/day)		0
Total (kWhr/yr)		0
$/kWhr	$	0.12
$/yr		$0

Labor[2]

Personnel	$/hr[1]	No.	Hr/Year	$/yr	
Operator	$40	2	8	$640	
Supervisor	$65	1	2	$130	
Maintenance	$45	1	8	$360	
SCADA/Electrical/Instrumentation	$50	1	2	$100	
Total					$1,300

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	2,000
Present Worth O&M (3.5%, 30 years)	18.446	$	37,000
Present Worth Cost		**$**	**65,000**

	Job No.			Calc. No.
Computation				
Project:	Lake Water Preliminary Engineering		***Computed:***	JB
Subject:	Hypochlorite Residual - Dose Pace and Add Mixer		***Date:***	1/7/2016
Task:	Deficiency 16 Alternative 2		***Reviewed:***	
File Name:	*C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\ZWUD\Costs\[ZWUD Costs.xlsx]Def 1*		***Date:***	

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
General Requirements				
Mobilization	1	LS	3.00%	$900
Demobilization	1	LS	1.00%	$300
Bonds and Insurance	1	LS	2.50%	$800
Construction Facilities/Fencing	1	LS	0.50%	$200
General Conditions	1	LS	2.00%	$600
Shop Drawings and O&M Manuals	1	LS	2.00%	$600
Facilities Start-up & Testing	1	LS	2.00%	$600
Contractor Overhead & Profit		LS	10.00%	$3,200
SUBTOTAL			23.0%	**$7,200**
Hypochlorite Feed Pumps				
Peristalltic Feed Pumps w/ Pacing Control	2	EA	$2,500	$5,000
Installation			30%	$1,500
Pump Programming		LS		$6,000
SUBTOTAL				**$12,500**
Mechanical Mixer				
Mixer		LS		$3,000
Installation			100%	$3,000
Controls & Electrical		LS		$10,000
SUBTOTAL				**$16,000**

SUBTOTAL	$28,500
(ADDITIVE FOR) DIVISION 1 (ABOVE)	$7,200
SUBTOTAL 2	$35,700
CONTINGENCY (25%)	$7,125
SUBTOTAL 3	$43,000
ADMINISTRATIVE (25%)	$11,000
TOTAL	**$54,000**

Deficiency 16 Alt 2 - Relative O&M Costs

Equipment Replacement

Item	Qty	Cost ($)	Lifetime (yrs)	Cost/yr ($)
Metering Pumps	2	$3,375	15	$450
Total ($/yr)				$500

Energy

Item	KVA (connected)	KVA (demand)	PF	KW	KWHr/d
Self Priming Pumps		0	0.9	0	0
Total (kWhr/day)					0
Total (kWhr/yr)					0
$/kWhr					$ 0.12
$/yr					$0

Labor[2]

Personnel	$/hr[1]	No.	Hr/Year	$/yr	
Operator	$40	2	8	$640	
Supervisor	$65	1	2	$130	
Maintenance	$45	1	8	$360	
SCADA/Electrical/Instrumentation	$50	1	2	$100	
Total					$1,300

Notes :

1. Labor costs include direct, OH, and benefits
2. Includes WTP, RW Intake, FW Pumpstation, transmission lines

Total O&M Cost		$	2,000
Present Worth O&M (3.5%, 30 years)	18.446	$	37,000
Present Worth Cost		**$**	**91,000**

APPENDIX B – TANK LOCATION PHOTOS

Altitude: 6690ft
Datum: WGS-84
Azimuth/Bearing: 165° S15E 2933mils (True)
Elevation Angle: -00.6°
Horizon Angle: -00.1°
Zoom: 1X

Altitude: 6690ft
Datum: WGS-84
Azimuth/Bearing: 085° N85E 1511mils (True)
Elevation Angle: +00.6°
Horizon Angle: -00.0°
Zoom: 1X

Altitude: 6690ft
Datum: WGS-84
Azimuth/Bearing: 339° N21W 6027mils (True)
Elevation Angle: -01.1°
Horizon Angle: +01.2°
Zoom: 1X

Altitude: 6694ft
Datum: WGS-84
Azimuth/Bearing: 252° S72W 4480mils (True)
Elevation Angle: +00.1°
Horizon Angle: -00.1°
Zoom: 1X

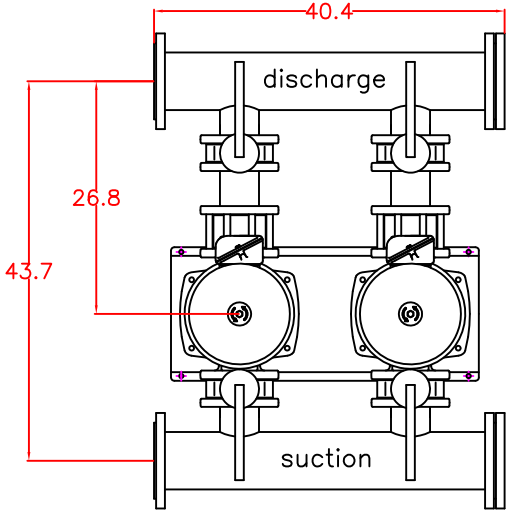
TANK LOCATION PANORAMA

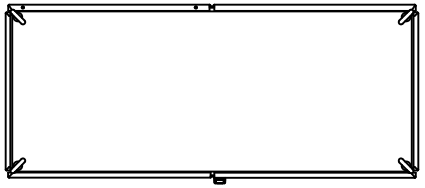

Lake Tahoe
Beverly Cir
Inspiration Dr
Rock Rd
N
TRUE
330
300
030
060
W
E
240
210
150
120
S

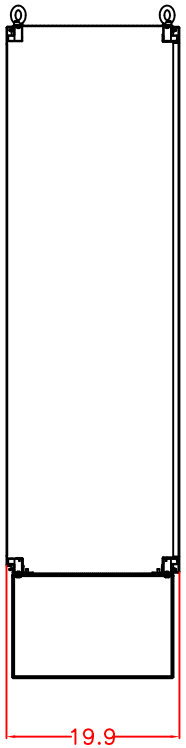
APPENDIX C – EQUIPMENT CUT SHEETS

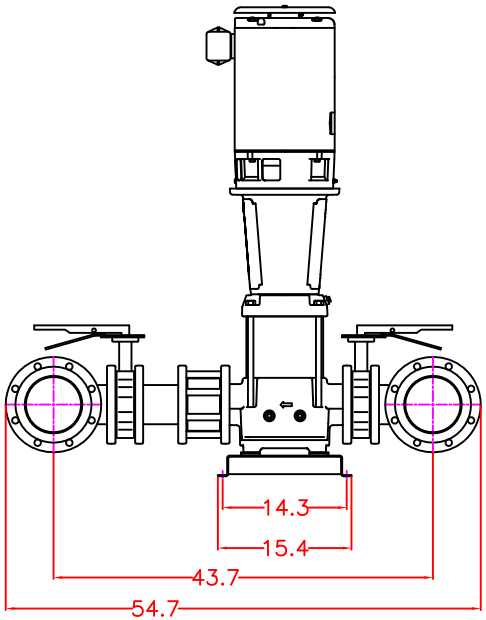
1. Manifolds 6" ANSI Class 150 AISI 316SS Schedule 10s ASTM A312 or ø168.3mm x2mm
2. Base/Frame AISI 304SS
3. Standard system layout : panel right facing suction.
4. 4" lug style ANSI 150# class butterfly valve
5. UL Type 3R rated electrical panel

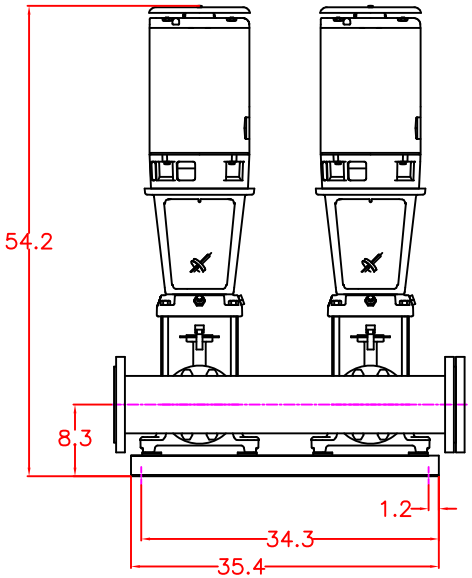
Note: panel size will vary with options

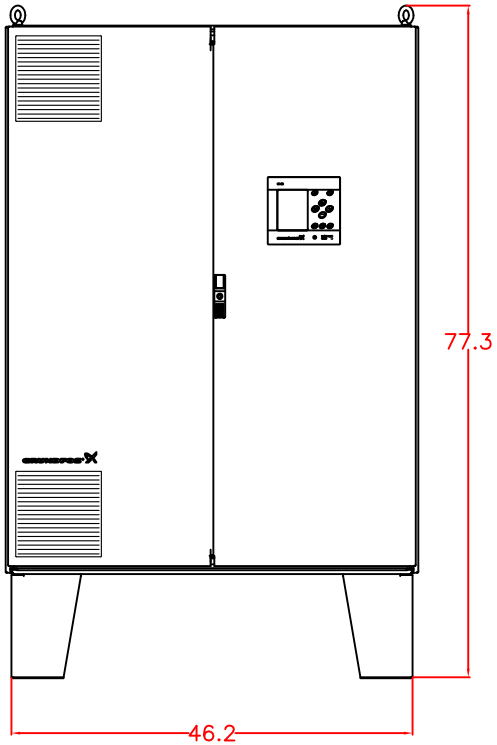












BoosterpaQ Model: MPC-E 2CR90-2-2 25hp				
Power: 208-230/3/60				
Job:				
Dwg No:	Rev: 0	Date: 2-15-11	Drawer: BSJ	Page: 1 of 1

Note:
All dimensions are ± 0.5"
Not for construction use.
All dimensions subject to change without notice.

GRUNDFOS

Tank Booster Pumps - Alt 2.

Phoenix Pump Hydro MPC-E BoosterpaQ (Panel Mount VFD) Guide Specification

Part I – GENERAL

1.1 WORK INCLUDED

A. Variable Speed Packaged Pumping System

1.2 REFERENCE STANDARDS

The work in this section is subject to the requirements of applicable portions of the following standards:

A. Hydraulic Institute
B. ANSI – American National Standards Institute
C. ASTM – American Society for Testing and Materials
D. IEEE – Institute of Electrical and Electronics Engineers
E. NEMA – National Electrical Manufacturers Association
F. NEC – National Electrical Code
G. ISO – International Standards Organization
H. UL – Underwriters Laboratories, Inc.

Part 2 – PRODUCTS

2.1 VARIABLE SPEED PACKAGED PUMPING SYSTEM

A. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.

B. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.

C. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

D. The complete packaged pumping system shall be NSF61 Annex G listed for drinking water and low lead requirements.

E. The pump station shall be as manufactured by Grundfos Pump model MPC-E(CUE)2CR90-2-2PPE 25 HP pumps, rated for 1200 GPM @ 65' TDH from a flooded suction inlet. Power supply to be 3X240VAC.

2.2 PUMPS

A. All pumps shall be ANSI/NSF 61 Annex G listed for drinking water and low lead requirements.

B. The pumps shall be of the in-line vertical multi-stage design.

C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

D. Large In-line Vertical Multi-Stage Pumps (Nominal flows from 130 to 500 gallons per minute) shall have the following features:

1. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.

2. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.

3. Pump Construction.

a. Suction/discharge base, pump head	Ductile Iron (ASTM 65-45-12)
b. Shaft couplings, flange rings:	Ductile Iron (ASTM 65-45-12)
b. Shaft	431 Stainless Steel
c. Motor Stool	Cast Iron (ASTM Class 30)
d. Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
e. Impeller wear rings:	304 Stainless Steel
f. Intermediate Bearing Journals:	Tungsten Carbide
g. Intermediate Chamber Bearings:	Leadless Tin Bronze
h. Chamber Bushings:	Graphite Filled PTFE
I. O-rings:	EPDM

4. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

a. Bellows:	904L Stainless Steel
b. Shaft Sleeve, Gland Plate, Drive Collar:	316 Stainless Steel
c. Stationary Ring:	Carbon
d. Rotating Ring:	Tungsten Carbide
e. O-rings:	EPDM

5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

2.3 VARIABLE FREQUENCY DRIVES (Panel Mount)

A. The VFD shall convert incoming fixed frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

B. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

C. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.

D. The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.

E. VFD shall automatically boost power factor at lower speeds.

F. The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.

G. An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation.

H. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

I. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

J. The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

K. VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to -15% of the rated input voltage.

L. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. VFD's without a DC link reactor shall provide a 5% impedance line side reactor.

M. VFD to be provided with the following protective features:

1. VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.

2. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.

3. VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

4. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.

5. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.

6. The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.

N. VFD to be provided with the following interface features:

1. VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
2. VFD shall display all faults in plain text; VFD's, which can display only fault codes, are not acceptable.
3. All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
4. VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to

the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.

5. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
6. A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
7. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.
8. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
9. There shall be three programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. An additional digital input is preprogrammed for start/stop.
10. The VFD shall have two analog signal inputs. One dedicated for sensor input and one for external set point input.
11. One programmable analog output shall be provided for indication of a drive status.
12. The VFD shall provide two user programmable relays with selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
13. The VFD shall store in memory the last 5 faults with time stamp and recorded data.
14. The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.

O. VFD service conditions:

1. Ambient temperature operating range, -10 to 45ºC (14 to 113°F).
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 1000 meters (3,300 feet) without derating.
4. VFD's shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -15% variations. Line frequency variation of ± 2% shall be acceptable.
5. No side clearance shall be required for cooling of the units.

2.4 FIXED SPEED MOTORS

A. Fixed Speed Motors are to be provided with the following basic features:

1. Designed for continuous duty operation, NEMA design B with a 1.15 service factor.
2. Totally Enclosed Fan Cooled with Class F insulation.
3. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
4. Motors shall have a NEMA C-Flange for vertical mounting.

5. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

2.5 PUMP SYSTEM CONTROLLER

A. The pump system controller shall be a standard product developed and supported by the pump manufacturer.

B. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.

C. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.

D. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.

E. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported to computer via standard connection. A minimum of 3600 samples per logged value with the following parameters available for logging:

- Estimated flow-rate
- Speed of pumps
- Inlet pressure
- Discharge pressure
- Power consumption
- Controlling parameter (process value)

F. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):

- Current value of the control parameter, (typically discharge pressure)
- Most recent existing alarm (if any)
- System status with current operating mode
- Status of each pump with current operating mode and rotational speed as a percentage (%)
- Estimated flow-rate, (not requiring flow meter connection)

G. The controller shall have as a minimum the following hardware inputs and outputs:

- Three analog inputs (4-20mA or 0-10VDC)
- Three digital inputs
- Two digital outputs
- Ethernet connection
- Field Service connection to PC for advanced programming and data logging

H. Pump system programming (field adjustable) shall include as a minimum the following:

- Water shortage protection (analog or digital)
- Transducer Settings (Suction and Discharge Analog supply/range)
- PI Controller (Proportional gain and Integral time) settings
- High system pressure indication and shut-down
- Low system pressure indication and shut-down

- Low suction pressure/level shutdown (via digital contact)
- Low suction pressure/level warning (via analog signal)
- Low suction pressure/level shutdown (via analog signal)
- Flow meter settings (if used, analog signal)

I. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

J. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

K. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

L. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

M. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.

N. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure	Low system pressure
Low suction pressure (warning and alarm)	Individual pump failure
VFD trip/failure	Loss of sensor signal (4-20 mA)
Loss of remote set-point signal (4-20mA)	System power loss

O. The pump system controller shall be mounted in a UL Type 12 rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include, but not be limited to:

Pump Run Lights	System Fault Light
Audible Alarm (80 db[A])	Surge Arrestor
Emergency/Normal Operation Switches	Service Disconnect Switches

Qty (9) Configurable Digital Outputs available for monitoring

P. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

Q. The controller shall have a pump “Test Run” feature such that pumps are switched on during periods of inactivity (system is switched to the “off” position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).

R. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.

S. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).

T. The controller shall be capable of displaying instantaneous specific energy use (kw/gpm), (optional flow meter must be connected).

U. The actual pump performance curves (5^{th} order polynomial) shall be loaded (software) into the pump system controller or be able to input manually into controller based on three points on pump curve of pumps controlled.

V. The controller shall be capable of displaying an estimated flow-rate on the default status screen.

W. The controller shall have the ability to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates without the requirement of a flow meter.

X. The controller shall have the ability to communicate common field-bus protocols, (BACnet, Modbus, Profibus, and LON), via optional communication expansion card installed inside controller.

Y. The controller shall have a built in Ethernet connection allowing controller to connected to network and access of controller via web browser and internet any where around the world where internet communication is available.

Z. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.

2.6 SEQUENCE OF OPERATION

A. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand.

B. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

C. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

D. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system. The set point of the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.

2.7 LOW FLOW STOP FUNCTION

The system controller shall be capable of stopping pumps during periods of low-flow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable.

Standard Low Flow Stop and Energy Saving Mode
For low or no flow shut-down (periods of low or zero demand) a 132 gallon, NON-ASME, bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

A. Low Flow Restart: If the drop in pressure is slow when the start pressure is reached (indicating the flow is still low), the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

B. Normal Flow Restart: If the drop in pressure is fast (indicating the flow is greater than 10% of pump nominal flow) the pump shall start and the speed shall be increased until the system pressure reaches the system set-point.

2.8 SYSTEM CONSTRUCTION

A. Suction and discharge manifold construction shall be in way that ensures minimal pressure drops, minimize potential for corrosion, and prevents bacteria growth at intersection of piping into the manifold. Manifold construction that includes sharp edge transitions or interconnecting piping protruding into manifold is not acceptable. Manifold construction shall be such that water stagnation can not exist in manifold during operation to prevent bacteria growth inside manifold.

B. The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:

4 inch through 8 inch:	ANSI Class 150 rotating flanges
10 inch and larger:	ANSI Class 150 flanges

C. Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

D. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2” and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2” and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

E. For systems that require a diaphragm tank, a connection of no smaller than ¾” shall be provided on the discharge manifold.

F. A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

G. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2/1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

H. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

I. The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pumps and baseframe to minimize vibration.

J. Depending on the system size and configuration, the control panel shall be mounted in one of the following ways:

On its own base (floor mounted with plinth)

2.9 TESTING

A. The entire pump station shall be factory tested for functionality. Functionality testing shall include the following parameters: Dry Run Protection, Minimum Pressure and Maximum Pressure alarms (where applicable), Setpoint Operation, and Motor Rotation.

B. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. Systems with 150# flange connections shall be tested at 350 psig, and systems with 300# flange connections shall be tested at 450 psig. The pressure shall be maintained for a minimum of 15 minutes with no leakage (slight leakage around pump(s) mechanical seal is acceptable) prior to shipment.

2.10 WARRANTY

A. The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture.

Pump Performance Datasheet

Customer	: HRD	Quote number	: 469184
Customer reference	: Zephyr Water Utility	Size	: 12A-54
Item number	: P-1, 2 & 3	Stages	: 6
Service	: Treated Water, Booster Pumps	Based on curve number	: VTP-12A-54-1760
Quantity	: 3	Date last saved	: 10/02/2015 2:41 PM

Operating Conditions

Flow, rated	: 600.0 USgpm
Differential head / pressure, rated (requested)	: 390.0 ft
Differential head / pressure, rated (actual)	: 396.6 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Performance

Speed, rated	: 1760 rpm
Impeller diameter, rated	: 8.55 in
Impeller diameter, maximum	: 8.75 in
Impeller diameter, minimum	: 7.75 in
Efficiency	: 81.1 %
NPSH required / margin required	: 13.02 / 2.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 1,624 / 6,565 US Units
MCSF	: 163.0 USgpm
Head, maximum, rated diameter	: 511.0 ft
Head rise to shutoff	: 31.01 %
Flow, best eff. point (BEP)	: 533.9 USgpm
Flow ratio (rated / BEP)	: 112.38 %
Diameter ratio (rated / max)	: 97.71 %
Head ratio (rated dia / max dia)	: 90.95 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Solids concentration, by volume	: 0.00 %
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 1.000 / 1.000 SG
Viscosity, rated	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

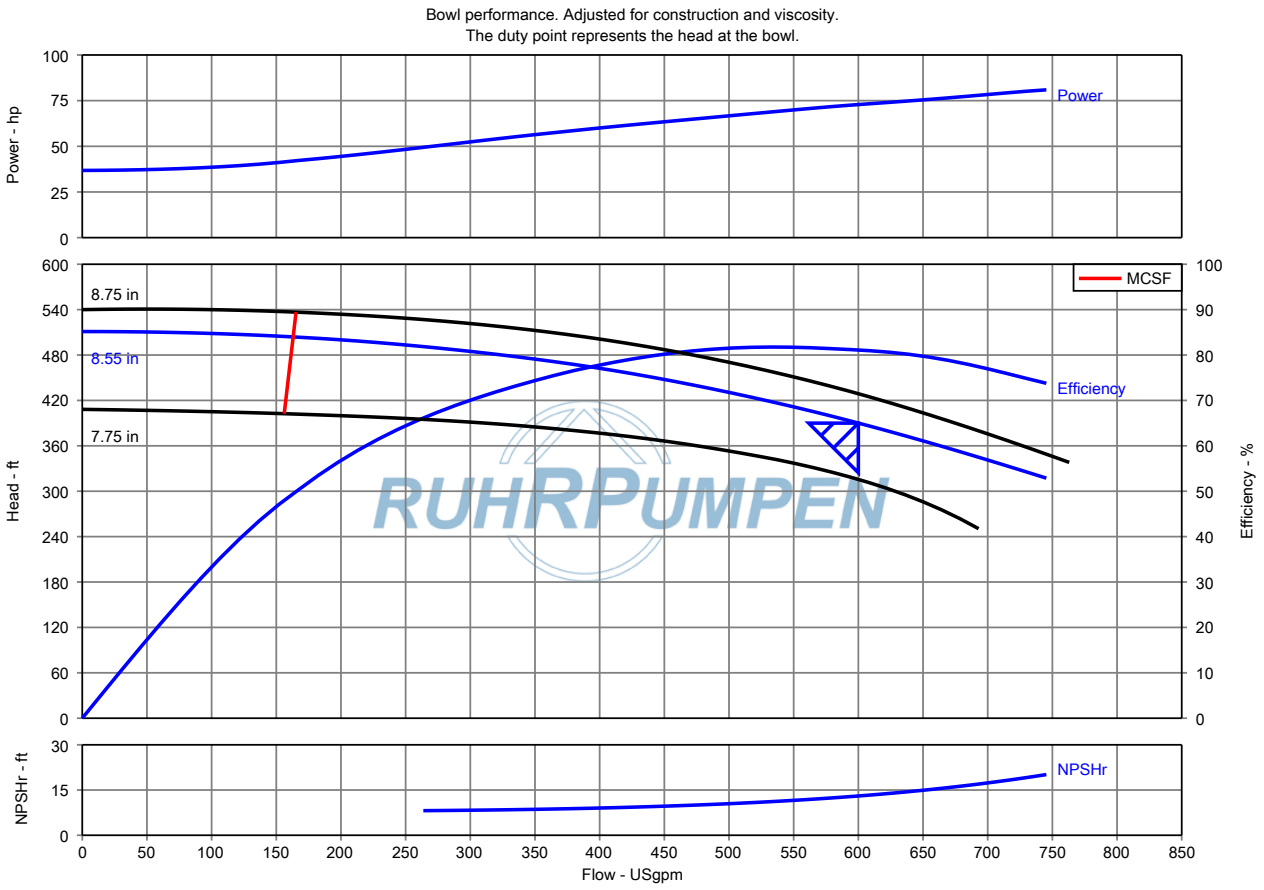
Material selected	: Cast iron, bronze fitted

Pressure Data

Maximum discharge pressure	: See the Additional Data page
Maximum allowable working pressure	: See the Additional Data page
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: See the Additional Data page

Driver & Power Data

Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 59.09 hp
Power (bowl / pump)	: 72.85 / - hp
Power, maximum, rated diameter	: 80.92 hp
Minimum recommended motor rating	: 75.00 hp / 55.93 kW



WTP High Service Pumps - Alt 2

Bellin, Joel

From: Vallejos, Ricardo
Sent: Friday, October 02, 2015 1:31 PM
To: Bellin, Joel
Cc: Marquez, Anita
Subject: Douglas Co PER: Cost estimate, Zephyr Water Utility (GPS# 469184)
Attachments: 469184 GA.PDF; 12A-54-6 stage, primary offering.pdf; 12B-75-6 stage, alternate.pdf

Cost estimate for existing high service pumps

Ricardo Vallejos, EI
D 702.938.6114

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From: Milton, Randy [mailto:rmilton@ruhrpumpen.com]
Sent: Friday, October 02, 2015 1:11 PM
To: Vallejos, Ricardo
Subject: RE: Cost estimate, Zephyr Water Utility (GPS# 469184)

Ricardo,

In response to our conversation of this morning, Ruhrpumpen is pleased to offer the following "budget" quotation.

This quotation is for a complete "new" Ruhrpumpen bowl assembly that will mount to the existing Ingersoll-Dresser pumps.

The Ruhrpumpen bowl assembly is rated for 600 GPM and 390' TDH (original pump was rated for 600 GPM at 350' TDH) running at 1760 RPM. I have offered two options, the first is a 12B-75/6 stage with a bowl efficiency of 83.1% (the rated point is to the left of the BEP) and a 12A-54/6 stage with a bowl efficiency of 81.1% (the rated point is to the right of the BEP). Depending on the required runout flow, you should be able to use the existing 75 HP motors **"not"** operating in the service factor until you are right of the rated point for both selections.

The bowl assemblies are priced the same and have the overall dimensions (see attached typical outline). At time of order Ruhrpumpen would supply a certified bowl assembly outline that would also show the applicable mounting dimensions to the existing Ingersoll-Dresser pumps.

Construction as Offered:
Open lineshaft, product lubricated

Bowls	cast iron
Suction bell	cast iron
Impellers	316ss
Collets	316ss
Bolting	316ss
Bearings	carbon
Shafting	416ss

The Ruhrpumpen "budget" price for the bowl assembly is $11,810 each (includes non-witness b/a perf test w/lab motor) x 3 units = $35,430 total, ex=works Tulsa, OK.

Please review and advise if you have any questions and this time and thank you for considering Ruhrpumpen.

Regards,

Randy Milton
Municipal National Sales Manager
Mobile : 918-845-4822
rmilton@ruhrpumpen.com
Skype: randy.milton-rp

From: Vallejos, Ricardo [mailto:Ricardo.Vallejos@hdrinc.com]
Sent: Tuesday, September 29, 2015 5:06 PM
To: Milton, Randy <rmilton@ruhrpumpen.com>
Subject: RE: Cost estimate

Randy,
Attached is the information provided to HDR about the pump. Pages 18-20 should have the information you are looking for.
Let me know if there is anything else you need from me.

Thanks,

Ricardo Vallejos, EI
D 702.938.6114

hdrinc.com/follow-us

From: Vago, Alex [mailto:avago@ruhrpumpen.com]
Sent: Monday, September 28, 2015 3:20 PM
To: Vallejos, Ricardo
Cc: Milton, Randy
Subject: FW: Cost estimate

Hello Ricardo,

Thank you for your interest in the Ruhrpumpen company and products.
It was nice to make your acquaintance over the phone.
To provide you w/the best possible advise we will need to get more information about the present pump installation.
Please, send us a copy of the present curve and outline drawing to ensure that should you need to a stage or upgrade the motor, this can be done with minor modifications to the installation.
As you send this information back to us, please, copy my colleague Randy Milton. Should this be for a municipal application he will further follow-up.

Best regards,

Alex Vago
Regional Sales Manager
Ruh***RP***umpen Group
Ph.: 918-237-5460
Skype: rp_avago

From: Kennedy, James
Sent: Monday, September 28, 2015 3:00 PM

To: Vago, Alex
Subject: FW: Cost estimate

Hi Alex:

Want to make the contact below? This probably came in via internet RFQ. Thanks.

James K. Kennedy
Director of Inside Sales
Ruhrpumpen Group
1-832-278-7688 cell
1-281-969-8131, x3428 office
1-281-969-7251 fax
Skype: jameskennedyruhrpumpenhouston
www.ruhrpumpen.com

From: Vallejos, Ricardo [mailto:Ricardo.Vallejos@hdrinc.com]
Sent: Friday, September 25, 2015 4:45 PM
To: Kennedy, James
Subject: Cost estimate

Hi,
I have an existing high service pump (vertical turbines) that is rated for 600 gpm at 350' TDH. I would like to increase the head to 390'. How much would something like this cost assuming a stage being added or increasing the bowl/impeller assembly?

Ricardo Vallejos
Water/Wastewater EI

HDR
6750 Via Austi Parkway, Suite 350
Las Vegas, NV 89119
D 702.938.6114
ricardo.vallejos@hdrinc.com

hdrinc.com/follow-us

C D S

Basic Pump

Self Priming Centrifugal Pump

Model U4B60S-B

Size 4” x 4”

PUMP SPECIFICATIONS

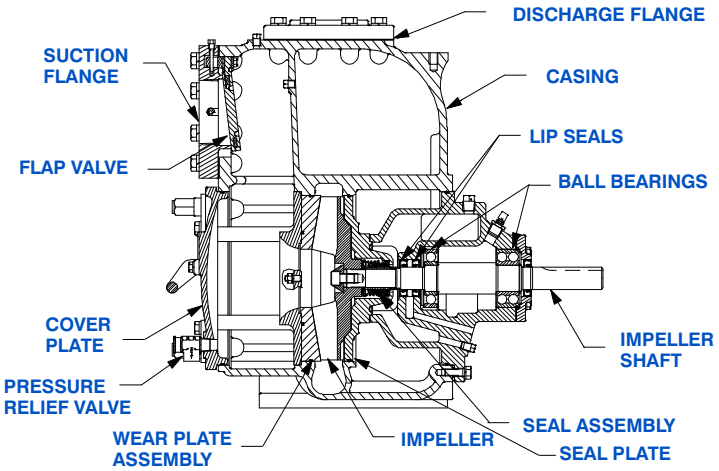
Size: 4” x 4” (102 mm x 102 mm) NPT - Female.
Casing: Gray Iron 30.
Maximum Operating Pressure 128 psi (883 kPa).*
Semi-Open Type, Six Vane Impeller: Ductile Iron 60-40-18.
Handles 1 1/8” (28,6 mm) Diameter Spherical Solids.
Impeller Shaft: Alloy Steel 4150.
Replaceable Wear Plate: Gray Iron 30.
Removable Adjustable Cover Plate: Gray Iron 30; 60 lbs. (27 kg).
Bearing Housing: Gray Iron 30.
Seal Plate: Gray Iron 30.
Shaft Sleeve: Alloy Steel 4130.
Flap Valve: Neoprene w/Nylon and Steel Reinforcing.
Radial Bearing: Open Single Row Ball.
Thrust Bearing: Open Double Row Ball.
Bearing and Seal Cavity Lubrication: SAE 30 Non-Detergent Oil.
Flanges: 125# Gray Iron 30.
Gaskets: Cork, Rubber, Vegetable Fiber, PTFE, Buna-N w/Compressed Synthetic Fibers.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.
Brass Pressure Relief Valve.
Bearing and Seal Cavity Oil Level Sight Gauges.

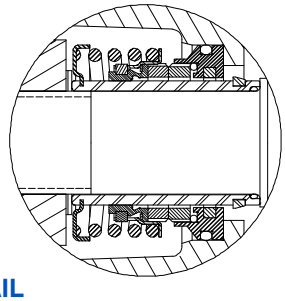
Optional Equipment: Stainless Steel 316 Seal Plate, Wear Plate and Pressure Relief Valve. G-R Hard Iron Impeller, Seal Plate and Wear Plate. Automatic Air Release Valve. 120V/240V Casing Heater. High Pump Temperature Shutdown Kit. Permalon, Kalrez or Fluorocarbon Metal Bellows Seals. Stainless Steel Cartridge Seal.
Gray Iron 30 Suction and Discharge Spool Flanges:
4” ASA **(Specify Model U4B60S-B /F)**.
100 mm DIN 2527 (PN 16) **(Specify Model U4B60S-B /FM)**.

**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

Shown w/Optional Spool Flanges

Deficiency 13 Alt 1

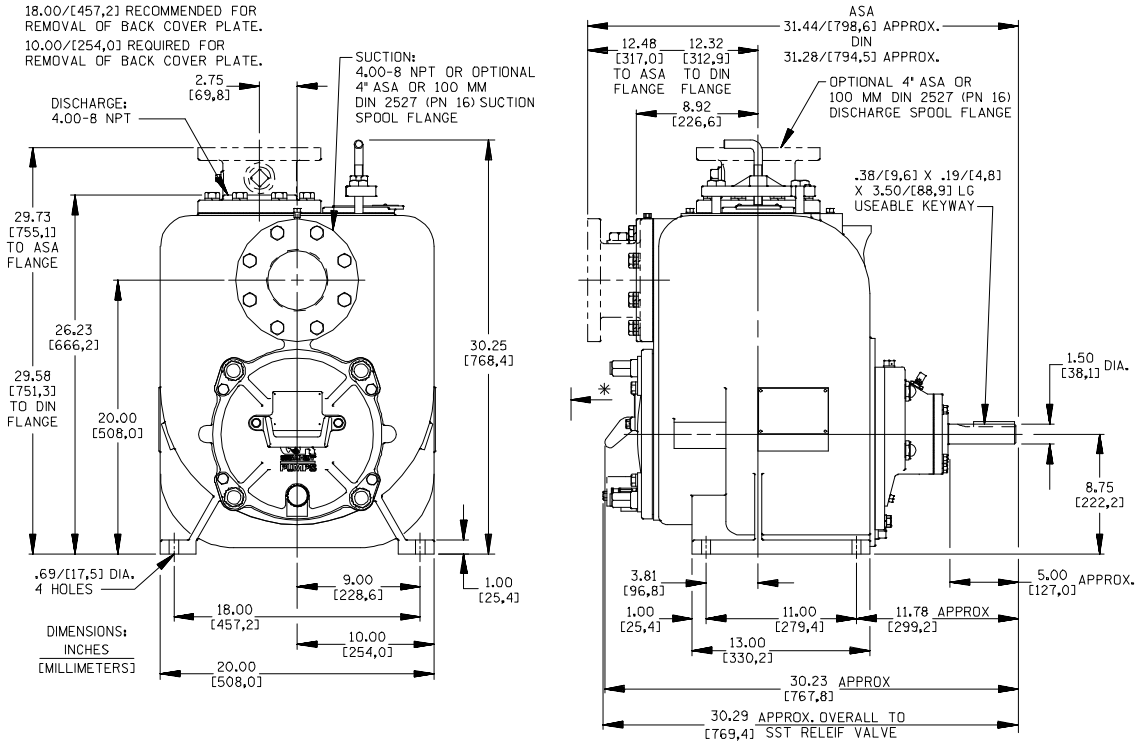




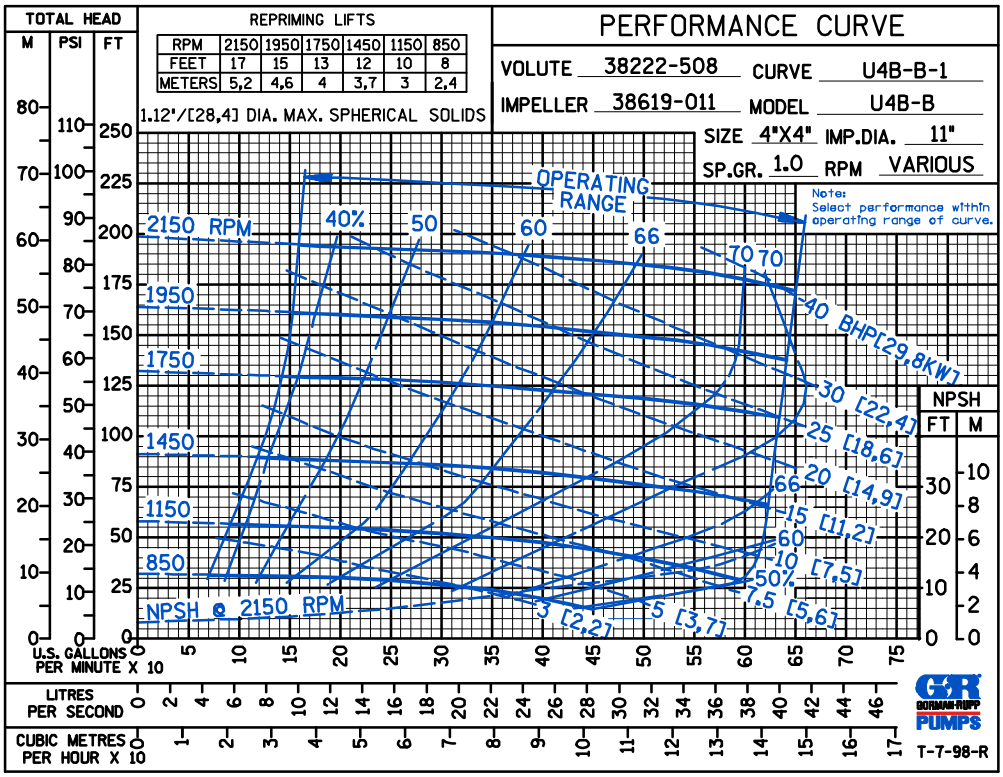
SEAL DETAIL

Cartridge Type, Mechanical, Oil-Lubricated, Double Floating, Self-Aligning. Silicon Carbide Rotating and Stationary Faces. Stainless Steel 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*

Specification Data	APPROXIMATE DIMENSIONS and WEIGHTS	NET WEIGHT: 662 LBS. (300 KG.)
SECTION 50, PAGE 2820		SHIPPING WEIGHT: 700 LBS. (318 KG.)
		EXPORT CRATE: 18 CU. FT. (0,5 CU. M.)



NOTE: OPTIONAL ASA OR DIN STANDARD SPOOL FLANGES AVAILABLE

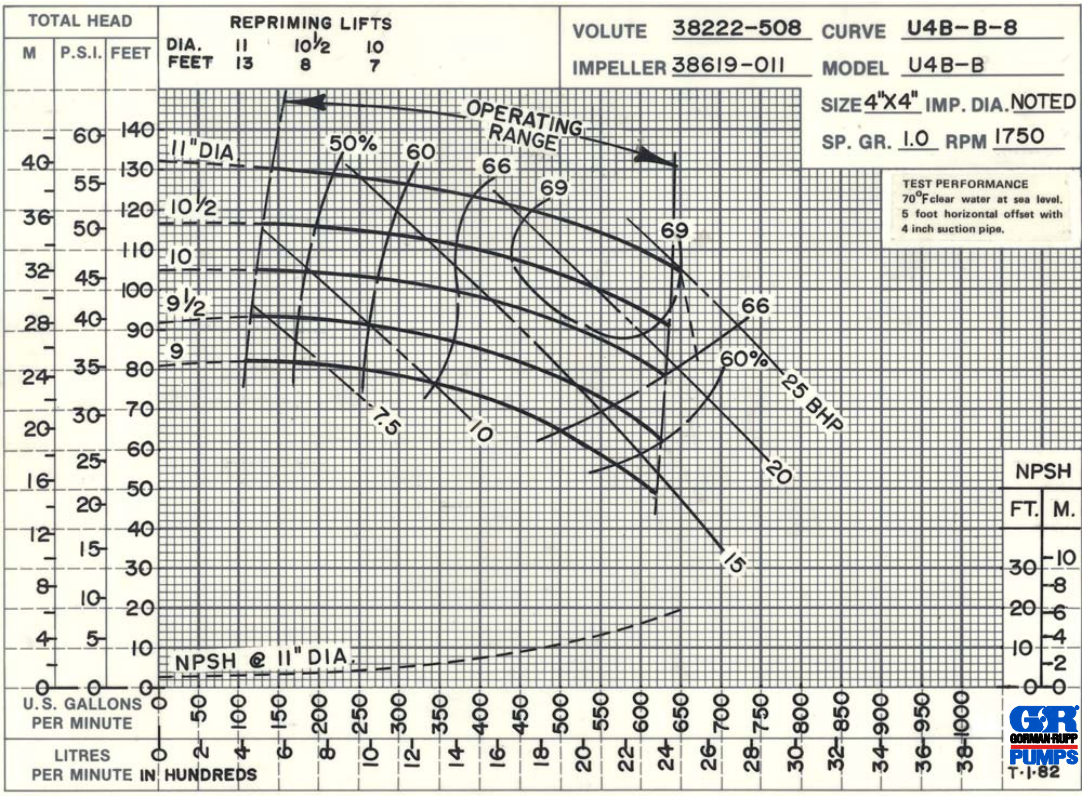


THE GORMAN-RUPP COMPANY ● MANSFIELD, OHIO

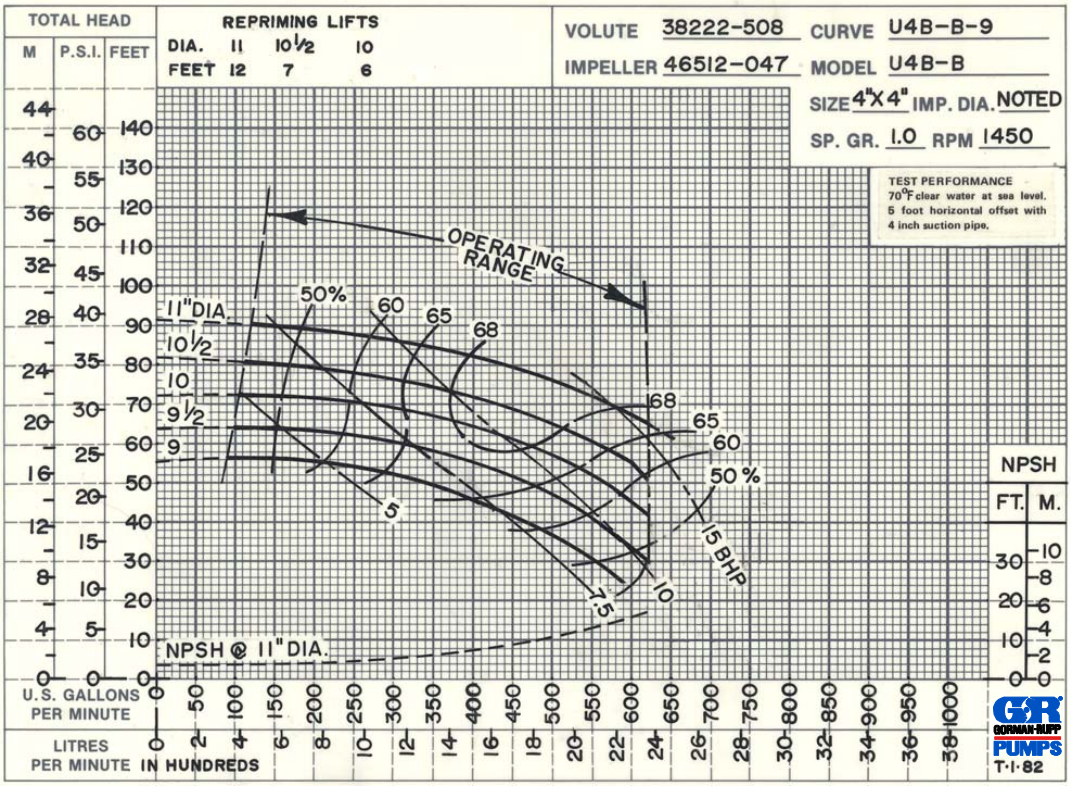
GORMAN-RUPP OF CANADA LIMITED ● ST. THOMAS, ONTARIO, CANADA

C D S

PERFORMANCE BASED ON WATER

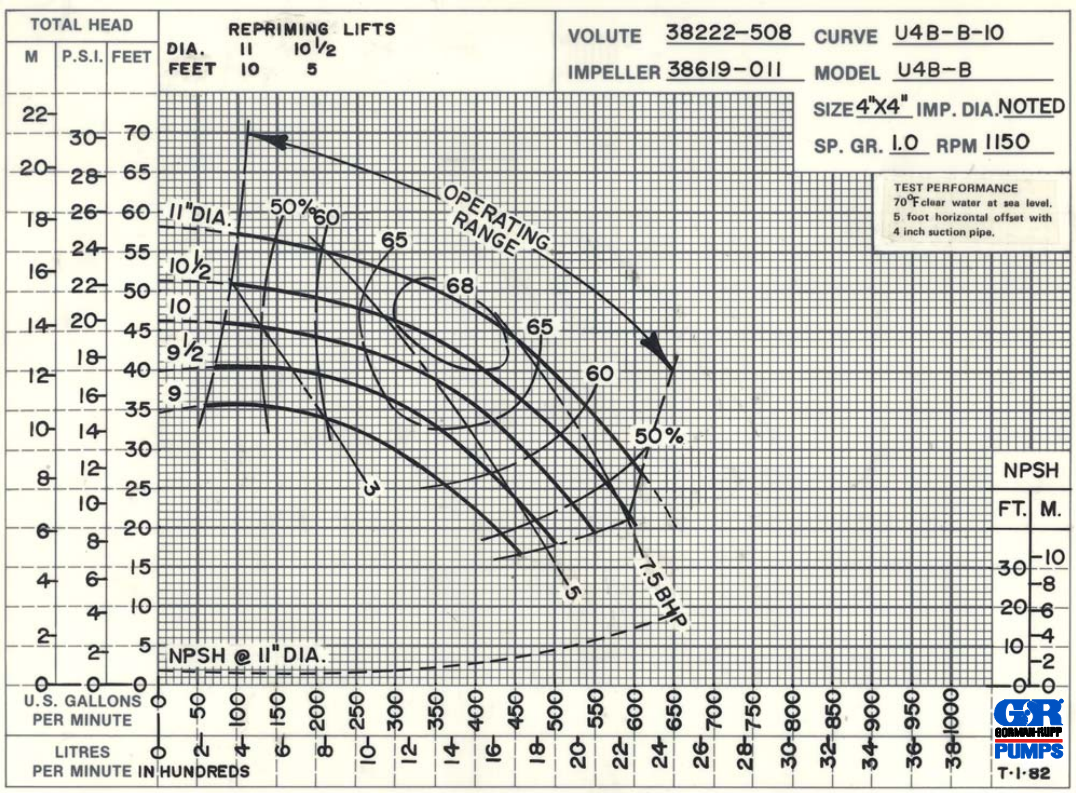


50 HERTZ PERFORMANCE BASED ON WATER

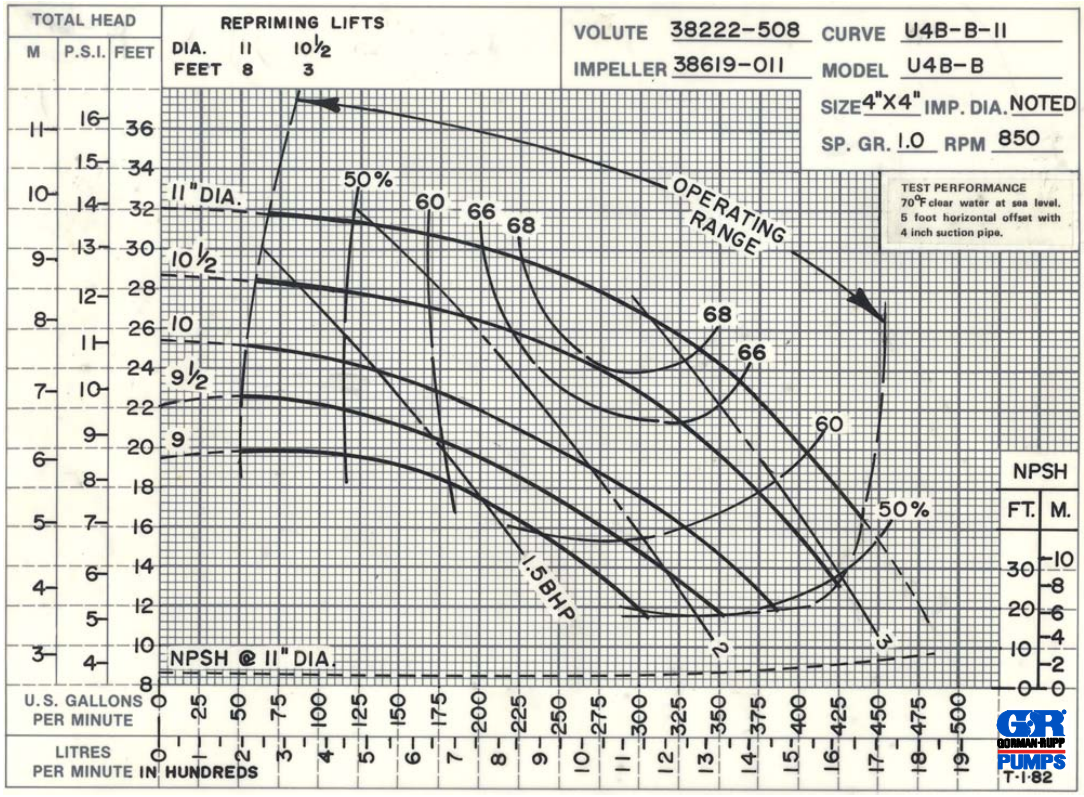


C D S

PERFORMANCE BASED ON WATER



PERFORMANCE BASED ON WATER



Bellin, Joel

From: Vallejos, Ricardo
Sent: Thursday, October 01, 2015 4:06 PM
To: Bellin, Joel
Cc: Marquez, Anita
Subject: Douglas Co Per: Self-Priming Pump
Attachments: 0502820.pdf; U4B report.pdf

Ricardo Vallejos, EI
D 702.938.6114

hdrinc.com/follow-us

From: Dennis Prahm [mailto:dprahm@thomaspumps.net]
Sent: Thursday, October 01, 2015 10:21 AM
To: Vallejos, Ricardo
Subject: RE: Cost Estimation

Ricardo,

Cost estimates for each self-priming pump is the following:

Qty. (1) Model U4B60S-B /F, 4" Self-Priming Centrifugal Pump in standard materials of construction with special fitted CD4MCu stainless steel impeller, seal plate, wear plate, and 17-4 pH stainless steel shaft. The pump impeller shall be trimmed for a duty of 450 GPM @ 115' TDH. The pump shall be internally coated with a NSF-61 approved ceramic coating. The pump shall be mounted on a standard steel horizontal base, and shall be flexible coupled to a 25 HP, 1,750 RPM, 284T Frame, 3-phase, premium efficient, CI, TEFC motor. Oil reservoir cavities shall be filled with food grade oil.

Budgetary Cost: $18,300.00 Each, Delivered.

If stainless steel fitted construction and internal coating are not required, please deduct: $6,000.00 per pump.

Let me know if have any questions or require any additional information.

Regards,

Dennis Prahm
Thomas and Asssociates
Office (415) 884-4501
Fax (415) 883-3961
Cell (415) 310-1944

From: Vallejos, Ricardo [mailto:Ricardo.Vallejos@hdrinc.com]
Sent: Thursday, October 01, 2015 9:37 AM
To: Dennis Prahm
Subject: RE: Cost Estimation

Hi Dennis,
Were you able to find a cost for either of the pumps we discussed earlier this week?

Ricardo Vallejos, EI
D 702.938.6114

hdrinc.com/follow-us

From: Dennis Prahm [mailto:dprahm@thomaspumps.net]
Sent: Friday, September 25, 2015 11:00 AM
To: Vallejos, Ricardo
Subject: RE: Cost Estimation

Ricardo,

I can assist with the Self-Priming Pumps. However, I'm concerned about them being used for potable water.

Please give me a call to discuss. Try me cell (415 310-1944

Regards,

Dennis Prahm
7 Pamaron Way, suite A
Novato, CA 94949
Office (415) 884-4501
Fax (415) 883-3961
Cell (415) 310-1944

From: Vallejos, Ricardo [mailto:Ricardo.Vallejos@hdrinc.com]
Sent: Friday, September 25, 2015 8:24 AM
To: DPrahm@Thomaspumps.net
Cc: Marquez, Anita <Anita.Marquez@hdrinc.com>
Subject: Cost Estimation

Hello Dennis,

I am trying to obtain some costs for some pumps. I was told you were the sales representative for the area, Reno, NV. I am looking to obtain cost for the following items:

1. Submersible (well type) pumps
   Requirements: 450 gpm; 120 TDH; Capable of being placed at a depth of 65'

2. Self-priming pumps
   Requirements: 450 gpm at 115' TDH. Needs to be self-priming due to leakage; for potable water

Both of these would be for the complete package (Frame, base,…etc.) not just for the pump.

Thanks,
Ricardo Vallejos
Water/Wastewater EI

HDR

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Pump Data Sheet - Gorman-Rupp IND 60Hz

Company: Thomas and Associates
Name: Dennis Prahm
Date: 10/1/2015

Pump:

Size: U4B-B-8

Type: U-SERIES
Synch speed: 1800 rpm

Speed: 1750 rpm
Dia: 10.875 in

Curve: U4B-B-8

Impeller: 38619-011

Specific Speeds:

Ns: ---
Nss: ---

Dimensions:

Suction: 4 in
Discharge: 4 in

Pump Limits:

Temperature: ---
Pressure: ---
Sphere size: 1.12 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 450 US gpm

Head: 115 ft

Fluid:

Water
SG: 1
Viscosity: 1.105 cP

Temperature: 60 °F
Vapor pressure: 0.2563 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 25 hp
Speed: 1800
Frame: 284T

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	450 US gpm
Head:	117 ft
Eff:	69%
Power:	19.3 hp
NPSHr:	8.91 ft

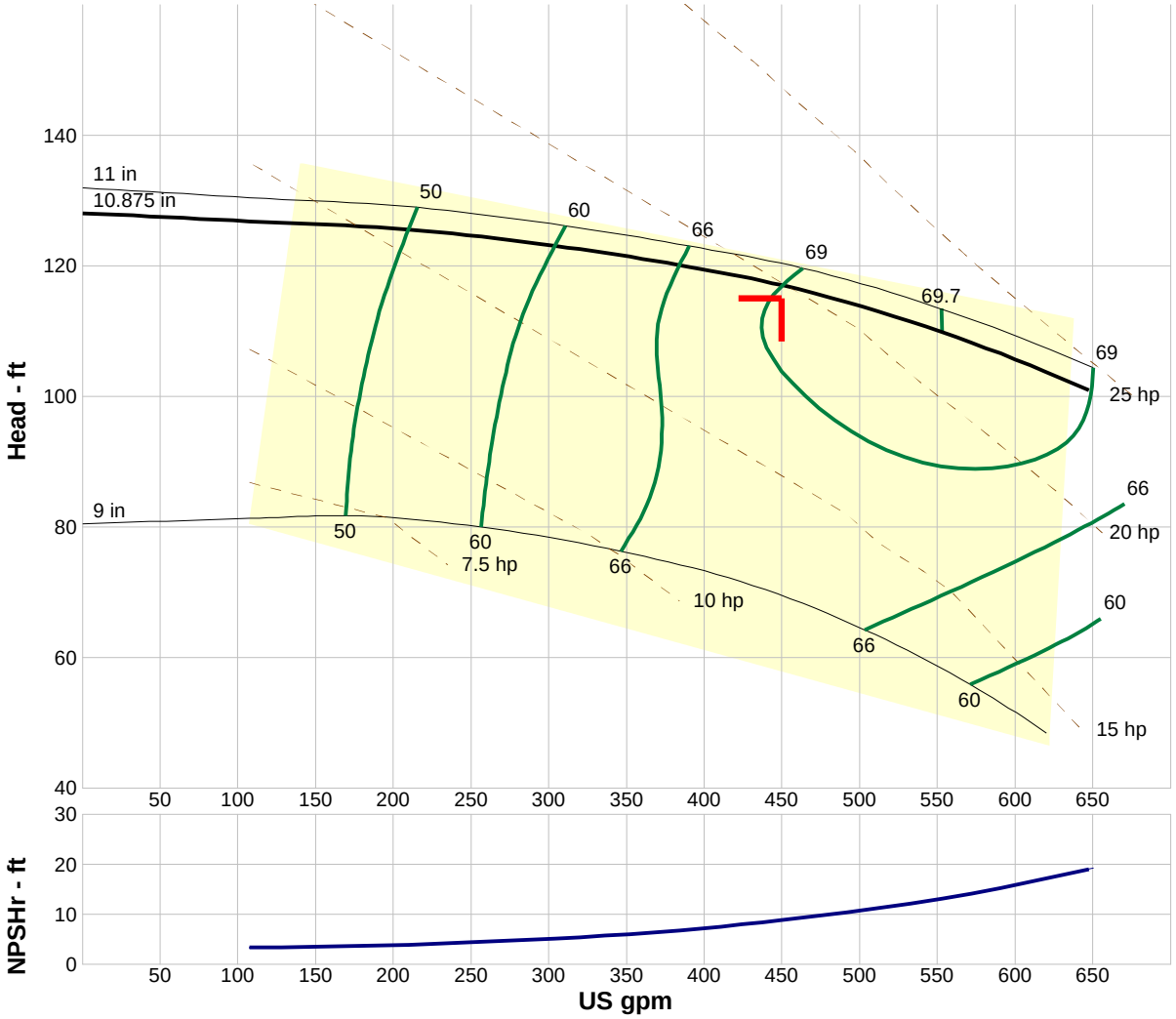
---- Design Curve ----

Shutoff head:	128 ft
Shutoff dP:	55.5 psi
Min flow:	---
BEP:	70% @ 553 US gpm

NOL power:
24 hp @ 647 US gpm

-- Max Curve --

Max power:
24.8 hp @ 650 US gpm



This curve is provided for preliminary selection only. Please consult factory before making final pump or motor selections.

Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
540	1750	111	70	21.7	12.6
450	1750	117	69	19.3	8.91
360	1750	121	64	17.1	6.34
270	1750	124	56	14.9	4.77
180	1750	126	43	13.3	3.81

Self Priming Pump Curve

Selected from catalog: Gorman-Rupp Industrial Pumps.60 Vers: 4.90

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TO: Bill Ettlich
HDR Engineering
FAX / E-mail: bill.ettlich@hdrinc.com
Date: December 15, 2015
Quotation #: 15645
re: Douglas County

*** Purchase Orders should be addressed to Schneider Electric USA Inc. ***

email orders to: orders@scadawise.com or fax to 888-275-7243 (888-FAX-SAGE)

Item	Qty	DESCRIPTION	Part #	Unit $	Total $
		Programming Tools & Software			
		Software Utilities			
1	1	SCADALog PC-based application for retrieval of logged data from SCADAPack Controllers.	TBUM327047	288.75	288.75
		NOTE: *Sage Designs is not a planholder for this project, does not have access to the entire specification and, therefore, cannot be held responsible for take-offs on quantities or general or technical requirements outside of the scope of our knowledge. All orders are governed by Schneider Electric USA's standard terms and conditions of sale.*			
Subtotal (not including sales taxes or shipping charges)					$288.75

*** Purchase Orders should be addressed to Schneider Electric USA Inc ***

*** See last page for ordering information ***

Quoted by: David Gunderson *for* Tony Sannella **email orders to:** orders@scadawise.com

TO PLACE AN ORDER:

Purchase orders must be addressed to the Alpharetta, GA address below, or you may use the remittance address which is based on your bill-to zip code.	*PO's must have complete Schneider Electric Part #'s and unit pricing for all line items. Ground shipping is included at no charge.*
Schneider Electric USA Inc. TRSS Logistics & Order Management 30000 Mill Creek Ave, Suite 300 Alpharetta, GA 30022 ---------- Sage Designs, Inc is your SEUSA rep email orders to: orders@scadawise.com fax orders to: 888-329-7243	
Remittance address based on your bill-to zip code →	**1st 3 digits of your billing zip code**
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NOTES:

1. *Orders should be addressed to Schneider Electric USA Inc, TRSS Logistics & Order Management, 30000 Mill Creek Avenue, Suite 300, Alpharetta, GA 30022. Email Sage Designs or to OrdersTRSS@schneider-electric.com. Remittance address is based on your billing zip code.*
2. *Schneider Electric US terms, conditions & warranty of sale apply to this quote:*
   http://connect-us.schneider-electric.com/terms-conditions/
   Note: SE|TRSS product warranty policy is as specified on product data sheets: SCADAPack Controllers & 5000-Series Expansion modules, 3 year warranty; SCADAPack Vision OIT, 1 year warranty; Trio radios, 3 year warranty;
3. *New customers must submit credit application form. Allow 8-10 business days to process. Goods must be staying within the USA.*
4. *All returns are subject to restocking fees. Open-boxed items are subject to inspection prior to credit or refund.*
5. *F.O.B. Ogdensburg, NY. Ground shipping included; expedited shipping prepaid and added to invoice or shipped freight collect.*
6. *Standard shipping lead time (after credit approval): 1-4 weeks ARO.*
7. *Prices quoted do not include any applicable sales taxes or shipping charges. Prices & specifications are subject to change without notice.*