South Tahoe Public Utility District

STPUD Water Facilities CIP

Final Report

Water System Optimization Plan

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Table of Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms

AC	asbestos cement
afa or af/yr	acre feet per year
AM	asset management
APN	assessor's parcel number
AWWA	American Water Works Association
BMP	best management practice
CCTV	closed-circuit television
CDPH	California Department of Public Health
CIP	capital improvement projects
COS	cost of service
DDW	Division of Drinking Water
District	South Tahoe Public Utility District
EIP	Environmental Improvement Program
ENR	Engineering News-Record
EPA	Environmental Protection Agency
fps, ft/s	feet per second
FY	Fiscal Year
GIS	Geographic Information System
gpcd	gallons per capita per day
gpm	gallons per minute
HR	high risk
IIMM	International Infrastructure Management Manual
KPI	key performance indicator
LiDAR	Light Detection and Ranging
LOS	level of service
LR	low risk
MCL	maximum contaminant level
MDD	maximum daily demand
MG	million gallons
mgd	million gallons per day
MR	moderate risk
MTBE	methyl tertiary butyl ether
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
NWWBI	National Water and Wastewater Benchmarking Initiative
O&M	operations and maintenance
OT	overtime
PAS	Plan Area Statement
PHD	peak-hour demand
PRV	pressure-reducing valve

psi	pounds per square inch
S&B	salaries and benefits
SBx7-7	Senate Bill x7-7
SCADA	supervisory control and data acquisition
SFD	single family dwelling
SOI	sphere of influence
STL	steel pipe
TBD	to be determined
TM	Technical Memorandum
TRPA	Tahoe Regional Planning Agency
UAFW	unaccounted for water
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTR	Upper Truckee River
UWMP	Urban Water Management Plan
West Yost	West Yost Associates
WSOP	Water System Optimization Plan

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Executive Summary

ES.1 Introduction

The South Tahoe Public Utility District (District) recognized a need to complete an assessment of its potable water system that serves over 14,000 residential and commercial customers and determine how the system could be optimized to provide reliable water services safely, efficiently and cost effectively. The result was a water system optimization approach that will be used by the District to guide its operations and capital investments to meet the goal of maintaining at all times a reliable potable water service.

The optimization approach included conducting a condition assessment of the existing water facilities; developing and evaluating the hydraulic capacity of the existing and buildout water system, establishing a level of service to measure the status of a reliable water service; identifying deficiencies that needed improvements to optimize the water system; and using the results of these efforts to develop a prioritized capital improvement program to achieve an optimized and reliable potable water system.

The District partnered with Kennedy/Jenks Consultants (Kennedy/Jenks) and West Yost Associates (West Yost) to complete this Water System Optimization Plan (WSOP). Each consultant took the lead authoring certain sections as listed below, with contribution from the other consultant and the District:

- Section 1 – Existing Facilities and Condition Assessment: Kennedy/Jenks
- Section 2 – Water Demands: West Yost
- Section 3 – Level of Service Study: Kennedy/Jenks
- Section 4 – Water System Hydraulic Model Development: West Yost
- Section 5 – System Evaluation: West Yost and Kennedy/Jenks
- Section 6 – Capital Improvement Program: Kennedy/Jenks

ES.2 Project Overview

The WSOP identifies potable water distribution system improvements to optimize the water system to provide a reliable, safe, and cost effective water system to serve the District's service area. To meet this objective, West Yost and Kennedy/Jenks performed the following work tasks:

- Reviewed relevant background materials to develop an understanding of the potable water system;

- Performed system condition assessment of major facilities including wells, pump stations, tanks, regulating valves, and critical pipelines;
- Developed land use-based, demand projections using available information, buildout demand projections, and expanded system demand projections;
- Established quantifiable Level of Service (LOS) goals;
- Created a system wide hydraulic water model using the District's GIS;
- Performed a potable water system evaluation to identify storage, pumping, and distribution pipeline optimization improvements that align with the LOS; and,
- Developed a capital improvement program that identifies recommended potable water system infrastructure to optimize the water system.

The resulting WSOP provides a comprehensive road map for the District's future water system planning.

ES.3 Existing Facilities and Condition Assessment

A physical condition assessment was completed of the critical potable water facilities by District water system operations and engineering staff and Kennedy/Jenks. The condition assessment evaluated five possible modes of failure (hydraulic capacity, functionality, physical mortality, financial efficiency, and reliability) using evaluation criteria established by the District. In addition, pump tests were performed for the wells and booster pump stations to establish the firm-capacity at each of these pumping facilities and the specific energy required to pump water.

The condition assessment used a checklist with a condition score of 1 (excellent) to 5 (poor) range and a weighting-factor of "1" for minor importance up to a "5" critically important factor. The product of the two scores provided a weighted score for each criterion. Weighted condition scores were aggregated by failure mode, a criticality-weighting factor of 0% to 100% assigned, totaled, and a second criticality-weighting factor applied to achieve an overall total factored risk score for each facility. The total factored score for each facility is an overall condition risk rating, which is an indication of potential failure. For each type of facility criteria were established for rating if a facility is: 1) Low Risk; 2) Moderate Risk; 3) High Risk. The score range for the seven categories of risk are unique to each type of facility.

A summary of the total factored condition assessment scores for the various facility types is shown in Table ES-1.

Table ES-1. Total Factored Condition Assessment Scores			
Facility Type	No. of Facilities by Type	Overall Condition Risk Rating	Overall Facility Risk Score Range
Booster Pump Stations	5 each	Low Risk (3.30 to <5.25)	3.53 to 5.14
	7 each	Moderate Risk (5.25 to <5.75)	5.27 to 5.72
	4 each	High Risk (6.00 to <16.50)	6.16 to 7.61
Wells	1 each	Low Risk (3.12 to <6.00)	5.87
	8 each	Moderate Risk (6.00 to <6.50)	6.00 to 6.44
	4 each	High Risk (6.50 to <15.62)	6.77 to 8.38
	8 each	Not Rated - offline	
Pressure Reducing Valves	1 each	Low Risk (<2.67 to <5.00)	4.59
	5 each	Moderate Risk (5.00 to <6.00)	5.02 to 5.95
	14 each	High Risk (6.00 to <13.34)	6.19 to 15
Storage Tanks	2 each	Low Risk (3.25 to <6.00)	5.50 to 5.50
	13 each	Moderate Risk (6.00 to <7.75)	6.40 to 7.52
	6 each	High Risk (7.75 to <16.24)	8.14 to 8.95
Critical Pipelines	1 each	Moderate Risk (7.50 to <10.00)	8.07
	3 each	High Risk (10.00 to <19.67)	10.10 to 11.76

In general, critical assets within the water system are in good condition, when evaluating them as a whole. The condition assessment performed in conjunction with the WSOP was limited in scope. To enhance the District's decision-making process before investing capital and/or operation and maintenance resources, the District may want to perform some or all of the following assessments of its critical facilities as described in Section 1.5 Recommendations for Future Condition Assessments.

ES.4 Water Demands

To inform the system evaluations, West Yost performed an assessment of existing and future water demands to use in the system evaluations.

ES.4.1 Existing Water Demands

The District currently tracks the daily water produced by its wells, and with the exception of a number of unmetered single family and multi-family residential accounts, it also meters its customers within the District. Although the District tracks water use in two ways (production records and meter records), unmetered single family residential consumption constitutes the largest use. As the District continues to install meters, they will be able to better track actual consumption and calculate unaccounted for water within the system.

The available production and consumption data available for 2009 through 2011 were used to develop unit demand factors which were applied to future planned land use.

ES.4.2 Future Water Demands

Land use and planning within the Tahoe Region is unique because a large part of the District's service area is made up of publically-owned vacant lands. These parcels are considered unavailable for future development. The future land use for the District's service area is limited by Tahoe Regional Planning Agency (TRPA), and much of the development will be infill and re-development.

Future water demands were estimated for the District for their buildout water system using land use data from the City of South Lake Tahoe's (City's) General Plan, which covers the District's service area. The future water use was projected using demand factors established based on the available existing data along with the allowable increase in dwelling units and commercial square footage as detailed in the City's General Plan.

The District expects the majority of future water demand not to come from new development, but from the potential expansion of the system to serve neighboring water agencies, Tahoe Keys, Lukins Brothers, and Lakeside Water Company. Table ES-2 shows the estimated demands for the District's existing, buildout, and expanded system.

Table ES-2. Existing and Future Water Demand Projections

Service Area	Projected Demand, afa
Existing System	5,303
Buildout System (Existing System + New + Infill + Redevelopment)	6,931
Expanded Service Area System (Existing + Buildout + Neighboring Agencies)	8,550
afa = acre feet per year	

ES.5 Level of Service Study

To guide the District to provide the highest level of service to its customers at the most economical price while ensuring its operations are carried out in a sustainable manner, Kennedy/Jenks developed a set of Level of Service (LOS) statements. The objective of this effort is to produce a Water System Enterprise Levels of Service Statement and identify the corresponding performance standards required to achieve the established goals.

One of the key objectives of an asset management program is to match the LOS provided by the asset with customer and regulatory requirements. There is a direct link between the LOS provided and the overall cost to the customer. When a higher LOS is provided, it is likely the cost to the customers will increase. These expectations deal not only with the product delivered by the District, but, more specifically, with the attributes of that product – the nature of the output, its frequency, content, and quality. Customers are concerned with the manner in which the District delivers water service. However, while customers want the District to be responsive to complaints they also want the District to be fiscally responsible.

In this way, the LOS establishes the desired services and provides information to the District's customers regarding the corresponding level of costs. Understanding these attributes enables the relationship between the LOS and the cost of service (COS) to be determined. This relationship provides an opportunity for the District to have an open dialogue with its customers regarding the LOS desired and the amount the customers are willing to pay for this level of existing or increased service. Finally, these LOS statements establish a foundation for the development of an Asset Management Plan that will act as a guide to achieving the target goals.

The established current LOS can be used to:

- Provide a direct link between costs and services.
- Inform customers of the proposed LOS to be offered.
- Develop the annual budget.
- Develop Asset Management (AM) strategies (*i.e.*, optimize CIP/O&M activities) to deliver the required LOS.
- Measure and reward performance.
- Identify the costs and benefits of the services offered.
- Enable customers to assess the suitability, affordability, and equity of the services offered.

The key to developing this optimized strategy is to take the LOS statements and use them to lay out a cost-effective road map to improve the water system through optimizing operations and implementing appropriate capital improvements. Hence, LOS statements will become the "filter" which all expenditure decisions must successfully be compared against to make sure the final actions by the District are cost effective and provide the intended value to the District's customers.

There are two key facets to asset management: 1) defining the LOS the system will strive to provide its customers over the long-term, and 2) determining the most efficient and economical way to deliver that service (the least cost approach). Therefore, determining and detailing the

LOS that the system is going to provide is an instrumental step in the overall process of guiding the District's asset management program.

The LOS Table ES-3 captures all appropriate measures currently required to perform effective asset management. This table shows which levels of service measures are essential at the customer interface and have an impact on future capital investment as well as operation and maintenance expenditures. It is the District's intent that the LOS be living document, updated periodically to reflect changes in priority and system configuration, and used as one of several tools to steer project development and priority.

Table ES-3. Level of Service Summary

Key Service Objectives	Strategic Goals	Performance Measures: Quantifiable Goals	Performance Measures: Driver	Performance Measures: Customer Impact	Cost Implications		
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What's it cost to meet the performance measure? (Highest value of a range is provided in calculation of cost)*		
						Current Cost to District	*Additional Cost to Implement*
Provide High Quality Water	Meet regulatory quality standards	Regulated constituents at or below MCL 100% of the time	EPA, CDPH, FDA	Better taste, no odors, public health benefit, increase life of plumbing fixtures	O&M:	$1,160,000	
					Capital:		$2,010,000
		Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.	CDPH (detectable levels); District records	Better taste, public health benefit, no odors	O&M:	$81,000	$71,000
					Capital:		$332,000
	Minimize MTBE in drinking water	Non-detect (<0.5 ppb) on MTBE 100% of the time	Board Mandate	Better taste/Less odor	O&M:	$2,640	
					Capital:		$230,000
	Address nuisance water issues (odor, corrosion, sediment)	Reduce system related nuisance complaints below 10 per 1000 services annually.	NWWBI 2011 Report; District records	Clean water, better taste, no odors, protect plumbing fixtures.	O&M:	$43,100	
					Capital:		No added cost
		Investigate and respond to customer complaint within 8 hours at least 90% of the time.	NWWBI 2011 Report	Clean water, better taste, no odors, protect plumbing fixtures, increase customer confidence.	O&M:	$51,000	
					Capital:		N/A
	Protect system from backflow and cross-connection	Comply with District's cross-connection protection program 100% of the time.	CDPH Title 17; CCR Sections 7583 - 7605; District administrative code; 10 State Standards; AWWA	Public health benefit.	O&M:	$59,000	
					Capital:		$3,400
	Secure water facilities	Meet or exceed national standard for site security for systems of STPUD's size and location.	Department of Homeland Security and District Vulnerability Assessment (RAM-W)	Increase customer confidence in water quality.	O&M: Note 2		No added cost
					Capital: Note 4		$1,576,000
Provide Water Reliably	Minimize and consolidate scheduled outages	Maintain number of scheduled outages of 12 hrs or less at or below industry standard (0.65 outages per year per 1000 services).	AWWA-QualServe Guidelines	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M: Note 2	$230,000	
					Capital:		No added cost
	Minimize unscheduled outages	Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at 50 per year.	District Records & Board Request	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M: Note 2	$123,500	$39,450
					Capital:		$1,702,000
		Implement Asset Management Principles for 100% of System Assets.	RCM II; District Records	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M:	$513,447	
					Capital:		N/A
	Provide redundancy within system	100% of macro zones meet maximum day demands with largest source out of service	CDPH Waterworks Standards	Water is there when it's needed; public health; water quality; reliable water	O&M:	$19,000	
					Capital:		TBD
		100% of facilities have backup power capabilities	10 State Standards, AWWA	Water is there when it's needed; water quality; reliable water	O&M:	$2,500	
					Capital:		$4,824,000
Provide Enough Water	Size system facilities to meet community demands	100% of system can meet MDD and PHD.	CDPH Waterworks Standards, 10-State Standard, AWWA	Water is there during normal conditions	O&M:	N/A	
					Capital:		TBD
		100% of system provides access to emergency water	CDPH, 10-State Standard, AWWA, District Records	Water is there when it's needed; Water is there during fire emergency	O&M:	No added cost	No added cost
					Capital:		$804,000
		Zero days with wells pumping at greater than 90% utilization.	NWWBI 2011 Report	Water is there when it's needed	O&M:		$27,000
					Capital:		No added cost
		100% of zone storage can meet MDD while accounting for zone replenishment with largest unit out of service	10-State Standard, AWWA	Water is there when it's needed	O&M:	N/A	
					Capital:		$2,164,000
		100% of zones combined sources can pump MDD plus max fire standard for zone with largest source out of service	CDPH, 10-State Standard, AWWA	Water is there when it's needed	O&M:	N/A	
					Capital:		$5,360,000

Table ES-3. Level of Service Summary (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures: Quantifiable Goals	Performance Measures: Driver	Performance Measures: Customer Impact	Cost Implications		
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What's it cost to meet the performance measure? (Highest value of a range is provided in calculation of cost)*		
						Current Cost to District	*Additional Cost to Implement*
Provide Enough Water	Maintain system pressures	Min pressure > 20 psi under all conditions	CDPH Waterworks Standard	Public Health	O&M:		
					Capital:		$55,375,000
		Max pressure < 120 psi 90% of the time	10-State Standard; District Records	Protects plumbing and fixtures; reduce District costs	O&M:		
					Capital:		TBD
Provide Water Cost Effectively	Minimize Unaccounted water	Utilize Commercial and Residential water meters to account for all water and compare to production trends	AWWA-QualServe Guidelines	Less waste, lower rates	O&M:		
					Capital:		$24,233,000
		Meter accuracy tests within industry standard 100% of the time.	AWWA	Less waste, lower rates	O&M:	$197,000	$34,000
					Capital:		N/A
	Meet industry standards for cost to deliver water	Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:	TBD	TBD
					Capital:		No added cost
	Maintain appropriate staffing level for regular and emergency needs	Limit unplanned overtime maintenance hours to less than 15% of total unscheduled maintenance hours.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:	TBD	
					Capital:		$1,809,000
		Maintain staff utilization rate of 100% during peak season	Board Request; AWWA-QualServe Guidelines	Maintain or Reduce Rates	O&M:	$254,625	
					Capital:		No added cost
	Extend life cycle of assets	Life of assets meet or exceed industry standard.	International Infrastructure Management Manual, AWWA M Manuals	Maintain or reduce rates	O&M:	$86,000	$26,200
					Capital:		$7,236,000
	Replace spent assets	Maintain annual renewal rate on capital expenditures at or above 1.7%.	AWWA-QualServe Guidelines; International Infrastructure Management Manual; EPA Guidelines	Maintain or reduce rates	O&M:	N/A	
					Capital:		See Note 1
		When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.	RCM II	Maintain or Reduce rates	O&M:	No added cost	
					Capital:		N/A
	Operate system energy efficiently	Maintain annual energy consumption at or below 20,000 kWh/MG.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:		$36,300
					Capital:		$241,000
	Comply with regulatory requirements	Reduce current water use by 20% by 2020.	SBX 7-7	Eligibility for grant funding; reduced rates	O&M:	$356,500	
					Capital: Note 3		
Protect Lake Tahoe and the Community	Minimize health and safety risks to public	No public injury or other negative impact attributed to water system	CDPH, DHS, OSHA, District Records	Protect public health and safety.	O&M: Note 2	$19,000	
					Capital: Note 4		$603,000
	Minimize unregulated discharges	Comply with requirements for no surface water discharge from properties.	TRPA/Lahontan	Customer confidence in District as a proactive partner	O&M:	$45,720	
					Capital:		$771,000
		Implement flushing BMPs 100% of the time.	Lahontan Regulations	Protect offsite receiving water bodies	O&M:		TBD
					Capital:		No added cost
	Collaborate and cooperate with other agency programs	Zero complaints from other agencies for District O&M procedures.	Multiple Local Regulatory and Jurisdictional agencies	Customer confidence in District as a proactive partner	O&M:	No added cost	
					Capital:		No added cost
		Minimize cost associated with relocation of water utilities for EIP Projects	TRPA	Customer confidence in District as a proactive partner	O&M:	No added cost	
					Capital:		No added cost
Total Estimated O&M Cost						$3,244,032	$233,950
Total Estimated Capital Cost (Note 1)							$109,273,400

Notes:

1) Based on total water system value LOS recommends $14.2M/year asset replacement. This $14.2M/year is not included in the Total Estimated Capital Cost. Years.

2) $230,000 is included in Provide High Quality Water, Address Nuisance Water, Reduce system related nuisance complaints below 10 per 1000 services annually.

3) $24,120,000 is included in Provide Water Cost Effectively, Minimize Unaccounted Water, Utilize Commercial and Residential Water Meters to Account for All Water and Compare to Production Trends.

4) $62,000 (hard entered, $27,000 (hard entered) and $1,488,000 (hard entered) is included in Provide High Quality Water, Secure Water Facilities, Meet or exceed national standard for site security for systems of STPUD's size and location.

Table ES-3. Level of Service Summary (cont'd)

Summary of Costs to Meet Level of Service Based on Drivers

	Annual O&M Current Cost to District	Annual O&M Additional Cost to Implement	Additional Capital Cost to Implement	
Mandated Requirements the District must meet	$1,721,220	$71,000	$60,670,400	
Recommended Industry Standards the District should meet	$1,142,094	$96,500	$46,671,000	
District developed requirements	$380,718	$66,450	$1,932,000	
TOTAL	**$3,244,032**	**$233,950**	**$109,273,400**	(See Note 1)

Notes

1) The Estimated Capital Cost encompasses new assets at $35,524,400 and replacement assets at $73,749,000.

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The District's next steps to updating the LOS are:

1) Take the LOS Statements and use them to update the District's internal draft Asset Management Plan.

2) Use the LOS Statements as one criterion as the District develops and prioritizes its capital improvement budget for each fiscal year.

3) Continue with the implementation of LOS Statements by:

   - Evaluating data collection requirements – systems support and collection mechanisms.
   - Develop cost/benefit of implementation.
   - Review and finalization of report contents, frequency of reporting, trigger points and actions.
   - Complete annual evaluations of financial data to determine the cost and resulting equitable distribution that supporting departments have on the four core water departments to improve the accuracy of the Current Cost and Additional Costs in the LOS tables.
   - Integrate with performance management support software.

   The District should continue to track this information regarding how well it is meeting the LOS criteria on a regular basis, and prepare an annual report on how well the system met these criteria over the course of a year and present the results at a public (*e.g.*, Board) meeting.

   Also at this annual meeting, but not greater than every two years, discuss any changes needed in the LOS, based on the operations data.

4) The District should continue to conduct studies and monitor regulatory trends that may change the LOS requirements beyond 2015. Areas that will likely require attention include:

   - Improve the understanding of customer perceptions and expectations, which the District is addressing by periodically conducting customer surveys every two years.
   - Assess impacts of upcoming Safe Drinking Water Act, State Water Resources Control Board, Division of Drinking Water (DDW), and other regulatory changes.
   - Improve the understanding of financial and water demand targets for the organization.

ES.6 Water System Hydraulic Model Development

West Yost developed a comprehensive distribution system hydraulic model from the District's GIS and existing water distribution system maps. The model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) was verified. The existing water demands were allocated by using available spatially located customer billing information and land use designations to distribute demands within the model.

The District's hydraulic model was calibrated to confirm that the computer simulation model can accurately represent the operations of the District's water distribution system under varying conditions. Calibration of the hydraulic model used data gathered through hydrant tests. The model was calibrated to simulate pressures and flows observed in the field. In developing the model, West Yost worked closely with the District staff to assure accuracy of the model. Based on the results of the model calibration, the hydraulic model provides a good tool for master planning purposes.

ES.7 System Evaluation

West Yost and Kennedy/Jenks evaluated the water distribution system performance under existing and future demand conditions to identify deficiencies within the District's service area. Improvements were identified to address the deficiencies and develop a recommended capital improvement program.

ES.7.1 Water System Performance Evaluation Criteria

The recommended planning and design criteria was established for analyzing the performance of the District's potable water distribution system. These criteria include recommendations for the pump station and regulating valve capacity, storage volume, required fire flow and flow duration, minimum and maximum system pressures, and maximum pipeline velocity.

ES.7.2 Existing Water System Performance Evaluation

The District's water supply infrastructure must be capable of reliably serving potable water during normal and emergency operational scenarios. All pressure zones and subzones should have enough firm-supply capacity to simultaneously satisfy the combined maximum-day demand. For purposes of this optimization plan, firm-supply capacity was defined as the combined output of all active wells with one unit out of service. The District's existing water system was evaluated to identify areas where performance deficiencies exist and improvements were recommended to address the deficiencies.

The reliability of the District's system to convey water between pressure zones for emergency conditions including fire flow were evaluated.

- Insufficient Supply Capacity – Pressure zones should meet the minimum recommended supply to meet maximum day and emergency demands. Water system should be able to provide 100% of the time 1) MDD and PHD; 2) access to emergency water; and 3) MDD plus fire standard for each zone with the largest source out of service. LOS objective is to "provide enough water."
- Service Redundancy – Pressure zone should be served with multiple connections or have access to supply source within the zone. LOS objective is to "provide water reliably".
- Storage – Pressure zones should meet minimum requirements for system storage criteria. LOS objective is to "provide enough water".
- Low Pressure – Pressure zones should meet the minimum pressure requirements of 20 psi for all conditions. LOS objective is to "provide enough water".
- Excessive Pressure – Pressure zones should not exceed the maximum pressure requirement of not greater than 120 psi. LOS objective is to "provide enough water".
- Fire Flow – Pressure zones should meet minimum recommended fire flow standards for flow and pressure. LOS objective is to "protect Lake Tahoe and the Community".

Table ES-4 provides a matrix showing the deficiencies identified in each zone. The base zone and associated subzones are distinguished in Table ES-4 through changing of the row shading.

Table ES-4. Summary of Zone Deficiencies

Pressure Zone	Deficiency					
	Insufficient Supply Capacity	Service Redundancy	Storage	Low Pressure	Excessive Pressure	Fire Flow
Stateline	×					
H Street		×				×
Gardner Mountain	×					
Keller		×	×			×
Upper Saddle		×				×
Middle Keller		×				
Sweeping Turn		×		×	×	×
Four Seasons						×
Needle Peak		×				×
Rocky Point		×				×
Heavenly Valley						
June Way						
Price Road		×				×
Terrace PRV		×				×
Overlook PRV						
Upper Montgomery		×				×
Montgomery Estates		×		×		×
Golden Bear		×				×
Kokanee		×				×
Christmas Valley			×			
Arrowhead						
Iroquois						
Comanche						
Ottawa						
Pine Valley		×				×
Susquehanna		×				×
Country Club		×				×
Flagpole					×	
Mt. Rainier						
Twin Peaks	×					
Forest Mountain						
Angora Highlands						

ES.7.3 Buildout Water System Performance Evaluation

The buildout water distribution system includes the buildout of the District's existing service area boundary and does not include demands for neighboring water companies. The buildout system evaluation assumes the recommendations for improvements from the existing system evaluation have been implemented.

The hydraulic model results for the buildout system indicate that by implementing the recommended existing system improvements, the District performance standards are met for the projected buildout demands without additional system improvements.

ES.7.4 Expanded Water system Performance Evaluation

The expanded water distribution system includes the buildout of the District's existing service area plus includes the additional demands from Lukins Brothers, Lakeside Mutual Water Company, and Tahoe Keys service areas. The expanded system evaluation assumes the recommendations for improvement from the existing system evaluation have been implemented.

Both Lukins and Tahoe Keys water systems are supplied by their own groundwater wells. Lakeside is supplied through surface water from Lake Tahoe and has a groundwater well for emergency supply. For this evaluation, it is assumed that one well from each of the systems would continue to operate and be incorporated into the District's water system. The following are the assumptions used for supply sources from each of the water companies:

- Lukins Brothers – Well 1 located on West Way is assumed to remain an active well for the buildout scenario. Well 1 is assumed to be capable of delivering approximately 720 gpm.
- Tahoe Keys – Well 1 located on Tahoe Keys Boulevard near Capri Drive is assumed to remain an active well for the buildout scenario. Well 1 is assumed to be capable of delivering approximately 1,000 gpm.
- Prior to acquiring or servicing any of the neighboring water companies, a detailed condition assessment of each water system is required to determine the adequacy of the facilities in each of the water companies system.
- Lakeside Mutual Water Company – Well 3 located on Pine Boulevard is assumed to be an active well for the buildout scenario. Well 3 is assumed to be capable of delivering approximately 250 gpm. Lakeside does have a surface water filter plant that would be evaluated if the system is acquired or served and could provide an additional supply source.

ES.7.5 Summary of Recommended Improvements for Existing and Expanded Water System

The recommended improvements needed to minimize deficiencies identified in the evaluation of the existing and expanded water distribution system are summarized in Table ES-5.

Associated costs for the improvements are provided in the Capital Improvement Projects.

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Table ES-5. Existing System Improvement Recommendations				
Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
1	Christmas Valley	Storage Service redundancy	• Christmas Valley needs a minimum storage volume of 0.39 MG, but there is only 0.19 MG of storage available with 0.08 mgd available for import. Thus, an additional 0.12 MG of storage is needed. • Improvements to the Cornelian booster pump station and additional pipeline would address service redundancy by providing an additional delivery avenue to the pressure zone.	• Replace existing fire flow booster pump with new 1,250 gpm fire pump at the Cornelian booster pump station. Loop discharge side of Cornelian booster pump station to existing dead-end line in Keetak Street with a 12-inch diameter pipeline (approximately 200').
2	Country Club Zone	Fire flow Service redundancy	• The north portion of Country Club Zone is fed from the south part of the zone through a single 6-inch diameter pipeline and from the Airport booster station which has limited capacity and is normally off. • Airport booster is a small pump and does not provide much supply for fire flow. • If hydrants opened up at Airport, Onnontioga St pressures drop below 20 psi.	• Add 6-inch PRV at Washoan Blvd and Nadowa St normally closed valve M33-047 (Pine Valley to Country Club).
3				• Add 6-inch PRV at Glen Eagle Rd (1321 Glen Eagle Rd) normally closed valve M34-021NC (Pine Valley to Country Club).
4	Flagpole Zone	System pressures	• Pressures are high in the southeast portion of Flagpole Zone. This area is low elevation compared to the other parts of the Flagpole Zone.	• Add 6-inch PRV at San Bernardino Ave and Shawnee St. New pressure zone off of Flagpole Zone to reduce service pressures below 120 psi.
5				• Add 6-inch PRV at 1863 Normuk St. New pressure zone off of Flagpole Zone to reduce service pressures below 120 psi.
6				• Add 6-inch check valve at San Bernardino Ave and Normuk St. (flow from new lower pressure zone to Flagpole Zone).
7				• Add 6-inch check valve at San Bernardino Ave and Cholula St (flow from new lower pressure zone to Flagpole Zone).
8				• Loop Normuk St and Ulmeca St pipelines with a 6-inch diameter pipeline (approximately 500').
9	H Street Zone	Fire flow Service redundancy	• H Street fed by a single pump with limited capacity and not able to provide 1,000 gpm for fire flow. • The District does keep a backup pump on the shelf for an emergency situation. • No secondary connections to other pressure zones to provide backup service. • Valves can be opened to allow Stateline Zone to feed the H Street Zone directly at lower pressure in emergency conditions.	• Add new 8-inch check valve between Stateline and H Street Zones in F Street to provide service redundancy.
10				• Add 1,000 gpm pump station with backup power to provide fire flow and redundancy for emergency conditions.
11	Keller Zone/ Upper Saddle Zone/ Sweeping Turn Zone	Service redundancy	• The existing Keller Tanks have been evaluated and determined to be vulnerable to a rock slide which would result in a large service area out of supply until the District is able to reconfigure valve operations. • Keller, Middle Keller, Sweeping Turn, Upper Saddle, Needle Peak, and Rocky Point Zones all rely on the supply pumped to the Keller Tanks through approximately 6,750 feet of 6-inch diameter pipeline. • No redundant service supply for Keller Zone exists. Heavenly Valley can be valved to serve part of the zone but higher elevations are above the Heavenly Valley Zone HGL.	• Remove Keller Tank 1 and 2 from service or remove rock hazard.
12				• Add new booster pump station and hydropneumatic tank at Saddle Rd and Keller Rd (boost from June Way Zone to Keller Zone). It is assumed Project numbers 43-46 have been implemented which move Needle Peak and Rocky Point Zones from being supplied off Keller Zone to being supplied off Heavenly Zone.
13				• Add 10-inch diameter pipeline from new booster pump station to Existing Keller Tank Fill 6-inch diameter pipeline (high pressure pipeline) (approximately 100').
14				• Add isolation valves at connection to high pressure pipeline to allow high pressure line to be closed northwest of tie-in location.
15				• Abandon parallel 6-inch diameter pipeline in Keller Rd from Saddle Rd to Sherman Way (approximately 2,800').
16				• Remove Keller PRV #2 and #3 from service.

Table ES-5. Existing System Improvement Recommendations				
Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
17				• Add new 8-inch diameter pipeline in Keller Rd from Saddle Rd to Sherman Way. Tie new pipeline in to existing pipeline near 1621 Keller Rd and existing 6-inch diameter pipeline at Sherman Wy (approximately 2,800').
18				• Middle Keller Zone and Keller Zone become a single zone. Upper Saddle Zone continues to be fed from the Keller Zone through the Keller PRV #1. Sweeping Turn Zone (as modified in Figures 1 and 5) is now fed through new PRVs added as shown in Figure 1.
19				• Keller booster pump station may be maintained as a back-up option to the new Saddle Rd booster pump station or altered to be lower pressure booster pump and be the main feed to the Sweeping Turn Zone.
20	Keller / Upper Saddle / Middle Keller / Sweeping Turn / Needle Peak / Rocky Point	Storage	• These zones need a minimum storage volume of 0.56 MG, but there is only 0.33 MG available. Thus additional storage of 0.23 MG is needed unless a new, higher capacity booster station is installed as recommended, Project 11 and 12.	• 0.23 MG of additional storage is needed.
21	Kokanee and Golden Bear Zones	Fire flow Service redundancy	• Kokanee and Golden Bear are both sub zones off of the Montgomery Estate Zone served by PRVs. • No secondary connections to other pressure zones to provide backup service.	• Add secondary 8-inch diameter connection (approximately 150 ft) to Stateline Zone At Pioneer Trail and Marshall Trail with a normally closed valve. Stateline operates at a lower pressure but would provide supply at a reduced pressure for emergency conditions. This connection would also provide emergency supply to the southeast area of Stateline Zone along Plateau Circle and Fair Meadow Trail which is reliant on a single pipeline approximately 4,800 lineal ft located in Pioneer Trail.
22				• Remove Pioneer-Kokanee PRV from service.
23	Montgomery Estates / Upper Montgomery Estates Zones	System pressure Service redundancy	• Montgomery Estates Zone has service elevations ranging from approximately 6,285 feet to 6,600 feet making it difficult to maintain District acceptable low and high pressure standards. • This zone supplies Upper Montgomery Estates Zone is contiguous and serves higher elevations with a small booster pump station that could be improved to serve a larger area.	• Re-zone the boundary between Montgomery Estates and Upper Montgomery Estates Pressure Zones.
24				• Perform evaluation to determine most efficient zone breaks to minimize impact to customers and ensure reliable service.
25	Pine Valley Zone/ Susquehanna Zone	Fire flow Service redundancy	• Pine Valley is fed through a single PRV from the Iroquois Zone which then feeds the Susquehanna Zone through a single PRV and pipeline. • Available fire flow is limited by head loss through the pipeline supplying the PRV from Iroquois Zone. • Available fire flow is less than 600 gpm at several locations within the Pine Valley and Susquehanna Zones. • Pipelines in Susquehanna Drive, Ibache St, Guadalupe St, and Aravaipa St in Susquehanna Zone are all long, dead-end 6-inch diameter pipelines. • The adjacent Country Club Zone was considered for emergency supply by installing check valves where existing normally closed valves are located between the zones. However, the Country Club Zone has existing low pressure issues during emergency operations at these tie-in locations and would not be able to supply water at a high enough head to supply all of the Pine Valley and Susquehanna Zones.	• Add 8-inch PRV at Pioneer Trail and Busch Way (Iroquois to Pine Valley Zone).
26				• Add 12-inch diameter pipeline in Pioneer Trail from Elks Club Dr to Busch Way (approximately 2,250').
27				• Loop Susquehanna Dr and Ibache St pipelines with a 6-inch diameter pipeline (approximately 300').
28				• Loop Ibache St and Guadalupe St pipelines with a 6-inch diameter pipeline (approximately 250').
29				• Loop Guadalupe St and Aravaipa St pipelines with a 6-inch diameter pipeline (approximately 300').

Table ES-5. Existing System Improvement Recommendations

Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
30	Price Rd (Ralph) Zone	Fire flow Service redundancy	• Price Rd (Ralph) Zone is fed from Heavenly Valley through a single 6-inch PRV. • Two normally closed valves exist between Stateline and Price Rd (Ralph) Zone and must be manually opened up. • One normally closed valve exists between Heavenly Valley and Price Rd (Ralph) Zone fed by a 4-inch diameter pipeline. • Available fire flow is less than 1,000 gpm with some locations less than 700 gpm.	• Add check valve at normally closed valve P25-042NC located at Pioneer Trail and Norma Dr (flow from Stateline to Price Rd (Ralph) Zone to allow water to only flow during emergencies when pressures drop in Price Rd (Ralph) Zone).
31				• Add 6-inch PRV at Pioneer Trail and Needle Peak Rd (Heavenly Valley to Price Rd (Ralph) Zone). Redundant service.
32				• Replace 4-inch diameter pipeline in Needle Peak Rd between Ski Run Blvd and Pioneer Trail with 8-inch diameter pipeline (approximately 1,340 ft).
33	Stateline Zone/ Gardner Mountain Zone/ Twin Peaks Zone	Insufficient supply capacity Service redundancy	• The Sunset Well supply capacity is partially limited by the 6-inch diameter distribution pipeline downstream of the well. • Hydraulic model results indicate high velocity and headloss in the downstream pipeline from Sunset Well. • The 12-inch diameter pipeline in Lake Tahoe Boulevard crossing the Bridge limits the supply from the east side of Stateline Zone to the west side of Stateline Zone. • The single pipeline is the main pipeline providing supply from the east side of the Stateline Zone to the west side of Stateline Zone and Gardner Mountain Zone.	• Replace 6-inch diameter pipeline in Sunset Drive and Conestoga Street from Sunset well to Lodi Ave with 12-inch diameter pipeline (approximately 580')
34				• Construct 12-inch diameter pipeline in Lodi Avenue from Conestoga Street to Lake Tahoe Boulevard (approximately 800')
35				• Construct 14-inch diameter pipeline in Lake Tahoe Boulevard from Lodi Avenue to southwest side of bridge (approximately 1,400').
36				• Install new 1,000 gpm well in the State Streets area to increase supply reliability to the west side of Stateline Zone and Gardner Mountain Zone.
37	Stateline	Insufficient Supply Capacity	• Firm-supply capacity is limited to 6,000 gpm under operational scenario nos. 2, 2A and 4 • Maximum-day demand is 7,400 gpm • Supply deficiency is 1,400 gpm	• Install new well in Stateline Zone with capacity of at least 1,400 gpm, or • Increase Pomona Well capacity from 1,200 gpm to 2,400 gpm and use Twin Peaks PRV for 200 gpm, which is available in an emergency condition • Evaluate two alternatives considering probability of this occurring and potential water quality (MTBE plume migration)
38	Sweeping Turn Zone/ Four Seasons Zone/ Upper Saddle Zone/ Needle Peak Zone/ Rocky Point Zone	Fire flow System pressure Service redundancy	• There are no isolation valves within Sweeping Turn to isolate small areas. If there is a leak in Sweeping Turn, all of Sweeping Turn, Needle Peak, and Rocky Point are out of service. • There are no hydrants within Sweeping Turn Zone on Bonita Rd, Bridle Rd, and Crest Rd due to the 4-inch diameter pipelines. Hydrants located on Needle Peak Rd. can supply approximately 300 gpm for fire flow. • Sweeping Turn is fed by Keller PRV #3. Could open N/C valve between Four Seasons and Sweeping Turn for emergency purposes. However, limited usefulness due to reduced pressure in Four Seasons and elevation changes in Sweeping Turn. • Sweeping Turn elevations range from approximately 6,500 feet to 6,760 feet, which results in high system pressure in the lower elevation of the pressure zone. • An Upper Saddle Zone 6-inch diameter pipeline in Saddle Rd is parallel to the 4-inch diameter Sweeping Turn Zone pipeline and service for parcels along Saddle Road between Bridle Rd	• Add 6-inch PRV at Crest Rd and Bonita Rd (Upper Saddle Zone to Sweeping Turn Zone). In progress.
39				• Remove Saddle PRV #1 feeding Four Seasons hydrant. In progress.
40				• Replace parallel 4-inch and 6-inch diameter pipeline in Saddle Rd between Bridal Rd and Keller Rd with 8-inch diameter pipeline (approximately 1,390 ft). In progress.
41				• Connect 6-inch pipeline in Needle Peak to low pressure 6-inch pipeline in Keller Rd. In progress.
42				• Replace all 4-inch diameter pipelines in Bonita, Crest, and Bridle Rds and add hydrants as required to meet minimum 500 ft requirement (approximately 4,750 ft). In progress.

Table ES-5. Existing System Improvement Recommendations

Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
43			and Keller Rd is split randomly between pipelines. This results in some services having high pressure and other services with low pressure right next to each other. • Needle Peak is fed through a single PRV from Sweeping Turn Zone, Needle Peak also feeds the Rocky Point Zone through a single PRV. • Supply to Needle Peak and Rocky Point Zone is pumped at high pressure from the Keller Booster Station located at the edge of the Needle Peak Zone up to the high elevation Keller Zone. • Supply travels from the Keller Zone through Keller PRV #2, then Keller PRV #3, and finally Keller PRV#5 to reach Needle Peak Zone. • No secondary connections to other pressure zones to provide backup service exist, except through Rocky Point which is at a lower elevation.	• Abandon 4-inch diameter pipeline in Bridle Rd between Saddle and Bonita Rds (steep area with no services and low pressures). In progress.
44			• Needle Peak has similar elevations and is contiguous to the Heavenly Zone. • Needle Peak is fed through a single PRV and single pipeline from Sweeping Turn Zone, Needle Peak also feeds the Rocky Point Zone through a single PRV. • Supply to Needle Peak and Rocky Point Zone is pumped at high pressure from the Keller Booster Station located at the edge of the Needle Peak Zone up to the high elevation Keller Zone. • Supply travels from the Keller Zone through Keller PRV #2, then Keller PRV #3, and finally Keller PRV#5 to reach Needle Peak Zone. • No secondary connections to other pressure zones to provide backup service exist, except through Rocky Point which is at a lower elevation.	• Close existing valve Q22-008 located on Keller Rd near Needle Peak Rd. Close Keller PRV #5. Needle Peak Zone and Sweeping Turn Zone south of Keller Rd become part of Heavenly Valley Zone. Rocky Point Zone is now fed from Heavenly Valley Zone through the Rocky Point PRV.
45				• Connect existing 6-inch diameter pipeline in Needle Peak Rd to existing 6-inch diameter pipeline in Keller with approximately 185 lf of new 6-inch diameter pipeline downstream of Keller PRV #5. In progress.
46				• Replace existing 6-inch diameter pipeline in Needle Peak from Keller Rd to 3809 Needle Peak Rd with 8-inch diameter pipeline (approximately 600 ft).
47				• Add 8-inch diameter pipeline in Needle Peak Rd from Wildwood Ave to replaced 6-inch diameter pipeline located at approximately 3809 Needle Peak Rd (approximately 400').
48	Terrace PRV Zone	Fire flow Service redundancy	• Terrace is fed through a 2-inch diameter PRV from the Heavenly Zone. • Terrace PRV pulls off of a 2,350 ft long, 4-inch diameter dead-end pipeline which starts at Donner Ln and Wildwood Ave and wraps around to serve connections along David Lane in the Heavenly Zone. • Terrace is located in the middle of the Heavenly Zone with no redundant service connections. • No fire hydrants are located within Terrace Zone or on the 4-inch diameter pipeline located in Wildwood Ave.	• Replace 2-inch and 4-inch diameter pipeline in Terrace Zone with 6-inch diameter pipeline (approximately 1,950').
49				• Connect new 6-inch diameter pipeline in Knoll Lane to existing 6-inch diameter pipeline in Needle Peak Rd at Verdon Ln (approximately 500').
50				• Remove Terrace PRV located at Wildwood Ave and Terrace Dr.
51				• Connect new 6-inch diameter pipeline at Terrace Dr (north) to existing 4-inch diameter pipeline in Wildwood Dr with approximately 700 lf of new 6-inch diameter pipeline.
52				• Add hydrants on new 6-inch diameter pipeline based on minimum spacing requirements.
53	Upper Montgomery Estates Zone	Fire flow Service redundancy	• Upper Montgomery Estates is fed by a small pump station with limited capacity and not able to provide 1,000 gpm for fire flow. • No secondary connections to other pressure zones to provide backup service. Montgomery Estates Zone is not practical to serve Upper Montgomery Estates Zone due to elevation differences.	• Add 1,000 gpm pump station with backup power to provide fire flow and redundancy for emergency conditions
54	Expanded System	Service Reliability	• Future growth may include acquiring or providing service to neighboring water companies of Lakeside Mutual Water Company, Lukins Brothers, and Tahoe Keys. The condition of the water systems is unknown and would need to be determined prior to acquisition.	• Perform detailed condition assessment for each water system acquired or serviced in the future by the District.

ES.8 Capital Improvement Program

The water system condition, capacity, and LOS deficiencies were summarized in the previous sections. Capital improvement projects were developed to correct these deficiencies. The projects are designated as either a capital improvement project, a Study (that may lead to a future CIP or operational improvement), or operation and maintenance (O&M) improvements project. The sum of these projects make up the recommended WSOP Capital Improvement Program (CIP). All of the projects were selected to improve the water system reliability, efficiency, safety, and cost effectiveness to strive to achieve the LOS goals set for the District.

A brief description and capital cost was developed for each project and are included in Appendix E. The projects were grouped by high, medium and low priority, but the number assigned to each project in each priority category does not reflect a prioritization. Each project capital cost has been escalated to a July 1, 2014 costs that is tied to an ENR Index (San Francisco 10,898 ENR Index).

High-priority projects are generally those projects that correct serious deficiencies and are shown in Table ES-6.

Table ES-6.
High-Priority Projects

Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A1	Critical Waterline Evaluation	Section 1.5.5	Pipeline Evaluation (in progress)	Airport Runway/Trout Creek/UTR Meyer Crossing/Keller Discharge/David Lane Discharge	$105,000		X	
A2	Water Supply to the Y - Engineering Study	Section 5: 4.33 to 36	Water-to-Y Engineering Study. Complete and part of WSOP.	Upper Truckee River Crossing	$42,000		X	
A3	H-Street Booster Station Improvements	Section 5: 4: 9	H-Street Zone check valve	H Street Booster PS	$104,000	X		
A4	Site Drainage and BMP Improvements	Section 1.4.1, Table1- 7 and Section 1.4.2, Table 1-8	Site Drainage and BMP Improvements	Multiple well and booster pump sites	$348,000	X		
A5 (note 1)	Mountain View Well Abandonment	Section 1.4.2, Table 1-8	Groundwater Protection	Mountain View Well abandoned 2014	$218,000	X		
A6	Chemical Safety Improvements at Well Buildings	Section 1.4.2, Table 1-8	Safety Improvements	Multiple well sites	$20,000			X
A7	Arcflash Assessment Wells and Booster Stations	Section 1.4.1, Table 1-7 and Section 1.4.2, Table 1-8	ARC-FLASH study improve emerg generator facilities, and useful life evaluation of electrical equipment	Multiple well and booster pump sites	$233,000		X	

Table ES-6. High-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A8	PRV Replacement and Reliability Improvements	Section 1.4.3, Table 1-9	PRV Improvements	Multiple PRV station sites	$836,000			X
A9a	Keller Tank Alternatives - Engineering Study	Section 5: 11 to 19	Replace Keller Booster and tanks w/ new pump station at Heavenly tank site	Keller Zone, Upper Saddle Zone, Sweeping Turn Zone	$79,000		X	
A9b	Keller Booster Station Relocation	Section 5: 11 to 19	Keller Tank Replacement at alternate location TBD (alternative to projects A9 and A9C)	Keller Tank	$1,861,000	X		
A9c	Keller Tanks Relocation	Section 1/ Section 5: Project 20, Alternative for projects 11 to 19	Keller Tank Replacement at existing site	Keller Tank	$3,125,000	X		
A9d	Keller Tanks Replacement	Section 1/ Section 5: Project 20, Alternative for projects 11 to 19	Keller/Heavenly Zone Storage and Fire Protection	Keller Zone, Upper Saddle Zone, Sweeping Turn Zone, Middle Keller, Needle Peak, Rocky Point	$1,778,000	X		
A10	Tank Access and Site Improvements	Section 1.4.4, Table 1-10	Tank Site Improvements	Multiple tank sites	$444,000	X		
A11	Tank Seismic Improvements	Section 1.4.4, Table 1-10	Tank Seismic Improvements	Multiple tank sites	$137,000		X	
A12	Well Inspections	Section 1.4.2, Table 1-8	Paloma and Sunset Well Inspections	Multiple well sites	$53,000	X		
A13 (note 2)	Crest-Bonita PRV Installation	Section 5: 38	Crest-Bonita PRV - Add 6-inch PRV (improve fire flow, pressures and service redundancy)	Crest Rd. & Bonita Rd. (Upper Saddle Zone to Sweeping Turn Zone)	$118,000	X		
A14	Pioneer-Norma Check Valve Installation	Section 5: 30	Pioneer at Norma Check Valve - Add 8-inch check valve at normally closed valve (P25-042NC)	Pioneer Trail & Norma Drive	$122,000	X		
A15	Forest Fire Capability Assessment - Engineering Study	Section 5: 59	Forest Fire Flow Engineering Study to improve capability to fight fires	System-wide	$26,000		X	
A16	Pioneer-Busch PRV Installation	Section 1/ Section 5: 25	Add 8-inch PRV	Pioneer Trail & Busch Way (Iroquois to Pine Valley zone)	$122,000	X		
A17	Pioneer Trail Waterline Installation	Section 5: 26	Add 2,250 ft. long 12-inch pipeline	Pioneer Trail from Elks Club Dr to Busch Way	$1,356,000	X		
A18	Washoan-Nadowa PRV Installation	Section 5: 2	Add 6-inch PRV	Washoan Blvd & Nadowa St at normally closed valve (M33-047) Pine Valley to Country Club	$118,000	X		
A19	Glen Eagle PRV Installation	Section 5: 3	Stateline Zone Supply Study - Add 6-inch PRV	Glen Eagle Rd at normally closed valve M34-021NC (Pine Valley to Country Club)	$118,000	X		
A20	Water Supply to Stateline Zone - Engineering Study	Section 1/ Section 5: 37	Evaluate alternatives to correct insufficient supply capacity	Stateline Zone	$79,000		X	
A21	Critical Valve Assessment	Section 1: 60	Valve criticality study	System-wide	$26,000		X	

Table ES-6. High-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A22	SCADA Improvements	Section 5: 55	SCADA Improvements - Improve collection to hourly or less	System-wide	$11,000			X
A23	Water Model Demand Allocation Improvements	Section 5: 56	Hydraulic Model Demand Allocation improvements	System-wide	$11,000		X	
A24	Pine Valley - Susquehanna Waterline	Section 5: 27, 28, & 29	Add loop system to improve fire flow and redundancy and combine with Project A18	Pine Valley & Susquehanna Zones	$258,000	X		
A25	Montgomery Estates Zone Evaluation - Engineering Study	Section 5: 23 & 24	Evaluate Montgomery Estates Zones - Re-configuration of Pressure Zones Evaluation	Montgomery Estates and Upper Montgomery Estates Zones	$53,000		X	
A26	Fire Flow Calibration Testing	Section 5: 57	Fire Flow Field Calibration	System-wide	$21,000		X	
A27	Fire Hydrants on 4-inch Waterlines - Engineering Study	Section 5: 58	Hydrants on 4" lines - Determine where to effectively add fire hydrants on 4" pipelines	System-wide	$11,000		X	
A28	Cornelian Fire Pump and Waterline Installation	Section 5: 1	Cornelian Booster Pump Station site - Provide additional fire flow for fire protection		$635,000	X		
A29	Upper Montgomery Estates Pump Station Replacement	Section 5: 53	New Upper Montgomery Estates P/S - Add 1,000 gpm capacity with backup power	Upper Montgomery Estates	$1,153,000	X		
A30	Install New Standby Generators	Section 3: LOS	Install at Keller Booster Pump (BP) Station a new 30 KW standby generator and at David Lane BP Station a 200 KW standby generator with building additions	Keller Zone and Heavenly Zone	$240,000 at Keller BP Station $522,000 at David Lane BP Station for total of $762,000	X		

Notes:

1. The District has taken Mountain View Well off line in 2014. The District will determine if they will implement Project A5 – Abandon Mountain View Well.
2. The District has already completed Project A13 – Crest-Bonita PRV installation in 2014.

The sum of the high-priority projects is estimated at $11 million (which does not include projects A9b and A9d).

Medium-priority projects consist of reliability improvements, engineering studies and other permit compliance activities, and consolidation of pressure zones as described above and as shown in Table ES-6.

Table ES-7. Medium-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
B1	UTR Bridge Freeze Protection	Section 1.4.5, Table 1-11	Install insulation on exposed pipelines on Upper Truckee River pipeline crossing	UTR Bridge Crossing	$44,000			X
B2	SCADA Improvements, Phase 2, Monitoring, Security	Section 1.4.4, Table 1-10	Miscellaneous SCADA Improvements - Monitoring and Security		$286,000			X
B3	Tank Coatings - Interior Repair and Replacement	Section1. 4.4, Table 1-10	Tank Coating Replacement (interior)		$1,400,000	X		
B4	Security Fencing at Tanks	Section 1.4.4, Table 1-10	Tank-Site Security Projects (fencing)		$470,000	X		
B5	Building Coatings, Insulation, and Security Improvements	Section 1.4.1, Table 1-7 and Section 1.4.2, Table 1-8	Improve Site Security and Building Maintenance Projects		$279,000			X
B6	Pump Reliability and Efficiency Assessments	Section 1.4.1, Table 1-7	Pump Reliability and Efficiency Projects		$104,000		X	
B7	Stateline Zone Capacity Improvements	Section 5: 33 to 36	Water to the Y Water System Improvement Project	MULTIPLE	$6,453,000	X		
B8	Airport Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Replacement	Airport Runway Crossing	$10,011,000	X		
B9	Trout Creek Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Replacement	Trout Creek Crossing	$521,000	X		
B10	Keller Booster Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Improvements	Keller Tank Supply	$200,000	X		
B11	UTR Meyers Waterline Reliability Improvements	Section 1.4.5, Table 1-11	Pipeline Replacement	UTR Meyer Waterline Crossing	$522,000	X		
B12	Well Assessment and Replacement Program	Section 1.4.2, Table 1-8	Develop a downhole well condition assessment and well replacement program	MULTIPLE	$154,000		X	
B13	Fire Hydrant Installations	Section 1.5.5	Installation of 75 new Fire Hydrants on Pipelines > 6" in diam with no fire hydrants within 500 ft. in developed areas and 1,000 ft. spacing in urban/forest undeveloped areas	MULTIPLE	$1,143,000	X		
B14	Rocky Saddle Multiple Zone Improvements	Section 5: 44 to 47	Reconfigure Pressure Zones, add pipelines between zones, and replace undersized pipelines	MULTIPLE	$440,000	X		
B15a	H-Street Booster Station Replacement	Section 5: 10	Replace existing H Street Pump Station	H Street Zone	$710,000	X		
B15b	H-Street Booster Pump Spare	Section 1.4.1, Table 1-8	Provide Spare Pump	H Street Pump Station	$13,000			X
B16	Kokanee - Golden Bear PRV Abandonment	Section 5: 21 & 22	Improve Fire Flow, Pressures and Redundancy for Kokane, and Golden Bear Zones	Kokanee and Golden Bear	$68,000			X

Table ES-7. Medium-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
B17 (note 1)	Upper Saddle-Sweeping Turn Zone Improvements	Section 5: 39 to 43	Upgrade by removing PRVs, adding PRV, replacing under sized pipelines with fire hydrants, adding pipeline interconnections to improve low pressure areas, and abandon undersized pipelines	Sweeping Turn, Four Seasons & Upper Saddle Zones	$2,653,000	X		
B18	Price-Ralph Improvements	Section 5: 31 & 32	Provide redundant service from Stateline to Ralph Zone and provide redundant service from Heavenly to Price Road	Price Rd (Ralph)	$631,000	X		
B19	Terrace Zone Improvements	Section 5: 48 to 52	Terrace PRV	Terrace PRV	$1,230,000	X		

Note:

1. Project B17 was completed by the District in 2014.

The total cost of medium-priority projects is estimated at $28 million.

Low-priority projects consist of activities that prolong the useful service life of existing water assets, and recommends pressure zone consolidation improvements to improve reliability and system performance in the Flagpole Zone, as shown in Table ES-8.

Table ES-8. Low-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
C1	PRV Improvements	Section 1.4.3, Table 1-9	PRV improvements	Multiple PRV sites	$592,000	X		
C2	Well Electrical Equipment Evaluation	Section 1.4.2, Table 1-8	Evaluate physical mortality of electrical gear	Multiple Well sites	$47,000		X	
C3	Water Quality Evaluation - Engineering Study	Section 5: 62	Conduct system-wide water quality evaluation for low-water demand periods	System-wide	$37,000		X	
C4	Well Sites Pipe Coating Improvements	Section 1.4.2, Table 1-8	Piping improvements	Multiple Well Sites	$58,000			X
C5	SCADA Improvements - Phase 3, Flowmeters	Section 1.4.2, Table 1-8	SCADA improvements	Multiple Well Sites	$550,000	X		
C6	Boulder Mountain and Cold Creek Tank Booster Pipe Coating Improvements	Section 1.4.1, Table 1-7	Piping improvements	Boulder Mountain and Cold Creek Tank booster pump stations	$13,000			X
C7	SCADA Improvements - Phase 3, Flowmeters	Section 1.4.1, Table 1-7	SCADA improvements	Multiple pump stations	$805,000	X		
C8	South Apache Booster Improvements	Section 1.4.1, Table 1-7	Building replacement	South Apache Booster	$337,000	X		

Table ES-8. Low-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
C9	Airport Booster Improvements	Section 1.4.1, Table 1-7	Miscellaneous improvements	Airport Booster	$436,000	X		
C10	Tank Inlet / Outlet Piping Retrofits	Section 1.4.4, Table 1-10	Piping and coating improvements	Multiple Tank sites	$1,698,000	X		
C11	Tata Tank Removal	Section 1.4.4, Table 1-10	Remove Storage Tank	Tata Tank	$54,000	X		
C12	Flagpole Zone Improvements	Section 5: 4 to 8	Pipeline projects to address excessive system pressures	Flagpole Zone	$798,000	X		
C13	Unidirectional Flushing Program	Section 5: 63	On-call engineering Support for System-Wide Unidirectional Flushing Program	Water system-wide	$21,000		X	
C14	Pipeline Replacement Program	Section 5: 61	Conduct an evaluation to develop a pipeline replacement priority program	Water system-wide	$347,000		X	

The total cost of low-priority projects is estimated at $5.8 million.

In addition to the WSOP CIP, the District has been allocating capital funds to complete additional capital projects that were already known by the District, most notably water meter installation at non-metered services (complete by 2018/2019), replacement of undersized water mains (125,000 feet replaced over the next 20 years), and other Lake Tahoe water quality protection projects, utility relocate projects, special studies, and implementing customer service LOS improvements.

The District's CIP planning process is very fluid, thus the District decided not to assign a priority implementation (budget) year to each project. Instead the District has added these projects to the District's "Unconstrained Project List". Each year the District reviews the CIP project list and assigns a priority and budget-year for implementation based on a review of the LOS objectives and how to achieve those objectives.

To visualize the capital outlay needs to implement all of the recommended WSOP capital improvement projects and other programs, a series of stacked charts have been developed that depict the budget needs to complete within a 20-year (see Figure ES-1) or 30-year (see Figure ES-2) period, using a 3% annual inflation rate. Only the actual capital improvement projects (combined value of $37.834 million in year 2015) were included in the charts (studies or O&M projects are not included with a combined value of $3.182 million). In addition, projects A1, A12, A13, and B17 (combined value of $2.92 million) have been completed by the District and have not been included in the stacked charts.

A second set of stacked charts was developed to visualize how the proposed projects improve the water system as shown in Figure ES-3 for a 20-Year Water System CIP – Projects by Program and Figure ES-4 for a 30-Year Water System CIP – Projects by Program. Each project was assigned one of three goals: new asset; asset replacement; and asset optimization in the two figures. The District has previously estimated the value of the water system at approximately $574 million in 2014 dollars. The annual capital outlay to replace the entire water system over a 100-year period curve is shown on Figures ES-2 through Figure ES-5 to depict how the two capital outlay scenarios for asset replacement would compare to this benchmark.

The conclusions from this study are:

- If the District were to complete the WSOP CIP and waterline upsizing program in next 20 years, then the annual capital outlay of $1- to $3-million earmarked to be spent between 2019 to 2024, nearly $10 million would need to be spent beginning 2025 and with a 3% annual increase thereafter until 2034.
- If the District completes the improvements over 20 years, the District will be on track to replace the existing assets over 100 years.
- If the District extends the implementation period to 30-years, the District would need to increase the capital outlay by approximately $5 million in 2025 and an additional 3% annual increase thereafter until 2044.
- These two above scenarios are intended to provide perspective on the fiscal impacts to the District if the identified infrastructure improvements to date are implemented to achieve the current LOS objectives. The economic climate, regulations, and other factors will drive the District in establishing the CIP.
- Due to the limited scope of work of the WSOP, the stacked charts cannot account for any infrastructure renewal or replacement needs that have not yet been identified (*e.g.*, system-wide replacement of waterlines ≥6-inches or projects from studies recommended by the WSOP).

Figure ES-1

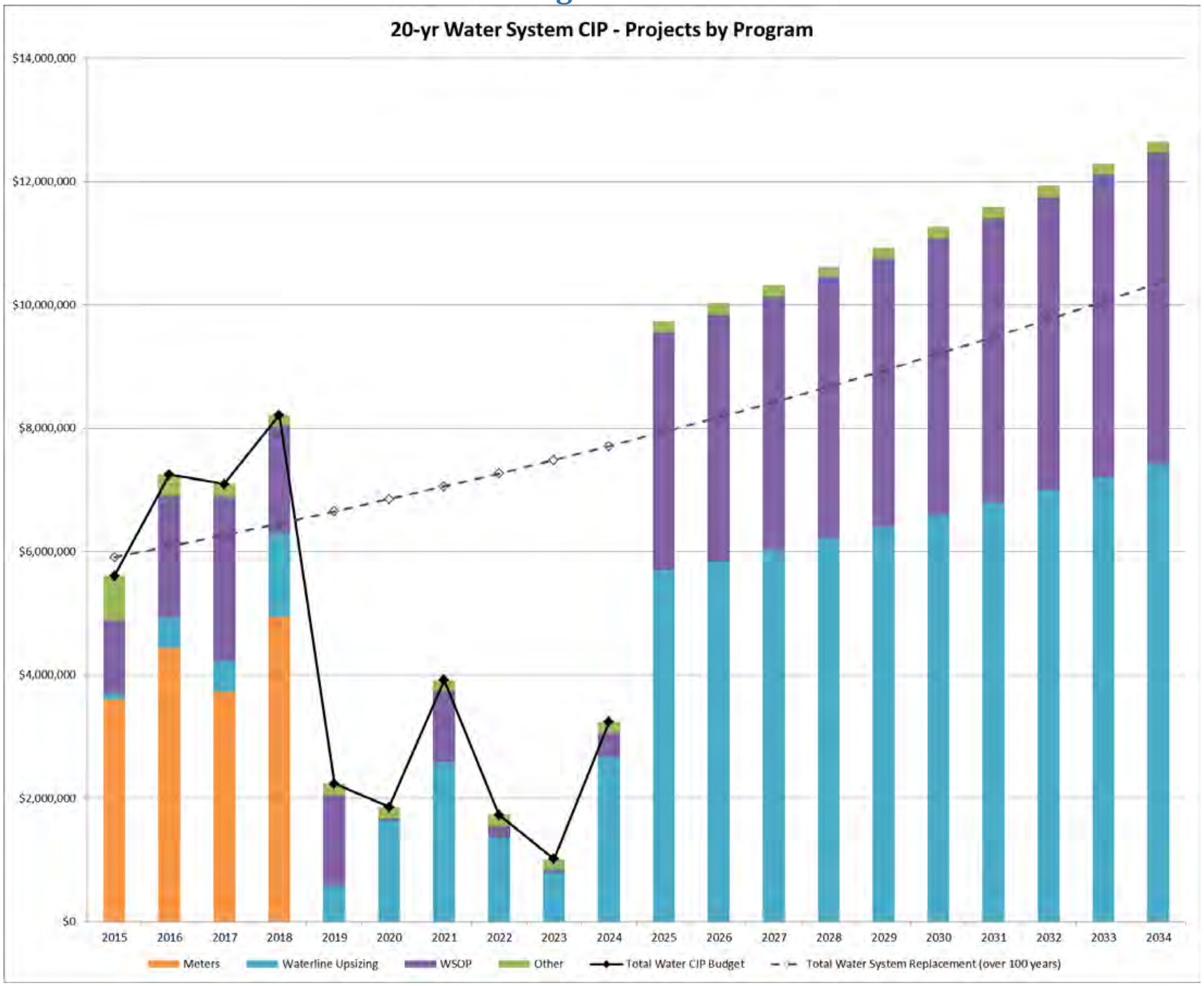
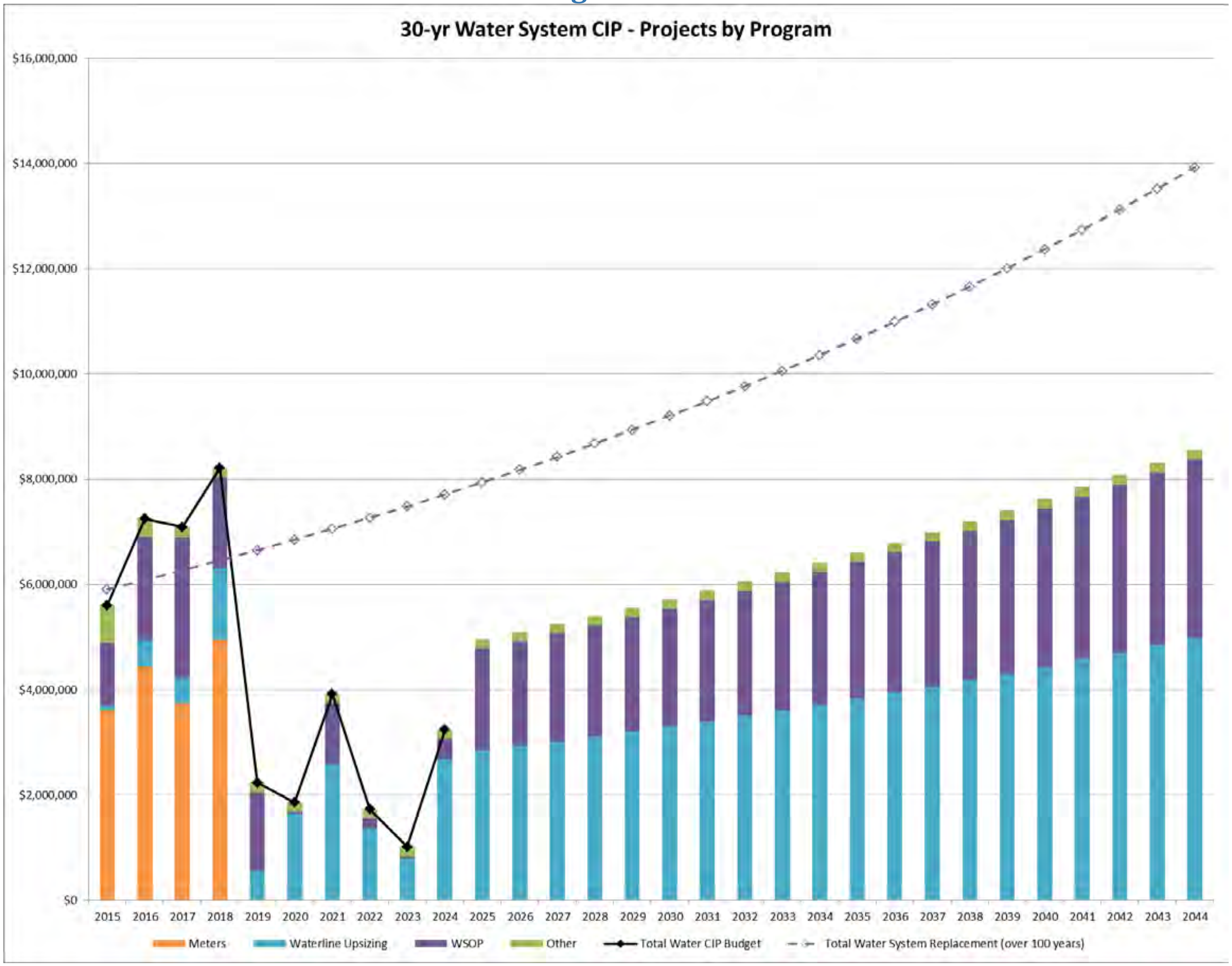

20-yr Water System CIP - Projects by Program
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
Meters
Waterline Upsizing
WSOP
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure ES-2



30-yr Water System CIP - Projects by Program
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Meters
Waterline Upsizing
WSOP
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure ES-3

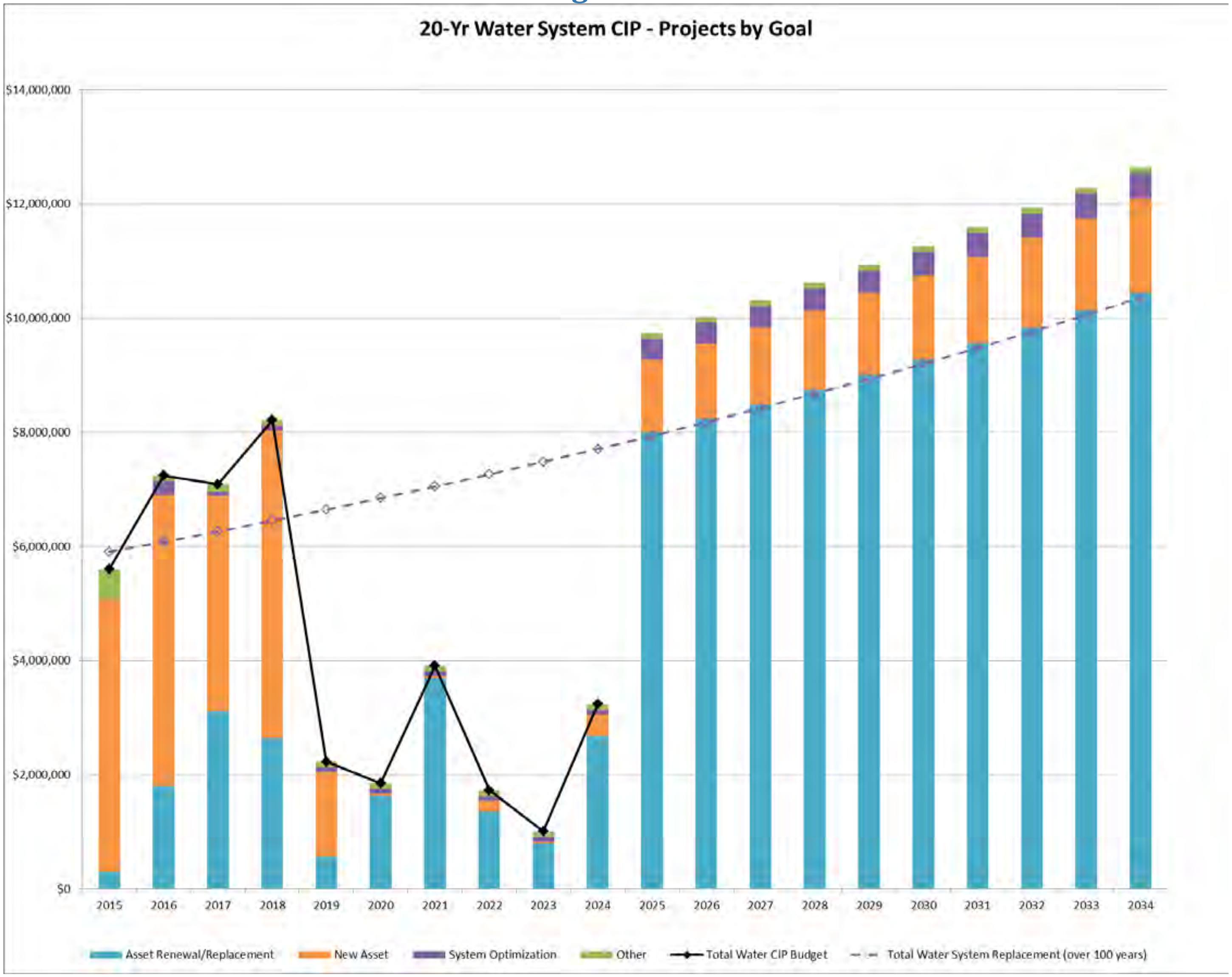
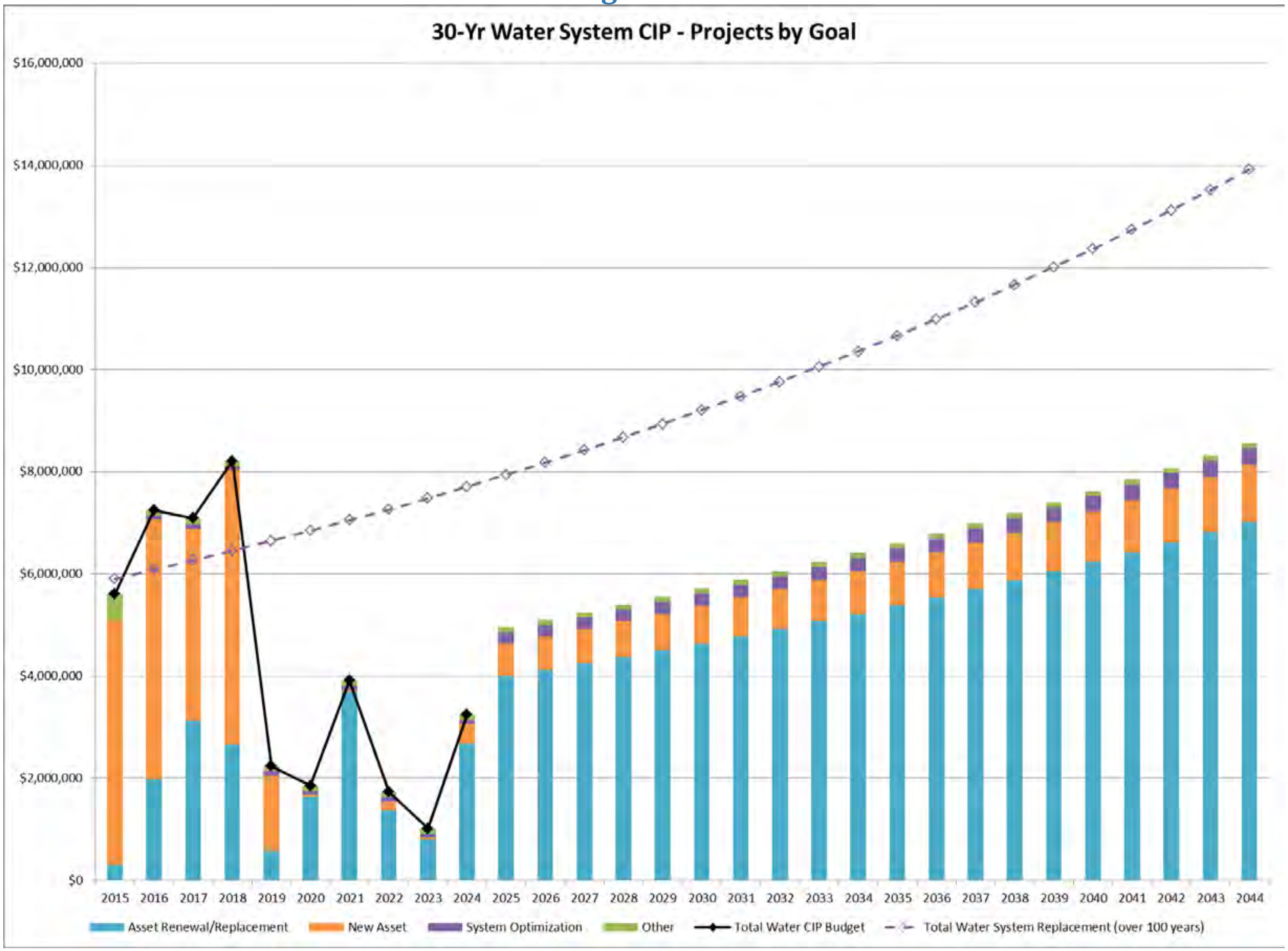

20-Yr Water System CIP - Projects by Goal
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
Asset Renewal/Replacement
New Asset
System Optimization
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure ES-4


30-Yr Water System CIP - Projects by Goal
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Asset Renewal/Replacement
New Asset
System Optimization
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

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Section 1: Existing Water Facilities and Condition Assessment (TM 1A)

1.1 Purpose

This Section 1 lists the condition of the South Tahoe Public Utility District's (District's) critical potable water infrastructure. Critical potable water infrastructure, identified by the District, is shown in Figure 1-1; they include:

- Booster pump stations – 16 each
- Wells – 21 each
- Storage tanks – 21 each
- Pressure reducing stations – 23 each
- Transmission mains that crossed creeks and the Tahoe Airport runway that would be difficult to access to repair – 4 each

For purposes of this planning effort, the condition of a facility is expressed in terms of five possible modes of failure:

- Hydraulic capacity
- Functionality
- Physical Mortality
- Financial Efficiency
- Reliability

Ultimately, findings and recommendations from this document will be incorporated into the District's Water System Optimization Plan.

1.2 Protocol for Condition Assessment

The first step of condition assessment was to identify all critical facilities that are currently in use. For the purpose of this analysis, the District selected as their critical facilities:

- booster pump stations,
- wells,
- storage tanks,
- pressure reducing valve stations,
- small set of transmission pipelines

Existing facilities that have been non-operational for an extended period were not assessed, as they were deemed non-critical.

The next step was to develop evaluation criteria by way of a condition assessment checklist (with an asset class rating system) and a form to be used in the field to capture the condition of a particular asset and complete an initial rating of each facility. This protocol included documentation of field conditions, including use of photographs, to support the condition assessment effort.

Once the critical facilities were identified, and protocol finalized, District staff performed physical inspections, and assigned initial condition ratings to several parameters that influence each of the five failure modes listed in Section 1.1. The condition parameters for each type of facility are listed under Section 1.3 of this document.

The condition parameters for any given facility included the electrical system, SCADA equipment, mechanical equipment, building structures, and the site. These parameters were further subdivided to provide assessments of several physical conditions and known risk factors, depending of the type of facility (*e.g.*, booster pump station, tank, PRV, etc.).

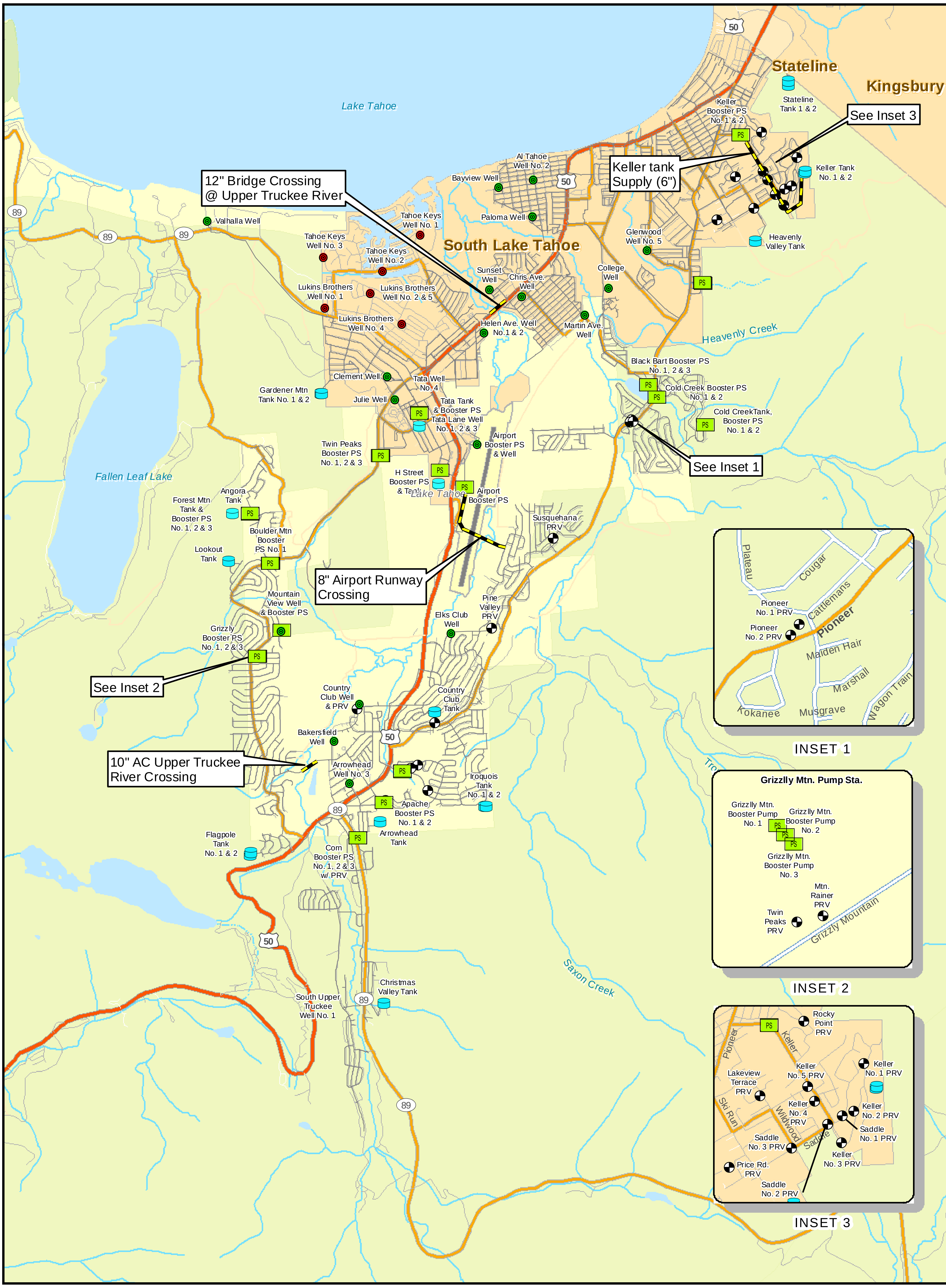
One example of a risk factor for a site is its proximity to known active seismic faults. Relative scores were assigned based on proximity to the two active faults located in the Lake Tahoe Basin as shown in Figure 1-2. Parameters for establishing the scores were as follows:

- 100 miles or greater from an active fault = 1
- 20 miles to < 100 miles away from an active fault = 2
- 5 miles to < 20 miles away from an active fault = 3
- 250 feet to < 5 miles away from an active fault = 4
- < 250 feet away from an active fault = 5

The above scoring is an objective way of quantifying the potential impacts of an earthquake based on the following references: USGS Maximum Considered Earthquake ground motions that form the basis for the International Building Code and USGS map of active earthquake faults, as accessed through their Google Earth mapping plug-in.

The last three scoring categories (*i.e.*, 3, 4 and 5) correspond to seismic-loading criteria defined in the Uniform Building Code: substantial seismic shaking can occur up to 20 miles from an active fault; near-source effects amplify forces within 5 miles; and the highest ground motion and likelihood of ground rupture is expected within 250 feet of an active fault.

In addition, pump-performance tests were conducted at each of the critical booster pump stations and well pumps. For wells and booster pump stations the pump curves, if available, were obtained. Data collected from each pump test was then analyzed to establish firm-capacity at each pumping facility, and the specific energy required to pump water.



Legend

- Booster Pump Station
- Tanks
- Pressure Reducing Valve
- District Wells
- Non-District Wells
- Critical Pipelines

N

0 2,450 4,900 9,800

1" = 5000'

Kennedy/Jenks Consultants

Water System Optimization Plan
South Tahoe Public District

Potable Water System Critical Facilities Map

K/J 1270004*00
JULY 2016

Figure 1-1

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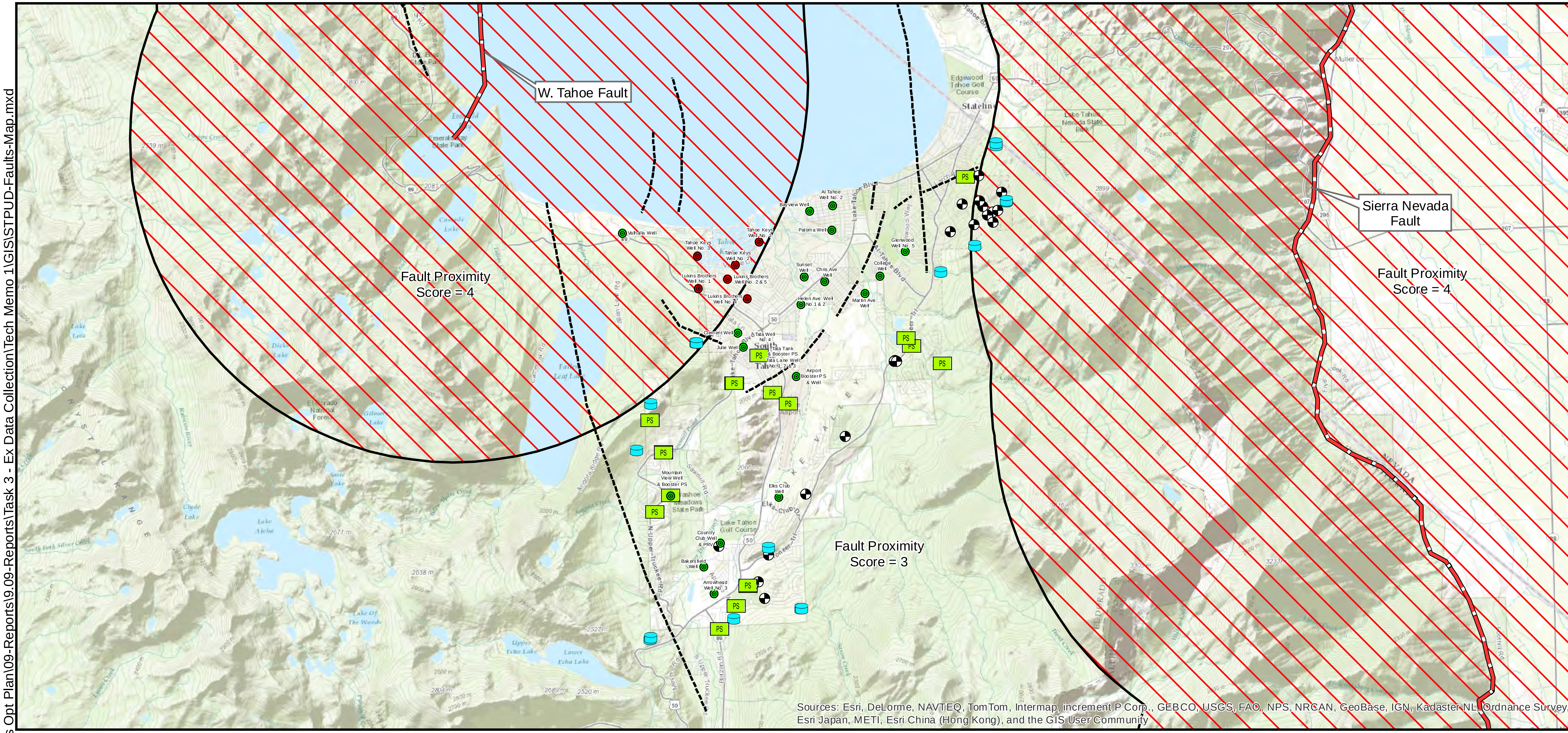

Legend

- Booster Pump Station
- Tanks
- Pressure Reducing Valve
- District Wells
- Non-District Wells
- Active Fault Lines
- Inactive Fault Lines

N

0 4,000 8,000 16,000

1" = 8000'

Kennedy/Jenks Consultants

Water System Optimization Plan
South Tahoe Public District

Potable Water System
Seismic - Hazard Map

K/J 1270004*00
JULY 2016

Figure 1-2

J:\2012\1270004.00_STPUD_Water Sys Opt Plan\09-Reports\9.09-Reports\Task 3 - Ex Data Collection\Tech Memo 1\GIS\STPUD-Faults-Map.mxd

In contrast, wells were only evaluated based on observed above-ground conditions. Subsurface conditions, such as screen and casing condition, were not taken into consideration as part of this assessment. The District's well information is included in Appendix A1 for future reference.

1.3 Infrastructure Condition Assessment

1.3.1 Introduction

Condition assessment checklists were completed for each type of facility. For example, in the case of booster pump stations, the checklist required condition scores for over 60 metrics that were categorized into the five basic failure modes. Raw condition scores will vary for each metric and will range between 1 (excellent) and 5 (poor).

In addition to a raw condition score, an importance-weighting factor was assigned to each metric, with a score of "1" representing an issue of minor importance, and a score of "5" being critically important. The product of raw-condition score and the weighting factors provided a weighted score for each metric.

Weighted condition scores were then aggregated according to each failure mode, and a criticality-weighting factor of 0% to 100% was assigned to each type of failure mode. The product of weighted condition scores and criticality factors established a factored score for each failure mode. These scores were then totaled and adjusted by a second criticality factor based on the importance of a given attribute, such as pump-station site, or building structure. The result of this calculation yielded an overall total factored risk score for the entire facility from 0 to 25. In general, low scores indicate facilities that are in "good" condition typically at a lower risk of failure and high scores indicate "poor" condition facilities typically at higher risk of failure.

The following sections, as shown in Tables 1-1, 1-2, 1-3, and 1-4, summarize the factored condition assessment scores for each facility. Completed checklists for each facility are included in Appendix A2.

1.3.2 Booster Pump Stations

Table 1-1. Factored Condition Assessment Scores

Facility Name	Zone Served	FACTORED CONDITION SCORES								Comments
		Site	Structure	Pumps	Piping & Valves	SCADA	Other	Electrical	Overall Facility	
Twin Peaks	Twin Peaks	0.29	0.17	0.91	0.40	0.76	1.04	1.73	5.30	Cannot run two pumps at same time - overpressure (1)
Tata	Gardner Mountain	0.39	0.36	1.75	0.41	0.97	0.16	1.68	5.72	
Forest Mountain	Angora	0.44	0.24	1.45	0.56	1.02	0.40	1.03	5.14	Cannot run pumps at max speed
Cornelian	Christmas Valley	0.37	0.24	1.71	0.40	0.70	0.40	0.92	4.74	Cannot run pumps at max speed - Excessive noise from unit no. 3
Airport	Country Club	0.25	0.17	1.31	0.67	1.18	0.56	2.02	6.16	No standby pump
Flagpole	Flagpole	0.35	0.32	1.20	0.56	0.95	0.32	1.03	4.73	Genset overheats
Grizzly Mountain	Flagpole	0.27	0.17	0.91	0.37	0.65	0.32	0.83	3.53	
Boulder Mountain	Forest Mountain	0.23	0.20	1.74	0.93	1.21	0.64	1.40	6.36	Excessive noise from unit no. 1; leaky seal at fire pump; problems w/ cooling water loop
H ST	H Street	0.49	0.48	2.59	0.76	1.58	0.48	1.23	7.61	Pump runs continuously
David Lane	Heavenly	0.36	0.27	1.85	0.37	1.13	0.48	1.23	5.70	
South Apache	Iroquois	0.38	0.56	2.75	0.69	1.13	0.10	1.13	6.75	High-pitch noise from unit no. 2
North Apache	Iroquois	0.35	0.17	0.90	0.37	0.65	0.32	1.76	4.53	District has selected to not run pumps at full speed – to prevent damaging existing AC water mains
Keller	Keller	0.54	0.25	1.49	0.37	0.97	0.10	1.55	5.27	
Cold Creek Filter Plant	Montgomery Estates	0.32	0.29	1.76	0.37	0.65	0.26	1.83	5.49	Excessive pump noise from unit no. 1
Black Bart	Montgomery Estates	0.37	0.45	1.48	0.41	1.05	0.10	1.85	5.71	Building in poor condition
Cold Creek Tank	Main	0.33	0.37	1.74	0.84	0.89	0.10	0.83	5.36	

Note:
(1) This was the condition at the time of the condition assessment. Since this time the District has corrected this deficiency.

Table 1-2. Booster Pump Performance						
Facility Name	Zone Served	Pump No.	Test Flow [gpm]	Efficiency [%]	Specific Energy [kW-hr/Mgal]	Firm-Capacity [gpm]
Twin Peaks Booster	Twin Peaks	1	1,006	70%	1,060	1,000
Twin Peaks Booster	Twin Peaks	2	1,003	67%	1,104	
Twin Peaks Booster	Twin Peaks	3	1,007	70%	1,075	
Tata Booster	Gardner Mountain	1	410	55%	1,009	410
Tata Booster	Gardner Mountain	2	610	63%	970	
Forest Mountain Booster	Angora	1	114	50%	1,591	180 (1)
Forest Mountain Booster	Angora	2	105	47%	1,689	
Forest Mountain Booster	Angora	3	362	59%	1,388	
Cornelian Booster	Christmas Valley	1	215	38%	832	303
Cornelian Booster	Christmas Valley	2	238	42%	759	
Cornelian Booster	Christmas Valley	3	569	32%	1,245	
Airport Booster	Country Club	1	242	37%	1,194	0 (2)
Flagpole Booster	Flagpole	1	472	60%	1,411	760
Flagpole Booster	Flagpole	2	456	60%	1,426	
Flagpole Booster	Flagpole	3	470	61%	1,418	
Grizzly Mountain Boosters	Flagpole	1	500	79%	Not available	500
Boulder Mountain Booster	Forest Mountain	1	136	47%	1,082	240
Boulder Mountain Booster	Forest Mountain	2	148	50%	1,009	
Boulder Mountain Booster	Forest Mountain	3	807	47%	N/A (3)	
H Street Booster	H Street	1	Not available	Not available	Not available	
David Lane Booster	Heavenly	1	576	59%	2,015	1,050
David Lane Booster	Heavenly	2	609	54%	2,210	
David Lane Booster	Heavenly	3	560	57%	2,099	
South Apache Booster	Iroquois	1	328	61%	1,368	550
South Apache Booster	Iroquois	2	241	50%	1,607	
South Apache Booster	Iroquois	3	335	58%	1,453	
North Apache Booster	Iroquois	1	534	72%	1,136	950
North Apache Booster	Iroquois	2	488	75%	1,108	
North Apache Booster	Iroquois	3	489	73%	1,110	
Keller Booster	Keller	1	253	74%	2,676	250
Keller Booster	Keller	2	253	76%	2,679	
Black Bart	Montgomery Estates	1	200	42%	1,333	360
Black Bart	Montgomery Estates	2	197	42%	1,394	
Black Bart	Montgomery Estates	3	468	45%	1,529	
Cold Creek Tank	Montgomery Estates	1	85	32%	951	84
Cold Creek Tank	Montgomery Estates	2	84	33%	949	

Notes:
(1) Forest Mountain Booster Pumps are clamped at 180 gpm by the District to prevent damage to water distribution system from over pressurization.
(2) Airport Booster includes a single duty pump, with no spare.
(3) Specific energy not computed for engine-driven fire pump.

1.3.3 Wells

Table 1-3. Factored Condition Assessment Scores												
Facility Name	Zone Served	FACTORED CONDITION SCORES										Comments
		California Waterworks Standards	Well Site	Structure	Well Pump	Piping & Valves	Sanitary Seal, Casing & Screen	Treatment	SCADA	Electrical Power	Overall Facility	
Bayview Well	Main	0.47	0.26	0.26	1.16	0.32	1.51	0.64	0.21	1.06	5.87	
Bakersfield Well	Arrowhead	0.43	0.21	0.24	1.34	0.37	2.39	0.35	0.19	0.90	6.43	
Arrowhead Well #3	Arrowhead	0.50	0.18	0.17	1.31	0.32	2.37	0.53	0.21	1.19	6.77	
So. Upper Truckee Well #3	Christmas Valley	0.50	0.21	0.17	1.40	0.32	2.37	0.35	0.19	0.91	6.42	
Elks Club Well #2	Country Club	0.50	0.21	0.26	1.40	0.32	2.07	0.44	0.19	0.69	6.06	
Valhalla Well	Gardner Mountain	0.53	0.28	0.18	1.42	0.37	2.01	0.44	0.19	0.69	6.10	
Airport Well	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Al Tahoe Well #2	Main	0.50	0.26	0.18	1.06	0.37	2.16	0.44	0.23	0.85	6.04	
Blackrock Well #2	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Chris Well	Main	0.62	0.21	0.29	1.40	0.92	2.44	0.00	0.68	0.38	6.92	
Clement Well	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
College Well	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Glenwood Well #5	Main	0.50	0.18	0.18	1.29	0.34	2.07	0.53	0.18	0.73	6.00	
Helen Ave. Well #2	Main	0.50	0.31	0.19	1.26	0.32	2.07	0.53	0.22	0.75	6.17	
Paloma Well	Main	0.54	0.19	0.18	1.20	0.32	2.24	0.53	0.17	1.09	6.44	
Sunset Well	Main	0.50	0.27	0.19	1.32	0.32	2.25	0.44	0.22	1.57	7.08	
Tata Well #1	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Tata Well #2	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Tata Well #3	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)
Mountain View Well	Twin Peaks	0.66	0.31	0.23	1.73	0.86	2.38	0.44	0.22	1.57	8.38	
Martin Well	Main	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	(offline)

1.3.4 Pressure-Reducing Valves

Table 1-4. Factored Condition Assessment Scores					
Facility Name	Zone Served	FACTORED CONDITION SCORES			Comments
		Site	PRV & Piping	Overall Facility	
Keller #4	Heavenly	2.87	6.36	8.84	
Comanche	Comanche	1.24	3.88	5.12	
Ottawa	Ottawa	1.61	6.17	7.65	
Country Club	Arrowhead	2.34	5.40	7.766	
Oflying	Country Club	1.26	3.33	4.59	
Saddle #1	Four Seasons	2.22	5.86	7.65	
Keller #1	Upper Saddle	1.53	4.66	6.19	
Keller #2	Middle Keller	1.40	3.74	5.13	
Keller #3	Sweeping Turn	2.44	4.75	7.01	
Keller #5	Needle Park	1.82	4.54	6.35	
Pioneer #1 (Pioneer-Marshall)	Montgomery	2.14	4.62	6.58	
Pioneer #2 (Pioneer-Kokanee)	Montgomery	2.14	4.64	6.60	
Price Rd.	Price Rd.	1.58	4.33	5.90	
Rocky Point	Rocky Point	1.80	4.71	6.51	
Terrace	Terrace	1.77	5.48	7.25	
Overlook	Overlook	TBD	TBD	15.00	Could not access to make an assessment. PRV is assumed to be buried. Since not accessible, assigned Potential Failure Condition rating
Saddle #3	Heavenly	2.69	5.06	7.75	
Saddle #2	Heavenly	1.47	3.55	5.02	Normally closed
Susquehana	Susquehana	1.47	4.47	5.95	
Pine Valley	Pine Valley	1.37	6.24	7.60	

1.3.5 Storage Tanks

Table 1-5. Factored Condition Assessment Scores								
Facility Name	Zone Served	FACTORED CONDITION SCORES						Comments
		California Water Works Standards	Tank Site	Tank Structure	Piping & Valves	SCADA System	Overall Facility	
Lookout Tank	Twin Peaks	1.36	3.47	0.89	0.38	0.60	6.70	
Echo View Tank	Twin Peaks	1.15	2.91	0.62	0.38	0.44	5.50	
Tata Tank	Gardner Zone	2.54	2.19	1.75	1.16	0.50	8.14	
Angora Tank	Angora	1.00	2.91	0.77	0.38	0.44	5.50	
Arrowhead Tank	Arrowhead	1.92	3.22	0.69	0.42	0.48	6.73	
Christmas Valley Tank	Christmas Valley	2.28	1.66	1.67	0.53	0.50	6.65	
Country Club Tank	Country Club	1.00	3.34	1.54	0.38	0.50	6.77	
Flagpole Tank #1	Flagpole	1.48	3.22	1.65	0.65	0.48	7.49	
Flagpole Tank #2	Flagpole	1.44	3.22	1.72	0.65	0.48	7.52	
Forest Mountain Tank	Forest Mountain	1.44	2.91	1.53	0.38	0.50	6.76	
Gardner Mountain Tank #1	Gardner Mountain	1.44	3.46	1.56	0.38	0.48	7.32	
Gardner Mountain Tank #2	Gardner Mountain	1.44	3.46	1.56	0.38	0.48	7.32	
H. St. Tank	H. Street	1.44	3.27	0.80	0.38	0.50	6.40	
Heavenly Valley Tank	Heavenly Valley	1.95	3.34	0.79	1.78	0.50	8.36	
Iroquois Tank #1	Iroquois	1.61	3.46	2.03	0.88	0.50	8.48	
Iroquois Tank #2	Iroquois	1.61	3.46	1.84	0.79	0.50	8.21	
Keller Tank #1	Keller	1.32	3.94	2.16	0.83	0.50	8.76	
Keller Tank #2	Keller	1.32	3.94	2.24	0.83	0.62	8.95	
Stateline Tank #1	Main	1.65	3.46	0.87	0.38	0.50	6.87	
Stateline Tank #2	Main	1.65	3.46	0.87	0.38	0.50	6.87	
Cold Creek Tank	Montgomery Estates	2.47	1.71	1.11	1.06	0.50	6.85	

1.3.6 Critical Pipelines

Table 1-6. Factored Condition Assessment Scores						
Facility	Zone Served	FACTORED CONDITION SCORES				Comments
		California Water Works Standards	Pipeline Route/ Alignment	Piping and Valves	Overall Facility	
10" AC Upper Truckee River Waterline Crossing (UTR Crossing)	Flagpole/ Arrowhead	0.20	7.05	4.51	11.76	
12" Lake Tahoe Boulevard Waterline (UTR Bridge Crossing Hwy 50)	Main/Gardner Mountain	0.20	3.38	5.69	8.07	
8" Steel line through meadow (Airport Runway Crossing)	Country Club/ Stateline	0.20	6.23	3.68	10.10	
6" dedicated Keller tank steel line (6" High Pressure Line)	Keller	0.80	5.70	5.07	11.19	

1.4 Summary of Water Facilities Condition Assessment Findings

The following sections summarize the condition assessment scores and ranking for each facility, organized by the five facility types. The overall facility score risk was considered to be an indication of the facility condition assessment and assigned one risk of these three categories:

- Low risk (LR) of failure
- Moderate risk (MR) of failure
- High risk (HR) of failure

The range assigned to each of the seven categories varied between the type of facility as described below.

1.4.1 Booster Pump Stations

The scores for the booster pump stations are shown in Table 1-7 and ranged from about 3.5 to above 7. For perspective, Grizzly Mountain Booster Pump Station is the newest pump station, which was completed and put into operation in 2012; it was rated a score of 3.53. An overall-condition risk rating for booster pump stations was established based on the overall score, in accordance with the following criteria:

- LR with an overall score of 3.30 to < 5.25
- MR with an overall score of 5.25 to < 6.00
- HR with an overall score of 6.00 to < 16.50

The booster pump stations that would be considered in poor condition are Boulder Mountain, South Apache, and H Street pump station.

Table 1-7. Summary of Booster Pump Station Facilities Condition Assessment Scores and Rankings

Overall-Condition Rating	Facility	Overall Facility Score (0 to 25)	Ranking
LR	Grizzly Mountain	3.53	1
LR	North Apache	4.53	2
LR	Flagpole	4.73	3
LR	Cornelian	4.74	4
LR	Forest Mountain	5.14	5
MR	Keller	5.27	6
MR	Twin Peaks	5.30	7
MR	Cold Creek Tank	5.36	8
MR	Cold Creek Filter Plant	5.49	9
MR	David Lane	5.70	10
MR	Black Bart	5.71	11
MR	Tata	5.72	12
HR	Airport	6.16	13
HR	Boulder Mountain	6.36	14
HR	South Apache	6.75	15
HR	H ST	7.61	16

1.4.2 Wells

Scores for the wells are shown in Table 1-8 and ranged from about 5 to just above 8. An overall-condition rating for wells was established based on the overall score, in accordance with the following criteria:

- LR with an overall score of 3.12 to < 6.00
- MR with an overall score of 6.00 to < 6.50
- HR with an overall score of 6.50 to < 15.62

Several wells were not rated because these wells are inoperable, due to poor water quality. Condition-assessment scores for these facilities were not computed.

- Airport – not operable
- College – not operable
- Tata #3 – not operable
- Blackrock #2 – not operable
- Clement – not operable
- Tata #1 and #2 – not operable
- Martin – not operable

Table 1-8. Summary of Well Facilities Condition Assessment Scores and Ranking			
Overall-Condition Rating	Facility	Overall Facility Score	Ranking
N/A	Airport Well	0.00	Not Rated (NR)
N/A	Blackrock Well #2	0.00	NR
N/A	Clement Well	0.00	NR
N/A	College Well	0.00	NR
N/A	Martin Well	0.00	NR
N/A	Tata Well #1	0.00	NR
N/A	Tata Well #2	0.00	NR
N/A	Tata Well #3	0.00	NR
LR	Bayview Well	5.87	1
MR	Glenwood Well #5	6.00	2
MR	Al Tahoe Well #2	6.04	3
MR	Elks Club Well #2	6.06	4
MR	Valhalla Well	6.10	5
MR	Helen Ave. Well #2	6.17	6
MR	So. Upper Truckee Well #3	6.42	7
MR	Bakersfield Well	6.43	8
MR	Paloma Well	6.44	9
HR	Arrowhead Well #3	6.77	10
HR	Chris Well	6.92	11
HR	Sunset Well	7.08	12
HR	Mountain View Well	8.38	13

1.4.3 Pressure-Reducing Valves

Scores for the PRV stations are shown in Table 1-9 and ranged from above 4 to 9. An overall-condition rating for PRVs was established based on the overall score, in accordance with the following criteria:

- LR with an overall score of 2.67 to < 5.00
- MR with an overall score of 5.00 to < 6.00
- HR with an overall score of 6.00 to < 13.34

The Overlook PRV was not previously known by the District to exist and was buried. A condition assessment could not be completed, but rating of 15.00 has been assigned assuming the valve is in very poor condition.

Table 1-9. Summary of PRV Condition Assessment Scores and Ranking			
Overall-Condition Rating	Facility	Overall Facility	Ranking
LR	Oflying	4.59	1
MR	Saddle #2	5.02	2
MR	Comanche	5.12	3
MR	Keller #2	5.13	4
MR	Price Road	5.90	5
MR	Susquehana	5.95	6
HR	Keller #1	6.19	7
HR	Keller #5	6.35	8
HR	Rock Point	6.51	9
HR	Pioneer #1 (Pioneer-Marshall)	6.58	10
HR	Pioneer #2 (Pioneer-Kokanee)	6.60	11
HR	Keller #3	7.01	12
HR	Terrace	7.25	13
HR	Pine Valley	7.60	14
HR	Ottawa	7.65	15
HR	Saddle #1	7.65	16
HR	Country Club	7.66	17
HR	Saddle #3	7.75	18
HR	Keller #4	8.84	19
HR	Overlook	15.00	20

1.4.4 Storage Tanks

Scores for the storage tanks are shown in Table 1-10 and ranged from about 5 to about 9. An overall-condition rating for storage tanks was established based on the overall score, in accordance with the following criteria:

- LR with an overall score of 3.25 to < 6.00
- MR with an overall score of 6.00 to < 7.75
- HR with an overall score of 7.75 to < 16.24

Table 1-10. Summary of Storage Tank Condition Assessment Scores and Ranking			
Overall-Condition Rating	Facilities	Overall Facility	Ranking
LR	Echo View Tank	5.50	1
LR	Angora Tank	5.50	2
MR	H. St. Tank	6.40	3
MR	Christmas Valley Tank	6.65	4
MR	Lookout Tank	6.70	5
MR	Arrowhead Tank	6.73	6
MR	Forest Mountain Tank	6.76	7

Table 1-10. Summary of Storage Tank Condition Assessment Scores and Ranking			
Overall-Condition Rating	Facilities	Overall Facility	Ranking
MR	Country Club Tank	6.77	8
MR	Cold Creek Tank	6.85	9
MR	Stateline Tank #1	6.87	10
MR	Stateline Tank #12	6.87	11
MR	Gardner Mountain Tank #1	7.32	12
MR	Gardner Mountain Tank #2	7.32	13
MR	Flagpole Tank #1	7.49	14
MR	Flagpole Tank #12	7.52	15
HR	Tata Tank	8.14	16
HR	Iroquois Tank #2	8.21	17
HR	Heavenly Valley Tank	8.36	18
HR	Iroquois Tank #1	8.48	19
HR	Keller Tank #1	8.76	20
HR	Keller Tank #2	8.95	21

1.4.5 Critical Pipelines

Scores for the critical pipelines are shown in Table 1-11 and range from low-9 to high-11. An overall-condition rating for pipelines was established based on the overall score, in accordance with the following criteria:

- LR with an overall score of 3.92 to < 7.50
- MR with an overall score of 7.50 to < 10.00
- HR with an overall score of 10.00 to < 19.67

Table 1-11. Summary of Critical Pipelines Condition Assessment Scores and Ranking			
Overall-Condition Rating	Facility	Overall Facility	Ranking
MR	12" Lake Tahoe Boulevard Waterline (UTR Bridge Crossing Hwy 50)	8.07	1
HR	8" Steel line through meadow (Airport Runway Crossing)	10.10	2
HR	6” dedicated Keller tank steel line (6" High Pressure Line)	11.19	3
HR	10” AC Upper Truckee River Waterline Crossing (UTR Crossing)	11.76	4

1.4.6 Condition Assessment Summary

In general, critical assets within the water system are in good condition, when evaluating them as a whole. However, there may be aspects for any given facility that could use some improvements to accomplish the following:

- restore or protect the physical condition to avoid a failure or extend the useful life,
- improve functionality and reliability to optimize operations, and
- improve performance of the facility to achieve a financially-efficient facility.

The next step will be to combine condition-assessment evaluations, described above, with the hydraulic-capacity assessment. Once this is done, the deficiency of each facility will be classified into one of three categories:

- condition-assessment deficiency,
- capacity deficiency, or
- condition-assessment and capacity deficiencies.

Recommended improvement alternatives will then be developed and evaluated to identify the preferred corrective measures.

In addition, an operation-procedures review and evaluation will be conducted. This process will help determine if there are cost-effective opportunities to modify District water system operations to adjust operations to establish the most efficient operation. The recommended alternatives will be evaluated by conducting a Business Risk Assessment. The process and findings will be summarized in Section 5: System Evaluation (Technical Memorandum No. 4).

1.5 Recommendations for Future Condition Assessments

The following are descriptions of future condition assessment measures that the District may want to consider to enhance evaluation of critical facilities. This enhanced condition assessment would then be used by the District to improve the decision making process when determining to invest capital and/or operation and maintenance resources into a facility.

1.5.1 Booster Pump Stations

- Monitor pump and motor condition with handheld vibration meter. Track vibration over time to provide early detection of mechanical problems.
- Monitor electrical panels periodically using thermal imaging equipment.
- Track mean-time-between-failures for all pumps. Use as predictive tool to perform preventive maintenance.
- Track run-time and production for each pump and review annually to compare if a performance impact is occurring.

- Conduct pump efficiency test once every three years and then annually once a pump performance decline is noted.
- Install customer-side metering to measure electricity consumption at each facility. This will allow real-time monitoring of specific energy (kW-hours/Mgal pumped), and provides a valuable tool for identifying energy-saving opportunities.

1.5.2 Wells

- Provide elevation datum data next to existing level transducers to facilitate pump condition assessment. Existing transducers/displays are difficult to interpret.
- Perform periodic drawdown tests to monitor specific yield over time.
- Install monitoring wells near production wells to facilitate drawdown testing and water quality sampling.
- Develop and implement down-hole condition assessment procedures.
- Perform regular down-hole inspections at each well.

1.5.3 Pressure-Reducing Valves

- Conduct regular checkup list of pressure-reducing valves (*i.e.*, schedule every 6-12 months).
- Perform rebuilds on an as-needed basis (*i.e.*, every 5-10 years, or as needed) to extend remaining useful life.

1.5.4 Storage Tanks

- Perform coating inspections, interior with diver recommend once every five years and exterior visual inspection annually per NACE requirements.
- Perform seismic evaluations on unanchored tanks.
- Install cathodic-protection test stations, and track condition annually.

1.5.5 Critical Pipelines

- Install corrosion test stations and actively monitor condition of metallic pipes.
- Install tracer wire and locating posts on all critical pipelines.
- Perform leak detection surveys on critical pipelines.
- CCTV the interior of existing major transmission steel, cast iron or ductile iron pipelines to determine/assess any internal corrosion.
- Recommend determine where additional fire hydrants are needed to provide adequate fire hydrant spacing in accordance with the District standards
- Recommend determine where valves are needed with spacing in transmission mains at least once every 5,000 ft. and for distribution mains at each tee and cross provide at least two to three valves, respectively.
- Develop a program to determine condition assessment, rating, and recommended replacement of remainder of the pipelines in the District water system.

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Section 2: Water Demands (TM 1B)

2.1 Overview

This section presents the existing and projected buildout water demands for the South Tahoe Public Utility District (District). These water demand estimates were used to identify the required water supply to service the 2030 buildout water system. They were also used to update the District's water distribution system model for hydraulic analyses.

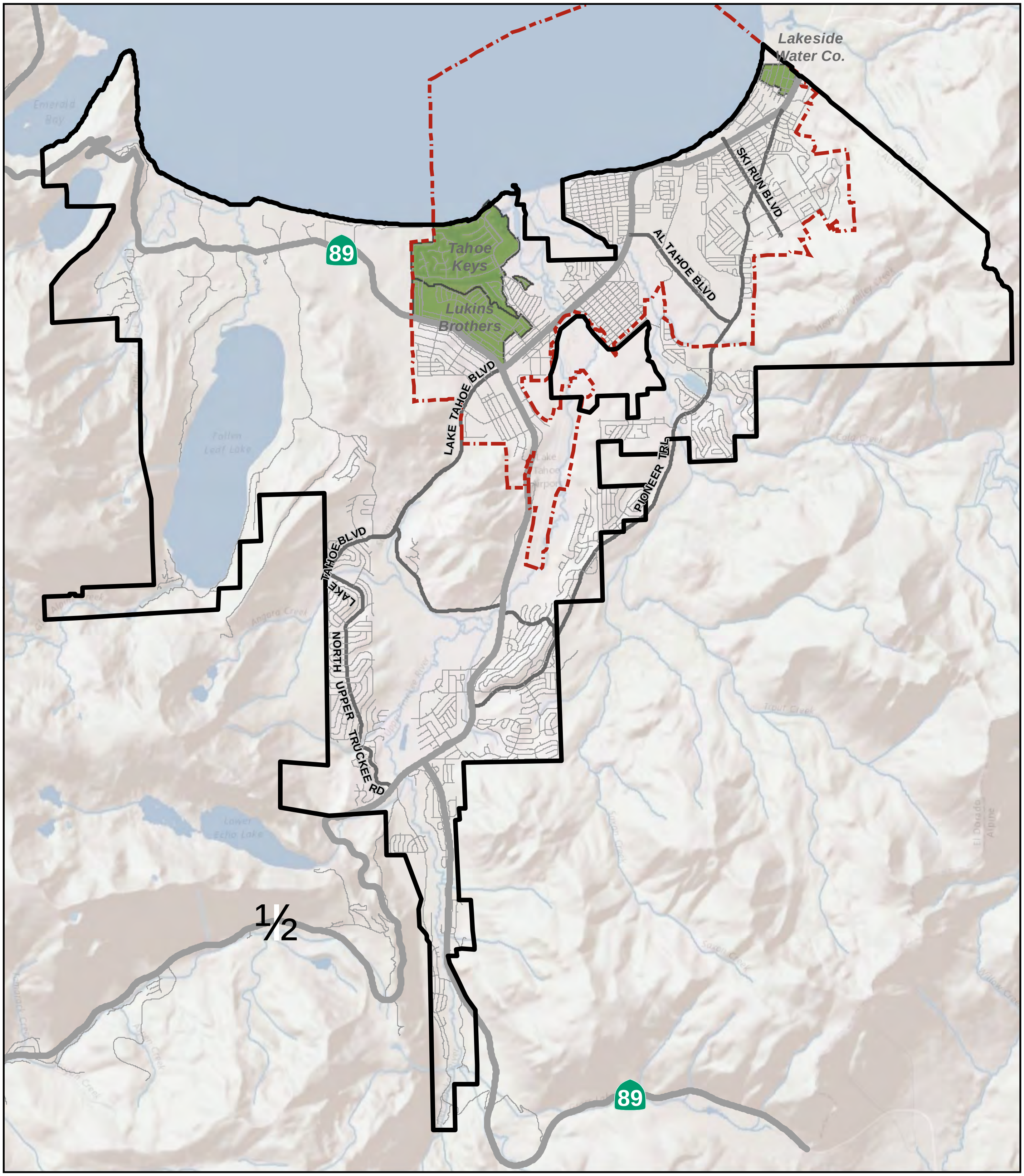
Accurate and detailed water demand data and projections are required to develop and calibrate the potable water system hydraulic model, help identify potential deficiencies in the existing water system, and assist in the assessment of the buildout water system capacity and future capital improvement program based on anticipated development. Future water demand projections also play a key role in helping the District identify and secure sufficient water supplies to serve their future customers under various hydrologic conditions.

The following sections describe the data and methodology used to determine the District's existing and future water system demands:

- Water Service Area Characteristics
- Historic Water Production and Consumption
- Water Demand Projections
- Peaking Factors
- Conclusions and Recommendations

2.2 Water Service Area Characteristics

The District was established as a special district in 1950 and is located in El Dorado County (County) on the southern shore of Lake Tahoe. The District's existing water service area is approximately 27,000 acres or about 7.6 square miles. The District provides water service to most of the City of South Lake Tahoe (City), as well as portions of unincorporated land within the County. While the existing water service area is generally contiguous with the City limit, it also extends westward to include Emerald Bay, eastward to the California-Nevada state line, and southward to include Christmas Valley, Figure 2-1 shows the District service boundary and the City limits.



LEGEND

District Boundary

South Lake Tahoe City Limits

Not Served by District

N

0 4,000 8,000

Scale in Feet

FIGURE 2-1

South Tahoe Public Utility District
Water System Optimization Plan

Service Area

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The Lake Tahoe area is a destination location. For the District's service area this results in peak demands occurring over holiday weekends with a series of consecutive maximum day demands over the summer holiday periods. In addition, the District's service area is situated within a National Forest and provides fire flow for both the community and Wildland-Urban interface locations.

The Tahoe Basin was historically served by several small water service companies. The District is the largest water service provider in the Tahoe Basin and has acquired several of these small water service companies over the years. Lukins Brothers, Lakeside Water Company, and Tahoe Keys are all small water companies within the Tahoe Basin with contiguous service areas to the District. The Study Area used for this analysis is based on the District's service area and includes the potential for acquiring the small water companies still operating within the South shore of the Tahoe Basin. The District's service area includes the current General Plan for the City, which was adopted May 17, 2011.

Currently, future growth potential for the District includes infill within the City limits and development of areas outside the City limits within the proposed Sphere of Influence (SOI) boundary. However, due to planning thresholds from Tahoe Regional Planning Agency (TRPA), the amount of growth within the District will be limited. The largest increase to the District water demands is expected to be a result of acquiring any of the existing small water companies within the District's sewer service area.

Subsequent sections describe the existing number of services by customer class, historical population served, and existing and projected land uses within the District.

2.2.1 Existing Number of Services

Currently, the District is partially metered. A meter implementation program is in place and the District anticipates being fully metered by 2025. A majority of the commercial customers and large water users within the District are metered. Table 2-1 summarizes the number of metered and unmetered water service connections by customer class.

Table 2-1. Summary of Water Service Connections by Customer Class[a]		
Customer Class	Number of Connections[b]	Percent of Total Connections
Single Family Residential Metered	4,427	31.5%
Multi-Family Residential Metered	486	3.5%
Commercial Metered	554	3.9%
Total Metered Connections	5,467	38.9%
Single Family Residential Unmetered	7,695	54.7%
Multi-Family Residential Unmetered	766	5.4%
Commercial Unmetered	135	1.0%
Total Un-Metered Connections	8,596	61.1%
Total Overall	**14,063**	**100%**

(a) Source: Data provided by District staff September 5, 2012.
(b) Number of customers reflects July 2012 active accounts.

The largest sector within the District is residential with single family residential making up approximately 86 percent of accounts and multi-family making up approximately nine percent. A majority of the residential accounts are unmetered. Commercial accounts make up approximately five percent of the District accounts and 80 percent of the commercial accounts are metered.

2.2.2 Historical and Future Population

The current District service area population is 33,100 persons. The District provides water to the unincorporated communities around the City, as well as within the City. Estimation of current population for the 2010 Urban Water Management Plan (UWMP) was based on data obtained from Demographics Now, which breaks the service area up into nine Census Tracts. The historical population of the District, shown in Table 2-2, was obtained from the UWMP. The water service area excludes the small water companies, Tahoe Keys, Lukins Brothers, and Lakeside Water Companies, within the District's boundary. As shown in Table 2-2, the population of the District's water service area shows a decreasing trend from about 34,000 people in 2000, to approximately 33,100 people in 2010, representing an approximate three percent decrease over the past 10 years. This decrease in population is mainly the result of the economic climate and the seasonal/vacation character of the Lake Tahoe area. A large percentage of homes in the Tahoe area are considered "seasonal housing" or second homes. These second homes have resulted in a larger number of foreclosures in the past few years within the District's service area.

Buildout population estimates for the District are based on the data Demographics Now used in the UWMP and the City's 2030 General Plan Background Reports. Growth rates within the District's service area are consistent with the TRPA Regional Plan. Based on the General Plan and TRPA Regional Plan, new residential units within the City are limited to approximately 1,162. This limit in new residential housing units results in a low 0.4 percent annual growth rate within the District. The population of the District's service area at buildout is estimated to be about 37,400.

Table 2-2. Historical and Projected Population[a]	
Year	Service Area Population
2000	34,042
2001	33,938
2002	33,835
2003	33,731
2004	33,627
2005	33,524
2006	33,420
2007	33,316
2008	33,213
2009	33,164
2010	33,124
2011	33,079
2015	34,194
2020	35,264
2025	36,334
2030	37,404

[a] Population estimates obtained from Final Urban Water Management Plan 2010, Table 3.2 and Table 2.2.

2.2.3 Existing and Projected Land Use

Land use planning within the Tahoe Region is unique. TRPA has the land use and environmental authority in the Tahoe Region. The Tahoe Regional Planning Compact gives TRPA the authority to adopt and enforce environmental quality standards, which directly impact growth within the District's service area.

Plan Area Statements (PAS's) are used by TRPA and the City to define the "permissible uses" for a given area. There are 26 adopted PAS's that are located either entirely or partially within the City limits. TRPA adopted these PAS's in 1987, in order to implement the Land Use Sub-element of the Regional Goals and Policies Plan. The City also adopted these in lieu of more traditional zoning in 1999. In April 2008, TRPA proposed to replace the current PAS system with Transect Zoning, which considers intensity and mixture of land uses rather than just types of land use.

Several PAS's have been replaced by Community Plans. Three of the Community Plans have been adopted by the City and TRPA. Table 2-3 shows the land use summary from the City's General Plan for areas within the City limits and the City's SOI which is contained within the District's service area. This table does not distinguish between parcels served by the District and parcels served by the other water companies that lie within the City and the SOI.

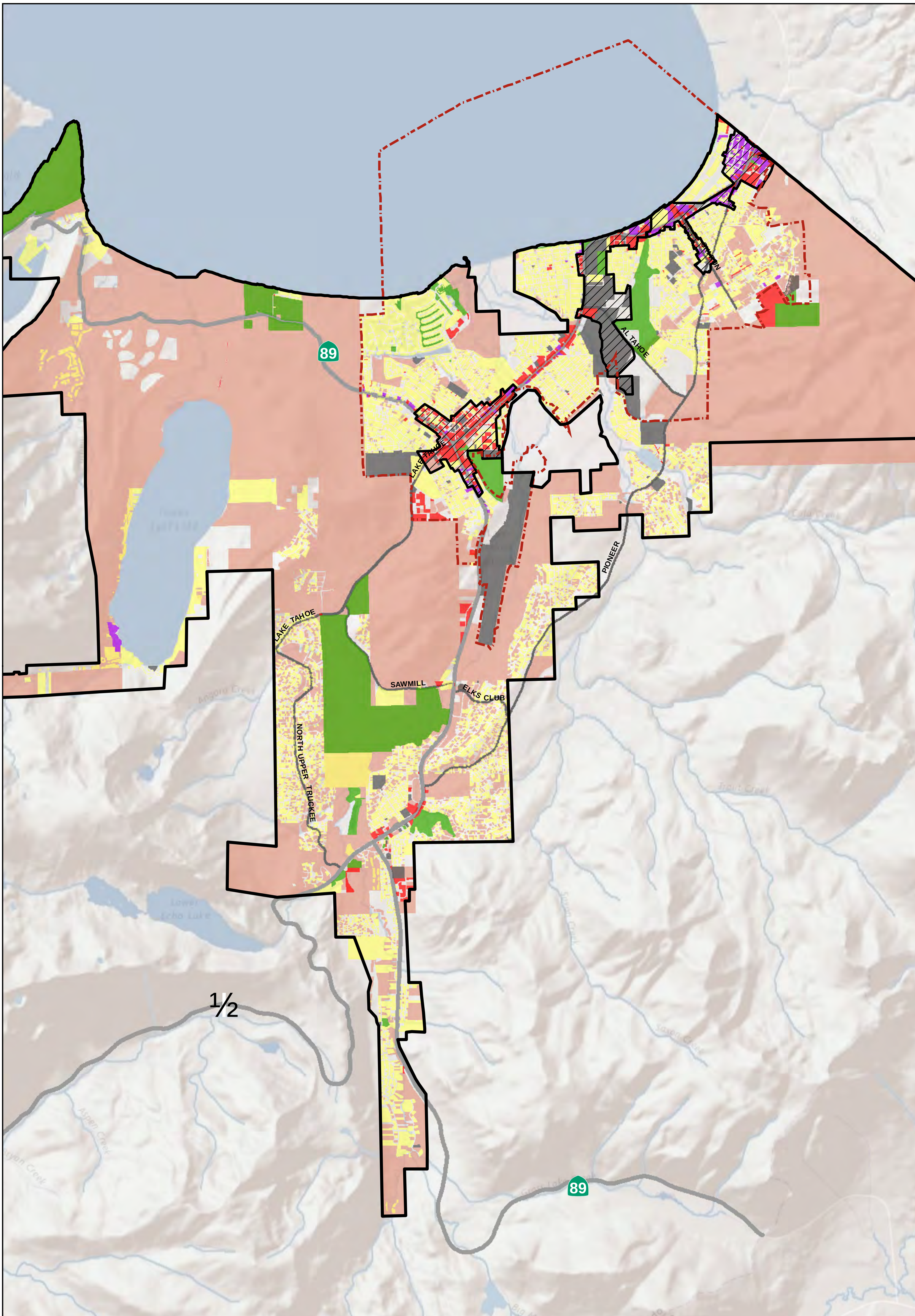
Table 2-3. Existing Land Use Summary for City Limits and General Plan Area			
Land use	Parcels	Acreage	Percent of Total Acreage
Existing (2008) City Limits[(a)]			
Open Space	1,589	1,463	7.7%
Recreation	63	236	1.2%
Residential	11,900	2,074	11.0%
Tourism	206	142	0.8%
Commercial	542	307	1.6%
Public	158	848	4.5%
Transportation	99	35	0.2%
Vacant	1,980	755	4.0%
Other/Not Classified	6	2	0.0%
Subtotal	*16,543*	*5,862*	*31.0%*
Outside City Limits (General Plan Area)[(a)]			
Open Space	3,041	8,686	45.9%
Recreation	6	1,106	5.8%
Residential	5,076	1,935	10.2%
Tourism			0.0%
Commercial		115	0.6%
Public		100	0.5%
Transportation		14	0.1%
Vacant	1,464	1,108	5.9%
Other/Not Classified	3	1	0.0%
Subtotal	*9,590*	*13,065*	69.0%
Total	**26,133**	**18,927**	**100.0%**

(a) The land use information is based on the City of South Lake Tahoe's General Plan Table 2-5. The area within the City's limits and outside City limits are all contained within the District's service area.

A large part of the District's service area is made up of publically-owned vacant lands. These parcels are considered unavailable for future development. Figure 2-2 shows existing land use based on the City's General Plan, the location of publicly owned vacant lands, and the three Community Plan areas.

Both the City and the County GIS databases for parcel information were provided for the demand evaluation. The land use categories used by the City and the County differ slightly between the two GIS databases. However, the County GIS data provided the most comprehensive data set for the District's entire service area including the publicly-owned vacant parcels. The County data was used for the demand evaluation in this section.

The County and the City land use categories do not correspond directly to the customer class categories used by the District for their account records. The District staff reviewed the land use categories from the County GIS and aggregated them to the five District customer categories as shown in Table 2-4.



LEGEND

- Recreation
- Residential
- Commercial
- Tourist Center
- Special District
- Publicly-Owned Vacant Land and Open Space
- Community Plan Areas
- District Boundary
- South Lake Tahoe City Limits

N

0 0.5 1

Scale in Miles

FIGURE 2-2

South Tahoe Public Utility District
Water System Optimization Plan

Existing Land Use

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Table 2-4. District Customer Categories from Land Use Data	
El Dorado County GIS Parcel Data Land Use Categories	District Customer Category[(a)]
MARINAS	C
MISC. IMPROVED COMMERCIAL	C
MOBILE HOME PARKS	MF
MOTEL, HOTEL	C
PARKING LOT	C
PLACE OF WORSHIP	C
RESTAURANT	C
RETAIL STORES <=5,000 SQ. FT.	C
RETAIL STORES >15,000 SQ. FT.	C
RETAIL STORES 5,001-15,000 SQ. FT.	C
SERVICE STATION	C
SUPERMARKETS	C
VACANT COMMERCIAL LAND	C
HOSPITALS & CONVALESCENT HOSPITALS	C
LIGHT MANUFACTURING	C
MEDICAL/DENTAL/VET OFFICES	C
MINI-WAREHOUSES (MINI-STORAGE)	C
MISC. IMPROVED INDUSTRIAL PROPERTY	C
OFFICES	C
PUBLIC UTILITY (ON STATE ASSESSED ROLL)	C
VACANT INDUSTRIAL LAND	C
WAREHOUSES	C
CONDOMINIUMS & TOWNHOUSES	MF
MULTI-RESIDENTIAL 2-3 UNITS	DT
MULTI-RESIDENTIAL 4+ UNITS	MF
RETIREMENT HOUSING	MF
VACANT MULTI-RES. LAND 4+ UNITS ALLOWED	MF
CAMPGROUNDS	C
CEMETERIES	C
COMMUNITY ORIENTED FACILITIES	C
ENV. SENSITIVE LAND - RESTRICTED USE	O
FIRE SUPPRESSION FACILITIES	O
MISC. IMPROVED RECREATIONAL	C
SCHOOLS - LARGE (101+ STUDENTS)	C
SCHOOLS - MEDIUM (13-100 STUDENTS)	C
SKI RESORTS	C
SUBJ. TO OPEN SPACE CONTRACT (NOT CLCA)	O
TIMBER PRESERVE ZONING - ACTIVE	O
UNASSIGNED	O
UNDERLYING INTEREST IN TIME SHARE PROJ	C
VACANT RECREATIONAL LAND	O

Table 2-4. District Customer Categories from Land Use Data	
El Dorado County GIS Parcel Data Land Use Categories	District Customer Category[(a)]
MOBILE HOME ON RENTED LAND	SF
NON-RES. IMPROVEMENTS <=2.5 AC.	SF
RESIDENCE ON LEASED LAND	SF
RURAL RES. 2.51-20.0 AC. 1 SF UNIT	SF
RURAL RES. 20+ AC. 1 RES. UNIT	SF
RURAL RES. LAND 20+ MINOR NON-RES IMPR	SF
SINGLE FAM. RES. <=2.5 AC.(INC. MAN. HMS	SF
VAC RURAL RES LAND 2.51-20.0 AC. 1 UNIT	SF
VACANT RES. LAND <=2.5 AC. 1-3 UNITS	SF

[(a)] C = Commercial, SF = Single Family, MF = Multi-Family, DT = Duplex/Triplex (multi-family), and O = No water use

2.3 Historical Water Production and Consumption

Water production is the total quantity of water produced by the District's groundwater wells, while water consumption is the quantity of water actually consumed or used by its customers. As will be discussed later, the difference between production and consumption is unaccounted-for water (UAFW).

The District currently tracks the daily water produced by its wells, and with the exception of a large number of unmetered single family and multi-family residential accounts, it also meters several of its customers within the District. Although the District tracks water use in two ways (production records and meter records), unmetered single family residential consumption constitutes the largest use. Therefore, UAFW must be estimated. Production, metered water use, and UAFW are discussed in more detail below.

2.3.1 Historical Water Production

Annual groundwater production from the District's well operational records during the 16-year period from 1996 to 2011 is summarized in Table 2-5. The District produced on average approximately 7,273 acre feet per year (af/yr), which is equivalent to an average day demand of approximately 6.49 million gallons per day (mgd). The District's water production shows a common trend among several water agencies within California. The year 2007 is the peak production year of approximately 8,161 af/yr. For the District, the significant spike seen for 2007 is due in part to the devastating Angora Wildfire, which destroyed 241 homes in the District. A steady decline in production has been recorded since 2007, with production dropping to 6,026 af/yr in 2011 which is a 26 percent reduction over the four-year period. There are several factors that may contribute to the trend of declining production including: economic down turn, vacant and foreclosed homes, climate change (recent wet and mild summers), increased conservation efforts, and the addition of meters.

Table 2-5. Historical Water Production (1996-2011)[a]			
Year	Annual Production, af	Annual Production, MG	Average Day Production, mgd
1996	7,229	2,356	6.45
1997	7,344	2,393	6.56
1998	6,792	2,213	6.06
1999	7,098	2,313	6.34
2000	7,732	2,519	6.90
2001	8,079	2,632	7.21
2002	7,833	2,552	6.99
2003	7,100	2,314	6.34
2004	7,506	2,446	6.70
2005	6,922	2,256	6.18
2006	7,445	2,426	6.65
2007	8,161	2,659	7.29
2008	7,635	2,488	6.82
2009	6,918	2,254	6.18
2010	6,546	2,133	5.84
2011	6,026	1,964	5.38
5-Year Average (2007-2011)	7,057	2,300	6.30
10-Year Average (2002-2011)	7,209	2,349	6.44
Average (1996-2011)	7,273	2,370	6.49

[a] Source: District Record data, Flowtrend.xls, containing monthly well production records and annual statistics from 1996 through 2011.

Figure 2-3 compares the total historical annual water production with historical average annual precipitation for 2001 through 2011. For this relatively short historical period, there are no discernible trends between water use and rainfall.

Figure 2-4 illustrates the historical monthly water production between 2001 and 2011. The average maximum month production is approximately 340 million gallons (MG) (11 mgd). These data indicate that the District's highest monthly water production has historically occurred in the months of July or August, which corresponds with high temperatures, minimal rainfall, and vacationers that reside in the South Lake Tahoe during the summer months. The lowest productions are observed most often during the months of November or April. It is usually expected that the lowest production months for most agencies occur when there is minimal outside water use in the winter. However, for the District, while December and January may be the coldest months, they are often not the lowest water production months due to increase in the number of vacationers for the winter ski months and/or the use of District water to "make snow" for some of the ski resorts when there has been a lack of natural snow.

Figure 2-3. Historical Annual Water Production (2001-2011)

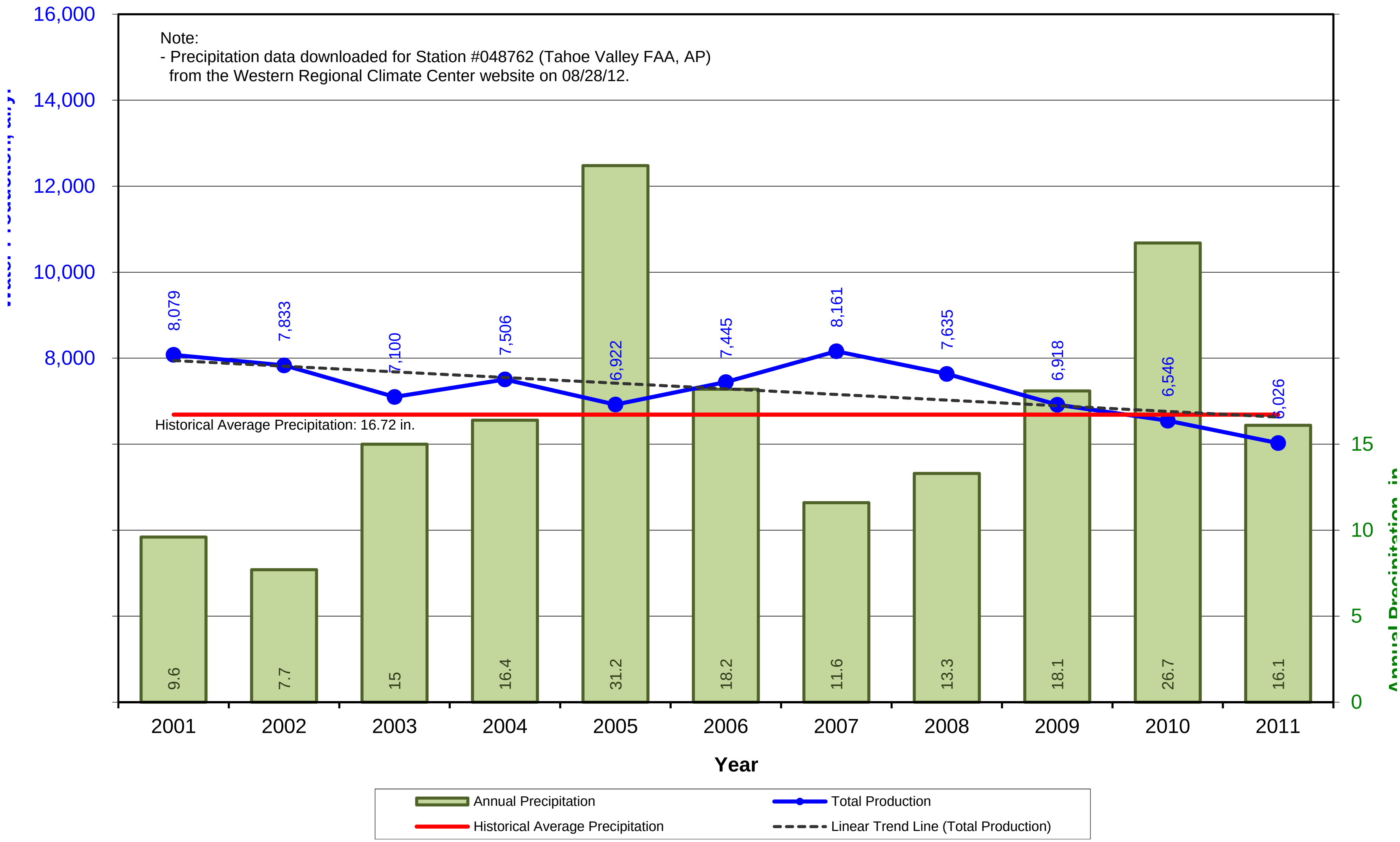
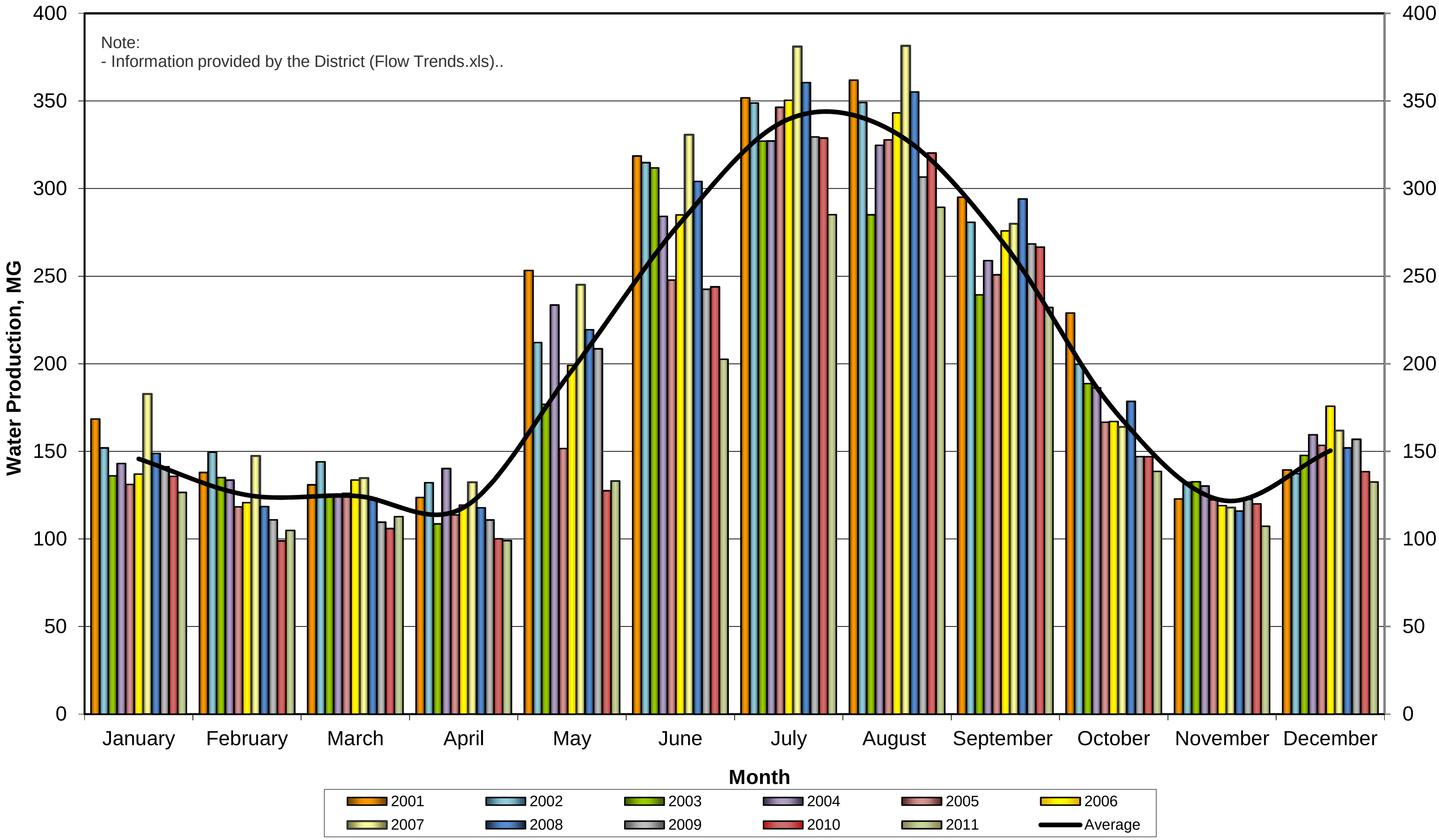


Figure 2-4. Historical Monthly Water Production (2001-2011)



2.3.2 Historical Water Consumption

Approximately 80 percent of the District's commercial customers are metered. The District's single family residential and multi-family residential accounts are still mostly unmetered with only 37 percent of single family and 40 percent of multi-family customers metered in July 2012. The District has required the installation of meters on all new construction, both residential and non-residential, since 1993. Approximately 1,800 new houses have been built since 1993. An additional 3,000 residential meters (on homes built before 1993) were installed during the summer of 2010. Up until 2011, residential customers with meters were billed a flat-rate fee for water use, the same as non-metered customers. Starting in the year 2011, the residential customers were billed based on water use. However, the 2011 residential metered data is considered skewed due to the long snow season, still having snow on the ground in July, which reduced the need for outdoor irrigation during the District's typical peak water use time.

As of July 2012, the District's service area has a total of 5,467 meters, on residential and non-residential accounts. This is more than one-third of the historically unmetered service area. Depending on available funding, the remaining residential water meter retrofits are scheduled to be installed by the year 2025. The total number of existing account meters to be installed by the year 2025 is approximately 8,600. The District installs meters with its mainline replacement program and expects that this program will result in the installation on average of 150 meters annually.

According to the District's 2010 UWMP, Section 6, in order to meet its 2020 water use target, the District will need to complete its metering program. The District is applying for State and Federal grants to offset the large expense of water meter retrofit/installation. These projects will be ongoing through 2025.

West Yost Associates (West Yost) reviewed the available billing data for 2009 through 2011 provided by the District. The data for commercial and multi-family users shows a trend of slight increase to metered accounts and slight decrease in consumption for each customer type. The decrease in consumption is consistent with the District's recorded decrease in production.

The District began reading single family residential meter data in 2009. Typically, when agencies begin to collect meter data, there is a time period for adjustment before billing based on consumption, which allows the agency to ensure the data being collected is accurate. The District originally collected data without billing customers for their water consumption for 2009 and 2010. In 2011, the District began billing customers based on consumption using a single tiered billing rate. The single family information for 2009 and 2010 data appears to have errors in the consumption data, which corresponds with the years the District collected, but did not bill for consumptive use. The number of metered accounts for the District's single family customer class is consistent with the meter implementation program showing a large increase in metered accounts between 2009 and 2010. However, the consumption information for the

2010 billing information indicates more water was consumed by metered users than was produced in the District, which is assumed inaccurate. The 2011 single family residential meter data appears accurate, but provides only a single year of usage information. Based on the information provided by the District and the evaluation of the available data, data for single family residential was not used to develop unit water factors for future use. Instead, use factors were estimated from production and non-residential billing records.

The historical metered water consumption by customer class for 2009 through 2011 is shown in Table 2-6. The demand evaluation in this section assumes the metered commercial and multi-family consumption information is consistent enough to use for developing unit water factors for the two types of customer classes. As the District continues to meter customers and collect actual billing information, it is recommended the District re-visit the unit water factors for each customer class.

Table 2-6. Historical Metered Water Consumption by Customer Class, million gallons/year[(a)]

Customer Class	2009	2010	2011
Single Family Residential[(b)]	273 (580 accounts)	1,715 (3,780 accounts)	323 (3,983 accounts)
Multi-Family Residential	111 (265 accounts)	154 (440 accounts)	134 (450 accounts)
Commercial	452 (532 accounts)	424 (546 accounts)	381 (546 accounts)
Total Metered Consumption	836	2,293	838
Total Production	2,254	2,133	1,964
Metered Consumption as a Percent of Total Production	37%	108%	43%

(a) Source: District billing data as adjusted by West Yost to remove duplicate accounts and anomalous readings.
(b) Single family consumption information is inconsistent and not used in unit demand evaluations.

2.3.3 Unaccounted For Water

UAFW is typically the difference between the recorded water production and metered water consumption. UAFW includes a combination of various water uses that are not metered, such as: water used for hydrant testing, firefighting, and system flushing, or water that is lost from system leaks and water main breaks.

Because the District does not currently meter all customer water use, it is impossible to calculate the exact amount of UAFW lost throughout the entire system. For purposes of this Water System Optimization Plan, UAFW for the overall system is assumed to be 12 percent based on discussion with the District on the condition of the system. However, metering and reading of the District’s entire residential sector will be required to verify this.

Water utilities strive to minimize the amount of UAFW; however, it is difficult, if not impossible, to eliminate entirely. A survey of water agencies in the United States conducted by the American Water Works Association (AWWA) found that UAFW in utilities across the country varied between 7.5 percent to 25 percent[1]. Therefore, the assumption of 12 percent UAFW is reasonable for the District's water system. Taking into account the meter implementation program, UAFW is assumed to decrease from 12 percent to 10 percent by buildout to account for improved leak detection and repair when the District is fully metered.

2.3.4 Historical Per Capita Demand

Historical per capita water demands were calculated by dividing the annual water production by the service area annual population. Table 2-7 summarizes the historical per capita water demands for the District between 2001 and 2011. As shown in Table 2-6, the historical average per capita water demand for the 2001 through 2011 period has averaged to approximately 194 gallons per capita per day (gpcd).

Figure 2-5 compares the historical per capita water demand, historical water production, and historical population. As shown on the figure, the historical population has been fairly stable with a slight decrease of approximately 2.5 percent since 2001. During that same time period, water production peaked in 2007, but has shown a steady decline through 2011. Overall, water production has declined at a greater rate than the population. As a result, per capita water use has been declining. The 10-year average per capita water use is 194 gpcd, while 2011 per capita use is 163 gpcd.

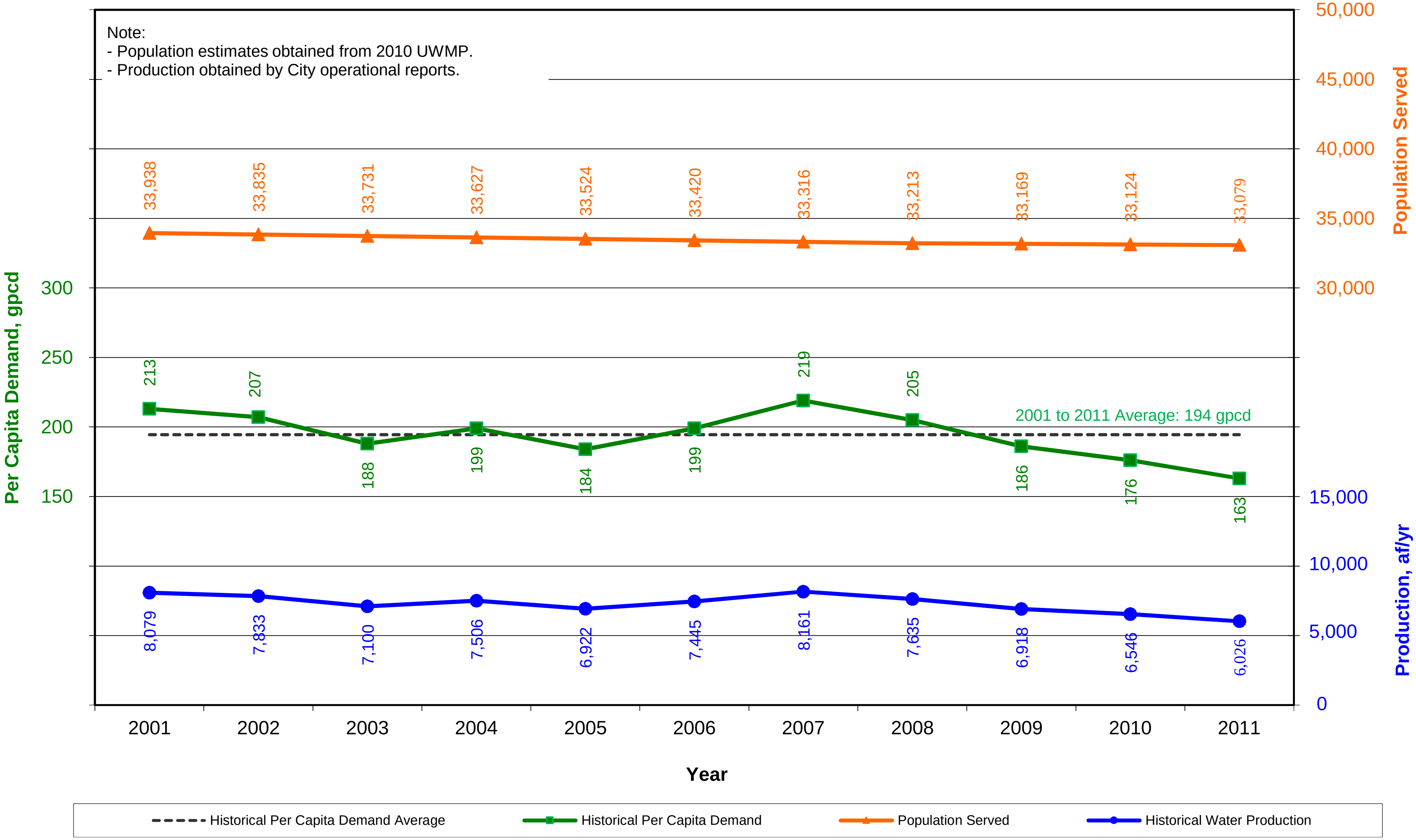
Table 2-7. Historical Per Capita Water Demand (2001-2010)

Year	Estimated Service Area Population[(a)]	Annual Water Production, MG[(b)]	Per Capita Water Demand, gpcd
2001	33,938	2,632	213
2002	33,835	2,552	207
2003	33,731	2,314	188
2004	33,627	2,446	199
2005	33,524	2,256	184
2006	33,420	2,426	199
2007	33,316	2,659	219
2008	33,213	2,488	205
2009	33,169	2,254	186
2010	33,124	2,133	176
2011	33,079	1,964	163
Average			194

(a) Source: See Table 2-2.
(b) Source: See Table 2-5.

[1] Survey of State Agency Water Loss Reporting Practices, Final Report to the American Water Works Association, prepared by Janice A. Beecher, Ph.D., Beecher Policy Research, Inc., January 2002.

Figure 2-5. Comparison of Historical Per Capita Water Demand, Production and Population



As part of the UWMP 2010, the District's per capita demands were evaluated based on SBx7-7 methodologies. The SBx7-7 legislation requires water agencies to calculate future target per capita demands that will help to achieve the statewide goal of 20 percent reduction in per capita water use by 2020. The District's baseline per capita demands were calculated based on the 10-year period of 1999 to 2008, which results in a 201 gpcd baseline per capita water use factor. The District evaluated the 2015 interim and 2020 target per capita water use factors using the four methodologies developed by the Department of Water Resources. The District selected the target per capita use factors from Method 3 – 95 Percent of Hydrologic Region during a Board Workshop on May 5, 2011. The District is located in the North Lahontan hydrologic region; the 2015 interim target is 198 gpcd and 2020 target is 164 gpcd.

Figure 2-6 shows the District's baseline, 2015 interim, and 2020 target per capita use factors, as compared to the 2001 thru 2011 actual per capita factor. As indicated on the figure, the District's actual per capita use factor has declined since 2007, and the 2011 per capita factor is below the 2020 target. The decline in the per capita factor has been seen throughout California; there are several factors that may contribute to this decline such as: economic downturn, home foreclosures, climate change (mild weather), and increased conservation efforts. The declining water use trend is anticipated to rebound as economic conditions recover. Table 2-8 shows the projected water demands based on per capita water use and population estimates.

Table 2-8. Projected Demand Based on Per Capita Water Use

Year	Estimated Service Area Population[(a)]	Per Capita Water Use Factor, gpcd[(b)]	Projected Water Demand, mgd	Projected Water Demand, afa
2015	34,194	198	6.8	7,584
2020	35,264	164	5.8	6,478
2025	36,334	164	6.0	6,675
2030	37,404	164	6.1	6,871

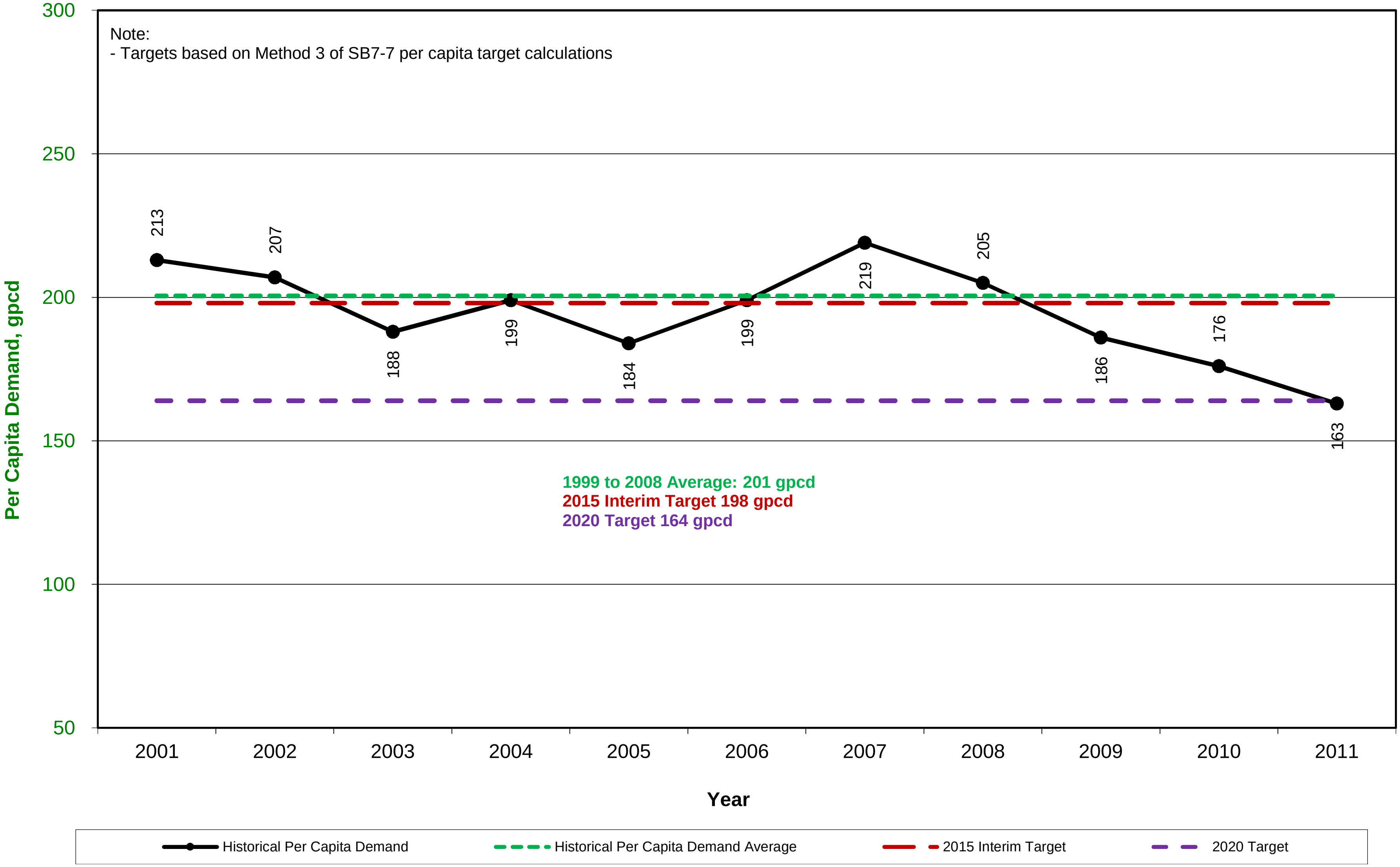
(a) Source: See Table 2-2.
(b) Per capita water use factors based on SBx7-7 developed per capita projections for the District using Method 3.

2.4 Water Demand Projections

2.4.1 Development of Unit Water Demand Factors

The District has not developed unit water demand factors based on land use or water category codes. Historical metered information is limited, especially for single family residential customers which make up a majority of the District's customers.

Figure 2-6. District's Per Capita Targets from Urban Water Management Plan



Typically, unit water use factors are expressed in terms of water use per developed acre, and then applied to future land use assuming full buildout of the particular land use type. Since the future land use for the District's service area is limited by TRPA, and much of the development will be infill and re-development, unit water factors were, instead, developed based on dwelling units and commercial square footage, consistent with available planning data. Future water use was projected using these unit water use factors, along with the allowable increase in dwelling units and commercial square footage as detailed in the City's General Plan.

To develop the unit water use factors, GIS-based estimates of current acreage, City General Plan information on existing commercial square footage and allowable residential units, and estimates of UAFW were used, along with historical water use information to analyze single family residential water use.

For the commercial and multi-family customer categories, existing water use was calculated using metered water use and the total number of commercial and multi-family accounts to estimate total water use (unmetered use was assumed to have the same usage per account as metered usage for the purposes of projecting future demand[2]). Commercial use factors were developed by dividing total commercial water use by the total amount of existing commercial square footage from the City's General Plan. Similarly, multi-family residential use factors were developed by dividing total multi-family water use by the total amount of existing multi-family metered account acreage (calculated using the County parcel GIS data). Table 2-9 shows the assumptions used to develop commercial and multi-family water use factors.

[2] Analysis of historical water use suggests that unmetered uses are higher than similar metered uses. However, as meters are installed, it is anticipated that customers will adjust their water use and have similar usage patterns as other metered users.

Table 2-9. Commercial and Multi-Family Calculated Water Use Factors						
Year	Metered Accounts(a)	Total Accounts(b)	Metered Usage(a), afa	Total Usage(c), afa	Area(d,e), (sf or acre)	Usage Per Account
Commercial					sf	gpd/sf
2009	532	689	1,388	1,798	936,115	1.71
2010	546	689	1,301	1,642	936,115	1.57
2011	546	689	1,169	1,475	936,115	1.41
July 2012(f)	554	689				
Average						1.56
Multi Family					acre	gpd/acre
2009	265	1,252	340	1,606	336	4,268
2010	440	1,252	473	1,346	336	3,576
2011	450	1,252	410	1,141	336	3,031
July 2012(f)	486	1,252				
Average						3,625

(a) Number of metered accounts and metered usage based on quarterly consumption data provided by the District.
(b) Total accounts assumed to have changed very little from 2009 to July 2012. Therefore, July 2012 total accounts used for all years.
(c) Total usage calculated by assuming the usage of unmetered accounts would be the same as metered accounts.
(d) Existing commercial square footage based on the City's General Plan existing square footage of 1,320,759 sf within the District's service area minus the estimated 384,644 sf located within the boundaries of the Lakeside, Lukin Brothers, and Tahoe Key service areas.
(e) Existing multi-family acres based on County GIS non-vacant parcels with a land use based on Table 2-4.
(f) July 2012 data provided as the base for active accounts.

For the single family customer class, the water use was calculated starting with the total historical system production and subtracting UAFW and the estimated historical water use for the commercial and multi-family customer classes. The volume of water remaining was assumed to be single-family consumption. The single family water use factors were developed by dividing the calculated single family water use by the total number of existing single family accounts. Table 2-10 shows the assumptions used to develop the single family water use factor.

Table 2-10. Single Family Calculated Water Use Factors								
Year	Metered Accounts[a]	Total Accounts[b]	System Production, afa	UAFW[c], afa	Commercial Usage, afa	Multi-Family Usage, afa	Single Family Usage[d], afa	Usage Per Account, gpd/DU
Single Family								
2009	580	12,122	6,918	830	1,798	1,606	2,684	198
2010	3,780	12,122	6,546	786	1,642	1,346	2,772	204
2011	3,983	12,122	6,026	723	1,475	1,141	2,687	198
July 2012[e]	4,427	12,122						
Average								200

[a] Number of metered accounts based on 2009 through 2011 quarterly consumption data provided by the District.
[b] Total accounts assumed to have changed very little from 2009 to July 2012. Therefore, July 2012 total accounts used for all years.
[c] Unaccounted for water assumed to be 12 percent of total production.
[d] Single family usage calculated based on total production minus UAFW, commercial usage, and multi-family usage.
[e] July 2012 data provided as the base for active accounts.

2.4.2 Projected Future Water Demands

The District's future growth is limited by TRPA, which establishes the allowable growth throughout the Tahoe Basin. Based on the City's General Plan and the District's 2010 UWMP, planned growth for both residential and non-residential land uses is well established. According to the City's GP Policy LU-1.9, 1,162 new residential units (940 market rate units + 220 affordable units) can be anticipated in the City by 2030. This would increase the available residential parcels to 16,260 units. The increase in residential units results in a growth of approximately 0.4 percent annually. While the City's General Plan includes the Lakeside, Lukins Brothers, and Tahoe Keys service areas, it is assumed these locations are buildout. Therefore, the anticipated 1,162 new residential units discussed in the City's GP are assumed to be located within the District's existing service area.

Non-residential development is anticipated to increase by 361,000 square feet by General Plan buildout in 2030. The non-residential development is anticipated to occur in the three Community Plan Areas, as shown on Figure 2-2. Similar to residential development, most is anticipated to occur in the District's service area. Most of the future new growth within the District is expected to be from commercial development. The commercial growth rate is estimated to be 1.4 percent annually.

Table 2-11 shows the buildout demand estimate based on the customer class water unit factors established in Section 1.3.2. The existing demands and developed water use factors reflect reduced water use trends from recent years, which are similar to long-term per capita water use goals that incorporate water conservation. Therefore, no further conservation adjustments have been made to the projected demands.

Table 2-11. Existing Service Area Projected Future Land Use and Water Use					
Customer Class	Water Use Factor	Land Use Increase at Buildout	Existing Demand, afa	New Demand, afa	Buildout Demand, afa
District's Service Boundary excluding other Water Companies					
Commercial	1.56 gpd/sf	361,000 sf	1,475	632	2,107
Multi-Family	3,625 gpd/ac	26 ac	1,141	106	1,247
Single Family	200 gpd/DU	1,162 DU	2,687	260	2,947
Subtotal			5,303	998	6,301
UAFW[a] (10%)					630
Total					6,931

[a] Buildout UAFW is assumed to reduce from 12 percent to 10 percent within the District due to improved leak detection and monitoring with full meter implementation.

The District expects the majority of future water demand not to come from new development, but from the potential of acquiring water companies located within their boundary. Demand estimates for buildout of the City's General Plan and the County's GIS database were used to determine the customer categories and estimated demands for the Lakeside Water Company, Lukins Brothers, and Tahoe Key service areas. Table 2-12 shows the estimated demand increases for the District's ultimate system assuming Lakeside Water Company, Lukins Brothers, and Tahoe Keys water companies have been acquired.

Table 2-12. Ultimate Service Area Projected Future Land Use and Water Use			
Customer Class	Water Use Factor	Estimated Land Use	Projected Demand, afa
Lakeside Water Company			
Commercial	1.56 gpd/sf	261,504 sf	458
Multi-Family	3,625 gpd/ac	4 ac	16
Single Family	200 gpd/DU	77 DU	17
Subtotal			491
UAFW[(a)] (15%)			74
Lakeside Water Company Total			565
Lukins Brothers Water Company			
Commercial	1.56 gpd/sf	123,140 sf	215
Multi-Family	3,625 gpd/ac	32 ac	130
Single Family	200 gpd/DU	958 DU	215
Subtotal			560
UAFW[(a)] (15%)			84
Lukins Brothers Water Company Total			644
Tahoe Keys Water Company			
Commercial	1.56 gpd/sf	0 sf	—
Multi-Family	3,625 gpd/ac	0.74 ac	3
Single Family	200 gpd/DU	1,577 DU	353
Subtotal			356
UAFW[(a)] (15%)			53
Tahoe Keys Water Company Total			410
Ultimate District's Service Boundary			
Existing Service Area Projected Demand			6,931
Lakeside Water Company Projected Demand			565
Lukins Brothers Water Company Projected Demand			644
Tahoe Keys Water Company Projected Demand			410
Ultimate District's Service Area Projected Demand			8,550

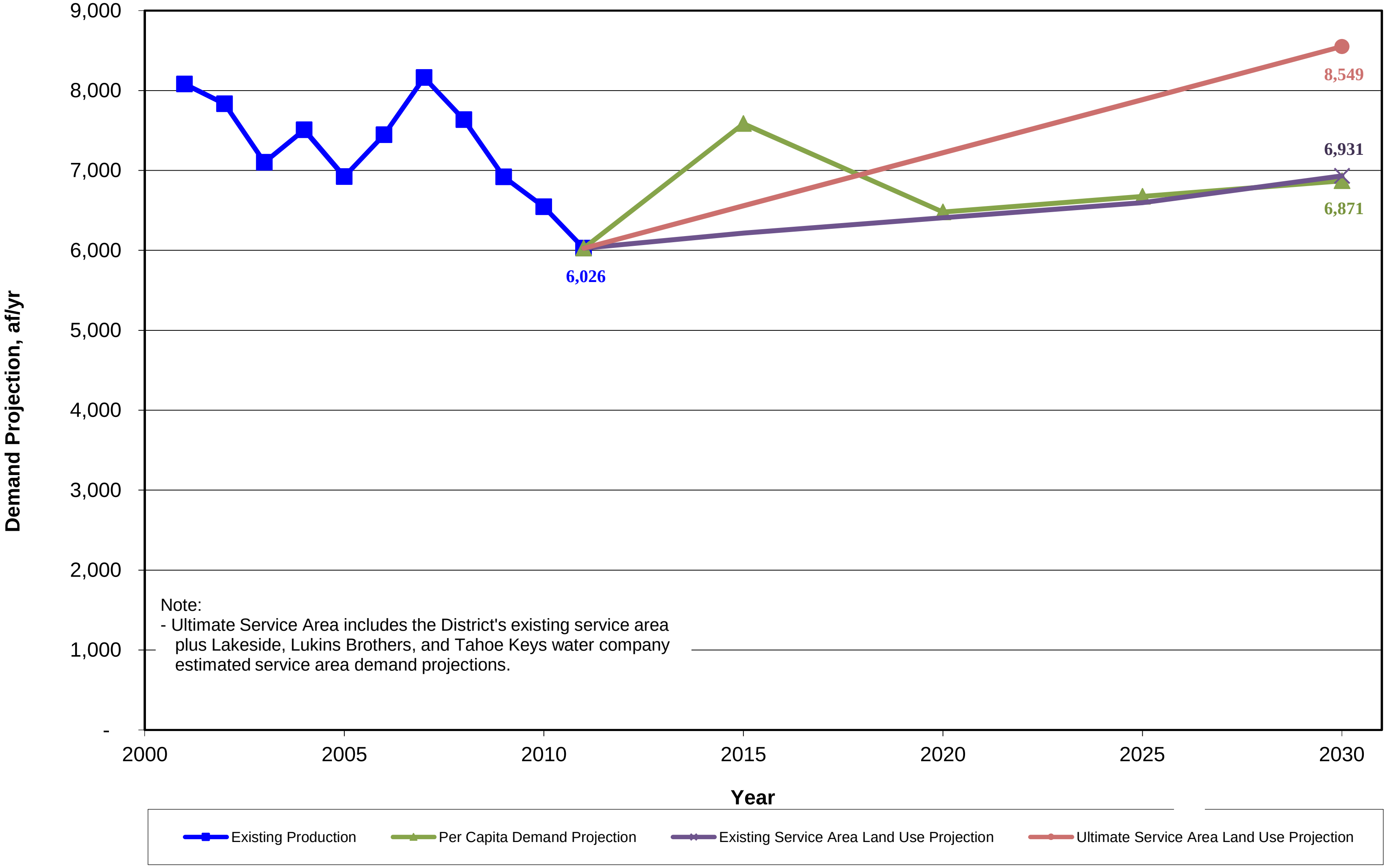
(a) The condition of the other water companies system is not known at this time. Therefore, a conservative estimate of 15 percent is assumed.

2.4.3 Comparison of Land Use and Population Based Demand Projections

Figure 2-7 compares future per capita water demand projections with future land use based water demand projections and illustrates the District's low and high water production needs through buildout of the General Plan.

The demand projections for per capita water use, existing service area (no reduction), and ultimate service area (with reduction) indicate very similar buildout projections. The low production needs are based on the existing service area (with reduction) and the high production needs are based on the ultimate service area (no reductions).

Figure 2-7. Comparison of Historical Per Capita Water Demand, Production and Population



Typically, per capita based water demand projections uniformly distribute water use over the entire service area and, therefore, do not account for specific land uses and locations. Additional, per capita based water demand projections do not accurately account for changes in the type of water demand over time (*e.g.*, commercial and residential). Therefore, the land use projections for planning the future water system will be based on the existing service area land use projections (no reduction).

2.5 Peaking Factors

Demand peaking factors are multiplication factors used to calculate water demands expected during high demand conditions. The most commonly used demand conditions for water supply and system evaluations include maximum day and peak hour demands. These demands are generally used to evaluate and size water transmission pipelines, pumping facilities, and storage facilities, and to define water supply needs and capacity requirements. The District has limited historical daily production information to use for the development of the peaking factors.

Table 2-13 shows the available historical average day and maximum day demand for the District's water system compiled from 2009 to 2011. The maximum day demand peaking factor varies from 2.08 to 2.44, and averages 2.24. It is recommended to use an average day to maximum day demand factor of 2.25 for this study.

Table 2-13. Historical Maximum Day Peaking Factors[a]

Year	Average Day, mgd	Maximum Day, mgd	Peaking Factor[b]
2009	6.18	12.87	2.08
2010	5.84	14.26	2.44
2011	5.38	11.83	2.20
		Average	2.24

(a) All data from District's daily well production operational records.
(b) Maximum day peaking factor is the Maximum Day Demand divided by the Average Day Demand.

To evaluate hourly usage trends and peak hour usage, total system flows are needed on an hourly basis over a period of time that includes the typical maximum day demands. Total system flows need to include all well production and tank inflow and outflow. Currently, the District does not have the supervisory control and data acquisition (SCADA) capabilities to monitor the flows at all wells and tanks on an hourly basis. Without the hourly production and tank inflow and outflow information, a system-specific diurnal curve could not be created. West Yost used AWWA representative diurnal curve information as a basis for developing a diurnal curve to use for the District, with adjustments based on hourly wastewater treatment plant inflow, which the District does record. The inflow to the wastewater treatment plant is assumed to have similar diurnal peaks to the water system. Diurnal curves were developed for the wastewater treatment plant inflows for July 3-4, 2012 data. These curves were compared to the AWWA curve to determine how well the AWWA curve represented the time of the diurnal peaks and magnitude of the peaks. Overall, the AWWA curve did represent the diurnal pattern developed for the wastewater treatment plant inflows well. Some adjustments were made to the AWWA curve for evening peak flows. The AWWA curve indicates a much larger spike in evening use than the developed wastewater diurnals. Rather than flatten out the evening peak for the water system, an adjustment was made to use the average from the AWWA curve and the maximum day inflow diurnal recorded on July 3, 2012 for the wastewater inflow. The comparison of the AWWA diurnal and the wastewater treatment plant inflow diurnal is shown on Figure 2-8.

Table 2-14 summarizes the peaking factors used in this study for the sizing of water system facilities.

Table 2-14. District Recommended Peaking Factors

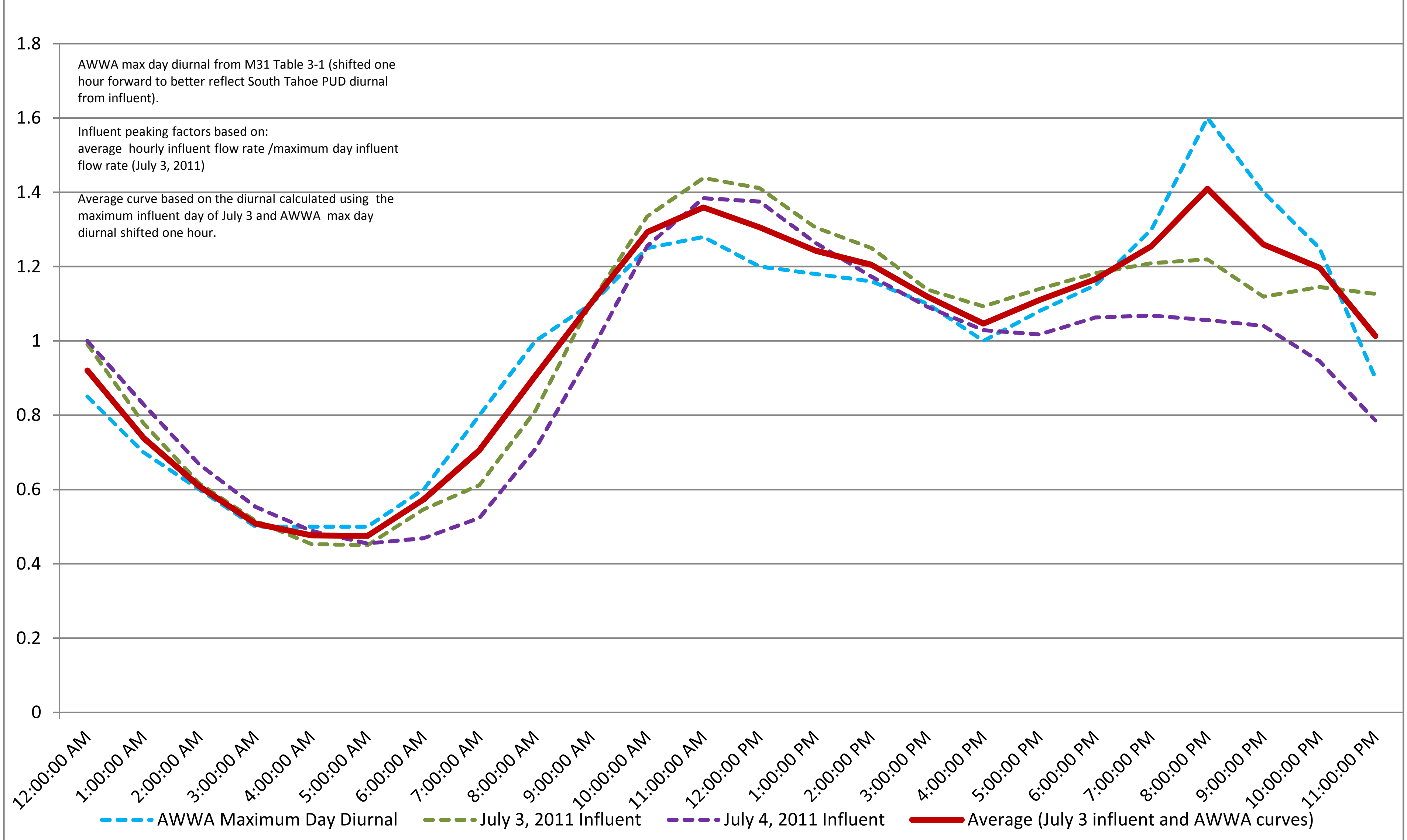
Peaking Factor	Value
Average Day to Maximum Day Demand	2.25
Maximum Day to Peak Hour Demand	1.41

2.6 Conclusions and Recommendations

The District is located in a unique setting which greatly impacts system demands. The South Lake Tahoe region is a vacation destination with a lot of vacation homes not occupied year round. The District typically experiences high demands around the summer holidays. As the District continues to add meters to their system and collect actual consumption information, the District should review and evaluate the water use data. The review and evaluation of data will help to ensure the reliability and accuracy of the data being collected. This will also assist the District in identifying residential use patterns and how the number of vacation homes effects water demand usage.

The District is still in the process of installing meters for all customers. Until the District is fully metered and collecting actual consumption data on all customers, allocation of existing demands and estimation of future demands will continue to rely on land use information for unmetered parcels. The District should work with the County and the City to reconcile existing land use information and confirm future land use assumptions. The District should also confirm the land use codes used by the County and the City with District customer categories to ensure demands are allocated correctly based on land use information.

Figure 2-8. Max Day Diurnal Curves



The District has expressed interest in using the hydraulic model in the future for water quality and detailed operational evaluations. The SCADA information currently collected by the District limits the ability of the model to be used for detailed operational or water quality evaluations. The District currently collects SCADA information on tanks, booster pumps, and wells. However, the collection of this information has limitations which made it difficult to incorporate in development of the system demand diurnal curve. For development of a diurnal curve, it is preferred to have production information from all supply sources in, at least, hourly increments. In addition, the inflow and outflow or levels for tanks in similar increments allows the isolation of the consumptive demand usage over time. The District has also expressed interest in developing more detailed system curves for specific pressure zones, which would require additional SCADA data be collected at pressure reducing valves to accurately track water usage within the pressure zones.

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Section 3: Level of Service Study (TM 2)

3.1 Purpose

This Section 3 documents the development of a set of Level of Service (LOS) statements for the South Lake Tahoe Public Utility District (District), pursuant to Task 4 of the 2012 Water Optimization Plan scope of work. The objective of this effort is to produce a Water System Enterprise Levels of Service Statement and identify the corresponding performance standards required to achieve the established goals. The results are intended to provide the highest level of service to the District's customers at the most economical price while ensuring District operations are carried out in a sustainable manner.

The development, status and future recommended actions related to the District's LOS statements are discussed in detail in the following sections:

- Introduction to LOS
- Current Status of LOS Statements
- Approach to LOS and Water Optimization Plan
- LOS Statement Development
- LOS Statement Results
- Applying LOS to District Business Practices
- Future Actions

3.2 Introduction to Levels of Service Concepts

3.2.1 What Is "Levels of Service"?

Levels of Service (LOS) can be defined as those characteristics or attributes of a product or service that describe its required minimum level of performance. These characteristics typically describe such characteristics as how much, of what nature, and how frequently the service will be delivered. LOS statements help Utilities to:

- Concentrate (focus) efforts and resources on agreed upon service levels, resulting in less service-level-defined-by-notion.
- Communicate service expectations and choices to inform customers.
- Identify costs and benefits of services offered.
- Develop asset management strategies to deliver the required service.
- Align service level expectations to budget capabilities.

Tying LOS directly to budget requirements reduces the “dissonance” created when an agency’s management team, Board and/or customers have an expectation of service that are not supportable by budget realities.

LOS, then, assists the District in articulating the core process results it needs to measure that will accurately predict business performance. What are these core processes? To address that question, we must identify what it is that the District “sells” to its customers. For wastewater, it is the collection, conveyance, treatment, and disposal of wastewater – a service (as opposed to a “product”). For water, it is the production, transmission, treatment, and distribution of potable water – more of a product, but with substantial customer service characteristics.

A useful approach to thoroughly articulate the “aspects” of water service that are important to the customer is to identify just what it is that causes “customer outrage” - the angry phone calls to Customer Service staff? Aspects of service that can typically cause outrage when they fall below a certain level include:

- Service adequacy
- Safety/health (standards, purity, pressure)
- Quality (standards, odor, taste, color, clarity, pressure)
- Reliability (frequency of outages)
- Availability/maintainability (duration of outages)
- Affordability/efficiency (price, equity, fiscal condition)
- Customer service (courtesy, timeliness)
- Environmental impact

These “outrage elements” of service were discussed in detail in the development of the District’s LOS statements and can be useful to the District to assist in forming a core framework to define LOS statements going forward.

3.2.2 Relationship of LOS to Cost of Service (COS)

One of the key objectives of an asset management program is to match the LOS provided by the asset with customer and regulatory requirements. There is a direct link between the LOS provided and the overall cost to the customer. When a higher LOS is provided, it is likely the cost to the customers will increase. These expectations deal not only with the product delivered by the District, but, more specifically, with the attributes of that product – the nature of the output, its frequency, content, and quality. Customers are concerned with the manner in which the District delivers water service. However, while customers want the District to be responsive to complaints they also want the District to be fiscally responsible.

For example, customers may complain about aesthetic contaminants in the water – those contaminants that cause taste, odor, or color issues in the water, but not health concerns – and wish to have these contaminants removed. The District could install treatment to remove these contaminants, but it will cost each customer more for their water each month. The District could have a dialogue with the customers to explain what the treatment would entail, what the finished water quality would be, and how much it would cost the customers. Following these discussions, the customers could decide whether or not they were willing to pay for the additional treatment. In this way, the LOS establishes the desired services and provides information to the District's customers regarding the corresponding level of costs.

Understanding these attributes enables the relationship between the LOS and the cost of service (COS) to be determined. This relationship provides an opportunity for the District to have an open dialogue with its customers regarding the LOS desired and the amount the customers are willing to pay for this level of existing or increased service. Finally, these LOS statements establish a foundation for the development of an Asset Management Plan that will act as a guide to achieving the target goals.

Once the District has established the current LOS, it can be used to:

- Provide a direct link between costs and services.
- Inform customers of the proposed LOS to be offered.
- Develop the annual budget.
- Develop Asset Management (AM) strategies (*i.e.*, optimize CIP/O&M activities) to deliver the required LOS.
- Measure and reward performance.
- Identify the costs and benefits of the services offered.
- Enable customers to assess the suitability, affordability, and equity of the services offered.

3.3 Current Status of LOS Statements

Draft working documents were presented to the Project Team that served as a starting point for developing specific levels of service statements for the District. Example statements were pulled from:

- USEPA Safe Drinking Water Act
- District's 2009-2010 AWWS-QualServe efforts
- National Water and Wastewater Benchmarking Initiative's (NWWBI) 2011 Report
- California Department of Public Health (CDPH) Water Works Standards
- 10 State Standards
- International Infrastructure Management Manual (IIMM)
- AWWA M-series Manuals
- Regional Water Quality Control Board Regulations

- Local Jurisdiction Rules and Regulations
- District Board Resolutions

A series of workshops and teleconferences were facilitated by the Consultant Team so that their experience with developing level of service statements with other water utilities of similar size and complexity could be efficiently integrated. As a result, this document is a composite of "best practice" measures used at the District as well as other water utilities. Typically the "best practice" measures were developed from similar size and complexity water utilities.

It was noted in the conversations that due to the unique operating conditions facing the District (*i.e.*, extreme topography, seasonal demand fluctuations, etc.), that District specific performance measures and service levels would need to be gathered from various points within the organization. In other words, while external references (*i.e.*, AWWA documents, IIMM, etc.) could be used, they would not on their own capture the unique aspects and challenges it takes to provide service to the District's customers.

Based on these facilitated work sessions with the Project Team, the group developed a recommended structure for consideration by the District's management team. The management team, Project Team and Consultant Team then met with the District's Board of Directors and presented the draft LOS statements, which in turn, are now being submitted for final review and adoption.

District Project Team members included:

- Paul Sciuto, Assistant General Manager (District's Project Manager)
- Paul Hughes, Chief Financial Officer
- Dennis Cocking, Public/Legislative Affairs Officer
- John Thiel, Principal Engineer
- Julie Ryan, Senior Engineer
- Ivo Bergsohn, Hydro-Geologist
- Peter Lavallee, Associate Engineer
- Randy Curtis, Field Operations Manager
- Phil Torney, Pumps Supervisor
- James (Cuz) Cullen, Inspection Supervisor
- Chris Stanley, URW Supervisor
- Glenn Roderick and Jeremy Rutherdale, Pumps Crew
- Michele Pinkel, Preventive Maintenance System Coordinator

Minutes for the Project Team work sessions are included in Appendix A.

3.4 Approach to LOS Related to Water System Optimization Plan

The District's current and future challenges are unique to foothill/Sierra communities. Some of the unique challenges include, but are not limited to:

- Improving and operating the water systems with the limitations placed by Lake Tahoe Basin regulatory agencies.
- Being able to meet your water demands using exclusively groundwater.
- Operating numerous facilities with varying topography and the energy required to serve its customers.
- Balancing a contracting financial outlook with the expanding capital needs of aging infrastructure, while meeting current and future regulations.

Key to determining how to address these challenges is finding the most effective, reliable District optimization strategy. The key to developing this optimized strategy is to take the LOS statements and use them to lay out a cost-effective road map to improve the water system through optimizing operations and implementing appropriate capital improvements. Hence, LOS statements will become the "filter" which all expenditure decisions must successfully be compared against to make sure the final actions by the District are cost effective and provide the intended value to the District's customers. While the actual optimization activities will be documented elsewhere in the Water System Optimization Plan, please note that these LOS statements will be actively used in discussion and deliberation of the final optimization strategies.

It should also be noted that a number of LOS statements and supporting measures refer to upcoming *new* initiatives for the District. For example, the value statement "Provide redundancy with the system"" refers to a future initiative to spend additional capital dollars to meet this LOS. An example of a corresponding performance measure is that 100% of the facilities will have backup power capabilities and the additional capital cost to provide this service is $4.8M. In addition, the value statement "reduce current water use by 20% by 2020" is driven by recently passed state mandated regulation. The District is implementing their 2010 Urban Water Management Plan "best management practices" to achieve this goal and once it is achieved the value statement may be changed to reflect more a management approach to ensure the District remains in compliance with the targeted water consumption per user type.

Other key new initiatives include:

- Other water conservation/demand management elements
- Leak detection program
- Customer willingness to pay and price/service level consultation programs

While not incorporated as an initiative at this time, future consideration may also be given to providing an active role in implementing management goals for clustered wellhead water treatment systems within the Lake Tahoe Basin. This program would support a broad environmental stewardship initiative for the District to actively contribute towards sustaining the environment.

3.4.1 Connected to Asset Management

There are many positive benefits of asset management. The benefits of asset management include, but are not limited to, the following:

- *Better operational decisions*
- *Improved emergency response*
- *Greater ability to plan and pay for future repairs and replacements*
- *More efficient operation*
- *Improved communication with customers*
- *Rates based on sound operational information*
- *Increased acceptance of rate changes*

LOS statements are key to developing a strong asset management program as they define the ways in which District customers, Board members, managers, and operators want the system to perform over the long term. The LOS statements can include any technical, managerial, or financial components the utility wishes, as long as all regulatory requirements are met. The LOS statements will become a fundamental part of how the utility is operated.

There are two key facets to asset management: 1) defining the level of service the system will strive to provide its customers over the long term, and 2) determining the most efficient and economical way to deliver that service (the least cost approach). Therefore, determining and detailing the level of service that the system is going to provide is an instrumental step in the overall process of guiding the District's asset management program. These are covered in more detail below.

Customer Communication

It is important for the District to communicate with its customers to be transparent in the management and operation of the water system. Clear communication will minimize customer confusion, accusations of improper operation, and make clear the District's understanding of the customer's expectations.

Determine Critical Assets

The LOS can be one factor in determining critical assets. Further considerations in criticality are discussed in the next section. An example of how the LOS can impact criticality is where a system's LOS includes the factor "water will be delivered to customers 99% of the time." If the system has only one water source, the source will be a critical asset for the system, and therefore it must keep the source operational at all times in order to meet this criterion.

Serve as an Internal Guide to System Operation and Management

It is much easier to operate or manage a water system when the operations and maintenance staff as well as the management team understand the goals of the operation. Defining the LOS sets these goals for the water system. These goals allow the operations staff to have a better understanding of what is desired from them and the management has a better understanding of how to use staff and other resources more efficiently and effectively. Checking how well the system is meeting LOS also allows the District to shift resources if appropriate from one task to another to meet all system goals more effectively and in a prioritized manner.

3.5 Level of Service Statement Development

During the development of the District's LOS statements, the following processes were followed to provide quality assurance and quality control. It is recommended that these processes be leveraged and built upon as the District revises/updates the LOS statements going forward. The following assumptions and guidelines were followed in the development of the Level of Service Statements:

1. The Level of Service Statements will ultimately undergo some level of consultation with customers and stakeholders; therefore, it is acceptable and expected if some of the measures are "non-technical."

2. The Level of Service Statements will use appropriate existing measures employed at the District when possible.

3. The initial Level of Service Worksheets would constitute the starting point for the exercise.

4. The Level of Service Statements will be incorporated into the District's Asset Management Plan, when/where appropriate.

5. The Level of Service Statements will be based on the triple bottom line (Social/Community, Economic/Financial, and Environment).

6. The Level of Service Statements will be formulated in the context of the District's Strategic Goals.

Existing District source documents were evaluated and contrasted with other water industry benchmarks to develop the initial LOS statement worksheets. The statements are segregated into Capital and Operations and Maintenance (O&M) related activities. This information was used as a starting point for developing the Level of Service Statements, and then further developed using the following approach:

Step 1 Review the initial Level of Service Worksheets. Assess/validate the District's current Key Service Objectives and Strategic Goals.

Step 2 Review and incorporate existing performance measures into the worksheets (data sources include District's Project Team input, past District QualServe results, National Water & Wastewater Benchmarking Initiative 2011 Report, FY12-13 Budget document, past Customer Satisfaction surveys, etc.). Mandated requirements are to be highlighted in "purple", recommended industry standards are highlighted in "blue" and District requirements are highlighted in "gold" on the worksheets.

Step 3 Identify any additional Level of Service Value Statements and performance measures required to fully address the District policies and customer driven management best practices.

Step 4 Vet the new and existing measures and value statements in the Capital and O&M worksheets with the Project Team.

Step 5 Establish the estimated cost and/or savings of each LOS statement and its data source.

Step 6 Identify organization function that is responsible for the measure.

Step 7 Assess the confidence level in the supporting data. Then use them to complete a composite score in Current Status.

Step 8 Assess the District's current performance with respect to each of the established LOS criteria.

Step 9 Vet the Draft Level of Service Statements with the District's Management Team and Board members.

Step 10 Recommend draft reporting frequencies and recipients.

Step 11 Document the results in a Draft Technical Memorandum.

3.6 LOS Statement Results

Steps 1-4 of LOS statement development (see Section 3.5) involved identifying what measures the organization currently uses, and sorting those measures into a hierarchical structure that is aligned to the District's current business practices and to their customers' needs. Steps 5-8 were completed by staff reviewing where data was tracked in the District's IT systems and compiling it into useful performance measurement statements. The Summary Worksheet that combines the Capital and O&M LOS Statements was then developed and discussed at the District Board Workshop on May 17, 2012, which covers Steps 9 and 10. The cost and composite scoring of the LOS Statements have not been reviewed with the District Board, but will be done at a future Board meeting or workshop. Step 11 is being completed as part of this Section 3 (TM 2).

The Level of Service Worksheet accompanying this Technical Memorandum, in MS Excel format, captures all appropriate measures currently required to perform effective asset management. This worksheet was analyzed to identify which levels of service measures are essential at the customer interface and have an impact on future capital investment as well as operation and maintenance expenditures. It is the District's intent that the LOS be a living document, updated periodically to reflect changes in priority and system configuration, and used as one of several tools to steer project development and priority.

The hierarchical relationship between Key Service Objectives, Strategic Goals, Performance Measures and Cost Implications comprise the external reporting Level of Service Statements (Refer to Table 3-1). This table outlines the measures that the District might consider taking to meet several key service objectives. This information may also be considered for inclusion in a customer survey for focused stakeholder input. Similarly, the hierarchical relationship between the measures that impact capital investment and O&M costs are established (Refer to Table 3-2), and more detailed level of service statements were derived to support internal reporting and tracking.

3.6.1 Glossary of Terms for Tables

The following is a glossary of terms that are used when describing asset management terminology as well as for use in the following LOS Summary table. The intent is to explain to the reader what each column heading means and its purpose to provide proper context so as to provide consistent "apples to apples" comparisons now and in the future.

- Asset Management - A systematic approach to the procurement, maintenance, operation, rehabilitation and disposal of one or more assets. It integrates the utilization of assets and their performance with the business requirements of asset owners or users. Asset management is all about the continuous alignment of asset performance to meet service level outputs to deliver the desired outcomes.

- Key Service Objectives – This is written to be taken from the customer's point of view. When evaluating the type of service the District would provide, you need to ask what is the customer's interest in the water service delivery to themselves. The questions asked in the table takes a holistic point of view (*i.e.*, they ask questions about the financial, social and environmental qualities of water service) in order to provide a balanced and sustainable approach to the service they receive. For example, one customer objective is that the District will provide high quality water.

- Strategic Goals – This is written to be taken from the District's point of view. When evaluating the customer's objectives, the District needs to translate that into actions they can take to meet the objectives. For instance, in order to provide high quality water to meet the customer's expectations the District has to accomplish several things, including:

    - Meet regulatory quality standards.
    - Minimize MTBE in drinking water.
    - Address nuisance water issues.
    - Protect the system from backflow and cross-connections.
    - Provide and maintain secure water facilities.

- Performance Measures – These measures are to be taken from the District's point of view. They are intended to quantitatively inform the District about the water services they provide and the processes to provide water to the District's customers. They are a tool to help staff understand, manage, and improve what the District does on a routine basis. They are comprised of a quantifiable goal, are referenced to an industry standard, regulation or local law and must have a defined impact on the customer. This is described in further detail below:

    - Quantifiable Goals – These goals are composed of a number and a unit of measurement and timeline. The number gives us a magnitude (how much, time, by when) and the unit gives the number a meaning (what). The goals developed by the District were given targets benchmarked to industry standards as described in the Driver section. Examples of these goals for providing high water quality are:

        - Regulated constituents at or below maximum contaminant level (MCL) 100% of the time.
        - Reduce system related nuisance complaints below 10 per 1000 service connections.
        - Comply with the District's cross-connection protection program 100% of the time.

- o Drivers – The District ensured that all LOS statements have a basis for each performance measure by assigning a reference source for each benchmark standard and/or regulation. This provides a higher confidence level that the District is achieving something based on benchmarks of peer utilities that can be referenced and validated, rather than just a perception based on notion. Example sources of driver benchmarks that the District has referenced include:
  - Environmental Protection Agency (EPA)
  - CDPH
  - AWWA QualServe
  - National Water and Wastewater Benchmarking Initiative's (NWWBI) 2011 Report
- o Customer Impact – This section describes the benefit of the activity to the District's customer. When assessing the impact/benefit of a particular LOS statement on the District's customers it is good to keep in mind the following:
  - What problems does this feature solve?
  - What desires does this feature fulfill?
  - What future disasters will it help avoid?
  - If this feature was not there what would I be missing?
  - What does this feature mean to the customer?

- Performance Indicator or Key Performance Indicator (KPI) – It is an expression for a type of performance management. These indicators are commonly used by an organization to evaluate its success or the success of a particular activity in which it is engaged. Sometimes success is defined in terms of making progress toward strategic goals, but in the context of this report success is gauged on the repeated achievement of operational goals (for example, perform water quality sampling and testing on a monthly basis; perform flushing on 100% of dead end lines on an annual basis; or cycle 15% of valves 6" and larger each year). Accordingly, choosing the right performance indicator is reliant upon having a good understanding of what is important to the organization. 'What is important' often depends on the District measuring the performance – for example the KPIs that are useful to finance will be quite different than the KPIs that are assigned to operations. Because of the need to develop a good understanding of what is important, performance indicator selection is often closely associated with the use of various techniques to assess the present state of the business, and its key activities. As a result of this effort with the District, many discussions and refinements of the KPIs occurred during the project to make sure they have been defined in a way that is understandable, meaningful, and measurable.

- Cost Implications – This section quantifies the cost of water system operation and maintenance (O&M) and capital to provide the particular level of service to the District's customers. Its purpose is to find the relationship between the cost and the level of service in water supply delivery chain. The goal for the District going forward is to track these costs on a regular basis to see where savings can be found by optimizing operations. Because this is a new process for the District, not all the tools are currently in place for tracking the past and future costs associated with individual performance indicators. For these, the table indicates either "TBD" (To Be Determined) or "Accounted Elsewhere". It is also noted in the table that where no O&M or capital funds are expected to be spent or are accounted for in other statement categories, these are called out as "No added costs". Finally, if the cell is left blank, the expected cost is equal to zero dollars.

    - Current Cost to District – This is the summation of the respective, current O&M and capital costs that the District is incurring to meet a particular LOS statement. A detailed breakdown of the evaluation of the current cost for four (4) departments at the District's water utility that directly work on the system's infrastructure is shown. These four (4) departments include:

        - Underground Repair Water
        - Pump
        - Laboratory
        - Inspection

      The O&M expenses and salary and benefits totaling about $3.24 million for these four departments have been assigned to the Current Cost to the District.

      There are other major costs that contribute to meeting the established LOS goals that have not been assigned to the District's Current Cost or Additional Cost to Implement as an additional in-depth evaluation is needed. These include, but are not limited to: (1) the other departments in the District that dedicate a portion of their time to provide support to these four primary water departments and (2) the cost of energy to produce and distribute water to the District's customers.

      1. The District will evaluate the supporting departments in more detail and develop an equitable distribution of the Current Cost to the District's LOS statements that will be shown in O&M Table 3-2 (see MS Excel O&M Tab, cells H54 and possibly J54) in the following row of the table:

          - Provide Water Cost Effectively → Meet industry standards for cost to deliver water → Maintain total O&M plus salaries and benefits (S&B) cost to deliver treated water during peak week under $69,000/MG → AWWA-

QualServe Guidelines → Maintain or Reduce rates → Maintain appropriate staffing level for regular and emergency needs.

2. The District will establish a baseline energy costs to meet the LOS goals, which once developed will be shown in O&M Table 3-2 (see MS Excel O&M Tab, cells H52 and H53, and possibly cells J52 and J53) in the following two rows of the table:

   - Provide Water Cost Effectively → Meet industry standards for cost to deliver water → Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG → AWWA-QualServe Guidelines → Maintain or Reduce rates → Balance energy demand on daily basis to achieve highest efficiency.

   - Provide Water Cost Effectively → Meet industry standards for cost to deliver water → Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG → AWWA-QualServe Guidelines → Maintain or Reduce rates → Balance chemical demand on daily basis to achieve highest efficiency.

- Additional Cost to Implement – This is the summation of the proposed O&M and capital costs necessary to meet a LOS statement where the District does not currently meet the minimum benchmark threshold. Because the LOS is a living document, the District will continue to update and refine the "current cost" and "additional cost to implement" as more data becomes available, and as priorities shift to match the requirements of the LOS. This process is described more fully in Section 8.

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Table 3-1. Level of Service Summary

Key Service Objectives	Strategic Goals	Performance Measures			Cost Implications		
		Quantifiable Goals	Driver	Customer Impact			
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What's it cost to meet the performance measure? (Highest value of a range is provided in calculation of cost)*		
						Current Cost to District	*Additional Cost to Implement*
Provide High Quality Water	Meet regulatory quality standards	Regulated constituents at or below MCL 100% of the time	EPA, CDPH, FDA	Better taste, no odors, public health benefit, increase life of plumbing fixtures	O&M:	$1,160,000	
					Capital:		$2,010,000
		Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.	CDPH (detectable levels); District records	Better taste, public health benefit, no odors	O&M:	$81,000	$71,000
					Capital:		$332,000
	Minimize MTBE in drinking water	Non-detect (<0.5 ppb) on MTBE 100% of the time	Board Mandate	Better taste/Less odor	O&M:	$2,640	
					Capital:		$230,000
	Address nuisance water issues (odor, corrosion, sediment)	Reduce system related nuisance complaints below 10 per 1000 services annually.	NWWBI 2011 Report; District records	Clean water, better taste, no odors, protect plumbing fixtures.	O&M:	$43,100	
					Capital:		No added cost
		Investigate and respond to customer complaint within 8 hours at least 90% of the time.	NWWBI 2011 Report	Clean water, better taste, no odors, protect plumbing fixtures, increase customer confidence.	O&M:	$51,000	
					Capital:		N/A
	Protect system from backflow and cross-connection	Comply with District's cross-connection protection program 100% of the time.	CDPH Title 17; CCR Sections 7583 - 7605; District administrative code; 10 State Standards; AWWA	Public health benefit.	O&M:	$59,000	
					Capital:		$3,400
	Secure water facilities	Meet or exceed national standard for site security for systems of STPUD's size and location.	Department of Homeland Security and District Vulnerability Assessment (RAM-W)	Increase customer confidence in water quality.	O&M: Note 2		No added cost
					Capital: Note 4		$1,576,000
Provide Water Reliably	Minimize and consolidate scheduled outages	Maintain number of scheduled outages of 12 hrs or less at or below industry standard (0.65 outages per year per 1000 services).	AWWA-QualServe Guidelines	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M: Note 2	$230,000	
					Capital:		No added cost
	Minimize unscheduled outages	Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at 50 per year.	District Records & Board Request	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M: Note 2	$123,500	$39,450
					Capital:		$1,702,000
		Implement Asset Management Principles for 100% of System Assets.	RCM II; District Records	Minimize customer inconvenience, reduce cost to customers, reduce rates	O&M:	$513,447	
					Capital:		N/A
	Provide redundancy within system	100% of macro zones meet maximum day demands with largest source out of service	CDPH Waterworks Standards	Water is there when it's needed; public health; water quality; reliable water	O&M:	$19,000	
					Capital:		TBD
		100% of facilities have backup power capabilities	10 State Standards, AWWA	Water is there when it's needed; water quality; reliable water	O&M:	$2,500	
					Capital:		$4,824,000
Provide Enough Water	Size system facilities to meet community demands	100% of system can meet MDD and PHD.	CDPH Waterworks Standards, 10-State Standard, AWWA	Water is there during normal conditions	O&M:	N/A	
					Capital:		TBD
		100% of system provides access to emergency water	CDPH, 10-State Standard, AWWA, District Records	Water is there when it's needed; Water is there during fire emergency	O&M:	No added cost	No added cost
					Capital:		$804,000
		Zero days with wells pumping at greater than 90% utilization.	NWWBI 2011 Report	Water is there when it's needed	O&M:		$27,000
					Capital:		No added cost
		100% of zone storage can meet MDD while accounting for zone replenishment with largest unit out of service	10-State Standard, AWWA	Water is there when it's needed	O&M:	N/A	
					Capital:		$2,164,000
		100% of zones combined sources can pump MDD plus max fire standard for zone with largest source out of service	CDPH, 10-State Standard, AWWA	Water is there when it's needed	O&M:	N/A	
					Capital:		$5,360,000

Table 3-1. Level of Service Summary (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures			Cost Implications		
		Quantifiable Goals	Driver	Customer Impact			
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What's it cost to meet the performance measure? (Highest value of a range is provided in calculation of cost)*		
						Current Cost to District	*Additional Cost to Implement*
Provide Enough Water	Maintain system pressures	Min pressure > 20 psi under all conditions	CDPH Waterworks Standard	Public Health	O&M:		
					Capital:		$55,375,000
		Max pressure < 120 psi 90% of the time	10-State Standard; District Records	Protects plumbing and fixtures; reduce District costs	O&M:		
					Capital:		TBD
Provide Water Cost Effectively	Minimize Unaccounted water	Utilize Commercial and Residential water meters to account for all water and compare to production trends	AWWA-QualServe Guidelines	Less waste, lower rates	O&M:		
					Capital:		$24,233,000
		Meter accuracy tests within industry standard 100% of the time.	AWWA	Less waste, lower rates	O&M:	$197,000	$34,000
					Capital:		N/A
	Meet industry standards for cost to deliver water	Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:	TBD	TBD
					Capital:		No added cost
	Maintain appropriate staffing level for regular and emergency needs	Limit unplanned overtime maintenance hours to less than 15% of total unscheduled maintenance hours.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:	TBD	
					Capital:		$1,809,000
		Maintain staff utilization rate of 100% during peak season	Board Request; AWWA-QualServe Guidelines	Maintain or Reduce Rates	O&M:	$254,625	
					Capital:		No added cost
	Extend life cycle of assets	Life of assets meet or exceed industry standard.	International Infrastructure Management Manual, AWWA M Manuals	Maintain or reduce rates	O&M:	$86,000	$26,200
					Capital:		$7,236,000
	Replace spent assets	Maintain annual renewal rate on capital expenditures at or above 1.7%.	AWWA-QualServe Guidelines; International Infrastructure Management Manual; EPA Guidelines	Maintain or reduce rates	O&M:	N/A	
					Capital:		See Note 1
		When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.	RCM II	Maintain or Reduce rates	O&M:	No added cost	
					Capital:		N/A
	Operate system energy efficiently	Maintain annual energy consumption at or below 20,000 kWh/MG.	AWWA-QualServe Guidelines	Maintain or Reduce rates	O&M:		$36,300
					Capital:		$241,000
	Comply with regulatory requirements	Reduce current water use by 20% by 2020.	SBX 7-7	Eligibility for grant funding; reduced rates	O&M:	$356,500	
					Capital: Note 3		
Protect Lake Tahoe and the Community	Minimize health and safety risks to public	No public injury or other negative impact attributed to water system	CDPH, DHS, OSHA, District Records	Protect public health and safety.	O&M: Note 2	$19,000	
					Capital: Note 4		$603,000
	Minimize unregulated discharges	Comply with requirements for no surface water discharge from properties.	TRPA/Lahontan	Customer confidence in District as a proactive partner	O&M:	$45,720	
					Capital:		$771,000
		Implement flushing BMPs 100% of the time.	Lahontan Regulations	Protect offsite receiving water bodies	O&M:		TBD
					Capital:		No added cost
	Collaborate and cooperate with other agency programs	Zero complaints from other agencies for District O&M procedures.	Multiple Local Regulatory and Jurisdictional agencies	Customer confidence in District as a proactive partner	O&M:	No added cost	
					Capital:		No added cost
		Minimize cost associated with relocation of water utilities for EIP Projects	TRPA	Customer confidence in District as a proactive partner	O&M:	No added cost	
					Capital:		No added cost
Total Estimated O&M Cost						$3,244,032	$233,950
Total Estimated Capital Cost (Note 1)							$109,273,400

Notes:

1) Based on total water system value LOS recommends $14.2M/year asset replacement. This $14.2M/year is not included in the Total Estimated Capital Cost. Years.

2) $230,000 is included in Provide High Quality Water, Address Nuisance Water, Reduce system related nuisance complaints below 10 per 1000 services annually.

3) $24,120,000 is included in Provide Water Cost Effectively, Minimize Unaccounted Water, Utilize Commercial and Residential Water Meters to Account for All Water and Compare to Production Trends.

4) $62,000 (hard entered, $27,000 (hard entered) and $1,488,000 (hard entered) is included in Provide High Quality Water, Secure Water Facilities, Meet or exceed national standard for site security for systems of STPUD's size and location.

Table 3-1. Level of Service Summary (cont'd)

Summary of Costs to Meet Level of Service Based on Drivers

	Annual O&M Current Cost to District	Annual O&M Additional Cost to Implement	Additional Capital Cost to Implement	
Mandated Requirements the District must meet	$1,721,220	$71,000	$60,670,400	
Recommended Industry Standards the District should meet	$1,142,094	$96,500	$46,671,000	
District developed requirements	$380,718	$66,450	$1,932,000	
TOTAL	**$3,244,032**	**$233,950**	**$109,273,400**	(See Note 1)

Notes

1) The Estimated Capital Cost encompasses new assets at $35,524,400 and replacement assets at $73,749,000.

Table 3-2. Level of Service Implementation Plan - Capital

Key Service Objectives	Strategic Goals	Performance Measures			District Actions									
		Quantifiable Goals	Driver	Customer Impact	Performance Indicators	Current Status	Cost Implications	Responsible Department	Metrics	STPUD Data Location	Confidence Level (+,0,-)			
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*What is the additional cost to meet standard over 10 year period?**	*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?*			
											Strategic Goals	Quantifiable Goals	Performance Indicators	Cost
Provide High Quality Water	Meet regulatory quality standards	Regulated constituents at or below MCL 100% of the time	EPA, CDPH, FDA	Better taste, no odors, public health benefit, increase life of plumbing fixtures	Evaluate treatment, rehabilitation, or replacement options for all wells that violate water quality criteria at any time	0	$670,000 to $2,010,000 (22)	Engineering / Lab	LIMS, Administrative	LIMS Database and design reports	-	0	0	-
		Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.	CDPH (detectable levels); District records	Better taste, public health benefit, no odors	Evaluate mixing options for tanks that fall below chlorine residual requirement on an annual basis.	-	$302,000 (1)	Engineering / Lab	LIMS	LIMS Database		-	-	-
					Explore chlorine injection options at booster stations and elsewhere on a routine basis.	-	$30,000 (2)	Engineering and Pumps	LIMS, CMMS	LIMS Database and Maintenance Connection			-	-
	Minimize MTBE in drinking water	Non-detect (<0.5 ppb) on MTBE 100% of the time	Board Mandate	Better taste / Less odor	Evaluate treatment or replacement options for all wells that violate requirement.	0	$230,000	Engineering / Lab	LIMS, Administrative	LIMS Database and design reports	0	0	0	-
	Address nuisance water issues (odor, corrosion, sediment)	Reduce system related nuisance complaints below 10 per 1000 services annually.	NWWBI 2011 Report; District records	Clean water, better taste, no odors, protect plumbing fixtures.	Evaluate clustered complaints to identify system problems on an annual basis.	-	No added cost	Engineering	Springbrook and CMMS	Customer Service and Maintenance Connection	-	-	-	0
	Protect system from backflow	Comply with District's cross-connection protection program 100% of the time.	CDPH Title 17; 10 State Standards; AWWA; District administrative code; CCR Sections 7583 -7605	Public health benefit.	Design all District facilities with required backflow devices	0	$3,400 (3)	Engineering	Administrative	Design Reports	0	0	0	-
	Secure water facilities	Meet or exceed national standard for site security for systems of STPUD's size and location.	Department of Homeland Security & District Vulnerability Assessment (RAM-W)	Increase customer confidence in water quality.	Install intrusion alarms with report to SCADA at all wells.	-	$62,000 (4)	Pumps/Engineering	Administrative. Add tracking to CMMS.	Maintenance Connection	-	-	-	-
					Install security fencing at all remote facilities.	-	$744,000 to $1,487,000 (5) (26)	Pumps/Engineering	Administrative. Add tracking to CMMS.	Maintenance Connection and design reports			-	-
					Install ladder guards on all tanks.	0	$14,000 to $27,000 (6) (26)	Pumps/Engineering	Administrative. Add tracking to CMMS.	Maintenance Connection and design reports			0	-
Provide Water Reliably	Minimize and consolidate scheduled outages	Maintain number of scheduled outages of 12 hours or less at or below industry standard (0.65 outages per year per 1000 services)	AWWA-QualServe Guidelines	Minimize customer inconvenience, reduce cost to customers, reduce rates	Coordinate timing and scope of all projects to minimize outages.	-	No added cost	All Departments	Administrative	Meeting Minutes	-	-	-	0
					Coordinate regular construction meetings with Pumps, URW, CS and Contractor, as appropriate.	-	No added cost	All Departments	Administrative	Meeting Minutes			-	0
	Minimize unscheduled outages	Maintain number of unscheduled outages for water mains at or below 350 per year.	District Records	Minimize customer inconvenience, reduce cost to customers, reduce rates	CIP will consider leak history in waterline replacement priority list 100% of the time.	0	No added cost	URW/Engineering	CMMS/Administrative	Maintenance Connection	-	-	0	+
					Annually, investigate and evaluate 100% of identified system deficiencies and add to CIP (if appropriate).	-	No added cost	Engineering / Pumps / URW	CIP	Engineering Reports and Meeting Minutes			-	0
					Install SCADA at 100% of PRVs stations.	-	$241,000 to $362,000 (7)	Pumps/Engineering/Electricians	CIP	Engineering Reports and Meeting Minutes			-	-
		Maintain number of services affected during a shut-down at or below 50 per year	Board Request	Minimize customer inconvenience, reduce cost to customers	Add valve to achieve less than 40 services affected in a shut down.	-	$1,340,000 (8)	URW/Engineering	CIP/Water Model	Engineering Reports		-	-	-
	Provide redundancy within system	100% of macro zones meet max day demand with largest source out of service	CDPH Waterworks Standards	Water is there when it's needed; public health	Size new facilities to meet this criteria.	0	TBD	Engineering	CIP	Engineering Reports and Meeting Minutes	-	0	0	-
		100% of facilities have backup power capabilities	10 State Standards, AWWA	Water is there when it's needed	Install generators at all "critical" facilities. (27)	-	$3,216,000 to $4,824,000 (9)	Pumps/Engineering	CIP	Engineering Reports and Meeting Minutes		-	-	-
Provide Enough Water	Size system facilities to meet community demands	100% of system can meet MDD and PHD.	CDPH Waterworks Standards, 10-State Standard, AWWA	Water is there during normal conditions	Size new facilities to meet max day plus fire flow and peak hour.	0	TBD	Engineering	CIP	Engineering Reports and Meeting Minutes	-	0	0	-
		100% of system provides access to emergency water	CDPH 10-State Standard, AWWA	Water is there when it's needed; Water is there during fire emergency	Provide hydrants on 500 ft spacing in urban areas	-	$402,000 to $804,000 (10)	Engineering	CIP	Engineering Reports and Meeting Minutes		-	-	-
					Provide hydrants on 1000 ft spacing at wildland boundary.	-	$402,000 to $804,000 (10) (26)	Engineering	CIP	Engineering Reports and Meeting Minutes			-	-
					Size waterline replacements for MDD plus max fire standard for zone with min 20 psi (6"Dia min).	0	No added cost	Engineering	CIP/Water Model	Engineering Reports			0	+
		100% of zone storage can meet MDD while accounting for zone replenishment with largest unit out of services.	10-State Standard, AWWA	Water is there when it's needed	Design replacement tanks to meet current safety/seismic standards	0	Strategy 1: $1,340,000 to $2,144,000 Strategy 2: $670,000 to $1,072,000 (11)	Engineering	CIP/Water Model	Engineering Reports		-	0	-
					Routinely review and identify zones that don't meet standard and develop program for adding storage or remapping zone boundaries	-	$20,000	Engineering / Pumps	CIP/Water Model	Engineering Reports			-	-

Table 3-2. Level of Service Implementation Plan - Capital (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures			District Actions						Confidence Level (+,0,-)			
		Quantifiable Goals	Driver	Customer Impact	Performance Indicators	Current Status	Cost Implications	Responsible Department	Metrics	STPUD Data Location				
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting the goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*What is the additional cost to meet standard over 10 year period?**	*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?*			
											Strategic Goals	Quantifiable Goals	Performance Indicators	Cost
Provide Enough Water (cont'd)	Size system facilities to meet community demands (cont'd)	100% of zones combined sources can pump MDD plus max fire standard for zone with largest source out of service	10-State Standard, AWWA	Water is there when it's needed	Identify zones that don't meet source of supply standard and develop program for adding new sources (boosters and wells)	-	No added cost	Engineering / Pumps	CIP/Water Model	Engineering Reports		-	-	0
					Design replacement boosters and wells to meet standard 100% of the time.	0	$2,680,000 to $5,360,000 (12)	Engineering	CIP/Water Model	Engineering Reports			0	-
		Zero days with wells pumping at greater than 90% utilization.	NWWBI 2011 Report	Water is there when it's needed	Revisit source capacity and system operation annually to optimize system and identify source needs.	-	No added cost	Engineering / Pumps	CIP	Engineering Reports		-	-	0
	Maintain system pressures	Min pressure > 20 psi under all conditions	CDPH Waterworks Standard	Public Health	Replace undersized waterlines. (Utilize the District's Waterline Replacement Priority List as a guideline.)	-	$55,275,000 (13)	Engineering	CIP	Engineering Reports	-	-	-	-
					Evaluate annually the need for individual boosters or small system boosters for properties that see less than 20 psi.	-	$100,000 (14)	Engineering / Customer Service	Springbrook, CMMS, Water Model	Customer Service and Engineering Reports			-	-
					Evaluate zone boundaries regularly for possible modification to improve zone pressure.	-	No added cost	Engineering	CIP/Water Model	Engineering Reports			-	0
		Max pressure < 120 psi 90% of the time	10-State Standard; District Records	Protects plumbing and fixtures; reduce District costs	Evaluate zone boundaries regularly for possible modification to improve zone pressure.	-	TBD	Engineering	CIP/Water Model	Engineering Reports		-	-	-
Provide Water Cost Effectively	Minimize Unaccounted water	Utilize Commercial and Residential water meters to account for all water and compare to production trends	AWWA-QualServe Guidelines	Less waste, lower rates	Implement Pilot Program for 5% of magmeter installs on small services.	-	$113,000 (15)	Customer Service Inspections	Springbrook	Customer Service	-	-	-	-
					Keep track of all construction water	-	No added cost	Customer Service Inspections	Springbrook	Customer Service			-	0
					Install residential meters by 2025.	0	$24,120,000 (16) (26)	Engineering / Customer Service	Springbrook and CIP	Customer Service and Design Reports			0	-
	Meet industry standards for cost to deliver water	Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.	AWWA-QualServe Guidelines	Maintain or reduce rates	Design all new facilities to comply with current energy efficiency standards	-	No added cost	Engineering	Administrative	Consultant and internal reports	-	-	-	0
					Maintain appropriate staffing level annually for CIP implementation.	-	No added cost	Engineering	Administrative	Consultant and internal reports			-	0
	Maintain appropriate staffing level for regular and emergency needs	Limit unplanned overtime maintenance hours to less than 15% of total maintenance hours.	AWWA-QualServe Guidelines	Lower rates	Install or supplement SCADA at all non-linear facilities.	-	$1,085,000 to $1,809,000 (17)	Pumps, Engineering, Electricians	CMMS/Administrative	Maintenance Connection, Internal and Consultant Reports	-	-	-	-
					Plan projects following best management practices to minimize OT.	-	No added cost	Engineering	Administrative	Internal Reports			-	0
		Maintain staff utilization rate of 100% during peak season	Board Request; AWWA QualServe Guidelines	Maintain or reduce rates	Maintain 1 Engineering Staff per $0.7M per annual CIP budget.	0	No added cost	Engineering	Administrative	Internal Reports		0	0	+
	Extend life cycle of assets	Life of assets meet or exceed industry standard.	International Infrastructure Management Manual; AWWA Manual	Maintain or reduce rates	Evaluate tank coatings every 5 years, and renew problem tank coating systems.	0	$5,628,000 to $7,035,000 (18)	Engineering / Pumps	CMMS/Administrative	Maintenance Connection and consultant reports	-	-	0	-
					Evaluate critical mains for corrosion potential, and install cathodic protection by 2015.	-	$134,000 to $201,000 (23)	Engineering	Administrative	Internal and Consultant Reports			-	-
					Complete Preventive Maintenance sheets for all new assets.	-	No added cost	Engineering	Administrative/CMMS	Maintenance Connection			-	0
	Replace spent assets	Maintain annual renewal rate on capital expenditures at or above 1.7%.	AWWA-QualServe Guidelines International Infrastructure Management Manual EPA Guidelines	Maintain or reduce rates	Implement CIP process 100% of the time for facility replacement.	0	$14.2M/year (24)	Engineering	Administrative	Internal Reports	0	0	0	-
	Operate system energy efficiently	Maintain annual energy consumption at or below 20,000 kWh/MG.	AWWA-QualServe Guidelines	Maintain or reduce rates	Program SCADA to cycle water in zones energy efficiently.	-	$97,000 to $241,000 (19)	Engineering / Pumps / Electricians	CMMS and CIP	Maintenance Connection and Internal Reports	-	-	-	-
					Design wellhead treatments for energy and chemical efficiency.	0	No added cost	Engineering / Pumps	CMMS	Maintenance Connection and Internal Reports			0	+

Table 3-2. Level of Service Implementation Plan - Capital (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures			District Actions						Confidence Level (+,0,-)			
		Quantifiable Goals	Driver	Customer Impact	Performance Indicators	Current Status	Cost Implications	Responsible Department	Metrics	STPUD Data Location				
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*What is the additional cost to meet standard over 10 year period?**	*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?*			
											Strategic Goals	Quantifiable Goals	Performance Indicators	Cost
Provide Water Cost Effectively (cont'd)	Comply with regulatory requirements	Reduce current water use by 20% by 2020.	SBX 7-7	Eligibility for grant funding; reduced rates	Implement Water Conservation Program	0	No added cost	Customer Service	Springbrook	Springbrook	-	-	0	+
					Implement Urban Water Management Plan (as approved by the Board)	-	$24,120,000 (16) (26)	Engineering / Pumps	CMMS	Maintenance Connection			-	-
					Install residential meters by 2025.	0	$24,120,000 (16) (26)	Engineering / Underground Repair Water / Customer Service	CMMS / CIP / Springbrook	Maintenance Connection / Internal Reports / Springbrook			0	-
Protect Lake Tahoe and the Community	Minimize health and safety risks to public	No public injury or other negative impact attributed to water system	CDPH, DHS, OSHA	Protect public health and safety.	Locate wells to minimize impact on private wells and other utilities.	0	TBD	Engineering	Administrative	Internal Reports	-	-	0	-
					Perform site stability investigations for potentially hazardous sites.	-	$67,000 (20)	Engineering	Administrative	Internal Reports			-	-
					Design new/replacement wellhouses for chemical separation.	-	New: No added cost Existing Facilities: $268,000 to $536,000 (21)	Engineering	Administrative	Internal and consultant Reports			-	-
					Install air gaps at all system discharge locations.	0	TBD	Engineering	Administrative	Internal Reports			0	-
					Install ladder guards on all tanks.	0	$14,000 to $27,000 (6) (26)	Engineering / Pumps	CMMS and Administrative	Maintenance Connection and Internal Reports			0	-
					Install security fencing at all remote facilities.	-	$744,000 to $1,487,000 (5) (26)	Engineering / Pumps	CMMS and Administrative	Maintenance Connection and Internal Reports			-	-
					Design systems to use sodium hypochlorite for disinfection, instead of gaseous disinfectants 100% of the time.	0	No added cost	Pumps	CMMS	Maintenance Connection			0	+
	Minimize unregulated discharges	Comply with requirements for no surface water discharge from properties.	TRPA/Lahontan	Customer confidence in District as a proactive partner	Install drainage control features to mitigate offsite flows 100% of the time.	-	$771,000 (25)	Engineering	Administrative	Internal and Consultant Reports	-	-	-	-
					Design fuel containment for 100% of new facilities.	0	No added cost	Engineering	Administrative	Internal and Consultant Reports			0	+
	Collaborate and cooperate with other agencies programs	Minimize cost associated with relocation of water utilities for EIP Projects	TRPA	Customer confidence in District as a proactive partner	Provide other agencies in the service area with updated grid sheets on an annual basis.	0	No added cost	Engineering	Administrative	Internal Reports	-	-	0	+
					Apply for utility relocation funding annually	0	No added cost	Engineering / Finance	Administrative	Internal Reports			0	+
					Coordinate waterline replacement with City/County improvements 100% of the time.	-	No added cost	Engineering	Administrative	Internal Reports			-	-
					Participate in TAC Meetings / Program Collaborations 100% of the time.	0	No added cost	Engineering	Administrative	Internal Reports			0	+

*All costs escalated at 3% for 10 years

(1) 15 Tanks need a mixing system at $15,000 per tank. *
(2) 11 Stations need chlorine injection at $2,000 per station. *
(3) Assume 5 new facilities in the planning period at $500 per backflow.*
(4) 31 facilities need intrusion alarms at $1,500 per facility.*
(5) 37 facilities need fencing at $15,000 to $30,000 per site.*
(6) Assume Replacement of ladders at the Keller Tanks. All other tanks in system meet this requirement already*
(7) 18 PRVs need SCADA at $10,000 to $15,000 per PRV.*
(8) Assume 100 valve clusters necessary throughout system at $10,000 per valve cluster.*
(9) Genset with building constructed on 6 critical facilities currently without power. *
(10) Assume 50 to 100 hydrants are needed at $6,000 per hydrant.*
(11) Costs Based on AWWA Sizing Strategies. Different Ranges are to bring current deficient tanks to level of Strategy 2 or Strategy 1 and include seismic design*
(12) Assume 2 new facilities in planning period at $1,000,000 to $2,000,000 per facility.*
(13) $275/LF of Pipe for 150,000LF*
(14) Assume 50 homes need boosters at $1,500 per home.*
(15) 700 small services at $120 per meter.*
(16) Approximately 9000 meters at $2,000 per meter.*
(17) 27 sites at $30,000 to $50,00 per site.*
(18) 21 Tanks at $200,000 to $250,000 per tank.*
(19) 36 sites for control at $2,000 to $5,000 per site.*
(20) Keller Tank Site Only Noted thus far
(21) 20 wells at $10,000 to $20,000 per well.*
(22) Range is dependent on treatment type and is per well*
(23) Cost based on 2010 Corrosion Assessment CIP List*
(24) $14.2M/Year is based on total water system value times 1.75%. This is a general guideline for annual asset replacement and will not be included in the
(25) This is the total cost for completing BMP Work on 34 sites*
(26) Costs should not be duplicated when calculating total cost
(27) "Critical facilities are facilities that are necessary to ensure continued water services when all other zone sources are out of service.

(purple)	Mandated Requirements the District must meet
(light blue)	Recommended Industry Standards the District should meet
(yellow)	District developed requirements

Additional Cost to the District to Implement by Requirement Type

Mandated Requirements	$60,670,400
Recommended Industry Standards	$46,671,000
District developed requirements	$1,932,000
Total =	$109,273,400

Table 3-2. Level of Service Implementation Plan – O&M (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures			District Actions												
		Quantifiable Goals	Driver	Customer Impact	Performance Indicators	Current Status	Cost Implications				Responsible Department	Metrics	STPUD Data Location	Confidence Level (+,0,-)			
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*Current Cost to District*		*Additional Cost to Implement*		*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?* Strategic Goals	Quantifiable Goals	Performance Indicators	Cost
Provide High Quality Water	Meet regulatory quality standards	Regulated constituents at or below MCL 100% of the time	EPA/CDPH/FDA	Better taste, no odors, public health benefit, increase life of plumbing fixtures	Perform WQ sampling and testing on monthly basis	+	$19,000		No added Cost		Lab	LIMS	LIMS	-	0	+	+
					Remove from primary service all wells that violate MCL.	0	$40,000		No added Cost		Pumps	Add tracking to CMMS	Maintenance Connection			0	0
					Keep wells exercised weekly in winter (every Wednesday)	0	$30,000		No added Cost		Pumps	Add tracking in CMMS	Maintenance Connection			0	0
					Comply with Coliform Monitoring Plan 100% of the time	0	$131,700		No added Cost		Lab	LIMS	LIMS			0	0
					Complete hot leak repair at least 90% of the time.	0	$929,300	(1)	No added Cost		URW	Add tracking in CMMS	Maintenance Connection			0	0
					Overflow or turnover tanks twice a year.	0	$10,000		No added Cost		Pumps	Add tracking in CMMS	Maintenance Connection			0	0
		Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.	CDPH (detectable level)	Better taste, public health benefit, no odors	Perform flushing on 100% of dead-end lines on annual basis.	-	--		$35,000		Pumps / URW	CMMS	Maintenance Connection		-	-	-
					Turn over tanks twice a year.	0	Accounted Elsewhere (H10)	(23)	No added Cost		Pumps	CMMS	Maintenance Connection			0	0
					Complete Hot Tap >90% of all NEW connections to existing mains.	-	$81,000	(18)	No added cost		URW	Add tracking to CMMS.	Maintenance Connection			-	0
					Review SCADA programming to improve turnover in storage tanks annually.	-	--		$16,000	(11)	Engineering / Pumps / Electricians	CIP	Engineering Reports and Meeting Minutes			-	-
					Back flush wells on 5 year cycle.	-	--		$20,000	(4)	Pumps	Add tracking in CMMS	Maintenance Connection			-	-
	Minimize MTBE in drinking water	Non-detect (<0.5 ppb) on MTBE 100% of the time	Board Mandate	Better taste/Less odor	Perform sampling and testing on quarterly basis	0	$2,640		No added Cost		Lab	LIMS	LIMS	0	0	0	0
					Remove from primary service wells that violate standard 100% of the time.	0	Accounted Elsewhere (H6)	(23)	No added Cost		Pumps	CMMS	Maintenance Connection			0	0
	Address nuisance water issues (odor, corrosion, sediment)	Reduce system related nuisance complaints below 10 per 1000 services annually.	NWWBI 2011 Report; District records	Clean water, better taste, no odors, protect plumbing fixtures.	Evaluate chlorine feed pump once every day and maintain as needed.	0	Accounted Elsewhere (H29)	(12) & (23)	--		Pumps	CMMS	Maintenance Connection	-	-	0	0
					Perform Post-shutdown flushing, where possible, 100% of the time.	0	$10,800	(19)	No added Cost		URW	Comments in CMMS. Track with UDF so no duplicate effort.	Maintenance Connection			0	0
					Implement unidirectional flushing program on 5 year cycle.	-	--		TBD		URW; Pumps	Add tracking in CMMS	Maintenance Connection			-	-
					Evaluate clustered complaints to identify system problems on an annual basis.	-	$26,000		No added cost		Engineering	Springbrook and CMMS	Customer Service and Maintenance Connection			-	0
					Clean tanks every 5 years.	0	$6,300	(2)	No added Cost		Pumps	Administrative. Add tracking in CMMS	Maintenance Connection			0	0
		Investigate and respond to customer complaint within 8 hours at least 90% of the time	NWWBI 2011 Report	Clean water, better taste, no odors, protect plumbing fixtures, increase customer confidence.	Standby responder to live within District service area or the Lake Tahoe Basin portion of the Douglas County Sanitary Improvement District	0	$51,000		No added Cost		Pumps/URW	Add tracking in CMMS: call time; time site left.	Maintenance Connection		0	0	0
					Maintain 1 staff member per 1000 services for regular needs and 2 staff members on call 24/7/365 for emergency needs.	0	Accounted Elsewhere (H9, H23 and H39)	(23)	No added Cost		Pumps/URW	CMMS	Maintenance Connection			0	0
	Protect system from backflow and cross-connection	Comply with District's cross-connection protection program 100% of the time.	CDPH Title 17; CCR Sections 7583 - 7605; District administrative code; and AWWA	Public health benefit.	Inspect and test existing backflow devices (meter protection) annually.	0	$20,000		No added Cost		Inspections	Springbrook	Customer Service Inspections	0	0	0	0
					Maintain backflow devices at all stations on annual basis.	0	$39,000		No added Cost		Pumps	CMMS	Maintenance Connection			0	0
	Secure water facilities	Meet or exceed national standard for site security for systems of STPUD's size and location.	Department of Homeland Security and District Vulnerability Assessment (RAM-W)	Increase customer confidence in water quality.	Perform site security evaluation on all tanks, wells and boosters on monthly basis.	0	Accounted Elsewhere (H29)	(12) & (23)	No added Cost		Pumps	Comments in CMMS.	Maintenance Connection	0	0	0	0
					Secure buildings, access doors.	0	--		No added cost		Pumps/Engineering	Administrative. Add tracking to CMMS.	Maintenance Connection and design reports			0	0

Table 3-2. Level of Service Implementation Plan – O&M (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures: Quantifiable Goals	Performance Measures: Driver	Performance Measures: Customer Impact	District Actions: Performance Indicators	Current Status	Cost Implications: Current Cost to District		Cost Implications: Additional Cost to Implement		Responsible Department	Metrics	STPUD Data Location	Confidence Level (+,0,-): Strategic Goals	Confidence Level: Quantifiable Goals	Confidence Level: Performance Indicators	Confidence Level: Cost
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*Current Cost to District*		*Additional Cost to Implement*		*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?*			
Provide Water Reliably	Minimize and consolidate scheduled outages	Maintain number of scheduled outages of 12 hrs or less at or below industry standard (0.65 outages per year per 1000 services).	AWWA-QualServe Guidelines	Minimize customer inconvenience, reduce cost to customers, reduce rates	Staff inspection of all in-service wells and boosters once a day.	0	$230,000	(12)	No added Cost		Pumps	Administrative.	Manual log at facility.	0	0	0	0
					Notify other crews of planned work for better coordination	0	--		No added Cost		All departments	Administrative.	Email or phone call.			0	0
	Minimize unscheduled outages	Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year.	District Records & Board Request	Minimize customer inconvenience, reduce cost to customers, reduce rates	Staff inspection of all in-service wells and boosters once a day.	0	Accounted Elsewhere (H29)	(12) & (23)	No added Cost		Pumps	Administrative.	Manual log at facility.	-	0	0	0
					Cycle 15% of valves (6" and larger) each year.	-	$9,800	(20)	$39,450	(14) & (23)	URW	CMMS and Administrative.	Maintenance Connection			-	-
					Inspect and flush 100% of NC valves each year	0	$10,000		No added Cost		Pumps	CMMS.	Maintenance Connection			0	0
					Inspect condition of 33% of Hydrants each year	City: - County: +	No Cost associated		No added Cost		City and County Fire	Administrative.	Reports from City/County.			0	0
					Repair 100% of inoperable hydrants each year.	0	$18,000	(3)	No added Cost		URW	CMMS	Maintenance Connection			0	0
					Perform acoustic leak detection on 250 miles of water main every 5 years.	+	$10,000	(13)	No added Cost		URW	Administrative	Contractor Reports			+	+
					Repair or replace 100% of inoperable or leaking valves each year.	0	$75,700	(16)	No added Cost		URW	CMMS	Maintenance Connection			0	0
		Implement Asset Management Principles for 100% of System Assets.	RCM II	Minimize customer inconvenience, reduce cost to customers, reduce rates	Achieve a ratio of 75% proactive to 25% reactive maintenance (Pumps)	0	$280,369	(22)	No added Cost		Pumps	CMMS/Administrative	Maintenance Connection		-	0	0
			District Records	Minimize customer inconvenience, reduce cost to customers, reduce rates	Achieve a ratio of 25% proactive to 75% reactive maintenance (URW)	-	$233,078	(21)	TBD		URW	CMMS/Administrative	Maintenance Connection			-	-
	Provide redundancy within system	100% of macro zones meet max day demand with largest source out of service	CDPH Waterworks Standards	Water quality, reliable water	Maintain backup pumps on standby for all booster stations.	0	$19,000		No added Cost		Pumps	CMMS	Maintenance Connection	0	0	0	0
		100% of facilities have backup power capabilities	District Records	Water quality, reliable water	Maintain mobile generators on standby for all facilities without dedicated generators.	0	$2,500		No added Cost		Pumps / Equipment Repair	CMMS	Maintenance Connection		0	0	0
Provide Enough Water	Size system facilities to meet community demands.	100% of system provides access to emergency water	CDPH; 10 State Standards; AWWA; District Records		Inspect condition of 33% of Hydrants each year	City: - County: +	No Cost associated		No added Cost		City and County Fire	Administrative.	Reports from City/County.	-	0	0	0
					Repair 100% of inoperable hydrants each year.	0	Accounted Elsewhere (H35)	(23)	No added Cost		URW	CMMS	Maintenance Connection			0	0
		Zero days with wells pumping at greater than 90% utilization.	NWWBI 2011 Report	Water is there when needed.	Program multiple sources in zone as primary/secondary position.	-	--		$27,000		Pumps and Electricians	SCADA	Wonderware Historian		-	-	-
	Maintain system pressures	Min pressure > 20 psi under all conditions	CDPH Waterworks Standard	Public health	Cycle 15% of valves (6" and larger) each year.	-	Accounted Elsewhere (H32)		Accounted Elsewhere (J32)		URW	CMMS and Administrative.	Maintenance Connection	-	-	-	-
		Max pressure < 120 psi 90% of the time	10 State Standards; District Records	Protect plumbing and fixtures; reduce District costs	Inspect and flush of 100% of NC valves each year	0	Accounted Elsewhere (H33)	(23)	No added Cost		Pumps	CMMS.	Maintenance Connection		0	0	0

Table 3-2. Level of Service Implementation Plan – O&M (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures: Quantifiable Goals	Performance Measures: Driver	Performance Measures: Customer Impact	District Actions: Performance Indicators	District Actions: Current Status	Cost Implications: Current Cost to District		Cost Implications: Additional Cost to Implement		Responsible Department	Metrics	STPUD Data Location	Confidence Level (+,0,-): Strategic Goals	Confidence Level: Quantifiable Goals	Confidence Level: Performance Indicators	Confidence Level: Cost
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*Current Cost to District*		*Additional Cost to Implement*		*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?*			
Provide Water Cost Effectively	Minimize Unaccounted water	Utilize Commercial and Residential water meters to account for all water and compare to production trends	AWWA-QualServe Guidelines	Less waste, lower rates	Perform acoustic leak detection on 250 miles of water main every 5 years.	+	Accounted Elsewhere (H36)	(23)	No added Cost		URW	Administrative	Contractor Reports		0	+	+
					Track overflow and flushing volumes on a daily basis.	-	--		TBD		Pumps	Administrative	Manual log at fountain shop			-	-
		Meter accuracy tests within industry standard 100% of the time.	AWWA	Less waste, lower rates	Test and maintain meters larger than 2" every 5years.	0	$57,000		No added Cost		Inspections	Springbrook	Customer Service Inspections	-		0	0
					Replace meters smaller than 2" every 20 years or at failure	-	$140,000	(5)	$34,000	(5)	Inspections.	Springbrook, Maintenance Connection	Customer Service Inspections		-	-	-
					Keep track of Production vs Metered Usage 100% of the time.	-	--		No added Cost		Pumps, Lab, Engineering, Customer Service	LIMS, Springbrook	Customer Service, LIMS, Engineering			-	0
	Meet industry standards for cost to deliver water	Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.	AWWA-QualServe Guidelines	Maintain or Reduce rates	Balance energy demand on daily basis to achieve highest efficiency.	TBD	TBD		TBD		Pumps	Administrative	Reports from Power company			TBD	-
					Balance chemical demand on daily basis to achieve highest efficiency.	TBD	TBD		TBD		Pumps and Lab	CMMS and LIMS	Maintenance Connection and LIMS	-	-	TBD	-
					Maintain appropriate staffing level for regular and emergency needs.	0	Accounted Elsewhere (H9, H23, H38, H39 and H56)	(23)	No added Cost		All departments	CMMS	Maintenance Connection			0	0
	Maintain appropriate staffing level for regular and emergency needs	Limit unplanned OT maintenance hours to less than 15% of total unscheduled maintenance hours.	District Records	Lower Rates	Plan jobs following best management practices to minimize OT	TBD	TBD		TBD		All departments	Administrative	Interdepartmental reports		-	TBD	-
		Maintain staff utilization rate of 100% during peak season	AWWA-QualServe Guidelines	Maintain or Reduce Rates	Maintain meter to staff ratio of 1,500 meters/employee (Inspections)	0	$254,625	(17)	No added Cost		Inspections	Springbrook	Customer Service Inspections	-		0	0
					Maintain total pumping capacity to staff ratio of 190MG/Employee (Pumps)	0	Accounted Elsewhere (H29, H23 and H38)	(23)	No added Cost		Pumps	CMMS	Maintenance Connection		0	0	0
					Maintain pipeline miles to staff ratio of 25miles/employee (URW)	0	Accounted Elsewhere (H9, H23 and H39)	(23)	No added Cost		URW	CMMS	Maintenance Connection			0	0
	Extend life cycle of assets	Life of assets meet or exceed industry standard.	International Infrastructure Management Manual, AWWA M Manuals	Maintain or reduce rates	Test 50% of hot tap coupons for pipe conditions on 2 inch and larger hot taps	-	--		$5,700	(6)	Engineering	Administrative	Consultant Reports			-	-
					Perform well inspections as required by test type (2x per year for well statics, 1 every 2 years for Specific Capacity and Pump performance.)	0	$80,000	(7)	No added Cost		Engineering and Pumps	CMMS and Administrative.	Contractor Reports and field logs			0	0
					Perform pump vibration analysis on yearly basis.	-	--		$6,000		Electricians and pumps	CMMS	Maintenance Connection	-	-	-	-
					Monitor corrosion stations on bi-annual basis.	-	--		$10,000	(15)	Engineering	Administrative	Internal or Consultant reports			-	-
					Perform tank coating inspections every 5 years during tank cleaning.	0	$6,000		No added Cost		Pumps	Administrative	Contractor Reports			0	0
					Perform thermal imaging of MCC and VFDs on yearly basis.	-	--		$4,500	(8)	Electricians	CMMS	Maintenance Connection			-	-
	Replace spent assets	When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.	RCM II	Maintain or Reduce rates	Track maintenance time to project replacement date.	-	--		No added Cost		Engineering	CMMS	Maintenance Connection			-	0
					Use test and inspection results (see Extend Life Cycle of Assets and Operate System Energy Efficiently) to project replacement date.	-	--		No added Cost		Engineering	CMMS and Administrative.	Inspection Reports and Consultant Reports	-	-	-	0
	Operate system energy efficiently	Maintain annual energy consumption at or below 20,000 kWh/MG.	AWWA-QualServe Guidelines	Maintain or reduce rates.	Perform pump efficiency tests on biannual basis.	-	--		TBD		Pumps	CMMS and Administrative.	Test Reports and Maintenance Connection			-	-
					Perform motor meggering annually.	-	--		$6,300	(9)	Electricians	CMMS	Maintenance Connection			-	-
					Trend energy usage on an annual basis	-	--		TBD		Engineering	CMMS and Administrative.	Power company reports and Maintenance Connection	-	-	-	-

Table 3-2. Level of Service Implementation Plan – O&M (cont'd)

Key Service Objectives	Strategic Goals	Performance Measures			District Actions												
		Quantifiable Goals	Driver	Customer Impact	Performance Indicators	Current Status	Cost Implications				Responsible Department	Metrics	STPUD Data Location	Confidence Level (+,0,-)			
What are the Customers primary interests for the water system?	*How does the District meet the objectives?*	*How is the goal defined in a measurable way?*	*What's the basis for the goal? (Reference source/regulation)*	*What's the benefit to the customer?*	*What does the District do to meet the goal?*	*How close does the District come to meeting this goal today?* "+" = Exceeds Goal "0" = Meets Goal "-" = Needs Improvement	*Current Cost to District*		*Additional Cost to Implement*		*Who does it?*	*How do we track it?*	*Where's the data kept?*	*How are we doing? Are we successful?* Strategic Goals	Quantifiable Goals	Performance Indicators	Cost
Provide Water Cost Effectively (cont'd)	Operate system energy efficiently (cont'd)				Check specific capacity of wells annually and track well efficiency every two years.	-	--		$30,000	(10)	Engineering	Administrative	Internal and Consultant Reports			-	-
	Comply with regulatory requirements	Reduce current water use by 20% by 2020.	SBX 7-7	Eligibility for grant funding; reduced rates	Implement Water Conservation Program and maintain annually per Urban Water Management Plan.	0	$350,000		No added Cost		Customer Service	Springbrook and Administrative	Customer Service	0	0	0	0
					Implement Drinking Source Water Assessment Program and maintain annually	0	$6,500		No added Cost		Engineering	Administrative	Internal Reports			0	0
Protect Lake Tahoe and the Community	Minimize health and safety risks to public	No public injury or other negative impact attributed to water system	District Records	Protect public health and safety.	Monitor contaminant plumes; well monitoring on yearly basis.	0	$19,000		No added Cost		Engineering and Lab	LIMS and Administrative	LIMS and Internal reports	0	0	0	0
					Operate wells (as needed) to minimize aquifer drawdown.	0	Accounted Elsewhere (H29)	(12) & (23)	No added Cost		Pumps	CMMS	Maintenance Connection			0	0
					Perform site security evaluation on all tanks, wells and boosters on monthly basis.	0	Accounted Elsewhere (H29)	(12) & (23)	No added Cost		Pumps	CMMS	Maintenance Connection			0	0
	Minimize unregulated discharges	Comply with requirements for no surface water discharge from properties.	TRPA/Lahontan	Customer confidence in District as a proactive partner	Maintain drainage control features (as needed annually) to mitigate offsite flows	-	--		No added Cost		Engineering and Pumps	Administrative	Design Reports	-	-	-	0
					Monitor fuel containment at facilities on yearly basis.	0	$45,720		No added cost		Equipment Repair	CMMS	Maintenance Connection			0	0
		Implement flushing BMPs 100% of the time.	Lahontan Regulations	Protect offsite receiving water bodies	Discharge to sewer whenever feasible, 75% of the time.	0	--		No added cost		Pumps, Engineering, URW	CMMS	Maintenance Connection		-	0	0
					Dechlorinate regular water system discharges 80% of the time.	-	--		TBD		Pumps, Engineering, URW	CMMS	Maintenance Connection			-	-
	Collaborate and cooperate with other agency programs	Zero complaints from other agencies for District O&M procedures.	Multiple Local Regulatory and jurisdictional agencies	Customer confidence in District as a proactive partner	Meet 1 time per year with other local jurisdiction to discuss O&M impacts	-	--		No added cost		Engineering	Administrative	Meeting Minutes	0	0	-	0
					Comply 100% with standing encroachment agreements and MOUs	+	--		No added cost		Engineering, Pumps, URW	Administrative	Internal Reports			+	+

(1) 90% of "Reactive Maint" portion of O&M budget, minus costs for standby, 1/2 of hydrant repair and 1/2 of valve replacement
(2) 21 Tanks at $1,500 per tank every 5 years
(3) 10 hydrants per year @$1,800 per hydrant
(4) 20 wells at $1,000 per well
(5)[1254] 2">Size>=1" Meters at $600/meter [4,920] 3/4"Meters at $200/meter spread evenly over 20 years
(6) 10 hot tap coupons at $425/ test and escalate by 3% for 10 years (multiply by factor of 1.34)
(7) 20 wells at $2,000 to $6,000 per well, average at $4,000 per well
(8) 36 sites to perform tests at $125 per test
(9) 36 Sites to perform tests at $175 per test
(10) $1,500 per well every two years for 40 wells
(11) 16 Stations at $1,000 per station
(12) Staff Expense to visit every site daily
(13) $50,000 for 5 year cycle
(14) 810 minus 21 valves per year at $50 per valve
(15) 20 Stations at $500 per station
(16) Actual cost to replace 57 valves in 2011 per MC
(17) Budgeted Salaries and Benefits for Inspections ($380,625) minus cost to test backflows, maintain large meters, and replace small meters.
(18) 90% of actual 2012 costs for service connections (41 services)
(19) 1% of 2012 costs for service connections
(20) Actual 2011 valve cycling costs per Maint. Conn. (21 valves)
(21) 25% of 2013 URW O&M Budget minus services, 1/2 of valve repairs and 1/2 of hydrant repairs (Assumes meeting goal)
(22) 75% of 2013 Pumps O&M Budget minus preventive maintenance accounted for elsewhere.
(23) The reference for example Accounted Elsewhere (H10) the (H10) refers to the MS Excel cell position. A legend of these references is as follows:
(H6) - Provide High Quality Water; Meet regulatory quality standards; Regulated constituents at or below MCL 100% f the time; EPA/CDPH/FDA; Better taste, no odors, public health benefit, increase life of plumbing fixtures; Remove from primary service all wells that violate MCL
(H9) - Provide High Quality Water; Meet regulatory quality standards; Regulated constituents at or below MCL 100% f the time; EPA/CDPH/FDA; Better taste, no odors, public health benefit, increase life of plumbing fixtures; Complete hot leak repair at least 90% of the time.
(H10) - Provide High Quality Water; Meet regulatory quality standards; Regulated constituents at or below MCL 100% f the time; EPA/CDPH/FDA; Better taste, no odors, public health benefit, increase life of plumbing fixtures; Overflow or turnover tanks twice a year.
(H23) - Provide High Quality Water; Address nuisance water issues (odor, corrosion, sediment); Investigate and respond to customer complaint within 8 hours at least 90% of the time; NWWBI 2011 Report; Clean water, better taste, no odors, protect plumbing fixtures, increase customer confidence; Standby responder to live within District service area or the Lake Tahoe Basin portion of the Douglas County Sanitary Improvement
(H29) - Provide Water Reliably; Maintain number of scheduled outages of 12 hrs or less at or below industry standard (0.65 outages per year per 1000 services); AWWA-QualServe Guidelines; Minimize customer inconvenience, reduce cost to customers, reduce rates; Staff inspection of all in-service wells and boosters once a day.
(H32) - Provide Water Reliably; Minimize unscheduled outages; Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year; District Records & Board Request; Minimize customer inconvenience, reduce cost to customers, reduce rates; Cycle 15% of valves (6" and larger) each year.
(J32) - Provide Water Reliably; Minimize unscheduled outages; Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year; District Records & Board Request; Minimize customer inconvenience, reduce cost to customers, reduce rates; Cycle 15% of valves (6" and larger) each year.
(H33) - Provide Water Reliably; Minimize unscheduled outages; Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year; District Records & Board Request; Minimize customer inconvenience, reduce cost to customers, reduce rates; Inspect and flush 100% of NC valves each year
(H35) - Provide Water Reliably; Minimize unscheduled outages; Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year; District Records & Board Request; Minimize customer inconvenience, reduce cost to customers, reduce rates; Repair 100% of inoperable hydrants each year.
(H36) - Provide Water Reliably; Minimize unscheduled outages; Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at or below 50 per year; District Records & Board Request; Minimize customer inconvenience, reduce cost to customers, reduce rates; Perform acoustic leak detection on 250 miles of water main every 5 years.
(H38) - Provide Water Reliably; Implement Asset Management Principles for 100% of System Assets; RCM II; Minimize customer inconvenience, reduce cost to customers, reduce rates; Achieve a ratio of 75% proactive to 25% reactive maintenance (Pumps).
(H39) - Provide Water Reliably; Implement Asset Management Principles for 100% of System Assets; District Records; Minimize customer inconvenience, reduce cost to customers, reduce rates; Achieve a ratio of 25% proactive to 75% reactive maintenance (URW).
(H56) - Provide Water Cost Effectively; Maintain appropriate staffing level for regular and emergency needs; Maintain staff utilization rate of 100% during peak season; AWWA-QualServe Guidelines; Maintain or Reduce Rates; Maintain meter to staff ratio of 1,500 meters/employee (Inspections).

		Current Cost to District by Requirement Type	Additional Cost to the District to Implement by Requirement Type
(purple)	Mandated Requirements the District must meet	$1,721,220	$71,000
(light blue)	Recommended Industry Standards the District should meet	$1,142,094	$96,500
(orange)	District developed requirements	$380,718	$66,450
	Total =	$3,244,032	$233,950

3.7 Applying LOS to District Business Practices (Performance Triggers and Actions)

Performance triggers, or levels of actual performance that indicate particular outcomes, can be set using a performance dashboard approach. The performance dashboard approach typically uses alert levels or performance values that correspond to a particular action. If the performance level is within predetermined ranges of the target, the factors contributing to performance are generally just monitored values. However, if the level does not meet the acceptable value, the measure is actively investigated with the objective of corrective action.

Figure 3-1 outlines a simple flow diagram for performance monitoring and actions for the District. The alert level or performance level that triggers an action is that the performance measure value is not moving towards the target level of performance. In this case the causes for the loss of performance are investigated and resolved collaboratively by District staff.

The goal is to monitor and adjust the performance of a Key Service Objectives and Strategic Goals to achieve a “Current Status” rating of “Meets Goals” or “Exceeds Goals” as listed in the LOS Statements Worksheets (refer to Tables 3-1 and 3-2). It will depend on the expectations of the District’s customers (*i.e.*, water users and Board of Directors) on which one is acceptable. There may also be times when the Current Status is at an Exceeds Goal and the District may elect to reduce capital and/or operation and maintenance efforts such that a Meets Goal rating is achieved. The resources saved from reducing the capital and/or operation and maintenance efforts will then be shifted to another Key Service Objective and Strategic Goal that is rated as “Needs Improvement”.

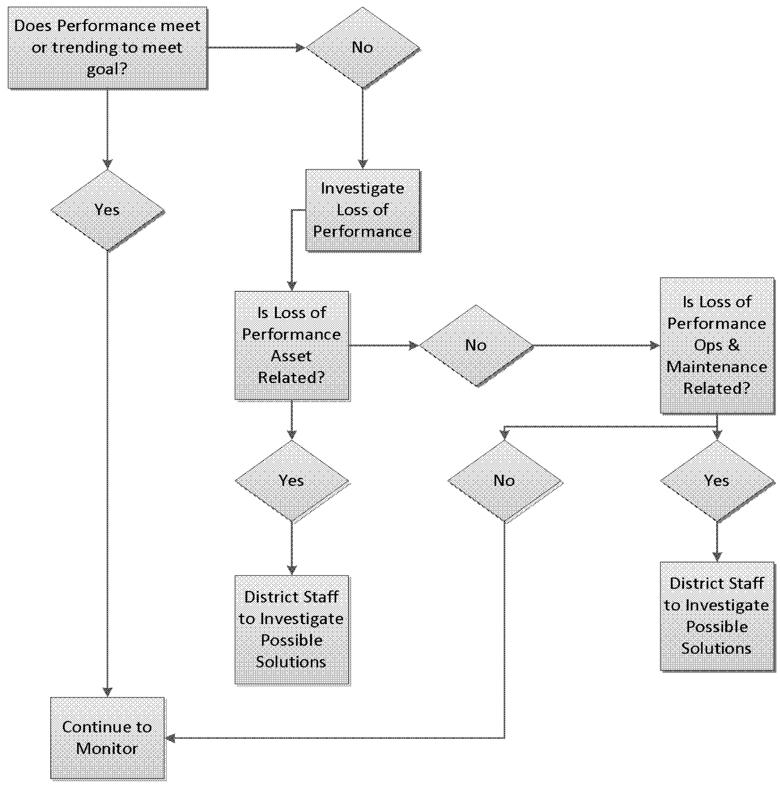

Figure 3-1. Performance Monitoring Plan

3.8 Future Actions

3.8.1 Future Approach to LOS

The District's next steps to updating the LOS are:

1) Take the LOS Statements and use them to update the District's internal draft Asset Management Plan.

2) Use the LOS Statements as one criteria as the District develops and prioritizes its capital improvement budget for each fiscal year.

3) Continue with the implementation of LOS Statements by:

   - Evaluating data collection requirements – systems support and collection mechanisms.

   - Develop cost/benefit of implementation.

- Review and finalization of report contents, frequency of reporting, trigger points and actions.

- Complete annual evaluations of financial data to determine the cost and resulting equitable distribution that supporting departments have on the four core water departments to improve the accuracy of the Current Cost and Additional Costs in the LOS tables.

- Integrate with performance management support software.

  The District should continue to track this information regarding how well it is meeting the LOS criteria on a regular basis, and use this information to prepare an annual report on how well the system met these criteria over the course of a year. This information could be presented to the District Board members at an annual meeting so that they and District customers are aware of how well the system met the overall system goals.

  This meeting could also be an opportunity to discuss any changes needed in the LOS, based on the operations data. Perhaps some of the LOS conditions are not possible to be met given the current staff or resources. The decision to increase staff or other resources or decrease LOS will directly impact customers, so it is important to use the opportunity of the annual meeting to discuss the potential solutions with the Board. At a minimum, it is recommended that this discussion be held at least once every two years.

4) The District should continue to conduct studies and monitor regulatory trends that may change the LOS requirements beyond 2012. Areas that will likely require attention include:

   - Improve the understanding of customer perceptions and expectations, which the District is addressing by conducting a customer survey in the next year.

   - Conduct a customer survey bi-annually going forward.

   - Assess impacts of upcoming Safe Drinking Water Act, DDW, and other regulatory changes.

   - Improve the understanding of financial and water demand targets for the organization.

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Section 4: Water System Hydraulic Development (TM 3)

4.1 Purpose

This section describes the development and calibration of South Tahoe Public Utility District's (District) water system hydraulic model.

To develop the District's hydraulic network model, West Yost Associates (West Yost) completed the following tasks:

- Used the District's existing water distribution system maps (exported from District's GIS) to create the hydraulic model;
- Verified that the hydraulic model system configuration (pipeline sizes, alignments, connections, and other facility sizes and locations) is representative of the District's current water system;
- Allocated existing water demands by using the District's available spatially located metered account information and land use information for flat rate accounts to distribute demands within the hydraulic model; and
- Calibrated the District's water system hydraulic model to simulate pressures and flows observed in the field.

To accomplish these tasks, West Yost worked closely with the District's staff to obtain and review available:

- Information regarding existing transmission and distribution mains, storage tanks, groundwater wells, pump stations and other water supply facilities;
- As-built drawings and maps detailing sections of the system to confirm pipeline sizes, material type, age, locations and alignments;
- Metered account data; and
- Land use information.

The water distribution system model was then calibrated using flow and pressure data observed in the field during July 2012. The hydraulic model development and calibration are described in the following sections.

4.2 Development of the Hydraulic Model

West Yost developed a hydraulic model of the District's water system using a series of steps that included the following:

- Imported pipelines from the District's GIS, and appended nodes and junctions
- Assigned pipeline material and age based on District's GIS
- Assigned approximate pipeline roughness factor (C-factor)
- Allocated elevations to nodes and junctions
- Incorporated water system facilities
- Applied a naming scheme to each model element
- Spatially located meter accounts in GIS
- Allocated water demands in the hydraulic model

Each of these steps is discussed in more detail below.

4.3 Description of the Model and Model Elements

Innovyze's InfoWater program is the hydraulic modeling software used to represent the District's water system. This computer simulation model transforms information about the physical system into a mathematical model that solves for various flow conditions based on specified water demands. The computer model then generates information on pressure, flow, velocity and head loss that is used to analyze system performance and to identify system deficiencies. The model can also be used to verify the adequacy of existing and recommended or proposed system improvements.

The hydraulic model is represented as a network of nodes (*e.g.*, location of a tank or location where pressure is monitored), and node-connecting elements (*e.g.*, pipes). However, because nodes are representative of various actual facilities (*e.g.*, tanks, pump stations, or wells) and their physical locations, a definition of each element was established during the development of the hydraulic model. A brief description of each type of node and node-connecting element is provided below.

<u>Node</u>: Nodes represent transitions in pipeline characteristics (*e.g.*, diameter) or points in the system where pressure is monitored. Nodes also represent locations in the system, such as pump station or tank connections, where metered water demands do not exist. Elevation and physical facility location are the data requirements for nodes.

<u>Junction</u>: Junctions represent locations in the system where water demands exist. In the model, water is subtracted from the system at junction locations. Junctions can also include transitions

in pipeline characteristics (*e.g.*, diameter). Data requirements for junctions are the demand at each junction, elevation and location.

Pipe: Pipes (*i.e.*, links) represent facilities that convey water from one point in the system to another, and are used in the model to represent pipelines or check valves. Diameter, from/to node or junction, length, and pipeline roughness factor are the input data required.

Reservoir: Reservoirs represent external sources of water for the model (*e.g.*, groundwater basin or supply turnout), and remain at a constant water level irrespective of the flow unless they are specified as variable-head reservoirs. Reservoirs are used to represent the source for each well in the District's model. Location and water surface elevation are the input data required.

Tank: Tanks are distinguished from reservoirs by having known volumes and water surface elevations that change with time as water flows into or out of the facility. This element is used to represent the District's storage tanks. Diameter, bottom elevation, overflow elevation, and location are the input data required.

Pump: Pumps represent locations in the model where the hydraulic grade line is raised to overcome elevation differences and friction losses, and are used to represent individual pumps at pump stations. Elevation, number of pumps, pump test results, pump curves, sequencing, pump efficiency, and location are the input data required.

Valve: Valves regulate either flow or pressure in the water distribution system model. Valve diameter, setting, elevation, and location are the input data required.

4.3.1 Pipelines, Nodes, and Junctions

District staff provided a GIS geodatabase file containing the geospatial location of existing pipelines for the District's water system. The geodatabase feature class of the existing water pipelines was imported into the hydraulic model, but did not include "from" and "to" nodes (*i.e.*, points designating the beginning and end of the pipeline). Consequently, InfoWater's Append Nodes feature was used to create and assign the beginning and end-points (from and to nodes) for the existing pipelines. In addition, West Yost also developed attributes in the hydraulic model database to include the unique IDs assigned by the District, pressure zone, grid page, and global ID allowing District staff to leverage or integrate model information with the District's GIS.

The District's GIS system features for valves, tees, crosses, and other fittings were spatially joined to the nodes that were appended to the pipelines. Similar to the pipelines, the attributes for the nodes were developed to integrate specific information from the GIS such as facility ID, pressure zone, grid page, and global ID.

West Yost reviewed the developed model for network connection issues to test the conversion from GIS to the hydraulic model software. Issues reviewed included:

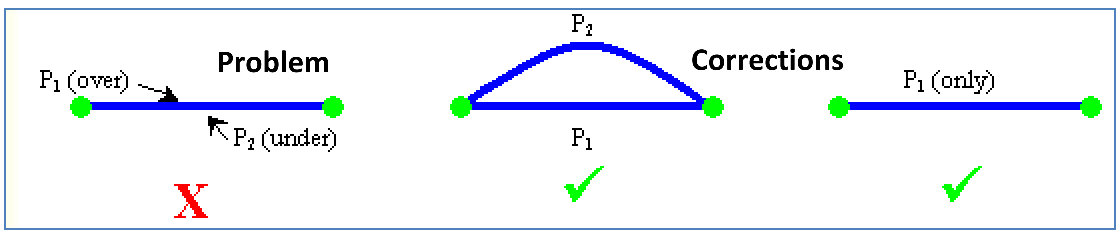
- Locating overlapping/duplicate nodes – This issue may be potential disconnects in pipelines where two or more junctions overlap each other, but there is no pipeline connecting the two notes. See Figure 4-1 for example.
- Locating nodes in close proximity to pipelines – This issue may be potential locations where one pipeline should intersect a second pipeline, but instead the node is close or overlays the pipeline without connection into the pipeline, see Figure 4-1 for example. Fitting locations such as tees or crosses are common areas where this occurs.
- Locating parallel pipes – This issue may be potential duplicate pipelines that overlay each other resulting in locations with two pipelines instead of a single pipeline, see Figure 4-1 for example.
- Identifying diameter discrepancies – This issue may be potential locations where a wrong diameter was entered in the model resulting in a smaller diameter pipeline connected in series to a larger diameter pipeline.

The review of the District's GIS conversion to the hydraulic model showed several locations where pipelines with cross or tee fittings were overlaid on a pipeline and did not intersect. A few locations contained pipelines with a diameter size of 0, some pipelines did not have unique Facility IDs, and a few locations had parallel pipelines that needed to be removed. West Yost worked with the District staff on locating the pipeline and fitting locations needing to be updated to create a hydraulic model that accurately matched the system hydraulics. The District's geodatabase went through several iterations of updates which improved the accuracy and flexibility of the District's GIS, as well as the hydraulic model.

Figure 4-1. Illustration of Network Connection Issues

Overlapping/Duplicate Nodes

Nodes in Close Proximity to



Parallel Pipelines

4.3.2 Pipeline Characteristics

The District's geodatabase feature class for existing water pipelines did not include roughness factors. However, the GIS did include fields with known material types and installation dates for pipelines. Unfortunately, several of the District's pipelines have been acquired from small water companies which did not maintain detailed records on when pipelines were installed. Therefore, West Yost relied on diameter and material information to determine roughness factors to use in the hydraulic model and not date of installation. Consequently, West Yost assigned a preliminary roughness factor (*i.e.*, C-factor) based on experience and professional judgment to each pipeline by using its material type and adjusted it slightly based on its size (diameter). Table 4-1 presents the preliminary C-factors assigned to each of the different pipeline material types within the District's water system. These C-factors were then validated during calibration of the hydraulic model, as described in the Hydraulic Model Calibration Section.

Table 4-1. Preliminary Pipeline C-Factors Assigned in the Model[a]

Pipeline Material Type	C-factor	
	Diameter ≤ 8-inches	Diameter > 8-inches
Asbestos Cement (AC)	130	140
Cast Iron (CI)	110	120
Ductile Iron (DI)	130	140
Galvanized Steel (GALV)	120	130
High Density Polyethylene (HDPE)	140	150
Permastrand (PS)	140	150
Polyvinyl Chloride (PVC)	140	150
Polyvinyl Chloride (PVC) C900	140	150
Polyvinyl Chloride (PVC) C905	140	150
Steel (STL)	120	130
	Diameter ≤ 4-inches	Diameter > 4-inches
Unknown	130	150

[a] Pipeline material type information is based on information provided by the District in the pressurized pipeline feature class for their GIS.

4.3.3 System Elevations

The District's service area is located in the Sierra Nevada Mountains and elevations range from approximately 6,230 feet along the lake shore to approximately 7,120 feet in the higher elevation communities. Having accurate elevations assigned to features in the model improves the accuracy of the results and calibration of the model.

The District provided a table of surveyed points for system features developed in 2005 plus an additional dataset of facilities surveyed in 2013. The surveyed elevation data was used to assign elevation to the tanks, pumps, and valves that were included in the datasets. A few exceptions were made in the use of the surveyed data on the major system features. The elevation for the Stateline tanks appeared to be incorrect when compared with other available elevation data surrounding the tank site. The Stateline elevation was approximately 135 feet lower than surrounding features. The Angora tank did not rely on the surveyed data since the tank has been replaced since the 2005 survey was performed. The new Angora tank was constructed approximately 15 feet lower than the original tank and as-built information was relied on for the new tank elevation assigned.

The surveyed points generally were located throughout the District's service area at various facility locations. Due to the amount of elevation change throughout the system, the surveyed points did not provide a detailed enough elevation profile to be used for extracting accurate elevations to the hydraulic model. To improve the accuracy of the elevations used, West Yost obtained additional high accuracy elevation information that was available to the public for download from the Tahoe Regional Planning Agency (TRPA). The high accuracy elevation data was from Light Detection and Ranging (LiDAR) data.

The LiDAR datasets provide high accuracy elevations which include the District's service area. Detailed information on the LiDAR dataset used is provided in Appendix C1. The raster files for the LiDAR information provided comprehensive elevation coverage and were used to assign elevations to the hydraulic model junctions using the Elevation Extractor feature in InfoWater. Once the elevations were assigned, a block edit was performed to convert the elevations from meters to feet.

West Yost compared the assigned elevations from the LiDAR data to the surveyed points provided by the District to confirm the LiDAR data closely matched the surveyed data points. The average difference between the LiDAR and survey data points was less than 2 feet. This differential gives confidence in the high accuracy of the elevation dataset being used to assign elevations to the features within the model where actual surveyed data was not available.

4.3.4 Water System Facilities

After the pipelines and nodes were incorporated into the hydraulic model, major system facilities (*e.g.*, pressure reducing valves, groundwater wells, pump stations, and storage tanks) were reviewed in the model to confirm direction of pump or valve flow, pipeline configurations at booster pumps and tanks, valve open and closed settings, and PRV survey data.

4.3.5 Naming Scheme

After the major facilities were added to the model, each model element was assigned a label which identifies the type of model element, the element's purpose, and the element's location. Assigning each model element a specific label allows the modeler to easily locate the specific elements or more readily identify potential problems during the calibration and verification process. The District's model was populated using the naming scheme presented in Table 4-2.

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Table 4-2. Naming Scheme for Network Elements	
Model Component	**Naming Scheme**
Pipelines	“6254” = Sequential Numbering P-AH- 6254 “AH” = Angora Highlands Pressure Zone “AZ” = Arrowhead Zone Pressure Zone “CV” = Christmas Valley Pressure Zone “CC” = Country Club Pressure Zone “P” = Pipeline
Junctions	“100” = Sequential Numbering J-AH-100 ““AH” = Angora Highlands Pressure Zone “AZ” = Arrowhead Zone Pressure Zone “CV” = Christmas Valley Pressure Zone “CC” = Country Club Pressure Zone “J” = Junction
Nodes	“100” = Sequential Numbering N-AH-100 “AH” = Angora Highlands Pressure Zone “AZ” = Arrowhead Zone Pressure Zone “CV” = Christmas Valley Pressure Zone “CC” = Country Club Pressure Zone “N” = Node
Control Valves	“1” = Sequential Numbering PRV-AH-1 “AH” = Angora Highlands Pressure Zone “AZ” = Arrowhead Zone Pressure Zone “CV” = Christmas Valley Pressure Zone “CC” = Country Club Pressure Zone “PRV” = Valve
Water Company Interties	“C1” = Connection Number W-LWC-C1 “LWC” = Lakeside Water Co “LB” = Lukins Brothers “ESB” = Easter Bowl Zone “W” = Water Company
Reservoirs / Wells	“01” = Sequential Numbering R-CLGWL-01 “CLGWL” = College Well Facility ID “APRTWL” = Airport Well Facility ID “R” = Reservoir
Tanks	“01” = Tank Number T-ITK1-01 “ITK1” =Iroquois Tank 1 Facility ID “CCKTK” = Cold Creek Tank Facility ID “T” = Tank
Booster Pumps	“01” = Pump Number PMP-APRBS-01 “APRBS” = Airport Booster Pump Facility ID “PMP” = Pump

The District has invested a lot of time and effort in the development of their GIS system. All of the features have been given Facility IDs which help to identify the type of facility and location by staff. For the conversion to the hydraulic model, West Yost maintained the Facility IDs assigned in GIS by adding a field in the model database which maintains a connection between Facility IDs with the two programs.

4.4 Accounts Spatially Located in GIS

This section describes the methodology used to spatially locate water consumption for two types of accounts:

- Metered Accounts (Multi-Family and Commercial)
- Flat Accounts (Single Family, Multi-Family, and Commercial)

4.4.1 Metered Accounts

Currently, the District is partially metered. All large water users and the majority of the commercial and multi-family residential customers within the District are metered. Table 4-3 summarizes the number of metered and unmetered water service connections by customer class.

Table 4-3. Summary of Water Service Connections by Customer Class[a]

Customer Class	Number of Connections[b]	Percent of Total Connections
Single Family Residential Metered	4,427	31.5%
Multi-Family Residential Metered	486	3.5%
Commercial Metered	554	3.9%
Total Metered Connections	5,467	38.9%
Single Family Residential Unmetered	7,695	54.7%
Multi-Family Residential Unmetered	766	5.4%
Commercial Unmetered	135	1.0%
Total Un-Metered Connections	8,596	61.1%
Total Overall	**14,063**	**100%**

(c) Source: Data provided by District staff September 5, 2012.
(d) Number of customers reflects July 2012 active accounts.

The District provided all metered consumption data for 2009 thru 2011. The spreadsheets provided included quarterly consumption readings, a customer number, parcel number, and type of account (multi-family, residential-SFD, or commercial). As discussed in Section 2, the single family residential meter data has only been collected for a few years and was being fine-tuned prior to actual billing of customers. Because of this, the single family residential meter data provided was not allocated in the model at this time. As the District continues to add meters and collect consumption data, the collected data should be reviewed for consistency and to identify methods to improve the usefulness of the collected consumption data.

Consumption data from metered commercial and multi-family residential accounts were spatially located by linking the consumption data by assessor's parcel number (APN) to a separate GIS parcel file. Figure 4-2 illustrates the methodology used to link the addresses associated with the consumption data to the addresses in the GIS parcel file.

West Yost was able to spatially locate approximately 97 percent (967 out of 996 accounts) of the metered commercial and multi-family accounts provided in the demand spreadsheet. The accounts which were not able to be spatially located have APNs or customer numbers that did not match to the GIS parcel or meter data. It is recommended the District review the consumption data collected with the GIS meter data to ensure an accurate and unique connection exists between the two data sets.

Figure 4-2. Illustration of Methodology for Locating Accounts Using Parcel Files

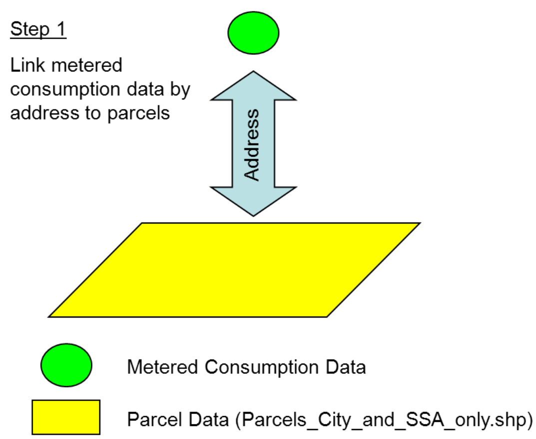

Table 4-4 presents the percentage of total accounts and metered demand spatially located for the City.

Table 4-4. Spatially Located Metered Account Results

Category	Number of Accounts	Total "Metered" Demand$^{(a)}$, AF/year	Average Day Demand, gpm
Actual 2011$^{(b)}$	996	1,579	979
Spatially Located using Parcel file$^{(c)}$	967	1,318	817
Percent of Actual	97.1%	83.5%	83.5%

(a) "Metered" demand does not include unaccounted for water.
(b) Data obtained from "Total Consumption 2009-2011.xlsx" provided by District in February 2011, and does not include unaccounted for water.
(c) Based on West Yost's GIS.

The spatially located metered demand was scaled up to include a portion of the system unaccounted for water. The total metered demand plus system losses of the spatially located meter accounts with unaccounted for water (12 percent) is 1,476 AF/year or 915 gpm (817 gpm * 1.12 = 915 gpm).

4.4.2 Non-metered Accounts

The non-metered accounts are all single family, multi-family residential and commercial customers which do not have recorded water consumption or the recorded information was not reliable for use. Therefore, water consumption had to be estimated by using production data, metered consumption data, and by using an unaccounted for water of 12 percent, as described in Section 2. The total estimated water consumption for non-metered accounts was approximately 4,550 AF/year in 2011.

The total non-metered consumption for allocation into the hydraulic model was estimated at 4,550 AF/year. The water demands were then assigned to each non-metered customer in proportion to the size or number of the parcel. Table 4-5 tabulates how the water demands for the non-metered accounts were calculated.

Table 4-5. Spatially Located Non-Metered Account Results

Locating Method	Water Duty Factor	Total Area or Count	Total Water Demand Allocated in Model[a], AF/year	Average Day Demand, gpm
Single Family Parcel[b]	200 gpd/du	11,994 du	2,687	1,666
Multi Family Parcel[b]	3,625 gpd/ac	179 ac	726	450
Commercial[c]	1.56 gpd/sf	650,769 sf	1,137	705
Total			**4,550**	**2,821**

(a) Total demand includes 12 percent of unaccounted for water.
(b) Parcel file provided by District.
(c) Square footage based on data provided in land use/general plan GIS file provided by City of South Lake Tahoe.
gpd/du = gallons per day per dwelling unit
gpd/ac = gallons per day per acre
gpd/sf = gallons per day per square footage

Figure 4-3 shows the spatial location of metered and non-metered accounts for the hydraulic model demand allocation. The non-metered accounts allocated in the model made up approximately 92 percent of total accounts within the District in 2011. The non-metered average day demand consists of approximately 76 percent of the total allocated system demand. While the methodology used for allocating the demands of the non-metered accounts provides very good results, there is still some potential for refinement to the demand allocation within the model and as additional metered data becomes available in the future.

Figure 4-3 also, compares the spatially located water demand data with existing pipelines for the City. As shown on Figure 4-3, all areas with spatially located meters and non-metered account also had an existing pipeline, indicating that the geodatabase layer used as the basis for the hydraulic model appears to have contained all existing pipelines.

Data from calendar year 2011 was used to develop the District's existing water demands for the hydraulic model. Table 4-6 presents the demands allocated into the model for the existing system.

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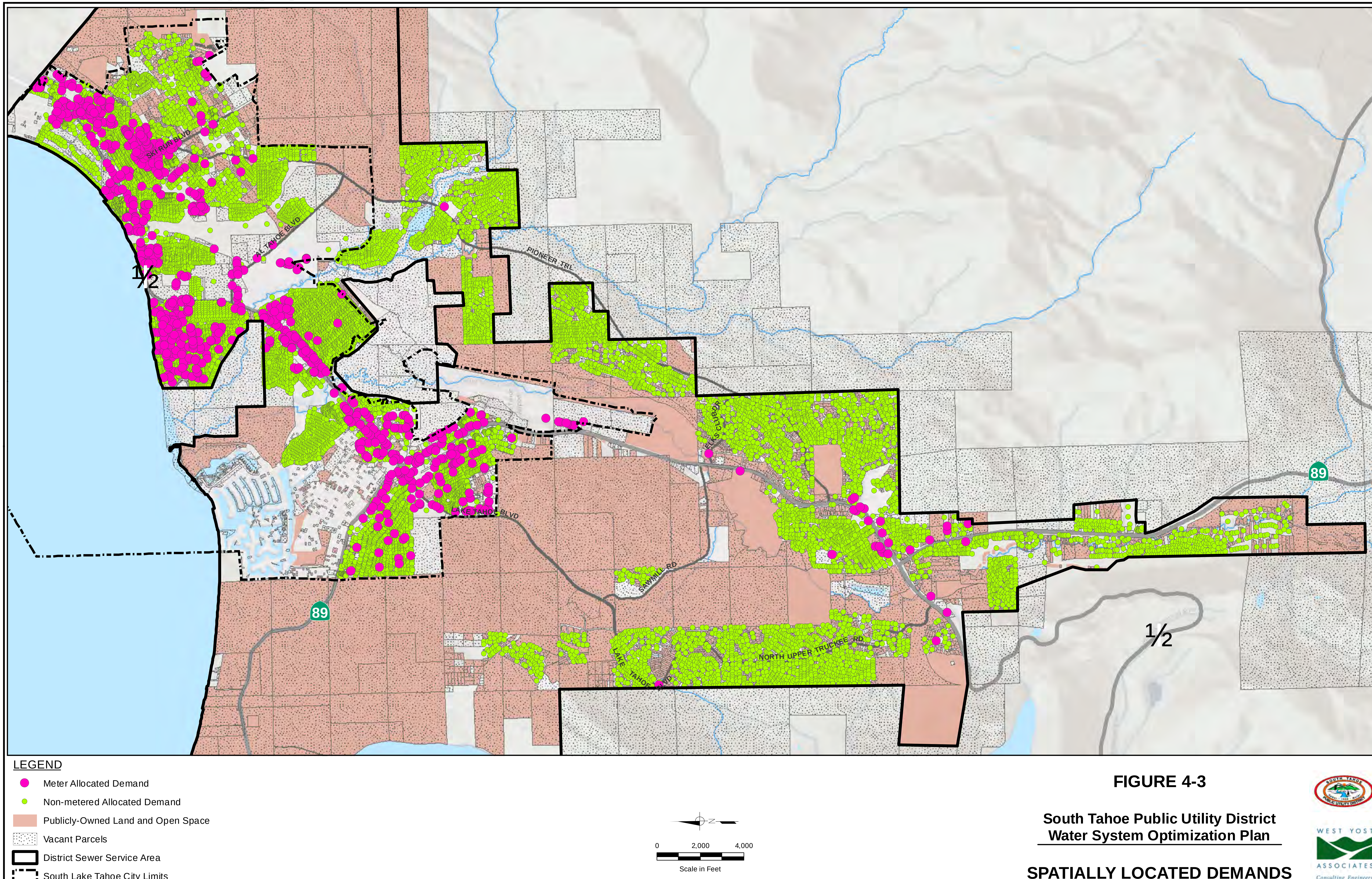


FIGURE 4-3

South Tahoe Public Utility District
Water System Optimization Plan

SPATIALLY LOCATED DEMANDS

WEST YOST ASSOCIATES
Consulting Engineers

Table 4-6. Hydraulic Model Demand Allocation Summary					
	Connections			Demand	
Class	Metered[a]	Unmetered	Total	afa	gpm
Single Family	0	12,122	12,122	2,687	1,666
Multi Family	450	802	1,252	1,141	707
Commercial	546	143	689	1,475	915
Total	**996**	**13,067**	**14,063**	**5,303**	**3,288**

[a] Represent actual meter location and demand allocated in the hydraulic model.

4.4.3 Water Demand Allocation

For the District's water system, water demands were allocated in the hydraulic model using the spatially located meter demand data developed in the previous section and the Demand Allocator module of the modeling software. The Demand Allocator automatically assigns the spatially located demand point to the closest junction node to its position in the system. West Yost staff reviewed the hydraulic model after running the Demand Allocator to confirm that the demands were allocated properly.

Water demand within the hydraulic model was allocated by customer sector to provide the District with additional flexibility in the model. In the future, as the District collects more data on their system, unique diurnal curves may be developed and applied to each customer class. Table 4-7 presents the demand column assigned to each customer sector within the hydraulic model.

Table 4-7. Customer Sector Assignment	
Customer Sector	Demand Column in Model[a]
Single Family Residential Metered[b]	1
Multi-Family Residential Metered	2
Commercial Metered[c]	3
Single Family Residential Unmetered	4
Multi-Family Residential Unmetered	5
Commercial Unmetered	6

[a] Column number corresponds to Demand # Column in Junction database of the InfoWater model.
[b] Single family residential metered accounts were not assigned to the hydraulic model; however, the demand column was reserved for future use.
[c] May include all other water use types (*e.g.*, Industrial), excluding residential.

4.5 Hydraulic Model Calibration

The District's hydraulic model was calibrated to confirm that the computer simulation model can accurately represent the operation of the District's water distribution system under varying conditions. Calibration of the hydraulic model used data gathered through hydrant tests as described in the following sections.

4.5.1 Development of Hydrant (C-Factor) Tests

After developing the hydraulic model, locations were chosen for possible hydrant flow testing as shown on Figure 4-4. Because the District does not have specific information on individual pipeline age and material type for the entire water distribution system, hydrant tests were developed to collect general pipeline friction loss information in targeted areas, rather than attempt to estimate friction losses for individual pipelines. These hydrant tests were used to "spot-check" the preliminary pipeline friction factors (C-factors) assigned and to calibrate the model to ensure that the hydraulic model closely represents observed pressure conditions in the field.

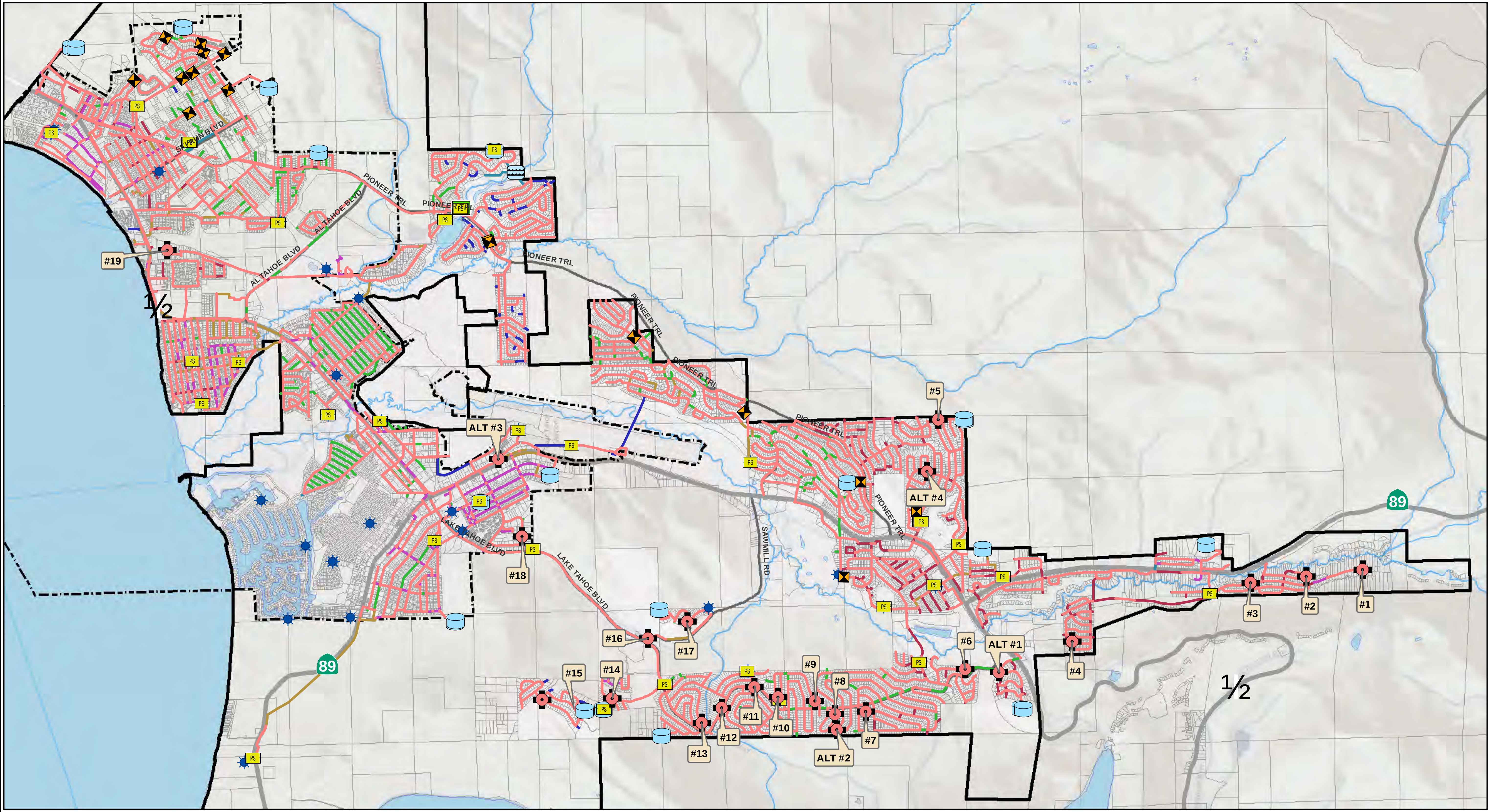
Hydrant flow testing was scheduled and performed on Thursday July 5 and Friday July 6, 2012. Table 4-9 provides the field status of each hydrant test. Of the original 19 scheduled hydrant tests, 18 hydrant tests were performed. One hydrant test (hydrant test #14) was canceled due to constraints identified by District staff.

Each hydrant test involved flowing water through pipelines of a general size and approximate material type and age, and then measuring the pressure drops through the pipelines to determine friction losses. The hydrant test procedure consisted of monitoring discharge flow and pressure at the key flowing hydrant, and pressures at other hydrants along the supply routes to that key hydrant. Static pressures were measured while the key hydrant was closed, and residual pressures were measured while the key hydrant was flowing.

Pipelines in the District's water system range in size from 1 to 19-inches in diameter. Pipeline materials consist mainly of STL and AC. Other pipeline materials as listed in Table 4-1 are also found in the District's water system. Prior to the model runs, each pipeline was assigned a preliminary C-factor based on the pipeline size and approximate material type as presented in Table 4-1.

Each hydrant flow test performed was simulated using the hydraulic model of the District's water system. Model results were compared to the field data to determine the accuracy of the model. The differences between observed static and residual pressures for the field hydrant test were calculated and compared to readings predicted by the model. The goal of the calibration effort was to achieve no greater than a 5 pounds per square inch (psi) differential between the field hydrant test data and model-simulated results, based on standard engineering practice for model calibration for water system master planning.

Results from the hydrant tests are discussed in more detail in the following section.



LEGEND

Year Installed

- Unknown
- 1950-1959
- 1960-1969
- 1970-1979
- 1980-1989
- 1990-1999
- 2000-2009
- 2010-2011

- RPZ
- EnclosedStorageFacility
- Booster Station
- StorageBasin
- TreatmentPlant
- Production Well
- Hydrants

Note:
- Pipeline diamters 4 inch and greater shown in figure.

0 2,000 4,000

Scale in Feet

FIGURE 4-4

South Tahoe Public Utility District
Water System Optimization Plan

HYDRANT TEST LOCATIONS

WEST YOST ASSOCIATES

Consulting Engineers

Table 4-8. Hydrant Test Locations and Status[a]				
Test #	Approximate Diameter, inches[b]	Approximate Material Type	Location	Field Status
1	8	C900	South Upper Truckee Road, south of Morton Drive	Completed
2	6	AC	East River Park Drive, northeast of the south end of Beaver Brae	Completed
3	8	AC	South Upper Truckee Road, north of West River Park Road	Completed
4	6	AC	Yokut Street, southwest of Henderson Street	Completed
5[c]	4	AC	Iroquois Circle, northwest of Chippewa Street	Completed
6	6	AC	Oaxaco Street, northwest of the southeast end	Completed
7	6	STL	Koru Street, west of North Upper Truckee Road	Completed
8	6	STL	Southeast end of Chochise Circle, west of North Upper Truckee Road	Completed
9	6	STL	Grizzly Mountain Drive, northeast of Grizzly Mountain Court	Completed
10	6	STL	Grizzly Mountain Drive, northeast of Little Bear Lane	Completed
11	12	PVC	Lake Tahoe Boulevard, north of North Upper Truckee Road	Completed
12	8	STL	Lake Tahoe Boulevard, northwest of View Circle	Completed
13	6	STL	Angora Creek Drive, northeast of Lake Tahoe Boulevard	Completed
14	10	C900	Boulder Mountain Road, northeast of Brush Road	Not performed
15[c]	6	STL	Glenmore Way, southwest of Highlands Drive	Completed
16	8	C900	Sawmill Road, southeast of Lake Tahoe Boulevard	Completed
17	6	STL	Mountain Canary Drive, northeast of Echo View Drive	Completed
18	8	STL	Industrial Avenue, west of Shop Street	Completed
19	8	C900	Treehaven Drive, west of Johnson Boulevard	Completed

(a) 19 Test Locations (#1-19) were initially identified for the hydrant testing.
(b) Tests did not involve closing valves to isolate specific pipeline diameters. Therefore, diameter shown is the general diameter of pipelines in the vicinity of the flowing hydrant.
(c) Location was revised during the day of testing.

4.5.2 Hydrant (C-factor) Test Results

The results of the simulated hydrant flow tests generally validate the water system pipeline configuration and the assigned C-factors previously shown in Table 4-1. However, based on the comparison of the collected hydrant flow test data and model simulation results, four of the hydrant flow tests (Tests 6, 12, 13, and 19) required further review and evaluation because they did not meet the ±5 psi tolerance limit established for calibration. The results from the remaining hydrant tests indicate that the hydraulic model accurately simulates the District's water system, and is able to closely replicate field-observed pressures and flows. The detailed results of each individual hydrant test that was performed in the field are provided in Appendix C2. Further discussions regarding Tests 6, 12, 13, and 19 are provided below.

4.5.2.1 Test 6: 6-inch AC Pipelines Unknown Construction Date

Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 6. The initial static pressures were in excess of 150 psi and the initial observed pressure differential ranged from 53 to 104 psi. This pressure differential could not be simulated in the model without assuming a partially closed valve east of the intersection of San Bernardino Avenue and Shawnee Street and an increase in the observed flow. West Yost recommends that District operations staff verify the status of the valves at the intersection of San Bernardino Avenue and Shawnee Street.

4.5.2.2 Test 12: 8-inch STL Pipelines Constructed Approximately in 1960

Initial model simulation results indicate that there may have been an error with the residual pressure reading at the observed hydrants. The hydraulic grade line is not consistent across the hydrants leading to the flowing hydrant. This may have to do with the high turbidity of the water when hydrant test 11 was run and the residual effects of stirring up the water along this pipeline. Since the C-factor for 8-inch STL pipelines was validated in Test 18, West Yost does not recommend re-testing this pipeline.

4.5.2.3 Test 13: 6-inch STL Pipelines Unknown Construction Date

Initial model simulation results indicate that there may have been an error with the residual pressure reading at observed Hydrant 13A. The difference between field-observed and model-simulated pressures for Hydrant 13A was 9 psi. However, model simulation results from observed Hydrants 13B and 13C were well within the ±5 psi tolerance limit. In addition, the C-factor for 6-inch STL pipelines was previously validated in Test 7 and 8. Therefore, it is recommended that the data from Hydrant 13A not be used.

4.5.2.4 Test 19: 8-inch C900 Pipelines Constructed Approximately in 2005

Initial model simulation results indicate that there may be system configuration issues (*e.g.*, partially closed valve(s), inaccurate representation of pipeline connectivity, etc.) within the area of Test 19. West Yost recommends that District staff verify the status of the valves northeast of the intersection of N. Marlette Circle and Johnson Boulevard, and northeast of the intersection of S. Marlette Circle and Johnson Boulevard.

4.5.3 Hydraulic Model Calibration Findings and Conclusions

In summary, the results from the hydrant tests indicate that the hydraulic model is generally well calibrated within a 5 psi differential from the field hydrant test data. Eighteen hydrant tests were conducted, four of the tests required additional review. Of these four tests, two tests assume model configuration issues (*i.e.*, pipelines not identified in GIS). Results matched closely when these configuration errors were simulated with the hydraulic model. One test, where field results indicate that there were likely field data measurement errors, had at least 2 (out of 3) residual readings that could be used to validate the model. In only one of the eighteen tests, model results could not be reconciled with field data.

These results indicate that the District's hydraulic model in general can accurately simulate a fire flow or other large demand conditions within the District's water system. Based on the results of the hydraulic model calibration, it can be concluded that the hydraulic model provides a reasonable representation of the District's water distribution system and can be used for master planning purposes.

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Section 5: System Evaluation (TM 4)

5.1 Purpose

This section presents the evaluation of the South Tahoe Public Utility District's (District) existing water distribution system and its ability to meet the District's recommended performance and planning criteria under existing and buildout water demand conditions.

The analysis includes a reliability evaluation to assess the existing water system's ability to meet recommended operational and design criteria under maximum day demand plus fire flow and peak hour demand scenarios. West Yost Associates (West Yost) conducted this evaluation using the hydraulic model developed for this Water System Optimization Plan (WSOP), which is described in Section 4.

Evaluations, findings, and recommendations for addressing any deficiencies identified in the existing water distribution system are included in this section. The cost associated with the recommendations is included in the Capital Improvement Program presented in Section 6.

The following topics are presented in this section:

- Existing and Buildout Water Demands: summarizes demands by pressure zone used for the existing and buildout water system evaluations;
- Water System Evaluation Criteria: presents the criteria used to determine the adequacy of the distribution system for meeting service standards;
- Existing Water System Performance Evaluation: assess the hydraulic performance of the water distribution system under existing peak hour and maximum day plus fire flow conditions and the pumping and storage capacity under five operational scenarios;
- System Redundancy Evaluation: reviews the reliability of the water system to convey water between pressure zones under emergency conditions;
- Summary of Recommended Improvements for the Existing Water System;
- Buildout Water System Performance Evaluation: assess the hydraulic performance of the water system under buildout peak hour and maximum day plus fire flow conditions;
- Summary of Recommended Improvements for the Buildout Water System; and
- Future System Planning.

5.2 Existing and Buildout Water Demands

Water demands for the existing system were developed based on well production and available meter use data provided by the District as detailed in Section 2. A diurnal curve was developed to determine peak demand factors for the District's Service Area. The limited amount of detailed information for metered connections required the development of a single diurnal curve rather than more detailed curves based on pressure zone or land use.

The District's Service Area is considered mostly buildout and estimates for buildout demands do not increase greatly within the service area as detailed in Section 2. However, the District may serve or acquire neighboring water agencies in the future, which will result in the largest increase to the District's buildout demands.

5.2.1 Existing Demands by Pressure Zone

Table 5-1 summarizes the District's water demands used for the existing water system analysis. The existing water demands for the District's water system were first spatially located in the hydraulic model. Average daily production was used to represent the District's "base" water year for the hydraulic evaluations.

Maximum day and peak hour demands were estimated for the existing system analysis. The peaking factors are based on the limited data available for the District as described in Section 2.

5.2.2 Buildout and Expanded System Demands by Pressure Zone

Table 5-2 summarizes the District's water demands used for the buildout and expanded water system analysis. Estimated demands for water systems, that in the future could be served by the District, are shown separately and include: Tahoe Keys, Lukins Brothers, and Lakeside Water Company. Maximum day and peak hour demands were estimated for the buildout system analysis. The peaking factors are based on the limited data available for the District as described in Section 2.

5.3 Water System Performance Evaluation Criteria

The purpose of this section is to define the recommended planning and design criteria for analyzing the performance of the District's potable water distribution system. These criteria include recommendations for the required fire flow and flow duration, minimum and maximum system pressures, and maximum pipeline velocity.

Table 5-1. Baseline Water Demands for the Existing System Analysis						
Pressure Zone	Average Day Demand		Max Day Demand		Peak Hour Demand	
	gpm	mgd	gpm	mgd	gpm	mgd
Angora Highlands	12.8	0.02	28.7	0.04	40.2	0.06
Arrowhead	113.5	0.16	255.4	0.37	357.6	0.51
Christmas Valley	119.6	0.17	269.1	0.39	376.7	0.54
Comanche	2.5	0.00	5.6	0.01	7.8	0.01
Country Club	65.7	0.09	147.8	0.21	206.9	0.30
Flagpole	115.4	0.17	259.6	0.37	363.4	0.52
Forest Mountain	6.6	0.01	14.9	0.02	20.9	0.03
Four Seasons	0.0	0.00	0.0	0.00	0.0	0.00
Gardner Mountain	205.7	0.30	462.8	0.67	647.9	0.93
H Street	6.7	0.01	15.0	0.02	21.0	0.03
Heavenly Valley	77.4	0.11	174.2	0.25	243.9	0.35
Iroquois	121.6	0.18	273.5	0.39	382.9	0.55
Keller	1.6	0.00	3.7	0.01	5.2	0.01
Middle Keller	0.1	0.00	0.3	0.00	0.4	0.00
Montgomery Estates	124.8	0.18	280.7	0.40	393.0	0.57
Mt. Rainier	24.4	0.04	54.8	0.08	76.7	0.11
Needle Peak	18.6	0.03	41.9	0.06	58.7	0.08
Ottawa	0.5	0.00	1.2	0.00	1.7	0.00
Pine Valley	60.9	0.09	137.0	0.20	191.8	0.28
Price Road	18.7	0.03	42.1	0.06	58.9	0.08
Rocky Point	5.0	0.01	11.2	0.02	15.7	0.02
Stateline	2658.5	3.83	5,981.7	8.61	8,374.4	12.06
Susquehanna	19.1	0.03	43.0	0.06	60.2	0.09
Sweeping Turn	69.7	0.10	156.8	0.23	219.5	0.32
Terrace	4.0	0.01	8.9	0.01	12.5	0.02
Twin Peaks	52.1	0.08	117.2	0.17	164.1	0.18
Upper Montgomery Estates	2.0	0.00	4.6	0.01	6.4	0.01
Upper Saddle	6.8	0.01	15.2	0.02	21.3	0.03
Total	3,914.2	5.6	8,806.9	12.7	12,329.7	17.8

Table 5-2. Water Demands for the Buildout System Analysis						
	Average Day Demand		Max Day Demand		Peak Hour Demand	
Pressure Zone	gpm	mgd	gpm	mgd	gpm	mgd
Angora Highlands	13.3	0.02	29.9	0.04	41.8	0.06
Arrowhead	127.5	0.18	286.8	0.41	401.5	0.58
Christmas Valley	132.4	0.19	297.8	0.43	416.9	0.60
Comanche	2.6	0.00	5.8	0.01	8.2	0.01
Country Club	69.6	0.10	156.5	0.23	219.2	0.32
Flagpole	120.0	0.17	270.1	0.39	378.1	0.54
Forest Mountain	6.9	0.01	15.4	0.02	21.6	0.03
Four Seasons	0.0	0.00	0.0	0.00	0.0	0.00
Gardner Mountain	233.5	0.34	525.4	0.76	735.6	1.06
H Street	6.9	0.01	15.5	0.02	21.7	0.03
Heavenly Valley	88.1	0.13	198.2	0.29	277.5	0.40
Iroquois	125.5	0.18	282.4	0.41	395.4	0.57
Keller	1.6	0.00	3.7	0.01	5.2	0.01
Middle Keller	0.4	0.00	1.0	0.00	1.4	0.00
Montgomery Estates	130.5	0.19	293.5	0.42	410.9	0.59
Mt. Rainier	25.3	0.04	56.9	0.08	79.6	0.11
Needle Peak	19.3	0.03	43.4	0.06	60.8	0.09
Ottawa	0.6	0.00	1.4	0.00	1.9	0.00
Pine Valley	63.2	0.09	142.3	0.20	199.2	0.29
Price Road	19.5	0.03	43.8	0.06	61.3	0.09
Rocky Point	5.2	0.01	11.6	0.02	16.2	0.02
Stateline	2,930.1	4.22	6,592.7	9.49	9,229.8	13.29
Susquehanna	19.8	0.03	44.6	0.06	62.4	0.09
Sweeping Turn	88.9	0.13	200.0	0.29	280.0	0.40
Terrace	4.1	0.01	9.3	0.01	13.0	0.02
Twin Peaks	53.9	0.08	121.2	0.17	169.7	0.24
Upper Montgomery Estates	2.1	0.00	4.8	0.01	6.7	0.01
Upper Saddle	6.8	0.01	15.2	0.02	21.3	0.03
Assumed Water Agencies Served or Acquired in the Future[a]						
Lakeside Water Company	350.3	0.50	788.1	1.13	1,103.4	1.59
Lukins Brothers	399.2	0.57	898.3	1.29	1,257.6	1.81
Tahoe Keys	253.8	0.37	571.0	0.82	799.4	1.15
Total	5,300.7	7.6	11,926.6	17.2	16,697.2	24.0

[a] Demand calculations for the three water agencies based on land use data obtained from City of South Lake Tahoe and the District's land use demand factors. Detail of demand projections are in Section 2.

Table 5-3 summarizes the recommended water system performance and operational criteria for the District that will be used in the water system capacity evaluation. These criteria are discussed in more detail below.

5.3.1 Peak Water Demands – Normal Operating Conditions

In accordance with California Title 22 requirements, the District's water supply should be capable of meeting a maximum day demand condition. This means that the water system as a whole, including individual pressure zones with storage, should have supply capability to meet at least a maximum day demand condition without the use of balancing storage. However, a peak hour demand condition can be met from a combination of supply sources (*i.e.*, water delivered via pump stations and/or pressure regulating stations, and water stored in storage tanks). Pressure zones without storage should have sufficient supply capacity to meet at least a peak hour demand condition.

5.3.2 Peak Water Demands – Fire flow Conditions

In accordance with typical industry standards, individual pressure zones that have storage should have the capability to meet a demand condition equal to the maximum day demand concurrent with a single fire flow event while meeting the recommended system performance criteria (*i.e.*, minimum and maximum system pressures). The fire flow applicable for each pressure zone is based on the highest fire flow requirement designated in that pressure zone of the District's service area, which will be determined based on land uses as defined in the City of South Lake Tahoe's General Plan.

In pressure zones with storage, maximum day demand plus fire flow would be met by a combination of supply capacity and balancing storage. In pressure zones without storage, supply capacity must be sufficient to meet a maximum day plus fire flow condition.

5.3.3 Fire Flow Requirements

The District operates and maintains the water distribution system within the service area. The South Lake Tahoe Fire Department and Lake Valley Fire Protection District (Fire Departments) are concerned with the availability of adequate water supply for firefighting purposes and Table 5-3 establishes minimum water flows and residual system pressures required during a firefighting event and provides these criteria to the District for use in master planning. It should be noted that the Fire Departments use the California Fire Code, which establishes minimum fire flows and durations for individual structures. In contrast, this WSOP evaluates available fire flows to assess distribution system adequacy under current and future demand conditions, using general land use categories that represent different types of development. Therefore, the fire flow requirements set forth in this WSOP are intended only for general planning purposes, and may not be reflective of the actual fire flow requirements sought for specific development approvals, and will not identify specific existing non-conforming developments.

Table 5-3. Summary of Recommended Water System Performance and Operational Criteria		
Component	Criteria	Remarks / Issues
WATER SYSTEM PERFORMANCE		
Distribution System Pressures		
Minimum Pressure - All Operating Conditions including Fire Flow	20 psi	Services with pressure less than 20 psi require an individual booster pump.
Maximum Pressure	120 psi	Services with pressure greater than 80 psi require individual pressure reducing valve.
Fire Flow Requirements		
Residential	1,000 gpm @ 2 hrs;	See Table 4-4 for explanation of ranges in values. Requirements are general requirements for master planning purposes, and may not be indicative of requirements for specific developments based on the California Fire Code.
Commercial	2,500 gpm @ 2 hrs	
Public	2,500 gpm @ 2 hrs	
Recreation	2,500 gpm @ 2 hrs	
Tourist	3,000 gpm @ 3 hrs	
FACILITIES SIZING		
Water Transmission Pipelines (10-inch diameter or larger)[(a)]		
Diameter	10-inch or larger	Locate new transmission pipelines within designated utility corridors wherever possible.
Maximum Velocity - Normal Conditions	5 ft/s	Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include pipeline age, material type, velocity, and system pressure.
Maximum Velocity - Fire Flow Conditions	10 ft/s	
Maximum Headloss - Normal Conditions	5 ft of loss per 1,000 ft of pipeline	
Maximum Headloss - Fire Flow Conditions	10 ft of loss per 1,000 ft of pipeline	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.
Water Distribution Pipelines (less than 10-inch diameter)[(a)]		
Diameter	Less than 10-inch	Locate new distribution pipelines within designated utility corridors wherever possible.
Maximum Velocity - Normal Conditions	5 ft/s	Criteria based on requirements for new development, existing transmission mains will be evaluated on case-by-case basis. Evaluation will include pipeline age, material type, velocity, and system pressure.
Maximum Velocity - Fire Flow Conditions	12 ft/s	
Hazen Williams "C" Factor	130	For consistency in hydraulic modeling.

[(a)] Recommended pipeline velocity and headloss criteria are used for sizing new pipelines. Existing pipelines not meeting the recommended criteria would not be identified as deficient unless there are also pressure deficiencies.

Table 5-4 presents the recommended fire flow requirements for the WSOP fire flow evaluation, based on general land use designations. These fire flow requirements will be used for the evaluation of the existing and future water system. Fire flows should be supplied at a minimum residual pressure of 20 psi. Based on the Fire Departments, hydrant spacing shall be such that developable lots be no more than 250 ft from a hydrant and that an undevelopable lot be no more than 500 ft from a hydrant.

The District has an ongoing renewal and replacement program to replace undersized aging water mains. The fire flow criteria are used to determine sizing of pipelines to meet current requirements, to guide proper sizing for new pipelines.

5.3.4 Booster Pump Station Criteria

Booster pump station capacity is typically based on firm pumping capacity. Firm pumping capacity is determined based on the highest capacity pump out of service where a pump station has multiple pumps. For example if a pump station has three pumps with two at 500 gpm and one at 250 gpm, the pump station firm capacity is considered 750 gpm, with one 500 gpm pump and one 250 gpm pump in operation, and one 500 gpm pump in standby (or out of service).

5.3.5 Potable-Storage Criteria

Operational storage is typically used to supply short-term (*i.e.*, peak-hour) demands that exceed supply capacity. Additional storage is typically maintained to fight fires. The sum of these two values equals the minimum-necessary storage that should be made available to each water service. Any additional storage beyond the minimum can be used for emergencies, such as when a pump station or well needs to be taken offline for a brief period.

1. Operational storage is computed by first subtracting firm supply-capacity from the peak-hour demand. The resulting incremental flow rate is then multiplied by a factor of four. This effectively represents four continuous hours of peak-hour demand.
2. Fire storage is computed by multiplying the required fire flow by the prescribed duration. Both the flow and duration depend on planned land use, and are listed in Table 5-3.

5.3.6 Pressure-Reducing Valve Criteria

Pressure-reducing valve (PRV) stations should be designed to supply both of the following scenarios with the largest valve out of service:

1. The maximum-day demand of downstream flows, plus fire flows
2. The peak-hour demand

Table 5-4. Recommended Fire Flow Requirements			
General Land Use Designation[a]	Examples of Specific Development	Fire Flow[b, c, d], gpm	Duration, hours
Residential	Single family, condominiums, mobile home, multi-family (2-4 units)	1,000	2
Multi-Family Residential	Multi-family greater than 4 units	2,500	2
Commercial	Auto services, general merchandise stores, grocery stores, professional offices, restaurants, warehouse	2,500	2
Public	Cemeteries, churches, day care centers, government offices, hospitals, public utility centers, schools	2,500	2
Recreational	Beach recreation, day use areas, camp grounds, ski facilities, golf courses, marinas, recreation centers	2,500	2
Tourist	Hotel, motel, bed and breakfast, time share	3,000	3

(a) Specific occupancy, construction type and fire area are not generally known during the development of a master plan; consequently, fire flow requirements developed for this WSOP are based on general land use designations.

(b) Unique projects or projects with alternate materials may require higher fire flows and should be reviewed by the Fire Marshal on a case-by-case basis (e.g., proposed commercial/industrial areas and schools).

(c) Fire flows to be supplied at a minimum residual pressure of 20 psi.

(d) The Fire Marshal normally allows up to a 50 percent reduction in fire flow if a building is provided with an approved automatic sprinkler system. However, the 2010 CFC also requires that no fire flow be less than 1,000 gpm for single family residential or 1,500 gpm for all other building types.

Hydraulic capacity of any PRV is taken to be equivalent to the flow corresponding to a velocity of 20 feet per second (ft/s). This is a typical design threshold for globe-style regulating valves.

5.3.7 Distribution System Pressures

Adequate system pressure is a basic indicator of acceptable distribution system performance. The recommended performance criteria for system pressures based on the District's Level of Service goals are:

- Allowable Pressures Under Normal Operating Conditions: 20 psi to 120 psi[3]
- Minimum Pressure Under Fire Flow Conditions: 20 psi

These performance criteria are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers outside of the normal service elevation ranges may have an individual pressure regulator or booster pump installed.

5.3.8 Water Transmission and Distribution Pipeline Sizing

The following criteria will be used as guidelines for sizing new transmission and distribution system pipelines. The District's existing system will be evaluated on a case-by-case basis. For example, if an existing pipeline experiences velocity or head loss in excess of the criteria described below, this condition, by itself, does not necessarily indicate a problem as long as the minimum system pressure criterion is satisfied.

Consequently, the District's existing system is evaluated using pressure as the primary criterion; and secondary criteria, such as pipeline velocity, head loss, age, and material type, are used as indicators to locate, and to help prioritize where water system improvements may be needed. New transmission and distribution pipelines to serve the District's future planning areas should be located within designated utility corridors wherever possible. These designated utility corridors should be within public rights-of-way to minimize or eliminate the need for utility easements within private property.

5.3.8.1 Water Transmission System

Transmission pipelines are generally defined as being 10 inches in diameter or larger. For planning purposes, West Yost recommends the following criteria for water transmission pipelines:

- Maximum velocity of 5 ft/s and maximum head loss of 5 ft/1000-ft during normal operating conditions; and
- Maximum velocity of 10 ft/s and maximum head loss of 10 ft/1000-ft during fire flow conditions.

[3] The Plumbing Code requires that individual services that exceed 80 psi have an individual pressure regulator on the service line; services that are less than 20 psi must have an individual booster pump on the service line.

For the existing water transmission system pipelines, pipeline velocity and head loss criteria are not used to identify deficient facilities. System pressure is used as the primary criterion for determining deficiencies. However, these constraints are used for sizing new transmission system pipeline facilities.

5.3.8.2 Water Distribution System

Distribution pipelines are generally less than 10-inch diameter. For planning purposes, West Yost recommends the following criteria for water distribution pipelines:

- Maximum velocity of 5 ft/s during normal operating conditions; and
- Maximum velocity of 12 ft/s during fire flow conditions.

For the existing water distribution system pipelines, pipeline velocity criteria are not used to identify deficient facilities. System pressure is used as the primary criterion for determining deficiencies. However, these velocity constraints are used for sizing new distribution system pipeline facilities.

5.4 Existing Water System Performance Evaluation

This section discusses the hydraulic performance evaluation of the existing water distribution system.

5.4.1 Storage and Pumping Capacity Evaluations

The District's water supply infrastructure must be capable of reliably serving potable water during the following operational scenarios under Normal and Emergency Operations. These scenarios were evaluated using the Water Demand and Supply Block Diagram as shown on Figures 5-1 through 5-5 to determine the firm pumping capacity for each booster pump station; if adequate water storage for each pressure zone is provided; and to conduct a capacity condition assessment evaluation for these assets that is covered in Section 1.

The Water Demand and Supply Block Diagram (Figures 5-1 to 5-5) represents each of the pressure zones that make up the District's integrated water system. Figures 5-1 to 5-5 shows the Demands for each pressure zone that include Peak Hour, Maximum Day, Fire, and Export (*i.e.*, amount of water available to export to adjacent pressure zones). Figures 5-1 to 5-5 also shows the Supplies for each pressure zone that include Total Well Capacity, Firm Well Capacity, and Imports (*i.e.*, amount of water to be imported into the pressure zone from adjacent zones to meet the pressure zone demand).

The District typical Summer Operational configuration is shown in Table 5-5. An evaluation of the District water system was completed under five scenarios for the current water system and the revised Heavenly Keller (H to K) water system as described below. These scenarios were designed to test the reliability of the water system under potential stressed conditions as summarized in Table 5-5.

For Scenarios 1, 2, 3 and 4, all operating wells are assumed to be pumping at their respective maximum capacity. In contrast, for Scenario 2A, all operating wells are assumed to be pumping at their respective firm capacity. For all scenarios, pump stations that are listed as operational in Table 5-5, are assumed to be operating at firm capacity as documented in Section 1. Firm capacity assumes the largest booster pump is offline at each pump station. Maximum-day demands were used for all scenarios, even though Scenarios 3 and 4 represent winter demands.

For the Keller Zone there were three options that were evaluated to correct a water supply deficiency. One of those options was the construction of a new Keller Booster Pump Station with Hydropneumatic Tank to serve the Keller Zone and the tributary pressure zones. The new Keller Booster Pump Station is assumed to have a 300 gpm domestic supply capacity to meet demands. The demands assume Needle Peak and Rocky Point pressure zones have been reconfigured and receive water through tie-ins with the Heavenly Zone rather than through the Keller Zone.

The District wanted to conduct a similar evaluation for the water system with this specific water system improvement in-place to confirm that this modification to the Heavenly and Keller Zones and their tributary zones would function adequately.

The five Operational Scenarios were modified based on this significant change and are shown in Block Diagrams Figures 5-6 through 5-10. A summary of the common modifications through all five operational scenarios is summarized as follows:

- Keller Booster from Stateline to Keller is offline
- Regina-Keller No. 4 PRV from Sweeping Turn to Heavenly is offline

Table 5-5. Summary of Standard Operations for Max Day Conditions and Five Operational Scenarios						
Water System Facility	Summer Configuration				Winter Configuration	
	Standard Operations	Scenario #1	Scenario #2	Scenario #2A	Scenario #3	Scenario #4
Stateline / Gardner Mountain Well Supply:						
Bayview	On	On	Off	Off	On	Off
Glenwood	On	On	On	On	On	On
Sunset	On	On	On	On	On	On
Helen	On	On	On	On	On	On
Al Tahoe	On	Off	On	On	Off	On
Paloma [(a)]	Off	On	On	On	On	On
Valhalla	On	On	On	On	On	On
Tahoe Paradise Well Supply:						
Bakersfield	On	On	Off	Off	On	Off
Arrowhead	On	Off	On	On	Off	On
So. Upper Truckee	On	On	On	On	On	On
Mountain View	On	On	On	On	On	On
Elks Club	On	On	On	On	On	On
Other Subzone Supply	On	On	On	Firm Capacity[(b)]	On	On
Booster Pumps						
Twin Peaks	On	On	Off	On	On	On
Grizzly Mountain	Off	Off	Off	Off	On	On
Flagpole	On	On	On	On	Off	Off
Cornelian	Off	Off	Off	Off	On	On
North Apache	On	On	On	On	On	On
South Apache	Off	Off	Off	Off	Off	Off
Airport	Off	Off	Off	Off	Off	Off
Tata	On	On	On	On	On	On
Pressure Reducing Valves / Flow Control Valves:						
Twin Peaks	Off	Off	Off [(c)]	Off [(c)]	Off	Off
Grizzly	Off	Off	On	Off [(c)]	Off	Off
Cornelian	On	On	On	On	Off	Off

(a) Flow limited to 1200 gpm. Can produce 2400 gpm in emergencies.
(b) Firm capacity used to evaluate the well source capacity in the other subzones.
(c) Available for emergencies.

5.4.2 Water-Supply Evaluation

In general, all zones and subzones should have enough firm-supply capacity to simultaneously satisfy the combined maximum-day demand. For purposes of this optimization plan, firm-supply capacity is defined as the combined output of all active wells with one unit out of service. The District has defined which wells would be out of service for each of the five operational scenarios described in the preceding section of this document.

The Stateline and Gardner Mountain zones are interconnected such that they can share water supplies from the following wells:

Stateline Zone Wells:

- Bayview
- Al Tahoe No. 2
- Paloma
- Glenwood No. 5
- Sunset
- Helen No. 2
- It is assumed that Chris Well is offline due to water quality issues

Gardner Mountain Zone Well:

- Valhalla

The following sub-zones are also served from Stateline and Gardner Mountain zones:

Sub-zones Served by Stateline:

- Montgomery Estates
- Upper Montgomery
- Keller
- Middle Keller
- Upper Saddle
- Sweeping Turn
- Needle Peak
- Rocky Point
- Heavenly

- Terrace
- Price Road/Ralph
- H Street

Sub-zones Served by Gardner Mountain:

- Twin Peaks
- Forest Mountain
- Angora Highlands

Based on a comparison of firm-supply capacity and combined maximum-day demands, there is a 258 gpm supply deficiency under operational scenario nos. 1 and 3. However, there is 1,371 gpm supply deficiency under operational scenario nos. 2, 2A and 4. *Thus, a new well should be constructed in the Stateline zone, with a recommended design capacity of at least 1,400 gpm.* The supply capacities and maximum-day demands are summarized in Table 5-6.

Similarly, Arrowhead, Christmas Valley and Country Club zones are also interconnected to share water supplies from the following wells:

- Arrowhead No. 3 (Arrowhead Zone)
- Elk's Club No. 2 (Country Club Zone
- South Upper Truckee No. 3 (Christmas Valley Zone)
- Bakersfield (Arrowhead Zone)

Table 5-6. Supply Summary for Stateline and Gardner Mountain Zones

Scenario No. 1		Scenario No. 2		Scenario No. 2A		Scenario No. 3		Scenario No. 4	
Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm
Bayview	4,000	Bayview	-	Bayview	-	Bayview	4,000	Bayview	-
Al Tahoe	-	Al Tahoe	2,500	Al Tahoe	2,400	Al Tahoe	-	Al Tahoe	2,500
Paloma	2,500	Paloma	2,500	Paloma	1,200	Paloma	2,500	Paloma	2,500
Glenwood	1,110	Glenwood	1,110	Glenwood	1,010	Glenwood	1,110	Glenwood	1,110
Sunset	594	Sunset	594	Sunset	594	Sunset	594	Sunset	594
Helen	260	Helen	260	Helen	260	Helen	260	Helen	260
Valhalla	675	Valhalla	675	Valhalla	550	Valhalla	675	Valhalla	675
Total Firm Supply	9,139	Total Firm Supply	7,639	Total Firm Supply	6,014	Total Firm Supply	9,139	Total Firm Supply	7,639
Zone Area[a]	Demands, gpm	Zone Area[a]	Demands, gpm	Zone Area[a]	Demands, gpm	Zone Area[a]	Demands, gpm	Zone Area[a]	Demands, gpm
Stateline	5,982	Stateline	5,982	Stateline	5,982	Stateline	5,982	Stateline	5,982
Gardner Mtn	624	Gardner Mtn	624	Gardner Mtn	624	Gardner Mtn	624	Gardner Mtn	624
H St	15	H St	15	H St	15	H St	15	H St	15
Montgomerey Estates	286	Montgomerey Estates	286	Montgomerey Estates	286	Montgomerey Estates	286	Montgomerey Estates	286
Heavenly	454	Heavenly	454	Heavenly	454	Heavenly	454	Heavenly	454
Total Max Day Demand	7,361	Total Max Day Demand	7,361	Total Max Day Demand	7,361	Total Max Day Demand	7,361	Total Max Day Demand	7,361
Supply Shortage	-	Supply Shortage	-	Supply Shortage	(1,347)	Supply Shortage	-	Supply Shortage	-

[a] Zone Areas represent the major pressure zone plus the subzones served off of them.

The following subzones are served from the Arrowhead, Christmas Valley and Country Club zones:

- Flagpole Mount Rainier
- Comanche
- Susquehanna
- Iroquois
- Pine Valley

The wells listed above furnish enough water to satisfy the combined maximum-day demand (1,446 gpm) under all operational scenarios defined in this document. The supply capacities and maximum-day demands for Arrowhead, Christmas Valley and Country Club zones are summarized in Table 5-7.

5.4.3 Storage Evaluation

The total storage volume for a zone is the sum of the operational storage and the fire supply storage. In practice, operational storage is defined as a volume of water needed to make up the difference between firm supply capacity to the zone and peak-hour demand, for four consecutive hours. In some areas of the distribution system there are subzones that are supplied from a main zone. In these areas, the peak-hour demand used for computing operational storage is the total for the main zone plus all tributary subzones that are served from the main zone.

In contrast, the storage volume designated for fire supply is determined by multiplying the required fire flow by a specified duration. In cases where multiple subzones are served from the same storage tank, the zone with the greatest fire-flow requirement governs the sizing.

The following additional storage volumes are based on an evaluation of the storage needs in each zone as represented in the tables in Appendix D1 for the scenarios nos. 1 through 4:

- Keller Zone – additional 230,000 gallons if Keller continues to be supplied via the Keller Booster. This is based on Operational Scenario No. 2A. Conversely, no additional storage is needed if Keller is served from Heavenly by a new Keller booster pump station. If that occurs, there will need to be a hydropneumatic tank with the new Keller booster pump station installed on the zone to aid with pressure regulation and pump control.
- Christmas Valley – additional 115,000 gallons is needed.

It is important to note that these recommended storage volumes are based on the assumption that a new 1,400-gpm well is installed in the Stateline zone, as described in the preceding section.

For additional fire protection the Sweeping Turn zone requires PRVs installed to provide adequate redundancy in case the largest PRV is not operable during a fire event. While this could be accomplished by upsizing the PRVs at Middle-Keller No. 2 and Heavenly-Keller No. 3, model results indicate that it is more efficient to reconfigure Sweeping Turn zone. This is accomplished with project nos. 38 - 47, as summarized in Table 5-9.

5.4.4 Pump Station Evaluation

In general, pump stations should have a firm capacity greater than or equal to the maximum day demand of the zone it serves, plus any subzones that are served off the main zone (*e.g.*, subzones served via a pressure-reducing valve). In cases where the zone served includes additional sources that could augment the pump station, such as a well, the contribution from the additional source may be considered in determining the necessary pump station capacity. Exceptions to these general rules include:

- When the zone served does not have fire storage (*e.g.*, H Street zone), the pump station should include a dedicated fire pump or a new booster pump station with dedicated standby generator for that purpose. Fire pumps that conform to NFPA standards include special features that enhance reliability.
- When the zone served does not have operational storage, the firm capacity should be greater than or equal to the peak-hour demand for the zone(s) it serves.

The following pump stations are undersized, based on these criteria:

- H Street Booster Pump Station serving the H Street Zone
- Cold Creek Tank Booster Pump Station serving the Upper Montgomery Estates Zone

Both of these pump stations should be upgraded to include a 1,000 gpm fire pump that conforms to NFPA standards or provided with booster pumps with permanent automatic standby generator.

5.4.5 Distribution System Evaluations

The following evaluations were performed to assess distribution system performance under existing water demand conditions:

- Normal Operations – Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations – Maximum Day plus Fire Flow Scenario: This scenario evaluates available fire flows in the system under a maximum day demand condition.

Table 5-7. Supply Summary for Arrowhead, Christmas Valley, and Country Club Zones									
Scenario No. 1		Scenario No. 2		Scenario No. 2A		Scenario No. 3		Scenario No. 4	
Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm	Well Supply Source	Capacity, gpm
Arrowhead No. 3	-	Arrowhead No. 3	1,000	Arrowhead No. 3	800	Arrowhead No. 3	-	Arrowhead No. 3	1,000
Elk's Club No. 2	300	Elk's Club No. 2	300	Elk's Club No. 2	275	Elk's Club No. 2	300	Elk's Club No. 2	300
South-Upper Truckee No. 3	1,400	South-Upper Truckee No. 3	1,400	South-Upper Truckee No. 3	1,250	South-Upper Truckee No. 3	1,400	South-Upper Truckee No. 3	1,400
Bakersfield	1,500	Bakersfield	-	Bakersfield	-	Bakersfield	1,500	Bakersfield	-
Total Firm Supply	3,200	Total Firm Supply	2,700	Total Firm Supply	2,325	Total Firm Supply	3,200	Total Firm Supply	2,700
Zone Area[(a)]	Max Day Demands, gpm	Zone Area[(a)]	Max Day Demands, gpm	Zone Area[(a)]	Max Day Demands, gpm	Zone Area[(a)]	Max Day Demands, gpm	Zone Area[(a)]	Max Day Demands, gpm
Arrowhead	255	Arrowhead	255	Arrowhead	255	Arrowhead	255	Arrowhead	255
Christmas Valley	269	Christmas Valley	269	Christmas Valley	269	Christmas Valley	269	Christmas Valley	269
Flagpole	315	Flagpole	315	Flagpole	315	Flagpole	315	Flagpole	315
Iroquois	607	Iroquois	607	Iroquois	607	Iroquois	607	Iroquois	607
Total Max Day Demand	1,446	Total Max Day Demand	1,446	Total Max Day Demand	1,446	Total Max Day Demand	1,446	Total Max Day Demand	1,446
Supply Shortage	-	Supply Shortage	-	Supply Shortage	-	Supply Shortage	-	Supply Shortage	-

[(a)] Zone Areas represent the major pressure zone plus the subzones served off of them.

These two scenarios use the hydraulic model developed for the WSOP to evaluate the existing water system performance. The purpose of the existing water system performance is to identify necessary improvements to support the District's existing water demands while meeting the District's recommended water system performance and operational criteria.

The existing water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria. Recommended system improvements were identified to address and fix any pressure deficiencies found, and to fix any fire flow deficiencies in the existing water distribution system. System improvements were not identified for pipelines that did not meet velocity or head loss criteria where no pressure deficiencies were identified.

5.4.5.1 Normal Operations – Maximum Day Diurnal Demand Scenario

Maximum day demand extended period simulation (EPS) was conducted using the hydraulic model to evaluate system performance under existing maximum day demand conditions including peak hour conditions. As shown in Table 5-1, the peak hour demand for the existing water service area was calculated to be 12,329 gpm (17.8 mgd). This analysis assumed storage tank and booster pump station operation based on operating set-point information provided by the District.

During a peak hour event, a minimum pressure of 20 psi must be maintained at service connections throughout the system. In addition, for planned pipelines, it is recommended that the maximum head loss per thousand feet of distribution main should not exceed 5 ft/1000 ft and maximum velocities should not exceed 5 ft/s during normal demand conditions, to help minimize energy (pumping) costs due to undersized pipelines.

Results from the maximum day demand EPS simulation indicate that the existing water system could adequately meet the District's minimum pressure criterion of 20 psi at all customers, except for the few locations shown as red nodes on Figures 5-11 through 5-16. The locations shown in red are typically near existing tanks and due to the elevation of the location, the pressure is below 20 psi. The water service connections near tank locations without an adequate elevation difference are required to install service booster pumps on the connection.

The results also indicate several areas within the system where the maximum pressure criterion of 120 psi is exceeded. These areas are shown as black nodes on Figures 5-11 through 5-16. Most of the high pressure locations are attributed to the elevation change within the pressure zone area. Specific areas include:

- Heavenly Valley Zone – along Ski Run Boulevard and Needle Peak Drive. Elevations in the Heavenly Valley Zone range from a low of 6,305 ft to a high of approximately 6,700 ft at tank site (395 ft difference).

- Flagpole Zone – the southern area of Flagpole Zone around Normuk Street and Oaxaco Street. Elevations in Flagpole Zone range from a low of approximately 6,310 ft to a high of approximately 6,730 ft at tank site (420 ft difference).
- Upper Saddle PRV Zone – along Crest Road. Elevations in Upper Saddle Zone range from a low of approximately 6,655 ft to a high of approximately 6,865 ft (210 ft difference).
- Needle Peak PRV Zone – along Timber Lane. Elevations in Needle Peak PRV Zone range from a low of approximately 6,440 ft to a high of approximately 6,600 ft (160 ft difference).
- Iroquois Zone – along Atroari Street and Mandan Street. Elevations in Iroquois Zone range from a low of approximately 6,300 ft to a high of approximately 6,685 ft (385 ft difference).

High velocity is seen in several pipelines in the Stateline Zone and shown as red lines on Figures 5-11 and 5-12. The pipelines are located in the vicinity of supply sources such as Bayview Well, Sunset Well, and Stateline Tanks. Below is a summary of the locations with the high velocities.

- Lake Tahoe Boulevard from San Jose Avenue to Fairway Avenue is a 14-inch diameter pipeline. This pipeline conveys supply to a large portion of the service area including demand needed to fill the Stateline Tanks. The high velocities range from 6 fps to 7 fps during the time the Stateline Tanks are filling. On average over the diurnal simulation of maximum day demands, the velocity in these pipelines ranges from 3.6 fps to 4.5 fps.
- The fill/drain pipeline for the Stateline tanks is 14-inch diameter. This pipeline conveys water to fill the tanks and also meet peak demands within the system from the tanks. The maximum velocity reached in this pipeline is approximately 8 fps when the tanks are draining to meet system demands. On average over the diurnal simulation of maximum day demands, the velocity in this pipeline is approximately 2.7 fps.
- Sunset Well conveyance pipeline is 6-inch diameter from the well location to the intertie at Lake Tahoe Boulevard and Lodi Avenue. This pipeline conveys the majority of flow from Sunset Well which ties into the 14-inch diameter pipeline in Lake Tahoe Boulevard. The 6-inch diameter pipeline has velocity ranging from 5.5 fps to 9 fps.
- Lake Tahoe Boulevard from Lodi Avenue to southwest side of bridge is a combination of 12-inch and 14-inch diameter pipeline. This pipeline conveys supply from the Stateline Zone to the Gardner Mountain and Twin Peak Zones. The 14-inch diameter pipeline has a maximum velocity of 5.1 fps and an average velocity of 3.2 fps. The 12-inch diameter pipeline for the bridge crossing has a maximum velocity of 6.9 fps and an average velocity of 4.3 fps.

As stated in the criteria for evaluating the District’s existing system, high velocity does not necessarily indicate a problem as long as the pressure criterion is satisfied. For the locations highlighted above with high velocity, the 6-inch diameter pipeline from Sunset Well and the

12-inch diameter pipeline in Lake Tahoe Boulevard for the bridge crossing are considered locations that restrict conveyance of water and impact downstream pressures.

5.4.5.2 Emergency Operations – Maximum Day Demand plus Fire Flow Scenario

The District's existing water system was evaluated to identify areas where fire flows are less than current fire flow criteria. While the District does not have a specific policy requiring replacement of pipelines to meet current fire standards, the fire flow analysis identifies pipeline sizes needed to meet current criteria, so that pipelines can be properly sized as part of the District's ongoing renewal and replacement program and so that the District can identify deficient areas for potential improvement projects.

Results from the emergency fire flow scenario indicate several areas within the District that are unable to meet a minimum residential single family fire flow requirement of 1,000 gpm for a two hour duration. Areas shown as red nodes are not able to meet a flow of 500 gpm and areas shown as orange nodes are not able to meet the minimum flow of 1,000 gpm as shown on Figures 5-17 through 5-22. Several of the locations not able to meet minimum fire flow requirements are restricted by system infrastructure being undersized for fire flow or they are limited in how supply is conveyed to the system.

The Pine Valley, Susquehanna and northern Country Club Zones are of greatest concern due to the large area and number of customers impacted. These areas are restricted by a lack of pipeline infrastructure, supply sources, and system redundancy to serve these areas. Evaluation of system redundancy is discussed below.

5.5 System Redundancy Evaluation

This section describes the reliability of the system to convey water between pressure zones for emergency conditions including fire flow. The necessary pipeline, pressure regulating stations, and pump station improvements to create a more robust and redundant system will be included in the summary of improvement recommendations.

The District's service area has been expanded over time by acquiring small water agencies. Often the small agencies were not developed with the intention of conveying a large capacity of water. Interconnections between the different agencies were also limited. The patchwork growth of the District's service area is one factor to the deficiencies identified in the existing system evaluation.

Another challenge for the District is the change in elevation within the service area which ranges from 6,230 ft to 7,030 ft. The District is made up of 32 pressure zones. Some of the pressure zones are supplied water through a single connection which makes them vulnerable. Some of the pressure zones also have limited supply and storage sources or pipeline networks to convey large amounts of water to the entire zone. A hydraulic grade line schematic of the

District's system is included in Appendix D2 which shows the elevations, supply sources, and pumping facilities for the pressure zones. Table 5-8 provides a matrix showing the deficiencies identified in each zone.

5.5.1 Summary of LOS Deficiencies

A definition of the deficiencies and the level of service (LOS) objective addressing the deficiency are listed below.

- Insufficient Supply Capacity – Pressure zones should meet the minimum recommended supply to meet maximum day and emergency demands. Water system should be able to provide 100% of the time 1) MDD and PHD; 2) access to emergency water; and 3) MDD plus fire standard for each zone with the largest source out of service. LOS objective is to "provide enough water."
- Service Redundancy – Pressure zone should be served with multiple connections or have access to supply source within the zone. LOS objective is to "provide water reliably".
- Storage – Pressure zones should meet minimum requirements for system storage criteria. LOS objective is to "provide enough water".
- Low Pressure – Pressure zones should meet the minimum pressure requirements of 20 psi for all conditions. LOS objective is to "provide enough water".
- Excessive Pressure – Pressure zones should not exceed the maximum pressure requirement of not greater than 120 psi. LOS objective is to "provide enough water".
- Fire Flow – Pressure zones should meet minimum recommended fire flow standards for flow and pressure. LOS objective is to "protect Lake Tahoe and the Community".

5.6 Summary of Recommended Improvements for the Existing Water System

The recommended improvements needed to minimize deficiencies identified in the evaluation of the existing and expanded water distribution system are summarized in Table 5-9. The hydraulic model was used to verify the pipeline and pressure zone realignment improvements using the projected buildout demands and expanded service area demands. Figures 5-23 through 5-30 show the improvements to the system pressures with the recommended existing system improvements listed in Table 5-9. Figures 5-29 through 5-34 show the improvements to available fire flow based on the recommendations listed in Table 5-8. Associated costs for the improvements are provided in Section 6 Capital Improvement Projects.

Table 5-8. Summary of Zone Deficiencies

Pressure Zone	Deficiency					
	Insufficient Supply Capacity	Service Redundancy	Storage	Low Pressure	Excessive Pressure	Fire Flow
Stateline	×					
H Street		×				×
Gardner Mountain	×					
Keller		×	×			×
Upper Saddle		×				×
Middle Keller		×				
Sweeping Turn		×		×	×	×
Four Seasons						×
Needle Peak		×				×
Rocky Point		×				×
Heavenly Valley						
June Way						
Price Road		×				×
Terrace PRV		×				×
Overlook PRV						
Upper Montgomery		×				×
Montgomery Estates		×		×		×
Golden Bear		×				×
Kokanee		×				×
Christmas Valley			×			
Arrowhead						
Iroquois						
Comanche						
Ottawa						
Pine Valley		×				×
Susquehanna		×				×
Country Club		×				×
Flagpole					×	
Mt. Rainier						
Twin Peaks	×					
Forest Mountain						
Angora Highlands						

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Table 5-9. Existing System Improvement Recommendations				
Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
1	Christmas Valley	Storage Service redundancy	• Christmas Valley needs a minimum storage volume of 0.39 MG, but there is only 0.19 MG of storage available with 0.08 mgd available for import. Thus, an additional 0.12 MG of storage is needed. • Improvements to the Cornelian booster pump station and additional pipeline would address service redundancy by providing an additional delivery avenue to the pressure zone.	• Replace existing fire flow booster pump with new 1,250 gpm fire pump at the Cornelian booster pump station. Loop discharge side of Cornelian booster pump station to existing dead-end line in Keetak Street with a 12-inch diameter pipeline (approximately 200').
2	Country Club Zone	Fire flow Service redundancy	• The north portion of Country Club Zone is fed from the south part of the zone through a single 6-inch diameter pipeline and from the Airport booster station which has limited capacity and is normally off. • Airport booster is a small pump and does not provide much supply for fire flow. • If hydrants opened up at Airport, Onnontioga St pressures drop below 20 psi.	• Add 6-inch PRV at Washoan Blvd and Nadowa St normally closed valve M33-047 (Pine Valley to Country Club).
3				• Add 6-inch PRV at Glen Eagle Rd (1321 Glen Eagle Rd) normally closed valve M34-021NC (Pine Valley to Country Club).
4	Flagpole Zone	System pressures	• Pressures are high in the southeast portion of Flagpole Zone. This area is low elevation compared to the other parts of the Flagpole Zone.	• Add 6-inch PRV at San Bernardino Ave and Shawnee St. New pressure zone off of Flagpole Zone to reduce service pressures below 120 psi.
5				• Add 6-inch PRV at 1863 Normuk St. New pressure zone off of Flagpole Zone to reduce service pressures below 120 psi.
6				• Add 6-inch check valve at San Bernardino Ave and Normuk St. (flow from new lower pressure zone to Flagpole Zone).
7				• Add 6-inch check valve at San Bernardino Ave and Cholula St (flow from new lower pressure zone to Flagpole Zone).
8				• Loop Normuk St and Ulmeca St pipelines with a 6-inch diameter pipeline (approximately 500').
9	H Street Zone	Fire flow Service redundancy	• H Street fed by a single pump with limited capacity and not able to provide 1,000 gpm for fire flow. • The District does keep a backup pump on the shelf for an emergency situation. • No secondary connections to other pressure zones to provide backup service. • Valves can be opened to allow Stateline Zone to feed the H Street Zone directly at lower pressure in emergency conditions.	• Add new 8-inch check valve between Stateline and H Street Zones in F Street to provide service redundancy.
10				• Add 1,000 gpm pump station with backup power to provide fire flow and redundancy for emergency conditions.
11	Keller Zone/ Upper Saddle Zone/ Sweeping Turn Zone	Service redundancy	• The existing Keller Tanks have been evaluated and determined to be vulnerable to a rock slide which would result in a large service area out of supply until the District is able to reconfigure valve operations. • Keller, Middle Keller, Sweeping Turn, Upper Saddle, Needle Peak, and Rocky Point Zones all rely on the supply pumped to the Keller Tanks through approximately 6,750 feet of 6-inch diameter pipeline. • No redundant service supply for Keller Zone exists. Heavenly Valley can be valved to serve part of the zone but higher elevations are above the Heavenly Valley Zone HGL.	• Remove Keller Tank 1 and 2 from service or remove rock hazard.
12				• Add new booster pump station and hydropneumatic tank at Saddle Rd and Keller Rd (boost from June Way Zone to Keller Zone). It is assumed Project numbers 43-46 have been implemented which move Needle Peak and Rocky Point Zones from being supplied off Keller Zone to being supplied off Heavenly Zone.
13				• Add 10-inch diameter pipeline from new booster pump station to Existing Keller Tank Fill 6-inch diameter pipeline (high pressure pipeline) (approximately 100').
14				• Add isolation valves at connection to high pressure pipeline to allow high pressure line to be closed northwest of tie-in location.
15				• Abandon parallel 6-inch diameter pipeline in Keller Rd from Saddle Rd to Sherman Way (approximately 2,800').
16				• Remove Keller PRV #2 and #3 from service.

Table 5-9. Existing System Improvement Recommendations				
Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
17				• Add new 8-inch diameter pipeline in Keller Rd from Saddle Rd to Sherman Way. Tie new pipeline in to existing pipeline near 1621 Keller Rd and existing 6-inch diameter pipeline at Sherman Wy (approximately 2,800').
18				• Middle Keller Zone and Keller Zone become a single zone. Upper Saddle Zone continues to be fed from the Keller Zone through the Keller PRV #1. Sweeping Turn Zone (as modified in Figures 1 and 5) is now fed through new PRVs added as shown in Figure 1.
19				• Keller booster pump station may be maintained as a back-up option to the new Saddle Rd booster pump station or altered to be lower pressure booster pump and be the main feed to the Sweeping Turn Zone.
20	Keller / Upper Saddle / Middle Keller / Sweeping Turn / Needle Peak / Rocky Point	Storage	• These zones need a minimum storage volume of 0.56 MG, but there is only 0.33 MG available. Thus additional storage of 0.23 MG is needed unless a new, higher capacity booster station is installed as recommended, Project 11 and 12.	• 0.23 MG of additional storage is needed.
21	Kokanee and Golden Bear Zones	Fire flow Service redundancy	• Kokanee and Golden Bear are both sub zones off of the Montgomery Estate Zone served by PRVs. • No secondary connections to other pressure zones to provide backup service.	• Add secondary 8-inch diameter connection (approximately 150 ft) to Stateline Zone At Pioneer Trail and Marshall Trail with a normally closed valve. Stateline operates at a lower pressure but would provide supply at a reduced pressure for emergency conditions. This connection would also provide emergency supply to the southeast area of Stateline Zone along Plateau Circle and Fair Meadow Trail which is reliant on a single pipeline approximately 4,800 lineal ft located in Pioneer Trail.
22				• Remove Pioneer-Kokanee PRV from service.
23	Montgomery Estates / Upper Montgomery Estates Zones	System pressure Service redundancy	• Montgomery Estates Zone has service elevations ranging from approximately 6,285 feet to 6,600 feet making it difficult to maintain District acceptable low and high pressure standards. • This zone supplies Upper Montgomery Estates Zone is contiguous and serves higher elevations with a small booster pump station that could be improved to serve a larger area.	• Re-zone the boundary between Montgomery Estates and Upper Montgomery Estates Pressure Zones.
24				• Perform evaluation to determine most efficient zone breaks to minimize impact to customers and ensure reliable service.
25	Pine Valley Zone/ Susquehanna Zone	Fire flow Service redundancy	• Pine Valley is fed through a single PRV from the Iroquois Zone which then feeds the Susquehanna Zone through a single PRV and pipeline. • Available fire flow is limited by head loss through the pipeline supplying the PRV from Iroquois Zone. • Available fire flow is less than 600 gpm at several locations within the Pine Valley and Susquehanna Zones. • Pipelines in Susquehanna Drive, Ibache St, Guadalupe St, and Aravaipa St in Susquehanna Zone are all long, dead-end 6-inch diameter pipelines. • The adjacent Country Club Zone was considered for emergency supply by installing check valves where existing normally closed valves are located between the zones. However, the Country Club Zone has existing low pressure issues during emergency operations at these tie-in locations and would not be able to supply water at a high enough head to supply all of the Pine Valley and Susquehanna Zones.	• Add 8-inch PRV at Pioneer Trail and Busch Way (Iroquois to Pine Valley Zone).
26				• Add 12-inch diameter pipeline in Pioneer Trail from Elks Club Dr to Busch Way (approximately 2,250').
27				• Loop Susquehanna Dr and Ibache St pipelines with a 6-inch diameter pipeline (approximately 300').
28				• Loop Ibache St and Guadalupe St pipelines with a 6-inch diameter pipeline (approximately 250').
29				• Loop Guadalupe St and Aravaipa St pipelines with a 6-inch diameter pipeline (approximately 300').

Table 5-9. Existing System Improvement Recommendations

Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
30	Price Rd (Ralph) Zone	Fire flow Service redundancy	• Price Rd (Ralph) Zone is fed from Heavenly Valley through a single 6-inch PRV. • Two normally closed valves exist between Stateline and Price Rd (Ralph) Zone and must be manually opened up. • One normally closed valve exists between Heavenly Valley and Price Rd (Ralph) Zone fed by a 4-inch diameter pipeline. • Available fire flow is less than 1,000 gpm with some locations less than 700 gpm.	• Add check valve at normally closed valve P25-042NC located at Pioneer Trail and Norma Dr (flow from Stateline to Price Rd (Ralph) Zone to allow water to only flow during emergencies when pressures drop in Price Rd (Ralph) Zone).
31				• Add 6-inch PRV at Pioneer Trail and Needle Peak Rd (Heavenly Valley to Price Rd (Ralph) Zone). Redundant service.
32				• Replace 4-inch diameter pipeline in Needle Peak Rd between Ski Run Blvd and Pioneer Trail with 8-inch diameter pipeline (approximately 1,340 ft).
33	Stateline Zone/ Gardner Mountain Zone/ Twin Peaks Zone	Insufficient supply capacity Service redundancy	• The Sunset Well supply capacity is partially limited by the 6-inch diameter distribution pipeline downstream of the well. • Hydraulic model results indicate high velocity and headloss in the downstream pipeline from Sunset Well. • The 12-inch diameter pipeline in Lake Tahoe Boulevard crossing the Bridge limits the supply from the east side of Stateline Zone to the west side of Stateline Zone. • The single pipeline is the main pipeline providing supply from the east side of the Stateline Zone to the west side of Stateline Zone and Gardner Mountain Zone.	• Replace 6-inch diameter pipeline in Sunset Drive and Conestoga Street from Sunset well to Lodi Ave with 12-inch diameter pipeline (approximately 580')
34				• Construct 12-inch diameter pipeline in Lodi Avenue from Conestoga Street to Lake Tahoe Boulevard (approximately 800')
35				• Construct 14-inch diameter pipeline in Lake Tahoe Boulevard from Lodi Avenue to southwest side of bridge (approximately 1,400').
36				• Install new 1,000 gpm well in the State Streets area to increase supply reliability to the west side of Stateline Zone and Gardner Mountain Zone.
37	Stateline	Insufficient Supply Capacity	• Firm-supply capacity is limited to 6,000 gpm under operational scenario nos. 2, 2A and 4 • Maximum-day demand is 7,400 gpm • Supply deficiency is 1,400 gpm	• Install new well in Stateline Zone with capacity of at least 1,400 gpm, or • Increase Pomona Well capacity from 1,200 gpm to 2,400 gpm and use Twin Peaks PRV for 200 gpm, which is available in an emergency condition • Evaluate two alternatives considering probability of this occurring and potential water quality (MTBE plume migration)
38	Sweeping Turn Zone/ Four Seasons Zone/ Upper Saddle Zone/ Needle Peak Zone/ Rocky Point Zone	Fire flow System pressure Service redundancy	• There are no isolation valves within Sweeping Turn to isolate small areas. If there is a leak in Sweeping Turn, all of Sweeping Turn, Needle Peak, and Rocky Point are out of service. • There are no hydrants within Sweeping Turn Zone on Bonita Rd, Bridle Rd, and Crest Rd due to the 4-inch diameter pipelines. Hydrants located on Needle Peak Rd. can supply approximately 300 gpm for fire flow. • Sweeping Turn is fed by Keller PRV #3. Could open N/C valve between Four Seasons and Sweeping Turn for emergency purposes. However, limited usefulness due to reduced pressure in Four Seasons and elevation changes in Sweeping Turn. • Sweeping Turn elevations range from approximately 6,500 feet to 6,760 feet, which results in high system pressure in the lower elevation of the pressure zone. • An Upper Saddle Zone 6-inch diameter pipeline in Saddle Rd is parallel to the 4-inch diameter Sweeping Turn Zone pipeline and service for parcels along Saddle Road between Bridle Rd	• Add 6-inch PRV at Crest Rd and Bonita Rd (Upper Saddle Zone to Sweeping Turn Zone). In progress.
39				• Remove Saddle PRV #1 feeding Four Seasons hydrant. In progress.
40				• Replace parallel 4-inch and 6-inch diameter pipeline in Saddle Rd between Bridal Rd and Keller Rd with 8-inch diameter pipeline (approximately 1,390 ft). In progress.
41				• Connect 6-inch pipeline in Needle Peak to low pressure 6-inch pipeline in Keller Rd. In progress.
42				• Replace all 4-inch diameter pipelines in Bonita, Crest, and Bridle Rds and add hydrants as required to meet minimum 500 ft requirement (approximately 4,750 ft). In progress.

Table 5-9. Existing System Improvement Recommendations				
Project Number	Zone(s)	Deficiency	Deficiency Description	Recommendations
43			and Keller Rd is split randomly between pipelines. This results in some services having high pressure and other services with low pressure right next to each other. • Needle Peak is fed through a single PRV from Sweeping Turn Zone, Needle Peak also feeds the Rocky Point Zone through a single PRV. • Supply to Needle Peak and Rocky Point Zone is pumped at high pressure from the Keller Booster Station located at the edge of the Needle Peak Zone up to the high elevation Keller Zone. • Supply travels from the Keller Zone through Keller PRV #2, then Keller PRV #3, and finally Keller PRV#5 to reach Needle Peak Zone. • No secondary connections to other pressure zones to provide backup service exist, except through Rocky Point which is at a lower elevation.	• Abandon 4-inch diameter pipeline in Bridle Rd between Saddle and Bonita Rds (steep area with no services and low pressures). In progress.
44			• Needle Peak has similar elevations and is contiguous to the Heavenly Zone. • Needle Peak is fed through a single PRV and single pipeline from Sweeping Turn Zone, Needle Peak also feeds the Rocky Point Zone through a single PRV. • Supply to Needle Peak and Rocky Point Zone is pumped at high pressure from the Keller Booster Station located at the edge of the Needle Peak Zone up to the high elevation Keller Zone. • Supply travels from the Keller Zone through Keller PRV #2, then Keller PRV #3, and finally Keller PRV#5 to reach Needle Peak Zone. • No secondary connections to other pressure zones to provide backup service exist, except through Rocky Point which is at a lower elevation.	• Close existing valve Q22-008 located on Keller Rd near Needle Peak Rd. Close Keller PRV #5. Needle Peak Zone and Sweeping Turn Zone south of Keller Rd become part of Heavenly Valley Zone. Rocky Point Zone is now fed from Heavenly Valley Zone through the Rocky Point PRV.
45				• Connect existing 6-inch diameter pipeline in Needle Peak Rd to existing 6-inch diameter pipeline in Keller with approximately 185 lf of new 6-inch diameter pipeline downstream of Keller PRV #5. In progress.
46				• Replace existing 6-inch diameter pipeline in Needle Peak from Keller Rd to 3809 Needle Peak Rd with 8-inch diameter pipeline (approximately 600 ft).
47				• Add 8-inch diameter pipeline in Needle Peak Rd from Wildwood Ave to replaced 6-inch diameter pipeline located at approximately 3809 Needle Peak Rd (approximately 400').
48	Terrace PRV Zone	Fire flow Service redundancy	• Terrace is fed through a 2-inch diameter PRV from the Heavenly Zone. • Terrace PRV pulls off of a 2,350 ft long, 4-inch diameter dead-end pipeline which starts at Donner Ln and Wildwood Ave and wraps around to serve connections along David Lane in the Heavenly Zone. • Terrace is located in the middle of the Heavenly Zone with no redundant service connections. • No fire hydrants are located within Terrace Zone or on the 4-inch diameter pipeline located in Wildwood Ave.	• Replace 2-inch and 4-inch diameter pipeline in Terrace Zone with 6-inch diameter pipeline (approximately 1,950').
49				• Connect new 6-inch diameter pipeline in Knoll Lane to existing 6-inch diameter pipeline in Needle Peak Rd at Verdon Ln (approximately 500').
50				• Remove Terrace PRV located at Wildwood Ave and Terrace Dr.
51				• Connect new 6-inch diameter pipeline at Terrace Dr (north) to existing 4-inch diameter pipeline in Wildwood Dr with approximately 700 lf of new 6-inch diameter pipeline.
52				• Add hydrants on new 6-inch diameter pipeline based on minimum spacing requirements.
53	Upper Montgomery Estates Zone	Fire flow Service redundancy	• Upper Montgomery Estates is fed by a small pump station with limited capacity and not able to provide 1,000 gpm for fire flow. • No secondary connections to other pressure zones to provide backup service. Montgomery Estates Zone is not practical to serve Upper Montgomery Estates Zone due to elevation differences.	• Add 1,000 gpm pump station with backup power to provide fire flow and redundancy for emergency conditions
54	Expanded System	Service Reliability	• Future growth may include acquiring or providing service to neighboring water companies of Lakeside Mutual Water Company, Lukins Brothers, and Tahoe Keys. The condition of the water systems is unknown and would need to be determined prior to acquisition.	• Perform detailed condition assessment for each water system acquired or serviced in the future by the District.

Among the recommendations for the existing system are improvements to increase the reliability of service for the Stateline, Gardner Mountain, and Twin Peaks Zone. The hydraulic evaluation identified high velocity in the discharge distribution pipeline from Sunset Well and the 12-inch diameter pipeline in lake Tahoe Boulevard which restrict the conveyance of water from the east side to the west side of Stateline Zone. The west side of Stateline Zone has the ability to provide water to the Gardner Mountain and Twin Peaks Zones which have limited supply options. The improvement recommendations include three projects that will: improve the ability to convey water from the Sunset Well and utilize the well's full capacity potential through pipeline improvements; increase system redundancy and conveyance capacity from the east side to the west side of Stateline Zone with a parallel pipeline improvement in Lake Tahoe Boulevard over the bridge; and, increase the supply availability on the west side of Stateline Zone with an additional well. Together the three projects greatly improve the District's system redundancy between Stateline, Gardner Mountain, and Twin Peaks Zones. However, the three projects are not required to be completed at a single time and may be phased overtime.

5.7 Buildout Water System Performance Evaluation

This section discusses the hydraulic performance evaluation of the buildout water distribution system. The buildout water distribution system includes the buildout of the District's existing service area boundary and does not include demands for neighboring water companies. The buildout system evaluation assumes the recommendations for improvements from the existing system evaluation have been implemented.

The projected maximum day demands for the buildout system increase the existing demands by approximately 1,200 gpm. The hydraulic model results for the buildout system indicate that by implementing the recommended existing system improvements, the District performance standards are met for the projected buildout demands without additional system improvements.

5.8 Expanded Water System Performance Evaluation

This section discusses the hydraulic performance evaluation of the expanded water distribution system. The expanded water distribution system includes the buildout of the District's existing service area plus includes the additional demands from Lukins Brothers, Lakeside Mutual Water Company, and Tahoe Keys service areas. The expanded system evaluation assumes the recommendations for improvement from the existing system evaluation have been implemented.

The projected maximum day demands for the expanded system increase the existing demands by approximately 3,250 gpm.

The following evaluations were performed to assess distribution system performance under the expanded water system demand conditions:

- Normal Operations – Peak Hour Demand Scenario: This scenario evaluates customer service pressures in the system during a peak hour demand condition.
- Emergency Operations – Maximum Day plus Fire Flow Scenario: This scenario evaluates available fire flows in the system under a maximum day demand condition.

These two scenarios use the hydraulic model developed for the WSOP to evaluate the expanded water system performance. The purpose of the expanded water system performance is to identify necessary improvements to support the potential future growth of the District's system which includes the potential addition of all water customers from Lakeside, Lukins, and Tahoe Keys water companies.

The water system is expected to deliver peak hour flows and maximum day demand plus fire flow within the acceptable pressure, velocity and head loss ranges as identified in the performance criteria. Recommended system improvements were identified to address and fix any pressure deficiencies found, and to fix any fire flow deficiencies in the expanded water distribution system. System improvements were not identified for pipelines that did not meet velocity or head loss criteria where no pressure deficiencies were identified.

5.8.1 Acquired Water System Assumptions

Increase in demands for the expanded water system occurs assuming the District will acquire or serve the neighboring water companies of Lakeside Water Company, Lukins Brothers, and Tahoe Keys. Each of these systems currently has their own pipeline network and supply sources. The expanded system scenario evaluated makes assumptions on which supply facilities will continue to operate based on discussions with the District as detailed below.

Both Lukins and Tahoe Keys water systems are supplied by their own groundwater wells. Lakeside is supplied through surface water from Lake Tahoe and has a groundwater well for emergency supply. For this evaluation, it is assumed that one well from each of the systems would continue to operate and be incorporated into the District's water system. The following are the assumptions used for supply sources from each of the water companies:

- Lukins Brothers – Well 1 located on West Way is assumed to remain an active well for the buildout scenario. Well 1 is assumed to be capable of delivering approximately 720 gpm.
- Tahoe Keys – Well 1 located on Tahoe Keys Boulevard near Capri Drive is assumed to remain an active well for the buildout scenario. Well 1 is assumed to be capable of delivering approximately 1,000 gpm.

- Lakeside Mutual Water Company – Well 3 located on Pine Boulevard is assumed to be an active well for the buildout scenario. Well 3 is assumed to be capable of delivering approximately 250 gpm. Lakeside does have a surface water filter plant that would be evaluated if the system is acquired and could provide an additional supply source.

The complete distribution system configurations for each of the neighboring water systems is not included in the hydraulic model. Limited information was available and the addition of the neighboring water systems' infrastructure was beyond the scope of this project.

Prior to acquiring or servicing any of the neighboring water companies, a detailed condition assessment of each water system is required to determine the adequacy of the facilities in each of the water companies system.

5.8.2 Normal Operations – Maximum Day Diurnal Demand Scenario

A maximum day demand EPS was conducted using the hydraulic model to evaluate system performance under the expanded system maximum day demand conditions including peak hour conditions. As shown in Table 5-2, the peak hour demand for the expanded water service area was calculated to be 16,697 gpm (24.0 mgd).

During a peak hour event, a minimum pressure of 20 psi must be maintained at service connections throughout the system. In addition, for planned pipelines, it is recommended that the maximum head loss per thousand feet of distribution main should not exceed 5 ft/1000 ft and maximum velocities should not exceed 5 ft/s during normal demand conditions, to help minimize energy (pumping) costs due to undersized pipelines.

Results from the maximum day demand EPS simulation indicate the expanded water system is capable of meeting the future demands with improvements to pipelines and new supply sources. The expanded system assumes a new groundwater supply source has been added to the District system in the Stateline Zone. The new groundwater well is located in the States streets area with a 1,000 gpm capacity. Supply assumptions for the Lukins Brothers, Tahoe Keys and Lakeside Water Company detailed in the Acquired Water System Assumptions Section are also assumed active in the expanded system evaluation. Additional supply capacity needed to meet the expanded demands assumes the Al Tahoe and/or Paloma well will operate during peak demand periods. These wells are considered backup wells to Bayview Well for the existing system. However, as demands increase in the future, these wells are assumed to be utilized to supplement Bayview Well to maintain system pressures.

The pipeline improvements and zone re-alignments recommended for the existing system are assumed to have been implemented. Additional pipeline improvements for the expanded system include a parallel 12-inch pipeline crossing the USBR bridge on Lake Tahoe Boulevard. This pipeline provide a redundancy for supplying water to the West side of Stateline as well as the Gardner Mountain and Twin Peaks pressure zones.

5.8.3 Emergency Operations – Maximum Day Demand plus Fire Flow Scenario

The District's expanded water system was evaluated to identify areas where fire flows are less than current fire flow criteria. While the District does not have a specific policy requiring replacement of pipelines to meet current fire standards, the fire flow analysis identifies locations where system deficiencies may exist. The expanded evaluation does not incorporate any potential pipeline replacements beyond what the District currently plans to replace. Improvements within the Lukins, Tahoe Keys, and Lakeside were not evaluated as it is out of the scope of this project.

Results from the emergency fire flow scenario indicate most areas within the buildout District are able to meet a minimum residential single family fire flow requirement of 1,000 gpm for a 2-hour duration. Areas shown as red nodes are not able to meet a flow of 500 gpm and areas shown as orange nodes are not able to meet the minimum flow of 1,000 gpm as shown on Figures 5-41 through 5-46.

5.9 Summary of Recommended Improvements for the Expanded Water System

The hydraulic model was used to verify the pipeline and pressure zone realignment improvements using the projected expanded system demands. Figures 5-35 through 5-40 show the expanded system pressures with the recommended improvements. Figures 5-41 through 5-46 show the available fire flow based on the recommendations.

Prior to acquiring or serving the Lakeside Water Company, Lukins Brothers or Tahoe Keys water system, a condition assessment and capacity evaluation of existing infrastructure should be conducted.

Associated costs for the improvements are provided in Section 6 Capital Improvement Projects.

5.9.1 Future Water Quality and Climate Change Requirements

The following future water quality requirements that could have an impact on the groundwater source water system, along with the California Air Quality Management District Cap and Trade program and Assembly Bill 32 emission limits and Greenhouse Gas reduction program is summarized below in Table 5-10.

Table 5-10. Future Water Quality and Climate Change Requirements

Regulatory Agency and Regulation Name	Description Summary	Actual or Anticipated Implementation Date	Impacts to the District	Recommended District Steps
GHG Reporting Rule – California Air Resource Board (ARB)	ARB's Mandatory Reporting Rule requires the State's largest emitters (single sources with GHG emissions greater than 25,000 $MTCO_2e$ per year) to annually report and verify their GHG emissions. The rules were revised to harmonize the State's reporting rules with the US EPA's Mandatory Reporting Rule and streamline the reporting and verification process for sources with GHG emissions between 10,000 and 25,000 $MTCO_2e$. ARB finalized the proposed changes in 2011. The rule can be found at: http://www.arb.ca.gov/cc/ccei.htm.	2011	None – No District facilities will exceed the single source threshold of 25,000 Metric Tons of CO_2e.	– Monitor ARB regulations and monitor for changes or reduction in threshold limit. – Conduct a Greenhouse Gas Inventory (GHGI) to assess the District's emissions. – Create a Climate Action Plan (CAP) to identify projects that can cost-effectively reduce the District's GHG emissions.
AB32 California Assembly Bill 32 – Global Warming Solutions Act	AB 32 established GHG reduction targets for California, put the California ARB in charge of implementation and rulemaking through the development of the "Scoping Plan." AB 32 aims to reduce statewide GHG emissions to 1990 levels (427 million $MTCO_2e$) by 2020. To meet this target a two percent reduction is needed each year for the next 10 years. To accomplish the goal the State is pursuing a number of direct regulations and market-based mechanisms that have been laid out in a Scoping Plan. The core measures of the Scoping Plan are tailpipe standards, transportation and land-use changes, low carbon fuel standard, enhanced energy efficiency, a Renewables Portfolio Standard (RPS) of 20 percent by 2010 and 33 percent by 2020, and a Cap & Trade program. More information about the Scoping Plan can be found at: http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm.	Enacted in 2006	Scoping Plan is undergoing an Update, and nine key focus areas were identified (energy, transportation, agriculture, **water**, waste management, and natural and working lands), along with short-lived climate pollutants, green buildings, and the cap-and-trade program. Water Section can be found at: http://www.arb.ca.gov/cc/scopingplan/2013_update/water.pdf	– Monitor Scoping Plan Update and review Water Section. – Develop an Energy & GHG Management Plan. Phase 1 would include: ▪ Energy Audits of facilities, baseline & forecast of energy use and cost, and GHGI. – Phase 2 would include: ▪ Identification of energy & GHG reduction projects, project assessments, development of a Preferred Portfolio of projects, and creation of an Action Plan.
Cap and Trade Program – California ARB	Under cap-and-trade, an overall limit on GHG emissions from capped sectors will be established and lowered every year until 2020. Facilities subject to the cap will be able to trade permits to emit GHGs or acquire offsets from uncapped sectors. Starting in 2013, entities with GHG emissions greater than 25,000 $MTCO_2e$ in process and combustion emissions (not indirect electricity emissions) will be subject to cap. More information about the Cap & Trade Program can be found at: http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm.	October 2011 enacted. Enforcement began January 1, 2013. First auction of emission credits was in November 2013.	None – the District does not meet the threshold for inclusion in the Cap & Trade Program.	– Monitor ARB regulations and monitor for changes or reduction in threshold limit. – Opportunity exists to fund projects from grant & loan programs designed to reduce GHG emissions. Funds are from the Cap & Trade proceeds which currently exceed \$530M. Specific programs for water & wastewater exist and are emerging. – SWRCB and CPUC to develop incentives by 2015 for resource-recovery related wastewater treatment projects. – SWRCB and RWQCB to modify policies and permits by 2016 to achieve conservation, water recycling, stormwater, reuse, and wastewater-to-energy goals.

Table 5-10. Future Water Quality and Climate Change Requirements				
Regulatory Agency and Regulation Name	Description Summary	Actual or Anticipated Implementation Date	Impacts to the District	Recommended District Steps
Clean Air Act – USEPA	Clean Air Act would be the vehicle for federal legislation to regulate GHGs.	Reauthorized in 1990. Supreme Court in 2007 ruled that GHG fall under the definition of air pollutant regulated by the USEPA.	None at this time because no pending GHG rule from the USEPA.	– Monitor USEPA for potential GHG regulations.
California Department of Public Health (CDPH) – Hexavalent Chromium (Cr6) Drinking Water Standard	Establish a drinking water standard maximum contaminant limit (MCL) for Cr6, which is currently anticipated at 10 µg/L.	April 2014 if MCL remains at the recommended MCL or June 2014 if MCL is adjusted from 10 µg/L.	The District has tested for Cr6 with all of the wells below 2 µg/L.	– Continue to monitor for Cr6 as required by CDPH once the MCL has been implemented.
US EPA and CDPH – modify MCL for Arsenic (As)	Currently As is regulated with an MCL of 10 µg/L. There are discussions within US EPA to possibly lower the MCL, which may be lowered to 5 µg/L.	Development of a revised MCL is anticipated to occur over the next 20 years.	If the MCL were reduced to 5 µg/L, CDPH typically requires the As concentration to be 80% of the MCL. The following wells would have to be partially treated and blended due to exceeding the anticipated 5 µg/L MCL: Arrowhead Well #3 (5.38 µg/L in 2013) Bakersfield Well (7.09 µg/L in 2013) Helen Ave. Well #2 (5.84 µg/L in 2013) Mountain View Well (9.39 µg/L in 2013 Sunset Well (4.16 µg/L)	– Continue to monitor discussions within US EPA and CDPH on As MCL. – New wells sample for As and factor in potential impacts of cost and footprint to add treatment for As removal in the future if necessary.

Table 5-10. Future Water Quality and Climate Change Requirements				
Regulatory Agency and Regulation Name	Description Summary	Actual or Anticipated Implementation Date	Impacts to the District	Recommended District Steps
US EPA Unregulated Contaminant Monitoring Rule 3 (UCMR 3)	The UCMR 3 requires that US EPA every five years monitor 30 constituents from the Contaminant Candidate List. The UCMR 3 is monitoring from January 2013 to January 2015 from represented water systems for the 30 constituents. The list of 30 includes: Assessment Monitoring, which includes 7 volatile organic compounds (VOCs); 1 synthetic organic compound (SOC); 6 metals; one oxhalide anion, 6 pre-fluorinated compounds Screening Survey, which includes 7 hormones Pre-Screen Testing, which includes two viruses	The time table to establish and set a MCL is probably by 2020 to 2025.	US EPA will use the data to determine if a contaminant should have a drinking water MCL set. Regulation may be established for a number of constituents of concern depending on the results from the testing. The likely constituents may be: VOCs, especially 1,2, 3 trichoropropane 1,4 dioxane (SOC) Perfluoro compounds – 6 each (i.e., PFOS, PFOA, PFNA, PFHxS, PFHpA, PFBS) Hormones – 7 each 2020 to 2025. The likely constituents may be: VOCs, especially 1,2, 3 trichoropropane 1,4 dioxane (SOC) Perfluoro compounds – 6 each (i.e., PFOS, PFOA, PFNA, PFHxS, PFHpA, PFBS) Hormones – 7 each	– Monitor progress and then trigger testing when appropriate for the constituents of concern, possibly 1 to 2 years prior to MCL being enacted.
US EPA and CDPH – modify MCL for Manganese (Mn)	Currently Mn is regulated with an MCL of 50 µg/L. There are discussions as part of Contaminant Candidate List 4 within US EPA to possibly lower the MCL, which may be lowered to 25 µg/L.	Development of a revised MCL may occur over the next 10 to 20 years.	If the MCL were reduced to 25 µg/L, CDPH typically requires the Mn concentration to be 80% of the MCL. Currently the water quality test detection limit is 20 µg/L with all wells producing less than 20 µg/L. No current impact to District.	– Continue to monitor discussions within US EPA and CDPH on revising manganese MCL. – Consider lowering the detection limit for Mn to 15 µg/L or less during sampling of well water qualities.

Table 5-10. Future Water Quality and Climate Change Requirements				
Regulatory Agency and Regulation Name	Description Summary	Actual or Anticipated Implementation Date	Impacts to the District	Recommended District Steps
US EPA Contaminant Candidate List 4 (CCL 4)	US EPA working on the CCL 4 that will include 100 chemicals and 12 microbials, which will include remaining CCL 3 members with the addition of Mn and nonylphenol.	Nominations closed on June 22, 2012 Issuing list date is to be determined by US EPA	To be determined based on the 30 candidates that make it on to the UCMR 4 list	– Track US EPA activities and comment as the UCMR 4 list is developed.
US EPA and CDPH Total Coliform Rule (TCR) Revisions	Changing from a monthly MCL violation to an assessment of the TC problem and taking corrective actions.	Published on February 13, 2013 and compliance date April 1, 2016	Establishes triggers to enact a Level 1 self-assessment, Level 2 qualified party detailed assessment, and coliform treatment techniques. Treatment technique based on Total Coliform (TC) and E. coli and an MCL for E. coli. Acute violation based on E. coli only. Modifies the reporting requirements. Prepare a written sampling plan by March 31, 2016 if not done so already. Repeat sampling sites can be fixed by the District if they are in the sampling plan or criteria for selection outlined in the sampling plan. Complete same samples routine for every TC positive sample the following month. Modify sampling methods. Modify Consumer Confidence Report information on TCR violations.	– Comply with TCR Revisions.
US EPA Lead and Copper Rule Long-term Revisions	US EPA evaluating the current rule. Evaluate what is effective and what should be modified.	Original SBAR #43 Panel efforts by US EPA completed in April 16, 2013 and are being revisited. No time table for issuing updated information on the rule revisions.	Currently District not having Lead and Copper issues in their water system.	– District will need to monitor US EPA activities in revising the Lead and Copper Rule.

5.10 Future System Planning

The hydraulic model developed as part of the WSOP is a powerful tool for the District to use in future system planning. The hydraulic model can be used by the District to perform further system evaluations or identify system improvement programs. Listed below are items for the District to incorporate to improve the hydraulic model results in the future and programs that the hydraulic model can be used to assist the District in implementing.

- SCADA Collection – improve the collection of SCADA information to include the ability to collect hourly (or smaller increments) tank level and flows, booster pump pressures and flows, and system valve flows. The flow information can be used to develop system specific diurnal curves and pressure zone specific curves. (Project 55)
- Demand Allocation – allocate actual meter usage throughout the system to improve the model operational results. As the District installs and gathers more meter usage, it will be important to update the model to reflect where actual usage occurs. This will allow the District to allocate demands during different seasons in the Tahoe area. (Project 56)
- Fire Flow Field Calibration – improve the results of the fire flow evaluations by performing additional field testing. (Project 57)
- New hydrant installations – Use the “all nodes” scenario to evaluate where additional hydrants would be effectively added to 4-inch diameter pipelines. (Project 58)
- Fighting Forest Fires – Evaluate existing system performance and identify operational procedures and system improvements to increase fire flows for extended periods of time.(Project 59)
- Valve Criticality/Vulnerability – evaluate critical valves and help identify “panhandle” areas and unvalved areas that are vulnerable in emergency and shut-down scenarios. (Project 60)
- Pipeline Replacement Priority – develop a pipeline replacement program based on physical attributes of pipelines such as diameter, age, and material as well as leak history. In addition, incorporate consequence of failure from model results to identify pipelines critical to maintaining level of service. Figure 5-47 shows location of existing small diameter pipelines as an example of physical attributes. (Project 61)
- Water Quality Evaluation – evaluate the system’s water quality to determine operational options to improve water quality during low demand periods. Accurate demand allocation and system diurnals are important to being able to evaluate system water quality. (Project 62)
- Unidirectional Flushing Program – create a unidirectional flushing program to improve efficiency to the District’s flushing program. (Project 63)

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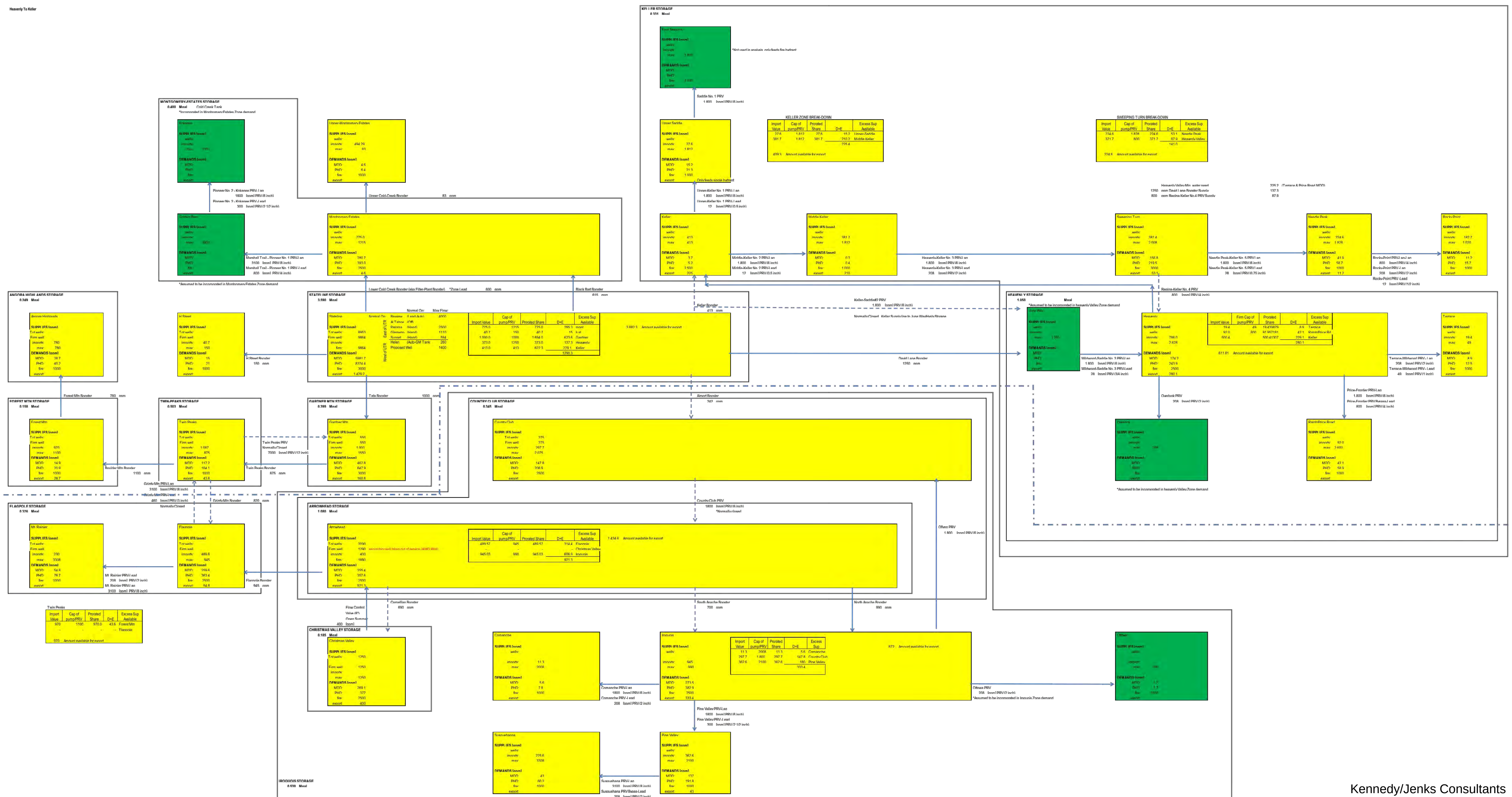

Kennedy/Jenks Consultants

SOUTH TAHOE PUBLIC UTILITIES DISTRICT
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 1

K/J 1270004.00

FIGURE 5-1

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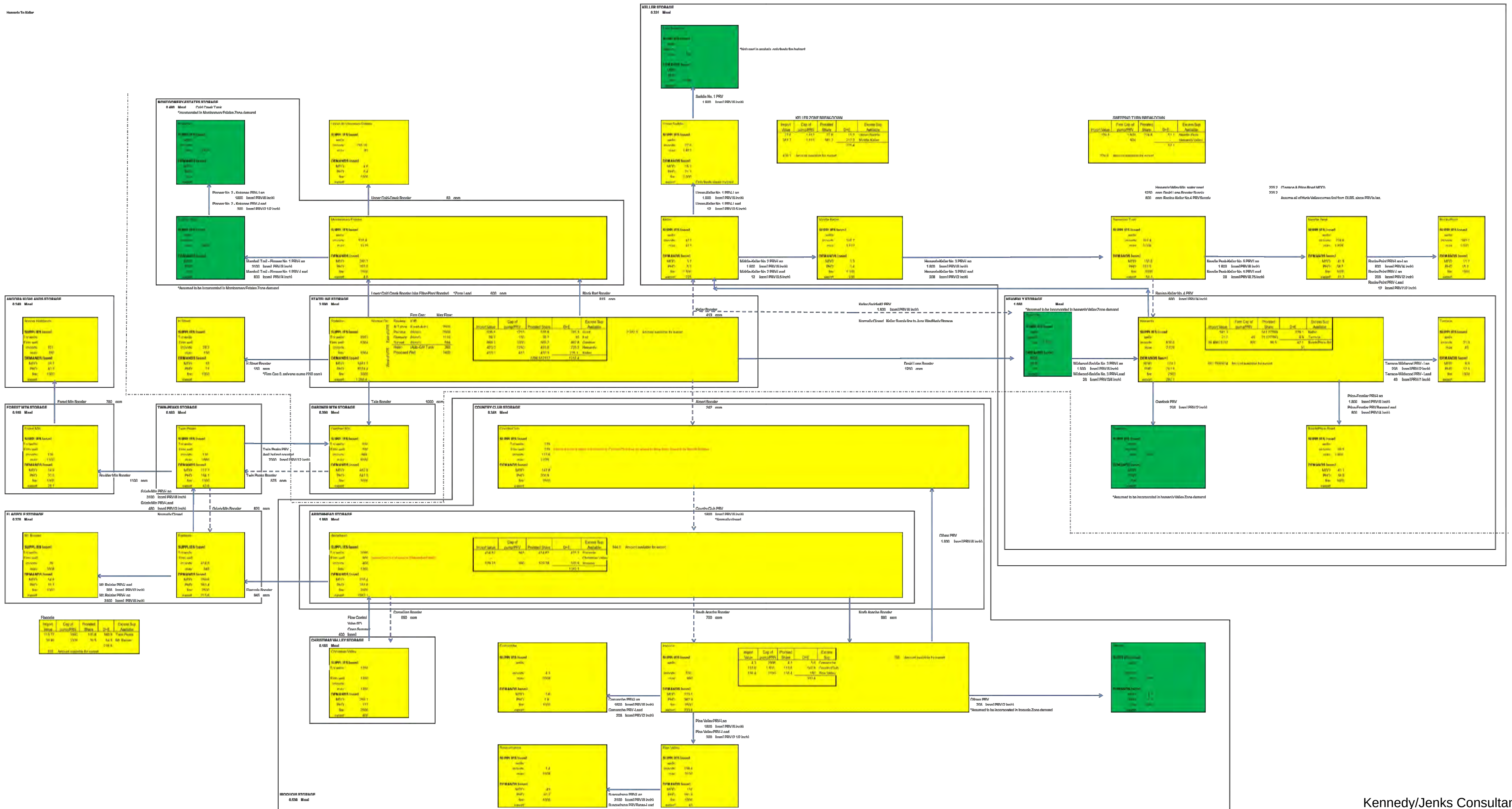

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SOUTH TAHOE PUBLIC UTILITIES DISTRICT
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 2

K/J 1270004.00

FIGURE 5-2

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1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 2A

K/J 1270004.00

FIGURE 5-3

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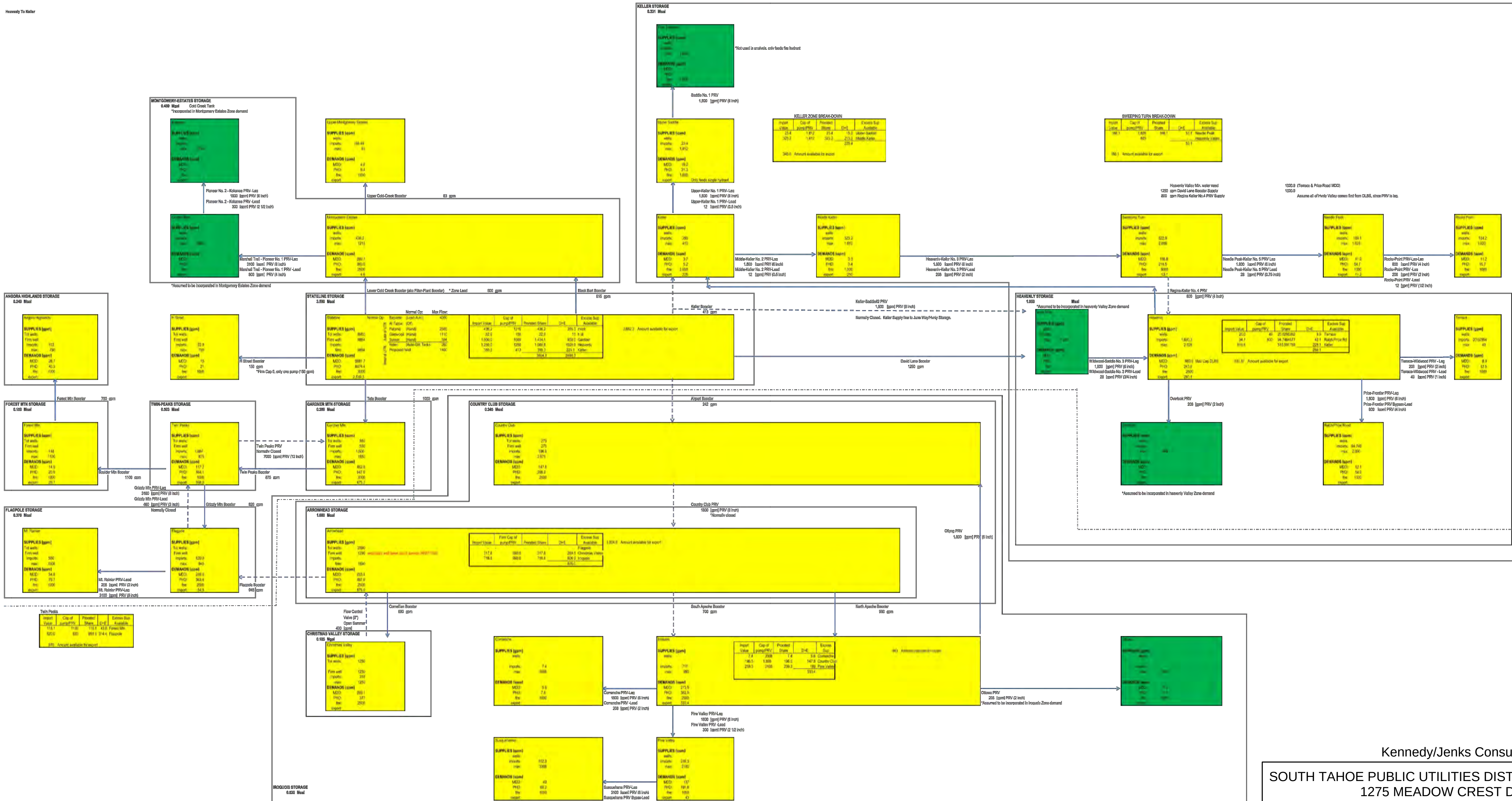

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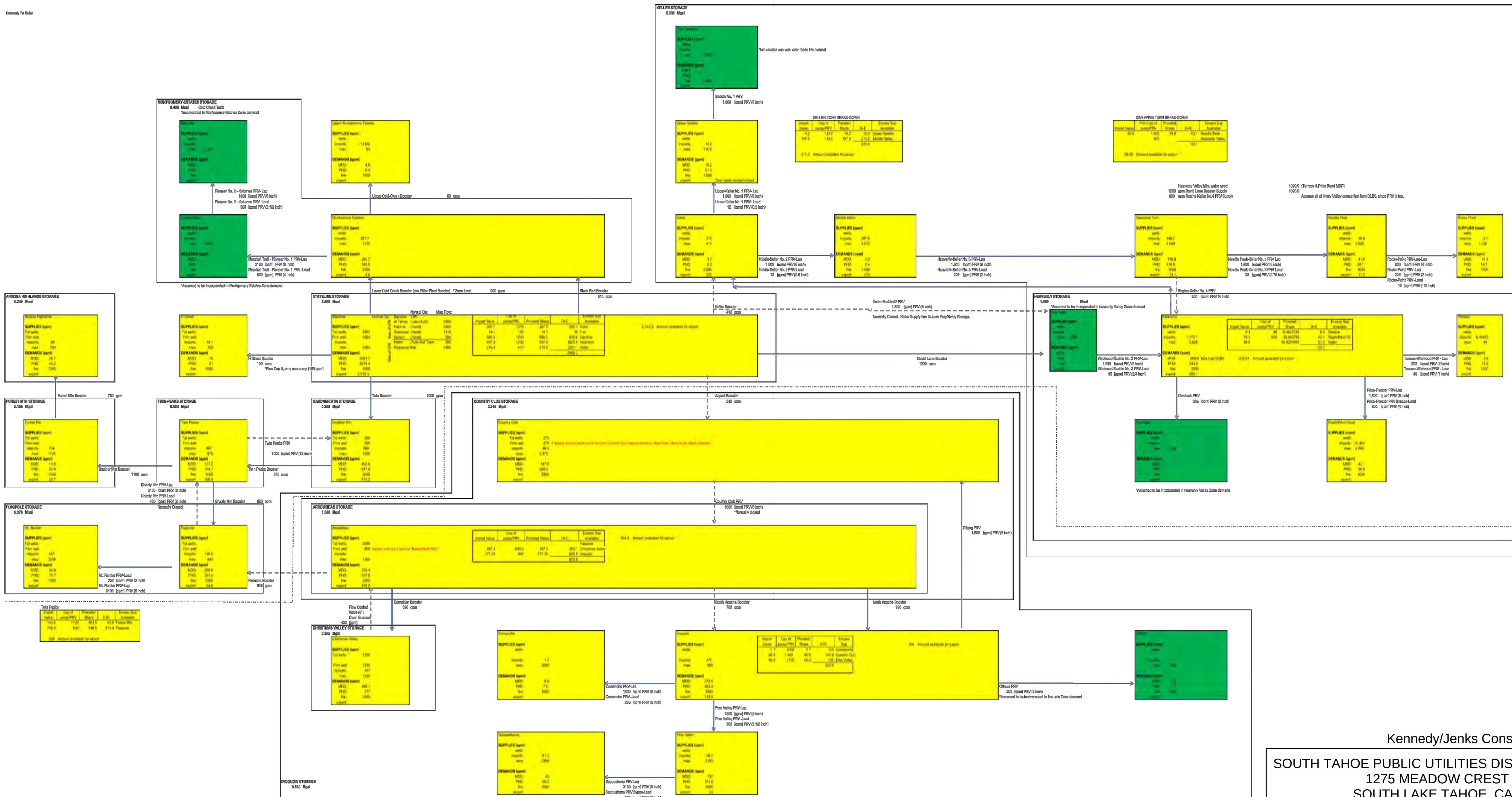
SOUTH TAHOE PUBLIC UTILITIES DISTRICT
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY BLOCK DIAGRAM OPERATIONAL SCENARIO 3

K/J 1270004.00

FIGURE 5-4



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SOUTH TAHOE PUBLIC UTILITIES DISTRICT
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 4

K/J 1270004.00

FIGURE 5-5

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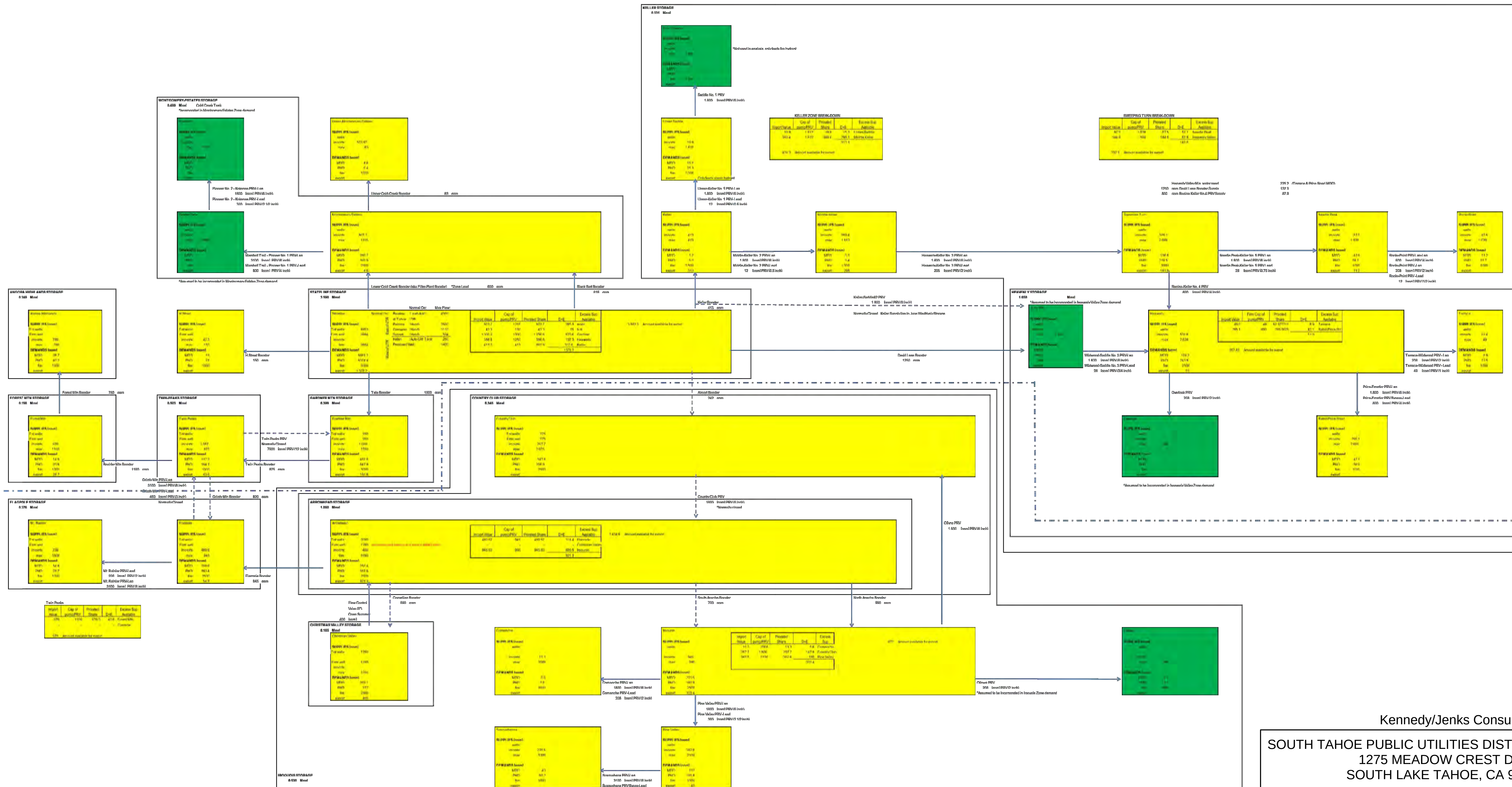

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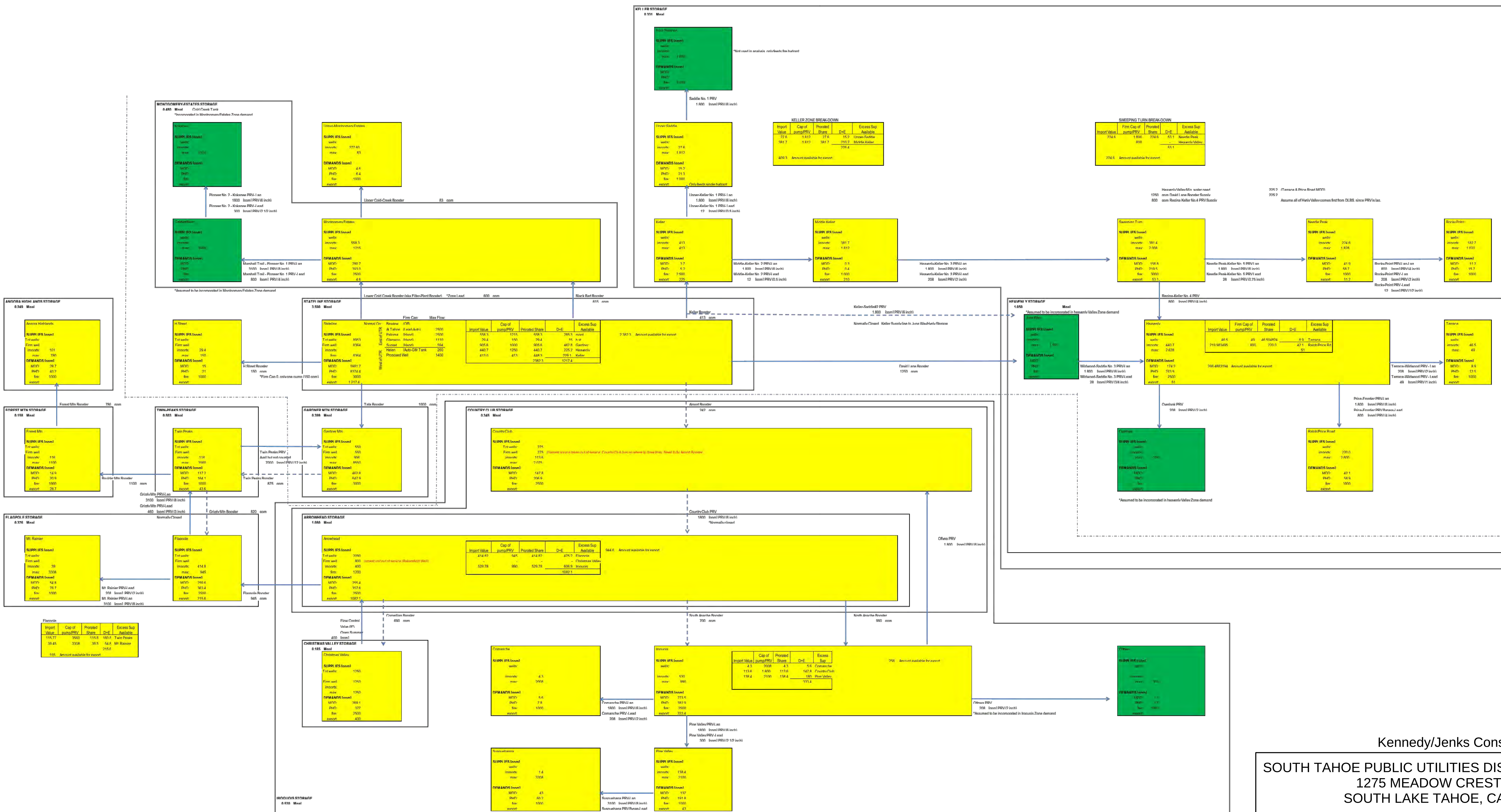
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 1 H TO K

K/J 1270004.00

FIGURE 5-6



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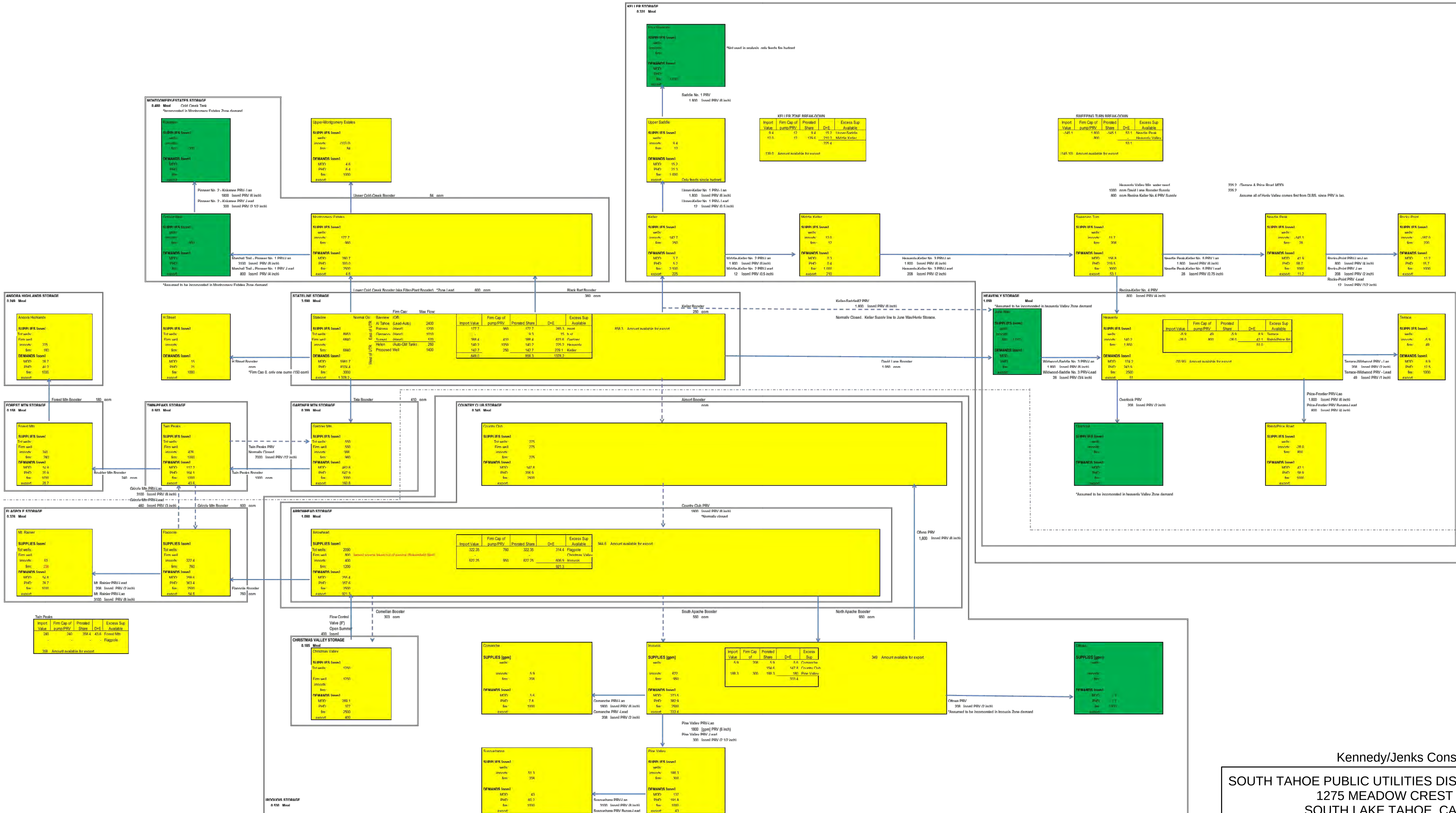
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 2 H TO K

K/J 1270004.00

FIGURE 5-7



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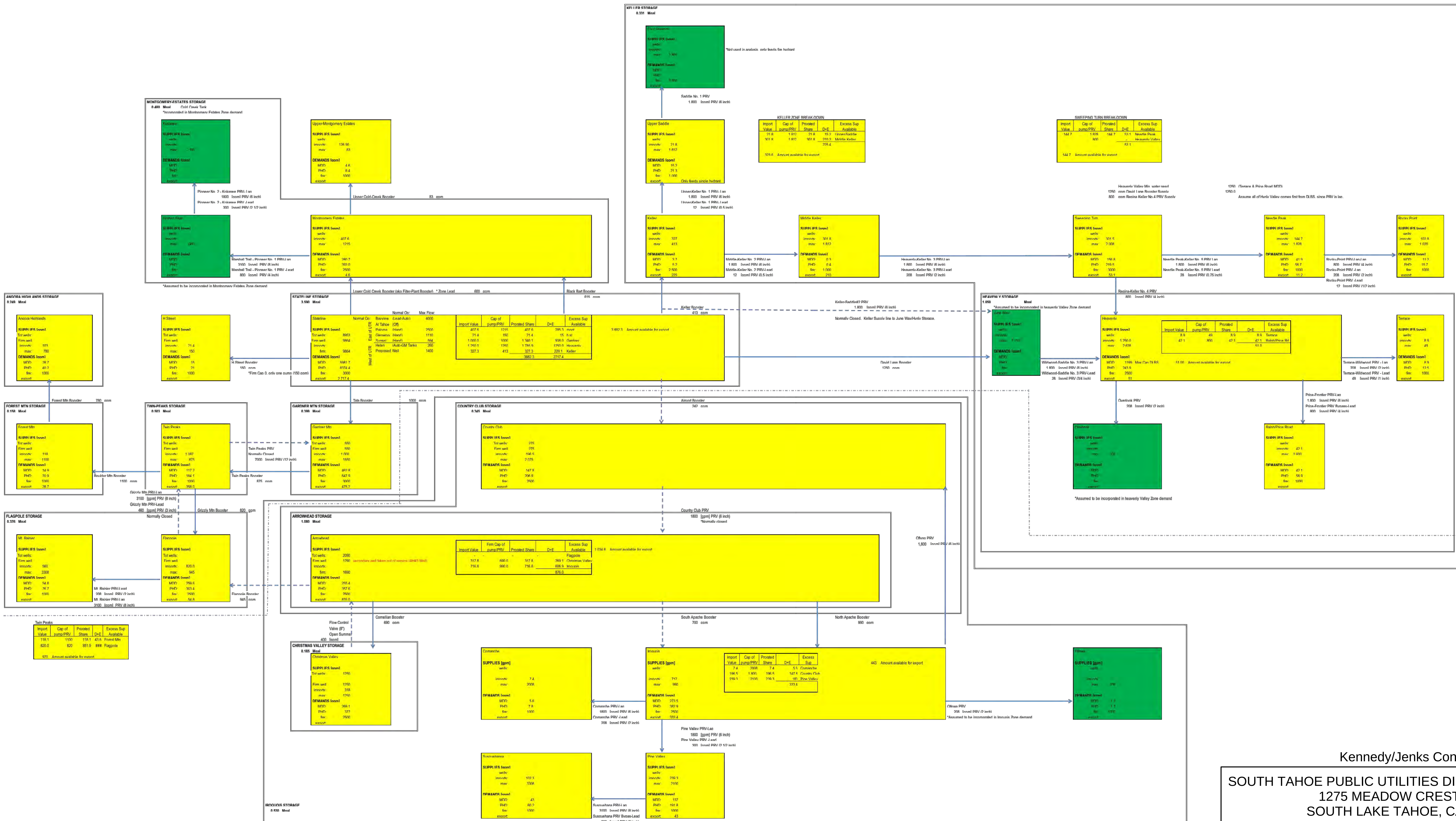
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY BLOCK DIAGRAM OPERATIONAL SCENARIO 2A H TO K

K/J 1270004.00

FIGURE 5-8



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1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 3 H TO K

K/J 1270004.00

FIGURE 5-9

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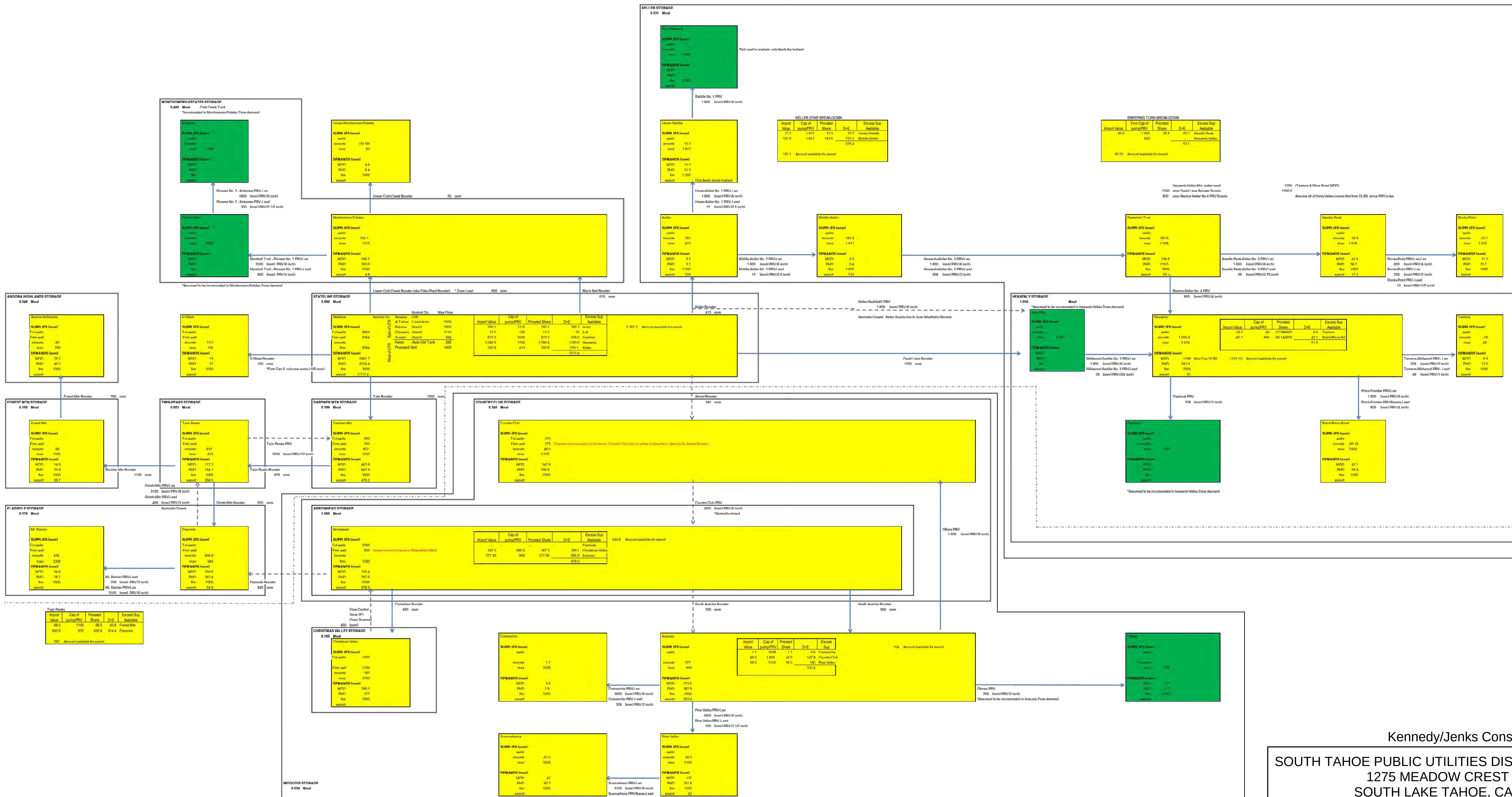

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SOUTH TAHOE PUBLIC UTILITIES DISTRICT
1275 MEADOW CREST DRIVE
SOUTH LAKE TAHOE, CA 96150

WATER DEMAND AND SUPPLY
BLOCK DIAGRAM OPERATIONAL
SCENARIO 4 H TO K

K/J 1270004.00

FIGURE 5-10

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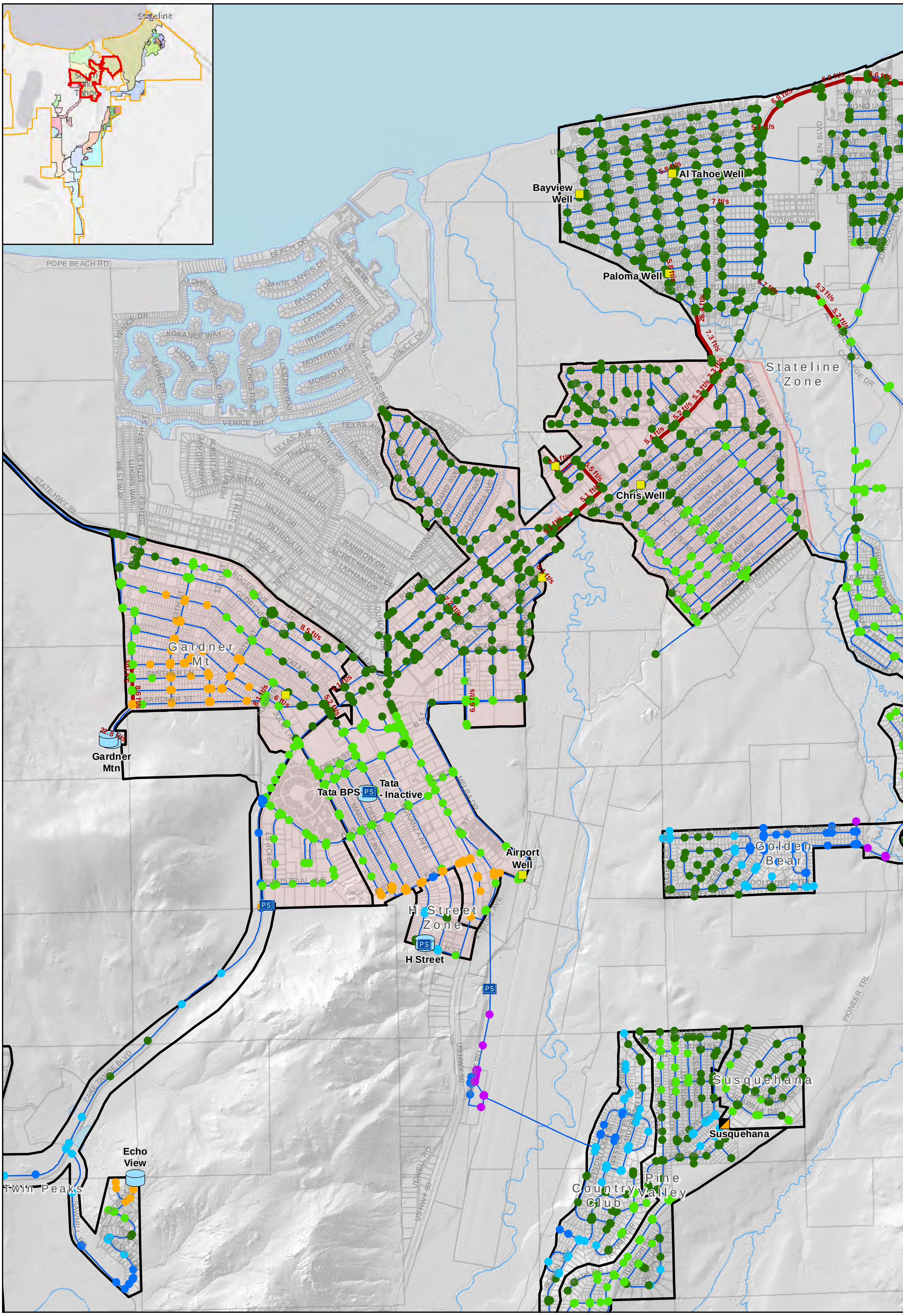

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank

PS Booster Pump Station
Groundwater Well
PRV

Note:
Zones include: Gardner Mt., H Street, Part of Stateline

0 900 1800
Scale in Feet

FIGURE 5-11
(Gardner Mt)

South Lake Tahoe PUD
Water System Optimization Plan

MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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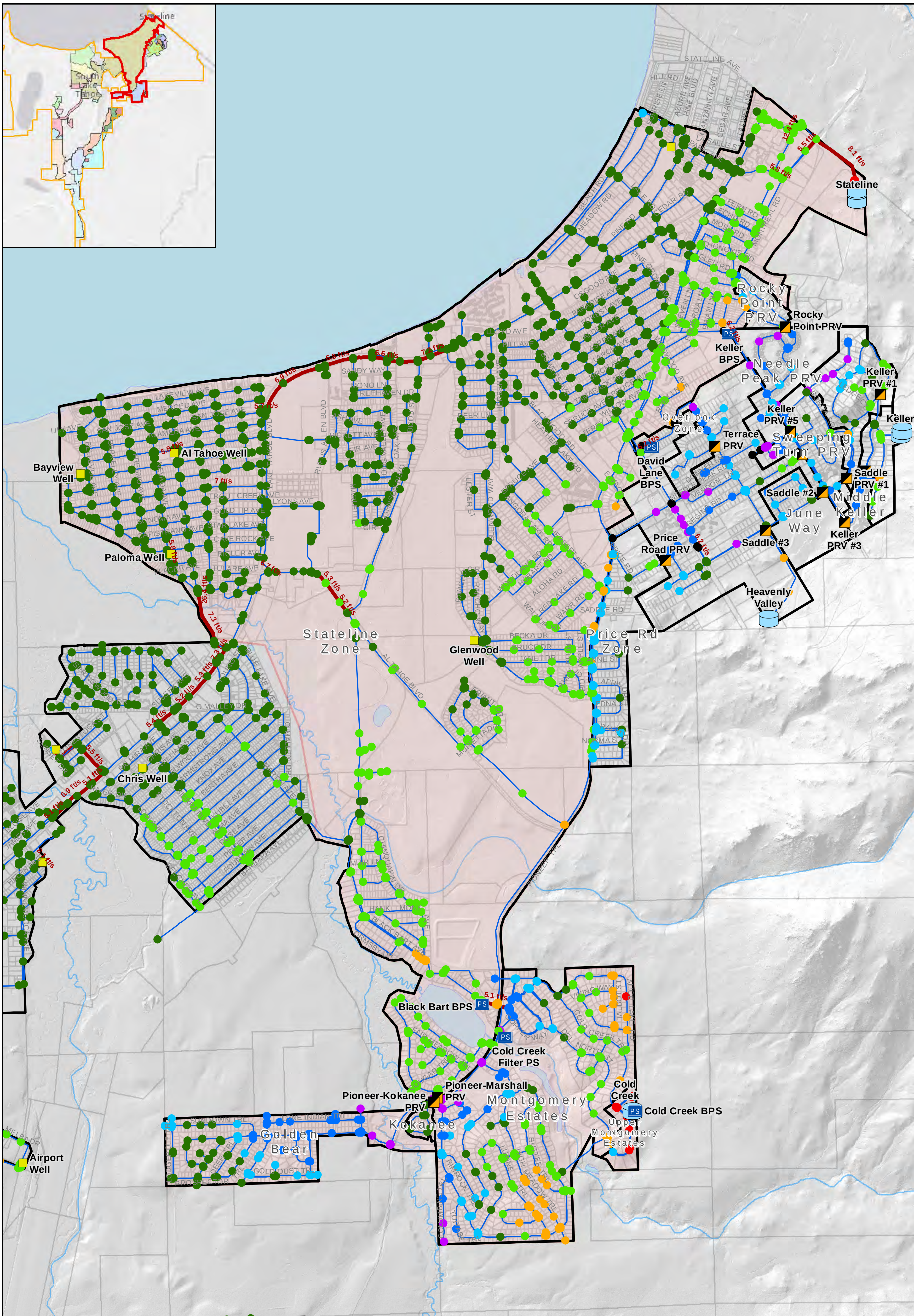

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank

PS Booster Pump Station
Groundwater Well
PRV

Note:
Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

0 900 1800
Scale in Feet

FIGURE 5-12
(Stateline Zone)

South Lake Tahoe PUD
Water System Optimization Plan

MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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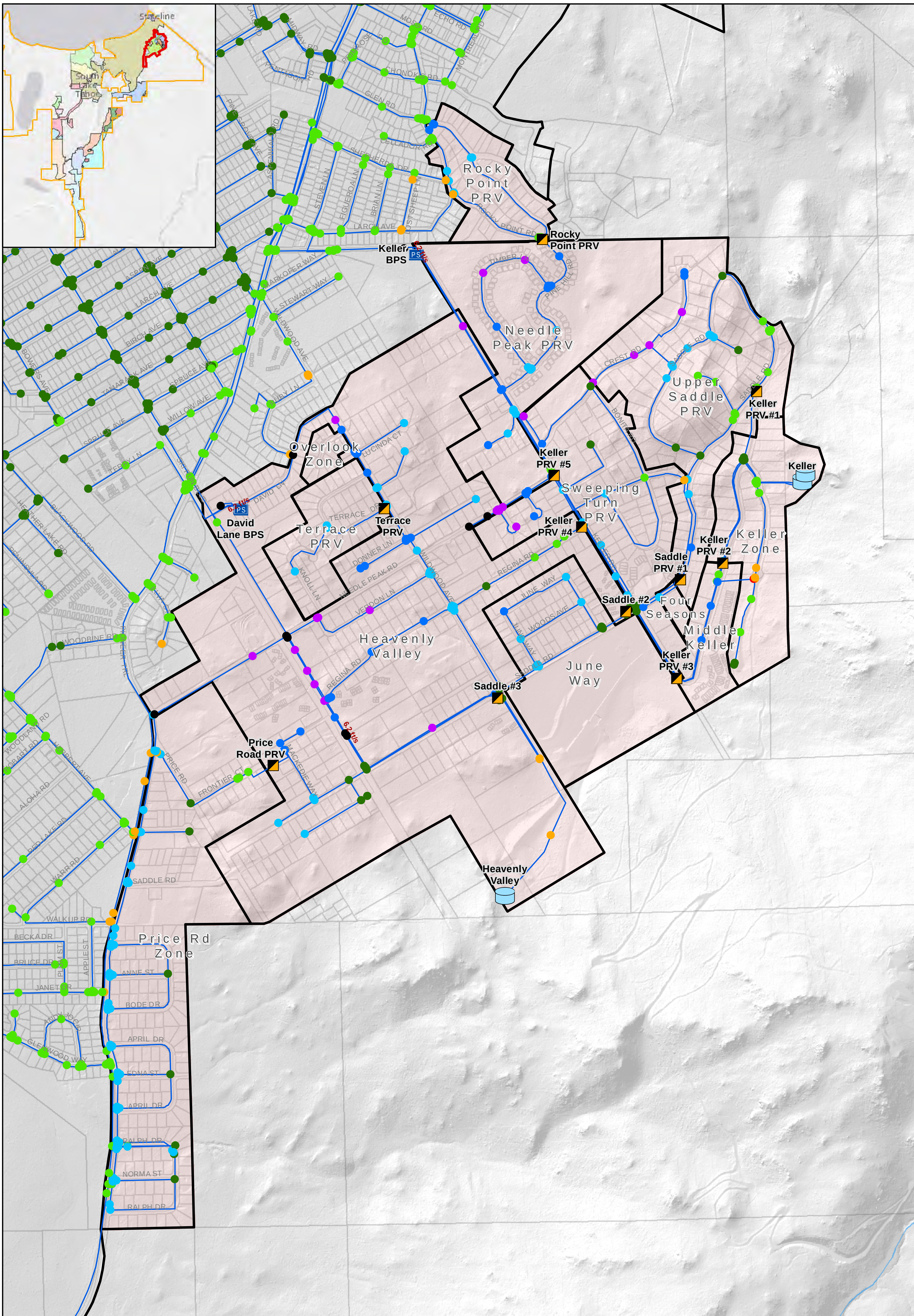

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- Storage Tank
- PS Booster Pump Station
- Groundwater Well
- PRV

Note:
Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

N

0 400 800

Scale in Feet

FIGURE 5-13
(Heavenly Valley)

South Lake Tahoe PUD
Water System Optimization Plan
MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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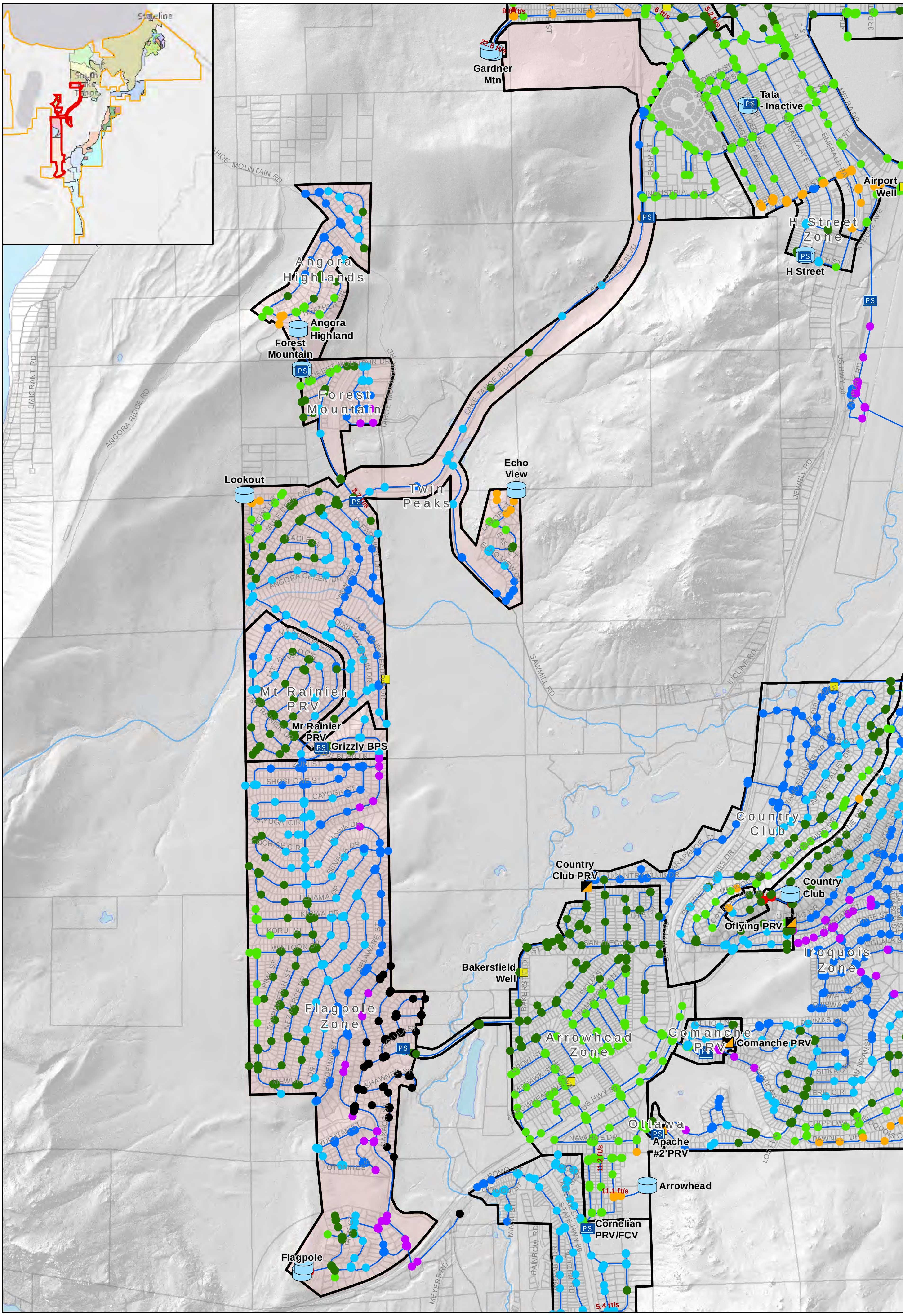

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- Storage Tank
- Booster Pump Station
- Groundwater Well
- PRV

Note:
Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

0 900 1800
Scale in Feet

FIGURE 5-14
(Twin Peaks)

South Lake Tahoe PUD
Water System Optimization Plan

MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

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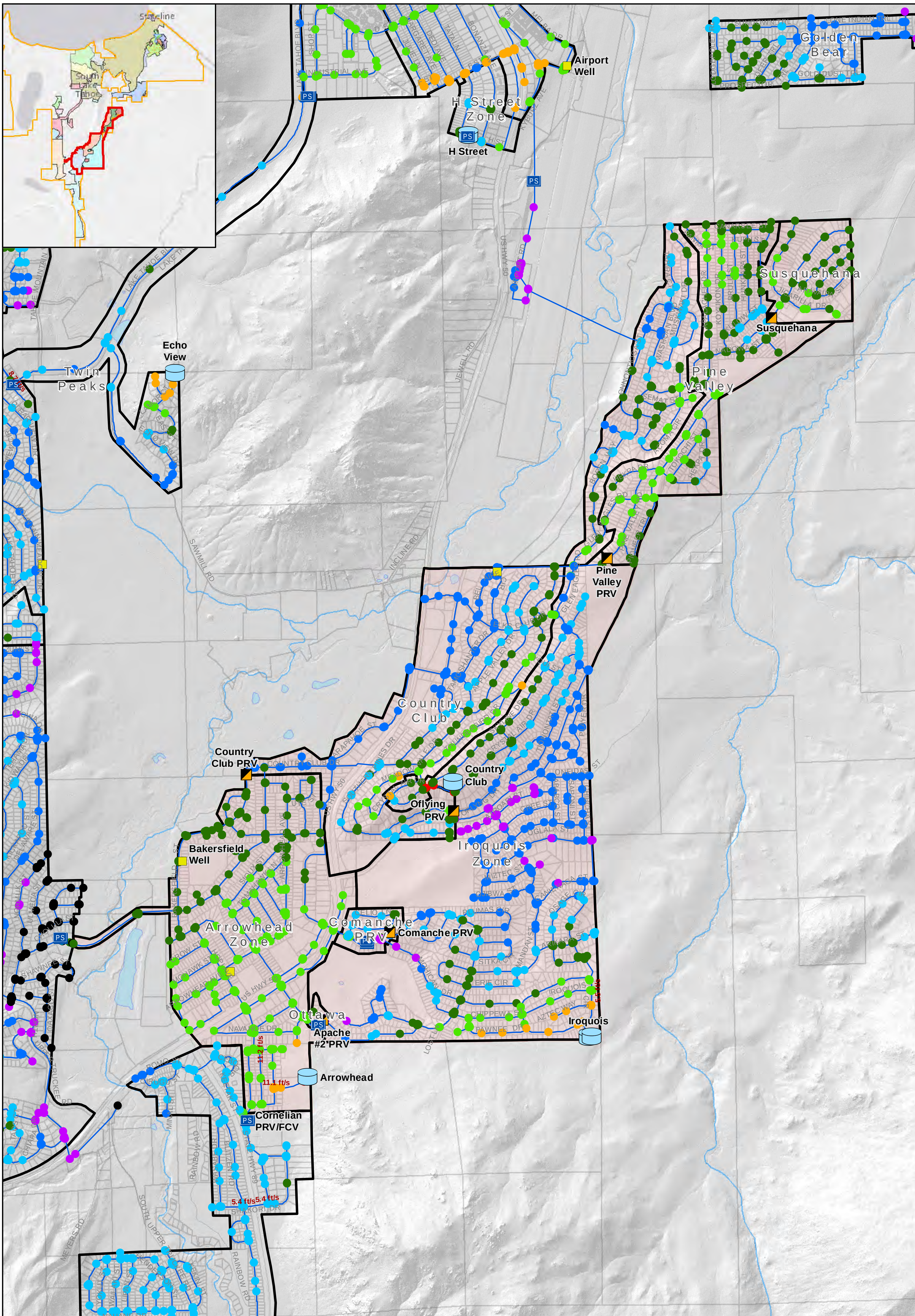

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- Storage Tank

- PS Booster Pump Station
- Groundwater Well
- PRV

Note:
Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

0 900 1800
Scale in Feet

FIGURE 5-15
(Arrowhead Zone)

South Lake Tahoe PUD
Water System Optimization Plan
MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
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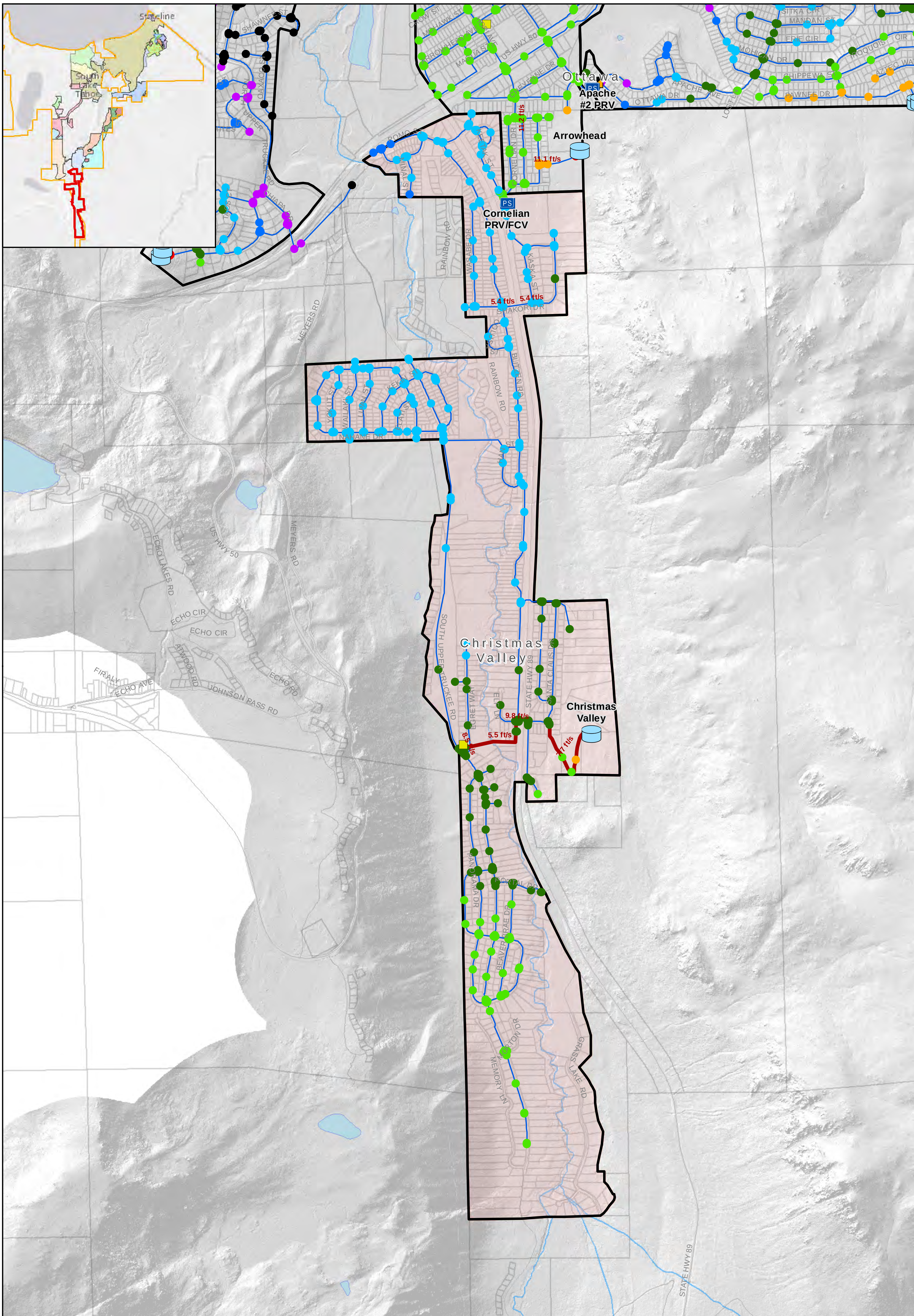

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank

PS Booster Pump Station
Groundwater Well
PRV

Note:
Zones include: Christmas Valley

N

0 750 1500
Scale in Feet

FIGURE 5-16
(Christmas Valley)

South Lake Tahoe PUD
Water System Optimization Plan

MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

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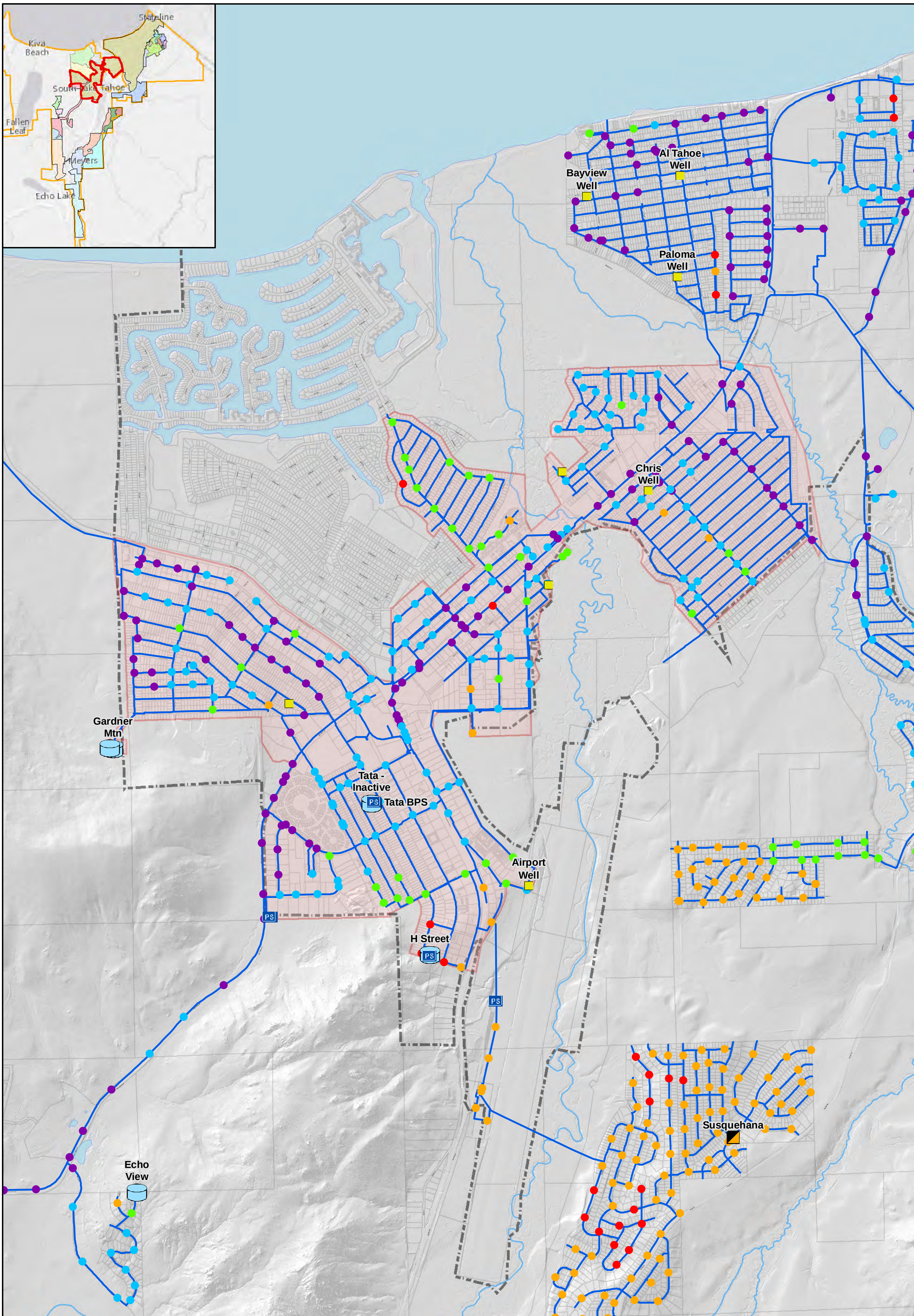

Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
PS Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Gardner Mt., H Street, Part of Stateline

N

0 900 1800
Scale in Feet

FIGURE 5-17
(Gardner Mt)

South Lake Tahoe PUD
Water System Optimization Plan
EXISTING SYSTEM
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
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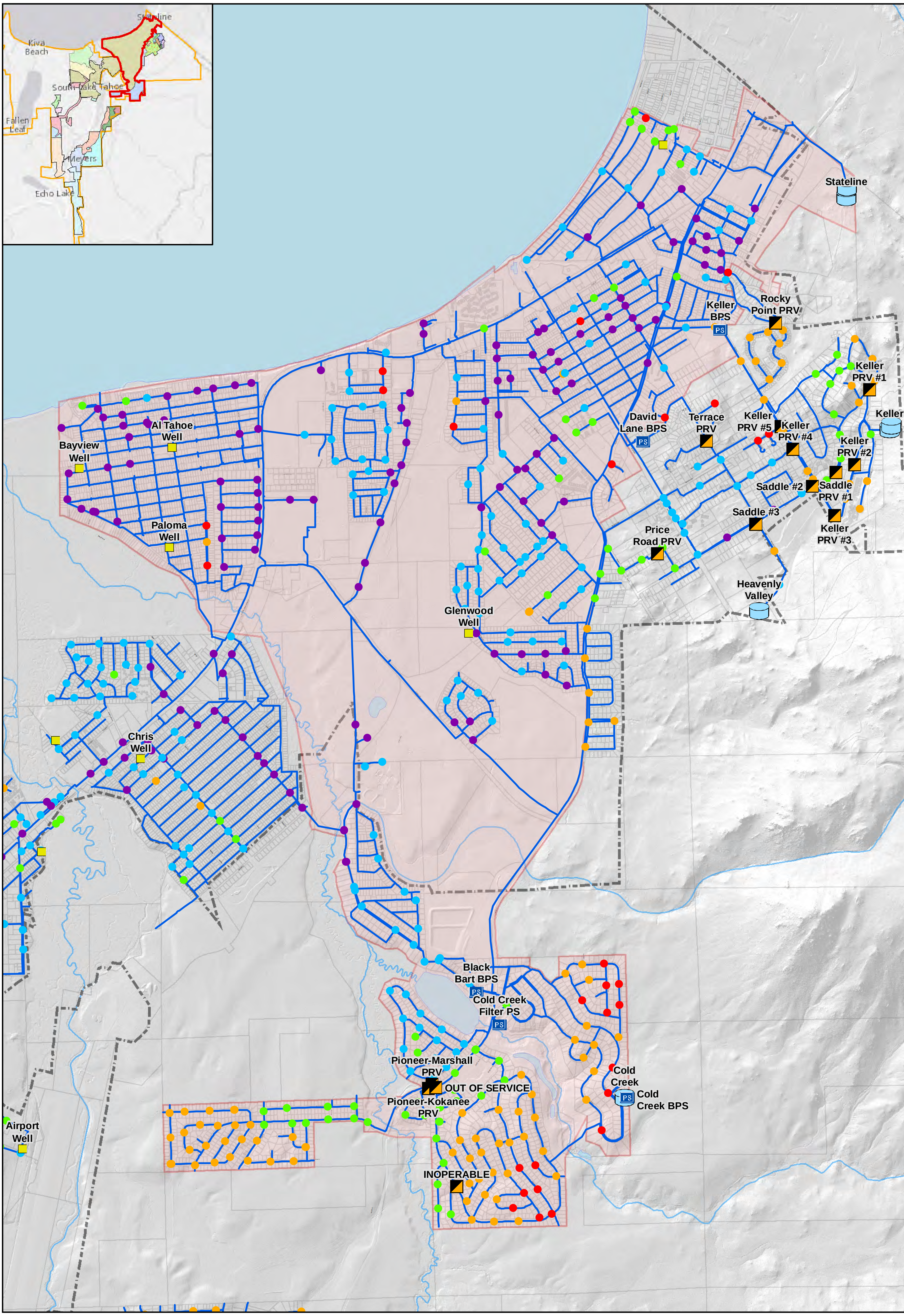

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Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
PS Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

0 900 1800
Scale in Feet

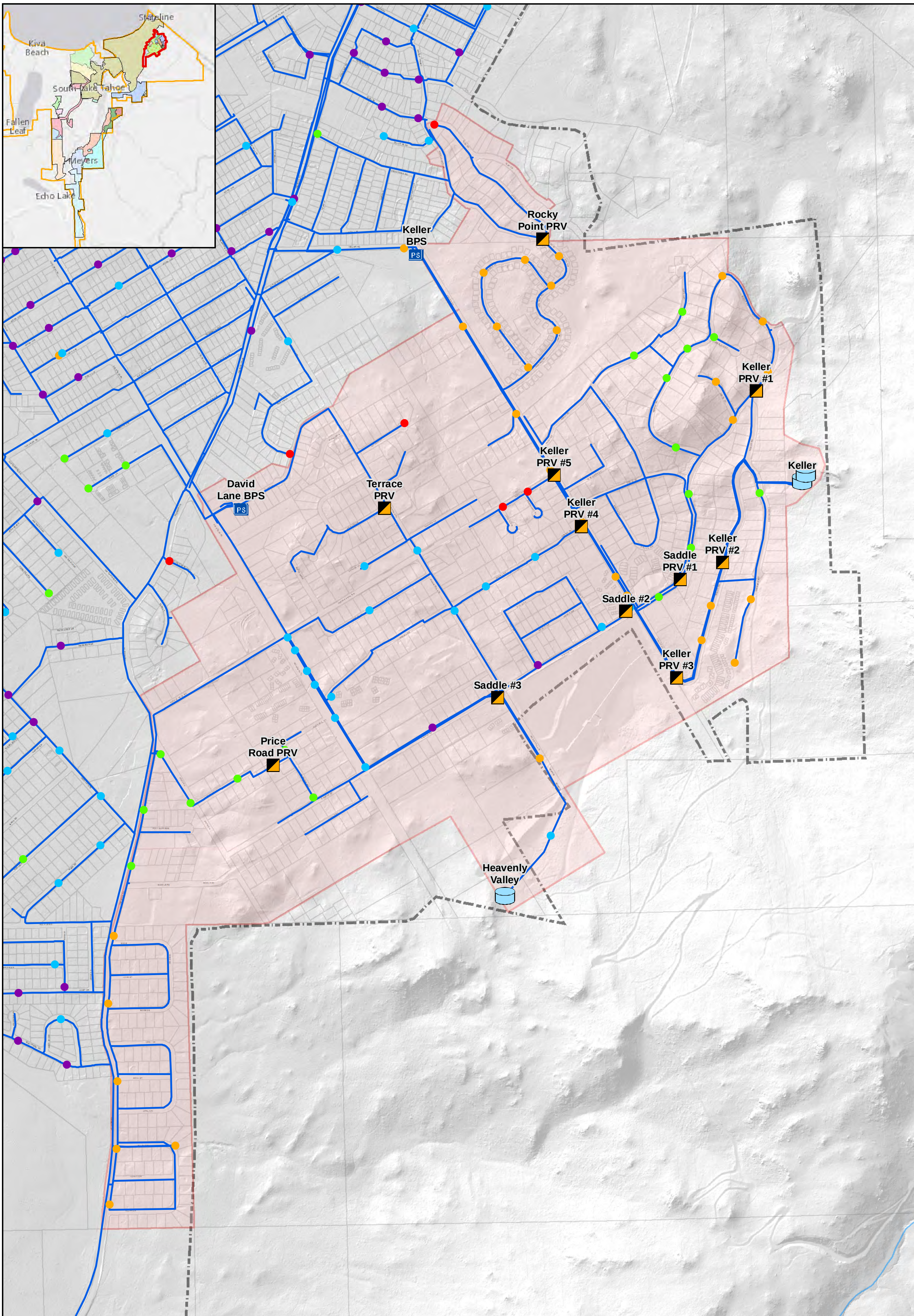
N

FIGURE 5-18
(Stateline Zone)

South Lake Tahoe PUD
Water System Optimization Plan

EXISTING SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

N

0 400 800
Scale in Feet

FIGURE 5-19
(Heavenly Valley)

South Lake Tahoe PUD
Water System Optimization Plan
EXISTING SYSTEM
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
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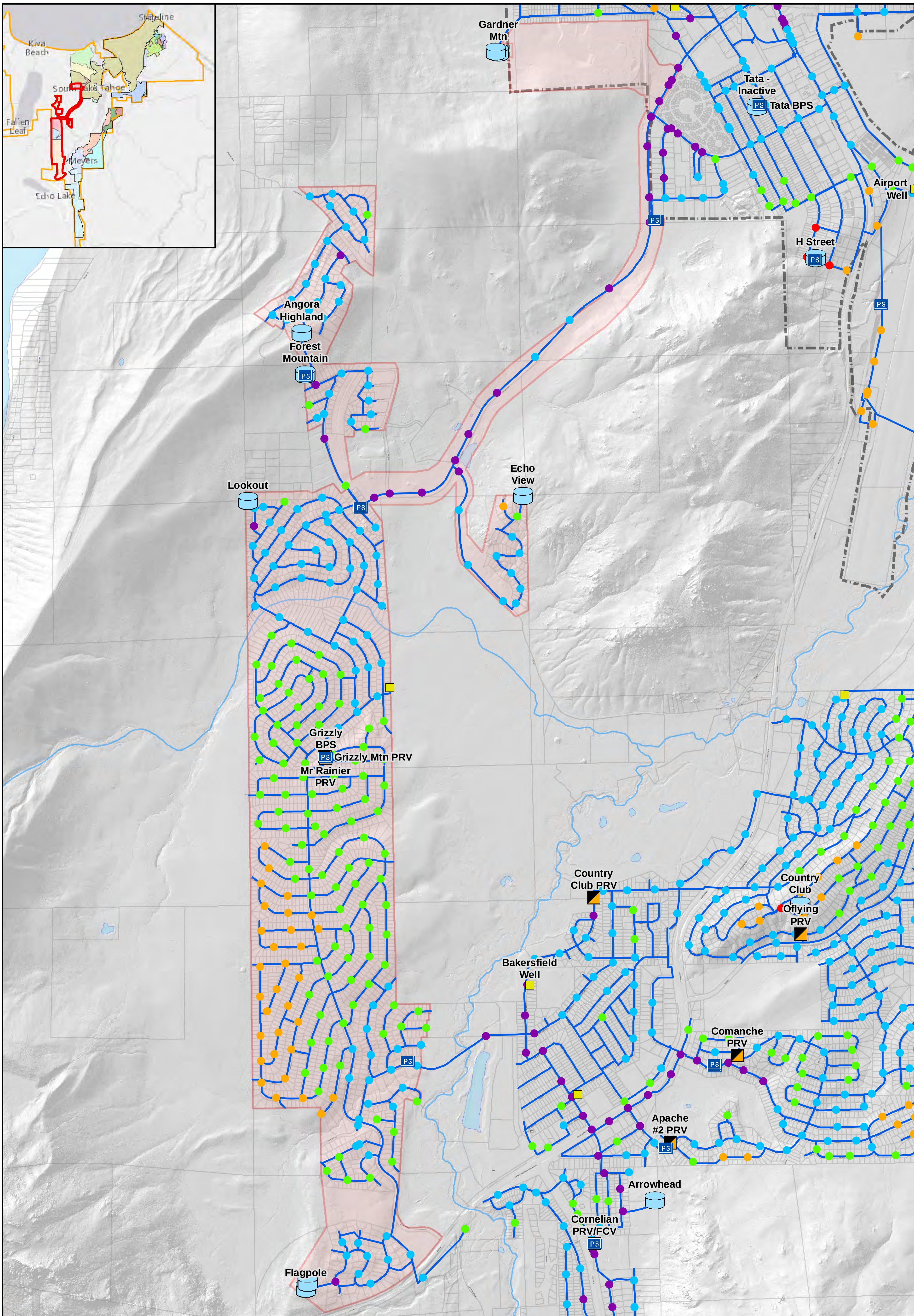

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Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
PS Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

N

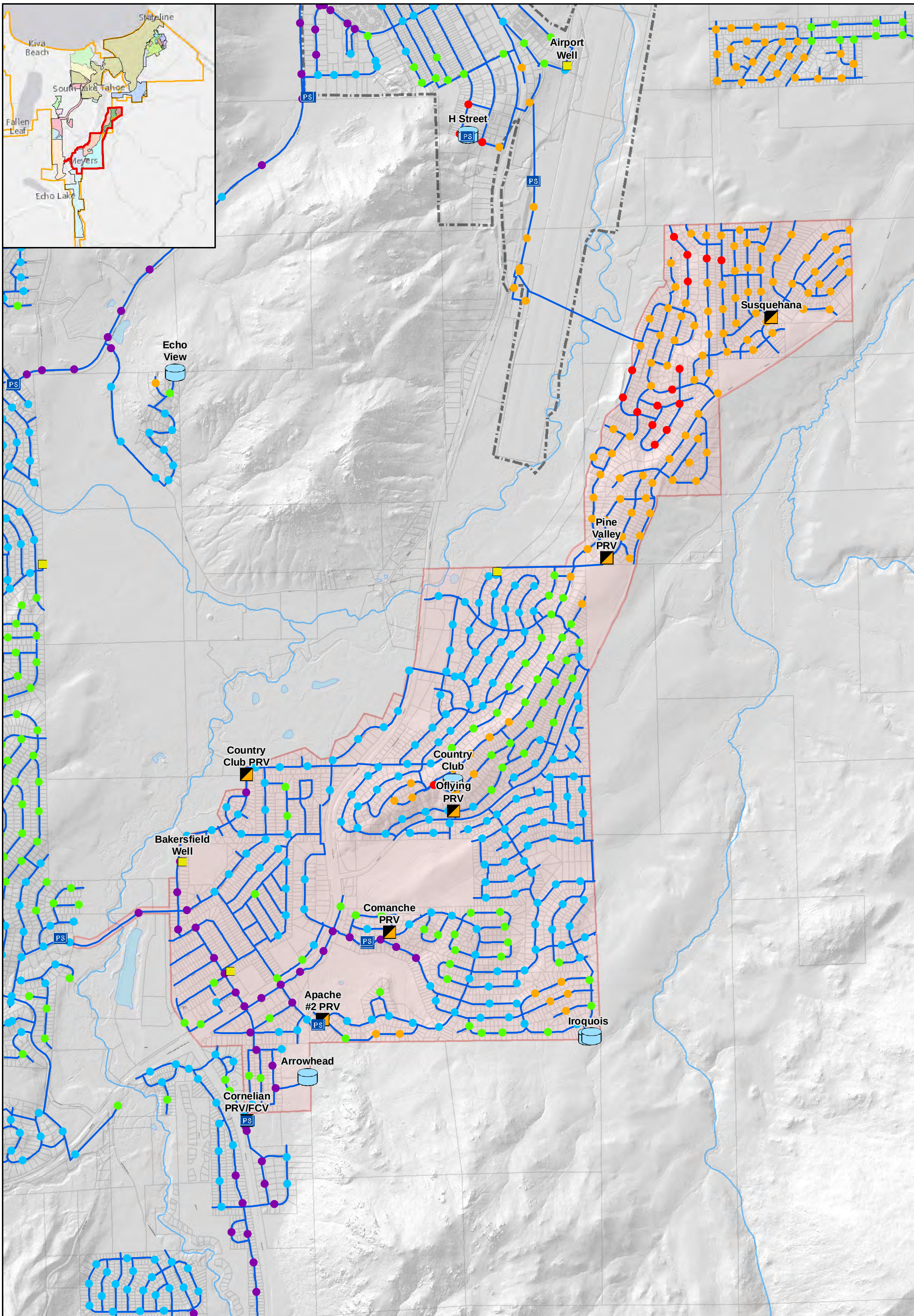
0 900 1800

Scale in Feet

FIGURE 5-20
(Twin Peaks)

South Lake Tahoe PUD
Water System Optimization Plan
EXISTING SYSTEM
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

0 900 1800
Scale in Feet

FIGURE 5-21
(Arrowhead Zone)

South Lake Tahoe PUD

Water System Optimization Plan

EXISTING SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
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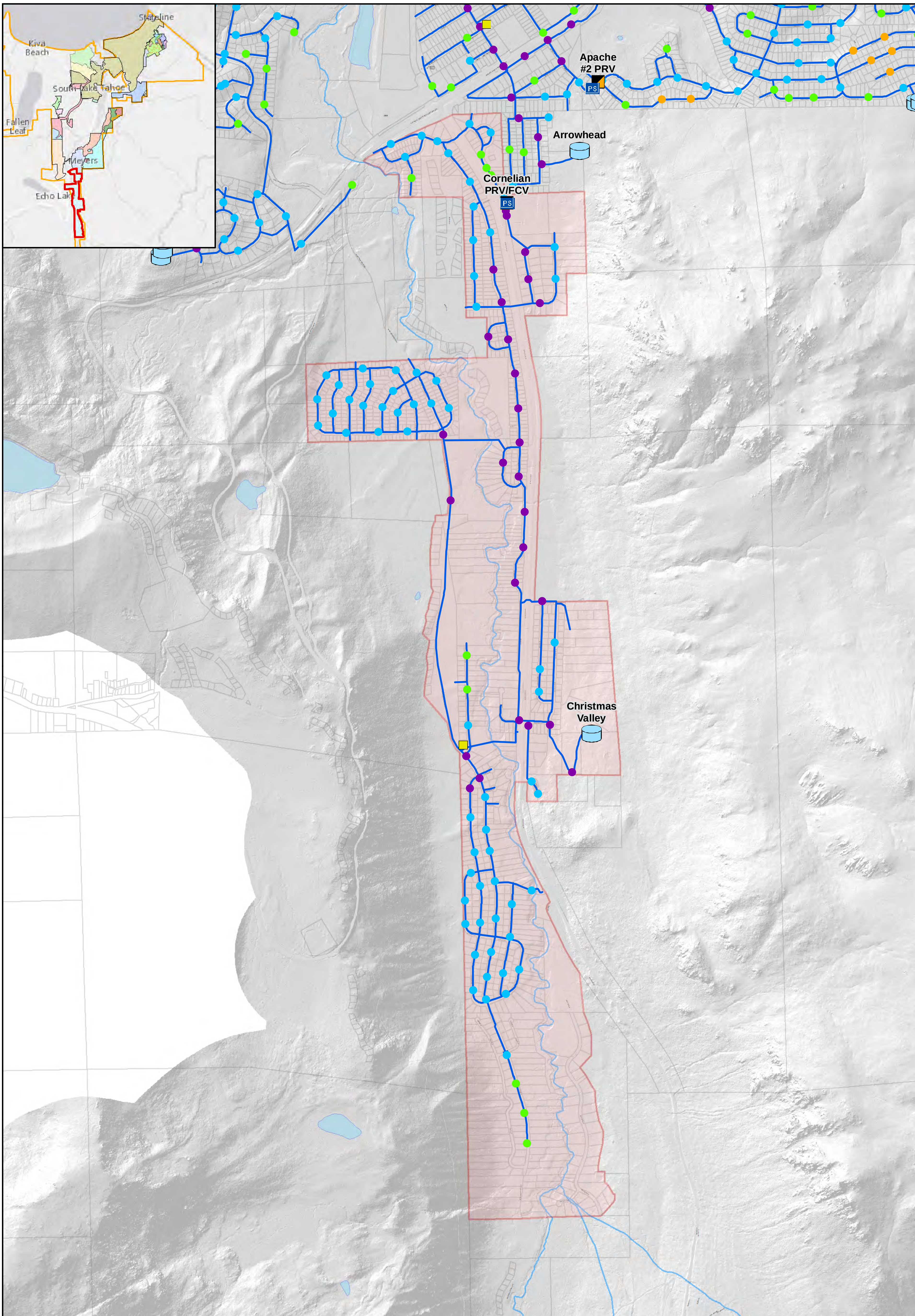

Available fire flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
PS Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Christmas Valley

N

0 750 1500
Scale in Feet

FIGURE 5-22 (Christmas Valley)

South Lake Tahoe PUD

Water System Optimization Plan

EXISTING SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
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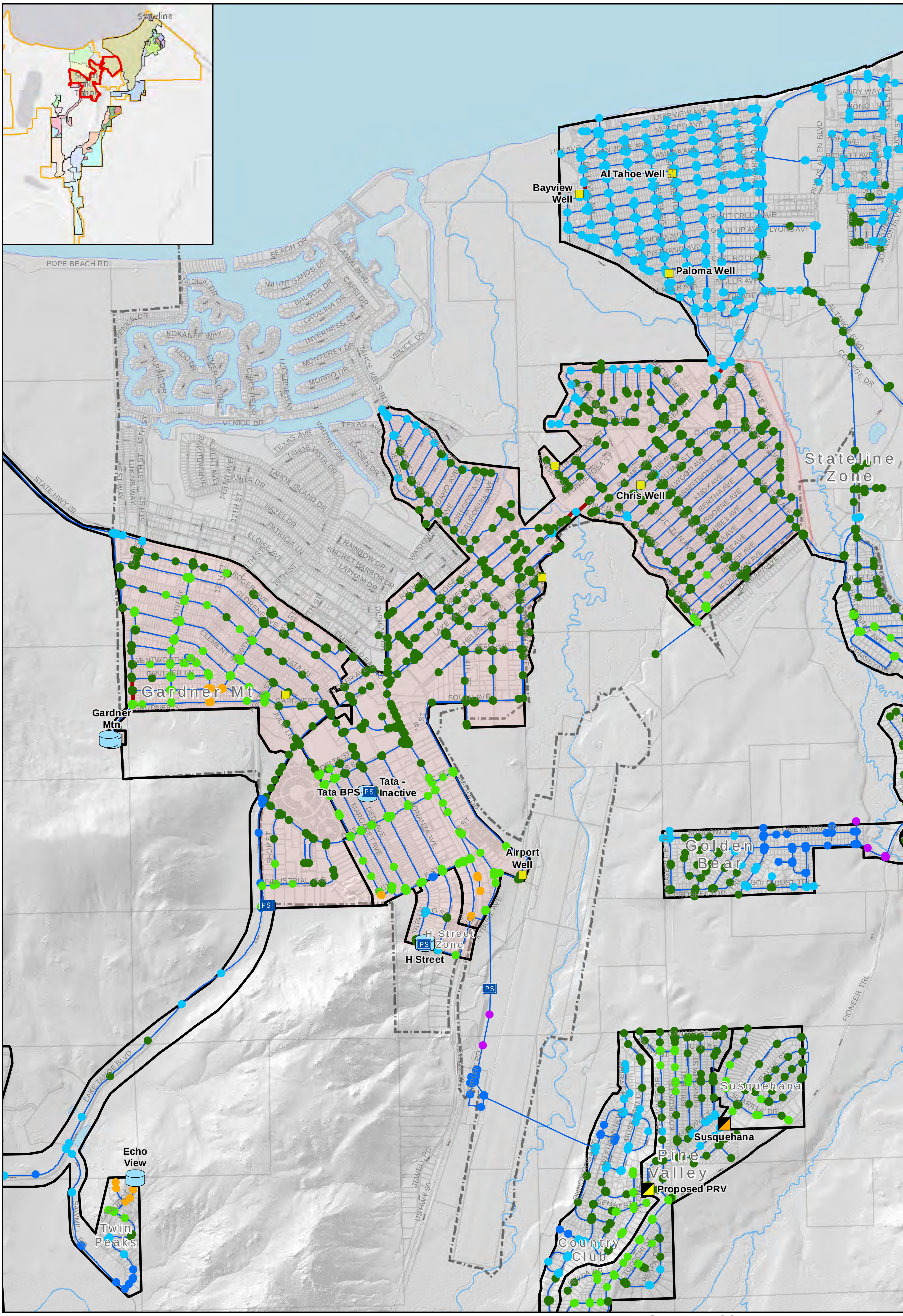


Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank
PS Booster Pump Station
Groundwater Well
Existing PRV
Proposed PRV

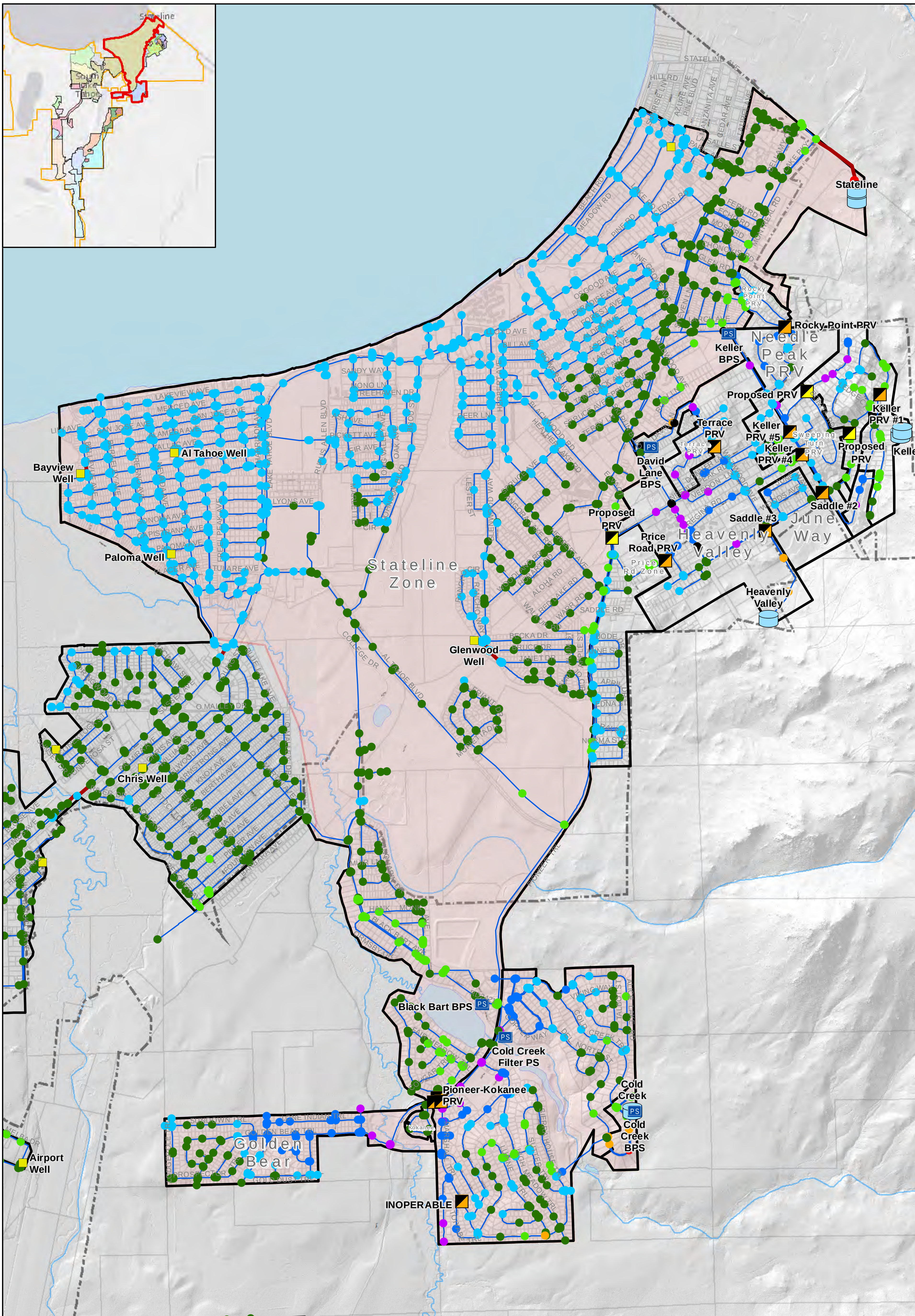
Note:
Zones include: Gardner Mt., H Street, Part of Stateline

N

0 900 1800
Scale in Feet

FIGURE 5-23
(Gardner Mt)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers



Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

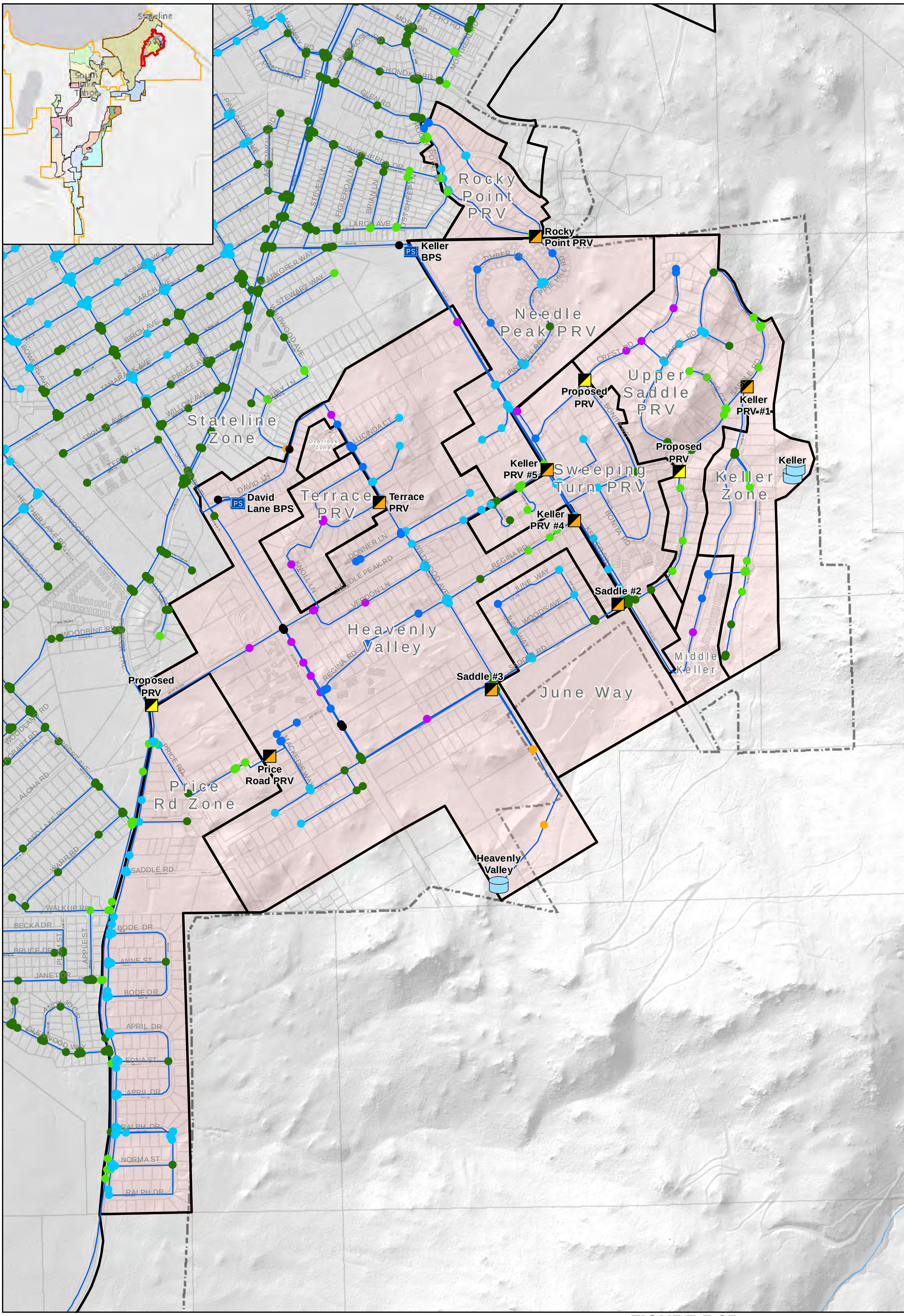
Less than 5 ft/s
Greater than 5 ft/s
Storage Tank
Booster Pump Station
Groundwater Well
Existing PRV
Proposed PRV

Note:
Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

0 900 1800
Scale in Feet

FIGURE 5-24
(Stateline Zone)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers



Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank

PS Booster Pump Station
Groundwater Well

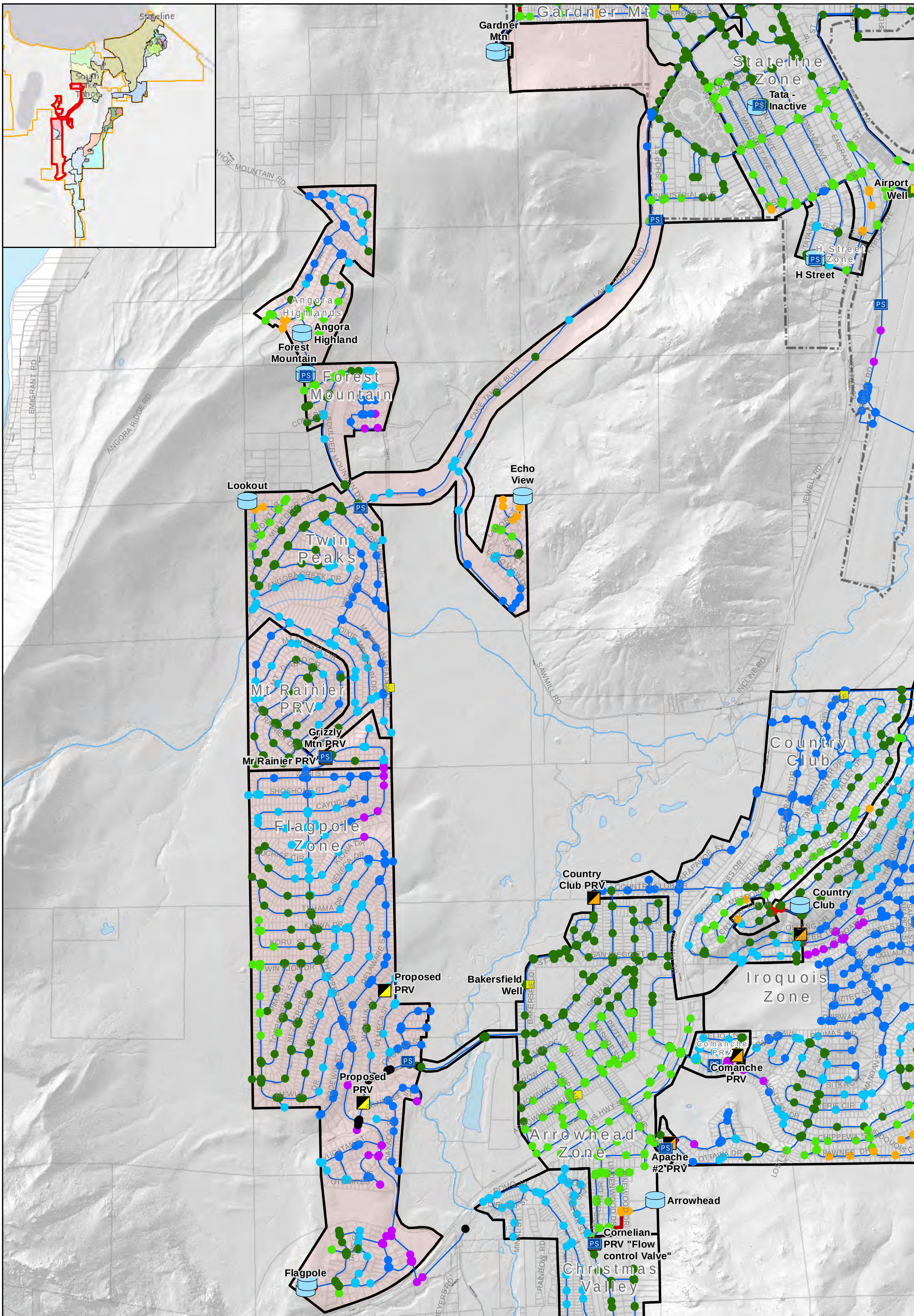
Existing PRV
Proposed PRV

Note:
Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

0 400 800
Scale in Feet

FIGURE 5-25
(Heavenly Valley)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers



Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
Storage Tank
PS Booster Pump Station
Groundwater Well
Existing PRV
Proposed PRV

Note:
Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

0 900 1800
Scale in Feet

FIGURE 5-26
(Twin Peaks)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

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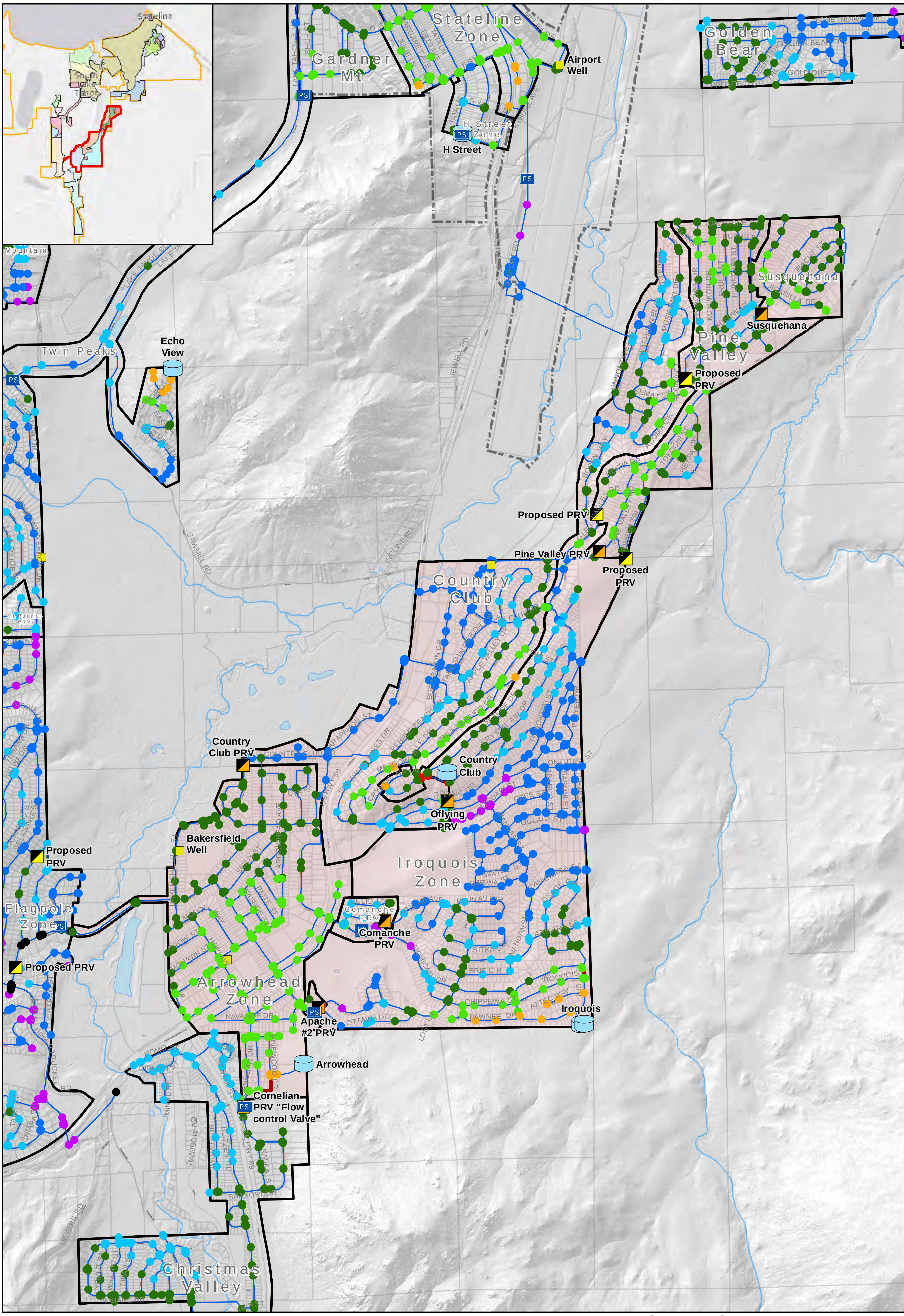

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- Storage Tank
- Booster Pump Station
- Groundwater Well
- Existing PRV
- Proposed PRV

Note:
Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

0 900 1800
Scale in Feet

FIGURE 5-27
(Arrowhead Zone)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

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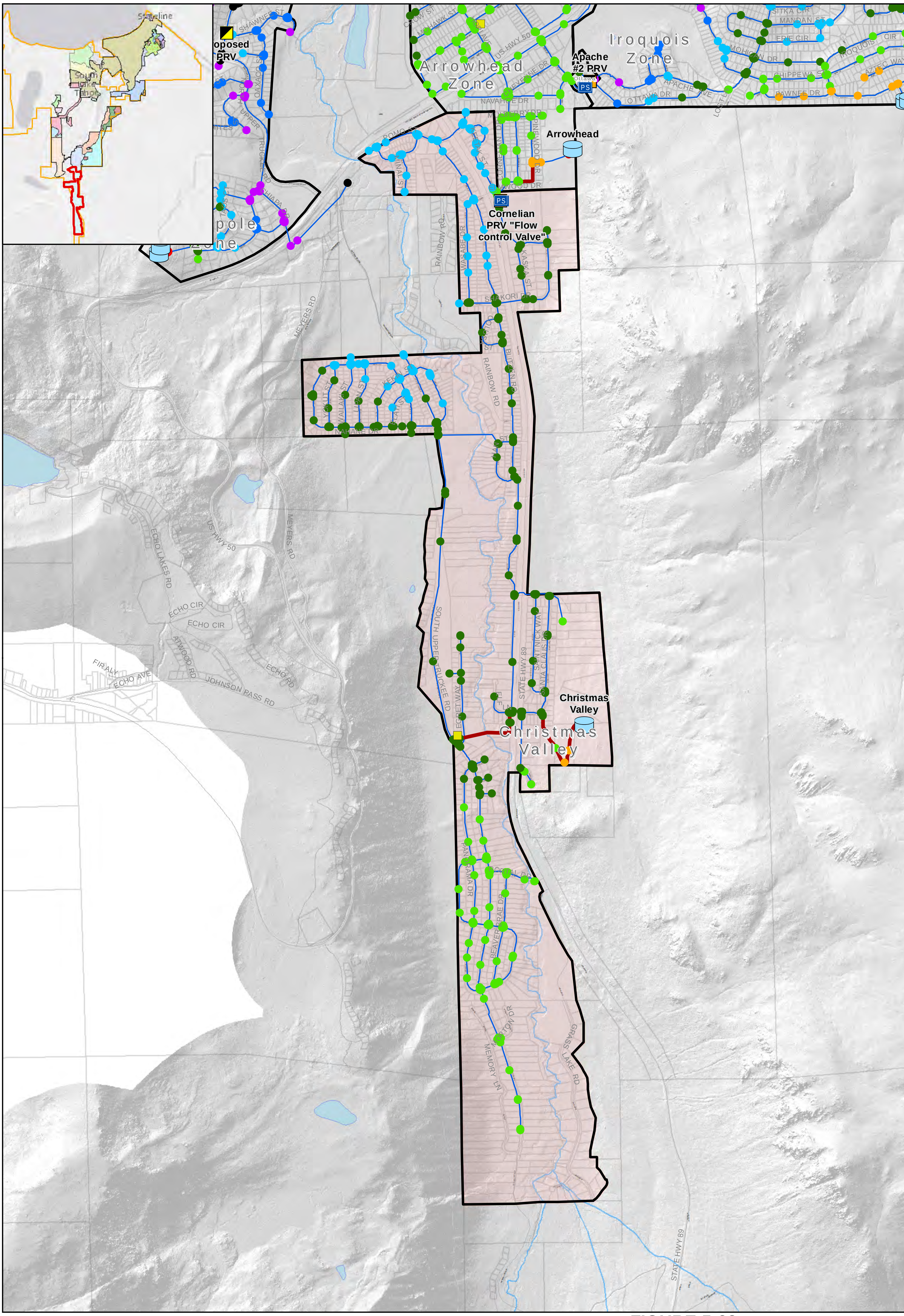

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- Storage Tank
- PS Booster Pump Station
- Groundwater Well
- Existing PRV
- Proposed PRV

Note:
Zones include: Christmas Valley

0 750 1500
Scale in Feet

FIGURE 5-28
(Christmas Valley)
South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

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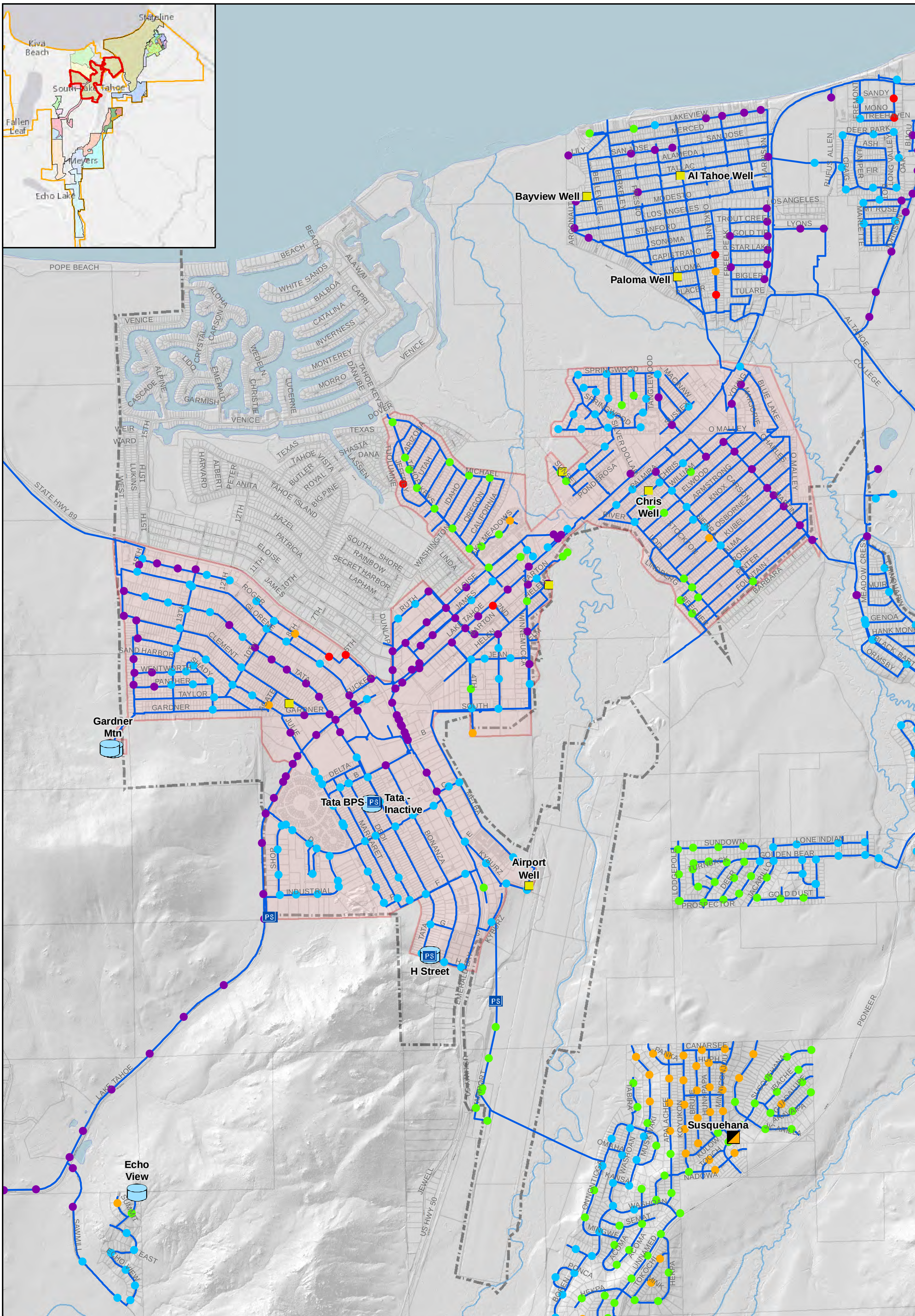

I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Gardner Mt., H Street, Part of Stateline

0 900 1800
Scale in Feet

FIGURE 5-29
(Gardner Mt)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS AVAILABLE FIRE FLOW

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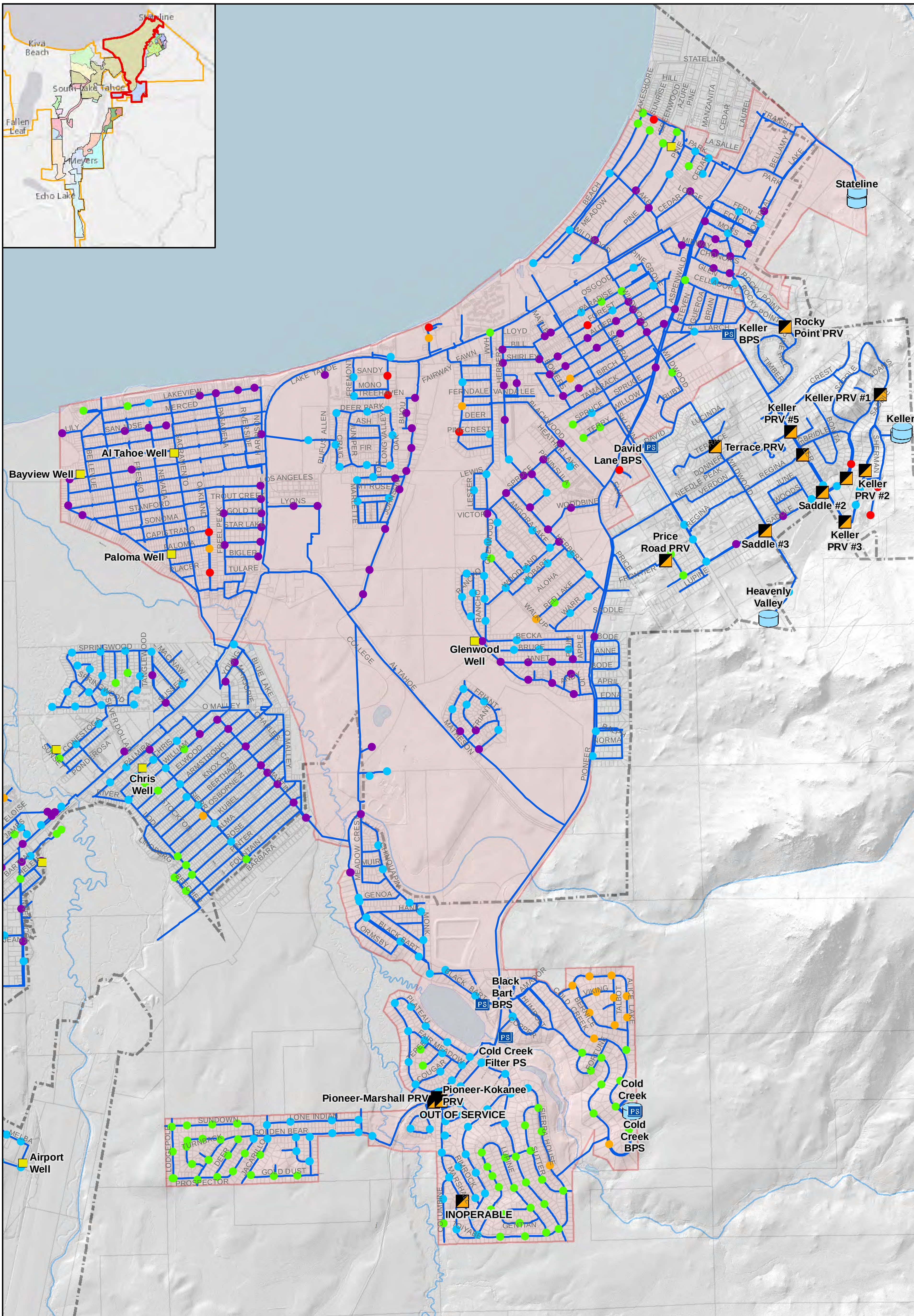

I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

N

0 900 1800
Scale in Feet

FIGURE 5-30
(Stateline Zone)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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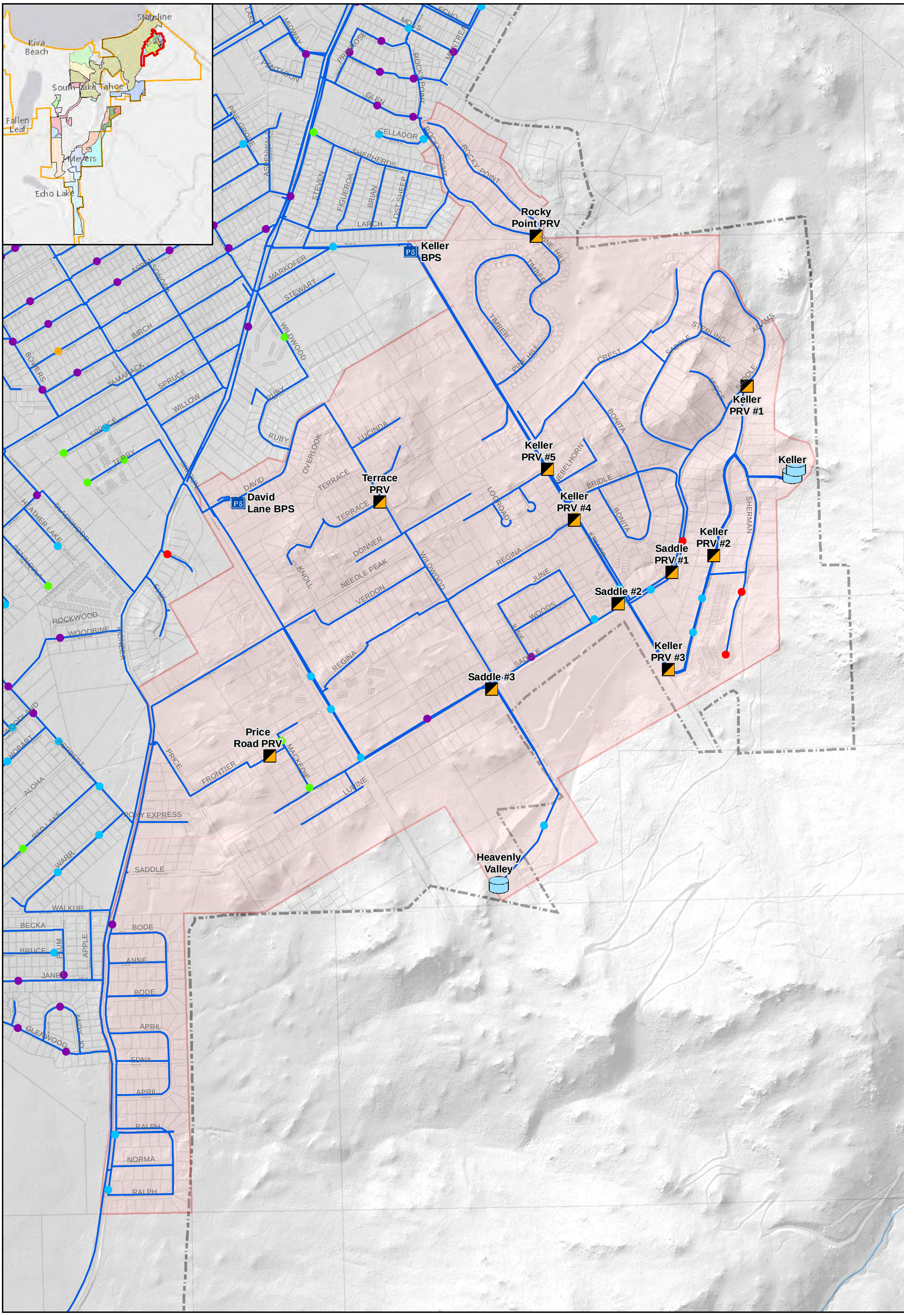

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I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
PS Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

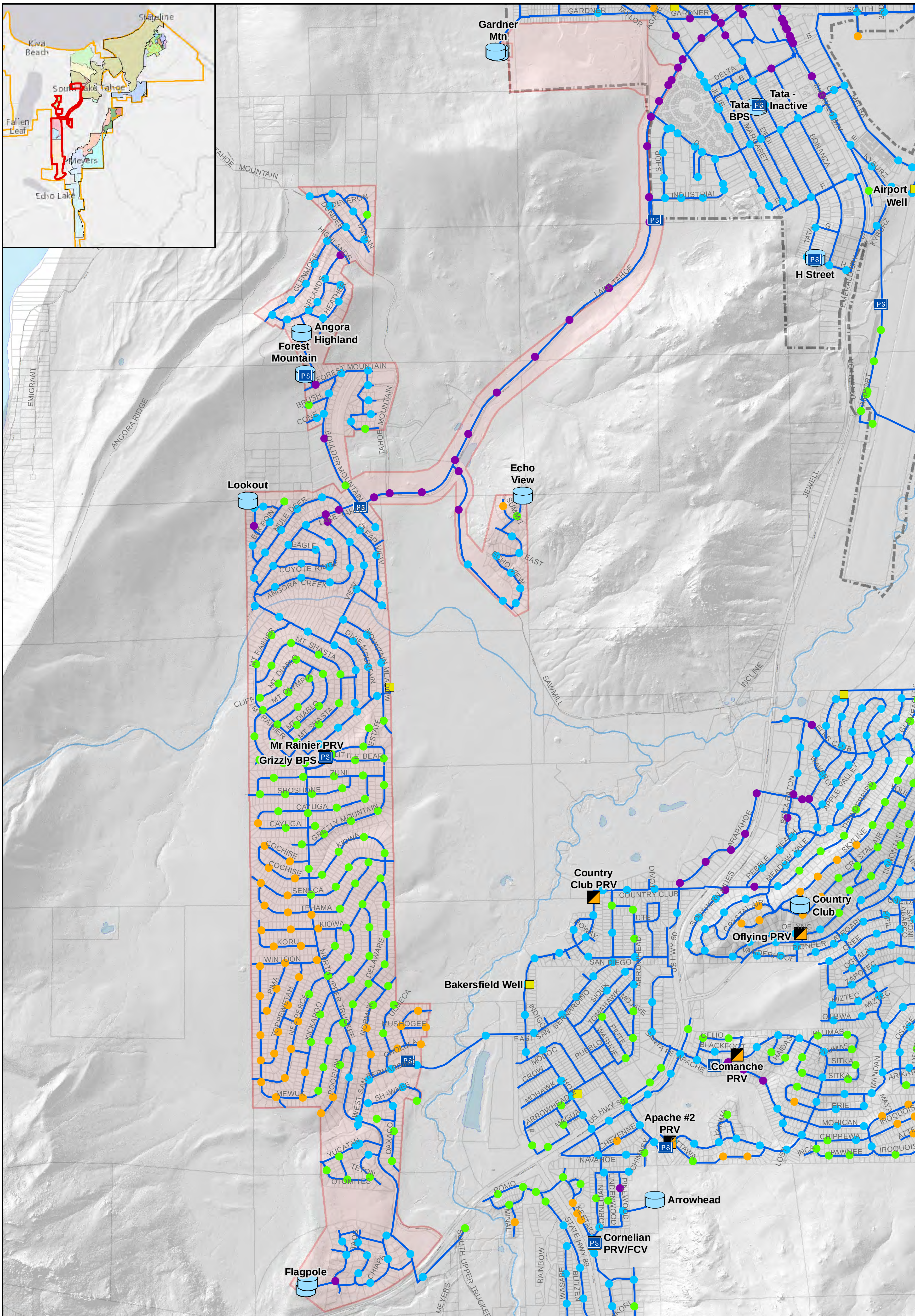
N

0 400 800
Scale in Feet

FIGURE 5-31
(Heavenly Valley)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

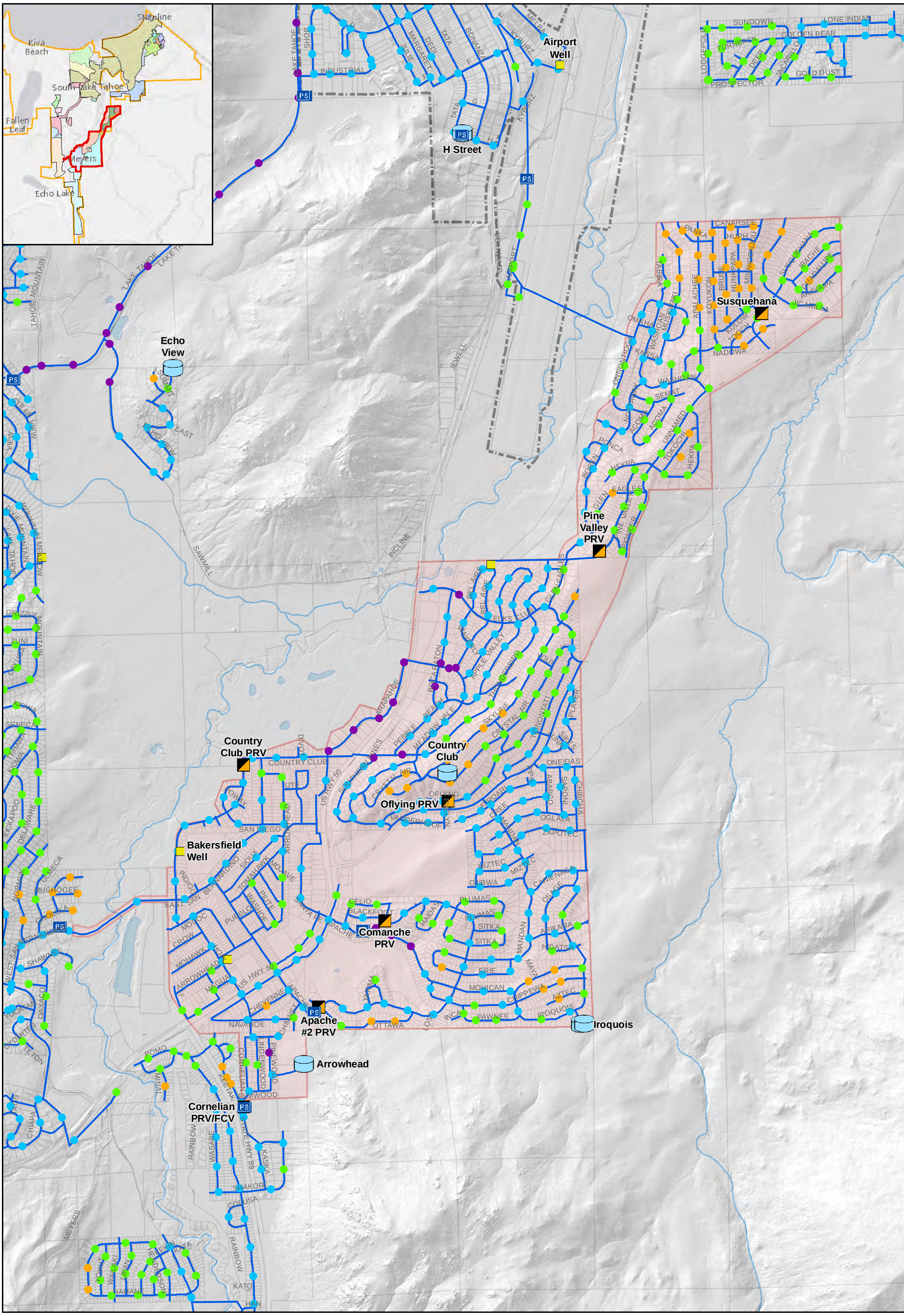
N

0 900 1800
Scale in Feet

FIGURE 5-32
(Twin Peaks)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

0 900 1800
Scale in Feet

FIGURE 5-33
(Arrowhead Zone)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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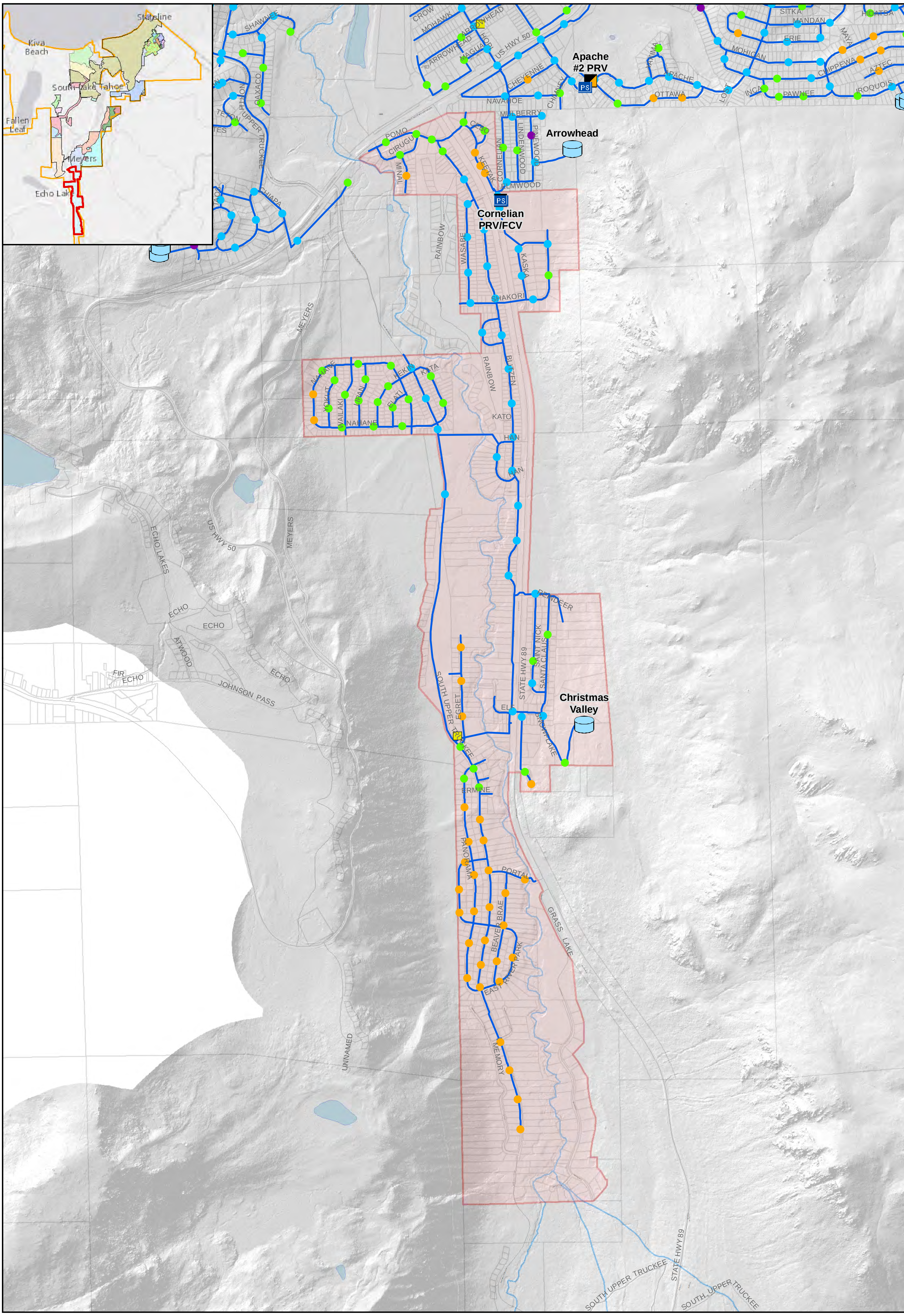

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I_MD_FFS.AVAIL_FLOW
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Existing Pipeline
Storage Tank
PRV
Booster Pump Station
Groundwater Well

Note:
Available fire flow shown based on locations with hydarnts.

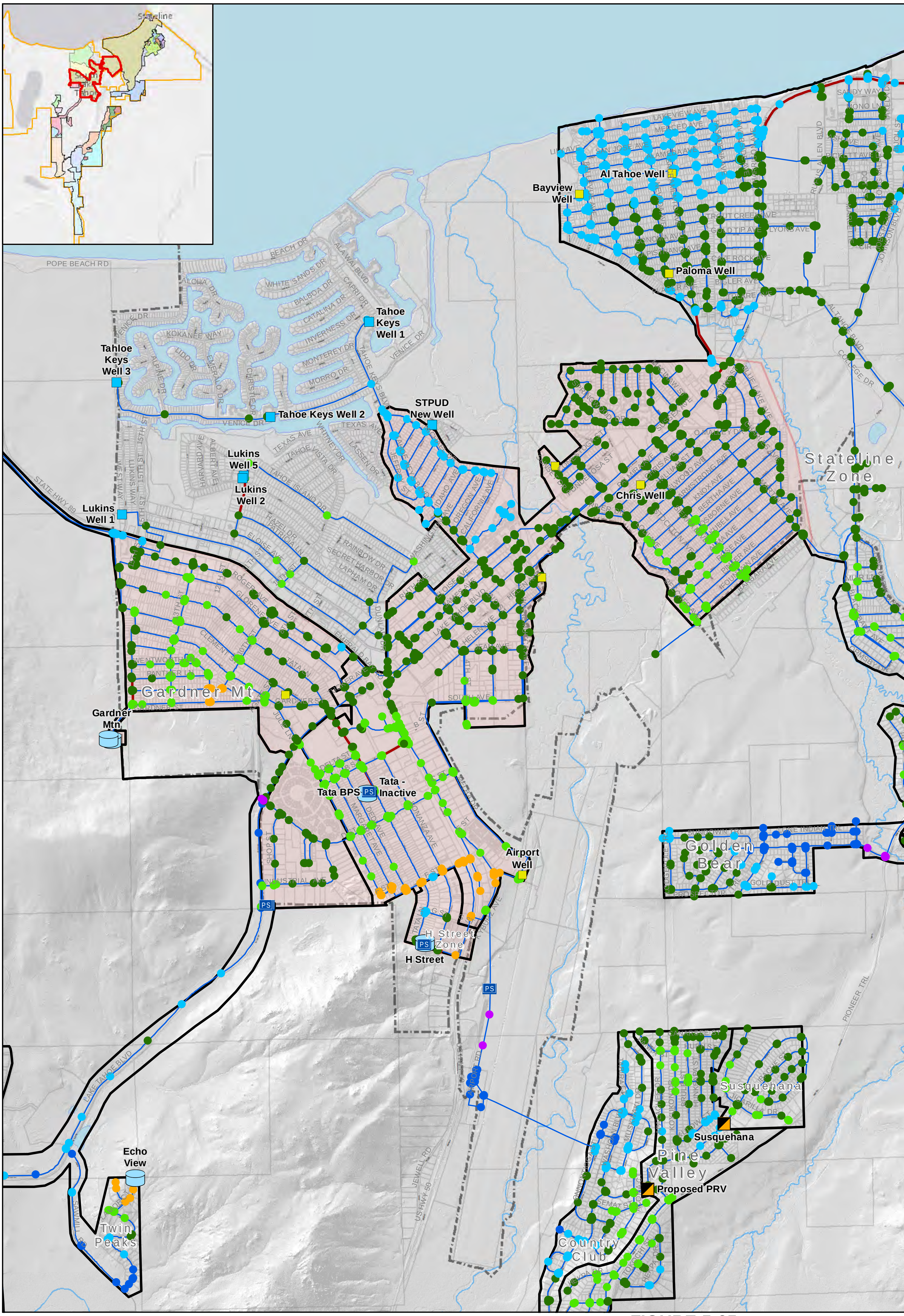
Zones include: Christmas Valley

0 750 1500
Scale in Feet

FIGURE 5-34
(Christmas Valley)

South Lake Tahoe PUD
Water System Optimization Plan
SYSTEM IMPROVEMENTS
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
New or Acquired Well
Storage Tank

PS Booster Pump Station
Groundwater Well
Existing PRV

Note:
Zones include: Gardner Mt., H Street, Part of Stateline

N

0 900 1800
Scale in Feet

FIGURE 5-35
(Gardner Mt)
South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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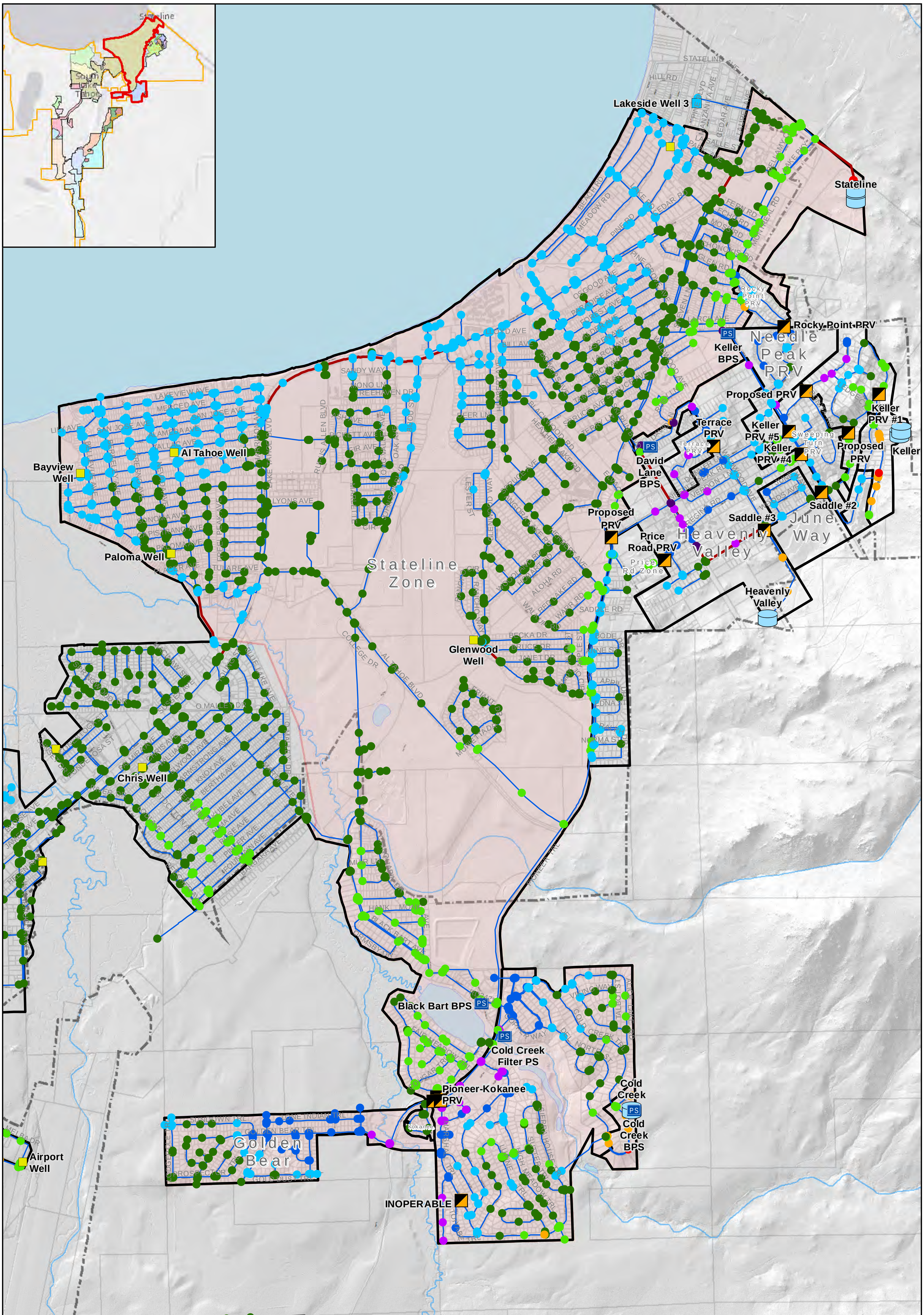

Minimum Pressure

- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- New or Acquired Well
- Storage Tank

Note:
Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

- Booster Pump Station
- Groundwater Well
- Existing PRV

0 900 1800
Scale in Feet

FIGURE 5-36
(Stateline Zone)

South Lake Tahoe PUD
Water System Optimization Plan

BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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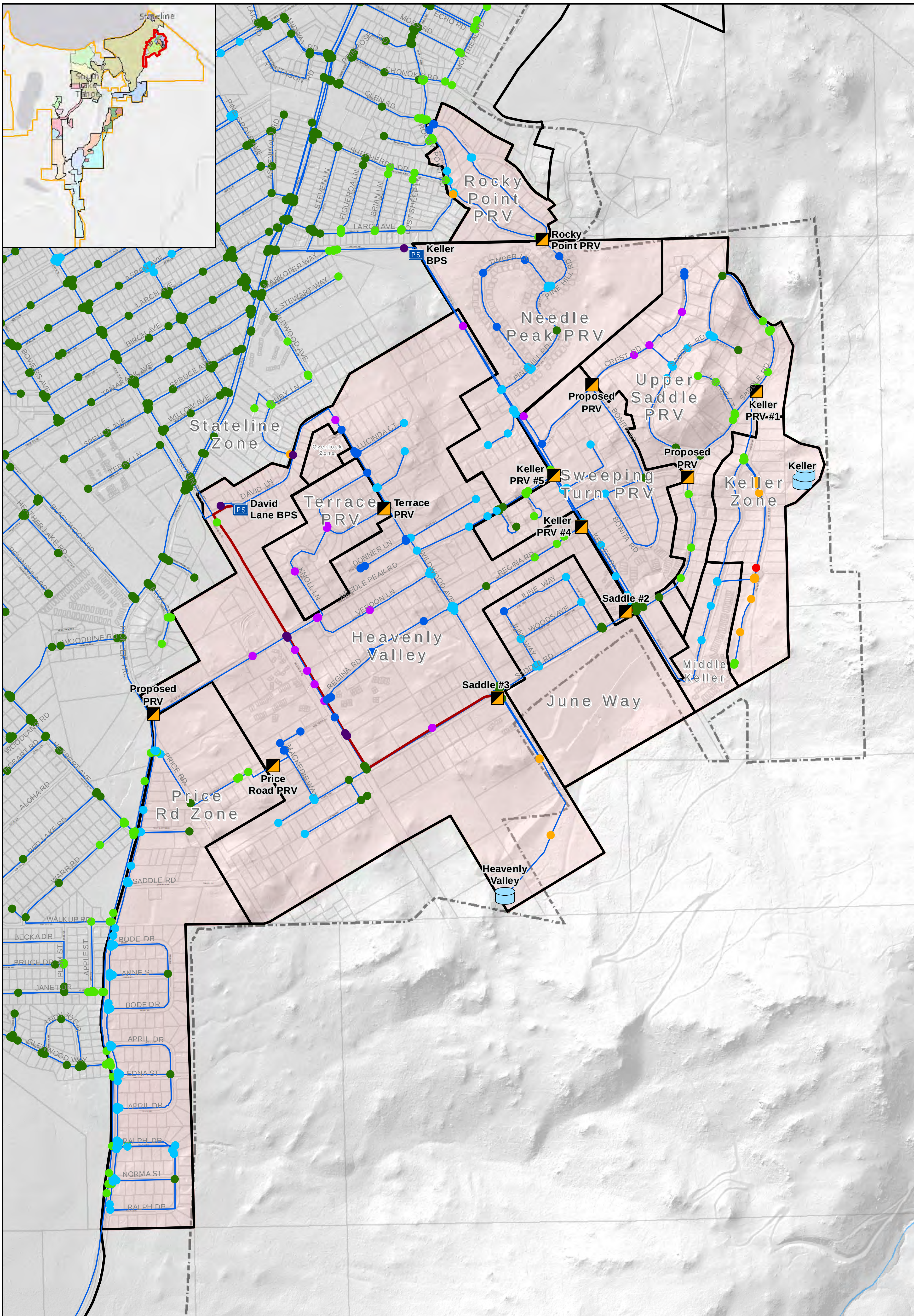

Minimum Pressure

- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- New or Acquired Well
- Storage Tank

- PS Booster Pump Station
- Groundwater Well
- Existing PRV

Note:
Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

0 400 800
Scale in Feet

FIGURE 5-37
(Heavenly Valley)
South Lake Tahoe PUD
Water System Optimization Plan

BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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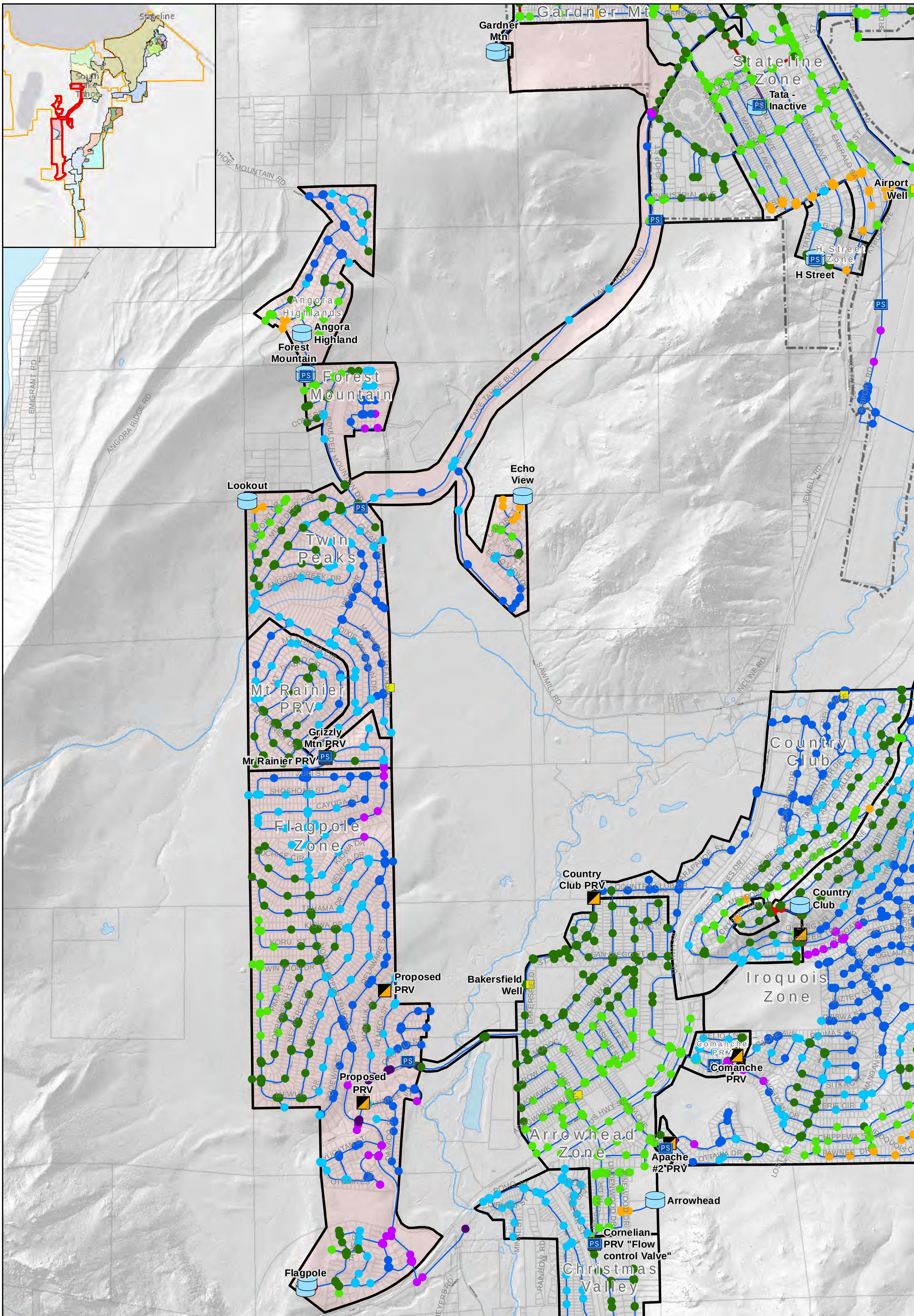

Minimum Pressure	
●	Less than 20 psi
●	20 - 40 psi
●	40 - 60 psi
●	60 - 80 psi
●	80 - 100 psi
●	100 - 120 psi
●	120 - 140 psi
●	Greater than 140 psi

Less than 5 ft/s
Greater than 5 ft/s
New or Acquired Well
Storage Tank

PS Booster Pump Station
Groundwater Well
Existing PRV

Note:
Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

0 900 1800
Scale in Feet

FIGURE 5-38
(Twin Peaks)
South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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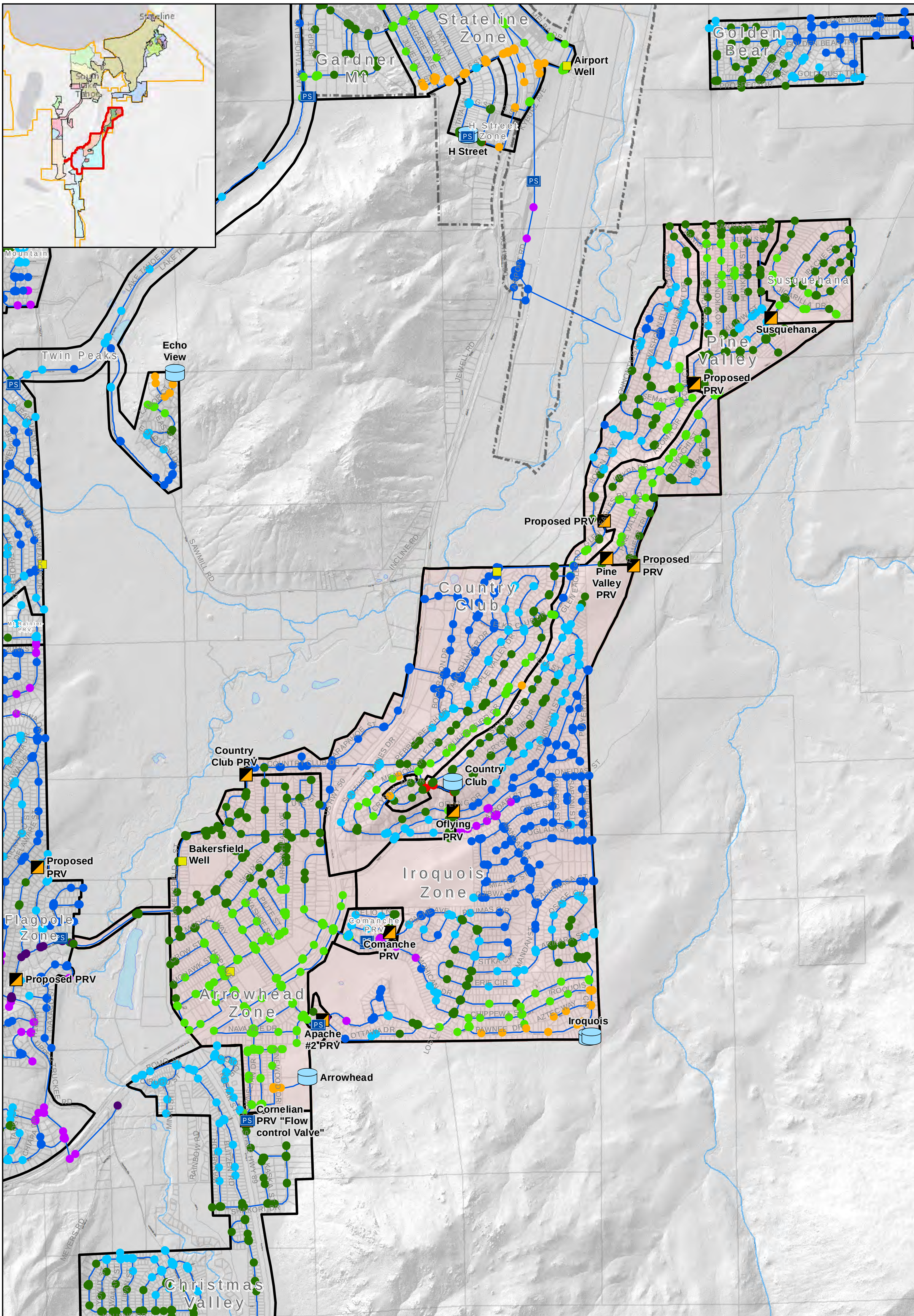

Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- New or Acquired Well
- Storage Tank

- Booster Pump Station
- Groundwater Well
- Existing PRV

Note:
Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

0 900 1800
Scale in Feet

FIGURE 5-39
(Arrowhead Zone)

South Lake Tahoe PUD
Water System Optimization Plan

BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers

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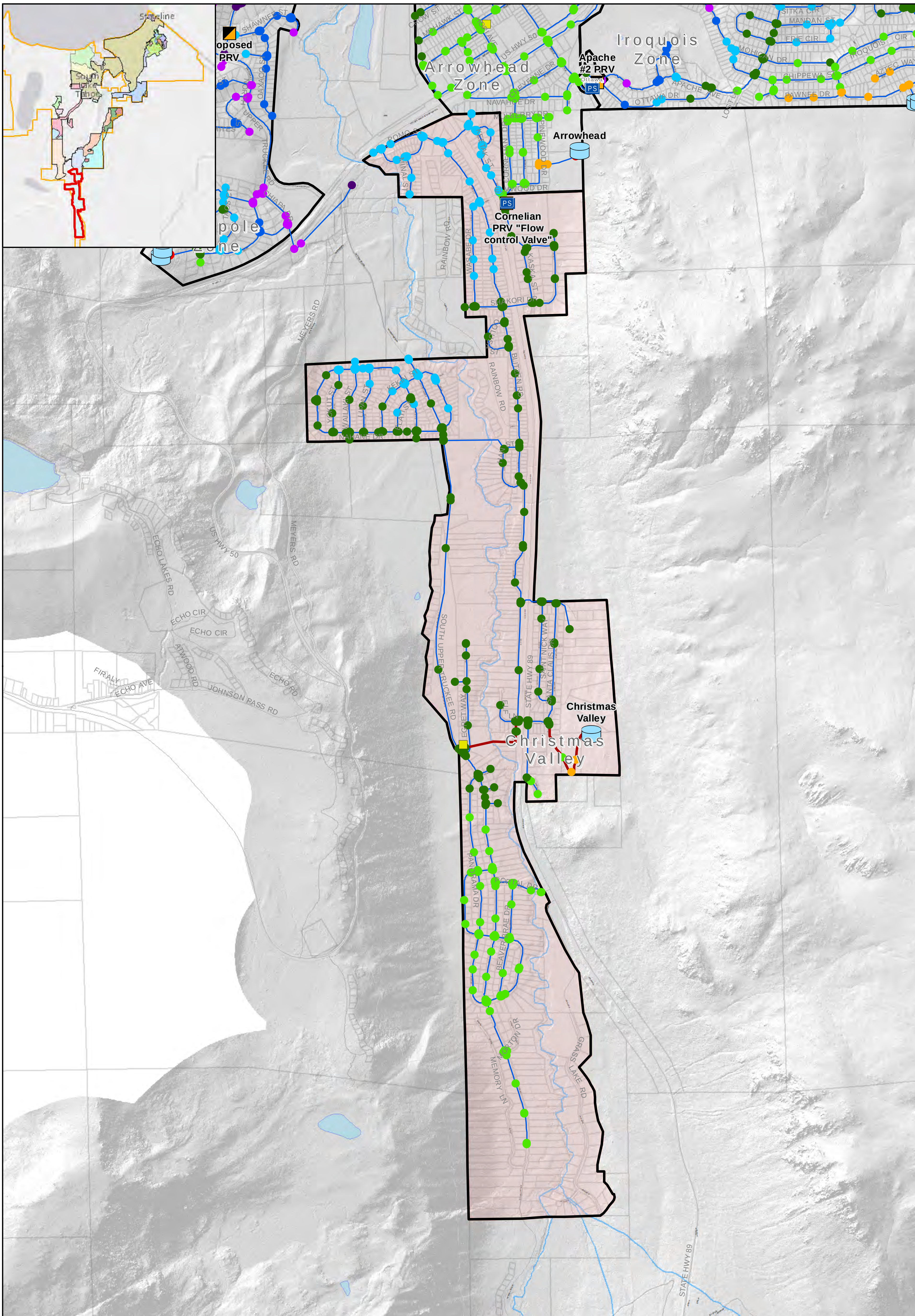


Minimum Pressure
- Less than 20 psi
- 20 - 40 psi
- 40 - 60 psi
- 60 - 80 psi
- 80 - 100 psi
- 100 - 120 psi
- 120 - 140 psi
- Greater than 140 psi

- Less than 5 ft/s
- Greater than 5 ft/s
- New or Acquired Well
- Storage Tank

Note:
Zones include: Christmas Valley

- PS Booster Pump Station
- Groundwater Well
- Existing PRV

N

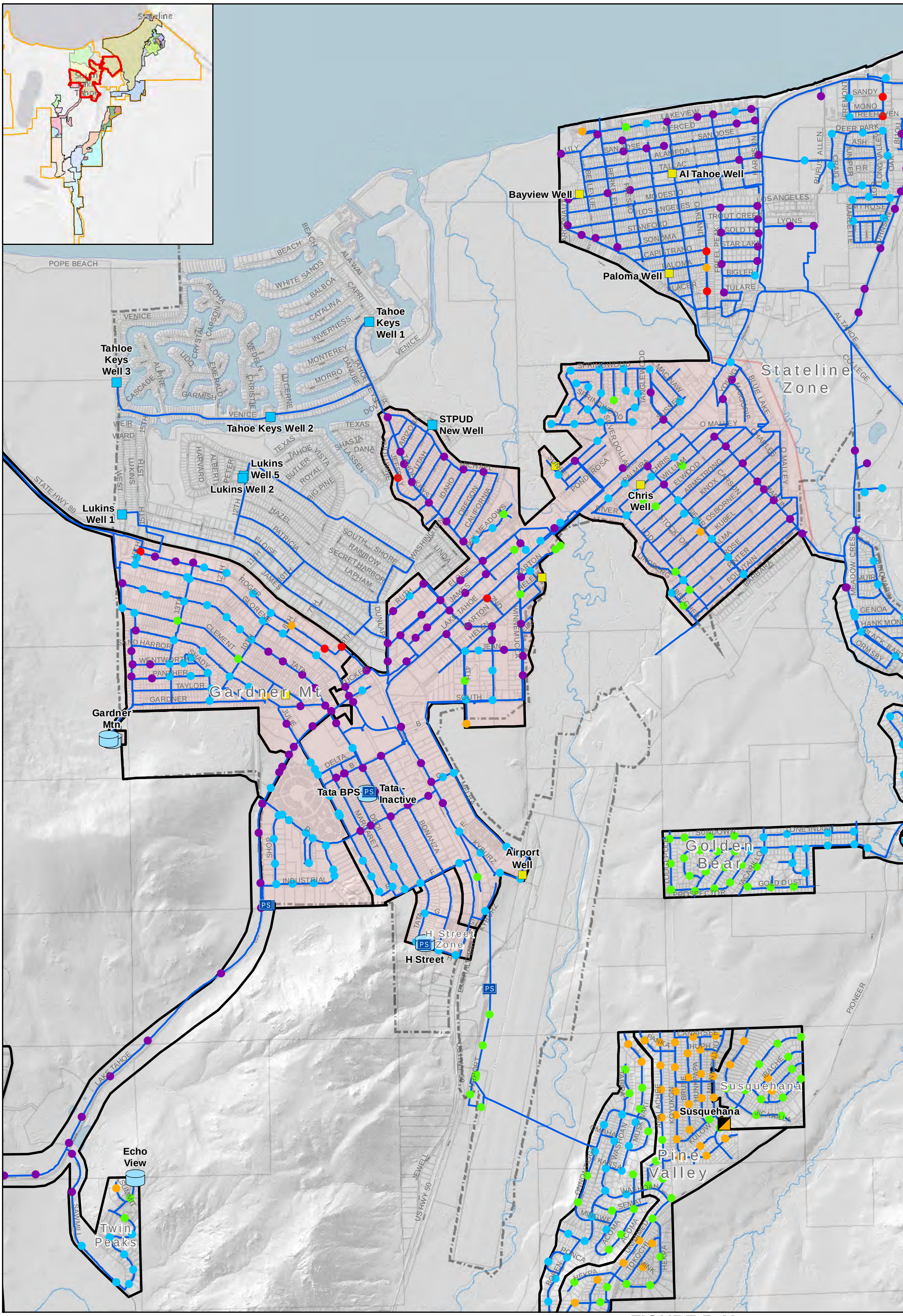
0 750 1500
Scale in Feet

FIGURE 5-40
(Christmas Valley)

South Lake Tahoe PUD
Water System Optimization Plan

BUILDOUT SYSTEM MINIMUM PRESSURE AND MAXIMUM VELOCITY RESULTS

WEST YOST ASSOCIATES
Consulting Engineers



Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Buildout Pipeline
New or Acquired Well
Storage Tank
Booster Pump Station
Groundwater Well
Existing PRV

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Gardner Mt., H Street, Part of Stateline

0 900 1800
Scale in Feet

FIGURE 5-41
(Gardner Mt)

South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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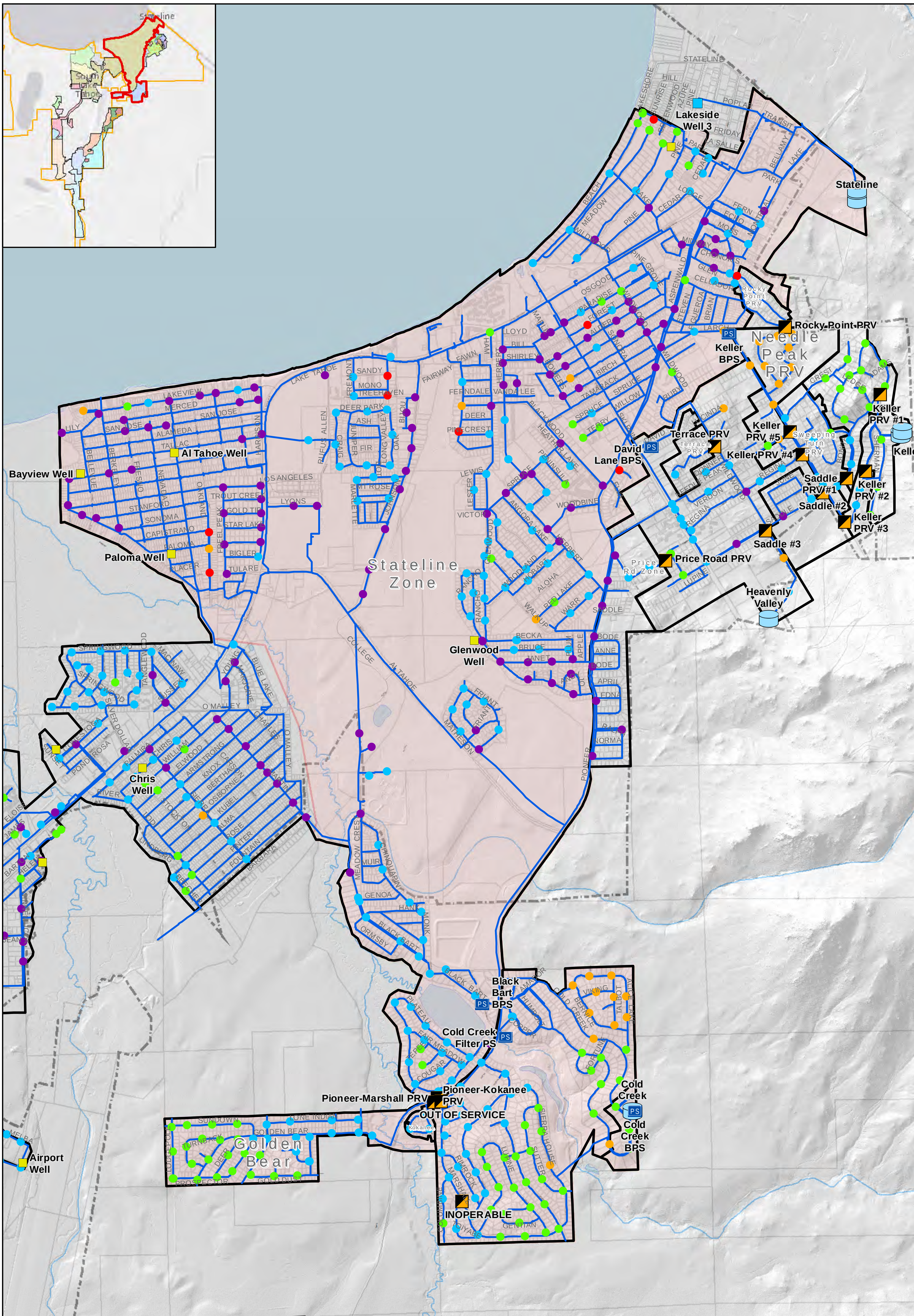

Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Buildout Pipeline
New or Acquired Well
Storage Tank
Booster Pump Station
Groundwater Well
Existing PRV

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Part of Stateline, Montgomery Estates, Upper Montgomery Estates, Golden Bear, Kokanee

0 900 1800
Scale in Feet

FIGURE 5-42
(Stateline Zone)

South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM
AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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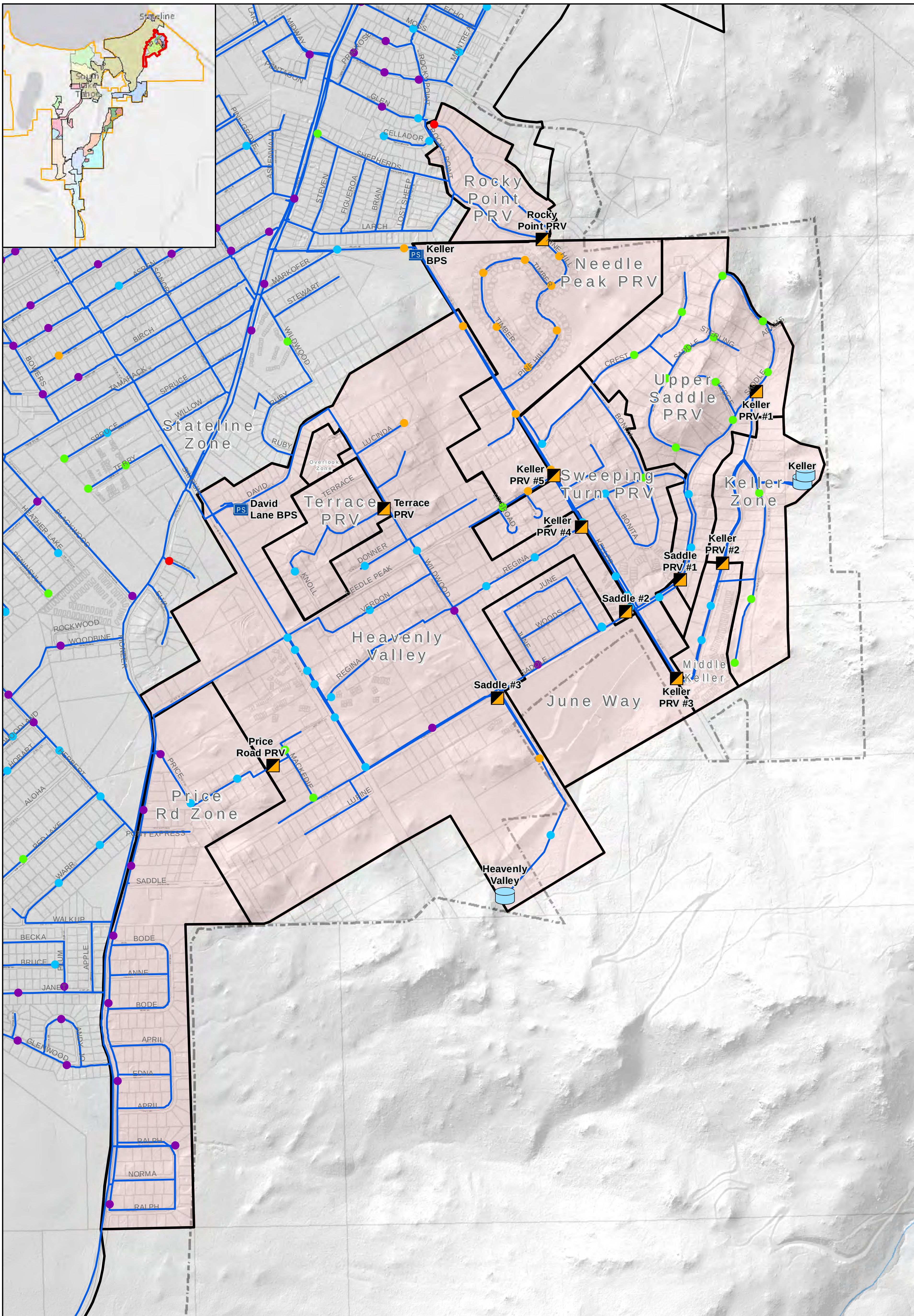

Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Buildout Pipeline
New or Acquired Well
Storage Tank

PS Booster Pump Station
Groundwater Well
Existing PRV

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Heavenly Valley, Price Road, Terrace PRV, Overlook PRV, Keller, Middle Keller, Upper Saddle PRV, Sweeping Turn, Four Seasons, Needle Peak, Rocky Point

N

0 400 800
Scale in Feet

FIGURE 5-43
(Heavenly Valley)

South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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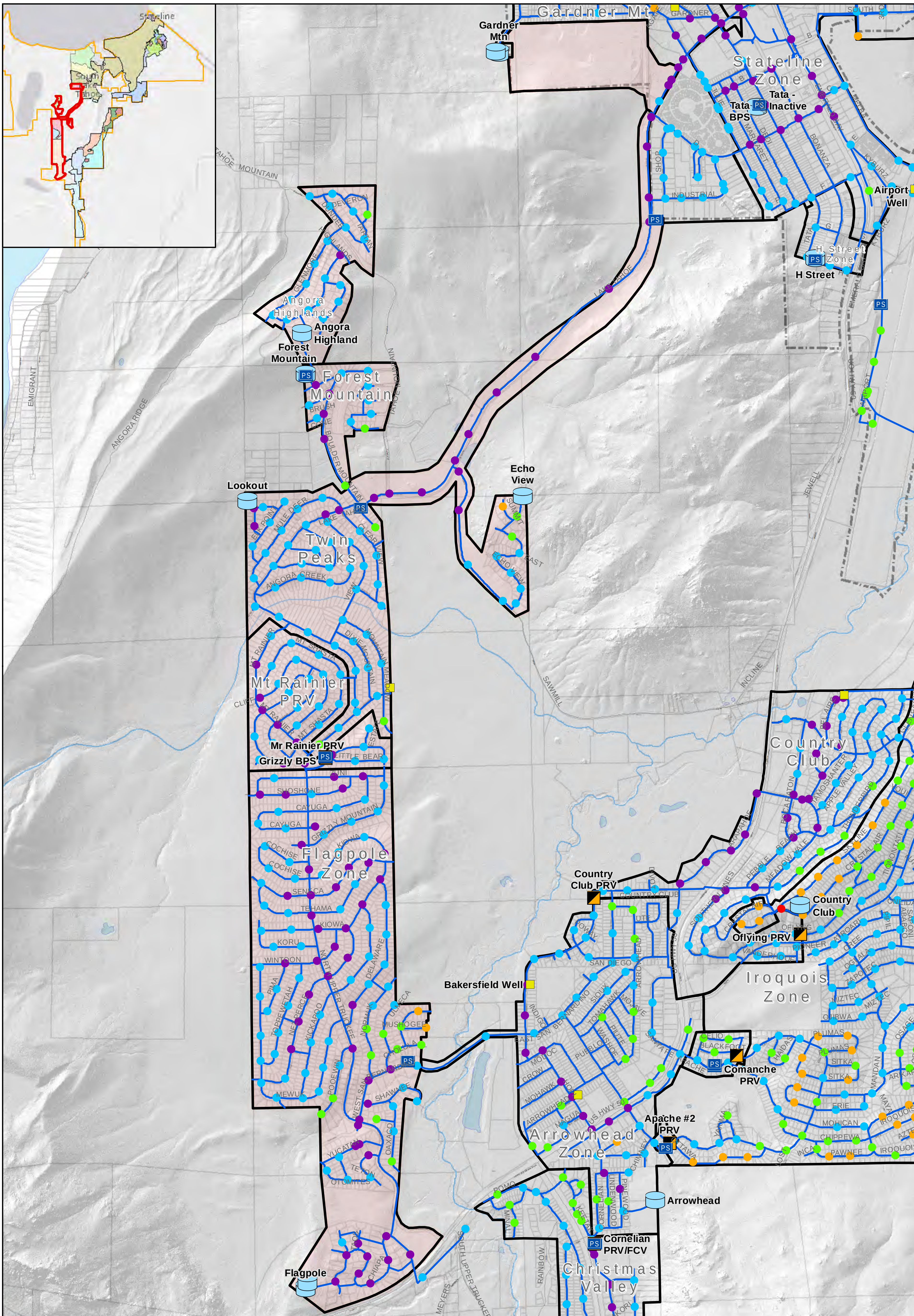


Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Buildout Pipeline
New or Acquired Well
Storage Tank
Booster Pump Station
Groundwater Well
Existing PRV

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Twin Peaks, Forest Mountain, Angora Highlands, Mt. Rainier PRV, Flagpole

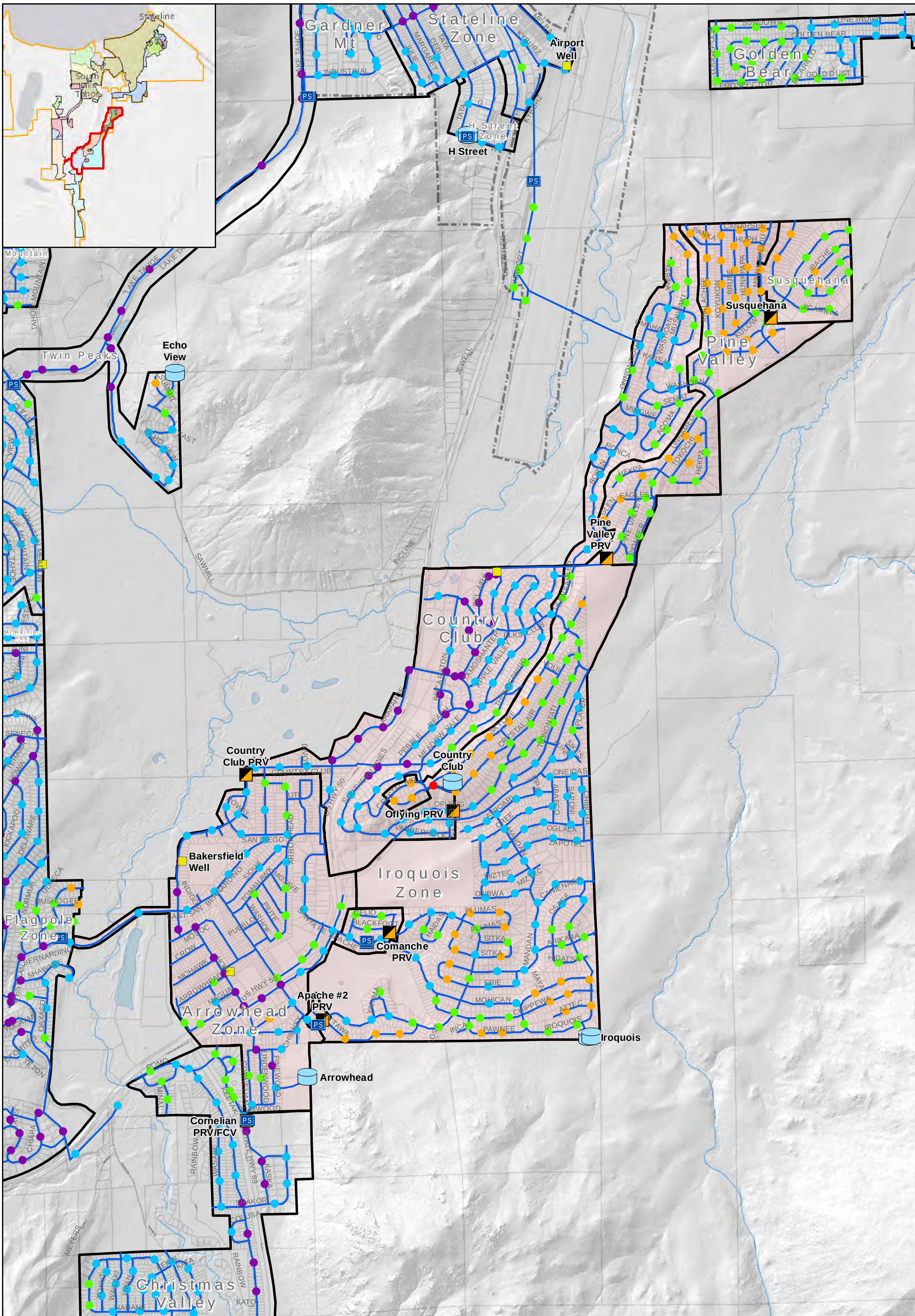
0 900 1800
Scale in Feet

FIGURE 5-44
(Twin Peaks)

South Lake Tahoe PUD
Water System Optimization Plan

BUILDOUT SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers



Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

- Buildout Pipeline
- New or Acquired Well
- Storage Tank
- PS Booster Pump Station
- Groundwater Well
- Existing PRV

Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Arrowhead, Iroquois, Ottowa, Comanche, Country Club, Pine Valley, Susquehana

N

0 900 1800
Scale in Feet

FIGURE 5-45
(Arrowhead Zone)

South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM AVAILABLE FIRE FLOW

WEST YOST ASSOCIATES
Consulting Engineers

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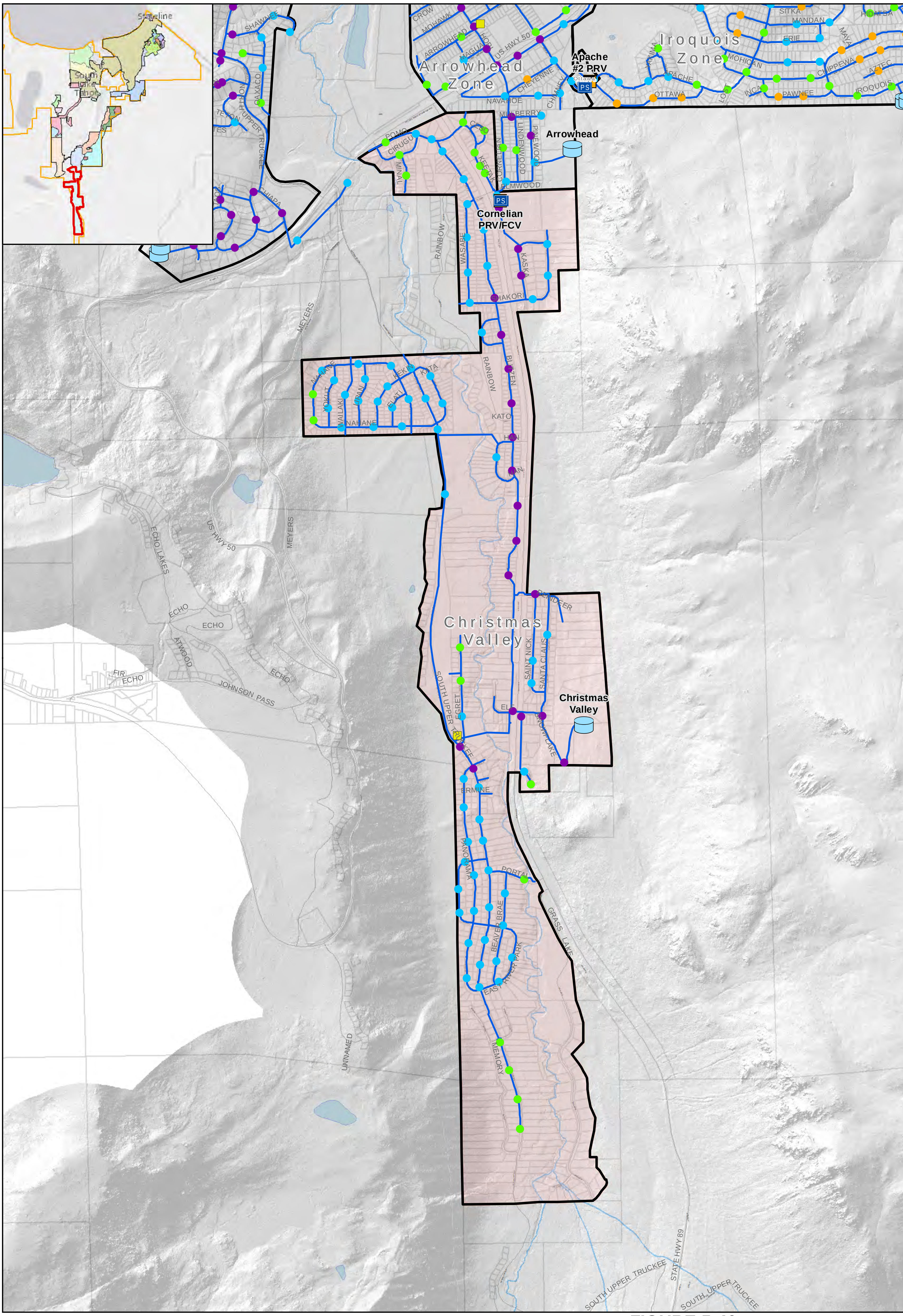


Available Fire Flow
- Less than 500 gpm
- 500 - 1,000 gpm
- 1,000 - 1,500 gpm
- 1,500 - 3,000 gpm
- Greater than 3,000 gpm

Buildout Pipeline
New or Acquired Well
Storage Tank
Booster Pump Station
Groundwater Well
Existing PRV

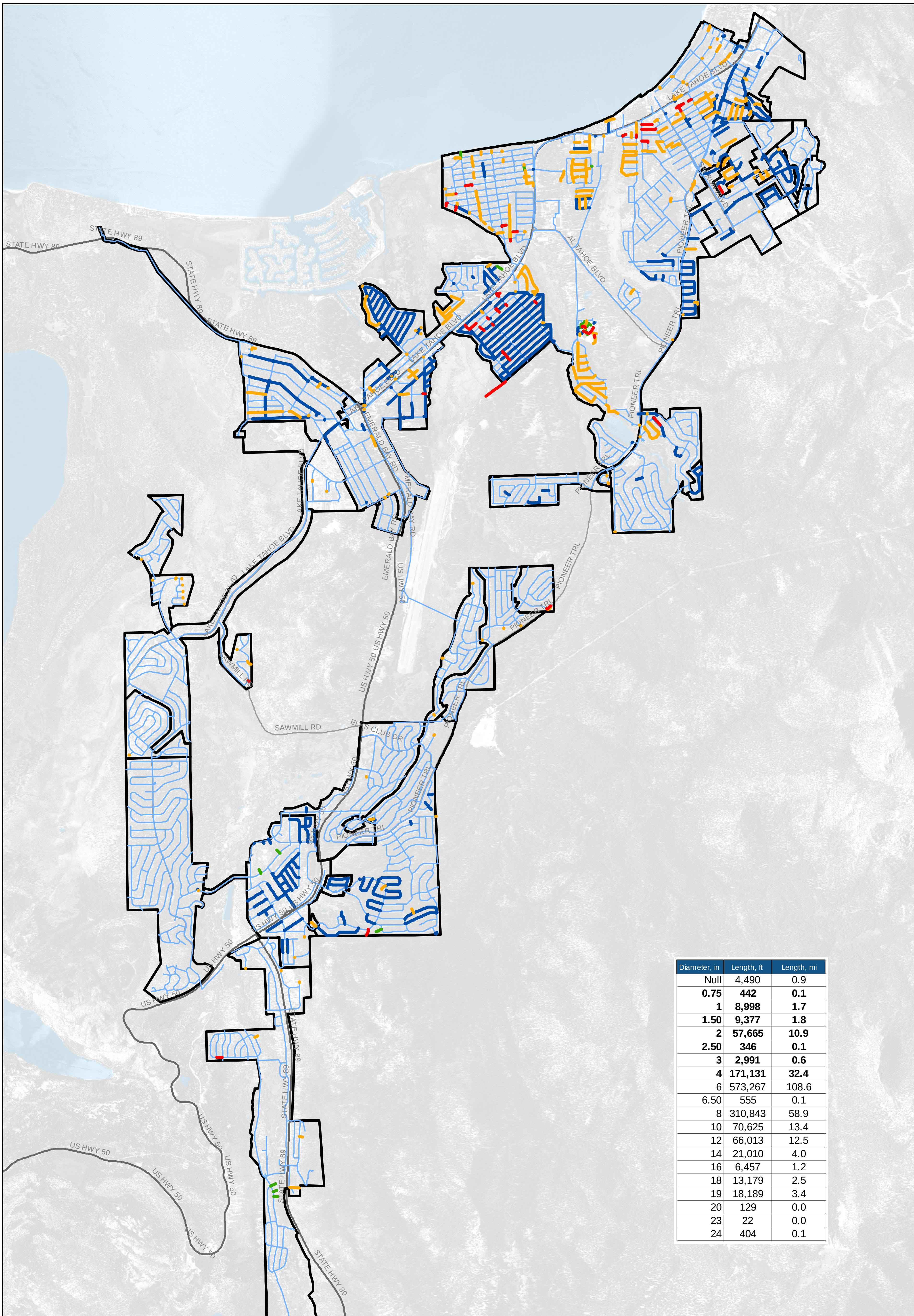
Note:
Available fire flow shown based on locations with hydarnts.

Zones include: Christmas Valley

0 750 1500
Scale in Feet

FIGURE 5-46
(Christmas Valley)

South Lake Tahoe PUD
Water System Optimization Plan
BUILDOUT SYSTEM AVAILABLE FIRE FLOW



Diameter, in	Length, ft	Length, mi
Null	4,490	0.9
0.75	**442**	**0.1**
1	**8,998**	**1.7**
1.50	**9,377**	**1.8**
2	**57,665**	**10.9**
2.50	**346**	**0.1**
3	**2,991**	**0.6**
4	**171,131**	**32.4**
6	573,267	108.6
6.50	555	0.1
8	310,843	58.9
10	70,625	13.4
12	66,013	12.5
14	21,010	4.0
16	6,457	1.2
18	13,179	2.5
19	18,189	3.4
20	129	0.0
23	22	0.0
24	404	0.1

LEGEND

Diameter

- 1 in and Less
- 2 inch
- 3 inch
- 4 inch
- Greater than 4 inch

Pressure Zones

Note:
Pipeline diameters shown are based on GIS data provided by the District.

FIGURE 5-47

South Lake Tahoe PUD
Water System Optimization Plan

EXISTING SMALL DIAMETER PIPELINES

WEST YOST ASSOCIATES

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Section 6: Capital Improvement Projects (TM 5)

6.1 Purpose

This section summarizes the capital improvement projects (CIP) necessary to sustain the levels of service adopted by the District. Projects were identified based on several factors that affect the levels of service provided by the District, including capacity deficiencies, safety hazards, infrastructure weaknesses, and physical mortality of assets. Projects are identified by priority, along with estimated costs and implementation schedule.

The Capital Improvement Projects are based on the previous work completed that included:

- Condition Assessment of the Wells, Storage Tanks, Booster Pump Stations, Pressure Reducing Valves, and Critical Pipelines as documented in Section 1 (Technical Memorandum [TM] No. 1). The condition assessment identified asset deficiencies and recommended improvements to correct deficiencies that align with the District's Level of Service (LOS) objectives.

- Levels of Service (LOS) as documented in Section 3 (TM No. 2). The LOS was completed to establish goals and objectives that the District will strive to achieve to provide a cost effective, reliable, and compliant water system for the District's customers. The LOS goals and objectives will be used as a tool to justify capital improvement projects and prioritize these projects.

- Capacity Evaluation as documented in Sections 4 and 5 (TM Nos. 3 and 4, respectively). The capacity evaluation used a new hydraulic model (TM No. 3) and evaluated various water demand scenarios for the existing, buildout, and expanded water system (TM No. 4). The capacity evaluation identified where the District currently had a shortfall with water supply, storage, and conveyance to provide an adequately redundant and reliable water system. The capacity evaluation also identified opportunities to consolidate or modify pressure zones to improve the operational efficiency of the water system. The evaluation recommended improvements that corrected the capacity deficiencies and improved operational performance that align with the LOS objectives.

6.2 Level-of-Service Objectives

In Section 3 (TM 2), the District identified and provided details on LOS objectives in five categories. These objectives define the District's commitment to providing a reliable, high-quality, cost-effective water service system to their rate payers and the community at large. In Section 3 (TM 2), the District also assessed its current status with respect to meeting each of these objectives. Where the District falls short of meeting its LOS objectives, is where the District should focus the attention of its CIP Program.

As such, the District's goal is for each recommended project to meet one or more LOS objectives. The LOS objectives that a project will achieve are identified in Table 6-2 for the High Priority Projects, Table 6-4 for the Medium Priority Projects, and Table 6-6 for the High Priority Projects for each recommended project, as well as the project's priority and cost. Those LOS objectives that were, at the time the LOS was developed, meeting the standard established in Section 3 (TM 2) have been shown in Tables 6-2, 6-4 and 6-6 as shaded rows, meaning that capital improvements are not required to continue meeting these LOS goals.

6.3 Cost Factors, Prioritization, and Implementation

Unit costs for equipment and other construction activities were based on a combination of sources including Mean's and Saylor cost-estimating guides, actual costs from previous similar projects, and engineering judgment. To these bare costs, the following factors were added:

- Sales tax: 7.75% applied to materials, which is assumed to comprise 33% of the bare costs
- Contractor's overhead and profit: 15%
- Estimating contingency: 30%
- Engineering and construction management: 25%
- Administration and permitting: 10%

Individual project estimates for each project by prioritization ranking are provided in Appendix A. The numbers assigned to each project do not reflect a prioritization of the projects, essentially the projects are grouped by high, medium and low priorities and within each group a priority has not been assigned. The District through its annual updating of the Capital Improvement Plan budget will determine the priority of each project, which could shift from year to year.

The prioritization of projects is based on high, medium and low priority rating. The capital cost is based on a Fiscal Year (FY) 12-13 and has been escalated to July 1, 2014 costs using an ENR Index Escalation Factor of 1.05. This factor is based on ENR Index for San Francisco July 1, 2014 / ENR Index for San Francisco June 1, 2014 (1.05 = 10,898 / 10,381). The projects have not been assigned an implementation year. When the District annually establishes their Capital Improvements Project (CIP) budget the selected projects will need the cost escalated to the implementation year. The implementation year coincides with the 20-year capital improvement program planning cycles used by the District.

The District plans on a 10-year CIP outlook. Beyond year 10, individual projects have not been assigned an implementation year, but the value of remaining projects has been distributed evenly. Due to the sheer volume of projects proposed, the District has projected that their implementation will require at least 20 years, and potentially 30 years. Each year as the District establishes their 10-year Capital Improvements Program plan the selected projects will need the cost escalated to the appropriate implementation year.

Although an implementation year was not assigned to each project, the criterion for prioritizing implementation of a project by the District as they update their capital improvement projects list is as follows:

- The proposed implementation years for high priority projects are years 1 through 5 are considered necessary projects that have a cost effective benefit or are needed to meet mandated requirements.
- The proposed implementation years for medium priority projects are years 6 through 10 are considered needed projects with moderately cost effective benefit or meets industry standards.
- The proposed implementation years for low priority projects are years 11 through 20 and beyond are considered desired projects with acceptable cost benefit or meets District standards.

The proposed implementation years are recognized as placeholders, as the District will evaluate and adjust the implementation each year as they deliberate the budget available with the desired LOS, level of risks, and project benefits from investing limited District capital funds or operational funds to dollars on a project by project basis.

6.4 High-Priority Projects

High-priority projects are generally those projects that correct serious deficiencies such as those that affect life safety (e.g., fire protection or source capacity). Deficiencies were initially identified during the condition-assessment (Section 1 – TM 1), LOS (Section 3 – TM 2), and capacity evaluation (Section 5 – TM 4) phases of this study.

The projects developed to provide additional well, booster pump, and storage capacities are based on the level of service requirements under “Key Service Objective: 3 – Provide Enough Water” and design criteria (summarized by West Yost in Section 5 – TM 4). Section 5 (TM 4) shows how the source and storage capacity shortages were identified by pressure zone.

The high-priority projects are listed in Table 6-1 and the level of service objectives that each of these high-priority projects achieves once implemented are listed in Table 6-2. Refer to Appendix E for high-priority project details. In Table 6-1 for each project it is designated as a Capital Improvement Project (CIP), Planning (Study) project, or Operation and Maintenance (O&M) project. A CIP is a project that makes a physical improvement to the water system. A Planning project is one that completes an evaluation or study to determine the optimal means to improve the water system. An O&M project is one that would enhance the operation or repair a condition of a water system facility or asset.

Projects A9b, A9c and A9d are three potential projects to solve a deficiency of storage and/or fire protection in the Keller Zone and the tributary zones it serves. A study recommended by Project A9a will be completed to determine the preferred alternative to correct these deficiencies. The sum of the High Priority Project costs assumes the implementation of Project A9c. Should another project alternative be selected, a corresponding cost adjustment will be made.

Project A20 recommends a study be completed to correct a shortage of well capacity in the Stateline Zone. The alternatives include increased production at Paloma Well and flows from Twin Peaks PRV and Airport PRV, or construction of a new well. The cost to install a new well in Stateline Zone has been developed as Project B7.

Project A2 recommends a study to improve water supply capabilities from the Stateline to the Gardner Mountain Zones at buildout.

Table 6-1.
High-Priority Projects

Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A1	Critical Waterline Evaluation	Section 1.5.5	Pipeline Evaluation (in progress)	Airport Runway/Trout Creek/UTR Meyer Crossing/Keller Discharge/David Lane Discharge	$105,000		X	
A2	Water Supply to the Y - Engineering Study	Section 5 4.33 to 36	Water-to-Y Engineering Study. Complete and part of WSOP.	Upper Truckee River Crossing	$42,000		X	
A3	H-Street Booster Station Improvements	TM 4: 9	H-Street Zone check valve	H Street Booster PS	$104,000	X		
A4	Site Drainage and BMP Improvements	Section 1.4.1, Table1- 7 and Section 1.4.2, Table 1-8	Site Drainage and BMP Improvements	Multiple well and booster pump sites	$348,000	X		
A5 (note 1)	Mountain View Well Abandonment	Section 1.4.2, Table 1-8	Groundwater Protection	Mountain View Well abandoned 2014	$218,000	X		
A6	Chemical Safety Improvements at Well Buildings	Section 1.4.2, Table 1-8	Safety Improvements	Multiple well sites	$20,000			X
A7	Arcflash Assessment Wells and Booster Stations	Section 1.4.1, Table 1–7 and Section 1.4.2, Table 1-8	ARC-FLASH study improve emerg generator facilities, and useful life evaluation of electrical equipment	Multiple well and booster pump sites	$233,000		X	
A8	PRV Replacement and Reliability Improvements	Section 1.4.3, Table 1-9	PRV Improvements	Multiple PRV station sites	$975,000			X
A9a	Keller Tank Alternatives - Engineering Study	Section 5:11 to 19	Replace Keller Booster and tanks w/ new pump station at Heavenly tank site	Keller Zone, Upper Saddle Zone, Sweeping Turn Zone	$79,000		X	
A9b	Keller Booster Station Relocation	Section 5: 11 to 19	Keller Tank Replacement at alternate location TBD (alternative to projects A9 and A9C)	Keller Tank	$1,861,000	X		
A9c	Keller Tanks Relocation	Section 1/ Section 5: Project 20, Alternative for projects 11 to 19	Keller Tank Replacement at existing site	Keller Tank	$3,125,000	X		
A9d	Keller Tanks Replacement	Section 1/ Section 5: Project 20, Alternative for projects 11 to 19	Keller/Heavenly Zone Storage and Fire Protection	Keller Zone, Upper Saddle Zone, Sweeping Turn Zone, Middle Keller, Needle Peak, Rocky Point	$1,778,000	X		
A10	Tank Access and Site Improvements	Section 1.4.4, Table 1-10	Tank Site Improvements	Multiple tank sites	$444,000	X		
A11	Tank Seismic Improvements	Section 1.4.4, Table 1-10	Tank Seismic Improvements	Multiple tank sites	$137,000		X	
A12	Well Inspections	Section 1.4.2, Table 1-8	Paloma and Sunset Well Inspections	Multiple well sites	$53,000	X		
A13 (note 2)	Crest-Bonita PRV Installation	Section 5: 38	Crest-Bonita PRV - Add 6-inch PRV (improve fire flow, pressures and service redundancy)	Crest Rd. & Bonita Rd. (Upper Saddle Zone to Sweeping Turn Zone)	$118,000	X		

Table 6-1.
High-Priority Projects

Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A14	Pioneer-Norma Check Valve Installation	Section 5: 30	Pioneer at Norma Check Valve - Add 8-inch check valve at normally closed valve (P25-042NC)	Pioneer Trail & Norma Drive	$122,000	X		
A15	Forest Fire Capability Assessment - Engineering Study	Section 5: 59	Forest Fire Flow Engineering Study to improve capability to fight fires	System-wide	$26,000		X	
A16	Pioneer-Busch PRV Installation	Section 1/ Section 5: 25	Add 8-inch PRV	Pioneer Trail & Busch Way (Iroquois to Pine Valley zone)	$122,000	X		
A17	Pioneer Trail Waterline Installation	Section 5: 26	Add 2,250 ft. long 12-inch pipeline	Pioneer Trail from Elks Club Dr to Busch Way	$1,356,000	X		
A18	Washoan-Nadowa PRV Installation	Section 5: 2	Add 6-inch PRV	Washoan Blvd & Nadowa St at normally closed valve (M33-047) Pine Valley to Country Club	$118,000	X		
A19	Glen Eagle PRV Installation	Section 5: 3	Stateline Zone Supply Study - Add 6-inch PRV	Glen Eagle Rd at normally closed valve M34-021NC (Pine Valley to Country Club)	$118,000	X		
A20	Water Supply to Stateline Zone - Engineering Study	Section 1/ Section 5: 37	Evaluate alternatives to correct insufficient supply capacity	Stateline Zone	$79,000		X	
A21	Critical Valve Assessment	Section 1: 60	Valve criticality study	System-wide	$26,000		X	
A22	SCADA Improvements	Section 5: 55	SCADA Improvements - Improve collection to hourly or less	System-wide	$11,000			X
A23	Water Model Demand Allocation Improvements	Section 5: 56	Hydraulic Model Demand Allocation improvements	System-wide	$11,000		X	
A24	Pine Valley - Susquehanna Waterline	Section 5: 27, 28, & 29	Add loop system to improve fire flow and redundancy and combine with Project A18	Pine Valley & Susquehanna Zones	$258,000	X		
A25	Montgomery Estates Zone Evaluation - Engineering Study	Section 5: 23 & 24	Evaluate Montgomery Estates Zones - Re-configuration of Pressure Zones Evaluation	Montgomery Estates and Upper Montgomery Estates Zones	$53,000		X	
A26	Fire Flow Calibration Testing	Section 5: 57	Fire Flow Field Calibration	System-wide	$21,000		X	
A27	Fire Hydrants on 4-inch Waterlines - Engineering Study	Section 5: 58	Hydrants on 4" lines - Determine where to effectively add fire hydrants on 4" pipelines	System-wide	$11,000		X	
A28	Cornelian Fire Pump and Waterline Installation	Section 5: 1	Cornelian Booster Pump Station site - Provide additional fire flow for fire protection		$635,000	X		

Table 6-1. High-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
A29	Upper Montgomery Estates Pump Station Replacement	Section 5: 53	New Upper Montgomery Estates P/S - Add 1,000 gpm capacity with backup power	Upper Montgomery Estates	$1,153,000	X		
A30	Install New Standby Generators	Section 3: LOS	Install at Keller Booster Pump (BP) Station a new 30 KW standby generator and at David Lane BP Station a 200 KW standby generator with building additions	Keller Zone and Heavenly Zone	$240,000 at Keller BP Station $522,000 at David Lane BP Station for total of $762,000	X		

Notes:

1. The District has taken Mountain View Well off line in 2014. The District will determine if they will implement Project A5 – Abandon Mountain View Well.
2. The District has already completed Project A13 – Crest-Bonita PRV installation in 2014.

6.4.1 Cost Summary for High Priority Projects

The total cost of high-priority projects is estimated at $11 million (which is rounded and does not include projects A9b and A9d).

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Table 6-2.
High-Priority Projects

Level of Service			High Priority Projects																																
Key Service Objectives	Strategic Goals	Quantifiable Goals	A1	A2	A3	A4	A5	A6	A7	A8	A9A	A9B	A9C	A9D	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30
1 -Provide High Quality Water	a - Meet regulatory quality standards	1 - Regulated constituents at or below MCL 100% of the time															X																		
		2- Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.																																	
	b - Minimize MTBE in drinking water	1 - Non-detect (<0.5 ppb) on MTBE 100% of the time																																	
	c - Address nuisance water issues (odor, corrosion, sediment)	1 - Reduce system related nuisance complaints below 10 per 1000 services annually.															X																		
		2- Investigate and respond to customer complaint within 8 hours at least 90% of the time.																																	
	d - Protect system from backflow and cross-connection	1 - Comply with District's cross-connection protection program 100% of the time.					X			X																									
	e - Secure water facilities	1 - Meet or exceed national standard for site security for systems of STPUD's size and location.								X	X	X																							
2 - Provide Water Reliably	a - Minimize and consolidate scheduled outages	1 - Maintain # of scheduled outages of 12 hrs. or less at or below industry std (0.65 outages/year/1000 services).																								X									
	b - Minimize unscheduled outages	1 - Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at 50 per year.	X	X	X					X	X								X																X
		2 - Maintain number of services affected during a shut-down at or below 50 per year			X						X							X	X							X							X		X
		3 - Implement Asset Management Principles for 100% of System Assets.	X	X	X				X	X	X	X	X	X					X							X									
	c - Provide redundancy within system	1 - 100% of macro zones meet maximum day demands with largest source out of service								X	X	X	X	X											X									X	X
		2 - 100% of facilities have backup power capabilities							X		X	X	X	X																				X	X
3 - Provide Enough Water	a - Size system facilities to meet community demands	1 - 100% of system can meet MDD and PHD.									X	X	X	X											X		X	X					X	X	X
		2 - 100% of system provides access to emergency water			X					X	X	X	X	X				X	X	X	X	X	X	X	X				X		X	X	X	X	X
		3 - Zero days with wells pumping at greater than 90% utilization.																							X										
		4 - 100% of zone storage can meet MDD with zone replenishment with largest unit out of service									X	X	X	X													X	X					X		
		5 - 100% of zones combined sources can pump MDD plus max fire for zone with largest source out of service									X	X	X	X						X					X		X	X			X	X	X	X	X
	b - Maintain system pressures	1 - Min pressure > 20 psi under all conditions								X								X	X		X	X	X	X			X	X	X	X				X	
		2 - Max pressure < 120 psi 90% of the time								X								X	X		X	X	X	X			X	X	X	X					

Table 6-2.
High-Priority Projects

Level of Service			High Priority Projects																																
Key Service Objectives	Strategic Goals	Quantifiable Goals	A1	A2	A3	A4	A5	A6	A7	A8	A9A	A9B	A9C	A9D	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30
4 - Provide Water Cost Effectively	a - Minimize Unaccounted water	1 - Utilize Commercial and Residential water meters to account for all water and compare to production trends								X																									
		2 - Meter accuracy tests within industry standard 100% of the time.																																	
	b - Meet industry standards for cost to deliver water	1 - Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.								X	X	X																							
	c- Maintain appropriate staffing level for regular and emergency needs	1 - Limit unplanned overtime maintenance hours to less than 15% of total unscheduled maintenance hours.						X																											
		2 - Maintain staff utilization rate of 100% during peak season																																	
	d - Extend life cycle of assets	1 - Life of assets meet or exceed industry standard.	X	X						X	X	X	X	X		X	X																		
	e - Replace spent assets	1 - Maintain annual renewal rate on capital expenditures at or above 1.7%.	X		X				X		X	X	X	X																					
		2 - When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.			X				X	X	X	X	X	X																					
	f - Operate system energy efficiently	1 - Maintain annual energy consumption at or below 20,000 kWh/MG.									X	X	X	X																					
	g - Comply with regulatory requirements	1 - Reduce current water use by 20% by 2020.								X																									
5 - Protect Lake Tahoe and the Community	a - Minimize health and safety risks to public	1 - No public injury or other negative impact attributed to water system	X	X		X	X	X		X	X	X		X	X	X				X						X					X	X	X	X	X
	b - Minimize unregulated discharges	1 - Comply with requirements for no surface water discharge from properties.				X					X	X		X	X	X																			
		2- Implement flushing BMPs 100% of the time.																																	
	c - Collaborate and cooperate with other agency programs	1 - Zero complaints from other agencies for District O&M procedures.				X					X	X		X																					
		2 - Minimize cost associated with relocation of water utilities for EIP Projects																																	

6.5 Medium-Priority Projects

In general, medium priority projects consist of reliability improvements, engineering studies and other permit compliance activities, and consolidation of pressure zones as described above.

The medium-priority projects are listed in Table 6-3 and the level of service objectives that each of these medium-priority projects achieves once implemented are listed in Table 6-4. In Table 6-3 for each project it is designated as a Capital Improvement Project (CIP), Planning project, or Operation and Maintenance (O&M) project. This follows the same approach as described for Table 6-1.

Table 6-3.
Medium-Priority Projects

Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
B1	UTR Bridge Freeze Protection	Section 1.4.5, Table 1-11	Install insulation on exposed pipelines on Upper Truckee River pipeline crossing	UTR Bridge Crossing	$44,000			X
B2	SCADA Improvements, Phase 2, Monitoring, Security	Section 1.4.4, Table 1-10	Miscellaneous SCADA Improvements - Monitoring and Security		$286,000			X
B3	Tank Coatings - Interior Repair and Replacement	Section1. 4.4, Table 1-10	Tank Coating Replacement (interior)		$1,400,000	X		
B4	Security Fencing at Tanks	Section 1.4.4, Table 1-10	Tank-Site Security Projects (fencing)		$470,000	X		
B5	Building Coatings, Insulation, and Security Improvements	Section 1.4.1, Table 1-7 and Section 1.4.2, Table 1-8	Improve Site Security and Building Maintenance Projects		$279,000			X
B6	Pump Reliability and Efficiency Assessments	Section 1.4.1, Table 1-7	Pump Reliability and Efficiency Projects		$104,000		X	
B7	Stateline Zone Capacity Improvements	Section 5: 33 to 36	Water to the Y Water System Improvement Project	MULTIPLE	$6,453,000	X		
B8	Airport Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Replacement	Airport Runway Crossing	$10,011,000	X		
B9	Trout Creek Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Replacement	Trout Creek Crossing	$521,000	X		
B10	Keller Booster Waterline Improvement	Section 1.4.5, Table 1-11	Pipeline Improvements	Keller Tank Supply	$200,000	X		
B11	UTR Meyers Waterline Reliability Improvements	Section 1.4.5, Table 1-11	Pipeline Replacement	UTR Meyer Waterline Crossing	$522,000	X		
B12	Well Assessment and Replacement Program	Section 1.4.2, Table 1-8	Develop a downhole well condition assessment and well replacement program	MULTIPLE	$154,000		X	
B13	Fire Hydrant Installations	Section 1.5.5	Installation of 75 new Fire Hydrants on Pipelines > 6" in diam with no fire hydrants within 500 ft. in developed areas and 1,000 ft. spacing in urban/forest undeveloped areas	MULTIPLE	$1,143,000	X		

Table 6-3. Medium-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
B14	Rocky Saddle Multiple Zone Improvements	Section 5: 44 to 47	Reconfigure Pressure Zones, add pipelines between zones, and replace undersized pipelines	MULTIPLE	$440,000	X		
B15a	H-Street Booster Station Replacement	Section 5: 10	Replace existing H Street Pump Station	H Street Zone	$710,000	X		
B15b	H-Street Booster Pump Spare	Section 1.4.1, Table 1-8	Provide Spare Pump	H Street Pump Station	$13,000			X
B16	Kokanee - Golden Bear PRV Abandonment	Section 5: 21 & 22	Improve Fire Flow, Pressures and Redundancy for Kokane, and Golden Bear Zones	Kokanee and Golden Bear	$68,000			X
B17 (note 1)	Upper Saddle-Sweeping Turn Zone Improvements	Section 5: 39 to 43	Upgrade by removing PRVs, adding PRV, replacing under sized pipelines with fire hydrants, adding pipeline interconnections to improve low pressure areas, and abandon undersized pipelines	Sweeping Turn, Four Seasons & Upper Saddle Zones	$2,653,000	X		
B18	Price-Ralph Improvements	Section 5: 31 & 32	Provide redundant service from Stateline to Ralph Zone and provide redundant service from Heavenly to Price Road	Price Rd (Ralph)	$631,000	X		
B19	Terrace Zone Improvements	Section 5: 48 to 52	Terrace PRV	Terrace PRV	$1,230,000	X		

Note:

1. Project B17 was completed by the District in 2014.

6.5.1 Cost Summary for Medium Priority Projects

The total cost of medium-priority projects is estimated at $28 million. Projects A3 and B15A are recommended to be combined into one project to improve the performance and reliability of H Street Booster Pump Station. If the District were to implement Project B15a by FY 14/15 as recommended, it is recommended that either the spare pump under Project B15b be sized to incorporate into the new pump station or not be implemented.

Table 6-4.
Medium-Priority Projects

Level of Service			Medium Priority Projects																			
Key Service Objectives	Strategic Goals	Quantifiable Goals	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15A	B15B	B16	B17	B18	B19
1 -Provide High Quality Water	a - Meet regulatory quality standards	1 - Regulated constituents at or below MCL 100% of the time																				
		2- Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.																				
	b - Minimize MTBE in drinking water	1 - Non-detect (<0.5 ppb) on MTBE 100% of the time																				
	c - Address nuisance water issues (odor, corrosion, sediment)	1 - Reduce system related nuisance complaints below 10 per 1000 services annually.																				
		2- Investigate and respond to customer complaint within 8 hours at least 90% of the time.																				
	d - Protect system from backflow and cross-connection	1 - Comply with District's cross-connection protection program 100% of the time.																				
	e - Secure water facilities	1 - Meet or exceed national standard for site security for systems of District's size and location.		X		X	X															
2 - Provide Water Reliably	a - Minimize and consolidate scheduled outages	1 - Maintain # of scheduled outages of 12 hrs. or less at or below industry std (0.65 outages/year/1000 services).						X										X				
	b - Minimize unscheduled outages	1 - Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at 50 per year.	X															X			X	
		2 - Maintain number of services affected during a shut-down at or below 50 per year																			X	
		3 - Implement Asset Management Principles for 100% of System Assets.						X						X								
	c - Provide redundancy within system	1 - 100% of macro zones meet maximum day demands with largest source out of service								X	X	X	X				X		X	X	X	X
		2 - 100% of facilities have backup power capabilities															X					
3 - Provide Enough Water	a - Size system facilities to meet community demands	1 - 100% of system can meet MDD and PHD.							X								X			X	X	X
		2 - 100% of system provides access to emergency water							X	X	X	X	X			X	X			X	X	X
		3 - Zero days with wells pumping at greater than 90% utilization.																				
		4 - 100% of zone storage can meet MDD with zone replenishment with largest unit out of service														X						
		5 - 100% of zones combined sources can pump MDD plus max fire for zone with largest source out of service						X	X								X		X	X		X
	b - Maintain system pressures	1 - Min pressure > 20 psi under all conditions							X							X	X	X		X	X	X
		2 - Max pressure < 120 psi 90% of the time														X				X		

Table 6-4.
Medium-Priority Projects

Level of Service			Medium Priority Projects																			
Key Service Objectives	Strategic Goals	Quantifiable Goals	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15A	B15B	B16	B17	B18	B19
4 - Provide Water Cost Effectively	a - Minimize Unaccounted water	1 - Utilize Commercial and Residential water meters to account for all water and compare to production trends																				
		2 - Meter accuracy tests within industry standard 100% of the time.																				
	b - Meet industry standards for cost to deliver water	1 - Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.																				
	c- Maintain appropriate staffing level for regular and emergency needs	1 - Limit unplanned overtime maintenance hours to less than 15% of total unscheduled maintenance hours.						X								X			X			
		2 - Maintain staff utilization rate of 100% during peak season																				
	d - Extend life cycle of assets	1 - Life of assets meet or exceed industry standard.	X		X		X	X		X	X	X	X	X								
	e - Replace spent assets	1 - Maintain annual renewal rate on capital expenditures at or above 1.7%.								X	X		X			X	X		X	X		X
		2 - When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.														X						
	f - Operate system energy efficiently	1 - Maintain annual energy consumption at or below 20,000 kWh/MG.																				
	g - Comply with regulatory requirements	1 - Reduce current water use by 20% by 2020.																				
5 - Protect Lake Tahoe and the Community	a - Minimize health and safety risks to public	1 - No public injury or other negative impact attributed to water system	X	X		X	X												X			
	b - Minimize unregulated discharges	1 - Comply with requirements for no surface water discharge from properties.		X																		
		2- Implement flushing BMPs 100% of the time.																				
	c - Collaborate and cooperate with other agency programs	1 - Zero complaints from other agencies for District O&M procedures.																				
		2 - Minimize cost associated with relocation of water utilities for EIP Projects																				

6.6 Low-Priority Projects

In general, low-priority projects consist of activities that prolong the useful service life of existing assets. This evaluation resulted in the third phase of recommended pressure-zone consolidation improvements to improve reliability and system performance in the Flagpole Zone as covered by project C12.

The low-priority projects are listed in Table 6-5 and the level of service objectives that each of these low priority projects achieves once implemented are listed in Table 6-6. In Table 6-5 for each project it is designated as a Capital Improvement Project (CIP), Planning project, or Operation and Maintenance (O&M) project. This follows the same approach as described for Table 6-1.

Table 6-5.
Low-Priority Projects

Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
C1	PRV Improvements	Section 1.4.3, Table 1-9	PRV improvements	Multiple PRV sites	$592,000	X		
C2	Well Electrical Equipment Evaluation	Section 1.4.2, Table 1-8	Evaluate physical mortality of electrical gear	Multiple Well sites	$47,000		X	
C3	Water Quality Evaluation - Engineering Study	Section 5: 62	Conduct system-wide water quality evaluation for low-water demand periods	System-wide	$37,000		X	
C4	Well Sites Pipe Coating Improvements	Section 1.4.2, Table 1-8	Piping improvements	Multiple Well Sites	$58,000			X
C5	SCADA Improvements - Phase 3, Flowmeters	Section 1.4.2, Table 1-8	SCADA improvements	Multiple Well Sites	$550,000	X		
C6	Boulder Mountain and Cold Creek Tank Booster Pipe Coating Improvements	Section 1.4.1, Table 1-7	Piping improvements	Boulder Mountain and Cold Creek Tank booster pump stations	$13,000			X
C7	SCADA Improvements - Phase 3, Flowmeters	Section 1.4.1, Table 1-7	SCADA improvements	Multiple pump stations	$805,000	X		
C8	South Apache Booster Improvements	Section 1.4.1, Table 1-7	Building replacement	South Apache Booster	$337,000	X		
C9	Airport Booster Improvements	Section 1.4.1, Table 1-7	Miscellaneous improvements	Airport Booster	$436,000	X		
C10	Tank Inlet / Outlet Piping Retrofits	Section 1.4.4, Table 1-10	Piping and coating improvements	Multiple Tank sites	$1,698,000	X		
C11	Tata Tank Removal	Section 1.4.4, Table 1-10	Remove Storage Tank	Tata Tank	$54,000	X		
C12	Flagpole Zone Improvements	Section 5: 4 to 8	Pipeline projects to address excessive system pressures	Flagpole Zone	$798,000	X		

Table 6-5. Low-Priority Projects								
Project No.	Project Name	Section and/or Project No. Reference	General Description	Site	Cost	CIP	Study	O&M
C13	Unidirectional Flushing Program	Section 5: 63	On-call engineering Support for System-Wide Unidirectional Flushing Program	Water system-wide	$21,000		X	
C14	Pipeline Replacement Program	Section 5: 61	Conduct an evaluation to develop a pipeline replacement priority program	Water system-wide	$347,000		X	

6.6.1 Cost Summary for Low-Priority Projects

The total value of low-priority projects is estimated at $5.8 million.

Table 6-6.
Low-Priority Projects

Level of Service			Low Priority Projects													
Key Service Objectives	Strategic Goals	Quantifiable Goals	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
1 -Provide High Quality Water	a - Meet regulatory quality standards	1 - Regulated constituents at or below MCL 100% of the time			X							X			X	
		2- Maintain residual chlorine levels within range (0.2 to 1.0) 100% of the time.			X							X			X	
	b - Minimize MTBE in drinking water	1 - Non-detect (<0.5 ppb) on MTBE 100% of the time														
	c - Address nuisance water issues (odor, corrosion, sediment)	1 - Reduce system related nuisance complaints below 10 per 1000 services annually.													X	X
		2- Investigate and respond to customer complaint within 8 hours at least 90% of the time.														
	d - Protect system from backflow and cross-connection	1 - Comply with District's cross-connection protection program 100% of the time.														
	e - Secure water facilities	1 - Meet or exceed national standard for site security for systems of District's size and location.	X							X	X		X			
2 - Provide Water Reliably	a - Minimize and consolidate scheduled outages	1 - Maintain # of scheduled outages of 12 hrs. or less at or below industry std (0.65 outages/year/1000 services).														X
	b - Minimize unscheduled outages	1 - Maintain number of unscheduled outages for water mains at or below 350 per year and for water services at 50 per year.														X
		2 - Maintain number of services affected during a shut-down at or below 50 per year														
		3 - Implement Asset Management Principles for 100% of System Assets.	X	X			X		X							
	c - Provide redundancy within system	1 - 100% of macro zones meet maximum day demands with largest source out of service														
		2 - 100% of facilities have backup power capabilities		X												
3 - Provide Enough Water	a - Size system facilities to meet community demands	1 - 100% of system can meet MDD and PHD.														
		2 - 100% of system provides access to emergency water									X					
		3 - Zero days with wells pumping at greater than 90% utilization.														
		4 - 100% of zone storage can meet MDD with zone replenishment with largest unit out of service														
		5 - 100% of zones combined sources can pump MDD plus max fire for zone with largest source out of service									X					
	b - Maintain system pressures	1 - Min pressure > 20 psi under all conditions														
		2 - Max pressure < 120 psi 90% of the time												X		

Table 6-6. Low-Priority Projects																
Level of Service			Low Priority Projects													
Key Service Objectives	Strategic Goals	Quantifiable Goals	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14
4 - Provide Water Cost Effectively	a - Minimize Unaccounted water	1 - Utilize Commercial and Residential water meters to account for all water and compare to production trends	X				X		X		X					
		2 - Meter accuracy tests within industry standard 100% of the time.														
	b - Meet industry standards for cost to deliver water	1 - Maintain total O&M plus S&B cost to deliver treated water during peak week under $69,000/MG.														
	c- Maintain appropriate staffing level for regular and emergency needs	1 - Limit unplanned overtime maintenance hours to less than 15% of total unscheduled maintenance hours.														X
		2 - Maintain staff utilization rate of 100% during peak season														
	d - Extend life cycle of assets	1 - Life of assets meet or exceed industry standard.	X			X		X		X	X	X				X
	e - Replace spent assets	1 - Maintain annual renewal rate on capital expenditures at or above 1.7%.		X						X	X					X
		2 - When reactive maintenance and OT costs exceed preventive maintenance costs, replace asset.		X												X
	f - Operate system energy efficiently	1 - Maintain annual energy consumption at or below 20,000 kWh/MG.			X											
	g - Comply with regulatory requirements	1 - Reduce current water use by 20% by 2020.	X				X		X							X
5 - Protect Lake Tahoe and the Community	a - Minimize health and safety risks to public	1 - No public injury or other negative impact attributed to water system	X		X							X	X			
	b - Minimize unregulated discharges	1 - Comply with requirements for no surface water discharge from properties.														
		2- Implement flushing BMPs 100% of the time.													X	
	c - Collaborate and cooperate with other agency programs	1 - Zero complaints from other agencies for District O&M procedures.														
		2 - Minimize cost associated with relocation of water utilities for EIP Projects														

6.7 CIP Fiscal Year Summary

In addition to the CIP projects described above, the District has been allocating capital funds to complete the following additional capital projects that were already known by the District:

- Installation of water meters at all non-metered water services. The District is on schedule to complete the meter installation by fiscal year 2018/2019.
- Replacement of undersized water mains of which the District has approximately up to 125,000 lineal feet remaining to complete. The District has over 20 years of undersized water mains to be replaced.
- Other projects that include implementing best management practices to protect Lake Tahoe water quality, completing utility relocation projects for City of South Lake Tahoe and Caltrans, completing special studies, and implementing customer service LOS improvements.

Stacked Charts Discussion

The District's annual Capital Improvement Planning process is very fluid. Generally the priority of projects will shift from year to year based on changes in facility performance, funding opportunities, regulatory requirements, and other outside influences, which are all driven by the District's Level of Service objectives. As such, the WSOP will not endeavor to assign the High, Medium and Low projects to a particular budget year. Rather, the entire list of High, Medium and Low projects will be added to the District's "Unconstrained Projects List", with District Staff identifying certain projects each year to be added to the CIP list for prioritization and budget-year assignment based on a review of the LOS objectives and how they will help achieve those objectives.

To visualize the capital outlay needs to implement all of the Capital Projects recommended by the WSOP and other programs, a series of stacked charts have been developed that depict the budget needs to complete the projects that have been identified to date within 20 years (Figure 6-1) or 30 years (Figure 6-2), as funding allows. These charts assume 3% annual inflation.

To create the charts, each WSOP project has been categorized as a Capital Project, O&M Project or Study. Only Capital Projects are included in stacked charts, with a combined 2015 value of $37,834,000. Generally O&M projects will be funded by Departments, not by the Engineering CIP. Studies are generally planning level, and may or may not ultimately contribute to the design of new or replacement assets. The O&M projects and Studies are:

- The O&M Projects not included in the stacked charts are: A6, A8, A22, B1, B2, B5, B16, C4 and C6 with a combined value of $1,754,000.
- The Studies not included in the stacked charts are: A2, A7, A9a, A11, A15, A20, A21, A23, A25, A26, A27, B6, B12, C2, C3, C13, and C14 with a combined value of $1,428,000.

In the three years since the start of the WSOP, several projects have been completed. Even though they are included in the WSOP list of projects, they are not included in the stacked charts, since their cost has been incurred by the District prior to FY15-16. The completed projects not included in the stacked charts are: A1, A12, A13, and B17 with a combined value of $2,929,000. For Projects with multiple alternatives (i.e., A9 and B15), only the most expensive option has been included in the stacked chart.

A second set of stacked charts was developed to visualize how the proposed projects will improve the water system (Figure 6-3: 20-Year Water System CIP – Projects by Program and Figure 6-4: 30-Year Water System CIP – Projects by Program). Each proposed project is meant to accomplish one of three general goals. While a particular project may have elements that work toward multiple goals, the project has been assigned to the chart based on the proportion of the cost working toward one of the three goals:

- New Asset: These projects *add* assets to the Districts inventory to improve the District's ability to meet Level of Service expectations. Examples of these new assets include, but are not limited to wells (for reliability), pressure reducing valves (for redundancy), and site improvements (for stability and security).
- Asset Replacement: These projects *replace* or *renew* existing District assets to improve the District's ability to meet Level of Service expectations. Examples of these projects include, but are not limited to, replacement and upsizing of booster stations and pressure reducing valves.
- Asset Optimization: These projects modify the operation of existing assets, without substantial replacement or addition of assets, to better meet Level of Service expectations. Generally, these projects have resulted from the operational assessments of the system (hydraulic modeling and capacity studies), however this category also includes facility abandonment projects (such as Mountain View Well Abandonment and Tata Tank Demolition).

Generally speaking, civil infrastructure is expected to have a service life of 25-100 years, depending on the type of facility. Using the estimate developed for the 2006 Water System Capacity Charge Study, the extrapolated 2014 replacement value of the water system is approximately $574 million. The annual capital outlay needed to replace the entire water system over a 100-year period curve is shown on the stacked charts on Figures 6-1 through

6-4 to depict how the different capital outlay scenarios for asset replacement might compare to this benchmark.

6.8 Conclusions

- If the District intends to complete all of the infrastructure improvement needs that have been identified to date by the WSOP and Waterline Upsizing programs in the next 20 years, then the annual capital outlays need to be extended significantly. Whereas $1 million to $3 million has been allocated for years 2019-2024, nearly $10 million would need to be spent in year 2025 and an additional 3% each year thereafter until 2034 to complete all the projects.
- If the District makes the all the recommended improvements over 20 years, then the District will be on track to replace the existing assets over 100 years.
- If the District extends the implementation period to 30 years, the District would need to increase its capital outlay to approximately $5 million in 2025, and an additional 3% each year thereafter to 2044 in order to complete all the projects.
- These two infrastructure improvement scenarios are intended to give a perspective on the impacts to the District if all of the identified to date infrastructure improvements were completed to reach the current LOS objectives. The economic climate, regulation environment, and other factors will drive the District in establishing the Capital Improvement Program.
- Due to the limited scope of the WSOP, the stacked charts cannot tell the whole story. The projection does not account for any infrastructure renewal or replacement needs that have not yet been identified in either the WSOP or Waterline Upsizing program. For example:
    - This projection does not account for system-wide replacement of waterlines 6-inches and larger (that are not otherwise accounted for as part of a WSOP project).
    - This projection does not account for any projects that might result from the studies recommended by the WSOP.

Figure 6-1

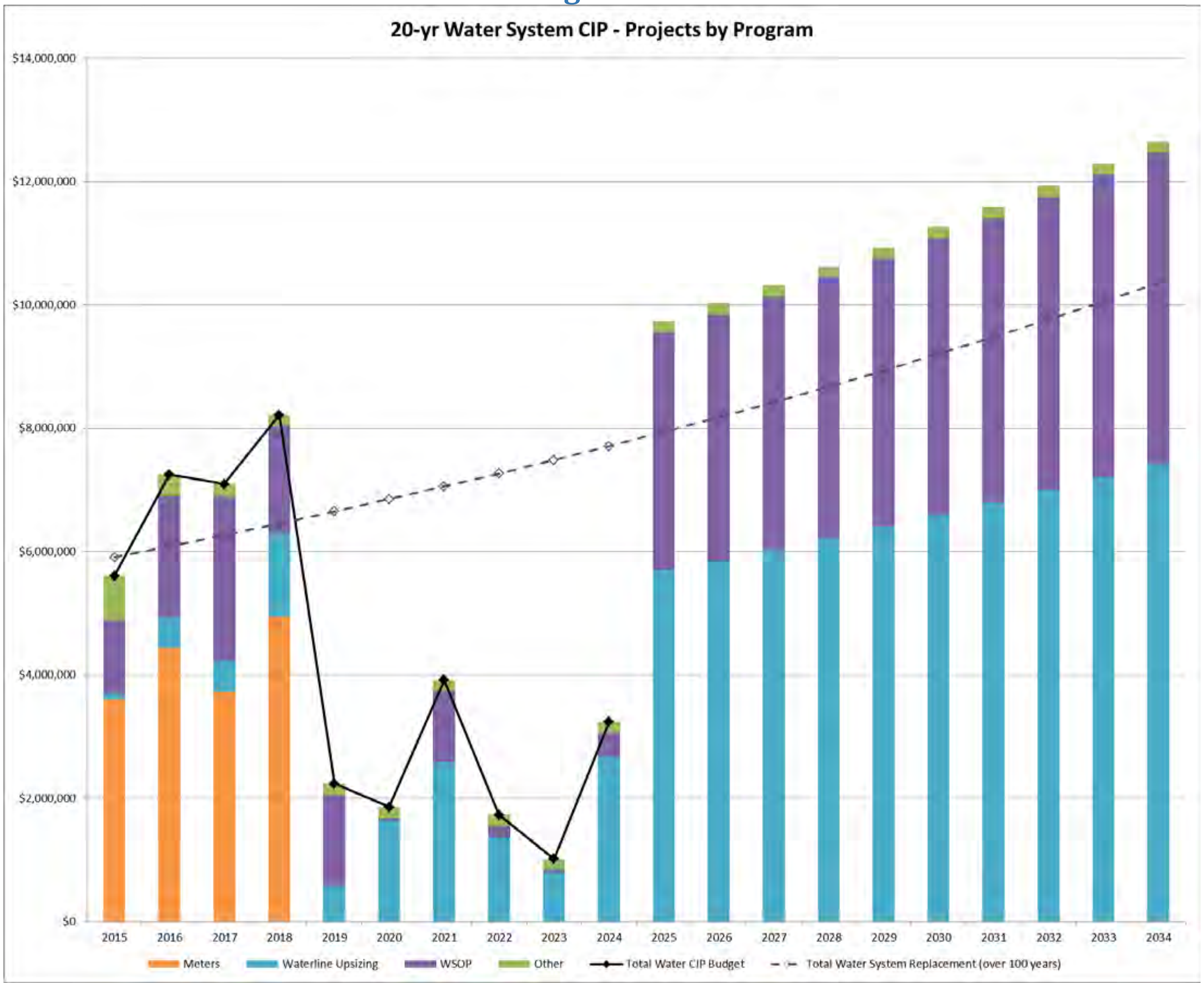

20-yr Water System CIP - Projects by Program
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
Meters
Waterline Upsizing
WSOP
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure 6-2

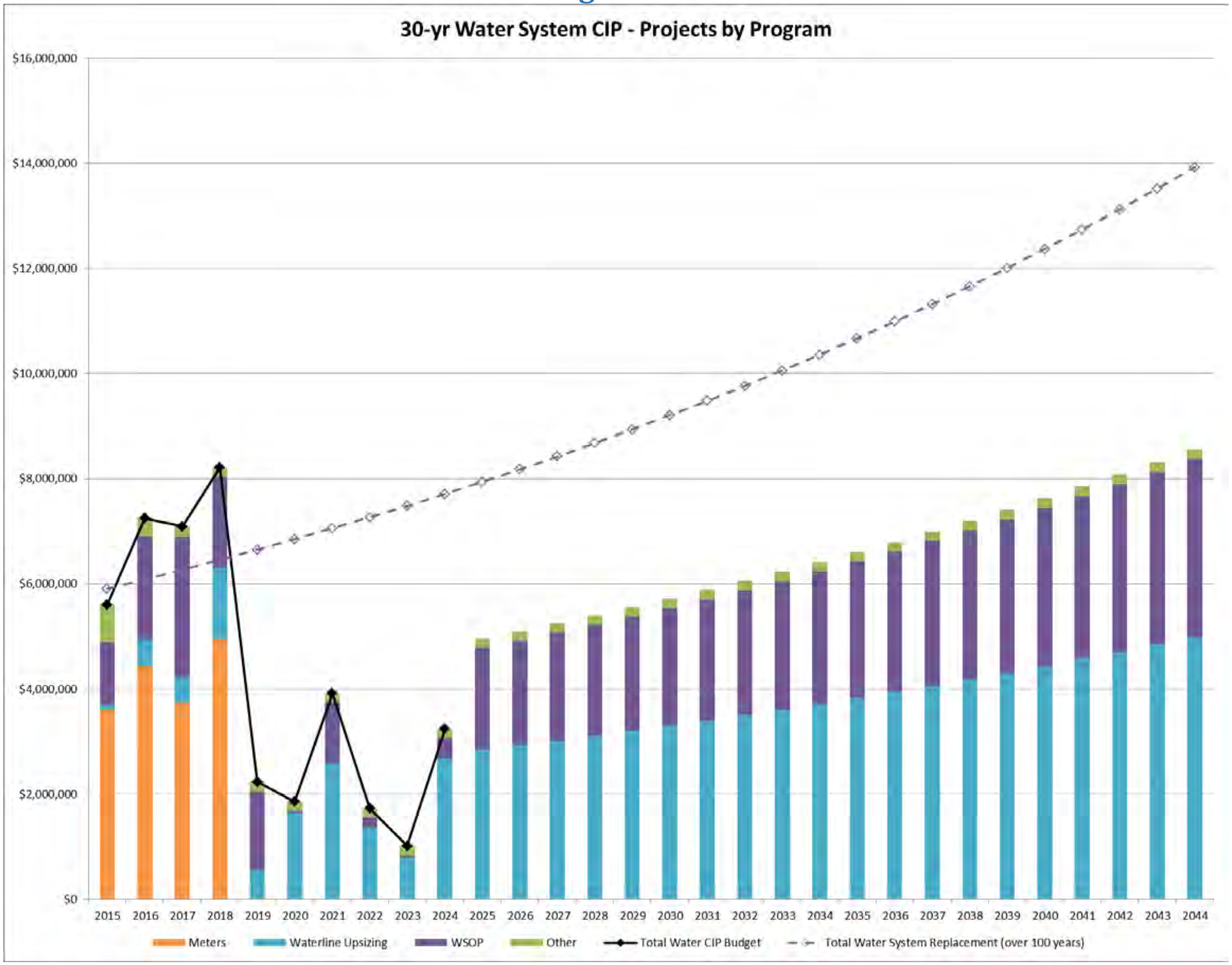

30-yr Water System CIP - Projects by Program
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Meters
Waterline Upsizing
WSOP
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure 6-3

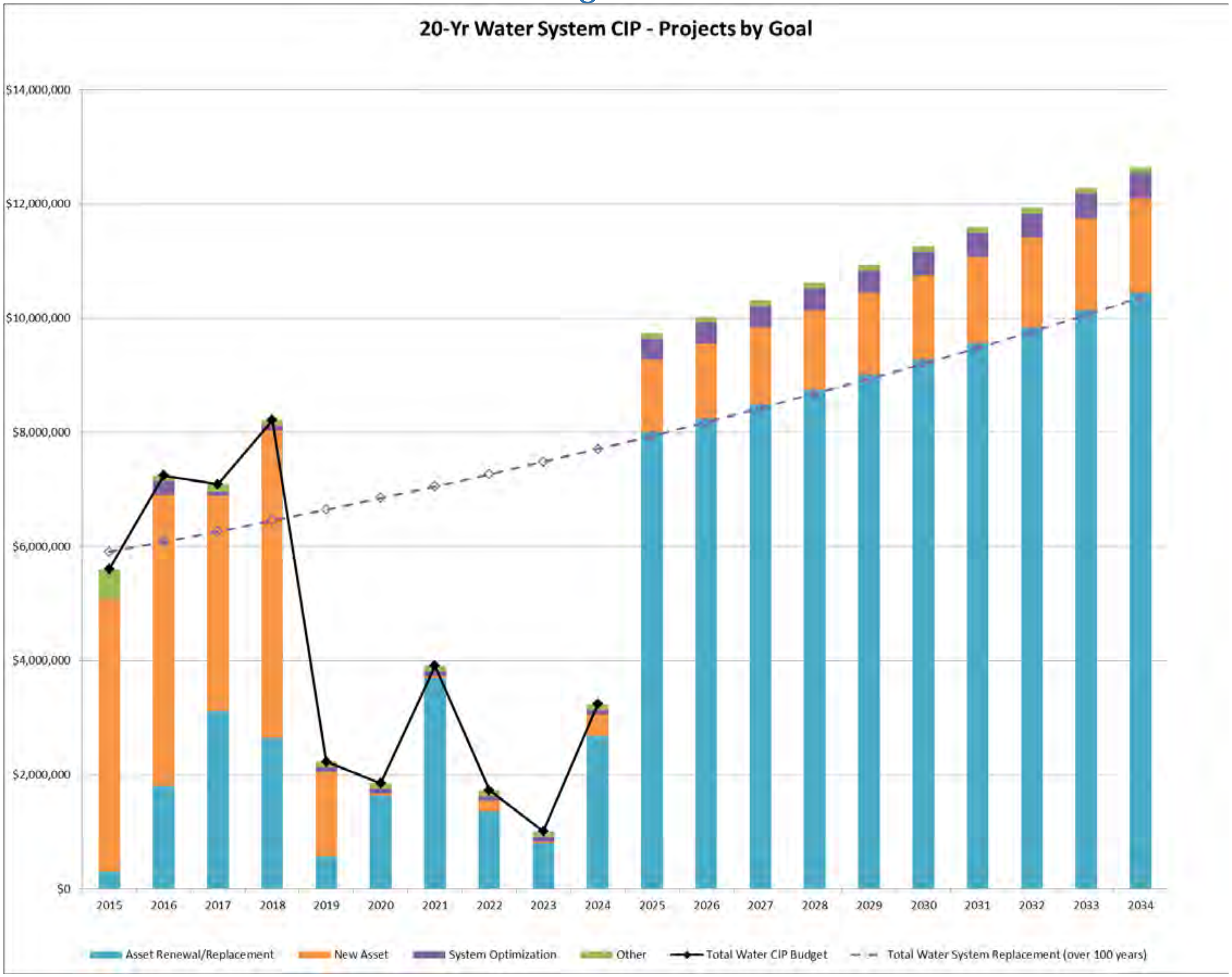
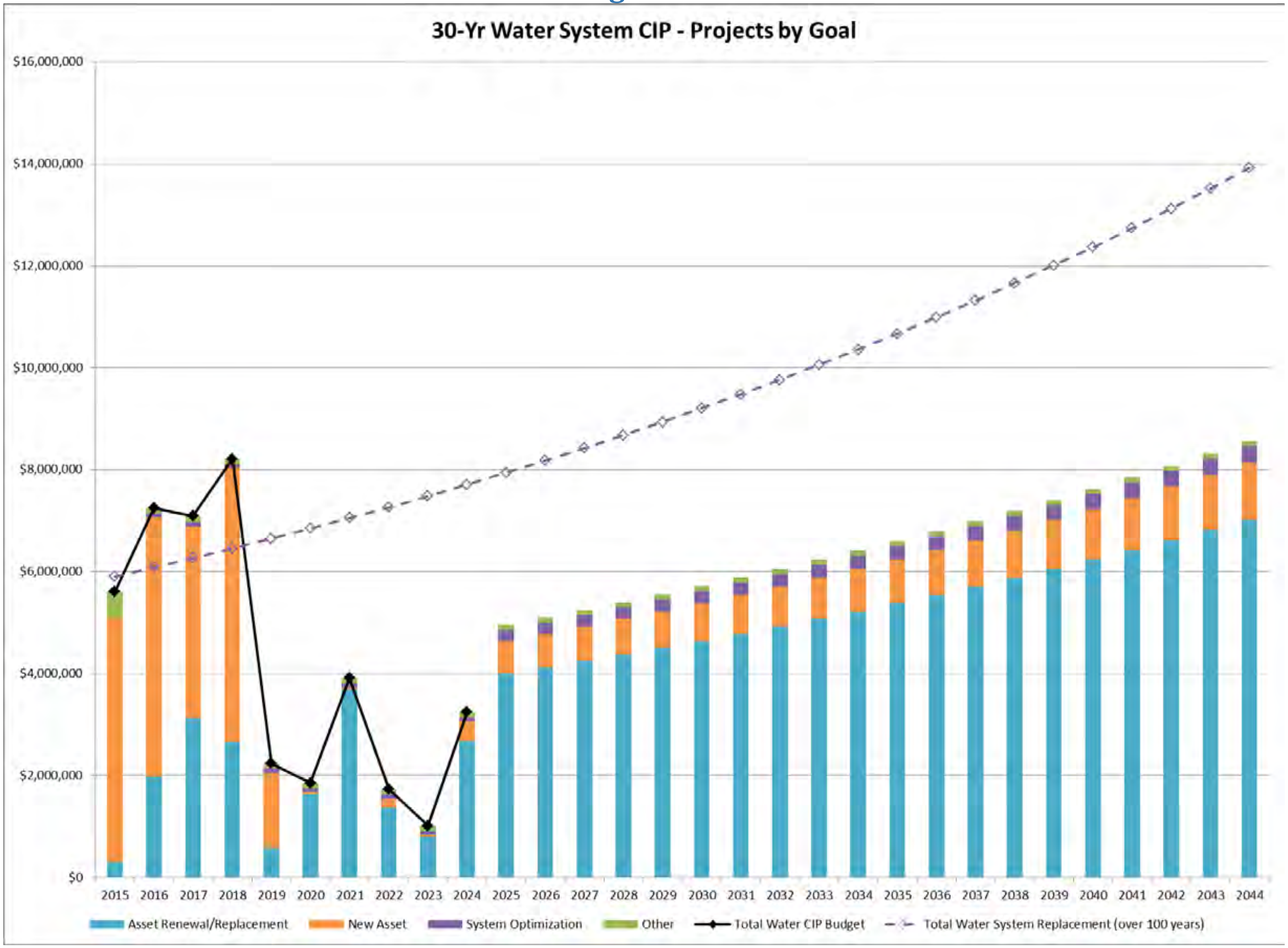

20-Yr Water System CIP - Projects by Goal
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034
Asset Renewal/Replacement
New Asset
System Optimization
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)

Figure 6-4


30-Yr Water System CIP - Projects by Goal
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044
Asset Renewal/Replacement
New Asset
System Optimization
Other
Total Water CIP Budget
Total Water System Replacement (over 100 years)