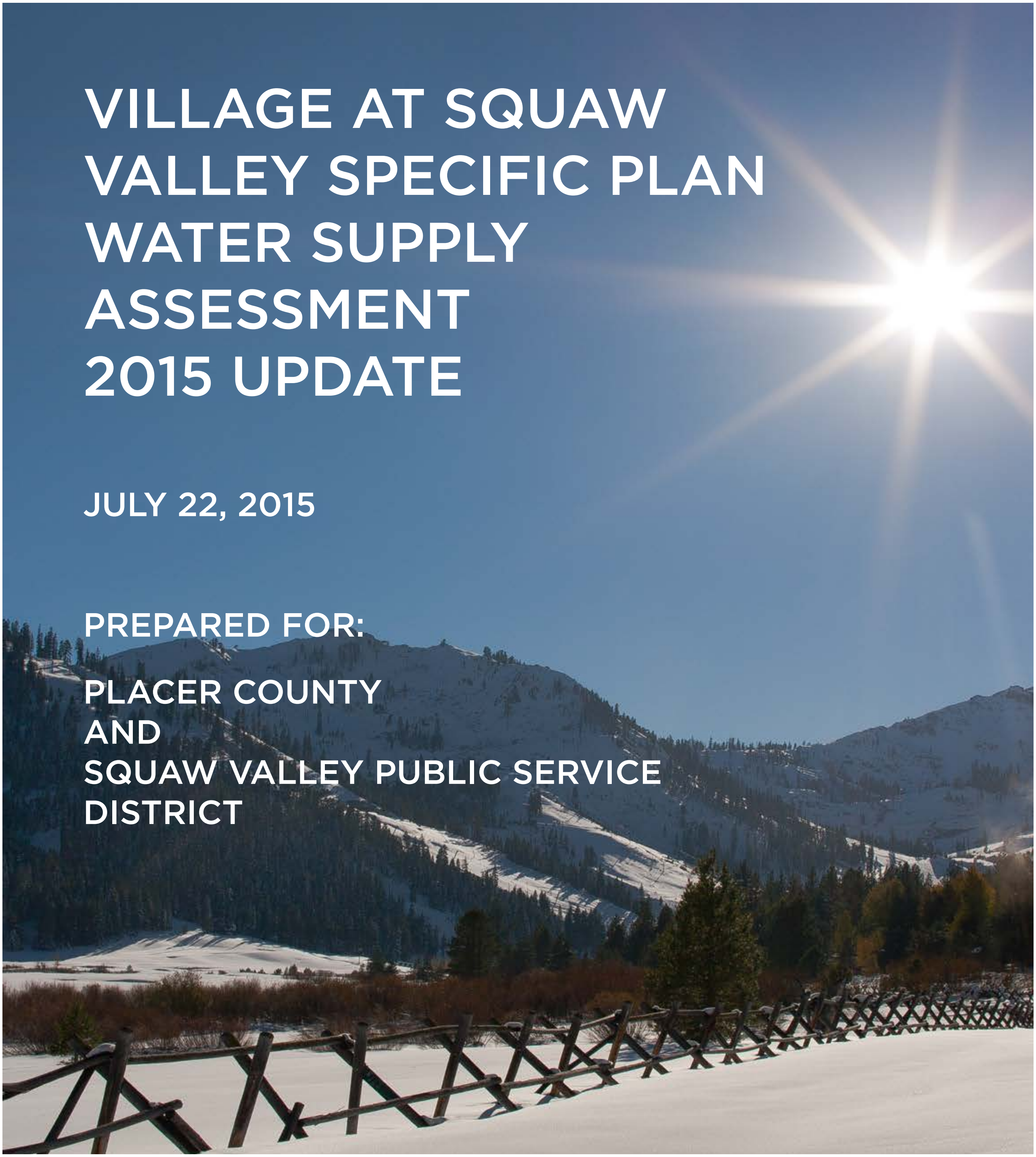
VILLAGE AT SQUAW VALLEY SPECIFIC PLAN WATER SUPPLY ASSESSMENT 2015 UPDATE

JULY 22, 2015

PREPARED FOR:

PLACER COUNTY
AND
SQUAW VALLEY PUBLIC SERVICE DISTRICT



FARR WEST ENGINEERING

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TODD GROUNDWATER

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Table of Contents

List of Tables

List of Figures

Appendices

EXECUTIVE SUMMARY

Squaw Valley Real Estate, LLC is proposing to develop the Village at Squaw Valley in accordance with The Village at Squaw Valley Specific Plan (Project). The Project will include commercial, resort residential, and recreational development in Olympic Valley, California. The purpose of this Water Supply Assessment (WSA) is to evaluate the water demands associated with both the Project and other development in Olympic Valley, to assess available water supplies, and to determine if sufficient water is available to meet existing and planned future demand, during normal, dry, and multiple dry water years over the 25 year construction time period of the Project.

The proposed Project is planned to develop approximately 94 acres in the Olympic Valley. Approximately 85 acres of the proposed development are located at the western end of the Olympic Valley, adjacent to the existing Project. The remaining approximately 9 acres of the development are planned for a separate site located approximately 1.5 miles east of the Village.

WATER DEMAND

Water demands for reasonably foreseeable planned future development in Olympic Valley were estimated through the Project timeline of 25 years. These demands include all existing water uses, water demand for the Project, and demand for reasonably foreseeable non-project future development in Olympic Valley.

Existing water demands were compiled from records of historical water use from the four water primary water producers in Olympic Valley: the Squaw Valley Public Service District (SVPSD), Squaw Valley Mutual Water Company, the Resort at Squaw Creek (RSC), and Squaw Valley Resort (SVR). These existing demands were compiled from records of water use data for the period of 2000 through 2014, which represents current development in Olympic Valley and a characteristic hydrologic period. The existing average annual water demand for all parties in Olympic Valley is 871 acre-feet per year (AFY). This existing average total is composed of 403 AFY for the SVPSD, 130 AFY for SVMWC, 257 AFY for the RSC, and 81 AFY for SVR.

Future water demands were also estimated for each of these water producing entities for the 25 year period ending in 2040. These demands were estimated in two major categories, those associated with the Project and those for reasonably-foreseeable non-project development. Development information for these two categories for 2040 was compiled from the Project Specific Plan and non-project growth projections developed by Placer County (County). The future water demand estimates were calculated using these development projections and unit water demand values derived from historical use in Olympic Valley. These unit demand values represent conservatively high estimates of future water use and do not include any reductions to account for future water conservation in new and existing construction or demand reductions resulting from drought conditions. These conservative demand assumptions are:

- High unit demand values for all future development.
- No reductions in future demand to account for State, County, and SVPSD implemented water demand reduction measures.
- No assumed reduction in water demands during drought.

The total water demand in Olympic Valley at 2040 was estimated to be 1,254 AFY, which is an increase in demand of 383 AFY compared to historical water use. Peak daily demand estimates associated with these annual demands indicate that the Project will require four new wells and that the non-project SVPSD demands will require an additional two new wells, for a total of six new wells in the SVPSD water supply system.

WATER SUPPLY

Currently two sources of water supply are used in the Olympic Valley: groundwater from the alluvial Olympic Valley Groundwater Basin (Basin) and groundwater from horizontal fractured bedrock wells in the mountainous areas above the Olympic Valley floor. Groundwater produced from the Department of Water Resources designated Basin alluvial aquifer has been the primary source of water supply in the area since the development of Olympic Valley. All four of the major groundwater pumpers in Olympic Valley currently produce water from the Basin. Neither the Department of Water Resources nor any previous studies have found the Basin to be in overdraft. Municipal water supply in Olympic Valley is currently produced primarily from the western portion of the Basin, where the SVPSD has four active wells and the SVMWC has two active wells. This portion of the Basin is the most productive. A small quantity of the water supply used in Olympic Valley is produced from horizontal wells located in fractured bedrock. There are four total horizontal bedrock wells, two each for the SVPSD and SVMWC. These wells are located on the hillsides above the Basin. Groundwater is present in the fractured crystalline rocks surrounding the Basin. Recent studies by Lawrence Livermore National Laboratories have shown that there is not a strong connection between the Basin and the fractured bedrock groundwater system.

The primary groundwater management agency in the Basin is the SVPSD, which has led the development of a Groundwater Management Plan in cooperation with a stakeholders group representing local groundwater users, environmental organizations, regulatory agencies, and the public.

Several previous studies have attempted to quantify the volume of groundwater that can be produced from the Basin over some period of time without causing impairment of one kind or another. These attempts to quantify the volume of available groundwater from the Basin reported a wide range of maximum groundwater production volumes and none were appropriate for use in assessing the specific demand distribution estimated in this WSA.

WATER SUPPLY SUFFICIENCY

As noted previously, no suitable total available water supply volume or criteria against which to judge water supply availability were available for this WSA. As a result, a methodology and set of criteria specific to the Basin were developed for assessing water supply sufficiency. The volume of groundwater that can be produced from the Basin in any year is dependent on four factors:

1. Volume and timing of recharge to the Basin (i.e., precipitation and snowmelt)
2. Timing of the demand
3. Location of pumping wells
4. Acceptable groundwater elevation response to pumping for long-term sustainability

SVPSD has an existing numerical MODFLOW groundwater model representing the Basin (Model). The Model was first constructed in 2001 and has been updated multiple times to incorporate new data and refine conceptualizations. The Model is a good representation of groundwater flow in the Basin and is a useful tool for assessing changes in groundwater production from the Basin.

To evaluate the sufficiency of supply, criteria were developed against which simulated (Modeled) groundwater elevations can be compared. These criteria are as follows:

- Average saturated thickness in the western municipal wellfield wells (existing and proposed new) may not fall below 65 percent for more than 3 consecutive months or more than 4 times total over the Model simulation period.

Saturated thickness is the water level elevation (head) in a well minus the elevation of the bottom of the Basin at that location. The maximum saturated thickness occurs when water levels are the highest. The percent saturated thickness is the saturated thickness at a location and time divided by the maximum saturated thickness for that location. The maximum saturated thickness values at specific locations do not change, and were derived from simulations representing current average pumping conditions (baseline conditions).

The existing municipal water supply wells are capable of producing more water than is currently used in Olympic Valley, but not enough to meet the projected demands at 2040. Therefore, an expanded wellfield with new wells will be required to meet these projected demands. The potential new wells sites were identified by evaluating geology, geometry, hydrostratigraphy, aquifer production capacity, and development plans for the western portion of the Basin.

All of the potential new wells were used in conjunction with the existing wells in assessing the sufficiency of supply. These well locations were included in the Model with pumping distributed to the wells for each pumper (i.e. SVPSD, SVMWC, RSC, and SVR) to meet total water demands at 2040. The remaining Model inputs for the future demand simulation were kept the same as those from the recently updated and calibrated Model.

The simulated results for the municipal wells in the western wellfield were extracted from the Model and used to calculate saturated thicknesses for each month in the Model time period. The results of the Modeling analysis indicate that over the entire Modeled period, the average percent saturation for all the wells in the western wellfield ranged from 77 percent to 99 percent, well above the 65 percent criteria. This indicates that there is sufficient available groundwater supply capacity to meet the estimated demands in 2040 with a margin of safety. As expected, the lowest simulated groundwater elevations generally occurred during the fall in drought years, which shows that these time periods are the most critical for water supply in the Olympic Valley.

CONCLUSIONS

The proposed Project and non-project growth over the next 25 years represents an increase in the water demand within Olympic Valley of 383 AFY for a total demand of 1,254 AFY at 2040. The Project would require 240 AFY of this increase, and the non-project development would require an additional 143 AFY of demand. This total projected water demand represents a 44 percent increase over the average annual volume of 871 AFY currently used in the Olympic Valley.

The future demand at 2040 was simulated over a Model period including wet, average, single dry and multiple dry year conditions as represented by climate data from Olympic Valley. The resulting Model-simulated groundwater elevations were compared to criteria developed to maintain simulated groundwater elevations in the Basin at a reasonable saturated thickness. Simulation of the expanded wellfield showed that the average saturation thickness in all the western wellfield was in a reasonable range and that neither the average saturated thickness nor the saturated thickness at any individual well ever fell below the 65 percent threshold. Accordingly, there is sufficient water supply availability from the Basin to meet the expected demand from the Project and other reasonably foreseeable non-project development through 2040 with a margin of safety. The Basin is not currently in overdraft and is not projected to be overdrafted with the addition of the future demands. This assessment included evaluation of 2040 demands in normal, single dry, and multiple dry years, as all of these conditions are represented in the Model.

The Model projects that the 2040 demand can be met with an adequate margin of safety even during single and multiple dry year periods. It is not possible to quantify this margin of safety, because the ability of the Basin to supply additional demand beyond 2040 will depend on the specific temporal and geographic distribution of those demands. However, the demand analyses that have been undertaken for this WSA included multiple conservative assumptions that reinforce the existence of the margin of safety.

Any additional demands above those projected for 2040 would need to be reevaluated using the specific demand schedule and the proposed water supply system at the time that such development is proposed.

1. INTRODUCTION

Squaw Valley Real Estate, LLC (SVRE) is proposing to develop the Village at Squaw Valley (Project) in accordance with The Village at Squaw Valley Specific Plan (Specific Plan, SVRE 2015). The Project—intended to implement an all-season, world-class resort—will include commercial, resort residential, and recreational development in Olympic Valley, California. The purpose of this Water Supply Assessment (WSA) is to evaluate the water demands of the Project, to assess available water supplies, and to determine if sufficient water is available to meet existing and planned future demand, including the Project, during normal, dry, and multiple dry water years.

California Water Code Section 10910 (Water Code) requires that a WSA be prepared for all proposed developments above a defined size. A WSA is required for any project with 500 or more dwelling units, 500 or more hotel rooms, 500,000 square feet of commercial shopping center space, or a mixed use project with a combination of these uses (with equivalent water demands). The Project is a qualifying project and therefore a WSA is required. Cities and counties are mandated to identify the public water system that might provide a project's water supply and request preparation of a WSA. The Squaw Valley Public Service District (SVPSD) is the largest water purveyor in the Squaw Valley community (Squaw Valley) and it has been identified as a potential water supplier for the Project. Although the SVPSD is a *Public Water System* as defined by Water Code Section 116275(h), because of its size and number of connections, it does not satisfy the WSA-related Water Code Section 10912(c) definition of a *Public Water System.* Therefore, Placer County, as the California Environmental Quality Act (CEQA) lead agency, is required to consider the adequacy of the water supply for the Project through a WSA, and to consider adopting the resulting WSA if it shows that there is adequate water supply. The County has asked SVPSD to coordinate a WSA for the Project, which the County will then consider.

The Water Code also requires that a WSA consider project and non-project demands on proposed water supply sources over a period of 20 years in 5 year increments. SVRE estimates that the Project will require approximately 25 years to achieve full buildout, and as a result, this WSA considers all existing and planned future uses of the projected water supplies through 2040. This WSA quantifies reasonably foreseeable Project and non-project water demands in Squaw Valley, documents water supply sources, assesses sufficiency of supply to meet demand, evaluates drought impacts, and provides a comparison of water supply and demand in normal, dry, and multiple dry years through the 25 year period ending in 2040. The additional 5 years of consideration is appropriate because it encompasses the entirety of the Project, and thus is a more conservative approach to evaluating the potential for the Project and other development to be served at the time of project completion.

Historically, most of the water used on the floor of Olympic Valley (Olympic Valley) has come from the Olympic Valley Groundwater Basin (Basin), which is designated as Department of Water Resources (DWR) Groundwater Basin Number 6-108 (DWR 2003a). There are currently two municipal water suppliers within Squaw Valley: SVPSD and the

Squaw Valley Mutual Water Company (SVMWC). There are also several private parties that use groundwater from the Basin to serve non-potable needs, including golf course irrigation at the Resort at Squaw Creek (RSC) and snowmaking at the Squaw Valley Resort (SVR). This WSA assumes that the SVPSD will provide all water supply services to the Project and that the Basin will be the source of supply for those services.

1.1. PURPOSE

The purpose of this WSA is to document the existing and future Squaw Valley water demands, including that of the proposed Project, and to compare them to available water supply. This comparison, conducted for both normal and drought conditions (single and multiple dry years), is the basis for an assessment of water supply sufficiency in accordance with the requirements of California Water Code Section 10910 and CEQA Section 15155. This updated WSA has been prepared to include recent hydrologic and water use data into the analyses of water supply sufficiency that were not available at the time the previous version of the WSA was prepared. Specifically, precipitation, streamflow, water production and use, and groundwater elevation data for the period from 2012 through January of 2015 were collected and analyzed to update the analyses used in this WSA. In addition, more recent occupancy rate information for the existing SVR were collected and used in the estimation of future water demands (Farr West 2015, MacKay & Somps 2015).

1.2. ACKNOWLEDGEMENTS

This assessment was prepared by Dave Hunt with Farr West Engineering; Derrik Williams, Stephen Hundt, and Sean Culkin of HydroMetrics WRI; and Chad Taylor, Maureen Reilly, and Iris Priestaf of Todd Groundwater.

2. PROJECT DESCRIPTION

The proposed Project is planned to develop approximately 94 acres in the community of Squaw Valley. Approximately 85 acres of the proposed development is located at the western end of the Olympic Valley, adjacent to the existing Village at Squaw Valley (Village). The remaining approximately 9 acres of the development is planned for a separate site located approximately 1.5 miles east of the Village.

The Project is described in detail in the Specific Plan prepared by SVRE (2015). The Project area is within the Squaw Valley General Plan and Land Use Ordinance (SVGPLUO) area (Placer County 1983) and the Specific Plan has been prepared to address and build upon the goals and policies set forth in the SVGPLUO and the Placer County General Plan (General Plan) (Placer County 2013). Under the SVGPLUO zoning guidelines, up to approximately 3,750 bedrooms, or 1,875 dwelling units, could be constructed within the Project area. The Specific Plan proposes development of the Project area with a total of up to 1,643 bedrooms in up to 900 units including employee housing, as well as retail, recreational and related services.

The Project is proposed to occur primarily on lands that have been developed previously or otherwise disturbed. These areas have been used historically for ski resort facilities including skier services, parking, lodging, and commercial uses.

The Project includes proposed development in two areas within Olympic Valley, the Village portion and the East Parcel portion. The Village portion of the Project is generally bounded by Squaw Valley Road on the north, ski resort operations on the south, lodging, single family homes, and undeveloped area to the west, and the meadow associated with the RSC golf course to the east. The East Parcel portion of the Project is northeast of the Village located north of Squaw Valley Road located generally between Creeks End Court and Indian Trail Road near the intersection of Squaw Valley Road and Squaw Creek Road (Figure 2-1).

2.1. LAND USES WITHIN THE VILLAGE

The Specific Plan envisions a Village Core as the center of the resort base area. This area will contain a wide variety of mixed-use high-density, active, visitor-focused land uses. It is envisioned as a pedestrian-oriented mixed-use core area primarily for transient occupancy visitors that would include hotel, condo hotel, fractional, timeshare, and visitor supporting commercial development. The Specific Plan identifies a maximum of 517 units with 883 bedrooms and 223,369 square feet (ft^2) of commercial development in the Village Core, including the 90,000 ft^2 Mountain Adventure Camp indoor recreation facility, which is planned to include a water park and other family oriented entertainment amenities. A 4,000 ft^2 transit center would also be located within the Village Core. Development of this area would also include removal of 54,937 ft^2 of existing commercial space.

A Village Neighborhood to the northeast of the Village Core would provide for medium and high density mixed use resort residential neighborhoods and small scale commercial uses. The Village Neighborhood area is anticipated to include condo hotels, fractional and timeshare condominiums, medium density fractional ownership properties, and commercial facilities to serve visitors and residents. The Specific Plan allows for a maximum of 333 units with 610 bedrooms and 40,364 ft^2 of new commercial space (with 36,585 ft^2 of commercial removed) in the Village Neighborhood.

The Project includes provisions for transfer of density between parcels, not to exceed 25 percent of assigned density for sending or receiving parcels. Transfer of density between lots within each planning area (i.e., Village Core or the Village Neighborhoods) would result in a net zero change to the Specific Plan composition and limitations on total development allowances of the Specific Plan. Density could not be transferred to or from properties located outside of the Specific Plan.

There are four additional land use designations called out in the Specific Plan within the Village area: Village Commercial-Parking, Village-Heavy Commercial, Village-Forest Recreation, and Village-Conservation Preserve. Of these additional land uses, water supply will only be required for the 10,000 ft^2 of commercial space in the Village-Heavy Commercial category and for limited landscape irrigation.

2.2. LAND USES WITHIN THE EAST PARCEL

This area is located north of Squaw Valley Road between Creeks End Court and Indian Trail Road, across from the SVPSD offices and the Squaw Valley Fire Station. It is planned for employee housing, off-site parking, a small market, open space, and ancillary activities related to resort operations (e.g., shipping and receiving). The Specific Plan designates the land uses in this area as Entrance Commercial and Conservation Preserve, with up to 150 employee bedrooms in up to 50 units housing a maximum of 300 employees. The East Parcel would also include 20,000 ft^2 of commercial space.

2.3. TOTAL PROJECT DEVELOPMENT

In total over the two areas, the Project is planned to occupy approximately 94 acres with a total of 297,733 ft^2 of commercial space and 900 proposed units that will contain a maximum of 1,643 bedrooms. As noted above, SVRE estimates that the Project will require 25 years to achieve full buildout. A summary of the planned development for the Project by land use designation in five year increments is presented on Table 2-1.

2.4. WATER SUPPLIER

The Project proposes to receive water service for all of the land use areas from the SVPSD. SVPSD is a Special District organized under Water Code Division 12 and incorporated in the State of California in 1964. The SVPSD provides water, wastewater, garbage collection, fire protection, and emergency medical services to Squaw Valley and is governed by a five-member Board of Directors. SVPSD currently serves 1,569 residential connections and 20 large commercial entities (SVPSD 2014) from four active wells in the Basin, two horizontal bedrock wells, and a distribution network that runs through most of Olympic Valley.

Table 2-1. Project Development Assumptions

Land Use Designation	Existing Commercial to be Removed (ft^2)	2015[1]			2020[1]			2025[1]			2030[1]			2035[1]			2040[2] (Full Buildout Project Plan)		
		Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)	Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)	Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)	Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)	Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)	Maximum Units	Maximum Bedrooms	Maximum Commercial (ft^2)
Village Commercial - Core (VC-C)	54,937	0	0	0	181	309	78,164	284	486	122,858	388	662	167,552	465	795	201,022	517	883	223,369
Village Commercial - Neighborhoods (VC-N)	36,585	0	0	0	117	213	14,125	183	336	22,201	250	458	30,278	300	549	36,326	333	610	40,364
Village Commercial - Parking (VC-P)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Village - Heavy Commercial (V-HC)	--	--	--	0	--	--	3,499	--	--	5,500	--	--	7,501	--	--	9,000	--	--	10,000
Village - Forest Recreation (V-FR)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Village - Conservation Preserve (V-CP)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
East Parcel - Entrance Commercial (EC)	--	0	0	0	17	52	6,999	28	83	11,000	38	113	15,002	45	135	17,999	50	150	20,000
Transit Center (TC)	--	--	--	0	--	--	1,400	--	--	2,200	--	--	3,000	--	--	3,600	--	--	4,000
Roads	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTALS	**91,522**	**0**	**0**	**0**	**315**	**575**	**104,187**	**495**	**904**	**163,760**	**675**	**1,232**	**223,333**	**810**	**1,479**	**267,946**	**900**	**1,643**	**297,733**

Notes:

General: - Due to the dormitory and studio unit housing proposed for project-generated new employees, employee beds and the total number of employees to be housed are utilized as the metric in recognition that demand for new infrastructure and services to serve employee housing are quantitatively distinct from new infrastructure and service demands created by construction of new hotel, condominium, and residential bedrooms.

- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: Five year incremental Project development projections based on full buildout (2040) and estimated timeline for Project water demand developed by MacKay & Somps (2015) as follows:

Year	Percent of Project Buildout
2015	0%
2020	35%
2025	55%
2030	75%
2035	90%
2040	100%

Incremental percent of full buildout ratio applied evenly to all land use designations and development types.

2: Full buildout (2040) Project development data from The Village at Squaw Valley Specific Plan, April 2015 Table 3-1.

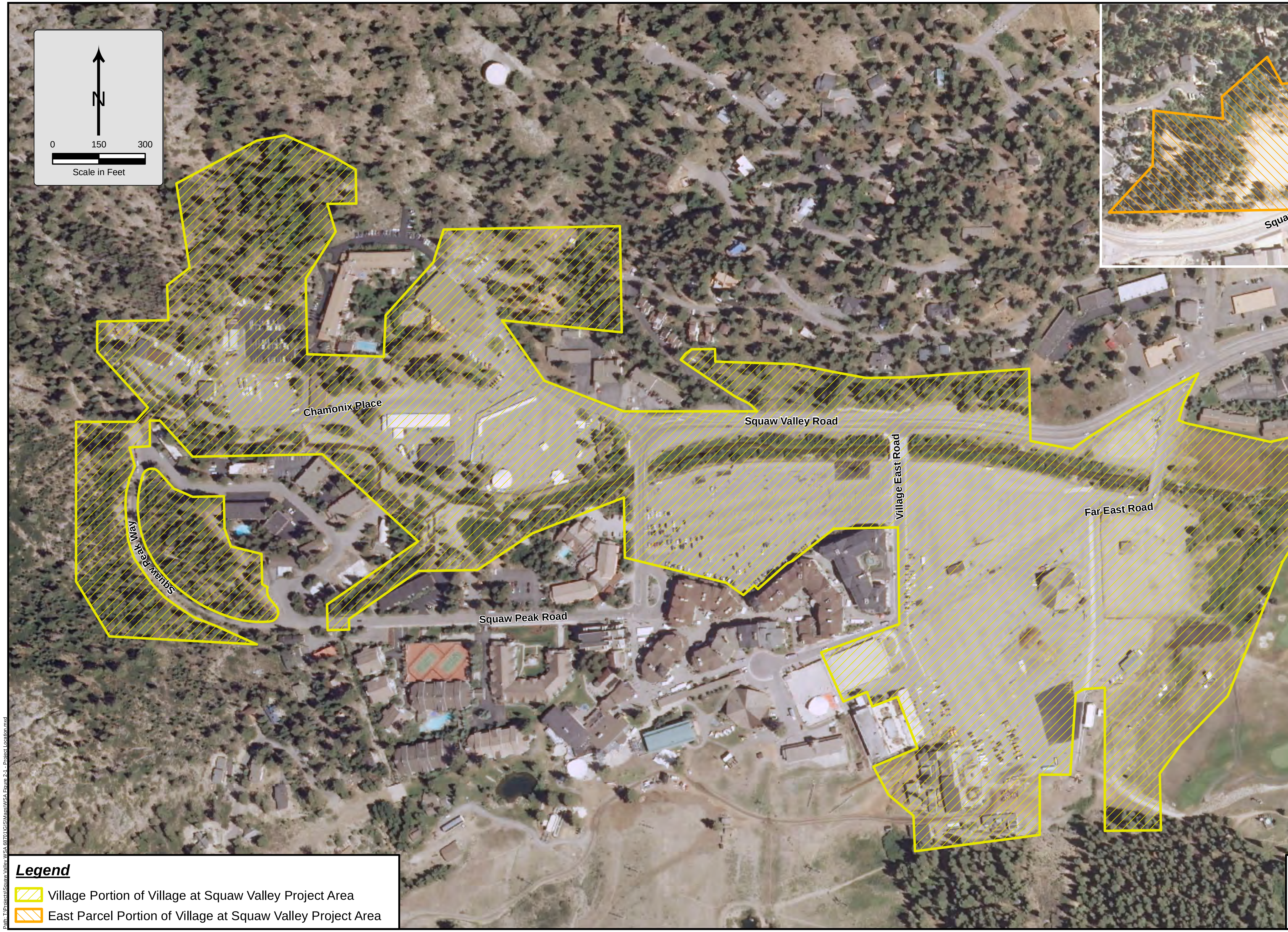


Figure 2-1
Village at Squaw Valley Project Area

3. BACKGROUND

The Project is proposed to be developed within Squaw Valley, which is a resort community in the Olympic Valley northwest of Lake Tahoe. Olympic Valley is a glacially carved high mountain valley located at an approximate elevation of 6,200 feet above sea level in the Sierra Nevada of California. Squaw Valley is a mix of single family homes and condominium and hotel lodging facilities. The primary industry in the Olympic Valley is the Squaw Valley Resort, which brings visitors to the area for winter and summer recreation activities.

3.1. CURRENT CLIMATE

Climate has a significant influence on water demand on a seasonal and annual basis. This influence particularly affects the portion of water demand for outside uses, specifically snowmaking and landscape irrigation.

Monthly average precipitation and temperature are presented in Table 3-1. The Precipitation summary data for both the Olympic Valley and the higher mountain elevations are presented in Table 3-1. Olympic Valley precipitation data is from the Squaw Valley Fire Station gage and high mountain precipitation data is from the Squaw Valley SNOTEL gage located within the ski resort at an elevation of 8,029 feet. The precipitation information from both of these weather stations represents monthly and annual water year average totals from both rain and snowfall events. Snowfall is measured as snow water equivalent, which is what is shown in the table. A water year is a 12 month period beginning October 1st and ending September 30th, corresponding to the common annual hydrologic cycle in the western United States, where fall is generally the end of the driest part of the year and the time when groundwater elevations are the lowest. Water years are designated by the calendar year in which they end, so the year ending September 30, 2014 was water year 2014.

The Squaw Valley Fire Station gage (located at the old Fire Station) records precipitation that is representative of the Olympic Valley, and the SNOTEL gage is representative of precipitation patterns in the higher elevations. The temperature data in Table 3-1 are monthly and annual averages from the National Oceanic and Atmospheric Administration (NOAA) gage in Truckee. Annual precipitation totals from water year 1993 through water year 2014 for both the Squaw Valley Fire Station and Squaw Valley SNOTEL gages are shown graphically on Figure 3-1. These precipitation data are also rain and snow events (as snow water equivalent).

It should be noted that years of lower than average precipitation on the Olympic Valley floor do not always correspond with lower than average precipitation on the mountain. For the purposes of the WSA, water year precipitation on the Olympic Valley floor was used to determine single and multiple dry years. Sufficiency of supply in this WSA (discussed in Section 6) assesses demand and supply using the 2015 version of the SVPSD Olympic Valley Groundwater Basin numerical groundwater flow model (Model). The conceptual water balance that is included in the Model relies on precipitation on the Olympic Valley floor to estimate areal recharge to the Basin. Precipitation on the mountain contributes indirectly to recharge through creek infiltration and limited subsurface inflow, as discussed in Section 5.

3.2. POPULATION

As noted above, there is a mixture of homes and resort oriented temporary lodging within Squaw Valley. As a result, the full time resident population of Squaw Valley is only a part of the effective population as it relates to water demand and use. The United States Census indicates that there were 879 full time residents in Squaw Valley in 2010. Visitors (both day and overnight) are not accounted for in the Census, and no assessment of this transient component of effective population has been completed. Future growth will also likely include a mixture of full time residents and day and overnight visitors.

The mixed use and recreational nature of the Squaw Valley makes current and future effective population estimates relating to water demand complex. For that reason, population has not been used as the sole basis for estimating water demands. An estimate of future population growth is presented in Table 3-2. This estimate was developed based on information relating to Project and non-project growth as presented in Section 4. The transient Project population estimate was generated by MacKay & Somps as part of the assessment of Project water demands. Separate estimates were completed for each lodging type as follows: Managed Lodging Units assumed to house 1.6 people per bedroom and be occupied at an average annual rate of 56.3 percent resulting in a population of 1,009 people, Unmanaged Lodging Units were assumed to house 2 people per bedroom and be occupied at an average annual rate of 28.2 percent contributing an additional 211 people, and Employee Housing was assumed to house 1 person per bed at an average annual occupation rate of 56.3 percent contributing 169 people (MacKay & Somps 2015). The estimated Project related effective population totals is 1,389, as shown in Table 3-2. Non-project growth related population was estimated in two categories; full time residents and the transient population of overnight visitors. Future full time non-project population growth was projected using single family residential unit estimates from the Placer County forecasted development projections (Placer County 2014), which indicated that a total of 109 new single family residences might be constructed by 2040. If each of these homes had an average population of 3.51 people (US Census average household) and were occupied full time, there could be a total of 383 new full time residents in Squaw Valley. Future transient non-project population growth was estimated using the Placer County growth projections for resort, condominium, and hotel bedrooms and assuming each bedroom will have 2 people per room, with an occupancy rate of 56.3 percent on average for the year. The total estimated non-project transient effective population is 698 people. The growth projections and occupancy rates used in these population estimates are discussed in detail in Section 4 and Appendix A. The total projected population increase in Squaw Valley at 2040 is 2,470 people.

Table 3-1. Climate Data

	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total / Average
Olympic Valley Precipitation (inches)[1]	9	7	5	3	2	1	0	0	1	3	5	10	47
High Mountain Precipitation (inches)[2]	14	12	10	6	4	1	0	0	1	4	7	16	76
Temperature (˚F)	29	31	36	42	51	58	67	64	57	47	37	28	45

Notes:

General: All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: Olympic Valley precipitation data average monthly from the Squaw Valley Fire Station gage for water year 1993 through water year 2014. Values include precipitation from both snowfall (as snow water equivalent) and rainfall.

2: High Mountain precipitation data average monthly from the Squaw Valley SNOTEL National Oceanic and Atmospheric Administration (NOAA) gage at 8,029 feet elevation for water year 1993 through wter year 2014. Values include precipitation from both snowfall (as snow water equivalent) and rainfall.

3: Temperature data average monthly mean from the National Oceanic and Atmospheric Administration (NOAA) Truckee Station.

Table 3-2. Population Change Projection

Population Type		2015	2020	2025	2030	2035	2040
Village at Squaw Valley Project[1]		0	486	764	1,042	1,250	1,389
Non-Project Growth[4]	Full Time[2]	0	96	192	268	345	383
	Transient[3]	0	175	349	489	628	698
PROJECTED TOTALS		**0**	**757**	**1,305**	**1,799**	**2,223**	**2,470**

Notes:

General: - Current full time population is estimated to be 879 people, according to the 2010 Census (US Census Bureau 2014).

- The population estimates presented above are for future growth only. No estimate of existing transient population exist, so an estimate of total existing or future population has not been completed.

- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: Project population estimated for each transient lodging type by MacKay & Somps (2015) as follows: Managed Lodging Units assumed to house 1.6 people per bedroom and be occupied at an average annual rate of 56.3 % (1,120 bedrooms x 1.6 people/bedroom x 56.3% = 1,009 people), Unmanaged Lodging Units assumed to house 2 people per bedroom and be occupied at an average annual rate of 28.2 % (373 bedrooms x 2 people/bedroom x 28.2% = 211 people), and Employee Housing units assumed to house 1 person per bed at an average annual occupation rate of 56.3 % (300 beds x 1 person/bed x 56.3% = 169 people) (MacKay & Somps 2015). Distribution into five year increments per MacKay & Somps (2015) in Table 2-1 and Appendix A.

2: Future full time non-project population growth estimated using single family residential unit numbers from Farr West (2015) with average population of 3.51 people per unit (US Census average household) occupied full time.

3: Future transient non-project population growth estimated resort/condo/hotel bedrooms from Placer County (2014) and Farr West (2015) with 2 people per room, occupied 56.3% of the year on average (Farr West 2015).

4: Non-project growth distributed into five year increments according to Placer County development projections (Placer County 2014), as shown below and in Appendix A.

Year	Percent of 25 Year Development
2015	0%
2020	25%
2025	50%
2030	70%
2035	90%
2040	100%

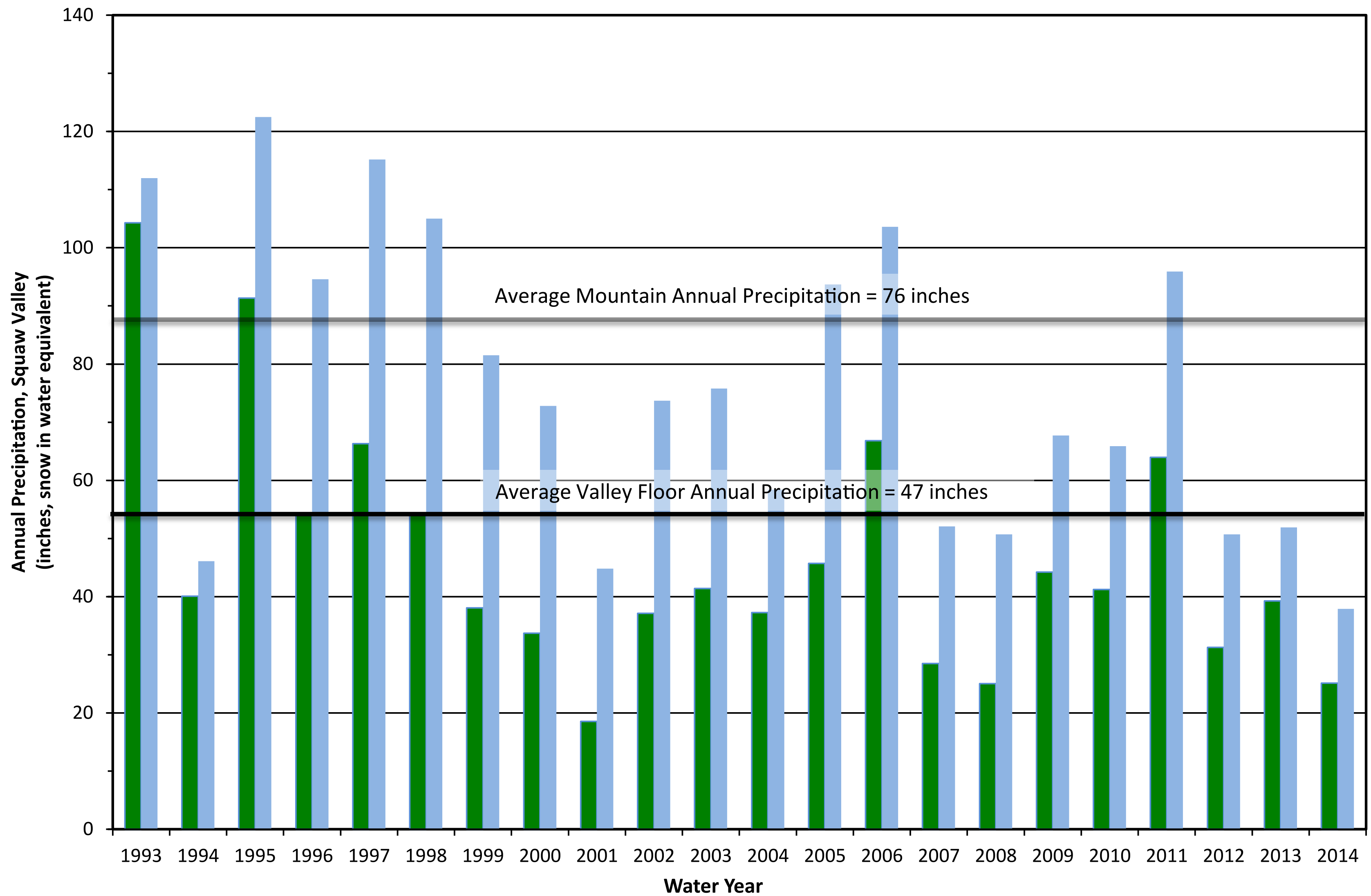


Figure 3-1
Annual Precipitation
Olympic Valley
and Mountains

4. WATER DEMAND

This section addresses water demands for Olympic Valley through the modified and extended WSA timeline of 25 years. These demands include all existing water uses, the Project, and reasonably foreseeable non-project future development in Squaw Valley. Existing water demands were compiled by Farr West (2015) from records of historical water use from the four water producers in Squaw Valley. Future water demands for Squaw Valley have been estimated for the Project and reasonably foreseeable non-project development for the next 25 years, to match the estimated Project completion timeline.

Project specific demands were estimated by MacKay & Somps (2015) for full build-out of the Project using unit demand factors developed collaboratively with Farr West and SVPSD. The estimation of non-project water demands first required estimating the amount of reasonably foreseeable development that might occur contemporaneous with the Project. Placer County prepared an estimate of this reasonably foreseeable development through the next 25 years for use in assessing non-project demands over the Project horizon (Placer County 2014). Farr West used the Placer County development projections along with historical use data to estimate the water demands associated with the reasonably foreseeable non-project development through 2040 (Farr West 2015, Appendix A).

Future Project and non-project demands were estimated on a monthly basis. The water demands are presented by each major component in this section. These demand data represent the assumed monthly distribution in an average year, as prepared in Farr West's demand estimates.

Past, existing, and projected water demands are presented for the four main groundwater pumpers in the Basin. These entities are:

- Squaw Valley Public Service District (SVPSD)
- Squaw Valley Mutual Water Company (SVMWC)
- Resort at Squaw Creek (RSC)
- Squaw Valley Resort (SVR)

Additional un-metered groundwater pumping from private wells within the Basin also occurs. These pumpers are the PlumpJack Squaw Valley Inn (PlumpJack) and Gladys K. Poulsen. No recorded information regarding the volume or timing of the water use or demand is available for these private parties. However, the volumes extracted by these two pumpers are considered to be limited in comparison to the four major pumpers identified above. PlumpJack is a hotel that receives potable water from SVPSD, and the private well on the property is used only for limited landscape irrigation. Based on area estimation from aerial photographs, the parcel is approximately 3.5 acres and of that only approximately 1.5 acres is irrigated. The volume of water demand associated with this small potential irrigated area is not expected to be significant in comparison to other pumping in the western portion of the Basin. The Gladys K. Poulsen private well is outside of the western portion of the Basin and pumping from this location would not affect water supply in the west.

4.1. EXISTING WATER USE

Existing water use in Squaw Valley has been compiled by Farr West from records kept by of the four primary water producers in the Olympic Valley: SVPSD, SVMWC, RSC, and SVR. These data are summarized in five year increments for 2000 through 2010 and for 2014 in Table 4-1, and presented in detail in Appendix A. Average annual existing demands by month were calculated from the recent historical use records of production data for 2000 through 2014. While this is not the entire period of record for SVPSD, SVMWC, or RSC, it does represent recent use rates at the current level of development in Squaw Valley in a range of hydrologic conditions including average, wet, and dry years. Pumping from wells in the Basin owned by SVR for snowmaking began in late 2010, so average use of this type represents only the 2010 through 2014 period. A portion of the RSC groundwater production is for snowmaking. This pumping is managed in conjunction with SVR for snowmaking in SVR facilities.

The historical use records were used by Farr West to assess current demand and as one of the components in estimating unit demand values for future conditions. The recent use records show existing demand by customer type within the SVPSD service area, in total for the SVMWC, and by use type for RSC and SVR. The recent historical uses by customer type in the SVPSD service area were used to estimate single family residential unit demand rates for growth through the WSA timeframe.

4.2. ESTIMATED FUTURE WATER DEMAND

For this WSA, water demands for all uses in Olympic Valley have been estimated for a period of 25 years in the future to match the estimated Project development timeline. These demands have been estimated in two major categories, those associated with the Project and those for reasonably foreseeable non-project development. Both of these demand categories were estimated for the end of 25 year timeline (2040), which represents the maximum water demand for the entire area within this period (Table 4-2). The 2040 demand estimates were then broken out into 5 year increments of development as shown in Table 4-3. The methods for estimating future water demands and distribution in 5 year increments are summarized below and described in detail in Appendix A.

4.2.1. Project Demands

The estimated total demands for the Project were developed by MacKay & Somps (2015). These estimates were prepared based on the land uses, development densities, and estimated occupancy rates for the Project presented in the Specific Plan. The unit demand rates for each land use type within the Project were developed according to SVPSD standards in collaboration with Farr West. Monthly occupancy rates used by MacKay & Somps are based on 2009 through 2014 occupancy rates in the existing Squaw Valley Village and resort industry occupancy data (MacKay & Somps 2015, Farr West 2015, Appendix A). Total Project water demand at buildout is estimated to be 240 acre-feet per year (AFY). A detailed presentation of the methods used in calculating the Project demands are presented in Appendix A, and summary monthly demand values are included in Table 4-2. The demand estimate for the Project includes landscape irrigation demands. The Specific Plan indicates that the Project could pursue an alternative landscape irrigation supply from private wells located outside of the Olympic Valley Groundwater Basin. However, to be conservative this component of the Project demands will be assessed as being supplied by the Basin, which is the more sensitive water supply source.

MacKay & Somps estimated the Project water demands in 5 year increments, distributed according to the breakdown shown in Table 4-3. This development schedule estimate assumes higher rates of development will occur early in the 25 year timeline to be conservative.

In addition to assessing monthly Project demands, MacKay & Somps estimated the number of wells required to meet those demands (MacKay & Somps 2015). The process for estimating the number of required wells used a conservative modification of the SVPSD method of estimating peak daily demand and dividing that demand by a conservative per-well maximum pumping rate. This analysis resulted in an estimated requirement of four wells to meet Project demands (MacKay & Somps 2015, Todd et. al. 2015).

4.2.2. Non-Project Demand

As noted above, the first step in estimating non-project demand was to identify reasonably foreseeable development that might occur in the Olympic Valley over the 25 years ending in 2040. Placer County reviewed planning records for Squaw Valley to identify approved planned and foreseeable projects, and they evaluated land use in Olympic Valley along with local and regional historical development trends and the SVGPLUO to create estimates of reasonably foreseeable forecasted development over the 25 year period associated with the Project (Placer County 2014). These projections include development in the following areas and categories:

- Approved Projects:
    - Resort at Squaw Creek Phase 2
    - Olympic Estates
- Foreseeable Projects:
    - Squaw Valley Ranch Estates
    - Mancuso
    - PlumpJack Redevelopment
    - Olympic Valley Museum
- Forecasted Development:
    - Single Family Residential in SVPSD and SVMWC service areas
    - Resort, Condo, Hotel Units
    - General Commercial

Placer County included estimates of the number of units and commercial square footage associated with each of these projected developments to facilitate evaluation of water demand from non-project development in Olympic Valley (Placer County 2014).

The development projections and associated unit and commercial area estimates were used by Farr West to develop non-project water demand estimates for Olympic Valley through 2040. Farr West used unit demand rates consistent with SVPSD standards to estimate water demand for all of the projected development identified by Placer County. Farr West also prepared monthly distributions for the average annual demands based on historical annual average demand distributions and occupancy rates appropriate for each type of future demand (MacKay & Somps 2015), as shown in Table 4-2. The methods used by Farr West to develop and apply these unit demands and demand distributions are described in detail in Appendix A. Total annual average non-project demands at 2040 are estimated to be 143 AFY.

Placer County also estimated future development in 5 year increments, as required for a WSA (Placer County 2014). The water demands associated with each of the categories of future non-project development are presented in 5 year increments in Table 4-3. The snowmaking demand volumes for RSC are assumed to be equal to those indicated in previous assessments of water supply availability (HydroMetrics 2006 and 2007b, Farr West 2015). Demand for future SVR snowmaking is assumed to be equal to the recent historical volumes plus a growth factor of ten percent. Future snowmaking demand estimates are shown in Table 4-3.

To estimate the number of wells required to meet the non-project demands, the same method used by MacKay & Somps was applied. The SVPSD estimates peak day demand by multiplying the average day demand by a peaking factor of 2.5 (ECO:LOGIC 2008). Instead of using the average daily demand calculated for the entire year, MacKay & Somps took the conservative approach of using the maximum monthly demand (the demand from July) and multiplying the daily demand rate by the 2.5 peaking factor. The maximum monthly non-project demands are estimated to occur in July. The resulting non-project peak day demand (excluding the RSC Phase 2 potable demands) is nearly 360,000 gallons per day (gpd). This peak demand is based on the current estimate of demand distribution (Farr West 2015, MacKay & Somps 2015). To estimate the number of wells required to meet this demand MacKay & Somps assumed that each well could produce a maximum of 200 gallons per minute (gpm) at a duty cycle of no more than 70 percent per day (e.g. 17 hours of pumping in a 24 hour period). The resulting maximum per well production capacity is 201,600 gpd. Dividing the peak day non-project demand by the maximum per well production capacity results in the need for at least two new wells for non-project water demands in addition to the four required for the Project demands. These six new wells in addition to the existing wells will provide SVPSD with the ability to continue to meet the California Water Works Standard requirement to be able to provide peak day demand with the largest water source offline.

4.2.3. Total Demand

The total water demands for all Project and non-project development at the 25 year WSA horizon of 2040 are presented in Table 4-2 and the phasing of these demands in 5 year increments is shown in Table 4-3. These demand estimates have been calculated using conservative unit demand values. The unit demands are based on historical use records, and the single family residential, commercial, and resort, condominium, and hotel historical demands in Squaw Valley are high. As a result, the total 2040 demand estimate is assumed to represent a conservative assessment.

As discussed in Section 5, monthly distribution of average annual demands at the 2040 horizon is important in the Basin because of its small size and dynamic response to recharge. As a result, the monthly distribution of average annual demands shown on Table 4-2 is used to assess supply sufficiency in Section 6 of this WSA.

4.3. CONSERVATION

There are a variety of methods for implementing water conservation. These include state and local laws that require indoor and outdoor conservation, such as plumbing codes, water fixture requirements, the DWR Model Water Efficient Landscape Ordinance (MWELO) and California Green Building Code standards (CGBSC). In addition, there are practices that promote voluntary conservation, like tiered rate structures, voluntary conservation incentive programs, and education. SVPSD has taken steps to foster water conservation, and the Project also proposes to implement conservation measures.

SVPSD has implemented state and local water conservation laws by adopting revisions that incorporate the water conservation standards into its Water Code. These adoptions include the MWELO, the Uniform Plumbing Code Standards, and other water saving device standards for new construction and reModeling. SVPSD has also implemented tiered water rates through an increasing block rate structure as a means of encouraging voluntary conservation. Placer County also has conservation measures that impact water demand in Squaw Valley. As a condition for issuance of a certificate of final completion and occupancy or final permit approval by the local building department, water-conserving plumbing fixtures must be installed in all new construction and replace noncompliant plumbing fixtures for all building alterations or improvements to all single-family residential and some multifamily residential real property and commercial property types. These conserving fixtures include water-saving shower heads, water saving aerators on kitchen sinks and lavatories, water saving toilets, shower flow control valves, and other measures. The SVPSD reports that as a result of its conservation measures implemented since 2006, it has achieved a 26 percent reduction in per capita water use (SVPSD 2014).

The Project also proposes to implement water conserving measures. The Specific Plan identifies the incorporation of several water conserving development standards, including: installation of high-efficiency fixtures and fittings, use of recirculating hot water systems, implementing graywater system applications, minimizing water intensive landscape, and use of smart irrigation controllers. These water conserving measures are consistent with Placer County and State standards and building codes, but are more stringent than current SVPSD requirements.

SVMWC has limited ability to implement water conservation measures in its service area. However, SVMWC has recently installed water meters on its connections and is considering implanting a use-based rate structure.

No information is available for use in projecting future reductions in unit demands as a result of the water conservation measures discussed above. So, while SVPSD and the Project both have water conservation measures in place, the demand factors used to estimate Project and non-project demands are based on recent historical water use for the period of 2000 through 2012 with no unit demand reductions to account for additional conservation. As noted above, the unit demands used to estimate total future demand at 2040 are high. This results in a conservatively high total water demand.

4.4. DRY YEAR WATER DEMAND

The SVPSD developed and adopted an Irrigation Conservation Ordinance that promotes conservation through a number of activities including: establishing a tiered rate structure, requiring dedicated landscape metering on new development, requiring dedicated landscape metering for customers with high water use, requiring pressure regulators on all landscape systems, and identifying water conservation actions for Stage 1 (normal), Stage 2 (significant water shortage), and Stage 3 (critical water shortage) periods. The conservation activities in this ordinance are designed to reduce excessive demand, thereby reducing and managing pumping from the Basin. Prior to 2015, the SVPSD had never required mandatory water use reduction measures during drought conditions. In May 2015 the SVPSD responded to DWR statewide water conservation requirements by implementing Stage 2 Water Conservation Restrictions and Emergency Irrigation Regulations (SVPSD 2015). These restrictions included the following prohibitions:

- Filling of swimming pools if uncovered while not in use.
- Ornamental fountains or similar water features, unless a water recycling system is used and public notice about the use of the system is prominently displayed.
- Installation of new landscaping that requires irrigation.
- Irrigating outdoors during and within 48 hours following measureable rainfall.
- Water use to wash sidewalks, driveways, parking areas, tennis courts, decks, patios or other improved areas, unless required for repair/maintenance, or immediate fire, sanitation, or health hazards.

The following general requirements for water use and management were also included:

- Outdoor irrigation limited to two times per week, one hour per irrigation zone.
- Lodging facilities must post water conservation literature in each room.

The SVPSD has indicated that these water use restrictions will remain in effect until the Board of Directors removes them and that violators risk partial or full disconnection of service.

There are no other regulatory provisions currently available through which groundwater pumping by private parties or the SVMWC can be reduced during droughts. The limited mandatory restrictions on water use or private pumping during drought indicates the WSA should apply a conservative approach that assumes no reduction in water demands during dry periods, even though the conservation actions included in the Irrigation Conservation Ordinance are in place.

Table 4-1. Historical Water Use

All values in Acre-Feet per Year (AFY)

	Year	2000	2005	2010	2014	Average[4]
Squaw Valley Public Services District Water Use		443	420	368	357	403
Squaw Valley Mutual Water Company Water Use		152	110	111	129	130
Resort at Squaw Creek Water Use	Golf Course Irrigation[1]	143	189	165	127	163
	Snowmaking[2]	101	69	28	100	94
Squaw Valley Resort Snowmaking[3]		-	-	1	85	81
TOTALS		**839**	**788**	**673**	**798**	**871**

Notes:

General :
- Table above shows five-year increments and recent available data for 2014, per WSA Guidelines (DWR 2003b)
- All values from Farr West June 2015 memorandum in Appendix A.
- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: RSC golf course irrigation water use records not available for all time periods: 2005 value above is 2004 data, 2010 values interpolated between 2007 (184 AFY) and 2012 (153 AFY) data.

2: RSC snowmaking water use records not available for all time periods: 2000 value above is 1999 data and 2005 value above is 2006 data.

3: Snowmaking water use from the Olympic Valley Aquifer by SVR began in late 2010.

4: Average historical values (2000-2014) from Farr West 2015, Appendix A.

Des by: CT
Ckd by: MR

Table 4-2. Average Year Total Demand by Month at 2040
All values in Acre-Feet

	Month	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
Squaw Valley Public Services District (SVPSD)[1]	*Existing Demand*	*26*	*28*	*27*	*22*	*29*	*45*	*58*	*57*	*44*	*26*	*15*	*24*	*403*
	New Single Family Demand	*5*	*6*	*5*	*3*	*3*	*5*	*10*	*9*	*7*	*5*	*3*	*4*	*64*
	New Resort, Hotel, Condo, and Commercial Demand	*3*	*4*	*4*	*3*	*2*	*3*	*4*	*4*	*3*	*2*	*1*	*3*	*35*
	Resort at Squaw Creek Phase 2 Potable Demand	*4*	*4*	*4*	*2*	*3*	*4*	*5*	*5*	*4*	*3*	*2*	*3*	*43*
	Village at Squaw Valley Project Demand	*21*	*22*	*24*	*18*	*17*	*20*	*26*	*27*	*19*	*16*	*12*	*19*	*240*
	Total	**60**	**63**	**64**	**48**	**54**	**76**	**102**	**102**	**78**	**52**	**34**	**53**	**786**
Squaw Valley Mutual Water Company (SVMWC)[2]	*Existing Demand*	*6*	*6*	*7*	*6*	*10*	*16*	*20*	*20*	*18*	*10*	*5*	*6*	*130*
	New Single Family Demand	*1*	*1*	*1*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*0*	*1*	*10*
	Total	**7**	**7**	**8**	**6**	**11**	**17**	**22**	**22**	**19**	**10**	**5**	**7**	**140**
Resort at Squaw Creek[3]	*Golf Course Irrigation (after Phase 2)*	*0*	*0*	*0*	*0*	*6*	*28*	*46*	*36*	*23*	*6*	*0*	*0*	*145*
	Snowmaking (after Phase 2)	*21*	*19*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*27*	*27*	*94*
	Total	**21**	**19**	**0**	**0**	**6**	**28**	**46**	**36**	**23**	**6**	**27**	**27**	**240**
Squaw Valley Resort Snowmaking[4]		23	16	0	0	0	0	0	0	0	1	19	30	**89**
	Total Average Year Demand by Month	**110**	**105**	**72**	**54**	**71**	**121**	**170**	**160**	**120**	**70**	**85**	**117**	**1,254**

Notes:

General : - Values based on Table 2 of Farr West June 2015 memorandum in Appendix A.

- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1 : SVPSD cumulative demands include Village at Squaw Valley demand estimate, current demands, cumulative single family residential and commercial/multifamily demands, and the Resort at Squaw Creek Phase 2 potable water demands.

2 : SVMWC cumulative demands include current demand and cumulative single family residential demands.

3 : RSC non-potable demands at 2040 assumed to be equivalent to the existing Development Agreement with SVPSD.

4 : Resort snow making volume and seasonal distribution supplied from the Olympic Valley Aquifer in 2040 assumed to be the same as recent historical averages.

Table 4-3. Projected Water Demand by Customer Type

All values in Acre-Feet per Year (AFY)

Water Supplier	Customer Type	2015	2020	2025	2030	2035	2040
Squaw Valley Public Services District (SVPSD)	Single Family Residential	120	136	152	165	178	184
	Multi Family Residential	142	147	196	200	205	207
	Commercial	94	98	101	104	106	108
	Irrigation	47	47	47	47	47	47
	Village at Squaw Valley Project	0	84	132	180	216	240
Squaw Valley Mutual Water Company (SVMWC)	Single Family Residential	130	133	135	137	139	140
Resort at Squaw Creek (RSC)[1]	Irrigation[1]	163	163	145	145	145	145
	Snowmaking	94	94	94	94	94	94
Squaw Valley Resort (SVR)	Snowmaking	89	89	89	89	89	89
	TOTALS	**879**	**991**	**1,091**	**1,161**	**1,219**	**1,254**

Notes:

General : - Annual average values above from Table 14 in Farr West May 2015 memorandum, Appendix A.

- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: Resort at Squaw Creek Phase 2 estimated to be completed by 2025, at which time the irrigation and snowmaking demands for RSC change to those dictated by the Development Agreement with SVPSD.

5. WATER SUPPLY

5.1. SUPPLY SOURCES

Currently two sources of water supply are used in the Olympic Valley: groundwater from the alluvial Olympic Valley Groundwater Basin and groundwater from horizontal fractured bedrock wells in the mountainous areas above the Olympic Valley floor. Both sources have been used previously and neither source has been adjudicated through litigation. More information about water rights can be found at the end of this section. Existing water supply users and sources are shown in Table 5-1. As noted previously, this WSA assumes that the Project's total demands will be met with groundwater produced from the Basin.

5.1.1. Olympic Valley Groundwater Basin

Groundwater produced from the alluvial aquifer beneath the Olympic Valley has been the primary source of water supply in the area since the development of Squaw Valley. The alluvial aquifer underlying Olympic Valley is the Olympic Valley Groundwater Basin, designated by DWR as Groundwater Basin Number 6-108 (DWR 2003a). The Basin has been characterized multiple times by several investigators over the course of the past 40 plus years. The characterizations from these multiple studies were combined into a single description in the 2007 Olympic Valley Groundwater Management Plan (GWMP, HydroMetrics 2007a) with independent analysis and confirmation from Todd Engineers in 2012. Further refinements of the interaction between the Basin and surface water and recharge sources for the Basin were developed in 2013 by HydroMetrics WRI (HydroMetrics) with assistance from Lawrence Livermore National Laboratory (LLNL) and the University of Nevada at Reno (UNR) (HydroMetrics 2013 and Moran 2013). Neither DWR nor any previous investigator has found the Basin to be in overdraft. A summary description of the Basin from these sources is presented below.

5.1.1.1. Physical Setting

Olympic Valley is a glacially carved valley approximately 2.5 miles long and 0.4 miles wide in the Sierra Nevada of California located northwest of Lake Tahoe at an elevation of approximately 6,200 feet. Steep mountains with elevations over 8,000 feet surround the Olympic Valley to the north, west, and south, and it narrows to the east before meeting with the Truckee River. The Olympic Valley is drained by Squaw Creek, which is a tributary to the Truckee River. The Squaw Creek watershed, the area of land where precipitation and its runoff is routed to Squaw Creek and its tributaries, extends to the mountain peaks above Olympic Valley to the north, west, and south. The total area of the watershed is 5,146 acres, and the Olympic Valley floor is 701 acres, which is 13 percent of the total watershed area. The DWR-mapped Olympic Valley Groundwater Basin boundaries are shown on Figure 5-1. HydroMetrics performed a more detailed evaluation of the geology of the Olympic Valley Groundwater Basin as part of the GWMP and developed refined boundaries for the Basin, which are shown in blue on Figure 5-1.

5.1.1.2. Groundwater Occurrence and Flow

In general, the western portion of the Olympic Valley Groundwater Basin is more coarse-grained than the eastern portion of the Basin. Well and boring logs from drilling show variation in lithology across Olympic Valley and in neighboring wells. For this reason, precise correlations of lithologic units laterally within the Olympic Valley have been problematic. Therefore, previously completed investigations have categorized geologic material in the Olympic Valley into three units with similar hydrogeologic characteristics (HydroMetrics 2007a, Todd 2012).

> **Hydrogeologic Unit 1** – This unit is generally limited to the upper five to twenty feet of the Basin and is composed of fine sands and silts in the western portion of Olympic Valley, with increasing fine-grained material (clay, silt, and peaty organics) towards the east.
>
> **Hydrogeologic Unit 2** – This is the primary water bearing material in the Basin. It is composed of gravels and sands, with silt and clay content increasing to the east. The depth and thickness of this material varies widely throughout the Basin, with the thickest and deepest portion in the west where the existing SVPSD and SVMWC production wells are located.
>
> **Hydrogeologic Unit 3** – This unit is present primarily in the eastern portion of the Basin and is composed of fine-grained material with occasional sand and gravel. This unit has limited production capacity and the water in it could be of low quality.

The unconsolidated sediments in all three of the Hydrogeologic Units were deposited primarily by glacial, lacustrine, and fluvial processes. Groundwater is present in each of these units where they exist throughout the Basin, but their relative ability to store and transmit water varies. Generally, the materials in the western portion of the Basin have a larger capacity for water supply production than those in the east. As a result, all the existing municipal water supply wells are located in this area. These units are underlain by igneous bedrock with no primary porosity, meaning that its water holding capacity is from fractures. Detailed descriptions, maps, and cross sections of these hydrogeologic units were presented in the GWMP and in Todd Engineers' Independent Analysis of Groundwater Supply (2012).

Recharge to the Olympic Valley Groundwater Basin occurs from infiltration of precipitation on the Olympic Valley floor, overland flow from the surrounding mountainsides, mountain front recharge in the higher elevation sediments on the edges of the Basin, and infiltration from Squaw Creek. Recent studies by Dr. Jean Moran (2013) and HydroMetrics (2013) have provided additional documentation of the mechanisms and timings associated with recharge to the Basin. These studies showed that in the western portion of the Basin, most of the water produced by the municipal supply wells comes from recharge occurring just above the Olympic Valley floor in shallow aquifer materials along the edge of the Basin (Moran 2013). The exact locations and extent of recharge from this source have not been identified. It is unknown whether recharge from this source occurs on all sides of the Basin, or if there are areas of more concentrated infiltration. This recharge occurs during precipitation and snowmelt events, so the volume and timing of this source of water depends on the timing of these events. This recharge source assessment also found very little evidence of flow into the Basin from fractured bedrock sources in the mountains above the Valley floor, which indicates that there is little connection between the Basin and fractured bedrock groundwater. In addition, these studies found that the Basin discharges to Squaw Creek more often than the Basin receives infiltration from the creek; moreover, the volume of discharge from the Basin to the Creek is likely greater than the volume of infiltration from the Creek to the Basin (HydroMetrics 2013).

Historical records of groundwater elevations in monitoring and production wells show that water levels peak near the same elevations in normal and wet years. This suggests that during normal and wet years, there is ample recharge to fill the sediments to a maximum level; above this level, recharge is rejected because the Basin is near to completely or locally full. Either rejected recharge flows overland to Squaw Creek or it is quickly drained from the shallow portion of the Basin by Squaw Creek (HydroMetrics 2007a).

HydroMetrics found that even in years with below average precipitation, water levels in monitored wells rose to near the maximum elevations, indicating that the Basin was still filled to near total capacity in dry conditions. Records from years with below average precipitation did show that water levels in late summer and fall are dependent on the amount of snowmelt that flows through Squaw Creek during the spring and summer. Accordingly, during this time low precipitation and high water demand could limit groundwater availability (HydroMetrics 2007a).

Groundwater flow within the Basin is generally from west to east, with some flow driven from the north and south boundaries of the Basin by topographic highs. During periods of increased pumping from the municipal wellfield, the flow pattern is modified by drawdown cones surrounding the wells.

5.1.2. Fractured Bedrock Groundwater

Groundwater is found in fractures in the crystalline rocks surrounding the Basin. These fractures appear to be close to vertical based on mapping of fractures and springs in the mountainsides to the south and east of the Olympic Valley Groundwater Basin performed by Kleinfelder & Associates (1991). As noted above, the recent LLNL study found that a major portion of the recharge to the Basin comes from mountain front recharge. This study also indicated no significant component of water from fractured bedrock sources present in the western portion of the Olympic Valley Groundwater Basin. That study showed there was very little evidence of water with a chemical signature of high mountain origin or bedrock flow in the Basin. This implies that there is not a strong connection between fractured bedrock groundwater occurring in the mountains above the Basin and the Olympic Valley Groundwater Basin.

The SVPSD and SVMWC have active horizontal wells that draw from fractures in the hillsides above Olympic Valley to both the north and the south, as shown on Figure 5-1. These wells are located in fractured bedrock, and not the alluvial Olympic Valley Groundwater Basin. Horizontal wells are not equipped with pumps. Instead, water that enters the well is drained out of the opening by gravity. Therefore, the quantity of water produced by a horizontal well is generally considered constant from year to year, unless the capacity of the fractures connected to the well is reduced. The SVPSD and SVMWC horizontal wells have not experienced reductions in supply capacity resulting from hydrologic conditions in the past. Currently, an average of 70 AFY of municipal supply is met from these horizontal bedrock wells located outside of the Basin (Table 5-2). The volumes produced from these wells are included in this report because they will continue to be a source of supply used to meet a small portion of the existing demand, which will continue to be served at the current average volume from this existing source in the future. However, this WSA assumes that all Project demand and non-project future demands will be met with water produced from the Olympic Valley Basin, and not from the bedrock water supply.

5.2. GROUNDWATER MANAGEMENT

The primary groundwater management agency in the Basin is the SVPSD. SVPSD has led the development of a GWMP in accordance with California Water Code Sections 10750 through 10756 and in cooperation with a stakeholders group representing local groundwater users, environmental organizations, regulatory agencies, and the public. The GWMP was first developed and adopted in 2007 (HydroMetrics 2007a). Groundwater condition reports have since been completed in 2008, 2009, and 2011 (HydroMetrics 2008, 2009 and 2011). The management area defined for the GWMP is smaller than the DWR Bulletin 118 groundwater Basin area, as discussed above (Figure 5-1). The GWMP area is defined by hydrologic and geologic features that limit groundwater flow; these include low-permeability glacial moraine deposits at the eastern end of the Basin. The moraine deposits, representing a relative barrier to groundwater, are not included in the GWMP. Neither the GWMP nor any of the subsequent groundwater condition reports showed any indications of overdraft conditions in the Basin.

5.3. OLYMPIC VALLEY GROUNDWATER BASIN MAJOR INFLOWS AND OUTFLOWS

Inflows and outflows to and from an aquifer are important components of conceptual and numerical Models that describe how the groundwater system works. This understanding of the groundwater system is simulated in the Model discussed in Section 6 and in Appendix B, and is one component that can be used to analyze effects of future changes to the Basin resulting from different hydrologic and development conditions.

The major Basin inflows include:

- Deep Percolation
- Surface Water Infiltration

The major outflows from the Basin include:

- Pumping
- Discharge to Surface Water

These major inflows and outflows are described in more detail below.

5.3.1. Deep Percolation

Deep percolation is the recharge that occurs as a result of precipitation that falls on the ground and infiltrates through the soil to the underlying water table. In the case of the Basin, this includes recharge from direct rainfall and from snowmelt in the Olympic Valley. The volume of deep percolation is influenced by the type, amount, and intensity of precipitation; rate of snowmelt; topography and soil type; vegetation cover and evapotranspiration; and area of impervious cover. Precipitation on the Olympic Valley floor could become evapotranspiration, runoff, or deep percolation; in addition, high groundwater levels in the Basin could prevent percolation and thereby lead to rejected recharge (additional stream flow). Snowmelt that occurs in the upper watershed either contributes to runoff and creek flow or percolates at higher elevations and enters the groundwater system above the Olympic Valley floor along the edges of the Basin. Runoff from these higher elevations results in additional creek flow that can recharge the Basin through surface water infiltration.

5.3.2. Surface Water Infiltration and Discharge

Squaw Creek is both a gaining and losing stream. In the summer when groundwater levels are low, flow from the creek recharges the groundwater Basin. In the winter and spring when groundwater levels are high, groundwater can flow into the creek. The direction and amount of flow to or from the creek and the Basin is highly variable and changes with relative groundwater levels along the creek channel and through time. Stream flow data for the main stem of Squaw Creek and the two upstream tributaries have been collected on 15-minute interval basis by Sound Watershed on behalf of the Friends of Squaw Creek.

5.3.3. Pumping

Most groundwater pumping is by four entities (SVPSD, SVMWC, RSC, and SVR) for residential, commercial, irrigation, and snowmaking uses. Pumping generally is greater in the summer months and less in the winter months. Water use by each of these users is documented in Section 4.

5.4. BASIN RESPONSE TO CHANGES TO INFLOWS AND OUTFLOWS

In general, with increased pumping, water levels are expected to decrease to lower levels throughout the summer and fall (as currently occurs). Decreased groundwater elevations can actually increase the running total volume of groundwater storage in the Basin by allowing more recharge to be captured from precipitation and snowmelt whenever they occur. In most conditions, there is ample runoff and recharge from precipitation and snowmelt to result in a nearly full Basin every winter. Because most of this runoff occurs at times when groundwater elevations in the Basin are high, water will continue to flow out of the Basin via the creek and overland flow. It is possible that during periods of extreme drought in the future (e.g., future single and multiple dry years); there might not be available runoff to fill up the Basin. These events are expected to be limited and the Basin would easily recover after a year of normal precipitation, because normal runoff substantially exceeds Basin capacity.

5.5. WATER SUPPLY AVAILABILITY

Several previous studies have attempted to quantify the volume of groundwater that can be produced from the Olympic Valley Groundwater Basin over some period of time without causing impairment of one kind or another. Several of these studies misused the term safe yield and the annual production volumes they present are unreasonably high (Todd 2012). More recent studies completed on behalf of the SVPSD have attempted to quantify a *sustainable yield* for the Basin using the existing Model. However, these studies evaluated the maximum amount of water that could be pumped from the Basin using existing wells during a critically dry year without significantly affecting the pumping water levels of the shallowest existing municipal supply well (West Yost 2001 and 2003). This *sustainable yield* actually is an *operational yield* that pertains more to the maintenance of specific well operations than to the potential yield of the Basin (Todd 2012, Slade 2006).

These attempts to quantify a *sustainable yield* reported a wide range of maximum groundwater production volumes including West Yost 2001 and Williams 2004. The large range of reported maximum supply values was the result of variations in the timing and distribution of demand and pumping. While each scenario represented a possible future scenario, the wide range indicates that the assumptions regarding these distribution factors play a significant part in the results of the analyses. Without firmly established and agreed upon criteria, a sustainable yield cannot be quantified. In addition, a sustainable yield analysis oversimplifies the dynamic complex Olympic Valley Groundwater Basin system.

Evaluation of the occurrence and flow of groundwater in the Olympic Valley Groundwater Basin and the related water balance for this WSA has shown that the groundwater system in Olympic Valley is highly dynamic and responsive to the timing and spatial distribution of recharge, demands, and pumping. This small groundwater system has a very high volume of water flowing through the watershed on an annual basis, which far exceeds the volume of groundwater storage or use (Todd 2012). This is clearly illustrated by the large volume of rejected recharge that has been identified by HydroMetrics and others (HydroMetrics 2013, Todd 2012).

It is very difficult to quantify the supply capacity of groundwater systems with large volumes of rejected recharge, because increased groundwater pumping can directly increase the volume of recharge that flows into the Basin. Therefore, the relationship between the timing of demand and recharge to the Basin is critical to the availability of supply in the Olympic Valley Groundwater Basin system. In these circumstances, it is necessary to evaluate the important water producing areas of the Basin over time, instead of individual wells. It is also impractical to establish a single value representing maximum annual groundwater availability such as a *safe* or *sustainable yield,* because the distribution and timing of demand can change the total volume of water that can be produced. The sufficiency of supply evaluation employed by this WSA presents and applies a more complete approach and methodology to assessing water supply availability as it relates to demand in the Olympic Valley Groundwater Basin. The evaluation of supply sufficiency is presented below in Section 6.

5.6. GROUNDWATER QUALITY

Water quality in the western portion of the Basin where the existing municipal wells are located is generally good. Studies have shown somewhat poorer water quality in the eastern portion of the Basin which is currently used only for irrigation and snowmaking supply. Future plans to meet demand for the RSC Phase 2 development include conversion of the existing irrigation and snowmaking supply well 18-3R to a municipal supply well operated by SVPSD. Evaluation of this well has shown that its water quality is sufficient to meet potable water supply standards. The SVPSD and SVMWC horizontal bedrock wells produce water that is sufficient to meet potable water supply standards.

The GWMP includes a good summary evaluation of water quality in the Olympic Valley Groundwater Basin (HydroMetrics 2007a). This summary indicates localized high concentrations of iron, manganese, total dissolved solids, and arsenic and some limited past anthropogenic sources of poor quality water in areas outside of the western wellfield. The high observed metals and total dissolved solids concentrations have historically been in the eastern portion of the Basin. The limited poor quality water will not affect the volume of high quality water available to meet Project and non-project demands as the western wellfield currently produces adequate quality water. In addition, it is not expected that additional water treatment will be required for new wells within the western wellfield in the future. However, water quality should be assessed and considered before new water supply wells are constructed and put into operation.

5.7. WATER RIGHTS AND REGULATORY APPROVALS

Water Code section 10910(d) provides that the WSA must include an identification of the right to produce water from the source identified to serve the proposed project. The key provisions applicable to the Project include assessment of water rights, proof of entitlement, and information regarding permits for infrastructure.

5.7.1. Proof of Entitlement to the Olympic Valley Groundwater Basin

The Olympic Valley Groundwater Basin is an un-adjudicated basin. Accordingly, the right of the Project to produce groundwater from the Basin is not governed by any court order or agreement (O.W.L. Foundation v. City of Rohnert Park 2008). Rather, California common law governs the right to use and extract percolating groundwater from the Basin. Percolating groundwater is distinguished from *subterranean streams flowing through known and definite channels*, which are legally classified as surface waters because of their stream-like characteristics. Surface waters, including subterranean streams, lie within the permitting jurisdiction of the State Water Resources Control Board (SWRCB), but percolating groundwater is not subject to any statewide permitting system or management program to regulate the use or appropriation of water (Water Code Section 1200). Groundwater rights in California may be of two basic types: overlying and appropriative.

5.7.2. Overlying Rights

As the owner of real property overlying the Basin, a groundwater aquifer, SVRE possesses a right as part and parcel of the land to extract groundwater from beneath the property for use on overlying land within the watershed (City of Santa Maria v. Adam 2011). The overlying right consists of a present right to use water for existing and prospective beneficial uses, including, for example, the potable and non-potable demands of the Project (City of Barstow v. Mojave Water Agency 2000). The right may remain unexercised or dormant, unless a court adjudication provides otherwise (Wright v. Goleta Water Dist. 1985). An overlying owner's groundwater right is correlative with all other overlying users' rights, which means that the overlying owner is entitled to extract and use a proportional and reasonable share of the common supply (City of Barstow v. Mojave Water Agency 2000). Absent a court adjudication of groundwater rights, the overlying owner is not limited to any specific quantity of water because, by definition, the amount of water to which the overlying owner is entitled fluctuates with the present beneficial needs of the landowner (California Water Service Co. v. Edward Sidebotham & Son, Inc. 1964, City of Barstow v. Mojave Water Agency 2000). Further, one with overlying water rights has rights superior to that of other persons who lack legal priority, but is nonetheless restricted to a reasonable beneficial use.

5.7.3. Appropriative Rights

Appropriative rights, on the other hand, are not derived from land ownership but depend upon the actual taking of water (City of Santa Maria v. Adam 2011). An appropriative right to groundwater is the right to pump and use surplus water not needed to satisfy overlying uses, for reasonable and beneficial purposes (City of Barstow v. Mojave Water Agency 2000). Where a public entity takes water and uses it within its system for municipal purposes or for sale to the public, such exercise of water rights is considered appropriative, even when water service is provided to customers overlying the basin from which the supply is drawn (City of Pasadena v. City of Alhambra 1949, City of San Bernardino v. City of Riverside 1921). Accordingly, the SVPSD produces groundwater from the Basin via four active wells pursuant to an appropriative right. Like overlying rights, appropriative rights must be exercised reasonably and beneficially (California Constitution Article X, Section 2; City of Barstow v. Mojave Water Agency 2000.)

5.7.4. Regulatory Approvals

All new wells constructed for the project will require a permit from Placer County and compliance with the state's well permit regulations. (Placer County Code, Section 13.08). To obtain water service from the SVPSD, SVRE must obtain a permit allowing it to receive water through SVPSD's infrastructure. (SVPSD Code Section 4.04) Permit applications are reviewed in order to ensure that "the proposed work or use complies with the provisions" of SVPSD's Code. (SVPSD Code Section 4.04, 5.05) Permits and assurances of water service "shall be issued on a first-come, first-served basis." (SVPSD Code Section 5.04(C)(3).)

5.7.5. Truckee River Operating Agreement

The Basin is located within the Truckee River watershed. In 1990, in order to resolve litigation involving claims to the Truckee River, Congress passed the Truckee-Carson-Pyramid Lake Water Rights Settlement Act (Settlement Act 1990). The Settlement Act mandated that the States of Nevada and California negotiate an agreement for Truckee River operations, and that the resulting operating agreement be promulgated as a federal regulation. After almost 20 years of negotiations between the states and Truckee River stakeholders, the Truckee River Operating Agreement (TROA 2008) was executed in September 2008. TROA was first published in December 2008 and its promulgation as a federal regulation became final in January 2009.

TROA does not take effect until certain conditions are satisfied (TROA 2008). All but two of these conditions have been satisfied. The remaining conditions are:

1. Changes to water rights held by the Pyramid Lake Paiute Tribe pursuant to Nevada State Engineer Ruling 4683 must be approved. Applications for those changes are pending, and this contingency can be waived.
2. The Pyramid Lake Paiute Tribe v. California and United States v. Truckee-Carson Irrigation District litigations must be resolved. The cases have been active for decades; however, the TROA Implementation Coordinator anticipates that TROA will be effective in the near future.

If and when TROA becomes effective, two elements of the Settlement Act and TROA are relevant to new groundwater production and uses within the Truckee River Basin:

1. The Settlement Act allocates California 32,000 AFY of total Truckee River water diversions from all surface water and groundwater sources (Settlement Act 1990). DWR predicted California water usage in the Truckee River Basin through 2033 would not exceed 22,700 AFY and that implementation of TROA would not affect this total (USBR 2008). Compliance with this allocation within California is to be enforced by DWR (Settlement Act 1990).
2. The Settlement Act also requires development of specifications the design of new wells in the Truckee River basin that will minimize short-term surface water reductions to the maximum extent possible.

To that end, TROA designates special zones and criteria for each of those zones that will lead to a presumption of compliance with the Settlement Act. The Basin is within the TROA Olympic Valley Special Zone, so wells constructed within the Basin after TROA is effective will be required to be drilled more than 500 feet from the centerline of the Truckee River. Prior to constructing new wells a Notice of Intent to Construct a Well will have to be filed with the TROA Administrator. If the Notice is properly filed, it will operate to provide presumptive compliance with TROA and the Settlement Act.

Although TROA is not yet in effect, DWR has developed a well notice form to be used until TROA is implemented. Parties who plan to drill a well within the TROA area have the opportunity to complete the form and submit it to DWR and the TROA parties to confirm compliance with TROA terms. If no objections are raised by the TROA signatories within 90 days, the documentation is submitted to the TROA Administrator, and the well is presumed to be in compliance when TROA comes into effect. All wells drilled after May 1, 1996 and until TROA is in effect that have not completed the pre-TROA Notice of Intent will be required to complete a Notice of Intent within thirty days of the date TROA becomes effective (TROA 2008).

Neither the Settlement Agreement nor TROA will limit the potential to construct new wells in or produce groundwater from the Basin, so long as the well meets the conditions for presumptive compliance. However, all wells proposed to be constructed as part of the Project must comply with all criteria for the Olympic Valley Special Zone, including completion of a Notice of Intent to Construct a Well in addition to a well drilling permit from the County.

5.8. SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA) OF 2014

The Sustainable Groundwater Management Act of 2014 (SGMA), which became law on January 1, 2015, applies to all groundwater basins in the state (Water Code Section 10720.3). Any local agency that has water supply, water management, or land use responsibilities within a DWR designated groundwater basin may elect to be a groundwater sustainability agency (GSA) for that basin (Water Code Section 10723). Local agencies have until January 1, 2017 to elect to become or form a GSA.

SGMA requires DWR to categorize each groundwater basin in the state as either high, medium, low, or very low priority (Water Code Sections 10720.7 and 10722.4). All basins designated as high or medium priority must complete a groundwater sustainability plan (GSP). Preparation of a GSP is not required for low and very low priority basins. DWR has ranked the Basin as very low priority. Therefore, a GSP will not be required for the Basin.

Even though a GSP is not currently required for the Basin, it is possible that SVPSD or the County may elect to become the GSA for the Basin. The County has no plans in the foreseeable future to do so.

Table 5-1. Historical Production by Source

All values in Acre-Feet per Year (AFY)

Water Supply Source	User	2000	2005	2010	2014	Average[3]
Olympic Valley Aquifer Groundwater Production	SVPSD	*416*	*385*	*349*	*334*	*377*
	SVMWC	*106*	*66*	*69*	*93*	*88*
	RSC[1]	*244*	*258*	*193*	*227*	*257*
	SVR[2]	*0*	*0*	*1*	*85*	*81*
	Subtotal	**766**	**709**	**613**	**738**	**802**
Horizontal Bedrock Well Production	SVPSD	*27*	*36*	*19*	*24*	*26*
	SVMWC	*46*	*44*	*42*	*36*	*42*
	Subtotal	**73**	**80**	**61**	**60**	**68**
	TOTAL	**839**	**788**	**673**	**798**	**871**

Notes:

General : - All values rounded to nearest whole number, totals may reflect the effects of rounding.

1: RSC production values not available for all years, so values presented above are interpolations from reported data. A summary of the sources for the data in the table is presented below:

2000 Irrigation from 2000 and snowmaking from 1999

2005 Irrigation from 2004 and snowmaking from 2006

2010 Irrigation interpolated between 2007 and 2012, snowmaking from 2010.

2014 Irrigation and snowmaking data both available.

2: SVR groundwater production from the Olympic Valley Aquifer is reported to have begun in late 2010.

3: Averages are for 2000 through 2014, as shown in Farr West 2015, Appendix A. Value may not be the same as the average of the limited dataset shown in this table.

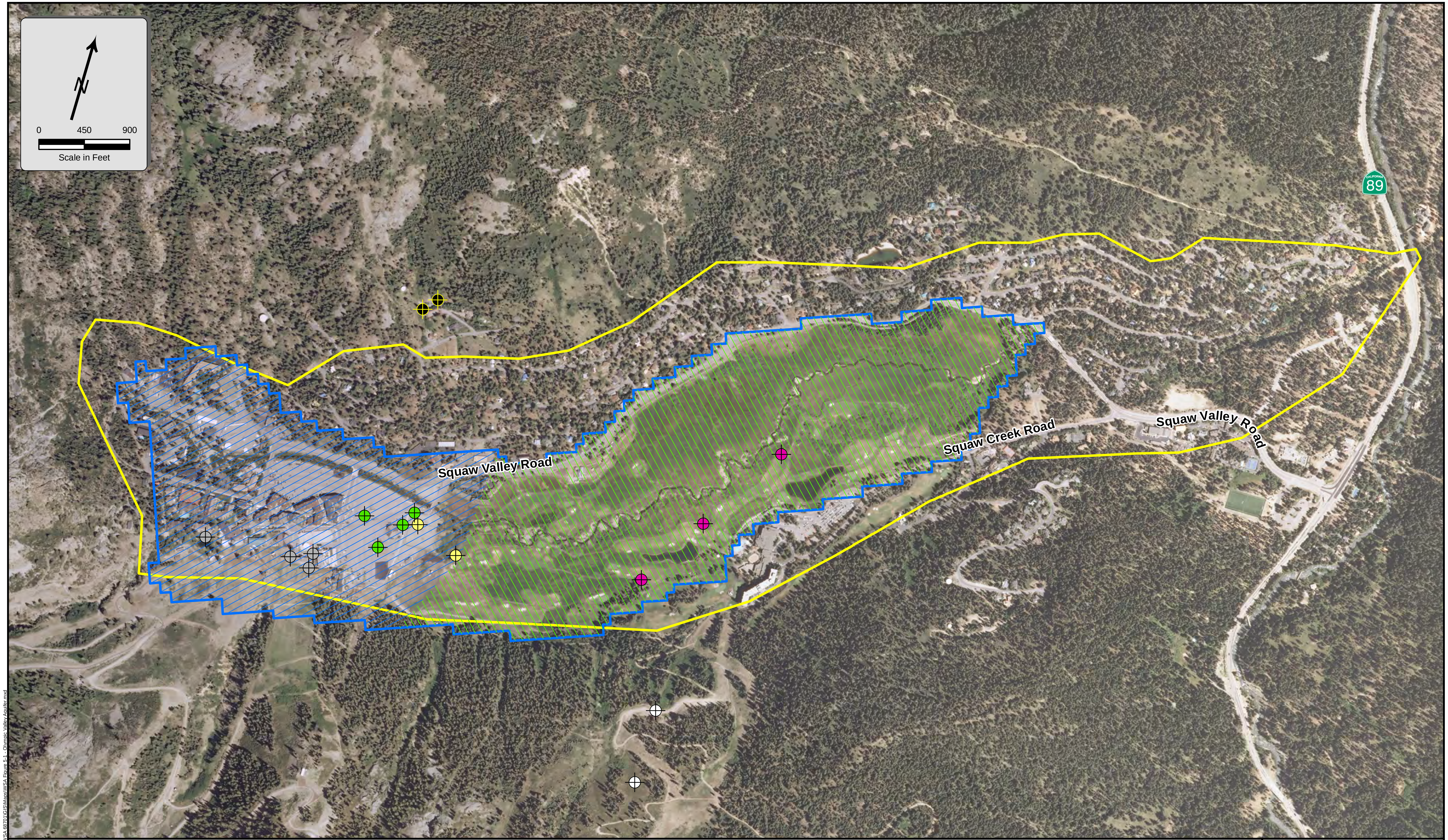
Table 5-2. Projected Supply by Source

All values in Acre-Feet per Year (AFY)

Water Supply Source	2015	2020	2025	2030	2035	2040
Olympic Valley Aquifer Groundwater Production	811	923	1,023	1,093	1,151	1,186
Horizontal Bedrock Well Production	68	68	68	68	68	68
TOTAL	**879**	**991**	**1,091**	**1,161**	**1,219**	**1,254**

Notes:

General : All values rounded to nearest whole number, totals may reflect the effects of rounding.



Legend

- Active SVPSD Aquifer Well
- SVPSD Horizontal
- Active SVMWC Aquifer Well
- SVMWC Horizontal
- Squaw Valley Resort Well
- Resort at Squaw Creek Well
- DWR Designated Olympic Valley Groundwater Basin
- Groundwater Management and Active SVPSD Model Area
- Western Portion of Basin
- Eastern Portion of Basin

Figure 5-1
Olympic Valley Groundwater Basin and Existing Wells

6. WATER SUPPLY SUFFICIENCY

The proposed Project and non-project growth over the next 25 years represent an increase in the water demand within Olympic Valley of 383 AFY for a total demand of 1,254 AFY (total average from Table 4-2 compared to that from Table 4-1). The Project will require 240 AFY of this increase, and the non-project development represents an additional 143 AFY of demand (Table 4-2). The total projected water demand represents a 44 percent increase over the average annual volume of 871 AFY currently used in the Olympic Valley, and a 48 percent increase over the current annual average groundwater production from the Basin.

As discussed in Section 5, given the highly dynamic nature and small size of the Basin, previous studies have found it impractical to define a single static supply availability value (i.e., a safe, sustainable, or perennial yield) for this groundwater resource (Todd 2012). Instead, this water sufficiency analysis is based on monthly projections using the existing Model, which was developed to assist in the evaluation of supply and management of groundwater in the Basin. This Model was prepared by HydroMetrics Water Resources, Inc. (HydroMetrics), and Hydrometrics continues to maintain and update the Model for SVPSD. The Model has been used in the past as a tool for managing groundwater supply, planning for future growth, and evaluating potential water supply sources for specific developments in Squaw Valley. The Model was previously used in the evaluation and approval of new developments at the RSC and the PlumpJack properties.

The volume of groundwater that can be produced from the Basin in any year is dependent on four factors:

1. Volume and timing of recharge to the Basin (i.e. precipitation and snowmelt)
2. Timing of the demand
3. Location of pumping wells
4. Acceptable Basin response to pumping for long-term sustainability

Historically, pumping has been limited to a few wells in the western portion of the Basin (existing wells on Table 6-1 and Figure 6-1). The existing wells are capable of producing more water than is currently used in the Olympic Valley, but not enough to meet the projected demands at 2040. Therefore, an expanded wellfield with new wells will be required to meet these projected demands.

As noted above, an estimated four new wells are required to meet the demands of the Project (MacKay & Somps 2015) and a minimum of two additional wells would be required to meet the SVPSD non-project demands at 2040. In order to assess the capacity of the Basin to produce water, more than just the minimum number of potential new well locations was identified. Limiting the potential new well sites to only the six new SVPSD wells required to meet demand at 2040 would have shown the ability of a specific wellfield to meet demands, not the Basin as a whole.

The potential new wells were identified by evaluating geology, geometry, hydrostratigraphy, aquifer production capacity, and development plans for the western portion of the Basin. Nine potential new well sites were identified through this process. In addition, a single SVPSD well (Well-1R) may need to be replaced to accommodate the Project. A replacement location for this well has been identified, as shown on Figure 6-1.

All of the potential new wells and the replacement well were used in conjunction with the existing wells shown in Table 6-1 and Figure 6-1 in assessing the sufficiency of supply. These well locations were included in the Model to perform simulations of pumping to meet total water demands at 2040. The simulated results of supplying total 2040 demand from the expanded wellfield are compared to a set of criteria developed for assessing wellfield conditions. Specifics relating to this approach are described below and in further detail in Appendix C.

6.1. NUMERICAL GROUNDWATER MODEL

The existing Model was first constructed in 2001 (Williams 2001). The Model was constructed to simulate the Basin using the widely-accepted MODFLOW code developed by the United States Geological Survey (USGS). The boundaries of the Model are the same as the modified Basin boundaries developed by HydroMetrics as discussed in Section 5.1 above.

Since its original construction, the Model has been updated multiple times to incorporate new data and refine conceptualizations (West Yost 2003, HydroMetrics 2006, 2007b, 2014, and 2015). The Model was updated in 2014 following significant additional data collection relating to Squaw Creek (HydroMetrics 2013). This update included recently acquired groundwater elevation, streamflow, stream bed conductance, and climate data. The incorporation of these data included an extension of the Model period and recalibration to simulate conditions from May 1992 through December 2011. Following this major documented Model update, HydroMetrics implemented additional changes and successfully recalibrated the Model to accommodate simulation of future conditions (HydroMetrics 2014, Appendix B). The Model was updated again in 2015 to expand the time period and include recent hydrologic conditions, including the dry years of 2012 through 2014. This most recent update included processing and incorporation of groundwater elevation, streamflow, and climate data through January 2015. In addition, the methodology for calculating recharge from precipitation was modified to account for limited infiltration during summer storm events, effectively reducing summer month infiltration (HydroMetrics 2015). The current version of the Model was assessed and found to adequately simulate groundwater elevations for the period from May 1992 through January 2015 (HydroMetrics 2015, Appendix C).

The current version of the numerical Model is a good tool for simulating changed conditions and management practice alternatives. The Model can be used to simulate future conditions and predict how increased pumping will affect Basin water levels and the water balance. For the assessment of supply sufficiency, the Model is run in a predictive mode with potential new wells added to the existing wellfield as discussed above in Section 4 and pumping distributed as described below in Section 6.2. The results of the Model simulations were then evaluated against criteria described in Section 6.3.

6.2. SIMULATION OF GROUNDWATER PRODUCTION TO MEET PROJECTED DEMANDS

The monthly production volumes by well shown in Table 6-2 were applied to the latest version of the Model described above. Groundwater Models are a collection of input files representing components of the groundwater system, a set of equations for how water moves, and a computer code that combines the inputs and solves the equations to simulate flow in the Model. In the case of the SVPSD Olympic Valley Groundwater Basin Model, variables simulated include Basin geometry (Model grid and elevations of layer tops and bottoms), aquifer parameters (hydraulic conductivity and storage coefficients), recharge, stream flow, and pumping. As described in Section 5, recharge in the Model is a combination of precipitation and irrigation and municipal return flows. Most of the Model inputs for the future demand simulation were kept the same as those from the recently updated and calibrated Model, because for the most part aspects such as aquifer parameters, Basin geometry, and boundary conditions will not change in the future. The following Model input files were assigned to represent future conditions:

6.2.1. Recharge

The precipitation component of the recharge inputs used measured Valley floor precipitation from October 1992 through December 2014, which is all of the full water years represented in the Model, plus the last three months of 2014. The Model uses precipitation data for Olympic Valley from the Squaw Valley Fire Station gage maintained by SVPSD to simulate recharge. Precipitation that occurs on the mountainous areas of the watershed above the Valley floor is not used in the Model as a direct or modified input variable. Precipitation that occurs on the mountainous portions of the watershed is represented in the Model only through measured stream discharge, which is continuously gaged and recorded in Squaw Creek at the western end of the Valley.

The period of October 1992 through December 2014 is used in the Model because it is the timeframe over which the data and information required to populate the Model are available. Prior to the beginning of this period, there were insufficient groundwater production, elevation, and climate record data to allow the Model to be populated or calibrated. The period from October 1992 through December 2014 includes a representative range of hydrologic conditions for the Olympic Valley, as shown in the climate data in Section 3.

Hydrologic conditions for future scenarios were based on the historical conditions. Precipitation that occurred from water year 1993 through water year 2014 was used to calculate the recharge into the Model. This facilitates the evaluation of normal, wet, and dry periods. The portion of recharge that comes from irrigation and municipal return flows and sewer pipe gains and losses are all calculated as a function of the water delivered within the

SVPSD, SVMWC, and RSC water production and distribution systems. These components were calculated from the average demand data presented in Table 6-2.

6.2.2. Streamflow

Flow in Squaw Creek for the period from October 1992 through December 2014 was used to represent future conditions, as was done for precipitation. Sqauw Creek flow in the Model is developed from stream discharge measurements collected by the Friends of Squaw Creek (FoSC 2015) from gages at the western end of the Valley.

6.2.3. Pumping

The volume, timing, and spatial distribution of pumping were assigned to an expanded wellfield, as described above. The larger wellfield includes most of the existing municipal supply wells and several new wells to meet increased SVPSD demands. The locations of all the simulated wells are shown on Figure 6-1, and basic information about each well is presented in Table 6-1.

As noted above, the Project and non-project demands are estimated to only require six new wells. However, in order to assess the capacity of the Basin to meet demand and limit the effects of a specific wellfield arrangement on the evaluation, wells were placed in all of the locations identified as being favorable for groundwater production. The potential new wells were placed in locations where no Project buildings are planned and selected to take advantage of deep and productive areas, maintain distance between wells to minimize interference, maximize distance from Squaw Creek, and distribute pumping over a large area to reduce cumulative drawdown effects in any one area of the Basin. One of the existing SVPSD wells (SVPSD-1R) is in a location where a new building is planned for the Project. SVPSD and SVRE plan to replace this well in the location shown as SVPSD-1RR on Figure 6-1. All of the other existing water supply wells will remain intact.

Total pumping volumes for each pumper (i.e. SVPSD, SVMWC, RSC, and SVR) were set to equal the average demands distributed by month shown in Table 6-2. These total demands were then distributed to specific wells as follows:

- Total SVPSD demand was distributed to the existing and new wells equally each month, with one exception. The exception is the demand for the RSC Phase 2 development, which was previously approved for development by the County and the SVPSD. SVPSD has agreed to serve potable water to the expansion in accordance with a development agreement (DA) that specifies the volume and timing of the associated potable demands (HydroMetrics 2006 and 2007b). The DA requires RSC to dedicate their Well 18-3R (RSC-18-3R) to SVPSD to meet those demands. The effects of pumping Well 18-3R were evaluated as part of the RSC Phase 2 planning process. This evaluation included assessment of impacts to surface water features (HydroMetrics 2006 and 2007b).
- The Model simulations used in this WSA assign all the planned RSC Phase 2 demands to RSC-18-3R, while the rest of the SVPSD demands at 2040 are spread equally among the remaining SVPSD wells.

- SVMWC demand was distributed to the two existing SVMWC wells according to percentage each produced in the recent historical period.
- RSC demand for irrigation and snowmaking listed on Table 6-2 will be satisfied from existing and planned RSC wells. The same DA that governs the volume, timing, and supply source of potable demand for Phase 2 at RSC also includes specifications for the volume and timing of non-potable groundwater production, including reductions in irrigation use. A schedule for the distribution of these demands to wells on RSC property was developed when the SVPSD was assessing service of RSC Phase 2 (HydroMetrics 2006 and 2007b).
- Demand for future SVR snowmaking is assumed to be equal to the recent historical volumes plus a growth factor of ten percent. Pumping to meet these demands is assumed to be distributed proportionally to the existing wells on Figure 6-1 as it was in the recent historical period, as described in Section 4.2.2.

Monthly distribution of pumping to all active wells in the predictive version of the Model is shown on Table 6-2. These monthly pumping rates represent average year production for each well. These average year values were assumed to represent pumping throughout the Model period. Therefore, pumping volume, distribution, and timing input to the Model is the same for every year from October 1992 through December 2014.

The input files described above were developed for 2040 conditions and evaluated in every year of the Model period, which include a representative range of hydrologic year types. Since demands at 2040 are at their peak for the WSA timeframe, running the Model with those demands for every year assesses water demands for the maximum Project and non-project growth.

6.3. CRITERIA FOR EVALUATING SUFFICIENT WATER SUPPLY

As noted in Section 5, no reliable estimates of maximum sustainable groundwater supply availability or agreed-upon criteria for evaluating this parameter existed prior to the preparation of this WSA. As a result, criteria were developed against which simulated (Modeled) groundwater elevations can be compared (Todd, et al., 2015, Appendix C). These criteria are as follows:

- Average saturated thickness in the western municipal wellfield wells (existing and proposed new) may not fall below 65 percent for more than 3 consecutive months or more than 4 times total over the Model simulation period.

Saturated thickness is the water level elevation (head) in a well minus the elevation of the bottom of the Basin at that location. The maximum saturated thickness occurs when water levels are the highest and the percent saturated thickness is the saturated thickness at a location and time divided by the maximum saturated thickness for that location. The maximum saturated thickness values at specific locations do not change, and were derived from simulations representing current average pumping conditions (baseline conditions).

These criteria should not be taken as recommendations for operational practices. New wells will need to be designed and constructed to maximize operational reliability and flexibility, based on location-specific hydrogeology. While there is no lower limit to percent saturation proposed for the short exceedances of the 65 percent threshold, in practice saturated thicknesses in any given month are affected by the preceding months, so extreme exceedance of this threshold in any month or months will result in exceedances of longer than the 3 consecutive month allowance.

To determine if there is a sufficient water supply for the Project and other future water demands, the simulated aquifer response was evaluated against these criteria. Details regarding the development, applicability, and application of these criteria are presented in Appendix C.

6.3.1. Sufficiency in Single and Multiple Dry Years

The Model simulates future demand conditions (total demand at 2040) and evaluates the Basin over a 22 plus year hydrologic period. The recharge and creek flow for this Model period represent the same hydrological conditions as the period from October 1992 through December 2014, which is the time period for which the Model is calibrated.

The Water Code requires a WSA to examine supply in a single dry year as well as multiple dry years, and the DWR Guidelines recommend defining dry years based on historical records (DWR 2003b). This allows the analysis to use the available observed data to draw conclusion about future events. The Model simulates the historical records and contains several dry periods, including the most recent statewide drought of 2012 through 2014.

Despite the severity of the statewide drought, the period between 2012 and the end of 2014 was neither the most severe single nor multiple water year dry period on the Olympic Valley floor. Precipitation records from the Squaw Valley Fire Station gage indicate that between water years 1993 and 2014 the single driest year was water year 2001, when precipitation on the Valley floor was just under 40 percent of average. The Squaw Valley Fire Station gage precipitation data show that the driest multiple water year dry period in this time period was 2000 through 2002, when the three water year precipitation total was just under 64 percent of average. For reference, the three year average precipitation from water years 2012 through 2014 represented over 68 percent of average. The recent 2012 to 2014 drought does represent the driest three year period on the mountain and when considering combined mountain and Valley precipitation, as shown in Figure 3-1. Precipitation on the mountain for water years 2012 through 2014 was just below 62 percent of average, and combined mountain and Valley precipitation during this period was 64 percent of average. In groundwater aquifers, water levels are generally significantly lower during single and multiple dry year periods. It is during these dry periods when the percent saturation would be most likely to not meet the percent saturation threshold.

The Tahoe region and the rest of California are still in the midst of a drought. The current drought is represented in the Model through the end of 2014. The only recent drought period that is not included in the Model is the last nine months of water year 2015. The effects of the 2015 drought period have not yet fully occurred and the observation data resulting from these effects (such as water levels, stream flow, etc.) continue to be collected. Water Code section 10910 indicates that the *groundwater description and analysis shall be based on information that is reasonably available, including, but not limited to, historical use records*. As such, using the historical period of the Model to predict future conditions is consistent with the intent and guidelines for the WSA.

Future changes in climate patterns may have an effect on precipitation volumes and timing. However, it is not possible to estimate groundwater elevations in the Basin based on projections of precipitation quantity alone, as this variable in isolation is not an indicator of groundwater elevations in the Basin; the relationship between precipitation volume on the watershed and groundwater elevations is not linear. The Basin is relatively small when compared with the larger watershed. In average years, only a small portion of the total snowmelt actually becomes recharge to groundwater; most of the snowmelt and creek flow continue to flow out of the Basin and not recharge the Basin because groundwater elevations are high. Decreased snowfall could result in increased artificial snowmaking and changes in water demand due to climatic changes, which add further variables to the non-linear relationship between precipitation and groundwater elevations. Therefore, it is not possible to accurately estimate the volume and timing of recharge to the Basin without appropriate data.

6.4. MODELING RESULTS

A groundwater Model simulates water elevations for every time step within its full time period. The SVPSD Model is constructed with monthly time steps, which means that there are individual groundwater elevation results for every month in the Model period of October 1992 through December 2014. The simulated results for the municipal wells in the western wellfield (the SVPSD and SVMWC wells in Table 6-1 and on Figure 6-1, with the exception of RSC-18-3R) were extracted from the Model and used to calculate saturated thicknesses for each month in the Model time period. These are the wells that make up the criteria for evaluating supply sufficiency described above and in Appendix C. The percent saturation results for each well are shown graphically on Figure 6-2. The average percent saturation for all of the wells combined is also shown on Figure 6-2 as a bold red line.

The results of the Modeling analysis indicate that over the entire Modeled period the average percent saturation for all the wells in the western wellfield ranged from 77 to 99 percent, well above the 65 percent criteria. This indicates that there is sufficient available groundwater supply capacity to meet the estimated demands in 2040 with a margin of safety above the criteria. As expected, the lowest groundwater elevations occurred during the fall in drought years, which shows that these time periods are the most critical for water supply in the Olympic Valley.

The Modeled minimum percent saturated thickness results are considerably above the 65 percent criteria, for the western wellfield average and the individual wells. This result indicates the Basin has sufficient supply to meet 2040 demand with an adequate margin of safety. Additional demands above those projected for 2040 would need to be reevaluated using the specific demand schedule and proposed water supply system if and when development is proposed that exceeds the water demands evaluated in this WSA.

The minimum Modeled average percent saturation during the single year dry period (water year 2001) and multiple dry year period (water years 2000 through 2002) was 77percent. The simulated results for these dry water years show good correlation between water year precipitation totals and groundwater elevations, especially in multiple dry year periods. However, not all of the variations in the simulated saturated thicknesses shown on Figure 6-2 relate to annualized precipitation patterns. This demonstrates that precipitation alone is not a predictor of groundwater elevations. The timing of high and low groundwater elevations is dependent on monthly distribution of precipitation, streamflow, pumping, and return flows. The temporal distribution and relationships between these factors produces the wide variation in saturated thickness shown in the Model results.

Even though the Model uses only Valley floor precipitation to calculate direct recharge, the volume and timing of precipitation and snowmelt on the mountains surrounding the Valley is still an important factor in groundwater availability. The patterns of precipitation on the Valley floor and the mountain areas are similar, but they are not the same. In some water years precipitation is above average on the mountains and below average in the Valley, as shown on Figure 3-1. This disparity is more evident when precipitation is viewed at a smaller time scale. Precipitation on the mountains affects the Model through streamflow, as noted above, and the timing and rate of snowmelt on the mountains is the primary factor in determining flow in Squaw Creek. Even in periods of very low mountain and combined precipitation, such as the water year 2012 to 2014 period, the Model shows the Basin still recovers enough to provide sufficient water supply. The minimum average saturated thickness during water years 2012 through 2014 was 81 percent.

It is important to note that the percent saturation values are based on the Modeled results from pumping in the well locations shown in Figure 6-1 with the distribution of pumping shown on Table 6-2. Other combinations of pumping location using the same monthly demand distribution and total annual volumes would likely be able to meet supply while still passing the criteria, but each would need to be tested independently for confirmation.

Table 6-1. Olympic Valley Basin Existing and Proposed Well Information

Well ID[1]	Existing, New, or Replacement	Well Type	Operator	Maximum Saturated Thickness[2] (feet)
SVPSD-1RR	Proposed Replacement	Municipal	SVPSD	153
SVPSD-2R	Existing	Municipal	SVPSD	78
SVPSD-3	Existing	Municipal	SVPSD	128
SVPSD-5R	Existing	Municipal	SVPSD	131
New-07/11	Proposed New	Municipal	SVPSD	98
New-09/14	Proposed New	Municipal	SVPSD	109
New-10/12	Proposed New	Municipal	SVPSD	114
New-14/08	Proposed New	Municipal	SVPSD	125
New-15/07	Proposed New	Municipal	SVPSD	114
New-16/10	Proposed New	Municipal	SVPSD	136
New-23/12	Proposed New	Municipal	SVPSD	122
New-39/54	Proposed New	Municipal	SVPSD	133
New-45/53	Proposed New	Municipal	SVPSD	142
RSC-18-3R	Existing	Municipal	SVPSD	--
SVMWC -1	Existing	Municipal	SVMWC	142
SVMWC -2	Existing	Municipal	SVMWC	128
RSC-Perini	Proposed New	Irrigation / Snow Making	RSC	--
RSC-Fourth Fairway	Existing	Irrigation / Snow Making	RSC	--
RSC-18-1	Existing	Irrigation / Snow Making	RSC	--
RSC-18-2	Existing	Irrigation / Snow Making	RSC	--
SC-ChildrensNW	Existing	Snow Making	SVR	--
SC-ChildrensNE	Existing	Snow Making	SVR	--
SC-ChildrensSE	Existing	Snow Making	SVR	--
SC-Cushing	Existing	Snow Making	SVR	--

Notes:

General : All values rounded to nearest whole number, totals may reflect the effects of rounding.

1 : Well identification notes: SVPSD-1RR is the replacement for well SVPSD-1R.
New wells are given designations based on row and column location within the model.
SC- designation wells are owned and operated by Squaw Valley Resort.

2: Maximum saturated thickness is the maximum modeled groundwater elevation in the well location minus the elevation of the bottom of the aquifer as represented in the model. This metric is shown only for those wells in the western municipal wellfield where this value is

3: RSC wells and snowmaking wells located outside of the area of increased pumping were not evaluted for the saturated thickness criteria

Des by: CT
Ckd by: MR

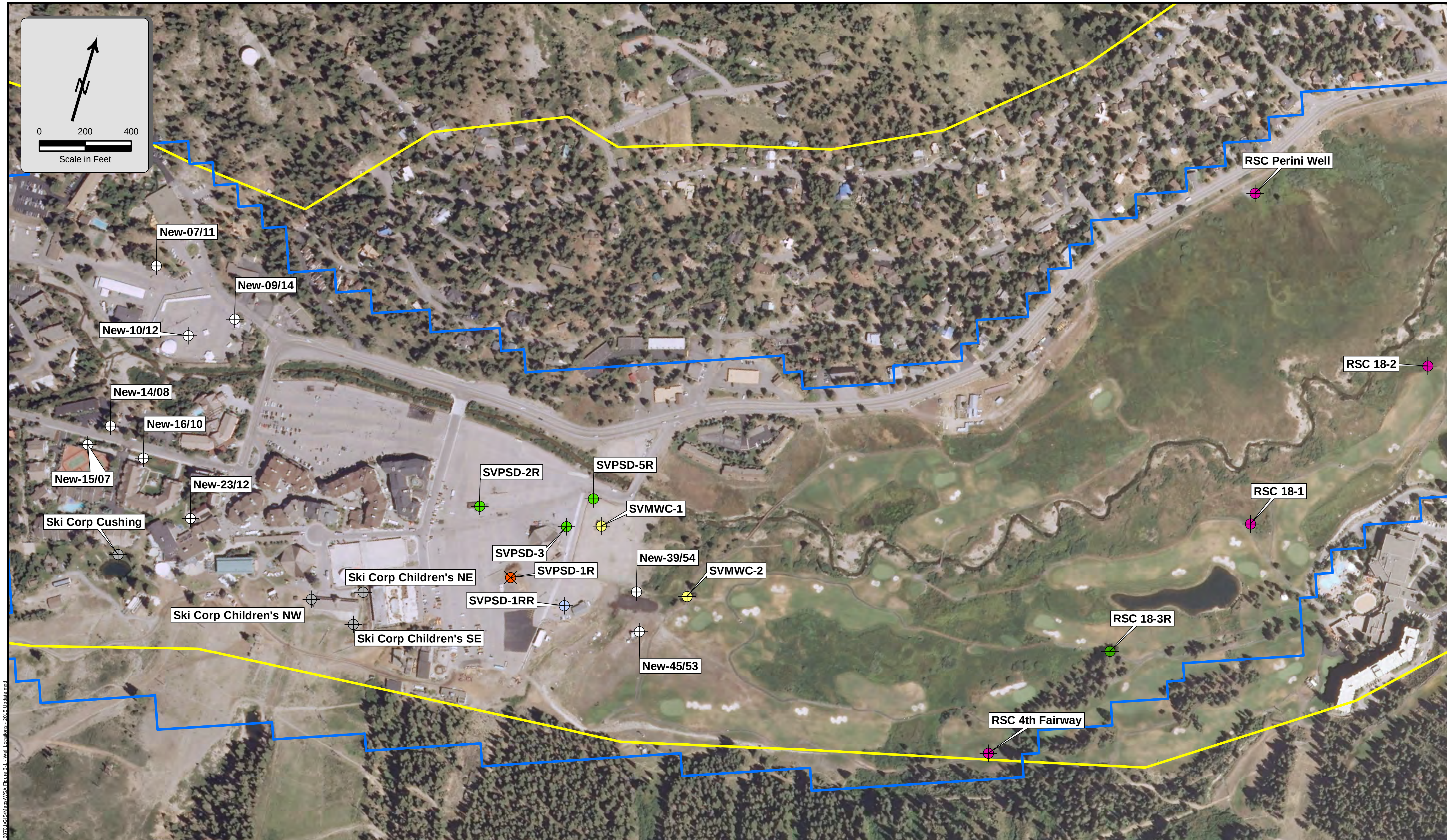
Table 6-2. Estimated Pumping by Well in 2040

All values in Acre-Feet

Month	SVPSD														SVMWC		RSC				SVR				Total Pumping
	SVPSD-1RR	SVPSD-2R	SVPSD-3	SVPSD-5R	New-07/11	New-09/14	New-10/12	New-14/08	New-15/07	New-16/10	New-23/12	New-39/54	New-45/53	RSC-18-3R	SVMWC -1	SVMWC -2	RSC-Perini	RSC-Fourth Fairway	RSC-18-1	RSC-18-2	SC-ChildrensNW	SC-ChildrensNE	SC-ChildrensSE	SC-Cushing	
January	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.3	1.4	2.1	12.8	7.7	0.0	0.0	5.5	5.5	5.5	6.2	**105**
February	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.2	2.0	1.4	12.1	7.3	0.0	0.0	3.8	3.8	3.8	4.3	**100**
March	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.4	2.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**66**
April	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	1.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**48**
May	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	2.7	4.1	2.9	3.8	2.6	0.0	0.0	0.0	0.0	0.0	0.0	**64**
June	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	4.0	6.6	6.6	16.4	10.9	0.3	0.6	0.0	0.0	0.0	0.0	**114**
July	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	4.7	6.9	11.3	17.2	11.4	5.8	11.36	0	0	0	0.00	**163**
August	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	5.4	7.2	11.3	17.3	11.5	2.5	5.0	0.0	0.0	0.0	0.0	**154**
September	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4.0	5.9	9.4	14.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	**114**
October	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	2.7	2.9	4.3	3.6	2.5	0.0	0.0	0.3	0.3	0.3	0.3	**65**
November	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.0	0.9	1.2	15.4	10.3	0.3	0.6	4.3	4.3	4.3	6.0	**81**
December	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.0	1.6	1.8	16.2	10.8	0.0	0.0	6.7	6.7	6.7	9.5	**112**
Total	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**43.2**	**43.9**	**54.4**	**128.9**	**84.2**	**8.9**	**17.5**	**20.7**	**20.7**	**20.7**	**26.4**	**1,186**

Notes:

General : All values rounded to nearest whole number, totals may reflect the effects of rounding.



Legend

- Proposed New Well
- PSD Replacement Well
- Existing PSD Well to Remain
- Existing MWC Well to Remain
- Squaw Valley Resort Well
- Resort at Squaw Creek 18-3R
- Resort at Squaw Creek Irrigation/Snow Making Well
- Well To Be Destroyed
- Active Model Area
- Olympic Valley Groundwater Basin

Figure 6-1
Existing and Modeled Well Locations

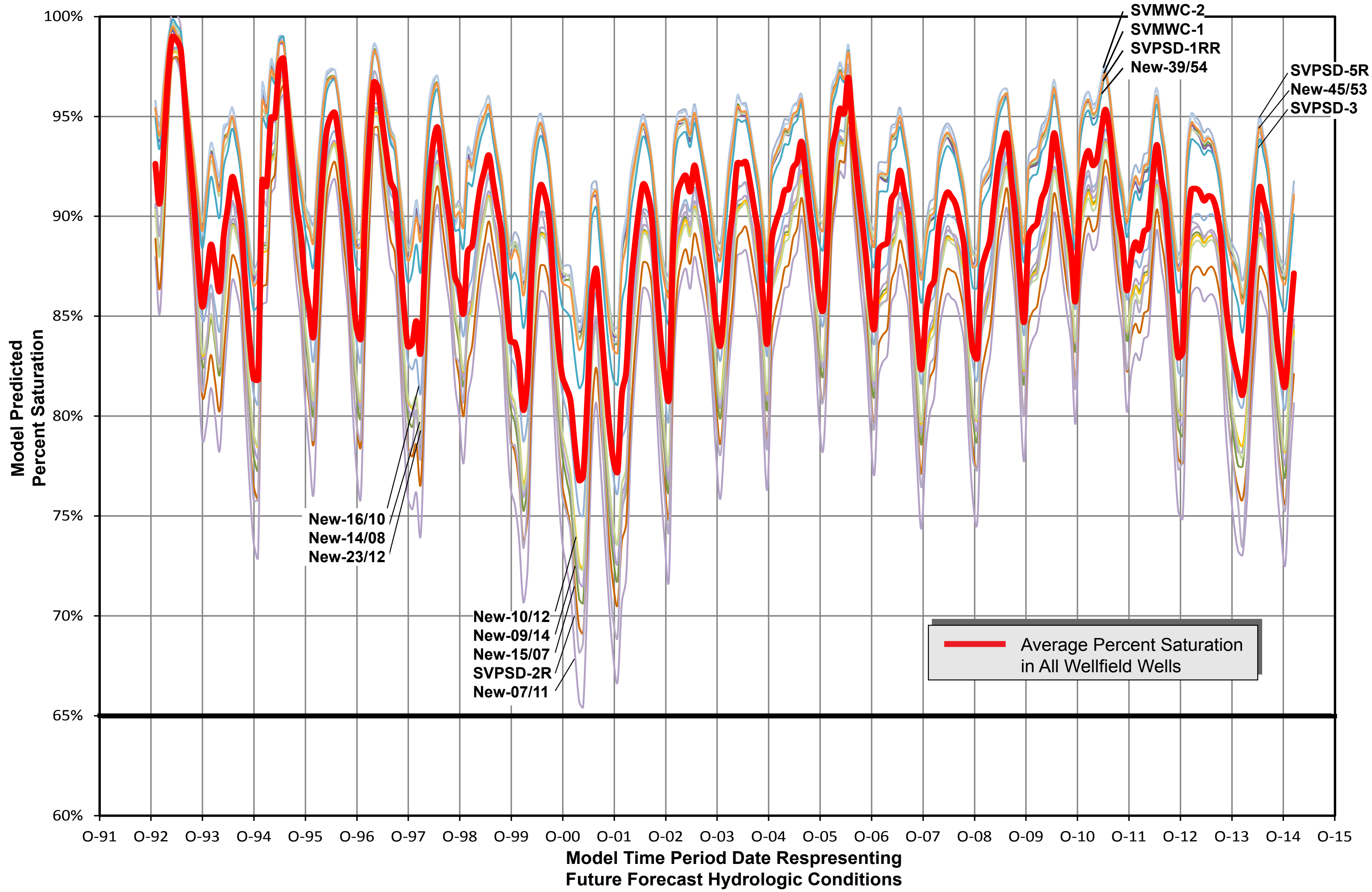


Figure 6-2
Percent Saturation All Wellfield Wells at 2040

7. WATER SUPPLY RELIABILITY

Groundwater supply in Olympic Valley could be influenced by changes in precipitation, runoff, and snowmelt volumes and/or timing. As noted previously, flows from these sources serve to recharge the Basin. Climate change Models (Shibatini 2012, Coates 2010, and Singleton 2010) indicate a potential decrease in snowfall at lower elevations, increased precipitation as rain, and earlier snowmelt in the Lake Tahoe region that could significantly affect water supply in the Olympic Valley. According to most climate change Models, there would be increasingly more precipitation as rain and less as snow, and earlier snowmelt and runoff during the water year (Coates 2010). Snowmelt and rainfall are the prime mechanism through which the Basin is recharged; the changing volume and timing of snowmelt has the potential to result in lower groundwater elevations, reduced base flow to streams, and less available groundwater supply (Singleton 2010).

It is unclear exactly when or how climate change may affect groundwater supply in the Olympic Valley, as few studies suggest quantitative values that are directly relatable to the components of recharge to the Basin. The net volume of snowmelt is expected to decrease in the Sacramento San Joaquin River Basin by 2050 (Shibatani 2012), but precise volumetric estimates of this potential decrease that relate to the Squaw Creek watershed have not been completed. Studies done in Olympic Valley indicate precipitation type is expected to be more variable, resulting in more winter rainfall events rather than the gradual spring warming that currently occurs (Singleton 2010). Under this scenario more runoff would be available in December through March, corresponding to rain events, rather than the current pattern of snowmelt occurring gradually in the April through June period. Shifting snowmelt volume and timing patterns could lead to more water available for recharge into the groundwater system earlier in the year and less availability later. The net volume of actual recharge would depend on groundwater levels and available storage at the time of runoff events. If groundwater levels are low enough and the rainfall rate is slow enough, the available potential recharge could be captured and groundwater supply would remain similar to current conditions. However, if groundwater levels remain high in winter months (when demand is relatively lower) or if rainfall occurs in the form of short duration high intensity events producing flashy runoff (in winter or other months), the result could be decreased infiltration and increased overland flow (Singleton 2010). In this scenario, the Basin would receive less recharge through the late spring and early summer as snowmelt would occur earlier in the year and available groundwater supply could decrease. There are few estimates relating to the extent and volumes to which these precipitation and runoff processes may change. As noted previously, recharge to the Basin is dependent on the rate, volume, timing, and form of precipitation as well as snowmelt. Quantitative estimates are available for the potential runoff from snowmelt in the San Joaquin River and indicate a reduction in mean runoff in the April through July period of 5 percent by the 2020s and 20.6 percent by the 2050s. However, December through March runoff is expected to increase due to the increase in rainfall by 10 and 10.7 percent in 2020 and 2050, respectively (Shibatani 2012).

While the long-term trends indicated by climate change studies may be significant, a corresponding change in snowmelt in the Squaw Creek watershed would result in a relatively small decrease in groundwater recharge in the Basin, as in current conditions only a small portion of the snowmelt is captured as groundwater recharge while most of the snowmelt runs off as overland flow. On average, 47 inches of precipitation as snow water equivalent falls on the Olympic Valley and 76 inches falls on the high mountains within the watershed. The watershed area is 5,146 acres, of that, 701 acres make up the Olympic Valley floor and the remaining 4,445 acres are higher elevation mountain slopes. Precipitation on the mountain slopes varies between the measured value for the Olympic Valley floor and measured value for the high elevations. The average of these two measured values is 61 inches of snow water equivalent. Assuming this volume of precipitation is representative of the entire mountain slope watershed area, over 25,000 AFY of water falls on the watershed and Olympic Valley in an average year, as shown below:

For the mountain slope areas of the watershed:

$$\left(61\frac{in}{year}\times 4{,}445acres\right)\times\frac{1ft}{12\ in} = 22{,}595\ AFY$$

And for the Olympic Valley

$$(47\ \ in/yr\ \times\ 710\ acres)\times\frac{1\ ft}{12\ in} = 2{,}746\ AFY$$

Totaling 25,341 AFY

For comparison, the total groundwater demand from the Basin in 2040 is expected to be 1,186 AFY (Table 5-2), which is 4.7 percent of the total precipitation on the watershed. The low ratio of groundwater development to precipitation suggests that future climate variation could be easily accommodated.

The simple analysis above shows that even the most conservative estimates of annual runoff reduction have a limited effect on the availability of potential recharge to the Basin. However, the mechanisms and timings of recharge in the Basin are complex and while total annual potential recharge is important, it is not the sole factor in groundwater water supply availability. Precipitation and runoff primarily occurs in the winter and early spring, a time when groundwater elevations in the Basin are high and the available space for additional recharge is reduced, resulting in rejected recharge. Changes to the timing of the precipitation and runoff could affect the available supply. However, these changes could also affect the use and visitation patterns in Squaw Valley and therefore also change the associated water demand volumes and timings. Both future supply availability and demand variations will be linked to the exact timing of precipitation and runoff and the effects of climate change. However, there is not currently adequate information regarding potential changes in the timing of recharge to the Basin or demands in Squaw Valley to reasonably predict the effects of climate change on water supply availability.

8. COMPARISON OF SUPPLY AND DEMAND

8.1. EXISTING CONDITIONS

The Olympic Valley Groundwater Basin currently meets the water demand of its existing users even in single dry and multiple dry years. The current supply and demand comparison is shown in Table 8-1. The table combines demand and supply from all entities and supply sources. Existing demand and supply is broken down in more detail in Table 4-1 and Table 5-1, respectively.

8.2. FUTURE CONDITIONS

The Village at Squaw Valley will increase the water demand in the Olympic Valley. The Project, which is estimated to be completed by 2040, will add 240 AFY to the total water demand. Additional non-project development in Squaw Valley (as estimated by Placer County) would increase total water demand by an additional 143 AFY. Given that existing water demand is 871 AFY, the total demand in 2040 is estimated to be 1,254 AFY, of which 1,186 AFY would be served from the Basin. The remaining 68 AFY demand would be met by the SVPSD and SVMWC horizontal bedrock wells, which are expected to produce water at the same level as under historical conditions (Table 5-1).

The future demand at 2040 was simulated over a Model period including wet, average, single dry and multiple dry year conditions as represented by climate data from Olympic Valley. The resulting Model simulated groundwater elevations were compared to criteria developed to maintain simulated water levels in the Basin at a reasonable saturated thickness. The wellfield scenario simulated for the WSA showed the average saturation thickness in all the western wellfield was in a reasonable range. The Basin is therefore sufficient to meet the expected demand from the Project and other reasonably foreseeable development through 2040 with a margin of safety. The future supply and demand comparison is shown in Table 8-2.

8.3. SINGLE AND MULTIPLE DRY YEAR CONDITIONS

As discussed in Section 4.3, the SVPSD has an Irrigation Conservation Ordinance with certain water conservation measures to reduce demand during drought conditions. However, the SVPSD has only recently needed to implement this drought water demand reduction plan. Because there are no historical data for active implementation of specific measures to reduce demand during a drought, it is conservatively assumed in this WSA that demand would continue to be the same under all conditions (average, single dry year, and multiple dry years). As demand remains stable, supply must also remain stable to meet demand. The Model simulation shows the water levels are at their lowest during drought conditions but the saturated thickness in the Basin remains well above the established criteria even during single and multiple year dry periods. There is therefore sufficient water supply capacity in the Basin to meet the Project and non-project demands in single and multiple year dry conditions.

8.4. CONCLUSION

This 2015 update to the Water Supply Assessment includes the most currently available hydrologic and water use data for precipitation, streamflow, groundwater elevation data, and water production and use estimates for project and non-project demand thorough 2040 using conservative assumptions that likely result in an overestimate of actual demand. The updated WSA determined that the Olympic Valley Groundwater Basin has sufficient supply to meet the needs of the Project, in addition to the existing and planned future uses in the Olympic Valley over the next 25 years in normal, single, and multiple dry years. The Basin is not currently in overdraft and no long term decline in groundwater elevations are indicated by the Model results, showing that the Basin is not projected to be overdrafted with the future demand. The Model projects that the 2040 demand can be met with an adequate margin of safety even during single and multiple dry years. It is not possible to quantify this margin of safety, because the ability of the Basin to supply additional demand beyond 2040 will depend on the specific temporal and geographic distribution of those demands. However, the demand analyses that have been undertaken for this WSA included multiple conservative assumptions that reinforce the existence of the margin of safety. These conservative demand assumptions are:

- High unit demand values for all future development.
- No reductions in future demand to account for State, County, and SVPSD implemented water demand reduction measures.
- No assumed reduction in water demands during drought.

Any additional demands above those projected for 2040 would need to be reevaluated using the specific demand schedule and proposed water supply system at the time that such development is proposed.

Table 8-1. Comparison of Current Supply and Demand

All values in Acre-Feet per Year (AFY)

Current Supply and Demand	Normal	Single Dry Year[3]	Multiple Dry Years[3]		
			2	3	4
Supply total[1]	871	871	871	871	871
Demand total[2]	871	871	871	871	871
Difference	0	0	0	0	0

Notes:

General : All values rounded to nearest whole number, totals may reflect the effects of rounding.

1 : Current total supply from averages presented in Table 5-1.

2 : Current demand total from Table 4-1 average demands.

3 : No reduction in demand or supply expected in dry years.

Table 8-2. Comparison of 2040 year Projection of Supply and Demand

All values in Acre-Feet per Year (AFY)

2040 Supply and Demand with Project	Normal	Single Dry Year[3]	Multiple Dry Years[3]		
			2	3	4
Supply total[1]	> 1,254	> 1,254	> 1,254	> 1,254	> 1,254
Demand total[2]	1,254	1,254	1,254	1,254	1,254
Difference[1]	+	+	+	+	+

Notes:

General : All values rounded to nearest whole number, totals may reflect the effects of rounding.

1 : Supply total at 2040 is based on the results of producing 1,186 AFY from the Olympic Valley Groundwater Basin Model and 68 AFY from horizontal wells outside the Basin, as described in detail in Section 6 of the WSA. The results of the sufficiency of supply analysis indicate that there is sufficient groundwater supply from the Olympic Valley Groundwater Basin with a margin of safety. The supply total shown above is not actually limited to the exact volume of the demands, but that is the equivalent volume that was anlyzed in the WSA.

2 : 2040 demand total from Tables 4-2 and 4-3.

3 : No reduction in demand or supply expected in dry years.

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APPENDIX A

Water Demands Projections through 2040
Squaw Valley Public Service District

Farr West Engineering, June 10, 2015

FARR WEST
ENGINEERING

TECHNICAL MEMORANDUM

Project: SQUAW VALLEY PUBLIC SERVICE DISTRICT
WATER DEMAND PROJECTIONS THROUGH 2040

Prepared For: Mike Geary, P.E.
General Manager
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Date: June 10, 2015

1.0 SUMMARY

This memorandum presents an analysis of past and existing water demands, as well as a projection of future water demands in Squaw Valley through 2040. The water demands presented will be used to support the groundwater modeling effort being performed by HydroMetrics WRC to assess available water supply from the Olympic Valley Groundwater Basin aquifer. Demands presented for the groundwater model include the total annual groundwater pumping requirement as well as monthly production requirements for the four main pumping entities in the Valley.

Past, existing and projected water demands are presented for the four main groundwater pumpers in the Olympic Valley groundwater basin. These entities include:

- Squaw Valley Public Service District (SVPSD),
- Squaw Valley Mutual Water Company (SVMWC),
- Resort at Squaw Creek (RSC) (snowmaking and irrigation), and
- Squaw Valley Resort (SVR) (snowmaking and irrigation/dust control).

The unit acronyms used in this memorandum includes:

- Acre-Foot AF
- Acre-Foot Annually AFA
- Gallons gal
- Gallons per day gpd
- Year yr
- Million Gallons MG

Table 1 presents a summary of the estimated annual water demand requirements for the Olympic Valley through 2040. The Total Production Requirement includes total estimated water demands by pumping entity in the Valley. The Main Well Field Total Production Requirement provides an estimate of the total water production requirements in the Valley from the groundwater wells only; excluding the average historical horizontal well contribution. These projected water demands will be described in more detail in subsequent sections of this memorandum.

Table 1 – Projected Annual Water Demand at 2040, AFA

Supplier / Use	Required Production
SVPSD (a)	786
SVMWC (b)	140
Resort at Squaw Creek	
Golf Course Irrigation (c)	145
Snowmaking (d)	94
Squaw Valley Resort Snow Making (e)	89
Total Production Requirement	**1,254**
Historic Horizontal Well Production	
SVPSD (f)	26
SVMWC (f)	42
Main Well Field Total Production Requirement	**1,186**

(a) Includes Average Existing Demands (Table 3), VSVSP (Table 6), Developable SFR (Table 9), Multi-family/Commercial Projection (Table 11) and RSC Phase II Potable (Table 12)
(b) Includes Existing Demands (Table 3), and Developable SFR (Table 9)
(c) RSC golf course irrigation based on RSC Phase 2 Development Agreement and SEIR
(d) RSC snowmaking based on long term average pumping 1992-2014
(e) SVR snowmaking based on average pumping 2011-2014
(f) Average Horizontal well production (2000-2014)

The 2040 water demand projections for the SVPSD are based on the existing historical water demands, as well as the future projected water demands associated with the VSVSP project, the RSC Phase 2, as well as demands associated with the cumulative projection of the growth in the Valley based on the 1983 Squaw Valley General Plan & Land Use Ordinance (prepared by Alex Fisch, Placer County). The 2040 water demand projections for the SVMWC include the existing historical water demands plus the remaining vacant residential zoned parcels in their service territory. Snowmaking demands for SVR were estimated using available historical water use data. Snowmaking demands for RSC are based on long term historical pumping data. Irrigation demands for the RSC are based on the agreed upon pumping schedule presented in the RSC Phase 2 Development Agreement and Supplemental EIR.

Table 2 presents a summary of the projected monthly water demands to be met by groundwater pumping in the Valley for each of the pumping entities. The demand from the Olympic Valley Groundwater Basin aquifer includes the summation of all water demands ***minus*** the average historical contribution by the SVPSD and SVMWC horizontal wells. Monthly water demand projections are provided to support the groundwater modeling effort.

Table 2 – Projected Total Water Demand at 2040 by Month, AF

Month	Water Demands						Average Horizontal Well Production (f)		Demand from Olympic Valley Groundwater Basin Aquifer (f)
	SVPSD (a)	SVMWC (b)	RSC Irrigation (c)	RSC Snow Making (d)	SVR Snow Making (e)	Total Demand	SVPSD	SVMWC	
January	59.6	7.1	0.0	20.6	22.8	110.0	1.4	3.6	105.0
February	62.9	6.8	0.0	19.4	15.9	105.0	1.3	3.4	100.3
March	64.2	7.8	0.0	0.0	0.0	72.0	1.6	4.0	66.4
April	47.6	6.4	0.0	0.0	0.0	54.0	2.0	3.9	48.1
May	53.7	10.9	6.4	0.0	0.0	71.1	3.3	3.9	63.9
June	76.2	16.6	28.2	0.0	0.0	121.0	4.0	3.3	113.7
July	102.4	21.7	45.7	0.0	0.0	169.8	3.3	3.4	163.1
August	102.0	21.7	36.2	0.0	0.0	159.9	3.1	3.2	153.7
September	77.5	18.7	23.3	0.0	0.0	119.5	2.2	3.4	113.9
October	52.3	10.5	5.5	0.6	1.2	70.0	1.6	3.2	65.2
November	34.0	5.3	0.0	26.5	19.1	84.9	1.1	3.2	80.6
December	53.4	6.9	0.0	27.1	29.7	117.1	1.2	3.5	112.4
Totals	**785.7**	**140.4**	**145.5**	**94.1**	**88.7**	**1,254.4**	**26.1**	**42.1**	**1,186.2**

(a) Includes Average Existing Demands (Table 3), VSVSP (Table 6), Developable SFR (Table 9), Multi-family/Commercial Projection (Table 11) and RSC Phase II Potable (Table 12)

(b) Includes Existing Demands (Table 3), and Developable SFR (Table 9)

(c) RSC golf course irrigation based on RSC Phase 2 Development Agreement and SEIR

(d) RSC snowmaking based on long term average pumping records 1992-2014 (compiled by Todd Groundwater)

(e) SVR snowmaking based on production data 2011-2014, monthly averages plus 10% (compiled by Todd Groundwater)

(f) 2000-2014 average production based on SVPSD and SVMWC production data,

(f) Olympic Valley Groundwater Basin demand calculated by subtracting Average Horizontal Well Production from Total Demand column

2.0 EXISTING DEMANDS

This section presents existing demands for the SVPSD, SVMWC, RSC and SVR based on historical production data. To establish the baseline existing water demands for the SVPSD and the SVMWC, an average of production data for the years 2000-2014 was used. For the baseline snowmaking and irrigation demands for the RSC, an average of all available data for 1992-2014, as provided by various sources, was used. For the SVR, groundwater pumping for the winter seasons 2010-2012 was averaged.

2.1 SVPSD and SVMWC Historical Water Demands

The water production data for both the SVPSD and SVMWC for the years of 2000-2014 is presented in Table 3. The data includes the total production, including the vertical wells (main well field) and horizontal wells.

The average production for the 2000-2014 time period was used for the baseline existing water demand. There was a noticeable decrease in water demand between 2007 and 2008 for the SVPSD. This reduction can be associated with a number of factors, including the District's diligent water conservation efforts, the rate increase implemented in 2008, and the overall effect of the shrinking economy. Overall, both the SVPSD and SVMWC have seen a reduction in water demands over the time period.

Table 3 – Existing Annual Water Demand for SVPSD and SVMWC

Year	SVPSD (a)		SVMWC (a)	
	Production (gal/yr)	Production (AFA)	Production (gal/yr)	Production (AFA)
2000	144,413,900	443.2	49,493,960	151.9
2001	143,753,400	441.2	48,108,400	147.6
2002	146,676,600	450.2	47,008,599	144.3
2003	141,441,900	434.1	51,011,020	156.6
2004	141,291,100	433.6	44,563,818	136.8
2005	137,009,964	420.5	35,810,600	109.9
2006	141,058,596	432.9	40,959,699	125.7
2007	136,350,441	418.5	39,754,520	122.0
2008	118,620,000	364.1	44,166,000	135.6
2009	116,330,000	357.0	42,631,020	130.8
2010	119,900,000	368.0	36,152,530	111.0
2011	108,283,560	332.3	40,027,210	122.8
2012	121,890,000	374.1	38,065,730	116.8
2013	134,372,318	412.4	36,184,623	111.1
2014	116,383,857	357.2	41,935,410	128.7
Average	**131,185,042**	**402.6**	**42,391,543**	**130.1**
Maximum	**146,676,600**	**450.2**	**51,011,020**	**156.6**

(a) Horizontal and Vertical well production records provided by SVPSD and SVMWC

Table 4 provides a summary of unbilled water in the SVPSD system for the 2000-2014 time period. Unbilled water represents the difference between metered water use and metered production. Unbilled water not only represents unaccounted for leaks within the distribution system and inaccurate water meters, but also accounted for unbilled water such as hydrant flushing, construction water, etc. The average unbilled water percentage for the District over this time period is 11.1%. As the SVMWC has no water consumption data, an unbilled water percentage is unable to be determined for that system. The 11.1% value will be used in calculating projected water demands presented in Section 3 of this memorandum for both the SVPSD and SVMWC projected water demands.

Table 4 – Existing Annual Unbilled Water Demand for SVPSD, MG

Year	Production	Metered	Difference	%
2000	144,413,900	141,070,901	3,342,999	2.3%
2001	143,753,400	124,836,433	18,916,967	13.2%
2002	146,676,600	124,104,349	22,572,251	15.4%
2003	141,441,900	129,408,642	12,033,258	8.5%
2004	141,291,100	128,858,811	12,432,289	8.8%
2005	137,009,964	125,883,531	11,126,434	8.1%
2006	141,058,596	127,352,122	13,706,474	9.7%
2007	136,350,441	126,179,725	10,170,716	7.5%
2008	118,620,000	112,401,682	6,218,318	5.2%
2009	116,330,000	106,820,190	9,509,810	8.2%
2010	119,900,000	106,893,633	13,006,367	10.8%
2011	112,483,560	95,236,194	17,247,366	15.3%
2012	121,890,000	104,047,729	17,842,271	14.6%
2013	134,360,000	103,998,351	30,361,649	22.6%
2014	116,400,000	93,087,206	23,312,794	20.0%
			Average	**11.1%**

2.2 Resort at Squaw Creek and Squaw Valley Resort Historical Snowmaking and Irrigation Demands

Snowmaking and irrigation data has been collected from a number of sources to compile the yearly water demands presented in Table 5. Data for both snowmaking and irrigation for the RSC golf course dates back to 1992 with a few missing years between 1992 and 2014. The SVR began pumping groundwater from the valley floor wells (west aquifer) in 2011. Irrigation and snowmaking data for both entities was compiled by Todd Groundwater.

For the RSC, average baseline existing demands for irrigation presented in Table 5 is based on historical avalible production data for 1992-2004, and 2007 and 2012-2014. Average baseline existing demands for snowmaking is based on data provided between the years of 1992-2014. For the SVR, only production data for 2011-2014 was used.

Table 5 – Existing Annual Water Demand for Irrigation and Snowmaking, AFA

Month	Golf Course Irrigation (a)	Snow Making - RSC (b)	Snow Making - SVR (c)	Total Production
January	0	20.6	20.7	41.3
February	0	19.4	14.4	33.8
March	0	0	0.0	0.0
April	6.1	0	0.0	6.1
May	9.3	0	0.0	9.3
June	30.3	0	0.0	30.3
July	43.6	0	0.0	43.6
August	36.4	0	0.0	36.4
September	24.4	0	0.0	24.4
October	13.0	0.6	1.1	14.6
November	0	26.5	17.3	36.0
December	0	27.1	27.0	54.1
Totals	**163.2**	**94.1**	**80.6**	**337.9**

(a) From historical available production data 1992-2004 and 2007 and 2012-2014 (only data provided with monthly pumping)
(b) Values consist of 1992-2014 data compiled by Todd Groundwater
(c) Values consist of 2011-2014 data compiled by Todd Groundwater

3.0 PROJECTED FUTURE WATER DEMAND

This analysis uses a 25-year projection period based on the proposed development schedule for the VSVSP. These projected water demands will be compared to estimated available water supply to verify that the District can meet the projected water demand associated with the proposed project, in addition to existing and planned future uses.

The future water demands are made up of the following components:

- VSVSP,
- Vacant single family residential (SFR) lots within the Valley,
- Undeveloped and underdeveloped commercial parcels within the Valley (Cumulative Projection), and
- RSC Phase 2.

Based on the best available information, estimated future snow making water demands for the RSC over the 25-year projection period are not expected to increase beyond the existing average baseline demands presented in Section 2. For the SVR, snowmaking demands are estimated based on the monthly average of data over the 2011-2014 time period, plus an additional 10%. Irrigation demands for the RSC are expected to decrease upon development of the RSC Phase 2. The irrigation demands were defined in the Development Agreement between the SVPSD and the RSC. The decreased RSC irrigation demands are presented in Table 2.

The sections below describe the methods used to estimate these future water demands over the 25-year study period.

3.1 VSVSP PROJECT DEMANDS

VSVSP consultants provided a detailed analysis of the water demands associated with the proposed Project. The original water demands analysis for the Project was submitted to the District in December 2012, and based on comments from the District and changes to the project size and layout, have been adjusted to incorporate these modifications. A detailed Project water demands memorandum prepared by MacKay & Somps is provided in Appendix A of the memorandum. The Project annual water demands will be realized over a 25-year timeframe as indicated by the VSVSP.

The projected Project buildout water demands shown in Table 6 will be used in the groundwater modeling effort. These demands are estimated to be 240.2 AFA at buildout.

Table 6 – Projected Monthly Water Demand for VSVSP Project at 2040

Month	Total Production (gal)	Total Production (AF) (a)
January	6,769,305	20.8
February	7,022,701	21.6
March	7,674,292	23.6
April	5,936,716	18.2
May	5,466,123	16.8
June	6,407,310	19.7
July	8,398,282	25.8
August	8,687,878	26.7
September	6,334,911	19.4
October	5,285,126	16.2
November	4,018,143	12.3
December	6,262,512	19.2
Total Annual Demand	**78,263,299**	**240.2**

(a) Values obtained from February 25. 2015 Appendix A Updated Water Demand Calculations Village at Squaw Valley Specific Plan (supersedes Mackay & Somps Technical Memorandum No. 1 Updated Water Study Village at Squaw Valley, June 10, 2014)

3.2 CUMMULATIVE PROJECTION DEMANDS

As presented previously, the 2040 water demand projections for the SVPSD are based on the existing historical water demands, future projected water demands associated with the VSVSP project, the RSC Phase 2, and demands associated with the cumulative projection of the reasonably foreseeable growth in the Valley based on the 1983 Squaw Valley General Plan & Land Use Ordinance. Placer County (County) performed a comprehensive analysis of residential and commercial properties in the Valley (Absorption Schedule Technical Memorandum, Alex Fisch, April 8, 2014). The County's analysis identified single family residential (SFR) and commercial development potential for approved projects, foreseeable projects, and forecasted development. The County's technical memorandum is provided in Appendix B. Table 7 provides a summary of the number of units, bedrooms, and commercial square footage associated with the cumulative projection.

Table 7 – Development Forecast to 2040

Approved Projects			
	Units	*Bedrooms*	*Commercial sq. ft.*
RSC Phase 2	441 condo units	464 bedrooms	--
Olympic Estates	16 residential units	64 bedrooms	--
Foreseeable Projects			
	Units	*Bedrooms*	*Commercial sq. ft.*
Squaw Valley Ranch Estates	8 residential units	40 bedrooms	--
Mancuso	4 residential units	20 bedrooms	--
PlumpJack Redevelopment	--	104 net hotel rooms/condo bedrooms	10,000 sq. ft. net new commercial
Olympic Valley Museum	--	--	14,500
Forecast Development			
	Units	*Bedrooms*	*Commercial sq. ft.*
SFR (SVPSD)	66	264	--
SFR (SVMWC)	15	60	
Resort/hotel/condo units	34	52	--
General Commercial	--	--	56,000
Total Development Outside the Project Boundary			
	569 units	1,008 bedrooms	80,500 sq. ft.

Source: Absorption Schedule Technical Memorandum, Alex Fisch, Placer County, April 8, 2014

3.2.1 SINGLE FAMILY RESIDENTIAL - CUMMULATIVE PROJECTION DEMANDS

The County's cumulative analysis has identified 94 developable SFR units within the SVPSD service area. This includes approved projects (16 units for Olympic Estates), foreseeable projects (8 units for Squaw Valley Ranch Estates, and 4 units for Mancuso), and forecast developments (66 units). SVMWC currently has 15 vacant SFR developable lots. The projected annual water demands associated with these parcels is shown in Table 8. It is anticipated that these SFR lots will be built out within the 25-year projection period.

The projected water demands associated with SFR parcels in the SVPSD service territory is approximately 550 gpd/connection based on an analysis of the historical customer metered data. This analysis included average water use by residential customers that showed water use throughout the year, each month. This portrays a more realistic estimate of a full time resident, as compared to transient, part time residents.

Based on review of the SVMWC production data, the average water demand factor (based on an approximate number of units served of 280) is approximately 400 gpd/unit. As the SVMWC has no water consumption data, it is not possible to determine the amount of water used by full time versus part time residents. It is assumed that water use and SFR development patterns are similar to the SVPSD; therefore, the same demand factors will be used for the vacant SFR lots in the SVMWC service area.

Table 8 – Projected Annual Water Demand for Vacant SFR at 2040

Supplier	# Developable Units (a)	Demand Factor (gpd)	Total Demand (gal/yr) (b)	Total Demand (AFA) (b)
SVPSD	94	550	20,965,126	64.3
SVMWC	15	550	3,345,499	10.3
Total Average Annual Water Demand			**24,026,162**	**74.6**

(a) Source: Absorption Schedule Technical Memorandum, Alex Fisch, Placer County, April 8, 2014
(b) Total includes 11.1% system unbilled water added to demand factor

Table 9 provides the average monthly water demands for the projected SFR parcels. These demands are calculated by multiplying the average percentage of water production per month by the average annual water demand. The percentage of water production per month is based on a review of water production data for the SVPSD and SVMWC over the 2000-2014 time period. It represents the percentage of water used in a given month based on the total annual water demand. The values show a bell curve pattern, with higher water use in the summer months and lower water use in the winter months, which is typical for a mixed land use community.

Table 9 – Projected Monthly Water Demand for Vacant SFR at 2040

Month	% Production / Month	SVPSD Demand (gal)	SVMWC Demand (gal)	Total (gal)	Total (AF)
January	7%	1,534,174	244,815	1,778,989	5.5
February	9%	1,810,470	288,905	2,099,375	6.4
March	8%	1,744,049	278,306	2,022,354	6.2
April	5%	1,138,909	181,741	1,320,650	4.1
May	5%	1,067,916	170,412	1,238,328	3.8
June	8%	1,675,738	267,405	1,943,143	6.0
July	15%	3,160,391	504,318	3,664,709	11.2
August	14%	2,957,581	471,954	3,429,535	10.5
September	11%	2,297,172	366,570	2,663,742	8.2
October	7%	1,511,118	241,136	1,752,253	5.4
November	4%	886,876	141,523	1,028,399	3.2
December	6%	1,180,733	188,415	1,369,148	4.2
Total Developable SFR Demand				**24,310,624**	**74.6**

3.2.2 COMMERCIAL PARCELS - CUMULATIVE PROJECTION DEMANDS

The County's cumulative analysis has also identified developable multifamily and commercial properties in their analysis. The projections include 464 bedrooms associated with the RSC Phase 2, 104 bedrooms associated with the PlumpJack Redevelopment project, and an additional 52 bedrooms in forecasted development. The analysis also identified 80,500 square feet of commercial development through the year 2040.

The number of bedrooms and average daily water demand per bedroom for multifamily is identified in Table 10. The water demands for the bedroom analysis are based on the assumption of a population of 2 persons per bedroom and a water demand of 100 gpd/person. These assumptions are consistent with the VSVSP Project water demands analysis that was prepared by MacKay & Somps and reviewed by the

District. These values represent a somewhat conservative estimation. The water demands represent the average day demand at 100% occupancy. A 11.1% factor was added to the water demand factor to account for system unbilled water. Table 10 identifies the water demands associated with 156 multifamily bedrooms. Water demands for the 464 bedrooms for the RSC Phase 2 are based on the Development Agreement between the SVPSD and the RSC. These demands are presented in Table 12 below.

Table 10 also provides estimated water demands for projected commercial development. The commercial floor area water demand factor of 0.24 gpd/square foot is based on a comprehensive review of the SVPSD commercial metered customer data for the time period 2005-2014. This demand factor represents the estimated average day demand during 100% occupancy. A 11.1% factor was also added to the water demand factor to account for system unbilled water.

Table 10 – Projected Daily Water Demand for Undeveloped/Underdeveloped Multi-Family Residential and Commercial at 100% Occupancy at 2040

Multi-Family Water Demand			
Category	**Number of Bedrooms (a)**	**gpd/bedroom (b)**	**Bedroom Demand (gpd) (d)**
Hotel/Motel Combo	156	200	34,663
Commercial Water Demand			
Category	**Commercial sf (a)**	**gpd/sf (c)**	**Bedroom Demand (gpd) (d)**
Commercial	80,500	0.24	21,465
Total			**56,128**

(a) Source: Absorption Schedule Technical Memorandum, Alex Fisch, Placer County, April 8, 2014
(b) (2.0 capita/bedroom) x (100 gpd/capita) = 200 gpd/bedroom
(c) Based on review of existing commercial usage data
(d) Demands include 11.1% system water loss to demand factor

The water demands shown in Table 10 represent the average day demand at 100% occupancy. Actual water demands for multi-family and commercial development will be dependent on occupancy rates in the Valley. Occupancy rates in an alpine resort type community vary by season with higher occupancies occurring during the winter ski season and summer months of July and August and lower occupancy rates seen during the shoulder spring and fall months. Occupancy rates used to determine monthly water use for the cumulative projection analysis were presented by VSVSP in their analysis and were based on a review of Village at Squaw Valley USA occupancy data for fiscal years 2008-2014. The SVPSD has determined that this occupancy data is also relevant for use in their cumulative projection analysis. The average monthly occupancy for commercial and multifamily land use is shown in Table 11.

Similar to the vacant SFR water demand calculation, the multi-family/commercial projection demand must be broken down to monthly use for the groundwater modeling effort. Table 11 provides the estimated monthly water demands based on the estimated occupancy. The monthly water demands are calculated by multiplying the average day demand at 100% occupancy, by the estimated occupancy by month.

Table 11 – Projected Daily Water Demand for Undeveloped/Underdeveloped Multi-Family Residential and Commercial at 2040

Month	ADD at 100% Occupancy (gpd)(a)	Occupancy Rate (%) (b)	ADD (gpd)	Day/Month	Total Monthly Demand (AF)
January	56,128	63%	35,360	31	3.4
February		74%	41,535	28	3.6
March		73%	40,973	31	3.9
April		49%	27,503	30	2.5
May		35%	19,645	31	1.9
June		52%	29,186	30	2.7
July		72%	40,412	31	3.8
August		77%	43,218	31	4.1
September		54%	30,309	30	2.8
October		42%	23,574	31	2.2
November		28%	15,716	30	1.4
December		57%	31,993	31	3.0
				Total Annual Demand	**35.4**

(a) Includes 11.1% system water loss

(b) Values obtained from February 25. 2015 Appendix A Updated Water Demand Calculations Village at Squaw Valley Specific Plan (supersedes Mackay & Somps Technical Memorandum No. 1 Updated Water Study Village at Squaw Valley, June 10, 2014)

As previously stated, water demands for the 464 bedrooms for the RSC Phase 2 are based on the Development Agreement between the SVPSD and the RSC. These demands are presented in Table 12 below.

Table 12 – Projected Monthly Potable Water Demand for RSC Phase 2 at 2040

Month	Total Monthly Demand, AF
January	4.3
February	4.2
March	4.4
April	1.7
May	2.7
June	4.0
July	4.7
August	5.4
September	4.0
October	2.7
November	2.0
December	3.0
Total Annual Demand	**43.2**

4.0 WATER DEMAND SCHEDULE

This analysis uses a 25-year projection period based on the proposed development schedule for the VSVSP. This section provides existing and projected water demands by water use sector for the groundwater pumpers in the Valley. The SVPSD water use is shown by service type based on their consumption data; SFR, multifamily, commercial, and irrigation. The VSVSP is shown as a separate projected water demand that will be supplied by the SVPSD. The other suppliers include the SVMWC (SFR), RSC snowmaking and irrigation, and SVR snowmaking.

Table 13 shows the historical water use back to 2000. The water use for SVPSD is based on metered data for each connection type as well as production data. In 2000, multifamily water use was billed under the commercial classification. By 2005, the SVPSD moved the multifamily billing to its own classification. The SVPSD also has a few irrigation connections for SFR as well as commercial and multifamily (HOA) common areas. The SVMWC demands are based on production records as the system was not individually metered during this time period. For the RSC, irrigation data was available for 2000, 2007, and 2012. The RSC snowmaking data was available for 2000, 2005, and 2010. Finally, the SVR began pumping their Valley floor wells in late 2010, with minimal pumping seen only in December 2010.

Table 13 – Existing Annual Water Demand by Use in 5-year Intervals, AFA

Customer Type		2000	2005	2010
SVPSD	SFR	140	125	110
	Multi Family (a)		145	130
	Commercial	243	100	85
	Irrigation	60	50	43
	VSVSP			
SVMWC	SFR	152	110	111
RSC	Irrigation	135	184 (b)	153 (c)
	Snowmaking	60	69 (d)	77
SVR	Snowmaking (e)			
TOTAL		**790**	**783**	**709**

(a) In 2000, Multi Family was included in Commercial usage data
(b) Actual data available for 2007
(c) Actual data available for 2012
(d) Actual data available for 2006
(e) Snowmaking water use for SVR began in late 2010

Table 14 provides the projected water demands, in 5-year increments, through 2040. The demands shown for 2015 are the baseline existing water demands presented previously in Section 2.0 of this memorandum. To establish the baseline existing water demands for the SVPSD and the SVMWC, an average of production data for the years 2000-2014 was used. For the baseline snowmaking and irrigation demands for the RSC, an average of all available data for 1992-2014, as provided by various sources, was used. For the SVR, groundwater pumping for the winter seasons 2011-2014 was averaged.

In projecting water demands forward through 2040, the following assumptions were made:

- VSVSP water demands based on values obtained from February 25. 2015 Appendix A Updated Water Demand Calculations Village at Squaw Valley Specific Plan (supersedes Mackay & Somps Technical Memorandum No. 1 Updated Water Study Village at Squaw Valley, June 10, 2014);
- Development projections for SFR, multi-family and commercial development are based on Placer County's Absorption Schedule Technical Memorandum, Alex Fisch, Placer County, April 8, 2014;
- RSC Phase 2 development demands realized in 2025, this includes both potable demands and the irrigation rollback pursuant to the Development Agreement, and
- Snowmaking demands for the RSC and SVR are assumed to remain consistent through 2040.

Based on the MacKay & Somps memorandum, the VSVSP water demands over the development period are estimated to be:

Year	Water Demand (AFA)
2015	0
2020	84.1
2025	132.1
2030	180.1
2035	216.2
2040	240.2

Based on the Placer County development projections, the cumulative demands for SFR, commercial and multifamily utilize increments of 25%, 25%, 20%, 20%, and 10% for each 5-year period through 2040.

Irrigation demands associated with the SVPSD irrigation meters are assumed to remain the same through 2040. Future irrigation demands for the SVPSD are incorporated into the water demand factors used to project future water demands by land use classification.

Table 14 – Projected Annual Water Demand by Use at 5-Year Intervals, AFA

Customer Type		2015 (a)	2020	2025 (b)	2030	2035	2040
SVPSD	SFR	120	136	152	165	178	184
	Multi Family	142	147	196	200	205	207
	Commercial	94	98	101	104	106	108
	Irrigation	47	47	47	47	47	47
	VSVSP	0	84	132	180	216	240
SVMWC	SFR	130	133	135	137	139	140
RSC	Irrigation	163	163	145	145	145	145
	Snowmaking	94	94	94	94	94	94
Ski Corp	Snowmaking	89	89	89	89	89	89
TOTAL, All Demands		**879**	**990**	**1,091**	**1,161**	**1,219**	**1,254**
TOTAL, Minus Horizontal Well Contribution (c)		**811**	**922**	**1,023**	**1,093**	**1,151**	**1,186**

(a) 2015 demands represent the baseline as described in Section 2.0 of this memorandum

(b) RSC Phase 2 potable demands realized in 2025, as well as irrigation rollback per DA

(c) Horizontal well contribution from SVPSD and SVMWC is 68 AFA

The "TOTAL, All Demands" includes the required amount to satisfy all water demands by the users. The actual demand on the main well field groundwater aquifer is based on this total demand minus the contribution from the SVPSD and SVMWC horizontal wells.

Appendix A

MACKAY & SOMPS
ENGINEERS PLANNERS SURVEYORS

TECHNICAL MEMORANDUM NO. 1

To: County of Placer
From: Ken Giberson
Date: June 9, 2015
Job No.: 18446.00
Subject: Updated Water Study
Village at Squaw Valley (V@SV)

REGISTERED PROFESSIONAL ENGINEER
KENNETH C. GIBERSON
No. 25573
Exp 12-31-14
CIVIL
STATE OF CALIFORNIA

INTRODUCTION

The illustrative land use plan for the project has continued to evolve since the time of the original application (December 2012). The December 2013 illustrative land use plan for the project is the basis of the analysis contained in this Technical Memorandum. Refer to **Exhibit 1** for the illustrative land use plan that was the basis for the Master Water Study submitted on December 31, 2012 ("Study") and **Exhibit 2** for the currently proposed illustrative land use plan.

Therefore, the Study reflects outdated water demands and needs to be updated to reflect revised project water demands. In lieu of preparing a new Study, this Technical Memorandum was prepared to provide a brief update to the analysis and findings contained in the original Study. Accordingly, this Technical Memorandum (TM) includes an update of the water demand projections for the project. This TM also includes an evaluation of the ability of the originally proposed water distribution and storage system improvements to meet these updated water demands.

UPDATED WATER DEMAND ASSUMPTIONS

In response to changes in the proposed illustrative land use plan, and comments received from Squaw Valley PSD Staff on the proposed water demands contained in the Study, an updated estimate of water demands was prepared for the project. Additionally, water demands have been prepared for the critical late summer and early fall periods (July – October) for build-out conditions of the project during both normal and dry water years.

The following significant changes in methodology are worthy of note:

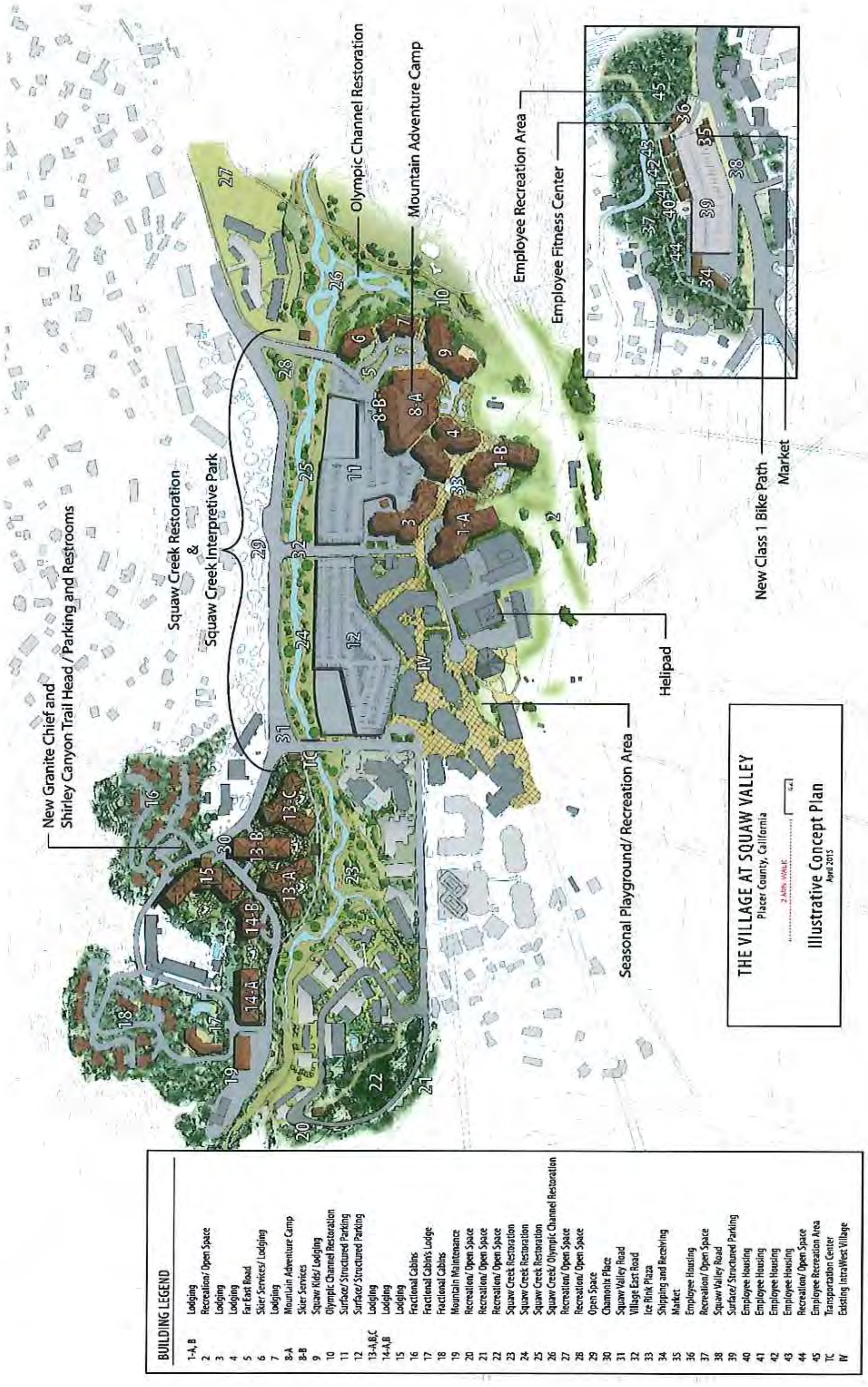
1. **Managed Lodging Occupancy Rates**. Lodging occupancy rates for managed units used in the analysis were based solely on V@SV units, for which Squaw Valley Resort, LLC manages. The PSD requested a more robust sample of historical occupancy rates and questioned the projected improvements to same related to new amenities and enhanced operations.

Exhibit 1

December 2012 Illustrative Land Use Plan

Exhibit 2

April 2015 Illustrative Land Use Plan



Accordingly, a new database was developed to track historical monthly occupancy rates from 2009-2011 related to six specific Olympic Valley properties (managed lodging). Thereafter, these occupancy rates were inflated by 5% per month, with the exception of August, which was inflated by 10% due to new amenities and enhanced lodging operations.

2. **Unmanaged Lodging Occupancy Rates**. Occupancy rates for non-managed units were based on inflated anecdotal information from other KSL Resorts properties. The PSD requested additional support related to Olympic Valley occupancy rates for non-managed units. Since specific occupancy records related to non-managed units wasn't directly available, a database of owners of non-managed units was developed and a use survey of these owners was initiated. The results were tabulated and analyzed, and now show empirical data of use patterns related to non-managed units. **Table A** shown below, provides support of our earlier assumptions.

Table A

Average Unit Use

Calculation of Average Unit Use
Excluding Rental Use

Type of Resident	Number of Responses	Percent of All Responses	Average Annual Nights of Use: November to April	Average Annual Nights of Use: May to October	Average Person-Nights by Unit Type: November to April	Average Person-Nights by Unit Type: May to October
Full Time	2	3.8%	181	184	271.5	276
Seasonal	14	26.4%	92.9	14	350.8	58.2
Second Home	37	69.8%	40.3	13.5	143.9	44
Weighted Average			59.5	20.1	203.4	56.6

3. **Mountain Adventure Camp Water Demands**. The original water demands for Mountain Adventure Camp (formerly known as Grand Camp) were adjusted according to lodging occupancy rates. While this may be appropriate for the dry amenities for Mountain Adventure Camp, the PSD suggested that water demand related to the wet amenities for Mountain Adventure Camp might not have a high correlation to lodging occupancy rates (i.e., once the pumps and heaters are running, the occupancy of the amenities may have little effect on water use). The Mountain Adventure Camp water demand analysis was revised to only apply lodging occupancy rates to the dry amenities of the facility and assumed 100% occupancy for the wet amenities. Additionally, while the overall magnitude of Mountain Adventure Camp has been reduced in scale, the water demands for Mountain Adventure Camp are assumed to remain unchanged in this update (a conservative assumption).

4. **Employee Housing**. Water demand related to employee housing was not specifically evident in the analysis. The incremental new employees that will be generated by the project were

specifically estimated based on the various land uses proposed within the project that will reside in Olympic Valley, and the incremental water demands specific to same were estimated.

5. **Residential Water Demands**. The scale of the residential portions of the project, in terms of unit and room counts, has been significantly reduced from those shown on the December 2012 illustrative land use plan. Accordingly, the associated water demands have been reduced pro-rata (from 1,093 units to 850 units).

6. **Non-Residential Water Demands**. The PSD requested a more specific reconciliation of new commercial space vs. demolished commercial space. Additionally, the amount of non-residential (commercial) space proposed for development has also been reduced in the new illustrative land use plan.

   Accordingly, the incremental commercial spaces (new vs. demolished) proposed by the project were updated and reconciled, and then segregated by type of commercial use. Specific water demands for the PSD's non-residential customers were researched, and a revised estimate of per unit water demand rates was applied to the non-residential (commercial) land uses. This work effort results in a higher integrity analysis of water demand for non-residential land uses.

   Further, the scale of the non-residential portions of the project has been reduced from those shown on the December 2012 illustrative land plan. In June 2014, and again in February 2015, a number of very small changes in the square footages of various non-residential land uses occurred. The water demands associated therewith are now adjusted from earlier projections.

7. **Conservation**. The original 15% conservation saving rate during drought years was believed to be too high since most conservation savings in drought years comes from irrigation programs and the vast majority of the potable water demands for this project are indoors. The conservation savings rate was reduced to 5%, a rate that is more consistent with the indoor savings observed throughout the hospitality industry during dry years. Dry year demands are reduced within the hospitality industry through a use of various public education and demand reduction strategies (e.g., placards in each bedroom, restaurants and public areas; provision of water in restaurants on request only; and changing of linens and towels only upon request). These education and demand reduction strategies are designed to create a heightened awareness among the guests to conserve water.

8. **Phasing**. Originally, the project was planned to be constructed in four (4) separate phases. The December 2013 illustrative land use plan, in addition to depicting a less intense development plan for the site, also eliminated the concept of geographic phasing in favor of a phasing approach that will be tied to construction of individual buildings. As a result, while they are nearly identical in methodology (except as noted otherwise herein), the water demand calculations contained herein are less voluminous than those contained in the earlier December 2012, July 2013 and February 2014 versions of this study.

9. **System Loss**. The Study was completed using a system loss of 9.8% as reported by the SVPSD on July 14, 2013. This system loss figure was derived from record data collected by the SVPSD from 2000 – 2011. Since that time the SVPSD has collected and analyzed record data for the

years 2012 – 2014. Based on this newer data the SVPSD estimates the system loss to be 11.1%. Accordingly, this increase system loss factor has been included in the most recent water demand calculations.

10. **Irrigation Demands**. The Study did not include irrigation demands for landscaping areas that would be included in the proposed development. At that time, the irrigation needs of the project were contemplated to be provided from the resort's snow making water supply system, which is separate and distinct from the Squaw Valley PSD potable water system. Since that time, though, it has been decided that these irrigation demands will, in fact, be served through the potable water supply system and not from the resort's snow making water supply system. Accordingly, the water demand calculations contained in **Table B** now reflect this increased demand :

Table B **Irrigation Demands (Including 11.1% System Loss)**		
Year	Normal Water Year (AFA)	Critical Dry Water Year (AFA)
Normal	15.0	8.7
Dry	14.1	8.1

UPDATED WATER DEMAND PROJECTIONS

The water demand calculations contained in the Study were then updated to reflect the above described changes. Also, a number of minor changes in these calculations and notes were made, as appropriate. **Appendix A**, attached hereto, reflects the updated water demands for the project.

The results of this update indicate that the projected annual water demands for the project at build out have changed slightly from those included in the December 2012 Study. **Table C** is a comparison of the current and prior annual water demands of the project during both a normal and a dry water year. **Table D** also demonstrates that the projected water demands for the project have been slightly increased during the critical dry period each summer (July – October), when the local aquifer isn't being recharged from runoff from the surrounding mountains.

EVALUATION OF PROPOSED SYSTEM IMPROVEMENTS

The resulting design flow rates for the water distribution system (average daily, maximum daily and peak hour water demands of the project) are now estimated to be lower than earlier projected. Additionally, the water storage requirement for the project has been reduced. **Table D** compares the water system design requirements between the December 2012 Study and this update.

It is important to understand the implication this update may have on the proposed water distribution system improvements. Since these updated peak water demands are smaller than those shown in the

December 2012 Study, the previously designed system, in terms of distribution main sizes, appear to be oversized to some degree given the lower estimate of design flow rates discussed above.

Clearly, the size of the distribution piping system can be reduced from that contained in the December 2012 Study. Also, the number of wells required to serve the project will be reduced and the water storage tank will be reduced in size (from 1.0 million gallons to 0.69 million gallons). Finally, due to the reduction in building footprints and the preservation of the main parking field for the day skiers, not all of the water lines shown in the Study will actually be required.

These adjustments in system improvements will be made during final design of the project. Refer to **Exhibit 3** for the proposed system improvements contemplated in the December 2012 Study and **Exhibit 4** for the proposed system improvements contemplated in this update.

Further, the December 2012 Study evaluated the hydraulic capacity of the existing system to accommodate the projected flows that would be generated by the development of the project. In all cases, with the exception of some of the existing pipelines within the immediate vicinity of the project area, the existing pipelines in the system were found to have adequate capacity to service the project in addition to continuing to service the existing customer base of the SVPSD.

As it relates to the existing pipelines within the immediate vicinity of the project, the December 2012 Study identified a few existing pipelines that will need to be replaced in order that the system meet the post development demands of the project. These improvements to the existing system will prevent any degradation in service levels for existing customers in the post development scenario.

While it was beyond the scope of the December 2012 Study to evaluate the condition of the existing system, it has been noted that the waterline pipe crossing of Squaw Creek Channel downstream of the Far East Bridge is in need of repair. In all likelihood, this pipeline crossing will need to be upgraded with the restoration of the channel and upgrading of the existing bridge structure that is currently proposed.

CONCLUSION

The results of this update indicate that the projected water demands for the project have changed slightly from those included in the December 2012 Study. These changes will need to be evaluated in terms of the ability of the groundwater basin to reliably meet these demands.

The proposed water storage tank required to serve the project will now be somewhat smaller than the one envisioned in the Study. While the proposed water distribution system is somewhat oversized for the updated water demands generated by the project, this probably isn't significant for purposes of CEQA evaluation and land use entitlement approvals.

The project is conservatively envisioned to build out over a twenty-five year time frame. Accordingly, the resulting increase in annual water demands over a twenty-five year time frame (2015 – 2040) by five year increments as required by SB 610 is shown in **Table E**.

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Table C

Comparison of Water Demands at Project Build Out

Annual Water Demand (AF) (Jan. – Dec.)						Critical Period Demand (AF) (July – Oct.)					
Normal Water Year											
Dec. `12	July `13	Feb. `14	Mar. `14	Jun. `14	Jun. '15	Dec. `12	July `13	Feb. `14	Mar. `14	Jun. `14	Jun. '15
252.3±	286.7±	221.0±	222.9±	233.9±	240.2±	84.6±	102.7±	78.6±	79.2±	86.4±	88.1±
Dry Water Year											
Dec. `12	July `13	Feb. `14	Mar. `14	Jun. `14	Jun. '15	Dec. `12	July `13	Feb. `14	Mar. `14	Jun. `14	Jun. '15
218.0±	274.8±	212.5±	214.2±	224.7±	230.8±	73.1±	98.4±	75.5±	76.1±	82.9±	84.6±

Table D

Water System Design Requirements at Build Out

Design Parameter	**Dec. 2012**	**June 2015**	**Percent Change**
Average Daily Demand (gpm)	0.62	0.45	<27%±>
Maximum Daily Demand (gpm)	1.40	0.96	<31%±>
Peak Hourly Demand (gpm)	2.04	1.38	<32%±>
Water Storage (MG)	0.97	0.69	<29%±>

Exhibit 3

Proposed Water System Improvements Per December 2012 Study

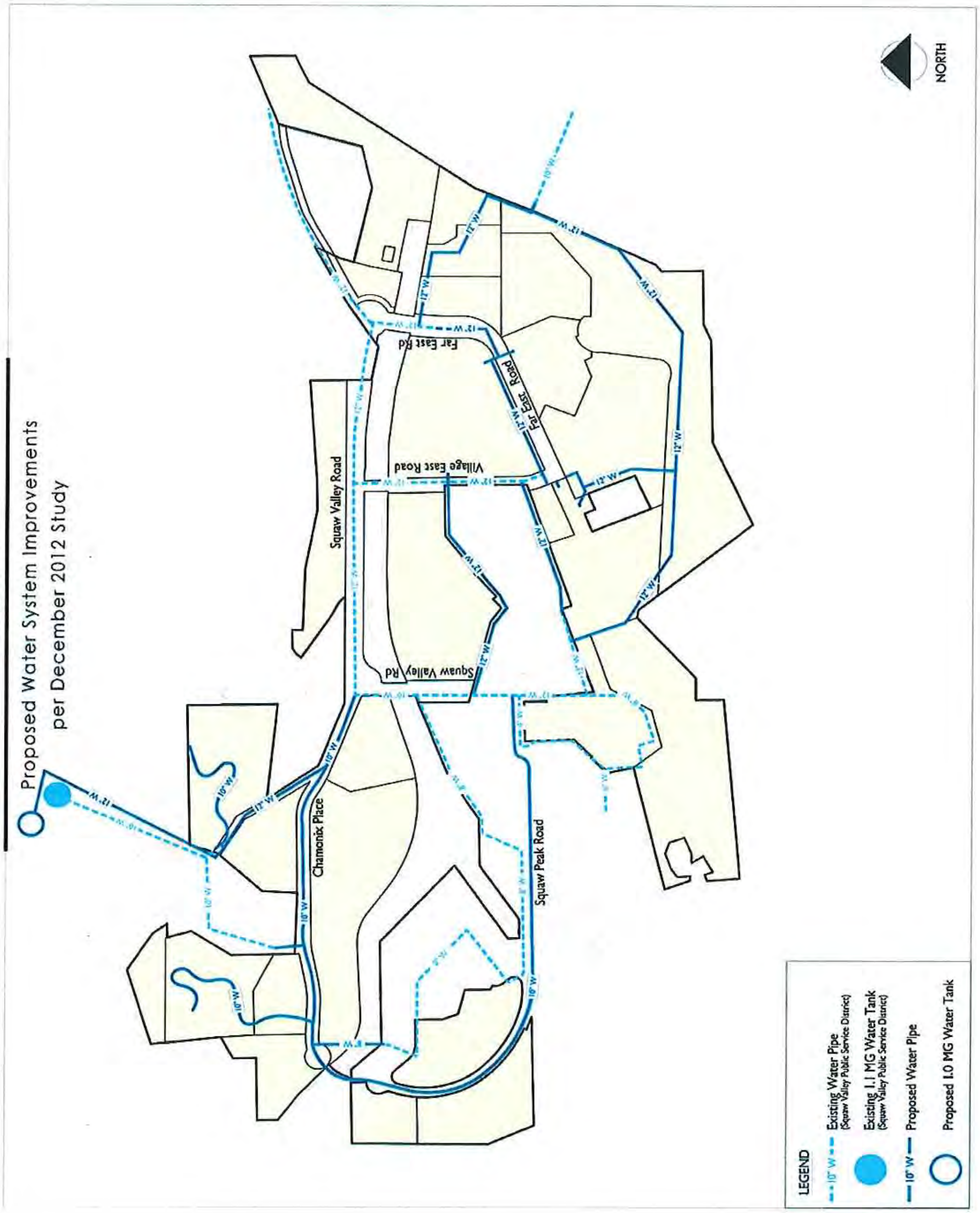

Exhibit 4

Proposed Water System Improvements Per Update

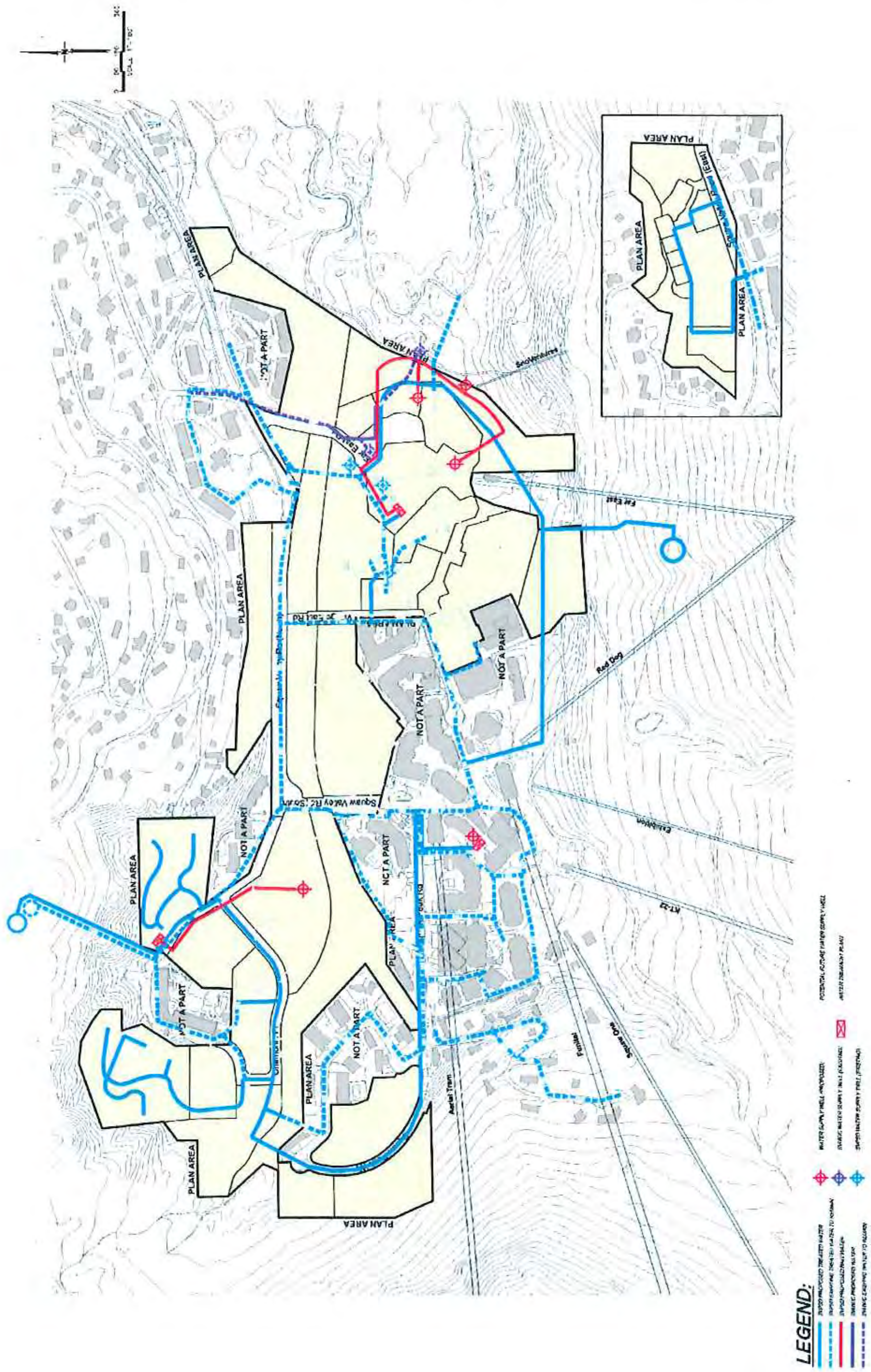

Table E

**Annual Water Demand in Five-Year Increments
(Normal Water Year Scenario)**

Year	Water Demand (AFA)
2015	0
2020	84.1±
2025	132.1±
2030	180.1±
2035	216.2±
2040	240.2±

Appendix A

Updated Water Demand Calculations

Village At Squaw Valley Specific Plan

June 9, 2015

Updated Water Demand Calculations

Village At Squaw Valley Specific Plan

Table of Contents

Table 1

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

Full Build Out - Normal Conditions	Average Daily Demand (gpd)			Average Daily Demand By Month (gpd)												Average Annual Occupancy	Annual Water Demand (Acre Feet)
	Units / Rooms / Population (19)	Unit Demand (17)	Total Average Daily Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Lodging Units																	
Managed (75%)																	
Units	850																
Bedrooms/Unit (22)	1.756																
Bedrooms	1,493																
Managed Bedroom Ratio	75%																
Managed Bedrooms	1,120																
x People per Bedroom (9)	1.6																
Population	1,792																
Occupancy/Usage Rate (18)	x	90 gal/capita/day =	161,244	63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month				101,584	119,321	117,708	79,010	56,435	83,847	116,096	124,158	87,072	67,722	45,148	91,909		
Monthly Demand (Acre-Feet)				9.7	10.3	11.2	7.3	5.4	7.7	11.0	11.8	8.0	6.4	4.2	8.7		101.7
		2.8 People/Unit															
		253 GPD/Unit															
		0.80 EDU/Unit															
Unmanaged (25%)																	
Units	850																
Bedrooms/Unit (22)	1.756	Occupancy															
Bedrooms	1,493	Rate (% of															
Managed Bedroom Ratio	25%	Managed															
Managed Bedrooms	373	Condo/Hotel) =															
x People per Bedroom (9)	2.0	50%															
Population	746																
Occupancy/Usage Rate (18)	x	90 gal/capita/day =	67,185	31.5%	37.0%	36.5%	24.5%	17.5%	26.0%	36.0%	38.5%	27.0%	21.0%	14.0%	28.5%	28.2%	
Average Daily Demand Per Month				21,163	24,858	24,523	16,460	11,757	17,468	24,187	25,866	18,140	14,109	9,406	19,148		
Monthly Demand (Acre-Feet)				2.0	2.1	2.3	1.5	1.1	1.6	2.3	2.5	1.7	1.3	0.9	1.8		21.2
		3.5 People/Unit															
		317 GPD/Unit															
		1.00 EDU/Unit															
Employee Housing																	
Lot 4 Employee Count (14)	300																
Existing Employee Count	(99)																
New Empolyee Count																	
Occupancy/Usage Rate (18)	201 x	90 gal/capita/day =	18,090	63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month				11,397	13,387	13,206	8,864	6,332	9,407	13,025	13,929	9,769	7,598	5,065	10,311		
Monthly Demand (Acre-Feet)				1.1	1.2	1.3	0.8	0.6	0.9	1.2	1.3	0.9	0.7	0.5	1.0		11.4

Table 1

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

Full Build Out - Normal Conditions	Average Daily Demand (gpd): Units / Rooms / Population (19)	Unit Demand (17)	Total Average Daily Demand	Average Daily Demand By Month (gpd): Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual Occupancy	Annual Water Demand (Acre Feet)
Commercial/Other																	
Net Retail (11)	27,692 sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	6,646.08	4,187	4,918	4,852	3,257	2,326	3,456	4,785	5,117	3,589	2,791	1,861	3,788		
Net Restaurant / Food & Bev (11)	29,525 sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	7,086.00	4,464	5,244	5,173	3,472	2,480	3,685	5,102	5,456	3,826	2,976	1,984	4,039		
Net Hotel Common Areas (11)	49,493 sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	11,878.32	7,483	8,790	8,671	5,820	4,157	6,177	8,552	9,146	6,414	4,989	3,326	6,771		
Net Membership (11)	- sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	-	-	-	-	-	-	-	-	-	-	-	-	-		
Net Meeting Space (11)	(3,120) sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	(748.80)	(472)	(554)	(547)	(367)	(262)	(389)	(539)	(577)	(404)	(314)	(210)	(427)		
Net Office Space (11)	(7,593) sf																
Occupancy/Usage Rate (18)				63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	(1,822.32)	(1,148)	(1,349)	(1,330)	(893)	(638)	(948)	(1,312)	(1,403)	(984)	(765)	(510)	(1,039)		
Ski Services (11)	27,586 sf																
Occupancy/Usage Rate (13)				73.0%	84.0%	83.0%	59.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	15.0%	67.0%	36.8%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	6,620.64	4,833	5,561	5,495	3,906	662	662	662	662	662	662	993	4,436		
Transit Facilities (11)	4,000 sf																
Occupancy/Usage Rate (13)				73.0%	84.0%	83.0%	59.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	15.0%	67.0%	36.8%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	960.00	701	806	797	566	96	96	96	96	96	96	144	643		
Amenities																	
Net Amenities (11)	32,500 sf																
Occupancy/Usage Rate (18) or (13)			-	63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.24 gal/sf/day	7,800.00	4,914	5,772	5,694	3,822	2,730	4,056	5,616	6,006	4,212	3,276	2,184	4,446		
Mountain Adventure Camp Wet Amenities (23)	32,926 gpd			32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926		
Total Average Daily Demand Per Month				57,888.6	62,114.8	61,730.6	52,509.8	44,477.8	49,720.5	55,888.3	57,430.3	50,337.3	46,636.6	42,698.1	55,583.4		
Monthly Demand (Acre-Feet)				5.5	5.3	5.9	4.8	4.2	4.6	5.3	5.5	4.6	4.4	3.9	5.3		59.4
			Subtotal Average Daily Water Demand (gal)	192,032	219,680	217,167	156,844	119,002	160,442	209,195	221,384	165,318	136,066	102,318	176,952		193.7
			Misc. Pool & Spa Daily Water Demand (24)	4,946	5,708	5,487	6,179	19,331	7,080	7,197	6,837	6,449	5,667	17,918	4,856		9.1
			Total Average Daily Water Demand (gal)	196,979	225,388	222,653	163,023	138,333	167,522	216,392	228,220	171,767	141,732	120,235	181,808		
			Sub-Total Monthly Demand (Acre-Feet)	**18.7**	**19.4**	**21.2**	**15.0**	**13.2**	**15.4**	**20.6**	**21.7**	**15.8**	**13.5**	**11.1**	**17.3**		**202.9**
			Irrigation Demands (25)	-	-	-	1.4	1.9	2.3	2.7	2.3	1.7	1.1	-	-		13.4
			Subtotal	**18.7**	**19.4**	**21.2**	**16.4**	**15.1**	**17.7**	**23.2**	**24.0**	**17.5**	**14.6**	**11.1**	**17.3**		**216.2**
	System Losses (15) @	**11.1%**		**2.1**	**2.1**	**2.4**	**1.8**	**1.7**	**2.0**	**2.6**	**2.7**	**1.9**	**1.6**	**1.2**	**1.9**		**24.0**
			Total Monthly Demand (Acre-Feet)	**20.8**	**21.5**	**23.5**	**18.3**	**16.8**	**19.7**	**25.8**	**26.7**	**19.4**	**16.2**	**12.3**	**19.2**		**240.2**

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

1. Demands shown are net of existing demands that currently exist within the Specific Plan Area.

2. Unit demand factors are per SVPSD Design Standards less 10% to reflect indoor use only.

Land Use	SVPSD Unit Demand Factor		Less 10%	Study Unit Demand Factor
Lodging Units	100	gal/capita/day	(10)	90 gal/capita/day
Commercial/Amenities/ Other	See Note 11	gal/sf/day	n/a	See Note 11 gal/sf/day

3. Occupancy/Usage Rates per Squaw Valley Ski Corporation estimates for post development activity levels (see Note 18).

4. Intentionally Blank.

5. Project Peak Demand Calculation (Based on Projected Occupancy):

Winter:

Max Month =	23.5	Acre-Feet (March)
Max Month =	190	gallons per minute
Max Day =	475	gallons per minute (PF = 2.5 per SVPSD 2007 Capacity and Reliability Study Update)
Peak Hour =	713	gallons per minute (PF = 3.75 (assumed at 1.5 x Max. Daily Demand P. F.))
No. Wells =	475	gpm / 200+/- gpm/well at Duty Factor of 70% = 3.40 new wells
Assume	4	new wells to meet peak winter demands

Summer:

Max Month =	26.7	Acre-Feet (Aug)
Max Month =	195	gallons per minute
Max Day =	487	gallons per minute (PF = 2.5 per SVPSD 2007 Capacity and Reliability Study Update)
Peak Hour =	730	gallons per minute (PF = 3.75 (assumed at 1.5 x Max. Daily Demand P. F.))
No. Wells =	487	gpm / 200+/- gpm/well at Duty Factor of 70% = 3.48 new wells
Assume	4	new wells to meet peak summer demands

Notes:
1. SVPSD requires all system demands to be met with largest well out of service. Since the SVPSD system already meets this requirement, additional redundancy is not required.
2. Maximum Day Demands actually controls the total number of new wells required (assuming 100% of well capacity), not the above calculations.
   MDD calculations at full buildout requires a minimum of 4 new wells.
3. The results of groundwater modeling may recommend additional wells be constructed to optimize the well field system to reduce overall impacts to the aquifer.

6. Residential land uses based on Illustrative Land Use Plan plus 0%

Land Use	Land Plan Unit Count	0%	Study Unit Count
Lodging Units	850 Units	0	850 Units

7. Summer period after snow melt ends is considered the critical demand/supply period when recharge from watershed is less than pumping requirements and groundwater elevations start to fall (typically July - October).

8. Late Summer/Early Fall water supply indicated by yellow highlighting (max summer time draw on aquifer) is estimated at 88.1 acre-feet for normal water years and 84.6 acre-feet for dry water years.

9. Assumes 40% Groups (1 Pop/Bedroom) and 60% Leisure (2 Pop/Bedroom) for blended average of 1.6 Pop/Bedroom

10. Assumes 0% Groups (1 Pop/Bedroom) and 100% Leisure (2 Pop/Bedroom) for a blended average of 2.0 Pop/Bedroom

11. Proposed new building areas per the December 2013 Illustrative Plan are as follows:

Proposed Use	Square Footage		Demand Rate	Occupancy Type
			Based on SVPSD non-residential average demand factors (Note 26).	
Amenities				
Mountain Adventure Camp Dry Amenities (FEC)	30,000	sf		
Fractional Cabins	2,500			
Net Amenities	32,500		0.24	Lodging (18)
Mountain Adventure Camp Wet Amenities	60,000		32,926	Wet area (23)
Subtotal Amenities	92,500	sf		

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

Commercial/Other				
Retail		33,620	sf	
Demo - Far East (Retail Warehouse)		(5,928)		
	Net Retail	**27,692**		0.24 Lodging (18)
Restaurant/F&B		31,120	sf	
Demo - Far East (Cantina)		(1,595)		
Demo - Olympic House (Food & Bev)		-		
	Net F&B	**29,525**		0.24 Lodging (18)
Hotel Common Area		**49,493**		0.24 Lodging (18)
Meeting Space		12,000	sf	
Demo - Olympic Valley Lodge (Meeting)		(15,120)		
	Net Meeting Sp	**(3,120)**		0.24 Lodging (18)
Office				
Demo - Clock Tower		(2,593)	sf	
Demo - Olympic Valley Lodge (Office)		(5,000)		
	Net Office	**(7,593)**		0.24 Lodging (18)
Ski Services		75,000	sf	
Demo - Clinic		(1,519)		
Demo - Building Services/Plumbing/BOH		(4,771)		
Demo - Vehicle Maintenance		(14,000)		
Demo - Groomers		(1,000)		
Demo - Carpenter Shop & Storage		(4,304)		
Demo - Uniforms		(3,720)		
Demo - Mountain Operations		(2,800)		
Demo - Ski Patrol		(2,480)		
Demo - Ski Patrol Storage		(240)		
Demo - Race Services		(740)		
Demo - Ski School Locker Room		(4,430)		
Demo - Snoventures		(2,360)		
Demo - Race Team		(2,050)		
Demo - Far East - Central Reservations		(3,000)		
	Net Ski Svc	**27,586**		0.24 Mountain (13)
Transit Facilities		**4,000**		0.24 Mountain (13)
Subtotal Commercial / Other		**127,583**	**sf**	
	Total	**220,083**	**sf**	
Employee Housing (New & Replace Demo)		**38,915**	**sf**	
Employee Housing Demolished		**(13,872)**	**sf**	
Total Commercial / Other/Employee Housing		**245,127**	**sf**	

12. Net increase in building area is 250,189 sf. Existing facilities (including existing maintenance facilities) totaling 91,522 sf will be replaced with new facilities totaling 341,711 sf as determined below:

New Uses (Proposed)	Area (SF)
Retail	33,620 sf
Restaurant/F&B	31,120
Hotel Common Area	49,493
Meeting Space	12,000
Ski Services	75,000
Transit Facilities	4,000
Cabins	2,500
Mountain Adventure Camp Wet Amenities	60,000
Mt. Adventure Camp Dry Amenities (FEC)	30,000
Subtotal Commercial / Amenities/ Other	**297,733** sf
Employee Housing (New & Replace Demo)	**38,916** sf
Total Replaced	**336,649** sf

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

Existing Uses (Demolished)	Area (SF)
Clinic	(1,519) sf
Race Team	(2,050)
Snoventures	(2,360)
Maintenance / Operations	(38,485)
Far East (Retail Warehouse)	(5,928)
Far East (Cantina)	(1,595)
Far East (Central Reservations)	(3,000)
Clock Tower	(2,593)
Olympic Valley Lodge (Meeting)	(15,120)
Olympic Valley Lodge (Office)	(5,000)
Employee Housing	(13,872)
Subtotal Demolished Facilities	(91,522) sf
NET ADDITIONAL BUILDING AREA	**245,127 sf**

13. Mountain Related Occupancy Rates Determination:

Dec - April 15% higher than Hotel Occupancy

Month	FY08FY14	Plus	Subtotal	Roundup (Use)
January	57.75%	15%	72.75%	73%
February	68.95%	15%	83.95%	84%
March	67.81%	15%	82.81%	83%
April	43.71%	15%	58.71%	59%
May	10.00%	0%	10.00%	10%
June	10.00%	0%	10.00%	10%
July	10.00%	0%	10.00%	10%
August	10.00%	0%	10.00%	10%
September	10.00%	0%	10.00%	10%
October	10.00%	0%	10.00%	10%
November	15.00%	0%	15.00%	15%
December	51.50%	15%	66.50%	67%

14. Employee Housing:

Total Employee Count proposed for Lot 4 =	300	Employees (204 Single Beds & 48 Double Beds)
Existing Employee Countd =	(99)	Employees
New Employee Count =	201	Employees

15. System Loss Rate per SVPSD (June 2, 2015) based on metered demand and production for Years 2000-2014.

16. Typical well production ranges from 150-250 gpm / assume 200 gpm/well for study purposes.

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

17. Indoor use only.

18. Lodging Occupancy Rates Determination:

Utilize average monthly occupancy rates for The Village at Squaw Valley USA (Phases 1 and 2) from FY 08 - FY 14 plus 5% for future projections of utilization, except August which is assumed to be +10%.

Month	FY08FY14	Plus	Subtotal	Roundup (Use)
January	57.75%	5%	62.75%	63%
February	68.95%	5%	73.95%	74%
March	67.81%	5%	72.81%	73%
April	43.71%	5%	48.71%	49%
May	29.17%	5%	34.17%	35%
June	46.47%	5%	51.47%	52%
July	66.44%	5%	71.44%	72%
August	66.06%	10%	76.06%	77%
September	48.31%	5%	53.31%	54%
October	36.32%	5%	41.32%	42%
November	22.37%	5%	27.37%	28%
December	51.50%	5%	56.50%	57%

19. Unit count and non-residential land uses based on assumption of Illustrative Land Use Plan plus 0% does not exceed maximum development levels contained in the VSP.

20. Numbers may not add due to round off error.

21. Water Storage Requirement (Full Occupancy Scenario/Normal Water Years):

Note: See Table 3 for Maximum System Demands (ADD, MDD & PHD)

			Storage
Operational Storage = 25% MDD:	25% times	0.96 MGD	0.24 MG (New)
Fire Storage = 2,500 gpm for 2 hours (fire storage volume already exists - no new fire storage required):	0 gpm times	2 Hrs.	0.00 MG (Existing)
Emergency Storage = 100% ADD =	100% times	0.45 MGD	0.45 MG (New)
		Total	0.69 MG

22. Rooms Per Unit: A total of 1,493 bedroms will be spread over a total of 850 units for an average density of 1.756 rooms per unit.

23. Mountain Adventure Camp includes an 60,000 sf Aquatic Center and a 30,000 sf Family Entertainment Center (FEC). Water demands for the FEC are calculated as standard non-residential areas using the a non-residential unit demand factor of 0.24 gallons per square foot per day. The water maximum daily water demand for the Mountain Adventure Camp with a maximum occupancy of 2,000 people was estimated by Aquatic Development Group (Cohoes, NY) on May 31, 2012 (as modified by MacKay & Somps in the MAC Aquatic Center Pool Water and Sewer Demands calculations dated 12/02/2014) as follows:

Demand	Useage	
Backwash System (Daily)	11,381	gpd
Splashout Loss	3,276	gpd
Evaporation Loss	3,519	gpd
Deck Washdown Water	750	gpd
Restroom Demands	14,000	gpd
Total	32,926	gpd

24. Miscellaneous pool and spa water demands for hot tubs and pools assumes similar count and size as per Illustrative Concept Plan dated September 7, 2012 are estimated as follows:

Phase	Pools	Spas
I	5	10
II	6	12
III	n/a	n/a
IV	n/a	n/a
Total	11	22

Facility	Dimensions	Number	Area Sq. Ft.	Total Sq. Ft.	Volume Cubic Feet	Total Volume (cf)
Pool	20' x 40' x 4' Avg. Depth	11	800	8,800	3,200	35,200
Spa	10' x 15' x 4' Avg. Depth	22	150	3,300	600	13,200
			Totals	12,100		48,400

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

Annual Demand Estimate:

Demand	Volume	Flushing	Evap. Loss Per Annum (Ft.)	Total Area (sf)		Annual Demand (cf)	AcFt Per Annum
Pools	35,200	2				70,400	1.62
Spas	13,200	12				158,400	3.64
Subtotal						228,800	5.25
Plus 20% Splash Allow.						45,760	1.05
Subtotal						274,560	6.30
Evaporation			4.5	12,100		54,450	1.25
Subtotal						329,010	7.55
Plus 20% Contingency						65,802	1.51
					Total (cf)	394,812	9.06

Assumptions:

1. Pools are flushed twice annually (Spring and Fall) and Spas are flushed monthly.
2. Splash Losses at 20% of subtotal of fill/drain and evap losses.
3. Evaporation Losses per California DWR CIMIS ETo Rate for Zone 13:

Month	ETo Rate (inches/month)	Percentage	Ac-Ft/Month
January	1.24	2.28%	0.03
February	1.96	3.61%	0.05
March	3.10	5.71%	0.07
April	4.80	8.84%	0.11
May	6.51	11.99%	0.15
June	7.80	14.36%	0.18
July	8.99	16.56%	0.21
August	7.75	14.27%	0.18
September	5.70	10.50%	0.13
October	3.72	6.85%	0.09
November	1.80	3.31%	0.04
December	0.93	1.71%	0.02
Total	54.30 Inches 4.5 Feet	100.00%	1.25

4. Pool/Spa Flushing & Splash Allowance (Incl. 20% Splash Loss):

Month	Pool Flushing	Spa Flushing	Sub-Total	Splash Allow	Total
January	0.00	0.30	0.30	0.06	0.36
February	0.00	0.30	0.30	0.06	0.36
March	0.00	0.30	0.30	0.06	0.36
April	0.00	0.30	0.30	0.06	0.36
May	0.81	0.30	1.11	0.22	1.33
June	0.00	0.30	0.30	0.06	0.36
July	0.00	0.30	0.30	0.06	0.36
August	0.00	0.30	0.30	0.06	0.36
September	0.00	0.30	0.30	0.06	0.36
October	0.00	0.30	0.30	0.06	0.36
November	0.81	0.30	1.11	0.22	1.33
December	0.00	0.30	0.30	0.06	0.36
Totals (Ac-Ft)	1.62	3.64	5.25	1.05	6.30

Table 1 - Notes

Estimated Net Increase in Annual Water Demands
Normal Water Years
The Village at Squaw Valley
Buildout Conditions

5. Daily Totals by Month (Incl. 20% Contingency):

	Acre-Feet					
Month	Pool & Spa Flushing & Splash	Evap. Losses	Subtotal	Contg.	Total	Gallons Per Day
January	0.36	0.03	0.39	0.08	0.47	4,946
February	0.36	0.05	0.41	0.08	0.49	5,708
March	0.36	0.07	0.43	0.09	0.52	5,487
April	0.36	0.11	0.47	0.09	0.57	6,179
May	1.33	0.15	1.48	0.30	1.78	19,331
June	0.36	0.18	0.54	0.11	0.65	7,080
July	0.36	0.21	0.57	0.11	0.68	7,197
August	0.36	0.18	0.54	0.11	0.65	6,837
September	0.36	0.13	0.49	0.10	0.59	6,449
October	0.36	0.09	0.45	0.09	0.54	5,667
November	1.33	0.04	1.37	0.27	1.65	17,918
December	0.36	0.02	0.39	0.08	0.46	4,856
Totals	6.30	1.25	7.55	1.51	9.06	

25. Irrigation Demands

Assumptions:

a. Area of landscaping for planning purposes (per Illustrative Land Plan June 6, 2014) = 6.65 Acres
b. Tahoe Resource Conservation District recommends irrigation only during months of April - October.
c. Drip Irrigation with Irrigation Efficiency (IE) of 90% assumed.
d. Use "Landscape Coefficient Method" used for estimating landscape irrigation demand (ET_L) - UC Coop Extension (August 2000)

$ET_L = K_L \times ET_O$

ET_O = Evapotranspiration Rate per CIMIS Data Base for Zone 13 (CIMIS 1999)

K_L = Landscape Coefficient = Ks x KD x KM =

Ks = Species Landscape Coeffiient (Above Average) = 0.4

K_D = Density Landscape Coefficient (Average) = 1.0

K_M = Microclimate Landscape Coefficient (Above Average) = 1.2

K_L = Landscape Coefficient = $Ks \times K_D \times K_M$ = 0.48

e. Theoretical Demand = $ET_L \div 12$ inches/foot
f. Assume plant palette per approved plant list in Specific Plan

Monthly Irrigation Demand (Inches/Month)				Irrigation Rate (Feet/Month)				
Month	ET_O	K_L	ET_L	Theoretical Demand	Irrigation Efficiency	Irrigation Demand	Irrigation Area (Acres)	Irrigation Demand / Month (AF/Mo)
January	1.24	0.48	0.60	0.05	90%	n/a	6.65	0.00
February	1.90	0.48	0.91	0.08	90%	n/a	6.65	0.00
March	3.10	0.48	1.49	0.12	90%	n/a	6.65	0.00
April	4.80	0.48	2.30	0.19	90%	0.21	6.65	1.42
May	6.51	0.48	3.12	0.26	90%	0.29	6.65	1.92
June	7.80	0.48	3.74	0.31	90%	0.35	6.65	2.31
July	8.99	0.48	4.32	0.36	90%	0.40	6.65	2.66
August	7.75	0.48	3.72	0.31	90%	0.34	6.65	2.29
September	5.70	0.48	2.74	0.23	90%	0.25	6.65	1.68
October	3.72	0.48	1.79	0.15	90%	0.17	6.65	1.10
November	1.80	0.48	0.86	0.07	90%	n/a	6.65	0.00
December	0.93	0.48	0.45	0.04	90%	n/a	6.65	0.00
Totals	**54.24**		**26.04**	**2.17**		**2.01**		**13.4**

26. Commercial (non-residential) unit water demands were developed by SVPSD from meter records for all PSD non-reseidential customers from 2005 - 2012 and is based on actual consumption of the maximum month of each calendar year divided by the square footage each non-residential customer occupies. The average of the unit demand factors derived from this data set were used to estimate the water demands for commerical non-residential land uses for the project. The resulting composite average day demand for the maximum months was determined to be:

SVPSD Survey 0.24 gpd/square foot.

Table 2

Estimated Distribution System Sizing Demands
Normal Water Year
The Village at Squaw Valley
Buildout Conditions

Full Build Out	Average Daily Demand			Maximum Daily Demand		Peak Hourly Demand	
	Units	Study Unit Demand Factor (1)	Average Daily Demand (gpd)	Peaking Factor	Maximum Daily Demand (gpd)	Peaking Factor	Peak Hourly Demand (gpd)
Lodging Units							
Managed (75%)							
Units	850						
Managed Units Ratio	75%						
Managed Units	637	317 gpd/unit	201,929	2.5	504,823	3.75	757,234
Unmanaged (25%)							
Units	850						
Unmanaged Units Ratio	25%						
Managed Units	213	317 gpd/unit	67,521	2.5	168,803	3.75	253,204
Employee Housing							
Net Employee Housing (Beds)	201	90 gpd/capita	18,090	2.5	45,225	3.75	67,838
Commercial/Amenities/Other							
Net Reteil (11)	27,692	0.24 gal/sf/day	6,646	2.5	16,615	3.75	24,923
Net Restaurant / Food & Bev (11)	29,525	0.24 gal/sf/day	7,086	2.5	17,715	3.75	26,573
Net Hotel Common Areas (11)	49,493	0.24 gal/sf/day	11,878	2.5	29,696	3.75	44,544
Net Membership (11)	-	0.24 gal/sf/day	-	2.5	-	3.75	-
Net Meeting Space (11)	(3,120)	0.24 gal/sf/day	(749)	2.5	(1,872)	3.75	(2,808)
Net Office Space (11)	(7,593)	0.24 gal/sf/day	(1,822)	2.5	(4,556)	3.75	(6,834)
Ski Services (11)	27,586	0.24 gal/sf/day	6,621	2.5	16,552	3.75	24,827
Transit Facilities (11)	4,000	0.24 gal/sf/day	960	2.5	2,400	3.75	3,600
Net Amenities (11)	32,500	0.24 gal/sf/day	7,800	2.5	19,500	3.75	29,250
Total Commercial/Amenities/ Other			38,420		96,050		144,075
Mountain Adventure Camp Restrooms (23)	14,000 gpd		14,000	2.5	35,000	3.75	52,500
Mountain Adventure Camp Activity Area (23)	18,926 gpd		18,926	1.0	18,926	1.0	18,926
Total Average Daily Demand Per Month			71,346		149,976		215,501
Subtotal			358,886		868,826		1,293,776
Misc. Pool & Spa Maximum Daily Water Demand (24)	19,331 x	Subtotal	19,331	1.0	19,331	1.0	19,331
Subtotal			378,217		888,157		1,313,106
Irrigation Demands (July)			27,927	1.0	27,927	1.0	27,927
Subtotal			406,144		916,084		1,341,034
System Losses @ 9.8%			39,802		39,802		39,802
Total (gpd)			445,946		955,886		1,380,836
Theoretical Maximum Demand (GPM) (Use for Distribution System Sizing)			309.7		663.8		958.9

New Wells @ 200 gpm/well at peak well output (wells producing at 100% of capacity) for the small number of maximum days that actually will occur during the year:
3.32
(Use 4 Wells)

Note (1): Assume Peak Day with all rooms occupied with 2.0 people/room (use unmanaged unit demand factors in all cases).
Note (2): Numbers do not total due to round off error.

Table 3
System Sizing Demands by Developable Areas
Squaw Valley Village Specific Plan
Buildout Conditions

Parcel	Lodging Units			Total Lodging Demand	Commercial/ Amenities/Other			Irrigation					Subtotal	System Loss		Total Demands					
																ADD (Subtotal + System Losses)		MDD ((2.50 x ADD) + System Losses)		PHD ((3.75 x ADD) + System Losses)	
	Units	Unit Demand	Demand		Area (SF)	Unit Demand	Demand	Units	Acres/ Unit	Acres	Unit Demand	Demand				GPD	GPM	GPD	GPM	GPD	GPM
Area A																					
Area B																					
Area C																					
Area D																					
Area E																					
Area F																					
Area G																					
Area H																					
Area I																					
Area J																					
Area K																					
Area L																					
Area N																					
Area DD																					
Area O																					
Sub-Totals	0		0	0	0		0	0		0.0		0	0		0	0	0	0	0	0	0

To Be Determined During Final Design

Table 4

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

Full Build Out - Normal Conditions	Average Daily Demand (gpd)			Average Daily Demand By Month (gpd)												Average Annual Occupancy	Annual Water Demand (Acre-Feet)
	Units / Rooms / Population (19)	Unit Demand (17)	Total Average Daily Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Lodging Units																	
Managed (75%)																	
Units	850																
Bedrooms/Unit (22)	1.756																
Bedrooms	1,493																
Managed Bedroom Ratio	75%																
Managed Bedrooms	1,120	90 gal/capita/day															
x People per Bedroom (9)	1.6	0.95 x Conservation Rate (5% Savings)															
Population	1,792																
Occupancy/Usage Rate (18)	x	86 gal/capita/day =	153,182	63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month				96,505	113,355	111,823	75,059	53,614	79,655	110,291	117,950	82,718	64,336	42,891	87,314		
Monthly Demand (Acre-Feet)				9.2	9.7	10.6	6.9	5.1	7.3	10.5	11.2	7.6	6.1	3.9	8.3		96.6
		2.8 People/Unit															
		241 GPD/Unit															
		0.80 EDU/Unit															
Unmanaged (25%)		Occupancy															
Units	850	Rate (% of															
Bedrooms/Unit (22)	1.756	Managed															
Bedrooms	1,493	Condo/Hotel) =															
Managed Bedroom Ratio	25%	50%															
Managed Bedrooms	373	90 gal/capita/day															
x People per Bedroom (9)	2.0	0.95 x Conservation Rate (5% Savings)															
Population	746																
Occupancy/Usage Rate (18)	x	86 gal/capita/day =	63,826	31.5%	37.0%	36.5%	24.5%	17.5%	26.0%	36.0%	38.5%	27.0%	21.0%	14.0%	28.5%	28.2%	
Average Daily Demand Per Month				20,105	23,616	23,296	15,637	11,170	16,595	22,977	24,573	17,233	13,403	8,936	18,190		
Monthly Demand (Acre-Feet)				1.9	2.0	2.2	1.4	1.1	1.5	2.2	2.3	1.6	1.3	0.8	1.7		20.1
		3.5 People/Unit															
		301 GPD/Unit															
		1.00 EDU/Unit															
Employee Housing																	
Lot 4 Employee Count (14)	300																
Existing Employee Count	(99)	90 gal/capita/day =															
New Empolyee Count		0.95 x Conservation Rate (5% Savings)															
Occupancy/Usage Rate (18)	201 x	86 gal/capita/day =	17,186	63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month				10,827	12,717	12,545	8,421	6,015	8,936	12,374	13,233	9,280	7,218	4,812	9,796		
Monthly Demand (Acre-Feet)				1.0	1.1	1.2	0.8	0.6	0.8	1.2	1.3	0.9	0.7	0.4	0.9		10.8

Table 4

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

Full Build Out - Normal Conditions	Average Daily Demand (gpd)			Average Daily Demand By Month (gpd)												Average Annual Occupancy	Annual Water Demand (Acre-Feet)
	Units / Rooms / Population (19)	Unit Demand (17)	Total Average Daily Demand	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Commercial/Other																	
Net Retail (11)	27,692 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	6,313.78	3,978	4,672	4,609	3,094	2,210	3,283	4,546	4,862	3,409	2,652	1,768	3,599		
Net Restaurant / Food & Bev (11)	29,525 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	6,731.70	4,241	4,981	4,914	3,299	2,356	3,500	4,847	5,183	3,635	2,827	1,885	3,837		
Net Hotel Common Areas (11)	49,493 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	11,284.40	7,109	8,350	8,238	5,529	3,950	5,868	8,125	8,689	6,094	4,739	3,160	6,432		
Net Membership (11)	- sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	-	-	-	-	-	-	-	-	-	-	-	-	-		
Net Meeting Space (11)	(3,120) sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	(711.36)	(448)	(526)	(519)	(349)	(249)	(370)	(512)	(548)	(384)	(299)	(199)	(405)		
Net Office Space (11)	(7,593) sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	(1,731.20)	(1,091)	(1,281)	(1,264)	(848)	(606)	(900)	(1,246)	(1,333)	(935)	(727)	(485)	(987)		
Ski Services (11)	27,586 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (13)		0.95 x Conservation Rate (5% Savings)		73.0%	84.0%	83.0%	59.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	15.0%	67.0%	36.8%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	6,289.61	4,591	5,283	5,220	3,711	629	629	629	629	629	629	943	4,214		
Transit Facilities (11)	4,000 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (13)		0.95 x Conservation Rate (5% Savings)		73.0%	84.0%	83.0%	59.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	15.0%	67.0%	36.8%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	912.00	666	766	757	538	91	91	91	91	91	91	137	611		
Amenities																	
Net Amenities (11)	32,500 sf	0.24 gal/sf/day															
Occupancy/Usage Rate (18) or (13)		0.95 x Conservation Rate (5% Savings)		63.0%	74.0%	73.0%	49.0%	35.0%	52.0%	72.0%	77.0%	54.0%	42.0%	28.0%	57.0%	56.3%	
Average Daily Demand Per Month	x	0.23 gal/sf/day	7,410.00	4,668	5,483	5,409	3,631	2,594	3,853	5,335	5,706	4,001	3,112	2,075	4,224		
Mountain Adventure Camp Wet Amenities (23)	32,926 gpd			32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926	32,926		
Total Average Daily Demand Per Month				56,640.5	60,655.4	60,290.4	51,530.6	43,900.2	48,880.8	54,740.2	56,205.1	49,466.7	45,951.0	42,209.5	54,450.5		
Monthly Demand (Acre-Feet)				5.4	5.2	5.7	4.7	4.2	4.5	5.2	5.3	4.6	4.4	3.9	5.2		58.3
		Subtotal Average Daily Water Demand (gal)		184,077	210,343	207,955	150,648	114,698	154,066	200,382	211,961	158,698	130,909	98,848	169,750		185.9
		Misc. Pool & Spa Daily Water Demand (24)		4,946	5,708	5,487	6,179	19,331	7,080	7,197	6,837	6,449	5,667	17,918	4,856		9.1
		Total Average Daily Water Demand (gal)		189,023	216,051	213,441	156,827	134,029	161,146	207,579	218,797	165,147	136,575	116,766	174,607		
		Sub-Total Monthly Demand (Acre-Feet)		**18.0**	**18.6**	**20.3**	**14.4**	**12.8**	**14.8**	**19.7**	**20.8**	**15.2**	**13.0**	**10.8**	**16.6**		**195.0**
		Irrigation Demands (25) w/ 5% Conservation		-	-	-	1.3	1.8	2.2	2.5	2.2	1.6	1.0	-	-		12.7
		Subtotal		**18.0**	**18.6**	**20.3**	**15.8**	**14.6**	**17.0**	**22.3**	**23.0**	**16.8**	**14.0**	**10.8**	**16.6**		**207.7**
		System Losses (15) @ 11.1%		**2.0**	**2.1**	**2.3**	**1.8**	**1.6**	**1.9**	**2.5**	**2.6**	**1.9**	**1.6**	**1.2**	**1.8**		**23.1**
		Total Monthly Demand (Acre-Feet)		**20.0**	**20.6**	**22.6**	**17.5**	**16.2**	**18.9**	**24.7**	**25.5**	**18.7**	**15.6**	**11.9**	**18.5**		**230.8**

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

1. Demands shown are net of existing demands that currently exist within the Specific Plan Area.

2. Unit demand factors are per SVPSD Design Standards less 10% to reflect indoor use only.

Land Use	SVPSD Unit Demand Factor		Less 10%	Study Unit Demand Factor
Lodging Units	100	gal/capita/day	(10)	90 gal/capita/day
Commercial/Amenities/ Other	See Note 11	gal/sf/day	n/a	See Note 11 gal/sf/day

3. Occupancy/Usage Rates per Squaw Valley Ski Corporation estimates for post development activity levels (see Note 18).

4. Intentionally Blank.

5. Project Peak Demand Calculation (Based on Projected Occupancy):

Winter:

- Max Month = 23.5 Acre-Feet (March)
- Max Month = 190 gallons per minute
- Max Day = 475 gallons per minute (PF = 2.5 per SVPSD 2007 Capacity and Reliability Study Update)
- Peak Hour = 713 gallons per minute (PF = 3.75 (assumed at 1.5 x Max. Daily Demand P. F.))
- No. Wells = 475 gpm / 200+/- gpm/well at Duty Factor of 70% = 3.40 new wells
- Assume 4 new wells to meet peak winter demands

Summer:

- Max Month = 25.8 Acre-Feet (July)
- Max Month = 188 gallons per minute
- Max Day = 471 gallons per minute (PF = 2.5 per SVPSD 2007 Capacity and Reliability Study Update)
- Peak Hour = 707 gallons per minute (PF = 3.75 (assumed at 1.5 x Max. Daily Demand P. F.))
- No. Wells = 471 gpm / 200+/- gpm/well at Duty Factor of 70% = 3.48 new wells
- Assume 4 new wells to meet peak summer demands

Notes:

1. SVPSD requires all system demands to be met with largest well out of service. Since the SVPSD system already meets this requirement, additional redundancy is not required.
2. Maximum Day Demands actually controls the total number of new wells required (assuming 100% of well capacity), not the above calculations.
   MDD calculations at full buildout requires a minimum of 4 new wells.
3. The results of groundwater modeling may recommend additional wells be constructed to optimize the well field system to reduce overall impacts to the aquifer.

6. Residential land uses based on Illustrative Land Use Plan plus 0%

Land Use	Land Plan Unit Count	0%	Study Unit Count
Lodging Units	850 Units	0	850 Units

7. Summer period after snow melt ends is considered the critical demand/supply period when recharge from watershed is less than pumping requirements and groundwater elevations start to fall (typically July - October).

8. Late Summer/Early Fall water supply indicated by yellow highlighting (max summer time draw on aquifer) is estimated at 88.1 acre-feet for normal water years and 84.6 acre-feet for dry water years.

9. Assumes 40% Groups (1 Pop/Bedroom) and 60% Leisure (2 Pop/Bedroom) for blended average of 1.6 Pop/Bedroom

10. Assumes 0% Groups (1 Pop/Bedroom) and 100% Leisure (2 Pop/Bedroom) for a blended average of 2.0 Pop/Bedroom

11. Proposed new building areas per the December 2013 Illustrative Plan are as follows:

Proposed Use	Square Footage		Demand Rate	Occupancy Type
			Based on SVPSD non-residential average demand factors (Note 26).	
Amenities				
Mountain Adventure Camp Dry Amenities (FEC)	30,000	sf		
Fractional Cabins	2,500			
Net Amenities	**32,500**		0.24	Lodging (18)
Mountain Adventure Camp Wet Amenities	**60,000**		32,170	Wet area (23)
Subtotal Amenities	**92,500**	sf		

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

Commercial/Other			
Retail		33,620 sf	
Demo - Far East (Retail Warehouse)		(5,928)	
	Net Retail	**27,692**	0.24 Lodging (18)
Restaurant/F&B		31,120 sf	
Demo - Far East (Cantina)		(1,595)	
Demo - Olympic House (Food & Bev)		-	
	Net F&B	**29,525**	0.24 Lodging (18)
Hotel Common Area		**49,493**	0.24 Lodging (18)
Meeting Space		12,000 sf	
Demo - Olympic Valley Lodge (Meeting)		(15,120)	
	Net Meeting Sp	**(3,120)**	0.24 Lodging (18)
Office			
Demo - Clock Tower		(2,593) sf	
Demo - Olympic Valley Lodge (Office)		(5,000)	
	Net Office	**(7,593)**	0.24 Lodging (18)
Ski Services		75,000 sf	
Demo - Clinic		(1,519)	
Demo - Building Services/Plumbing/BOH		(4,771)	
Demo - Vehicle Maintenance		(14,000)	
Demo - Groomers		(1,000)	
Demo - Carpenter Shop & Storage		(4,304)	
Demo - Uniforms		(3,720)	
Demo - Mountain Operations		(2,800)	
Demo - Ski Patrol		(2,480)	
Demo - Ski Patrol Storage		(240)	
Demo - Race Services		(740)	
Demo - Ski School Locker Room		(4,430)	
Demo - Snoventures		(2,360)	
Demo - Race Team		(2,050)	
Demo - Far East - Central Reservations		(3,000)	
	Net Ski Svc	**27,586**	0.24 Mountain (13)
Transit Facilities		**4,000**	0.24 Mountain (13)
Subtotal Commercial / Other		**127,583 sf**	
	Total	**220,083 sf**	
Employee Housing (New & Replace Demo)		**38,916 sf**	
Employee Housing Demolished		**(13,872) sf**	
Total Commercial / Other/Employee Housing		**245,127 sf**	

12. Net increase in building area is 250,189 sf. Existing facilities (including existing maintenance facilities) totaling 91,522 sf will be replaced with new facilities totaling 341,711 sf as determined below:

New Uses (Proposed)	Area (SF)
Retail	33,620 sf
Restaurant/F&B	31,120
Hotel Common Area	49,493
Meeting Space	12,000
Ski Services	75,000
Transit Facilities	4,000
Cabins	2,500
Mountain Adventure Camp Wet Amenities	60,000
Mt. Adventure Camp Dry Amenities (FEC)	30,000
Subtotal Commercial / Amenities/ Other	**297,733** sf
Employee Housing (New & Replace Demo)	**38,916** sf
Total Replaced	**336,649** sf

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

Existing Uses (Demolished)	Area (SF)
Clinic	(1,519) sf
Race Team	(2,050)
Snoventures	(2,360)
Maintenance / Operations	(38,485)
Far East (Retail Warehouse)	(5,928)
Far East (Cantina)	(1,595)
Far East (Central Reservations)	(3,000)
Clock Tower	(2,593)
Olympic Valley Lodge (Meeting)	(15,120)
Olympic Valley Lodge (Office)	(5,000)
Employee Housing	(13,872)
Subtotal Demolished Facilities	**(91,522)** sf
NET ADDITIONAL BUILDING AREA	**245,127 sf**

13. Mountain Related Occupancy Rates Determination:

Dec - April 15% higher than Hotel Occupancy

Month	FY08FY14	Plus	Subtotal	Roundup (Use)
January	57.75%	15%	72.75%	73%
February	68.95%	15%	83.95%	84%
March	67.81%	15%	82.81%	83%
April	43.71%	15%	58.71%	59%
May	10.00%	0%	10.00%	10%
June	10.00%	0%	10.00%	10%
July	10.00%	0%	10.00%	10%
August	10.00%	0%	10.00%	10%
September	10.00%	0%	10.00%	10%
October	10.00%	0%	10.00%	10%
November	15.00%	0%	15.00%	15%
December	51.50%	15%	66.50%	67%

14. Employee Housing:

Total Employee Count proposed for Lot 4 =	300	Employees (204 Single Beds & 48 Double Beds)
Existing Employee Countd =	(99)	Employees
New Employee Count =	201	Employees

15. System Loss Rate per SVPSD (June 2, 2015) based on metered demand and production for Years 2000-2014.

16. Typical well production ranges from 150-250 gpm / assume 200 gpm/well for study purposes.

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

17. Indoor use only.

18. Lodging Occupancy Rates Determination:

Utilize average monthly occupancy rates for The Village at Squaw Valley USA (Phases 1 and 2) from FY 08 - FY 14 plus 5% for future projections of utilization, except for August which is assumed to be +10%.

Month	FY08FY14	Plus	Subtotal	Roundup (Use)
January	57.75%	5%	62.75%	63%
February	68.95%	5%	73.95%	74%
March	67.81%	5%	72.81%	73%
April	43.71%	5%	48.71%	49%
May	29.17%	5%	34.17%	35%
June	46.47%	5%	51.47%	52%
July	66.44%	5%	71.44%	72%
August	66.06%	10%	76.06%	77%
September	48.31%	5%	53.31%	54%
October	36.32%	5%	41.32%	42%
November	22.37%	5%	27.37%	28%
December	51.50%	5%	56.50%	57%

19. Unit count and non-residential land uses based on assumption of Illustrative Land Use Plan plus 0% does not exceed maximum development levels contained in the VSP.

20. Numbers may not add due to round off error.

21. Water Storage Requirement (Full Occupancy Scenario/Normal Water Years):

Note: See Table 3 for Maximum System Demands (ADD, MDD & PHD)

			Storage
Operational Storage = 25% MDD: 25% times	0.96	MGD	0.24 MG (New)
Fire Storage = 2,500 gpm for 2 hours (fire storage volume already exists - no new fire storage required): 0 gpm times	2	Hrs.	0.00 MG (Existing)
Emergency Storage = 100% ADD = 100% times	0.45	MGD	0.45 MG (New)
		Total	0.69 MG

22. Rooms Per Unit: A total of 1,493 bedroms will be spread over a total of 850 units for an average density of 1.756 rooms per unit.

23. Mountain Adventure Camp includes an 60,000 sf Aquatic Center and a 30,000 sf Family Entertainment Center (FEC). Water demands for the FEC are calculated as standard non-residential areas using the a non-residential unit demand factor of 0.24 gallons per square foot per day. The water maximum daily water demand for the Mountain Adventure Camp with a maximum occupancy of 2,000 people was estimated by Aquatic Development Group (Cohoes, NY) on May 31, 2012 (as modified by MacKay & Somps in the MAC Aquatic Center Pool Water and Sewer Demands calculations dated 12/02/2014) as follows:

Demand	Useage	
Backwash System (Daily)	11,375	gpd
Splashout Loss	3,276	gpd
Evaporation Loss	3,519	gpd
Restroom Demands	14,000	gpd
Total	32,170	gpd

24. Miscellaneous pool and spa water demands for hot tubs and pools assumes similar count and size as per Illustrative Concept Plan dated September 7, 2012 are estimated as follows:

Phase	Pools	Spas
I	5	10
II	6	12
III	n/a	n/a
IV	n/a	n/a
Total	11	22

Facility	Dimensions	Number	Area Sq. Ft.	Total Sq. Ft.	Volume Cubic Feet	Total Volume (cf)
Pool	20' x 40' x 4' Avg. Depth	11	800	8,800	3,200	35,200
Spa	10' x 15' x 4' Avg. Depth	22	150	3,300	600	13,200
			Totals	12,100		48,400

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

Annual Demand Estimate:

Demand	Volume	Flushing	Evap. Loss Per Annum (Ft.)	Total Area (sf)		Annual Demand (cf)	AcFt Per Annum
Pools	35,200	2				70,400	1.62
Spas	13,200	12				158,400	3.64
Subtotal						228,800	5.25
Plus 20% Splash Allow.						45,760	1.05
Subtotal						274,560	6.30
Evaporation			4.5	12,100		54,450	1.25
Subtotal						329,010	7.55
Plus 20% Contingency						65,802	1.51
					Total (cf)	394,812	9.06

Assumptions:

1. Pools are flushed twice annually (Spring and Fall) and Spas are flushed monthly.
2. Splash Losses at 20% of subtotal of fill/drain and evap losses.
3. Evaporation Losses per California DWR CIMIS ETo Rate for Zone 13:

Month	ETo Rate (inches/month)	Percentage	Ac-Ft/Month
January	1.24	2.28%	0.03
February	1.96	3.61%	0.05
March	3.10	5.71%	0.07
April	4.80	8.84%	0.11
May	6.51	11.99%	0.15
June	7.80	14.36%	0.18
July	8.99	16.56%	0.21
August	7.75	14.27%	0.18
September	5.70	10.50%	0.13
October	3.72	6.85%	0.09
November	1.80	3.31%	0.04
December	0.93	1.71%	0.02
Total	54.30 Inches 4.5 Feet	100.00%	1.25

4. Pool/Spa Flushing & Splash Allowance (Incl. 20% Splash Loss):

Month	Pool Flushing	Spa Flushing	Sub-Total	Splash Allow	Total
January	0.00	0.30	0.30	0.06	0.36
February	0.00	0.30	0.30	0.06	0.36
March	0.00	0.30	0.30	0.06	0.36
April	0.00	0.30	0.30	0.06	0.36
May	0.81	0.30	1.11	0.22	1.33
June	0.00	0.30	0.30	0.06	0.36
July	0.00	0.30	0.30	0.06	0.36
August	0.00	0.30	0.30	0.06	0.36
September	0.00	0.30	0.30	0.06	0.36
October	0.00	0.30	0.30	0.06	0.36
November	0.81	0.30	1.11	0.22	1.33
December	0.00	0.30	0.30	0.06	0.36
Totals (Ac-Ft)	1.62	3.64	5.25	1.05	6.30

Table 4 - Notes

Estimated Net Increase in Annual Water Demands
Dry Water Years
The Village at Squaw Valley
Buildout Conditions

5. Daily Totals by Month (Incl. 20% Contingency):

	Acre-Feet					
Month	Pool & Spa Flushing & Splash	Evap. Losses	Subtotal	Contg.	Total	Gallons Per Day
January	0.36	0.03	0.39	0.08	0.47	4,946
February	0.36	0.05	0.41	0.08	0.49	5,708
March	0.36	0.07	0.43	0.09	0.52	5,487
April	0.36	0.11	0.47	0.09	0.57	6,179
May	1.33	0.15	1.48	0.30	1.78	19,331
June	0.36	0.18	0.54	0.11	0.65	7,080
July	0.36	0.21	0.57	0.11	0.68	7,197
August	0.36	0.18	0.54	0.11	0.65	6,837
September	0.36	0.13	0.49	0.10	0.59	6,449
October	0.36	0.09	0.45	0.09	0.54	5,667
November	1.33	0.04	1.37	0.27	1.65	17,918
December	0.36	0.02	0.39	0.08	0.46	4,856
Totals	6.30	1.25	7.55	1.51	9.06	

25. Irrigation Demands

Assumptions:

a. Area of landscaping for planning purposes (per Illustrative Land Plan June 6, 2014) = 6.65 Acres
b. Tahoe Resource Conservation District recommends irrigation only during months of April - October.
c. Drip Irrigation with Irrigation Efficiency (IE) of 90% assumed.
d. Use "Landscape Coefficient Method" used for estimating landscape irrigation demand (ET_L) - UC Coop Extension (August 2000)

$ET_L = K_L \times ET_O$

ET_O = Evapotranspiration Rate per CIMIS Data Base for Zone 13 (CIMIS 1999)

K_L = Landscape Coefficient = $Ks \times K_D \times K_M$

Ks = Species Landscape Coeffiient (Above Average) = 0.4

K_D = Density Landscape Coefficient (Average) = 1.0

K_M = Microclimate Landscape Coefficient (Above Average) = 1.2

K_L = Landscape Coefficient = $Ks \times K_D \times K_M$ = 0.48

e. Theoretical Demand = $ET_L \div 12$ inches/foot
f. Assume plant palette per approved plant list in Specific Plan

	Monthly Irrigation Demand (Inches/Month)			Irrigation Rate (Feet/Month)				
Month	ET_O	K_L	ET_L	Theoretical Demand	Irrigation Efficiency	Irrigation Demand	Irrigation Area (Acres)	Irrigation Demand / Month (AF/Mo) - Including 5% Conservation
January	1.24	0.48	0.60	0.05	90%	n/a	6.65	0.00
February	1.90	0.48	0.91	0.08	90%	n/a	6.65	0.00
March	3.10	0.48	1.49	0.12	90%	n/a	6.65	0.00
April	4.80	0.48	2.30	0.19	90%	0.21	6.65	1.35
May	6.51	0.48	3.12	0.26	90%	0.29	6.65	1.83
June	7.80	0.48	3.74	0.31	90%	0.35	6.65	2.19
July	8.99	0.48	4.32	0.36	90%	0.40	6.65	2.52
August	7.75	0.48	3.72	0.31	90%	0.34	6.65	2.18
September	5.70	0.48	2.74	0.23	90%	0.25	6.65	1.60
October	3.72	0.48	1.79	0.15	90%	0.17	6.65	1.04
November	1.80	0.48	0.86	0.07	90%	n/a	6.65	0.00
December	0.93	0.48	0.45	0.04	90%	n/a	6.65	0.00
Totals	**54.24**		**26.04**	**2.17**		**2.01**		**12.7**

26. Commercial (non-residential) unit water demands were developed by SVPSD from meter records for all PSD non-reseidential customers from 2005 - 2012 and is based on actual consumption of the maximum month of each calendar year divided by the squre footage each non-residential customer occupies. The average of the unit demand factors derived from this data set were used to estimate the water demands for commerical non-residential land uses for the project. The resulting composite average day demand for the maximum months was determined to be:

SVPSD Survey 0.24 gpd/square foot.

Table No. 5
Village at Squaw Valley Conceptual Plan
Development Summary - New & Demolished Spaces

Land Use		Total		
Parcel #	**Description**	**New**	**Demo**	**Net Total**
Lodging (Keys)				
Condo Hotel				
1	Core - Condo Hotel (223 units)	346	-	346
1	West Wing - Condo Hotel (22 units)	34	-	34
3	Condo Hotel (98 units)	175	-	175
4	Condo Hotel (87 units)	156	-	156
6	Ski Services / Condo Hotel (17 units)	40	-	40
7	Condo Hotel (12 units)	28	-	28
9	Squaw Kids / Condo Hotel (58 units)	104	-	104
13	Condo Hotel (167 units)	298	-	298
15	Condo Hotel (88 units)	142	-	142
Timeshare		-	-	-
14	Timeshare (47 units)	77	-	77
Fractional		-	-	-
16	Fractional Cabins (17 units)	51	-	51
18	Fractional Cabins (14 units)	42	-	42
TOTAL KEYS [(1)]		**1,493**	**-**	**1,493**
Commercial/Other (Sq Ft)				
Amenities				
8	Mountian Adventure Camp / Ski Services	90,000	-	90,000
17	Fraction Cabins	2,500	-	2,500
Total Amenities		**92,500**	**-**	**92,500**
Retail				
1	Core - Condo Hotel	4,220	-	4,220
1	West Wing - Condo Hotel	-	-	-
3	Condo Hotel	3,250	-	3,250
4	Condo Hotel	6,150	-	6,150
6	Ski Services / Condo Hotel	1,500	-	1,500
7	Condo Hotel	1,500	-	1,500
9	Squaw Kids / Condo Hotel	3,000	-	3,000
13	Condo Hotel	3,000	-	3,000
14	Timeshare	2,000	-	2,000
15	Condo Hotel	3,000	-	3,000
17	Fraction Cabins	1,000	-	1,000
36	Shipping & Receiving	5,000	-	5,000
	Far East - Retail Warehouse	-	(5,928)	(5,928)
Total Retail		**33,620**	**(5,928)**	**27,692**
Restaurant / F&B				
1	Core - Condo Hotel	4,220	-	4,220
1	West Wing - Condo Hotel	-	-	-
3	Condo Hotel	3,250	-	3,250
4	Condo Hotel	6,150	-	6,150
6	Ski Services / Condo Hotel	2,000	-	2,000
7	Condo Hotel	2,000	-	2,000
9	Squaw Kids / Condo Hotel	3,000	-	3,000
13	Condo Hotel	3,000	-	3,000
14	Timeshare	2,000	-	2,000
15	Condo Hotel	3,000	-	3,000
17	Fraction Cabin Lodge	2,500	-	2,500
	Far East - Cantina	-	(1,595)	(1,595)
Total Restaurant / F&B		**31,120**	**(1,595)**	**29,525**

Table No. 5
Village at Squaw Valley Conceptual Plan
Development Summary - New & Demolished Spaces

Land Use			Total	
Parcel #	**Description**	**New**	**Demo**	**Net Total**
Hotel Common Areas				
1	Core - Condo Hotel	12,203	-	12,203
1	West Wing - Condo Hotel	1,478	-	1,478
3	Condo Hotel	4,755	-	4,755
4	Condo Hotel	4,936	-	4,936
6	Ski Services / Condo Hotel	1,814	-	1,814
7	Condo Hotel	1,814	-	1,814
9	Squaw Kids / Condo Hotel	4,129	-	4,129
13	Condo Hotel	8,603	-	8,603
14	Timeshare	2,124	-	2,124
15	Condo Hotel	4,008	-	4,008
17	Fraction Cabins	3,629	-	3,629
	Total Hotel Common Area	**49,493**	-	**49,493**
Meeting Space				
1	Core - Condo Hotel	12,000	-	12,000
	Olympic Valley Lodge - Meeting	-	(15,120)	(15,120)
	Total Meeting Space	**12,000**	**(15,120)**	**(3,120)**
Office				
	Demo - Clock Tower	-	(2,593)	(2,593)
	Demo - Olympic Valley Lodge (Office)	-	(5,000)	(5,000)
	Total Office Space	-	**(7,593)**	**(7,593)**
Ski Services				
6	Ski Services / Condo Hotel	10,000	-	10,000
8	Mountain Adventure Camp / Ski Services	20,000	-	20,000
9	Squaw Kids / Condo Hotel	20,000	-	20,000
19	Mountain Maintenance	10,000	-	10,000
36	Shipping & Receiving	15,000	-	15,000
	Clinic	-	(1,519)	(1,519)
	Building Services / Plumbing / BOH	-	(4,771)	(4,771)
	Vehicle Maintenance	-	(14,000)	(14,000)
	Groomers	-	(1,000)	(1,000)
	Carpenter Shop & Storage	-	(4,304)	(4,304)
	Uniforms	-	(3,720)	(3,720)
	Mountain Operations	-	(2,800)	(2,800)
	Ski Patrol	-	(2,480)	(2,480)
	Ski Patrol Storage	-	(240)	(240)
	Race Services	-	(740)	(740)
	Ski School Locker Room	-	(4,430)	(4,430)
	Snoventures	-	(2,360)	(2,360)
	Race Team	-	(2,050)	(2,050)
	Far East - Central Reservations	-	(3,000)	(3,000)
	Total Ski Services	**75,000**	**(47,414)**	**27,586**
Transit Facilities				
TC	Transit Facilities	4,000	-	4,000
	Total Transit Facilities	**4,000**	-	**4,000**
	Sub Total Commercial / Other Spaces	**297,733**	**(77,650)**	**220,083**
Employee Housing				
34 & 35	Employee Housing	38,916	-	38,916
	Employee Housing (Courtside)	-	(6,960)	(6,960)
	Employee Housing (Hostel)	-	(6,912)	(6,912)
	Total Employee Housing	**38,916**	**(13,872)**	**25,044**
Total Commercial / Other Spaces		**336,649**	**(91,522)**	**245,127**

Notes:

(1) The number of keys is equal to the number of bedrooms. Water demand projections based on 1,493 badrooms as compared with 1,493 keys shown above.

Appendix B

Absorption Schedule Technical Memorandum

To: Mike Geary, Squaw Valley Public Services District General Manager
From: Alex Fisch, Placer County Planning Services Division
Date: April 8, 2014
Subject: Village at Squaw Valley Specific Plan Water Supply Assessment

Placer County is the lead agency for the Village at Squaw Valley Specific Plan (VSVSP) project in compliance with the California Environmental Quality Act (PRC 2100 et. seq.). The County is preparing a Program EIR to analyze the environmental effects of project approval and implementation. To comply with the statutory requirements of CEQA, the County will analyze and disclose the impacts of the VSVSP project including analysis of the project's incremental contribution to cumulative effects considered together with other probable future projects. While there is no precise definition in CEQA for what is a probable future project, two approaches are prescribed. A list approach is commonly used whereby the lead agency will generate a list of "past, present and probable future projects producing related or cumulative impacts including, if necessary, those projects outside the control of the agency" (CEQA Guidelines § 15130). When utilizing the list approach Placer County would include approved projects currently under construction, projects that are approved that have not been constructed, and projects that are expected to be approved and constructed for which the County is currently processing an application(s) or has direct knowledge of the project and reasonably expects it to be carried out (including those outside the local agency control). The second approach prescribed by CEQA is to utilize projections contained in adopted local, regional, or statewide plan(s) or which are forecast from such plan(s). When plans do not include quantifiable projections, forecast growth projections can be developed in accordance with the adopted development regulations. Projections are often utilized for projects that are expected to build out over a relatively long period of time and the forecast timeframe will typically match the projected build out of the project.

For the VSVSP project, which is proposed to build out over a 25-year period, the County determined that it was appropriate to use both a list and forecast approach to determine cumulative development within the Olympic Valley study area[1]. The cumulative development projections therefore include approved projects that have not yet been built, such as the Resort at Squaw Creek Phase 2 and the Olympic Estates Subdivision, project applications that the County has on file, and valley-wide development projections forecast out to 25 years[2]. The forecast does not assign development to any specific properties nor grant or restrict any development rights. Rather, the forecast identifies a total development projection for use in the EIR cumulative impact analysis and SB 610 Water Supply Assessment.

The following text and tables details the cumulative list and projections prepared by Placer County.

[1] Regional development projections from neighboring communities such as Truckee, Alpine Meadows and Tahoe City are also included in the cumulative analysis. This memorandum deals specifically with the methodology used to prepare cumulative assumptions for the Olympic Valley study area in support of cumulative impact analysis within that community and the Water Supply Assessment.

[2] This memo does not describe linear utility projects within the Olympic Valley study area that may occur within the 25-year cumulative horizon such as the Squaw Valley Public Service District's Alternative/Supplemental Water Supply & Enhanced Utilities Feasibility Study preferred alternative.

Cumulative Projections

1. Development capacity is expressed in total bedrooms and commercial square footage in accordance with policies of the Squaw Valley General Plan, which is applicable to the entire Olympic Valley study area.
2. Cumulative projections include projects that are approved and are likely to be constructed and projects that the County is processing which have a reasonable expectation of being approved and constructed. This includes the approved Resort at Squaw Creek Phase 2 and the Olympic Estates Subdivision projects, and other projects that the County is currently processing including the Squaw Valley Ranch Estates, the Mancuso Rezone project, and redevelopment of the PlumpJack Hotel.
3. A parcel inventory of the study area was used to determine locations where additional development could be constructed during the 25-year cumulative timeframe and to verify that forecast development would not exceed the holding capacity of the Squaw Valley General Plan. The parcel inventory does not assign any development to any specific parcel. The forecast is a metric defining a number of bedrooms and commercial square-footage only and development could occur anywhere where it is authorized within the Olympic Valley study area. It is intended solely to provide a reasonable basis for predicting cumulative conditions within the 25-year time frame so that an appropriate cumulative impact analysis can be performed. The analysis is not intended to serve as a precise prediction regarding the amount of development that will occur on a particular parcel; rather, the analysis is a forecast of the cumulative, aggregate level of development that will exist in 25 years.

The results of the County's analysis of approved projects, foreseeable projects, and forecast future development for the Olympic Valley study area are shown in the table below.

Cumulative List and Forecast to 2040

Approved Projects			
	Units	*Bedrooms*	*Commercial sq. ft.*
RSC Phase 2	441 condo units	464 bedrooms	--
Olympic Estates	16 residential units	64 bedrooms	--
Foreseeable Projects			
	Units	*Bedrooms*	*Commercial sq. ft.*
Squaw Valley Ranch Estates	8 residential units	40 bedrooms	--
Mancuso	4 residential units	20 bedrooms	--
PlumpJack Redevelopment	--	104 net hotel rooms/condo bedrooms	10,000 sq. ft. net new commercial
Olympic Valley Museum	--	--	14,500
Forecast Development			
	Units	*Bedrooms*	*Commercial sq. ft.*
Single-Family Residential	66	264	--
Resort/hotel/condo units	34	52	--
General Commercial	--	--	56,000
Total Development Outside the Project Boundary			
	569 units	1,008 bedrooms	80,500 sq. ft.
Village at Squaw Valley Specific Plan Project Development			
Resort Residential	600	1,243	--

Hotel	250	250	--
Employee Housing	21	264*	20,000
Net Other Commercial	--	--	200,083
Total Development			
	1,440 units	2,765 bedrooms*	300,583 sq. ft.

*264 employees in dormitory housing and studio units are included in the 2,765 total bedrooms of probable and forecast development. Total employees are utilized as the metric in recognition that demand for new infrastructure and services to serve dormitory employee housing are quantitatively distinct from new infrastructure and service demands created by construction of new hotel, condominium, and residential bedrooms.

Development Absorption

The following table details projected absorption rates for the project and for the cumulative development for the identified 25-year period in 5-year increments. To be conservative, the overall absorption rate is weighted to assume higher development rates in the near term for the VSVSP and for the cumulative projects/development. Absorption rates for the VSVSP assume a slightly higher rate of development in the near term due to the known tentative development schedule for the plan. Absorption rates for the VSVSP utilize increments of 35%, 20%, 20%, 15%, and 10% for each 5-year period and are expressed in units of bedrooms and commercial square footage. Commercial square footage for the VSVSP does not follow this formula precisely due to known amenities that are likely to be constructed in early phases of development, such as the Mountain Adventure Camp. Employee beds are calculated at corollary rates.

Absorption rates for the cumulative projects/development utilize increments of 25%, 25%, 20%, 20%, and 10% for each 5-year period and are also expressed in units of bedrooms and commercial square footage. Due to known commercial projects that are more likely to occur in the near term, commercial square footages do not follow this formula precisely.

Project Plus Cumulative Absorption Schedule

VSVSP Village Area		
Year	*Bedrooms*	*Commercial sq. ft.*
2020	522	104,940
2025	298	30,000
2030	298	30,000
2035	223	20,000
2040	152	15,143
Total	**1,493**	**200,083***
VSVSP East Parcel		
Year	*Beds***	*Commercial sq. ft.*
2020	92	15,000
2025	52	5,000
2030	52	--
2035	39	--
2040	29	--
Total	**264**	**20,000**
Cumulative projects/development		
Year	*Bedrooms*	*Commercial sq. ft.*
2020	252	24,500
2025	252	20,125
2030	201	14,000

2035	201	14,000
2040	102	7,875
Total	**1,008**	**80,500**

*The VSVSP is projected to construct a total of 277,733 square-feet of commercial uses, not including the 20,000 square-feet of commercial planned for the East Parcel. 77,650 square feet of the 277,733 square feet is replacement of existing commercial uses for a net total of 200,083 square feet of new commercial uses.

**Due to the dormitory and studio unit housing proposed for project-generated new employees, employee beds are utilized as the metric in recognition that demand for new infrastructure and services to serve employee housing are quantitatively distinct from new infrastructure and service demands created by construction of new hotel, condominium, and residential bedrooms.

Conclusions

The 25-year *cumulative list and forecast* includes all approved projects that are within the project vesting period, known active projects that are likely to be approved and carried out, and forecasted development for the 25-year planning horizon. The 25-year *project plus cumulative Absorption Schedule* identifies total development in excess of 20% beyond the prior 25 years of development within the Olympic Valley indicating that the quantity of development within the Olympic Valley study area for the identified 25-year period would exceed development that had occurred over the prior 25-year period and that the project development in this analysis would occur at a faster rate than historic levels. Based on observed development patterns, constraints and other factors, these figures will enable an appropriately conservative analysis of cumulative development and related environmental effects in the Olympic Valley and the VSVSP's potential incremental contribution to these cumulative effects. This will also enable an appropriately conservative analysis of the total water demand in order to complete the SB 610 Water Supply Assessment for this project, which will determine the availability of water for this same 25-year period.

APPENDIX B

Squaw Valley Groundwater Model 2014 Recalibration

HydroMetrics, WRI, June 17, 2014

HydroMetrics WRI
1814 Franklin St, Suite 501
Oakland, CA 94612

TECHNICAL MEMORANDUM

To: Mike Geary/SVPSD

From: Stephen Hundt

Derrik Williams

Date: June 17, 2014

Subject: Squaw Valley Groundwater Model 2014 Recalibration

SECTION 1
Background and Purpose

This technical memorandum documents a recent update to the Squaw Valley groundwater model. This model update reassesses and modifies various model inputs. The purpose of this update is to produce an updated model that is better calibrated than the previous model, and is based on more realistic and widely accepted assumptions.

The updated and recalibrated groundwater model accurately simulates groundwater levels in Squaw Valley better than the previous model. In general, the model simulates groundwater levels and the creek/aquifer interaction in the western portion of Squaw Valley better than the eastern portion. This is consistent with the model objectives of providing a tool for managing groundwater pumping in the western portion of Squaw Valley. The updated groundwater model can be confidently used to develop future groundwater pumping plans that minimize impacts on Squaw Creek.

SECTION 2
Model Modifications

2.1 HYDROSTRATIGRAPHY

Elevations of the hydrostratigraphic units that define the groundwater model layers were modified in early 2014. These modifications were based on geologic data from test well borings installed by Todd Groundwater. Todd Groundwater developed new elevations of the three hydrostratigraphic units, using the surface datum of the existing groundwater model. The new mapped surfaces were used to adjust elevations of the three model layers. Some additional adjustments to the surfaces were required to ensure that all observation wells and pumping wells were included in the model without changing their location or depth. The updated extents and bottom elevations for the three model layers are shown in Figure 1.

2.2 RECHARGE

2.2.1 WESTERN RECHARGE ZONE ADJUSTMENT

Two changes were made to the recharge zones that cover the western side of the basin. The first change combined two recharge zones into one zone. The western basin previously included two large recharge zones: numbered 1 and 9. Zone 1 received recharge from rainfall, and zone 9 received recharge from rainfall, irrigation return flows, pipe losses, and sewer inflow and outflow. As development increases, the two zones will include similar land uses and similar impermeable surface percentages. As a result, the zones were combined into single zone that receives recharge from rainfall, irrigation return, pipe losses, and sewer inflow and outflow. The extent of the new recharge zone is shown in Figure 2.

The second change made to this recharge zone was to increase the percentage of rainfall that infiltrates and recharges the aquifer. Most permeable surfaces in the model are assigned a recharge percentage of 10% of rainfall. Most relatively impermeable surfaces in the model are assigned a recharge percentage of 2.5% of rainfall. The percentage of rainfall that becomes recharge in the new zone was increased from 2.5% to 6%. This change was made to acknowledge the general ratio of permeable and impermeable surfaces in the recharge zone.

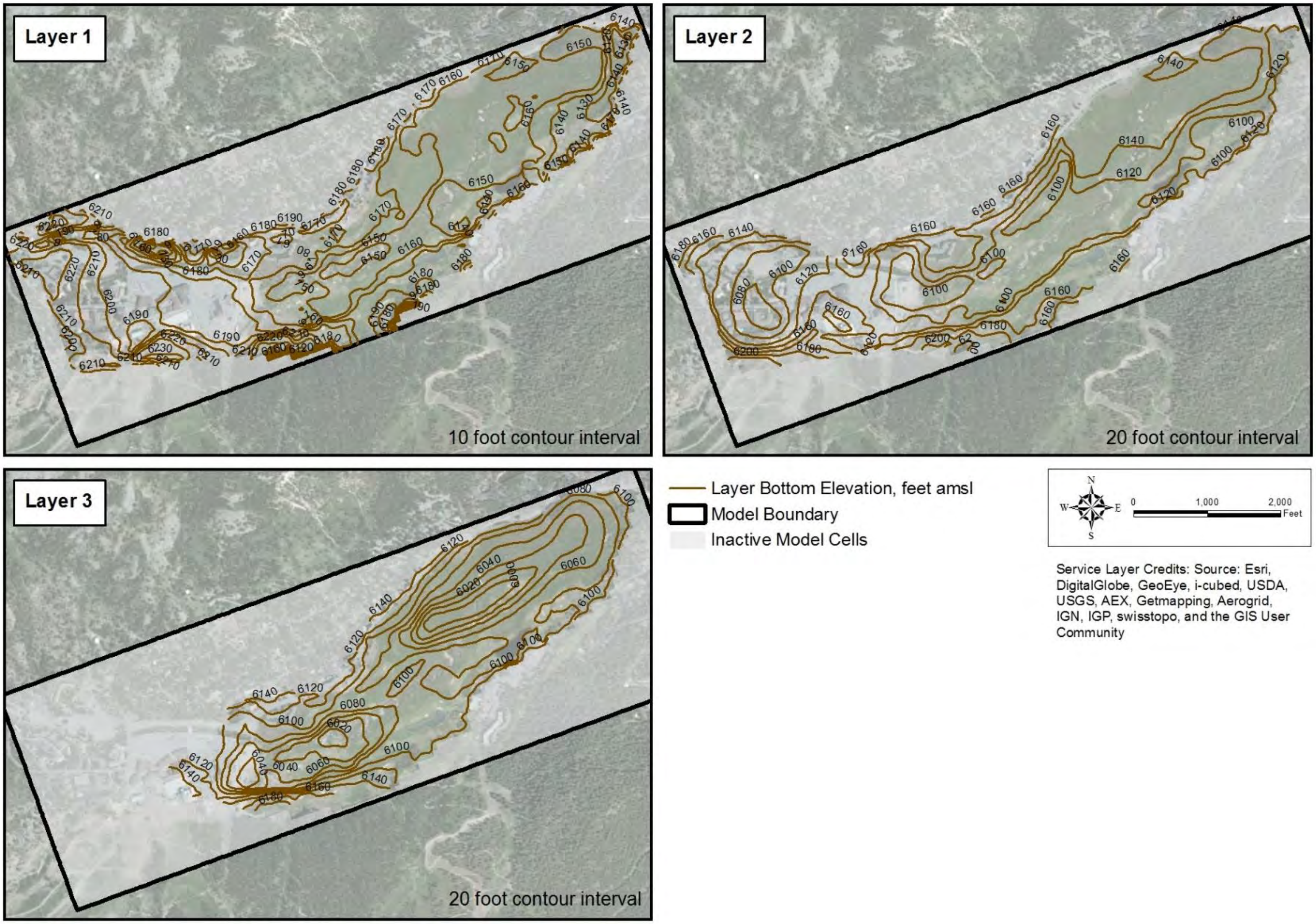

Figure 1: Model Layer Extents and Bottom Elevations

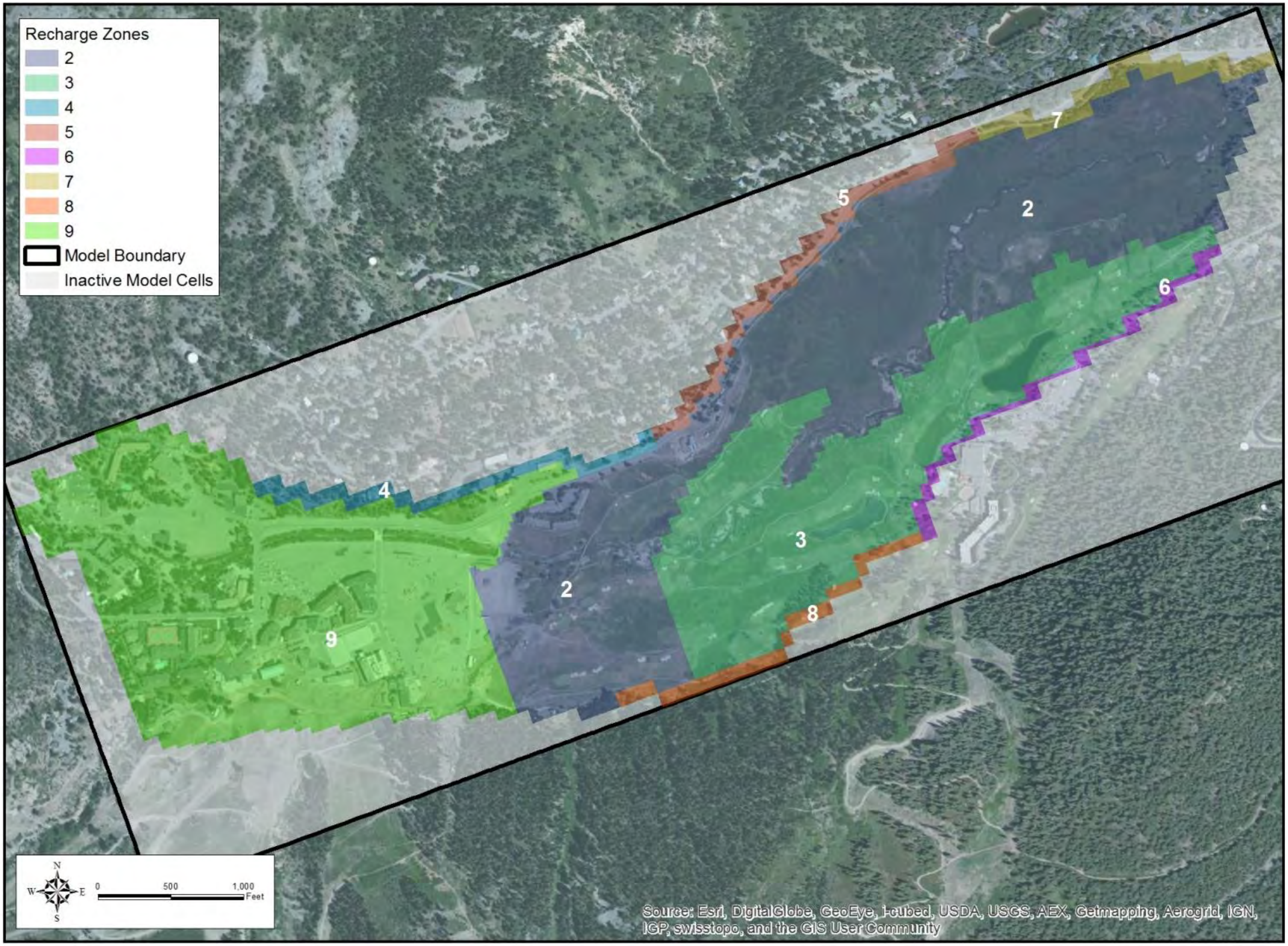

Figure 2: Recharge Zones

2.2.2 PRECIPITATION DELAY

The month in which precipitation infiltrates and recharges the aquifer was modified to approximate snow accumulation and melting. Rather than trying to model the highly complex dynamics that occur in melting snowpacks, a simple and transparent scheme was used to delay the infiltration of precipitation during cold months when it likely falls as snow. We assumed that between December and March, not all precipitation would immediately infiltrate. Instead, some of that precipitation remains as snow which melts and infiltrates in later months. Table 1 shows how precipitation was allocated during winter months.

Table 1: Method of Delaying Precipitation Recharge

Rainfall Month	Average Air Temperature (°F)	Month of Precipitation Recharge		
		Month of Rainfall	1st Month After Rainfall	2nd Month After Rainfall
January	23	50%	25%	25%
February	27	50%	25%	25%
March	31	60%	40%	0%
April	33	100%	0%	0%
May	41	100%	0%	0%
June	49	100%	0%	0%
July	55	100%	0%	0%
August	57	100%	0%	0%
September	52	100%	0%	0%
October	43	100%	0%	0%
November	34	100%	0%	0%
December	23	50%	25%	25%

The adjustment in the timing of precipitation recharge does not change the annual amount of precipitation recharge estimated by the model. The effect of the delay is to somewhat attenuate the spikes in recharge that had previously occurred during December and increase the recharge that occurs during the spring. Figure 3 compares the effective precipitation rate with and without the delay. The blue bars on Figure 3 are the infiltration rates if all infiltration takes place during the same month as precipitation. The salmon bars on Figure 3 show new times when infiltration takes place due to a snowmelt delay. The red bars on Figure 3 show times when infiltration takes place in both situations.

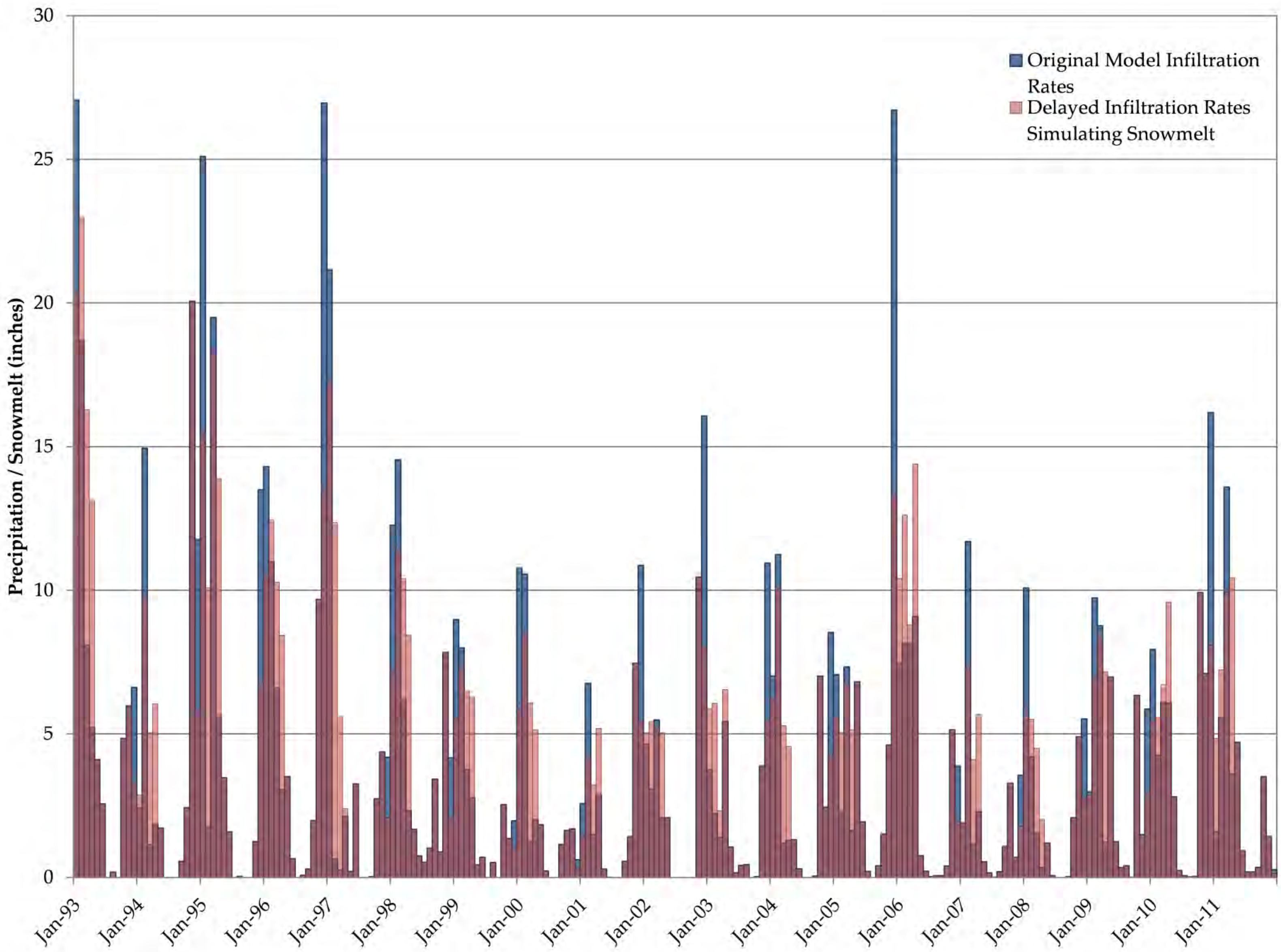

Figure 3: Precipitation and Delayed Precipitation

2.2.3 RESORT AT SQUAW CREEK-PHASE II PIPE AND SEWER LOSSES

Distribution pipe losses from the planned Resort at Squaw Creek (RSC) Phase II development were added to recharge zone 6 (Figure 2). The sewer losses from the development were combined with all other sewer losses that take place in the Valley.

2.2.4 LIMIT SEWER INFILTRATION AND EXFILTRATION

A limit was placed on the amount of groundwater that flows into and out of sewer lines in the Valley. Monthly sewer infiltration and exfiltration rates were originally calculated by comparing measured sewer flows with measured water deliveries (Williams, 2001). These calculations resulted in estimated sewer losses and gains by month, based on water delivery. In general, the aquifer gains water from the sewers during summer months when groundwater levels are lower than the sewer, and the aquifer loses water to the sewer during winter months when groundwater levels are elevated.

As projected water deliveries increased from future development, the corresponding projected amount of sewer infiltration and exfiltration became unrealistically large. To ensure that sewer infiltration and exfiltration does not become unrealistic, the total gains and losses to sewer lines were capped. The maximum amount of sewer infiltration during summer months was set to 7.9 acre feet per month; the maximum amount of sewer exfiltration during winter months was set to 5.1 acre-feet per month. These rates were the highest sewer gains and losses calculated during the calibration period.

Groundwater gains and losses from sewer infiltration and exfiltration remain a minor component of the Valley's water budget. Figure 4 shows total recharge contributed by sewers throughout the model period alongside the contribution of rainfall, pipe losses, and irrigation return flows. Rainfall dominates groundwater recharge. Irrigation return flow is the second largest recharge component, and becomes the dominant component during summer months when rainfall ceases. Recharge from sewer exfiltration remains a small component of recharge throughout the simulation.

The annual net sewer gains and losses can be derived by summing annual sewer exfiltration with total annual sewer infiltration. Figure 5 shows the annual net sewer gains and losses as a percent contribution to total recharge under the WSA scenario. The net sewer gains and losses average 0.94% of all recharge.

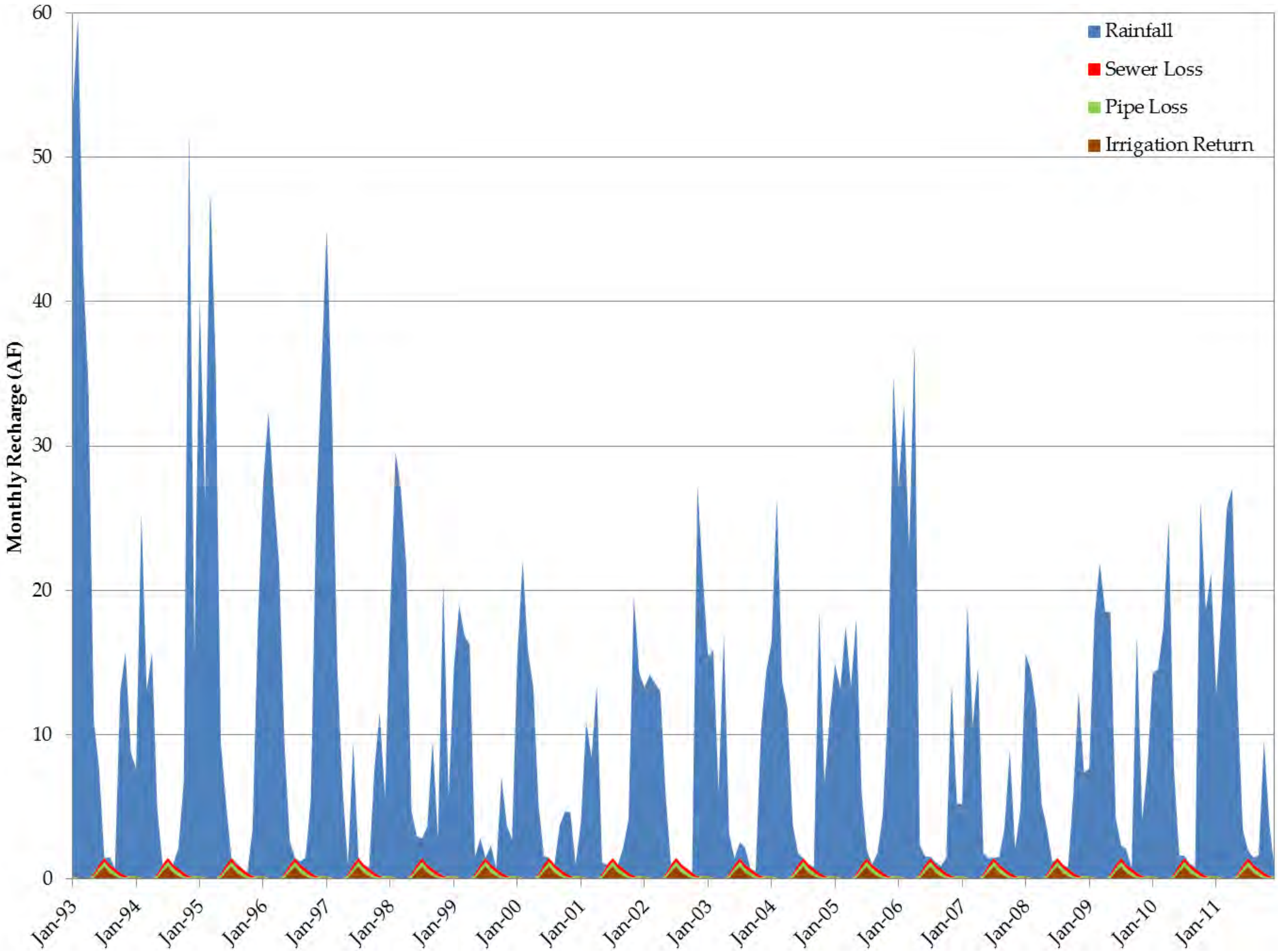

Figure 4: Monthly Recharge by Source for WSA Scenario

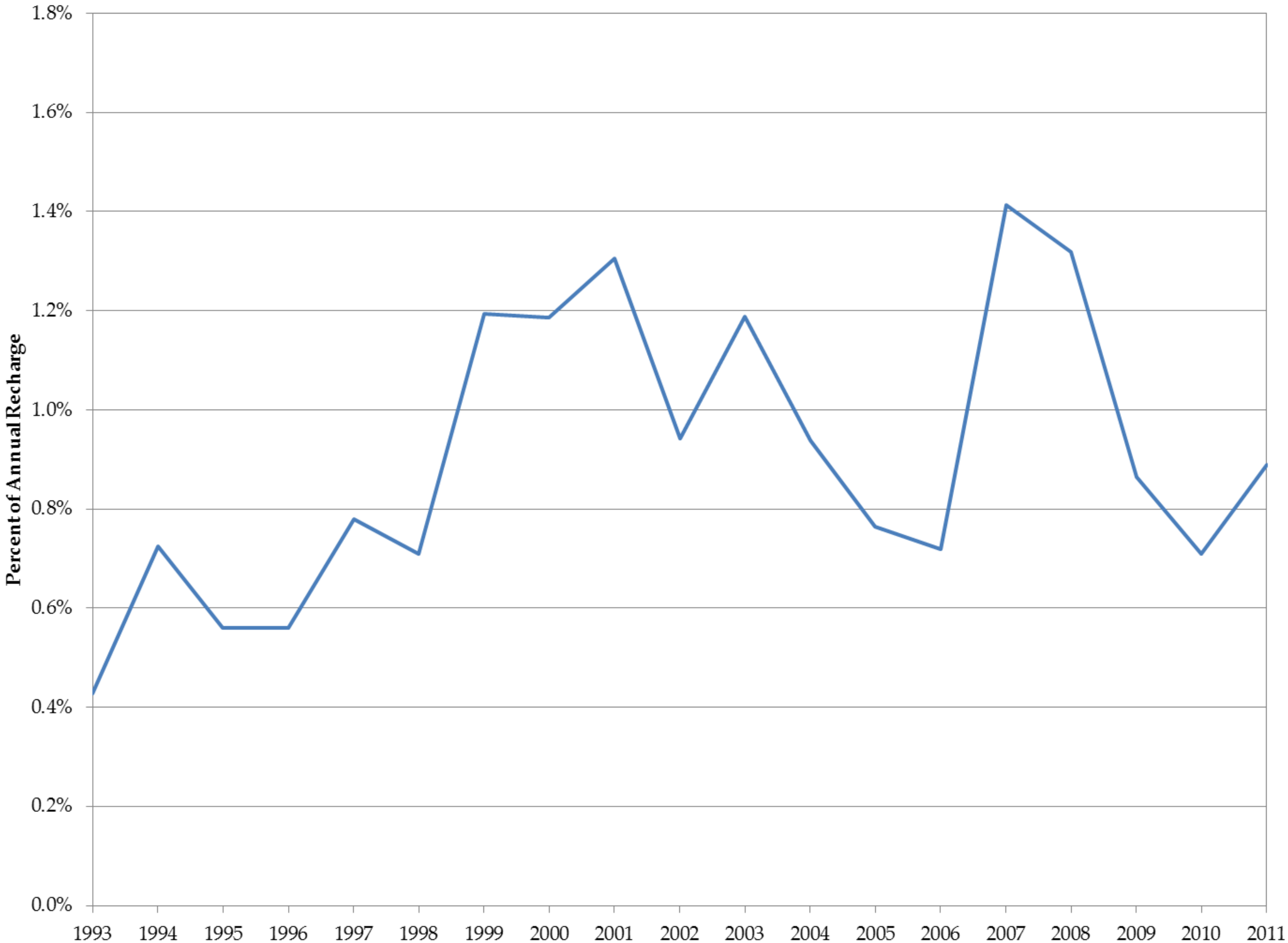

Figure 5: Sewer Leakage Percent of Annual Recharge for WSA Scenario

SECTION 3
Model Calibration

3.1 APPROACH

Calibrating the regional groundwater flow model involved successive attempts to match model output to measured data from the calibration period. Simulated groundwater elevations were compared against available observed groundwater elevations. The model was considered calibrated when simulated results matched the measured data within an acceptable measure of accuracy, and when successive calibration attempts did not notably improve the calibration statistics. Calibration was conducted by varying relatively uncertain and sensitive parameters such as horizontal and vertical hydraulic conductivities, over a reasonable range of values. Parameters varied during calibration included:

- Horizontal conductivity
- Vertical to horizontal conductivity
- Specific yield
- Specific storage
- Stream leakage
- Fault conductance

3.2 CALIBRATION PERIOD

The primary criterion for choosing the appropriate calibration period was the availability of a relatively complete set of data. The necessary data included complete pumping data, recharge data, streamflow data, and groundwater elevation data from the network of groundwater monitoring wells. Taking into account these criteria, we chose the period from May 1992 through December 2011 for calibration.

All groundwater elevation data from the calibration period were not treated equally. Squaw Creek flow monitoring began in 2004. Therefore post-2004 streamflow data are more accurate than the pre-2004 streamflow estimates, and the model will likely perform better for the time period after 2004. To reflect the improvement in the data beginning in 2004, groundwater elevation observations after 2004 were given a ten times larger weight than observations prior to 2004.

3.3 STRESS PERIODS

Stress periods define time periods in the groundwater model over which hydraulic stresses such as pumping and recharge are held constant. Stress period selection depends on the model objectives and the time frame of interest. The primary objective of the model is to assist with groundwater management strategies and simulating impacts from potential water projects. Because seasonal fluctuations in groundwater elevations are important in groundwater management, the stress periods must be at least seasonal. Based on the existing data and model objectives, monthly stress periods were chosen. These stress periods allow adequate resolution of seasonal groundwater level fluctuations while performing the simulations in a reasonable amount of time.

3.4 PILOT POINT METHOD FOR MODEL CALIBRATION

A pilot point approach, rather than a zoned conductivity approach, was used to distribute aquifer parameters during calibration. The pilot point approach results in a smoothly varying hydraulic conductivity field. Doherty (2003) describes the methodology for the use of pilot points in groundwater model calibration. Using this method, the values of aquifer hydraulic properties are estimated at the locations of a number of points spread throughout the model domain. Hydraulic properties are then assigned to the model grid through spatial interpolation from those points (Doherty, 2007).

Prior to estimating any hydraulic parameters, the pilot points were selected manually based on following criteria (Doherty, 2002):

1) More pilot points were placed where there are more data;
2) Pilot points were placed between data points in order to calibrate to head difference between wells;
3) Pilot points were placed in between wells and outflow boundaries.
4) Pilot points were placed to eliminate big gaps between adjacent pilot points;

In addition, pilot points for horizontal hydraulic conductivity were placed at locations with estimated hydraulic conductivities derived from aquifer tests.

Between 18 and 78 pilot points were selected for each layer. The pilot points are used to estimate horizontal hydraulic conductivity, ratio of horizontal to vertical hydraulic conductivity, specific yield, and specific storage. Layer 1 was treated as homogeneous with respect to specific storage and layer 3 was treated as homogenous with respect to specific yield. The values in these two instances were specified and omitted from the parameter estimation process.

The pilot point methodology results in 480 parameter values that can be varied during calibration. PEST software, with its Singular Value Decomposition (SVD)-assist functionality (Watermark Numerical Computing, 2004, 2008), was used to help update the full set of parameter values and improve the calibration.

3.5 CALIBRATION RESULTS

3.5.1 MODEL PARAMETER MODIFICATIONS

Model calibration consisted of modifying the distribution and magnitude of horizontal hydraulic conductivity, ratio of horizontal to vertical hydraulic conductivity, specific yield, and specific storage values using the pilot point method discussed above. The final distributions of aquifer parameter values for horizontal hydraulic conductivity, vertical anisotropy ratio, specific storage, and specific yield are shown on Figure 6 through Figure 9.

Streambed conductance values for Shirley Canyon and the South Fork of Squaw Creek were included as adjustable parameters in the calibration. The final values obtained from calibration equate to average streambed hydraulic conductivity values of 1.1×10^{-3} feet per day and 1 foot per day. These values are similar to the values of 1.9×10^{-4} feet per day and 1 foot per day that were used in the previous version of the model.

The calibrated value for the fault hydraulic conductivity is 0.16 feet per day, assuming a one-foot thick fault. This value is lower than the surrounding aquifer material and higher than the previously used value of 0.010 feet per day.

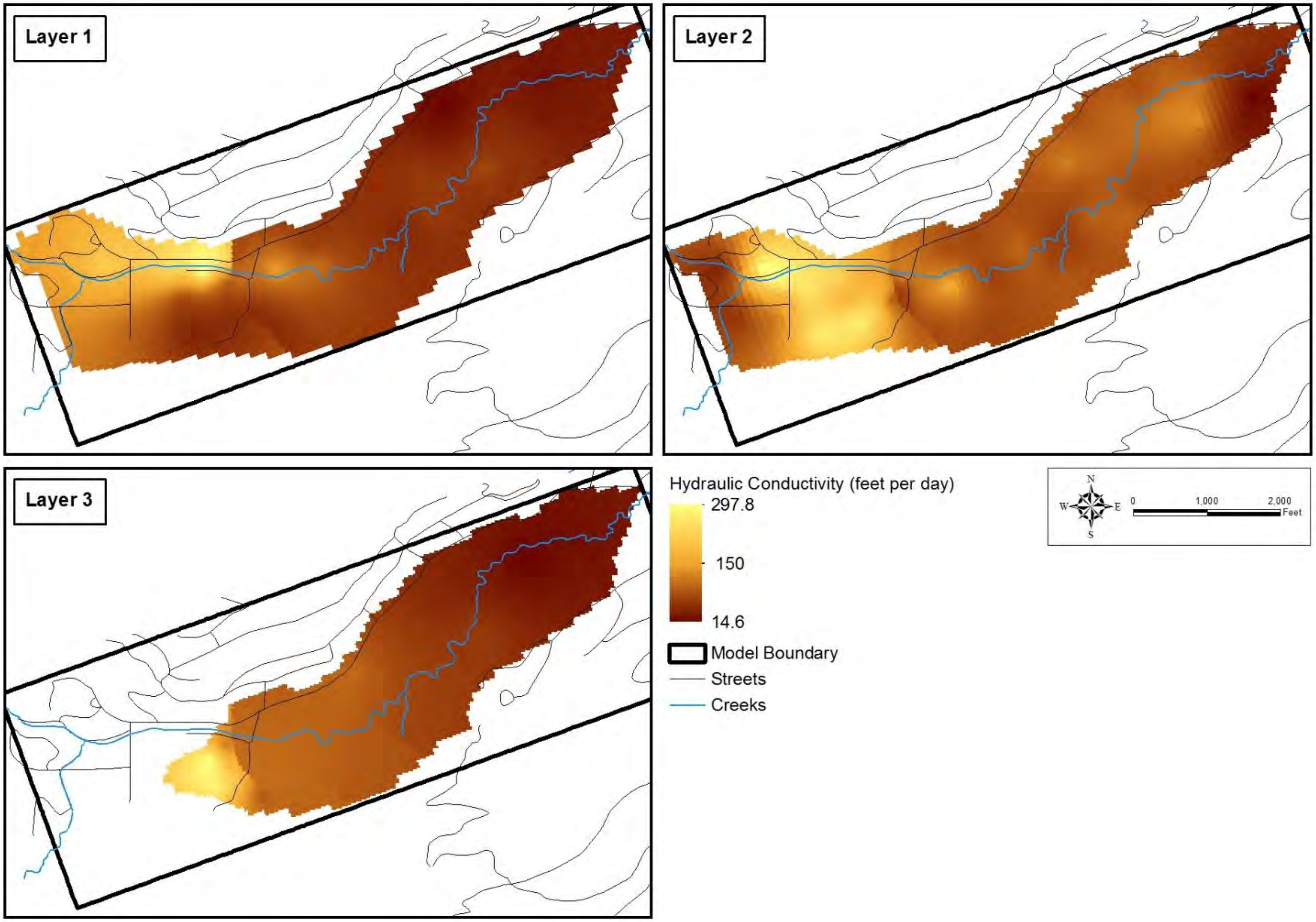

Figure 6: Distribution of Hydraulic Conductivity

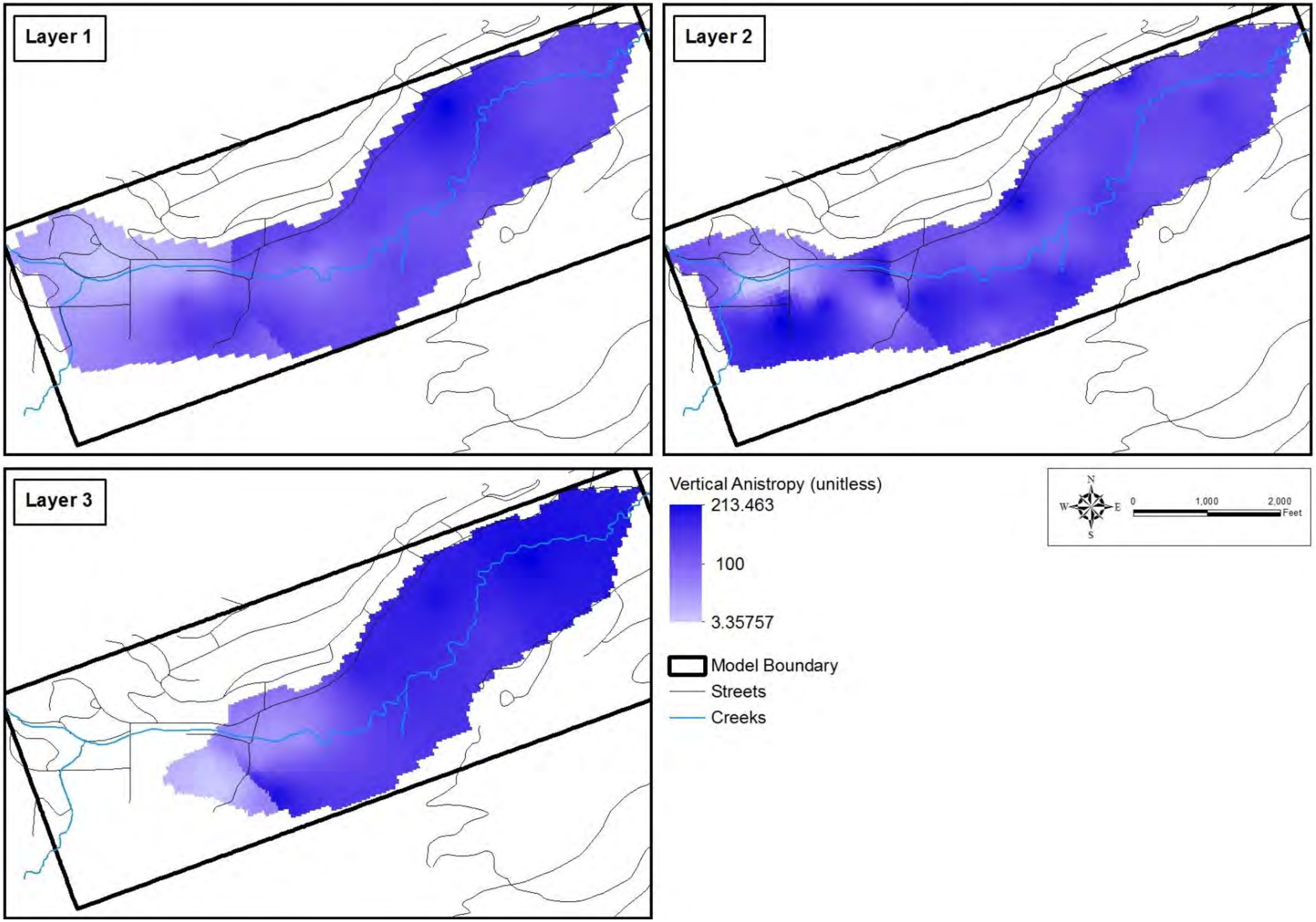

Figure 7: Distribution of Vertical Anisotropy Ratio

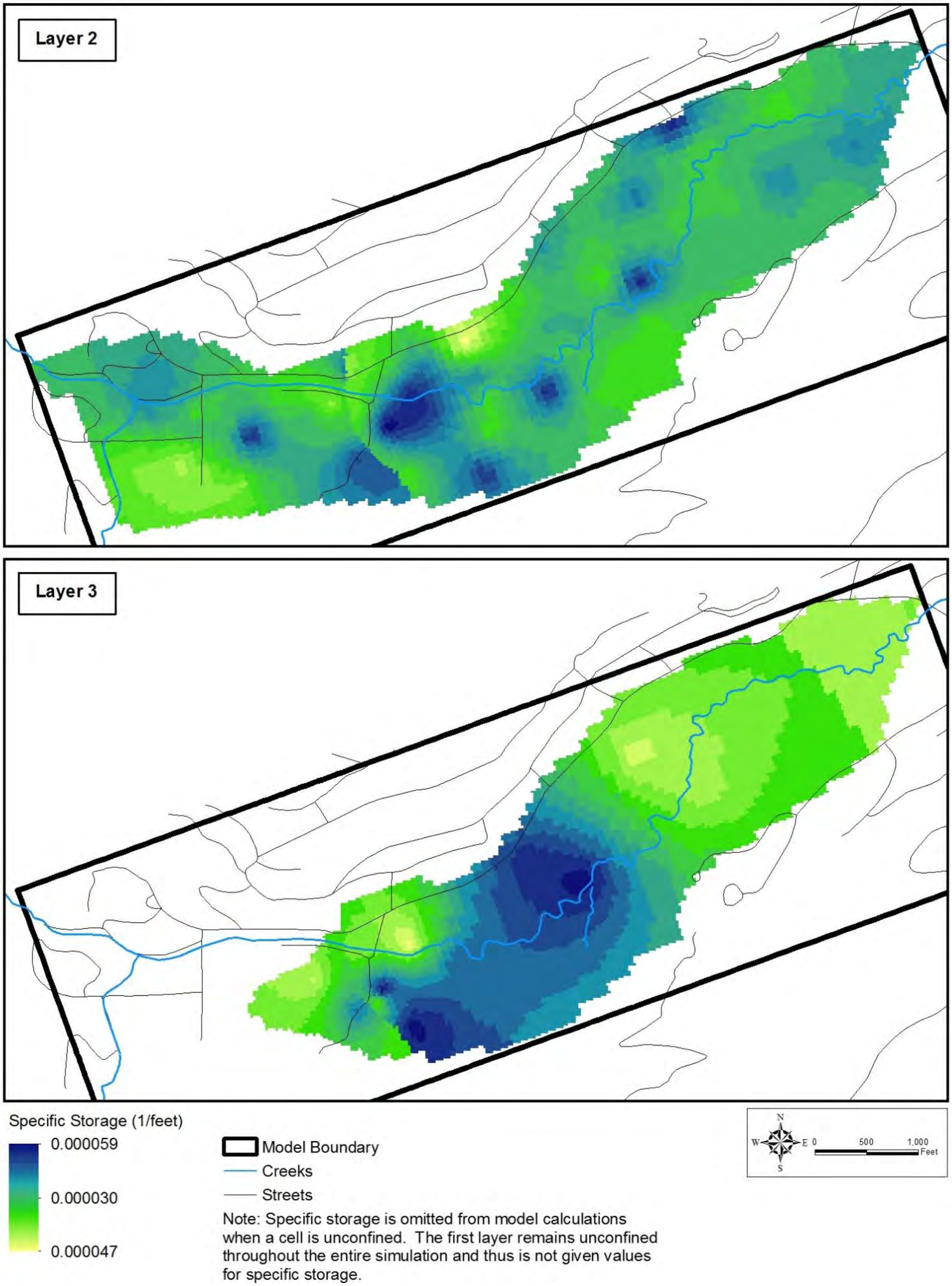

Figure 8: Distribution of Specific Storage

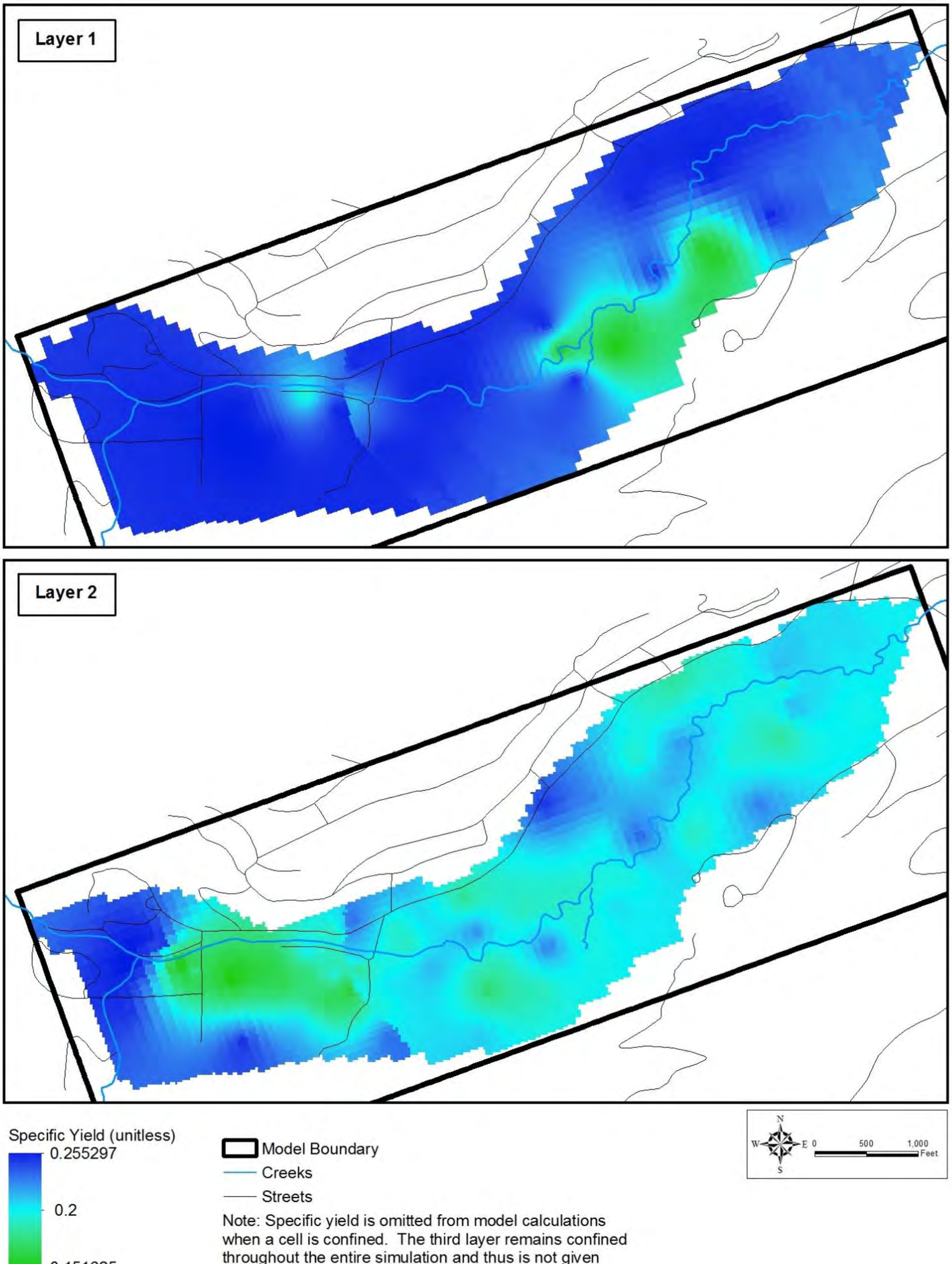

Figure 9: Distribution of Specific Yield

3.5.2 GROUNDWATER ELEVATION CALIBRATION

Flow model calibration is commonly evaluated by comparing simulated groundwater elevations with observed groundwater elevations from monitoring and production wells. Hydrographs of simulated groundwater elevations should generally match the trends and fluctuations observed in measured hydrographs. Furthermore, the average errors between observed and simulated groundwater elevations should be relatively small and unbiased. The well locations used for calibrating the groundwater flow model are shown on Figure 10.

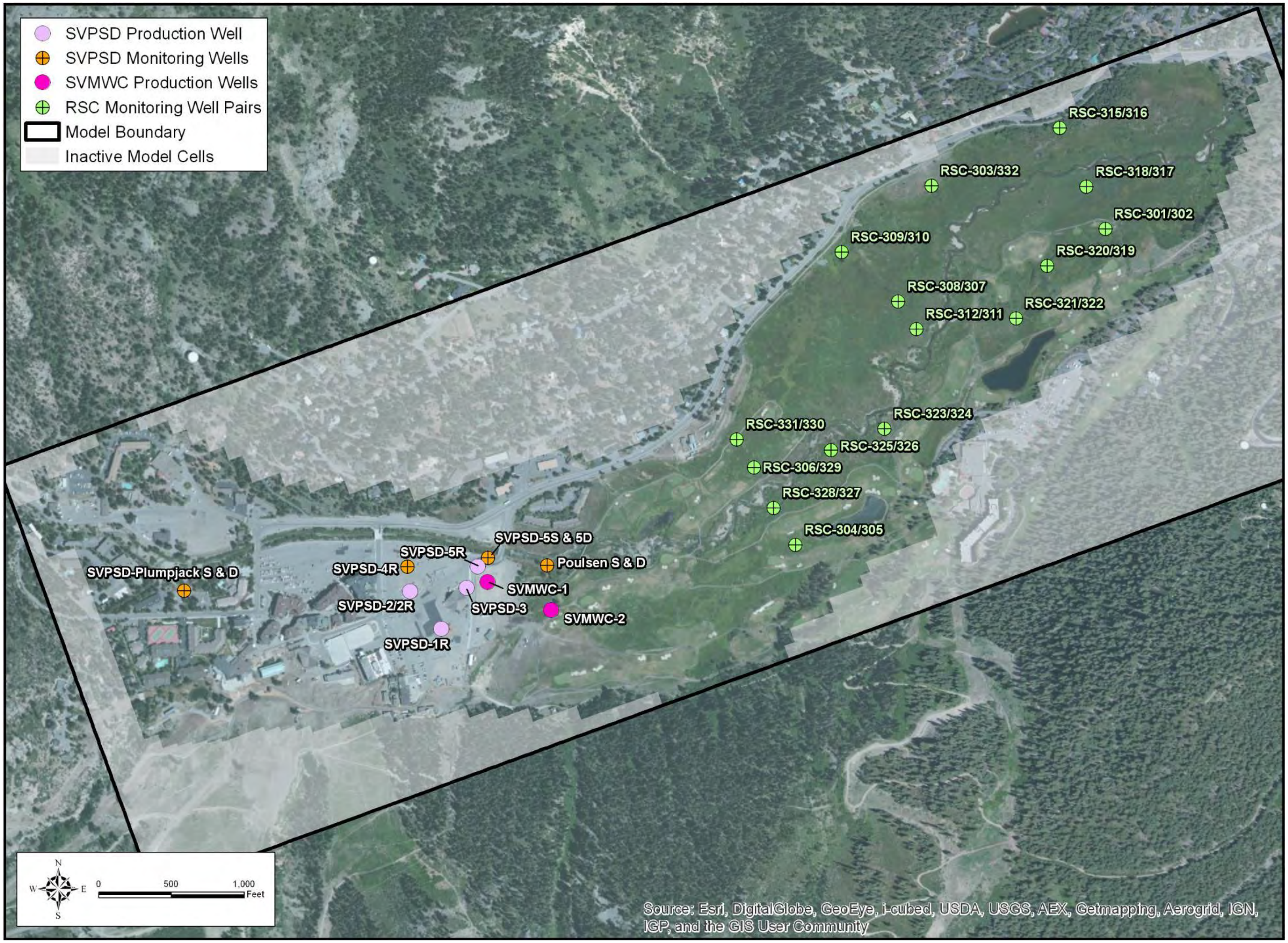

Figure 10: Target Well Locations

A complete set of hydrographs showing both observed and simulated groundwater elevations are included in Appendix A. These hydrographs show that the simulated groundwater elevations track measured groundwater elevations well.

Various graphical and statistical methods can be used to demonstrate the magnitude and potential bias of the calibration errors. Figure 11 shows all simulated groundwater elevations plotted against observed groundwater elevations. Results from an unbiased model will scatter around a 45° line on this graph. If the model has a bias such as exaggerating or underestimating groundwater levels, the results will diverge from this 45° line. Figure 11 demonstrates that the results tend to lie close, but slightly below, a 45° line. This suggests that model has a minor bias towards underestimating average groundwater levels. This is likely due to the fact that the model cannot simulate the measured groundwater elevations that are above ground surface in the meadow area.

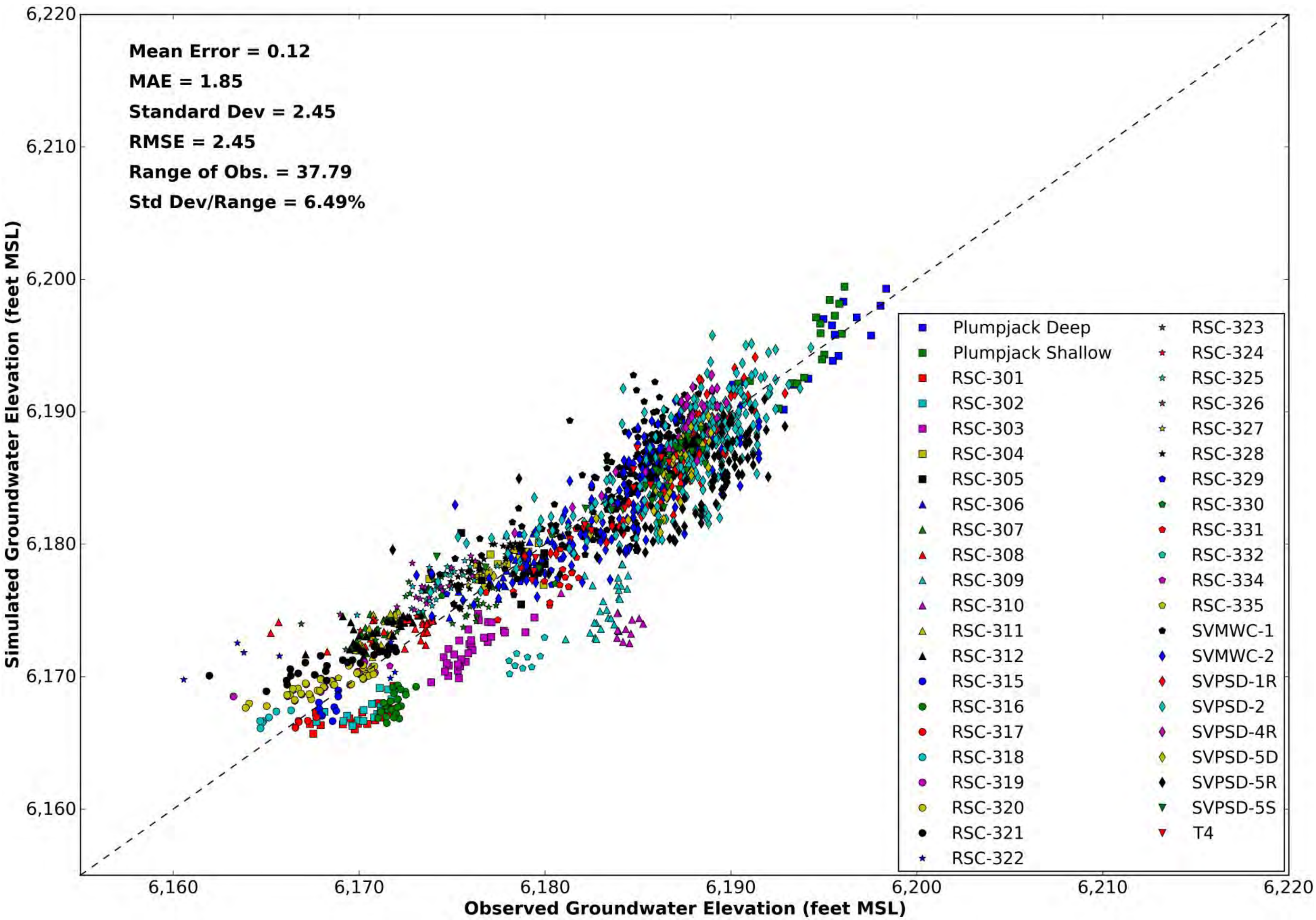

Figure 11: Simulated Versus Observed Groundwater Elevations

Figure 11 also includes various statistical measures of calibration accuracy. The four statistical measures used to evaluate calibration are the mean error (ME), the mean absolute error (MAE), the standard deviation of the errors (STD), and the root mean squared error (RMSE). Each of these statistical measures was calculated using weighted measurements, where all weights have been normalized such that the sum of all weights is equal to one.

The mean error is the average error between measured and simulated groundwater elevations for all data on Figure 11.

$$ME = \sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i$$

Where h_m is the measured groundwater elevation, h_s is the simulated groundwater elevation, w_i is the normalized observation weight and n is the number of observations.

The mean absolute error is the average of the absolute differences between measured and simulated groundwater elevations.

$$MAE = \sum_{i=1}^{n} w_i \left|h_m - h_s\right|_i$$

The standard deviation of the errors is one measure of the spread of the errors around the 45º line on Figure 11. The population standard deviation is used for these calculations

$$STD = \sqrt{\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i^2 - \left(\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i\right)^2}$$

The RMSE is similar to the standard deviation of the error. It also measures the spread of the errors around the 45º line on Figure 11, and is calculated as the square root of the average squared errors.

$$RMSE = \sqrt{\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i^2}$$

As a measure of successful model calibration, Anderson and Woessner (1992) state that the ratio of the spread of the errors to the total head range in the system should be small to ensure that the errors are only a small part of the overall model response. As a general rule, the RMSE should be less than 10% of the total head range in the model. The RMSE of 2.45, shown on Figure 11, is approximately 6.49% of the total head range of 37.8 feet. A second general rule that is occasionally used is that the mean error should be less than 5% of the total head range in the model. The mean error of 0.12 is approximately 0.32% of the total head range. Therefore, on average, the model errors are within an acceptable range.

These calibration statistics are better than the calibration statistics shown in the *Squaw Valley creek/aquifer study model update report* (HydroMetrics WRI, 2013). Table 2 compares the calibration statistics from the 2013 calibration effort with the current calibration effort. This table shows that the modifications, along with additional calibration efforts, improved the model's ability to predict groundwater elevations and impacts from proposed pumping.

Table 2: Comparison of Calibration Statistics

	November 2013 Calibration	Current Calibration
Mean Error	1.38 feet	0.12 feet
Mean Avg. Error	2.31 feet	1.85 feet
RMSE	2.92 feet	2.45 feet
RMSE/Range of Obs.	7.72 %	6.49 %

A second graph used to evaluate bias in model results is shown on Figure 12. This figure is a graph of observed groundwater elevations versus model residual (simulated elevation minus observed elevation). Results from a non-biased simulation will appear as a cloud of data points clustered around the zero model residual line. Results that do not cluster around the zero residual line show potential model bias. Results that display a trend instead of a random cloud of points may suggest additional model bias.

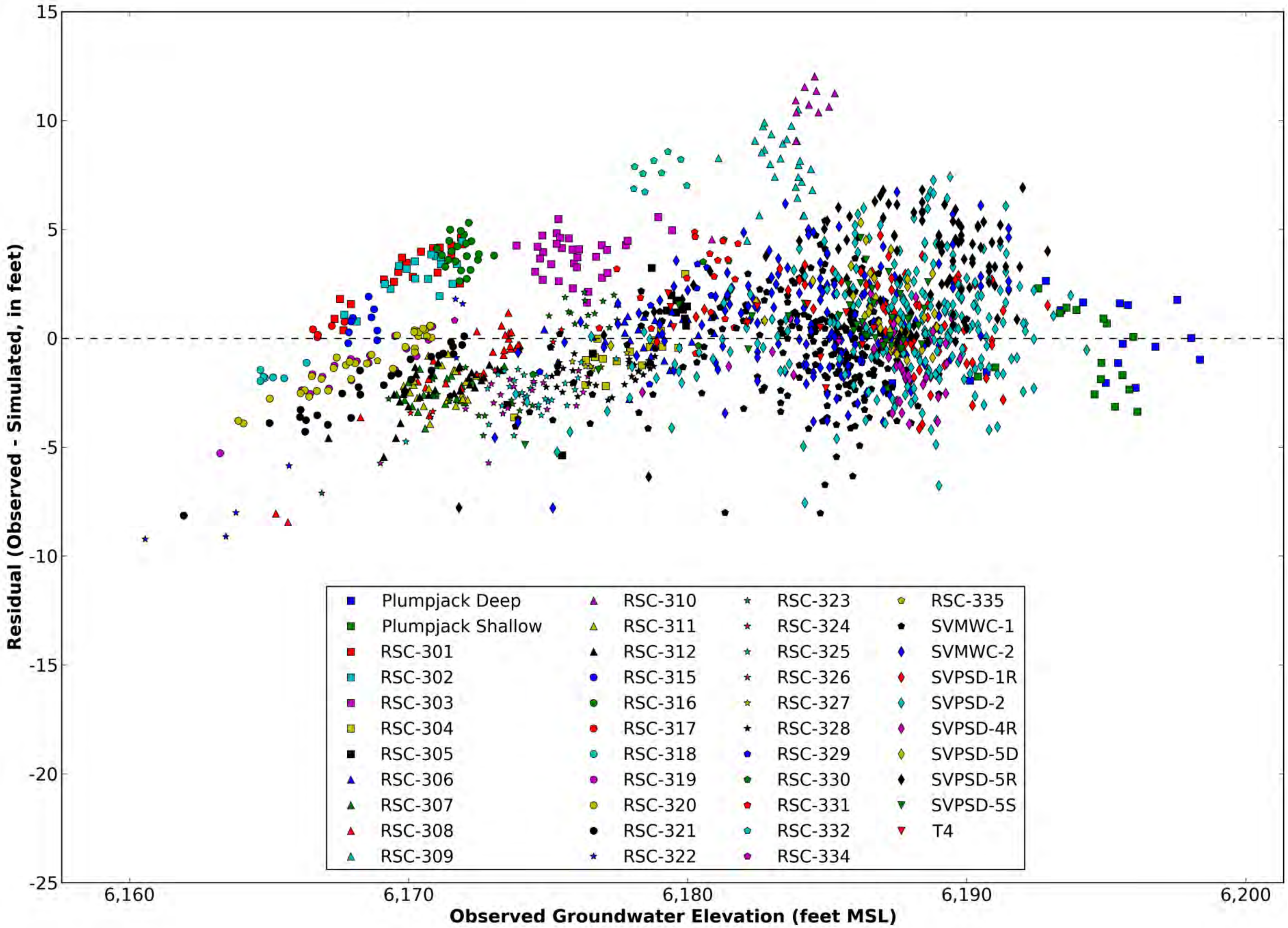

Figure 12: Observed Groundwater Elevations versus Model Residual

SECTION 4
Conclusions

Assumptions in the Squaw Valley groundwater model were strengthened and updated to produce a more accurate and justifiable groundwater model. Four model assumptions were modified:

- Depth and extent of aquifers in Squaw Valley;
- Percentage of precipitation that becomes recharge in the western end of Squaw Valley;
- Timing of precipitation recharge; and
- Maximum sewer infiltration and exfiltration rates.

The updated and recalibrated groundwater model accurately simulates groundwater levels in Squaw Valley quite well. The updated groundwater model continues to be an accurate and dependable tool that can be confidently used to develop future groundwater pumping plans.

SECTION 5
References

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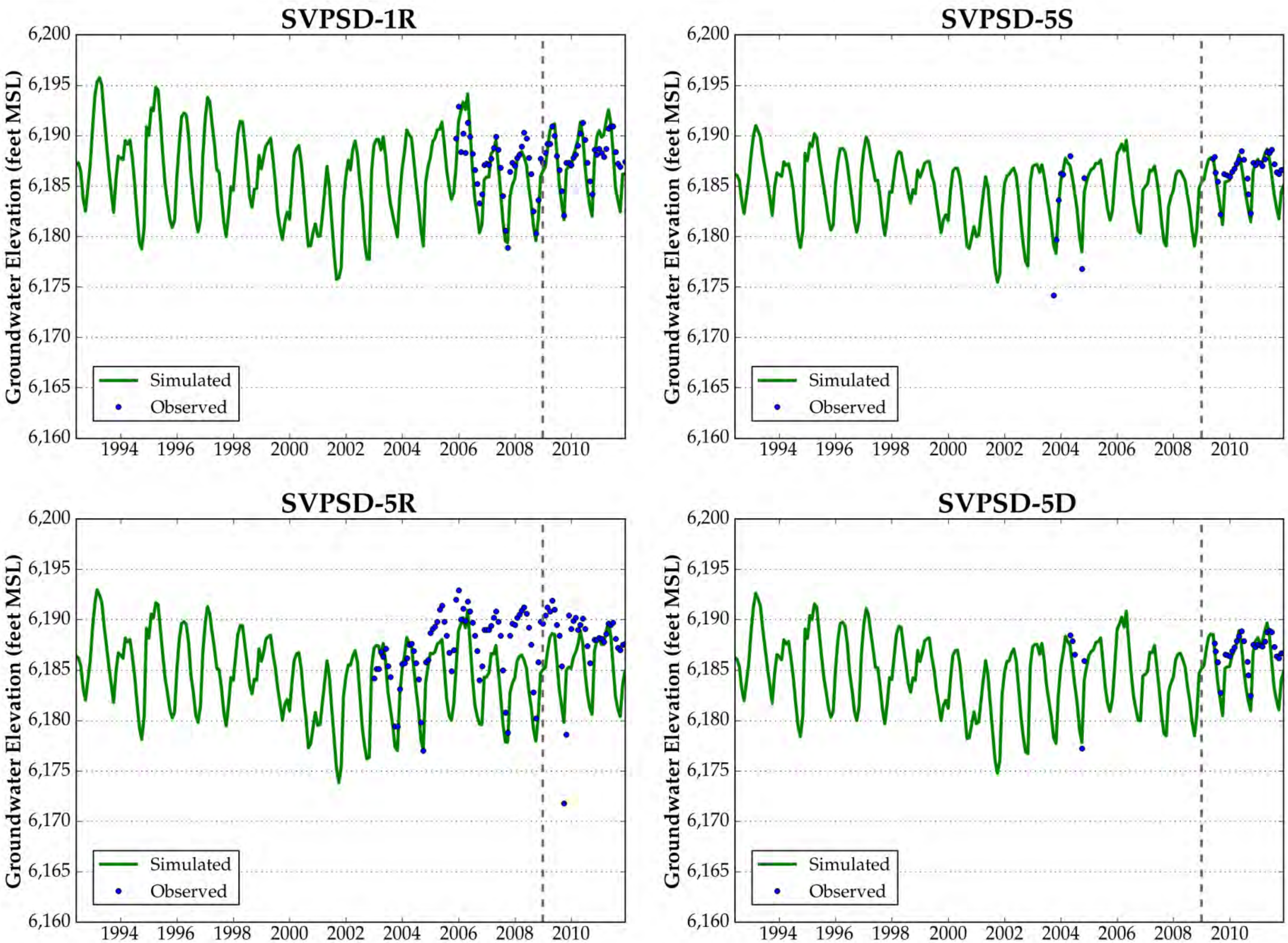
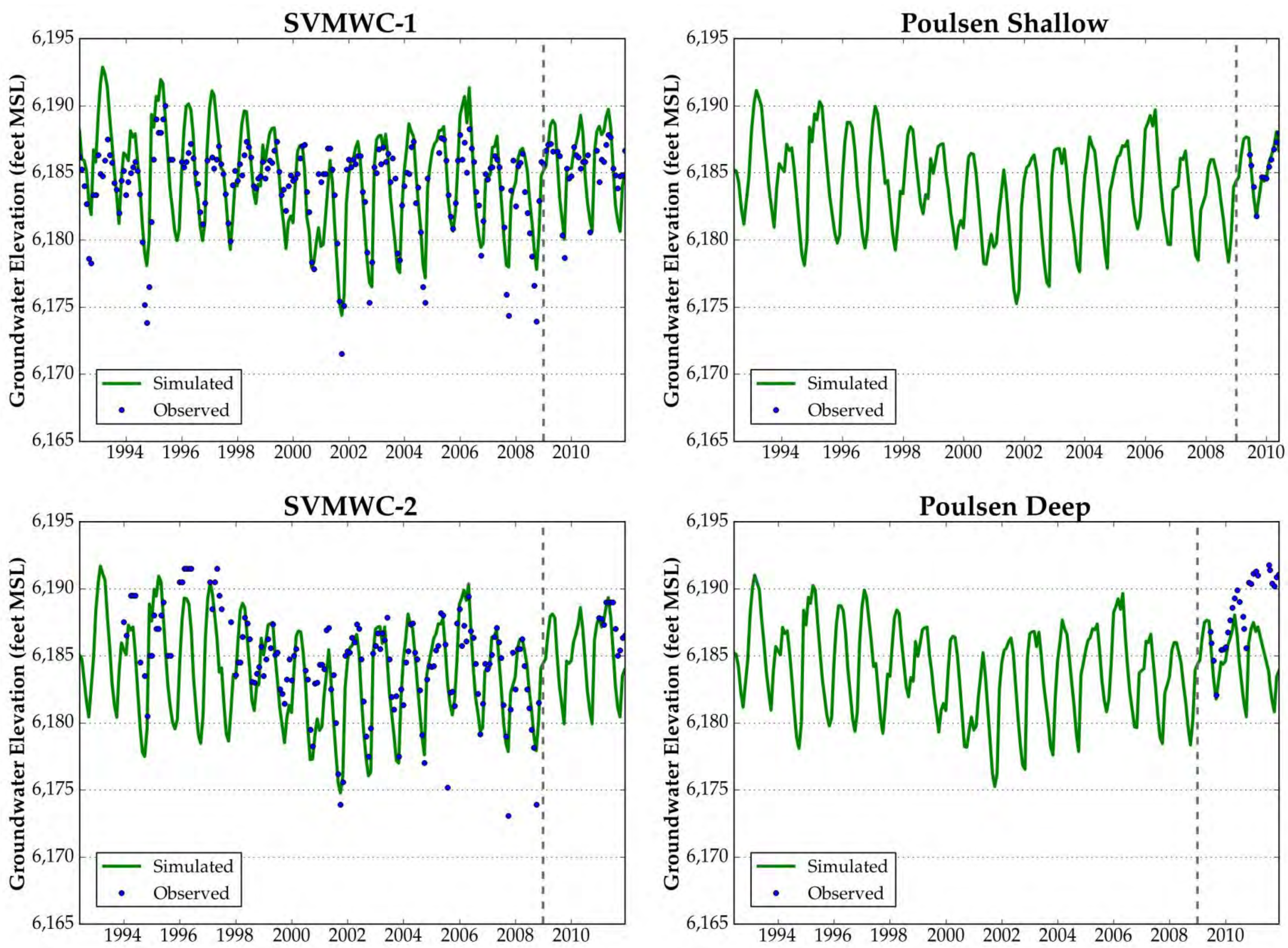
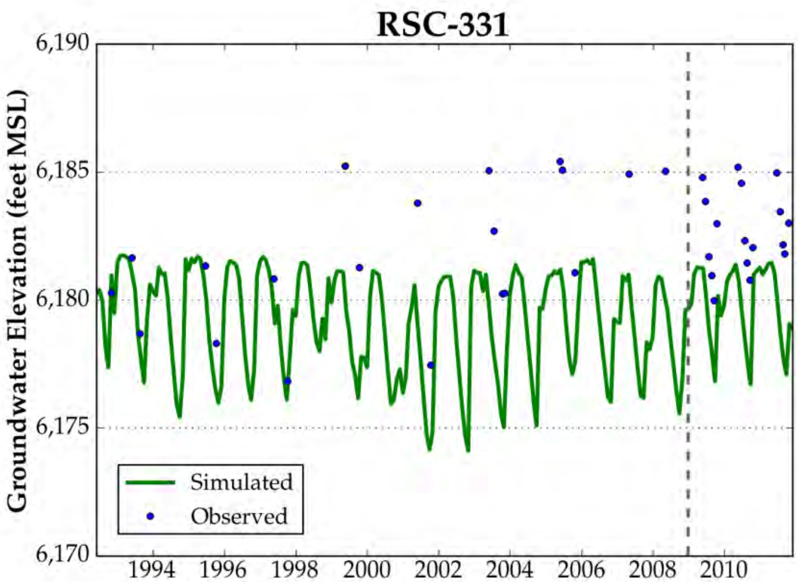
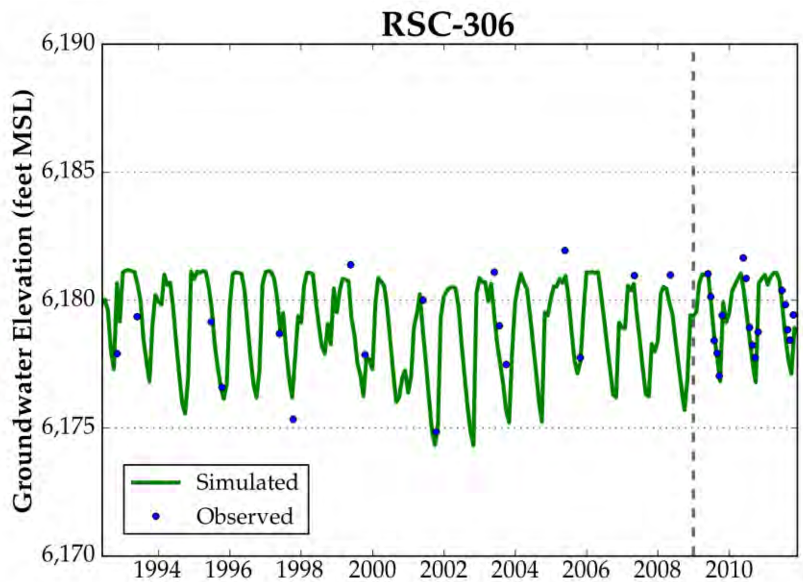
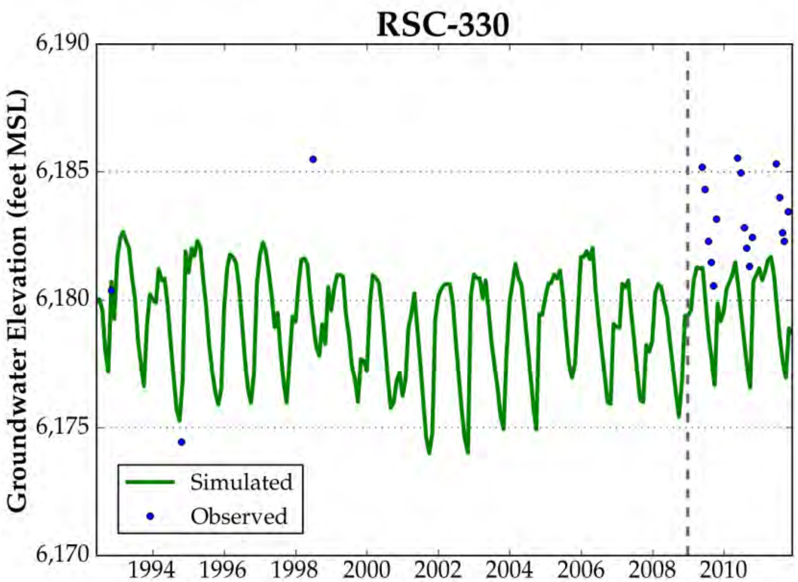
Appendix A: Measured and Simulated Hydrographs

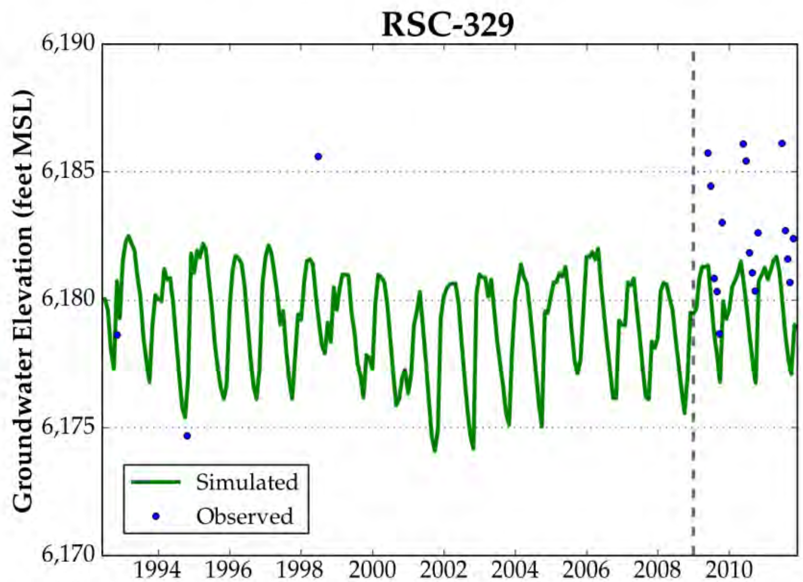

SVPSD-1R
SVPSD-5S
SVPSD-5R
SVPSD-5D
Groundwater Elevation (feet MSL)
6,200
6,195
6,190
6,185
6,180
6,175
6,170
6,165
6,160
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed

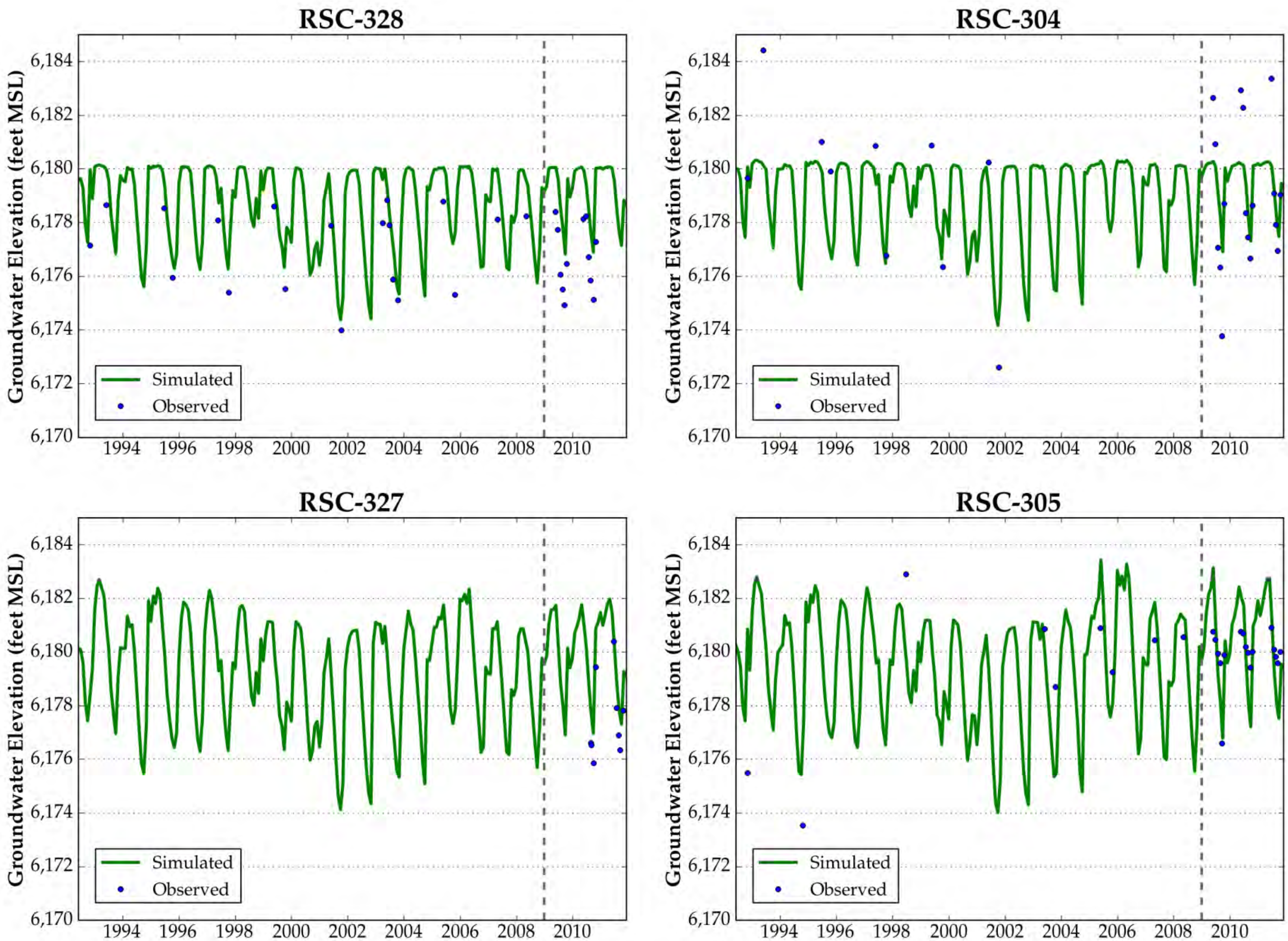

SVMWC-1
Poulsen Shallow
SVMWC-2
Poulsen Deep
Groundwater Elevation (feet MSL)
6,195
6,190
6,185
6,180
6,175
6,170
6,165
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed

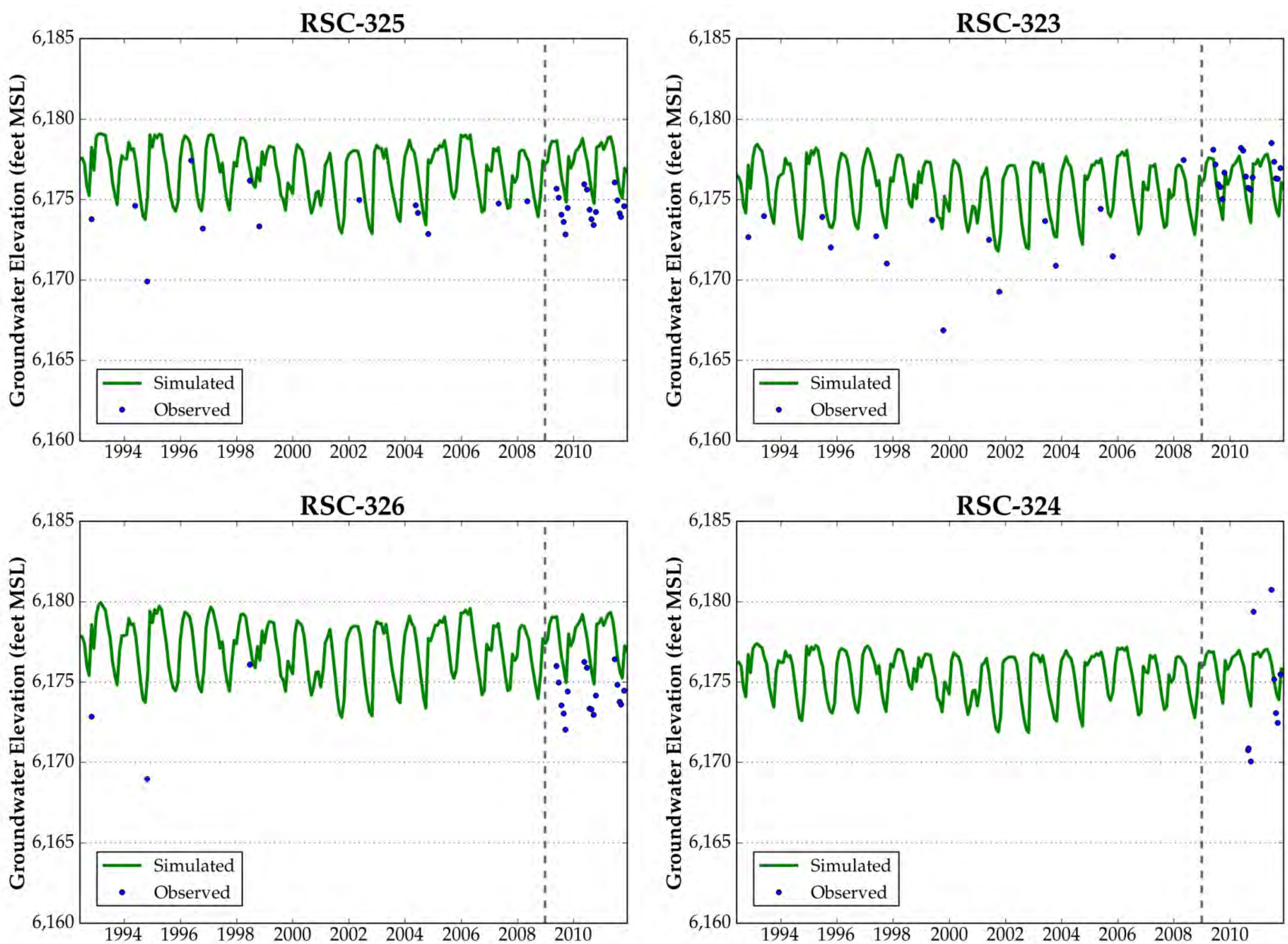

RSC-331
Groundwater Elevation (feet MSL)
6,190
6,185
6,180
6,175
6,170
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed

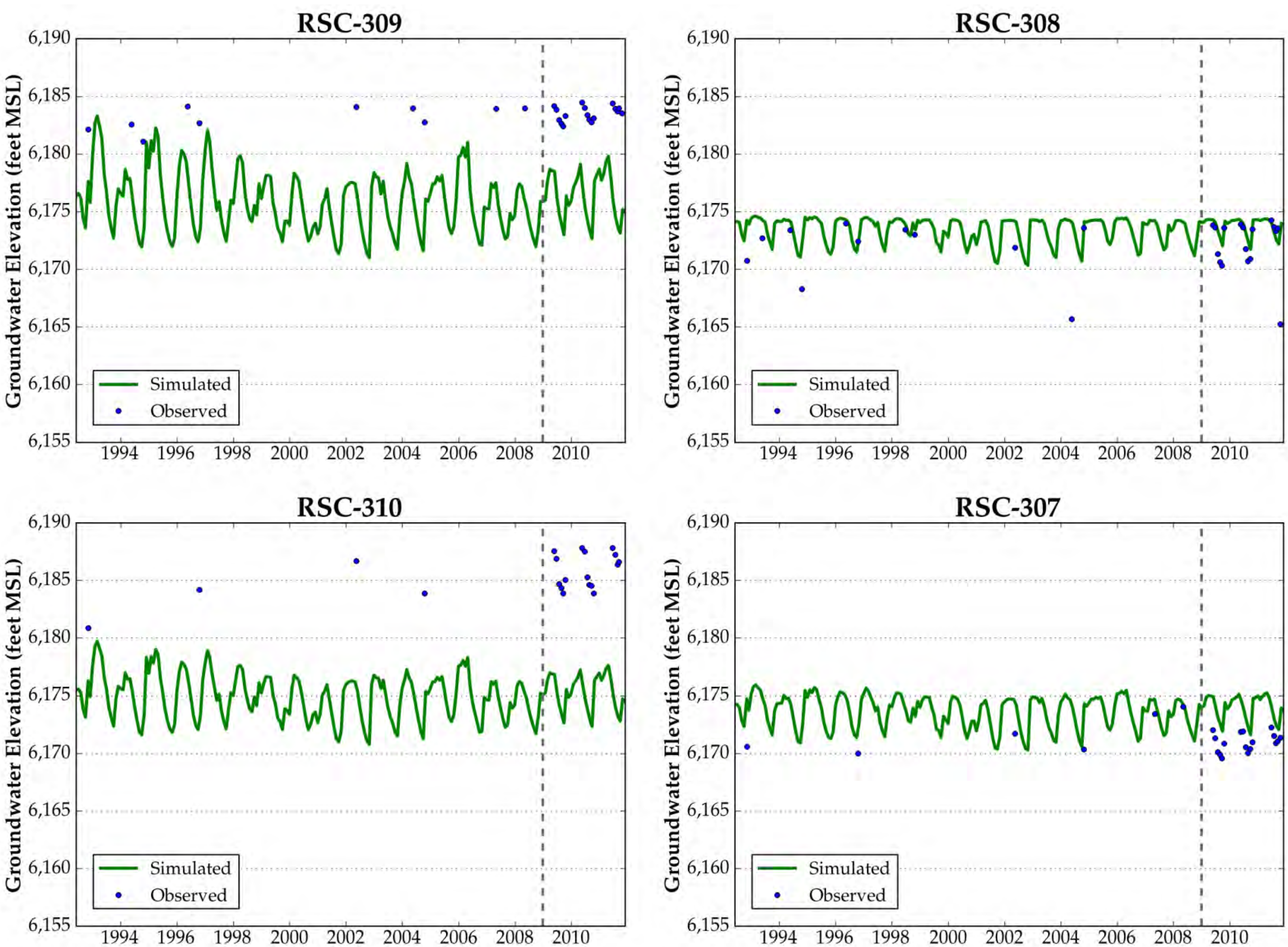

RSC-306
Groundwater Elevation (feet MSL)
6,190
6,185
6,180
6,175
6,170
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-330
Groundwater Elevation (feet MSL)
6,190
6,185
6,180
6,175
6,170
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-329
Groundwater Elevation (feet MSL)
6,190
6,185
6,180
6,175
6,170
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-328
RSC-304
RSC-327
RSC-305
Groundwater Elevation (feet MSL)
6,170
6,172
6,174
6,176
6,178
6,180
6,182
6,184
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-325
RSC-323
RSC-326
RSC-324
Groundwater Elevation (feet MSL)
6,185
6,180
6,175
6,170
6,165
6,160
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed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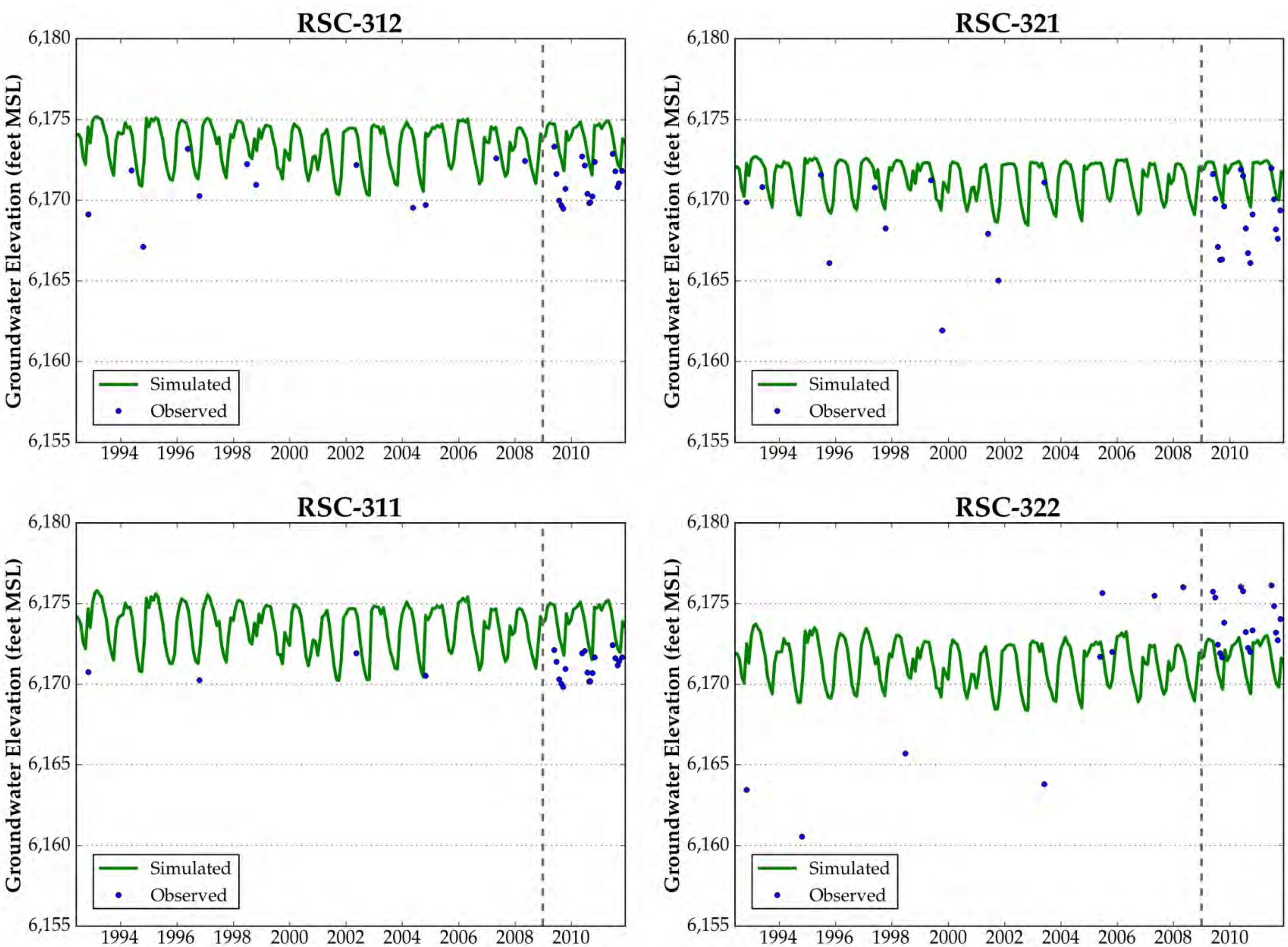
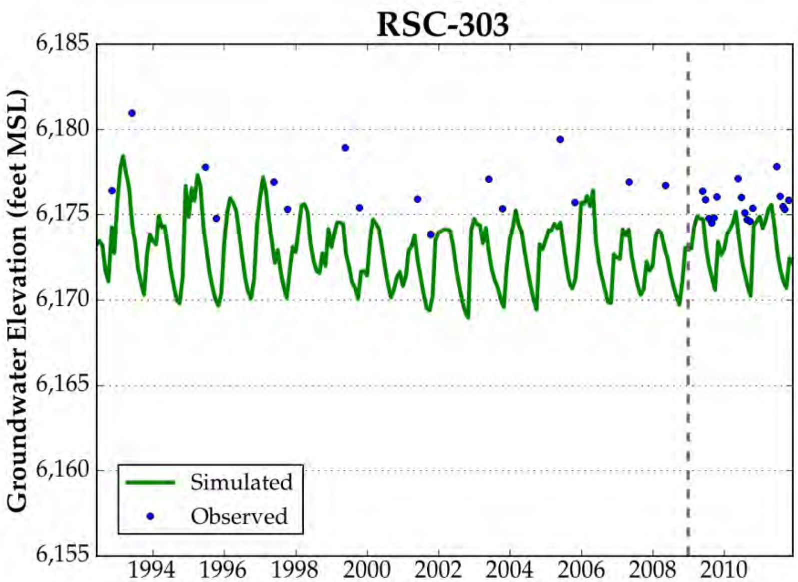
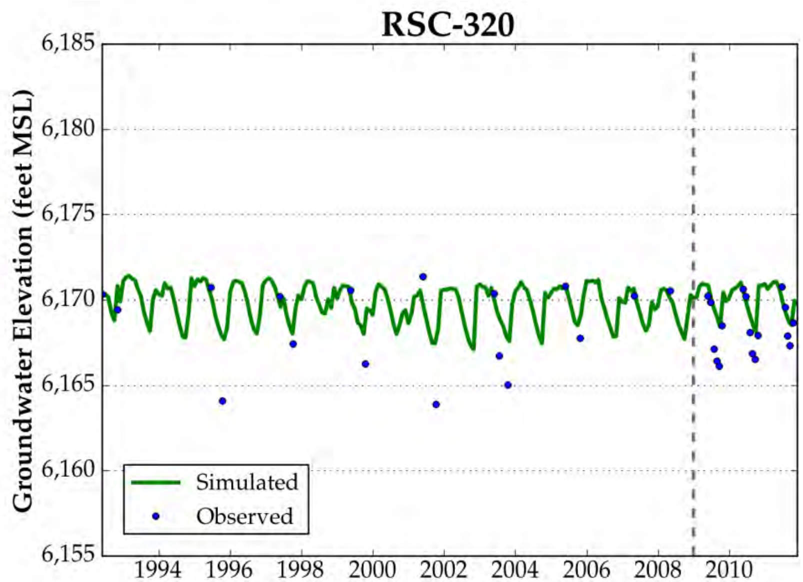
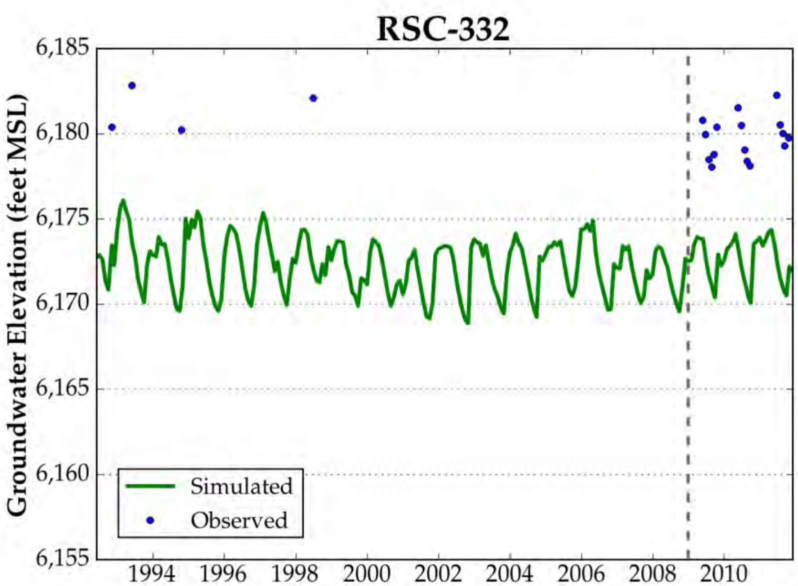
RSC-308
RSC-310
RSC-307
Groundwater Elevation (feet MSL)
6,190
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-312
RSC-321
RSC-311
RSC-322
Groundwater Elevation (feet MSL)
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-303
Groundwater Elevation (feet MSL)
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-320
Groundwater Elevation (feet MSL)
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed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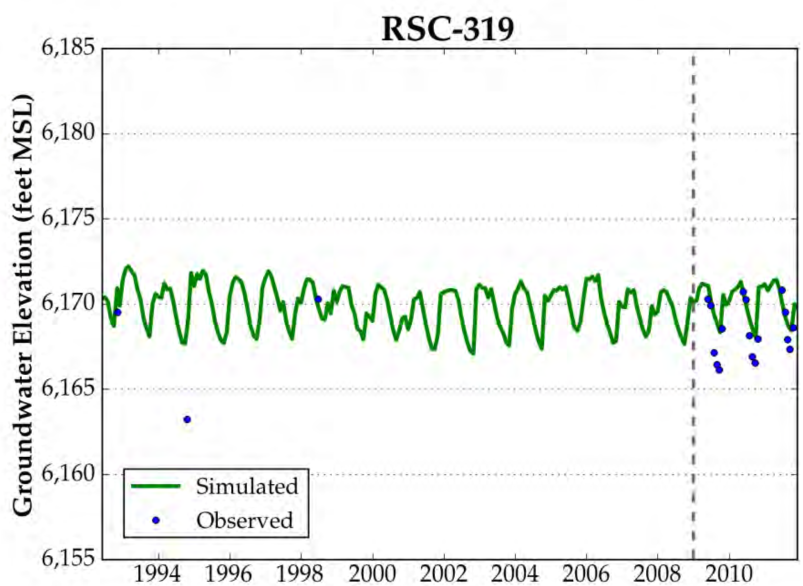
Groundwater Elevation (feet MSL)
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed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Groundwater Elevation (feet MSL)
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
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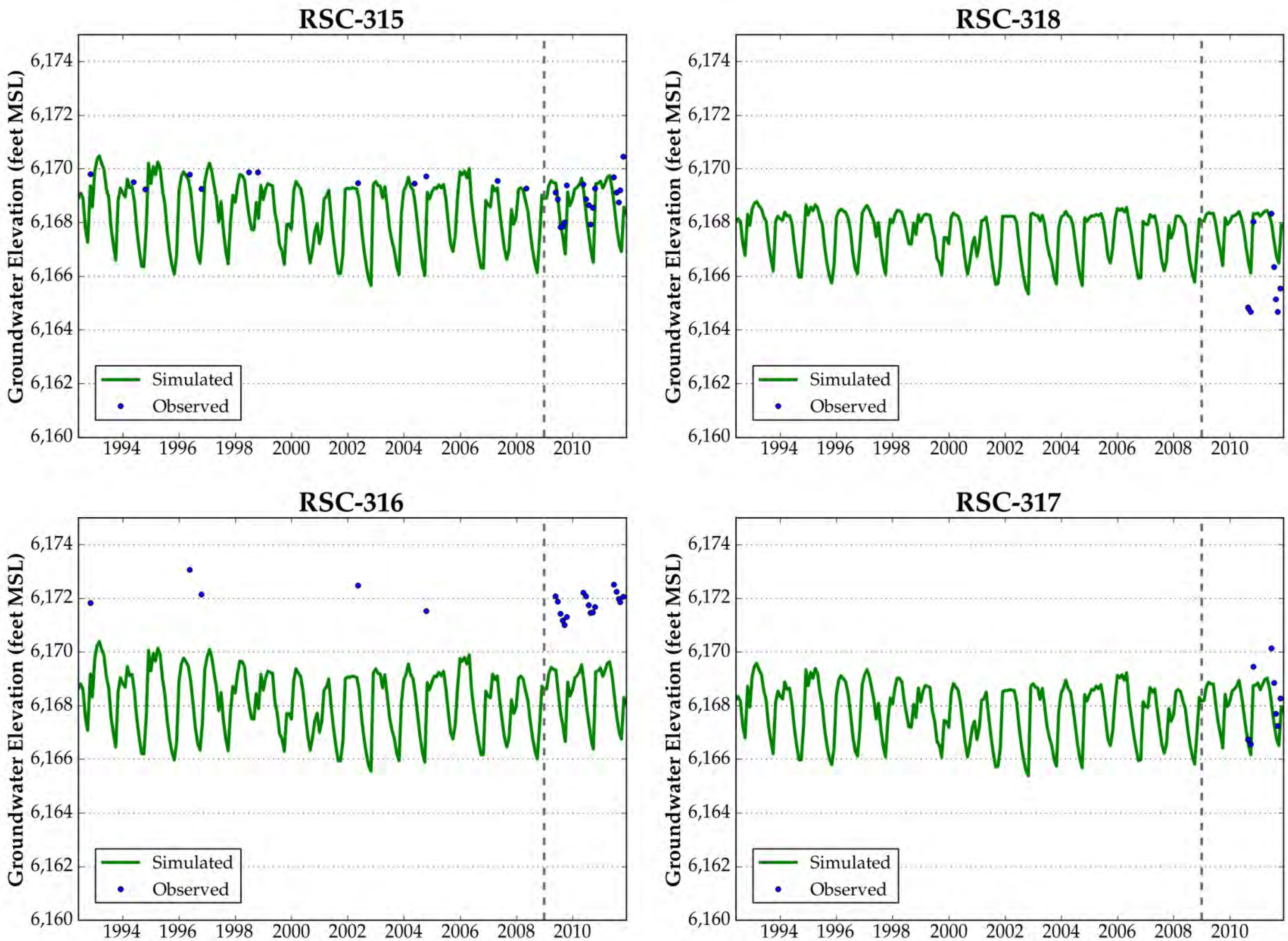
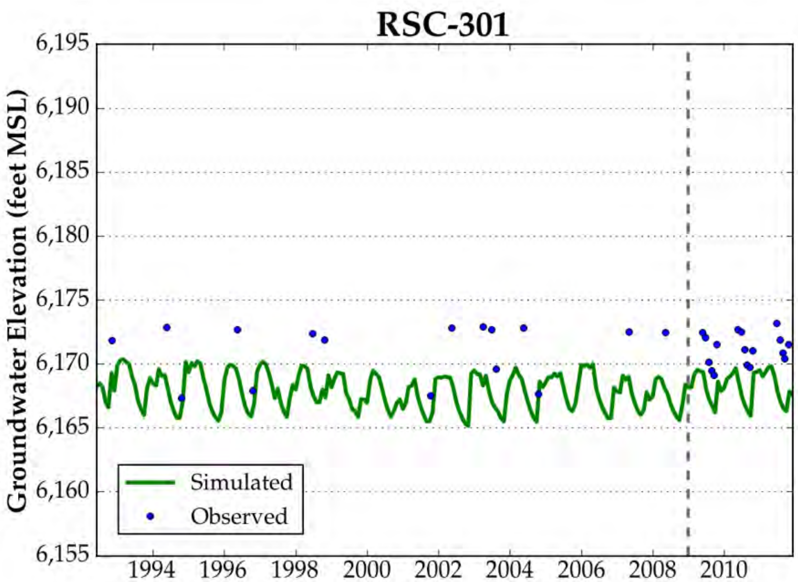
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-315
RSC-318
RSC-316
RSC-317
Groundwater Elevation (feet MSL)
6,174
6,172
6,170
6,168
6,166
6,164
6,162
6,160
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed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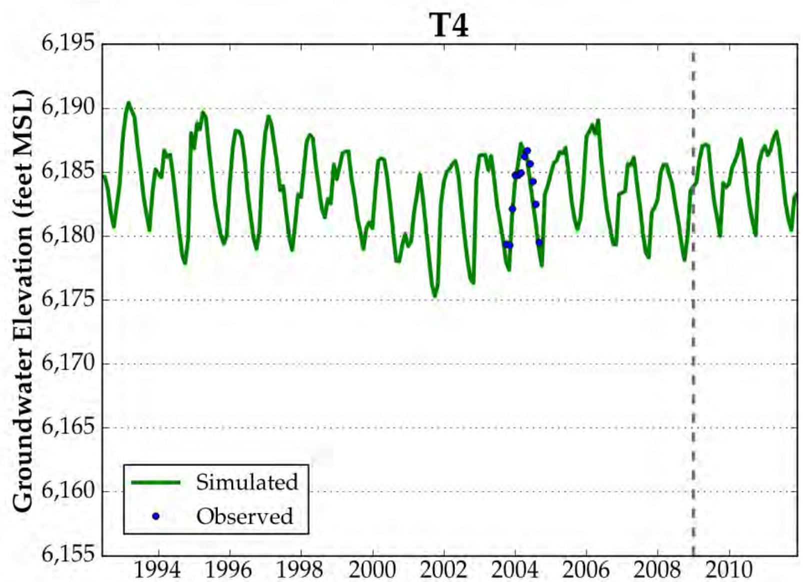
Groundwater Elevation (feet MSL)
6,195
6,190
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed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Groundwater Elevation (feet MSL)
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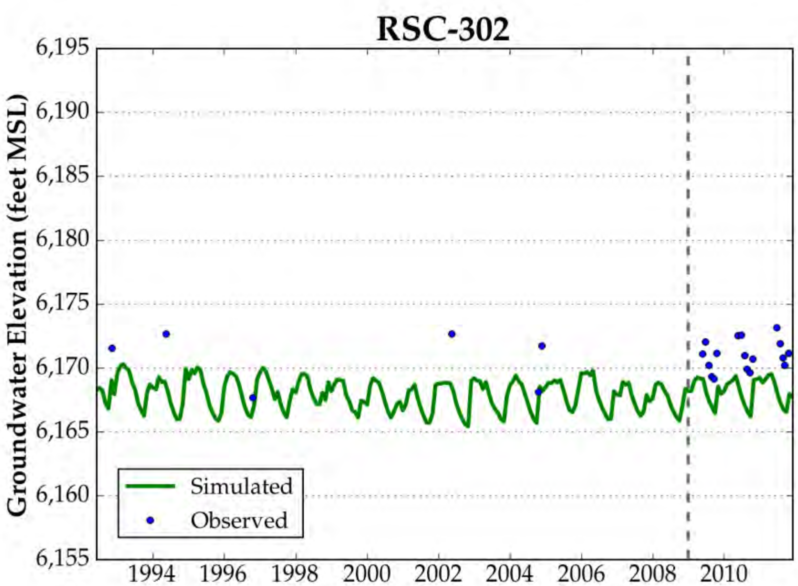
6,190
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed


RSC-302
Groundwater Elevation (feet MSL)
6,195
6,190
6,185
6,180
6,175
6,170
6,165
6,160
6,155
1994
1996
1998
2000
2002
2004
2006
2008
2010
Simulated
Observed

APPENDIX C

Squaw Valley Groundwater Update 2015

HydroMetrics, WRI, July 6, 2015

HydroMetrics WRI
1814 Franklin St, Suite 501
Oakland, CA 94612

TECHNICAL MEMORANDUM

To: Mike Geary/SVPSD

From: Derrik Williams/Sean Culkin

Date: July 6, 2015

Subject: Squaw Valley Groundwater Model 2015 Update

SECTION 1
Background and Purpose

This technical memorandum documents a recent update to the Squaw Valley groundwater model. This model update reassesses and modifies the existing groundwater flow model. The modified model simulates flow conditions up through January 2015, and is appropriate for use in future predictive scenarios and water supply assessments.

The updated model follows, and is based upon, a previous update and recalibration effort documented in a Technical Memorandum dated June 17, 2014 (Hydrometrics WRI, 2014), as well as earlier versions of the model (HydroMetrics WRI, 2013). The updated groundwater model accurately simulates groundwater levels and flow within Squaw Valley to a similar degree as in the 2014 update, and will continue to serve as an effective tool for managing groundwater pumping in Squaw Valley. The updated groundwater model can be confidently used to develop future groundwater pumping plans that minimize impacts on Squaw Creek.

SECTION 2
Model Modifications

Major structural changes to the groundwater model made in the previous version (Hydrometrics WRI, 2014) were retained in this update. No changes to the hydrostratigraphy or material properties were made during this 2015 update. The following sub-sections document the changes made to the model since 2014.

2.1 Stress Periods

The transient groundwater model consists of monthly stress periods beginning in May 1992. The previous version of the model simulated from May 1992 to December 2011. The number of stress periods was extended through (and inclusive of) January 2015 for the update presented here.

2.2 Recharge

The aerial recharge zonation of the model was retained through the current model update. Recharge to the model domain continues to consist of nine zones (Figure 1) that receive recharge from a variable combination of precipitation, irrigation return flows, pipe losses, and sewer inflow/outflow. The relative percentages of recharge from precipitation were also retained, with recharge zones assigned a recharge percentage of either 6% or 10% of precipitation to reflect the general distribution of permeable and impermeable surfaces within each zone. In addition, The precipitation delay applied to the 2014 model (Hydrometrics WRI, 2014) was retained in the current version of the model.

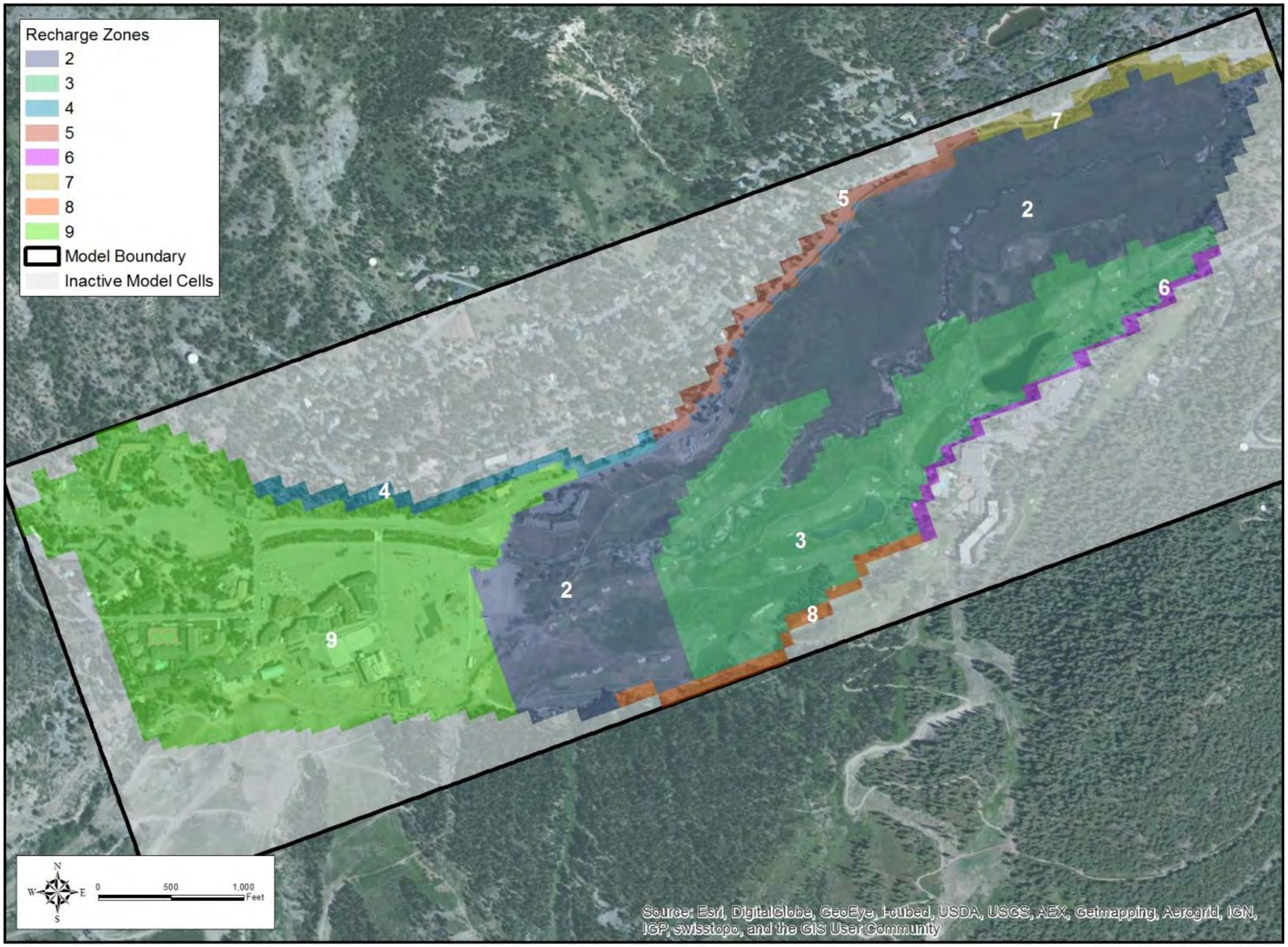


Figure 1: Recharge Zones

2.2.1 RECHARGE INFILTRATION THRESHOLD

One modification to the recharge dynamics of the model is a threshold value placed on the amount of precipitation needed before infiltration begins. For all stress periods, a maximum threshold of 1 inch of monthly precipitation was imposed before any precipitation entered the model as recharge. Conceptually, this change was applied to the model to account for the uptake of water by plants and soil resaturation prior to infiltration. The value of one inch was a calibrated parameter used to improve simulated hydrographs in summer months. This change particularly improved calibration, during recent-time monthly stress periods.

2.2.2 SEWER INFILTRATION AND EXFILTRATION

Sewer infiltration and exfiltration are calculated similarly to the previous model. Figure 2 shows that groundwater gains and losses from sewer infiltration and exfiltration remain a minor component of the Valley's water budget through 2014. This plot also demonstrates the relatively low monthly recharge from rainfall over the past several years. The rainfall recharge data plotted in Figure 2 reflect the threshold modification described in Section 2.2.1.

The annual net sewer gains and losses can be derived by summing annual sewer exfiltration with total annual sewer infiltration. Figure 3 shows the annual net sewer gains and losses as a percent contribution to total recharge in the updated version of the model. The net sewer gains and losses average 0.99% of all recharge for the period of 1993 through 2014. The apparent increase in proportional sewer contribution to recharge is likely due to the relatively low annual precipitation totals over the last several years.

2.2.4 STREAM FLOW

Streamflow inputs to the model were updated for the simulated time period up to and including January 2015, and applied to the model as in previous versions. Streamflow data was obtained from gauges in the North Fork (Shirley Canyon) and South Fork reaches of Squaw Creek. These data were obtained from the Friends of Squaw Creek website.

2.2.5 PUMPING AND MONITORING WELLS

Groundwater extraction was simulated from 14 pumping wells within the model domain, listed below:

Squaw Valley Resort Production Wells	Squaw Valley Resort – Children's W
	Squaw Valley Resort – Children's N
	Squaw Valley Resort – Children's S
	Squaw Valley Resort – Cushing
RSC Irrigation Wells	RSC-18-1
	RSC-18-2
	RSC-18-3R
SVMWC Production Wells	SVMWC-1
	SVMWC-2
SVPSD Production Wells	SVPSD-1
	SVPSD-1R
	SVPSD-2/SVPSD-2R
	SVPSD-3
	SVPSD-5/5R

For all pumping wells, monthly total flow rates were applied to each monthly stress period through January 2015. Pumping was distributed among the three RSC wells slightly differently than in previous models. The Resort at Squaw Creek does not measure pumping at individual wells; instead it measures total delivered water and divides that amount among its three operating wells. RSC has changed the methodology for dividing delivered water among its three wells over the years. For the current model, pumping was redistributed between the three wells for all years based on the most recent RSC methodology. This redistribution had little noticeable effect on the calibration or water budget of the groundwater flow model, as the cumulative outflow from the three RSC wells did not change from previous versions of the model.

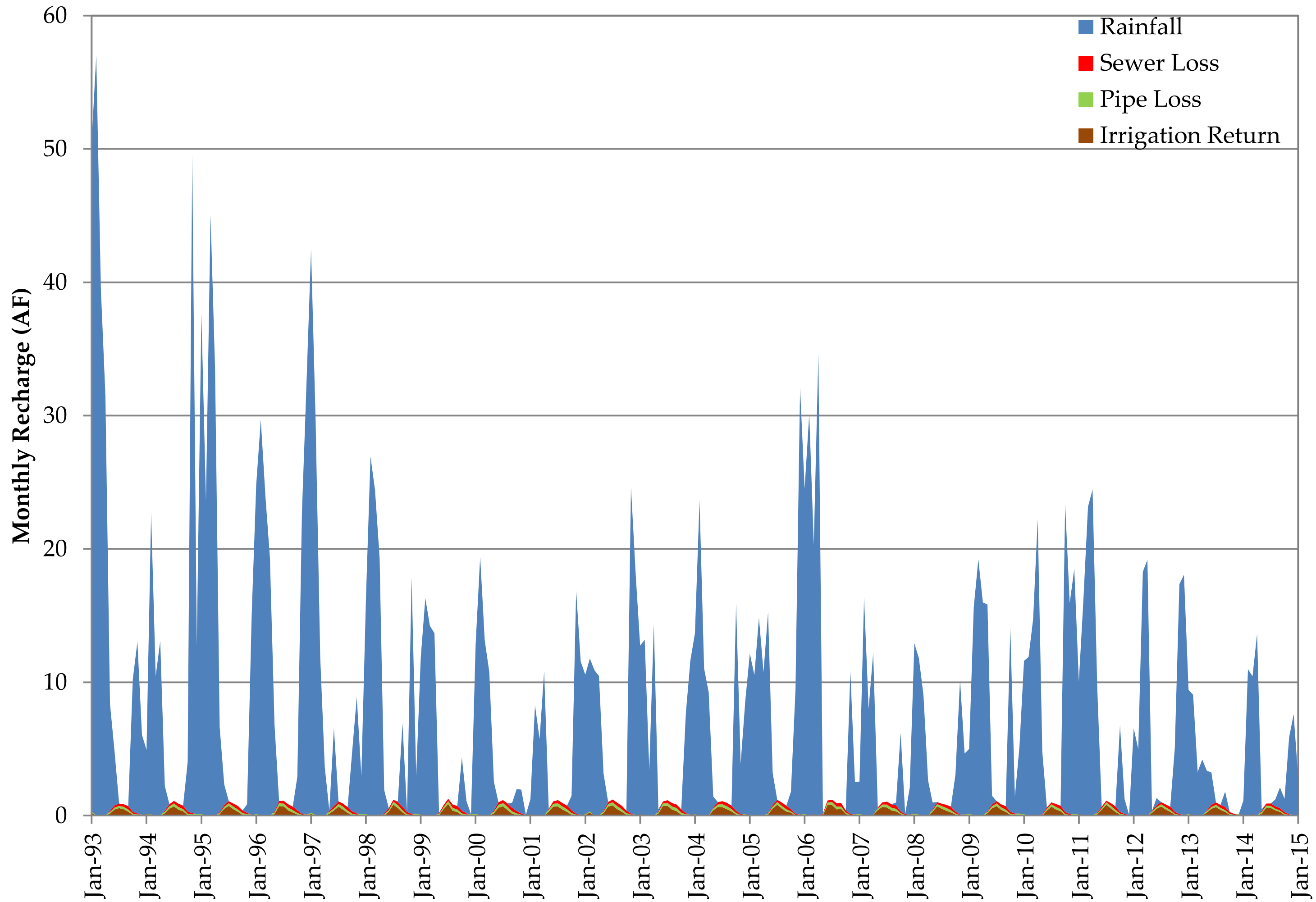


Figure 2: Monthly Recharge by Source for WSA Scenario

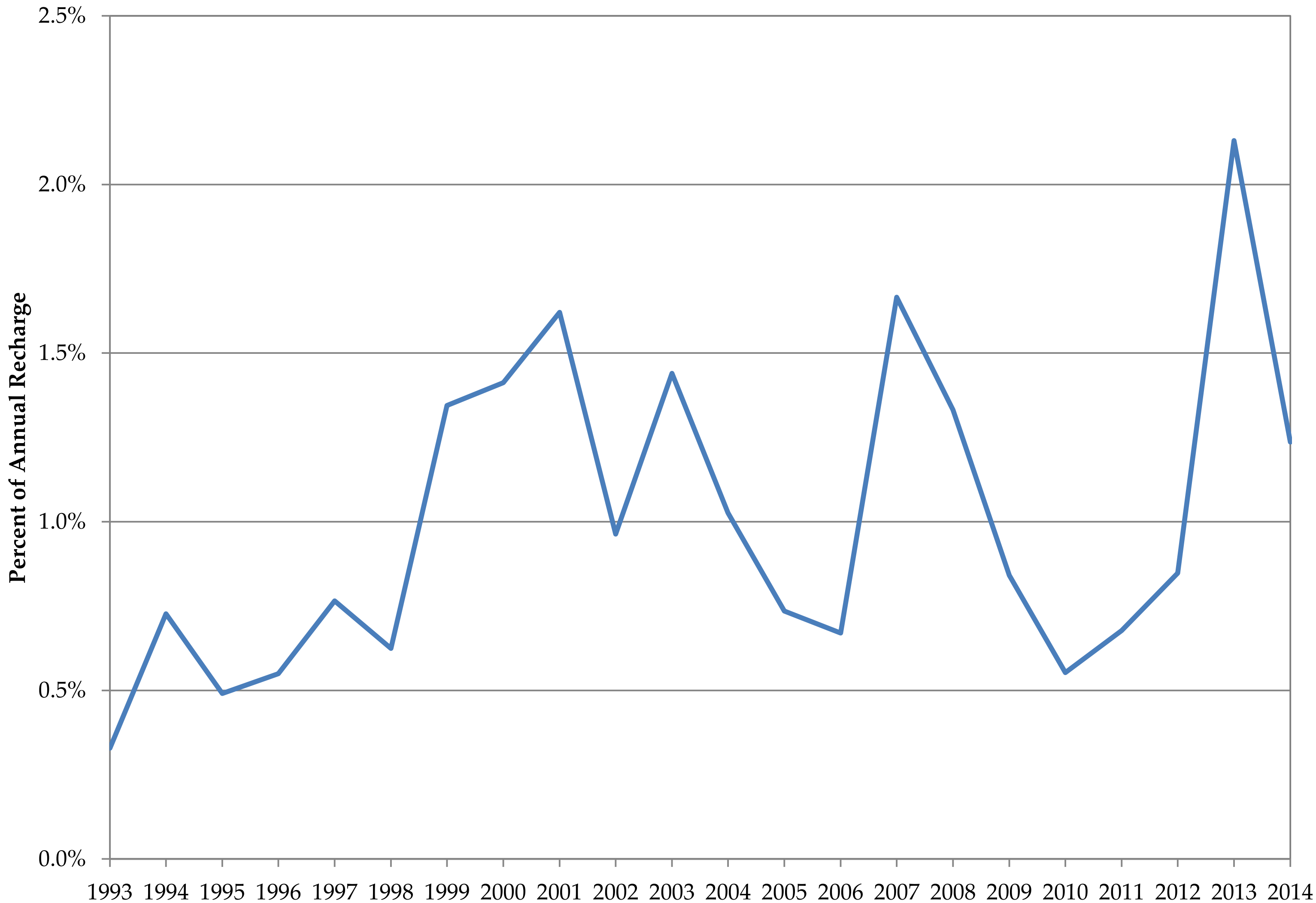


Figure 3: Sewer Leakage Percent of Annual Recharge for WSA Scenario

SECTION 3
Model Calibration

3.1 APPROACH

Previous calibration efforts on the regional groundwater flow model involved successive attempts to match model output to measured data from the calibration period. The 2015 model update built upon calibration efforts performed in 2014 and documented in the Technical Memorandum dated June 17, 2014 (HydroMetrics WRI, 2014). Unlike the calibration procedures described in that document, no changes to the material properties or boundary conditions were made to the current version of the model. Only changes to the amount of precipitation entering the model, as described in Section 2.2.1, were made in the interest of improving model fit.

3.2 CALIBRATION RESULTS

3.2.1 GROUNDWATER ELEVATION CALIBRATION

The degree of calibration achieved by the groundwater flow model was evaluated by comparing simulated groundwater elevations with observed groundwater elevations measured at monitoring and production wells, and the differences between simulated and observed values were analyzed per generally-accepted statistical methods. The well locations used for calibrating the groundwater flow model are shown on Figure 4.

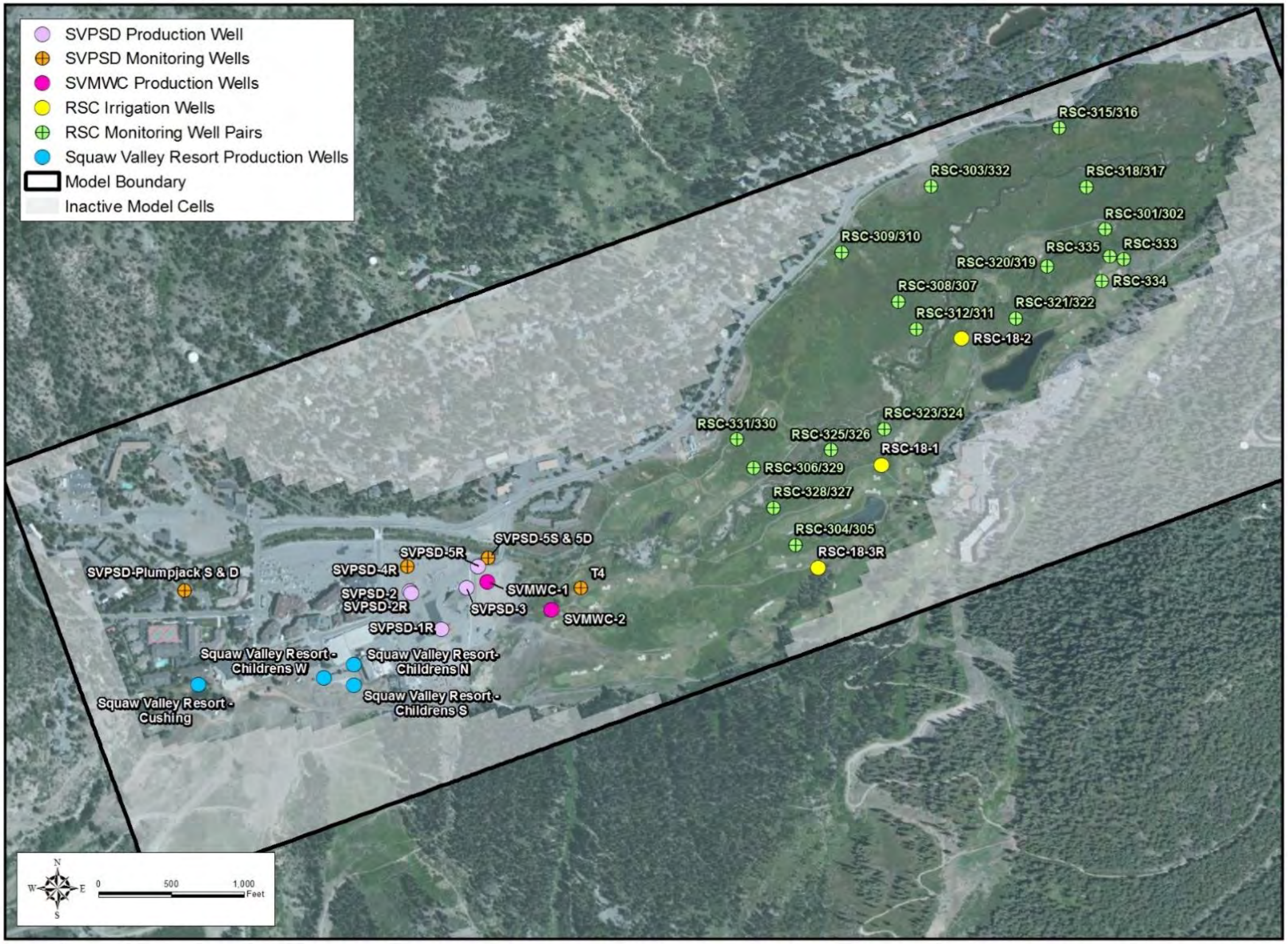


Figure 4: Target Well Locations

A complete set of hydrographs showing both observed and simulated groundwater elevations are included in Appendix A. These hydrographs show that the simulated groundwater elevations generally track measured groundwater elevations well, particularly between 2012 and 2014.

Various graphical and statistical methods can be used to demonstrate the magnitude and potential bias of the calibration errors. Figure 5 shows all simulated groundwater elevations plotted against observed groundwater elevations for the time period covering May 1992 through January 2015. Results from a unbiased model will scatter around a 45° line on this graph. Models that have a bias either overestimating or underestimating groundwater elevations will exhibit results that tend to cluster above or below this line, respectively.
Figure 5 demonstrates that the results tend to cluster slightly below the 45° line, with suggests a minor bias towards underestimating average groundwater levels. This is likely due to the fact that the model cannot simulate the measured groundwater elevations that are above ground surface in the meadow area, where the RSC observation wells are located. This bias is reflected on Figure 6, which plots model residuals along the range of observed groundwater elevations, and shows that a slightly denser distribution of residuals which fall below the "zero" line of residual values, relative to above that line.

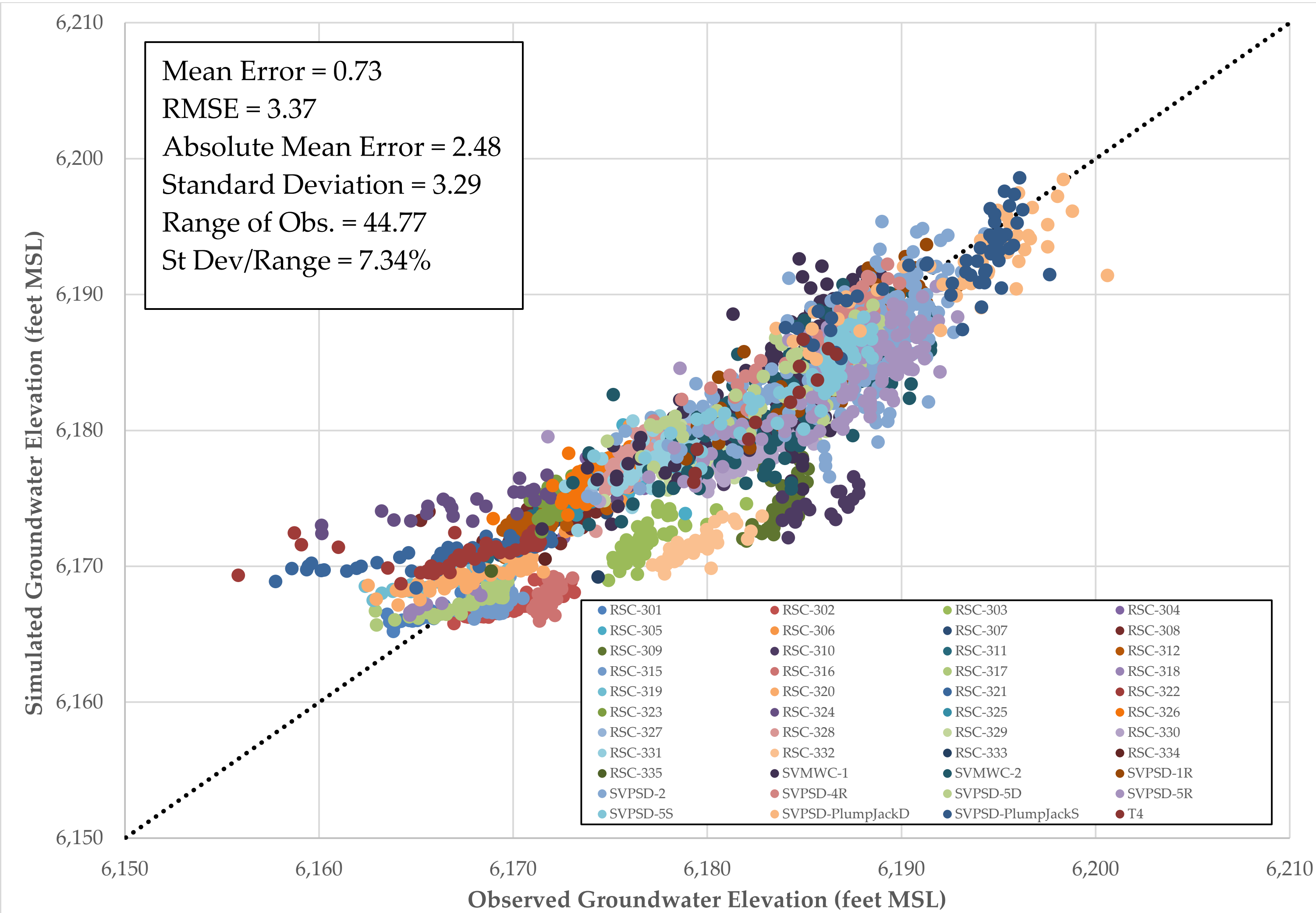


Figure 5: Simulated Versus Observed Groundwater Elevations

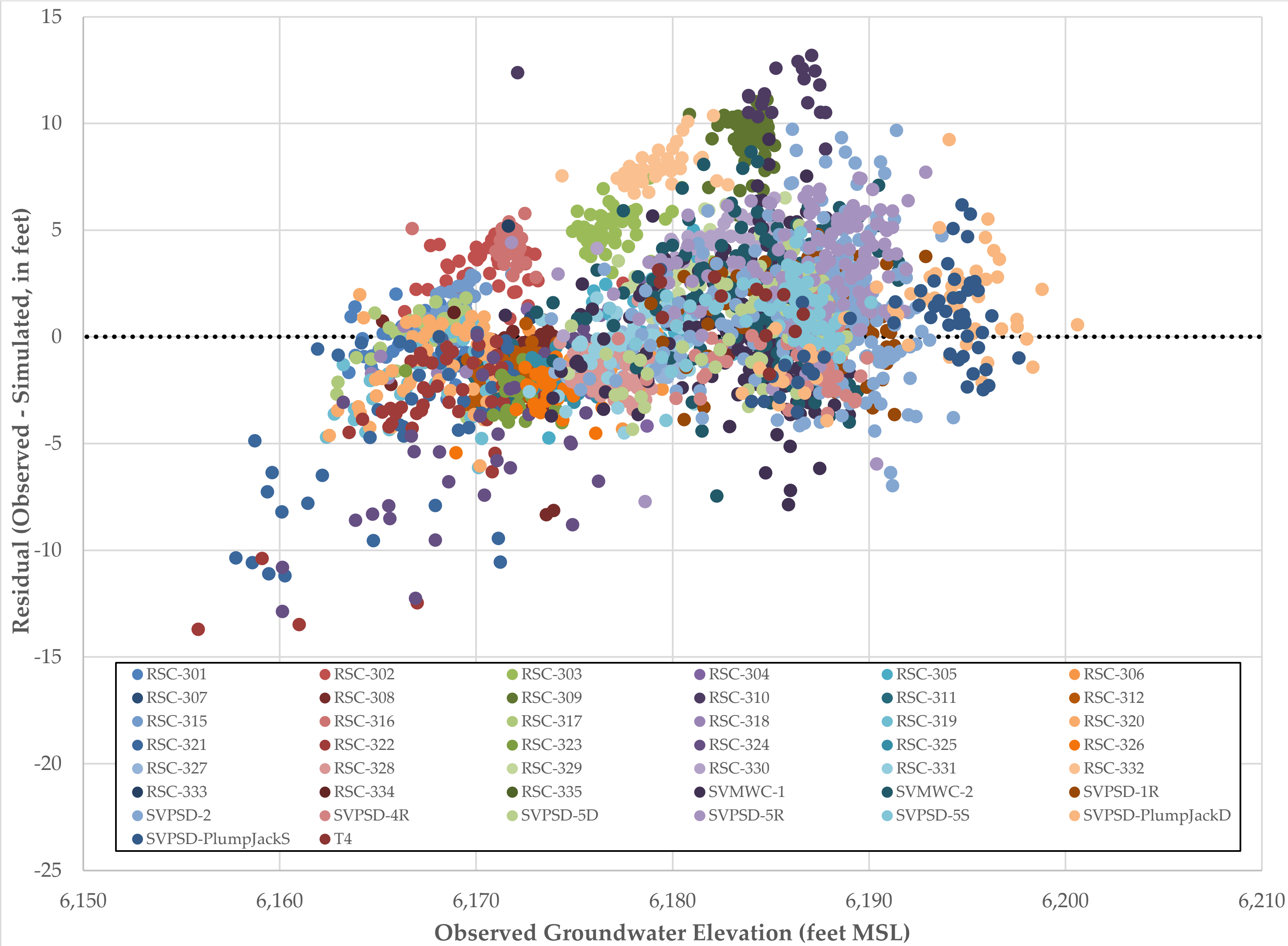


Figure 6: Observed Groundwater Elevations versus Model Residual

Figure 5 also includes various calibration statistics. The four statistical measures used to evaluate calibration are the mean error (ME), the mean absolute error (MAE), the standard deviation of the errors (STD), and the root mean squared error (RMSE). Each of these statistical measures was calculated using weighted measurements, where all weights have been normalized such that the sum of all weights is equal to one.

The ME is the average error between measured and simulated groundwater elevations for all data on Figure 5.

$$ME = \sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i$$

Where h_m is the measured groundwater elevation, h_s is the simulated groundwater elevation, w_i is the normalized observation weight and n is the number of observations.

The MAE is the average of the absolute differences between measured and simulated groundwater elevations.

$$MAE = \sum_{i=1}^{n} w_i \left|h_m - h_s\right|_i$$

The STD of the errors is one measure of the spread of the errors around the 45º line on Figure 5. The population standard deviation is used for these calculations.

$$STD = \sqrt{\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i^2 - \left(\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i\right)^2}$$

The RMSE is similar to the STD of the error. It also measures the spread of the errors around the 45º line on Figure 5, and is calculated as the square root of the average squared errors.

$$RMSE = \sqrt{\sum_{i=1}^{n} w_i \left(h_m - h_s\right)_i^2}$$

As a measure of successful model calibration, the ratio of the spread of the errors to the total head range in the system should be small to ensure that the errors are only a small part of the overall model response. According to Anderson and Woessner (1992), the RMSE should be less than 10% of the total range of observed heads in the model. The RMSE of 3.37, as shown on Figure 5, is approximately 7.53% of the total head range of 44.77 feet. A second general rule that is occasionally used is that the mean error should be less than 5% of the total range of observed heads in the model. The mean error of 0.73 is approximately 1.6% of the total head range. Therefore, on average, these calibration statistics fall within the range of generally-accepted values for a well-calibrated model.

SECTION 4
Conclusions

The recent modeling update builds upon successive historical model improvement and calibration efforts, most recently those presented in June, 2014 (Hydrometrics WRI, 2014). The model's time domain was extended through January 2015; and groundwater pumping, recharge conditions, streamflows, and observed groundwater elevations were added to the model for this recent time period. All assumptions regarding boundary conditions, hydrostratigraphy, and material properties made in previous model documentation were retained in the updated model. The amount of precipitation entering the model domain as recharge was modified both to reflect our current understanding of the recharge dynamics of the Squaw Valley, as well as to improve simulated model fit to observed data, particularly for recent years. The fact that modifications to the model constrained to this relatively minor change to recharge inputs should reinforce the success of earlier calibration efforts in providing a robust platform for successive model updates and predictive simulations.

The updated and recalibrated groundwater model continues to accurately simulate groundwater levels in Squaw Valley reasonably well, and to within the generally-accepted range of calibration statistics for a well-calibrated model. The updated groundwater model continues to be an accurate and dependable tool for development of future groundwater pumping plans.

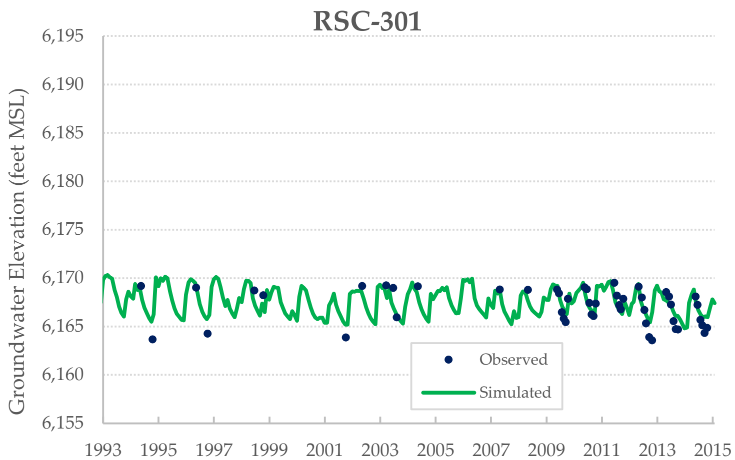
SECTION 5
References

Anderson, M.P., and W.W. Woessner. 1992. *Applied groundwater modeling, simulation of flow and advective transport,* Academic Press, Inc., San Diego, California, 381 p.

HydroMetrics WRI. 2013. *Squaw Valley creek/aquifer study model update report*, prepared for Squaw Valley Public Service District, November, 49 p.

HydroMetrics WRI. 2014. *Technical memorandum, Squaw Valley Groundwater model 2014 Recalibration*, prepared for Squaw Valley Public Service District, June, 36 p.

Appendix A: Measured and Simulated Hydrographs


RSC-301
Groundwater Elevation (feet MSL)
6,195
6,190
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6,180
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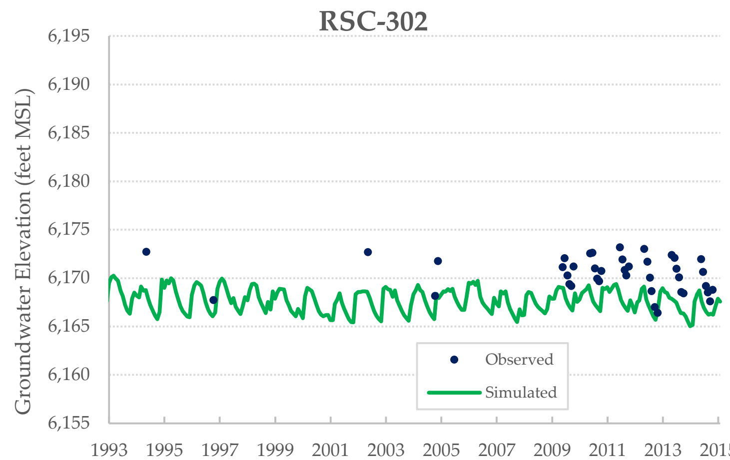
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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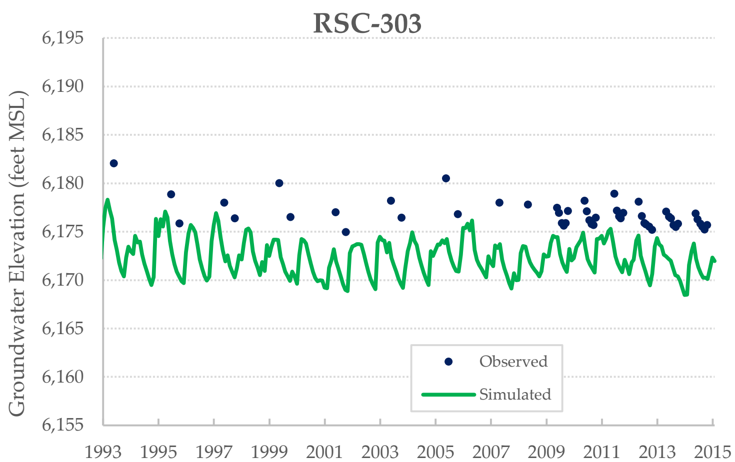
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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Groundwater Elevation (feet MSL)
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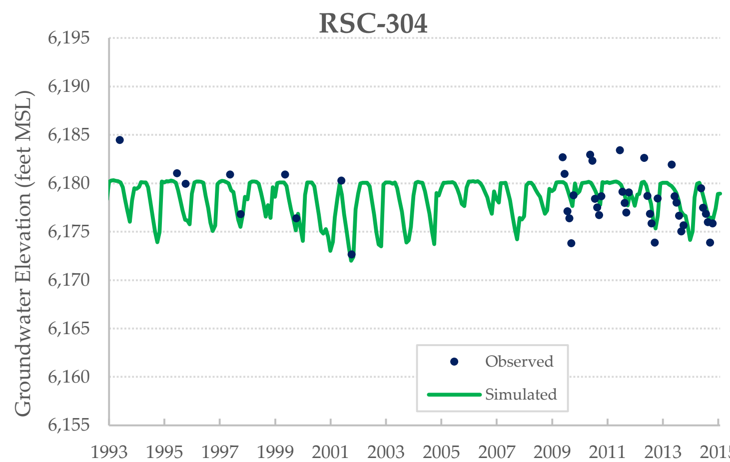
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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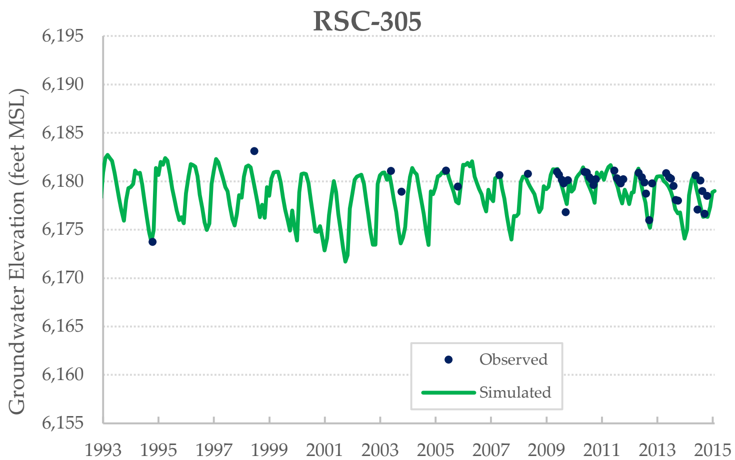
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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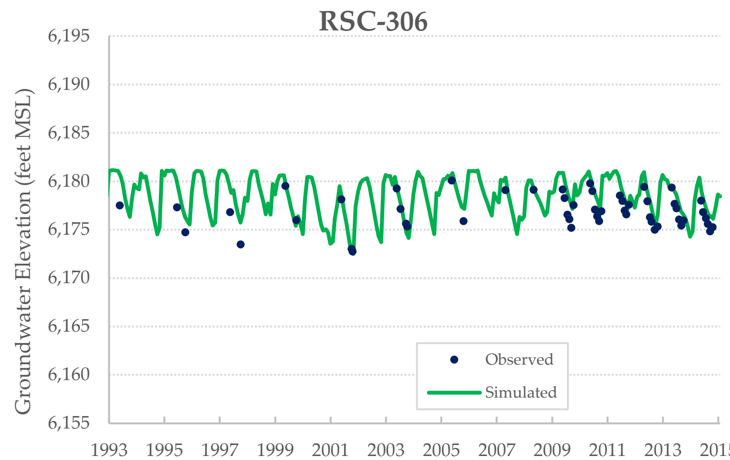
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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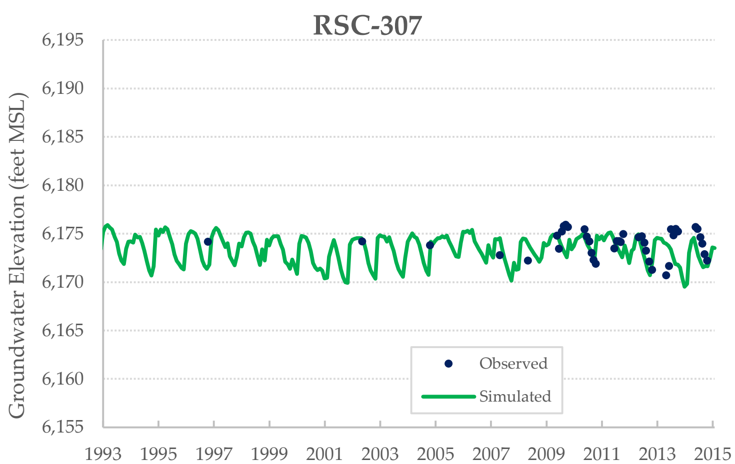
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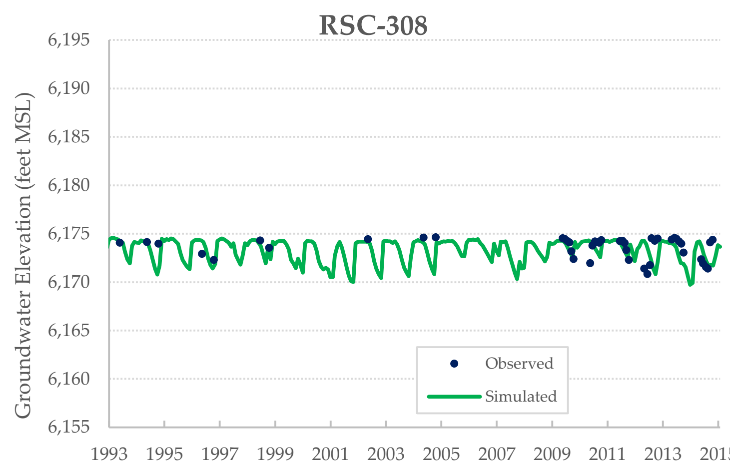
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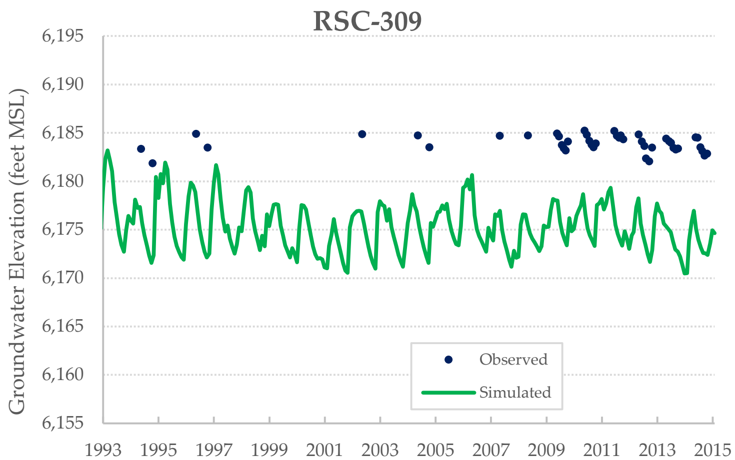
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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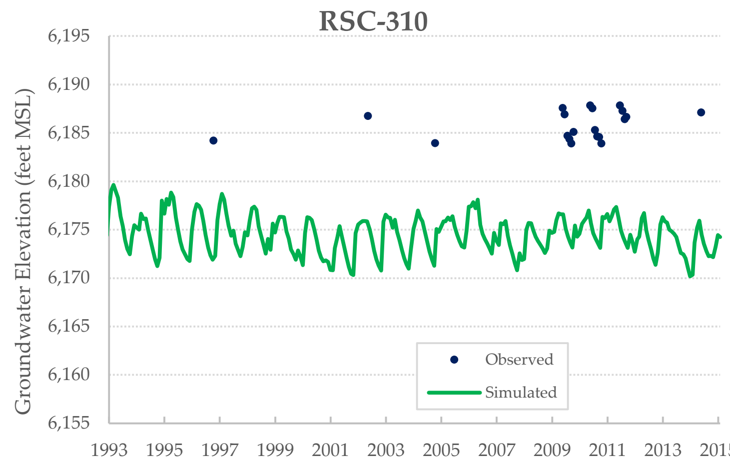
Simulated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Groundwater Elevation (feet MSL)
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Observed
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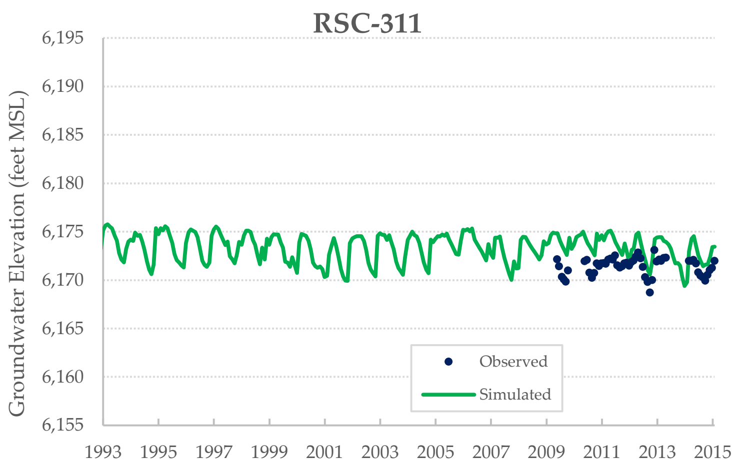
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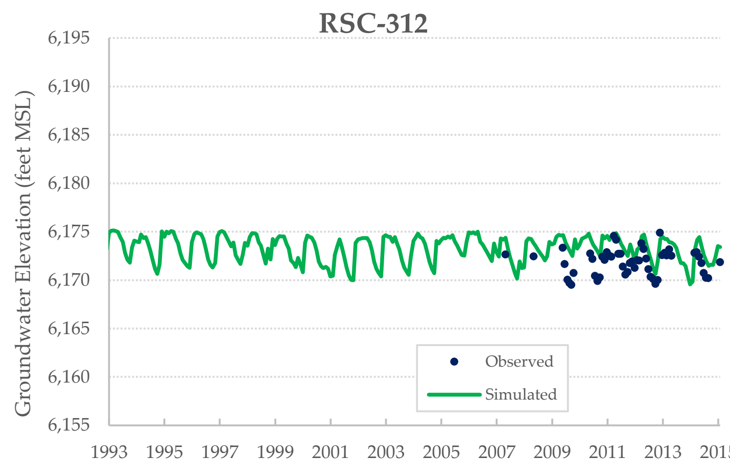
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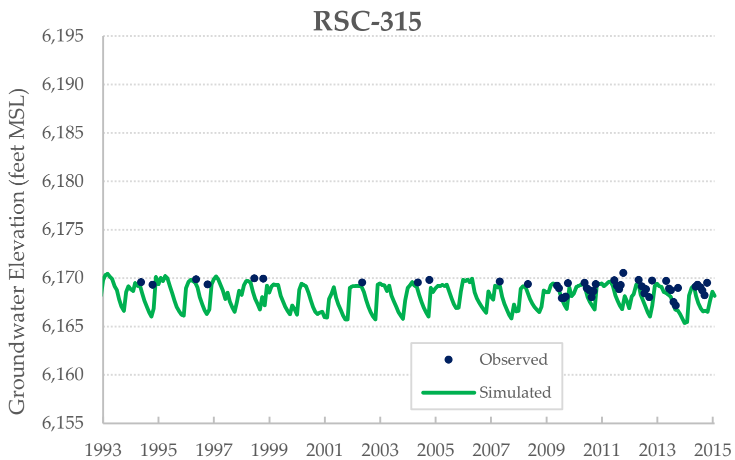
Observed
Simulated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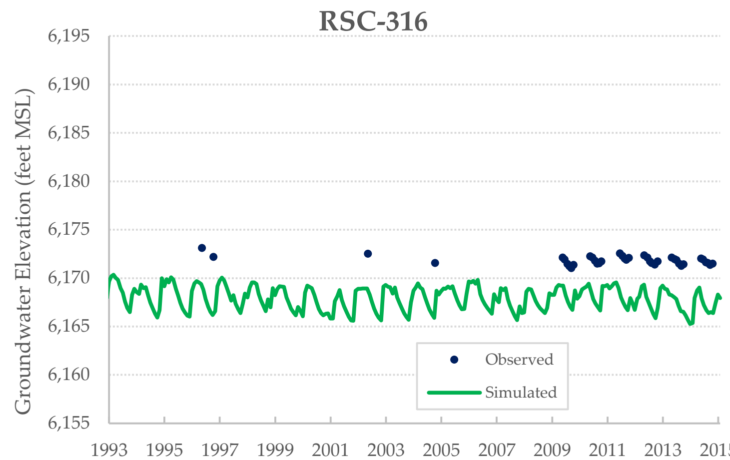
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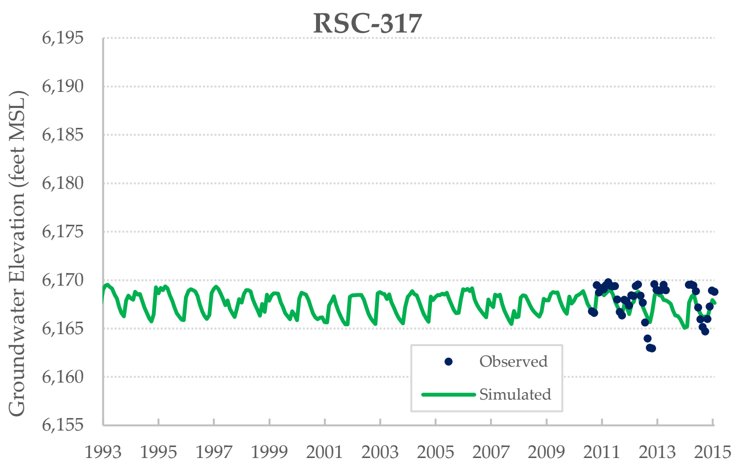
Observed
Simulated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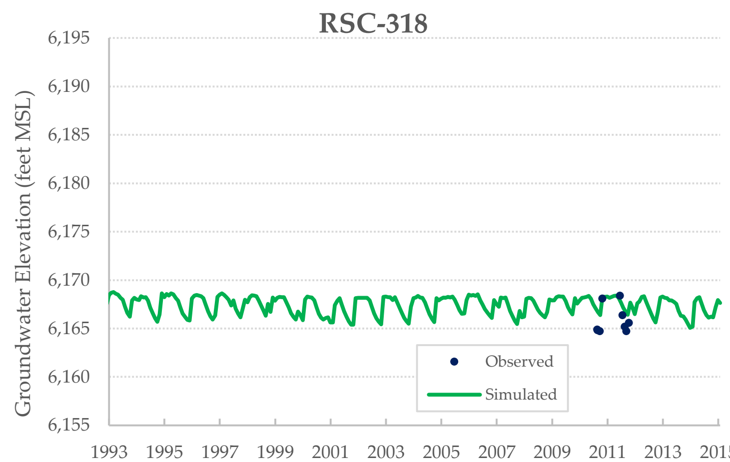
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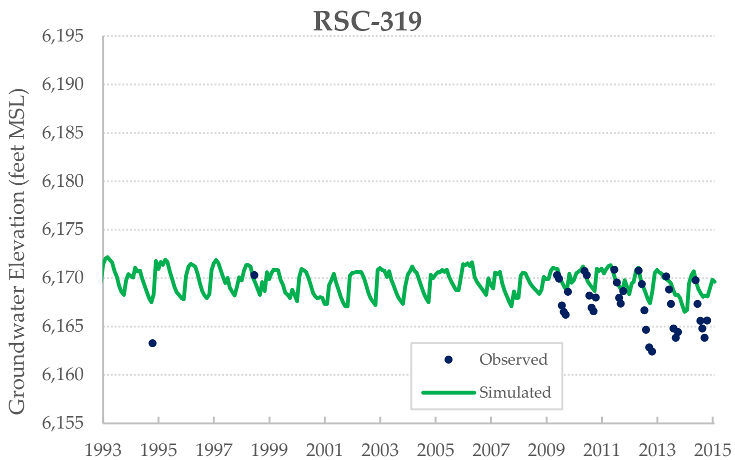
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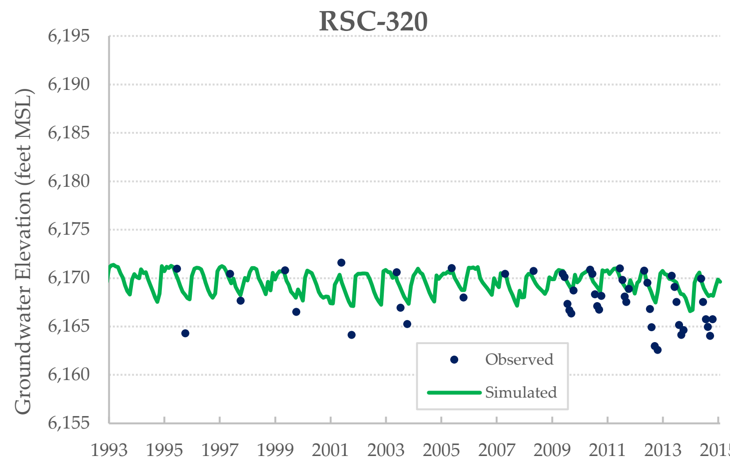
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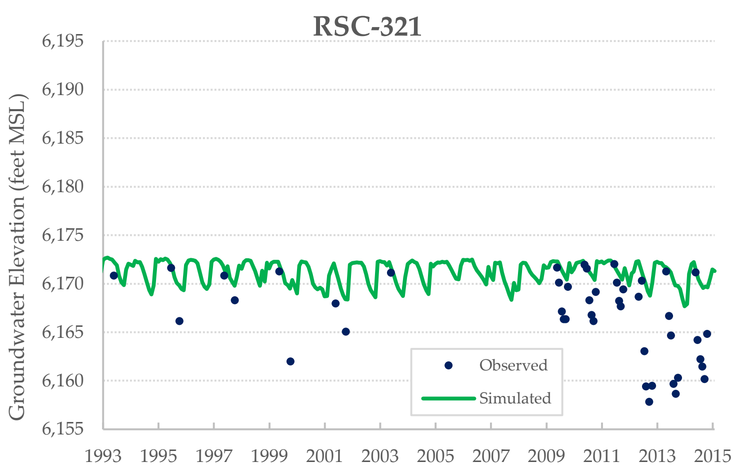
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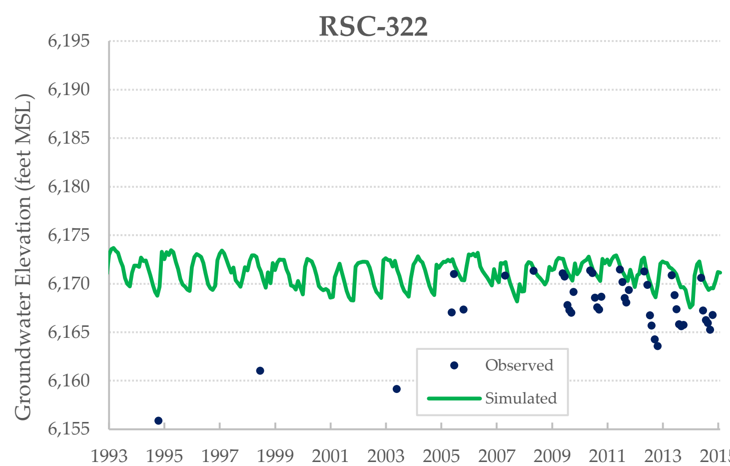
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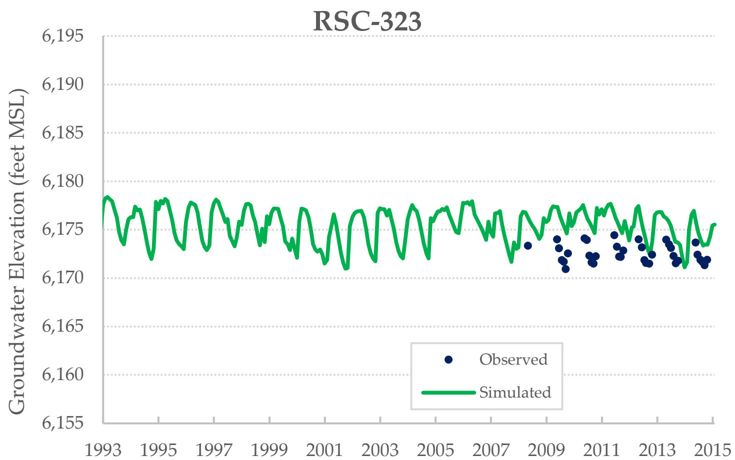
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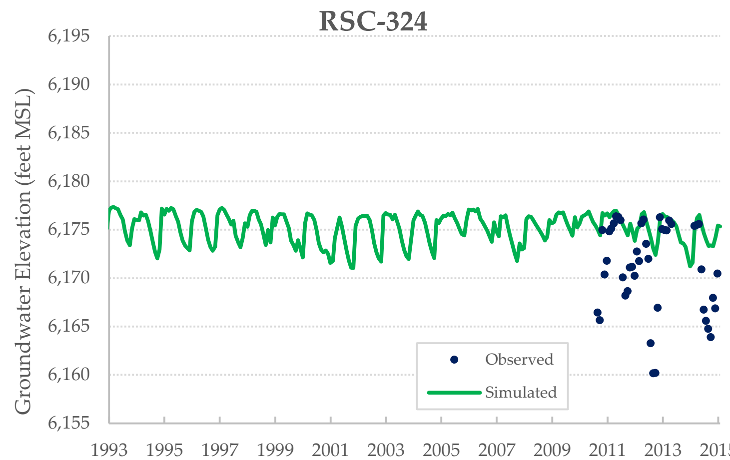
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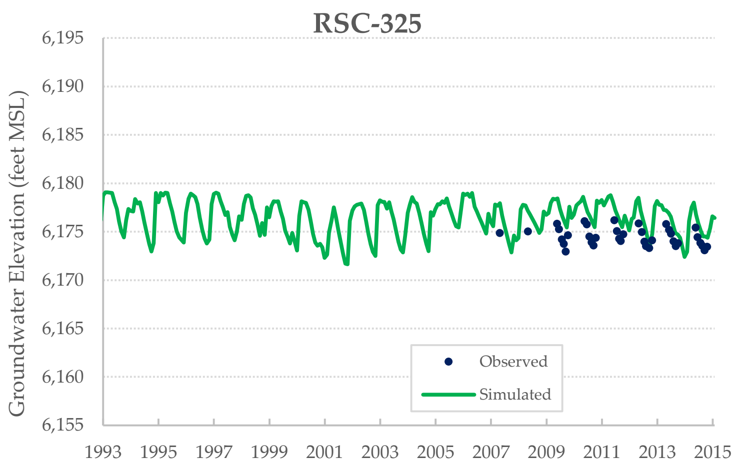
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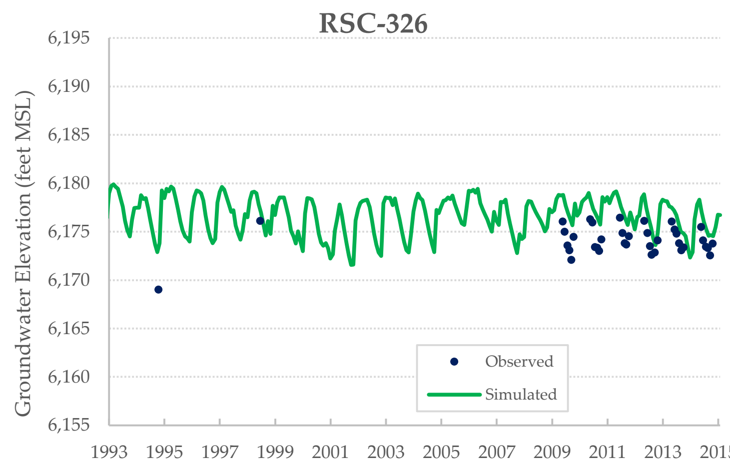
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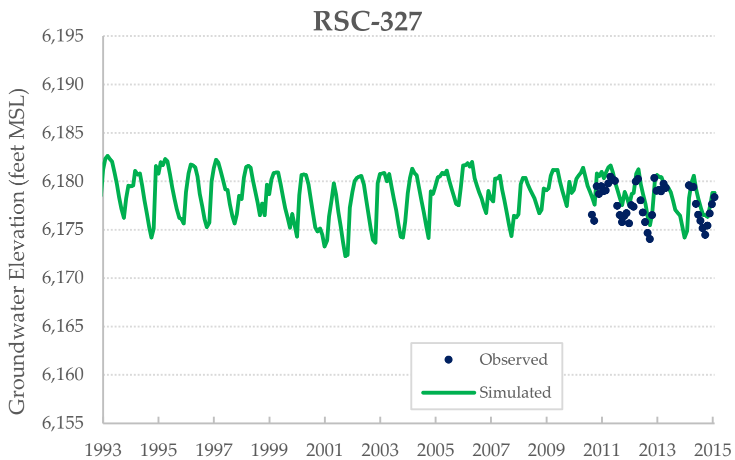
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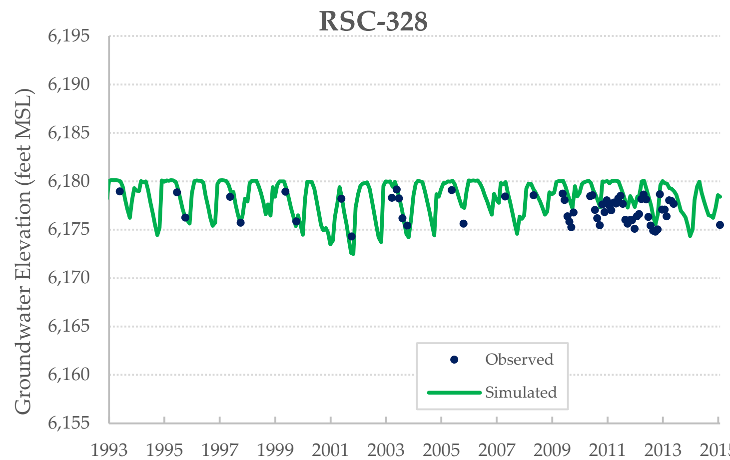
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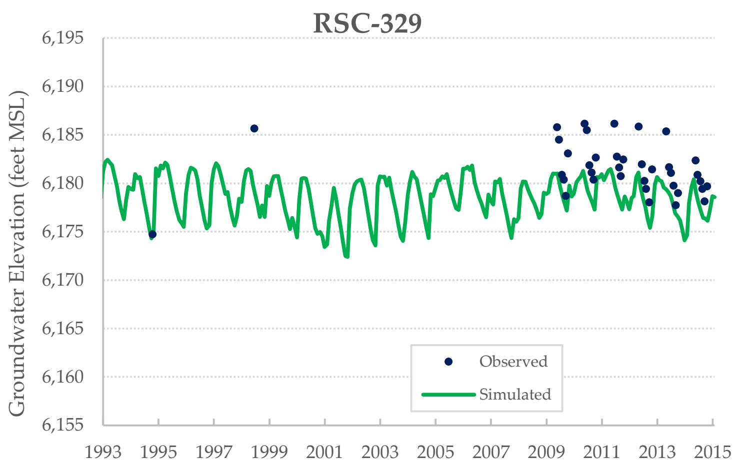
1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
Observed
Simulated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Groundwater Elevation (feet MSL)
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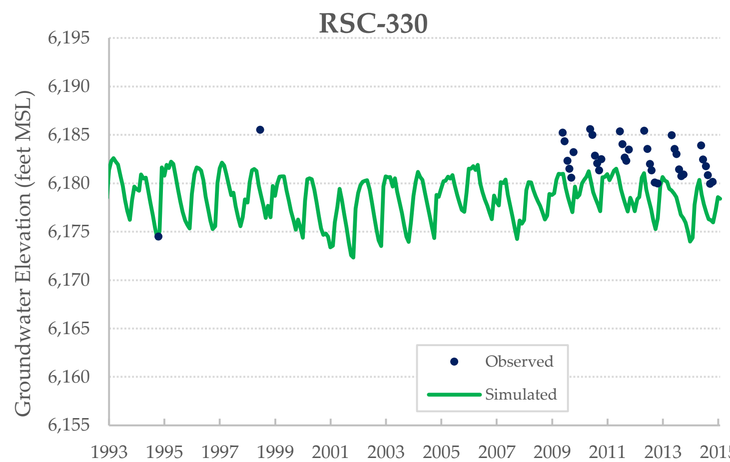
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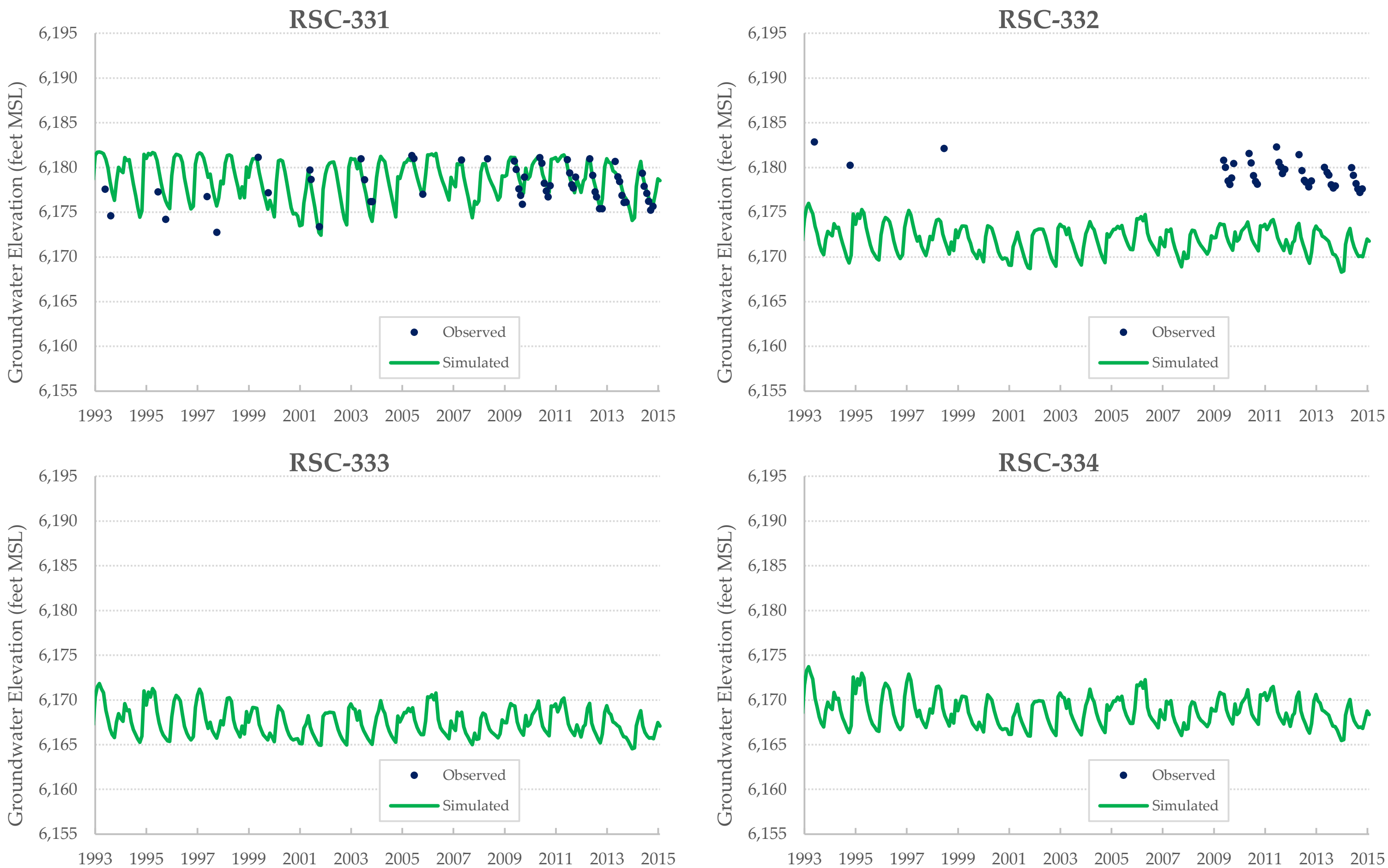
Observed
Simulated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RSC-332
RSC-333
RSC-334
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Observed
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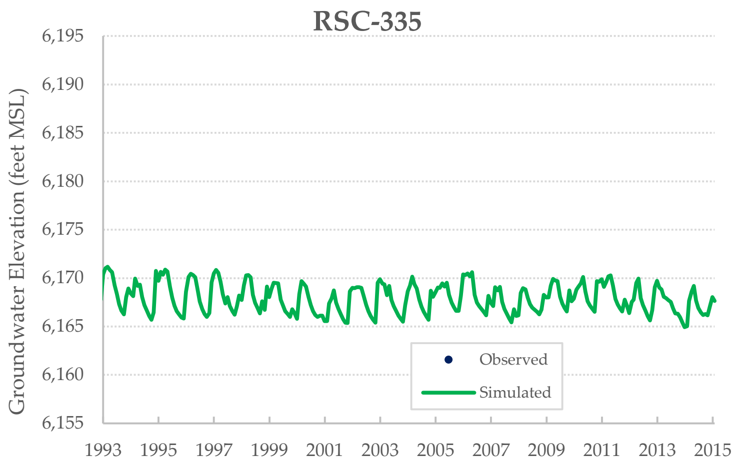
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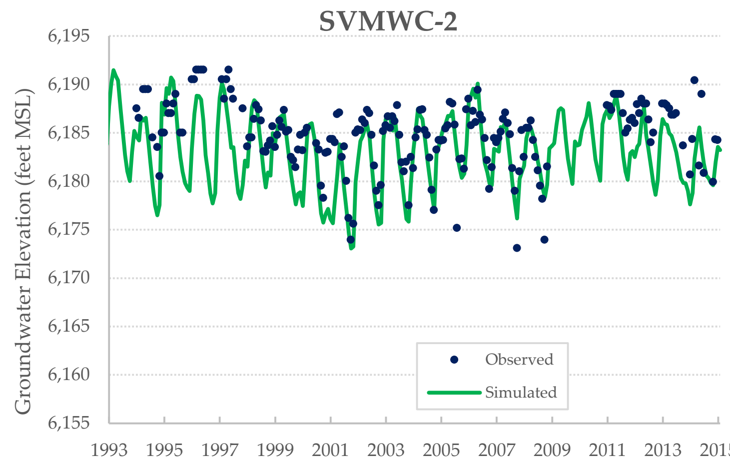
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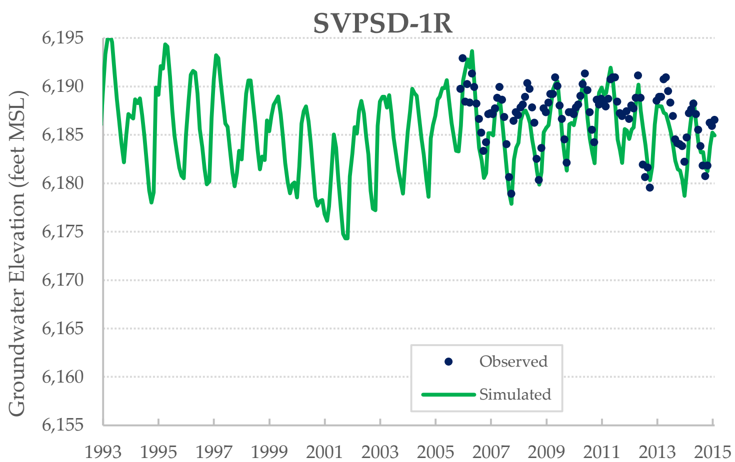
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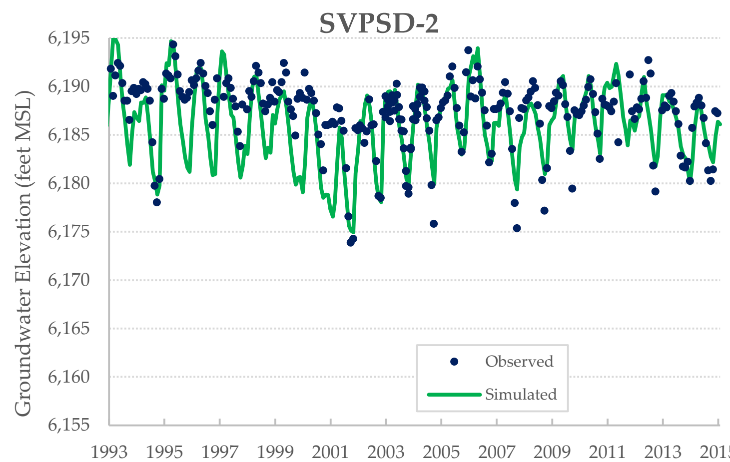
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Groundwater Elevation (feet MSL)
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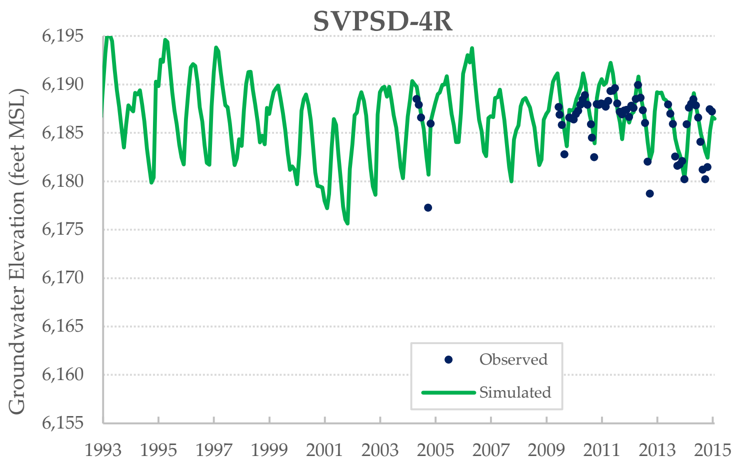
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Groundwater Elevation (feet MSL)
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6,185
6,180
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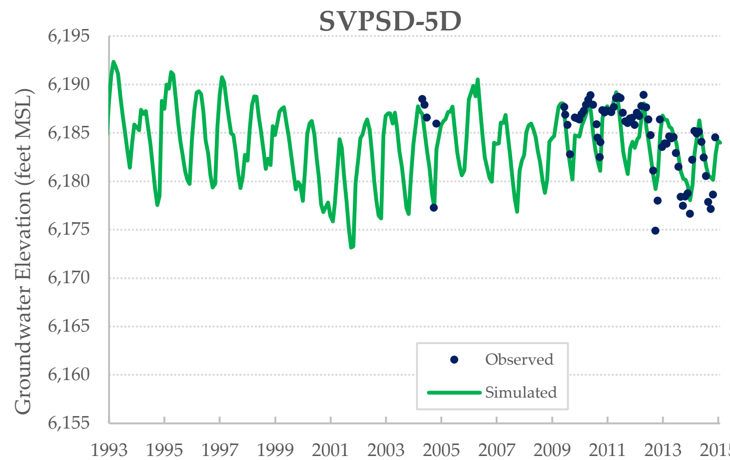
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6,185
6,180
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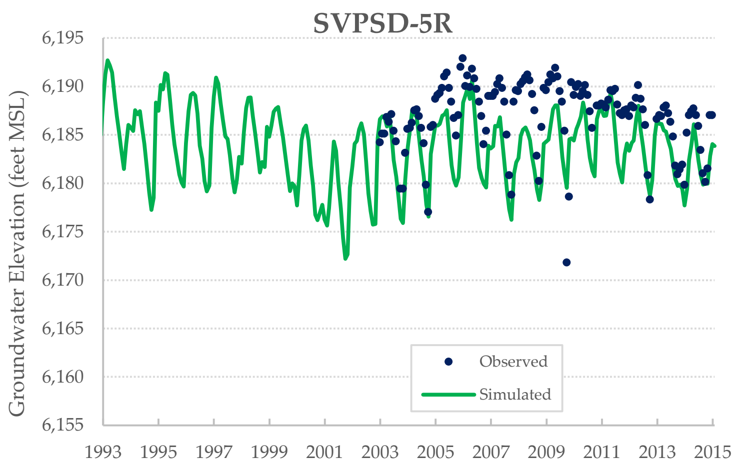
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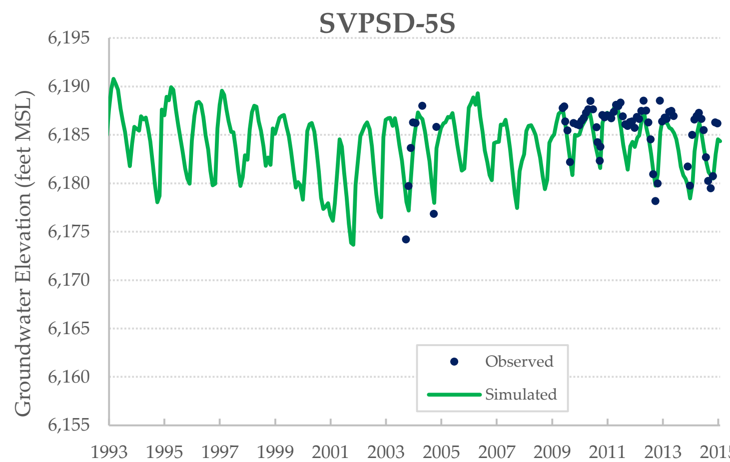
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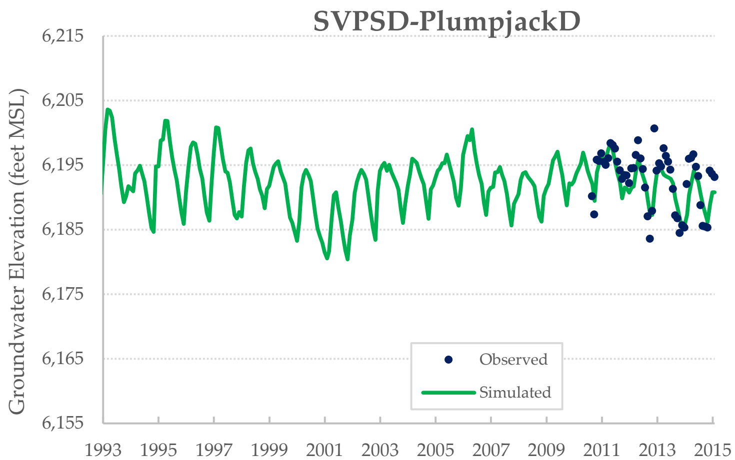
SVPSD-PlumpjackD
Groundwater Elevation (feet MSL)
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1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
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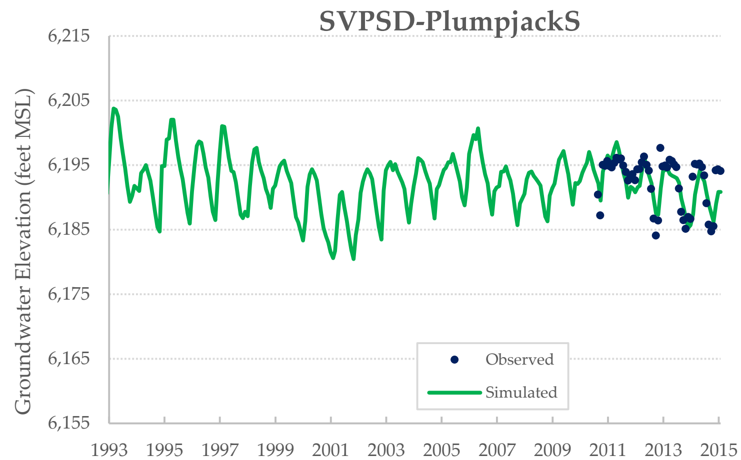
SVPSD-PlumpjackS
Groundwater Elevation (feet MSL)
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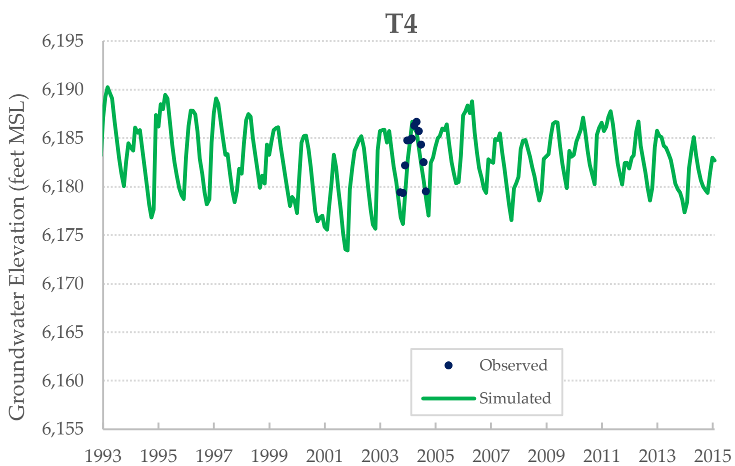
T4
Groundwater Elevation (feet MSL)
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APPENDIX D

Updated Sufficiency of Supply Assessment for Village at Squaw Valley and Other Growth, Squaw Valley California

Todd Groundwater, Farr West Engineering, and HydroMetrics WRI, July 21, 2015

TODD GROUNDWATER

July 21, 2015

TECHNICAL MEMORANDUM

To: Mike Geary, Squaw Valley Public Services District

From: Chad Taylor PG CHg and Maureen Reilly PE, Todd Groundwater
Dave Hunt PE, Farr West Engineering
Derrik Williams PG CHg, HydroMetrics WRI

Re: Updated Sufficiency of Supply Assessment for Village at Squaw Valley and Other Growth, Squaw Valley California

Squaw Valley Real Estate, LLC (SVRE) is planning to develop the Village at Squaw Valley in accordance with the Draft Village at Squaw Valley Specific Plan (SVRE 2015). The Village at Squaw Valley Specific Plan (Project) will include commercial, resort residential and recreational development. The purpose of this memorandum is to provide an update on the sufficiency of supply methodology and findings. Farr West Engineering (Farr West) has prepared a separate memorandum documenting the water demands (Farr West 2015).

1. INTRODUCTION

There are currently two water suppliers within Squaw Valley: the Squaw Valley Public Service District (SVPSD) and the Squaw Valley Mutual Water Company (SVMWC). SVPSD plans to provide potable water supply service to the Project. There are also private parties that use groundwater from the valley to serve non-potable needs, including golf course irrigation at the Resort at Squaw Creek (RSC) and snowmaking at the Squaw Valley Resort. Farr West's June 2015 memorandum documents recent historical water use by each of these suppliers and the private parties in Squaw Valley.

2. WATER DEMANDS

Future water demands for Squaw Valley have been estimated for Project and reasonably foreseeable non-project development for the next 25 years. Project specific demands were estimated by MacKay & Somps (2015) for full build-out of the Project using unit demand factors developed collaboratively with Farr West and SVPSD. The estimation of non-project water demands first required evaluation of the reasonably foreseeable development that might occur contemporaneous with the Project. Placer County prepared an estimate of this reasonably foreseeable development through the next 25 years for use in assessing non-project growth over the Project time frame (Placer County 2014). Farr West used these Placer County development projections along with historical use data and SVPSD standard unit demand factors to estimate water demands associated with the planned future non-project development through 2040 (Farr West 2015).

The water demands at the end of a 25-year period (2040) were used to evaluate sufficiency of supply. Unlike most supply assessments that provide annual estimates, future Project and non-project demands were estimated on a monthly basis. This allows accounting for the dynamic aquifer system that is largely recharged by snowmelt, such that the timing of demand affects the volume of available supply. Accordingly, the specific distribution of demands in time and space results in unique water supply availability.

The water demands evaluated in the sufficiency of supply assessment are presented by each major component in Table 1. These demand data represent the assumed monthly distribution in an average year. Assessment of monthly distribution was included in Farr West's demand calculations. Additional details relating to demand estimates are presented in Farr West's June 2015 memorandum. Table 1 also includes average historical water use from horizontal wells that do not produce groundwater from the Olympic Valley Groundwater Basin (Basin). These volumes are subtracted from the demands as this production is assumed to continue to be available at current volumes to meet existing demand in the future.

In addition to assessing monthly Project demands, MacKay & Somps also estimated the number of wells required to meet those demands (MacKay & Somps 2015). The process for estimating the number of required wells used a conservative modification of the SVPSD method of estimating peak daily demand and dividing that demand by a conservative per-well maximum pumping rate. The SVPSD estimates peak day demand by multiplying the average day demand by a peaking factor of 2.5 (ECO:LOGIC 2008). Instead of using the average daily demand calculated for the entire year, MacKay & Somps took the conservative approach of using the maximum monthly demand (the demand from August) and multiplying the daily demand rate by the 2.5 peaking factor. The resulting peak day demand was just over 700,000 gallons per day (gpd). To estimate the number of wells required to meet this demand MacKay & Somps assumed that each well could produce a maximum of 200 gallons per minute (gpm) at a duty cycle of no more than 70 percent per day (e.g. 17 hours of pumping in a 24 hour period). The resulting maximum per well production capacity is 201,600 gpd. Dividing the peak day demand by the maximum per well production capacity results in the need for four new wells (3.5 rounded up to 4). Applying this methodology to the SVPSD non-project demands at 2040 shows that the non-project demands for the peak month of July (excluding the RSC Phase 2 potable demand) will require a minimum of two additional wells above the four wells for the Project.

3. WATER SUPPLY

As noted previously, two municipal water suppliers in Squaw Valley (SVPSD and SVMWC) and two private parties are known to produce groundwater for their own use (SVR and RSC). The water used by these four entities all comes from groundwater sources that are local to Squaw Valley, as described below.

3.1 Supply Sources

Currently two sources of water supply are used on the valley floor in Squaw Valley: groundwater from the alluvial Olympic Valley Groundwater Basin and groundwater from horizontal fractured bedrock wells in the mountainous areas above the valley floor.

3.1.1 Olympic Valley Groundwater Basin

Groundwater produced from the alluvial aquifer beneath Olympic Valley has been the primary source of water supply in the area since the beginning of development in Squaw Valley. The alluvial aquifer underlying Olympic Valley is the Olympic Valley Groundwater Basin, designated by the Department of Water Resources (DWR) as Groundwater Basin Number 6-108 (DWR 2003). The Basin has been characterized multiple times by several investigators over the course of the past 40 plus years. The characterizations from these multiple studies were combined into a single description in the 2007 Olympic Valley Groundwater Management Plan (GWMP, HydroMetrics 2007a) with independent analysis and confirmation from Todd Engineers in 2012. Further refinement of the interaction between the Basin and surface water and the recharge sources for the Basin was developed in 2013 by HydroMetrics with assistance from Lawrence Livermore National Laboratory (LLNL) and the University of Nevada at Reno (UNR) (HydroMetrics 2013 and Moran 2013). A summary description of the Basin from these sources is presented below.

3.1.1.1 Physical Setting

Olympic Valley is a glacially carved valley approximately 2.5 miles long and 0.4 miles wide in the Sierra Nevada of California located west of Lake Tahoe at an elevation of approximately 6,200 feet. Steep mountains with elevations over 8,000 feet surround the valley to the north, west, and south, and the valley narrows to the east before meeting with the Truckee River. The valley is drained by Squaw Creek, which is a tributary to the Truckee River. The DWR-mapped Basin boundaries are shown on Figure 1. HydroMetrics performed more detailed evaluation of the geology of the Basin as part of the GWMP and developed refined boundaries for the Basin, which are shown in blue on Figure 1.

3.1.1.2 Groundwater Occurrence and Flow

In general, the western portion of the Basin is more coarse-grained than the eastern portion of the Basin. Well and boring logs from drilling show variation in lithology across the valley and in neighboring wells. As a result, precise correlations of lithologic units laterally within the valley have been problematic. Nonetheless, previously completed investigations have categorized geologic material in the valley into three units with similar hydrogeologic characteristics (HydroMetrics 2007a, Todd 2012).

Hydrogeologic Unit 1 – This unit is generally limited to the upper five to twenty feet of the basin and is composed of fine sands and silts in the western portion of the valley, with increasing fine grained material (clay, silt, and peaty organics) towards the east.

Hydrogeologic Unit 2 – This is the primary water bearing material in the valley. It is composed of gravels and sands, with silt and clay content increasing to the east.

This material is present at varying thicknesses in most of the basin, with the thickest portion in the west where the SVPSD and SVMWC production wells are located.

Hydrogeologic Unit 3 – This unit is present primarily in the eastern portion of the valley and is composed of fine grained material with occasional sand and gravel. This unit has limited production capacity and the water in it could be of low quality.

The unconsolidated sediments in each of these Hydrogeologic Units were deposited primarily by glacial, lacustrine, and fluvial processes. Groundwater is present in each of these units where they exist throughout the valley, but their relative ability to store and transmit water varies. Generally, the materials in the western portion of the Basin have a larger capacity for water supply production than those in the east. As a result, all the existing municipal water supply wells are located in this area. These units are underlain by igneous bedrock with no primary porosity, meaning that any water holding and transmitting capacity in these materials is in the form of fractures. Detailed descriptions, maps, and cross sections of these hydrogeologic units were presented in the GWMP and in Todd Engineers' Independent Analysis of Groundwater Supply (2012).

Recharge to the Basin occurs from infiltration of precipitation on the valley floor, overland flow from the mountainsides surrounding the valley, mountainfront recharge in the higher elevation sediments on the edges of the Basin, and infiltration from Squaw Creek. Recent studies by Dr. Jean Moran (2013) and HydroMetrics (2013) have provided additional documentation of the mechanisms and timings associated with recharge to the Basin. These studies showed that in the western portion of the Basin, most of the water produced by the municipal supply wells comes from mountainfront recharge occurring just above the valley floor in shallow aquifer materials along the edge of the groundwater basin (Moran 2013). This source of recharge occurs during precipitation and snowmelt, so the volume and timing of this source of water to the Basin is dependent on these factors. This recharge source assessment also showed very little evidence of flow into the Basin from fractured bedrock sources in the mountains above the valley floor, which indicates that there is little connection between the Basin and fractured bedrock groundwater. In addition, these studies found that the Basin discharges to Squaw Creek more often than it receives infiltration from this source. Moreover, the volume of discharge from the Basin to the Creek is likely greater than the volume of infiltration from the Creek to the Basin (HydroMetrics 2013).

Historical records of groundwater elevations in monitoring and production wells show that water levels peak near the same elevations in normal and wet years. The elevation of these peaks is generally near ground surface. This suggests that during most years, there is ample recharge to fill the sediments to a maximum level; above this level, recharge is rejected because the Basin is nearly completely or locally full. Rejected recharge either flows overland to Squaw Creek or it is quickly drained from the shallow portion of the Basin by Squaw Creek (HydroMetrics 2007a).

The GWMP found that even in years with below average precipitation, water levels in monitored wells rose to near the maximum elevations, indicating that the Basin was still filled to near total capacity in dry conditions. Records from years with below average precipitation did show that water levels in late summer and fall are dependent on the amount of snowmelt that flows through Squaw Creek during the spring and summer. Accordingly, this is the portion of the year during which low precipitation and high water demand could limit groundwater availability (HydroMetrics 2007a).

Groundwater flow within the Basin is generally from west to east, with some flow driven from the north and south boundaries of the basin by topographic highs. During periods of increased pumping from the municipal wellfield, the flow pattern is modified by drawdown cones surrounding the wells.

3.1.1.3 Water Supply from the Olympic Valley Groundwater Basin

Current and recent historical groundwater supply from the Basin has been assessed by Farr West as part of the estimation of Project and non-project demand (Farr West 2015). The total average production from the Basin is 871 AFY, and each of the four main water producers pumps approximately the following average annual volume from the Basin:

- SVPSD average production of 403 AFY for all municipal uses
- SVMWC average 130 AFY of municipal supply use
- SVR average of 81 AFY for snowmaking
- RSC average of 257 AFY for golf course irrigation and snowmaking combined

3.1.2 Fractured Bedrock Groundwater

Groundwater is found in fractures in the crystalline rocks surrounding the Basin. Kleinfelder & Associates (1991) mapped steeply dipping fractures and springs in the mountainsides to the south and east of the Basin. As noted above, the recent LLNL study found that a major portion of the recharge to the Basin comes from mountainfront recharge. This study also indicated that there was not a significant component of water from fractured bedrock sources present in the western portion of the Basin. This implies that there is not a strong connection between fractured bedrock groundwater occurring in the mountains above the valley and the Basin.

The SVPSD and SVMWC have active horizontal wells that draw from fractures on both the north and south sides of the valley, as shown on Figure 1. These wells are completed in fractured bedrock, and not the alluvial Basin. Horizontal wells are not equipped with pumps; water that enters the well is drained out of the opening by gravity. Therefore, the quantity of water produced by a horizontal well is generally considered to be constant from year to year, unless the capacity of the fractures connected to the well is reduced. The SVPSD and SVMWC horizontal wells do not appear to have shown reductions in supply capacity in the past. Currently, approximately 68 acre-feet per year (AFY) of municipal supply is met from these horizontal bedrock wells located outside of the Basin (Table 1). The volumes produced from these wells are included in this report because they will continue to be a source of supply used to meet demand in the future. No additional development of bedrock water supply is anticipated to meet Project or other future water demands at this time.

3.2 Groundwater Management

The primary groundwater management agency in the basin is the SVPSD. SVPSD has led the development of a GWMP in accordance with the California Water Code and in cooperation with a stakeholders group of representatives from local groundwater users, environmental organizations, regulatory agencies, and the public. The GWMP was first developed and adopted in 2007 (HydroMetrics 2007a). Groundwater condition reports have since been completed in 2008, 2009, and 2011 (HydroMetrics 2008, 2009 and 2011). The management area defined for the GWMP is smaller than the DWR Bulletin 118 groundwater basin area, as discussed above (Figure 1). The GWMP area is defined by hydrologic and geologic features that limit groundwater flow; these include low-permeability glacial moraine deposits at the eastern end of the basin. The moraine deposits, representing a relative barrier to groundwater, are not included in the GWMP.

3.3 Water Supply Availability

Several previous studies have attempted to quantify the volume of groundwater that can be produced from the Basin over some time period without causing impairment of one kind or another. Several of these studies misused the term safe yield and the annual production volumes they present are unreasonably high (Todd 2012). More recent studies completed on behalf of the SVPSD have attempted to quantify a *sustainable yield* for the Basin using the existing SVPSD model. However, these studies evaluated the maximum amount of water that could be pumped from the Basin using existing wells during a critically dry year without significantly impacting the pumping water levels of the shallowest existing well municipal supply well (West Yost 2001 and 2003). This *sustainable yield* actually is an *operational yield* that pertains more to the maintenance of specific well operations than to the potential yield of the groundwater basin (Todd 2012, Slade 2006).

These attempts to quantify a *sustainable yield* reported a wide range of maximum groundwater production volumes (West Yost 2001, Williams 2004, and Todd 2012). The large range of reported maximum supply values was the result of variations in the timing and distribution of demand and pumping. The wide range indicates that the assumptions regarding these distribution factors play a significant part in the results of the analyses. Without firmly established and agreed upon criteria, a sustainable yield cannot be quantified. In addition, a sustainable yield analysis resulting in a single, static value for groundwater availability oversimplifies the dynamic and complex Olympic Valley Groundwater Basin system.

Evaluation of the occurrence and flow of groundwater in the Basin and the related water balance has shown that the groundwater system in Squaw Valley is highly dynamic and responsive to the timing and spatial distribution of recharge, demands, and pumping. This small groundwater system has a very high volume of water flowing through the watershed on an annual basis, which far exceeds the volume of groundwater storage or use (Todd 2012). This is clearly illustrated by the large volume of rejected recharge that has been identified by HydroMetrics and others (HydroMetrics 2013, Todd 2012).

It is very difficult to quantify the supply capacity of groundwater systems with large volumes of rejected recharge, because increased groundwater pumping can directly increase the volume of recharge that flows into the Basin. Therefore, the relationship between the timing of demand and recharge to the Basin is important to the availability of supply in the system. In these circumstances, it is necessary to evaluate the important water producing areas of the Basin over time, instead of individual wells. It is also impractical to establish a single value representing maximum annual groundwater availability such as a *safe* or *sustainable yield,* because the seasonal distribution of demand over the course of the year could change the total volume of water that can be produced. The sufficiency of supply evaluation below presents and applies a methodology for comparing demand to supply availability in the Basin.

4. WATER SUPPLY SUFFICIENCY

The proposed Project and non-project growth over the next 25 years represent an increase in the water demand within Squaw Valley of 383 AFY. The Project will require 240 AFY of this increase, and the non-project development presents an additional 143 AFY of demand. The total projected water demand represents a 44 percent increase over the average annual volume (871 AFY) currently used in the valley.

Given the highly dynamic nature and small size of the Basin, previous studies have found it impractical to define a single static supply availability value (i.e., a safe, sustainable, or perennial yield) for this groundwater resource (Todd 2012).

SVPSD developed a numerical groundwater model of the basin to assist in the evaluation of supply and management of groundwater in the valley. This model was prepared and is maintained and updated by HydroMetrics for SVPSD. The SVPSD groundwater model has been used in the past as a tool for managing groundwater supply, planning for future growth, and evaluating potential water supply sources for specific developments in Squaw Valley. The model was previously used in the evaluation and approval of new developments at the RSC and the PlumpJack properties.

The volume of groundwater that can be produced from the Basin in any year is dependent on four factors:

1. Timing of recharge to the Basin (i.e. precipitation and snowmelt)
2. Timing of the demand
3. Location of pumping wells
4. Acceptable Basin response to pumping for long-term sustainability

Factor 1 – Timing of recharge to the Basin

When potential recharge is available in the Basin is an important component of water supply sufficiency. However, this factor is largely dictated by hydrologic and weather conditions. The volume and timing of potential recharge to the aquifer used in the evaluation of supply sufficiency are based on recorded historical data.

Factor 2 – Timing of demand
As noted previously, the relationship between the timing of demand for groundwater supply and recharge to the Basin has a significant impact on the balance of water available in Squaw Valley. Since the timing of demand is determined by the quantity of each type of development in the valley, accurate estimation of development and associated water demands is important. Different temporal distributions of demand with the same annual totals could have very different effects on groundwater elevations and availability in the Basin. Therefore, any changes in the monthly distribution of demand will require re-evaluation to assess sufficiency of supply.

The assessment of supply sufficiency presented below uses the estimated water demands at 2040 according to the temporal distribution that resulted from the specific quantity and type of demand anticipated (Farr West 2015). Consequently, the results of this analysis are valid only for this specific demand distribution.

Factor 3 – Location of pumping wells
Historically, groundwater pumping to provide municipal water supply has been limited to a few wells in the western portion of the Basin (existing wells on Table 2 and Figures 1 and 2). The existing wells are capable of producing more water than is currently used in Squaw Valley, but previous evaluations using only the existing wells showed that they would not be capable of meeting the projected demands at 2040 because production of higher volumes from the limited wellfield would cause too much drawdown in the existing wells for proper function (Williams 2004). Therefore, an expanded wellfield with new wells will be required to meet these projected demands. The locations of the new wells are important. If wells are too close to one another or located in disadvantageous locations, pumping could cause groundwater elevation declines that restrict groundwater supply availability or interfere with well and pump operability.

The sufficiency of water supply in the Basin has been assessed by adding potential new wells in advantageous locations and simulating the effects of pumping those wells along with the existing wells to meet total water demands at 2040. As noted above, a total of four new wells are estimated to be required to meet the demands of the Project (MacKay & Somps 2015) and two additional wells are required to meet the SVPSD non-project demands at 2040. In order to assess the capacity of the Basin to produce water, more than just the minimum number of potential new well locations was identified. Limiting the potential new well sites to only the six new SVPSD wells required to meet demand at 2040 would have shown the ability of a specific wellfield to meet demands, not the Basin as a whole.

The potential new wells were identified by evaluating geology, geometry, hydrostratigraphy, aquifer production capacity, and development plans for the western portion of the Basin. Nine potential new wells sites were identified through this process. In addition, a single SVPSD well (Well-1R) may need to be replaced to accommodate the Project. A replacement location for this well has been identified, as shown on Figure 2. All of the potential new wells and the replacement well were used in conjunction with the existing wells shown in Table 2 and Figure 2 in assessing the sufficiency of supply. The number and locations of wells has the potential to change the outcome of this analysis.

Factor 4 – Acceptable Basin response to pumping for long-term sustainability
In order to assess sufficiency of a groundwater supply source to meet demand, it is necessary to have a criterion or set of criteria defining acceptable Basin responses to pumping. As discussed above, previous attempts to establish such a criterion have been problematic. In order to assess future groundwater supply availability, it is necessary to have a set of criteria that pertains to the entire productive portion of the Basin, not simply to operational parameters in specific existing or potential new wells.

The simulated results of supplying total 2040 demand from the expanded wellfield have been compared to a set of criteria developed for assessing wellfield conditions. Specifics relating to this approach are described below.

4.1 Numerical Groundwater Model

The existing SVPSD model was first constructed in 2001 (Williams 2001). The model was constructed to simulate the Olympic Valley Groundwater Basin using the widely-accepted MODFLOW software developed by the United States Geological Survey (USGS). The boundaries of the Model extend to the modified Basin boundaries developed by HydroMetrics and shown on Figure 1.

Since its original construction, the model has been updated multiple times to incorporate new data and refine conceptualizations (West Yost 2003, HydroMetrics 2006, 2007b, 2014, and 2015). The model was updated in 2014 following significant additional data collection relating to Squaw Creek (HydroMetrics 2013). This update included incorporation of groundwater elevation, streamflow, stream bed conductance, and climate data and an extension of the model period and recalibration to simulate conditions from May 1992 through December 2011. Following this major documented model update, HydroMetrics implemented additional changes and successfully recalibrated the model to accommodate simulation of future conditions (HydroMetrics 2014). The model was updated again in 2015 to expand the time period and include recent hydrologic conditions, including the dry years of 2012 through 2014. This most recent update included processing and incorporation of groundwater elevation, streamflow, and climate data through January 2015. In addition, the methodology for calculating recharge from precipitation was modified to account for limited infiltration during summer storm events, effectively reducing summer month infiltration (HydroMetrics 2015). The current version of the model was assessed and found to adequately simulate groundwater elevations for the period from May 1992 through January 2015 (HydroMetrics 2015).

The current version of the numerical model is a good tool for simulating changed conditions and management practice alternatives. The model can be used to simulate future conditions and predict how increased pumping will affect Basin water levels and the water balance. For the assessment of supply sufficiency, the model is run in a predictive mode with potential new wells added to the existing wellfield as discussed above in Section 4 and pumping distributed as described below in Section 4.2. The results of the model simulations were then evaluated against criteria described in Section 4.3.

4.2 Simulation of Groundwater Production to Meet Projected Demands

The projected demands at 2040 were distributed by pumper and by well. The monthly pumping volumes by well required to meet the 2040 average year demand are presented in Table 3. Average annual demands were used because there are currently no methods for assessing the magnitude of demand reductions that may occur in Squaw Valley as a result of mandatory water use cuts during drought periods. The assumption that water demand does not decrease during dry conditions results in conservatively high demand estimates.

The monthly production volumes by well shown in Table 3 were applied to the latest version of the model described above. Groundwater models are a collection of input files representing components of the groundwater system, a set of equations for how water moves, and a computer code that combines the inputs and solves the equations to simulate flow in the model. In the case of the Basin model, the input parameters are aquifer geometry (model grid and elevations of layer tops and bottoms), aquifer parameters (hydraulic conductivity and storage coefficients), recharge, streamflow, and pumping. Recharge in the Basin model is a combination of precipitation, irrigation and municipal return flows, and sewer pipe gains and losses. Most of the model inputs for the future demand model simulation were kept the same as those from the recently updated and calibrated model, because for the most part aspects such as aquifer parameters, aquifer geometry, and boundary conditions will not change in the future. The following model input files were assigned to represent future conditions:

- Recharge – The precipitation component of the recharge inputs used measured precipitation from October 1992 through December 2014, which is all of the full water years represented in the model, plus the last three months of 2014. A water year is the 12 month period from October 1st to September 30th, and designated by the year in which it ends. The model uses precipitation data for Olympic Valley from the Squaw Valley Fire Station gage maintained by SVPSD to simulate recharge. Precipitation that falls on the mountainous areas of the watershed above the Valley Floor is not used in the Model as a direct or modified input variable. Mountain precipitation is represented in the Model only through measured stream discharge, which is continuously gaged and recorded in Squaw Creek at the western end of the Valley.

  The time period of October 1992 through December 2014 is used in the model because it is the timeframe over which the data and information required to populate the model are available. Prior to the beginning of the model time period there were insufficient groundwater production, elevation, and climate record data to allow the model to be populated or calibrated. The period from October 1992 through December 2014 includes a representative range of hydrologic conditions for Squaw Valley (HydroMetrics 2014).

  The hydrologic inputs for recharge were kept at historical values to represent variable hydrologic conditions over a long period of time. This facilitates the evaluation of normal, wet, and dry periods. The portions of recharge that come from irrigation and municipal return flows and sewer pipe gains and losses are all calculated as a function of the delivered water within the SVPSD, SVMWC, and RSC water production and distribution systems. These components were calculated from the average demand data presented in Table 1.

- Streamflow – Flow in Squaw Creek for the period from October 1992 through December 2014 was used to represent future conditions, as in the case of precipitation. Sqauw Creek flow in the Model is developed from stream discharge measurements collected by the Friends of Squaw Creek (FoSC 2015) from gages at the western end of the Valley.

- Pumping – The volume, timing, and spatial distribution of pumping was assigned to an expanded wellfield. The larger wellfield includes most of the existing municipal supply wells and nine new wells to meet increased SVPSD demands. The locations of all the wells are shown on Figure 2, and basic information about each well is presented in Table 2.

  As noted above, the Project and non-project demands are estimated to only require six new wells. However, in order to assess the capacity of the aquifer to meet demand and limit the effects of a specific wellfield arrangement on the evaluation, wells were placed in all of the locations identified as being favorable for groundwater production. The potential new wells were placed in locations where no Project buildings are planned and were selected to take advantage of deep and productive areas, maintain distance between wells to minimize interference, maximize distance from Squaw Creek, and distribute pumping over a large area to reduce cumulative drawdown effects in any one area of the Basin. One of the existing SVPSD wells (SVPSD-1R) is in a location where a new building is planned for the Project. SVRE plans to replace this well in the location shown as SVPSD-1RR on Figure 2. All of the other existing water supply wells will remain intact.

  Total pumping volumes for each pumper (i.e., SVPSD, SVMWC, RSC, and SVR) were set to equal the average demands distributed by month shown in Table 3. These total demands were then distributed to specific wells according to the following logic:

  - Total SVPSD demand was distributed to the existing and new wells equally each month, with one exception. Equal distribution of pumping to all the wells was used for two reasons:

    1. Spreading pumping out among a large number of wells so that no one well is responsible for pumping large volumes at any given time reduces the discrete water level declines. This balanced pumping distribution allows withdrawals from the Basin to be more evenly spread throughout the area of the wellfield, which reduces water level declines in any one area and minimizes impacts between wells.

2. The actual distribution of pumping in any wellfield is the result of management decisions that take into account distribution system pressures and flow rates, storage considerations, water treatment requirement, equipment maintenance, etc. Any attempt to predict the outcome of this set of operational and management decisions would be incorrect and overly complicated.

The exception to the demand distribution methodology is the demand for the RSC Phase 2 development, which was previously approved for development by the County and the SVPSD. SVPSD has agreed to serve potable water to the expansion in accordance with a development agreement (DA) that specifies the volume and timing of the associated potable demands (HydroMetrics 2006 and 2007b). The DA requires RSC to dedicate their Well 18-3R (RSC-18-3R) to SVPSD to meet those demands. As a result, the planned RSC Phase 2 demands are all assigned to RSC-18-3R, while the rest of the SVPSD demands at 2040 are spread equally among the remaining SVPSD wells.

The monthly pumping rates in the existing SVPSD wells are actually lower in the modeled 2040 pumping scenario than in current average conditions. This is the result of the wider distribution of groundwater production to more wells in the expanded wellfield. Existing SVPSD Basin groundwater production from four wells was approximately 377 AFY on average (94 AFY per well). In the modeled 2040 pumping scenario there are 14 SVPSD wells producing a total of 760 AFY, or approximately 54 AFY per well (Table 3).

- SVMWC demand was distributed to the two existing SVMWC wells according to percentage each produced in the recent historical period.
- RSC demand for irrigation and snowmaking listed on Table 3 will be satisfied from existing and planned RSC wells. The same DA that governs the volume, timing, and supply source of potable demand for Phase 2 at RSC also includes specifications for the volume and timing of non-potable groundwater production, including reductions in irrigation use. A schedule for the distribution of these demands to wells on RSC property was developed when the SVPSD was assessing service of RSC Phase 2 (HydroMetrics 2006 and 2007b).
- Demand for future SVR snowmaking is assumed to be equal to the recent historical volumes plus a growth factor of ten percent. Pumping to meet these demands is assumed to be distributed proportionally to the existing wells on Figure 2 as it was in the recent historical period.

Monthly distribution of pumping to all active wells in the predictive model is shown on Table 3. These monthly pumping rates represent average year production for each well. These average year values were assumed to represent pumping throughout the model period. Therefore, pumping volume, distribution, and timing input to the model is the same for every year from October 1992 through December 2014.

The input files described above were all developed for 2040 conditions and run for every year of the model period. Since the demands estimated by Farr West (2015) are the highest at the end of the period of study (2040), running the model with those demands for every year represents a conservative approach to assessing supply sufficiency.

4.3 Criteria for Evaluating Sufficient Water Supply

As noted in the discussion of water supply in Section 3, no reliable estimates of maximum groundwater supply availability or agreed-upon criteria for evaluating this parameter have been developed in previous work completed in Squaw Valley. As a result, criteria have been developed against which simulated (modeled) groundwater elevations can be compared.

4.3.1 Development of Sufficiency of Supply Criteria

The development of the set of criteria defining an acceptable Basin response to pumping for long-term sustainability (Factor 4 above) was a detailed and exhaustive process. The criteria incorporate operational concerns in existing wells, consider Basin viability in proposed new well locations, and maintain groundwater elevations in the Basin at acceptable levels.

One common method for assessing supply sufficiency is to estimate the portion of the water balance that goes towards subsurface outflow and evaluate the annual portion that can be used without impacting groundwater availability. In the case of the Basin, the eastern end of the Basin has very low hydraulic conductivity and acts as a lateral aquiclude (Williams 2001) restricting the flow of groundwater out of the Basin to the east. As a result, the Basin fills up and water that could potentially infiltrate into the Basin instead leaves the valley during peak runoff periods. This phenomenon of *rejected recharge* is due to the much larger volume of potential recharge water (precipitation and snowmelt) that flows through the valley on an annual basis relative to available storage capacity in the Basin (HydroMetrics 2013, Todd 2012). For a water balance, this means that the volume of groundwater pumping outflow has little to no effect on the volume of subsurface outflow, but a large impact on the volume of recharge into the Basin. Therefore, evaluation of the water balance components was not useful in the development of sufficiency of supply criteria.

One of the most distinguishing characteristics of the Basin is the pattern of winter and spring groundwater elevations at or near historical highs year after year regardless of hydrologic conditions. As noted previously in this memorandum, observations of historical groundwater elevations and production in the valley and results of modeled conditions show that the Basin generally fills to the same levels every year in the winter and spring months. Even in dry years when groundwater elevations sometimes fall to relatively low levels in the late summer and fall, they generally recover to high elevations in the winter and spring regardless of whether the area is experiencing average, wet, or dry hydrologic conditions. This is another example of rejected recharge in the Basin (HydroMetrics 2013, Todd 2012). In these cases, the relationship between potential recharge volume and available groundwater capacity implies that additional groundwater production-related water level declines would not cause year-on-year reductions in groundwater elevations or availability, but would instead induce increased recharge to the Basin. These same groundwater elevation patterns also show that the late summer and fall months are the times when water levels are lowest and groundwater supply availability is potentially limited.

Interactions between groundwater and Squaw Creek were considered in the early stages of criteria development as well. The model can simulate changes in volumetric flow between groundwater and the creek. It can also simulate volumetric flow in the creek, but the accuracy of these predictions and the resolution of the results are low due to the limited available streamflow calibration parameters. Impacts to streamflow are more related to biological considerations than to groundwater conditions, which are in turn dependent on additional factors including creek velocity, flow depth, and temperature and their effect on individual species. No previous investigations have identified specific flow volume and timing requirements for Squaw Creek. Such an analysis is being prepared for inclusion in an Environmental Impact Report (EIR) for the Project at this time, but the results are not available for inclusion in water supply sufficiency criteria.

The groundwater elevation patterns and associated observations regarding recharge and low water level periods guided the development of the supply sufficiency criteria toward a water-level based evaluation. Groundwater elevations in an unconfined aquifer without context specific to the location or aquifer are not meaningful. A more useful consideration is the proportion of the Basin that is saturated, and the maximum potential saturation in either the entire Basin or a specific location. Saturated thickness is the groundwater elevation (head) in a well minus the elevation of the bottom of the aquifer at that location. The maximum saturated thickness occurs when water levels are the highest. The percent saturated thickness is a simple metric that combines the saturated thickness at any given time with the maximum saturated thickness. Percent saturated thickness is the saturated thickness at a location and time divided by the maximum saturated thickness for that location. The maximum saturated thickness values at specific locations do not change, and were derived from model simulations representing historical actual pumping conditions (baseline conditions).

Further evaluation of a groundwater-elevation based criteria using saturated thickness and percent saturation was completed to identify the locations in the Basin that would be most affected by reduced groundwater elevations. The evaluation focused on the following elements:

1. Because groundwater production at 2040 is proposed to come almost exclusively from the western portion of the wellfield (Figure 1), the criteria should focus on this area.
2. Groundwater elevations in the area of interest should be maintained at a reasonable level that will not risk impeding the ability of the Basin to store and transmit water.
3. Operation of existing and new municipal wells should be considered.

The western portion of the Basin is the most productive groundwater area in Squaw Valley. The existing SVPSD and SVMWC wells and the proposed new municipal wells are all within this area. Previous studies have identified a change in groundwater elevations at the eastern edge of this area, which has been interpreted as a hydraulic separation of some kind (Kleinfelder 2000, Williams 2001, West Yost 2001, HydroMetrics 2013). This appears to indicate that there could be a separation between the western and eastern portions of the Basin, which supports the concept of evaluating the western portion on its own.

One well is proposed for municipal supply use that is outside the western portion of the Basin, RSC-18-3R (Figure 2). However, this well and the production associated with it was already assessed as part of the RSC Phase 2 project approval (HydroMetrics 2007b). The previously completed assessment indicated little to no interaction between the wells in the western portion of the Basin and RSC-18-3R.

Technical literature were reviewed to locate any guidance that might be available for maintaining groundwater elevations at a reasonable level that does not risk impeding Basin capacity. Driscoll (1986) states that, "Theoretical considerations and experience have shown that screening of the bottom one-third to one-half of an aquifer less than 150 feet thick provides the optimum design for … unconfined aquifers." Driscoll goes on to say that, "it is impractical to pump a well in an unconfined aquifer at a drawdown that exceeds two thirds the thickness of the water bearing sediments." Therefore, at a minimum between 33 and 50 percent of the Basin must remain saturated.

The development of criteria for assessing supply sufficiency also evaluated operational considerations. These considerations include maintaining water levels above screens, preserving minimum pump submergence depths, and limiting interference between wells. All of these factors were reviewed for the existing SVPSD and SVMWC Basin municipal wells. Because the proposed new wells have not been designed or installed yet, no screen elevation or pump setting depths could be used to evaluate these operational considerations in the proposed wells. Assessment of Basin thickness and historical saturation was used in the new well locations in the absence of construction or equipment information. The review of these operational and Basin character parameters for the existing and new wells showed that modeled water levels in specific wells had been as low as 65 percent saturated thickness in the past without causing operational problems.

The operational review indicated a threshold of 65 percent saturated thickness, and the literature review identified a range of suggested minimum saturated thicknesses of 33 to 50 percent. Because the operational review is a more conservative threshold (i.e. a greater saturated thickness with higher groundwater elevations) that value was chosen as the basis of the threshold for evaluating sufficiency.

The future forecast predictive modeling uses average annual groundwater production and equal distribution of monthly demand among all the SVPSD wells. As mentioned earlier, the average annual demand was used in the model because there have been no reductions in demand relating to drought or other conditions in the past. In addition, pumping was distributed equally to all SVPSD wells to minimize impacts and reduce assumptions relating to wellfield operation and management. Because the demand and distribution of pumping are averaged across the wellfield and there is a desire to focus on the entire western portion of the Basin, it made more sense to apply the threshold to this area of the Basin as a whole, rather than to individual existing or proposed new wells. These considerations directed the criteria development to apply the threshold to the average percent saturation in all the western wellfield wells instead of in individual wells. The western wellfield refers to only those existing and new municipal supply wells in the western portion of the Basin where most of the groundwater production takes place. These wells are all of the municipal supply wells west of and including SVMWC-2.

However, because there is an operational component to the threshold, a check was performed using model simulations to identify any difference in overall groundwater supply when the threshold was applied to individual wells or to the entire wellfield. These simulations showed that varying pumping among individual wells to maximize water availability produced similar groundwater availability results to assessing average percent saturated thickness from all wellfield wells. The existing and new wells are relatively well distributed throughout the western portion of the Basin, which makes them appropriate for use as targets for evaluating this area as a whole. Therefore, the average percent saturation in the western wellfield wells is a good indicator of the overall condition of this portion of the Basin.

Experience with groundwater production in other unconfined aquifers in California has shown that in times of extreme water shortage, it is sometimes operationally necessary to produce water even though water levels in wells could be below operational thresholds for short periods, so long as these situations are not a frequent part of a long term management strategy. Managing wells and aquifers in this manner should not cause long term problems so long as these conditions do not occur with regularity or extend for significant periods of time and do not result in any reduction in water quality of damage to equipment. In the Basin, historical groundwater elevation records show that dry periods can cause declining water levels for six months during the year (HydroMetrics 2007a). The criteria should allow water levels to fall below the 65 percent threshold to permit flexibility in supplying water, but limit the duration of such exceedances to no more than half of the declining water level period. Therefore, the criteria include allowance for the average percent saturation to fall below the 65 percent threshold for no more than three consecutive months. In addition, the number of times that such exceedances can happen within the model period was limited to four occurrences.

4.3.2 Sufficiency of Supply Criteria

The criteria that resulted from the detailed evaluation presented above are as follows:

- Average saturated thickness in the western municipal wellfield wells (existing and proposed new) may not fall below 65 percent for more than 3 consecutive months or more than 4 times total over the model simulation period.

As noted previously, saturated thickness is the groundwater elevation in a location minus the elevation of the bottom of the Basin at that location. Maximum saturated thickness is the highest groundwater elevation minus the Basin bottom elevation. The maximum saturated thickness values at specific locations do not change, and these values were derived for the existing and new well locations from model runs representing historical actual pumping conditions in the calibrated model. Percent saturated thickness for any location and time is the saturated thickness at that location and time divided by the maximum saturated thickness for that location.

These criteria should not be taken as recommendations for operational practices. New wells will need to be designed and constructed to maximize operational reliability and flexibility, based on location-specific hydrogeology. While there is no lower limit to percent saturation proposed for the short exceedances of the 65 percent threshold, in practice saturated thicknesses in any given month are affected by the preceding months, so extreme exceedance of this threshold in any month or months will result in exceedances of longer than the 3 consecutive month allowance.

While the criteria were developed in consideration of the elements presented in Section 4.3.1, they do rely on model simulated results. The SVPSD Basin model is, like all groundwater models, an approximation of reality. The model has grid cells ranging from 625 to 10,000 square feet in area. Simulated groundwater elevations in any location represent an average over the entire area and thickness of the particular cell. The model was developed to simulate volumetric flow in the Basin, but lacks the granularity to predict exact and absolute differences in groundwater elevations at discrete locations such as wells.

4.3.3 Sufficiency in Single and Multiple Year Droughts

The model was applied to simulate future demand conditions (total demand at 2040) and provide information to evaluate groundwater elevations in the Basin over a 23 year hydrologic period. The recharge and creek flow for this model period represent the same hydrological conditions as the period from October 1992 through December 2014. This is the same period that was used in the calibrated model (HydroMetrics 2015).

Historical drought conditions are simulated in the current version of the model. While the model was updated to include the most recent statewide drought of 2012 through 2014, this was neither the most severe single nor multiple year dry period on the Olympic Valley floor. Precipitation records from the Squaw Valley Fire Station gage indicate that between water year 1993 and water year 2014, the single driest year was 2001, when precipitation on the valley floor was just under 40 percent of average. The Squaw Valley Fire Station gage precipitation data show that the driest multiple year dry period in this time was water year 2000 through water year 2002, when the three year precipitation total was just under 64 percent of average (HydroMetrics 2015). Evaluating single and multiple dry year periods specifically focuses on the effects of drought on the water supply source. In groundwater basins, water levels are generally significantly lower during single and multiple year droughts. It is during these drought periods that average percent saturation would be most likely not to meet the percent saturation threshold.

Future changes in climate patterns may have an effect on precipitation volumes and timing. However, it is not possible to estimate groundwater elevations in the Basin based on projections of precipitation alone, as the rate of precipitation is not an indicator of Basin water levels and the relationship between precipitation on the watershed and water levels is not linear. The groundwater basin is relatively small when compared with the larger watershed. In average years, only a small portion of snowmelt recharges the groundwater; most of the snowmelt and creek flow continue to flow out of the basin and do not recharge the groundwater as the basin fills up. Decreased snowfall also indicates increased artificial snowmaking and low water demand due to reduced visitors, which add significant uncertainty to any attempt to generate approximations of future conditions where the effects of variation in weather conditions have not yet affected the Basin.

4.4 Modeling Results

A groundwater model simulates water elevations for every time step within its full time period. The SVPSD model is constructed with monthly time steps, which means that there are individual groundwater elevation results for every month in the model period of October 1992 through December 2014. The simulated results for the municipal wells in the western wellfield (the new and existing SVPSD and existing SVMWC wells in Table 2 and on Figure 2, with the exception of RSC-18-3R) were extracted from the model and used to calculate saturated thicknesses for each month in the model time period. These are the wells used for application of the criteria for evaluating supply sufficiency described above.

To assess if there is a sufficient water supply for the Project and other future water demands, the simulated Basin responses in the municipal supply wells in the western portion of the Basin were evaluated against the criteria discussed above. The percent saturation results are shown graphically on Figure 3. The average percent saturation for all of the wells combined is also shown on Figure 3 as a bold red line. The modeled results are also shown as absolute saturated thickness by month for each well on Figure 4.

The results of the modeling analysis indicate that, over the entire modeled period, the average percent saturation ranged from 77 to 99 percent, well above the 65 percent criteria. This analysis shows that there is sufficient supply to meet the Project and non-project demands in 2040 with a margin of safety. As expected, the lowest groundwater elevations generally occurred during the fall in drought years, which shows that these time periods are the most important for water supply in Squaw Valley.

Comparison of the model simulated results to the criteria shows that there is sufficient supply to meet the Project and non-project demands through 2040 with a margin of safety. While the modeled minimum average percent saturated thickness results are considerably above the 65 percent criteria, there is no way to estimate how much more groundwater could be produced without further model simulations. Such simulations would have to be prepared to simulate the monthly distribution of demands past 2040, because the timing of demands compared to recharge is an important factor in how simulated groundwater elevations respond to increased groundwater use.

Not only does the average value not fall below the 65 percent criteria, but no individual existing or potential future well of the 15 in the modeled western wellfield ever falls below this threshold.

The model results include hydrologic conditions representing dry years. The model timeframe corresponding to water year 2001 represents hydrologic conditions equivalent to a single dry year period, and the modeled time of water year 2000 through water year 2002 represents a multiple dry year period. The minimum modeled average percent saturation during the single year dry period (water year 2001) and multiple dry year period (water years 2000 through 2002) was 77percent. The simulated results for these dry water years show good correlation between water year precipitation totals and groundwater elevations, especially in multiple dry year periods. However, not all of the variations in the simulated saturated thicknesses shown on Figures 3 and 4 relate to annualized precipitation patterns. This demonstrates that precipitation alone is not a predictor of groundwater elevations. The timing of high and low groundwater elevations is dependent on monthly distribution of precipitation, streamflow, pumping, and return flows. The temporal distribution and relationships between these factors produces the wide variation in saturated thickness shown in the model results.

It is important to note that the percent saturation values are based the modeled results from pumping in the well locations shown in Figure 2 with the distribution of pumping shown on Table 3. Other combinations of pumping locations (e.g. different wells) using the same monthly demand distribution and total annual volumes could also be able to meet supply while still passing the criteria, but each would need to be tested independently. Similarly, while the modeling indicates there is a margin of safety above the demands simulated for 2040 using the modeled wells shown in Table 2 and Figure 2, the ability of the Basin to meet additional demands will depend on the distribution of demand in time and the distribution of pumping in the Basin.

4.5 Conclusions

This memorandum documents the results of modeled groundwater supply sufficiency for the specific demand distribution developed for the Project and non-project development within Squaw Valley through 2040. These demands were distributed to the appropriate pumpers and then to specific well locations primarily within the most productive groundwater supply portions of the valley. The modeled results of this pumping distribution show that there is sufficient water supply to meet the estimated Project and non-project demands at 2040.

For the purposes of the determining the sufficiency of supply, the Project and non-project demands in the SVPSD service area were distributed evenly over three of the existing and one replacement SVPSD well and nine potential new SVPSD wells in the western wellfield. The same demands (volume and timing) could also be pumped from other well field configurations and pass the criteria, assuming that they are located in the western portion of the model.

This sufficiency of supply scenario focused on meeting the total demand. Phasing of well development, pumping distributions, and well sites could vary based on available land, phasing of the Project and non-project demands.

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TABLES

Table 1. Average Year Total Demand by Month at 2040

All values in Acre-Feet

Month	Squaw Valley Public Services District (SVPSD)[1]					Squaw Valley Mutual Water Company (SVMWC)[2]		Resort at Squaw Creek[3]		Squaw Valley Resort Snowmaking[4]	Total Average Year Demand by Month	Average Horizontal Well Production[5]			Demand from Olympic Valley Groundwater Basin[6]
	Existing Demand	Project Demand	New Single Family Demand	New Resort, Hotel, Condo, & Commercial Demand	Resort at Squaw Creek Phase 2 Potable Demand	Existing Demand	New Single Family Demand	Golf Course Irrigation (after Phase 2)	Snowmaking (after Phase 2)			SVPSD	SVMWC	Total	
January	26	21	5	3	4	6	1	0	21	23	110	1	4	5	105
February	28	22	6	4	4	6	1	0	19	16	105	1	3	5	100
March	27	24	5	4	4	7	1	0	0	0	72	2	4	6	66
April	22	18	3	3	2	6	1	0	0	0	54	2	4	6	48
May	29	17	3	2	3	10	1	6	0	0	71	3	4	7	64
June	45	20	5	3	4	16	1	28	0	0	121	4	3	7	114
July	58	26	10	4	5	20	2	46	0	0	170	3	3	7	163
August	57	27	9	4	5	20	1	36	0	0	160	3	3	6	154
September	44	19	7	3	4	18	1	23	0	0	120	2	3	6	114
October	26	16	5	2	3	10	1	6	1	1	70	2	3	5	65
November	15	12	3	1	2	5	0	0	27	19	85	1	3	4	81
December	24	19	4	3	3	6	1	0	27	30	117	1	4	5	112
TOTALS	**403**	**240**	**64**	**35**	**43**	**130**	**10**	**145**	**94**	**89**	**1,254**	**26**	**42**	**68**	**1,186**

Notes:

General : - All values from Table 2 of Farr West June 2015.
- All values rounded to nearest whole number, totals may reflect the effects of rounding.

1 : SVPSD demands include Village at Squaw Valley demand estimate, current demands, non-project single family residential and commercial/multifamily demands, and the Resort at Squaw Creek Phase 2 potable water demands.

2 : SVMWC cumulative demands include current demand and new single family residential demands.

3 : RSC non-potable demands at 2040 assumed to be equivalent to the existing Development Agreement with SVPSD.

4 : Resort snow making volume and seasonal distribution supplied from the Olympic Valley Aquifer in 2040 assumed to be the same as recent historical averages plus a growth factor of 10 percent.

5 : 2000 to 2014 average production reported by SVPSD and SVMWC.

6 : Olympic Valley Groundwater Basin demand calculated by subtracting Total Average Horizontal Well Production from Total Demand column.

Des by: DH
Ckd by: CT

Table 2. Well Information

Well ID[1]	Existing, New, or Replacement	Well Type	Operator	Maximum Saturated Thickness[2] (feet)
SVPSD-1RR	Proposed Replacement	Municipal	SVPSD	153
SVPSD-2R	Existing	Municipal	SVPSD	78
SVPSD-3	Existing	Municipal	SVPSD	128
SVPSD-5R	Existing	Municipal	SVPSD	131
New-07/11	Proposed New	Municipal	SVPSD	98
New-09/14	Proposed New	Municipal	SVPSD	109
New-10/12	Proposed New	Municipal	SVPSD	114
New-14/08	Proposed New	Municipal	SVPSD	125
New-15/07	Proposed New	Municipal	SVPSD	114
New-16/10	Proposed New	Municipal	SVPSD	136
New-23/12	Proposed New	Municipal	SVPSD	122
New-39/54	Proposed New	Municipal	SVPSD	133
New-45/53	Proposed New	Municipal	SVPSD	142
RSC-18-3R	Existing	Municipal	SVPSD	--
SVMWC -1	Existing	Municipal	SVMWC	142
SVMWC -2	Existing	Municipal	SVMWC	128
RSC-Perini	Proposed New	Irrigation / Snow Making	RSC	--
RSC-Fourth Fairway	Existing	Irrigation / Snow Making	RSC	--
RSC-18-1	Existing	Irrigation / Snow Making	RSC	--
RSC-18-2	Existing	Irrigation / Snow Making	RSC	--
SC-ChildrensNW	Existing	Snow Making	SVR	--
SC-ChildrensNE	Existing	Snow Making	SVR	--
SC-ChildrensSE	Existing	Snow Making	SVR	--
SC-Cushing	Existing	Snow Making	SVR	--

Notes:

1 : Well identification notes: SVPSD-1RR is the replacement for well SVPSD-1R.
New wells are given designations based on row and column location within the model.
SC- designation wells are owned and operated by Squaw Valley Resort.

2: Maximum saturated thickness is the maximum modeled groundwater elevation in the well

Des by: CT
Ckd by: MR

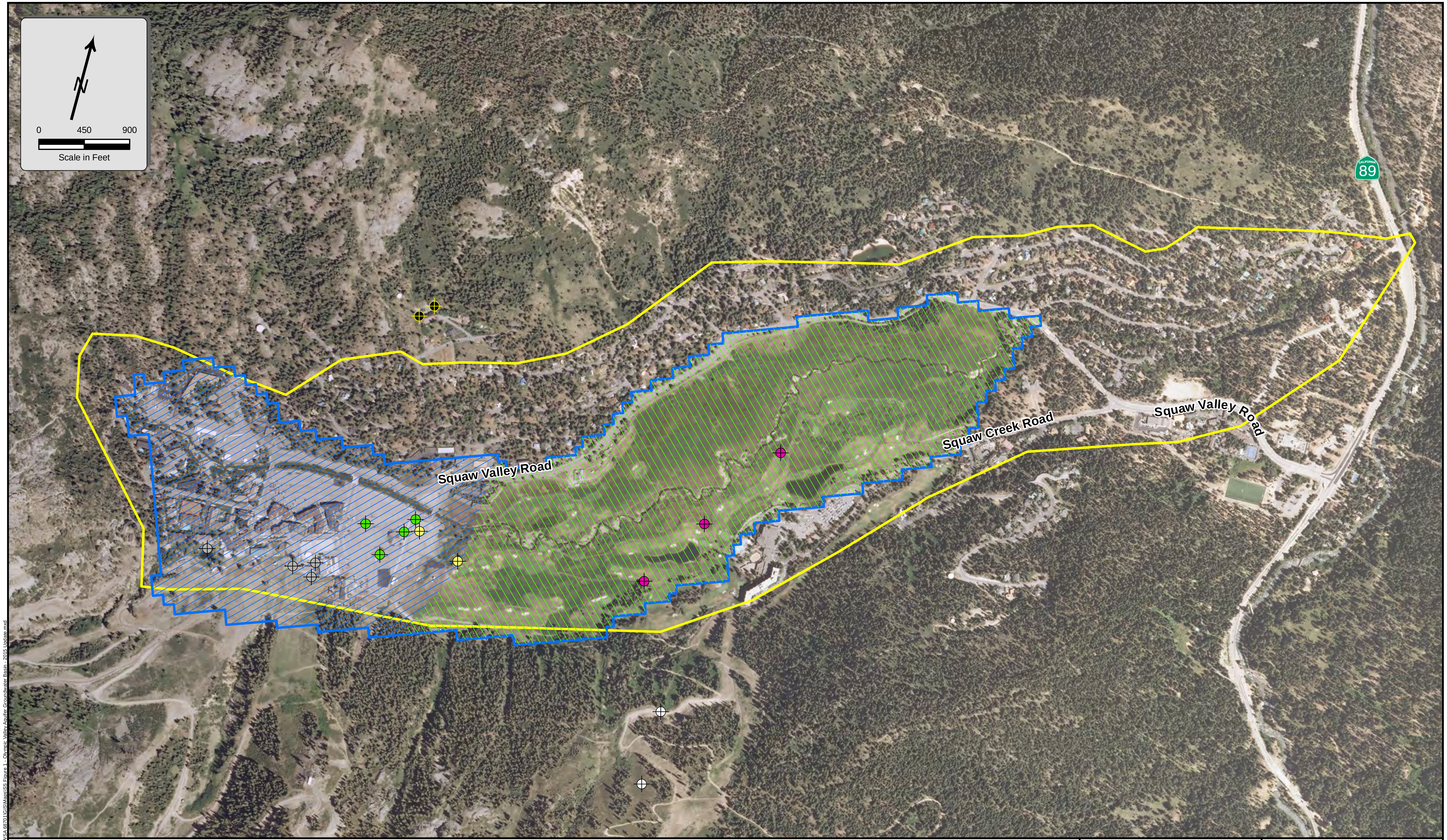
Table 3. Estimated Pumping by Well in 2040

All values in Acre-Feet

	SVPSD														SVMWC		RSC				SVR				
Month	**SVPSD-1RR**	**SVPSD-2R**	**SVPSD-3**	**SVPSD-5R**	**New-07/11**	**New-09/14**	**New-10/12**	**New-14/08**	**New-15/07**	**New-16/10**	**New-23/12**	**New-39/54**	**New-45/53**	**RSC-18-3R**	**SVMWC -1**	**SVMWC -2**	**RSC-Perini**	**RSC-Fourth Fairway**	**RSC-18-1**	**RSC-18-2**	**SC-ChildrensNW**	**SC-ChildrensNE**	**SC-ChildrensSE**	**SC-Cushing**	**Total Pumping**
January	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.3	1.4	2.1	12.8	7.7	0.0	0.0	5.5	5.5	5.5	6.2	**105**
February	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.2	2.0	1.4	12.1	7.3	0.0	0.0	3.8	3.8	3.8	4.3	**100**
March	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.4	2.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**66**
April	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	1.7	1.7	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**48**
May	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	2.7	4.1	2.9	3.8	2.6	0.0	0.0	0.0	0.0	0.0	0.0	**64**
June	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	4.0	6.6	6.6	16.4	10.9	0.3	0.6	0.0	0.0	0.0	0.0	**114**
July	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	4.7	6.9	11.3	17.2	11.4	5.8	11.36	0	0	0	0.00	**163**
August	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	5.4	7.2	11.3	17.3	11.5	2.5	5.0	0.0	0.0	0.0	0.0	**154**
September	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4.0	5.9	9.4	14.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	**114**
October	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	2.7	2.9	4.3	3.6	2.5	0.0	0.0	0.3	0.3	0.3	0.3	**65**
November	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.0	0.9	1.2	15.4	10.3	0.3	0.6	4.3	4.3	4.3	6.0	**81**
December	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.0	1.6	1.8	16.2	10.8	0.0	0.0	6.7	6.7	6.7	9.5	**112**
Total	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**55.1**	**43.2**	**43.9**	**54.4**	**128.9**	**84.2**	**8.9**	**17.5**	**20.7**	**20.7**	**20.7**	**26.4**	**1,186**

54.2635

FIGURES

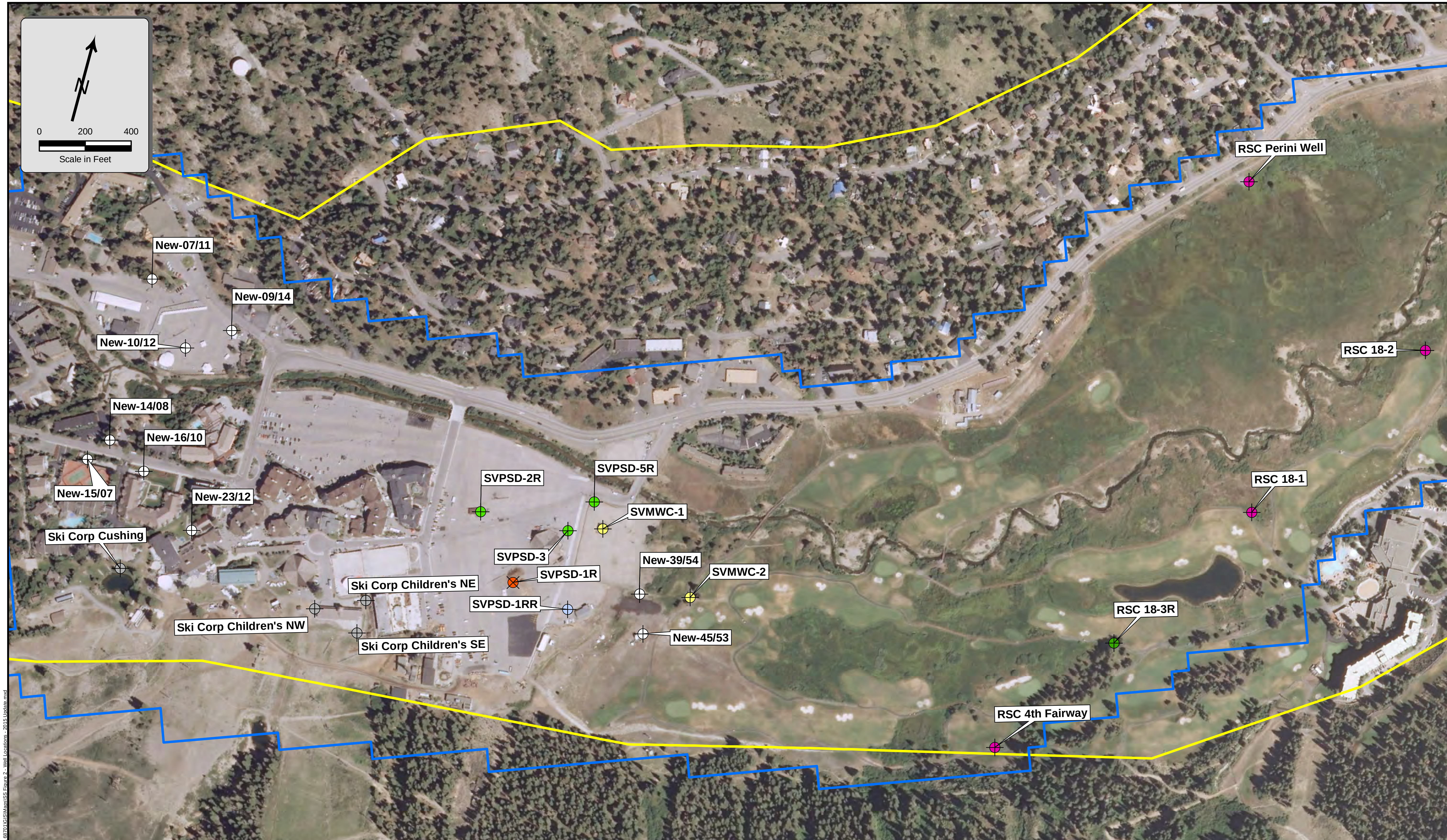


Active SVPSD Aquifer Well
SVPSD Horizontal
Active SVMWC Aquifer Well
SVMWC Horizontal
Squaw Valley Resort Well
Resort at Squaw Creek Well
DWR Designated Olympic Valley Groundwater Basin
Groundwater Management and Active SVPSD Model Area
Western Portion of Basin
Eastern Portion of Basin

July 2015

TODD GROUNDWATER

Figure 1
Olympic Valley Groundwater Basin and Existing Wells

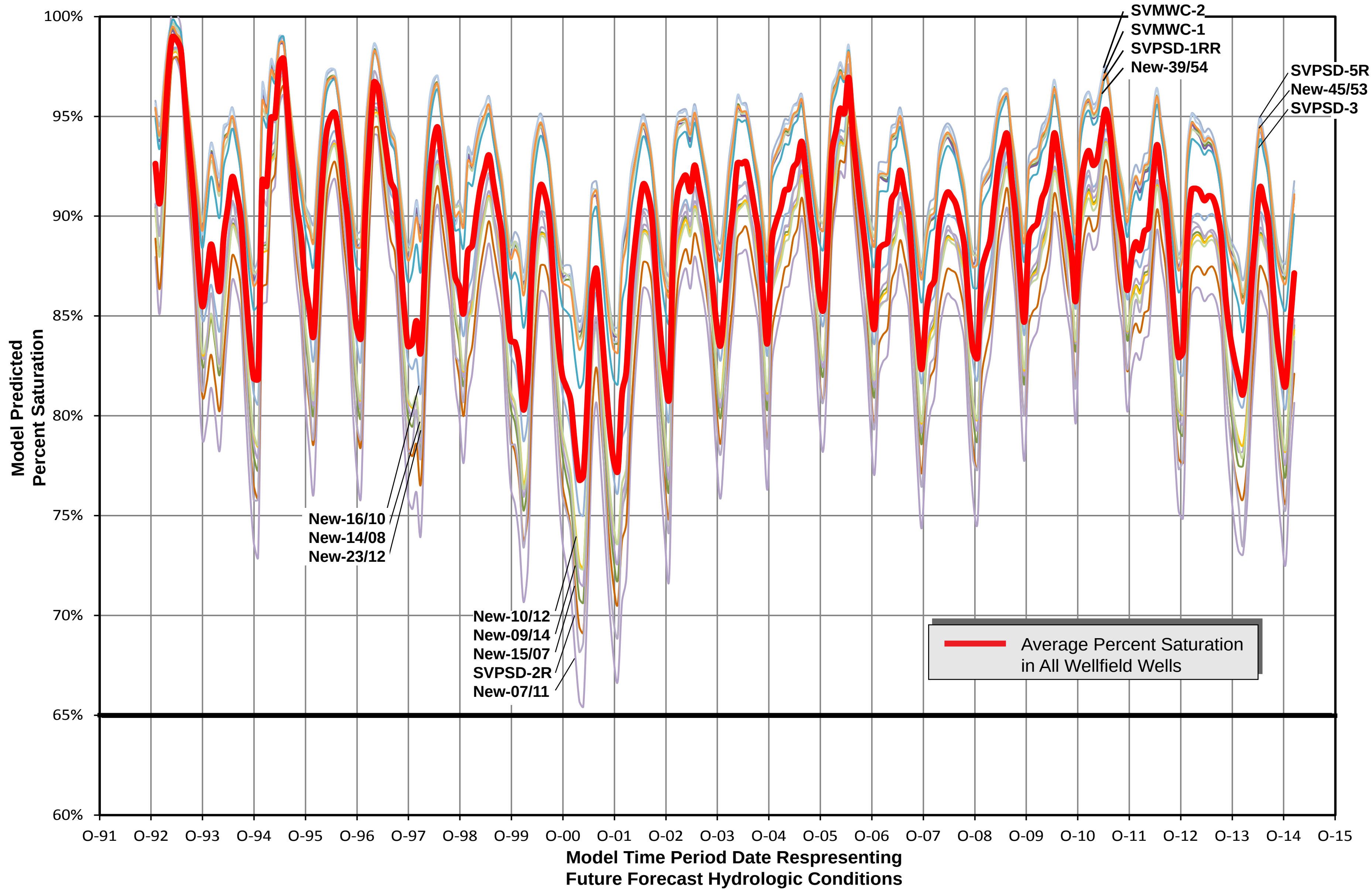


Proposed New Well
PSD Replacement Well
Existing PSD Well to Remain
Existing MWC Well to Remain
Squaw Valley Resort Well
Resort at Squaw Creek 18-3R
Resort at Squaw Creek Irrigation/Snowmaking Well
Well To Be Destroyed
Active Model Area
Olympic Valley Groundwater Basin

July 2015

TODD GROUNDWATER

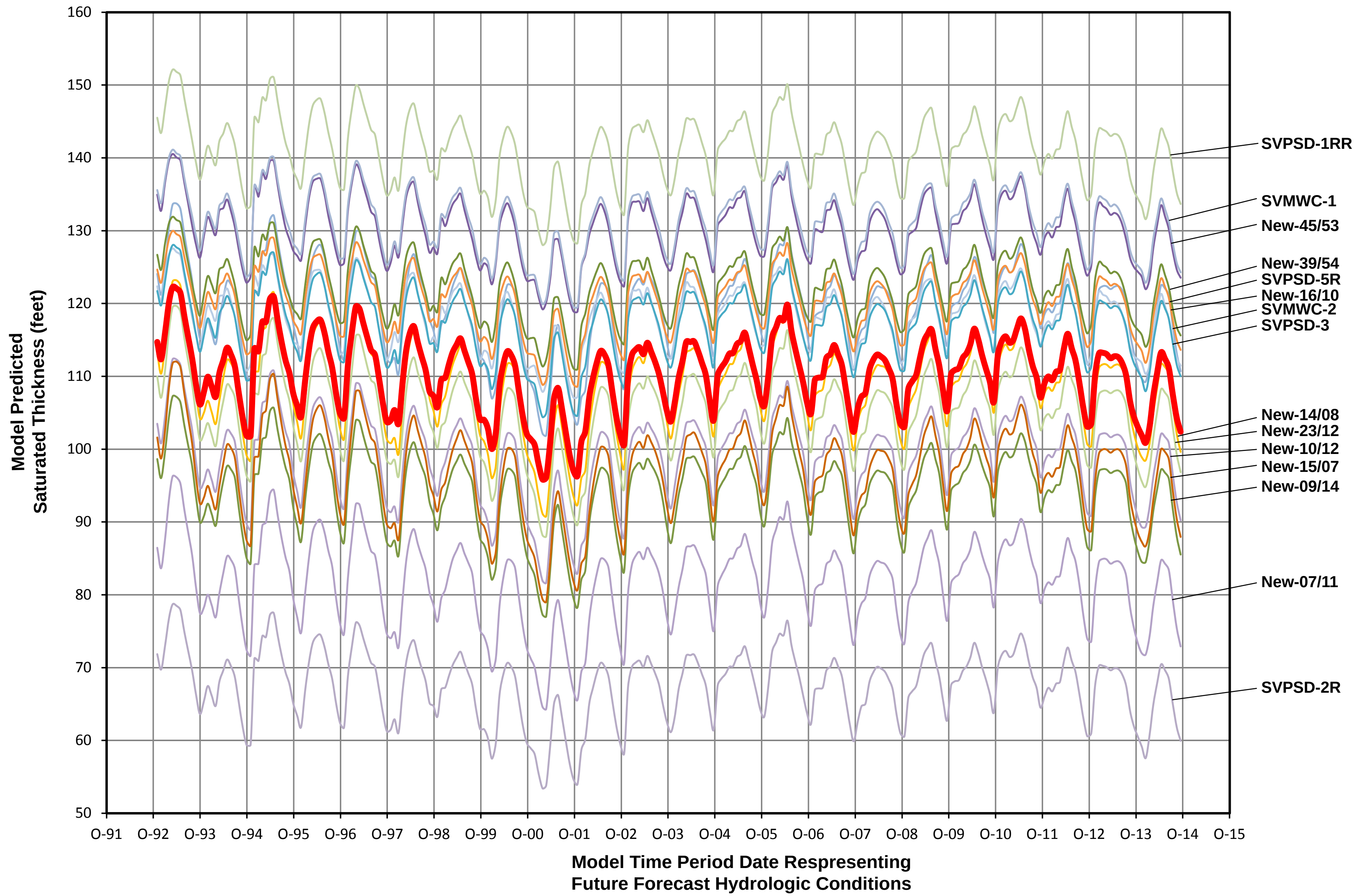
Figure 2
Existing and Modeled Well Sites
Village at Squaw Valley



July 2015

TODD GROUNDWATER

Figure 3
Percent Saturation All Wellfield Wells at 2040



July 2015

TODD GROUNDWATER

Figure 4
Saturated Thickness All Wellfield Wells at 2040