Olympic Valley
Groundwater Management Plan

Prepared for:
Squaw Valley Public Service District

May 2007
(Revised June 1, 2007)

Prepared by:

Hydro Metrics LLC

Squaw Valley Public Service District
Placer County, California

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ABBREVIATIONS, SYMBOLS, AND ACRONYMS

AB	Assembly Bill
AB3030	Assembly Bill 3030 (Section 10750, et seq. of the California Water Code)
ARR	Annual Review and Report
ASR	Aquifer Storage and Retrieval
BMO	Basin Management Objective
cfs	Cubic Feet per Second
CCR	California Code of Regulations
CWC	California Water Code
DHS	California Department of Health Services
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection Program
GMP	Groundwater Management Plan
GPS	Global Positioning System
HSU	Hydrostratigraphic Unit
InSAR	Interferometric Synthetic Aperture Radar
LRWQCB	Lahontan Regional Water Quality Control Board
MAWA	Maximum Applied Water Allowance
MCL	Maximum Contaminant Level
MG	Million Gallons
NBMG	Nevada Bureau of Mines and Geology
µg/L	Micrograms per Liter (parts per billion)
PCA	Potential Contaminating Activity
PCWA	Placer County Water Agency
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
TDS	Total dissolved solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

CONVERSION FACTORS

1 acre-foot = 325,850 gallons
1 cubic foot per second = 449 gallons per minute

Section 1
INTRODUCTION AND PURPOSE

1.1 INTRODUCTION

The Groundwater Management Act found in the California Water Code (CWC) §10753 *et seq*, enacted as Assembly Bill (AB) 3030 in 1992, encouraged local public agencies to adopt formal plans to manage groundwater resources within their jurisdictions. In September 2002, Senate Bill (SB) 1938 was signed into law amending sections of the Water Code related to groundwater management. SB1938 requires any public agency seeking State funds administered through the California Department of Water Resources (DWR) for groundwater related activities to prepare and implement a groundwater management plan (GMP) with certain specified components. Additionally, SB1938 sets forth specific requirements for GMPs. New requirements include establishing Basin Management Objectives (BMOs), preparing a plan to involve other local agencies in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management.

In accordance with AB3030 and SB1938, the Squaw Valley Public Service District (SVPSD) developed this GMP. This plan was developed in coordination with input from a Stakeholders group that included representatives from other groundwater users, environmental advocates, regulatory agencies, and the general public. The plan has been prepared with assistance from the consulting firm of HydroMetrics, LLC.

This report consists of the following sections:

Section 1 Introduction and Purpose – This section contains general information about the SVPSD and the purpose of the GMP.

Section 2 Groundwater Management Process – This section describes the steps and procedures that were conducted to draft, review, and finalize this GMP. Information about public participation, the Stakeholders group, and the timeline of all events relating to the GMP process are included in this section.

Section 3 Existing Groundwater Conditions – This section addresses the current hydrogeological conditions and issues related to the GMP area. This section includes a discussion of groundwater basin boundaries, hydrogeology and

groundwater levels, existing water supplies and groundwater extractions, and groundwater quality.

Section 4 Basin Management Goals and Objectives – This section presents the strategy for managing the groundwater basin with specific goals and objectives. These include goals with broad principles, and BMOs which are quantifiable or verifiable attributes that support and corroborate achievements of the basin goals.

Section 5- Basin Management Elements – This section details the specific projects, programs, and policies that will be implemented to manage the basin. This section describes new elements, and formalizes existing programs and policies.

Section 6 Implementation Plan – This section outlines the procedures and schedule for implementing this GMP, as well as discussing future coordination with other agencies.

As shown in the Table of Contents, several appendices are included containing documents related to this GMP Update. The written public comments to the Draft GMP with responses are in Appendix E.

1.2 PURPOSE

The Olympic Valley GMP satisfies multiple objectives, including:

- Building on and formalizing existing groundwater management activities in the basin;
- Developing a framework for implementing future groundwater management activities;
- Establishing a framework for identifying a specific set of programs, projects, and policies for near-term and long-term implementation to achieve management goals and objectives, subject to CEQA as then applicable.

The Olympic Valley GMP does not allow any entity to restrict or otherwise limit the extraction of groundwater by other users. Groundwater management activities, such as minimizing impacts on Squaw Creek and distributing pumping depressions, are accomplished through cooperative management by all groundwater users.

A central principle of this GMP is to produce a plan that is in conformance with the changes to CWC §10753 *et seq*. imposed by SB1938. To that end, this GMP addresses the following:

- Seven mandatory components included in CWC §10753 *et seq*. These seven components are required for agencies to be eligible for funds administered by DWR;
- Seven recommended components as described in California Groundwater Management (DWR, 2003);
- Twelve voluntary components included in CWC §10753.8. These components describe 12 specific technical issues that could be addressed in GMPs to manage the basin optimally and protect against adverse conditions.

All seven mandatory components are addressed directly in the GMP. Many of the seven recommended components and twelve voluntary components are also addressed in this. These various components are addressed throughout the GMP. Table 1 lists the section(s) in which each component is addressed.

Table 1: Location of Olympic Valley GMP Components

	Description	***Section of GMP Report***
California Water Code §10750 et seq. Mandatory Components (7 *components*)		
1	Documentation that a written statement was provided to the public "describing the manner in which interested parties may participate in developing the groundwater management plan" (Water Code, § 10753.4 (b))	Section 2
2	Basin management objectives (BMOs) for the groundwater basin that is subject to the plan (Water Code, § 10753.7 (a)(1))	Section 4
3	Components relating to the monitoring and management of groundwater levels, groundwater quality, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping (Water Code, § 10753.7 (a)(1))	Section 5; Elements 1, 2, 3

	Description	*Section of GMP Report*
4	A plan by the managing entity to "involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin" (Water Code, § 10753.7 (a) (2)). A local agency includes "any local public agency that provides water service to all or a portion of its service area" (Water Code, § 10752 (g))	Section 5, Element 4
5	Adoption of monitoring protocols (Water Code, § 10753.7 (a)(4)) for the components in Water Code section 10753.7 (a)(1). Monitoring protocols are not defined in the Water Code, but the section is interpreted to mean developing a monitoring program capable of tracking changes in conditions for the purpose of meeting BMOs	Section 4, Appendix A
6	A map showing the area of the groundwater basin as defined by DWR Bulletin 118 with the area of the local agency subject to the plan as well as the boundaries of other local agencies that overlie the basin in which the agency is developing a groundwater management plan (Water Code, § 10753.7 (a)(3))	Section 3
7	For local agencies not overlying groundwater basins, plans shall be prepared including the above listed components and using geologic and hydrologic principles appropriate to those areas (Water Code, § 10753.7 (a)(5))	Not applicable
Department of Water Resources (DWR) Suggested Components (7 components)		
1	Manage with guidance of an advisory committee	Section 2
2	Describe area to be managed under the GMP	Section 3
3	Create a link between BMOs and the goals and actions of the GMP	Sections 4, 5
4	Describe the GMP monitoring programs	Section 5, Elements 1, 2, 3. Appendix A
5	Describe integrated water management planning efforts	Section 5, Elements 1, 4, 5
6	Report on implementation of GMP	Section 6
7	Evaluate GMP periodically	Section 6
California Water Code §10750 et seq. Voluntary Components (*12 components*)		
1	Control of saline water intrusion	Not Applicable
2	Identification and management of wellhead protection areas and recharge areas	Section 4, BMO 2-4 Section 5, Element 9
3	Regulation of the migration of contaminated groundwater	Section 4, BMO 2-3 Section 5 Elements 4, 9
4	Administration of well abandonment and well destruction program	Section 5, Element 6

	Description	*Section of GMP Report*
5	Mitigation of conditions of overdraft	Section 4, BMO 1-2. Section 5, Elements 5, 7
6	Replenishment of groundwater extracted by producers	Not Applicable
7	Monitoring of groundwater levels and storage	Section 5, Element 1
8	Facilitating conjunctive use operations	Not Applicable
9	Identification of well construction policies	Section 5, Element 6
10	Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects	Section 5, Elements 7, 9
11	Development of relationships with state and federal regulatory agencies	Section 5, Element 4
12	Review of land use plans and coordination with land use planning agencies to assess activities that create reasonable risk of groundwater contamination	Section 4, BMO 2-2, 2-4, Section 5, Elements 6, 9

Section 2
GROUNDWATER MANAGEMENT PLAN PROCESS

2.1 LEAD AGENCY

In accordance with CWC §10753, groundwater management plans can be developed by "Any local agency, whose service area includes a groundwater basin or a portion of a groundwater basin… ". The SVPSD is the only entity in this basin that qualifies as a local agency, as defined by CWC §10752, and therefore is the lead agency on this GMP.

2.2 PUBLIC OUTREACH AND NOTIFICATION

The Olympic Valley GMP was completed as an open process with public participation, consistent with CWC §10750 *et seq*. For this GMP, the following steps were taken to provide opportunity for public input:

2.2.1 INITIAL NOTICE OF INTENT

In accordance with CWC §10753.2, a notice of intent to adopt a resolution to prepare a GMP was published in the *Sierra Sun* newspaper on May 11, 2006 and again on May 17, 2006. The SVPSD Board of Directors adopted the resolution of intent at their publicly held Board Meetings on May 30, 2006. The resolution of intention to prepare a GMP was published on June 16, 2006 in the *Sierra Sun* newspaper. Both the Notice of Intent and the Resolution of Intent are included in Appendix B.

2.2.2 PUBLIC OUTREACH AND NOTIFICATION

During the GMP development, the public was provided information on the GMP progress through the following:

- Initial Invitation List – A list of 64 groups potentially interested in the GMP process was compiled. These groups included media, businesses, organizations, individuals, governmental entities, other basin pumpers, and SVPSD staff. These 64 invitees were mailed an invitation to attend the June 28, 2006 kick-off meeting and the following August 9, 2006 Stakeholders Meeting (Appendix C).

- Direct Mail and E-mail List – This list consisted of 29 interested individuals and organizations that expressed an interest in the GMP, or who had attended meetings about development of the GMP. All announcements and GMP drafts were sent to the list members (Appendix C).

- Web Pages – A web page was maintained that allowed anybody to comment on the GMP process, and suggest edits to the draft GMP. (http://olympicvalleygmp.grouphub.com/projects/791160/project/log). Additionally, all meeting announcements were posted on the Squaw Valley Public Service's web page. (http://www.svpsd.org/).

- Press Releases – All meeting notices were given to the *Sierra Sun* for publication. The *Sierra Sun* covers Truckee, Donner Summit, and all the local communities around North Lake Tahoe. Articles on the GMP process appeared in the *Sierra Sun* on May 11, 2006, June 14, 2006, June 21, 2006, July 18, 2006, August 1, 2006, and May 1, 2007 (Appendix D).

- Public Postings and Announcements – All meeting notices and agendas were posted at three (3) public buildings in Olympic Valley, including the SVPSD office, the post office, and the former fire station building. All agendas were additionally posted on the SVPSD web page (http://www.svpsd.org). An article announcing the GMP was included in the SVPSD July 2006 newsletter, included with all customer bills. A copy of this newsletter article is included in Appendix D.

2.2.3 Public Comment Period for the Draft GMP

The Draft GMP was made available to the public on April 9, 2007. Public comment was accepted on the Draft GMP between April 9 and May 29, 2007.

2.2.4 Public Hearings

There were three public hearings during which the public had an opportunity to comment on the Draft GMP. The first public hearing was held on April 24, 2007, the second on May 16, 2007, and the third on May 29, 2007.

2. 3 FORMATION OF A STAKEHOLDERS GROUP TO ASSIST WITH DEVELOPING THE GMP

A Stakeholders Group was convened regularly during the GMP development to facilitate community input into the GMP. The Stakeholders Group was open to all groundwater pumpers, interested regulatory agencies, and all members of the public. Although there were many differing opinions among the members of the Stakeholders Group, every effort was made to reach some level of consensus on contentious issues. The Stakeholders Group met throughout the GMP development to review and discuss the GMP. Meeting dates included:

- June 28, 2006 – Introduce the purpose of the GMP and agree on a general outline;
- August 9, 2006 – Review and discuss the Goals and Objectives of the GMP;
- August 9 – Review and discuss the Elements proposed for the GMP;
- October 11, 2006 – Review and discuss the Elements proposed for the GMP;
- February 8, 2007 – Discuss the GMP implementation plan

Additionally, the Draft GMP was made available to the entire Stakeholders Group for comment.

2.4 DEVELOPING RELATIONSHIPS WITH FEDERAL, STATE, AND LOCAL AGENCIES

As interested stakeholders, it was critical to develop and maintain good working relationships with local, state, and federal regulatory agencies during the development of the GMP. Federal, State, and local agencies that were invited to take part in the GMP development included:

- Truckee River Water Master
- California Department of Water Resources (DWR),
- California Department of Fish & Game

- California Regional Water Quality Control Board (RWQCB), Lahontan Division
- Placer County Water Agency (PCWA),
- Placer County Community Development & Resource Agency
- Placer County Environmental Health
- Placer County Executive Office

2.5 CONSISTENCY WITH OTHER LOCAL PROGRAMS AND POLICIES

This GMP has been checked for consistency with programs initiated by other agencies. These include, but are not limited to the following:

- Placer County General Plan
- Lahontan Regional Water Quality Control Board Water Quality Control Plan for the Lahontan Region
- Lahontan Regional Water Quality Control Board Resolution r6t-2006-0017 to reduce sediment loads in Squaw Creek
- Integrated Water Management Plans

2.6 CONSISTENCY WITH CEQA

This GMP is a policy statement authorizing the GMP Implementation Group and Advisory Group to consider and approve future programs and projects. This GMP is categorically exempt from CEQA under California Code of Regulations § 15306, information collection. As stated in the notice of exemption, "The [purpose for adopting] the OV [Olympic Valley] GMP is to collect information only at this time in order to build on and formalize existing groundwater management activities; develop a framework for implementing future groundwater management activities; and identify programs, projects and policies for near-term and long-term implementation to achieve management goals and objectives, subject to CEQA applicable at that time to specific identified projects." The categorical exemption is based the following observations:

- This plan authorizes feasibility and planning studies.
- Other than data collection activities, the plan does not adopt, approve, or fund any specific projects.

- Future projects considered by the GMP Implementation and Advisory Groups as part of the implementation of this GMP shall be subject to CEQA review, as applicable.
- Adoption of this plan does not specify nor mandate any specific projects or mitigations.
- Required elements of this plan consist only of data gathering and analysis activities.
- Adoption of the plan shall not cause any change in the environment of Olympic Valley or impose significant effects on the environment.

Section 3
EXISTING GROUNDWATER CONDITIONS

All domestic, municipal, and irrigation water in Olympic Valley is derived from local groundwater sources. Groundwater is primarily extracted from glacial deposits and river alluvium filling Olympic Valley; a minor amount is also extracted from fractured bedrock along the sides of the Valley. This chapter describes the existing groundwater conditions in the sediments filling the Valley and discusses current groundwater management strategies.

3.1 PHYSICAL SETTING

3.1.1 LOCATION AND TOPOGRAPHY

Olympic Valley is a glacially carved valley in the Sierra Nevada of California. The Valley is situated west of Lake Tahoe, at an elevation of approximately 6,200 feet (Figure 1). Steep mountains ring the Valley, rising to an elevation of over 9,000 feet at the top of Granite Chief Peak. Olympic Valley measures approximately 2.5 miles by 0.4 miles, covering an area of approximately 600 acres. Steep mountains bound the Valley on the North, West, and South. A terminal moraine on the Valley's eastern side separates the Valley from the Truckee River. The Valley is drained by Squaw Creek. The north and south forks of Squaw Creek enter along the Valley's western side. Squaw Creek exits the Valley through the terminal moraine on the Valley's eastern side.

Land use in the Valley is mainly commercial, recreational, residential, and open space. Commercial and recreational development is prominent in the western portion of the Valley. This portion of the Valley is largely paved and covered with commercial buildings. The Resort at Squaw Creek, and the associated golf course, dominates the southeast portion of the Valley. An undeveloped meadow overlies the northeastern portion of the Valley. Residential development partially rings the Valley on the North and East sides.

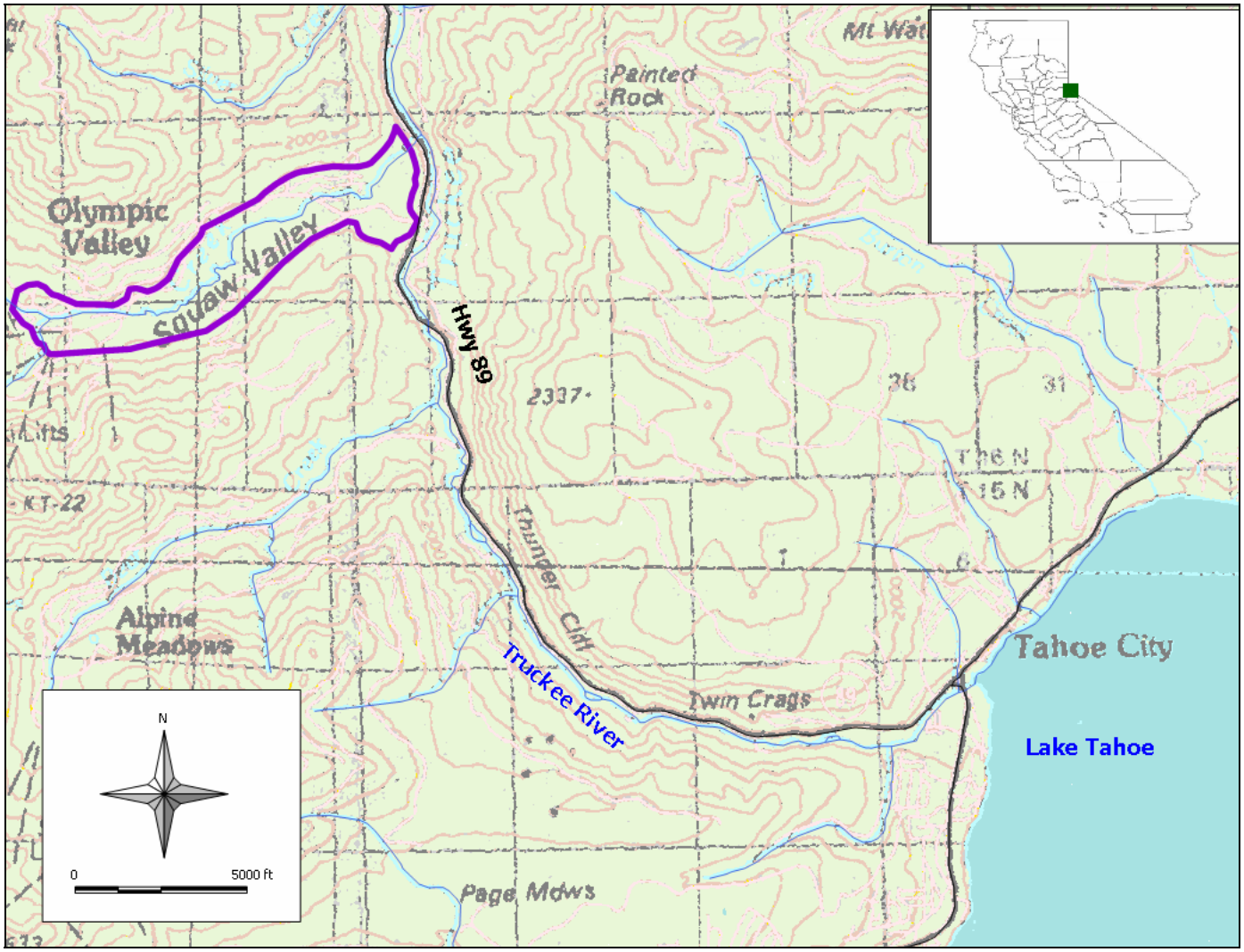

Figure 1: Olympic Valley Location

3.1.2 WATER SERVICE AREAS

Water for municipal and commercial uses is served by two water companies in Olympic Valley. The SVPSD is a County Water District formed under Division 12 of the California Water Code; the Squaw Valley Mutual Water Company (SVMWC) is a non-profit, member owned corporation. The service areas of the two water companies are shown on Figure 2. In addition to the two water companies, groundwater is pumped for domestic and irrigation uses by the Resort at Squaw Creek, the PlumpJack Squaw Valley Inn, and Gladys K. Poulsen. Although unverified, Squaw Valley Ski Corporation claims to pump groundwater for irrigation.

The SVPSD serves a population of approximately 924 year-round residents, with a maximum overnight population of approximately 6,573. The SVPSD delivers an average of 141 million gallons per year to 663 residential units, 1,180 condominiums, and approximately 20 commercial entities consisting of ski resorts, hotels and supporting businesses. The SVPSD water service area, exclusive of the SVMWC service area, encompasses approximately 5,350 acres within the Olympic Valley. Within the SVPSD service area, water for golf course irrigation and snow making at the Resort at Squaw Creek is not provided by the SVPSD. The average annual groundwater demand for golf course irrigation and snow making pumped by the Resort at Squaw Creek is approximately 78 million gallons.

The SVMWC provides on average 32 million gallons per year to 325 residential connections in Olympic Valley. The service area of the SVMWC covers approximately 115 acres, and is completely within the boundaries of the SVPSD.

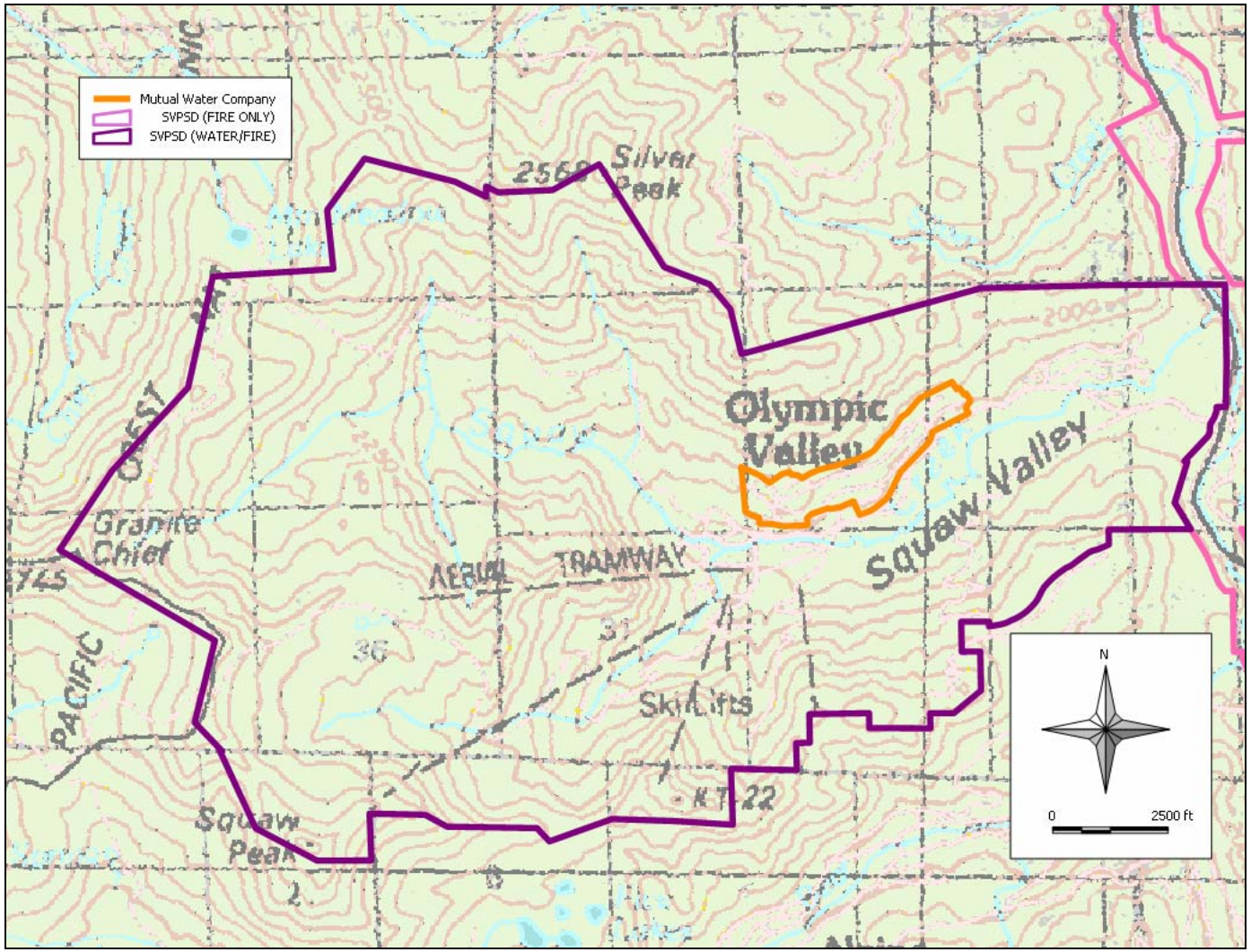

Figure 2: Water Company Service Areas

3.1.3 CLIMATE AND PRECIPITATION

Olympic Valley is characterized by mild summers and cool, wet winters. Olympic Valley has average high temperatures in January and July of 42°F and 82°F, respectively (http://www.wunderground.com). Annual precipitation in the watershed varies from an average of 65 inches in the west to approximately 40 inches per year in the east (Kleinfelder & Associates, 1987). Figure 3 displays mean annual precipitation isohyetals, estimated by Oregon Climate Service (Oregon State University, 2007). The majority of the precipitation occurs as snowfall during winter months. A relatively small amount of precipitation occurs during spring and summer as rain.

Climate records only reflect recent conditions. Conditions may change in the future, as climate change modifies precipitation patterns. We currently do not know how precipitation will be affected, although it is likely that more precipitation will fall as rain than snow.

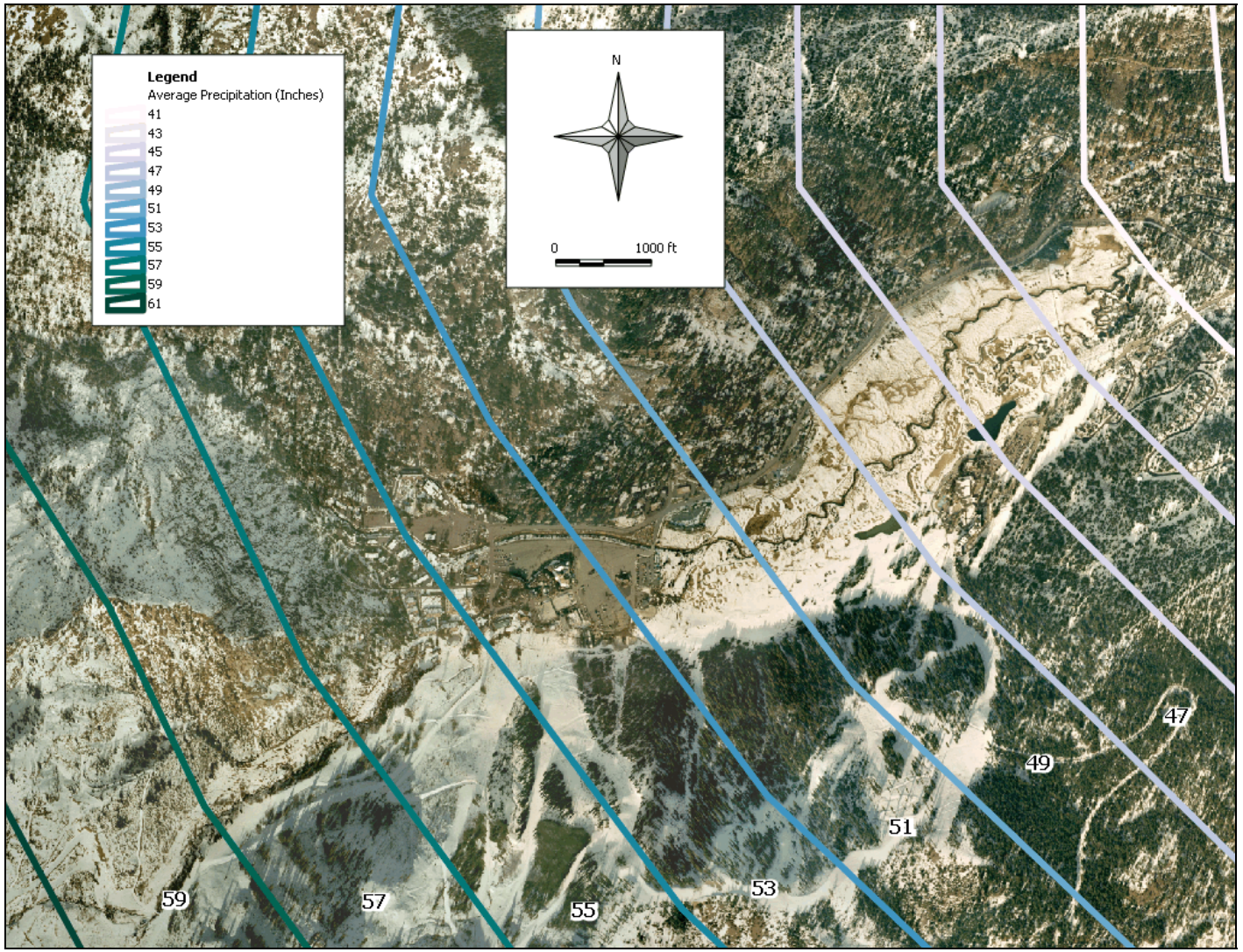

Figure 3: Average Rainfall in Olympic Valley

3.2 BASIN BOUNDARIES AND GMP MANAGEMENT AREA

The area managed under this GMP constitutes a portion of the Olympic Valley Groundwater Basin as defined by DWR Bulletin 118. The boundaries of the basin managed under this GMP are defined by geologic and hydrologic features that limit the movement of groundwater. The boundary of the GMP management area coincides with the DWR basin boundary, except that the eastern end of the basin near the Truckee River and an area of limited to no alluvial fill along the northern edge of the basin are excluded.

Two interpretations of the groundwater basin boundaries are shown in Figure 4. The first interpretation is the boundary shown in the California Department of Water Resources' Bulletin 118, which is an index and map of all groundwater basins in California (DWR, 2003). The Olympic Valley Groundwater Basin was only included in the most recent edition of Bulletin 118. DWR staff estimated the boundary alignment from topographic maps and aerial photographs. The delineation encompassed all developed areas, even if they extended some distance up the mountain slopes at the edge of the Valley. The eastern end was limited to a narrow corridor along Squaw Creek.

The second interpretation shows the hydrogeologic groundwater basin boundary that was refined for this management plan, based on field mapping of bedrock outcrops and principles of glaciofluvial deposition and groundwater flow. This boundary does not represent the GMP management area, but rather, a refined version of the DWR basin boundary. This second boundary is also shown on Figure 4.

The refinements included shifting the northern and western boundaries to coincide with the break in slope at the edge of the Valley floor. This break in slope marks the transition from alluvial deposits in the Valley to bedrock thinly covered with colluvium on the hillsides. This adjustment eliminated hillslope areas that have limited or no alluvial and colluvial deposits. The refined basin boundary coincides with Squaw Valley Road, which follows the break in slope at the edge of the Valley.

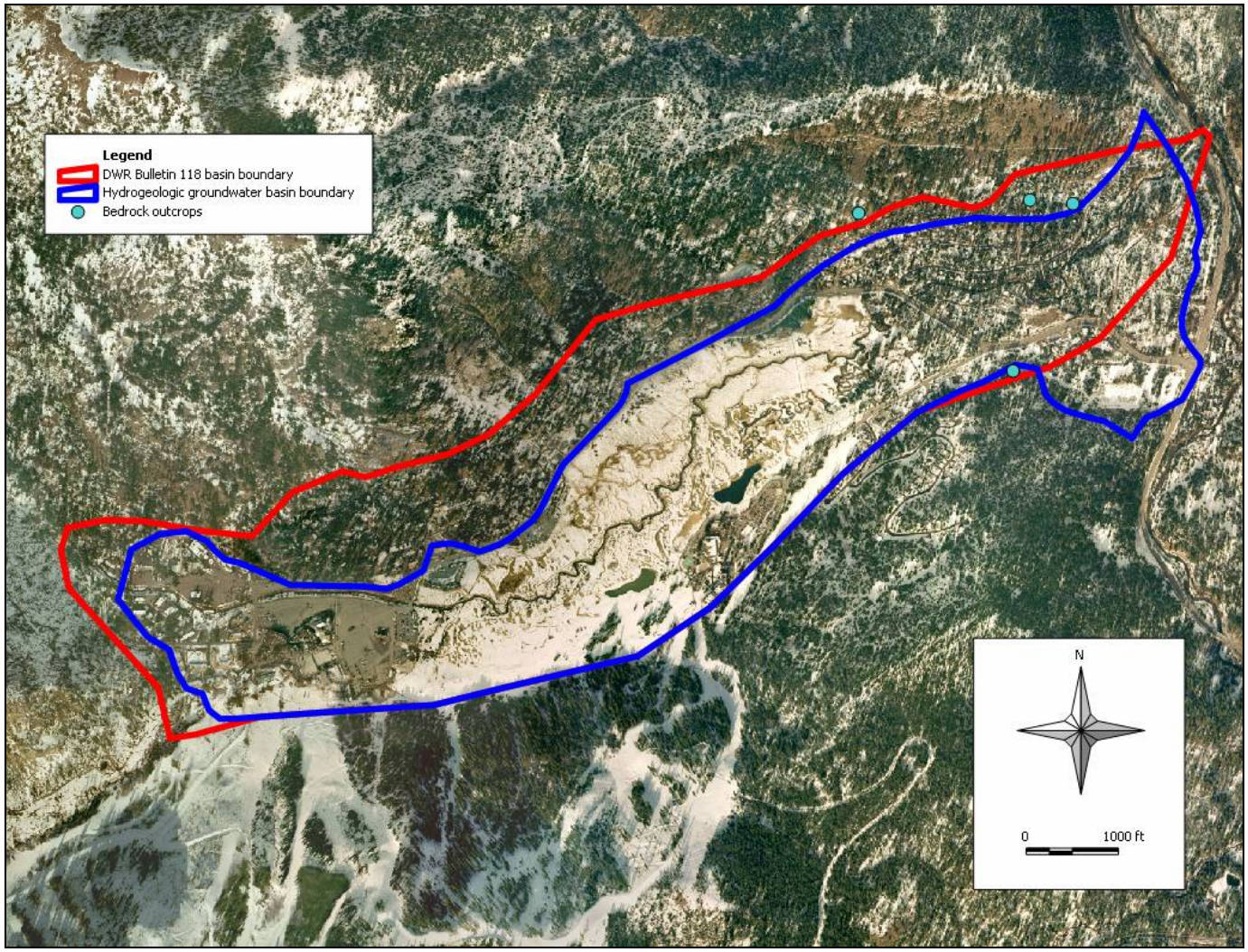

Figure 4: DWR Bulletin 118 and Mapped Hydrogeologic Basin Boundaries

The geologic boundaries at the eastern end of the basin were also revised from the DWR interpretation. A number of bedrock outcrops were mapped in the eastern portion of the Valley, as shown on Figure 4. These outcrops were used to define the revised eastern basin boundary. The eastern basin boundary now encompasses considerably more area than the boundary defined by DWR. Bedrock mapping and data from two test holes drilled by the SVPSD suggest that relatively low permeability moraine deposits and alluvium extend continuously from the higher permeability deposits underlying the eastern edge of the Meadow in Olympic Valley to the Truckee River. A projection of bedrock elevations encountered in various wells also suggests that a substantial thickness of permeable materials extends east to the River. Test wells and private wells drilled in the moraine deposits east of the Meadow have yielded extremely low amounts of groundwater. This suggests that that the moraine deposits are considerably less permeable than sediments in other parts of Olympic Valley, and the moraine is not a significant source of groundwater.

The eastern boundary of the basin was modified to follow the Truckee River. Groundwater in the narrow strip of alluvium east of the river probably interacts directly with the river, although it could be considered part of the basin. A bedrock outcrop in a road cut on the west side of Highway 89 just south of Squaw Creek is probably an extension of the bedrock spur on the mountainside across the river. The bedrock surface underlying the basin undoubtedly has considerable relief, and its shape is conjectural in the eastern part of the basin. However, available surface and subsurface geologic information suggest that groundwater in that area can flow continuously to the Truckee River. Accordingly, the eastern boundary follows the river except at the aforementioned bedrock outcrop exposed on the Highway 89 road cut.

Figure 5 shows the boundary of the area managed under this GMP. It is identical to the revised geologic basin boundary except that the easternmost part of the basin is excluded. This is consistent with the interpretation that the moraine sediments yield little groundwater, and have a low permeability. The moraine is interpreted to be a barrier to groundwater flow, and forms the eastern boundary of the area managed under this GMP This GMP focuses on issues within the central and western parts of Olympic Valley where all municipal, commercial and irrigation pumping occurs.

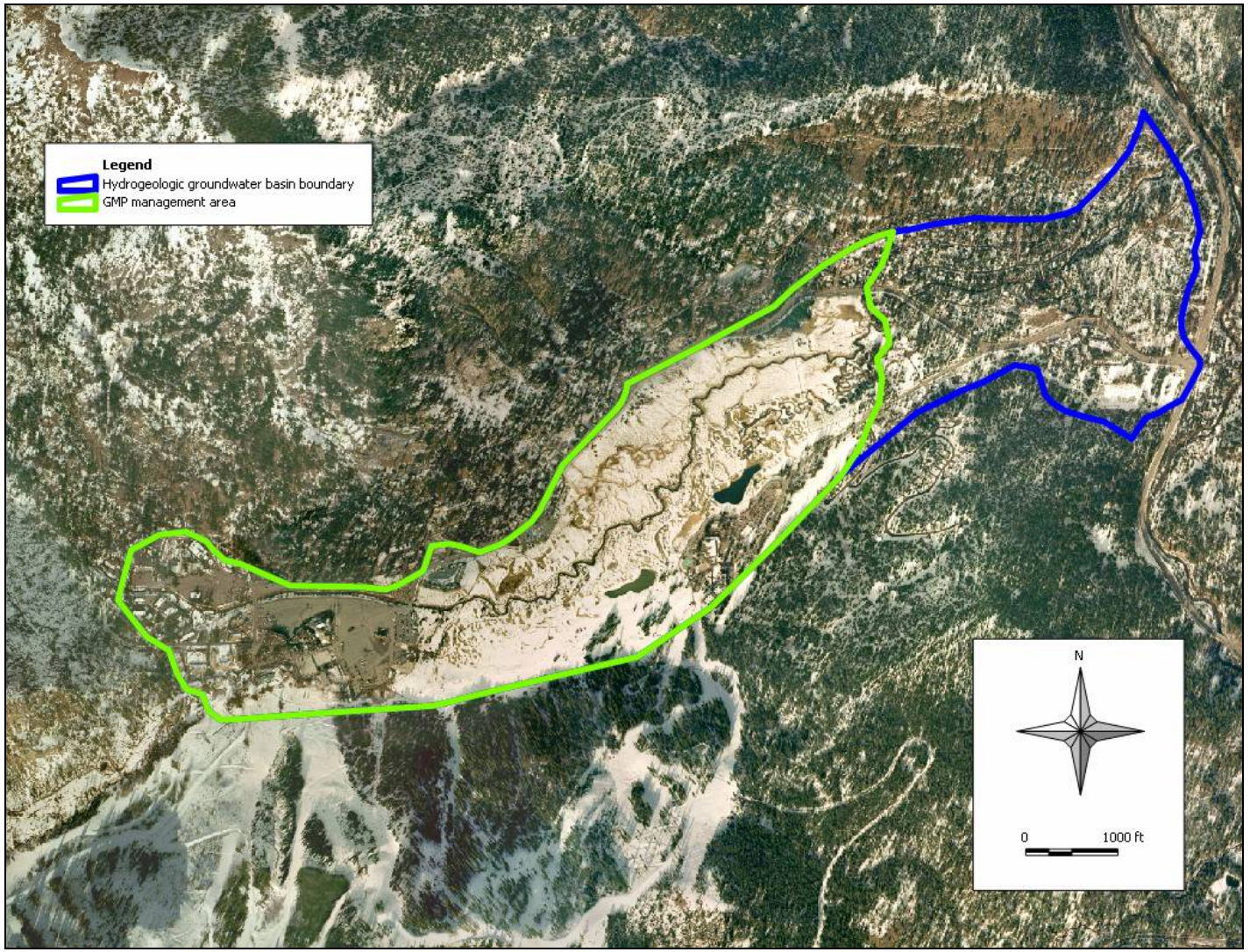

Figure 5: GMP Management Area

3.3 LOCAL GEOLOGY AND HYDROGEOLOGY

Groundwater extracted from Olympic Valley is derived primarily from unconsolidated sediments filling the Valley. These unconsolidated valley fill sediments are underlain by Cretaceous granitic rocks of the Sierra Nevada batholith and Pliocene volcanic rocks. These same rocks form the mountains that flank the Valley on the north, west, and south.

The unconsolidated sediments were deposited primarily by glacial, lacustrine, and fluvial processes. The most prominent glacial feature is the terminal moraine at the eastern end of the Valley. This moraine formed a dam in the Valley outlet. Various alluvial, glacial, and lacustrine sediments collected behind this dam, filling in the Valley to its present elevation. This moraine currently serves as a barrier to groundwater flow, and forms the eastern boundary of the area managed under this GMP, as discussed in Section 3.2.

3.3.1 STRATIGRAPHY OF BASIN SEDIMENTS

Geological interpretation of the basin fill sediments is difficult because the alluvial and lacustrine deposits do not show any clear lateral continuity between wells. However, in general the sediments filling the Valley are coarser in the western part of the Valley, and become finer towards the northeastern part of the Valley. This is consistent with the fact that Squaw Creek flows from west to east through the Valley. Coarser material is deposited by Squaw creek proximal to the mountain front; finer material is carried farther downstream and deposited in the eastern portion of the Valley.

The basin fill sediments have been described with two hydrogeological frameworks:

3.3.1.1 KLEINFELDER DESCRIPTION

Kleinfelder & Associates (1987) divided the Valley sediments into upper and lower units. The upper unit consists of the top ten to twenty feet of the valley fill sediments. These are described as modern post-glacial Squaw Creek deposits. The sediments consist of channel sands and clay-silt overbank deposits of a meandering stream system. The lower unit, which comprises most of the basin fill, consists of glacial deposits. These glacial deposits are poorly sorted till, fine grained glacial lake deposits, and glacial stream and deltaic deposits, predominantly sand and gravel.

3.3.1.2 WEST YOST DESCRIPTION

West Yost & Associates (2005) divided the basin sediments into three hydrostratigraphic units (HSU). HSU 1 is the shallowest unit. This unit consists of fine grained glacial lake and modern stream deposits. The modern Squaw Creek has cut channels in the lake deposits and deposited coarser grained stream sediments within the glacial sediments. HSU 2 underlies HSU 1 and consists of sands and gravels. West Yost & Associates interpreted these sediments as deposited between periods of glacial lake deposition. HSU 3, the deepest unit, consists primarily of dark fine grained sediments which may represent glacial lake deposits. A map showing the location of one cross section developed by West Yost & Associates is shown on Figure 6. This cross-section is shown in Figure 7. Additional cross-sections can be found in the West Yost & Associates Groundwater Characterization Report (West Yost & Associates, 2005).

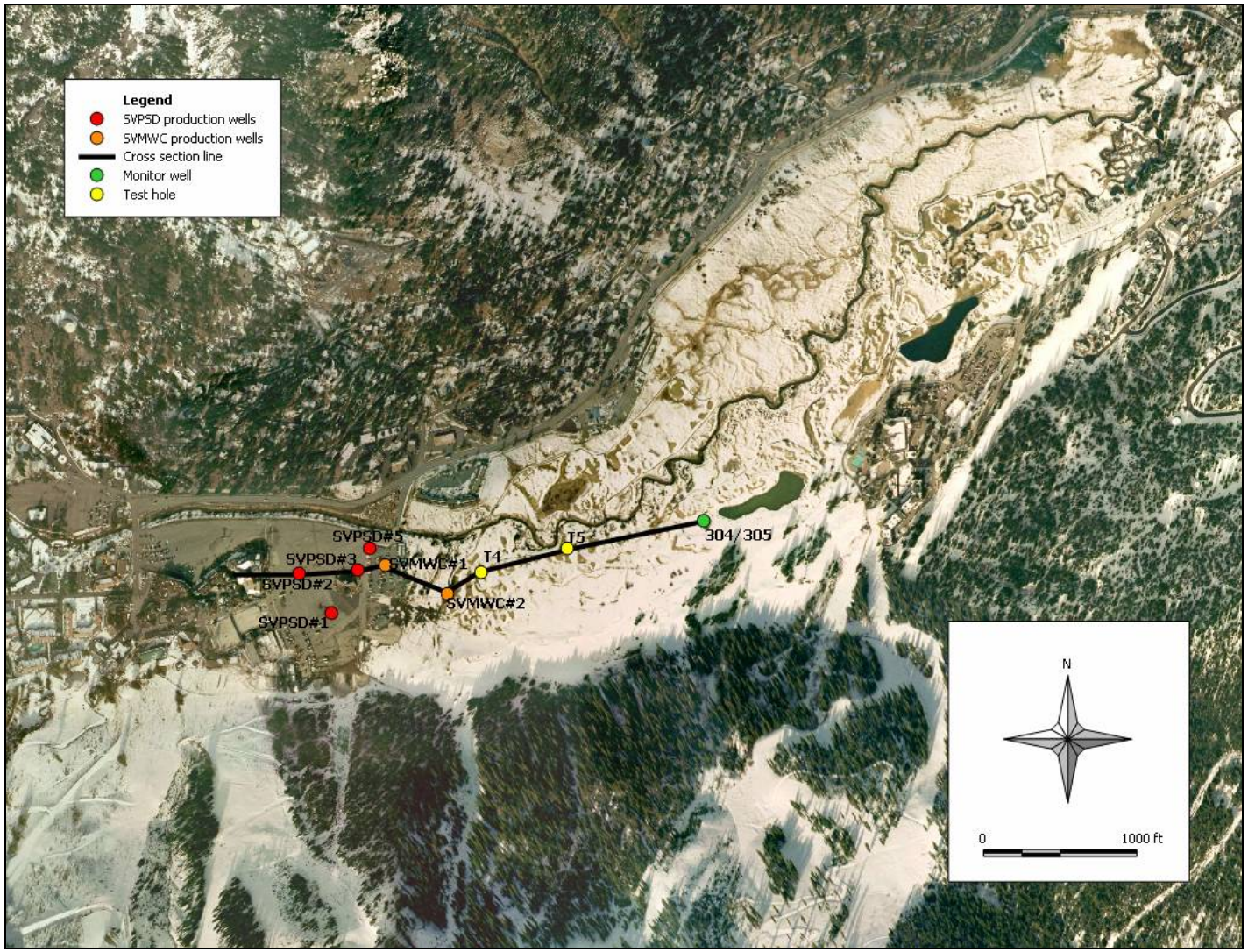

Figure 6: Location of West Yost & Associates Cross Section Line

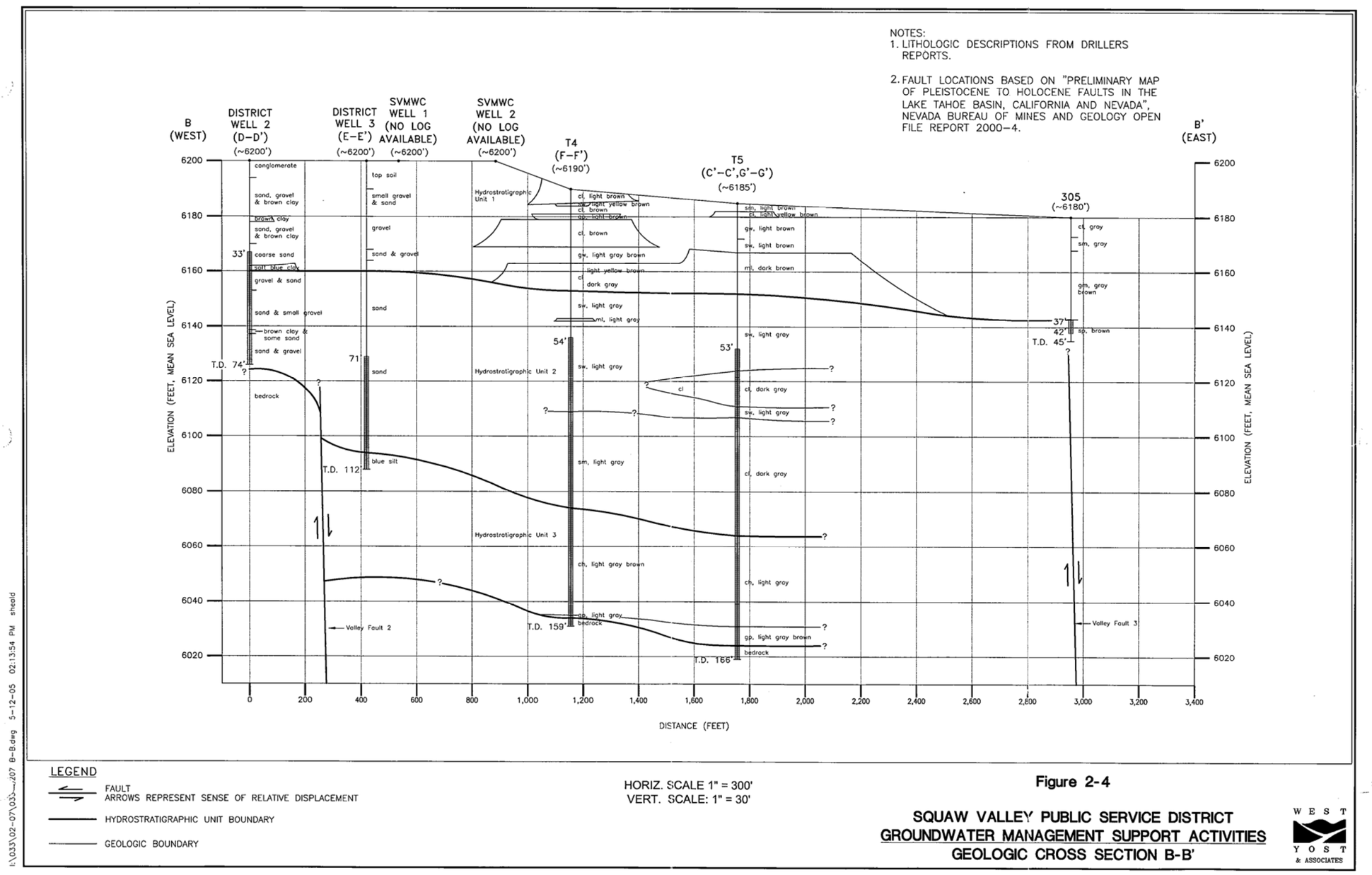

Figure 7: Cross Section B-B' (from West Yost & Associates, 2005)

3.3.2 BEDROCK STRUCTURE

The bedrock beneath Olympic Valley forms a trough that trends generally east of northeast. The deepest portion of the trough appears to run near the axis of the basin. Gasch & Associates (1973) prepared a map showing estimated depth to bedrock based on an interpretation of five seismic survey lines. The locations of the five seismic lines are shown on Figure 8. The estimated depth to bedrock developed by Gasch & Associates is shown on Figure 9.

3.3.3 FAULTS

Four faults that appear to cross under Olympic Valley have been mapped by the Nevada Bureau of Mines and Geology (NBMG, 2000). Locations of these faults are shown in Figure 10. At least one of these faults (Valley Fault 3) has evidence of recent movement (NBMG 2000), and therefore may have been active during the deposition of the sediments currently underlying the Valley floor. West Yost (2005) inferred that these faults may have caused vertical offsets in the bedrock seen in well logs. Figure 7 shows two of these bedrock offsets.

Sharp drops in groundwater levels observed across Valley Fault 2 (West Yost & Associates, 2004 Appendix E) also imply that these faults have offset the sediments in the basin (West Yost & Associates, 2005). Faulting can create a barrier to groundwater flow in the basin sediments by offsetting high conductivity layers or by smearing of clays or low conductivity materials across the fault surface.

Faults in the bedrock may act as conduits where water from bedrock fractures may enter the basin. Evidence of this occurs at a spring, locally known as the Upwelling. The Upwelling is located along the trace of Valley Fault 3. Water from the Upwelling generally has lower levels of iron and manganese than water found in nearby monitoring wells. These facts suggest that water flowing from the Upwelling is not derived from nearby sediments, but is associated with water in Valley Fault 3. The Upwelling is one potential occurrence of fault controlled water sources; it is likely that other faults or fractures provide water to the basin through subsurface flow.

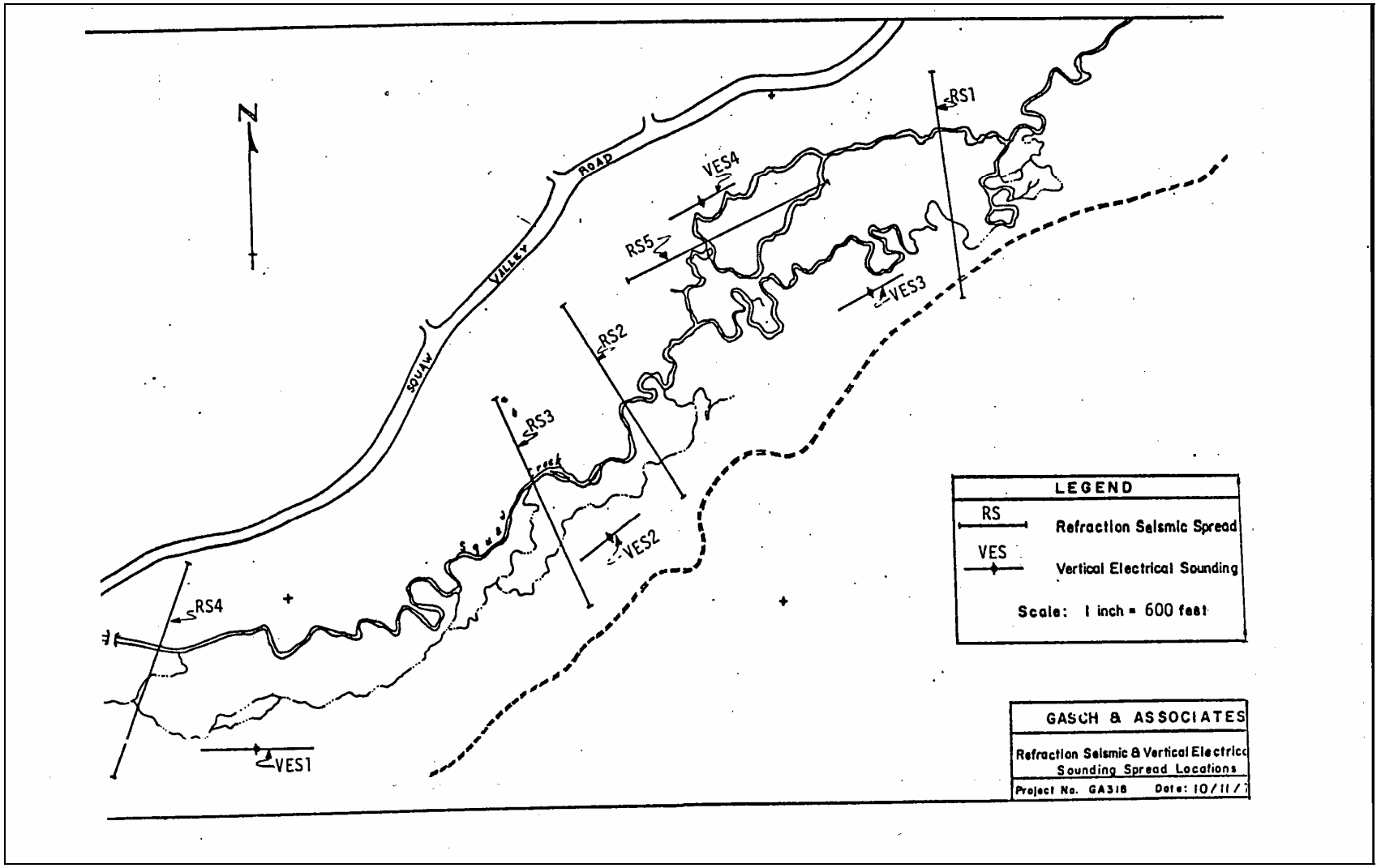

Figure 8: Seismic Line Locations (from Gasch & Associates, 1973)

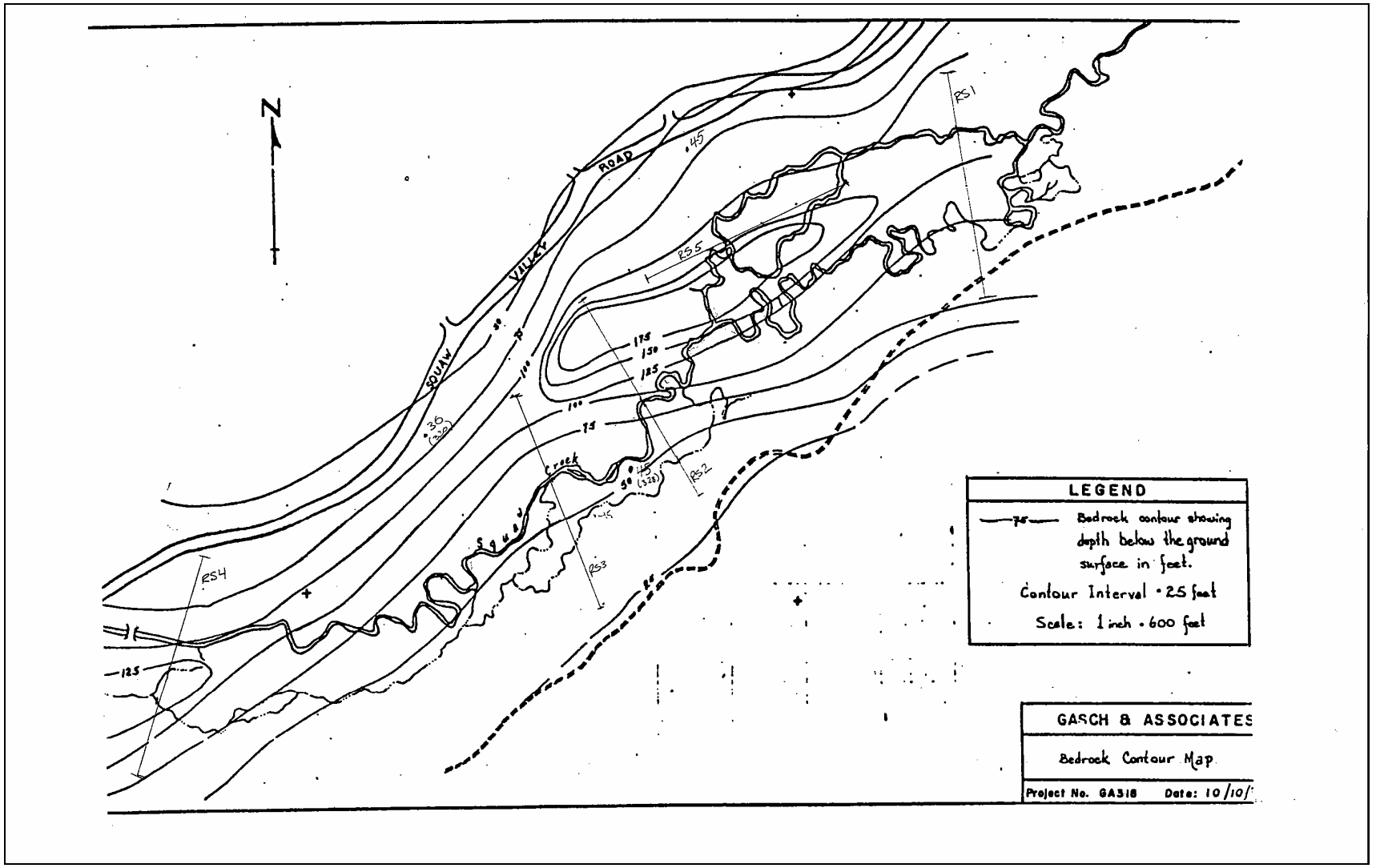

Figure 9: Estimated Bedrock Contours (from Gasch & Associates, 1973)

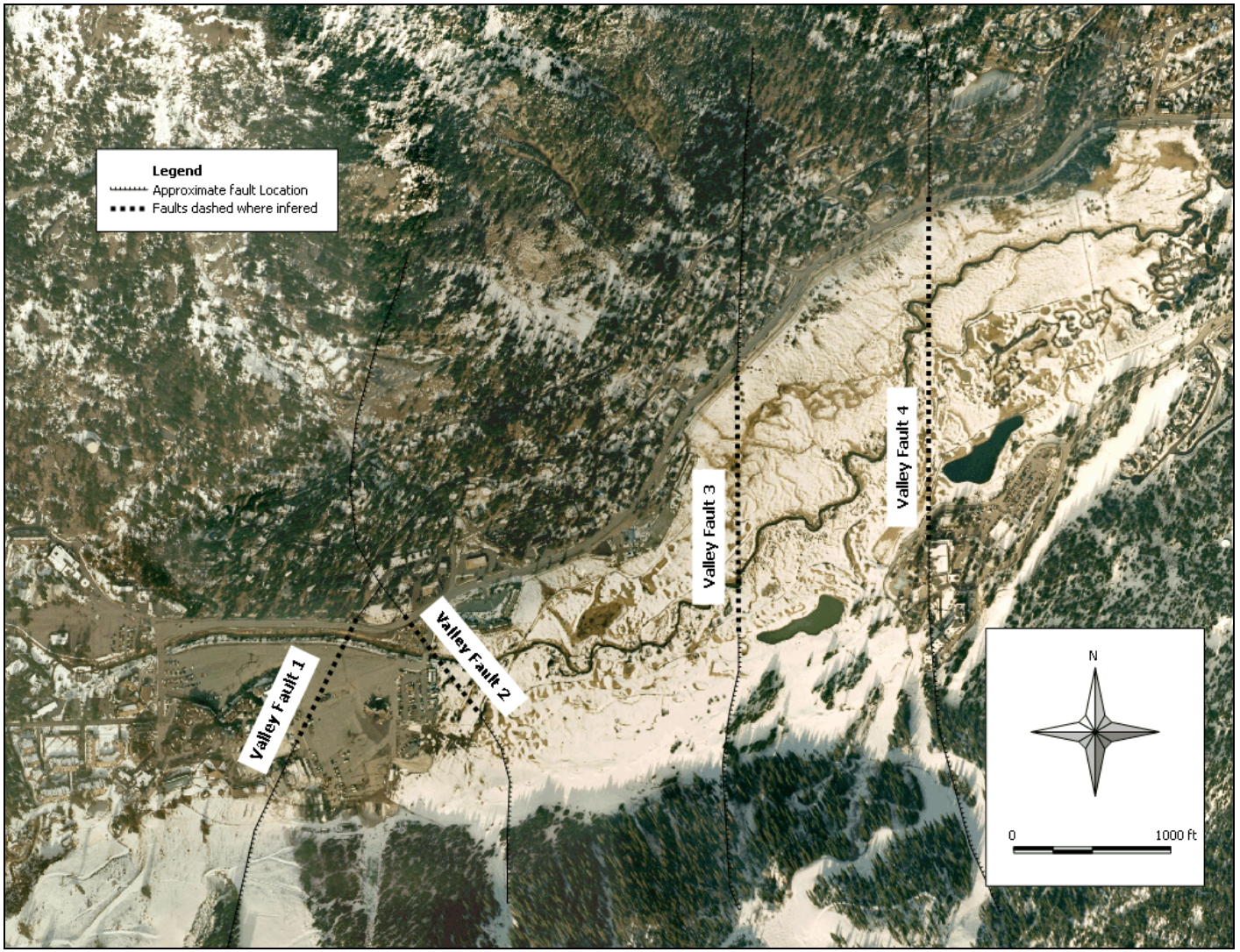

Figure 10: Mapped Fault Locations

3.4 GROUNDWATER CONDITIONS

3.4.1 GROUNDWATER IN CRYSTALLINE ROCK

Groundwater is found in fractures in the crystalline rocks surrounding and underlying the basin sediments. These fractures appear to dip steeply; Kleinfelder & Associates (1991) mapped three sets of fractures, all dipping between 85^{o} and 90^{o}.

The fractures feed at least four springs identified by Kleinfelder & Associates (1991) (Figure 11). Flow rates for the four springs were not available. The fractures also provide water to horizontal wells on both the North and South sides of the Valley. The Mutual Water Company owns and operates two horizontal wells north of the Valley, and the SVPSD owns and operates two horizontal wells south of the Valley. Two additional horizontal wells were installed south of the Valley, near the fourth fairway of the Resort at Squaw Creek Golf Course. The horizontal wells appear to produce between 20 and 50 gallons per minute. There is also a horizontal well that is used to maintain water levels in Hidden Lake. The rate and volume of water pumped from this well is unknown.

3.4.2 GROUNDWATER IN BASIN SEDIMENTS

Groundwater is encountered in the sediments of Olympic Valley throughout most of the basin. Data about groundwater conditions in the basin sediments are derived from production wells, test holes, and monitoring wells in the meadow area. Figure 12 shows the locations of the production and monitoring wells that provide most of the groundwater data in Olympic Valley.

Hydrographs showing water levels in wells SVPSD#2 and SVWMC#1 are presented in Figure 13 and Figure 14 respectively. The peaks of the hydrographs shown on Figure 13 and Figure 14 generally occur at close to the same elevation every year. The elevation of these peaks is generally just a few feet below 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 by either flowing overland to Squaw Creek or is quickly drained from the sediments by Squaw Creek.

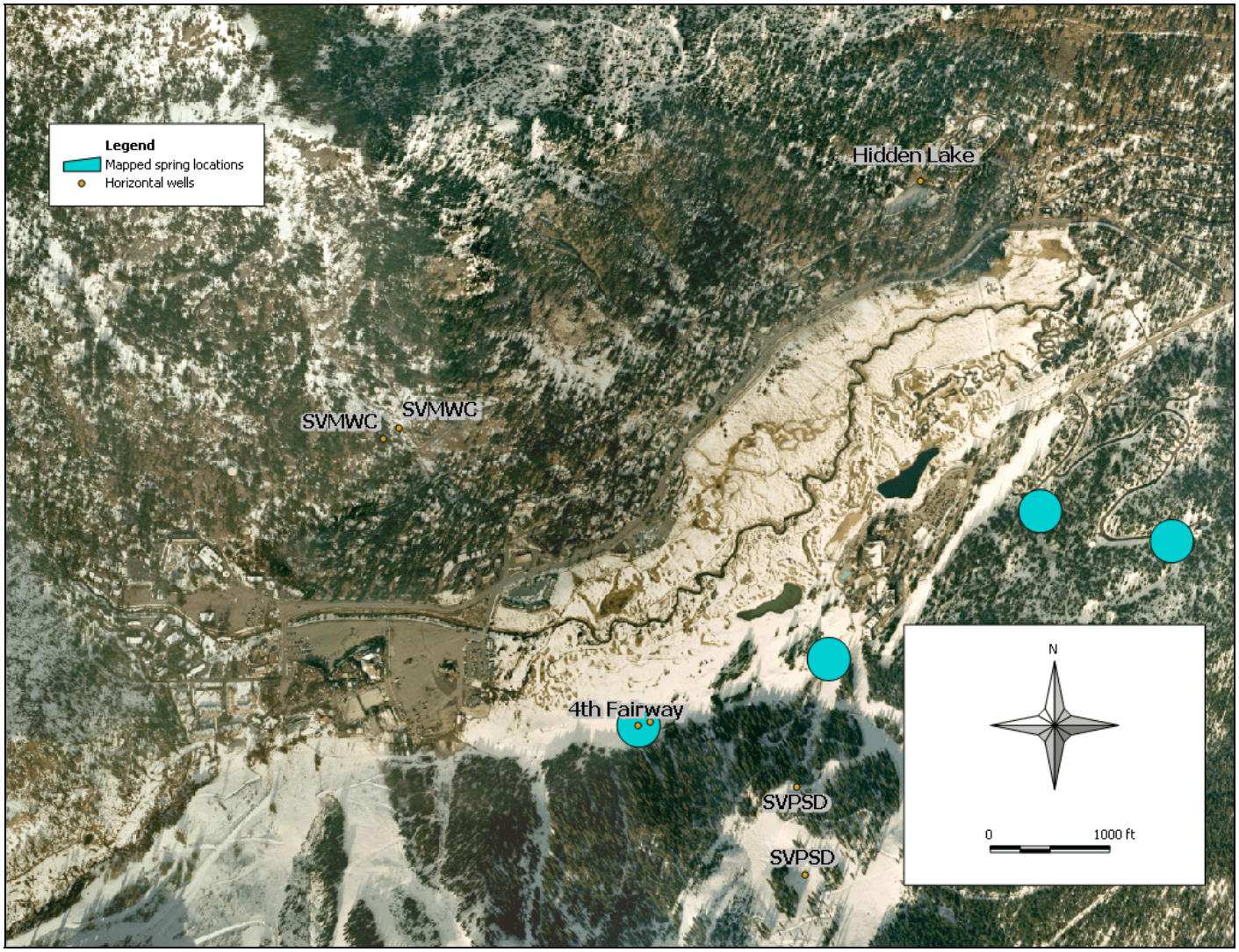

Figure 11: Locations of Springs and Horizontal Wells

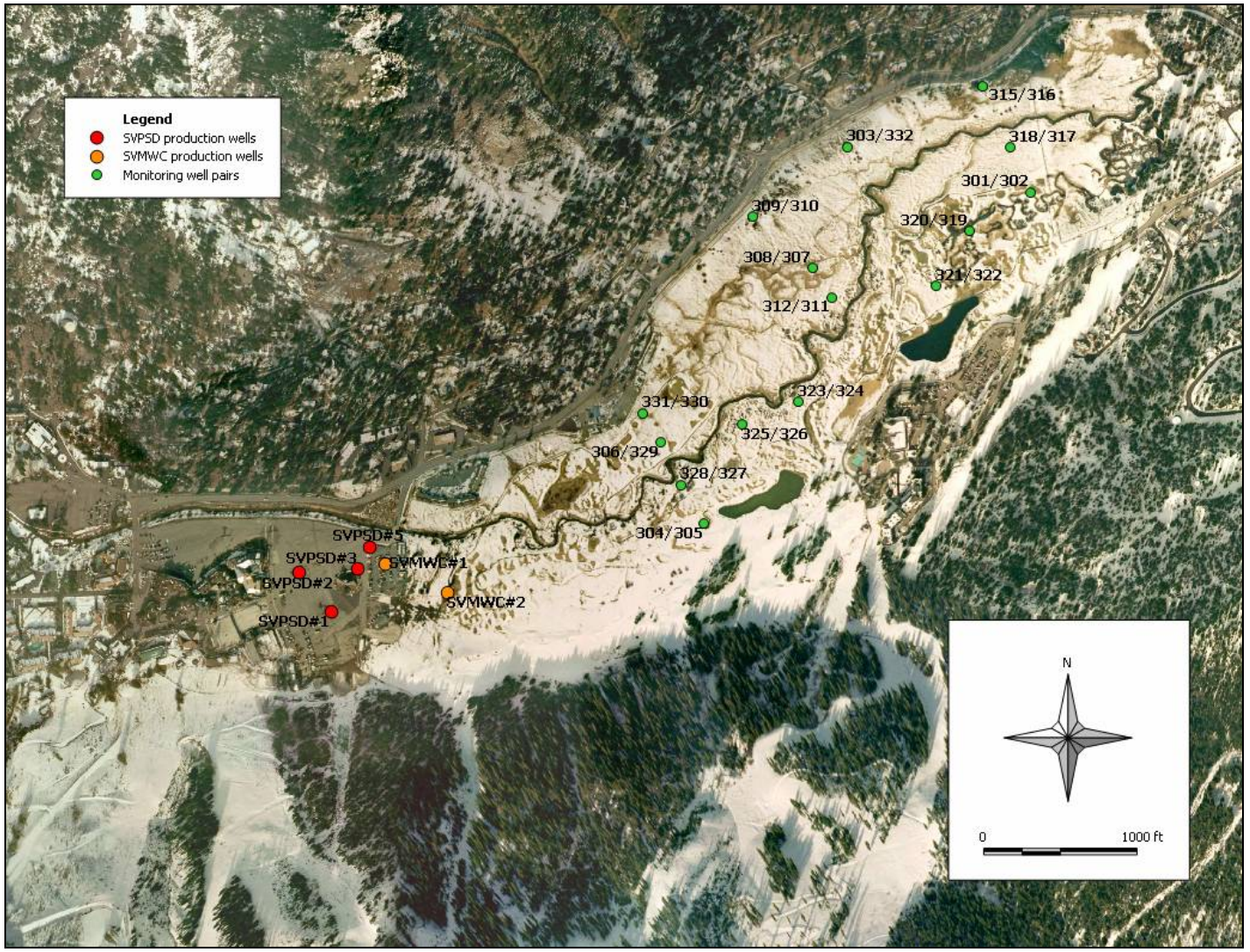

Figure 12: Wells with Monitoring Data

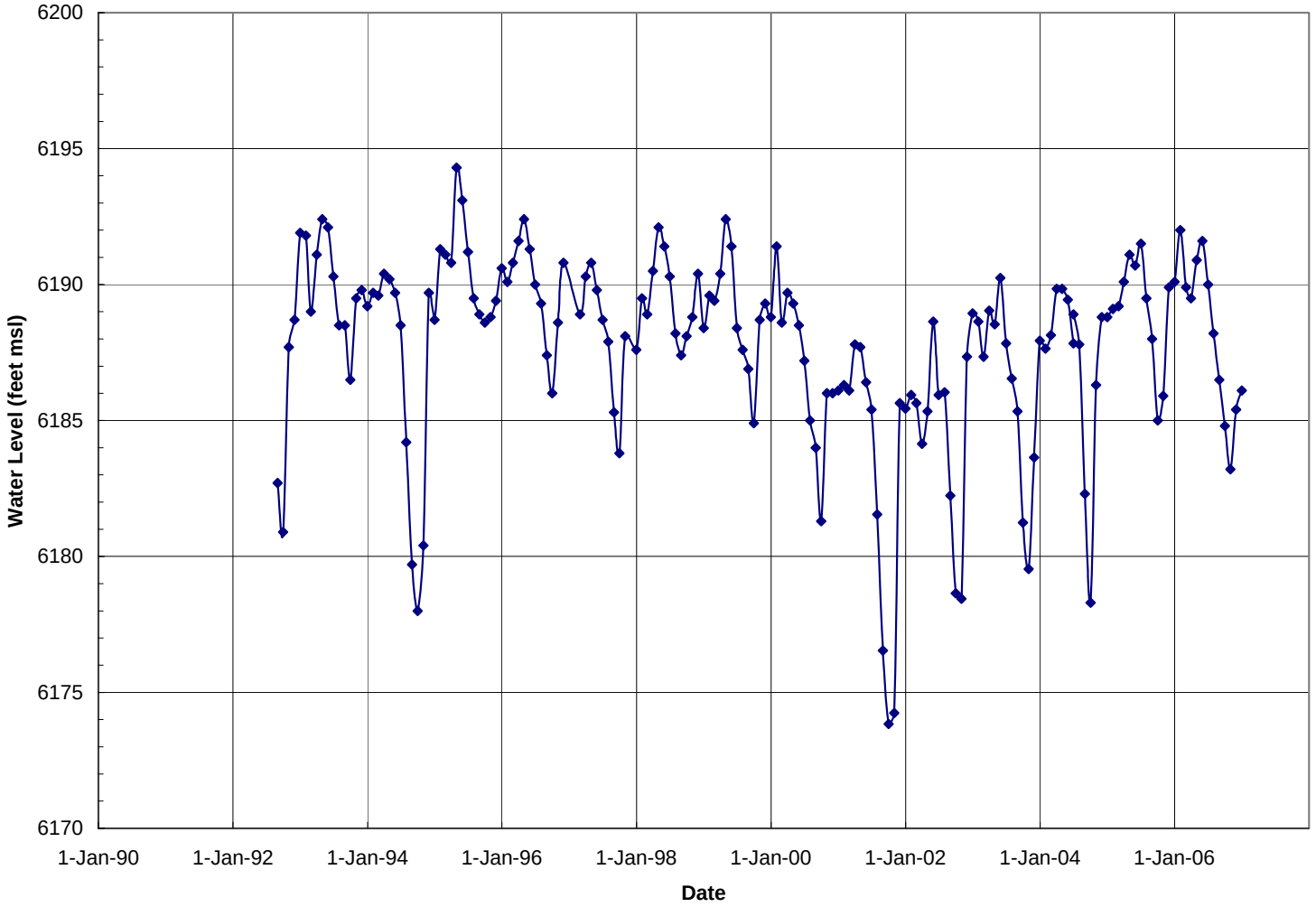

Figure 13: SVPSD#2 Hydrograph

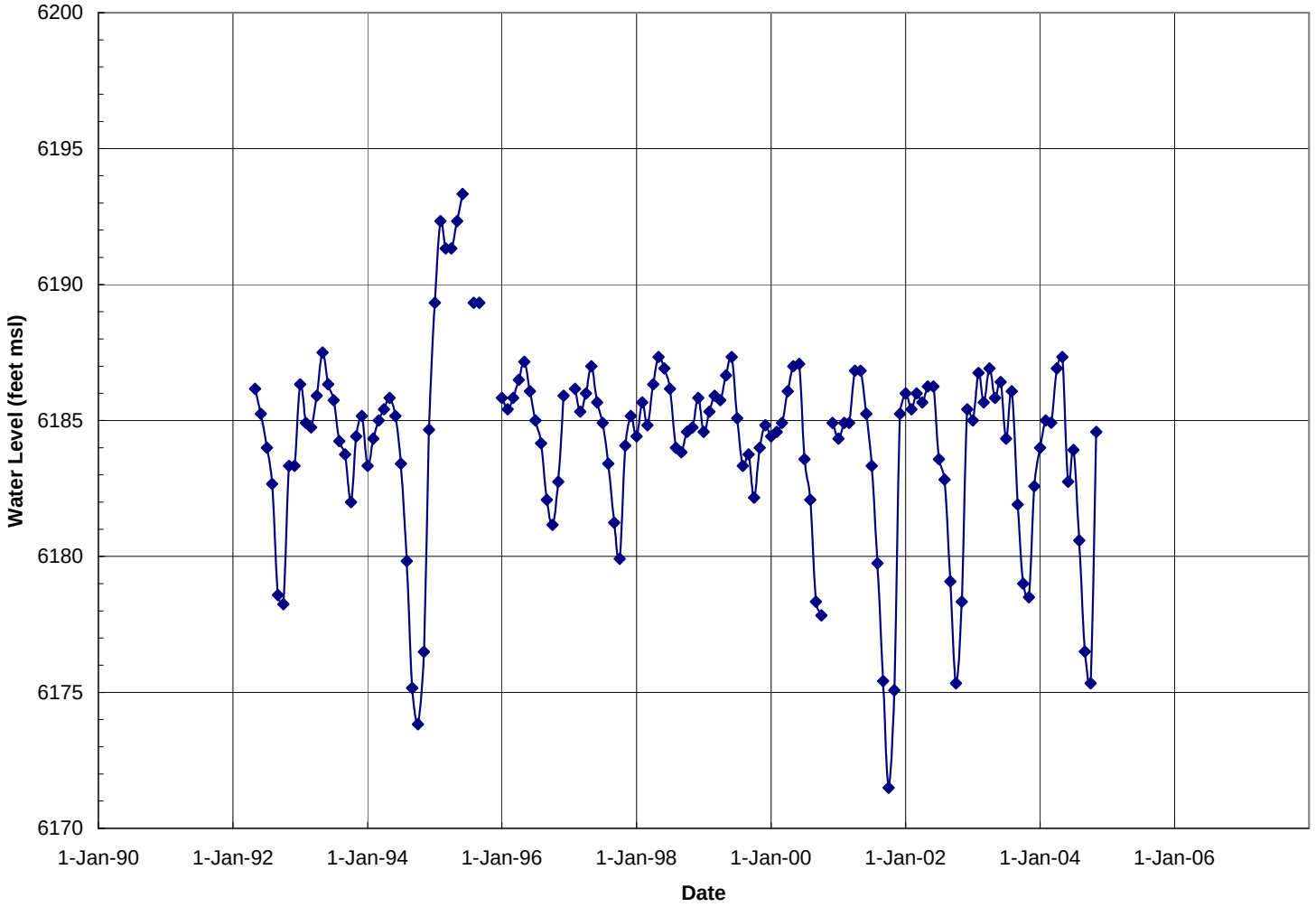

Figure 14: SVMWC#1 Hydrograph

Figure 14 shows water levels in well SVMWC#1 are fairly consistent over time; there is no long-term rise or fall in water levels. The water levels appear to respond to annual pumping stresses in the summer and autumn, then rebound to consistent pre-pumping levels in winter and spring.

Water levels shown in Figure 13 are also relatively consistent; however water levels in well SVPSD#2 did not fully rebound during certain years. When precipitation, shown in Figure 15, reaches a sufficiently low threshold, such as during water years 2000 and 2001, water levels do not rebound to the levels of a full groundwater basin - or to the levels of the preceding winter. These years have insufficient recharge to fill up the groundwater basin in the vicinity if SVPSD#2.

Both hydrographs show some response to recharge availability. The low water levels recorded in summer and autumn of 1994 are a response to precipitation of only 65% of normal during the preceding winter. The relatively higher water levels recorded during the summer and autumn of 1995 are a response to the preceding winter's rainfall that was approximately 129% of average. These hydrographs suggest that even though the basin sediments are recharged to some maximum level every winter and spring, water levels in late summer and fall are dependent on the amount of snowmelt that flows through Squaw Creek during the spring and summer.

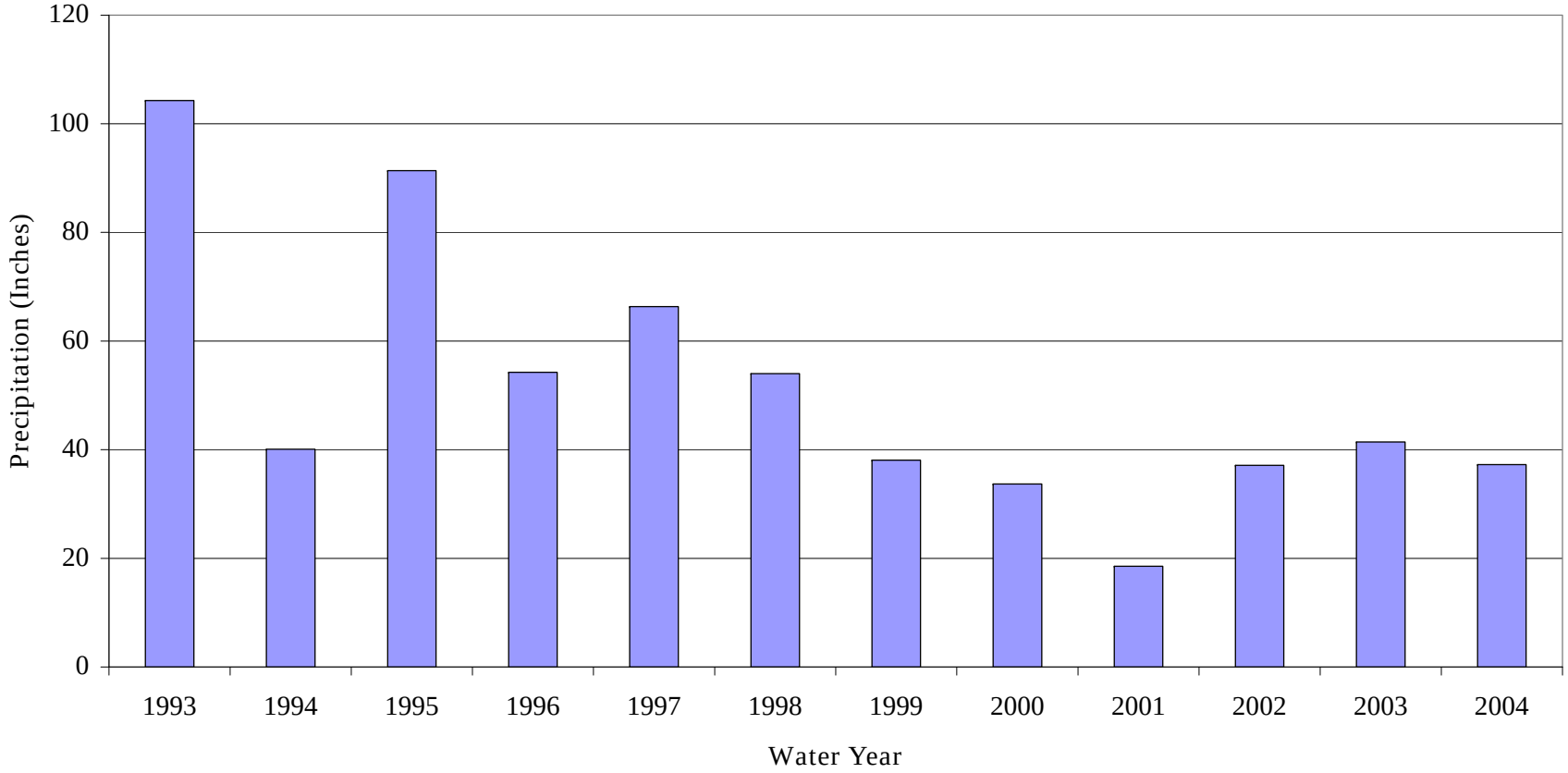

Figure 15: Olympic Valley Precipitation by Water Year

3.4.3 GROUNDWATER FLOW DIRECTIONS

3.4.3.1 HORIZONTAL FLOW DIRECTIONS

Groundwater generally flows from the basin boundaries towards the center of the basin, and generally from west to east in Olympic Valley. This general flow pattern is modified by drawdown cones surrounding municipal and private wells.

3.4.3.2 VERTICAL FLOW DIRECTIONS

Head differences between shallow monitoring wells and deeper monitoring wells have been observed in the basin, particularly in the meadow. Both downward and upward vertical gradients have been observed. Upward vertical gradients have been observed throughout most of the meadow, consistent with the idea that the meadow is a groundwater discharge area. Hydrographs of an example well pair (MW-317 and MW-318) showing upward vertical gradients are shown in Figure 16. Downward vertical gradients have been observed at a limited number of locations in the meadow. Hydrographs of an example well pair (MW-307 and MW-308) showing downward vertical gradients are shown in Figure 17.

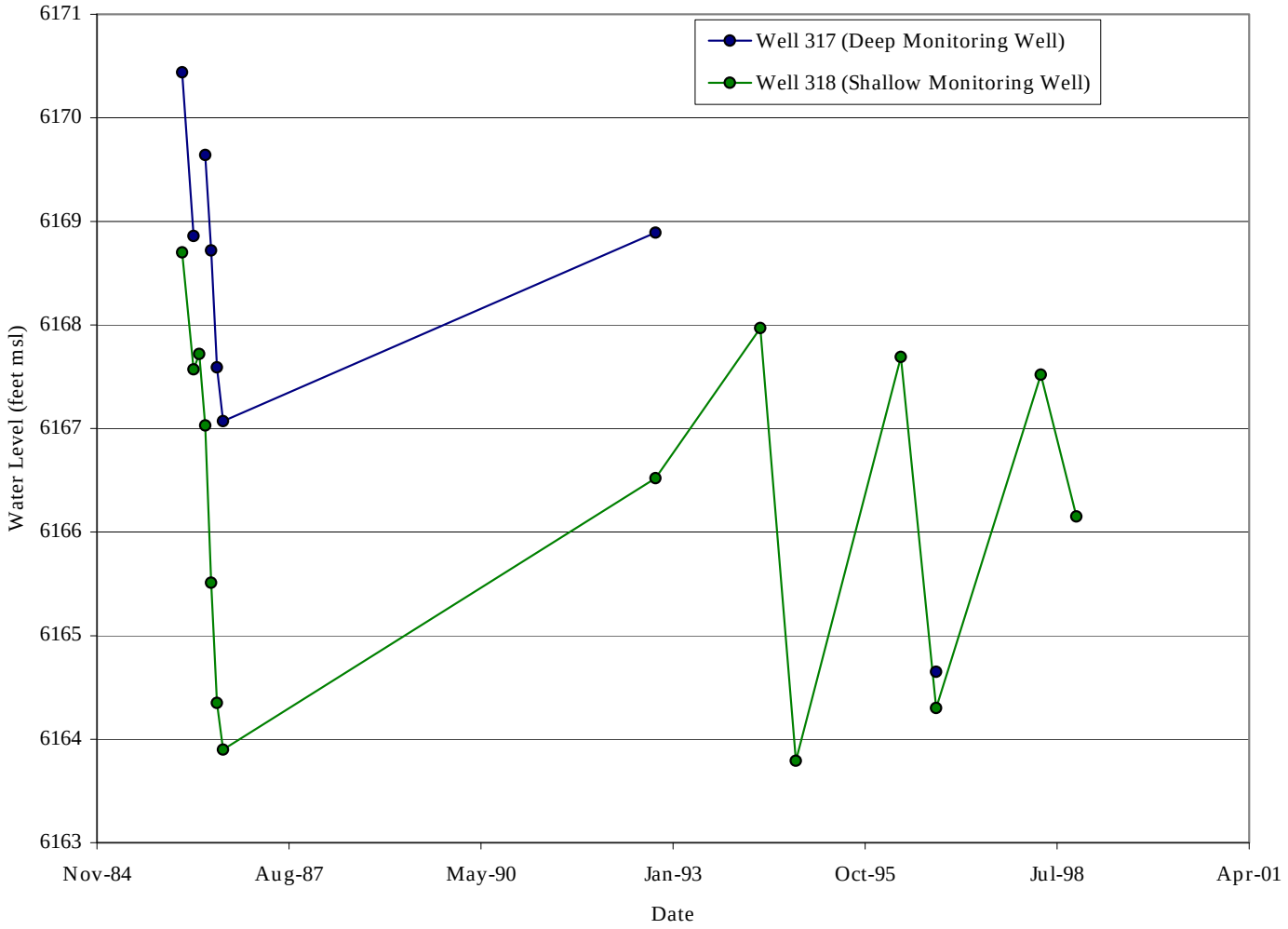

Figure 16: Well Pair MW 317 and MW-318 Showing Upward Vertical Gradient

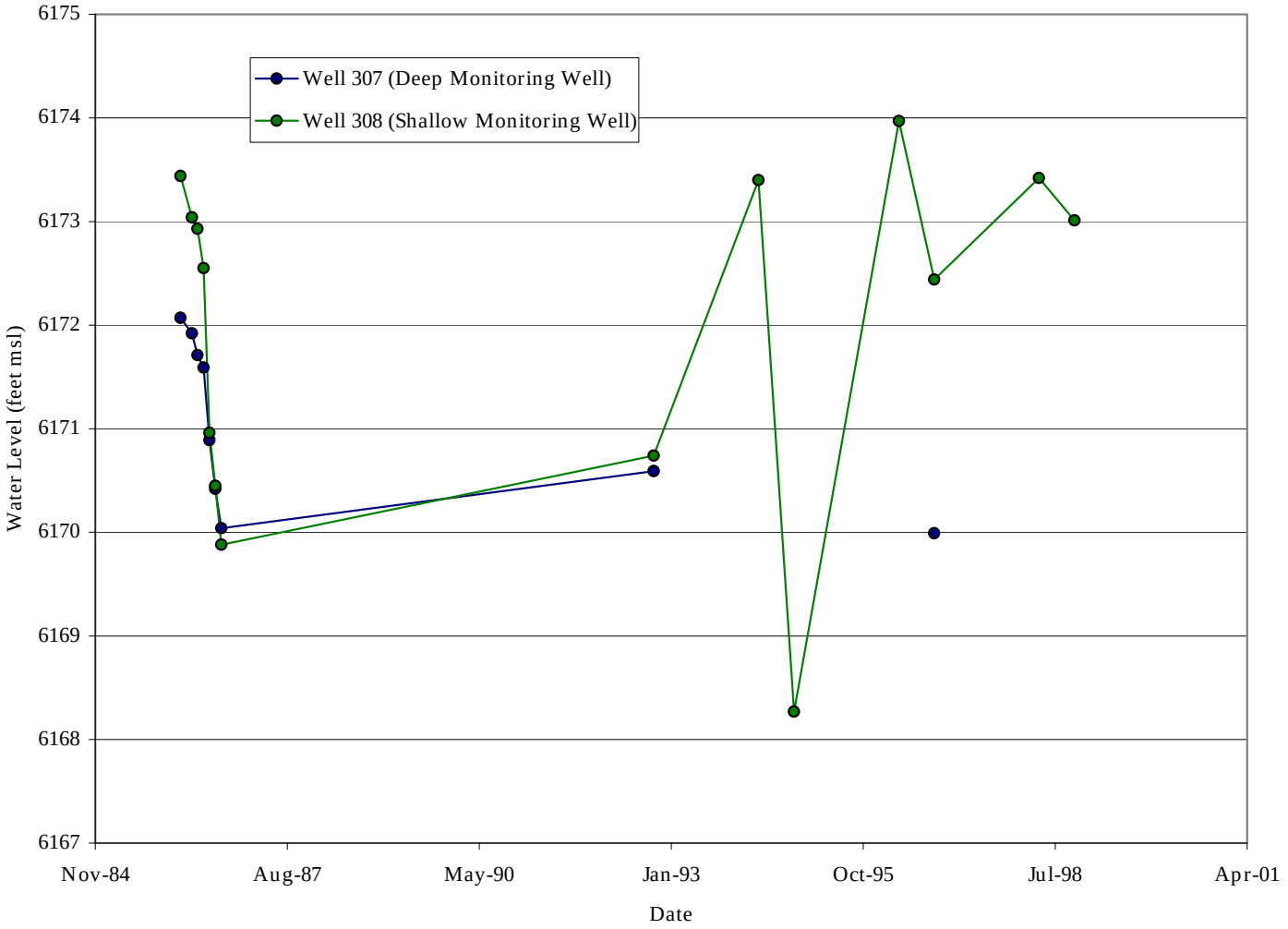

Figure 17: Well Pair MW-307 and MW-308 Showing a Predominately Downward Vertical Gradient

There is no laterally continuous aquitard in the basin that is associated with the vertical gradients. The vertical gradients appear to result from a combination of groundwater recharge, subsurface inflow from fractures, and discharge conditions, combined with localized low permeability sediments. The collection of low permeability clay and silt stringers encountered in the basin effectively imparts a mild, confinement. In this situation, there is no identifiable single confined aquifer. Rather, the lower sediments in the basin show a degree of confinement due to overlying discontinuous low permeability sediments.

3.5 CURRENT GROUNDWATER EXTRACTION

Groundwater is extracted from the GMP management area by SVPSD, SVMWC, Resort at Squaw Creek, PlumpJack Squaw Valley Inn, and Gladys K. Poulsen. These entities pump from a total of nine wells. Four wells are currently pumped by SVPSD, two wells are pumped by SVWMC, and one well each is pumped by the Resort at Squaw Creek, PlumpJack Squaw Valley Inn, and Gladys K. Poulsen. In addition, although unverified, the Squaw Valley Ski Corporation claims to pump four wells for irrigation. There are no other known groundwater extractors in the GMP management area. Figure 18 shows the locations of the known production wells in the GMP management area. There are also inactive production wells in the GMP management area. These wells are not discussed in this GMP since they do not currently have an impact on groundwater management.

Between 1992 and 2004, SVPSD and SVMWC pumped an average of 128 million gallons (MG) (392 acre-feet) and 32 MG (99 acre-feet) per year, respectively. Figure 19 shows historical monthly pumping for SVPSD and SVWMC. This figure shows that pumping by SVPSD steadily increased from 1992 through 2001, and has steadily decreased since then. Pumping by SVMWC shows no clear trend; fluctuations are apparently due to climatic variation. Groundwater production varies during the year as a function of seasonal demand, with peak demands occurring in August. Demand in winter (January/February) is approximately half of the summer demand

The Resort at Squaw Creek pumps water for golf course irrigation and snowmaking from the GMP management area. Golf course irrigation demand typically occurs from mid-May through mid-October and snow making typically

occurs during November through mid-January (West Yost & Associates 2001). Figure 20 shows the historical monthly pumping for golf course irrigation and snowmaking. Water pumped to supply golf course irrigation averages about 53 MG per year (163 acre-feet per year) and pumping for snowmaking averages 22 MG per year (69 acre-feet per year).

Annual pumping by PlumpJack and Gladys K. Poulsen is unknown, but is assumed to be insignificant compared to other pumping in the Valley. The amount of pumping by Squaw Valley Ski Corporation is also unknown.

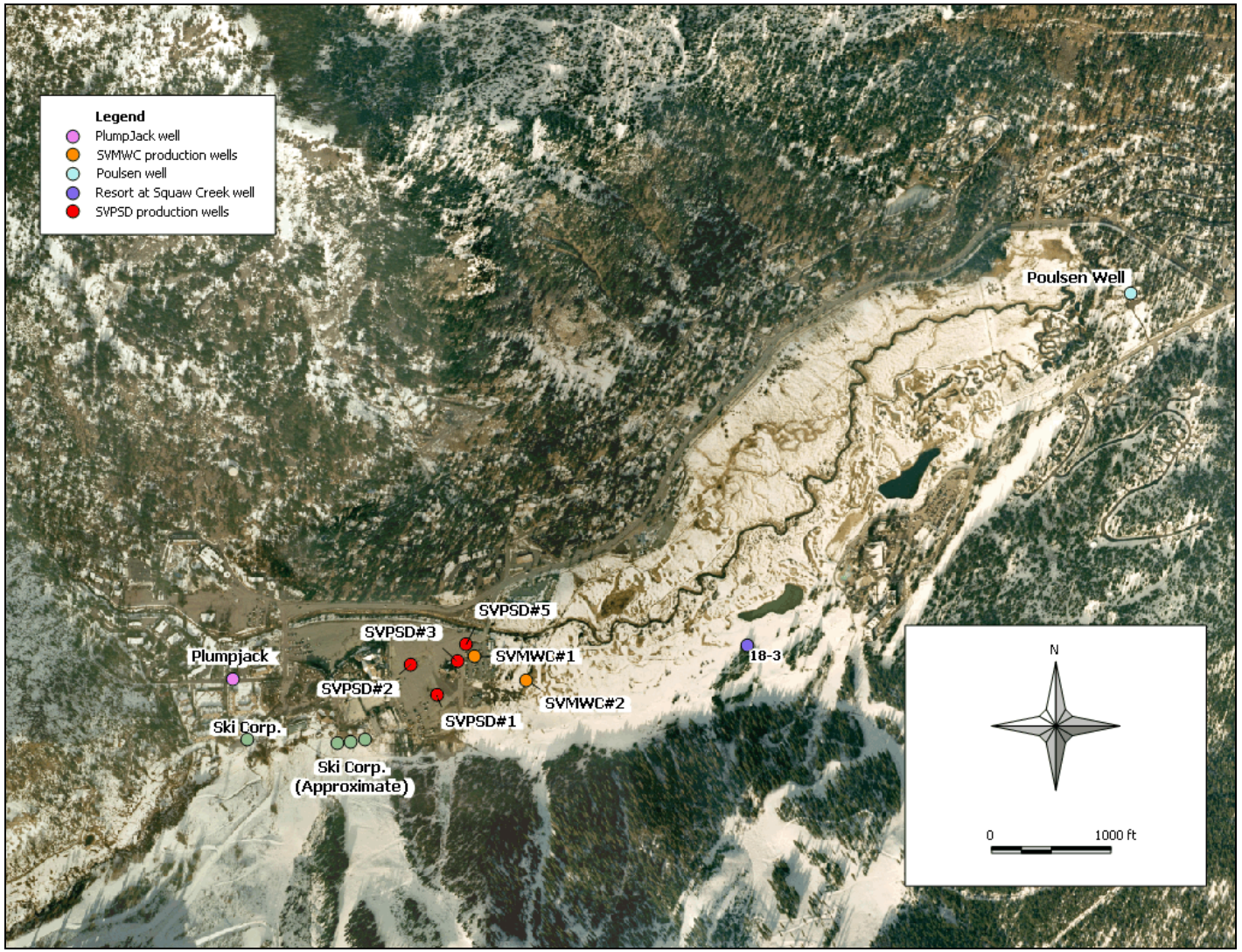

Figure 18: Production Well Locations

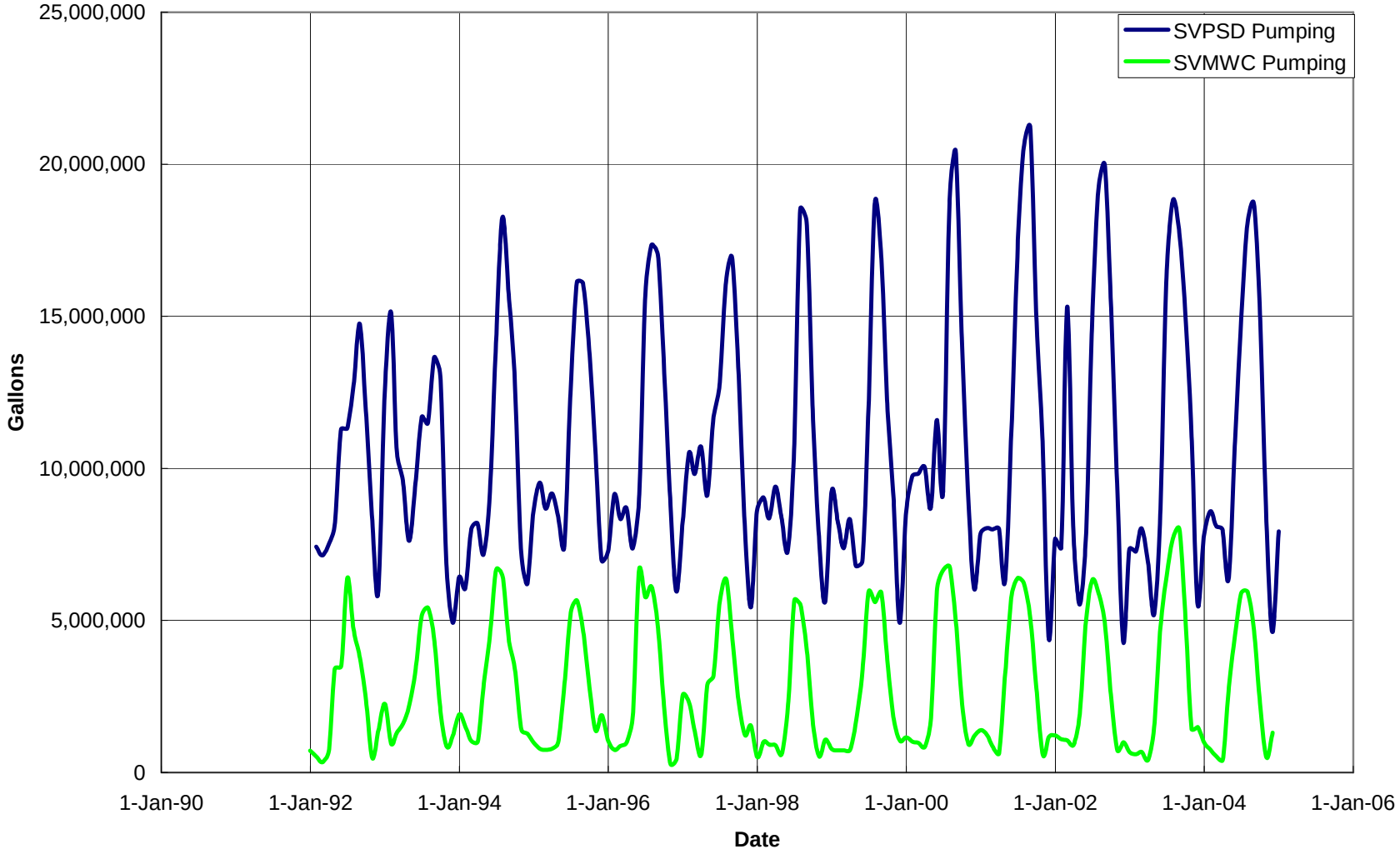

Figure 19: Historical Monthly SVPSD and SVMWC Pumping

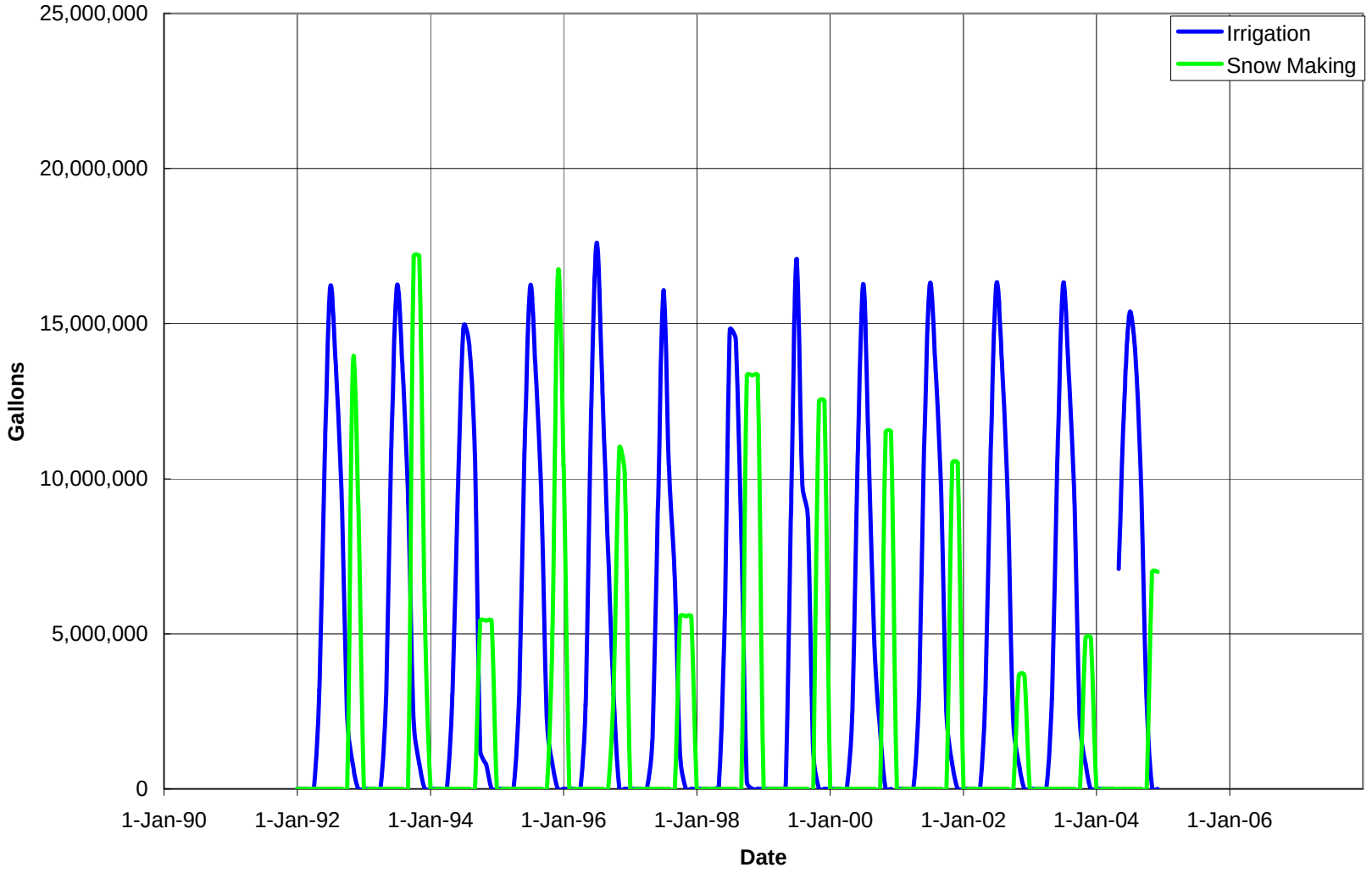

Figure 20: Historical Monthly Irrigation and Snow Making Pumping

3.6 SURFACE WATER CONDITIONS

3.6.1 DESCRIPTION OF SQUAW CREEK

Squaw Creek and its tributaries are the only significant surface water bodies in Olympic Valley (Figure 21). Two forks of Squaw Creek, the South Fork and Shirley Canyon, enter Olympic Valley along the western margin. Shirley Canyon is the larger of the two main forks of Squaw Creek, with flows of up to 138 cubic feet per second (cfs) recorded during Water Years 2003 and 2004. Over the same time period, the highest flow recorded in the South Fork was 103 cfs.

The two main forks converge in an area locally known as the confluence. The confluence is a wide gravel filled portion of Squaw Creek that has generally maintained its natural configuration. Water flows from the confluence into a manmade trapezoidal channel. This channel is not lined, and runs generally parallel to Squaw Valley Road to the bridge on the eastern end of the Squaw Valley parking lot.

Below the bridge on the eastern end of the Squaw Valley parking lot, Squaw Creek meanders through the meadow in a relatively natural channel. Squaw Creek exits the Valley beneath Squaw Valley Road Bridge on the eastern end of the meadow, and flows through an incised channel cut into the terminal moraine to the Truckee River.

Additional surface water tributaries to Squaw Creek include the Upwelling and overland flow sources. An ephemeral stream channel runs from the Upwelling to Squaw Creek, providing Squaw Creek with an additional water source in the meadow. Shallow groundwater along the northwestern portion of the meadow often flows to the surface, and flows overland in small rivulets into Squaw Creek.

The primary source of Squaw Creek's annual flow is snowmelt flowing in the South Fork and Shirley Canyon forks of Squaw Creek. This snowmelt peaks in spring, and often continues through July and August. After flow from snowmelt ends in late summer, the confluence and trapezoidal channel rapidly dry up. Small amounts of water continue to flow in many parts of the meadow due to inflow from shallow groundwater.

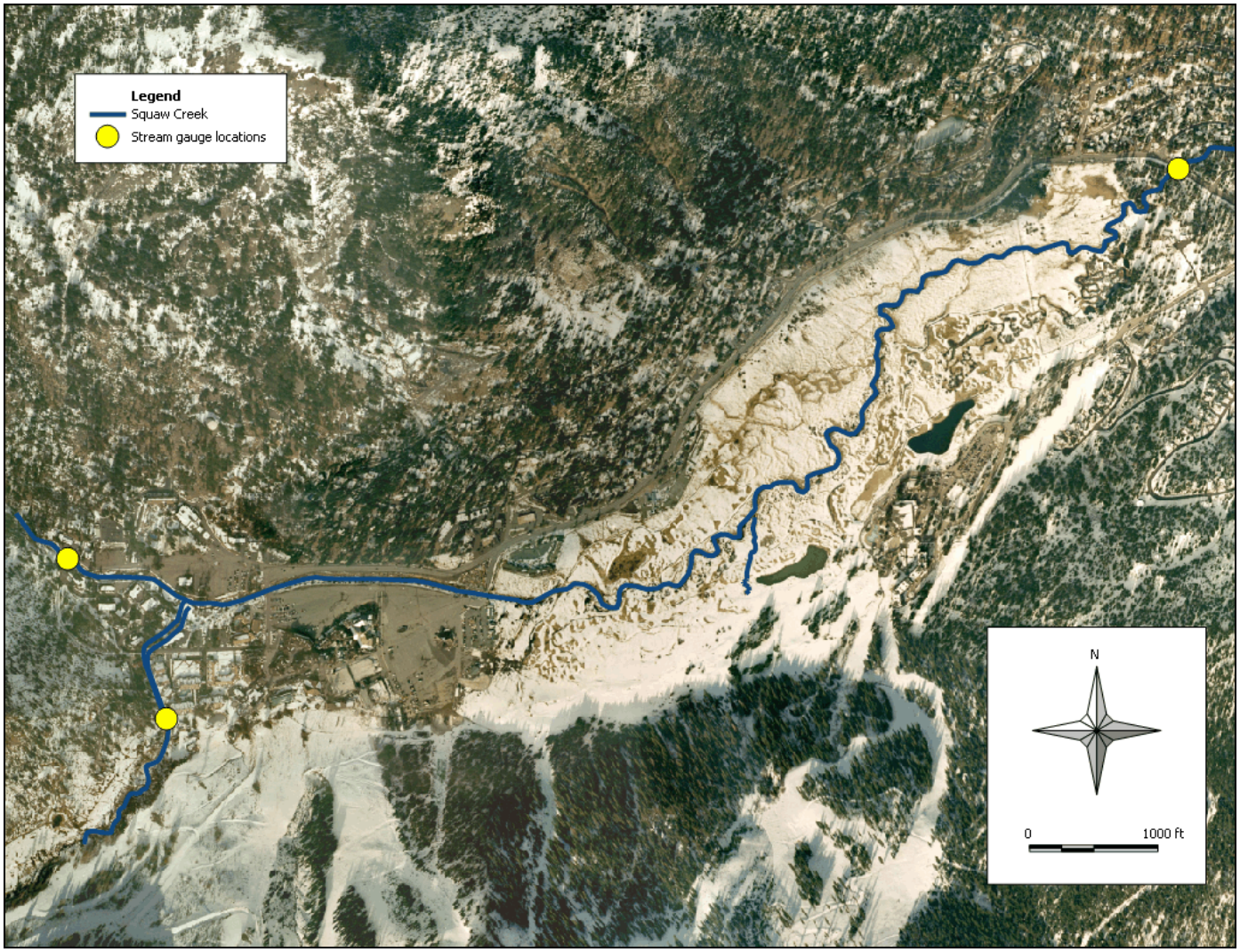

Figure 21: Squaw Creek and Stream Gauge Locations

3.6.2 SURFACE WATER GROUNDWATER INTERACTION

As documented by West Yost & Associates (2005), Squaw Creek is in close connection with the groundwater in Olympic Valley. Groundwater levels rise rapidly in response to stream flow in late fall, until the groundwater basin is filled. When the groundwater basin is full the creek acts as a drain, preventing water levels from rising above the level of the creek. In late summer and early autumn, streamflow decreases while groundwater extractions are rising. Recharge from the stream cannot keep up with the depletion of groundwater in the basin and groundwater levels drop more rapidly. (West Yost & Associates, 2005)

3. 7 NATURAL GROUNDWATER QUALITY

The crystalline rocks that surround the basin, granite and andesite, tend to produce groundwater which contains a relatively high proportion of calcium and bicarbonate, with much smaller amounts of magnesium, sodium, and sulfate. The volcanic rocks, in particular, also contain iron and manganese which may be mobilized under certain naturally occurring conditions in the basin (Kleinfelder & Associates, 1987).

SVPSD and SVMWC routinely test their untreated groundwater to determine the water quality of the basin. Water quality parameters analyzed by SVPSD and SVMWC include general minerals, general physical parameters, and organic/inorganic compounds. Analyses for these are conducted in accordance with the requirements of the California Code of Regulations (CCR), Title 22. Water quality results are compared against primary and secondary drinking water standards, established by the US Environmental Protection Agency (USEPA), and water quality standards established by the California Department of Health Services

Water extracted for municipal, residential, fire suppression and commercial uses by SVPSD and SVMWC does not regularly exceed any primary drinking water standard. A few naturally occurring constituents including iron and manganese are closely monitored because they are found in other wells in the basin, even though they remain below drinking water standards in the production wells.

3.7.1 IRON AND MANGANESE

Kleinfelder & Associates (1987) reported high values of iron and manganese in the eastern end of Olympic Valley. Shallow wells had iron values as high as 18,000 micrograms/liter (µg/l) and deeper wells as high as 12,800 µg/l. Manganese in the shallow wells was as high as 1,980 µg/l and a high of 10,200 µg/l was reported in the deeper groundwater. These values are well above the secondary standards for iron and manganese of 300 and 50 µg/l respectively.

High iron and manganese levels are also occasionally found in monitoring wells in the western end of Olympic Valley. West Yost & Associates (2005) collected water quality samples in the spring and fall of 2004. In the spring, iron levels in SVPSD monitoring wells MW-5S and MW-5D were found to be 720 µg/l in the shallow well, and were below the detection limit in the deeper well. Spring manganese levels were 640 µg/l in the shallow well, and were below the detection limit in the deeper well.

In the fall, iron levels were found to be 1,900 µg/l in well MW-5S, and 100 µg/l in well MW-5D. Manganese levels were 390 µg/l in well MW-5S, and below the detection limit in MW-5D.

3.7.2 TOTAL DISSOLVED SOLIDS (TDS)

Kleinfelder & Associates (1987) found shallow wells with elevated TDS levels in two distinct areas in the basin. While a majority of the basin had reported TDS concentrations generally less than 100 mg/L, the eastern third of the Valley showed water of greater than 400/L in the shallow wells and the western area showed values greater than 100 mg/L. TDS values in the deeper wells were in general greater than in the shallow wells. Two areas had TDS values over 1,000 mg/L. These locations with of elevated TDS values indicate potential areas of subsurface inflow from fractures.

3.7.3 ARSENIC

Kleinfelder & Associates (1987) reported arsenic concentrations in the eastern area of the groundwater basin. Average arsenic concentrations were 4.3 µg/l in 23 analyses of shallow groundwater. Samples from three of the wells were reported to have concentrations ranging from 10 to 20 µg/l. Significant arsenic concentrations were reported in the deeper wells. Several analyses of water from these wells had values exceeding 50 µg/l. For comparison, the current federal drinking water standard for arsenic that was adopted by the USEPA on January

22, 2001 is 10 µg/l. These high arsenic concentrations appear to occur in the same areas where high iron and manganese levels occur.

3.8 ANTHROPOGENIC IMPACTS ON WATER QUALITY

As part of the Water Supply Feasibility Study conducted by SVPSD (West Yost & Associates, 2001), a watershed sanitary survey was conducted to obtain information regarding existing contaminant sources and to identify activities in the watershed that may contaminate surface water and groundwater resources of the Valley. Identifying these sources was an important step in developing the watershed management plan.

The sanitary survey found a number of potentially contaminating activities in the Valley. These sites have confirmed spills or leaks from underground storage tanks of diesel fuel oil and additives. The identified sites include:

- Opera House Site, case status: open;
- Red Dog Site, case status: closed;
- PlumpJack Site, case status: open;
- Squaw Valley Lodge Site, case status: closed;
- Clock Tower Site, case status: closed;
- Olympic House Loading Dock, case status: closed;
- Lower Vehicle Maintenance Shop Site, case status: closed;

Figure 22 shows the locations of these potentially contaminating activities. The sites that are open are currently being monitored, and have not impacted existing production wells.

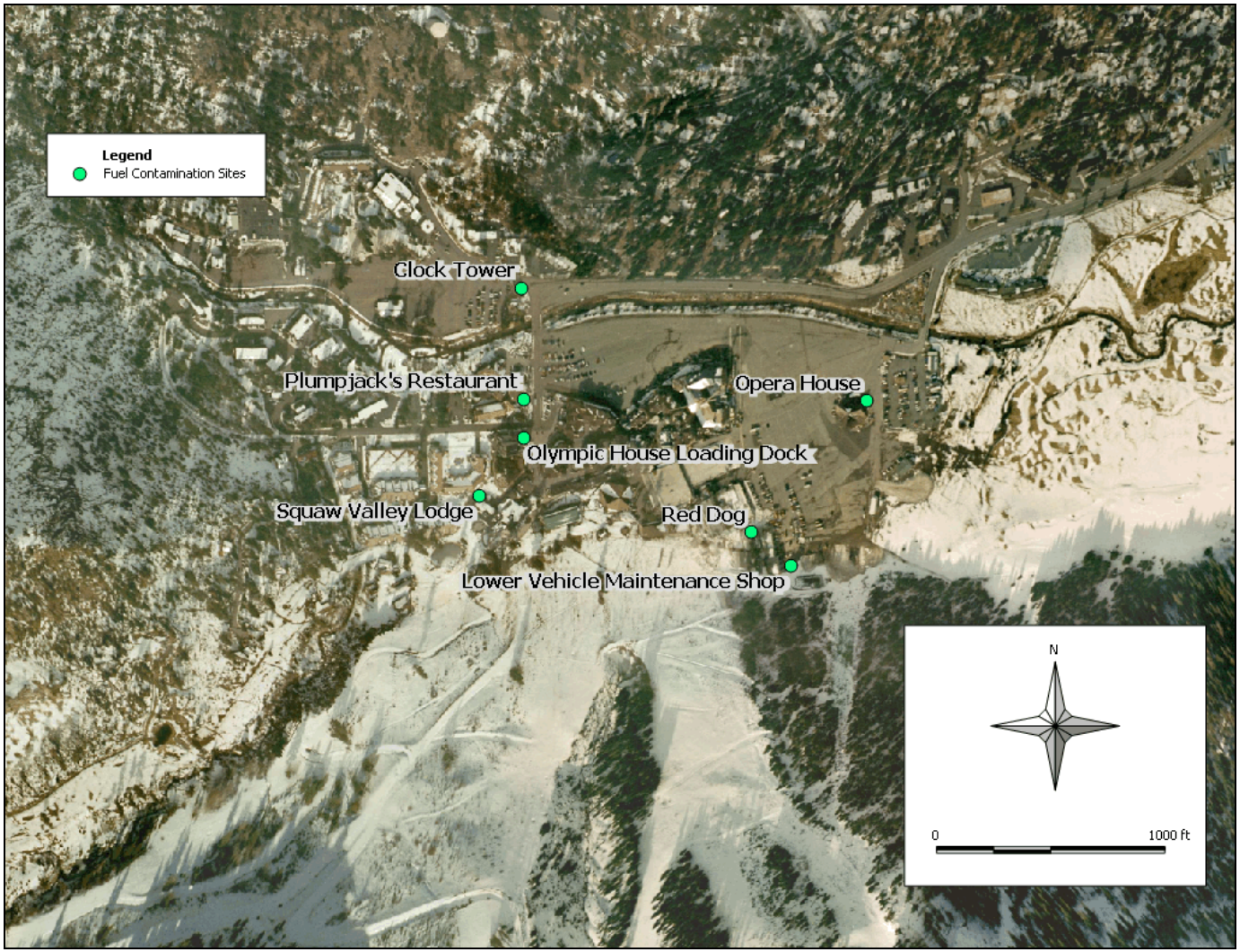

Figure 22: Fuel Contamination Site Locations

3.9 HISTORICAL AND ONGOING BASIN MANAGEMENT ACTIVITIES

The aquifer system of the GMP management area has been investigated for over 20 years with the goal of managing the basin for long-term sustainability. Management activities have included regular groundwater level monitoring from production wells and dedicated monitoring wells, regular groundwater quality monitoring from production wells and dedicated monitoring wells, developing water conservation programs, practicing pumping management, and investigating supplemental supply sources.

3.9.1 GROUNDWATER MONITORING

Both groundwater levels and groundwater quality are monitored at existing production wells, and with a network of dedicated monitoring wells operated by the Resort at Squaw Creek and SVPSD. Figure 12 shows the locations of the production wells and dedicated monitoring wells in Olympic Valley that have historical monitoring data. Additionally, water quality and water level data are collected by responsible parties at a number of leaking underground fuel tank sites in the Valley.

3.9.2 WATER CONSERVATION EFFORTS

Ongoing water conservation measures include the irrigation and water conservation ordinance passed by SVPSD, and voluntary efforts by irrigators in the Valley. The SVPSD irrigation and water conservation ordinance includes:

1. Defining target water usages by implementing a Maximum Applied Water Allowance (MAWA).
2. Implementing increasing tiered water pricing that encourages efficient water use.
3. Developing drought response plans with various stages, each having objective criteria and a list of response actions.

The Resort at Squaw Creek has voluntarily offered to limit the amount of water used for irrigating the golf course as a condition of its will serve letter for Phase II of Resort construction. Although this is not finalized, it represents an important offer for limiting and capping water use in the Valley.

3.9.3 COORDINATING GROUNDWATER MANAGEMENT

In 2005 the Olympic Valley Pumpers Group was formed by SVPSD to coordinate and support groundwater management efforts undertaken in the GMP management area. The group consists of all entities and private parties known at the time to extract water from Olympic Valley. The pumpers group has met a number of times to cooperatively improve understanding of the groundwater basin.

3.9.4 CONJUNCTIVE USE AND SUPPLEMENTAL SUPPLY PLANNING

In 2001, SVPSD funded a study that investigated the feasibility of various supplemental water supply options (West Yost & Associates, 2001). The study concluded that maximizing local groundwater supplies was the most cost efficient approach. Since the feasibility study was completed, SVPSD has continued to investigate supplemental supply options in response to local environmental concerns and new supply opportunities. Options currently being considered are a conjunctive use option using Aquifer Storage and Recovery technology, building a water treatment facility, and a water import option.

3.10 KEY BASIN MANAGEMENT ISSUES

Key basin management issues include the obstacles to groundwater management, and the impacts from current groundwater use that must be addressed in the Goals, Objectives, and Elements of this GMP. Key basin management issues in the Olympic Valley area include the following:

- Avoiding overdraft;
- Avoiding stream baseflow depletion;
- Avoiding subsidence;
- Preserving groundwater quality;
- Preserving the integrity of mapped wetlands;
- Planning for and meeting future increases in demand;
- Developing water supply reliability, particularly during dry periods.
- Effects from anticipated climate change

Section 4
GOALS AND OBJECTIVES

The Olympic Valley GMP provides a framework under which all users of the Olympic Valley aquifer can move towards a commonly held set of goals and objectives concerning groundwater use and protection. Groundwater management goals express the desired state of the groundwater basin in qualitative terms. These groundwater management goals provide the foundation for the more specific basin management objectives. Basin Management Objectives (BMOs) are specific criteria defining the desired state of the basin. They provide a mechanism for determining whether groundwater management goals are being achieved. They are verifiable and are ideally quantifiable.

4.1 GMP GOALS

GOAL 1: MANAGE THE GROUNDWATER BASIN IN A MANNER THAT PROVIDES A SUSTAINABLE SUPPLY FOR CURRENT AND FUTURE BENEFICIAL USES.

Developing adequate water supplies to meet the various domestic, municipal, commercial, fire protection, and environmental demands must be one of the primary purposes of a groundwater management strategy. For purposes of this GMP, sustainable supply is defined as the amount of water that can reliably be withdrawn from the Olympic Valley Aquifer without inducing permanent and detrimental ecological, health, or economic damage. Aspects of developing water supply reliability include optimizing the use of existing resources, reducing demand for groundwater, and maintaining or enhancing groundwater recharge and storage.

GOAL 2: SUSTAIN, AND WHERE POSSIBLE IMPROVE, EXISTING GROUNDWATER QUALITY.

The Water Quality Control Plan (Basin Plan) developed by the Lahontan RWQCB in 1995 establishes groundwater quality objectives throughout the basin based on the beneficial uses of the groundwater. For the residential, commercial and institutional beneficial uses common in Olympic Valley, water quality

objectives of taste and odor, bacteria and coliform, CCR Title 22 chemicals, and radionuclides are applicable.

Maintaining high quality groundwater in the basin is more cost-effective than treating groundwater after it has been extracted from the basin. Implementing policies and procedures to effectively manage groundwater quality in the basin will prevent expensive future treatment costs.

GOAL 3: PROTECT, PROMOTE, AND IMPROVE THE ENVIRONMENTAL QUALITY OF OLYMPIC VALLEY.

A purpose of this GMP is to manage groundwater in an environmentally sensitive manner. It is the aim of this GMP to manage the impacts from groundwater pumping on surface water such that groundwater extraction does not cause significant environmental effects. This GMP recognizes that groundwater impacts on Squaw Creek should be avoided or minimized.

4.2 GMP OBJECTIVES

Basin Management Objectives are specific criteria defining the desired state of the basin. They provide a mechanism for determining whether groundwater management goals are being achieved. They are verifiable and are ideally quantifiable. BMOs adopted for this GMP are listed below, organized by groundwater management goal. Table 1 summarizes the relationship between the basin management goals and the BMOs in this GMP.

GOAL 1: MANAGE THE GROUNDWATER BASIN IN A MANNER THAT PROVIDES A SUSTAINABLE SUPPLY FOR CURRENT AND FUTURE BENEFICIAL USES.

BMO 1-1: MAINTAIN GROUNDWATER SUPPLIES SUFFICIENT TO PROVIDE WATER FOR CURRENT AND FUTURE DOMESTIC, MUNICIPAL, COMMERCIAL, PRIVATE, AND FIRE PROTECTION USES DURING SUMMER AND AUTUMN OF THE SECOND CONSECUTIVE YEAR OF LOW RAINFALL.

Verifiable actions and targets

- Estimate, verify, and regularly update sustainable pumping rates

- Increase conservation efforts to reduce demand
- Modify pumping locations and schedules to maximize sustainable supplies

Goal 1: Manage the groundwater basin in a manner that provides a sustainable supply for current and future beneficial uses		Goal 2: Sustain and where possible improve existing groundwater quality		Goal 3: Protect, promote, and improve the environmental quality of Olympic Valley	
Objective	**Element**	**Objective**	**Element**	**Objective**	**Element**
BMO 1-1: Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall	1. Groundwater monitoring 4. Interagency and ongoing stakeholder coordination 5. Manage groundwater pumping 7. Water conservation and public education 8. Enhance groundwater basin management tools	BMO 2-1: Comply with existing water quality standards	1. Groundwater monitoring 2. Surface water monitoring	BMO 3-1: Protect the structure and hydraulic characteristics of the groundwater basin by avoiding withdrawals that cause subsidence	3. Subsidence monitoring 5. Manage groundwater pumping
BMO 1-2: Minimize drawdown and maximize use of basin storage	1. Groundwater monitoring 5. Manage groundwater pumping 8. Enhance groundwater basin management tools	BMO 2-2: Minimize the risk of groundwater contamination	6. Develop and support ordinances for well construction and abandonment procedures 9. Wellhead protection measures	BMO 3-2: Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on streamflows	1. Groundwater monitoring 2. Surface water monitoring 5. Manage groundwater pumping
BMO 1-3: Encourage water conservation and manage or reduce water demand	4. Interagency and ongoing stakeholder coordination 7. Water conservation and public education	BMO 2-3: Improve groundwater quality where feasible	4. Interagency and ongoing stakeholder coordination 9. Wellhead protection measures	BMO 3-3: Minimize future impacts from pumping on identified wetlands	1. Groundwater monitoring 5. Manage groundwater pumping
BMO 1-4: Estimate and acknowledge likely future water demands in management decisions	4. Interagency and ongoing stakeholder coordination 7. Water conservation and public education 8. Enhance groundwater basin management tools	BMO 2-4: Identify and protect the recharge water quality and recharge capacity of groundwater recharge zones	2. Surface water monitoring 9. Wellhead protection measures	BMO 3-4: Support ongoing stream restoration efforts as they relate to groundwater management	2. Surface water monitoring 4. Interagency and ongoing stakeholder coordination

Table 2: Relationship between Basin Management Goals and the BMOs

BMO Description
Groundwater in Olympic Valley serves many purposes. Groundwater is used for domestic and municipal supplies, commercial supplies, irrigation, and fire suppression. Additionally, groundwater has important environmental functions including supporting the health of the meadow and sustaining natural, stream flows in the lower reaches of Squaw Creek. The aquifer must be managed so that all of these groundwater uses can be met.

This BMO uses two-years as the planning time frame. Each of the years of the two year period is assumed to be hydrologically similar to the low precipitation conditions of 1994. This time frame allows groundwater managers to plan for dry periods, without being unrealistically restrictive. In addition to the two-year low rainfall planning time frame, long-term groundwater management decisions will acknowledge the potential effects of climate change on groundwater conditions.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by seeking to prevent long-term depletion or overdraft of the groundwater resource.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 1 – Groundwater Monitoring
Element 4 – Interagency and Ongoing Stakeholder Coordination
Element 5 – Manage Groundwater Pumping
Element 7 – Water Conservation and Public Education
Element 8 – Enhance Groundwater Basin Management Tools

These elements are discussed in detail in Section 5.

BMO 1-2: MINIMIZE DRAWDOWN AND MAXIMIZE USE OF BASIN STORAGE

Verifiable actions and targets

- Regularly monitor water levels in Olympic Valley
- Modify pumping locations and schedules
- Coordinate efforts among all groundwater extractors

BMO Description
Minimizing drawdown around wells and maximizing the storage capacity of the Olympic Valley aquifer allows the most efficient use of the resource with the least environmental impact. Drawdown targets are location dependent. Drawdown around wells should be managed based on well design. Wells should be located to minimize overlapping drawdown cones, thereby maximizing the use of stored groundwater. Drawdown near Squaw Creek should be minimized, particularly in the meadow, where shallow groundwater contributes to flows in the Creek.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by distributing stresses on the resource, thereby using the groundwater more efficiently.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 1 – Groundwater Monitoring
Element 5 – Manage Groundwater Pumping
Element 8 – Enhance Groundwater Basin Management Tools

These elements are discussed in detail in Section 5.

BMO 1-3: ENCOURAGE WATER CONSERVATION, AND MANAGE OR REDUCE WATER DEMAND

Verifiable actions and targets
- Monitor and meter water use
- Participate in public education

BMO Description
Water conservation is an effective method for reducing demand on the Olympic Valley groundwater resource. Water conservation can be promoted through public education and outreach, and through promoting water use awareness by water metering. Currently the SVPSD meters individual water users; however SVWMC water users are not metered. Water conservation in Olympic Valley depends on community outreach and community acceptance. The intent of this GMP is to promote conservation and wise water use in Olympic Valley in order to preserve and protect the water resource.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by relieving pumping stresses on the groundwater basin.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 4 – Interagency and Ongoing Stakeholder Coordination
Element 7 – Water Conservation and Public Education

These elements are discussed in detail in Section 5.

BMO 1-4: ESTIMATE AND ACKNOWLEDGE LIKELY FUTURE WATER DEMANDS IN MANAGEMENT DECISIONS

Verifiable actions and targets

- Annually review likely future demands
- Incorporate agreed demand projections in management decisions

BMO Description
Effective groundwater management relies on realistic estimates of future demands. There are multiple private and institutional groundwater extractors in Olympic Valley. Each extractor will provide an estimate of how much water they will need in the future. The purpose of this BMO is to coordinate estimates of future extractions so that management decisions reflect the most complete information. Additionally, this BMO intends, to the degree practical, to account for all future demands. Known demands that are not explicitly assigned to any extractor should still be accounted for in management decisions.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by supporting groundwater management decisions based on the most complete data available.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 4 – Interagency and Ongoing Stakeholder Coordination
Element 7 – Water Conservation and Public Education

Element 8 – Enhance Groundwater Basin Management Tools

These elements are discussed in detail in Section 5.

GOAL 2: SUSTAIN AND WHERE POSSIBLE, IMPROVE EXISTING GROUNDWATER QUALITY.

BMO 2-1: COMPLY WITH EXISTING WATER QUALITY STANDARDS

Verifiable actions and targets

- Compare groundwater monitoring results to water quality standards.

BMO Description

The intent of this BMO is to demonstrate that local groundwater quality meets the numerical water quality objectives of the Lahontan RWQCB and all other regulatory requirements. These water quality objectives include criteria for taste, odor, bacteria, and chemical concentrations that meet shrinking water standards. The CCR title 22 drinking water standards (MCLs) that make up this BMO are listed on the California Department of Health Services website (http://www.dhs.ca.gov).

BMO Contribution to Reliability of Long-Term Beneficial Uses

This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by testing for and demonstrating adequate groundwater quality for beneficial uses including domestic, municipal, commercial, fire protection, and environmental.

Elements Associated with this BMO

Management actions that will help achieve this BMO include:

Element 1 – Groundwater Monitoring
Element 2 – Surface Water Monitoring

These elements are discussed in detail in Section 5.

BMO 2-2: MINIMIZE THE RISK OF GROUNDWATER CONTAMINATION

Verifiable actions and targets

- Compare groundwater monitoring results to water quality standards.

BMO Description

A number of potential sources of groundwater contamination overlie many parts of Olympic Valley. One strategy for decreasing the risk of contamination is identifying natural and artificial pathways for the downward movement of contaminants. Supporting and implementing well abandonment policies is one method for reducing groundwater contamination. A second strategy for minimizing contamination is to inventory potential sources of contamination in the basin, particularly ones in close proximity to wells or areas of rapid recharge.

BMO Contribution to Reliability of Long-Term Beneficial Uses

This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by helping prevent groundwater contamination. This in turn supports BMO 2-1, demonstrating adequate groundwater quality for all beneficial uses including domestic, municipal, commercial, fire protection, and environmental.

Elements Associated with this BMO

Management actions that will help achieve this BMO include:

Element 6 – Develop and Support Ordinances for Well Construction and Abandonment Procedures
Element 9 – Wellhead Protection Measures

These elements are discussed in detail in Section 5.

BMO 2-3: IMPROVE GROUNDWATER QUALITY WHERE FEASIBLE

Verifiable actions and targets

- Support ongoing remedial efforts by sharing data and managing pumping.

BMO Description

Portions of the Olympic Valley Aquifer have been impacted by anthropogenic groundwater contamination. This groundwater contamination presents a threat to the groundwater resources of Olympic Valley. It is the intent of this BMO to improve the groundwater quality by supporting ongoing remedial efforts.

Support may include exchanging data, or managing pumping to reduce the spread of contaminants. It is not the intent of this BMO to remediate naturally occurring minerals such as iron and manganese.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater by supporting improved groundwater quality for all beneficial uses including domestic, municipal, commercial, fire protection, and environmental.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 4 – Interagency and Ongoing Stakeholder Coordination
Element 9 – Wellhead Protection Measures

These elements are discussed in detail in Section 5.

BMO 2-4: IDENTIFY AND PROTECT THE RECHARGE WATER QUALITY AND RECHARGE CAPACITY OF GROUNDWATER RECHARGE ZONES

Verifiable actions and targets

- Map primary groundwater recharge zones

BMO Description
Primary groundwater recharge zones represent potential locations where contamination may enter the groundwater basin. It is the intent of this BMO to identify primary recharge zones, and prevent activities that might increase the risk of contaminating the recharge zones. In Olympic Valley primary recharge zones are likely along the banks of Squaw Creek, and along the margins of the basin.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater because the quantity and quality of available groundwater depends on the quantity and quality of recharge.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 2 – Surface Water Monitoring
Element 9 – Wellhead Protection Measures

These elements are discussed in detail in Section 5.

GOAL 3: PROTECT, PROMOTE, AND IMPROVE THE ENVIRONMENTAL QUALITY OF OLYMPIC VALLEY.

BMO 3-1: PROTECT THE STRUCTURE AND HYDRAULIC CHARACTERISTICS OF THE GROUNDWATER BASIN BY AVOIDING WITHDRAWALS THAT CAUSE SUBSIDENCE

Verifiable actions and targets

- Monitor changes in ground surface elevation

BMO Description

Declining groundwater levels can result in compaction of clay layers in the aquifer system due to decreasing interstitial pore water pressures. The resulting lowering of the land surface, known as subsidence, can change gradients in streams and pipes and cause flooding and structural damage to roads, bridges, and buildings. It is the intent of this BMO to prevent subsidence caused by groundwater extraction.

BMO Contribution to Reliability of Long-Term Beneficial Uses

This BMO will contribute to a more reliable supply for long-term beneficial uses of groundwater because subsidence could potentially constrain the sustainable groundwater yield.

Elements Associated with this BMO

Management actions that will help achieve this BMO include:

Element 3 – Subsidence Monitoring
Element 5 – Manage Groundwater Pumping

These elements are discussed in detail in Section 5.

BMO 3-2: PROMOTE VIABLE AND HEALTHY RIPARIAN AND AQUATIC HABITATS BY AVOIDING OR MINIMIZING FUTURE IMPACTS FROM PUMPING ON STREAM FLOWS

Verifiable actions and targets

- Monitor and analyze stream flows.
- Monitor and analyze shallow groundwater levels near Squaw Creek.

BMO Description

As discussed in Section 3, Squaw Creek acts as both a source of recharge to the groundwater basin, and as a drain that removes groundwater from the basin. Groundwater extraction can deplete stream baseflow by intercepting groundwater that would otherwise seep into the stream (in gaining stream reaches) or by increasing the rate at which water seeps out of streams (in losing stream reaches). Baseflow depletion decreases the total amount of aquatic habitat, interferes with migration of anadromous fish, and tends to increase water temperature. It is difficult to estimate natural baseflow in Squaw Creek, as parts of the Creek dry up regularly. However, it is the intent of this BMO to manage groundwater such that extractions either avoid or minimize additional impact on stream flows in the meadow, thereby minimizing any significant adverse biological effects from pumping.

BMO Contribution to Reliability of Long-Term Beneficial Uses

This BMO will contribute to a more reliable supply by directly addressing the most likely adverse environmental impact related to groundwater extraction.

Elements Associated with this BMO

Management actions that will help achieve this BMO include:

Element 1 – Groundwater Monitoring
Element 2 – Surface Water Monitoring
Element 5 – Manage Groundwater Pumping

These elements are discussed in detail in Section 5.

BMO 3-3: MINIMIZE FUTURE IMPACTS FROM PUMPING ON IDENTIFIED WETLANDS

Verifiable actions and targets

- Monitor and analyze shallow groundwater levels in the meadow.

BMO Description
Wetlands provide Olympic Valley with important ecological and aesthetic benefits. The health of the wetlands in the meadow is dependent on shallow groundwater levels. It is the intent of this BMO to manage groundwater such that extractions either avoid or minimize additional impact on identified wetlands.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable supply by directly addressing an important adverse environmental impact related to groundwater extraction that limits groundwater management.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 1 – Groundwater Monitoring
Element 5 – Manage Groundwater Pumping

These elements are discussed in detail in Section 5.

BMO 3-4: SUPPORT ONGOING STREAM RESTORATION EFFORTS AS THEY RELATE TO GROUNDWATER MANAGEMENT

Verifiable actions and targets

- Take part in Squaw Creek studies and restoration efforts as they relate to groundwater management by:
    - Sharing of data and information
    - Redistributing pumping to minimize impacts on stream flow
    - Promoting conservation to minimize pumping
    - Participating in cooperative stream/aquifer interaction studies.

BMO Description
Some stream restoration activities may provide groundwater storage benefits by raising shallow groundwater levels and providing additional shallow groundwater storage. Additionally, the health of Squaw Creek is important in the success of other BMOs including 1-1, 1-2, 2-4 and 3-2. It is in the interest of groundwater managers to assist with maintaining Squaw Creek as a viable and healthy waterway.

BMO Contribution to Reliability of Long-Term Beneficial Uses
This BMO will contribute to a more reliable groundwater supply by identifying and addressing important restrictions and limitations on groundwater pumping.

Elements Associated with this BMO
Management actions that will help achieve this BMO include:

Element 2 – Surface Water Monitoring
Element 4 – Interagency and Ongoing Stakeholder Coordination

These elements are discussed in detail in Section 5.

Section 5
ELEMENTS

ELEMENT 1: GROUNDWATER MONITORING

Required: Yes [California Water Code 10753.7 (a) (4)]

Type: Program

Status: Ongoing

Description

Groundwater monitoring assists with managing pumping, corroborates groundwater storage efforts, tracks groundwater quality, and assists with estimating stream-aquifer interactions. Groundwater monitoring programs meet the following Basin Management Objectives:

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall
BMO 1-2 – Minimize drawdown and maximize basin storage
BMO 2-1 – Comply with existing water quality standards
BMO 3-2 – Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on stream flows
BMO 3-3 – Minimize future impacts from pumping on identified wetlands.

As part of this Groundwater GMP, the following action items have been identified for the groundwater monitoring element:

1. Continue existing groundwater monitoring programs.

A number of groundwater monitoring programs exist in Olympic Valley, including monitoring conducted by the SVPSD, SVMWC, and the Resort at Squaw Creek. These programs are specifically designed to identify trends and changes in groundwater elevation and quality throughout the basin. These monitoring programs rely on an extensive network of dedicated shallow monitoring wells and production wells, as shown on Figure 23. The existing monitoring programs are included in Appendix A. These monitoring plans include the monitoring procedures, monitoring schedule, monitored parameters, and QA/QC requirements.

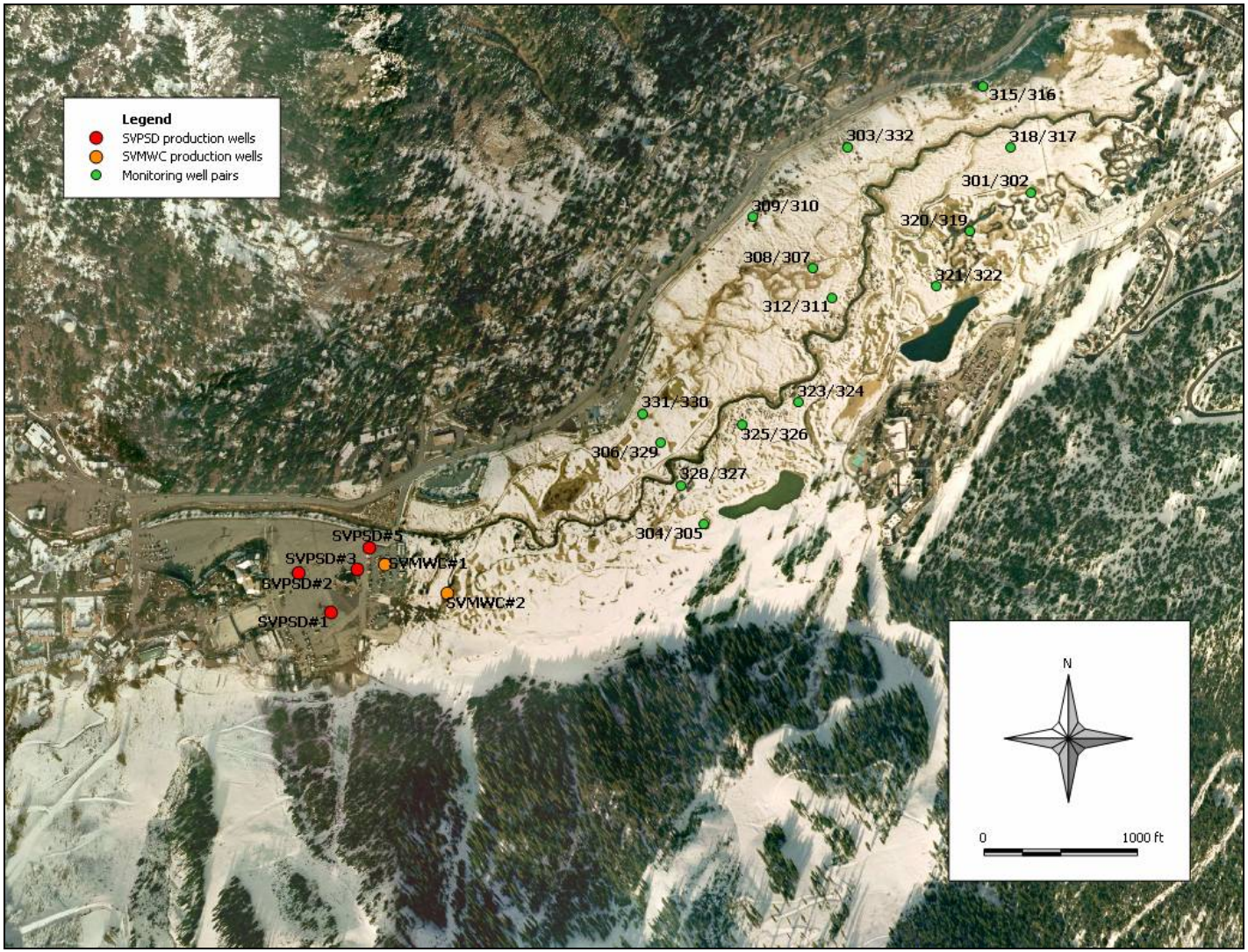

Figure 23: Locations of Monitored Wells

2. Coordinate and expand the existing groundwater monitoring programs.

The three existing groundwater monitoring programs will be combined into a single, coordinated groundwater monitoring program. This unified program will be designed to monitor both groundwater levels and groundwater quality throughout the GMP management area. Coordinating the existing monitoring plans will have the advantage of producing a single, consistent data set that can be used for basin analysis. As data deficiencies are identified, the coordinated monitoring program will be updated and expanded. This may entail analyzing for additional parameters or expanding the monitoring network.

3. Analyze data, and assess the adequacy of the monitoring well network annually.

Groundwater data are analyzed annually in support of a number of the elements in this GMP. As part of the analysis, a determination of the adequacy of the existing monitoring programs will be developed. Recommendations for modifying or expanding each monitoring program will be included in the annual analysis.

ELEMENT 2: SURFACE WATER MONITORING

Required: Yes [California Water Code 10753.7 (a) (4)]

Type: Program and project

Status: Ongoing and new

Description

Surface flow and surface water quality can directly affect groundwater levels and groundwater quality. In addition, stream flows can be influenced by groundwater extractions, potentially impacting riparian and aquatic habitats. Surface water monitoring helps evaluate background conditions, the relationship between groundwater recharge and stream discharge, and the potential impacts of groundwater pumping on stream flow. Stream flows must be monitored to address the following Basin Management Objectives:

BMO 2-1 – Comply with existing water quality standards
BMO 2-4 – Identify and protect the recharge water quality and capacity of groundwater recharge zones
BMO 3-2 – Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on stream flows
BMO 3-4 – Support ongoing stream restoration efforts as they relate to groundwater management

The following action items have been identified as part of the surface water monitoring element:

1. **Continue and expand existing stream monitoring programs, and participate in stream restoration projects as they relate to groundwater management by:**
    - Sharing of data and information
    - Redistributing pumping to minimize impacts on stream flow
    - Promoting conservation to minimize pumping
    - Participating in cooperative stream/aquifer studies

The SVPSD currently monitors stream flows at three locations, shown on Figure 24. Data from these three monitoring locations constitute the most complete set of stream flow data available for Squaw Creek. Continuing the existing monitoring program will extend this data set and allow additional analyses of stream flows in Olympic Valley. The existing monitoring program for these three locations is included in Appendix A. The monitoring program includes information on monitoring procedures, monitoring schedule, and QA/QC requirements.

The GMP Implementation Group and the Advisory Group, described in Section 6, will furthermore support ongoing stream flow and water quality data collection efforts. Additionally, the GMP Implementation Group will support ongoing stream restoration efforts as appropriate. Such support may consist of data sharing, pumping redistribution and conservation measures to reduce pumping. In particular, the existing Lahontan RWQCB plan to reduce sediment loads as described in resolution r6t-2006-0017 (RWQCB, 2006) are fully supported as important to the health of Squaw Creek.

2. **Support a cooperative stream/aquifer interaction study.**

   Understanding the relationship between shallow groundwater levels, stream flows, groundwater quality, and stream quality will lead to better management of the basin's water resources. The GMP Implementation Group will participate in stream/aquifer interaction studies in cooperation with State agencies or other groundwater users. The Implementation Group will help identify potential grants or other funding mechanisms that could support such studies.

3. **Analyze stream gauge data, precipitation data, and shallow groundwater monitoring data annually.**

   Data collected from the monitoring programs identified above will be analyzed and reported annually to the GMP Implementation Group and Advisory Group described in Section 6. At a minimum, the annual analyses will include the following:

   - Identify baseflow trends
   - Identify stream water quality trends
   - Identify shallow groundwater level trends
   - Identify changes in the apparent stream-aquifer interaction

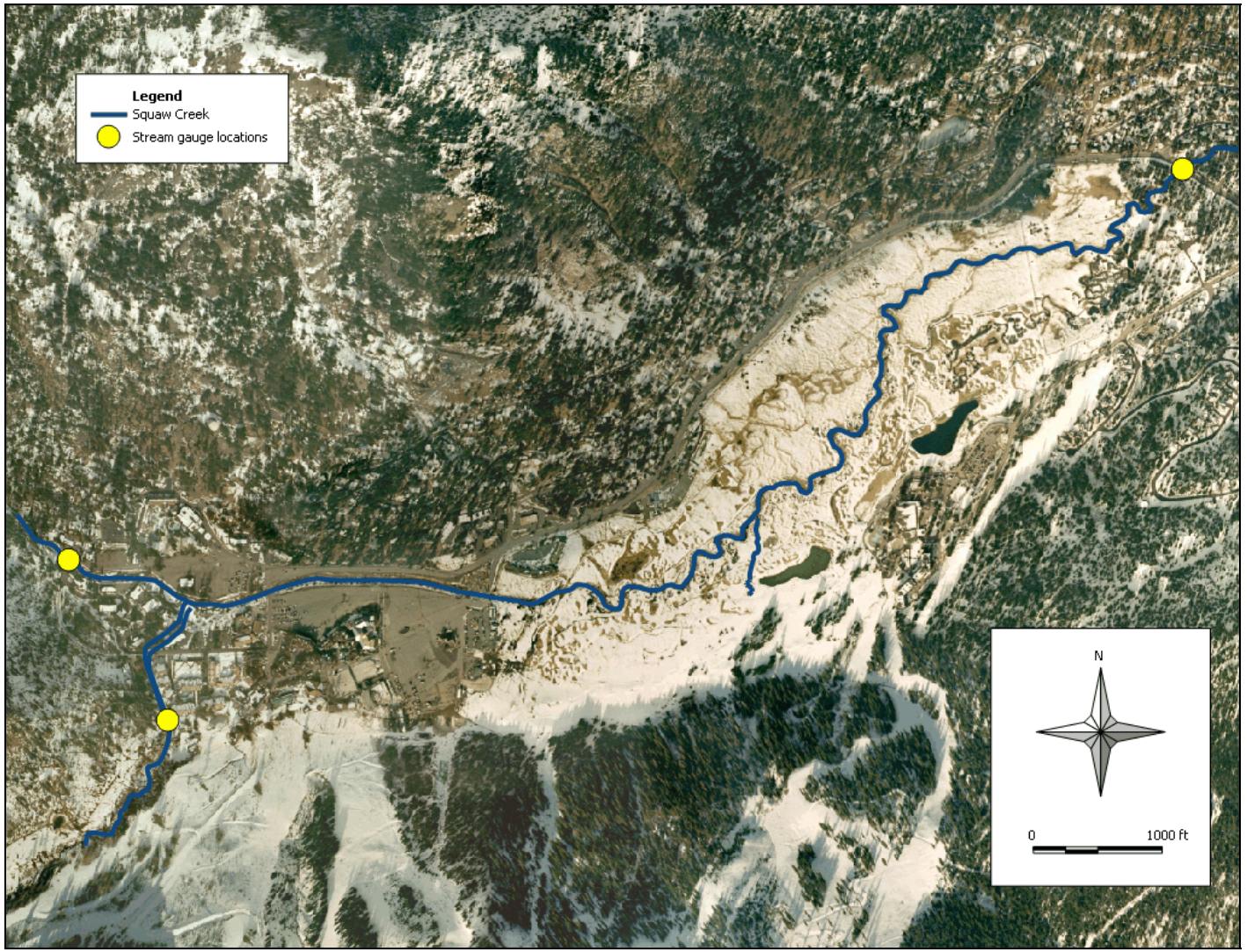

Figure 24: Stream Gauge Locations

ELEMENT 3: SUBSIDENCE MONITORING

Required: Yes [California Water Code 10753.7 (a) (4)]

Type: Program

Status: New

Description

Land subsidence is the gradual or sudden lowering of the land surface resulting from groundwater extraction. There is no known documented or anecdotal evidence of subsidence in Olympic Valley. A monitoring program will be implemented to meet the following Basin Management Objective:

BMO 3-1 – Protect the structure and hydraulic characteristics of the groundwater basin by avoiding withdrawals that cause subsidence.

The following action items have been identified as part of the subsidence monitoring element:

1. **Develop and implement a GPS based subsidence monitoring program.**

   The subsidence monitoring program will consist of a set of benchmarked stations where land surface elevation is periodically measured, most likely by means of Global Positioning System (GPS) surveys. Using sophisticated satellite transponders in accordance with guidelines created by the National Oceanographic and Atmospheric Administration's National Geodetic Survey, ground elevation can be measured to within a few centimeters. GPS technology eliminates the need for stable ground-based reference stations, which may only be possible to establish some distance from the areas of interest.

2. **Analyze data and assess the frequency of the subsidence monitoring.**

   Ground surface elevations will initially be monitored every 2 years. If no significant subsidence is observed after the first two years, monitoring will be

conducted every 5 years unless water levels at nearby wells fall below their historic minimum levels, at which point measurement frequency would be increased to once per year.

3. Review other means of subsidence measuring and monitoring.

The GMP Implementation Group will look into the possibility of using Interferometric Synthetic Aperture Radar (InSAR) satellite data for measuring subsidence instead of a GPS based system. InSAR data have been used successfully by the U.S. Geological Survey in other basins to estimate subsidence. The InSAR analysis, however, requires estimates of soil properties that may need to be developed, and currently InSAR data used by the USGS is collected by the European Space Agency.

ELEMENT 4: INTERAGENCY AND ONGOING STAKEHOLDER COORDINATION

Required: Yes [California Water Code 10753.7 (a) (2)]

Type: Program

Status: Ongoing

Description

Groundwater from the GMP management area is the primary source of water for the SVPSD, SVMWC, Resort at Squaw Creek, PlumpJack Squaw Valley Inn, Squaw Valley Ski Corporation, and Gladys K. Poulsen. In addition to providing potable water for domestic and commercial uses, groundwater from the basin supports stream flows and provides water for irrigation and seasonal snowmaking. Comprehensive projects, programs and policies developed to manage the groundwater basin are therefore dependent on interagency coordination.

Coordinating interagency efforts support the following Basin Management Objectives:

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.
BMO 1-3 – Encourage water conservation, and manage or reduce water demand
BMO 1-4 – Estimate and acknowledge likely future water demands in management decisions
BMO 2-3 – Improve groundwater quality where feasible
BMO 3-4 – Support ongoing stream restoration efforts as they relate to groundwater management

The following action item has been identified as part of the interagency coordination element:

1. **Continue to cooperatively manage groundwater under the auspices of the GMP Implementation Group and Advisory Group.**

   The GMP Implementation Group, along with the attendant Advisory Group, is described in Section 6. These groups will meet annually or more frequently if a need is identified, to help create and oversee the projects, programs, and policies established in this GMP. These groups will be the primary forum for estimating future demands on the groundwater basin by accepting estimated demands from current groundwater extractors, and supplementing these demands with any additional pumping needed for known, planned development not included in the current extractor's estimates. These groups will additionally oversee and comment on the monitoring protocols outlined in this GMP.

2. **Coordinate with Lahontan RWQCB to protect water resources by implementing effective storm water treatment.**

   The Lahonton Regional Water Quality Control Board (LRWQCB) and SVPSD successfully negotiated a storm water treatment system for recent developments in Olympic Valley that protected groundwater quality. This agreement will serve as a model for all groundwater users, including the SVPSD, SVMWC, Resort at Squaw Creek, Squaw Valley Ski Corporation, Gladys K. Poulsen, and PlumpJack to work with LRWQCB to prevent groundwater contamination from non-point source pollution.

3. **Coordinate with the appropriate agencies on decisions that may impact flows of Squaw Creek.**

   It is the intention of this GMP to manage groundwater resources in a manner that minimizes impacts to flows in Squaw Creek. Additionally, the California Department of Fish and Game, the Truckee River Watershed Council, and the LRWQCB all have an interest in maintaining flows in Squaw Creek. Groundwater management decisions that may affect stream flows will be coordinated with these agencies in order to minimize or avoid any impacts that may unnecessarily reduce stream flows.

4. **Coordinate with the Army Corp of Engineers and LRWQB on decisions that may impact delineated wetlands.**

   It is the intention of this GMP to manage groundwater resources in a manner that minimizes impacts to wetlands in Olympic Valley. Additionally, Army

Corp of Engineers and the LRWQB have interests in maintaining healthy wetlands. Groundwater management decisions that may involve wetlands will be coordinated with these agencies in order to minimize or avoid any impacts on the health or extent of delineated wetlands.

5. Coordinate with additional local, state, and federal agencies as necessary.

Many local, state, and federal agencies may have some interest or jurisdiction over various groundwater management decisions. The appropriate agencies will be consulted as necessary. A tentative list of agencies that might be contacted or consulted includes:

- California State Water Resources Control Board
- Lahontan Regional Water Quality Control Board
- California Department of Water Resources
- California State Lands Commission
- Placer County Planning Department
- Placer County Division of Environmental Health
- Placer County Department of Public Works
- Army Corp of Engineers
- California Department of Fish and Game
- Truckee River Watershed Council

ELEMENT 5: MANAGE GROUNDWATER PUMPING

Required: No

Type: Program and project

Status: Ongoing and new

Description

Managing pumping entails both spatial and temporal redistribution of pumping. The present pumping distribution has created localized water-level depressions that overlap and exist near Squaw Creek. It is the intention of this GMP to coordinate and manage pumping such that impacts to Squaw Creek are minimized, groundwater storage is maximized, and local pumping depressions are widely distributed.

Managing groundwater pumping supports the following Basin Management Objectives:

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.
BMO 1-2 – Minimize drawdown and maximize basin storage
BMO 3-1 – Protect the structure and hydraulic characteristics of the groundwater basin by avoiding withdrawals that cause subsidence.
BMO 3-2 – Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on stream flows
BMO 3-3 – Minimize future impacts from pumping on identified wetlands.

The following action item has been identified as part of the groundwater pumping management element:

1. **Identify and develop new well sites.**

Managing pumping requires operational flexibility. New wells will provide opportunities to distribute pumping throughout the GMP management area and minimize local drawdown. New well sites can be developed to minimize both impacts from individual wells, and cumulative impacts from all Olympic Valley pumpers. Potential new well sites may be obtained from land owners in Olympic Valley. Land owners will be identified and contacted, and new well sites will be developed as they become available.

2. **Evaluate opportunities for redistributing pumping to meet particular goals such as minimum drawdown in the meadow, or broadest drawdown cone.**

   To the extent possible, groundwater pumping should be redistributed to meet specific criteria. These criteria may include minimum drawdown near Squaw Creek or minimizing interference between pumping wells.

3. **Identify and evaluate opportunities for developing a coordinated pumping plan between all groundwater users.**

   The GMP Implementation Group in coordination with the Advisory Group will investigate developing a groundwater pumping plan that serves the interest of all the users. A coordinated pumping plan will reduce the cumulative impacts from pumping individual wells.

4. **Analyze groundwater pumping data at least annually, and recommend changes to the groundwater pumping distribution as necessary.**

   Pumping quantities and pumping distributions should be analyzed and reported annually to the GMP Implementation Group and Advisory Group. These analyses will form the bases for annual modifications to the groundwater pumping distribution. Evidence of stream baseflow depletion, anthropogenic contamination, or excessive drawdown may all be cause for modifying the groundwater pumping distribution. During average or wet years, annual analysis of pumping distributions will likely suffice. During years with low rainfall, pumping distributions may have to be analyzed more frequently.

5. **Investigate the impact of horizontal wells on the Basin's groundwater conditions.**

   Horizontal wells installed along the sides of Olympic Valley tap water from fractures in the surrounding volcanic rocks. The impact of these horizontal

wells on the Basin's groundwater conditions is unclear. A study will be implemented that attempts to identify any impacts on groundwater levels, or stream flows. The study will likely occur when stream gauging stations are already in place in Squaw Creek and in the Upwelling.

6. **Investigate the impact of faults on the Basin's groundwater conditions.**

   At least four faults have been mapped crossing Olympic Valley (Nevada Bureau of Mines and Geology, 2000). One fault is known to impede groundwater flow between the parking lot and the meadow. The impact of the other faults is uncertain, although the Upwelling appears to be coincident with one of the faults. A study will be implemented in coordination with the groundwater monitoring programs that will attempt to identify any impacts by the faults on groundwater flow.

ELEMENT 6: DEVELOP AND SUPPORT ORDINANCES FOR WELL CONSTRUCTION AND ABANDONMENT PROCEDURES

Required: No

Type: Policy

Status: Ongoing

Description

Improperly constructed or abandoned wells can be a significant pathway for the migration of groundwater contamination. Properly constructing wells and properly destroying abandoned wells will address the following Basin Management Objective:

BMO 2-2 – Minimize the risk of groundwater contamination

The following action items have been identified as part of the well abandonment element:

1. **Identify unused and improperly abandoned wells.**

   In 2004, SVPSD inventoried unused and improperly abandoned wells in the groundwater basin (West Yost & Associates, 2004). The SVPSD, and others as required by law, will continue to monitor for unused or abandoned wells, so that such wells can be abandoned as necessary, thereby removing potential pathways for contamination.

2. **Identify and secure funding for well abandonment.**

   Grants and loans that could provide funding for well abandonment will be identified and secured. These may include Local Groundwater Assistance grants, Integrated Regional Water Management grants, or similar.

3. **Support existing State and County well construction and well destruction standards.**

The State of California and Placer County have specific well abandonment standards, intended to reduce the risk of groundwater contamination. Should additional modifications to the State or County well construction and abandonment ordinances be required in the future, the GMP Implementation Group and Advisory Group described in Section 6 will provide technical and political support to implement needed changes.

ELEMENT 7: WATER CONSERVATION AND PUBLIC EDUCATION

Required: No

Type: Program

Status: Ongoing and new

Description

Water conservation reduces demand on the groundwater basin, allowing more efficient use of the limited groundwater resource. Implementing water conservation measures will support the following Basin Management Objectives:

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall
BMO 1-3 – Encourage water conservation, and manage or reduce water demand
BMO 1-4 – Estimate and acknowledge likely future water demands in management decisions

The following action items have been identified as part of the water conservation and public education element:

1. **Continue to Develop Water Conservation Measures and Ordinances**.

   All groundwater pumpers and major water users are urged to adopt water conservation measures. Example measures that are currently being included in the SVPSD Irrigation and Water Conservation ordinance include:

   A. Defining target water uses by implementing a Maximum Applied Water Allowance (MAWA).
   B. Implementing increasing tiered water pricing that encourages efficient water use.

C. Developing drought response plans with various stages, each having objective criteria and a list of response actions.

2. **Encourage residential water use audits for those customers using disproportionate amounts of water**.

Water use audits are designed to identify ways people can implement water efficient measures, identify needed repairs, save water, and help control water and sewer costs. Water audits generally consist of a visit to a home or business by trained technicians, along with follow up analysis. Common aspects of water use audits include:

- Determining historic water use
- Testing for leaks
- Providing or offering retrofit devices (e.g. low-flow shower heads, faucet aerators, toilet displacement devices)
- Evaluating outdoor irrigation practices and other outdoor water uses
- Identifying conservation opportunities
- Providing educational materials

3. **Meter water use at all service connections.**

Although all SVPSD connections are metered, the SVMWC could meter connections to identify water use patterns. Installing and reading individual water meters on all service connections will help monitor water use, identify potential water leaks, and pinpoint opportunities to save water. All service connections should be metered as funds become available.

4. **Annually review production, and estimate future extractions.**

The projects and policies resulting from this GMP should account for all groundwater used in the basin. Accurate estimates of extraction are necessary to adequately manage the basin. A reasonable estimate of future demands will be adopted by the GMP Implementation Group. This estimate of future demands will be based on recommendations from the Advisory Group, who will develop the estimate by accepting estimated demands from current groundwater extractors, and supplementing these demands with any

additional pumping needed for known, planned development not included in the current extractor's estimates.

5. Encourage conservation through education.

Successful water conservation programs often employ information dissemination and public education. Methods of public education available in Olympic Valley may include:

- Inserts included in SVPSD and SVWMC water bills detailing methods and advantages of water conservation;
- Participation in local fairs;
- Public signs and postings;
- Notices in resorts, inns, hotels, and restaurants.

ELEMENT 8: ENHANCE GROUNDWATER BASIN MANAGEMENT TOOLS

Required: No

Type: Program and project

Status: Ongoing and new

Description

Improving groundwater basin management tools is necessary to develop and maintain up to date, relevant, and preferably quantifiable targets for the Basin Management Objectives. Some BMOs have quantified targets that will be regularly updated and revised by this element. Targets for other BMOs will be developed under this element. This element will develop tools and methods for obtaining additional data and evaluating future management strategies.

Improving groundwater basin management instruments addresses the following Basin Management Objectives:

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.
BMO 1-2 – Maximize basin storage
BMO 1-4 – Estimate and acknowledge likely future water demands in management decisions

The following action items have been identified as part of the updating basin management tools element:

1. **Update the groundwater model as data become available, or a need is identified.**

   The existing groundwater model should be kept current, reflecting the best understanding of the groundwater basin. Model updates should be

undertaken to incorporate recently collected data as they become available. In addition to incorporating new data, the underlying conceptual model should be modified as necessary.

Approaches to updating the groundwater model should be investigated in order for it to more accurately reflect flows in Squaw Creek. This update will likely require using a coupled surface water groundwater flow model. This update should only be undertaken after a more complete understanding of the interaction between Squaw Creek and the shallow groundwater system is understood.

2. **Provide access to the groundwater model for peer review.**

   The SVPSD will provide access to the existing groundwater model for peer review by others. Results and data from the groundwater model will be accessible to others in the presence of the SVPSD hydrologist. The group or individuals requesting the review will incur all costs associated with the peer review.

3. **Develop a single database of groundwater data.**

   Both water level data and groundwater quality data are presently collected and stored by many entities, in many formats. The various databases will be combined into a single database of water level and water quality data. The single database simplifies analysis of groundwater conditions.

ELEMENT 9: WELLHEAD PROTECTION MEASURES

Required: No

Type: Program and project

Status: Ongoing and new

Description:

Wellhead protection measures protect the quality of the groundwater resource, allowing it to be used for potable or other beneficial uses. The SVPSD developed a *Watershed Investigation, Source Water Assessment, and Groundwater Protection Plan* in 2000 (Standish-Lee Consultants, 2000). The plan was developed to prevent contaminants from entering the public water supply, reduce treatment costs, and increase public confidence in the quality, reliability, and safety of its drinking water.

Wellhead protection measures support the following Basin Management Objectives:

BMO 2-2 – Minimize the risk of groundwater contamination
BMO 2-3 – Improve groundwater quality where feasible
BMO 2-4 – Identify and protect the recharge water quality and capacity of groundwater recharge zones

In addition to implementing and maintaining the *Watershed Investigation, Source Water Assessment, and Groundwater Protection Plan,* the following action items have been identified for supporting and implementing wellhead protection measures.

1. **Periodically update and review the Drinking Water Source Assessment and Protection (DWSAP) analysis and submittals.**

   The California Department of Health Services requires water system operators to complete DWSAP analyses for each well or surface water intake

in their system (Section 11672.60 of the California Health and Safety Code). DWSAP reports include:

- A delineation of the groundwater protection zone around each well
- An inventory of possible contaminating activities (PCAs) that might lead to the release of microbiological or chemical contaminants within the delineated area. These may include chemical leaks, storm water recharge, or sewer leaks among other activities.
- A vulnerability analysis of the PCAs to which the drinking water source is most vulnerable

These DWSAPs will be updated as new wells are installed, as new PCAs are identified, as new analysis tools become available, or as required by statute.

2. Support the RWQCB in their remediation efforts.

The Lahontan RWQCB oversees groundwater remediation in the GMP management area. This GMP will not implement an additional layer of regulation. Instead, the SVPSD, SVMWC, and other groundwater pumpers will participate in information exchanges to support the State, and to use contamination information in managing local wellfield operation. Local groundwater users will periodically obtain updated information from the RWQCB regarding the locations and status of groundwater contamination sites to consider when planning new well sites or changes in the distribution of pumping among existing wells.

3. Map recharge areas.

Groundwater quality can be protected by preventing contaminating activities over areas of natural groundwater recharge. Natural recharge areas will be mapped using a combination of soil data, land use data, topography, and inferred groundwater flow directions. These recharge area maps will be provided to the Placer County Planning Department with a request that they incorporate the map into future planning decisions.

Section 6
IMPLEMENTATION PLAN

This section details the structure and method for implementing the GMP after it has been adopted. The purposes of this implementation plan are to continue existing groundwater management efforts, and carry out the proposed activities outline in Section 5.

Taking part in implementing this GMP does not preclude any agency, person, district, or company from pursuing other programs and projects related to groundwater management. These additional programs and projects may be undertaken individually, or in cooperation with other agencies and individuals that may or may not be involved in implementing this GMP.

6.1 STRUCTURE AND ROLE OF GMP IMPLEMENTATION GROUP

As discussed in Section 2 of this GMP, the SVPSD is the only local agency authorized by the CWC to develop this GMP. The portion of the groundwater basin managed under this GMP lies wholly within the SVPSD service area (Figure 2). Therefore, the locally elected Board of Directors of the SVPSD is the appropriate group for implementing this GMP.

The primary roles of the GMP Implementation Group include:

1. Securing and providing funds for implementing the GMP
2. Issuing and managing contracts necessary for implementing the GMP
3. Overseeing the quality and accuracy of all reports associated with GMP implementation
4. Advancing and facilitating the pursuit of the goals and objectives identified in this GMP in a timely manner
5. Directing future updates to the GMP every five years, or more frequently if needed, to reflect changes in State law on in local conditions/programs

The Implementation Group will meet at least annually at which time it will:

1. Review the annual report on the status of the basin

2. Review progress on meeting the GMPs goals and objectives
3. Discuss and approve the work plan for the upcoming year as recommended by the Advisory Group
4. Consider any proposed amendments to the GMP

6.2 STRUCTURE AND ROLE OF ADVISORY GROUP

Although the managed area lies wholly within the SVPSD service area, many other entities and individuals in Olympic Valley have an interest in managing the Valley's groundwater and protecting the health of the Valley's water resources. Through their participation in the Stakeholder group, these entities and individuals have played an important role in developing the policies in this GMP. It is the intent of this GMP that all interested parties contribute to managing the groundwater basin.

The Advisory Group provides a structure by which interested parties can influence groundwater management decisions without accepting the responsibility and liability associated with funding and overseeing the GMP implementation. The Advisory Group will include, at a minimum, one representative from each of the entities that pump water from the basin. The Advisory Group may include other members of the public or interested groups, as agreed to by the permanent members. The Advisory Group will operate independently of the GMP Implementation Group.

While the GMP Implementation Group handles administrative duties of implementing the GMP, the Advisory Group provides community input and technical review of the plans and programs while they are ongoing. The primary roles of the Advisory Group include:

1. Annually recommending a work plan to the Implementation Group for the following year;
2. Independently reviewing data, analyses, and reports generated as part of the GMP implementation;
3. Acting as liaison between GMP implementation activities and agencies, individuals, and entities represented by the group members.

This Advisory Group will, at a minimum, meet annually to develop the recommended work plan for the following year. The Advisory Group may meet more often to review ongoing projects that are part of the GMP implementation.

6.3 ANNUAL REVIEW AND REPORT

An annual review and report (ARR) will be prepared by the GMP Implementation Group's consulting hydrologist each year. The ARR will be prepared following each water year (October 1 -- September 30) and will summarize groundwater conditions in the basin, document the status of groundwater management activities from the previous year, and recommend any amendments to the GMP. The ARR will include:

- Status of the groundwater conditions within the GMP management area;
- Summary and analyses of monitoring efforts;
- Summary and status of the elements identified in section 5;
- Review of the annual work plan and BMOs, and an assessment of whether management activities are meeting those BMOs;
- Contingency actions, should any BMOs not be met;
- Prioritization of projects and programs to achieve BMOs, based on funding and other resources;
- Recommendations for revisions to the BMOs or elements.

The administrative draft will first be presented to the Advisory Group for review and comment. When the draft report is provided to the GMP Implementation Group, it will also be made available for public review. Prior to accepting the report, the GMP Implementation Group will consider comments from the Advisory Group and the general public. The GMP will be amended to reflect any changes to the basin management objectives or elements as directed by the GMP Implementation Group.

6.4 FINANCING MECHANISMS

The projects, programs and policies that encompass the many groundwater management-related activities will be financed through a variety of sources which include, but aren't limited to:

- Revenues from SVPSD, including connection and service fees, water sales, and bonds or loans if applicable.

- Finances from other interested entities, other pumpers, local resorts, or local corporations.
- In-kind services by other entities within the basin. This may include staff support or collaborative funding.
- State or Federal grant programs
- Local, State, and Federal partnerships. Staffing, funding, and providing services, such as laboratory services, may be provided by local, state, or federal agencies. For example, agencies with an interest in Squaw Creek or the surrounding wetlands may be willing to enter into partnerships to study these issues.

6.5 IMPLEMENTATION SCHEDULE

The schedule for implementing the GMP must remain flexible to account for many factors that influence the implementation. In particular, the following components will influence the implementation schedule:

- Advisory Group and community preferences. The schedule for implementing various activities will be partially dictated by the Advisory Group and community input.
- Environmental documentation. Some of the projects and programs outlined in Section 5 will require environmental documentation such as CEQA or NEPA documentation.
- Funding availability.

Implementation schedule flexibility is not grounds for delay. The Advisory Group's initial meetings must quickly identify high priority activities that can be undertaken immediately. In particular, required activities such as groundwater monitoring and subsidence monitoring will be initiated within the first year.

6.6 COORDINATION WITH OTHER LOCAL AGENCIES

Coordination with other local agencies during implementation will continue to play a vital role in the success of the Olympic Valley groundwater management strategy. Working together with the local groundwater extractors as well as State, Local, and Federal agencies, will enhance the effectiveness of this GMP.

6.7 CONFLICT RESOLUTION

Any conflicts regarding the implementation of the GMP will be resolved in the following manner:

1. Any party (public or private) that disagrees with any aspect of the implementation, hereinafter referred to as the Appellant, may request a hearing before the GMP Implementation Group to voice their objections and propose a resolution that satisfies their concerns. Such requests shall be made in writing and include the following:
   - Name;
   - Address and telephone number of the appellant or authorized representative;
   - A statement of the issues;
   - Any material the appellant wishes to be considered before a decision is rendered;
   - A statement of the resolution that would satisfy the appellant.

2. The GMP Implementation Group shall schedule a public hearing to consider the appeal. The procedure of the hearing shall be as follows:

   A. Staff report and recommendation.

   B. Appellant presentation including supporters of the appellant.

   C. Opposition presentation.

   D. Deliberation and decision by the GMP Implementation Group as determined by majority vote. In deciding the matter the GMP Implementation Group members will consider what action would serve the best interests of the public and cite findings that support the decision.

6.8 FUTURE REVIEW AND REVISION OF THE PLAN

The GMP and documents developed as part of the implementation are part of an on-going and evolving groundwater management program. The GMP will be reviewed and updated based on new issues, changed conditions, and future technological advancements that will occur over time.

A comprehensive review of the GMP will be scheduled every five years, unless the Implementation Committee decides otherwise. This action will help

maintain the GMP as a current and viable tool to guide continuing management of groundwater resources within the GMP management area.

Section 7
REFERENCES

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