City of Rohnert Park

Final Water Supply Assessment

January 2005

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Executive Summary

ES.1 Purpose

This Water Supply Assessment (WSA) has been prepared to assist the City of Rohnert Park (City) in satisfying the requirements of Senate Bill 610 (SB 610) and City Resolution Number 2004-95 (The Water Policy Resolution). The stated intent of SB 610 is to strengthen the process by which local agencies determine the adequacy and sufficiency of current and future water supplies to meet current and future demands. The WSA :

- Provides information on the City's water supplies consistent with Water Code Sections 10620 et. seq. (the Urban Water Management Act) and 10910 et. seq. (Water Supply Planning to Support Existing and Planned Future Uses);
- Provides information on current water demands and projected water demands based on the City's General Plan and specific project proposals currently under review by the City;
- Compares water supplies and water demands for the normal, single dry and multiple dry years;
- Provides the data to make the sufficiency findings required by the California Environmental Quality Act (CEQA).

The City has commissioned the preparation of this WSA in its role as Lead Agency under CEQA for various planned development projects. Table ES-1, on the following page, provides an index of the requirements for Water Supply Assessments and the location of each required discussion in this report.

ES.2 Approval

The City Council may approve the WSA, after hearing all testimony and evidence presented at a hearing. Upon the conclusion of the hearing, the City Council may determine, based on the entire record, whether projected water supplies will be sufficient to satisfy the demands of proposed projects, in addition to existing and planned future uses. The City must include the assessment in the environmental documents prepared for designated projects pursuant to the CEQA.

ES.3 Projects Under Consideration

The WSA includes water demands that will occur as the City reaches buildout under its General Plan. Because the City uses groundwater, the WSA considers the demands of other pumpers in the groundwater basin. The WSA is triggered by six planning applications that meet the definition of a "project" under SB 610 or that require review under the Water Policy Resolution or both. These six projects include

- University District Specific Plan Area Development
- Northeast Specific Plan Area Development
- Southeast Specific Plan Area Development
- Northwest Specific Plan Area Development
- Wilfred Dowdell Specific Plan Area Development
- Stadium Lands Development

Table ES-1

Index of SB 610 Requirements

Requirements for all Water Supply Assessments		
Required Element		**Location in Document**
Description of Service Area		Section 2.2
Population Projections in 5-year Increments		Table 4-1
Description and Quanitification of Water Supplies		
	Sonoma County Water Agency Supply	Section 2.3
	Recycled Water Supply	Section 2.4
	Groundwater Supply	Section 3
Description of Supply Reliability to Climatic Conditions		
	Sonoma County Water Agency Supply	Section 2.3
	Recycled Water Supply	Section 2.4
	Groundwater Supply	Section 3
Description of Contingency Plans		Sections 2.3, 4.4*
Description of Demand Management Potential		Section 4.4
Description of Conjunctive Use Potential		Section 5.5
Projection of Water Demands in 5-year Increments		Table 4-2
Description of Projects & Programs Undertaken to meet Demands		Section 5.6
Description of Demand Management Measures Employed		Section 4.4 **

* Contingency Planning Discussion incorporates the 2000 Urban Water Management Plan by SCWA as allowed by SB 610

** Demand Management Discussion incorporates City's reporting under the CUWCC MOU as allowed by SB610

Additional Requirements for Water Supply Assessment that involve Groundwater	
Required Element	**Location in Document**
Discussion of adopted Groundwater Management Plans	Section 3.1.1
Description of the groundwater basin	Section 3.2, 3.3, 3.5, 3.6, 3.7
Description of any court orders that affect legal rights to pump	Section 3.1.1
Information on condition of the basin and efforts limit overdraft	Section 3.5, 3.8
Detatiled description and analysis of pumping over past 5 years	Section 3.4
Analyis of the sufficiency of the groundwater basin to meet demands	Section 3.9

Additional Requirements for Water Supply Assessments prepared by the Lead Agency under CEQA		
Required Element		**Location in Document**
Determination of Supply Sufficiency under Normal, Single & Multiple Dry Years		Tables 5-1 and 5-2
Identification of Water Supply Entitlements & Rights and water received under rights		
	Sonoma County Water Agency Supply	Section 2.3
	Recycled Water Supply	Section 2.4
	Groundwater Supply	Section 3
Description of groundwater basin and information regarding overdraft		Section 3
Analysis of the sufficiency of the groundwater basin to meet demands		Section 3.9
Information related to capital outlay programs for financing delivery of water supply		Section 5.6
Information on permits needed and regulatory requirements associated with water supply		Section 5.7

ES.4 Summary of Supplies

The City has three sources of water supply. These are the Sonoma County Water Agency's System, recycled water and local groundwater.

ES.4.1 Sonoma County Water Agency

The Sonoma County Water Agency's (Agency's) Russian River System is described in detail in the Agency's 2000 Urban Water Management Plan (UWMP), which in accordance with SB 610 is incorporated by reference. As part of developing the 2000 UWMP, the Agency updated its operations model which predicts the amount of water available to its system in a Normal Year, a Single Dry Year and Multiple Dry Years. The Agency has a current water right of 75,000 acre-feet per year (AFY). Table ES -2 presents a summary of the supply available to Agency's system and the Agency's rights and illustrates that currently the Agency has more water available to its system, even in dry years, than it has the right to divert.

Table ES-2

Agency Supply under Various Hydrologic Conditions

Agency Supply Under Various Conditions (AFY)	*Total Supply**
Available to the Agency's System	
Normal Water Year	211,945
Single Dry Water Year	86,955
Multiple Dry Water Year 1	126,885
Multiple Dry Water Year 2	126,685
Multiple Dry Water Year 3	126,485
Permitted Water Rights	
Current	75,000

*2000 Urban Water Management Plan Table 6-1

The Agency provides wholesale water supply to eight Prime Contractors (Forestville Water District, Santa Rosa, Rohnert Park, Cotati, Petaluma, Sonoma, North Marin Water District and Valley of the Moon Water District, hereinafter the Contractors). The *Eleventh Amended Agreement for Water Supply* (11^{th} Amended Agreement) describes the business relationship between the Agency and its Contractors including each Contractors' allocation of water. The City has an allocation of 7,500 AFY and a peak month pumping allocation of 15.0 million gallons per day (mgd) under the 11^{th} Amended Agreement.

The 11^{th} Amended Agreement is premised on the completion of the Agency's Water Supply and Transmission System Project (the WSTSP) which was planned in the 1990's. The WSTSP included numerous improvements to the Agency's system and increase in total water rights from 75,000 AFY to 101,000 AFY.

Due to both legal challenges and changes in circumstances, Agency's Board of Directors has elected to prepare a new EIR that will provide the public and decision-makers with an environmental document that not only addresses legal deficiencies but also more closely reflects the Agency's and its customers' current water supply circumstances. This direction defined a new project, the Water Supply, Transmission, and Reliability Project, commonly referred to as the Water Project.

The Agency and its Contractors have entered into a *Memorandum of Understanding Regarding Water Transmission System Capacity Allocation During Temporary Impairment (*Temporary Impairment MOU) which went into effect in March of 2001 and expires in September of 2005. The Agency and its contractors are currently negotiating a new MOU. Under the Temporary Impairment MOU, the City's peak month allocation is reduced to 5.3 mgd.

Notwithstanding the City's contracted water allocation of 7,500 AFY and taking into account the Agency's water rights, the current condition of the Agency's system, the City's plans and the plans of other water contractors as represented to the Agency, the City is basing this Water Supply Assessment on receipt of 6,476 AFY from the Agency's system during the Normal Water Year. This figure is consistent with the City's recent communications to the Agency regarding its development plans and potential for recycled water use.

The Agency's water rights decision requires a reduction in diversions of 30% when the volume of water stored in Lake Sonoma is less than 100,000 AF. It is unlikely this cut in diversions would be triggered after a single dry year.[1] However, if the Agency saw indications that a hydrologic cycle similar to either the single or multiple dry years was beginning, it is likely that Agency would work with its contractors to implement water shortage provisions consistent with Section 3.5 of the 11th Amended Agreement in order to avoid the need for immediate large cutbacks. Section 3.5 of the 11th Amended Agreement provides a qualitative description of water allocation provisions not numerical allocations.. Because there is no formally adopted numerical allocation of water, the WSA estimates water supply available from the Agency in single dry year will be 70% of the City's allocation or 5,250 AFY. (A 30% curtailment, while unlikely, is used). The analysis estimates water supply available from the Agency in multiple dry years will be 80% of the City's allocation or 6,000 AFY consistent with the contingency plan developed in the UWMP.

Table ES-3 presents a summary of the water available to the Agency's system in normal, single and multiple dry years and how this water is anticipated to be allocated to the City given the Agency's current and proposed water rights and the agreements between the Agency and its Contractors.

[1] Personal Communication, Christopher Murray, Sonoma County Water Agency
[3] Incremental Recycled Water Program – Recycled Water Master Plan, February 2004.

Table ES-3

Summary of Agency Water Supply

Agency Supply Under Various Conditions (AFY)	*Total Supply*	*Rohnert Park Supply*
Available to the Agency's System		
Normal Water Year	211,945	7500*
Single Dry Water Year	86,955	5,250
Multiple Dry Water Year 1	126,885	6,000
Multiple Dry Water Year 2	126,685	6,000
Multiple Dry Water Year 3	126,485	6,000
Current Water Supply System Conditions	**75000****	**6476*****

* Supply Contracted to the City under 11th Amended Agreement
** Agency's Current Water Right
*** Estimate based on City Analysis of April 1, 2004 Data

ES.4.2 Recycled Water

The City is the largest urban recycled water user in Sonoma County with a current average use of over 1,000 AFY. Planned recycled water use will reach over 1,300 AFY. Expansion to the City's recycled water system has been documented in the Incremental Recycled Water Program EIR prepared by the Subregional Water Recycling System.[3] Expansion of the recycled water system will enable additional schools, parks, and other private and public properties to receive recycled water. In addition the Community Fields, described in the General Plan and all new parks and irrigated buffer areas associated with the Specific Plan Areas will use recycled water. The City is actively entertaining proposals to use recycled water for residential irrigation purposes within each of the Specific Plan Areas further offsetting demands on either the Agency supply or groundwater supply. The City has adopted a Water Waste Ordinance which requires the use of recycled water when it is available and of appropriate quality.

The Subregional System has a great deal of operational flexibility and the system is able to reliably deliver recycled water to customers under a the full range of hydrologic conditions. This is principally accomplished by reducing discharge of recycled water during drier hydrologic cycles.

ES.4.3 Groundwater

The City pumps groundwater from 42 wells located in the Laguna de Santa Rosa watershed of the Santa Rosa Plain Subbasin of Santa Rosa Valley Groundwater Basin. All wells are located inside the City limits. Groundwater supply sufficiency was evaluated for a study area that encompasses the upper portion of the Laguna de Santa Rosa watershed (above the Stony Point Road gauge). The 2004 Water Policy Resolution specifies that new projects will not be approved if they contribute to the City exceeding an average annual groundwater pumping rate of 2.3 mgd (2,577 AFY). This WSA considers 2,577 AFY as the amount of groundwater available to the City for the sufficiency analysis.

The City's wells are located in a very complex aquifer system. Well profiles were used to divide the aquifer into four vertical zones, which do not represent laterally extensive aquifers but are strictly depth based for purposes of evaluating hydrogeologic conditions. The vertical zones of the aquifer system were designated:

- shallow (0 to 200 foot depth),
- intermediate (200 to 600 foot depth),
- deep (600 to 800 foot depth), and
- lower (depths greater than 800 feet).

All of the City's wells are perforated primarily in the intermediate zone.

ES 4.3.1 Groundwater Pumpage

City pumpage data from 1970 to the present and pumpage data and estimates from other pumpers in the basin were evaluated to determine the relationship between historical groundwater level trends and the total pumpage in the study area. Annual pumpage data were obtained for Sonoma State University (SSU) and the City of Cotati. Pumpage estimates for 1970 through 2003 were derived for private, commercial, and agricultural pumpers based on population census data, planned land use, and/or water use estimates because metered data are not available.

In 2003, total City pumpage was 3,556 AFY and the estimate of pumpage from all other pumpers in the study area is 3,522 AFY. One of the requirements for a WSA is an evaluation of water supply sufficiency based on a 20-year projection. Future pumpage was projected to 2025, and it was assumed that build-out of the Specific Plan Areas would have occurred by that time. The maximum City pumpage in 2025 was assumed to be 2,577 AFY, consistent with the 2004 Water Policy Resolution. Based on data provided by other public agencies, pumpage from the City of Cotati and SSU is projected to increase from approximately 412 to 602 AFY. Agricultural pumpage was assumed to remain at 2003 levels (about 1,400 AFY). Private and commercial pumpage are projected to experience the largest increase, from about 1,700 to 2,760 AFY. The total 2025 projected pumpage for the study area (City and non City) is 7,350 AFY, a slight increase (approximately 270 AFY) from the total current pumpage but a notable decrease from recent historical pumping (i.e., average pumpage during 1990-1997 was 8,700 AFY).

ES 4.3.2 Groundwater Levels

Water level hydrographs constructed from the available groundwater level data were categorized according to zone(s) of predominant completion in order to assess water level trends by zone.

Hydrographs for most shallow zone wells located near the City exhibit a stable long-term groundwater level trend from about 1975 to present. Regardless of increases or decreases in pumpage in the central Rohnert Park area, or the occurrence of dry, normal, or wet years, spring water levels in the shallow zone generally showed little response to changed conditions. Groundwater levels in Agency monitoring wells located outside the study area declined by about two to three feet during the 1987-1991 dry period. Groundwater levels subsequently recovered during the 1994-1998 wet period.

Hydrographs for intermediate zone wells, from which the majority of the City's pumpage occurs, show that changes in pumpage have a greater effect on intermediate zone groundwater levels than changes in climatic conditions (i.e., water year type). Spring groundwater elevations in the central Rohnert Park wells were generally stable from 1977 to 1981, declined from 1982 to 1990 as pumpage increased, and gradually increased from 1990 to 1997 when pumpage for the study area averaged about 8,700 AFY. Groundwater levels were stable from 1997 to 2003 and exhibited a marked recovery when total pumpage decreased to about 7,100 AFY in 2003. Water level recovery since 1990 indicates that the water level decline during 1982 to 1990 was not an indication of overdraft conditions. There is also no indication of generally declining groundwater levels elsewhere in the subbasin in any zone, i.e., there is no indication that overdraft has occurred on a subbasin scale.

Groundwater elevation contours for Spring 2004 were prepared for the shallow and intermediate zones. The shape of the shallow zone contours and directions of groundwater flow are similar to those shown for 1951 (Cardwell, 1958). The direction of groundwater flow in the shallow zone in the Rohnert Park area is generally westerly, and there is groundwater outflow in this zone to the rest of the Santa Rosa Plain.

The data also indicate a groundwater divide in the general vicinity of the watershed boundary. North of this divide, the direction of groundwater flow is generally northwesterly and toward the City. South of the divide, the groundwater flow direction in the Petaluma Valley Groundwater Basin is southeasterly toward Petaluma. Groundwater elevations for the intermediate and deeper zones in Spring 2004 in the central and western portions of the City are significantly lower than in the shallow zone. The direction of groundwater flow is generally toward the City and toward a cone of depression present beneath the western portion of the City. Unlike the shallow zone, the intermediate zone groundwater elevation contours show a gradient for inflow into the study area from the west.

ES.4.3.3 Groundwater Quality

Groundwater produced from City wells meets primary state drinking water standards. Overall mineral content, as indicated by specific conductance (electrical conductance; EC), ranges from 270 to 620 µmhos/cm, while the average EC levels are 300 µmhos/cm in intermediate zone wells and about 430 µmhos/cm in wells completed in multiple zones. All EC values are below the recommended secondary Maximum Contaminant Level (MCL) of 900 µmhos/cm. No serious or widespread issues that affect community water supplies due to organic chemical sources are known to be present in the City.

ES.4.3.4 Soil Recharge Characteristics

In 1975 and 1982, the California Department of Water Resources (DWR, 1975 and 1982) assessed areas of natural recharge in Sonoma County. Based on soil recharge characteristics (primarily soil permeability and slope), and mapping of these characteristics by three broad categories using criteria similar to those developed by the U.S. Geological Survey (USGS), less than five percent of the WSA study area would be classified as a "recharge area" (the category with the highest recharge potential). The USGS and DWR recharge classifications are useful for identifying areas with the highest recharge rates, but these classifications oversimplified recharge conditions by ignoring much of the variability in soil permeability and slope within the study area.

In order to update the DWR recharge analysis, Geographic Information System (GIS) techniques were used for the WSA to delineate areas with different recharge properties based on soil characteristics and topography. The updated information was then used to assess the potential loss of recharge due to proposed development of the Specific Plan Areas. New development involves buildings, paving, and other features that affect groundwater recharge. Areas with the highest recharge rates occur east of the City primarily along streambeds, at the heads of alluvial fans, and on some portions of the Sonoma Volcanics. In contrast, soils beneath the City are predominantly Clear Lake Clays with low permeability and poor recharge characteristics.

The City's General Plan specifies that future development within the Urban Growth Boundary will incorporate buffer areas and open space along the three creek corridors where recharge occurs. Thus, protective measures have been incorporated in the General Plan, its Environmental Impact Report and its Mitigation Monitoring Program, and the affect on areas of high recharge is anticipated to be minimal.

ES.4.3.5 Groundwater Recharge Estimates

Previously, estimates of groundwater recharge in Sonoma County have been developed by various methods. For purposes of the Draft Environmental Impact Report (DEIR) for the Rohnert Park General Plan, PES Environmental, Inc. (PES) developed a groundwater flow model that was used to estimate recharge for a 17,700 acre study area that included the City (Dyett & Bhatia, 2000). The PES model was based on a simplified conceptualization of the aquifer system; from the model results, PES estimated that the average annual recharge rate during 1970-1999 was 1.6 mgd (about 1,800 AFY). This was a low estimate due to many factors, including model boundaries that exclude most of the areas with the highest recharge potential in the WSA study area.

Subsequently, Todd Engineers prepared a water budget for a study area almost identical to that used for the groundwater portion of this WSA (Todd, 2004). This water budget was prepared for the Canon Manor West DEIR and provided a comprehensive estimate of all inflows to and outflows from the study area during 1986-2001. The Todd water budget includes recharge from direct precipitation, streams, irrigation return flows, and septic systems. The average annual groundwater recharge for the study area during the 1986-2001 period of analysis was estimated to be about 8,300 AFY.

The analysis of the relationship between groundwater levels and pumpage conducted for the WSA resulted in an estimated average recharge rate of at least 8,400 AFY during 1990-1997, a period of stable to slightly increasing groundwater levels. Since 1990-1997 was a wetter than average period, the long-term average recharge rate would be expected to be less than 8,400 AFY. The WSA estimate is similar to the recharge estimate derived from the Todd water budget for 1986-2001.

ES.4.3.6 Groundwater Sufficiency

Analyses of the historical groundwater level and pumpage data have allowed the development of an estimated range of pumpage within which the City and other pumpers in the study area could operate without causing persistent groundwater level declines. Based on evaluation of historical groundwater levels and pumpage, the estimated total watershed pumpage that would not be expected to cause long-term groundwater declines ranges from 7,100 to 8,700 AFY. The projected total 2025 study area pumpage is 7,350 AFY, with 2,577 AFY of that pumpage projected for use by the City as one of the sources of supply to meet its 20-year water demands. The projected total 2025 pumpage is a slight increase from the total current pumpage but is less than recent historical pumping. As a result, the projected 2025 pumpage falls within the range of historically sustainable pumpage.

The evaluation of groundwater conditions and supply sufficiency for this WSA demonstrates that the groundwater supplies available during normal, single-dry, and multiple-dry years within a 20-year projection will meet the projected demand associated with the proposed subdivisions, in addition to existing and other planned groundwater uses in the study area.

ES 4.4 Summary of Available Supplies

Table ES-4 below, summarizes the water supplies available to the City under a range of hydrologic conditions. This summary includes the City's estimate of Agency allocation under current water supply conditions.

Table ES-4

Total Water Supply Available to the City

Total Water Supply Available to City in AFY	*Current Water Supply Conditions*	*Single Dry Year*	*Multiple Dry Years*			*Full Agency Allocation*
Sonoma County Water Agency	6,476	5,250	6,000	6,000	6,000	7,500
Recycled Water	1,302	1,302	1,302	1,302	1,302	1,302
Groundwater	2,577	2,577	2,577	2,577	2,577	2,577
Totals	**10,355**	**9,129**	**9,879**	**9,879**	**9,879**	**11,379**

ES.5 Summary of Demands

In 2000, the City adopted its General Plan. The General Plan sets land-use patterns and population goals. The City is anticipating potential development within five designated Specific Plan Areas (SPAs); the Northwest Area, the Wilfred-Dowdell Area, the Northeast Area, the University District and the Southeast Area. In addition, the City is anticipating infill development, consisting largely of non-residential land uses.

The City has an adopted Growth Management Ordinance that is intended to provide for orderly build-out of residential development over the General Plan planning horizon. In its simplest form, the Growth Management Ordinance has the effect of limiting the number of residential building permits issued to 225 per year. Population and Demand projections reflect the rate of development allowed by the Growth Management Ordinance. Table ES-5 below presents the anticipated development pattern in 5-year increments from 2005 until 2025.

Table ES-5

Projected Development Pattern

Customer Type	*Unit*	*Current*	*2005*	*2010*	*2015*	*2020*	*2025*
SFR Detached	EA	7,492	7,492	8,352	8,737	8,993	8,993
SFR Attached	EA	3,039	3,039	3,518	3,631	3,744	3,744
MFR & Mobile	EA	6,035	6,035	6,696	7,336	7,867	7,867
Comm/Retail	AC	311	322	407	437	467	467
Industrial	AC	320	328	371	436	500	500
Office	AC	47	47	54	68	77	77
Public	AC	93	93	93	93	93	93
Subtotal							
Irrigation-potable	AC	70	70	28	28	28	28
Irrigation-recycled	AC	452	452	536	546	546	546

Projected water demands are based on the unit demand rates consistent with existing City data and good engineering practices. Demand classes are consistent with guidance provided by Department of Water Resources for SB 610 reporting. The City is a signatory to the California Urban Water Conservation Council’s MOU and is actively engaged in water conservation efforts. The City expects to see a 10% voluntary reduction in overall demands throughout the buildout cycle, consistent with conservation implementation. Table ES-6 reflects water demands under normal conditions.

Table ES-6

Water Demand Projections

Customer Type	*Unit*	*Current**	*2005*	*2010*	*2015*	*2020*	*2025*
SFR Detached	AFY	3,241	3,241	3,285	3,437	3,538	3,538
SFR Attached	AFY	983	983	1,115	1,145	1,181	1,181
MFR & Mobile	AFY	1,009	1,076	1,171	1,275	1,368	1,368
Comm/Retail	AFY	680	704	890	955	1,021	1,021
Industrial	AFY	524	537	607	714	819	819
Office	AFY	51	51	59	74	84	84
Public	AFY	102	102	102	102	102	102
Subtotal		6,591	6,694	7,229	7,702	8,112	8,112
Irrigation-potable	AFY	159	159	85	85	85	85
Irrigation-recycled	AFY	1,040	1,040	1,256	1,302	1,302	1,302

The City has adopted an Ordinance establishing a Water Shortage Emergency Plan. This ordinance provides for 20% and 30% reductions as necessary to respond to curtailed supply in the event of a drought. Table ES-7 outlines the anticipated water demands at General Plan buildout for the normal water year and with the 20% and 30% curtailments

Table ES-7

Water Demands with Demand Management

Water Demands with Management	Demand at Buildout	20% Reduction	30% Reduction
Water Demand in AFY			
Total Non-Irrigation Demands	8,112	7,301	6,490
Irrigation from the Potable System	85	76	68
Irrigation from the Recycled Water System	1,302	1,302	1,302
Total	9,499	8,679	7,859

ES.6 Sufficiency

The groundwater analysis confirms the groundwater supply is sufficient to meet City demands and those of other pumpers in the basin. The City intends to pursue a conjunctive use strategy with its three supply sources. During Normal and Above Normal Water years under this strategy, the City would meet demands using its Agency allocation and recycled water first, minimizing its demands on groundwater and allowing the groundwater basin to recharge during these periods.

In dry and multiple dry years, the City will continue to use recycled water to the maximum extent possible. During these periods, the City anticipates some cutbacks in its Agency allocation may occur as provided for under the 11th Amended Agreement. The

City will implement demand curtailment measures consistent with its Water Shortage Emergency Plan and the City will utilize its groundwater resources.

Table ES-8 provides supply and demand information for the Normal Water Year in 5-year increments from 2005 to 2025. This analysis is presented reflecting the impaired condition of the Agency's system for the entire planning period.

Table ES-8

Normal Year Sufficiency Analysis

Normal Year Supply and Demand Comparison	Current*	2005	2010	2015	2020	2025
Water Demand in AFY						
Total Non-Irrigation Demands	6,591	6,694	7,229	7,702	8,112	8,112
Irrigation from the Potable System	159	159	85	85	85	85
Irrigation from the Recycled Water System	1,040	1,040	1,256	1,302	1,302	1,302
Total	**7,789**	**7,893**	**8,570**	**9,088**	**9,499**	**9,499**
Water Supplies in AFY						
SCWA Supply	3,194	6,476	6,476	6,476	6,476	6,476
Groundwater Supply	3,556	2,577	2,577	2,577	2,577	2,577
Recycled Water Supply	1,040	1,040	1,256	1,302	1,302	1,302
Total	**7,790**	**10,093**	**10,309**	**10,355**	**10,355**	**10,355**
Sufficiency (Supply Less Demand)	**0**	**2,200**	**1,739**	**1,267**	**856**	**856**

* Current Sufficiency Calculation reflects actual demand and actual supply through December 2003.

Table ES-9 outlines the supply and demand patterns at buildout under Normal, Single Dry and Multiple Dry Years. In all cases, supply is sufficient to meet demand.

Table ES-9

Dry Year Sufficiency Analysis

Dry Year Supply Demand Comparison	Normal	Single Dry	Multiple Dry		
			1	2	3
Water Demand in AFY					
Total Non-Irrigation Demands	8,112	6,490	7,301	7,301	7,301
Irrigation from the Potable System	85	68	76	76	76
Irrigation from the Recycled Water System	1,302	1,302	1,302	1,302	1,302
Total	**9,499**	**7,859**	**8,679**	**8,679**	**8,679**
Water Supplies in AFY					
Agency Supply*	6,476	5,250	6,000	6,000	6,000
Groundwater Supply	2,577	2,577	2,577	2,577	2,577
Recycled Water Supply	1,302	1,302	1,302	1,302	1,302
Total	**10,355**	**9,129**	**9,879**	**9,879**	**9,879**
Sufficiency (Supply Less Demand)	**856**	**1,269**	**1,200**	**1,200**	**1,200**

ES.7 Actions Required to Make the Water Supply Available

The City has adopted a Water Waste Ordinance that prohibits waste of water and requires the use of recycled water when it is available. The City has also adopted a Water Shortage Emergency Plan Ordinance that gives it the authority to implement demand management. These policy tools are in place and can be used to achieve the demand management and recycled water supplies outlined in this assessment.

The City's water model indicates a need to extend a new water transmission main from the Agency aqueduct to the proposed East-side developments and to make several other modifications to the distribution system to provide adequate water service. These improvements are under design. The City has approved Mitigation Fees to fund this construction. Work is expected to be complete in 2006.

The Santa Rosa Subregional Water Reclamation System has approved a Programatic EIR for its long-term Incremental Recycled Water Program (IRWP). Expansion of the recycled water system serving Rohnert Park is included in the IRWP. The City has applied for a State grant to complete the planning of the recycled water system expansion.

The recycled water system expansion will include the construction of a recycled water storage reservoir (with approximately 300 AF of capacity) and extension of the recycled water transmission system to connect the new reservoir to the existing recycled water system. The City is current negations with the proponents of the University District Specific Plan and the Subregional system to move forward with the project implementation. The proponents of the University District Specific Plan have acquired and are proposing to contribute a site for the reservoir. Conceptual design has also been completed by the proponents. The conceptual design and siting will be presented to the Subregional System.

The City has approved a Public Facilities Finance Plan and adopted Mitigation Fees to fund this construction. The plan will be revised as necessary to incorporate the full scope of the project. Work is expected to be complete in 2008.

The City has initiated a number of activities to manage its groundwater supply and ensure supply sufficiency. These include:

- Decreased groundwater use and increased use of Agency water;
- Expansion of its groundwater monitoring program;
- Expansion of its water conservation program;
- Continuation and expansion of its recycled water use for irrigation;
- Protection of groundwater recharge areas;
- Support of the planned joint United States Geologic Survey and Agency Santa Rosa Plain Subbasin study.

The Agency anticipates issuing a new Notice of Preparation for the Water Project EIR in 2005 and anticipates it will release its Draft EIR for public review by May 2006, after completion of its Urban Water Management Plan 2005. A Final EIR is scheduled for completion in May 2007, and EIR certification and project approval could be considered by the Board by the early summer of 2007.

Completion of the Water Project will allow the City to access its full 7,500 AFY allocation of Agency supply. The WSA documents that the City has adequate supply even without the completion of the Water Project.

1 Introduction

1.1 Purpose

This Water Supply Assessment (WSA) describes the relationship between projected demands on the City of Rohnert Park's (City) water supply and the availability of that supply under normal and dry years. The WSA is required by both Senate Bill 610 (SB 610) and City Resolution Number 2004-95 and is designed to assist in water supply planning efforts.

The WSA is a comprehensive document which is prepared to assist the City Council in making decisions related to land use and water supply from the present until 2025. The WSA proposes a strategy for utilizing the City's Sonoma County Water Agency allocation, its current and future recycled water supplies and its local groundwater supply to meet the water supply demands associated with implementation of the City's General Plan.

While SB 610 does not require a formal hearing on a proposed WSA, the City conducted one in order to give the pubic added opportunity to comment on how the WSA should address the projects. The City received written and oral comments. Through this process and by other means of gathering as much information as possible the City has assembled extensive evidence that is reflected in this WSA. Based upon all the information before it, the City Council may determine whether projected water supplies will be sufficient to satisfy the demands of the proposed projects in addition to existing and planned future uses. The City must include the assessment in the environmental documents prepared for designated projects pursuant to the California Environmental Quality Act.

1.2 Scope of Analysis

The WSA includes a review of the City's water supplies and existing and future development as described in the City's General Plan. The water demands created by this development are then related to City's available water supply in normal, single dry and multiple dry years and the sufficiency of that supply to meet the demand is analyzed. The WSA is based upon and intended to fulfill the requirements of SB 610 and City Resolution No. 2004-95 (the "Water Policy Resolution") each described below.

1.2.1 Senate Bill 610

SB 610 (Costa) became effective January 1, 2002. The stated intent of SB 610 is to strengthen the process by which local agencies determine the adequacy and sufficiency of current and future water supplies to meet current and future demands. SB 610 amended the California Public Resources Code to incorporate Water Code findings within the CEQA process for certain types of projects. SB 610 amended the Water Code to broaden the types of information included in Urban Water Management Plans ((UWMP) – Water Code Section 10620 et. seq.) and to add Water Code Part 2.10 Water Supply Planning to Support Existing and Planned Future Uses (Section 10910 et. seq.). Part 2.10 clarifies the roles and responsibilities of the Lead Agency under CEQA and the "water supplier" with respect to describing current and future supplies compared to current and future demands.

1.2.1.1 Water Code Part 2.10

Water Code Part 2.10 defines the "Projects" that are subject to a WSA and the Lead Agency's responsibilities related to the WSA.

A WSA is required for (1) a proposed residential development of more than 500 dwelling units, (2) a proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space, (3) a proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space (4) a proposed hotel or motel, or both, having more than 500 rooms, (5) a proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area, (6) a mixed-use development that includes one or more of the uses described above, (7) a development that would demand an amount of water equivalent to or greater than the amount of water required by a 500-dwelling-unit project and (8) for Lead Agencies with under 5,000 water service connections, any new development that will increase the number of water service connections in the service area by ten percent or more.

Under Part 2.10, the Lead Agency must identify the affected water supplier and research whether the new demands are included in the suppliers' UWMP. If the UWMP includes the demands it may be incorporated by reference. If not, the Lead Agency must prepare the WSA. (Water Code Section 10912(c)).

The UWMP adopted by the City was prepared in 2000 by the Sonoma County Water Agency (Agency). The UWMP was prepared and approved prior to the adoption of SB 610. While the Agency is a wholesale water supplier to the City, it also acts a forum through which local governments in Sonoma County coordinate water policy. Thus the Agency prepared an UWMP applicable to all participating jurisdictions in Sonoma County.

The UWMP does not include all the information required by SB 610 particularly as it relates to the City's groundwater and recycled water supplies. In addition, the UWMP anticipated the construction of the Agency's Water Supply and Transmission System Project (WSTSP), which was planned in the 1990s. Due to a series of legal and regulatory activities, the Agency's Board of Directors has directed its staff to begin work on a new long-term project, the Water Supply, Transmission, and Reliability Project ("Water Project") that will replace the WSTSP and more closely reflects the Agency's and its customers' current water supply circumstances.

Therefore this analysis augments the UWMP information to provide a comprehensive picture of the City's water supplies.

1.2.1.2 The Urban Water Management Planning Act

The Urban Water Management Planning Act requires the supplier to document water supplies available during normal, single dry, and multiple dry water years during a 20-year projection and the existing and projected future water demand during a 20-year projection. The Act requires that the projected supplies and demands be presented in 5-year increments for the 20-year projection. In order to comply with the SB 610 requirements the WSA includes the following information:

- A description of the water service area including climate, current and projected population and other demographic factors that affect water management planning. Demographic data is presented in 5-year increments for 20-years.
- A description and quantification of the existing and planned water sources.
- A description of the reliability and vulnerability of the water supply to seasonal or climatic shortages in the average water year, single dry water year and multiple dry water year. Contingency plans including demand management and conjunctive use potential are discussed.
- A description of current and projected water demands among all user classes in 5-year increments.
- A description of all water supply projects and water supply programs that may be undertaken by the City, the Agency and the Subregional Water Reclamation Project to meet the total projected water use.
- A description of demand management measures employed and scheduled to be employed. Because the City is a signatory to the California Urban Water Conservation Council's Memorandum of Understanding (CUWWC MOU), its annual reports are incorporated by reference to provide this documentation.

In addition, because the City utilizes ground water as one of its three supply sources, the WSA includes:

- A discussion of whether and how adopted or authorized groundwater management plans affect the City's use of the basin.
- A description of any groundwater basin (or basins) from which the City pumps groundwater.
- A description of any court orders, decrees adopted by the court or the State Water Resources Control Board and a description of the amount

of groundwater the City has a legal right to pump under the order or decree if the basin has been adjudicated.
- Information that characterizes the condition of the groundwater basin and a description of the measures currently being taken by the City to minimize any potential for overdraft conditions occurring *(the groundwater basin used by the City is not overdrafted)*.
- A detailed description and analysis of the amount and location of groundwater pumped by the City for the past five years from any groundwater basin from which the proposed project will be supplied.
- An analysis of the location, amount, and sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed projects.

If the Lead Agency is preparing the WSA, it must also:
- Determine the sufficiency of the supply to meet the project demands under normal, single dry and multiple dry years.
- Identify existing water supply entitlements and water rights for the proposed project and quantify water received in prior years pursuant to these existing entitlements and rights.
- Describe the groundwater basin from which the proposed project will be supplied, if applicable. The description must include information regarding overdraft in the basin. The amount and location of groundwater pumped by the City must be quantified, based on reasonably available information.
- Describe and analyze the amount and location of groundwater projected to be pumped by the City from a basin from which the project will be supplied. The assessment must include an analysis of the sufficiency of groundwater from the basin to meet the projected water demand associated with the proposed project.
- Provide information related to capital outlay programs for financing delivery of water supply.
- Provide information on federal, state, and local permits for construction of necessary infrastructure and regulatory requirements associated with delivery of the water supply.

1.2.2 The Water Policy Resolution

On April 27, 2004, the City Council adopted its *Resolution No 2004-95, A Resolution of the City Council of the City of Rohnert Park Implementing Requirements Imposed on Specific Plan Areas Outside the City's 1999 Boundaries***.** This resolution essentially requires the City to undertake analysis consistent with SB 610 for all development envisioned by its 2000 General Plan and occurring outside its 1999 City limits and within its Sphere of Influence *regardless of the size of the development proposal*.

1.3 Summary of Proposed Projects

The City is currently processing development applications from five Specific Plan Areas (SPAs) within its Sphere of Influence and one redevelopment proposal within its Stadium Lands area. Several of these developments may be small enough to avoid definition as a "Project" under Water Code Part 2.10. However, because of the City Resolution 2004-95, these developments are included in the WSA. Each of these proposed developments is described briefly below and illustrated on Figure 1-1.

The WSA covers these proposals and all other new development described in the General Plan except the Canon Manor Specific Plan Area (SPA). The Canon Manor SPA is located in unincorporated Sonoma County. The County has an agreement with the Penngrove Water Company to supply water to the Canon Manor SPA. Because the City will not supply water to this SPA, it is not included in this WSA. However, the projected increases in water consumption related to the County's Canon Manor West Assessment District are included in future water pumping estimates for the groundwater analysis.

1.3.1 University District SPA

The University District SPA consists of 20 assessor's parcels on approximately 300 acres. A Specific Plan application has been submitted covering the entire SPA. The application requests 1610 residential units and approximately 250,000 square feet of commercial land uses. The application triggers a review under SB 610 and the Water Policy Resolution. The Draft EIR for the University District SPA is currently being prepared and is expected to be considered for certification in the spring of 2005.

The entire SPA has the potential for 1,610 units and 350,000 square feet of commercial space under the City's General Plan.[1]

1.3.2 Northeast SPA

The Northeast SPA consists of 36 assessor's parcels on approximately 264 acres. A Specific Plan Application has been submitted covering 122 acres and 11 of these parcels. The application requests 559 residential units which triggers review under SB 610 and the Water Policy Resolution. The Draft EIR for the Northeast SPA is currently being prepared and is expected to be considered for certification in the spring of 2005.

The entire SPA has the potential for 1085 units under the City's General Plan.[2]

1.3.3 Southeast SPA

The Southeast SPA consists of 2 assessor's parcels on approximately 80 acres. A Specific Plan Application has been submitted covering this entire SPA. The application requests 499 residential units and 20,000 square feet of commercial use. While the residential unit count is just under the SB 610 threshold for a "project", the addition of the commercial square footage likely pushes the project

[1] Table 2.4-1 Land Use Program: University District Specific Plan Area, General Plan.
[2] Table 2.4-4: Land Use Program: Northeast Specific Plan Area, General Plan.

above the SB 610 threshold. In addition, because the area is outside of the current City limits, review is required by the City's Water Policy Resolution. The Draft EIR for the Southeast SPA is currently being prepared and is expected to be considered for certification in the spring of 2005.

1.3.4 Northwest SPA

The Northwest SPA consists of approximately 170 acres. A Specific Plan Application has been submitted for the southern portion of the SPA covering approximately 102 acres on 16 assessor's parcels. The application requests 495 residential units and 495,000 square feet of commercial/industrial use, which triggers review under SB 610 and the Water Policy Resolution. The Draft EIR for the project is underway and expected to be complete in 2005.

The entire SPA has the potential for 900 units, 480,000 square feet of commercial space, 260,000 square feet of office space and 560,000 square feet of industrial space under the City's General Plan.[3]

1.3.5 Wilfred Dowdell SPA

The Wilfred Dowdell SPA consists of approximately 25 acres. The City is sponsoring an EIR on the proposed development plan because of its location between the existing City limits and the Northwest SPA. The future land uses include approximately 300,000 square feet commercial space. A Specific Plan Application has been submitted. The proposed development does not trigger SB 610 review (it is not large enough to meet the definition of a "project"). However because the SPA is outside the current City limits, review is required by the Water Policy Resolution. The City is currently preparing a Supplemental EIR for the project. It is expected to be considered for certification in 2005.

1.3.6 Stadium Lands

The Stadium Lands is an area consisting of approximately 55 acres intended for commercial and residential use. The area is within the City limits and the City's redevelopment area. While specific square footages and unit counts within the planning area are not yet available, it will likely meet the threshold that triggers SB 610 review. A Preliminary Development Plan and General Plan Amendment Application have been submitted. The Draft EIR is not yet underway.

1.4 Structure of this Report

This report is structured to facilitate the presentation of information required by the Water Code and to outline the analysis necessary to evaluate the sufficient of water supply to meet planned growth.

Chapter 1 provides an overview of the legal requirements for the WSA and describes the development "projects" that are covered by this WSA.

[3] Table 2.4-2: Land Use Program: Northwest Specific Plan Area, General Plan.

Chapter 2 outlines the Water Service Area (basically the City of Rohnert Park and its sphere of influence, describes the City's two wholesale water supplies: the Sonoma County Water Agency supply and the Santa Rosa Subregional System recycled water supply. The chapter includes discussions of the contractual supply arrangements and the reliability of the supply under a range of hydrologic conditions.

Chapter 3 describes the City's local groundwater supply. The chapter analyzes the full range of demands placed on the local supply (including City and non-City pumpage) and evaluates the sufficiency of the ground water supply to meet the City's needs and the needs of other pumpers.

Chapter 4 describes current and future water demands based on the City's planned growth, including the six "projects" that triggered the preparation of this WSA. Chapter 4 also describes the City's demand management program.

Chapter 5 provides an overview of the overall supply sufficiency by comparing projected water demands to supplies available from each of the City's three water sources, under a range of hydrologic conditions. This chapter outlines the City's overall supply management strategy including the potential for conjunctive use. Because the City has commissioned this WSA in its role as lead Agency under CEQA, this chapter also includes a discussion of the projects and permits necessary to make the water supply available to planned new development.

2 Water Service Area and Wholesale Water Supplies

2.1 Introduction

This chapter provides a brief discussion of the City's water service and discusses the wholesale water and recycled water supplies available to the City. This section provides descriptions of the most current Urban Water Management Plan (UWMP) adopted by the City and the contracts the City has for various supply sources. The UWMP and various contracts are incorporated by reference.

Information on the City's groundwater supply is included in Chapter 3.

2.2 Water Service Area

The Water Service Area under consideration is bounded by the City's Sphere of Influence as outlined in its 2000 General Plan (see Figure 1-1). This Sphere of Influence includes six Specific Plan Areas. All but the Canon Manor Specific Plan Area are anticipated to annex to the City in the next 1 to 5 years.

The Canon Manor Specific Plan Area has contracted with the Penngrove Water Company for water supply and its demands are not considered demands on the City supply in this WSA.

2.2.1 Climatic and Hydrologic Data

The City is located in the Russian River watershed. The climate and hydrology of the Russian River watershed directly affects the City because its wholesale supply from the Agency is drawn from the Russian River. The climate of the Russian River watershed is tempered by its proximity to the Pacific Ocean and is characterized by seasonal rainfall patterns. Approximately 93 percent of the total annual precipitation falls between October and May. Winters are cool, but below freezing temperatures are rarely experienced. Summers are warm and frost-free. Average annual precipitation is 41-inches with a range from 22-inches to 80-inches annually. The Rohnert Park area is subject to marine influence and fog. Average annual rainfall is approximately 30-inches. The lowest and highest temperatures recorded are 16 degrees and 110 degrees.[1]

The UWMP provides a detailed discussion on the climate and hydrology that affect the Agency's Russian River system. Chapter 3 provides additional detail on localized climate and hydrologic factors that affect the groundwater supply.

2.3 Sonoma County Water Agency Supply

The Agency provides wholesale water service to eight prime contractors (Forestville Water District, Santa Rosa, Rohnert Park, Cotati, Petaluma, Sonoma, North Marin Water

[1] Urban Water Management Plan 2000, Sonoma County Water Agency.

District and Valley of the Moon Water District, hereinafter the Contractors) and "other agency customers" from its Russian River System.[2]

The Agency documents its supply availability under normal and dry year conditions every 5 years in an *Urban Water Management Plan*, the most recent of which was prepared in 2000. The Agency's relationship with its contractors is governed by the *Eleventh Amended Agreement for Water Supply*, adopted in 2001. The Agency is currently working to negotiate a *Restructured Agreement for Water Supply* that will replace the Eleventh Amended Agreement for Water Supply. The Agency and its contractors are also party to a *Memorandum of Understanding Regarding Water Transmission System Capacity Allocation During Temporary Impairment (*Temporary Impairment MOU) which became effective March 2001 and expires in September 2005.

Each of these documents provides some information on the water supply that the City can expect from the Agency under a range of hydrologic conditions. These documents are discussed below.

2.3.1 The 2000 Urban Water Management Plan

The 2000 Urban Water Management Plan (UWMP) is a comprehensive discussion of the Agency's Water Supply and Transmission System and includes the results of its operations model of the Russian River System under a range of hydrologic conditions[3]. The operations model predicts the total amount of water available to the Agency's system under the normal, single dry and multiple dry years. This total amount of available water is the result of hydrologic conditions and includes allowances for water rights allocated to other agencies and storage required in the reservoirs that are part of the Russian River system. The total amount of water available predicted by the model may be more or less than the Agency's water rights.

Table 2-1 outlines the water supply available to the Agency's system under the Normal Year Condition, the Single Dry Year Condition and the Multiple Dry Year Condition and compares these to the Agency's water rights. Under every hydrologic condition, the amount of water available to the Agency's system exceeds the Agency's current diversion rights of 75,000 AFY.

[2] See the Urban Water Management Plan for a detailed description of the Russian River System, the Prime Contractors, the "other agency customers" and their relationships.
[3] See the Urban Water Management Plan for a detailed discussion of the hydrologic model.

Table 2-1

Agency Supply under Various Hydrologic Conditions

Agency Supply Under Various Conditions (AFY)	*Total Supply**
Available to the Agency's System	
Normal Water Year	211,945
Single Dry Water Year	86,955
Multiple Dry Water Year 1	126,885
Multiple Dry Water Year 2	126,685
Multiple Dry Water Year 3	126,485
Permitted Water Rights	
Current	75,000

*2000 Urban Water Management Plan Table 6-1

2.3.1.1 Agency's Water Rights[4]: The Agency currently diverts and rediverts water from the Russian River system under four permits issued by the State Water Resources Control Board (SWRCB). These permits (Numbers 12947A, 12949, 12950 and 16596) provide the Agency with the rights to divert and redivert up to 75,000 AFY, and to store water in Lake Mendocino and Lake Sonoma. These permits also set minimum instream flow requirements to protect fish and wildlife and maintain recreation in the Russian River. The SWRCB's decision 1610 provides for different minimum instream flow requirements under different hydrologic cycles (i.e. instream flow requirements are lower in Dry Water Years than in Normal Water Years). The agency works with the SWRCB on a regular basis to implement the various instream flow requirements of its permits based on current hydrologic conditions.

2.3.1.2 The Water Supply and Transmission System Project (WSTSP): The UWMP was premised on the Agency's construction of the Water Supply and Transmission System Project (WSTSP) that was approved by its Board of Directors in 1998. The WSTSP provided for:

- an increase in the Agency's water rights from 75,000 AFY to 101,000 AFY
- construction of new diversion facilities in the Russian River and
- construction of new storage and transmission system facilities to allow distribution of increased water supply throughout the Agency's service area.

[4] State of California, California Environmental Protection Agency, State Water Resources Control Board, WR Order 2004-0035 EXEC.

2.3.2 Developments since the 2000 Urban Water Management Plan

A number of developments that affect the Agency's water supply have occurred since the UWMP was published. These developments do not affect the Agency's current water rights or hydrologic model and there is currently no activity pending before the SWRCB that would affect the Agency's ability to divert and redivert water under its current permits[5]. These developments did, however, impact the implementation of the WSTSP and are briefly described below.

The Section 7 Consultation[6]: The Agency and the U.S. Army Corps of Engineers (Corps) are undertaking a Section 7 Consultation under the Federal Endangered Species Act (ESA) with the National Oceanic and Atmospheric Administration (NOAA Fisheries) to evaluate effects of operations and maintenance activities. The Russian River watershed is designated as critical habitat for threatened stocks of coho salmon, chinook salmon, and steelhead. The Agency and the Corps operate and maintain facilities and conduct activities related to flood control, water diversion and storage, hydroelectric power generation, and fish production and passage. The Agency and Corps also are participants in a number of institutional agreements related to the fulfillment of their respective responsibilities. The Biological Assessment prepared as part of this consultation recommends modifications to the minimum instream flow requirements contained in the Agency's water rights permits. These modifications do not affect the Agency's existing water rights. The Biological Assessment provides that the Agency will continue to meet its obligations to its contractors.

The Eel River v. SCWA Appellate Court Decision: On May 16, 2003 the California First District Appellate Court issued a decision that the Environmental Impact Report prepared for the WSTSP provided inadequate information on the project and its impacts. This decision directly affects the Agency's ability to implement the WSTSP including its ability to increase its water right above the current 75,000 AFY and to make improvements to its transmission system. The decision, however, does not affect the Agency's current water rights in any way.

Federal Energy Regulatory Commission June 2004 Order on Rehearing and January 28, 2004 Order Amending License: This decision by the Federal Energy Regulatory Commission (FERC) affects the way Pacific Gas and Electric Company operates its Potter Valley Project. This operation is relevant to the Agency's water supply because water is diverted from the Eel River to the Russian River through the Potter Valley Project. The FERC decision reduces the amount of water diverted from the Eel to the Russian, where it becomes available to the Agency's Russian River System. The hydrologic model developed by the Agency for the

[5] Personal Communication, Erica Phelps, Sonoma County Water Agency, November 22, 2004.
[6] Sonoma County Water Agency Web site, www.scwa.ca.gov.

UWMP anticipated the reoperation of the Potter Valley Project and modeled a range of diversions that included the reduced diversion rate in the actual decision issued by FERC. The Agency will update its model of its system during the 2005 Urban Water Management Plan update but does not expect significant changes in the modeled results for the Normal, Dry and Multiple Dry Years. As a result of this decision and other factors, the Agency is proposing its new Water Program as described in Section 2.3.3 below.

2.3.3 The Water Project

In May 2004, the Agency released a Notice of Preparation (NOP) of Supplemental EIR for the WSTSP: Litigation, Project Updates, Changes in Circumstances and New Information. The Agency received comments from sixteen entities and individuals. Some common themes were echoed by many commentors: demand updates should be based on current general plans (rather than those in effect in the 1990s), additional water conservation measures (reflecting progress in water conservation technologies) should be evaluated, impacts of Eel River diversions should be evaluated, the Agency's ongoing Section 7 consultation process should be discussed, and recycled water and wastewater projects that have occurred since the WSTSP was approved in 1998 should be discussed. Many comments also questioned whether a Supplemental EIR was appropriate, given the range of topics needing to be addressed. Based on comments received in response to the NOP of the Supplemental EIR and events that have occurred since the WSTSP was approved in 1998, Agency staff presented an approach to its Board at a Water Supply Workshop held on November 1, 2004. At the workshop, staff recommended to the Board that the Agency prepare a new EIR that will provide the public and decision-makers with an environmental document that not only addresses the deficiencies identified by the Court of Appeals, but also more closely reflects the Agency's and its customers' current water supply circumstances. On November 9, 2004, the Agency's Board adopted a resolution directing the preparation of a new EIR, the Water Supply, Transmission, and Reliability Project EIR.

The objective of the new project would remain similar to that identified in 1992—to provide a reliable water supply for future needs in the Agency's service area. However, over the intervening twelve years, the need for some project components (for example, facilities to ensure that the Agency's Ralphine, Sonoma, and Kastania storage tanks operate reliably during periods of peak demand) has grown more urgent. In some cases what was a future need is now a current need. Therefore, the project objective would be updated to "provide a safe, economical, and reliable water supply to meet the defined current and future water supply needs in the Agency's service area." The project would also be expanded to include a reliability component with the purpose of providing facilities needed to increase the reliability of the existing and future transmission system, particularly to address the storage tank level issues noted previously, and to address any modifications or additions suggested by the natural hazard study that is currently being prepared by the Agency. To reflect the reliability component, the project will be called the "Water Supply, Transmission, and Reliability Project" and referred to as the "Water Project." The Water Project EIR will include the demand analysis that is currently being completed as part of the Agency's Urban Water Management Plan 2005 Update. The new projected demands will assume 7500 acre-feet per year of savings by the contractors, and will form the foundation for the Water Project, and the demand analyses will be updated and incorporated into the new Water Project EIR. The updated demands will reflect current general plan projections, water use patterns, and savings from water conservation measures and recycled water use.

In addition, Agency staff is also assessing the potential to include site-specific environmental documentation in the new Water Project EIR for the WSTSP facilities collectively known as the South Transmission System Project (STSP). The Agency released an NOP, received scoping comments, and has completed site-specific surveys and much of the analysis. Agency staff expects to merge the STSP site-specific information into the Water Project EIR, so that site-specific review for those proposed transmission system facilities will occur at the same time as the program-level review for the Water Project. Site-specific information for additional facilities may also be included, for example for facilities to respond to peak water demand problems, or for projects identified in the Agency's ongoing natural hazard study.

It is anticipated that a new Notice of Preparation would be issued within the next several months, and scoping meetings would occur during the public review period for the NOP. It is anticipated that a Draft EIR would be released for public review by May 2006, after completion of the Urban Water Management Plan 2005. A Final EIR would be completed by May 2007, and EIR certification and project approval could be considered by the Board by the early summer of 2007.

Because of the timing of the Water Project EIR, this WSA makes supply projections based only on the Agency's current water right of 75,000 AFY.

2.3.4 Contracts for Agency Water Supply

The City is party to two contracts with the Agency related to water supply and is currently negotiating changes to both contracts. These contracts are described below and incorporated by reference.

2.3.4.1 The Eleventh Amended Agreement for Water Supply: The Eleventh Amended Agreement for Water Supply (11^{th} Amended Agreement), executed on January 26, 2001, is the contractual document that outlines how the Agency's proposed 101,000 AFY water right is allocated among the Contractors in normal water years. Section 3.5 of the 11^{th} Amended Agreement also provides guidance on how water allocations would be curtailed (the water shortage provisions).

The 11th Amended Agreement allocates 7,500 AFY to the City, with a maximum daily pumping rate of 15.0 mgd under normal year conditions.

The Agency's water rights decision[7] requires a reduction in diversions of 30% when the volume of water stored in Lake Sonoma is less than 100,000 AF. It is unlikely this cut in diversions would be triggered after a single dry year.[8] However, if the Agency saw indications that a hydrologic cycle similar to either the single or multiple dry years was beginning, it is likely the Agency would work with its contractors to implement water shortage provisions consistent with Section 3.5 of the 11th Amended Agreement in order to avoid the need for a 30% cutback over a very short period time.

Section 3.5 of the 11th Amended Agreement provides a qualitative discussion of the allocation methodology that would be used in the event of a water shortage. The Agency and its Contractors have been working to develop a quantitative expression of this qualitative methodology in order to allow each contractor to plan for potential curtailments. However, because there is no formally adopted numerical allocation of water, this analysis estimates water supply available from the Agency in single dry year will be 70% of the City's allocation or 5,250 AFY. (A 30% curtailment, while unlikely, is used). The analysis estimates water supply available from the Agency in multiple dry years will be 80% of the City's allocation or 6,000 AFY consistent with the contingency plan developed in the UWMP.

Because the Agency has not yet achieved the 101,000 AFY water right, its current diversion rights are more limiting on a regular basis than the Single or Multiple Dry year scenarios predicted by its hydrologic model (see Table 2-1). Section 2.3.4.3, below, discusses the availability of Agency water supply to the City under the current water right.

2.3.4.2 The Restructured Agreement for Water Supply

The Agency and its Contractors are in the process of negotiating a Restructured Agreement for Water Supply (Restructured Agreement) that would replace the 11th Amended Agreement. The Restructured Agreement will not change the City's normal year water allocation from the Agency. The Restructured Agreement would provide for additional investments in alternative water supplies (conservation and recycling) and in watershed restoration activities to benefit the Russian River ecosystem, and therefore could improve the reliability of the Agency supply.

2.3.4.3 The Temporary Impairment MOU

As indicated above, the WSTSP anticipated in the 2000 UWMP has been redefined and its implementation schedule has been extended. The decision to

[7] State Water Resources Control Board Decision 1610.
[8] Personal Communication, Christopher Murray, Sonoma County Water Agency

develop a new EIR has prevented the Agency from undertaking upgrades to the transmission system that will allow the Contractors to receive their full peak month allocations. This decision also means that the Agency's established water rights will remain at 75,000 AFY for the near future.

The Temporary Impairment MOU, executed on March 1, 2001, outlines each Contractor's allocation of water during peak usage periods. The City's peak usage under the Temporary Impairment MOU is curtailed from 15 mgd to 5.3 mgd, although the annual allocation of 7,500 AFY remains unchanged.

The Temporary Impairment MOU expires on September 30, 2005. Based on the recent decisions by the Agency's Board related to the Water Project, the Agency and its contractors are negotiating a new MOU. The new MOU is anticipated to include essentially the same terms regarding system reliability. It is anticipated that under the new MOU, the water contractors will continue to use their best efforts to limit deliveries from the Agency's transmission system to that which can be reliability delivered during the summer months through the facilities that exist. The new MOU, as proposed, will establish a team of Agency and contractor representatives who will meet during times of high water demand to consider ways to reduce demand in order not to exceed the capacity of the transmission system.

2.3.5 Summary of the Availability and Reliability of Agency Supply

Notwithstanding the City's contract allocation of 7,500 AFY under the 11th Amended Agreement and whether the Temporary Impairment MOU is renewed or not, the Agency's physical facilities and current water rights are likely to limit the amount of water that can be delivered to the City, other water contractors or other customers in the near term. The City believes it is imprudent to rely on its full allocation and, for the purposes of this assessment, has worked to develop an estimate of water supply from the Agency. This estimate is based on recent data provided by the water contractors and collected, summarized and distributed by the Agency.

In 2004, and in order to assist in the prudent management of the Russian River supply, the Agency began requesting that its contractors provide annual updates on their projected water needs including new demands created by proposed operational changes, approved new development and pending development projects that are not yet approved.

In April 2004, the Agency prepared and distributed a Summary Report that outlines the current diversions under the Agency's water rights and each water contractor's projected demands. The Agency's diversions through its transmission system for the 2001/2002 Water Year (October 2001 through September 2002) were 59,803 AF. The contractors have indicated that their planned new demands (from operational changes, approved new development and pending new development applications) total 9,839 AFY. The total existing and planned demands equate to 69,642 AFY (59,803 + 9,839 = 72,439 AFY). This total can be accommodated within the Agency's water right of 75,000 AFY. These reported demands represent a snapshot of each water contractor's current land use planning activity.

The City, in a March 1, 2004 letter, represented its planned total demands to the Agency as:

- 2,646 AFY for Water Year 2003 consumption
- 2,002 AFY for operational changes (reduced groundwater pumping and increased Agency purchases in accordance with the City's General Plan)
- 232 AFY for approved development projects
- 1,848 AFY for proposed development projects (including the major projects that triggered this WSA)
- 450 AFY of Recycled Water Offsets

The City therefore indicated a total planned demand of 6,926 AFY (2,646 + 2,002 + 232+ 1,848 = 6926).

The City also indicated that its Agency demand could be as little as 6,476 AFY (6,926 – 450 in recycled water offsets = 6476).

This demand can reasonably be accommodated with the Agency's existing right and seasonal peak usage restrictions, while acknowledging the planned development envisioned by other water contractors.

Thus the conclusions of this WSA are based on the assumption that the City will receive no more than 6,476 AFY under its Agency contracts, at least until substantial changes occur in the Agency's system. That is the reality of this WSA, and the City believes it would be imprudent to assume a larger allocation of water, despite its existing contractual agreements, for the purposes of this assessment.

Table 2-2, below, presents a summary of the water available to the Agency's system in normal, single and multiple dry years and how this water is anticipated to be allocated to the City given the Agency's current and proposed water rights and the agreements between the Agency and its Contractors.

Table 2-2

Summary of Agency Water Supply

Agency Supply Under Various Conditions (AFY)	*Total Supply*	*Rohnert Park Supply*
Available to the Agency's System		
Normal Water Year	211,945	7500*
Single Dry Water Year	86,955	5,250
Multiple Dry Water Year 1	126,885	6,000
Multiple Dry Water Year 2	126,685	6,000
Multiple Dry Water Year 3	126,485	6,000
Current Water Supply System Conditions	**75000****	**6476*****

* Supply Contracted to the City under 11th Amended Agreement
** Agency's Current Water Right
*** Estimate based on City Analysis of April 1, 2004 Data

Prior to the adoption of its General Plan and the execution of the 11th Amended Agreement, the City had relied primarily on groundwater to meet its water demands. Since the adoption of its General Plan, the City has adopted a policy to modify the operation of its system and secure a larger percentage of its water supply from the Agency. Table 2-3, below, presents the water supply purchased by the City from the Agency since 1998. (Note the Agency reports total diversions by Water Year in accordance with its permit. The City tracks it use by both Calendar Year and Water Year. This assessment has utilizes the calendar year tracking to facilitate comparisons between supply and demand. Demand is projected on a Calendar Year basis.)

Table 2-3

Summary of Purchased Agency Water Supply

(By Calendar Year)

1998	1999	2000	2001	2002	2003	2004
2936 AFY	3008 AFY	2713 AFY	2976 AFY	2870 AFY	3194 AFY	5126 AFY

2.4 Santa Rosa Subregional System Recycled Water Supply

The City is the largest urban recycled water user in Sonoma County, using recycled water for irrigation of parks and school grounds south of Golf Course Drive, the North and South Rohnert Park Municipal Golf courses, and various commercial and industrial sites. Current recycled water use averages over 1,000 AFY. Recycled water is supplied by the

City of Santa Rosa Subregional System (Subregional System), of which the City is a member. Table 2-4, below presents the historic recycled water use. The use is relatively constant, however because recycled water is used almost exclusively for irrigation purposes the demand can fluctuate with local rainfall patterns and attendant irrigation demands.

Table 2-4

Historic Recycled Water Deliveries to the Rohnert Park System

(By Calendar Year)

1999	2000	2001	2002	2003
1113 AFY	976 AFY	1090 AFY	950 AFY	1057 AFY

The recycled water supply available to the City is relatively drought-proof because of the operational nature of the Subregional System's recycled water program. The Subregional System facilities include extensive recycled water storage ponds, system-owned land ("City Farms"), facilities to deliver recycled water to customers including urban and agricultural users and the Geyser's steamfield and facilities to discharge recycled water under an NPDES permit. The Subregional system treats and stores recycled water for reuse by its customers. The volume of wastewater recycled is relatively constant, but the total volume of water available to the system is influenced by rainfall on the open storage ponds. During periods of lower rainfall, the system can be operated to minimize discharges and delivery of water to the City Farms in order to deliver water to its customers first. This provides the system with operational flexibility and the ability to meet recycled water demands under a range of hydrologic conditions. Expanding the availability of the recycled water system will require additional storage. This is discussed under Section 2.4.3, below.

2.4.1 Contracts for Recycled Water Supply

The Subregional System currently maintains a contract with each individual user on the Rohnert Park Urban Reuse system, including the City. These contracts are included in the Subregional System's Title 22 Report on the Production, Distribution and Use of Reclaimed Water. The Contracts outline the acreage which is committed to recycled water use and generally provide for a 20-year term.

Recycled water service can only be suspended as a result of inadequate treatment of recycled water (a temporary situation) or regulatory directive (i.e. changes in the State Health or Regional Board Regulations regarding the use of recycled water for landscape irrigation). These regulatory requirements are well established, well tested and have been the basis of recycled water use throughout the State for over 30 years.

2.4.2 Mandatory Use of Recycled Water

On October 29, 2004, the City adopted its Ordinance 723, a Water Waste Ordinance. This Ordinance requires the use of recycled water when it is available and of appropriate quality. This Ordinance will assure that the recycled water supply is fully utilized where appropriate.

2.4.3 The Incremental Recycled Water Program (IWRP)

Planned recycled water use will reach over 1,300 AFY. Expansion to the City's recycled water system has been documented in the Incremental Recycled Water Program EIR prepared by the Subregional Water Recycling System, which is incorporated by reference. The expanded system is anticipated to be available in 2010.

Expansion of the recycled water system will enable additional schools, parks, and other private and public properties to receive recycled water. In addition the Community Fields, described in the General Plan and all new parks and irrigated buffer areas associated with the SPAs will use recycled water. The City is actively entertaining proposals to use recycled water for residential irrigation purposes within each of the SPAs further offsetting demands on either the Agency supply or groundwater supply.

Expansion of the recycled water system will require the addition of approximately 300 AFY of recycled water storage and modifications to the recycled water distribution facilities in the City. The IRWP Program EIR has provided an overview of these facilities and their potential impacts. The City is currently working with the Subregional System to develop project level proposals.

3 Groundwater Supply Assessment

3.1 Introduction

This section of the WSA summarizes the analyses that address the groundwater supply sufficiency portion of the SB 610 requirements for the five Specific Plan Areas proposed within the Sphere of Influence. Included in this section are a description of the groundwater resources used by the City, including historical, present, and future utilization of groundwater for a 20-year planning horizon; and an evaluation of the relationship between historical groundwater levels and pumpage by the City and other entities in the study area.

Major topics addressed in this section include the following:

- SB 610 requirements for groundwater sources;
- Study area for groundwater supply analysis;
- Hydrogeologic conditions, including the regional geologic setting, prior geologic studies, local hydrogeology, groundwater production zones, and aquifer characteristics;
- Annual precipitation and period of analysis;
- Groundwater conditions, including historical, current and projected pumpage, groundwater levels, and groundwater quality;
- Groundwater recharge areas;
- Water budget; and
- Future groundwater supply sufficiency, including analysis of historical and future pumping effects and an estimated level of total pumpage for the study area.

3.1.1 SB 610 Requirements for Groundwater Sources

SB 610 requirements pertaining to the sufficiency of groundwater as a source of supply are summarized below. Where noted, the item is not applicable to the City's WSA. Other items, specifically items 3, 5, 6 and 7, are described in detail in this WSA.

1) A review of any information contained in the urban water management plan relevant to the identified water supply for the proposed project. Documents reviewed for this WSA included the Urban Water Management Plan 2000 (SCWA, 2000).

2) Indicate whether a groundwater management plan or any other specific authorization for groundwater management for the basin has been adopted and how it affects the City's use of the basin. No groundwater management plan currently exists for the Santa Rosa Plain Subbasin, nor is one necessarily required by law. However, the City is supporting the planned joint study by the U.S. Geological Survey (USGS) and the Agency to evaluate groundwater resources in the Santa Rosa Plain Subbasin. One of the objectives of the joint study is to evaluate the hydrologic impacts of alternative groundwater

management strategies for the basin (USGS, 2003). The study began in Fall 2004.

3) A description of any groundwater basin (or basins) from which the City pumps groundwater.

4) A copy of the court order or decree adopted by the court or the board and a description of the amount of groundwater the City has a legal right to pump under the order or decree if the basin has been adjudicated. The basin has not been adjudicated. However, the City Water Policy Resolution No. 2004-95 adopted on April 27, 2004 requires the City to undertake analyses consistent with SB 610 for all development envisioned by its 2000 General Plan and occurring outside its 1999 City Limits regardless of the size of the development proposal. The Water Policy Resolution is consistent with the Stipulated Judgment (South County Resource Preservation Committee et al vs. City of Rohnert Park California Superior Court, South County Case No. 224976, 2002) which specifies that the new projects will not be approved if they would contribute to the City exceeding an average annual pumping rate of 2.3 mgd (2,577 AFY).

5) Information obtained from any recent California Department of Water Resources (DWR) bulletin that characterizes the condition of the groundwater basin (i.e., if the basin is or is potentially in overdraft and what measures are being taken to eliminate potential overdraft conditions). If the basin "has not been evaluated by DWR, data that indicate groundwater level trends over a period of time should be collected and evaluated" (DWR, 2002).

6) A detailed description and analysis of the amount and location of groundwater pumped by the City for the past five years from any groundwater basin from which the proposed project will be supplied.

7) An analysis of the location, amount, and sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project. The definition of water supply sufficiency used for a WSA is discussed in the next section.

3.1.2 Definition of Terms

The SB 610 requirements discussed above include evaluation of the condition of the groundwater basin, including whether the basin is in overdraft or is projected to become overdrafted. The term "overdraft" was first applied to groundwater basins by Mendenhall (1908), who used it to describe steadily declining groundwater levels during a period of high precipitation that was otherwise conducive to groundwater level recovery. Overdraft is most often defined in terms of "safe yield." Safe yield was first introduced in the early 20th century to describe the net annual supply of groundwater that may be developed without persistent lowering of groundwater levels (Lee, 1914). It is a term that has been used interchangeably with other terms such as perennial or sustainable yield; all the expressions are commonly understood to convey the same concept or intent, i.e. development and use of groundwater at a rate that is renewable. The generally accepted legal definition of safe yield was first delineated by the State Water Rights Board in its "Report of Referee" (1962):

> "...the safe yield of the ground water reservoir … is the maximum average annual pumping draft which can be continually withdrawn for useful purposes under a given set of conditions without causing an undesired result".

An "undesired result" is most commonly interpreted to mean a progressive lowering of the groundwater levels resulting eventually in depletion of the supply. Undesired results would also include long-term depletion of groundwater storage, inducement of seawater intrusion or other degraded water quality, or land subsidence (Mann, 1968; Todd, 1980).

While the Water Code does not require an estimate of safe yield for a WSA, the projected total pumping would necessarily need to be within the safe yield (or water management conditions adjusted accordingly) in order to avoid potential overdraft conditions.

Based on the definition of safe yield, overdraft can be defined as follows: Overdraft is a condition caused by pumping in excess of safe yield that produces an undesirable result such as:

- Chronic lowering of groundwater levels (toward depletion of supply),
- Chronic depletion of groundwater storage,
- Inducement of seawater intrusion or other degraded water quality, and/or
- Land subsidence.

The question of whether overdraft conditions currently exist in the groundwater basin in the Rohnert Park area or would be expected to occur in the future at projected pumping levels is addressed in this WSA. Water Code Section 10910(f)(5) specifies that "an analysis of the sufficiency of the groundwater from the basin or basins from which the proposed project will be supplied to meet the projected water demand associated with the proposed project." A "sufficient water supply" is defined in Government Code 66473.7 as follows:

> "the total water supplies available during the normal, single-dry, and multiple-dry years within a 20-year projection that will meet the projected demand associated with the proposed subdivisions, in addition to existing and planned future uses, including, but not limited to, agricultural and industrial uses."

For purposes of this report, groundwater level changes in response to historical pumpage are assessed to determine whether overdraft conditions have occurred or would be expected to occur in the future.

3.1.3 Study Area and Data for Groundwater Supply Analysis

The City pumps groundwater from the Santa Rosa Valley Groundwater Basin (Figure 3-1). Three subbasins occur within this basin, including the Santa Rosa Plain Subbasin, Healdsburg Subbasin, and Rincon Valley Subbasin (DWR, 2004); the City of Rohnert Park is located within the Santa Rosa Plain Subbasin. The Santa Rosa Plain Subbasin is a large area for purposes of assessing sufficiency with the available data, so subsets of this area were considered. Based upon prior hydrologic analyses (Todd, 2004), and independent review and analysis of the subsurface geologic conditions and available groundwater data, the upper Laguna de Santa Rosa watershed, above the Stony Point Road Gauging Station, was selected as the study area for the SB 610 evaluation (Figure 3-1). The study area is similar to the one used by Todd (2004) except that the southern and eastern watershed boundaries used by the WSA are based on official watershed boundaries shown on the California Interagency Watershed map of 1999 as updated in May 2004. Mapping standards are established by the CalWater Committee, and the current California watershed map is labeled CalWater version 2.2.1. The CalWater mapping effort is part of the Natural Resources Conservation Service nationwide program to develop a nationally uniform hydrologic unit system. The study area and political boundaries within the study area are shown on Figure 3-2. One difference between the WSA study area based on the CalWater watershed boundary and the study area used by Todd (2004) is that the CalWater watershed boundary places the Penngrove Water Company (PWC) Canon Manor East well outside of the WSA study area and in the Petaluma Valley Groundwater Basin. Wells with water level or water quality measurements within the study area and surrounding vicinity are shown on Figure 3-3.

Data reviewed for this analysis were gathered from the City and other state and local entities. These data included:

- Historical groundwater levels;
- Historical pumpage;
- Historical precipitation;
- Groundwater quality data;
- Geological information, including driller’s reports and geophysical logs;
- Published and unpublished reports and maps; and
- Projected water demands for the City and other pumpers in the study area.

3.2 Hydrogeologic Conditions

3.2.1 Regional Geologic Setting and Previous Geologic Studies

The City of Rohnert Park is located at the southern end of the Santa Rosa Plain in the California Coastal Ranges north of San Francisco Bay. The Santa Rosa Plain drains to the northwest toward the Russian River and then to the Pacific Ocean. The Petaluma Valley Groundwater Basin, located south of Rohnert Park and including the unincorporated community of Penngrove[1], drains to the southeast toward San Francisco Bay. The broad gentle plain on which the City lies is topographically known as the Cotati Valley. The Cotati Valley lies within the subbasin designated as the Santa Rosa Plain Subbasin by DWR (Figure 3-1).

Numerous geologic and hydrogeologic studies have been conducted in the area and summarized in various reports (Cardwell, 1958; DWR, 1975, 1982, 1987). The primary geologic formations underlying the study area consist of:

- Bedrock of the Mesozoic Franciscan Complex which is strongly deformed, weakly metamorphosed marine sedimentary rocks with blocks and slabs of volcanic oceanic crust tectonically mixed within the sedimentary rocks.
- Overlying the bedrock is a thick sequence of volcanic and volcano-clastic rocks of late Tertiary age (late Miocene and Pliocene): Tolay Volcanics and Sonoma Volcanics. Interbedded and interfingered with the volcanic rocks are non-marine, transitional marine and marine sedimentary rocks: Petaluma Formation and Wilson Grove (formerly known as Merced) Formation.
- Interfingered and overlying these Tertiary units are late Pliocene and Quaternary (Pleistocene and Holocene) non-marine sedimentary deposits of fluvial, lacustrine, and alluvial plain origins. The area is extremely structurally complex with numerous faults, both active and inactive, that cut through all the geologic units. Groundwater in the Rohnert Park area is produced largely from the upper 800 feet of the sedimentary deposits.

The surface exposure of these geologic units is illustrated on Figure 3-4. Appendix A includes more detail on the underlying geology.

3.2.2 Local Hydrogeology and Groundwater Production Zones

The local hydrogeology was evaluated by constructing vertical profiles of the City's 42 production wells and some nearby private wells in addition to several geologic cross sections. The well profiles show the geologic materials as recorded on individual water well driller's reports, an interpreted profile of the geophysical electric log for each well or borehole where available, and the depth of perforated or screened intervals in the well casing. The cross sections show geologic materials and perforated intervals for wells that lie along or near the cross section location. Six working cross sections were prepared for the area, and two of these are included in the WSA and discussed in detail below. The locations of these cross sections are shown on Figure 3-4. One of these cross sections (Figure 3-5)

[1] The term "Penngrove" is used to describe the geographic location of the unincorporated area of Penngrove south of Rohnert Park and in the general vicinity of the intersection of Petaluma Hill Road and Adobe Road. The reference does not include the area encompassed by the zip code for the Penngrove area.

has an east-west orientation, and the other (Figure 3-6) has a north-south orientation.

The well profiles and cross sections provide a generalized depiction of the subsurface geologic conditions. Most City wells are constructed to depths of 600 feet or less. A few wells extend to depths of about 800 feet. Three wells (RP-14, -15, and -16) extend to greater depths (up to 1,500 feet). The vertical zones of the aquifer system were designated:

- Shallow (0 to 200 foot depth),
- Intermediate (200 to 600 foot depth, comprised of upper and lower sequences as described below),
- Deep (600 to 800 foot depth), and
- Lower (depths greater than 800 feet).

These zones do not represent laterally extensive aquifers but are strictly depth based for purposes of evaluating hydrogeologic conditions. These designations are based on an approximate correlation to the geologic units and on water well completion depths. Each zone is described below.

Shallow Zone

The shallow zone appears to consist largely of fine-grained clays and sandy clays with a few thin sand to gravel beds (Figure 3-5). In the northern part of the Rohnert Park area, the sands appear to occur largely towards the margins of the Valley. Somewhat more sand occurs further south possibly deposited by alluvial fan sources in the Copeland and Lichau Creek areas east of RP-9. The depositional system appears to have been small alluvial fans grading into a fluvial plain or possibly lacustrine area.

Intermediate Zone

Most of the City's wells are constructed in the intermediate zone and have perforated intervals located between depths of 200 to 600 feet. Based on review of well profiles and working cross sections, this zone is indicated to consist of a complex sequence of largely thin (and rare occurrences of thick) sand to sand and gravel beds interbedded with clay to sandy clay beds (Figures 3-5 and 3-6). The correlation of individual sand and gravel beds is generally poor between wells. Locally, sand sequences can be roughly outlined based on sand bed thickness, but lateral correlations are more difficult. The intermediate zone appears to be the most complex stratigraphically of the four zones.

In the northern half of the Rohnert Park area, a lower sand sequence consisting of many thin sand beds occurs in the intermediate zone between depths of 400 to 600 feet (lower intermediate zone). It is difficult to determine whether this sequence represents alluvial plain deposits or possible transitional deposits to a western marine or estuary area. The sequence may be either upper interbedded Wilson Grove-Petaluma Formation, or a late Pliocene-Pleistocene fluvial-lacustrine deposit. To the east of the Sonoma State Fault, a thicker sequence of high-resistivity beds may represent a marginal-fault trapped area (Figure 3-4). In central Rohnert Park (near RP-4, -9, and -13), this sandy sequence tends to be thinner and more finer-grained. South of the City (near RP-8 and -35), a thicker, high-resistivity, gravelly sequence is present (Figure 3-6). This sequence appears somewhat different from those to the north, but this may also reflect differences in driller's logs and geophysical log characteristics. It is unknown whether this gravelly sequence correlates with the Tertiary Sands and Gravels of Cotati mapped by Clahan and others (2004). A high-resistivity sequence that is up to 100 feet thick and logged by drillers as "hard rock" occurs to the east of the gravelly sequence exhibited in RP-34, -36, -38, -39, and -40. It is unclear whether these materials represent a conglomerate alluvial fan unit or an extension of the Sonoma Volcanics exposed in the hills south of Roberts Road.

An upper sand sequence in the intermediate zone, located between depths of about 200 to 400 feet (upper intermediate zone), occurs in the northern portion of the City (Figure 3-5). The sand to sand and gravel beds appear to be slightly thicker and more numerous than in the lower intermediate sequence. Bed correlation remains poor; however, the character of the geophysical log responses appears to be more of an alluvial plain or fluvial nature. The sandy deposits of this upper sequence appear to be concentrated along the Valley axis (Figure 3-6); and, these deposits may be lacking east of the Sonoma State Fault (Figure 3-5). In addition, the base of the upper sand sequence appears to rise somewhat to the southeast (Figure 3-6). It is unclear whether this rise is related to a southeastern sourced depositional pattern or basin tectonics.

Deep Zone

Underlying the intermediate zone, the deep zone is defined as occurring at depths between 600 to 800 feet. The deep zone is best defined in the north by deposits observed in RP-3, -15, -16, and -41. In RP-3, -15, and -41, the deep zone occurs as an approximately 100 to 150 foot interval of thin to thicker sand and gravel beds with interbeds of clays (Figure 3-5). These beds appear to rapidly thin or pinch out to the south. Consequently, the deposits at RP-16 display only a 30-foot finer-grained sand bed (Figure 3-6). The City wells do not extend to sufficient depths to examine stratigraphic relationships, but it appears that the coarser aquifer units do not extend south beyond RP-16.

Correlation of the deep zone to surficial map units is difficult. It is unclear whether the deposits in the deep zone represent Tertiary sedimentary deposits (interbedded Wilson Grove-Petaluma) or Quaternary non-marine deposits.

Lower Zone

The geologic information for the three deepest City wells (RP-14, -15 and -16) indicates that low resistivity, fine-grained clays were encountered between depths of 800 to 1,500 feet. RP-15 and -16 encountered a higher-resistivity, 30 to 50 foot thick tight sand bed at depths of 1,150 feet and 1,310 feet, respectively, along with a few thinner beds. The units encountered by the wells constructed to depths greater than 800 feet are believed to be older Tertiary sedimentary units, probably

Petaluma Formation or interbedded Wilson Grove-Petaluma Formation or equivalent. Because of the limited deep borehole information, it is difficult to correlate the lower zone laterally beneath the City. Because of the fine-grained nature of this zone, and the limited potential aquifer thickness, it appears the lower zone represents a poor target for groundwater production.

In contrast, RP-14 encountered a high resistivity, thick to massive unit below a depth of 900 feet and extending to 1,300 feet; this material was logged by the driller as “lava sands with hard streaks”. This unit is interpreted to be on the uplifted eastern side of the Sonoma State fault; it is probably part of the Sonoma Volcanics, or possibly the older Tolay Volcanics. RP-14 was screened across this interval, and it reportedly yielded 2,000 gallons per minute (gpm) following construction. However, water quality problems, including high boron concentrations and hydrogen sulfide gas, caused the well to be sealed off below 800 feet (Slade and Associates, 2004).

3.2.3 Well Yields and Aquifer Characteristics

Aquifer characteristics refer to the ability of aquifers to transmit and store groundwater. Aquifer characteristics are generally estimated using data from long-term constant rate pumping tests. The ability of the aquifer to transmit water is referred to as transmissivity (permeability times saturated thickness). Aquifer test data are limited in the study area, and estimates of aquifer transmissivity are based primarily on short-term specific capacity tests periodically conducted in the City of Rohnert Park wells (Slade and Associates, 2004).

Table 3-1 summarizes specific capacity test data for City wells, including some that are no longer operable. The table shows average specific capacities for individual City wells based on the most recently collected specific capacity results, which are primarily based on tests conducted from 1994 to 2003. The table also shows the perforated interval and the primary zone of production (shallow, intermediate, and/or deeper zones) and the capacities (pumping rates) for the City wells. Nearly all City wells pump predominantly from the intermediate zone. The specific capacities of these wells vary over about one order of magnitude, ranging from 0.6 to 6 gallons per minute per foot of drawdown (gpm/ft), including RP-4 completed in the shallow zone and RP-15 completed in deeper zones.

Specific capacity data can be used to estimate aquifer transmissivity. For a confined aquifer, the empirical equation for this estimate is:

$$T = Q/s * 2000$$

Where: T = transmissivity of the well, in gallons per day/ft (gpd/ft)
Q = yield of the well, in gpm
s = drawdown in the well, in ft

Based on the above empirical formula, the transmissivity of the intermediate zone in the vicinity of the City is estimated to range from about 1,000 to 12,000 gpd/ft.

The DWR (1975) report on groundwater resources in Sonoma County contains descriptions of well yields for various formations in the County. Aquifer test data are quite limited, but DWR reported specific capacity data for several formations and aquifer test results from one test considered to be representative of the Petaluma Formation. An aquifer transmissivity of about 3,800 gpd/ft was estimated from a 72-hour pump test conducted in the well completed in the Petaluma Formation (DWR, 1975). Well yields in the Petaluma Formation are reported to range from 5 to 300 gpm. The well yield and specific capacity information gathered from the City wells is consistent with the data reported by DWR.

Overall, the specific capacity and transmissivity values calculated from tests conducted on the City wells are indicative of low yielding formation materials. The specific capacity tests for the City wells suggest that the intermediate zone, from which the majority of the City's groundwater extraction occurs, has a transmissivity of less than 12,000 gpd/ft. Well yields are correspondingly low, ranging from 44 to 304 gpm.

The geology of the study area is stratigraphically and structurally complex. Prior analyses of groundwater level responses to local groundwater extraction have reported on the semi-confined to confined nature of the deeper aquifers in the Rohnert Park area. Particularly, DWR (1982) notes that there are differences in the water level declines observed in three piezometers completed to different depths and also that there are confining layers between the perforated intervals of the piezometers. The deepest of the three piezometers was further noted as similar in depth to most of the City wells; the water level difference in this zone was attributed to the response of "pressure aquifers" (i.e., confined aquifers).

3.3 Period of Analysis

3.3.1 Precipitation Data

An isohyetal map showing mean annual precipitation contours in the study area is presented on Figure 3-7. This map was obtained from an Agency (1983) report, and the associated period of record and gauge locations are unknown. The mean precipitation ranges from less than 30 inches in the western portion of the study area to more than 45 inches in the eastern portion.

Sonoma County precipitation gauges with long periods of record are located outside the study area. Annual precipitation data from 1905 to 2003 (Figure 3-8) are from the Santa Rosa gauge, which is located north of the City of Santa Rosa at an elevation of 174 feet.[2] The lowest annual rainfall during this period was 12.78

[2] The period of record for the Santa Rosa gauge is generally from 1905 to the present, but missing data for

inches during the 1977 water year (October 1, 1976 to September 30, 1977), and the highest annual rainfall was 55.68 inches in the 1983 water year. The mean annual precipitation was 29.92 inches, which is approximately the same as the annual mean precipitation for the City shown on Figure 3-7.

The long-term precipitation characteristics at the Santa Rosa gauge are shown by plotting the cumulative departure from the mean annual precipitation (Figure 3-9). This plot shows alternating wet, average, and dry periods of various durations, which are indicated by the slope of the cumulative departure curve. An upward slope indicates a wet period, and a downward slope indicates a dry period on the cumulative departure curve.

3.3.2 Selection of Period of Analysis

For detailed hydrologic studies, a study period should satisfy a number of criteria (Peters, 1981). The most significant criteria are the following: the study period would include both wet and dry cycles, the study period would end near the present, historical data are available, the cumulative departure from mean annual precipitation should be similar for the beginning and end of the study period, and cultural conditions are similar during the period of data availability. For the WSA, the availability of groundwater level data is the chief factor in the selection of the period of analysis. The period of record for water level measurements in most City wells is 1977 to 2004. Additionally, available municipal pumpage data, including City pumpage from 1970 to 2003, have been obtained and evaluated. Unmetered pumpage has also been estimated for this period. The combined period of available water level and pumpage data, therefore, is 1977-2003.

Although it is preferable to have a dry period occur near the beginning and end of a study period, the cumulative departure curve shows that conditions near the present have been wetter than average, followed by a single-dry year and a normal year. For this WSA, an analysis of groundwater level trends in multiple-completion monitoring wells owned by the Agency and located away from any municipal wells was conducted to assess the effect of climatic conditions on water levels. A detailed discussion is presented in Section 3-5. The historical record for these wells from 1977-1999 was used to evaluate normal, dry, and wet year effects. Ideally, a hydrologic study period of 1986-2001, when the cumulative departure from the mean annual precipitation was zero, would be preferred to evaluate climatic effects. However, pumping of a nearby production well precludes use of data after 1999. As a result, the 1986-1999 hydrologic period was additionally used to assess the potential climatic effects that would be expected to occur over a longer period. The departure from the mean annual precipitation on the cumulative departure curve is relatively small (11 inches) between the beginning and end of the 1986-1999 period (Figure 3-9), i.e., this period is only

portions of the 1937, 1979, 2000, and 2001 water years had to be estimated using data from the Graton station, located west of the study area.

slightly wetter than normal. The small departure from mean annual precipitation during 1986-1999 also results in a small effect on recharge and hence groundwater levels in the shallow zone. The increase in water levels estimated to occur as a result of this slightly wetter period is less than one foot.

As described in Section 3.5, long-term water level trends in the shallow zone Agency monitoring well (SCWA-01) demonstrate a strong correlation to the small estimated change in water levels due to somewhat wetter conditions during the 1986-1999 period. During this period, SCWA-01 exhibited no change in groundwater levels, i.e., Spring 1986 and 1999 levels were the same.

In contrast, groundwater levels measured in SCWA-03, an intermediate zone well, declined by about seven feet during the 1986-1999 period. It is unclear whether local pumpage influenced the decline. During a relatively wetter period (1990-1997), which corresponds to the period used to further evaluate pumpage and water level responses in the central Rohnert Park area, there was no decline in groundwater elevations at SCWA-03. The lack of water level response in the intermediate zone during these wetter periods shows that pumpage in the central Rohnert Park area has a much greater effect on water levels in the study area than changes in climatic conditions (e.g., water year type).

As described later in this report, a water budget for essentially the same study area as used in this WSA was prepared for a 1986-2001 study period (i.e., water years 1987-2001) by Todd (2004). The departure from the mean annual precipitation on the cumulative departure curve for this period is the same as for the 1986-1999 hydrologic period described above, i.e., 11 inches between the beginning and end of the period (Figure 3-9). Thus, this period is also only slightly wetter than normal.

In summary, although data availability constrains selection of a study period, the period where there are historical water level data (1986-1999) for the Agency multiple-completion monitoring wells that can be used to assess climatic effects on groundwater conditions and trends meets the most significant criteria described above. In addition, the study period employed by Todd for developing a water budget for the study area during 1987-2001 is suitable for that purpose. As a result of the limited effect of climatic conditions on water level trends, the period of available historical groundwater level and pumpage data for this WSA (1977-2003) is adequate for purposes of assessing groundwater conditions and trends.

3.4 Groundwater Pumpage

3.4.1 Historical Pumpage

This analysis included review of City pumpage data from 1970 to the present. The City provided monthly pumpage totals by well for 1972 to 2003. Todd provided annual pumpage for 1970 and 1971 (Iris Priestaf, personal communication, 2004). The historical data were evaluated to determine the relationship between groundwater level trends and City pumpage using the longest period of record available.

Metered pumpage by other entities within the watershed was also evaluated to determine the relationship between historical groundwater level trends and the total pumpage in the study area. Annual pumpage data for the City of Cotati for 1986 and 1988-2003 were provided by Todd. City of Cotati water demand was estimated for other years based on census population data for 1970, 1980, and 1990 (Figure 3-10). Pumpage was assumed to be equivalent to the estimated demand minus the estimated Agency deliveries during those years. Annual pumpage data for SSU for 1994-2003 were provided by Todd. For 1970 to 1993, annual pumpage was estimated based on SSU student population for 1970, 1980 and 1990 from "System and Campus Enrollment" (SSU, personal communication, 2004) and an average water use per student (1994-2003). Pumpage by the PWC Canon Manor East well is not included on Table 3-2 because it is located outside of the study area boundary.

Pumpage data are not available for non-municipal wells in the study area, but pumpage estimates based on estimated water demand during 1970-2003 were made for private domestic, commercial, and agricultural pumpers. These estimates are based on land use categories and estimated average consumption rates. The estimates of unmetered pumpage must be considered for the supply sufficiency analysis because they constitute a significant amount of the total pumpage in the study area.

Historical unmetered domestic and commercial pumpage was estimated based on census data that show population in unincorporated portions of Sonoma County during 1970, 1980, 1990, and 2000. Population was assumed to change linearly between census periods, and pumpage was assumed to be directly proportional to population. The City provided population estimates for 1990 and 2000 for the unincorporated watershed area based on census block group maps. For 1970 and 1980, the unincorporated watershed population percentage increase was derived from the "unincorporated" population for the county (Economic and Planning System, Inc., 2003). Multi-family and single-family water demands provide by Todd (2004) were applied to the estimated rural population to estimate domestic pumpage for 1970 to 2000. Commercial pumpage was assumed to change by the same annual percentage as domestic pumpage. Estimates of historical pumpage in unincorporated portions of the study area are shown on Table 3-2.

Estimates of historical agricultural pumpage estimates were partially based on a 1970 crop report (Sonoma County Farm Bureau, personal communication, 2004) and a chart of total harvested acreage for 1980-2002 (Figure 3, Economic Planning Systems Inc., 2003). Agricultural pumpage was assumed to be directly proportional to the harvested acreage. The amount of water applied per acre was based on an estimate made by Todd (2004) based primarily on DWR’s 1986 land use map.

The historical metered and unmetered pumpage are summarized on Table 3-2 and plotted on Figure 3-10. The estimated total pumpage in the study area was 3,992 AF in 1970. It increased to 7,126 AF in 1980 and 8,929 AF in 1990 due largely to increases in City pumpage.

3.4.2 Current Pumpage

Total City pumpage was 3,556 AF in 2003, which reflects the shift begun by the City in that year toward greater use of Agency water, and total pumpage in the study area decreased to 7,078 AF. The estimate of pumpage from all other pumpers in the study area is 3,522 AF. For 2003, this includes 412 AF by the City of Cotati and SSU, 1,699 AF by private and commercial pumpers, and 1,411 AF by agricultural pumpers (Table 3-2). City pumpage accounted for about half of the total pumpage in 2003.

The total City pumpage for calendar year 2004 is 1,520 AF (Darrin Jenkins, City of Rohnert Park, personal communication, 2004), which reflects increased reliance on the Agency supply. This level of pumpage is similar to the City's pumpage in 1974.

3.4.3 Projected Pumpage (2005 to 2025 groundwater source estimates)

Projects outside the 1999 City Limits will not be approved if they would contribute to the City exceeding an average annual pumpage of 2.3 mgd (2,577 AFY), consistent with the 2004 Water Policy Resolution. Therefore, City pumpage in 2025 is assumed to be 2,577 AFY.

Estimates of future non-City pumpage made by Todd (2004) were reviewed for this WSA. These estimates, which are based primarily on land use, indicate that significant increases in non-City pumpage would occur by the time that build-out in the Rohnert Park area is complete.

Based on data provided by other public agencies, Todd estimated that pumpage from the City of Cotati and SSU would increase from approximately 412 to 602 AFY. Agricultural pumpage is assumed to remain at similar levels, or about 1,411 AFY (personal communication, Sonoma County Farm Bureau, 2005). Historical agricultural pumpage has been relatively constant from 1990 to 2003; so continued pumpage at this level appears reasonable. Private and commercial pumpage were projected to experience the largest increase, from 1,699 to 2,760 AFY. The total projected increase in non-City pumpage is from 3,522 to 4,773 AFY, an increase of 36%. These projected pumpage increases are shown on Table 3-2. The projected total study area pumpage is 7,350 AFY, a slight increase (approximately 270 AFY) from current pumping but a notable decrease from recent historical pumping (i.e., an average of 8,700 AFY during 1990-1997).

3.5 Groundwater Levels

Historical groundwater level data for the Santa Rosa Plain Subbasin from a 1982 DWR investigation are posted online at DWR's web site. That study concluded that the "Santa Rosa Plain groundwater basin as a whole is about in balance, with increased groundwater levels in the northeast and decreased groundwater levels in the south."

In order to update DWR's evaluation of groundwater resources in Sonoma County (DWR, 1982) and assess groundwater level trends and conditions, groundwater level data were obtained for 123 wells located in the Santa Rosa Plain Subbasin. These data were provided by DWR, the City of Rohnert Park, the Agency, and Todd Engineers (PWC well located in Canon Manor East). Additionally, groundwater level data for numerous monitoring wells located at 14 underground storage tank sites, as available online in the State Water Resources Control Board (SWRCB) Geotracker system (http://geotracker.swrcb.ca.gov), were reviewed to further evaluate levels for the shallow zone. Groundwater level data were also obtained from DWR for wells in the northern portion of the Petaluma Valley Groundwater Basin.

3.5.1 Water Level Hydrographs

Water level hydrographs were constructed for 138 wells with available groundwater level data; from these, a subset of hydrographs, particularly for wells within or near the study area, was used for further analysis. Well construction details were evaluated and the completion of the wells within one or more of the four zones defined above was determined. Well construction information is summarized in Appendix B. Hydrographs were then categorized according to zone(s) of predominant completion. The historical data were further evaluated to assess water level trends by zone (i.e., hydrographs for 72 wells, including 21 completed in the shallow zone, 49 completed in deeper zones, and two with unknown completion). In addition to groundwater elevations, reported as feet above Mean Sea Level (feet MSL), the hydrographs discussed below show the total metered and estimated pumpage (using a second y-axis) and the annual precipitation at the Santa Rosa gauge. Most of the hydrographs show only the highest groundwater elevations reported during the January to May period for each well in order to assess long-term groundwater level trends. Figure 3-11 shows the locations of wells with hydrographs discussed in this section. The full set of hydrographs showing all water level data is contained in Appendix C.

3.5.2 Shallow Zone

Hydrographs for most shallow zone wells located on the periphery of the City exhibit relatively stable long-term groundwater levels, indicating little response to changes in pumpage or variations in climatic conditions. Regardless of increases or decreases in pumpage or the occurrence of dry, normal, or wet years, spring water levels in the shallow zone are essentially stable for all of the historical monitoring record. One well, 6N/8W-15J3 (15J3), which is located in the northwestern portion of the City. Well 15J3 has a period of record of 1950 to the present and exhibited groundwater level declines from 1950 to the late 1980s. Water levels in well 15J3 have been relatively stable since 1988.

Figure 3-12 contains a hydrograph for well 6N/8W-26L1 (26L1) and includes all water level data available for the period of record (1972 to 2004). The hydrograph of well 26L1 is similar to hydrographs of other shallow wells located around the periphery of Rohnert Park. Well 26L1 is a domestic well located in the City of Cotati and screened from 54 to 94 feet in depth. The large y-scale on the hydrograph (-100 to 100 feet MSL) was selected to allow direct comparison with the hydrograph of a typical intermediate zone well discussed in the next section. Spring water levels in well 26L1 were generally stable during the period of record but showed some response to changes in precipitation. Spring water levels declined during drier than average periods, including declines of about four feet in 1977 and five feet from 1986 to 1990. Spring water levels increased by about eight feet from 1990 to 1999, a wetter than average period. Spring water levels in 1999, 2000, and 2004 were essentially the same as spring water levels prior to 1984. Seasonal fluctuations ranged from 10 to 17 feet during most years; larger fluctuations that occur occasionally are probably drawdown caused by pumping of this well for domestic use. There is no indication that other shallow pumpage in the area or intermediate zone pumpage by the City and others had a significant effect on water levels in this well.

Hydrographs of water levels in well 15J3 and five other shallow zone wells located north and west of the City from 1970 to the present are shown on Figure 3-13. Hydrographs of three wells monitored by DWR located south and southeast of the City are shown on Figure 3-14. Also shown on Figure 3-14 are data from a monitoring well (L828) downloaded from the SWRCB Geotracker site. This well, located in close proximity to the southern watershed/study area boundary, shows groundwater levels comparable to those reported for 1951 by Cardwell (1958). While limited data are available for this site, groundwater levels appear stable during the 10-year period of record (1993-2003).

Although the unincorporated community of Penngrove is located primarily in a different basin (the Petaluma Valley Groundwater Basin), the historical record for three wells in this area monitored by DWR were also evaluated. These wells, 07A1, 18B1, and 13Q1, are located within, south, and southwest of Penngrove, respectively. Figure 3-15 shows hydrographs for these wells; groundwater levels are generally stable for all three wells.

In summary, hydrographs for most shallow zone wells located near the City exhibit a stable long-term groundwater level trend from about 1975 to present. Regardless of increases or decreases in pumpage in the central Rohnert Park area, or the occurrence of dry, normal, or wet years, spring water levels in the shallow zone generally showed little response to changed conditions. Groundwater levels in Agency monitoring wells located outside the study area declined by about two to three feet during the 1987-1991 dry period. Groundwater levels subsequently recovered during the 1994-1998 wet period.

3.5.3 Intermediate and Deeper Zones

Hydrographs for wells completed in the intermediate zone, from which the majority of the City's pumpage occurs, show changes in groundwater elevations primarily in response to variations in pumpage. Figure 3-16 shows a hydrograph for City well RP-01, which is representative of hydrographs of Rohnert Park wells completed in the intermediate zone. Well RP-01 is located in the central portion of the City. It is screened from 265 to 458 feet in depth and has a period of record that generally began in 1975 and extends to the present (2004). Spring water levels declined from a high of about 38 feet MSL in 1980 to a low of -48 feet MSL in 1991, a period of progressively increasing pumpage. Spring water levels increased by about 40 feet (to -17 feet MSL) from 1991 to 1997, a period that included drier than average conditions in the early 1990s and wetter conditions beginning in 1994. Water levels increased significantly during 2003-2004 in response to a large decrease in pumpage. Seasonal fluctuations ranged from about 50 to 60 feet during most years. These seasonal fluctuations and year-to-year water level changes are much greater than for shallow zone wells (see Figure 3-12).

Spring groundwater elevations observed in the central Rohnert Park wells (Figure 3-17) were generally stable during the first few years of groundwater monitoring (1977-1981), followed by a decline from 1982 to 1990. Groundwater levels were stable to slightly increasing from 1990 to 1997, stabilized, and then exhibited a much larger recovery when pumpage was reduced in 2003.

Hydrographs were evaluated for Agency wells located northwest of the study area (Figure 3-11) and at least three miles away from the Rohnert Park municipal wells. These Agency wells include two monitoring wells completed in the intermediate zone (SCWA-02 and -03) and a nearby production well located on Todd Road (SCWA-04), and production wells located on Sebastopol Road (SCWA-05) and Occidental Road (SCWA-06). The Todd Road wells represent the best available data from monitoring wells constructed in different zones and adjacent to a production well. The period of record for water levels measured in these wells is 1977 to 2003. As shown on Figure 3-18, spring groundwater levels in these wells were relatively stable through most of the record until the Agency began pumping its production wells in 1999. The Agency wells were not affected by groundwater level declines that occurred in the Rohnert Park area due to City pumping.

Hydrographs for intermediate zone wells, from which the majority of the City's pumpage occurs, show that changes in pumpage have a greater effect on intermediate zone groundwater levels than changes in climatic conditions (e.g. water year type). Spring groundwater elevations in the central Rohnert Park wells were generally stable from 1977 to 1981, levels declined from 1982 to 1990 as pumpage increased, and levels were stable to slightly increasing from 1990 to 1997 when total pumpage in the study area averaged about 8,700 AFY. Groundwater levels were stable from 1997 to 2003 and exhibited a marked recovery when pumpage was reduced in 2003. Water level recovery since 1990 indicates that water level declines during the 1980s were not indicative of overdraft conditions. There is also no indication of generally declining groundwater levels elsewhere in the subbasin in any zone, i.e., there is no indication that overdraft has occurred on a subbasin scale.

3.5.4 Hydrographs of Paired Wells

Hydrographs of paired shallow and deeper wells were prepared to show variations in groundwater levels in different zones. These hydrographs also show the total metered and estimated pumpage in the study area and the annual precipitation at the Santa Rosa gauge. Figure 3-19 is a hydrograph showing groundwater elevations for two shallow monitoring wells and two deeper City production wells. City wells RP-03 (805 feet deep) and RP-15 (1,491 feet deep) are completed in the intermediate and lower zones. The shallow monitoring wells shown on these hydrographs are located at underground tank clean-up sites; water level data prior to 2002 are not available from the Geotracker web site. Figure 3-19 shows a downward vertical gradient with groundwater elevations in 2002 ranging from about 90 feet MSL in the shallow monitoring wells to -40 feet MSL in the deepest production well (RP-15). The larger water level fluctuations in deeper zones are an indication of greater aquifer confinement with increasing depth.

Hydrographs were also evaluated for SCWA-03, the deepest of the Agency monitoring wells on Todd Road discussed above, and a shallow monitoring well (SCWA-01) at the same location. Hydrographs of these wells are included on Figure 3-20 along with pumpage for the nearby Todd Road production well (SCWA-04). The monitoring wells have water level data from 1977 to 2003. Monitoring well SCWA-01 is a shallow well (80 feet deep), and SCWA-03 is an intermediate zone well (570 feet deep). The production well is perforated from a depth of 650 to 800 feet in the intermediate zone. Data for the monitoring wells show stable groundwater levels in both zones until 1999. The lowest water levels shown on the hydrograph for SCWA-01 occurred in 1977 (65 feet MSL); higher groundwater levels occurred in 1980 and subsequent years. The Agency began pumping the nearby production well in 1999, and groundwater levels exhibited declines in all zones to varying degrees depending on the depth of completion of the monitoring wells. The shallowest monitoring well (SCWA-01) exhibited a decline of about two feet, and SCWA-03, the intermediate zone monitoring well, experienced a decline of about 130 feet between 1999 and 2003. No influence from the City’s pumping is indicated at these wells.

The Agency’s multiple-completion monitoring wells provide a useful means for assessing the effects of hydrologic conditions on groundwater level responses in different aquifer zones during drier and wetter periods. Until the Agency began pumping near these monitoring wells in 1999, the water level responses at this location provided a better indication of hydrologic responses to changes in precipitation than intermediate zone wells located in and near Rohnert Park, which are strongly affected by local pumping. Subtle groundwater level trends observed in the Agency monitoring wells from about 1980 to 1999 provide an indication of the increase or decrease in groundwater levels occurring in response to climatic conditions. This in turn provides an indication of the relative portion of the total observed water level change occurring in wells located in the central Rohnert Park area that is attributable to climatic conditions versus local pumping effects caused by pumping in a semi-confined aquifer system.

The hydrograph of SCWA-01 (Figure 3-20) shows generally stable groundwater levels from 1980 to 1999, and SCWA-03 shows stable groundwater levels (but at a lower elevation) from about 1983 to 1999. Until 1999, the Agency's Todd Road well had primarily been on standby for emergency purposes. Therefore, except for recent years, the Agency monitoring wells had not been subject to significant drawdown due to pumping.

Slight groundwater level differences are discernible in the spring water levels for the SCWA-01 and -03 wells. These subtle trends are summarized below:

SCWA-01 (Shallow Zone Well)

- During 1980-1986, when wetter than average conditions were occurring, the average spring groundwater elevation was relatively stable at about 79 feet MSL.
- During 1987-1992, a dry period, the average spring groundwater elevation declined by about 2.6 feet.
- During 1993-1999, a wetter than normal period, the average spring groundwater level increased by about 1.6 feet from the previous period.
- During 2000-2003, a period of approximately average precipitation, there was a decline of about 4.3 feet due to pumping of the Agency's Todd Road well, which began in 1999. The decline during this period suggests that leakage from the shallow aquifer to the deeper aquifer increased due to pumping.
- During 1986-1999, i.e., the period described in Section 3.3 as being only slightly above the mean annual precipitation and unaffected by Rohnert Park pumping, water levels were stable.
- The overall groundwater level trend from 1980 to 1999 was also stable.

SCWA-03 (Intermediate Zone Well)

- During 1980-1986, when wetter than average conditions were occurring, the spring groundwater elevation increased from 57 feet MSL to 65 feet MSL.
- During 1987-1992, when drier conditions were occurring, the average spring groundwater level declined by about three feet.

- During 1993-1999, a relatively wet period, the average spring groundwater elevation was the same as the average groundwater elevation occurring during 1980-1986 (60 feet MSL).
- During 2000-2003, significant drawdown occurred due to pumping of the Todd Road production well.
- Groundwater level trends were stable during the 1986-1999 period and the 1980-1999 period.

3.5.5 Groundwater Elevation Contours

Maps showing contours of equal groundwater elevation are useful to show differences in groundwater levels over the study area. The direction of groundwater flow can also be inferred from these maps because it is perpendicular to the groundwater elevation contour lines.

Historical groundwater elevation contours for April 1951 are available from a USGS report by Cardwell (1958). The 1951 investigation focused on groundwater elevations and movement over a large area that included the Santa Rosa and Petaluma Valleys. More data were available for this period than any other historical or recent period because the USGS conducted a one-time round of water level measurements in a large number of wells (approximately 450 shallow and deep wells) in April 1951. The majority of these wells are shallow, and the shapes of the contours primarily reflect groundwater conditions in the shallow zone. The overall direction of groundwater flow in the southern portion of the Santa Rosa Plain was westerly toward the Laguna de Santa Rosa in the valley trough and ultimately to the northwest. A portion of the 1951 contour map showing the Rohnert Park area is included in Figure 3-21. This map shows that the direction of groundwater flow in the vicinity of the City is generally to the northwest in the study area. South of the study area boundary, the direction of groundwater flow is generally to the southeast toward Petaluma.

There is a groundwater divide between the two watersheds, and Cardwell illustrated the estimated location of the divide with two arrows located approximately midway between the 100-foot elevation contour lines on either side of the divide. The lack of water level data near the divide, and the fact that groundwater elevations north of the divide were very flat in 1951, means that the actual location of the divide could not be precisely determined for this period.

The 1951 water level data and Cardwell's groundwater elevation contours were reevaluated for the WSA, and the results of this review suggested that the divide was located further south than indicated by the arrows on the Cardwell (1958) map. The most likely location of the divide in 1951 is shown on Figure 3-21 as a shaded area in the general vicinity of the CalWater watershed boundary. This is based in part on the location of the divide in the hills east of Cotati where it is much better defined. The groundwater divide clearly lies beneath the watershed boundary east of the Cotati plain and probably continues to follow the watershed boundary to the west. A divide located as far north as suggested by the arrows on Cardwell's map would result in abrupt offsets from the eastern and western portions of the divide that clearly follow the topographic expression of the watershed boundary; such offsets are considered highly unlikely. Furthermore, prior to significant groundwater development in the area, the location of the divide would have mirrored the watershed boundary, and it is unlikely that there was sufficient pumpage in the area prior to or during 1951 to cause the location of the divide to shift.

Two contour maps of equal groundwater elevation in Spring 2004 were prepared for the southern portion of the Santa Rosa Plain Subbasin. Figure 3-22 shows groundwater elevation contours for the shallow zone, and Figure 3-23 shows contours for the intermediate and deeper zones. The shallow zone contour map also includes the Penngrove area to the south (i.e., the northern portion of the Petaluma Valley Groundwater Basin). The shape of the 2004 shallow zone contours and directions of groundwater flow are generally similar to Cardwell's 1951 map (Figure 3-22). The 2004 shallow zone contour map includes data from a number of wells in the Rohnert Park area available from the SWRCB Geotracker web site. The direction of groundwater flow in the shallow zone in the Rohnert Park area is generally westerly, and there is groundwater outflow in this zone from the study area to the rest of the Santa Rosa Plain. The estimated location of the groundwater divide in 2004 is also shown as a shaded area in the general vicinity of the watershed boundary and is essentially the same as the estimated location in 1951. Although there may have been a slight shift to the south since 1951, this cannot be substantiated, and there is no evidence that significant movement of the divide has occurred. The lack of movement is supported by water level hydrographs for shallow wells near the groundwater divide (Figure 3-14), which indicate that shallow groundwater levels have generally been stable for at least the last 15 years. Limited depth to water data is also available for shallow well L828 located in close proximity to the divide. These depth to water measurements, ranging from 8 to 11 feet, represent groundwater elevations of approximately 118 to 121 feet MSL during the 10-year period from 1993 to 2003. These measurements also suggest that shallow groundwater levels near the divide have been relatively stable.

Contour maps of equal groundwater elevation for the intermediate and deeper zones in Spring 2004 are shown on Figure 3-23. This map only shows contours in the study area due to lack of data for deeper wells south of the watershed boundary. Groundwater elevations in the central and western portions of the City are significantly lower than in the shallow zone. The direction of groundwater flow is generally toward the City and toward a cone of depression present beneath the western portion of the City. Unlike the shallow zone, the intermediate zone groundwater elevation contours show a gradient for inflow into the study area from the west.

3.6 Groundwater Quality

Groundwater produced from 31 City of Rohnert Park wells meets primary state drinking water standards. Major cation and anion concentrations, and also trace element concentrations, are summarized in Table 3-3. Overall mineral content for all zones, as indicated by specific conductance (electrical conductance; EC), ranges from 270 to 620 µmhos/cm, while the average EC levels are 300 µmhos/cm in intermediate zone completion wells and 434 µmhos/cm in wells completed in multiple zones. EC values are below the recommended secondary Maximum Contaminant Level (MCL) of 900 µmhos/cm.

Other water quality considerations in the study area include nitrate, arsenic, iron, and manganese concentrations. Nitrate concentrations in City wells perforated in the intermediate zone or in multiple zones range from not detected to 23 mg/L. Thus, nitrate concentrations are less than the primary MCL for nitrate of 45 mg/L. The maximum recorded nitrate values during 2000 to the present in the City's and other local entity wells are shown in Figure 3-24.

While all City wells are below the primary MCL for nitrate, a few wells exhibit increasing concentrations and/or higher than typical concentrations (Figure 3-25) three of these wells are located near Canon Manor (RP-34, -39, and -40). For example, RP-39 had a nitrate concentration of about 7 mg/L in 1991, and nitrate levels exhibited a steady increase to about 12 mg/L in 2003. Similarly, nitrate concentrations in RP-40 were more variable but generally showed a gradual increase from 9 mg/L in 1994 to 14 mg/L in 2003. In RP-34, nitrate concentrations increased sharply from 5 mg/L in 1995 to 21 mg/L in 1996. This was followed by a much slower increase to 23 mg/L in 2001. Todd (2004) concluded that the source of these nitrates is household septic systems, particularly where nitrates are observed in the Canon Manor area. Water samples collected from private wells located in the Canon Manor area have demonstrated nitrate levels exceeding the primary drinking water standard of 45 mg/L.

Samples collected from RP-04, which is predominantly completed in the shallow zone and is located in the southern portion of the City, have an average nitrate concentration of 13 mg/L (Figure 3-25). Notably, this well has highly varied nitrate detections that have ranged from non detect to 30 mg/L. Elevated nitrate levels in the shallow zone may be attributable to additional land use factors.

Arsenic is naturally occurring in the area, and concentrations in City wells range from 2 to 12 go/L with an average of about 5 µg/L (Table 3-3). Figure 3-26 shows the maximum reported arsenic concentration in City wells from 2000 to the present. Arsenic concentrations at the upper end of the range of detected concentrations occur in City wells completed in the northwestern area in the deep and lower zones (well depths greater than 600 feet). Arsenic concentrations in these deeper wells are at levels near or above 10 µg/L (the pending federal MCL effective 2006). A new California MCL for arsenic is in progress. It will be no higher than the federal MCL and could be lower. In the future, treatment for arsenic may be required for any groundwater developed from the lower zone.

Naturally occurring iron and manganese concentrations occasionally exceed the secondary MCLs for these constituents in certain wells. One sample from RP-37 in the southeastern area of the City had an iron concentration that exceeded the secondary MCL of 300 µg/L. Also, one sample from RP-15 in the northwestern area of the City had a manganese concentration that exceeded the secondary MCL (50 µg/L).

Organic chemicals introduced through known point sources could influence groundwater quality conditions. Locations of underground storage tanks and their current status are shown on Figure 3-27. The majority of these sites are closed, but 19 are currently undergoing remediation. No serious or widespread issues that affect community water supplies due to organic chemical sources are known to be present in the City.

3.7 Soil Recharge Characteristics

3.7.1 Recharge Area Mapping by DWR

The development associated with the five Specific Plan areas involves buildings, paving, and other features that may affect recharge. The potential effect of the proposed development on groundwater recharge is discussed in this section. DWR assessed areas of natural recharge in Sonoma County in studies published in 1975 and 1982. The 1975 study covered the entire county and was based on mapping of geologic units (DWR, 1975). The DWR (1982) map of recharge areas focused on the Santa Rosa Plain and was based on data from a U.S. Department of Agriculture (USDA) Sonoma County soil survey (Miller, 1972). The DWR (1982) study was partially based on the methodology and criteria developed by the USGS (Muir and Johnson, 1979) to refine natural recharge locations. Muir and Johnson classified the soil recharge characteristics as good, fair, or poor based on permeability, slope, and underlying geology. Soil permeability was considered the most important factor in determining the recharge potential. DWR used three recharge classifications based on soil permeability and slope in its 1982 study:

- *Recharge Area*: This included soils with an infiltration rate greater than 1.5 centimeters per hour (cm/hr) (0.6 in/hr) and mapped with slopes less than 15% (6.75 degrees).
- *Potential Recharge Area*: This included soils with an infiltration rate greater than 1.5 cm/hr and a range of slopes; if the slope is less than 15%, the area was classified as a recharge area.
- *Slow Recharge Area*: This included soils with infiltration rates less than 1.5 cm/hr or slope greater than 15%.

Based on DWR's definitions and mapping, less than five percent of the study area would be classified as a "recharge area" (DWR, 1982). Most of the DWR recharge and potential recharge areas occur east of the City along stream beds, at the heads of alluvial fans, and on some portions of the Sonoma Volcanics. The remainder of the study area, including most of the City, was classified as a "slow recharge area".

The USGS and DWR recharge classifications are useful for identifying areas with the highest recharge rates but oversimplify recharge conditions by ignoring much of the variability in soil permeability and slope within the study area. The results of an evaluation of soil recharge characteristics conducted for the WSA indicate that a significant amount of recharge could occur annually in some areas designated as "slow recharge areas" by DWR. As described below, a groundwater model developed by PES Environmental, Inc. (PES) was based in part on the DWR recharge classifications. Based on results of the PES modeling effort, it appears that DWR's recharge area definitions and mapping may have resulted in the misconception that recharge in the majority of the Santa Rosa Plain (the "slow recharge areas") is negligible. In order to update the DWR recharge analysis, Geographic Information System (GIS) data were used to delineate areas with different recharge properties based on soil permeability and slope. Geology does not appear to be a limiting factor in the study area because mapped geologic units are sufficiently permeable to not restrict recharge that infiltrates through the soil column.

3.7.2 GIS Mapping of Soil Permeability and Slope

The Natural Resources Conservation Service (a division of USDA) compiled the data contained in the Sonoma County soil survey (Miller, 1972) into a database that allows more detailed mapping of recharge characteristics using GIS software. In the soil database, there are three different permeabilities provided for each soil type and horizon (labeled low, representative, and high) based on ring infiltrometer tests, and data for one to five different horizons are provided for each soil type. The horizon with the lowest permeability was assumed to be the limiting factor for infiltration, and the "representative" permeability for that horizon is plotted on Figure 3-28. This figure shows permeability data from the soil database grouped into five categories: 1) less than 0.5 cm/hr, 2) 0.5 to 1.5 cm/hr, 3) 1.5 to 5 cm/hr, 4) 5 to 15 cm/hr, and 5) greater than 15 cm/hr. The approximate acreage represented by each category is indicated on Table 3-4. Over 18,000 acres (73%) of the study area has a soil permeability of less than 0.5 cm/hr. Soils with permeabilities between 1.5 and 5 cm/hr constitute the next largest category (5,840 acres or 23%).

The GIS data allow the slope of the ground surface to be calculated using a digital elevation model. The slope is calculated as rise over run, which means that a 100% slope is equivalent to 45 degrees. The slopes were grouped into three categories (less than 15%, 15% to 25%, and greater than 25%) and plotted on Figure 3-28 along with the soil permeabilities. The amount of acreage represented by each slope is shown on Table 3-4. As expected, slopes are less than 15% in the majority of the study area (18,800 acres or 75%). Slopes of 15 to 25% occur over

3,200 acres or 13% of the study area, and slopes greater than 25% occur over 3,000 acres or 12% of the study area.

Table 3-4 also shows acreages for different combinations of soil permeability and slope. The highest recharge rate would be expected to occur in areas with the high permeability and low slope, but significant recharge can occur in areas with high permeabilities and high slopes or low permeabilities and low slopes. The various combinations of soil permeability and slope on Table 3-4 have been grouped into four categories of recharge potential for purposes of this WSA. The term "recharge potential" is used because the actual recharge rate is also dependent on other factors such as land use and precipitation patterns. Like the DWR classifications, these categories are based only on soil properties and topography; land use is not considered. The four categories are defined as follows:

- Very low – permeability <0.5 cm/hr and slope >15%;
- Low - permeability <0.5 cm/hr and slope <15%, permeability 0.5-1.5 cm/hr and slope >25%;
- Moderate – permeability 0.5-1.5 cm/hr and slope <15%, permeability 1.5-5.0 cm/hr and slope >15%, permeability >5 cm/hr and slope >25%; and
- High - permeability 1.5-5.0 cm/hr and slope <15%, permeability >5 cm/hr and slope 15-25%.

The division of the study area into recharge potential categories is shown on Figure 3-29. Based on these categories, approximately 8% of the study area has a very low recharge potential, 65% has a low recharge potential, 18% has a moderate recharge potential, and 9% has a high recharge potential. There are some similarities between DWR's recharge classification and the categories shown on Figure 3-29. Typically, soils with a high recharge potential, which occur primarily along stream channels, correspond to the "recharge areas" defined by DWR. However, soils considered to have a moderate recharge potential cover a much larger area in the hills east of the Santa Rosa Plain than DWR's "potential recharge areas".

3.7.3 Recharge in Specific Plan Areas

The location of the five Specific Plan Areas (SPAs) relative to soils with different recharge potentials is also shown on Figure 3-29. Most of the SPAs overlie areas mapped as having a low recharge potential. The acreages of recharge areas within the five SPAs are summarized on Table 3-5. The five SPAs contain a total of 928 acres. Of that total area, 142 acres or 15%, has been designated as open space or buffer zone areas, including parks and creek corridors. Three of the SPAs only overlie soils with a low recharge potential.

Figure 3-30 shows more detail, including designated open space, for the two SPAs (the Northeast and University District) that overlie some soils with a higher recharge potential. These areas contain a total of 656 acres, of which 577 acres overlie soils with a low recharge potential. As shown on Table 3-5, these SPAs overlie approximately 45 acres of soils with moderate recharge potential and 38 acres of soils with high recharge potential. Most of the areas with high recharge potential correspond to the Five Creek, Crane Creek, and Copeland Creek corridors. Almost all of the areas with high recharge potential have been designated as open space or buffer zone, but there are approximately eight acres, mostly along Five Creek, that are not included in the open space/buffer zone area. This represents less than one percent of the total acreage of soils with high recharge potential in the study area. In addition, approximately 33 acres of soil along Crane Creek with a moderate recharge potential are not included in areas designated as open space or buffer zone. This represents less than one percent of the total acreage of soils with a moderate recharge potential in the study area.

The designation of areas with higher recharge potential as open space or buffer zone is one of the protective measures that have been incorporated in the General Plan, its Environmental Impact Report, and its Mitigation Monitoring Program. The affect of development in the SPAs on recharge in the study area is anticipated to be small**.**

3.8 Groundwater Recharge Estimates

Annual groundwater recharge can be defined as the volume of water that moves downward from the ground surface or unsaturated zone to the underlying groundwater system, either naturally or artificially, each year. Sources of recharge include infiltration from precipitation, irrigation return flows, and septic systems and seepage from surface water bodies such as streams and canals. Estimates of groundwater recharge in the Rohnert Park area have been developed by various methods. In 2000, PES used a groundwater flow model to estimate recharge during 1970-1999 for a 17,700 acre study area that included the City. In 2004, Todd developed a water budget to estimate all surface and subsurface inflows and outflows during 1986-2001 for a 25,000 acre study area almost identical to the one used for the WSA. Groundwater recharge was not listed separately in tables in the Todd (2004) report but can be extracted from the water budget as discussed below. A third estimate of groundwater recharge was made for this WSA based on an assessment of the relationship between historical groundwater levels and pumpage.

3.8.1 PES Model and Recharge Estimate

PES developed a numerical groundwater flow model that employed the USGS MODFLOW code for purposes of the DEIR for the Rohnert Park General Plan and specifically to assess the effect of the City’s municipal pumping on groundwater levels (Dyett & Bhatia, 2000). The PES model was based on a simplified conceptualization of the aquifer system that combined all water-bearing zones into a single, unconfined model layer. The relationship between the PES model boundaries and the upper Laguna de Santa Rosa watershed study area used for the groundwater portion of the WSA is shown on Figure 3-31. The major difference between the two study areas is that the PES model did not include the eastern portion of the WSA study area where a significant portion of the groundwater recharge occurs. The PES model grid was bounded by no-flow boundaries, with the exception of a general head boundary along the northwestern edge of the model grid to allow groundwater outflow from the model area. The eastern no-flow boundary did not allow simulation of groundwater inflow from the hills east of the Rohnert Park area. The model area was divided into three recharge zones with simulated recharge rates of 0.01%, 2%, and 18% of direct precipitation based in part on DWR's 1975 and 1982 studies (Pogoncheff, personal communication, 2004). Most of the model area was placed in the 0.01% or 2% recharge category, which resulted in a very low estimate of recharge from precipitation. The DEIR does not indicate whether other sources of recharge such as infiltration from streamflow, irrigation return flows, or septic systems were included in the model.

Based on model results, PES estimated that the average annual recharge rate during the simulation period (1952 and 1970-1999) was 1.6 mgd (about 1,800 AFY) for a model area of 17,700 acres (Dyett & Bhatia, 2000). As further described below, this recharge rate is substantially less than the recharge estimate based on the water budget prepared by Todd (2004) or the estimate based on the assessment of groundwater levels and pumpage conducted for the WSA. Listed below are some of the factors that contribute to the low PES average annual recharge estimate:

- The discussion of the PES model in the DEIR only refers to recharge from precipitation and discharge due to municipal pumpage. If other sources of recharge and discharge are not included in the simulations, estimates of groundwater recharge based on model results would be inaccurate.
- The PES model boundary excludes a significant portion of the eastern part of the WSA study area; this area contains the majority of areas with the most permeable soils and highest recharge potential (see Section 3.7). Groundwater inflow from this area to the PES model area is also not simulated because a no-flow boundary was used along this edge of the model grid.
- Simulation of the aquifer system as a single, unconfined layer ignores the complexity of groundwater flow in the Rohnert Park area, which includes both unconfined and semi-confined aquifers. The simplified model cannot distinguish between the responses of the different aquifer zones to pumping stresses. Specifically, as described in Section 3.5, the shallow zone exhibits a much different (higher) hydraulic head than that of the intermediate and deeper zones. Groundwater levels in shallow zone wells show little variation with time in response to different hydrologic stress periods, while deep wells experience large fluctuations primarily in response to pumping changes. This is not adequately represented with the PES model where the hydraulic head measured in City wells, which are completed in deeper semi-confined aquifers, was used to calibrate the "unconfined" aquifer simulated with the model. Leakage from the shallow zone to deeper zones is not accounted for as a source of recharge to the lower zones.

The calibration period for the PES model is 1970-1989, but the simulation period also included 1990-1999. Groundwater levels were declining during much of the calibration period, and the PES model was apparently able to simulate this condition. Groundwater levels were stable to slightly increasing during the 1990s, however, and this condition cannot be reproduced by the PES model because the amount of recharge used in the model is significantly less than the volume of pumpage. During 1990-1997, for example, the recharge rate estimated by PES averaged about 1.7 mgd, and City pumpage alone averaged 4.5 mgd. Because simulated water levels will decline during any year that outflows exceed inflows, the PES model simulates declining groundwater levels during the 1990s. The recharge rate estimated using the PES model appears to be unrealistic; other recharge estimates are discussed below.

3.8.2 Recharge Estimates Based on Todd Water Budget and WSA Analysis

A water budget provides a means to estimate inflows to and outflows from a basin (or hydrologic study area) and assess the change in groundwater storage occurring during a selected period of analysis. A water budget is also one method that can be employed to estimate groundwater recharge or basin yield.

Todd Engineers prepared a water budget for a study area almost identical to that used for the groundwater portion of the WSA (Todd, 2004). This water budget was prepared for the Canon Manor West DEIR and provided a more comprehensive estimate of inflows to and outflows from the study area during 1986-2001 (water years 1987-2001) than previous investigations. The components of the Todd water budget, as presented in the DEIR, are shown in Table 3-6. The Todd water budget included recharge from direct precipitation, streamflow, irrigation return flows, and septic systems. Although recharge due to these factors is not explicitly shown in Table 3-6, the recharge rate can be derived from other information in the Todd report, as discussed below.

Estimates of inflow and outflow components developed by Todd appear to be reasonable and are generally consistent with the evaluation conducted for the WSA. However, the estimate of groundwater inflow to the study area (999 AFY) appears to be high because it is partially based on the assumption that the groundwater divide has moved to the south since 1951. As described in Section 3-5, reevaluation of the 1951 groundwater level data (Cardwell, 1958) and more recent (2004) shallow groundwater level data show no indication that a significant change in the location of the divide has occurred. As a result, the estimated 664 AFY of subsurface inflow to the study area from the south may be overstated. The revised water budget shown on Table 3-7 shows only the subsurface inflow from the west in the intermediate zone (estimated at 355 AFY). This results in an estimated change in groundwater storage of +151 AFY. The estimated groundwater recharge due to all factors is also summarized on Table 3-7. The average annual groundwater recharge for the study area during the 1986-2001 period of analysis is estimated to be about 8,300 AF based on the Todd water budget.

The recharge estimate developed for the groundwater portion of the WSA is based on evaluation of historical groundwater extraction and water level trends. The analysis is based primarily on data from 1990 to 1997, a period of stable to slightly increasing groundwater levels. Inflows to the study area must exceed outflows during this period during this period in order to support rising groundwater levels. Therefore, the total recharge must be greater than the total pumpage (8,722 AFY) minus the groundwater inflow (355 AFY), or at least 8,400 AFY. Because 1990-1997 was a wetter than normal period, however, the recharge rate for the study area would be expected to be less than 8,400 AFY based on a long-term average. This recharge estimate is consistent with the estimate of recharge based on the Todd water budget for a longer period (1986-2001) that was only slighter wetter than normal.

In summary, the Todd water budget and the method of analysis employed in this WSA provide similar estimates of recharge from a combination of sources that have resulted in a positive change in groundwater storage and stable to slightly increasing water levels from about 1990 to 1997. The observed groundwater level trend supports the computation of a positive change in groundwater storage during this period.

3.8.3 USGS/SCWA Joint Study

The USGS and the Agency have begun a joint groundwater study for the Santa Rosa Plain, and the City of Rohnert Park has supported the planned joint effort (Rohnert Park City Council Meeting and letter of April 13, 2004). Objectives for the five-year study include development of an updated assessment of hydrogeology and geochemistry, quantification of the distribution and quantity of groundwater recharge and discharge, development of refined water budgets, development of a multi-aquifer groundwater flow model, and evaluation of future groundwater management strategies. It is planned that the groundwater flow model will update the physical conceptual model of the groundwater flow system based on new data and results that are being generated from recent and planned USGS studies in the area. It is ultimately planned that the model developed for the Santa Rosa Plain area will link with the models developed by the USGS for other groundwater basins within Sonoma County to facilitate an understanding of multi-basin water management strategies that could be employed for the efficient use of surface and groundwater resources.

3.9 Future Groundwater Supply Sufficiency

The evaluation of future groundwater supply sufficiency is based on planned City pumpage and estimated future pumpage by other entities in the study area. Historically, groundwater served as the predominant source of the City’s supply. As described above, the City has shifted its primary source of water supply from groundwater to surface water supplied by the Agency. This re-operation is planned to continue in the future consistent with the 2004 Water Policy Resolution.

3.9.1 Historical Groundwater Levels and Pumpage

Hydrographs for most shallow zone wells located on the periphery of the City exhibit relatively stable long-term groundwater levels, indicating little response to changes in pumpage or climatic conditions. In contrast, groundwater elevations in intermediate zone wells in the vicinity of the City have shown considerable variation. The subtle groundwater level trends (e.g., changes in elevation on the order of a few feet) observed in the Agency monitoring wells from about 1980 to 1999 provide an indication of the increase or decrease in groundwater levels occurring in response to climatic conditions. This in turn provides an indication of the relative portion of the total observed water level change occurring in City wells located in the central Rohnert Park area that is attributable to climatic conditions versus the effects of local pumping in the semi-confined aquifer system. Groundwater level trends observed in the City's wells, which are almost all completed primarily in the intermediate zone, are due largely to variations in pumpage rather than climatic conditions.

Analyses of the historical groundwater level and pumpage data indicate the estimated range of pumpage within which the City and other pumpers have operated historically without causing persistent groundwater level declines in the intermediate zone. The analysis provides a guide to the pumpage that could be sustained in the study area in the future, under hydrologic and operational conditions comparable to those occurring historically, without resulting in persistent, long-term groundwater level declines that would be considered to represent overdraft conditions. These estimates can be refined as additional data become available.

The relationship between City and total pumpage in the study area and representative groundwater levels in City wells is shown on Figure 3-32. Notably, the shape of the plot of total estimated pumpage generally follows that of the City pumpage. The water level hydrographs shown on this figure include data for five centrally located City wells (RP-01, -10, -11, -14, and -16). The analysis of groundwater elevations and pumpage shows that pumpage increased during the period of relatively stable groundwater elevations from 1977 to 1981. Toward the end of this period (1980-1981), when water levels were stable and prior to the decline that began in 1982, City pumpage and estimated total pumpage averaged about 3,900 and 7,100 AFY, respectively. Pumpage increased significantly from 1981 to 1990, and groundwater levels declined to historical low levels. City pumpage increased at a much slower rate during 1990-1997, with an average of 5,100 AFY. The total estimated pumpage was relatively stable during this period, with an average of 8,700 AFY, and groundwater levels in the intermediate zone in the central Rohnert Park area showed a stable to gradually increasing trend. As a result of the City's reduced pumpage in 2003 and 2004, the total pumpage also decreased significantly, and the groundwater levels increased in response to the reduced pumpage.

Notably, the average total pumpage in the study area in both 1980-1981 and 2003 was about 7,100 AFY, and groundwater elevations in Spring 2004 were similar to the water levels observed in 1980-1981. The similarity between the pumpage/groundwater level responses for these periods further shows the correlation between pumpage and groundwater levels in wells completed in the intermediate zone.
While the completion of all wells in the study area is not known, the majority of the pumpage consists of groundwater extracted from the intermediate zone. Specifically, during 1980-1981 and 1990-1997, approximately 80 percent of the pumpage is estimated to be from the intermediate zone based on the known completion of municipal wells and the likely completion of most agricultural wells in the intermediate zone, and the probable completion of most private wells in the shallow zone (Parsons, 1995). The future correlation between pumpage and groundwater levels for this WSA is based on the assumption that the current distribution of pumpage between the shallow and intermediate zones will not change significantly. Some change in this distribution has occurred since 2003 when substantial reductions in City pumpage began.

3.9.2 Projected Future Pumpage

Figures 3-33 through 3-35 are bar graphs showing historical, current, and projected 2025 pumpage by the City and other entities in the study area. As discussed above, pumpage shown on these graphs consists primarily of groundwater extracted from the intermediate zone, but some pumpage from other zones is also included. Figure 3-33 shows City pumpage, and Figures 3-34 and 3-35 show total estimated pumpage in the study area. Dashed lines shown on these graphs represent pumpage levels that would not be expected to cause long-term groundwater level declines based on the historical data discussed above. The lower dashed line on Figures 3-34 and 3-35 represents the average pumpage in the study area of 7,100 AFY that occurred during 1980-1981 when groundwater levels were generally stable (prior to the large decline that began in 1982). The upper line represents the average pumpage in the study area during 1990-1997 (8,700 AFY) when groundwater levels showed a stable to gradually increasing trend.

Figure 3-33 shows 1970, 1980, 1990, 2003 (current), 2004, and estimated 2025 pumpage by the City. City pumpage increased from 907 AF in 1970 to 3,978 AF in 1980 and 5,222 AF in 1990. City pumpage decreased to 3,556 AF in 2003 and to 1,520 AF in 2004. The 2025 pumpage value shown on the figure is based on the limit of 2.3 mgd (2,577 AFY) specified in the 2004 Water Policy Resolution. This value is much less than the City's historical pumpage during either 1980-1981 (3,900 AFY) or 1990-1997 (5,100 AFY). City pumpage during these periods of relatively stable groundwater levels are shown as dashed lines on the graph.

In 2003, the City's pumpage represented about half of the total estimated pumpage in the study area (Table 3-2). Since groundwater levels are affected by all pumpage, two scenarios were analyzed to evaluate future groundwater supply sufficiency for different levels of non-City pumpage. The first scenario (Figure 3-34) was based on the assumption that pumpage by other entities would remain constant at 2003 levels (about 3,500 AFY). The second scenario (Figure 3-35) was based on the assumption that non-City pumpage would increase by 36% (to about 4,800 AFY).

The five vertical bars on Figure 3-34 represent the historical (1970, 1980, and 1990), current, and future annual groundwater pumpage for the study area. The stacked bars show the breakdown of the total pumpage based on four categories:

- the City of Rohnert Park,
- the City of Cotati and SSU,
- private and commercial, and
- agricultural.

Under this scenario, the total pumpage would decrease significantly by 2025 because the City's pumpage would decrease and other pumpage would remain constant. The total 2025 pumpage for the study area would be about 6,100 AFY. At this pumping rate, groundwater levels would be expected to increase from current levels to levels that would be greater than the 1980-1981 historical levels. The anticipated pumpage/groundwater level response assumes that other conditions are comparable to those observed historically, including the distribution of pumpage between zones.

The second scenario (Figure 3-35) recognizes that the assumption of constant pumpage by other entities in the study area is probably unrealistic. Estimates of future increases in non-City pumpage shown on Table 3-2 are based on water demand estimates made by Todd (2004). The water demand estimates are based on continuation of current levels of residential and commercial development in the area and the number of vacant commercial parcels and allowable dwelling units. The projections are based on build-out rather than a specific time period. For purposes of this WSA, it is assumed that build-out would occur by 2025. Pumpage by the City of Cotati and SSU is projected to increase from 412 to 602 AFY. Private and commercial pumpage is projected to increase from 1,699 to 2,760 AFY. Agricultural pumpage is projected to remain similar to current levels, or about 1,411 AFY. Other factors could contribute to lower estimates of future pumpage, e.g., recycled water for irrigation or other non-potable water uses. The total projected increase in non-City pumpage is from 3,522 to 4,773 AFY, an increase of about 36%. The projected total pumpage for the study area is 7,350 AFY.

The maximum projected total pumpage (7,350 AFY) is slightly more than the study area's historical pumpage during 1980-1981 (7,100 AFY) but less than 1990-1997 historical pumpage (8,700 AFY). Therefore, the maximum projected 2025 pumpage would not be expected to cause long-term groundwater level declines. This is based on the assumption that the pumpage distribution and other factors would not change significantly. Some change in this distribution has occurred since 2003 when substantial reductions in City pumpage began. This meant that a lower percentage of the total pumpage during 2003 was from the intermediate zone. As long as major increases in shallow zone pumpage do not occur, however, the current relationship between groundwater levels and pumpage would be representative of future conditions. Increased pumpage by private and commercial pumpers from the shallow zone could shift the future pumpage distribution. Thus, while the City's pumpage at 2,577 AFY along with other intermediate zone pumpage that remains within historical levels is not expected to result in long-term groundwater level declines, it is not clear how much additional pumpage the shallow zone could sustain. The joint USGS/Agency 5-year groundwater modeling study that is now underway will assist in further analyzing future groundwater pumpage scenarios that may involve additional development of the shallow zone for private domestic and commercial uses.

3.9.3 Summary of Groundwater Supply Sufficiency Evaluation

Pumpage is the predominant factor causing water level changes in intermediate zone and deeper wells. Groundwater levels in the intermediate zone show little response to changes in precipitation. Groundwater levels in the shallow zone for wells located at the perimeter of Rohnert Park exhibit stable historical trends, while groundwater levels in the intermediate zone beneath Rohnert Park declined from 1982 to 1990, gradually increasing until 1997, and stabilizing from 1997 to 2003. Due to the increasing groundwater levels in the intermediate zone since 1990, the 1982-1990 water level decline was not an indication of overdraft conditions. The water level decline was due to the development of a localized cone of depression in the intermediate zone beneath the City area followed by stabilization of that cone at a lower groundwater elevation. There is also no indication of generally declining groundwater levels in the study area or elsewhere in the subbasin in any zone, e.g., there is no indication that overdraft has occurred.

The relationship between historical groundwater levels and pumpage was evaluated from 1977 to 2003, a 26-year period that included several cycles of wet, normal, single-dry, and multiple-dry years. The total study area pumpage that would not be expected to cause long-term groundwater declines is based on groundwater levels occurring in response to pumpage during two periods when levels were either generally stable or increasing, i.e., 1977-1981 and 1990-1997. The lower pumping rate, or more conservative amount of total annual pumpage for the study area (7,100 AFY), that occurred toward the end of the 1977-1981 period when water levels were stable and before the decline in 1982, represents the amount of pumpage that would be anticipated to result in groundwater levels in the intermediate zone comparable to those occurring in the City's wells during this period. The higher pumping rate (8,700 AFY) would be expected to again result in short-term local groundwater level declines followed by a stabilization of groundwater levels at a lower elevation, similar to what occurred during the 1990-

1997 period. Although short-term groundwater level declines from current levels would be anticipated with the higher level of pumpage, long-term groundwater level declines would not be expected since the total projected 2025 pumpage is less than pumpage that occurred during the 1990-1997 period. Therefore, the 2025 pumpage, which includes groundwater extracted by the City to meet 20-year projected water demands and also pumpage by others, would not be expected to result in overdraft conditions in the study area.

During 1990 to 1997 when the City was pumping about 5,100 AFY and the average total study area pumpage was estimated to be 8,722 AFY, water level hydrographs showed stable to slightly increasing groundwater levels. Subsurface groundwater inflow to the study area from the west was estimated to be about 355 AFY (Todd, 2004). Based on these estimates, groundwater recharge from all sources (precipitation, streams, and return flows from irrigation and septic systems) would have been at least 8,400 AFY in order to support rising groundwater levels. The Todd water budget and the analysis conducted for this WSA provide similar estimates of recharge from all sources that resulted in a positive change in groundwater storage and stable to slightly increasing water levels from about 1990 to 1997. The observed groundwater level trend supports the computation of a positive change in groundwater storage.

Total pumpage in 2025 is projected to be a maximum of 7,350 AFY, depending on assumptions about increases in non-City pumpage. Up to 2,577 AFY of the total would be used by the City as one of the sources of supply to meet its 20-year water demands. The total projected pumpage of 7,350 AFY is slightly more than the historical pumpage during 1980-1981 (7,100 AFY) but less than the 1990-1997 historical pumpage (8,700 AFY). Therefore, the 2025 projected pumpage falls within the range of historically sustainable pumpage. The City's projected pumpage of up to 2,577 AFY (specified in the 2004 Water Policy Resolution), along with other projected pumpage in the study area, is not expected to result in long-term groundwater level declines and would be sustainable.

As required for a WSA, the evaluation of water supply sufficiency is based on a 20-year projection that includes all projected demands in the study area. Up to 35% of the total City demand is projected to be supplied by groundwater. Based on evaluation of the historical relationship between pumpage and groundwater levels, the future groundwater supply will be sufficient to meet projected demands by the City and others in normal, single-dry, and multiple-dry years.

4 City-wide Water Demands

4.1 Introduction

In 2000, the City adopted its General Plan. The General Plan sets land-use patterns and population goals. The City's population in 1999 was 41,000. At buildout, the City anticipates a population of 50,400. Jobs in the City are expected to increase from 21,900 in 1999 to 31,600 at buildout.[1] The City is anticipating potential development within five designated Specific Plan Areas (SPAs); the Northwest Area, the Wilfred-Dowdell Area, the Northeast Area, the University District and the Southeast Area. In addition, the City is anticipating infill development, consisting largely of non-residential land uses.

4.2 The Growth Management Ordinance

The City has an adopted Growth Management Ordinance [2] that is intended to provide for orderly build-out of residential development over the General Plan planning horizon. In its simplest form, the Growth Management Ordinance has the effect of limiting the number of residential building permits issued to 225 per year. There are exceptions for affordable housing and provisions to carry over building permits (i.e. if 50 are issued in one year, 400 may be issued the following year, providing a 2-year average of 225 per year).

In October 2003, the City Council adopted Resolution 2003-252 approving a Growth Management Allocation System ("GMAS"). The intent of the GMAS is to provide guidance on the methods used for allocating residential building permits if developers request more permits in a given year than the Growth Management Ordinance allows. The GMAS is intended to "structure growth to ensure that it is not haphazard and that it supports broader planning objectives". While the GMAS system will affect the location of residential development, it will not reflect the rate at which development proceeds. The projections in Table 4-1 reflect the rate of development allowed by the Growth Management Ordinance.

Table 4-1, below presents the anticipated development pattern in 5-year increments from 2005 until 2025. Current land use data in Table 4-1 includes building permits anticipated to be allocated through the end of 2004. The City reaches General Plan build-out in 2020. The specific development projects described in Chapter 1 are anticipated to be complete by approximately 2015.

The total number of residential units at buildout shown in Table 4-1 is slightly higher than presented in the General Plan. This is the result of detailed, local research on total housing units performed for the City's Public Facilities Financing Plan. This research indicated that the Statewide estimates used in the General Plan to represent total housing units in 2000 are slightly lower than the local records indicate. This slightly higher

[1] Table 2.3-3: General Plan Buildout: Population and Jobs, General Plan
[2] Chapter 17.66 of the Rohnert Park Municipal Code.

baseline in included in Table 4-1. The total new housing units projected in Table 4-1 are consistent with the General Plan.

Table 4-1

Projected Development Pattern

Customer Type	***Unit***	***Current***	***2005***	***2010***	***2015***	***2020***	***2025***
SFR Detached	EA	7,492	7,492	8,352	8,737	8,993	8,993
SFR Attached	EA	3,039	3,039	3,518	3,631	3,744	3,744
MFR & Mobile	EA	6,035	6,035	6,696	7,336	7,867	7,867
Comm/Retail	AC	311	322	407	437	467	467
Industrial	AC	320	328	371	436	500	500
Office	AC	47	47	54	68	77	77
Public	AC	93	93	93	93	93	93
Subtotal							
Irrigation-potable	AC	70	70	28	28	28	28
Irrigation-recycled	AC	452	452	536	546	546	546

4.3 Current and Projected Demands

The City's historic demand pattern is difficult to track because the City only recently installed residential water meters. Because of this historical demand data is available from only in totals and not be individual customer types. The UWMP lists the City's historic demands at 7,045 AFY in 1993, 7,695 AFY in 1999 and 7,778 AFY in 2000. The City's 2003 data, which does include some of the first data from the residential metering program indicates a total demand of 7,789 AFY.

Projected water demands are based on the unit demand rates consistent with existing City data and good engineering practices. The City currently models water demand by unit type (i.e. gallons per day per Single Family Dwelling Unit or gallons per day per Commercial Retail Acre) not by population equivalent (gallons per day per person or employee). This convention is carried forward into Table 4-2 because it is consistent with existing data. Under the City's convention, dwelling units and developed acreage are substitutes for population. Table 4-2 presents the projected demand scenarios accounting for both potable and recycled water. Demand classes are consistent with guidance provided by Department of Water Resources for SB 610 reporting.

The City has installed irrigation meters on large landscape accounts and the Subregional system has a similar metering program for recycled water accounts. The "Irrigation" categories outlined in Table 4-2 include separately metered irrigation accounts, not irrigation that occurs through residential meters. The demand analysis includes conversion of portions of the existing irrigation demand from potable to recycled water in 2010. This is consistent with the IRWP. The City has adopted a Water Waste Ordinance that requires the use of recycled water, when it is available, for appropriate uses.

Table 4-2

Water Demand Projections

Customer Type	*Unit*	*Current**	*2005*	*2010*	*2015*	*2020*	*2025*
SFR Detached	AFY	3,241	3,241	3,285	3,437	3,538	3,538
SFR Attached	AFY	983	983	1,115	1,145	1,181	1,181
MFR & Mobile	AFY	1,009	1,076	1,171	1,275	1,368	1,368
Comm/Retail	AFY	680	704	890	955	1,021	1,021
Industrial	AFY	524	537	607	714	819	819
Office	AFY	51	51	59	74	84	84
Public	AFY	102	102	102	102	102	102
Subtotal		6,591	6,694	7,229	7,702	8,112	8,112
Irrigation-potable	AFY	159	159	85	85	85	85
Irrigation-recycled	AFY	1,040	1,040	1,256	1,302	1,302	1,302

*"Current" reflects data through December 2003

4.4 Demand Management

The City is a signatory to the California Urban Water Conservation Council's MOU and reports annually on its implementation of Best Management Practices for Water Conservation. This reporting satisfies the SB 610 descriptions for demand management in the Normal Year.

The City has adopted an Ordinance establishing a Water Shortage Emergency Plan. This ordinance describes the demand management programs implemented and demand reduction achieved during dry years. The ordinance is consistent with the Agency's Urban Water Management Plan. The ordinance provides for a 10% voluntary reduction at all times (consistent with the Water Waste Ordinance and included in the baseline demand calculations) and 20% and 30% reductions as necessary to respond to curtailed supply in the event of a drought. The demand estimates in Table 4-2 reflect a 10% voluntary reduction for existing users phased-in between the present and 2010. Demand projections for new development are based on unit water use data that reflects water efficient appliances.

Table 4-3 below outlines the anticipated water demands at General Plan buildout for the normal water year and with the 20% and 30% curtailments that could be implemented in the event of drought.

5 Sufficiency Analysis

5.1 Introduction

SB 610 requires that the Lead Agency make findings related to supply sufficiency under the normal, single dry and multiple dry year planning scenarios. This Chapter makes the comparisons between water demands and supply based on the supply data and analysis outlined in Chapters 2 and 3 and the demand data and analysis outlined in Chapter 4.

5.2 Summary of Water Supplies

Table 5-1 below, summarizes the water supplies available to the City under a range of hydrologic conditions. This summary presents the City's Agency supply system in its current condition and without the benefit of the proposed Water Project. The groundwater portion of the WSA (Chapter 3) has analyzed the City's projected future pumpage and also considered additional pumpage by others in the watershed. Sufficient groundwater supplies occur in the study area to allow City pumpage consistent with the Water Policy Resolution.

Table 5-1

Total Water Supply Available to the City

Total Water Supply Available to City in AFY	*Current Water Supply Conditions*	*Single Dry Year*	*Multiple Dry Years*			*Full Agency Allocation*
Sonoma County Water Agency	6,476	5,250	6,000	6,000	6,000	7,500
Recycled Water	1,302	1,302	1,302	1,302	1,302	1,302
Groundwater	2,577	2,577	2,577	2,577	2,577	2,577
Totals	**10,355**	**9,129**	**9,879**	**9,879**	**9,879**	**11,379**

5.3 Normal Year Sufficiency Analysis

Table 5-2 provides supply and demand information for the Normal Water Year in 5-year increments from 2005 to 2025. This analysis is presented reflecting the impaired condition of the Agency's system for the entire planning period. Supply is sufficient to meet demand throughout the planning horizon.

Table 5-2

Normal Year Sufficiency Analysis

Normal Year Supply and Demand Comparison	*Current**	*2005*	*2010*	*2015*	*2020*	*2025*
Water Demand in AFY						
Total Non-Irrigation Demands	6,591	6,694	7,229	7,702	8,112	8,112
Irrigation from the Potable System	159	159	85	85	85	85
Irrigation from the Recycled Water System	1,040	1,040	1,256	1,302	1,302	1,302
Total	**7,789**	**7,893**	**8,570**	**9,088**	**9,499**	**9,499**
Water Supplies in AFY						
SCWA Supply	3,194	6,476	6,476	6,476	6,476	6,476
Groundwater Supply	3,556	2,577	2,577	2,577	2,577	2,577
Recycled Water Supply	1,040	1,040	1,256	1,302	1,302	1,302
Total	**7,790**	**10,093**	**10,309**	**10,355**	**10,355**	**10,355**
Sufficiency (Supply Less Demand)	**0**	**2,200**	**1,739**	**1,267**	**856**	**856**

* Current Sufficiency Calculation reflects actual demand and actual supply through December 2003.

5.4 Dry Year Sufficiency Analysis

Table 5-3 outlines the supply and demand patterns at buildout under Normal, Single Dry and Multiple Dry Years. Table 5-3 incorporates demand reductions consistent with the City's Water Shortage Emergency Plan during the single and multiple dry years. In all cases, supply is sufficient to meet demand.

Table 5-3

Dry Year Sufficiency Analysis

Dry Year Supply Demand Comparison	*Normal*	*Single Dry*	*Multiple Dry*		
			1	*2*	*3*
Water Demand in AFY					
Total Non-Irrigation Demands	8,112	6,490	7,301	7,301	7,301
Irrigation from the Potable System	85	68	76	76	76
Irrigation from the Recycled Water System	1,302	1,302	1,302	1,302	1,302
Total	**9,499**	**7,859**	**8,679**	**8,679**	**8,679**
Water Supplies in AFY					
Agency Supply*	6,476	5,250	6,000	6,000	6,000
Groundwater Supply	2,577	2,577	2,577	2,577	2,577
Recycled Water Supply	1,302	1,302	1,302	1,302	1,302
Total	**10,355**	**9,129**	**9,879**	**9,879**	**9,879**
Sufficiency (Supply Less Demand)	**856**	**1,269**	**1,200**	**1,200**	**1,200**

5.5 Water Resources Management Strategy

The City intends to pursue a conjunctive use strategy with its three supply sources. During Normal and Above Normal Water years, the City would meet demands using its Agency allocation and recycled water first, minimizing its demands on groundwater and allowing the groundwater basin to recharge during these periods.

In dry and multiple dry years, the City will continue to use recycled water to the maximum extent possible. During these periods, the City anticipates some cutbacks in its Agency allocation may occur as provided for under the 11th Amended Agreement. The City will implement demand curtailment measures consistent with its Water Shortage Emergency Plan and the City will utilize its groundwater resources.

5.6 Projects and Permits Necessary to Accomplish the Program

1. The City has adopted a Water Waste Ordinance that prohibits waste of water (consistent with the recommendations of the California Urban Water Conservation Council) and requires the use of recycled water when it is available. The City has also adopted a Water Shortage Emergency Plan Ordinance that gives it the authority to implement demand management. These policy tools are in place and can be used to achieve the demand management and recycled water supplies outlined in this assessment.

2. The City's water model indicates a need to extend a new water transmission main from the Agency aqueduct to the proposed East-side developments and to make several other modifications to the distribution system to provide adequate water service. These improvements are under design. The City has approved a Public Facilities Finance Plan and adopted Mitigation Fees, as authorized by Government Code Section 66000 et. seq. to fund this construction. Work is expected to be complete in 2006.

3. The Santa Rosa Subregional Water Reclamation System has approved a Programatic EIR for its long-term Incremental Recycled Water Program (IRWP). Expansion of the recycled water system serving Rohnert Park is included in the IRWP. The City has applied for a State grant to complete the planning of the recycled water system expansion.

   The recycled water system expansion will include the construction of a recycled water storage reservoir (with approximately 300 AF of capacity) and extension of the recycled water transmission system to connect the new reservoir to the existing recycled water system. The City is current negotiations with the proponents of the University District Specific Plan and the Subregional system to move forward with the project implementation. The proponents of the University District Specific Plan have acquired and are proposing to contribute a site for the reservoir. Conceptual design has also been completed by the proponents. The conceptual design and siting will be presented to the Subregional System.

   The City has approved a Public Facilities Finance Plan and adopted Mitigation Fees to fund this construction. The plan will be revised as necessary to incorporate the full scope of the project. Work is expected to be complete in 2008.

4. The City has initiated a number of activities to manage its groundwater supply and ensure supply sufficiency. These include:
   - Decreased groundwater use and increased use of Agency water;
   - Expansion of its groundwater monitoring program;
   - Expansion of its water conservation program;
   - Continuation and expansion of recycled water use for irrigation;
   - Protection of groundwater recharge areas; and
   - Support of the planned joint USGS and Agency Santa Rosa Plain Subbasin study.

5. The Agency anticipates issuing a new Notice of Preparation for the Water Project EIR in 2005 and anticipates it will release its Draft EIR for public review by May 2006, after completion of its Urban Water Management Plan 2005. A Final EIR is scheduled for completion in May 2007, and EIR certification and project approval could be considered by the Board by the early summer of 2007.

Completion of the Water Project will allow the City to access its full 7,500 AFY allocation of Agency supply. The WSA documents that the City has adequate supply without the completion of the Water Project.

5.7 Regulatory Requirements for Delivery of Water Supply

The City's supply sources comply with all current regulatory standards. The City will continue to monitor its system in accordance with its permit from the Department of Health Services.

References

Allen, James, 2003, Stratigraphy and tectonics of neogene strata, Northern San Francisco Bay Area: San Jose State University, M.S. Thesis, 183 p.

California Department of Water Resources, 1975, Evaluation of ground water resources, Sonoma County: Volume I, Geologic and Hydrologic Data, Bulletin 118-4, 177 p.

California Department of Water Resources, 1982, Evaluation of ground water resources, Sonoma County: Volume 2, Santa Rosa Plain, Bulletin 118-4, 107 p.

California Department of Water Resources – Central District, 1987, Santa Rosa Plain ground water model: unnumbered report, 318 p.

California Department of Water Resources, 2002, Draft Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001.

California Department of Water Resources, 2004, Groundwater basin descriptions posted on DWR's website.

Cardwell, G.T., 1958, Geology and ground water in the Santa Rosa and Petaluma Valley areas, Sonoma County, California: U.S. Geological Survey, Water-Supply Paper 1427, 273 p.

Clahan, K.B., Bezore, S.P., Koehler, R.D., and Witter, R.C., 2004 – Draft, Geologic map of the Cotati 7.5' Quadrangle, Sonoma County, California: A Digital Database, California Geological Survey – In preparation.

Dyett and Bhatia, 2000, Rohnert Park general plan, revised draft environmental impact report: prepared for the City of Rohnert Park Department of Planning and Community Development.

Economic and Planning System, Inc., 2003, Draft report Sonoma County land use audit: for Greenbelt Alliance and Sonoma County Farm Bureau.

Fox, Jr., K.F., Sims, J.D., Bartow, J.A., and Helley, E.J., 1973, Preliminary geologic map of Eastern Sonoma County and Western Napa County, California: U.S. Geological Survey, Misc. Field Studies, MF-483, 4 Sheets, Scale 1:62,500.

Huffman, M.E. and Armstrong, C.F., 1980, Geology for planning in Sonoma County, California: California Division of Mines and Geology, Special Report 120, 31 p.

Lee, C.H., 1914, The determination of safe yield of underground reservoirs of the closed-basin type: American Society of Civil Engineers, Papers and Discussions, Volume XL, Number 4, pgs 817-887.

Mann, J. F., 1968, Safe Yield and Overdraft: Concepts and Methods of Evaluation, Section 4.

McLaughlin, R.J. and Sarna-Wojcicki, A., 2003, Geology of the Right Stepover Region between the Rodgers Creek, Healdsburg, and Maacama Faults, Northern San Francisco Bay Region: U.S. Geological Survey, Open-File Report 03-502.

Mendenhall, W.C., 1908, Ground waters and irrigation enterprises in the foothill belt, Southern California: U.S. Geological Survey, Water-Supply Paper 219, 180 p.

Miller, V. C., 1972, Soil survey in Sonoma County California: U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the University of California Agricultural Experiment Station, 188 p.

Muir, K.S. and Johnson, M.J., 1979, Classification of ground water recharge potential in three parts of Santa Cruz County, California: U.S. Geological Survey Water Resources Investigation, Open-File Report 79-1065.

Parsons Engineering Science, Inc., 1995, Evaluation of groundwater supply alternatives, water supply and transmission system project: prepared for Sonoma County Water Agency, 25 p.

Peters, H. J., 1981, Groundwater basins: in Concepts of Groundwater Management, Notes for University of California, Davis Extension Course, section 3.

Slade, R.C. and Associates, 2004, Preliminary hydrogeologic evaluation of existing municipal-supply water wells City of Rohnert Park: for Brelje and Race Consulting Engineers, and City of Rohnert Park.

Sonoma County Water Agency, revised 1983, Flood control design criteria manual for waterways, channels and closed conduits, 52 p.

Sonoma County Water Agency, 2000, Urban water management plan 2000.

State Water Rights Board, 1962, Report of Referee.

Todd, D.K., 1980, Groundwater Hydrology, Second Edition: John Wiley & Sons.

Todd Engineers, 2004, Canon Manor West Subdivision Assessment District groundwater study: for Sonoma County.

U.S. Geological Survey, 2003, Draft - Evaluation of the ground-water resources of the Santa Rosa Plain, May 23, 2003.

Wagner, D.L. and Bortugno, E.J. – Compliers, 1982, Geologic map of the Santa Rosa Quadrangle: California Division of Mines and Geology, Regional Geologic Map Series, Map No. 2A, Scale 1:250,000

Weaver, C.E., 1949, Geology and mineral deposits of an area north of San Francisco Bay: California Division of Mines and Geology, Bulletin 149, 135 p. (*also Geol. Soc. America, Memoir 35*).

Figures

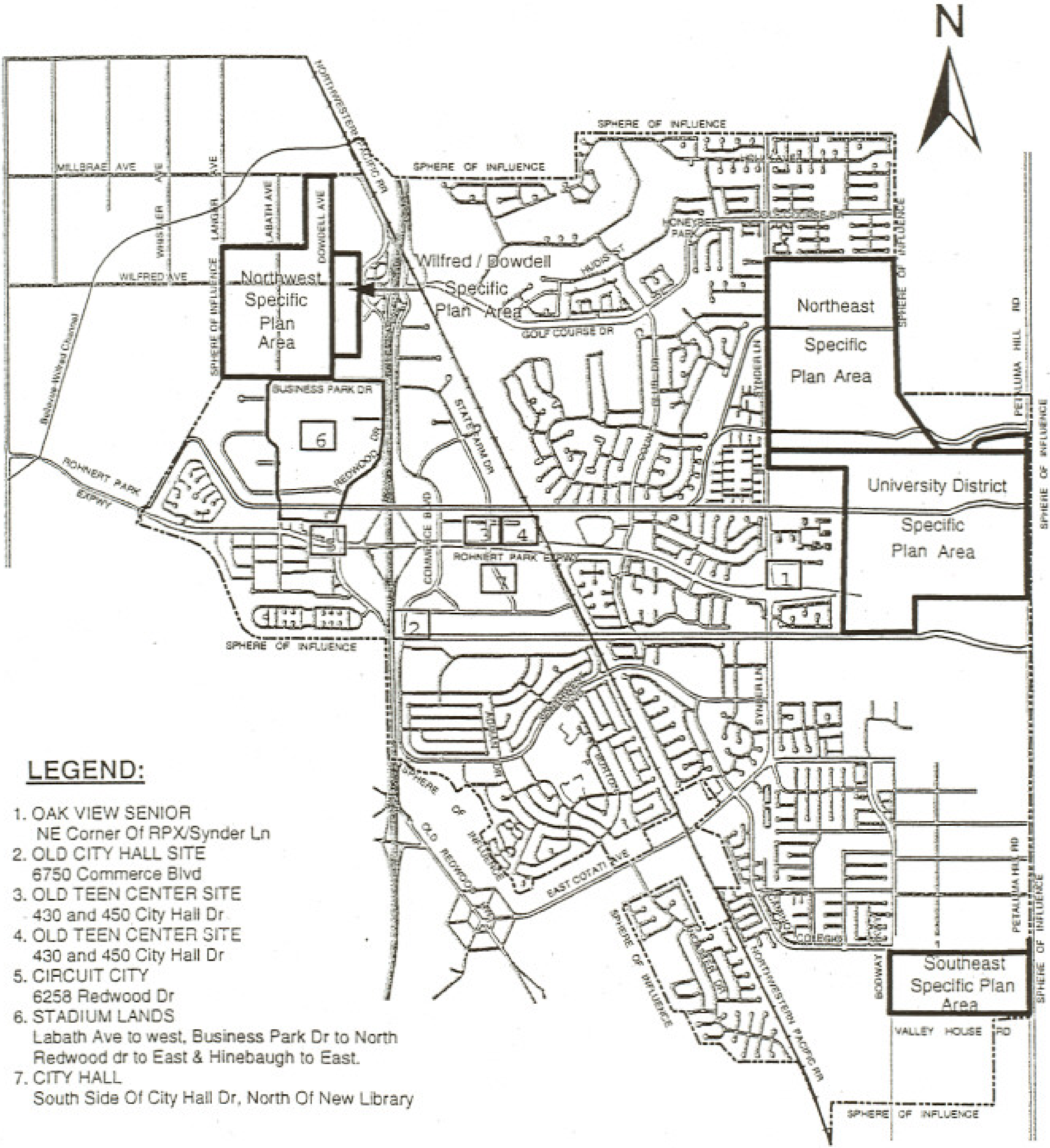

Figure 1 Specific Planning Areas

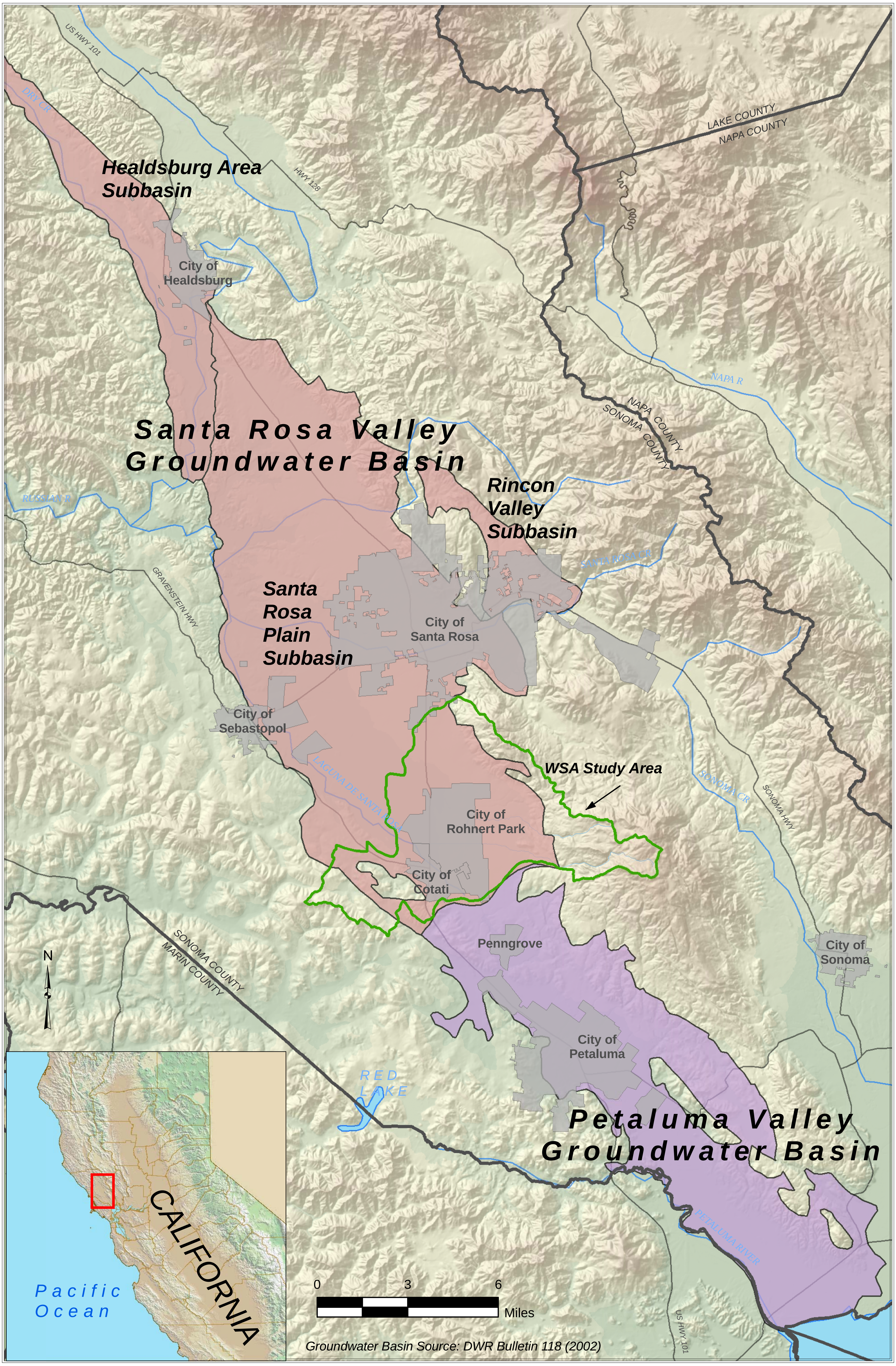

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Figure 3-1
Groundwater Basins and Subbasins
City of Rohnert Park WSA

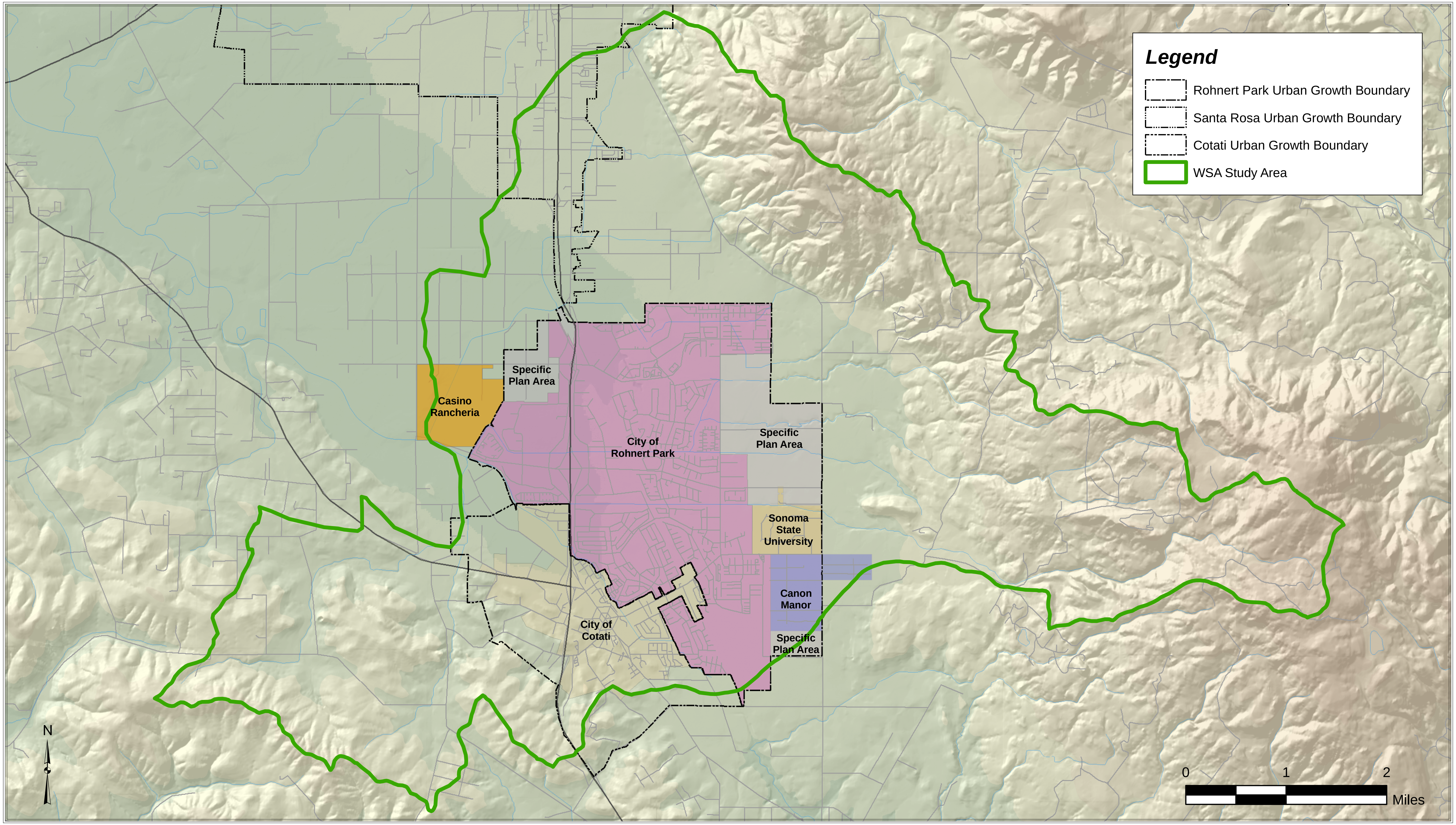

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Figure 3-2
Political Boundaries in Study Area
City of Rohnert Park WSA

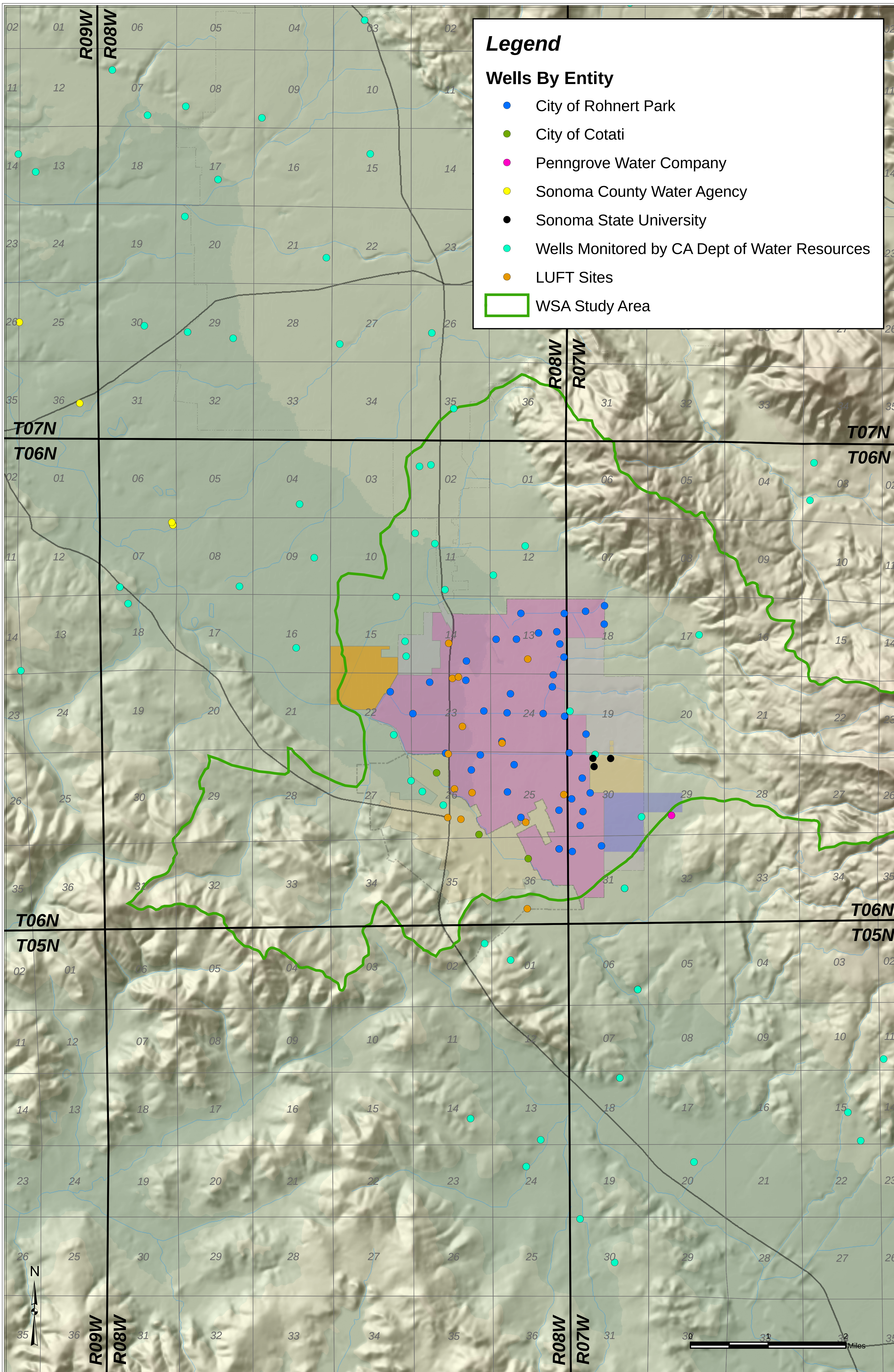

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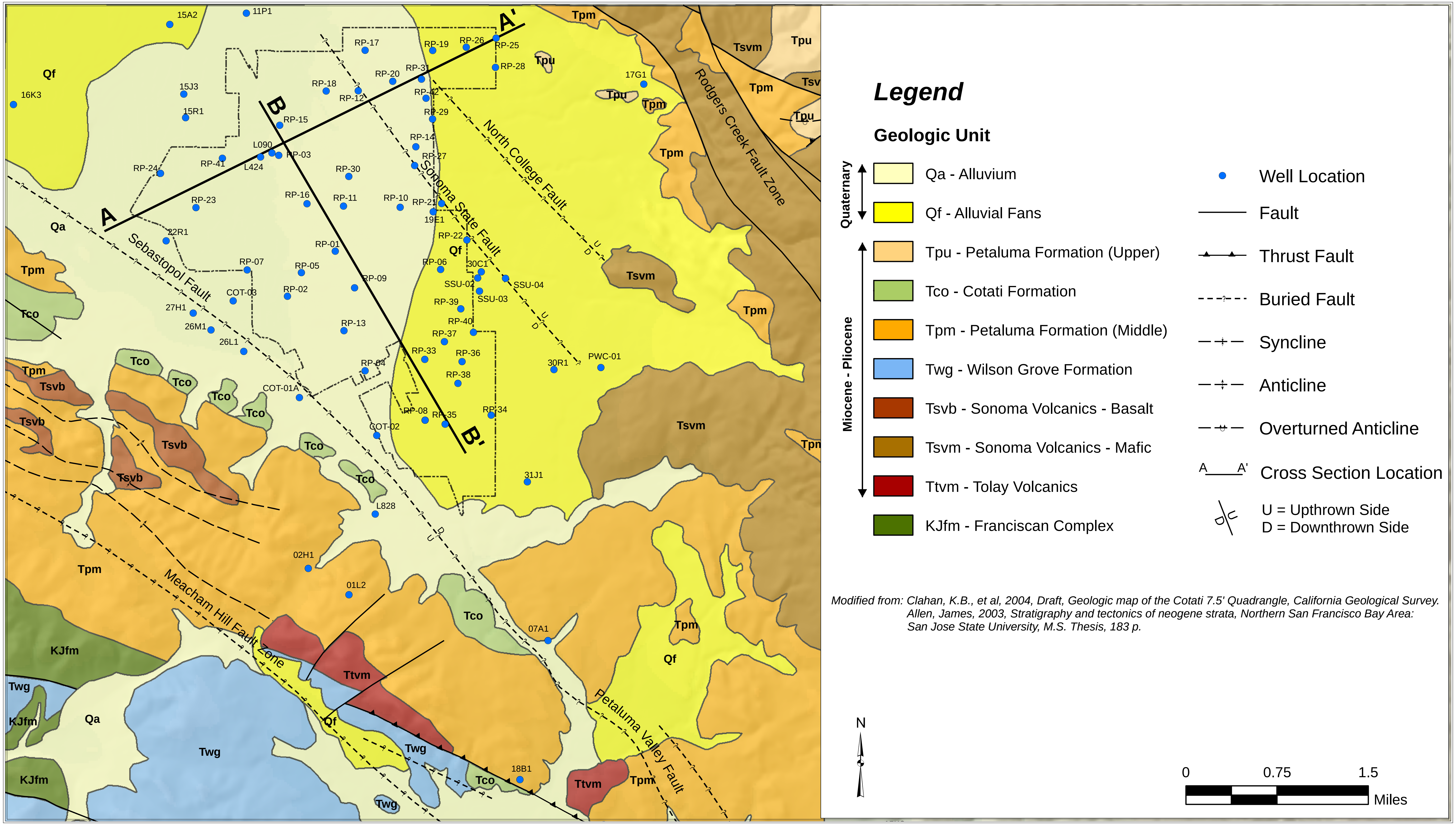
Figure 3-3
Locations of Wells with Water Level or Water Quality Measurements
City of Rohnert Park WSA



Modified from: Clahan, K.B., et al, 2004, Draft, Geologic map of the Cotati 7.5' Quadrangle, California Geological Survey. Allen, James, 2003, Stratigraphy and tectonics of neogene strata, Northern San Francisco Bay Area: San Jose State University, M.S. Thesis, 183 p.

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Figure 3-4
Geologic Map of Rohnert Park and Vicinity
City of Rohnert Park WSA

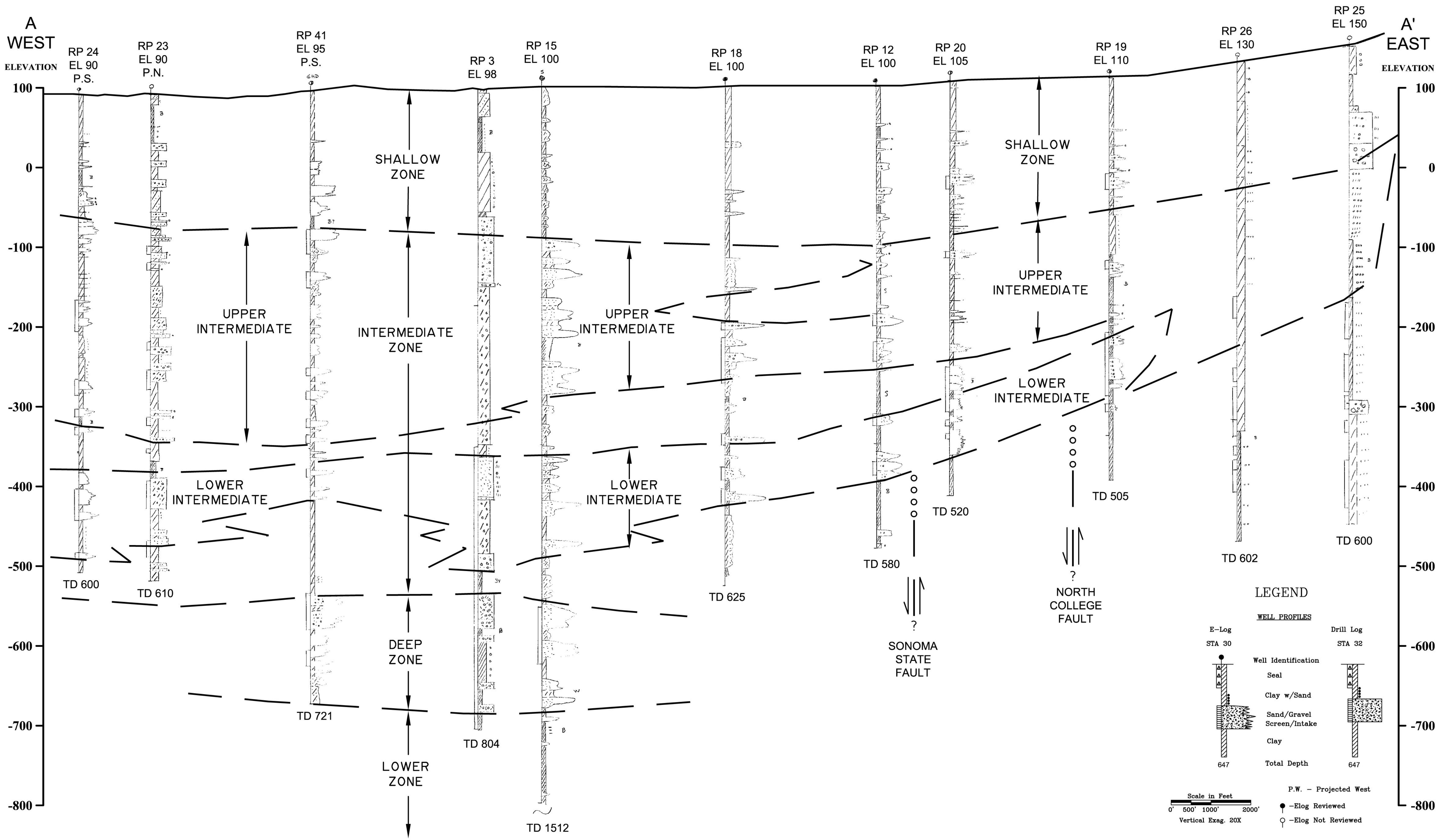

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Figure 3-5
Geologic Cross Section A-A'
City of Rohnert Park WSA

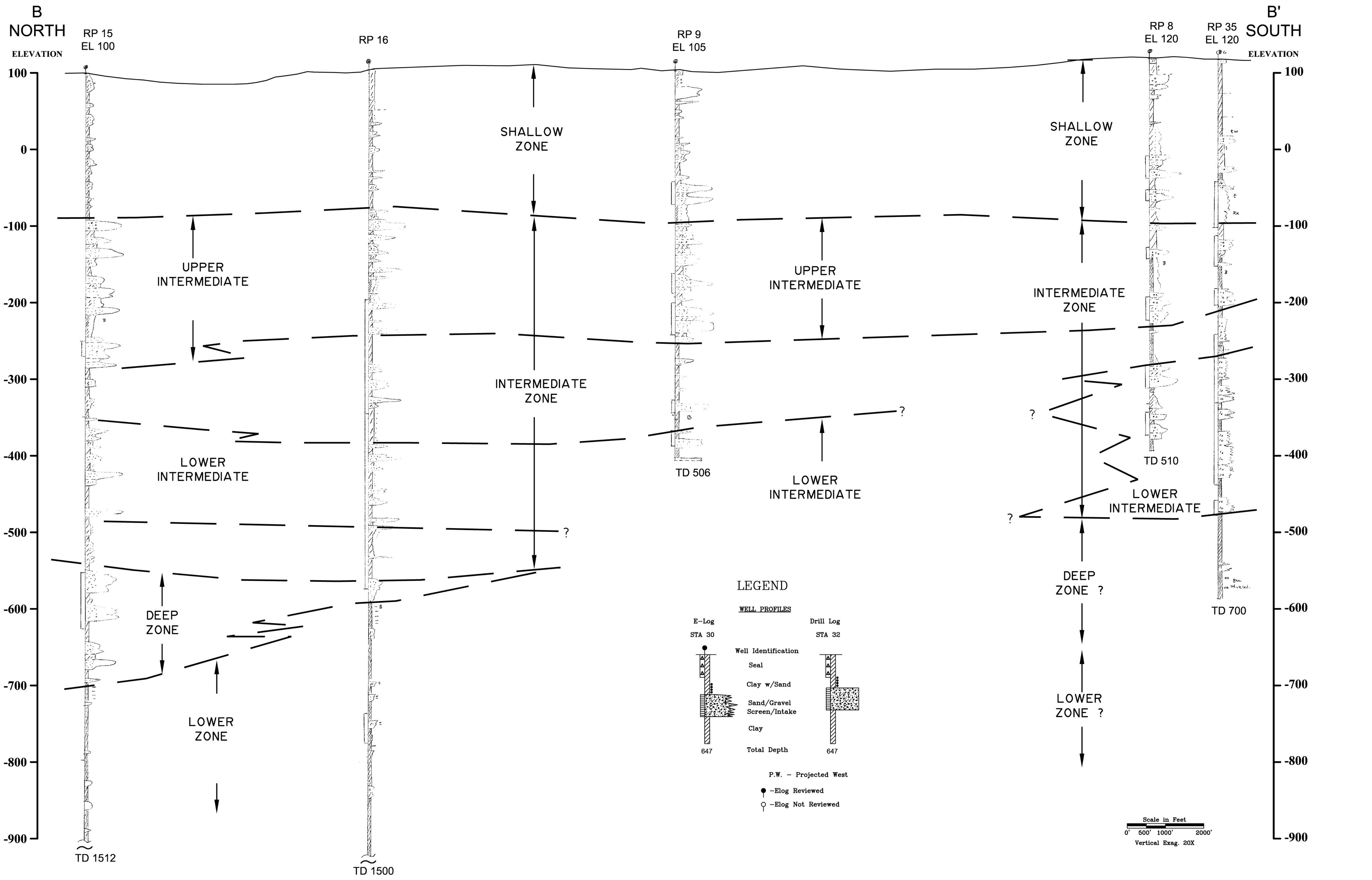

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Figure 3-6
Geologic Cross Section B-B'
City of Rohnert Park WSA

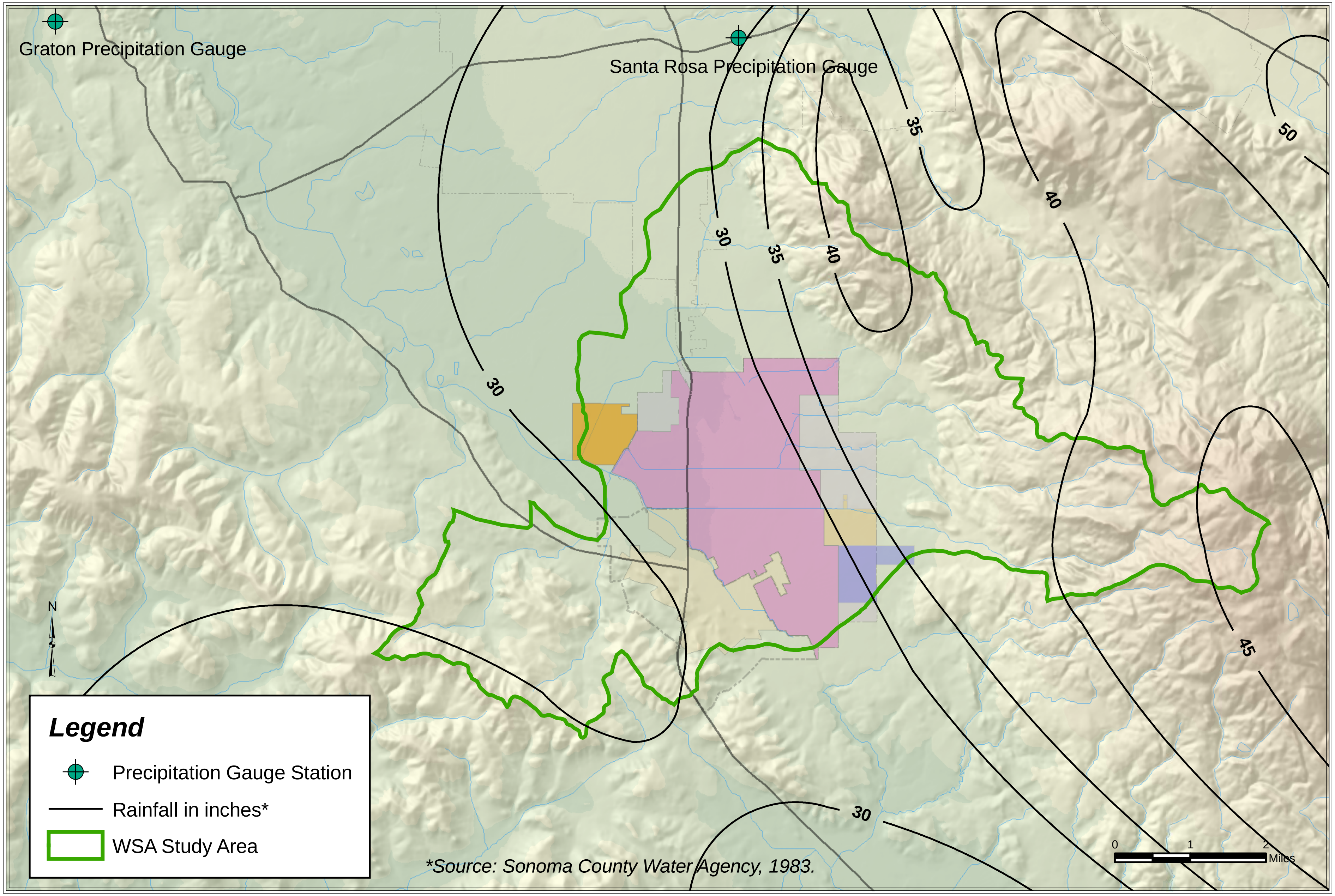

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Figure 3-7
Contours of Mean Annual Precipitation in Study Area
City of Rohnert Park WSA

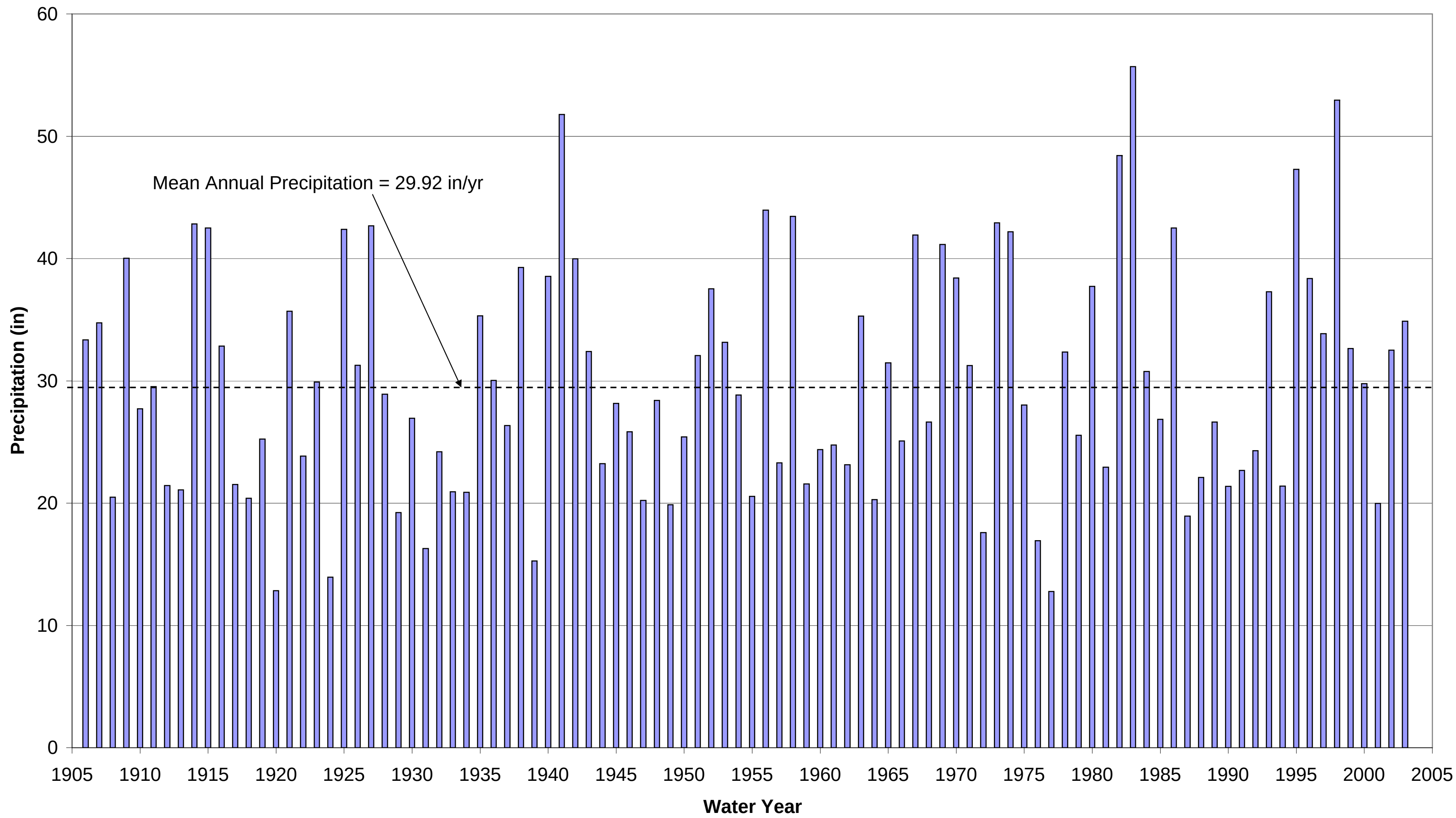

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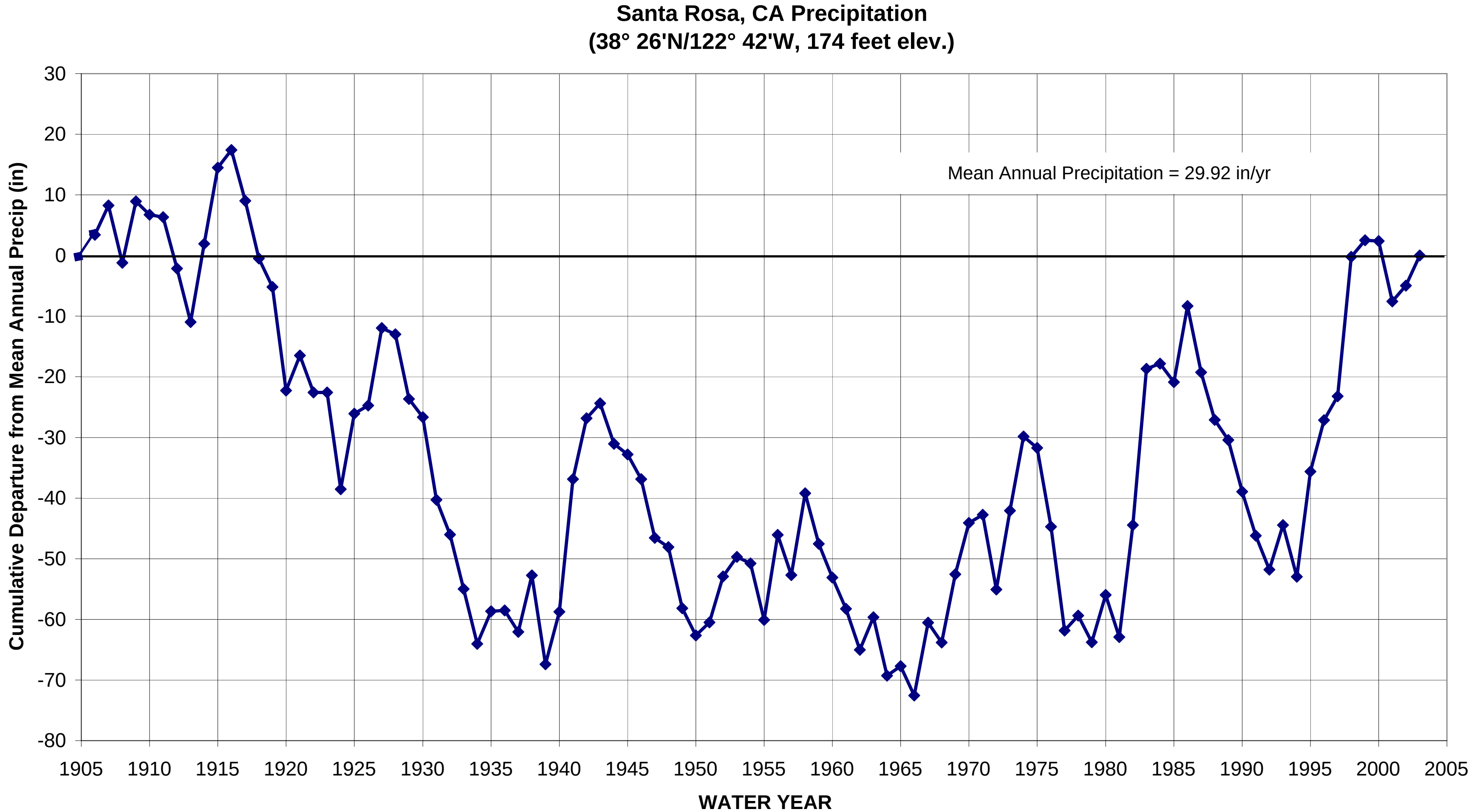
Figure 3-8
Annual Precipitation at Santa Rosa Gauge Water Year 1906-2003
City of Rohnert Park WSA



1906-1965 Santa Rosa Station monthly precipitation data from California Data Exchange Center (38°26.7'N / 122°45'W, 109 feet elev)
1931-2003 Santa Rosa Station monthly precipitation data from National Climatic Data Center. Missing data (Aug '37, Jan-May '79, Apr-May '00 and Mar-May '01) approximated using correlation with Graton Station (38°26'N / 122°52'W, 200 feet elev).

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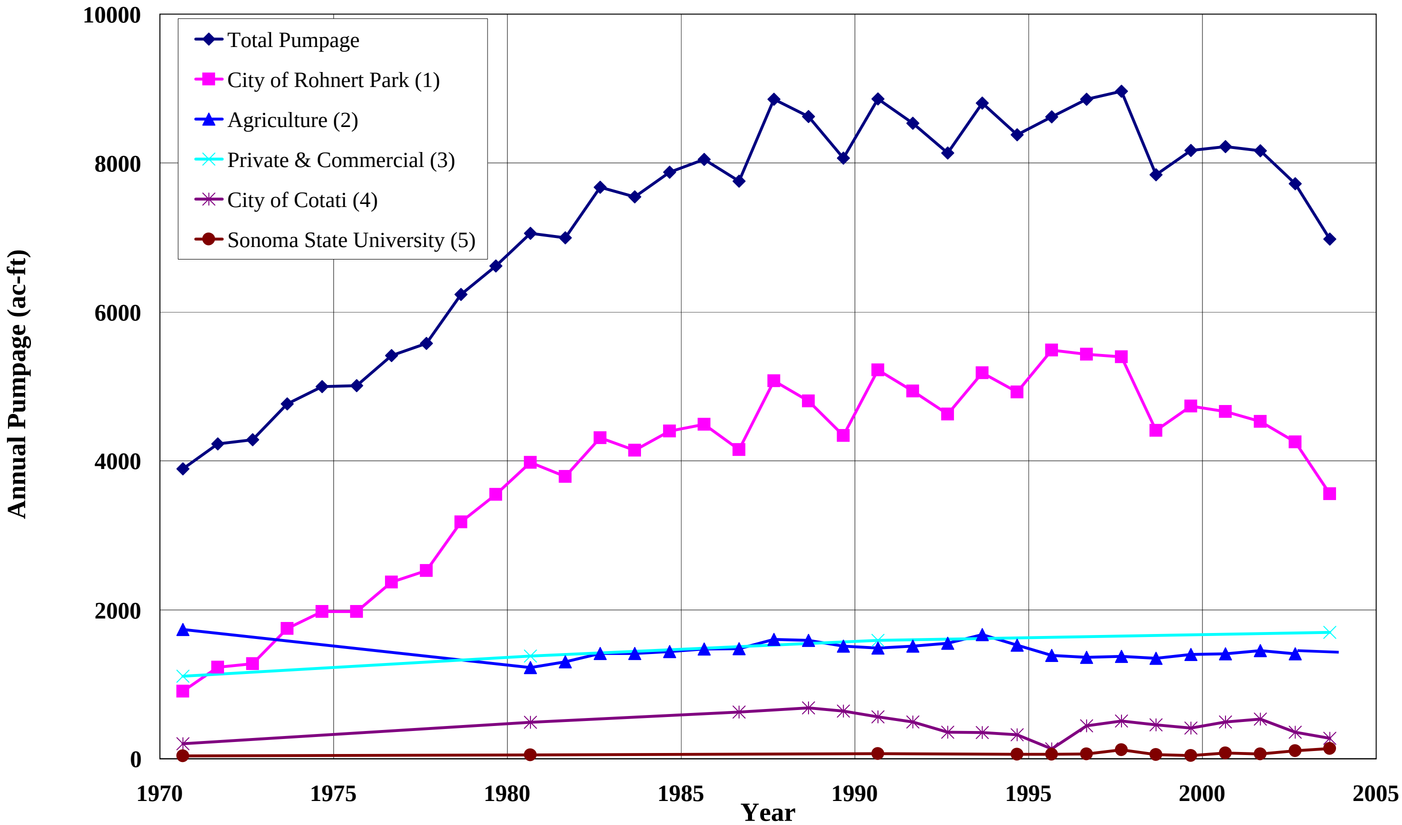
Figure 3-9
Cumulative Departure from Mean
Annual Precipitation at Santa Rose Gauge
City of Rohnert Park WSA



(1) City of Rohnert Park: City provided monthly pumpage totals by well for 1972 to 2003. Todd provided annual pumpage for 1970 and 1971.

(2) Agriculture: 1986 pumpage value reported by Todd (2004). Variation during 1980-2002 based on Figure 3 "Harvested Acreage" (Sonoma County Land Use Audit by Economic Planning Systems, Inc. http://www.epsys.com/client_site /12140 SCLUA/12140draft.pdf). 1970 value based on Sonoma County Farm Bureau crop report. 2002 estimate also used for 2003.

(3) Private and Commercial: Todd (2004) provided a 2003 pumpage estimate (current). The City provided population estimates for 1990 and 2000 for unincorporated watershed area based on census block group maps. 1970 and 1980 unincorporated watershed population percentage increase derived from "unincorporated" population for the county (Economic & Planning System, Inc., 2003, Draft Report. Sonoma County land use audit, for: Greenbelt Alliance and Sonoma County Farm Bureau, October 2003). Todd's (2004) multi-family and single-family water demands were applied to the estimated units based on rural population to determine pumpage for 1970 to 2000. Commercial and Accommodations pumpage assumed the same annual percentage change as calculated for private users.

(4) City of Cotati: 1986/1988-2003 annual pumpage provided by Todd. 1970 to 1985 and 1987 pumpage based on 1970, 1980, and 1990 census population data. Pumpage estimated by population and reduced for estimated Agency deliveries.

(5) Sonoma State University: 1994-2003 annual pumpage provided by Todd (persional communication). 1970 to 1993 annual pumpage based on SSU studen population for 1970, 1980, and 1990 from "System and Campus Enrollment" and an average water use per student (1994-2003).

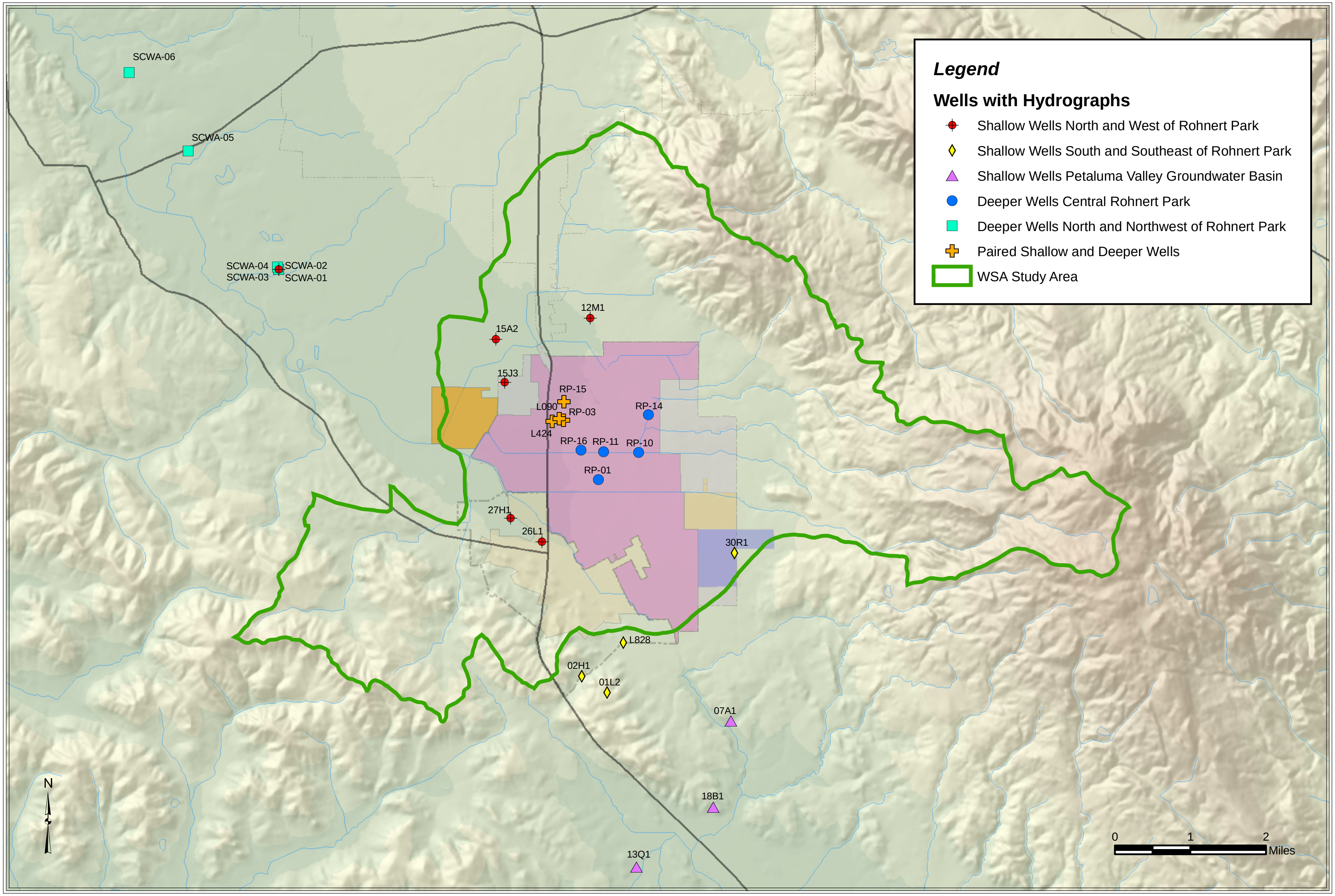


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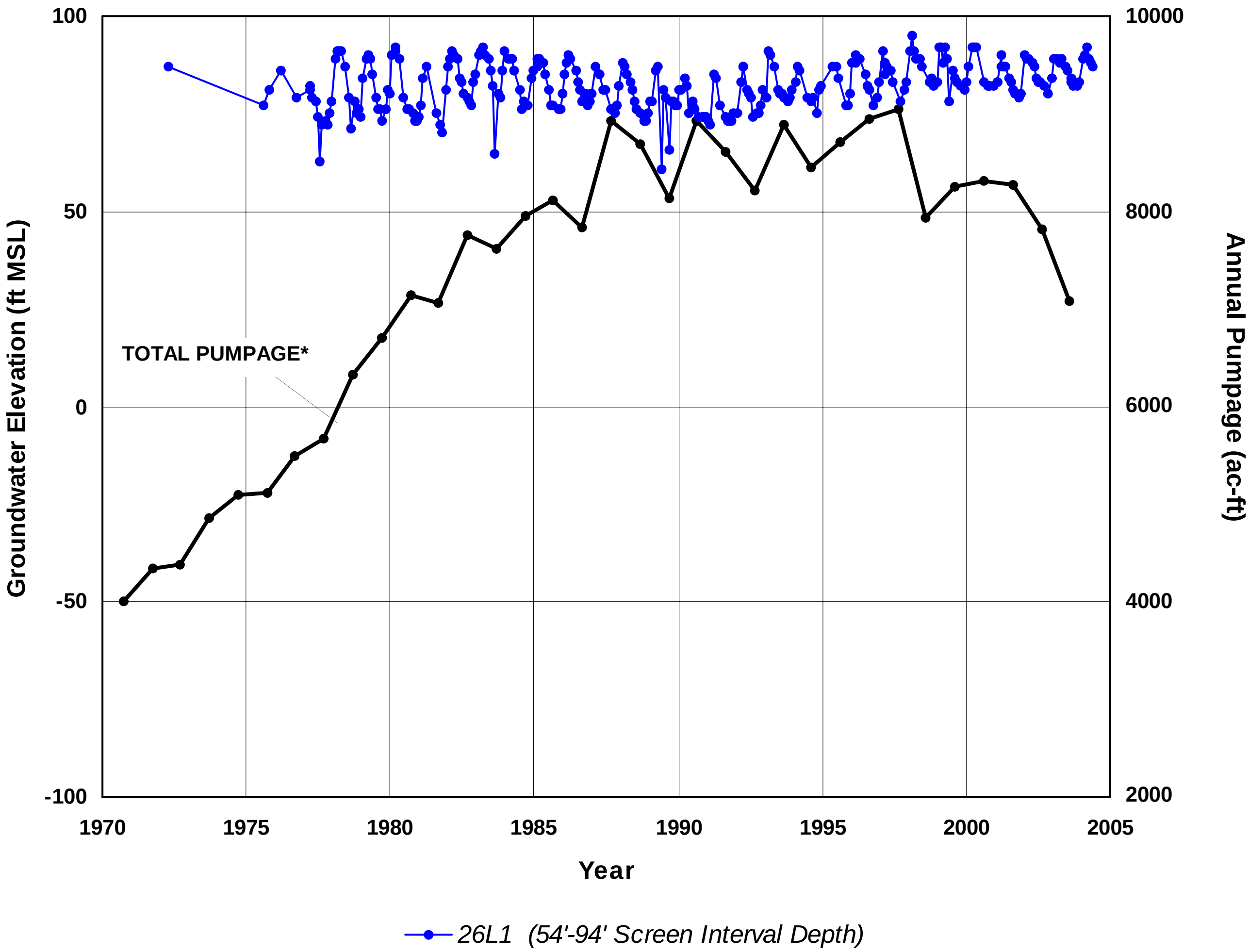
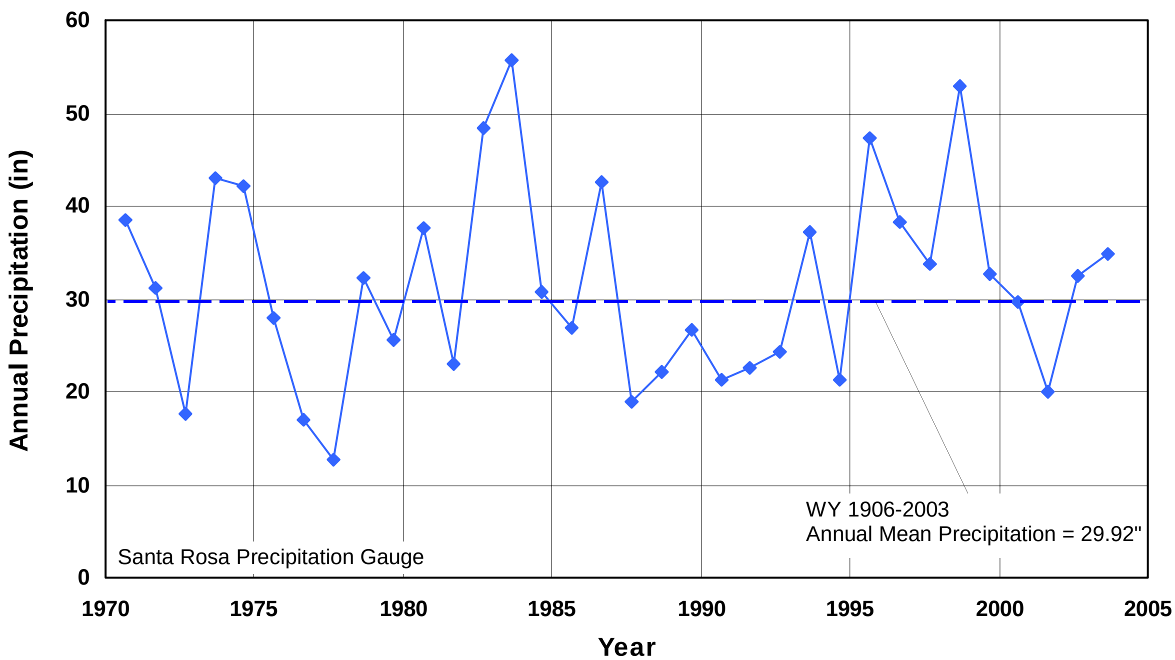
Figure 3-11
Location of Wells with Water Level Hydrographs
City of Rohnert Park WSA





*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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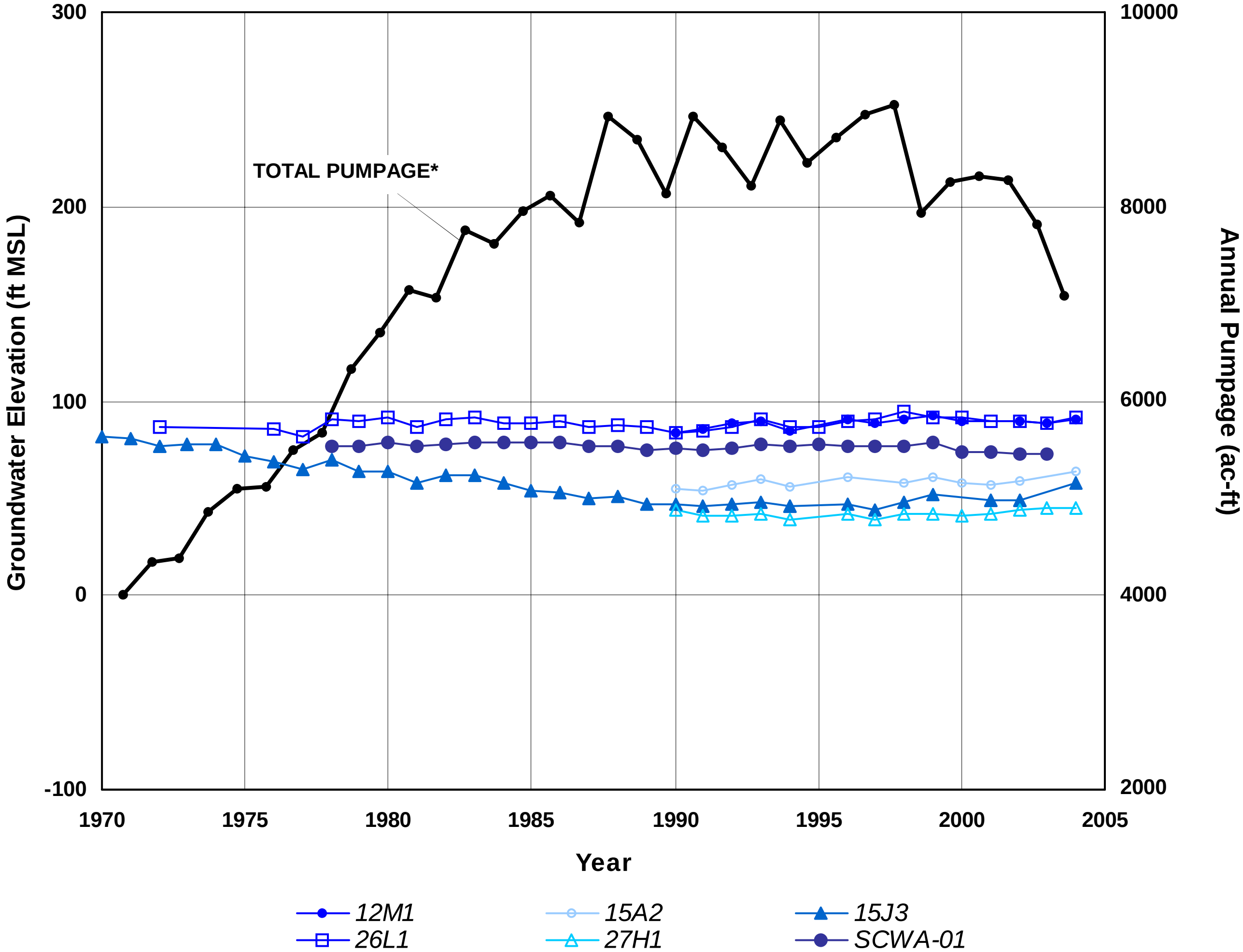
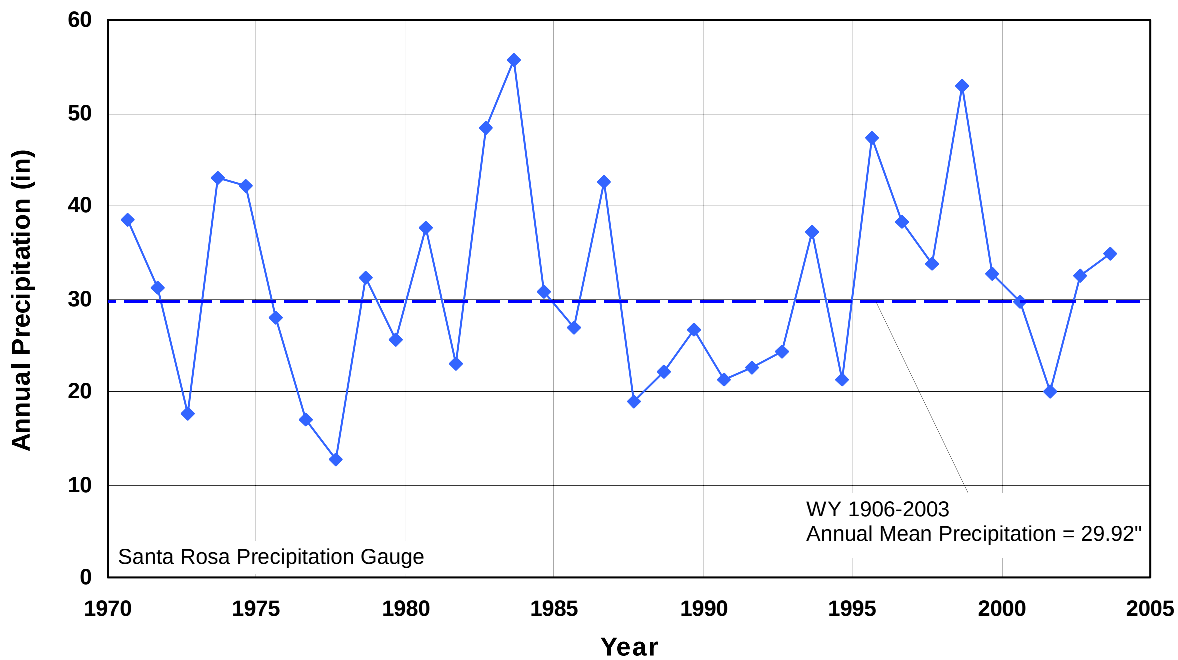
Figure 3-12
Groundwater Elevations in Shallow Well
T06N/R08W-26L1 in City of Cotati
City of Rohnert Park WSA





Note: Groundwater elevation is the maximum for the period January through May.

*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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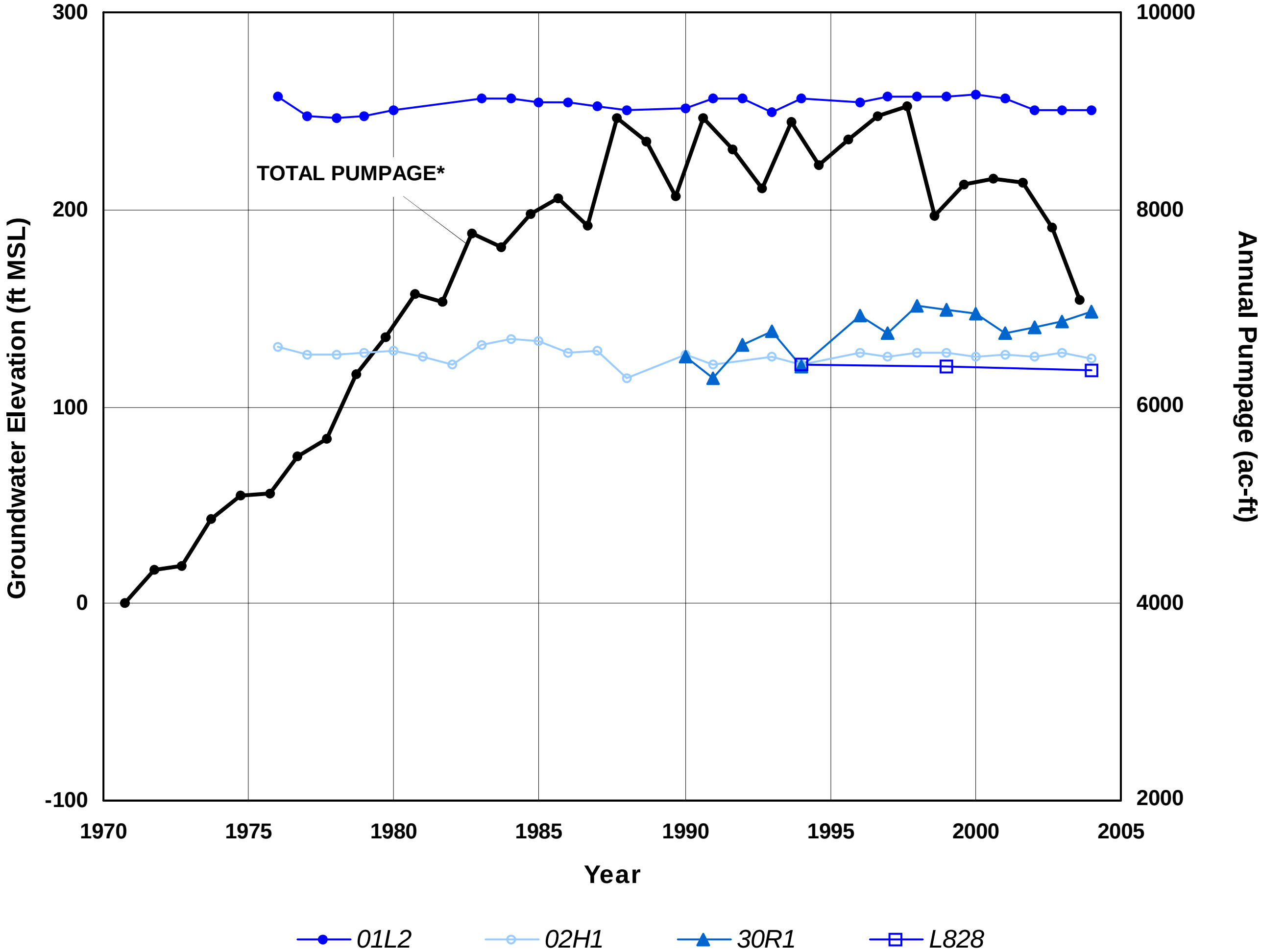
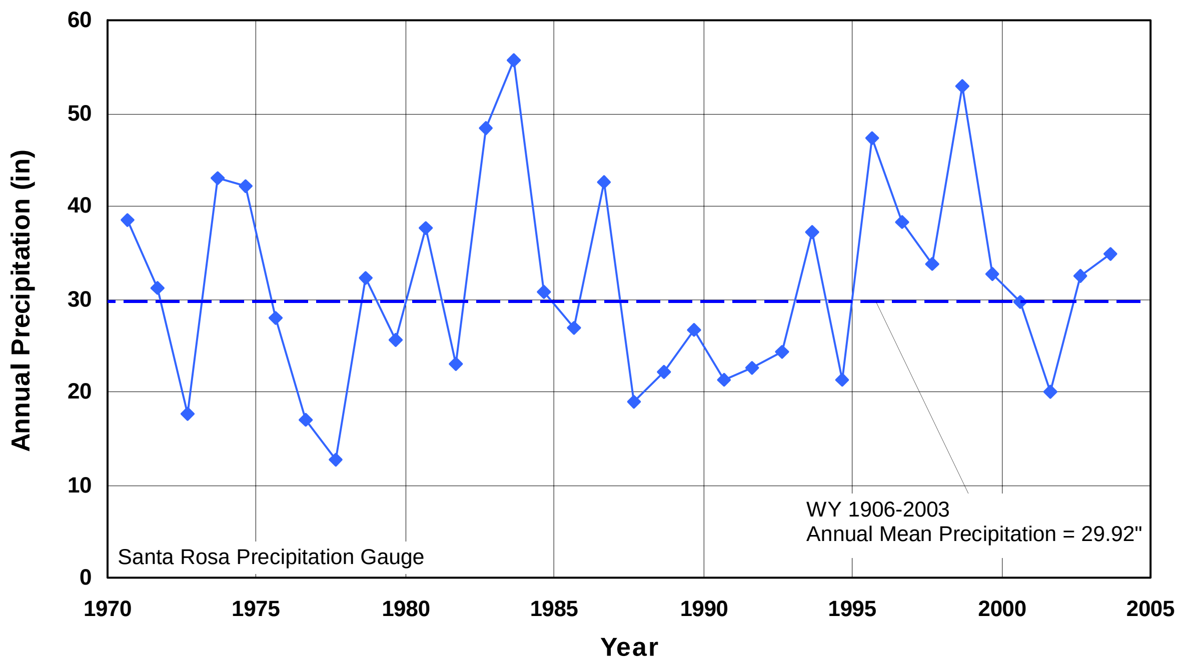
Figure 3-13
Groundwater Elevations in Shallow Wells North and West of Rohnert Park
City of Rohnert Park WSA





Note: Groundwater elevation is the maximum for the period January through May except for L828.

*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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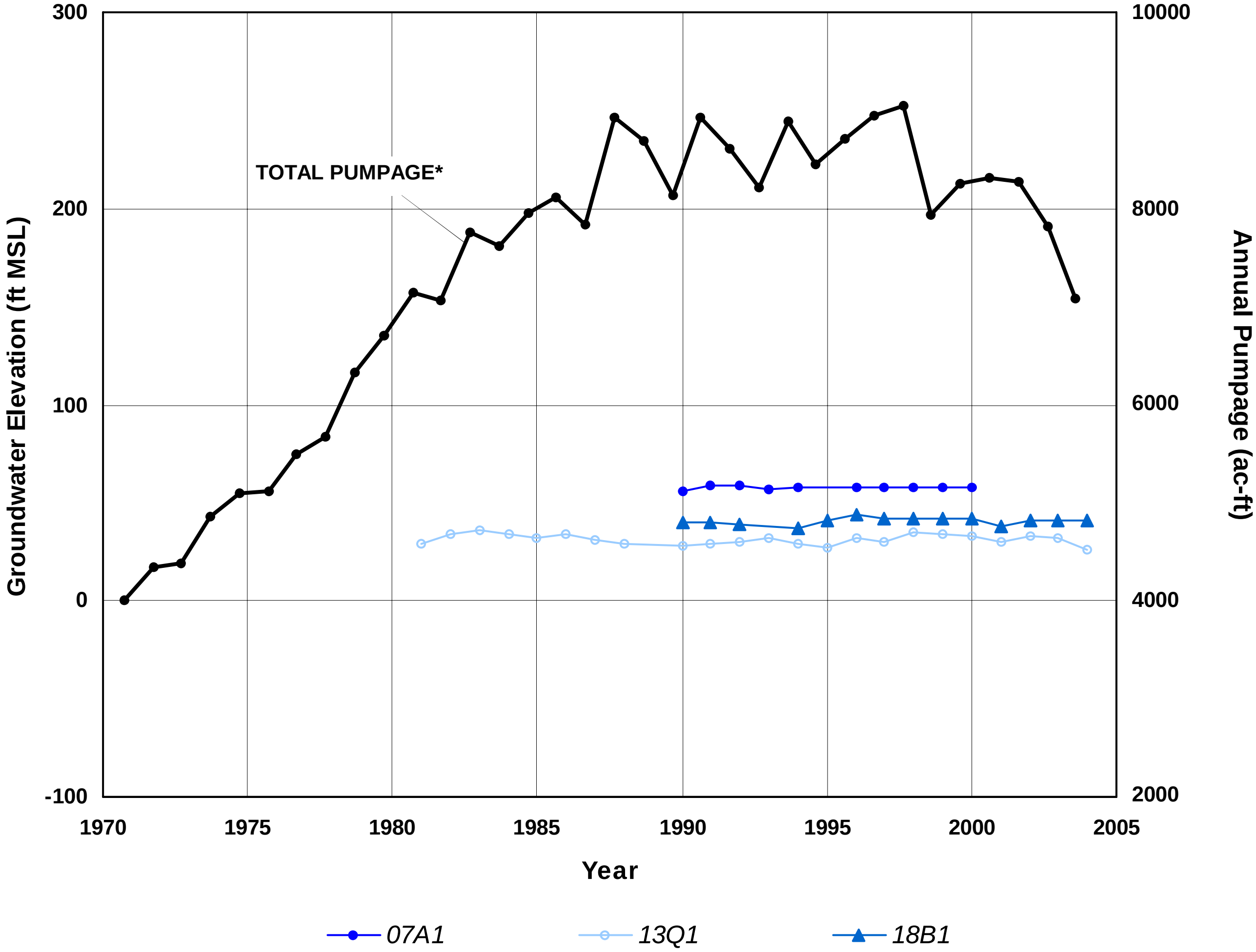
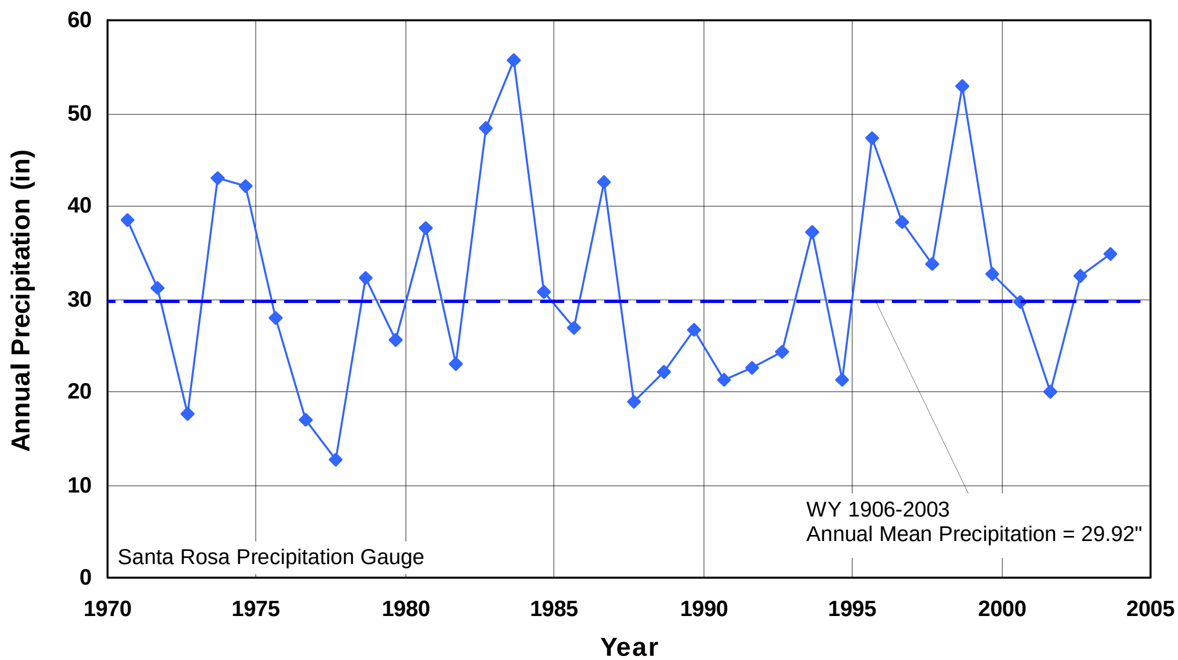
Figure 3-14
Groundwater Elevations in Shallow Wells South and Southeast of Rohnert Park
City of Rohnert Park WSA





Note: Groundwater elevation is the maximum for the period January through May.

*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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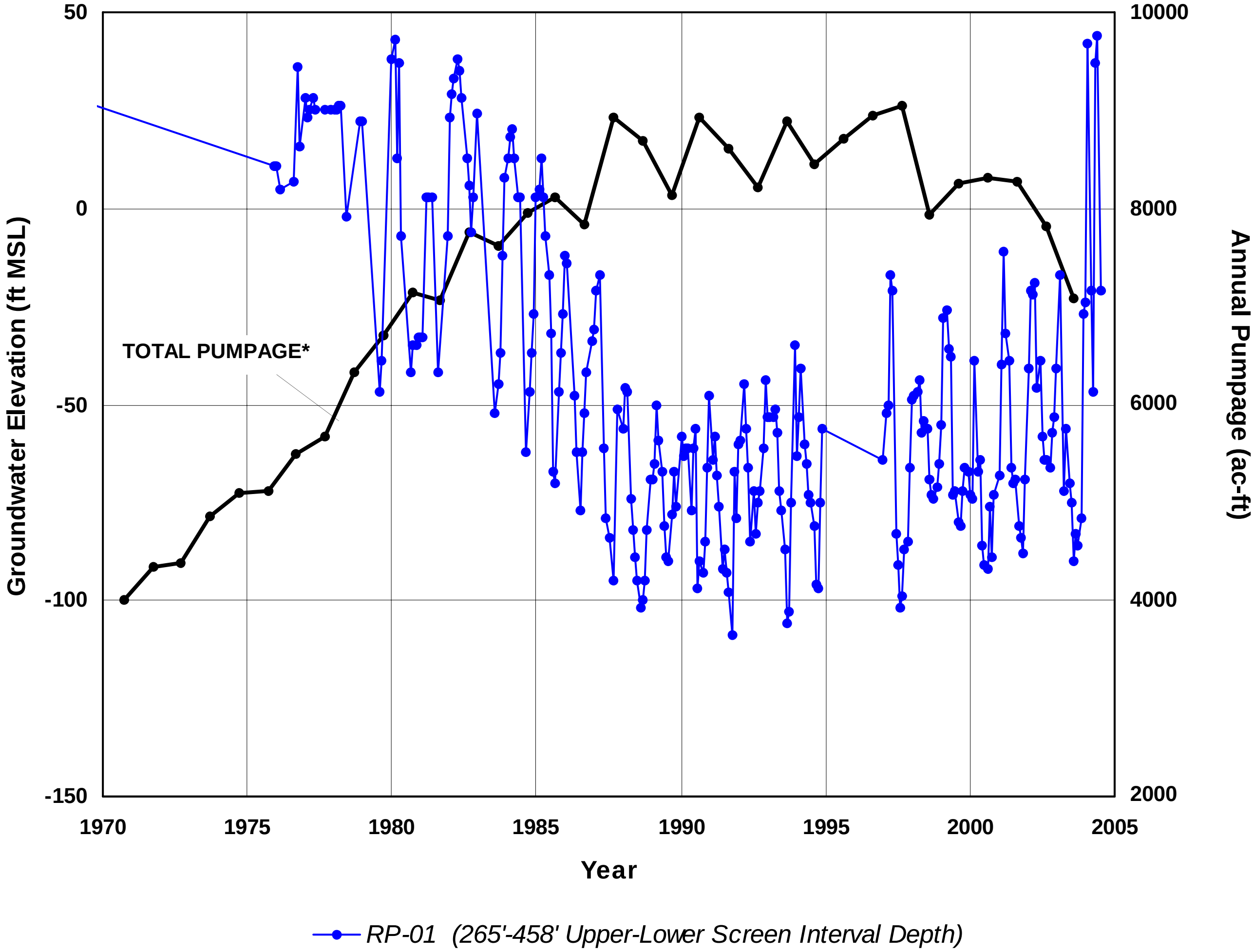
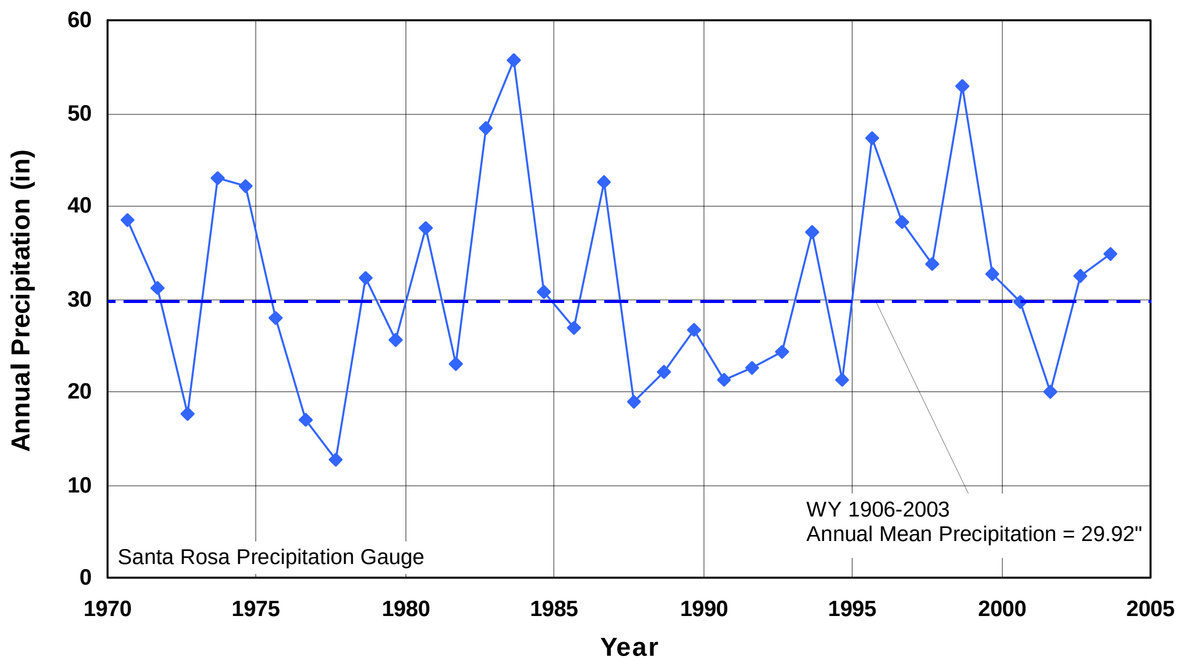
Figure 3-15
Groundwater Elevations in Shallow Wells
Petaluma Valley Groundwater Basin
City of Rohnert Park WSA





*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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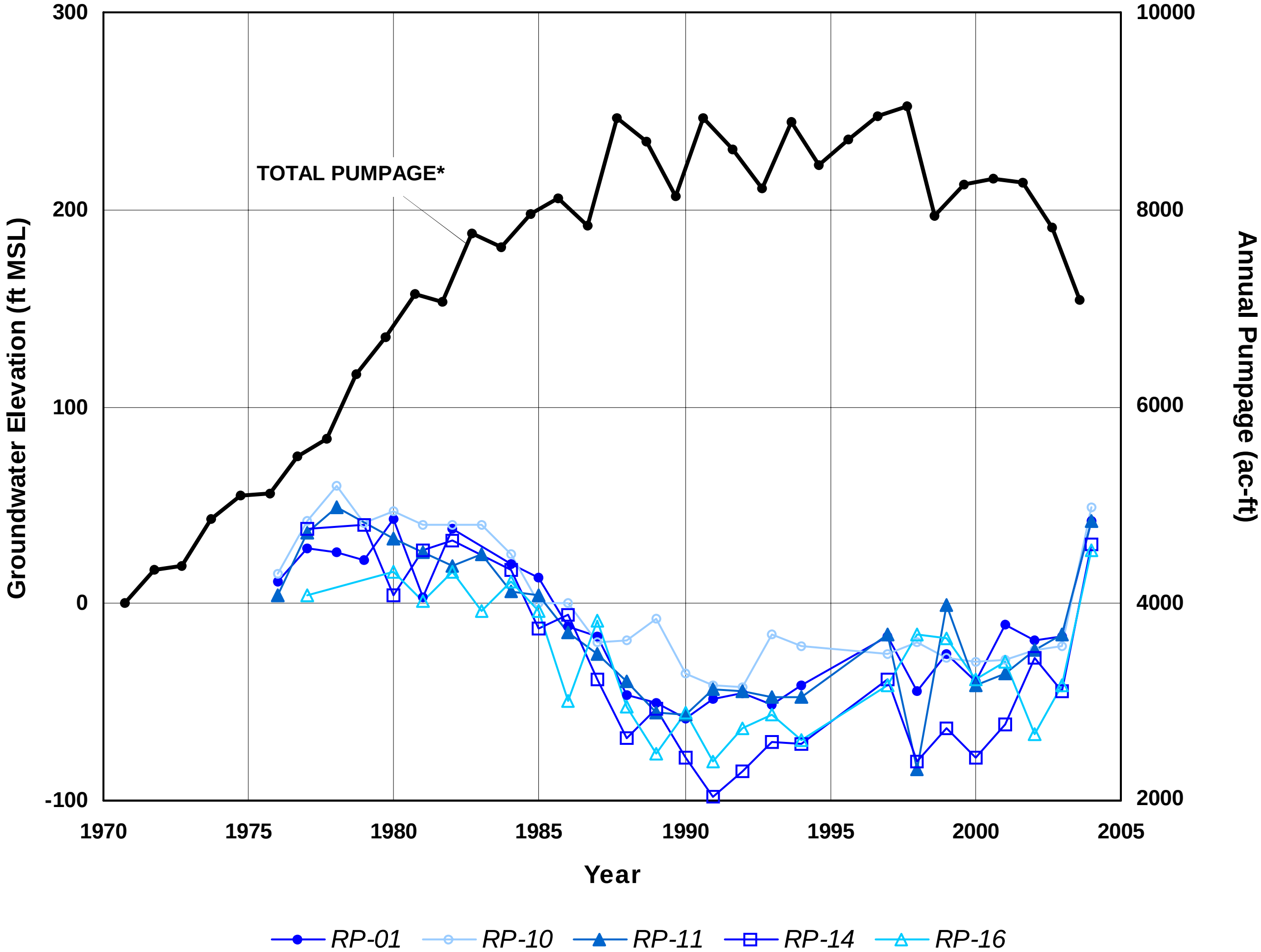
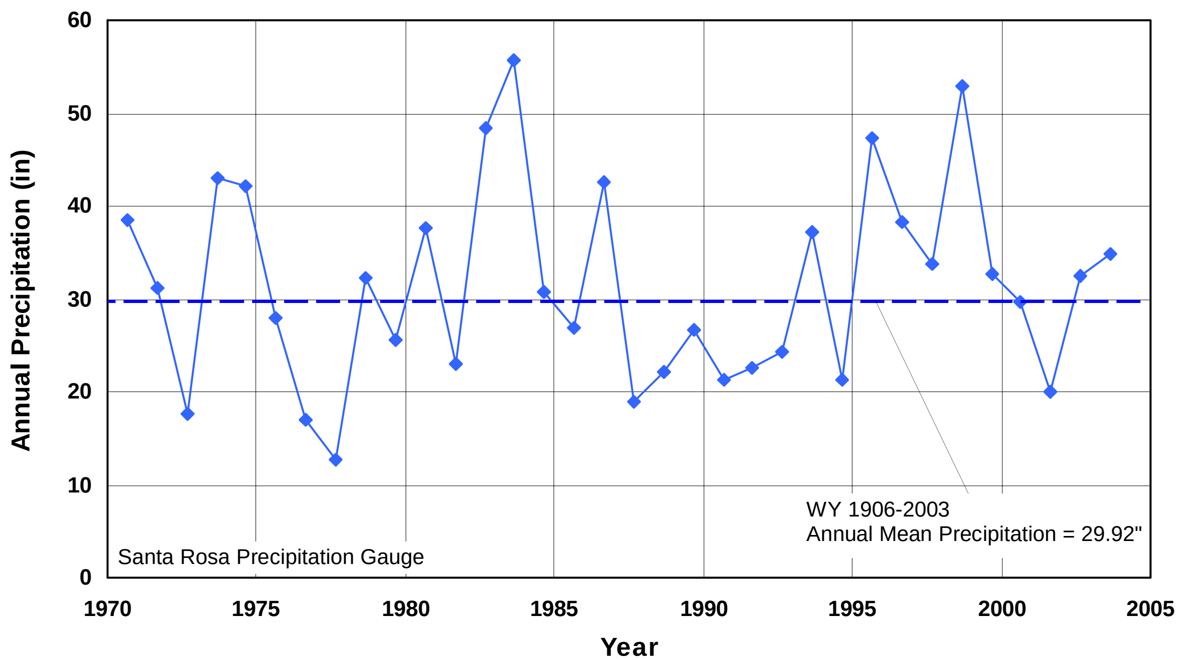
Figure 3-16
Groundwater Elevations in Intermediate Zone
City Well RP-01
City of Rohnert Park WSA





Note: Groundwater elevation is the maximum for the period January through May.
*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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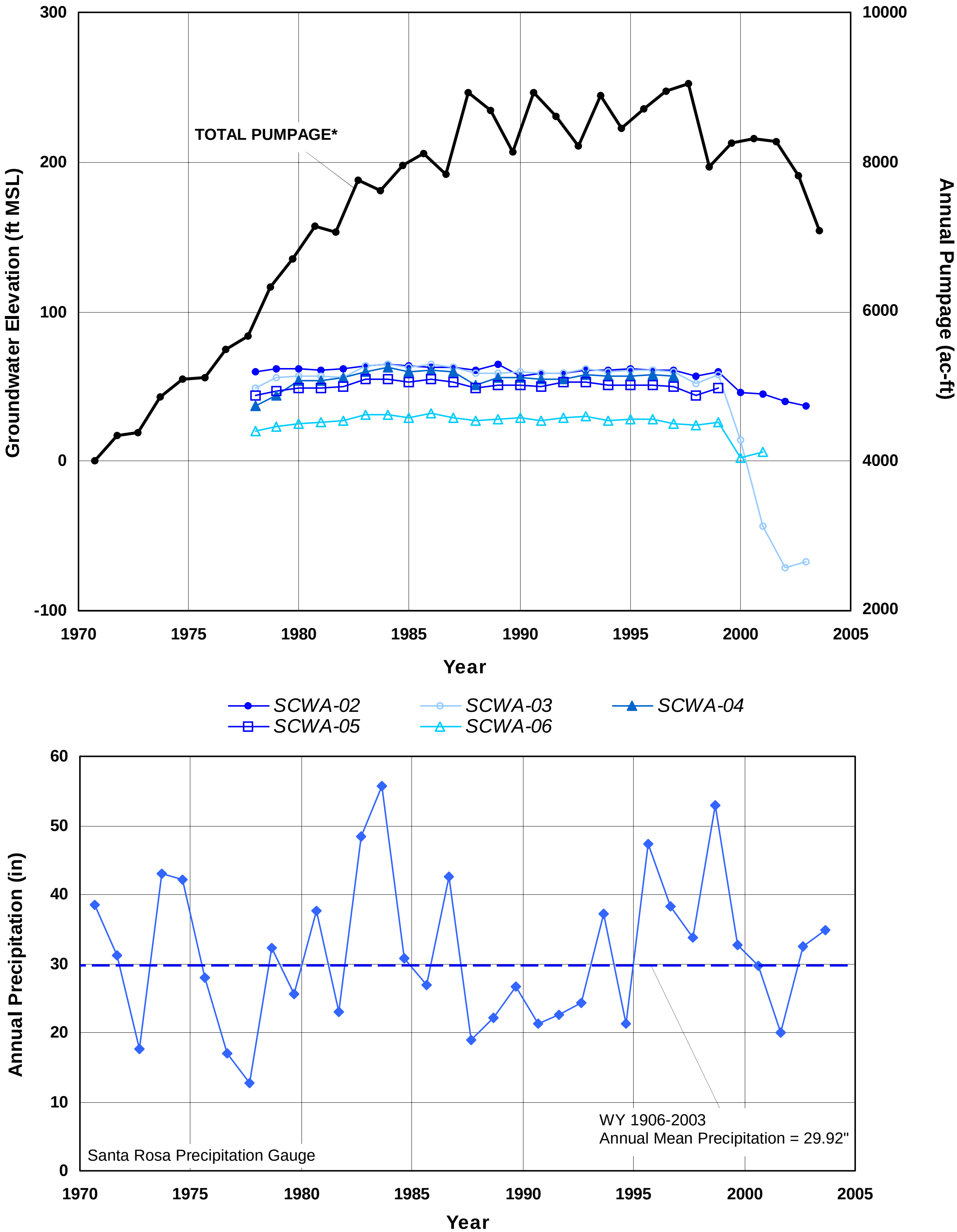
Figure 3-17
Groundwater Elevations in Intermediate and Deeper Wells in Central Rohnert Park
City of Rohnert Park WSA



Note: Groundwater elevation is the maximum for the period January through May.
*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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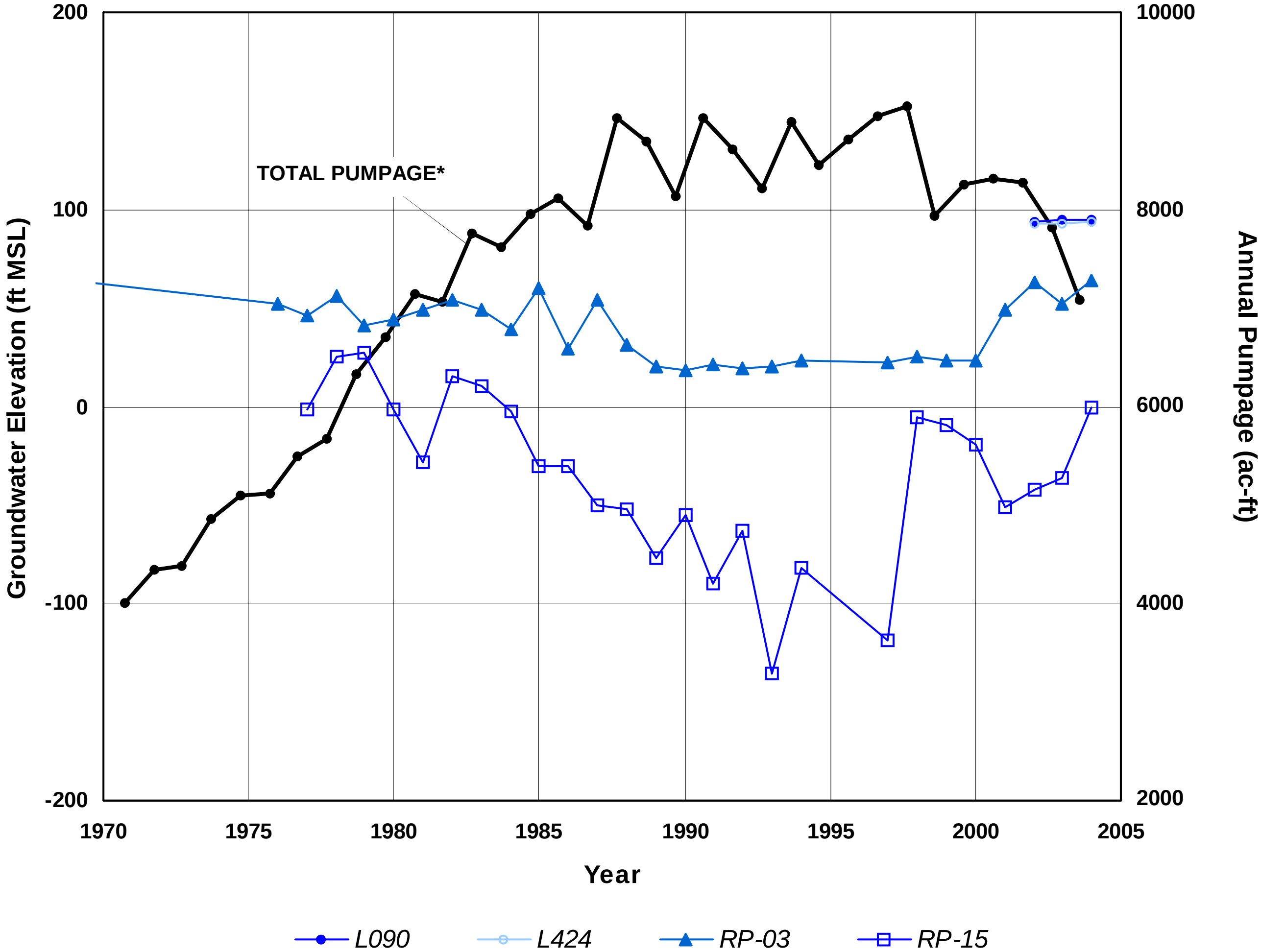
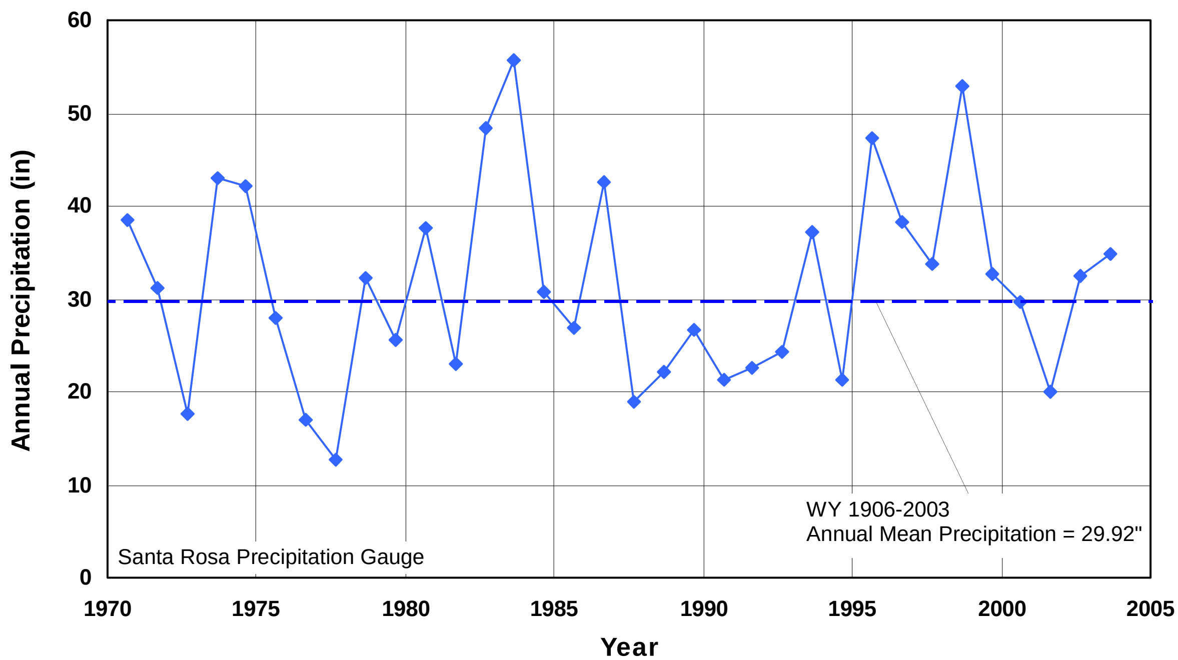
Figure 3-18
Groundwater Elevations in Intermediate and Deeper Wells North and Northwest of Rohnert Park
City of Rohnert Park WSA





Note: Groundwater elevation is the maximum for the period January through May.
*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

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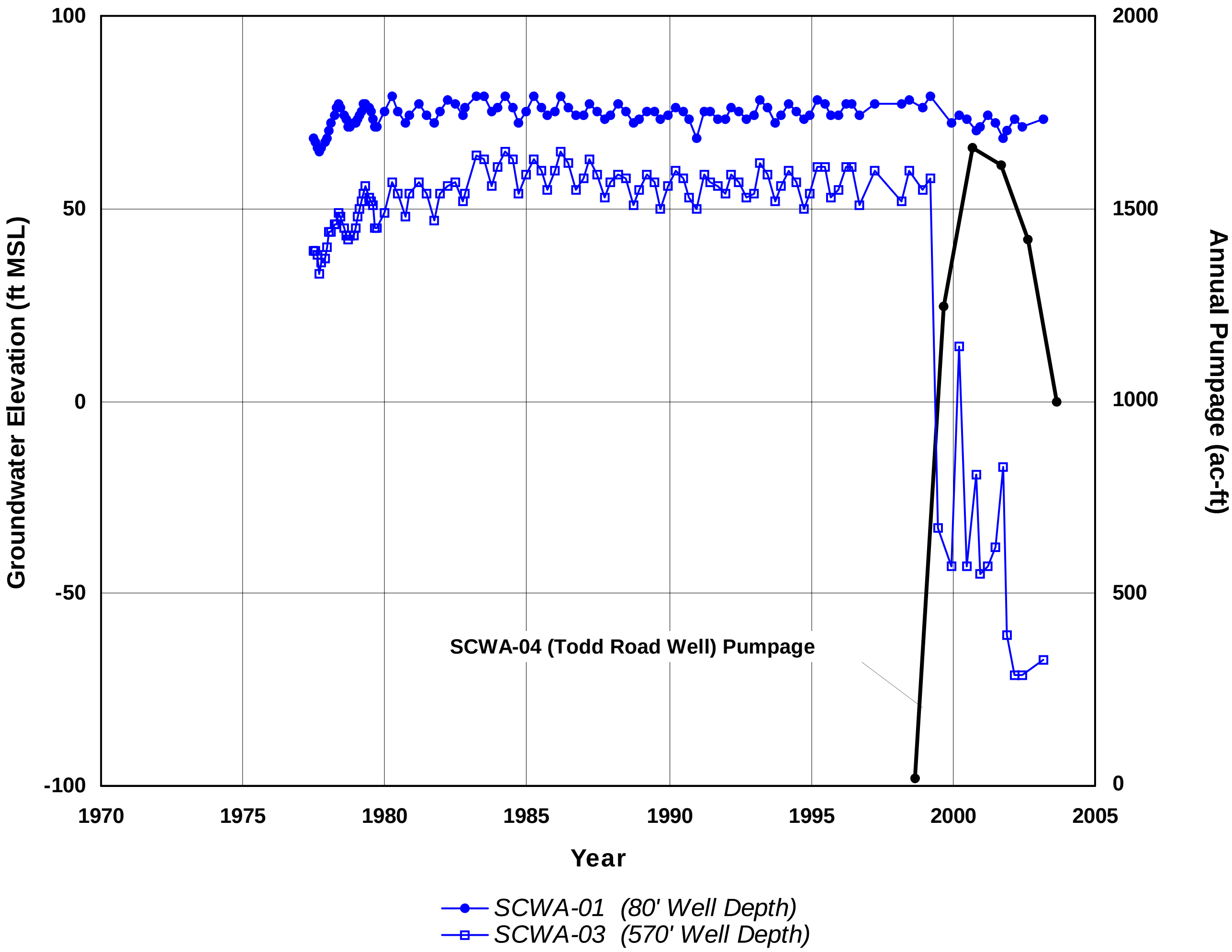
Figure 3-19
Groundwater Elevations in Paired Shallow and Intermediate/Deeper Wells in Rohnert Park
City of Rohnert Park WSA



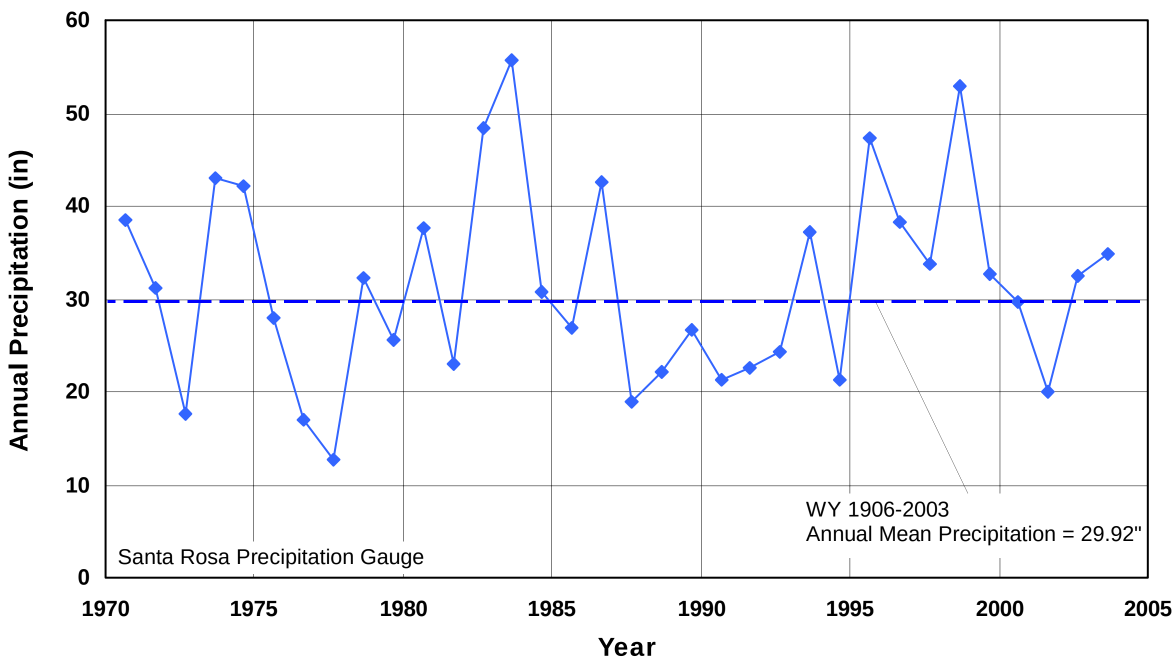


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Figure 3-20
Groundwater Elevations in Paired Shallow and Intermediate/Deeper Wells: SCWA-01 and -03
City of Rohnert Park WSA

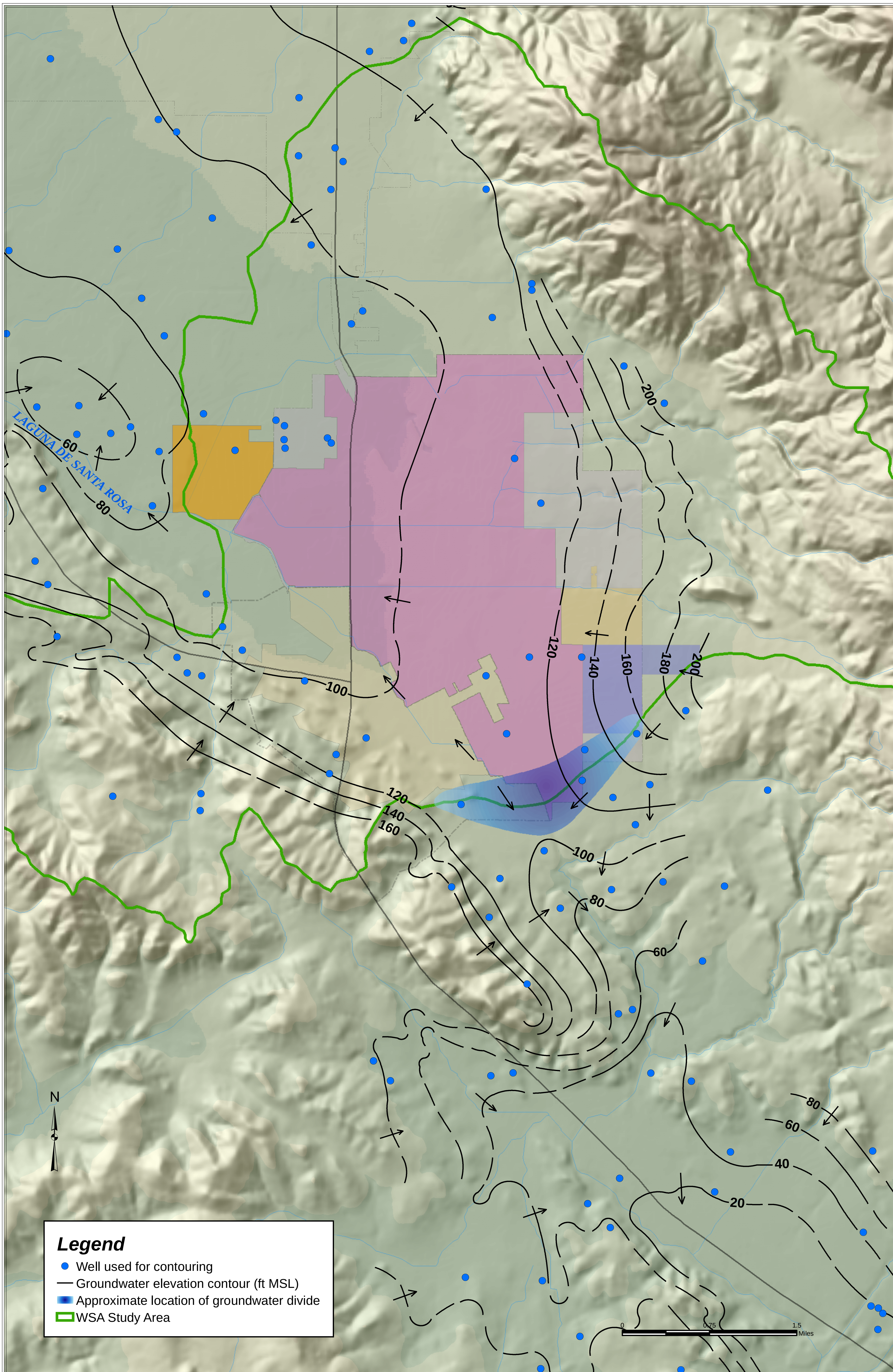

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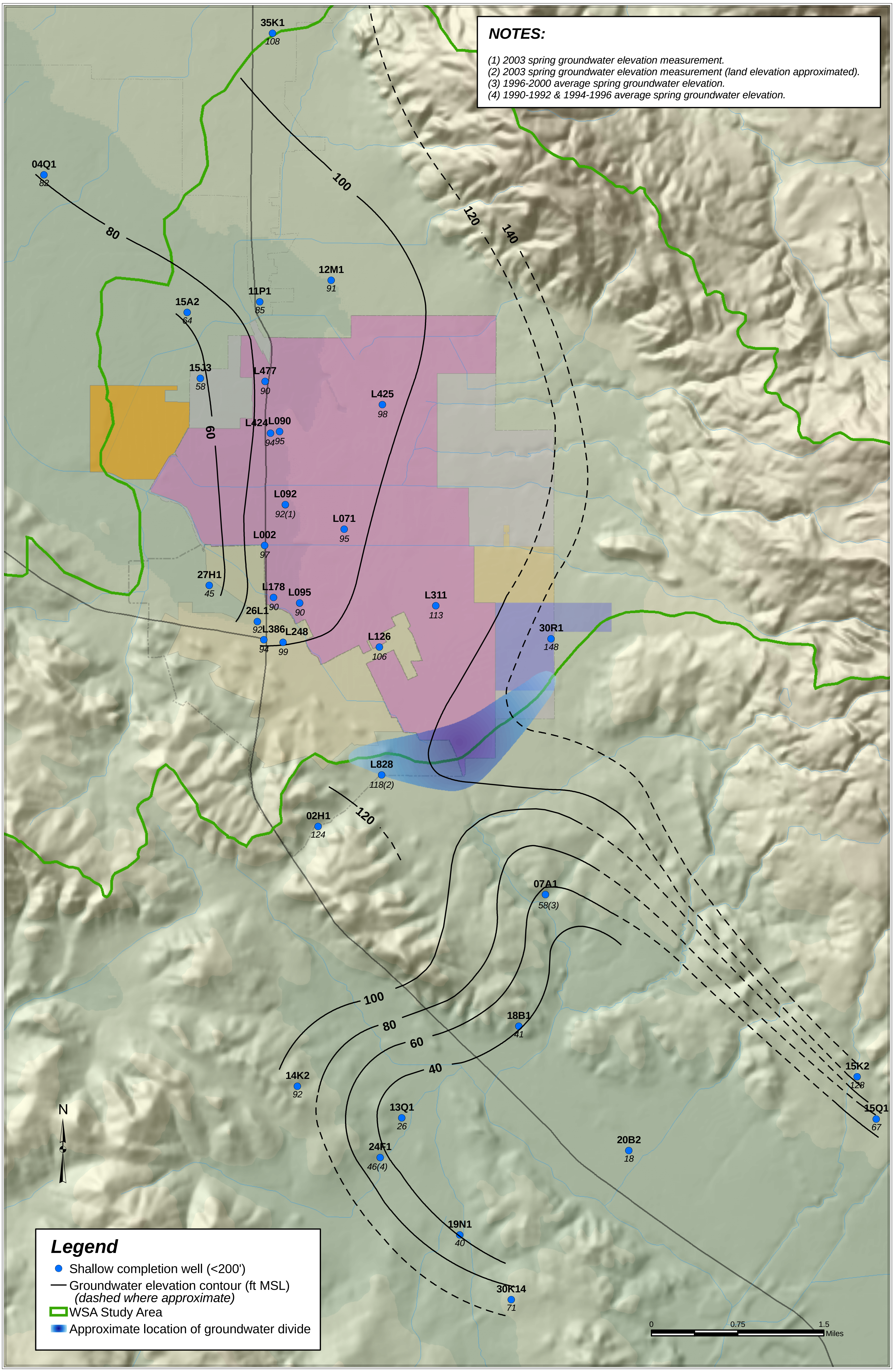
Figure 3-21
Spring 1951 Groundwater Elevation Contours
Prepared by Cardwell (1958)
City of Rohnert Park WSA



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LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-22
Spring 2004 Groundwater Elevation Contours for Shallow Wells in the Rohnert Park and Petaluma Area
City of Rohnert Park WSA

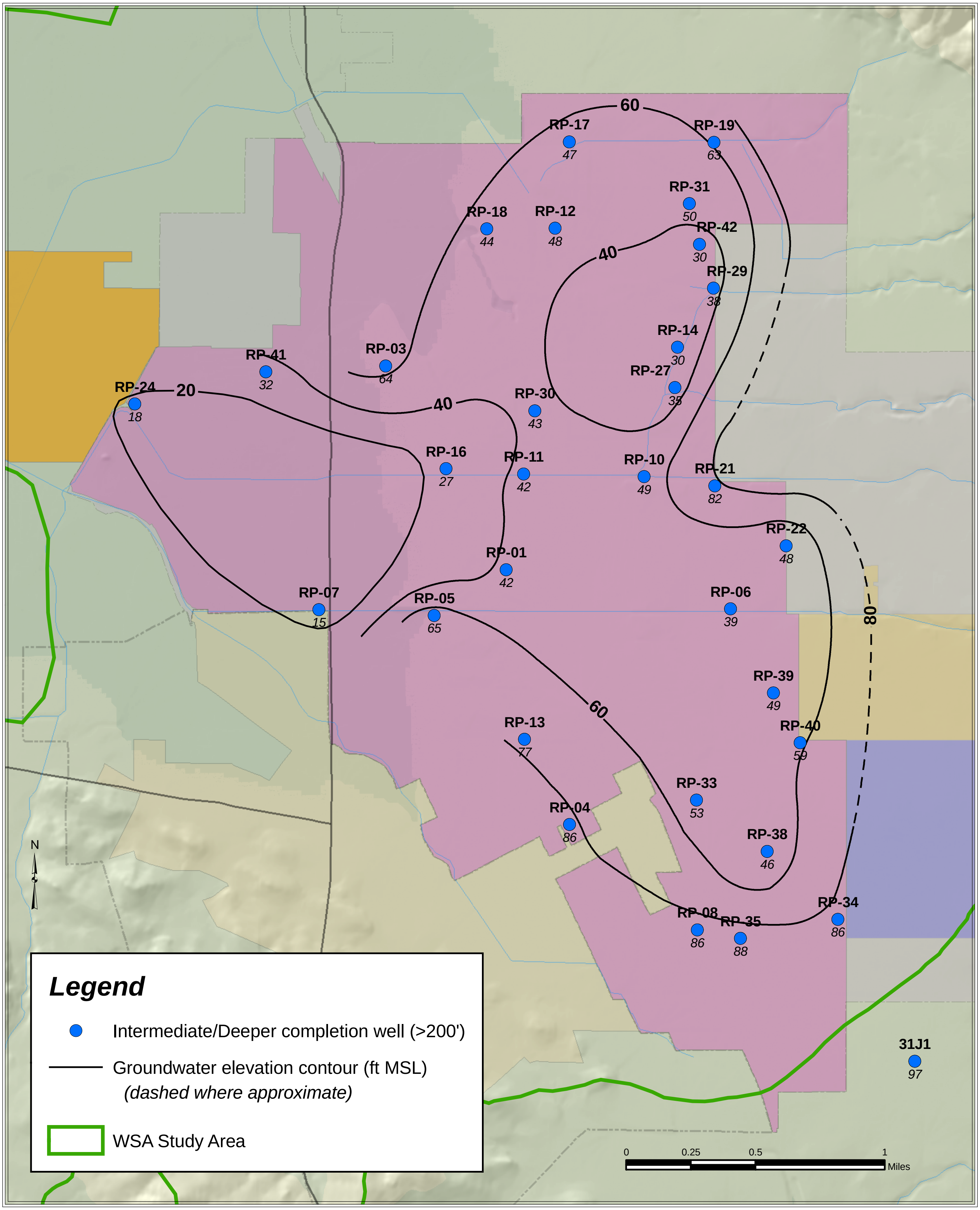

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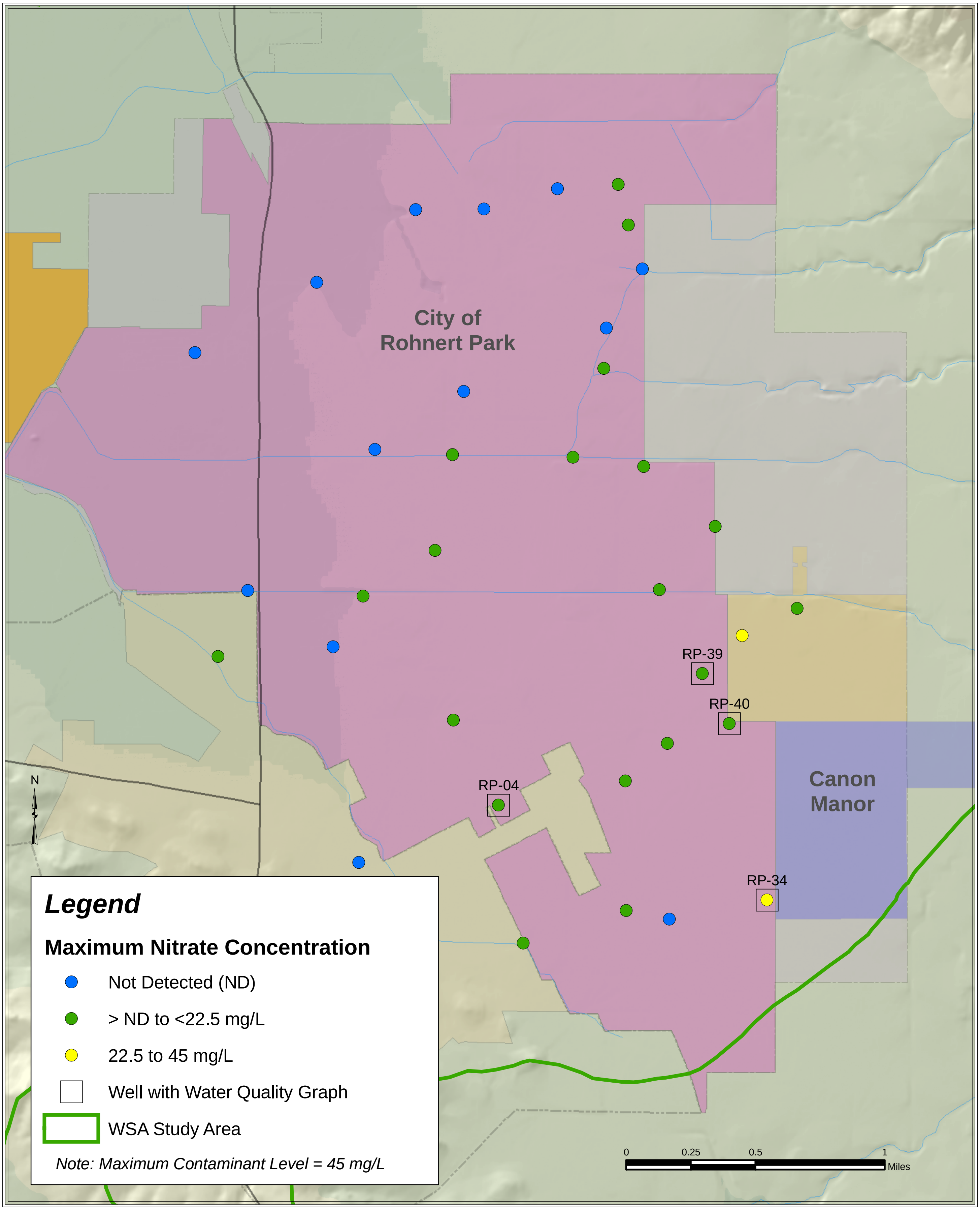
Figure 3-23
Spring 2004 Groundwater Elevation Contours for Intermediate/Deeper Wells in the Rohnert Park Area
City of Rohnert Park WSA



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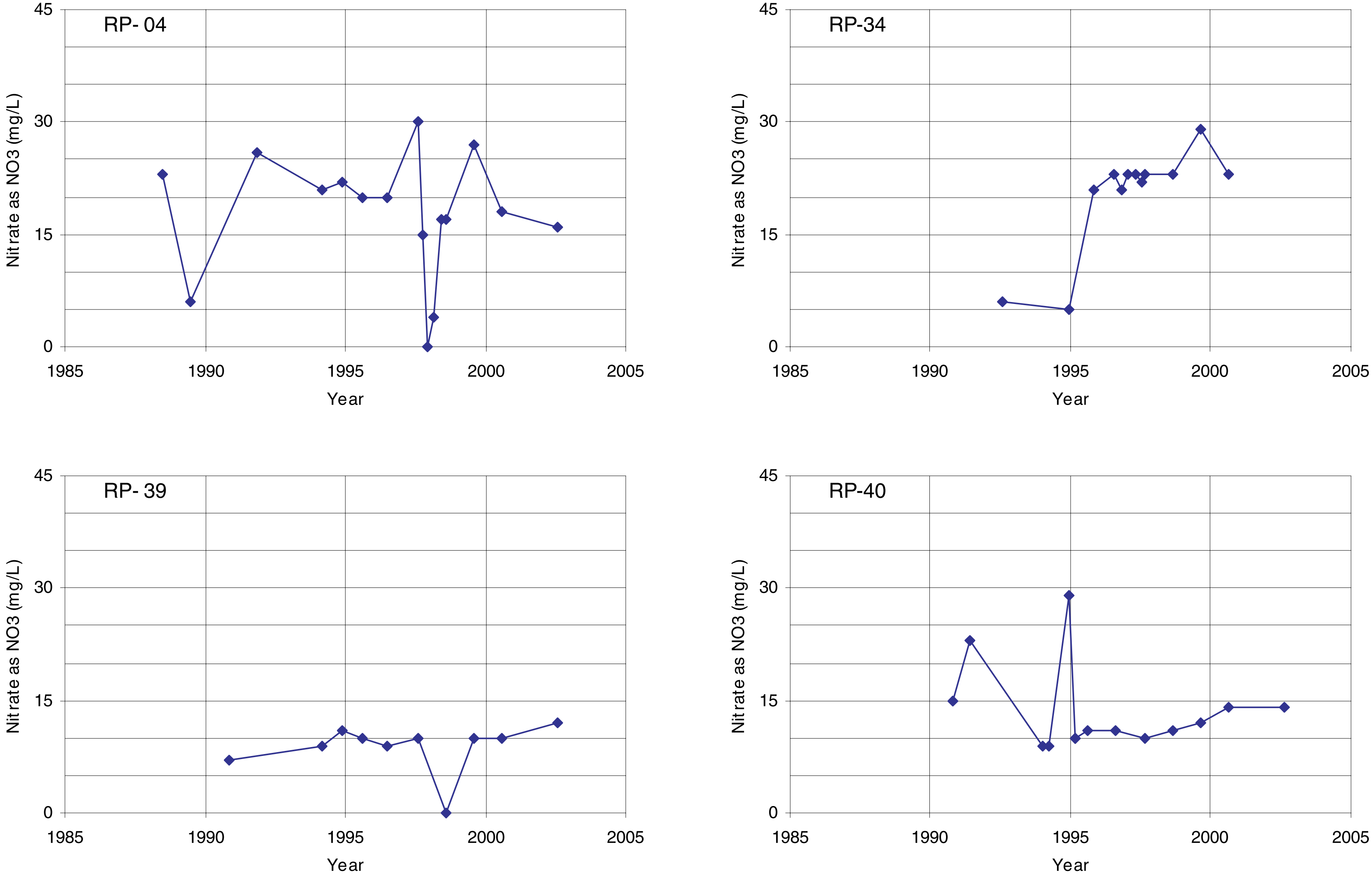
CONSULTING ENGINEERS

Figure 3-24
Maximum Nitrate Concentrations
Rohnert Park Area, January 2000 to March 2004
City of Rohnert Park WSA



Note: CA Dept of Health Services Maximum Contaminant Level allowed in public drinking water for Nitrate (as NO3) = 45 mg/L

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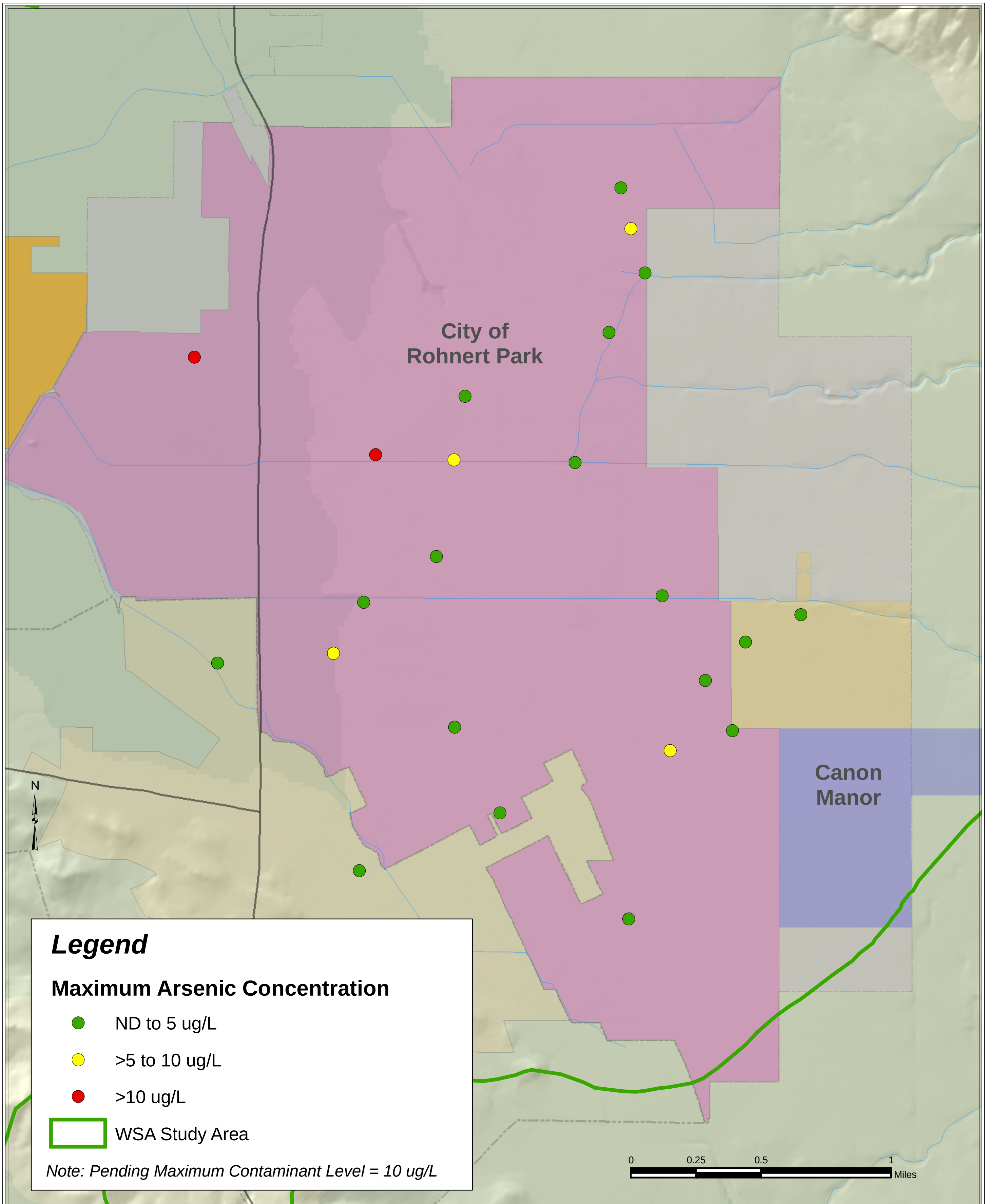
Figure 3-25
Nitrate Concentrations in City Wells
City of Rohnert Park WSA



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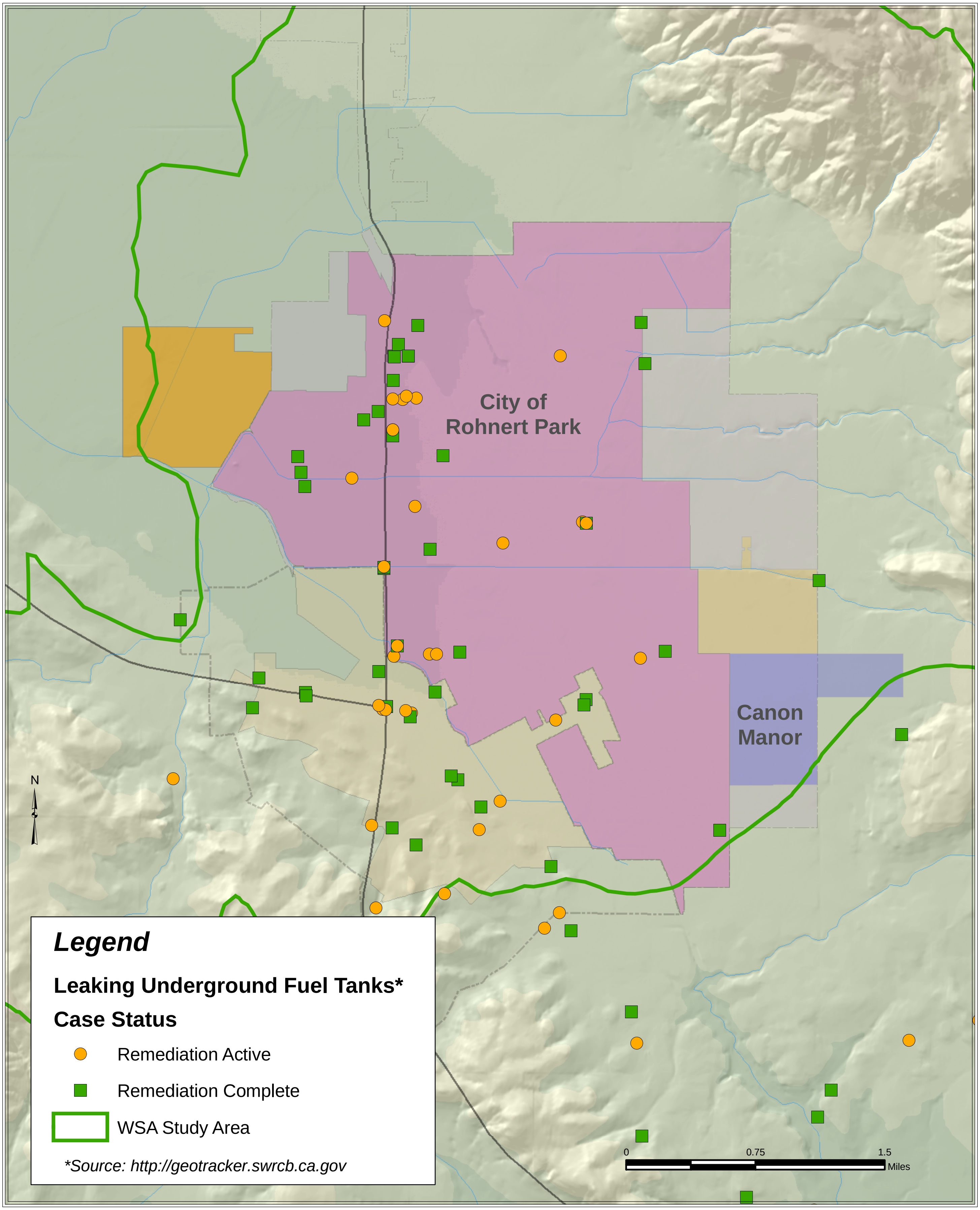
LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-26
Maximum Arsenic Concentrations
Rohnert Park Area, January 2000 to March 2004
City of Rohnert Park WSA



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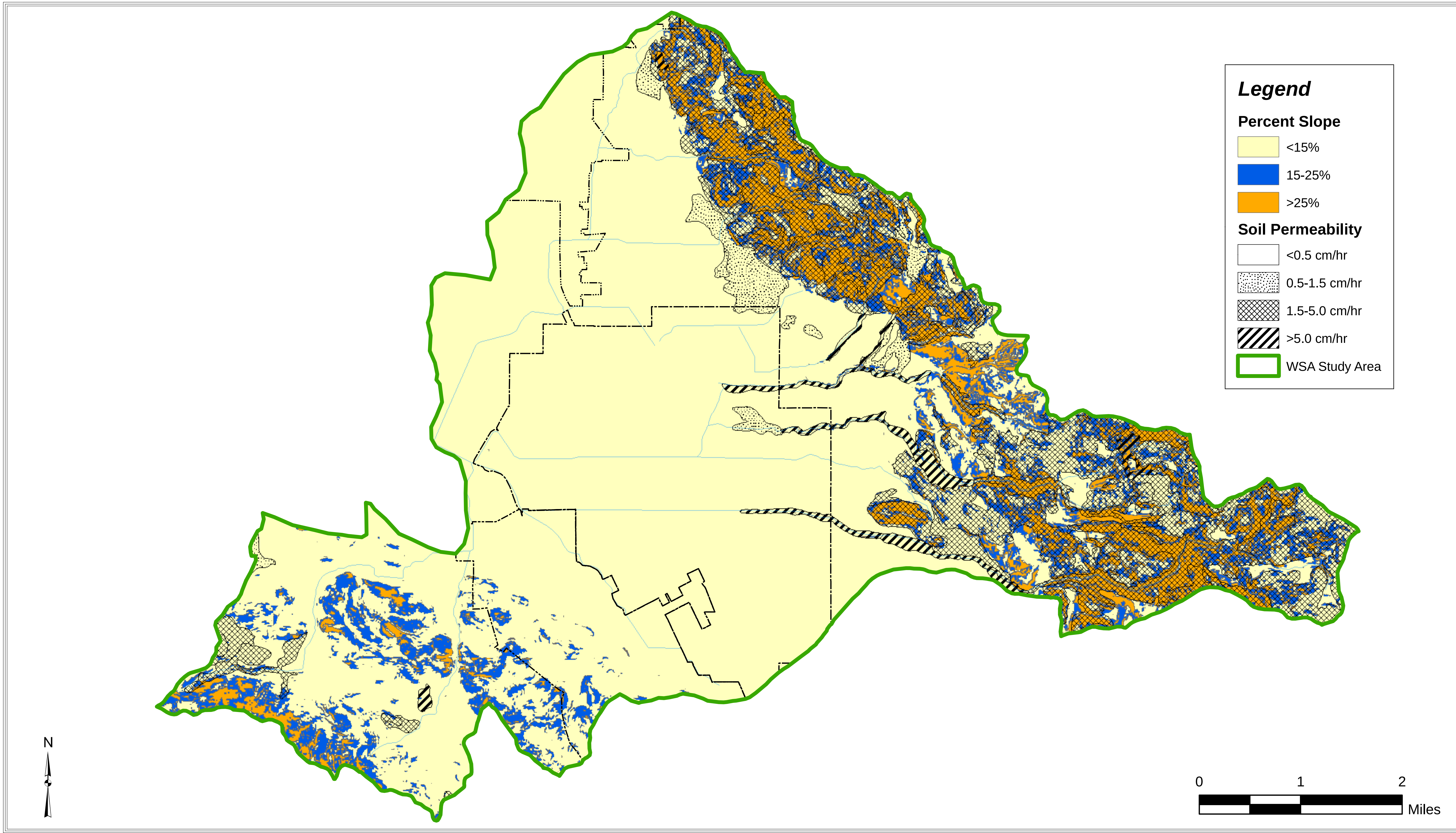
LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Figure 3-27
Leaking Underground Fuel Tank Locations
Cities of Rohnert Park and Cotati
City of Rohnert Park WSA



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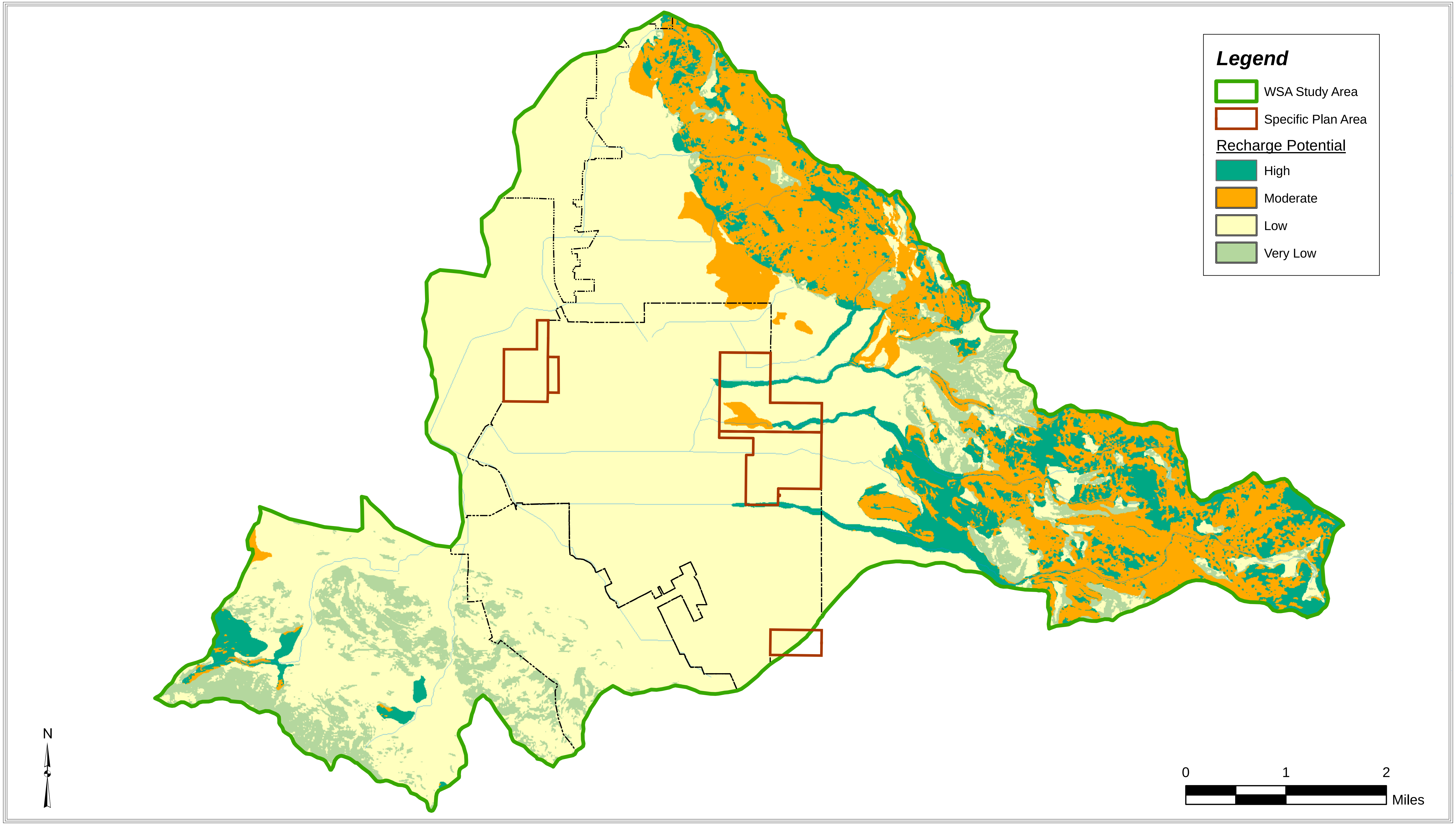
LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-28
Soil Permeability and Slope in Study Area
City of Rohnert Park WSA



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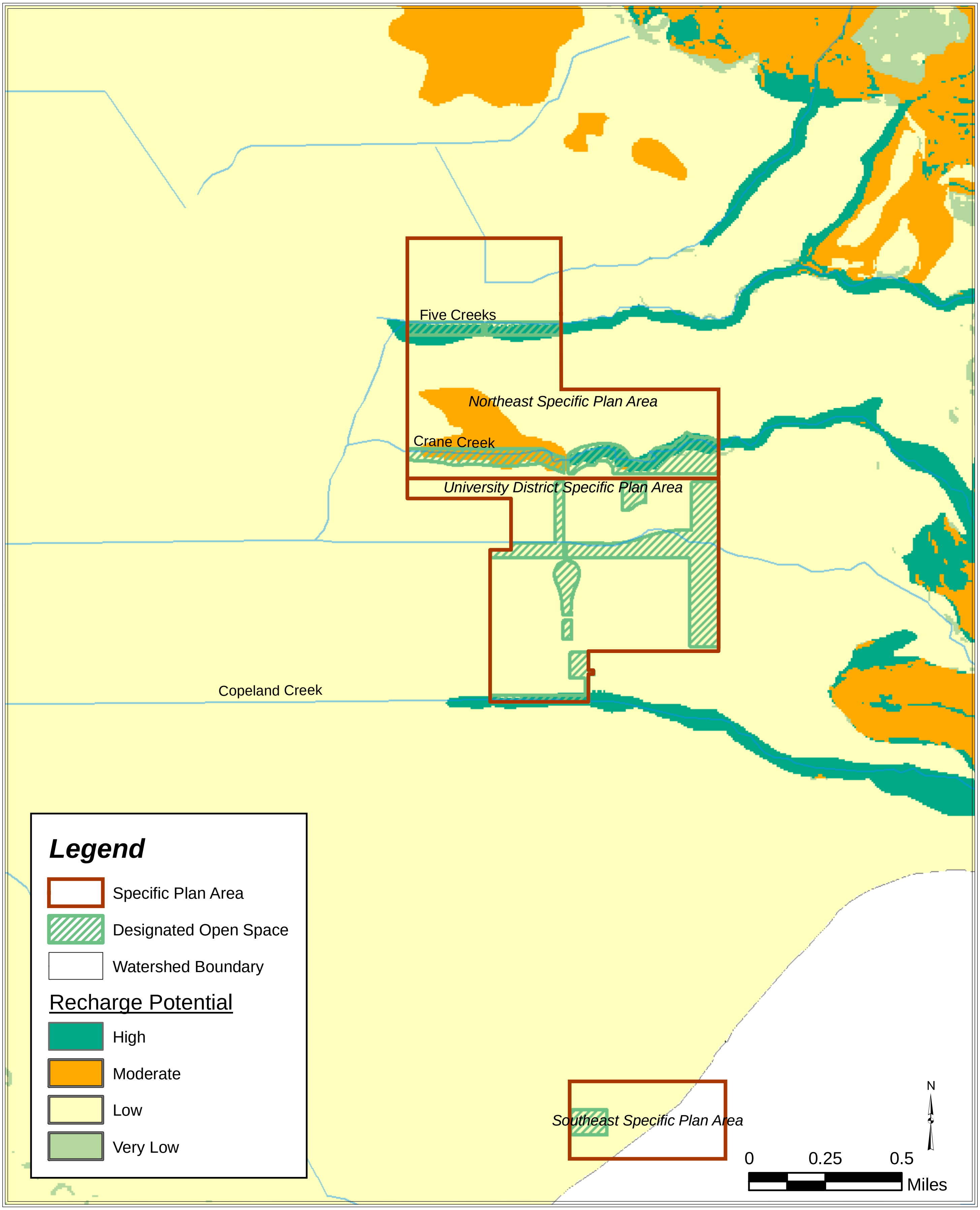
LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-29
Recharge Potential Defined for WSA
City of Rohnert Park WSA



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LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-30
Recharge Potential
in Specific Plan Areas
City of Rohnert Park WSA

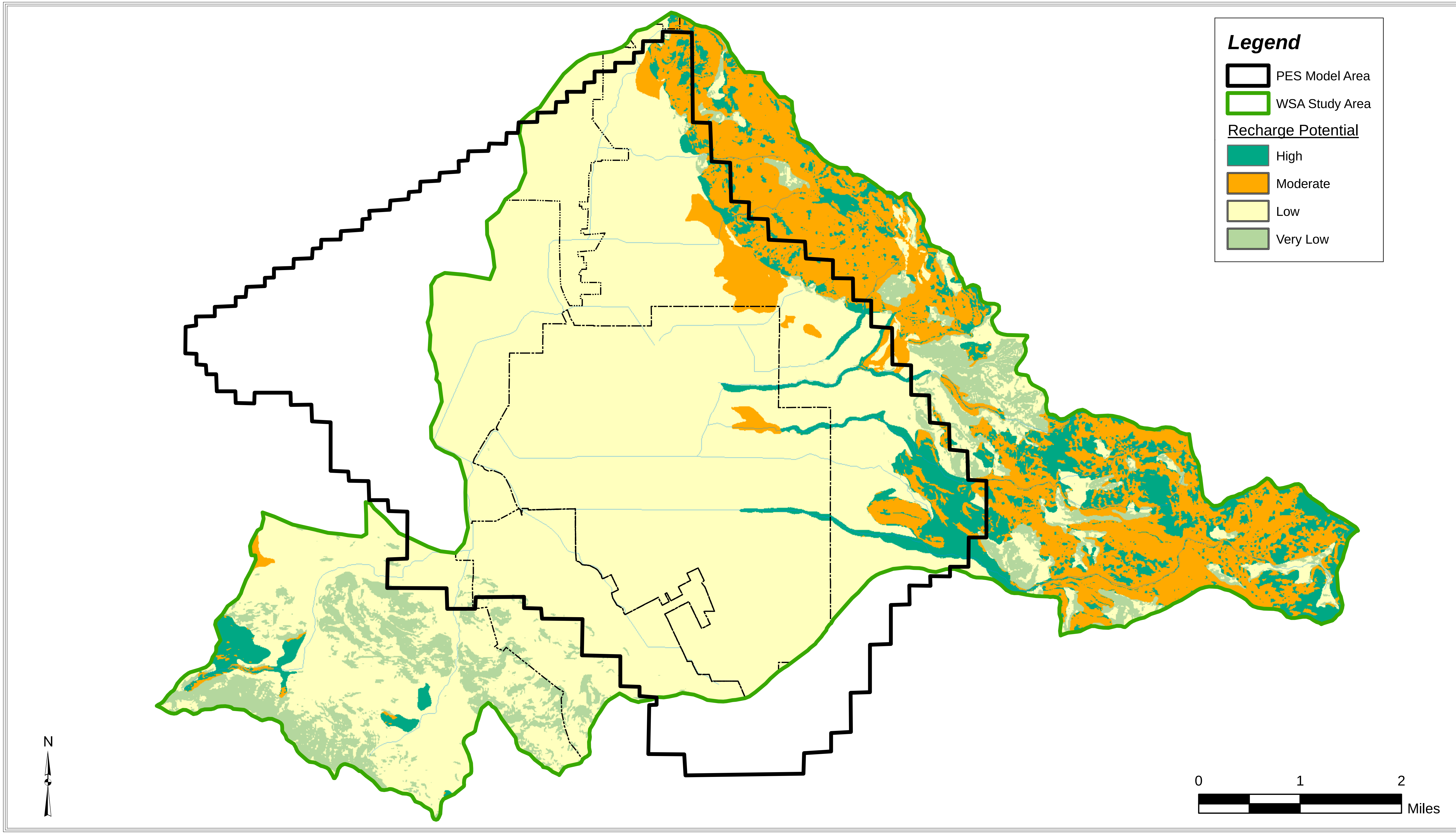

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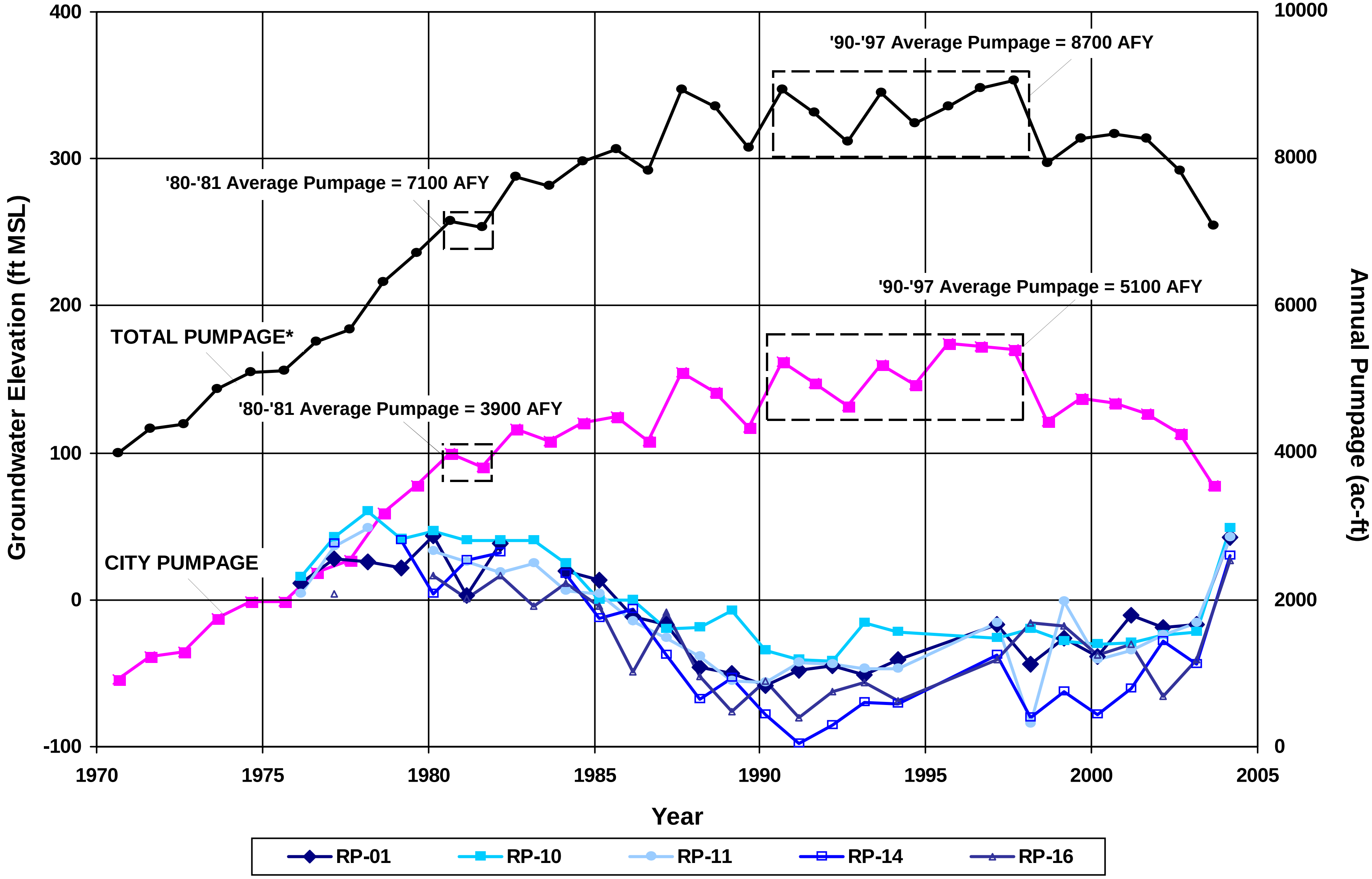
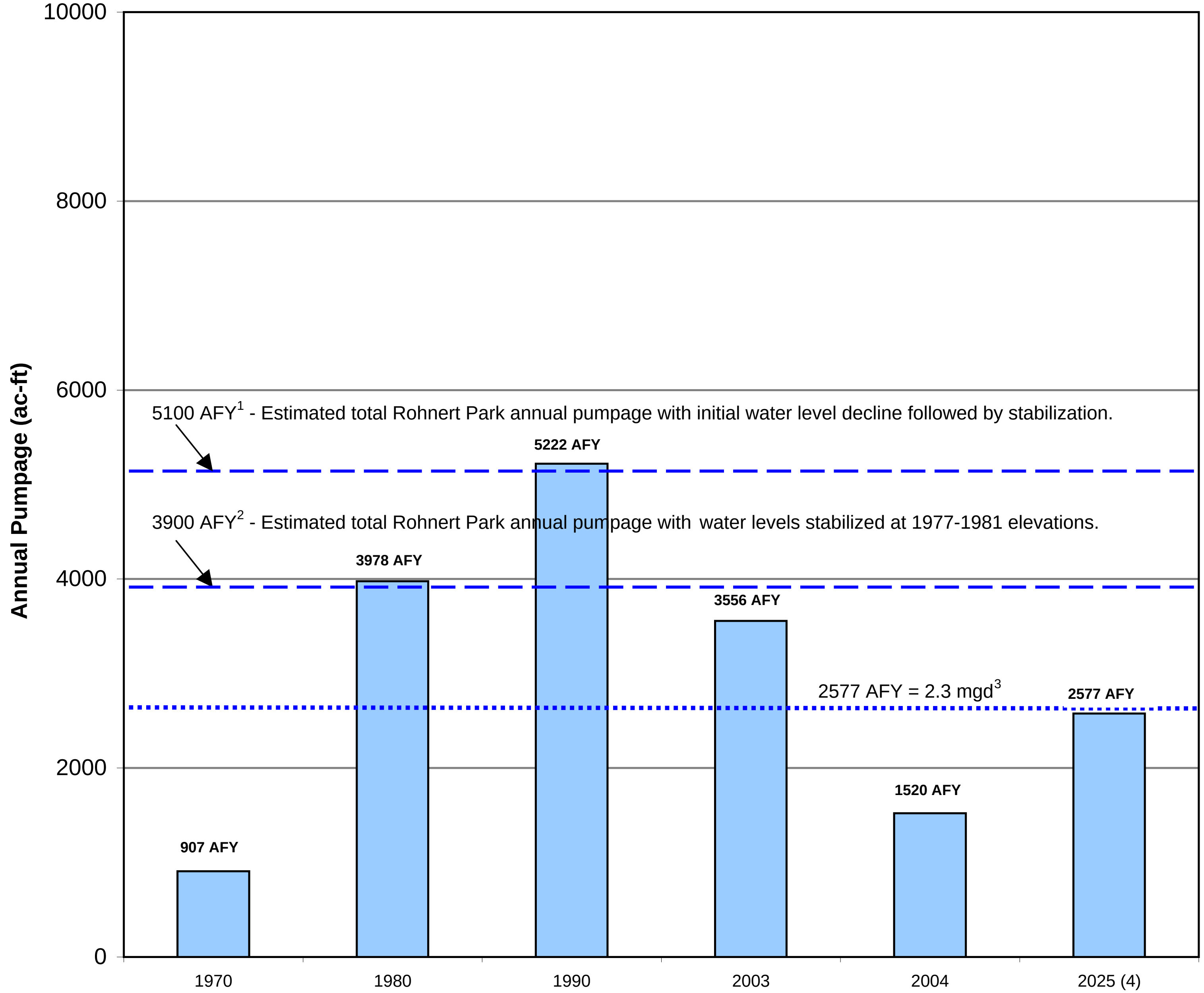
Figure 3-31
PES Model Area and Recharge Potential Areas
City of Rohnert Park WSA



Note: Groundwater elevation is the maximum for the period January through May.
*Total Pumpage includes City of Rohnert Park, City of Cotati, Sonoma State University, and other Agricultural, Private and Commercial Entities.

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-32
Annual Pumpage and Representative Groundwater Elevations in Central Rohnert Park Wells



[1] Calculated using average City pumpage (1990-1997).

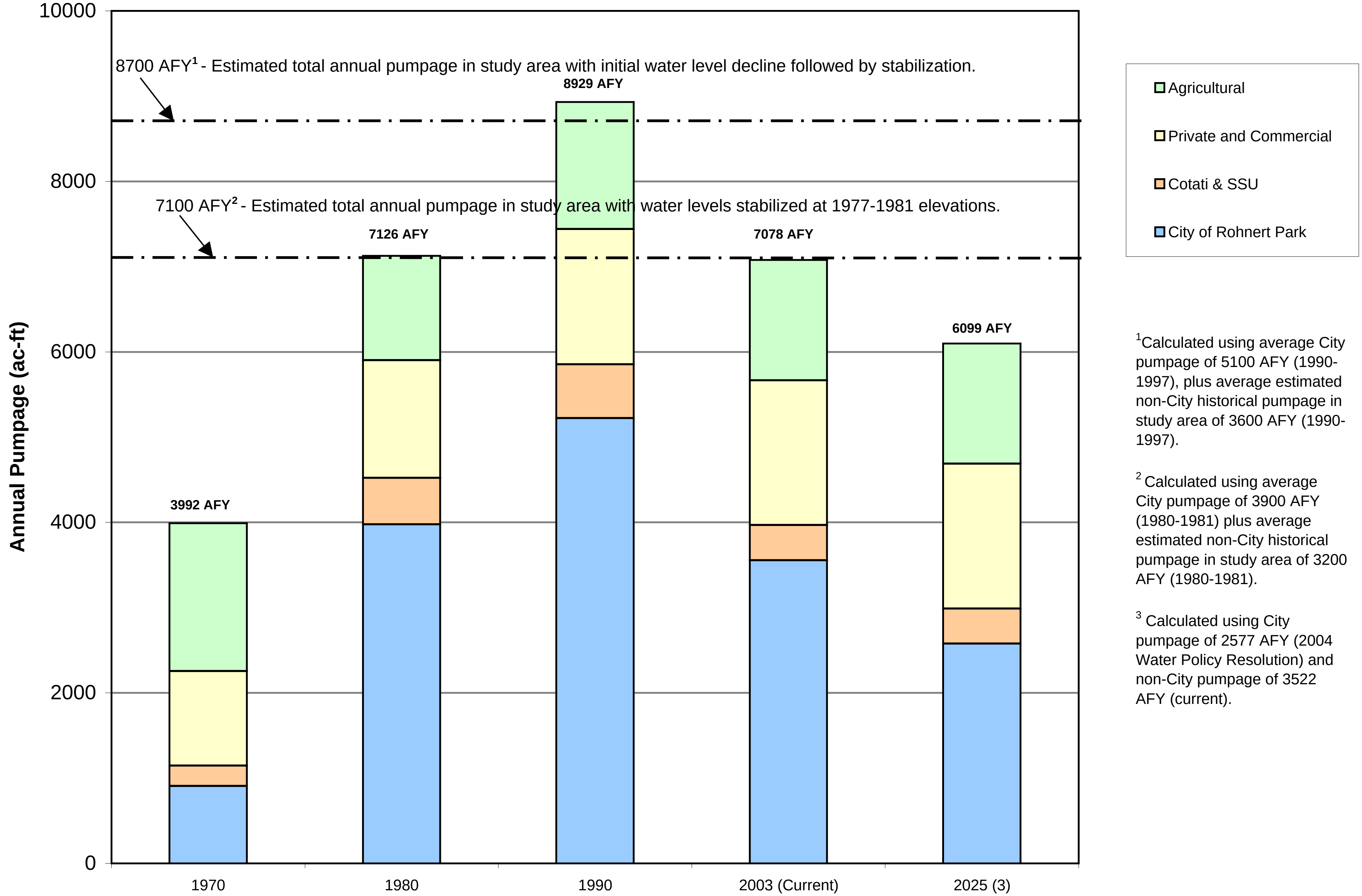
[2] Calculated using average City pumpage (1980-1981).

[3] 2004 Water Policy Resolution.

[4] Groundwater supply for sufficiency analysis (2004 Water Policy Resolution).

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Figure 3-33
Historical, Current, and Future Annual Groundwater Pumpage
City of Rohnert Park
City of Rohnert Park WSA



[1]Calculated using average City pumpage of 5100 AFY (1990-1997), plus average estimated non-City historical pumpage in study area of 3600 AFY (1990-1997).

[2] Calculated using average City pumpage of 3900 AFY (1980-1981) plus average estimated non-City historical pumpage in study area of 3200 AFY (1980-1981).

[3] Calculated using City pumpage of 2577 AFY (2004 Water Policy Resolution) and non-City pumpage of 3522 AFY (current).

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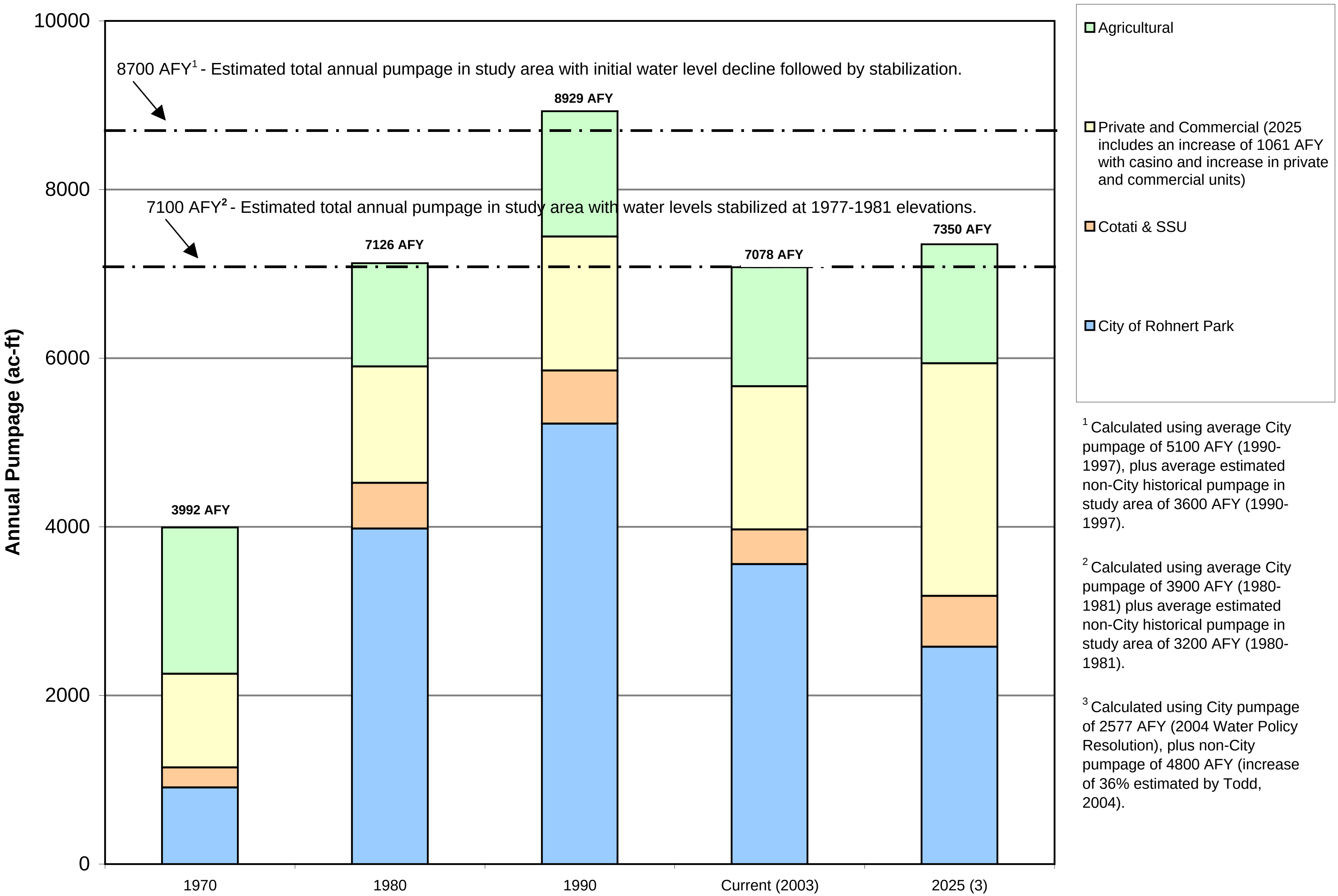
CONSULTING ENGINEERS

Figure 3-34
Historical, Current, and Future Annual Groundwater Pumpage with No Increase in Future Non-City Pumpage in Study Area
City of Rohnert Park WSA



[1] Calculated using average City pumpage of 5100 AFY (1990-1997), plus average estimated non-City historical pumpage in study area of 3600 AFY (1990-1997).

[2] Calculated using average City pumpage of 3900 AFY (1980-1981) plus average estimated non-City historical pumpage in study area of 3200 AFY (1980-1981).

[3] Calculated using City pumpage of 2577 AFY (2004 Water Policy Resolution), plus non-City pumpage of 4800 AFY (increase of 36% estimated by Todd, 2004).

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Figure 3-35
Historical, Current, and Future Annual Groundwater Pumpage with Increase in Future Non-City Pumpage in Study Area
City of Rohnert Park WSA

Tables

Table 3-1

Summary of Specific Capacities for City of Rohnert Park Wells

Well ID	Perforated Interval (ft below surface)		Well Completion in Zone (percent)				Average Pumping Rate (gpm)	Average Specific Capacity (gpm/ft)
	Top	Bottom	Shallow <200 ft	Intermediate 200-600 ft	Deep 600-800 ft	Lower >800 ft		
RP-01	265	458	0	100	0	0	225	2.3
RP-02	288	462	0	100	0	0	87	3.4
RP-03	272	805	0	45	52	3	-	-
RP-04	60	425	72	28	0	0	74	2.4
RP-05	160	463	11	89	0	0	154	2.0
RP-06	120	380	29	71	0	0	110	1.6
RP-07	128	460	12	88	0	0	304	6.1
RP-08	125	490	30	70	0	0	119	2.4
RP-08A	80	594	23	77	0	0	89	0.6
RP-09	144	490	24	76	0	0	238	5.9
RP-10	200	450	0	100	0	0	108	1.5
RP-11	224	494	0	100	0	0	216	5.0
RP-12	224	565	0	100	0	0	106	1.0
RP-13	118	478	23	77	0	0	136	2.7
RP-14	275	819	0	75	16	10	169	1.9
RP-15	351	1491	0	7	43	50	257	4.3
RP-16	300	1500	0	56	14	30	239	2.1
RP-17	302	462	0	100	0	0	-	-
RP-18	298	522	0	100	0	0	140	1.6
RP-19	120	420	33	67	0	0	124	-
RP-20	100	470	17	83	0	0	183	1.5
RP-21	190	395	10	90	0	0	148	2.4
RP-22	242	344	0	100	0	0	126	4.3
RP-23	190	580	8	92	0	0	-	-
RP-24	258	582	0	100	0	0	165	1.1
RP-25	323	580	0	100	0	0	-	-
RP-26	297	540	0	100	0	0	-	-
RP-27	260	594	0	100	0	0	261	2.3
RP-28	395	595	0	100	0	0	-	-
RP-29	130	450	22	78	0	0	123	2.2
RP-30	161	421	15	85	0	0	246	1.9
RP-31	110	510	25	75	0	0	111	3.7
RP-32	38	411	43	57	0	0	86	-
RP-33	156	666	16	68	16	0	159	2.1
RP-34	170	680	12	71	16	0	80	1.4
RP-35	160	590	12	88	0	0	96	-
RP-36	210	695	0	65	35	0	187	-
RP-37	130	380	37	63	0	0	44	0.9
RP-38	165	280	25	75	0	0	-	-
RP-39	238	398	0	100	0	0	298	3.8
RP-40	220	480	0	100	0	0	128	1.9
RP-41	175	675	15	55	30	0	262	2.9
RP-42	300	440	0	100	0	0	-	-

Table 3-2

Summary of Historical, Current, and Future Groundwater Pumpage for the Study Area

Entity		Pumpage in AFY[(1)]				
		1970	1980	1990	Current (2003)[2]	Future (2025)[3]
City of Rohnert Park		907	3978	5222	3556	2577
Cotati and Sonoma State University	City of Cotati	201	492	562	273	382
	Sonoma State University	38	51	70	139	220
Private and Commercial	Multi-family Dwelling Units (Todd's sewered & septic from Todd,2004)	177	220	253	274	274
	Single Family Dwelling Units (sewered & septic from Todd,2004)	750	933	1073	1145	2044
	Commercial Parcels	162	202	232	248	310
	Accommodations	21	26	30	32	32
	Graton Rancheria Casino					100
Agricultural	Agricultural pumpage (based on irrigated acres)	1735	1224	1488	1411	1411
Total pumpage		3992	7126	8929	7078	7350

1 For 1970,1980,1990 City pumpage is metered. See figure 3-10 for an explanation of other calculated values.

2 Pumpage values for SSU and the Cities of Rohnert Park and Cotati are metered and are for the 2003 calendar year; private, and commercial and agricultural pumpage values are estimated.

3 Rohnert Park pumpage is 2.3 mgd (2577 AFY) from 2002 Stipulated Judgment. Non-City pumpage is estimated by Todd (2004, Table 12 and the text). Except for agricultural. Agrigultural is kept constant from 2003 to 2025 (personal communication, Lex McCorvey, Sonoma County (Farm Bureau, Jannuary 2005). The total increase of Non-City pumpage is 36%.

Table 3-3
Summary of Groundwater Quality Data City of Rohnert Park Wells
January 2000 to March 2004

Analyte	Limit	Units	Intermediate Zone					Multiple Zones				
			No. of Wells	No. of Meas.	Range of Values	Avg. Value (Detects)	No. of Detects	No. of Wells	No. of Meas.	Range of Values	Avg. Value (Detects)	No. of Detects
Alkalinity	N/A	mg/L	7	7	140-190	163	7	13	13	130-330	198	13
Aluminum	1000(1)/200(3)	ug/L	7	7	<50			13	13	<50		
Arsenic	10(1)	ug/L	7	7	2-9	5	7	13	13	3-12	6	13
Barium	1000(3)	ug/L	7	7	<100-100	100	1	13	13	<100-200	149	7
Cadmium	5(3)	ug/L	7	7	<1			13	13	<1		
Calcium	N/A	mg/L	7	7	16-35	24	7	13	13	11-62	30	13
Chloride	250/500(4)	mg/L	7	7	10-37	16	7	13	13	9-56	22	13
Chromium	50(3)	ug/L	7	7	<10			13	13	<10		
Copper	1000(4)	ug/L	7	7	<50			13	13	<50		
Hardness	N/A	mg/L	4	4	89-140	115	4	8	8	42-300	165	8
Iron	300(4)	ug/L	7	7	<100			13	13	<100-890	890	1
Lead	15(2)	ug/L	7	7	<5			13	13	<5		
Magnesium	N/A	mg/L	7	7	9-18	14	7	13	13	6-35	17	13
Manganese	500(2)/50(4)	ug/L	7	7	<20-29	29	1	14	14	<20-83	60	2
Mercury	2(3)	ug/L	7	7	<1			13	13	<1		
Nitrate as NO3	45(3)	mg/L	11	19	<2-14	6	13	20	34	<2-23	11	16
pH	6.5/8.5(5)	pH units	7	7	7-8	7	7	13	13	7-8	7	13
Potassium	N/A	mg/L	7	7	<0-3	2	5	13	13	<0-4	3	9
Selenium	50(3)	ug/L	7	7	<5			13	13	<5-9	9	1
Silver	100(4)	ug/L	7	7	<10			13	13	<10		
Sodium	N/A	mg/L	7	7	16-70	27	7	13	13	16-83	34	13
Specific Conductance (EC)	900/1600(4)	umhos/cm	4	4	270-330	300	4	8	8	300-620	434	8
Sulfate	250/500(4)	mg/L	7	7	2-10	5	7	13	13	2-25	12	13
Total Dissolved Solids	500/1000(4)	mg/L	7	7	200-240	217	7	13	14	180-660	299	14
Zinc	5000(4)	ug/L	7	7	<50			13	13	<50		

1. Federal MCL, State to be determined
2. Action Level
3. State Primary MCL
4. Secondary MCL (recommended/upper)
5. Suggested Range

Table 3-4

Designation of Recharge Potential in Study Area Based on Soil Permeability and Slope

Permeability (cm/hr)	Acreage			
	Slope			Total
	<15%	15-25%	>25%	
<0.5	16,126	1,492	627	**18,246**
0.5-1.5	478	24	20	**522**
1.5-5.0	1,901	1,654	2,285	**5,840**
>5.0	324	36	35	**396**
Total Acres	**18,829**	**3,207**	**2,967**	**25,004**

Recharge Potential

High

Low

Moderate

Very Low

Table 3-5

Recharge Potential Designation in Specific Plan Areas

Specific Plan Area (SPA)	Recharge Potential* Acreage									
	High		Moderate		Low		Very Low		Total	
	SPA	Open Space	SPA	Open Space	SPA	Open Space	SPA	Open Space	SPA	Open Space
Northeast	33	26	45	12	270	17	0		348	55
University District	5	4	0		303	74	0		308	78
Southeast	0		0		83	5	0		83	5
Northwest	0		0		165	4	0		165	4
Wilfred/Dowdell	0		0		24	NA	0		24	NA

* Recharge Potential catagories defined in Table 3-4.
NA Area plan not available.

Table 3-6

Water Budget for
Water Years 1987-2001
(Todd, 2004)

		Estimate, AFY
Inflows		
Rainfall		73,908
Imported Water		2,604
Subsurface Inflow		999
	Total	**77,511**
Outflows		
Evapotranspiration		44,074
Stream Outflow		22,557
Subsurface Outflow		0
Phreatophytes, etc. ET		455
Import Water Consumed/Exported		2,428
Groundwater Consumed/Exported		
Sewered		5,541
Septic Tank		376
Agriculture		1,285
	Total	**76,716**
Computed Change in Storage		**795**

Note: Source of data Table 9, Todd (2004).

Table 3-7

Revised Water Budget for Water Years 1987-2001 (Modified from Todd, 2004)

		Estimate, AFY
Inflows		
Rainfall		73,908
Imported Water		2,604
Subsurface Inflow		355
Return Flows from Pumped Groundwater		
Sewered		372
Septic Tank		701
Agriculture		193
	Total	**78,133**
Outflows		
Evapotranspiration		44,074
Stream Outflow		22,557
Subsurface Outflow		0
Phreatophytes, etc ET		455
Import Water Consumed/Exported		2,428
Groundwater Pumped		
Sewered		5,913
Septic Tank		1,077
Agriculture		1,478
	Total	**77,982**
Computed Change in Storage		**151**

Groundwater Recharge (Extracted from Water Budget)		
Deep Percolation from Precipitation and Streams		6,822
Deep Percolation from Imported Water		176
Return Flows from Pumped Groundwater		1,266
	Total Estimated Recharge	**8,264**

Appendix A

Regional Geologic Setting and Previous Geologic Studies

The City of Rohnert Park is located at the southern end of the Santa Rosa Plain in the California Coastal Ranges north of San Francisco Bay. The Santa Rosa Plain drains to the northwest toward the Russian River and then to the Pacific Ocean. The Petaluma Valley Groundwater Basin, located south of Rohnert Park and including the unincorporated community of Penngrove, drains to the southeast toward San Francisco Bay. The broad gentle plain on which the City lies is topographically known as the Cotati Valley. The Cotati Valley lies within the DWR subbasin designated as the Santa Rosa Plain Subbasin (see Appendix A Figure 2).

Bedrock in the area consists of the Mesozoic Franciscan Complex of strongly deformed, weakly metamorphosed marine sedimentary rocks with blocks and slabs of volcanic oceanic crust tectonically mixed within the sedimentary materials. Overlying the bedrock is a thick sequence of volcanic and volcano-clastic rocks of late Tertiary age (late Miocene and Pliocene) known as the Tolay Volcanics and Sonoma Volcanics. Interbedded and interfingered with the volcanic rocks are non-marine, transitional marine, and marine sedimentary rocks of the Petaluma Formation and Wilson Grove (formerly known as Merced) Formation. Interfingered and overlying these Tertiary units are late Pliocene and Quaternary (Pleistocene and Holocene) non-marine sedimentary deposits of fluvial, lacustrine, and alluvial plain origins. The area is highly structurally complex with numerous faults, both active and inactive, that cut through the geologic units.

Over the last 100 years, numerous geologic investigations have been conducted in the area and are summarized in Cardwell (1958) and subsequent reports. The pioneering and classic investigation by Cardwell (1958) describes the hydrogeology of the Santa Rosa Valley. DWR has also conducted a series of investigations of the Santa Rosa Valley (or Plain) (DWR, 1975; 1982; and 1987). Numerous geologic maps have also been generated from the various investigations. Early mapping was summarized in Weaver (1949) and subsequent maps include Fox and others (1973), Huffman and Armstrong (1980), Allen (2003), and Clahan and others (2004, in preparation). Wagner & Bart (1982) is probably the most readily available large area map. However, continued evaluation and interpretation of the stratigraphic and structural complexities of the geology of the area present problems with even the most recent geologic maps.

In the Santa Rosa Plain area, three general areas can be described (see Appendix A Figure 5). East of the Santa Rosa Plain, the low hills and mountain ranges are underlain by the volcanic and volcano-clastic rocks of the Sonoma Volcanics, interbedded with the largely non-marine Petaluma Formation. This area is highly deformed and cut by numerous faults.

West of the Santa Rosa Plain, a broad, low topographic area is underlain by the Miocene-Pliocene, locally fossiliferous marine sandstone formerly known as the “Merced”

Formation (Cardwell, 1958); more recently (post-1982), it has been referred to as the Wilson Grove Formation.

The stratigraphic relationship between the western and eastern areas remains obscure due to poor exposures and the fact that it is covered by the younger deposits in the Santa Rosa Plain. A generalized relationship of interfingering and interbedding of the western marine deposits with transitional marine and non-marine deposits is believed to occur beneath the Valley. Allen (2003) mapped a region just west of the City of Cotati that contains interbedded Wilson Grove and Petaluma Formation, which extend beneath the Valley.

In the Santa Rosa Plain, surface geophysical survey interpretations indicate that up to 2.5 to 3 kilometers of Tertiary and younger deposits exist in this area (Allen, 2003; Mclaughlin & Sarna-Wojcicki, 2003). Investigators (Cardwell, 1958; DWR, 1978 and 1982; and Allen, 2003) have developed various interpretations of the depositional relationships. These interpretations tend to show an interfingering and/or interbedding relationship between the Wilson Grove (Merced) Formation to the west with Petaluma Formation and Sonoma Volcanics to the east. However, previous interpretations are largely based on limited deep borehole information from a few oil and gas testholes, deep water wells, and/or projections of measured angles of dip at surface exposures (Allen, 2003).

A Quaternary sequence of alluvium deposits, described as alluvial fan to fluvial and lacustrine origin, overlies the Tertiary units in the Cotati Valley. Cardwell (1958) initially ascribed much of these deposits to interbedded “Merced Formation” and non-marine Glen Ellen Formation, but this terminology has been largely dropped in favor of a Pleistocene older alluvium (Fox and others, 1973), Quaternary alluvial fans (DWR, 1982), and Pliocene-Pleistocene fluvial-lacustrine deposits (Mclaughlin and Sarna-Wojcicki, 2003). In the Rohnert Park area of the Santa Rosa Plain, groundwater is produced largely from the upper 800 feet of the sedimentary deposits.

Appendix B

Well Construction Information

CA Department of Water Resources, LUFT Sites,
City of Rohnert Park and Sonoma County Water Agency

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
05N07W07A001M	66		S	1
05N07W18B001M	80		S	2
05N08W01L002M	280		S	3
05N08W02H001M	161		S	4
05N08W13Q001M	41		S	5
06N07W17G001M	256		SI	6
06N07W30R001M	176		S	7
06N07W31J001M	134		SI	8
06N08W04Q001M	91		S	9
06N08W08R002M	83		S	10
06N08W15A002M	92		S	11
06N08W15J003M	96		S	12
06N08W16K003M	92		S	13
06N08W26L001M	101		S	14
06N08W27H001M	97		S	15
07N08W21J001M	123		SI	16
07N08W26L002M	144		I	17
07N08W27N002M	116		S	18
07N08W30K001M	96		SI	19
07N09W02L001M	91		S	20
07N09W15K001M	76		S	21
07N09W34F001M	182		S	22
07N09W35D004M	96		S	23
T0609700090LP-1	99		S	24
T0609700424MW-1	99		S	25
T0609700828MW-1	129		S	26

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-01	103		I	27
		265 - 458		
RP-02	99		I	28
		288 - 345		
		421 - 462		
RP-03	99		IDL	29
		272 - 343		
		717 - 805		
RP-04	108		SI	30
		60 - 62		
		80 - 150		
		106 - 108		
		146 - 150		
		380 - 385		
		400 - 425		
RP-05	100		SI	31
		160 - 175		
		215 - 240		
		363 - 463		
RP-06	118		I	32
		120 - 144		
		168 - 195		
		217 - 257		
		275 - 310		
		320 - 355		
		365 - 380		
RP-07	96		SI	33
		128 - 140		
		268 - 280		
		356 - 390		
		420 - 460		
RP-08	119		SI	34
		125 - 155		
		170 - 185		
		245 - 260		
		310 - 340		
		400 - 430		
		460 - 490		

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-08A	119		SI	35
		80 - 594		
RP-09	105		SI	36
		144 - 174		
		266 - 290		
		302 - 344		
		430 - 448		
		478 - 490		
RP-10	110		SI	37
		200 - 220		
		284 - 324		
		360 - 450		
RP-11	104		I	38
		224 - 234		
		260 - 280		
		300 - 390		
		454 - 474		
		484 - 494		
RP-12	104		I	39
		224 - 244		
		237 - 302		
		322 - 345		
		415 - 426		
		473 - 490		
		550 - 565		
RP-13	105		SI	40
		118 - 478		
RP-14	112		IDL	41
		275 - 340		
		365 - 385		
		405 - 425		
		555 - 615		
		732 - 747		
		799 - 819		

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-15	95		IDL	42
		351 - 371		
		656 - 726		
		746 - 806		
		1146 - 1206		
		1306 - 1326		
		1346 - 1376		
		1406 - 1418		
		1436 - 1441		
		1481 - 1491		
RP-16	101		IDL	43
		300 - 675		
		840 - 880		
		1020 - 1060		
		1300 - 1340		
		1440 - 1460		
		1480 - 1500		
RP-17	101		I	44
		302 - 310		
		326 - 332		
		404 - 462		
RP-18	101		I	45
		298 - 307		
		316 - 372		
		438 - 450		
		478 - 492		
		506 - 522		
RP-19	110		SI	46
		120 - 140		
		230 - 240		
		320 - 340		
		410 - 420		

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-20	106		SI	47
		100 - 115		
		195 - 200		
		340 - 395		
		405 - 415		
		425 - 455		
		465 - 470		
RP-21	117		SI	48
		190 - 200		
		246 - 266		
		274 - 284		
		290 - 330		
		350 - 370		
		390 - 395		
RP-22	123		I	49
		242 - 292		
		302 - 312		
		339 - 344		
RP-23	91		SI	50
		190 - 200		
		210 - 220		
		310 - 320		
		345 - 370		
		405 - 415		
		445 - 450		
		485 - 520		
		560 - 580		
RP-24	90		I	51
		258 - 298		
		358 - 378		
		396 - 406		
		418 - 428		
		496 - 536		
		576 - 582		

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-25	154		I	52
		323 - 368		
		389 - 434		
		440 - 455		
		471 - 486		
		520 - 580		
RP-26	126		I	53
		297 - 322		
		387 - 402		
		410 - 470		
		482 - 492		
		500 - 540		
RP-27	112		I	54
		260 - 275		
		284 - 294		
		304 - 315		
		324 - 334		
		354 - 379		
		394 - 404		
		414 - 429		
		440 - 445		
		465 - 470		
		545 - 560		
		574 - 594		
RP-28	138		I	55
		395 - 510		
		520 - 545		
		560 - 595		
RP-29	115		SI	56
		130 - 450		
RP-30	105		SI	57
		161 - 421		
RP-31	109		SI	58
		110 - 450		
		490 - 510		

[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-32	111		I	59
		38 - 58		
		78 - 98		
		121 - 141		
		181 - 202		
		223 - 243		
		268 - 288		
		308 - 328		
		368 - 411		
RP-33	119		SID	60
		156 - 356		
		426 - 446		
		586 - 606		
		626 - 666		
RP-34	139		SID	61
		170 - 245		
		300 - 390		
		415 - 430		
		445 - 460		
		590 - 600		
		640 - 680		
RP-35	123		SI	62
		160 - 220		
		230 - 270		
		300 - 320		
		360 - 550		
		570 - 590		
RP-36	135		ID	63
		210 - 230		
		260 - 270		
		390 - 430		
		585 - 605		
		655 - 695		
RP-37	126		SI	64
		130 - 270		
		290 - 320		
		360 - 380		

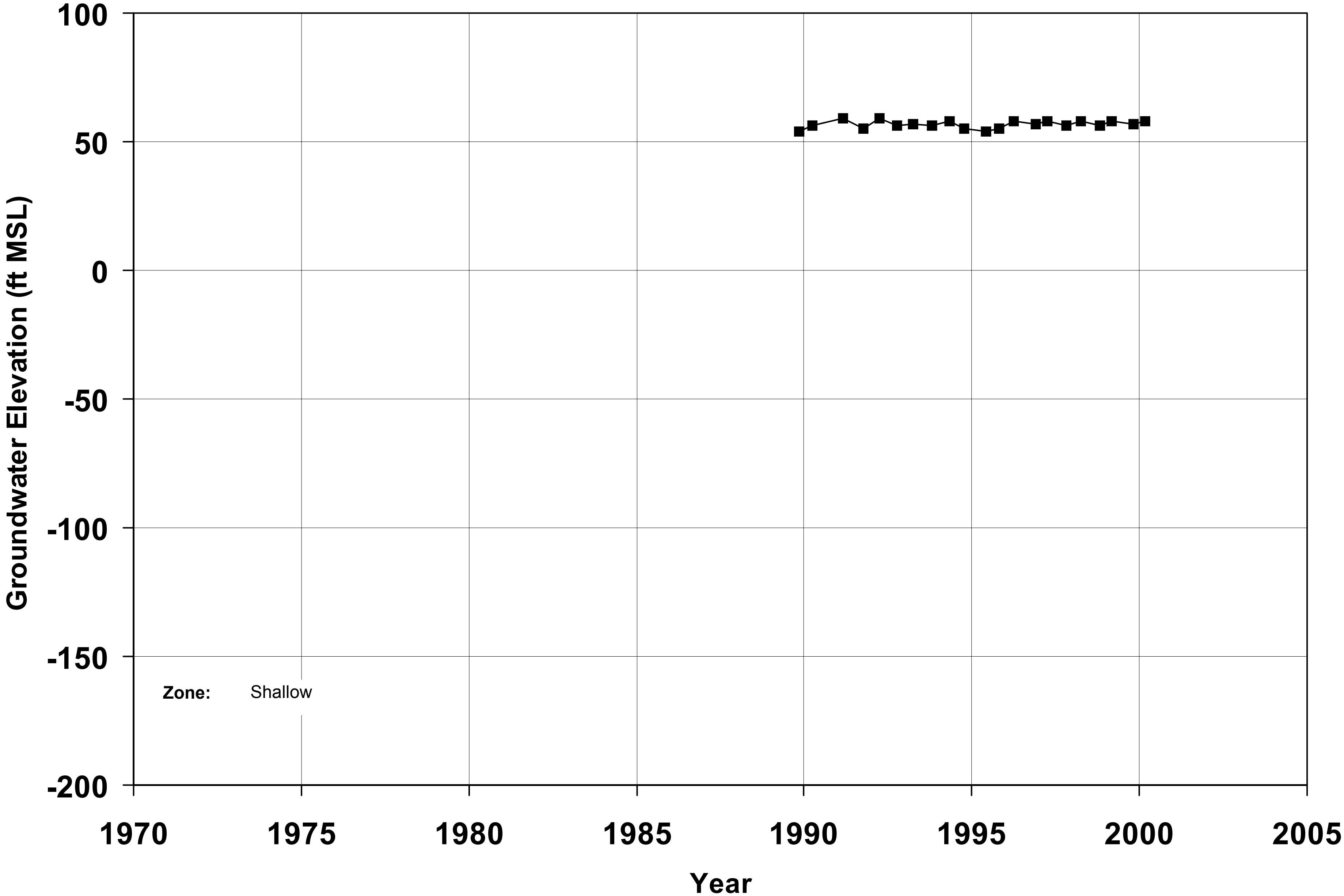
[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

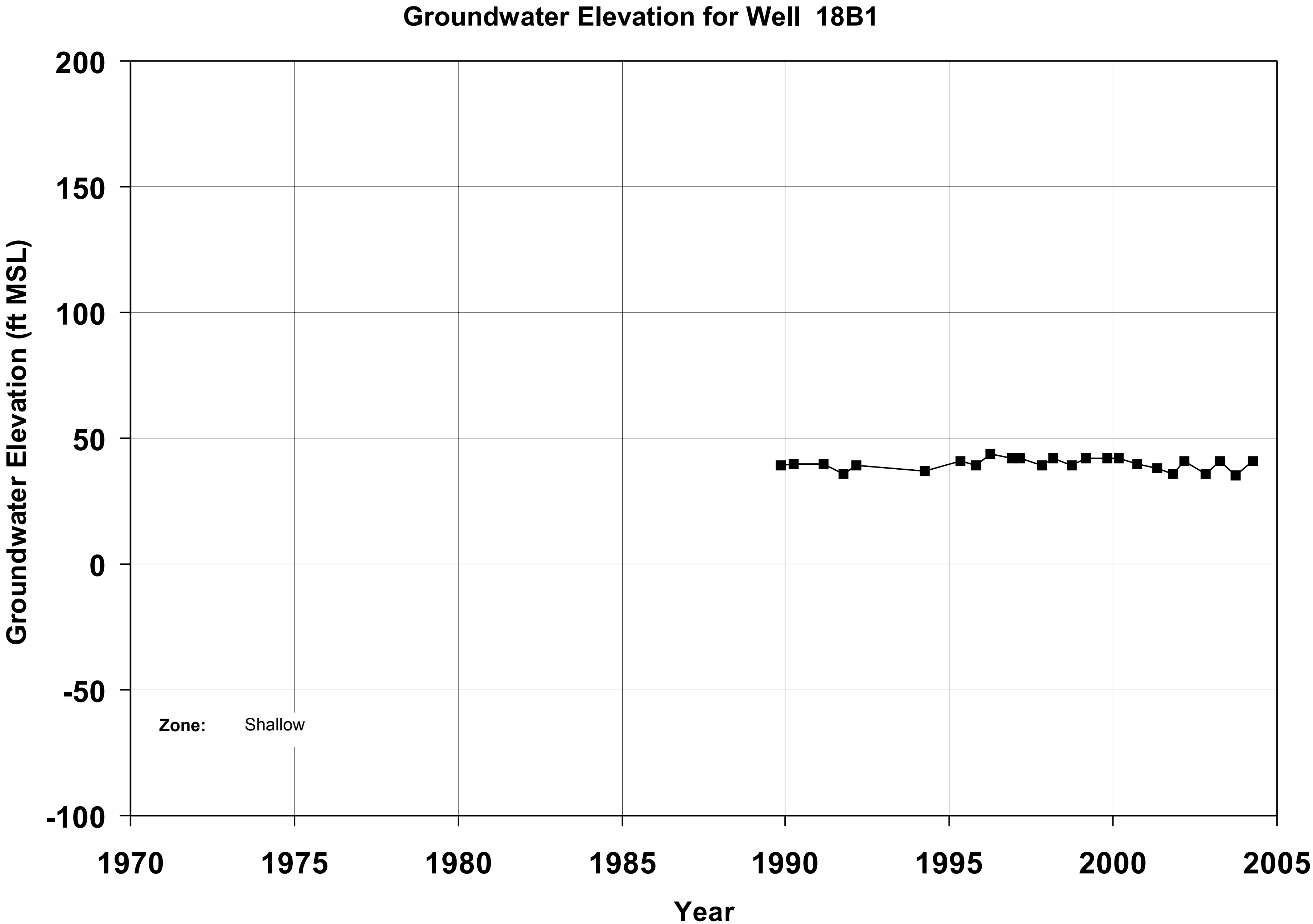
Well	Reference Point Elevation (ft MSL)	Screened Interval Depth Top-Bottom[1] (ft)	Zone[2]	Appendix C Page Number
RP-38	132		SI	65
		165 - 175		
		195 - 225		
		260 - 280		
RP-39	129		I	66
		238 - 398		
RP-40	136		I	67
		220 - 260		
		275 - 295		
		310 - 340		
		385 - 435		
		460 - 480		
RP-41	93		SID	68
		175 - 205		
		230 - 250		
		350 - 360		
		380 - 390		
		415 - 425		
		435 - 445		
		478 - 488		
		585 - 630		
		655 - 675		
RP-42	111		I	69
		300 - 320		
		340 - 400		
		420 - 440		
SCWA-01	85		S	70
		60 - 80		
SCWA-02	85			71
		- 257[3]		
SCWA-03	85			72
		- 570[3]		
SCWA-04	85		D	73
		650 - 800		
SCWA-05	75		IDL	74
		400 - 1040		
SCWA-06	71		ID	75
		400 - 600		

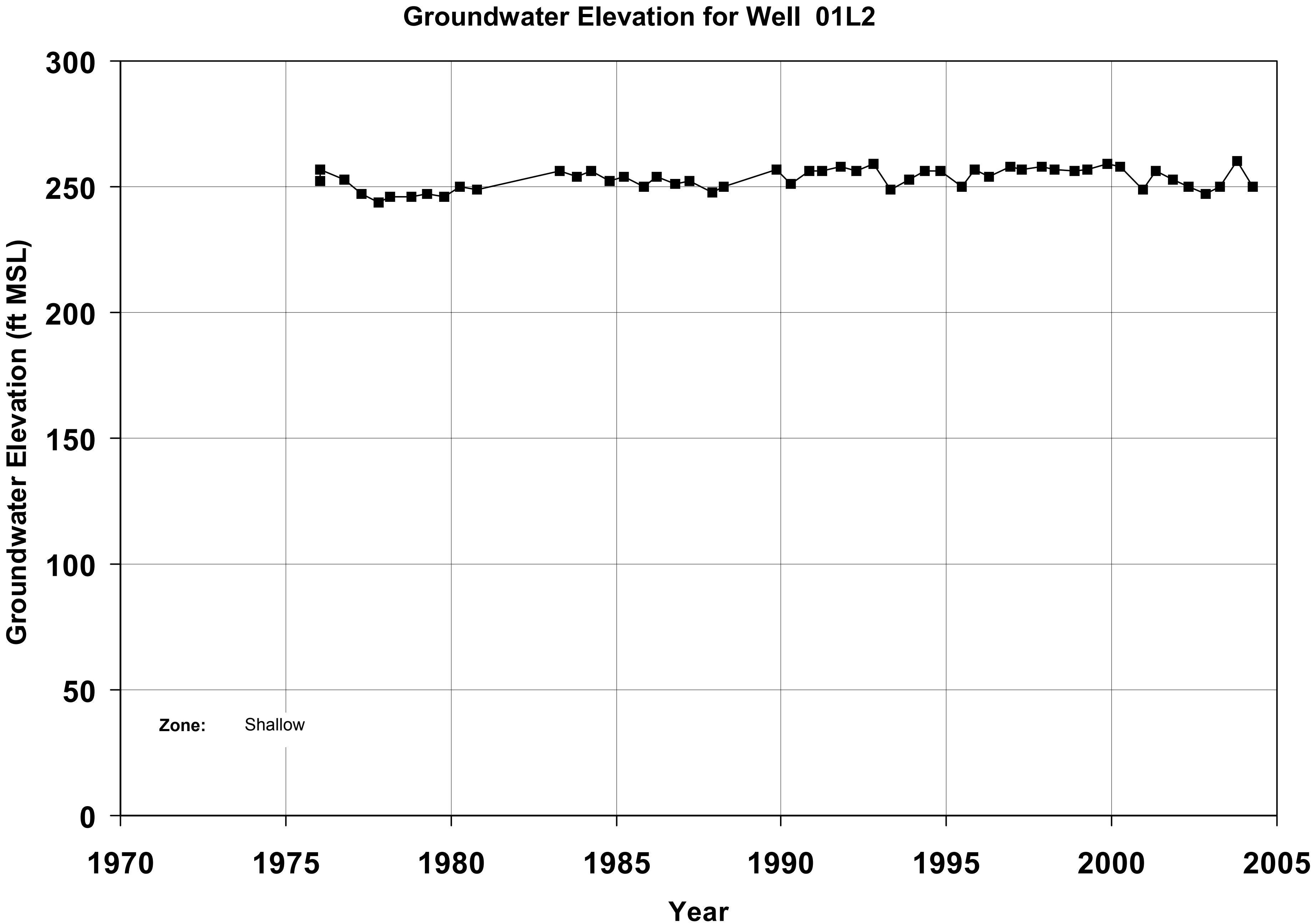
[1] DWR well information is confidential.
[2] S=Shallow; I=Intermediate; D=Deep; L=Lower
[3] Depth of well provided when screened interval is not available.

Appendix C

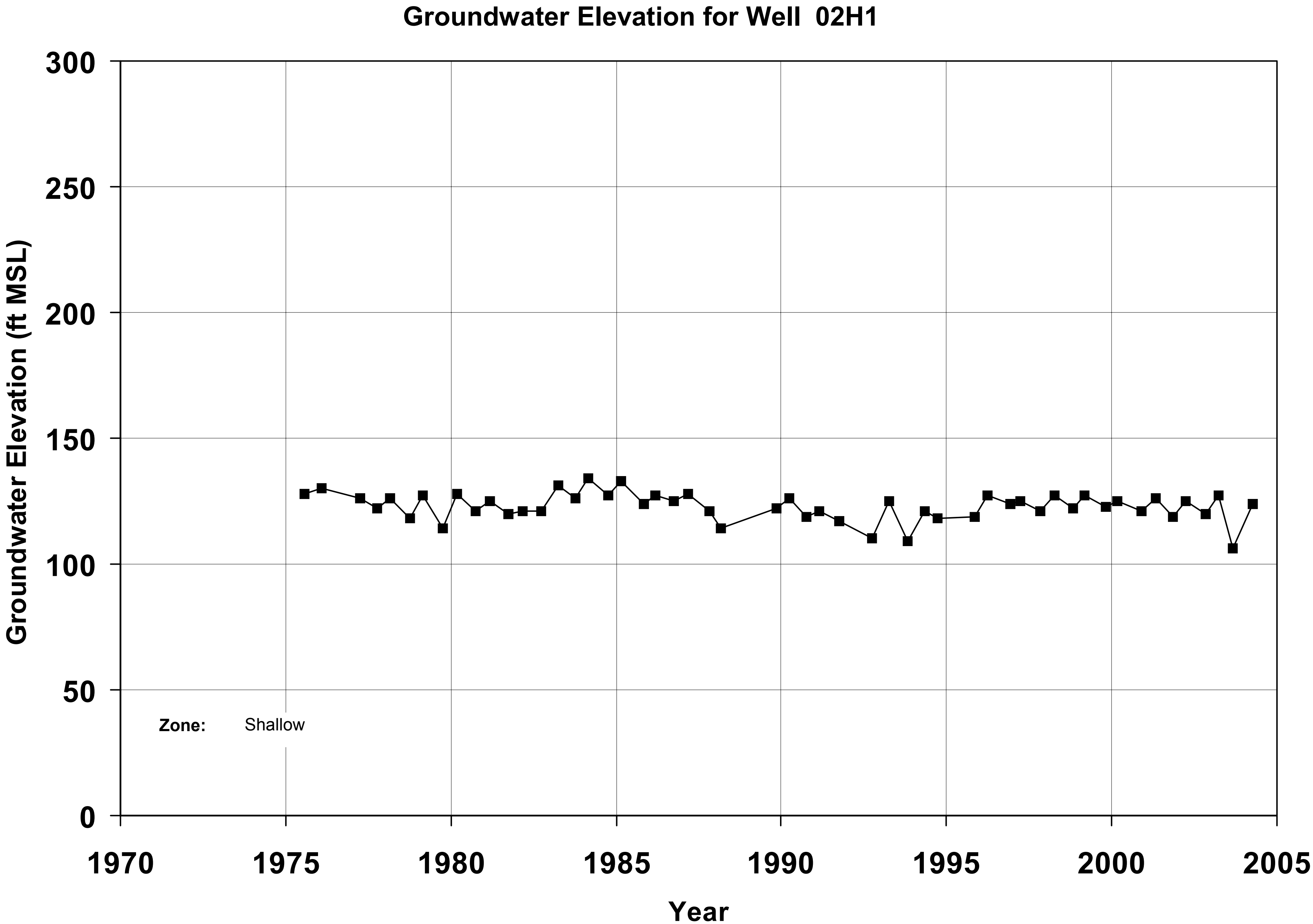
Groundwater Elevation for Well 07A1

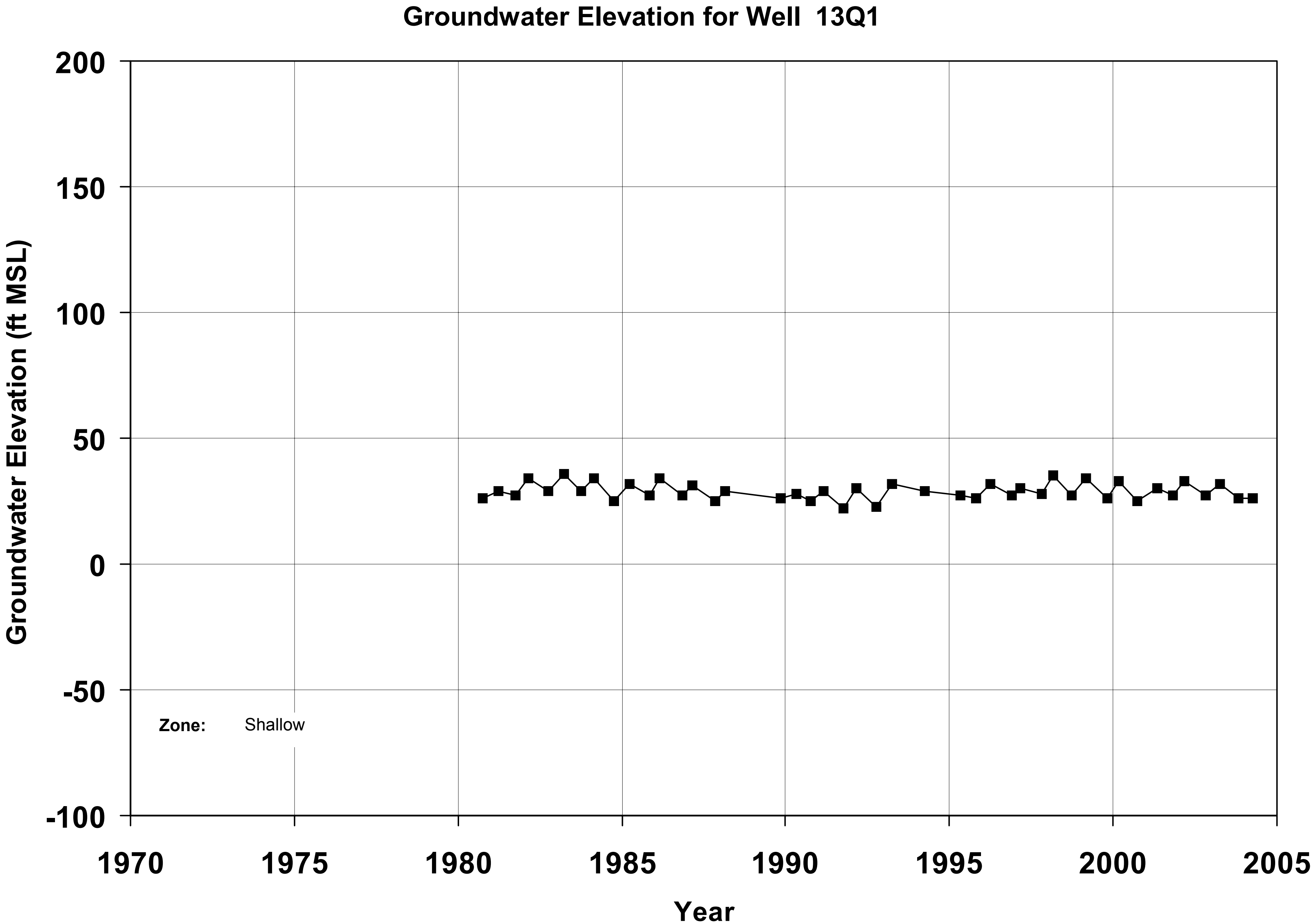



Groundwater Elevation for Well 18B1
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
Zone:
Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

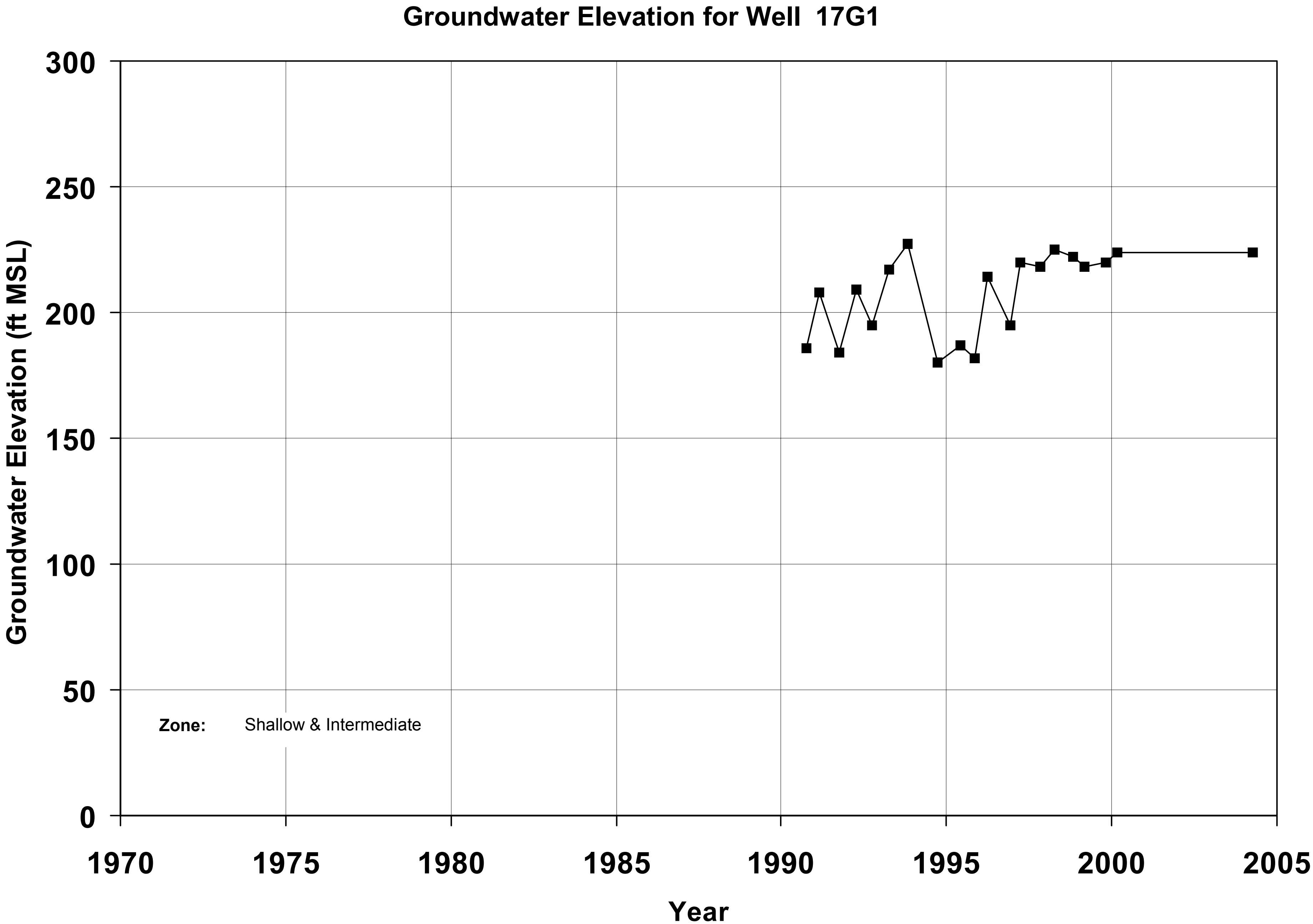


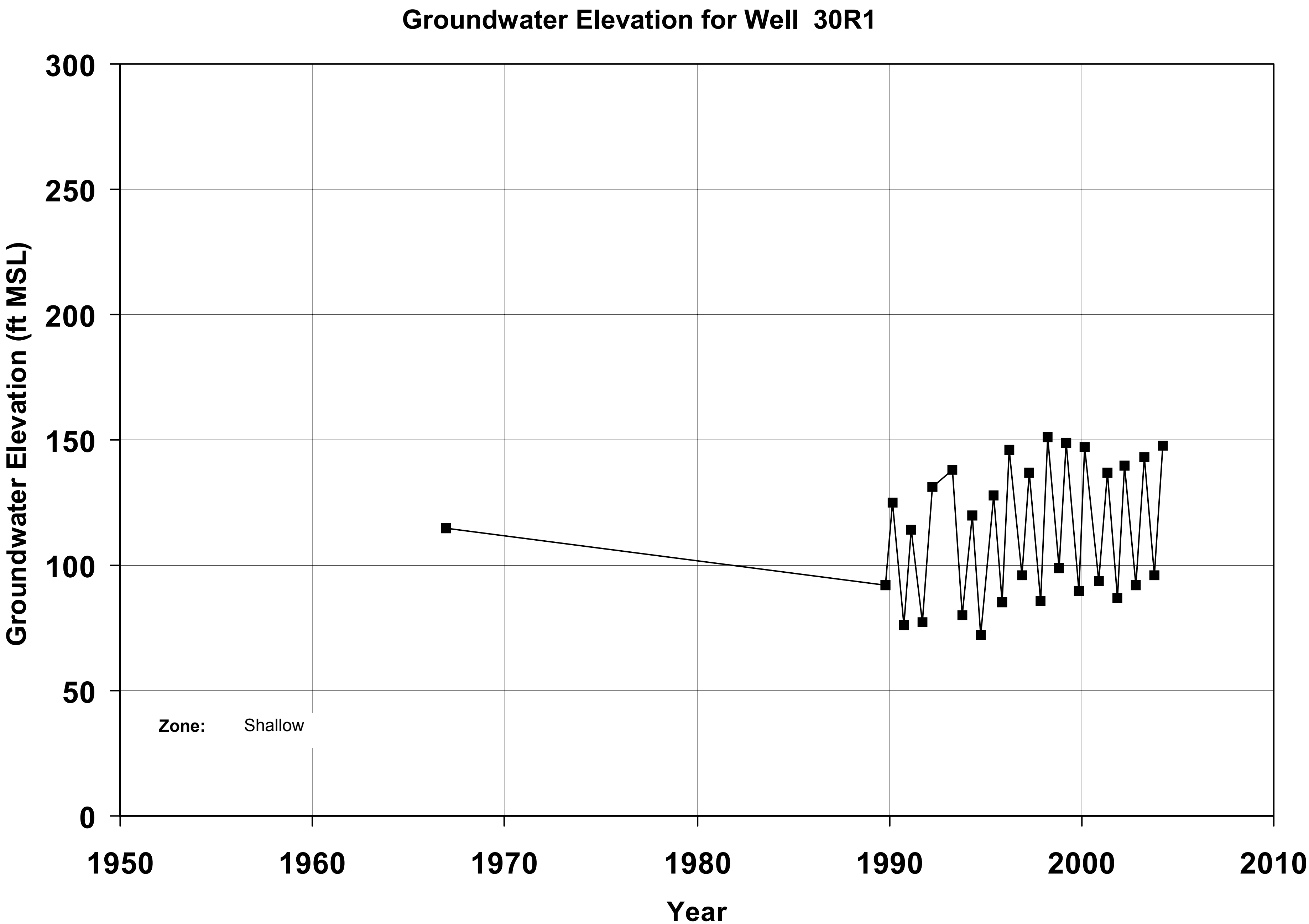
Groundwater Elevation for Well 01L2
Groundwater Elevation (ft MSL)
300
250
200
150
100
50
0
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

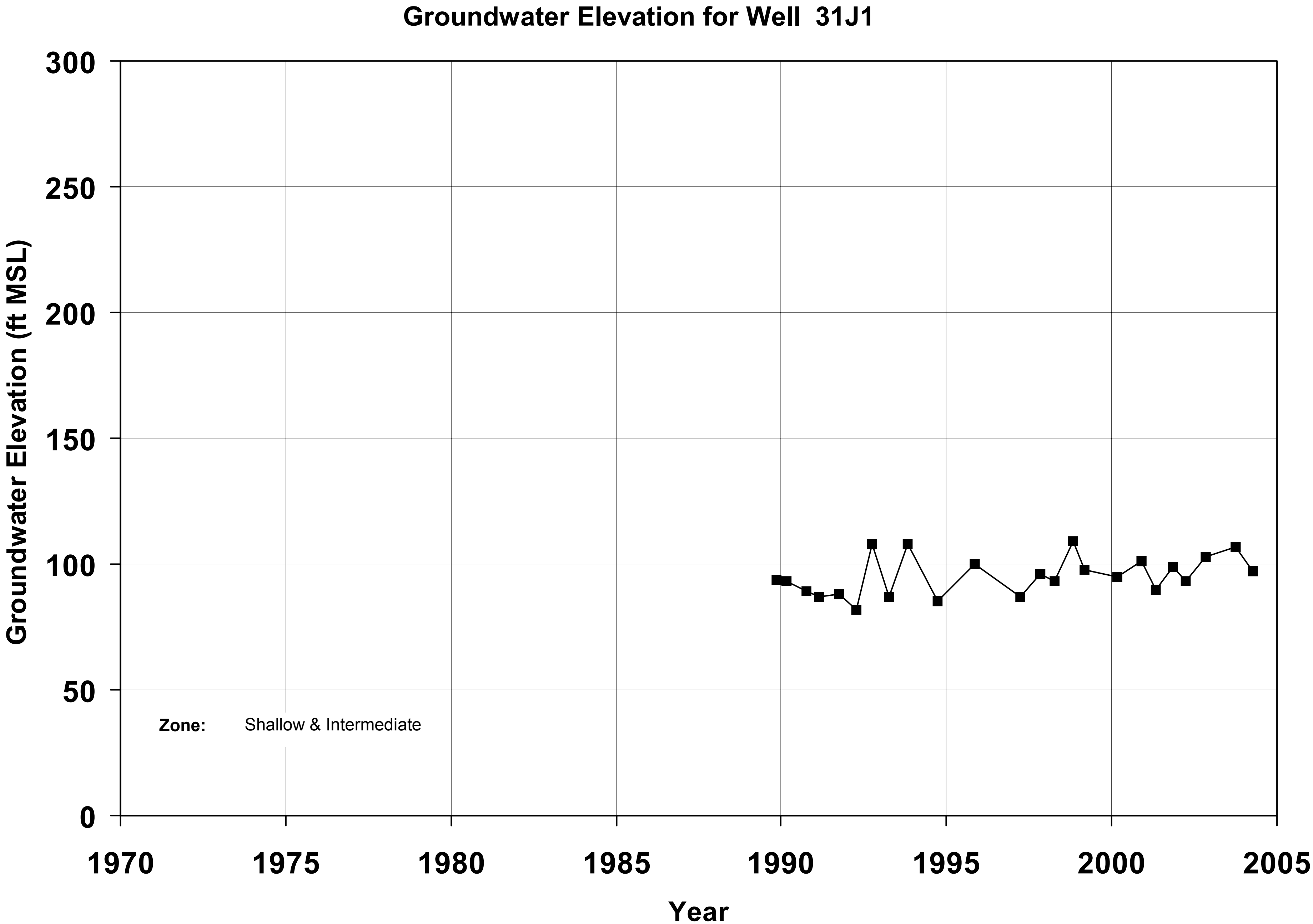

Groundwater Elevation for Well 02H1
Groundwater Elevation (ft MSL)
300
250
200
150
100
50
0
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow



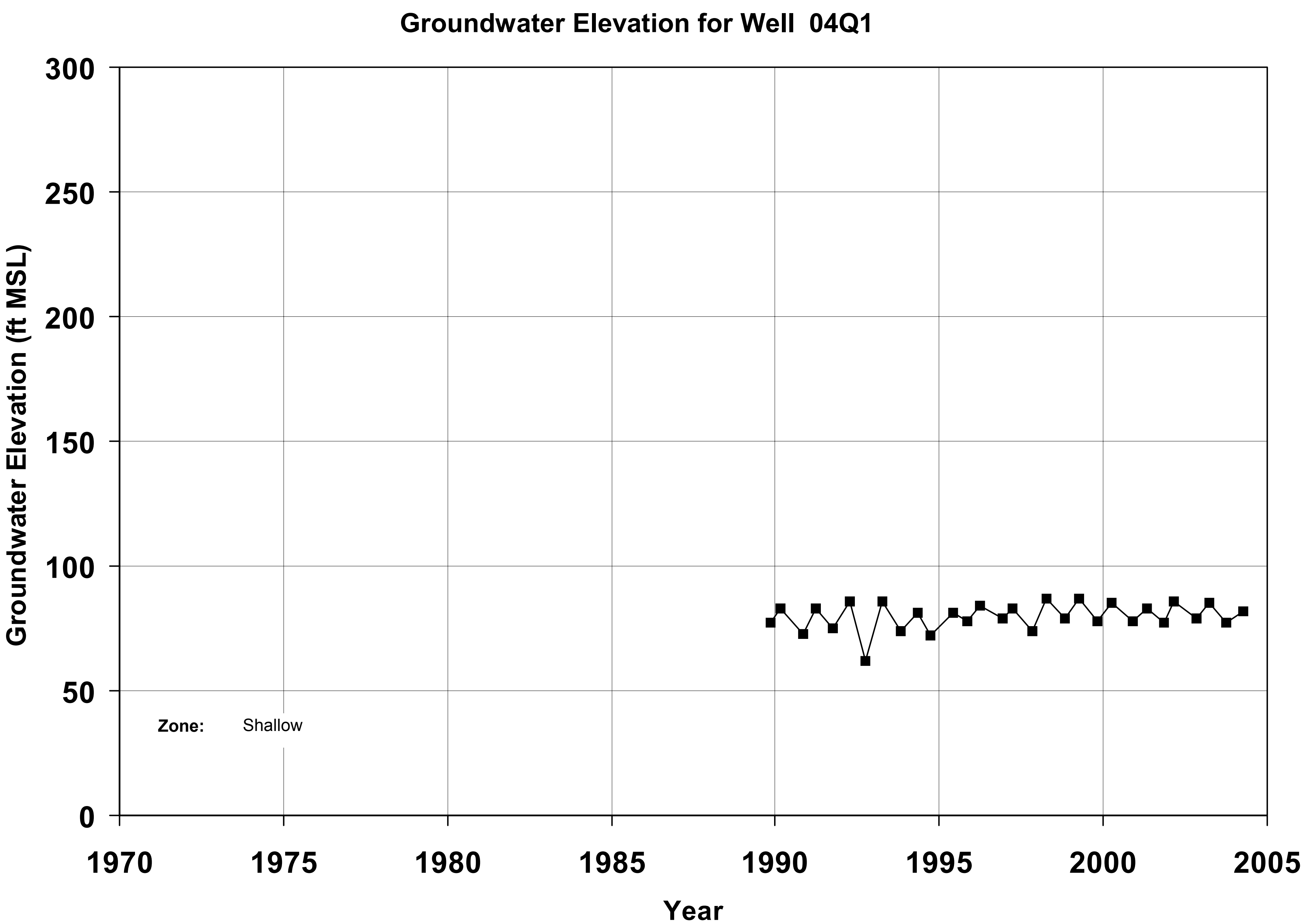
Groundwater Elevation for Well 13Q1
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

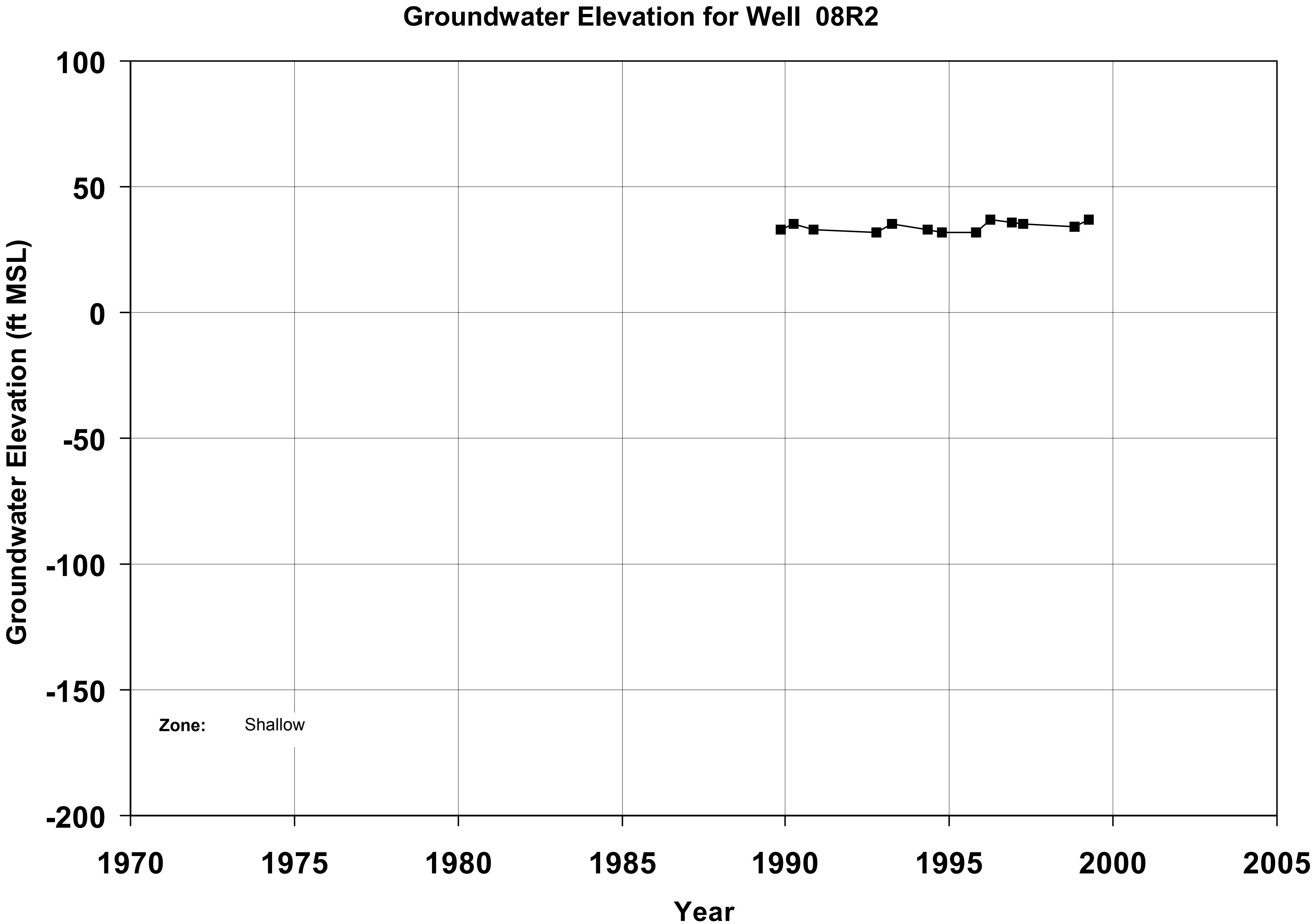

Groundwater Elevation for Well 17G1
300
250
200
150
100
50
0
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well 30R1
Groundwater Elevation (ft MSL)
300
250
200
150
100
50
0
1950
1960
1970
1980
1990
2000
2010
Year
Zone: Shallow

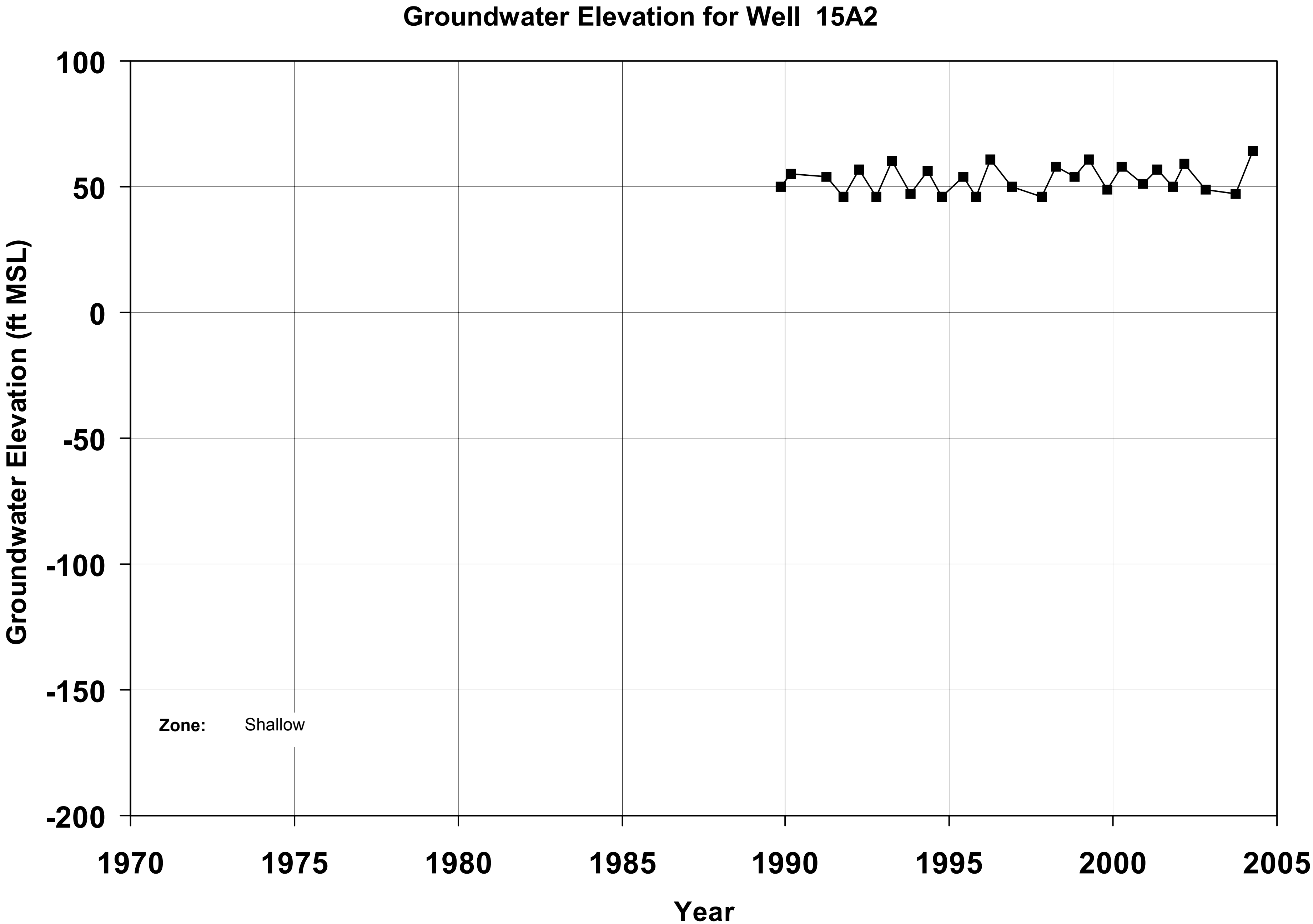


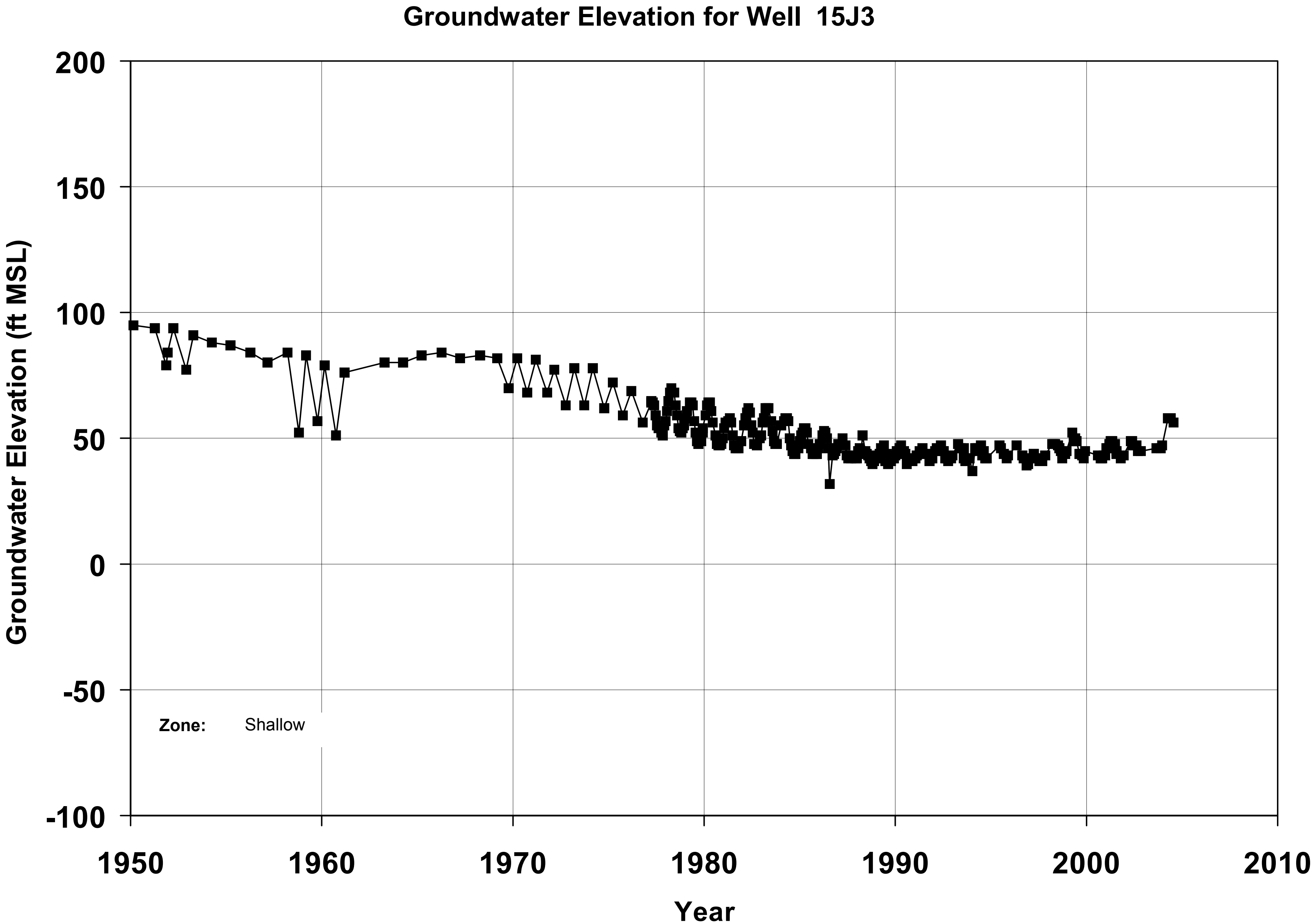
Groundwater Elevation for Well 31J1
Groundwater Elevation (ft MSL)
300
250
200
150
100
50
0
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow & Intermediate


Groundwater Elevation for Well 04Q1
Groundwater Elevation (ft MSL)
300
250
200
150
100
50
0
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

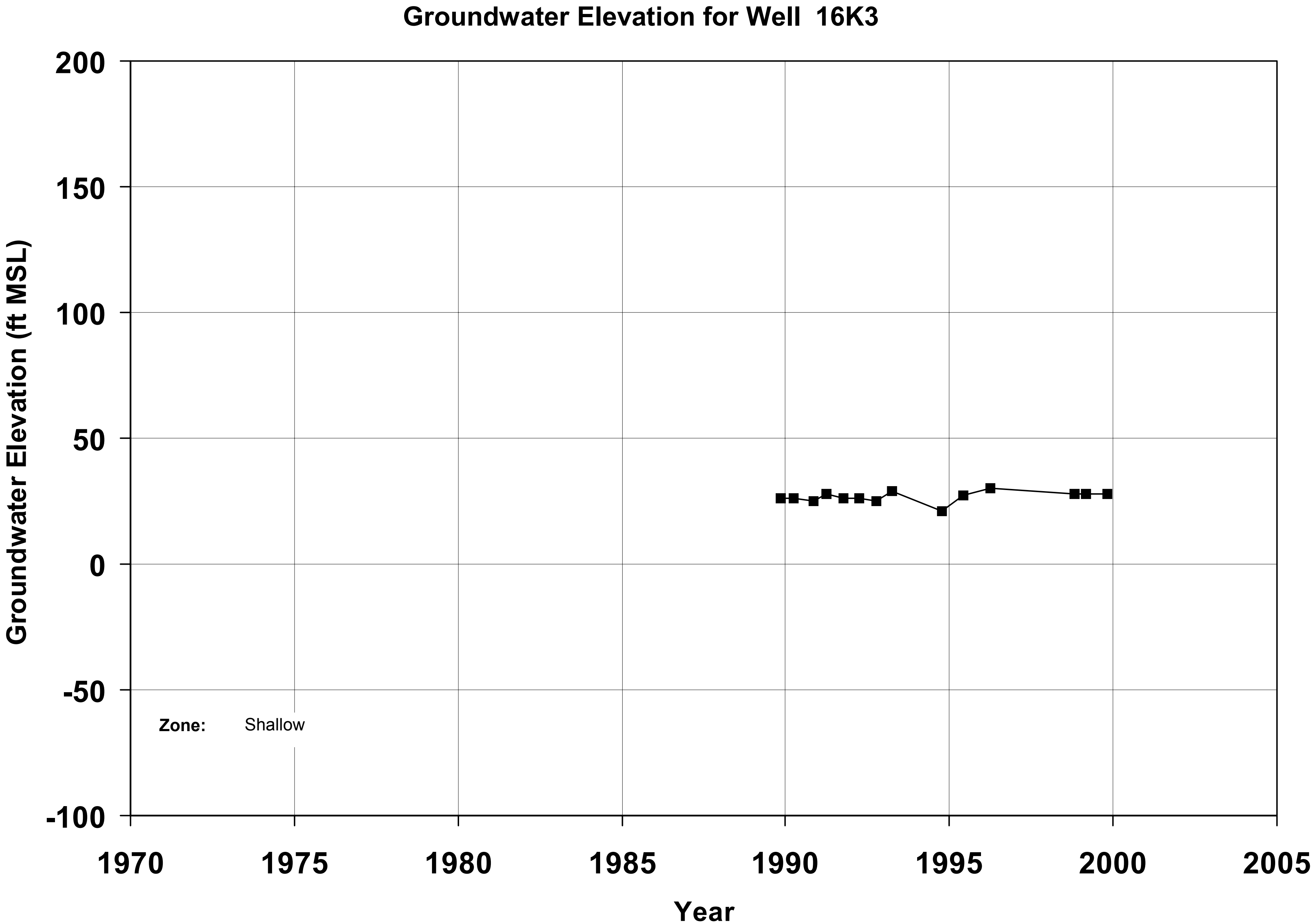


Groundwater Elevation for Well 08R2
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well 15A2
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

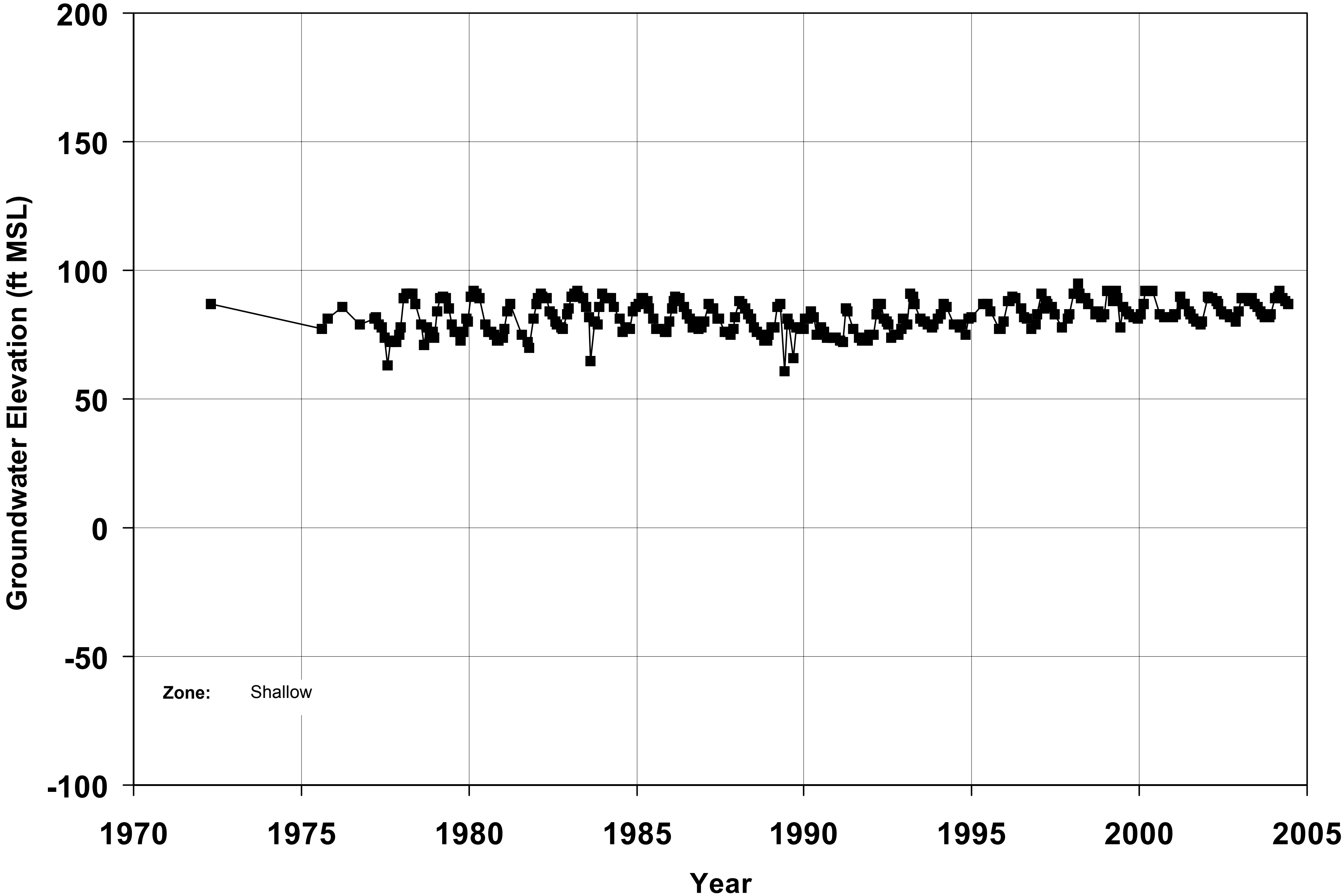


Groundwater Elevation for Well 15J3
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1950
1960
1970
1980
1990
2000
2010
Year
Zone: Shallow

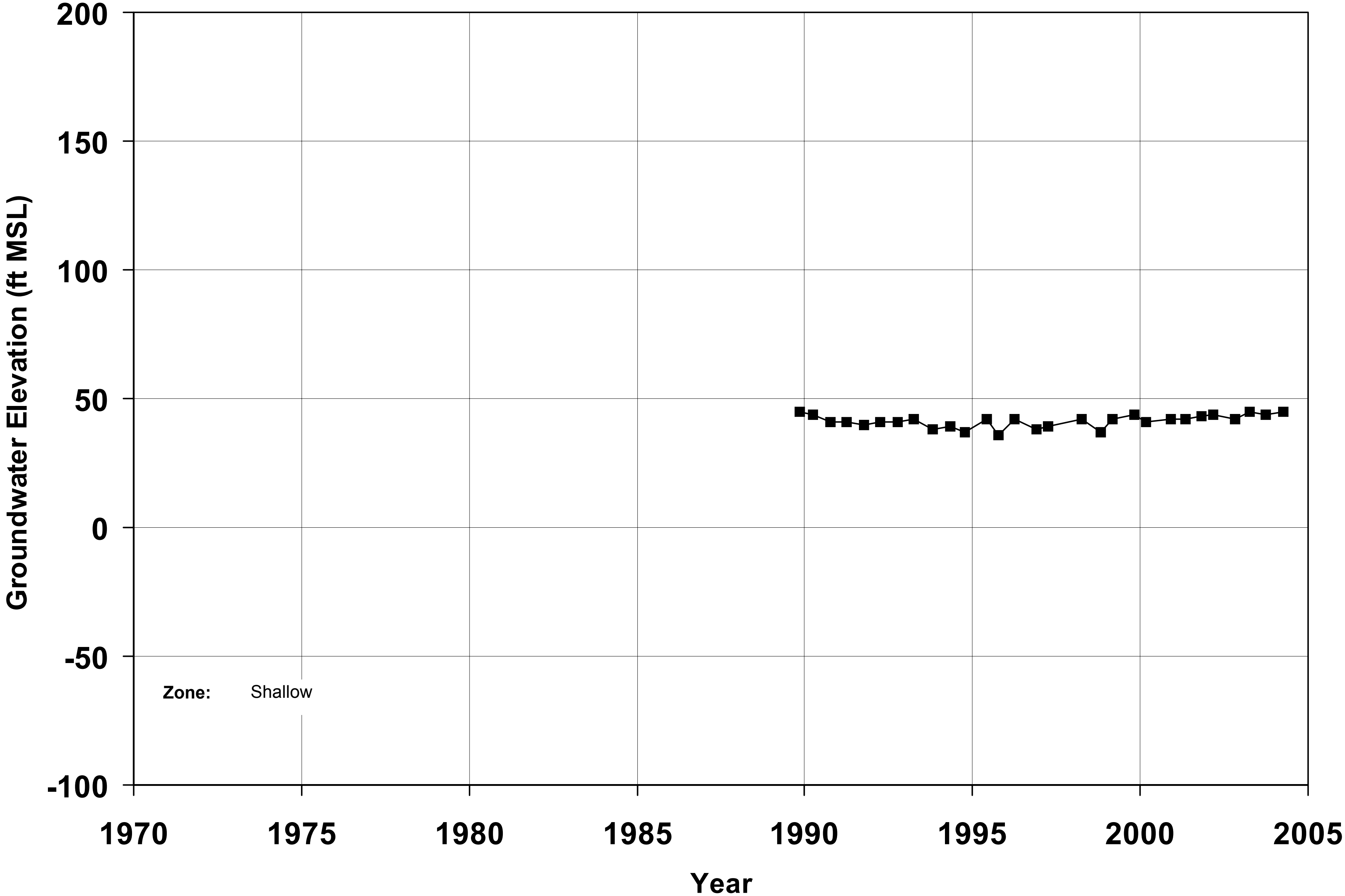


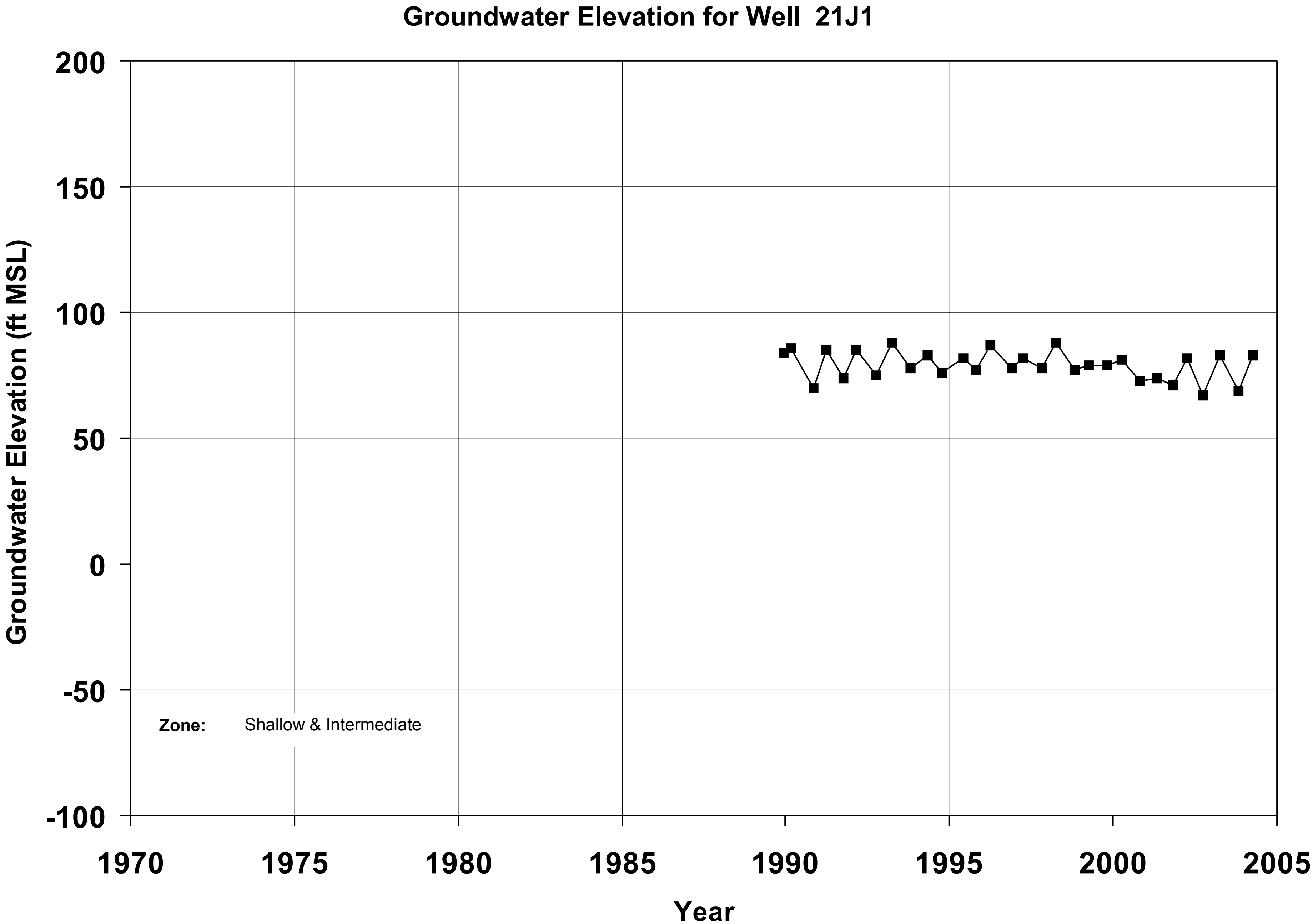
Groundwater Elevation for Well 16K3
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year

Groundwater Elevation for Well 26L1

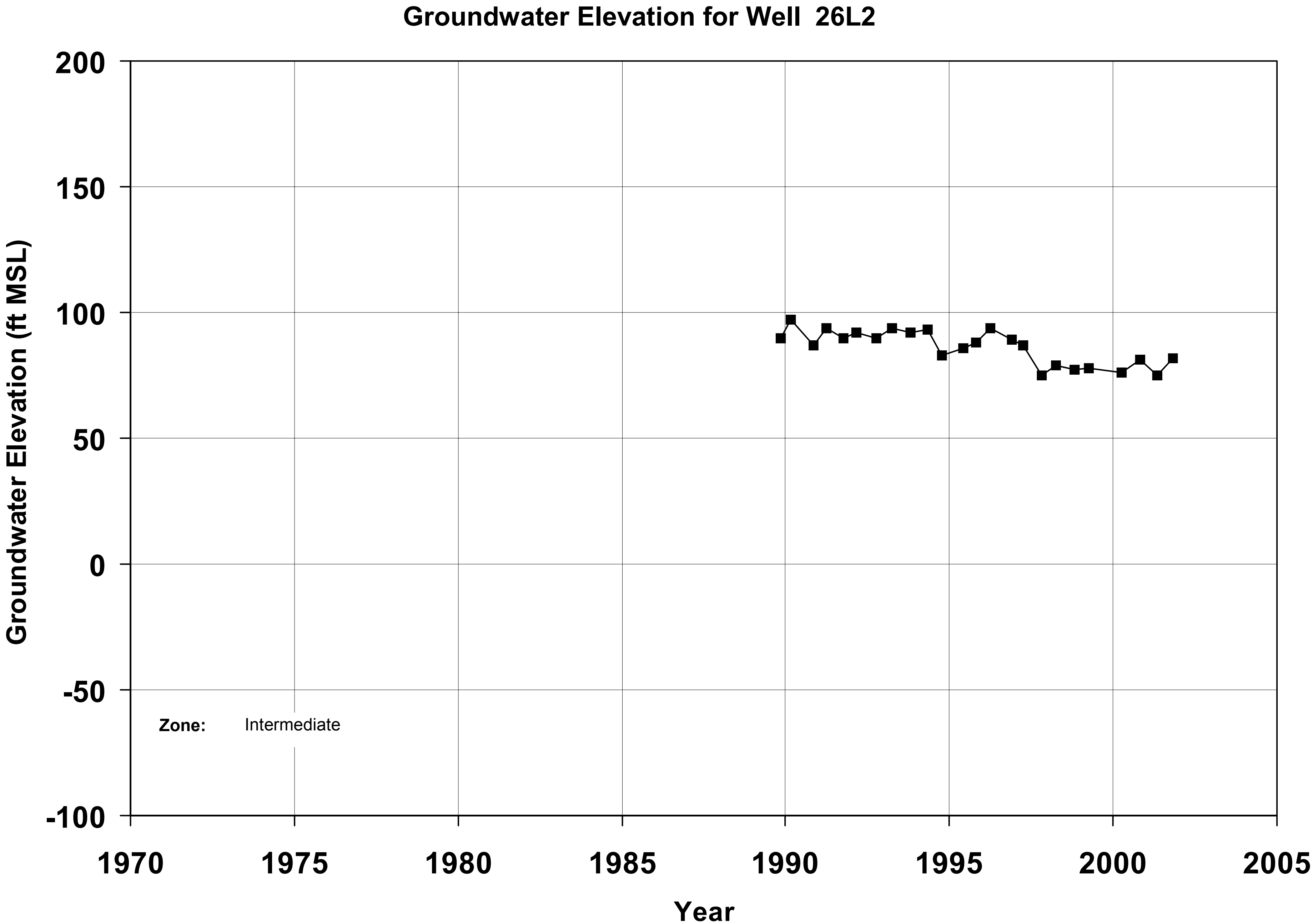


Groundwater Elevation for Well 27H1

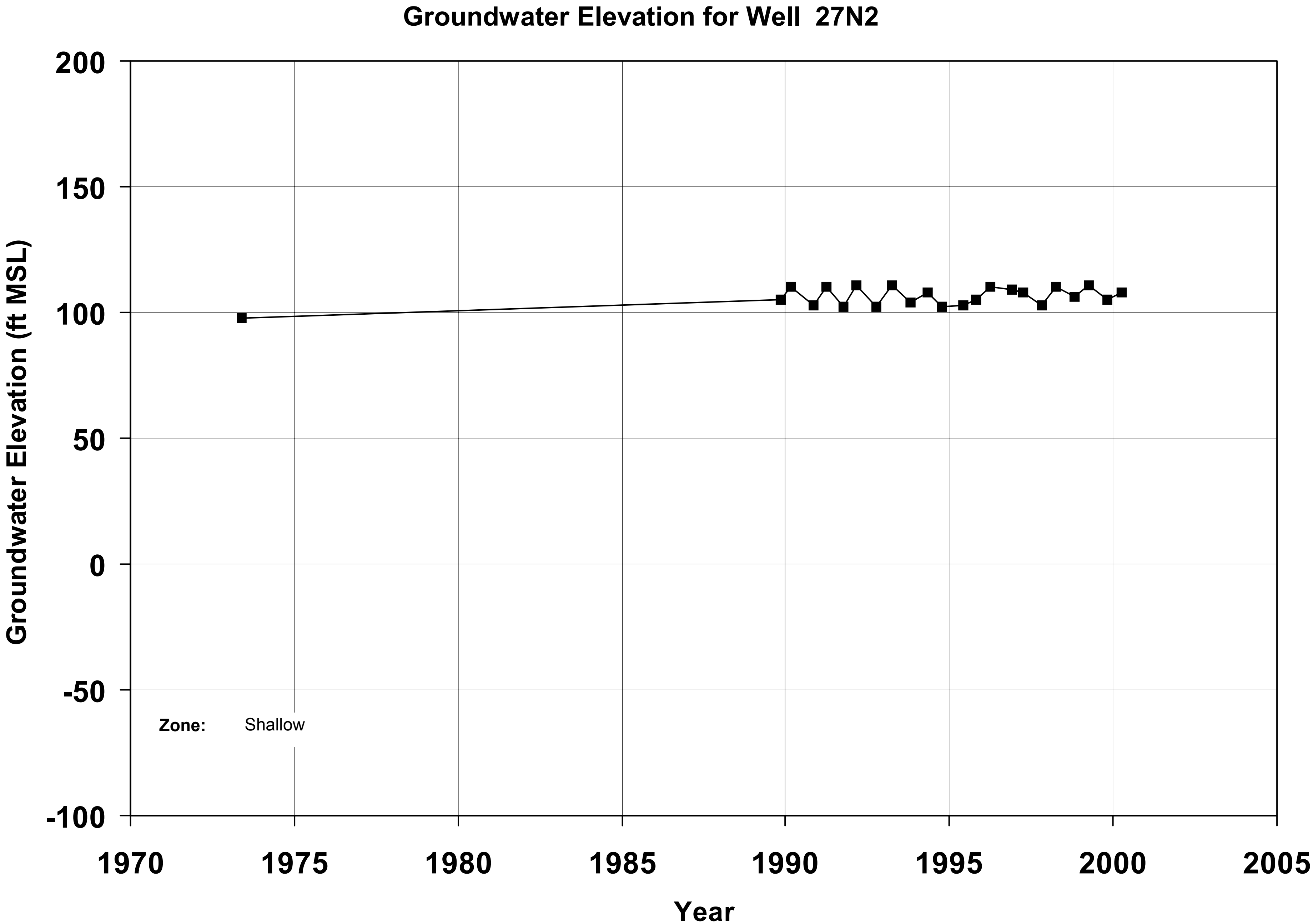




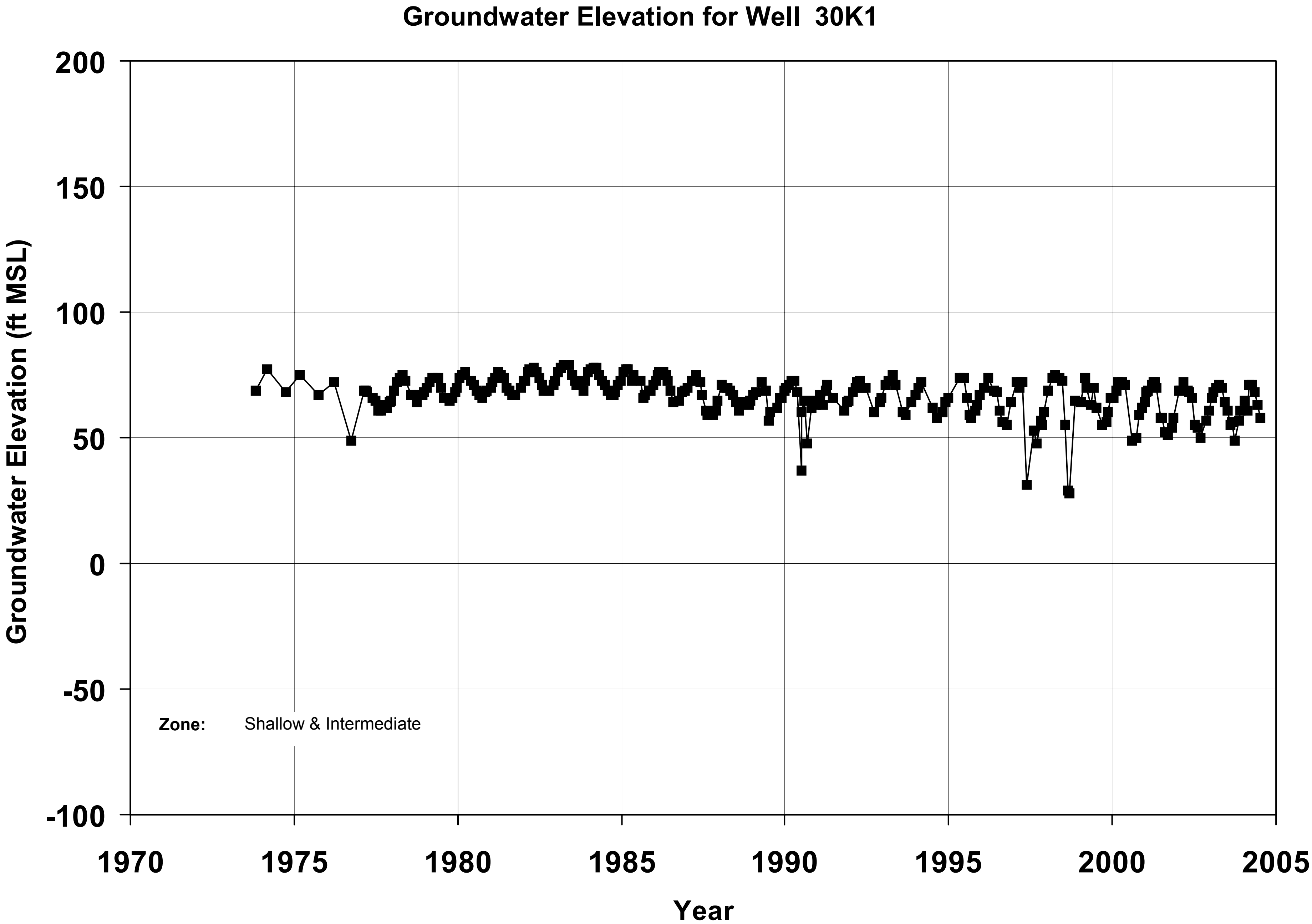
Groundwater Elevation for Well 21J1
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year



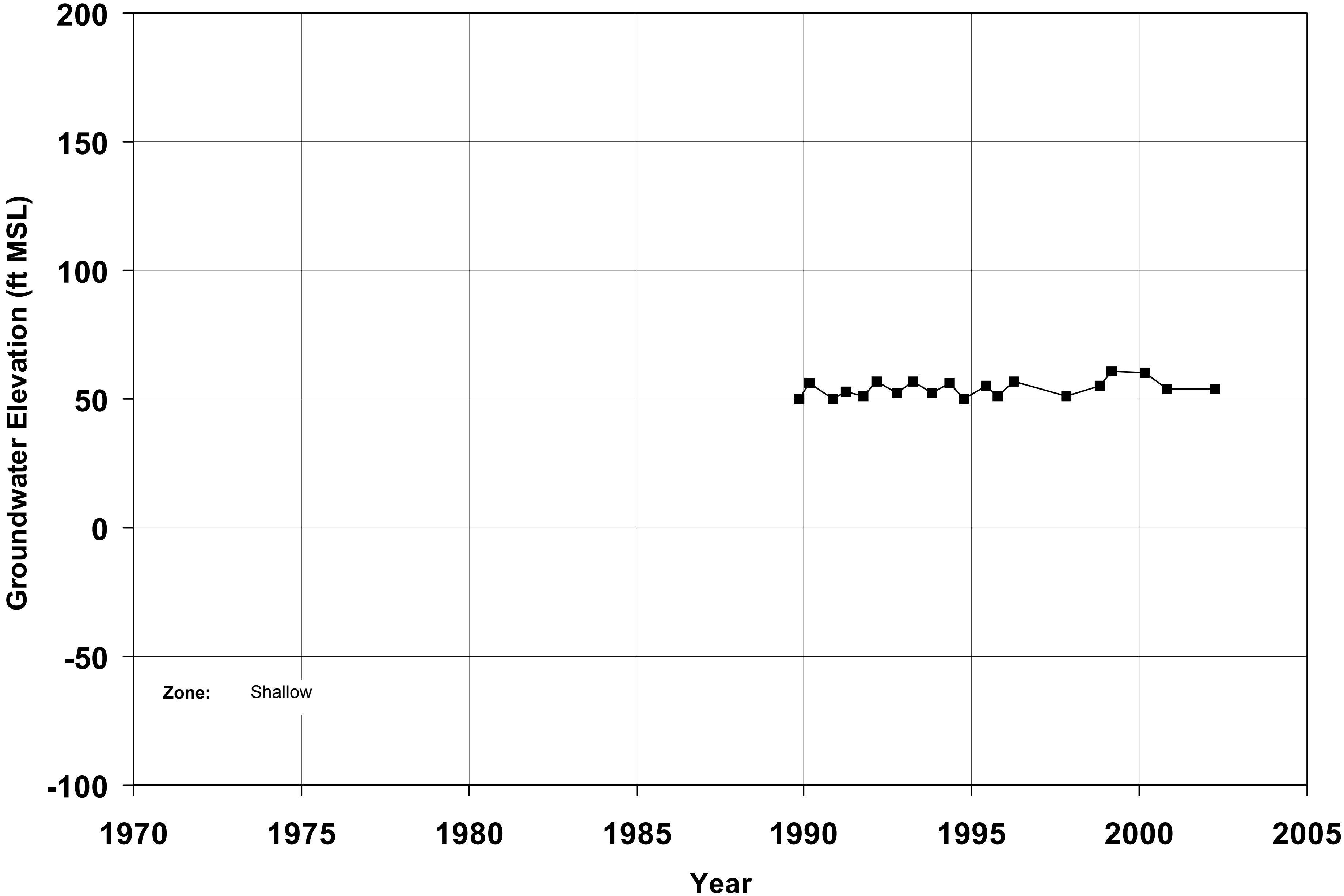
Groundwater Elevation for Well 26L2
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
Zone: Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

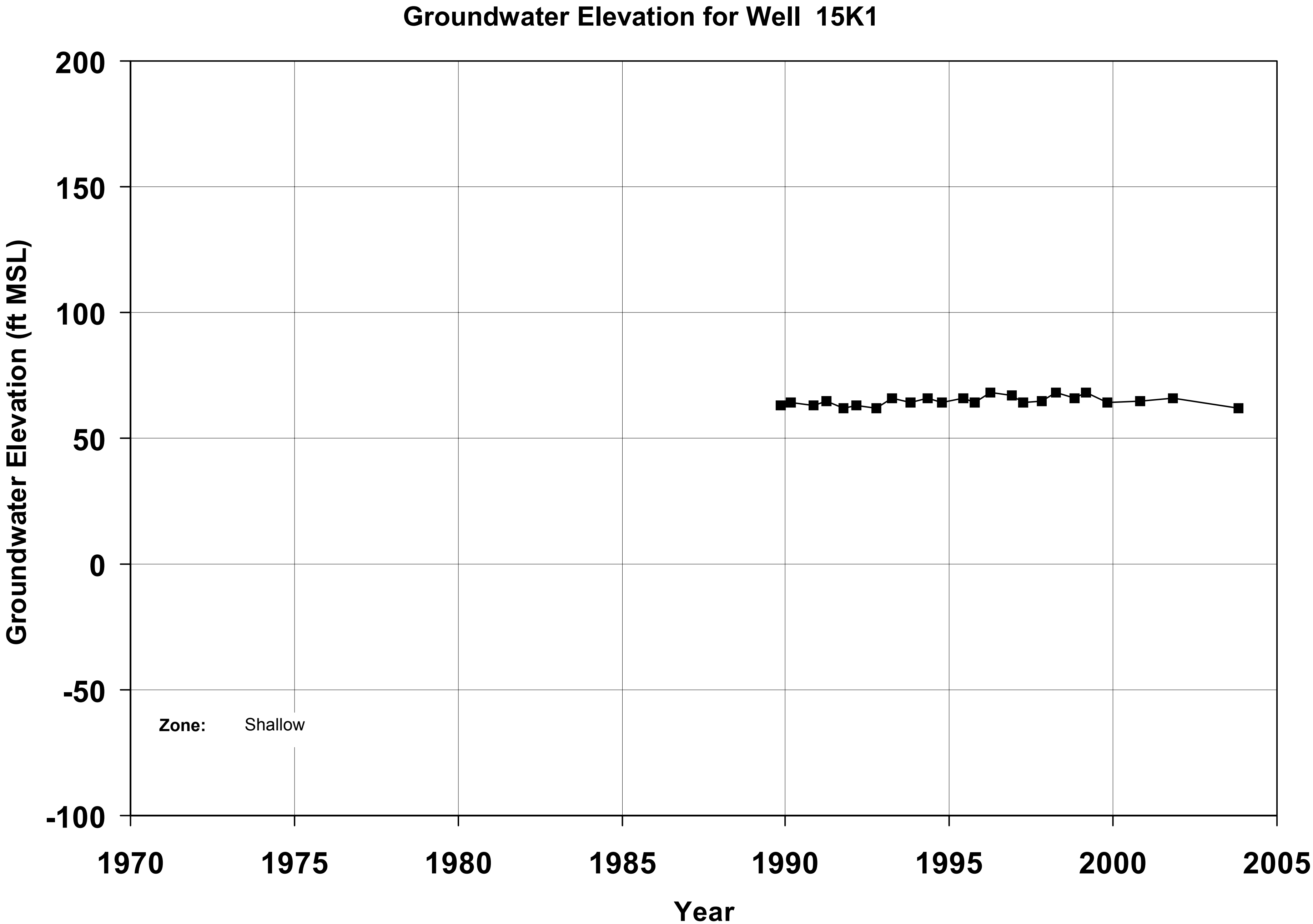


Groundwater Elevation for Well 27N2
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow

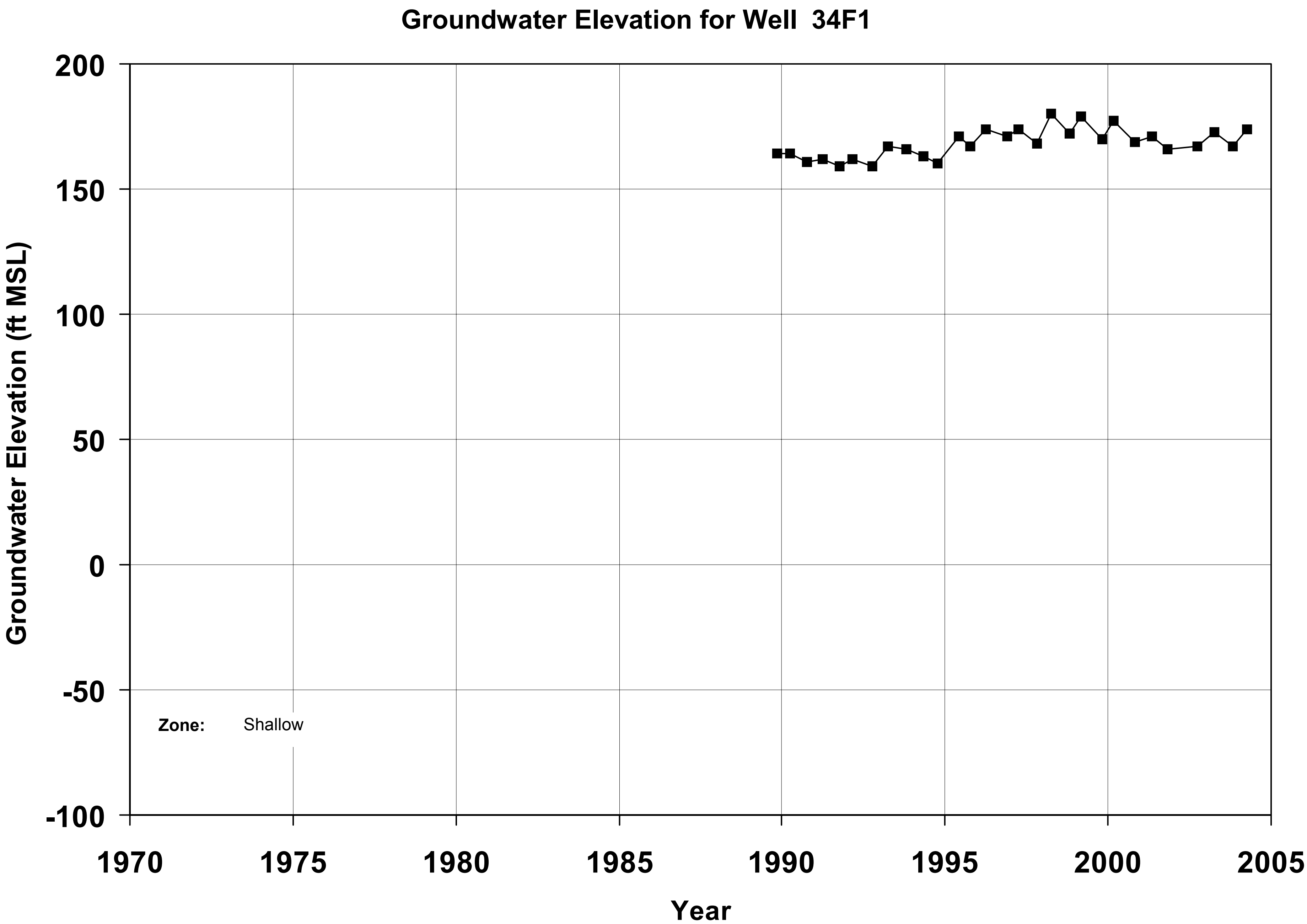

Groundwater Elevation for Well 30K1
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate

Groundwater Elevation for Well 02L1

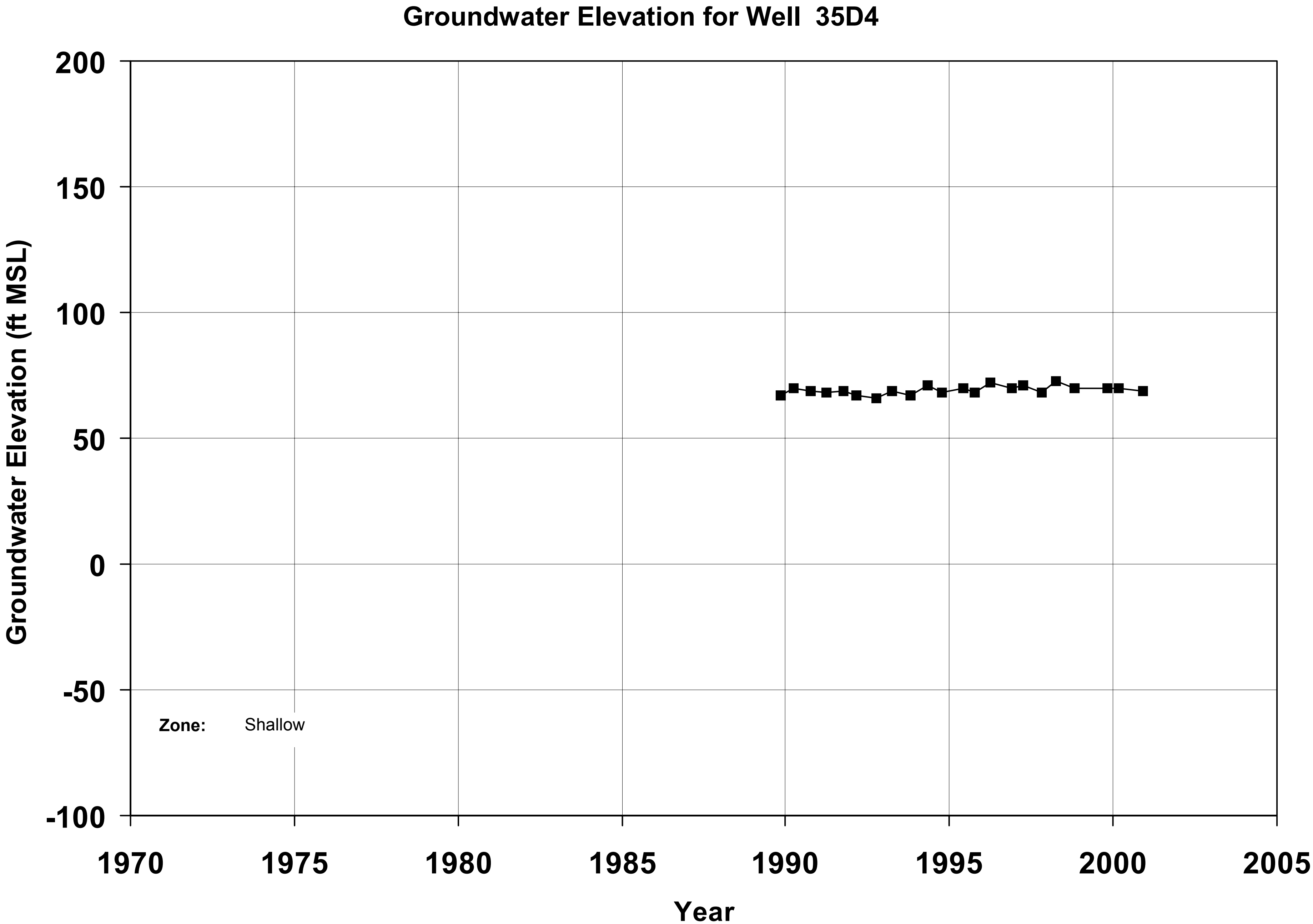


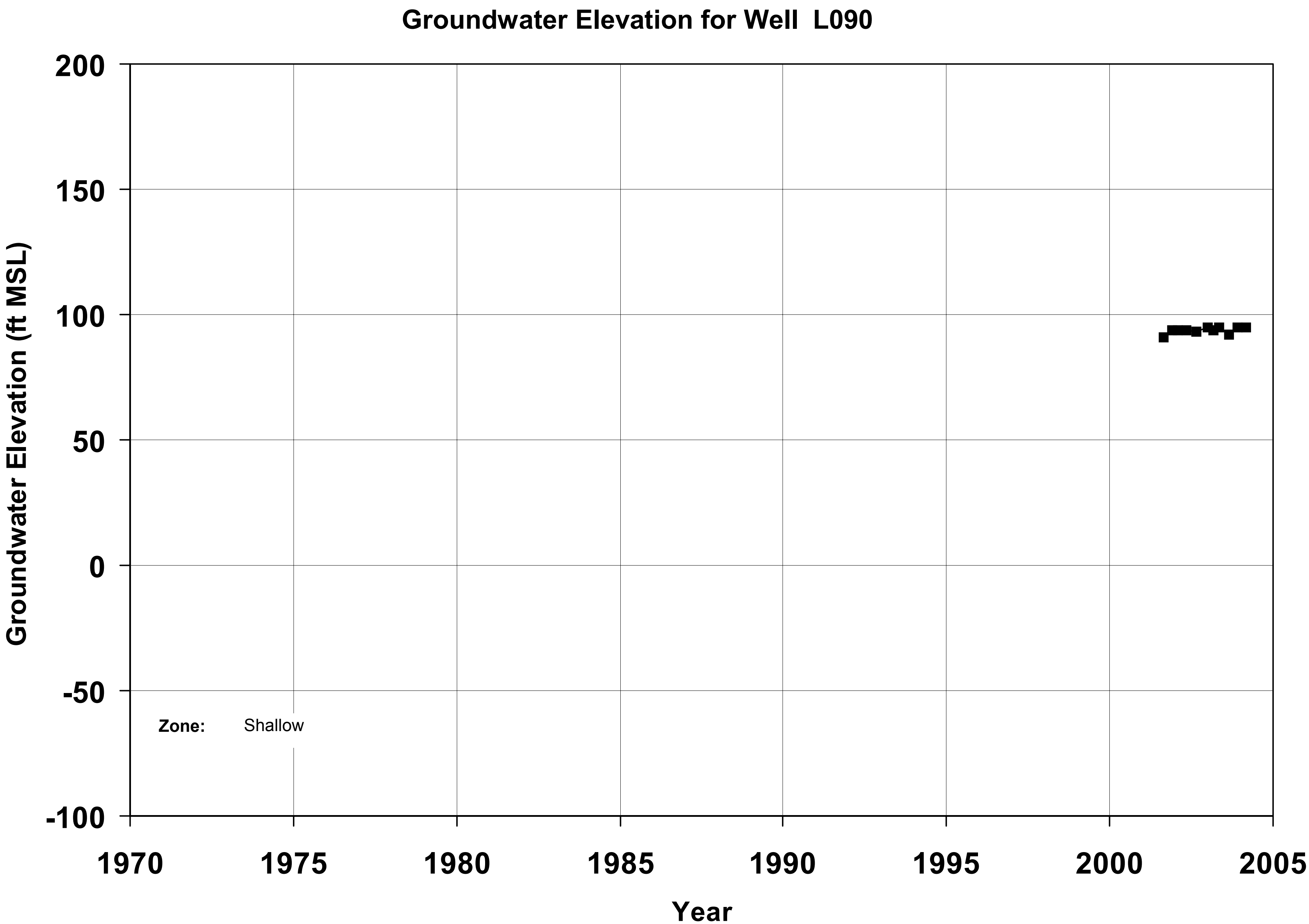


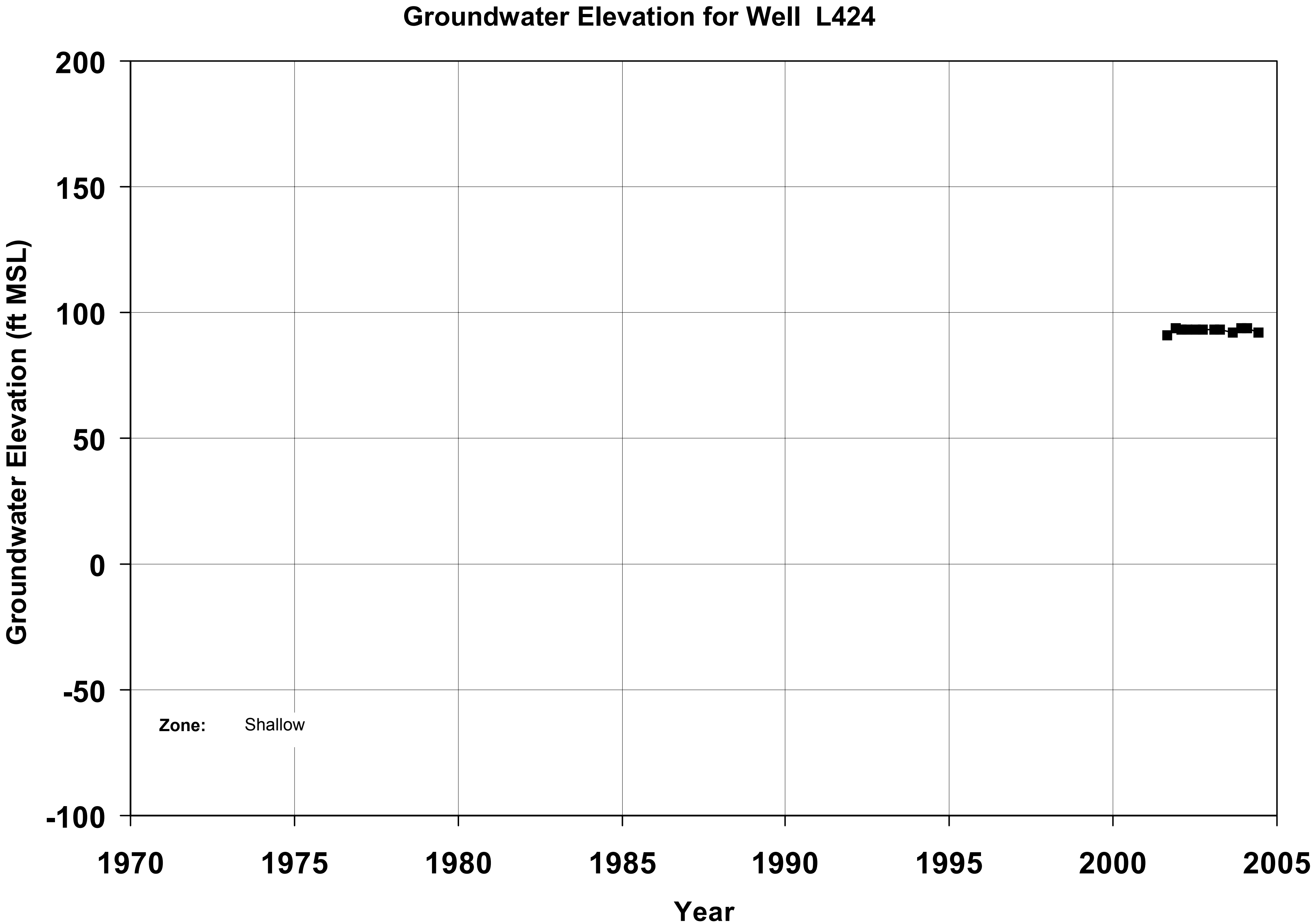
Groundwater Elevation for Well 15K1
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow



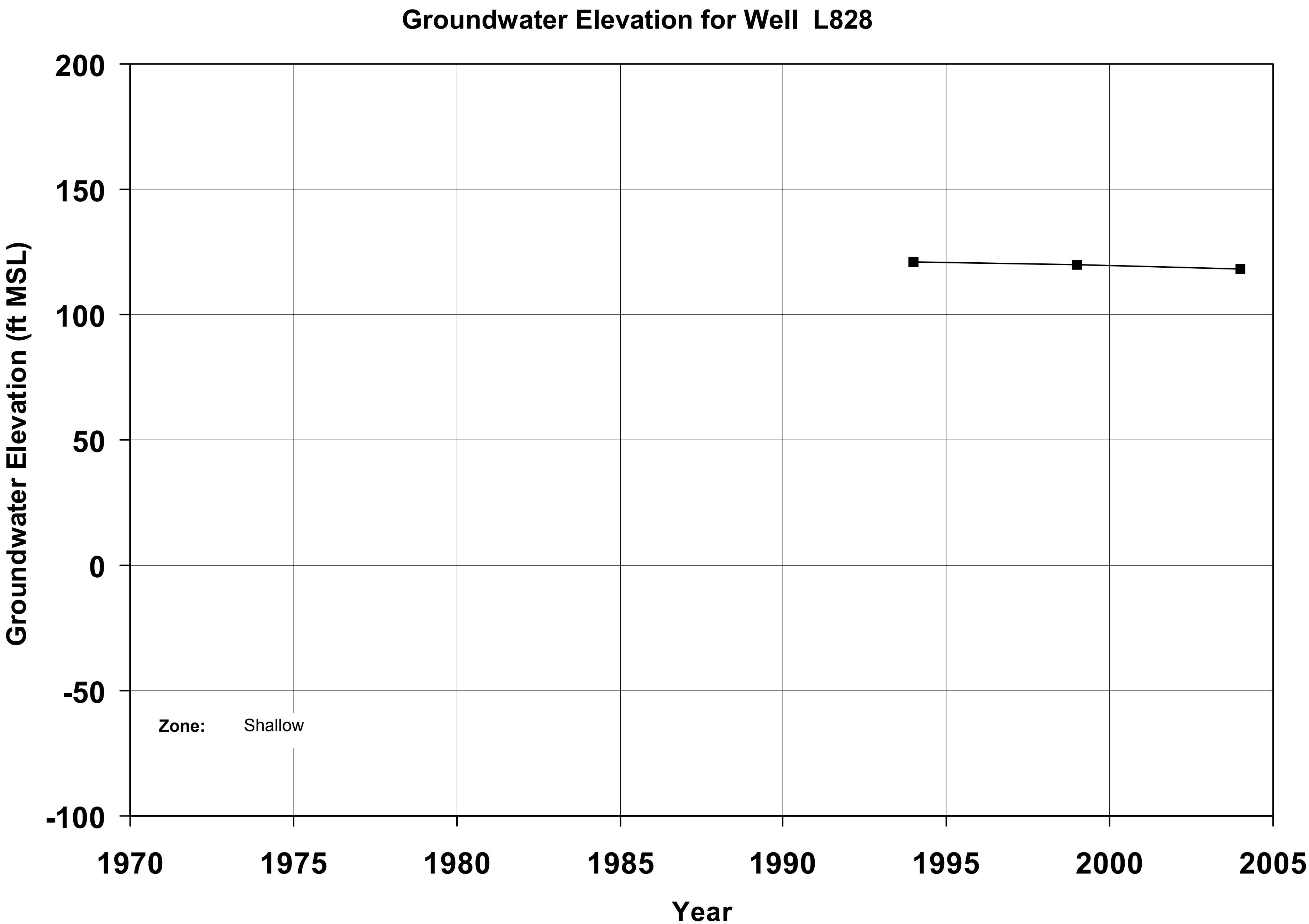
Groundwater Elevation for Well 34F1
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
Zone:
Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well 35D4
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow

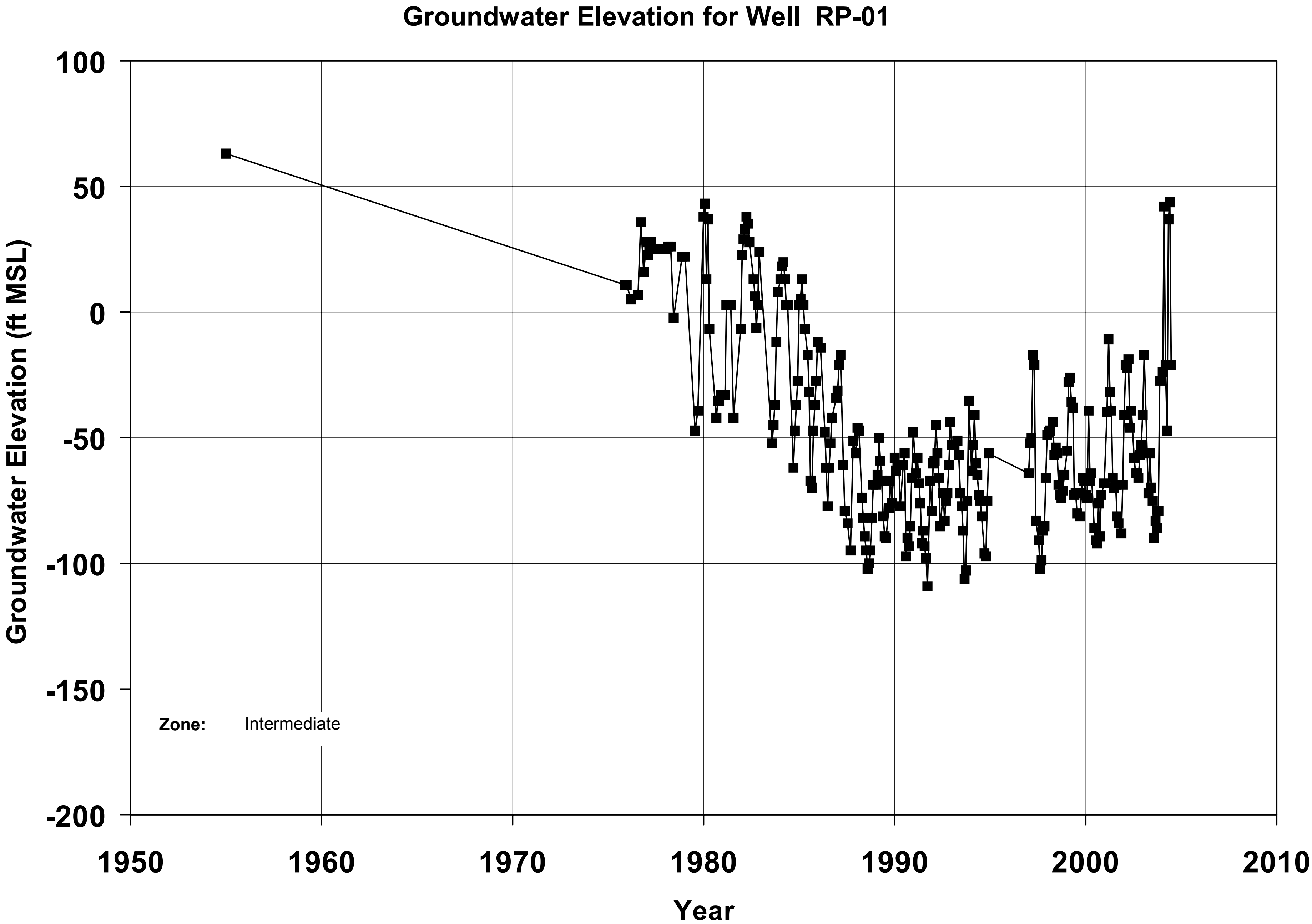

Groundwater Elevation for Well L090
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
Zone: Shallow
1970
1975
1980
1985
1990
1995
2000
2005
Year



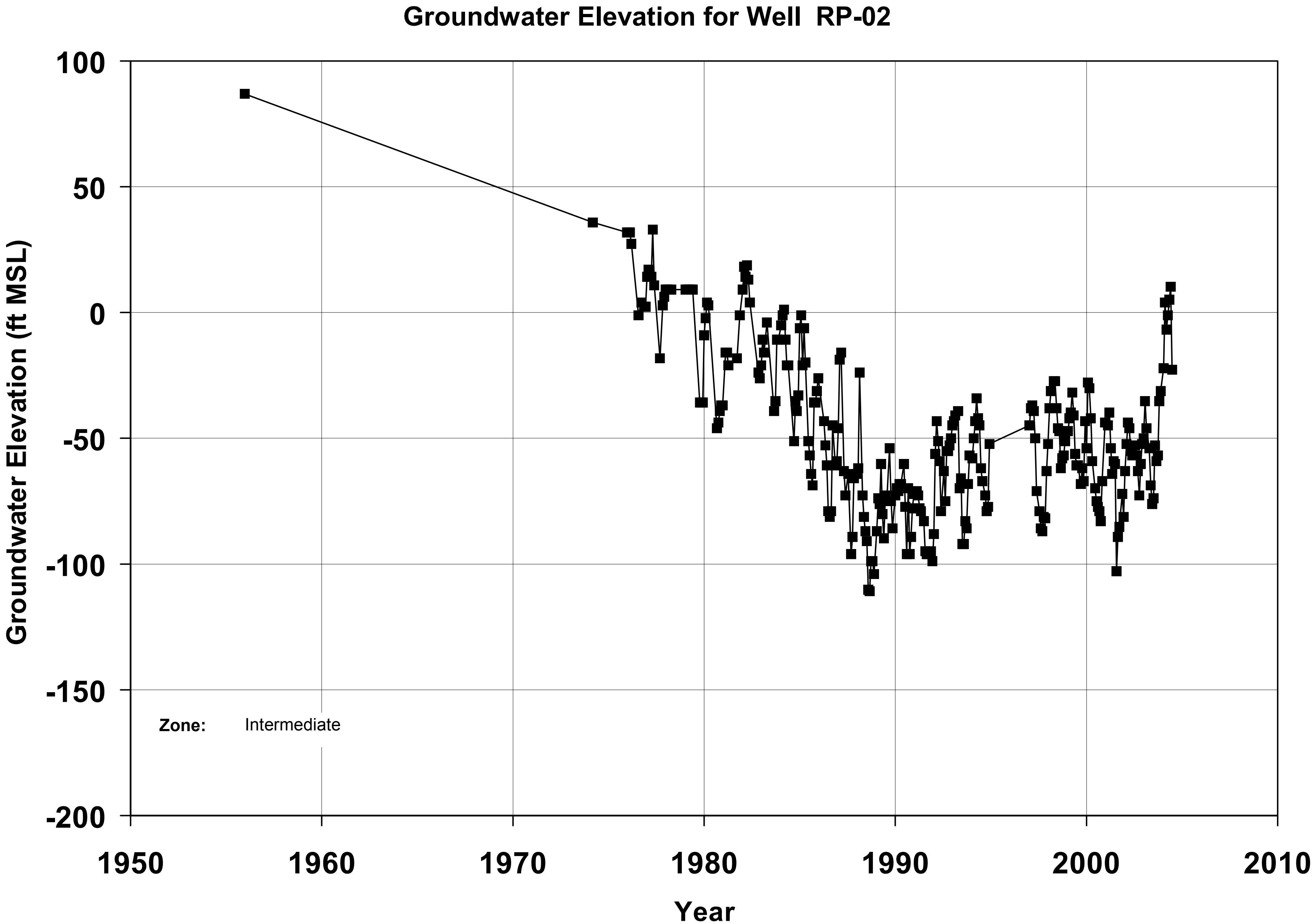
Groundwater Elevation for Well L424
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow



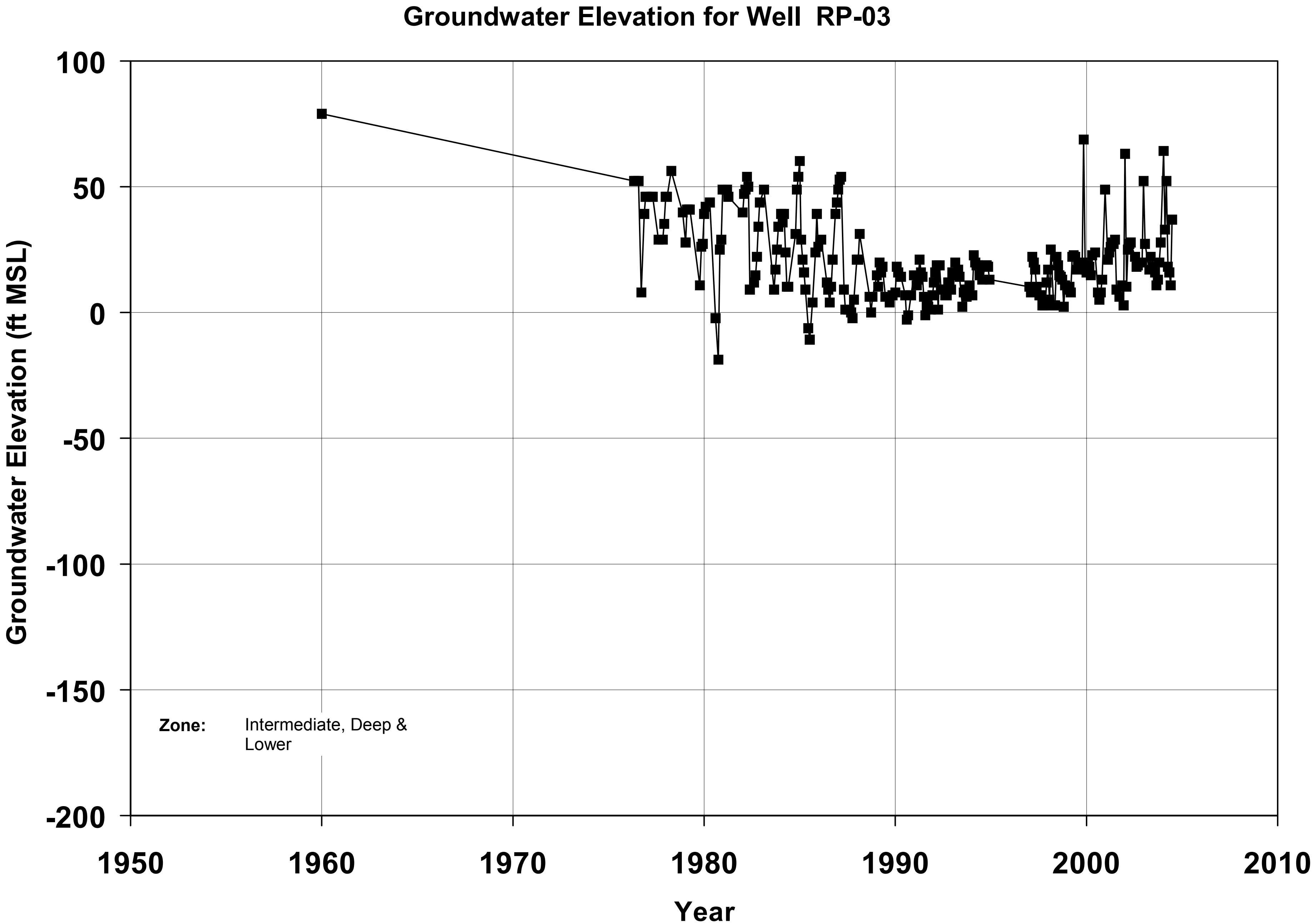
Groundwater Elevation for Well L828
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow



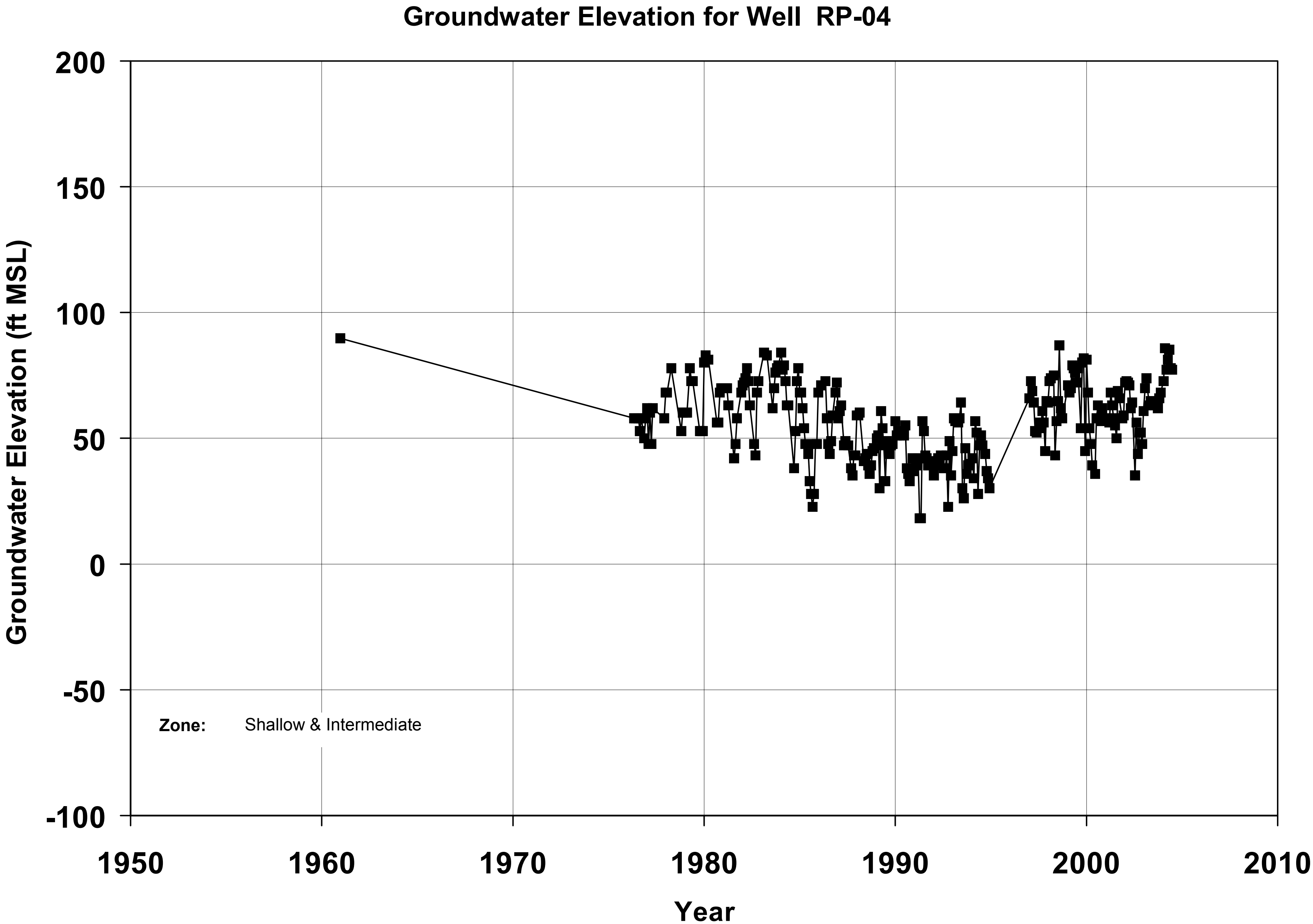
Groundwater Elevation for Well RP-01
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
1950
1960
1970
1980
1990
2000
2010
Year
Zone: Intermediate

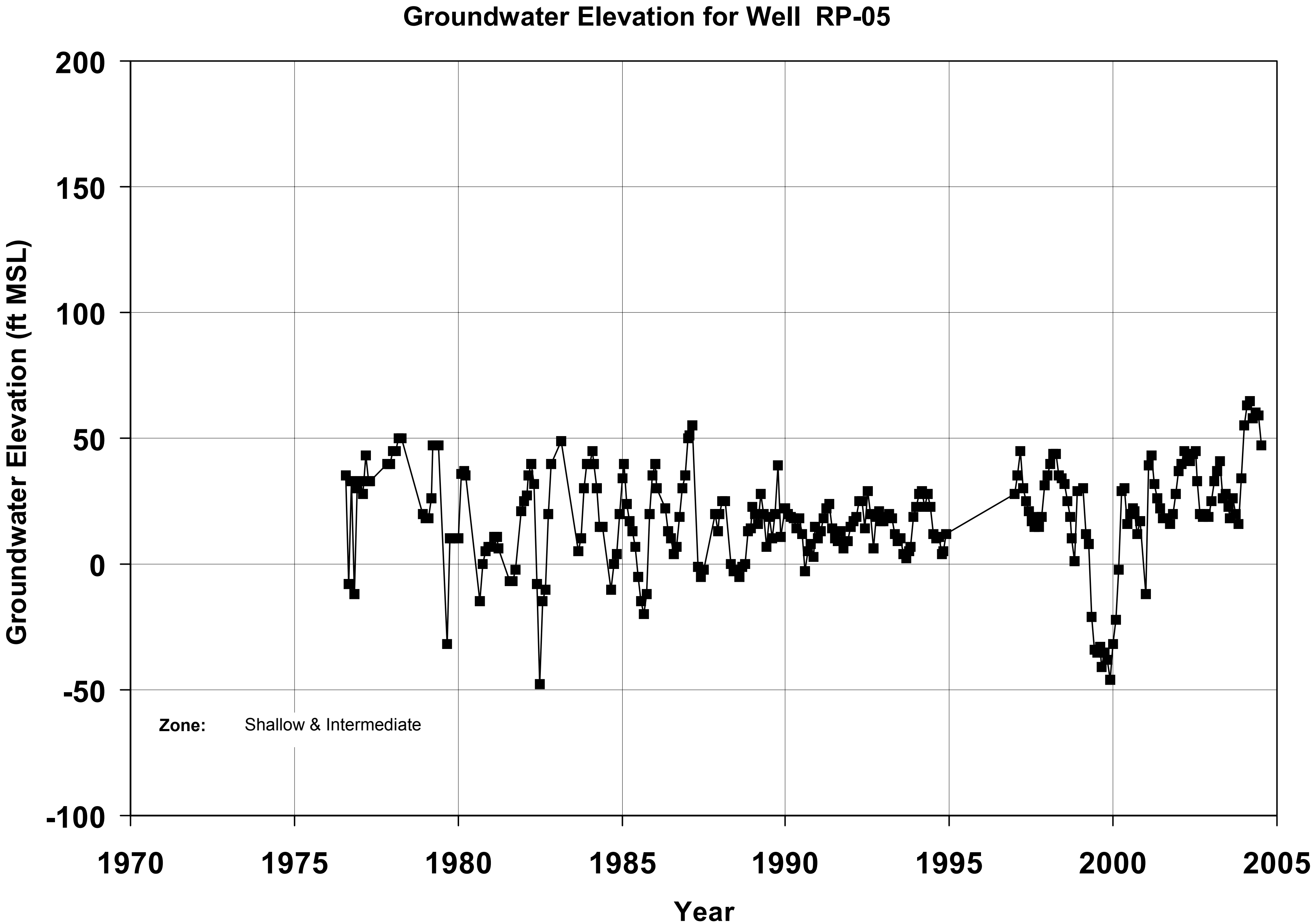


Groundwater Elevation for Well RP-02
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1950
1960
1970
1980
1990
2000
2010
Year
Zone: Intermediate

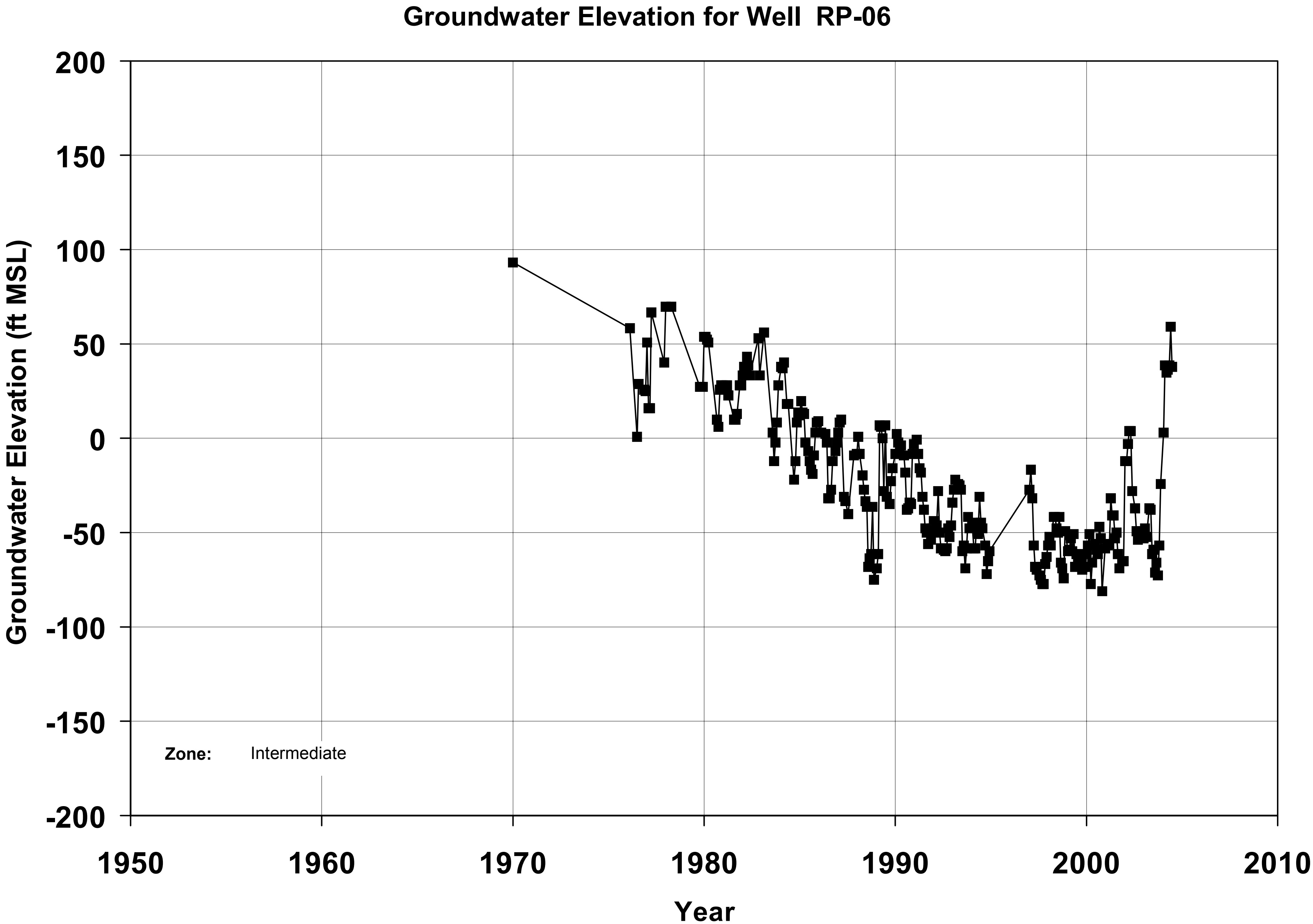


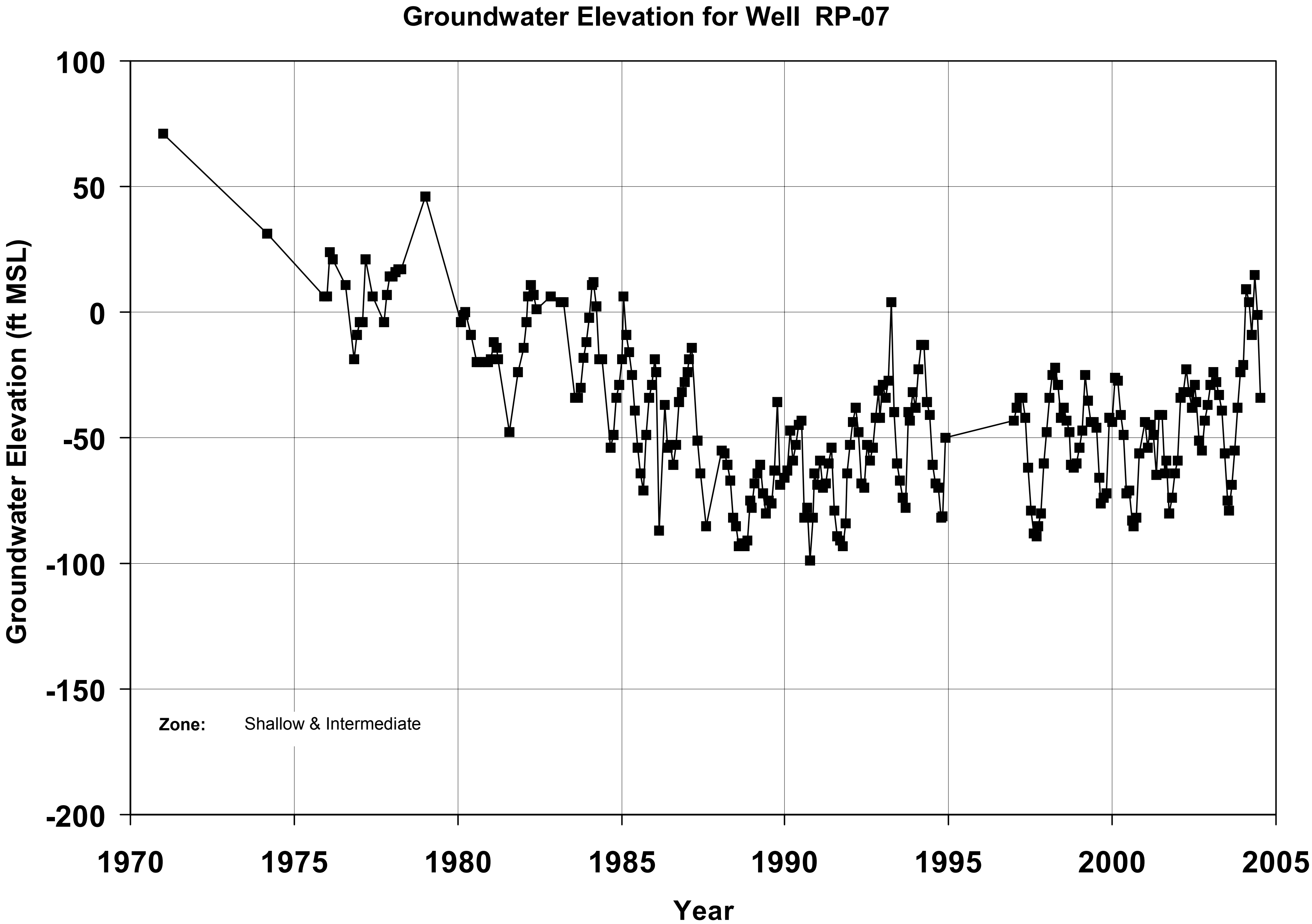
Groundwater Elevation for Well RP-03
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1950
1960
1970
1980
1990
2000
2010
Year
Zone:
Intermediate, Deep & Lower

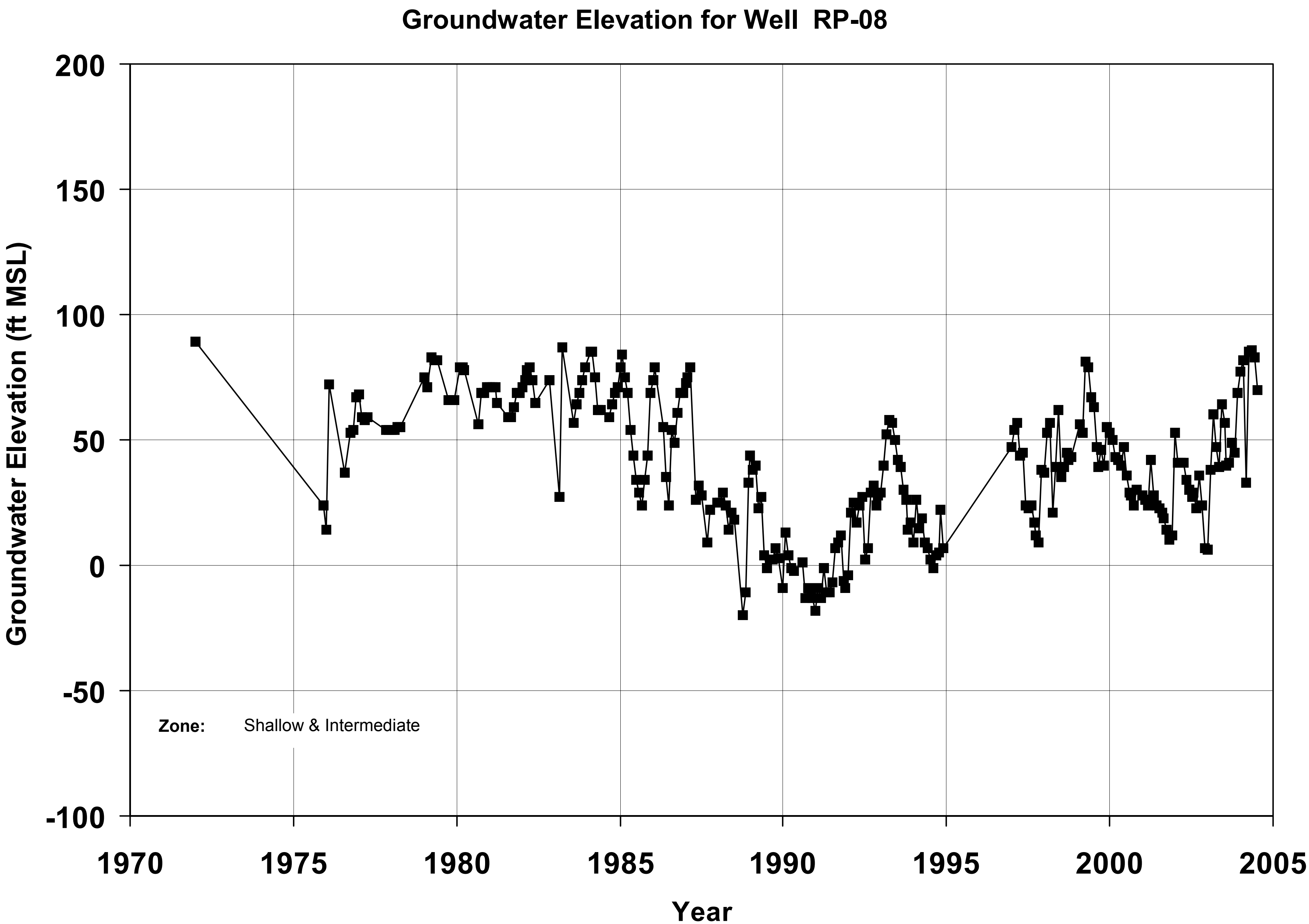

Groundwater Elevation for Well RP-04
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1950
1960
1970
1980
1990
2000
2010
Year
Zone:
Shallow & Intermediate

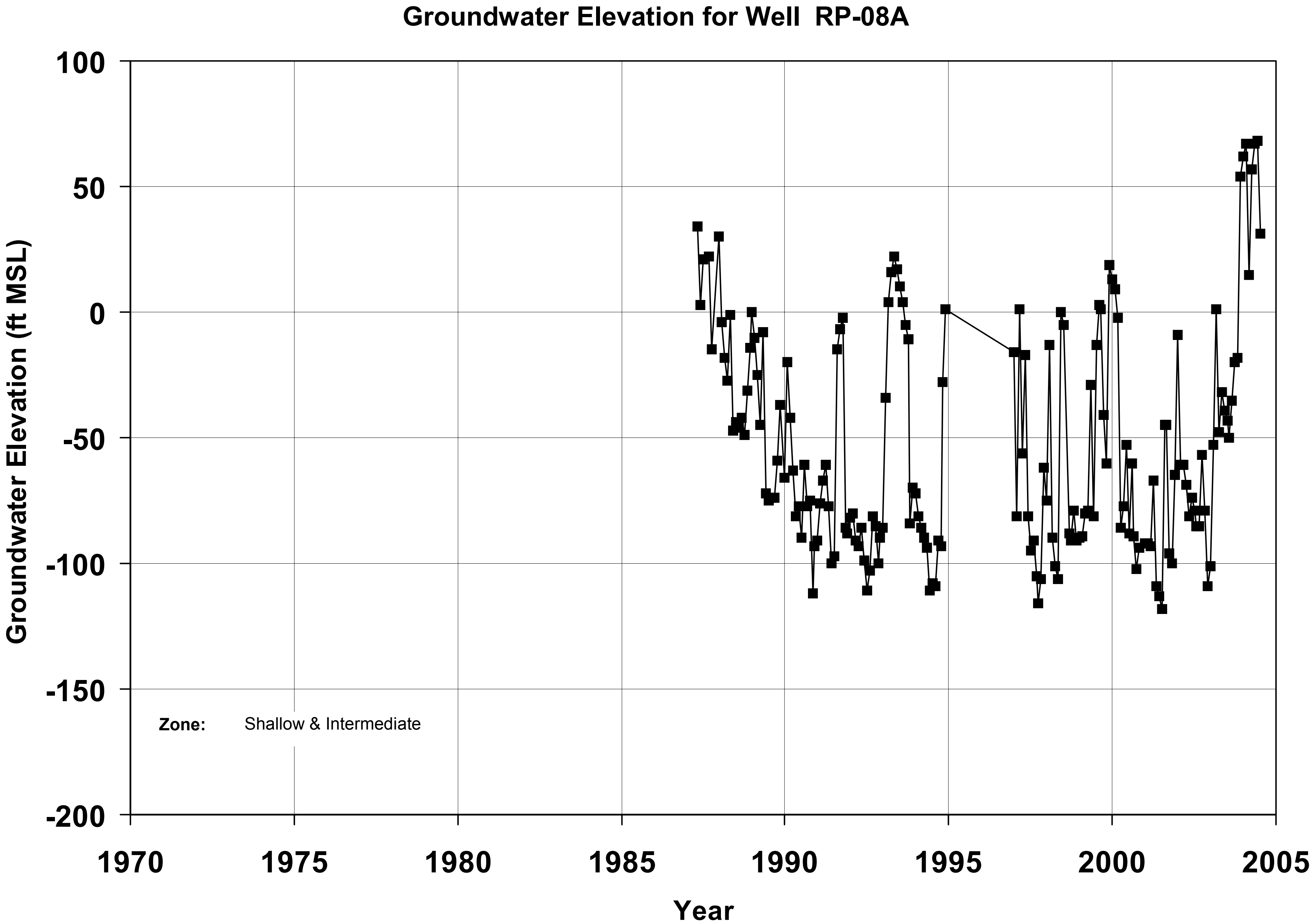


Groundwater Elevation for Well RP-05
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate

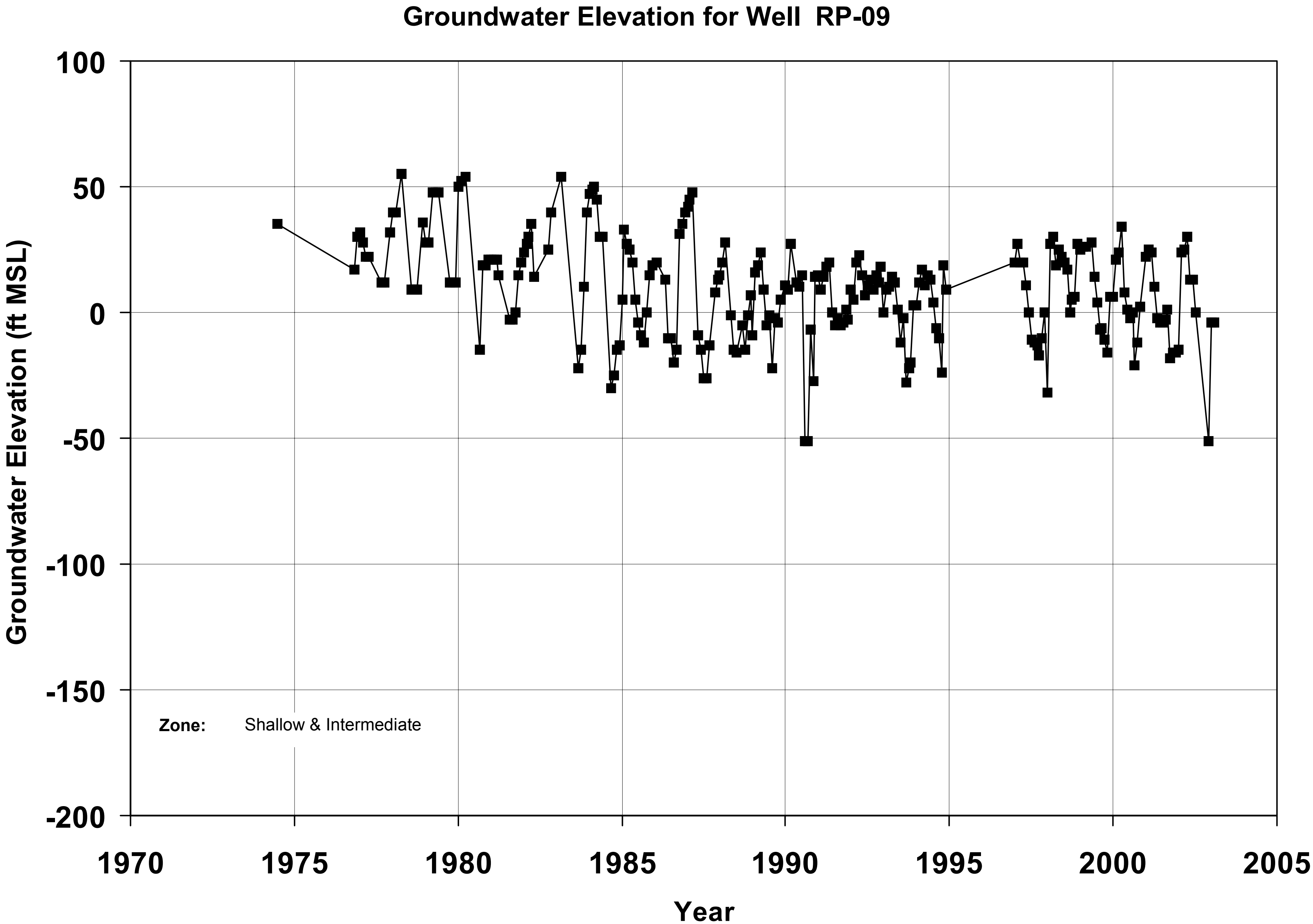

Groundwater Elevation for Well RP-06
200
150
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
1950
1960
1970
1980
1990
2000
2010
Year
Zone: Intermediate

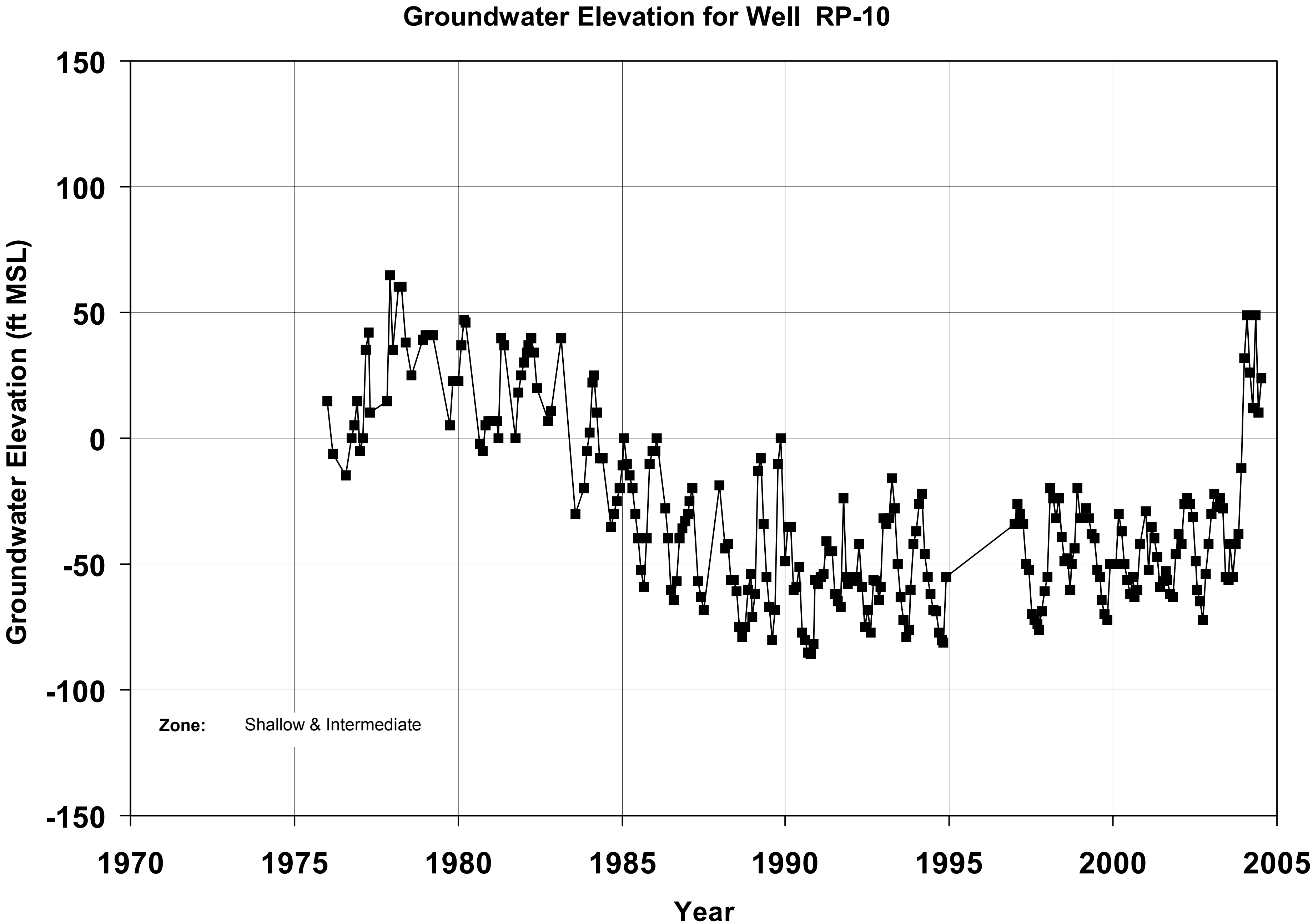

Groundwater Elevation for Well RP-07
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well RP-08
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate

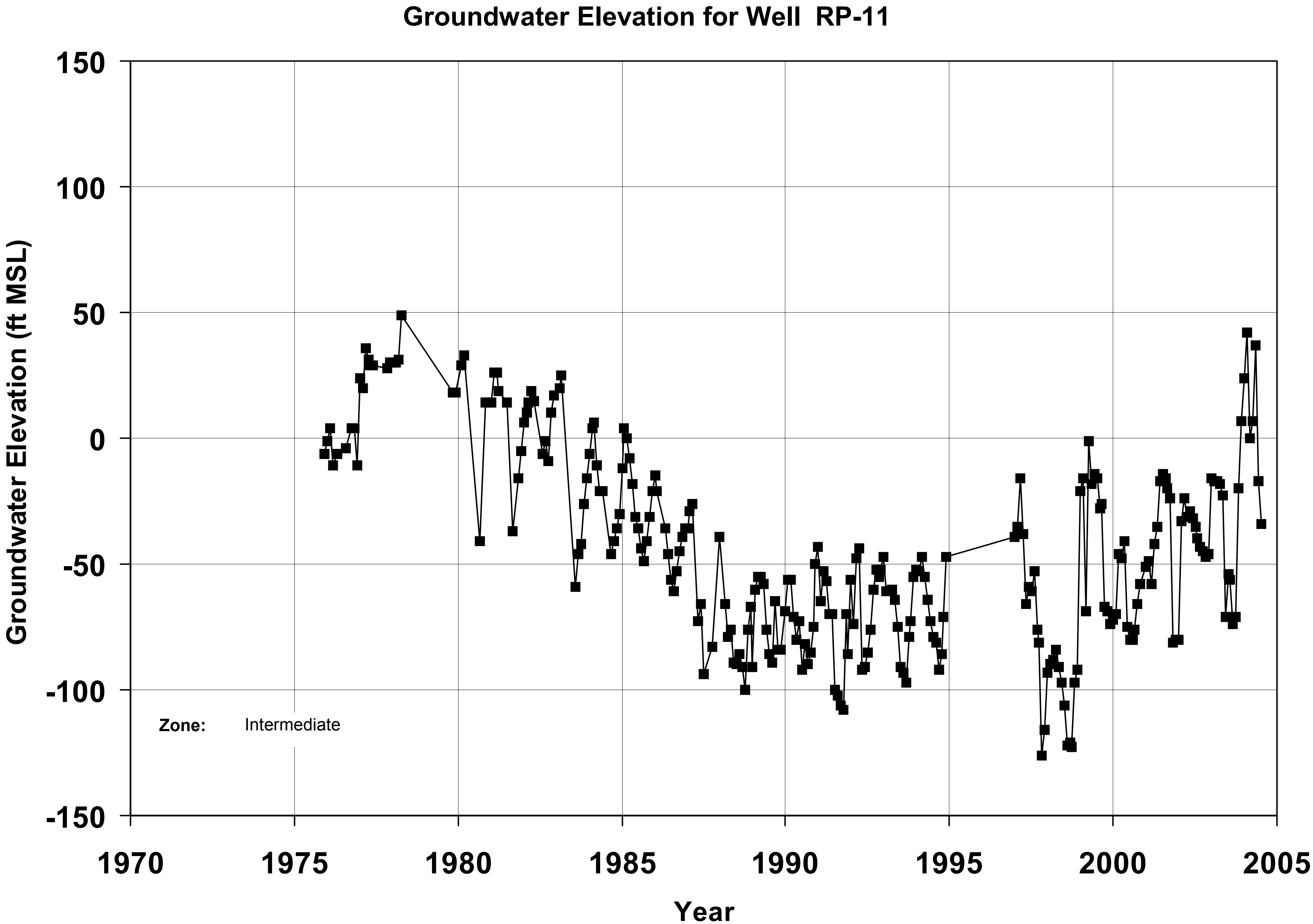


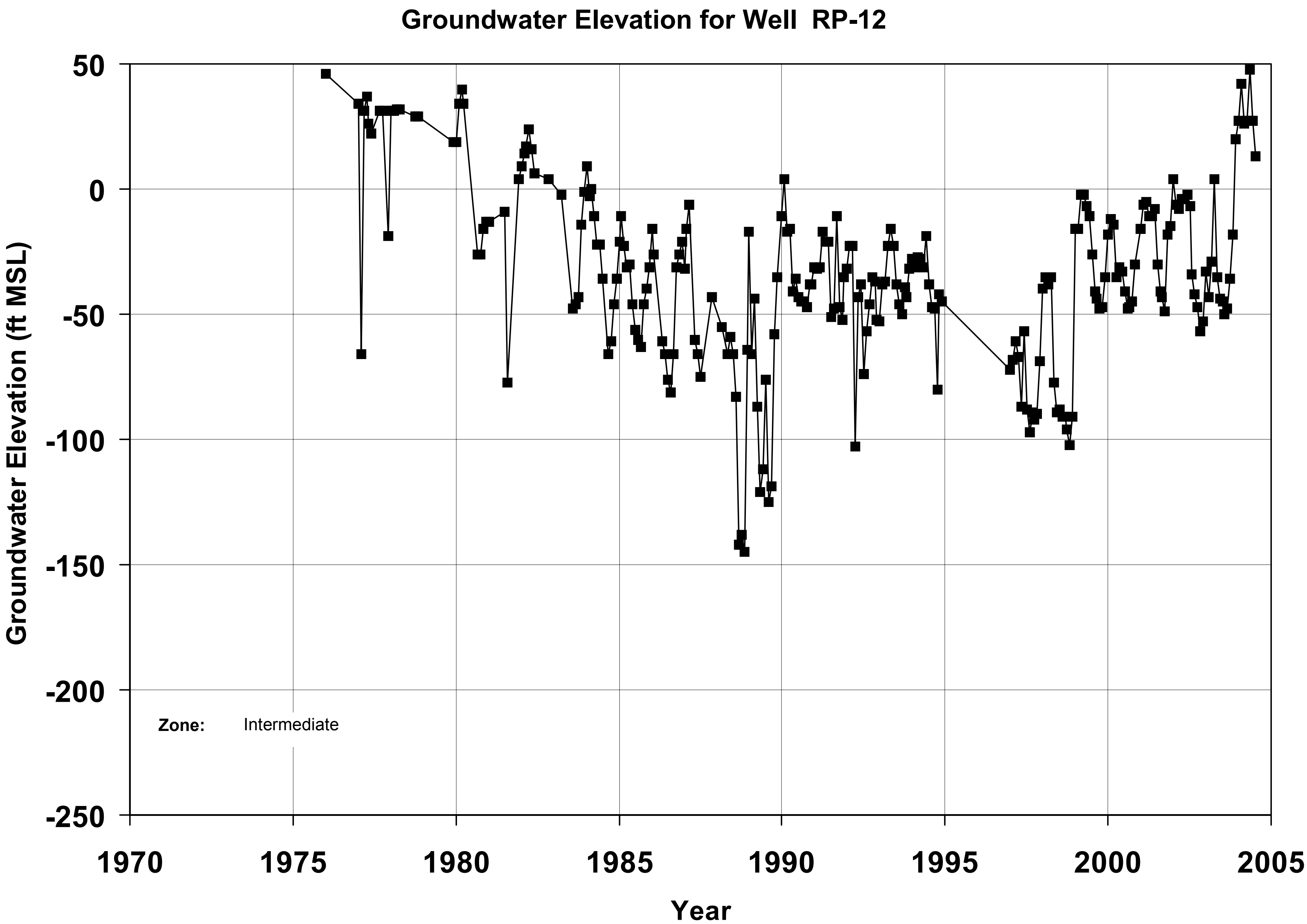
Groundwater Elevation for Well RP-08A
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow & Intermediate

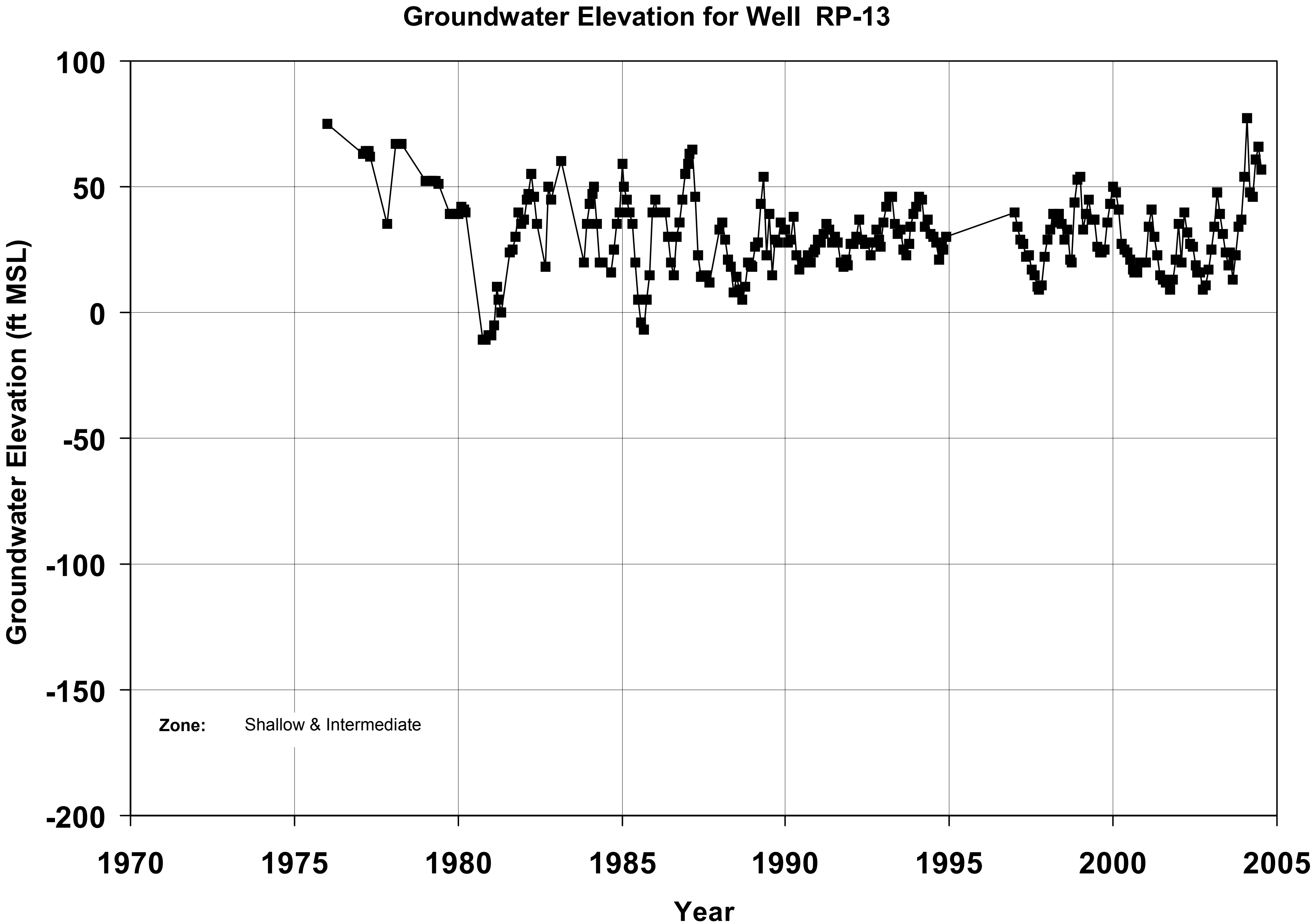

Groundwater Elevation for Well RP-09
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate



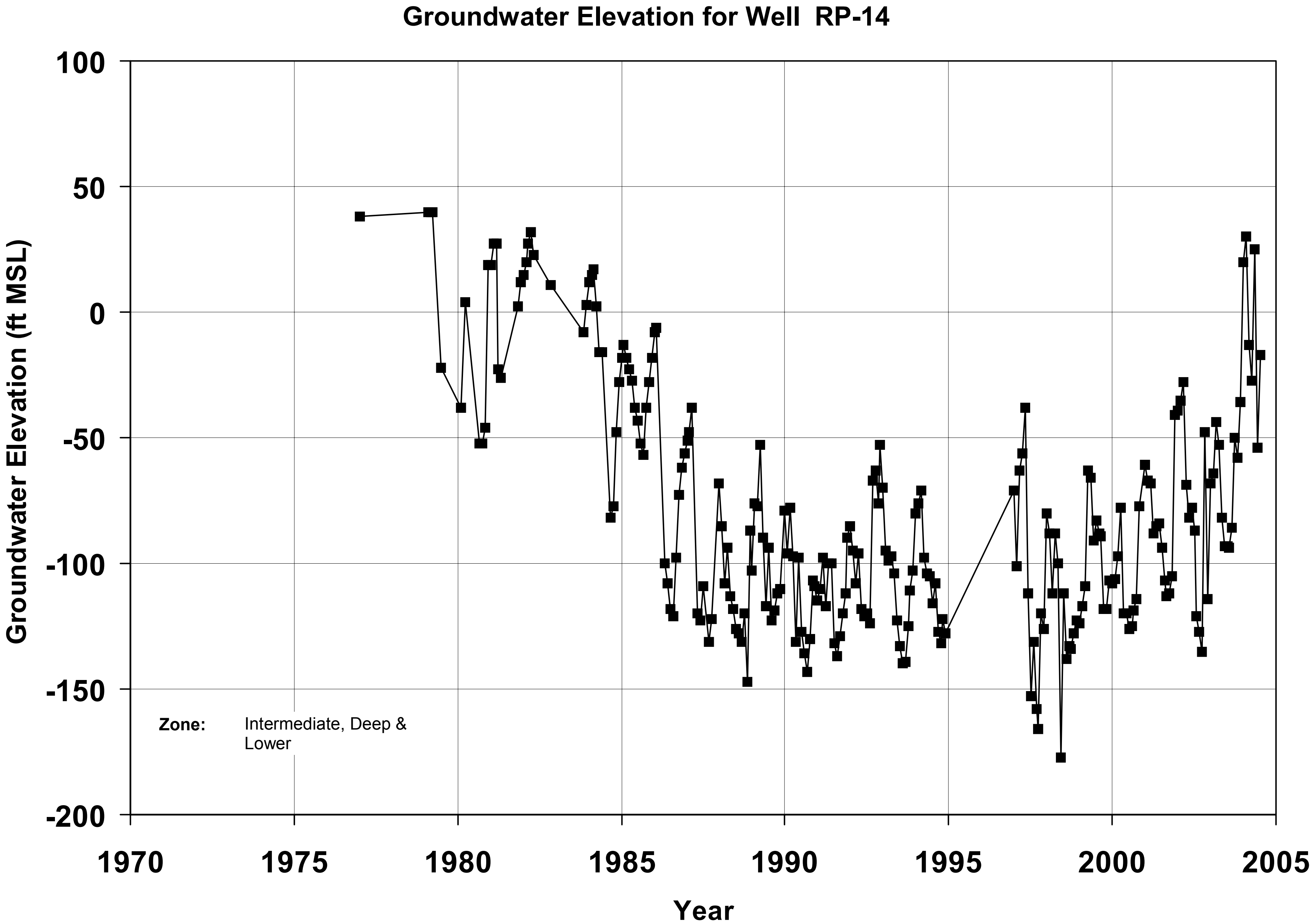
Groundwater Elevation for Well RP-10
150
100
50
0
-50
-100
-150
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well RP-11
150
100
50
0
-50
-100
-150
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Intermediate

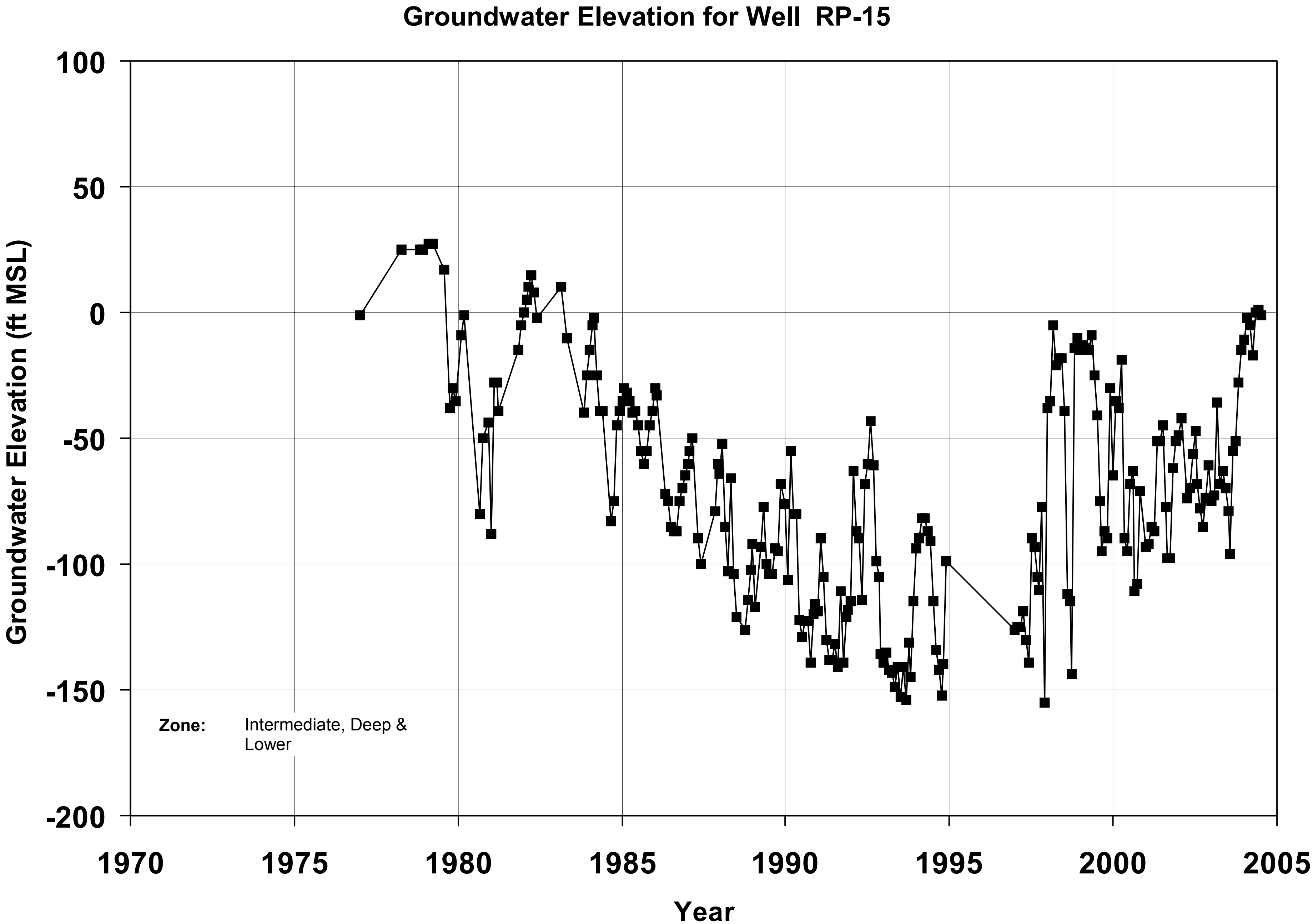

Groundwater Elevation for Well RP-12
Groundwater Elevation (ft MSL)
50
0
-50
-100
-150
-200
-250
Zone:
Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year



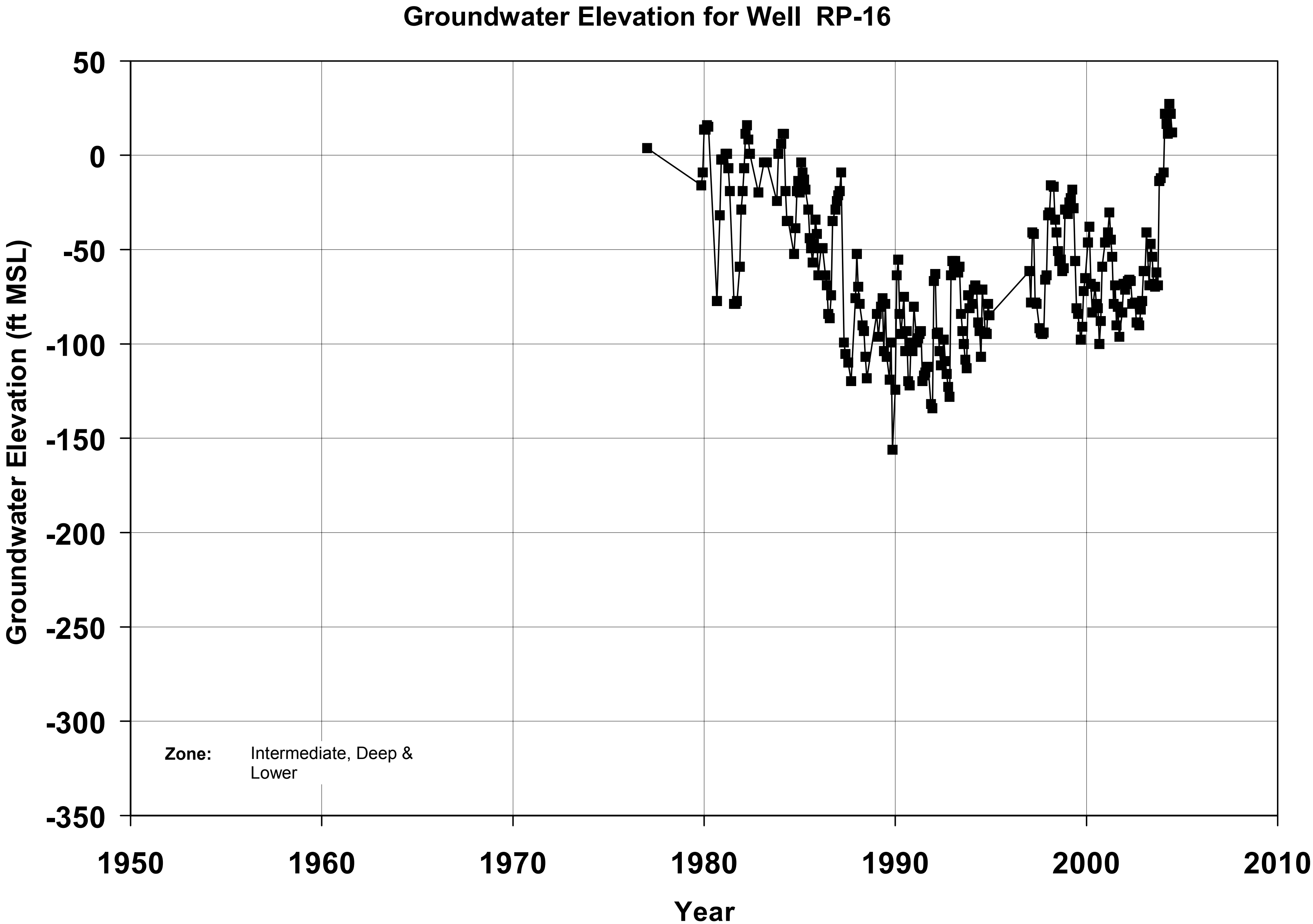
Groundwater Elevation for Well RP-13
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone:
Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year



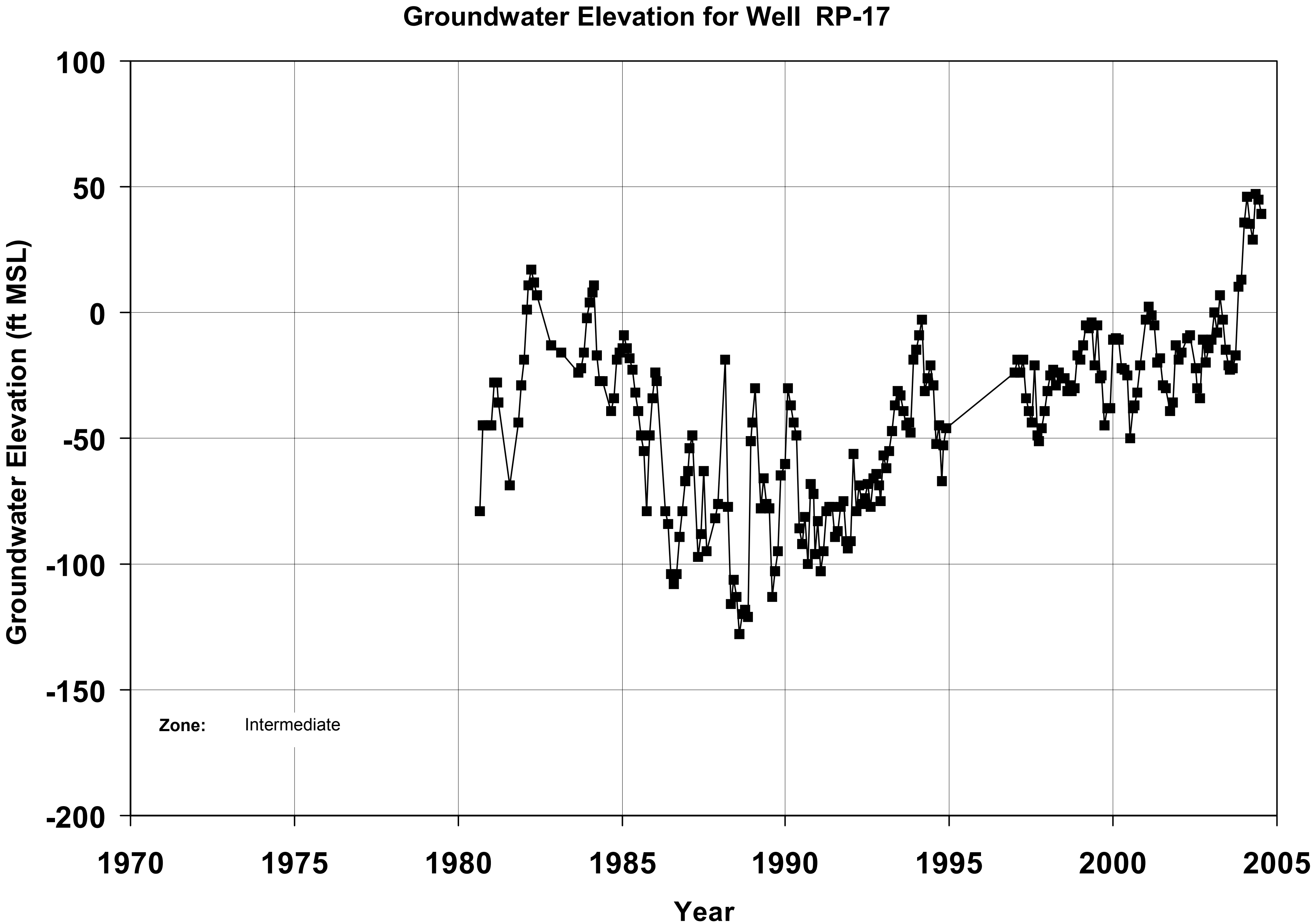
Groundwater Elevation for Well RP-14
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Intermediate, Deep & Lower



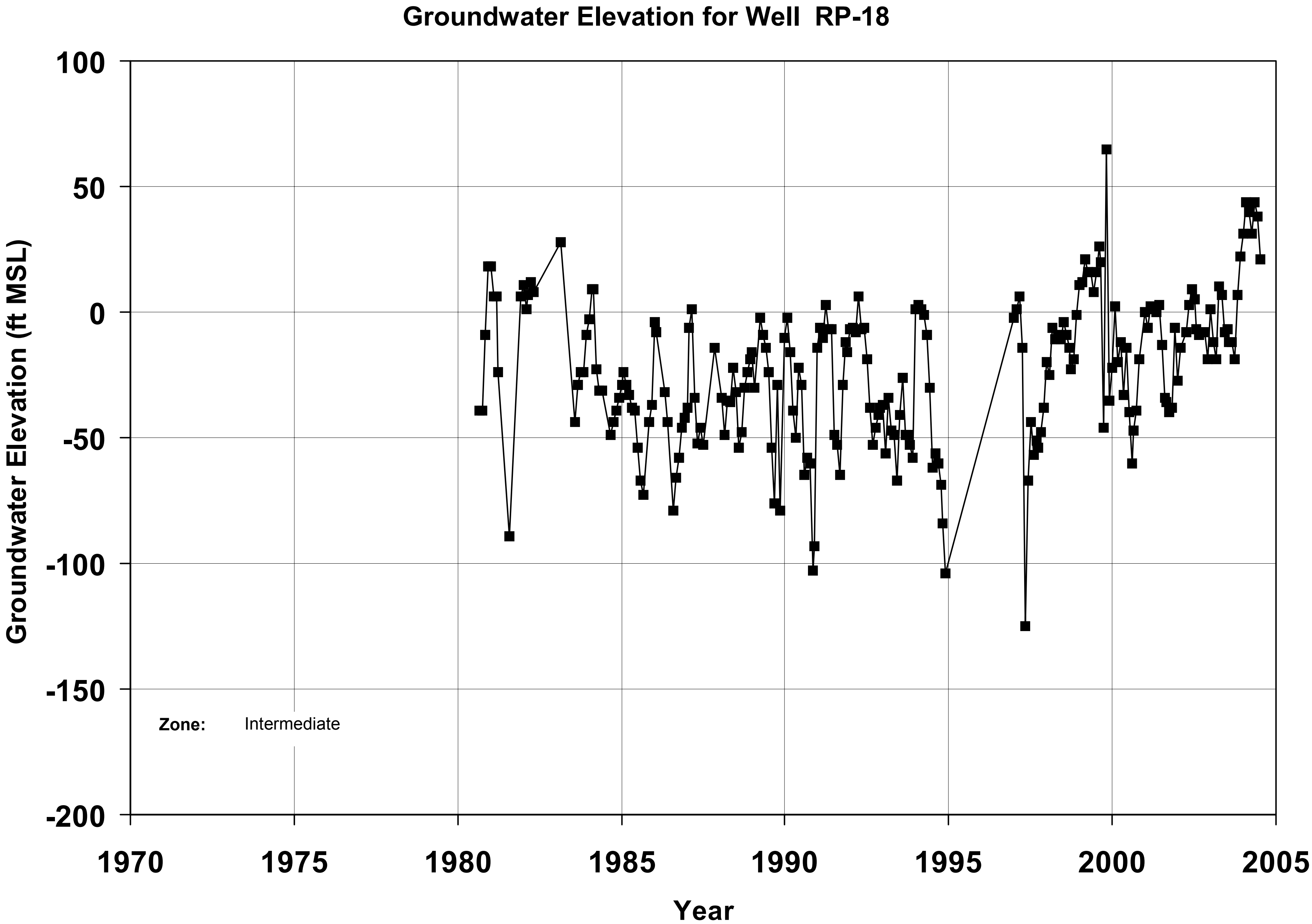
Groundwater Elevation for Well RP-15
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Intermediate, Deep & Lower

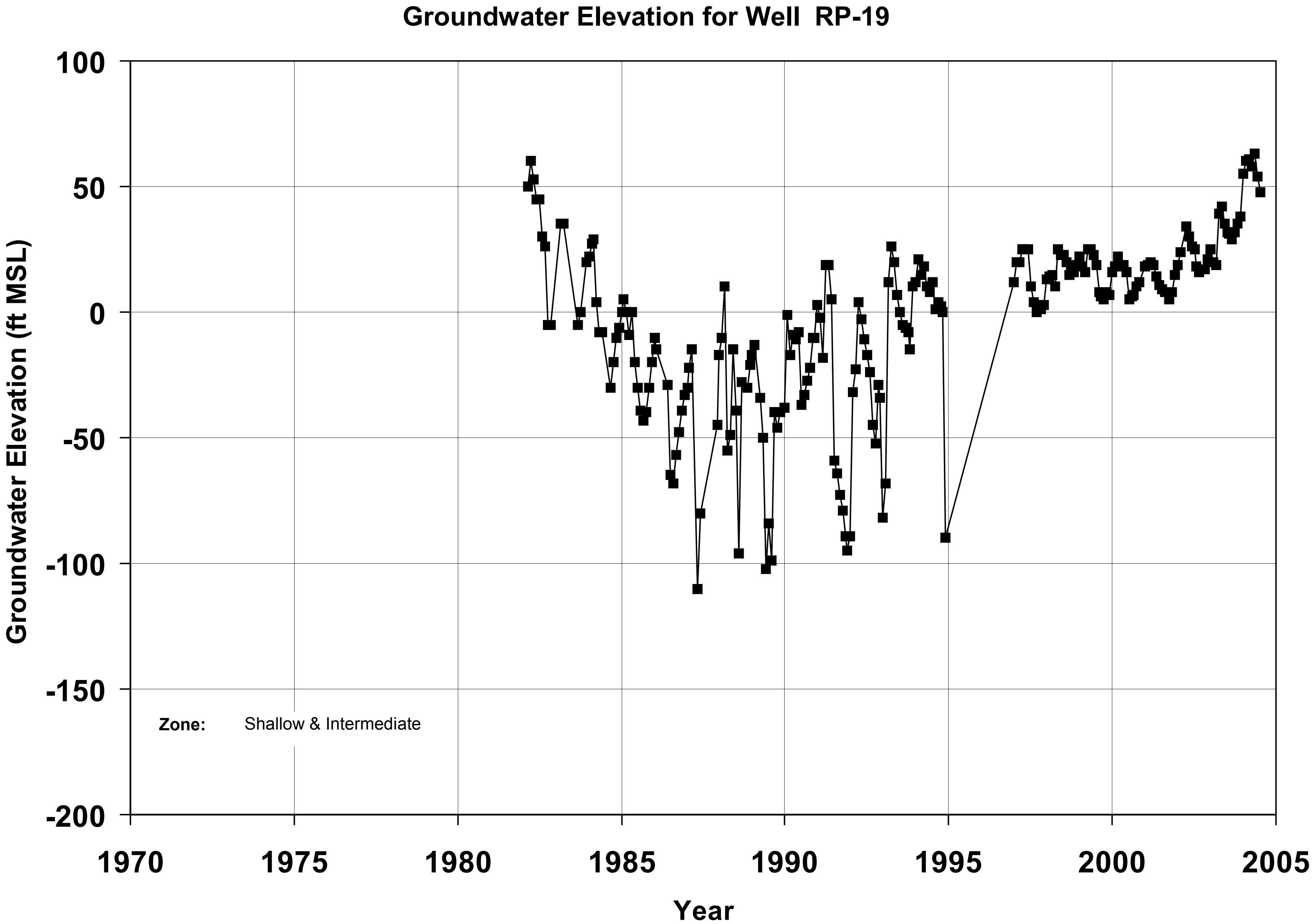


Groundwater Elevation for Well RP-16
50
0
-50
-100
-150
-200
-250
-300
-350
Groundwater Elevation (ft MSL)
1950
1960
1970
1980
1990
2000
2010
Year
Zone:
Intermediate, Deep &
Lower

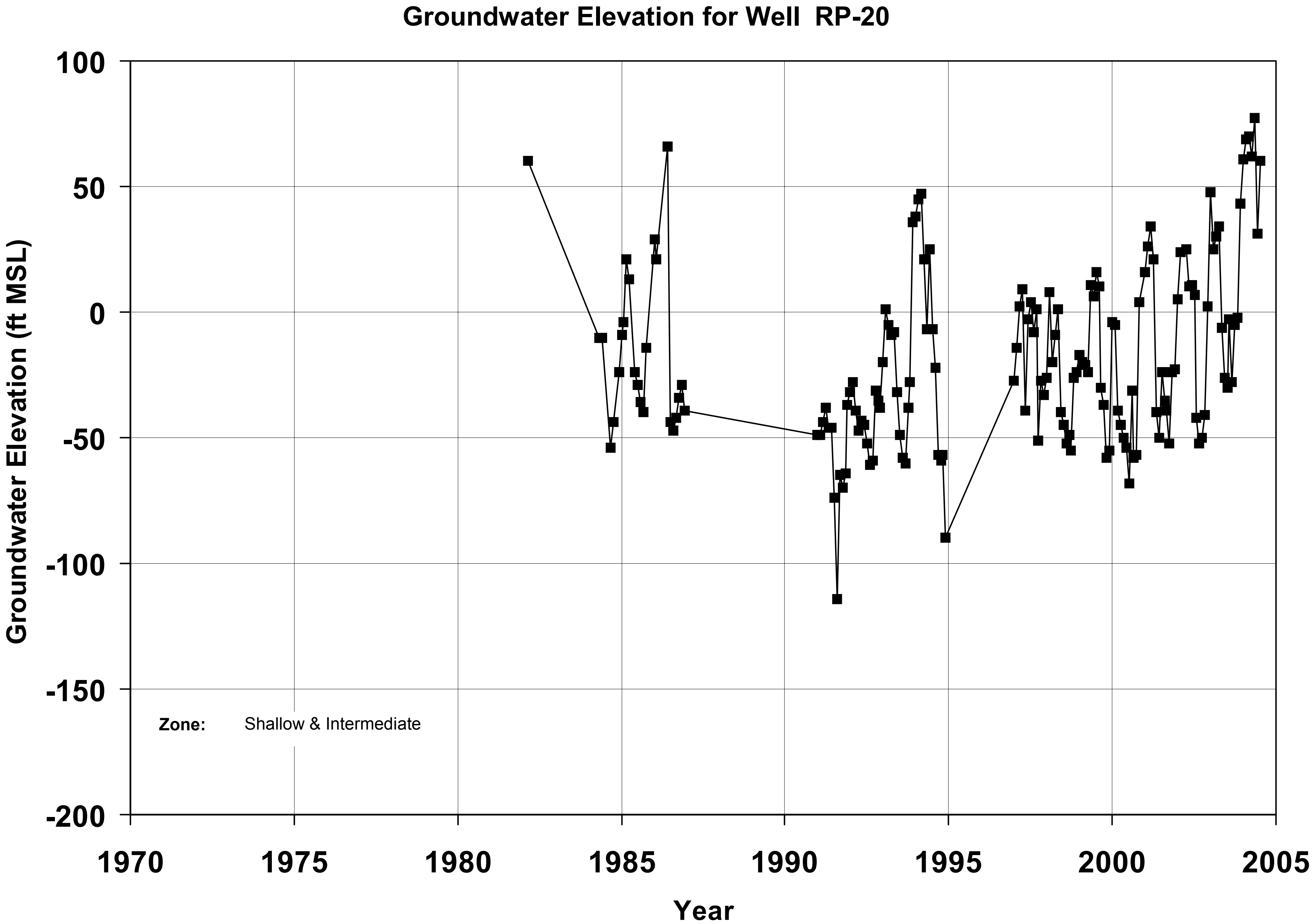


Groundwater Elevation for Well RP-17
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
Zone: Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

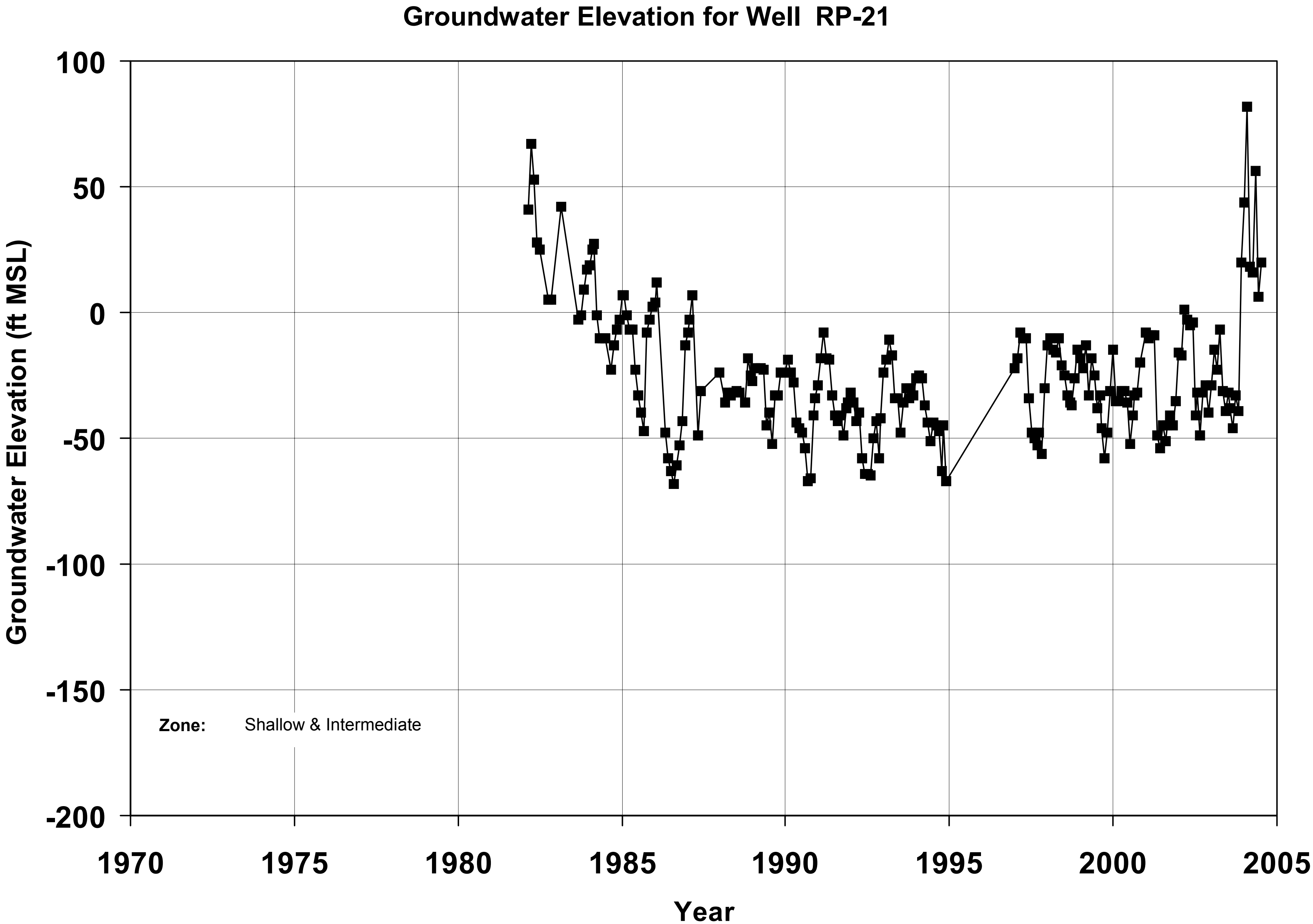

Groundwater Elevation for Well RP-18
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
Zone: Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

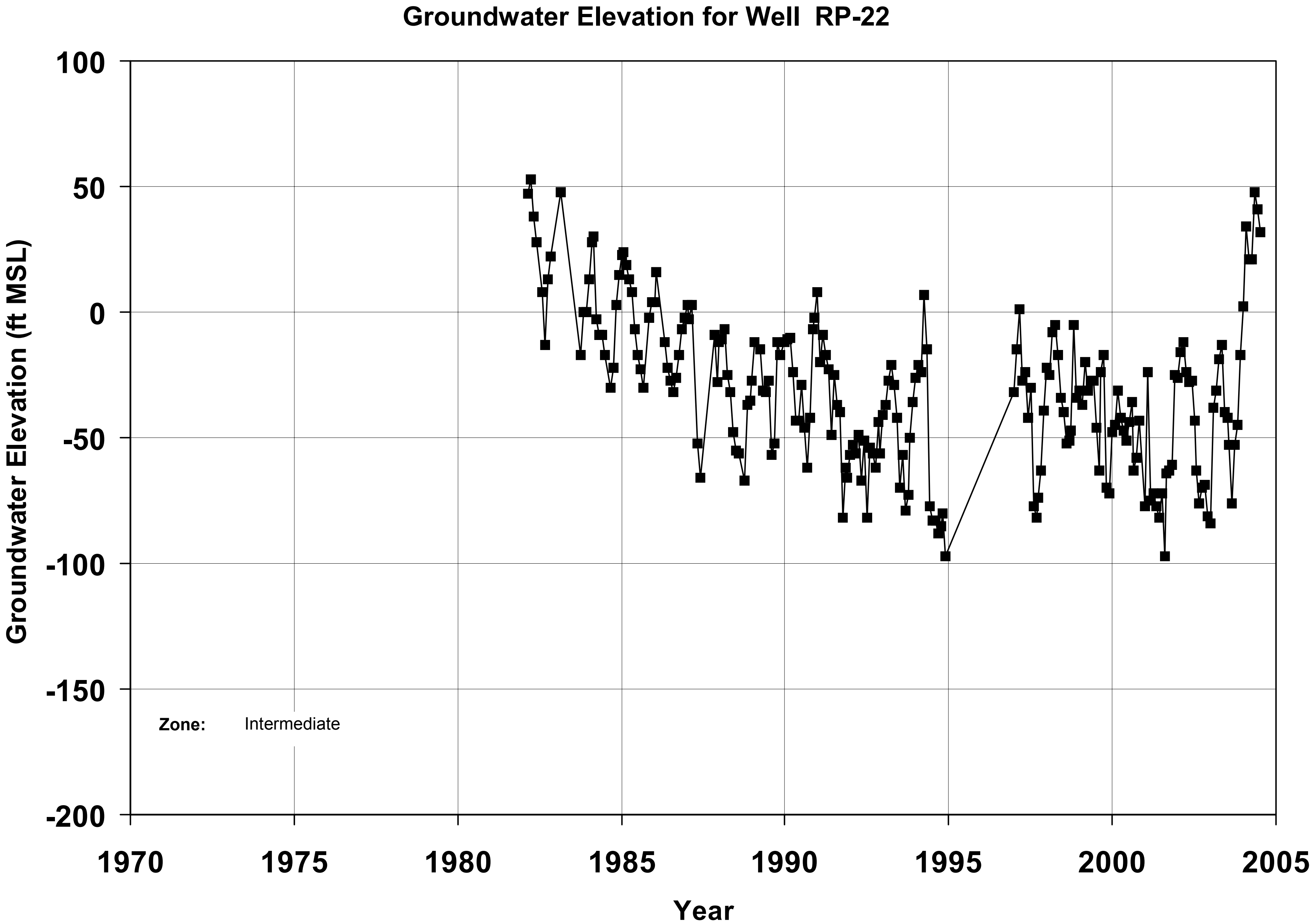


Groundwater Elevation for Well RP-19
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone:
Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

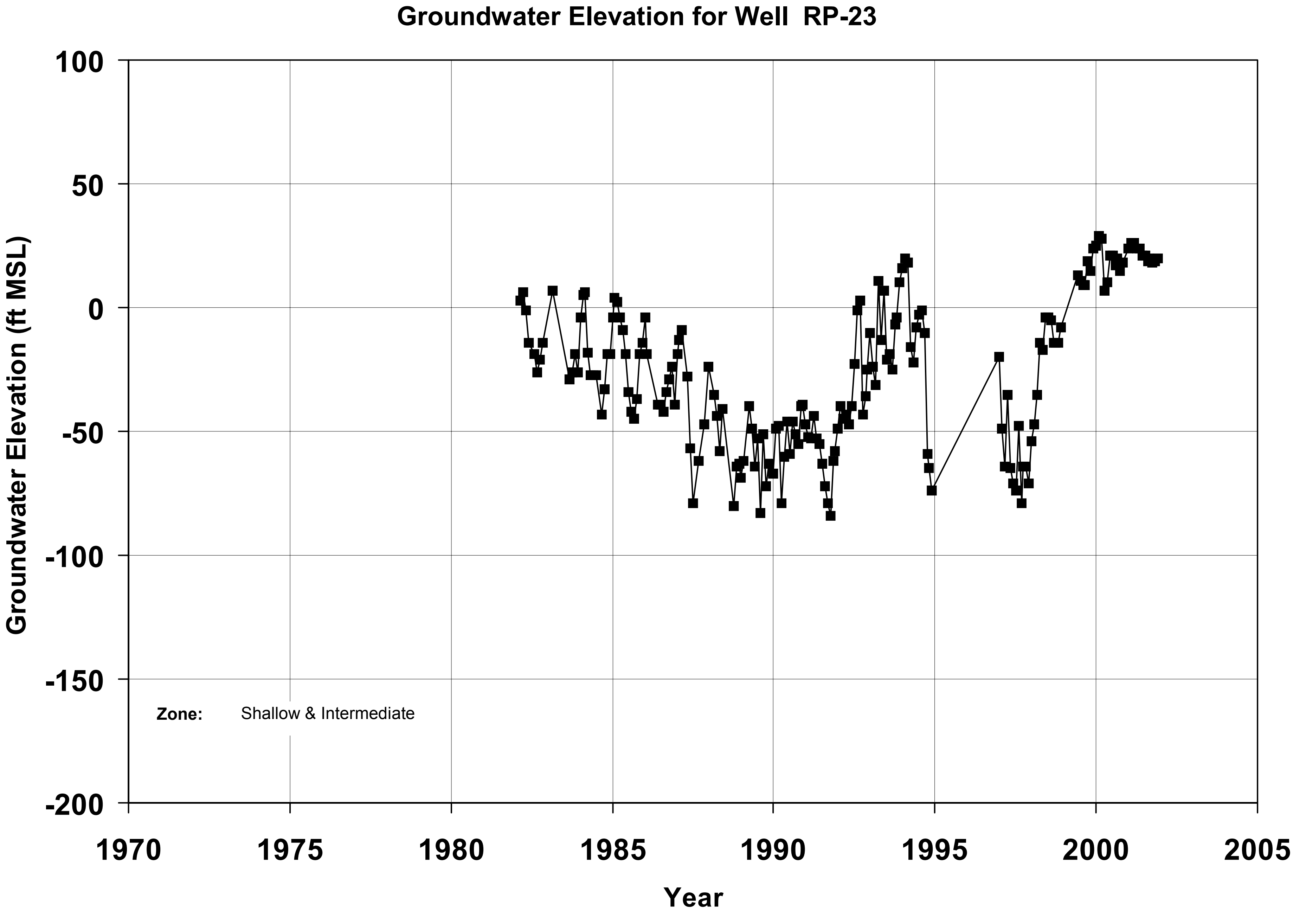


Groundwater Elevation for Well RP-20
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

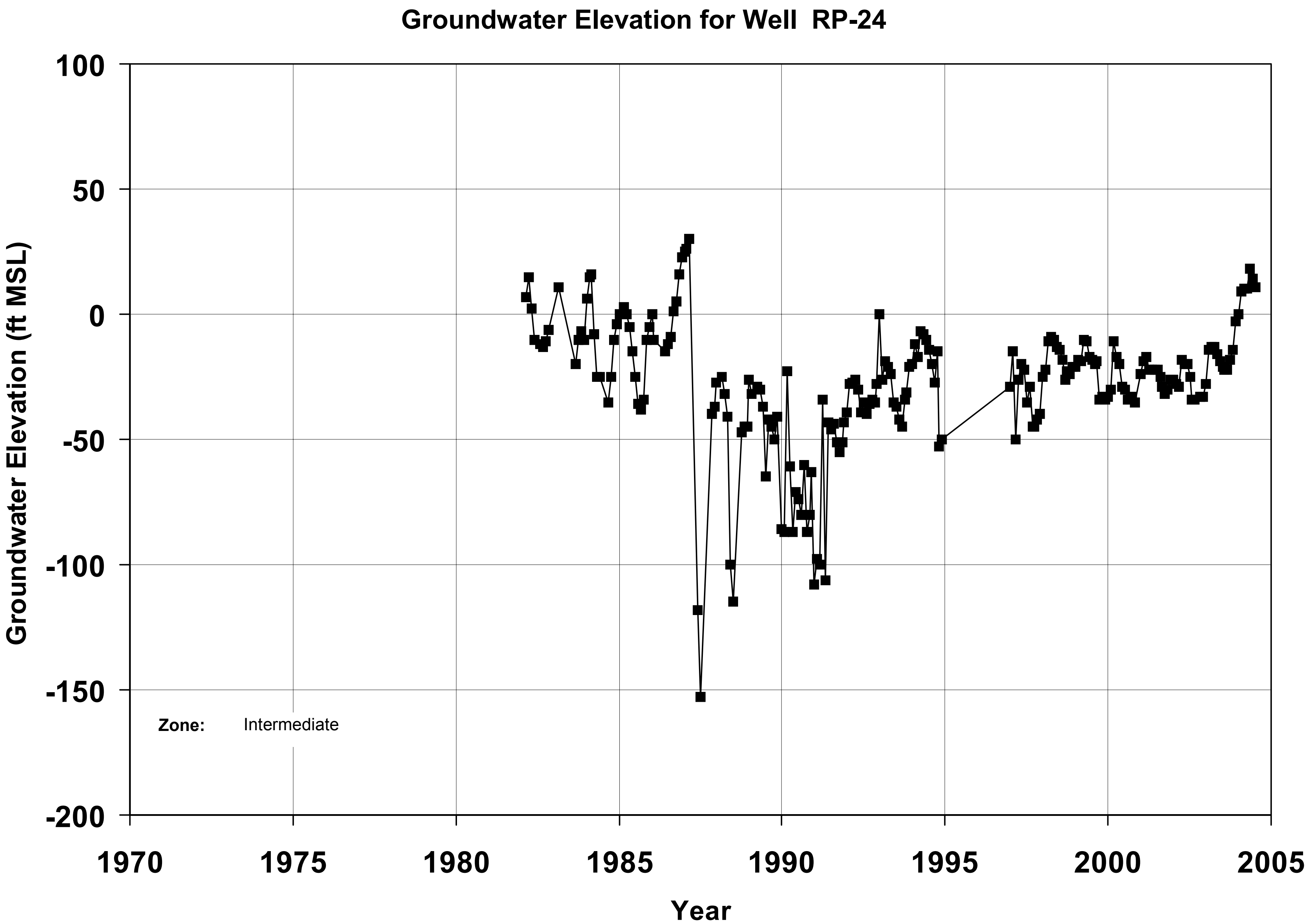

Groundwater Elevation for Well RP-21
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow & Intermediate

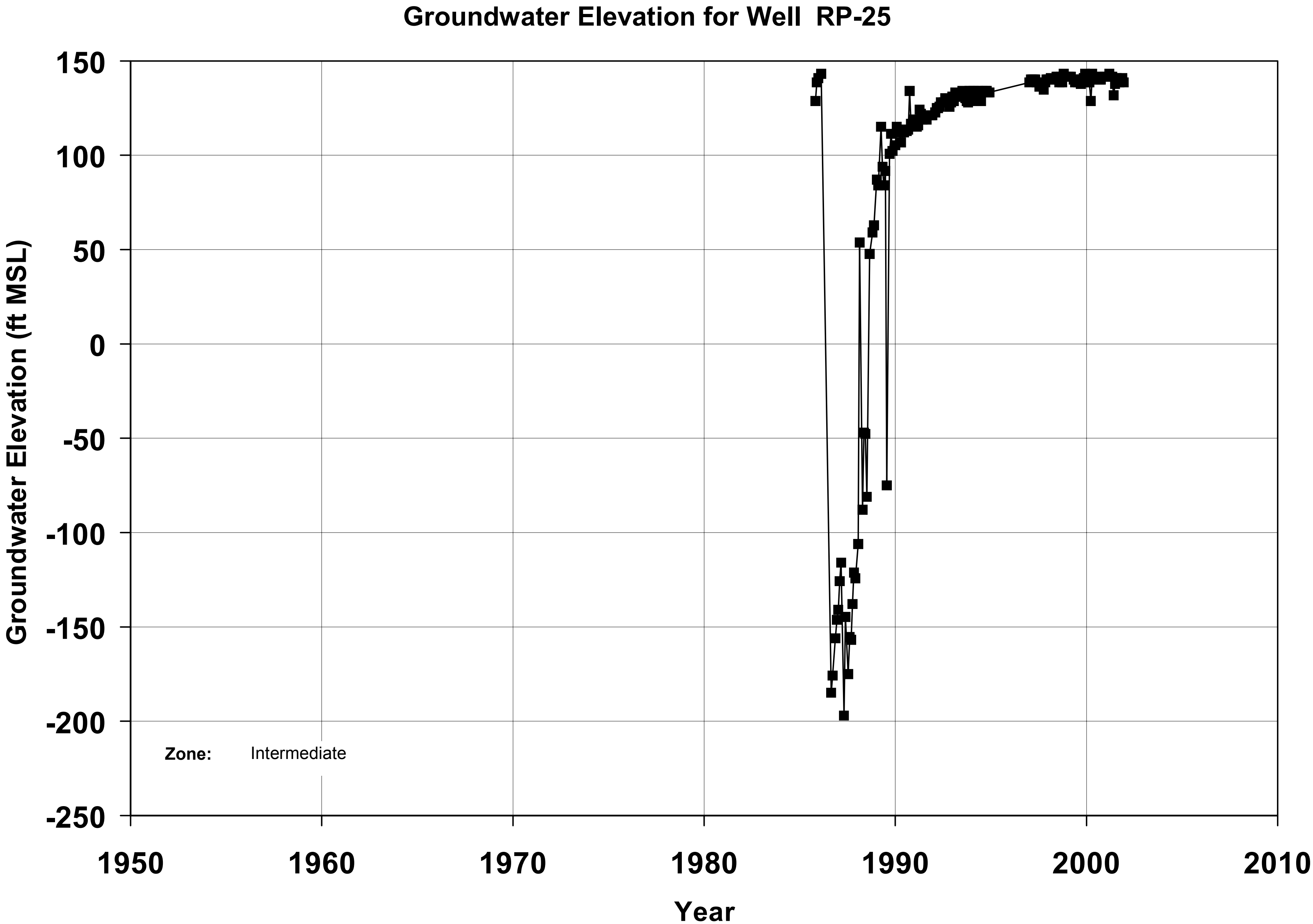


Groundwater Elevation for Well RP-22
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Intermediate

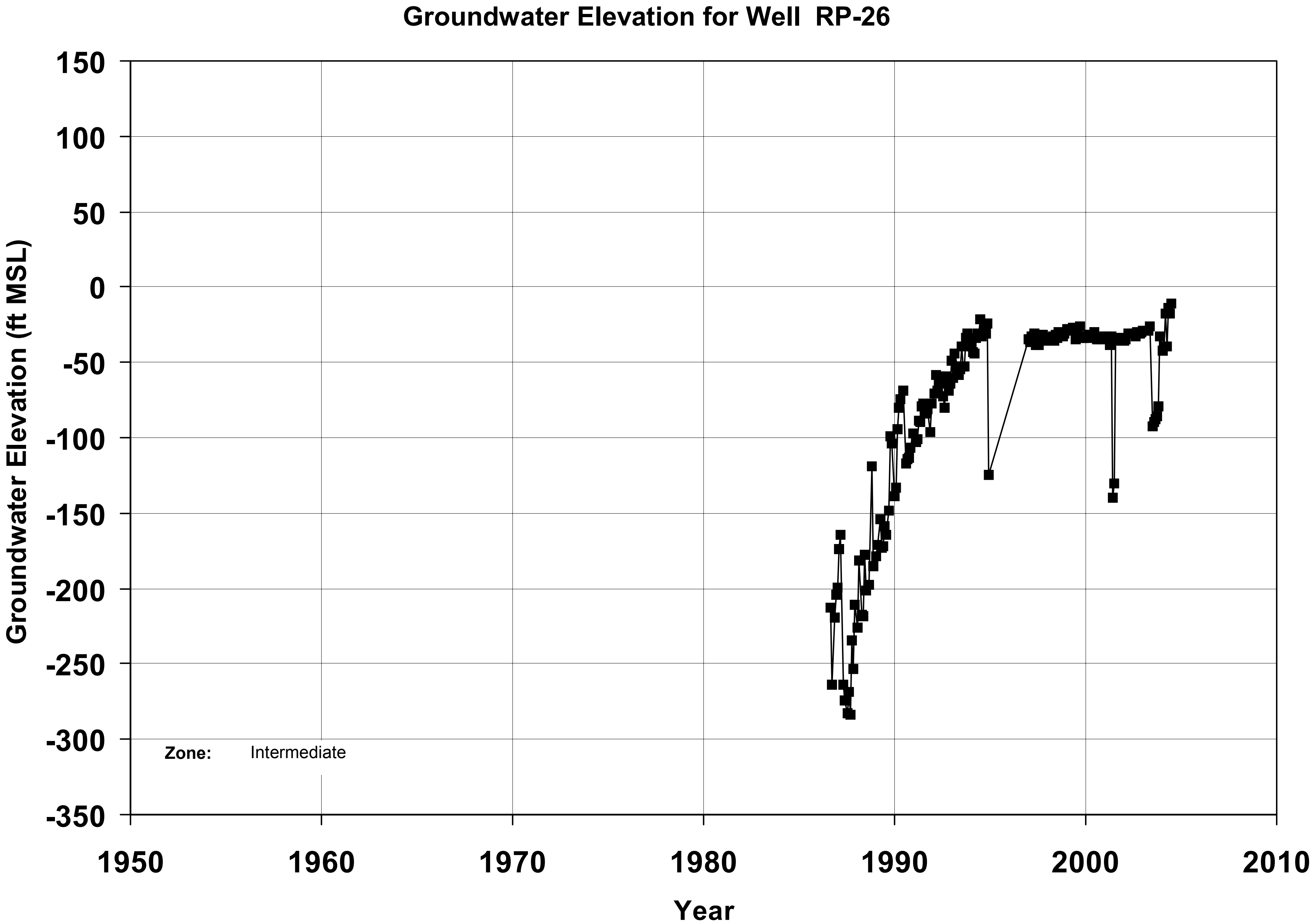


Groundwater Elevation for Well RP-23
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate

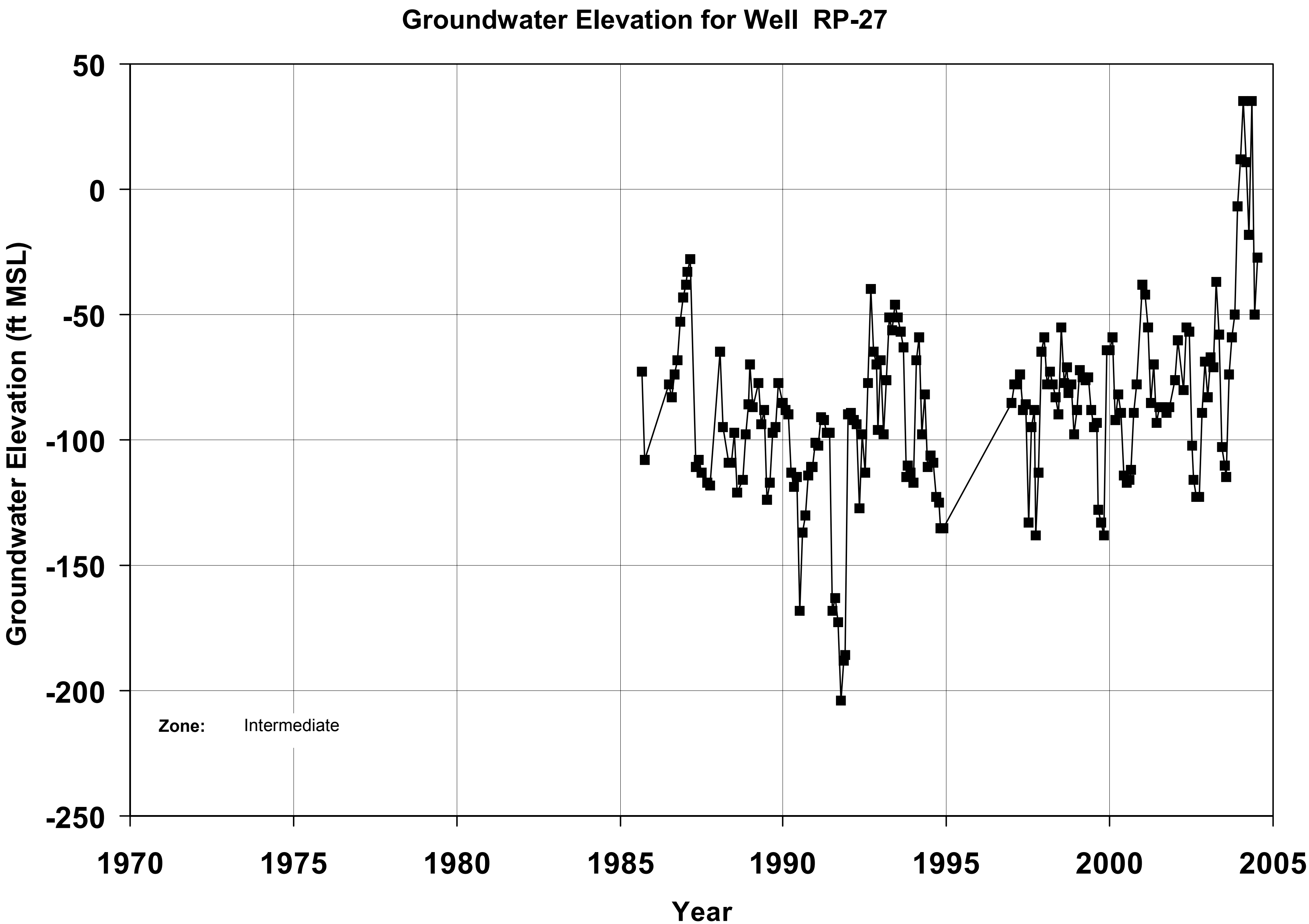

Groundwater Elevation for Well RP-24
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Intermediate

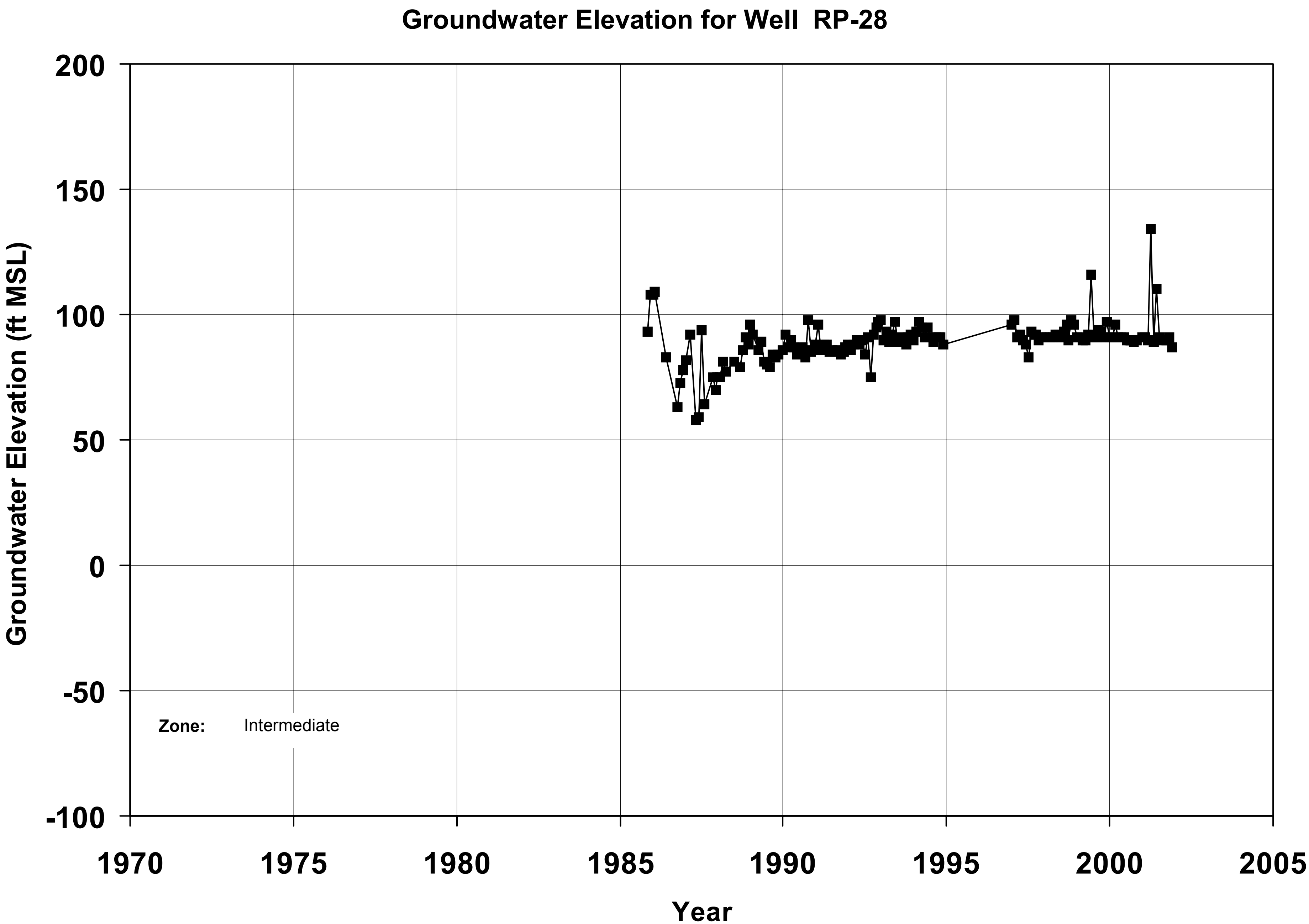


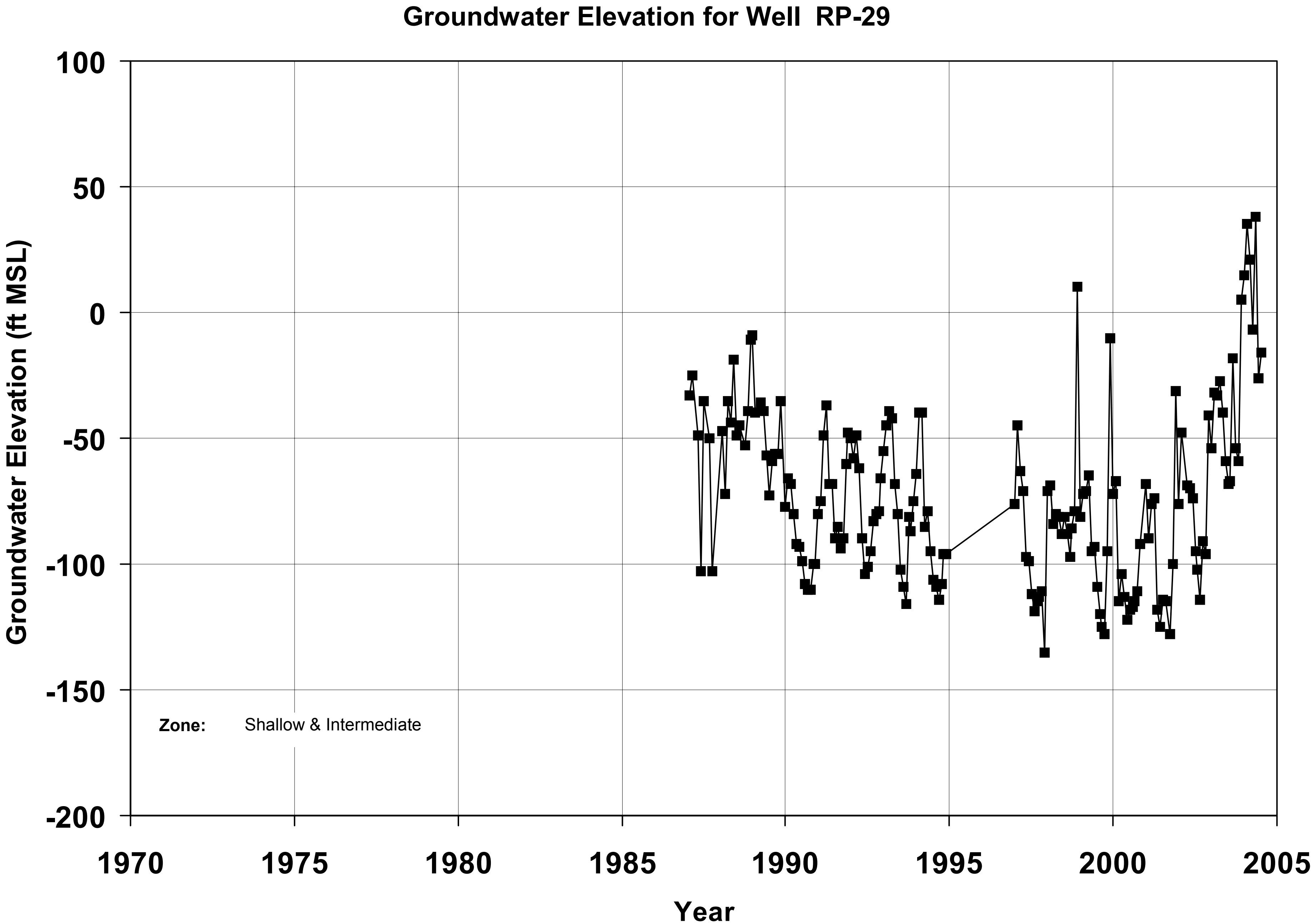
Groundwater Elevation for Well RP-25
150
100
50
0
-50
-100
-150
-200
-250
Groundwater Elevation (ft MSL)
Zone: Intermediate
1950
1960
1970
1980
1990
2000
2010
Year



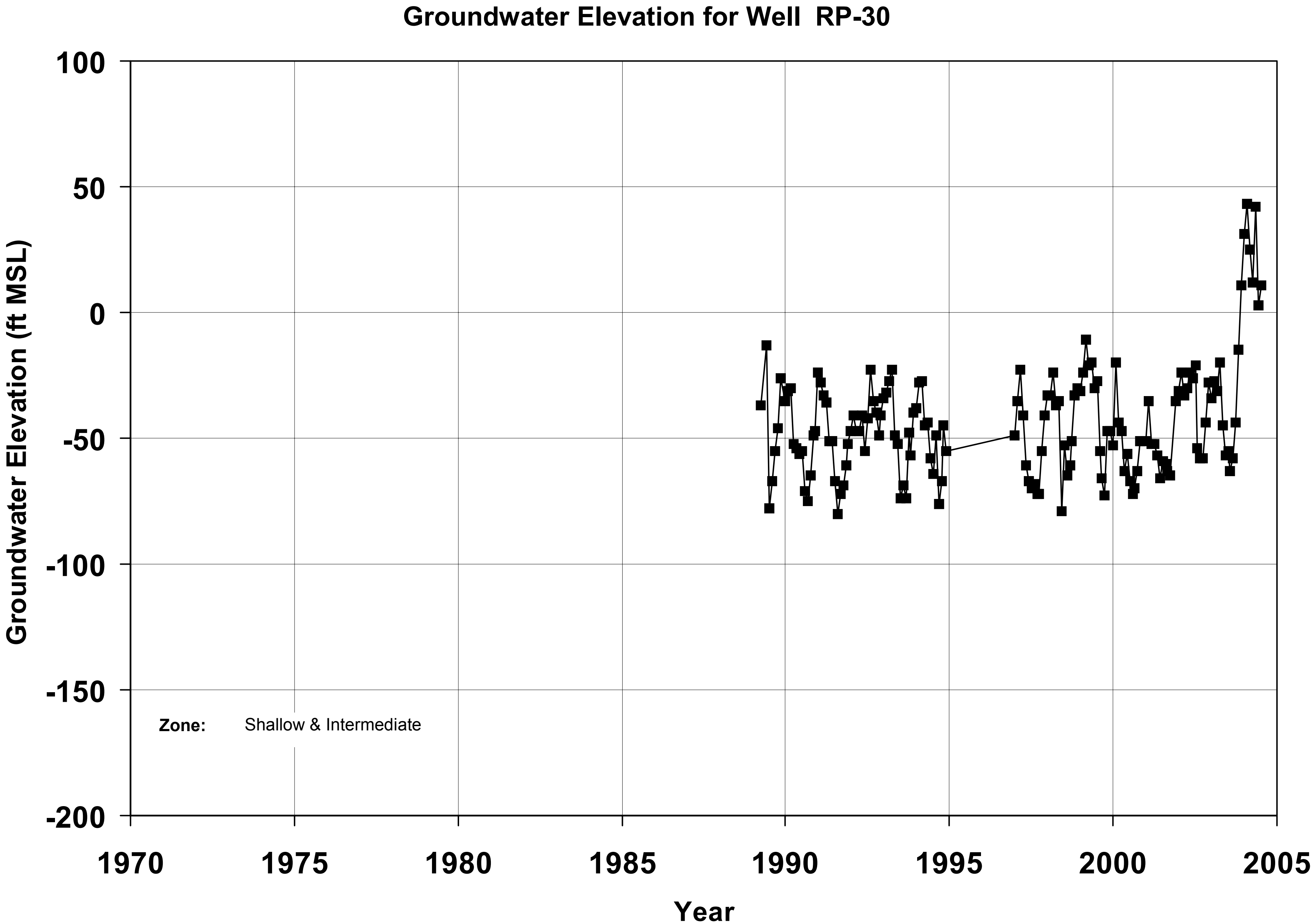
Groundwater Elevation for Well RP-26
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
Groundwater Elevation (ft MSL)
Zone: Intermediate
1950
1960
1970
1980
1990
2000
2010
Year

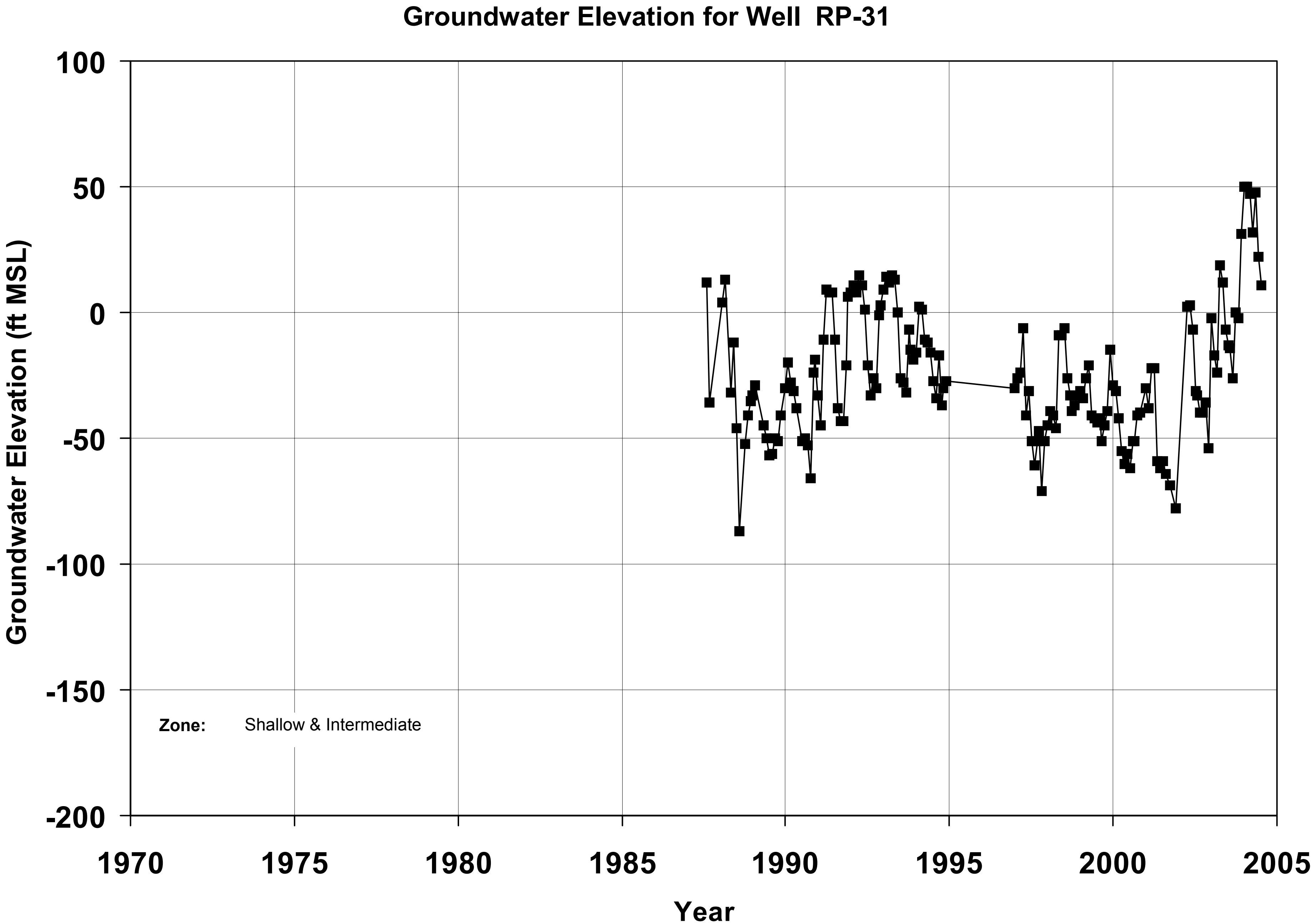

Groundwater Elevation for Well RP-27
Groundwater Elevation (ft MSL)
50
0
-50
-100
-150
-200
-250
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Intermediate


Groundwater Elevation for Well RP-28
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone:
Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

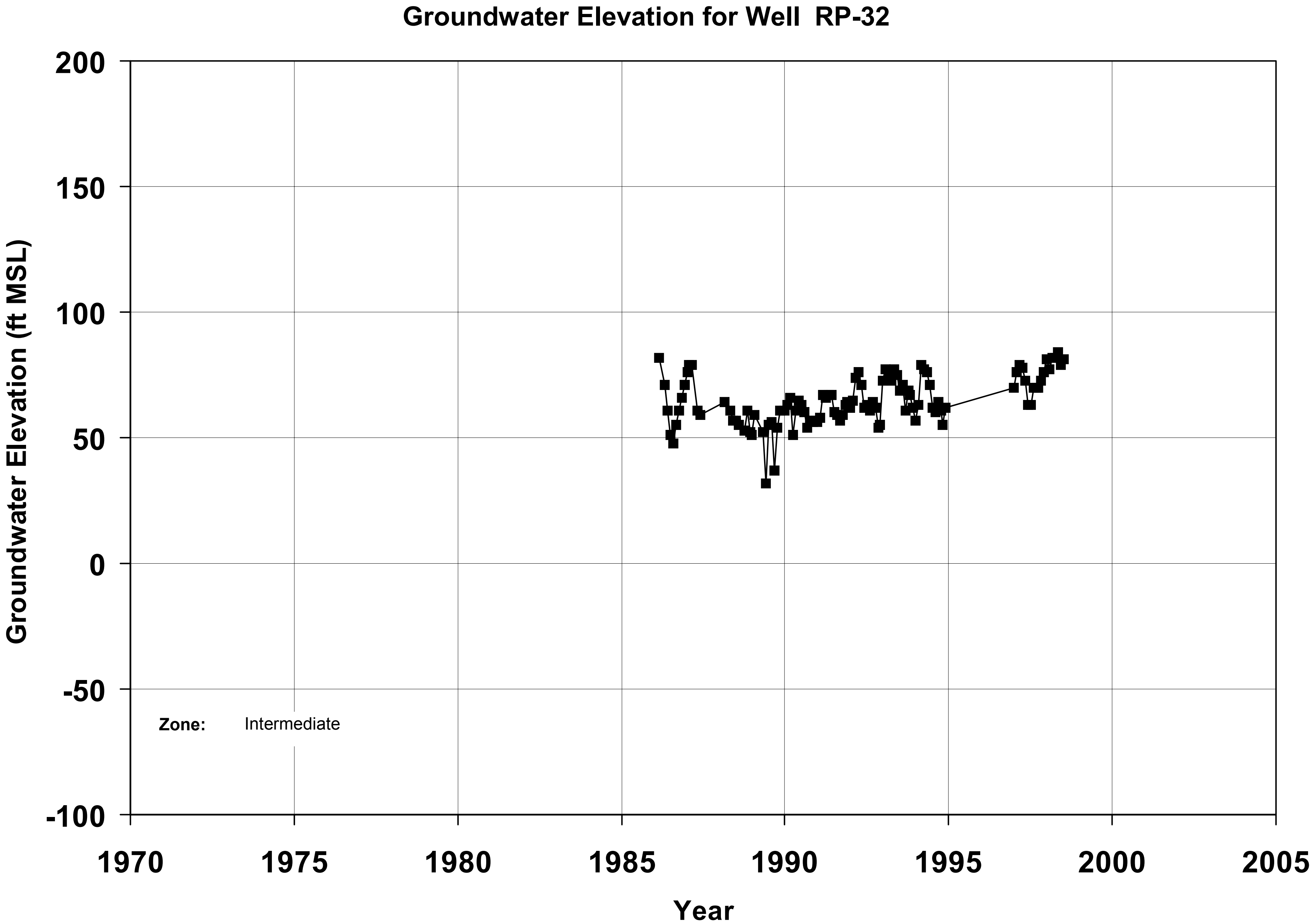


Groundwater Elevation for Well RP-29
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow & Intermediate

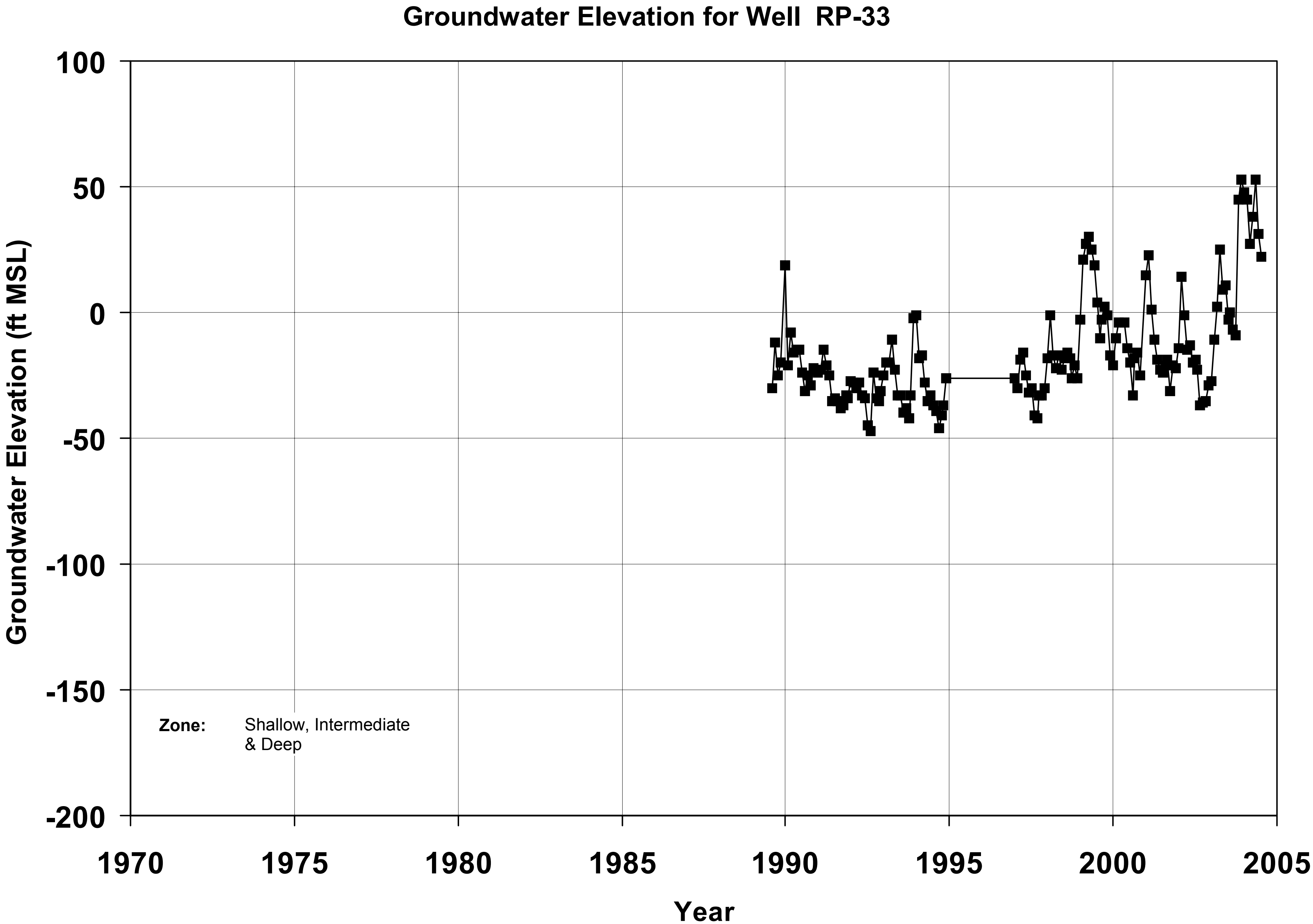

Groundwater Elevation for Well RP-30
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year



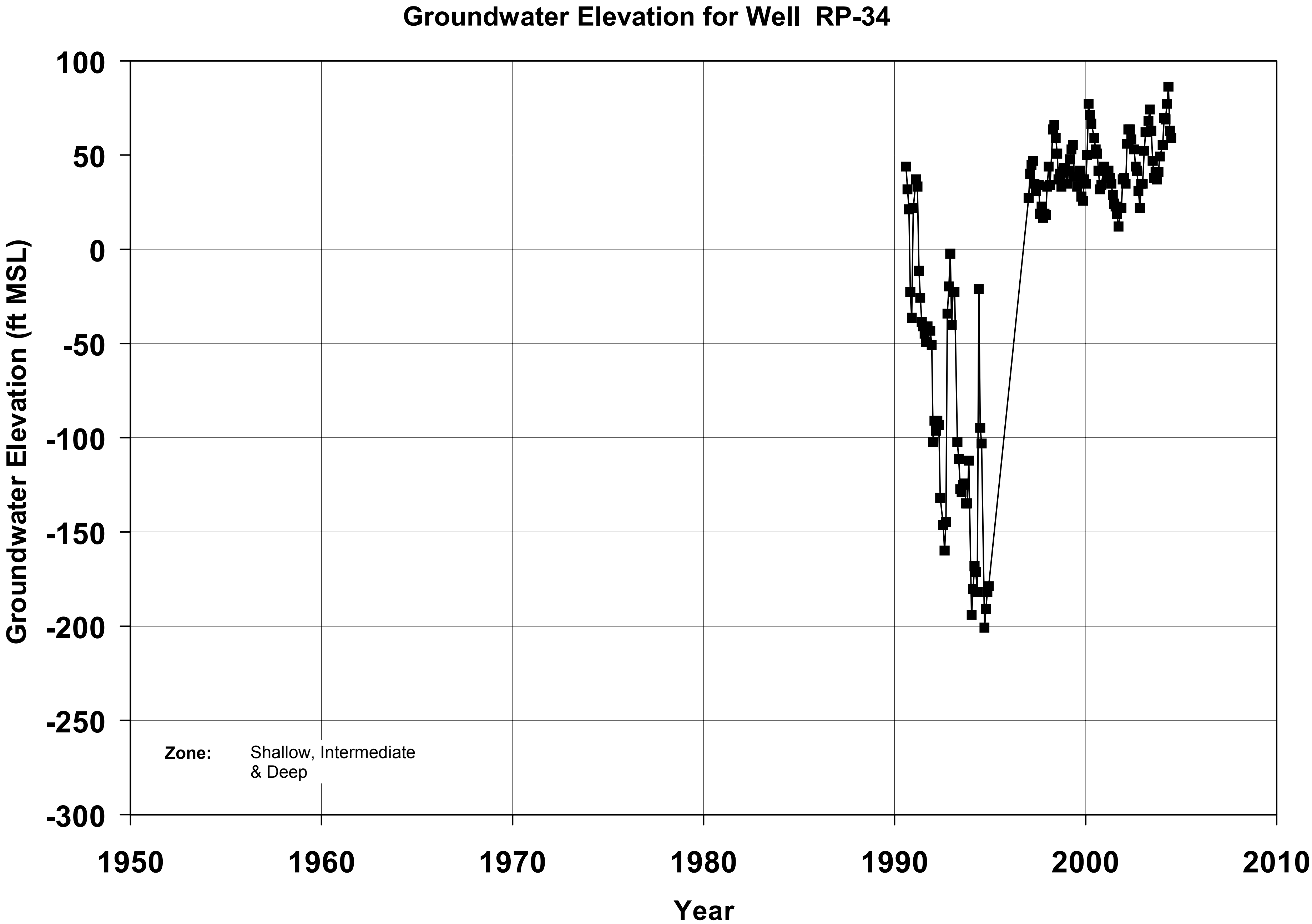
Groundwater Elevation for Well RP-31
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow & Intermediate

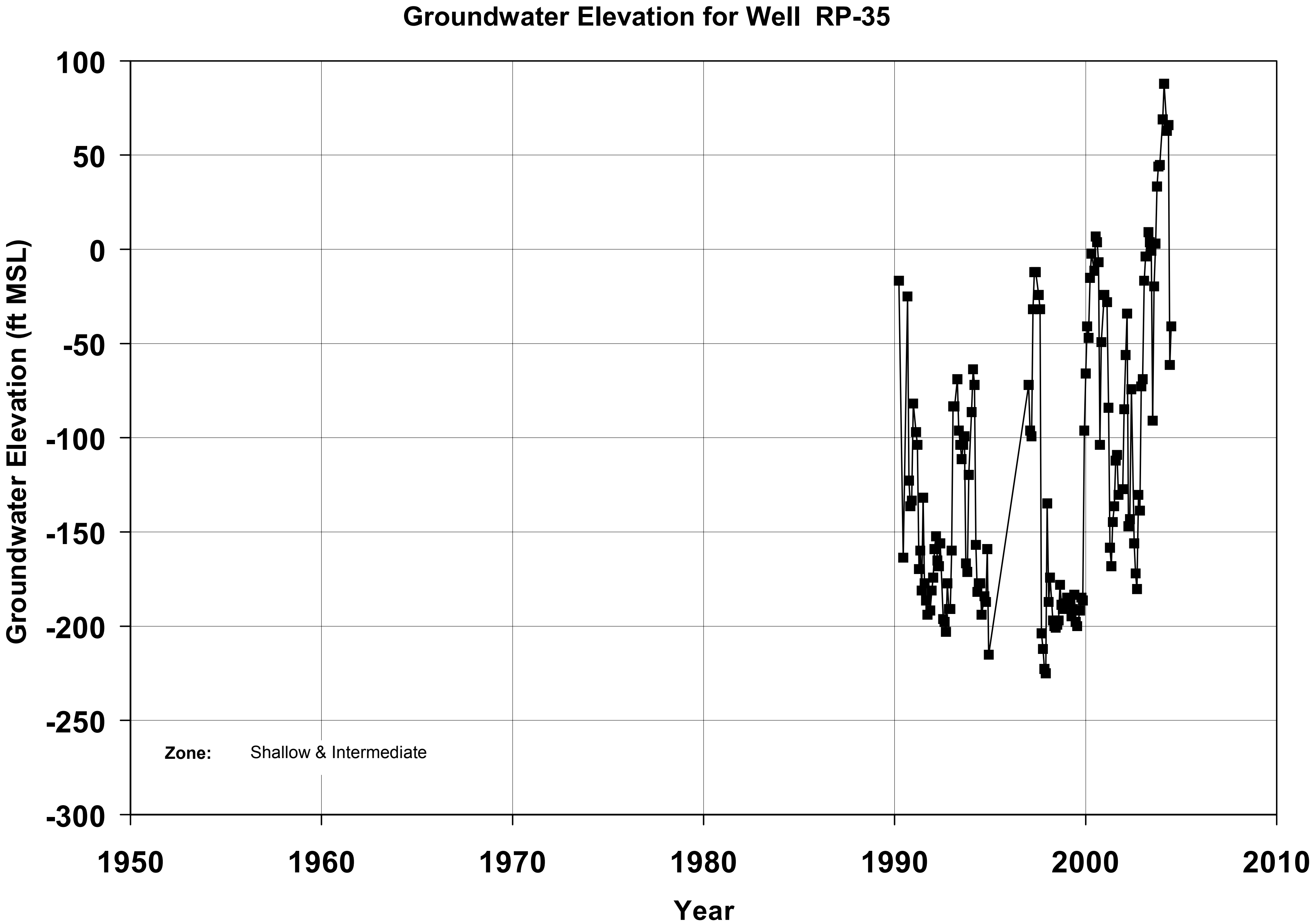


Groundwater Elevation for Well RP-32
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Intermediate

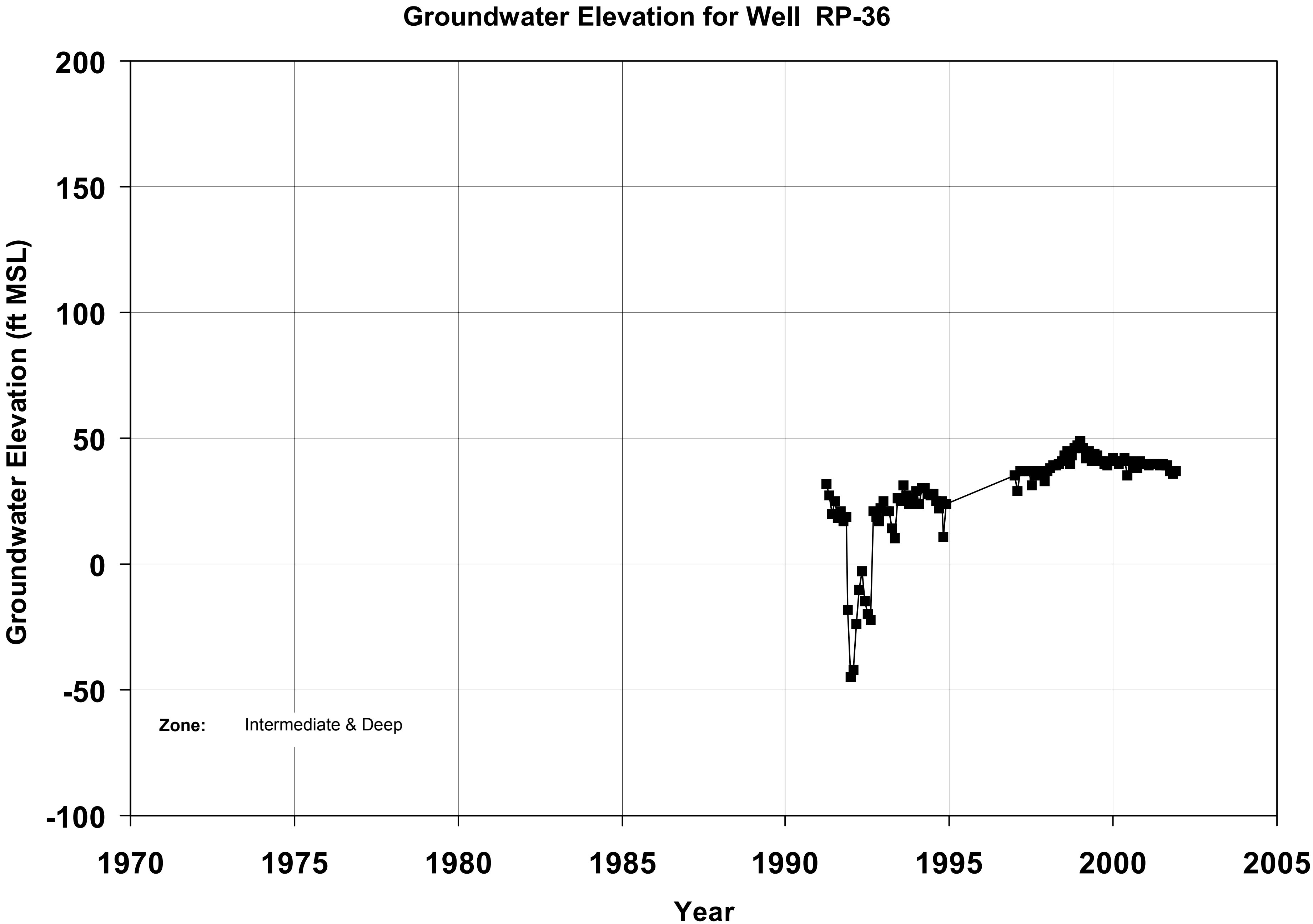


Groundwater Elevation for Well RP-33
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow, Intermediate & Deep

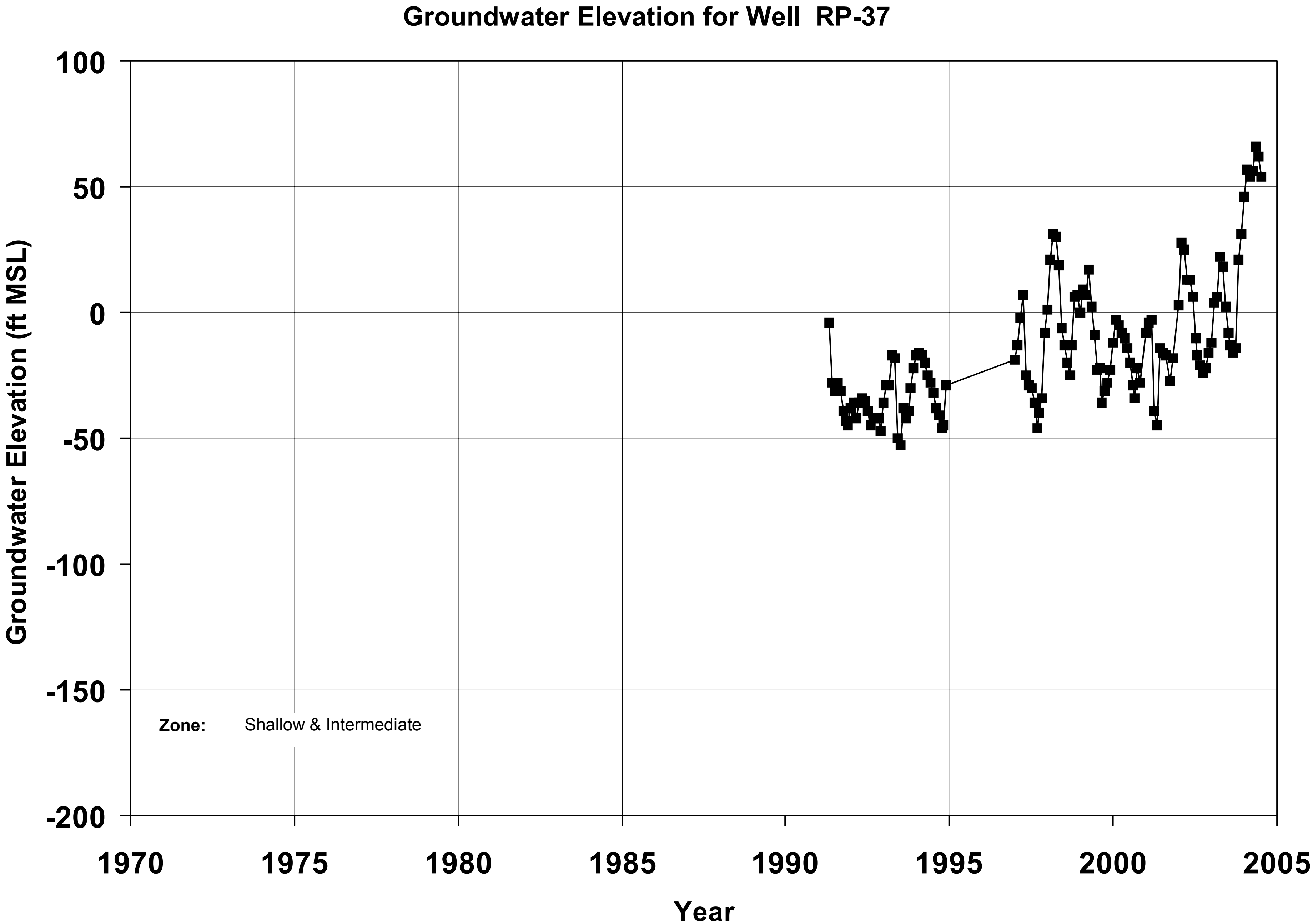

Groundwater Elevation for Well RP-34
100
50
0
-50
-100
-150
-200
-250
-300
Groundwater Elevation (ft MSL)
1950
1960
1970
1980
1990
2000
2010
Year
Zone:
Shallow, Intermediate
& Deep

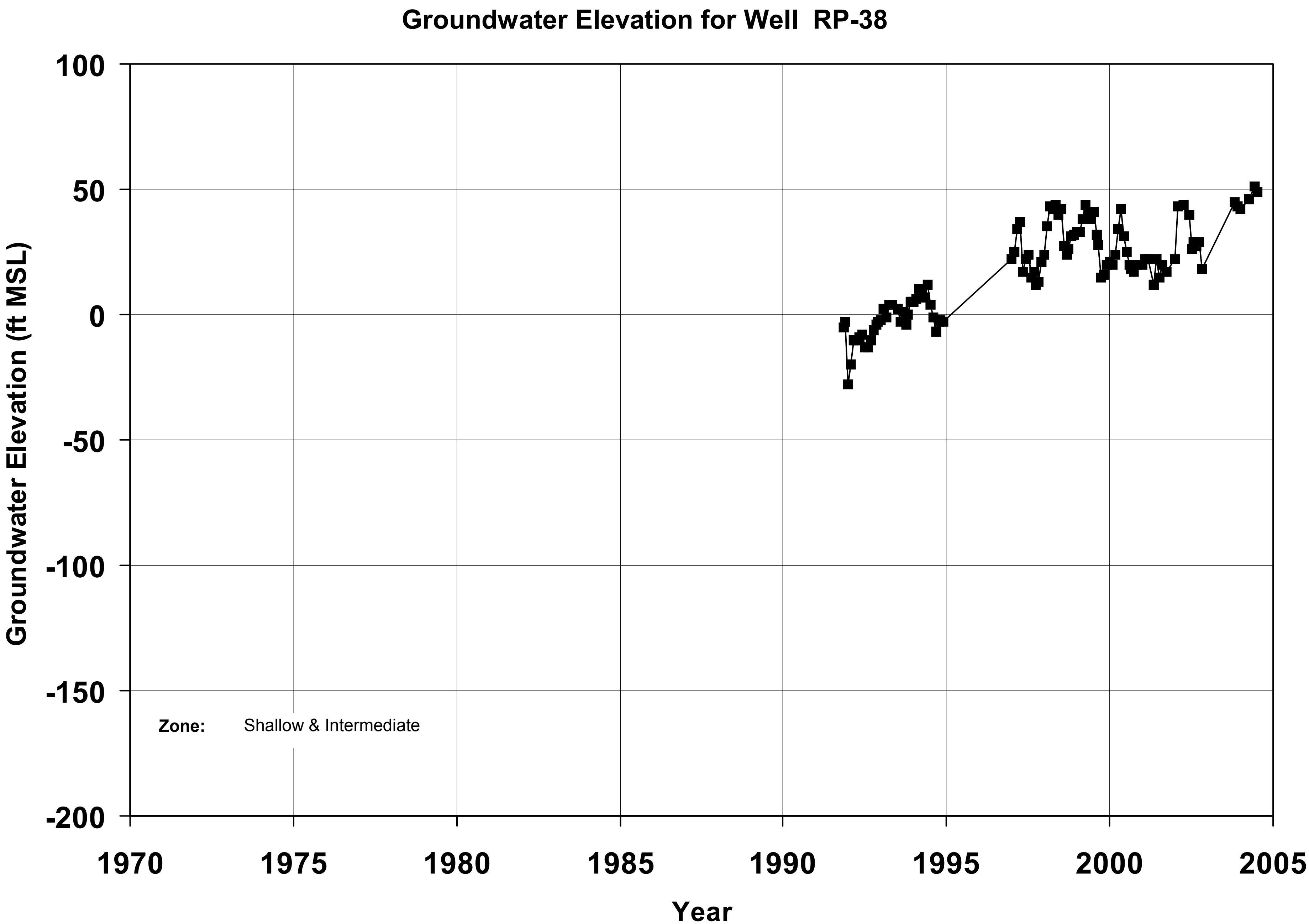


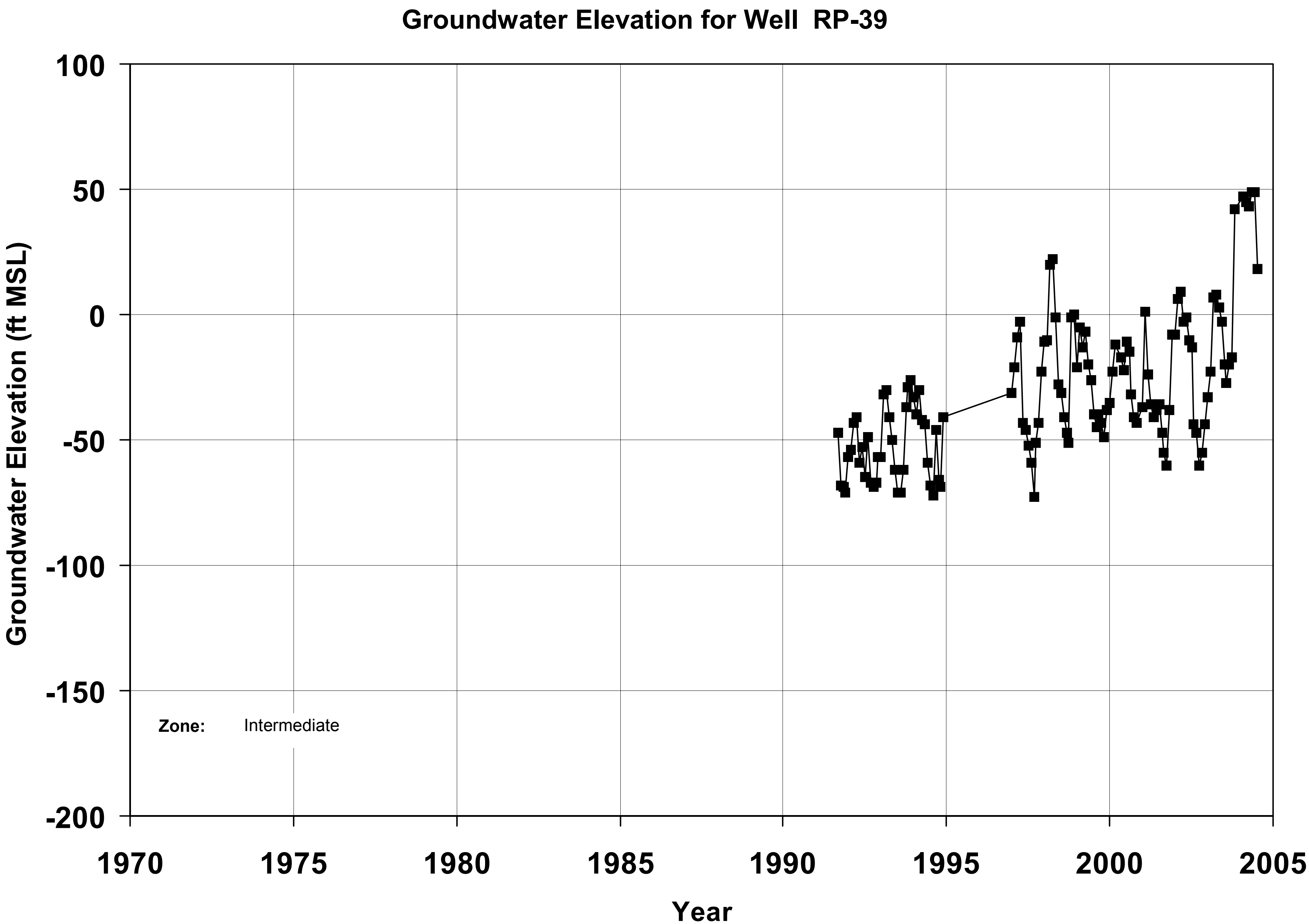
Groundwater Elevation for Well RP-35
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
-250
-300
Zone:
Shallow & Intermediate
1950
1960
1970
1980
1990
2000
2010
Year

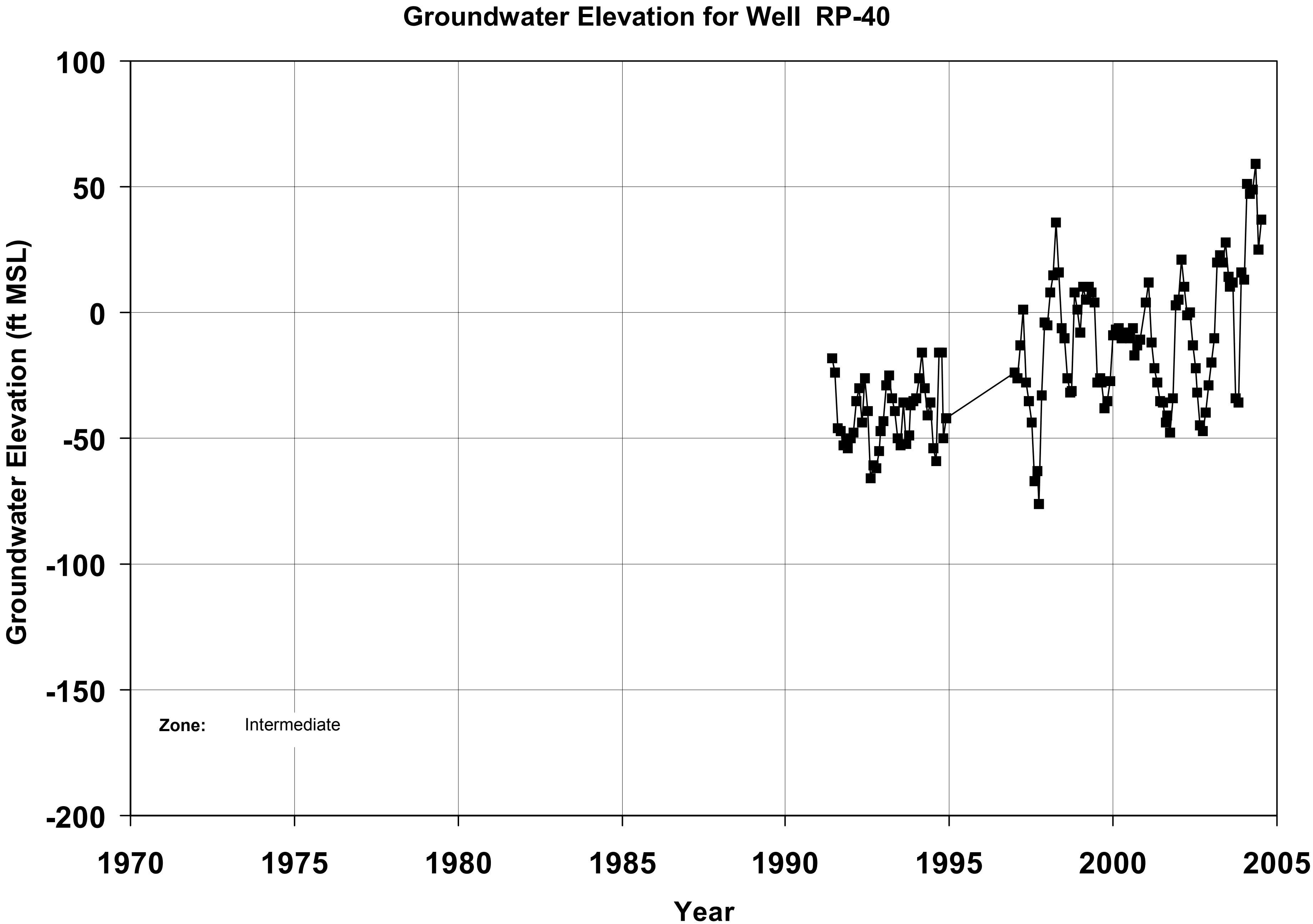


Groundwater Elevation for Well RP-36
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Intermediate & Deep
1970
1975
1980
1985
1990
1995
2000
2005
Year

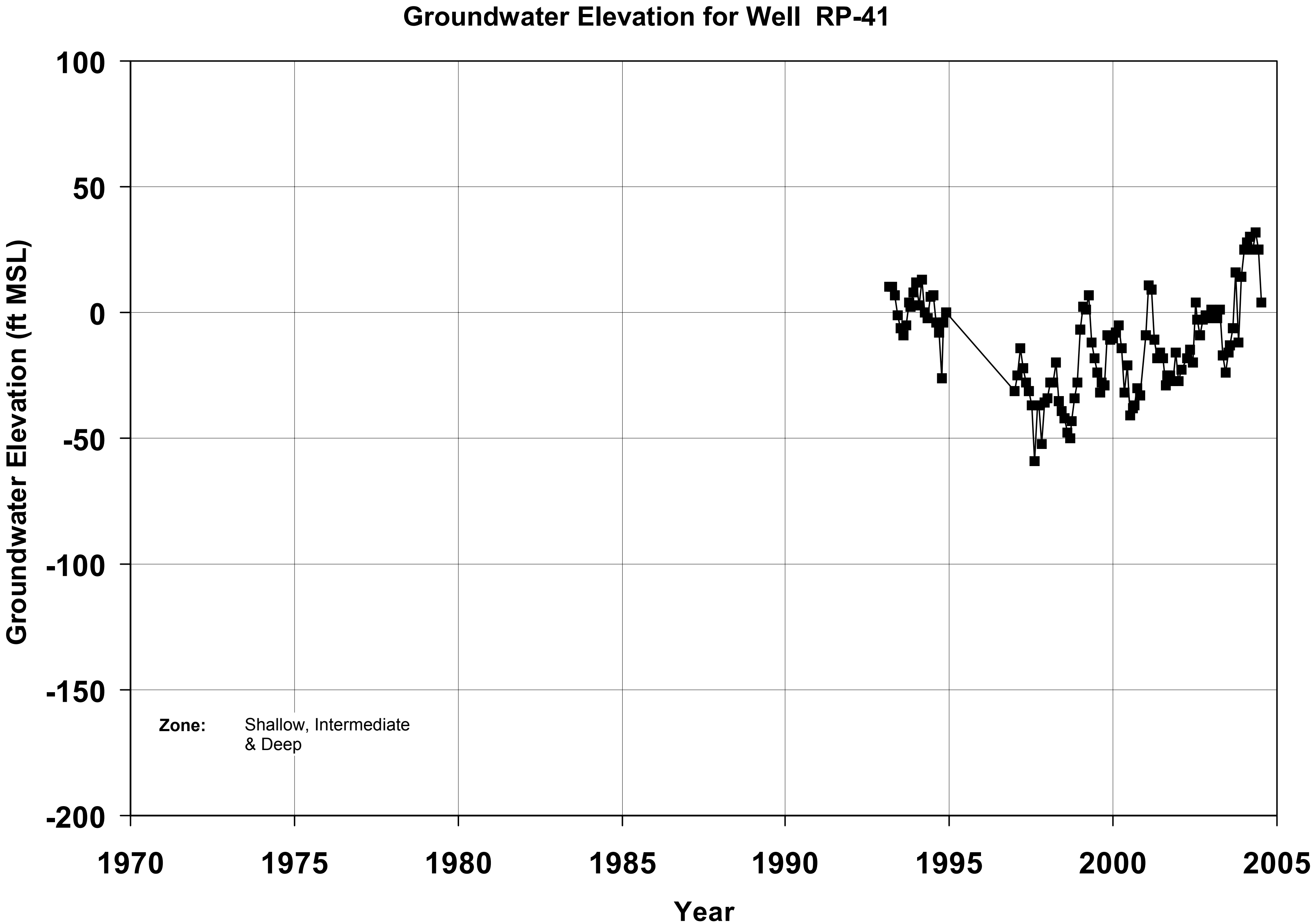

Groundwater Elevation for Well RP-37
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

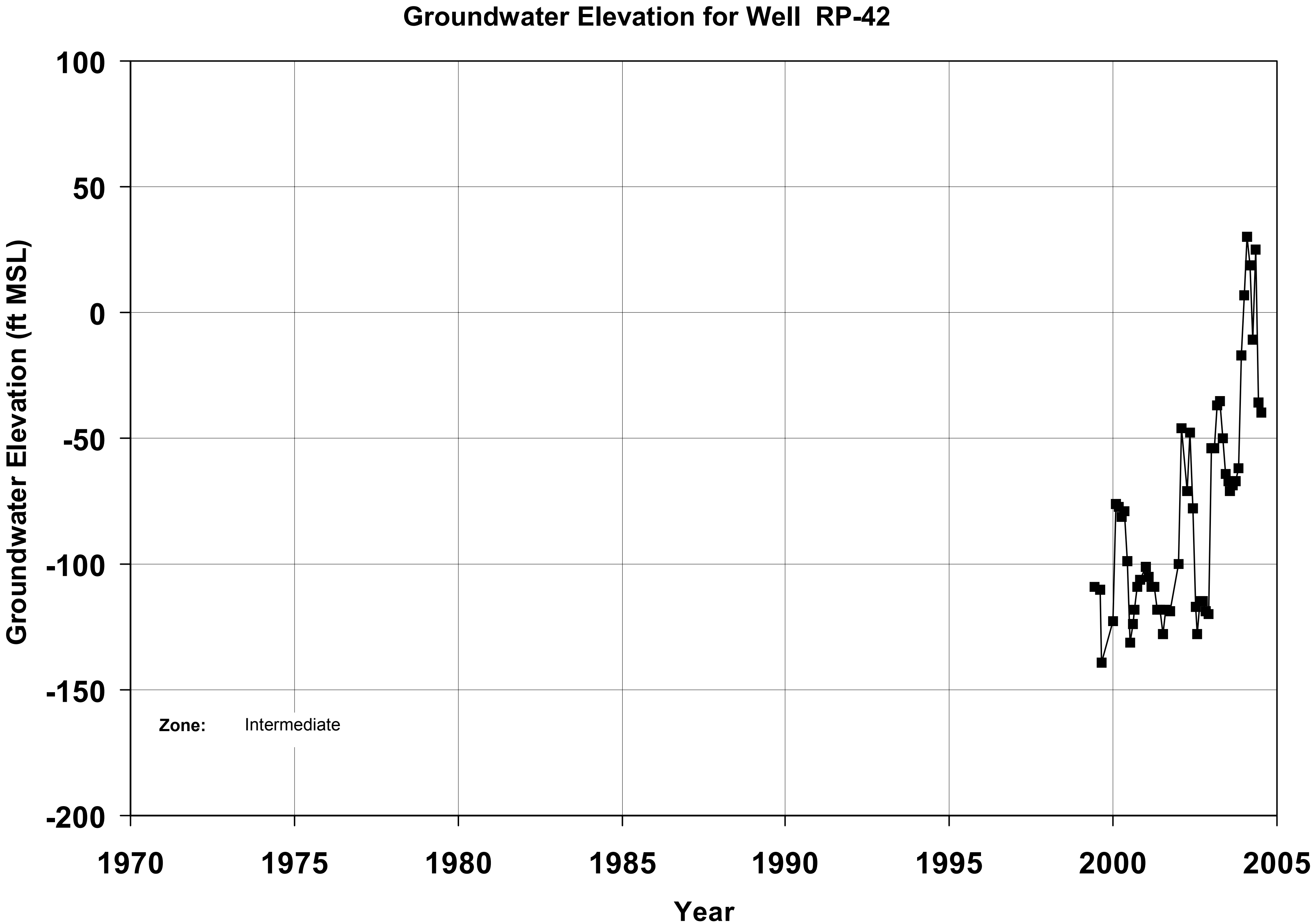

Groundwater Elevation for Well RP-38
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Shallow & Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

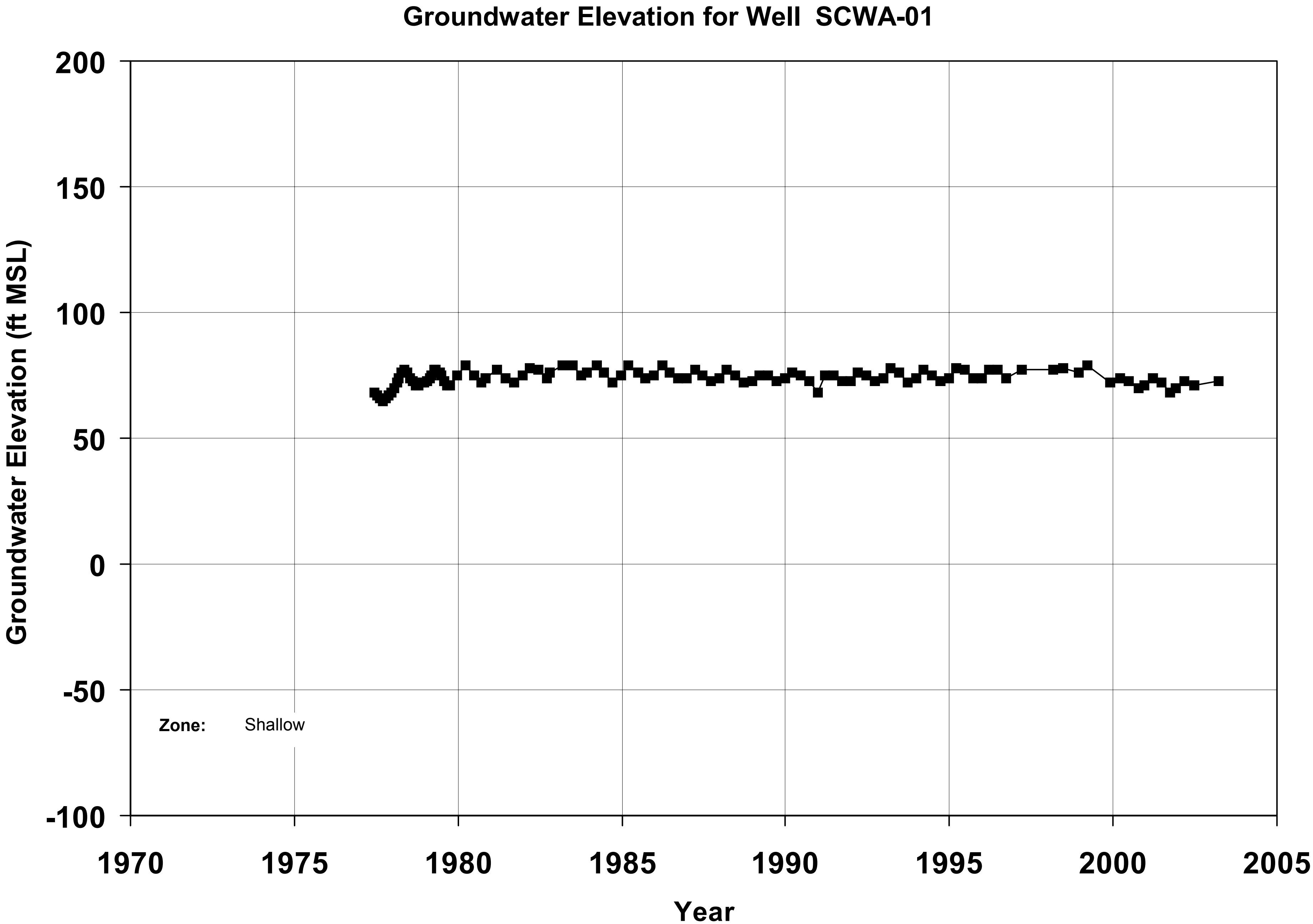

Groundwater Elevation for Well RP-39
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
Zone: Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

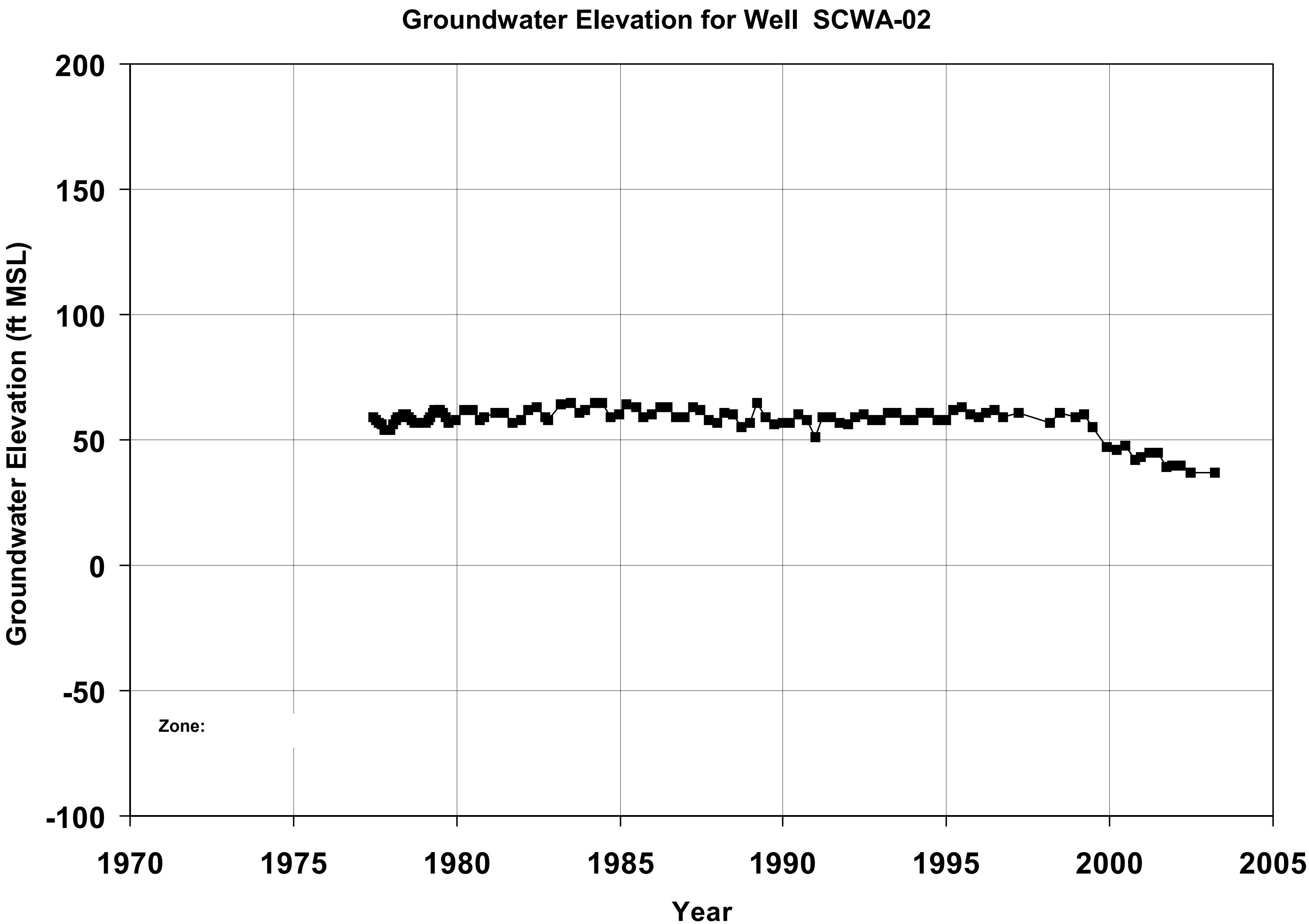


Groundwater Elevation for Well RP-40
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
Zone:
Intermediate
1970
1975
1980
1985
1990
1995
2000
2005
Year

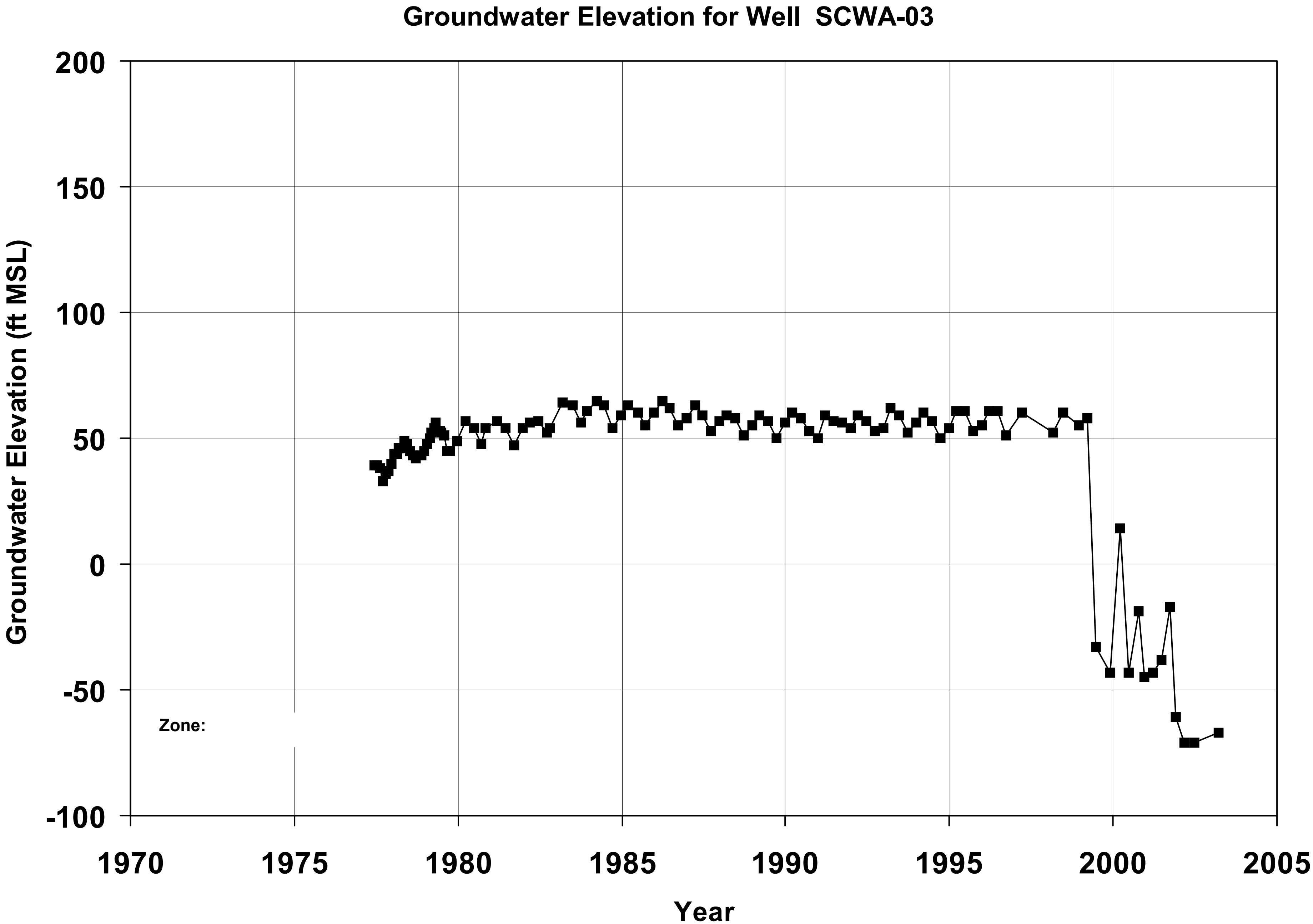

Groundwater Elevation for Well RP-41
Groundwater Elevation (ft MSL)
100
50
0
-50
-100
-150
-200
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Shallow, Intermediate
& Deep

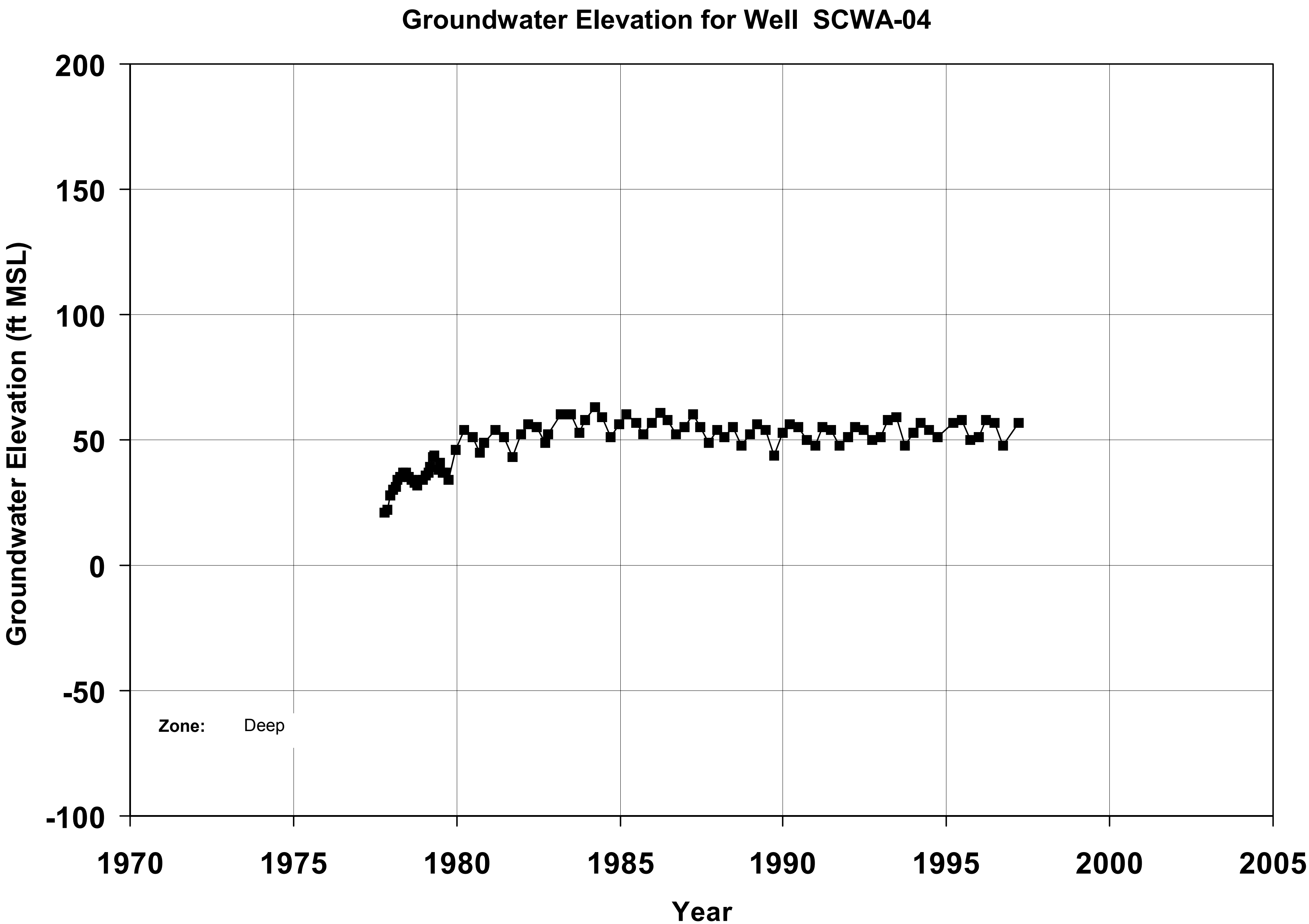

Groundwater Elevation for Well RP-42
100
50
0
-50
-100
-150
-200
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Intermediate

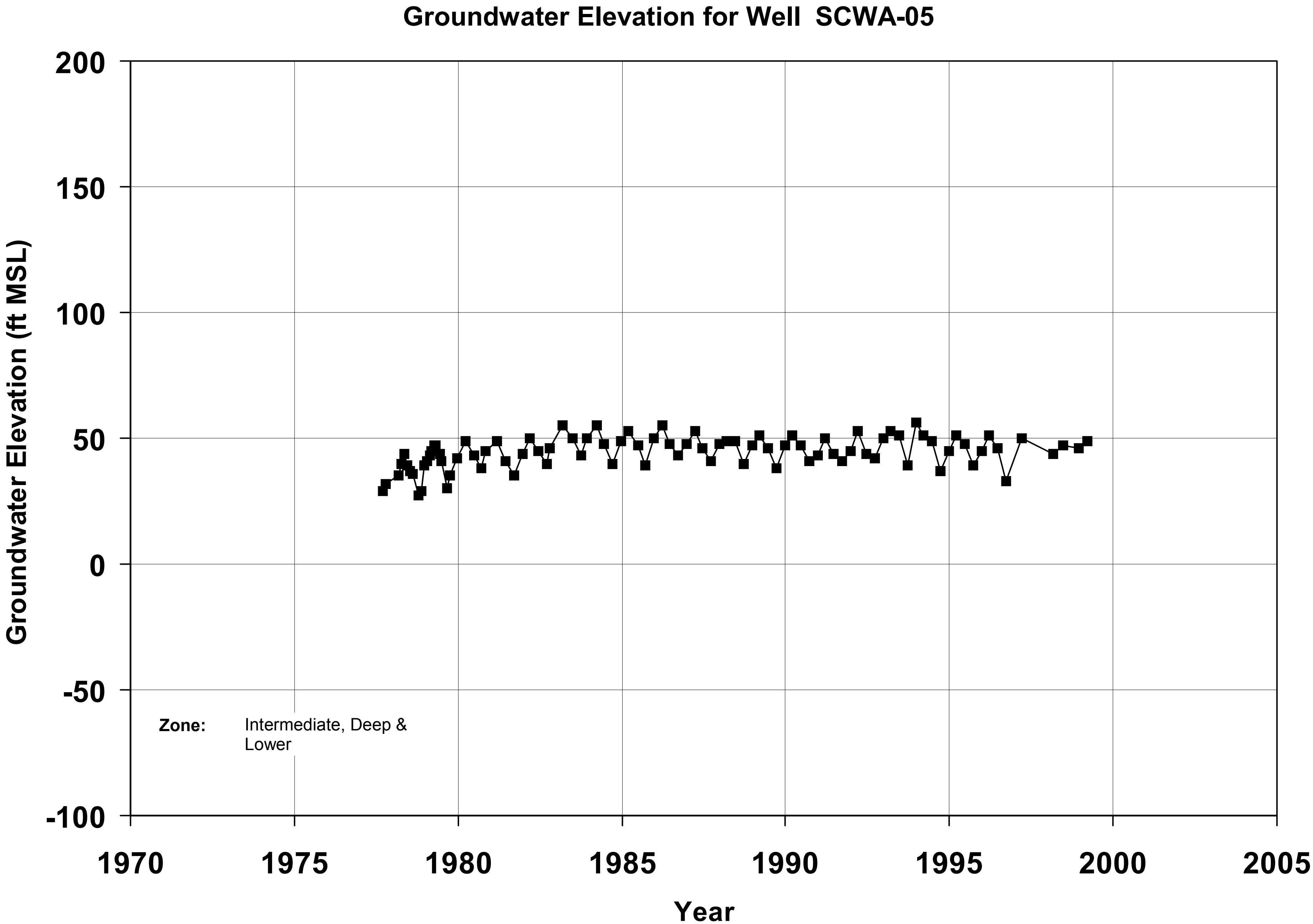

Groundwater Elevation for Well SCWA-01
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone: Shallow



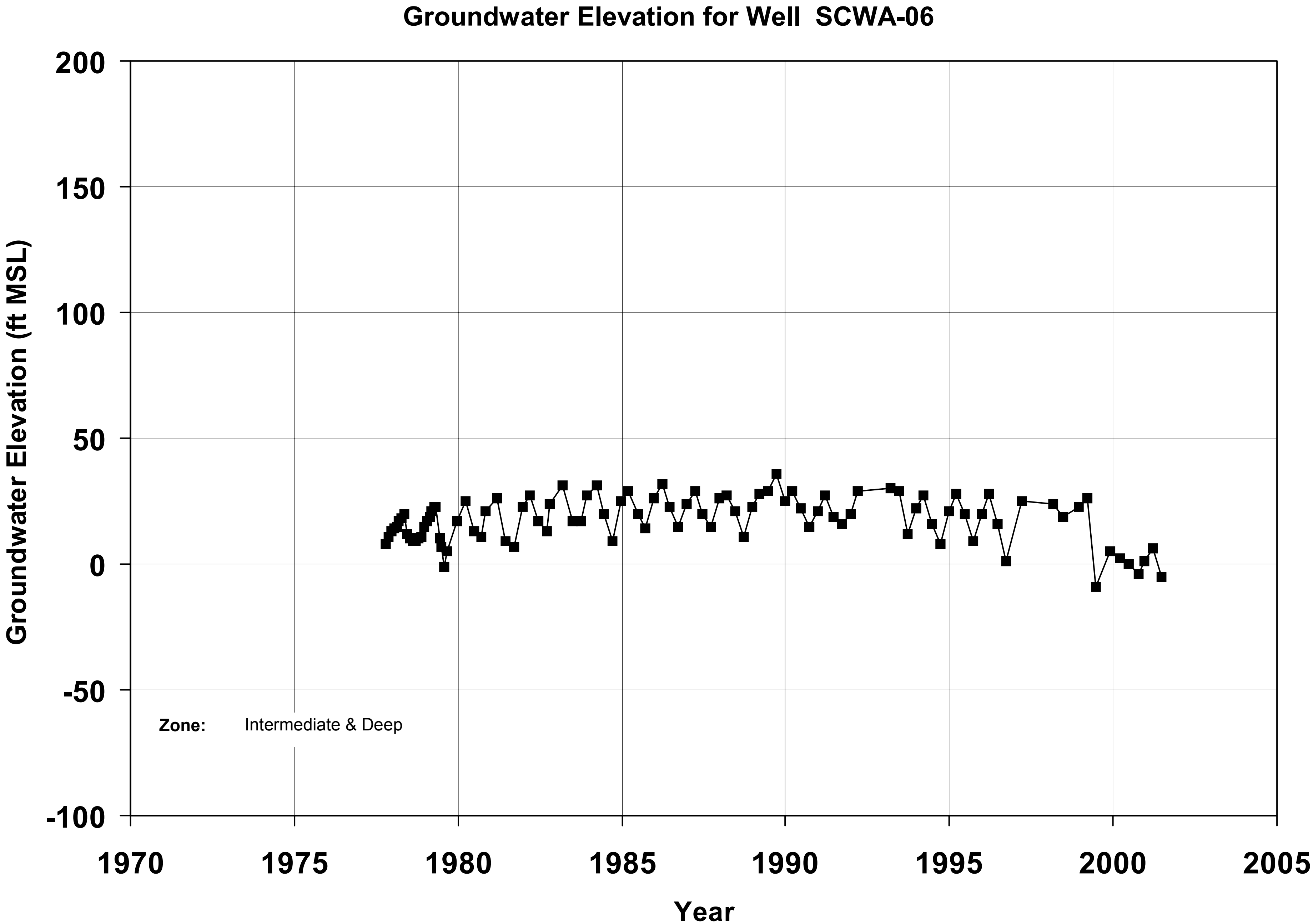
Groundwater Elevation for Well SCWA-02
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
Zone:
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well SCWA-03
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone:
1970
1975
1980
1985
1990
1995
2000
2005
Year


Groundwater Elevation for Well SCWA-04
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Deep
1970
1975
1980
1985
1990
1995
2000
2005
Year



Groundwater Elevation for Well SCWA-05
Groundwater Elevation (ft MSL)
200
150
100
50
0
-50
-100
1970
1975
1980
1985
1990
1995
2000
2005
Year
Zone:
Intermediate, Deep &
Lower


Groundwater Elevation for Well SCWA-06
200
150
100
50
0
-50
-100
Groundwater Elevation (ft MSL)
Zone: Intermediate & Deep
1970
1975
1980
1985
1990
1995
2000
2005
Year