

1 TO: Michael LeBrun, Interim General Manager, Nipomo Community Services District  
2 FROM: Joel Degner E.I.T., Brad Newton, Ph.D., P.G.  
3 RE: Fall 2009 Groundwater Index  
4 DATE: December 01, 2009

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5 **INTRODUCTION**

6 Groundwater surface elevations (GSE) underlying the Nipomo Mesa are regularly  
7 measured at many places (wells) across the mesa. The Fall 2009 Groundwater Index (GWI) has  
8 been estimated and presented herein along with historical GWI from 1975 to present based on  
9 these groundwater surface elevation measurements collected during spring and fall across the  
10 Nipomo Mesa. Limited measurements of GSE were available for the years 1982, 1983, 1984,  
11 1994 and 1997, thus precluding a reliable estimate of GWI for those years.

12 Ground elevation surveys for the key wells were conducted in preparation of the 1<sup>st</sup>  
13 Annual Report - Calendar Year 2008 for the Nipomo Mesa Management Area (NMMA). These  
14 updated reference points were not incorporated into the GWI to preserve consistency in the  
15 historical calculations and presentations.

16 The NMMA Technical Group has not reviewed this technical memorandum, its findings,  
17 or any presentation of this evaluation.

18  
19 **RESULTS**

20 Estimated Fall 2009 GWI is 59,000 acre-feet (AF), which is 6,000 AF less than Fall 2009  
21 (Table 1, Figure 1). The Key Well Index from NMMA 1<sup>st</sup> Annual Report Calendar Year 2008  
22 generally follows the same historical trends as the GWI estimates (Figure 1).

23  
24 **METHODOLOGY**

25 The annual estimates of Spring and Fall GWI are based on GSE measurements regularly  
26 made by San Luis Obispo County Department of Public Works (SLO DPW), NCSD, USGS, and  
27 Woodlands. The integration of GSE data is accomplished by using computer software to  
28 interpolate between measurements and calculate GWI within the principal production aquifer  
29 assuming an unconfined aquifer and a specific yield of 11.7 percent. Limited measurements of  
30 GSE were available for the years 1982, 1983, 1984, 1994 and 1997, precluding a reliable estimate  
31 of GWI for those years.

32 **Groundwater Surface Elevation Measurements**

33 Groundwater surface elevation data were obtained from SLO DPW, NCSD, USGS, and  
34 Woodlands. SLO DPW measures GSE in monitoring wells during the spring and the fall of

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1 each year. Woodlands and NCSD measures GSE in their monitoring wells monthly. For the  
2 years 1975 to 1999, available representative GSE data were used to estimate GWI. For the years  
3 2000 to 2009, only GSE data from the same 45 wells were used to estimate GWI.

4 The GSE data was reviewed in combination with well completion reports and historical  
5 hydrographic records in order to exclude measurements that do not accurately represent static  
6 water levels within the principal production aquifer. Wells that do not access the principal  
7 production aquifer or were otherwise determined to not accurately represent static water levels  
8 within the aquifer were not included in analysis.

### 9 **Groundwater Surface Interpolation**

10 The individual GSE measurements from each year were used to produce a GSE field by  
11 interpolation using the inverse distance weighting (IDW) method.

### 12 **Groundwater Index**

13 The value of the groundwater index was estimated for the boundary determined in Phase  
14 III of the trial. The GWI was estimated by subtracting both the mean sea level surface (elevation  
15 equals zero) and the volume of bedrock above sea level from the saturated volume. The  
16 bedrock surface elevation is based on Figure 11: Base of Potential Water-Bearing Sediments,  
17 presented in the report, Water Resources of the Arroyo Grande - Nipomo Mesa Area (DWR  
18 2002). The bedrock surface elevation was preliminarily verified by reviewing driller reports  
19 obtained from DWR. The saturated volume above sea level was multiplied by a specific yield of  
20 11.7% to estimate the recoverable amount of GWI. The specific yield is based on the average  
21 weighted specific yield for the Nipomo Mesa Hydrologic Sub-Area (DWR 2002, pg. 86).

### 22 **Key Well Index**

23 The NMMA Technical Group selected the data from eight inland key wells to represent  
24 the whole of the NMMA. The average spring groundwater elevation of these key wells is used  
25 to calculate the Key Wells Index.

26 The Key Well Index was calculated annually using Spring GSE measurements from 1975  
27 to 2008. The Key Wells were selected to represent various portions of the groundwater basin  
28 within the NMMA. In selecting the eight key wells, the following criteria were applied so that  
29 the wells generally represent the NMMA as a whole:

- 30 (1) The wells are geographically distributed,
- 31 (2) No single well overly influences the Key Well Index.

32 The first criterion was met in the selection of the wells, such that no well represented a  
33 disproportionate area. To meet the second criterion, groundwater elevations from each well  
34 were normalized so that any well where elevations were on the average higher or lower than  
35 the other wells did not overly influence the magnitude of the Key Well Index. This

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1 normalization was accomplished by dividing each spring groundwater elevation measurement  
2 by the sum of all the Spring GSE data for that well.

3 The Key Well Index was defined for each year as the average of the normalized spring  
4 groundwater data from each well. The lowest value of the Key Well Index could be considered  
5 the "historical low" within the NMMA.

6

7 **REFERENCES**

8 Department of Water Resources (DWR). 2002. Water Resources of the Arroyo Grande -  
9 Nipomo Mesa Area, Southern District Report.

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Table 1

Spring and Fall  
 Groundwater Index  
 (GWI)

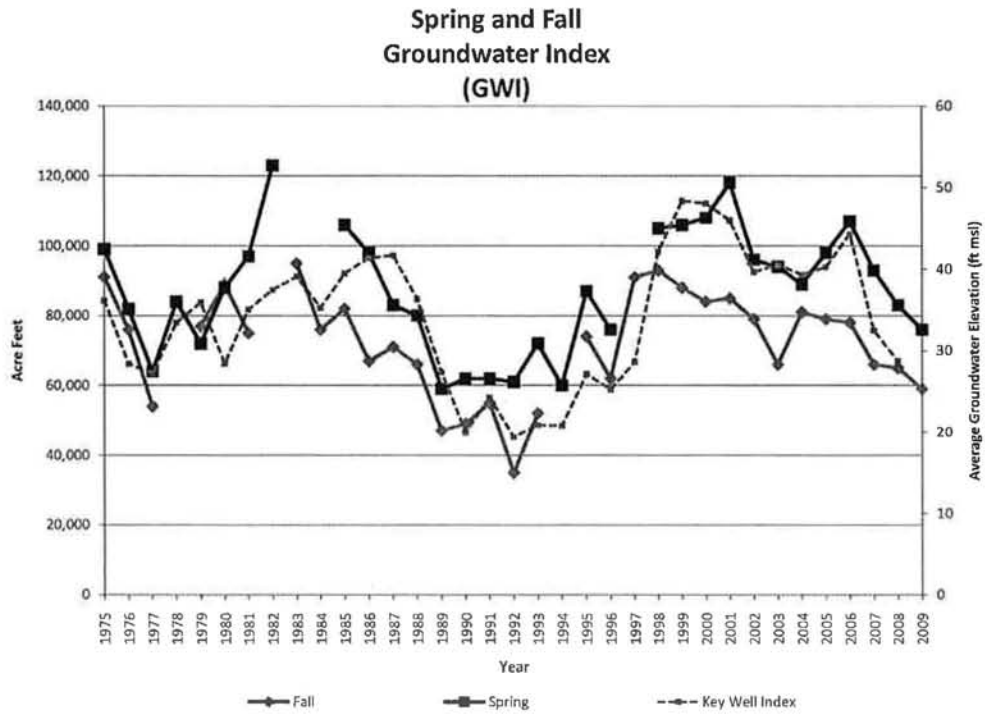
Year	Rainfall (inches)	Spring GWI (Acre-Feet)	Number of Wells	Fall GWI (Acre-Feet)	Number of Wells	Spring to Fall Difference (Acre-Feet)
1975	17.29	99,000	54	91,000	54	8,000
1976	13.45	82,000	45	76,000	65	6,000
1977	10.23	64,000	59	54,000	63	10,000
1978	30.66	84,000	62	---	35	---
1979	15.80	72,000	57	77,000	63	(5,000)
1980	16.57	88,000	55	89,000	46	(1,000)
1981	13.39	97,000	46	75,000	47	22,000
1982	18.58	123,000	42	---	31	---
1983	33.21	---	35	95,000	42	---
1984	11.22	---	14	76,000	37	---
1985	12.20	106,000	37	82,000	41	24,000
1986	16.85	98,000	51	67,000	51	31,000
1987	11.29	83,000	48	71,000	52	12,000
1988	12.66	80,000	51	66,000	49	14,000
1989	12.22	59,000	47	47,000	57	12,000
1990	7.12	62,000	55	49,000	53	13,000
1991	13.06	62,000	52	55,000	54	7,000
1992	15.66	61,000	52	35,000	48	26,000
1993	20.17	72,000	54	52,000	61	20,000
1994	12.15	60,000	54	---	36	---
1995	25.47	87,000	35	74,000	52	25,000
1996	16.54	76,000	45	62,000	57	14,000
1997	20.50	---	20	91,000	48	---
1998	33.67	105,000	41	93,000	44	12,000
1999	12.98	106,000	56	88,000	49	18,000
2000	14.47	108,000	44	84,000	41	24,000
2001	18.78	118,000	43	85,000	35	33,000
2002	8.86	96,000	29	79,000	41	17,000
2003	11.39	94,000	37	66,000	42	28,000
2004	12.57	89,000	42	81,000	35	8,000
2005	22.23	98,000	38	79,000	39	19,000
2006	20.83	107,000	44	78,000	41	29,000
2007	6.96	93,000	44	66,000	42	27,000
2008	15.18	83,000	43	65,000	42	18,000
2009	10.15	76,000	44	59,000	44	17,000

---: insufficient for evaluation

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Figure 1



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An aerial photograph of a rural landscape, likely a farm or agricultural area. A prominent yellow line is drawn across the image, tracing a path through fields and pastures. The terrain is a mix of green and brown, suggesting different types of vegetation or soil. In the background, there are some buildings and structures, possibly a farmstead or a small town. The overall scene is a typical rural setting.

# Fall 2009 Groundwater Surface Elevations and Rainfall 2009

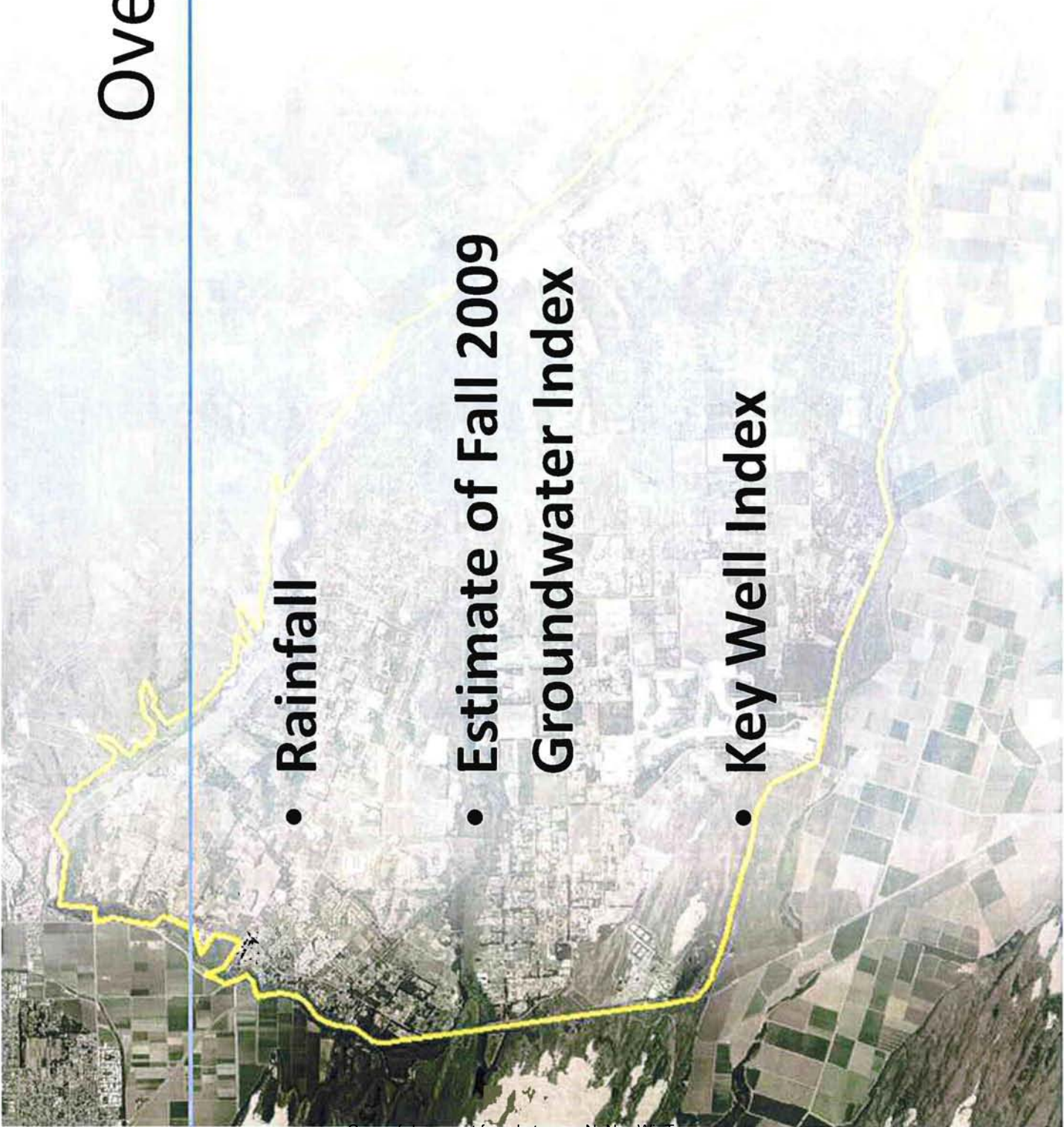
Prepared by SAIC Engineering, Inc.

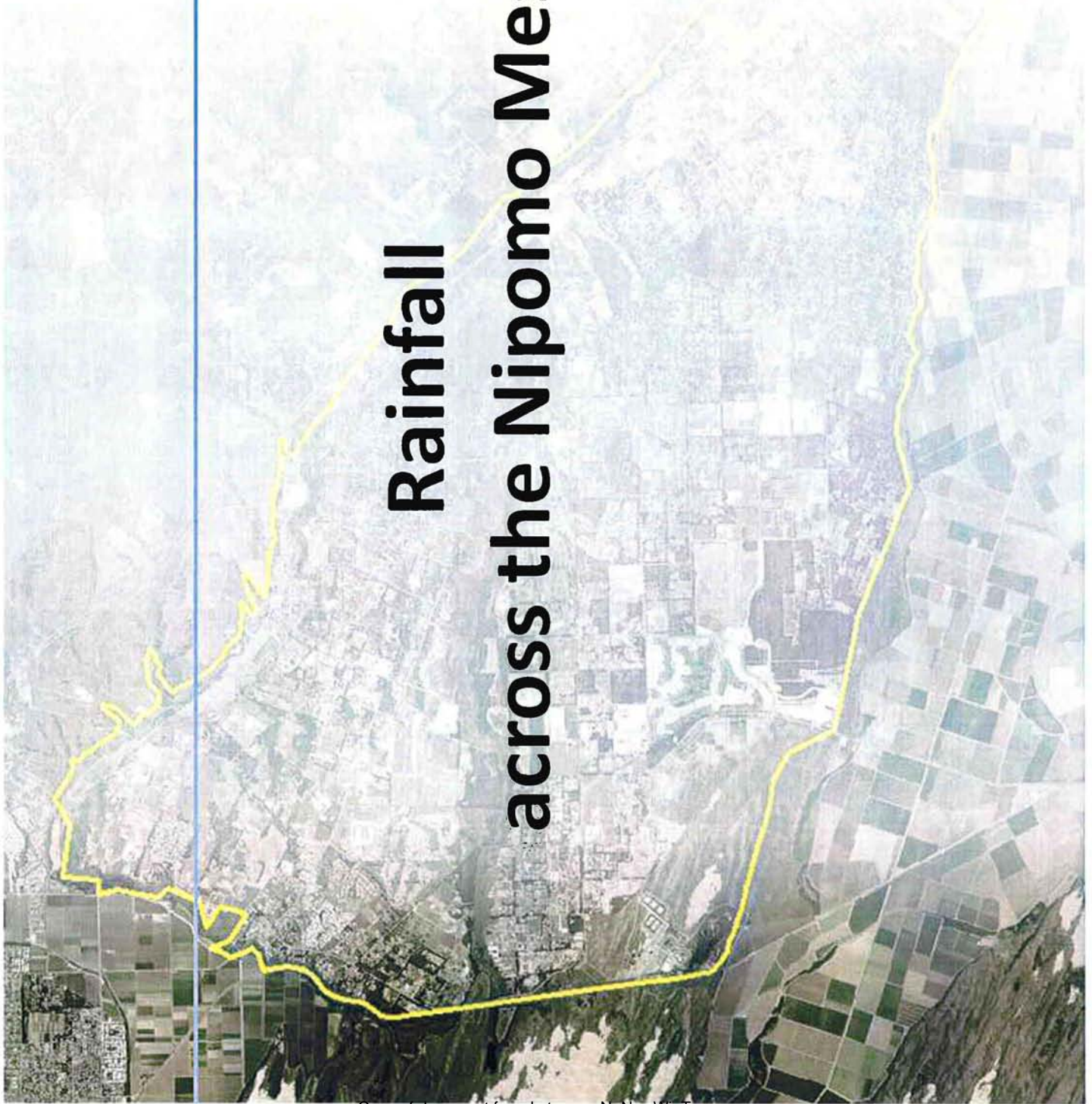
December 9 , 2009

# Overview

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- Rainfall
- Estimate of Fall 2009 Groundwater Index
- Key Well Index





# Rainfall across the Nipomo Mesa



Rainfall

# Annual Data

Historical Rainfall on the Nipomo Mesa

Water Year	Mehlschau (38)	Nipomo CDF (151.1)
1990-1991	16.47	13.18
1991-1992	18.02	15.66
1992-1993	22.2	20.17
1993-1994	13.87	12.15
1994-1995	31.47	25.87
1995-1996	18.57	16.54
1996-1997	23.38	20.5
1997-1998	39.05	33.67
1998-1999	15.53	12.98
1999-2000	19.93	
2000-2001	21.62	
2001-2002	10.25	
2002-2003	16.95	11.39
2003-2004	13.35	12.57
2004-2005	25.81	22.23
2005-2006	26.52	20.83
2006-2007	8.22	7.11
2007-2008	15.8	15.18
2008-2009	12.15	10.31
Period of Record Average	16.6	15.4

**2008-2009**

Melschau (38)

12.15 in

Nipomo CDF(151.1)

10.31 in

Copy of document found at www.NoNewWpIax.com

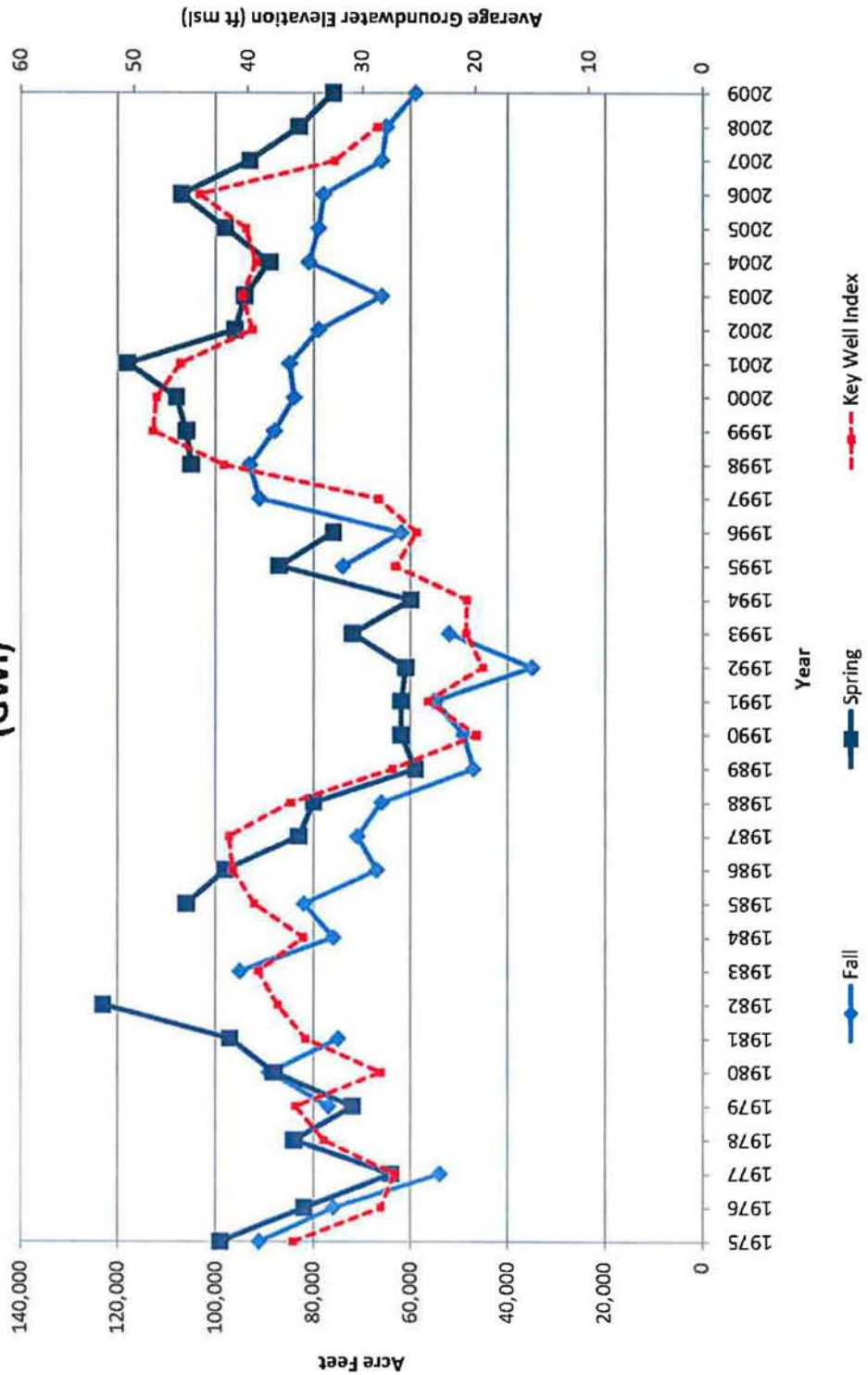
An aerial photograph of a rural landscape, likely a valley or basin, showing a mix of agricultural fields, some buildings, and a winding road or river. A prominent yellow line is drawn across the image, forming an irregular boundary that encloses a large portion of the central and right-hand side of the scene. The terrain appears to be a mix of flat and slightly elevated areas.

# Fall 2009 Groundwater Index



# GWI Estimate

Spring and Fall  
Groundwater Index  
(GWI)



Fall 2009 GWI

# GWI Estimate

Spring and Fall  
Groundwater Index  
(GWI)

Year	Rainfall (inches)	Spring GWI (Acre-Feet)	Number of Wells	Fall GWI (Acre-Feet)	Number of Wells	Spring to Fall Difference (Acre-Feet)
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Year	Rainfall (inches)	Spring GWI (Acre-Feet)	Number of Wells	Fall GWI (Acre-Feet)	Number of Wells
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1992	15.66	61,000	52	35,000	48	26,000
1993	20.17	72,000	54	52,000	61	20,000
1994	12.15	60,000	54	---	36	---
1995	25.47	87,000	35	74,000	52	25,000
1996	16.54	76,000	45	62,000	57	14,000
1997	20.50	---	27	91,000	48	---
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2003	11.39	94,000	37	66,000	42	28,000
2004	12.57	89,000	42	81,000	35	8,000
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2008	15.18	83,000	43	65,000	42	18,000
2009	10.15	76,000	44	59,000	44	17,000

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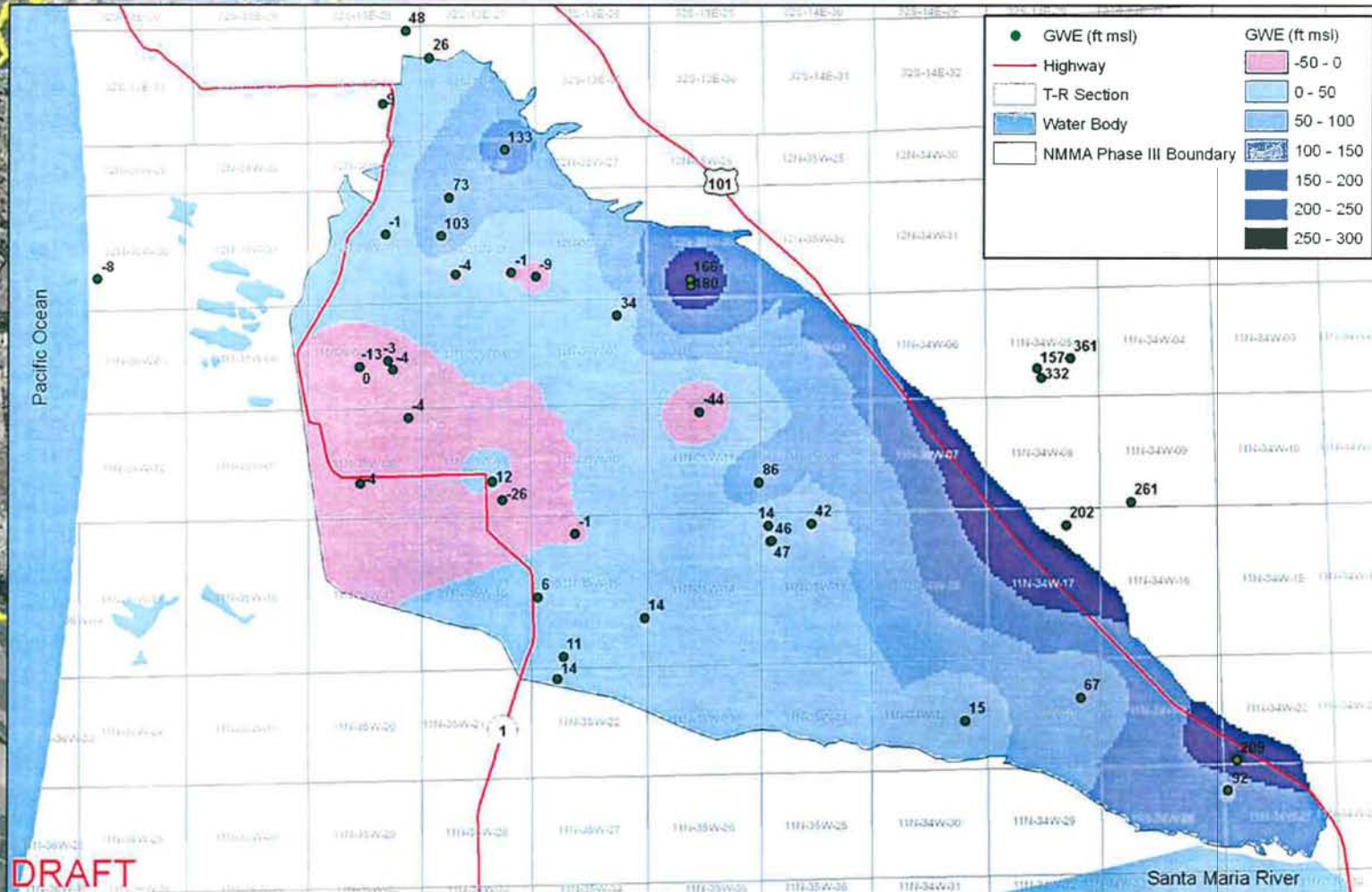
Fall 2009 GWI

# Spatial Distribution

- **Groundwater surface elevations are not uniform**
- **Lowest water levels are in the central and western portion of the Nipomo Mesa**
- **Several GWE are below sea level in the western portion of the Nipomo Mesa**

Fall 2009 GWI

# Groundwater Surface Elevation Map

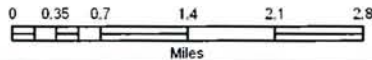


**DRAFT**

**NOTES:**  
 GWE: groundwater surface elevation  
 ft msl: feet above mean sea level  
 Coordinate System: UTM Zone 10N  
 Horizontal Datum: NAD 83



Fall 2007  
 Groundwater Surface Elevations



**SAIC**  
 From Science to Solutions

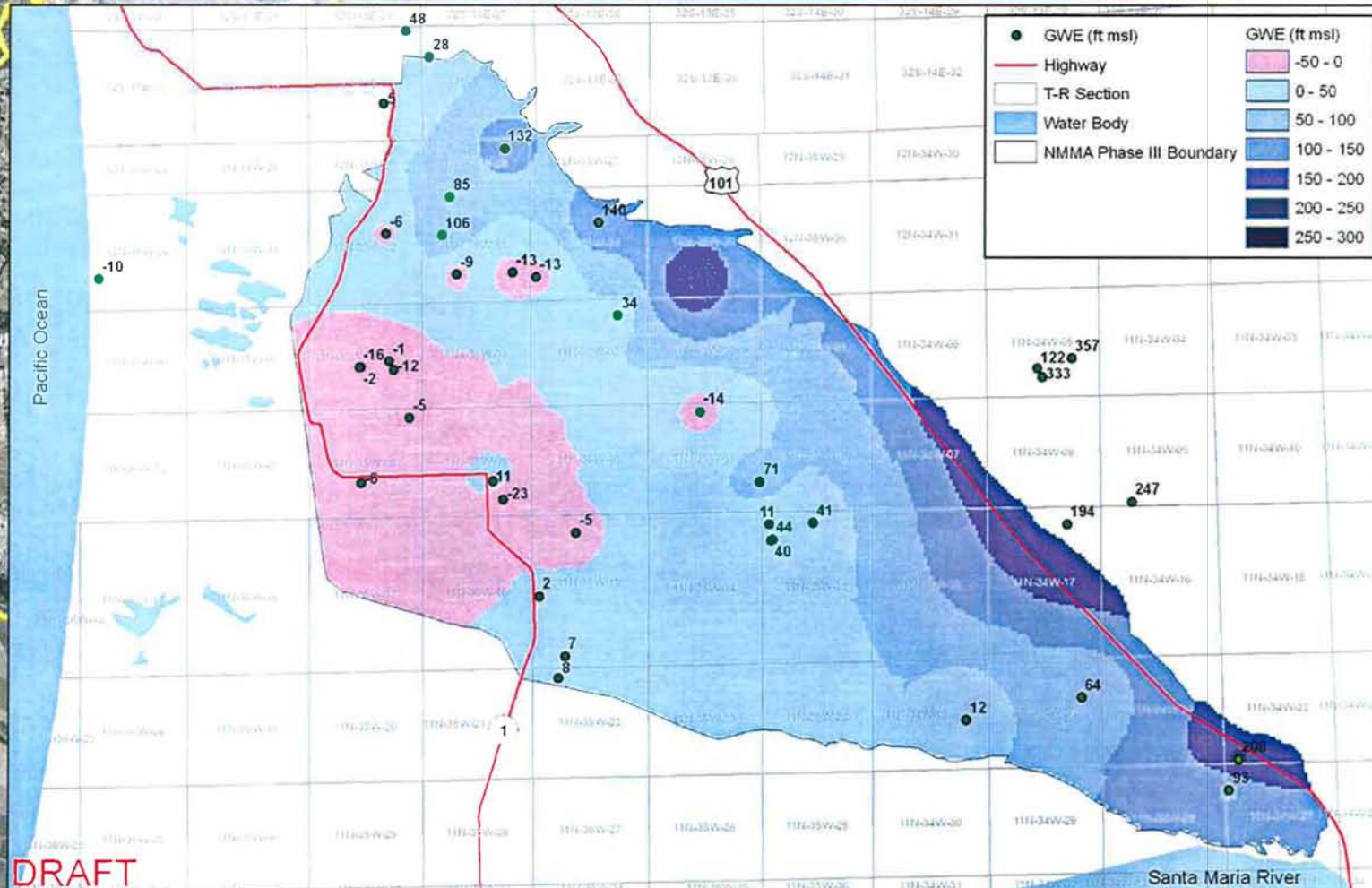
DATE 11/19/09

By J. Degler

FIGURE

Fall 2009 GWI

# Groundwater Surface Elevation Map

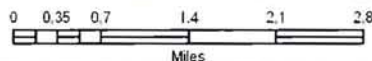


**DRAFT**

**NOTES:**  
 GWE: groundwater surface elevation  
 ft msl: feet above mean sea level  
 Coordinate System: UTM Zone 10N  
 Horizontal Datum: NAD 83



Fall 2008  
 Groundwater Surface Elevations

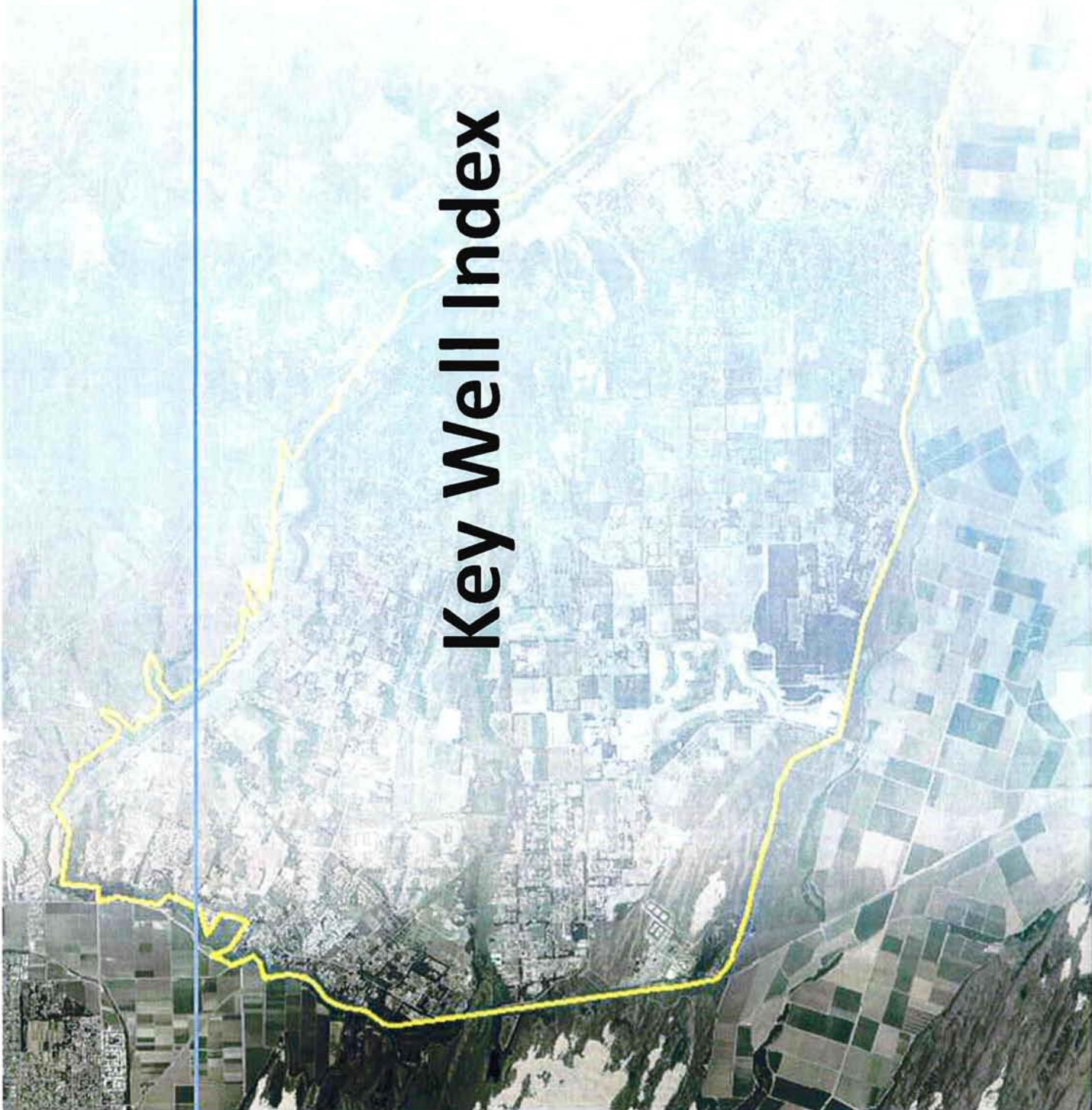


DATE: 11/19/09 BY: J. Digray

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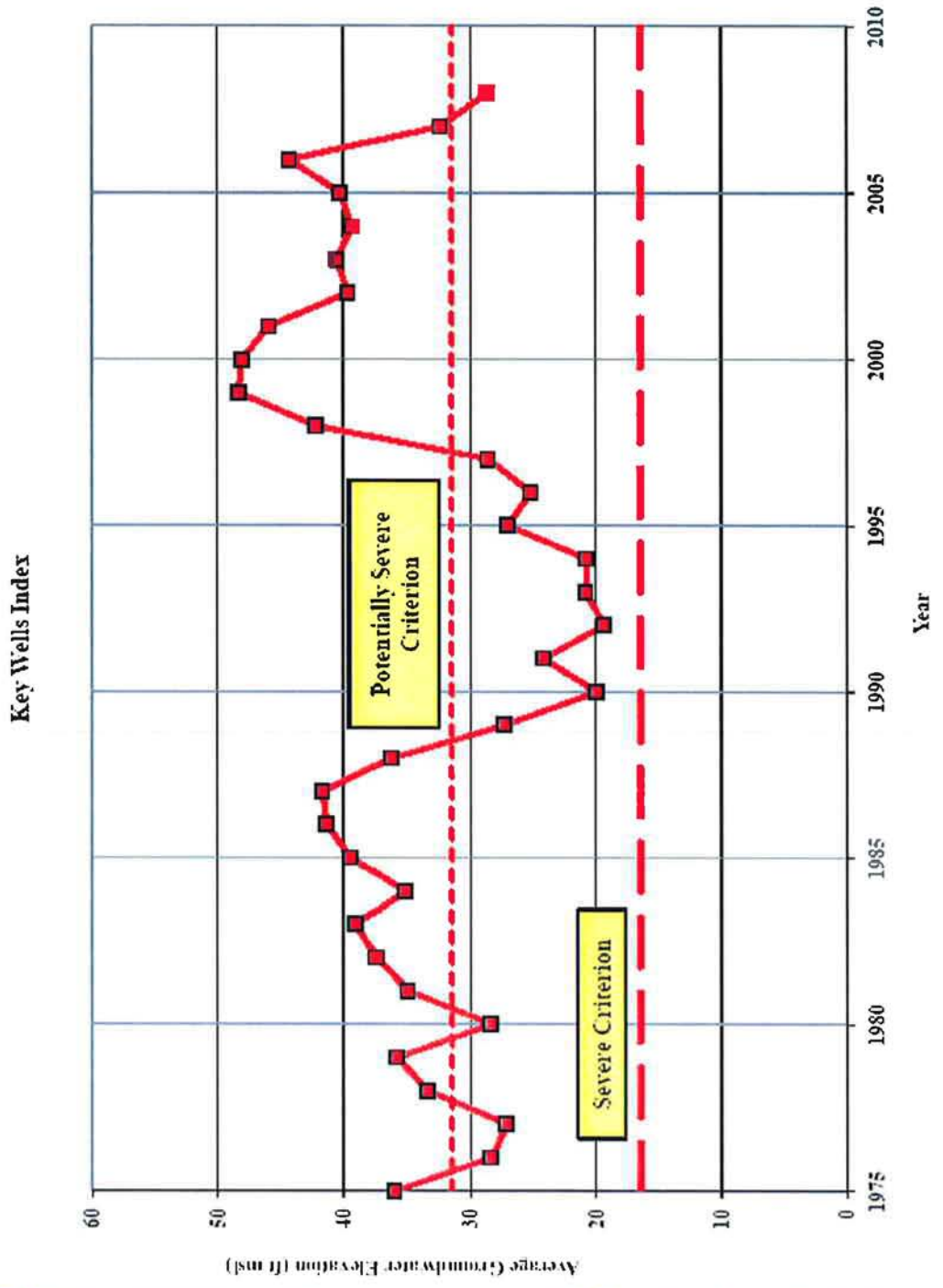




# Key Well Index

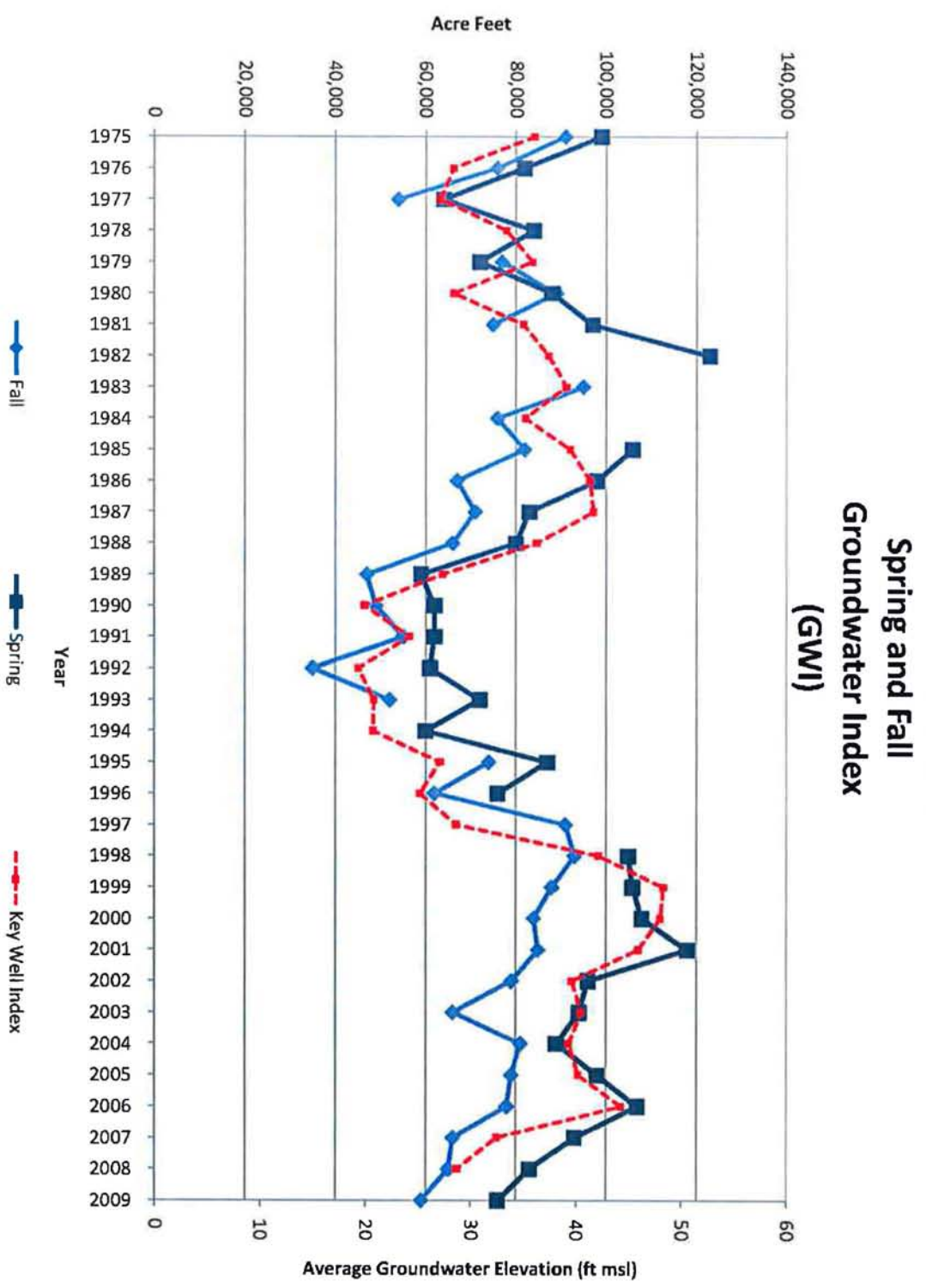
Fall 2009 GWI

# Key Well Index



Fall 2009 GWI

# Key Well Index

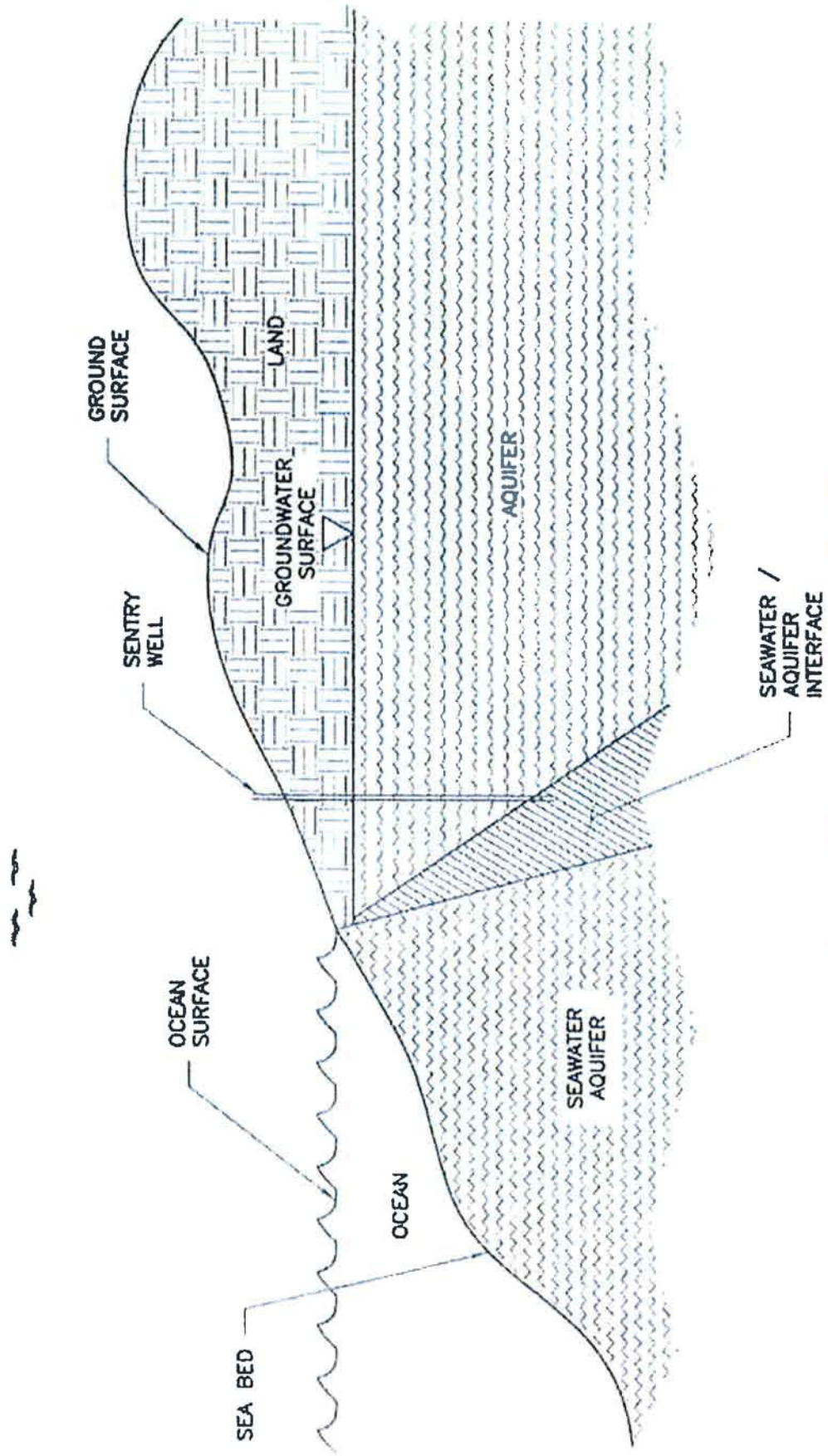


An aerial photograph of a coastal region, likely in Massachusetts, showing a mix of urban development, agricultural fields, and natural terrain. A yellow line traces a boundary around a central area, and a blue vertical line is positioned on the left side of the image. The text 'COASTAL SENTRY WELL MONITORING' is overlaid in the center.




# COASTAL SENTRY WELL MONITORING







# SENTRY WELLS

-  Coastal Monitoring Wells
-  Management Areas
-  Highway

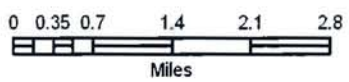
- 32S/12E-24B1,2,3
- 32S/13E-30F1,2,3
- 32S/13E-30N1,2,3
- 12N/36W-36L1,2
- 11N/36W-12C1,2,3
- 11N/36W-35J1,2,3,4,5

Copy of document found at www.NONewWPItax.com

**NOTES:**  
 GWE: groundwater surface elevation  
 ft msl: feet above mean sea level  
 Coordinate System: UTM Zone 10N  
 Horizontal Datum: NAD 83



## Coastal Monitoring Wells



DATE: 12/3/09 | BY: J. Degner

FIGURE

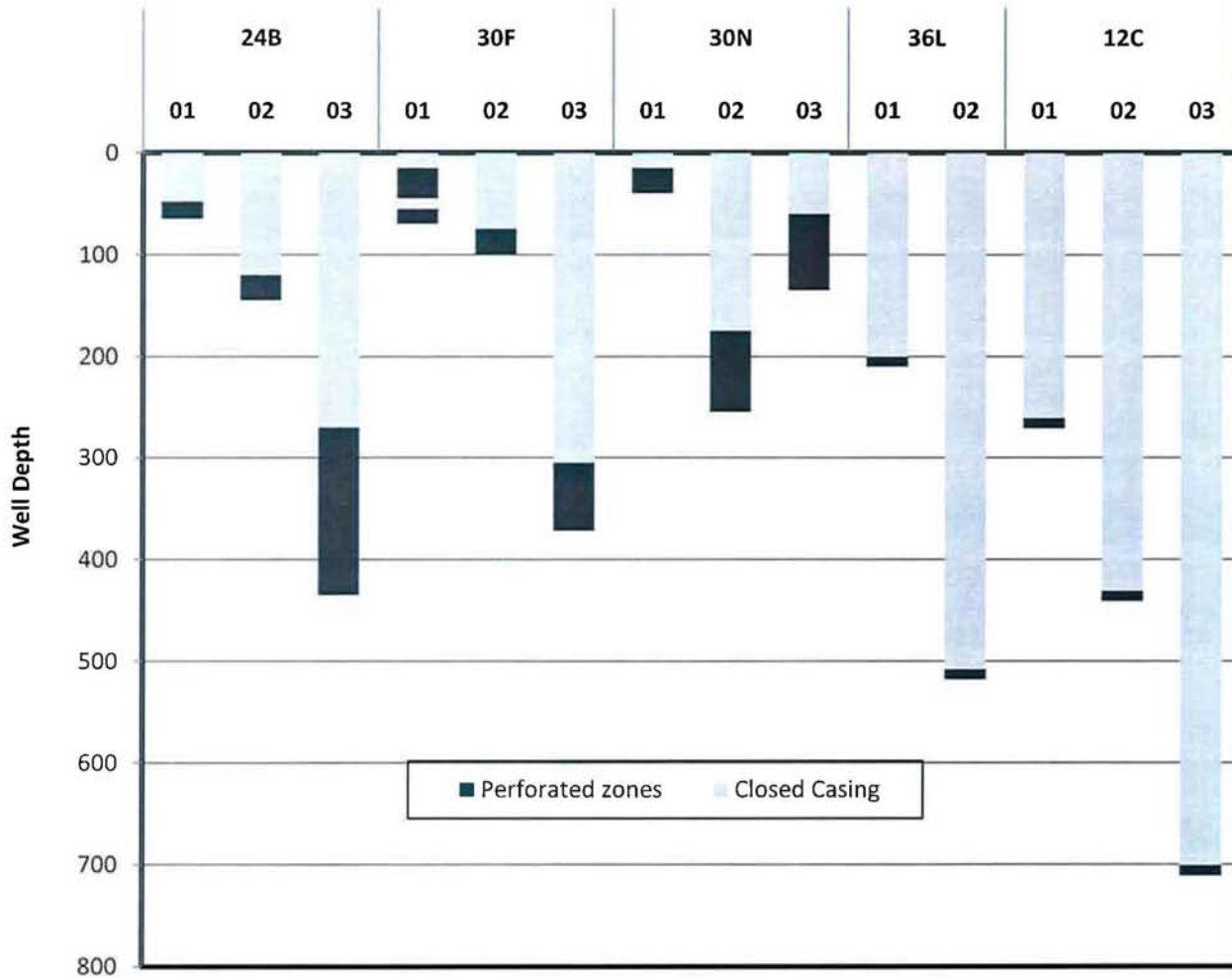


# SENTRY WELLS

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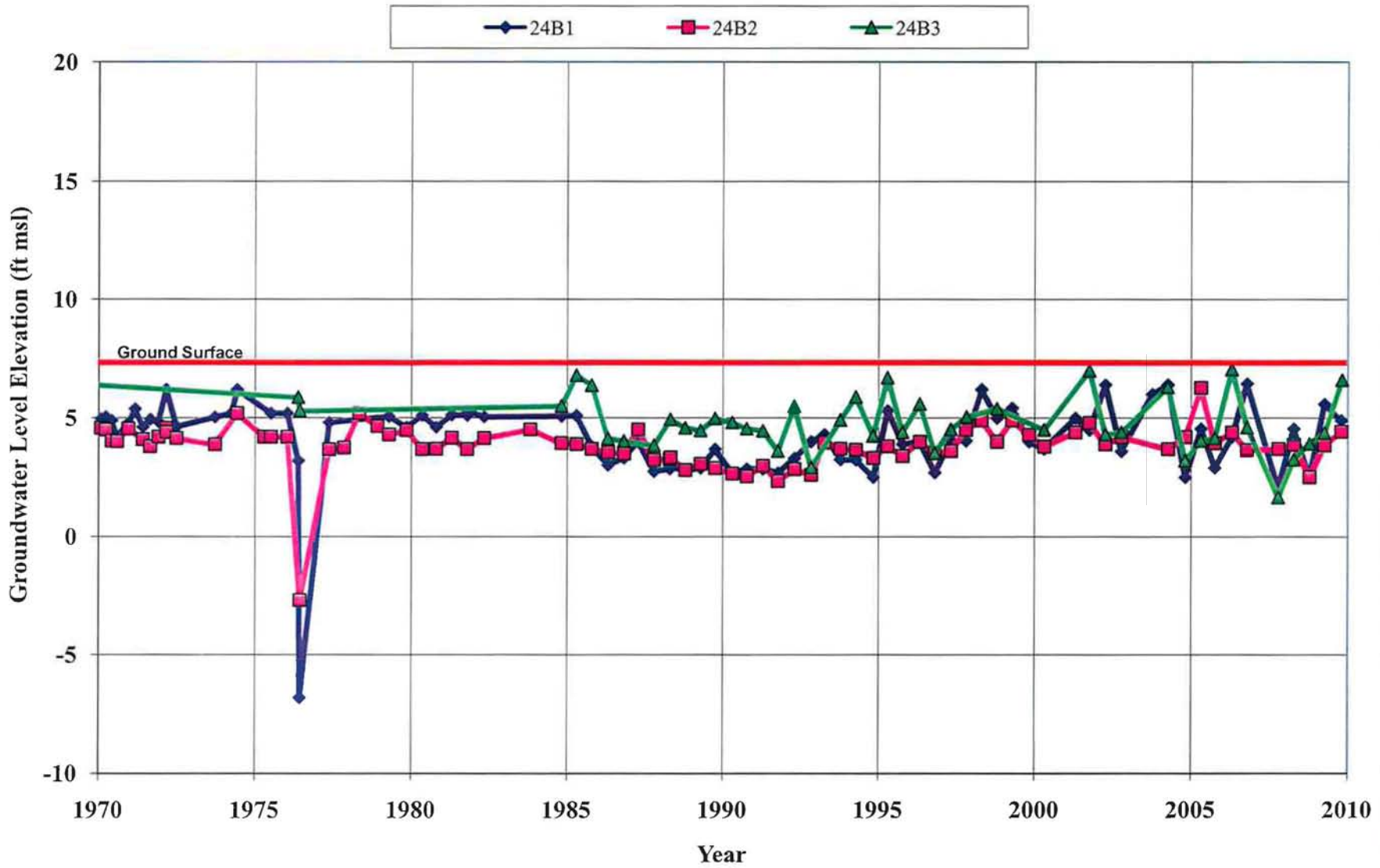


Coastal Monitoring Wells



# SENTRY WELLS

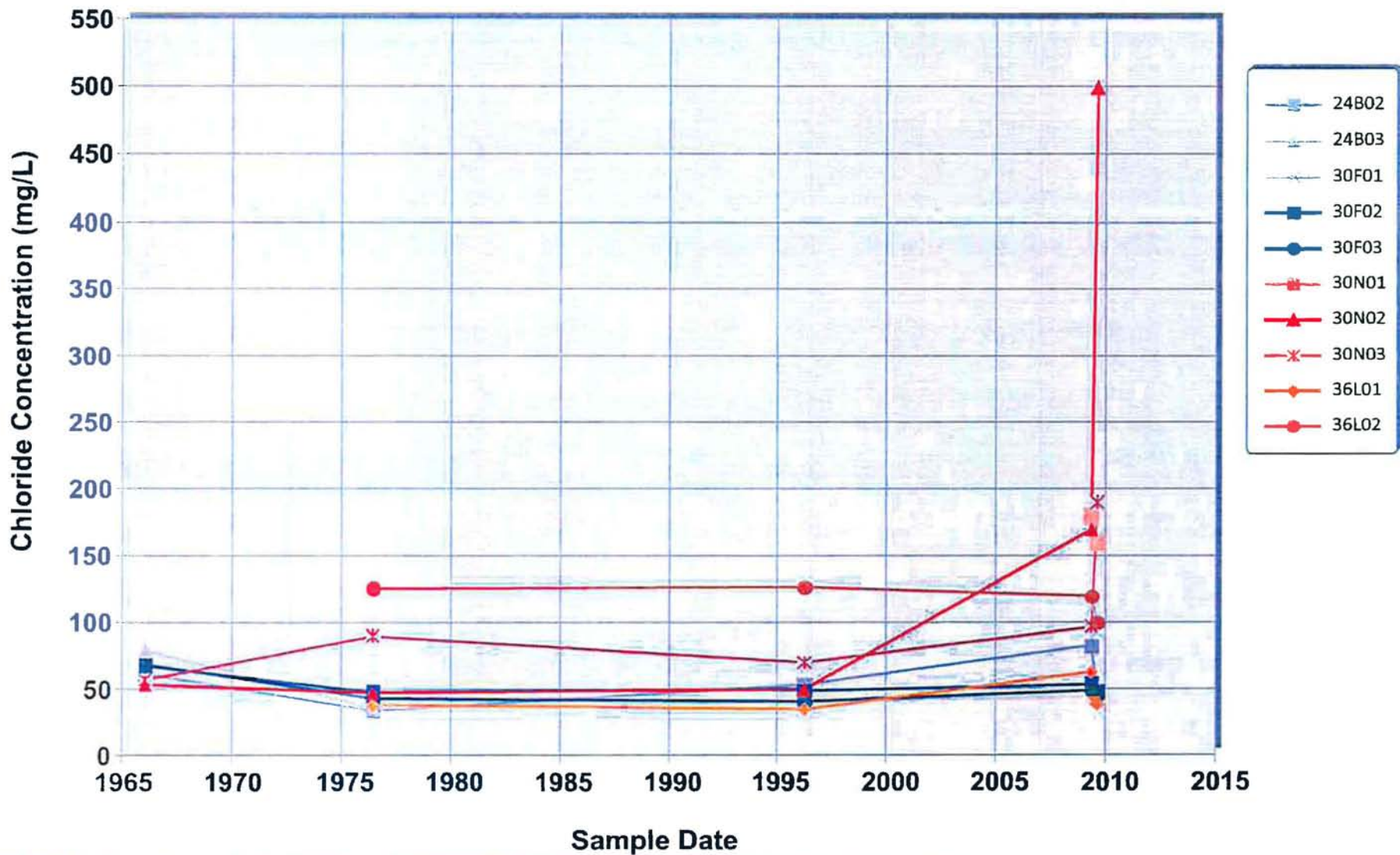
## Water Level Elevation -- Coastal Monitoring Wells 32S/12E-24B



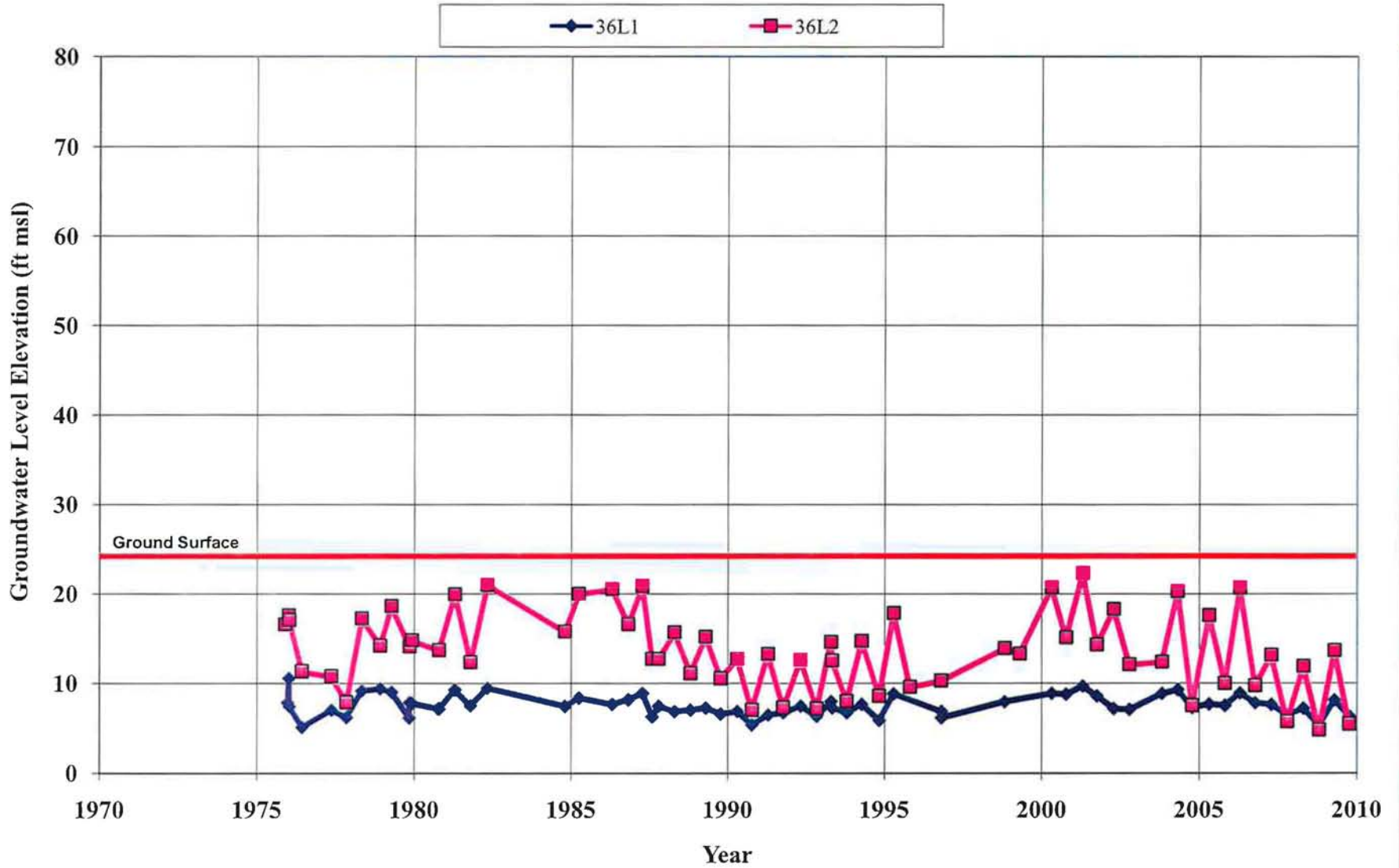
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# SENTRY WELLS

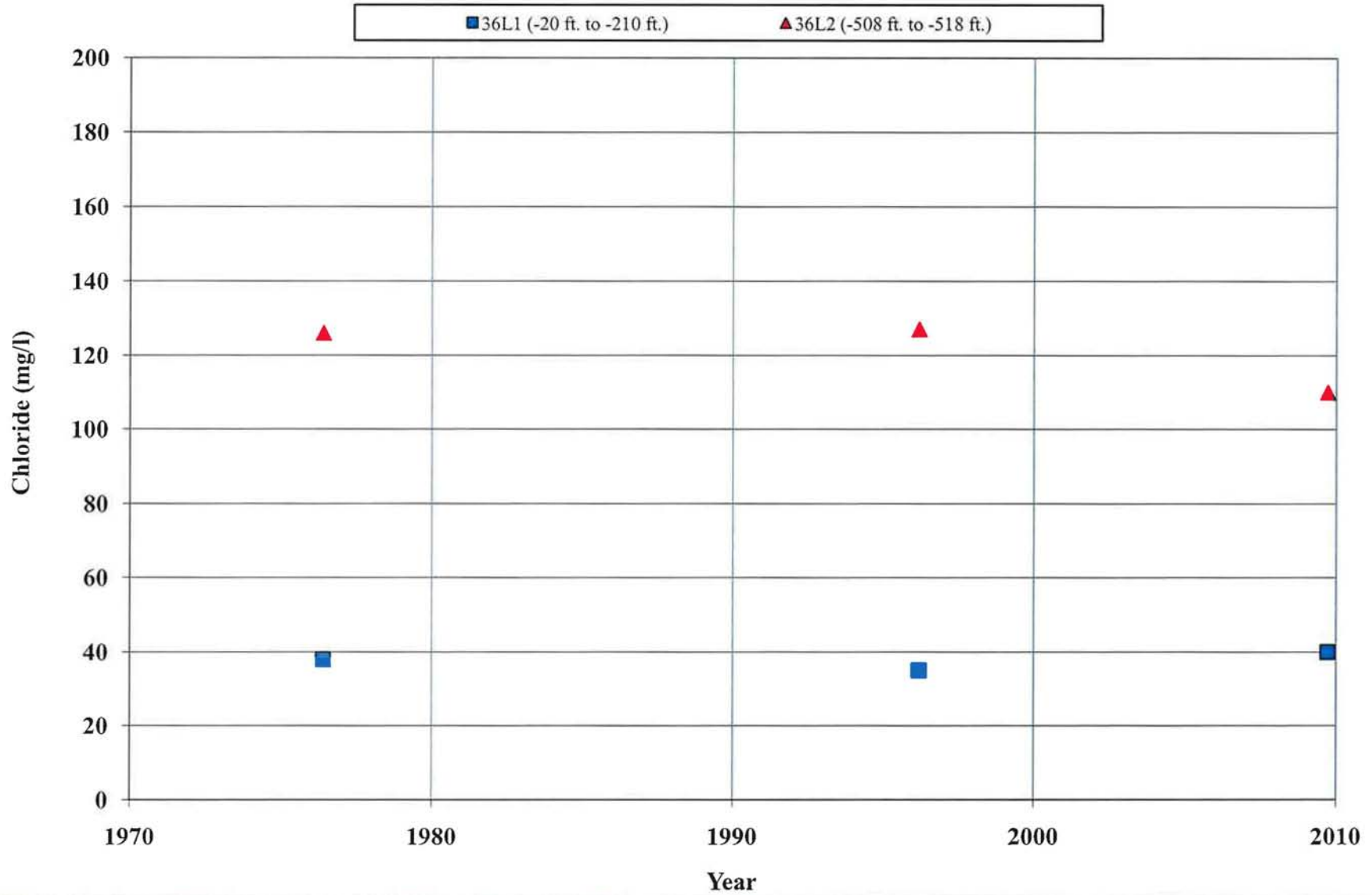
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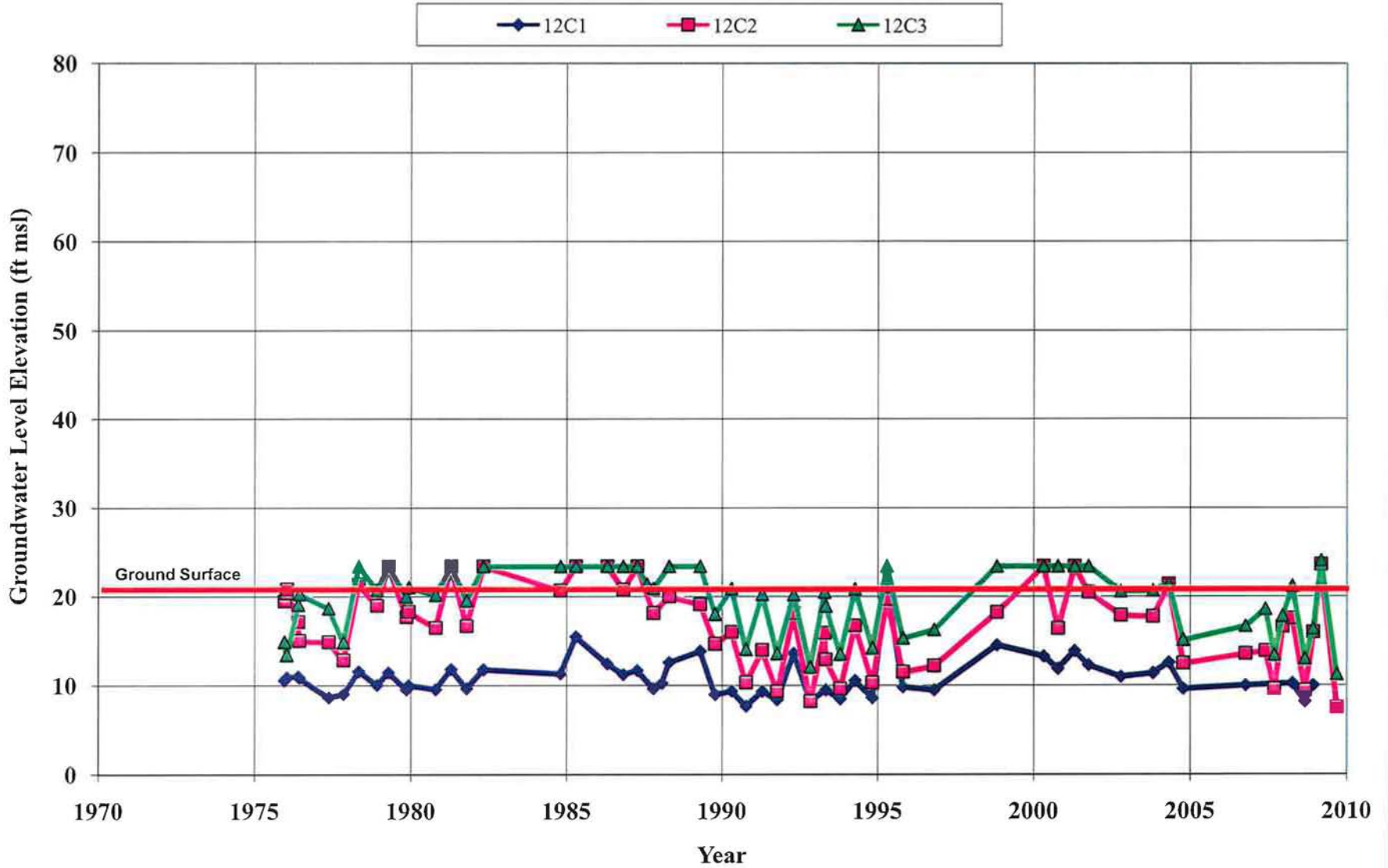
Water Level Elevation -- Coastal Monitoring Wells 12N/36W-36L



Chloride Concentrations for Coastal Monitoring Wells 12N/36W-36L1, -36L2

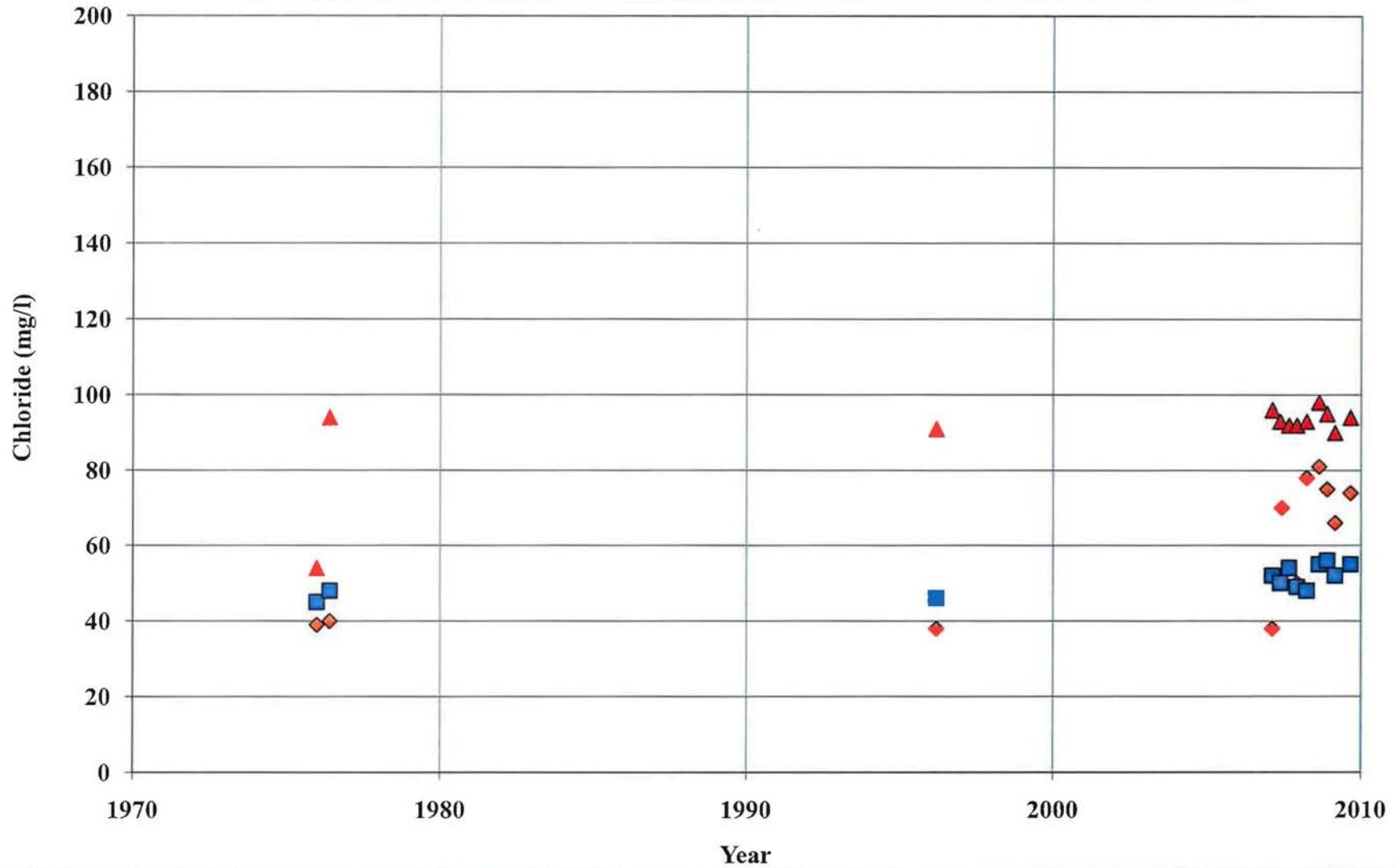


Water Level Elevation -- Coastal Monitoring Wells 11N/36W-12C



Chloride Concentrations for Coastal Monitoring Wells 11N/36W-12C1, -12C2, -12C3

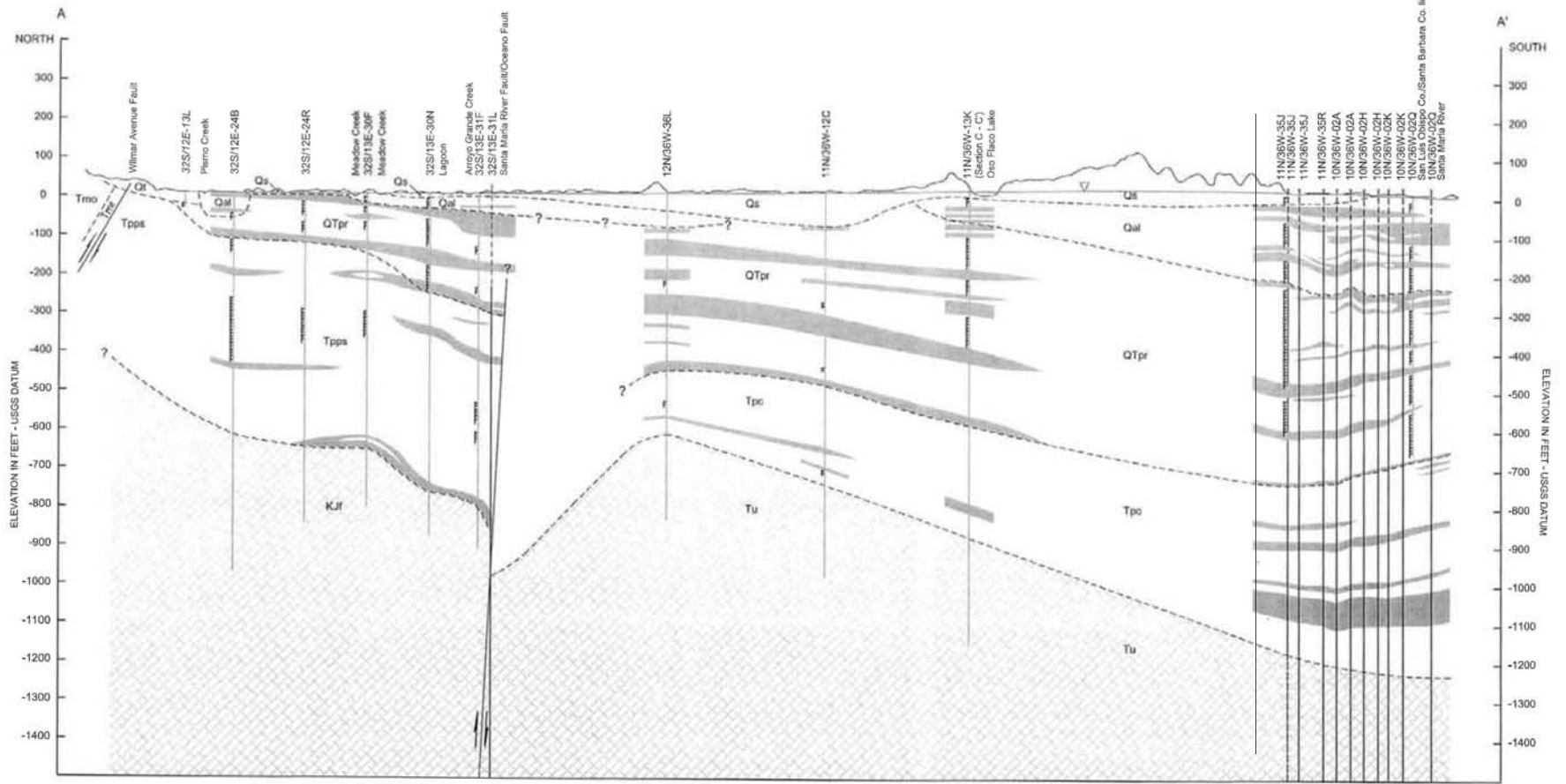
◆ 12C1 (-261 ft. to -271 ft.)    ■ 12C2 (-431 ft. to -441 ft.)    ▲ 12C3 (-701 ft. to -711 ft.)



An aerial photograph of a rural landscape, likely a valley or a small town. The terrain is a mix of green fields, brownish-grey patches, and some buildings. A prominent yellow line is drawn across the image, forming an irregular boundary that encloses a large portion of the central and right-hand side of the scene. The word "QUESTIONS?" is written vertically in large, bold, black capital letters across the center of the image, overlapping the yellow boundary.

# QUESTIONS?





**EXPLANATION**

Formation and Symbol	
Qs	Dune Sand
Qal	Alluvial Deposits
Qt	Terrace Deposits
QTpr	Paso Robles Formation
Tpc	Careaga Formation
Tpps	Squire Member, Plismo Formation
Tmo	Obispo Formation
Tmr	Rincon Formation
Tu	Undifferentiated Tertiary Deposits
KJf	Franciscan Complex

12N/36W-36L	Water well with electric and geologic log
32S/12E-13L	Water well with geologic log
10N/36W-02G	Oil well with electric log, dashed above record

Hydrogeologic Unit	
[Symbol]	Unconsolidated to weakly cemented clayey silt to silty clay with minor sand and gravel
[Symbol]	Unconsolidated to weakly cemented sand, gravel, silt, sandstone with minor clay and silty clay
[Symbol]	Bedrock

[Symbol]	Perforated Interval
[Symbol]	Fault, arrows indicate relative vertical movement
[Symbol]	Unconformity
[Symbol]	Contact
[Symbol]	1995 Groundwater Elevation

Note: References include: Department of Water Resources, 1970; Buchanan-Banks et al., 1978; Hall, 1981; Nitchman, 1988; Manson et al., 1994; Lettis et al., 1994.  
 Location of geologic section shown on Plate 2  
 Vertical scale 20 times horizontal scale  
 Horizontal scale in feet  
 4000 0 4000

**WATER RESOURCES OF THE ARROYO GRANDE - NIPOMO MESA AREA**



**PLATE 3**

**GEOLOGIC SECTION A - A'**