TO: BOARD OF DIRECTORS

FROM: BRUCE BUEL

DATE: MARCH 21, 2008

AGENDA ITEM
C-1
MAR 26, 2008

SAIC PRESENTATIONS

ITEM

Dr. Brad Newton of SAIC presentations re Fall Groundwater Storage Volumes and Inter-Basin Transfers [NO ACTION REQUESTED].

BACKGROUND

Dr. Brad Newton of SAIC is scheduled to present the two attached memorandums and will be available to answer questions at the direction of the Board.

RECOMMENDATION

Staff recommends that your Honorable Board receive the presentations and ask questions as appropriate.

ATTACHMENTS

- Fall Groundwater Storage Memorandum
- Inter-Basin Transfer Memorandum

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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
WATER RESOURCES ENGINEERING - CARPINTERIA

TO: Bruce Buel, General Manager Nipomo Community Services District

FROM: Joel Degner, Drew Beckwith, Alex Pappas, Brad Newton, Ph.D., P.G.

RE: Spring and Fall Groundwater in Storage above Mean Sea Level 1975 - 2007

DATE: March 20, 2008

INTRODUCTION

Groundwater surface elevations (GSE) underlying the Nipomo Mesa are regularly measured at many places (wells) across the mesa. Hydrographs from individual wells provide a temporal record of the GSE measurements at one location. GSE increase and decrease in response to recharge from rainfall, discharge from production, and the balance of natural subsurface flows at that place. Fluctuations in GSE vary across the mesa and make it difficult to assess the regional trend in GSE. Integrating GSE measurements made at one time across the mesa and computing groundwater in storage above mean sea level (GWS) provides a metric to understand the available water for production under the Nipomo Mesa and accounts for disparate trends between wells.

The potential for sea water intrusion to the principal production aquifer is of paramount concern to water supply managers and to all residents who rely on the local groundwater for their supply. The balance between the volume of fresh water under the mesa and the flow of fresh water to the ocean sufficient to prevent sea water intrusion to the principal production aquifer is not currently well understood. However, historical annual GWS estimates for Spring and Fall along with measurements of water quality and GSE collected at the sea water intrusion sentinel wells provide meaningful insights to manage levels of GWS so to guard against permanent degradation that would occur if sea water was to intrude the principal production aquifer.

Presented herein are estimates of historical annual variability in GWS from 1975 to 2007 based on groundwater surface elevation measurements collected during Spring and Fall across the Nipomo Mesa. Limited measurements of GSE were available for the years 1982, 1983, 1984, 1994 and 1997, thus precluding a reliable estimate of GWS for those years.

RESULTS

Overall, the Spring GWS is slightly lower (6,000 AF) in 2007 as compared to 1975, whereas the Fall GWS is much lower (25,000 AF) in 2007 as compared to 1975 (Table 1). Historic GWS ranges from 120,000 AF to 60,000 AF annually during the Spring, and from 95,000 AF to 35,000 AF annually during the Fall (Figure 1). The Spring and Fall hydrographs increase and decrease concurrently with decadal periods of wet and dry climatic conditions. Two periods of increased GWS are marked by maximums occurring in 1982 and 2001. One period of decreased GWS is marked by a minimum occurring in 1992. Substantial reductions in the GWS occurred during

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the historical periods from 1976 to 1980 and from 1987 to 1996. The recovery from these historical lows in GWS occurred over time scales on the order of five years. The one year change in GWS has been as large as 10,000 AF, and is typically on the order of 5,000 AF or less (Table 1).

Seasonal difference in GWS has generally increased from 1975 to 2007 (Figure 1). The data is scattered about the linear trend line; nonetheless, the trend is likely real and continues to increase. This observation is may be related to the increase in consumptive use (Technical Memorandum dated January 7, 2008, and presented at Public Workshop dated January 30, 2008). Consumptive use directly impacts the difference between Spring and Fall estimates because typically no recharge to the GWS occurs during the period from Spring to Fall and the greatest production of water from the principal aquifer occurs from Spring to Fall. However, the Spring GWS increase from Fall GWS is expected to be on average consistent with the recharge from rainfall and thus Spring GWS are expected to parallel the Fall GWS values. The departure from the parallel tracking over the longer multiple year period is not currently understood, and may be in response to increased subsurface flow from the steeper hydraulic gradient occurring with the low Fall GWS. Variations in pumping patterns across the mesa may also contribute to the departure of Spring to Fall GWS values where the GSE measurement of an individual monitoring location may exaggerate or diminish the GWS estimates over time.

METHODOLOGY

The annual estimates of Spring and Fall GWS from 1975 to 2007 are based on GSE measurements regularly made by San Luis Obispo County Department of Public Works (SLO DPW), NCSD, USGS, and Woodlands. The integration of GSE data is accomplished by using computer software to interpolate between measurements and calculate the GWS within the principal production aquifer, to ensure a consistent methodology is used, and to produces a repeatable and therefore comparable metric of the water supply available to the Nipomo Mesa. Limited measurements of GSE were available for the years 1982, 1983, 1984, 1994 and 1997, thus precluding a reliable estimate of GWS for those years.

The amount of GWS under the Nipomo Mesa Management Area (NMMA) was computed by multiplying the saturated volume above sea level with the aerially weighted specific yield (DWR, 2002), excluding bedrock (Figure 11: Base of Potential Water-Bearing Sediments, presented in the report, Water Resources of the Arroyo Grande - Nipomo Mesa Area [DWR 2002]). The amount of GWS under the NMMA was constrained to the boundary determined in Phase III of the trial. Limited data exist in the additional area included in the Phase V boundary, west of the Phase III boundary.

Data provided by DWR, consisting of well completion reports, lithographic logs, electronic logs, and pump tests, were used to develop an understanding of the hydrogeologic conditions underlying the NMMA. A systematic review of these data pertaining to wells used for storage calculations was conducted in order to verify that each well's screened interval is within the principal production aquifer (Paso Robles Formation). Groundwater surface elevation measurements that do not represent water in the Paso Robles Formation were not included in the calculations.

Groundwater Surface Elevation Measurements

Groundwater surface elevation data were obtained from the San Luis Obispo County Department of Public Works (SLO DPW), NCSD, USGS, and Woodlands (Table 2). SLO DPW measures GSE in monitoring wells during the spring and the fall of each year. Woodlands and NCSD measures GSE in their monitoring wells monthly. For the years 1975 to 1999, available representative GSE data were used to estimate GWS. For the years 2000 to 2007, only GSE data from wells in the proposed Hydrologic Monitoring Program (HMP) were used to estimate GWS.

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

Groundwater Surface Interpolation

The individual GSE measurements from each year were considered to produce a GSE field by interpolation using the inverse distance weighting (IDW) method. In the IDW method, the GSE field values are computed by from the value, weighted by the distance, of adjacent GSE measurements. The interpolation is based on GSE data alone, and does not incorporate structural geology that may or may not influence the groundwater surface elevations. In places where a groundwater well has a large areal influence, a small change in GSE can produce a proportionally large change in the estimate of GWS.

Groundwater Volume Estimate

The amount of groundwater in storage under the mesa was estimated for the boundary determined in Phase III of the trial. The GWS was estimated by subtracting both the mean sea level surface (elevation equals zero) and the volume of bedrock above sea level from the saturated volume (Table 1). The bedrock surface elevation is based on Figure 11: Base of Potential Water-Bearing Sediments, presented in the report, Water Resources of the Arroyo Grande - Nipomo Mesa Area (DWR 2002). The bedrock surface elevation was preliminarily verified by reviewing driller reports obtained from DWR. The saturated volume above sea level was multiplied by the specific yield of 11.7% to estimate the recoverable amount of GWS. The specific yield was based on the average weighted specific yield for the Nipomo Mesa Hydrologic Sub-Area (DWR 2002, pg. 86).

REFERENCES

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

Spring and Fall
Groundwater in Storage Above Mean Sea Level
for Phase III Boundary

Year	Rainfall (inches)	Spring GWS (Acre-Feet)	Number of Wells	Fall GWS (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	15.8	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	12.2	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	62,000	52	25,000
1996	16.54	76,000	45	62,000	57	14,000
1997	20.5	---	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	6.92	93,000	44	66,000	42	27,000

--- Insufficient data for evaluation

Table 1

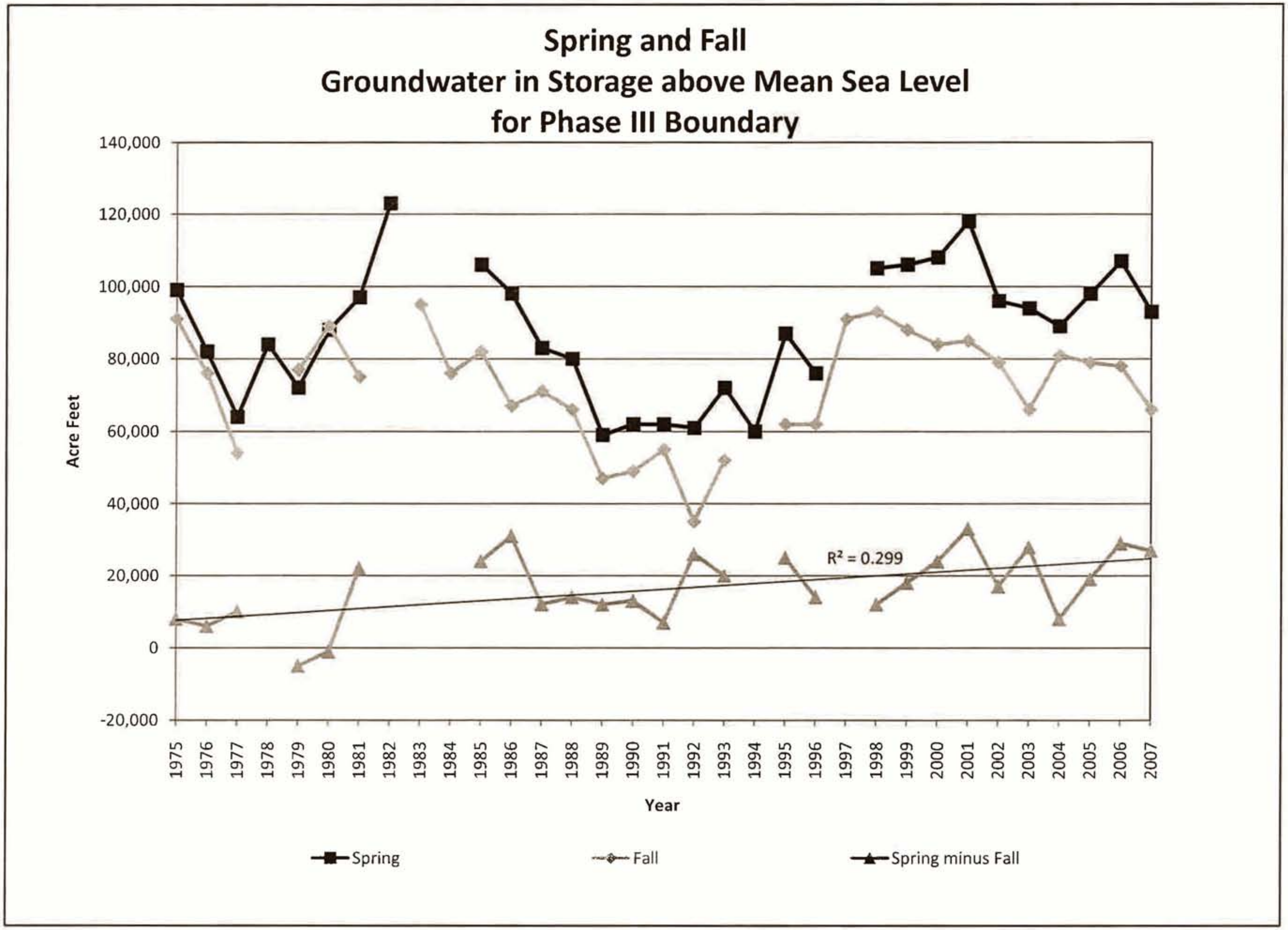
Spring and Fall
Groundwater in Storage above Mean Sea Level
for Phase III Boundary
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-20,000
Acre Feet
R² = 0.299
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
Spring
Fall
Spring minus Fall

Figure 1

Table 2. Groundwater surface elevation data in feet above mean sea level

State Well ID	Latitude	Longitude	1975		1976		1977		1978		1979		1980		1981		1982		1983		1984		1985		1986		1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		2005		2006		2007	
			S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F
11N34W05J01S	35.0604	-120.4757	371	-	-	-	296	-	347	-	-	-	366	-	-	-	-	-	-	-	-	-	361	-	-	-	-	-	-	-	-	-	325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	369	366	370	359	-	-	-	307	363	358	368	334	373	331	359	361
11N34W05K01S	35.0580	-120.4803	-	-	-	-	-	-	-	-	-	-	341	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	329	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	340	336	343	333	337	330	336	320	331	329	338	335	339	337	335	332
11N34W05K02S	35.0592	-120.4810	-	339	316	303	-	239	-	294	323	261	289	-	-	-	276	257	-	-	-	-	-	-	273	249	267	240	247	218	220	208	208	-	203	156	198	136	221	181	197	-	-	281	-	268	-	277	352	313	314	276	304	257	322	267	-	192	-	242	-	-	-	214	293	250	253	157
11N34W06L01S	35.0616	-120.5011	-	-	-	-	264	-	281	-	-	-	-	-	-	-	-	-	140	198	-	-	233	-	-	-	-	-	-	-	-	132	158	127	136	111	157	61	169	88	-	-	185	-	-	101	-	162	181	-	-	-	207	-	260	-	-	-	-	146	187	-	-	-	213	80	202	-
11N34W09P01S	35.0417	-120.4667	301	292	-	274	78	-	79	281	-	277	295	293	301	-	300	-	315	-	-	276	281	264	288	-	286	259	278	253	267	247	-	-	251	246	258	-	276	-	278	-	-	295	305	297	-	299	322	-	305	-	306	-	308	-	-	279	305	-	-	-	283	272	288	-	285	261
11N34W17B04S	35.0389	-120.4769	282	278	276	270	-	254	-	275	280	274	282	277	280	272	280	272	288	282	281	273	271	269	262	249	251	246	245	240	229	208	-	214	209	212	227	210	239	235	245	240	272	272	280	275	-	278	-	280	282	275	281	259	276	248	-	223	225	186	214	203	258	237	264	247	253	203
11N34W18P01S	35.0303	-120.4993	83	72	75	80	16	79	24	-	80	79	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W18P02S	35.0297	-120.4971	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W19Q01S	35.0138	-120.4935	28	28	(3)	13	159	8	159	27	27	18	28	21	36	20	37	29	35	-	-	31	46	23	45	32	43	23	31	14	14	11	14	4	14	(13)	11	(11)	12	2	17	-	-	7	30	4	25	13	48	32	61	37	55	32	53	30	42	24	41	19	40	14	35	18	46	21	29	15
11N34W20J02S	35.0164	-120.4753	-	-	-	-	99	-	98	-	-	-	-	-	-	-	-	-	-	-	84	91	-	-	83	78	84	79	81	79	71	56	75	72	71	68	68	-	96	63	66	-	-	66	78	56	-	-	-	-	68	-	77	-	71	-	-	73	73	69	73	69	71	71	73	72	70	67
11N34W27D01S	35.0078	-120.4510	158	150	158	159	-	159	150	156	161	162	162	163	164	163	164	-	164	165	169	169	169	168	168	167	168	166	159	164	154	162	161	160	159	159	159	156	160	157	155	-	-	162	-	164	-	166	168	170	173	175	181	179	180	-	182	190	185	197	201	203	204	206	206	209	208	209
11N34W27E01S	35.0039	-120.4525	102	-	101	99	-	95	-	95	91	100	98	102	105	103	-	-	104	104	111	98	-	100	112	110	111	99	95	91	92	99	98	95	91	90	94	89	92	91	87	91	94	96	93	98	-	-	-	105	115	110	107	103	115	109	104	107	105	91	89	89	75	90	82	97	101	92
11N34W27P01S	35.0021	-120.4462	162	162	-	159	54	-	85	161	-	165	163	172	179	168	-	-	185	185	-	-	-	-	182	182	179	183	174	177	168	-	-	162	159	159	-	159	158	158	161	-	-	165	168	172	-	177	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W29Q02S	34.9974	-120.4801	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-	75	63	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W29R01S	34.9994	-120.4734	72	70	-	58	32	-	41	75	80	82	-	-	96	89	89	-	-	157	-	-	-	-	108	97	-	-	-	-	76	67	64	-	-	-	64	25	-	-	-	-	-	-	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W29R02S	34.9994	-120.4764	68	-	-	-	45	-	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	-	-	111	118	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W30D02S	35.0091	-120.5024	46	37	39	33	-	15	-	34	44	36	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W30Q01S	34.9992	-120.4939	-	58	41	41	32	41	34	51	51	53	-	59	60	57	63	60	68	-	104	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	74	-	76	-	82	-	-	-	116	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N34W31H01S	34.9928	-120.4921	59	-	-	-	150	-	149	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W02F01S	35.0646	-120.5379	35	34	35	34	37	33	-	32	33	33	30	32	33	32	-	-	33	33	-	33	35	-	35	36	34	24	37	33	34	36	32	33	34	36	-	34	35	33	35	32	31	33	-	28	-	30	-	-	33	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W02G02S	35.0642	-120.5291	-	145	152	145	48	144	47	146	152	146	147	144	148	145	147	-	148	-	-	158	-	141	148	141	145	138	146	141	140	-	141	138	143	142	144	142	144	141	141	141	139	-	-	143	-	146	148	-	148	148	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W02N01S	35.0553	-120.5375	43	-	-	38	3	34	13	-	36	32	40	-	34	28	32	-	31	-	-	18	28	23	30	24	0	25	27	20	25	20	24	17	24	-	23	12	20	17	22	17	19	-	13	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W03B01S	35.0674	-120.5469	49	-	-	48	(3)	45	8	-	47	40	47	-	44	45	46	-	47	-	-	-	47	-	37	48	47	46	47	-	-	44	41	40	40	39	39	38	38	36	37	-	44	36	34	33	-	34	35	34	34	34	40	35	36	36	36	35	37	33	40	38	42	-	38	38	37	34
11N35W05G01S	35.0622	-120.5830	-	5	8	1	(7)	(3)	(4)	-	15	5	-	-	13	2	15	10	13	10	-	6	-	8	18	11	18	7	11	5	10	4	7	(0)	11	(0)	9	-	9	(0)	9	-	7	2	12	-	6	2	16	3	17	7	13	6	-	5	-	3	6	(2)	12	(2)	11	(1)	16	1	8	(3)
11N35W05G02S	35.0610	-120.5823	6	(0)	(1)	(1)	-	(6)	-	-	9	2	-	(1)	-	(7)	8	7	5	5	-	0	10	2	12	6	8	(0)	5	(3)	0	(3)	(4)	(7)	(1)	(9)	1	-	0	(9)	(3)	-	3	(7)	(0)	(7)	(4)	(7)	9	(4)	11	(0)	12	(3)	8	(3)	(3)	(4)	3	(9)	3	(11)	3	(6)	9	(5)	(4)	(5)
11N35W05L01S	35.0615	-120.5874	4	(2)	(2)	(4)	1	(10)	18	-	7	(1)	(1)	(3)	4	(5)	6	4	8	3	2	(2)	-	-	12	-	12	(2)	6	(7)	(2)	-	(7)	-	1	(12)	(4)	-	(3)	(10)	(5)	-	-	(9)	(11)	(13)	(6)	(8)	7	(6)	10	(1)	6	(4)	5	(4)	-	(10)	2	(13)	2	(12)	-	-	9	(7)	(3)	(13)
11N35W05L03S	35.0615	-120.5876	-	-	-	-	3	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	7	6	3	14	2	10	-	12	1	9	-	14	5	13	6	8	6	21	4	24	12	19	10	21	9	-	7	16	4	15	1	14	6	22	6	6	0
11N35W05N02S	35.0566	-120.5922	20	11	12	1	8	(0)	23	-	8	(10)	-	(12)	16	(10)	(1)	11	-	7	-	(8)	2	2	17	3	22	4	9	1	(9)	0	5	(2)	-	(4)	2	-	11	3	7	-	19	4	23	25	-	28	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W05R01S	35.0548	-120.5800	17	-	8	6	6	(0)	18	-	22	8	7	5	14	3	16	16	21	13	-	-	16	9	22	13	19	7	15	4	8	4	4	(1)	11	(3)	8	(4)	10	(2)	5	-	6	0	8	3	-	(0)	-	-	22	1	16	5	18	6	14	6	13	2	12	(1)	11	-	19	2	6	(4)
11N35W06J01S	35.0610	-120.5962	11	11	24	10	15	8	-	-	24	24	10	10	11	9	11	11	10	11	-	11	12	11	14	11	13	8	11	8	9	8	7	6	8	5	7	-	7	6	7	-	8	7	9	7	6	7	12	9	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W07A01S	35.0531	-120.5936	17	13	12	8	-	2	-	-	19	9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W07R01S	35.0408	-120.5941	22	-	-	-	7	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W08L01S	35.0465	-120.5878	-	-	-	-	(2)	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	2	22	8	20	3	87	3	6	1	12	0	12	(4)	9	(0)	19	2	4	(4)
11N35W08N01S	35.0400	-120.5908	-	-	-	-	(11)	-	4	-	-	-	-	-	-	(3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W09K02S	35.0463	-120.5671	16	5	1	2	-	(6)	48	-	9	3	(10)	(13)	(2)	-	9	9	-	(1)	-	-	-	-	14	6	9	(11)	10	-	(0)	(15)	(22)	(17)	(6)	(28)	(21)	(30)	(12)	(27)	(19)	-	25	9	0	12	15	5	-	16	34	20	34	17	26	15	25	15	28	18	27	16	28	15	33	13	21	12
11N35W09K04S	35.0439	-120.5655	5	(5)	(7)	(8)	-	-	(7)	-	1	(4)	(12)	(15)	(5)	-	2	-	2	(12)	-	(19)	(20)	(17)	12	0	9	(8)	2	(16)	(9)	(11)	7	(23)	3	(20)	(12)	-	(7)	(14)	(17)	-	25	-	(12)	(28)	-	-	7	(29)	15	(28)	5	(26)	(10)	(24)	-	(17)	5	(14)	(4)	(16)	-	(25)	12	(15)	(6)	(26)
11N35W09P01S	35.0417	-120.5708	-	41	-	38	2	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W10G01S	35.0495	-120.5474	-	-	15	-	18	23	35	-	-	-	-	-	(9)	-	-	6	7	(12)	-	-	-	24	28	(6)	(1)	(16)	(8)	(18)	(6)	(25)	(15)	(32)	(21)	(24)	-	-	(16)	(24)	(15)	-	-	-	(18)	(27)	(43)	(32)	(15)	(42)	(5)	(22)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W10G02S	35.0492	-120.5494	-	-	-	17	-	-	-	-	6	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W10G03S	35.0500	-120.5494	-	-	-	31	15	(60)	-	-	(66)	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W10J01S	35.0469	-120.5439	-	15	-	14	40	-	41	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W11C01S	35.0547	-120.5340	-	-	-	16	-	13	54	-	13	-	30	-	-	(0)	-	-	(0)	-	-	(1)	(4)	-	9	5	7	-	0	4	(10)	2	-	(3)	4	-	0	(2)	1	(2)	0	(2)	(1)	(7)	12	(11)	(8)	-	-	-	(5)	-	(20)	(21)	1	(4)	(14)	(8)	(3)	(23)	(1)	-	1	(5)	0	-	(4)	-
11N35W11C02S	35.0547	-120.5342	-	-	-	41	48	38	50	-	-	34	34	-	-	-	-	-	-	-	-	-	-	4	10	6	0	5	(3)	6	6	3	-	-	1	-	1	0	-	(1)	3	(0)	1	(8)	-	-	-	-	-	-	(4)	-	(20)	(17)	2	(5)	-	(11)	-	(22)	(4)	(18)	(10)	(7)	(6)	(26)	(22)	(44)
11N35W11J01S	35.0454	-120.5251	78	51	55	-	-	-	-	-	55	52	52	-	-	-	-	-	-	46	-	46	51	54	57	59	60	61	62	61	64	65	64	67	67	69	70	63	76	78	81	83	-	84	85	85	-	86	87	87	82	88	81	91	90	90	133	88	87	89	87	87	91	75	88	88	89	86
11N35W12E02S	35.0494	-120.5214	52	-	-	49	-	45	52	-	48	46	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W12E04S	35.0493	-120.5224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	39	41	41	40	38	-	37	36	38	37	-	32	-	31	-	34	37	35	38	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W13C01S	35.0399	-120.5169	64	53	61	51	45	-	52	-	50	-	48	-	52	49	-	-	51	51	-	49	-	50	52	53	55	-	58	48	-	50	49	-	50	44	47	47	40	42	44	-	-	33	32	36	-	38	45	42	49	46	55	45	53	49	51	47	54	51	54	49	54	51	52	46	52	42
11N35W13D01S	35.0398	-120.5238	-	-	-	-	46	-	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	21	-	34	27	39	25	34	25	-	-	27	29	36	-	37	30	33	-	25	14
11N35W13E02S	35.0377	-120.5235	46	39	24	42	12	20	41	-	52	42	48	34	-	45	54	-	-	44	37	40	41	40	47	41	38	45	35	50	31	53	53	47	53	46	52	41	34	44	50	41	46	40	-	9	-	40	50	46	57	50	58	42	62	53	60	48	57	51	62	-	59	46	47	37	55	47
11N35W13E03S	35.0378	-120.5233	-	36	31	45	-	32	-	-	52	33	43	31	58	41	-	-	50	42	32	46	-	40	46	47	40	45	34	49	28	46	47	40	47	41	44	36	46	49	46	45	41	52	-	34	-	35	41	41	53	44	52	39	59	49	-	44	47	48	59	48	54	50	59	27	58	46
11N35W13K01S	35.0347	-120.5158	-	30	-	36	(11)	30	5	-	41	39	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W15D01S	35.0393	-120.5542	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(1)
11N35W16B01S	35.0370	-120.5670	16	-	-	10	-	1	-	-	18	-	(2)	-	0	-	20	-	8	18	-	7	(2)	-	29	18	21	8	-	-	-	-	-	-	-	(2)	-	-	(2)	4	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W17E01S	35.0344	-120.5908	-	20	-	-	28	-	32	-	-	20	16	-	-	-	-	-	-	29	-	29	27	18	-	-	-	-	-	-	-	13	14	9	-	-	-	-	12	5	17	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W18M01S	35.0317	-120.6128	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W19C02S	35.0216	-120.6060	28	32	30	29	3	29	22	-	30	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W20E01S	35.0186	-120.5922	35	-	-	-	(16)	-	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W21K01S	35.0172	-120.5639	28	14	8	15	-	(4)	-	-	-	-	12	13	21	11	23	30	20	-	20	-	22	20	43	33	30	25	33	-	-	14	10	6	10	1	12	(5)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W23B01S	35.0272	-120.5300	-	25	35	36	63	-	-	-	-	29	25	28	40	26	42	45	-	23	-	-	-	-	-	-	-	31	-	24	-	19	-	16	-	-	19	-	-	15	-	-	-	-	9	15	-	22	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W23L01S	35.0139	-120.5365	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	38	40	26	31	24	22	26	26	35	32	37	-	-	-	46	45	-	45	69	62	82	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W24L01S	35.0153	-120.5168	-	-	-	-	-	-	-	-	7	-	50	49	-	-	-	-	-	51	-	-	-	55	-	-	-	-	-	-	0	-	1	(2)	15	(5)	3	(1)	-	-	1	-	-	(8)	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W25F03S	35.0039	-120.5181	-	-	-	-	-	-	-	-	-	45	53	54	59	-	-	-	-	-	-	-	83	-	-	-	-	-	-	-	-	38	41	-	37	-	-	22	41	35	44	39	54	45	58	50	59	48	83	73	90	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W26K02S	35.0025	-120.5331	50	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W28L01S	35.0011	-120.5700	39	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W28M01S	35.0033	-120.5749	-	39	28	19	37	14	40	39	29	23	39	42	43	38	45	-	-	49	52	54	52	-	-	-	-	-	-	-	-	-	56	-	34	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-	60	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W29D01S	35.0072	-120.5908	17	15	15	15	-	11	33	-	-	19	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W33G01S	34.9908	-120.5675	-	35	37	24	6	21	9	28	29	28	-	-	46	42	53	51	-	58	-	-	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N35W35A01S	34.9950	-120.5252	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W12C01S	35.0524	-120.6281	-	-	9	-	-	7	-	-	9	7	-	7	9	7	9	-	-	-	-	9	13	-	10	9	9	7	10	-	11	7	7	5	7	6	11	6	7	6	8	6	19	7	-	7	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W12C02S	35.0526	-120.6282	-	-	-	-	12	10	-	-	-	15	-	14	-	14	-	-	-	-	-	18	-	-	-	18	-	16	-	-	-	12	-	8	-	7	-	6	-	7	-	8	-	9	-	10	-	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W12C03S	35.0525	-120.6285	-	-	-	-	-	12	-	-	-	18	-	18	-	17	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	16	-	12	-	11	-	10	-	11	-	12	-	13	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(4) Indicates GSE is below mean sea level

DRAFT

Table 2 cont., Groundwater surface elevation data in feet above mean sea level

State Well ID	Latitude	Longitude	1975		1976		1977		1978		1979		1980		1981		1982		1983		1984		1985		1986		1987		1988		1989		1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		2005		2006		2007	
			S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F	S	F
11N36W13K02S	35.0326	-120.6256	-	-	-	-	11	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W13K03S	35.0326	-120.6256	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W13K04S	35.0327	-120.6256	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W13K05S	35.0327	-120.6256	-	-	-	-	-	10	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11N36W13K06S	35.0327	-120.6257	-	-	-	-	147	10	155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N34W31F01S	35.0780	-120.5004	-	317	-	318	143	-	-	320	332	315	-	-	-	-	324	321	-	-	-	-	-	-	324	-	-	-	308	-	-	-	-	260	298	-	303	-	320	-	284	291	-	-	319	294	-	294	-	-	327	295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W27N03S	35.0844	-120.5568	-	160	-	153	-	148	25	-	162	158	162	158	161	157	161	157	-	-	-	-	157	151	156	-	-	146	151	142	135	-	-	-	127	135	146	-	153	148	-	146	158	-	149	154	-	152	-	159	160	156	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W28J02S	35.0893	-120.5640	144	-	144	143	-	141	24	-	144	144	145	143	143	141	141	140	143	143	-	-	128	136	136	-	120	-	112	-	126	-	121	122	-	129	130	-	130	131	131	131	132	134	136	135	137	138	140	140	141	138	142	45	137	136	138	136	138	136	134	134	132	131	133	133	134	133
12N35W29L01S	35.0905	-120.5916	9	15	14	17	11	-	20	23	16	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W29N01S	35.0872	-120.5935	14	-	-	16	5	5	22	21	22	13	17	11	-	11	-	24	28	14	11	12	16	4	-	-	16	5	-	(1)	-	4	-		-	4	17	5	20	9	18	12	-	16	21	13	-	12	25	17	25	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W29R03S	35.0871	-120.5802	17	9	10	(3)	11	16	27	12	16	12	-	10	18	-	-	13	-	3	-	-	-	-	13	1	12	1	(4)	(1)	7	(9)	6	-	-	5	32	33	16	13	-	7	9	-	10	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W30K02S	35.0897	-120.6004	5	9	5	13	-	5	-	16	19	12	15	9	19	-	18	15	21	13	-	-	13	-	-	7	14	6	13	-	5	11	4	-	14	1	14	6	16	8	-	-	18	-	-	11	14	12	20	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W30K03S	35.0889	-120.6018	18	14	-	20	-	11	-	23	-	17	21	14	25	13	-	22	26	19	-	16	21	7	22	12	-	12	20	-	-	-	-	-	-	8	16	12	23	20	19	13	22	19	23	16	19	18	26	21	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W30M02S	35.0911	-120.6064	-	6	-	15	(0)	-	25	-	-	11	-	7	-	9	-	15	-	-	-	-	-	(6)	-	(1)	-	8	-	1	-	8	-	(5)	-	(5)	-	6	-	8	-	2	-	12	-	10	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W30M04S	35.0884	-120.6066	-	-	-	-	1	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(1)	-	6	-	-	-	-	-	5	-	11	-	-	-	12	-	10	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W30P02S	35.0861	-120.5974	15	11	-	17	(2)	7	7	22	23	15	-	13	22	12	24	21	-	16	-	-	18	7	20	13	-	-	17	-	8	-	(12)	-	(1)	-	18	7	21	-	18	-	-	17	21	-	-	5	-	-	26	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W32G01S	35.0787	-120.5830	9	8	9	5	-	(0)	-	8	12	5	9	6	12	5	13	-	13	17	-	5	11	3	14	7	12	4	10	1	5	(0)	2	(3)	3	(1)	5	(0)	6	0	4	(1)	8	1	5	-	-	(1)	11	3	12	2	10	181	11	3	5	(0)	8	(0)	9	(3)	9	0	12	3	4	(1)
12N35W32Q02S	35.0719	-120.5843	-	-	-	-	-	(7)	-	5	13	(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W33D01S	35.0833	-120.5729	-	-	-	-	-	-	(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	138	103	100	101	87	98	92	99	94	93	88	90	89	89	73
12N35W33E01S	35.0783	-120.5742	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113	148	108	107	108	108	108	95	109	108	110	109	110	107	107	103
12N35W33J02S	35.0727	-120.5595	4	8	1	(3)	10	-	13	(3)	(1)	(4)	-	(4)	-	(5)	(1)	-	(3)	(2)	-	65	(1)	(1)	1	(2)	1	(4)	(6)	(5)	(3)	(12)	(5)	(9)	(7)	(10)	(8)	(11)	(8)	(12)	(9)	(11)	-	63	(9)	(13)	-	(13)	(4)	(8)	(12)	(6)	(7)	260	(2)	-	(10)	(8)	0	(9)	(1)	(9)	1	(6)	(1)	(7)	(5)	(9)
12N35W33J03S	35.0733	-120.5633	-	-	11	6	-	3	-	7	10	-	8	5	11	-	13	-	-	74	-	-	-	5	11	7	11	1	9	3	11	(8)	3	(11)	-	(0)	2	(4)	2	(2)	2	(3)	-	(5)	(2)	-	-	(6)	6	-	-	1	6	255	9	-	-	3	8	(17)	7	(2)	-	-	16	1	4	(1)
12N35W33L01S	35.0732	-120.5721	14	36	22	10	-	6	142	-	15	10	15	8	9	-	11	-	-	11	-	8	14	7	15	9	14	6	11	4	10	4	8	1	8	(3)	-	(0)	4	0	4	0	6	(1)	-	-	-	(1)	9	19	11	1	8	293	9	-	-	1	-	(3)	7	(3)	10	(2)	5	(14)	2	(5)
12N35W33M01S	35.0758	-120.5756	-	(9)	-	(8)	165	(4)	187	(5)	-	(8)	-	(8)	-	(8)	-	-	-	(4)	-	(12)	-	(13)	-	(9)	-	(14)	-	(17)	-	(15)	-	(22)	-	-	-	(35)	-	58	-	(21)	-	-	-	(24)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W34C03S	35.0822	-120.5521	142	-	132	-	-	120	174	137	141	-	141	-	139	-	139	132	143	-	137	-	136	-	133	128	128	-	123	112	-	108	109	107	141	108	122	111	124	124	129	119	140	-	141	129	-	127	140	138	134	131	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W34G06S	35.0781	-120.5481	183	-	171	-	193	-	-	177	184	-	185	175	182	170	181	170	-	-	-	167	174	161	171	-	165	-	161	152	-	-	-	133	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W34G08S	35.0795	-120.5496	170	161	160	150	186	-	183	164	171	159	172	-	-	-	168	161	-	168	-	154	-	-	-	-	151	147	149	140	-	137	134	130	140	135	-	138	-	154	155	144	-	162	-	155	-	155	173	-	166	-	166	34	167	-	158	145	148	-	145	136	168	154	164	161	154	-
12N35W35K02S	35.0769	-120.5294	196	190	-	190	189	183	184	197	-	-	205	-	204	189	207	190	212	196	-	-	-	179	201	185	-	181	184	-	181	174	172	167	192	-	192	-	208	-	188	-	215	-	-	179	205	176	217	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W35P01S	35.0711	-120.5351	207	202	200	187	-	181	-	175	-	172	168	159	171	-	-	-	164	-	-	-	-	173	179	179	179	172	161	173	170	175	173	167	173	173	155	-	169	168	170	169	201	168	162	-	-	167	-	169	171	-	179	202	176	176	183	178	178	176	178	180	182	161	181	182	183	180
12N35W35P02S	35.0706	-120.5339	197	197	197	197	(8)	183	(6)	174	172	173	172	171	-	-	-	-	-	-	-	-	-	-	176	152	162	123	165	165	162	-	175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12N35W35P03S	35.0719	-120.5352	-	-	-	-	-	-	-	-	-	-	-	-	154	154	155	-	-	157	-	156	159	155	158	159	160	157	158	156	153	145	155	149	155	154	154	153	153	152	154	-	-	155	154	151	-	152	152	152	153	154	160	233	158	-	159	158	167	165	167	165	168	167	168	169	168	166
12N36W36L01S	35.0737	-120.6283	-	-	-	-	62	(9)	68	-	(6)	4	-	(8)	(6)	(7)	(6)	-	-	-	-	(8)	-	-	(7)	(7)	(6)	(8)	(8)	(8)	(8)	(8)	(8)	(10)	(8)	(8)	(8)	(9)	(7)	(8)	(7)	(9)	(6)	-	-	(8)	-	-	-	(7)	-	-	(6)	15	(5)	(6)	(8)	(8)	-	(6)	(6)	(8)	(7)	(7)	(6)	(7)	(7)	(9)
12N36W36L02S	35.0737	-120.6283	-	-	-	-	-	(7)	-	-	-	(1)	-	(1)	-	(3)	-	-	-	-	-	1	-	-	-	2	-	(2)	-	(4)	-	(4)	-	(8)	-	(8)	-	(8)	-	(7)	-	(6)	-	(5)	-	(5)	-	-	-	(1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32S13E33A05M	35.1049	-120.5792	-	64	64	51	8	-	26	65	67	63	-	68	69	67	70	68	71	67	69	-	-	59	71	(37)	70	49	58	47	54	46	47	46	64	46	68	45	70	47	67	35	70	68	70	56	70	53	72	71	72	69	75	68	70	67	69	52	-	49	66	46	69	51	71	70	68	48
32S13E33A06M	35.1014	-120.5756	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	45	38	39	31	37	23	31	24	31	21	34	-	47	34	53	35	44	35	-	48	56	43	48	44	66	52	60	47	60	48	57	46	49	38	46	35	37	28	57	33	51	40	41	26
32S13E33K03M	35.0956	-120.5830	-	13	-	16	-	5	-	22	24	15	16	13	25	14	27	22	33	19	16	7	14	6	23	14	16	9	17	3	6	6	6	2	14	4	23	6	21	9	20	12	26	16	21	14	19	-	31	25	29	16	23	17	28	15	19	13	17	11	14	9	20	11	24	17	18	9
32S13E33L02M	35.0925	-120.5877	-	15	-	17	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	6	-	6	-	12	-	13	-	19	-	14	-	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32S13E33M02M	35.0944	-120.5908	-	17	-	19	-	(4)	-	25	-	-	-	-	-	16	-	24	-	-	-	-	-	6	-	15	-	-	-	3	-	7	-	-	-	-	-	-	-	11	-	-	-	18	-	14	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FLINTCOTE	35.0234	-120.5564	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	29	38	22	44	29	34	23	35	22	32	22	33	6	40	14	32	11
HERMRECK	35.0481	-120.4780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	303	317	-	-	314	330	319	321	313	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HOMESTEAD	35.0205	-120.5575	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	28	42	30	45	30	33	53	37	20	15	-	-	6	41	17	21	14
HWY 1	35.0312	-120.5603	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	21	33	22	38	21	26	15	30	15	24	-	25	(1)	34	10	24	6
MESA ROAD	35.0282	-120.5435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	28	42	27	46	29	32	21	38	23	30	-	29	5	41	17	32	14
Count			54	54	45	65	59	63	62	35	57	63	55	46	46	47	42	31	35	42	14	37	37	41	51	51	48	52	51	49	47	57	55	53	52	54	52	48	54	61	54	36	35	52	45	57	20	48	41	44	56	49	44	41	43	35	29	41	37	42	42	35	38	39	44	41	44	42

(4) Indicates GSE is below mean sea level

TECHNICAL MEMORANDUM

TO: Mr. Bruce Buel, General Manager NCSD

FROM: Drew Beckwith, Brad Newton Ph.D. P.G., Robert G. Beeby, P.E.

RE: Estimate of 2007 Subsurface Flow Across the Phase III Boundary

DATE: March 11, 2008

INTRODUCTION

The historic low rainfall of 2007 (less than 7 inches or less than 50% of normal) resulted in a substantial decrease in groundwater surface elevations (GSE) and a decrease in the groundwater in storage under the Nipomo Mesa (SAIC technical memorandum dated August 28, 2007). This decrease in GSEs underlying the Nipomo Mesa potentially altered hydraulic gradients along the Phase III boundary (henceforth Boundary) and may have affected subsurface flow across specific flow zones as well as net subsurface flow, as compared to previous years.

SAIC estimated subsurface flow across the Boundary in year 2007. Two estimates of subsurface flow are presented herein that differentiate between subsurface flow related to fresh water, and a portion of fresh water available for water supply. The difference depends on the definition of the base of the flow zone: 1) Fresh Water was defined following work conducted by Slade and Associates titled, "Map of 'Base of Fresh Water' " dated March 2000 (Slade 2000), and 2) Water Supply was defined as the higher of the data collected by the California Department of Water Resources (DWR) presented in "Base of the Potentially Water-Bearing Sediments" (Plate 11, DWR 2002), or sea level.

Geologic characteristics (stratigraphy and structure) play an important role in the flow of groundwater. The estimates presented herein are based on the assumption that the aquifer is unconfined and no barriers to flow exist internal to the Boundary. Refinements to the understanding of the local geology and its effect on groundwater flow will occur as data become available and evaluations are conducted.

RESULTS

Net subsurface flow in year 2007 across the Boundary was 5,050 acre-feet (AF) for Fresh Water, and 1,370 AF for Water Supply. The Boundary was divided into five separate flow zones adjacent to the following areas: Nipomo Valley, Los Berros Creek, Arroyo Grande Plain, Pacific Ocean, and Santa Maria River Valley to estimate the net subsurface flow to Nipomo Mesa (Figure 1). The calculation method is based on Darcy's Law and GSE measurements taken during Spring 2007 (Table 1). The daily estimate of flow from Spring 2007 GSE measurements was converted to its annual equivalent for the purposes of comparison to tangible and

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meaningful values of groundwater in storage above sea level (GWS). The sign convention established herein presents inflow to the Nipomo Mesa as positive values and outflow from the Nipomo Mesa as negative values. Net subsurface flow compares inflows to outflows estimated across the five flow zones.

Fresh Water flow is more than three times Water Supply flow because a significant amount of water flows across the Boundary below sea level and therefore is not currently considered as water supply for production. For example, the Fresh Water inflow across the Santa Maria Valley flow zone considered flow through a saturated height on the order of 1,500 feet (ft) (Col. 4, Table 3), as compared to the Water Supply flow which considered flow through a saturated height on the order of 100 ft (Col. 5, Table 4).

Table 1. Subsurface flow across the Boundary (presented as an annual total)

	Inflow (AF)	Outflow (AF)	Net Subsurface Flow (AF)
1) Fresh Water			
Nipomo Valley	940		
Los Berros Creek	1,030		
Arroyo Grande		2,270	
Ocean		1,060	
Santa Maria Valley	6,410		
Total	**8,380**	**3,330**	**5,050**
2) Water Supply			
Nipomo Valley	870		
Los Berros Creek	380		
Arroyo Grande		30	
Ocean		0	
Santa Maria Valley	150		
Total	**1,400**	**30**	**1,370**

METHODOLOGY

Darcy's Law was used to estimate year 2007 subsurface flow across the Boundary. Darcy's Law describes the flow of a fluid through a porous medium, and states that the flow of water through a cross-section is equal to the product of the hydraulic conductivity, hydraulic gradient, and cross-sectional area, as follows:

$$Q = K * I * A$$

where,

Q = subsurface groundwater flow [cubic feet per day (ft^3pd)];

K = hydraulic conductivity [cubic feet per day per square foot (ft^3pd/ft^2)];

I = hydraulic gradient [feet per feet (ft/ft)];

A = cross-sectional area [square feet (ft^2)].

Darcy's Law is straightforward and therefore frequently used to estimate groundwater flow. However, because of data limitations, determining the value of each variable requires some interpretation and can lead to various approaches used to determine the quantity of each variable. Various approaches and their resulting quantities may lead to large differences in the estimate of flow. Here, GSE measurements were collected and compiled. Contours of GSE were created on a map by linear interpolation between measurements (Figure 2). Each flow zone was divided into segments (Col. 1 Tables 3 and 4). The flow zones were segmented along the Boundary to account for spatial variations in the elevation of the bottom of the flow zone according to previous work performed by SAIC (SAIC 2002). Cross-sectional area (Col. 5 Table 3, and Col. 6 Table 4) was computed for each segment along each flow zone by multiplying the segment length (Col. 1 Tables 3 and 4) with the saturated height (Col. 4 Table 3, and Col. 5 Table 4) determined from the contour map and base of flow. Hydraulic gradients were measured on the map normal to GSE contours at each segment along each flow zone (Col. 6 Table 3, and Col. 7 Table 4). Hydraulic conductivity was measured and compiled by DWR and attributed to the five flow zones (Table 2).

Groundwater Contour Map

Spring 2007 GSE measurements provided by the San Luis Obispo County Department of Public Works were used to create a contour map of the GSE underlying the Nipomo Mesa (Figure 2). Groundwater surface elevations were assumed to vary linearly between measurement locations. Geologic structures were assumed to not influence the groundwater contour shape.

Cross-Sectional Area

Cross-sectional area was defined as the length of the flow zone times the saturated height of the flow. In the Fresh Water estimate, the saturated height was determined as the difference between the elevations from a GSE contour map (Col. 3 Table 3), and elevations from a contour map of the Base of Fresh Water (Col. 2 Table 3). The depth of flow used in this approach considered as much as 1,500 ft of fresh water aquifer in a few segments, consistent with the work previously presented during the Santa Maria Groundwater Litigation.

In the Water Supply estimate, the saturated height was determined as the difference between the elevations from a GSE contour map (Col. 4 Table 4), and the higher of 1) the base of the potentially water-bearing sediments (Col. 2 Table 4), or 2) sea level (Col. 3 Table 4). The depth of flow used in this approach considered only the upper portion of the fresh water aquifer and generally represents the flow that contributes to GWS. In this case, the saturated height is at most 120 ft of the upper portion of the fresh water aquifer in all segments.

The length of each segment, multiplied by the average of the saturated height at each end-point of the segment defines the cross-sectional area of the segment used in subsurface flow calculations (Col. 5 Table 3, and Col. 6 Table 4).

Hydraulic Gradient

The gradient within each segment is the average of the gradients measured at each segment endpoint from GSE contours at the Boundary (Col. 6 Table 3, and Col. 7 Table 4). Gradient measurements were made over a length scale of approximately one and a half miles and represent the average of locally steep and shallow variations in GSE present along the Boundary.

Hydraulic Conductivity

Hydraulic conductivity values for stratigraphy underlying the Nipomo Mesa are presented in "Water Resources of the Arroyo Grande-Nipomo Mesa Area" (DWR 2002). SAIC obtained the geometric mean of hydraulic conductivity along segments (flow zones) of the DWR study boundary (personal communication, Evelyn Tompkins, DWR). For each flow zone, the geometric mean of hydraulic conductivity was used in the subsurface flow calculation for all approaches presented herein, except along the Arroyo Grande flow zone, where the geometric mean of hydraulic conductivity for the Nipomo Valley flow zone was used (Table 2, Col. 7 Table 3, Col. 8 Table 4).

Table 2. Hydraulic Conductivity Values

Flow Zone	Hydraulic Conductivity (ft^3pd/ft^2)
Nipomo Valley	2.46
Los Berros Creek	2.46
Arroyo Grande	2.46
Ocean	12.70
Santa Maria Valley	6.95

DISCUSSION

Subsurface flow above sea level relates to GWS available as water supply to the Nipomo Mesa. Long-term production of groundwater below sea level in excess of the recharge will cause groundwater surface elevations underlying the Nipomo Mesa to drop below sea level and induce sea water intrusion. Consequently, the estimate of net subsurface flow presented herein related to the water supply to the Nipomo Mesa is 1,370 AF. It is based on GSE measurements made during Spring 2007, presented as an annual value, and is predicated on the assumptions of an unconfined aquifer with no geologic structural controls.

Deep groundwater flow may be an important component of the hydrologic balance under the Nipomo Mesa, particularly where fresh water flow crossing the Boundary at the Santa Maria Valley and Ocean flow zones is influenced by the hydrostatic pressures of water above sea level and perhaps from water at significant distances from the Boundary. Given the same assumptions, the estimate of net subsurface flow presented herein representing deep groundwater is 5,050 AF.

While GSE measurements are compiled on a frequent basis within the Boundary, much fewer measurements have been compiled for the area outside of the Boundary. This data limitation makes GSE contouring difficult, especially near the edges of the Boundary where resultant hydraulic gradient calculations are vital to determining subsurface flow. The Santa Maria Valley flow zone is paramount to the water supply of the Nipomo Mesa. The data compiled in this area is limited, and therefore the GSE contours along this flow zone have the greatest uncertainty.

Geologic characteristics (stratigraphy and structure) may play an important role in the flow of groundwater. The estimates presented herein assume the aquifer is unconfined and no barriers to flow exist internal to the Boundary. Improvements to the understanding of groundwater flow may occur as data become available and evaluations are made that re-define geologic controls.

RECOMMENDATIONS

The following recommendations are suggested to improve estimates of subsurface flow across the Boundary:

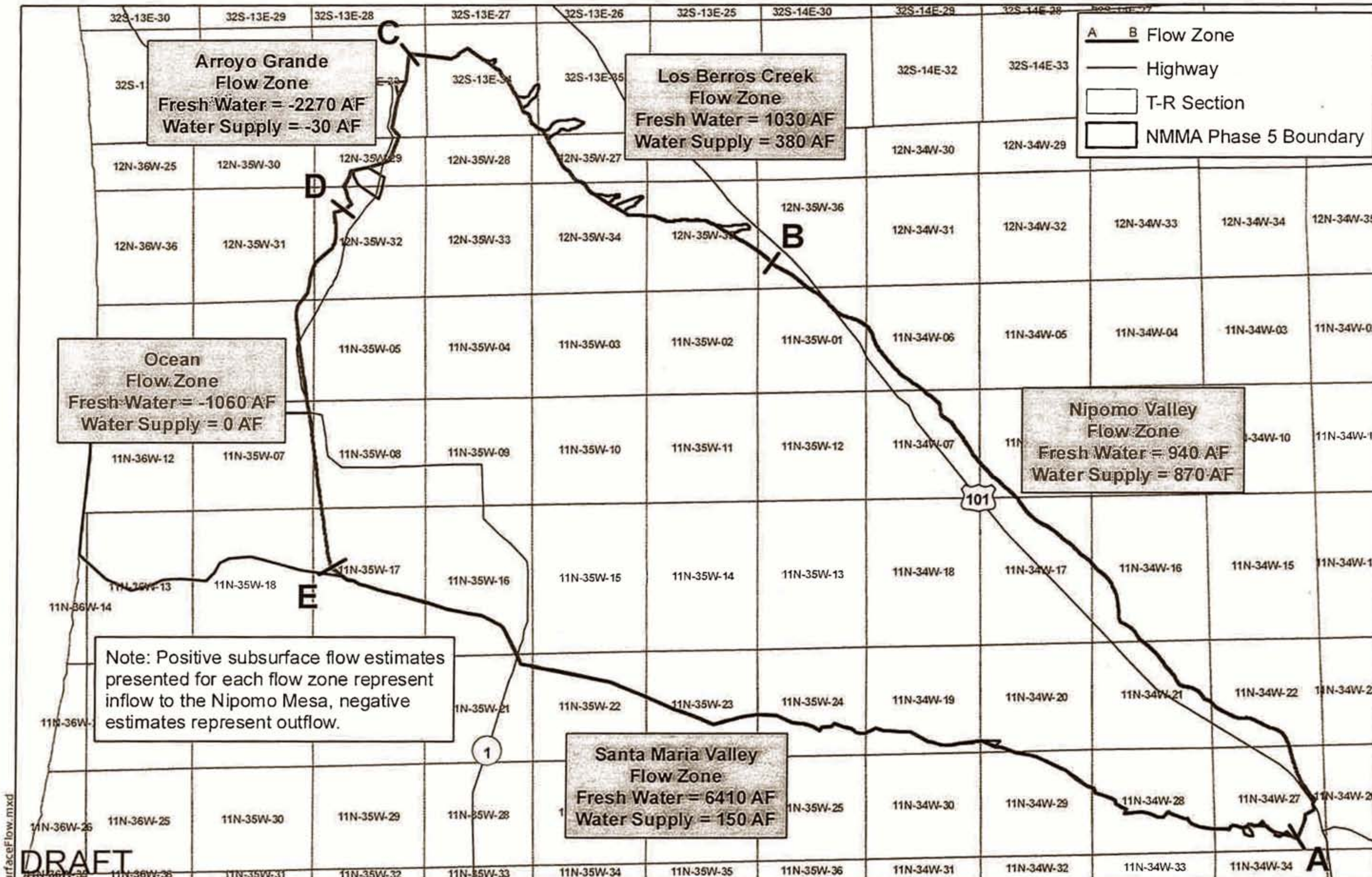
- Collect and compile a greater number of GSE measurements proximal to the Ocean and Santa Maria Valley flow zones;
- Determine the extent that geologic characteristics control groundwater flow;
- Refine understanding of freshwater/saltwater interface and deep groundwater flow within the Paso Robles Formation.

REFERENCES

California Department of Water Resources. 2002. (DWR 2002). Water Resources of the Arroyo Grande-Nipomo Mesa Area. September 24, 2002.

Richard C. Slade and Associates. 2000 (Slade 2000). Map of "Base of Fresh Water". March 2000.

SAIC. 2002. (SAIC 2002). Estimation of Subsurface Inflow for the Hydrologic Inventory for the Nipomo Mesa Management Area. June 11, 2002.



NOTES:

Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83

Flow Zones Used In Subsurface Flow Estimate

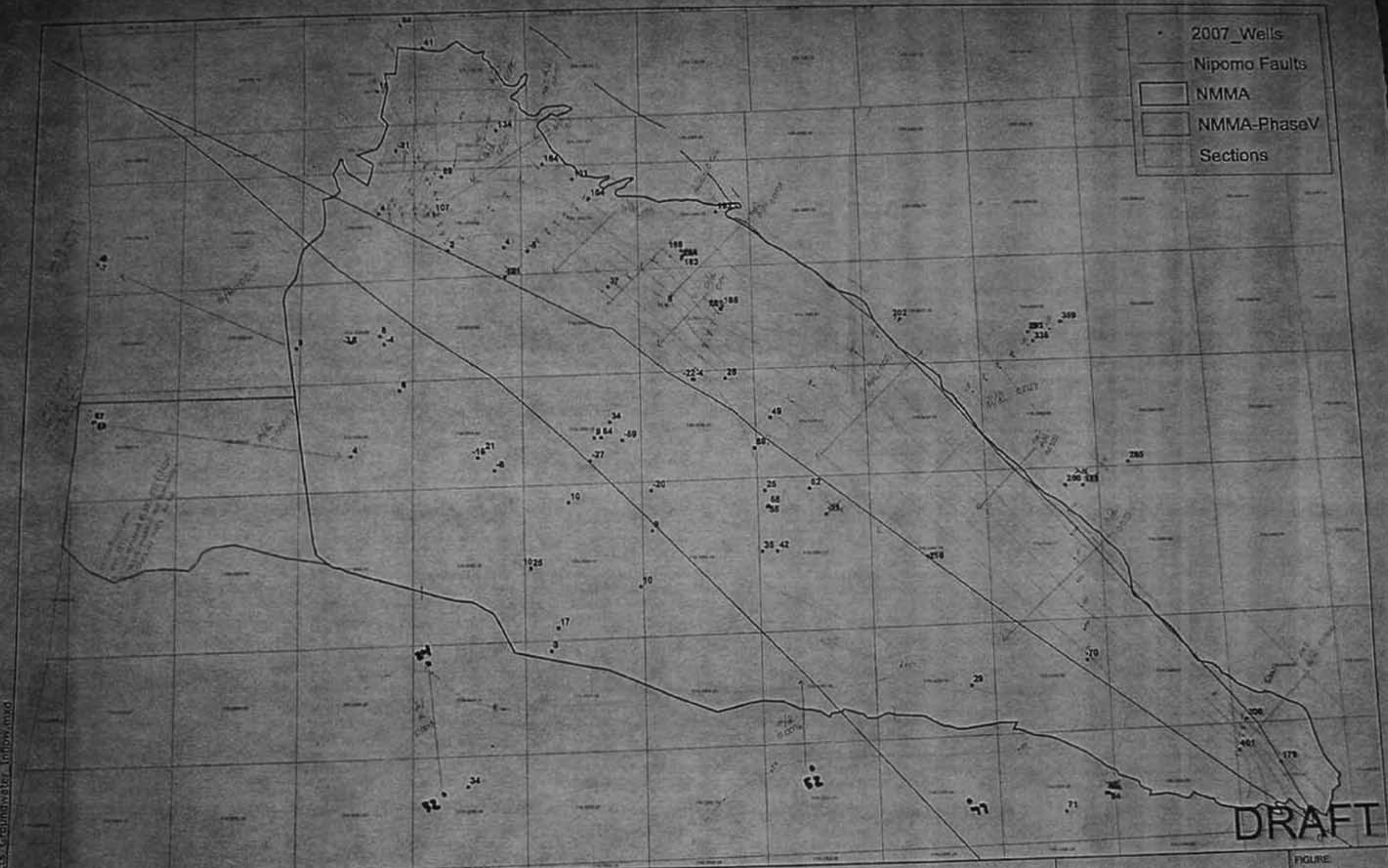
0 0.5 1 2 3 4
Miles

SAIC
From Science to Solutions

DATE: 03/07/08 BY: D Beckwith

FIGURE: 1

File: WTR-Nipomo/SubsurfaceFlow.mxd



NOTES:
Coordinate System: UTM Zone 10N
Horizontal Datum: NAD 83

2007 Groundwater Elevation Measurements

0 0.5 1 2 3 4
Miles
1:30,000

SAIC
From Science to Solutions

DATE: 02-14-08
BY: DB

FIGURE:
2

File: WTR_Nipomo/Projects_Groundwater_Inflow.mxd

Table 3. Fresh Water - variables and results

				A	I	K	Q	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Segment Along Flow Zone (ft)	Base of Flow Zone[1] (ft msl)	GWE From Contour[2] (ft msl)	Saturated Height of Flow Zone (ft)	Segment Area (ft^2)	Gradient From Contours[2,3] (ft/ft)	Hydraulic Conductivity[4] (ft^3pd/ft^2)	GW Flow (ft^3/d)	GW Flow[5] (AFY)
	(Slade 2000)	(Figure 2)	[3] - [2]	length from [1] * average of [4]	(Figure 2)	(DWR 2002)	[5] * average of [6] * [7]	[8] * 365 / 43560
Nipomo Valley Flow Zone (Figure 1 A-B)								
0	120	183	63		0.03592	2.46		
5,000	180	259	79	355,000	0.03592	2.46	31,370	260
7,000	160	254	94	173,000	0.03592	2.46	15,290	130
8,000	150	250	100	97,000	0.03543	2.46	8,510	70
10,500	135	225	90	237,500	0.03419	2.46	20,340	170
14,800	150	215	65	333,300	0.03207	2.46	27,170	230
16,400	200	238	38	82,400	0.03128	2.46	6,420	50
19,000	230	230	0	49,400	0.03000	2.46	3,720	30
21,000	240	221	0	0	0.02880	2.46	0	0
24,000	230	205	0	0	0.02700	2.46	0	0
28,000	230	200	0	0	0.02700	2.46	0	0
30,400	250	185	0	0	0.02700	2.46	0	0
31,500	300	190	0	0	0.02686	2.46	0	0
33,000	310	190	0	0	0.02666	2.46	0	0
36,000	300	195	0	0	0.02626	2.46	0	0
37,500	250	197	0	0	0.02607	2.46	0	0
38,000	225	198	0	0	0.02600	2.46	0	0
							Total	940
Los Berros Creek Flow Zone (Figure 1 B-C)								
0	220	198	0		0.02600	2.46		
2,000	150	194	44	44,000	0.02600	2.46	2,810	20
3,000	100	194	94	69,000	0.02600	2.46	4,410	40
5,000	-50	185	235	329,000	0.02267	2.46	19,690	160
6,000	-100	175	275	255,000	0.02100	2.46	13,700	110
8,000	-200	160	360	635,000	0.01767	2.46	30,200	250
9,000	-200	165	365	362,500	0.01600	2.46	15,010	130
10,000	-200	170	370	367,500	0.01433	2.46	13,710	110
12,000	-50	170	220	590,000	0.01100	2.46	18,380	150
13,500	100	170	70	217,500	0.01100	2.46	5,890	50
16,000	125	130	5	93,800	0	2.46	1,270	10
17,800	100	100	0	4,500	0	2.46	0	0
19,000	0	84	84	50,400	0	2.46	0	0
19,400	-30	70	100	36,800	0	2.46	0	0
21,400	-200	60	260	360,000	0	2.46	0	0
							Total	1,030
Arroyo Grande Flow Zone (Figure 1 C-D)								
1st 2000 feet added to Los Berros Cr segment								
2,000	-200	28	228		-0.01950	2.46	0	0
3,000	-330	23	353	290,500	-0.02294	2.46	-15,170	-130
4,000	-425	18	443	398,000	-0.02639	2.46	-24,150	-200
5,000	-470	9	479	461,000	-0.02983	2.46	-31,880	-270
6,500	-500	0	500	734,300	-0.03500	2.46	-58,560	-490
8,000	-525	-1	524	768,000	-0.03500	2.46	-66,120	-550
9,700	-500	-3	497	867,900	-0.03500	2.46	-74,730	-630
							Total	-2,270
Ocean Flow Zone (Figure 1 D-E)								
0	-620	-3	617		-0.00150	12.7		
2,500	-675	-1	674	1,613,800	-0.00150	12.7	-30,740	-260
2,510	-825	-1	824	7,500	-0.00150	12.7	-140	0
4,500	-800	0	800	1,615,900	-0.00150	12.7	-30,780	-260
6,000	-770	5	775	1,181,300	-0.00150	12.7	-22,500	-190
8,500	-800	9	809	1,980,000	-0.00150	12.7	-37,720	-320
10,400	-850	7	857	1,582,700	-0.00089	12.7	-24,070	-200
11,700	-900	6	906	1,146,000	-0.00048	12.7	-10,010	-80
13,100	-950	5	955	1,302,700	-0.00004	12.7	-4,270	-40
15,000	-1,000	5	1,005	1,862,000	0.00057	12.7	6,320	50
16,000	-1,170	5	1,175	1,090,000	0.00057	12.7	7,890	70
17,000	-1,370	5	1,375	1,275,000	0.00057	12.7	9,230	80
18,000	-1,500	5	1,505	1,440,000	0.00057	12.7	10,420	90
							Total	-1,060
Santa Maria Valley Flow Zone (Figure 1 E-A)								
0	-1,500	5	1,505		0	6.95		
5,000	-1,400	4	1,404	7,272,500	0.00130	6.95	32,850	280
9,000	-1,400	4	1,404	5,616,000	0.00235	6.95	71,230	600
12,000	-1,460	3	1,463	4,300,500	0.00314	6.95	82,010	690
14,000	-1,400	7	1,407	2,870,000	0.00366	6.95	67,820	570
16,000	-1,150	13	1,163	2,570,000	0.00419	6.95	70,110	590
17,000	-900	17	917	1,040,000	0.00445	6.95	31,220	260
18,800	-800	21	821	1,564,200	0.00492	6.95	50,950	430
20,100	-700	25	725	1,004,900	0.00526	6.95	35,570	300
29,000	-550	38	588	5,842,900	0.00760	6.95	261,190	2,190
33,000	-500	39	539	2,254,000	0	6.95	59,530	500
35,000	-450	41	491	1,030,000	0	6.95	0	0
40,000	-400	84	484	2,437,500	0	6.95	0	0
45,000	-200	120	320	2,010,000	0	6.95	0	0
45,200	-190	120	310	63,000	0	6.95	0	0
45,300	0	120	120	21,500	0	6.95	0	0
49,000	120	140	20	259,000	0	6.95	0	0
							Total	6,410
							Net Flow	5,050

[1] Slade 2000, "Base of Fresh Water"
[2] from Figure 2: Groundwater Elevation Contour Map
[3] gradient of 0 when subsurface flow is parallel to Boundary
[4] geometric mean value (DWR 2002)
[5] 1 acre-foot equals 43560 cubic feet

Table 4. Water Supply - variables and results

					A	I	K	Q	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Segment Along Flow Zone (ft)	Base of Flow Zone[1] (ft msl)	Alternative Minimum Flow Elevation (ft msl)	GWE From Contour[2] (ft msl)	Saturated Height of Flow Zone (ft)	Segment Area (ft^2)	Gradient From Contours[2,3] (ft/ft)	Hydraulic Conductivity[4] (ft^3pd/ft^2)	GW Flow (ft^3/d)	GW Flow[5] (AFY)
	(DWR 2002)		(Figure 2)	[4] - greater of [3] or [2]	length from [1] * average of [5]	(Figure 2)	(DWR 2002)	[6] * average of [7] * [8]	[9] * 365 / 43560
Nipomo Valley Flow Zone (Figure 1 A-B)									
0	128	-	183	55		0.03592	2.46		
5,000	160	-	259	99	385,000	0.03592	2.46	34,020	290
7,000	167	-	254	87	186,000	0.03592	2.46	16,440	140
8,000	172	-	250	78	82,500	0.03543	2.46	7,240	60
10,500	181	-	225	44	152,500	0.03419	2.46	13,060	110
14,800	196	-	215	19	135,500	0.03207	2.46	11,040	90
16,400	192	-	238	46	52,000	0.03128	2.46	4,050	30
19,000	194	-	230	36	106,600	0.03000	2.46	8,040	70
21,000	196	-	221	25	61,000	0.02880	2.46	4,410	40
24,000	195	-	205	10	52,500	0.02700	2.46	3,600	30
28,000	199	-	200	1	22,000	0.02700	2.46	1,460	10
30,400	197	-	185	0	1,200	0.02700	2.46	80	0
31,500	198	-	190	0	0	0.02686	2.46	0	0
33,000	197	-	190	0	0	0.02666	2.46	0	0
36,000	195	-	195	0	0	0.02626	2.46	0	0
37,500	191	-	197	6	4,500	0.02607	2.46	290	0
38,000	190	-	198	8	3,500	0.02600	2.46	220	0
								Total	870
Los Berros Creek Flow Zone (Figure 1 B-C)									
		Sea Level							
0	190	-	198	8		0.02600	2.46		
2,000	160	-	194	34	42,000	0.02600	2.46	2,690	20
3,000	141	-	194	53	43,500	0.02600	2.46	2,780	20
5,000	109	-	185	76	129,000	0.02267	2.46	7,720	60
6,000	96	-	175	79	77,500	0.02100	2.46	4,160	30
8,000	41	-	160	119	198,000	0.01767	2.46	9,420	80
9,000	46	-	165	119	119,000	0.01600	2.46	4,930	40
10,000	50	-	170	120	119,500	0.01433	2.46	4,460	40
12,000	84	-	170	86	206,000	0.01100	2.46	6,420	50
13,500	97	-	170	73	119,300	0.01100	2.46	3,230	30
16,000	99	-	130	31	130,000	0	2.46	1,760	10
17,800	88	-	100	12	38,700	0	2.46	0	0
19,000	50	-	84	34	27,600	0	2.46	0	0
19,400	11	-	70	59	18,600	0	2.46	0	0
21,400	-	0	60	60	119,000	0	2.46	0	0
								Total	380
Arroyo Grande Flow Zone (Figure 1 C-D)									
		Sea Level							
1st 2000 feet added to Los Berros Cr									
2,000	-	0	28	28		-0.01950	2.46		
3,000	-	0	23	23	25,500	-0.02294	2.46	-1,330	-10
4,000	-	0	18	18	20,500	-0.02639	2.46	-1,240	-10
5,000	-	0	9	9	13,500	-0.02983	2.46	-930	-10
6,500	-	0	0	0	6,800	-0.03500	2.46	-540	0
8,000	-	0	-1	0	0	-0.03500	2.46	0	0
9,700	-	0	-3	0	0	-0.03500	2.46	0	0
								Total	-30
Ocean Flow Zone (Figure 1 D-E)									
		Sea Level							
0	-	0	-3	0		-0.00150	12.7		
2,500	-	0	-1	0	0	-0.00150	12.7	0	0
2,510	-	0	-1	0	0	-0.00150	12.7	0	0
4,500	-	0	0	0	0	-0.00150	12.7	0	0
6,000	-	0	5	5	3,800	-0.00150	12.7	-70	0
8,500	-	0	9	9	17,500	-0.00150	12.7	-330	0
10,400	-	0	7	7	15,200	-0.00089	12.7	-230	0
11,700	-	0	6	6	8,500	-0.00048	12.7	-70	0
13,100	-	0	5	5	7,700	-0.00004	12.7	-30	0
15,000	-	0	5	5	9,500	0.00057	12.7	30	0
16,000	-	0	5	5	5,000	0.00057	12.7	40	0
17,000	-	0	5	5	5,000	0.00057	12.7	40	0
18,000	-	0	5	5	5,000	0.00057	12.7	40	0
								Total	0
Santa Maria Valley Flow Zone (Figure 1 E-A)									
		Sea Level							
0	-	0	5	5		0	6.95		
5,000	-	0	4	4	22,500	0.00130	6.95	100	0
9,000	-	0	4	4	16,000	0.00235	6.95	200	0
12,000	-	0	3	3	10,500	0.00314	6.95	200	0
14,000	-	0	7	7	10,000	0.00366	6.95	240	0
16,000	-	0	13	13	20,000	0.00419	6.95	550	0
17,000	-	0	17	17	15,000	0.00445	6.95	450	0
18,800	-	0	21	21	34,200	0.00492	6.95	1,110	10
20,100	-	0	25	25	29,900	0.00526	6.95	1,060	10
29,000	-	0	38	38	280,400	0.00760	6.95	12,530	100
33,000	-	0	39	39	154,000	0	6.95	4,070	30
35,000	-	0	41	41	80,000	0	6.95	0	0
40,000	-	0	84	84	312,500	0	6.95	0	0
45,000	-	0	120	120	510,000	0	6.95	0	0
45,200	-	0	120	120	24,000	0	6.95	0	0
45,300	-	0	120	120	12,000	0	6.95	0	0
49,000	120	-	140	20	259,000	0	6.95	0	0
								Total	150
								Net Flow	1,370

[1] Plate 11: Base of Potentially-Water Bearing Sediments (DWR 2002)
[2] from Figure 2: Groundwater Elevation Contour Map
[3] gradient of 0 when subsurface flow is parallel to Boundary
[4] geometric mean value (DWR 2002)
[5] 1 acre-foot equals 43560 cubic feet