

Big Bear Area Regional Wastewater Agency
 Geohydrologic Evaluation of Artificial Recharge Potential
 in the Big Bear Valley, California

Summary of Uncased Borehole and Well Completion Data

Site	Boring / Well ID	Ground Surface Elevation [ft amsl ¹]	Borehole Diameter [inches]	Total Depth [ft bgs ²]	Perforated Interval(s) [ft bgs]	Casing Diameter / Type [inches]	Slot Size [inches]	Reference Point Elevation [ft amsl]
Green Spot	GS MW-1	6,862.67	10.75	208	100-140	2/PVC	0.02	6,864.08
	GS MW-2 (shallow)	6,855.00	12.25	220	100-140	2/PVC	0.02	6,857.73
	GS MW-2 (deep)	6,855.02	12.25	220	170-210	2/PVC	0.02	6,857.70
	GS MW-3	6,858.47	12.25	230	110-210	4/PVC	0.02	6,860.15
	GS MW-4	6,862.25	12.25	235	110-180	4/PVC	0.02	6,864.28
	GS MW-5	6,864.63	12.25	228	110-210	4/PVC	0.02	6,866.58
	GS 20-M	6,860.00	9.875	212	86-186	5/PVC	0.032	6,863.01
	GS MW-6	6,820.00	12.25	200	50-195	4/PVC	0.02	NA
	GS MW-7	6,820.00	12.25	200	50-195	4/PVC	0.02	NA
	GS BH-1	6,860.30	7.875	95	NA ³	NA	NA	NA
	GS BH-2	6,855.00	7.875	100	NA	NA	NA	NA
	GS BH-3	6,859.40	7.875	142	NA	NA	NA	NA
	GS BH-4	6,861.40	7.875	98	NA	NA	NA	NA
	GS BH-5	6,862.80	7.875	115	NA	NA	NA	NA

Table 3

Big Bear Area Regional Wastewater Agency
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Site	Boring / Well ID	Ground Surface Elevation [ft amsl ¹]	Borehole Diameter [inches]	Total Depth [ft bgs ²]	Perforated Interval(s) [ft bgs]	Casing Diameter / Type [inches]	Slot Size [inches]	Reference Point Elevation [ft amsl]
Van Dusen Canyon	VDC MW-1	6,788.64	10.75	195	84-184	2/PVC	0.02	6,791.31
	VDC MW-2	6,797.87	12.25	201	90-190	4/PVC	0.02	6,800.39
	VDC MW-3	6,801.21	12.25	202	95-195	4/PVC	0.02	6,802.64
	VDC MW-4	6,792.27	12.25	200	90-190	4/PVC	0.02	6,794.22
	VDC MW-5	6,788.24	12.25	195	85-185	4/PVC	0.02	6,790.77
	VDC BBCCSD #5	6,770.00	28	157	75-145	12.75/steel	0.006	6,767.00
	VDC BH-1	6,800.00	7.875	125	NA	NA	NA	NA
	VDC BH-2	6,785.00	7.875	105	NA	NA	NA	NA
	VDC BH-3	6,795.00	7.875	115	NA	NA	NA	NA
	VDC BH-4	6,785.00	7.875	95	NA	NA	NA	NA
VDC BH-5	6,780.00	7.875	95	NA	NA	NA	NA	

Notes:

1. amsl = above mean sea level
2. bgs = below ground surface
3. NA = Not Applicable

Table 3

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Summary of Infiltrometer Data

Greenspot Area												
Infiltrometer Number	y_n	t_n	i_n	x	i_w	L	y_t	n_e	z	h_{we}	K	K
	[cm]	[min]	[cm/min]	[cm]	[cm/min]	[cm]	[cm]		[cm]	[cm]	[cm/min]	[ft/day]
GS I-1	11.0	113	0.097	23.5	0.031	79.0	35.0	0.141	17.0	-20	0.02	1.00
GS I-2	22.0	107	0.206	52.5	0.028	97.5	49.5	0.068	11.0	-10	0.02	1.08
GS I-3	19.0	146	0.130	29.5	0.034	> 90.0	50.0	0.143	9.5	-5	> 0.03	> 1.37
GS I-4	18.0	190	0.095	28.0	0.026	71.0	28.0	0.107	9.0	-10	0.02	0.96
GS I-5	14.0	86	0.163	27	0.046	> 132.0	50.5	0.108	7.0	-10	> 0.04	> 1.92
											Average	> 1.26
Van Dusen Canyon Area												
VDC I-1	15.0	214	0.070	15.0	0.031	> 77.0	23.7	0.138	7.5	-20	> 0.02	> 1.10
VDC I-2	11.0	137	0.080	26.0	0.023	> 82.0	36.0	0.128	5.5	-5	> 0.02	> 0.98
VDC I-3	18.5	57	0.325	12.0	0.167	> 177.0	50.0	0.145	9.3	-5	> 0.15	> 7.31
											Average	> 3.13

- t_n Elapsed time during the last recorded drop in water level.
- i_n Infiltration rate during the last drop in water level (y_n/t_n).
- x Lateral divergence determined by measuring the lateral extent of wetting front after test.
- i_w Vertical infiltration rate.
- L Vertical extent of wetting front after test.
- y_t Cumulative infiltration throughout the test.
- n_e Fillable porosity (assumed to be effective porosity).
- z Average depth of water in the cylinder during the last water level drop.
- h_{we} Water entry value of soil (from Bouwer, 1998; pg. 6).
- K Long-term infiltration rate in shallow inundated areas.

Table 4

List of Water Quality Analyses

Constituent	Units	Detection Limit	EPA Method Number
General Physical Properties			
Color	Color unit	1	110.2
Odor	Odor unit	1	140.1
Turbidity	NTU ¹	0.1	180.1
General Minerals			
Total Alkalinity	mg/L ²	2	310.1
Bicarbonate	mg/L	2	310.1/SM2320B
Carbonate	mg/L	2	310.1/SM2320B
Chloride	mg/L	1	325.3
Total Hardness	mg/L	2	130.2
pH	pH unit	0.01	EPA 9040
Specific Conductance	µmhos/cm ³	1	120.1
Sulfate	mg/L	2	375.4
Total Dissolved Solids (TDS)	mg/L	10	160.1
Nitrate as N	mg/L	1	SM4500NO3D
Calcium	mg/L	0.2	6010
Chromium (Total)	mg/L	0.2	200.7/6010B
Copper	mg/L	0.01	200.7/6010B
Iron	mg/L	0.01	200.7/6010B
Magnesium	mg/L	0.1	EPA 6010
Manganese	mg/L	0.005	200.7/6010B
Potassium	mg/L	0.4	EPA 6010
Sodium	mg/L	2	EPA 6010
Zinc	mg/L	0.05	200.7/6010B
Silica	mg/L	0.5	200.7
Other			
Boron	mg/L	0.1	200.7/6010B
Fluoride (total)	mg/L	0.1	340.2
Arsenic	mg/L	0.002	200.7/6010B

Notes:

¹ nephelometric turbidity units

² milligrams per liter

³ microµmhos per centimeter

Summary of Ground Water Quality Laboratory Results
 Green Spot Site

	Well	Sample Date	General Physical Properties			Cations					Anions							Total Dissolved Solids [mg/L]	
			Color [color units]	Odor [T.O.N.]	Turbidity [NTU]	Total Hardness [mg/L]	Calcium [mg/L]	Magnesium [mg/L]	Sodium [mg/L]	Potassium [mg/L]	Total Alkalinity [mg/L]	Hydroxide [mg/L]	Carbonate [mg/L]	Bicarbonate [mg/L]	Sulfate [mg/L]	Chloride [mg/L]	Nitrate (as N) [mg/L]		Fluoride [mg/L]
Baseline Ground Water Quality (Pre-Recharge)	MW-2S	23-Dec-03	< 3.0	< 1.0	< 0.2	220	43	27	19	3.0	230	< 3.0	< 3.0	280	28	6.7	< 0.20	0.2	280
	MW-2D	22-Dec-03	< 3.0	< 1.0	< 0.2	120	24	13	25	2.6	140	< 3.0	< 3.0	160	33	4.2	< 0.20	0.3	200
	MW-3	15-Dec-03	< 3.0	< 1.0	0.27	210	43	24	15	2.4	100	< 3.0	< 3.0	120	29	5.2	33	0.3	330
	MW-4	19-Dec-03	< 3.0	< 1.0	3.9	210	44	24	15	2.6	190	< 3.0	< 3.0	240	28	5.7	0.27	0.3	260
	MW-5	6-Jan-04	< 3.0	< 1.0	3.4	210	42	25	12	2.8	220	< 3.0	< 3.0	260	25	4.1	< 0.20	0.2	270
	MW-6	23-Jun-04	< 3.0	< 1.0	2.8	240	48	30	15	3.2	230	< 3.0	< 3.0	280	23	8.2	0.56	0.2	310
Post-Recharge Ground Water Quality	MW-2S	10-May-04	< 3.0	< 1.0	66	220	44	27	6.6	2.8	230	< 3.0	< 3.0	280	19	4.4	0.34	0.2	280
	MW-2D	10-May-04	< 3.0	< 1.0	0.52	100	22	12	29	2.5	140	< 3.0	< 3.0	180	31	2.8	< 0.20	0.2	200
	MW-3	10-May-04	< 3.0	< 1.0	9.5	210	42	26	11	2.7	230	< 3.0	< 3.0	280	23	4.7	0.20	0.2	270
	MW-4	10-May-04	< 3.0	< 1.0	4.9	220	43	26	5.6	2.6	230	< 3.0	< 3.0	280	19	3.7	< 0.20	0.2	260
	MW-5	10-May-04	< 3.0	< 1.0	12	200	39	23	8.3	2.6	210	< 3.0	< 3.0	260	22	4.2	0.23	1.9	250
	MW-6	23-Jun-04	< 3.0	< 1.0	2.8	240	48	30	15	3.2	230	< 3.0	< 3.0	280	23	8.2	0.56	0.2	310
	FH	7-May-04	NA	NA	NA	210	40	26	5.8	3.4	200	< 3.0	< 3.0	240	27	3.0	< 0.20	0.3	260
	Lakewood Well #6	19-May-04	< 3.0	< 1.0	0.91	130	29	14	11	1.8	140	< 3.0	< 3.0	170	7.7	6.3	0.25	0.1	190

Well	Sample Date	Specific Conductance [µmho/cm]	pH	MBAS [mg/L]	Metals and Metalloids								
					Aluminum [µg/L]	Arsenic [µg/L]	Boron [µg/L]	Total Chromium [µg/L]	Copper [µg/L]	Iron [µg/L]	Manganese [µg/L]	Total Silica [mg/L]	Zinc [µg/L]
MW-2D	22-Dec-03	360	8.0	< 0.05	NA	< 2.0	< 100	2.6	< 10	< 20	94	13	10
MW-2S	23-Dec-03	500	7.8	< 0.05	NA	< 2.0	< 100	2.4	< 10	100	48 ¹ , 51 ²	16	12
MW-3	15-Dec-03	530	6.5	0.07	NA	< 2.0	< 100	< 10	14	< 20	43	15	83
MW-4	19-Dec-03	460	7.5	< 0.05	NA	< 5.8	< 100	< 10	< 10	300	60	23	67
MW-5	6-Jan-04	460	7.6	< 0.05	NA	< 2.0	< 100	1.4	< 10	< 20	72	17	200
MW-6	23-Jun-04	500	7.2	< 0.05	< 50	NA	< 100	1.9	< 10	< 20	11	18	18
Lakewood Well #6	19-May-04	320	6.6	NA	NA	< 2.0	< 100	< 10	19	< 20	< 10	27	< 10
MW-2S	10-May-04	470	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	16	< 11
MW-2D	10-May-04	350	8.1	NA	NA	< 2.0	< 100	< 10	< 10	21	100	13	< 12
MW-3	10-May-04	480	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	15	< 13
MW-4	10-May-04	450	7.6	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	15	< 14
MW-5	10-May-04	450	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	36	16	< 15
Vaqueros	10-May-04	210	7.1	NA	NA	< 2.0	< 100	< 10	< 10	22	< 10	20	11
FH	7-May-04	390	7.8	< 0.05	< 50	NA	NA	< 10	35	360	11	16	14

Notes:

µg/L = Micrograms per Liter

mg/L = Milligrams per Liter

NA = Not Analyzed

¹ EPA Method 200.8

² EPA Method 200.7

MBAS = Methylene Blue Active Substances

< 2.0 Constituent not detected above the indicated detection limit

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Date	Depth to Ground Water [ft bgs ¹]							Ground Water Elevation [ft amsl ²]						
	MW-1 ³	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M	MW-1	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M
Reference Point Elevation								6,864.08	6,857.73	6,857.70	6,860.15	6,864.28	6,866.58	6,863.01
15-Dec-03	NM ⁴	98.31	82.85	NM	94.28	95.19	93.80	NM	6,759.42	6,774.85	NM	6,770.00	6,771.39	6,769.21
16-Dec-03	NM	101.07	85.90	105.08	NM	97.65	95.91	NM	6,756.66	6,771.80	6,755.07	NM	6,768.93	6,767.10
17-Dec-03	NM	101.16	85.76	105.25	NM	98.04	96.11	NM	6,756.57	6,771.94	6,754.90	NM	6,768.54	6,766.90
22-Dec-03	NM	NM	NM	104.76	107.70	98.08	96.00	NM	NM	NM	6,755.39	6,756.58	6,768.50	6,767.01
23-Dec-03	NM	NM	NM	104.95	107.96	98.09	95.98	NM	NM	NM	6,755.20	6,756.32	6,768.49	6,767.03
13-Jan-04	NM	99.50	83.30	102.80	105.40	96.00	94.50	NM	6,758.23	6,774.40	6,757.35	6,758.88	6,770.58	6,768.51
14-Jan-04	NM	99.46	83.39	102.50	105.39	95.86	94.38	NM	6,758.27	6,774.31	6,757.65	6,758.89	6,770.72	6,768.63
15-Jan-04	NM	102.25	85.98	104.59	108.40	98.18	96.52	NM	6,755.48	6,771.72	6,755.56	6,755.88	6,768.40	6,766.49
22-Jan-04	NM	102.16	86.00	104.34	107.14	98.19	96.29	NM	6,755.57	6,771.70	6,755.81	6,757.14	6,768.39	6,766.72
23-Jan-04	NM	102.14	85.94	104.34	107.25	98.15	96.24	NM	6,755.44	6,771.76	6,755.81	6,757.03	6,768.43	6,766.77
11-Feb-04	98.62	102.29	85.40	104.53	107.41	98.18	96.36	6,765.46	6,755.44	6,772.30	6,755.62	6,756.87	6,768.40	6,766.65
12-Feb-04	98.65	102.30	85.39	104.57	107.53	98.20	96.38	6,765.43	6,755.43	6,772.31	6,755.58	6,756.75	6,768.38	6,766.63
16-Feb-04	NM	102.67	85.69	104.88	107.70	119.27	96.67	NM	6,755.06	6,772.01	6,755.27	6,756.58	6,747.31	6,766.34
17-Feb-04	NM	102.91	85.67	105.26	107.97	98.81	96.68	NM	6,754.82	6,772.03	6,754.89	6,756.31	6,767.77	6,766.33
18-Feb-04	NM	102.46	85.33	104.70	107.54	98.25	96.50	NM	6,755.27	6,772.37	6,755.45	6,756.74	6,768.33	6,766.51
19-Feb-04	NM	102.33	85.19	104.60	107.40	98.19	96.37	NM	6,755.40	6,772.51	6,755.55	6,756.88	6,768.39	6,766.64
20-Feb-04	NM	102.37	85.19	104.63	107.47	98.19	96.36	NM	6,755.36	6,772.51	6,755.52	6,756.81	6,768.39	6,766.65
23-Feb-04	95.90	102.10	85.13	104.33	107.14	95.05	90.05	6,768.18	6,755.63	6,772.57	6,755.82	6,757.14	6,771.53	6,772.96
24-Feb-04	NM	101.96	85.16	104.20	107.32	94.34	88.91	NM	6,755.77	6,772.54	6,755.95	6,756.96	6,772.24	6,774.10
25-Feb-04	NM	101.82	85.14	104.00	105.65	94.00	88.56	NM	6,755.91	6,772.56	6,756.15	6,758.63	6,772.58	6,774.45
27-Feb-04	NM	101.54	85.02	103.63	106.39	93.38	87.95	NM	6,756.19	6,772.68	6,756.52	6,757.89	6,773.20	6,775.06
28-Feb-04	NM	101.37	85.02	103.41	106.56	93.16	87.69	NM	6,756.36	6,772.68	6,756.74	6,757.72	6,773.42	6,775.32
1-Mar-04	NM	100.85	85.00	103.06	106.05	92.22	86.37	NM	6,756.88	6,772.70	6,757.09	6,758.23	6,774.36	6,776.64
3-Mar-04	NM	99.71	84.91	102.50	105.15	91.17	85.12	NM	6,758.02	6,772.79	6,757.65	6,759.13	6,775.41	6,777.89
5-Mar-04	NM	92.36	84.95	101.39	104.85	90.30	84.50	NM	6,765.37	6,772.75	6,758.76	6,759.43	6,776.28	6,778.51
8-Mar-04	NM	84.81	84.90	99.22	103.11	88.44	82.90	NM	6,772.92	6,772.80	6,760.93	6,761.17	6,778.14	6,780.11
10-Mar-04	NM	75.04	84.83	97.45	102.92	86.84	81.52	NM	6,782.69	6,772.87	6,762.70	6,761.36	6,779.74	6,781.49

Table 7

Big Bear Area Regional Wastewater Agency
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Summary of Ground Water Level Measurements and Elevations
 Green Spot Site

Date	Depth to Ground Water [ft bgs ¹]							Ground Water Elevation [ft amsl ²]						
	MW-1 ³	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M	MW-1	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M
Reference Point Elevation								6,864.08	6,857.73	6,857.70	6,860.15	6,864.28	6,866.58	6,863.01
12-Mar-04	NM	71.01	84.71	95.60	100.95	85.41	80.26	NM	6,786.72	6,772.99	6,764.55	6,763.33	6,781.17	6,782.75
13-Mar-04	NM	69.33	84.70	94.98	100.01	84.31	78.32	NM	6,788.40	6,773.00	6,765.17	6,764.27	6,782.27	6,784.69
15-Mar-04	NM	67.96	84.59	93.83	99.26	83.23	77.52	NM	6,789.77	6,773.11	6,766.32	6,765.02	6,783.35	6,785.49
16-Mar-04	NM	66.90	84.53	93.29	98.82	83.23	78.42	NM	6,790.83	6,773.17	6,766.86	6,765.46	6,783.35	6,784.59
16-Mar-04	NM	66.75	84.48	93.18	98.66	83.19	77.92	NM	6,790.98	6,773.22	6,766.97	6,765.62	6,783.39	6,785.09
17-Mar-04	NM	66.79	84.46	92.91	98.60	83.77	79.89	NM	6,790.94	6,773.24	6,767.24	6,765.68	6,782.81	6,783.12
19-Mar-04	NM	68.04	84.43	92.80	98.58	84.77	81.82	NM	6,789.69	6,773.27	6,767.35	6,765.70	6,781.81	6,781.19
20-Mar-04	NM	68.99	84.42	92.87	98.55	85.20	82.43	NM	6,788.74	6,773.28	6,767.28	6,765.73	6,781.38	6,780.58
22-Mar-04	NM	71.60	84.41	93.12	98.83	86.11	83.64	NM	6,786.13	6,773.29	6,767.03	6,765.45	6,780.47	6,779.37
24-Mar-04	NM	74.91	84.47	93.86	98.29	87.57	85.27	NM	6,782.82	6,773.23	6,766.29	6,765.99	6,779.01	6,777.74
26-Mar-04	NM	77.44	84.45	94.54	99.78	88.67	86.45	NM	6,780.29	6,773.25	6,765.61	6,764.50	6,777.91	6,776.56
29-Mar-04	NM	81.15	84.67	95.87	100.76	90.48	88.29	NM	6,776.58	6,773.03	6,764.28	6,763.52	6,776.10	6,774.72
31-Mar-04	NM	82.97	84.73	96.71	101.80	91.50	89.29	NM	6,774.76	6,772.97	6,763.44	6,762.48	6,775.08	6,773.72
1-Apr-04	NM	83.84	84.78	97.06	101.78	91.97	89.77	NM	6,773.89	6,772.92	6,763.09	6,762.50	6,774.61	6,773.24
2-Apr-04	NM	84.79	84.80	97.56	102.03	92.56	90.32	NM	6,772.94	6,772.90	6,762.59	6,762.25	6,774.02	6,772.69
5-Apr-04	NM	86.82	84.95	98.66	102.97	93.73	91.86	NM	6,770.91	6,772.75	6,761.49	6,761.31	6,772.85	6,771.15
7-Apr-04	NM	90.09	85.02	99.38	104.19	94.44	92.26	NM	6,767.64	6,772.68	6,760.77	6,760.09	6,772.14	6,770.75
9-Apr-04	NM	91.28	85.03	99.92	104.53	94.97	92.77	NM	6,766.45	6,772.67	6,760.23	6,759.75	6,771.61	6,770.24
12-Apr-04	NM	95.99	85.06	100.66	104.69	95.59	93.46	NM	6,761.74	6,772.64	6,759.49	6,759.59	6,770.99	6,769.55
14-Apr-04	NM	97.30	85.02	100.99	104.88	95.85	93.69	NM	6,760.43	6,772.68	6,759.16	6,759.40	6,770.73	6,769.32
16-Apr-04	NM	98.78	85.04	100.23	104.78	96.07	93.93	NM	6,758.95	6,772.66	6,759.92	6,759.50	6,770.51	6,769.08
19-Apr-04	NM	99.20	85.04	101.58	104.85	96.37	94.24	NM	6,758.53	6,772.66	6,758.57	6,759.43	6,770.21	6,768.77
21-Apr-04	NM	99.38	85.16	101.70	104.99	96.42	94.35	NM	6,758.35	6,772.54	6,758.45	6,759.29	6,770.16	6,768.66
23-Apr-04	NM	99.59	85.13	101.89	105.06	96.59	94.52	NM	6,758.14	6,772.57	6,758.26	6,759.22	6,769.99	6,768.49
26-Apr-04	NM	99.91	85.21	102.25	105.74	96.83	94.79	NM	6,757.82	6,772.49	6,757.90	6,758.54	6,769.75	6,768.22
30-Apr-04	NM	100.06	85.29	102.39	105.59	96.95	94.89	NM	6,757.67	6,772.41	6,757.76	6,758.69	6,769.63	6,768.12
10-May-04	NM	100.49	85.43	102.87	106.23	97.17	95.15	NM	6,757.24	6,772.27	6,757.28	6,758.05	6,769.41	6,767.86
19-May-04	NM	100.85	85.70	103.14	106.48	97.56	95.51	NM	6,756.88	6,772.00	6,757.01	6,757.80	6,769.02	6,767.50

Table 7

**Summary of Ground Water Level Measurements and Elevations
 Green Spot Site**

Date	Depth to Ground Water [ft bgs ¹]							Ground Water Elevation [ft amsl ²]						
	MW-1 ³	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M	MW-1	MW-2S	MW-2D	MW-3	MW-4	MW-5	20M
Reference Point Elevation								6,864.08	6,857.73	6,857.70	6,860.15	6,864.28	6,866.58	6,863.01
2-Jun-04	NM	101.56	86.46	103.93	107.44	98.10	96.43	NM	6,756.17	6,771.24	6,756.22	6,756.84	6,768.48	6,766.58
8-Jun-04	NM	101.76	86.67	104.21	107.80	98.24	96.22	NM	6,755.97	6,771.03	6,755.94	6,756.48	6,768.34	6,766.79
17-Jun-04	NM	102.12	86.96	104.51	107.96	98.45	96.58	NM	6,755.61	6,770.74	6,755.64	6,756.32	6,768.13	6,766.43
24-Jun-04	NM	102.40	85.26	107.96	108.72	98.57	96.61	NM	6,755.33	6,772.44	6,752.19	6,755.56	6,768.01	6,766.40
1-Jul-04	NM	102.67	85.55	105.23	108.27	98.72	97.54	NM	6,755.06	6,772.15	6,754.92	6,756.01	6,767.86	6,765.47

Notes:

- ¹ bgs = below ground surface
- ² amsl = above mean sea level
- ³ Well MW-1 contained a transducer that collected water level measurements every 10 minutes.
Manual measurements were not obtained on a regular basis.
- ⁴ NM = Not Measured

**Summary of Sulfur Hexafluoride Tracer Concentrations
 Green Spot Site**

Well Name	SF ₆ Concentration [pmol/L ¹]								
	1-Mar	3-Mar	8-Mar	12-Mar	5-Apr	14-Apr	21-Apr	26-Apr	10-May
GS MW-1	1.13	10.37	1.15	ND ²	1.24	0.27	1.20	0.27	2.80
GS MW-2S	4.59	9.94	ND	ND	ND	ND	ND	ND	ND
GS MW-2D	1.42	9.43	ND	ND	ND	ND	ND	ND	ND
GS MW-3	1.19	18.49	ND	ND	ND	ND	ND	ND	ND
GS MW-4	27.92	29.77	ND	0.10	ND	0.12	ND	ND	ND
GS MW-5	ND	54.80	ND	0.20	ND	ND	ND	ND	ND

Notes:

¹ pmol/L = Picomoles per Liter

² ND = Not Detected

Summary of Ground Water Quality Laboratory Results
 Van Dusen Canyon

Well	Sample Date	General Physical Properties			Cations					Anions							Total Dissolved Solids [mg/L]	
		Color [color units]	Odor [T.O.N.]	Turbidity [NTU]	Total Hardness [mg/L]	Calcium [mg/L]	Magnesium [mg/L]	Sodium [mg/L]	Potassium [mg/L]	Total Alkalinity [mg/L]	Hydroxide [mg/L]	Carbonate [mg/L]	Bicarbonate [mg/L]	Sulfate [mg/L]	Chloride [mg/L]	Nitrate (as N) [mg/L]		Fluoride [mg/L]
MW-1	27-Jan-04	< 3.0	< 1.0	3.7	250	48	30	9.3	2.4	260	< 3.0	< 3.0	320	10	6.2	< 0.20	0.3	290
MW-2	21-Jan-04	< 3.0	< 1.0	< 0.20	250	48	32	12	1.7	260	< 3.0	< 3.0	320	13	5.0	< 0.20	0.3	330
MW-3	13-Jan-04	< 3.0	< 1.0	< 0.20	250	53	29	9.7	1.8	270	< 3.0	< 3.0	320	11	5.2	0.27	0.2	320
MW-4	16-Jan-04	< 3.0	< 1.0	< 0.20	230	47	27	8.8	1.6	240	< 3.0	< 3.0	300	13	4.3	< 0.20	0.2	310
MW-5	27-Jan-04	< 3.0	< 1.0	1.4	230	46	27	10	2.5	250	< 3.0	< 3.0	310	11	4.1	< 0.20	0.2	280
FH	7-May-04	NA	NA	NA	190	43	20	22	1.7	200	< 3.0	< 3.0	240	29	5.9	0.63	1.6	260
MW-1	10-May-04	< 3.0	< 1.0	45	250	54	27	6.3	1.7	280	< 3.0	< 3.0	340	11	4.0	< 0.20	0.2	300
MW-2	10-May-04	< 3.0	< 1.0	2.4	270	59	30	7.3	1.7	290	< 3.0	< 3.0	360	15	4.6	< 0.20	0.1	320
MW-3	10-May-04	< 3.0	< 1.0	2.2	260	57	28	6.9	1.5	280	< 3.0	< 3.0	340	9.3	4.9	0.23	0.2	300
MW-4	10-May-04	< 3.0	< 1.0	5.3	240	51	26	6.5	1.6	250	< 3.0	< 3.0	310	11	3.8	< 0.20	1.1	280
MW-5	10-May-04	< 3.0	< 1.0	2.3	240	50	26	6.4	1.8	250	< 3.0	< 3.0	300	9.3	3.6	< 0.20	0.8	280

Well	Sample Date	Specific Conductance [µmho/cm]	pH	MBAS [mg/L]	Metals and Metalloids								
					Aluminum [µg/L]	Arsenic [µg/L]	Boron [µg/L]	Total Chromium [µg/L]	Copper [µg/L]	Iron [µg/L]	Manganese [µg/L]	Total Silica [mg/L]	Zinc [µg/L]
MW-1	27-Jan-04	520	7.6	< 0.05	NA	< 2.0	< 100	3.0	< 10	34	150	26	25
MW-2	21-Jan-04	520	7.1	< 0.05	NA	< 2.0	< 100	< 1.0	< 10	< 20	88	33	25
MW-3	13-Jan-04	530	7.8	< 0.05	NA	< 2.0	< 100	< 1.0	< 10	< 20	19	26	21
MW-4	16-Jan-04	480	7.6	< 0.05	NA	< 2.0	< 100	5.1	< 10	< 20	32	23	18
MW-5	27-Jan-04	490	7.6	< 0.05	NA	< 2.0	< 100	4.3	< 10	< 20	29	24	34
FH	7-May-04	430	7.5	< 0.05	< 50	NA	NA	< 1.0	55	230	< 10	22	< 10
MW-1	10-May-04	530	7.6	NA	NA	< 2.0	< 100	< 10	< 10	< 20	15	22	< 10
MW-2	10-May-04	570	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	23	< 10
MW-3	10-May-04	540	7.6	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	23	< 10
MW-4	10-May-04	500	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	22	< 10
MW-5	10-May-04	480	7.7	NA	NA	< 2.0	< 100	< 10	< 10	< 20	< 10	24	< 10

Notes:
 µg/L = Micrograms per Liter
 mg/L = Milligrams per Liter
 NA = Not Analyzed
¹ EPA Method 200.8
² EPA Method 200.7
 MBAS = Methylene Blue Active Substances
 < 2.0 Constituent not detected above the indicated detection limit

Big Bear Area Regional Wastewater Agency
 Geohydrologic Evaluation of Artificial Recharge Potential
 in the Big Bear Valley, California

Summary of Ground Water Level Measurements and Elevations
 Van Dusen Canyon Site

Date	Depth to Ground Water [ft bgs ¹]					Ground Water Elevation [ft amsl ²]				
	MW-1 ³	MW-2	MW-3	MW-4	MW-5	MW-1	MW-2	MW-3	MW-4	MW-5
Reference Point Elevation						6,791.31	6,800.39	6,802.64	6,794.22	6,790.77
5-Feb-04	85.24	94.19	96.43	88.05	84.63	6,706.07	6,706.20	6,706.21	6,706.17	6,706.14
16-Feb-04	85.29	94.02	96.42	87.98	84.57	6,706.02	6,706.37	6,706.22	6,706.24	6,706.20
17-Feb-04	85.68	94.21	96.58	88.10	84.76	6,705.63	6,706.18	6,706.06	6,706.12	6,706.01
23-Feb-04	85.39	94.32	96.62	88.27	84.81	6,705.92	6,706.07	6,706.02	6,705.95	6,705.96
27-Feb-04	85.42	94.35	96.61	88.32	84.83	6,705.89	6,706.04	6,706.03	6,705.90	6,705.94
12-Mar-04	NM ⁴	94.13	96.42	88.03	84.62	NM	6,706.26	6,706.22	6,706.19	6,706.15
15-Mar-04	NM	93.76	96.12	87.66	84.32	NM	6,706.63	6,706.52	6,706.56	6,706.45
16-Mar-04	NM	93.62	96.00	87.53	84.20	NM	6,706.77	6,706.64	6,706.69	6,706.57
17-Mar-04	NM	93.41	95.82	87.32	84.02	NM	6,706.98	6,706.82	6,706.90	6,706.75
19-Mar-04	NM	92.99	95.48	86.90	83.67	NM	6,707.40	6,707.16	6,707.32	6,707.10
20-Mar-04	NM	92.84	95.36	86.74	83.56	NM	6,707.55	6,707.28	6,707.48	6,707.21
22-Mar-04	NM	92.34	94.86	86.19	83.50	NM	6,708.05	6,707.78	6,708.03	6,707.27
24-Mar-04	NM	91.95	94.56	85.89	82.76	NM	6,708.44	6,708.08	6,708.33	6,708.01
26-Mar-04	NM	91.56	94.21	85.53	82.43	NM	6,708.83	6,708.43	6,708.69	6,708.34
29-Mar-04	NM	91.09	93.74	85.04	81.94	NM	6,709.30	6,708.90	6,709.18	6,708.83
31-Mar-04	NM	90.83	93.45	84.74	81.66	NM	6,709.56	6,709.19	6,709.48	6,709.11
1-Apr-04	NM	90.55	93.28	84.56	81.50	NM	6,709.84	6,709.36	6,709.66	6,709.27
2-Apr-04	NM	90.55	93.18	84.46	81.39	NM	6,709.84	6,709.46	6,709.76	6,709.38
5-Apr-04	NM	90.16	92.78	84.04	80.99	NM	6,710.23	6,709.86	6,710.18	6,709.78
7-Apr-04	NM	89.91	92.54	83.78	80.74	NM	6,710.48	6,710.10	6,710.44	6,710.03
9-Apr-04	NM	89.68	92.31	83.52	80.49	NM	6,710.71	6,710.33	6,710.70	6,710.28
12-Apr-04	NM	89.33	91.91	83.09	80.09	NM	6,711.06	6,710.73	6,711.13	6,710.68
14-Apr-04	NM	88.95	91.57	82.71	79.71	NM	6,711.44	6,711.07	6,711.51	6,711.06
16-Apr-04	NM	88.65	91.25	82.36	78.37	NM	6,711.74	6,711.39	6,711.86	6,712.40
19-Apr-04	NM	88.24	90.82	81.94	78.97	NM	6,712.15	6,711.82	6,712.28	6,711.80
21-Apr-04	NM	87.88	90.44	81.57	78.60	NM	6,712.51	6,712.20	6,712.65	6,712.17
23-Apr-04	NM	87.69	90.24	81.33	78.35	NM	6,712.70	6,712.40	6,712.89	6,712.42
26-Apr-04	NM	87.47	90.03	81.19	78.16	NM	6,712.92	6,712.61	6,713.03	6,712.61
30-Apr-04	NM	87.44	89.93	81.18	78.09	NM	6,712.95	6,712.71	6,713.04	6,712.68

Table 10

**Summary of Ground Water Level Measurements and Elevations
 Van Dusen Canyon Site**

Date	Depth to Ground Water [ft bgs ¹]					Ground Water Elevation [ft amsl ²]				
	MW-1 ³	MW-2	MW-3	MW-4	MW-5	MW-1	MW-2	MW-3	MW-4	MW-5
Reference Point Elevation						6,791.31	6,800.39	6,802.64	6,794.22	6,790.77
10-May-04	NM	87.58	90.02	81.47	78.22	NM	6,712.81	6,712.62	6,712.75	6,712.55
19-May-04	NM	88.14	90.55	82.04	78.75	NM	6,712.25	6,712.09	6,712.18	6,712.02
2-Jun-04	NM	89.03	91.44	83.02	79.66	NM	6,711.36	6,711.20	6,711.20	6,711.11
9-Jun-04	NM	89.65	91.95	83.64	80.25	NM	6,710.74	6,710.69	6,710.58	6,710.52
17-Jun-04	NM	90.36	92.65	84.32	80.89	NM	6,710.03	6,709.99	6,709.90	6,709.88
24-Jun-04	NM	91.02	93.21	84.88	81.46	NM	6,709.37	6,709.43	6,709.34	6,709.31
1-Jul-04	NM	91.59	93.85	85.53	82.08	NM	6,708.80	6,708.79	6,708.69	6,708.69

Notes:

1. bgs = below ground surface
2. amsl = above mean sea level
3. Well MW-1 contained a transducer that collected water level measurements every 10 minutes.
 Manual measurements were not obtained on a regular basis.
4. NM = Not Measured

**Summary of Seepage Velocity Calculations
 Green Spot Site**

	[A]	[B]	[C]			
Ground Water Condition	Average Hydraulic Gradient ¹ [ft/ft]	Hydraulic Conductivity ² [ft/day]	Effective Porosity ³	Seepage Velocity ⁴ [ft/day]	Travel Time ⁵ (Days)	Travel Time (Months)
Static (Pre-Recharge)	0.032	15	0.09	5.3	525	17.5
Maximum Mounding	0.066	15	0.09	11.0	255	8.5
Post-Recharge	0.0525	15	0.09	8.8	320	10.7

¹ Average hydraulic gradient measured between the Green Spot Site and the Lakewood Well Field from Figures 13, 32, 37 and 38.

² Hydraulic conductivity estimated using Hantush, 1967 as described in Section 7.6.1

³ Effective porosity estimated from the soil moisture sensor data as described in Section 7.6.1

⁴ Seepage velocity = [A]*[B]/[C]

⁵ Travel time based on distance between Green Spot Site and Lakewood Well Field of 2,800 ft

**Summary of Seepage Velocity Calculations
 Van Dusen Canyon Site**

	[A]	[B]	[C]			
Ground Water Condition	Average Hydraulic Gradient ¹ [ft/ft]	Hydraulic Conductivity ² [ft/day]	Effective Porosity ³	Seepage Velocity ⁴ [ft/day]	Travel Time ⁵ (Days)	Travel Time (Months)
Static (Pre-Recharge)	0.004	9	0.04	0.9	4,778	159.3
Maximum Mounding	0.006	9	0.04	1.4	3,185	106.2
Post-Recharge	0.004	9	0.04	0.9	4,778	159.3

¹ Average hydraulic gradient measured between the Van Dusen Canyon Site and the Maltby Monitoring Well from Figures 13, 46, 51 and 52.

² Hydraulic conductivity estimated using Hantush, 1967 as described in Section 7.6.1

³ Effective porosity estimated from the soil moisture sensor data as described in Section 8.6.1

⁴ Seepage velocity = [A]*[B]/[C]

⁵ Travel time based on distance between Van Dusen Canyon Site and BBCCSD Well No. 1 of 4,300 ft

