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Date: January 19, 2009
Subject: Summary of test wells drilled on Ocean View Farms, Rancho Corral de Tierra, San Mateo County, California

Background

Water supply in the unincorporated communities of Montara and Moss Beach, California is provided by a public water system managed by Montara Water and Sanitary District. Montara Sanitary District (MSD) purchased the system from California-American Water Company (formerly Citizens Utilities Company of California) on August 1, 2003 and became Montara Water and Sanitary District (MWSD). The water system relies on the collection of local ground-water supplies.

Former owners of the water system have not been capable of expanding production levels or protect its water quality. This situation triggered concern over the sustainable yield of the sub-basin during a drought or even several consecutive drier-than-normal years, as well as the related potential for sea water intrusion. In late 1999, the California Department of Water Resources (DWR) issued a report titled “Montara Water Supply Study” that identified the Martini Creek terrace and alluvial aquifers as a potential source of ground water to meet supplemental drought-year demand. MWSD was awarded a DWR Local Groundwater Assistance Program Grant (AB303 fiscal year 2002-3) that provided partial funding for a Martini Creek sub-basin ground-water program.

One task of the investigation was to install test wells within the Martini Creek marine terrace to provide regular water level data, water quality samples, and locations from which conduct pumping tests in order to evaluate aquifer storage and permeability. Two test wells, identified as wells 2004-1 and 2004-2, were installed on Ocean View Farms, north of Montara, California (Figure 1). Ocean View Farms is part of Rancho Corral de Tierra, which is a 4,262-acre holding currently in Peninsula Open Space Trust (POST) ownership. This memo documents the site selection, drilling and testing of wells 2004-1 and 2004-2. Appendices to this memo contain well logs and yield and water quality data.

Both wells are currently being utilized by MWSD to monitor ground-water levels. Monitoring the water level in well 2004-2 is required per monitoring protocols adopted by California Coastal Commission under application no. 2-06-006, dated November 17, 2008.

Well Siting and Permitting

We initially selected seven sites on Rancho Corral de Tierra for potentially drilling test wells, labeled BH-1 through BH-7. Two sites were located on APN 036-330-040, and five sites on APN 036-320-100. Of the seven sites, two wells were drilled and complete. They are identified as wells 2004-1 and 2004-2 in the attached Figure 1.

- Well 2004-1 (BH-1) was located east of Highway 1 on APN 036-330-040. The objective for drilling well 2004-1 was to assess the hydrogeologic properties of the marine terrace at the mouth of Marini Creek. The highest permeabilities were expected in coarser sediments at the bedrock contact. The site was positioned 500 feet south of Martini Creek to minimize pumping effect on the creek
- Well 2004-2 was located at the mouth of Daffodil Canyon on APN 036-320-100. The objective for drilling well 2004-2 was to assess the alluvial fan deposits and underlying fractured granitic bedrock for potential well yield. It is also located near a fault which may affect the yield by potentially having higher fault fracturing. Ground-water quality may also be affected by the fault by potentially drawing on deeper ground-water.

General locations for the wells were recommended by the California Department of Water Resources in their report “Montara Water Supply Study for Montara Sanitary District” (CDWR, June 1999). With assistance from Jean Lauer and Bert Smith of POST and David Lea of Cabrillo Farms, we sited the wells at the perimeter of existing agricultural fields on Ocean View Farms. POST issued a License, Release and Waiver, and Indemnification Agreement to MWSD (then MSD) on July 29, 2002, and MSD resolution number 1239 authorized execution of the agreement with POST. Prior to drilling the well sites, San Mateo County Planning and Building Division issued a Coastal Development Permit, dated December 2, 2003 (County file number PLN 2002-00306).

Well Drilling

Maggiara Brothers Drilling (Maggiara) was the drilling contractor. Balance Hydrologics (Balance) specified well construction and testing details and observed the drilling, completion and development of the wells. Prior to drill, Norcal Geophysical Consultants conducted a borehole clearance survey at each site consisting of a) ground-penetrating radar to identify solid obstacles, b) directional radio-frequency receiver (RD 400) to identify utility wires, and c) metal detector (M Scope). Norcal Geophysical Consultants also conducted down-hole geophysical logs prior to completing the wells.

No specific preparation was required at well sites and all drilling fluids were contained on the agricultural field and tilled in when completed. Well 2004-1 was completed on January 20, 2004, and well 2004-2 was completed on February 29, 2004. Drilling and construction details for each well are summarized in the attached Table 1.

Well Testing Program

Wells 2004-1 and 2004-2 were evaluated for yield and water quality. The wells were tested for yield by pumping at a constant rate with a submersible pump while monitoring drawdown within the well. A one-day step test was conducted prior to the constant-rate test to evaluate a pumping rate for the test. Balance Hydrologics planned and directed the yield tests, with Henry Plumbing as the pumping contractor. Well 2004-1 was tested for 72-hours at 9.6 gallons per minute (gpm), and well 2004-2 was tested for 72-hours at 45 gpm. Results are summarized in Table 1.

The drawdown data were analyzed using Cooper and Jacob time-drawdown methods and other analytical methods to assess the well and aquifer properties. The conventional technical approach to analyzing drawdown data in pumped wells is to plot drawdown and recovery on a semi-log chart as a function of the duration of pumping. In a homogeneous and anisotropic ground-water flow media (or under approximate conditions) this analysis can quantify the transmissivity of ground water and predict ground-water capture areas. Charted data for well 2004-1 are in Appendix A, and in Appendix B for well 2004-2.

To assess changes in water quality during each the yield test, the water pumped from the well was also monitored for specific conductance and temperature. A water quality samples were collected towards the end of yield test and analyzed for general mineral composition and Title 22 inorganic constituents by Soil Control Laboratories in Watsonville, a facility certified by the State of California to conduct such analyses. Water samples were also collected for general mineral analyses from:

- the well at the McNee State Park ranger's residence at Old San Pedro Trail Bridge;
- the well at the stables on Ocean View Farms;
- Montara Creek at the gage above Old San Pedro Trail; and,
- Daffodil Canyon at Old San Pedro Trail.

Results are shown in attached Table 2, and plotted in a piper diagram (Figure 2) as a means of characterizing ('fingerprinting') common source waters. Laboratory reports are found in the Appendices.

WELL 2004-1

Drilling Well 2004-1

Drilling of well 2004-1 (BH-1) commenced on Thursday, January 15, 2004 with an air rotary drill rig and an 8¾-inch tricone bit. Driller was Jose Fernandez, with Maggiora Bros. Cutting samples were collected every 5 feet. From ground surface to a depth of 5 feet below ground surface (bgs), we drilled through 5 feet of highly organic loam of high clay content. Below 5 feet bgs, we drilled through terrace deposits that were light brown to yellowish-orange, poorly sorted cohesive sandy clay (CL). At 25 feet bgs the terrace deposits changed to light brown to yellowish-orange, poorly sorted sand, silt and clay (SC) and continued to 115 feet bgs, where we stopped drilling for the day. The average drilling rate was 36 feet per hour

On Friday, January 16 drilling continued with the same drill bit. From a depth of 115 feet to 135 feet bgs the samples were light brown to yellowish-orange, coarse sand with gravel (SW). At 135 feet bgs, encountered the first decomposed (weathered) quartz diorite. The hole collapsed at 155 feet bgs. After cleaning out the hole, continued to drill. At 195 feet bgs encountered competent granitic bedrock, and continued drilling to 235 feet bgs to end drilling at this depth. The hole subsequently collapsed to 228 feet bgs.

Geologic Interpretation of Borehole Samples from Well 2004-1

In borehole 1, the upper 130 feet are composed of terrace deposits, with the upper 10 feet being noticeably enriched in organic matter (5YR2/1, 5YR3/2, and 5YR4/4 at 5, 10 and 15 feet, respectively). Granitic clasts encountered in the terrace deposits are mainly angular granodiorites, with less than 15 percent total dark minerals (mainly black hornblende) and a relatively low percentage of quartz. At 130 feet, the drill penetrated weathered medium- to very fine-grained quartz diorite, which extended throughout the 255-foot total depth of this hole. The entire 125 feet of granitic rock is noticeably decomposed, with a deep-orange tint, and with plagioclase crystals that have weathered in place to sub-rounded. No mafic or dark zones were encountered; one clear vein sample at 215 feet is the only marked deviation from typical quartz dioritic composition.

Geophysical Logging Well 2004-1

Down-hole geophysical surveys were conducted by Norcal Geophysical Consultants (Norcal) on Saturday, January 17, 2004. Norcal ran several surveys: fluid conductance log, caliper log, elog suite (comprising natural gamma, resistivity and spontaneous potential), and induction resistivity log. The graphical logs by depth are integrated with the geologists' lithologic and hydrologic observations and well construction details, and presented in Appendix A.

The logs confirmed the weathered granitic contact at 135 feet bgs with possible fractures in the granitics at 150 and 170 feet bgs, and overlying coarse sands and gravels from 120 to 135 feet bgs. The bentonite plug at the top of the sand-filter pack between 80 and 85 feet bgs was placed in a clayey portion of the marine terrace deposits.

Completion of Well 2004-1

After evaluating the geophysical logs, cuttings samples and geologist's notes, the well was cased on Monday, January 19, 2004 with 5-inch diameter PVC casing, Certa-Lok IB well casing IC-1 PVC SDR21 (ASTM F480-02 SE NSF-61), as advised by Balance Hydrologics. During the installation of the casing the borehole had filled with native material from 228 to 215 feet bgs. A 20-foot section of solid casing ('bull-nose') was installed from 215 feet to 195 feet bgs. This section of pipe was followed by 100 feet of 0.032-inch slotted casing to 95 feet bgs. Above this perforated section, solid casing was installed to ground surface. The annulus surrounding the well casing was filled with 6/12 grade sand as a filter pack from the bottom of the borehole up to 85 feet bgs. A 5-foot bentonite plug was placed from 85 to 80 feet bgs.

On the following morning, on January 20, 2004, a 80 feet of concrete grout was poured to ground surface, and inspected by Panaka Chea of San Mateo County Environmental Health Services. After development, the well yielded 21 gallons per minute during the air-lift test. The specific conductance of the ground water was 840 $\mu\text{mhos/cm}$ at 17 ° C.

Yield Testing Well 2004-1

We conducted a 72-hour constant-rate yield test at 9.6 gallons per minute (gpm) at well 2004-1. The test was carried out while discharging pumped water with sprinklers to unfarmed agricultural soils located at the north end of Ocean View Farms. Richard Henry (Henry Plumbing) installed a Goulds submersible turbine pump model 25GS with a 30 HP pump at a depth of 200 feet below ground surface (bgs). A 1¼ - inch diameter steel pipe extended from the pump, to the surface and to a 4-inch diameter sprinkler line.

The 72-hour yield test started on September 21, 2004 at a static water level of 31.25 feet below ground surface (bgs). The well was pumped for 72-hours at an average pumping rate of 9.6 gpm. The total drawdown was 98.3 feet, which corresponded to 129.5 feet bgs. The water level in the well then recovered 100 percent in 2 days after pumping was discontinued. Plots of the yield test results are found in Appendix A.

The specific capacity (Cs) of the well (a measure of its unit yield) is 0.091 gpm per foot of drawdown (when extrapolated to 10,000 minutes of pumping). Besides being useful when comparing well yields of

wells, the specific capacity may be used to size and setup pumps for long-term pumping, so as not to over-pump the well and potentially expose well screens to air where soluble metals such as iron and manganese may oxidized and precipitate on the perforations, limiting ground-water flow in the well. We estimated a long-term pumping rate of 5.8 gpm, which would draw the water level in the well to the top of the well screens at 95 feet bgs.

Both the pumping and recovery data were consistent in estimating aquifer transmissivity (T). The estimated transmissivity using the pumping data was 127 gallons per day per foot (gpd/ft), and using the recovery data it was estimated at 156 gpd/ft. Hydraulic conductivity (K), if calculated from these estimates would be 0.77 to 0.96 gpd/ft², or about 4×10^{-5} centimeters per second (cm/s).

WELL 2004-2

Drilling Well 2004-2

Drilling of borehole BH-3 commenced on Friday, January 23, 2004 with a rotary rig using air and a 8¾-inch tricone drilling bit. Driller was again Jose Fernandez; with Maggiora Bros. Cutting samples were collected every 5 ft. Organic topsoil loam, of high clay content was encountered in the first 5 ft. below ground surface (bgs). Below 5 ft. we started to drill into light brown to yellowish orange terrace deposits. Cuttings samples were of poorly sorted, cohesive sandy clay (SC). Water was first encountered at 10 ft. below surface with artesian flow of approximately 1 to 1.5 gallons per minute (gpm). The bottom of the hole reached 18 ft. bgs before stopping for the day.

At the beginning of the day on Monday, January 26, the drilling bit was changed to an 8 ¾-inch bit. Similar terrace deposits were encountered down to 25 ft. when we started drilling through decomposed (weathered) quartz diorite. When the borehole was 97 feet bgs, switched to drilling with foam in order to prevent cave-ins. At 150 ft. we started to drill through more competent, though fractured, quartz diorite. Stopped drilling for the day when the bottom of the hole reached 154 ft. bgs.

On Tuesday, January 27 the hole was found to have collapsed to a depth of 30 feet. On Thursday, January 29, the drilling crew started cleaning out the hole with a 9 7/8-inch tricone bit through collapsed material reaching 70 feet bgs. Before stopping work for the day, 65 feet of steel conductor casing were installed.

On Friday, January 30 resumed cleaning out the hole down to 147 ft. bgs. Nevertheless, the hole collapsed again, this time back up to 120 ft. On Saturday, January 31 the hole was cleaned out down to 154 ft. Before drilling resumed, the bit was found to be dull and was replaced. At 182 ft. bgs drilling slowed down

from 240 feet per hour to 5 feet per hour. Throughout the day we drilled through fractured quartz diorite similar to what was found above. Drilling continued down to 192 ft. and stopped for the day.

Drilling resumed on Thursday, February 5 with a new button bit and using Baroid Quick-Gel mud. A depth of 222 ft. was reached by the end of the day. On Friday, February 6 drilling continued through similar material down to a depth of 238 ft. bgs. The hole collapsed over the weekend up to 153 ft. On Monday, February 9 the hole was cleaned back down to 238 ft. On Tuesday, February 10 drilling of the well was switched to air-hammer. Conductor casing was advanced down to 153 ft. Drilling stopped at the end of the day with the bottom of hole at 304 ft. bgs.

On Wednesday, February 11, drilling continued with air-hammer, water and foam at a rate of 120 feet per hour. A depth of 464 ft. was reached by the end of the day through continued fractured quartz diorite. A geophysical log was run on this well on Thursday, February 12 by Bill Henrich, of Norcal Geophysics. On Friday, February 13, drilling continued with air hammer until it reached a well total depth of 554 ft. at 14:50, still in fractured granitics.

Geologic Interpretation of Borehole Samples from Well 2004-2

The upper 25 to 30 feet of borehole 3 are relatively fine-grained light-brown to yellow-orange (7.5YR4/4) terrace deposits, primarily silt and fine sand with some angular coarse sand and fine gravel. There is little sign of organic enrichment in the upper 5 to 10 feet. Weathered granitics first appear in the 30-foot sample extending to about 155 feet, with a short zone of intense weathering at 150 feet, likely associated with a fracture or joint. At 170 to 265 feet fresh quartz diorite prevailed, with the 240-foot sample likely being mafic schlieren with 70 percent dark minerals. This material transitions at 275 feet to a darker, very-fine-grained (aphanitic?) dioritic or quartz dioritic rock, with 50 to 60 percent black hornblende which is sub-horizontally fractured. An interval of coarser-grained rock of similar composition was encountered at depths of 455 to 470 feet. A sharp transition from the conspicuously dark grey-black rock to a very unweathered felsic granitic with up to 25 percent quartz occurs at 525 feet; this light rock continues to the final depth of 561 feet. Quite striking is the relative absence of green hornblendes, which appear only faintly just above the 525-foot transition.

Geophysical Logging Well 2004-2

Down-hole geophysical surveys were conducted by Norcal Geophysical Consultants (Norcal) on Thursday, February 12, 2004. Norcal ran several surveys: an acoustic televiwer survey, temperature and fluid conductance log, caliper log, and elog suite (comprising natural gamma, resistivity and spontaneous

potential). The graphical logs by depth are integrated with the geologists' lithologic and hydrologic observations and well construction details, and presented in Appendix B.

The logs began at 150 feet bgs at competent granitic bedrock and the base of the conductor casing. Principal fracture zones within the granitics were identified below 295 feet bgs: 295 to 325 feet bgs, 340 feet bgs, and below 380 feet bgs. Artesian flow from the well of about 1 gallon per minute suggested flow from these bedrock fractures.

The borehole acoustic televiewer survey images the rock formation and is helpful to assess anomalies indicated by the other geophysical logs, particularly in fractured bedrock. Analysis of the images measures the orientation of fractures intersected by the borehole, which are illustrated on a stereo net plot.¹ The fracture orientations clearly show two fracture/joint populations (Appendix B):

- Striking about north 25 degrees east and dipping 72 degrees to the southeast; and,
- Striking approximately south 37 degrees east and dipping 72 degrees to the northwest.

We logged similar orientations in other test wells in the region. Broadly similar joint and fracture orientations were noted along the crest of Montara Mountain by USGS geologic-mapping staff (Pampeyan, 1984), and are dominant orientations of valleys and channel courses.

Completion of Well 2004-2

After evaluating the geophysical logs, cuttings samples and geologist's notes, the well was cased on Sunday, February 29, 2004 with 6-inch diameter PVC casing, Certa-Lok IB well casing IC-1 PVC SDR21 (ASTM F480-02 SE NSF-61), as advised by Balance Hydrologics. A 20-foot section of solid casing ('bull-nose') was installed at the bottom of the well and 0.032-inch slotted sections of casing were placed from 530 to 470 feet, 440 to 370 feet, 350 to 290 feet, and 190 to 90 feet, with interconnecting solid sections. Above these perforated sections, solid casing was installed to ground surface. The annulus surrounding the well casing was filled with 6/12 grade sand as a filter pack from the bottom of the borehole up to 52 feet bgs and concrete grout was poured to ground surface. Panaka Chea of San Mateo County Environmental Health Services approved inspection of the seal by Balance Hydrologics geologist. This well was completed at total depth of 552 feet bgs on Sunday, February 29. A summary of well characteristics is presented in Table 1.

¹ The conventional method to plot a 2-D feature like a fracture or a joint is to project the plane of the fracture as one-dimensional poles-to-planes on a stereo net projection. Clusters of data points in specific regions of the stereo net projection define a population. When contoured, the highest density can be interpreted as an average orientation of the fracture population.

On Wednesday, March 3 an airlift test was carried out on this well with the following results:

Depth (ft)	Flow (gpm)	Water Temperature (°C)	Specific Conductance (µmhos/cm)
160	36	21	374
300	43	21	357
400	48	21	357
520	45	25	337

Yield Testing Well 2004-2

We conducted a 72-hour constant-rate yield test at 45 gallons per minute (gpm) at well 2004-2. As with the yield test at well 2004-1, this test was also carried out while discharge pumped water with sprinklers to unfarmed agricultural soils on Ocean View Farms. Richard Henry (Henry Plumbing) installed a Goulds submersible turbine pump model 40GS with a 75 HP pump at a depth of 460 feet below ground surface (bgs). A 1¼ -inch diameter steel pipe extended from the pump, to the surface and to a 4-inch diameter sprinkler line.

The 72-hour yield test started at a static water level of 4.5 feet below ground surface (bgs). The well was pumped for 72-hours at an average pumping rate of 9.6 gpm. The total drawdown was 195 feet, or 199.5 feet bgs. The water level in the well then recovered 100 percent during 3 days after pumping was discontinued. Plots of the yield test results are found in Appendix B.

The specific capacity (Cs) of the well (a measure of its unit yield) is 0.22 gpm per foot of drawdown (when extrapolated to 10,000 minutes of pumping). Besides being useful when comparing well yields of wells, the specific capacity may be used to size and setup pumps for long-term pumping, so as not to over-pump the well and potentially expose well screens to air where soluble metals such as iron and manganese may oxidized and precipitate on the perforations, limiting ground-water flow in the well. We estimated a long-term pumping rate of 19 gpm, which would draw the water level in the well to the top of the well screens at 90 feet bgs. Higher yields from the well would correspond with lowered water levels.

Both the pumping and recovery data were consistent in estimating aquifer transmissivity (T). The estimated transmissivity using the pumping data was 370 gallons per day per foot (gpd/ft), and using the recovery data it was estimated at 700 gpd/ft. Hydraulic conductivity (K), if calculated from these estimates would be 2.6 to 4.8 gpd/ft², or about 2×10^{-4} centimeters per second (cm/s).

Limitations

The content of this memo was prepared in general accordance with the accepted standard of practice in surface-water and ground-water hydrology existing in Northern California for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

This memo assembled information collected while drilling and testing two wells. No conclusions or recommendations are presented. As is customary, readers should recognize that interpretation and evaluation of subsurface conditions and physical factors affecting the hydrologic context of any site is a difficult and inexact art. We note that many factors affect local and regional ground-water levels. Judgments leading to conclusions and recommendations are generally and customarily made with an incomplete knowledge of the conditions present. More extensive or extended studies, including additional and more complete aquifer tests, can reduce the inherent uncertainties associated with such studies.

Concepts, findings and interpretations contained in this memo were intended for the exclusive use of Montara Water and Sanitary District under the conditions presently prevailing except where noted otherwise. Their use beyond the boundaries of the site could lead to environmental or structural damage, and/or to noncompliance with water-quality policies, regulations or permits.

References

- California Department of Water Resources, 1999, Montara water supply study for Montara Sanitary District, San Mateo County, California: California Department of Water Resources, Central District, June 1999, 57p.
- Pampeyan, E.H., 1994, Geologic map of the Montara Mountain and San Mateo 7-1/2' quadrangles, San Mateo County, California: U.S. Geological Survey Map I-2390.

TABLES

**Table 1. Well drilling and construction descriptors and yield test results,
Ocean View Farms, Montara, San Mateo County, California.**

	Well 2004-1	Well 2004-2
Site locators		
Borehole number	BH-1	BH-3
Well drillers report number	0915990	1095583
Assessors parcel number	036-330-040	036-320-100
Latitude, NAD27	N37.5519	N37.5505
Longitude, NAD27	W122.5107	W122.5077
Elevation, feet	60	100
Property owner	POST	POST
Drilling and well construction descriptors		
Date drilling began	1/15/2004	1/23/2004
Date of well completion	1/20/2004	2/29/2004
Depth of static water, feet	25	artesian
Air lift test, gpm	21	48
Specific conductance, umhos/cm @ field temperature	840	357
Temperature, C	17	21
Diameter of well casing, inches	5	6
Depth of seal, feet	85	52
Depth of bentonite plug	80 to 85	--
Screened intervals, feet	95 to 195	90 to 190 290 to 350 370 to 440 470 to 530
Bottom of casing, feet	215	552
Depth of borehole, feet	235	554
Step-drawdown tests		
Date of test	9/20/2004	11/15/2004
Step 1		
Flow rate, gpm	14	60
Duration, hours	3.5	5.6
Drawdown, feet	97.35	298.00
Specific capacity (Cs), gpm per foot of drawdown	0.14	0.20
Step 2		
Flow rate, gpm	25	--
Duration, hours	test terminated after 1.6 hrs	--
Drawdown, feet	max pump head reached	--
Specific capacity (Cs), gpm per foot of drawdown	--	--
Step 3		
Flow rate, gpm	--	--
Duration, hours	--	--
Drawdown, feet	--	--
Specific capacity (Cs), gpm per foot of drawdown	--	--
Total volume of water pumped, gallons	5,045	20,200

Yield testing

Date pumping began	9/21/2004	11/16/2004
Flow rate, gpm	9.6	45
Pumping duration, hours	72	75
Total volume of water pumped, gallons	41,600	202,500
Static depth to water level, feet	31.25	4.50
Depth to water at end of pumping, feet	129.53	201.35
Drawdown at end of pumping, feet	98.28	196.85
Projected drawdown at 10,000 minutes, feet	106	204
Specific capacity (Cs), gpm per foot of drawdown	0.091	0.22
Maximum pumping rate while keeping perforations submerged (Cs x depth to perforations), gpm	5.8	19
Aquifer permeability based on pumping drawdown data:		
Transmissivity (T), gpd/ft	127	371
Hydraulic conductivity (K), gpd/ft ²	0.77	2.6
Hydraulic conductivity (K), cm/sec	3.6E-05	1.2E-04
Date pumping ended and recovery began	9/24/2004	11/19/2004
Recovery duration, hours	48	74
Depth to water at end of recovery, feet	32.36	4.45
Percent recovery at end of recovery	99%	100%
Aquifer permeability based on residual drawdown data during recovery:		
Transmissivity (T), gpd/ft	156	699
Hydraulic conductivity (K), gpd/ft ²	0.96	4.80
Hydraulic conductivity (K), cm/sec	4.5E-05	2.3E-04

Notes:

POST = Peninsula Open Space Trust

**Table 2. Summary of field measurements and water quality analyses,
Ocean View Farms, Montara, San Mateo County, California.**

PARAMETER	UNITS	DETECTION LIMIT	MCL	Water Well Samples				Surface Water Samples	
DESCRIPTORS									
Sample I.D. Site				040922:1900 Well 2004-1 (BH-1)	041118:1100 Well 2004-2 (BH-3)	041007:1338 McNee Ranch Domestic Well	041007:1550 Ocean View Stables Well	041007:1616 Martini Creek Gage	041126:1720 Daffodil Canyon near BH-3
Assessors parcel number				036-330-040	036-320-100	036-330-030	036-330-040	036-330-040	036-330-040
Latitude, NAD27	degrees			N37.5519	N37.5505	N37.5537	N37.5534	N37.5541	N37.5504
Longitude, NAD27	degrees			W122.5107	W122.5077	W122.5067	W122.5068	N122.5057	W122.5072
Elevation, NGVD29	feet			60	100	100	100	100	120
Lab used				Soil Control	Soil Control	Soil Control	Soil Control	Soil Control	Soil Control
Sample collected by				gp	jp	jp	mw	mw	jp
Sample filtering				yes	yes	yes			yes
FIELD MEASUREMENTS									
Date	MM/DD/YY			9/22/2004	11/18/2004	10/7/2004	10/7/2004	10/7/2004	11/26/2004
Time	HH:MM			19:00	11:00	13:38	15:50	16:16	17:20
Specific conductance (@ 25 C°)	umhos/cm			511	347	368		219	
Conductance (@ field temp)	umhos/cm			391	333	320		170	
Temperature	deg C			13.5	22.6	18.5		14	
WATER QUALITY INDICATORS									
Alkalinity (total)	mg/L CaCO3	1		82	68	92	190	57	64
Hardness (total)	mg/L CaCO3	5		110	61	110	260	73	79
pH	pH Units	0.1	10.6	8.1	8.1	7.5	6.6	7.2	7.5
Specific conductance (@ 25 C°)	umhos/cm	1	1600	450	340	370	670	240	250
Total dissolved solids (TDS)	mg/L	10	1000	290	220	240	430	150	160
GENERAL MINERALS									
Bicarbonate (as CaCO3)	mg/L	1		82	68	92	190	57	64
Calcium (Ca)	mg/L	0.5		32	19	33	69	22	24
Carbodate (as CaCO3)	mg/L	1	120	0	0	0	0	0	0
Chloride (Cl)	mg/L	1	250	92	56	52	82	32	37
Iron (Fe)	mg/L	0.05	0.3	0	0	0	4.8	0.069	0.33
Magnesium (Mg)	mg/L	0.5		7.3	3.3	6.8	22	4.4	4.7
Manganese (Mn)	mg/L	0.02	0.05	0.037	0.03	0	0.34	0	0.032
Potassium (K)	mg/L	0.5		0.93	1.1	1.1	0.94	0	0
Sodium (Na)	mg/L	0.5		54	44	34	66	24	25
Sulfate (SO4)	mg/L	1	250	15	8.4	10	46	7.9	7.1
TITLE 22 PRIMARY STANDARDS, INORGANIC									
Aluminum (Al)	mg/L	0.05	1	0	0				
Antimony (Sb)	mg/L	0.006	0.006	0	0				
Arsenic (As)	mg/L	0.002	0.010	0	0				
Barium (Ba)	mg/L	0.1	1	0	0				
Beryllium (Be)	mg/L	0.001	0.004	0.0025	0				
Cadmium (Cd)	mg/L	0.001	0.005	0	0				
Chromium (Cr)	mg/L	0.001	0.05	0.0013	0				
Fluoride (F)	mg/L	0.1	1	1.1	1.8	1.1	0.85	0.39	0.57
Mercury (Hg)	mg/L	0.0002	0.002	0	0				
Nickel (Ni)	mg/L	0.01	0.1	0	0				
Nitrate as (NO3)	mg/L	1	45	0	0	1.8	0	0	0
Selenium (Se)	mg/L	0.005	0.05	0	0				
Thallium (Tl)	mg/L	0.001	0.002	0	0				
OTHER CONSTITUENTS									
Boron (B)	mg/L	0.1		0	0				
Copper (Cu)	mg/L	0.05	1	0	0				
Lead (Pb)	mg/L	0.005	0.015	0	0				
Sliver (Ag)	mg/L	0.01		0	0				
Zinc (Zn)	mg/L	0.05	5	0.054	0				
Gross Alpha	pCi/L		15		0.405				
LAB CHECK									
Major Cations (Ca+Mg+K+Na+Fe+Mn)	meq/L	--	--	4.57	3.16	3.71	8.33	2.51	2.68
Major Anions (HCO3+CO3+Cl+SO4+F+NO3)	meq/L	--	--	4.60	3.21	3.60	7.11	2.23	2.50
Ion Balance (Cations/Anions)	--	--	--	0.99	0.99	1.03	1.17	1.13	1.07
NOTES									
Observer key: mw = Mark Woyshner; jp = Jason Parke; gp = Gustavo Porras;									
Lab results: 0 = not detected; blank value = not tested									
MCL = Title 22 Maximum Contaminant Level as of June 12, 2003; the MCL of Lead is the Regulatory Action Level									

FIGURES

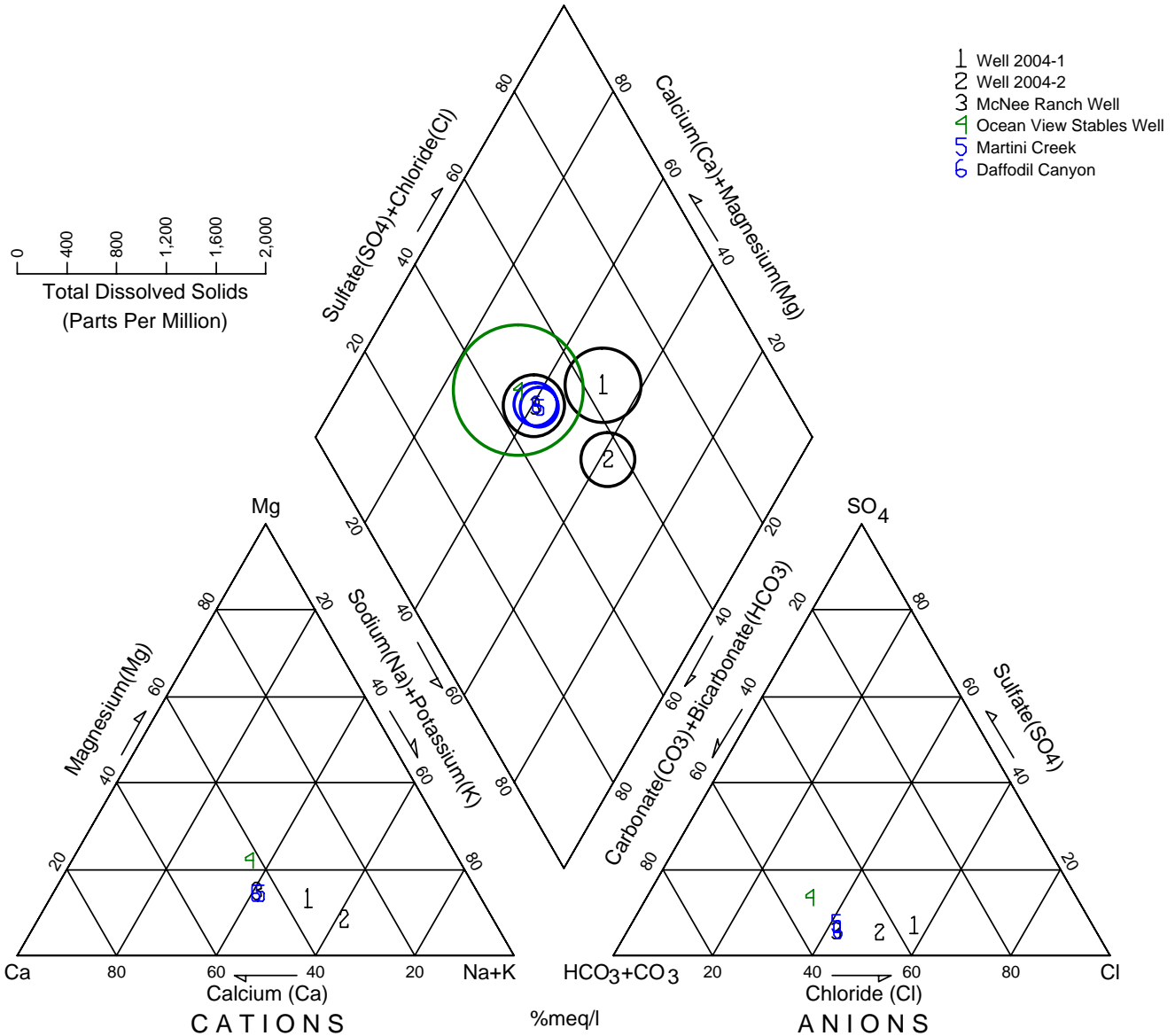


Figure 1. Well locations on Ocean View Farms, Montara, San Mateo County, California



Ocean View Farms

Montara, San Mateo County, California



This diagram shows cations in the ternary graph on the left and anions on the right graph. The diamond graph in the center illustrates both cations and anions. Hardness dominated water plots to the left and top of the diamond graph, soft monovalent-salt dominated water to the right, and soft alkaline water towards the bottom. The radius of circle around the plotted points represents the concentration of dissolved solids, calibrated to the scale shown.



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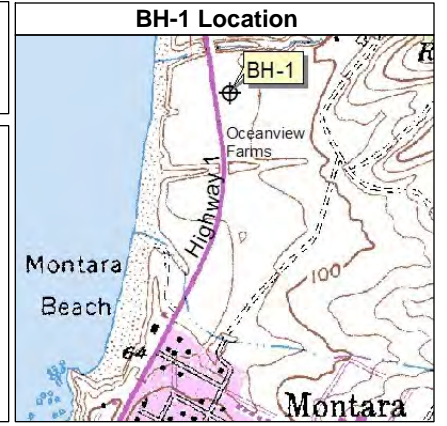
Figure 2. Piper diagram illustrating different ionic signatures of water samples collected from wells and surface waters on Ocean View Farms, Montara, San Mateo County, California.

APPENDIX A

Well 2004-1 geologic and geophysical logs, pumping yield and water quality test results, Ocean View Farms, Montara, San Mateo County, California.

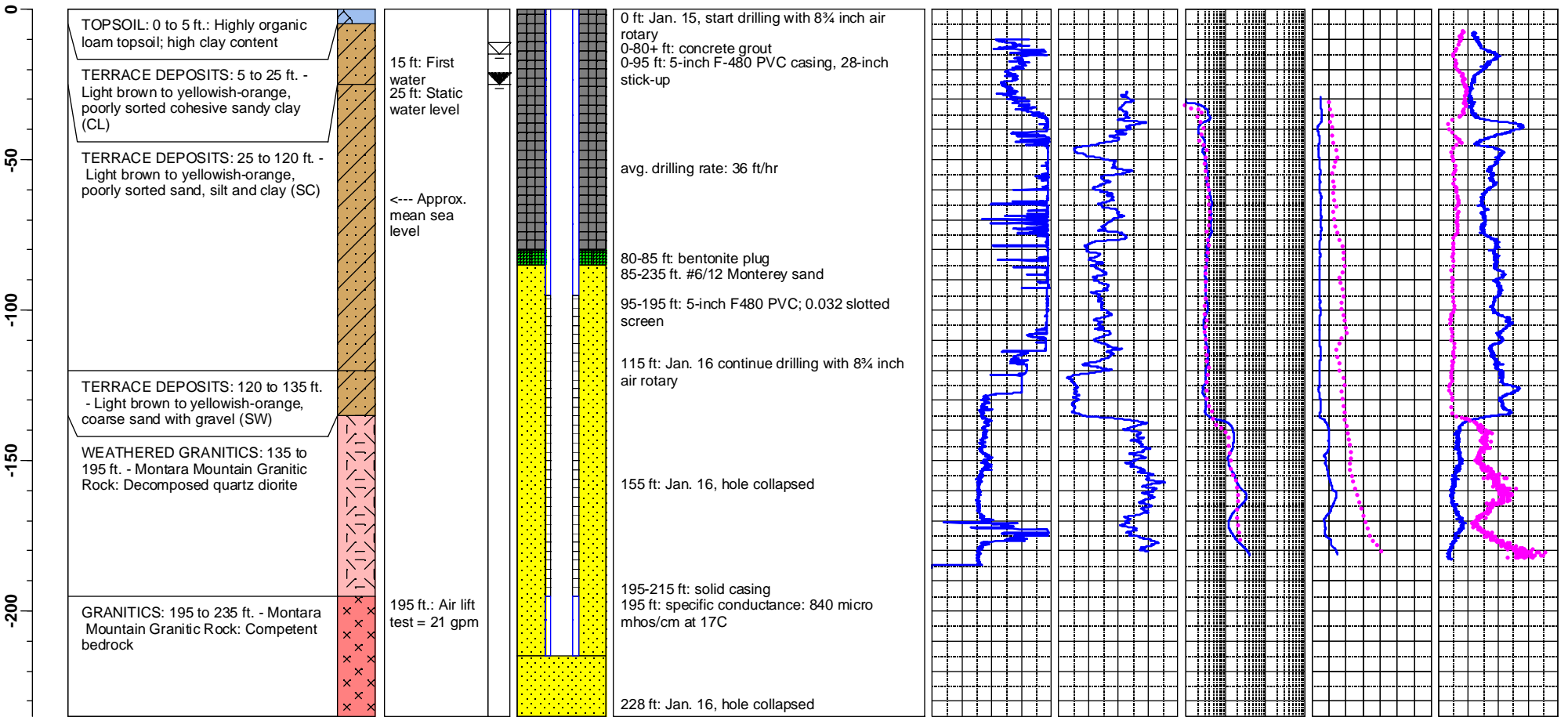
Note: Prior to drilling and completing well 2004-1, the borehole site was labeled BH-1.

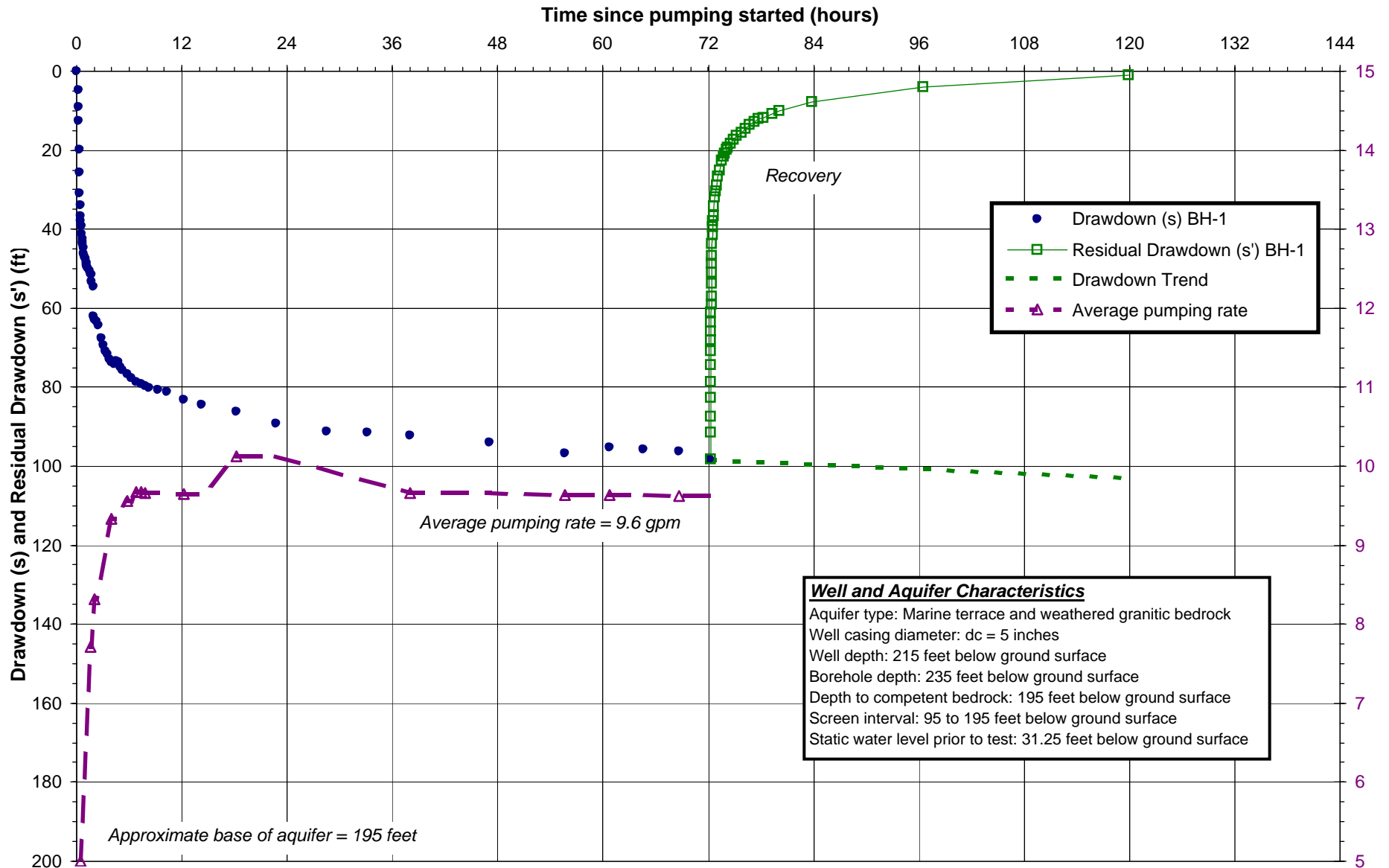
Appendix A: Geologic and geophysical logs and construction diagram for well 2004-1, APN 036-330-040, San Mateo County,



APN:	036-330-040	Driller:	Jose Fernandez, Maggiora Bros. Drilling
Location:	Oceanview Farms, Montara, CA	Drilling rig:	Ingersoll Rand 1150/350
Latitude, Longitude:	N37.5519, W122.5107 NAD27	Drilling equipment:	8 3/4 in. air rotary, 8 3/4 in. air hammer, 16 in. rotary ream
Ground surface elevation:	60 feet (approximate)	Cutting samples taken every 5 feet	
Start drilling date:	January 15, 2004	Depth of borehole:	235 feet below ground surface
Well completion date:	January 20, 2004	Depth of casing:	215 feet below ground surface
Borehole geologists:	Jason Parke, Gustavo Porras, Vic Abadie	Diameter of casing:	5 inches I.D.
Geophysical log:	Bill Henrich, Norcal Geophysics		

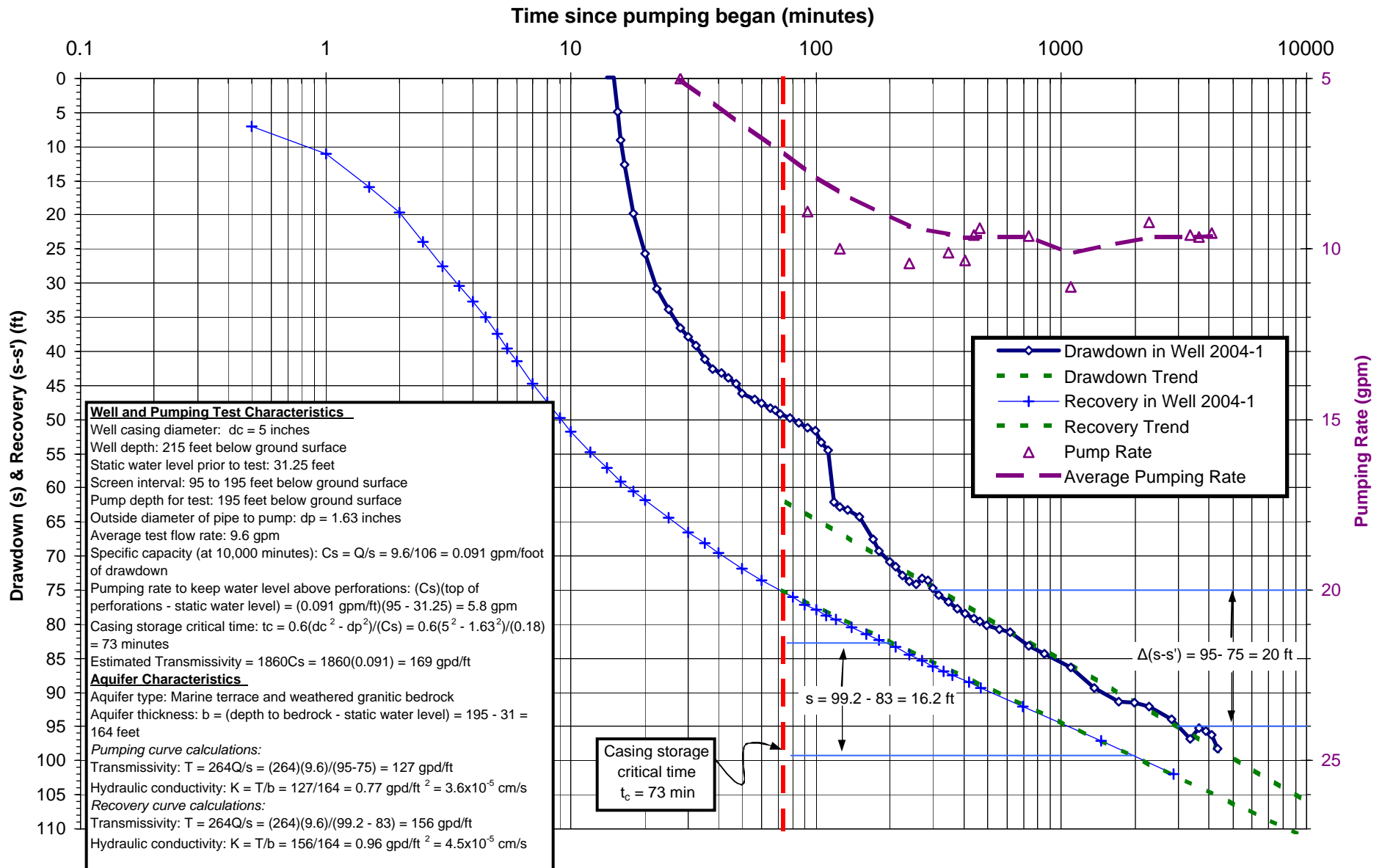
Depth feet	Lithology	Hydrology	Well Construction	Remarks	Caliper Inches	Natural Gamma API Cs.	16N Ohm-m	SPR Ohm	Cond mS/m
							10	0	0
					6	0	64N Ohm-m	SP Millivolt	R I Ohm-m





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Appendix A. Drawdown and recovery in well 2004-1, September 21 through September 26, 2004, from constant-rate pumping test, APN 036-330-040, San Mateo County, California



Appendix A. Results from a 72-hour constant rate pumping test at 2004-1 from September 21 through September 26, 2004, APN 036-330-040, San Mateo County, California



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29 SEP 04

Well 2004-1 on Ocean View Farms APN 036-330-040 near Highway 1.

MATERIAL:	Water sample received 23 September 2004	
IDENTIFICATION:	Project #204119, Well BH1 Sample ID: 2041190409221905	PUBLIC HEALTH DRINKING WATER LIMITS¹
REPORT:	Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):	
pH value (units)	8.1	10.6
Conductivity (micromhos/cm)	450	1600
Carbonate Alk. (as CaCO ₃)	0	120
Bicarbonate Alk. (as CaCO ₃)	82	-
Total Alkalinity (as CaCO ₃)	82	-
Total Hardness (as CaCO ₃)	110	-
Total Dissolved Solids	290	1000
Nitrate (as NO ₃)	< 1	45
Chloride (Cl)	92	250
Sulfate (SO ₄)	15	250
Fluoride (F)	1.1	1.0
Calcium (Ca)	32	-
Magnesium (Mg)	7.3	-
Potassium (K)	0.93	-
Sodium (Na)	54	-
Total Iron(Fe)	< 0.05	0.3
Manganese (Mn)	0.037	0.05

¹California Administrative Code; Title 22



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Well 2004-1 on Ocean View Farms APN 036-100-040 near Highway 1.

MATERIAL:	Water sample received 23 September 2004	
IDENTIFICATION:	Project #204119, Well BH1	PUBLIC HEALTH
	Sample ID: 2041190409221905	DRINKING
REPORT:	Quantitative chemical analysis is as follows	WATER
	expressed as milligrams per liter:	LIMITS ¹
Arsenic (As)	< 0.002	0.05
Barium (Ba)	< 0.10	1.0
Boron (B)	< 0.10	-
Cadmium (Cd)	< 0.001	0.005
Chromium (Cr)	0.0013	0.05
Copper (Cu)	< 0.05	1.0
Cyanide (CN)	< 0.05	0.2
Lead (Pb)	< 0.005	0.05
Mercury (Hg)	< 0.0002	0.002
Selenium (Se)	< 0.005	0.05
Silver (Ag)	< 0.010	0.1
Zinc (Zn)	0.054	5.0
MBAS (Surfactants)	0.030	0.5
Aluminum (Al)	< 0.05	1.0
Antimony (Sb)	< 0.006	0.006
Beryllium (Be)	0.0025	0.004
Nickel (Ni)	< 0.01	0.1
Thallium (Tl)	< 0.001	0.002
Nitrite (as NO ₂)	< 0.5	-

¹ California Administrative Code;
Title 22



ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
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FAX: 831 724-3188

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Well 2004-1 on Ocean View Farms APN 036-130-040 near Highway 1.

MATERIAL: Water sample received 23 September 2004
IDENTIFICATION: Project #204119, Well BH1
Sample ID: 2041190409221905
REPORT: General Physical Analysis is as follows:

TEMPERATURE (°C)	COLOR (Co/Pt) (Units)	ODOR (Threshold (Number)	TURBIDITY (NTU)	pH value (units)
-	< 3	< 1	0.56	8.1

-not determined
Odor test performed at 60°C

A Division of Control Laboratories Inc.

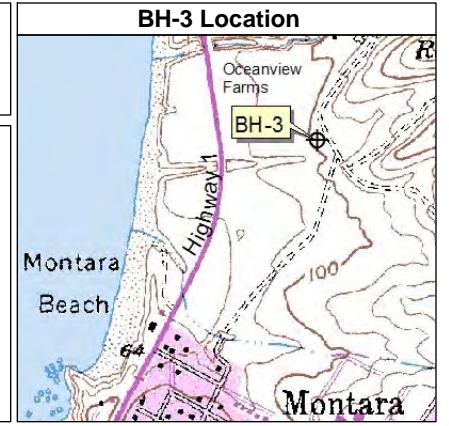


APPENDIX B

Well 2004-2 geologic and geophysical logs, pumping yield and water quality test results, Ocean View Farms, Montara, San Mateo County, California.

Note: Prior to drilling and completing well 2004-2, the borehole site was labeled BH-3.

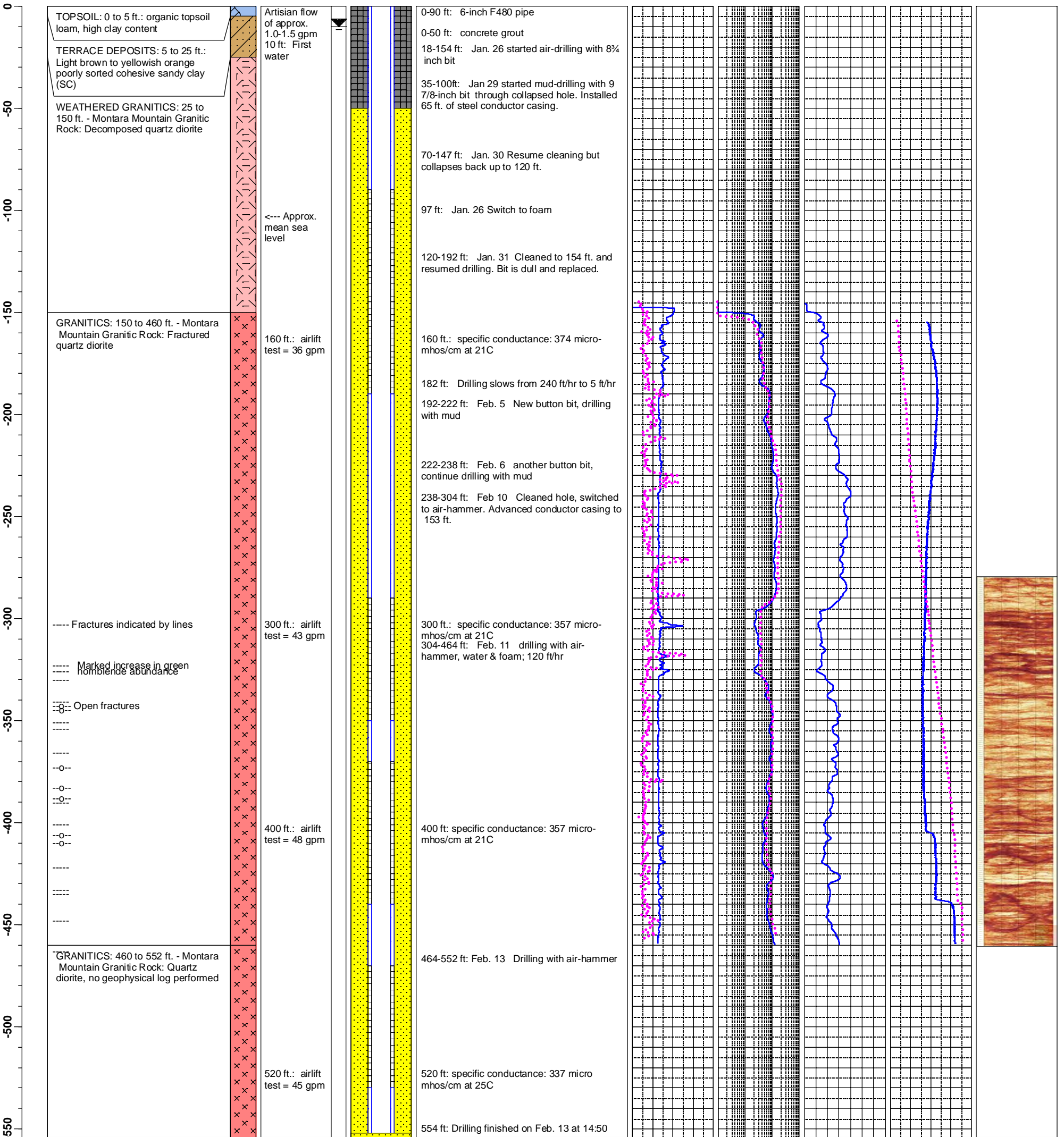
Appendix B: Geologic and geophysical logs and construction diagram for well 2004-2, APN 036-320-100, San Mateo County, California



APN: 036-320-100
 Location: Oceanview Farms, Montara, CA
 Latitude, Longitude: 37.5505, W122.5077 NAD 27
 Ground surface elevation: 100 feet
 Start drilling date: January 23, 2004
 Well completion date: February 29, 2004; airlift on March 3, 2004
 Borehole geologists: Jason Parke, Gustavo Porras, Vic Abadie
 Geophysical log: Bill Henrich, Norcal Geophysics on Feb. 12, 2004

Driller: Jose Fernandez, Maggiora Bros. Drilling
 Drilling rig: Ingersoll Rand 1150/350
 Drilling bits: 8 3/4 in. air rotary; 9 7/8 in. rotary, air hammer
 Cutting samples taken every 5 feet
 Depth of borehole: 554 feet below ground surface
 Depth of casing: 552 feet below ground surface
 Diameter of casing: 6 inches, I.D.

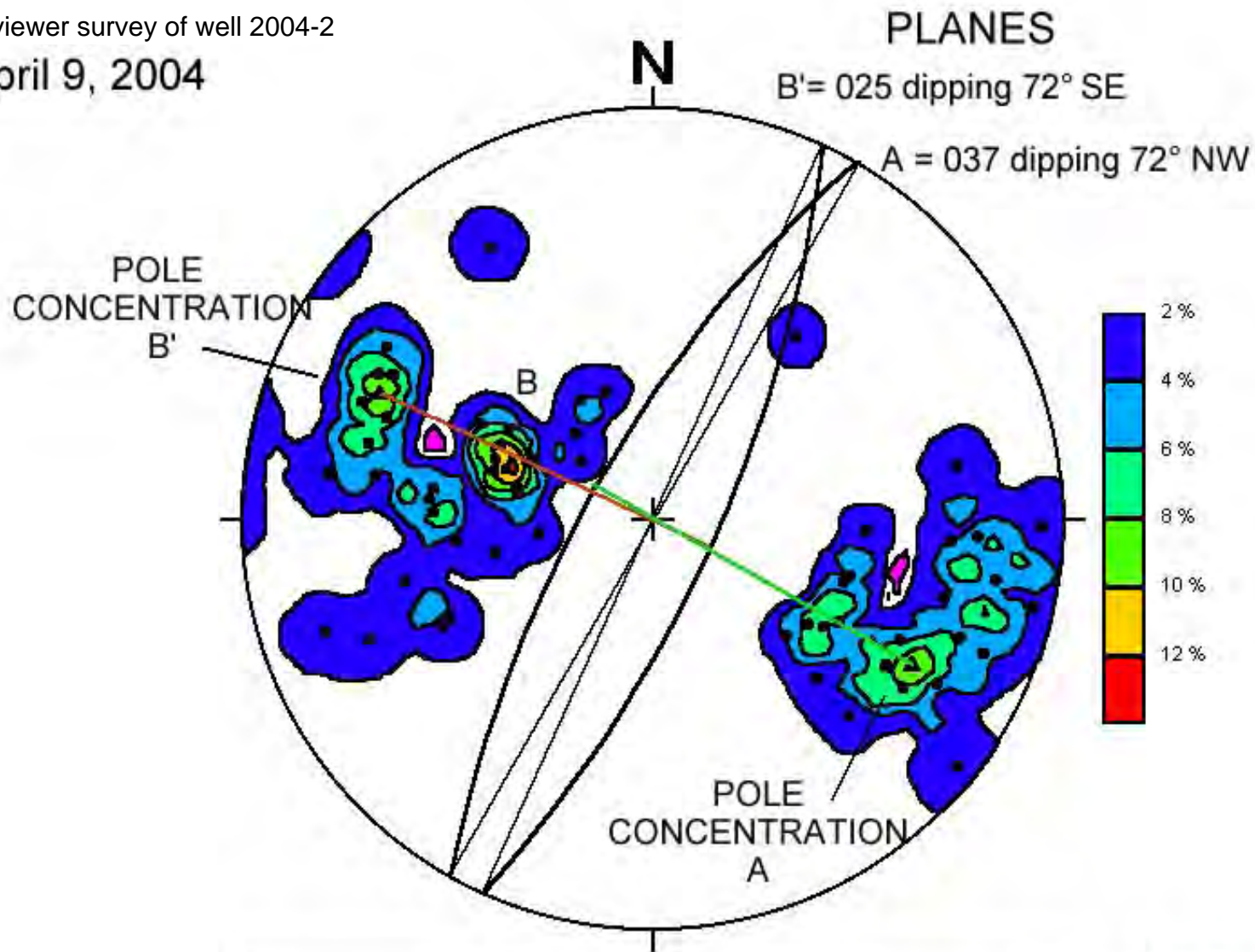
Depth feet	Lithology	Hydrology	Well Construction	Remarks	Caliper inches		16N Ohm-m		SPR Ohm		SC uS/cm		Acoustic Tele Viewer Amplitude (360° view) N E S W N
					6	16	10	10000	0	700	18	260	



STEREO-NET ANALYSIS

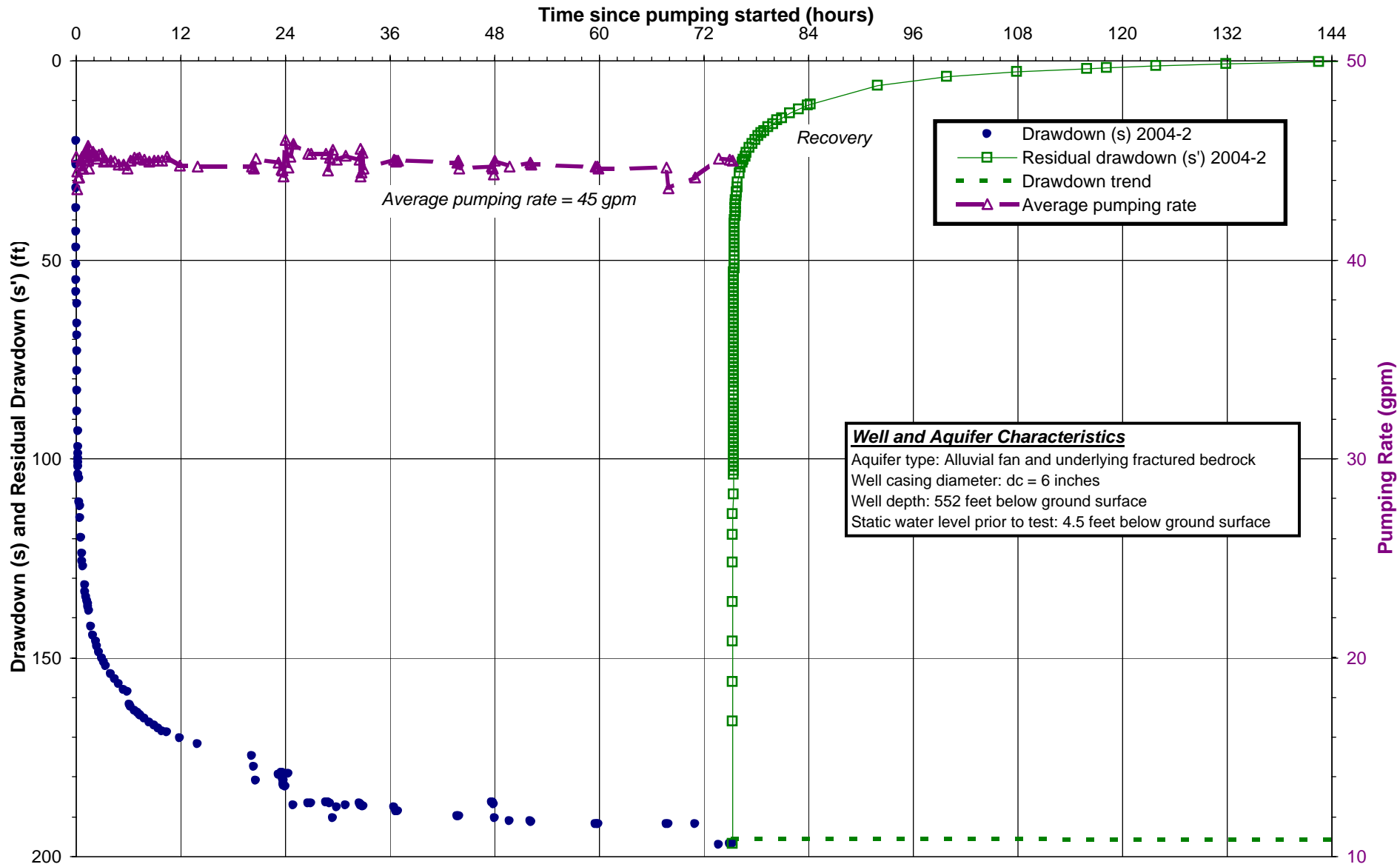
Acoustic televiewer survey of well 2004-2

April 9, 2004



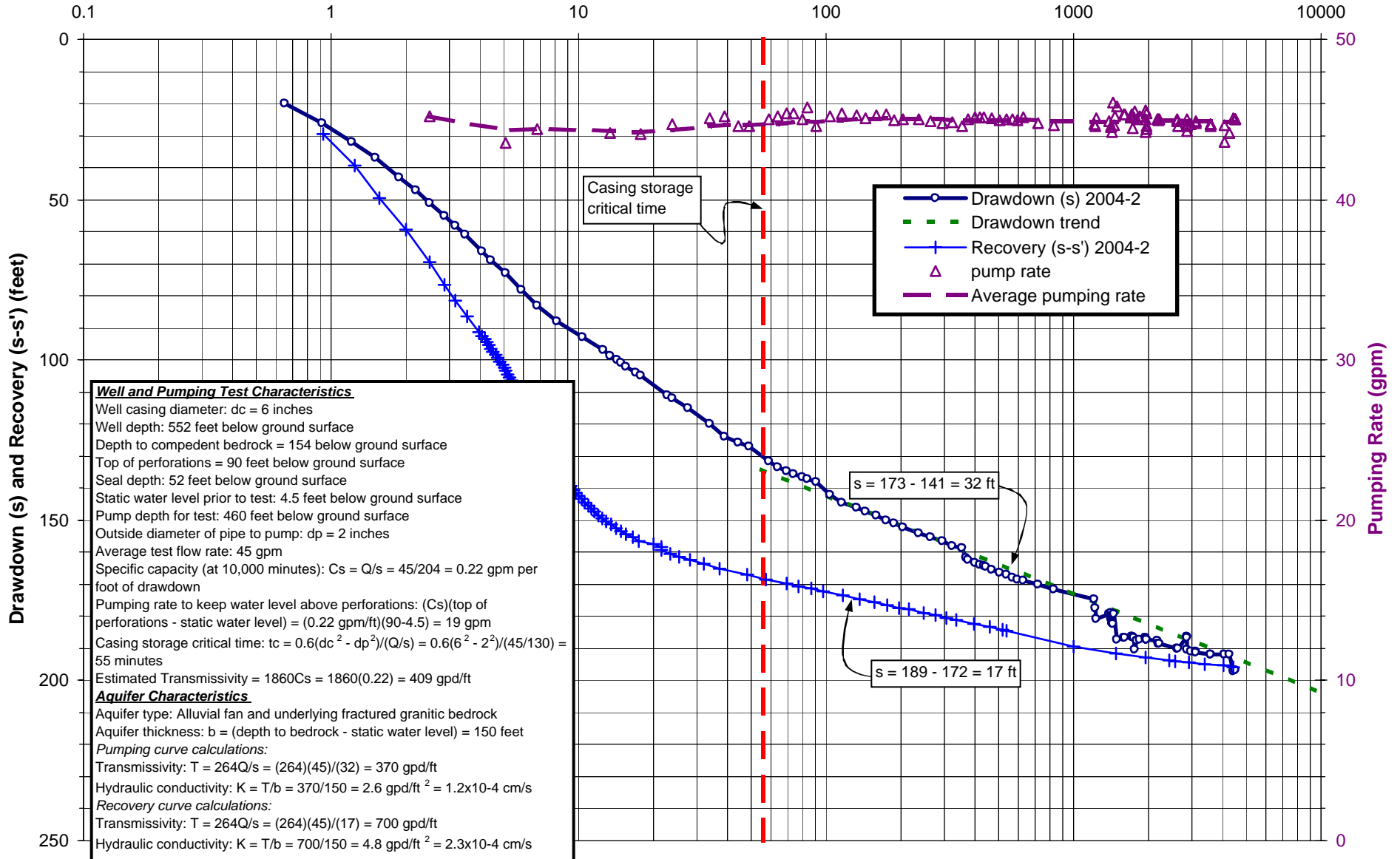
Lower hemisphere - B-3 Montarra			
dip direction			
dip			
N=58	Search area=1.0%	Peak=12.07	





Appendix B. Drawdown in well 2004-2, November 16 to 22, 2004 constant-rate pumping test, APN 036-320-100, San Mateo County, California.

Time (in minutes) since pumping began (drawdown) and since pumping stopped (recovery)



Appendix B. Water-level drawdown and recovery in well 2004-2 during constant-rate pumping test, November 16 to 22, 2004, APN 036-320-100, San Mateo County, California.



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29 NOV 04

Mark Woysner

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.

Well 2004-2

MATERIAL:	Water sample received 18 November 2004	
IDENTIFICATION:	Project 204119 - BH3 Pump Test Sample ID: BH3041118:1100	PUBLIC HEALTH DRINKING WATER LIMITS ¹
REPORT:	Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):	
pH value (units)	8.1	10.6
Conductivity (micromhos/cm)	340	1600
Carbonate Alk. (as CaCO ₃)	0	120
Bicarbonate Alk. (as CaCO ₃)	68	-
Total Alkalinity (as CaCO ₃)	68	-
Total Hardness (as CaCO ₃)	61	-
Total Dissolved Solids	220	1000
Nitrate (as NO ₃)	< 1	45
Chloride (Cl)	56	250
Sulfate (SO ₄)	8.4	250
Fluoride (F)	1.8	1.0
Calcium (Ca)	19	-
Magnesium (Mg)	3.3	-
Potassium (K)	1.1	-
Sodium (Na)	44	-
Total Iron(Fe)	< 0.05	0.3
Manganese (Mn)	0.030	0.05

¹California Administrative Code; Title 22



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Mark Woysner

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.

Well 2004-2

MATERIAL:	Water sample received 18 November 2004	
IDENTIFICATION:	Project 204119 - BH3 Pump Test	
	Sample ID: BH3041118:1100	
REPORT:	Quantitative chemical analysis is as follows	PUBLIC
	expressed as milligrams per liter:	HEALTH
		DRINKING
		WATER
		LIMITS¹
Arsenic (As)	< 0.002	0.05
Barium (Ba)	< 0.10	1.0
Boron (B)	< 0.10	-
Cadmium (Cd)	< 0.001	0.005
Chromium (Cr)	< 0.001	0.05
Copper (Cu)	< 0.05	1.0
Cyanide (CN)	< 0.05	0.2
Lead (Pb)	< 0.005	0.05
Mercury (Hg)	< 0.0002	0.002
Selenium (Se)	< 0.005	0.05
Silver (Ag)	< 0.010	0.1
Zinc (Zn)	< 0.05	5.0
MBAS (Surfactants)	< 0.025	0.5
Aluminum (Al)	< 0.05	1.0
Antimony (Sb)	< 0.006	0.006
Beryllium (Be)	< 0.001	0.004
Nickel (Ni)	< 0.01	0.1
Thallium (Tl)	< 0.001	0.002
Nitrite (as NO ₂)	< 0.5	-

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Title 22



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29 NOV 04

Mark Woysner

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.

Well 2004-2

MATERIAL: Water sample received 18 November 2004
IDENTIFICATION: Project 204119 - BH3 Pump Test
Sample ID: BH3041118:1100
REPORT: General Physical Analysis is as follows:

TEMPERATURE (°C)	COLOR (Co/Pt) (Units)	ODOR (Threshold (Number)	TURBIDITY (NTU)	pH value (units)
-	< 3	< 1	0.38	8.1

-not determined
Odor test performed at 60°C





BH-3



ANALYTICAL CHEMISTS

December 1, 2004

Lab ID : SP 412159
Customer : 2020008

Soil Control Lab
42 Hangar Way
Watsonville, CA 95076

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.

Laboratory Report

Introduction: This report package contains total of 3 pages divided into three sections:

- Case Narrative (1 Page): An overview of the work performed at FGL.
Chemical Results (1 Page): Results for each sample submitted.
Quality Control (1 Page): Supporting Quality Control (QC) results.

This report package pertains to the following sample:

Table with 5 columns: Sample Description, Date Sampled, Date Received, FGL Lab Sample ID #, Matrix. Row 1: BH3041118:1100 Well 2004-2, 11/18/2004, 11/19/2004, SP 412159-01, DW

Sampling and Receipt Information: The sample was received, prepared and analyzed within the method specified holding times. All samples arrived at 5 °C. All samples were checked for pH if acid or base preservation required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Forms.

Quality Control: All samples were prepared and analyzed according to the following tables:

Radio Chemistry QC

Table with 2 columns: Sample ID, Description. Row 1: 900.0, 11/22/2004:A207 All preparation quality controls are within established criteria. Row 2: 11/26/2004:A - GP214 All analysis quality controls are within established criteria.

Certification: I certify that this data package is in compliance with NELAC Standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following signature.

FGL ENVIRONMENTAL

Signature of Kelly A. Dunnahoo, B.S.
Laboratory Director

KAD:c1



ANALYTICAL CHEMISTS

December 1, 2004

Lab ID : SP 412159-01
Customer ID: 2-20008

Soil Control Lab
42 Hangar Way
Watsonville, CA 95076

Sampled On : November 18, 2004-00:00
Sampled By : Jason Parke
Received On: November 19, 2004-09:30
Matrix : Drinking Water

Description : BH3041118:1100
Project : Balance Hydroligcs #188648/204119 BH3 Pump Test *Well 2004-2*

Sample Results - Radiological

Constituents	Result ± Error	Units	MCL	Preparation		Analysis	
				Method	Date/ID	Method	Date/ID
Radio Chemistry P:1 Gross Alpha	0.405 ± 0.914	pCi/L	15*	900.0	11/22/04:A207	900.0	11/26/2004:A01

MCL = Maximum Contaminat Level. Containers: (P) Plastic Preservatives: (I) Cool 4°C
* Including Radium but excluding Uranium. (Ref. Title 22 sec. 64441.)

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.



ANALYTICAL CHEMISTS
 December 01, 2004
Soil Control Lab

Lab ID : SP 412159
 Customer : 2-20008

Quality Control - Radio

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Gross Alpha	900.0	11/22/2004:A207 (SP 412156-01)	Blank	pCi/L		ND	<1	
			LCS	pCi/L	42.33	95.5%	75-125	
			MS	pCi/L	42.33	98.2%	60-140	
			MSD	pCi/L	42.33	112%	60-140	
			MSRPD	pCi/L		13.2%	≤30	
Alpha-α	900.0	11/26/2004:A	00-CCB	cpm		ND	.0588 ± .062	
			00-CCV	cpm	24390	50.1%	49.9 ± .79	

Definitions

- Blank : Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples.
- LCS : Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery.
- MS/MSD : Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
- CCB : Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
- CCV : Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
- ND : Non-detect - Result was below the DQO listed for the analyte.
- DQO : Data Quality Objective - This is the criteria against which the quality control data is compared.

Well 2004-2 on Ocean View Farms APN 036-320-100 at the mouth of Daffodil Canyon.