Department of Energy
Carlsbad Field Office
P. O. Box 3090
Carlsbad, New Mexico 88221

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Hazardous Waste Bureau

Mr. John E. Kieling, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 E. Rodeo Park Dr. Bldg. 1
Santa Fe, New Mexico 87505-6303

Subject: Transmittal of the Waste Isolation Pilot Plant May 2014 Semi-Annual Groundwater Surface Elevation Report

Dear Mr. Kieling:

The purpose of this letter is to submit the Waste Isolation Pilot Plant May 2014 Semi-Annual Groundwater Surface Elevation Report. This report is required by Part 5, Section 5.10.2.2. of the Hazardous Waste Facility Permit No. NM4890139088-TSDF.

We certify under penalty of law that this document and all attachments were prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

Please contact Mr. George T. Basabilvazo at (575) 234-7488, if you have any questions regarding this data transmittal.

Sincerely,

Jose R. Franco, Manager
Carlsbad Field Office

Robert L. McQuinn, Project Manager
Nuclear Waste Partnership LLC

Enclosure

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UNITED STATES DEPARTMENT OF ENERGY

WASTE ISOLATION PILOT PLANT

CARLSBAD, NEW MEXICO

Semi-Annual Groundwater Surface Elevation Report

Water Level Monitoring Program Data Collection,

September 2013 – February 2014

SUBMITTED TO THE

NEW MEXICO ENVIRONMENT DEPARTMENT

April 2014

This report has been reviewed and approved by:

R. A. Salness, Manager.
Environmental Monitoring and Hydrology

4/17/14
Date

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1.0 Introduction

The Waste Isolation Pilot Plant (WIPP) Hazardous Waste Facility Permit (Permit), Part 5.10.2.2, and Attachment L, Section L-5c, requires a Semiannual Groundwater Surface Elevation Report by May 31 and November 30. Changes in Detection Monitoring Well (DMW) water levels greater than two feet for a calendar year and a potentiometric surface map will be discussed in the November report. The Culebra Member (Culebra) of the Rustler Formation (Rustler) is the most transmissive hydrologic unit in the WIPP site area and is considered the most significant potential hydrologic pathway for a release to the accessible environment. The reporting period covered by this semiannual report is September 1, 2013, through February 28, 2014.

The transmissivity of the Culebra varies spatially over ten orders of magnitude from east to west in the vicinity of the WIPP site. Transmissivities have been calculated at 1×10^{-7} square feet per day (1×10^{-13} square meters per second) at well SNL-15 east of the WIPP site to 1×10^{3} square feet per day (1×10^{-3} square meters per second) at well H-7 in Nash Draw (see Amended Renewal Application Addendum L1, Section L1-2a(3)(a)(ii) [DOE, 2009]). The regional flow direction of groundwater in the Culebra is generally south. Figure 1 shows a map of the current Culebra monitoring well locations.

2.0 Summary of Groundwater Activities

Permit-required routine groundwater monitoring activities include groundwater quality sampling, groundwater level monitoring, and the pressure density surveys. Supporting activities during this reporting period included well maintenance and reference elevation surveys. Table 1 contains a list of the active Culebra wells monitored through February 2014.

Monthly groundwater level data and yearly pressure density data were gathered from 43 Culebra wells across the WIPP region. Well C-2737 is equipped with a production-injection packer (PIP) to allow groundwater level surveillance of different hydrologic zones within the same well. The 6 redundant wells on the H-19 pad are measured quarterly for water level and annually for fluid density. Monthly water levels were not taken where access was poor, or in certain wells when testing equipment was present, blocking access to the well.

Table 1 - Culebra Wells Monitored September 2013 - February 2014

AEC-7R	C-2737(PIP)	ERDA-9	H-02b2	H-03b2	H-04bR	H-05b
H-06bR	H-07b1	H-09bR	H-10c	H-11b4R	H-12	H-15R
H-16	H-17	H-19b0	H-19b2[1]	H-19b3[1]	H-19b4[1]	H-19b5[1]
H-19b6[1]	H-19b7[1]	I-461	SNL-01	SNL-02	SNL-03	SNL-05
SNL-06	SNL-08	SNL-09	SNL-10	SNL-12	SNL-13	SNL-14
SNL-15	SNL-16	SNL-17	SNL-18	SNL-19	WIPP-11	WIPP-13
WIPP-19	WQSP-1	WQSP-2	WQSP-3	WQSP-4	WQSP-5	WQSP-6
Note 1: Redundant wells on H-19 pad, measured quarterly						

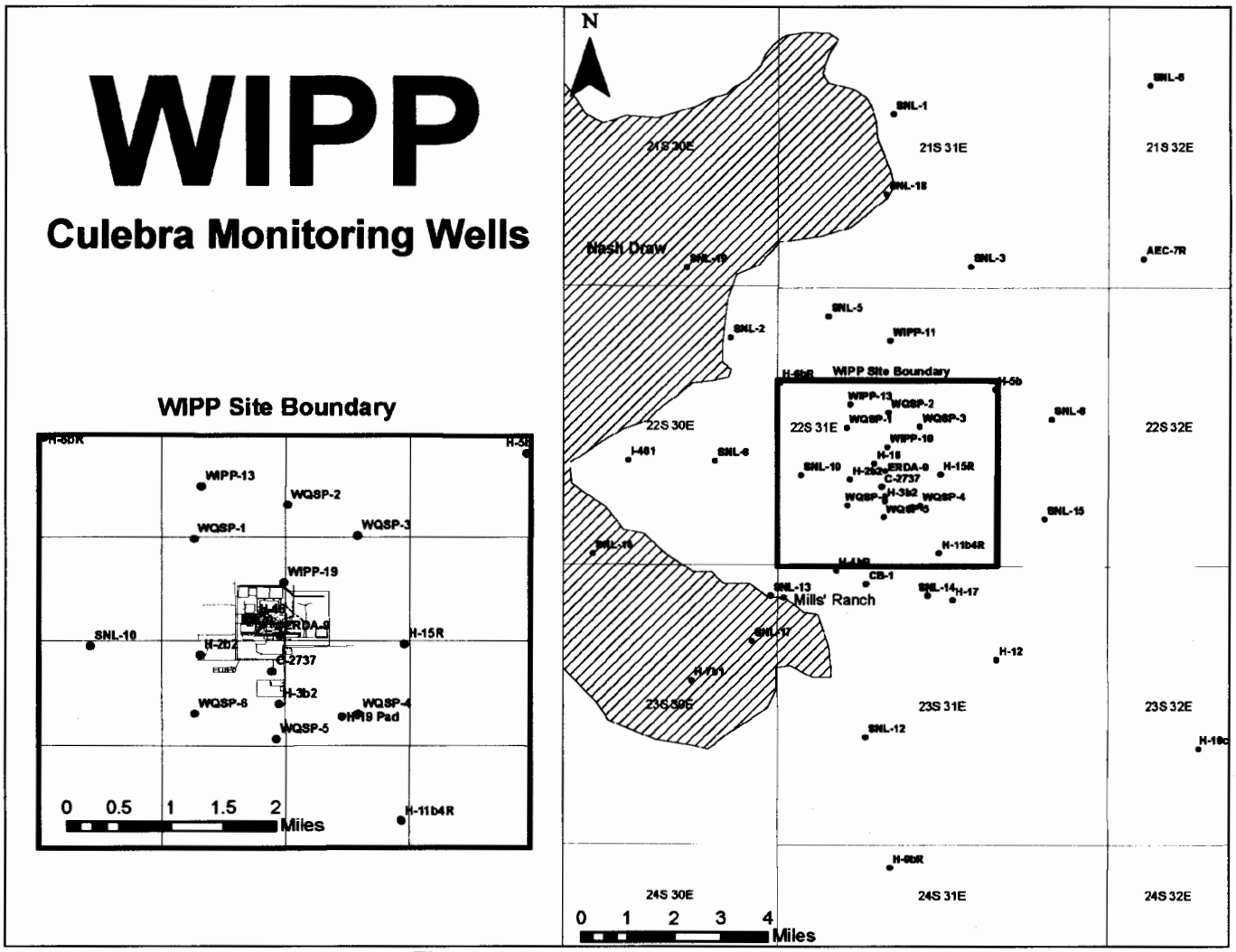


Figure 1 - Culebra Monitoring Wells

2.1 Plugging and Abandonment, Drilling, and Well Maintenance

Well AEC-7 was plugged and abandoned due to its deteriorating condition and replaced by AEC-7R in September. The total depth of the drill hole was 891 feet below ground surface with the screened interval in the Culebra at 875 to 855 feet below ground surface.

2.2 Pumping/Testing and Other Activities that Impacted Culebra Water Levels

Beginning in September, wells in the southern half of the monitoring network were influenced by a new industrial-use water well completed in the Culebra on Mills Ranch. H-4bR was impacted the most with over a 60 foot decrease, and changes are being seen as far north as SNL-9. This is marked on the hydrographs in Appendix 1. H-7b1 was affected by pumping on a BLM well located on the H-7 well pad.

3.0 Fluid Density Survey

Around the WIPP facility, variable total dissolved solids (TDS) concentrations result in variability in groundwater fluid density. The Permittees measure the density of well-bore fluids in Culebra monitoring wells to adjust water

levels to their equivalent freshwater head values. This allows more accurate determination of relative heads between wells. In 2013, fluid densities were derived from 49 wells, as shown in Table 2.

Prior to 2007, fluid density was determined using a mobile trailer-mounted system that obtained data at each well. After 2007, Sandia National Laboratories (SNL) installed a dedicated pressure transducer in each well. This approach employs several calibrated pressure measuring transducers dedicated to given wells at varying times during the year. For the DMP wells (WQSP wells in Table 1), field hydrometer measurements are used. Fluid densities have been adjusted to 70°F since 2009, when it was determined that was the average Culebra water temperature.

Previous years are also shown in Table 2 for comparison. When historical fluid densities are plotted back to the beginning of SNL continuous measurements in 2007, there do not appear to be any distinct overall trends between years. In general, wells to the south and west (i.e., H-9bR and SNL-16) of the WIPP facility tend to have lower fluid densities compared to eastern wells (i.e., H-12 and SNL-15).

4.0 Groundwater Trends

Over the last year (Feb.'13 to Feb.'14), Culebra water levels have generally been decreasing across the monitoring region. This may be attributed to a decreasing pressure-head throughout the Culebra system. A larger decrease is seen in wells to the west of WIPP near Nash Draw compared to eastern wells (see hydrographs of SNL-1 and SNL-3 compared to H-5b and H-10c).

H-16 has shown a trend of drawdown and recovery cycles each year since it was reconfigured to a Culebra only well in 2008. This may be attributed to its close proximity to the WIPP Air Intake Shaft (AIS). The water level decrease has started in the winter months, and the well recovers by mid-spring each year.

Hydrographs

The annotated hydrographs as required by the Permit are included in Appendix 1. New well AEC-7R does not have a hydrograph since the reference elevation for the top of casing is not complete.

Groundwater Level Data

Groundwater data and equivalent freshwater heads recorded for this reporting period are in Appendix 2.

5.0 References

NM4890139088-TSDF. 2012. *Waste Isolation Pilot Plant Hazardous Waste Facility Permit*. New Mexico Environment Department, Santa Fe, New Mexico.

U.S. Department of Energy (DOE). 2009. *WIPP Hazardous Waste Facility Permit Amended Renewal Application*. Carlsbad, New Mexico.

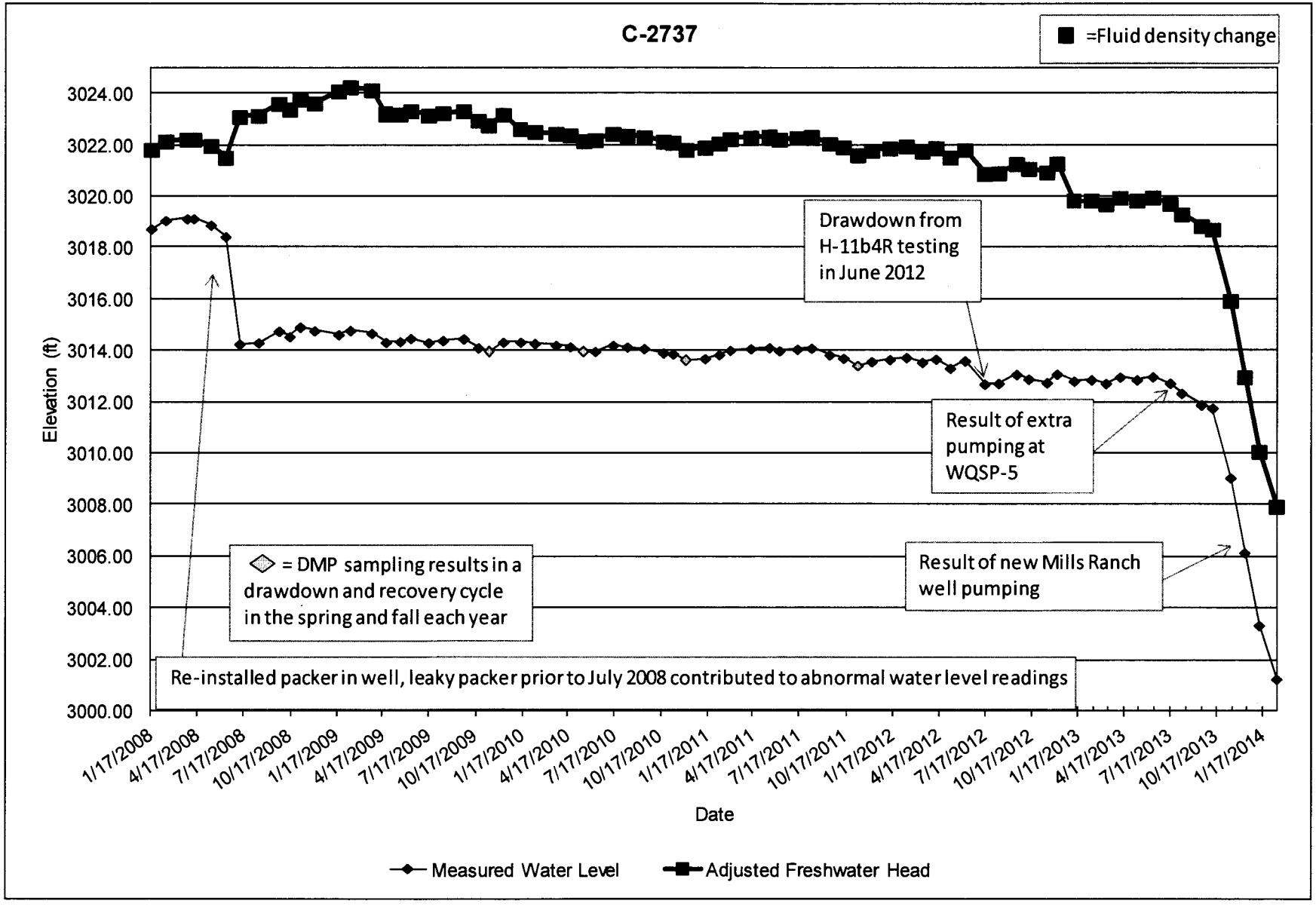
Table 2 – Fluid Density Survey for 2013

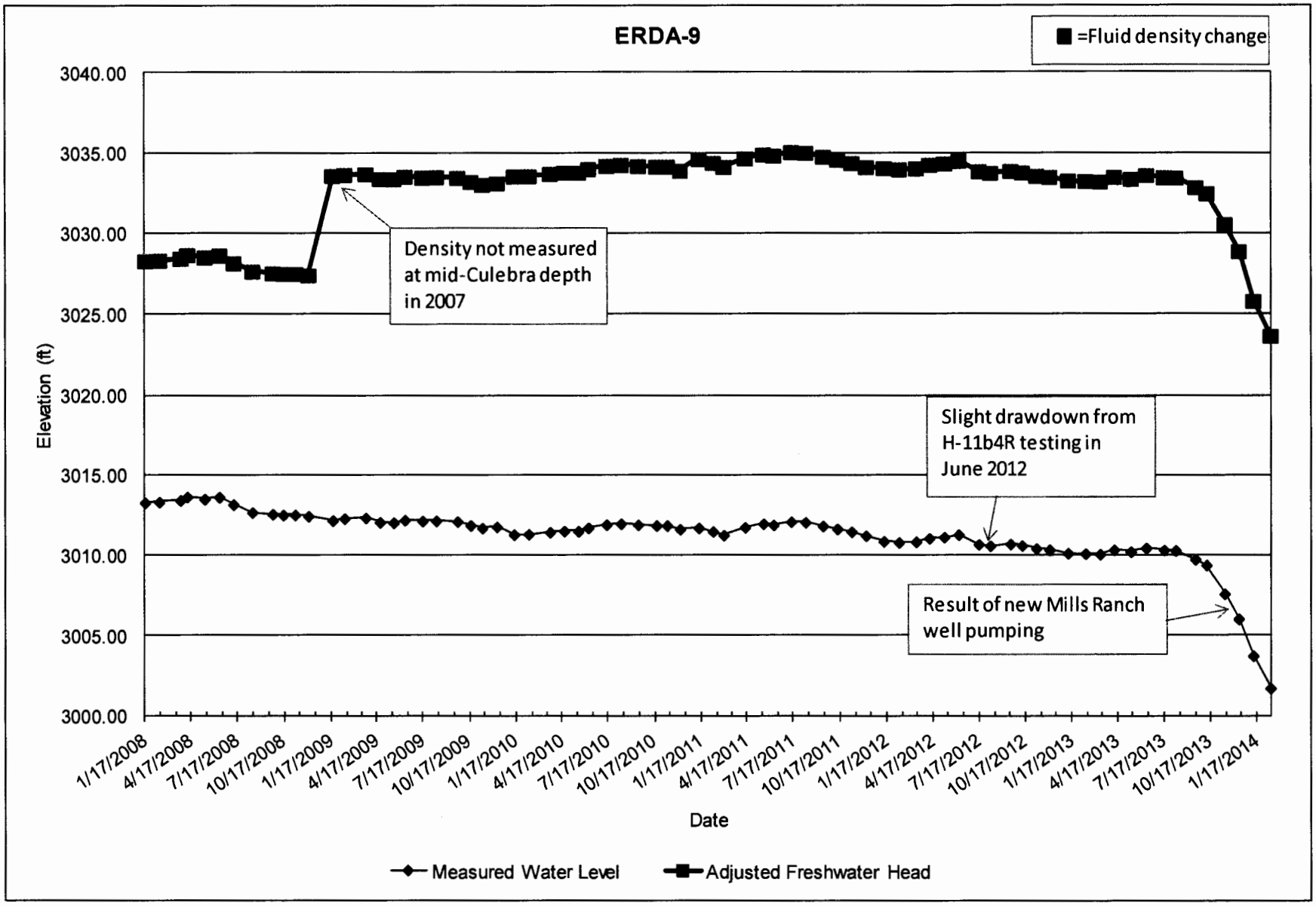
	2011 Fluid Density Survey Result	2011 Conversion to Specific Gravity at 70° F	2012 Fluid Density Survey Result	2012 Conversion to Specific Gravity at 70° F	2013 Fluid Density Survey Result	2013 Conversion to Specific Gravity at 70° F	Notes for 2011-2013 Fluid Density Survey
Well	Density (g/cc)	Density (g/cc)	Density (g/cc)	Density (g/cc)	Density (g/cc)	Density (g/cc)	
AEC-7	1.069	1.071	1.065	1.067	1.066	1.068	
C-2737	1.025	1.027	1.021	1.023	1.021	1.023	
ERDA-9	1.071	1.073	1.071	1.073	1.069	1.071	
H-02b2	1.010	1.012	1.010	1.012	1.011	1.013	
H-03b2	1.039	1.041	1.034	1.036	1.030	1.032	
H-04bR	1.015	1.017	1.015	1.017	1.015	1.017	
H-05b	1.095	1.097	1.093	1.095	1.090	1.092	
H-06bR	1.036	1.038	1.036	1.038	1.037	1.039	
H-07b1	1.004	1.006	1.005	1.007	1.005	1.007	
H-9bR	1.000*	1.000*	1.000*	1.000*	0.999	1.001	* Rounded up to 1.000 for 2011 & 2012
H-10c	1.092	1.094	1.092	1.094	1.093	1.095	
H-11b4	1.039	1.041	NA	NA	NA	NA	Plugged and abandoned in Nov. 2011
H-11b4R	NA	NA	1.074	1.076	1.074	1.076	New replacement well to H-11b4 drilled in 2011
H-12	1.105	1.107	1.111	1.113	1.106	1.108	
H-15R	1.117	1.119	1.116	1.118	1.116	1.118	
H-16	1.035	1.037	1.035	1.037	1.034	1.036	
H-17	1.134	1.136	1.131	1.133	1.131	1.133	
H-19b0	1.064	1.066	1.064	1.066	1.064	1.066	
H-19b2	1.059	1.061	1.060	1.062	1.066	1.068	
H-19b3	1.052	1.054	1.064	1.066	1.064	1.066	
H-19b4	1.054	1.056	1.065	1.067	1.064	1.066	
H-19b5	1.062	1.064	1.067	1.069	1.067	1.069	
H-19b6	1.061	1.063	1.068	1.070	1.068	1.070	
H-19b7	1.062	1.064	1.070	1.072	1.068	1.070	
I-461	1.000*	1.000*	1.000*	1.000*	1.000*	1.000*	* Rounded up to 1.000 for 2011-2013
SNL-01	1.029	1.031	1.027	1.029	1.028	1.030	
SNL-02	1.007	1.009	1.007	1.009	1.007	1.009	
SNL-03	1.026	1.028	1.026	1.028	1.026	1.028	
SNL-05	1.007	1.009	1.007	1.009	1.007	1.009	
SNL-06	1.239	1.241	1.241	1.243	1.241	1.243	
SNL-08	1.092	1.094	1.092	1.094	1.093	1.095	
SNL-09	1.016	1.018	1.016	1.018	1.016	1.018	
SNL-10	1.007	1.009	1.007	1.009	1.008	1.010	
SNL-12	1.003	1.005	1.004	1.006	1.004	1.006	
SNL-13	1.023	1.025	1.016	1.018	1.015	1.017	
SNL-14	1.045	1.047	1.044	1.046	1.044	1.046	
SNL-15	1.230	1.232	1.227	1.229	1.227	1.229	
SNL-16	1.006	1.008	1.007	1.009	1.006	1.008	
SNL-17	1.004	1.006	1.003	1.005	1.003	1.005	
SNL-18	1.005	1.007	1.003	1.005	1.007	1.009	

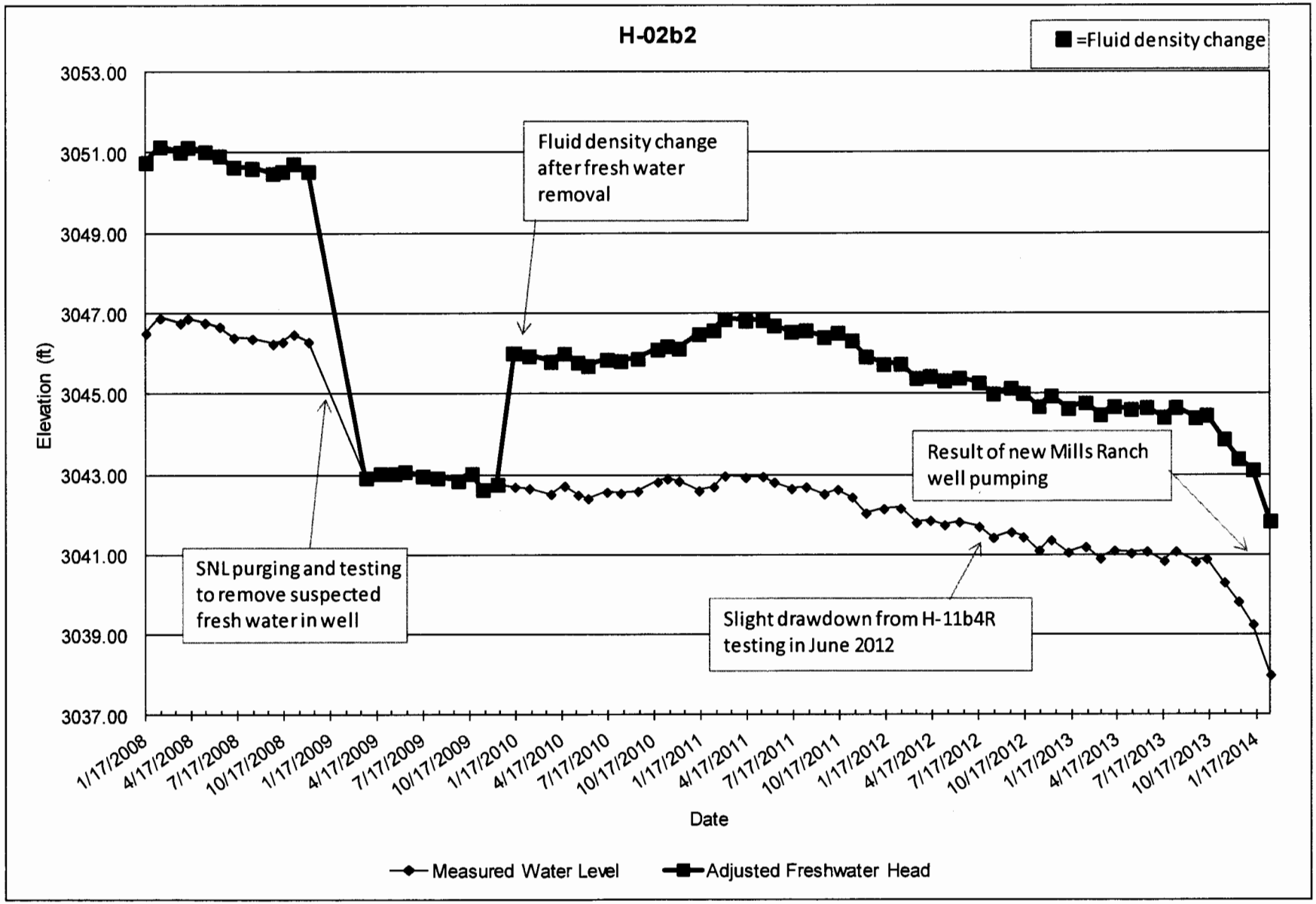
	2011 Fluid Density Survey Result	2011 Conversion to Specific Gravity at 70° F	2012 Fluid Density Survey Result	2012 Conversion to Specific Gravity at 70° F	2013 Fluid Density Survey Result	2013 Conversion to Specific Gravity at 70° F	Notes for 2011-2013 Fluid Density Survey
Well	**Density (g/cc)**	**Density (g/cc)**	**Density (g/cc)**	**Density (g/cc)**	**Density (g/cc)**	**Density (g/cc)**	
SNL-19	1.004	1.006	1.005	1.007	1.005	1.007	
WIPP-11	1.036	1.038	1.036	1.038	1.036	1.038	
WIPP-13	1.041	1.043	1.039	1.041	1.038	1.040	
WIPP-19	1.050	1.052	1.050	1.052	1.050	1.052	
WQSP-1	1.047	1.049	1.049	1.051	1.047	1.049	Average Round 35, field hydrometer
WQSP-2	1.046	1.048	1.046	1.048	1.045	1.047	Average Round 35, field hydrometer
WQSP-3	1.143	1.146	1.145	1.147	1.146	1.148	Average Round 35, field hydrometer
WQSP-4	1.074	1.076	1.075	1.077	1.074	1.076	Average Round 35, field hydrometer
WQSP-5	1.025	1.027	1.025	1.027	1.025	1.027	Average Round 35, field hydrometer
WQSP-6	1.015	1.017	1.013	1.015	1.013	1.015	Average Round 35, field hydrometer
NA: no available measurement							
g/cc: grams per cubic centimeter							

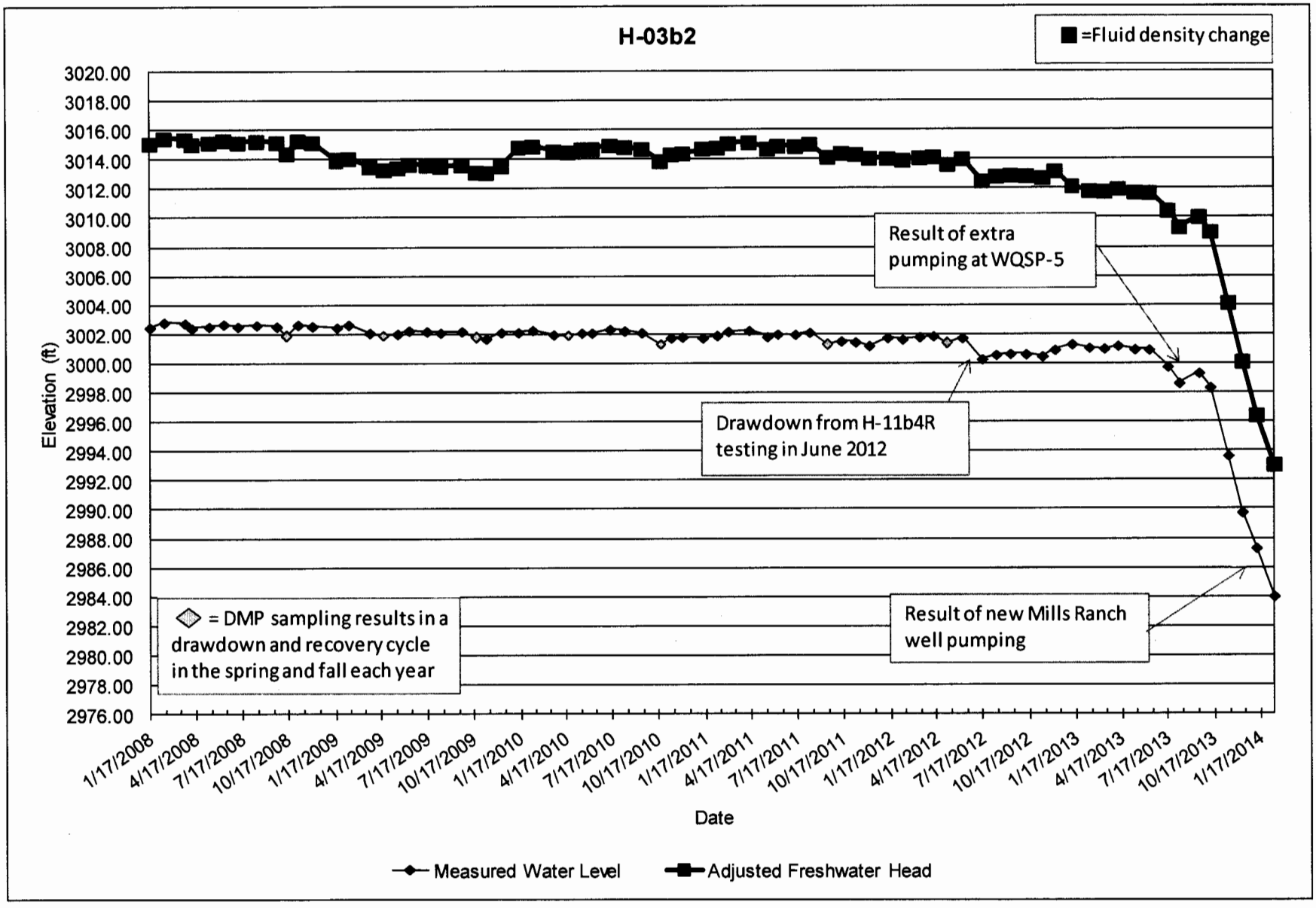
Appendix 1

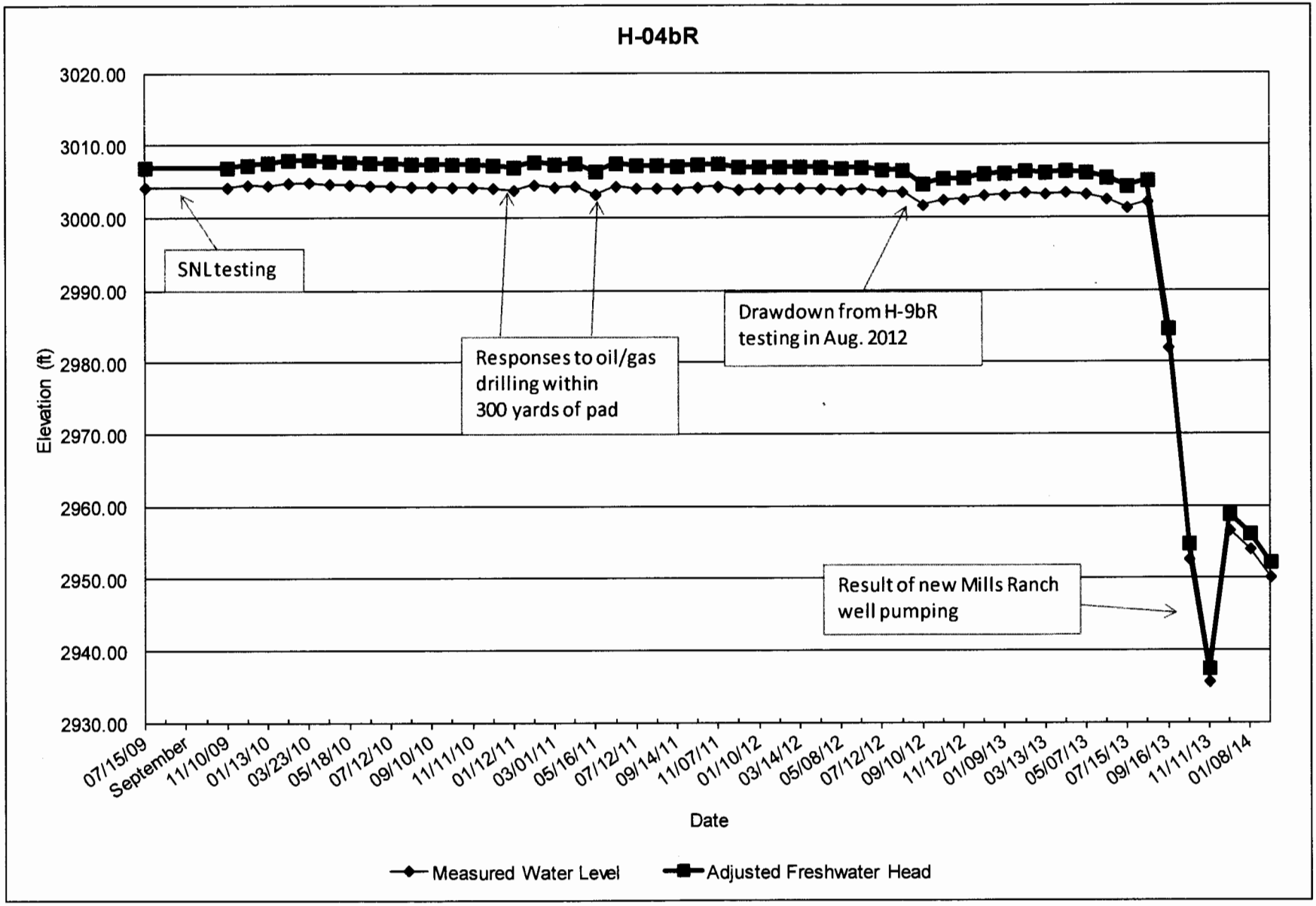
Annotated Hydrographs

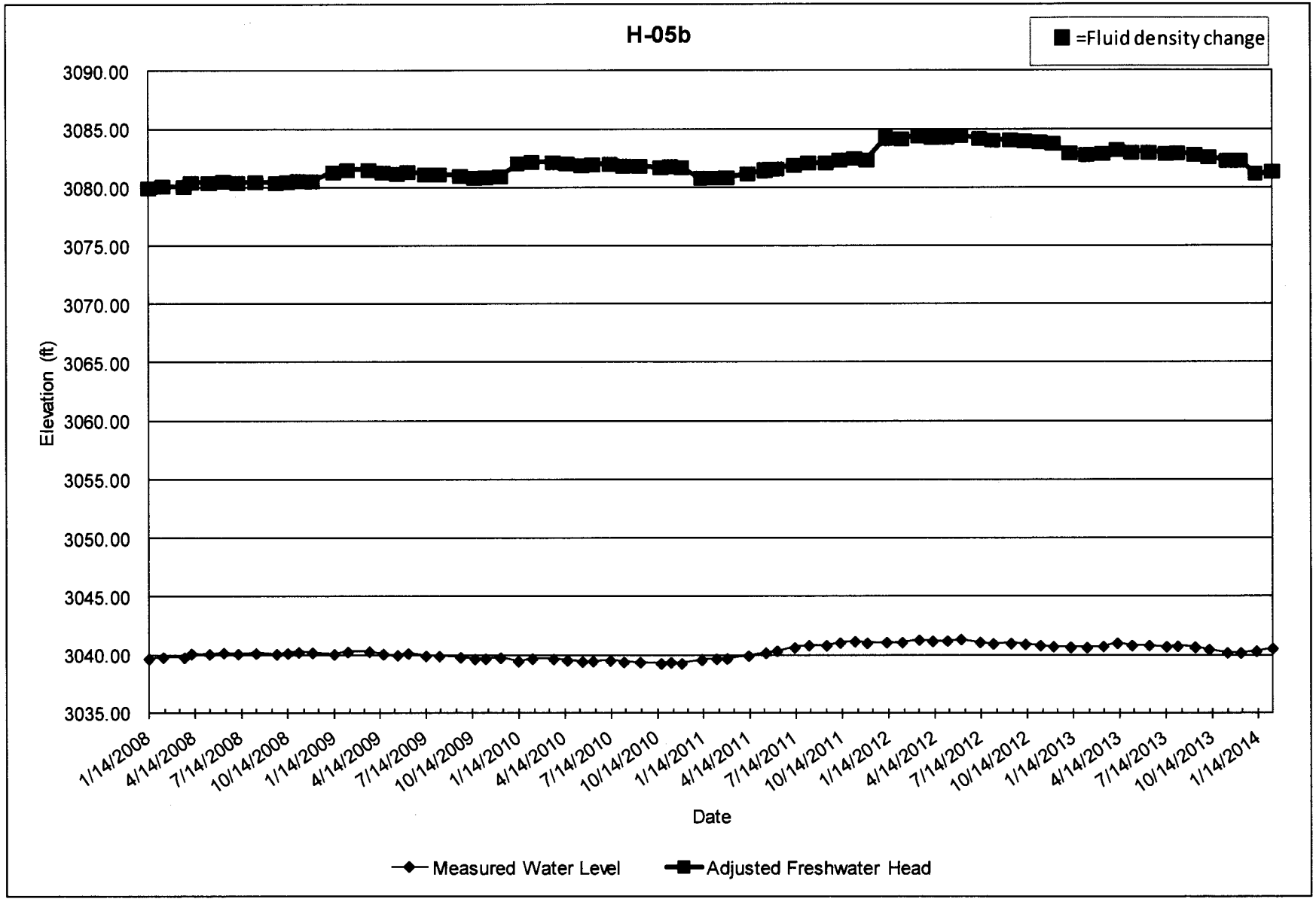

C-2737
=Fluid density change
Elevation (ft)
3024.00
3022.00
3020.00
3018.00
3016.00
3014.00
3012.00
3010.00
3008.00
3006.00
3004.00
3002.00
3000.00
Drawdown from H-11b4R testing in June 2012
Result of extra pumping at WQSP-5
Result of new Mills Ranch well pumping
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Re-installed packer in well, leaky packer prior to July 2008 contributed to abnormal water level readings
1/17/2008
4/17/2008
7/17/2008
10/17/2008
1/17/2009
4/17/2009
7/17/2009
10/17/2009
1/17/2010
4/17/2010
7/17/2010
10/17/2010
1/17/2011
4/17/2011
7/17/2011
10/17/2011
1/17/2012
4/17/2012
7/17/2012
10/17/2012
1/17/2013
4/17/2013
7/17/2013
10/17/2013
1/17/2014
Date
Measured Water Level
Adjusted Freshwater Head

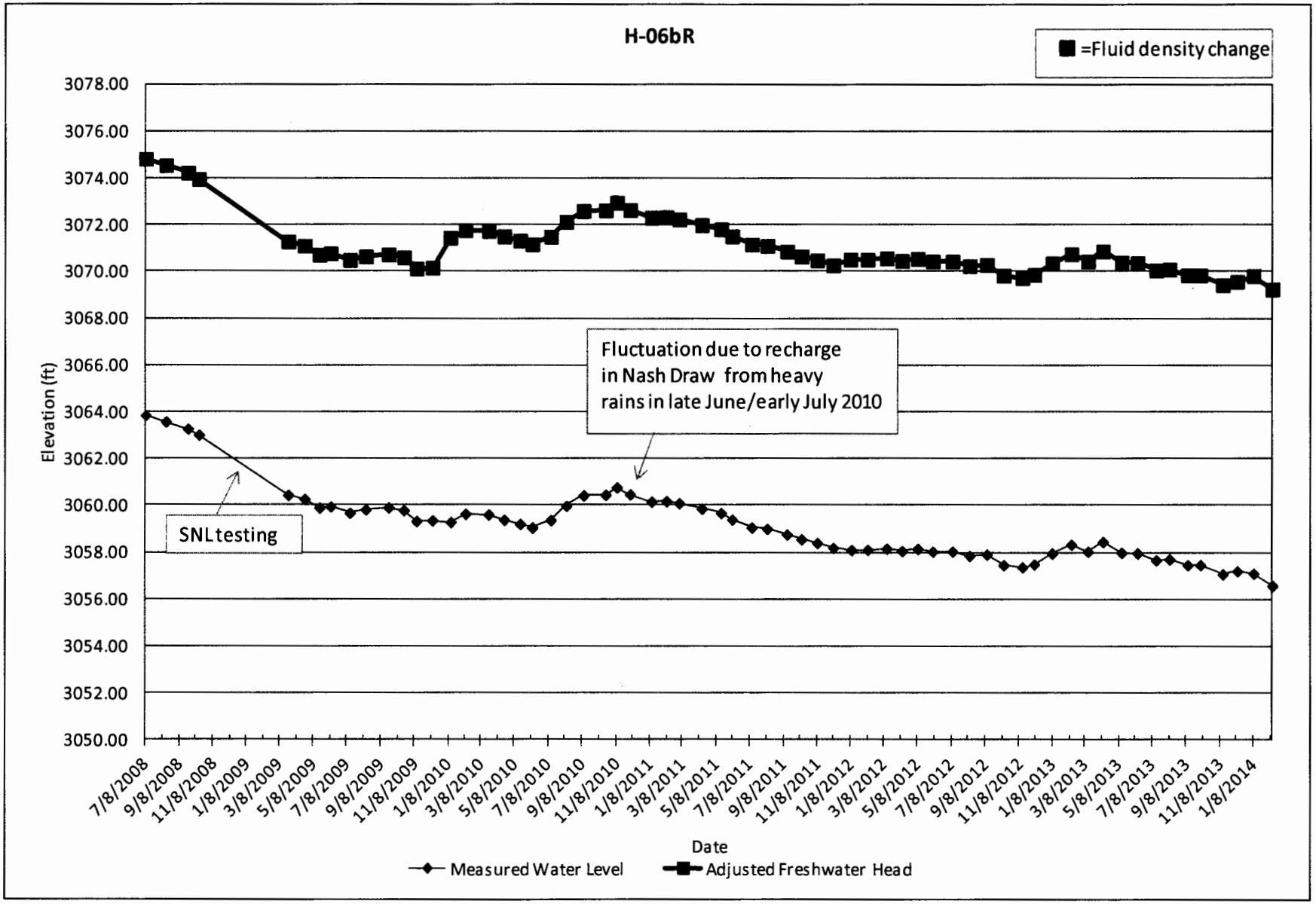

ERDA-9
=Fluid density change
Elevation (ft)
3040.00
3035.00
3030.00
3025.00
3020.00
3015.00
3010.00
3005.00
3000.00
Density not measured at mid-Culebra depth in 2007
Slight drawdown from H-11b4R testing in June 2012
Result of new Mills Ranch well pumping
1/17/2008
4/17/2008
7/17/2008
10/17/2008
1/17/2009
4/17/2009
7/17/2009
10/17/2009
1/17/2010
4/17/2010
7/17/2010
10/17/2010
1/17/2011
4/17/2011
7/17/2011
10/17/2011
1/17/2012
4/17/2012
7/17/2012
10/17/2012
1/17/2013
4/17/2013
7/17/2013
10/17/2013
1/17/2014
Date
Measured Water Level
Adjusted Freshwater Head

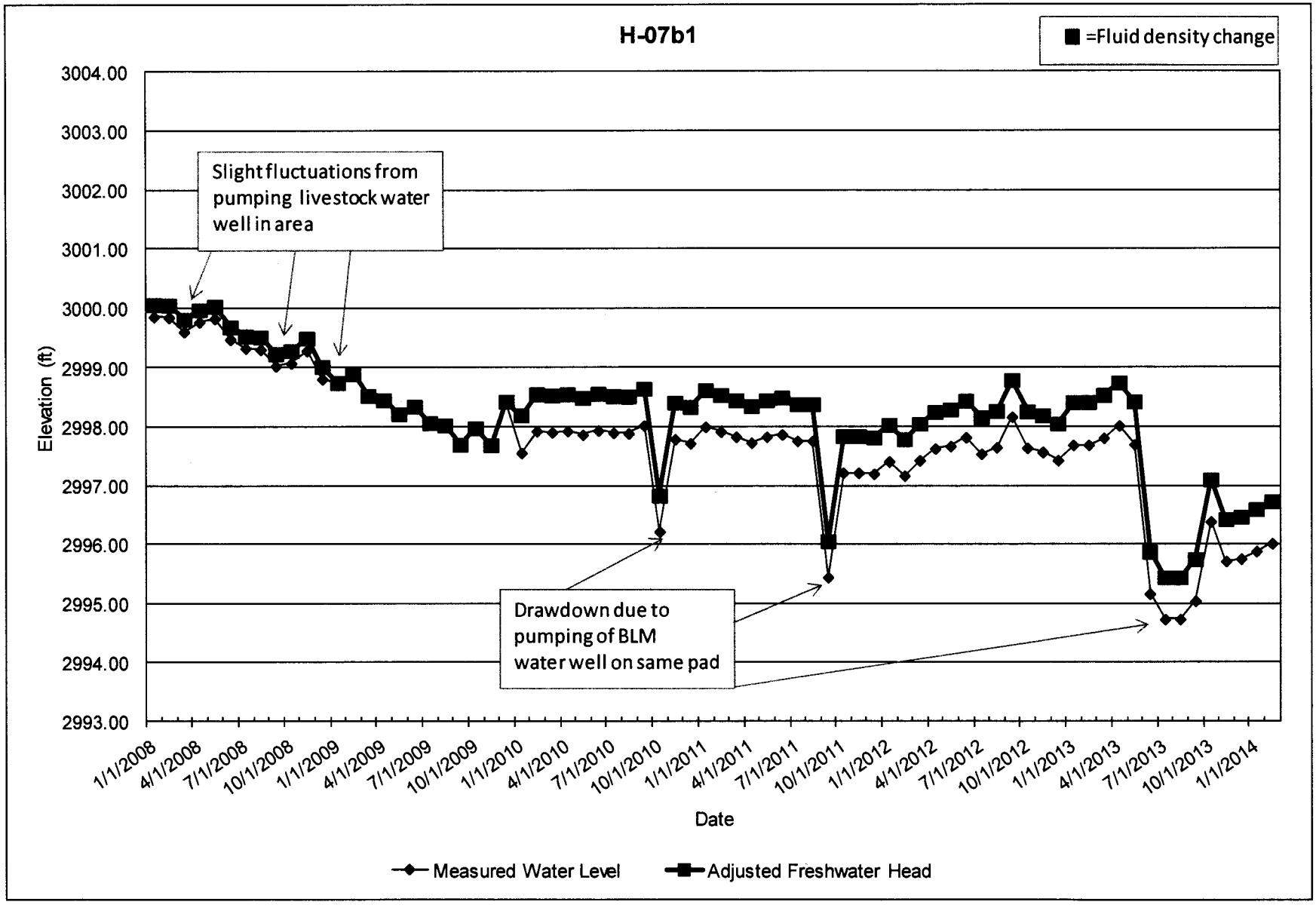

H-02b2
=Fluid density change
Fluid density change after fresh water removal
SNL purging and testing to remove suspected fresh water in well
Result of new Mills Ranch well pumping
Slight drawdown from H-11b4R testing in June 2012
Elevation (ft)
3053.00
3051.00
3049.00
3047.00
3045.00
3043.00
3041.00
3039.00
3037.00
1/17/2008
4/17/2008
7/17/2008
10/17/2008
1/17/2009
4/17/2009
7/17/2009
10/17/2009
1/17/2010
4/17/2010
7/17/2010
10/17/2010
1/17/2011
4/17/2011
7/17/2011
10/17/2011
1/17/2012
4/17/2012
7/17/2012
10/17/2012
1/17/2013
4/17/2013
7/17/2013
10/17/2013
1/17/2014
Date
Measured Water Level
Adjusted Freshwater Head

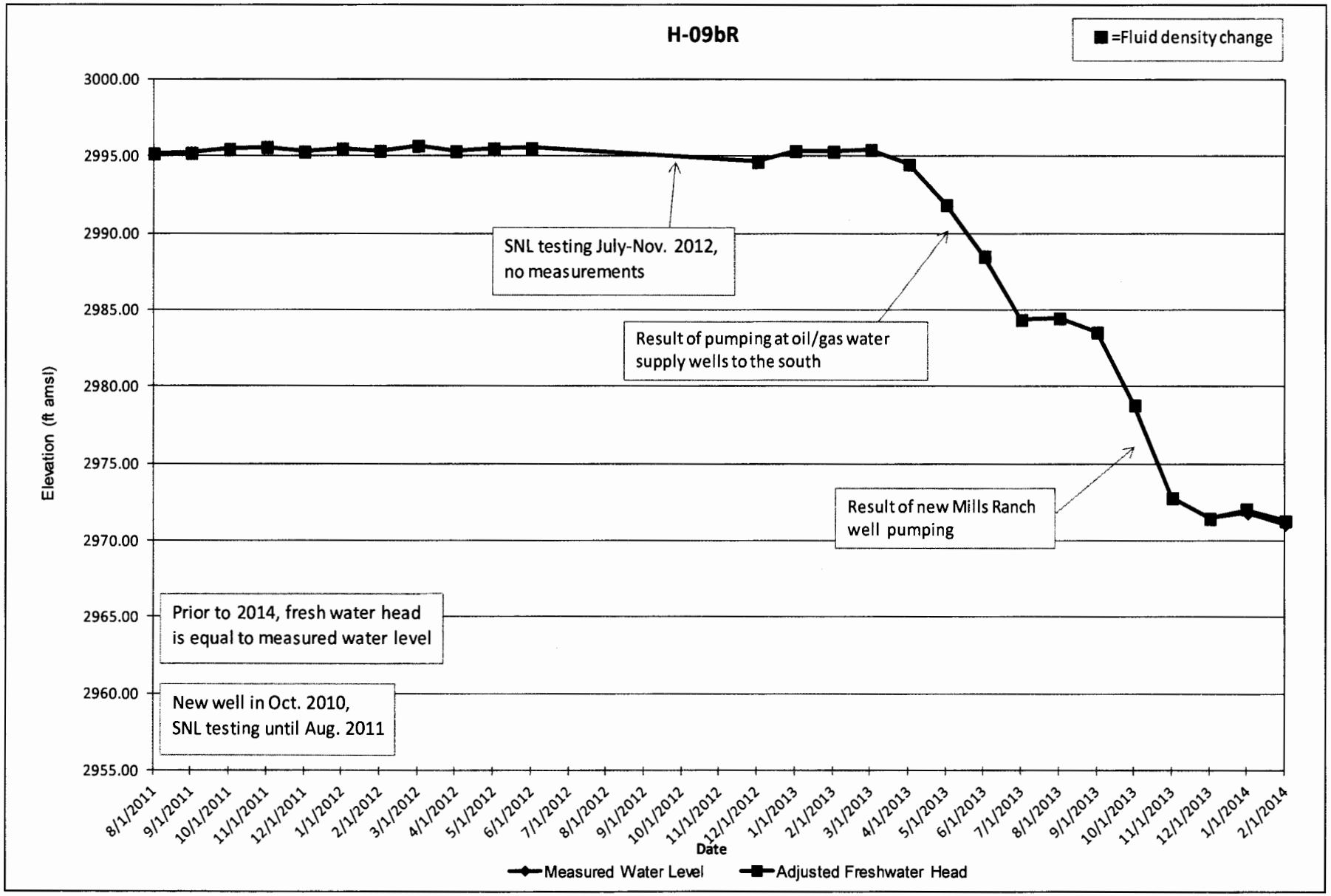

H-03b2
=Fluid density change
Result of extra pumping at WQSP-5
Drawdown from H-11b4R testing in June 2012
Result of new Mills Ranch well pumping
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Elevation (ft)
3020.00
3018.00
3016.00
3014.00
3012.00
3010.00
3008.00
3006.00
3004.00
3002.00
3000.00
2998.00
2996.00
2994.00
2992.00
2990.00
2988.00
2986.00
2984.00
2982.00
2980.00
2978.00
2976.00
1/17/2008
4/17/2008
7/17/2008
10/17/2008
1/17/2009
4/17/2009
7/17/2009
10/17/2009
1/17/2010
4/17/2010
7/17/2010
10/17/2010
1/17/2011
4/17/2011
7/17/2011
10/17/2011
1/17/2012
4/17/2012
7/17/2012
10/17/2012
1/17/2013
4/17/2013
7/17/2013
10/17/2013
1/17/2014
Date
Measured Water Level
Adjusted Freshwater Head

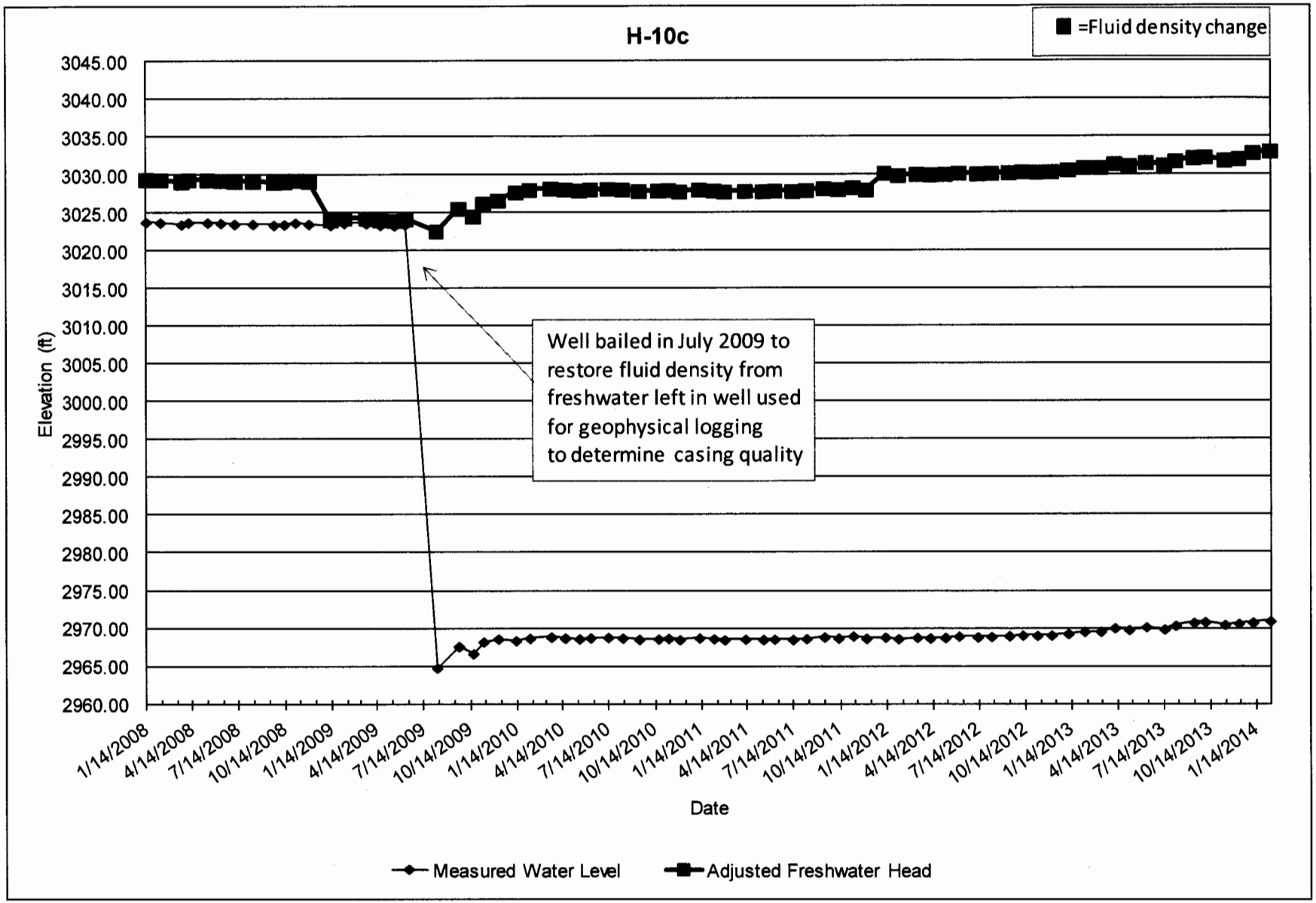

H-04bR
3020.00
3010.00
3000.00
2990.00
2980.00
2970.00
2960.00
2950.00
2940.00
2930.00
Elevation (ft)
SNL testing
Responses to oil/gas drilling within 300 yards of pad
Drawdown from H-9bR testing in Aug. 2012
Result of new Mills Ranch well pumping
07/15/09
September
11/10/09
01/13/10
03/23/10
05/18/10
07/12/10
09/10/10
11/11/10
01/12/11
03/01/11
05/16/11
07/12/11
09/14/11
11/07/11
01/10/12
03/14/12
05/08/12
07/12/12
09/10/12
11/12/12
01/09/13
03/13/13
05/07/13
07/15/13
09/16/13
11/11/13
01/08/14
Date
Measured Water Level
Adjusted Freshwater Head

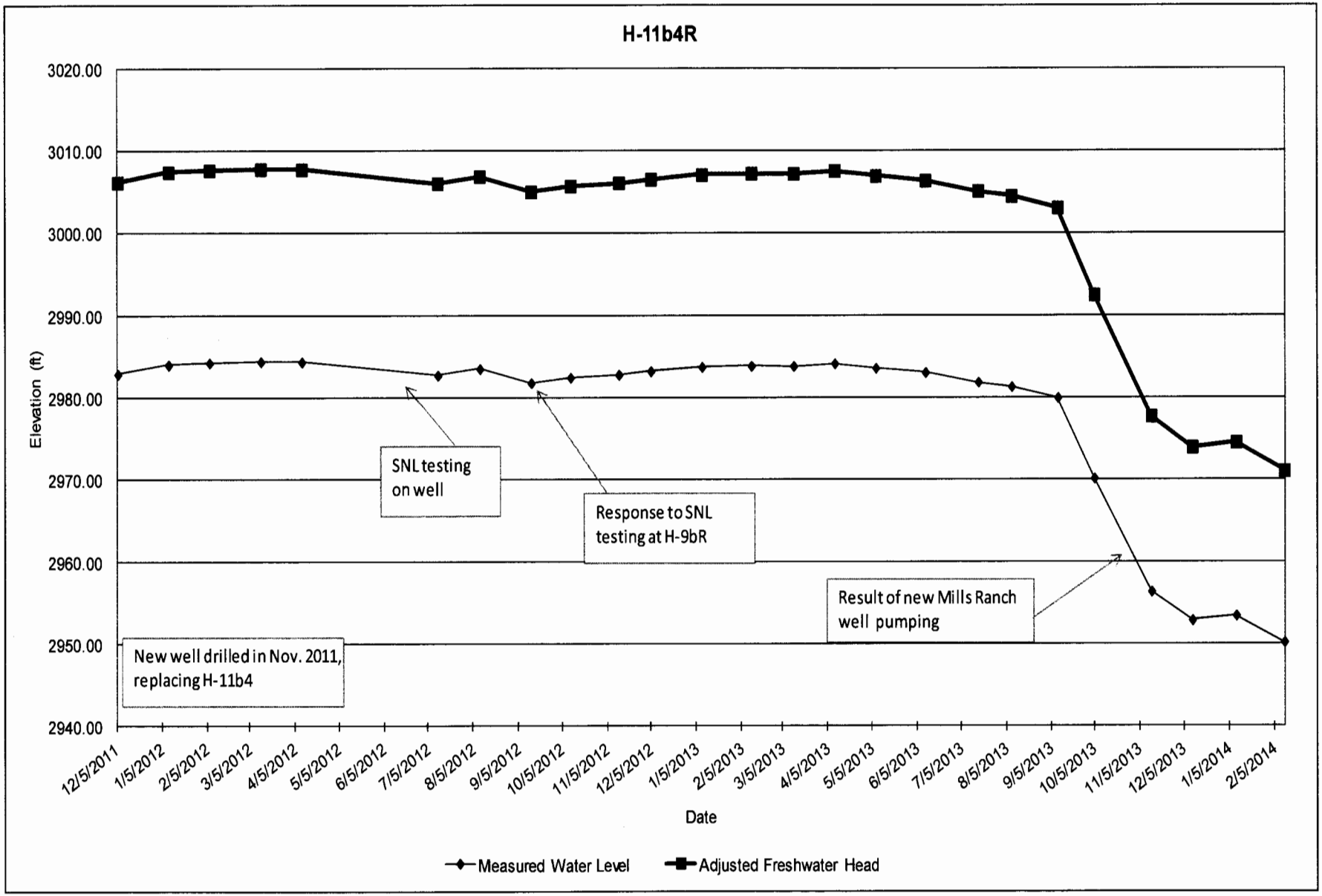

H-05b
=Fluid density change
3090.00
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
3050.00
3045.00
3040.00
3035.00
Elevation (ft)
1/14/2008
4/14/2008
7/14/2008
10/14/2008
1/14/2009
4/14/2009
7/14/2009
10/14/2009
1/14/2010
4/14/2010
7/14/2010
10/14/2010
1/14/2011
4/14/2011
7/14/2011
10/14/2011
1/14/2012
4/14/2012
7/14/2012
10/14/2012
1/14/2013
4/14/2013
7/14/2013
10/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

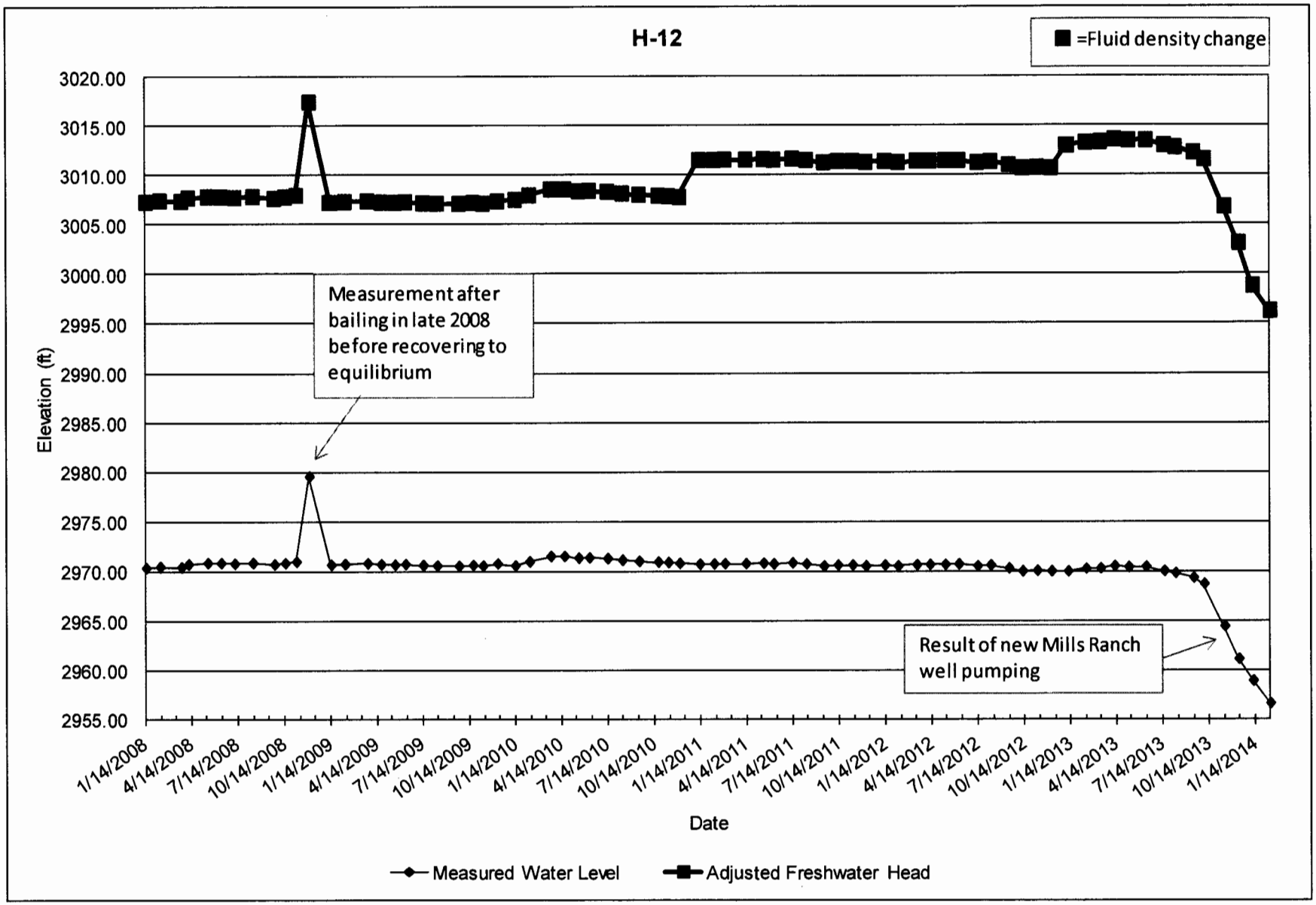

H-06bR
=Fluid density change
Fluctuation due to recharge in Nash Draw from heavy rains in late June/early July 2010
SNL testing
Elevation (ft)
3078.00
3076.00
3074.00
3072.00
3070.00
3068.00
3066.00
3064.00
3062.00
3060.00
3058.00
3056.00
3054.00
3052.00
3050.00
7/8/2008
9/8/2008
11/8/2008
1/8/2009
3/8/2009
5/8/2009
7/8/2009
9/8/2009
11/8/2009
1/8/2010
3/8/2010
5/8/2010
7/8/2010
9/8/2010
11/8/2010
1/8/2011
3/8/2011
5/8/2011
7/8/2011
9/8/2011
11/8/2011
1/8/2012
3/8/2012
5/8/2012
7/8/2012
9/8/2012
11/8/2012
1/8/2013
3/8/2013
5/8/2013
7/8/2013
9/8/2013
11/8/2013
1/8/2014
Date
Measured Water Level
Adjusted Freshwater Head

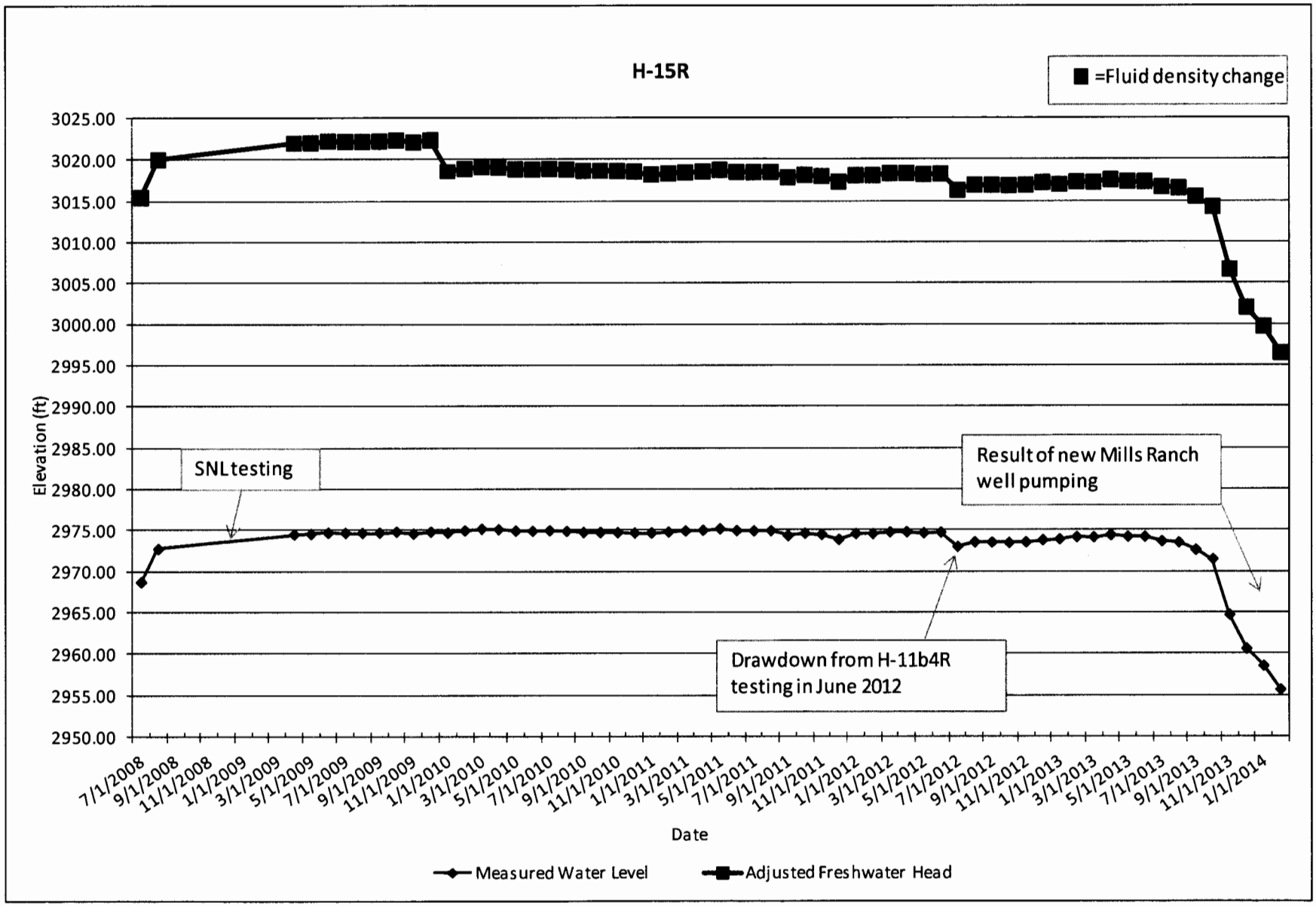

H-07b1
=Fluid density change
Slight fluctuations from pumping livestock water well in area
Drawdown due to pumping of BLM water well on same pad
Elevation (ft)
3004.00
3003.00
3002.00
3001.00
3000.00
2999.00
2998.00
2997.00
2996.00
2995.00
2994.00
2993.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

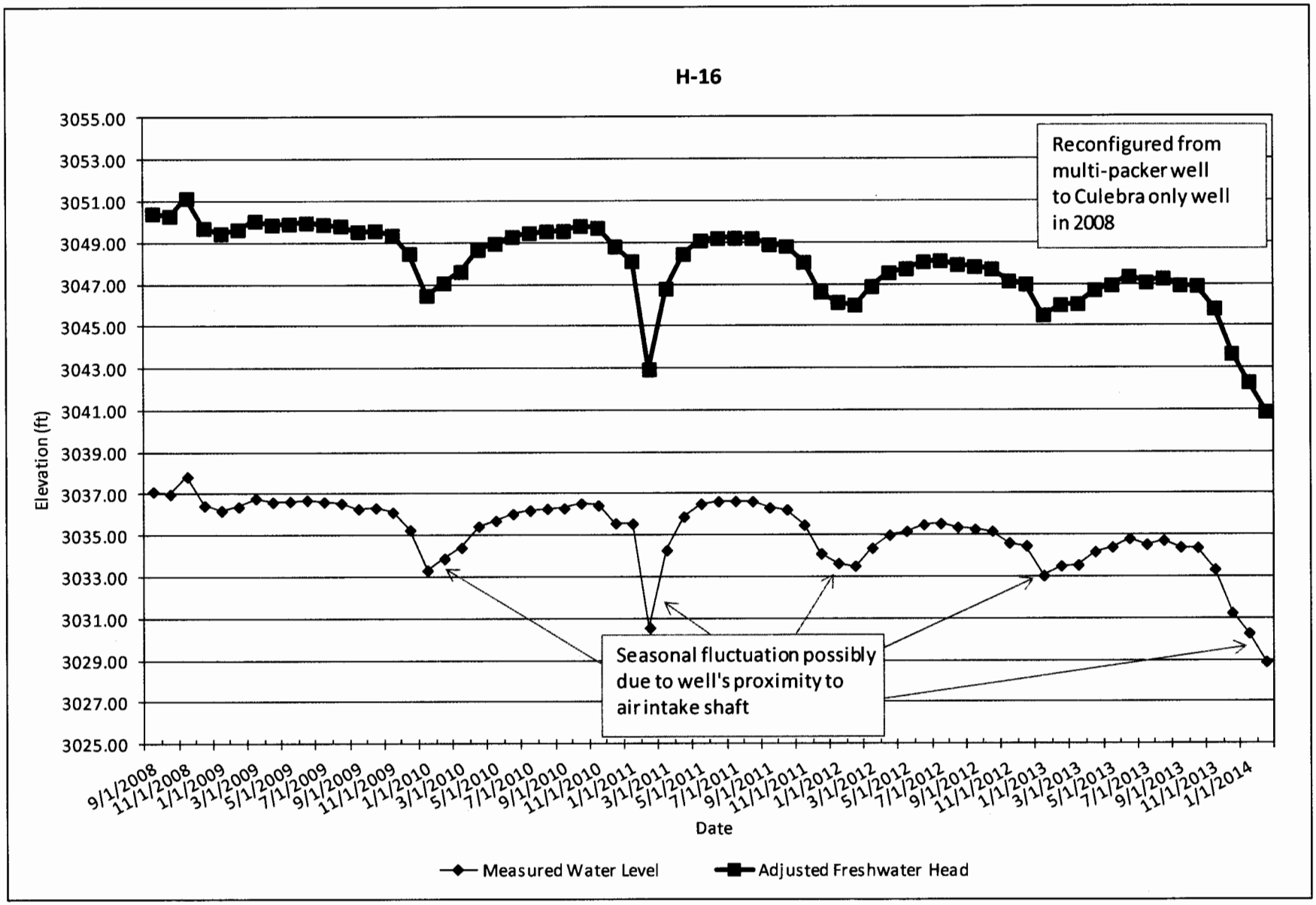

H-09bR
=Fluid density change
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
Elevation (ft amsl)
SNL testing July-Nov. 2012, no measurements
Result of pumping at oil/gas water supply wells to the south
Result of new Mills Ranch well pumping
Prior to 2014, fresh water head is equal to measured water level
New well in Oct. 2010, SNL testing until Aug. 2011
8/1/2011
9/1/2011
10/1/2011
11/1/2011
12/1/2011
1/1/2012
2/1/2012
3/1/2012
4/1/2012
5/1/2012
6/1/2012
7/1/2012
8/1/2012
9/1/2012
10/1/2012
11/1/2012
12/1/2012
1/1/2013
2/1/2013
3/1/2013
4/1/2013
5/1/2013
6/1/2013
7/1/2013
8/1/2013
9/1/2013
10/1/2013
11/1/2013
12/1/2013
1/1/2014
2/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

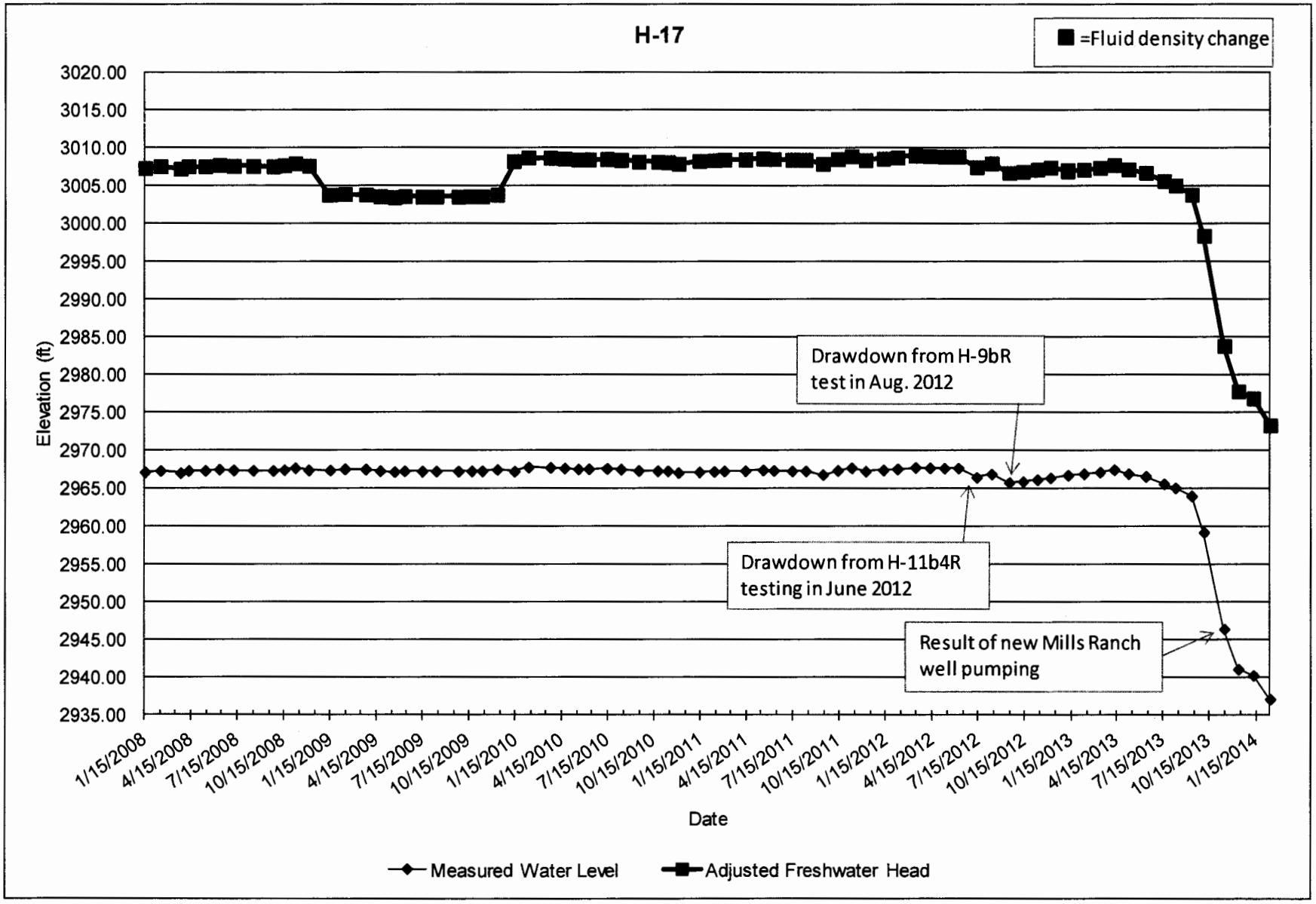

H-10c
=Fluid density change
Elevation (ft)
3045.00
3040.00
3035.00
3030.00
3025.00
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
Well bailed in July 2009 to restore fluid density from freshwater left in well used for geophysical logging to determine casing quality
1/14/2008
4/14/2008
7/14/2008
10/14/2008
1/14/2009
4/14/2009
7/14/2009
10/14/2009
1/14/2010
4/14/2010
7/14/2010
10/14/2010
1/14/2011
4/14/2011
7/14/2011
10/14/2011
1/14/2012
4/14/2012
7/14/2012
10/14/2012
1/14/2013
4/14/2013
7/14/2013
10/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

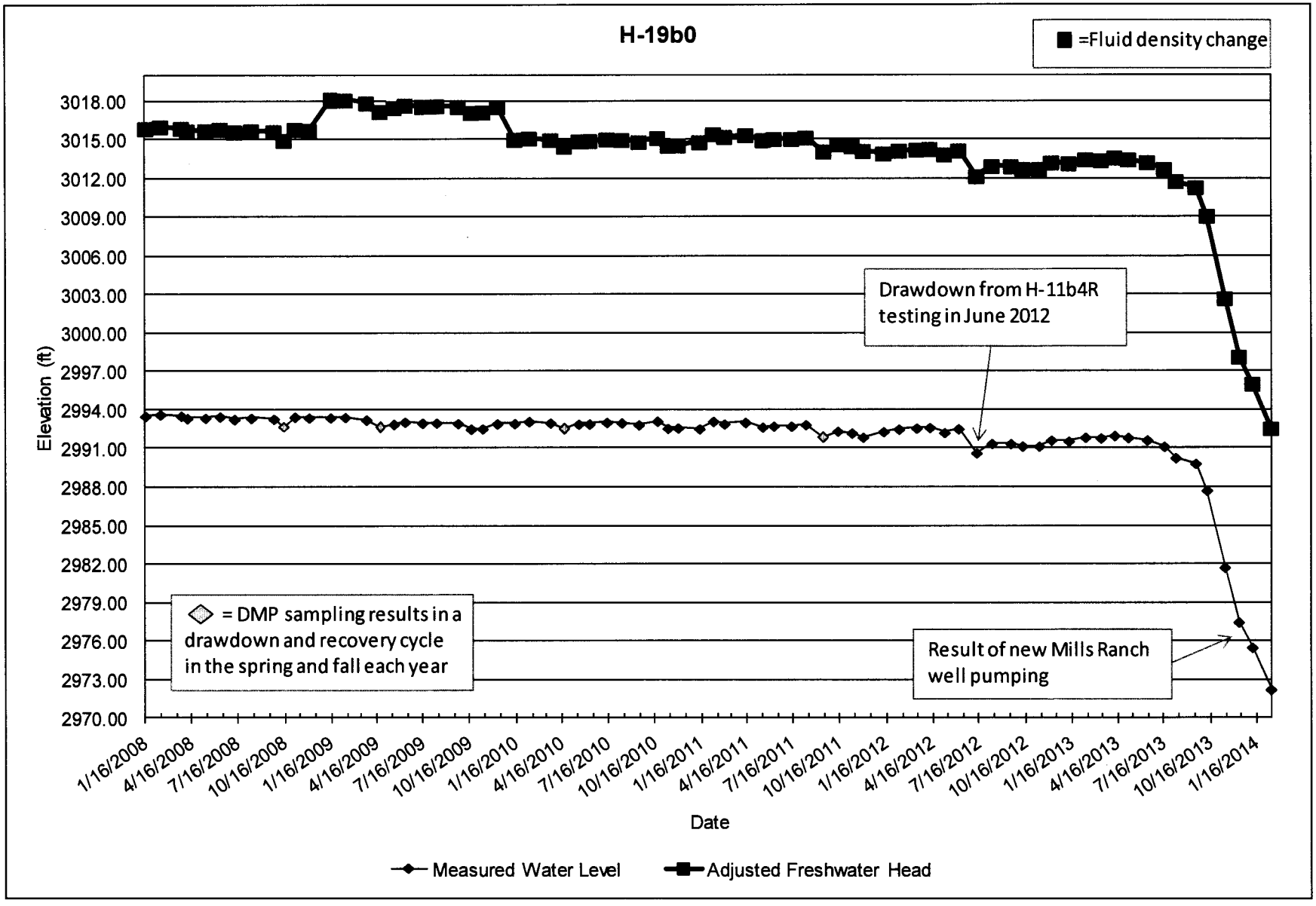

H-11b4R
3020.00
3010.00
3000.00
2990.00
2980.00
2970.00
2960.00
2950.00
2940.00
Elevation (ft)
12/5/2011
1/5/2012
2/5/2012
3/5/2012
4/5/2012
5/5/2012
6/5/2012
7/5/2012
8/5/2012
9/5/2012
10/5/2012
11/5/2012
12/5/2012
1/5/2013
2/5/2013
3/5/2013
4/5/2013
5/5/2013
6/5/2013
7/5/2013
8/5/2013
9/5/2013
10/5/2013
11/5/2013
12/5/2013
1/5/2014
2/5/2014
Date
SNL testing on well
Response to SNL testing at H-9bR
Result of new Mills Ranch well pumping
New well drilled in Nov. 2011, replacing H-11b4
Measured Water Level
Adjusted Freshwater Head

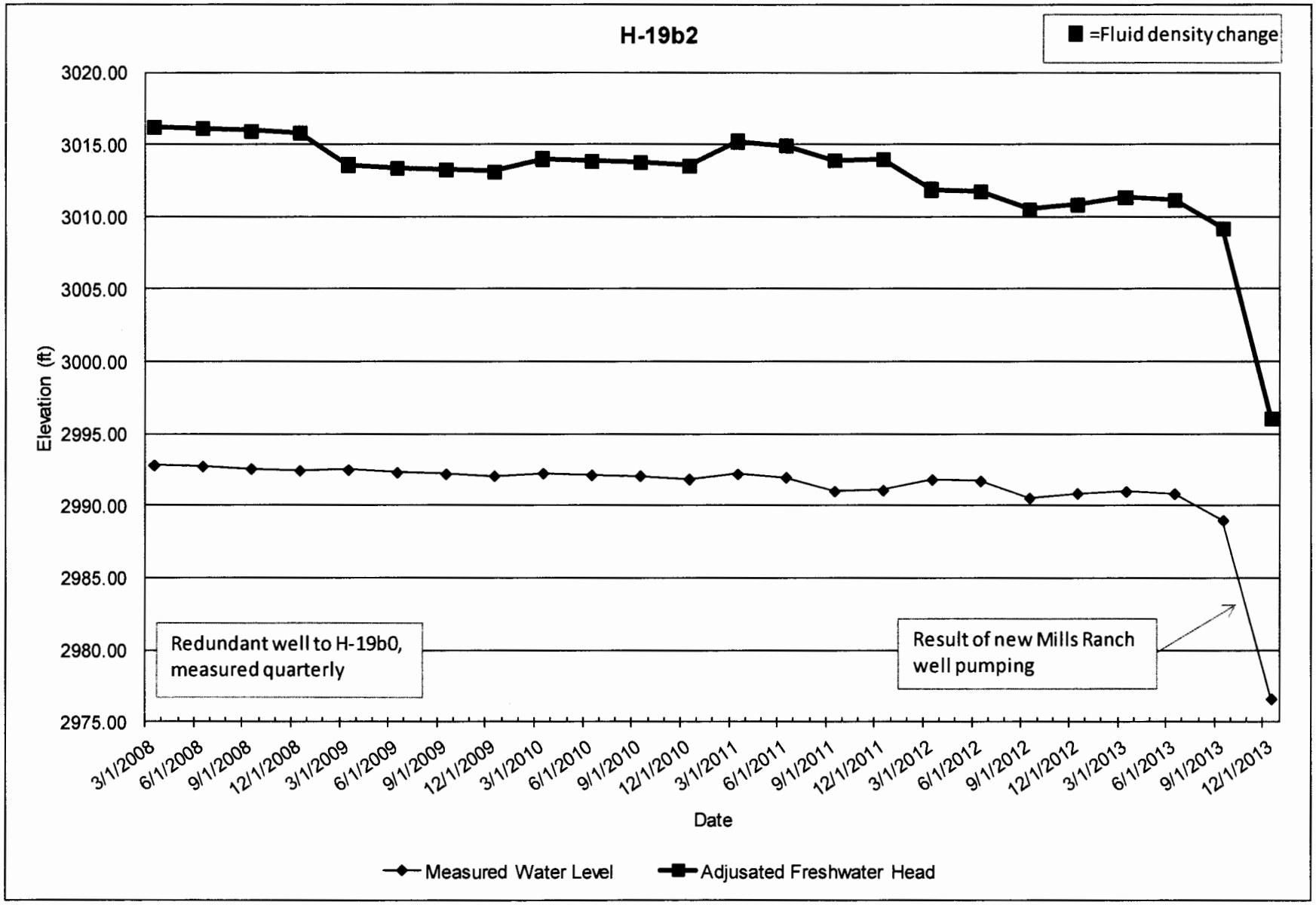

H-12
=Fluid density change
Measurement after bailing in late 2008 before recovering to equilibrium
Result of new Mills Ranch well pumping
Elevation (ft)
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
1/14/2008
4/14/2008
7/14/2008
10/14/2008
1/14/2009
4/14/2009
7/14/2009
10/14/2009
1/14/2010
4/14/2010
7/14/2010
10/14/2010
1/14/2011
4/14/2011
7/14/2011
10/14/2011
1/14/2012
4/14/2012
7/14/2012
10/14/2012
1/14/2013
4/14/2013
7/14/2013
10/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

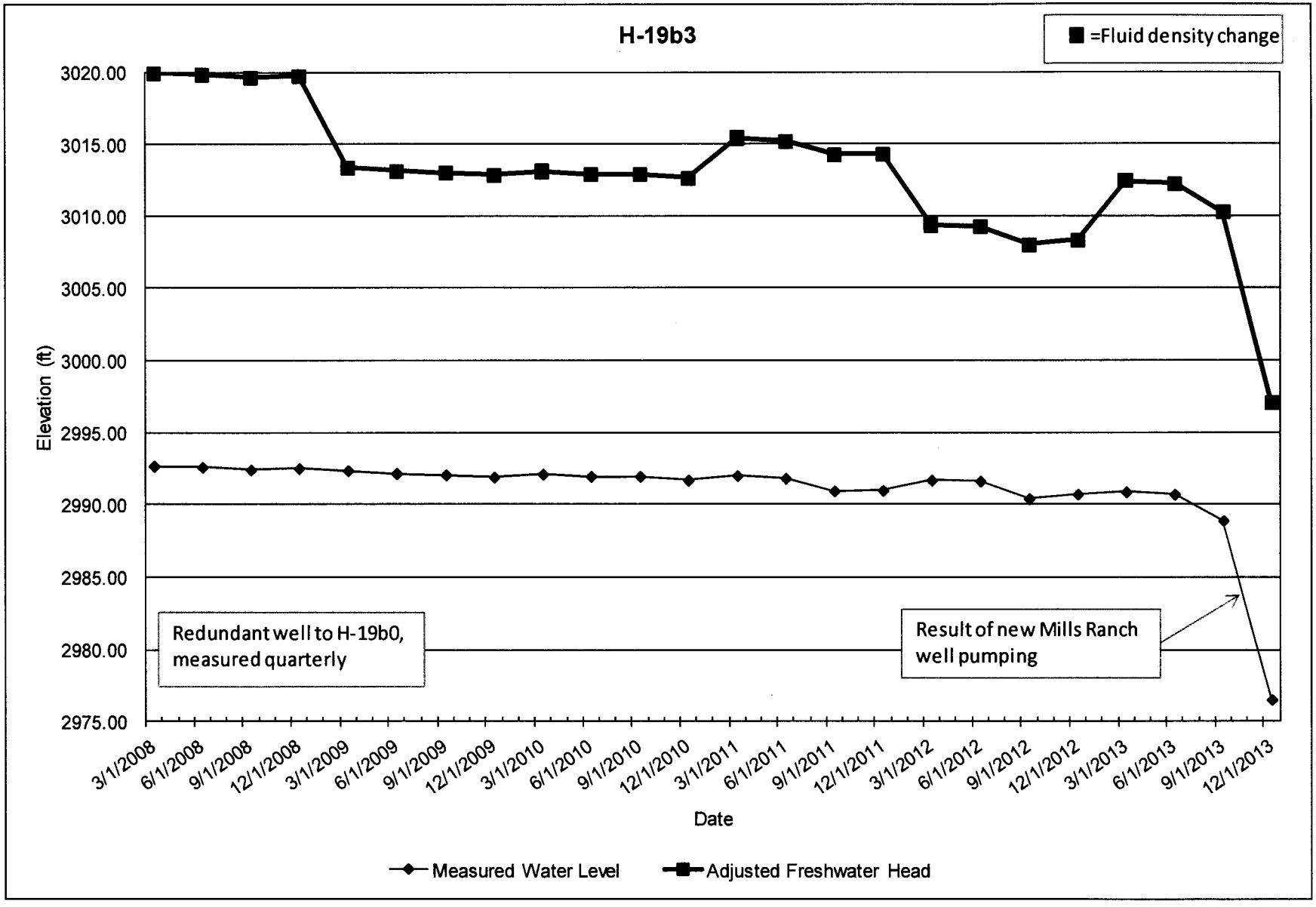

H-15R
=Fluid density change
Elevation (ft)
3025.00
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
2950.00
SNL testing
Result of new Mills Ranch well pumping
Drawdown from H-11b4R testing in June 2012
7/1/2008
9/1/2008
11/1/2008
1/1/2009
3/1/2009
5/1/2009
7/1/2009
9/1/2009
11/1/2009
1/1/2010
3/1/2010
5/1/2010
7/1/2010
9/1/2010
11/1/2010
1/1/2011
3/1/2011
5/1/2011
7/1/2011
9/1/2011
11/1/2011
1/1/2012
3/1/2012
5/1/2012
7/1/2012
9/1/2012
11/1/2012
1/1/2013
3/1/2013
5/1/2013
7/1/2013
9/1/2013
11/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

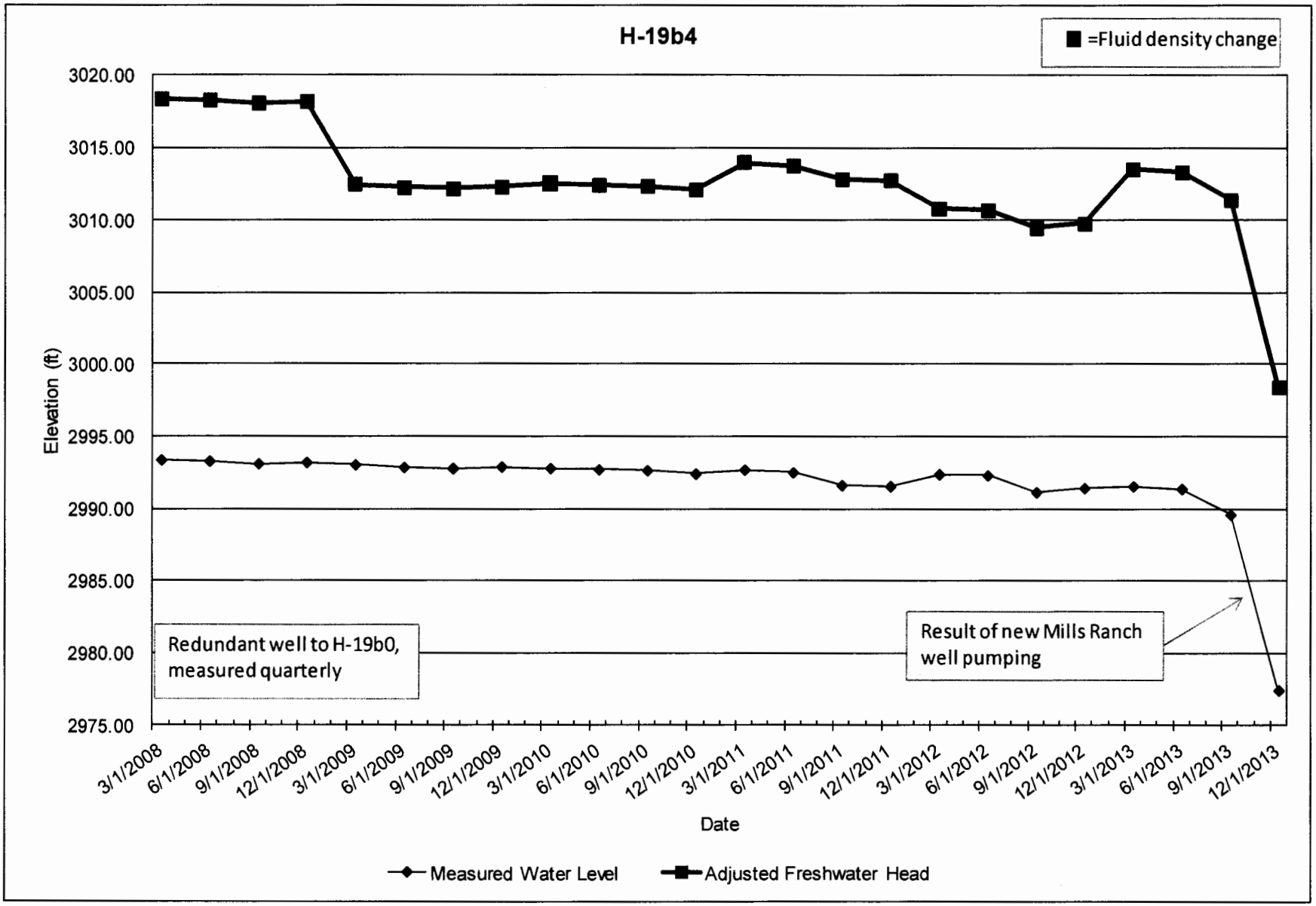

H-16
Reconfigured from multi-packer well to Culebra only well in 2008
Seasonal fluctuation possibly due to well's proximity to air intake shaft
Elevation (ft)
3055.00
3053.00
3051.00
3049.00
3047.00
3045.00
3043.00
3041.00
3039.00
3037.00
3035.00
3033.00
3031.00
3029.00
3027.00
3025.00
9/1/2008
11/1/2008
1/1/2009
3/1/2009
5/1/2009
7/1/2009
9/1/2009
11/1/2009
1/1/2010
3/1/2010
5/1/2010
7/1/2010
9/1/2010
11/1/2010
1/1/2011
3/1/2011
5/1/2011
7/1/2011
9/1/2011
11/1/2011
1/1/2012
3/1/2012
5/1/2012
7/1/2012
9/1/2012
11/1/2012
1/1/2013
3/1/2013
5/1/2013
7/1/2013
9/1/2013
11/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

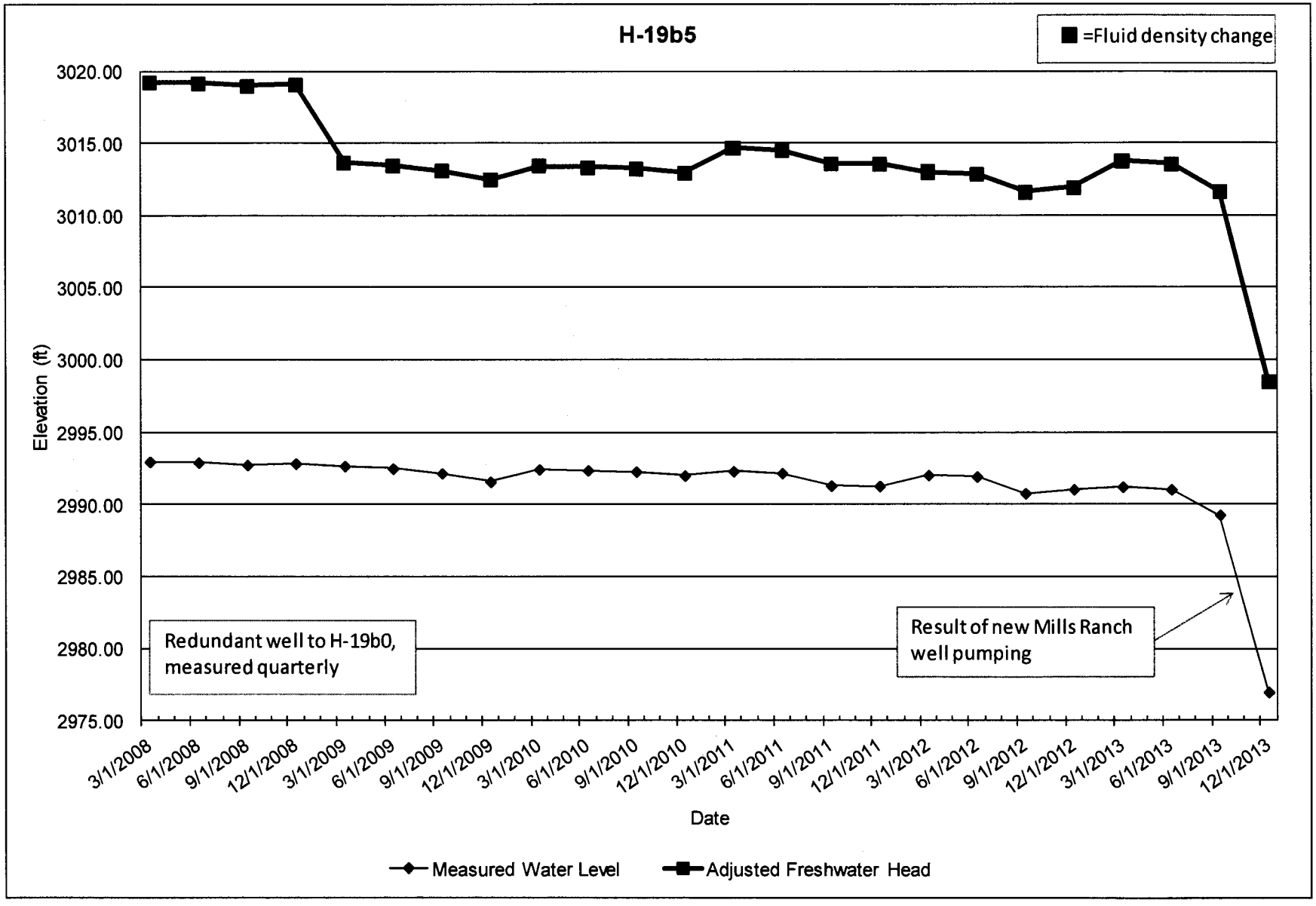

H-17
=Fluid density change
Elevation (ft)
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
2950.00
2945.00
2940.00
2935.00
Drawdown from H-9bR test in Aug. 2012
Drawdown from H-11b4R testing in June 2012
Result of new Mills Ranch well pumping
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Measured Water Level
Adjusted Freshwater Head

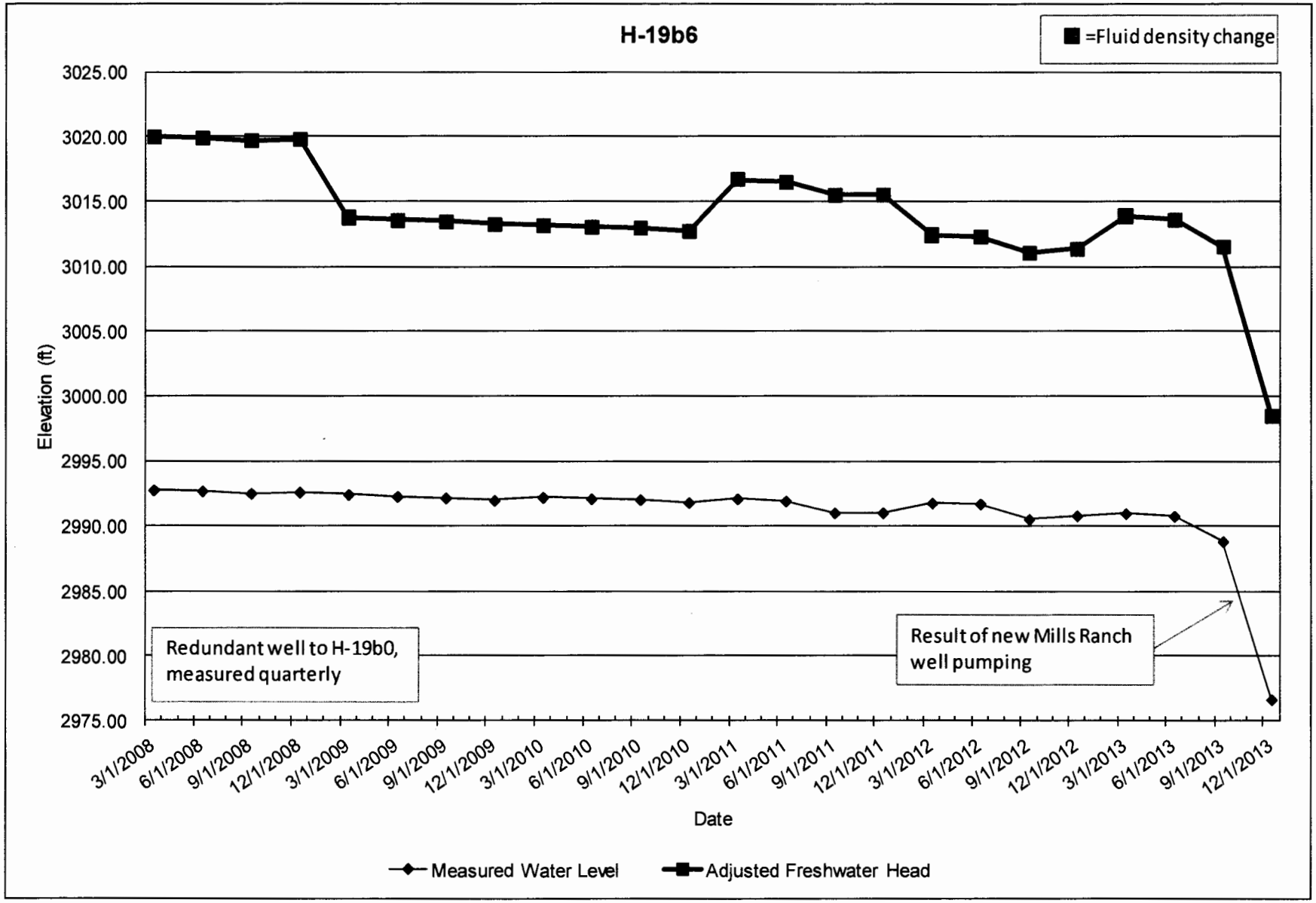

H-19b0
=Fluid density change
Drawdown from H-11b4R testing in June 2012
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Result of new Mills Ranch well pumping
Elevation (ft)
3018.00
3015.00
3012.00
3009.00
3006.00
3003.00
3000.00
2997.00
2994.00
2991.00
2988.00
2985.00
2982.00
2979.00
2976.00
2973.00
2970.00
1/16/2008
4/16/2008
7/16/2008
10/16/2008
1/16/2009
4/16/2009
7/16/2009
10/16/2009
1/16/2010
4/16/2010
7/16/2010
10/16/2010
1/16/2011
4/16/2011
7/16/2011
10/16/2011
1/16/2012
4/16/2012
7/16/2012
10/16/2012
1/16/2013
4/16/2013
7/16/2013
10/16/2013
1/16/2014
Date
Measured Water Level
Adjusted Freshwater Head

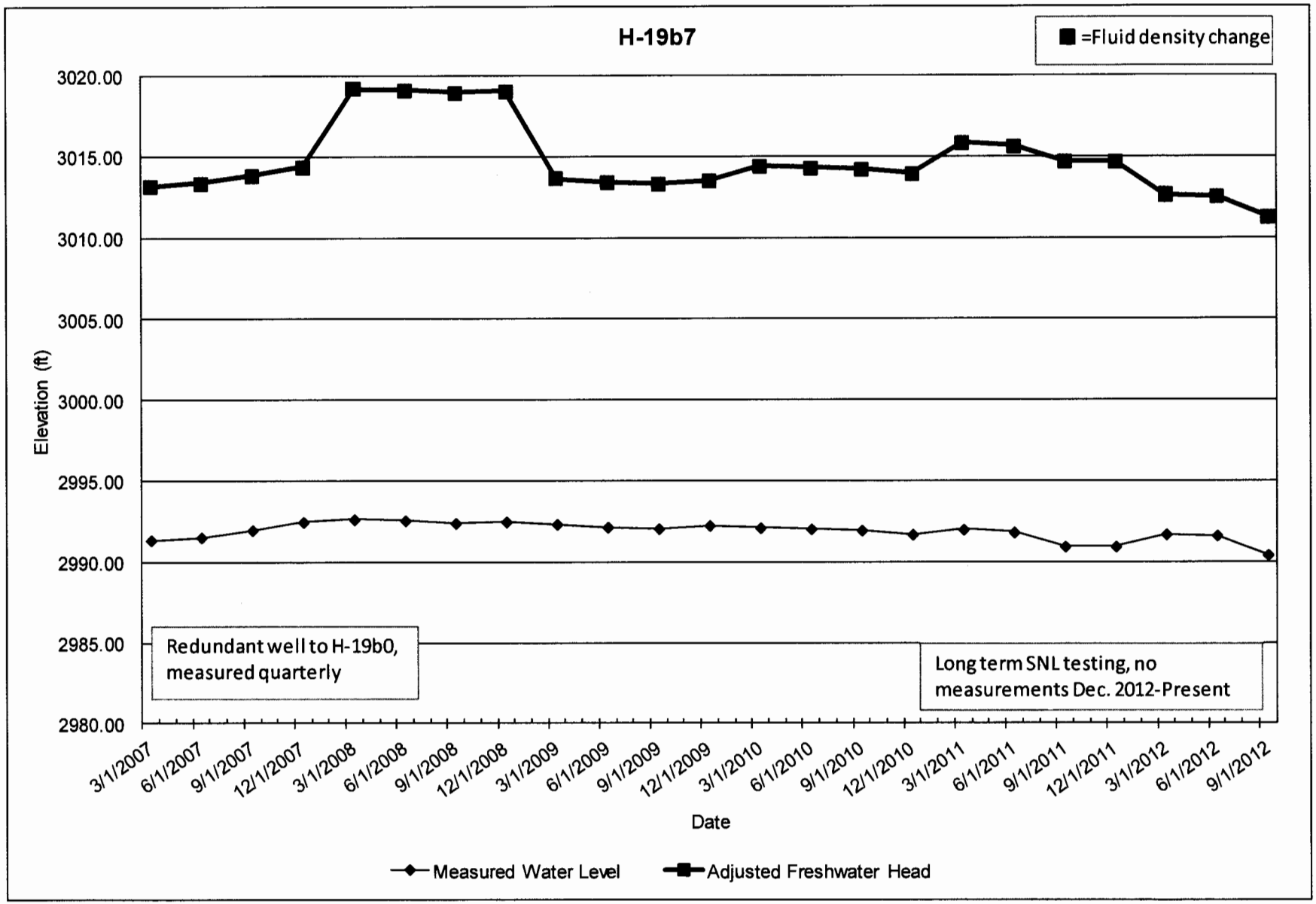

H-19b2
=Fluid density change
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
Elevation (ft)
Redundant well to H-19b0, measured quarterly
Result of new Mills Ranch well pumping
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
12/1/2013
Date
Measured Water Level
Adjusated Freshwater Head

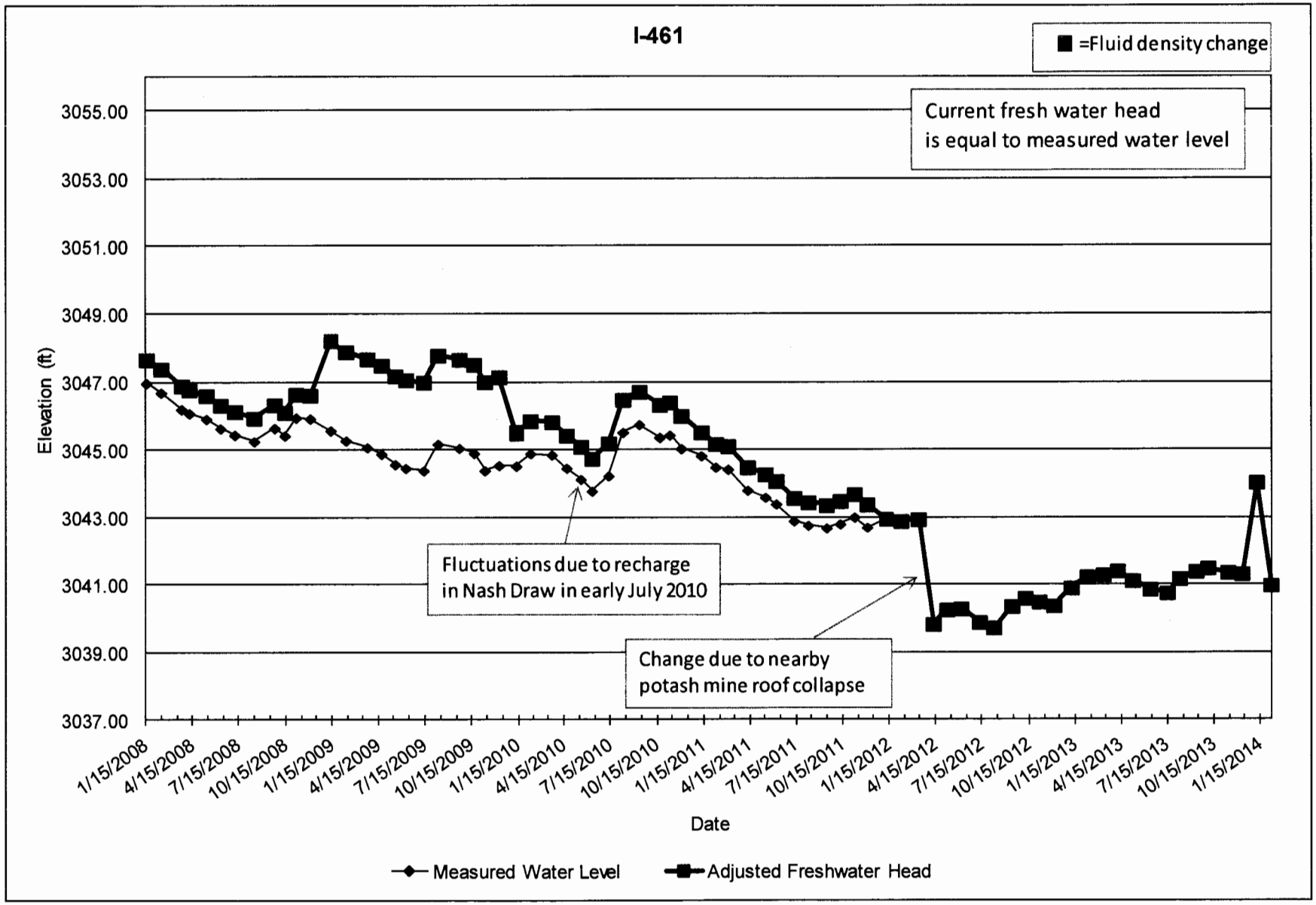

H-19b3
=Fluid density change
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
Elevation (ft)
Redundant well to H-19b0, measured quarterly
Result of new Mills Ranch well pumping
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
12/1/2013
Date
Measured Water Level
Adjusted Freshwater Head

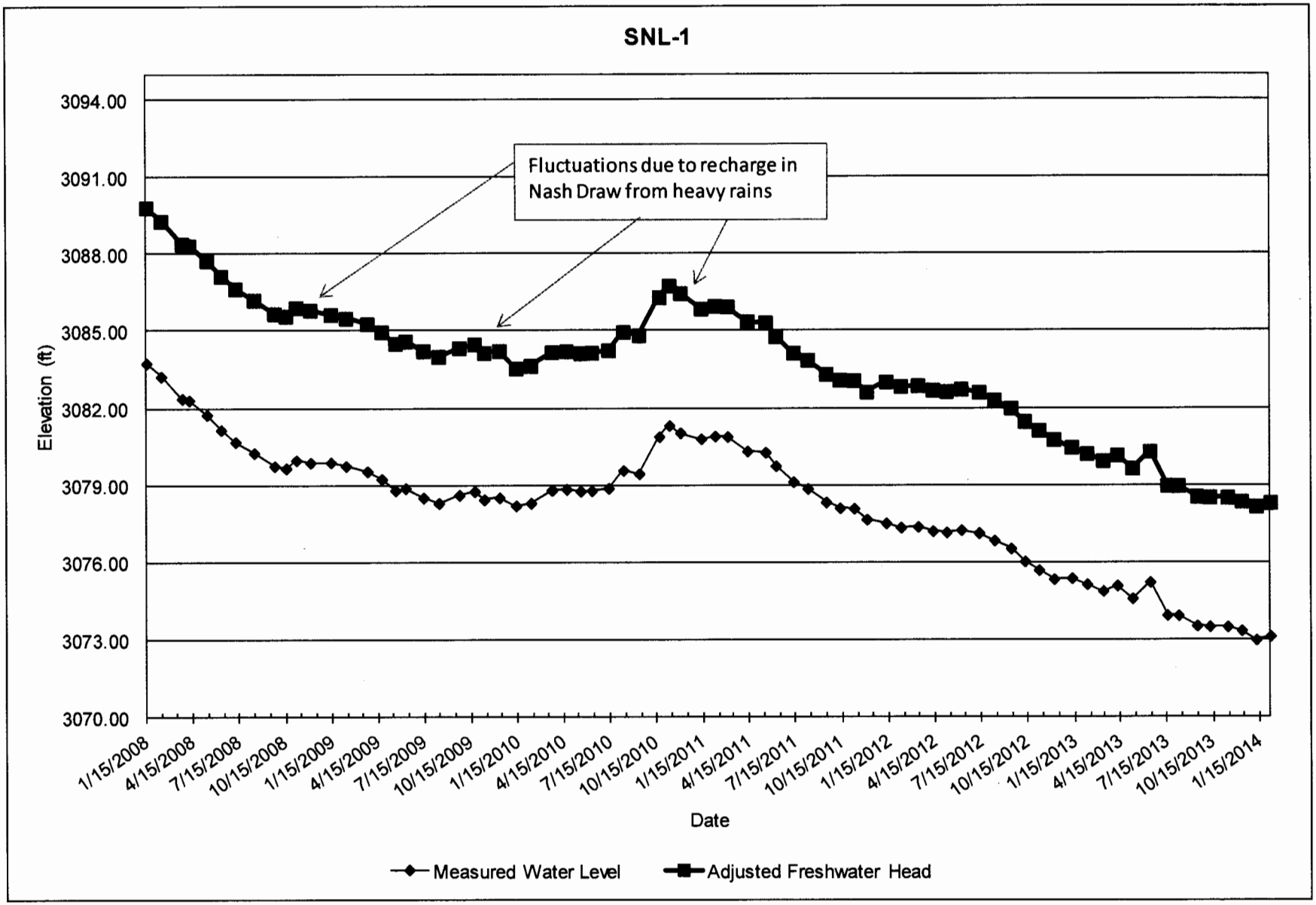

H-19b4
=Fluid density change
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
Elevation (ft)
Redundant well to H-19b0, measured quarterly
Result of new Mills Ranch well pumping
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
12/1/2013
Date
Measured Water Level
Adjusted Freshwater Head

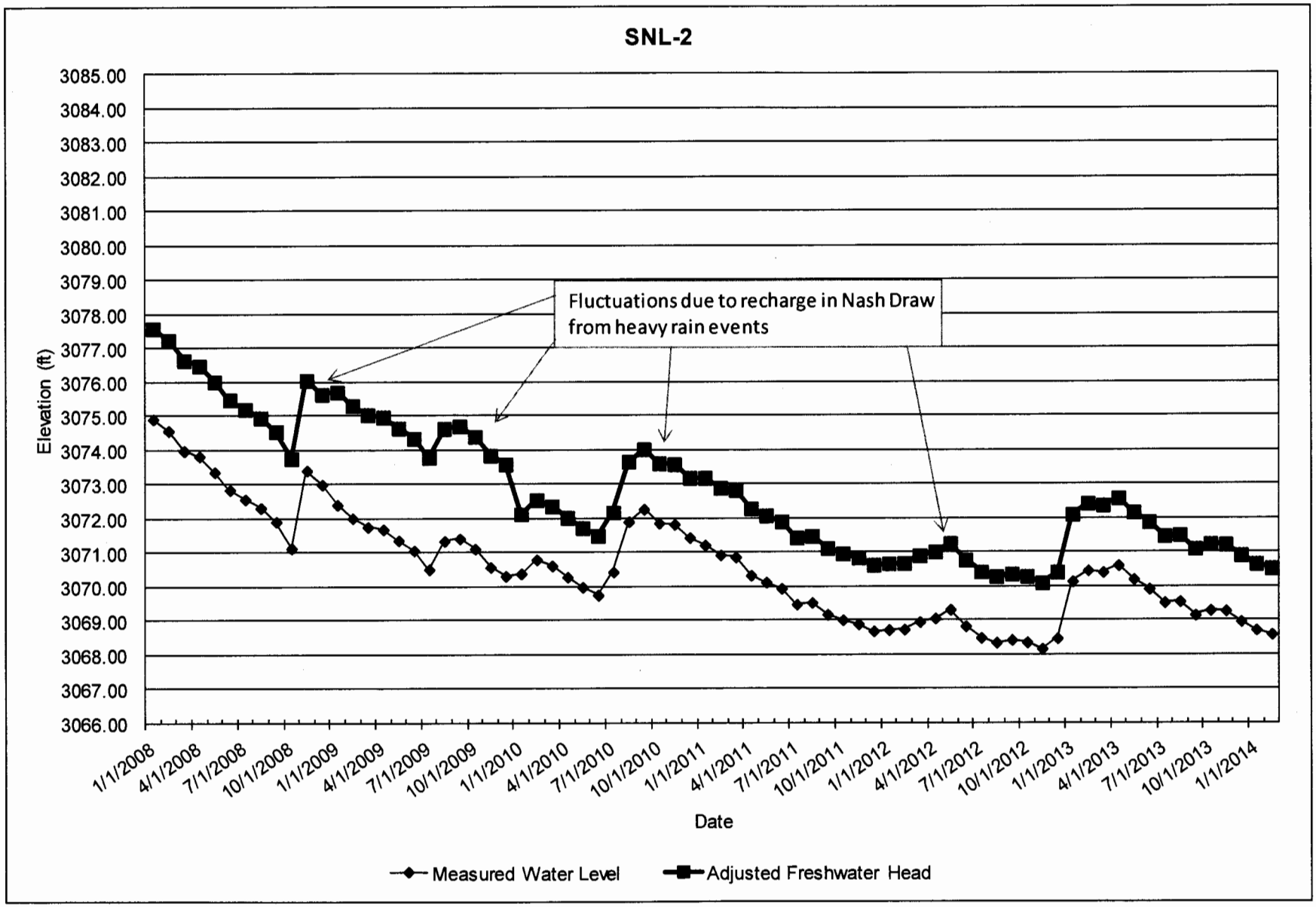

H-19b5
=Fluid density change
Elevation (ft)
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
Redundant well to H-19b0, measured quarterly
Result of new Mills Ranch well pumping
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
12/1/2013
Date
Measured Water Level
Adjusted Freshwater Head

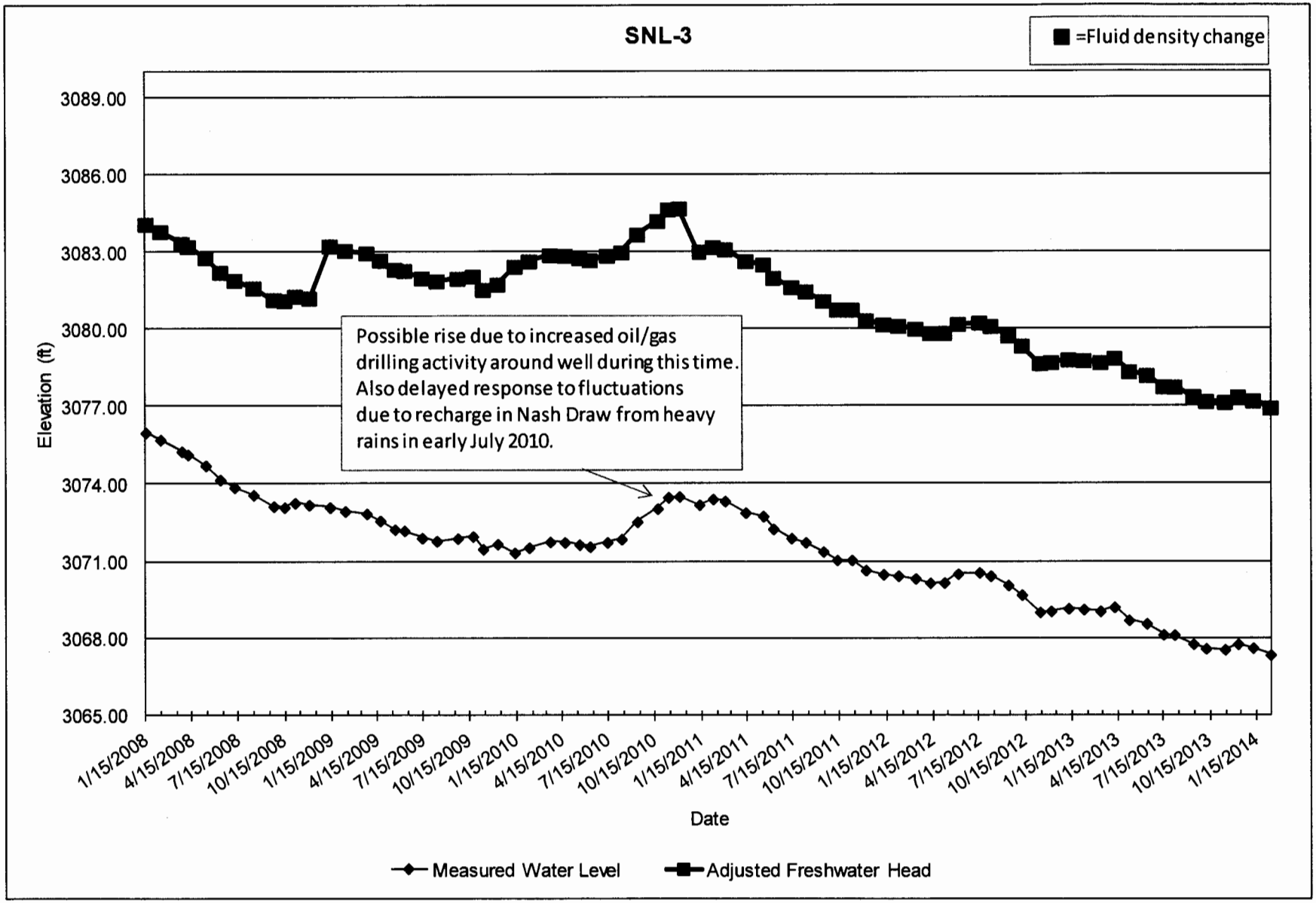

H-19b6
=Fluid density change
3025.00
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
Elevation (ft)
Redundant well to H-19b0, measured quarterly
Result of new Mills Ranch well pumping
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
12/1/2012
3/1/2013
6/1/2013
9/1/2013
12/1/2013
Date
Measured Water Level
Adjusted Freshwater Head

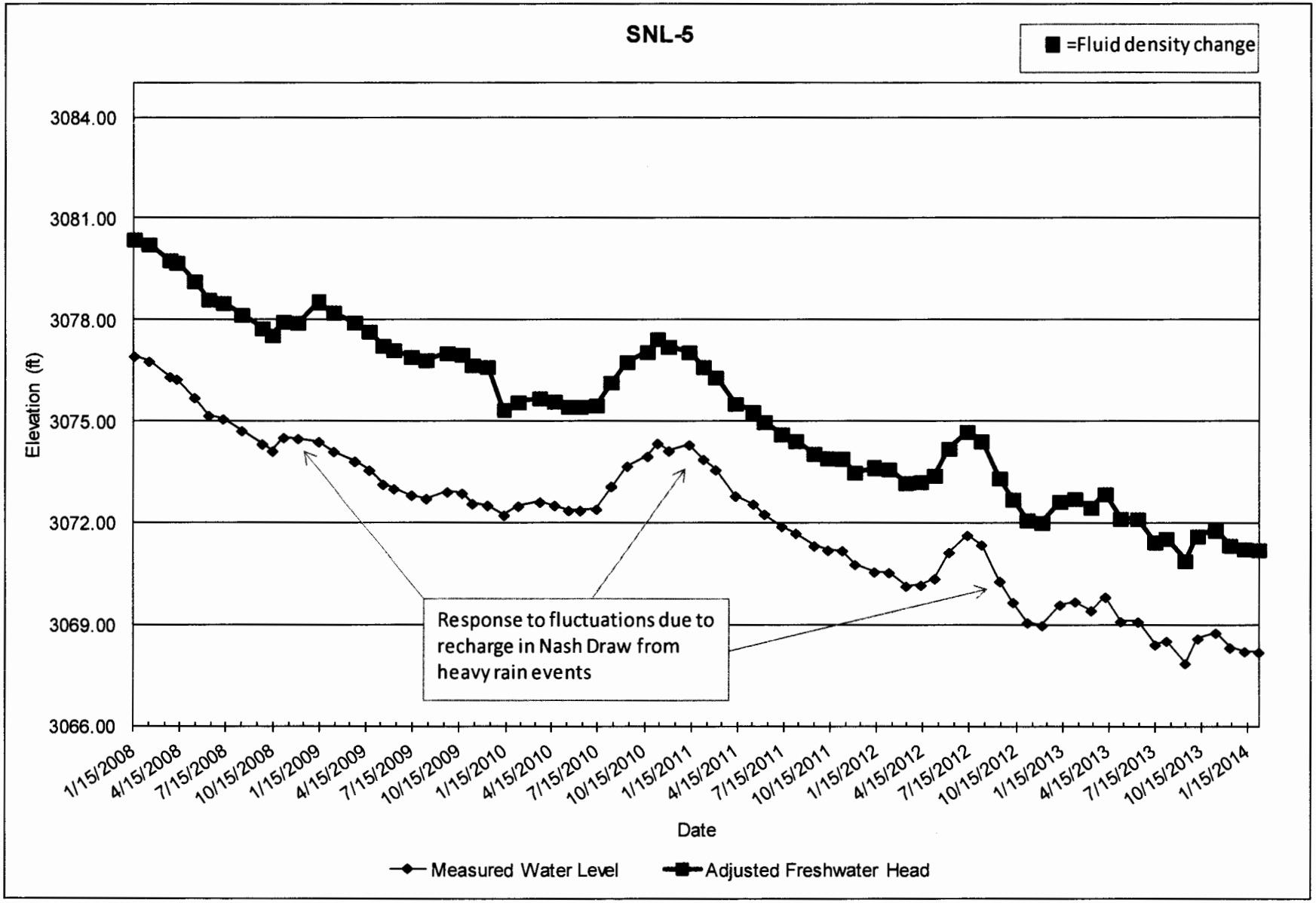

H-19b7
=Fluid density change
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
Elevation (ft)
Redundant well to H-19b0, measured quarterly
Long term SNL testing, no measurements Dec. 2012-Present
3/1/2007
6/1/2007
9/1/2007
12/1/2007
3/1/2008
6/1/2008
9/1/2008
12/1/2008
3/1/2009
6/1/2009
9/1/2009
12/1/2009
3/1/2010
6/1/2010
9/1/2010
12/1/2010
3/1/2011
6/1/2011
9/1/2011
12/1/2011
3/1/2012
6/1/2012
9/1/2012
Date
Measured Water Level
Adjusted Freshwater Head

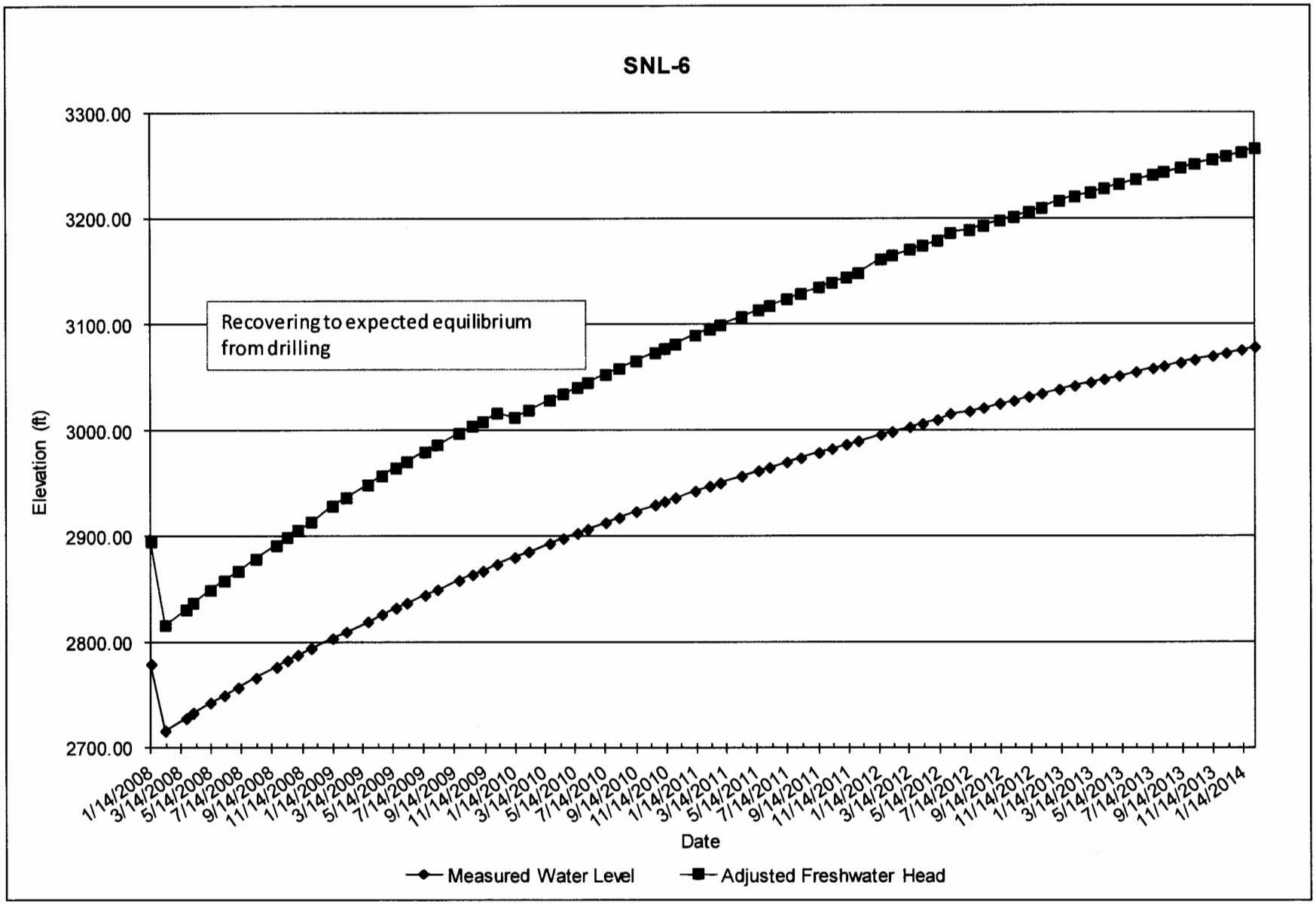

I-461
=Fluid density change
Current fresh water head
is equal to measured water level
Fluctuations due to recharge
in Nash Draw in early July 2010
Change due to nearby
potash mine roof collapse
Elevation (ft)
3055.00
3053.00
3051.00
3049.00
3047.00
3045.00
3043.00
3041.00
3039.00
3037.00
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Measured Water Level
Adjusted Freshwater Head

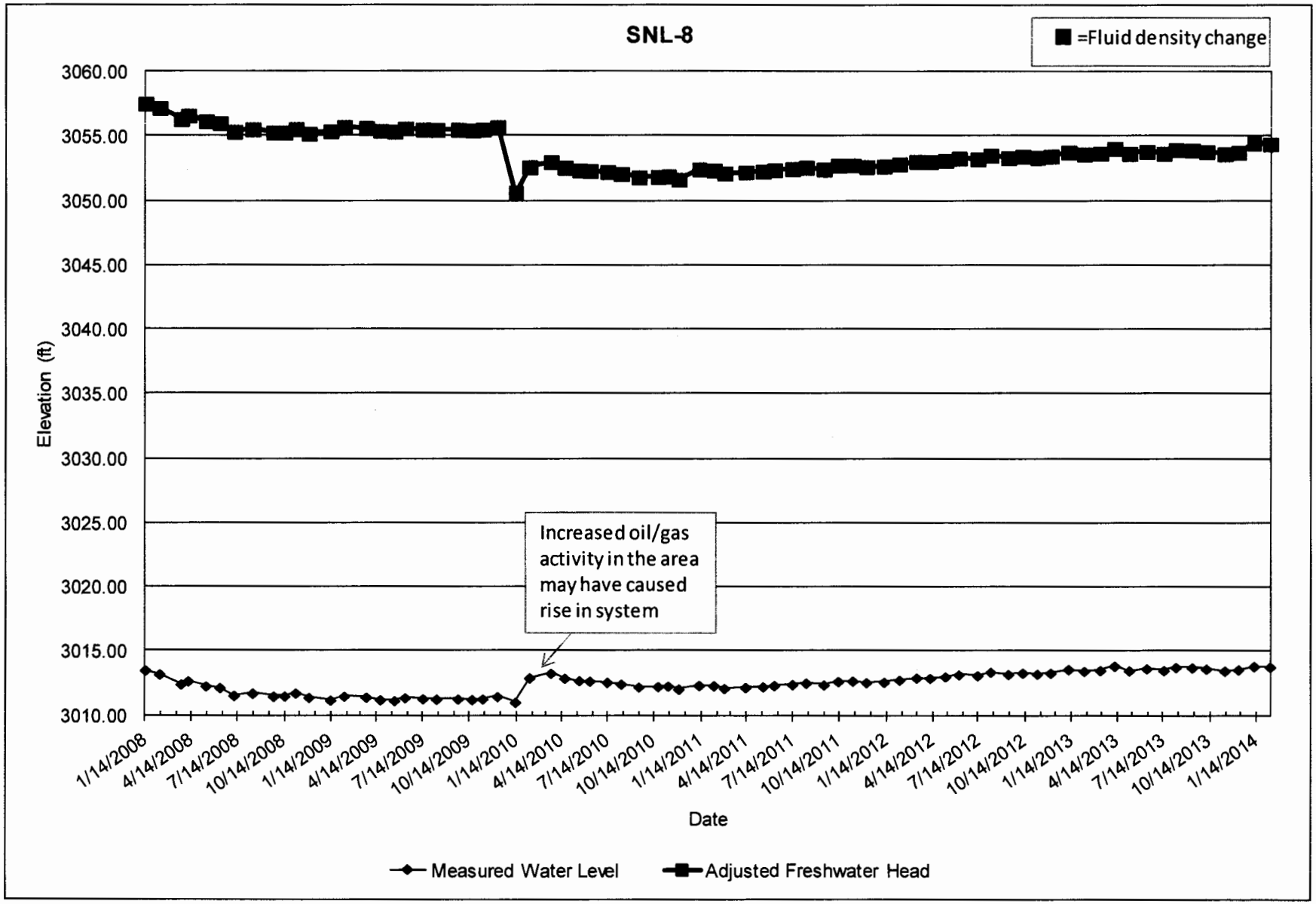

SNL-1
Fluctuations due to recharge in Nash Draw from heavy rains
Elevation (ft)
3094.00
3091.00
3088.00
3085.00
3082.00
3079.00
3076.00
3073.00
3070.00
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Measured Water Level
Adjusted Freshwater Head

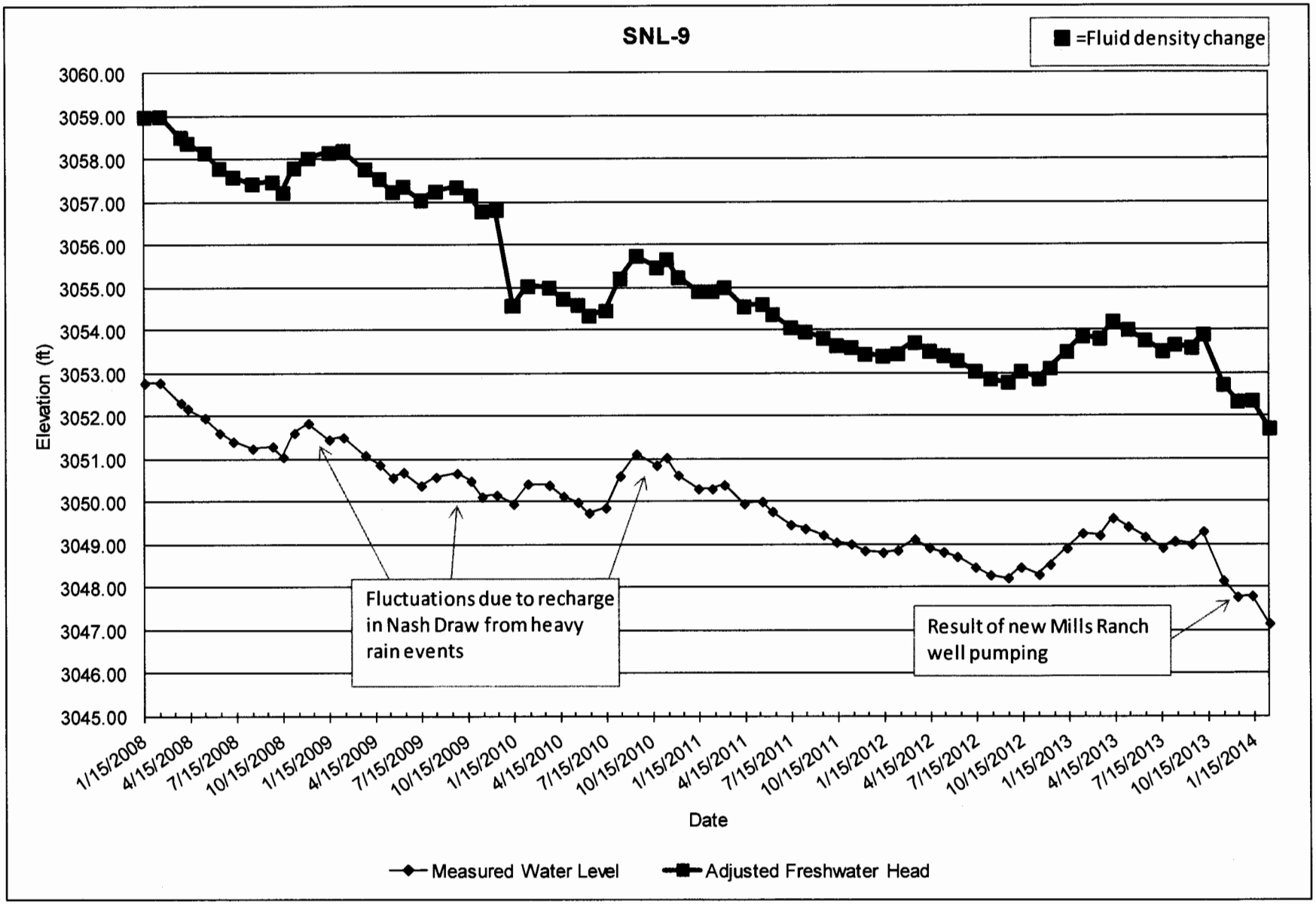

SNL-2
Elevation (ft)
3085.00
3084.00
3083.00
3082.00
3081.00
3080.00
3079.00
3078.00
3077.00
3076.00
3075.00
3074.00
3073.00
3072.00
3071.00
3070.00
3069.00
3068.00
3067.00
3066.00
Fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

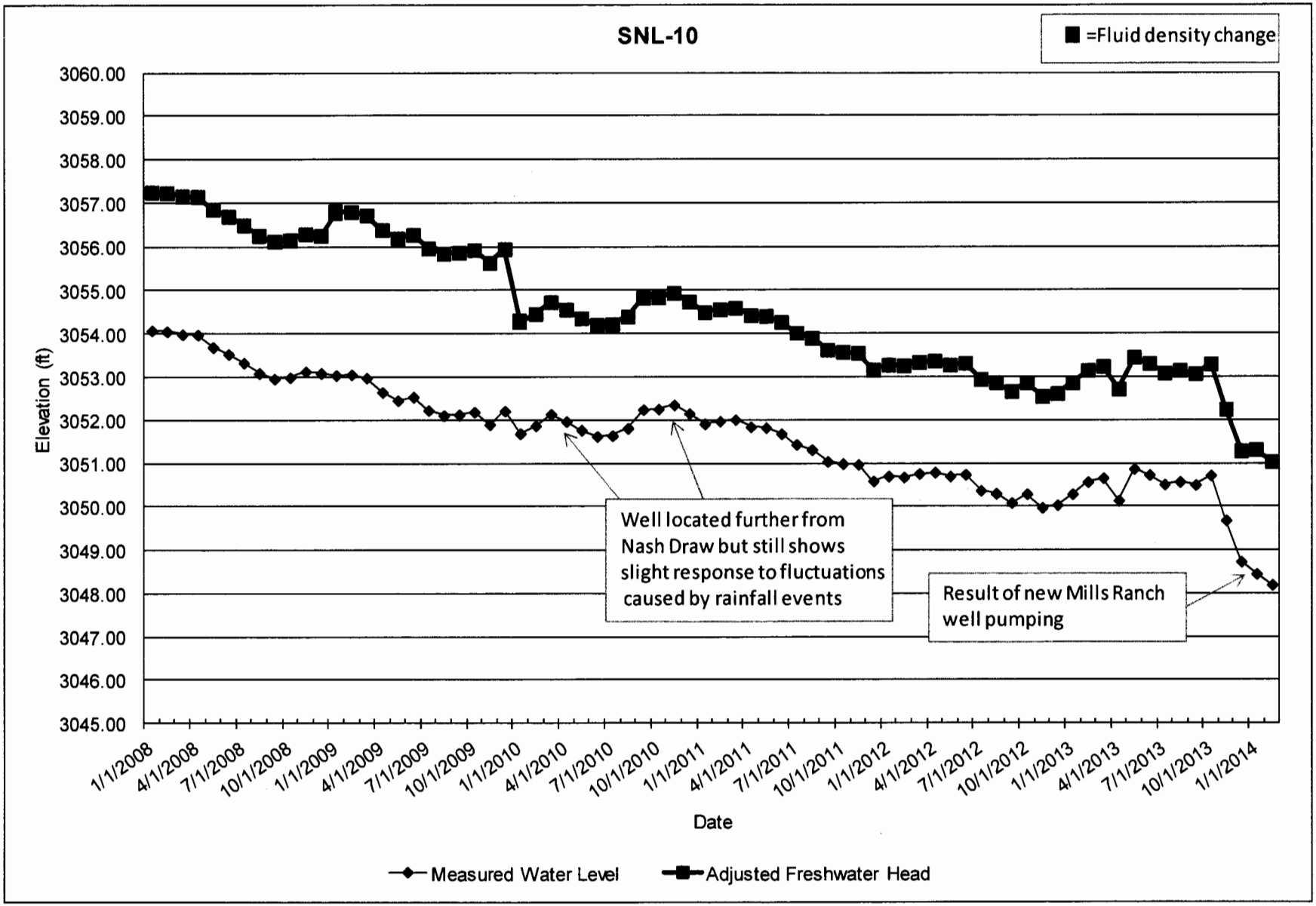

SNL-3
=Fluid density change
3089.00
3086.00
3083.00
3080.00
3077.00
3074.00
3071.00
3068.00
3065.00
Elevation (ft)
Possible rise due to increased oil/gas drilling activity around well during this time. Also delayed response to fluctuations due to recharge in Nash Draw from heavy rains in early July 2010.
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Measured Water Level
Adjusted Freshwater Head

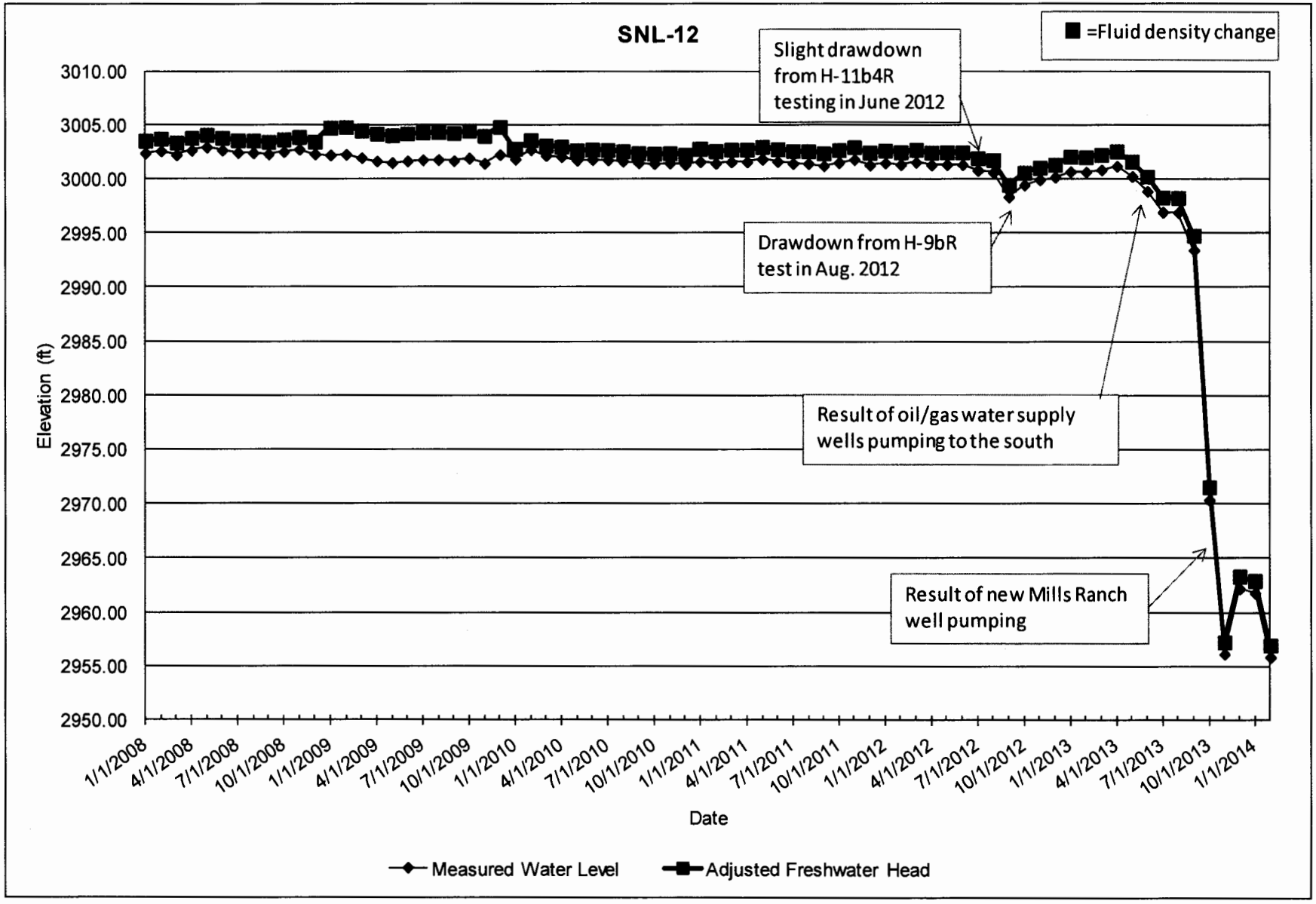

SNL-5
=Fluid density change
3084.00
3081.00
3078.00
3075.00
3072.00
3069.00
3066.00
Elevation (ft)
Response to fluctuations due to recharge in Nash Draw from heavy rain events
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Measured Water Level
Adjusted Freshwater Head

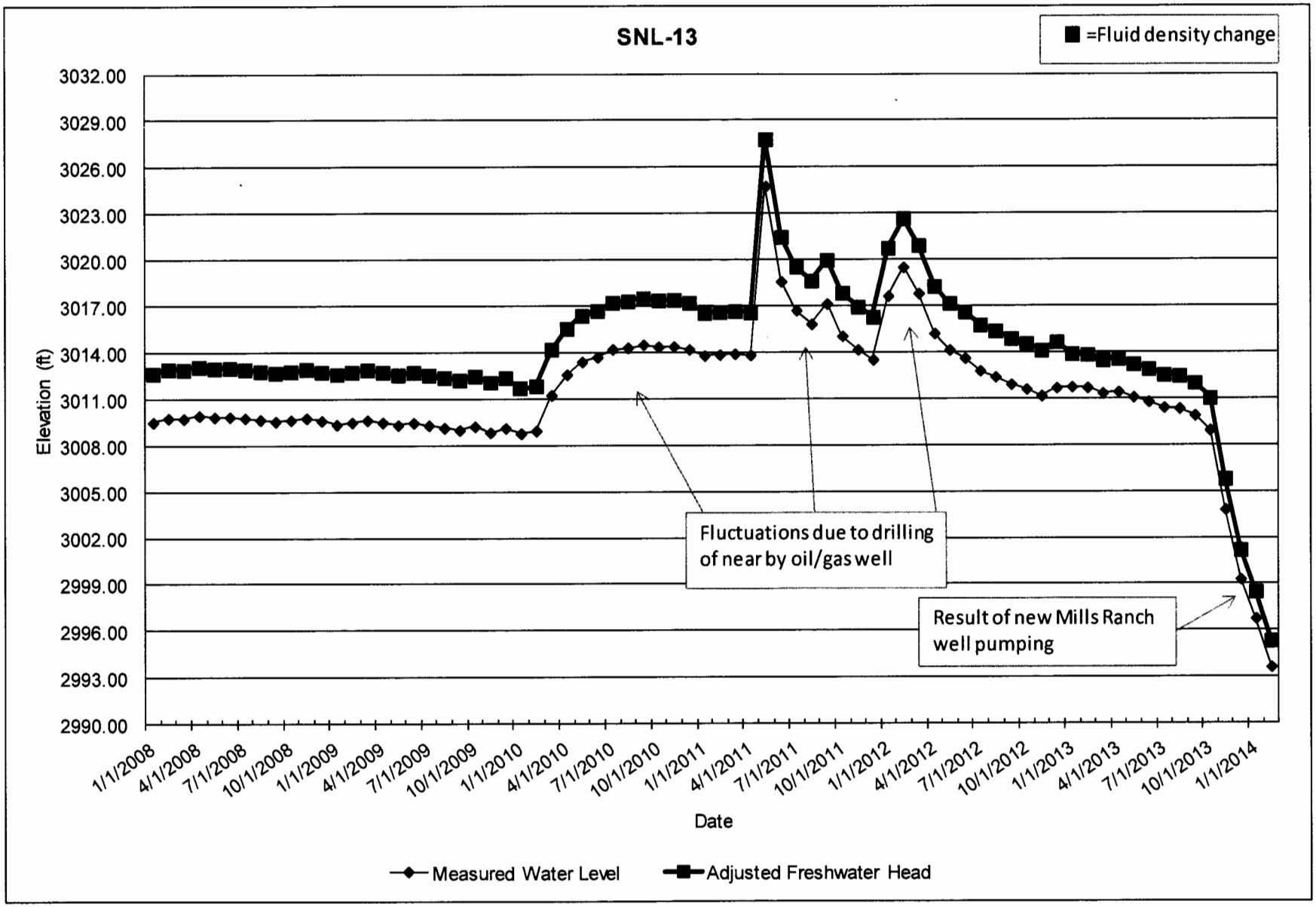

SNL-6
Recovering to expected equilibrium from drilling
Elevation (ft)
3300.00
3200.00
3100.00
3000.00
2900.00
2800.00
2700.00
1/14/2008
3/14/2008
5/14/2008
7/14/2008
9/14/2008
11/14/2008
1/14/2009
3/14/2009
5/14/2009
7/14/2009
9/14/2009
11/14/2009
1/14/2010
3/14/2010
5/14/2010
7/14/2010
9/14/2010
11/14/2010
1/14/2011
3/14/2011
5/14/2011
7/14/2011
9/14/2011
11/14/2011
1/14/2012
3/14/2012
5/14/2012
7/14/2012
9/14/2012
11/14/2012
1/14/2013
3/14/2013
5/14/2013
7/14/2013
9/14/2013
11/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

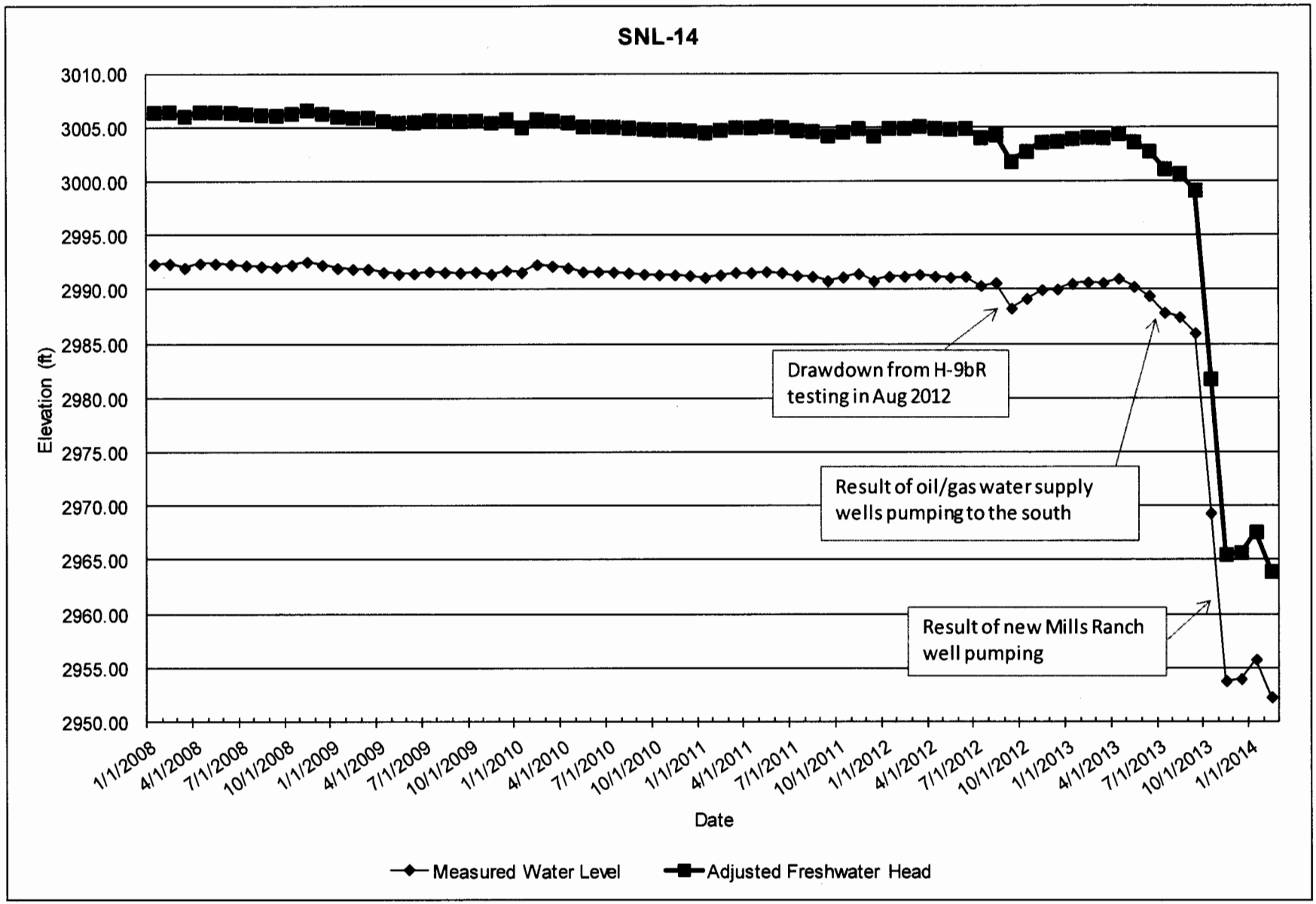

SNL-8
=Fluid density change
3060.00
3055.00
3050.00
3045.00
3040.00
3035.00
3030.00
3025.00
3020.00
3015.00
3010.00
Elevation (ft)
Increased oil/gas activity in the area may have caused rise in system
1/14/2008
4/14/2008
7/14/2008
10/14/2008
1/14/2009
4/14/2009
7/14/2009
10/14/2009
1/14/2010
4/14/2010
7/14/2010
10/14/2010
1/14/2011
4/14/2011
7/14/2011
10/14/2011
1/14/2012
4/14/2012
7/14/2012
10/14/2012
1/14/2013
4/14/2013
7/14/2013
10/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

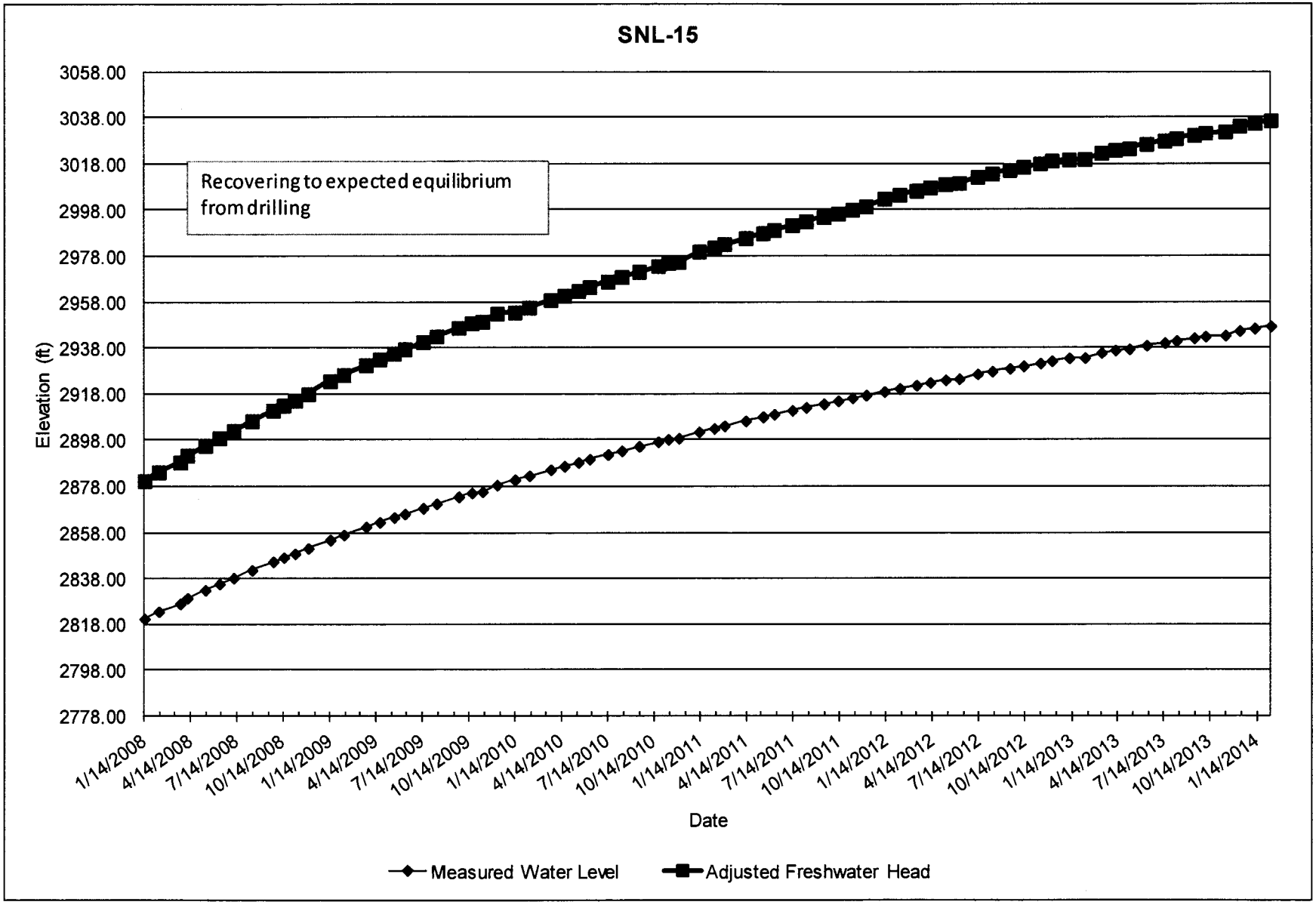

SNL-9
=Fluid density change
Elevation (ft)
3060.00
3059.00
3058.00
3057.00
3056.00
3055.00
3054.00
3053.00
3052.00
3051.00
3050.00
3049.00
3048.00
3047.00
3046.00
3045.00
1/15/2008
4/15/2008
7/15/2008
10/15/2008
1/15/2009
4/15/2009
7/15/2009
10/15/2009
1/15/2010
4/15/2010
7/15/2010
10/15/2010
1/15/2011
4/15/2011
7/15/2011
10/15/2011
1/15/2012
4/15/2012
7/15/2012
10/15/2012
1/15/2013
4/15/2013
7/15/2013
10/15/2013
1/15/2014
Date
Fluctuations due to recharge in Nash Draw from heavy rain events
Result of new Mills Ranch well pumping
Measured Water Level
Adjusted Freshwater Head

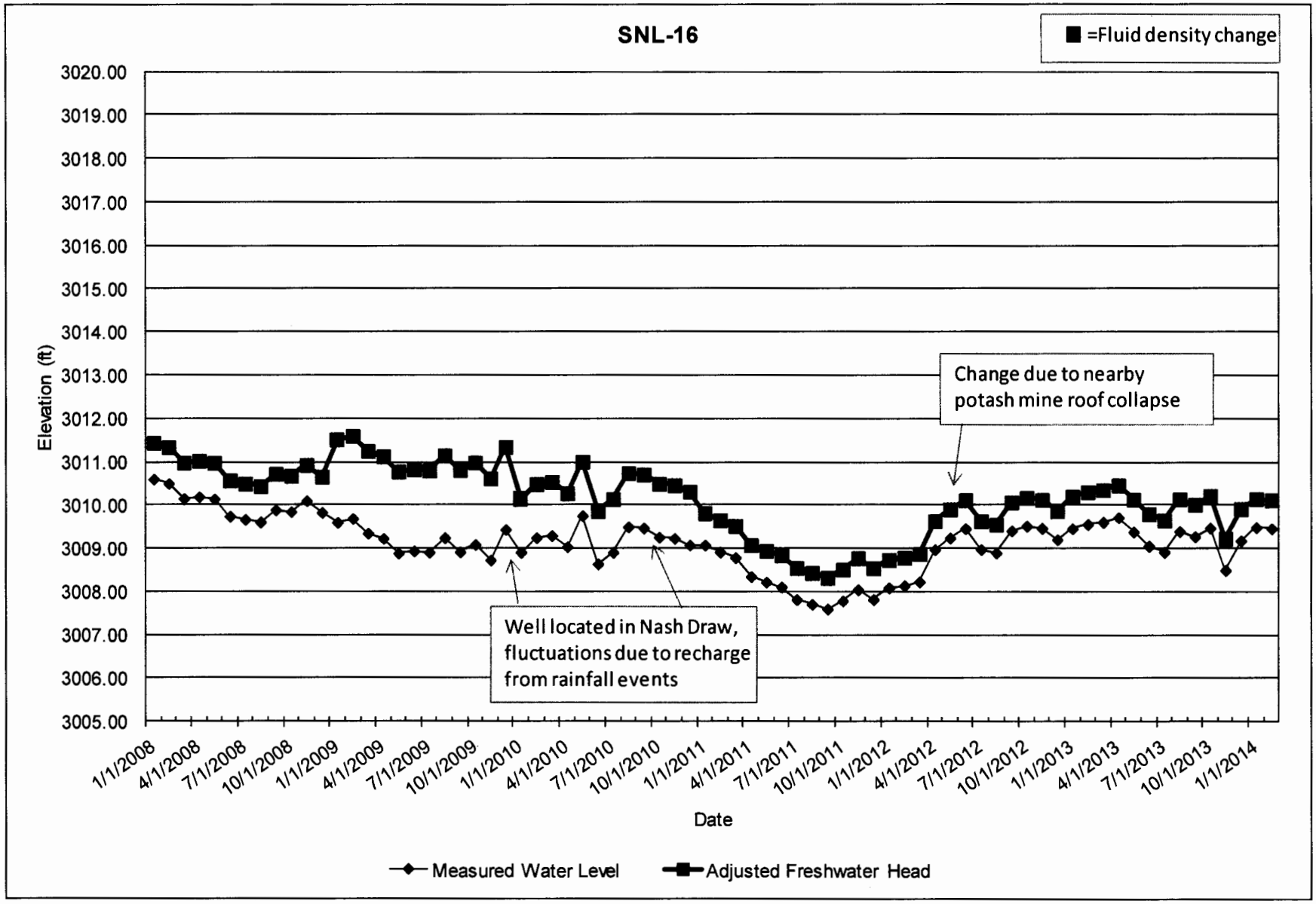

SNL-10
=Fluid density change
Elevation (ft)
3060.00
3059.00
3058.00
3057.00
3056.00
3055.00
3054.00
3053.00
3052.00
3051.00
3050.00
3049.00
3048.00
3047.00
3046.00
3045.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Well located further from Nash Draw but still shows slight response to fluctuations caused by rainfall events
Result of new Mills Ranch well pumping
Measured Water Level
Adjusted Freshwater Head

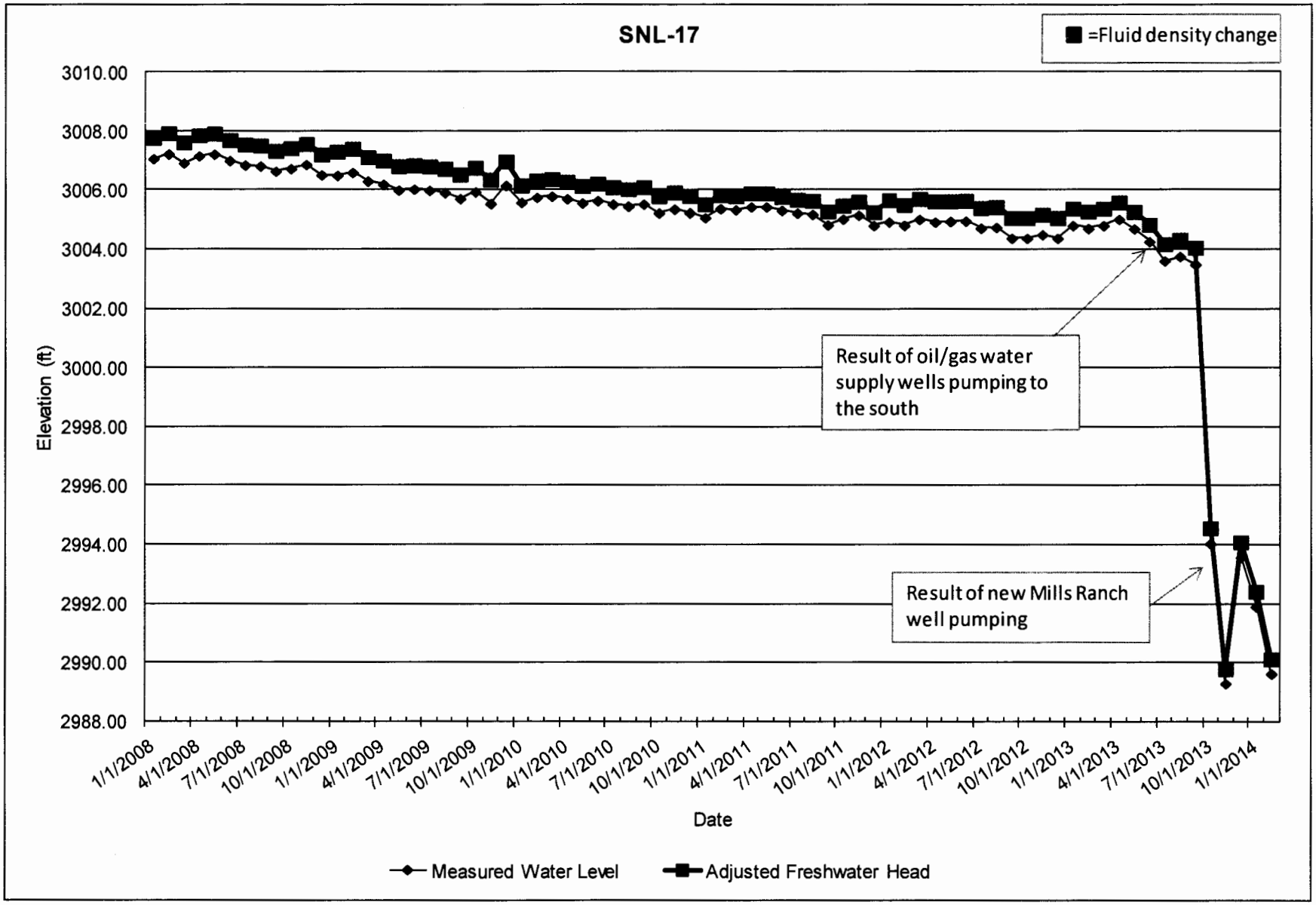

SNL-12
=Fluid density change
Slight drawdown from H-11b4R testing in June 2012
Drawdown from H-9bR test in Aug. 2012
Result of oil/gas water supply wells pumping to the south
Result of new Mills Ranch well pumping
Elevation (ft)
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
2950.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

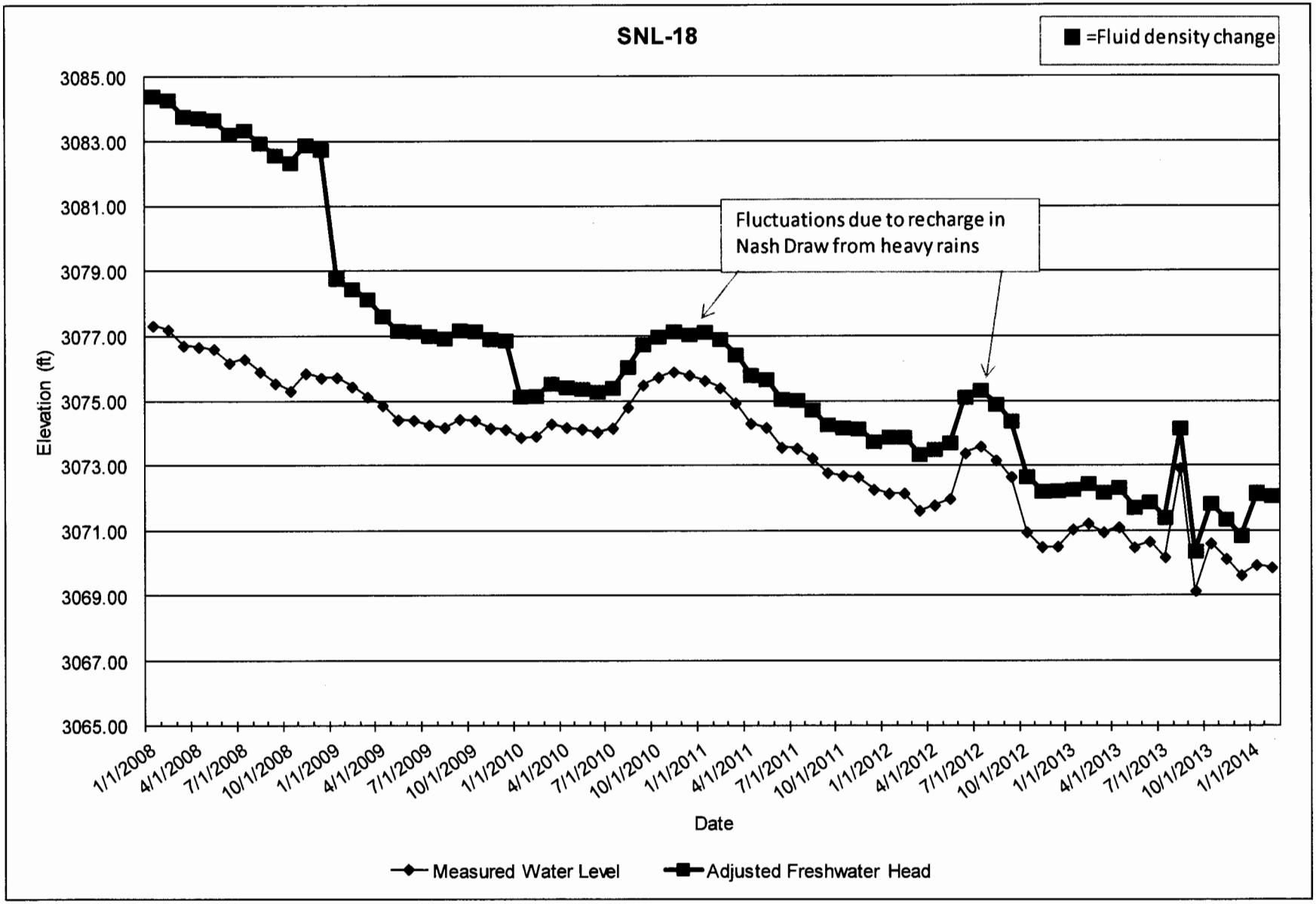

SNL-13
=Fluid density change
3032.00
3029.00
3026.00
3023.00
3020.00
3017.00
3014.00
3011.00
3008.00
3005.00
3002.00
2999.00
2996.00
2993.00
2990.00
Elevation (ft)
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Fluctuations due to drilling of near by oil/gas well
Result of new Mills Ranch well pumping
Measured Water Level
Adjusted Freshwater Head

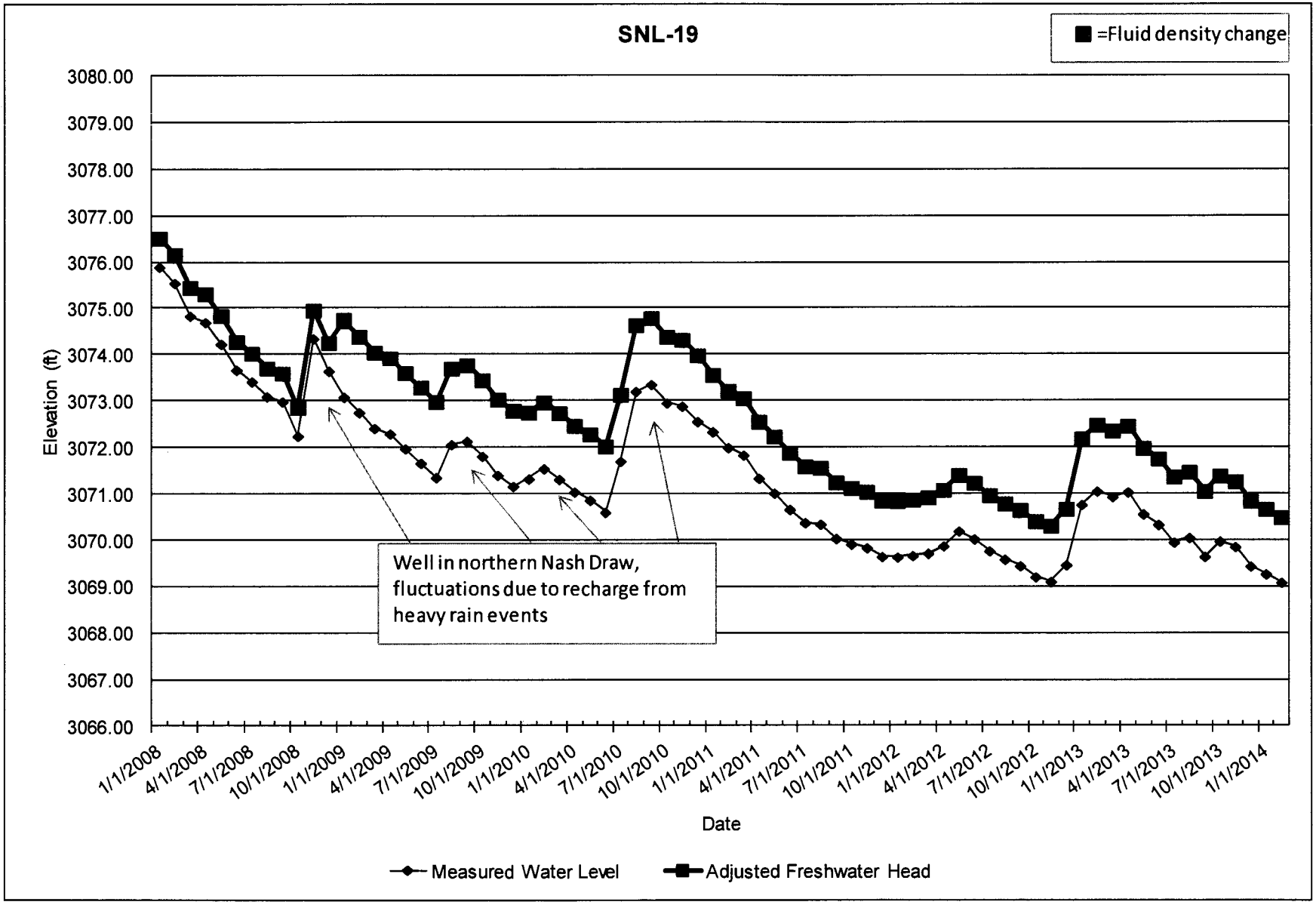

SNL-14
Elevation (ft)
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
2955.00
2950.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Drawdown from H-9bR testing in Aug 2012
Result of oil/gas water supply wells pumping to the south
Result of new Mills Ranch well pumping
Measured Water Level
Adjusted Freshwater Head

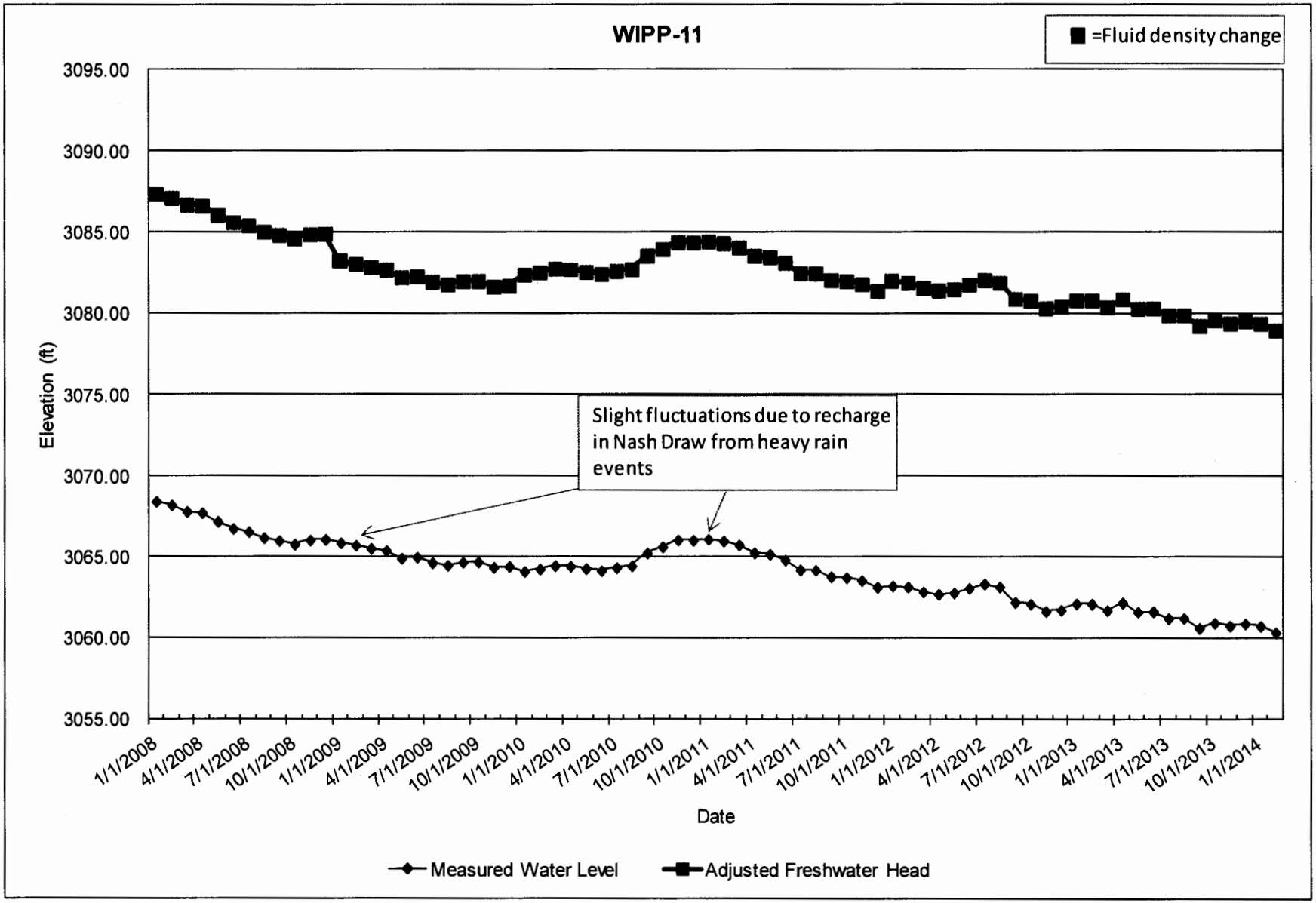

SNL-15
Recovering to expected equilibrium from drilling
Elevation (ft)
3058.00
3038.00
3018.00
2998.00
2978.00
2958.00
2938.00
2918.00
2898.00
2878.00
2858.00
2838.00
2818.00
2798.00
2778.00
1/14/2008
4/14/2008
7/14/2008
10/14/2008
1/14/2009
4/14/2009
7/14/2009
10/14/2009
1/14/2010
4/14/2010
7/14/2010
10/14/2010
1/14/2011
4/14/2011
7/14/2011
10/14/2011
1/14/2012
4/14/2012
7/14/2012
10/14/2012
1/14/2013
4/14/2013
7/14/2013
10/14/2013
1/14/2014
Date
Measured Water Level
Adjusted Freshwater Head

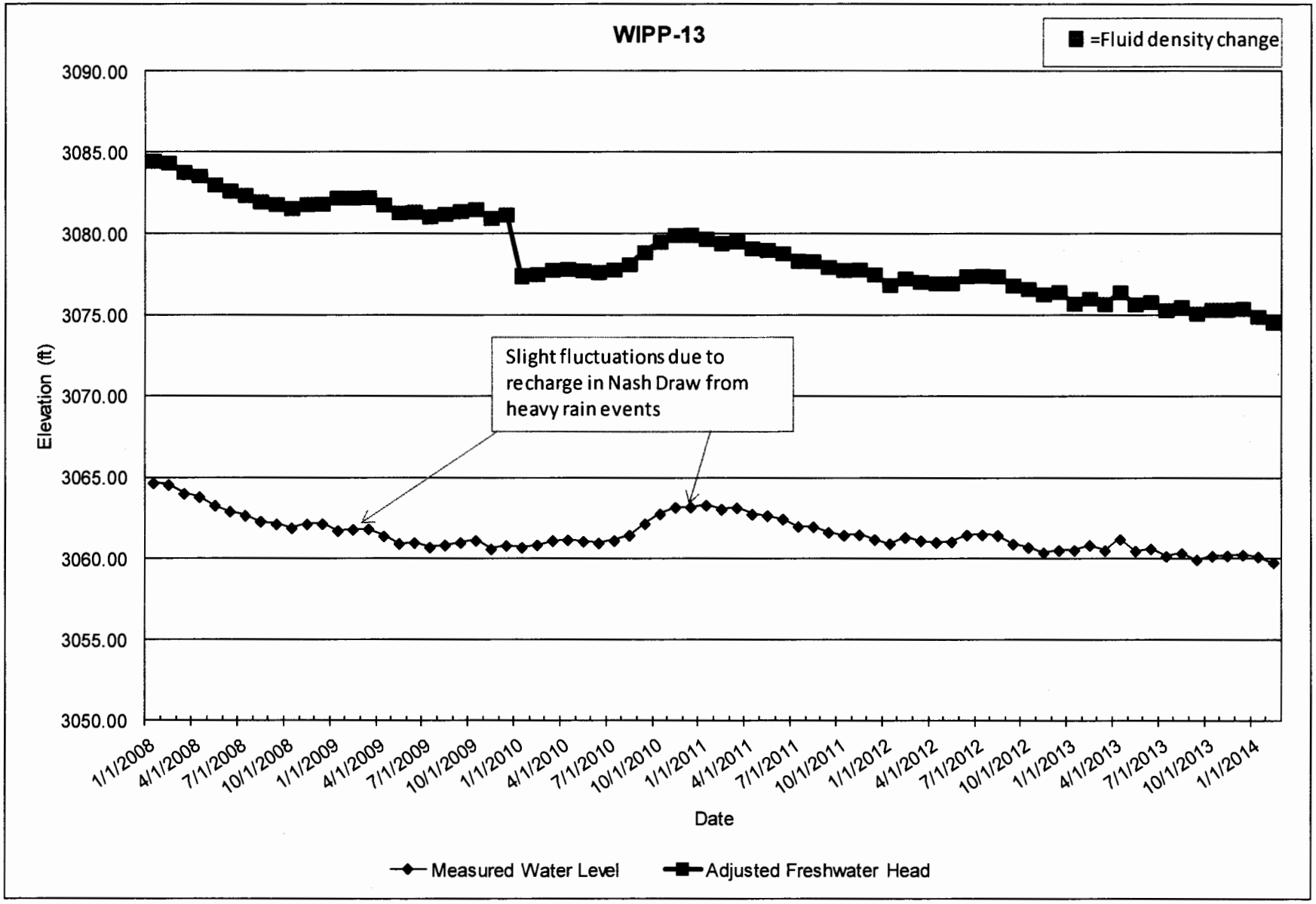

SNL-16
=Fluid density change
Elevation (ft)
3020.00
3019.00
3018.00
3017.00
3016.00
3015.00
3014.00
3013.00
3012.00
3011.00
3010.00
3009.00
3008.00
3007.00
3006.00
3005.00
Change due to nearby potash mine roof collapse
Well located in Nash Draw, fluctuations due to recharge from rainfall events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

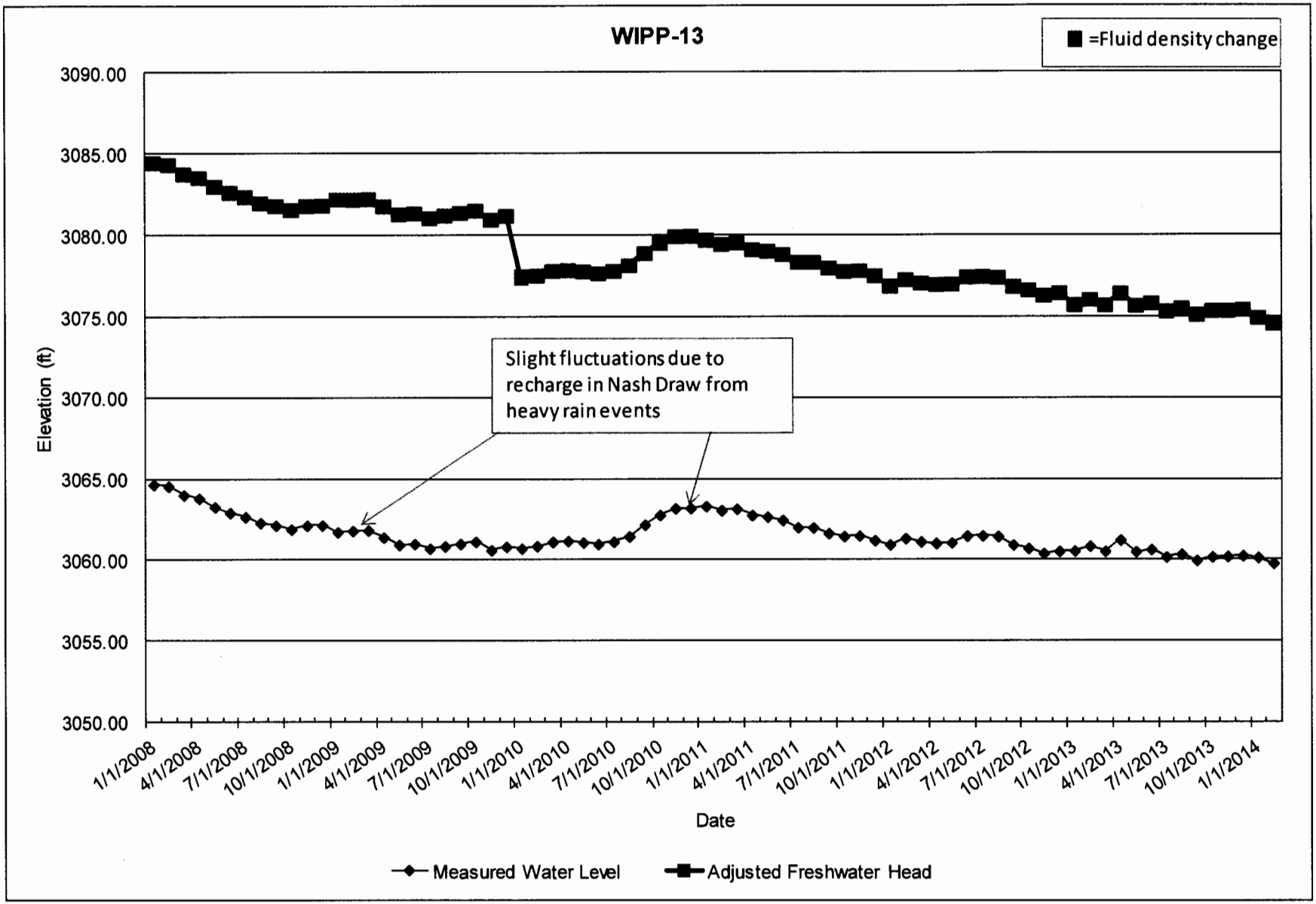

SNL-17
=Fluid density change
3010.00
3008.00
3006.00
3004.00
3002.00
3000.00
2998.00
2996.00
2994.00
2992.00
2990.00
2988.00
Elevation (ft)
Result of oil/gas water supply wells pumping to the south
Result of new Mills Ranch well pumping
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

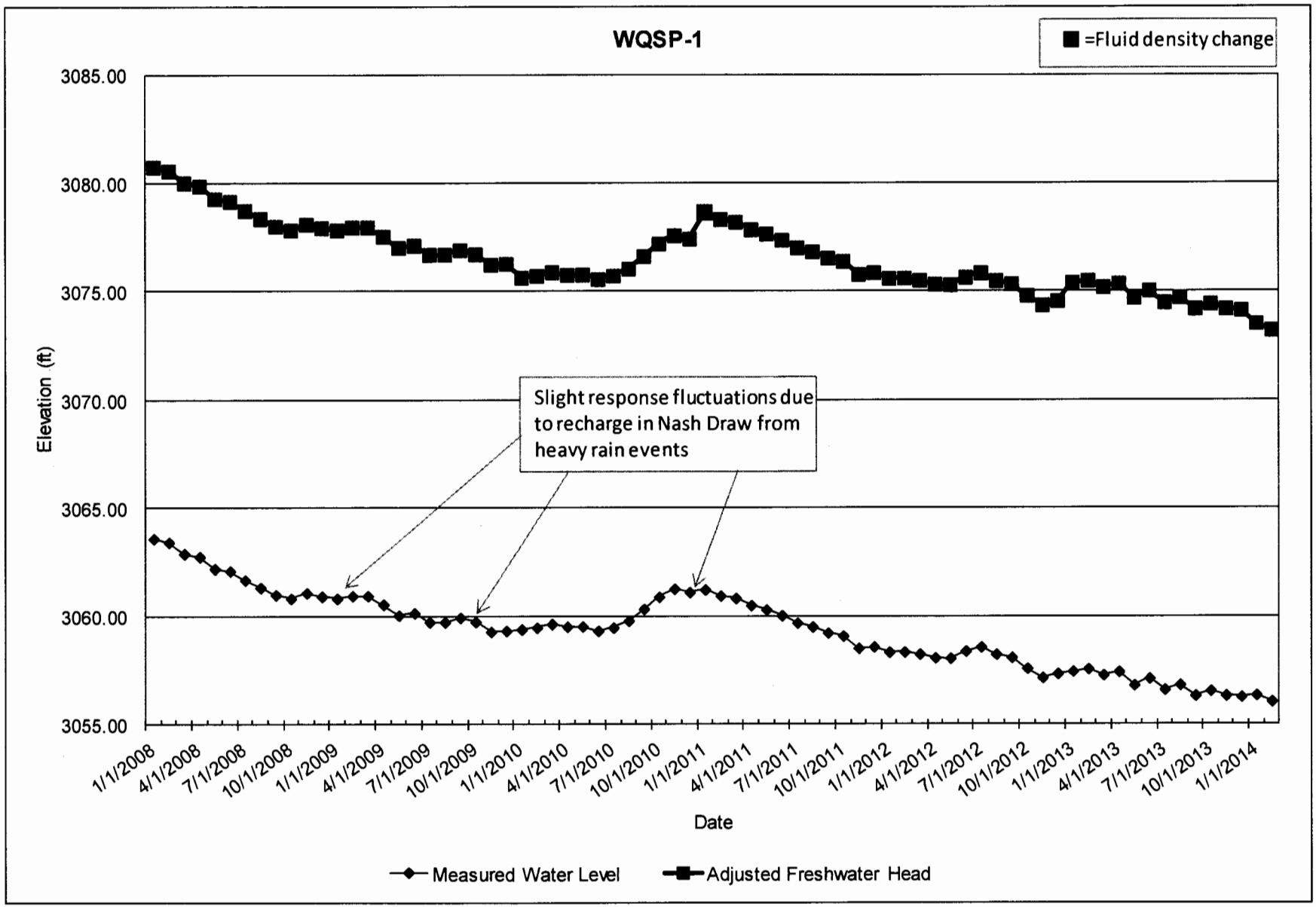

SNL-18
=Fluid density change
Fluctuations due to recharge in Nash Draw from heavy rains
Elevation (ft)
3085.00
3083.00
3081.00
3079.00
3077.00
3075.00
3073.00
3071.00
3069.00
3067.00
3065.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

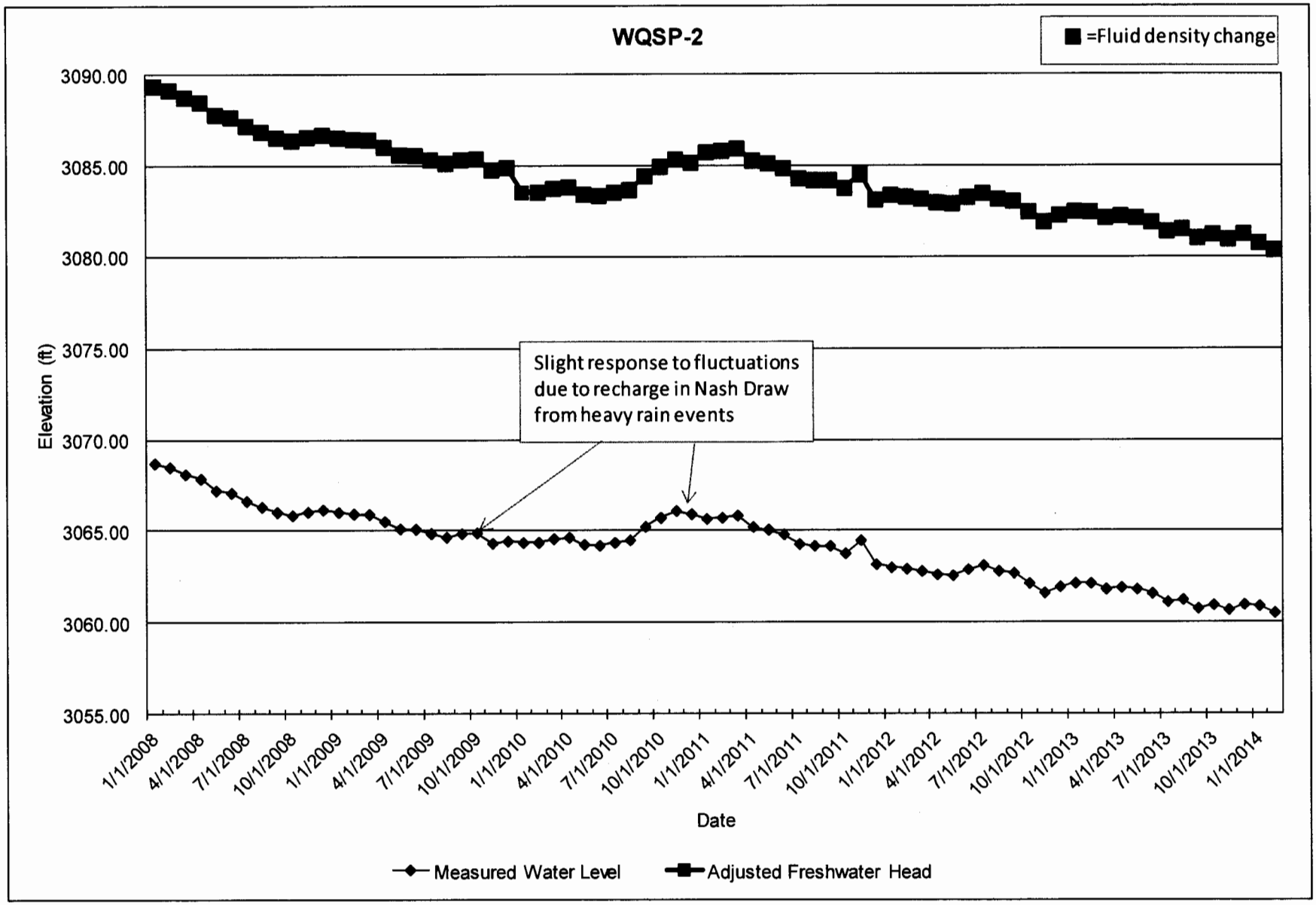

SNL-19
=Fluid density change
3080.00
3079.00
3078.00
3077.00
3076.00
3075.00
3074.00
3073.00
3072.00
3071.00
3070.00
3069.00
3068.00
3067.00
3066.00
Elevation (ft)
Well in northern Nash Draw, fluctuations due to recharge from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

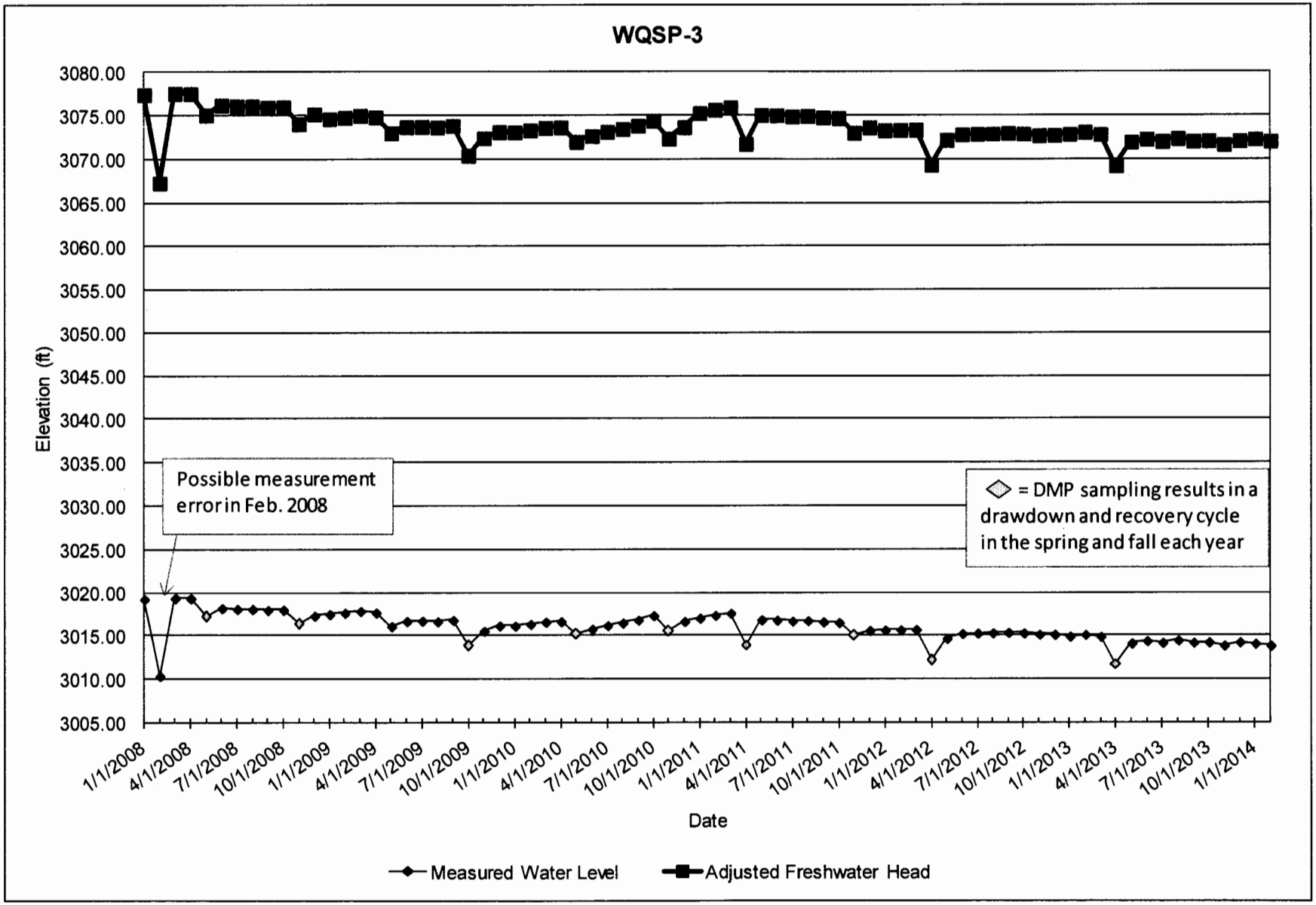

WIPP-11
=Fluid density change
3095.00
3090.00
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
Elevation (ft)
Slight fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WIPP-13
=Fluid density change
3090.00
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
3050.00
Elevation (ft)
Slight fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WIPP-13
=Fluid density change
Elevation (ft)
3090.00
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
3050.00
Slight fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WQSP-1
=Fluid density change
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
Elevation (ft)
Slight response fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WQSP-2
=Fluid density change
3090.00
3085.00
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
Elevation (ft)
Slight response to fluctuations due to recharge in Nash Draw from heavy rain events
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WQSP-3
Elevation (ft)
3080.00
3075.00
3070.00
3065.00
3060.00
3055.00
3050.00
3045.00
3040.00
3035.00
3030.00
3025.00
3020.00
3015.00
3010.00
3005.00
Possible measurement error in Feb. 2008
◇ = DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
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7/1/2010
10/1/2010
1/1/2011
4/1/2011
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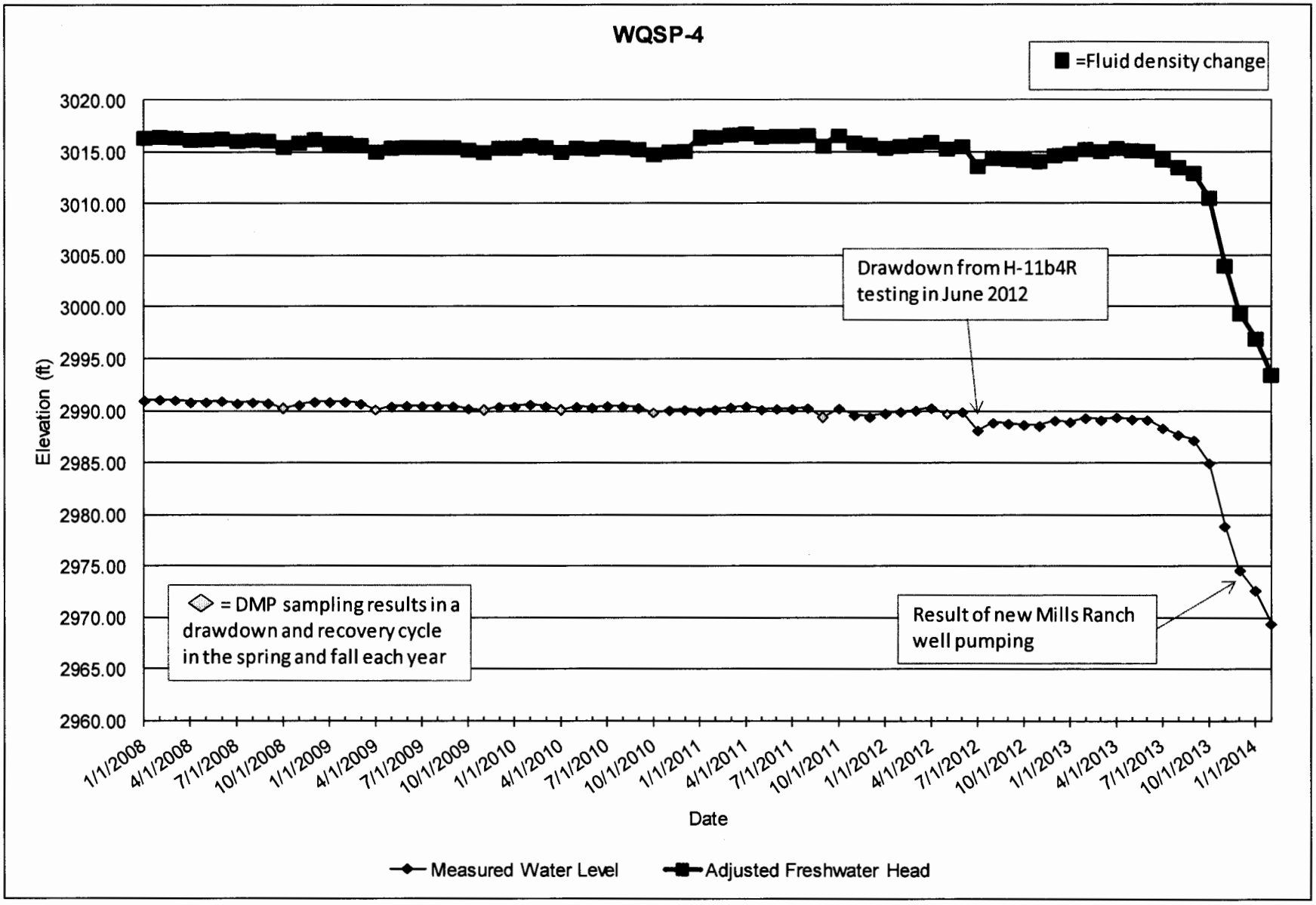
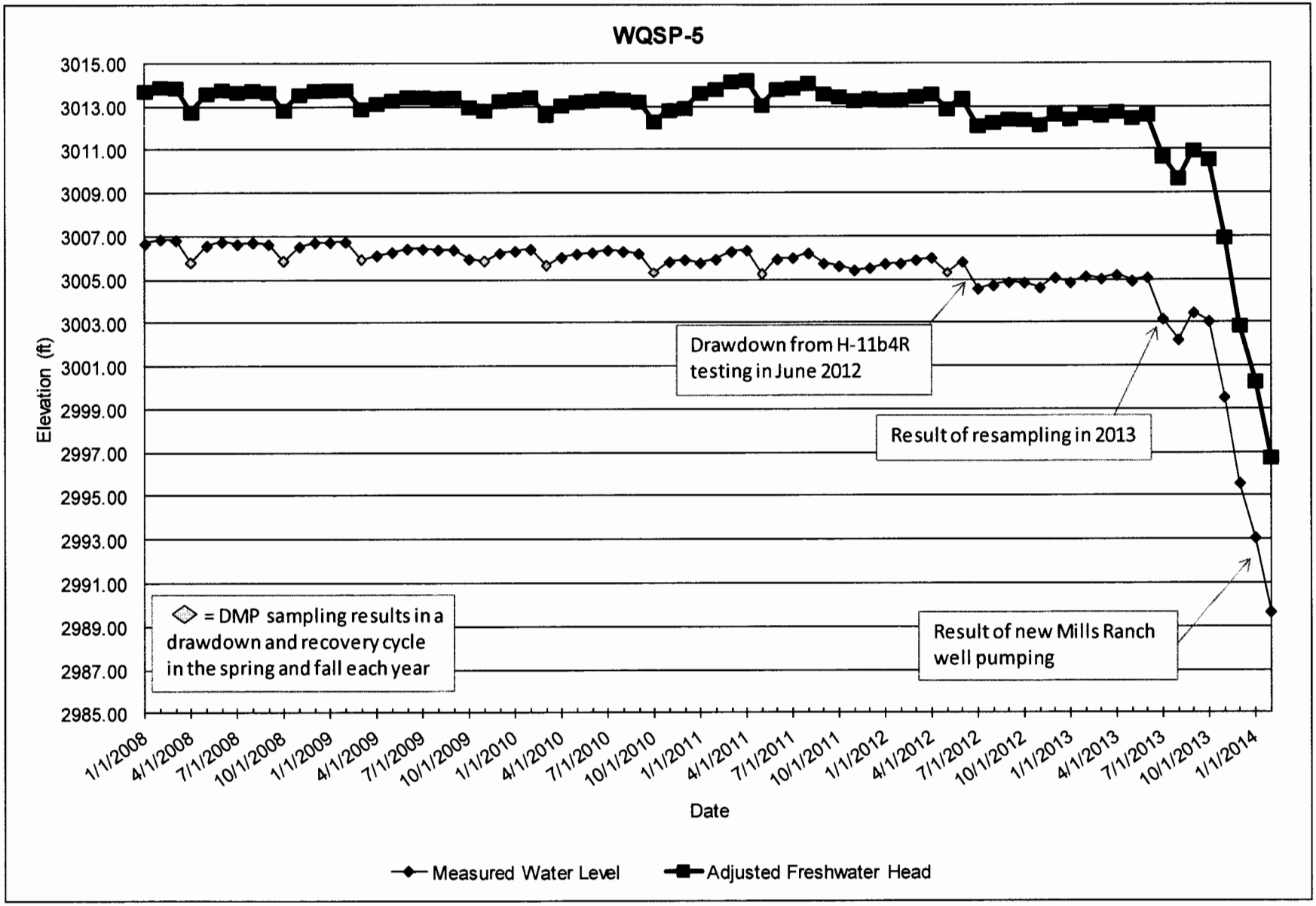
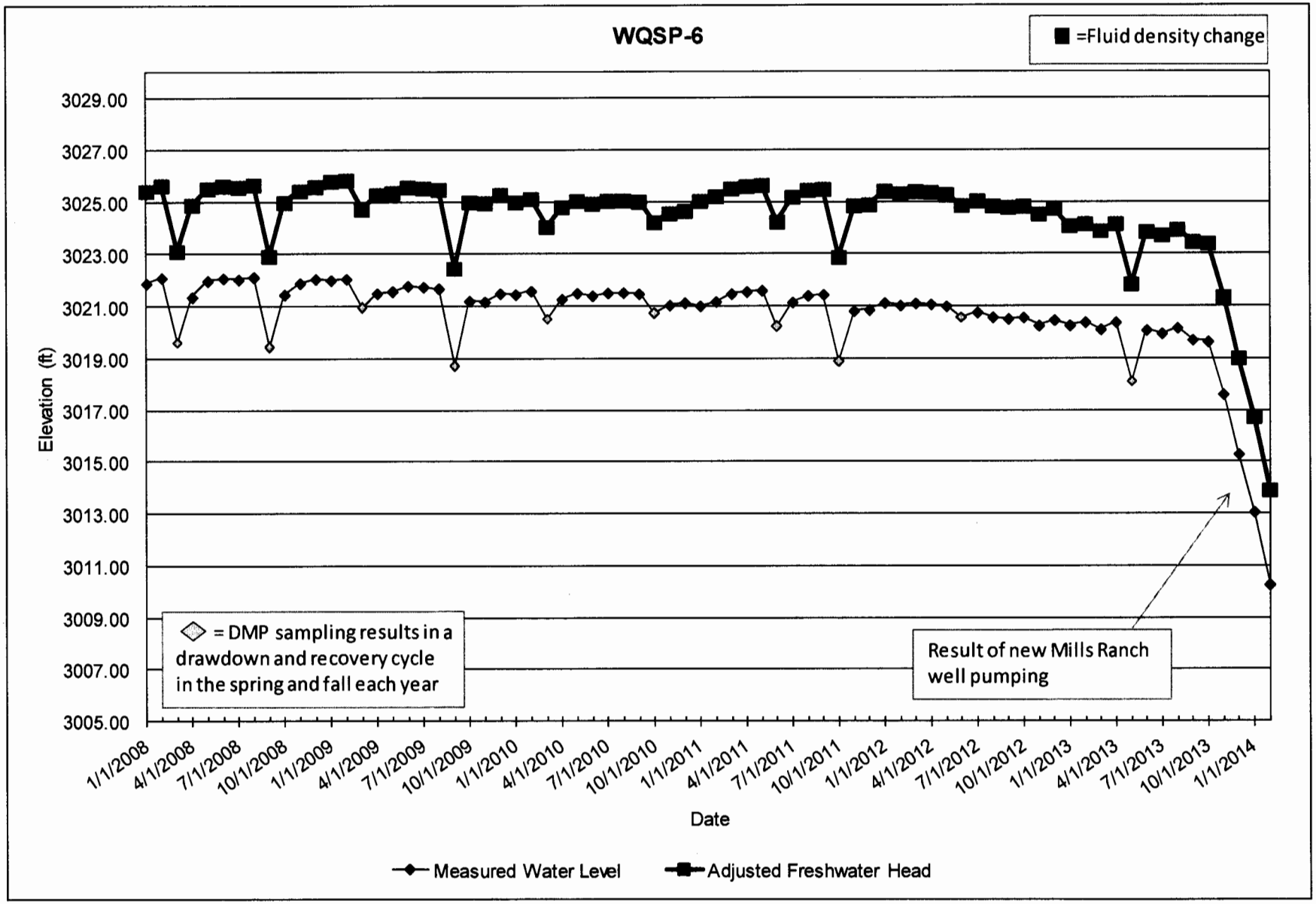
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WQSP-4
=Fluid density change
Drawdown from H-11b4R testing in June 2012
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Result of new Mills Ranch well pumping
Elevation (ft)
3020.00
3015.00
3010.00
3005.00
3000.00
2995.00
2990.00
2985.00
2980.00
2975.00
2970.00
2965.00
2960.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head


WQSP-5
Elevation (ft)
3015.00
3013.00
3011.00
3009.00
3007.00
3005.00
3003.00
3001.00
2999.00
2997.00
2995.00
2993.00
2991.00
2989.00
2987.00
2985.00
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Drawdown from H-11b4R testing in June 2012
Result of resampling in 2013
Result of new Mills Ranch well pumping
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Measured Water Level
Adjusted Freshwater Head


WQSP-6
=Fluid density change
3029.00
3027.00
3025.00
3023.00
3021.00
3019.00
3017.00
3015.00
3013.00
3011.00
3009.00
3007.00
3005.00
Elevation (ft)
= DMP sampling results in a drawdown and recovery cycle in the spring and fall each year
Result of new Mills Ranch well pumping
1/1/2008
4/1/2008
7/1/2008
10/1/2008
1/1/2009
4/1/2009
7/1/2009
10/1/2009
1/1/2010
4/1/2010
7/1/2010
10/1/2010
1/1/2011
4/1/2011
7/1/2011
10/1/2011
1/1/2012
4/1/2012
7/1/2012
10/1/2012
1/1/2013
4/1/2013
7/1/2013
10/1/2013
1/1/2014
Date
Measured Water Level
Adjusted Freshwater Head

Appendix 2

Culebra Water Levels

Sept. 2013 – Feb. 2014

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
AEC-7R	CUL	09/09/13	614.14	NA[2]	NA[2]
AEC-7R	CUL	Oct. '13	SNL Testing[3]		
AEC-7R	CUL	Nov. '13	SNL Testing		
AEC-7R	CUL	Dec. '13	SNL Testing		
AEC-7R	CUL	Jan. '14	SNL Testing		
AEC-7R	CUL	02/04/14	619.17	NA[2]	NA[2]
C-2737 (PIP)	CUL	09/17/13	388.86	3011.90	3018.85
C-2737 (PIP)	CUL	10/09/13	388.99	3011.77	3018.72
C-2737 (PIP)	CUL	11/13/13	391.70	3009.06	3015.95
C-2737 (PIP)	CUL	12/11/13	394.60	3006.16	3012.98
C-2737 (PIP)	CUL	01/09/14	397.42	3003.34	3010.09
C-2737 (PIP)	CUL	02/12/14	399.51	3001.25	3007.96
ERDA-9	CUL	09/17/13	400.40	3009.77	3032.89
ERDA-9	CUL	10/09/13	400.76	3009.41	3032.51
ERDA-9	CUL	11/13/13	402.55	3007.62	3030.59
ERDA-9	CUL	12/11/13	404.11	3006.06	3028.91
ERDA-9	CUL	01/09/14	406.40	3003.77	3025.83
ERDA-9	CUL	02/12/14	408.42	3001.75	3023.67
H-02b2	CUL	09/17/13	337.52	3040.84	3044.42
H-02b2	CUL	10/09/13	337.45	3040.91	3044.49
H-02b2	CUL	11/13/13	338.04	3040.32	3043.89
H-02b2	CUL	12/11/13	338.52	3039.84	3043.40
H-02b2	CUL	01/09/14	339.09	3039.27	3043.12
H-02b2	CUL	02/12/14	340.35	3038.01	3041.85
H-03b2	CUL	09/17/13	390.55	2999.36	3010.06
H-03b2	CUL	10/09/13	391.53	2998.38	3009.04
H-03b2	CUL	11/13/13	396.22	2993.69	3004.18
H-03b2	CUL	12/11/13	400.10	2989.81	3000.16
H-03b2	CUL	01/08/14	402.55	2987.36	2996.49
H-03b2	CUL	02/12/14	405.84	2984.07	2993.09
H-04bR	CUL	09/16/13	352.59	2982.05	2984.69
H-04bR	CUL	10/04/13	381.92	2952.72	2954.86
H-04bR	CUL	11/11/13	398.90	2935.74	2937.59
H-04bR	CUL	12/11/13	377.95	2956.69	2958.90
H-04bR	CUL	01/08/14	380.55	2954.09	2956.25
H-04bR	CUL	02/12/14	384.44	2950.20	2952.30
H-05b	CUL	09/09/13	466.11	3040.67	3082.87
H-05b	CUL	10/07/13	466.31	3040.47	3082.65
H-05b	CUL	11/12/13	466.60	3040.18	3082.33
H-05b	CUL	12/09/13	466.60	3040.18	3082.33
H-05b	CUL	01/09/14	466.46	3040.32	3081.15
H-05b	CUL	02/10/14	466.23	3040.55	3081.40
H-06bR	CUL	09/10/13	291.74	3057.48	3069.85
H-06bR	CUL	10/03/13	291.74	3057.48	3069.85
H-06bR	CUL	11/13/13	292.14	3057.08	3069.44
H-06bR	CUL	12/09/13	292.00	3057.22	3069.58
H-06bR	CUL	01/08/14	292.11	3057.11	3069.79
H-06bR	CUL	02/11/14	292.63	3056.59	3069.25
H-07b1	CUL	09/10/13	168.67	2995.05	2995.76

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
H-07b1	CUL	10/03/13	167.33	2996.39	2997.11
H-07b1	CUL	11/13/13	168.00	2995.72	2996.43
H-07b1	CUL	12/11/13	167.96	2995.76	2996.47
H-07b1	CUL	01/07/14	167.83	2995.89	2996.60
H-07b1	CUL	02/04/14	167.70	2996.02	2996.74
H-09bR	CUL	09/12/13	424.75	2983.59	2983.59
H-09bR	CUL	10/04/13	429.50	2978.84	2978.84
H-09bR	CUL	11/11/13	435.53	2972.81	2972.81
H-09bR	CUL	12/10/13	436.87	2971.47	2971.47
H-09bR	CUL	01/07/14	436.55	2971.79	2972.02
H-09bR	CUL	02/04/14	437.26	2971.08	2971.31
H-10c	CUL	09/12/13	717.62	2970.78	3032.30
H-10c	CUL	10/04/13	717.53	2970.87	3032.40
H-10c	CUL	11/12/13	717.91	2970.49	3031.98
H-10c	CUL	12/10/13	717.75	2970.65	3032.16
H-10c	CUL	01/07/14	717.61	2970.79	3032.97
H-10c	CUL	02/10/14	717.43	2970.97	3033.16
H-11b4R	CUL	09/09/13	431.90	2979.97	3003.07
H-11b4R	CUL	10/04/13	441.72	2970.15	2992.50
H-11b4R	CUL	11/12/13	455.45	2956.42	2977.73
H-11b4R	CUL	12/10/13	458.95	2952.92	2973.96
H-11b4R	CUL	01/09/14	458.40	2953.47	2974.56
H-11b4R	CUL	02/11/14	461.64	2950.23	2971.07
H-12	CUL	09/12/13	458.02	2969.31	3012.30
H-12	CUL	10/03/13	458.64	2968.69	3011.61
H-12	CUL	11/12/13	462.94	2964.39	3006.82
H-12	CUL	12/10/13	466.25	2961.08	3003.14
H-12	CUL	01/07/14	468.47	2958.86	2998.82
H-12	CUL	02/10/14	470.76	2956.57	2996.28
H-15R	CUL	09/17/13	509.39	2972.63	3015.50
H-15R	CUL	10/04/13	510.52	2971.50	3014.24
H-15R	CUL	11/13/13	517.30	2964.72	3006.66
H-15R	CUL	12/10/13	521.42	2960.60	3002.05
H-15R	CUL	01/08/14	523.49	2958.53	2999.74
H-15R	CUL	02/12/14	526.38	2955.64	2996.51
H-16	CUL	09/17/13	375.64	3034.42	3046.96
H-16	CUL	10/03/13	375.67	3034.39	3046.92
H-16	CUL	11/13/13	376.71	3033.35	3045.85
H-16	CUL	12/12/13	378.80	3031.26	3043.68
H-16	CUL	01/08/14	379.78	3030.28	3042.33
H-16	CUL	02/11/14	381.15	3028.91	3040.91
H-17	CUL	09/09/13	421.25	2963.99	3003.78
H-17	CUL	10/03/13	426.04	2959.20	2998.36
H-17	CUL	11/12/13	438.86	2946.38	2983.83
H-17	CUL	12/10/13	444.18	2941.06	2977.80
H-17	CUL	01/09/14	444.99	2940.25	2976.88
H-17	CUL	02/11/14	448.14	2937.10	2973.32
H-19b0	CUL	09/17/13	428.49	2989.84	3011.32
H-19b0	CUL	10/09/13	430.58	2987.75	3009.09

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
H-19b0	CUL	11/13/13	436.57	2981.76	3002.71
H-19b0	CUL	12/11/13	440.83	2977.50	2998.16
H-19b0	CUL	01/07/14	442.81	2975.52	2996.05
H-19b0	CUL	02/12/14	446.08	2972.25	2992.57
H-19b2	CUL	09/17/13	429.92	2989.01	3009.23
H-19b2	CUL	12/11/13	442.30	2976.63	2996.08
H-19b3	CUL	09/17/13	430.12	2988.90	3010.32
H-19b3	CUL	12/11/13	442.50	2976.52	2997.12
H-19b4	CUL	09/17/13	429.35	2989.63	3011.42
H-19b4	CUL	12/11/13	441.51	2977.47	2998.45
H-19b5	CUL	09/17/13	429.31	2989.27	3011.69
H-19b5	CUL	12/11/13	441.61	2976.97	2998.54
H-19b6	CUL	09/17/13	430.17	2988.85	3011.56
H-19b6	CUL	12/11/13	442.35	2976.67	2998.53
H-19b7	CUL	Sept. '13	SNL Testing		
H-19b7	CUL	Dec. '13	SNL Testing		
I-461	CUL	09/10/13	242.21	3041.40	3041.40
I-461	CUL	10/03/13	242.11	3041.50	3041.50
I-461	CUL	11/11/13	242.24	3041.37	3041.37
I-461	CUL	12/09/13	242.28	3041.33	3041.33
I-461	CUL	01/07/14	239.58	3044.03	3044.03
I-461	CUL	02/04/14	242.62	3040.99	3040.99
SNL-01	CUL	09/12/13	439.31	3073.53	3078.56
SNL-01	CUL	10/07/13	439.34	3073.50	3078.53
SNL-01	CUL	11/11/13	439.35	3073.49	3078.52
SNL-01	CUL	12/09/13	439.50	3073.34	3078.37
SNL-01	CUL	01/07/14	439.86	3072.98	3078.17
SNL-01	CUL	02/04/14	439.72	3073.12	3078.31
SNL-02	CUL	09/12/13	253.89	3069.17	3071.12
SNL-02	CUL	10/07/13	253.75	3069.31	3071.26
SNL-02	CUL	11/11/13	253.77	3069.29	3071.24
SNL-02	CUL	12/09/13	254.08	3068.98	3070.93
SNL-02	CUL	01/07/14	254.33	3068.73	3070.68
SNL-02	CUL	02/04/14	254.46	3068.60	3070.55
SNL-03	CUL	09/12/13	422.59	3067.76	3077.39
SNL-03	CUL	10/07/13	422.77	3067.58	3077.21
SNL-03	CUL	11/13/13	422.81	3067.54	3077.16
SNL-03	CUL	12/09/13	422.60	3067.75	3077.38
SNL-03	CUL	01/08/14	422.75	3067.60	3077.23
SNL-03	CUL	02/11/14	423.02	3067.33	3076.95
SNL-05	CUL	09/12/13	312.11	3067.87	3070.90
SNL-05	CUL	10/07/13	311.38	3068.60	3071.64
SNL-05	CUL	11/11/13	311.21	3068.77	3071.81
SNL-05	CUL	12/09/13	311.65	3068.33	3071.37
SNL-05	CUL	01/07/14	311.76	3068.22	3071.25
SNL-05	CUL	02/04/14	311.78	3068.20	3071.23
SNL-06	CUL	09/09/13	581.73	3064.38	3248.20
SNL-06	CUL	10/07/13	579.03	3067.08	3251.56
SNL-06	CUL	11/12/13	575.59	3070.52	3255.84

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
SNL-06	CUL	12/09/13	572.94	3073.17	3259.13
SNL-06	CUL	01/09/14	569.99	3076.12	3262.80
SNL-06	CUL	02/05/14	567.17	3078.94	3266.30
SNL-08	CUL	09/09/13	541.98	3013.75	3053.96
SNL-08	CUL	10/07/13	542.08	3013.65	3053.85
SNL-08	CUL	11/12/13	542.24	3013.49	3053.67
SNL-08	CUL	12/09/13	542.14	3013.59	3053.78
SNL-08	CUL	01/09/14	541.88	3013.85	3054.50
SNL-08	CUL	02/10/14	541.93	3013.80	3054.44
SNL-09	CUL	09/10/13	311.95	3049.01	3053.60
SNL-09	CUL	10/03/13	311.65	3049.31	3053.91
SNL-09	CUL	11/11/13	312.80	3048.16	3052.74
SNL-09	CUL	12/09/13	313.18	3047.78	3052.35
SNL-09	CUL	01/08/14	313.16	3047.80	3052.37
SNL-09	CUL	02/11/14	313.80	3047.16	3051.72
SNL-10	CUL	09/10/13	327.09	3050.50	3053.08
SNL-10	CUL	10/09/13	326.87	3050.72	3053.30
SNL-10	CUL	11/11/13	327.91	3049.68	3052.25
SNL-10	CUL	12/11/13	328.86	3048.73	3051.29
SNL-10	CUL	01/08/14	329.14	3048.45	3051.29
SNL-10	CUL	02/04/14	329.39	3048.20	3051.04
SNL-12	CUL	09/12/13	346.00	2993.46	2994.81
SNL-12	CUL	10/04/13	369.06	2970.40	2971.61
SNL-12	CUL	11/11/13	383.29	2956.17	2957.30
SNL-12	CUL	12/10/13	377.25	2962.21	2963.37
SNL-12	CUL	01/07/14	377.64	2961.82	2962.98
SNL-12	CUL	02/04/14	383.59	2955.87	2956.99
SNL-13	CUL	09/10/13	284.19	3009.92	3012.02
SNL-13	CUL	10/04/13	285.15	3008.96	3011.05
SNL-13	CUL	11/11/13	290.28	3003.83	3005.82
SNL-13	CUL	12/11/13	294.79	2999.32	3001.23
SNL-13	CUL	01/08/14	297.33	2996.78	2998.54
SNL-13	CUL	02/12/14	300.46	2993.65	2995.36
SNL-14	CUL	09/09/13	382.41	2986.00	2999.21
SNL-14	CUL	10/03/13	399.05	2969.36	2981.80
SNL-14	CUL	11/12/13	414.58	2953.83	2965.56
SNL-14	CUL	12/10/13	414.40	2954.01	2965.75
SNL-14	CUL	01/08/14	412.59	2955.82	2967.64
SNL-14	CUL	02/11/14	416.08	2952.33	2963.99
SNL-15	CUL	09/12/13	537.74	2942.19	3030.38
SNL-15	CUL	10/04/13	536.97	2942.96	3031.32
SNL-15	CUL	11/12/13	536.53	2943.40	3031.86
SNL-15	CUL	12/10/13	534.53	2945.40	3034.32
SNL-15	CUL	01/09/14	533.53	2946.40	3035.55
SNL-15	CUL	02/10/14	532.58	2947.35	3036.72
SNL-16	CUL	09/10/13	123.72	3009.28	3010.02
SNL-16	CUL	10/03/13	123.52	3009.48	3010.23
SNL-16	CUL	11/12/13	124.50	3008.50	3009.24
SNL-16	CUL	12/11/13	123.82	3009.18	3009.92

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
SNL-16	CUL	01/07/14	123.51	3009.49	3010.15
SNL-16	CUL	02/04/14	123.54	3009.46	3010.12
SNL-17	CUL	09/10/13	234.55	3003.51	3004.09
SNL-17	CUL	10/04/13	244.00	2994.06	2994.59
SNL-17	CUL	11/11/13	248.75	2989.31	2989.81
SNL-17	CUL	12/11/13	244.47	2993.59	2994.12
SNL-17	CUL	01/07/14	246.14	2991.92	2992.44
SNL-17	CUL	02/10/14	248.42	2989.64	2990.15
SNL-18	CUL	09/12/13	306.28	3069.16	3070.38
SNL-18	CUL	10/07/13	304.82	3070.62	3071.85
SNL-18	CUL	11/11/13	305.30	3070.14	3071.37
SNL-18	CUL	12/09/13	305.80	3069.64	3070.87
SNL-18	CUL	01/07/14	305.49	3069.95	3072.16
SNL-18	CUL	02/04/14	305.56	3069.88	3072.09
SNL-19	CUL	09/12/13	153.00	3069.65	3071.06
SNL-19	CUL	10/07/13	152.67	3069.98	3071.40
SNL-19	CUL	11/11/13	152.79	3069.86	3071.28
SNL-19	CUL	12/09/13	153.21	3069.44	3070.85
SNL-19	CUL	01/07/14	153.38	3069.27	3070.68
SNL-19	CUL	02/04/14	153.56	3069.09	3070.50
WIPP-11	CUL	09/16/13	367.16	3060.62	3079.26
WIPP-11	CUL	10/09/13	366.84	3060.94	3079.60
WIPP-11	CUL	11/13/13	367.02	3060.76	3079.41
WIPP-11	CUL	12/09/13	366.88	3060.90	3079.55
WIPP-11	CUL	01/08/14	367.03	3060.75	3079.40
WIPP-11	CUL	02/11/14	367.43	3060.35	3078.98
WIPP-13	CUL	09/16/13	345.69	3059.98	3075.14
WIPP-13	CUL	10/09/13	345.46	3060.21	3075.38
WIPP-13	CUL	11/13/13	345.45	3060.22	3075.39
WIPP-13	CUL	12/09/13	345.40	3060.27	3075.44
WIPP-13	CUL	01/08/14	345.51	3060.16	3074.95
WIPP-13	CUL	02/11/14	345.87	3059.80	3074.58
WIPP-19	CUL	09/16/13	392.62	3042.49	3062.12
WIPP-19	CUL	10/09/13	392.59	3042.52	3062.15
WIPP-19	CUL	11/12/13	393.20	3041.91	3061.51
WIPP-19	CUL	12/09/13	393.13	3041.98	3061.58
WIPP-19	CUL	01/09/14	393.59	3041.52	3061.10
WIPP-19	CUL	02/12/14	394.41	3040.70	3060.24
WQSP-1	CUL	09/16/13	362.91	3056.34	3074.23
WQSP-1	CUL	10/09/13	362.69	3056.56	3074.46
WQSP-1	CUL	11/13/13	362.91	3056.34	3074.23
WQSP-1	CUL	12/11/13	362.97	3056.28	3074.16
WQSP-1	CUL	01/08/14	362.89	3056.36	3073.55
WQSP-1	CUL	02/12/14	363.18	3056.07	3073.24
WQSP-2	CUL	09/16/13	403.10	3060.77	3081.02
WQSP-2	CUL	10/09/13	402.91	3060.96	3081.22
WQSP-2	CUL	11/12/13	403.17	3060.70	3080.95
WQSP-2	CUL	12/09/13	402.89	3060.98	3081.24
WQSP-2	CUL	01/09/14	402.96	3060.91	3080.75

WELL NUMBER	ZONE	DATE	ADJUSTED DEPTH TOC ft	WATER LEVEL ELEVATION ft amsl[1]	ADJUSTED FRESHWATER HEAD ft amsl
WQSP-2	CUL	02/12/14	403.33	3060.54	3080.36
WQSP-3	CUL	09/16/13	465.92	3014.22	3072.13
WQSP-3	CUL	10/09/13	465.89	3014.25	3072.16
WQSP-3	CUL	11/12/13	466.26	3013.88	3071.74
WQSP-3	CUL	12/09/13	465.89	3014.25	3072.16
WQSP-3	CUL	01/07/14	466.06	3014.08	3072.36
WQSP-3	CUL	02/12/14	466.29	3013.85	3072.10
WQSP-4	CUL	09/17/13	445.86	2987.23	3013.03
WQSP-4	CUL	10/09/13	448.07	2985.02	3010.65
WQSP-4	CUL	11/13/13	454.17	2978.92	3004.08
WQSP-4	CUL	12/11/13	458.44	2974.65	2999.48
WQSP-4	CUL	01/07/14	460.39	2972.70	2997.06
WQSP-4	CUL	02/12/14	463.62	2969.47	2993.58
WQSP-5	CUL	09/16/13	380.90	3003.48	3010.98
WQSP-5	CUL	10/09/13	381.30	3003.08	3010.57
WQSP-5	CUL	11/13/13	384.82	2999.56	3006.95
WQSP-5	CUL	12/11/13	388.78	2995.60	3002.89
WQSP-5	CUL	01/08/14	391.29	2993.09	3000.31
WQSP-5	CUL	02/12/14	394.71	2989.67	2996.80
WQSP-6	CUL	09/16/13	345.01	3019.71	3023.49
WQSP-6	CUL	10/09/13	345.07	3019.65	3023.43
WQSP-6	CUL	11/13/13	347.10	3017.62	3021.37
WQSP-6	CUL	12/11/13	349.42	3015.30	3019.02
WQSP-6	CUL	01/08/14	351.65	3013.07	3016.75
WQSP-6	CUL	02/12/14	354.44	3010.28	3013.92

Notes:
1: amsl = Above Mean Sea Level
2: New well in Sept. 2013, fluid density and surface elevation not yet available.
3: SNL Testing = testing equipment in well so not accessible for water level measurements