

Fourth Quarterly Monitoring Report

for

Town of Hamilton Well #14

Stone Eden Well
Hamilton, Virginia

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Town of Hamilton

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TRIAD Project # 05-07-0092

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1.0 INTRODUCTION

This Annual Report presents the results of the monitoring activities during the fourth (4th) quarter (June, July, and August 2010) of active pumping operation in Well 14 by the Town of Hamilton. This report is submitted to the Loudoun County Department of Building and Development, in compliance with the approved Town's Pumping, Monitoring, and Mitigation Plan (PMMP, November 2008). The PMMP addresses the groundwater monitoring requirements of Section 6.240, G., I., J., and K. of the Loudoun County Facility Standards Manual (FSM).

This report includes the water level data and water quality field-testing from ASI's previously submitted reports: "Background and Initial Pump Start-up (30-day) Monitoring Report", dated October 13, 2009 ("30-Day Report"), and the First Quarterly Monitoring Report (QMR1), dated November 15, 2009, and the Second and Third Quarterly Monitoring Report (QMR3), dated May 10, 2010. Please refer to the 30-Day Report for details regarding monitoring well information, installation of the probes, and the water quality sampling methods.

Relevant information on the monitored wells is summarized in Table 1 below.

Table 1
Domestic Well Monitoring Locations

Well #	Residence Address	PIN	Well Yield (gpm)	Total Depth (feet)	Depth to Bedrock (feet)	Static Water Level (feet)	Water-Bearing Depths (feet)**
4	Gaston and Kapsang Gutierrez 38286 Alfalfa Ct	419157282	50	380	20	30	180 (2), 365 (48)
5	Robert and Lori Gammache 38280 Alfalfa Ct	419155183	30	400	10	12	190 (4), 360 (26)
6	Hemadri and Aparna Dasari 38274 Alfalfa Ct	419153482	30	275	10	30	253
7	Edward and Courtney Cooke 38268 Alfalfa Ct	419150980	50	250	8	0	225
9	Bernardo and Jackyln Dedekind 17936 Manassas Gap Ct	454105978	60	383	50	30	381
12	James and Amy Walton 17979 Sands Road	454297930	15	380	25	2	365
13	Brian and Sherri Omara 17969 Sands Road	454302227	15	260	51	40	235
32	Omara, Maureen A. & E. B. Omara J/T 17899 Sands Road	454204465	50	260	20	2	235

2.0 WATER QUALITY MONITORING

Section 4.5 of the PMMP recommended that the monitoring program should include an evaluation of water quality. Laboratory results from the sampling of all monitored domestic wells were reported in the 30-Day Report. The laboratory results from Well 32 were reported in the QMR1. The water samples were tested by calibrated field instrumentation for the following parameters: pH, specific conductivity, turbidity and temperature.

2.1 Field Parameters

Field parameters (Temperature, pH, Specific Conductance, and Turbidity) were measured regularly in domestic water samples. Water samples were collected from the residences from outside spigots. The results of sampling events have been tabulated in Appendix A. The new results do not appear to change the findings of the previous reports that some variations have been recorded in the field measurements; however, no long term trends are readily discernable. Additional data will be useful in evaluating any potential trends in the recorded data.

During the 4th quarter, the Cook residence, at 38268 Alfalfa Court, requested that their well be modified to permit water level monitoring. The well modification, which consisted of vertically extending the well casing, has been completed. Water has not been observed to overflow the casing and a probe will be installed in this well (designated "Well 7"). ASI personnel visited the Cooke residence during the August 25, 2010, site visit to collect an initial water sample for measuring and recording of field parameters. The results for the Cooke Residence have been included in Appendix A.

2.2 Laboratory Analysis

Sampling for laboratory analyses was not conducted during the 4th quarter of active pumping.

3.0 GROUNDWATER LEVEL MONITORING

ASI personnel mobilized to the site on the following dates to check the operation of the probes and to download data from the probes:

- November 17, 2009
- December 28, 2009
- January 29, 2010
- February 24, 2010
- March 24, 2010, and
- April 30, 2010.
- May 25, 2010
- August 25, 2010

Water level monitoring began at Well #32 on November 17, 2009. Water level measurements were automatically recorded by the probes on an hourly basis. Water level data collected during June, July and August 2010 have been plotted for each monitor well. The plots of background phase and the previous pumping periods have been presented in previous reports. Graphs for each individual monitor well have been included in Appendix C. An electronic copy of the monitoring data has been included in Appendix E.

3.1 Water Level Analysis

Water levels fluctuations in the monitored wells continued in the general pattern described in the previous reports. As reported previously, significant water level fluctuations in Wells 4, 5, 6, and 32 appear to occur approximately simultaneously during the 4th quarter of Well 14 pumping, as shown in Figure 2. These simultaneous drawdown events appear to closely match the dates of Well 14 operation, as discussed in Section 4.2 below. The pumping/drawdown events continue to be sporadically timed, with variable time-intervals between events.

Significant water level fluctuations in Well #13 also occur during the fourth quarter and at least some of the drawdown events appeared to be closely timed not only with drawdown events in Wells 4, 5, 6, and 32, but also to Well 14 pumping events. In contrast, some of the significant water level fluctuations in Well 13, including a major drawdown event of over 70 feet that occurred between July 9 to July 11, 2010, do not appear to be influenced by Well 14 pumping events, based on both Well 14 operational data and drawdown events in other wells. The recovery in all of the monitored wells continues to be relatively rapid, with water levels usually re-stabilizing at pre-drawdown levels in most wells. This rapid recovery suggests that the wells are strongly recharged by the local aquifer.

Wells 9 and 12 continue to exhibit minimal decreases in their water levels during the apparent operation of Well #14. Well 12 data indicates maximum drawdowns of 10 feet during Well 14 pumping events, with rapid recovery. Water levels in Well 9 appear to be virtually unaffected by Well 14 withdrawals. These findings suggest that withdrawals from Well 14 may have a lesser impact on Wells 9 and 12 than on the other five monitored wells.

During ASI's site visit of August 25, 2010, ASI personnel spoke with Mr. Gammache of 38280 Alfalfa Court (Well 5). Mr. Gammache indicated that he had experienced several momentary but severe drops in water pressure during the previous months.

3.2 Discharge Data from Well #14

Well #14 discharge data were obtained from the Hamilton Water Treatment Plant (WTP) for the period of October 2009 through August 2010. In response to comments received from the Loudoun County Department of Building and Development, dated March 31,

2010, ASI staff have requested data from the WTP staff to include Well 14 water levels, and the clock-time of Well14 pumping events. ASI has met with WTP staff at the WTP to discuss data needs and the data collection equipment and process. The data provided to ASI for the fourth quarter are indicated below.

Beginning in the month of June 2010, WTP staff changed the format of data delivery to ASI. WTP staff has provided ASI with copies from their daily monitoring log, which includes total gallons pumped, number of hours that Well 14 was pumped ("pumping hours"), and well datalogger level. The data sheets indicate that the gallons pumped and water level data were only intermittently available; however, the pumping hours are available for the entire period (fourth quarter), indicating the duration of pumping and days on which pumping occurred.

Data provided by the WTP staff indicate that water withdrawals took place on 20 days during the 4th quarter, for a total of 33.6 hours. Using the average pumping rate (350 gpm) obtained from the five events in August for which the total gallons pumped are known for each event, the 20 events resulted in a total estimated withdrawal of 706,460 gallons. The average pumping duration for the three months was 1.6 hours, the maximum pumping duration was 5.8 hours, which occurred sometime between July 8 and 9. The minimum duration was 0.4 hours between July 19 and 20.

Additional Well 14 water level data included a single water level datapoint for each of 39 days during the fourth quarter of pumping. The data represent the depth of the probe in feet beneath the water level in the well. Assuming a probe depth of 300' (based on personal communication with WTP staff), the water level data varied between 116 feet below the top of the well casing to 178 feet below the top of well casing. It is not known whether these levels represent pumping, recovering, or static water levels; therefore, their usefulness in relation to drawdown in Well 14 and to the residential water level data is limited. Totals and averages for each month during the pumping period are summarized below in Table 2. The pumping data, including daily pumping durations and volumes, are provided in Appendix D.

**Table 2. Well 14
Pumping Data Summary**

Month	Pumping Days	Total Hours	Pumpage (gal)
October '09	12	17.7	287,800
November '09	14	20	294,300
December '09	9	14	231,500
January '10	14	14.4	209,900
February '10	7	9	156,300
March '10	14	23	373,900
April '10	10	15	243,300
May '10	11	10.7	167,100
June '10	10	14.9	313,281
July '10	6	15.1	317,486
August '10	5	3.6	75,692

Total	112	158.3	2,671,059
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Note: * = averaged from August discharge data.

4.0 CONCLUSIONS AND RECOMMENDATIONS

This reports documents the monitoring of water levels in seven residential wells during the twelve months since pumping operations began in Well 14. Approximately simultaneous drops in well water levels during numerous occasions in four (Wells 4, 5, 6, and 32) of the monitored residential wells are believed to be associated with the withdrawal of groundwater from Well #14. Recoveries in the wells continue to be strong. Data from Well 13 indicate significant water level fluctuations, although some of the major drawdown events in Well 13 are not concurrent with the pumping times of Well 14. Wells 9 and 12 show minor impacts from the pumping operations. Water levels in the monitored wells have continued to recover to approximately background levels; however, additional monitoring data will be needed to evaluate more long term effects following the continued active operation of Well #14.

Water quality parameters suggested some variation in water quality during the monitoring period; however, the collection of additional quality data will enable a better assessment of water quality trends over time including potential seasonal fluctuations. While data collected and included in this report are considered useful in evaluating potential effects of the pumping of Well #14, future monitoring data may be more representative of conditions during the active operation of Well #14.

ASI continues to work with the Hamilton staff to obtain the Well 14 data requested by the Loudoun County Department of Building and Development in their letter to TRIAD Engineering, dated March 31. ASI has met with Hamilton staff at the WTP to discuss methods and equipment of data collection. Hamilton staff has indicated that equipment repairs have recently been made that may allow recording of water levels fluctuations in Well 14. ASI has also discussed potential equipment that may allow the recording of start and stop times of the Well 14 pump.

5.0 LIMITATIONS

The work performed in conjunction with this project, and the data developed, are intended as a description of available information at the sample locations indicated and the dates specified. Generally accepted industry standards were used in the preparation of this report.

Laboratory data are intended to approximate actual conditions at the time of sampling. Results from future sampling and testing may vary significantly as a result of natural conditions, a changing environment, or the limits of analytical capabilities. This report does not warrant against future operations or conditions, nor does it warrant against operations or conditions present of a type or at a specific location not investigated. The limited sampling conducted was intended to approximate subsurface conditions by extrapolation between data points. Actual conditions may vary.

FIGURES

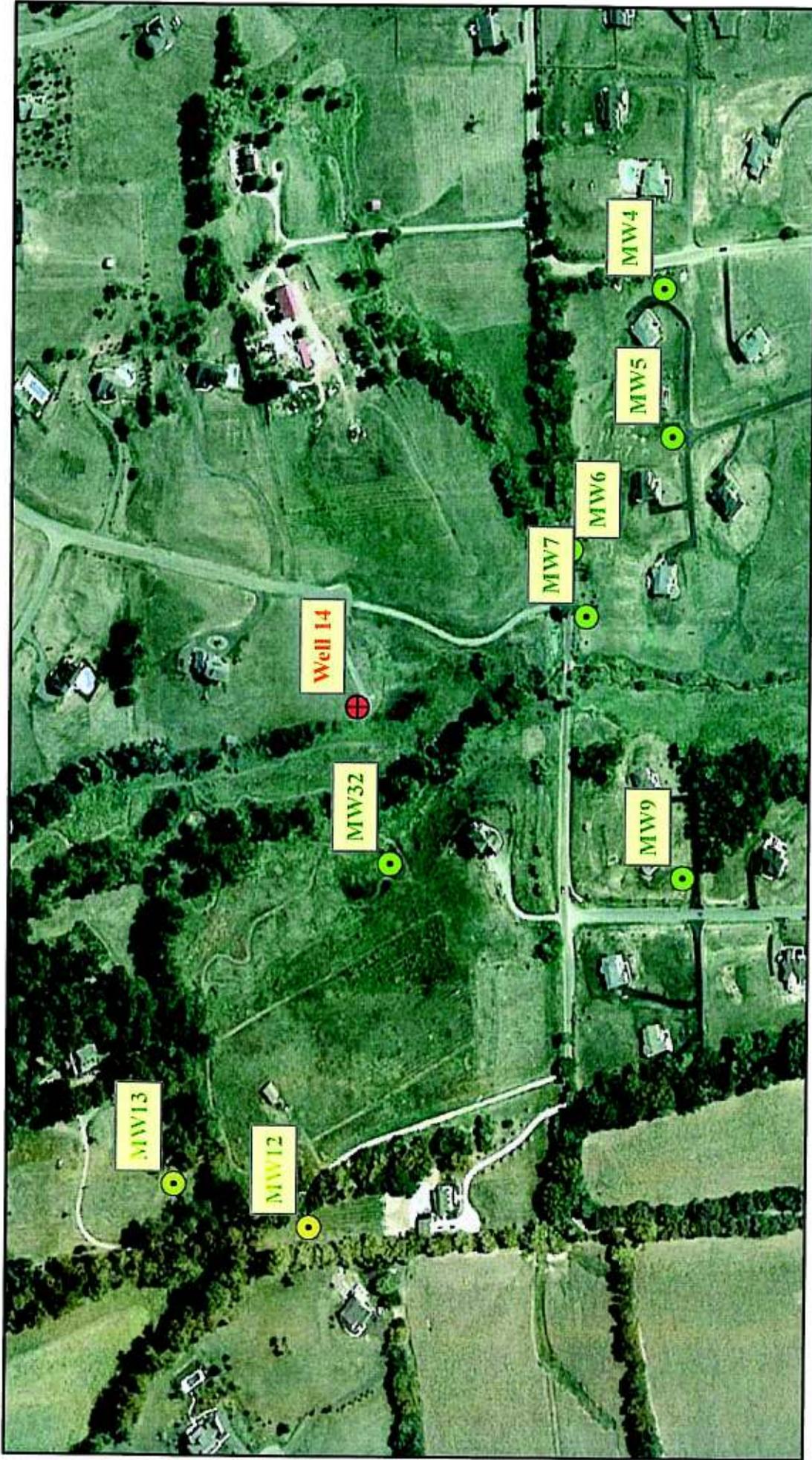


Figure 1. Area of Well Monitoring

Legend

-  Town of Hamilton Well
-  Monitored Domestic Supply Wells

Imagery Source: ESRI ArcGIS Map Service



Figure 2. Well 4, 5, 6 and 32: 4th Quarter, 1st Year

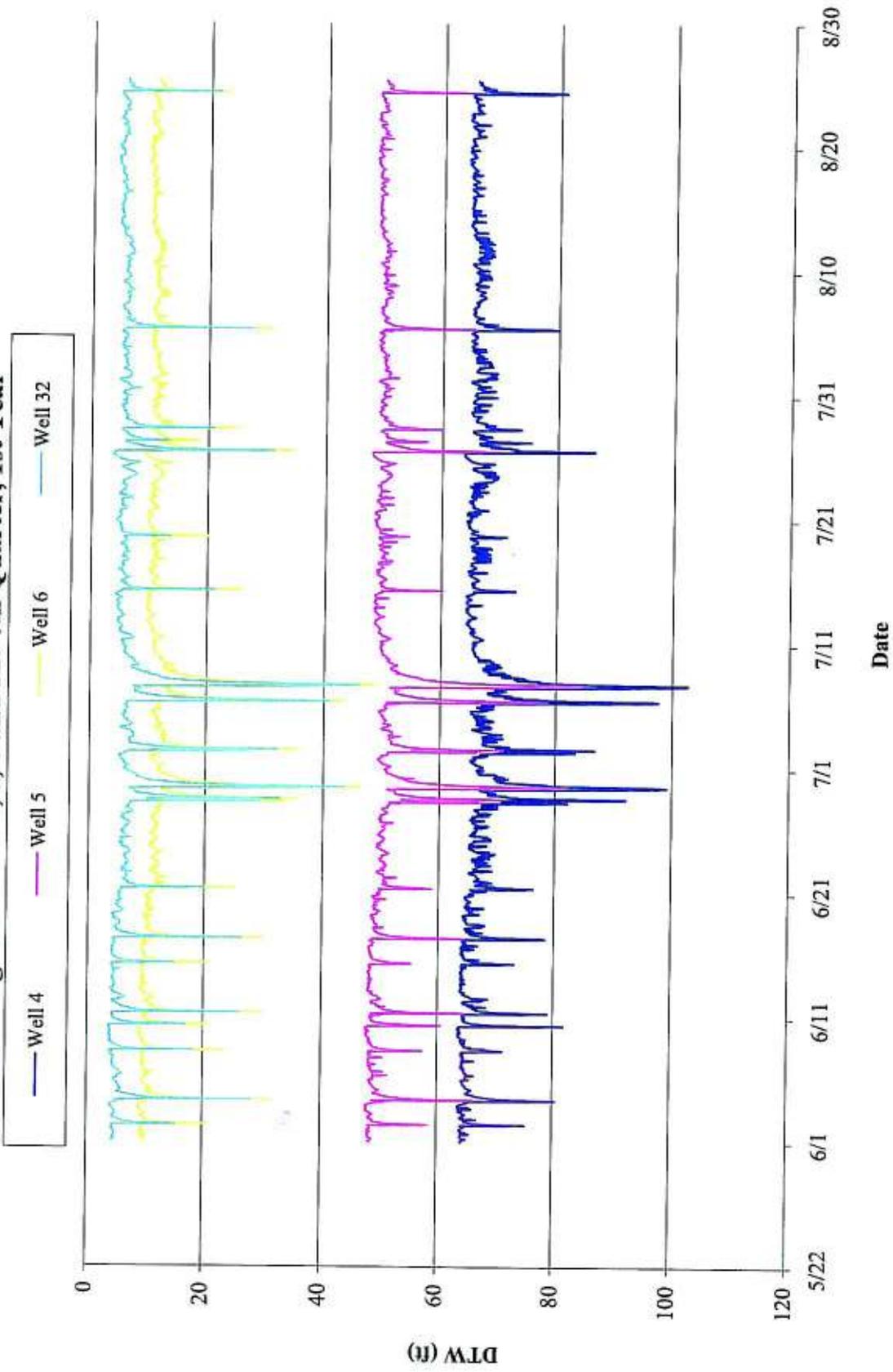


Figure 3. Wells 9, 12, and 13: 4th Quarter, 1st Year

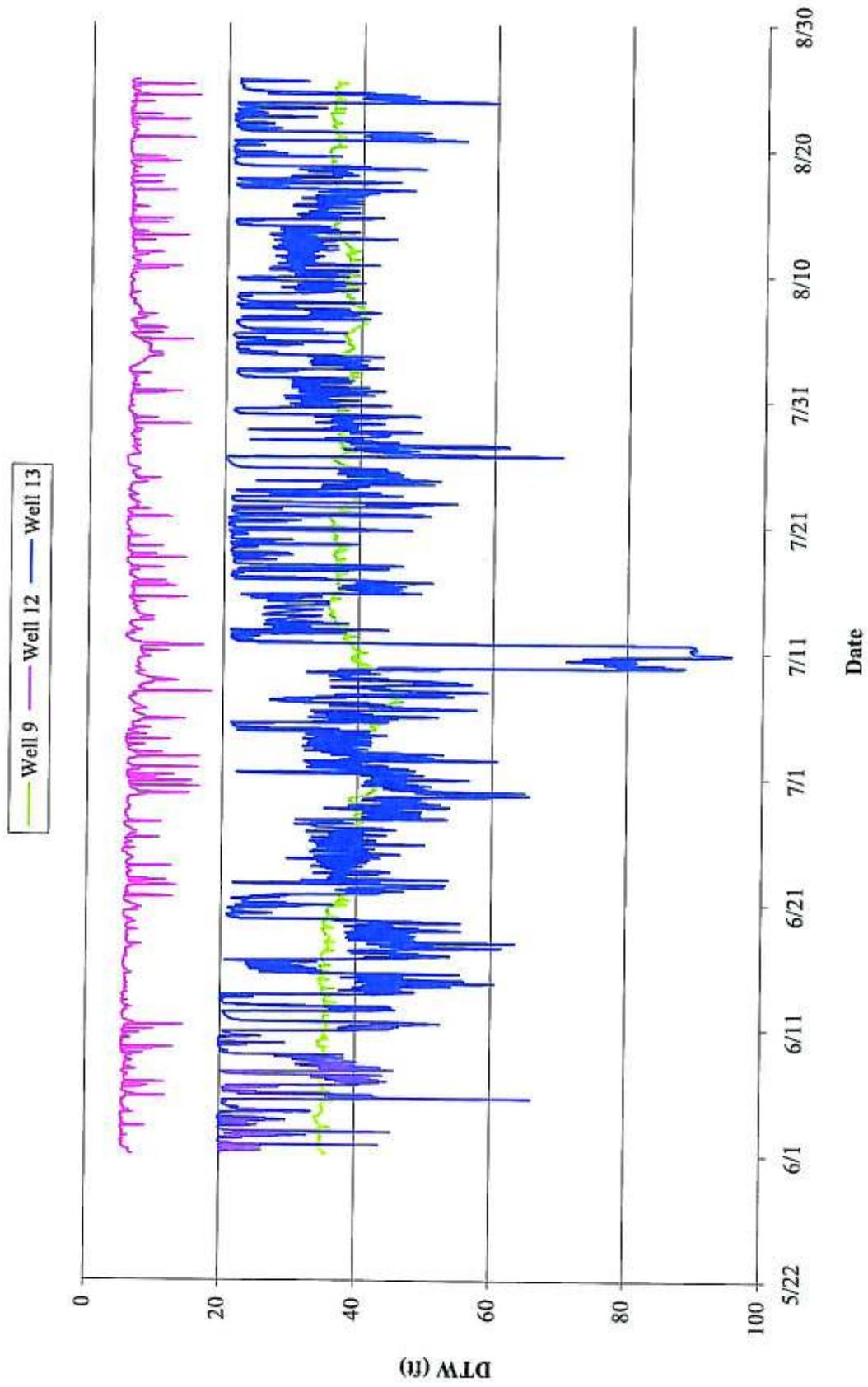
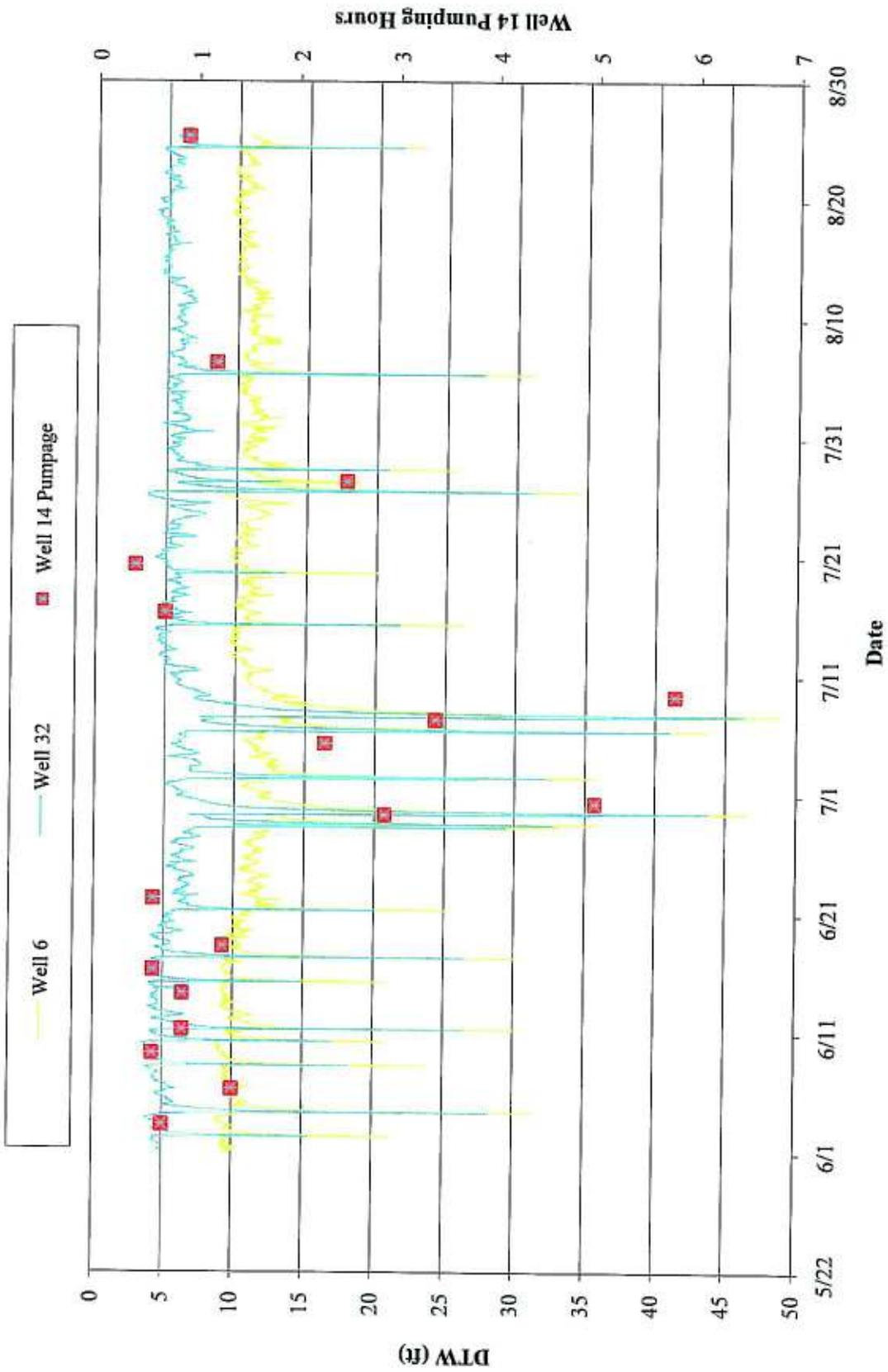


Figure 4. Well 14 Pumping with Examples of Drawdowns in Wells 6 and 32



APPENDIX A

SUMMARY TABLE OF FIELD PARAMETERS

APPENDIX A. Field Parameters

Date	1/9/09	8/9/09	8/26/09	10/6/09	10/29/09	11/17/09	12/28/09	1/29/10	2/24/10	3/24/10	4/30/10	5/25/10	8/25/10
Well ID													
pH (Standard Units)													
Well 4	6.79	7.8	7.93	8.17	7.84	7.6	7.66	*	*	*	7.24	7.61	7.57
Well 5	7.27	7.15	7.42	7.1	7.46	7.26	7.44	7.18	*	*	7	6.98	7.15
Well 6	6	7.7	7.77	7.61	7.96	7.68	7.86	*	*	*	7.33	7.4	7.34
Well 7													6.63
Well 9	6.1	7.9	8.16	7.77	8.22	7.89	7.95	*	*	8.11	7.52	7.39	7.28
Well 12	7.71	7.54	7.37	7.53	7.54	7.23	7.47	*	*	7.27	7.08	6.64	6.47
Well 13	7.41	7.4	7.5	7.34	7.42	7.45	7.39	6.96	*	6.94	6.77	6.1	6.16
Well 32						7.6	7.61	*	*	7.18	7.09	6.76	6.45
Specific Conductance (µS)													
Well 4	420	288	524	365	424	321	335	*	*	*	466	384	442
Well 5	342	355	415	390	416	372	381	381	*	*	387	371	431
Well 6	315	271	322	295	290	281	279	*	*	*	282	300	291
Well 7													298
Well 9	270	229	250	263	244	230	254	*	*	281	248	254	231
Well 12	311	286	260	290	277	247	269	*	*	322	278	279	281
Well 13	269	284	255	270	333	275	242	243	*	276	255	240	246
Well 32						234	236	*	*	259	270	262	257
Temperature (°C)													
Well 4	16	17.5	21.9	16.3	15.8	15.3	18.9	*	*	*	17.6	21.2	22.8
Well 5	13.3	19	21	17.8	15.8	16.1	17	14.2	*	*	18.8	19.1	23.5
Well 6	11	21	25.7	18.3	15.9	15.6	21.4	*	*	*	18.3	20.5	23.1
Well 7													23.1
Well 9	11.4	24.5	23.1	19.6	16.9	16.9	17.4	*	*	18.2	18.3	22	21.4
Well 12	12.4	19.5	23.3	18.8	15.7	14.4	12.1	*	*	12.8	17.1	19.8	22.6
Well 13	13.3	21	23.2	19	16.3	14.7	10.8	10	*	13.7	17.3	21.7	21.9
Well 32						16.5	13.8	*	*	17.6	19	22	24.6

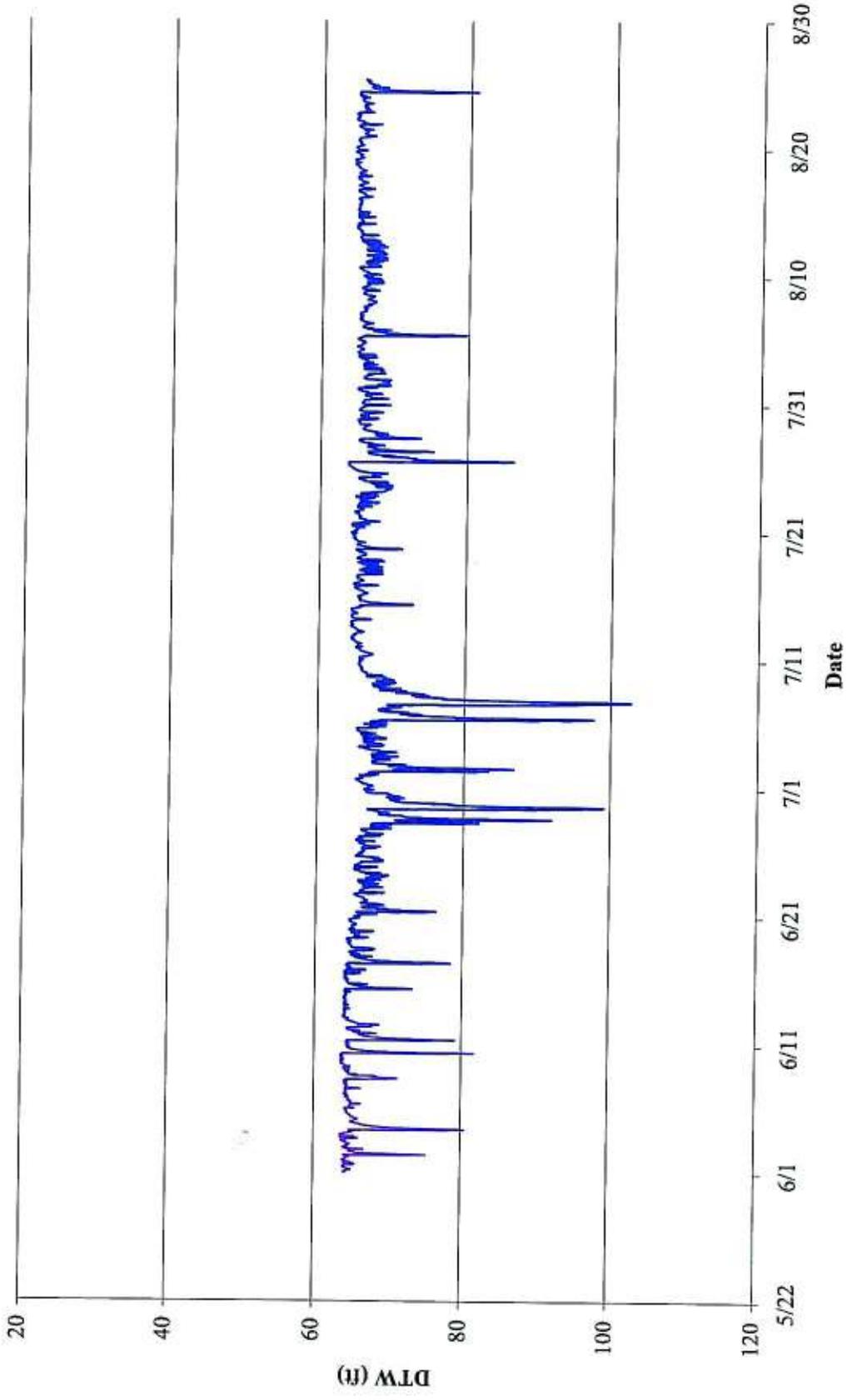
APPENDIX A. Field Parameters

Turbidity (NTUs)														
	0.08	0.2	1.38	0.005	0.51	10.96	3.59	*	*	*	*	0.46	0.58	0.66
Well 4	0.01	0.55	0.77	2.84	0.46	8.47	0	0.03	*	*	*	2.73	6.17	1.91
Well 5	0	0.89	0.6	0.61	0.16	10.33	0	*	*	*	*	0.24	0.54	2
Well 6														
Well 7														
Well 9	1.23	1.82	0.45	0.64	1.09	15.23	0.18	*	*	*	*	1.28	0.64	2.3
Well 12	0.01	0.21	4.5	0.59	0.21	14.22	0.01	*	*	*	*	3.78	1.39	5.9
Well 13	0.06	0.83	0.75	0.86	0.17	15.62	0	0	*	*	*	0.7	1.17	0.56
Well 32						15.92	0	*	*	*	*	0.83	0.34	4.74

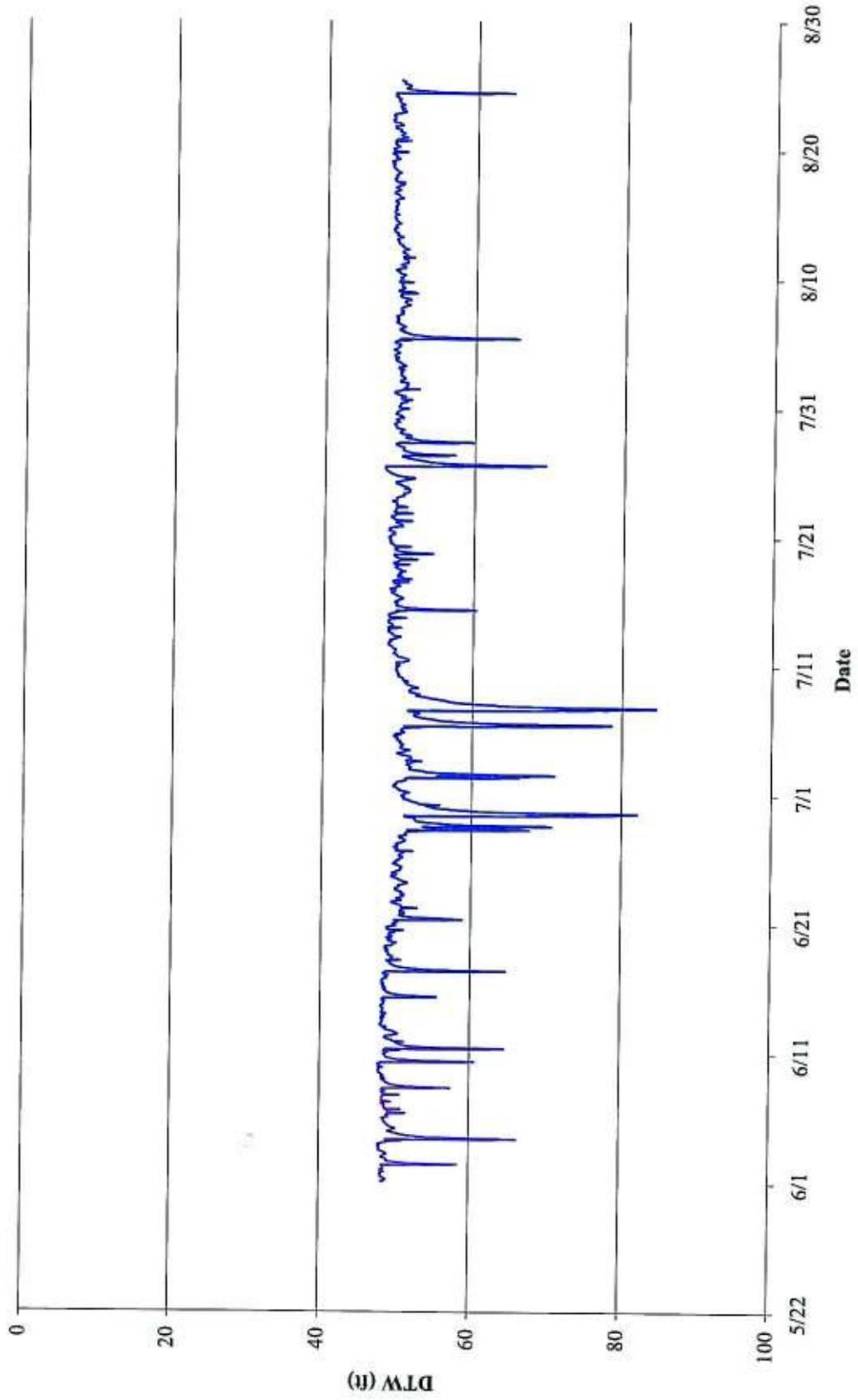
Note: *: Outdoor spigots were shut off because of freezing weather. No sample was collected.

APPENDIX B
WATER LEVEL GRAPHS FOR INDIVIDUAL WELLS
FOR THE FOURTH QUARTER OF PUMPING
(June, July, August, 2010)

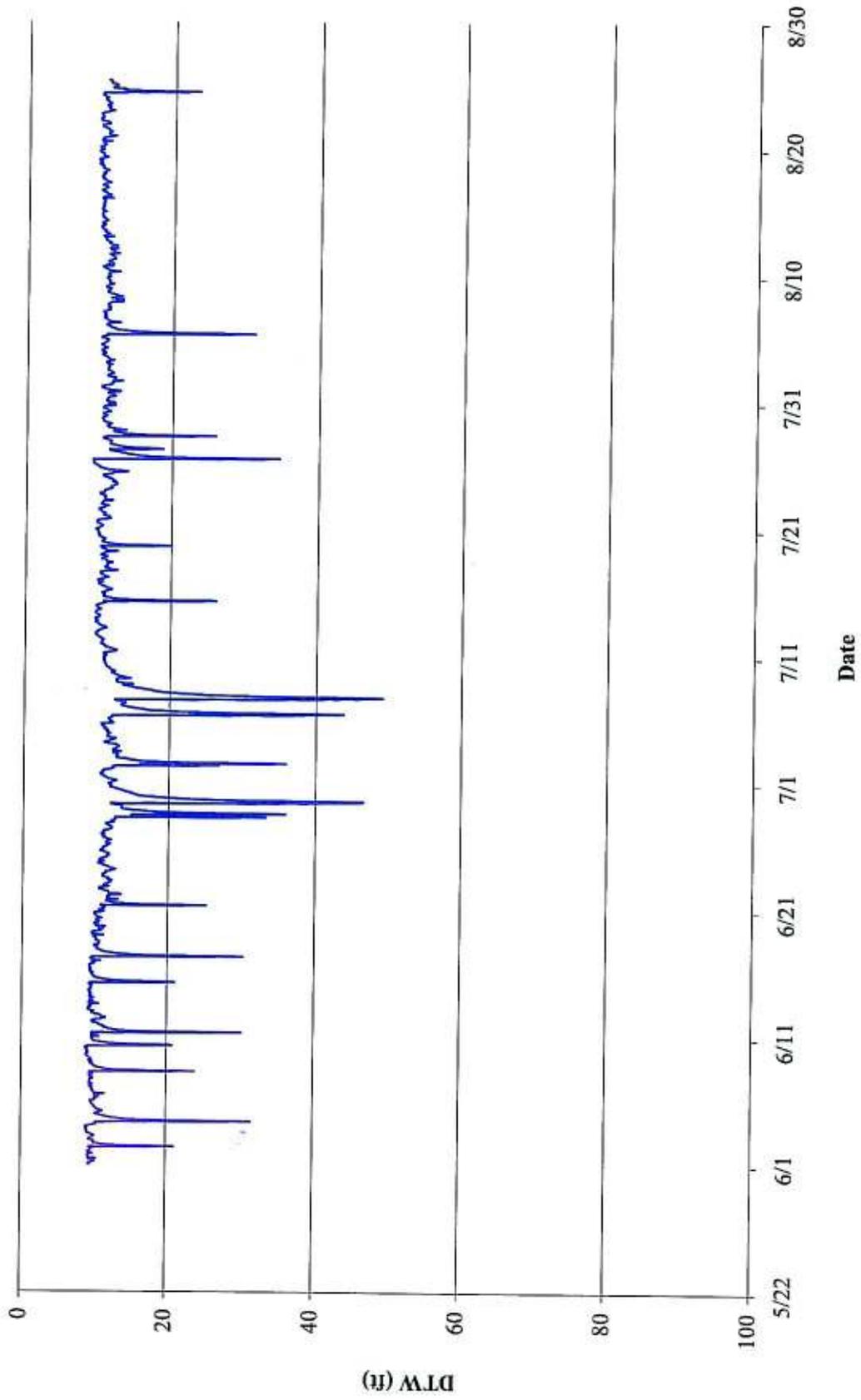
Well 4: 4th Quarter, 1st Year



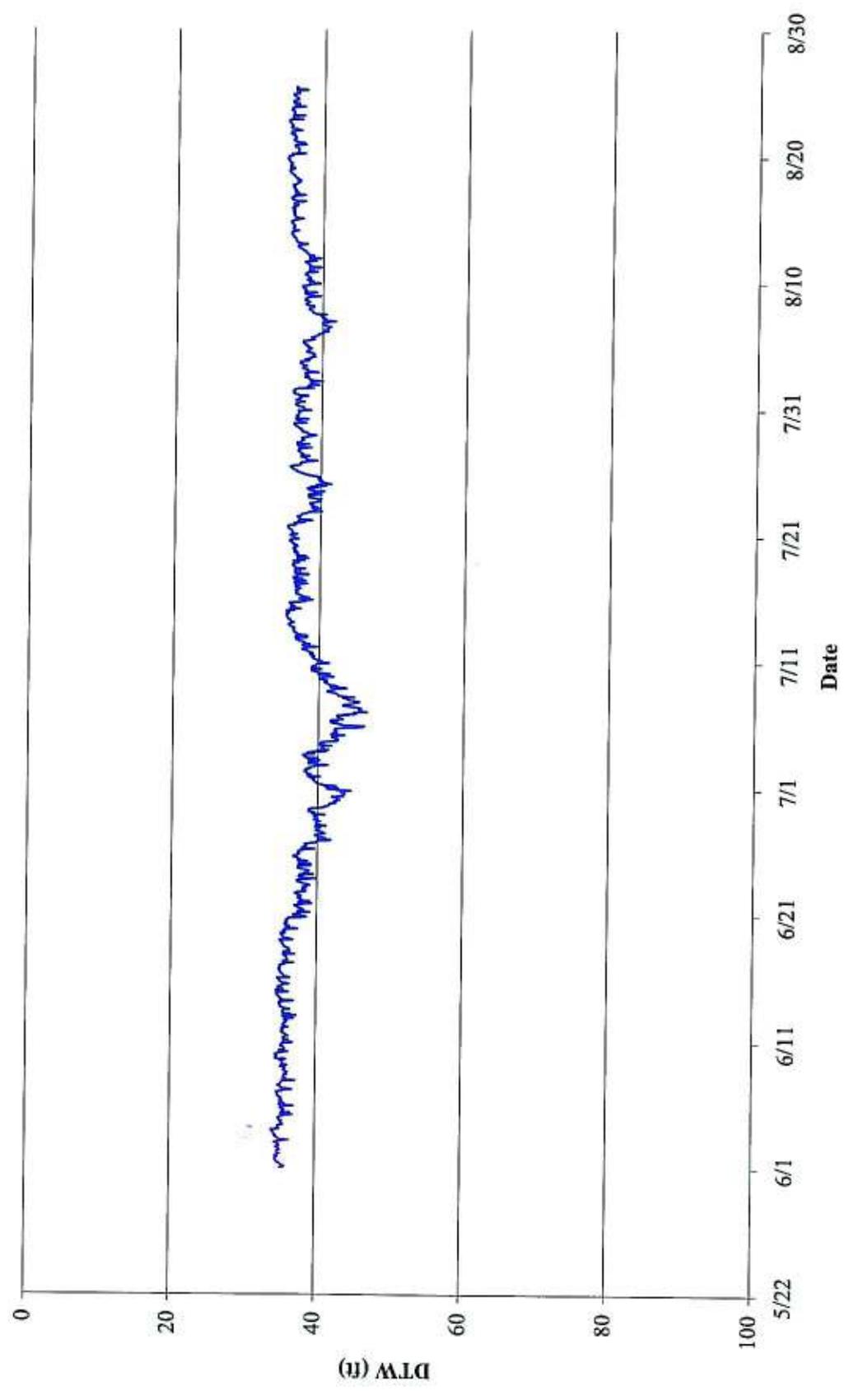
Well 5: 4th Quarter, 1st Year



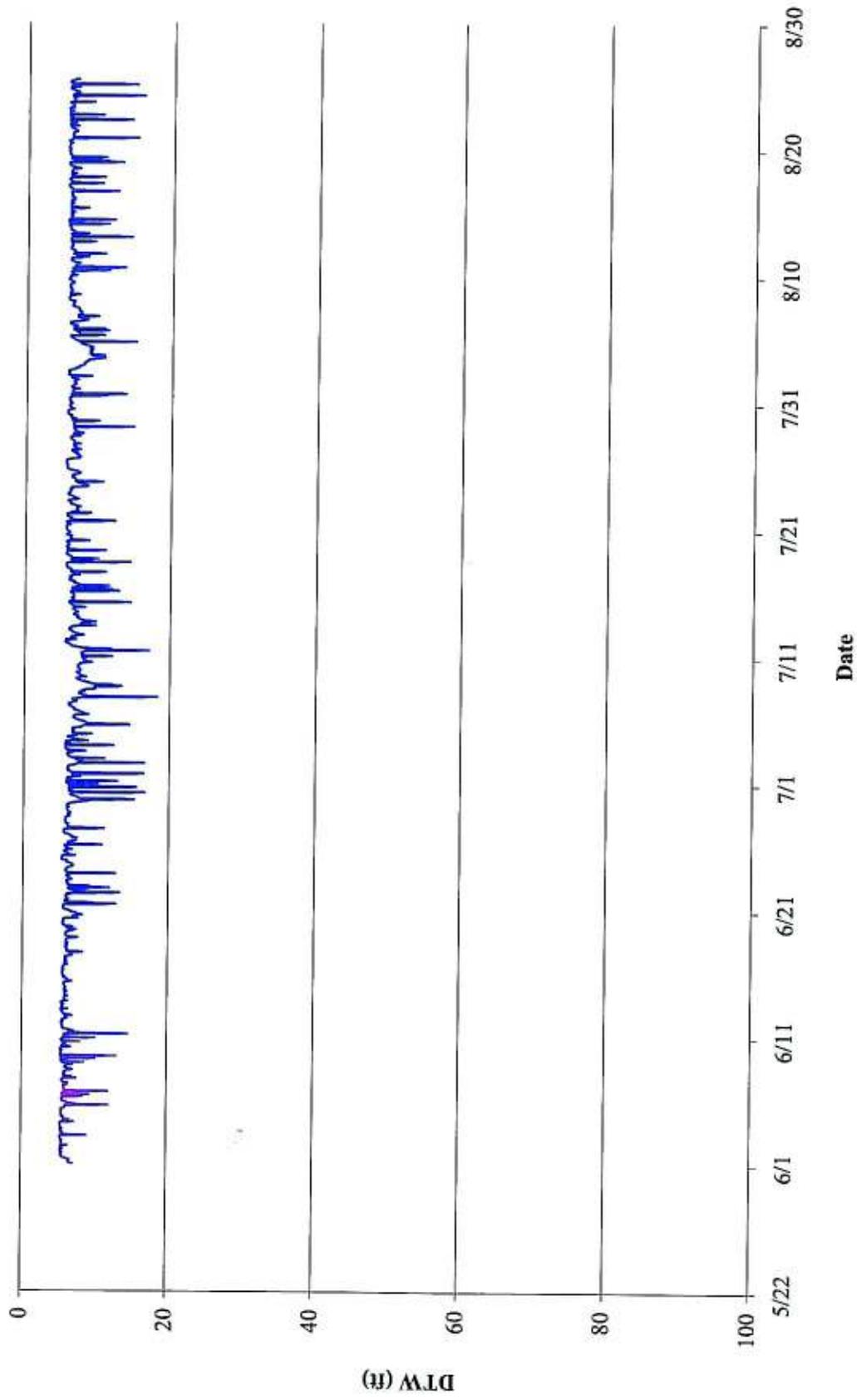
Well 6: 4th Quarter, 1st Year



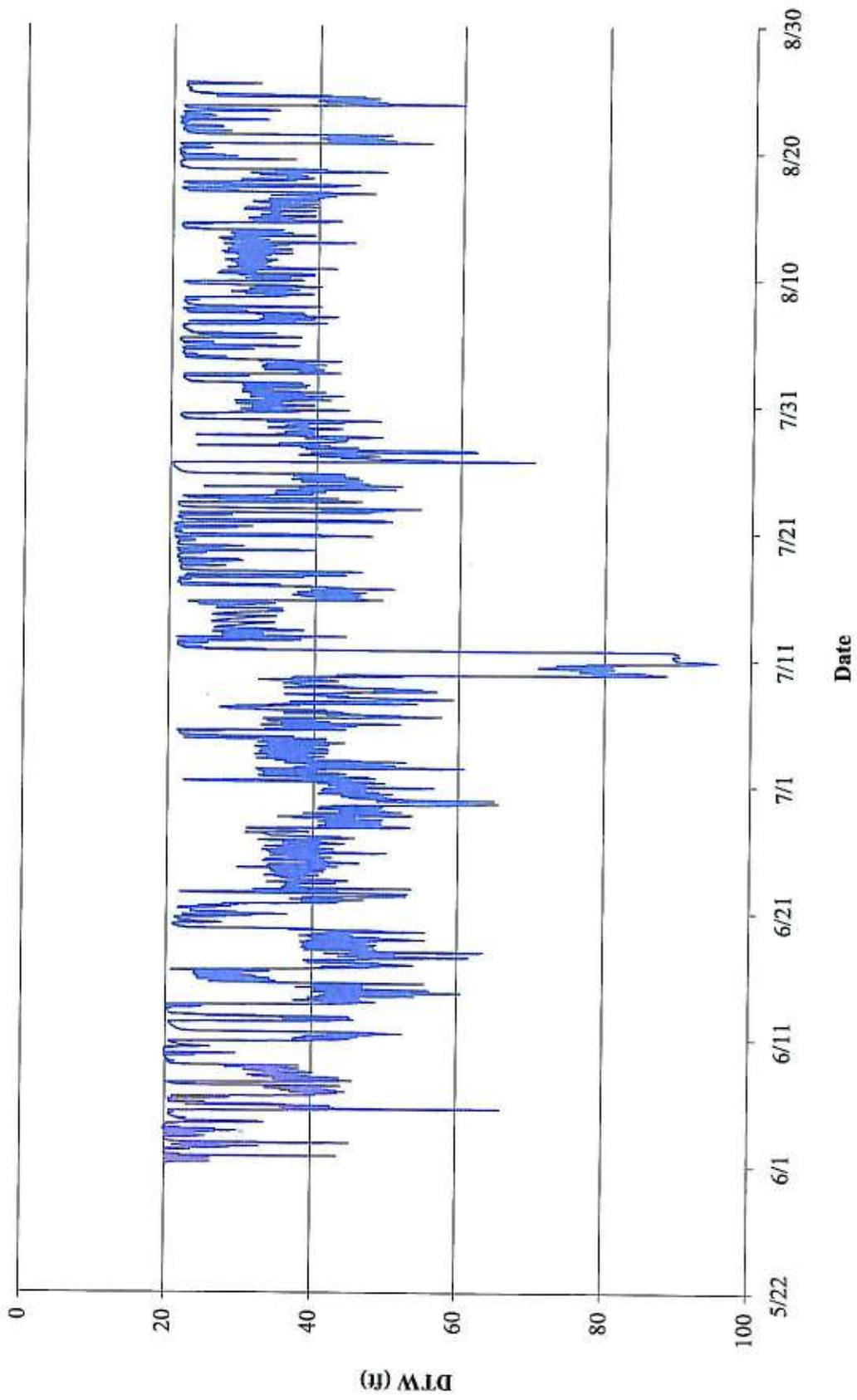
Well 9: 4th Quarter, 1st Year



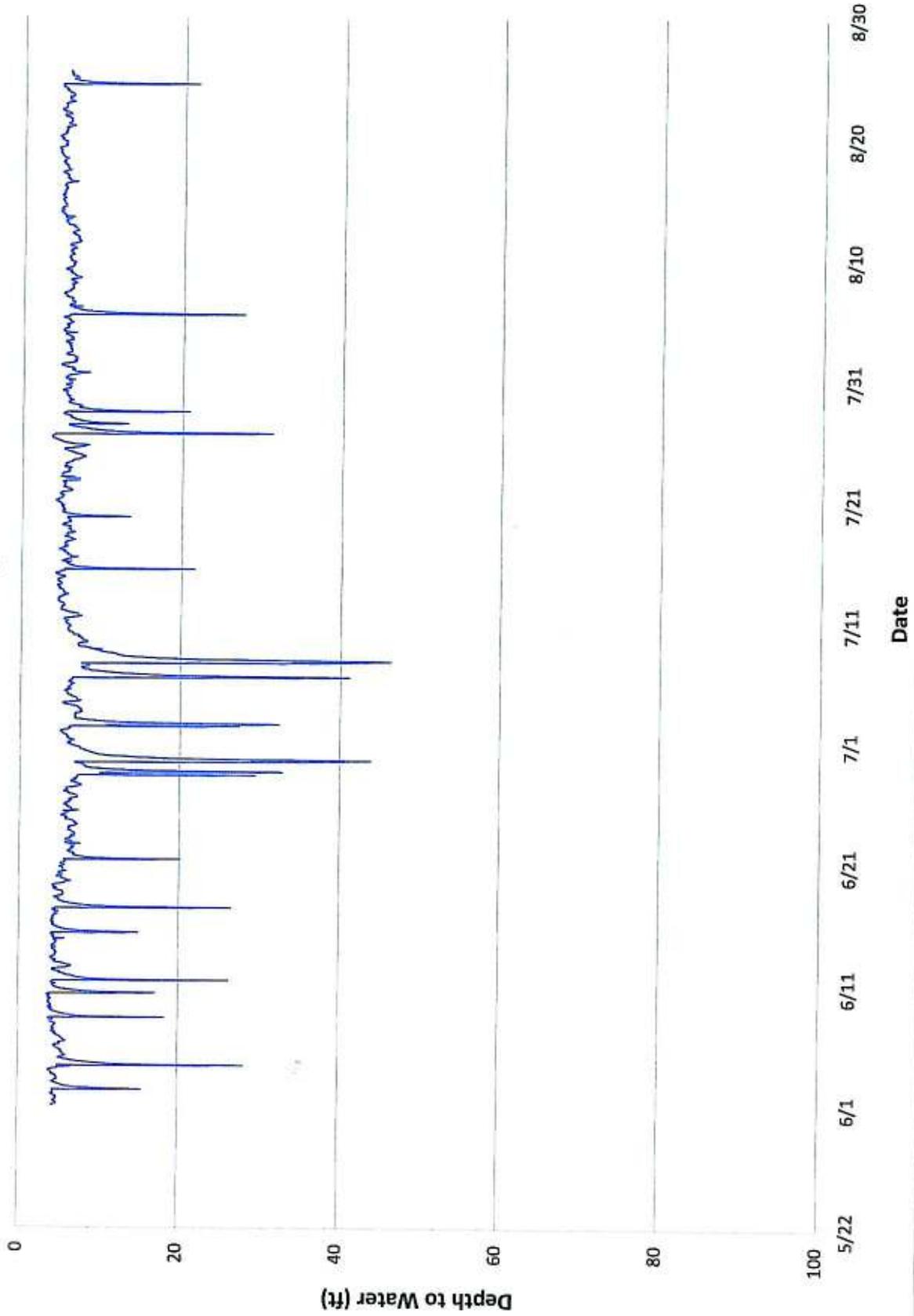
Well 12: 4th Quarter, 1st Year



Well 13: 4th Quarter, 1st Year



Well 32: 4th Quarter, 1st Year



APPENDIX C
WELL #14 PUMPING DATA

APPENDIX C. Well 14 Pumping Data

Well 14			
Date & Time¹	Hours	Gallons	gpm²
10/7/2009 9:00	2.5	38,000	253
10/8/2009 9:00	1.8	31,700	294
10/19/2009 9:00	0.9	15,000	278
10/21/2009 9:00	0.6	9,500	264
10/23/2009 9:00	3.1	51,900	279
10/27/2009 9:00	0.5	8,400	280
10/28/2009 9:00	3.5	56,200	268
10/29/2009 9:00	3.3	53,900	272
10/30/2009 9:00	1.5	23,200	258
11/2/2009 9:00	1.2	20,300	282
11/3/2009 9:00	0.4	7,600	317
11/4/2009 9:00	0.8	13,600	283
11/8/2009 9:00	0.6	9,300	258
11/10/2009 9:00	0.5	8,100	270
11/12/2009 9:00	0.9	14,400	267
11/13/2009 9:00	0.5	8,700	290
11/16/2009 9:00	0.6	10,300	286
11/17/2009 9:00	4	63,900	266
11/19/2009 9:00	1.4	18,700	223
11/20/2009 9:00	1.7	28,100	275
11/21/2009 9:00	0.5	7,700	257
11/24/2009 9:00	1	17,900	298
11/30/2009 9:00	5.9	65,700	186
12/3/2009 9:00	1	16,600	277
12/7/2009 9:00	1	18,000	300
12/9/2009 9:00	0.9	14,200	263
12/10/2009 9:00	2.3	38,400	278
12/14/2009 9:00	0.2	2,600	217
12/15/2009 9:00	1.7	28,500	279
12/16/2009 9:00	0.9	14,600	270
12/21/2009 9:00	0.9	14,600	270
12/22/2009 9:00	1	17,000	283
12/27/2009 9:00	1.4	23,100	275
12/28/2009 9:00	2.2	36,500	277
12/29/2009 9:00	0.5	7,400	247
1/1/2010 9:00	2.1	36,200	287
1/4/2010 9:00	1.6	26,100	272
1/6/2010 9:00	0.8	12,300	256
1/8/2010 9:00	2.9	18,700	107
1/11/2010 9:00	0.6	9,800	272
1/13/2010 9:00	0.7	12,800	305
1/14/2010 9:00	0.5	7,700	257

Notes

1: Time of day is estimated.

2: gpm = gallons per minute

APPENDIX C. Well 14 Pumping Data

Date & Time¹	Hours	Gallons	gpm²
1/18/2010 9:00	0.6	10,100	281
1/19/2010 9:00	0.7	12,000	286
1/20/2010 9:00	1.4	23,200	276
1/22/2010 9:00	0.8	12,500	260
1/26/2010 9:00	0.5	9,500	317
1/27/2010 9:00	0.6	10,000	278
1/28/2010 9:00	0.6	9,000	250
2/1/2010 9:00	1.8	30,100	279
2/8/2010 9:00	2.2	36,300	275
2/9/2010 9:00	0.7	11,800	281
2/15/2010 9:00	0.9	14,800	274
2/17/2010 9:00	1.5	24,200	269
2/24/2010 9:00	1.8	30,300	281
2/25/2010 9:00	0.5	8,800	293
3/1/2010 9:00	0.9	14,700	272
3/3/2010 9:00	1.2	18,800	261
3/4/2010 9:00	0.5	10,000	333
3/8/2010 9:00	1.3	20,900	268
3/9/2010 9:00	0.7	11,600	276
3/10/2010 9:00	5	81,200	271
3/11/2010 9:00	4.2	66,800	265
3/16/2010 9:00	0.7	13,000	310
3/18/2010 9:00	5.3	84,700	266
3/21/2010 9:00	0.5	9,400	313
3/23/2010 9:00	0.5	8,800	293
3/24/2010 9:00	0.3	3,800	211
3/25/2010 9:00	1.5	17,700	197
3/29/2010 9:00	0.8	12,500	260
4/4/2010 9:00	0.2	3,600	300
4/5/2010 9:00	4.2	67,800	269
4/11/2010 9:00	1.8	30,000	278
4/12/2010 9:00	2.9	47,700	274
4/18/2010 9:00	1.6	25,900	270
4/19/2010 9:00	0.5	8,900	297
4/20/2010 9:00	0.8	12,800	267
4/22/2010 9:00	0.6	10,900	303
4/26/2010 9:00	1	16,000	267
4/27/2010 9:00	1.1	19,700	298
5/3/2010 9:00	1.2		
5/9/2010 9:00	1.3		
5/10/2010 9:00	1.2		
5/13/2010 9:00	0.7		
5/16/2010 9:00	0.7		

APPENDIX C. Well 14 Pumping Data

Date & Time¹	Hours	Gallons	gpm²
5/17/2010 9:00	1		
5/19/2010 9:00	0.8		
5/23/2010 9:00	0.6		
5/24/2010 9:00	1		
5/26/2010 9:00	0.7		
5/31/2010 9:00	1.5		
6/3/2010 9:00	0.7		
6/6/2010 9:00	1.4		
6/9/2010 9:00	0.6		
6/11/2010 9:00	0.9		
6/14/2010 9:00	0.9		
6/16/2010 9:00	0.6		
6/18/2010 9:00	1.3		
6/22/2010 9:00	0.6		
6/29/2010 9:00	2.9		
6/30/2010 9:00	5		
7/5/2010 9:00	2.3		
7/7/2010 9:00	3.4		
7/9/2010 9:00	5.8		
7/16/2010 9:00	0.7		
7/20/2010 9:00	0.4		
7/27/2010 9:00	2.5		
8/6/2010 9:00	1.2	26500	368.056
8/25/2010 9:00	0.9	18400	340.741
8/27/2010 9:00	0.5	9400	313.333
8/28/2010 9:00	0.5	10800	360
8/31/2010 9:00	0.5	11100	370

APPENDIX D
ELECTRONIC MONITORING DATA

**Digital monitoring data have been submitted to
Loudoun County Department of Building and Development**