

Wyckoff Groundwater Elevation Data Acquisition System - A Field Check

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A new centralized groundwater level data acquisition system was installed in select Wyckoff extraction and monitoring wells in August 2011 (see CH2MHILL Technical Memorandum *Wyckoff Groundwater Level Transducer Project Summary*, dated October 28, 2011). The primary advantage of the new system is the ability to obtain real time groundwater level information to help better optimize the groundwater extraction pumps to maintain hydraulic containment. The new system also reduces field time for downloading and data handling compared to the original Levellogger system. Moreover, the original Levellogger system had reached the end of its service life and was becoming more unreliable. As part of the field commissioning of the new system, groundwater levels determined by the new system were compared to the old Levellogger system for the period of September 19, 2011 to November 29, 2011. This memorandum summarizes the results of this comparison.

Primary Conclusions / Recommendations

- The new transducer system is functioning as designed and obtaining accurate groundwater elevation data in real time. All transducer readings are close to manually measured groundwater elevations. All future hydraulic containment evaluations from September 28, 2011 should be based on transducer derived data.

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- Each new transducer should be “recalibrated” against a manual water/fluid level measurement as part of the routine raw data processing workflow. The timing can be quarterly, semiannual or annual, but should be made at the time of a quarterly download to minimize the data correction effort.
 - The Levellogger readings when compared to manual groundwater level measurement showed that 5 of 20 Levelloggers installed in the 10 vertical gradient well pair monitoring wells yielded groundwater elevations that differed by greater than +/- 1 foot from manual measurements (MW14, CW05, MW18, CDMW02A, and CW02). Levellogger drift is the most likely cause of the discrepancies. Examination of the historic procedure for converting raw pressures to water level elevations showed that the Levelloggers had not been factory re-calibrated nor had the measured readings been adjusted to match manual measurements since installation in 2004.
 - Based on the Levellogger drift identified during the comparison to manual measurements, the overall conclusion that hydraulic containment was maintained at the Wyckoff site presented in the previous CH2MHILL Technical Memorandum *Evaluation of Wyckoff Groundwater Level Data, June 30 – September 27, 2011*, dated February 6, 2012 was checked to determine if correcting the Levellogger data sets based on manual measurements would change the overall conclusion. The overall conclusion did not change – hydraulic containment was maintained in all 10 well pairs over the 90-day monitoring period.

Water Level Data Collection Equipment

Solinst Levelloggers are currently installed in 10 upper aquifer wells and 18 lower aquifer wells. Levelloggers have been used to monitor hydraulic containment through evaluation of vertical gradients measured in upper and lower aquifer monitoring wells at the site since May 2004. The Levelloggers are non-vented and measure absolute pressure (water pressure + barometric pressure) and temperature. Actual water pressure (internally converted to feet of water) is obtained by subtracting the average barometric pressure obtained from two onsite barometric pressure loggers (Barologger). Groundwater surface elevation is then calculated by adding the physical elevation of the Levellogger to the barometric pressure compensated water level readings recorded by the Levellogger.

New Model 705 KPSI™ Level and Pressure Transducers were installed in 22 upper aquifer wells and 18 lower aquifer wells in August 2011 and calibrated in September 2011. The Series 705 is a hydrostatic level transducer specifically designed to meet the adverse environments such as those encountered in wastewater applications and marine environments. The transducer assembly is integrated with supporting electronics in a waterproof housing constructed of titanium. Each transducer is vented and uses the SuperDry™ Vent Filter that prevents moisture from entering the vent tube for at least one year without maintenance, even in the most humid environment. Pressure readings are internally converted to elevation by adding the physical elevation of the transducer to the measured pressure converted to feet of water.

Water Level Data Collection

Data from the Levelloggers and pressure transducers were downloaded on November 29, 2011. The data set presented in this memorandum is from September 19 to November 29, 2011. The locations of the wells are shown in Figure 1, wells with loggers are listed in Table 1, and wells with transducers are listed in Table 2. All data are available in e-format upon request.

Table 1 – Wells with Levelloggers, September 19 – November 29, 2011

Upper Aquifer		Lower Aquifer		
CW03	PO13	02CDMW01	PZ11	P-1L
CW08	VG-2U	99CDMW02A	VG-1L	P-2L
CW13	VG-3U	CW01	VG-2L	P-3L
MW14	VG-5U	CW02	VG-3L	P-4L
MW18		CW05	VG-4L	P-5L
PO03		PZ03	VG-5L	P-6L

Table 2 – Wells with Transducers, September 19 – November 29, 2011

Upper Aquifer ¹		Lower Aquifer ¹	
CW03	PO13	02CDMW01	PZ03
CW08	RPW-1	99CDMW02A	SE02
CW13	RPW-2	CW02	VG-1L
E-02	RPW-4	CW05	VG-2L
E-04	RPW-5	CW09	VG-3L
E-06	RPW-6	P-1L	VG-4L
E-07 ²	PW-8	P-2L	VG-5L
MW14	PW-9	P-3L	
MW18	VG-2U	P-4L	
MW21	VG-3U	P-5L	
PO03	VG-5U	P-6L	

¹ When the new transducers were installed, select upper aquifer E-0x wells (located within the Pilot Test sheet pile wall) and all operational RPW/PW extraction pumping wells were included in the monitoring network. In addition, the individual lower aquifer wells CW09 and SE02 and upper aquifer MW21 were added to the network to add additional spatial coverage. Upgradient well PZ11 was removed from the network because it was no longer needed.

² E-07 (not shown in Figure 1) is located west southwest of E-03 within the Pilot Test sheet pile wall.

Levellogger and Pressure Transducer Data Evaluation

As part of the Levellogger and pressure transducer data evaluation, CH2M HILL prepared groundwater elevation hydrographs, conducted a snapshot comparison of Levellogger and transducer data at selected dates and times, and compared Levellogger and transducer data to manual water level measurements collected at the time of Levellogger download. This section presents these comparisons and summarizes relevant observations.

Visual Hydrograph Comparison

The wells used for comparison of Levellogger and transducer groundwater elevation data are the 10 well pairs that are used to evaluate hydraulic containment at the Wyckoff site. The wells pairs selected are: MW14/CW05, MW18/02CDMW01, PO03/99CDMW02A, CW03/CW02, VG-2U/VG-2L, VG-3U/VG-3L, VG-5U/VG-5L, PO13/VG-1L, CW13/VG-4L, and CW08/P-4L. Visual comparisons were conducted for the Levellogger and transducer in each well. There is one graph for each well, showing both sets of groundwater elevation data from the Levellogger and the transducer. Hydrographs from the 20 wells are shown in Figures 2 through 21 for the data collection period. Note there are several sudden downward elevation spikes in the transducer water level elevations observed for the wells during the data collection period. The pressure transducers are connected by data cable from the well head to a computer system in the groundwater treatment plant at Wyckoff. Brief power outages within the treatment plant, or periods when calibration or computer programming activities were performed on the transducers cause the transducer to record a zero elevation value. Similar zero or below elevation values from the Levelloggers were recorded while the logger was out of the water for transducer calibration or for Levellogger download.

Visual inspections of the hydrographs indicate a clear difference between the groundwater elevations derived from the Levellogger and the transducers in some, but not all of the wells. The inspection also indicates that the response of both types of units to tidal fluctuation was similar in absolute magnitude and timing indicating that the internal clocks in the Levelloggers and transducers were basically in sync and that the relative accuracies, but not the absolute accuracies, were similar.

Snapshot Comparison

The Levelloggers were programmed to record water levels every 15 minutes during the monitoring period, while the transducers recorded water level elevations every hour. Because the Levelloggers and pressure transducers recorded water levels at different time intervals, a snapshot comparison of Levellogger and pressure transducer data at select dates and times was conducted to evaluate relative performance. Five dates and times were chosen for comparison where the water level data displayed peaks in water level elevation in some wells at the same or almost the same time. In general, the water levels recorded by the Levelloggers and the transducers are following the same trends; however, the two sets of elevation readings in all wells do not closely match. The snapshot comparison of the Levellogger and transducer data showed that readings differed by less than one foot in elevation in most wells indicating a reasonable match (CDMW01, PO03, CW03, VG2U, VG2L, VG3U, VG3L, VG5U, VG5L, PO13, VG1L, CW13, VG4L, CW08, and P4L). However, in wells MW14, CW05, MW18, CDMW02A, and CW02, the Levellogger and transducer readings differed by more than one foot. The maximum differences between Levellogger and transducer readings were seen in lower aquifer monitoring well CDMW02A, where readings for the snapshot comparison ranged from 9.16 to 12.24 feet difference in elevation, with readings from the Levellogger being greater than the transducer readings. Table 3 summarizes the results of the snapshot comparison for the five wells with the greatest differences. Well CW03 was included to represent the wells with a reasonable match. The calendar dates selected for comparison are also indicated in Figures 2 through 21.

Table 3 – Snapshot Comparison of Levellogger and Transducer Water Elevations for Wells with the Greatest Differences

	Date and Time	upper aquifer	lower aquifer	upper aquifer	lower aquifer	lower aquifer	upper aquifer
		MW14	CW05	MW18	CDMW02A	CW02	CW03
Levellogger	9/26/11 6:00 AM	9.97	14.79	5.89	20.49	9.72	8.26
Transducer	9/26/11 6:00 AM	7.42	11.49	7.48	11.32	10.89	8.36
Difference		2.55	3.29	-1.59	9.16	-1.18	-0.11
Levellogger	10/2/11 9:15 PM	10.10	15.28	5.48	21.11	10.24	8.53
Transducer	10/2/11 9:23 PM	7.10	11.46	6.78	11.31	11.34	8.93
Difference		3.00	3.82	-1.30	9.80	-1.10	-0.41
Levellogger	10/10/11 5:15 PM	9.52	15.33	2.77	21.52	10.36	7.19
Transducer	10/10/11 5:15 PM	6.53	11.49	4.02	11.30	11.44	7.21
Difference		2.99	3.84	-1.25	10.22	-1.08	-0.02
Levellogger	11/2/11 11:15 PM	7.55	13.20	2.35	20.83	7.92	5.43
Transducer	11/2/11 11:12 PM	4.53	9.40	3.57	9.41	9.01	5.46
Difference		3.02	3.79	-1.23	11.41	-1.09	-0.03
Levellogger	11/23/11 6:30 AM	6.08	14.88	1.46	22.91	9.97	5.73
Transducer	11/23/11 6:29 AM	3.18	10.58	3.19	10.66	10.42	5.44
Difference		2.89	4.29	-1.73	12.24	-0.46	0.28

Notes:
 (1) Shaded right-hand column is a surrogate for all the wells with a reasonable match between transducer and Levellogger groundwater elevations.

The results of the snapshot comparison show that data from the Levelloggers are usually slightly higher in elevation (positive difference in Table 3) than the transducer data, with differences ranging from 12.24 feet in CDMW02A to -1.73 feet in MW18. CDMW02A showed the most variation between snapshots with differences ranging from 9.16 to 12.24 feet indicating a poor relative correlation with the transducer derived groundwater elevation and the likelihood that its Levellogger was near failure. The similar differences between the Levellogger and transducer elevations, in the other 4 wells at the 5 snapshot times, indicates a close match in relative behavior.

As with the Visual Hydrograph Comparison discussed above, the Snapshot Comparison cannot differentiate absolute accuracy. To determine absolute accuracy, a comparison to manual measurement was made as discussed in the next Section.

Comparison with Manual Water Level Measurements

Absolute accuracy was evaluated by comparing groundwater elevations from the Levelloggers and new transducers to manual water level measurements taken at the time of download. Although the comparisons are less accurate because the manual, transducer,

and Levellogger measurements were not all coincident, four of the same wells identified previously showed significant Levellogger and manual measurement differences (MW14, CW05, MW18, CDMW02A) and reasonably close agreement between all of the transducers and manual measurements. The water level elevations recorded at the time closest to the manual water level measurements are listed in Table 4.

Table 4 – Manual Water Elevation Comparison

Monitoring Well Id	Manual Water Elevation (ft MLLW)	Manual Water Level Reading Date & Time	Transducer Elevation Reading (ft MLLW)	Transducer Elevation Date and Time	Levellogger Water Elevation (ft MLLW)	Levellogger Date and Time
MW14	5.15	11/29/11 9:24	5.24	11/29/11 9:47 AM	8.11	11/29/11 9:30 AM
CW05	11.76	11/29/11 9:10	11.71	11/29/11 9:47 AM	15.51	11/29/11 9:15 AM
MW18	6.29	11/29/11 11:10	6.24	11/29/11 11:47 AM	5.06	11/29/11 11:15 AM
02CDMW01	11.25	11/29/11 10:25	11.07	11/29/11 10:47 AM	11.08	11/29/11 10:30 AM
PO03	6.22	11/29/11 10:02	6.27	11/29/11 10:47 AM	5.96	11/29/11 10:00 AM
99CDMW02A	11.59	11/29/11 9:48	11.72	11/29/11 9:47 AM	21.85	11/29/11 9:45 AM
CW03	7.08	11/29/11 10:54	7.12	11/29/11 10:47 AM	7.29	11/29/11 10:45 AM
CW02	10.97	11/29/11 11:07	10.44	11/29/11 11:47 AM	10.60	11/29/11 11:00 AM
VG-2U	9.64	11/29/11 8:58	9.81	11/29/11 8:44 AM	9.29	11/29/11 9:00 AM
VG-2L	11.22	11/29/11 8:55	11.46	11/29/11 8:44 AM	10.88	11/29/11 9:00 AM
VG-3U	6.22	11/29/11 9:30	6.32	11/29/11 9:47 AM	6.14	11/29/11 9:30 AM
VG-3L	12.19	11/29/11 9:40	12.29	11/29/11 9:47 AM	12.52	11/29/11 9:45 AM
VG-5U	9.07	11/29/11 10:17	8.22	11/29/11 10:47 AM	7.64	11/29/11 10:15 AM
VG-5L	13.46	11/29/11 10:20	12.42	11/29/11 10:47 AM	12.38	11/29/11 10:15 AM
PO13	5.62	11/29/11 10:50	5.91	11/29/11 10:47 AM	5.71	11/29/11 10:45 AM
VG-1L	11.21	11/29/11 10:43	11.27	11/29/11 10:47 AM	11.15	11/29/11 10:45 AM
CW13	11.12	11/29/11 10:10	11.25	11/29/11 9:47 AM	10.74	11/29/11 10:15 AM
VG-4L	13.10	11/29/11 9:58	13.32	11/29/11 9:47 AM	13.33	11/29/11 10:00 AM
CW08	5.88	11/29/11 9:36	5.99	11/29/11 9:47 AM	6.00	11/29/11 9:30 AM
P-4L	11.43	11/29/11 9:30	11.41	11/29/11 9:47 AM	11.37	11/29/11 9:30 AM

Notes:

- (1) Shaded and non-shaded cells indicate vertical gradient well pairs.
- (2) Bolded & underscored results indicate differences of approximately ½ foot or greater between manual elevation measurement and Levellogger or transducer readings.
- (3) The transducers in VG-5U and VG-5L have been recalibrated to reflect the manual measurements.

Table 4, shows that the readings recorded by the transducers more closely match the manual measurements and that the Levellogger readings do not, especially in 5 of the 20 monitoring wells (MW14, CW05, MW18, CDMW02A, and CW02) with the greatest differences identified in the Visual Hydrograph and Snapshot comparisons.

The reason for the observed differences is most likely caused by long-term drift in the Levellogger calibrations. Examination of the procedure for converting raw pressure data to groundwater elevation showed that the Levelloggers had not been pulled for factory recalibrated nor the Levellogger readings adjusted to match manual measurements taken since installation in 2004.

Conclusion Check: June 30 – September 27, 2011 Technical Memorandum

Because of the groundwater elevation discrepancies identified in the Levellogger data sets, the overall conclusion that hydraulic containment was maintained presented in the previous *Evaluation of Wyckoff Groundwater Level Data, June 30 – September 27, 2011*, CH2MHILL Technical Memorandum dated February 6, 2012 was checked to see if correcting the Levellogger data sets based on manual measurements would change the overall conclusion.

Table 5 summarizes the re-evaluation results and shows that the overall conclusion would not change – hydraulic containment was maintained in all 10 well pairs over the 90-day monitoring period.

The methodology used to re-evaluate if hydraulic containment was maintained is as follows:

- 1) At each of the 10 well pairs, the 90-day average upper and lower aquifer groundwater elevations used in the June to September 2011 evaluation were tabulated (i.e., the non-manual measurement adjusted Levellogger data).
- 2) The average water levels for the monitoring period were then adjusted up or down by the difference between the manual and Levellogger measurements taken during the November 29, 2011 download. This procedure assumes that there was no drift between September 27, 2011 and the November 29, 2011 download date and that each constant elevation correction applies backward to June 30, 2011 over the entire preceding 90-day monitoring period.
- 3) The corrected lower aquifer average groundwater elevations were then divided by the corrected upper aquifer elevations at each of the 10 well pair locations. If the result was greater than 1, then by definition, hydraulic containment had been maintained over the monitoring period.
- 4) A complicating factor is that the Levelloggers have been moved among wells over the course of the groundwater level monitoring program. However, since at least June 30, 2011, the Levelloggers in the 10 well pairs have not been moved. Therefore, the current re-evaluation is valid, but to carry out the same analysis further back in time would require significant time and effort.

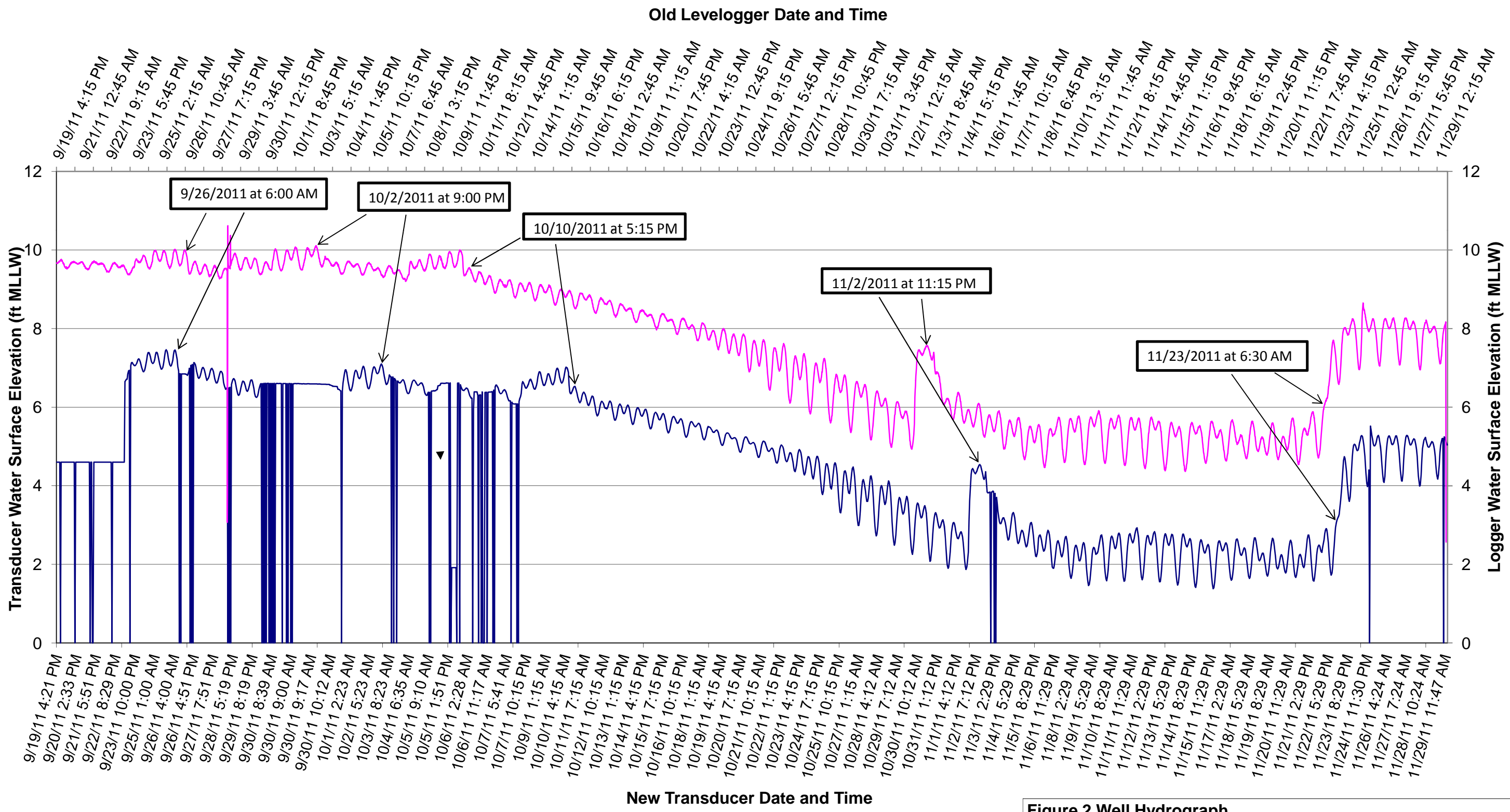
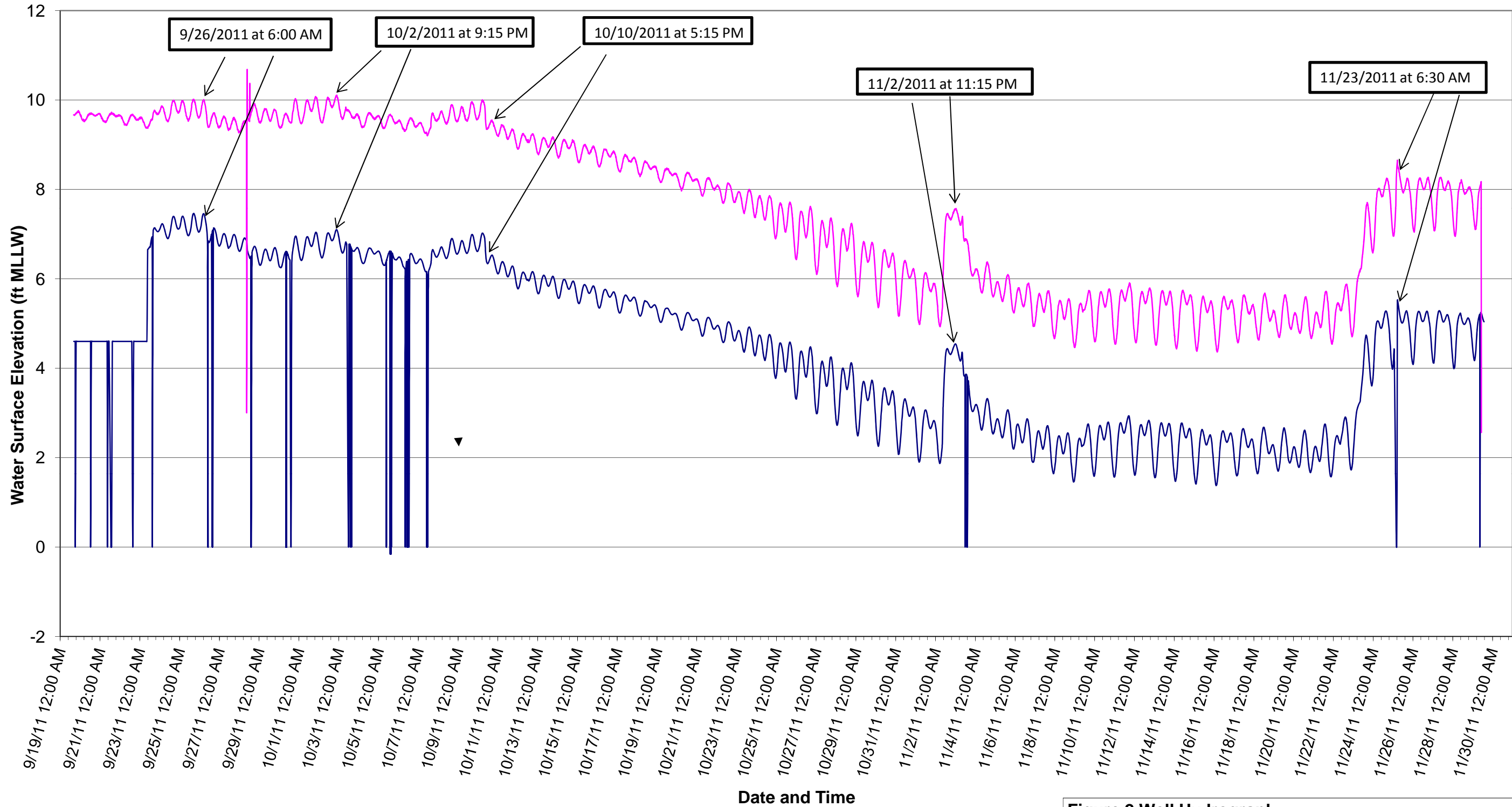


Figure 2 Well Hydrograph
Old Levellogger & New Transducer, Upper Aquifer Well MW14
September 19, 2011 - November 29, 2011



— MW14 Transducer — MW14 Logger

Figure 2 Well Hydrograph
Old Levellogger & New Transducer, Upper Aquifer Well MW14
September 19, 2011 - November 29, 2011

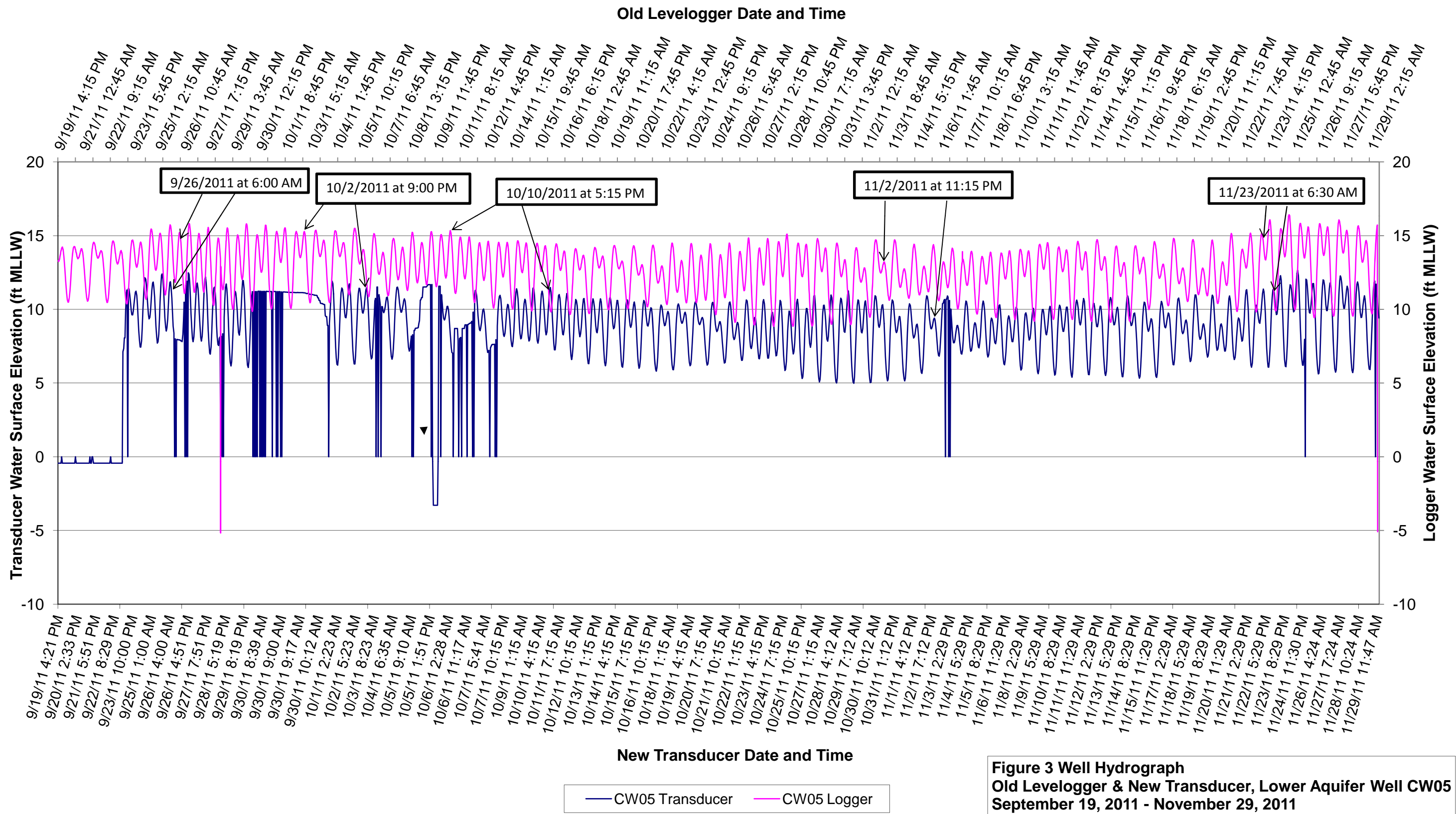
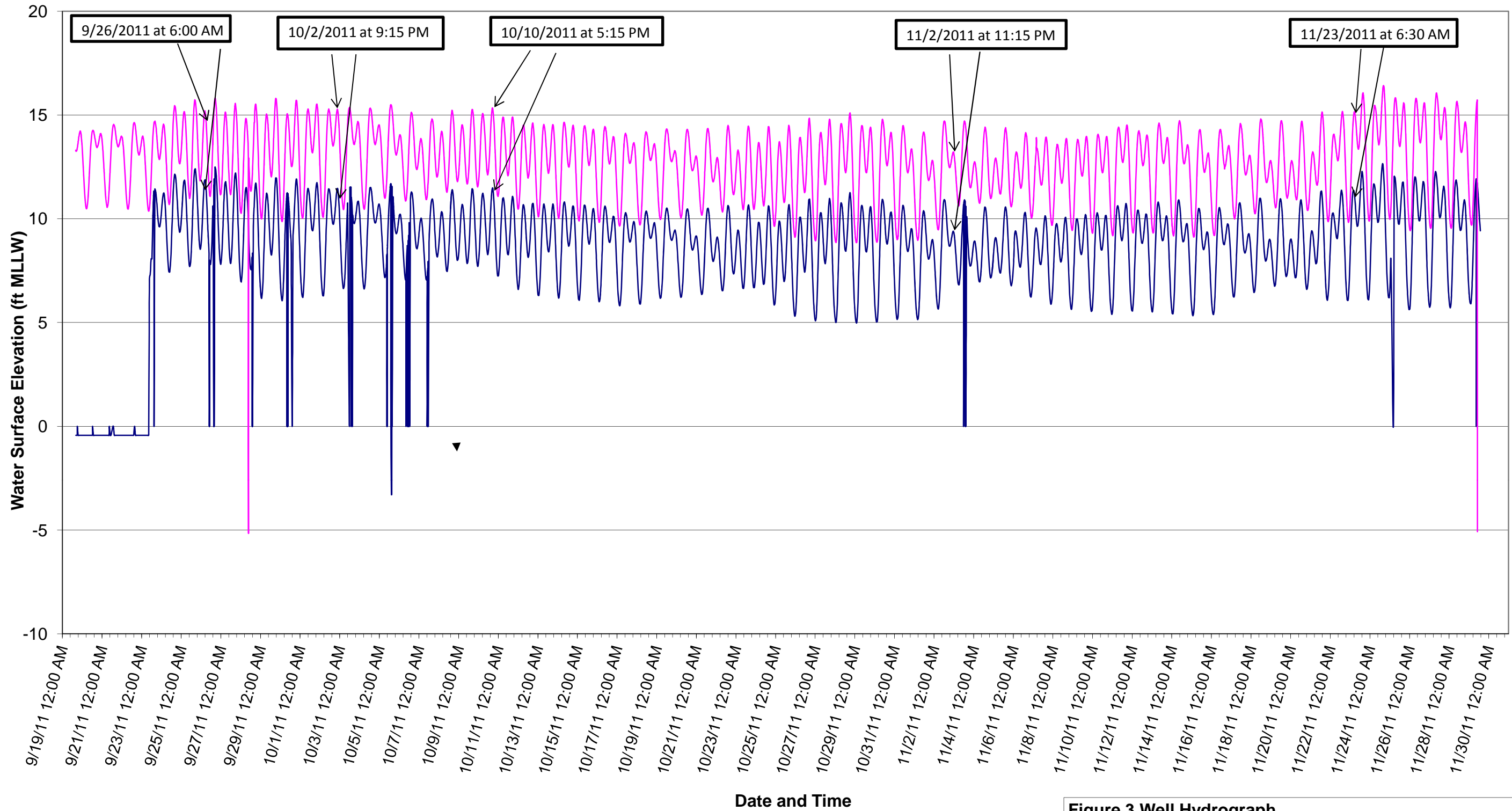
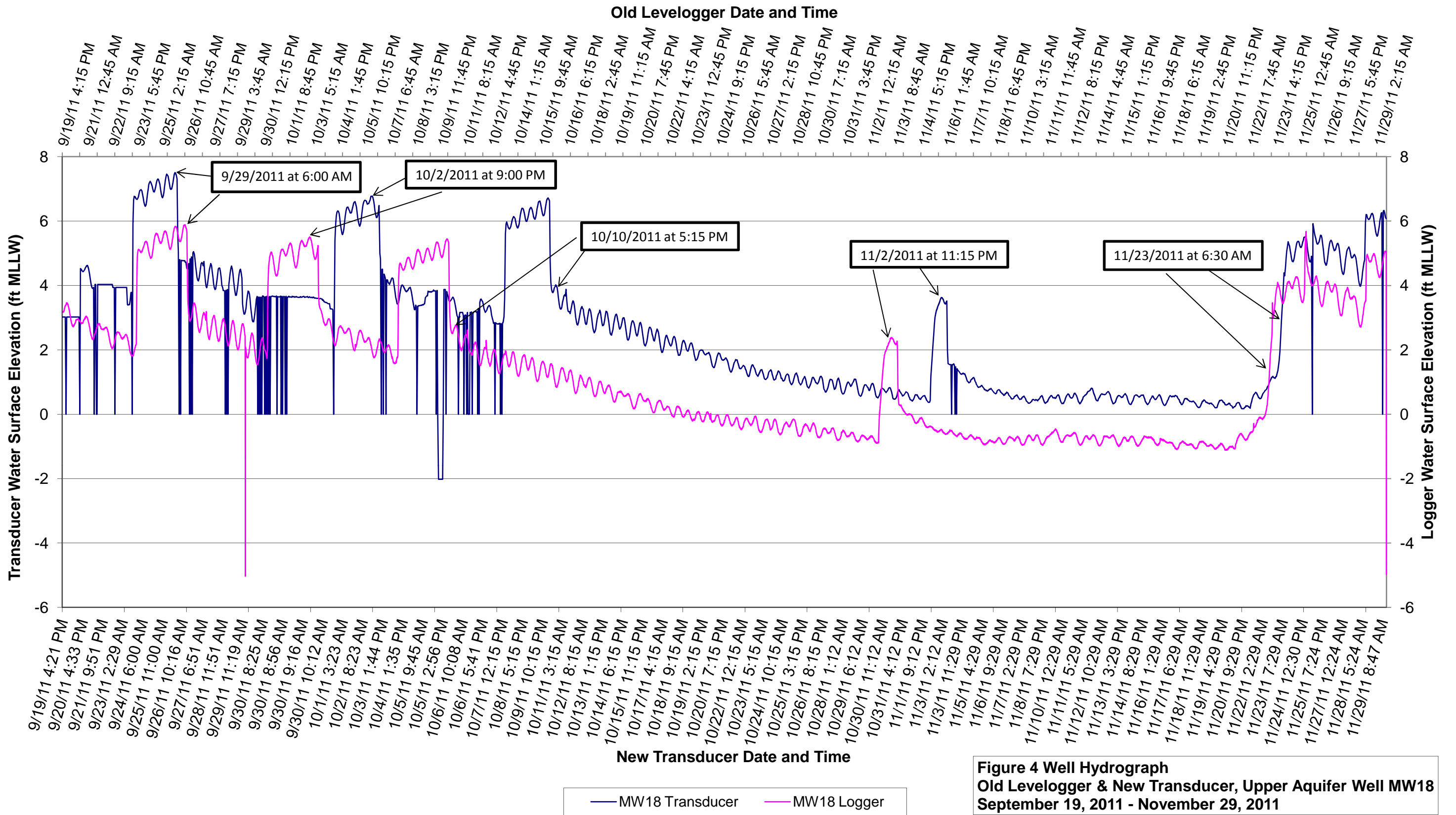


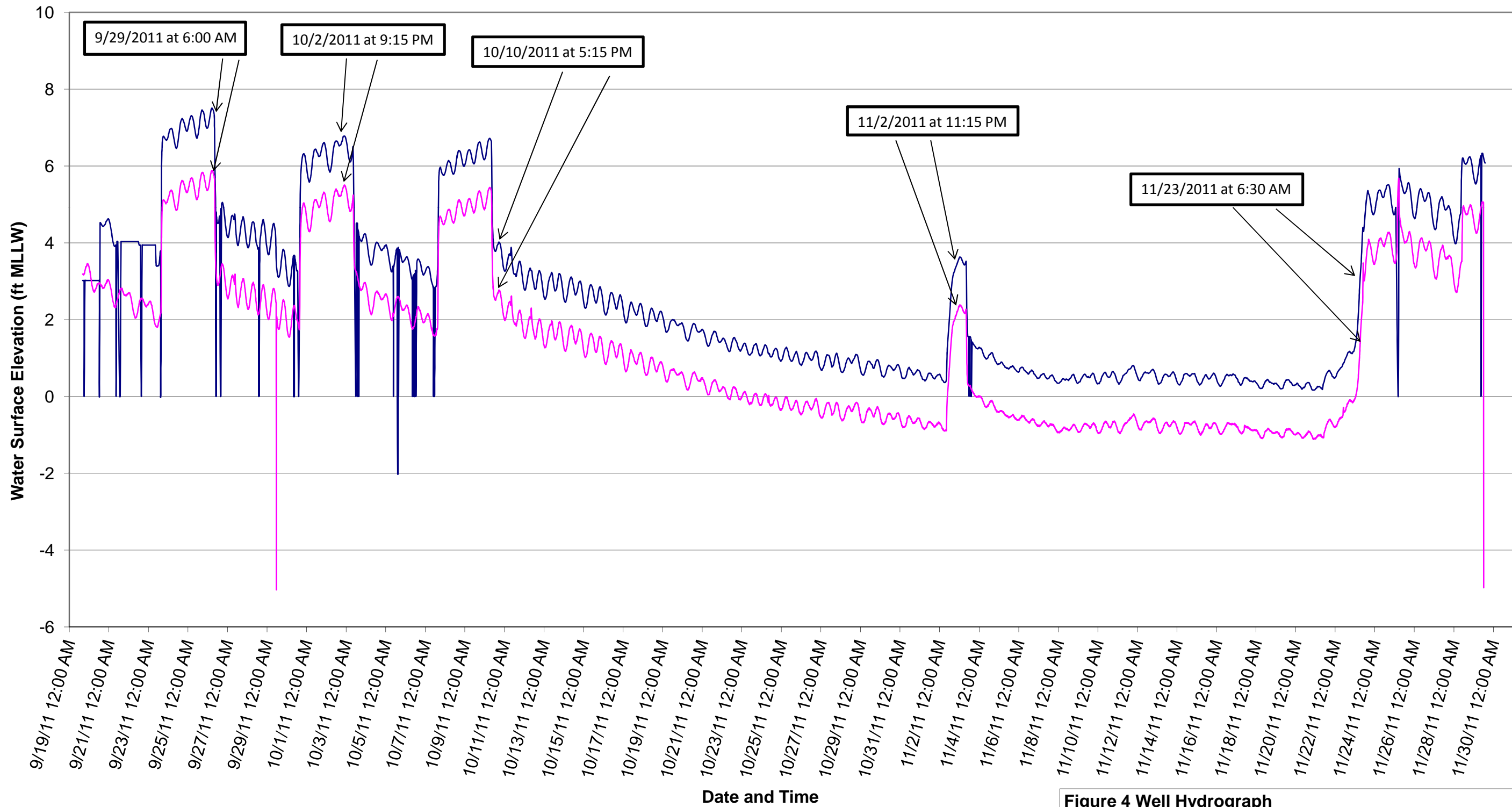
Figure 3 Well Hydrograph
Old Levellogger & New Transducer, Lower Aquifer Well CW05
September 19, 2011 - November 29, 2011



— CW05 Transducer — CW05 Logger

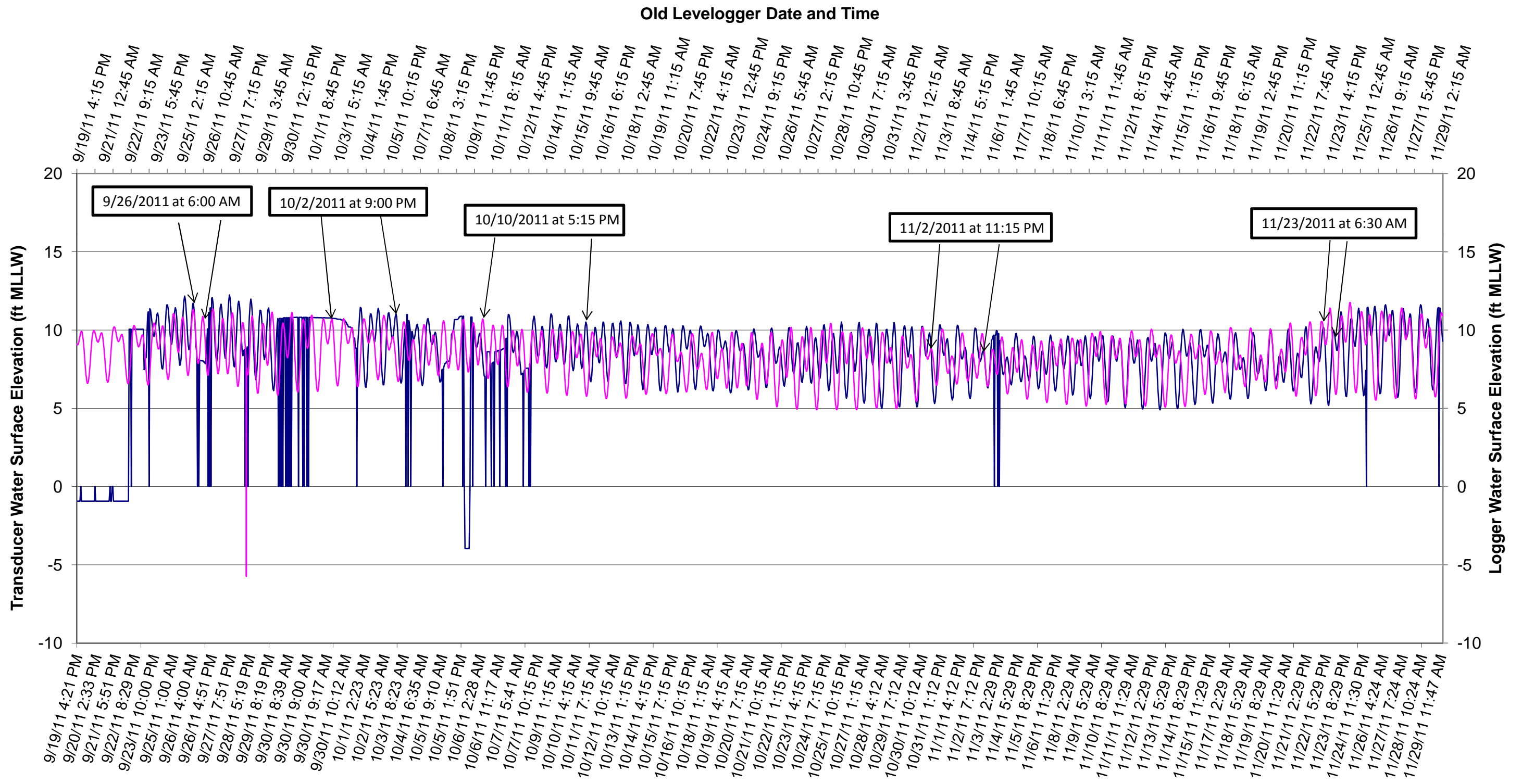
Figure 3 Well Hydrograph
Old Levelogger & New Transducer, Lower Aquifer Well CW05
September 19, 2011 - November 29, 2011





— MW18 Transducer — MW18 Logger

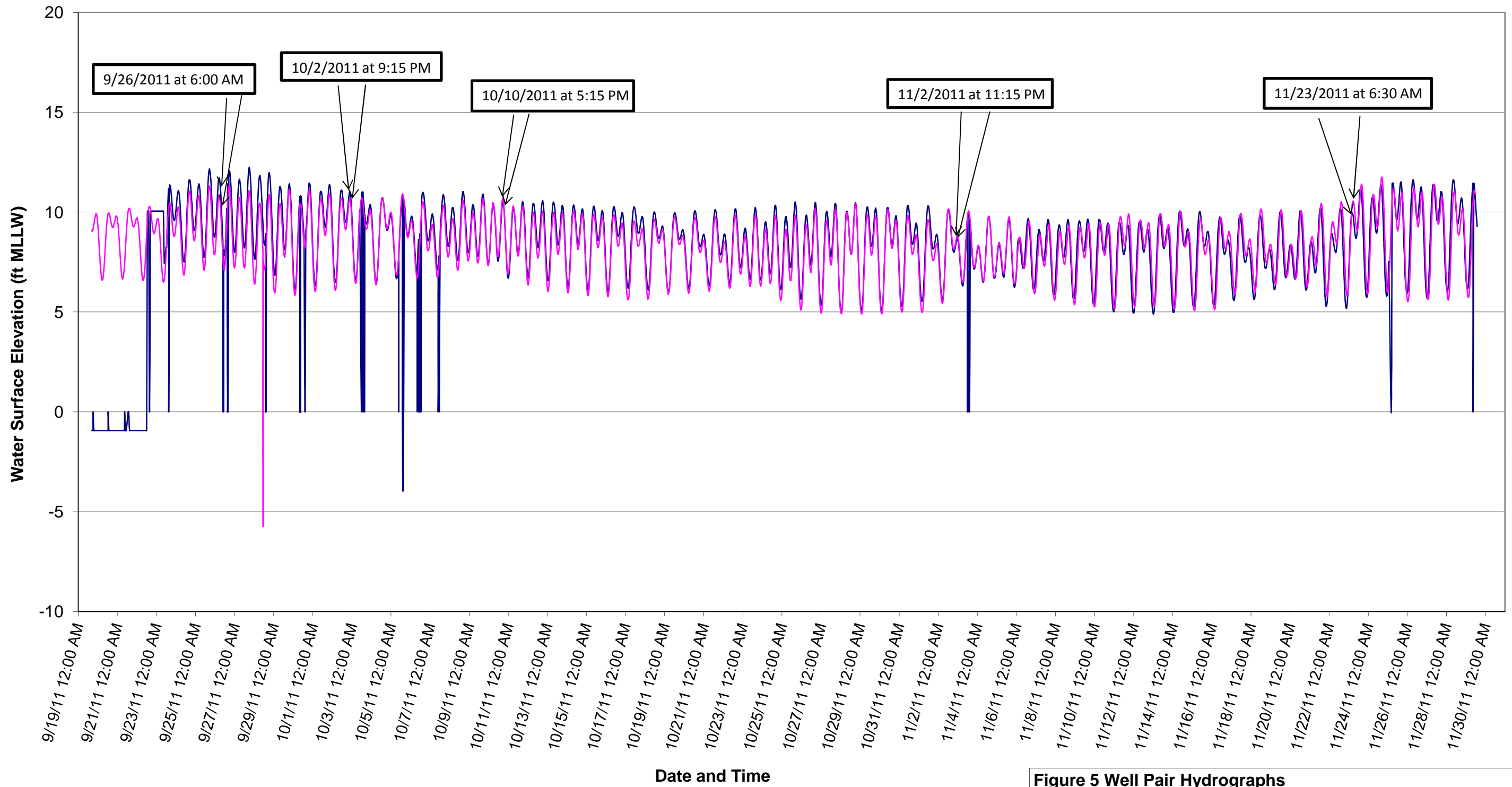
Figure 4 Well Hydrograph
Old Levellogger & New Transducer, Upper Aquifer Well MW18
September 19, 2011 - November 29, 2011



New Transducer Date and Time

— CDMW01 Transducer — CDMW01 Logger

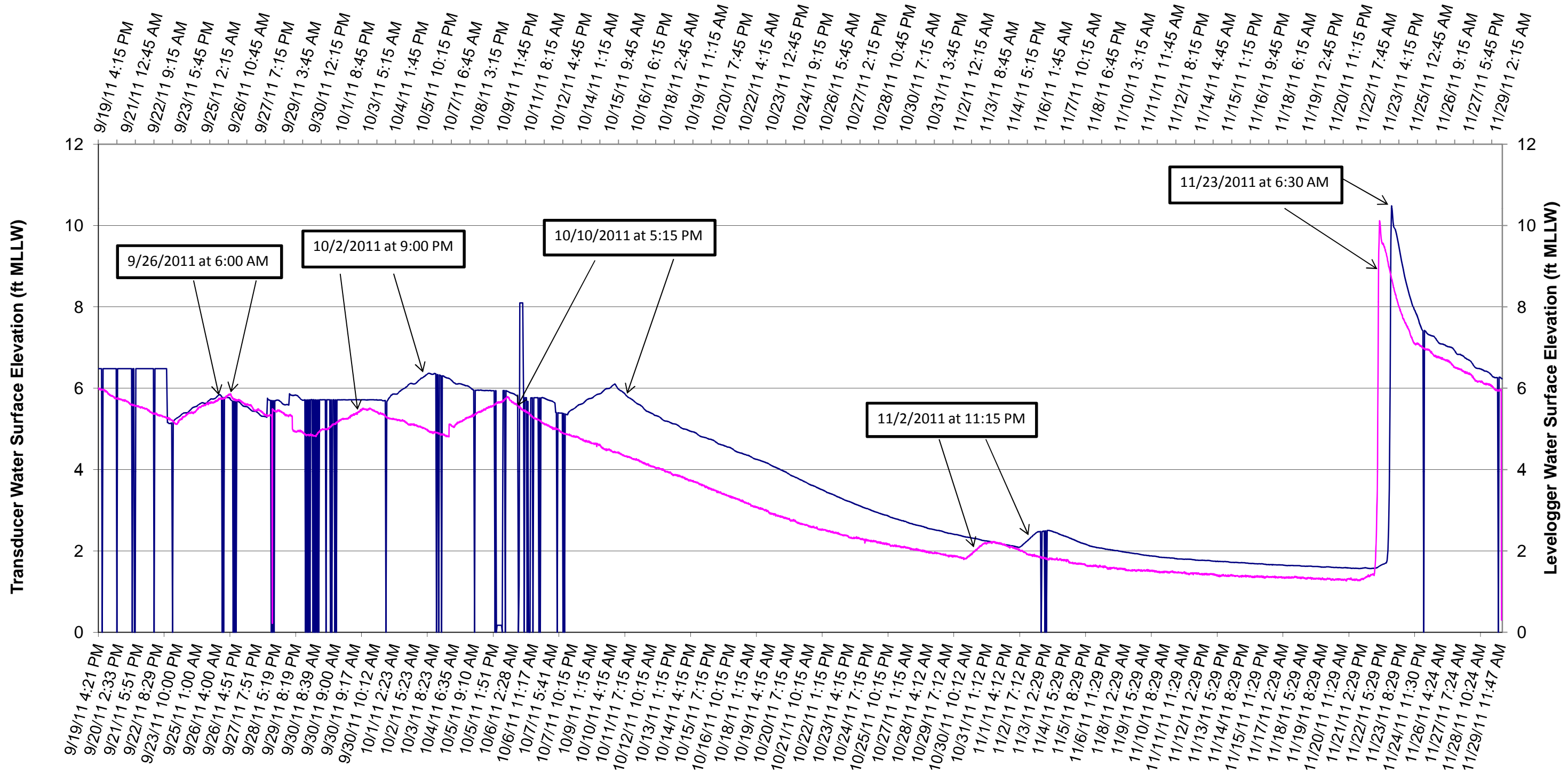
Figure 5 Well Pair Hydrographs
Old Levelogger & New Transducer, Lower Aquifer Well CDMW01
September 19, 2011 - November 29, 2011



— CDMW01 Transducer — CDMW01 Logger

Figure 5 Well Pair Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well CDMW01
September 19, 2011 - November 29, 2011

Old Levellogger Date and Time



New Transducer Date and Time

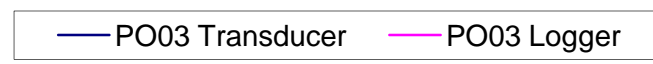


Figure 6 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well PO03
September 19, 2011 - November 29, 2011

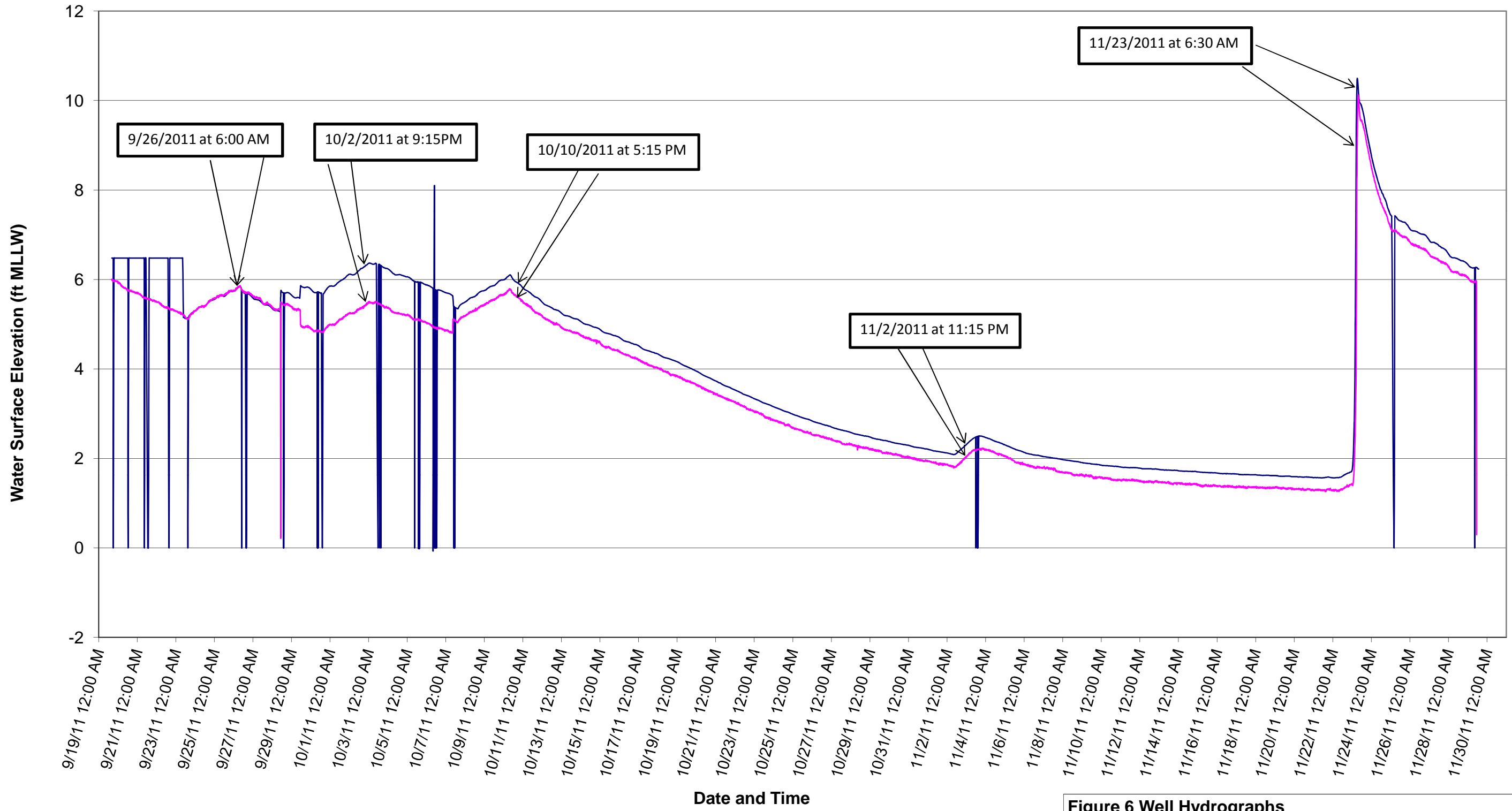
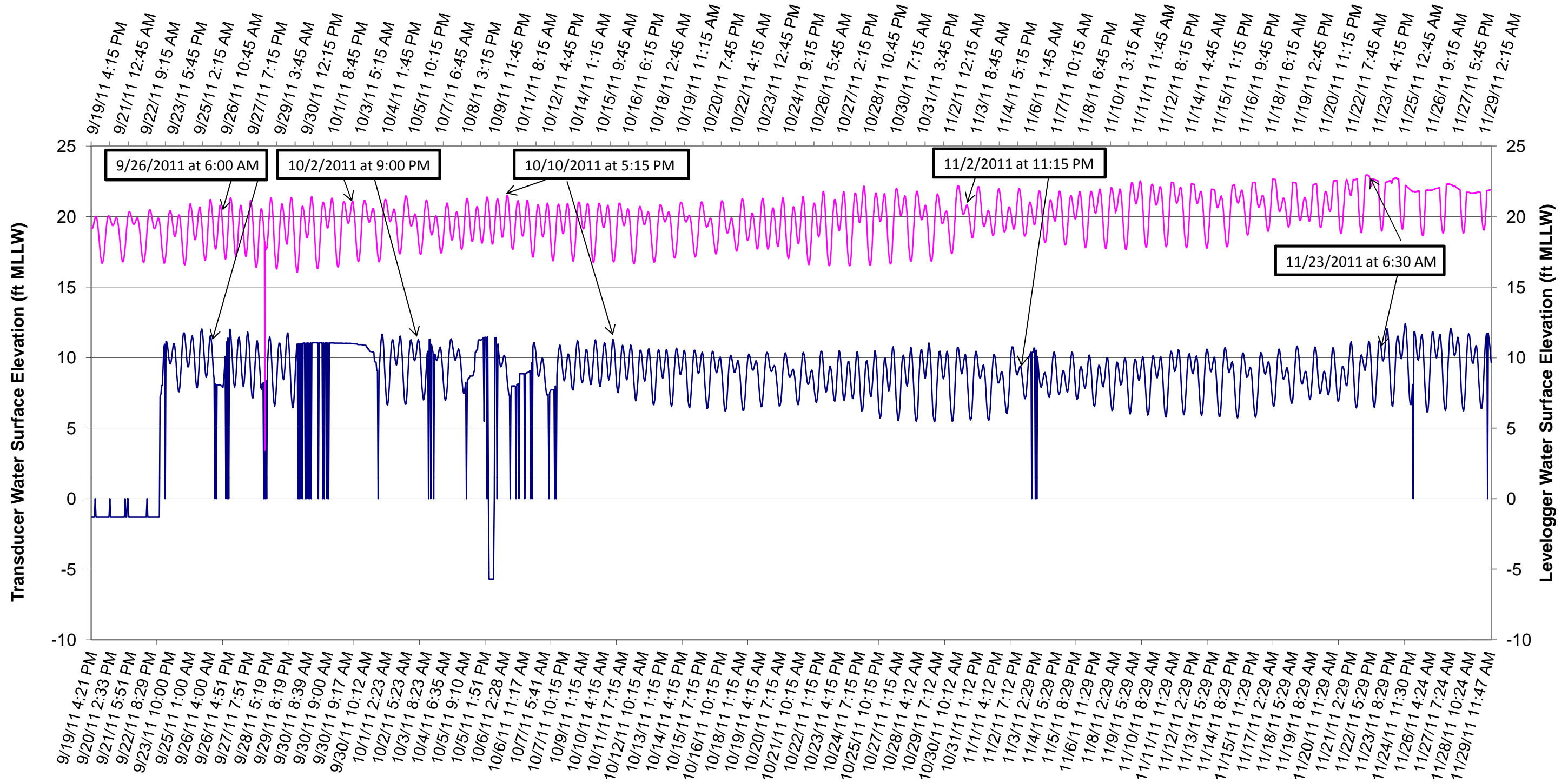


Figure 6 Well Hydrographs
Old Levelogger & New Transducer, Upper Aquifer Well PO03
September 19, 2011 - November 29, 2011

— PO03 Transducer — PO03 Logger

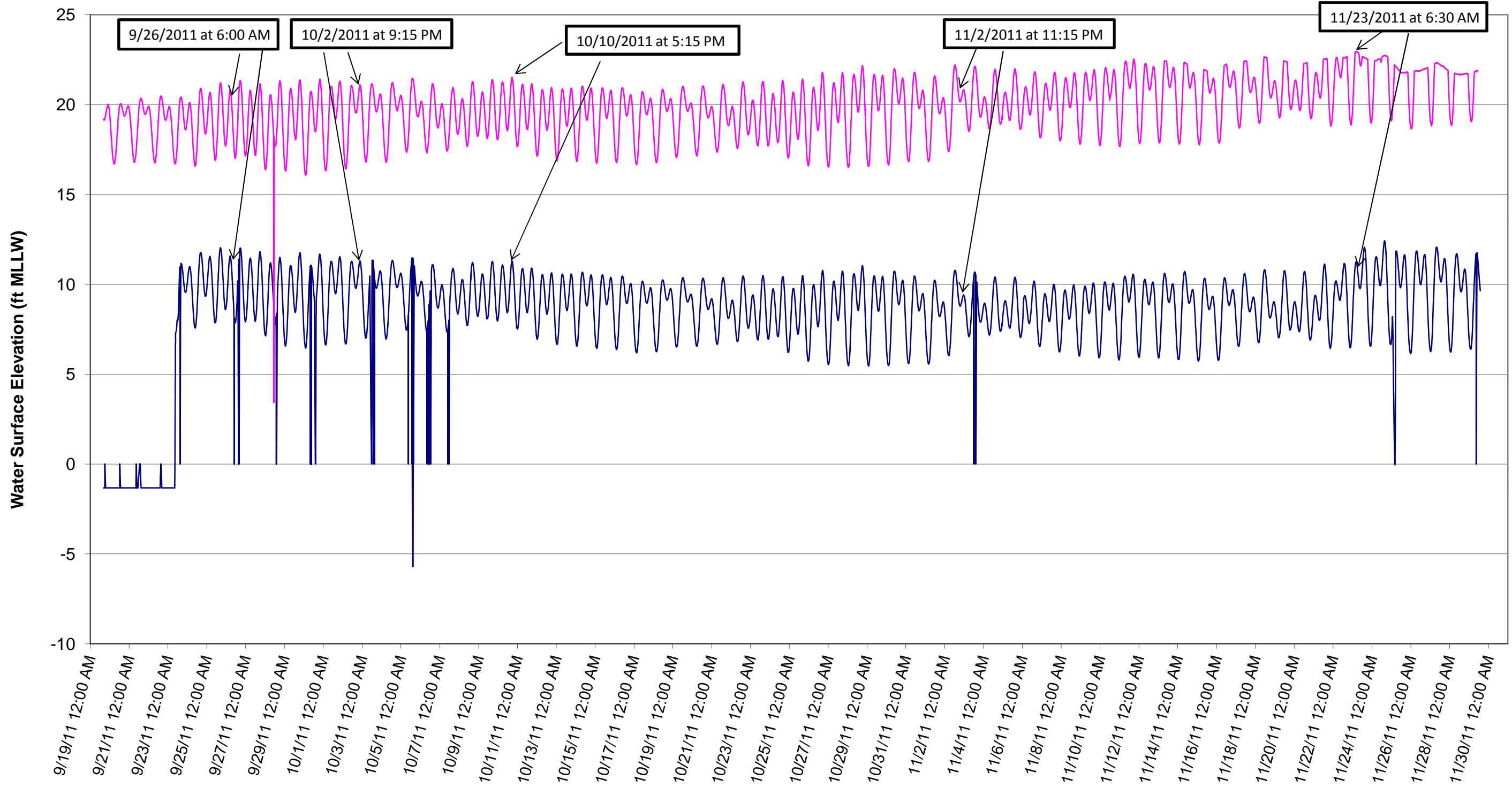
Old Levellogger Date and Time



New Transducer Date and Time

— CDMW02 Transducer — CDMW02 Logger

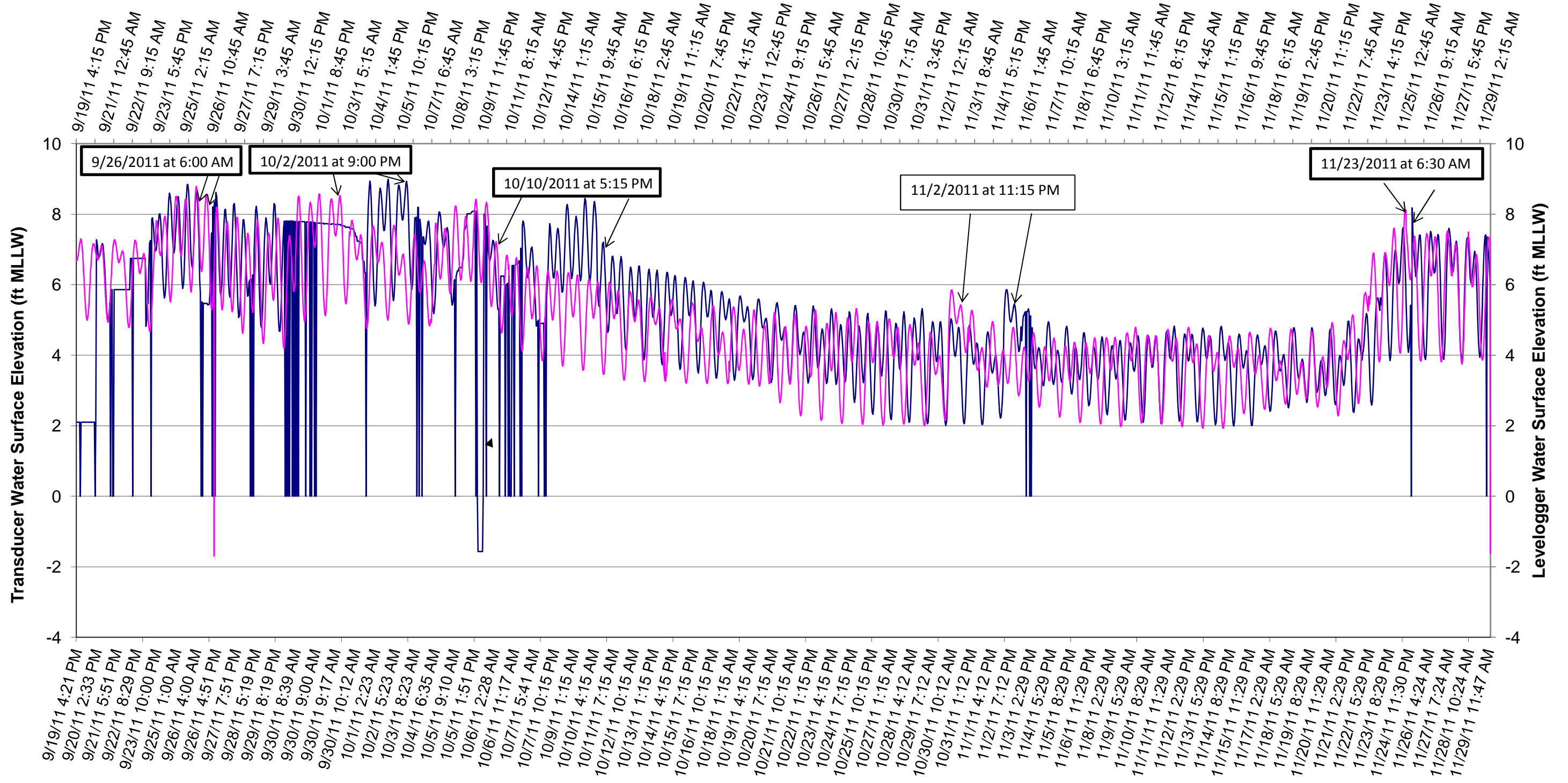
Figure 7 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well CDMW02
September 19, 2011 - November 29, 2011



— CDMW02 Transducer — CDMW02 Logger

Figure 7 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well CDMW02
September 19, 2011 - November 29, 2011

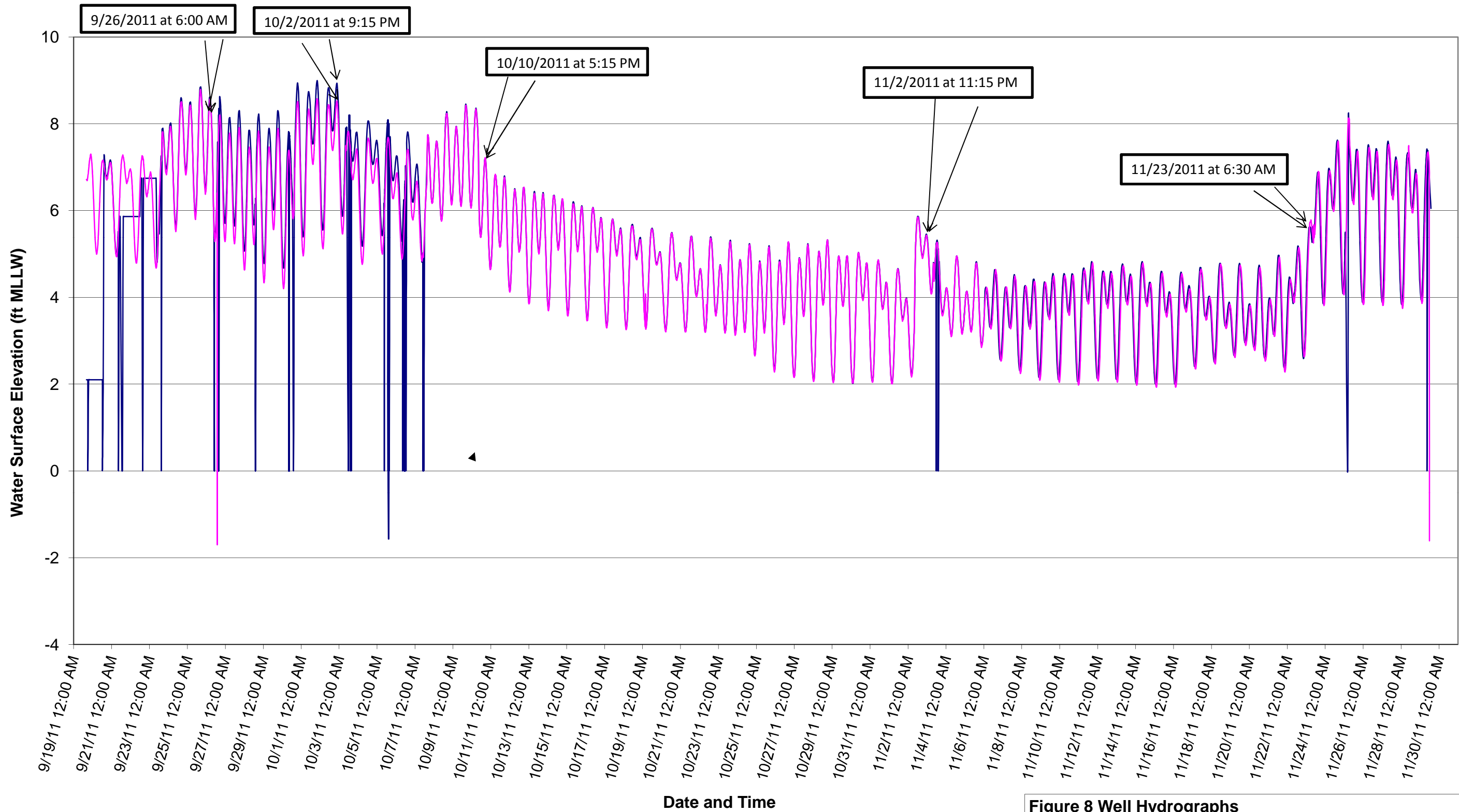
Old Levellogger Date and Time



New Transducer Date and Time

— CW03 Transducer — CW03 Logger

Figure 8 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well CW03
September 19, 2011 - November 29, 2011

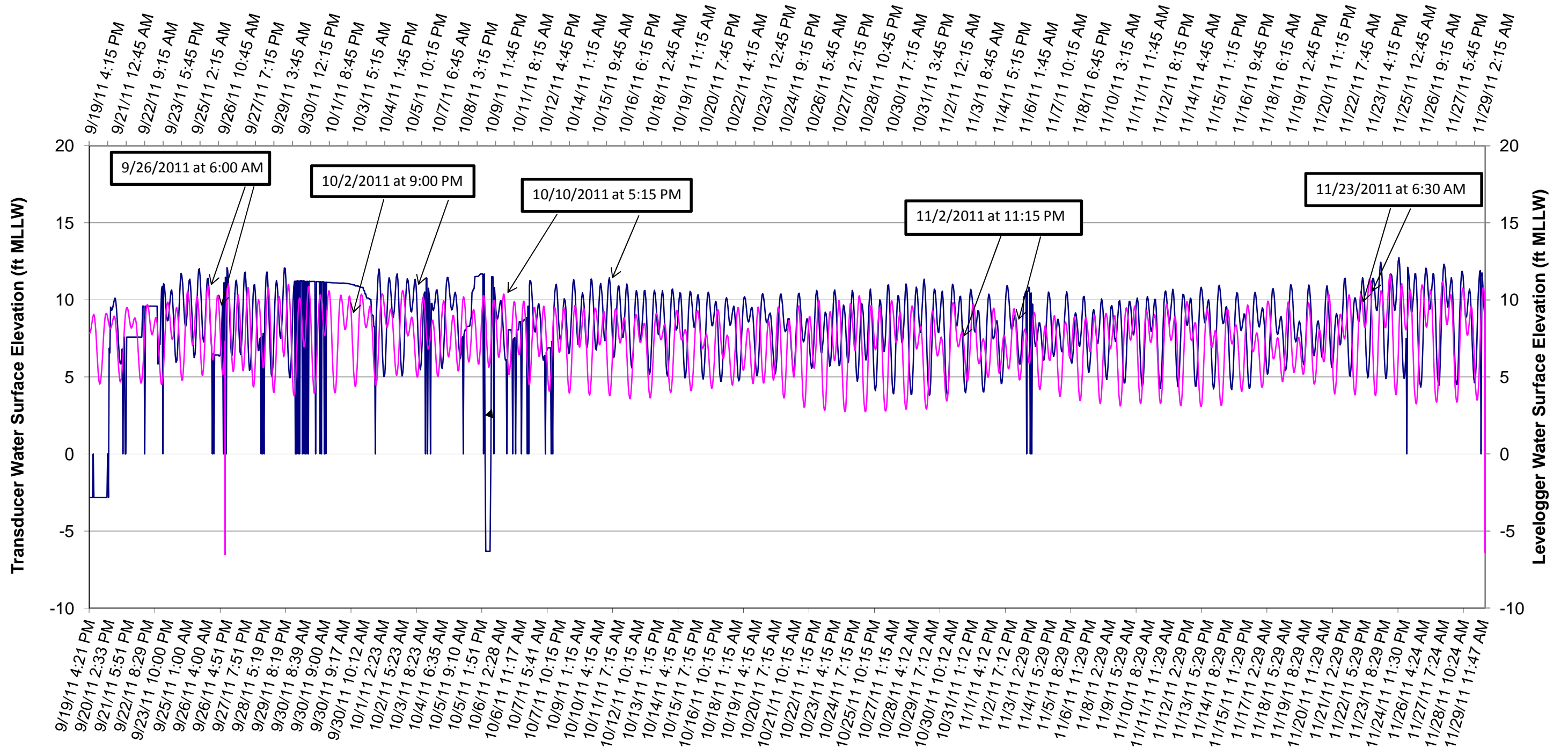


Date and Time

— CW03 Transducer — CW03 Logger

Figure 8 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well CW03
September 19, 2011 - November 29, 2011

Old Levellogger Date and Time



New Transducer Date and Time

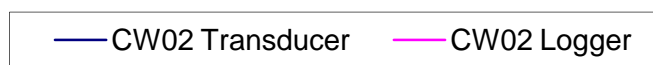


Figure 9 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well CW02
September 19, 2011 - November 29, 2011

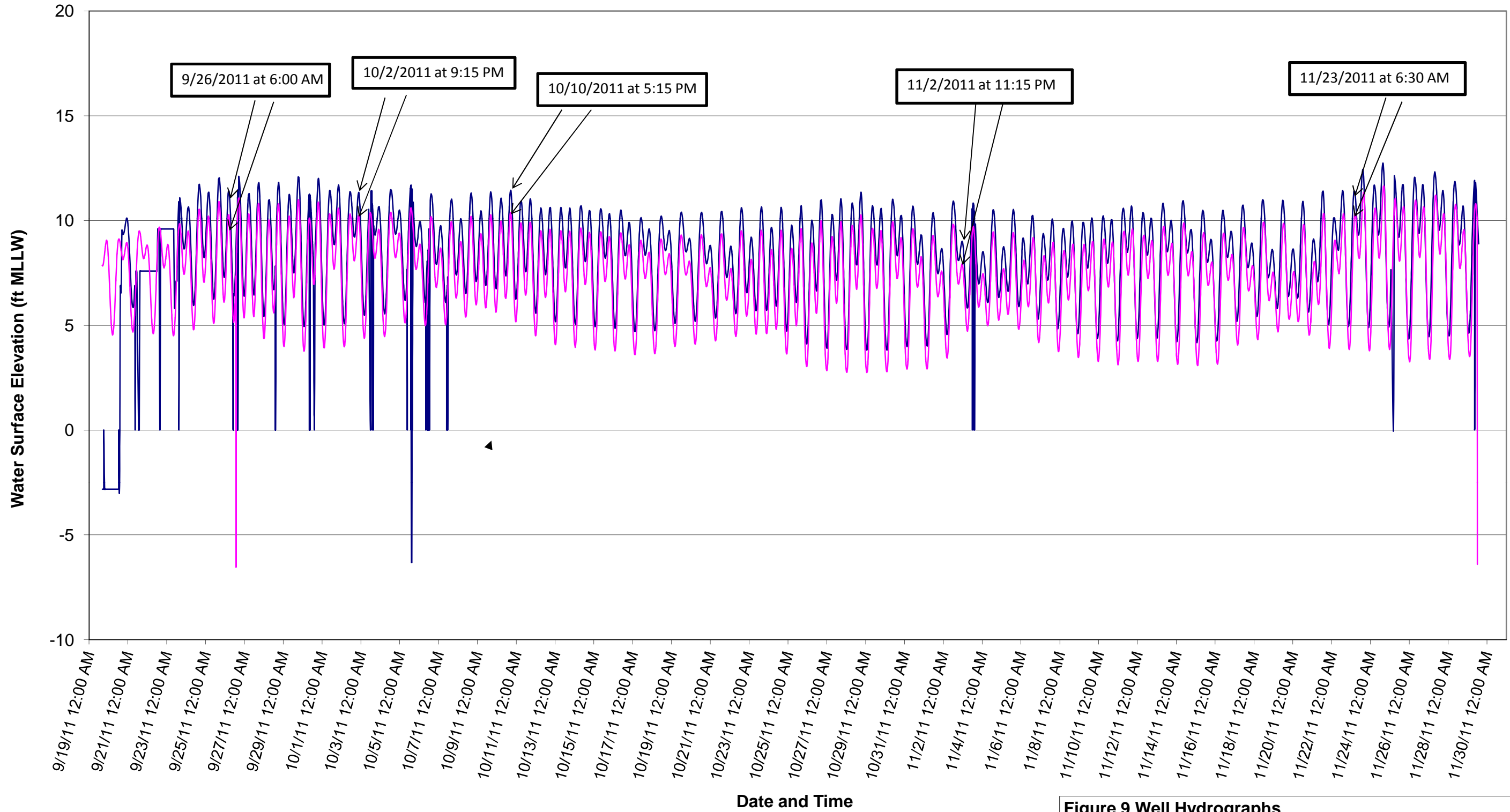
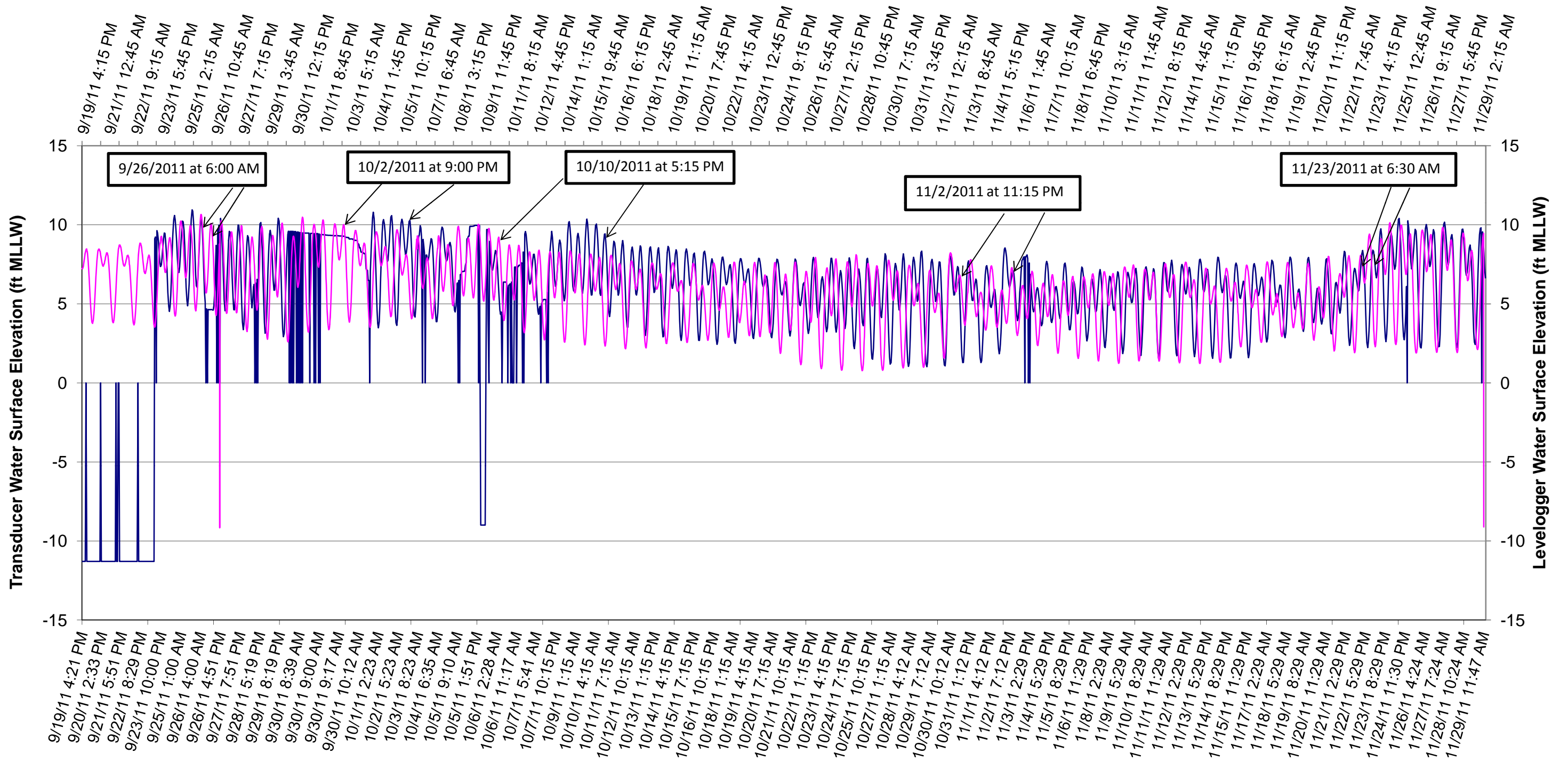


Figure 9 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well CW02
September 19, 2011 - November 29, 2011

— CW02 Transducer — CW02 Logger

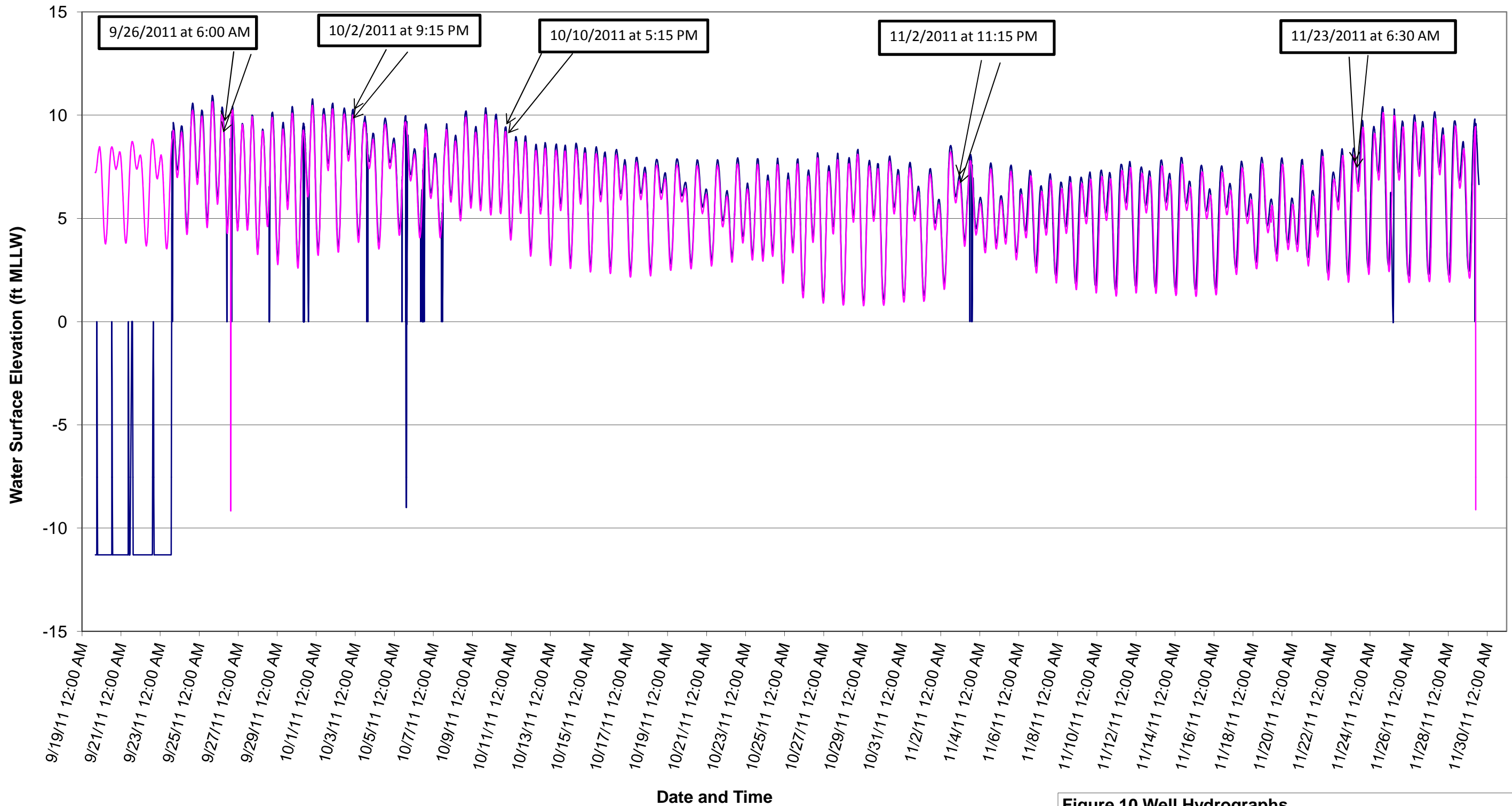
Old Levelogger Date and Time



New Transducer Date and Time

— VG2U Transducer — VG2U Logger

Figure 10 Well Hydrographs
Old Levelogger & New Transducer, Upper Aquifer Well VG2U
September 19, 2011 - November 29, 2011

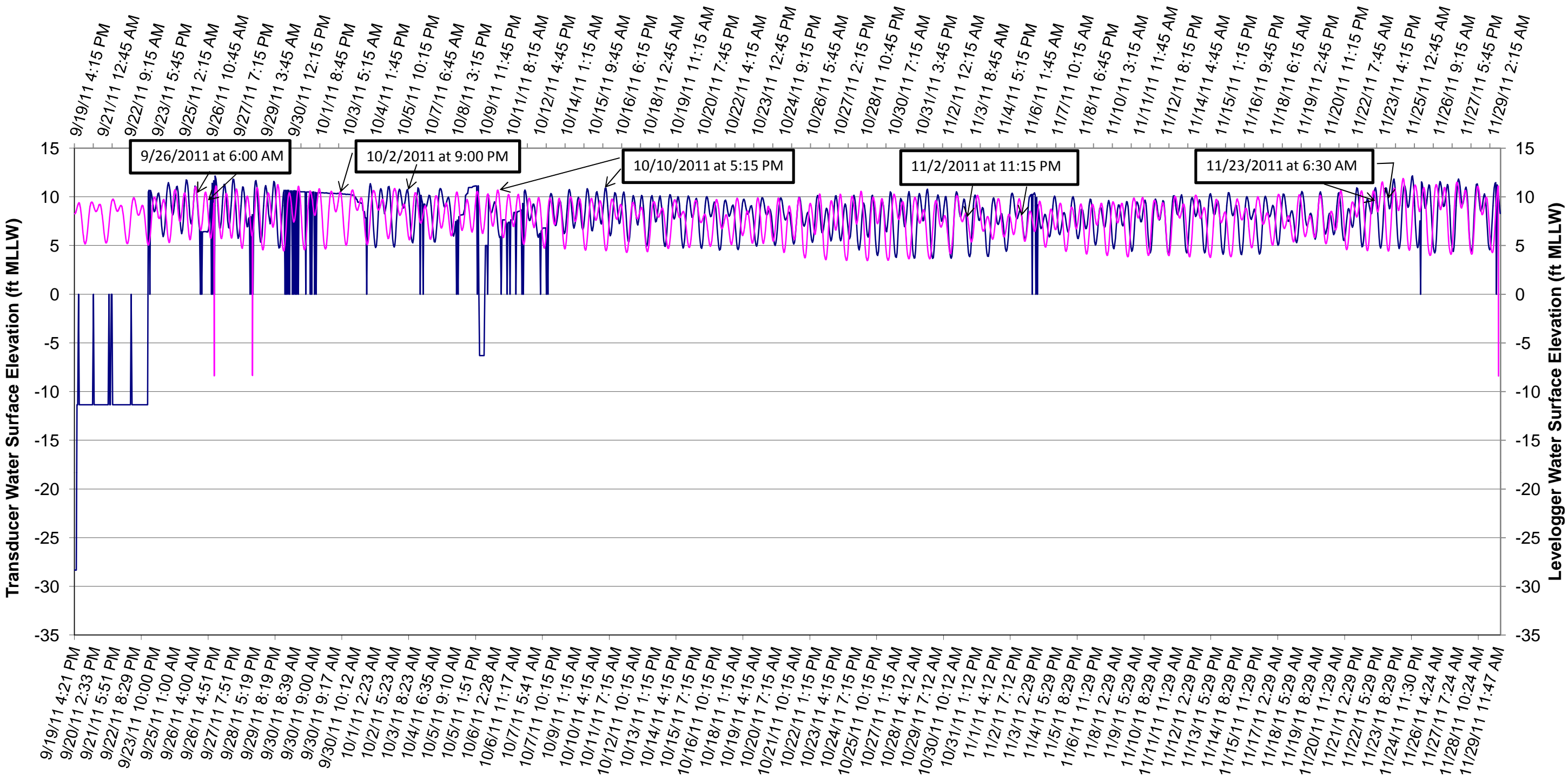


Date and Time

— VG2U Transducer — VG2U Logger

Figure 10 Well Hydrographs
Old Levelogger & New Transducer, Upper Aquifer Well VG2U
September 19, 2011 - November 29, 2011

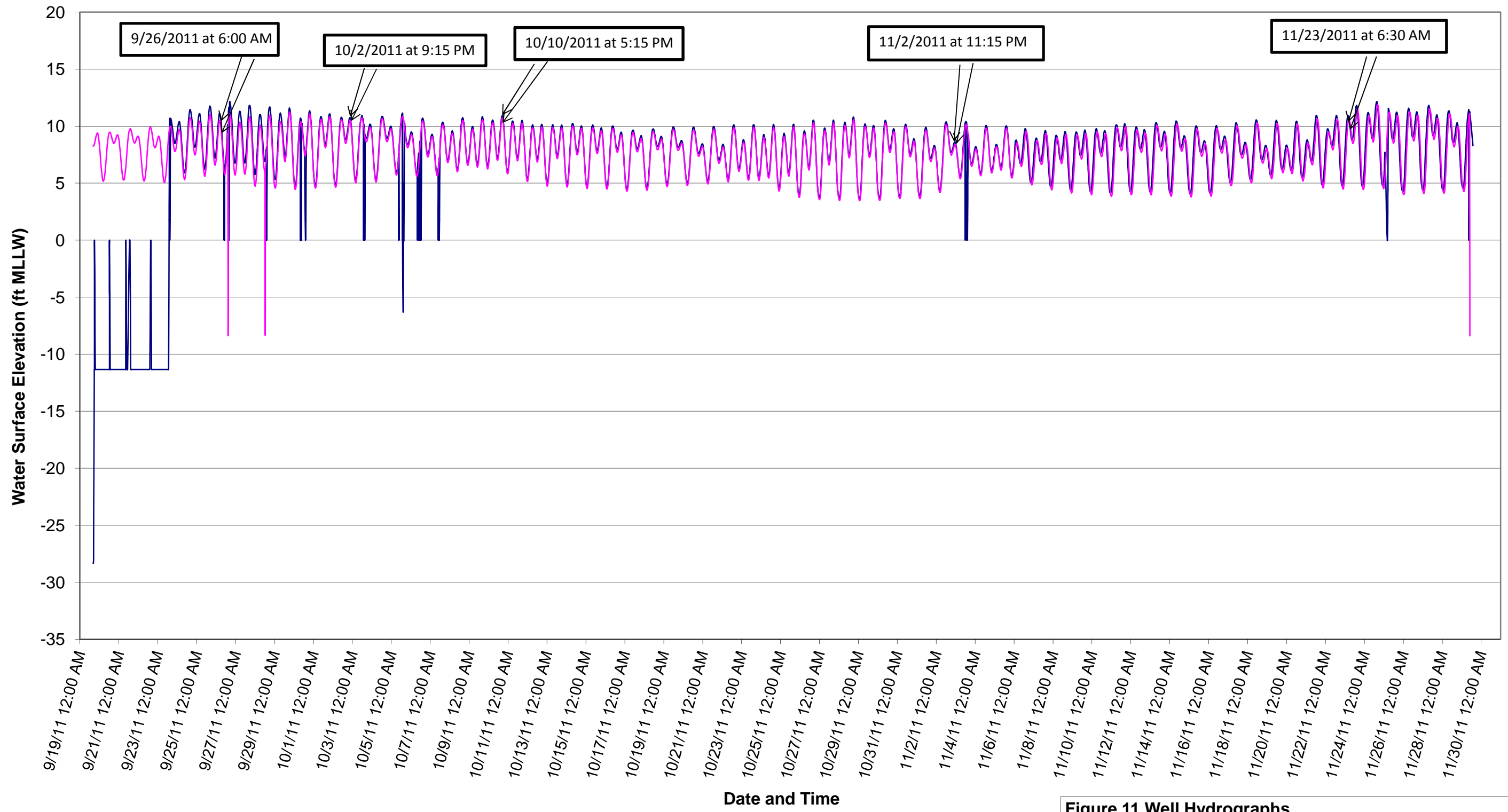
Old Levelogger Date and Time



New Transducer Date and Time



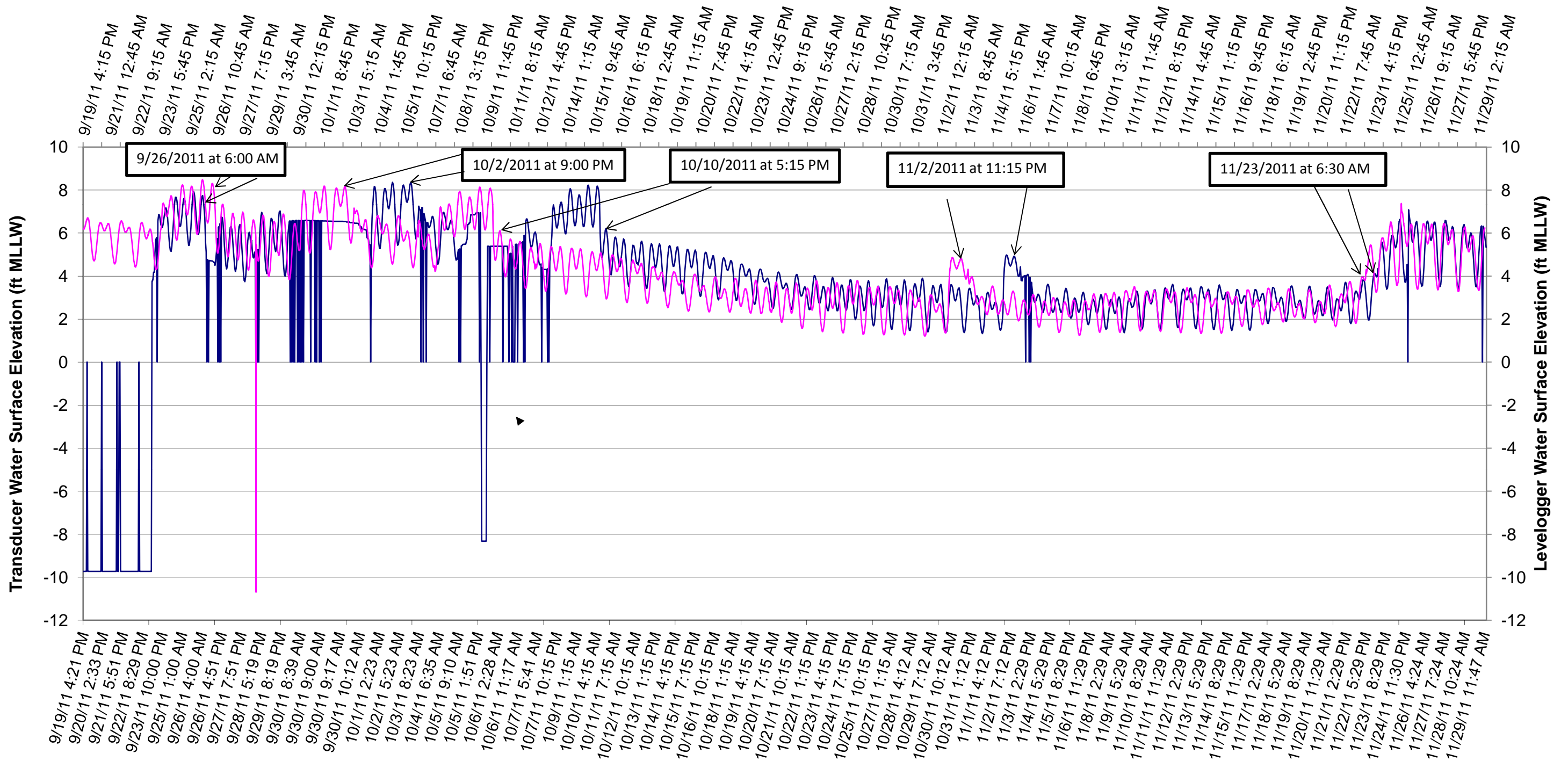
Figure 11 Well Hydrographs
Old Levelogger & New Transducer, Lower Aquifer Well VG2L
September 19, 2011 - November 29, 2011



— VG2L Transducer — VG2L Logger

Figure 11 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well VG2L
September 19, 2011 - November 29, 2011

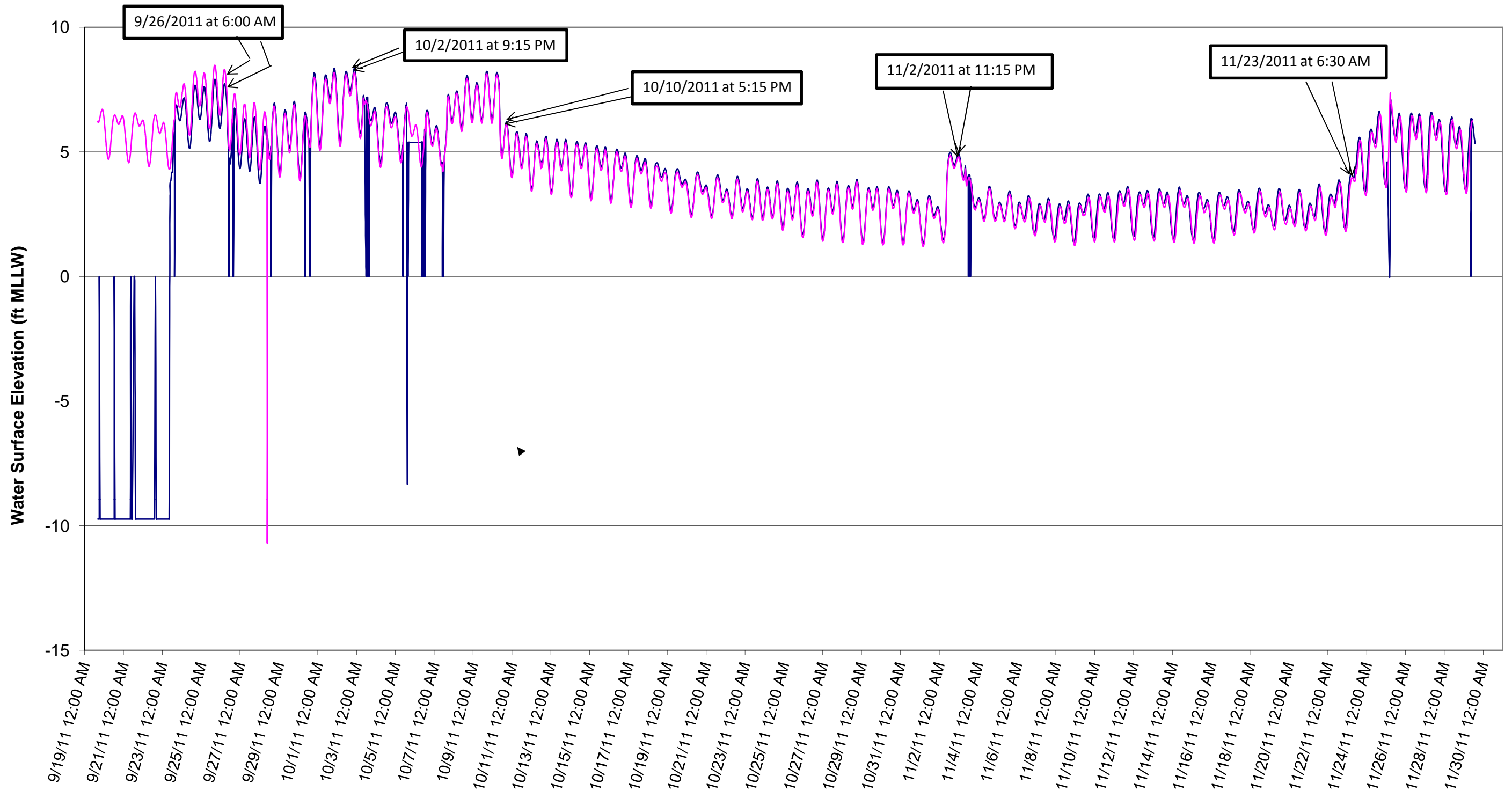
Old Levellogger Date and Time



New Transducer Date and Time



Figure 12 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well VG3U
September 19, 2011 - November 29, 2011

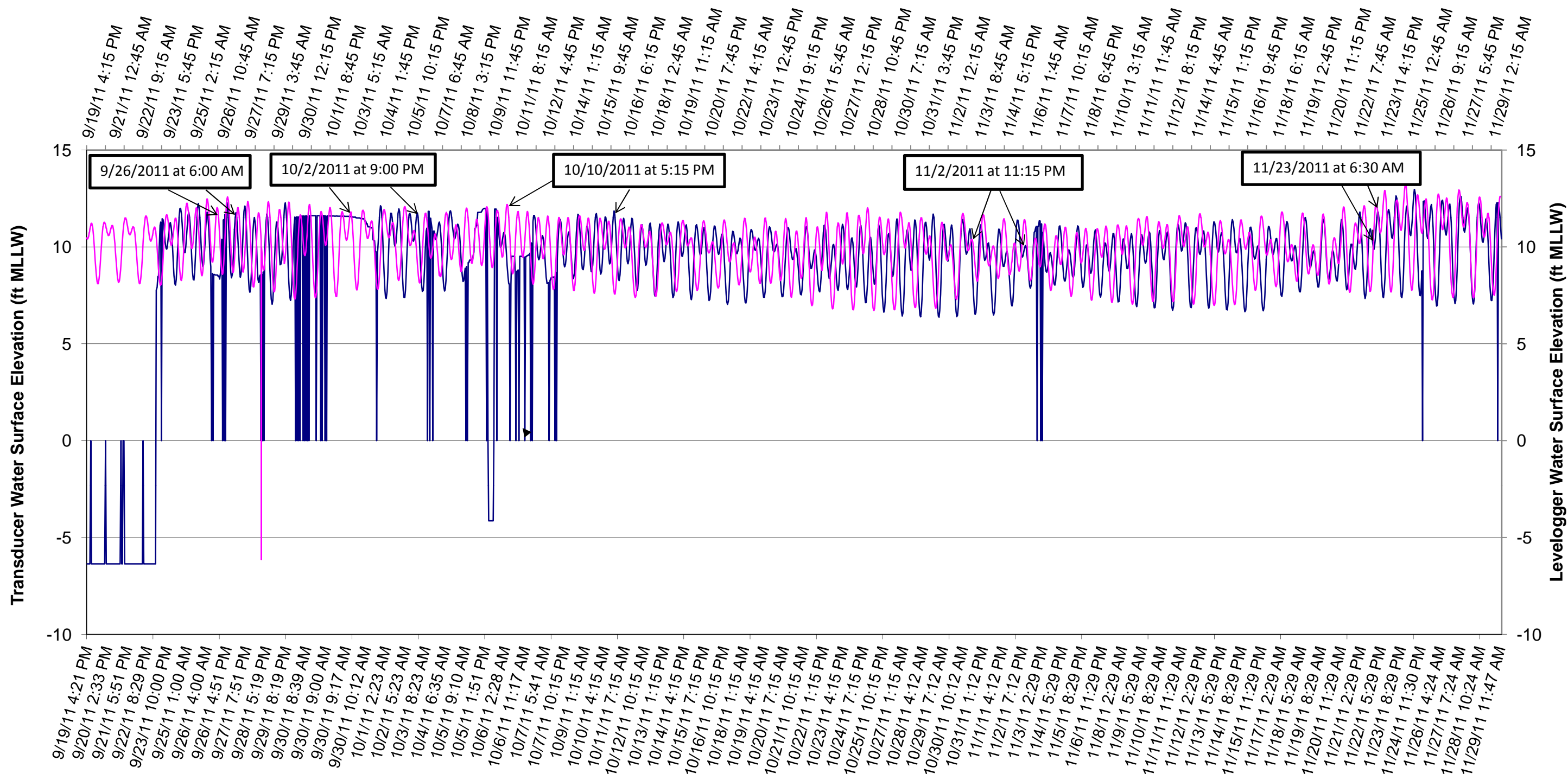


Date and Time

— VG3U Transducer — VG3U Logger

Figure 12 Well Hydrographs
Old Levelogger & New Transducer, Upper Aquifer Well VG3U
September 19, 2011 - November 29, 2011

Old Levellogger Date and Time



New Transducer Date and Time

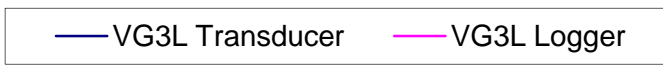
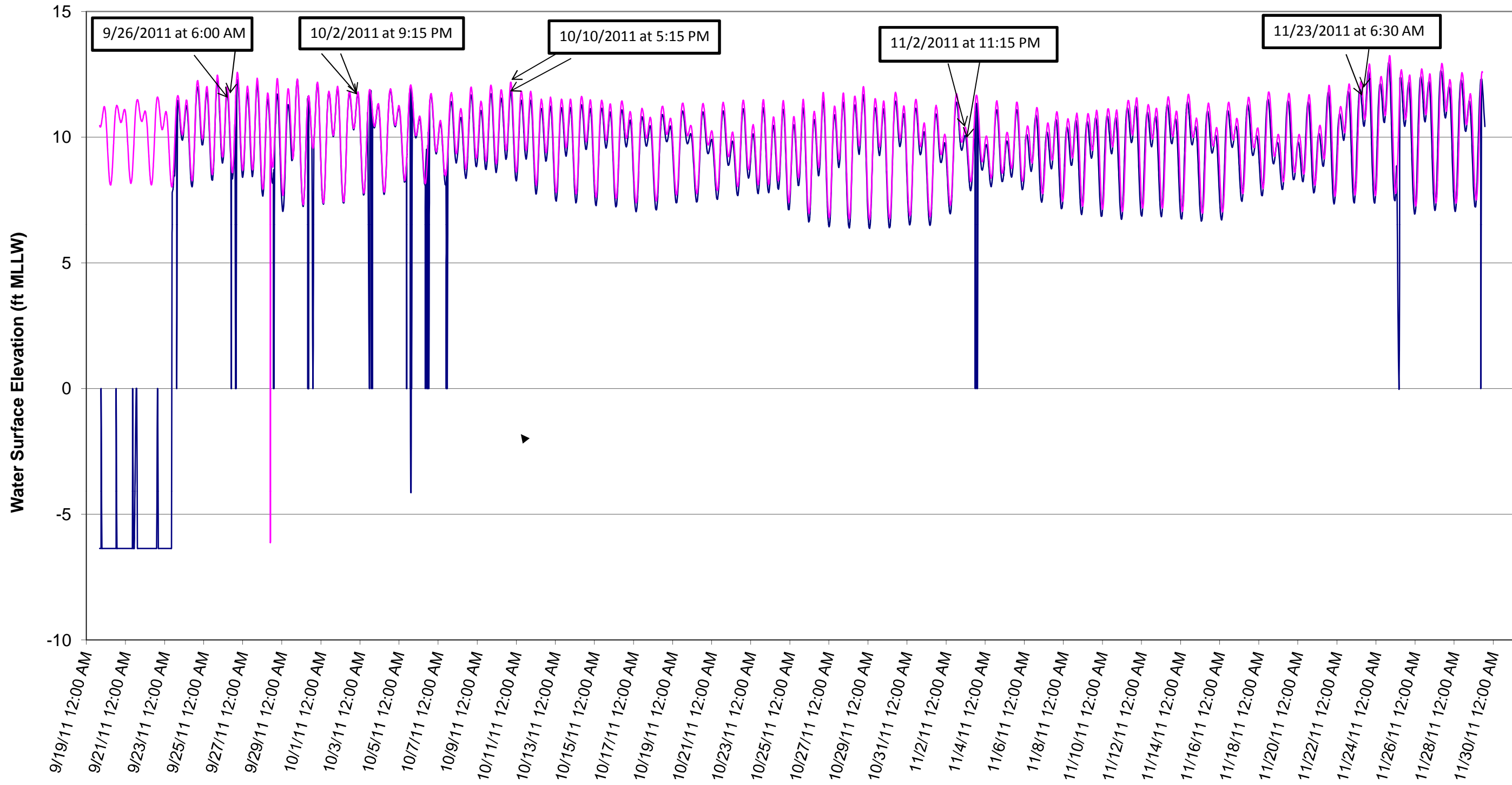


Figure 13 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well VG3L
September 19, 2011 - November 29, 2011

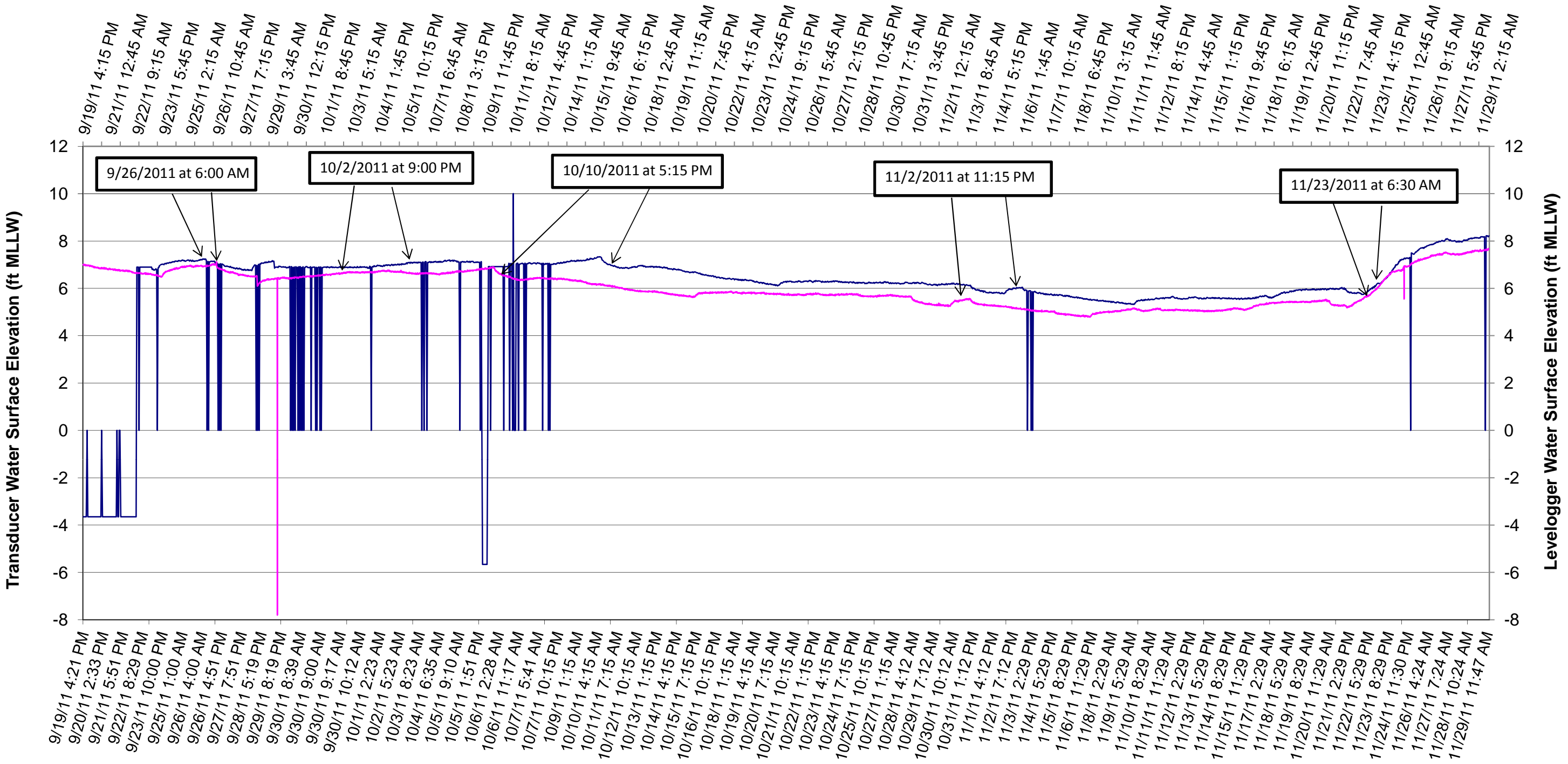


Date and Time

— VG3L Transducer — VG3L Logger

Figure 13 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well VG3L
September 19, 2011 - November 29, 2011

Old Levellogger Date and Time



New Transducer Date and Time

— VG5U Transducer — VG5U Logger

Figure 14 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well VG5U
September 19, 2011 - November 29, 2011

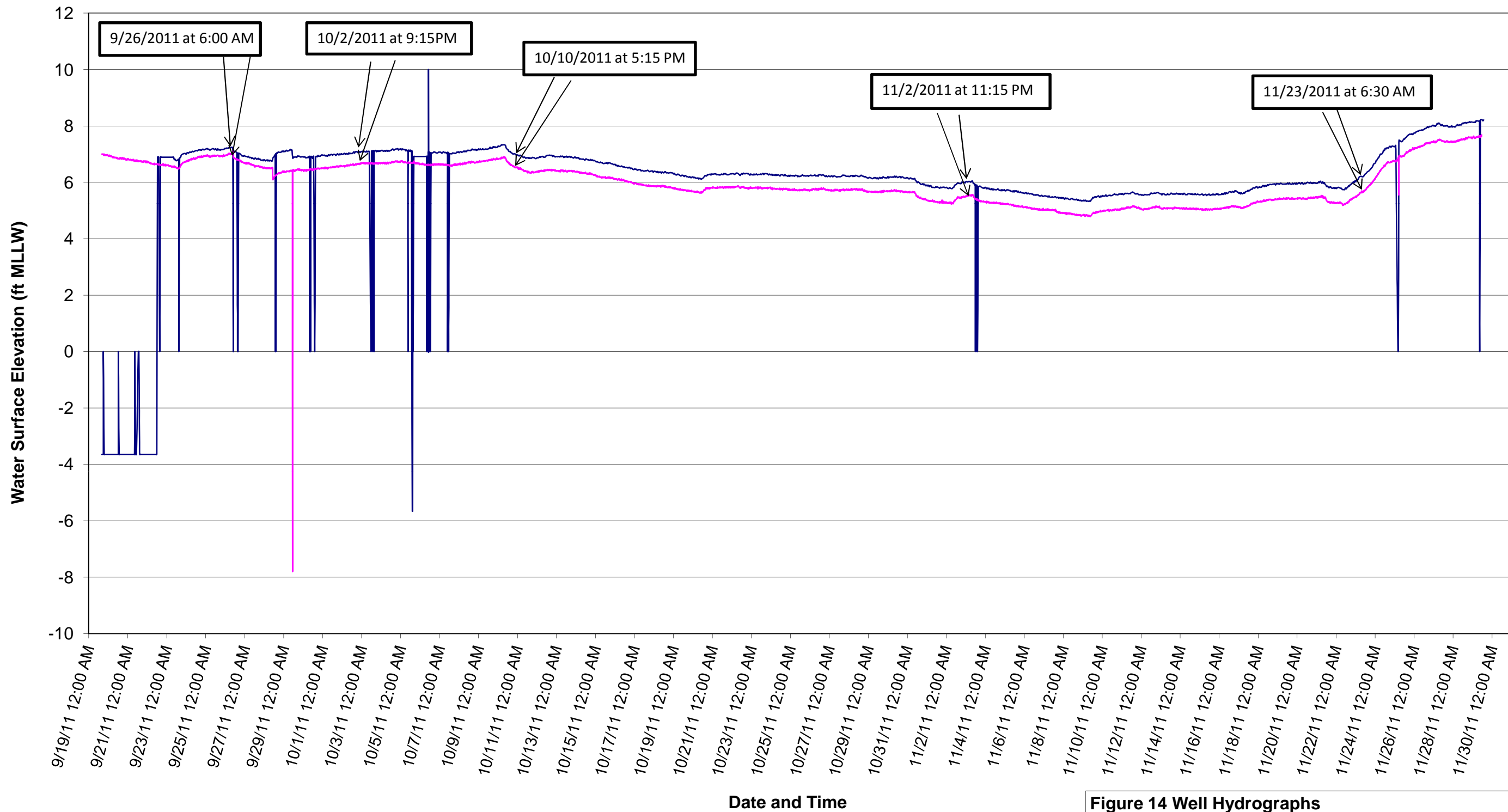
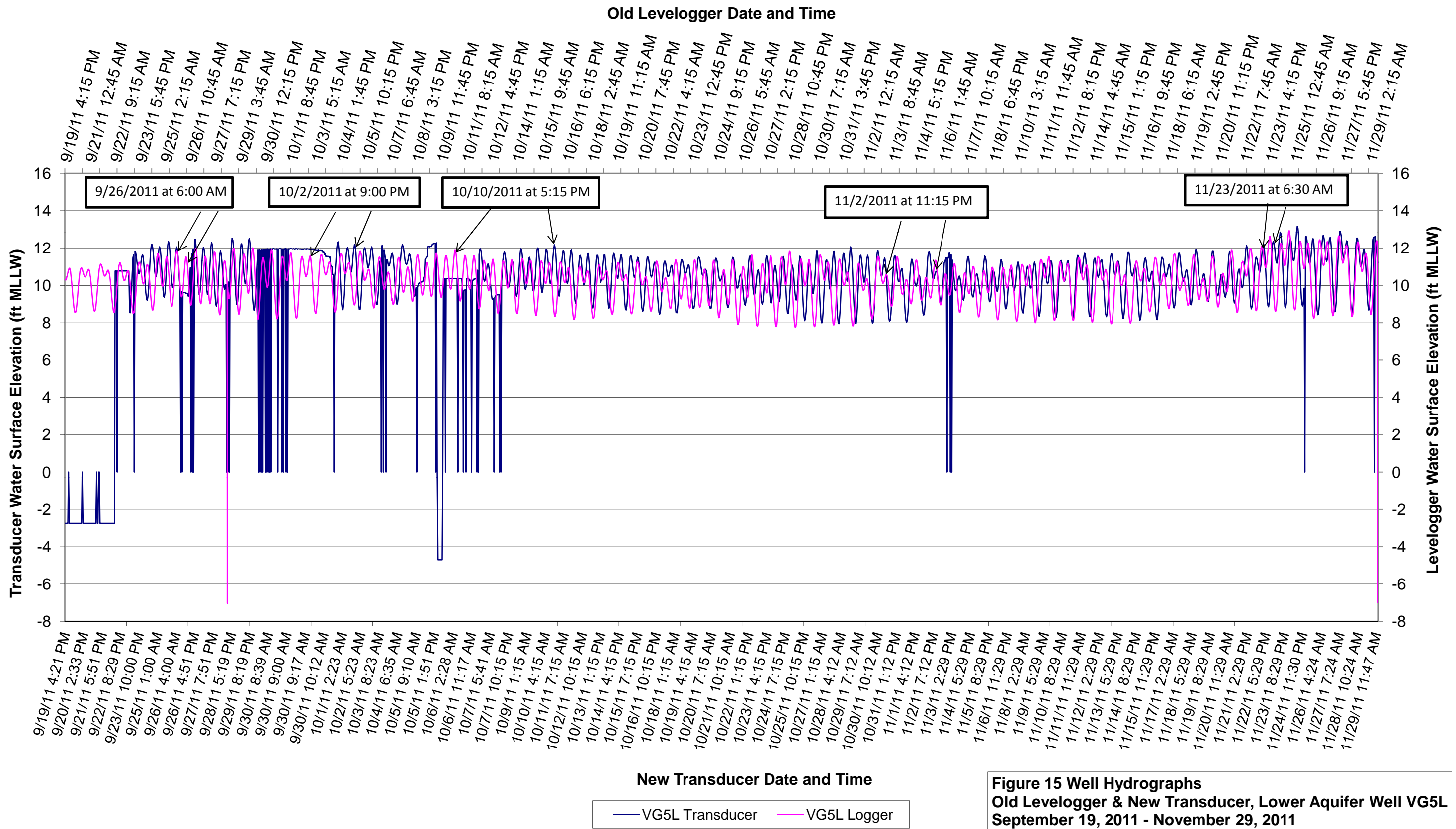
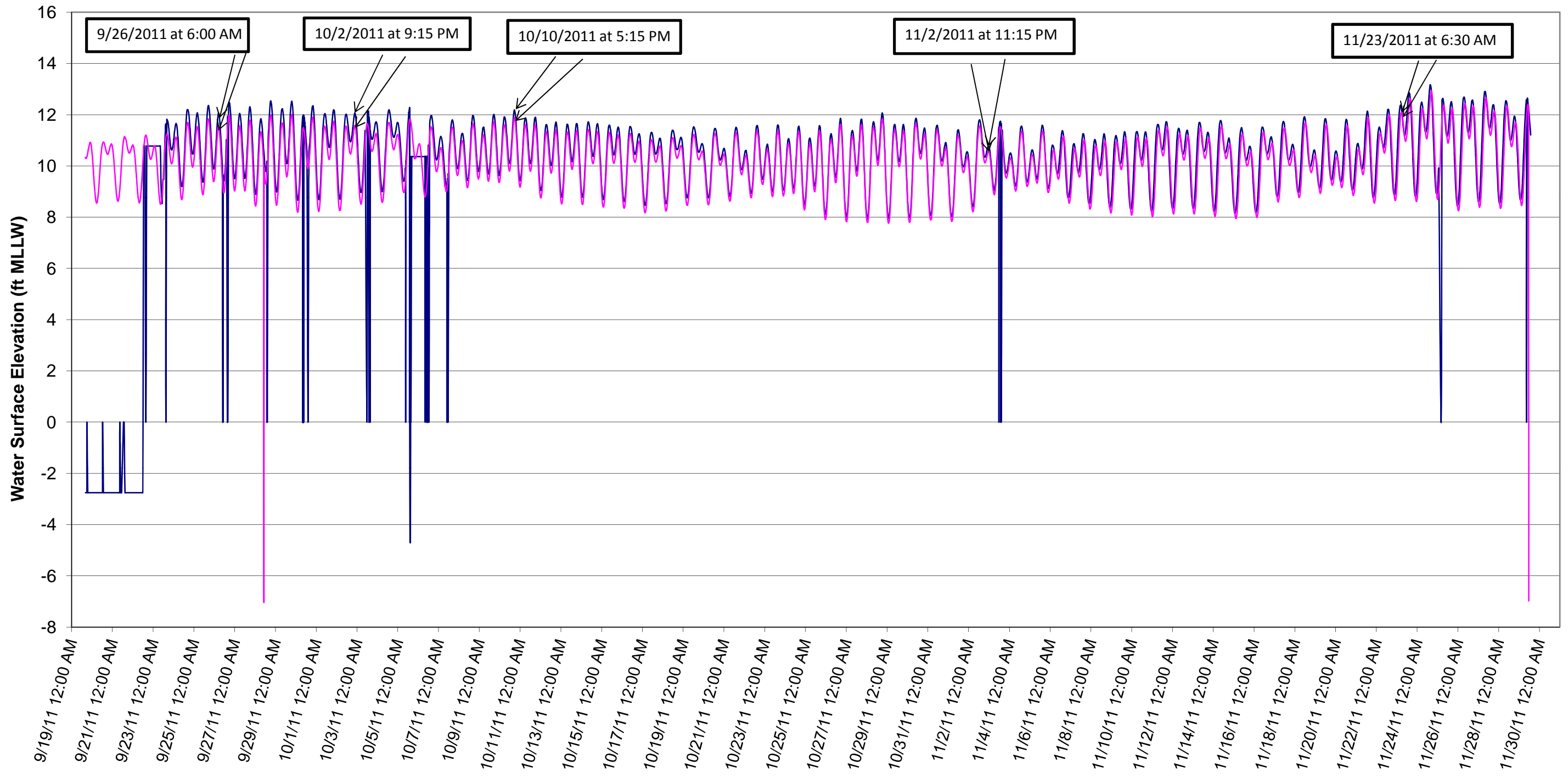


Figure 14 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well VG5U
September 19, 2011 - November 29, 2011





Date and Time

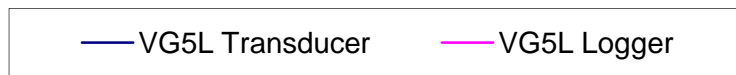
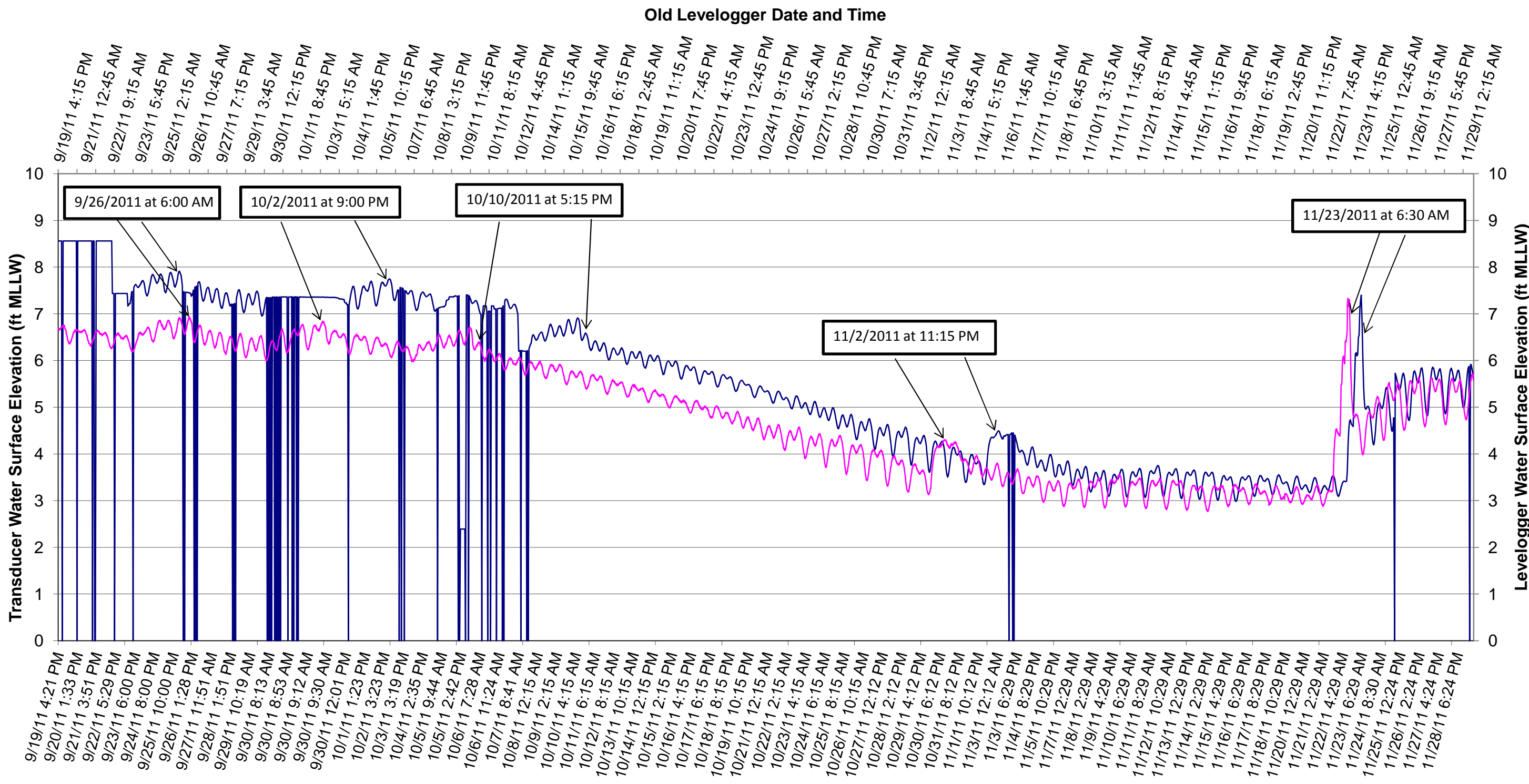


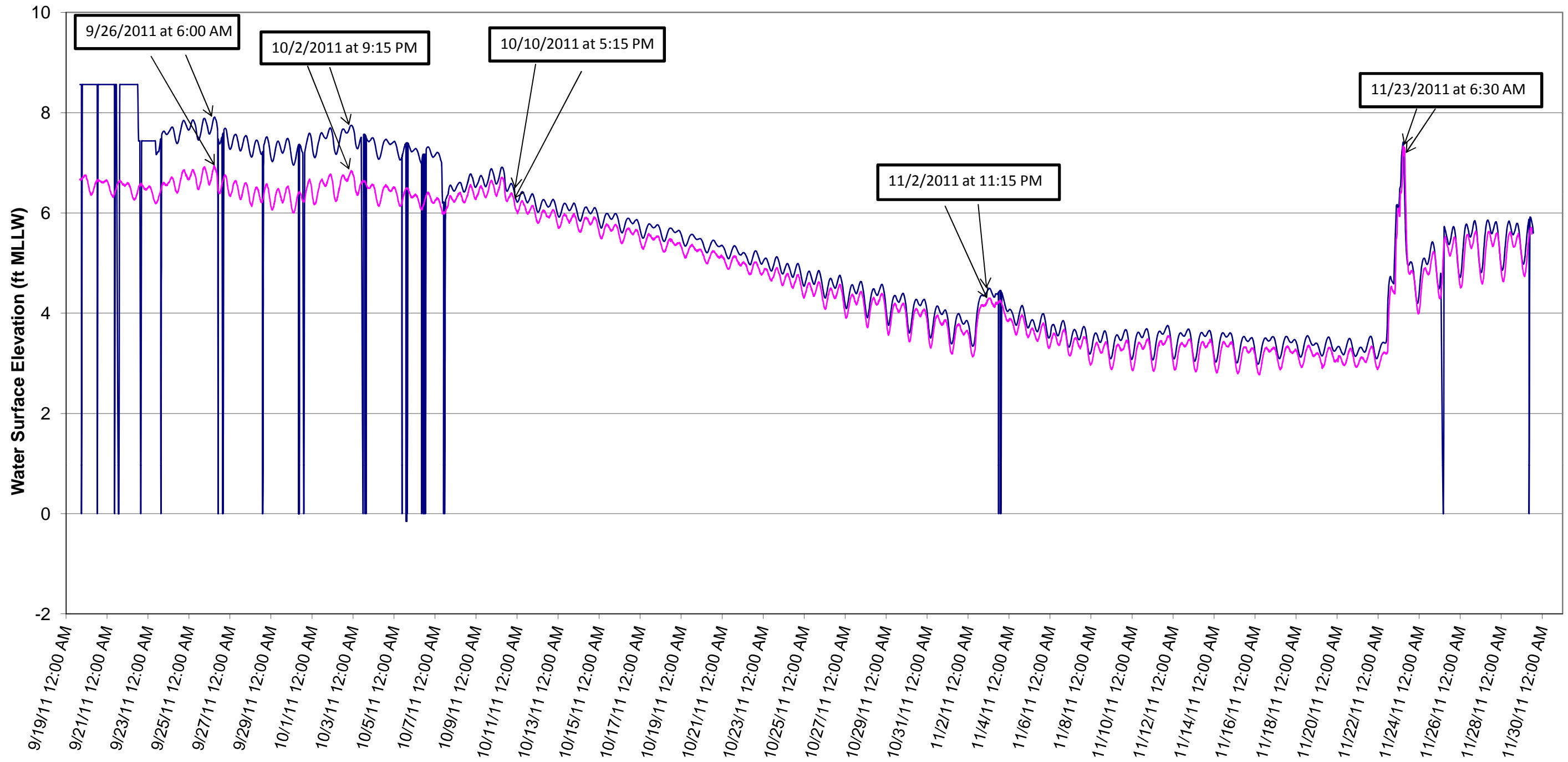
Figure 15 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well VG5L
September 19, 2011 - November 29, 2011



New Transducer Date and Time

— PO13 Transducer — PO13 Logger

Figure 16 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well PO13
September 19, 2011 - November 29, 2011

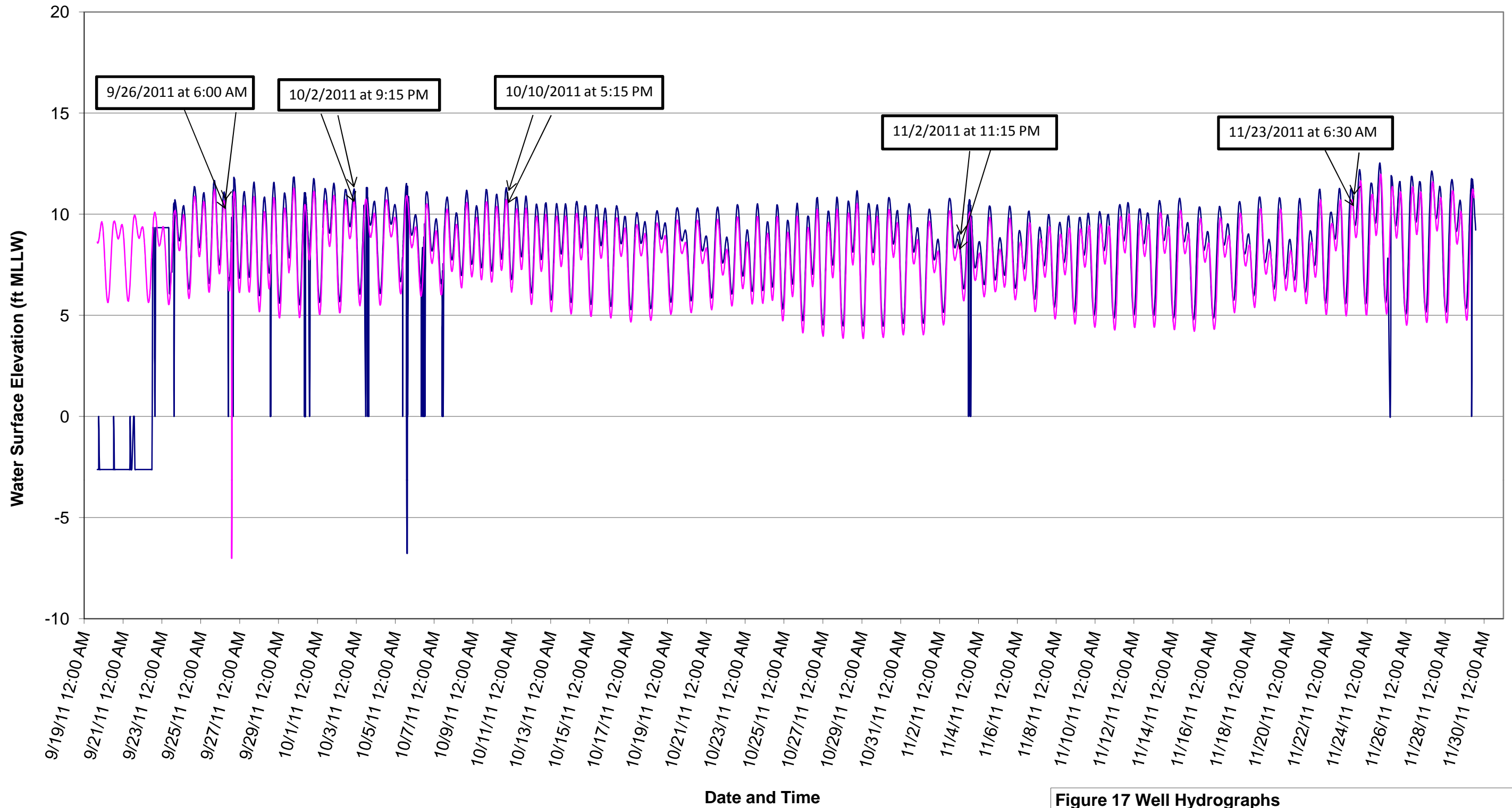


Date and Time

— PO13 Transducer — PO13 Logger

Figure 16 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well PO13
September 19, 2011 - November 29, 2011

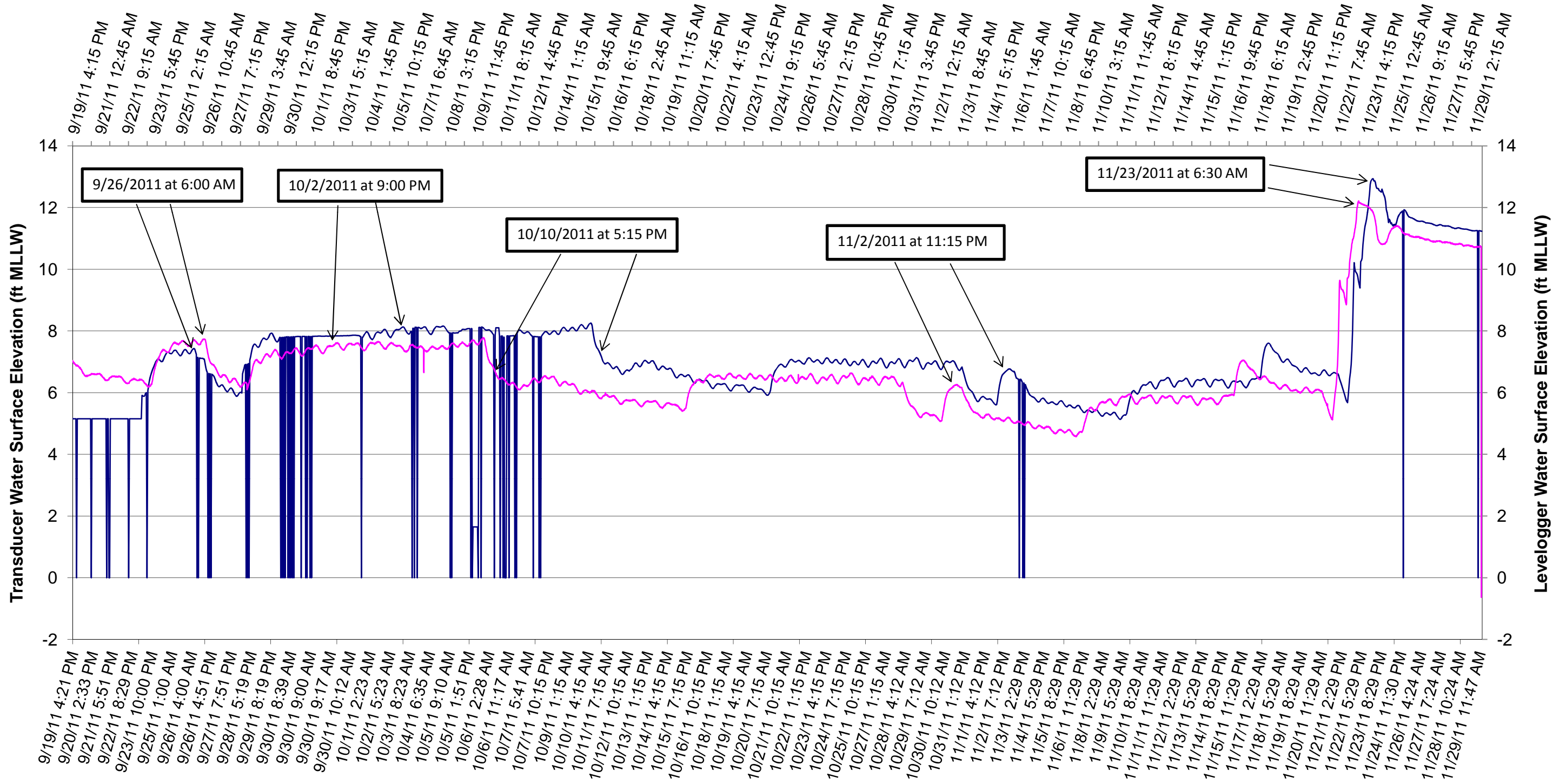




— VG1L Transducer — VG1L Logger

Figure 17 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well VG1L
September 19, 2011 - November 29, 2011

Old Levellogger Date and Time



New Transducer Date and Time

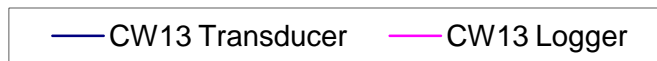
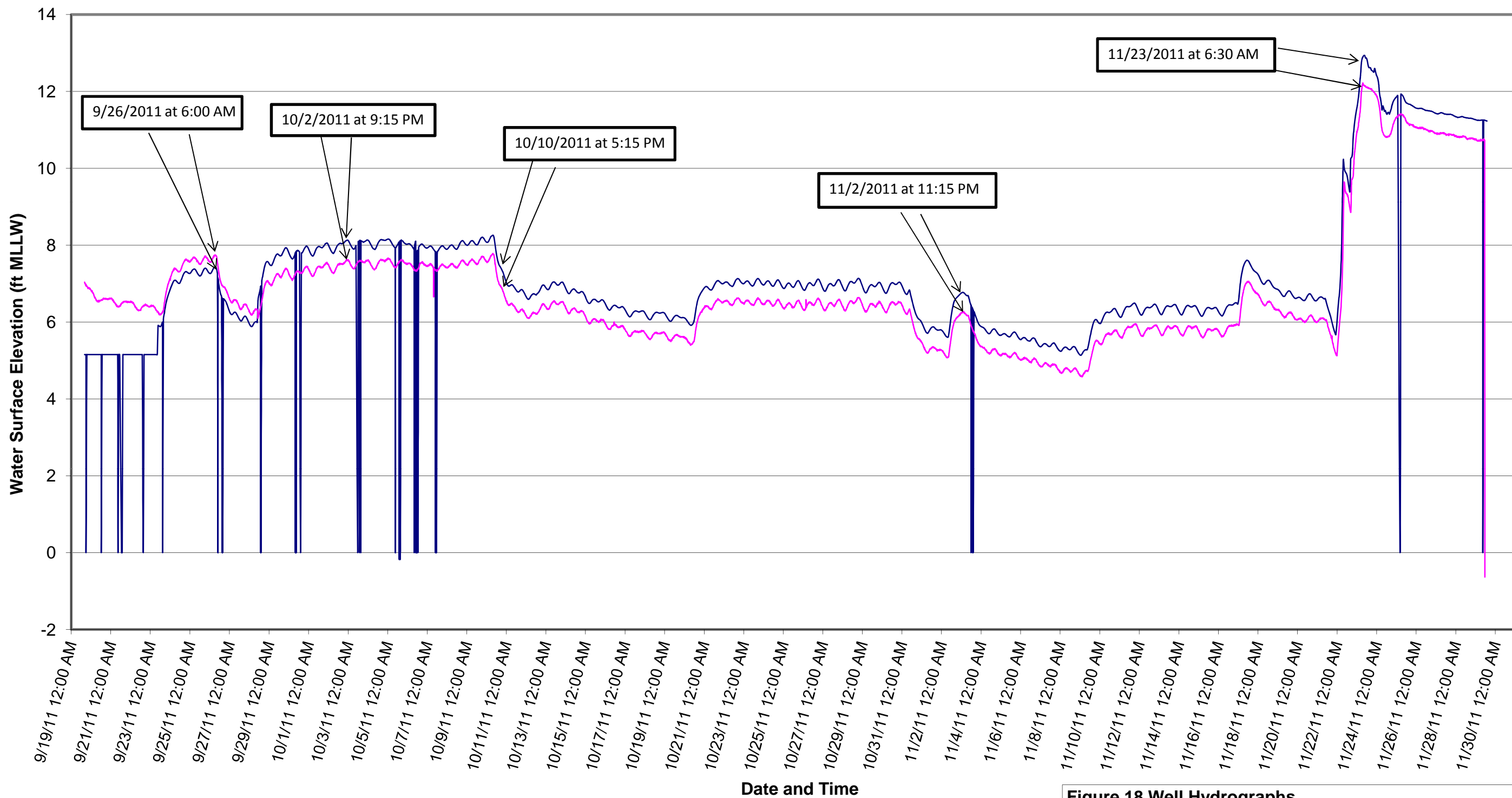


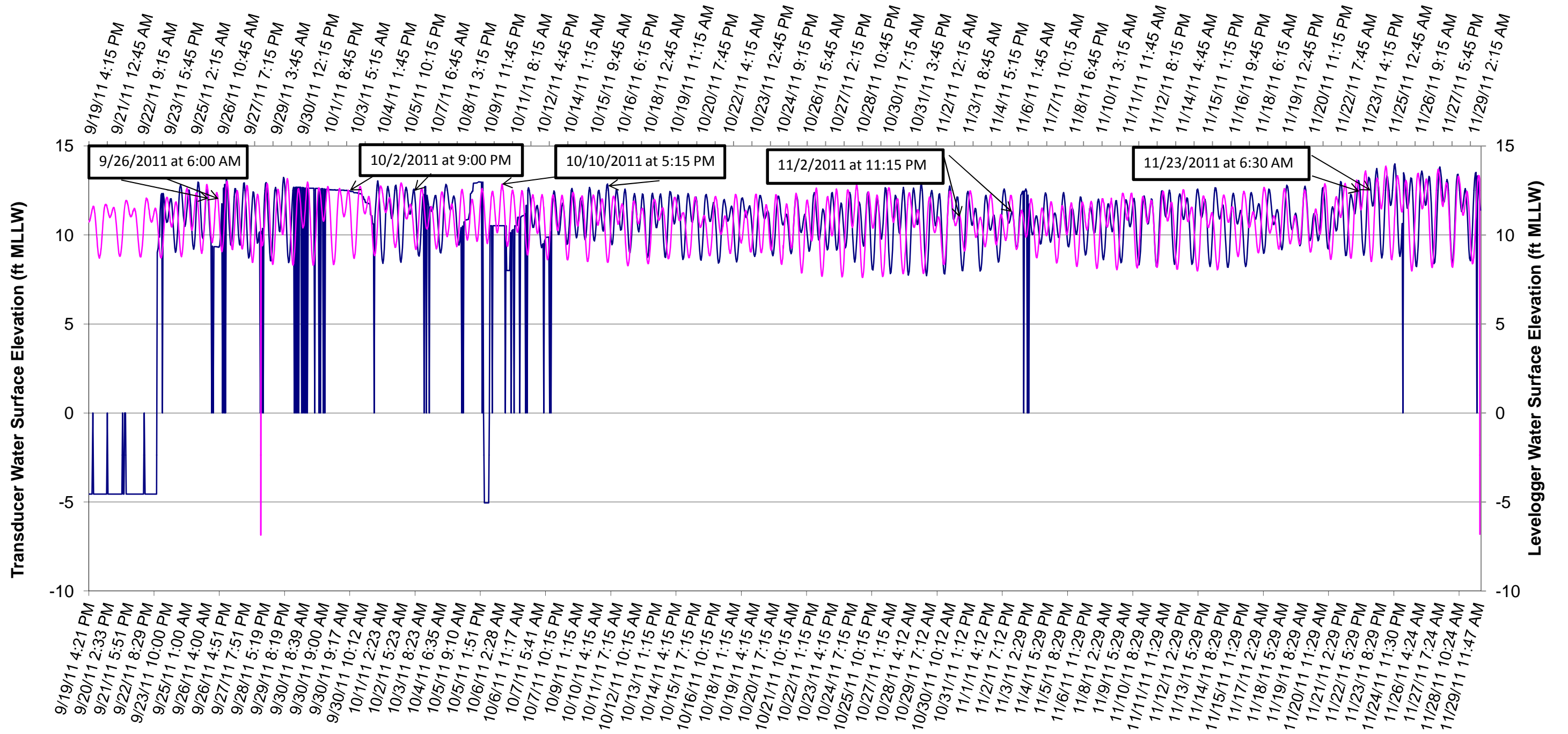
Figure 18 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well CW13
September 19, 2011 - November 29, 2011



— CW13 Transducer — CW13 Logger

Figure 18 Well Hydrographs
Old Levellogger & New Transducer, Upper Aquifer Well CW13
September 19, 2011 - November 29, 2011

Old Levelogger Date and Time



New Transducer Date and Time

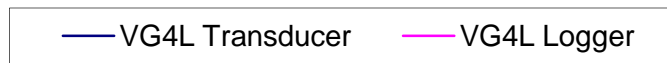
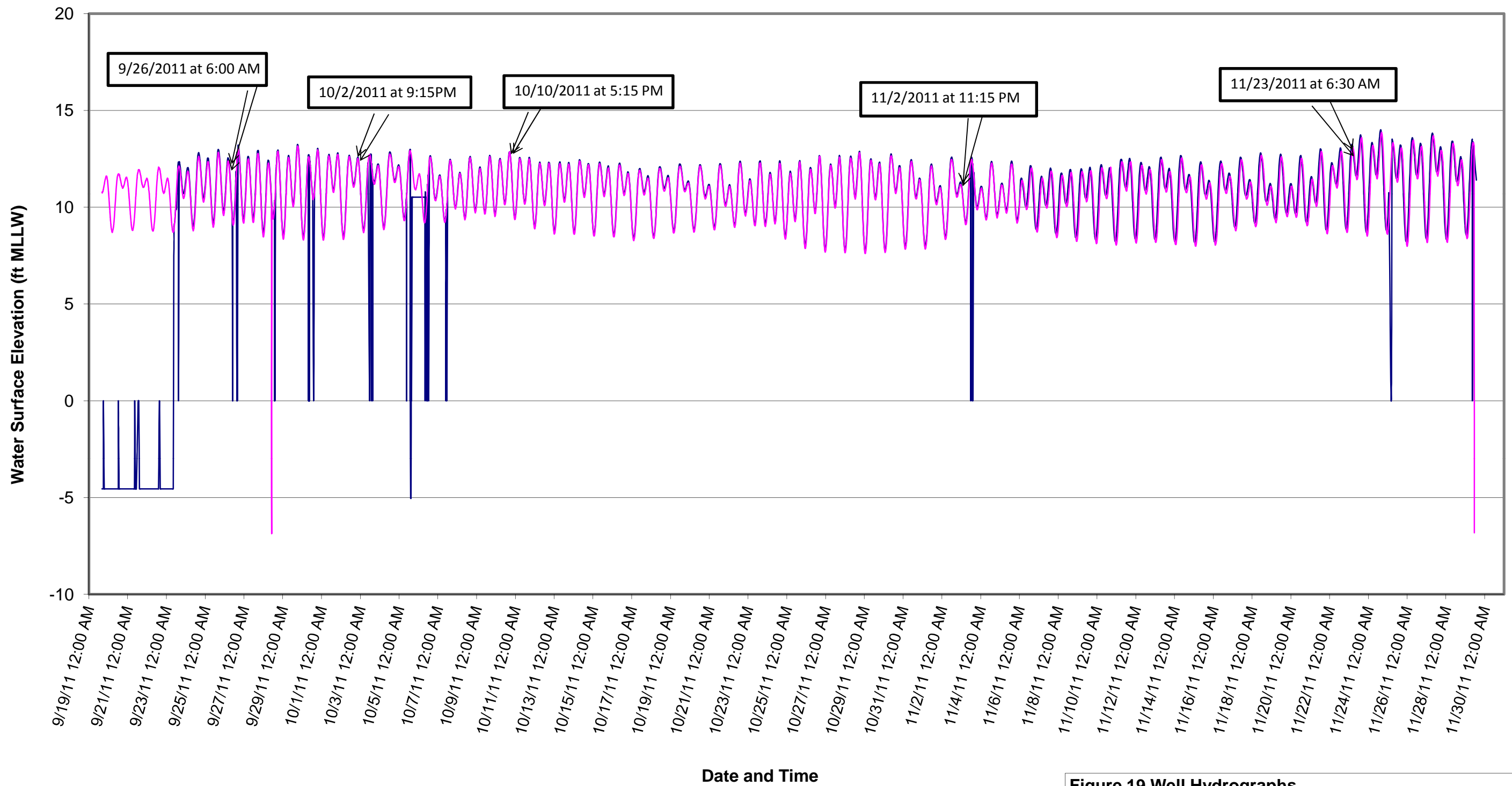
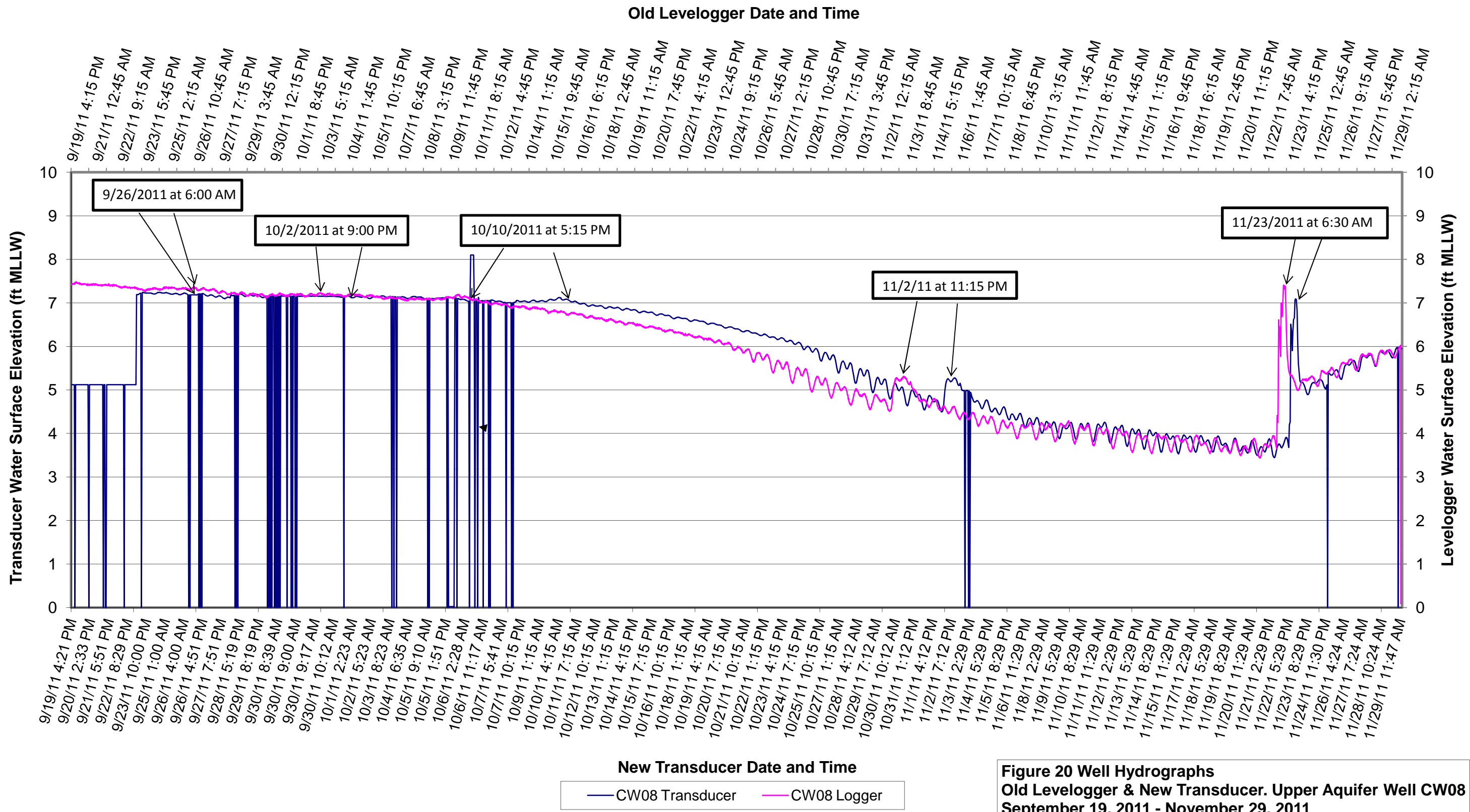


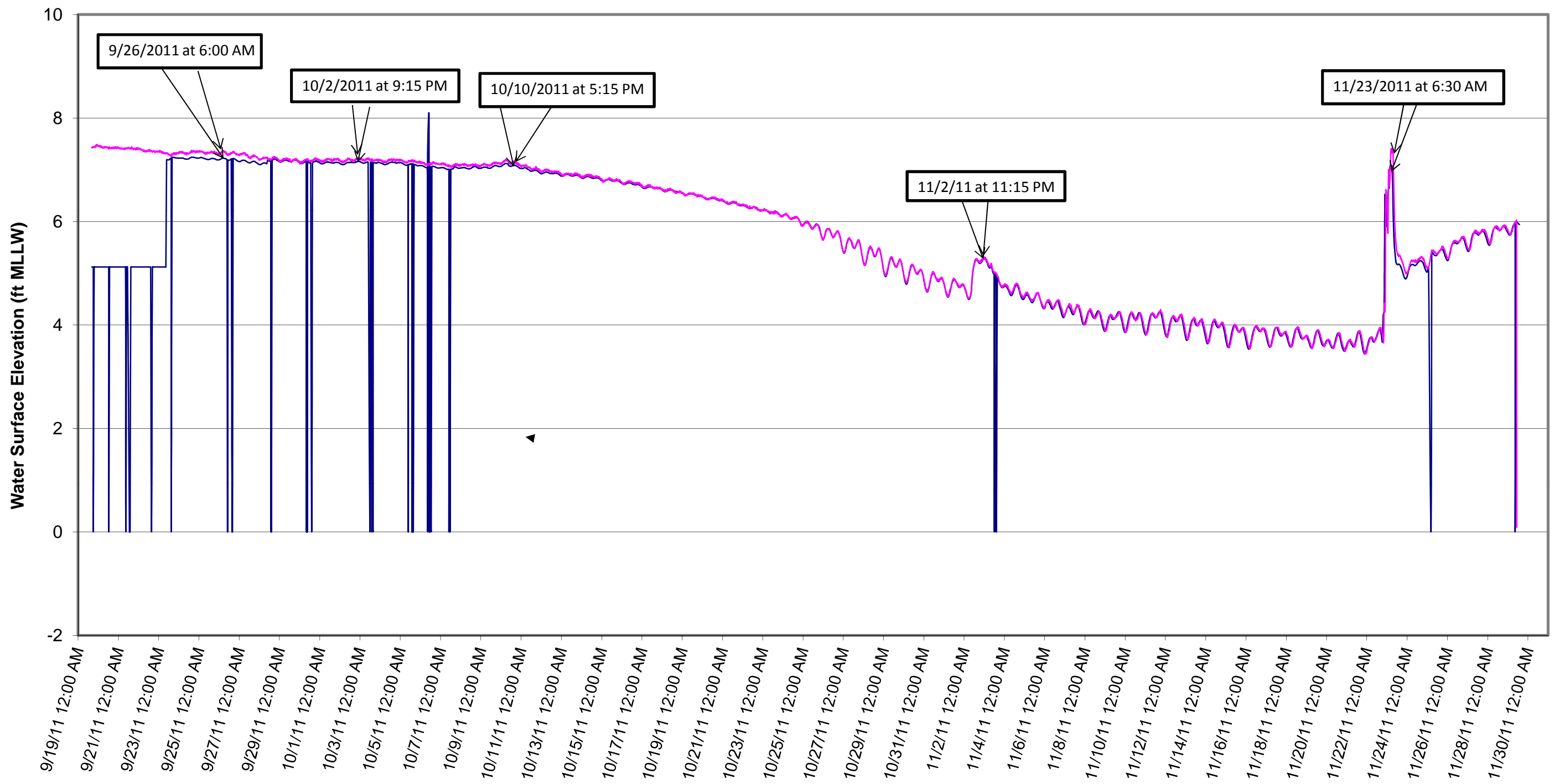
Figure 19 Well Hydrographs
Old Levelogger & New Transducer, Lower Aquifer Well VG4L
September 19, 2011 - November 29, 2011



— VG4L Transducer — VG4L Logger

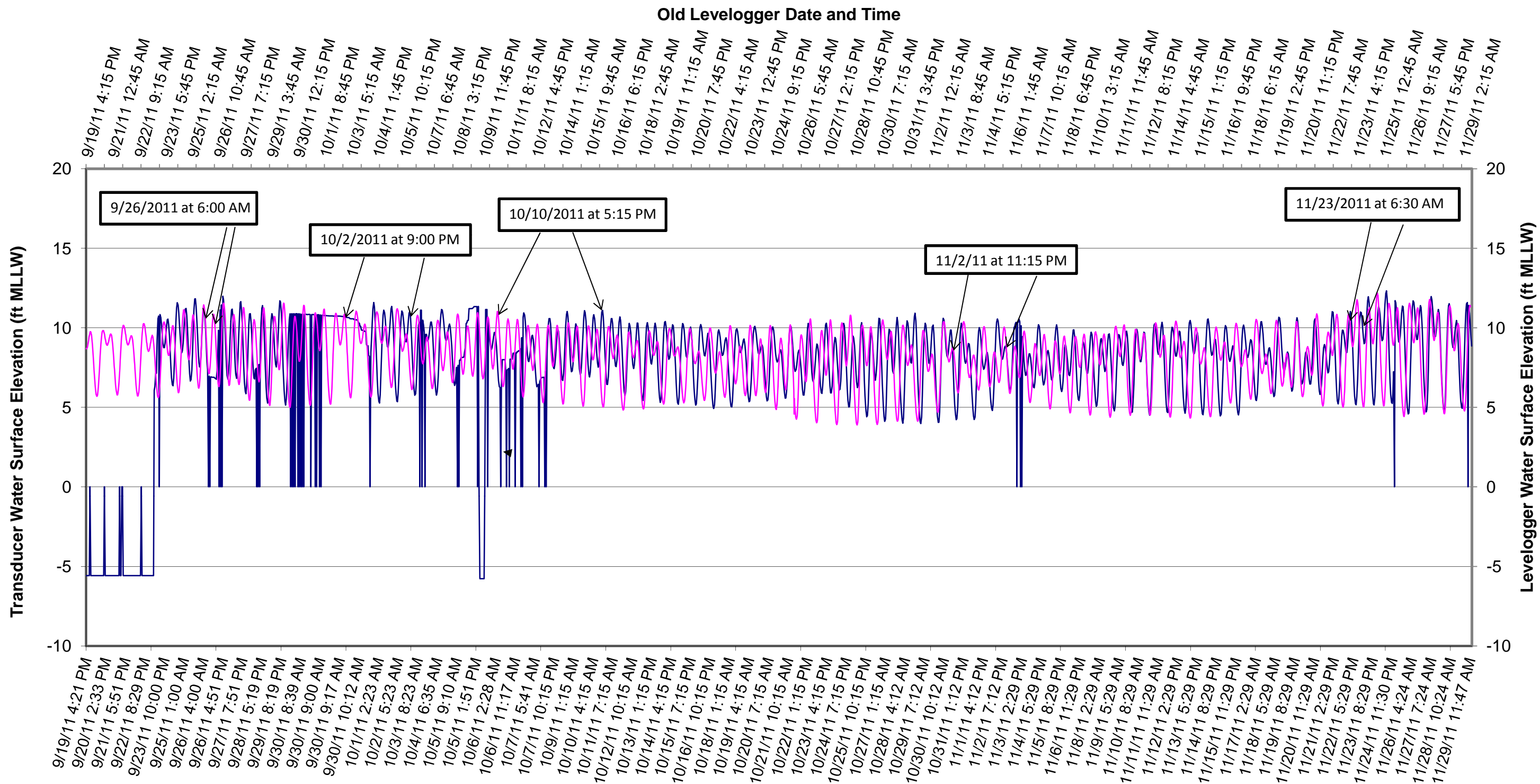
Figure 19 Well Hydrographs
Old Levelogger & New Transducer, Lower Aquifer Well VG4L
September 19, 2011 - November 29, 2011





— CW08 Transducer — CW08 Logger

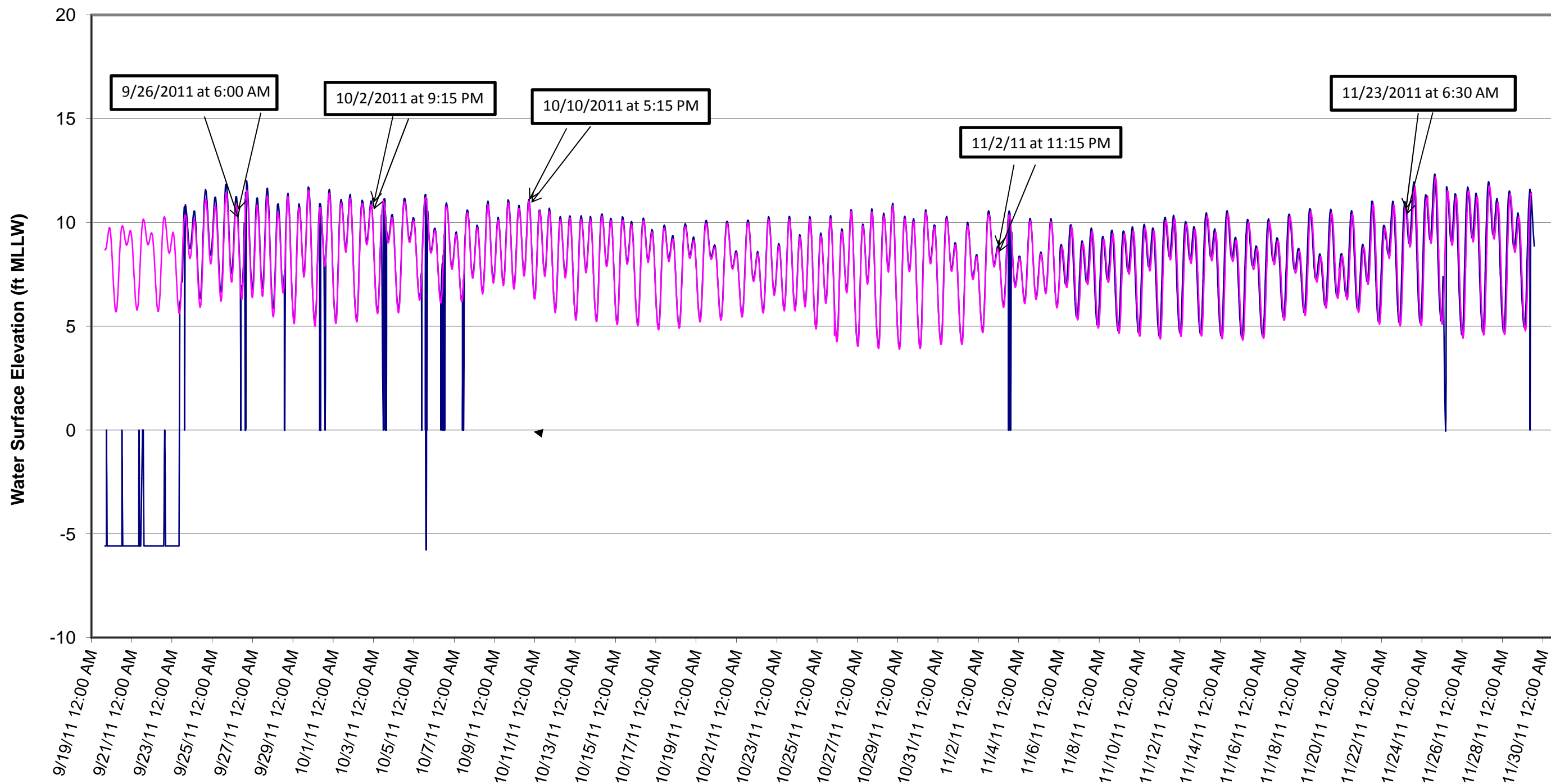
Figure 20 Well Hydrographs
Old Levellogger & New Transducer. Upper Aquifer Well CW08
September 19, 2011 - November 29, 2011



New Transducer Date and Time

— P4L Transducer — P4L Logger

Figure 21 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well P4L
September 19, 2011 - November 29, 2011



Date and Time

— P4L Transducer — P4L Logger

Figure 21 Well Hydrographs
Old Levellogger & New Transducer, Lower Aquifer Well P4L
September 19, 2011 - November 29, 2011

Table 5 -- Re-evaluation of Hydraulic Containment Conclusion in June 30 -- September 27, 2011 Technical Memorandum

Monitoring Well Identification	Date & Time Manual WL Measurement	Manual Elevation (ft MLLW)	Time of Levelogger Reading	Levelogger Elevation (ft MLLW)	Adjustment [Levelogger - Manual Elev.] (ft)	Average WL Elevation Reported in Previous TM (ft MLLW)	Ratio of Upper/Lower Aquifer WLS Reported in Previous TM ¹	Manual Measurement Corrected Average WL Elevation (ft MLLW)	Corrected Ratio of Upper/Lower Aquifer WLS ¹
MW14	11/29/11 9:24	5.15	9:30:00	8.11	2.96	9.36		6.41	
CW05	11/29/11 9:10	11.76	9:15	13.51	1.75	13.29	1.42	11.54	<u>1.80</u>
MW18	11/29/11 11:10	6.29	11:15	5.06	-1.24	5.07		6.31	
02CDMW01	11/29/11 10:25	11.25	10:30	11.07	-0.18	9.18	1.81	9.36	<u>1.48</u>
PO03	11/29/11 10:02	6.23	10:00	5.96	-0.27	6.25		6.52	
99CDMW02A	11/29/11 9:48	11.59	10:00	21.87	10.28	17.86	2.86	7.58	<u>1.16</u>
CW03	11/29/11 10:54	7.08	11:00	7.25	0.16	7.16		7.00	
CW02	11/29/11 11:07	10.97	11:00	10.60	-0.37	7.89	1.10	8.26	<u>1.18</u>
VG-2U	11/29/11 8:58	9.64	9:00	9.29	-0.35	7.50		7.85	
VG-2L	11/29/11 8:55	11.22	9:00	10.88	-0.34	8.34	1.11	8.68	<u>1.11</u>
VG-3U	11/29/11 9:30	6.22	9:30	6.13	-0.09	7.02		7.11	
VG-3L	11/29/11 9:40	12.19	9:45	12.52	0.33	10.52	1.50	10.19	<u>1.43</u>
VG-5U	11/29/11 10:17	9.07	10:15	7.64	-1.43	7.34		8.77	
VG-5L	11/29/11 10:20	13.46	10:15	12.38	-1.08	10.55	1.44	11.63	<u>1.33</u>
PO13	11/29/11 10:50	5.62	10:45	5.71	0.09	6.60		6.51	
VG-1L	11/29/11 10:43	11.21	10:45	11.15	-0.06	8.82	1.34	8.88	<u>1.36</u>
CW13	11/29/11 10:10	11.12	10:15	10.74	-0.38	7.79		8.17	
VG-4L	11/29/11 9:58	13.10	10:00	13.33	0.23	10.96	1.41	10.73	<u>1.31</u>
CW08	11/29/11 9:36	5.88	9:30	6.00	0.11	7.21		7.10	
P-4L	11/29/11 9:30	11.43	9:30	11.37	-0.06	8.98	1.25	9.04	<u>1.27</u>

Alternate shading highlights upper/lower aquifer well pairs used in the hydraulic containment evaluation.

¹ -- Value of greater than 1 indicates that hydraulic containment was achieved.