Evaluation of Wyckoff Groundwater Level Data, April 2010 – October 2010

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The purpose of this memorandum is to summarize the Wyckoff groundwater level results for two 90-day monitoring periods: of April 6, 2010 through July 4, 2010 and July 5, 2010 through October 2, 2010.

Summary/Recommendations

- Hydraulic containment was maintained in all 10 well pairs over both 90- day monitoring periods, from April 6, 2010 through July 4, 2010, and July 5, 2010 through October 2, 2010.
- The Levelogger in well CW05 malfunctioned and began to record incorrect water level data starting in May 2010. Therefore, the evaluation of well pair data for MW14/CW05 could only be completed for part of the first monitoring period. During that time, hydraulic containment was maintained for this well pair. The logger in well CW05 will be replaced.
- The Leveloggers should be downloaded again in January 2011 or April 2011 to maintain a quarterly schedule consistent with the definition of hydraulic containment.

Water Level Data Collection

Solinst Leveloggers are installed in 11 upper aquifer wells and 21 lower aquifer wells. The loggers were downloaded on May 7, 2010, July 8, 2010, and October 21, 2010. For this memorandum, the data sets are analyzed in two 90-day periods, April 6, 2010 – July 4, 2010 and July 5, 2010 – October 2, 2010. The remaining data, in excess of 90 days, from the

October 21 download (October 3, 2010 – October 21, 2010) will be included in the next memorandum with the next set of downloaded data. The locations of the wells are shown in Figure 1 and wells with loggers are listed in Table 1. All data in e-format are available upon request.

Table 1 – Wells with Data Loggers, April 6, 2010 – October 21, 2010

Upper Aquifer		Lower Aquifer		
CW03	PO13	02CDMW01	PZ09	P-1L
CW08	VG-2U	99CDMW02A	PZ11	P-2L
CW13	VG-3U	CW01	VG-1L	P-3L
MW14	VG-5U	CW02	VG-2L	P-4L
MW18		CW05[1]	VG-3L	P-5L
MW21		CW09	VG-4L	P-6L
PO03		PZ03	VG-5L	SE-2
1 – The logger in well CW05 failed on May 8, 2010; this logger will be replaced.				

Hydraulic Containment / Isolation Discussion

The hydraulic containment/isolation performance at the Wyckoff site has been evaluated based on water level data from ten upper and lower aquifer well pairs: 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. The hydraulic containment at each well pair is evaluated in two steps. First, the average groundwater elevation of the upper and lower aquifers is calculated by averaging the water level data (converted to elevations) recorded every 15 minutes during the monitoring period. Second, the average groundwater elevations are compared. If the average lower aquifer groundwater elevation is greater than that of the upper aquifer, indicating an overall net upward movement of groundwater, then hydraulic containment is demonstrated. If a well pair meets the definition of hydraulic containment, then the ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for that well pair will be greater than 1.

Data collected from the Leveloggers indicate that some of the logger timers drifted over the data collection period (from the May 7, 2010 download to the recent download on October 21, 2010). In cases where the logger timer did "drift", the logger time was most often ahead of the actual clock time. The loggers in wells SE-2 and PZ-11were 1 minute behind actual clock time at the October 21 download. In most of the drift cases, the logger timer drift was small (less than 15 minutes). The average timer drift was calculated to be 7 minutes for the May 7, 2010 download, 3.5 minutes for the July 8, 2010 download, and 6 minutes for the October 21, 2010 download. The loggers in two wells (02CDMW01 and MW14), however experienced significant drift over the data collection periods. The logger and clock times varied by 1 hour and 3 minutes (02CDMW01) and 1 hour and 2 minutes (MW14) for the May 7, 2010 download, 33 minutes (02CDMW01) and 31 minutes (MW14) for the July 8, 2010 download, and 55 minutes (02CDMW01) and 54 minutes (MW14) for the October 21, 2010 download. However, because hydraulic containment is defined by the average lower and upper aquifer water level elevations over the monitoring period, errors in the recorded

logger time have no effect on the hydraulic containment results presented in this memorandum.

Hydrographs from the ten well pairs are shown in Figures 2 through 11 for the monitoring period.

Well Pair MW14/CW05

Two Leveloggers were installed in well CW05 in January 2010 to replace a failed logger. One of the two loggers failed prior to the July 8, 2010 download and was not downloadable. Because the second logger in CW05 was downloadable, able to be re-programmed, and did not cease to work, it was reinstalled. However, upon analysis of the data, the second logger failed on May 7, 2010. It will be replaced during the next data download.

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The data for well pair MW14/CW05 were analyzed from April 6, 2010 at 12:00 AM to May 7, 2010 at 09:15 AM, after which the logger in well CW05 failed. The hydrograph for well pair MW14/CW05 (Figure 2a) shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment during this shortened time period.

From April 6, 2010 to May 7, 2010, the average groundwater elevation was calculated to be 13.87 feet MLLW in the lower aquifer (Well CW05) and 8.50 feet MLLW in the upper aquifer (Well MW14). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair MW14/CW05 was calculated to be 1.63, thus demonstrating hydraulic containment during this shortened 30-day monitoring period.

Over the approximate 30-day shortened monitoring period, there were no occurrences of downward flow potential for well pair MW14/CW05.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

Analysis of data for well pair MW14/CW05 could not be completed for the second 90-day monitoring period because CW05 had failed. The hydrograph for well pair MW14/CW05 is shown in Figure 2b (without CW05 data).

Well Pair MW18/02CDMW01

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair MW18/02CDMW01 (Figure 3a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 9.59 feet MLLW in the lower aquifer (Well 02CDMW01) and 5.34 feet MLLW in the upper aquifer (Well MW18). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair MW18/02CDMW01 was calculated to be 1.80, thus demonstrating hydraulic containment.

Over the first 90-day monitoring period, there were no occurrences of downward flow potential for well pair MW18/02CDMW01.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair MW18/02CDMW01 (Figure 3b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 9.23 feet MLLW in the lower aquifer (Well 02CDMW01) and 6.28 feet MLLW in the upper aquifer (Well MW18). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair MW18/02CDMW01 was calculated to be 1.47, thus demonstrating hydraulic containment.

Over the second 90-day monitoring period, 18 periods of downward flow potential occurred for well pair MW18/02CDMW01. The sum of all downward gradient periods over the monitoring period was 43 hours and 45 minutes (approximately 1.5 days). The average duration of a downward gradient period was 2 hours and 25 minutes. The maximum duration of a downward gradient period was 3 hours and 30 minutes. The average downward flow potential was calculated to be – 0.19 feet. The maximum downward flow potential was calculated to be – 0.48 feet and occurred on September 5, 2010 at 10:00 and 10:15.

Well Pair PO03/99CDMW02

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair PO03/99CDMW02 (Figure 4a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 10.11 feet MLLW in the lower aquifer (Well 99CDMW02) and 6.96 feet MLLW in the upper aquifer (Well PO03). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair PO03/99CDMW02 was calculated to be 1.45, thus demonstrating hydraulic containment.

Over the 90-day period, 17 periods of downward flow potential occurred for well pair PO03/99CDMW02. The sum of all downward gradient periods over the monitoring period was 47 hours and 45 minutes (approximately 2 days). The average duration of a downward gradient period was 2 hours and 48 minutes. The maximum duration of a downward gradient period was approximately 5 hours and 45 minutes. The average downward flow potential was calculated to be – 0.37 feet. The maximum downward flow potential was calculated to be – 1.09 feet and occurred on April 6, 2010 at 17:15.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair PO03/99CDMW02 (Figure 4b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 10.17 feet MLLW in the lower aquifer (Well 99CDMW02) and 7.29 feet MLLW in the upper aquifer (Well PO03). The ratio of the average lower aquifer water elevation to the

average upper aquifer water elevation for well pair PO03/99CDMW02 was calculated to be 1.40, thus demonstrating hydraulic containment.

Over the 90-day period, 27 periods of downward flow potential occurred for well pair PO03/99CDMW02. The sum of all downward gradient periods over the monitoring period was 75 hours (approximately 3 days). The average duration of a downward gradient period was 2 hours and 46 minutes. The maximum duration of a downward gradient period was approximately 4 hours and 15 minutes. The average downward flow potential was calculated to be – 0.30 feet. The maximum downward flow potential was calculated to be – 0.76 feet and occurred on September 6, 2010 at 10:30.

Note: An erroneous logger reading in well CDMW02 occurred on July 9, 2010 at 04:00. This data point was neglected and therefore not included in the calculations above.

Well Pair CW03/CW02

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair CW03/CW02 (Figure 5a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 8.38 feet MLLW in the lower aquifer (Well CW02) and 7.87 feet MLLW in the upper aquifer (Well CW03). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW03/CW02 was calculated to be 1.06, thus demonstrating hydraulic containment.

Over the 90-day period, 105 periods of downward flow potential occurred for well pair CW03/CW02. The sum of all downward gradient periods over the entire monitoring period was 625 hours and 15 minutes (approximately 26 days). The average duration of a downward gradient period was approximately 5 hours and 57 minutes. The maximum duration of a downward gradient period was 8 hours and 15 minutes. The average downward flow potential was calculated to be – 0.67 feet. The maximum downward flow potential was calculated to be -1.88 feet and occurred on April 18, 2010 at 13:30, 13:45 and 14:15.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair CW03/CW02 (Figure 5b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 8.11 feet MLLW in the lower aquifer (Well CW02) and 7.90 feet MLLW in the upper aquifer (Well CW03). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW03/CW02 was calculated to be 1.03, thus demonstrating hydraulic containment.

Over the 90-day period, 133 periods of downward flow potential occurred for well pair CW03/CW02. The sum of all downward gradient periods over the entire monitoring period was 810 hours and 45 minutes (approximately 34 days). The average duration of a

downward gradient period was approximately 6 hours and 5 minutes. The maximum duration of a downward gradient period was 9 hours and 45 minutes. The average downward flow potential was calculated to be – 0.78 feet. The maximum downward flow potential was calculated to be -1.96 feet and occurred on September 5, 2010 at 09:30.

Well Pair VG-2U/VG-2L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair VG-2U/VG-2L (Figure 6a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 8.71 feet MLLW in the lower aquifer (Well VG-2L) and 7.77 feet MLLW in the upper aquifer (Well VG-2U). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair VG-2U/VG-2L was calculated to be 1.12, thus demonstrating hydraulic containment.

Over the 90-day period, there were no occurrences of downward flow potential for well pair VG-2U/VG-2L.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair VG-2U/VG-2L (Figure 6b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 8.38 feet MLLW in the lower aquifer (Well VG-2L) and 7.85feet MLLW in the upper aquifer (Well VG-2U). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair VG-2U/VG-2L was calculated to be 1.07, thus demonstrating hydraulic containment.

Over the 90-day period, 28 periods of downward flow potential occurred for well pair VG-2U/VG-2L. The sum of all downward gradient periods over the entire monitoring period was 15 hours and 15 minutes. The average duration of a downward gradient period was approximately 32 minutes. The maximum duration of a downward gradient period was 2 hours and 45 minutes. The average downward flow potential was calculated to be -0.02 feet. The maximum downward flow potential was calculated to be – 0.07 feet and occurred on September 6, 2010 at 15:00.

Well Pair VG-3U/VG-3L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair VG-3U/VG-3L (Figure 7a), shows that water levels in the lower aquifer were always greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 10.88 feet MLLW in the lower aquifer (Well VG-3L) and 7.27 feet MLLW in the upper aquifer (Well VG-3U). The ratio of the average lower aquifer water elevation to the average

upper aquifer water elevation for well pair VG-3U/VG-3L was calculated to be 1.50, thus demonstrating hydraulic containment.

Over the 90-day period, there were no occurrences of downward flow potential for well pair VG-3U/VG-3L.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair VG-3U/VG-3L (Figure 7b), shows that water levels in the lower aquifer were always greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 10.47 feet MLLW in the lower aquifer (Well VG-3L) and 7.64 feet MLLW in the upper aquifer (Well VG-3U). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair VG-3U/VG-3L was calculated to be 1.37, thus demonstrating hydraulic containment.

Over the 90- day period, there were no occurrences of downward flow potential for well pair VG-3U/VG-3L.

Well Pair VG-5U/VG-5L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair VG-5U/VG-5L (Figure 8a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 10.99 feet MLLW in the lower aquifer (Well VG-5L) and 9.25 feet MLLW in the upper aquifer (Well VG-5U). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair VG-5U/VG-5L was calculated to be 1.19, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 57 periods of downward flow potential occurred for well pair VG-5U/VG-5L. The sum of all downward gradient periods over the monitoring period was 197 hours (approximately 8 days). The average duration of a downward gradient period was approximately 3 hours and 27 minutes. The maximum duration of a downward gradient period was 9 hours. The average downward flow potential was calculated to be – 0.44 feet. The maximum downward flow potential was calculated to be – 1.57 feet and occurred on April 6, 2010 at 17:45.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair VG-5U/VG-5L (Figure 8b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 10.40 feet MLLW in the lower aquifer (Well VG-5L) and 8.30 feet MLLW in the upper aquifer (Well VG-5U). The ratio of the average lower aquifer water elevation to the average

upper aquifer water elevation for well pair VG-5U/VG-5L was calculated to be 1.25, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 17 periods of downward flow potential occurred for well pair VG-5U/VG-5L. The sum of all downward gradient periods over the monitoring period was 44 hours and 45 minutes (approximately 2 days). The average duration of a downward gradient period was approximately 2 hours and 38 minutes. The maximum duration of a downward gradient period was 3 hours and 45 minutes. The average downward flow potential was calculated to be – 0.18 feet. The maximum downward flow potential was calculated to be – 0.51 feet and occurred on September 5, 2010 at 09:30, 09:45, and 10:00.

Well Pair PO13/VG-1L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair PO13/VG-1L (Figure 9a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 9.28 feet MLLW in the lower aquifer (Well VG-1L) and 7.93 feet MLLW in the upper aquifer (Well PO13). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair PO13/VG-1L was calculated to be 1.17 thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 94 periods of downward flow potential occurred for well pair PO13/VG-1L. The sum of all downward gradient periods over the monitoring period was 483 hours (approximately 20 days). The average duration of a downward gradient period was approximately 5 hours and 8 minutes. The maximum duration of a downward gradient period was 8 hours and 15 minutes. The average downward flow potential was calculated to be – 1.05 feet. The maximum downward flow potential was calculated to be – 2.72 feet and occurred on April 16, 2010 at 12:30 and 12:45.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair PO13/VG-1L (Figure 9b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 9.04 feet MLLW in the lower aquifer (Well VG-1L) and 7.58 feet MLLW in the upper aquifer (Well PO13). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair PO13/VG-1L was calculated to be 1.19, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 101 periods of downward flow potential occurred for well pair PO13/VG-1L. The sum of all downward gradient periods over the monitoring period was 463 hours and 30 minutes (approximately 19 days). The average duration of a downward gradient period was approximately 4 hours and 35 minutes. The maximum duration of a downward gradient period was 7 hours. The average downward flow

potential was calculated to be – 0.85feet. The maximum downward flow potential was calculated to be – 2.23 feet and occurred on September 5, 2010 at 09:45 and on September 6, 2010 at 10:00.

Well Pair CW13/VG-4L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair CW13/VG-4L (Figure 10a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 11.32 feet MLLW in the lower aquifer (Well VG-4L) and 10.37 feet MLLW in the upper aquifer (Well CW13). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW13/VG-4L was calculated to be 1.09, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 95 periods of downward flow potential occurred for well pair CW13/VG-4L. The sum of all downward gradient periods over the monitoring period was 593 hours and 30 minutes (approximately 24.5 days). The average duration of a downward gradient period was approximately 6 hours and 15 minutes. The maximum duration of a downward gradient period was 20 hours and 15 minutes. The average downward flow potential was calculated to be – 1.06 feet. The maximum downward flow potential was calculated to be – 3.05 feet and occurred on April 6, 2010 at 17:00.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair CW13/VG-4L (Figure 10b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 10.77 feet MLLW in the lower aquifer (Well VG-4L) and 8.46feet MLLW in the upper aquifer (Well CW13). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW13/VG-4L was calculated to be 1.27, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 43 periods of downward flow potential occurred for well pair CW13/VG-4L. The sum of all downward gradient periods over the monitoring period was 118 hours (approximately 5 days). The average duration of a downward gradient period was approximately 2 hours and 44 minutes. The maximum duration of a downward gradient period was 4 hours and 30 minutes. The average downward flow potential was calculated to be – 0.30 feet. The maximum downward flow potential was calculated to be – 0.90 feet and occurred on September 6, 2010 at 09:45.

Well Pair CW08/P-4L

First 90-Day Monitoring Period (April 6, 2010 through July 4, 2010)

The first monitoring period hydrograph for well pair CW08/P-4L (Figure 11a), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the first monitoring period, the average groundwater elevation was calculated to be 9.44 feet MLLW in the lower aquifer (Well P-4L) and 9.01 feet MLLW in the upper aquifer (Well CW08). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW08/P-4L was calculated to be 1.05, thus demonstrating hydraulic containment.

Over the first 90-day monitoring period, 120 periods of downward flow potential occurred for well pair CW08/P-4L. The sum of all downward gradient periods over the monitoring period was 804 hours (approximately 33.5 days). The average duration of a downward gradient period was approximately 6 hours and 42 minutes. The maximum duration of a downward gradient period was 18 hours and 15 minutes. The average downward flow potential was calculated to be – 1.54 feet. The maximum downward flow potential was calculated to be -4.03 feet and occurred on April 30, 2010 at 13:00.

Second 90-Day Monitoring Period (July 5, 2010 through October 2, 2010)

The second monitoring period hydrograph for well pair CW08/P-4L (Figure 11b), shows that water levels in the lower aquifer were on average greater than the water levels in the upper aquifer, thus meeting the definition of hydraulic containment.

During the second monitoring period, the average groundwater elevation was calculated to be 9.16 feet MLLW in the lower aquifer (Well P-4L) and 8.12 feet MLLW in the upper aquifer (Well CW08). The ratio of the average lower aquifer water elevation to the average upper aquifer water elevation for well pair CW08/P-4L was calculated to be 1.13, thus demonstrating hydraulic containment.

Over the 90-day monitoring period, 112 periods of downward flow potential occurred for well pair CW08/P-4L. The sum of all downward gradient periods over the monitoring period was 609 hours and 30 minutes (approximately 25 days). The average duration of a downward gradient period was approximately 5 hours and 26 minutes. The maximum duration of a downward gradient period was 8 hours. The average downward flow potential was calculated to be – 1.24 feet. The maximum downward flow potential was calculated to be -2.88 feet and occurred on September 5, 2010 at 10:00.

Treatment Plant Operations and Precipitation Effects on Vertical Gradients

During the two monitoring periods (April 6, 2010 through July 4, 2010 and July 5, 2010 through October 2, 2010), Former Process Area (FPA) groundwater extraction well pumps were periodically shut down. The majority of the shut downs were scheduled weekend plant shut downs. Shutdowns of the extraction well pumps that occurred for one day or longer (as noted in CH2M HILL operation records) are listed in Table 2. These shut downs are graphically overlaid with the precipitation records and are shown in Figure 12.

Note: The extraction system and the groundwater treatment plant have been operated 24 hours per day for 5 days per week at a flow rate of approximately 40 gallons per minute during the monitoring periods.

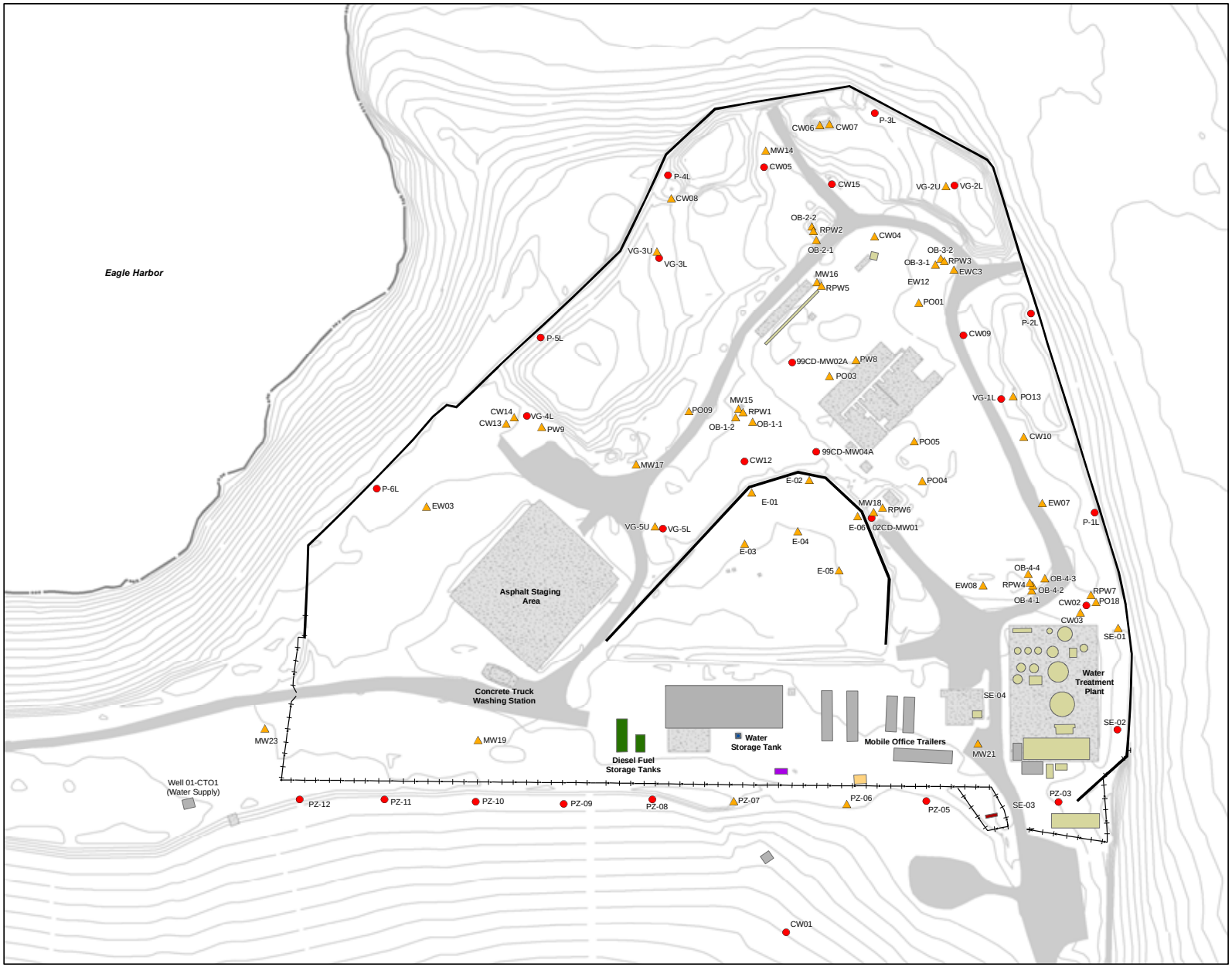
First Period: A total of 10.96 inches of precipitation was measured at the site during the two monitoring periods with the heaviest precipitation occurring April through June during the first period. Three well pairs did not have any periods of negative downward gradients during the first monitoring period (MW18/02CDMW01, VG2U/VG2L, and VG3U/VG3L). Maximum negative gradients occurred in four well pairs (MW14/CW05, CW03/CW02, PO13/VG1L, and CW08/P4L) during various well field shutdowns (see Figure 12). Three well pairs (PO03/99CDMW02, VG-5U/VG-5L, and CW13/VG-4L) experienced maximum negative gradients April 6, 2010 at the beginning of the monitoring period that were not correlated with a well field shutdown, but were rather most likely associated with precipitation carried over from the week preceding the first period download.

Second Period: Three well pairs did not have any periods of negative downward gradients during the second monitoring period (MW14/CW05, CW03/CW02, and VG3U/VG3L). During the extended well shutdown event from July 14 – September 7, 2010, the maximum negative gradient occurred in the remaining 7 well pairs near the end of the shutdown period: MW18/02CDMW01, PO03/99CDMW02, VG2U/VG2L, VG-5U/VG-5L, PO13/VG1L, CW13/VG4L, and CW08/P4L. It should also be noted that the maximum one day precipitation total of about 1.46 inches on September 20, 2010, when the well field was in operation, did not help generate maximum negative gradients in any of the 10 well pairs.

Table 2 – Former Process Area (FPA) Extraction Well Pump Shutdown Periods

Date	Wells Shut Down	Reason
April 9 – April 12, 2010	PW-1, PW-2, PW-4, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
April 16 – April 19, 2010	PW-1, PW-2, PW-4, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
April 23 – April 26, 2010	PW-1, PW-2, PW-4, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
April 30 – May 3, 2010	PW-1, PW-2, PW-4, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
May 7 – May 10, 2010	PW-1, PW-2, PW-4, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
May 11, 2010 -	PW-4	Pump failure, pump offline until replacement part received
May 14 – May 17, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
May 21 – 24, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
May 28 – June 1, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
June 4 – June 7, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
June 11 – June 14, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
June 18 – June 21, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
June 25 – June 28, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down
July 1 – July 6, 2010	PW-9, EW-2	Scheduled weekend plant shut down
July 2 – July 6, 2010	PW-1, PW-2, PW-5, PW-6, PW-8	Scheduled weekend plant shut down
July 8 – July 12, 2010	PW-9	Scheduled weekend plant shut down
July 9 – July 12, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, EW-2	Scheduled weekend plant shut down
July 14 – September 7, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled shutdown for well field upgrades
September 10 – September 13, 2010	PW-1, PW-2, PW-5, PW-6, PW-9, EW-2	Scheduled weekend plant shut down
September 10 – September 15, 2010	PW-8	Scheduled weekend plant shut down
September 17 – September 20, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2	Scheduled weekend plant shut down

January 29 – September 20, 2010	EW-6	Hammerhead pump failure; extraction well remained off line due to the low flow rate that this well is capable of producing (less than 2 gpm).
September 24 – September 27, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2, EW-6	Scheduled weekend plant shut down
October 1 – October 4, 2010	PW-1, PW-2, PW-5, PW-6, PW-8, PW-9, EW-2, EW-6	Scheduled weekend plant shut down



Lower Aquifer Well
Upper Aquifer Well
Fence
Sheetpile Wall
Roads
Buildings
Concrete Slab
Structures

N

0 50 100 200 Feet

FIGURE 1

Former Process Area Well Locations

WYCKOFF/EAGLE HARBOR SUPERFUND SITE

File Path: \\bianca\proj\URSGreiner\180776\GIS\Layouts\Former_Process_Area_Well_Locations_v2.mxd, Date: February 12, 2009

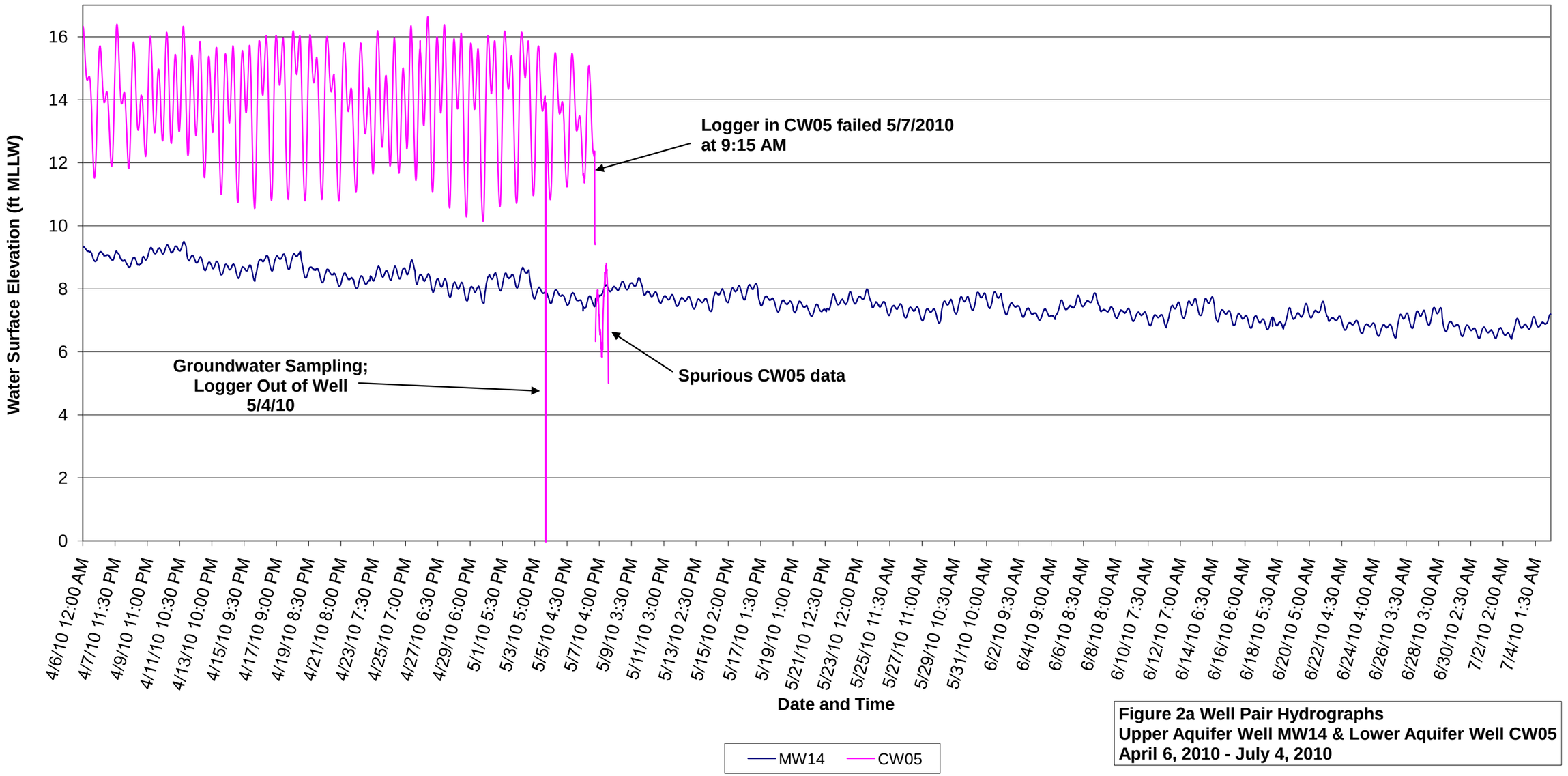
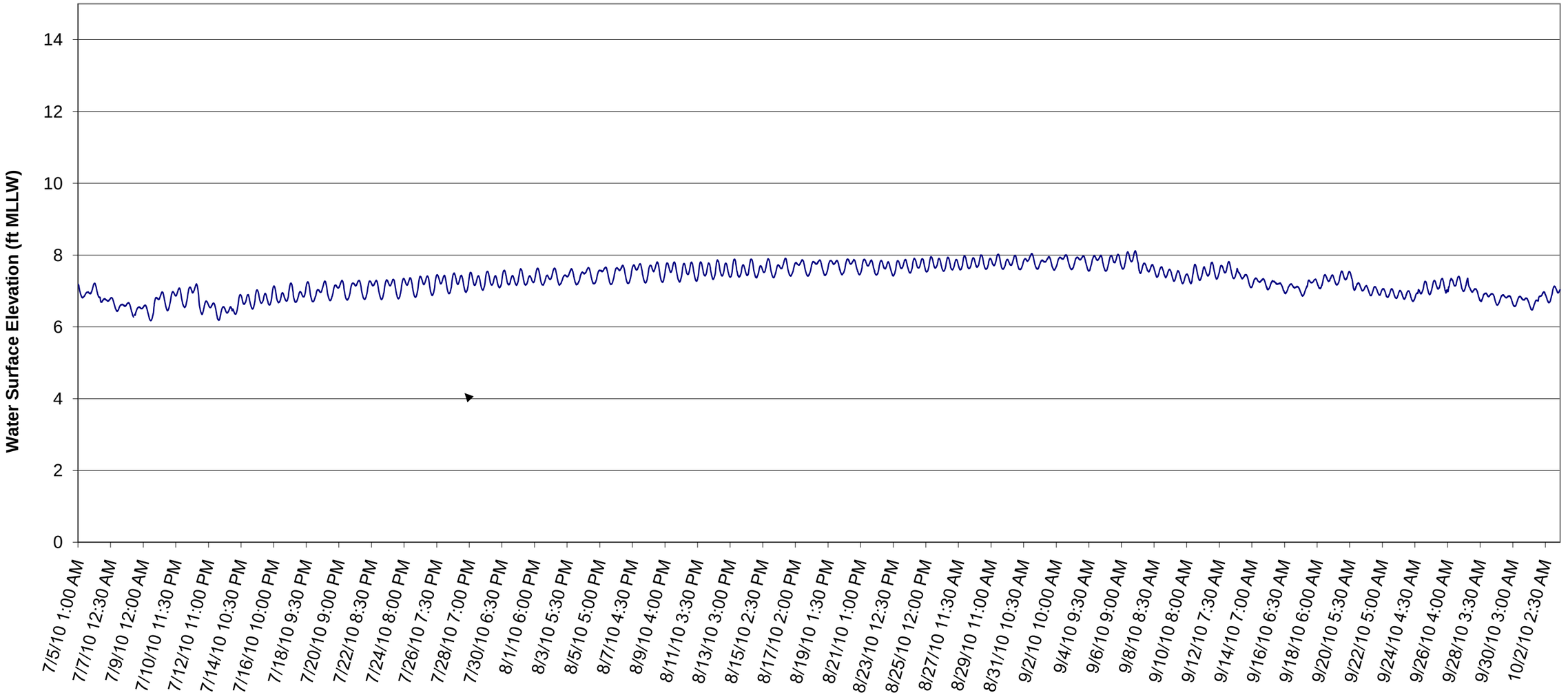


Figure 2a Well Pair Hydrographs
Upper Aquifer Well MW14 & Lower Aquifer Well CW05
April 6, 2010 - July 4, 2010



Note: Logger in CW05 failed

Figure 2b Well Pair Hydrographs
Upper Aquifer Well MW14 & Lower Aquifer Well CW05
July 5, 2010 - October 2, 2010

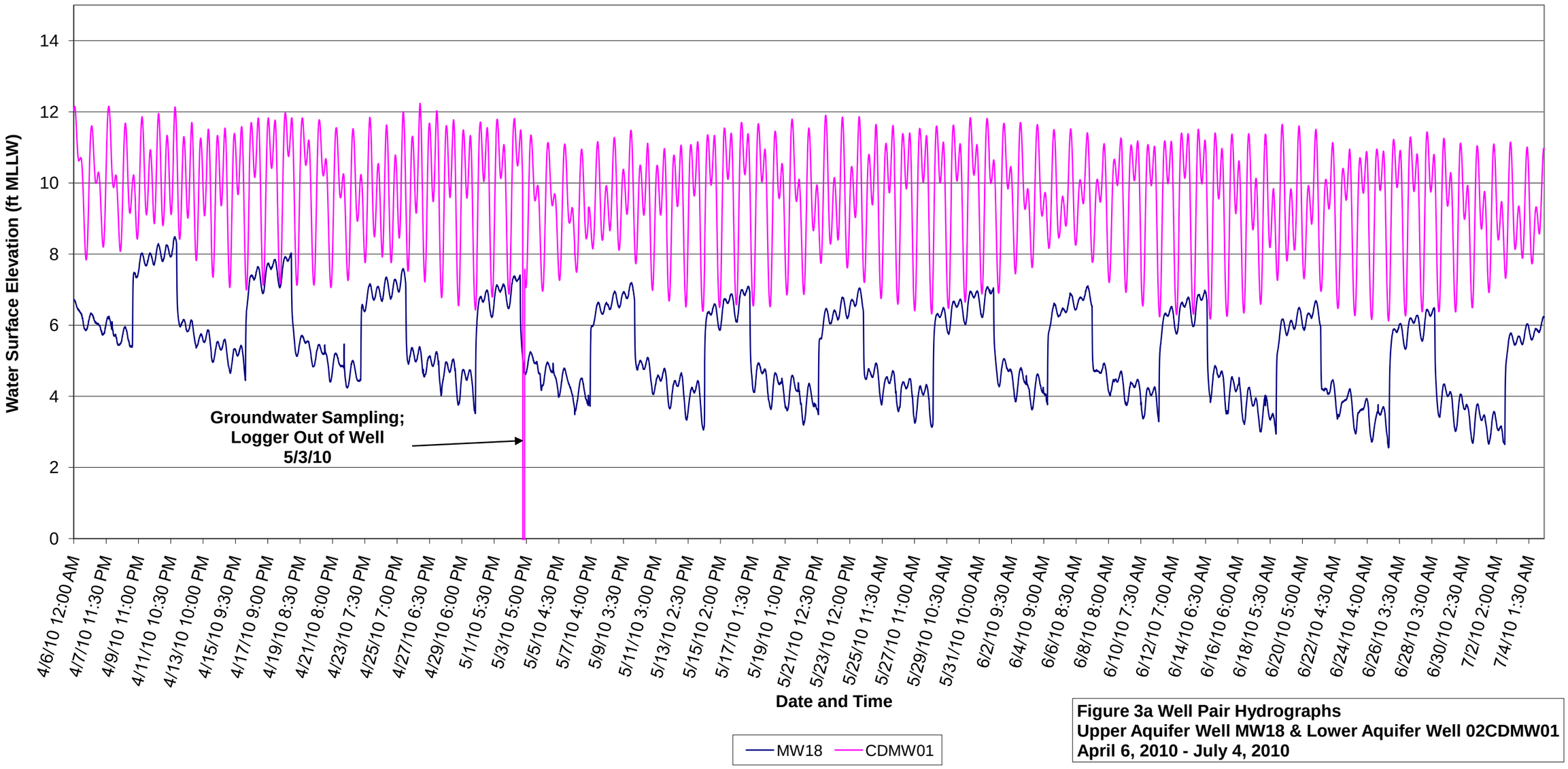


Figure 3a Well Pair Hydrographs
Upper Aquifer Well MW18 & Lower Aquifer Well 02CDMW01
April 6, 2010 - July 4, 2010

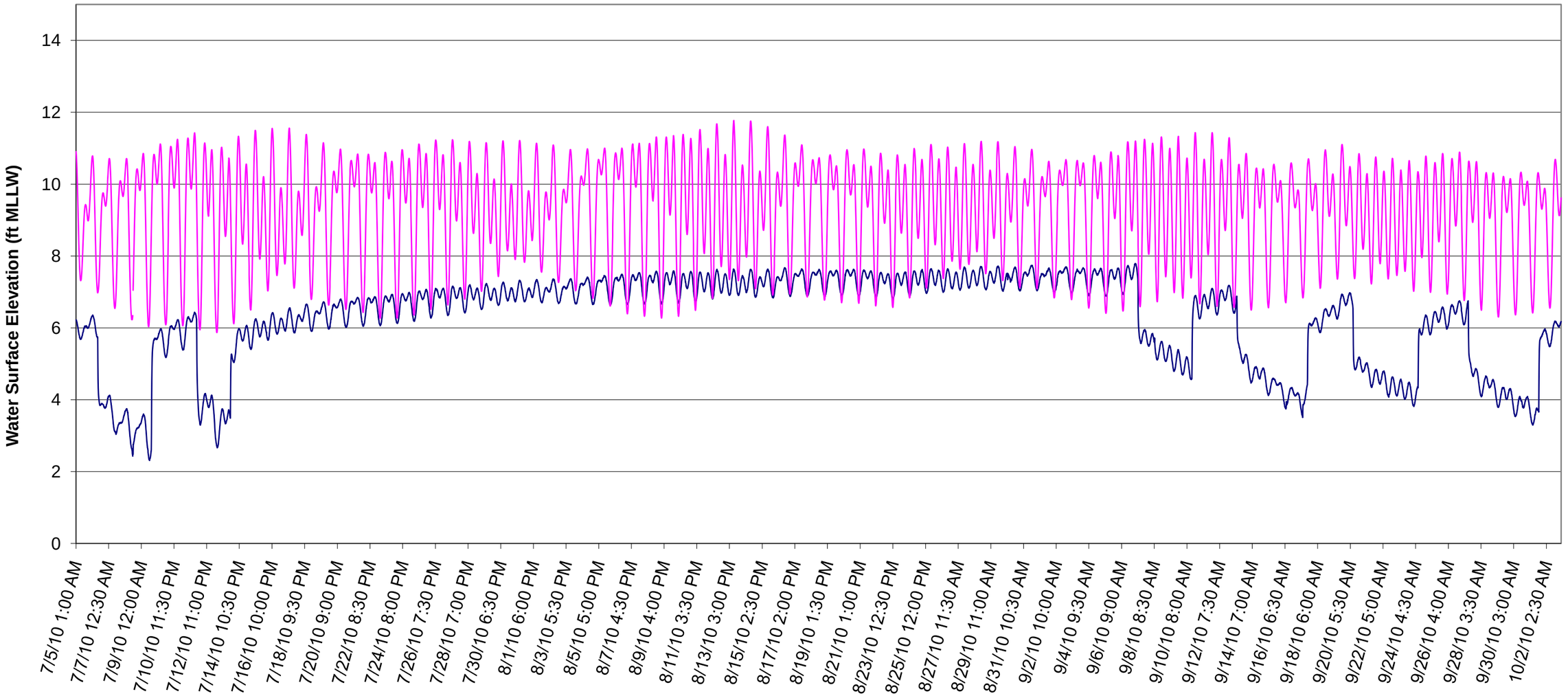


Figure 3b Well Pair Hydrographs
Upper Aquifer Well MW18 & Lower Aquifer Well CDMW01
July 5, 2010 - October 2, 2010

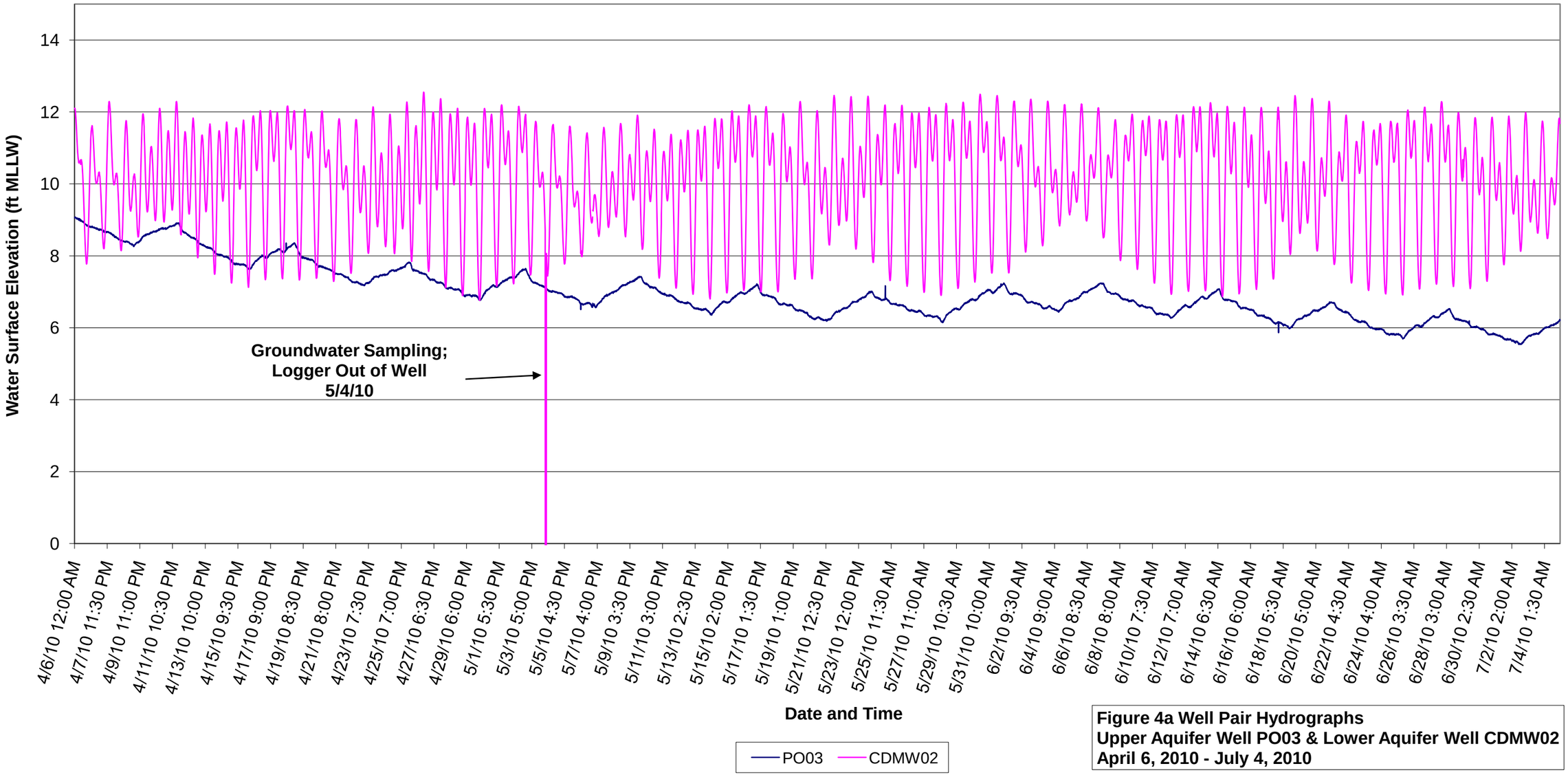


Figure 4a Well Pair Hydrographs
Upper Aquifer Well PO03 & Lower Aquifer Well CDMW02
April 6, 2010 - July 4, 2010

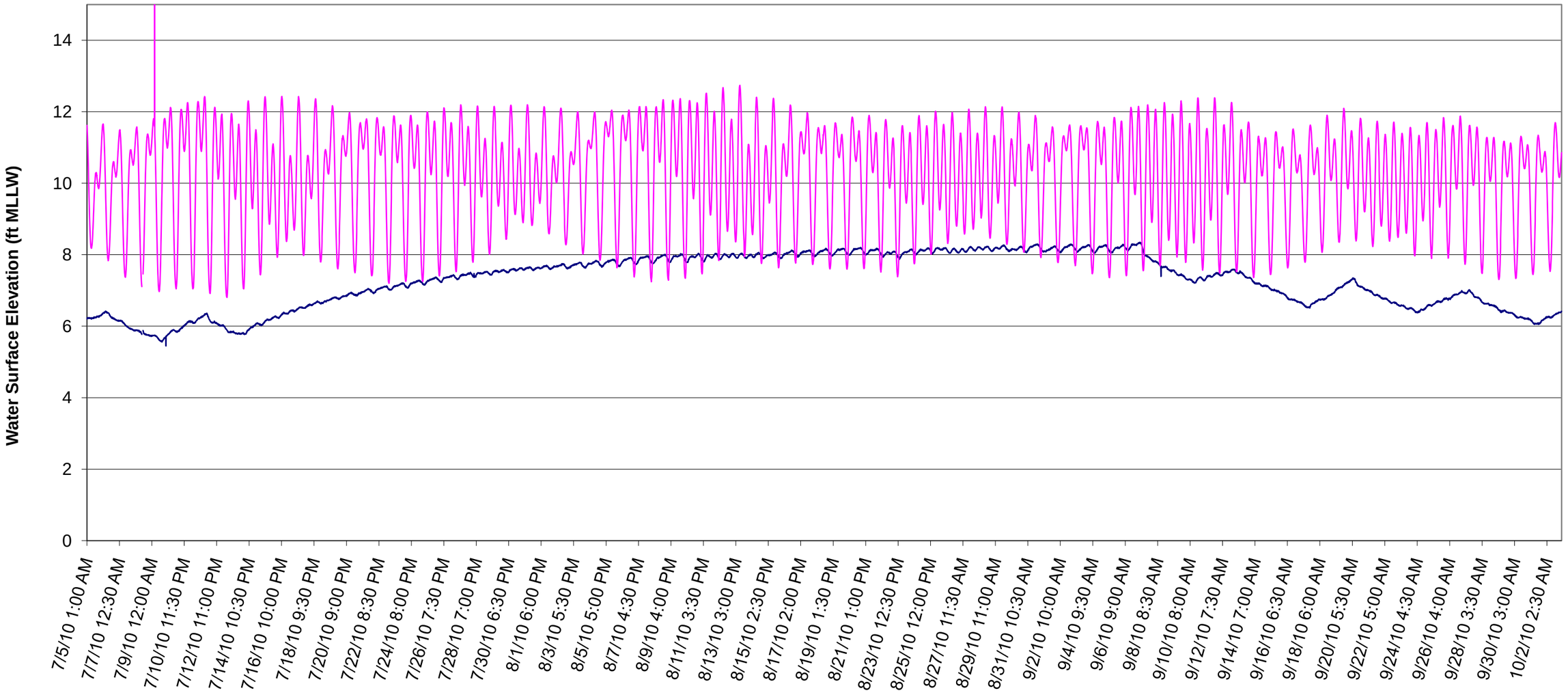


Figure 4b Well Pair Hydrographs
Upper Aquifer Well PO03 & Lower Aquifer Well CDMW02
July 5, 2010 - October 2, 2010

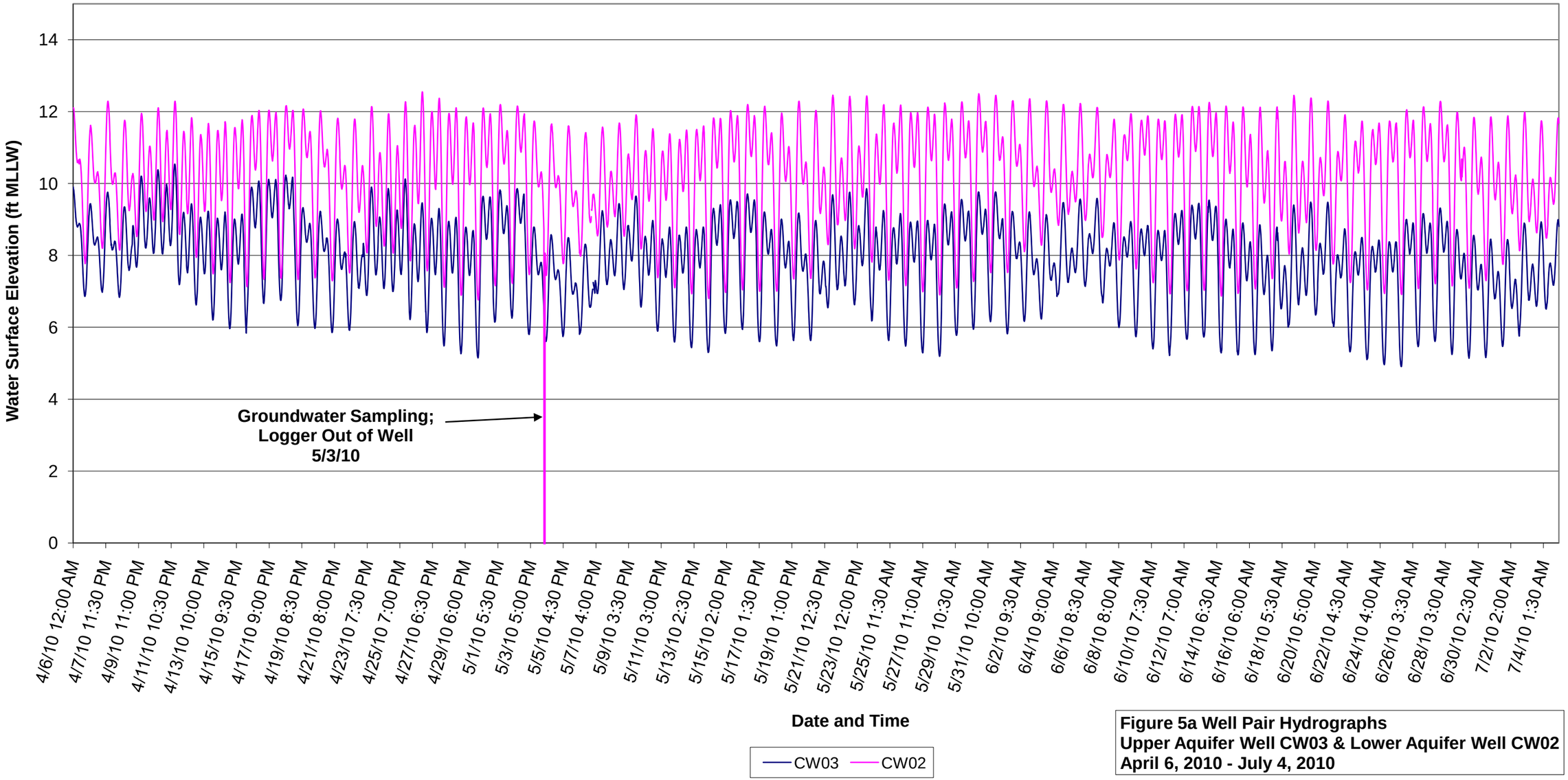


Figure 5a Well Pair Hydrographs
Upper Aquifer Well CW03 & Lower Aquifer Well CW02
April 6, 2010 - July 4, 2010

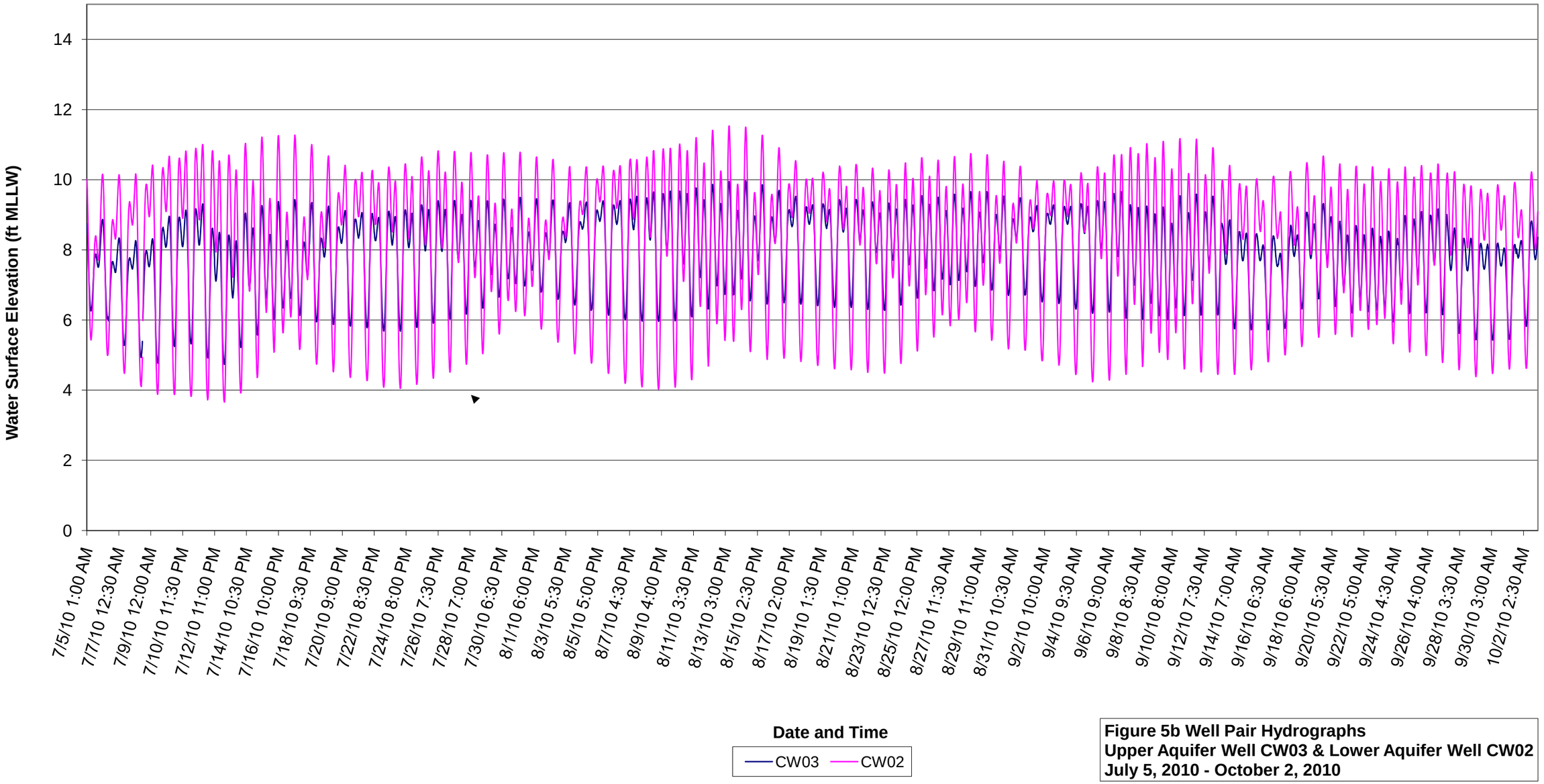


Figure 5b Well Pair Hydrographs
Upper Aquifer Well CW03 & Lower Aquifer Well CW02
July 5, 2010 - October 2, 2010

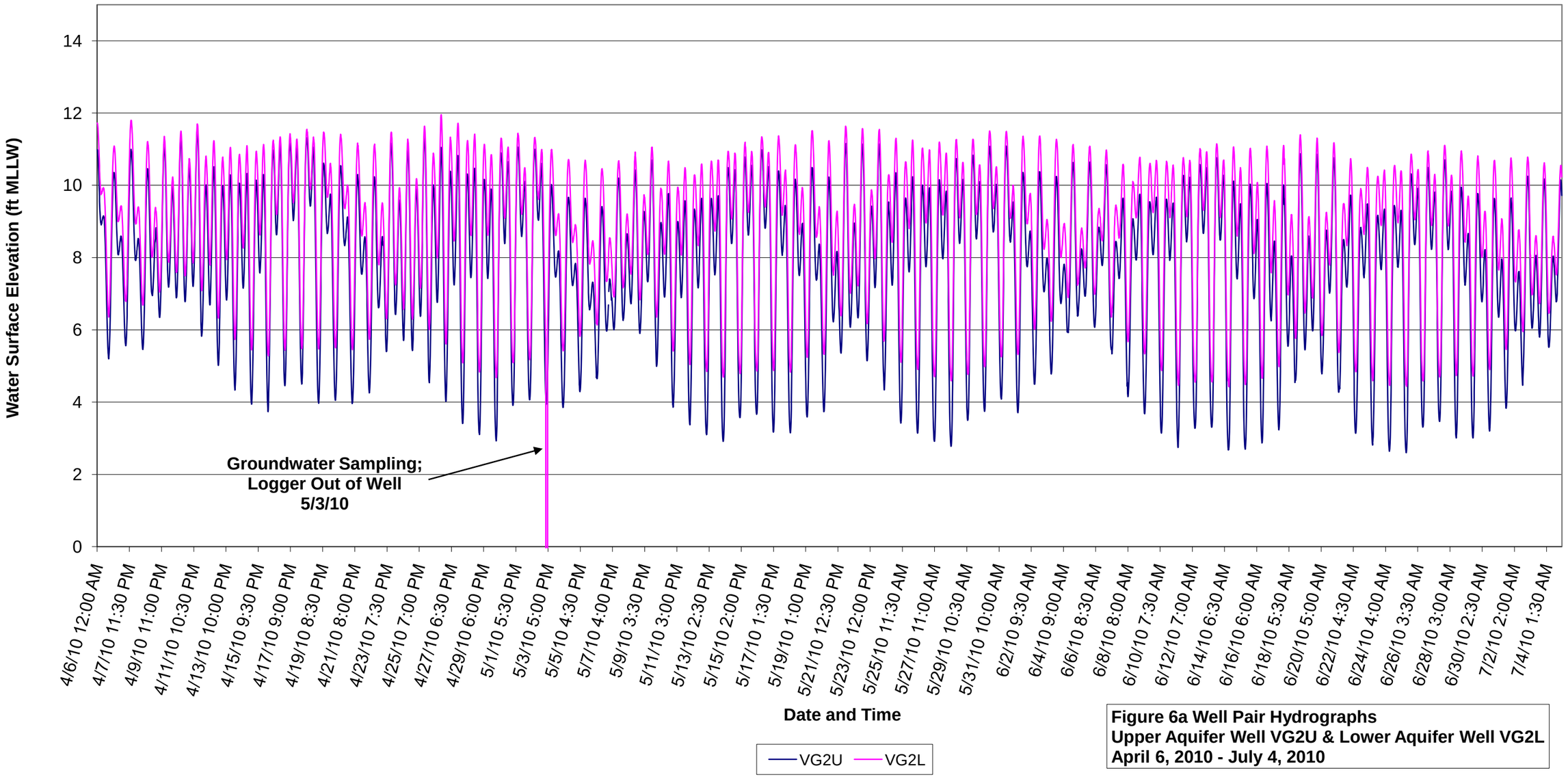


Figure 6a Well Pair Hydrographs
Upper Aquifer Well VG2U & Lower Aquifer Well VG2L
April 6, 2010 - July 4, 2010

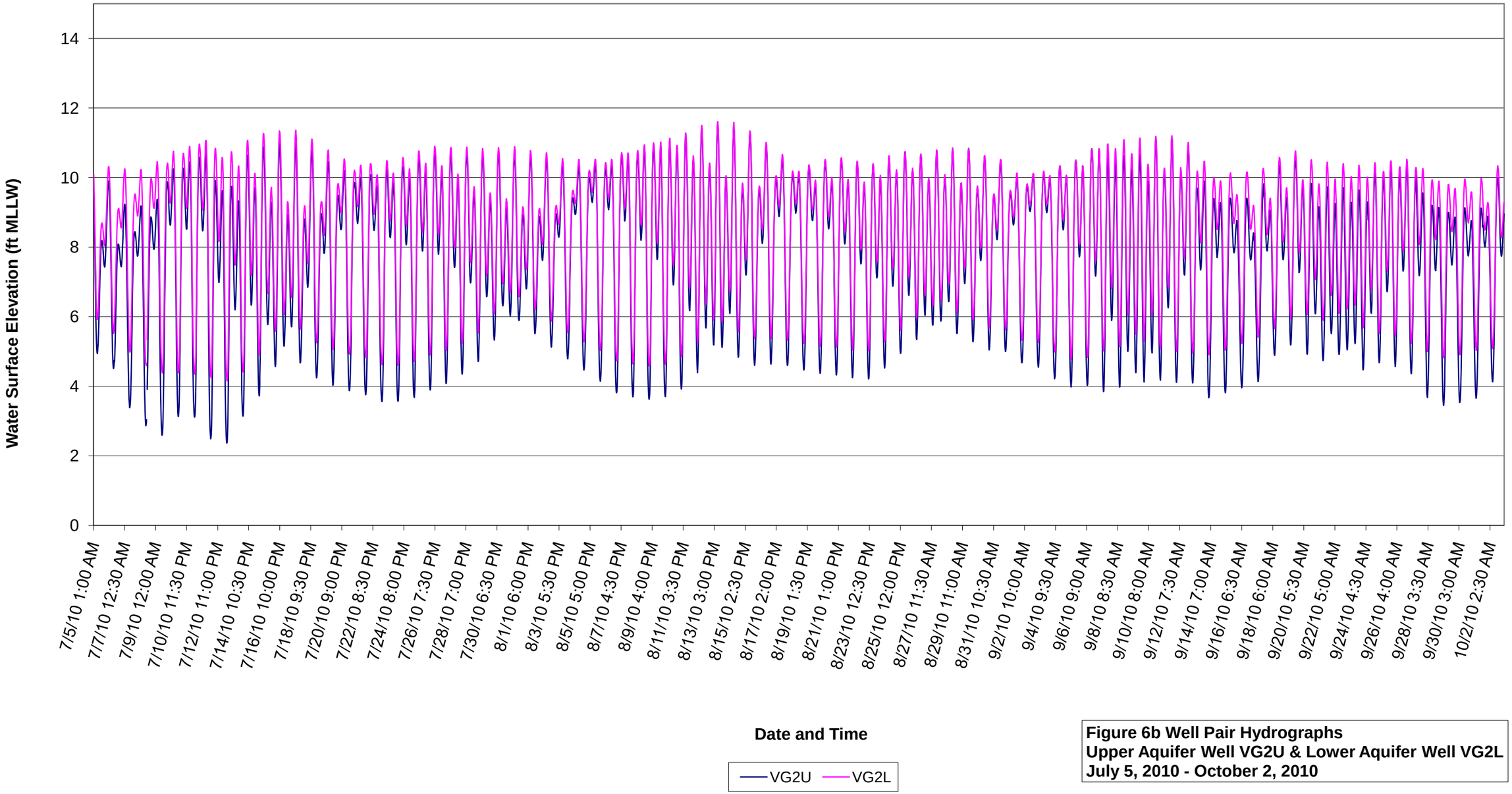


Figure 6b Well Pair Hydrographs
Upper Aquifer Well VG2U & Lower Aquifer Well VG2L
July 5, 2010 - October 2, 2010

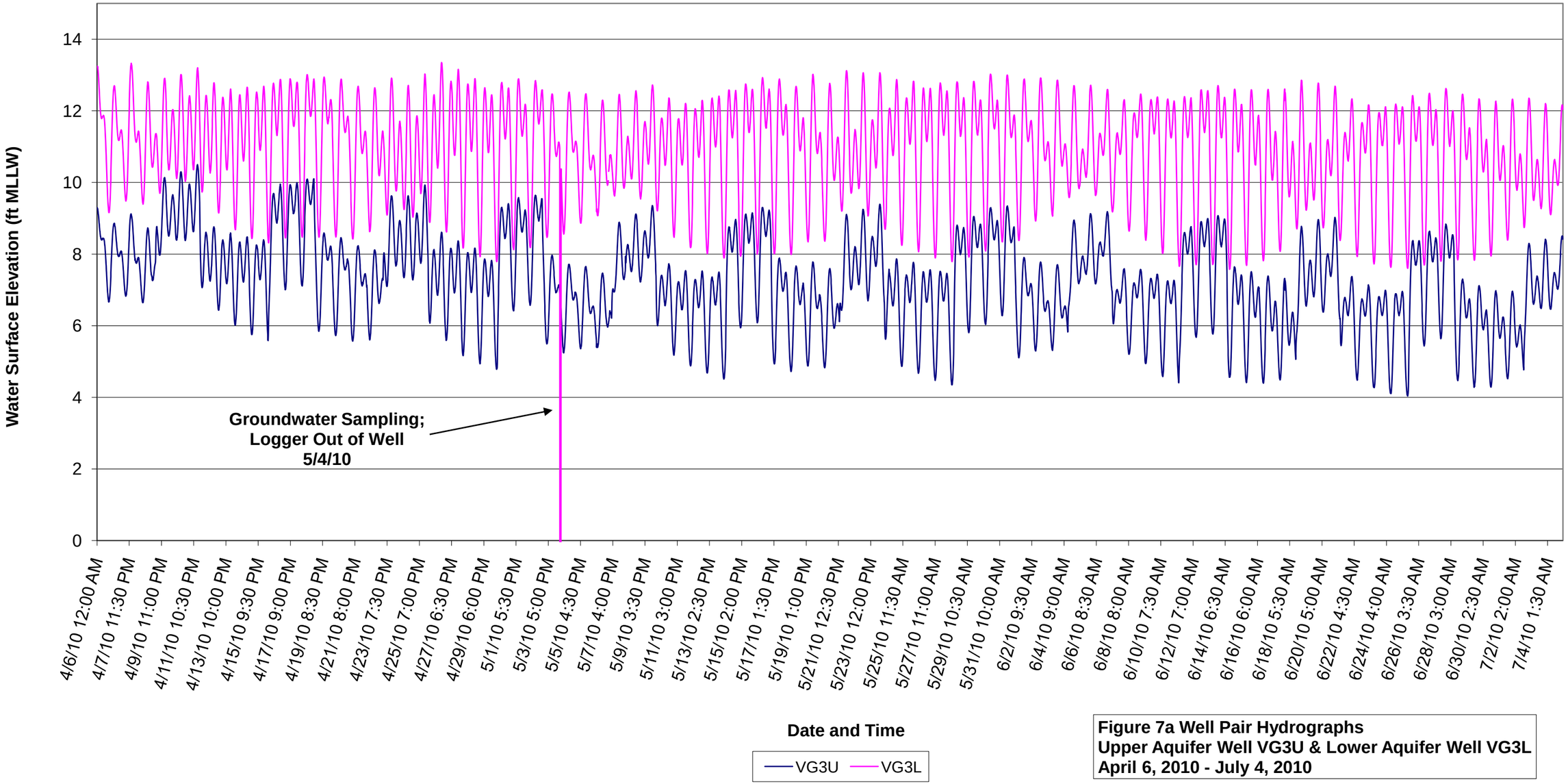


Figure 7a Well Pair Hydrographs
Upper Aquifer Well VG3U & Lower Aquifer Well VG3L
April 6, 2010 - July 4, 2010

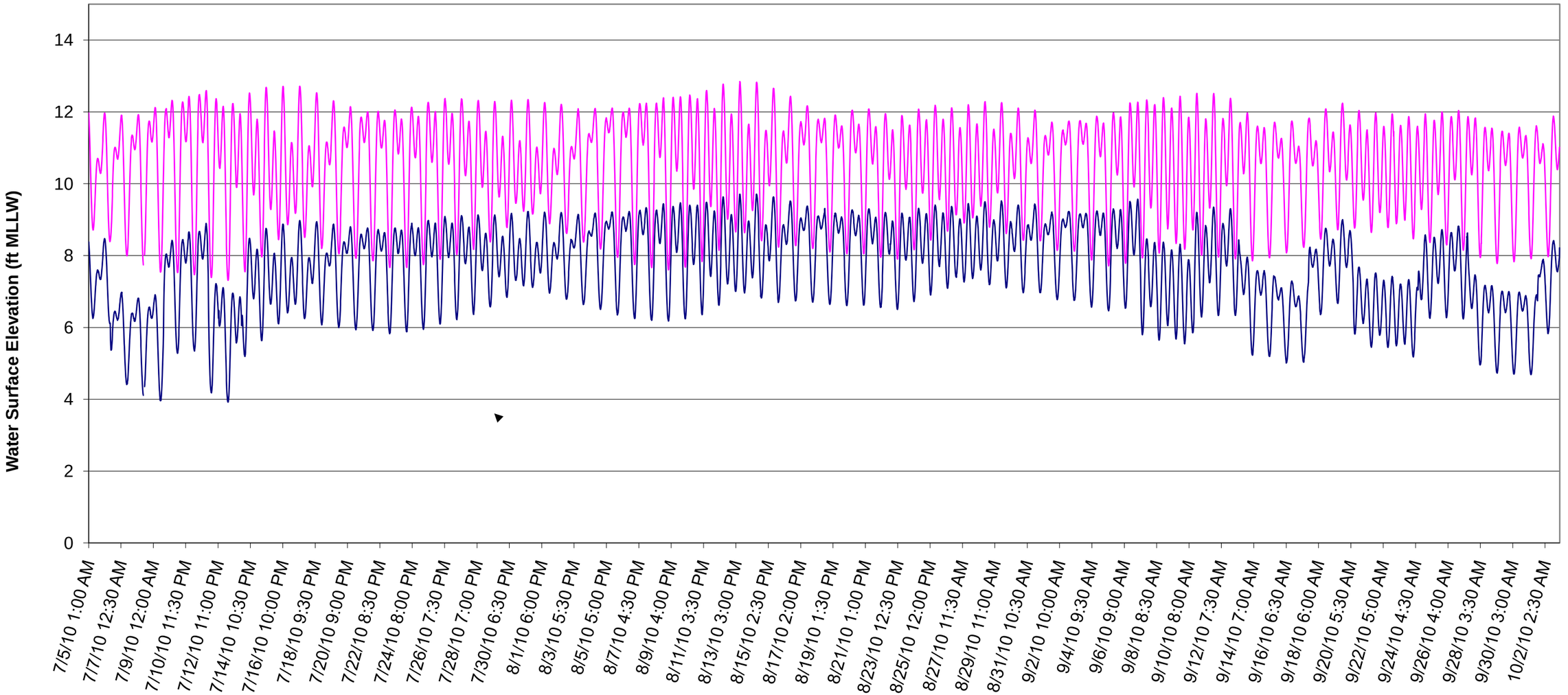


Figure 7b Well Pair Hydrographs
Upper Aquifer Well VG3U & Lower Aquifer Well VG3L
July 5, 2010 - October 2, 2010

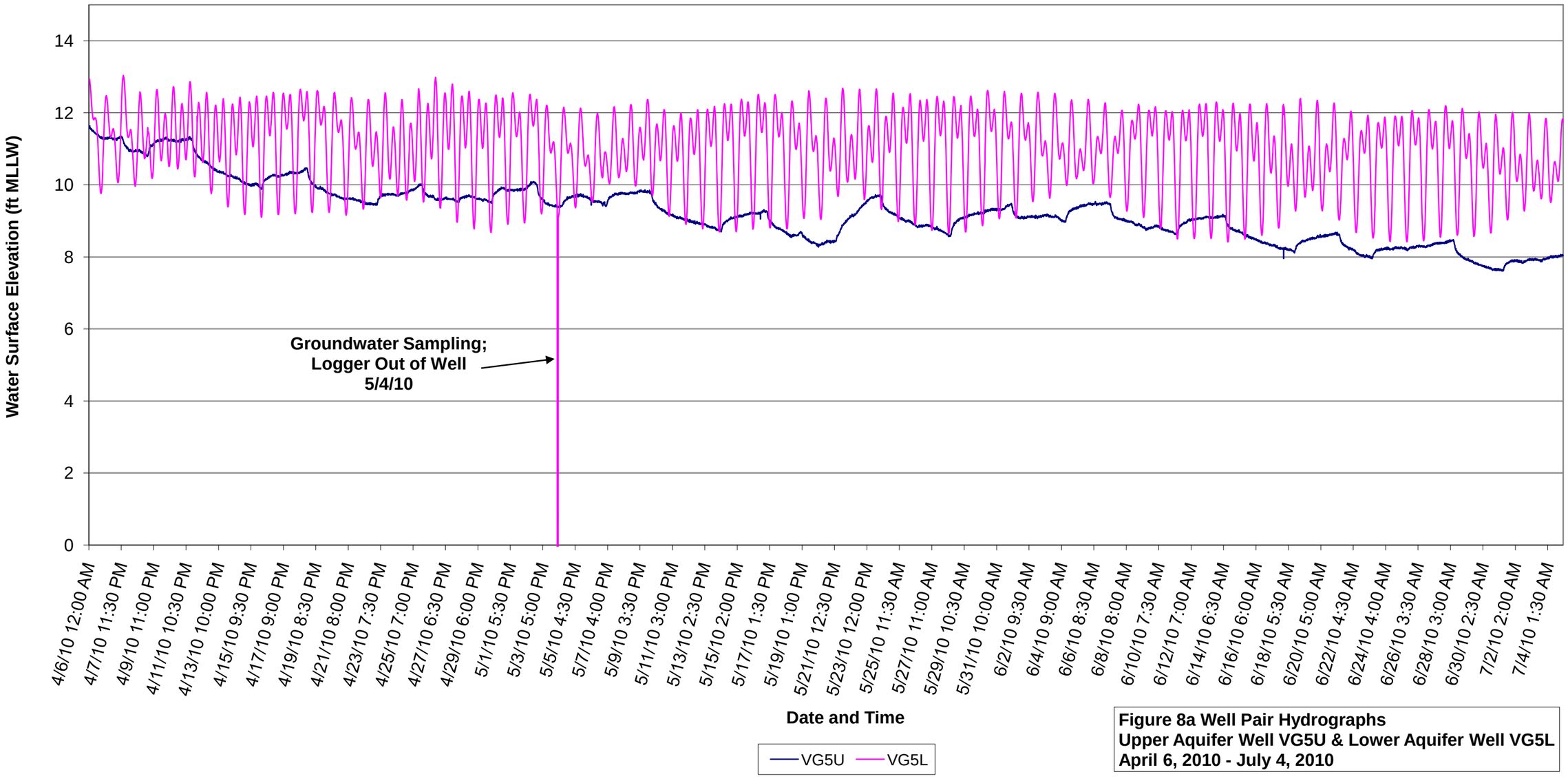


Figure 8a Well Pair Hydrographs
Upper Aquifer Well VG5U & Lower Aquifer Well VG5L
April 6, 2010 - July 4, 2010

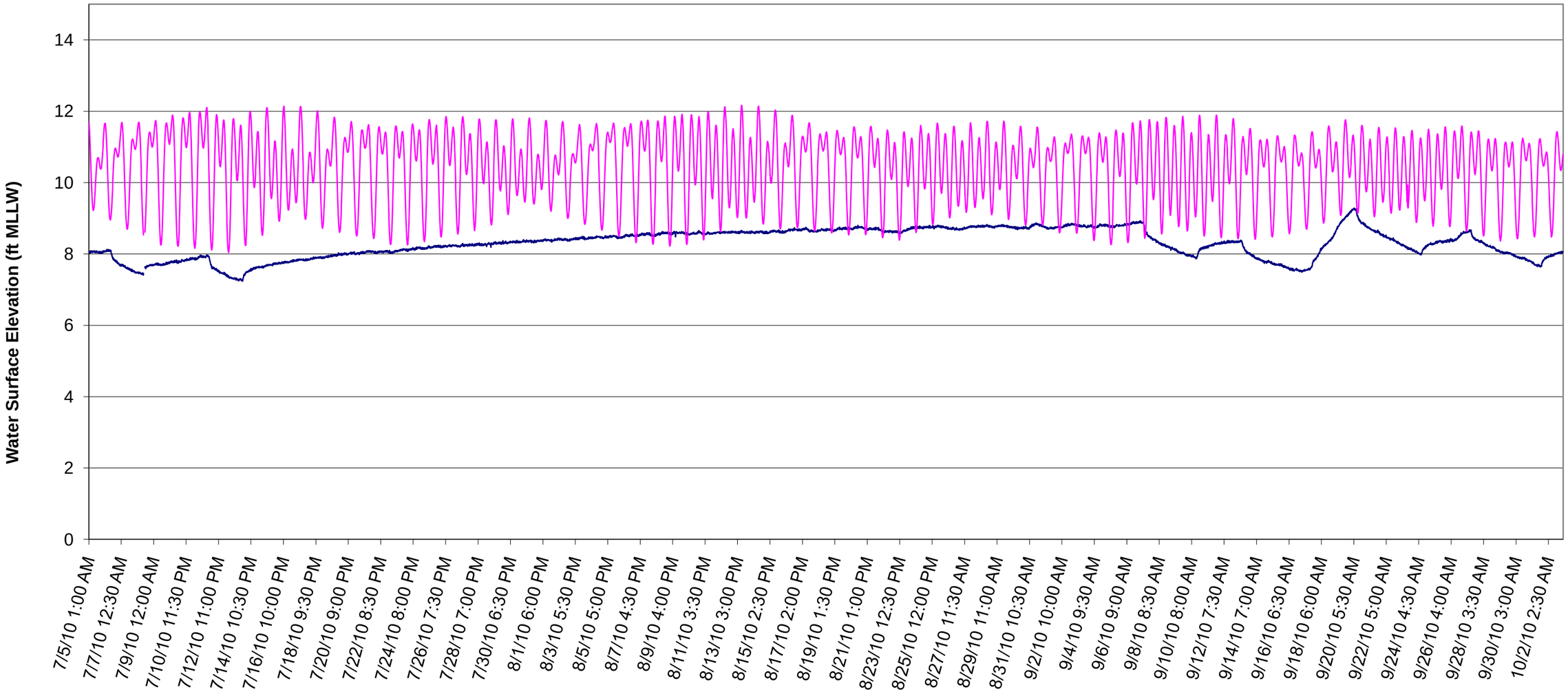


Figure 8b Well Pair Hydrographs
Upper Aquifer Well VG5U & Lower Aquifer Well VG5L
July 5, 2010 - October 2, 2010

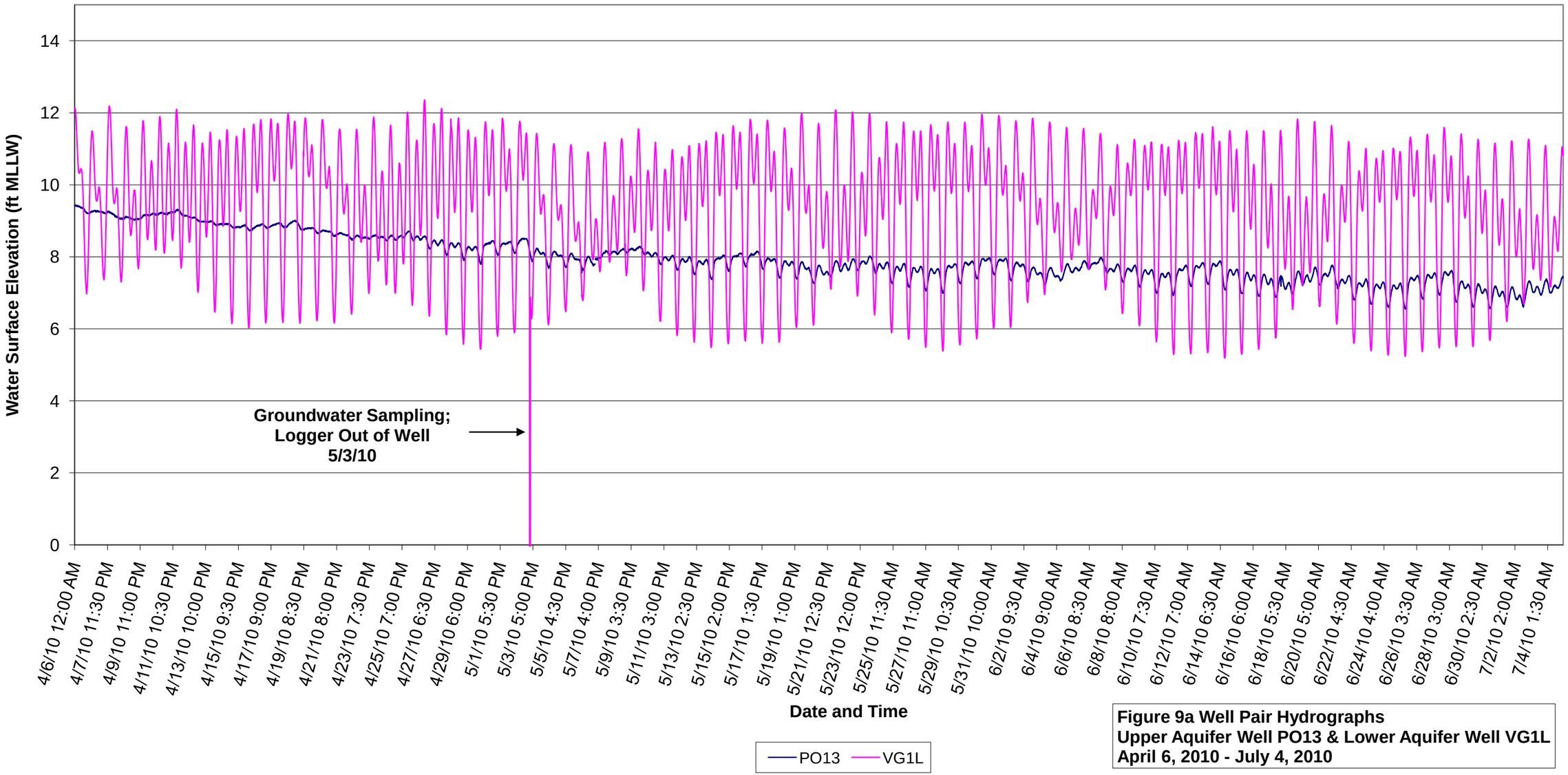


Figure 9a Well Pair Hydrographs
Upper Aquifer Well PO13 & Lower Aquifer Well VG1L
April 6, 2010 - July 4, 2010

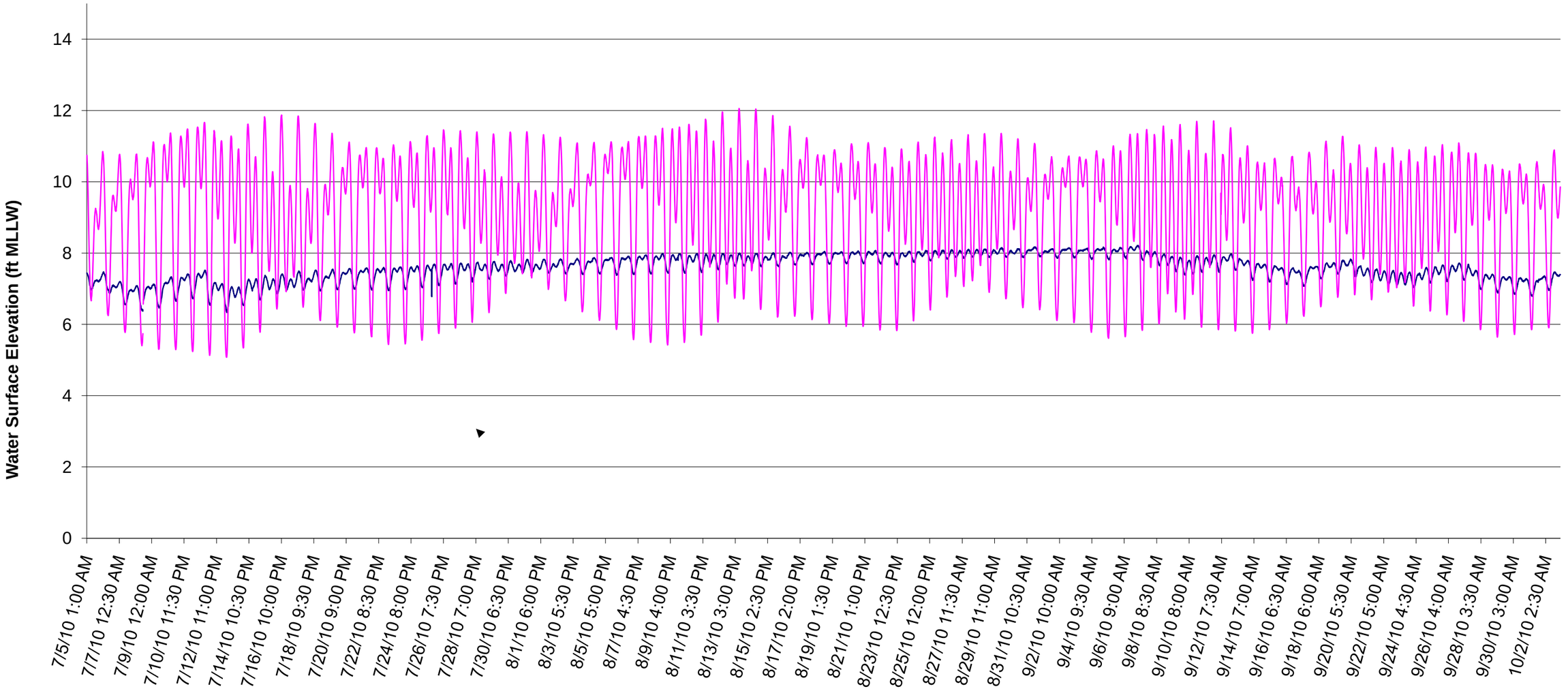


Figure 9b Well Pair Hydrographs
Upper Aquifer Well PO13 & Lower Aquifer Well VG1L
July 5, 2010 - October 2, 2010

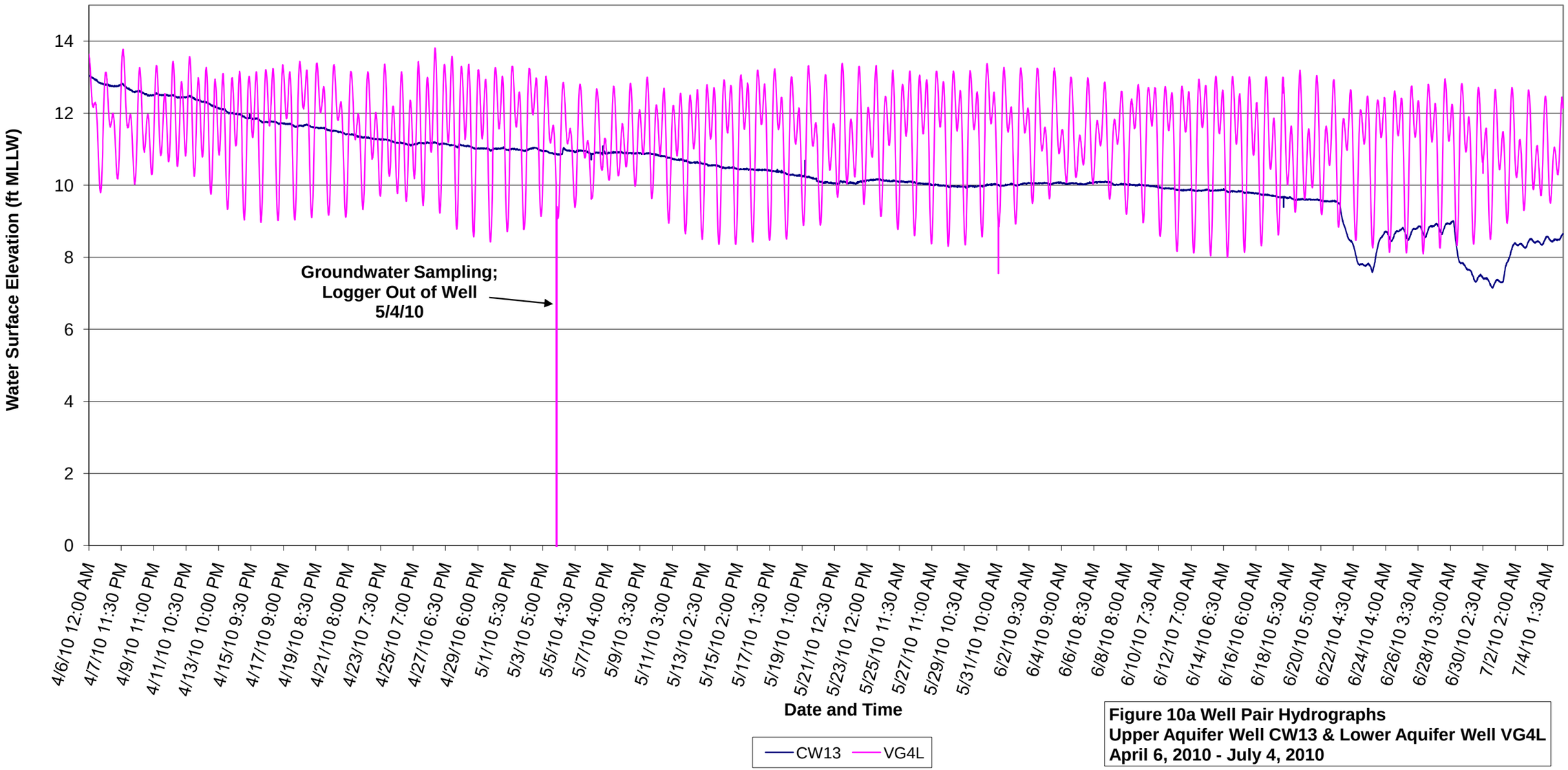


Figure 10a Well Pair Hydrographs
Upper Aquifer Well CW13 & Lower Aquifer Well VG4L
April 6, 2010 - July 4, 2010

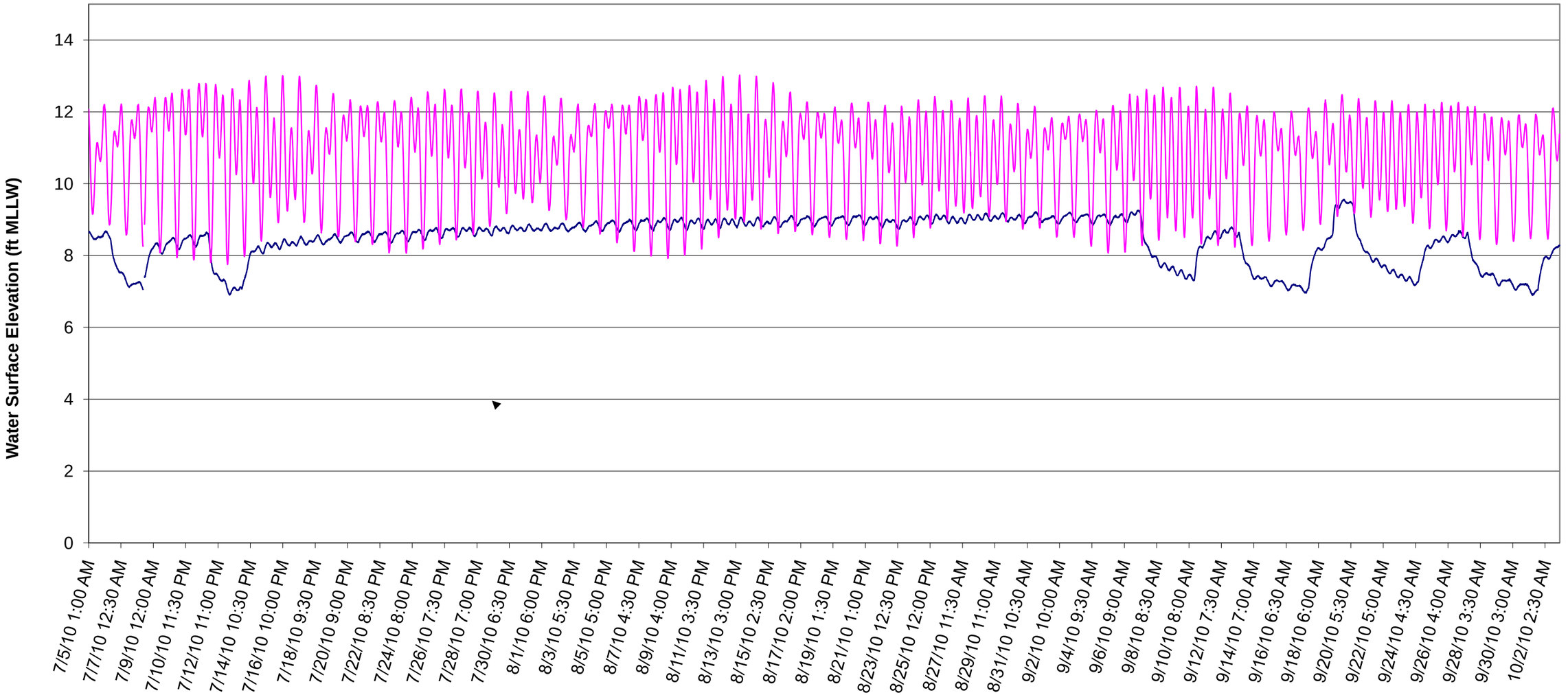


Figure 10b Well Pair Hydrographs
Upper Aquifer Well CW13 & Lower Aquifer Well VG4L
July 5, 2010 - October 2, 2010

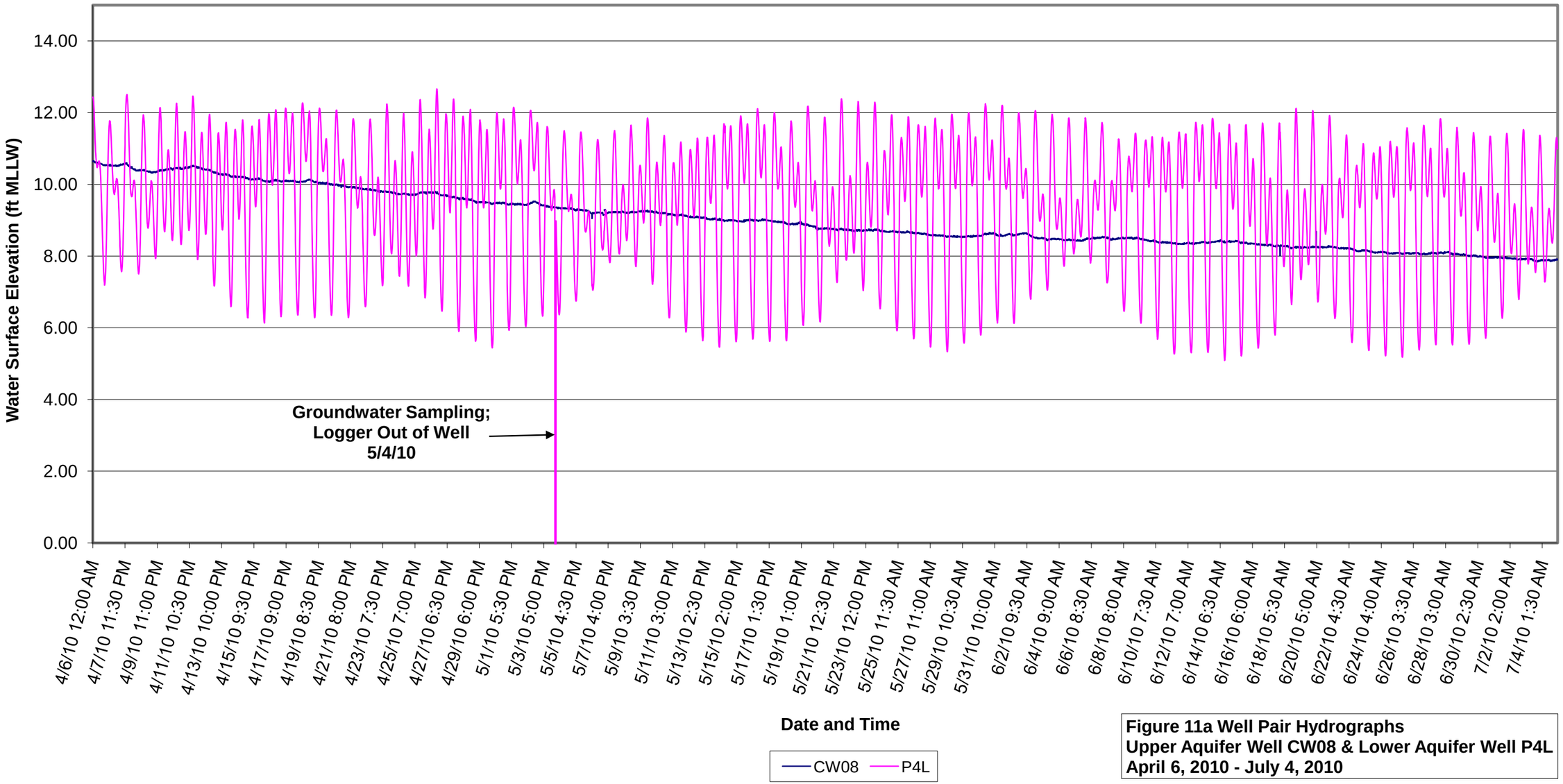


Figure 11a Well Pair Hydrographs
Upper Aquifer Well CW08 & Lower Aquifer Well P4L
April 6, 2010 - July 4, 2010

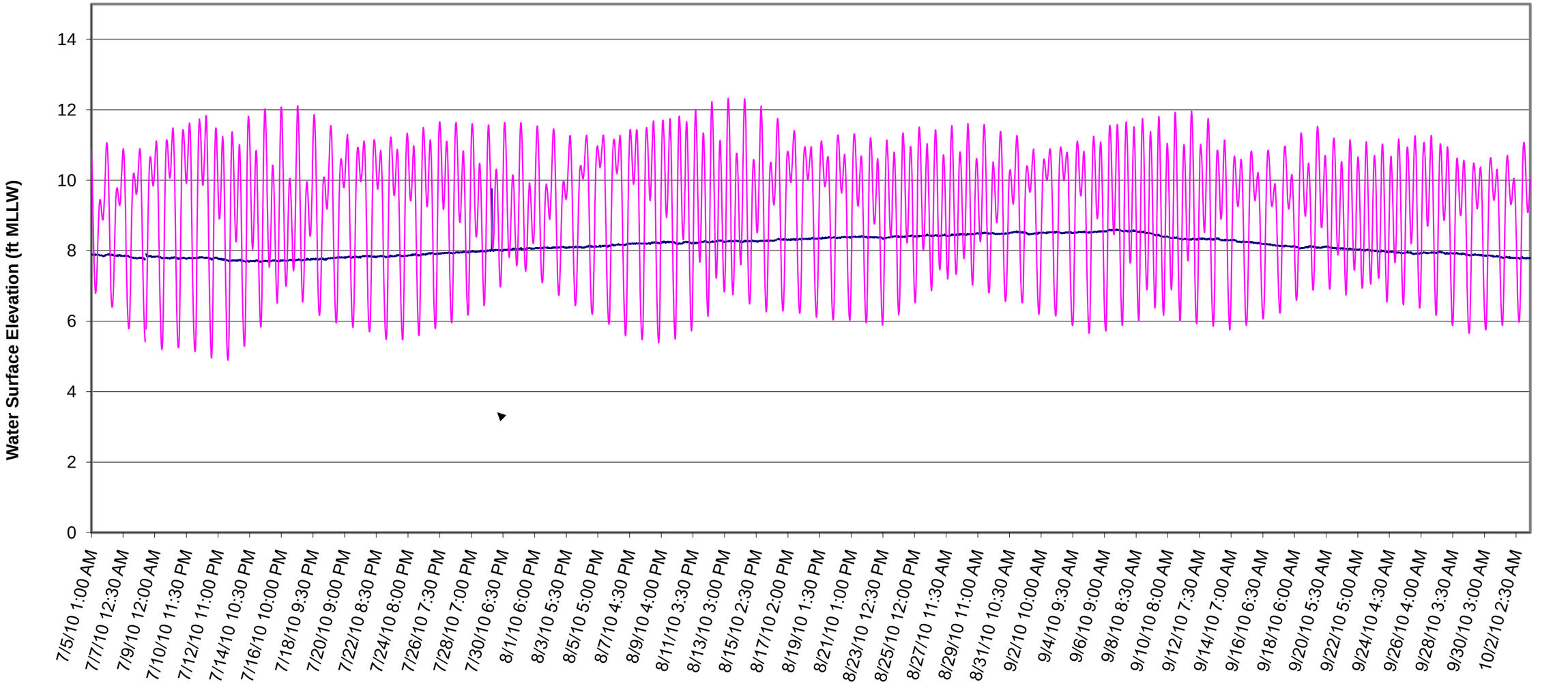


Figure 11b Well Pair Hydrographs
Upper Aquifer Well CW08 & Lower Aquifer Well P4L
July 5, 2010 - October 2, 2010

Maximum Negative Vertical Gradient

Well Pair	Period 1: Apr-Jul 2010	Period 2: Jul-Oct 2010
MW14/CW05	5/7/2010	none
MW18/02CDMW01	none	9/5/2010
PO03/99CDMW02	4/6/2010	9/5/2010
CW03/CW02	4/18/2010	none
VG2U/VG2L	none	9/6/2010
VG-3U/VG-3L	none	none
VG5U/VG5L	4/6/2010	9/5/2010
PO13/VG1L	4/16/2010	9/5/2010 - 9/6/2010
CW13/VG4L	4/6/2010	9/6/2010
CW08/P4L	4/30/2010	9/5/2010

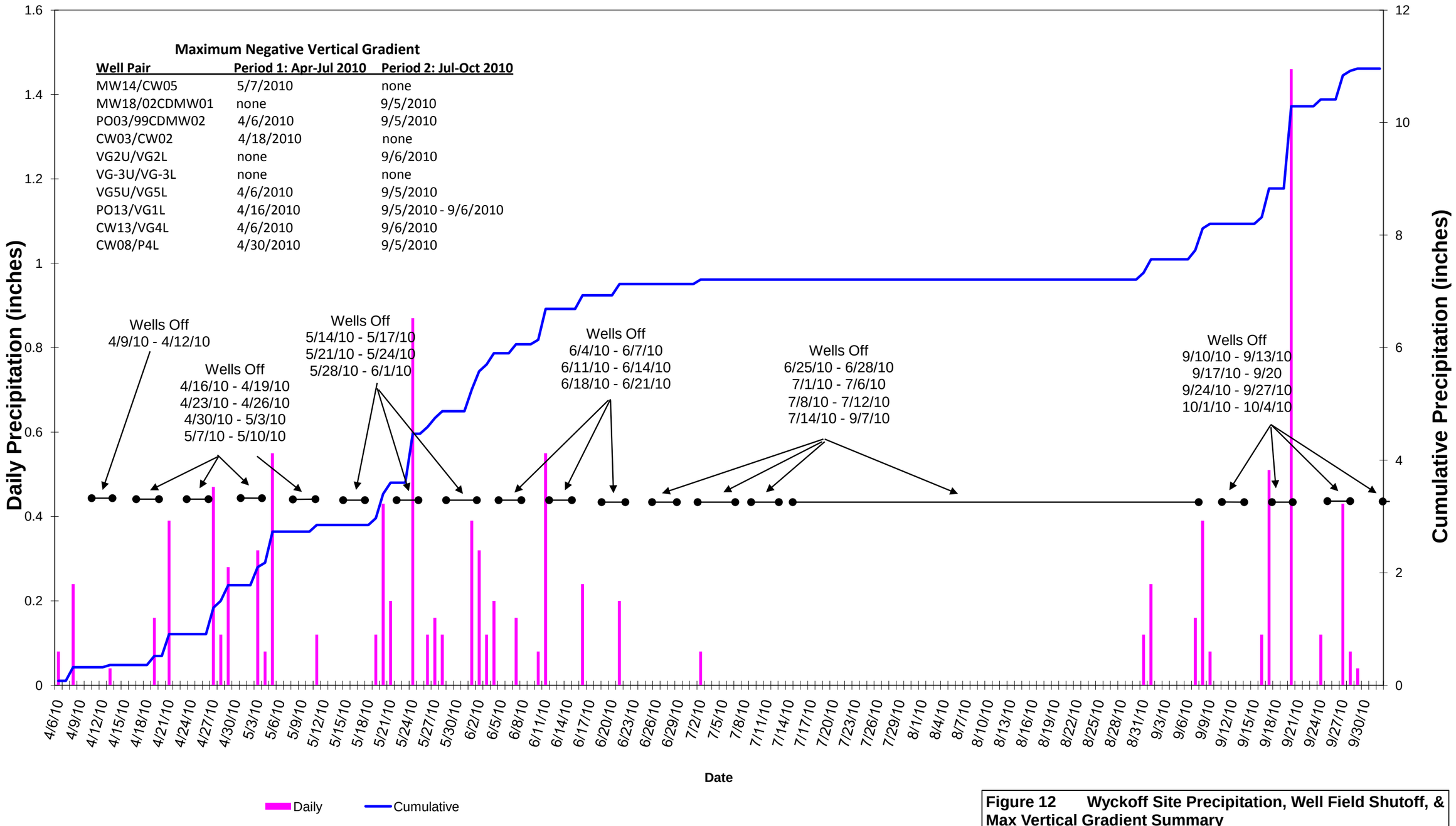


Figure 12 Wyckoff Site Precipitation, Well Field Shutoff, & Max Vertical Gradient Summary
April 6, 2010 - October 2, 2010