Final Report
Of the Chief Engineer

Prepared pursuant to K.A.R. 5-4-1

Concerning a Claim of Water Right Impairment

In the Matter of

Water Right File No. 16,111
Owned and operated by
John Hallock

March 8, 2013

David W. Barfield, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture

John Hallock, owner and operator of a well in Pawnee County, Water Right, File No. 16,111 filed a written complaint of water right impairment dated July 26, 2006 with the Stafford Field Office of the Division of Water Resources.

Data collection in the area began in the fall of 2006 and continues at a number of wells within two miles of 16,111 ("Mr. Hallock's well").

Staff from the Stafford Field Office installed equipment at the site to evaluate water levels in the area. They also assessed the pumping rate and compliance condition of the surrounding wells.

Water level transducers were first installed in the area in March, 2007; at an observation well close to Mr. Hallock's well in May, 2007; and in Mr. Hallock's redrilled well in July, 2008. The transducers and rate loggers enabled the division to monitor the pumping operations and water levels in Mr. Hallock's well, in the nearby observation well, and in three nearby irrigation wells, Water Right File Numbers: 16,125; 25,001; and 29,706.

The division recorded water level fluctuations and well drawdown for the 2009 and 2010 irrigation seasons and observed several periods of pumping interaction and impact on Mr. Hallock's well from the three wells named above. A technical report on the investigation and data analyses is attached hereto.

Based on the data collected by the division and subsequently analyzed and assembled in the technical report, I find that:

1. The source of water is a regional aquifer.
2. There is a significant degree of interaction between Mr. Hallock's well and wells in the immediate vicinity, such that the neighboring junior wells cause in excess of 40% of the drawdown in Mr. Hallock's well at critical times of the pumping session.
3. As a result, Mr. Hallock experienced significant reductions in pumping capacity and pumping depths in his well approached the top of his well screen.
4. Impairment to Mr. Hallock's well occurs when the pumping of nearby junior wells prevents water from moving to Mr. Hallock's well such that, given proper diversion works, Mr. Hallock cannot reasonably fulfill his right to beneficially use water .
5. More specifically, until further data analysis indicates otherwise, due to the significant degree of interference with the operation of Mr. Hallock's diversion works and the resulting reduction in pumping capacity caused thereby, I find that impairment to Mr. Hallock's well occurs when the water level within his well drops to less than 5 feet above the top of his well screen which is 177 feet below the surface of the well. It can be anticipated that this might occur late in the irrigation season when local pumping is heaviest and seasonal aquifer declines are most pronounced.

6. Such impairment to Mr. Hallock's water right is not substantially caused by a regional overall lowering of the water table as evidenced by the annual cycle of water level recovery when pumping ceases.

Pursuant to K.A.R. 5-4-1, this final report is posted on the agency's website as of March 8, 2013 (http://www.ksda.gov/water_management_services/content/321/cid/1745).

David Barfield, P.E.
Chief Engineer

Technical Report

Prepared pursuant to K.A.R. 5-4-1

On the Investigation of
A Claim of Water Right Impairment

In the Matter of

Water Right File No. 16,111
Owned and operated by
John Hallock

Phases I & II:

Technical Evaluation
Of the Merits of the Complaint
And
Monitoring and Analysis of Hydrologic Conditions
And Operational Practices

May 11, 2011

John W. Munson
James O. Bagley, P.E.
Division of Water Resources
Kansas Department of Agriculture

SUMMARY

John Hallock, owner and operator of a well in Pawnee County, Water Right, File No. 16,111 filed a written complaint of water right impairment dated July 26, 2006 with the Stafford Field Office of the Division of Water Resources.

Data collection began August 1, 2006 and continued through 2007 at wells within two miles of 16,111 ("Mr. Hallock's well"). In the course of the investigation it was determined that Mr. Hallock's well was defective.

Mr. Hallock drilled a nearby replacement well in July 2008, located 42 feet from the originally permitted well. Review of the driller's log indicates that the replacement well fully penetrates the productive aquifer in this area and is screened in the most productive zone of the aquifer. See Attachments 1 and 2. Pumping and DWR monitoring of Mr. Hallock's well began July 29, 2008. Monitoring continued through 2010 and is ongoing.

Because a full year of pumping and water level data was collected in the investigation area in 2009, and because similar observations are apparent from analyzing the available 2010 data, this report is based primarily on the calendar year 2009 data.

Analysis of the data indicates that the coincident pumping of nearby wells evidences significant well-to-well interaction with pumping at Mr. Hallock's well. This well-to-well interaction caused the water level to be drawn down to within at least 17 feet[1] of the top of the well screen in Mr. Hallock's well in August, 2009, when Mr. Hallock's pumping alone caused 45.2 feet of drawdown in his own well and the pumping of neighboring wells caused an additional 34.3 feet of drawdown at Mr. Hallock's well; an additional 75.9 percent. Coincident pumping caused water levels to be drawn down to within 8 feet of his well screen in August, 2010. See Attachments 1, 2, 6, and 9.

The early season pumping rate at Mr. Hallock's well in March 2009 was 740 gallons per minute. Actual rate measurements in August, 2009 show that, with nearby pumping, the rate at Mr. Hallock's well reached a minimum of 663 gallons per minute — a 10 percent reduction in rate — with a maximum recorded drawdown of 79.5 feet. This drawdown caused the water level in Mr. Hallock's well to fall to at least 164.5 feet. See Attachments 3 and 6.

In each of the years 2008-2011, in the spring, after water levels have recovered from the previous year's pumping, the water level returns to approximately 69 feet below the top of the observation well near Mr. Hallock's well. DWR has observed no evidence of a regional overall lowering of the water table.

[1] The constant depth to water recorded in Mr. Hallock's well on August 16, 2009 as show in Attachment 6 indicates that the depth to water may have exceeded the length of the transducer measuring the water level. If so, the pumping level would have been even closer to the top of the well screen.

PUMPING SYSTEM

The pump in Mr. Hallock's well is driven with a 60 horsepower electric motor. Pumping rates were logged every 30 minutes between March 22 and March 26, 2009. The maximum rate during this period was 746 gallons per minute; the minimum was 735 gallons per minute; the average was 740 gallons per minute. These were the highest rates recorded at Mr. Hallock's well during 2009 and occurred after three nearby wells had pumped for several days each. See Attachment 3.

The electric motor driving the pump is not variable and operated at a constant speed during the year. Pump curves and other technical characteristics of the pump and motor are not available. The gearing of the drive was not changed during the year.

On August 14, 2010, when nearby wells were pumping, Mr. Hallock's system pumped 642 gallons per minute when the water level had been drawn down to 174 feet; 8 feet above the top of the well screen. See Attachment 9. DWR finds that Mr. Hallock's pumping system did not limit his ability to fulfill his water right in 2009 and 2010.

COLLECTION OF PUMPING OPERATIONS AND WATER LEVEL DATA

On July 29, 2008, DWR installed water level sensors with data loggers at Mr. Hallock's well (16,111). The pumping rate of Mr. Hallock's well was monitored with a rate logger. Water levels at an observation well (obs16111) located 79 feet away from Mr. Hallock's well were monitored with a water level sensor and data logger. Pumping of the nearest irrigation well to the west (16,125) was monitored with a rate logger. Pumping of the nearest irrigation well to the south (25,001) was monitored with a water level sensor at a deep well casing (cas25001) located 32 feet from the irrigation well. Pumping of the nearest irrigation well to the southwest (29,706) was monitored with a water level sensor at the irrigation well.

Pumping of the nearest irrigation well to the northeast (20,837) was not monitored due to in part to functional issues with the water meter and in part to the quantity of water used at the site. Water use reports submitted to DWR indicate that 20,837 pumped 44.5 acre feet of water in 2009 and 26 acre-feet in 2010. DWR contacted the operator of 20,837 regarding the meter issues and those issues have been addressed. Because of the relatively small quantity of water reported, pumping by 20,837 was determined not to have a significant impact on Mr. Hallock's well in 2009 and that pumping was not considered in the analyses of the 2009 and 2010 data.

The four nearest irrigation wells are junior in priority to Mr. Hallock's well and are located 1,349 feet (site 16,125); 1,800 feet (site 25,001); 3,218 feet (site 20,837); and 3,222 feet (site 29,706) from Mr. Hallock's well.

Pumping of two other deep irrigation wells, both senior in priority to Mr. Hallock's well, were monitored with water level sensors either at the irrigation well or at a nearby

casing. The more distant senior water rights monitored were site 11,601 located 5,492 feet west-southwest and site 12,270 located 5,748 feet east of Mr. Hallock's well.

Pumping of two other deep irrigation wells; 16,117 and 17,091; located about the same distances from the Mr. Hallock's well as sites 11,601 and 12,270; was not monitored.

Figure 1 - Local Area of Investigation. Mr. Hallock's well is denoted by the star symbol

Pumping at 25,001 was out of compliance, exceeding the authorized rate of 470 gallons per minute, for all of 2009. DWR addressed this issue and it was resolved in 2010.

AQUIFER TEST

An aquifer test spanning 66 days and focused on Mr. Hallock's well began on February 24, the first day the well was pumped in 2009. The test included data gathered while the two nearest junior water rights 16,125 and 25,001 and a more distant senior

water right 11,601 all had periods of pumping. The aquifer test ended when the water level fully recovered on May 1. Recorded pumping data was analyzed with AQTESOLV aquifer test analysis software. An aquifer transmissivity of 3,909.7 feet^2/day (29,245 gallons per day/foot) and a storage coefficient of 0.0003155 were computed from this test. See Attachment 8.

OBSERVATIONS

Over the course of the 2009 irrigation season, significant well-to-well interaction between Mr. Hallock's well and nearby pumping wells was observed.

At the beginning of 2009, after water levels had recovered over the winter months, Mr. Hallock's irrigation system pumped water at a rate of 740 gallons per minute ("early season rate").

While Mr. Hallock's system was not operating, pumping of nearby wells caused the water level in the observation well (obs16111) to fall from 77 feet below the top of the observation well on June 24 to 132 feet below the top of the observation well on July 25. When Mr. Hallock began pumping on July 29, his rate averaged 700 gallons per minute.

The greatest impacts of nearby pumping occurred in mid-August. While Mr. Hallock's system was not operating, pumping of nearby wells caused the water level in the observation well (obs16111) to fall from 116 feet on August 10 to 131 feet on August 14. When Mr. Hallock's well was pumped from August 14 – 17, the rate averaged 675 gallons per minute; a 9% reduction from the early season rate and the greatest average reduction to rate observed during the year. During this period, the rate at Mr. Hallock's well dropped to the lowest observed value of the season, 663 gallons per minute.

Annotated graphics were developed using the collected data. See Attachments 3 through 7.

IMPACTS

Direct well to well interaction occurs between the well authorized under Water Right, File No. 16,111 and the wells authorized by Water Right, File Nos. 16,125; 25,001; and 29,706. If Water Right, File No. 20,837 was exercised at or near its authorized rate of 765 gallons per minute and authorized quantity of 195 acre-feet, DWR assumes it would have roughly the same impact on Mr. Hallock's well as File No. 29,706 due to 20,837 being roughly the same distance from his well. However, due to the relatively small amount of pumping (44.5 acre-feet) reported under 20,837 in 2009; DWR assumes that its impacts to Mr. Hallock's well were negligible in 2009. The 2010 water use report for 20,837 showed only 26 acre-feet pumped and DWR again assumed negligible impacts to Mr. Hallock's well due to pumping at 20,837.

The impact on Mr. Hallock's pumping operation caused by the pumping of specific nearby wells was determined by using the collected data, the Theis equation, and the principle of superposition. On August 16, during the period when nearby pumping caused the greatest reduction in the pumping rate at Mr. Hallock's well, Theis analysis of data measured at the observation well (obs16111) shows that the relative contributions were:

- Pumping by 16,125 caused 11.3 feet of the total drawdown and 36% of the reduction in rate.
- Pumping by 25,001 caused 10.8 feet of the total drawdown and 34% of the reduction in rate.
- Pumping by 29,706 caused 9.6 feet of the total drawdown and 30% of the reduction in rate.
- Pumping by 20,837 was minimal compared to nearby irrigation wells, and impacts to Mr. Hallock's well were considered negligible in 2009 and 2010. However, impacts would be significant if 20,837 were exercised at or near its authorized rate and quantity.

The depth to water at Mr. Hallock's irrigation well on August 16, 2009 may have exceeded the depth of the water level sensor that was set at 164.5 feet when the depth to water at the observation well was measured at 151 feet. For the 2010 irrigation season a longer transducer was installed to a depth of 190 feet in Mr. Hallock's irrigation well. On August 14, 2010 the depth to water reading at Mr. Hallock's irrigation well was 174 feet while the depth to water reading at the observation well reached 157 feet. Critical points of interest regarding depth to water readings at Mr. Hallock's irrigation well are:

- The depth to water at the irrigation well of 174 feet, reached on August 14, 2010, is only 8 feet from the top of the well screen at 182 feet. See Attachments 2 and 9.
- Mr. Hallock's irrigation well pumped at 660 gallons per minute while the water level was 174 feet and dropped to 642 gallons per minute before it was turned off. See Attachment 9.
- The well driller pumped 946 gallons per minute at a depth of 167.5 feet or 169.5 feet from the top of a 24 inch casing on July 23, 2008 and Mr. Hallock pumped 670 gallons per minute at the same depth on August 3, 2010. See Attachments 1 and 9.
- Mr. Hallock's irrigation well dropped to 681 gallons per minute while pumping continuously at a depth to water of between 155 feet to 165 feet during June 30 to July 5, 2010. See Attachment 9.
- If nearby pumping causes the water level at the observation well to fall below 115 feet while Mr. Hallock's well is not pumping, and nearby pumping continues, the

expected rate of Mr. Hallock's well when it begins operation is less than 700 gallons per minute. See Attachments 5 and 6.

- If Mr. Hallock's well was the only well pumping, the maximum depths to water at his irrigation well due to only his well pumping in 2009 and 2010 would not have exceeded 125 feet. Observed depth to water reached 174 feet with nearby wells pumping. See Attachments 9, 10 and 11.

Attachment 1 – Driller's Log of Mr. Hallock's well as completed August 13, 2008

WATER WELL RECORD **Form WWC-5** Division of Water Resources; App. No. 16111

1 LOCATION OF WATER WELL: County: Pawnee | Fraction: SE ¼ SW ¼ NW ¼ | Section Number: 27 | Township Number: T 22 S | Range Number: R 16 E/W

Distance and direction from nearest town or city street address of well if located within city? 4½ South, 3/4 East of Larned

Global Positioning Systems (decimal degrees, min. of 4 digits) Latitude: Longitude: Elevation: Datum: Data Collection Method:

2 WATER WELL OWNER: John Hallock
RR#, St. Address, Box # : 854 100th Ave
City, State, ZIP Code : Larned, Ks. 67550

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX: N / W / E / S; NW, NE, SW, SE

4 DEPTH OF COMPLETED WELL 212 ft.

Depth(s) Groundwater Encountered (1)..... ft. (2)..... ft. (3)..... ft.
WELL'S STATIC WATER LEVEL 120 ft. below land surface measured on mo/day/yr 7-23-08.
Pump test data: Well water was 164 ft. after 4 hours pumping 900 gpm
Est. Yield 946 gpm: Well water was 167½ ft. after 4½ hours pumping 946 gpm
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
1 Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Incustrial 7 Domestic (lawn & garden) 10 Monitoring well .....

Was a chemical/bacteriological sample submitted to Department? Yes ..... No X; If yes, mo/day/yrs Sample was submitted..... Water well disinfected? Yes HTH. No .....

5 TYPE OF CASING USED: 5 Wrought Iron 8 Concrete tile CASING JOINTS: Glued X Clamped.....
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded.....
2 PVC 4 ABS 7 Fiberglass ..... Threaded.....
Blank casing diameter 16 in. to 182 ft., Diameter. ..... in. to ..... ft., Diameter ..... in. to ..... ft.
Casing height above land surface 24 in., Weight Sch 40 lbs./ft. Wall thickness or guage No. .....
TYPE OF SCREEN OR PERFORATION MATERIAL:
1 Steel 3 Stainless Steel 5 Fiberglass 7 PVC 9 ABS 11 Other (Specify) .....
2 Brass 4 Galvanized Steal 6 Concrete tile 8 RM (SR) 10 Asbestos-Cement 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE:
1 Continuous slot 3 Mill slot 5 Gauzed wrapped 7 Torch cut 9 Drilled holes 11 None (open hole)
2 Louvered shutter 4 Key punched 6 Wire wrapped 8 Saw cut 10 Other (specify) .....
SCREEN-PERFORATED INTERVALS: From 212 ft. to 182 ft., From ..... ft. to ..... ft.
From ..... ft. to ..... ft., From ..... ft. to ..... ft.
GRAVEL PACK INTERVALS: From 212 ft. to 20 ft., From ..... ft. to ..... ft.
From ..... ft. to ..... ft., From ..... ft. to ..... ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other hole plug
Grout Intervals: From ..... ft. to ..... ft., From ..... ft. to ..... ft., From 20 ft. to 0 ft.
What is the nearest source of possible contamination:
1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 13 Insecticide storage 16 Other (specify below)
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 14 Abandoned water well House
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 15 Oil well/gas well
Direction from well? West How many feet? 900

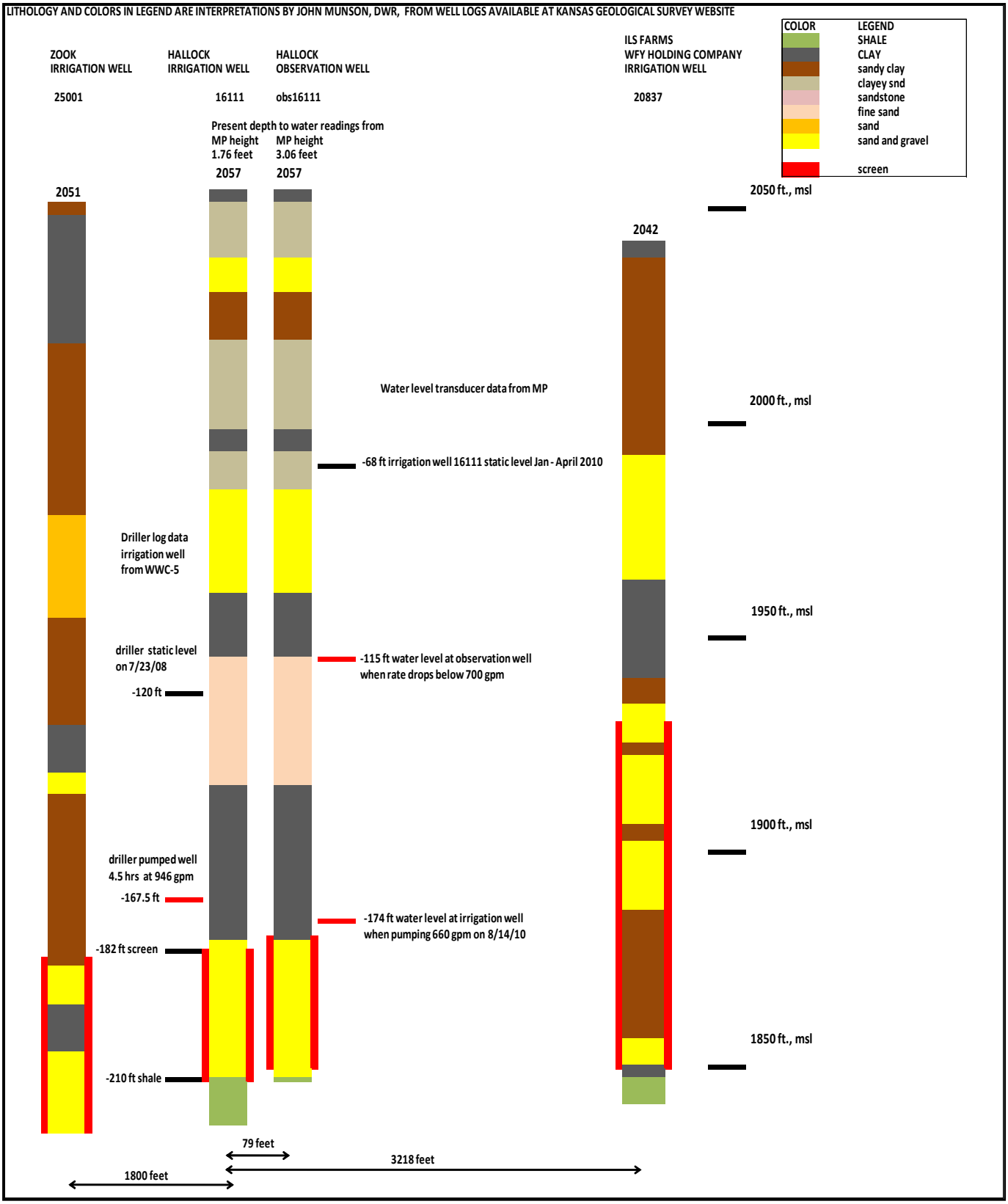
FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	3	Top soil	112	142	Fine sand
3	6	Brown clay	142	178	Blue, gray & brown clay
6	19	Fine sand with clay streaks	178	195	Sand & gravel fine, small, loose
19	27	Sand & gravel- fine & small	195	210	Sand & gravel med & loose
27	38	Tan clay & fine sand	210	220	Gray shale
38	59	Fine sand with caly streaks			
59	64	Yellow & tan clay			
64	73	Fine sand with clay streaks			
73	97	Sand & gravel- small to med, loose			
97	112	Blue gray clay			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 8-13-08 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 134 This Water Well Record was completed on (mo/day/year) 8-22-08 under the business name of Rosencrantz- Bemis by (signature) Dora Alex

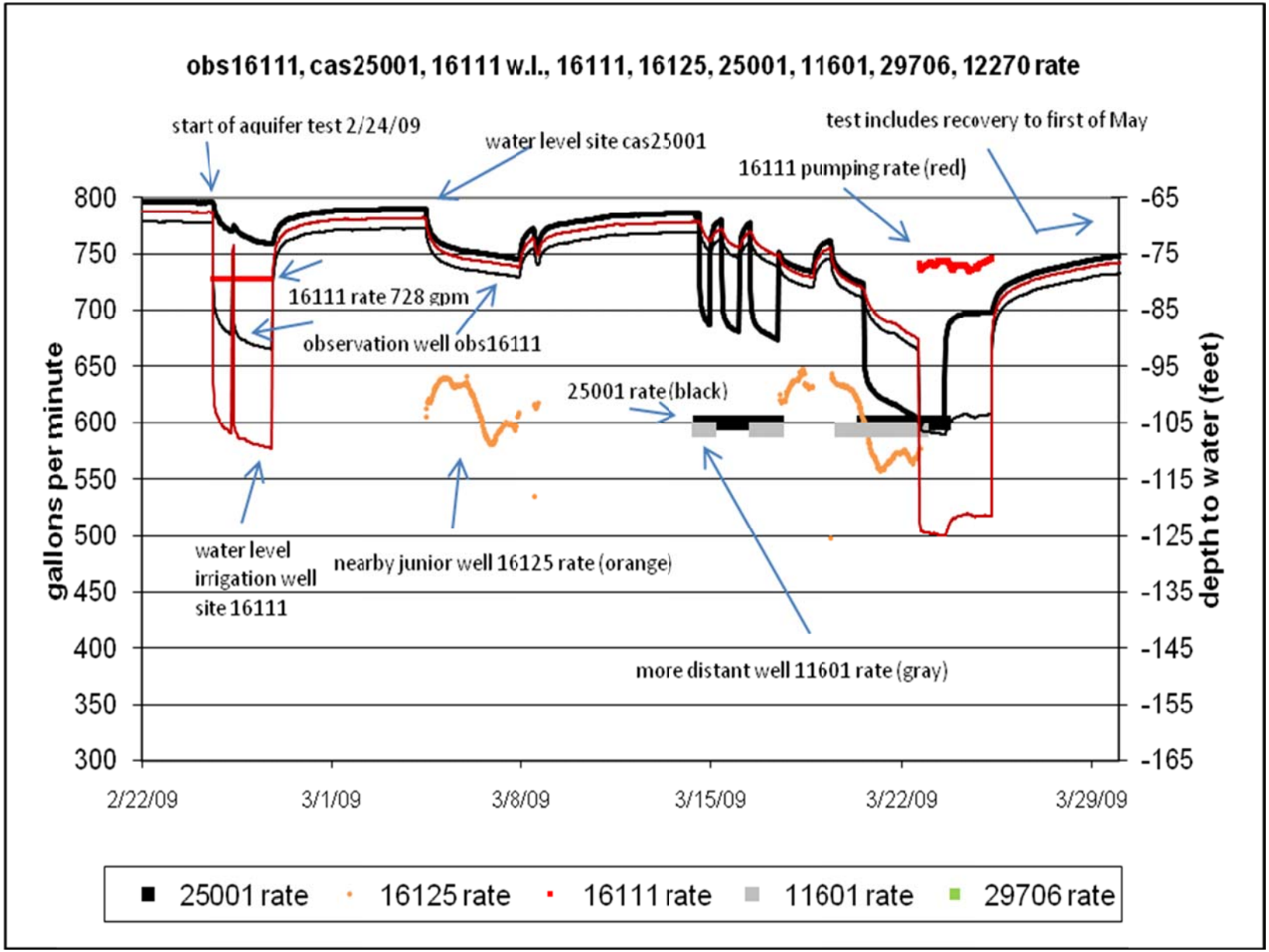
INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Geology Section, 1000 SW Jackson St., Suite 420, Topeka, Kansas 66612-1367. Telephone 785-296-5522. Send one to WATER WELL OWNER and retain one for your records. Fee of $5.00 for each constructed well. Visit us at http://www.kdheks.gov/waterwell/index.html.

KSA 82a-1212

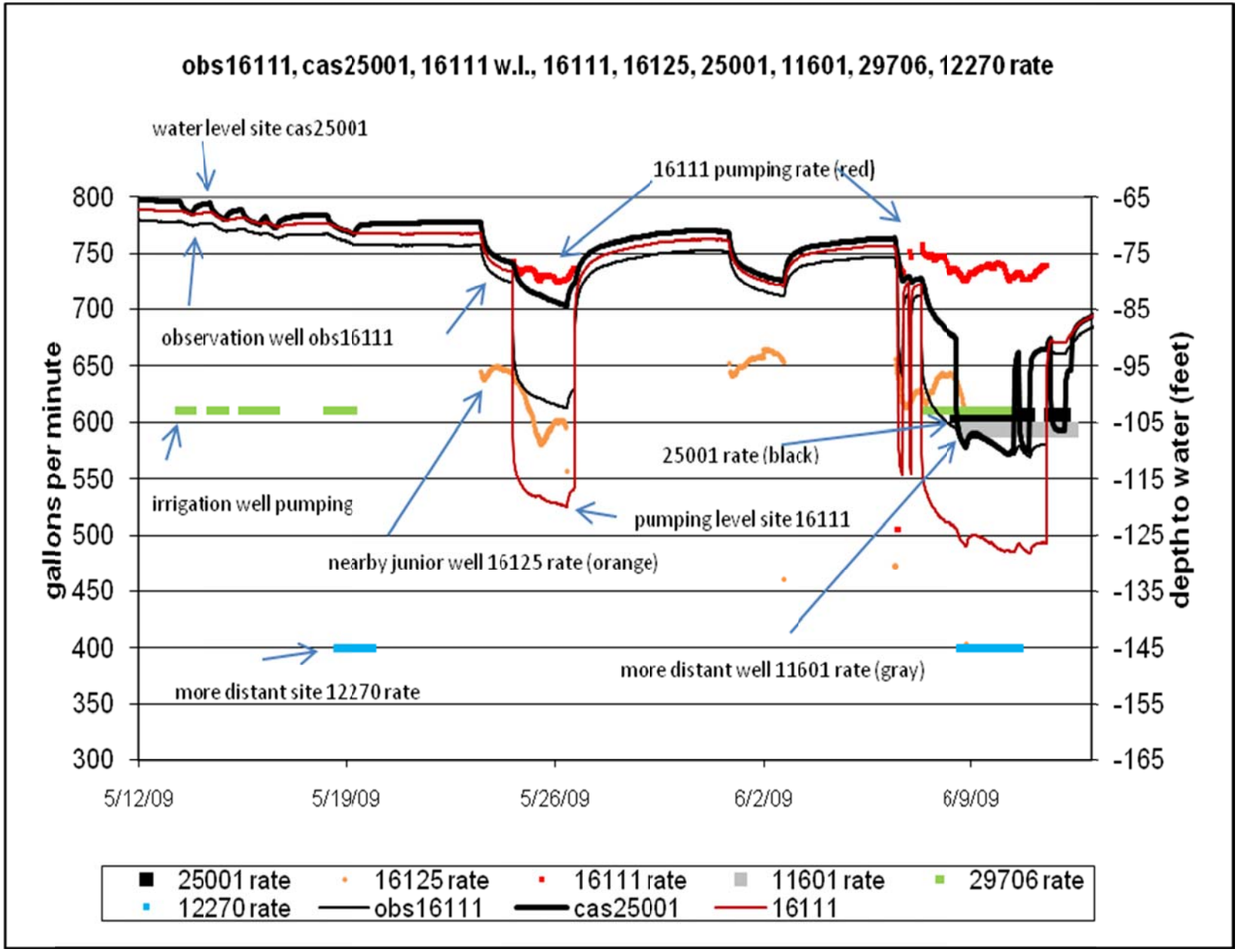
Attachment 2 – Lithology of Mr. Hallock's well, nearby wells, and key water levels.



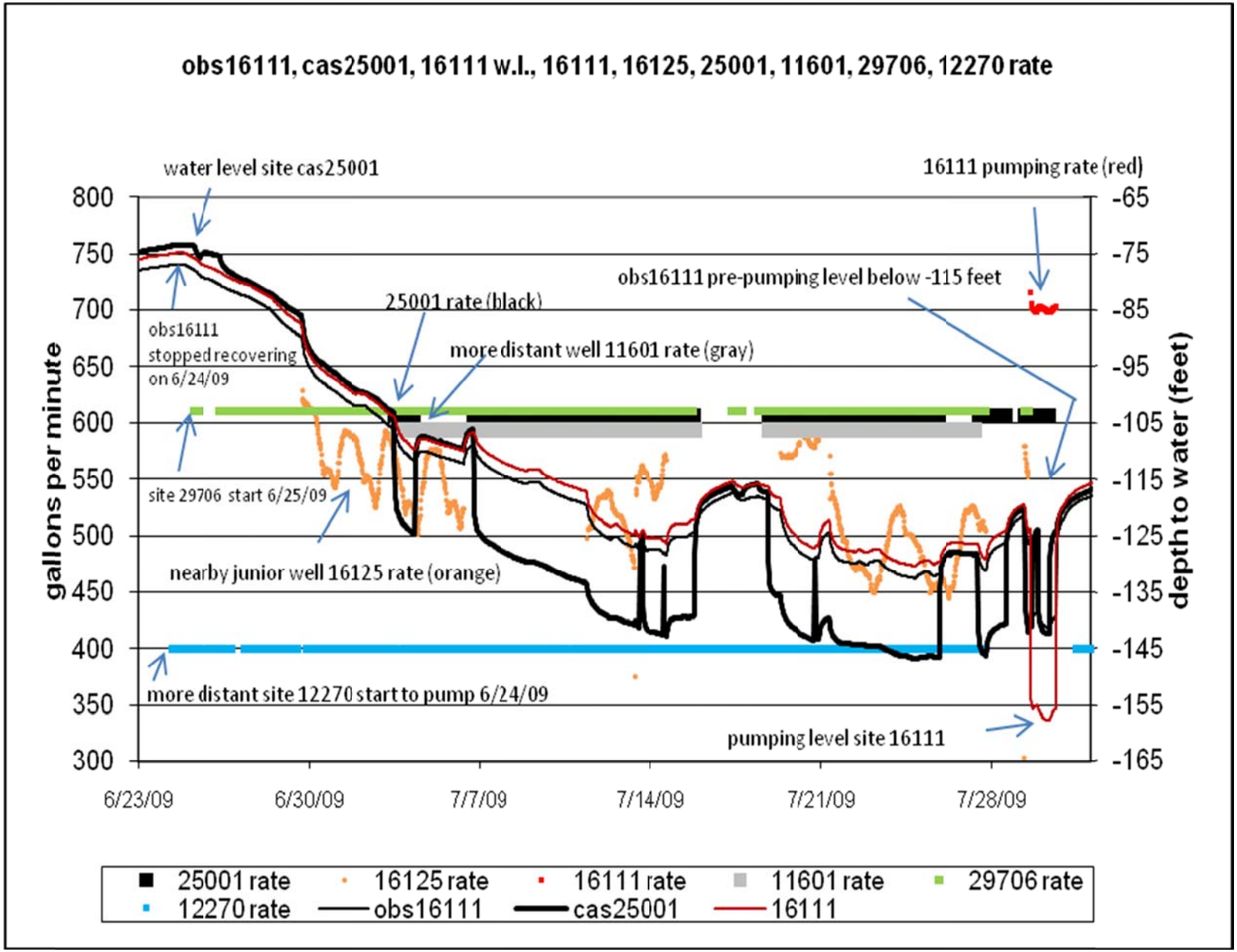
Attachment 3 – Hydrographs and Pumping Rates for Area Wells, Late February through March 2009

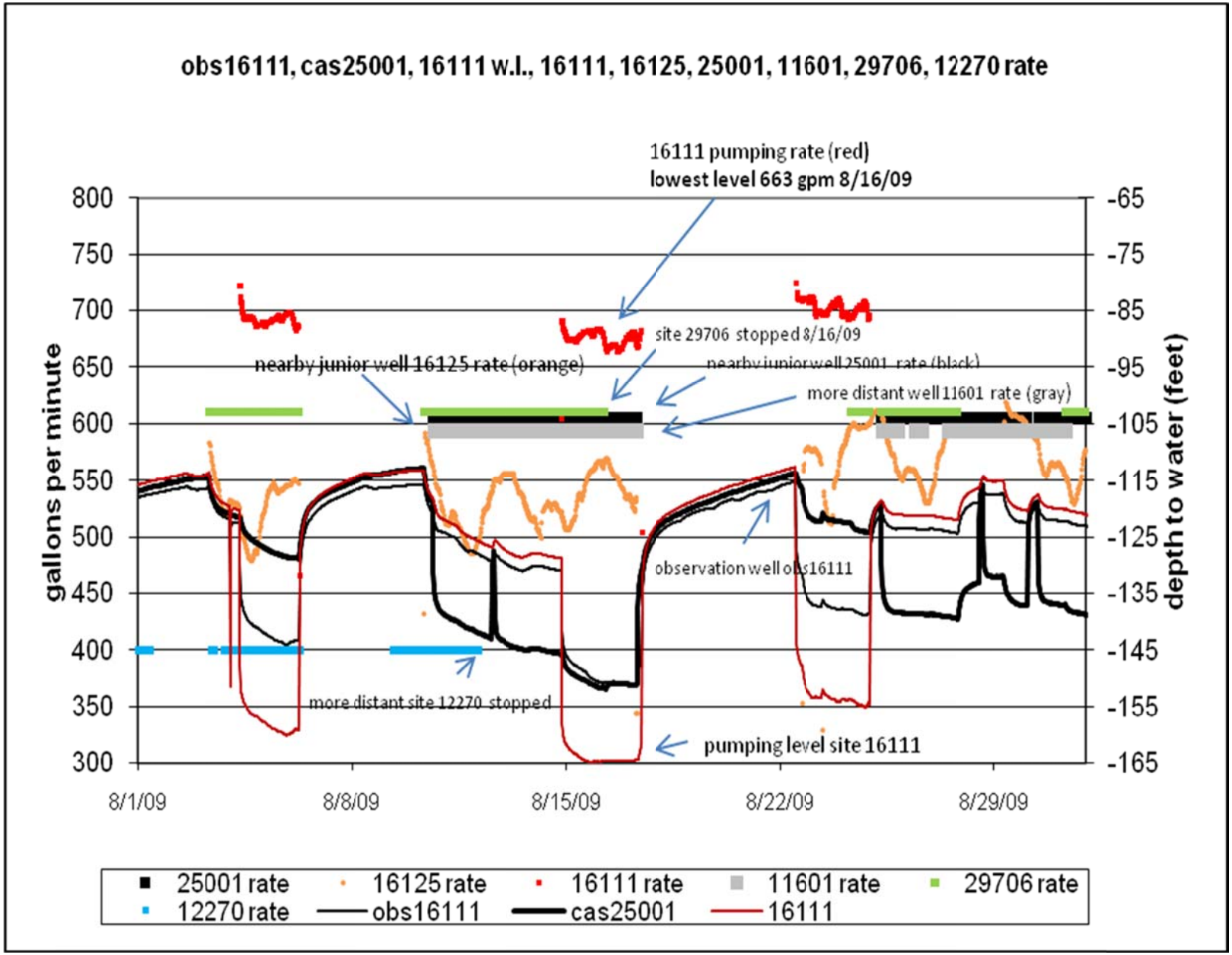


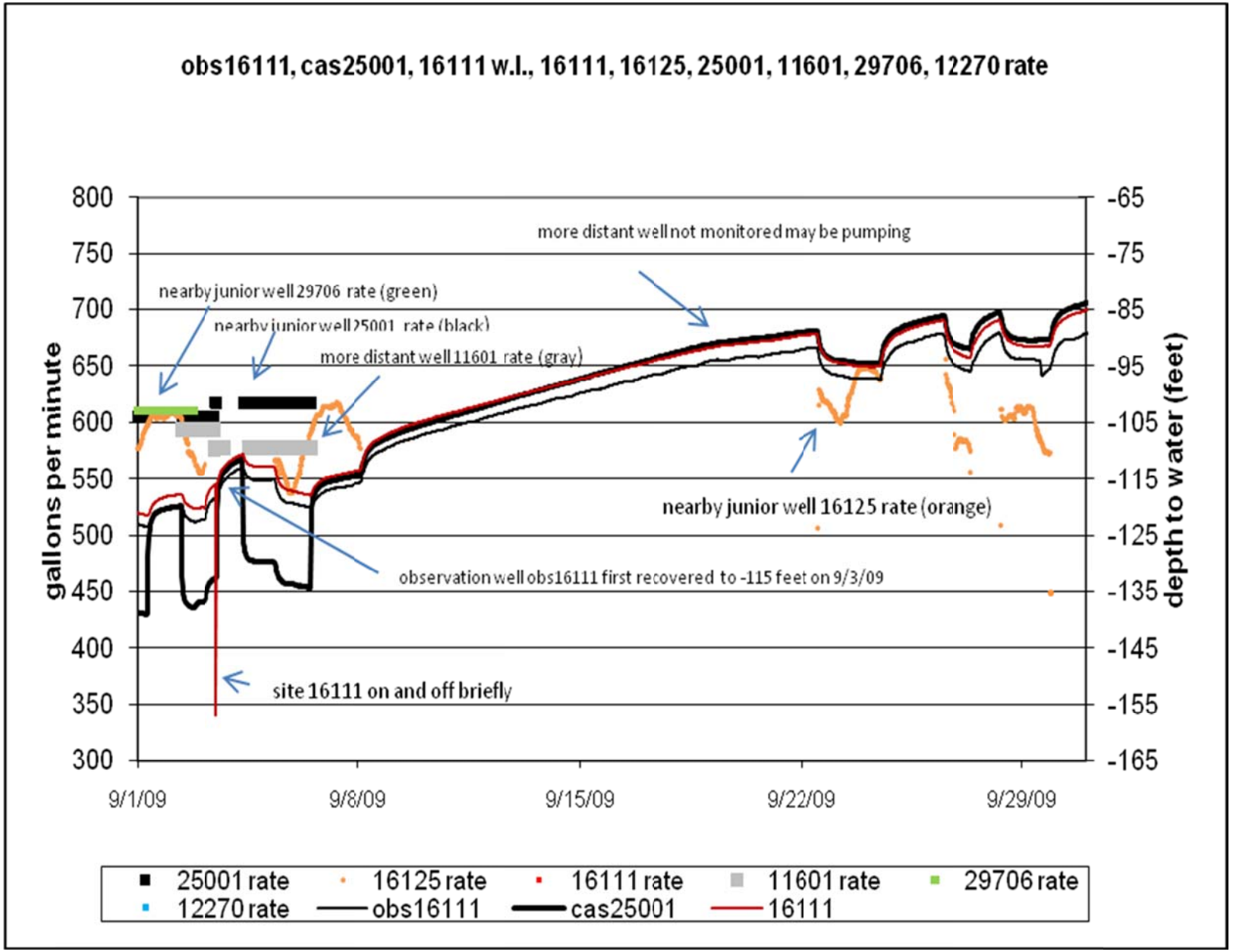
Attachment 4 – Hydrographs and Pumping Rates for Area Wells, Mid-May through Mid-June 2009



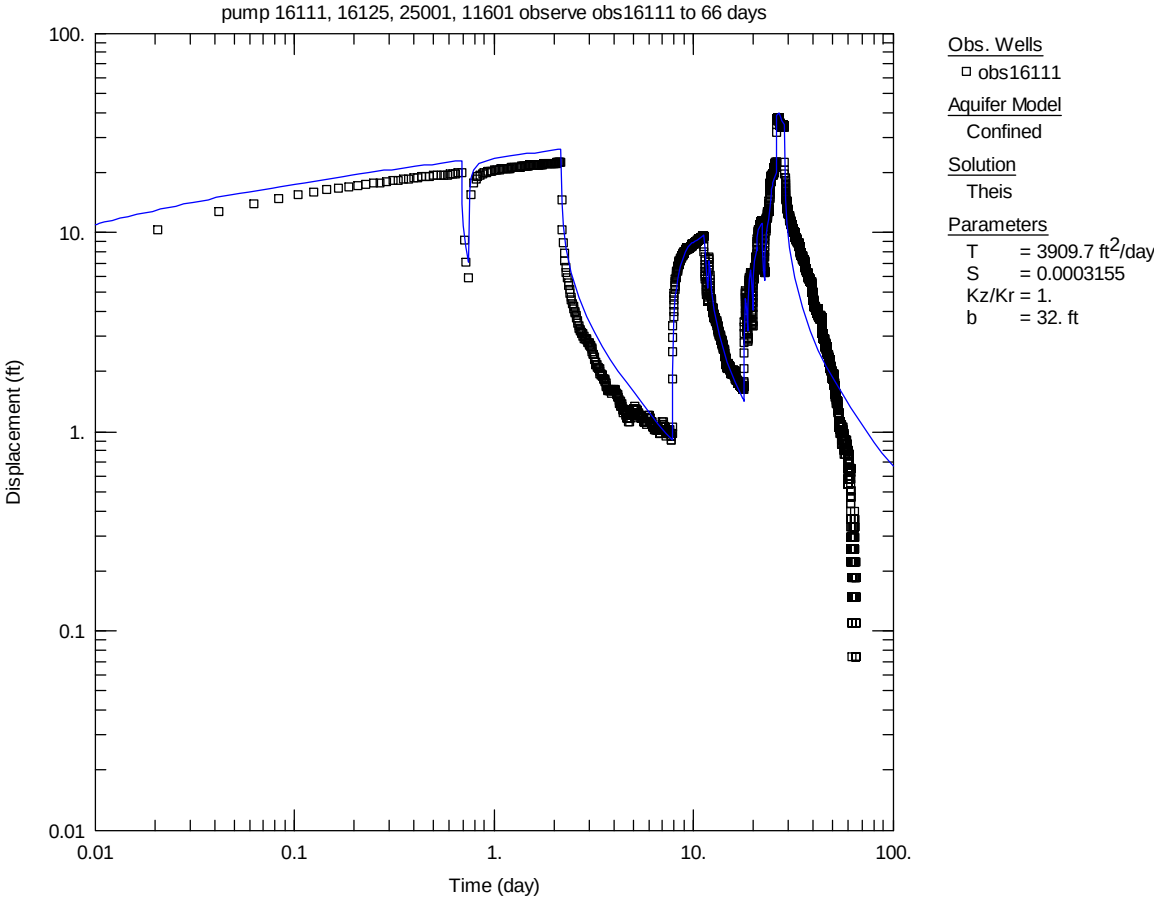
Attachment 5 – Hydrographs and Pumping Rates for Area Wells, Late June through July 2009



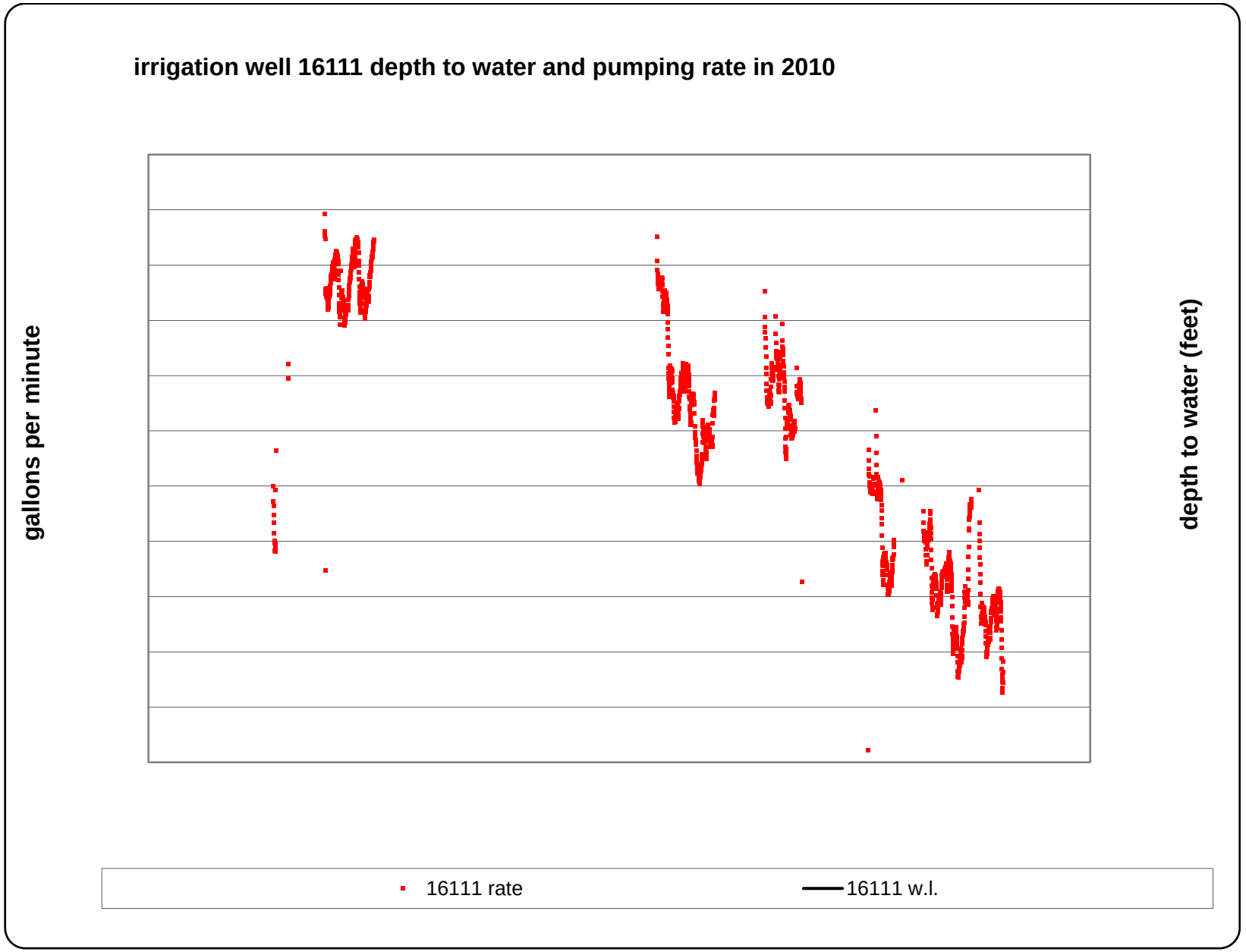

obs16111, cas25001, 16111 w.l., 16111, 16125, 25001, 11601, 29706, 12270 rate
16111 pumping rate (red)
lowest level 663 gpm 8/16/09
site 29706 stopped 8/16/09
nearby junior well 16125 rate (orange)
nearby junior well 25001 rate (black)
more distant well 11601 rate (gray)
observation well obs16111
more distant site 12270 stopped
pumping level site 16111
gallons per minute
depth to water (feet)
800
750
700
650
600
550
500
450
400
350
300
-65
-75
-85
-95
-105
-115
-125
-135
-145
-155
-165
8/1/09
8/8/09
8/15/09
8/22/09
8/29/09
25001 rate
16125 rate
16111 rate
11601 rate
29706 rate
12270 rate
obs16111
cas25001
16111


obs16111, cas25001, 16111 w.l., 16111, 16125, 25001, 11601, 29706, 12270 rate
gallons per minute
depth to water (feet)
800
750
700
650
600
550
500
450
400
350
300
-65
-75
-85
-95
-105
-115
-125
-135
-145
-155
-165
9/1/09
9/8/09
9/15/09
9/22/09
9/29/09
more distant well not monitored may be pumping
nearby junior well 29706 rate (green)
nearby junior well 25001 rate (black)
more distant well 11601 rate (gray)
nearby junior well 16125 rate (orange)
observation well obs16111 first recovered to -115 feet on 9/3/09
site 16111 on and off briefly
25001 rate
16125 rate
16111 rate
11601 rate
29706 rate
12270 rate
obs16111
cas25001
16111

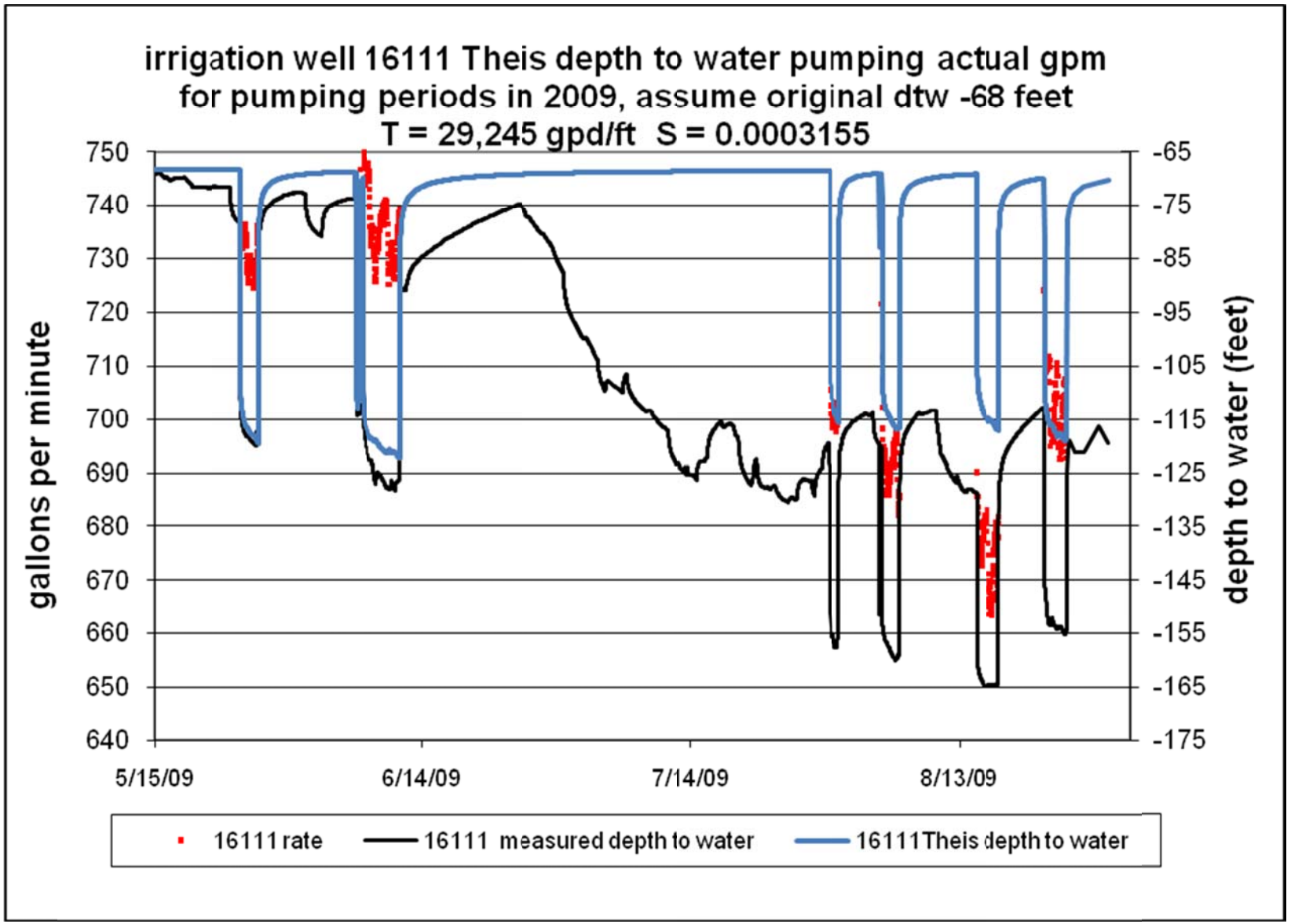
Attachment 8 – AQTESOLV Aquifer Parameter Estimation Output from 66-Day Aquifer Test



Attachment 9 – Hydrographs and Pumping Rates for Mr Hallock's well 16,111; 2010



Attachment 10 – Hydrographs Comparing Measured Water Depth in Mr. Hallock's Well to the Theis Simulation of Water Depth When No Other Nearby Wells Are Operated: 2009



Attachment 11 – Hydrographs Comparing Measured Water Depth in Mr. Hallock's Well to the Theis Simulation of Water Depth When No Other Nearby Wells Are Operated: 2010