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TECHNICAL MEMORANDUM

DATE: May 23, 2008 **Project – 605.07011**

TO: Craig Stevens and Greg Ghidotti
RIO TINTO TECHNOLOGY AND INNOVATION

FROM: Daniel Weber and Mark Thomasson
ERROL L. MONTGOMERY & ASSOCIATES, INC.

cc: Todd Keay and Kate Duke
ERROL L. MONTGOMERY & ASSOCIATES, INC.

SUBJECT: **HYDROGEOLOGIC CHARACTERIZATION WELL HRES-4: RESULTS OF LONG-TERM AQUIFER TEST, RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA**

SUMMARY

In accordance with a request from Craig Stevens, Rio Tinto Technology and Innovation (RTTI), Errol L. Montgomery & Associates, Inc. (Montgomery & Associates) has prepared this technical memorandum to summarize the results of a long-term aquifer test conducted at Resolution Project hydrologic characterization well HRES-4. Well HRES-4 is completed in the Apache Leap Tuff aquifer near Oak Flat, in the upper Queen Creek drainage basin of eastern Pinal County, Arizona. Location of the study area is shown on **Figure 1**.

Montgomery & Associates (2005) reported results of a preliminary hydrogeologic characterization for the Apache Leap Tuff aquifer that details a conceptual hydrogeologic model of the Apache Leap Tuff aquifer system, provides estimates of aquifer hydraulic parameters based on short-term single-well tests, and provides results of preliminary numerical groundwater flow modeling developed to simulate groundwater and surface water impacts resulting from proposed block-cave mining operations. A long-term aquifer test was conducted during the period October – November 2006. Information for wells used for the aquifer test is summarized in **Table 1**. Results of aquifer test analyses are summarized in **Table 2**. Results of field and laboratory analyses for common constituents, routine parameters, and trace constituents are summarized in **Tables 3 and 4**. The principal goals of the long-term aquifer test were to:

- Evaluate the conceptual model of the Apache Leap Tuff aquifer

- Verify aquifer parameters used for the preliminary groundwater flow model

Initial analysis of the long-term test was presented in a draft technical memorandum to Resolution Copper Mining LLC (RCML) dated February 15, 2007 (Montgomery & Associates, 2007). During a meeting on September 17, 2007, Shlomo P. Neuman, Regents' Professor from the Department of Hydrology and Water Resources at the University of Arizona and member of the Resolution Copper Pre-Feasibility Study (PFS) Hydrogeology Steering Committee, reviewed comments to the draft technical memorandum and provided suggestions for alternative methods for analysis of the test data.

The reanalysis of the data and final estimates of aquifer parameters were presented at the PFS Hydrogeology Steering Committee Meeting on January 8, 2008. Because of the uncertainties caused by barometric pressure fluctuations occurring during the test and lost circulation of drilling fluids at nearby exploration wells during the last 15 days of the test, the reanalysis focused on applying analytical methods on water level data obtained during the first 10 days of pumping and uncorrected for barometric pressure.

Results are summarized as follows:

1. Well HRES-4 was pumped at a constant pumping rate of 35.6 gallons per minute (gpm) or 2.25 liters per second (L/s) for period of 25 days.

2. Pre-pumping depth to groundwater level at well HRES-4 was 121.9 meters below land surface (m bls). At the end of the 25-day pumping period, drawdown was 11.2 m and specific capacity of the well was 3.18 gpm/m of drawdown (0.201 L/s/m of drawdown).

3. Groundwater level drawdown and recovery was measured at seven observation wells spaced at radial distances ranging from about 1,000 to 3,000 m from the pumped well. At approximately 10 days of pumping at well HRES-4, maximum water level drawdown at observation wells ranged from about 0.03 to 0.19 m **(Table 1)**. After this period, drawdown trends at observation wells are indeterminate due to displacements caused by lost circulation conditions in the Apache Leap Tuff aquifer during drilling at nearby exploration boreholes.

4. Based on analysis of aquifer test data at the pumped well and observation wells, computed transmissivity ranged from 11 to 53 square meters per day (m^2/d). Storativity ranged from 0.0001 to 0.0009 (dimensionless). Using an operative transmissivity of 35 m^2/d and an average aquifer thickness of 400 m, hydraulic conductivity is estimated to be 0.088 meters per day (m/d) **(Table 2)**.

5. The reliability of water level data measured at observation wells during the aquifer test was reduced and analytical solutions were complicated due to:

- Displacement of drawdown trends at observation wells caused by lost circulation conditions in the Apache Leap Tuff aquifer during drilling at nearby exploration boreholes
- Oscillation of drawdown trends at observation wells caused by barometric pressure changes occurring during the aquifer test
- Lack of sufficient drawdown trends at some observation wells caused by large distances from the pumped well (i.e., low signal to noise ratio)

6. Laboratory inorganic chemical analyses of groundwater samples obtained at the end of the 25-day pumping period at well HRES-4 show that chemical quality of groundwater is excellent; concentrations of dissolved constituents do not exceed State or Federal primary or secondary maximum contaminant levels **(Tables 3 and 4)**.

7. Analysis of results of the long-term aquifer test in the Apache Leap Tuff aquifer at well HRES-4 indicates that the fractured-rock aquifer system is laterally and vertically contiguous, which is consistent with the previously reported conceptual hydrogeologic model for the aquifer. Aquifer testing for longer durations at other wells that result in larger signal to noise ratios at observation wells are recommended for further refinement of aquifer parameters. Testing should occur during periods when minimal impact from drilling at exploration boreholes is anticipated.

BACKGROUND

Figure 1 shows the location of hydrogeologic characterization wells (HRES series), other water wells in the area, and mineral exploration boreholes (RES series). Well HRES-4 was used as the pumping well for the aquifer test; other HRES and water wells in the area were used as observation wells. Prior to testing, inflatable packers were installed in some HRES observation wells in order to monitor hydraulic head in different vertical parts of the aquifer during the long-term test. A suffix was added to the well identifier representing hydrostatic conditions for shallow (“s”) or deep (“d”) parts of the Apache Leap Tuff aquifer isolated by the packer in the well. **Table 1** summarizes information for wells used for the aquifer test. An inventory of wells and schematic diagrams of well construction and lithologic conditions for wells in the project area are given in Montgomery & Associates (2005).

METHODS

The aquifer test was designed by Montgomery & Associates and monitored by Montgomery & Associates with assistance of RCML personnel. Pumping at well HRES-4 was conducted using a submersible pump installed in the well by Layne Christensen Company, Chandler, Arizona. The submersible pump was a Grundfos pump model 40S75-25, 460V, 7.5HP. Power was supplied by a portable generator. Groundwater was discharged to a small ephemeral wash leading to Queen Creek under an Arizona Pollutant Discharge Elimination System De Minimus Discharge permit (No. AZG2004-001).

The 25-day pumping period at well HRES-4 was conducted from October 9, 2006, through November 3, 2006. Following the pumping period, water levels in wells were monitored for a recovery period equal to or greater than the pumping period. During the pumping period, pumping rate, temperature, pH, and specific conductance of the pumped water were monitored and recorded. The discharge manifold was equipped with a NuFlow instantaneous and totalizing digital flowmeter. Flowmeter measurements were recorded automatically using a Campbell Scientific CR10 datalogger and verified daily with recorded manual measurements. Temperature, pH and specific conductance were measured daily with a Myron L Ultrameter™. Groundwater samples were obtained near the end of the pumping period for laboratory analyses of inorganic chemical constituents. Photographs of the pumping operation set-up at well HRES-4 are shown on **Figure 2**.

During pumping and non-pumping periods, measurements were obtained for depth to groundwater level using pressure transducers and dataloggers installed in the wells. Water levels were referenced and periodically verified using an electrical water level sounder. In-Situ MiniTROLLS, Geokon pressure transducers and dataloggers, and Campbell Scientific dataloggers were used as components of remote data acquisition system for water levels during the test. Because pressure transducers used for the test were non-vented (i.e., absolute), measurements of barometric pressure were obtained; water level data uncorrected and corrected for barometric change is shown in **Appendix A**. A digital copy of measurements of pumping rate and water level drawdown and recovery is available upon request.

RESULTS

Montgomery & Associates collected and compiled data periodically throughout the test into standardized spreadsheets using Microsoft® Excel 2003. After organization and data verification in spreadsheets, pumping test data were exported to AQTESOLV, computer-based, aquifer test analysis software (HydroSOLVE, 2006). Standard AQTESOLV analysis output included curve-matching graphs, description of analytical technique, and all parameters used for the analysis.

Hydrographs of water level for the pumped well and observation wells during aquifer test operations are shown in **Appendix A; Figures A-1 through A-12**. Analysis of hydrographs and water level responses at the wells during the aquifer test are as follows:

- After inflation of the packer at well HRES-1, hydraulic heads in well HRES-1s and HRES-1d did not equilibrate prior the aquifer test. At the start of monitoring, the vertical hydraulic gradient was substantial between HRES-1s and HRES-1d. About 80 meters of hydrostatic pressure separated the shallow and deep zones of the Apache Leap Tuff aquifer at the well; water level in the shallow zone was higher than water level in the lower zone, indicating direction of vertical hydraulic gradient was downward. Hydraulic nonequilibrium at well HRES-1 is believed to be influenced by the well's proximity to Shaft No. 9 and long-term drainage of the Apache Leap Tuff aquifer by Shaft No. 9 causing disparate local hydraulic gradients **(Figures 1, A-1, and A-2)**. Because of hydraulic nonequilibrium conditions, water level data obtained at well HRES-1 during the aquifer test was not analyzed for aquifer parameters.

- At other observation wells with packers installed (HRES-2 and HRES-5), water levels in the shallow and deep zones of the Apache Leap Tuff aquifer also indicate that vertical hydraulic gradients is directed downward, with aquifer water levels for shallow zones being higher than water levels for deep zones. However, unlike well HRES-1, magnitude of hydraulic gradient is small at these wells, ranging from about 0.05 meter at well HRES-2 to about 0.2 meter at well HRES-5. Water level response in the shallow and deep zones was similar during the aquifer test **(Figures A-3 through A-6, A-8, and A-9)**.

- Transient positive and/or negative hydraulic stresses in the aquifer were caused by drilling activities at mineral exploration boreholes in the project area. These transient hydraulic stresses affected water levels measured during the test. Documented events include loss of drilling fluid circulation at RES-12 as the mineral exploration borehole was advancing through the Apache Leap Tuff. Borehole RES-12 is 1,099 meters northeast of well HRES-5 **(Figure 1)**. Start of lost circulation at RES-12 was reported to be about 10 days after start of pumping at well HRES-4.

- Barometric pressure fluctuations, small changes in observation well drawdown and large distances from the observation wells to the pumped well (i.e., low signal to noise ratio), and undefined heterogeneities or anisotropy within the aquifer diminished the reliability of water level data for clear evaluation of aquifer parameters. For observation wells HRES-1s and HRES-1d one or more of these factors resulted in unreliable water level data for evaluation of aquifer parameters.

Results of aquifer test analyses are summarized in **Table 2** and shown on **Figures 3 through 12.** Due to uncertainties caused by "over-correcting" low signal to noise ratio water level data for barometric pressure fluctuations that occurred during the test, analytical methods were applied to water level data uncorrected for barometric pressure. Also, due to lost circulation of drilling fluids at nearby exploration wells that occurred during the last 15 days of the test, analytical methods were applied to the first 10 days of pumping. Estimates of transmissivity (T) are provided for pumped well water level drawdown and recovery data and observation well water level drawdown and recovery data in units of square meters per day per meter width of aquifer at 1:1 hydraulic gradient (m^2/d). Estimates of storativity (S) are included when observation well data were sufficient for analysis.

Groundwater samples obtained near the end of the constant-rate aquifer test for HRES-4 were submitted to Test America, Phoenix, Arizona, for inorganic chemical analyses. Results of field and laboratory analyses for common constituents, routine parameters, and trace constituents are summarized in **Tables 3 and 4**. The laboratory reports are given in **Appendix B**.

Average pumping rate at well HRES-4 was 35.6 gpm (2.25 L/s) for the 600-hour pumping period. Total groundwater pumped was about 1,281,600 gallons (4,851 cubic meters). Depth to pre-pumping water level was 121.9 meters bls. Maximum drawdown at the well occurred near the end of the pumping period and was 11.2 meters. Specific capacity for the test was about 3.18 gpm/m of drawdown (0.201 L/s/m of drawdown). The specific capacity estimate for the pumped well is based on average pumping rate for the pumping period and water level drawdown at the end of the pumping period. Computed aquifer parameters are summarized as follows:

Pumped Well HRES-4: **Figure 3** shows the drawdown and recovery graphs for the aquifer test. Using the methods of Cooper and Jacob (1946) and Theis (1935), the semi-log graphical straight-line analysis of drawdown and recovery data indicates computed aquifer T of 23 and 26 m^2/d **(Table 2)**.

Observation Wells HRES-2s and HRES-2d: **Figures 4 and 5** show the log-log drawdown and recovery graph for wells HRES-2s and HRES-2d during the aquifer test. Using the method of Theis (1935) and Hantush (1961a, b) that extended the Theis method to correct for partially penetrating wells, aquifer T is computed to be 13 and 11 m^2/d, respectively; S is estimated to be 0.0009 **(Table 2).**

Observation Well HRES-3s and HRES-3d: **Figures 6 and 7** shows the log-log drawdown and recovery graph for well HRES-3s during the aquifer test. Using the method of Theis (1935) and Hantush (1961a, b), aquifer T is computed to be 38 and 37 m^2/d, respectively; S is estimated to be 0.0004 **(Table 2).**

Observation Wells HRES-5s and HRES-5d: **Figures 8 and 9** show the log-log drawdown and recovery graph for wells HRES-5s and HRES-5d during the aquifer test. Using the method of Theis (1935) and Hantush (1961a, b), aquifer T is computed to be 35 and 43 m^2/d, respectively; S is estimated to be 0.0004 **(Table 2).**

Observation Well Oak Flat: **Figure 10** shows the log-log drawdown and recovery graph for well Oak Flat during the aquifer test. Using the method of Theis (1935) and Hantush (1961a, b), aquifer T is computed to be 53 m^2/d; S is estimated to be 0.0004 **(Table 2).**

Observation Wells A-06 and MJ-11: **Figures 10 and 11** show the log-log drawdown and recovery graph for wells A-06 and MJ-11 during the aquifer test. Using the method of Theis (1935) and Hantush (1961a, b), aquifer T is computed to be 38 and 49 m^2/d, respectively; S is estimated to be 0.0006 and 0.0001, respectively **(Table 2).**

DISCUSSION AND CONCLUSIONS

Results of analyses for aquifer parameters for pumped well HRES-4 indicate that T ranges from about 23 to 26 m^2/d. After about 6.9 days of pumping (10,000 minutes), water level data at the pumped were affected by a negative hydraulic boundary. Water level measurements obtained after this period were not used for estimates of aquifer T. In most cases, water level recovery data at the pumped well are believed to be more reliable for analysis because water level drawdown data are subject to errors resulting from variations in pumping rate, head loss associated with skin effects in the aquifer adjacent to the well bore and entrance through the well screen, and by additional well development during the pumping period.

Results of the analyses of aquifer parameters for observation wells indicate that T ranges from about 11 to 53 m^2/d and S ranges from about 0.0001 to 0.0009. Operative T, defined for this report as the arithmetic average of computed T derived from pumped well recovery analysis and observation well analysis, is approximately 35 m^2/d **(Table 2)**. Based on an average aquifer thickness of 400 meters, represented by the depth interval from water level at well HRES-3d to bottom of perforations at well HRES-1d, and operative T of 35 m^2/d, operative hydraulic conductivity is estimated to be 0.088 m/d.

The quality of water level data obtained at observation wells during the aquifer test was diminished and analytical solutions were complicated due to: 1) lost circulation conditions in the Apache Leap Tuff aquifer during drilling at nearby exploration boreholes, 2) oscillation of drawdown trends at observation wells caused by large barometric pressure changes occurring during the aquifer test, and 3) lack of sufficient drawdown trends at observation wells caused by large distances from the pumped well (i.e., low signal to noise ratio).

Chemical quality of groundwater from well HRES-4 is excellent; concentrations for the constituents analyzed do not exceed State or Federal primary or secondary maximum contaminant levels. Results of laboratory chemical analyses from previous groundwater sampling at well HRES-4 are summarized in **Tables 3 and 4**. These groundwater samples were obtained during short-term pumping tests conducted soon after well completion (Montgomery & Associates, 2005). Comparison of results given in **Tables 3 and 4** indicate groundwater samples obtained at the end of the 25-day pumping period are similar to groundwater samples obtained after short-duration pumping periods.

Analysis of results of the long-term aquifer test in the Apache Leap Tuff aquifer at well HRES-4 indicates that the fractured-rock aquifer system is laterally and vertically contiguous, which is consistent with the previously reported conceptual hydrogeologic model for the aquifer (Montgomery & Associates, 2005). Additional aquifer testing in the Apache Leap Tuff aquifer is recommended for longer durations and at other wells completed in the regional groundwater system for further refinement of aquifer parameters and conceptualization. Longer duration testing at other wells would result in larger signal to noise ratios at observation wells. Testing should occur during periods when minimal impact from drilling at exploration boreholes is anticipated.

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TABLE 1. SUMMARY OF HYDROLOGIC DATA OBTAINED DURING 25-DAY AQUIFER TEST CONDUCTED AT WELL HRES-4 RESOLUTION COPPER MINING LLC PINAL COUNTY, ARIZONA

PUMPED WELL IDENTIFIER [a]	OBSERVATION WELL IDENTIFIER	CASING PERFORATED INTERVAL OF WELL (m bls)[b]	DISTANCE TO PUMPED WELL (m)	PREPUMPING WATER LEVEL (m bls)	MAXIMUM WATER LEVEL DRAWDOWN [c] (m)
HRES-4		178.1 – 190.3	---	121.9	11.2
		220.8 – 233.0			
		391.4 – 397.5			
		432.6 – 438.9			
	HRES-1s [d]	321.5 – 328.1	1,957	268.2	NA
	HRES-1d	414.4 – 427.7	1,957	349.1	NA
		480.8 – 486.9			
	HRES-2s [e]	199.9 – 206.6	885	90.6	0.06
	HRES-2d	312.7 – 319.4	885	90.6	0.06
		383.8 – 399.3			
	HRES-3s[f]	103.2 – 121.3	2,013	88.7	0.06
	HRES-3d	443.9 – 457.2	2,013	86.8	0.03
	HRES-5s[g]	117.3 – 129.5	1,357	97.6	0.18
	HRES-5d	178.3 – 184.4	1,357	97.9	0.19
		309.4 – 315.5			
	Oak Flat	122.2 – 131.7	1,959	89.2	0.06
	A-06	ND	2,082	158.7	0.08
	MJ-11	ND	3,304	90.7	0.06

[a] Pumping started October 9, 2006; average pumping rate was 35.6 gallons per minute; pumping period was 25 days (t = 36,000 minutes).
[b] m bls = meters below land surface
[c] Maximum Water Level Drawdown = maximum drawdown, uncorrected for barometric change, prior to displacement of drawdown trend caused by lost circulation conditions in the Apache Leap Tuff aquifer during drilling at nearby exploration boreholes (October 19, 2006).
[d] Packer inflated in well HRES-1 at 335.3 m bls.
[e] Packer inflated in well HRES-2 at 213.4 m bls.
[f] One-inch perforated PVC standpipe installed in well annulus.
[g] Packer inflated in well HRES-5 at 137.2 m bls.
NA = data could not be analyzed due to non-equilibrium of hydraulic heads after packer inflation, influence of nearby drilling activity influencing water level, or water level did not respond to pumping.
ND = data not available.
‘--- = not applicable

TABLE 2. SUMMARY OF COMPUTED AQUIFER PARAMETERS
25-DAY AQUIFER TEST CONDUCTED AT WELL HRES-4
RESOLUTION COPPER MINING LLC
PINAL COUNTY, ARIZONA

PUMPED WELL IDENTIFIER	OBSERVATION WELL IDENTIFIER	SEMI-LOG GRAPHICAL METHOD: COOPER-JACOB DRAWDOWN METHOD Transmissivity (m^2/d)[a]	SEMI-LOG GRAPHICAL METHOD: THEIS RECOVERY METHOD Transmissivity (m^2/d)	THEIS LOG-LOG GRAPHICAL METHOD Transmissivity (m^2/d)	THEIS LOG-LOG GRAPHICAL METHOD Storativity[b]	REPRESENTATIVE AQUIFER PARAMETERS: OPERATIVE Transmissivity (m^2/d)[c]	REPRESENTATIVE AQUIFER PARAMETERS: AQUIFER THICKNESS (meters)[d]	REPRESENTATIVE AQUIFER PARAMETERS: OPERATIVE HYDRAULIC CONDUCTIVITY (m/d)[e]
HRES-4		23	26	---	---	35	400	0.088
	HRES-1s	---	---	–	–			
	HRES-1d	---	---	–	–			
	HRES-2s	---	---	13	0.0009			
	HRES-2d	---	---	11	0.0009			
	HRES-3s	---	---	38	0.0004			
	HRES-3d	---	---	37	0.0004			
	HRES-5s	---	---	35	0.0004			
	HRES-5d	---	---	43	0.0004			
	Oak Flat	---	---	53	0.0004			
	A-06	---	---	38	0.0003			
	MJ-11	---	---	49	0.0001			

[a] Transmissivity = meters squared per day per meter width of aquifer at 1:1 hydraulic gradient (m^2/d). Transmissivity is defined as the rate of flow of groundwater at the prevailing temperature through a vertical strip of aquifer 1 unit wide, extending the full saturated thickness of the aquifer, under a unit hydraulic gradient.
[b] Storativity = ratio of the volume of water that a permeable unit will release from storage per unit surface area per unit change in head (dimensionless).
[c] Operative Transmissivity = arithmetic average of computed transmissivities derived from pumped well recovery analysis and observation well analysis.
[d] Aquifer Thickness = depth interval from water level at well HRES-3d to bottom of first perforated interval at well HRES-1d.
[e] Operative Hydraulic Conductivity = meters per day at 1:1 hydraulic gradient. Hydraulic conductivity is the quotient of transmissivity divided by representative aquifer thickness at the start of the pumping test.
--- = method not applicable for analysis.
– = indeterminate water level response.

TABLE 3. SUMMARY OF COMMON CONSTITUENTS AND ROUTINE PARAMETERS FOR WATER SAMPLES OBTAINED AT WELL HRES-4 RESOLUTION COPPER MINING LLC PINAL COUNTY, ARIZONA

			COMMON CONSTITUENTS[a]												ROUTINE PARAMETERS[b]					
															FIELD				LABORATORY	
SAMPLE LOCATION	SAMPLE IDENTIFIER and / or DESCRIPTION	SAMPLE DATE	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Cl (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	SiO_2 (mg/L)	F (mg/L)	$NO^3 + NO^2$ (mg/L)	TDS (mg/L)	T (°C)	pH	EC (µmhos/cm)	TURBIDITY (NTU)	pH	EC µmhos/cm
Well HRES-4	HRES-4AL; open borehole test	3-Mar-04	27	4.0	37	1.1	6.8	<5.0	171	11	56	0.50	0.62	230	23.1	8.31	306	---	8.36	320
Well HRES-4	RESE-1001110; Test 1	15-Apr-04	29	4.31	30.9	<1.0	8.45	<1.0	182	9.25	56.1	0.41	0.36	217	---	---	---	---	7.9	321
Well HRES-4	PPK0193-01; 25-day Test	3-Nov-06	28	4.3	27	<1.0	5.9	<5.0	130	5.0	68	0.46	0.589	210	27.1	6.72	298	---	7.83	260

[a] Ca = Calcium
Mg = Magnesium
Na = Sodium
K = Potassium
Cl = Chloride
CO_3 = Carbonate

HCO_3 = Bicarbonate
SO_4 = Sulfate
SiO_2 = Silica
F = Fluoride
NO_3+NO_2 = Nitrate as N
TDS = Total dissolved solids

[b] T = Temperature in degrees Celsius
EC = Electrical conductivity in micromhos per centimeter
NTU = nephelometric turbidity units

[c] Weber and Evans, 1988
[d] Davidson and others, 1998
[e] Arizona Department of Environmental Quality water quality database

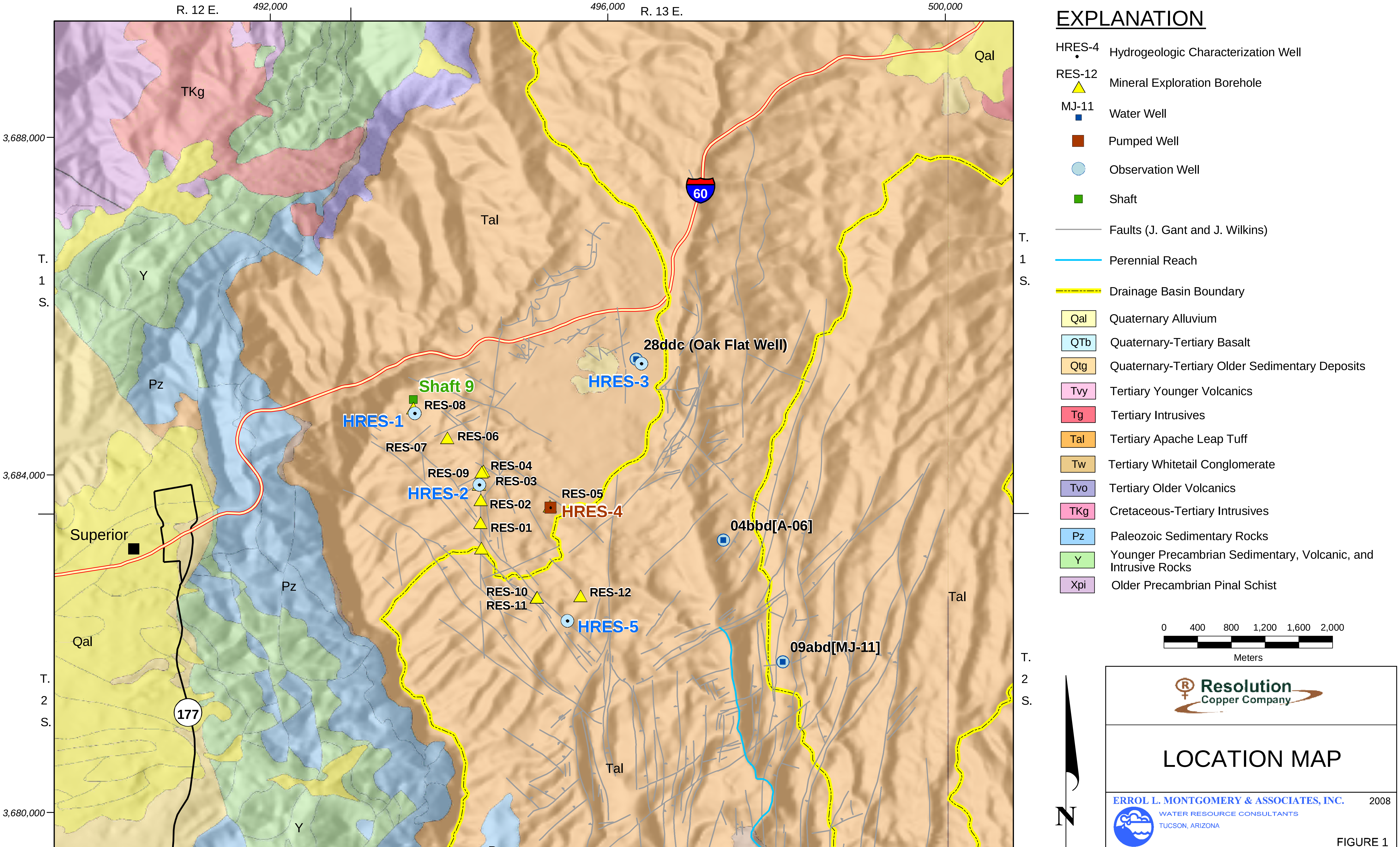
mg/L = milligrams per liter
--- = not analyzed
ND = not detected
Samples obtained in 2004 analyzed by Del Mar Analytical, Phoenix, Arizona
Samples obtained in 2006 analyzed by Test America, Phoenix, Arizona

TABLE 4. SUMMARY OF TRACE CONSTITUENTS FOR WATER SAMPLES OBTAINED AT WELL HRES-4 RESOLUTION COPPER MINING LLC PINAL COUNTY, ARIZONA

SAMPLE LOCATION		SAMPLE DATE	TRACE CONSTITUENTS[a] Al (mg/L)	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Hg (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Tl (mg/L)	Zn (mg/L)
Well HRES-4	HRES-4AL; open borehole test	3-Mar-04	<0.50	<0.050	<0.050	<0.010	<0.0040	<0.50	<0.0050	<0.010	<0.050	<0.020	<0.20	<0.050	0.024	<0.00020	<0.050	<0.050	<0.050	<0.0050	<0.050	<0.050
Well HRES-4	RESE-1001110; Test 1	15-Apr-04	<0.020	<0.0030	<0.0030	0.0105	<0.0020	<0.040	<0.00010	<0.0060	<0.0060	<0.0030	0.061	<0.0030	0.0775	<0.00020	0.0094	<0.010	<0.0030	<0.00010	<0.0020	0.017
Well HRES-4	PPK0193-01; 25-day Test	3-Nov-06	<0.50	<0.0020	0.0042	<0.010	<0.0040	<0.50	<0.0050	0.012	<0.050	<0.020	<0.20	<0.0020	<0.020	<0.00020	<0.050	<0.050	<0.0020	<0.0050	<0.0010	0.057

[a] Al = Aluminum
Sb = Antimony
As = Arsenic
Ba = Barium
Be = Beryllium
B = Boron
Cd = Cadmium
Cr = Chromium (total)
Co = Cobalt
Cu = Copper
Fe = Iron
Pb = Lead
Mn = Manganese
Hg = Mercury
Mo = Molybdenum
Ni = Nickel
Se = Selenium
Ag = Silver
Tl = Thallium
Zn = Zinc

mg/L = milligrams per liter
Samples obtained in 2004 analyzed by Del Mar Analytical, Phoenix, Arizona.
Samples obtained in 2006 analyzed by Test America, Phoenix, Arizona.



Source: Montgomery & Associates (2005)

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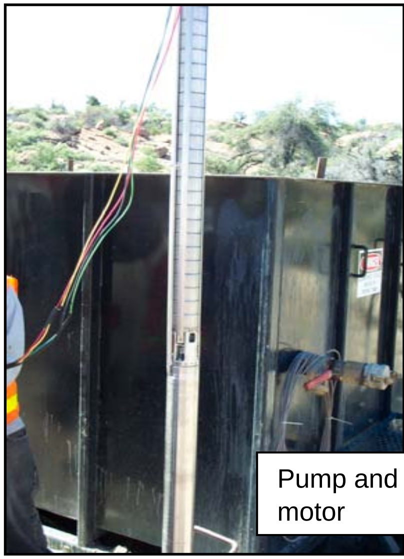
Pump and motor


Wellhead


Discharge manifold


Discharge to wash


Discharge to wash and use of temporary control structures for erosion control

Project	Title	Project Number 605.07011		
RESOLUTION COPPER MINING LLC HYDROGEOLOGIC CHARACTERIZATION	FIGURE 2. PHOTOGRAPHS OF AQUIFER TEST SET-UP AT PUMPED WELL HRES-4	Prepared by:	D. Weber	30-Apr-2008
		Checked by:	A. Brown	15-May-2008
		File:	fig_HRES4_PumpingTest_Photos.xls	
		ERROL L. MONTGOMERY & ASSOCIATES, INC. WATER RESOURCE CONSULTANTS		

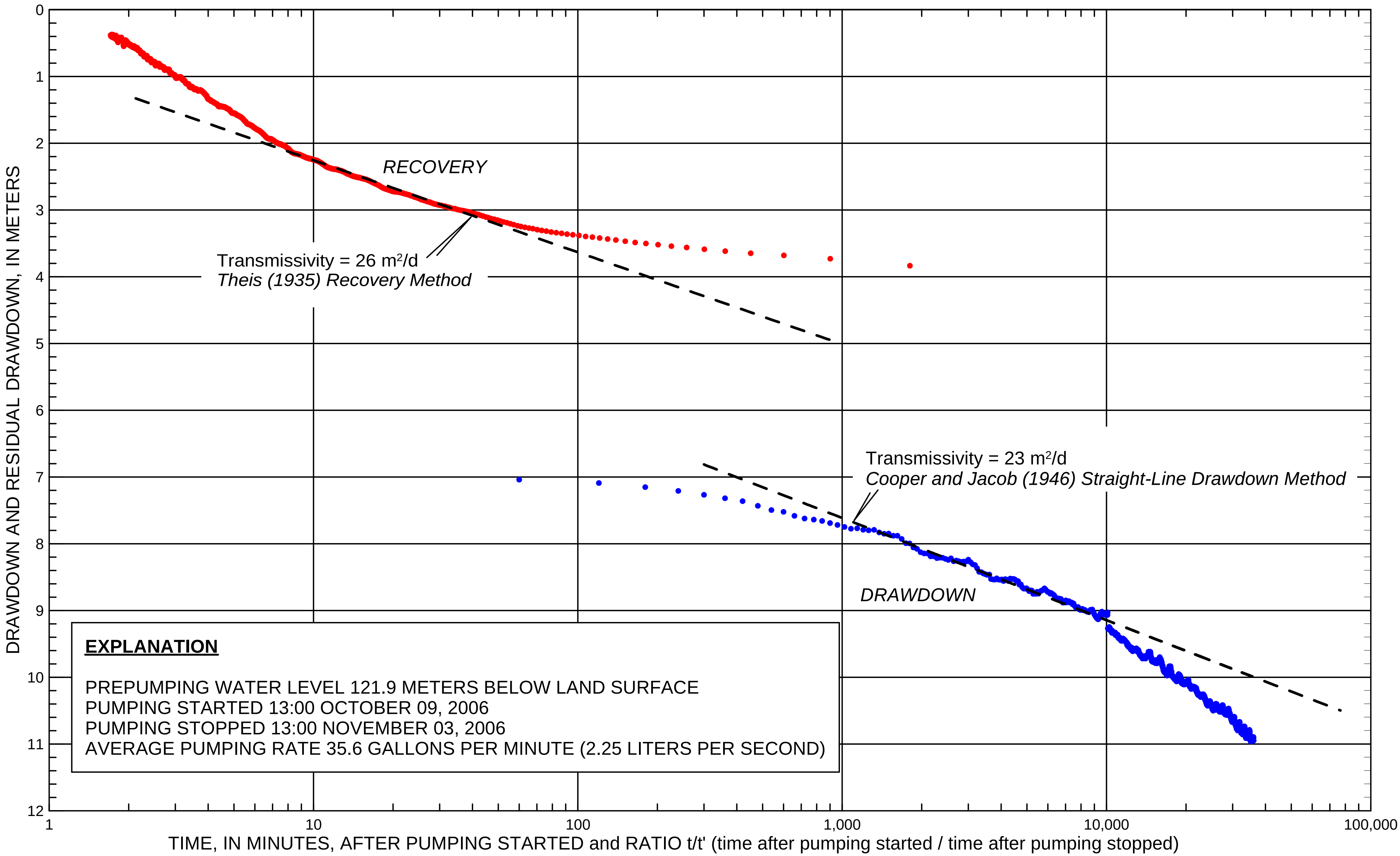

FIGURE 3. DRAWDOWN AND RECOVERY GRAPH FOR PUMPED WELL HRES-4 DURING 25-DAY AQUIFER TEST

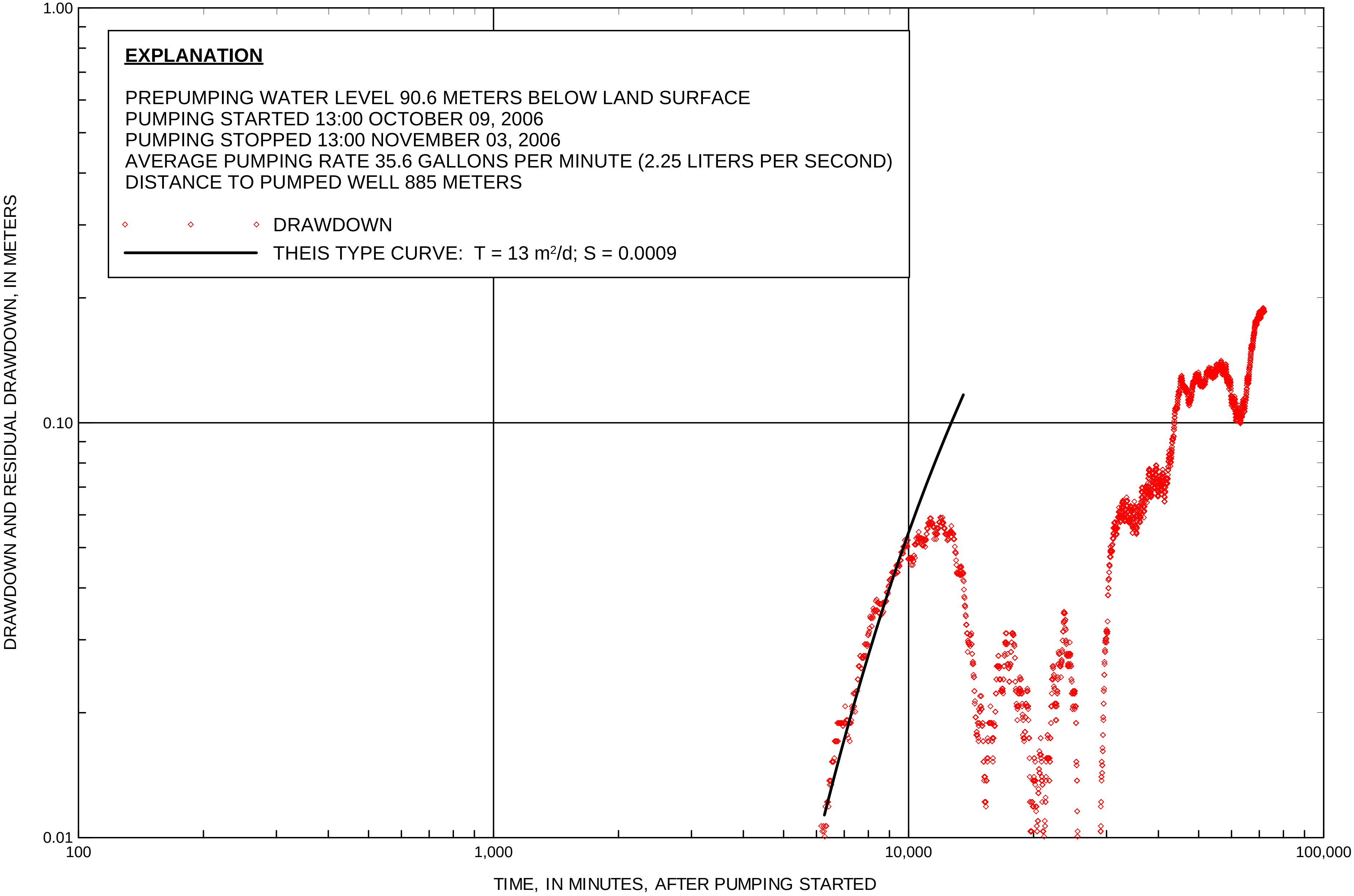

FIGURE 4. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-2s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

605\06\02 - Long-term Test HRES-4\Report\Figures\HRES4Pump-2sobs_NoBaro.grf 12May2008

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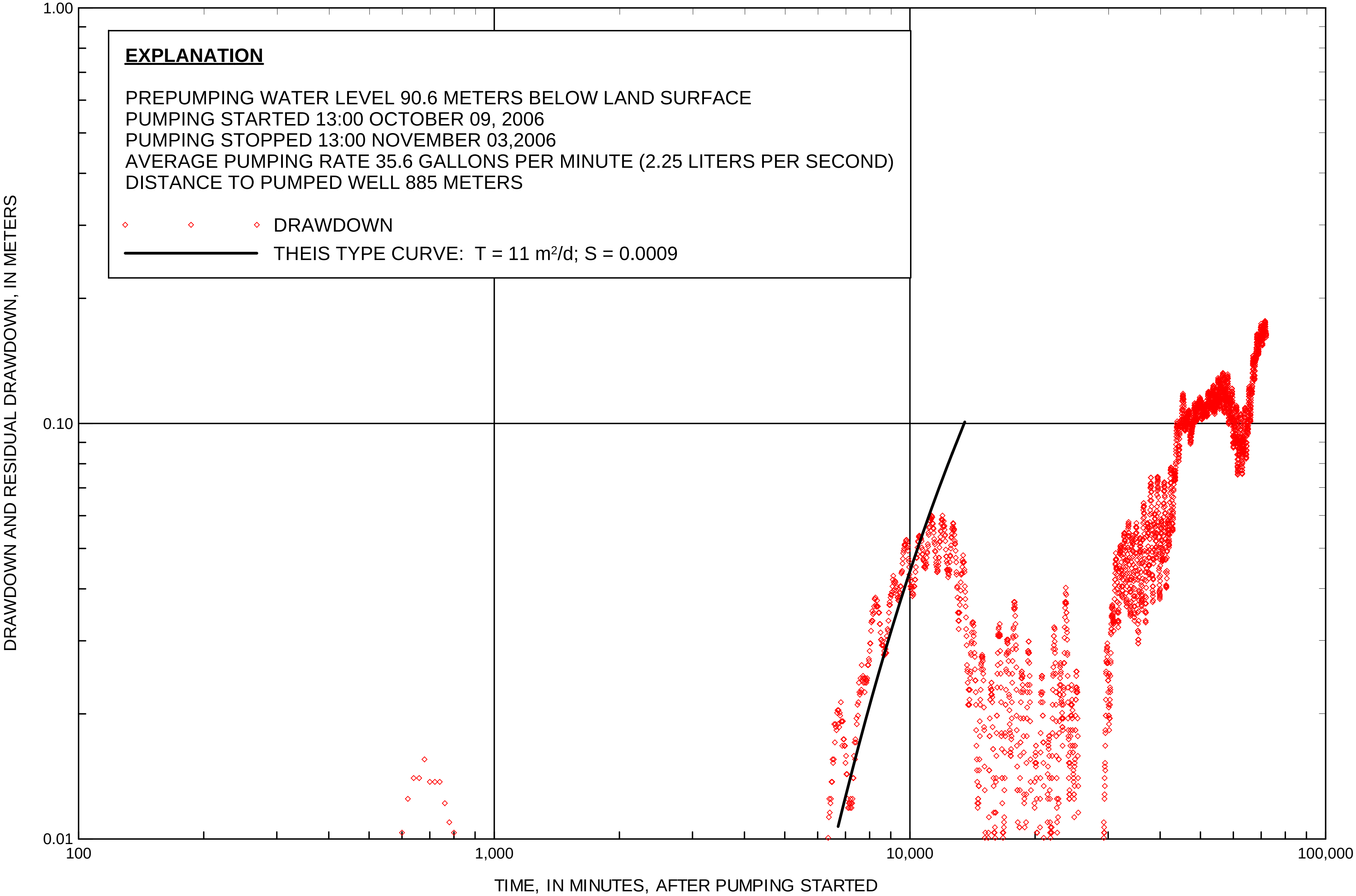

FIGURE 5. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-2d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

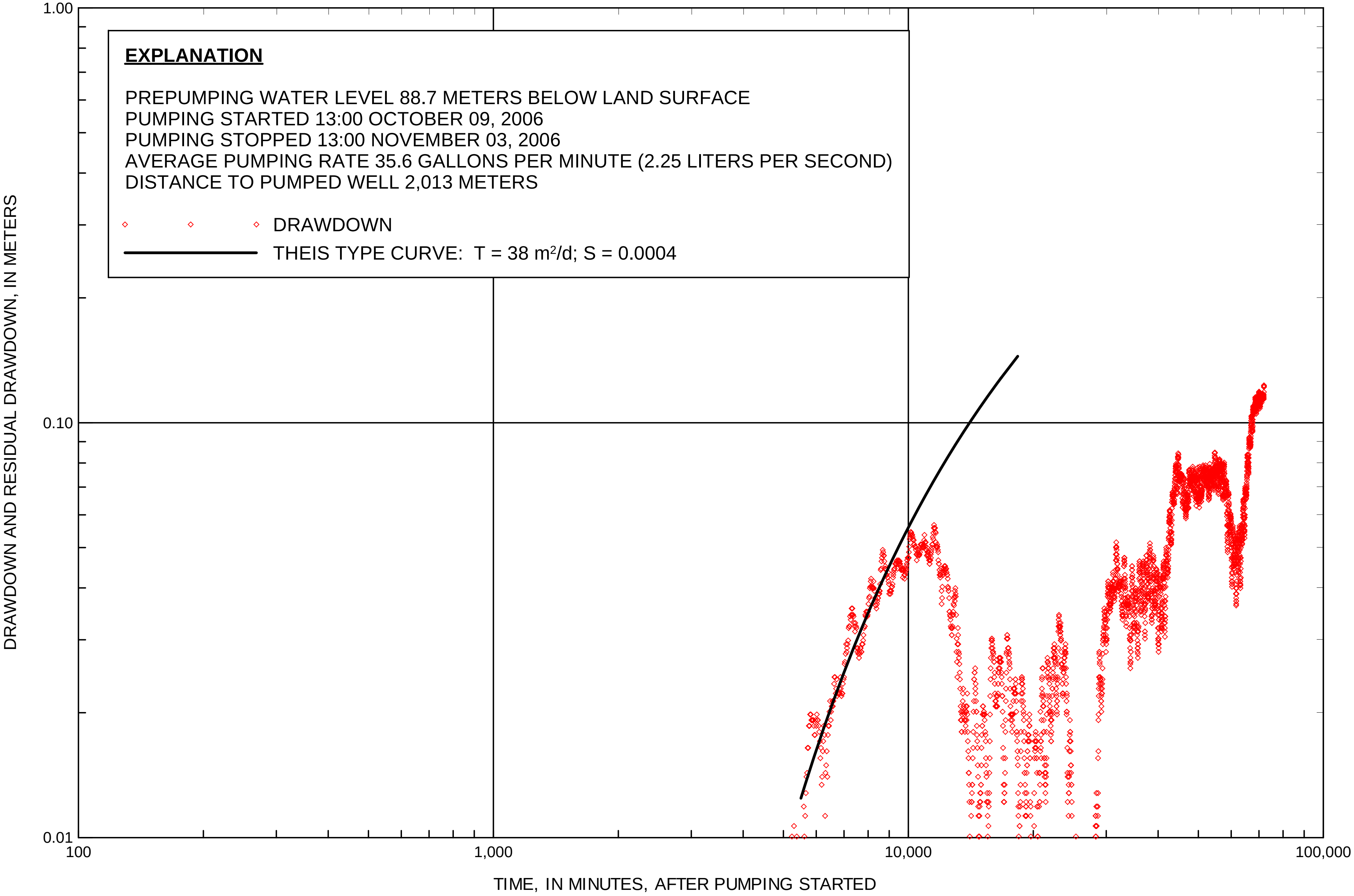

FIGURE 6. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-3s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

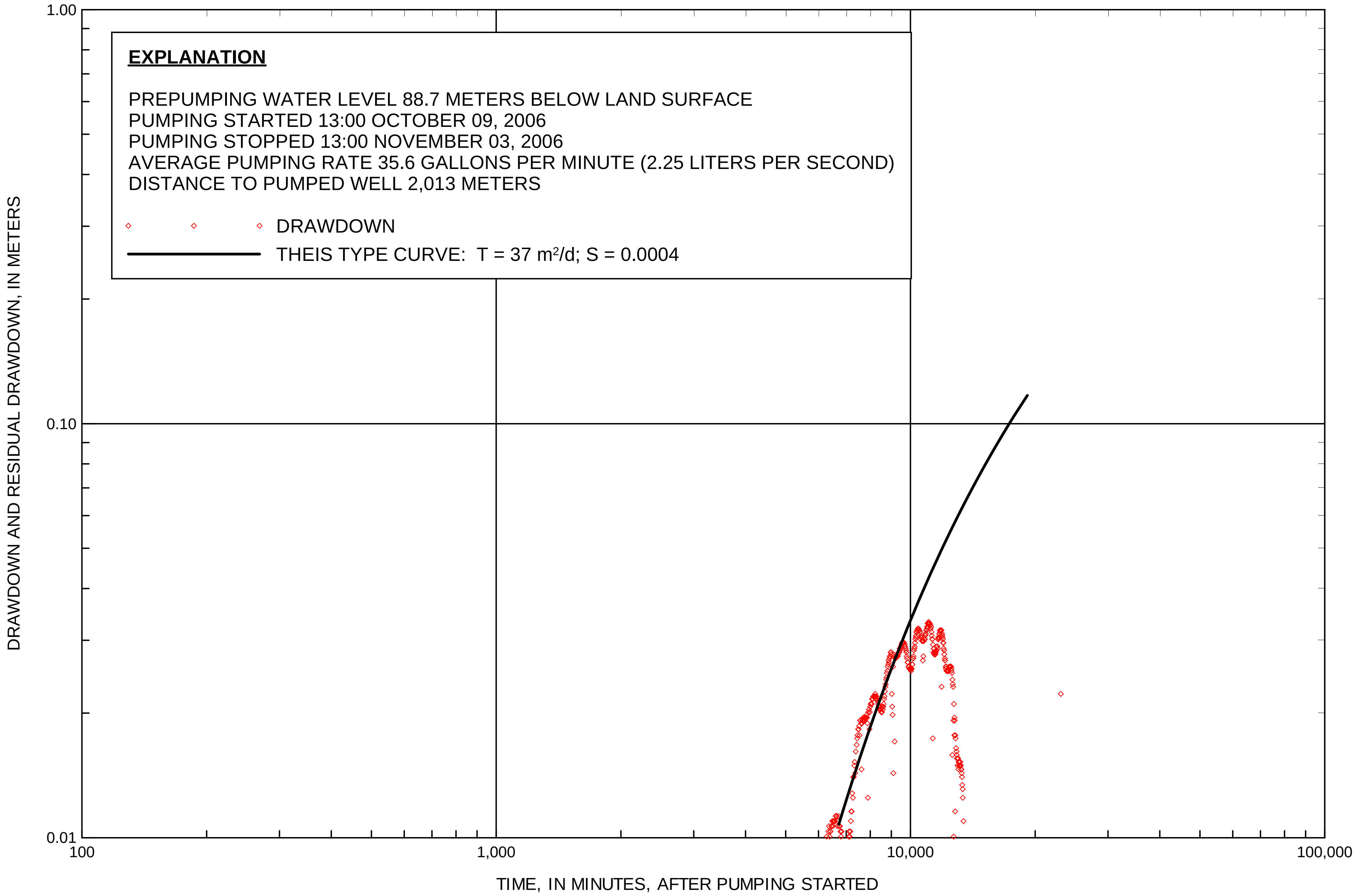

FIGURE 7. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-3d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

605\06\02 - Long-term Test HRES-4\Report\Figures\HRES4Pump_3dobs_NoBaro.grf 12May2008

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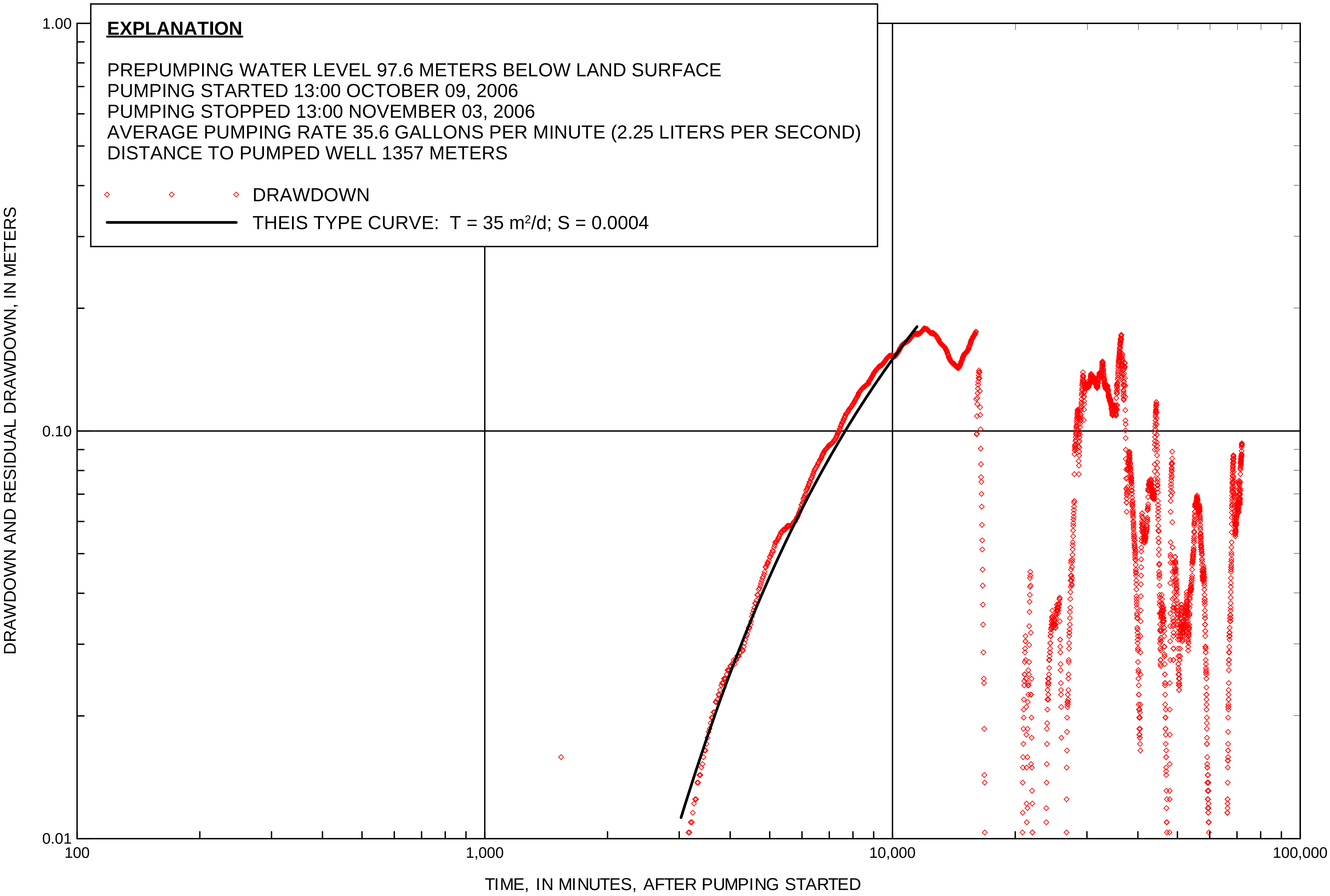

FIGURE 8. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-5s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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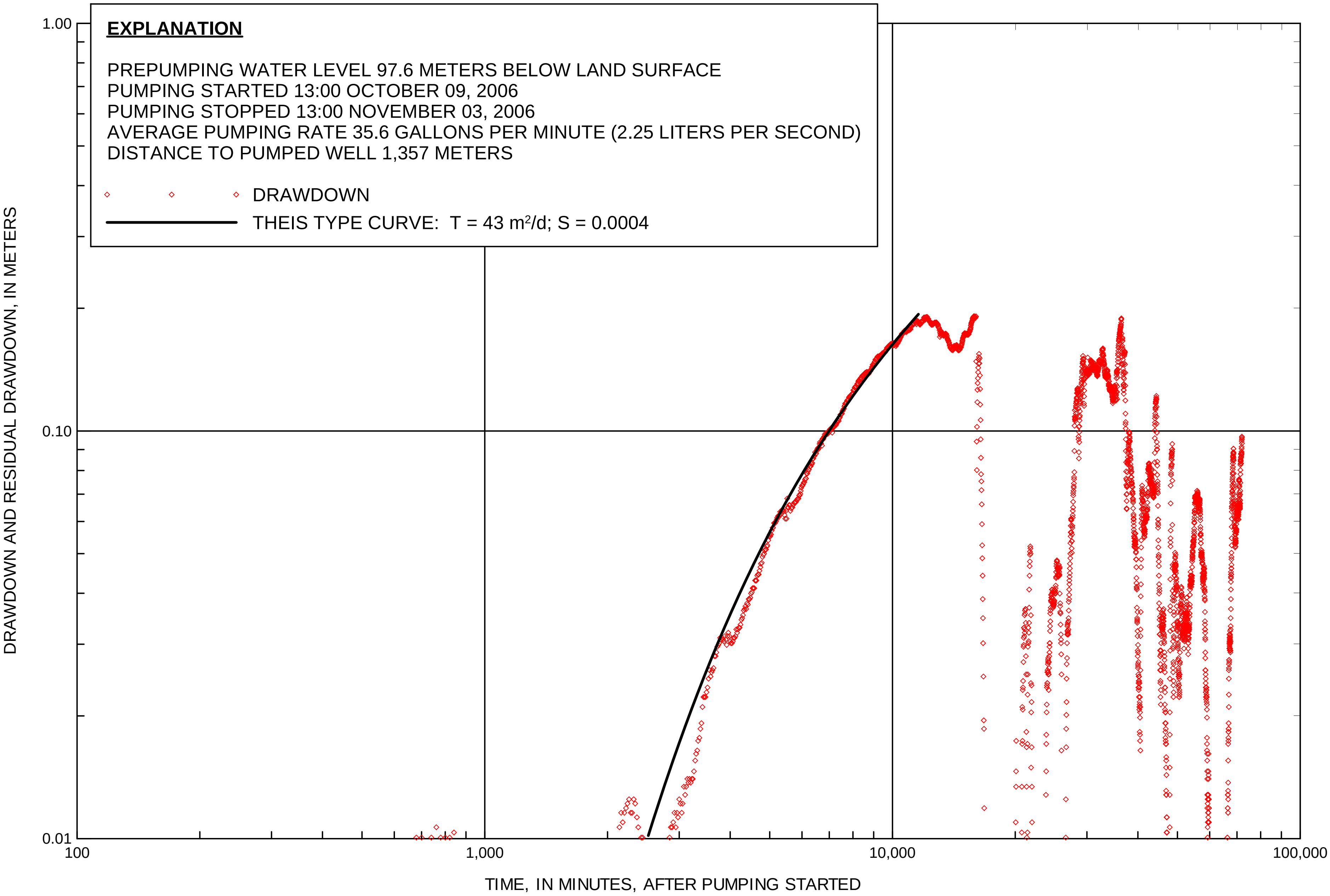

FIGURE 9. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL HRES-5d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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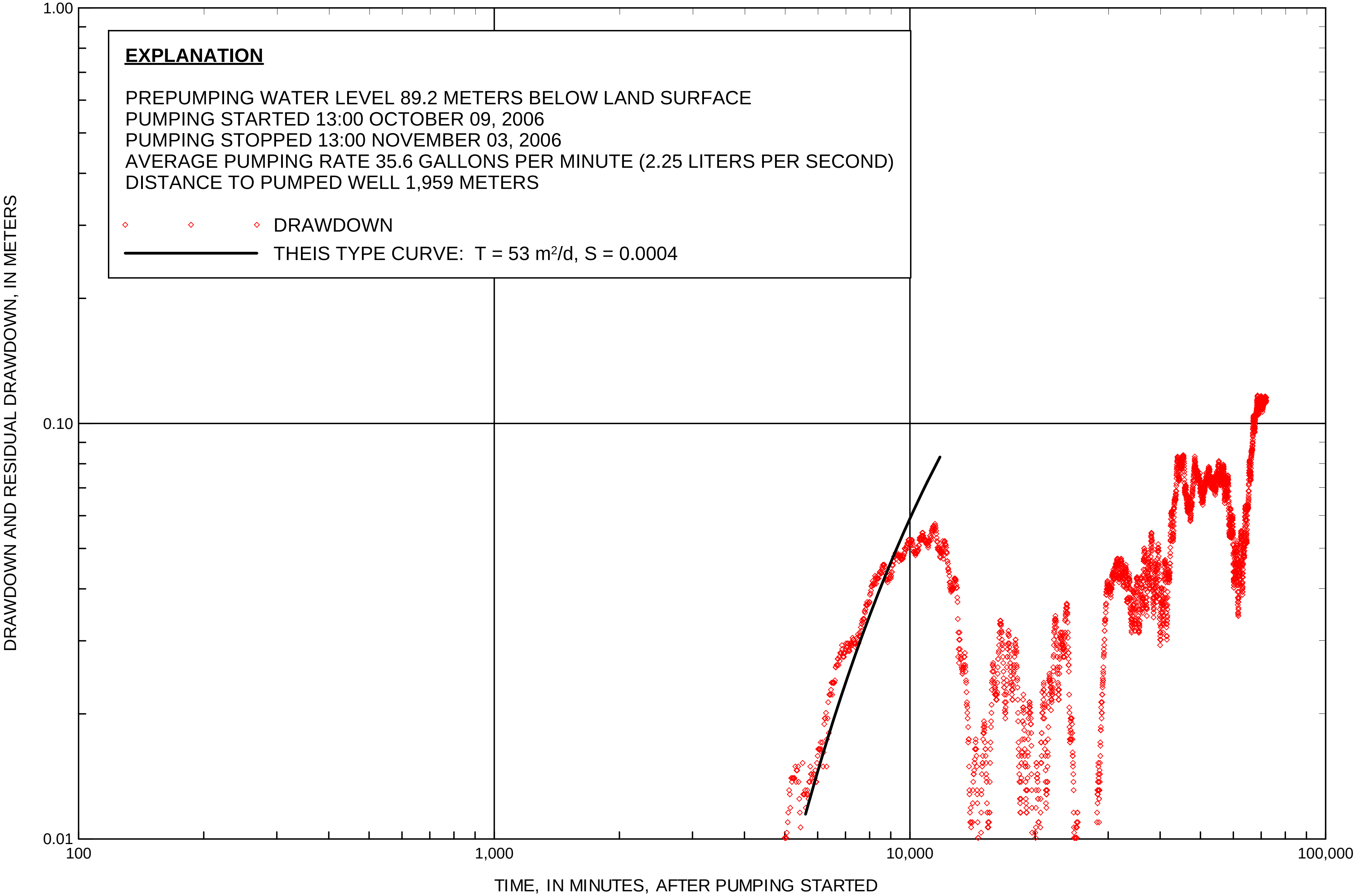

FIGURE 10. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL OAK FLAT DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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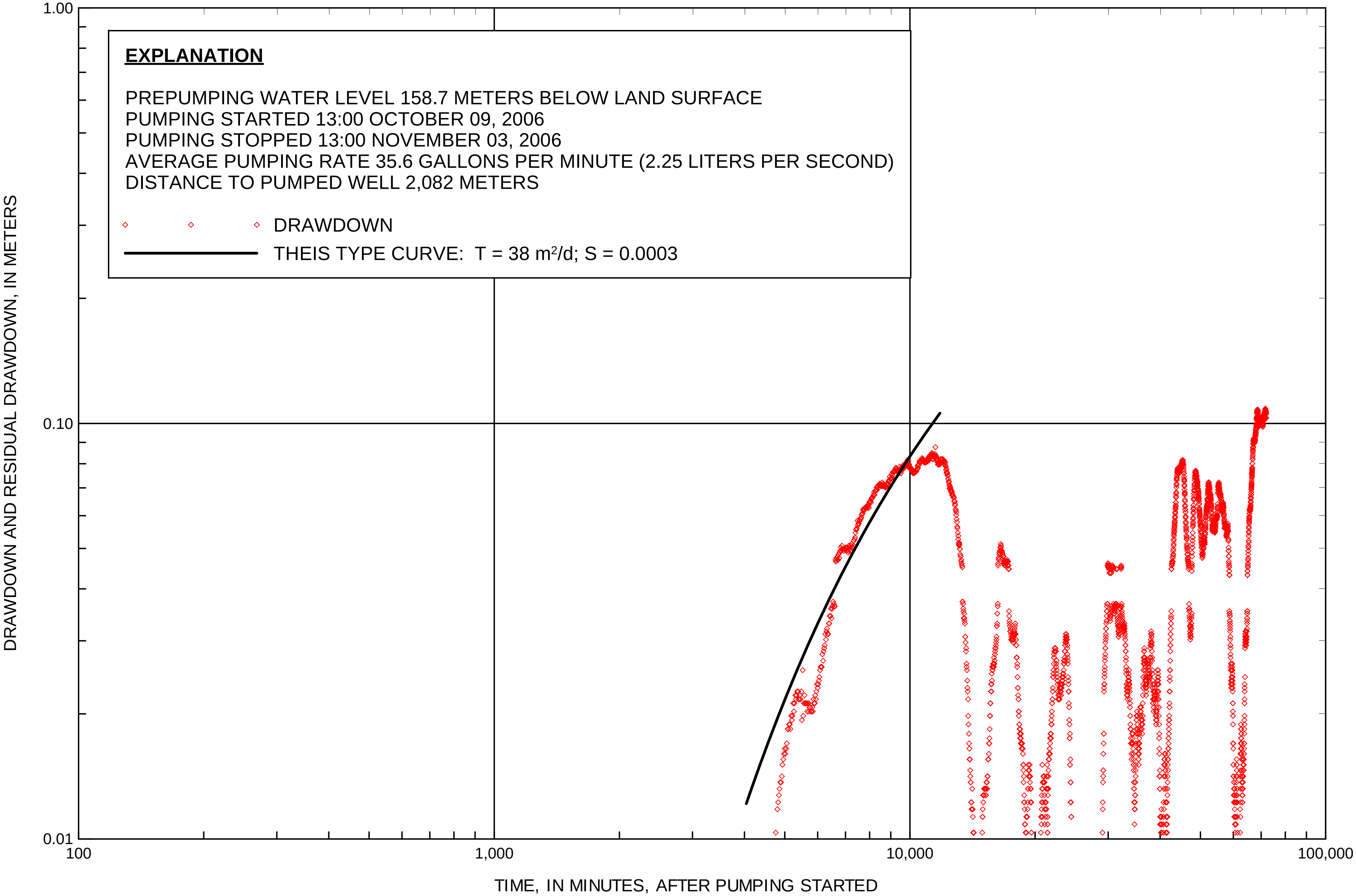

FIGURE 11. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL A-06 DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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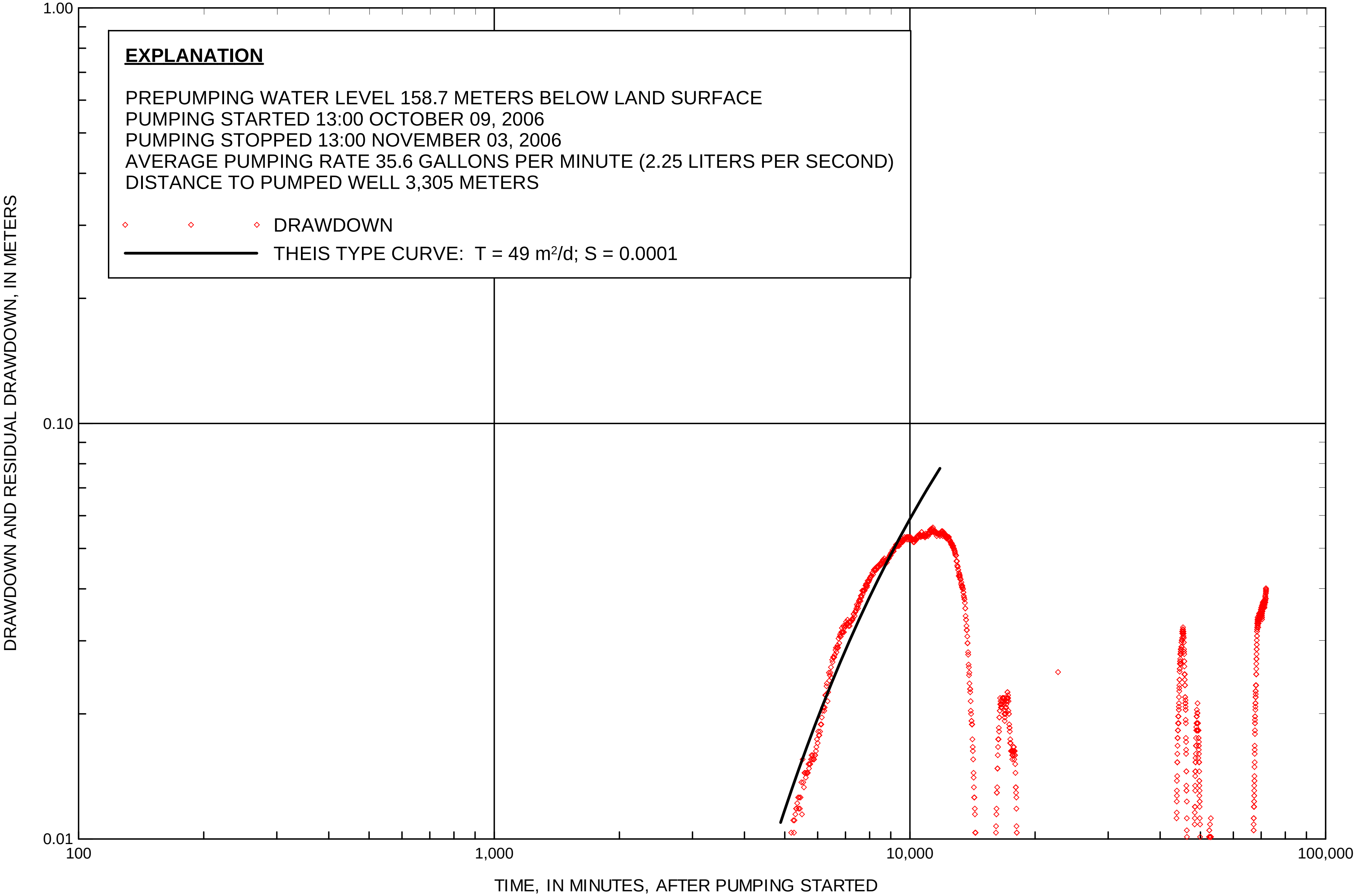

FIGURE 12. LOG-LOG DRAWDOWN AND RECOVERY GRAPH FOR OBSERVATION WELL MJ-11 DURING 25-DAY AQUIFER TEST AT WELL HRES-4

605\06\02 - Long-term Test HRES-4\Report\Figures\HRES4PUMP_MJ11OBS_NoBaro.GRF 14May2008

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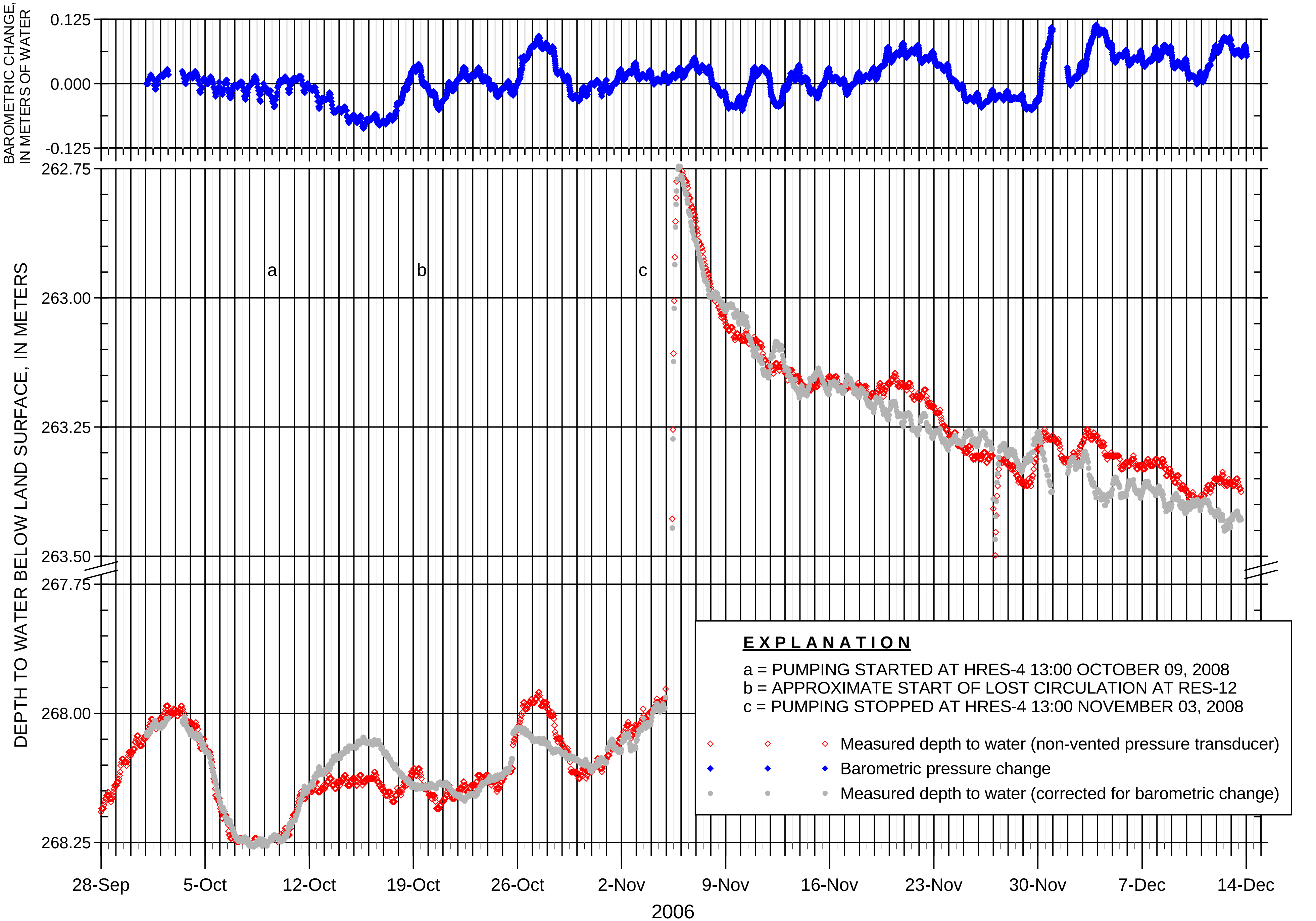

FIGURE A-1. WATER LEVEL HYDROGRAPH FOR WELL HRES-1s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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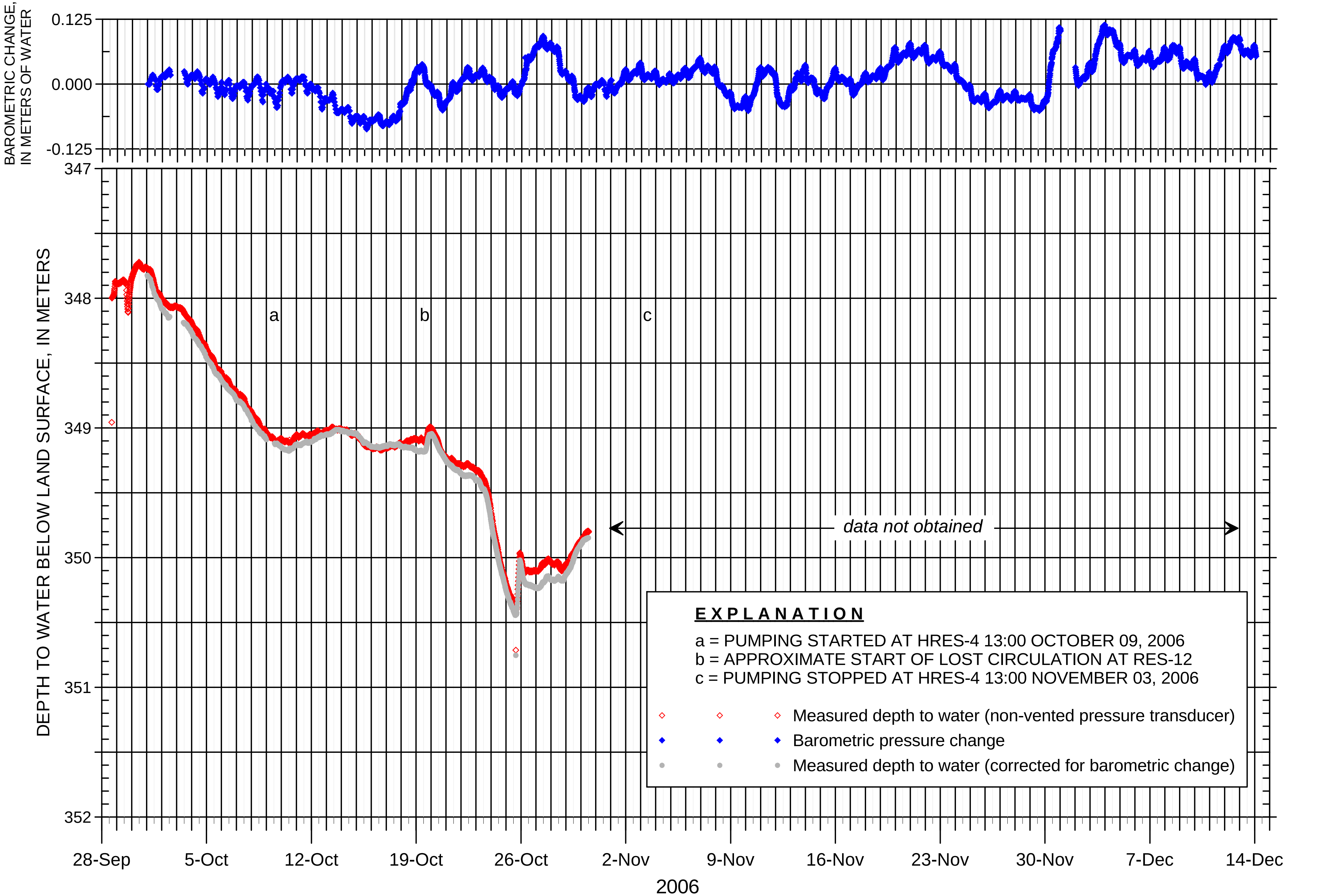

FIGURE A-2. WATER LEVEL HYDROGRAPH FOR WELL HRES-1d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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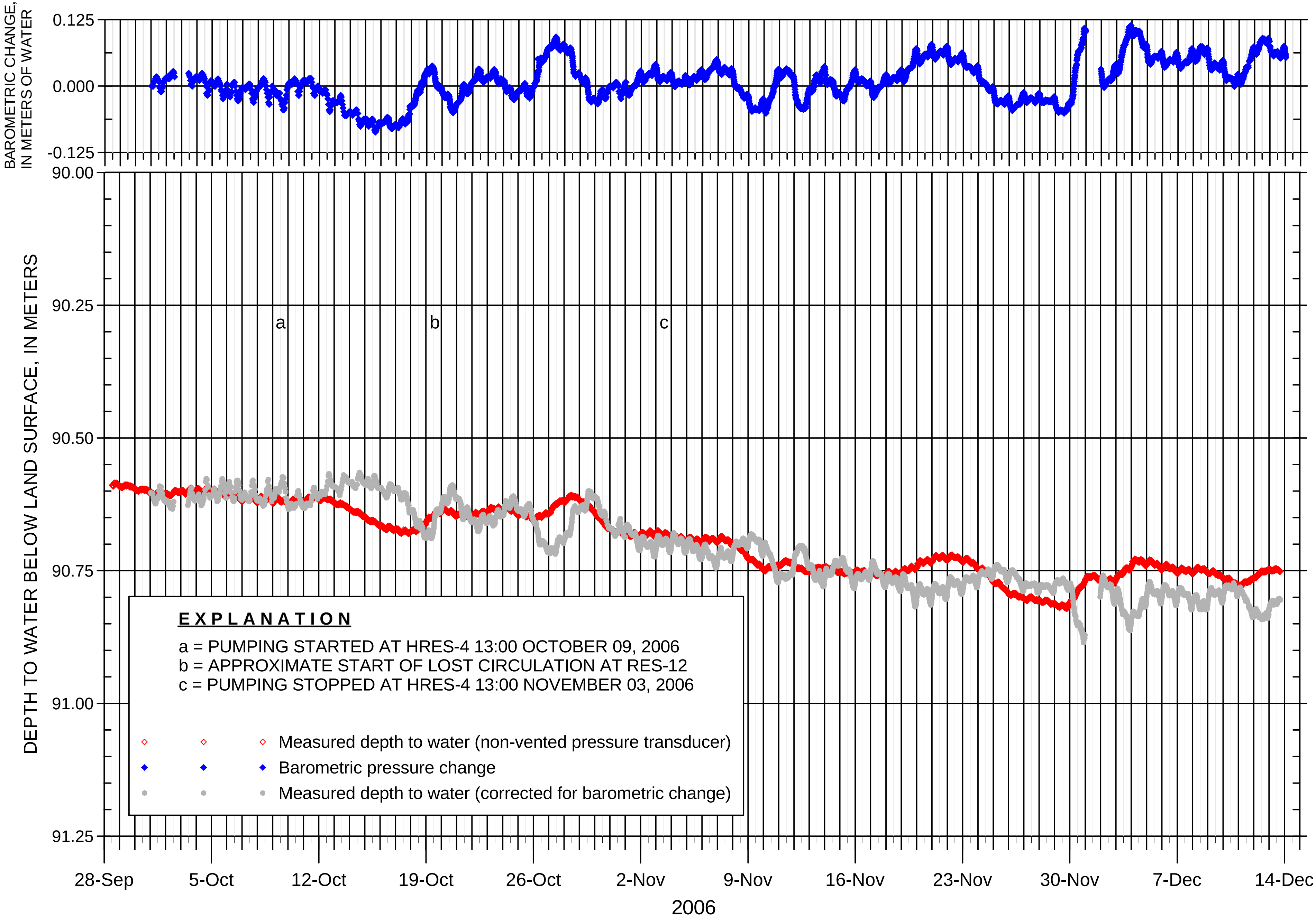

FIGURE A-3. WATER LEVEL HYDROGRAPH FOR WELL HRES-2s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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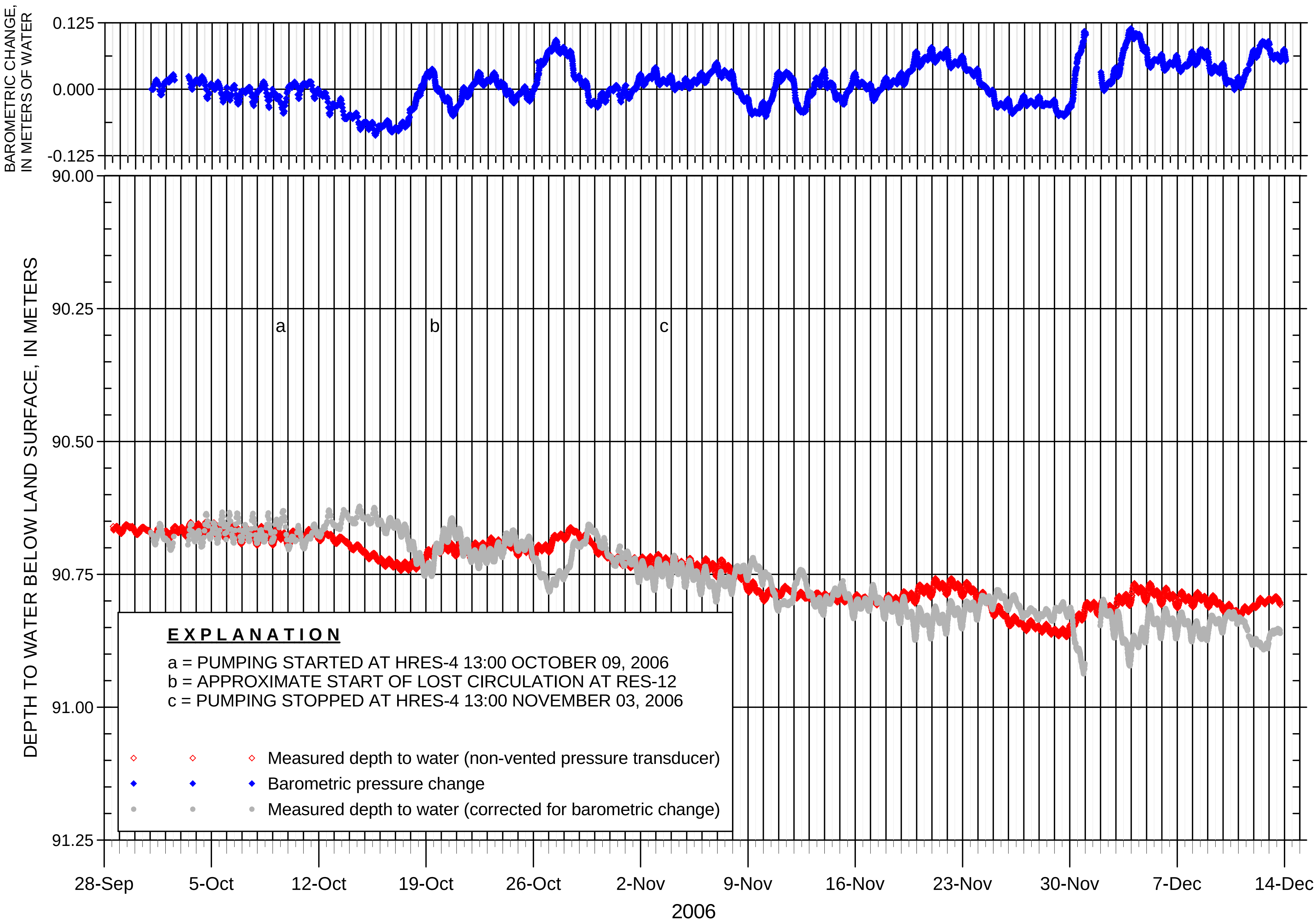

FIGURE A-4. WATER LEVEL HYDROGRAPH FOR WELL HRES-2d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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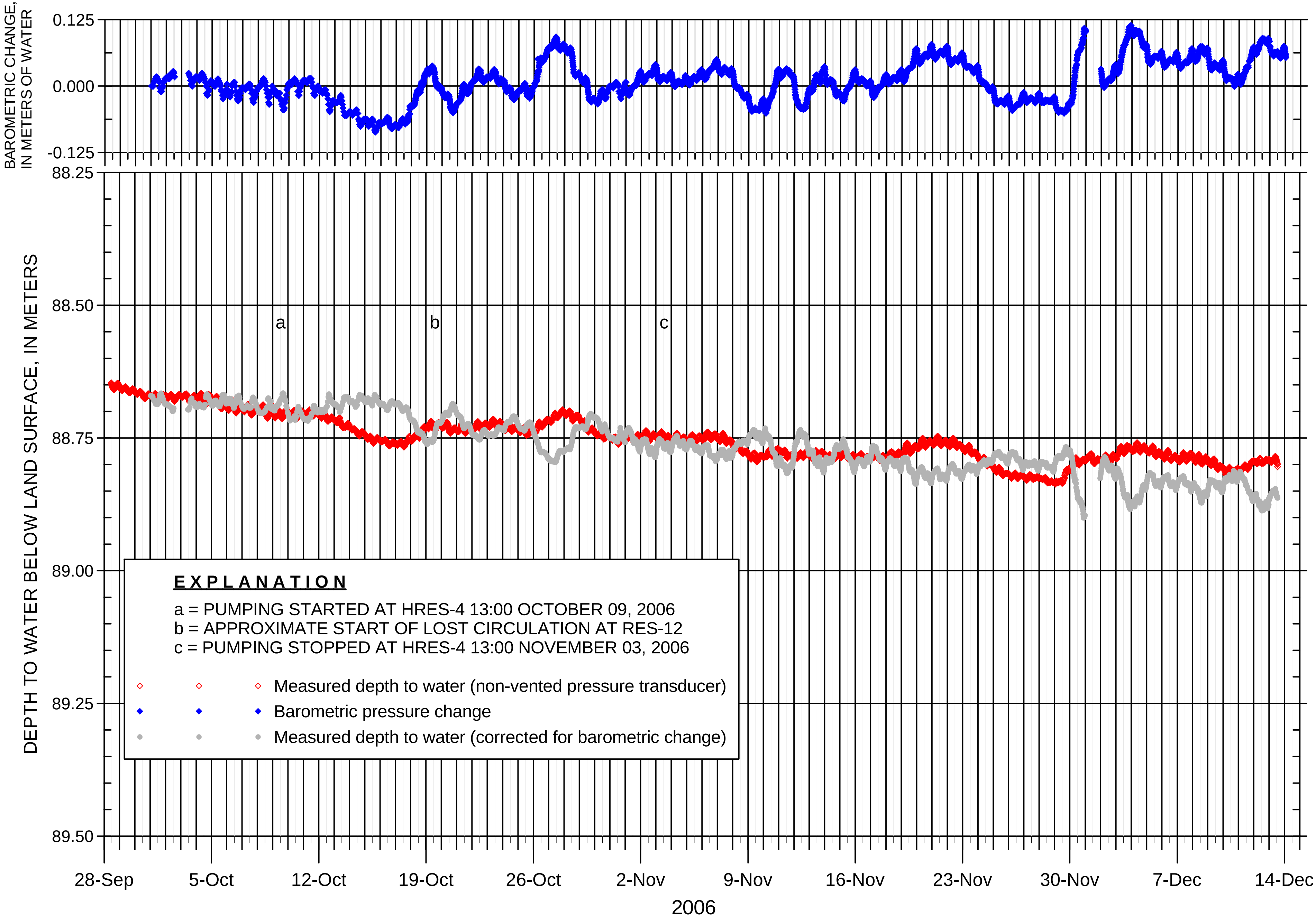

FIGURE A-5. WATER LEVEL HYDROGRAPH FOR WELL HRES-3s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

605\06\02 - Long-term Test HRES-4\Report\Figures\HRES-3s_BASELINE_2.GRF 17May2008

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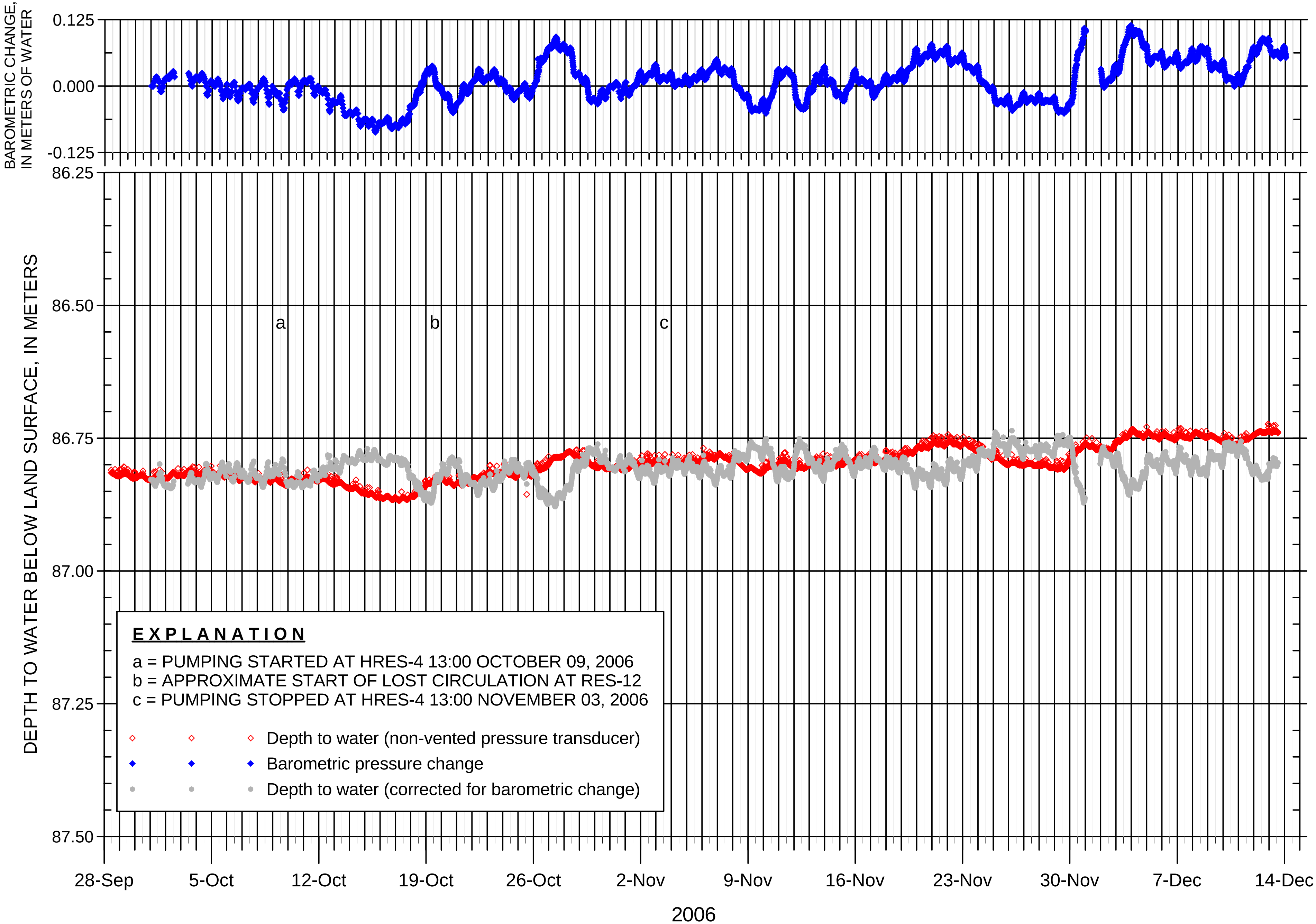

FIGURE A-6. WATER LEVEL HYDROGRAPH FOR WELL HRES-3d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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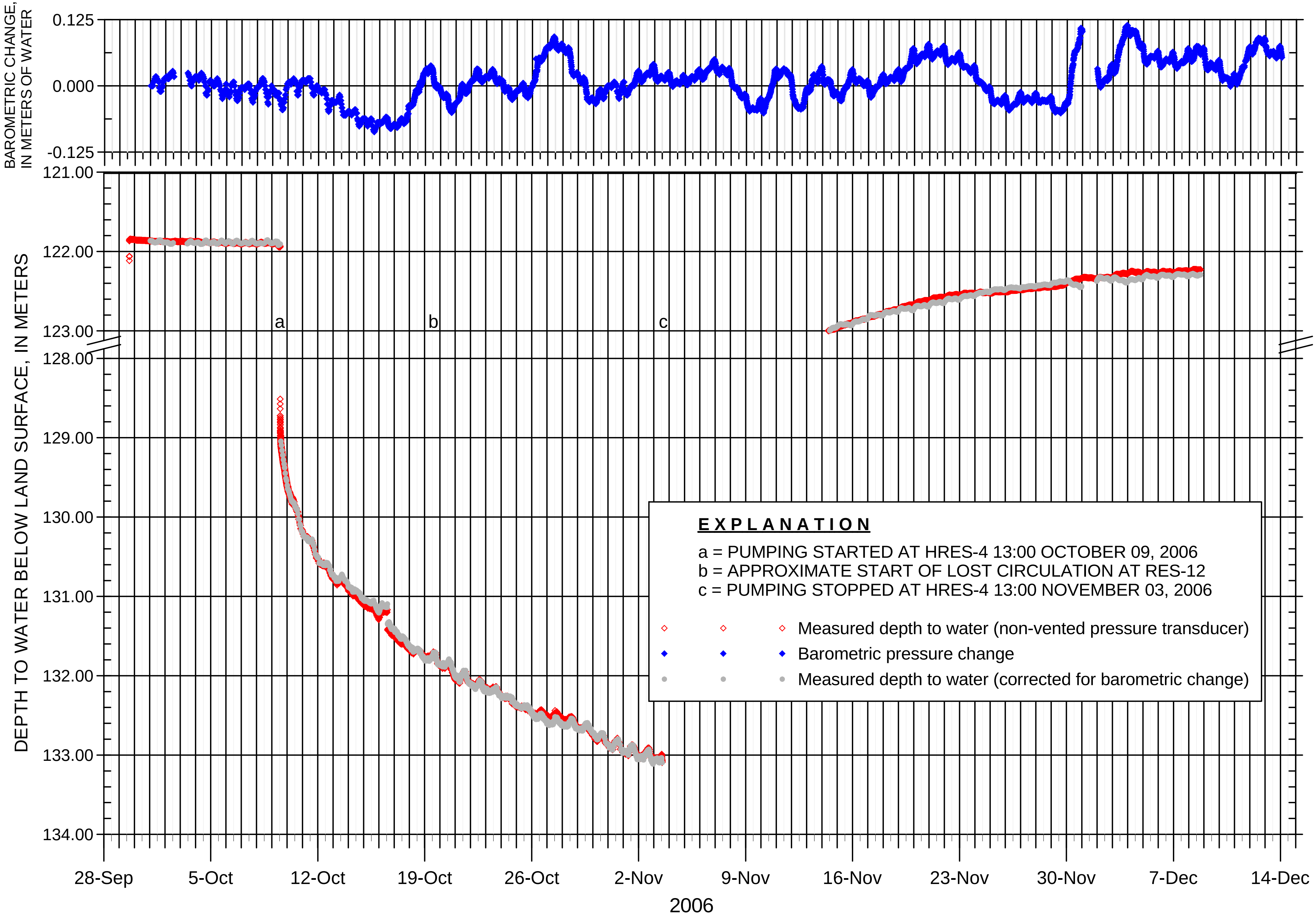

FIGURE A-7. WATER LEVEL HYDROGRAPH FOR WELL HRES-4 DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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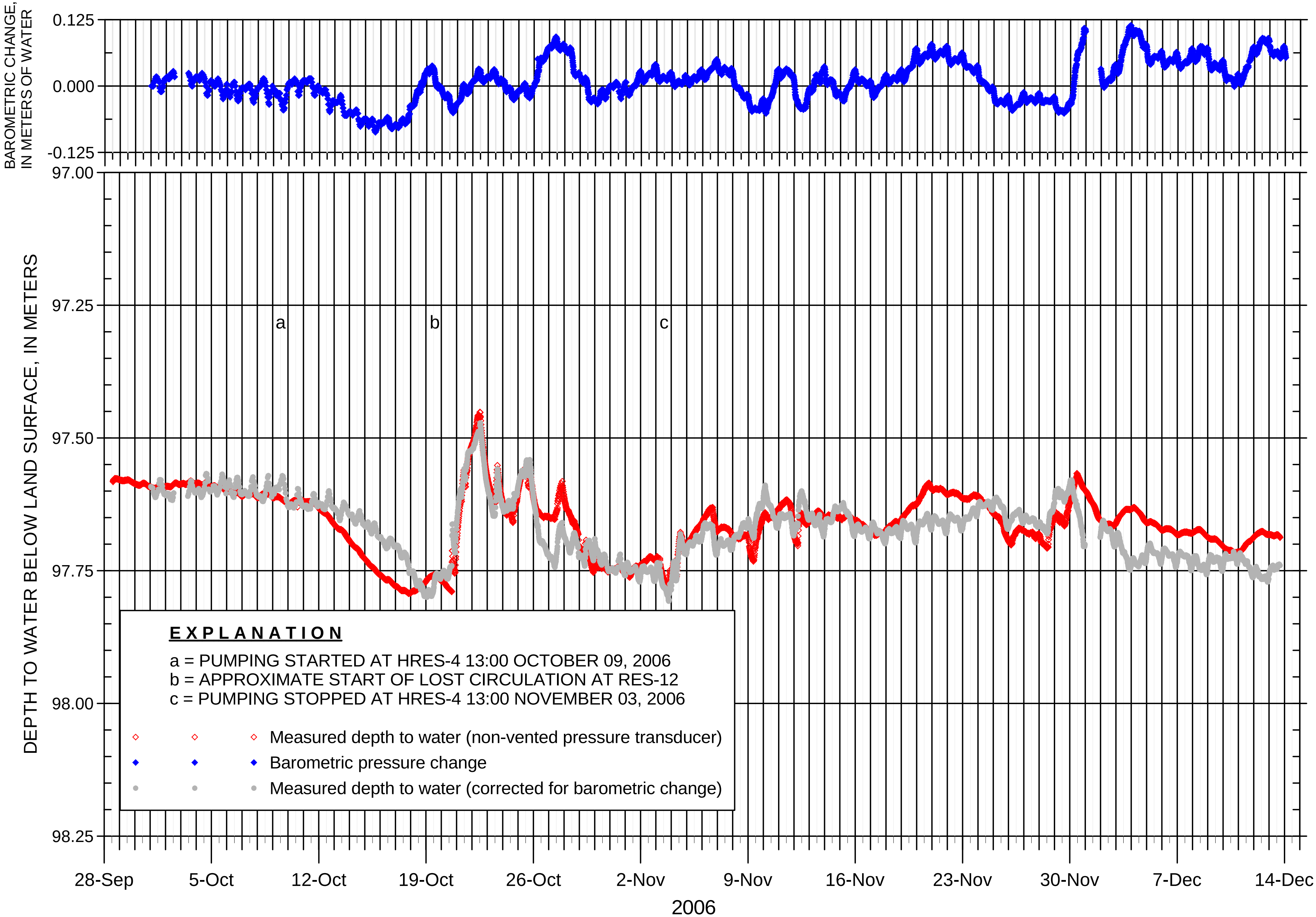

FIGURE A-8. WATER LEVEL HYDROGRAPH FOR WELL HRES-5s DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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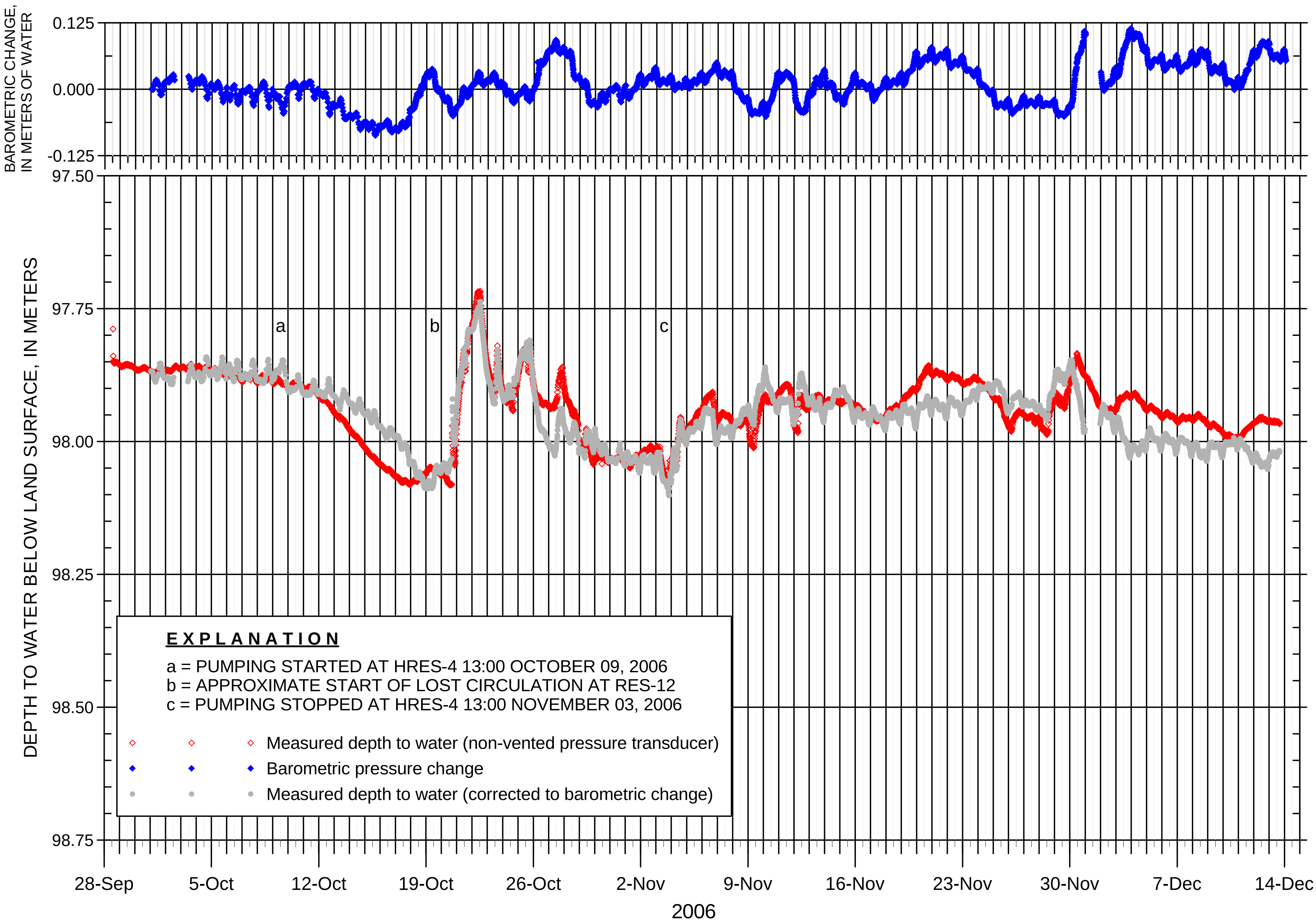

FIGURE A-9. WATER LEVEL HYDROGRAPH FOR WELL HRES-5d DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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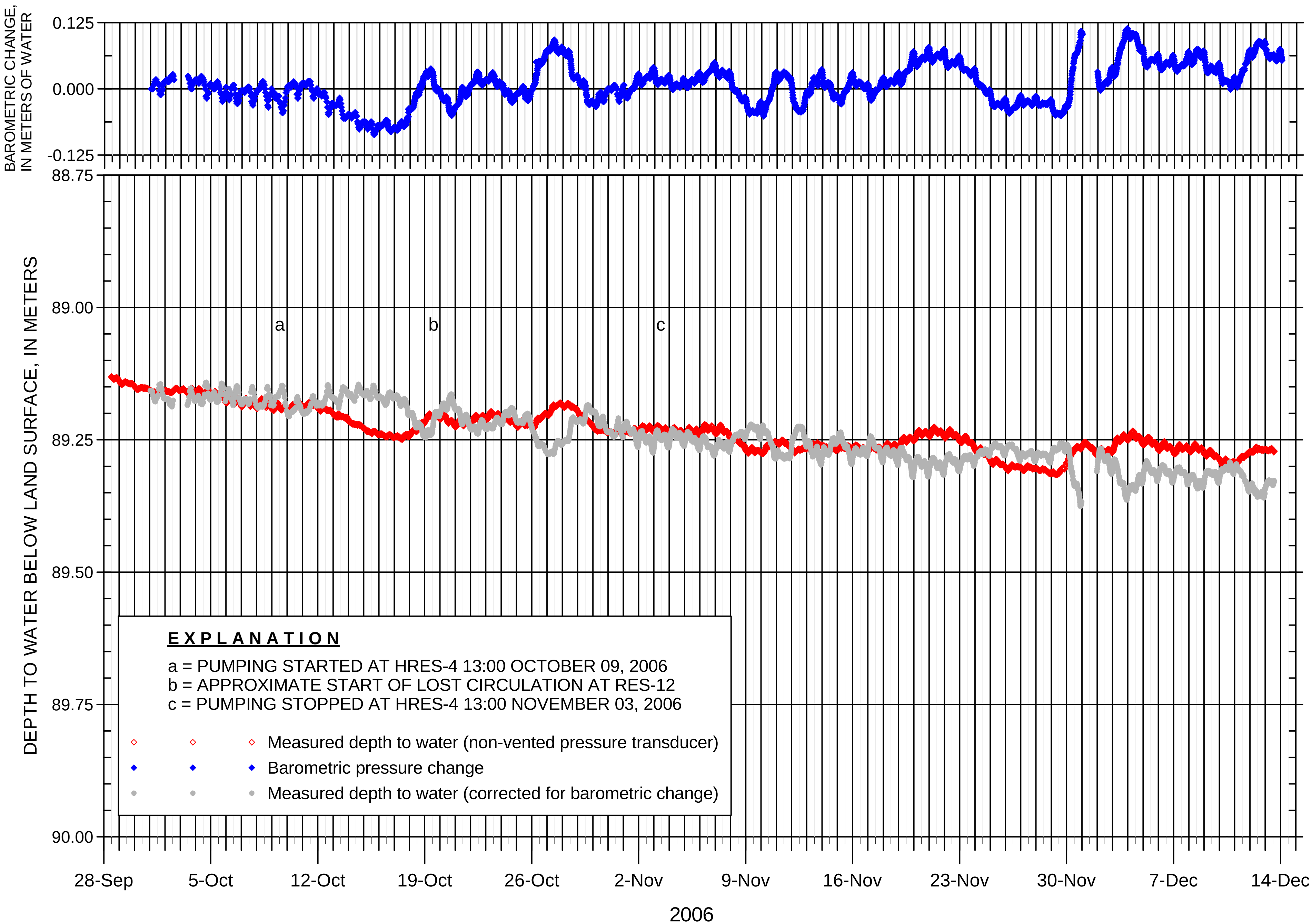

FIGURE A-10. WATER LEVEL HYDROGRAPH FOR OAKFLAT WELL DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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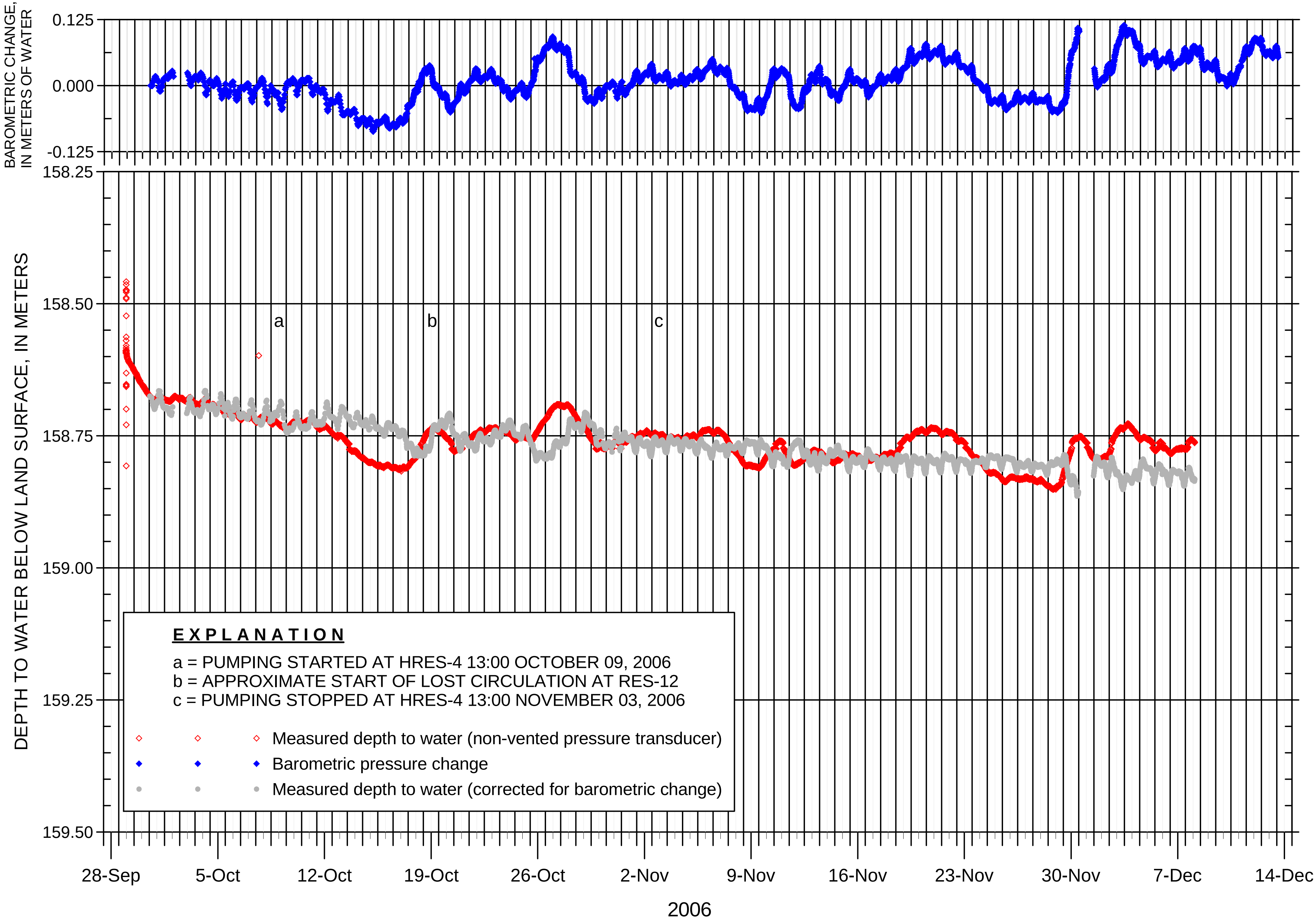

FIGURE A-11. WATER LEVEL HYDROGRAPH FOR WELL A-06 DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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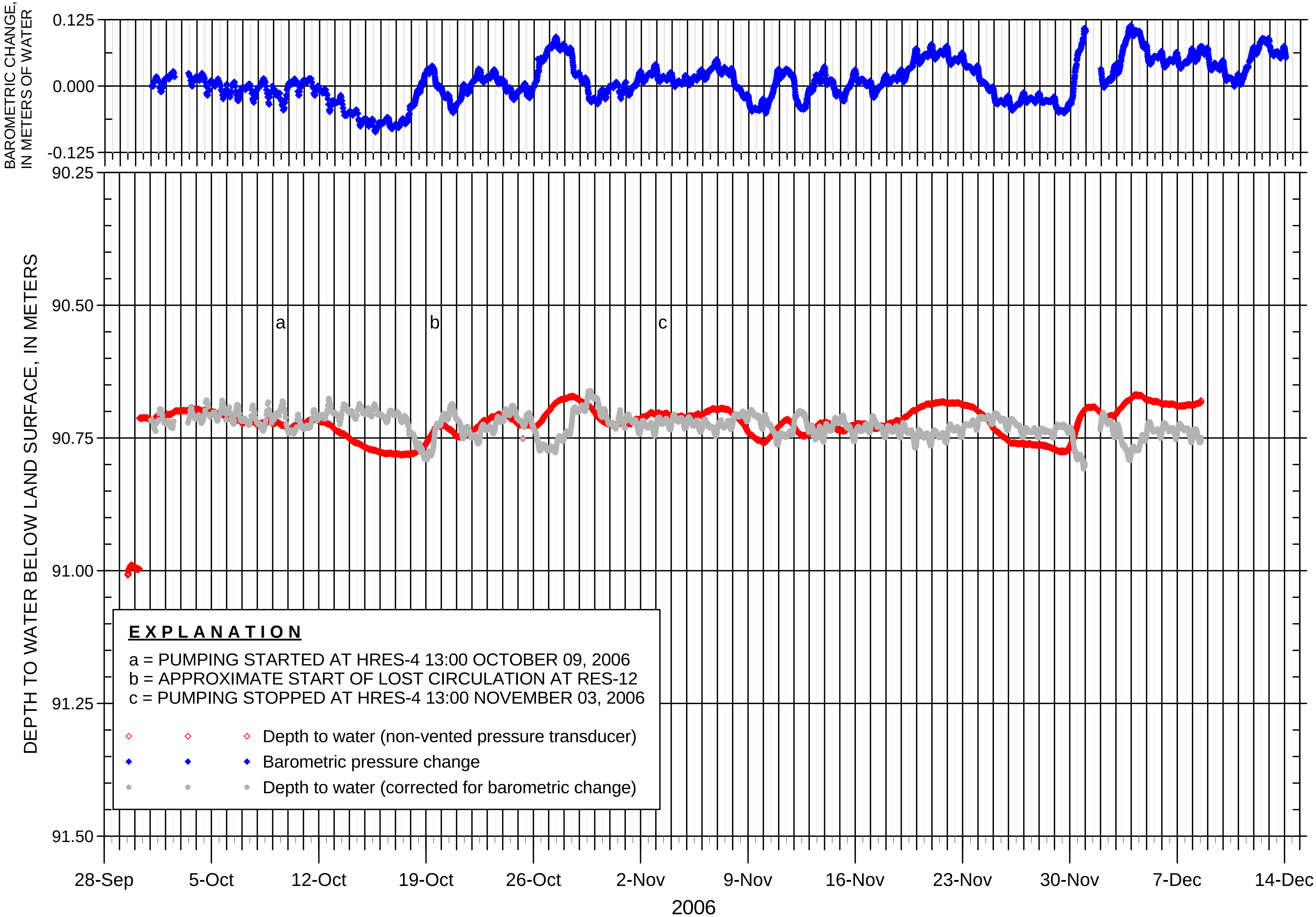

FIGURE A-12. WATER LEVEL HYDROGRAPH FOR WELL MJ-11 DURING 25-DAY AQUIFER TEST AT WELL HRES-4

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