SECTION K.6

TABLE OF CONTENTS

FIGURES

SECTION K.6

TABLE OF CONTENTS
FIGURES
(continued)

SECTION K.6

TABLE OF CONTENTS
FIGURES
(continued)

Page Number

SECTION K.6

TABLE OF CONTENTS
FIGURES
(continued)

SECTION K.6

TABLE OF CONTENTS
FIGURES
(continued)

SECTION K.6

TABLE OF CONTENTS
FIGURES
(continued)

SECTION K.6

TABLE OF CONTENTS
TABLES

Page Number

SECTION K.6

TABLE OF CONTENTS
TABLES
(continued)

Page Number

SECTION K.6

TABLE OF CONTENTS
TABLES
(continued)

SECTION K.6

TABLE OF CONTENTS
TABLES
(continued)

K.6.0 PW4-3 TEST

As stated in the introduction, this aquifer test was conducted: 1) to demonstrate communication between the area to be mined (production zone) and the surrounding monitor well ring, 2) to determine the degree of hydrologic communication between the production zone and overlying and underlying aquifers, 3) to determine the presence of hydrologic boundaries, and 4) to determine the hydrologic characteristics of the production zone aquifer. The PW4-3 multi-well test was conducted to achieve these objectives for the northwestern half of Wellfield 4A.

In order to achieve the objective of determining the production zone aquifer's hydrologic properties, data on time and drawdown were plotted, and calculations of transmissivity and storage coefficient were made by using the Theis non-leaky aquifer method. See Section E.7 in Attachment E of Volume III in Permit to Mine #633 of Rio Algom and Hydro-Engineering, L.L.C. (1997) in the 1997 PW1 test for aquifer test theory discussion. The straight-line drawdown method (semi-log plot), which approximates the Theis method, and the Theis recovery, were also used to analyze these pump tests. The aquifer test theory in Hydro-Engineering, L.L.C. (1997) also presents the equations for both of these methods. The tables and figures in this section present the uncorrected drawdown data, which was used in our analysis of this pump test.

These drawdown plots and data fits are important in the evaluation of boundary conditions. Boundary conditions are not important to this pump-test analysis as discussed in Section K.6.4.3. The directional transmissivities were also calculated and the results are discussed in Section K.6.4.4.

The test clearly demonstrated communication between the monitor well ring and the production zone, and the lack of hydrologic communication with the overlying O Sand and underlying K Sand aquifers.

Rio Algom's data logger records barometric pressure while it is logging the water levels. The water level change plots (the A set of figure numbers) contain a plot of the barometric pressure, along with the water-level changes. Barometric pressure changed only approximately 0.8 inches of mercury over the pre-test, pumping and recovery phases of the PW4-3 test. This amount of barometric change would result in small water-level correction for changes in barometric pressure. No corrections for barometric pressure were made for the analysis of this pump test.

Water levels prior to the initiation of the PW4-3 pump test were falling in most of the M Sand wells as a result of the changes in trends caused by Wellfield 4. A prior trend correction was not used to correct for these trends in water levels for this test due to the conclusion that these trends are caused by fluctuations in Wellfield 4 and vary with time and areally across Wellfield 4A. The M Sand wells closest to Wellfield 4 showed the effects of these fluctuations much more than the M Sand wells that were further away, and a constant prior trend was not appropriate for the PW4-3 wells. Water levels are presented for three days before the start of the test in the water-level change plots (A figure numbers). Changes in the prior trend, after the pump test has started, result in incorrect corrections for prior trend. Therefore, no correction for prior trend was used in our analysis of this test.

The drawdown and water-level change data presented in the figures and tables have not been corrected for barometric pressure changes or prior trends. The barometric pressure corrections would result in relatively small changes, and the prior trend corrections would be relatively large for many of the wells and neither were considered in analysis of the PW4-3 test results.

K.6.1 M SAND RESPONSES

Well PW4-3, which is located in the northwestern half of Wellfield 4A, was pumped at an average rate of 16.2 gpm from 11:00 a.m. on November 29, 1999 through 11:00 a.m. on December 3, 1999. The discharge from well PW4-3 was held steady throughout the test (see Table K.6-12C for a tabulation of flow rates). Pumping well PW4-3 was pumped for a period of four days in an attempt to obtain as much data as possible to distinguish the pumping effects from the effects of the trend changes caused by Wellfield 4.

This sub-section presents a discussion of the drawdown developed by pumping well PW4-3, the demonstration of communication with the monitoring ring wells and a summary of the M Sand aquifer properties developed by this test. The analyses of the M Sand pump test are presented in Section K.6.4.

The pump test figures and tables for each particular well are given the same number with the addition of the letter A, B, C or D to distinguish the different type of figure or table. The manual data is presented in the A series tables, while the transducer data is given in the B series. The A series figures give a linear plot of the pre-test, pumping and recovery data. The B and C series figures contain the semi-log and log-log drawdown plots, while the D series presents the recovery plot.

K.6.1.1 DRAWDOWN IN M SAND

Figure K.6-1 presents the drawdown in the M Sand after four days of PW4-3 pumping. The drawdowns at the end of the pump test from the transducer tables (B series) were used to obtain these drawdown values after four days of pumping.

Table K.6-1 also presents a tabulation of these drawdowns at the end of the pump test in the fourth column. Figure K.6-1 shows that the drawdowns decrease with distance away from pumping well PW4-3. A drawdown of at least 1.8 feet was developed in all of the northwestern M Sand wells, except for the three wells closest to Wellfield 4 (M401, M402, and M434). At these three wells, drawdowns ranged from –2.82 feet to 0.36 feet. The drawdown plots for these wells indicate that drawdown caused by the pumping well was observed, but the effects of the trend changes caused by Wellfield 4 dampened the observed drawdown. Figure K.6-1 shows that drawdowns are much greater to the southeast of the pumping well than they are closer to Wellfield 4 to the northwest.

Drawdowns of greater than 30 feet extend to 600 feet to the south of the pumping well. The twenty-foot contour generally extends out to 1100 feet from the pumping well.

K.6.1.2 MONITOR WELL COMMUNICATION WITH PUMP WELL PW4-3

The drawdown developed at the end of the pump test shows good communication with all of the northwestern M Sand monitoring wells, except the three northwestern wells. Well M434 indicated a water-level rise at the end of the pumping phase, but the straight-line plot for this well indicates that there is actually communication with the pumping well at this location. Figure K.6-1 presents the drawdown at the end of the test for all of the M Sand wells. The straight-line plots of the drawdown data are also useful in determining whether a consistent pattern of drawdown has developed with respect to the PW4-3 pumping in the outer monitoring ring wells, i.e. those wells with "M" designations. All of the northwestern monitoring wells are in communication with pumping well PW4-3. Wells M401, M402, and M434 are the closest wells to Wellfield 4, and the drawdowns from these wells were affected by Wellfield 4 variations more than the pumping well. However, the straight-line plots for these wells indicate that there is drawdown caused by the pumping well and communication is present. The minimum drawdown in the remainder of the monitoring wells was 1.8 feet, which indicates that all of these wells are in communication with PW4-3. This pump test, therefore, adequately demonstrates that the northwest half of the well field monitoring ring is in good communication with the production wells within the M Sand.

The Wellfield 4 pump test demonstrated good communication with M Sand wells M401, M402 and M434. The effects from variations in operation in Wellfield 4 extend beyond these three wells and farther into Wellfield 4A. This also demonstrates communication between the M Sand near the three northwestern wells and the M Sand to the southeast in Wellfield 4A.

Water levels were not measured immediately prior to or at the end of the PW4-3 pumping for the southeastern M Sand wells (PW4-4 monitoring wells). However, since the northwestern wells indicated good communication with the PW4-4 pumping well, it can be assumed that the southeastern wells have good communication with the PW4-3 pumping well also.

K.6.1.3 SUMMARY OF AQUIFER PROPERTIES FROM THE PW4-3 TEST

Transmissivities from the PW4-3 observation wells varied from 90 gal/day/ft to 210 gal/day/ft (see Figure K.6-2 for transmissivity values). Transmissivities from the log-log drawdown plots are recommended to be used for all wells except M Sand wells M401, M402, and M434 instead of the values from the semi-log drawdown or recovery plots because the pumping time does not meet the straight-line requirements for some of these wells. The straight-line plots are recommended to be used for wells M401, M402, and M434. The log-log plots for these wells show drawdown occurring too soon to be caused by the PW4-3 pumping and fits on this data would not be representative of the PW4-3 pumping. The straight-line plots for these wells yield reasonable aquifer properties and even though their transmissivities are lower than the other M Sand wells, it is believed that the effects of the PW4-3 pumping are present. Changes in water-level trends also affected the recovery plots. A transmissivity of 160 gal/day/ft is thought to best represent the M Sand in the northwestern half of Wellfield 4A.

The hydraulic conductivities, based on an aquifer thickness of 27 feet and the straight-line semi-log transmissivities for wells M401, M402, and M434 and the Theis log-log transmissivities for the remainder of the M Sand wells, are also tabulated in Table K.6-1, and they vary from 0.45 to 1.04 ft/day (0.14 to 0.32 Darcy) with an average of 0.78 ft/day.

Storage coefficients varied from a low of 5.2E-06 to a high of 6.2E-05 from the log-log and semi-log plots. A storage coefficient of 3.2E-05 is thought to best represent the M Sand in the southeastern area of Wellfield 4A.

A transmissivity of 160 gal/day/ft and storage coefficient of 3.5E-05 is thought to best represent average conditions for Wellfield 4A, based on both the PW4-4 and PW4-3 multi-well tests. A hydraulic conductivity of 0.84 ft/day (0.26 Darcy) is thought to best represent average conditions in the M Sand in Wellfield 4A.

K.6.2 O SAND RESPONSES

The overlying aquifer in Wellfield 4A is the O Sand. Four O Sand wells were monitored during the PW4-3 multi-well test. The geologic cross-sections in Section K.2 show a continuous overlying N Shale in this area. The water-level responses in the O Sand monitoring wells during the PW4-3 test do not indicate any connection between the M Sand and the O Sand in this area. Table K.6-2 presents the static water levels prior to the start of the PW4-3 test for the O Sand wells.

Table K.6-3 presents the distance to the O Sand (MS) wells from pumping well PW4-3, along with the estimated drawdown in the M Sand, at the end of the test near each of these O Sand wells. The estimated drawdown in the M Sand was used in this table because this is the stress on the N Shale adjacent to these MS wells.

The water-level change plots for the MS wells are presented in Figures K.6-3A through K.6-6A. The tabulation of water levels is presented in Tables K.6-4A through K.6-7B. The transducer water levels for the O Sand wells used in the PW4-3 multi-well test are presented in the K.6-4B through K.6-7B tables. The manual data is presented in the A series tables, while the transducer data is given in the B series tables for the O Sand wells also. Only A series linear time plots with all of the water-level change data (pre-test, pumping and recovery) are presented for the adjacent aquifer wells.

Figure K.6-3A presents the water-level change data for O Sand well, MS412. The manual data is shown by blue diamonds on this figure, while the transducer data is shown with magenta dots. The pre-test water levels in O Sand well MS412 were fairly steady prior to the start of the PW4-3 pump on November 29, 1999. The shape of the water-level changes in well MS412 after the start of the pump test are very similar to the shape of the barometric changes. These small water-level changes are thought to be mainly due to changes in the barometric pressure. These water-level changes for well MS412 do not indicate any drawdown and, therefore, no connection between the M and O Sands in this area.

Figure K.6-4A presents the water-level changes for O Sand well MS413. Water levels in this well rose approximately 0.4 feet during the pumping phase of this test, and fell approximately 0.2 feet early in the recovery phase before rising 0.2 feet by the end of recovery. The small water-level changes in well MS413 do not indicate connection between the O and M Sands in this area, these changes are thought to be caused by changes in the barometric pressure throughout the test.

Figure K.6-5A presents the water-level change for well MS414. The water-level changes for this observation well indicate a gradual rising trend throughout the pumping phase of the test pump test caused by a gradual decline of the barometric pressure. This data indicates no connection between the M and O Sands.

Figure K.6-6A presents the water-level change for well MS415. The water-level change in O Sand well MS415 is very similar to the other O Sand wells. The manual data for MS415 indicates more of a drop in water level than the transducer data during the recovery phase of the test. The transducer data is thought to best represent the water-level changes at well MS415.

None of the water-level changes in the O Sand wells indicates drawdown from the PW4-3 test. Therefore, the PW4-3 test indicates that there is no connection between the O Sand and the M Sand in the northwestern half of Wellfield 4A.

K.6.3 K SAND RESPONSES

The water-level changes observed in the K Sand wells are presented in Tables K.6-8A through K.6-11B. MD wells 416 and 417 were not used in the PW4-3 test. A manual table (A) and a transducer table (B) are presented for the remainder of the MD wells. The static water levels in the K Sand wells prior to the start of the PW4-3 test are presented in Table K.6-2.

The estimated drawdowns in the M Sand near the K Sand wells are presented in Table K.6-3. The drawdown in the M Sand is the stress on the L Shale. The minimum drawdown in the M Sand adjacent to an MD well at the end of the PW4-3 test was one foot at well MD412. Water levels in the M Sand in this area varied over a thirty-foot range during the PW4-4 test. This amount of water-level change adequately stressed the L Shale in the area of well MD412.

The water-level changes in the K Sand wells are presented for monitoring wells MD412 through MD415 in Figures K.6-7A through K.6-10A, respectively. Only the A series of plots are presented for the adjacent aquifer K Sand (MD) wells because the pre-test, pumping and recovery water-level changes are presented on one figure. Water-level change plots for these K Sand wells do not indicate drawdown.

Figure K.6-7A presents the water-level changes for K Sand well MD412. Water levels in this well changed very similar to the changes in barometric pressure. Water levels rose approximately six-tenths throughout the pumping phase of the test before dropping and rising approximately three-tenths during recovery. No trend in the water-level changes is indicated by the MD412 data. The water-level changes in K Sand well MD415 indicate that the M and K Sands are not connected in this area. The water-level changes are thought to be caused by the changes in barometric pressure.

The water-level changes in K Sand monitoring well MD413 are presented in Figure K.5-8A. The water-level change data from this K Sand well is also very similar to the barometric changes with no trend indicated. This data indicates that the M and K Sands are not connected near well MD413.

The other K Sand wells (MD414 and MS415) are presented in Figures K.6-9A and K.6-10A, respectively. The water-level changes in these K Sand well are similar to those from the other two MD wells. The good agreement of water-level change and barometric change indicates that the K and M Sands are not connected near wells MD414 and MD415.

The K Sand wells in the PW4-3 multi-well test show that the M and K Sands are not connected in the northwestern half of Wellfield 4A.

K.6.4 M SAND PUMP TEST ANALYSIS

This section presents a detailed analysis of the M Sand pumping and observation wells. The drawdowns developed from this multi-well test and a summary of aquifer properties are presented in Section K.6.1 and tabulated in Table K.6-1. Figure K.6-2 presents the transmissivities obtained from the PW4-3 multi-well test.

Tables K.6-13A through K.6-32A present the manual water-level data collected for the M Sand wells during the PW4-3 multi-well pump test. Transducer data for the pumping well and the M Sand observation wells are also presented in a second table. These tables use the same table number followed with the letter B rather than the letter A. Figure K.6-2 shows which of the monitoring wells were used in this multi-well pump test. All wells used in the PW4-3 pump test were equipped with a transducer. All wells northwest of the line drawn between monitoring ring wells M453 and M452 and between wells M439 and M440 were used in the PW4-3 multi-well test.

Each of the M Sand observation wells in the PW4-3 pump test contain four plots: a water-level change plot on a linear time basis, a semi-log drawdown plot, a log-log drawdown plot and a semi-log recovery plot. The log-log drawdown plot is not presented for the pumping well because the effective radius of a pumping well can vary significantly and greatly affects the results of a log-log plot. Therefore, only water level change, semi-log drawdown and semi-log recovery plots are presented for pumping well PW4-3. Figures K.6-11A through K.6-31D present the results for the M Sand wells from the PW4-3 pump test.

K.6.4.1 PW4-3 PUMPING WELL

The PW4-3 pumping well was pumped at an average rate of 16.2 gpm from 11:00 a.m. on November 29 to 11:00 a.m. on December 3, 1999. Water levels were monitored for approximately three days prior to the start of the PW4-3 test (see Tables K.6-16A and K.6-16B). The A series of tables are presented for the manual data for the M Sand wells and the B series are presented for the transducer water-level data. All wells that are northwest of the red line on Figure K.6-2 were used in the PW4-3 test. Water-level changes are presented for approximately three days prior to the pumping of this well and for slightly greater than three days after the pump was turned off (see Figure K.6-11A).

The figures for the M Sand wells consist of "A" (linear water-level change), "B" (semi-log drawdown), "C" (log-log drawdown) and "D" (semi-log recovery) figures. A log-log plot was not developed for the pumping well.

The drawdown in well PW4-3 was approximately 190 feet (see Figure K.6-11A). The semi-log plot of this drawdown data yields a transmissivity of 150 gal/day/ft (see Figure K.6-11B). The very early drawdown data in pumping well PW4-3 was affected by well storage. The straight-line fit from 10 to 800 minutes after pumping started is due to the transmitting ability of the M Sand. The deflection of the data below this straight line is due to higher transmissivities in the M Sand away from well PW4-3, and also because of trend changes caused by Wellfield 4.

The recovery data of the water levels in pumping well PW4-3 are presented on Figure K.6-11C and Tables K.6-12A and K.6-12B. The late portion of the recovery plot is thought to be most representative of the M Sand transmissivity.

K.6.4.2 M SAND OBSERVATION WELLS

The PW4-3 multi-well pump test does not indicate boundary conditions near Wellfield 4A. The results from the semi-log drawdown and recovery plots must be used with caution due to the long time required to meet the straight-line approximation. Also, trend changes caused by Wellfield 4 on the M Sand water levels affected the drawdown and recovery data for the wells closest to Wellfield 4. The Theis type curve was fit to the late time drawdown data giving less weight to the very early time data, except for M Sand wells M401, M402, and M434. The late time drawdown data for these wells was smeared by trend changes caused by Wellfield 4, and therefore, the straight-line (semi-log) plots were used to determine the aquifer properties for these wells. These aquifer properties are fairly representative of the M Sand but are affected by Wellfield 4. Table K.6-1 presents the transmissivities obtained from the multi-well test for the straight-line, Theis and recovery.

Figure K.6-2 presents the transmissivities from the semi-log fits of wells M401, M402, and M434 and the log-log fits of the remainder of the M Sand wells for the northwestern half of Wellfield 4A. The log-log fits are thought to produce the best aquifer properties for most of the wells in this pump test. The semi-log fits are thought to produce the best aquifer properties for wells M401, M402, and M434. However, the aquifer properties for these wells should be used with caution because the trend changes caused by Wellfield 4 appear to be causing lower transmissivities at these wells than what would be expected. The transmissivity and storage coefficient calculated from the log-log fits and the semi-log fits should be representative of the M Sand in the area of the observation well. A late time, straight-line fit on the semi-log drawdown plots was used but four days was not long enough to meet the straight-line method requirements for some of the larger distance wells. In closer wells, the straight-line values should produce an accurate transmissivity and storage coefficient. In wells at greater distances, the straight-line results should be used with caution and evaluated as to whether the straight-line method is appropriate (u values less than 0.1, see Section E.7.1.1 of Hydro-Engineering L.L.C., 1997). Also, the straight-line fits from the recovery data were generally not used due to changes in water-level trends caused by Wellfield 4.

Well storage affected only the pumping well. The semi-log plot (Figure K.6-11B) shows typical well storage effects with a steeper straight line being observed prior to reaching the true straight line for the aquifer.

Tables K.6-13A through K.6-32B present the manual and transducer data for the M Sand observation wells. The A, B, C and D series of plots were developed for each of the M Sand observation wells used in the PW4-3 multi-well test.

The transmissivities from the M Sand observation wells varied from 90 to 210 gal/day/ft. The average transmissivity from the straight-line fit of M Sand wells M401, M402, and M434 and the Theis fit of the remainder of the M Sand wells is 160 gal/day/ft. The transmissivities from the straight-line method yielded, in general, slightly smaller values due to some of these semi-log plots not meeting the straight-line time requirement, and also due to changes in trends caused by Wellfield 4. The recovery straight-line plots were not fit with a straight line for many of the M Sand wells because variations in Wellfield 4 affected the recovery.

Table K.6-1 also presents the hydraulic conductivity for the M Sand wells. The transmissivities from the Theis log-log plot were used in calculating the hydraulic conductivities for all wells except PW4-3, M401, M402, and M434 in which the semi-log transmissivity was used, along with an aquifer thickness of 27 feet at pumping well PW4-3. This produced hydraulic conductivities that varied from 0.45 to 1.04 ft/day (0.14 to 0.32 Darcy).

Table K.6-1 also presents a tabulation of storage coefficients obtained from this multi-well pump test. The storage coefficients varied from 5.2E-06 to 6.2E-05 with an average value of 3.2E-05. The storage coefficients derived from the semi-log fits of wells M401, M402, and M434, and the Theis log-log fits of the remainder of the M Sand wells are tabulated in Table K.6-1, and the Theis log-log values are best storage coefficient to use from this multi-well pump test.

The aquifer properties from the PW4-3 multi-well test for the M Sand are fairly consistent with the lower values found in Wellfield 4A. The smaller transmissivities in Wellfield 4A are a function of a thinner and less permeable M Sand in this area.

K.6.4.3 BOUNDARY CONDITIONS

The semi-log and log-log plots of drawdown versus time for the M wells for the PW4-3 pump test do not indicate the effects of a boundary in the M Sand. Some of the variations in the recovery plots could be construed to be due to a boundary. This is not consistent with the results from the drawdown plots. The lag in recovery is thought to be due to variations in Wellfield 4 operation because the wells closer to

Wellfield 4 showed more lag in recovery. The PW4-3 multi-well pump test did not detect boundaries in this area of the M Sand.

K.6.4.4 DIRECTIONAL TRANSMISSIVITY

Several different combinations of three observation wells were used to analyze the directional transmissivity for the M Sand. The log-log match point values were used in this analysis, along with the observation well locations.[1]

Tables K.6-55 through K.6-60 present the results from the different combinations of three monitoring wells that were used to determine the anisotropic ratio. The direction of the major transmissivity axis from these results varied from negative 80 degrees to 8 degrees, are highly variable and relative to the x-axis where positive is counterclockwise. These results do not produce a consistent direction major axis.

The drawdown from this pump test (see Figure K.6-1) indicates a little elongation toward the north and south of pumping well PW4-3. The ratio of the major to minor axis (anisotropic ratio) varied from a 0.99 to 502.6 factor. The varied results of the direction of the major transmissivity axis and the anisotropic ratios make the use of directional transmissivity questionable for the M Sand in this area.

[1] Papadopulos, 1965, Method for Anisotropic Analysis was used to determine the horizontal anisotropic properties.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: FIG. K.6-1, REV. NO. 1 SMITH RANCH PROJECT WELLFIELD 4A PATTERNS M SAND DRAWDOWN AT THE END OF THE PW4-3 PUMP TEST, IN FEET

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DOCUMENT/REPORT FIG. K.6-1, REV. NO. 1

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

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THAT CAN BE VIEWED AT THE RECORD TITLED:

FIG. K.6-2, REV. NO. 1

SMITH RANCH PROJECT WELLFIELD 4A PATTERNS M SAND TRANSMISSIVITY RESULTS FROM THE PW4-3 TEST, GPD/FT

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FIG. K.6-2, REV. NO. 1

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

FIGURE K.6-3A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MS412

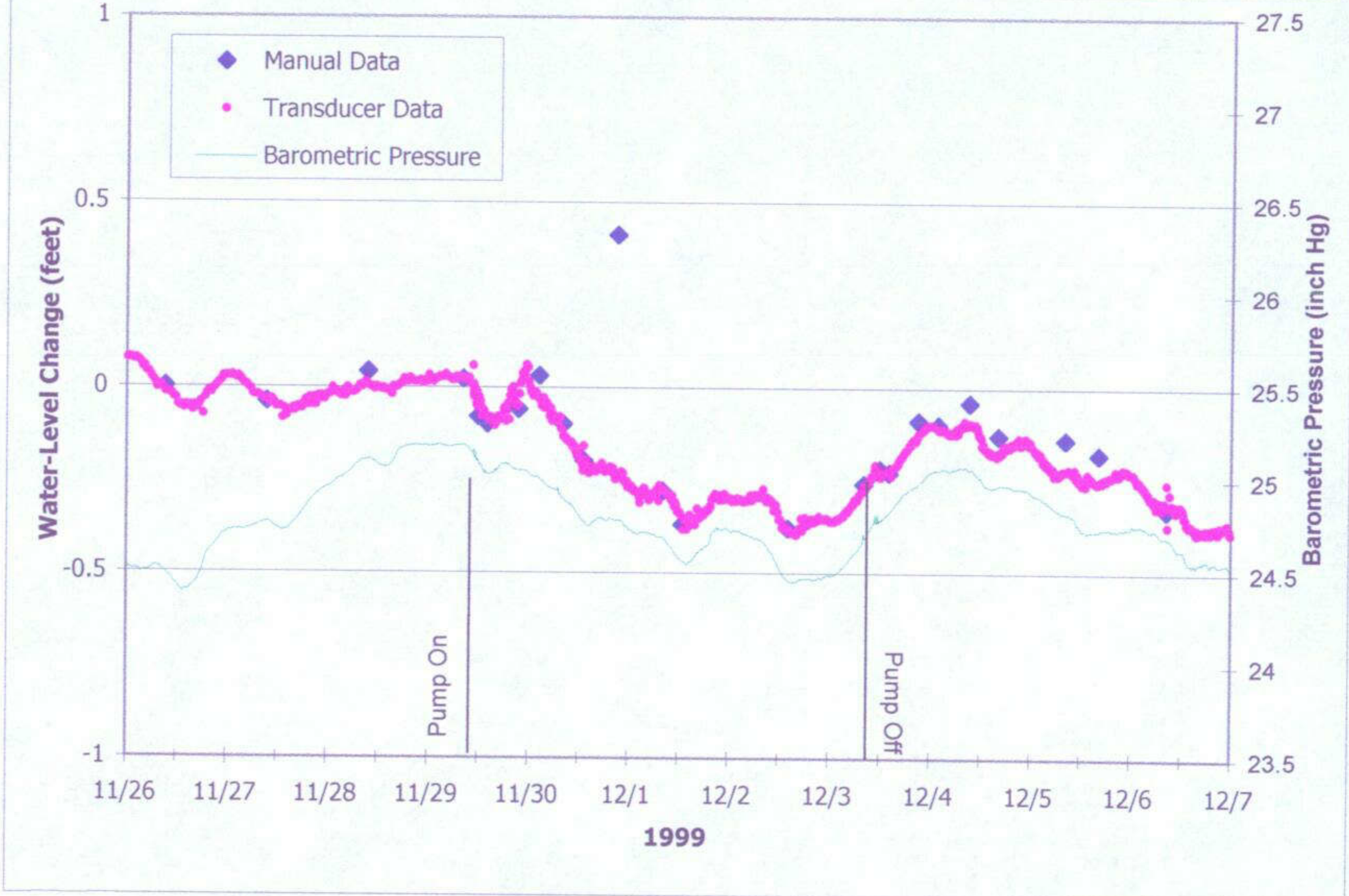


FIGURE K.6-4A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MS413

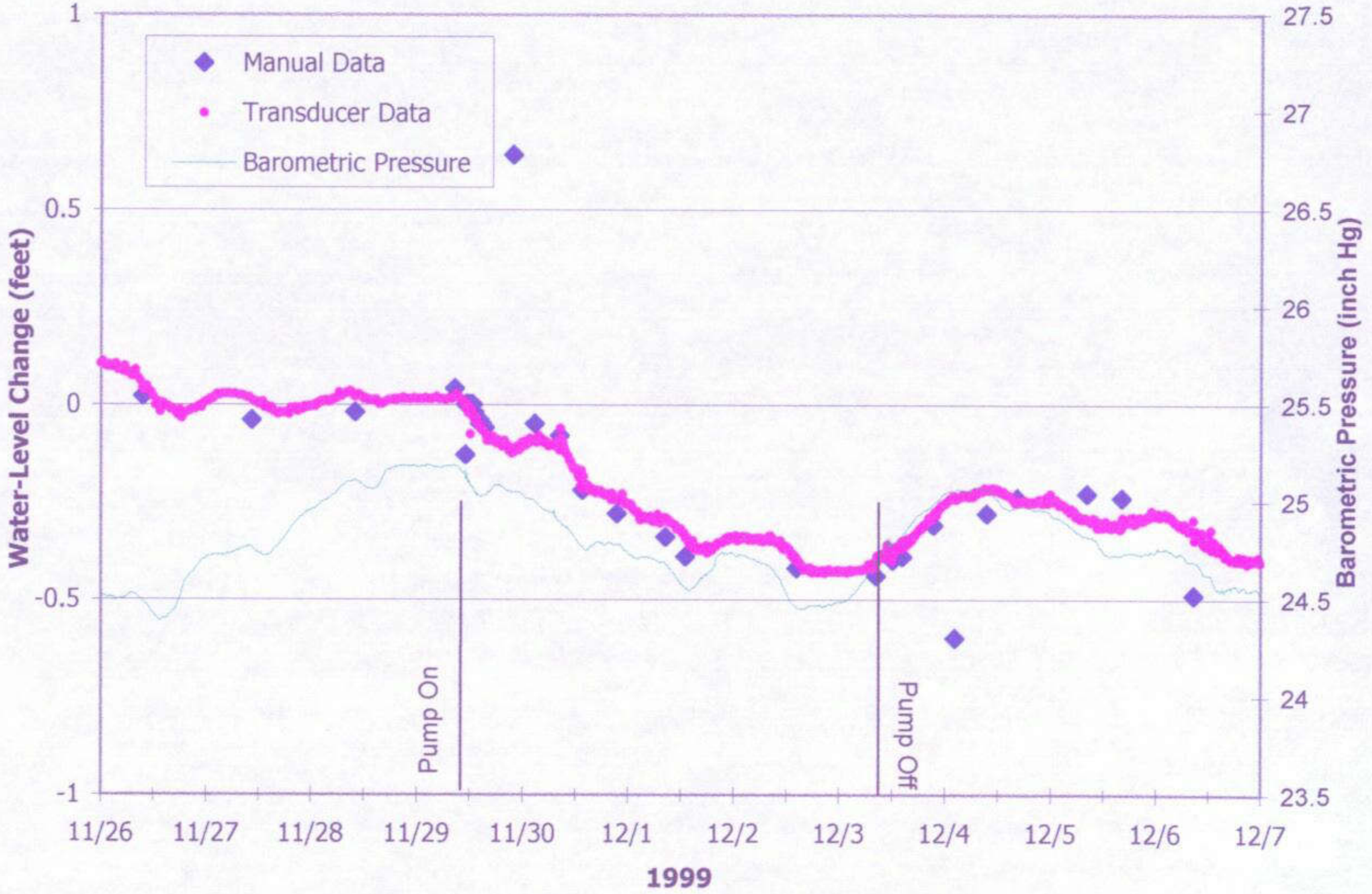


FIGURE K.6-5A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MS414

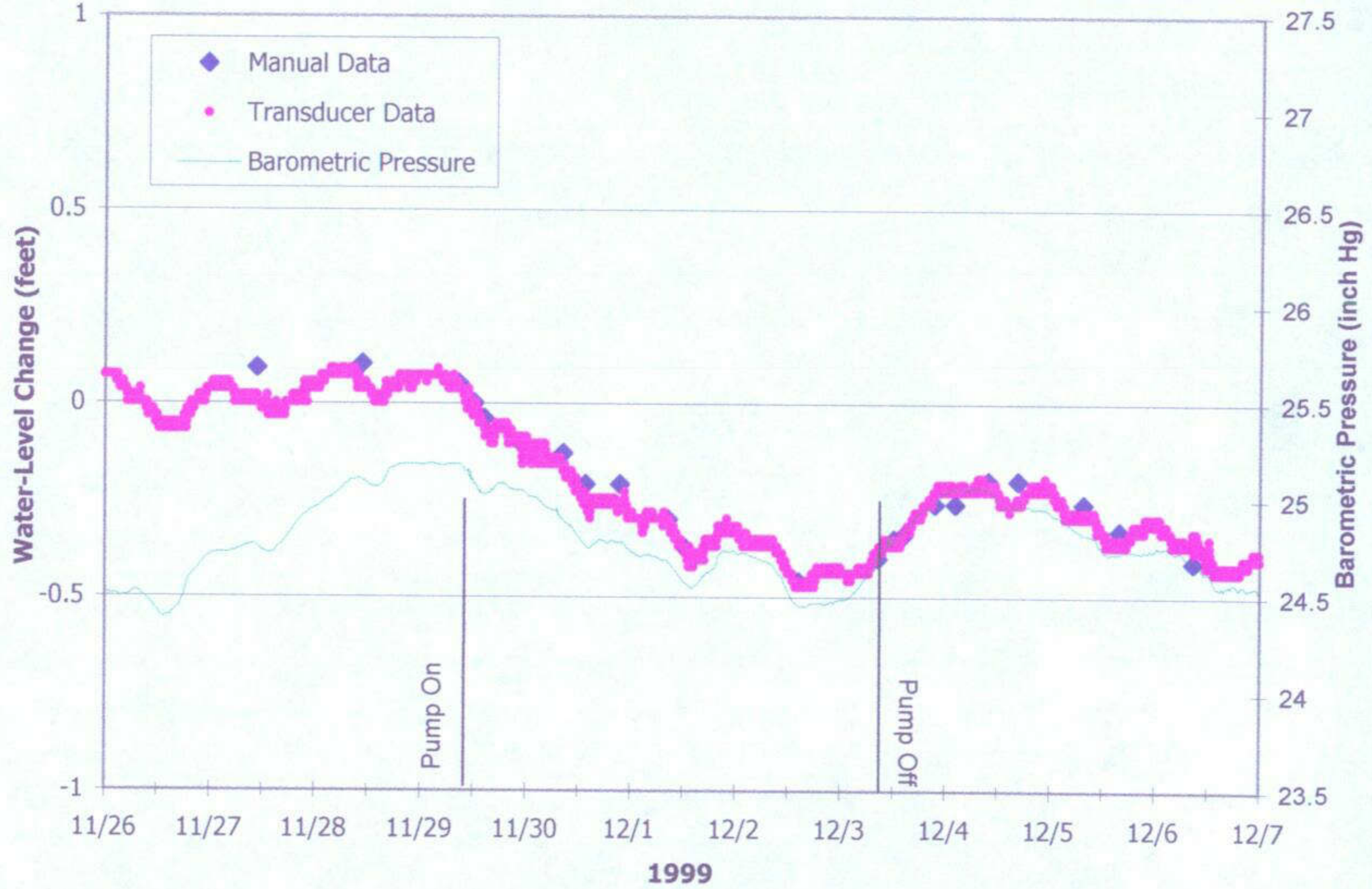


FIGURE K.6-6A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MS415

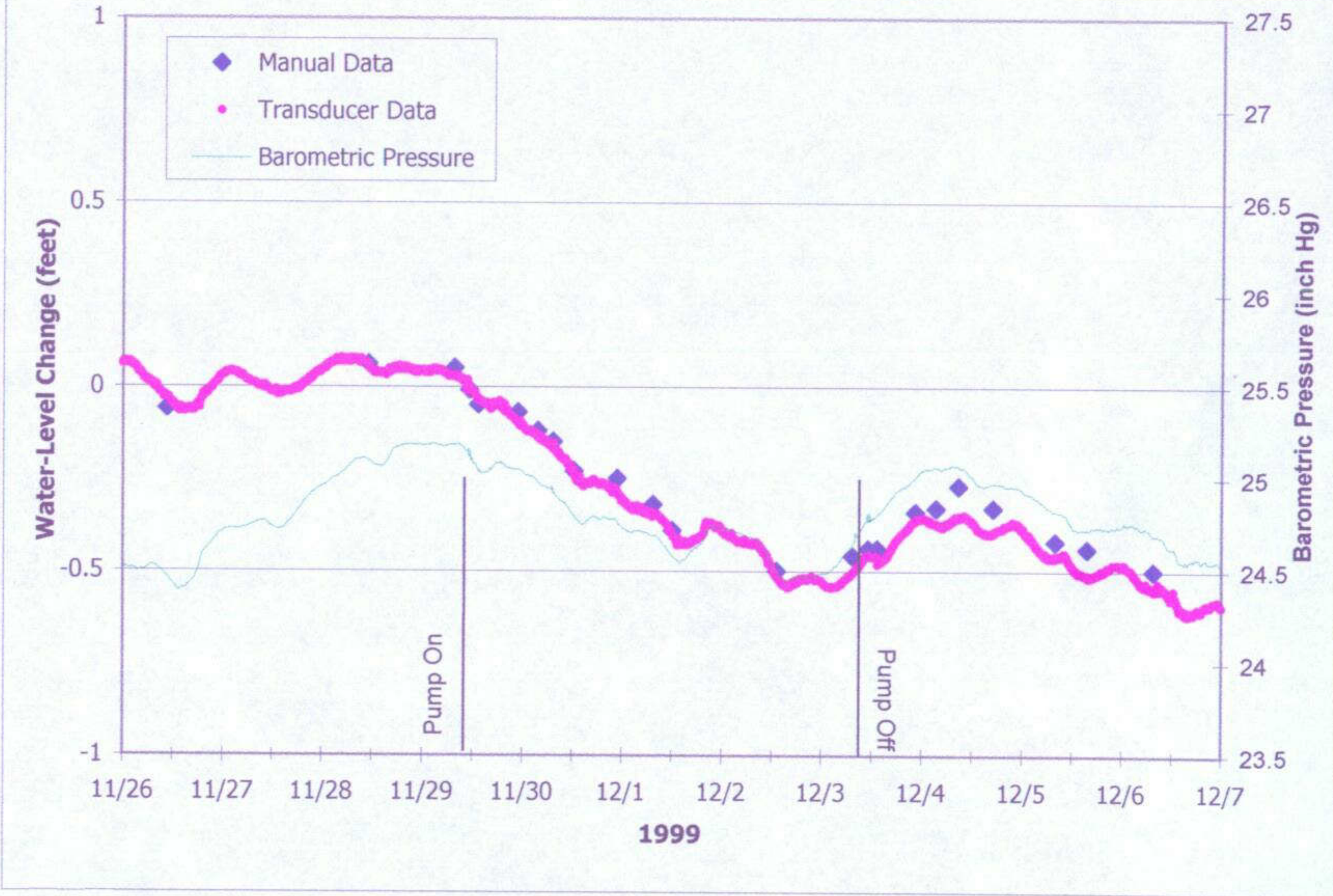


FIGURE K.6-7A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MD412

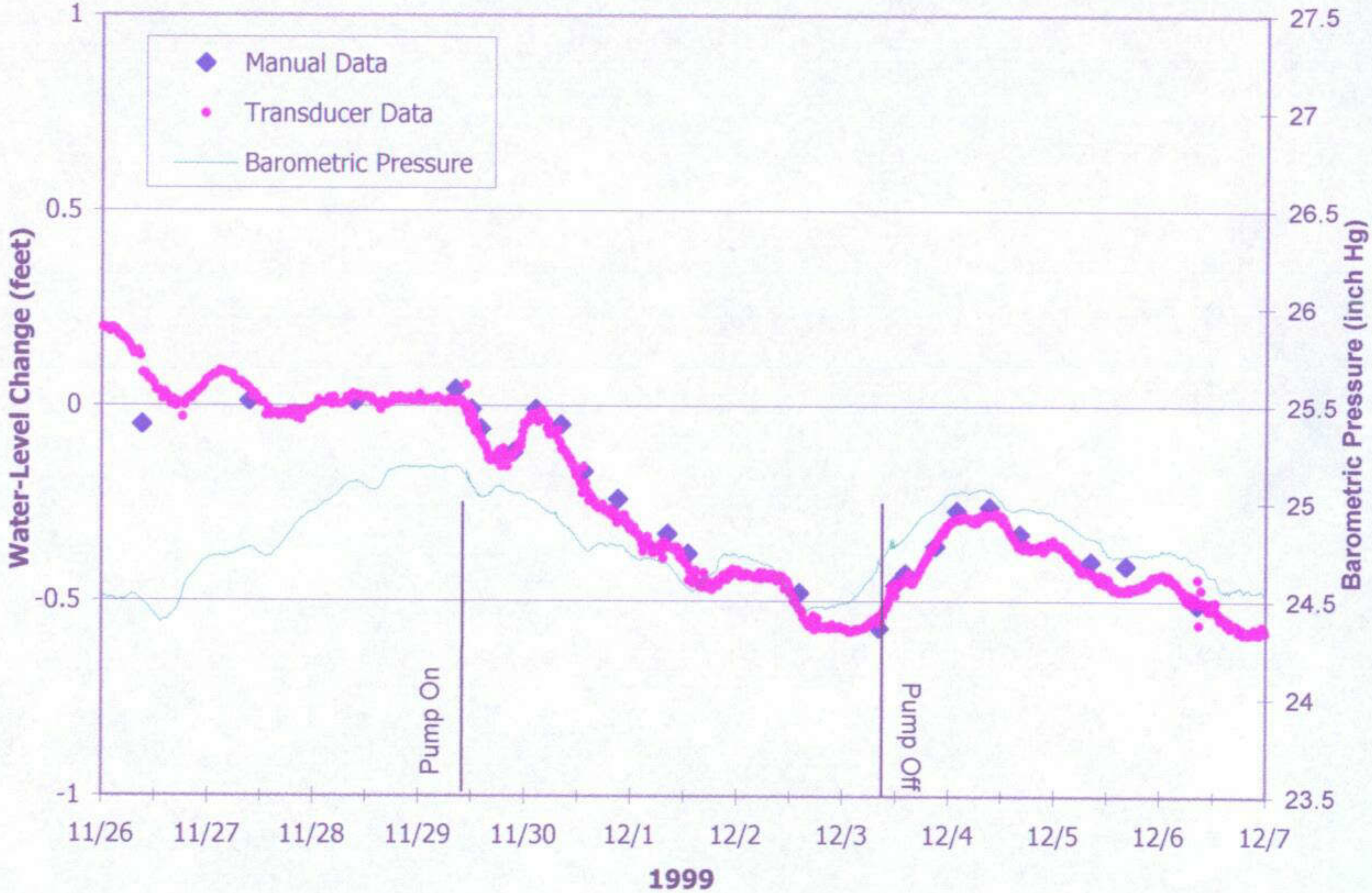


FIGURE K.6-8A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MD413

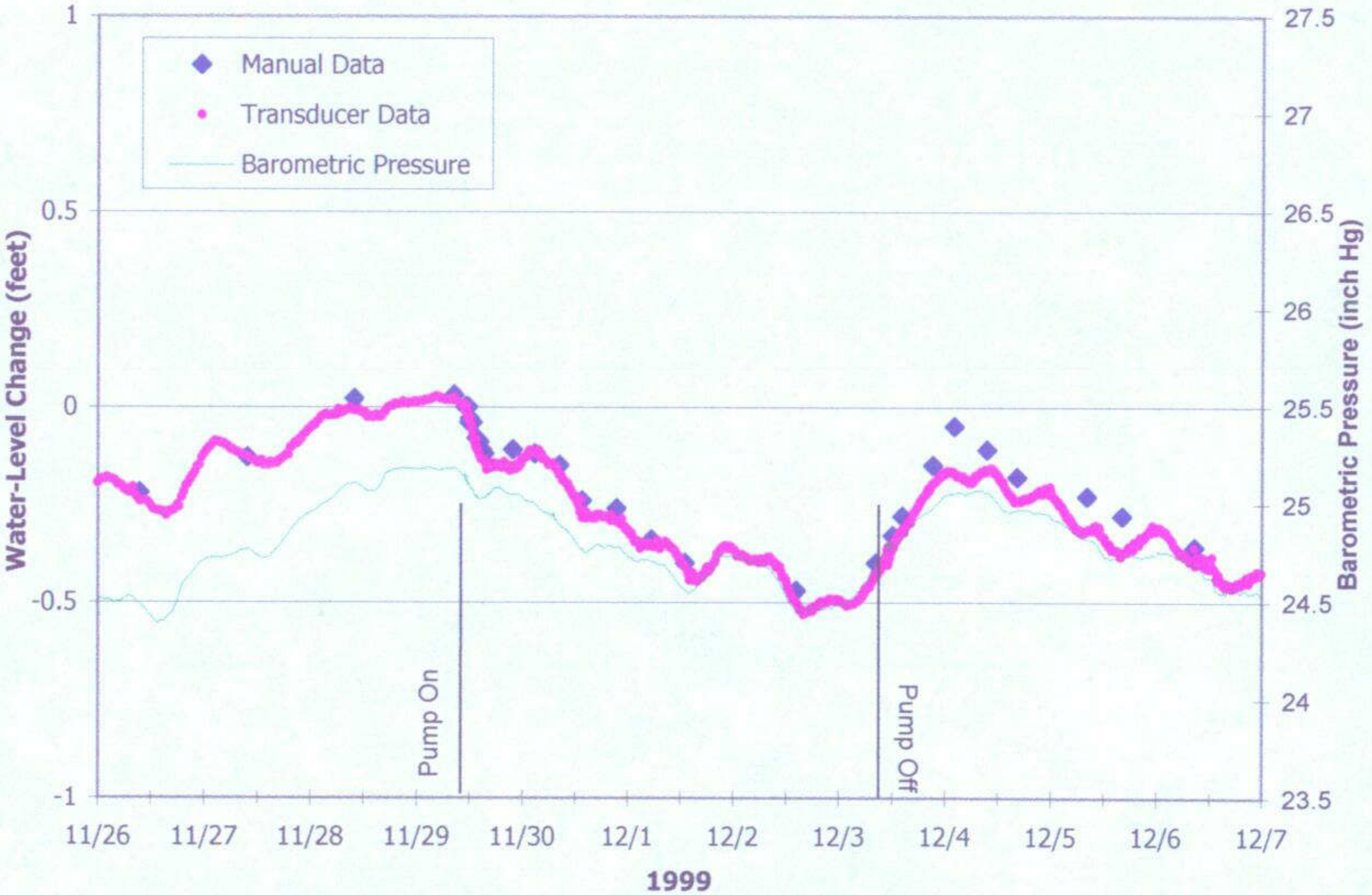


FIGURE K.6-9A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MD414

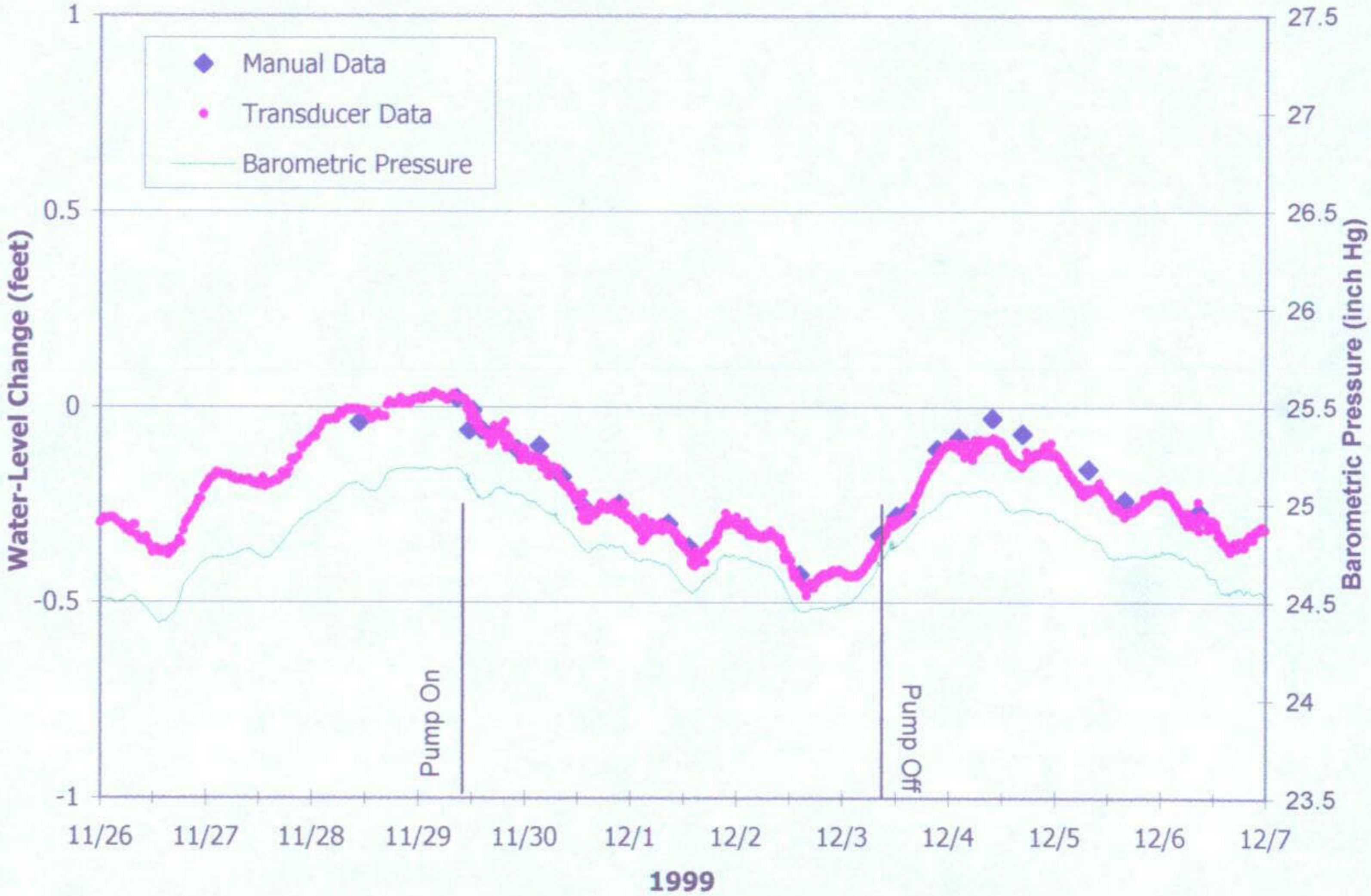


FIGURE K.6-10A. WATER-LEVEL CHANGES IN ADJACENT AQUIFER WELL MD415

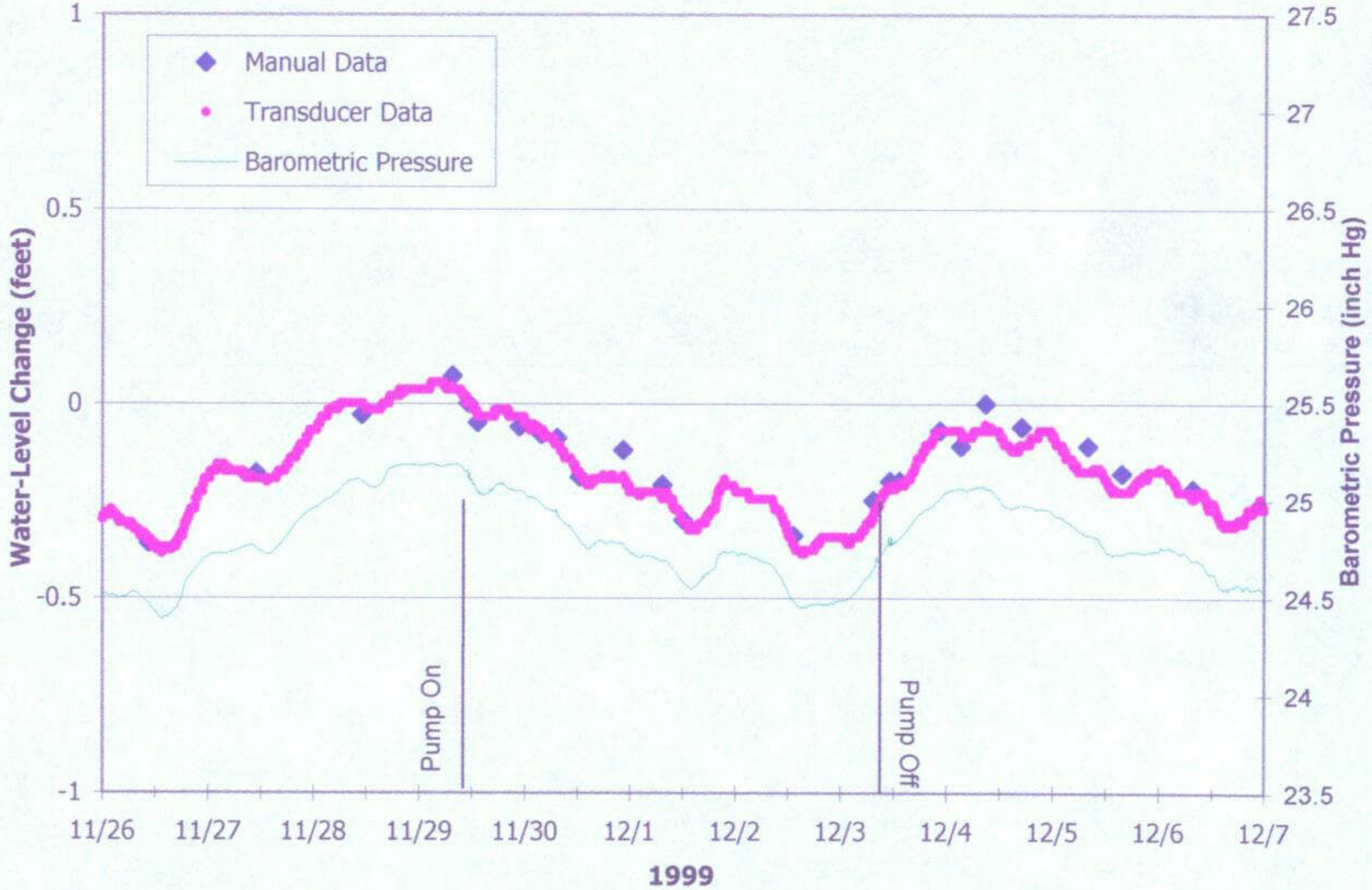
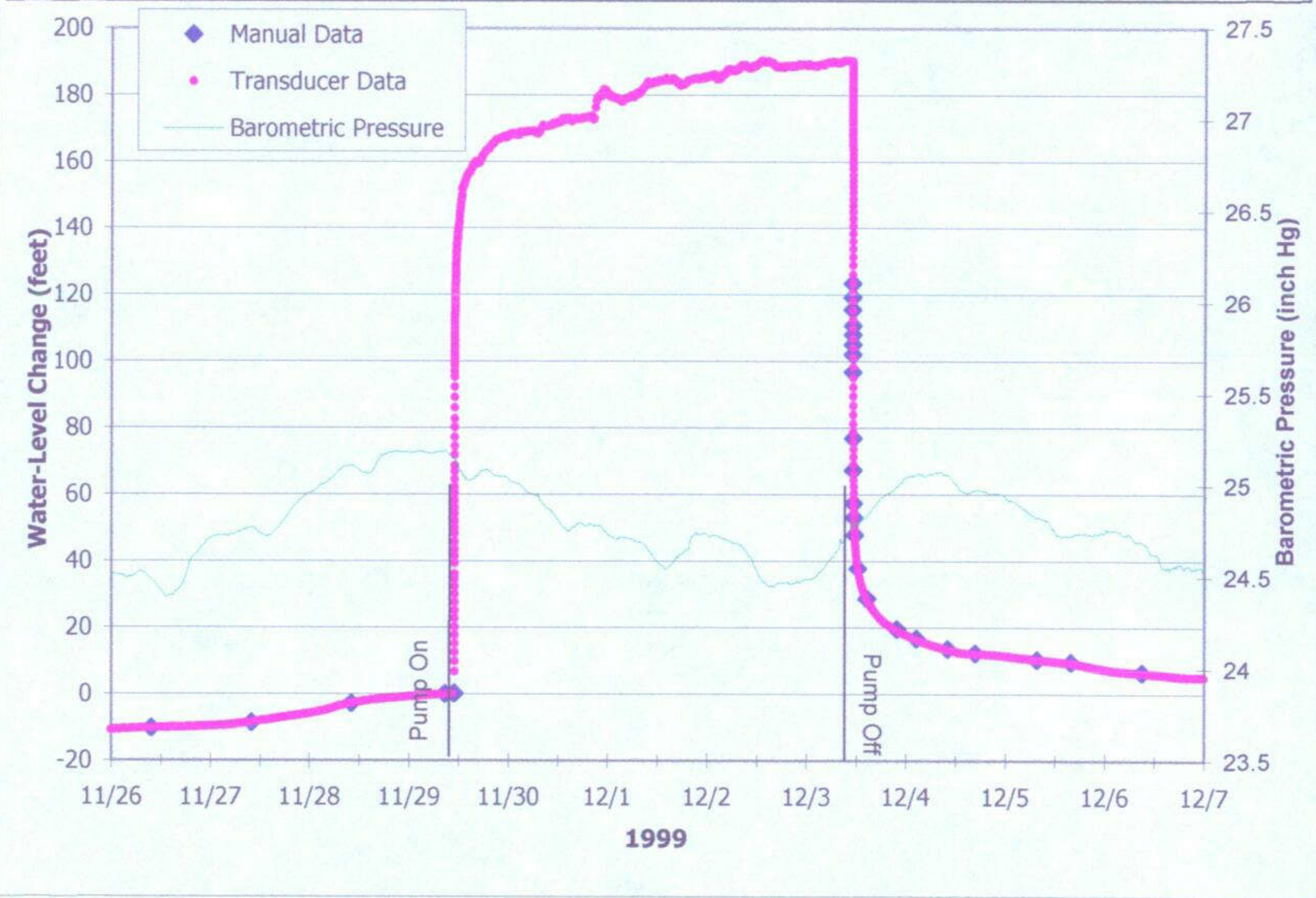


FIGURE K.6-11A. WATER-LEVEL CHANGE IN PUMPING WELL PW4-3



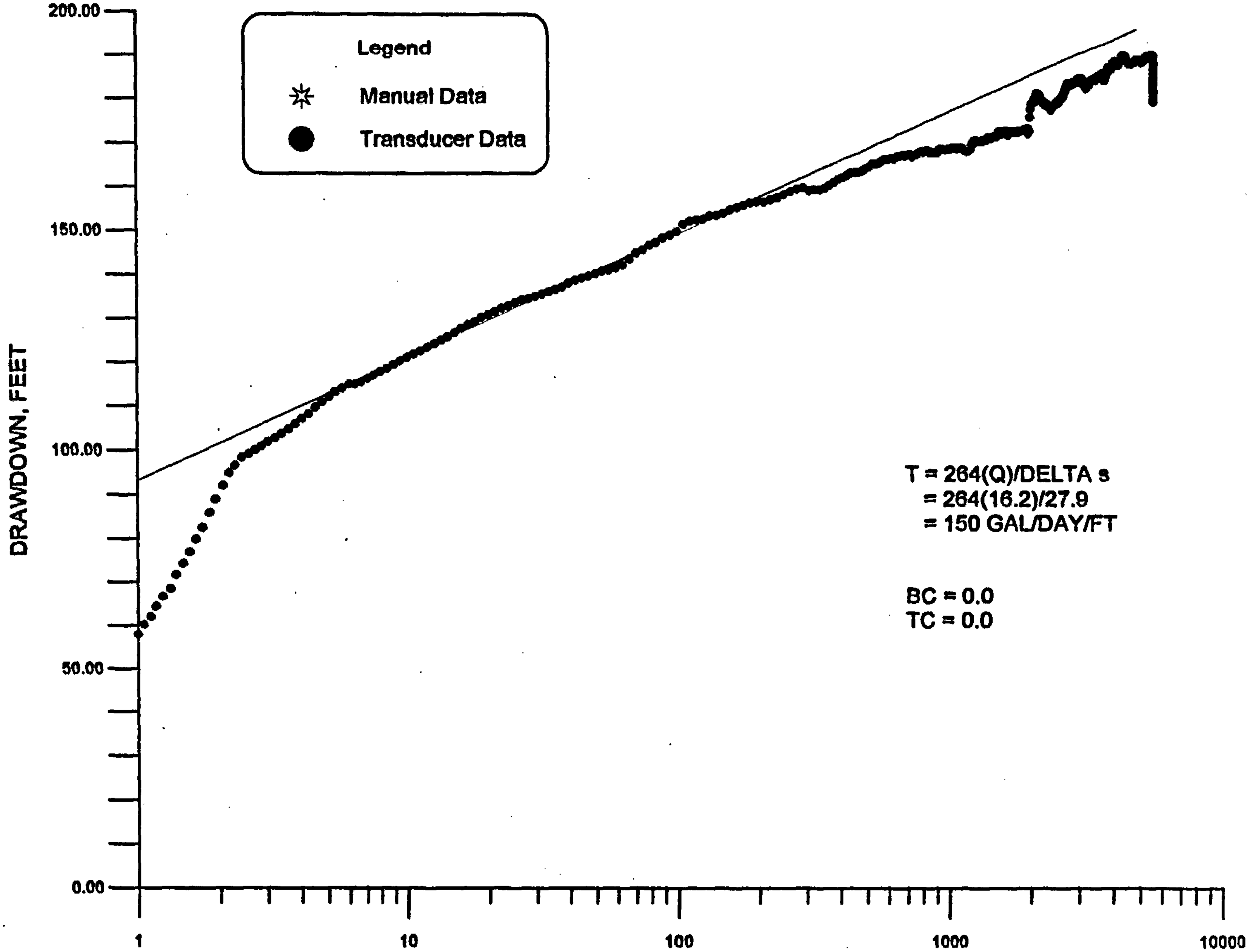


FIGURE K.6-11B. DRAWDOWN IN PUMPING WELL PW4-3, SEMI-LOG.

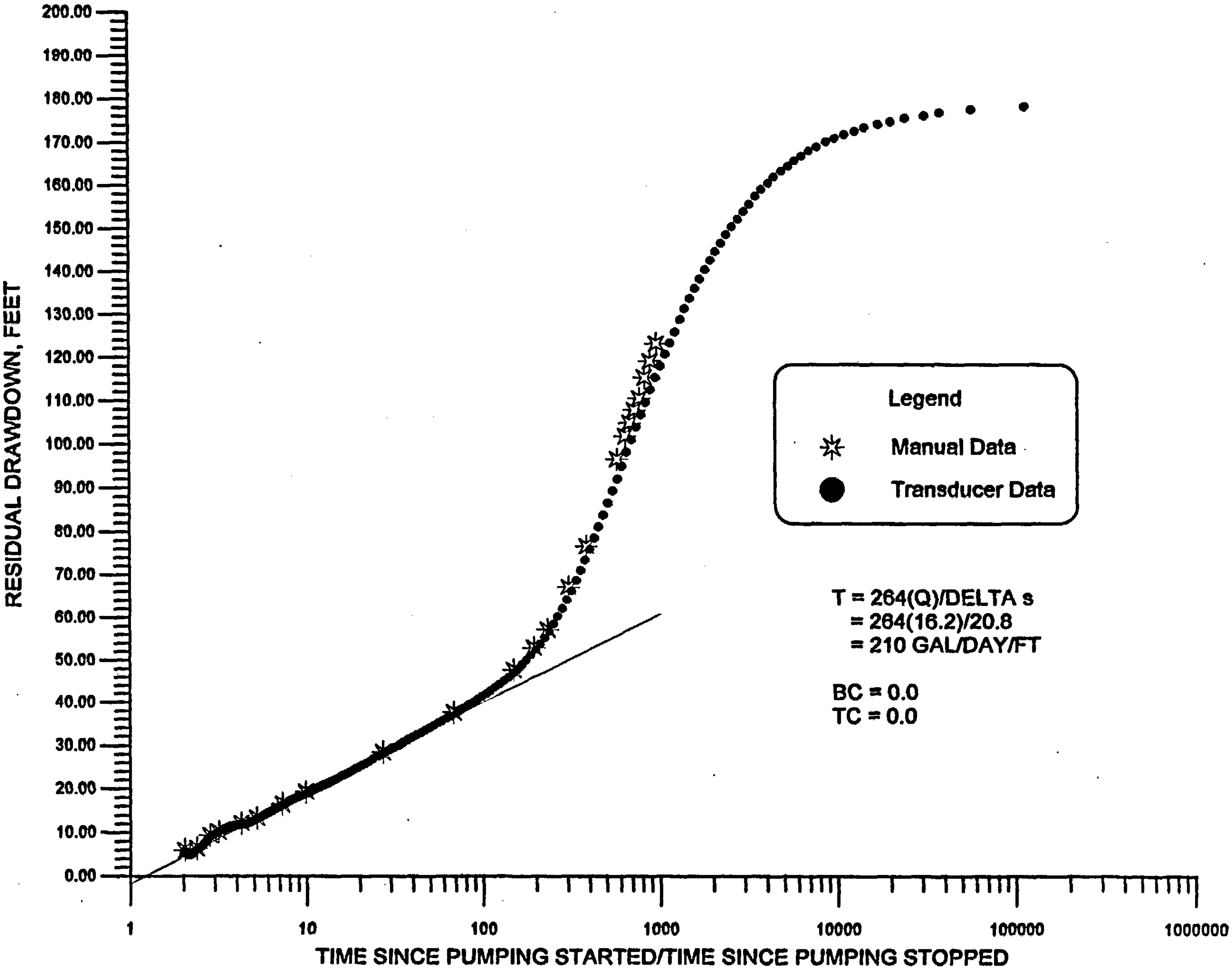
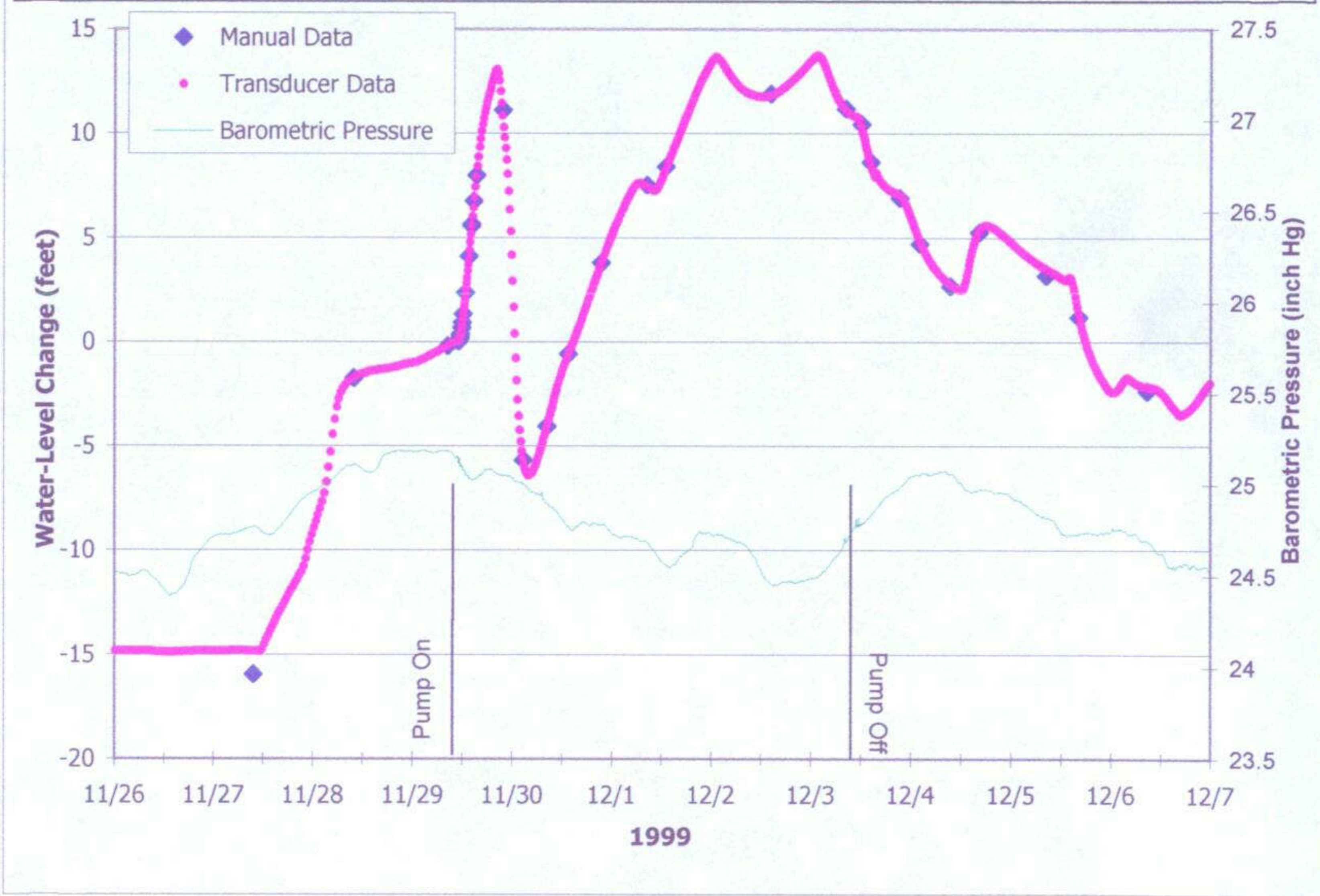


FIGURE K.6-11C. RECOVERY IN PUMPING WELL PW4-3.

FIGURE K.6-12A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP422



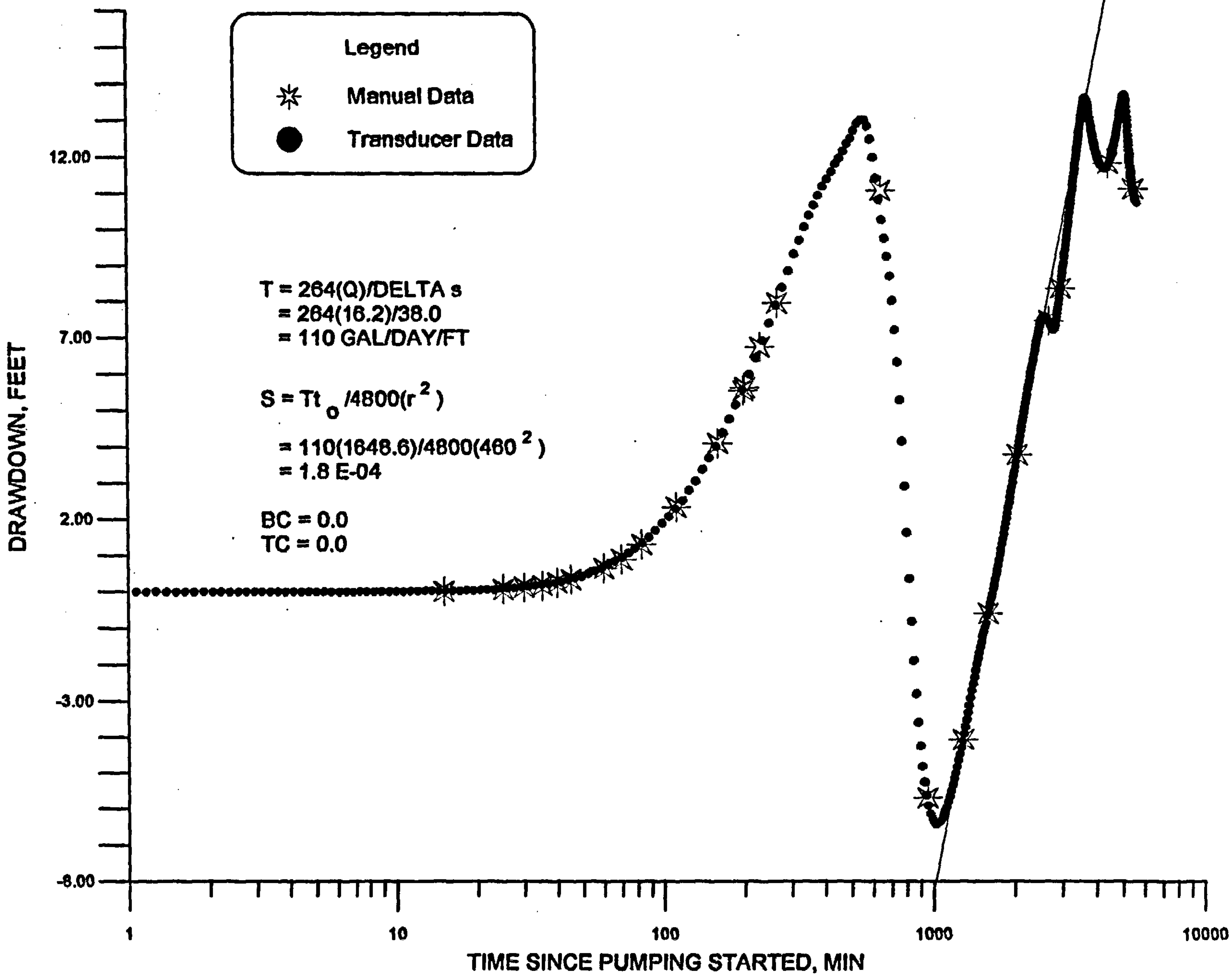


FIGURE K.6-12B. DRAWDOWN IN OBSERVATION WELL MP422, SEMI-LOG.

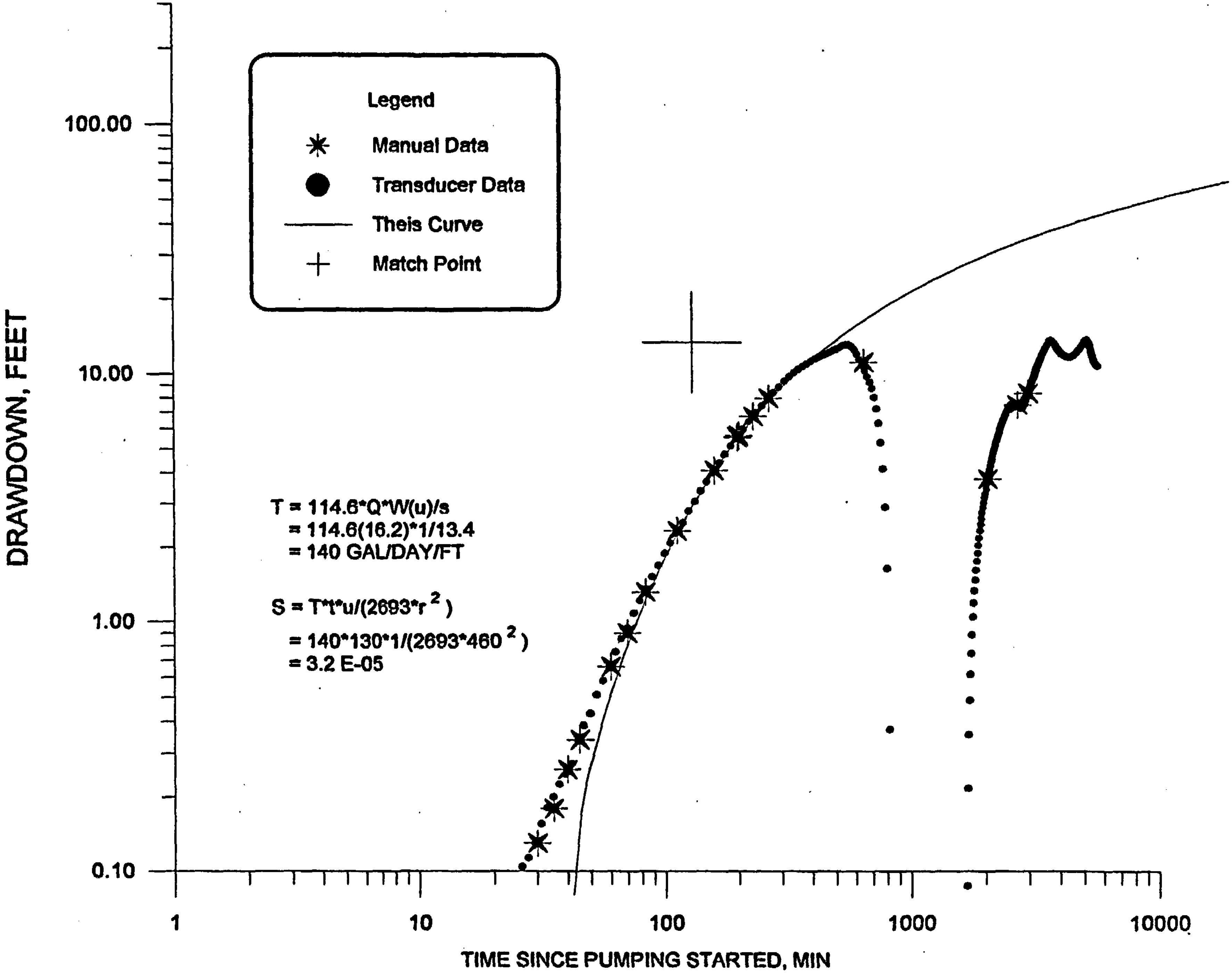


FIGURE K.6-12C. DRAWDOWN IN OBSERVATION WELL MP422, LOG-LOG.

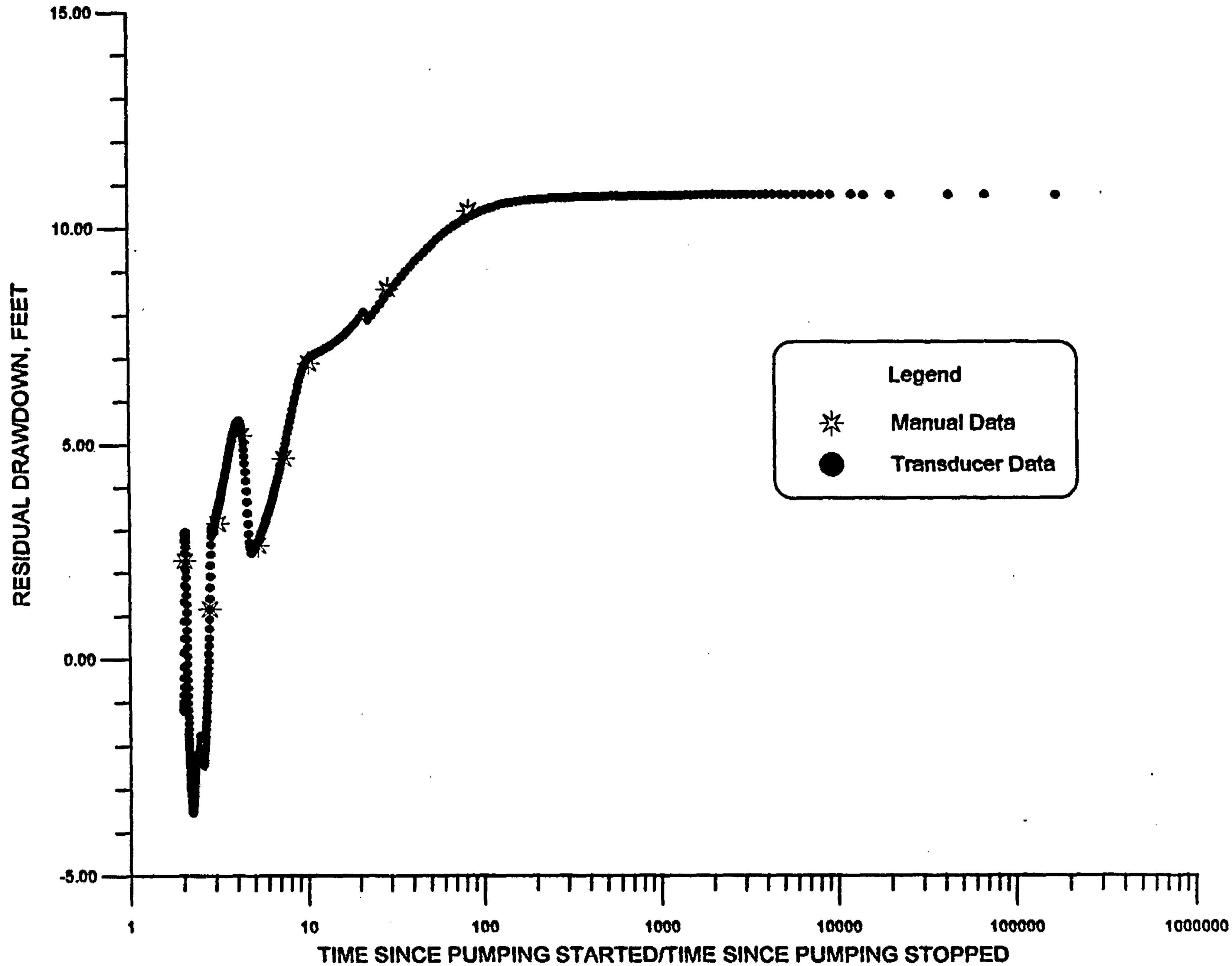
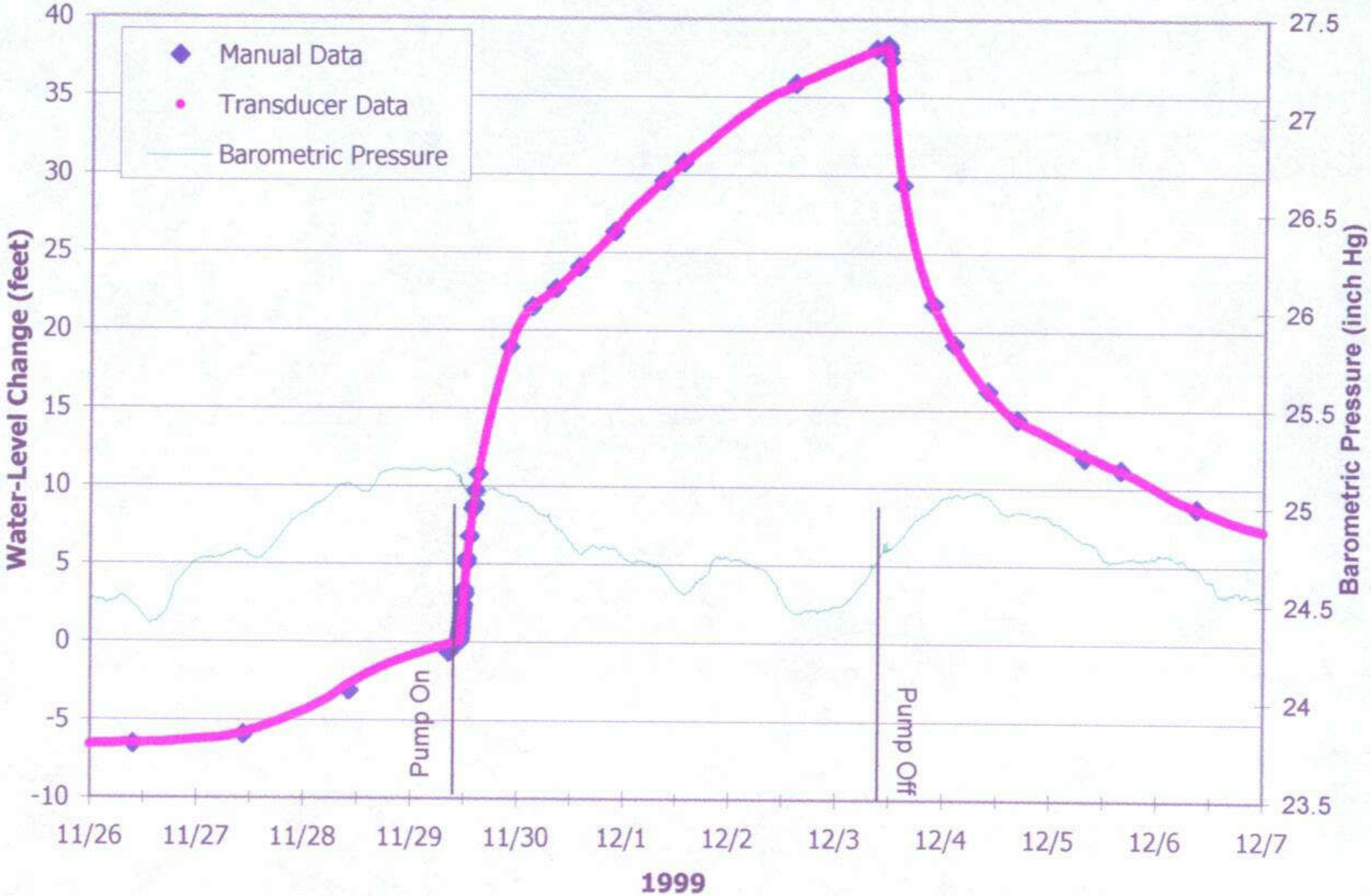


FIGURE K.6-12D. RECOVERY IN OBSERVATION WELL MP422.

FIGURE K.6-13A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP423



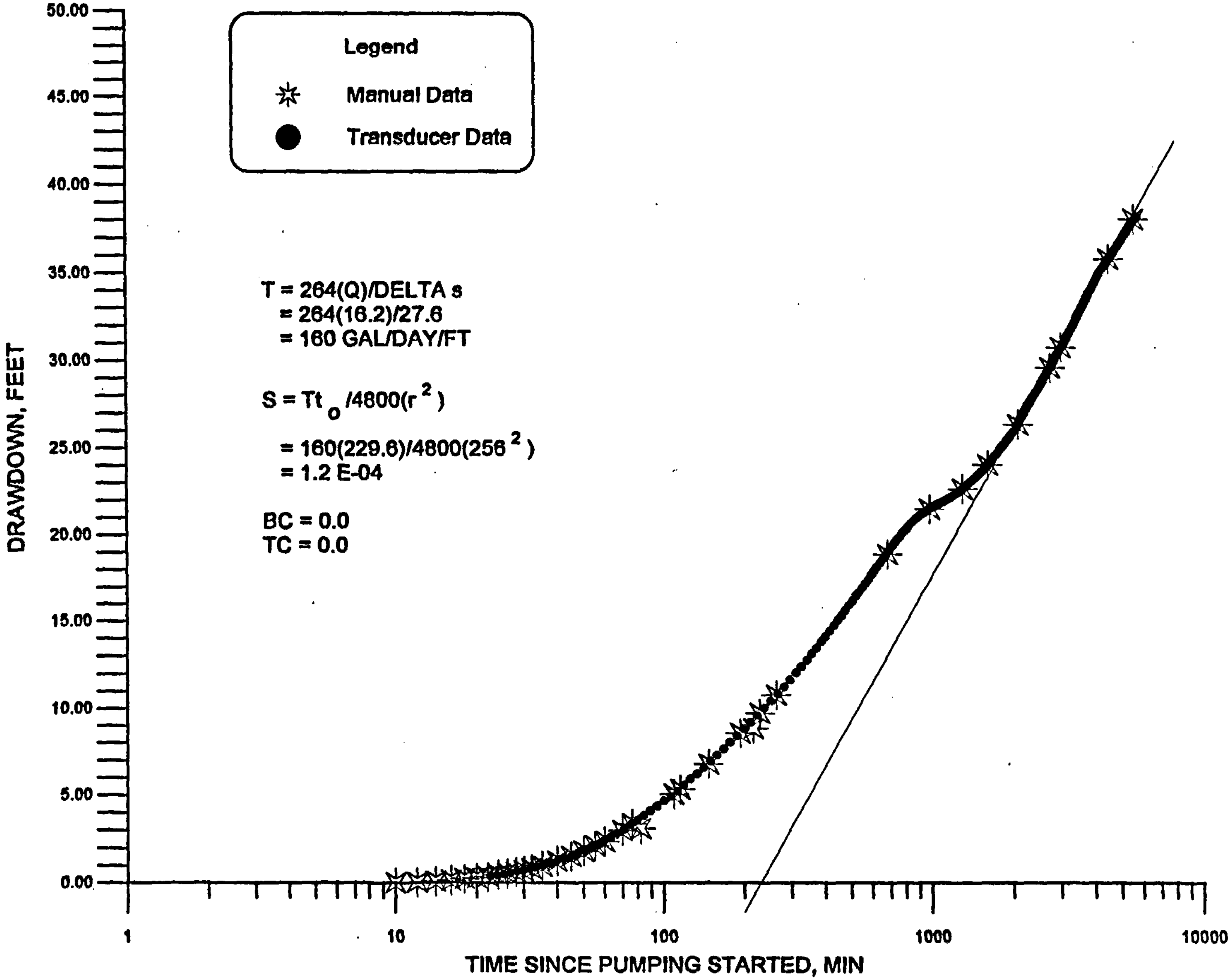


FIGURE K.6-13B. DRAWDOWN IN OBSERVATION WELL MP423, SEMI-LOG.

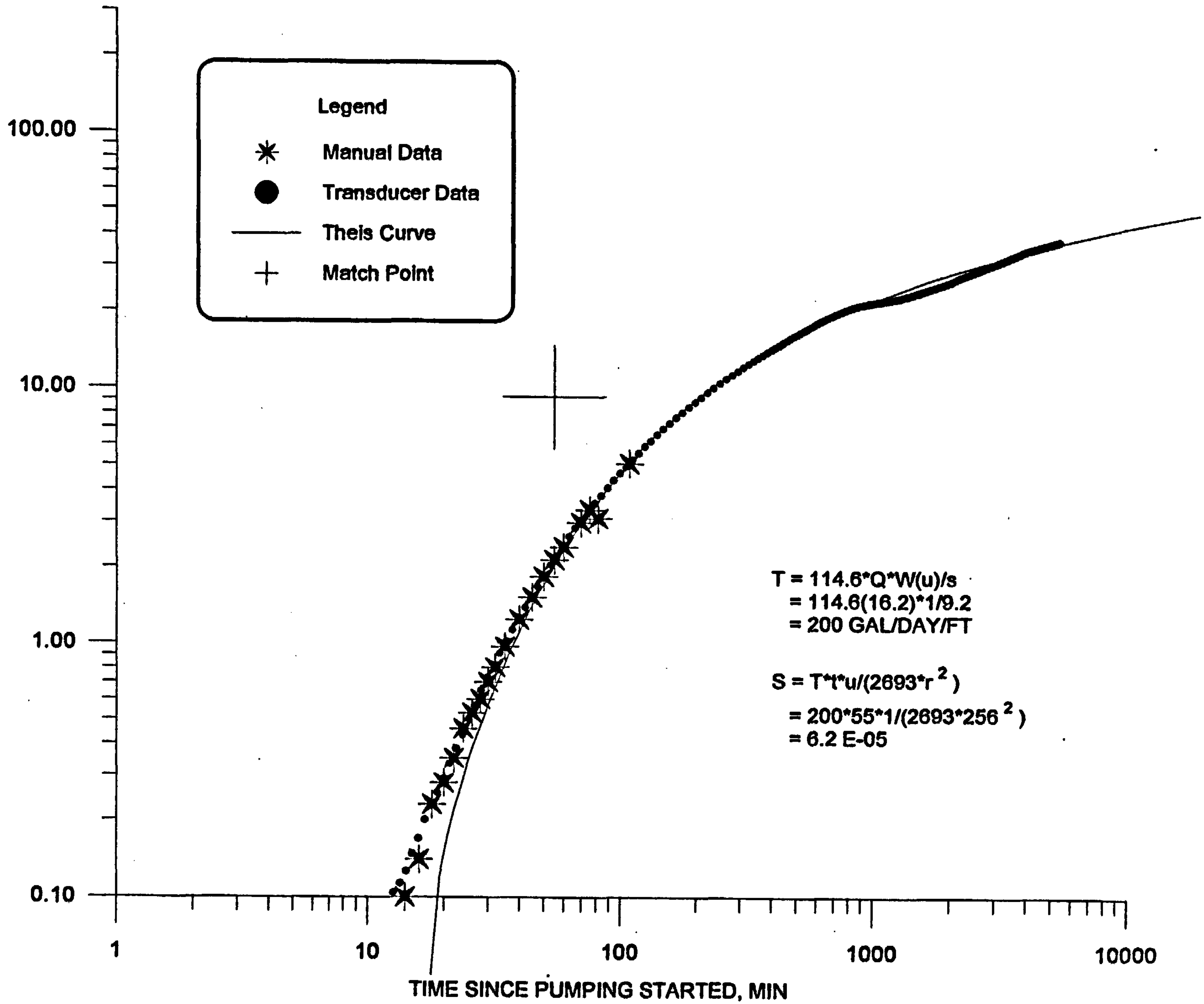


FIGURE K.6-13C. DRAWDOWN IN OBSERVATION WELL MP423, LOG-LOG.

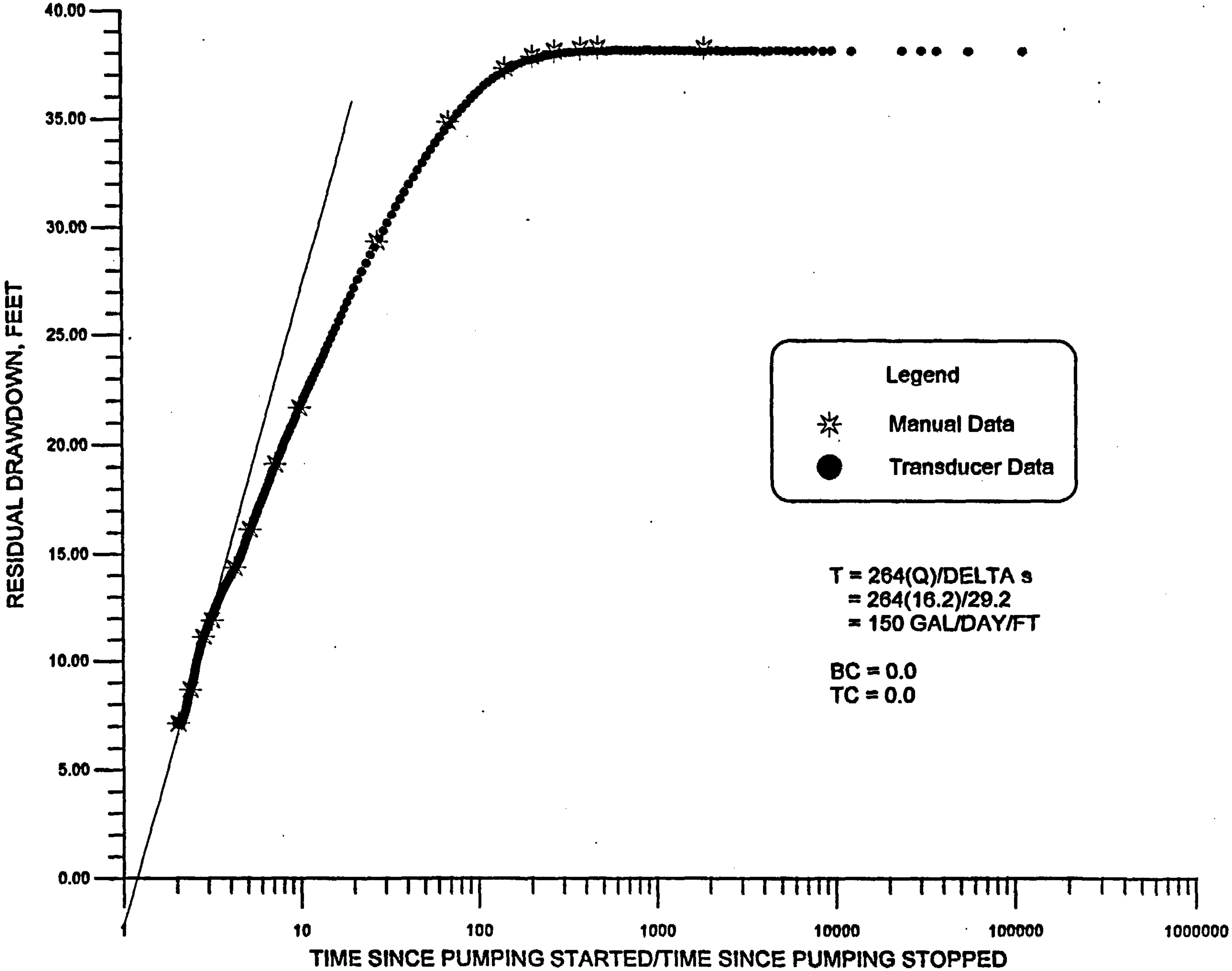


FIGURE K.6-13D. RECOVERY IN OBSERVATION WELL MP423.

FIGURE K.6-14A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP424

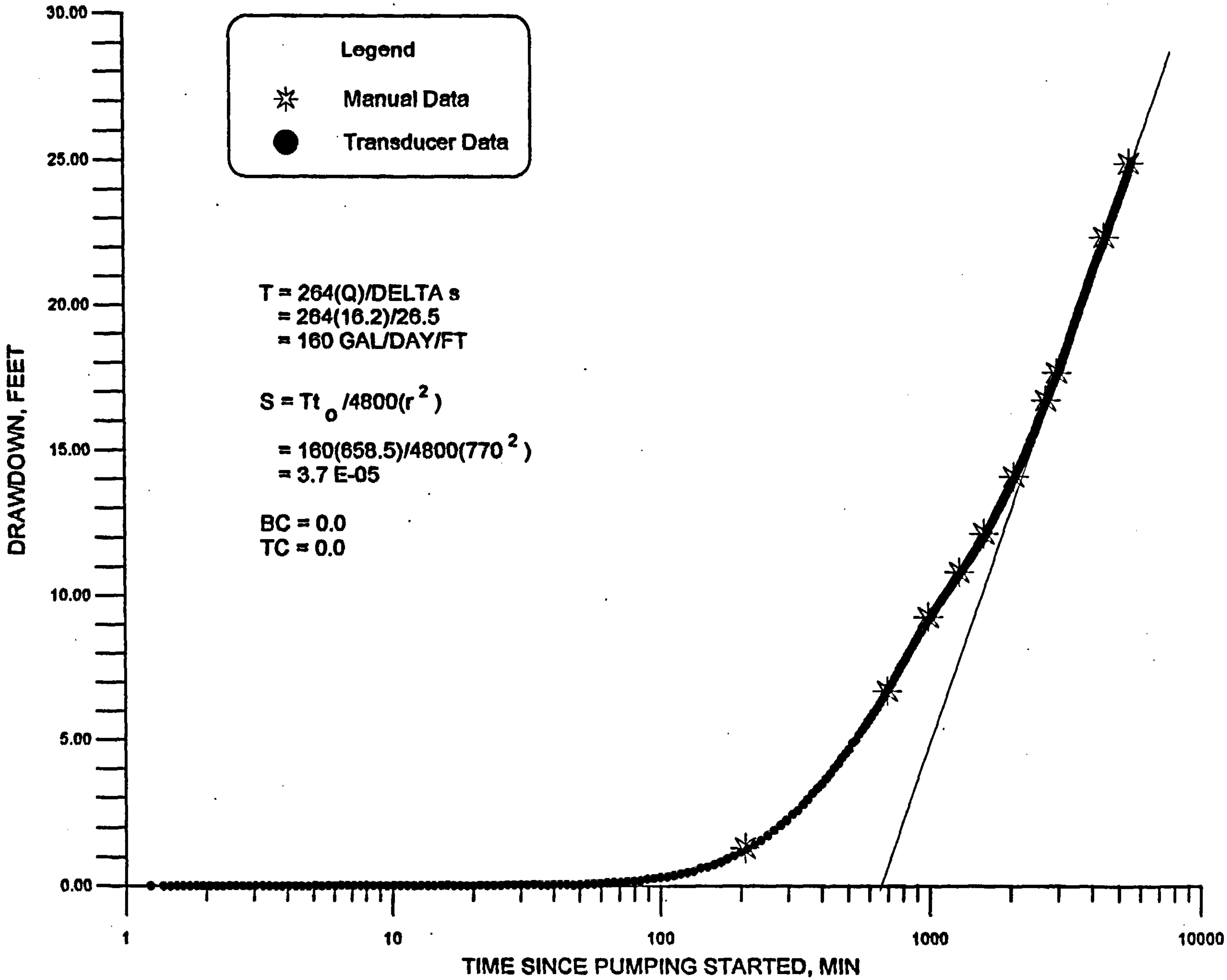


FIGURE K.6-14B. DRAWDOWN IN OBSERVATION WELL MP424, SEMI-LOG.

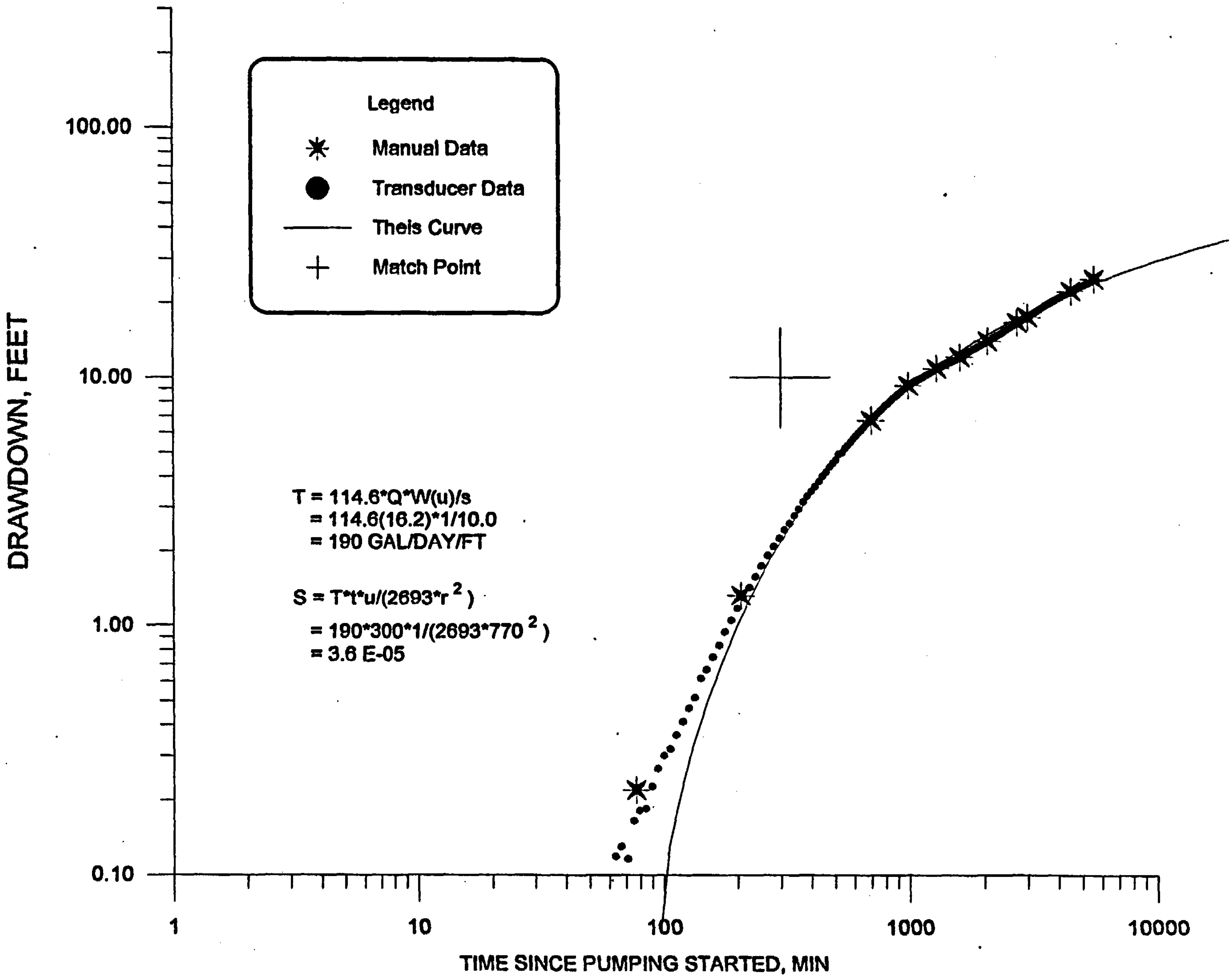


FIGURE K.6-14C. DRAWDOWN IN OBSERVATION WELL MP424, LOG-LOG.

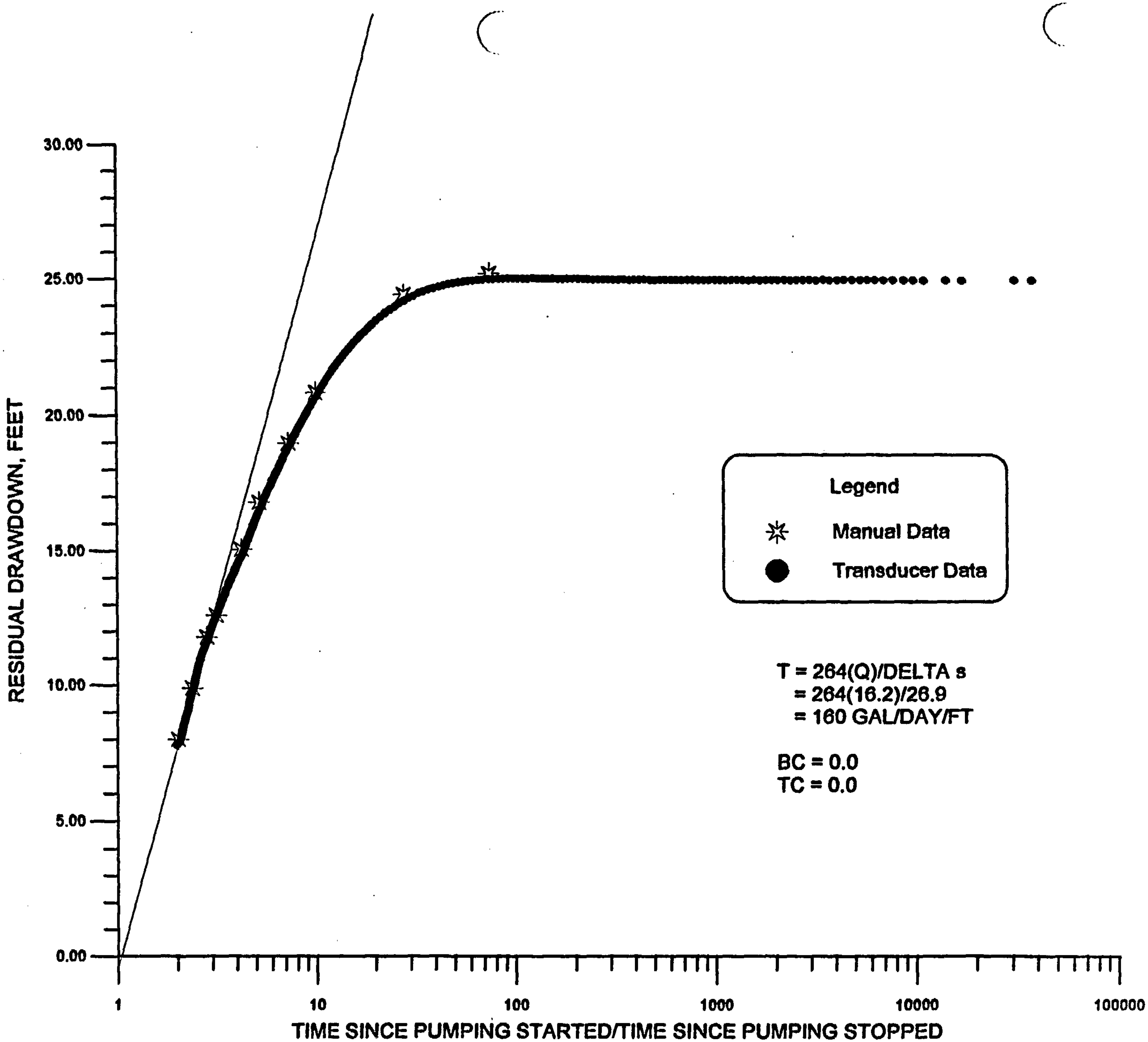
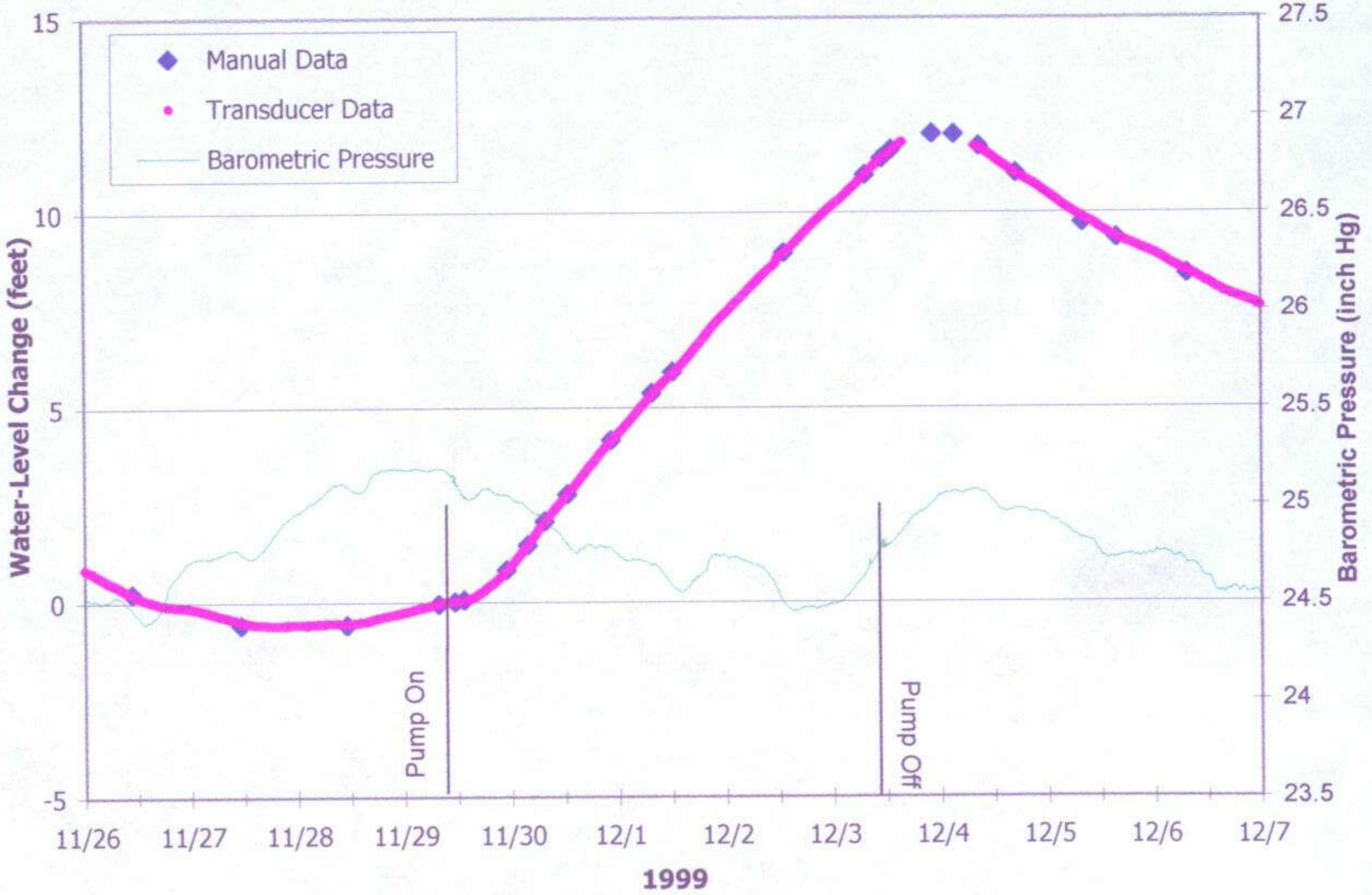


FIGURE K.6-14D. RECOVERY IN OBSERVATION WELL MP424.

FIGURE K.6-15A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP425



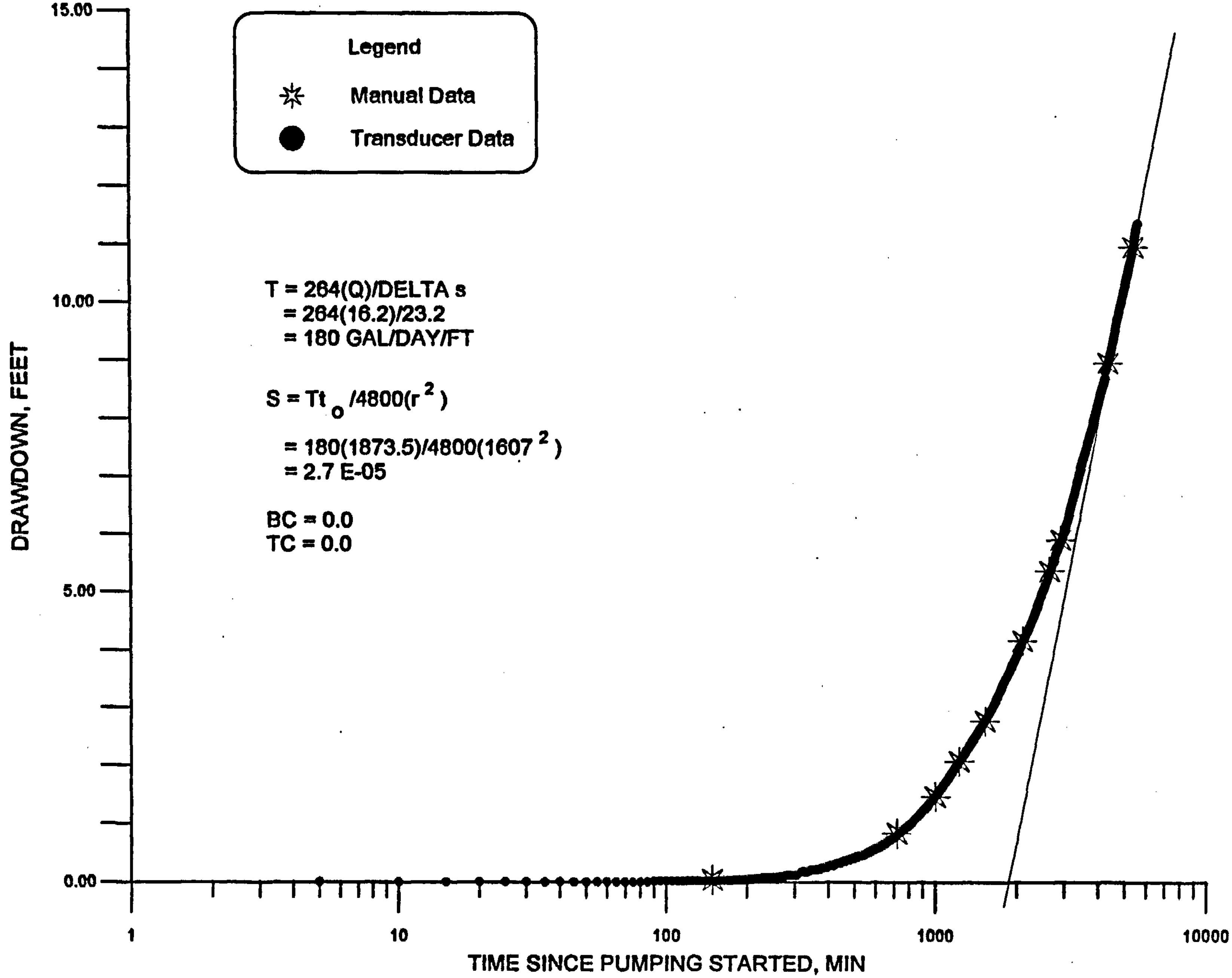


FIGURE K.6-15B. DRAWDOWN IN OBSERVATION WELL MP425, SEMI-LOG.

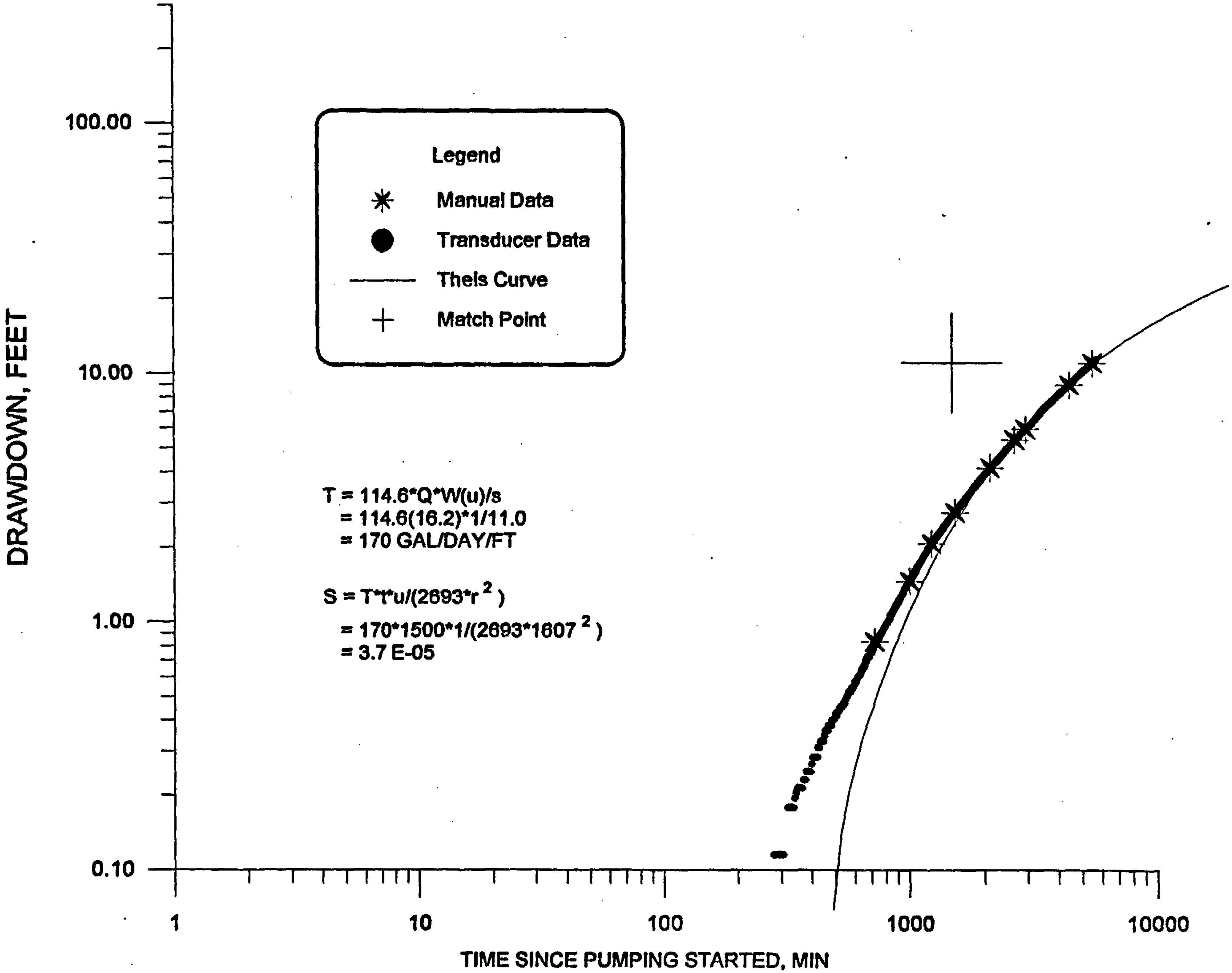


FIGURE K.6-15C. DRAWDOWN IN OBSERVATION WELL MP425, LOG-LOG.

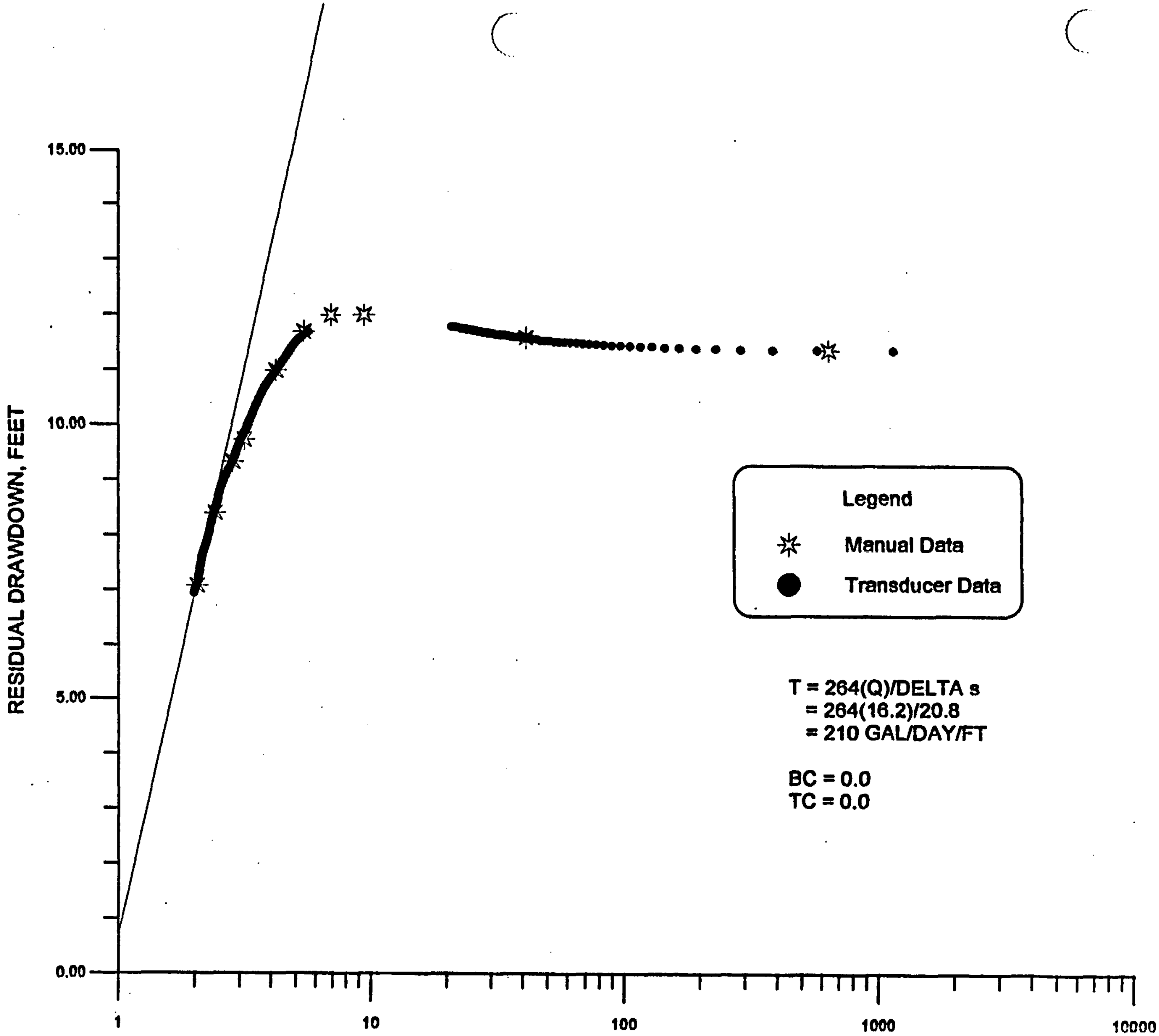
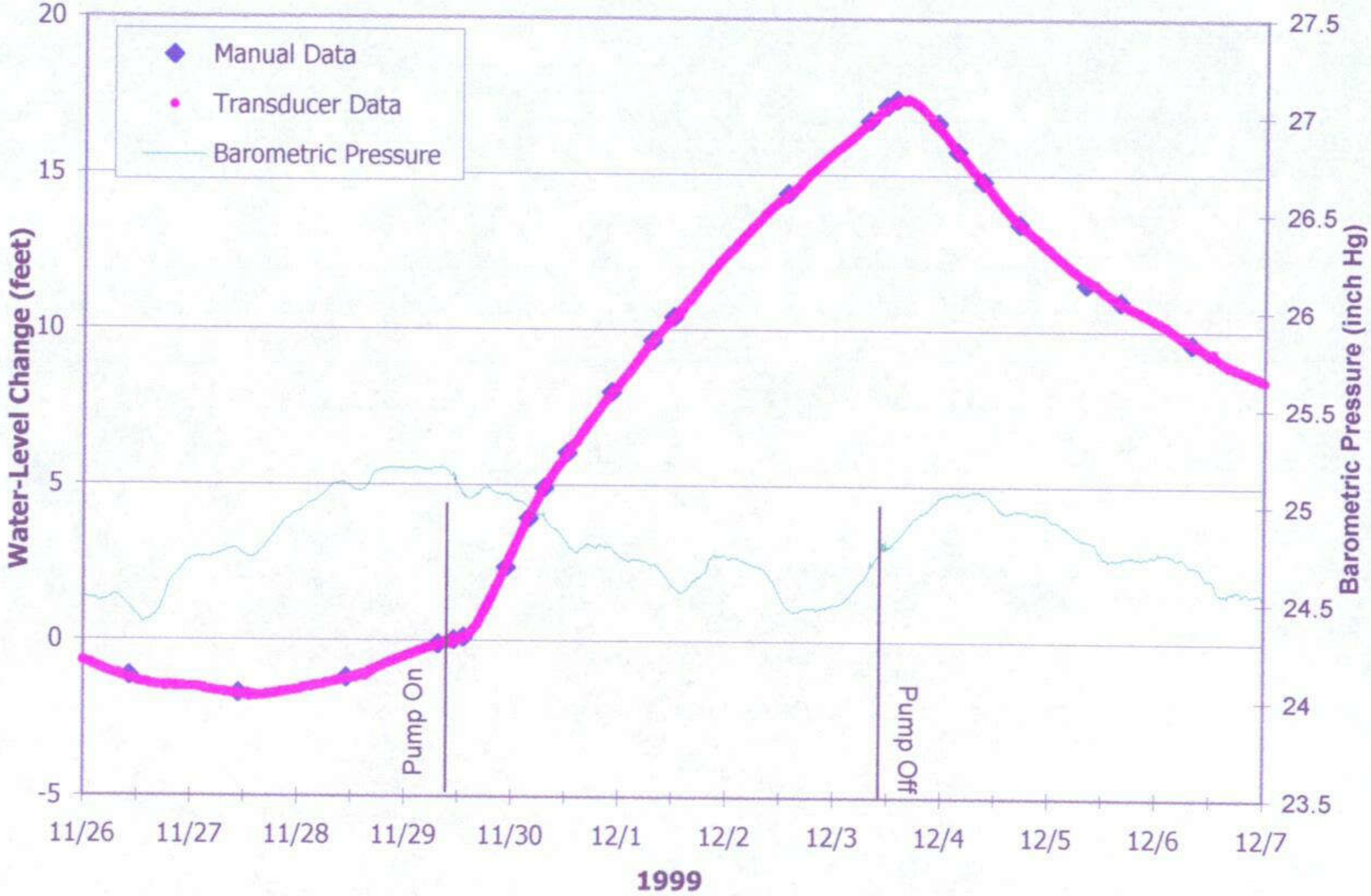


FIGURE K.6-15D. RECOVERY IN OBSERVATION WELL MP425.

FIGURE K.6-16A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP426



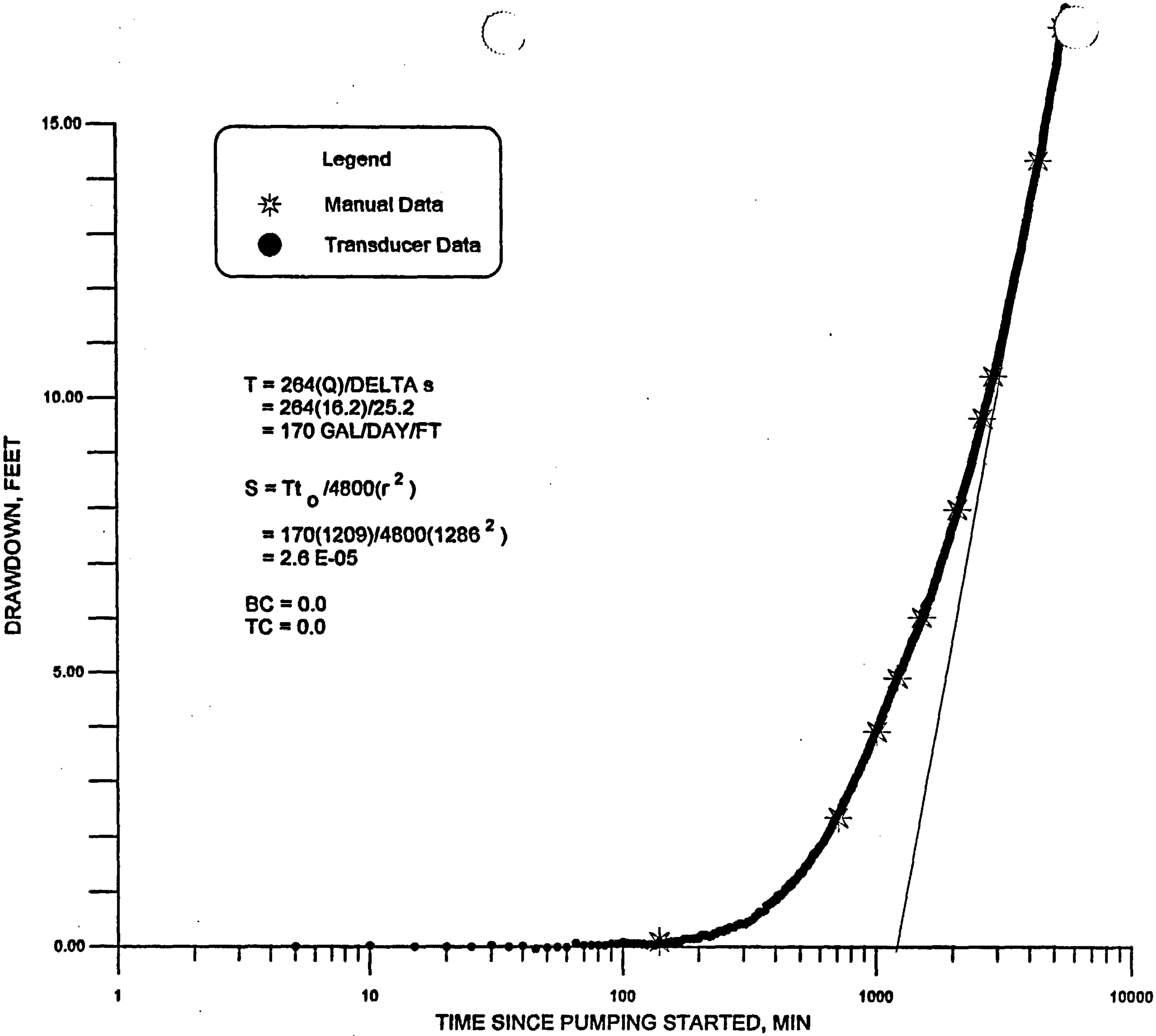


FIGURE K.6-16B. DRAWDOWN IN OBSERVATION WELL MP426, SEMI-LOG.

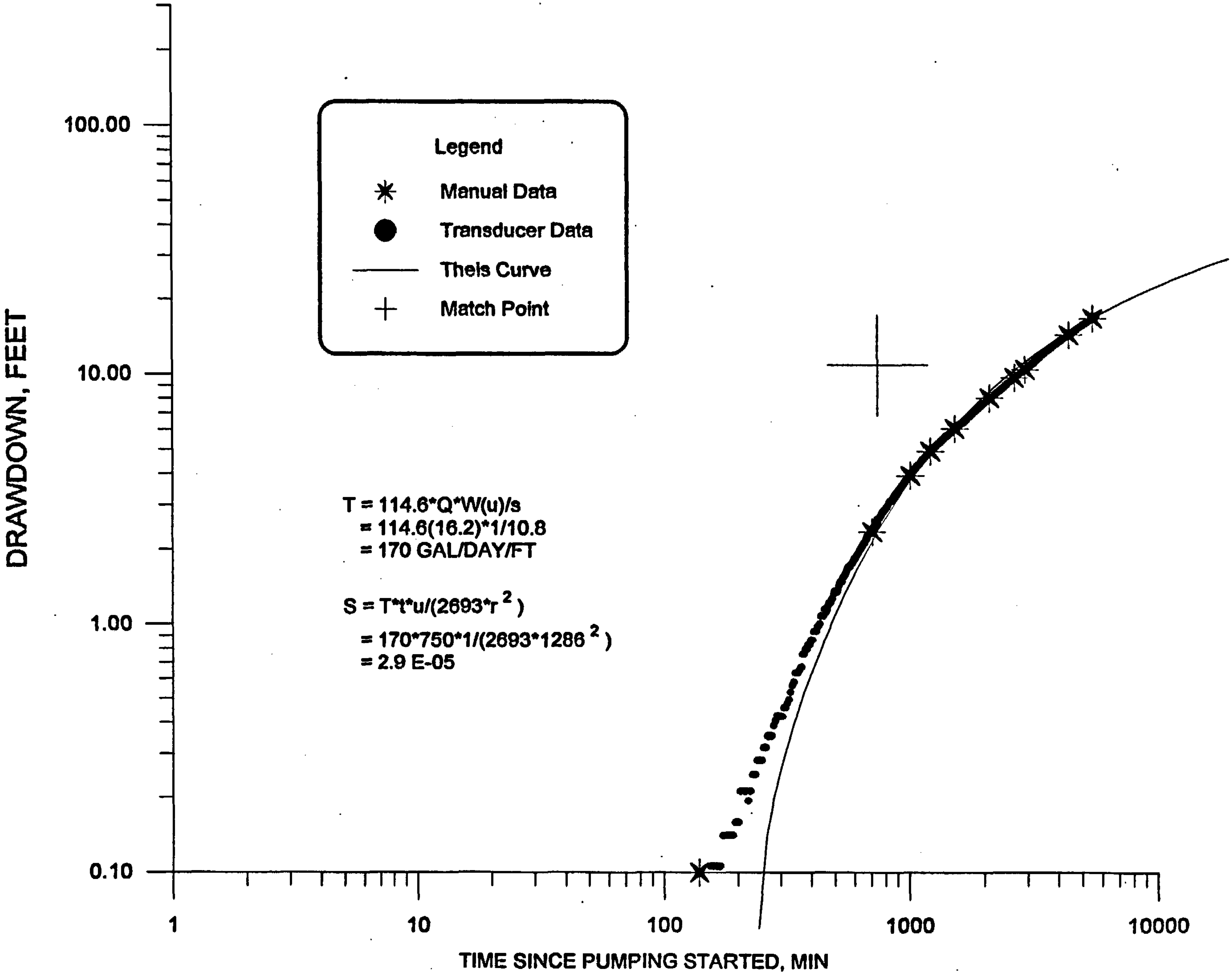


FIGURE K.6-16C. DRAWDOWN IN OBSERVATION WELL MP426, LOG-LOG.

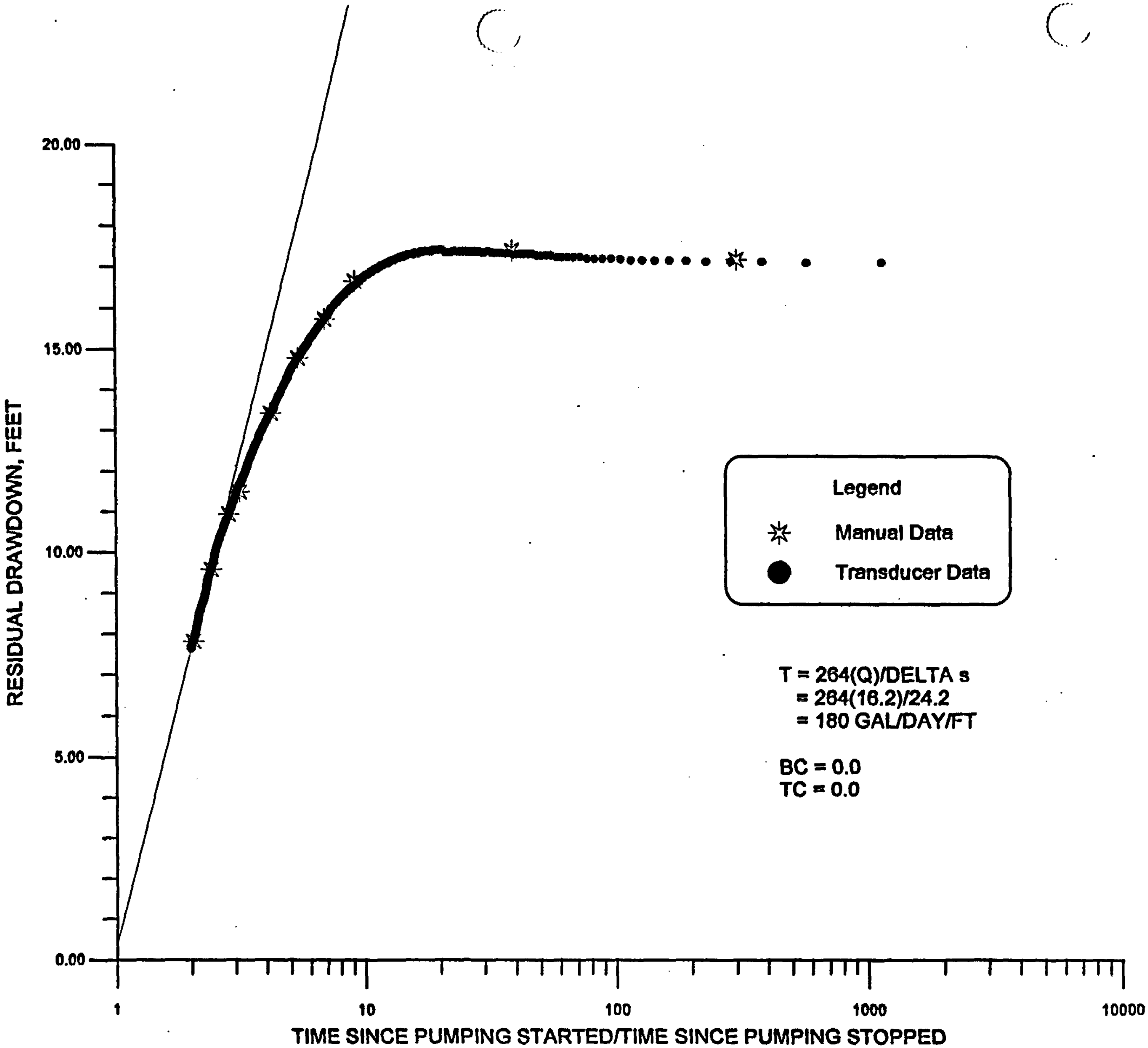
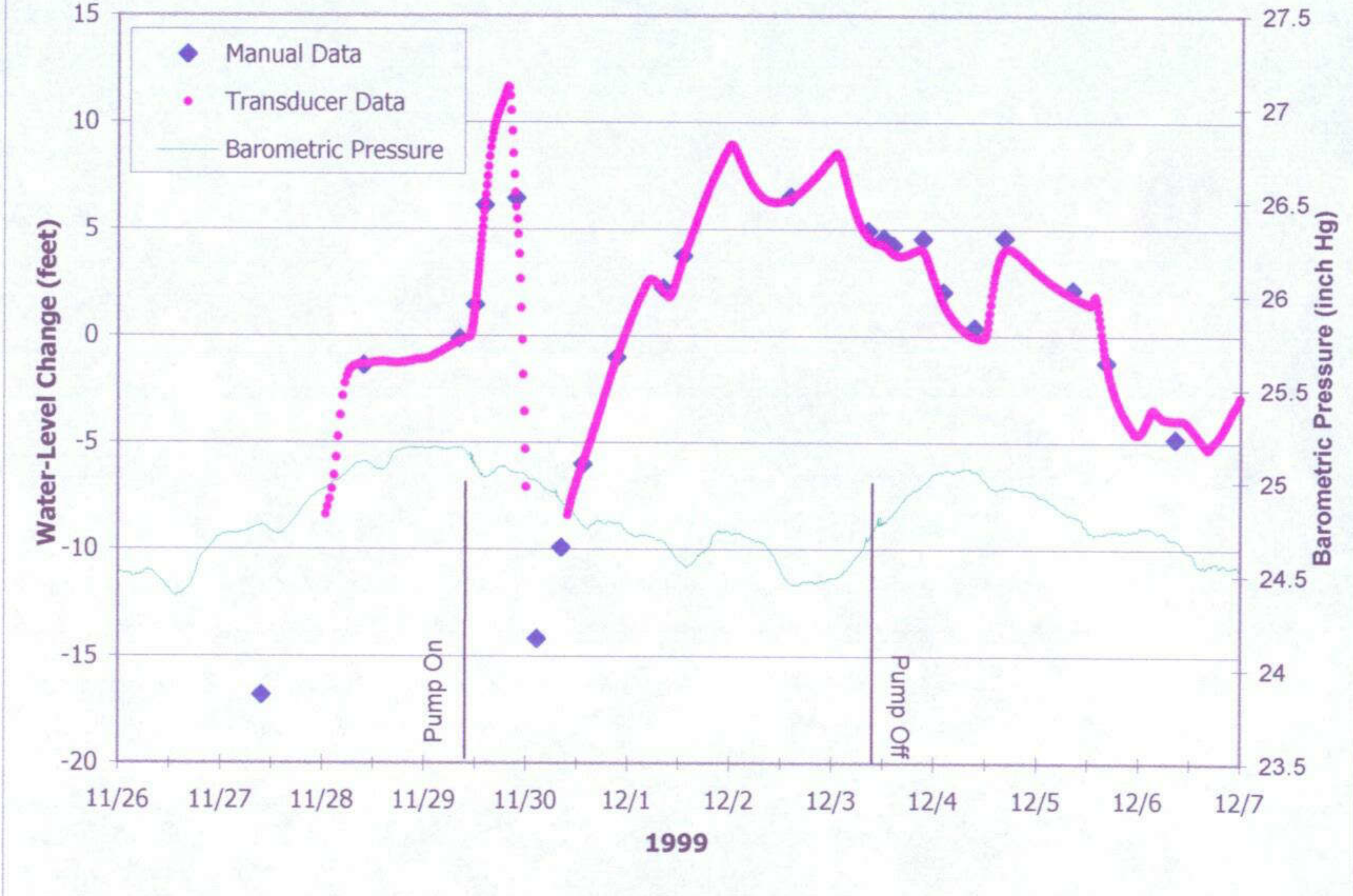


FIGURE K.6-16D. RECOVERY IN OBSERVATION WELL MP426.

FIGURE K.6-17A. WATER-LEVEL CHANGE IN OBSERVATION WELL MP432



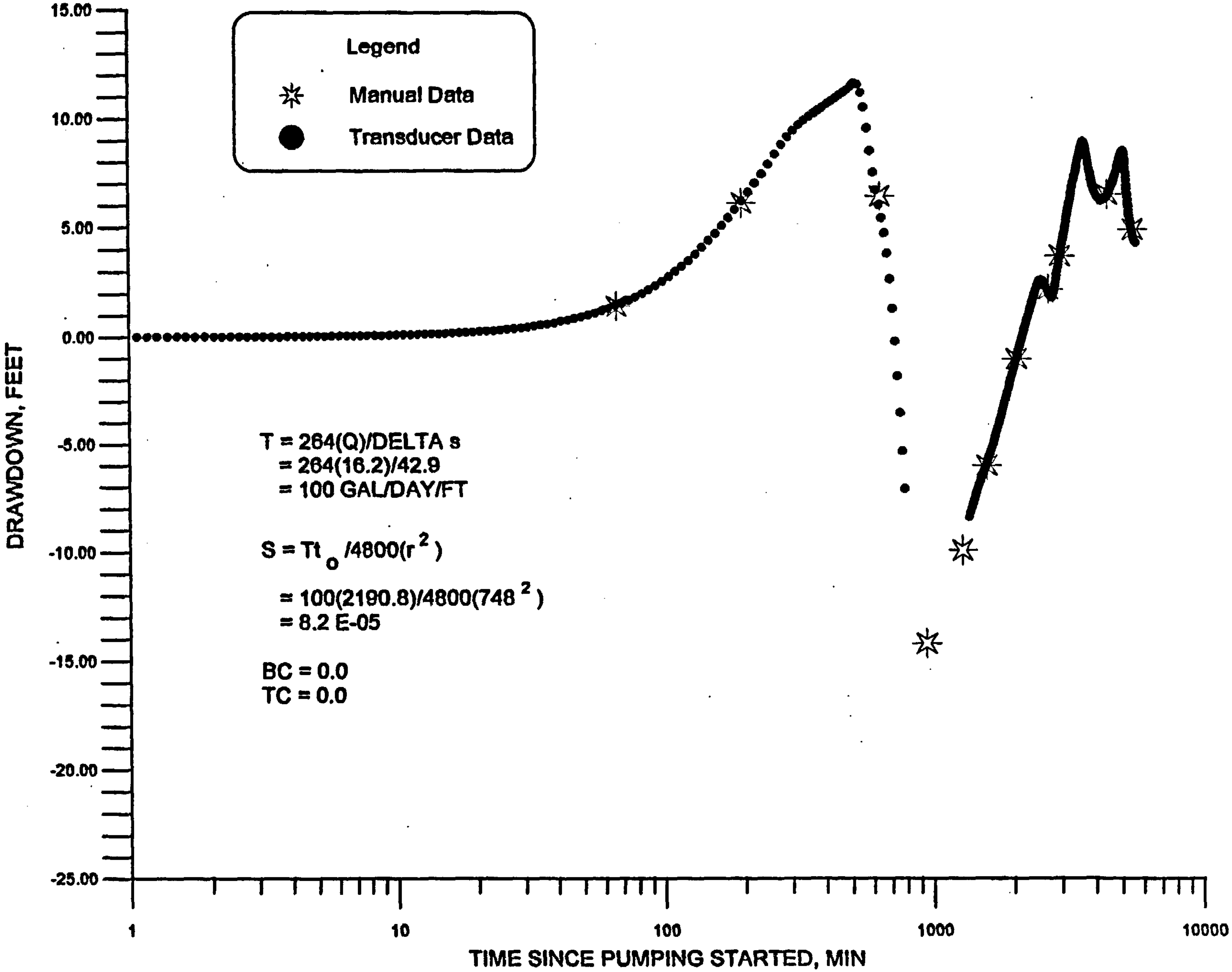


FIGURE K.6-17B. DRAWDOWN IN OBSERVATION WELL MP432, SEMI-LOG.

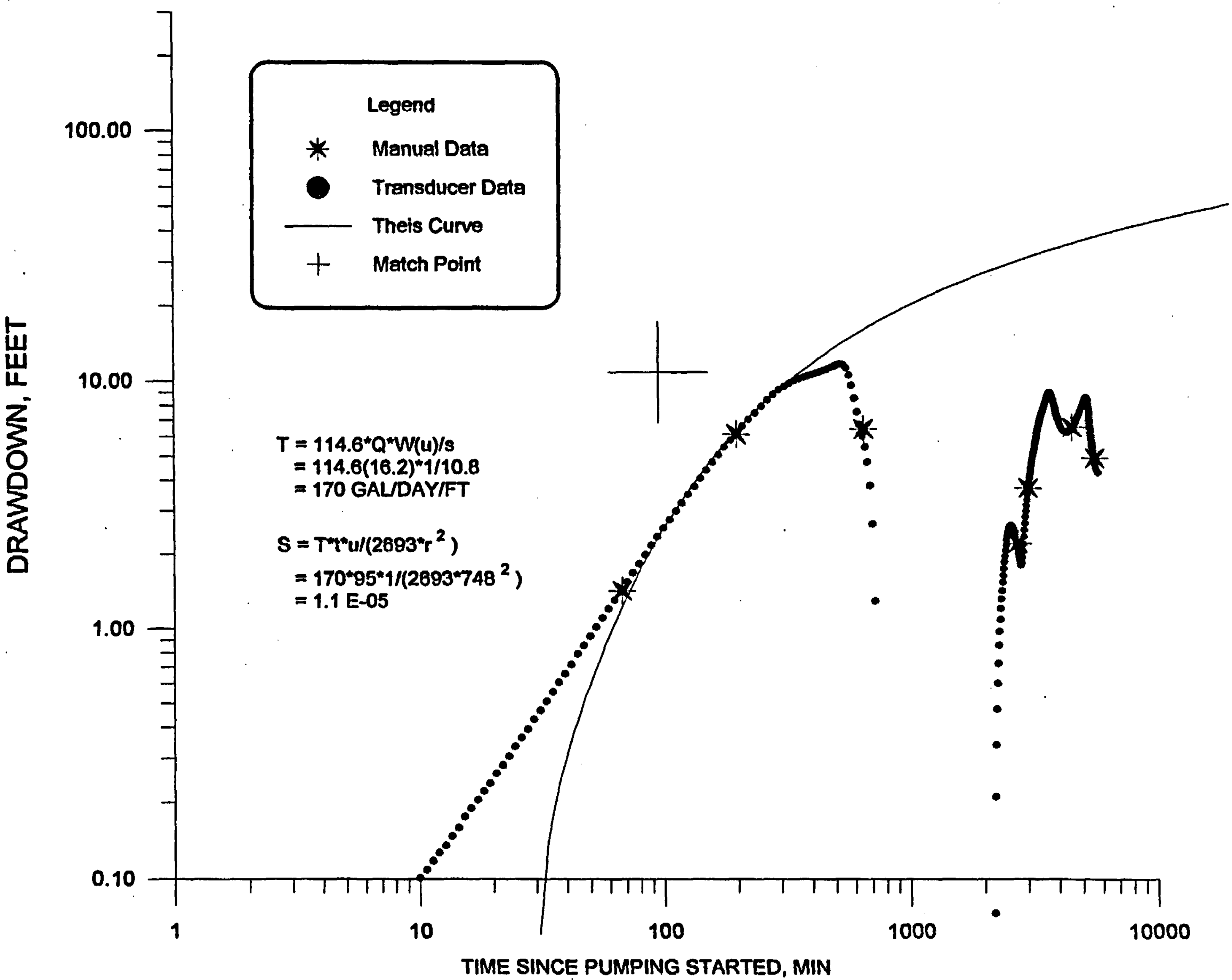


FIGURE K.6-17C. DRAWDOWN IN OBSERVATION WELL MP432, LOG-LOG.

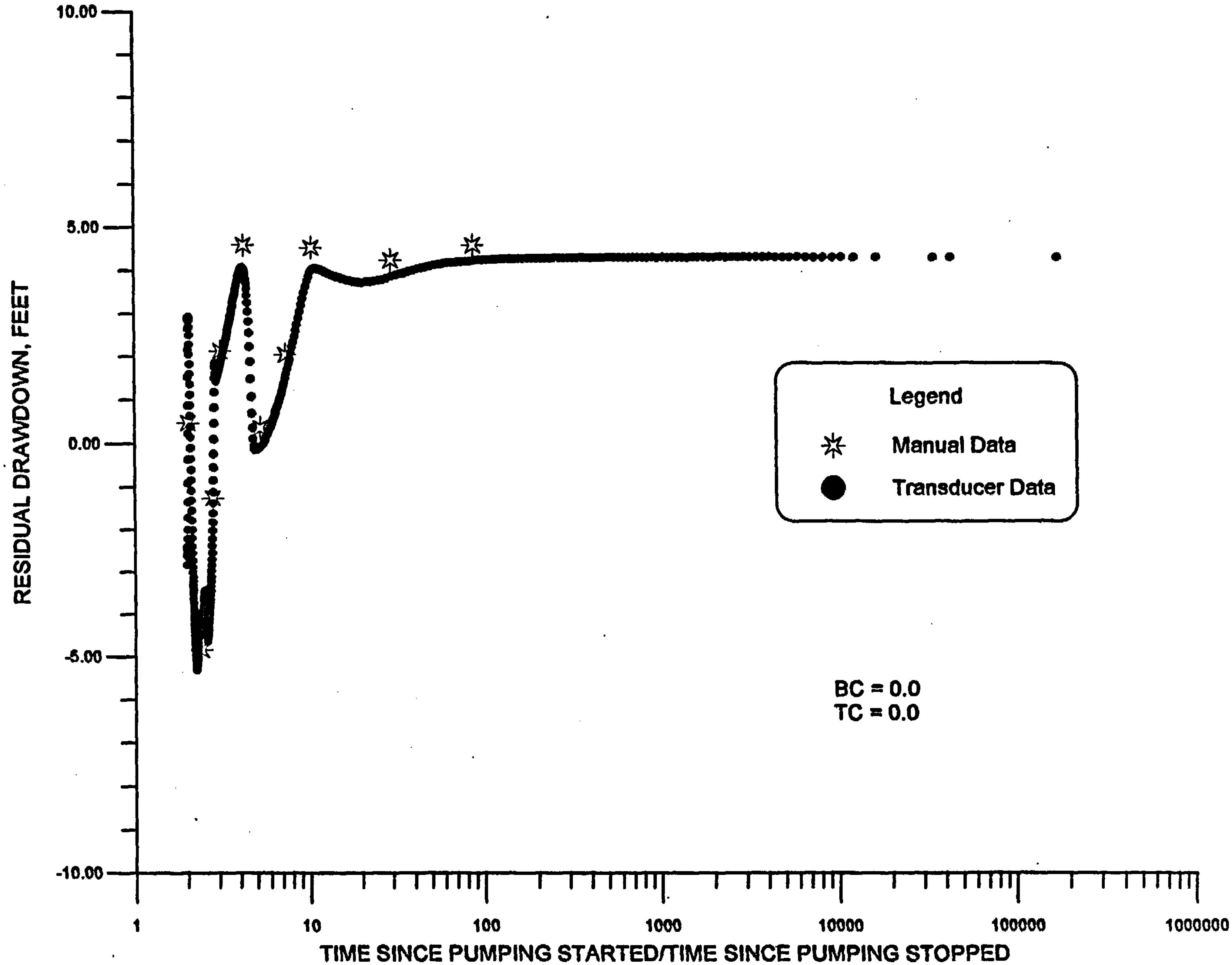
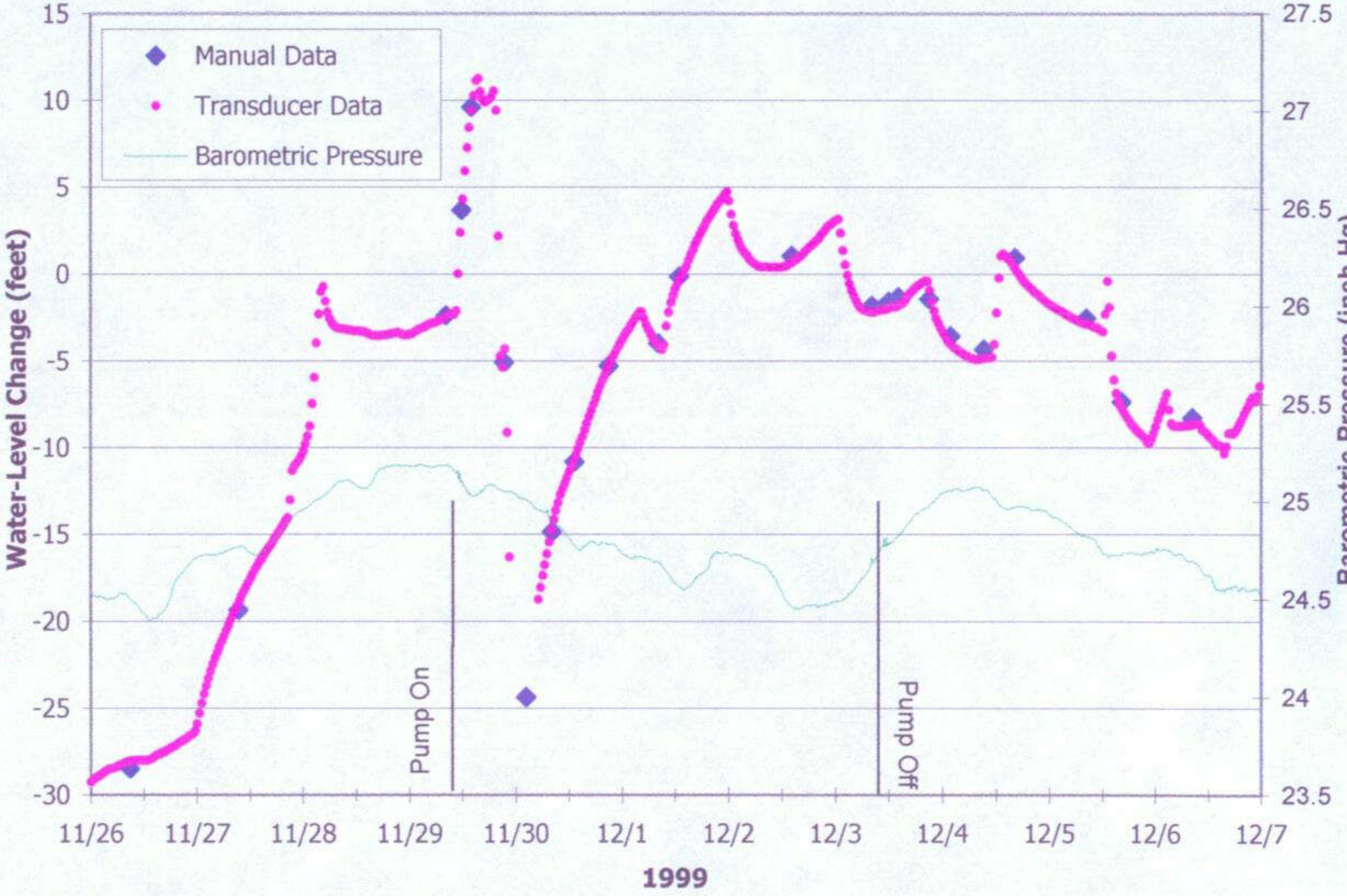


FIGURE K.6-17D. RECOVERY IN OBSERVATION WELL MP432.

FIGURE K.6-18A. WATER-LEVEL CHANGE IN OBSERVATION WELL M401



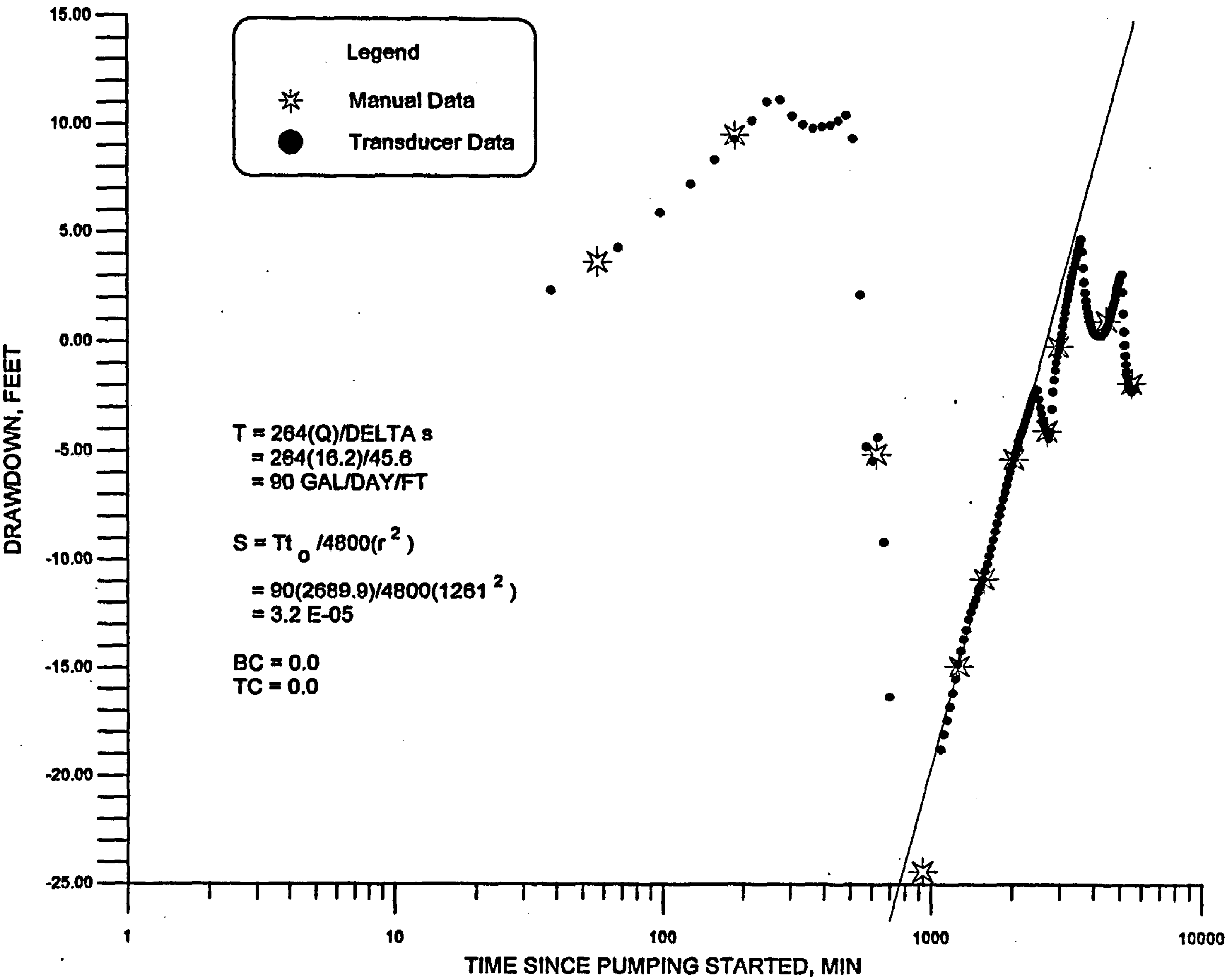


FIGURE K.6-18B. DRAWDOWN IN OBSERVATION WELL M401, SEMI-LOG.

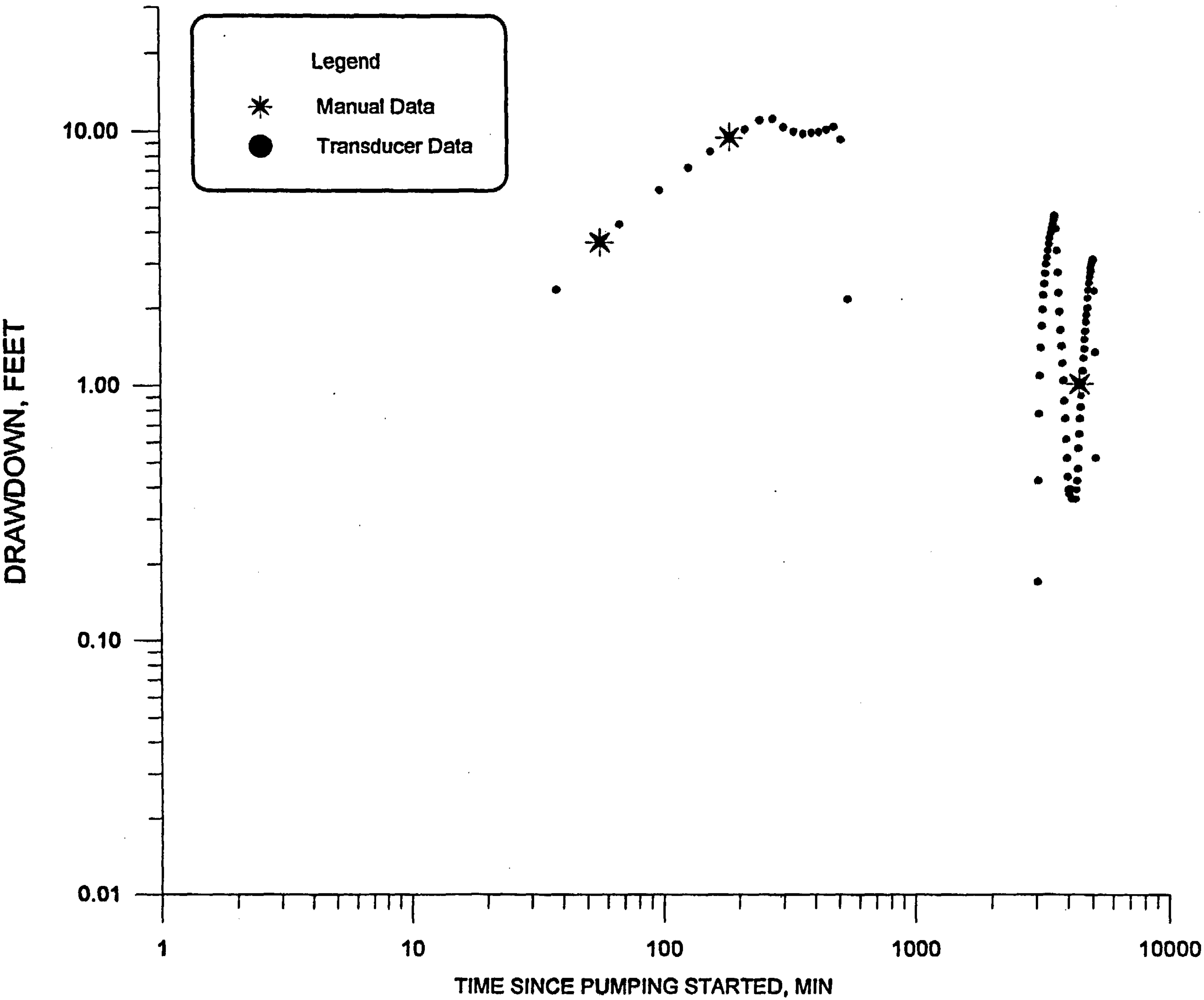


FIGURE K.6-18C. DRAWDOWN IN OBSERVATION WELL M401, LOG-LOG.

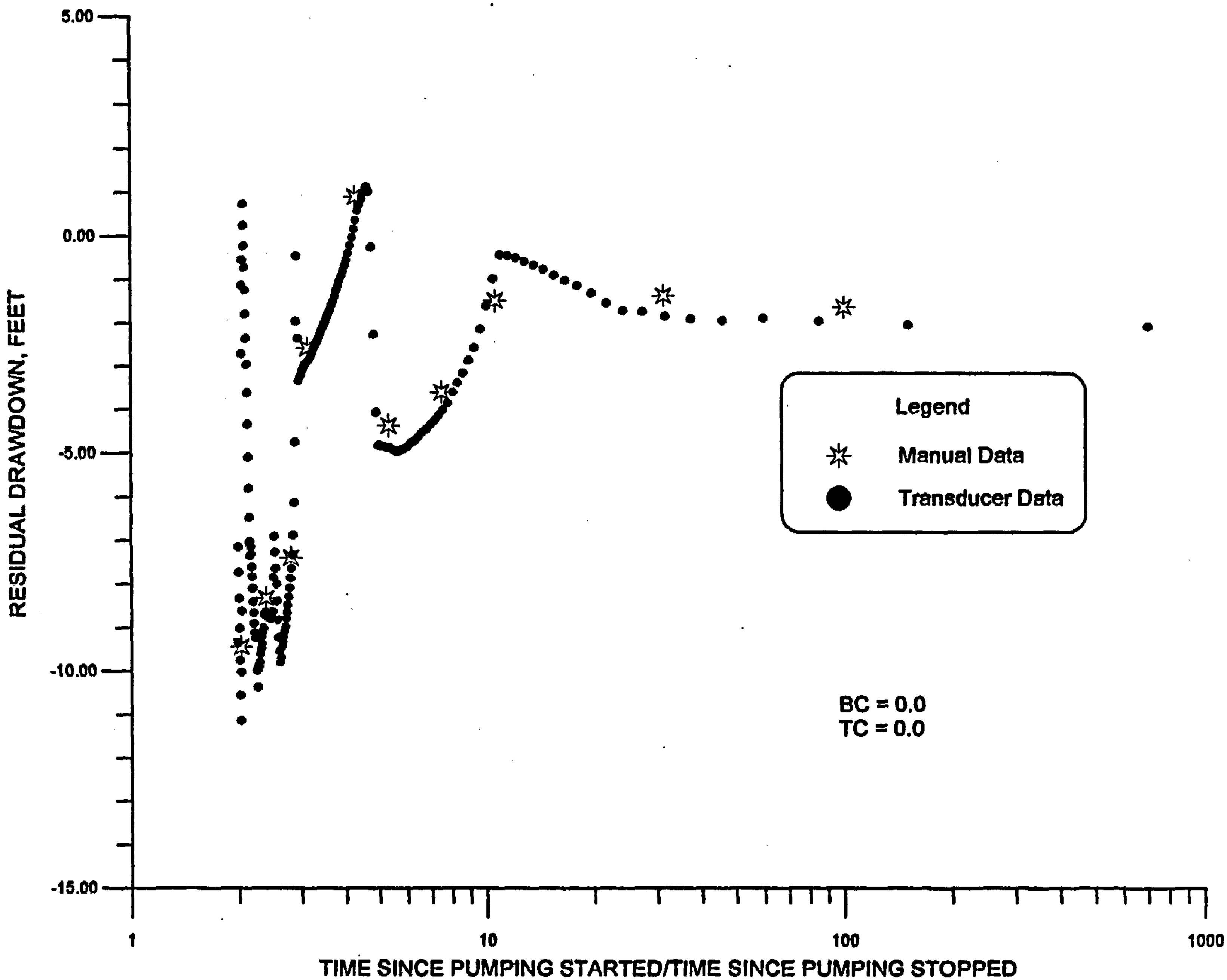
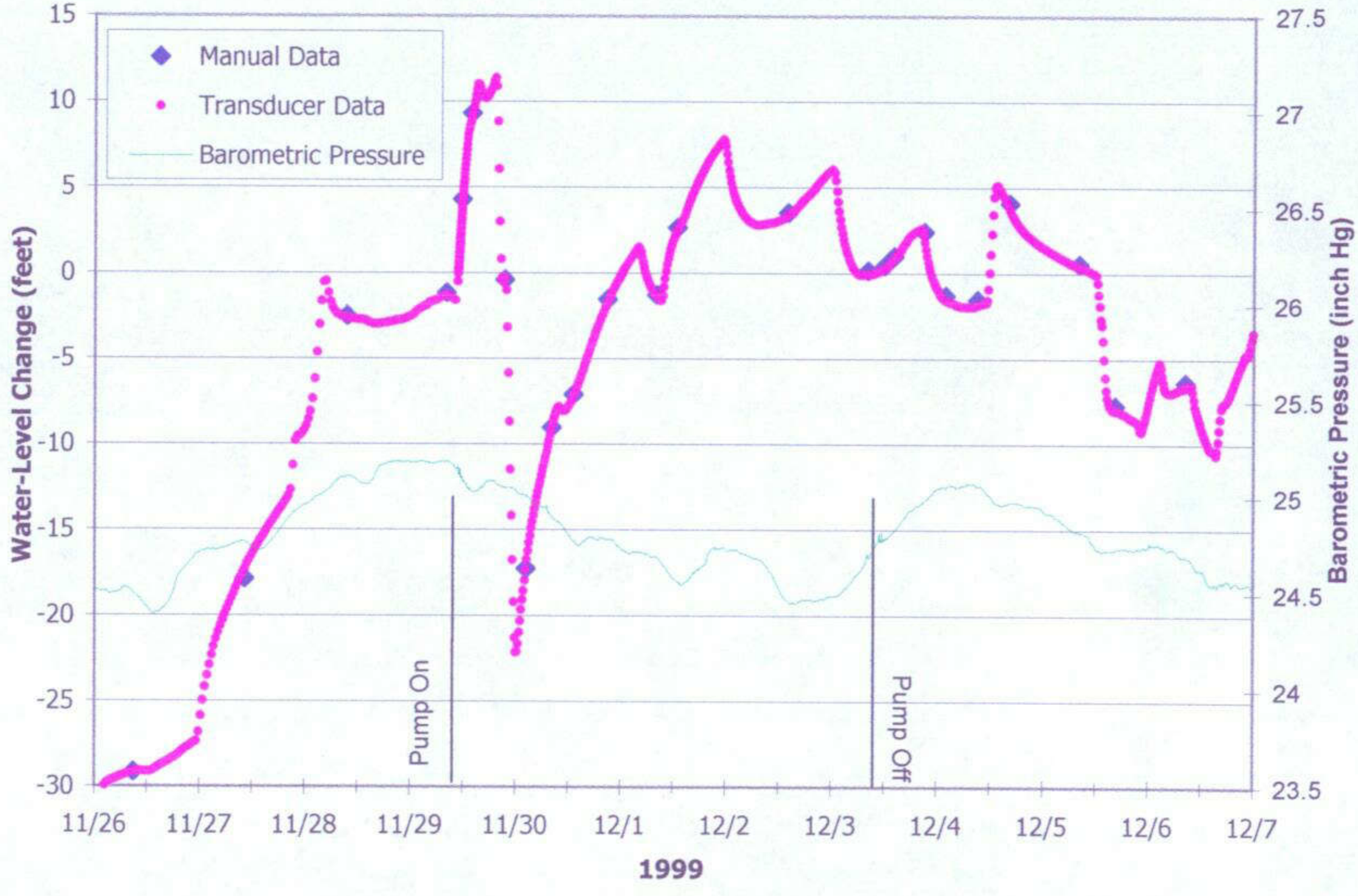


FIGURE K.6-18D. RECOVERY IN OBSERVATION WELL M401.

FIGURE K.6-19A. WATER-LEVEL CHANGE IN OBSERVATION WELL M402



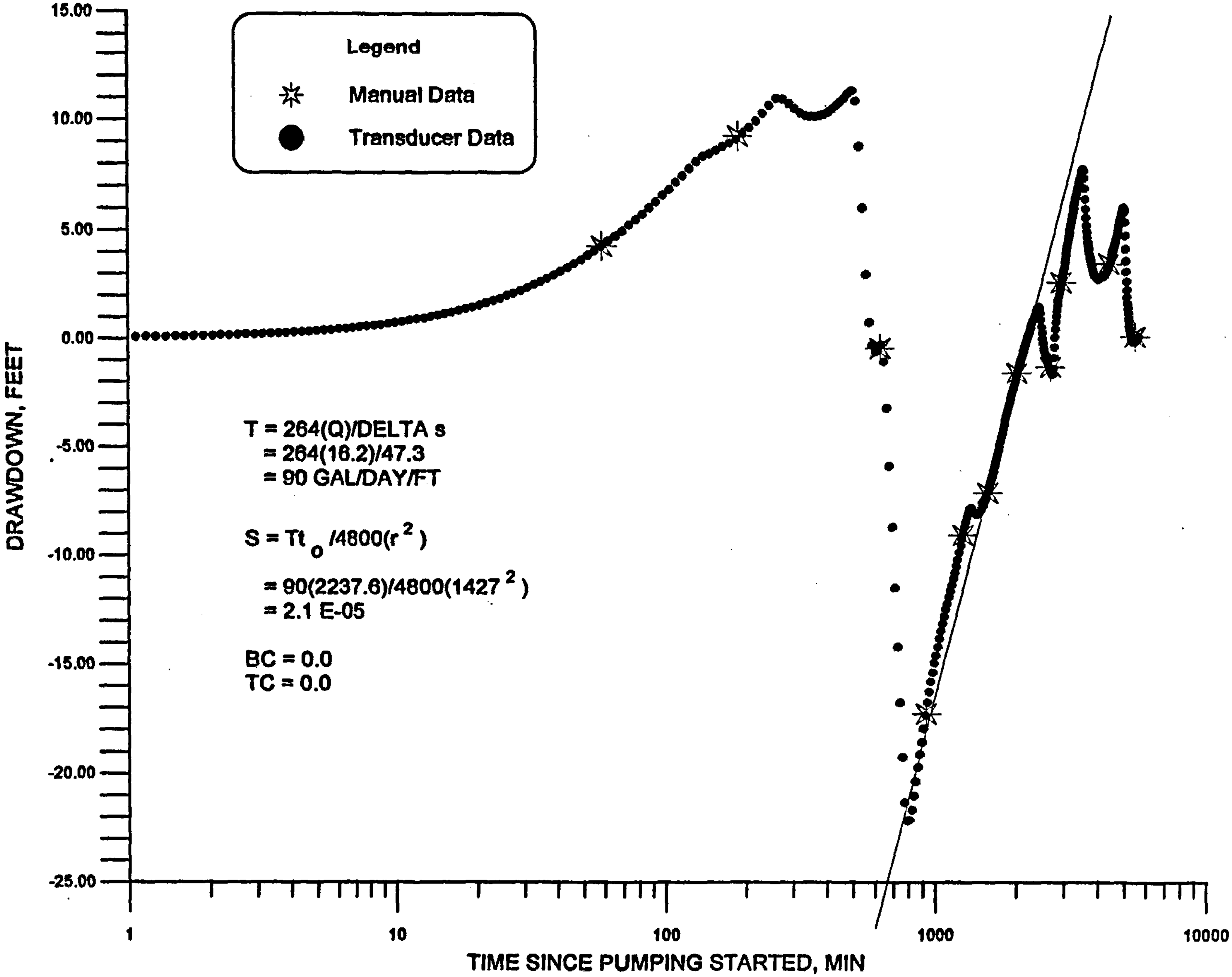


FIGURE K.6-19B. DRAWDOWN IN OBSERVATION WELL M402, SEMI-LOG.

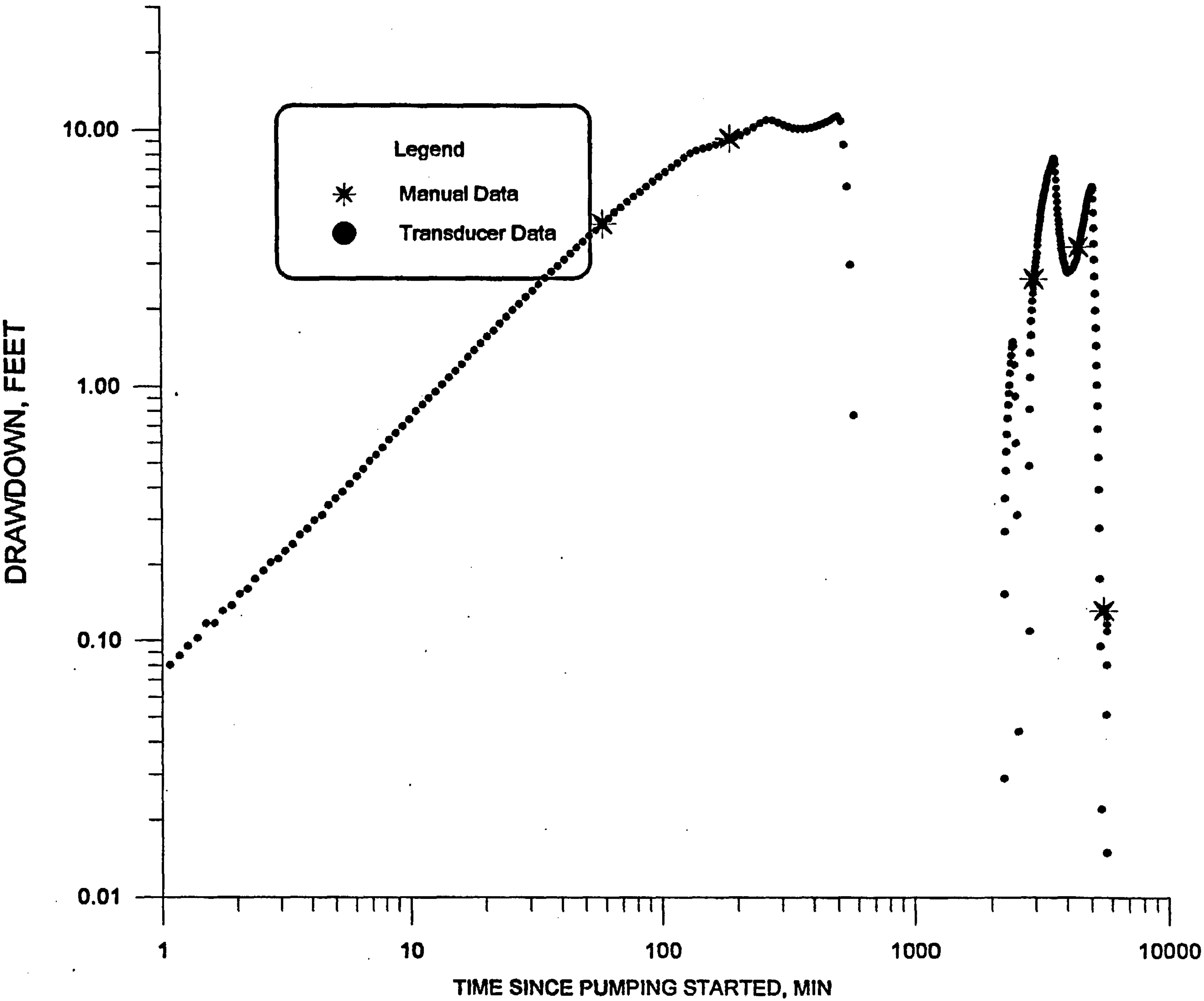


FIGURE K.6-19C. DRAWDOWN IN OBSERVATION WELL M402, LOG-LOG.

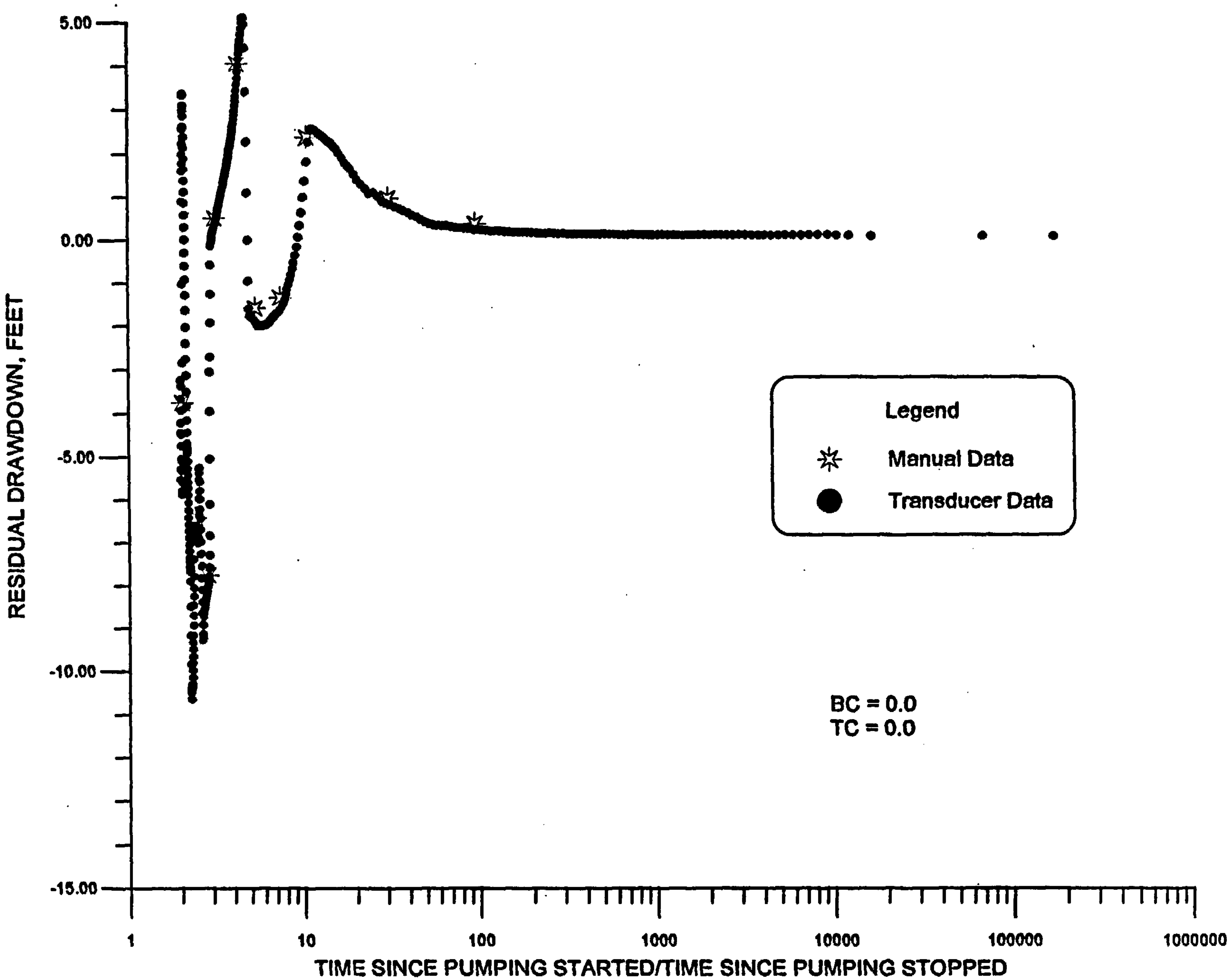
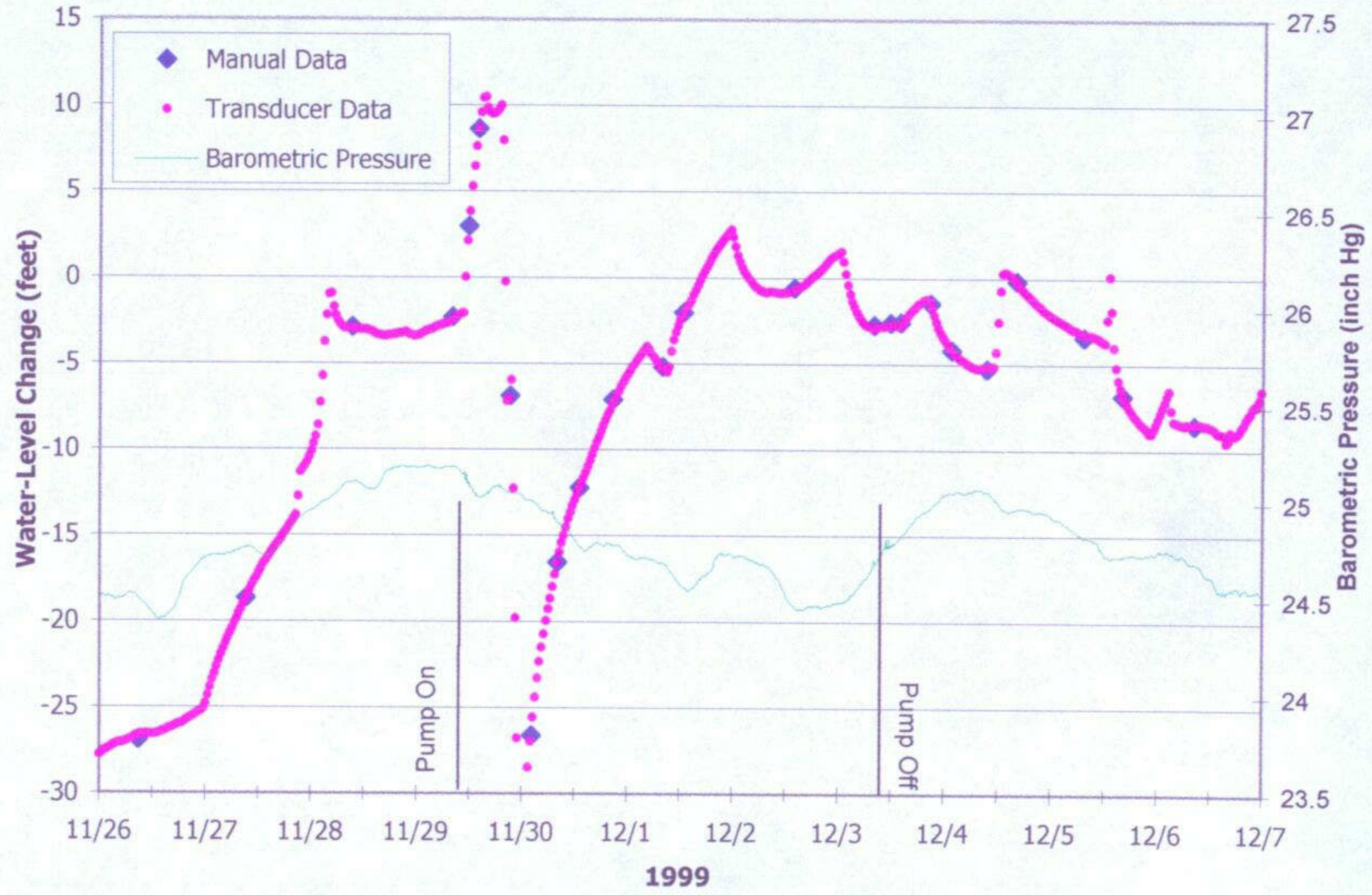


FIGURE K.6-19D. RECOVERY IN OBSERVATION WELL M402.

FIGURE K.6-20A. WATER-LEVEL CHANGE IN OBSERVATION WELL M434



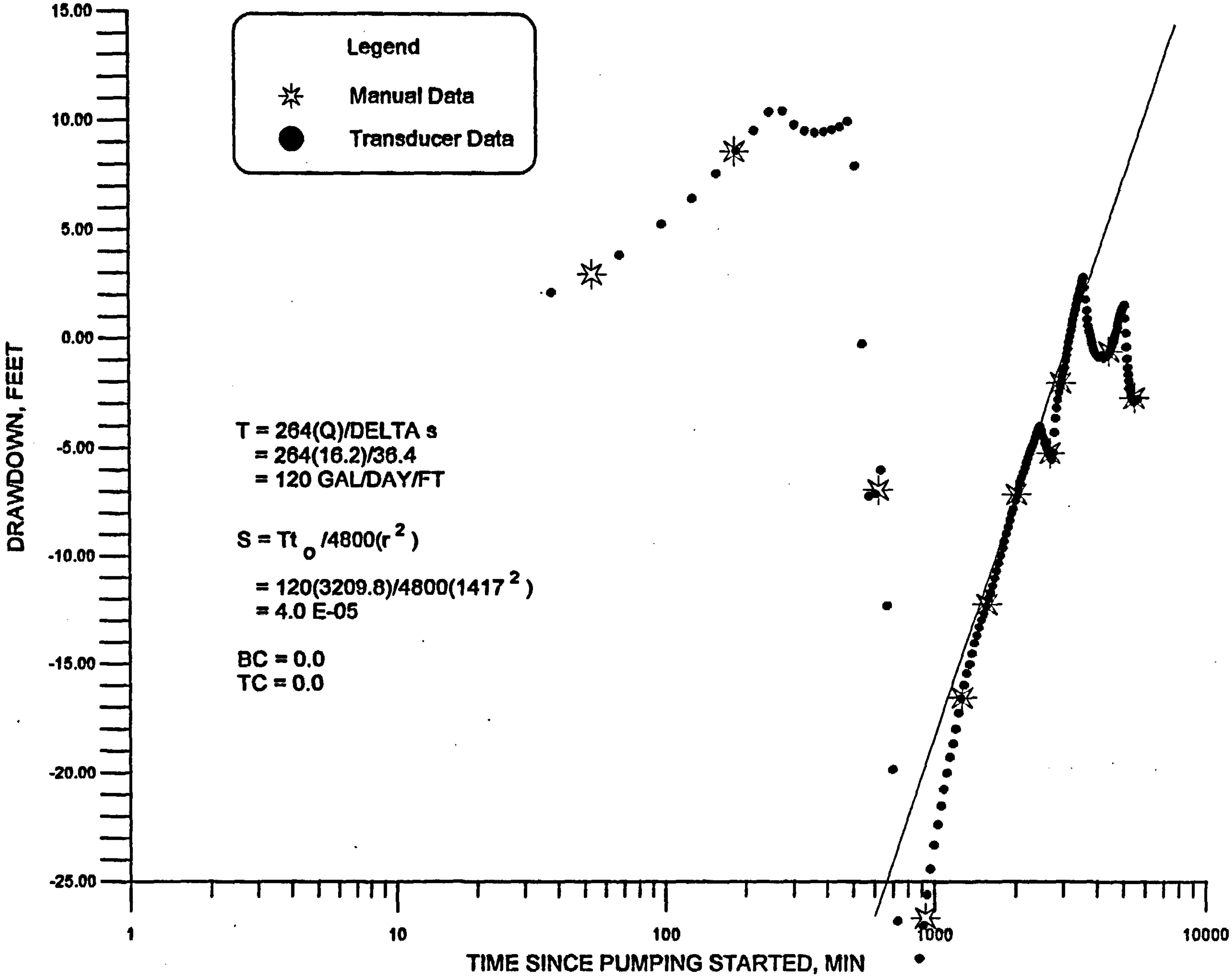


FIGURE K.6-20B. DRAWDOWN IN OBSERVATION WELL M434, SEMI-LOG.

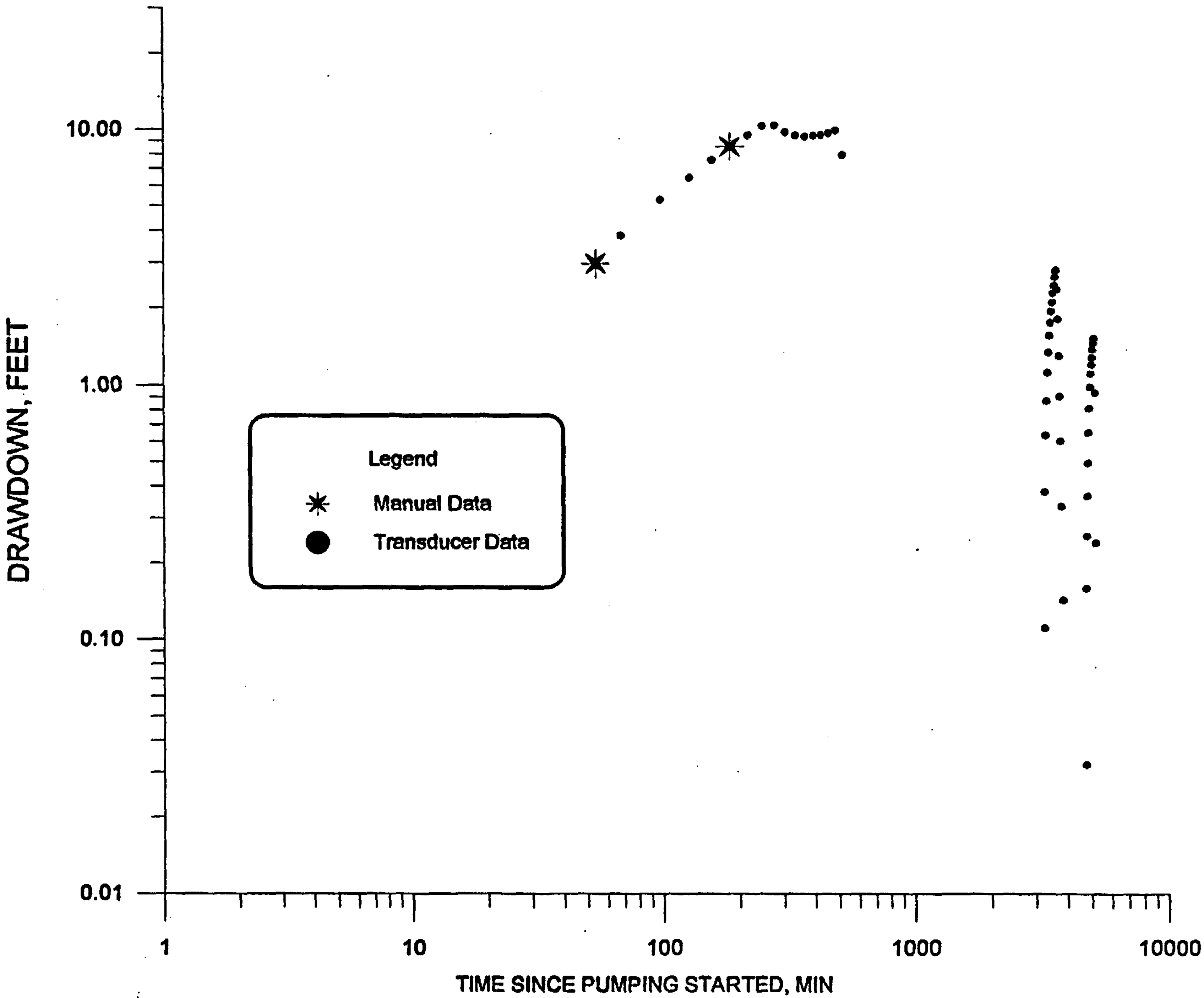


FIGURE K.6-20C. DRAWDOWN IN OBSERVATION WELL M434, LOG-LOG.

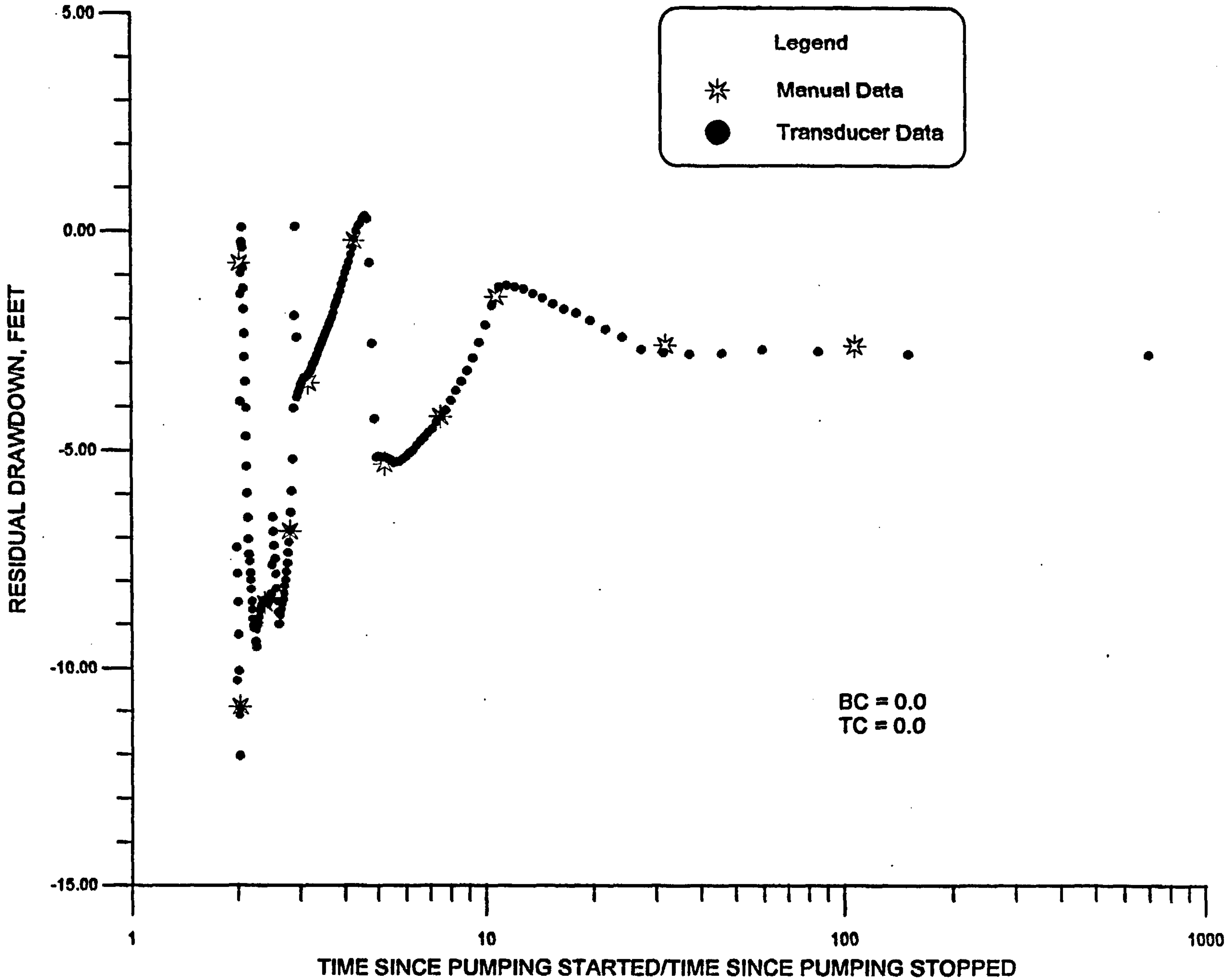
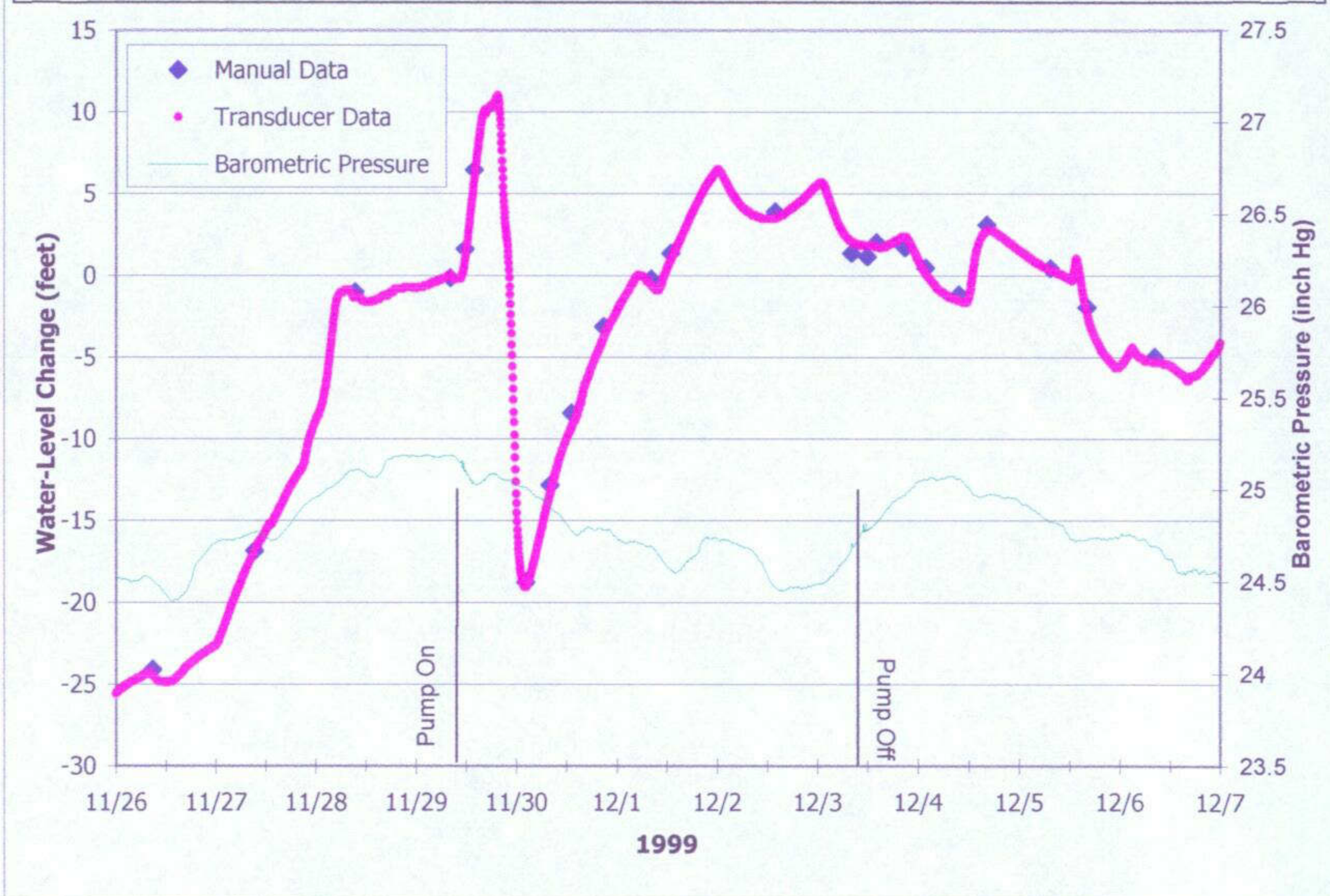


FIGURE K.6-20D. RECOVERY IN OBSERVATION WELL M434.

FIGURE K.6-21A. WATER-LEVEL CHANGE IN OBSERVATION WELL M435



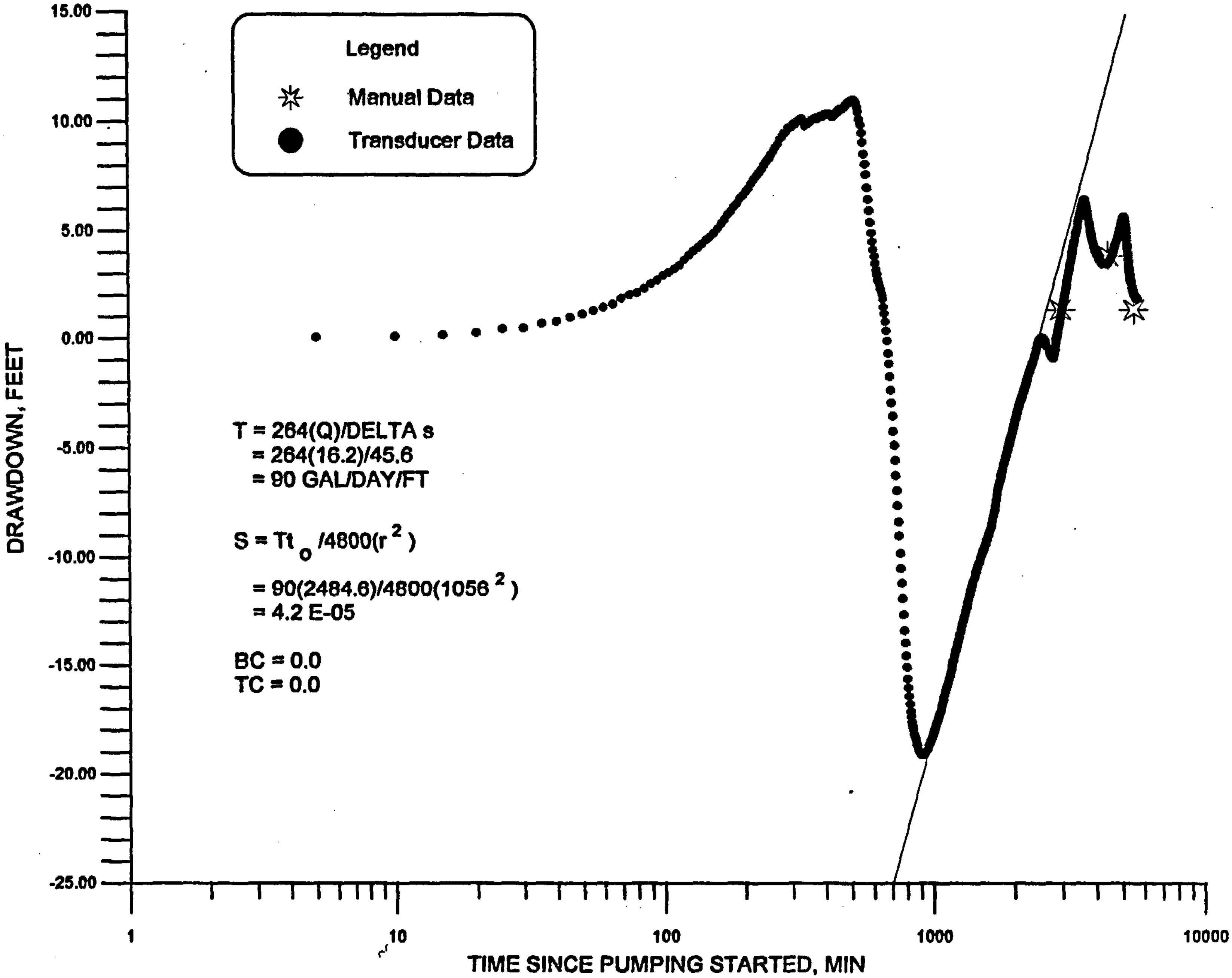


FIGURE K.6-21B. DRAWDOWN IN OBSERVATION WELL M435, SEMI-LOG.

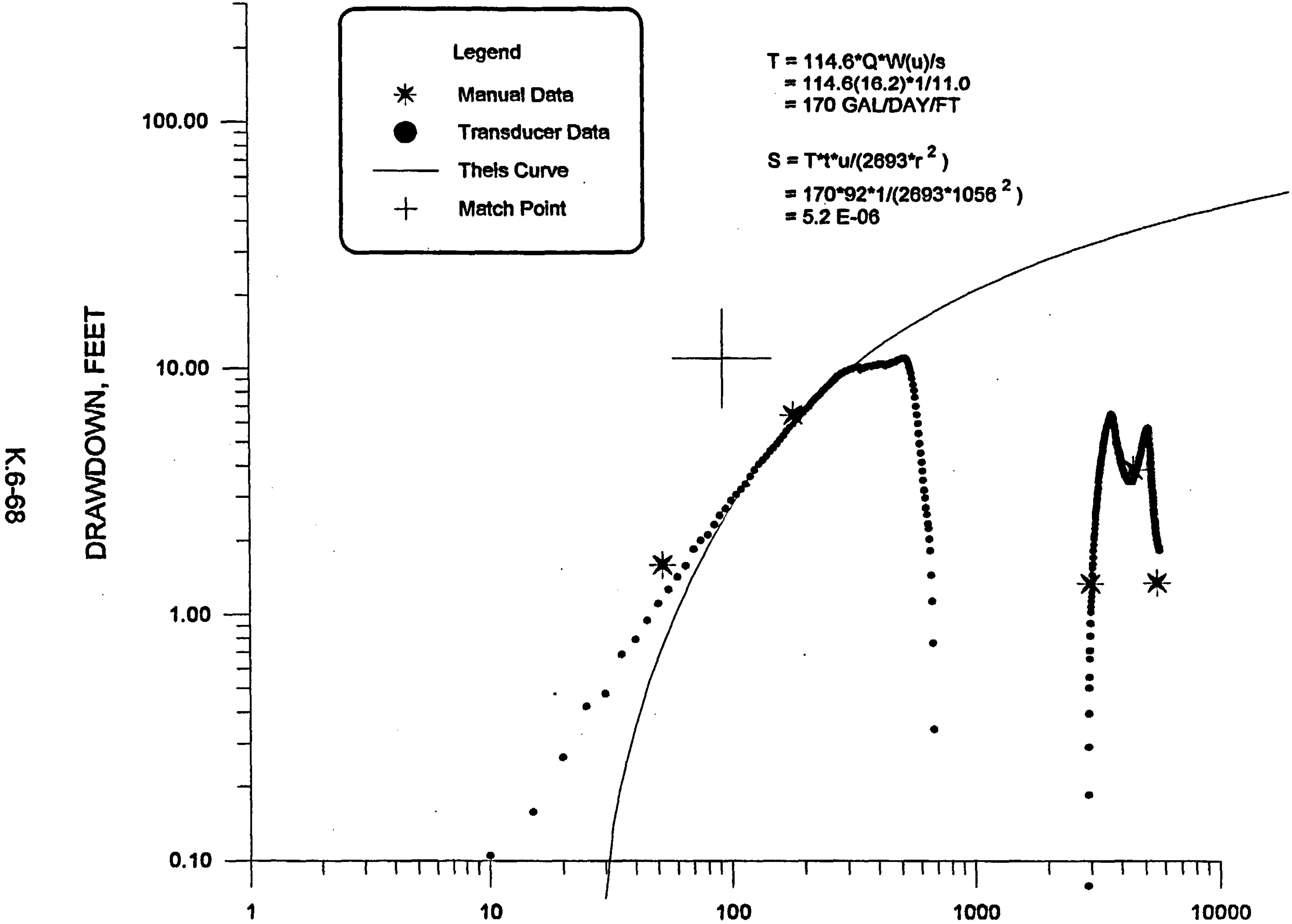


FIGURE K.6-21C. DRAWDOWN IN OBSERVATION WELL M435, LOG-LOG.

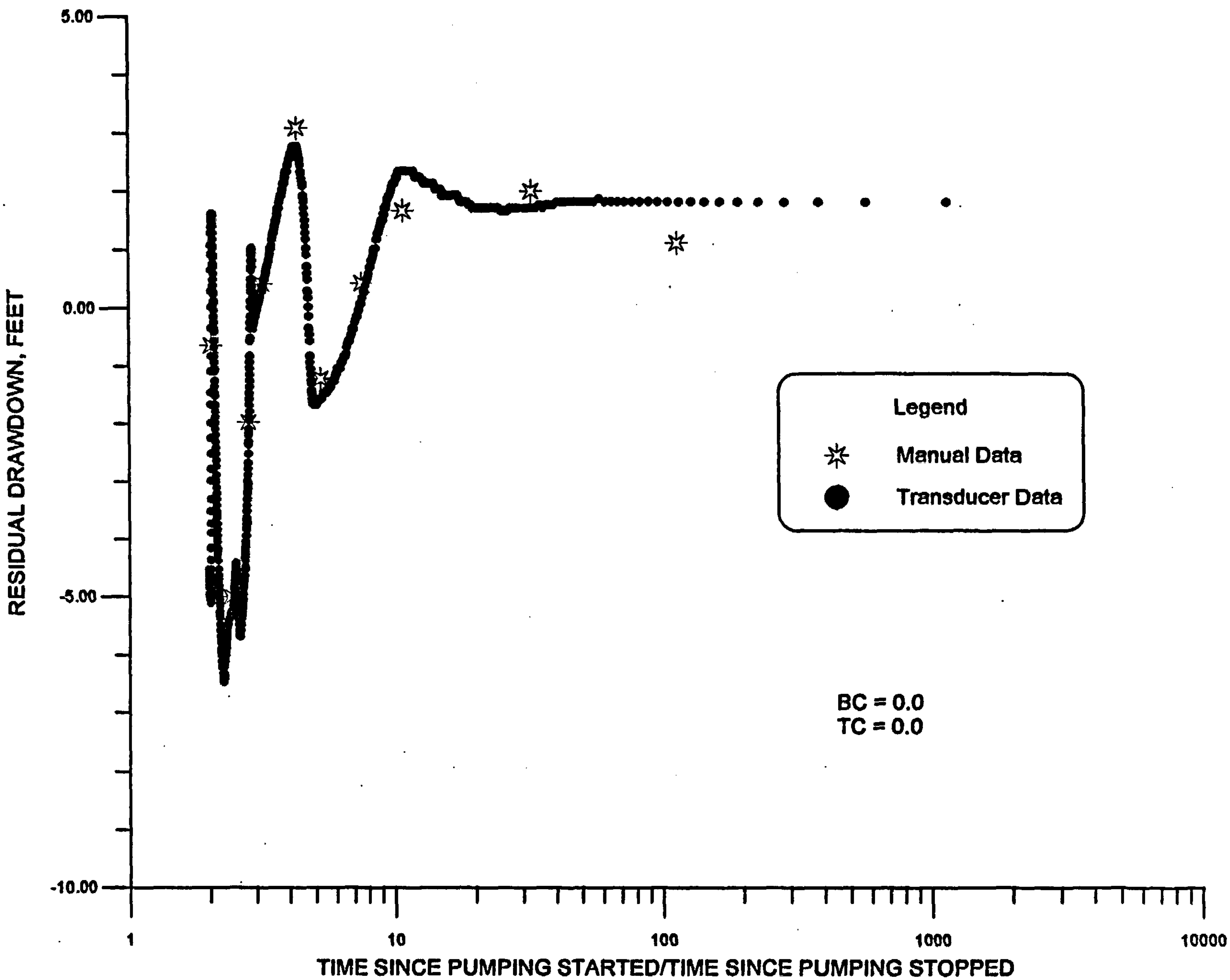
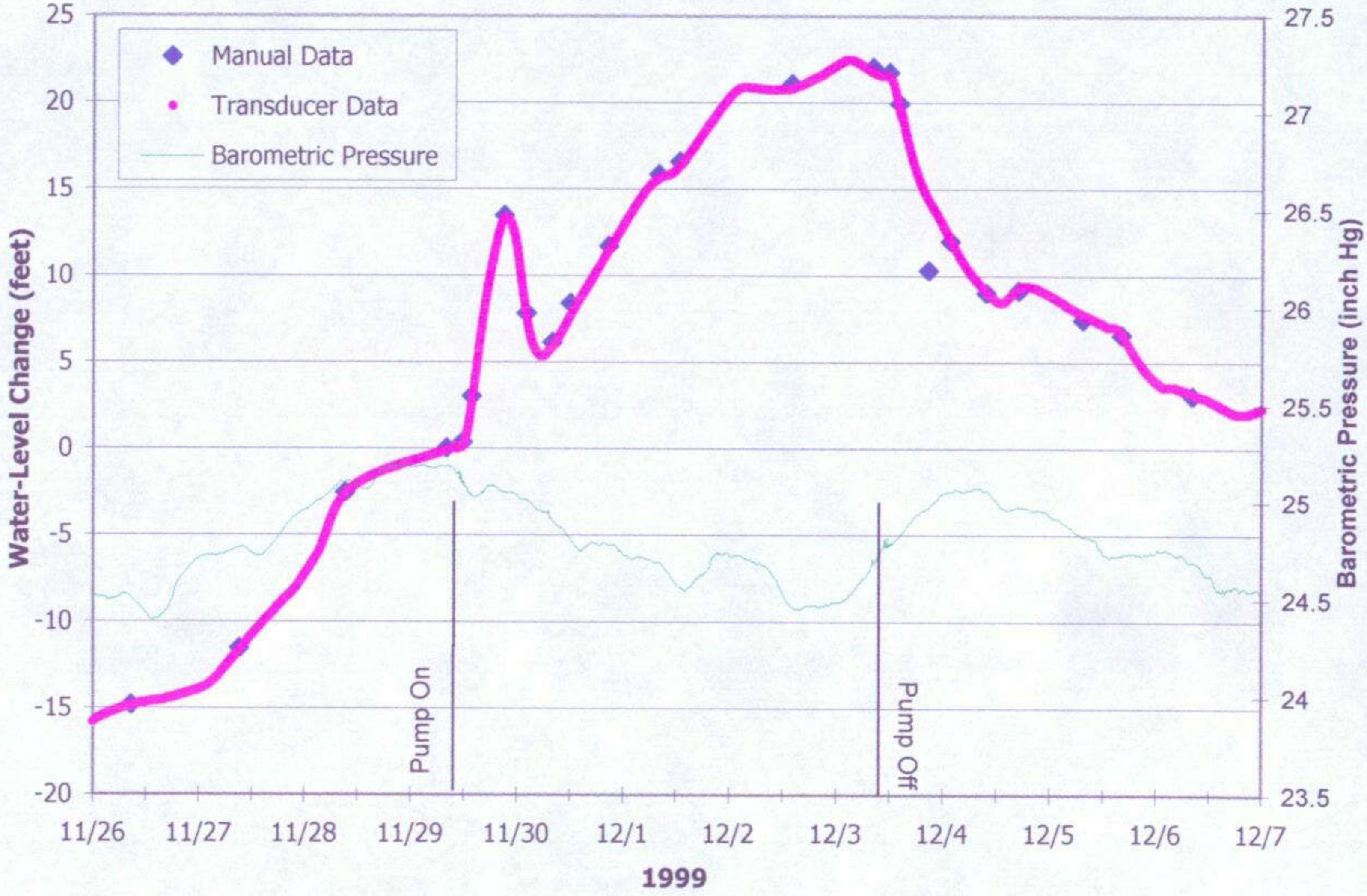


FIGURE K.6-21D. RECOVERY IN OBSERVATION WELL M435.

FIGURE K.6-22A. WATER-LEVEL CHANGE IN OBSERVATION WELL M436



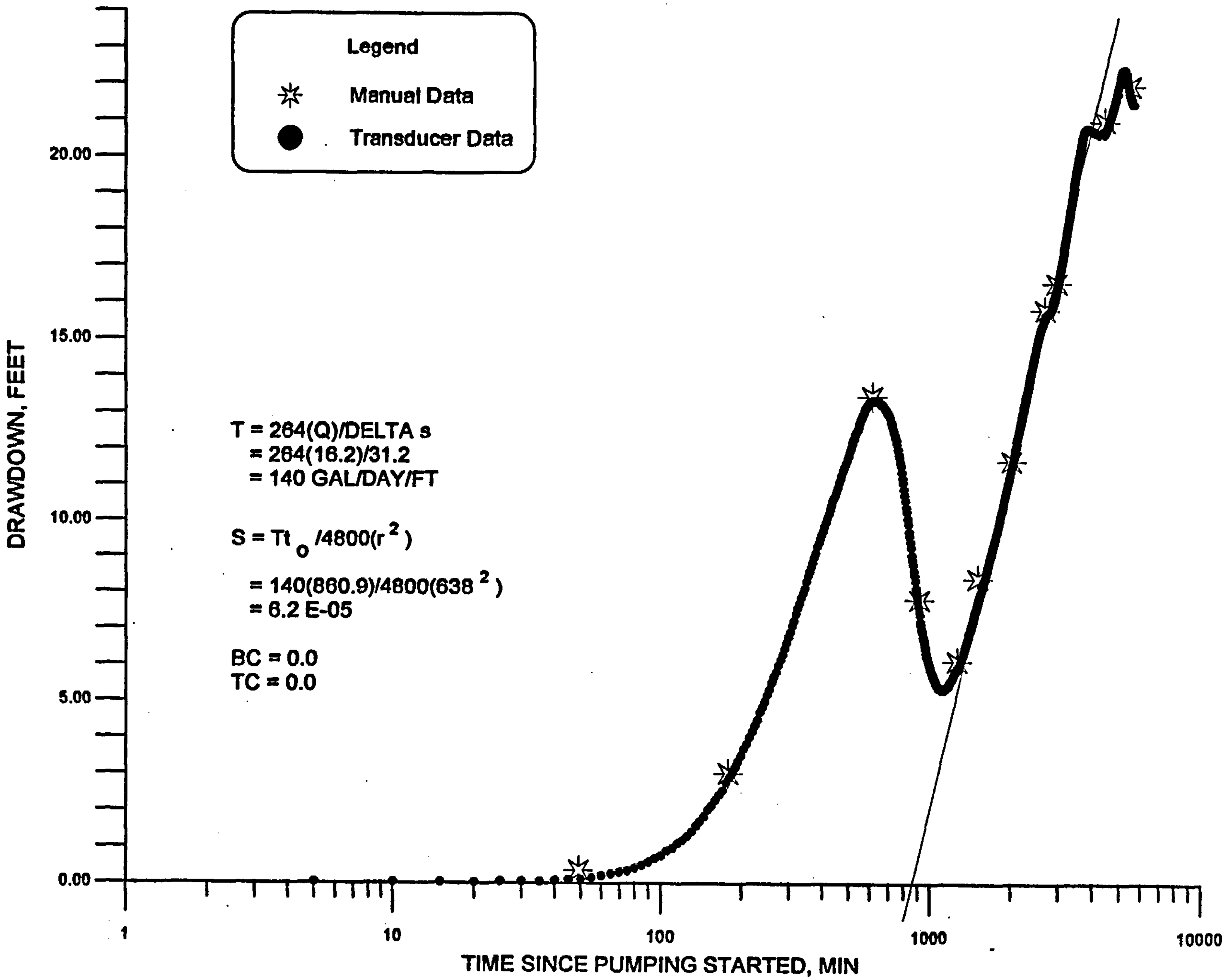


FIGURE K.6-22B. DRAWDOWN IN OBSERVATION WELL M436, SEMI-LOG.

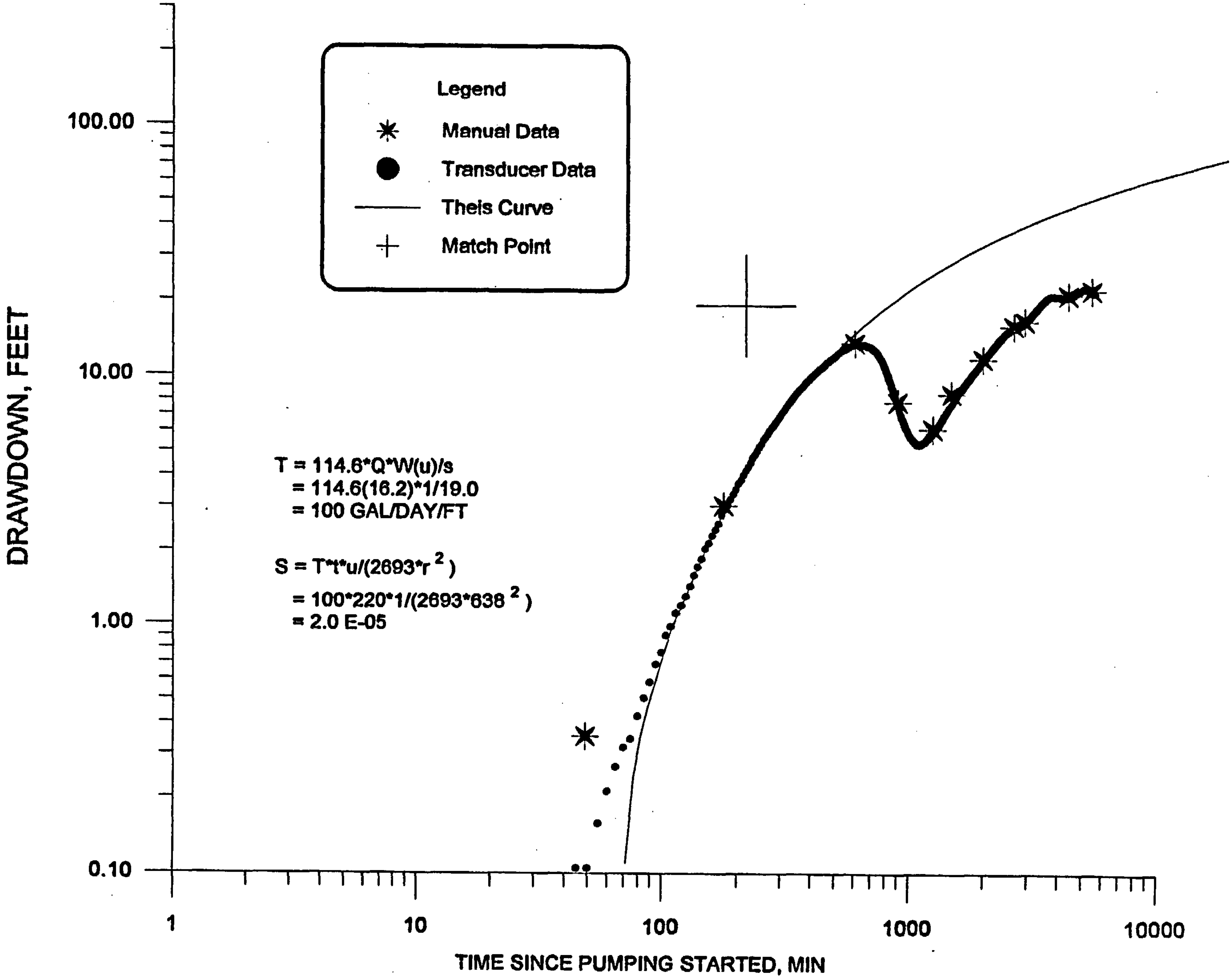


FIGURE K.6-22C. DRAWDOWN IN OBSERVATION WELL M436, LOG-LOG.

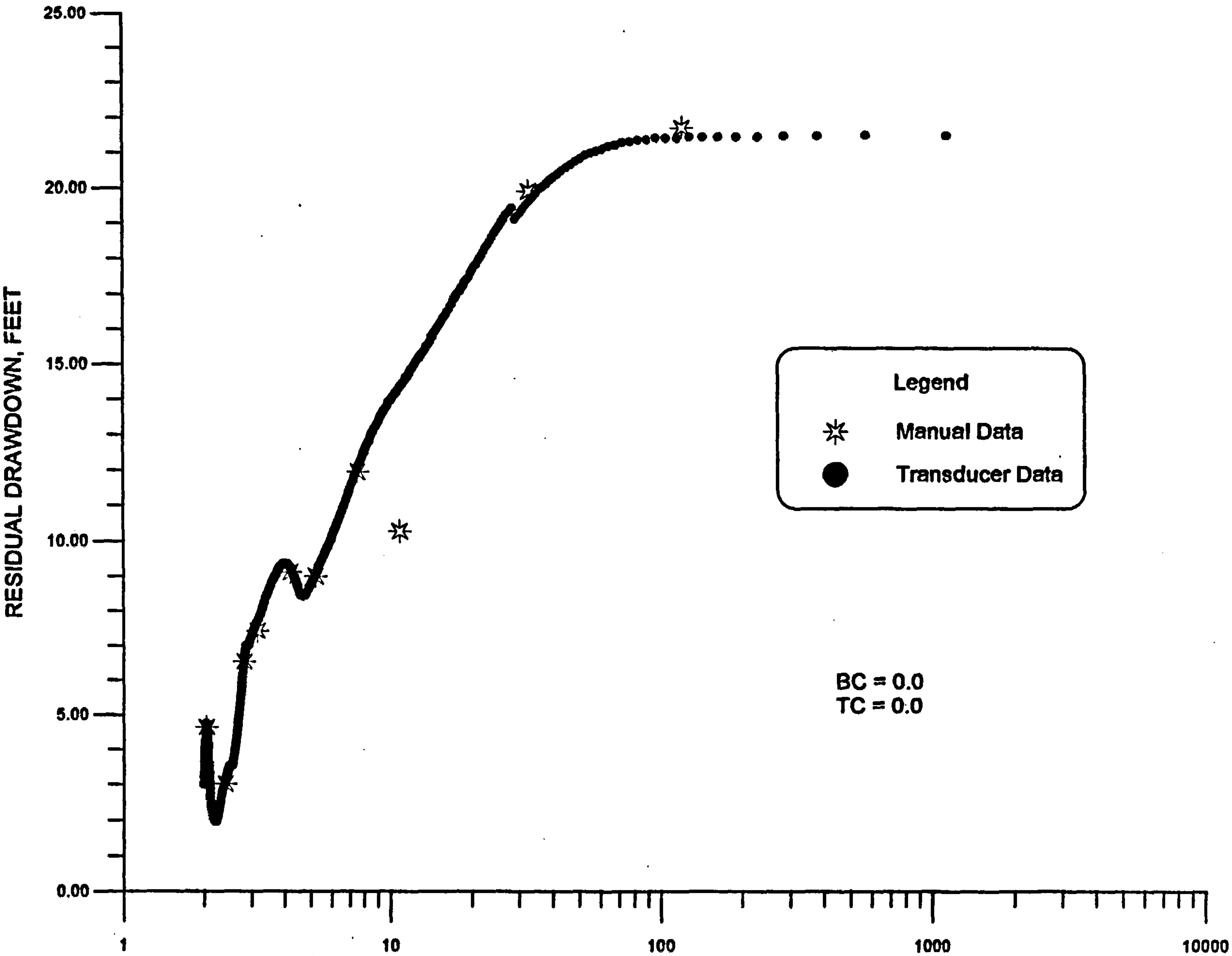
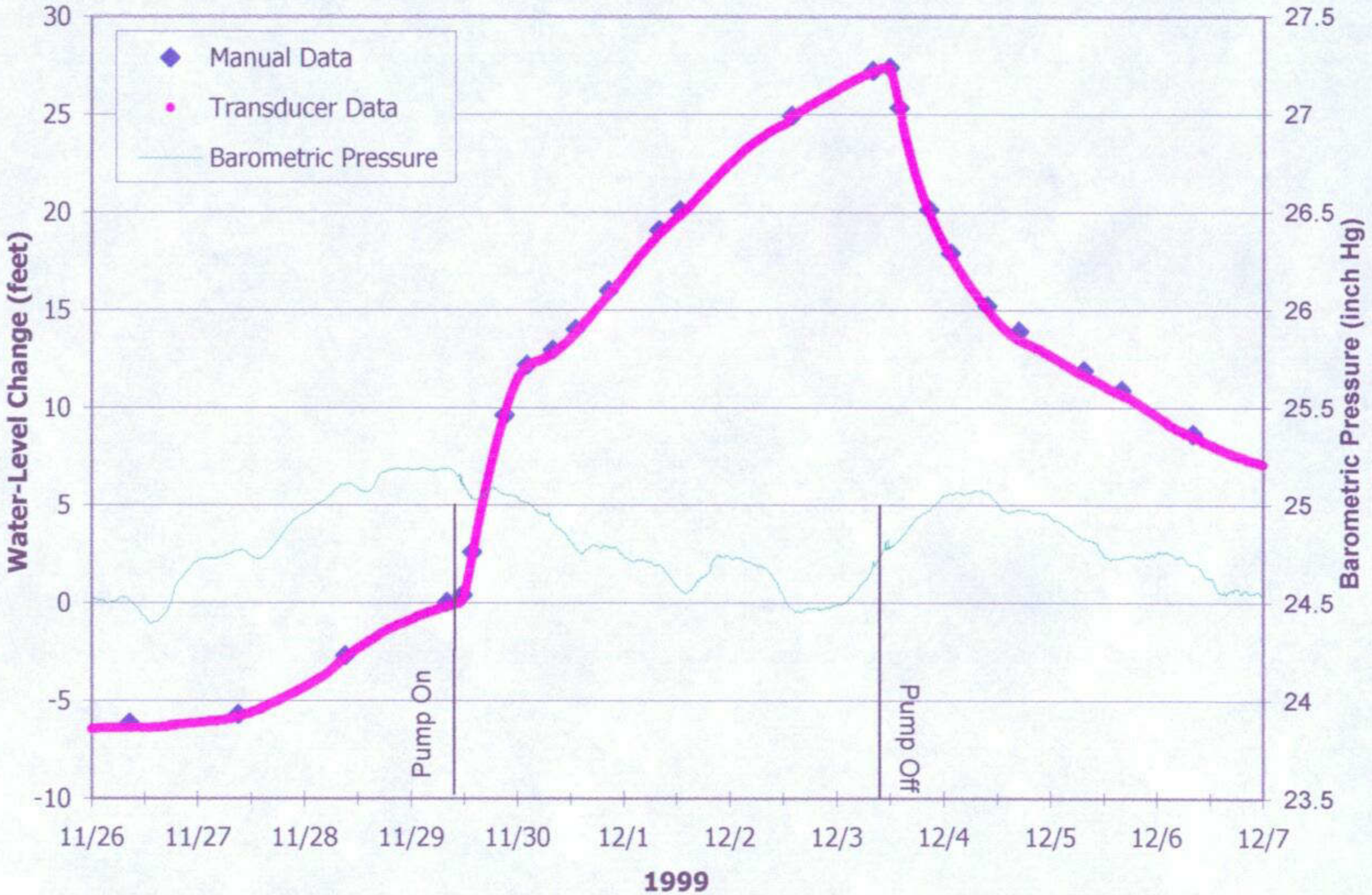


FIGURE K.6-22D. RECOVERY IN OBSERVATION WELL M436.

FIGURE K.6-23A. WATER-LEVEL CHANGE IN OBSERVATION WELL M437



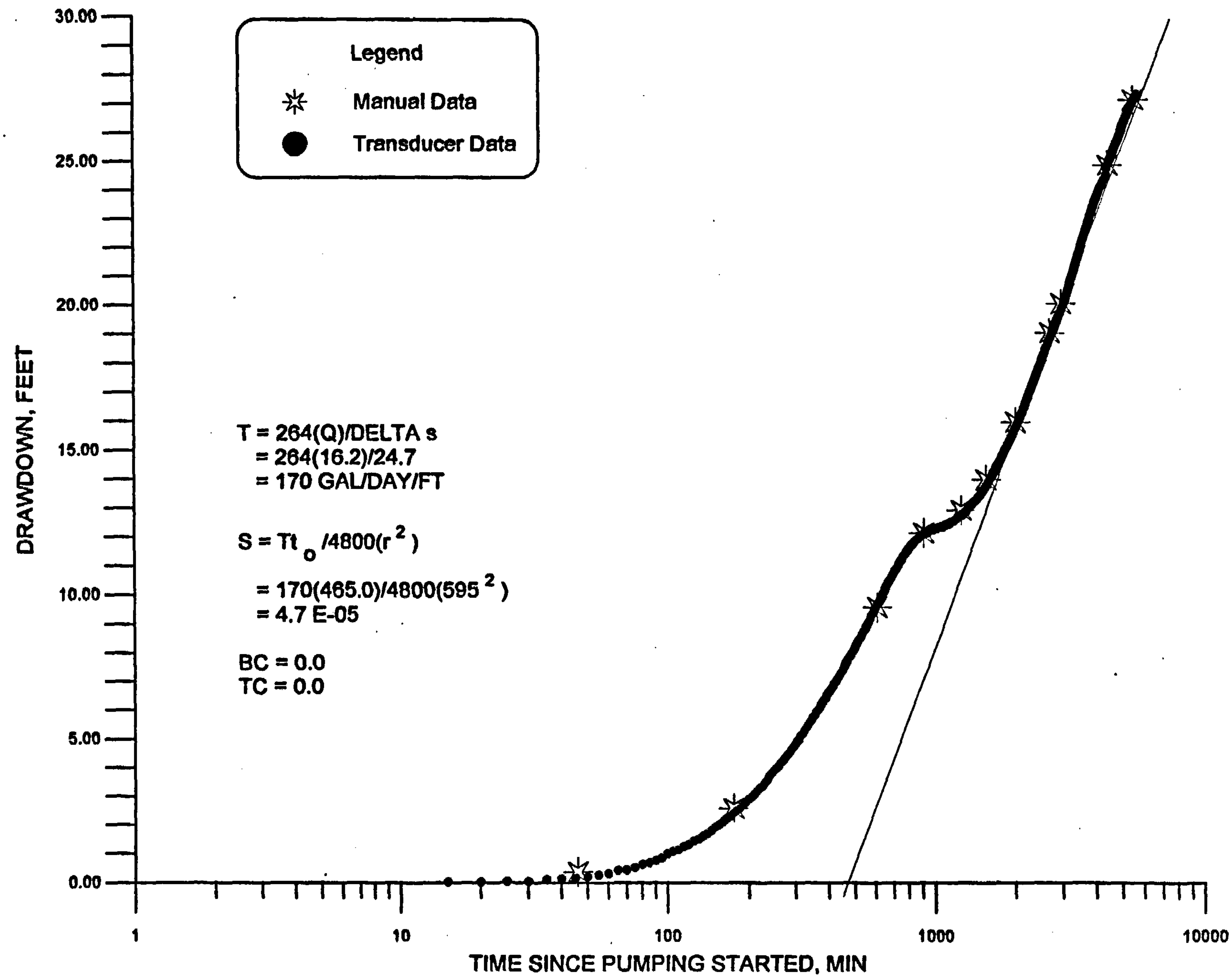


FIGURE K.6-23B. DRAWDOWN IN OBSERVATION WELL M437, SEMI-LOG.

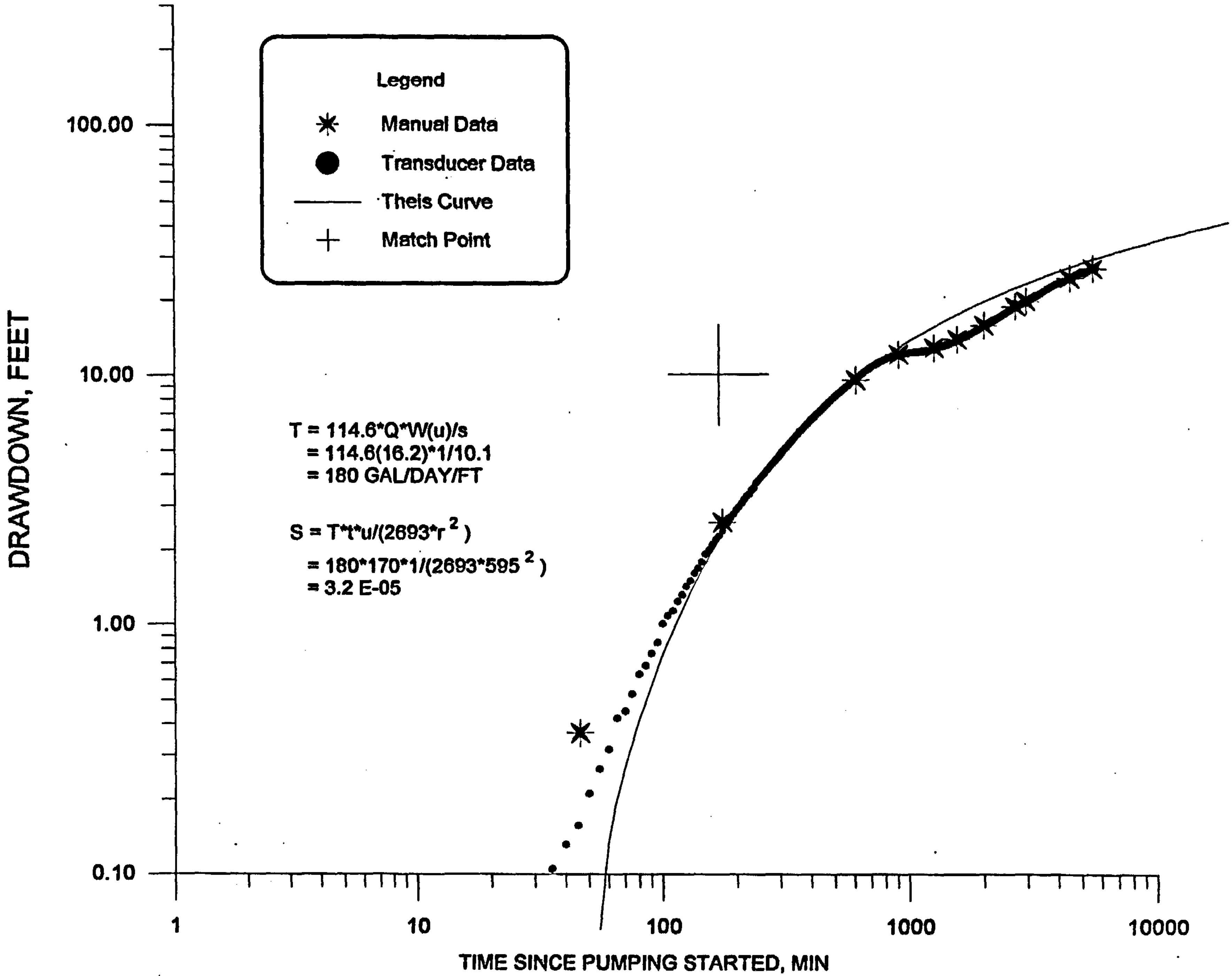


FIGURE K.6-23C. DRAWDOWN IN OBSERVATION WELL M437, LOG-LOG.

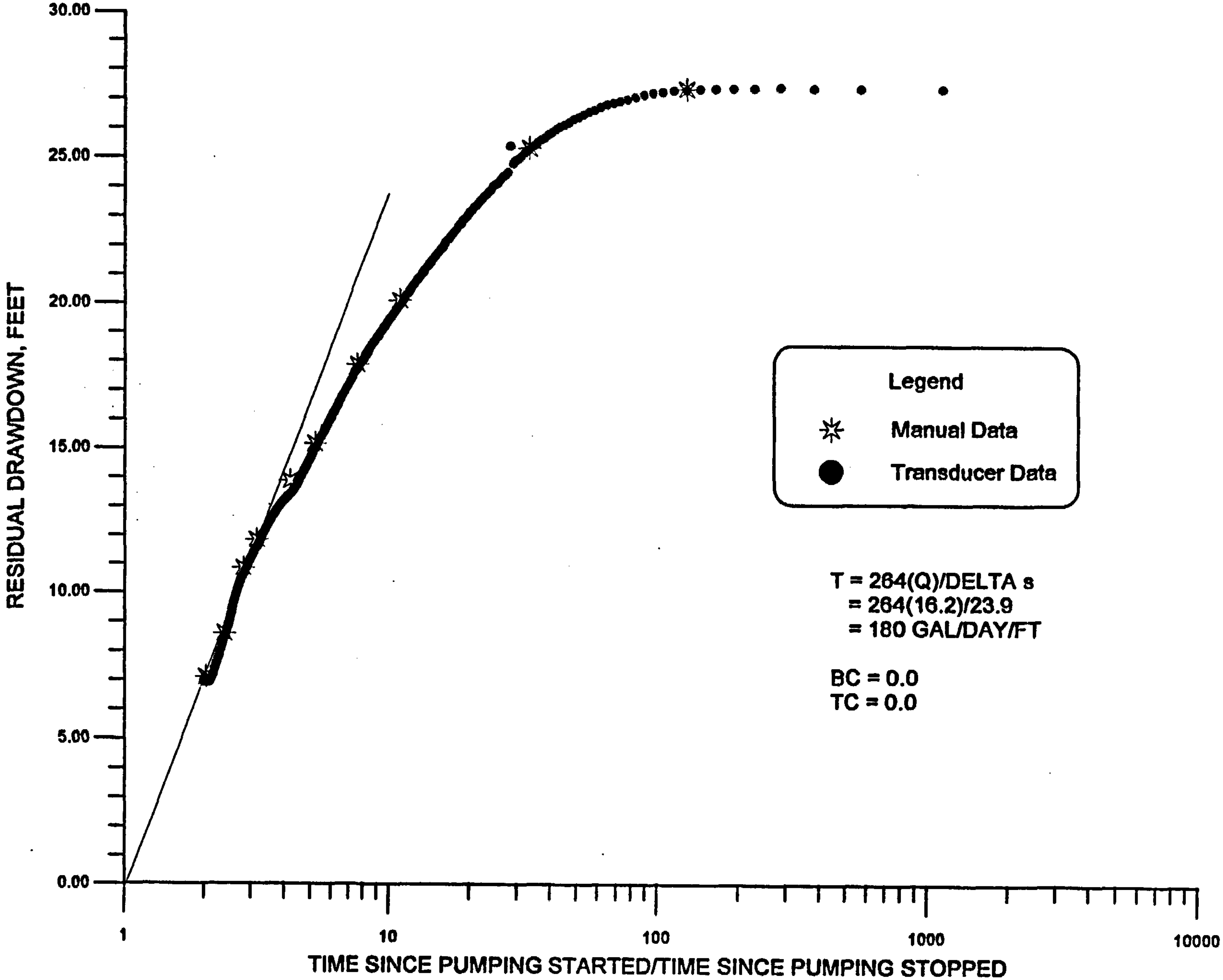
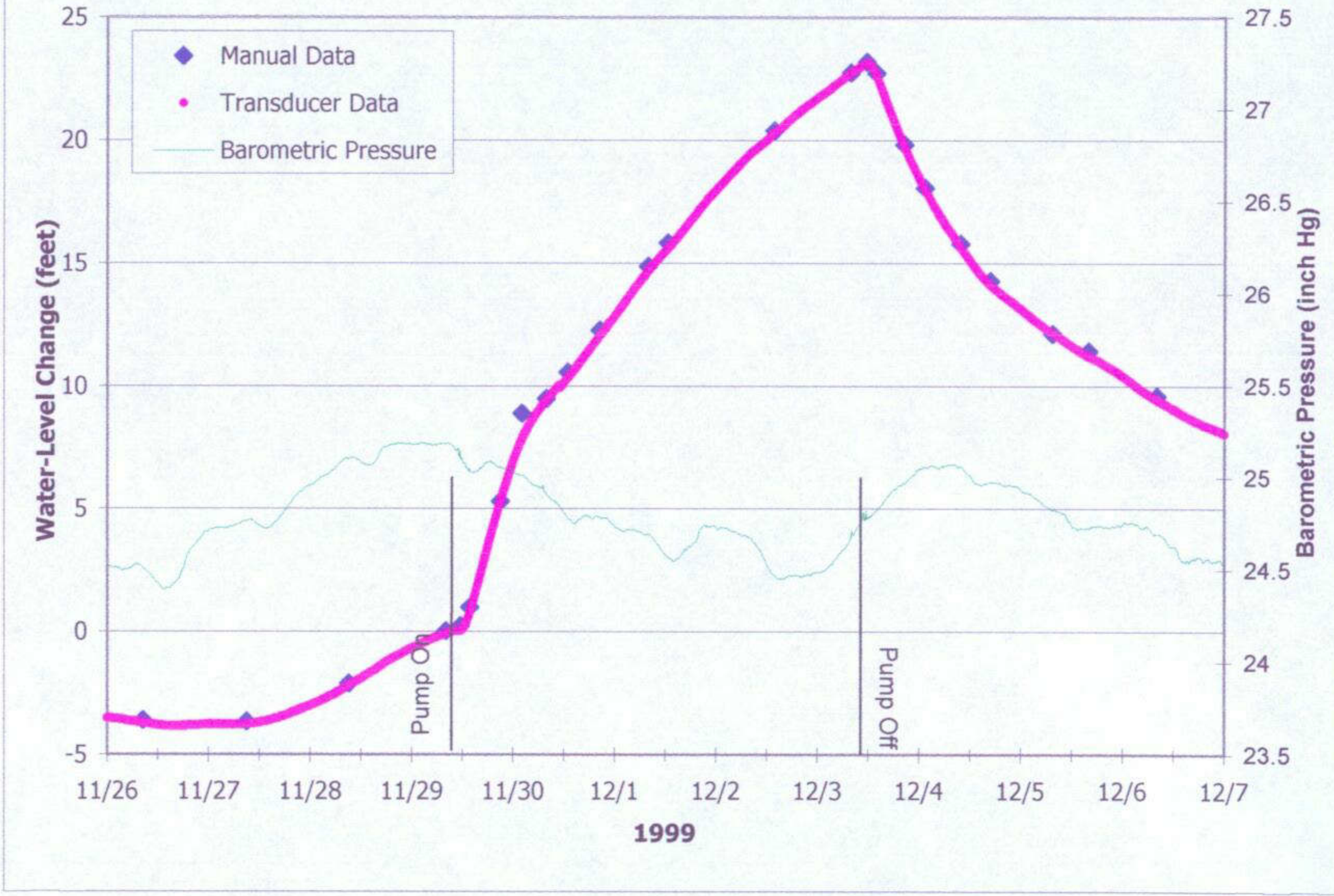


FIGURE K.6-23D. RECOVERY IN OBSERVATION WELL M437.

FIGURE K.6-24A. WATER-LEVEL CHANGE IN OBSERVATION WELL M438



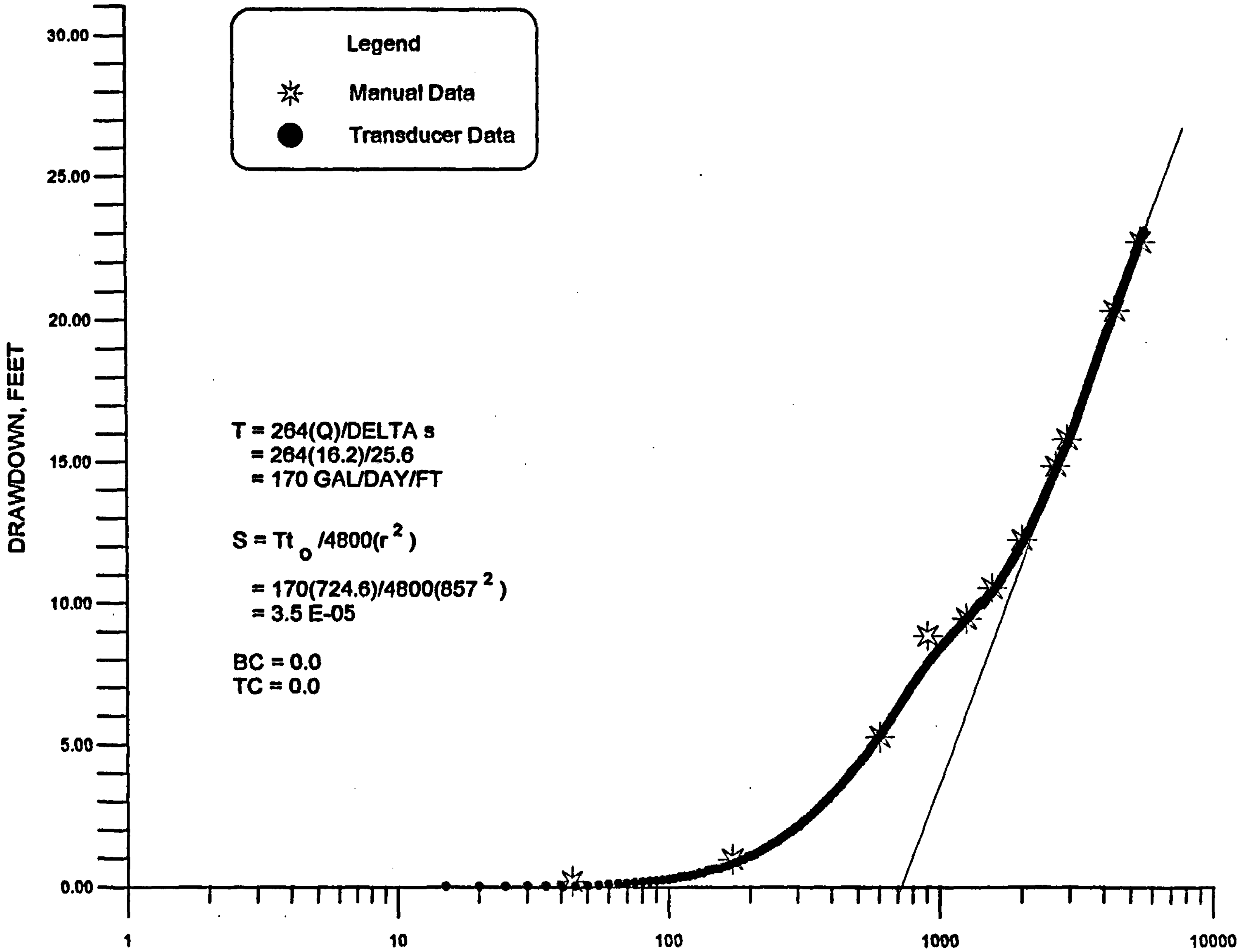


FIGURE K.6-24B. DRAWDOWN IN OBSERVATION WELL M438, SEMI-LOG.

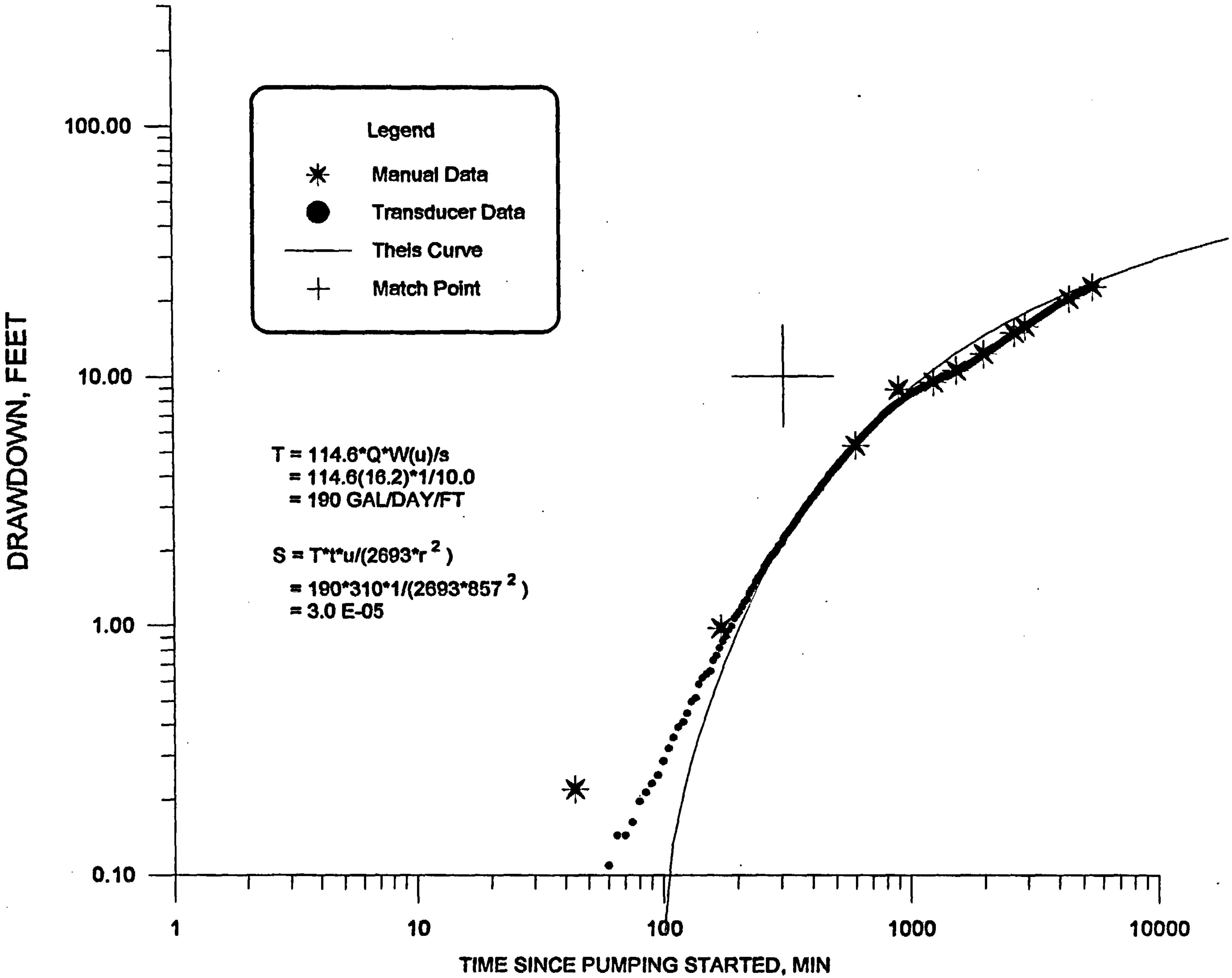


FIGURE K.6-24C. DRAWDOWN IN OBSERVATION WELL M438, LOG-LOG.

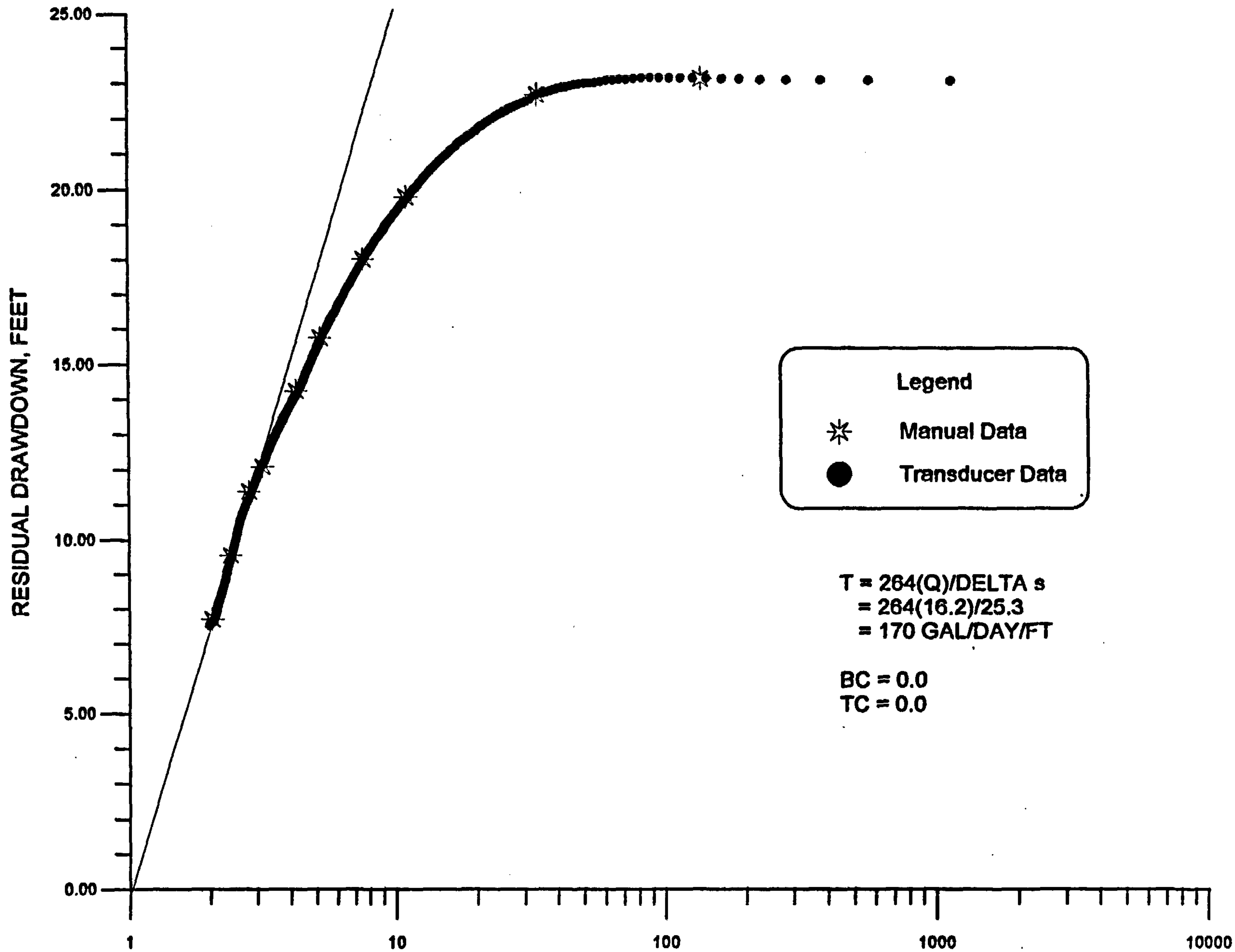


FIGURE K.6-24D. RECOVERY IN OBSERVATION WELL M438.

FIGURE K.6-25A. WATER-LEVEL CHANGE IN OBSERVATION WELL M439

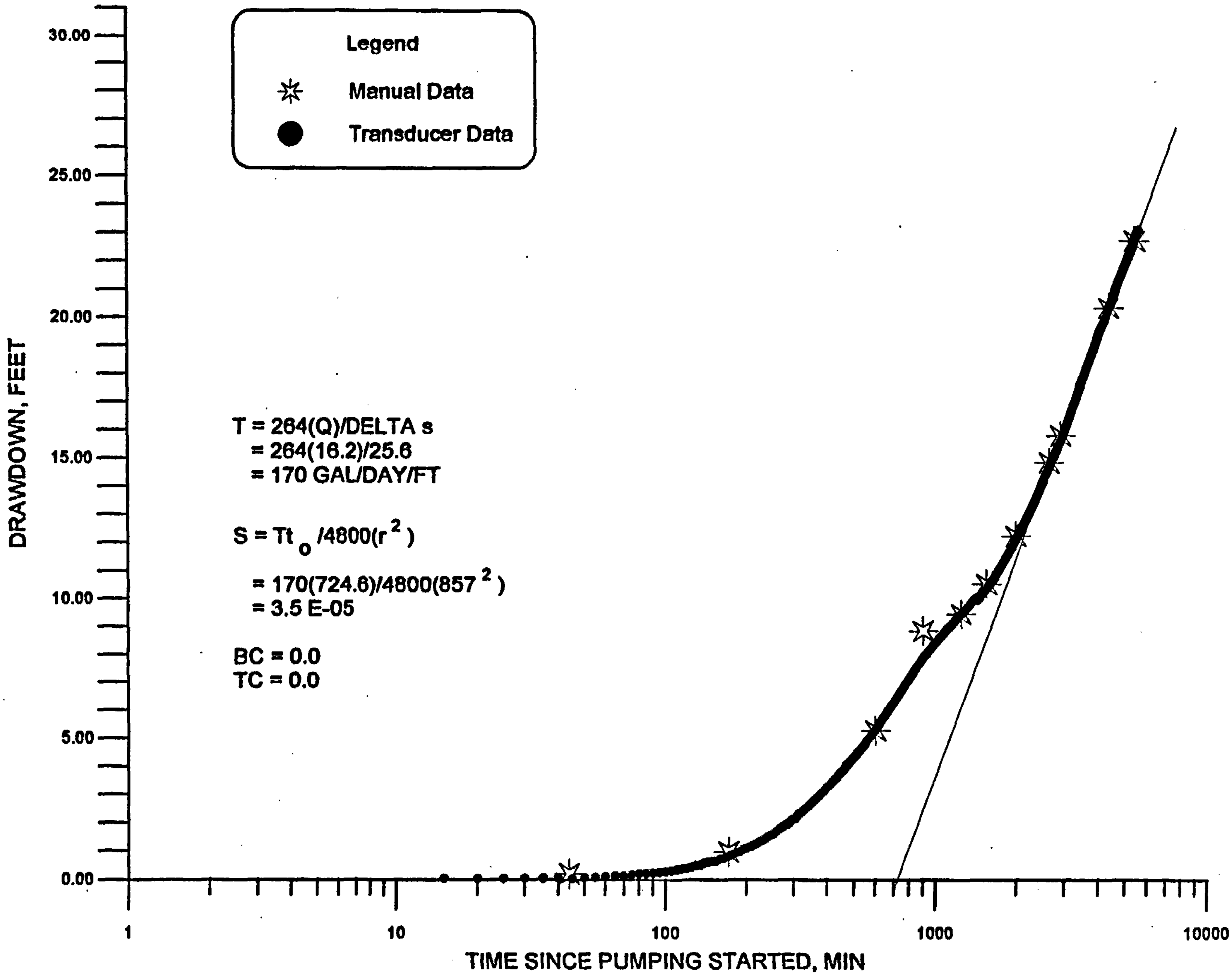


FIGURE K.6-25B. DRAWDOWN IN OBSERVATION WELL M439, SEMI-LOG.

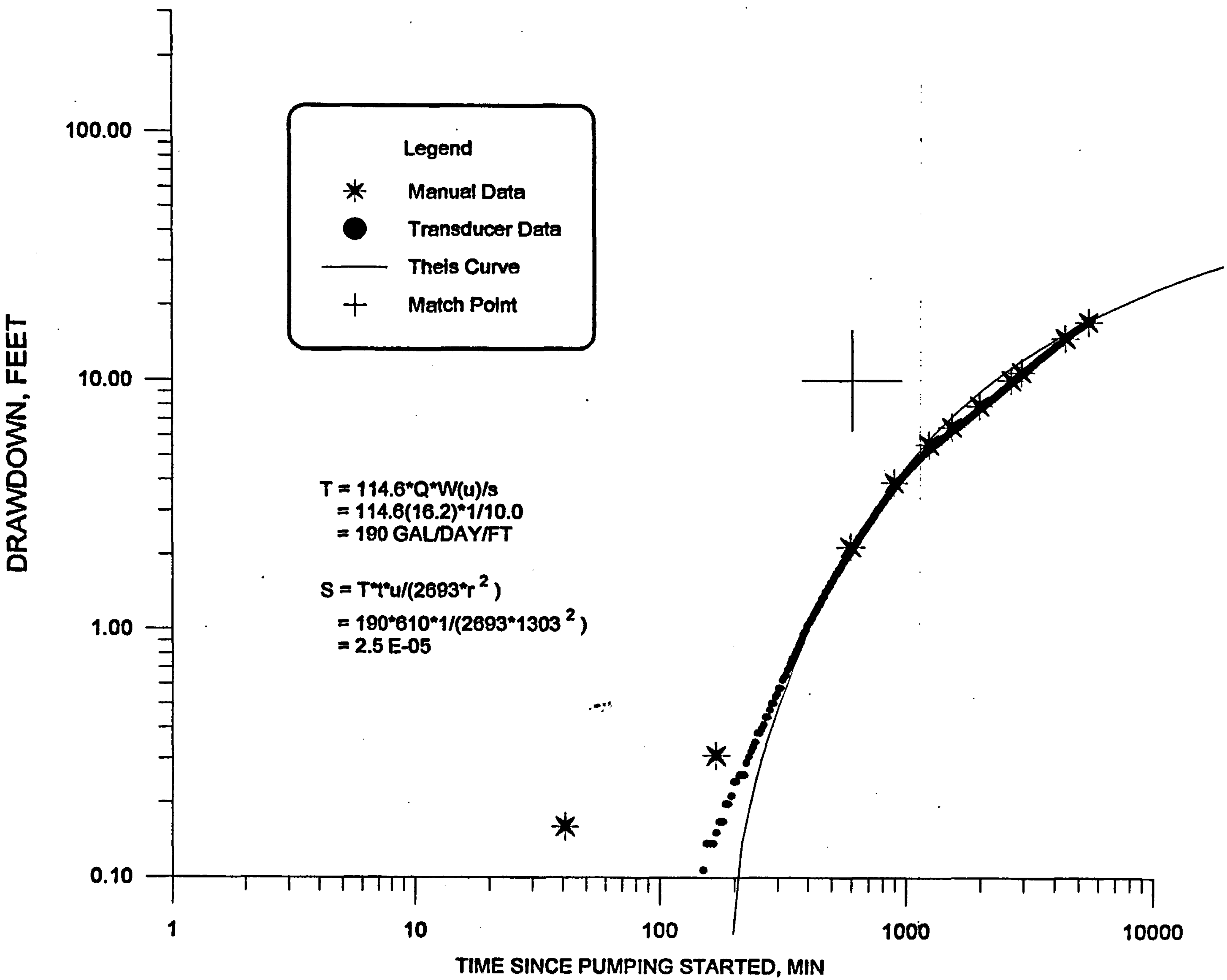


FIGURE K.6-25C. DRAWDOWN IN OBSERVATION WELL M439, LOG-LOG.

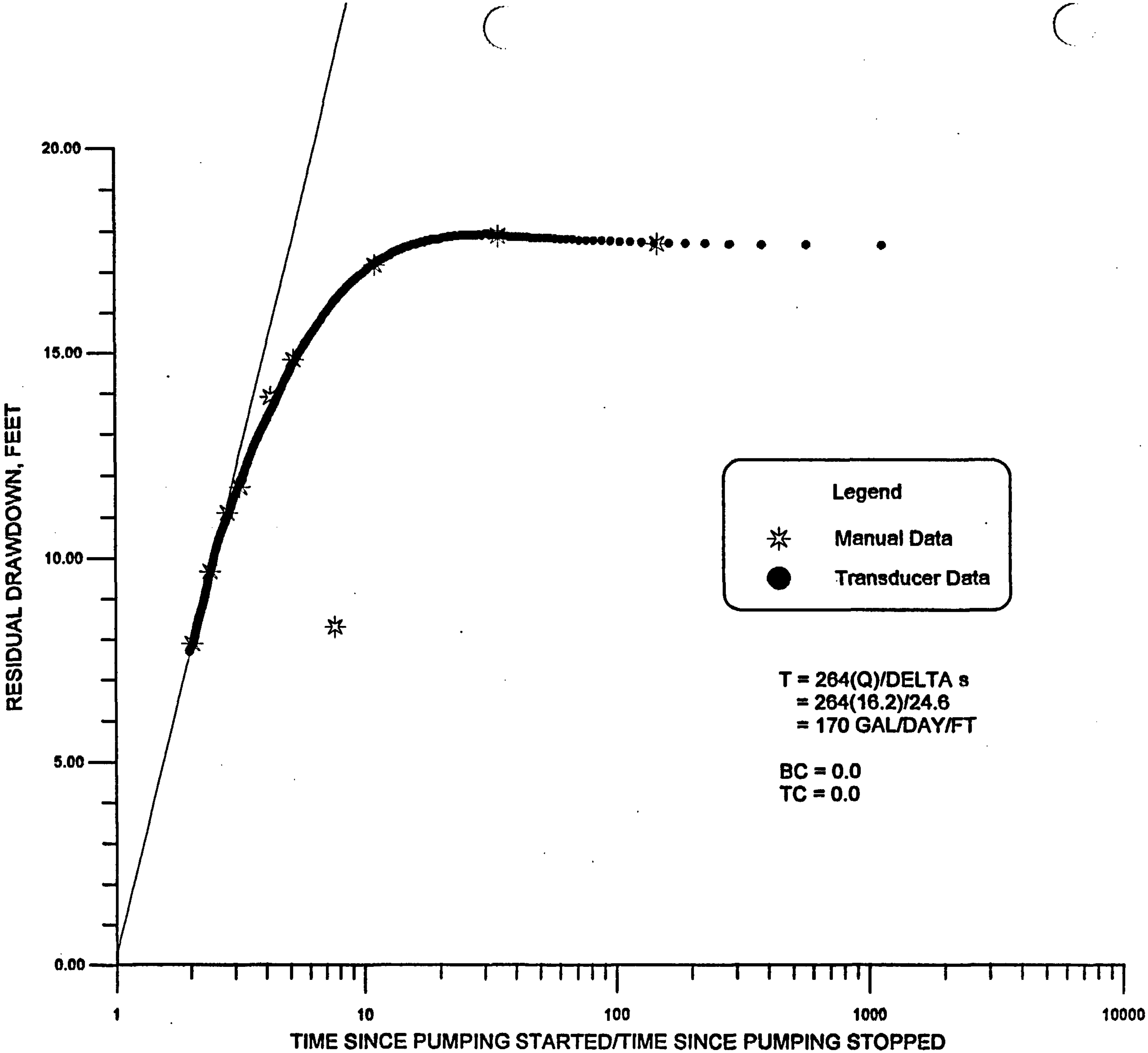
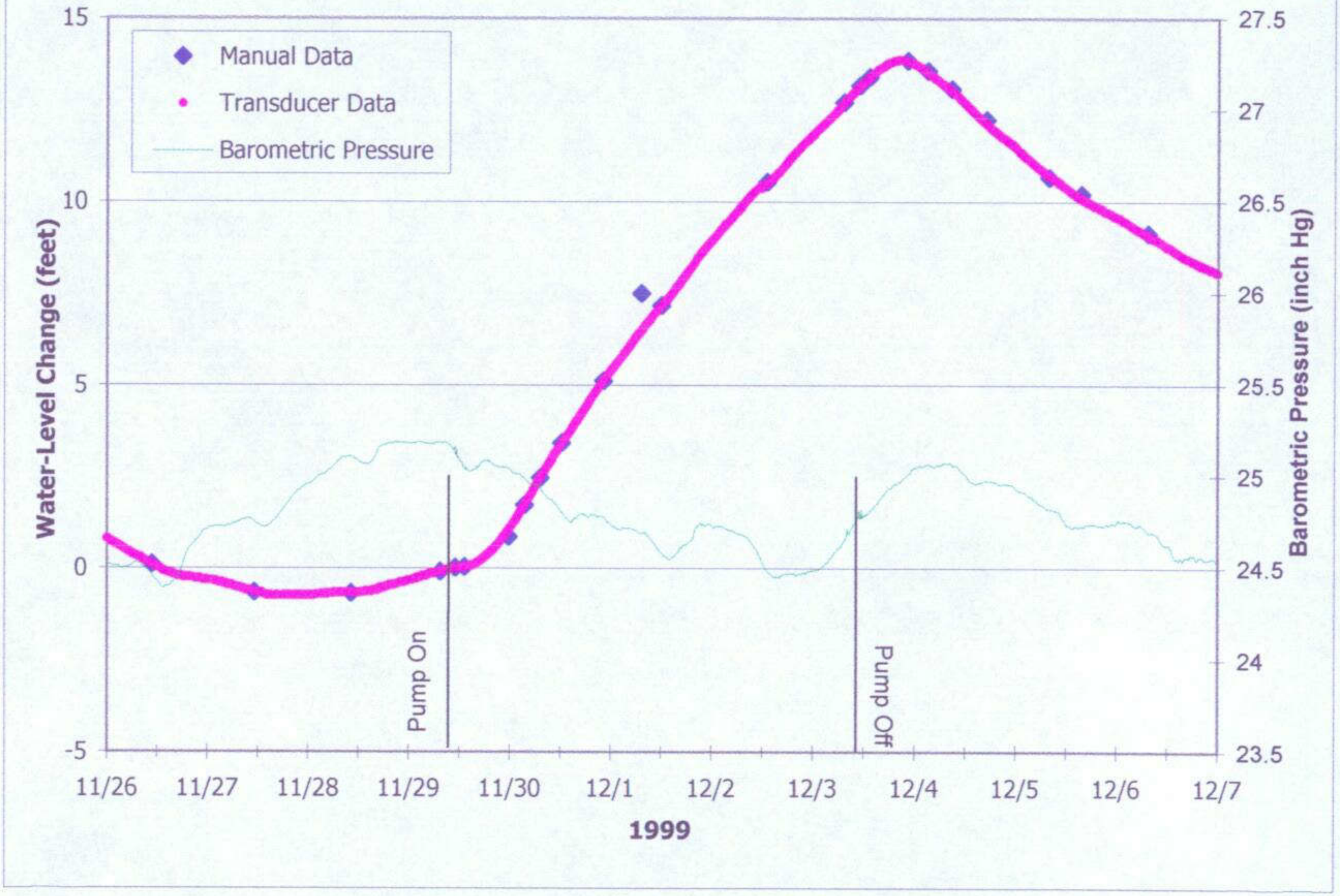


FIGURE K.6-25D. RECOVERY IN OBSERVATION WELL M439.

FIGURE K.6-26A. WATER-LEVEL CHANGE IN OBSERVATION WELL M453



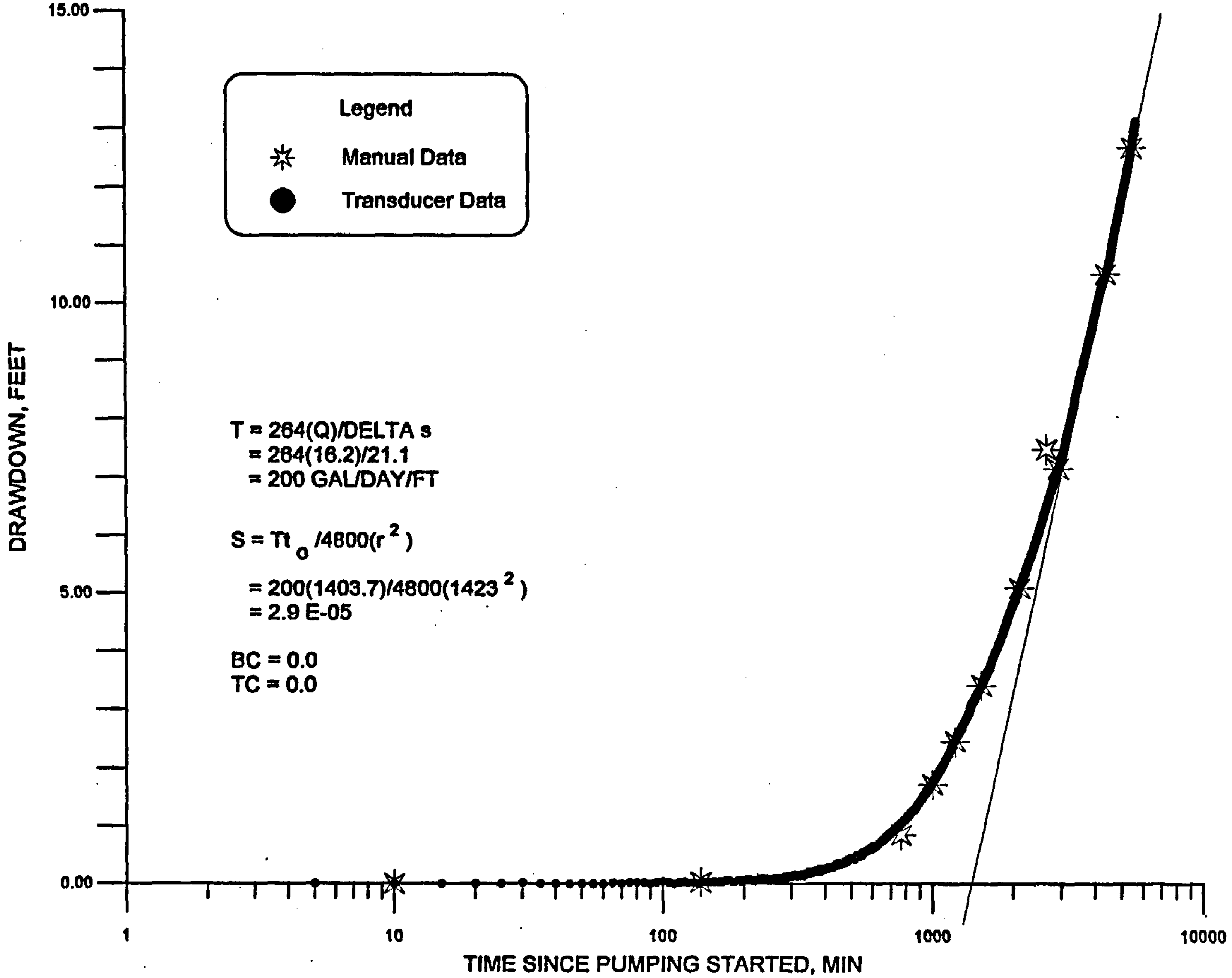


FIGURE K.6-26B. DRAWDOWN IN OBSERVATION WELL M453, SEMI-LOG.

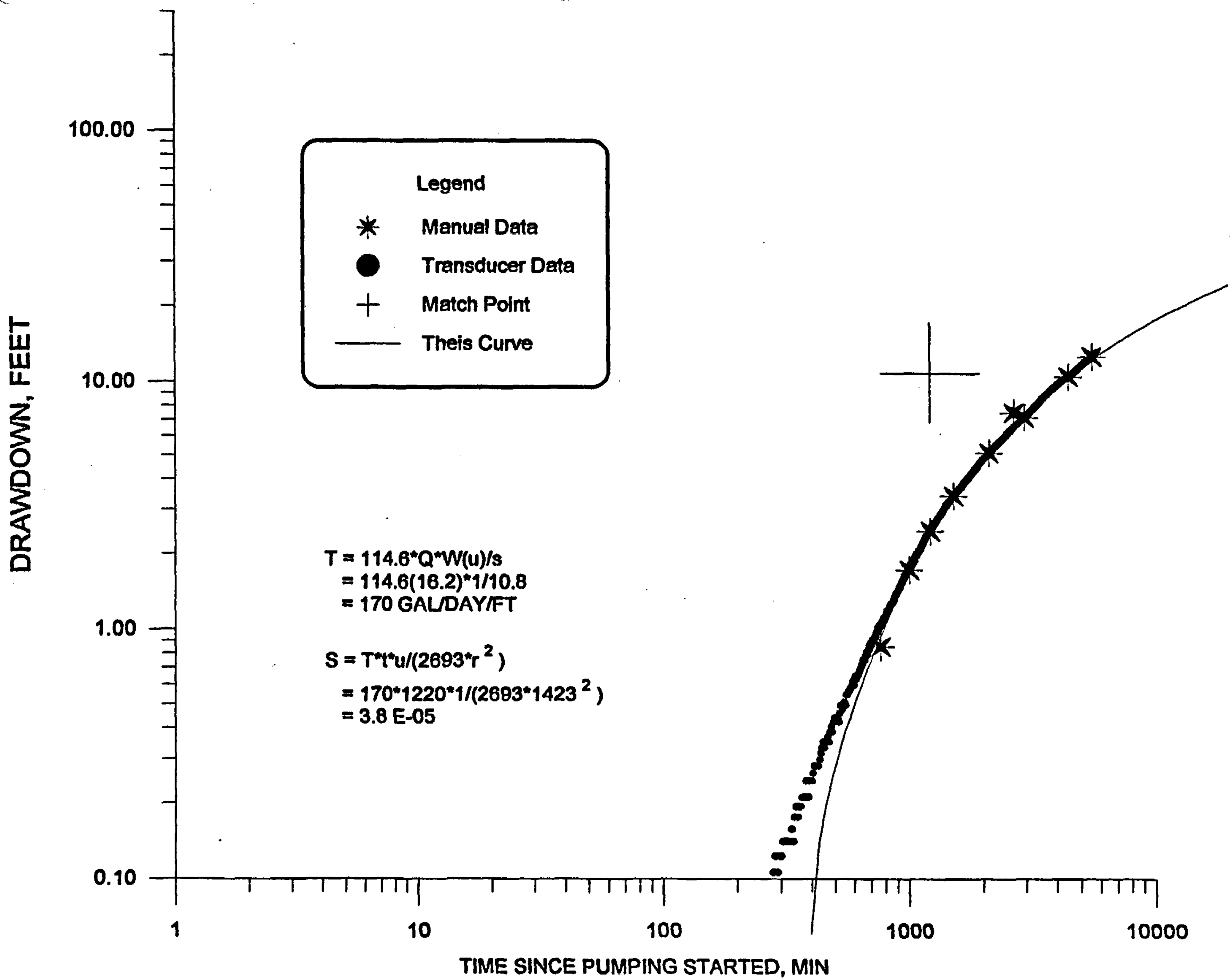


FIGURE K.6-26C. DRAWDOWN IN OBSERVATION WELL M453, LOG-LOG.

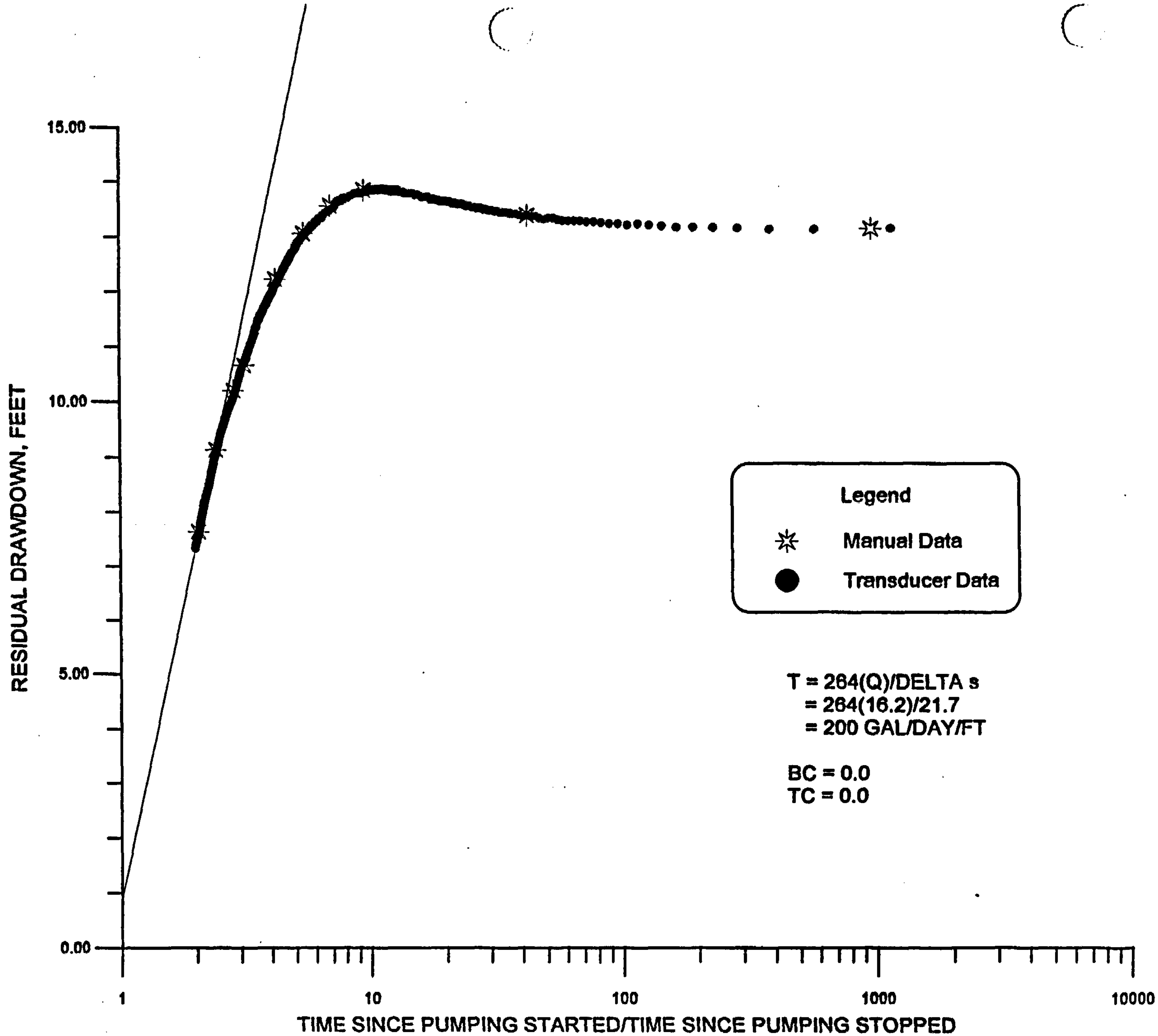
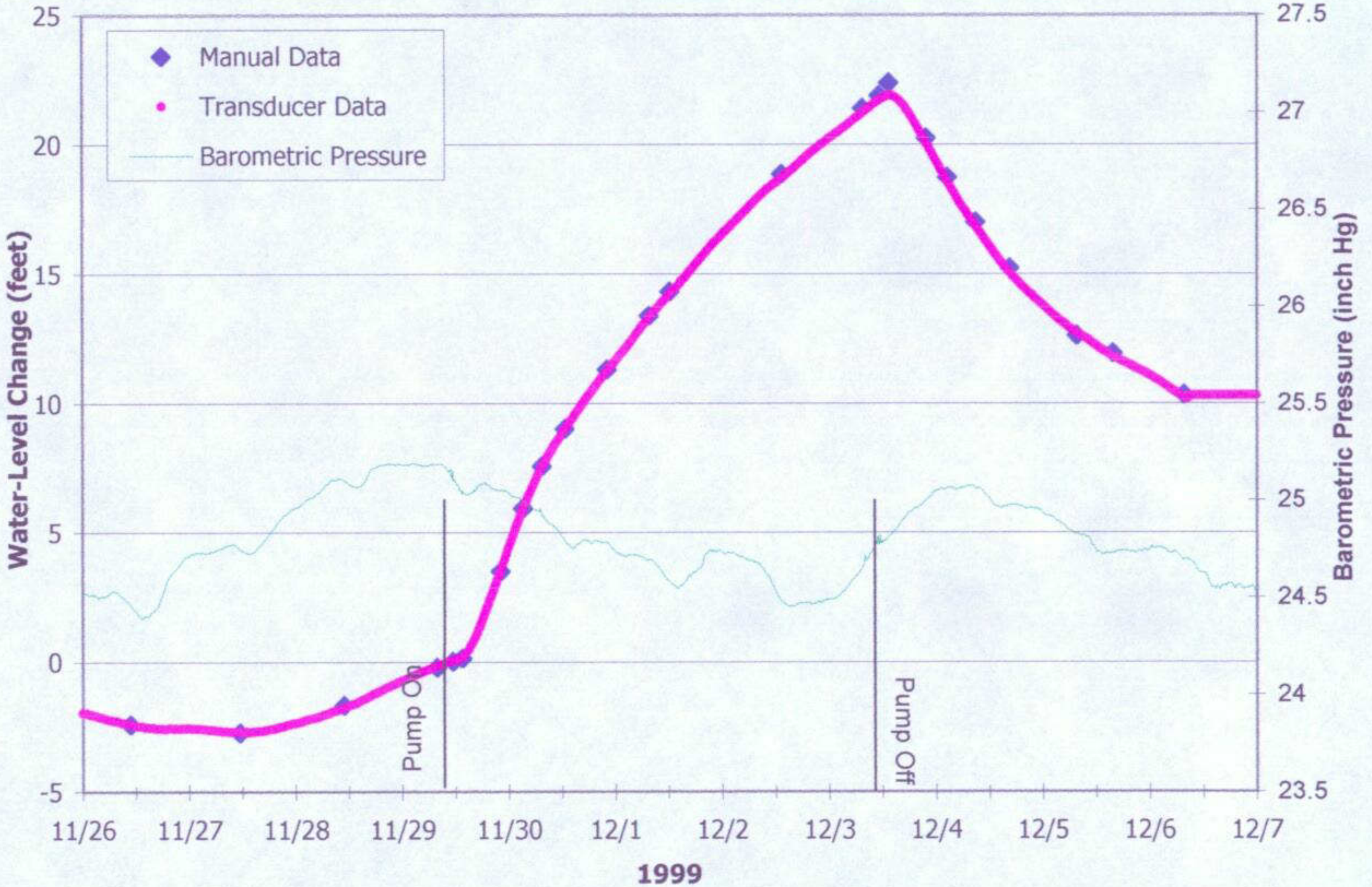


FIGURE K.6-26D. RECOVERY IN OBSERVATION WELL M453.

FIGURE K.6-27A. WATER-LEVEL CHANGE IN OBSERVATION WELL M454



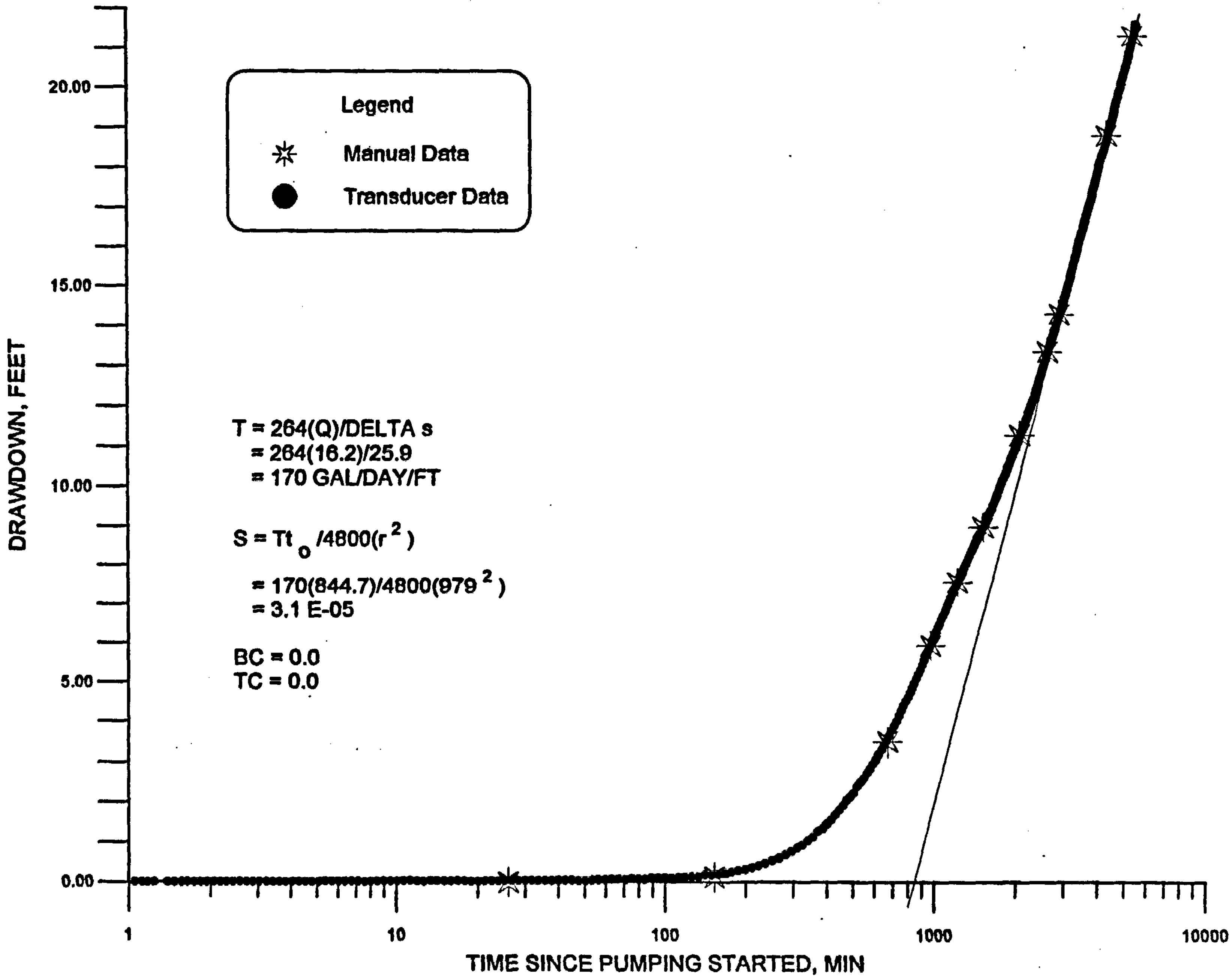


FIGURE K.6-27B. DRAWDOWN IN OBSERVATION WELL M454, SEMI-LOG.

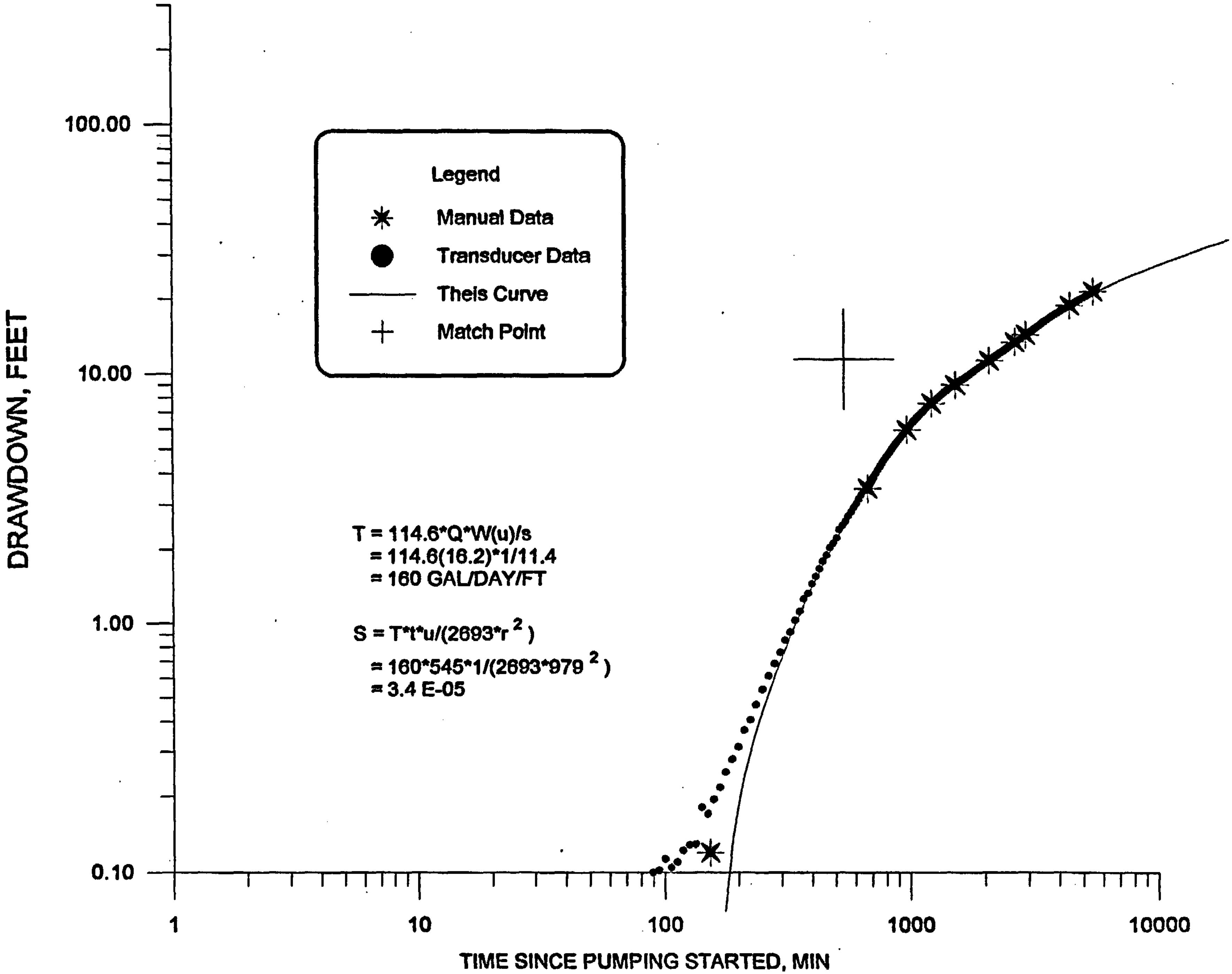


FIGURE K.6-27C. DRAWDOWN IN OBSERVATION WELL M454, LOG-LOG.

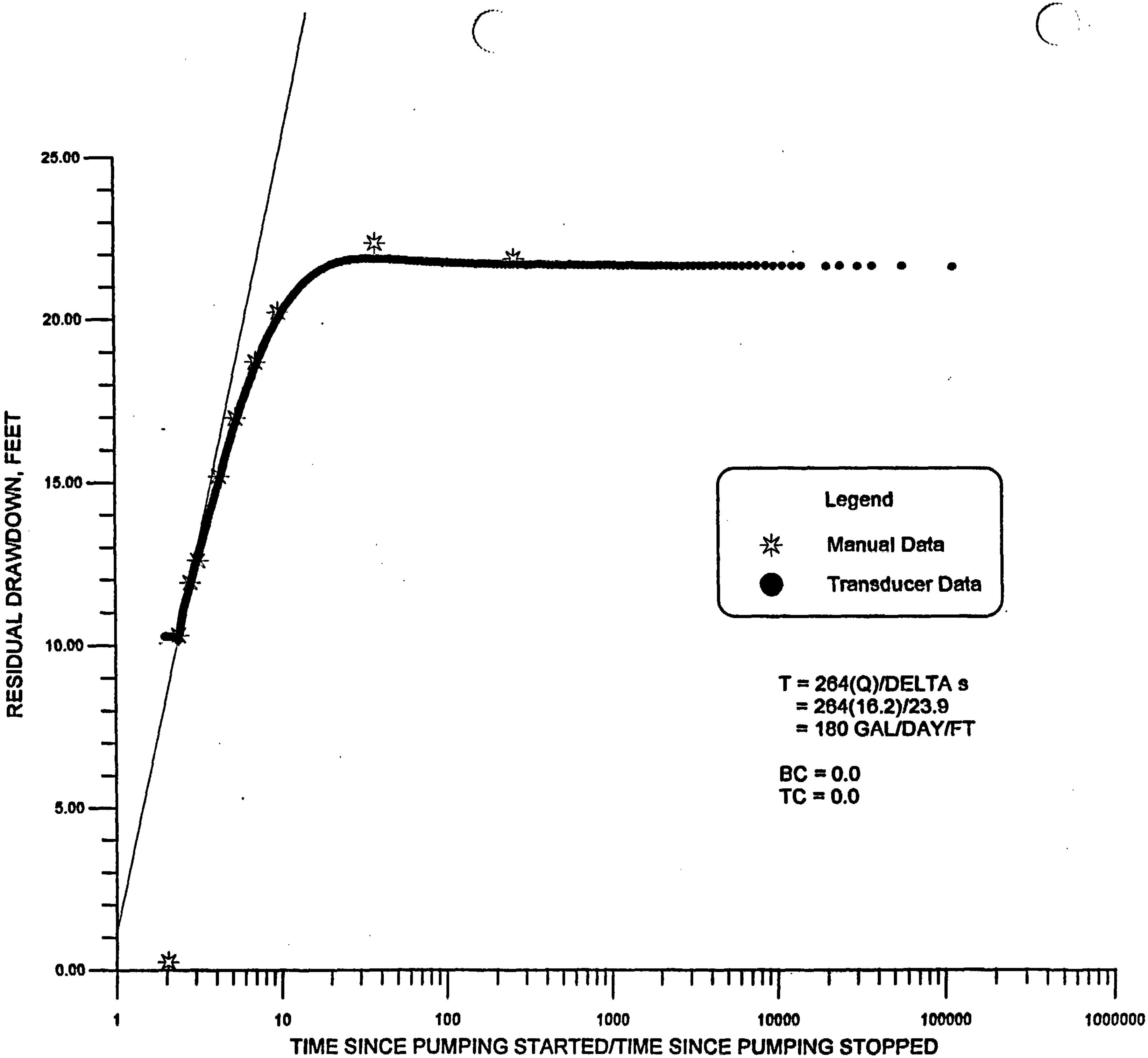
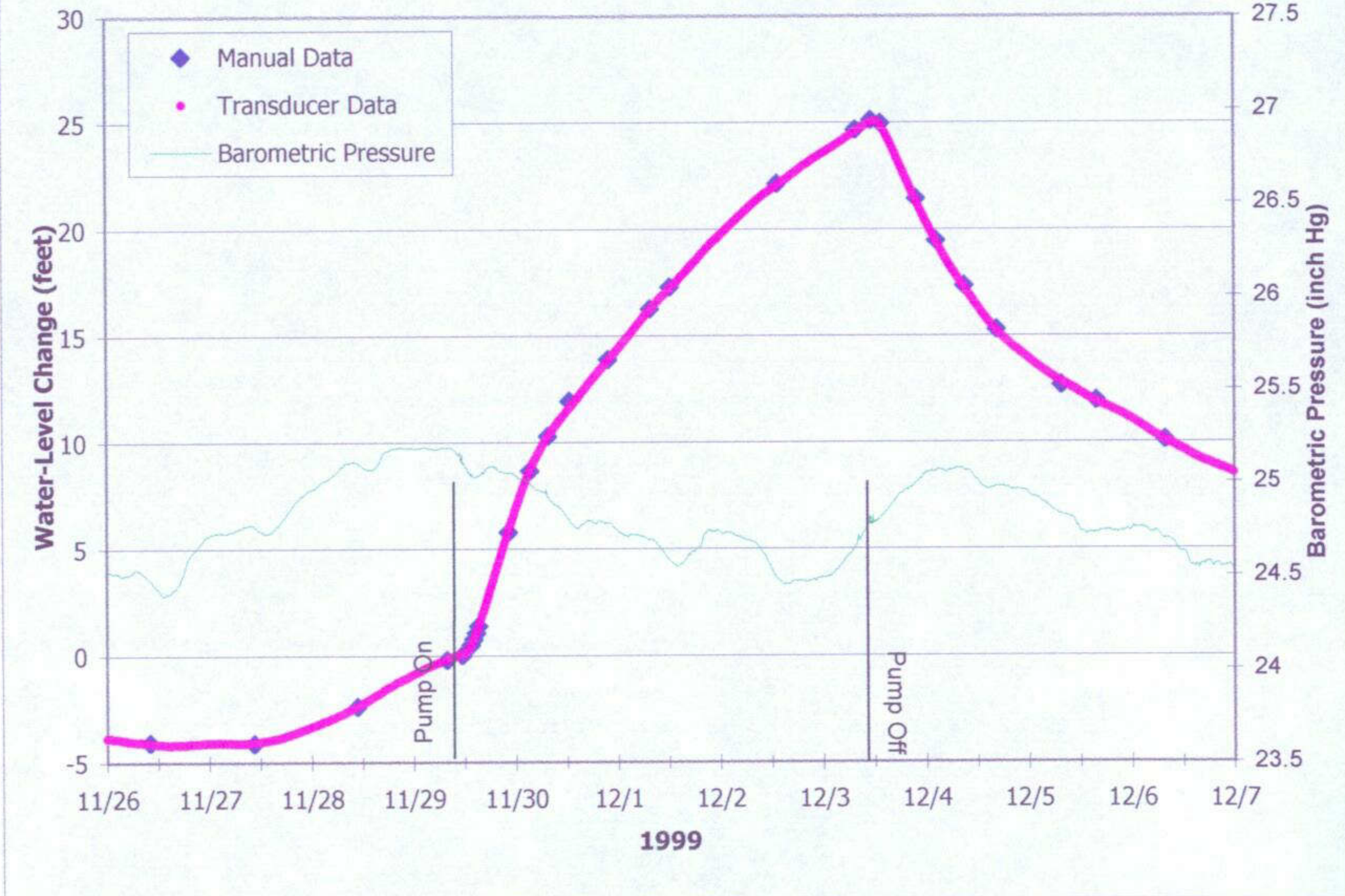


FIGURE K.6-27D. RECOVERY IN OBSERVATION WELL M454.

FIGURE K.6-28A. WATER-LEVEL CHANGE IN OBSERVATION WELL M455A



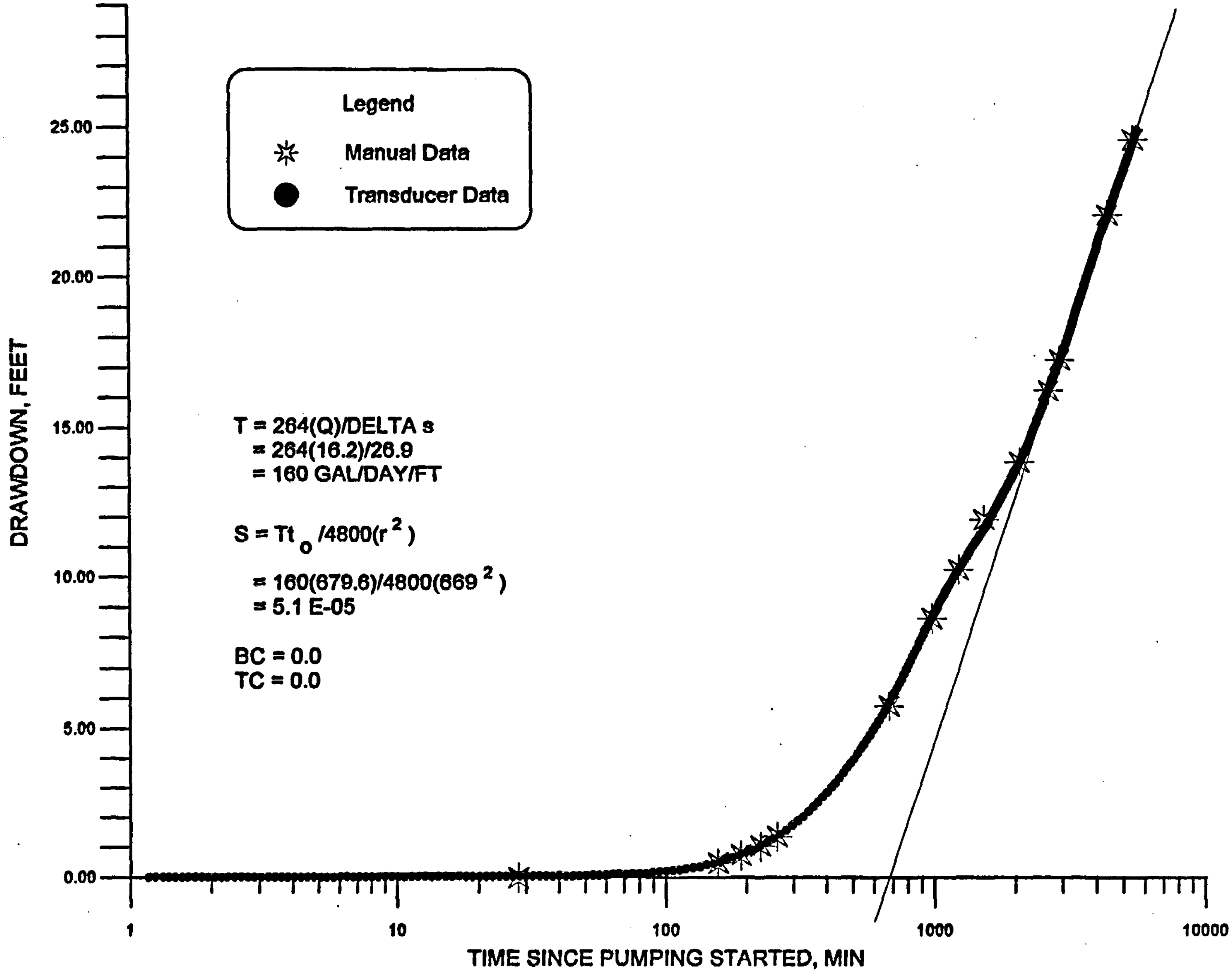


FIGURE K.6-28B. DRAWDOWN IN OBSERVATION WELL M455A, SEMI-LOG.

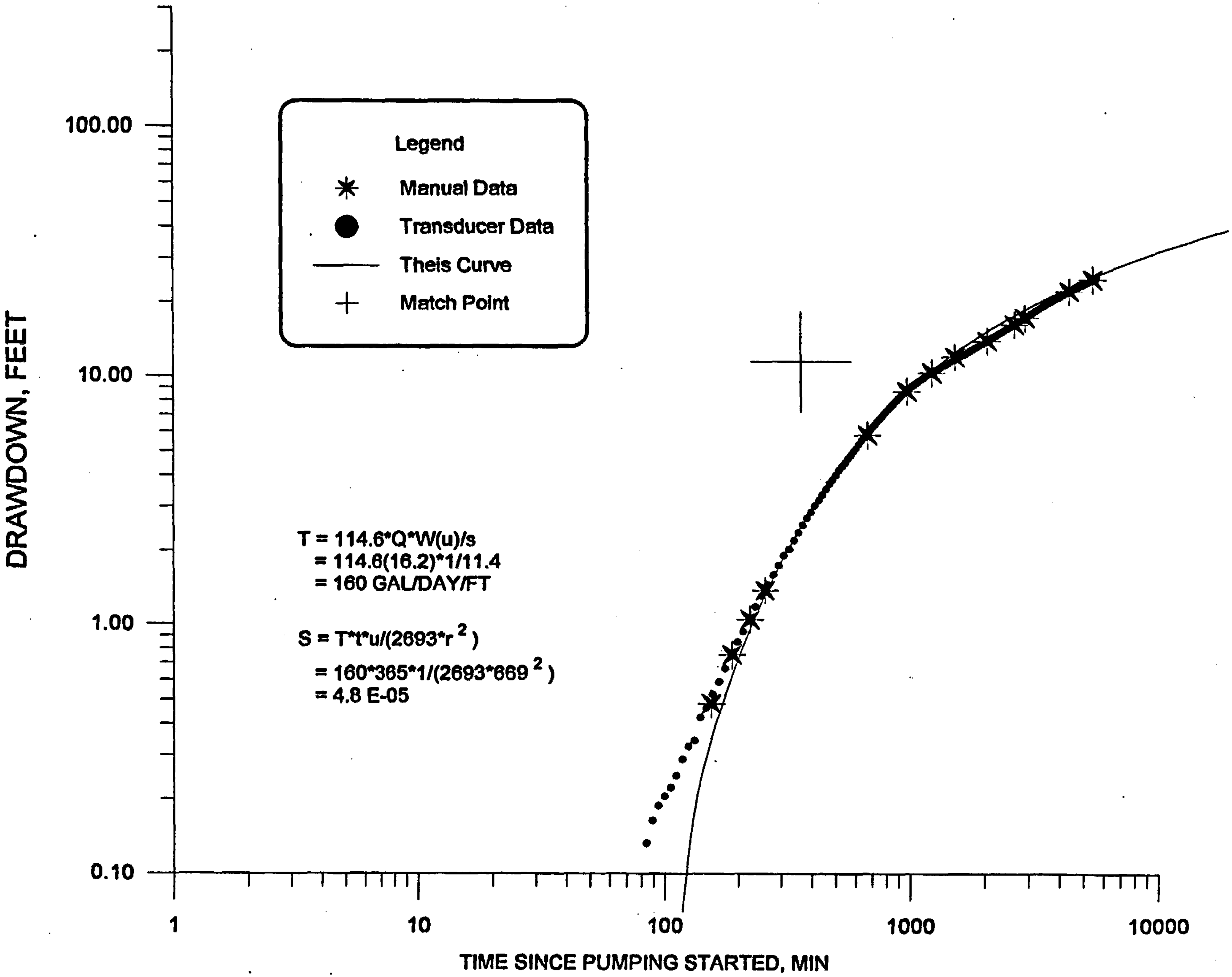


FIGURE K.6-28C. DRAWDOWN IN OBSERVATION WELL M455A, LOG-LOG.

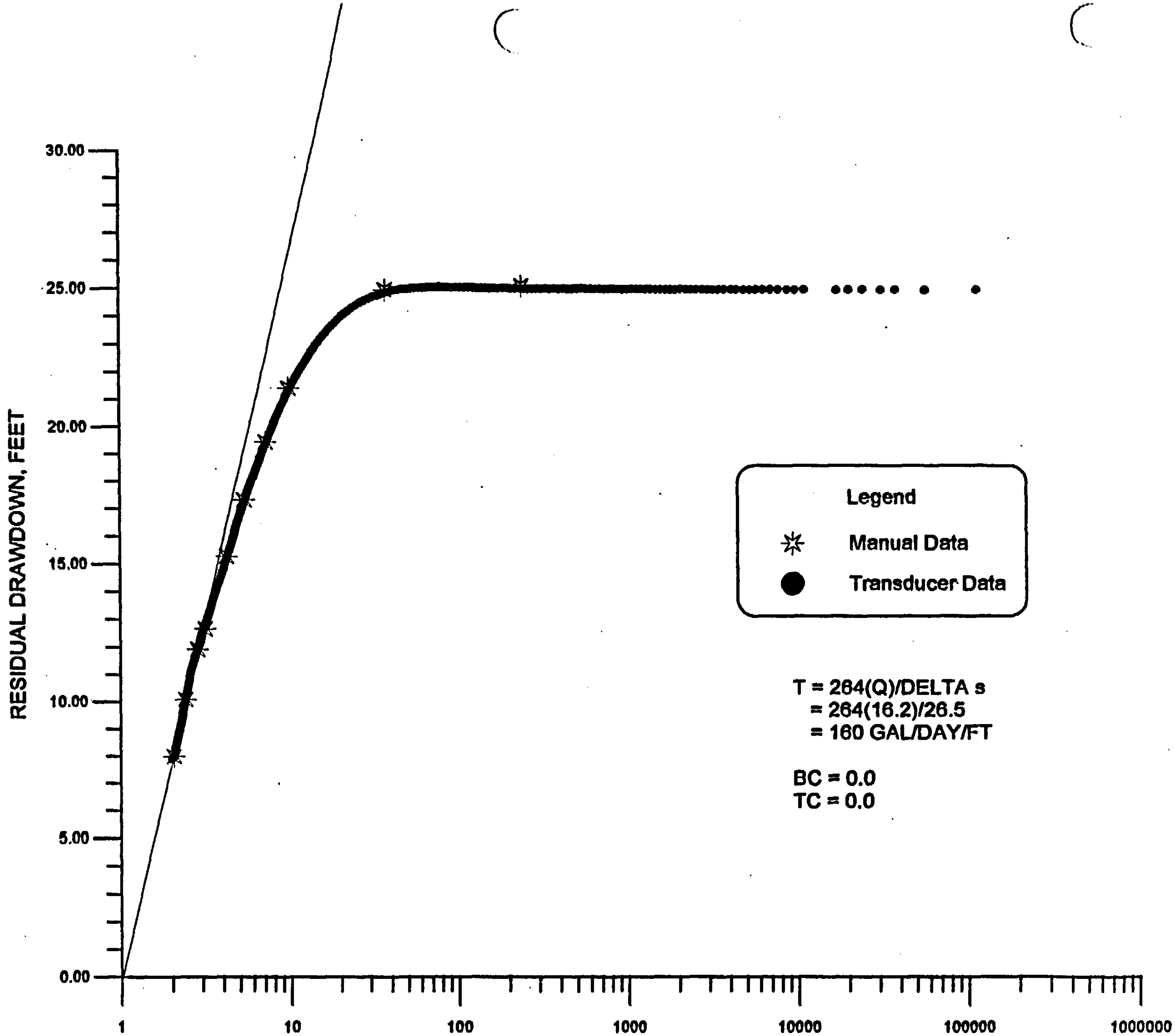
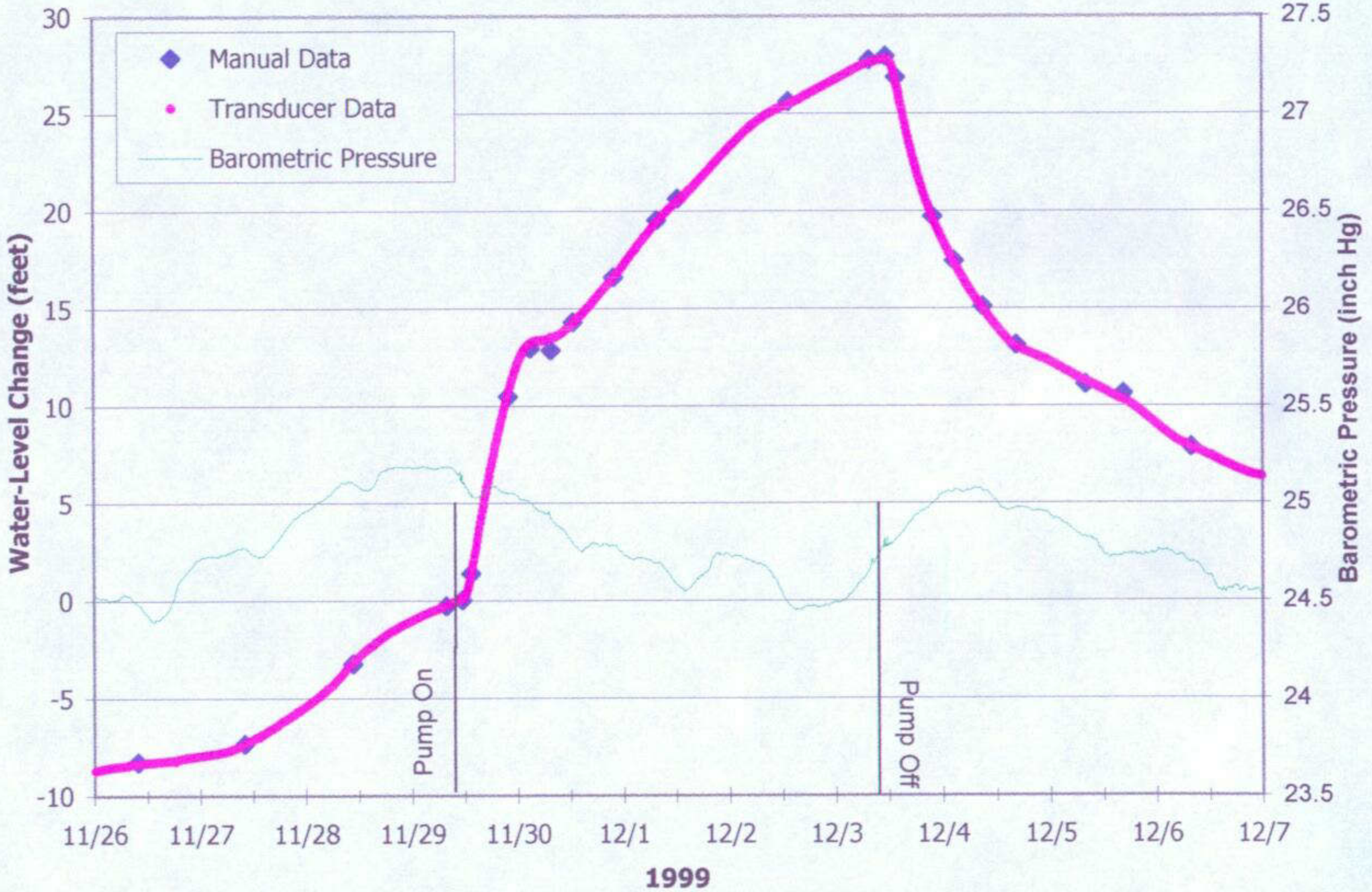


FIGURE K.6-28D. RECOVERY IN OBSERVATION WELL M455A.

FIGURE K.6-29A. WATER-LEVEL CHANGE IN OBSERVATION WELL M456



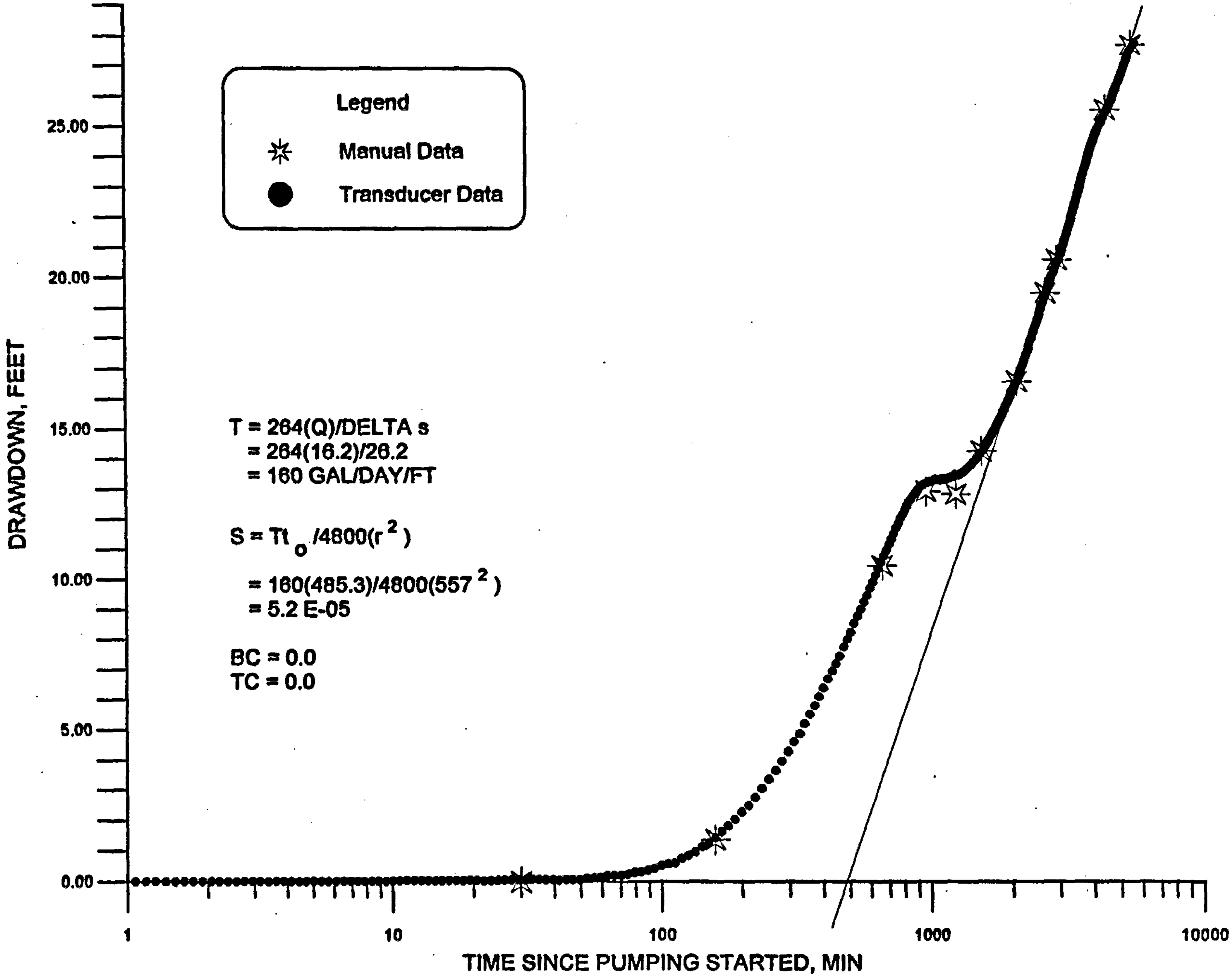


FIGURE K.6-29B. DRAWDOWN IN OBSERVATION WELL M456, SEMI-LOG.

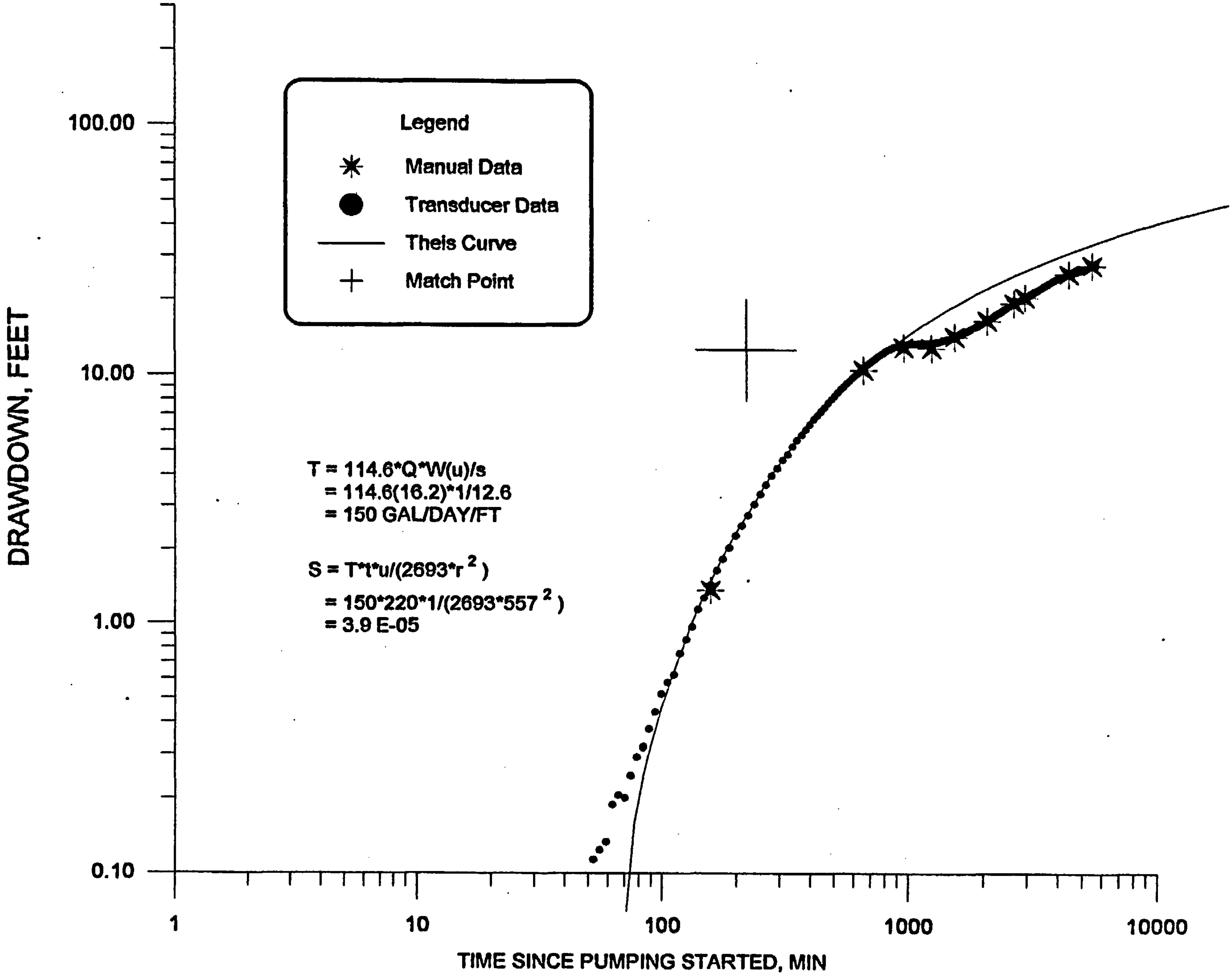


FIGURE K.6-29C. DRAWDOWN IN OBSERVATION WELL M456, LOG-LOG.

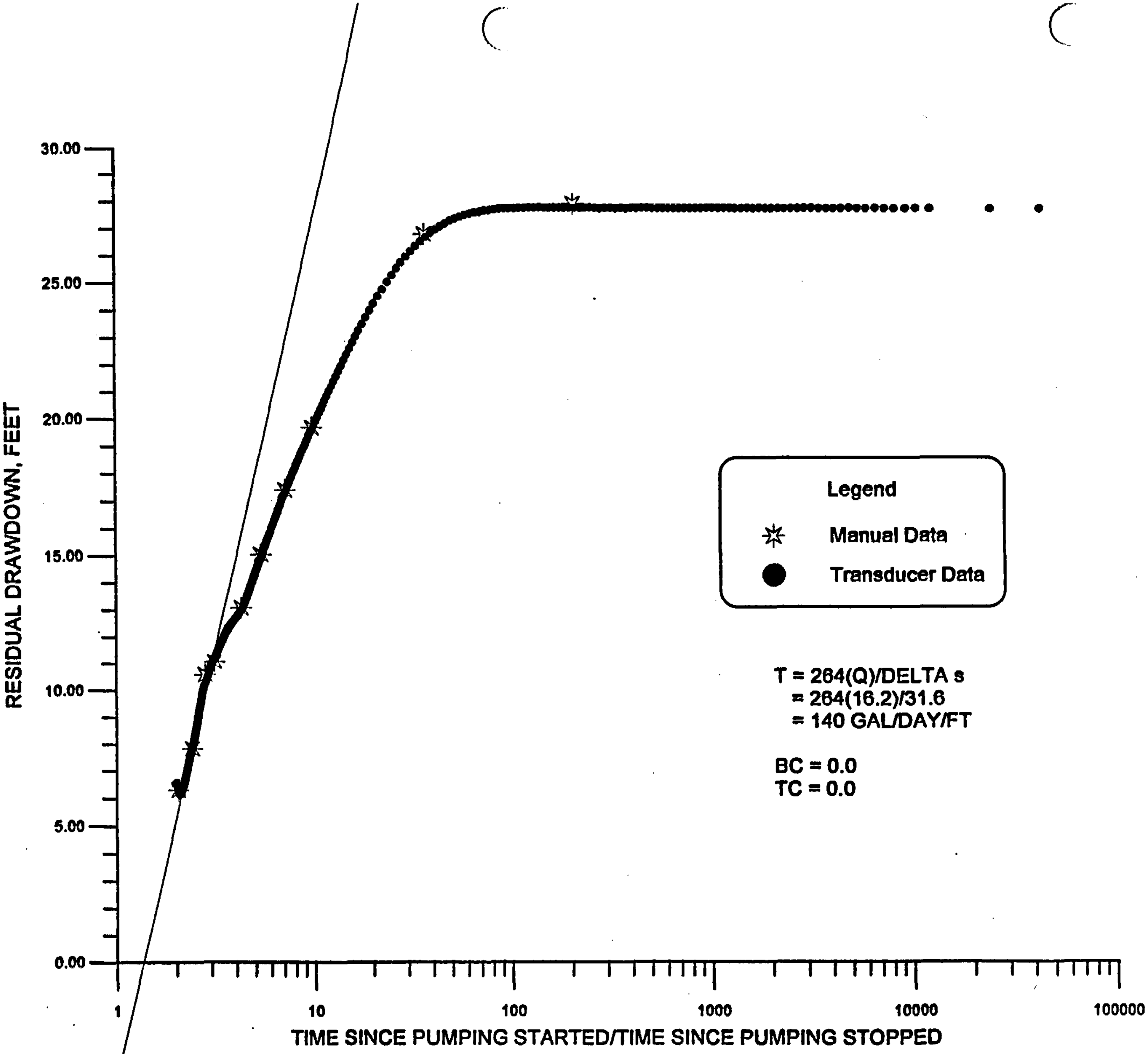
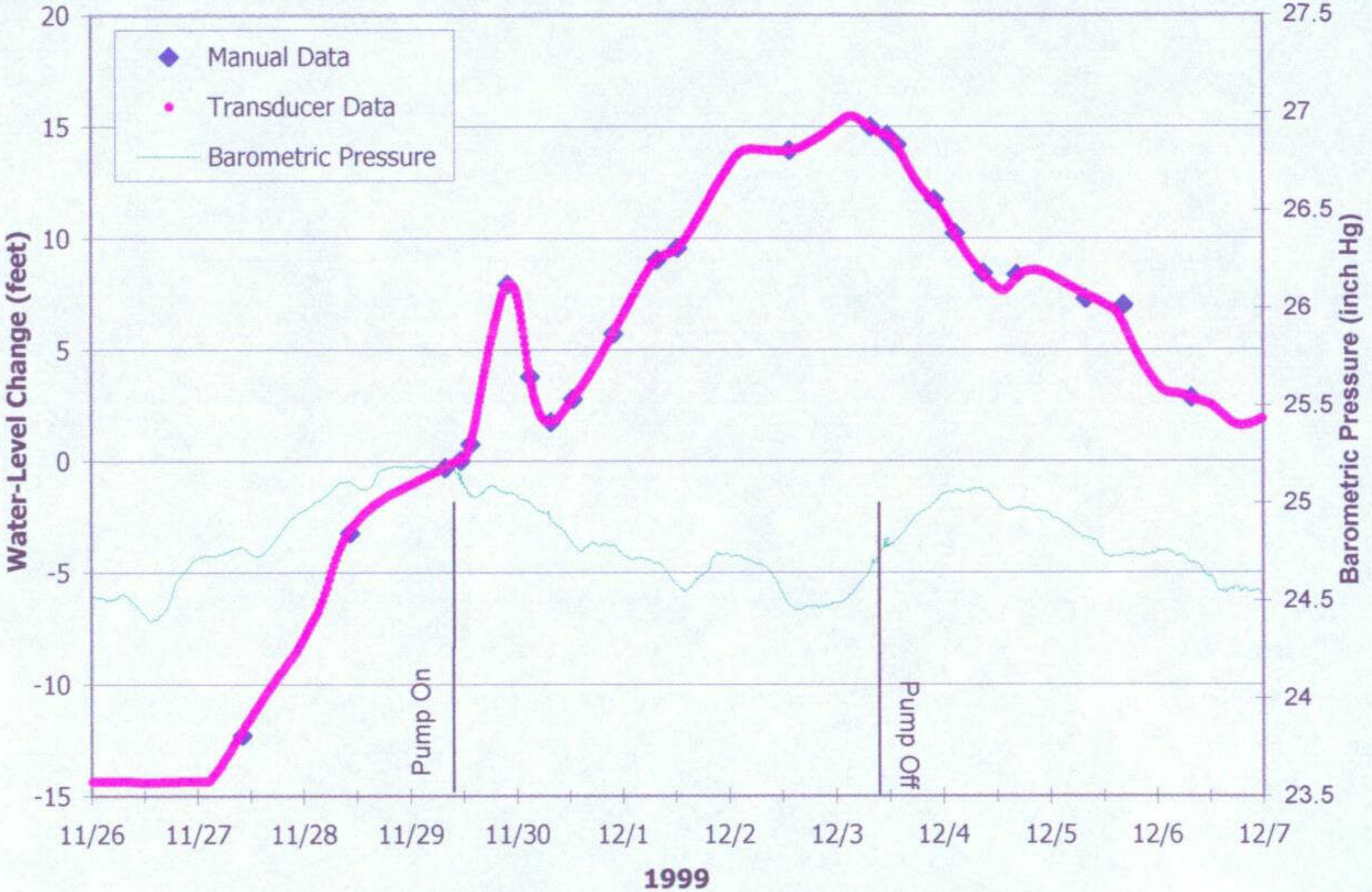


FIGURE K.6-29D. RECOVERY IN OBSERVATION WELL M456.

FIGURE K.6-30A. WATER-LEVEL CHANGE IN OBSERVATION WELL M457



K.6-102

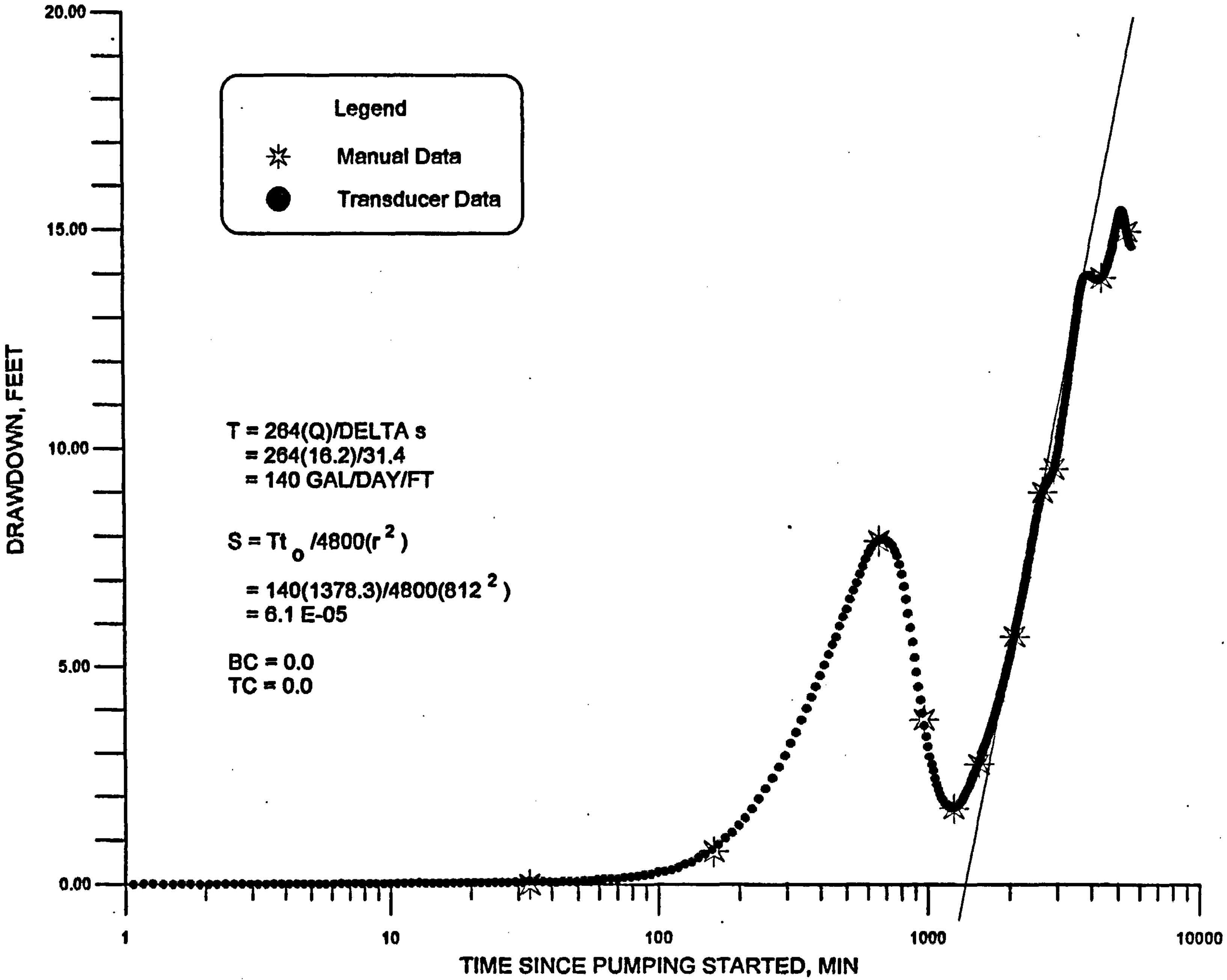


FIGURE K.6-30B. DRAWDOWN IN OBSERVATION WELL M457, SEMI-LOG.

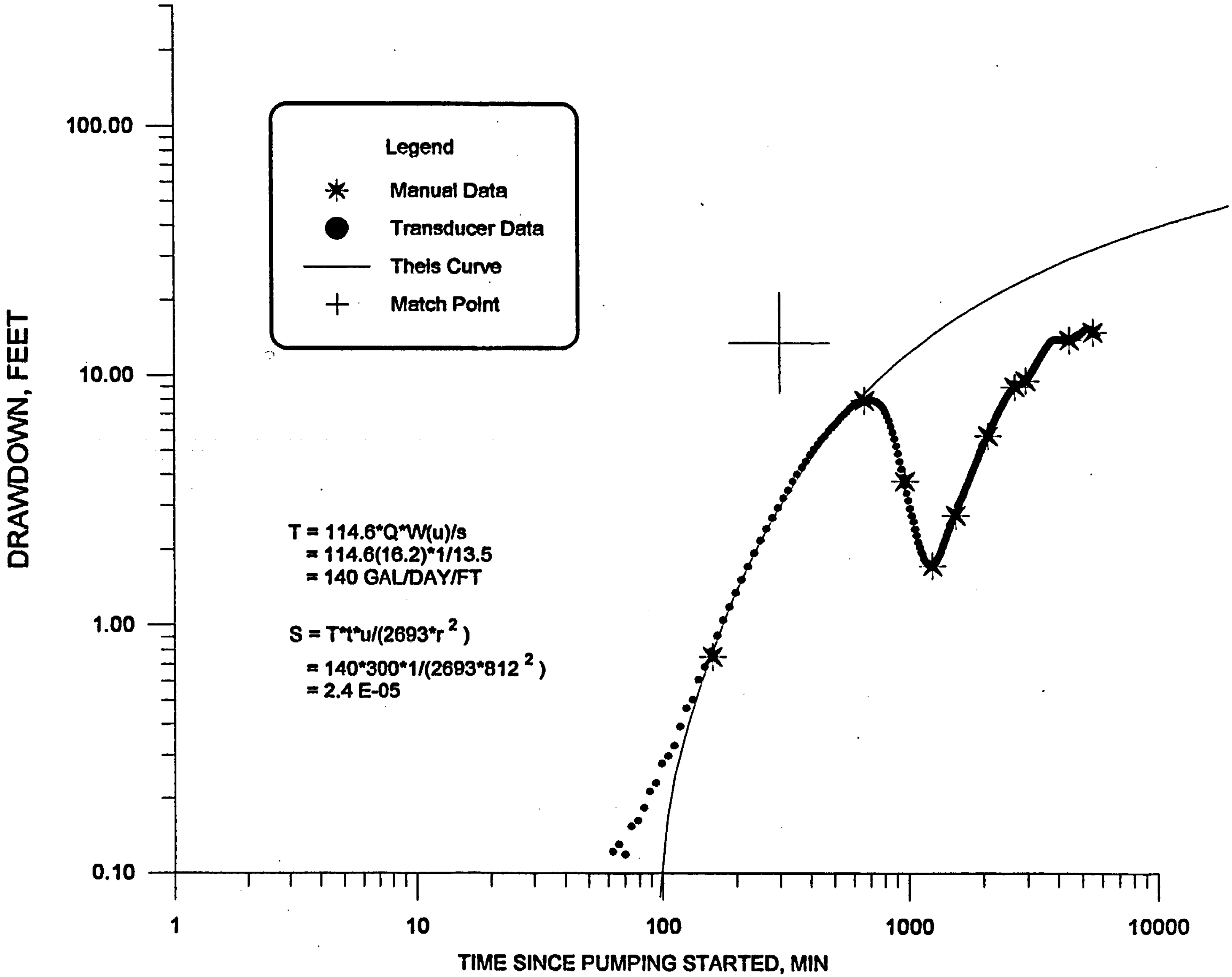


FIGURE K.6-30C. DRAWDOWN IN OBSERVATION WELL M457, LOG-LOG.

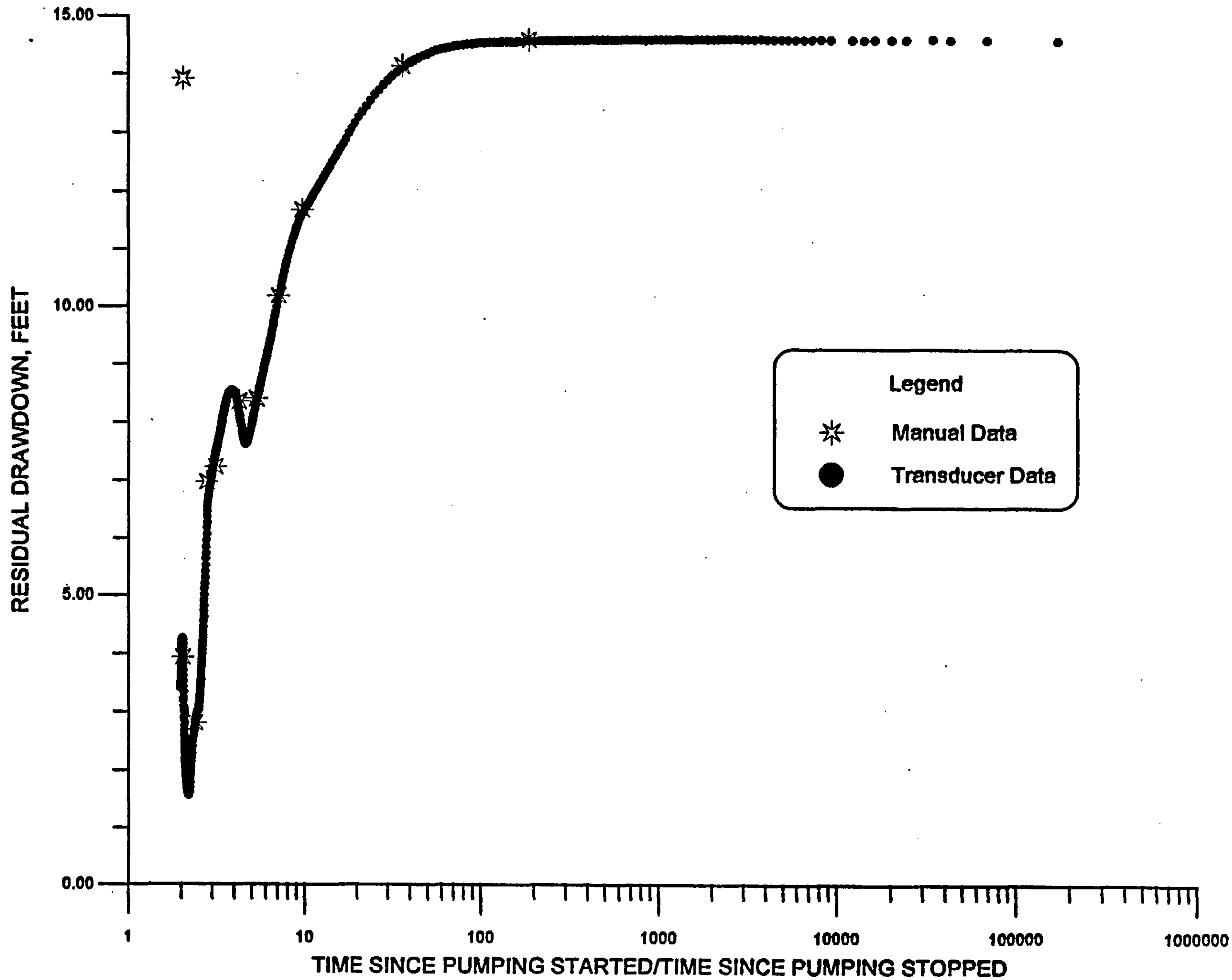
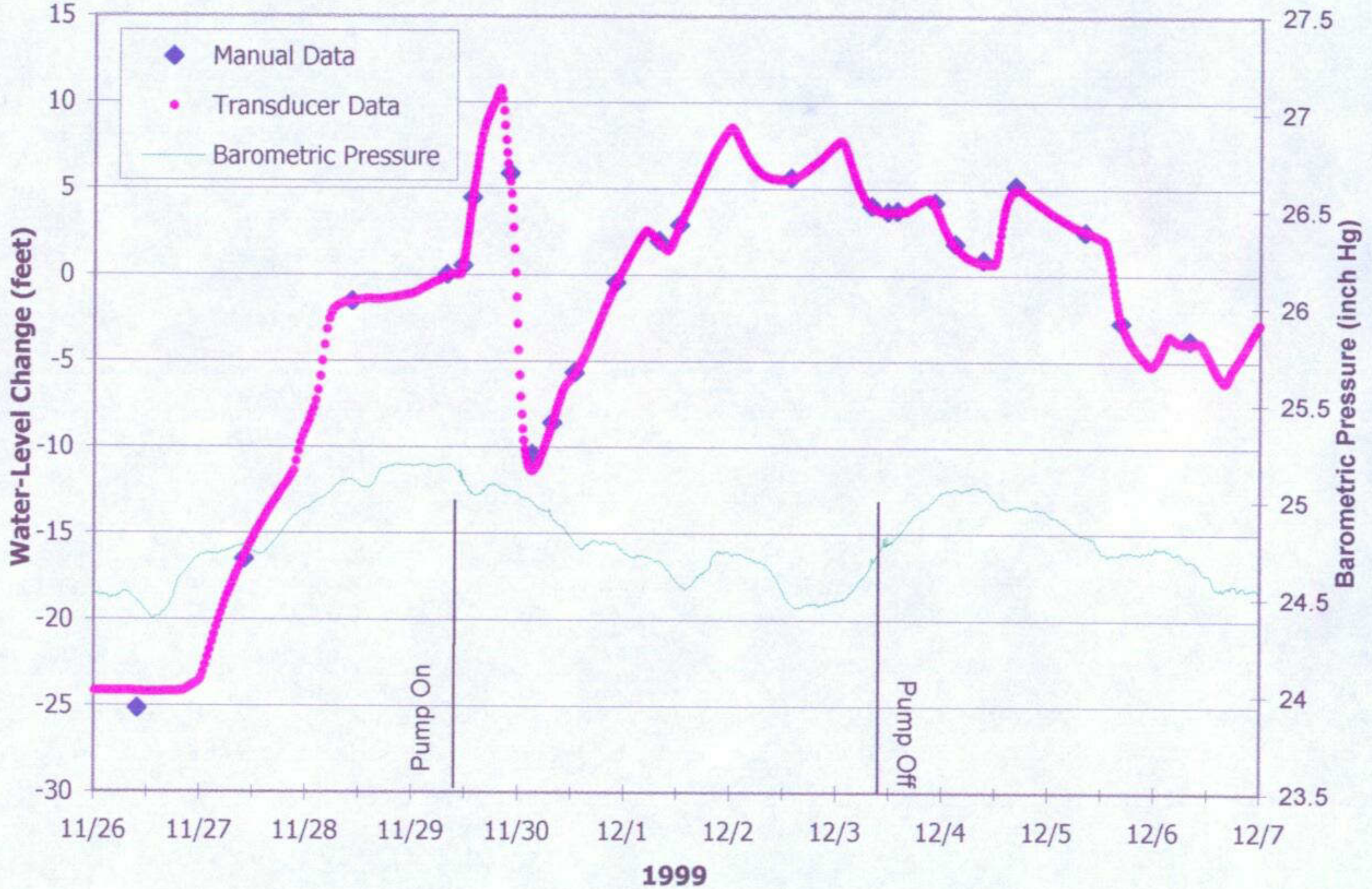


FIGURE K.6-30D. RECOVERY IN OBSERVATION WELL M457.

FIGURE K.6-31A. WATER-LEVEL CHANGE IN OBSERVATION WELL M458



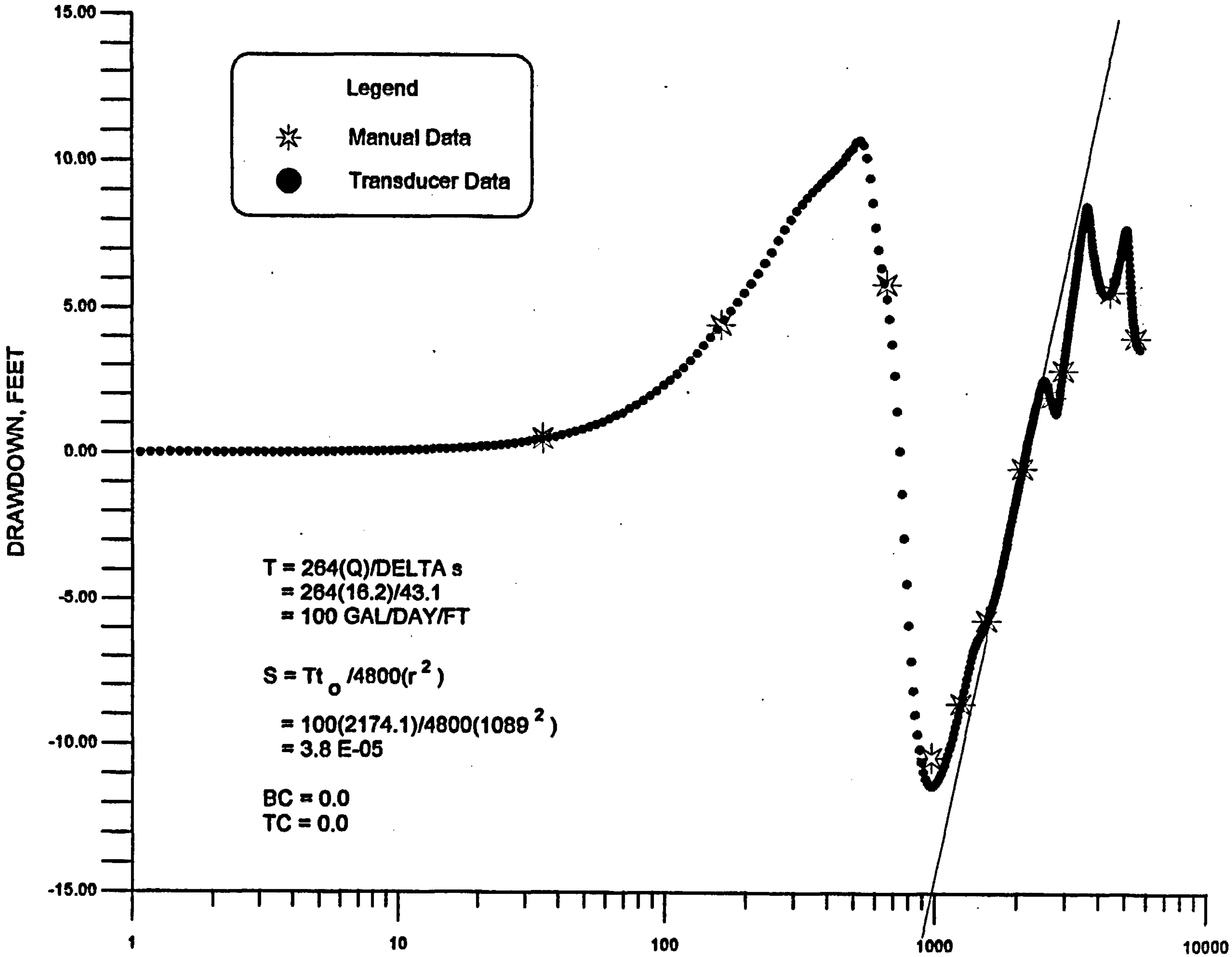


FIGURE K.6-31B. DRAWDOWN IN OBSERVATION WELL M458, SEMI-LOG.

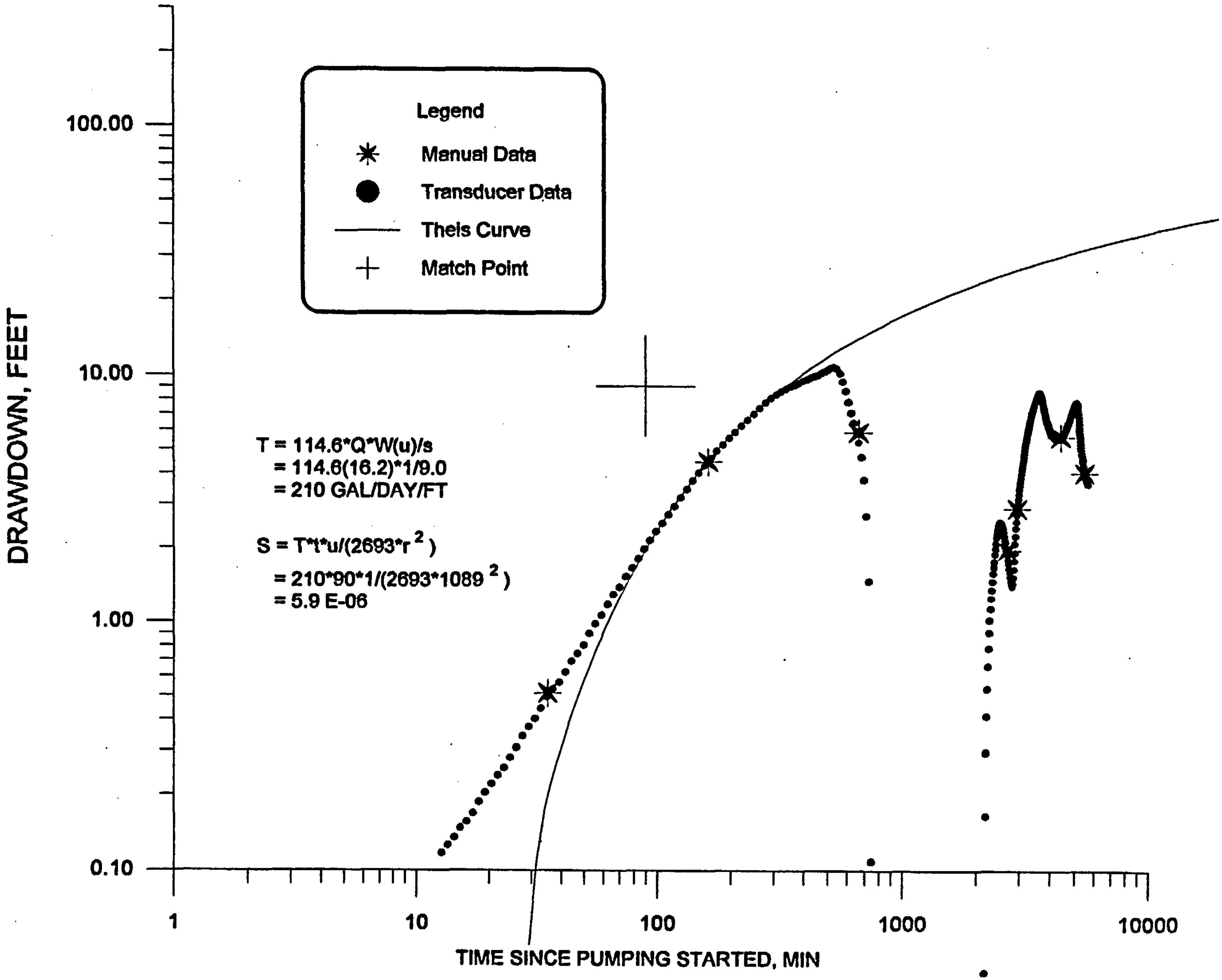


FIGURE K.6-31C. DRAWDOWN IN OBSERVATION WELL M458, LOG-LOG.

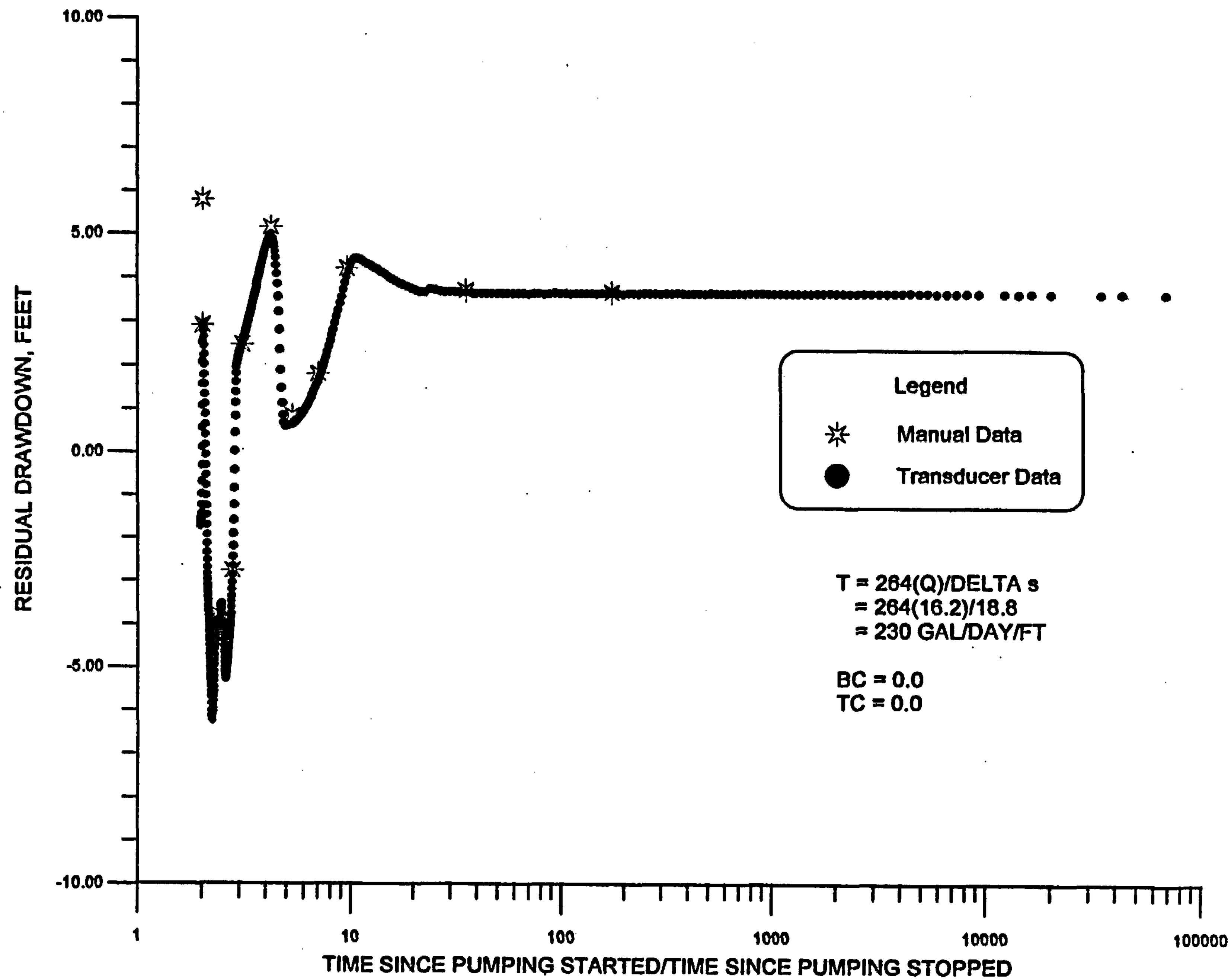


FIGURE K.6-31D. RECOVERY IN OBSERVATION WELL M458.