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DRAFT REPORT

RESULTS OF THE SHALLOW ALLUVIAL AQUIFER PUMP TESTING PROGRAM MAY-AUGUST, 1988

FRENCH LIMITED SITE
CROSBY, TEXAS

Applied Hydrology Associates, Inc.

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RESULTS OF THE SHALLOW ALLUVIAL AQUIFER PUMP TESTING PROGRAM MAY-AUGUST, 1988

FRENCH LIMITED SITE
CROSBY, TEXAS

Prepared for

ARCO Chemical Company
and
French Limited Task Force

Prepared By

Applied Hydrology Associates, Inc.
Denver, Colorado

September 15, 1988

1.0 INTRODUCTION

The French Limited Site located on 15 acres south of State Highway 90 near Crosby, Texas. An abandoned lagoon, formally a sand and gravel pit, on the site was used for the disposal of a variety of petrochemical and wood preservative residues during the 1960's and 1970's The residues have formed a sludge layer containing unacceptably high concentrations of certain organic constituents at the bottom of the lagoon In 1982, the site was designated for remediation action under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

The French Limited Task Group was formed in late 1983 by potentially responsible parties to determine the most reasonable and environmentally acceptable remedial actions to be taken at the site A Remedial Investigation and Feasibility study has been completed and accepted by EPA Pilot bioremediation tests were initiated on site in , 1987 and are currently in progress Extensive groundwater monitoring and contaminant transport modeling have been underway to assess possible groundwater impacts that may occur during bioremediation and to enable design of remedial actions that would mitigate these impacts.

1.1 OBJECTIVES

Pump testing of the shallow alluvial aquifer has been completed under the direction of Applied Hydrology Associates, Inc to support the assessment of groundwater impacts that may occur during bioremediation testing or final remediation of the French Limited lagoon The pump testing results will also facilitate the design of groundwater recovery systems that may be installed to remediate groundwater contamination

The only previous testing of the upper alluvial aquifer at the French Limited site took place at well REI-3-3 located to the south of the French Limited Lagoon. The results of this test have been incorporated into the documentation of hydraulic characteristics of the upper alluvial aquifer provided in this report The details of the test are included in the 1986 Field Investigation Hydrology Report prepared by Applied Hydrology Associates, Inc , December 19, 1986

This report provides a compilation and summary of the shallow alluvial aquifer pump tests that were completed under the direction of Applied Hydrology Associates Inc in 1988 These tests were conducted in two stages preliminary short term tests conducted on site between May 24 and May 26, 1988 and longer term (6 to 8 hour) testing program conducted on site from August 5 through August 15, 1988 A work plan for the longer term testing was prepared and submitted on June 13, 1988 An update of this work plan dated August 3, 1988 was prepared partly in response to questions and concerns raised by Kathleen O'Reiley of EPA. The update also includes details that were not discussed in the work plan including the use of control measurements on select wells and the recommended monitoring intervals A number of modifications to the testing program were also made in the field either in response to the sustainable pumping rates which were generally lower than anticipated or to address concerns raised by EPA and Jacobs Engineering concerning test locations

1.2 HYDROGEOLOGIC SETTING

The French Limited site is located within the flood plain of the San Jacinto River The attached Figure 1-1 shows the location of the waste lagoon relative to monitoring wells and surface water features The shallow stratigraphy of the site as can be divided into three zones an upper predominantly sandy zone, a middle clayey zone and a lower silty-sand zone Figure 1-2 shows the relative consistency of the these units at different locations within the general vicinity of the French Limited site

1.2 1 Upper Alluvial Zone

The upper zone consists of poorly consolidated sands and silty sands with occasional clayey zones The zone is water bearing and due to its sandy nature yields water easily to wells The upper alluvial zone is approximately 50 feet thick and tends to contain the coarsest sands and occasional gravels in the uppermost 20 to 30 feet This uppermost coarse sandy unit has been interpreted as a recent alluvial deposit of an abandoned channel of the San Jacinto River The aquifer is unconfined but may display confined characteristics locally where significant clay lenses exist within the zone

The water table occurs very close to ground surface in most areas of the site and is close to the water levels of adjacent ponds Water level fluctuations in wells completed in this zone respond to precipitation and evapotranspiration influences These fluctuations have been documented during the 1986 Hydrologic testing program Water levels in the alluvial wells were observed to rise rapidly in response to the start of the precipitation event, typically within 30 to 50 minutes A lag time period of 200 to 500 minutes between the end of the precipitation event and the end of alluvial water level rise was observed in the response to precipitation A very similar precipitation response was observed in the control wells monitored on August 10 prior to and during the test of well ERT-22

The influence of evapotranspiration on alluvial groundwater was not as consistent among the control wells monitored during the August, 1988 pump testing program and the wells monitored during the 1986 Hydrology Field Program. Water level drops of several hundredths of a foot are apparent in the alluvial wells between the night hours and the middle of the day, particularly on clear sunny days

Pump testing of the upper alluvial zone was not conducted during the 1986 Field Investigations because the focus of that investigation was to evaluate the potential for contaminant migration through the middle clay zone

1.2.2 Middle Clayey Zone

The middle zone consists of thinly interbedded silty clays and clayey silts of the Beaumont Formation The zone is saturated but due to its clayey nature does not yield water easily to wells and tends to restrict the transmission of groundwater to adjacent aquifers A geologic unit having these types of characteristics is generally termed an aquitard or an aquiclude depending on the degree of transmission (Freeze and Cherry, 1979)

The middle clayey zone is about 70 feet thick and contains a consistent 11 to 14 foot thick zone of stiff red clay at a depth of about 75 feet below ground level The clays of this zone are characteristically reddish-brown or blue-grey with reddish mottling, blocky in texture and contain slickensides

The middle clayey zone consists of low permeability clays and silts which do not yield significant quantities of water to wells installed in this zone The hydrogeologic characteristics of the middle clay unit were analyzed by field and laboratory tests conducted the 1986 Field Investigations These results are reported in the 1986 Field Investigation Hydrology Report prepared by Applied Hydrology Associates, Inc , December 19, 1986 The investigation confirmed the generally low permeability of the clay and silt units and the lateral consistency of the zone in the vicinity of the French Limited site The predominance of fine-grained materials and the observation of large potentiometric differences across the zone also supported the conclusion that the zone is an effective barrier to downward migration of groundwater and acts as a confining layer for the underlying lower silty sand zone

The middle clay zone has been referred to as an aquitard in the regional groundwater system. AHA's analysis of the 1986 field tests indicates that the unit should more appropriately be referred to as an aquiclude because it is incapable of transmitting significant quantities of water under ordinary hydraulic gradients

1.2.3 Lower Silty Sand Zone

The lower zone is a poorly consolidated water bearing silty sand or sandy silt zone directly underlying the clayey middle zone The zone yields water easily to wells and is considered to be an aquifer (Freeze and Cherry, 1979)

The lower silty sand zone varies in thickness from 15 to 30 feet It tends to thin and contain more fines in the southern and eastern parts of the site based on conditions encountered at the REI-3-4 and REI-7 wells. It is bounded at its base by a silty clay unit having a thickness of at least five feet This lower zone may represent a sandy zone within the Beaumont Formation or the upper part of the Lissie Formation which underlies the Beaumont

The hydrogeologic characteristics of the lower silty sand zone were analyzed by several long term pump tests conducted during the 1986 Field Investigations These results are reported in the 1986 Field Investigation Hydrology Report prepared by Applied Hydrology Associates, Inc , December 19, 1986.

2.0 UNCONFINED AQUIFER PUMP TEST ANALYSES

Analysis of unconfined aquifer pump test results is possible using a variety of equations and type curves that have been developed to approximate the response of an unconfined aquifer to radial flow to a pumping well Earlier solutions were derived by invoking the Dupuit assumptions (Bear, 1979) Using an adjusted drawdown $s' = s - s^2/2Ho$ and the Dupuit assumptions, Jacob derived a solution for unconfined flow that was equivalent to the Theis solution. The Dupuit assumptions require that vertical gradients are negligible Anisotropy with respect to the vertical dimension and the increase in the slope of the water table around a pumping well cause the

actual drawdowns to deviate from that determined based on the Dupuit assumptions.

Boulton (1963) observed that the drawdowns from unconfined aquifer pump test when plotted against time on logarithmic paper tended to follow an inflected curve consisting of a steep segment at early times that closely matched the Theis response, a flat segment at intermediate times, and a somewhat steeper segment at later times The intermediate segment suggested the release from storage of an additional water source which Boulton referred to as "delayed yield" Boulton derived a new flow equation assuming that a component of the storage coefficient varies with time

A variety of explanations have been offered to explain the "delayed yield" phenomenon Drainage from the unsaturated zone has been dismissed by theoretical and experimental data which show that the influence is negligible Work by Neuman (1975) and Streltsova(1972) both showed that delayed yield phenomenon may be caused by a time lag between the early artesian response of the aquifer and the subsequent downward movement of the water table Bower and Rice (1978) have hypothesized that the delayed yield response could be due to delayed air entry during the early drawdown response However, Neuman (1979) has observed that the delayed yield phenomenon has been observed in a variety of site conditions and does not appear to correlate with hydrogeologic conditions which would contribute to delayed air entry

Neuman's (1975) explanation has gained the greatest acceptance Neuman's developed type curves from solutions based on linearization These solutions are generally less restrictive than Jacob's Theis curve analysis but still depend on an assumption that the drawdown at the water table remains small in comparison with the initial saturated thickness of the aquifer

Walton (1978) concludes that analysis of unconfined pump test response can provide meaningful results provided vertical components of flow, anisotropy in permeability, decreases in aquifer saturated thickness, well bore storage effects and partial penetration of wells are recognized and taken into account in the analyses All these factors may appreciably affect the time rate of drawdown, particularly during early pumping periods

2.1 SHORT TERM TESTING PROGRAM

Preliminary aquifer testing was conducted at the French Limited site between May 24 and May 26, 1988 The testing was coordinated with the monthly sampling of wells monitoring the upper alluvial zone ion the vicinity of the French Limited site.

The results of these tests were included in a report "Preliminary Shallow Aquifer Pumping Tests" dated July 1, 1988 The pump test measurements were taken when the wells were purged prior to sampling Consequently there was little control over the pumping rate The pumping times were of short duration which usually allowed for only one flow measurement The only tests with more than one flow measurement, pump tests at ERT-4 and REI-10-3, showed that pumping rates appear to have varied significantly during the test with

rates dropping during the later part of the pumping period The variable pumping rates make interpretations from one pumping rate measurement suspect

Because of the problems with pumping rate control, it appears that the most reliable tests from the short term testing program are the tests that were of short enough duration to be interpreted as slug tests Thus, the transmissivity values from the timelag analysis of the test results from wells ERT-28 and ERT-30 are thought to be valid results, although they still should be viewed as order of magnitude estimates

The results from wells ERT-23 and ERT-24 indicate relatively high transmissivities Because of the high specific capacity for these wells, the well bore storage effects appear to have had minimal influence on the test and would have been negligible beyond two minutes into the drawdown and recovery periods Furthermore, it is likely that the pumping rate was less variable because of the limited drawdown The pumping period was from 8 to 9 minutes and the flow measurement was recorded about midway through the pumping period The transmissivities estimated from the drawdown and recovery data were 7133 and 8420 gpd/ft respectively for well ERT-23 and 2448 and 2922 respectively for well ERT-24. AHA believes that these estimates are representative of approximate magnitude for transmissivities in the immediate vicinity of these wells

The other results from the preliminary testing program are unreliable because of unknown variable pumping rates and well bore storage effects The attempts to use the results to design the longer term testing program led to overestimating the pumping rates because of the overestimation of transmissivities from some of the tests In retrospect, attempts to develop preliminary information on aquifer characteristics during well purging may be inappropriate without considerable more control over pumping rates Results would be most reliable for wells with very low transmissivities where the tests can be interpreted as slug tests or for wells with small diameters and relatively high transmissivites where well bore storage effects are negligible for most of the drawdown and recovery period In the latter case frequent flow measurements should be taken during the test

2.2 LONGER TERM PUMP TESTING PROGRAM

In the work plan "Pumping Test Program For Shallow Alluvial Aquifer Zone" (July 28, 1988), five wells were selected for the longer term pump tests Four of the locations were selected to develop aquifer characteristics in the area where groundwater recovery wells would most likely be located immediately south of the French Limited Lagoon. The fifth well, ERT-29 was selected to characterize the aquifer between the French Limited Lagoon and the Riverdale subdivision The test program called for pumping each well for six to 8 hours and to measure drawdown and recovery in the pumped well and in any observation wells. Two of the tests, ERT-20 and ERT-21, were designed as single well tests

An update of this work plan dated August 3, 1988 was prepared This update included the provision to monitor control variables during each of the tests. The recommended control variables were precipitation, lagoon levels (for the proposed REI-10-3) test and at least one control well for each test The purpose of the control measurements and in particular the control wells is to

be able to identify the extraneous fluctuations associated with evapotranspiration and recharge from precipitation and to remove these fluctuations from the water level response in the observation wells in order to arrive at the response due only to pumping It is known from the extensive measurements taken during the aquitard evaluation tests performed in 1986 that the water level fluctuations in the upper alluvial zone are unaffected by barometric fluctuations Therefore, barometric measurements were not included as a control variable

2.3 AQUIFER PUMPING TEST RESULTS

A number of modifications to the testing program were also made in the field either in response to the sustainable pumping rates which were generally lower than anticipated or to address concerns raised by EPA and Jacobs Engineering concerning test locations Short term step drawdown tests were performed on wells REI-10-2, REI-10-3 and REI-10-4 These tests did not include control measurements A longer term test of well REI-10-3 was not performed Instead, a seven hour pump test was conducted on well ERT-10 A seven hour test was also conducted on well ERT-22 Tests of six to eight hours were performed on wells ERT-7 and ERT-21, as called for in the work plan The tests on wells ERT-20, and ERT-29 were terminated short of 6 hours due to measurement difficulties and problems with sustaining a constant pumping rate as explained in more detail in Appendix 1

A description of the background, procedures and results for each test are provided in Appendix 1 along with the field data and reduced data from the pumping well, the observation wells and the control wells

The estimates considered to be most representative for each well test are summarized in Table 1 along with the reliable results from the preliminary testing program and a test of well REI-3-3 conducted during the 1986 Field investigations The results from the later test are included in Appendix 2

The results from wells ERT-20, ERT-21 and ERT-22 all indicate similar values for transmissivity in the range from 595 to 714 gpd/ft Results from the drawdown analyses indicate a broader range for transmissivity but the recovery data is considered to be the most reliable Recovery data tends to be less susceptible to variations in pumping rate The transmissivity estimate of 1387 gpd/ft calculated in the vicinity of well ERT-7 is somewhat higher but corresponds with the higher well yields from wells ERT-7 and ERT-8 The storage coefficient of 0 0041 determined from the recovery analysis corresponds with the early test, elastic storage coefficient as described by Neuman(1975) It is not representative of the specific yield that would characterize the storage coefficient for a long term test or pumping program

Transmissivity values appear to decrease toward the southwest corner of the lagoon The transmissivity calculated from the ERT-10 test is 489 gpd/ft The storage coefficient of 0 0042 is remarkably close to the estimate from the ERT-7 well test. The transmissivity values around the wells REI-10-2, REI-10-3 and REI-10-4 is even lower as evidenced by the very low values for specific capacity.

Unfortunately, all the pumping well data results from the step drawdown tests at wells REI-10-2, REI-10-3 and REI-10-4 were subject to significant well bore

storage influence The drawdown response at the observation wells was relatively minor The best response was in well REI-10-4 during pumping of well REI-10-2 Even though the pumping rate changed during the test, the rate change was less than 30% and it occurred relatively early during the test The drawdown response was successfully matched to a Boulton Delayed Yield curve with r/B = 2 0 The resulting transmissivity is 142 gpd/ft which seems reasonable if somewhat on the high side while the corresponding storage coefficient of 0092 is thought to be reasonable for the early test response for ann unconfined aquifer

A more transmissive zone appears to exist in the vicinity of well ERT-23 This zone is localized as evidenced by the low transmissivity values at wells REI-10-2 and REI-10-4 northeast of the well and at wells ERT-28 and ERT-30 located southwest of the well The estimated transmissivity is approximately 8000 gpd/ft. The high transmissivity may be associated with a channel sand This more transmissive zone does not appear to extend to the southeast as far as the REI-3-3 well but may extend toward the northwest and west in the direction of well ERT-24 and well ERT-27 The preliminary test results at well ERT-24 suggested a transmissivity for this well of approximately 2500 gpd/ft Likewise, the recovery analysis from well ERT-27 indicate a transmissivity of about 7000 gpd/ft However, the results from well ERT-27 were considered to be less reliable because of possible errors in pumping rate measurement and possible influence of well bore storage

The slug test analysis of wells ERT-28 and ERT-30 suggest very low values of transmissivity for these wells These results should be viewed as order of magnitude estimates considering the limitations of slug test analyses Furthermore, slug test results are representative of the zone immediately around the well bore which may not be representative of the aquifer Results are somewhat dependent on the degree of well development that could be achieved

Finally, results from a 12 5 hour pump test of well REI-3-3 conducted during the 1986 hydrologic field studies were analyzed with a Boulton Delayed Yield type curve. The results appear to indicated a delayed yield phenomenon. The calculated transmissivity was 500 gpd/ft The calculated storage coefficient for the early test response was .003 which is very similar to the value calculated for the ERT-10 and ERT-7 well tests

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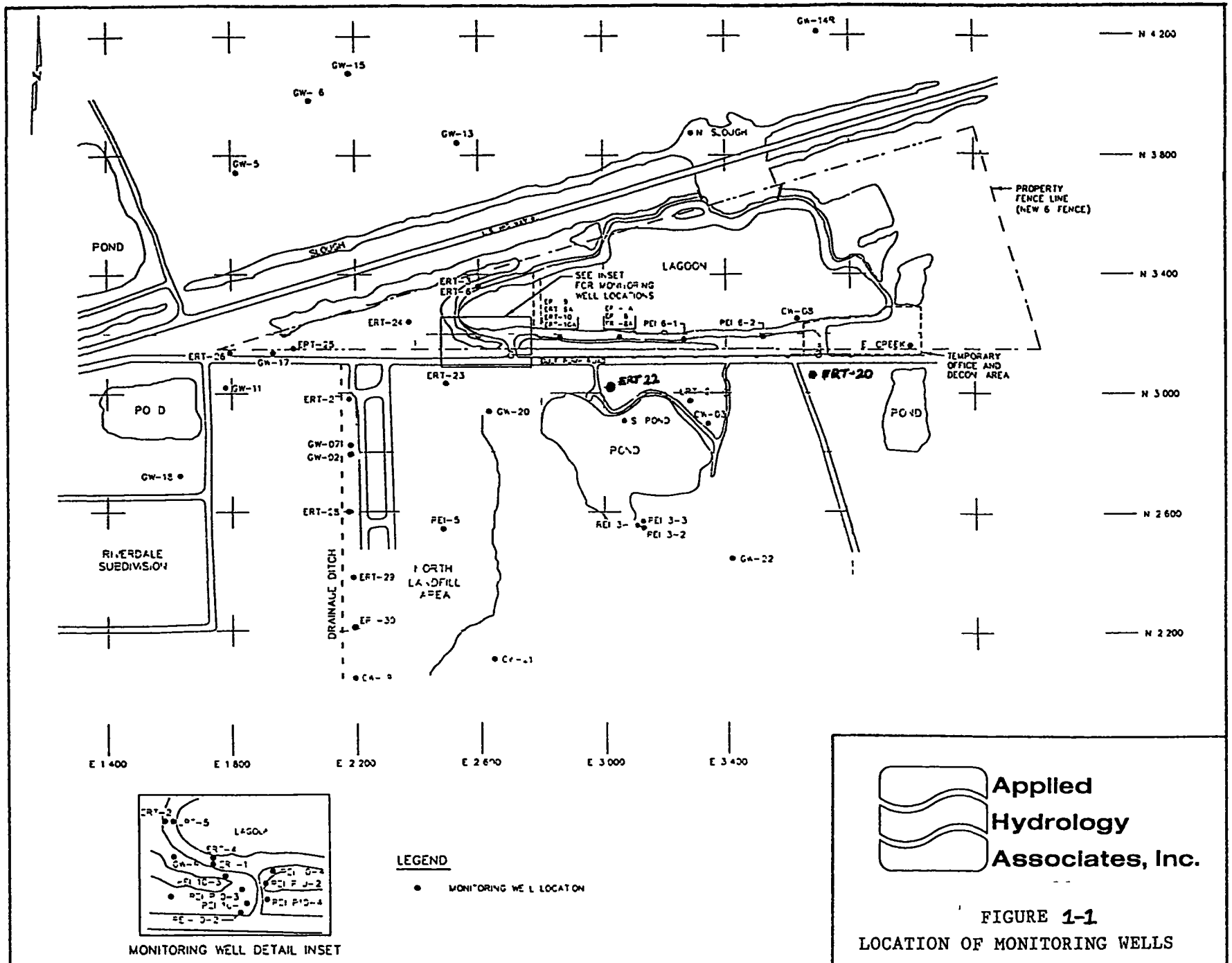
TABLE 1

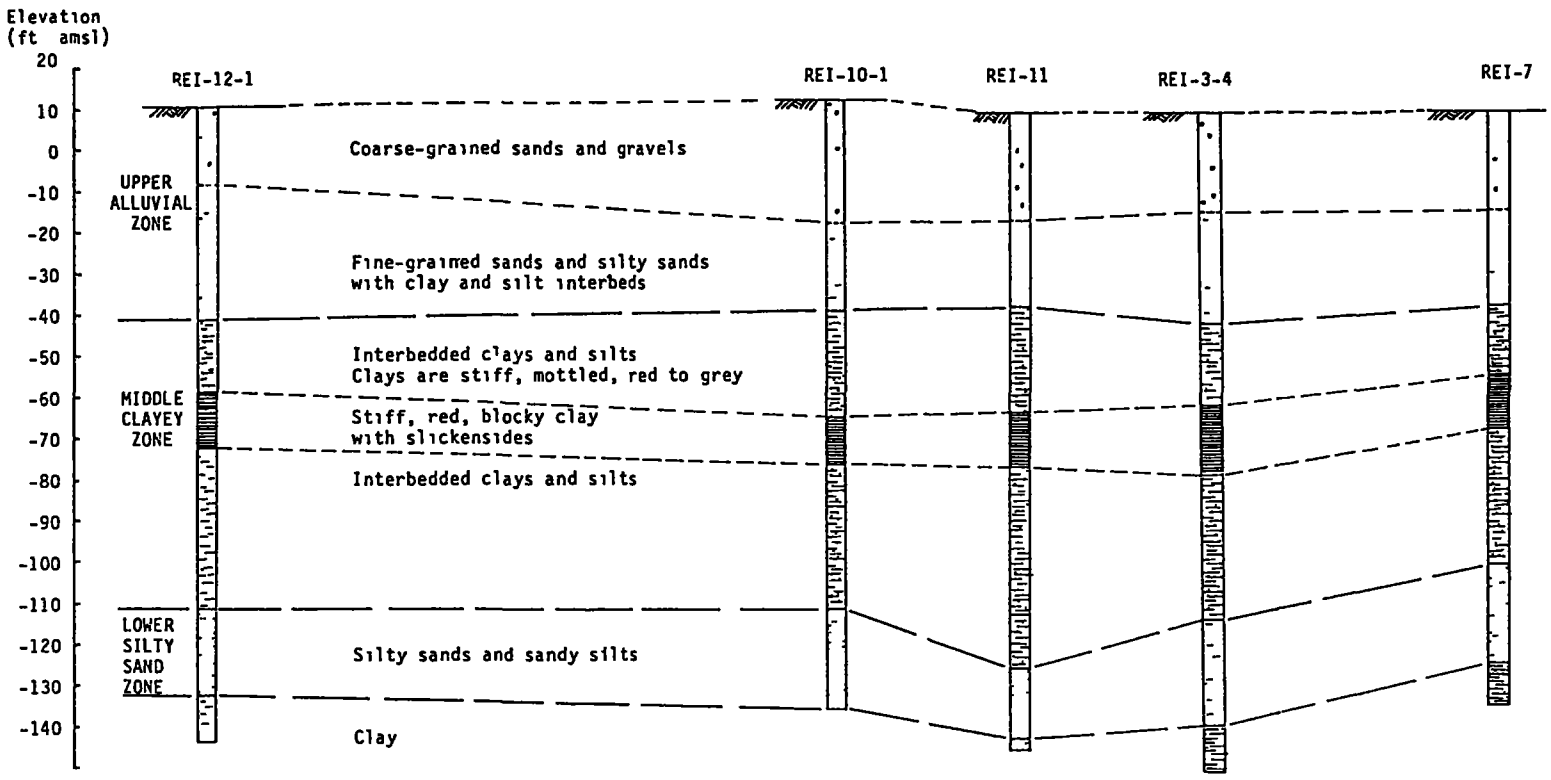
SUMMARY OF AQUIFER TEST DATA
FRENCH LIMITED SITE
CROSBY, TEXAS

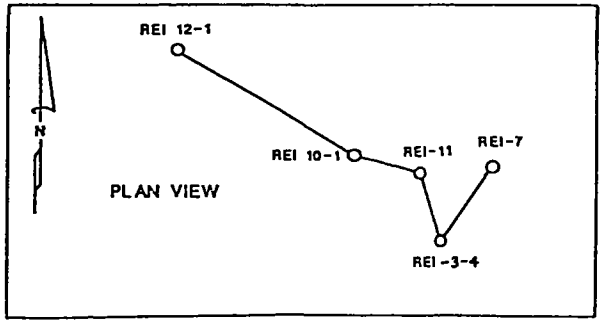
PUMP WELL	OBS WELL	ANALYSIS METHOD	T GPD/FT	K CM/S	S	SATURATED THICKNESS
ERT-10	ERT-9	Bursoy & Sommers (Recovery)	489	9 8X10^{-4}	0042	30 feet
		Bursoy & Sommers (Drawdown)	463	9 3X10^{-4}	0074	30 feet
ERT-10	REI-10-4	Boulton Del Yld	145	2 9X10^{-4}	00079	30 feet
ERT-20	ERT-20	Bırsoy & Sommers (Recovery)	695	1 4X10^{-3}		30 feet
ERT-21	ERT-21	Theıs Recovery	595	1 2X10-3		30 feet
ERT-22	ERT-22	Brısoy & Sommers (Recovery)	714	1 4X10^{-3}		30 feet
ERT-7	ERT-8	Theis Recovery	1387	2 8X10^{-3}		30 feet
REI-3-3	REI-3-5	Boulton Del Yld	500	1 5X10^{-3}	003	20 feet
REI-10-2	REI-10-4	Boulton Del Yld	142	4 3X10^{-4}	0092	20 feet
ERT-23	ERT-23	Theıs Recovery	8420	1 7X10^{-2}		30 feet
ERT-24	ERT-24	Theis Recovery	2922	5 8X10^{-3}		30 feet
ERT-25	ERT-25	Jacob Recovery	1550	2 3x10^{-3}		40 feet
ERT-26	ERT-26	Jacob Recovery	1260	1 9x10^{-3}		40 feet
ERT-27	ERT-27	Jacob Recovery	7000	1 1x10^{-2}		40 feet
ERT-28	ERT-28	Hvorslev Slug Test	52	7 8X10^{-5}		40 feet
ERT-30	ERT-30	Hvorslev Slug Test	63	9 5X10^{-5}		40 feet



Applied Hydrology Associates, Inc.

FIGURE 1-1
LOCATION OF MONITORING WELLS





Horizontal Scale (ft)
0 300

Vertical Scale (ft)
0
10
20

FRENCH LIMITED PROJECT
CROSBY TEXAS

FIGURE 1-2

STRATIGRAPHIC CROSS-SECTION THROUGH FRENCH LIMITED SITE (NW to SE)

PROJECT No 26	DATE 9-1-88	REVISION 1

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

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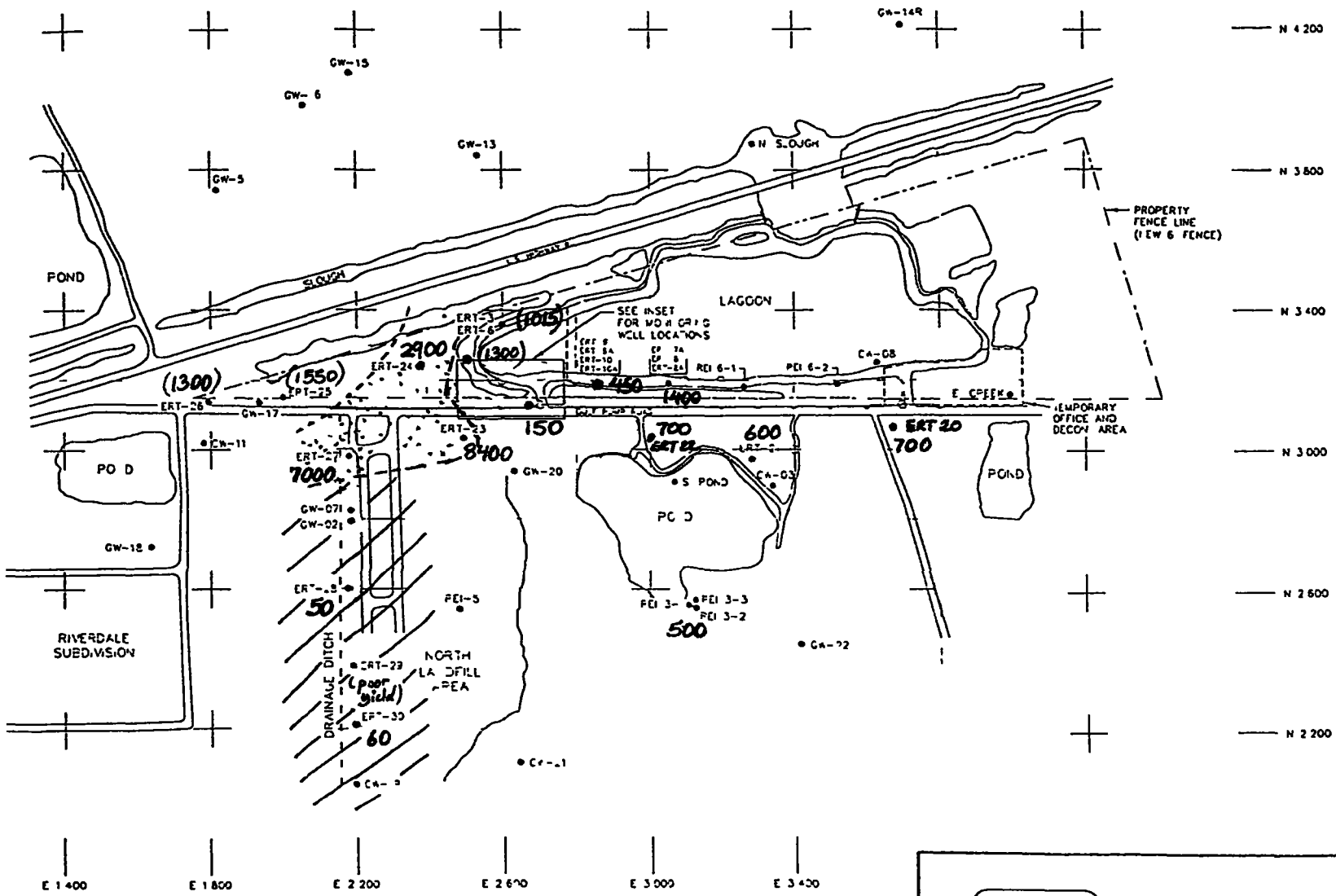

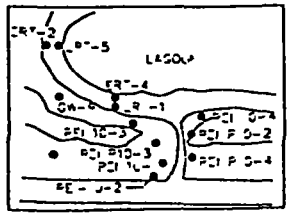

MONITORING WELL DETAIL INSET

LEGEND

- MONITORING WELL LOCATION
- /// TRANSMISSIVITY < 100 gpd/ft
- ∴ " > 2500 gpd/ft

Applied Hydrology Associates, Inc.

FIGURE 1-3

LOCATION OF MONITORING WELLS SHOWING CALCULATED TRANSMISSIVITIES (gpd/ft)

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APPENDIX A

SHALLOW ALLUVIAL ZONE PUMP TEST DATA AND INTERPRETATION

French Limited Site
Crosby, Texas

August 5 to August 15, 1988

BOOKMARK

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APPENDIX B

PUMP TEST OF WELL REI-3-3

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FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST August 15, 1988

PUMPED WELL: ERT-10

TOTAL DEPTH: 50 FEET

SCREENED INTERVAL· 20 FT TO 50 FT. CASING DIAMETER· 4 INCHES

OBSERVATION WELLS ERT-9, ERT-9A and ERT-10A

CONTROL WELLS· REI-10-4, ERT-1, ERT-1A, ERT-8 and ERT-8A

BACKGROUND AND DESCRIPTION OF TEST

The test of well ERT-10 was not in the original work plan for pump testing the shallow alluvial aquifer zone dated June 13, 1988 The original work plan called for testing well REI-10-3 located approximately 170 feet west of well ERT-10

In the review of the work plan, Kathleen O'Reiley of EPA expressed concern that the REI-10-3 well may not be representative because of the low transmissivity associated with the single well recovery analysis of the short term (15 minute) test performed on May 26, 1988 It was agreed that we would perform a step drawdown or variable rate test on wells REI-10-2, REI-10-3 and REI-10-4 to help select a well for pumping in a 6 to 8 hour test

The results of these variable rate tests indicated that all three wells were poor producers and transmissivities in the area were quite low. Following discussion of these results with Kathleen O'Reiley on site on August 11, 1988, it was agreed that we would test either well ERT-9 or ERT-10 rather than one of the wells at the REI-10 well cluster. The primary reason for pump testing either the ERT-9 or ERT-10 well was to provide information about aquifer characteristics between the poor transmissive REI-10 well cluster and the higher transmissive zone around well ERT-7 Furthermore, it was concluded that the variable rate tests would provide an indication of the magnitude for transmissivity around the REI-10 well cluster Well ERT-10 was selected for pumping because it generally produced more water than well ERT-9 during purging the well prior to sampling.

A preliminary variable rate test was performed on well ERT-10 by Applied Hydrology Associates and ERT on August 12, 1988 in order to select an appropriate pumping rate for the 6 to 8 hour test. Water level measurements were taken on the pumped well and on wells ERT-10A, ERT-9 and ERT-9A It was not possible to set or adjust the flow rate using the rotometer because water was too turbid and dark to observe the gage Flow measurements were taken using a 5-gallon bucket and stop watch The well was pumped for 30 minutes at

a rate of approximately 0.93 gpm although it was more difficult to maintain a constant rate without being able to read the flow meter

The drawdown after 31 minutes was only 2 33 feet so the pumping rate was increased to a rate which averaged about 2 14 gpm for the next 35 minutes An additional 7.14 feet of drawdown occurred after pumping at this rate for 35 minutes. Pumping was terminated and recovery measurements were taken for about 4 hours after the test. Field measurements are attached. Water produced from the test was pumped directly into the French Limited Lagoon

On the basis of the preliminary step test, it was decided to pump at a rate of about 2.14 gpm during the 6 to 8 hour test The valves were left at the position which produced a rate of 2 14 gpm in the latter portion of the step test, the pump remained in the well over the weekend, and the test was started at 9 am on August 15 Because of the difficulty reading the flow meter, flow measurements were taken almost continually with a 5-gal bucket and stop watch.

After about 97 minutes into the test, the drawdown reached the pump level even though the well was pumped at a rate of only about 2 05 gpm Rather than terminating the test, it was decided to continue pumping at a lower rate Subsequent measurements with a 5-gallon bucket and stop watch showed this pumping rate to average about 0 84 gpm and to range from 0 72 to 1 03 gpm. After pumping at this rate for about 220 minutes, the water levels reached the pumping level and we were unable to sustain the pumping rate at 0 84 gpm. For the last 113 minutes of the test, the pumping rate averaged about 0 64 gpm and ranged from 0 59 to 0.71 gpm

Recovery measurements were taken from the pumping well and the observation wells for 342 minutes following termination of pumping. Field measurements are attached. Water produced from the test was pumped directly into the French Limited Lagoon.

INTERPRETATION·

The control wells ERT-1, ERT-8 and ERT-8a showed a similar diurnal pattern as shown in Figure 1. Measurements at control well ERT-1A were not included because organics in the well precluded precise measurement. The diurnal fluctuation in wells ERT-1, ERT-8 and ERT-8A was approximately 0 1 feet. No precipitation was recorded during the test The highest water levels appeared between 16·00 and 17·30 and the lowest levels appeared between 11·00 and 12:00.

Because of the relatively small response in well REI-10-4, it was decided to adjust the response for diurnal fluctuations based on the pattern of fluctuations seen in the control wells The response in wells ERT-9A and ERT-10A was so small (less than .05 feet) that the drawdown response could not be interpreted quantitatively with or without adjustment for the observed diurnal fluctuations. Qualitatively, it was obvious that the lack of a significant response in wells ERT-9A and ERT-10A located 15 05 and 11 4 ft respectively from the pumped well, is indicative of a much a vertical hydraulic conductivity that may be several orders of magnitude lower than the horizontal hydraulic conductivity

An adjustment of water level measurements for the observation well ERT-9 and the pumped well ERT-10 was not performed because the diurnal fluctuation was so small relative to the drawdown response in these wells

Drawdown values determined from water level measurements in wells ERT-10 and ERT-9 were adjusted using Jacob's correction for water table conditions. Jacob's correction is:

$$s_{adj} = s - (s^2/2*m)$$

where s is drawdown,
s_{adj} is adjusted drawdown, and
m is the aquifer thickness from static measurements

Drawdown and adjusted drawdown values are included in the attached spread sheet Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data

The ratio of adjusted drawdown to the associated pumping rate for wells ERT-9 and ERT-10 were plotted against the log of adjusted time on the attached semi-log plots in Figures A-1 and A-2 The ratio of the adjusted residual drawdown (recovery) to the final pumping rate were also plotted against the log of dimensionless time on the same semi-log plots. Well bore effects had a significant influence on the production well response data It was concluded that no portion of the single well data could be used to evaluate aquifer characteristics

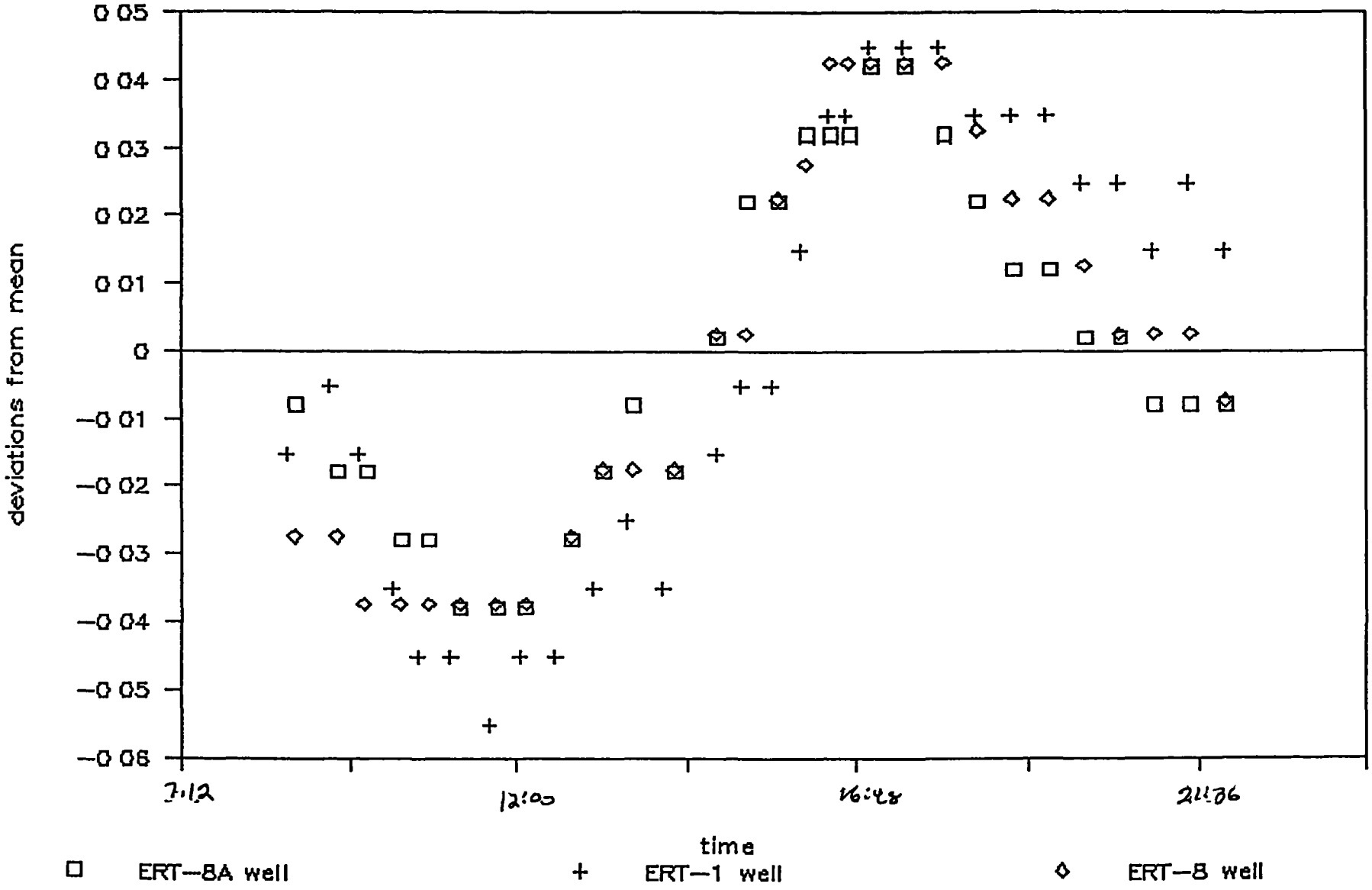
Better results were obtained from the observation well ERT-9 The transmissivity and storage coefficient calculated from the recovery data from the semilog plots were 372 gpd/ft. and 0035 The transmissivity was about 20% the magnitude calculated fro the ERT-7 well site but the storage coefficients were similar Delayed yield effects were not observed but could have been masked by the variable pumping rate

The response in well REI-10-4 due to the constant pumping during the first 95 minutes was plotted on log-log paper included in Figure A-3 The drawdown response at well REI-10-4 did not follow a Theis response A good match was obtained using the early test portion of a Boulton Delayed-Yield Type Curve with r/B equal to 1 5 The calculated transmissivity from the match was 145 gpd/ft and the storage coefficient from the early test match was 0.0008. These results seem reasonable since the hydraulic conductivity decreases in the direction of the REI-10-4 well

As indicated previously, the drawdown response in observation wells ERT-9A and ERT-10A were not analyzed quantitatively because of the very small (less than .05 ft.) response in these wells

ERT–10 Aquifer Pump Test

Control Well Water Level Fluctuations



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ERT-10 Aquifer Pump Test
Control Well Water Level Fluctuations

hour	minute	ERT-8A	mean-dev ERT-8A 5.15	ERT-1	mean-dev ERT-1 6.30	ERT-8	mean-dev ERT-8 4.50
11.00	1.00			6.35	-0.05		
10.00	33.00			6.35	-0.05		
10.00	11.00			6.34	-0.04		
9.00	43.00			6.32	-0.02		
8.00	42.00			6.32	-0.02		
9.00	18.00			6.31	-0.01		
11.00	34.00			6.36	-0.06		
12.00	2.00			6.35	-0.05		
12.00	32.00			6.35	-0.05		
13.00	4.00			6.34	-0.04		
13.00	31.00			6.33	-0.03		
14.00	3.00			6.34	-0.04		
14.00	47.00			6.32	-0.02		
15.00	8.00			6.31	-0.01		
15.00	34.00			6.31	-0.01		
15.00	58.00			6.29	0.01		
16.00	21.00			6.27	0.03		
16.00	37.00			6.27	0.03		
16.00	57.00			6.26	0.04		
17.00	26.00			6.26	0.04		
17.00	56.00			6.26	0.04		
18.00	26.00			6.27	0.03		
18.00	56.00			6.27	0.03		
19.00	26.00			6.27	0.03		
19.00	56.00			6.28	0.02		
20.00	26.00			6.28	0.02		
20.00	56.00			6.29	0.01		
21.00	26.00			6.28	0.02		
21.00	56.00			6.29	0.01		
10.00	42.00					4.54	-0.04
10.00	18.00					4.54	-0.04
9.00	48.00					4.54	-0.04
9.00	24.00					4.53	-0.03
8.00	49.00					4.53	-0.03
11.00	8.00					4.54	-0.04
11.00	40.00					4.54	-0.04
12.00	7.00					4.54	-0.04
12.00	45.00					4.53	-0.03
13.00	11.00					4.52	-0.02
13.00	37.00					4.52	-0.02
14.00	12.00					4.52	-0.02
14.00	47.00					4.50	0.00
15.00	12.00					4.50	0.00
15.00	39.00					4.48	0.02
16.00	3.00					4.48	0.03
16.00	24.00					4.46	0.04
16.00	40.00					4.46	0.04
16.00	59.00					4.46	0.04
17.00	28.00					4.46	0.04

023203

hour	minute	ERT-8A	mean-dev ERT-8A 5.15	ERT-1	mean-dev ERT-1 6.30	ERT-8	mean-dev ERT-8 4.50
18.00	0.00					4.46	0.04
18.00	28.00					4.47	0.03
18.00	58.00					4.48	0.02
19.00	28.00					4.48	0.02
19.00	58.00					4.49	0.01
20.00	28.00					4.50	0.00
20.00	58.00					4.50	0.00
21.00	28.00					4.50	0.00
21.00	58.00					4.51	-0.01
10.00	19.00	5.18	-0.03				
10.00	42.00	5.18	-0.03				
9.00	50.00	5.17	-0.02				
9.00	25.00	5.17	-0.02				
8.00	50.00	5.16	-0.01				
11.00	9.00	5.19	-0.04				
11.00	41.00	5.19	-0.04				
12.00	7.00	5.19	-0.04				
12.00	45.00	5.18	-0.03				
13.00	12.00	5.17	-0.02				
13.00	37.00	5.16	-0.01				
14.00	13.00	5.17	-0.02				
14.00	48.00	5.15	0.00				
15.00	13.00	5.13	0.02				
15.00	40.00	5.13	0.02				
16.00	4.00	5.12	0.03				
16.00	25.00	5.12	0.03				
16.00	41.00	5.12	0.03				
17.00	0.00	5.11	0.04				
17.00	29.00	5.11	0.04				
18.00	1.00	5.12	0.03				
18.00	29.00	5.13	0.02				
18.00	59.00	5.14	0.01				
19.00	29.00	5.14	0.01				
19.00	59.00	5.15	0.00				
20.00	29.00	5.15	0.00				
20.00	59.00	5.16	-0.01				
21.00	29.00	5.16	-0.01				
21.00	59.00	5.16	-0.01				
10.00	8.00						
9.00	40.00						
10.00	31.00						
8.00	46.00						
9.00	20.00						
11.00	4.00						

023204

STEP DRAWDOWN TEST - WELL ERT 10

Saturated Thickness 50 feet

static water level 5 74 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti	ADJUSTED TIME min	s/Q	RECOVERY TIME-t' min	t/t'
0 00	5.74	0.00	0.00		0 00	0 00		
1.00	7.68	1.94	1 90		1 00	0 93		
2.00	8.16	2 42	2 36		2 00	1 15		
3.00	8.40	2 66	2 59		3 00	1 26		
4 00	8 57	2.83	2.75		4 00	1 34		
5 00	8 70	2 96	2.87		5 00	1.40		
6 00	8.80	3.06	2.97		6.00	1 45		
7.00	8.86	3 12	3 02		7.00	1 47		
8 00	9.12	3 38	3 27		8.00	1.59		
9 00	9.16	3 42	3 30		9 00	1 61		
10 00	10 20	4 46	4 26		10.00	2 08		
11.00	11 27	5.53	5 22		11 00	2 55		
12.00	11 84	6 10	5 73		12 00	2 79		
13 00	12 42	6 68	6.23		13 00	3.04		
14 00	13 02	7.28	6.75		14 00	3 29		
15 00	13 58	7 84	7 23		15 00	3 52		
20 00	16.08	10.34	9 27		20.00	4 52		
25.00	17.38	11 64	10.29		25 00	5 02		
30 00	18.47	12 73	11 11		30 00	5 42		
35.00	19.67	13.93	11.99		35.00	5 85		
40 00	20 95	15 21	12 90		40.00	6 29		
70 00	29.02	23.28	17 86		70 00	8 71		
75 00	31.07	25 33	18 91		75 00	9 23		
80 00	33 25	27.51	19 94		80 00	9 73		
85.00	36 20	30 46	21 18		85 00	10 33		
88 00	37.82	32 08	21 79		88 00	10 63		
90 00	39 20	33 46	22 26		90 00	10.86		
98.50	39.30	33.56	22.30	1 50	40858 12	26 54		
100.00	37 82	32.08	21 79	3 00	15619 62	25 94		
105.00	33 97	28 23	20 26	8 00	4283 36	24 12		
110.00	31.15	25.41	18 95	13 00	2384.30	22 56		
115 00	29 90	24 16	18.32	18 00	1663 01	21 81		
120.00	29.42	23 68	18.07	23.00	1296 15	21.51		
125.00	29.05	23.31	17 88	28 00	1078 60	21 28		
130.00	28 90	23 16	17 80	33 00	936 80	21.19		
135.00	29.35	23.61	18.04	38 00	838.28	21 47		
140.00	29.47	23.73	18.10	43 00	766 66	21 55		
145 00	29.50	23 76	18 11	48.00	712 82	21 57		
150 00	29 60	23.86	18.17	53 00	671.31	21 63		
155.00	29 60	23 86	18.17	58 00	638 67	21 63		
160.00	29.92	24 18	18.33	63 00	612 63	21 83		
170.00	30 20	24 46	18 48	73 00	574 49	22 00		
180 00	30 62	24 88	18.69	83 00	548 97	22 25		
190.00	30 93	25 19	18 84	93 00	531 73	22 43		

023205

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-T1	ADJUSTED TIME min	s/Q	RECOVERY TIME-t' min	t/t'
200.00	31.96	26.22	19.35	103 00	520.19	23.03		
210.00	32 85	27 11	19 76	113 00	512 76	23 52		
220.00	33.68	27.94	20.13	123.00	508 36	23 97		
230.00	34 35	28 61	20 42	133 00	506 27	24 32		
240.00	35 21	29.47	20 79	143 00	505 99	24 74		
250.00	36.05	30.31	21 12	153 00	507 13	25 15		
260 00	36 73	30 99	21 39	163 00	509 43	25 46		
270.00	38.04	32 30	21 87	173 00	512 66	26.03		
280 00	38.84	33.10	22 14	183 00	516 68	26 36		
292.00	38 75	33 01	22 11	195 00	522 36	26 33		
304.50	38.74	33 00	22.11	207 50	529 09	26 32		
314.00	39.68	33 94	22 42	217 00	534 67	26 69		
320 00	39 74	34 00	22 44	3 00	2725 49	35 06		
330.00	39 23	33.49	22 27	13.00	1750 76	34 80		
340.00	39.41	33.67	22 33	23 00	1488 73	34 90		
350 00	39 32	33.58	22 30	33 00	1352 17	34.85		
360.00	40.20	34.46	22.59	43 00	1266 10	35 29		
370.00	40.20	34.46	22 59	53 00	1206 60	35 29		
400 00	40.25	34 51	22 60	83 00	1105 44	35 31		
430.00	40.25	34.51	22.60	113.00	1058 63	35 31		
431 45	39 30	33.56	22 30	1 45	729 06	34 84	1 45	297 55
431.75	39 00	33 26	22 20	1 75	603.90	34 68	1 75	246 71
432.88	38.00	32.26	21.85	2.88	366.57	34 15	2 88	150 31
434.02	37 00	31.26	21.49	4.02	262 34	33 58	4 02	107 97
435.08	36.00	30.26	21.10	5 08	207 41	32 97	5 08	85.65
436.50	35 00	29 26	20 70	6 50	161 90	32 34	6 50	67 15
437 82	34.00	28.26	20 27	7 82	134 42	31 68	7 82	55 99
439 13	33.00	27.26	19 83	9 13	115 01	30 98	9.13	48.10
440.50	32.00	26.26	19 36	10.50	99 90	30 26	10 50	41 95
442 90	31 00	25.26	18 88	12 90	81 17	29 50	12 90	34 33
443.33	30 00	24.26	18.37	13 33	78.53	28.71	13 33	33 26
446.43	28 00	22.26	17 30	16 43	63 58	27 04	16 43	27 17
449.50	26 00	20.26	16 16	19 50	53 47	25 24	19 50	23 05
451.60	24.00	18.26	14.93	21 60	48 21	23 32	21 60	20 91
454.97	22.00	16.26	13 62	24.97	41.63	21 28	24 97	18 22
460 50	20 00	14 26	12 23	30 50	33 99	19 10	30 50	15 10
466.08	18 00	12 26	10 76	36 08	28 67	16 81	36 08	12 92
473.17	16.00	10 26	9.21	43 17	23.91	14 39	43 17	10 96
481 92	14.00	8.26	7 58	51 92	19 85	11 84	51 92	9 28
493.42	12.00	6 26	5 87	63 42	16 23	9 17	63.42	7 78
500.50	11.00	5.26	4 98	70 50	14 60	7.79	70.50	7.10
508.83	10 00	4 26	4 08	78 83	13 06	6 37	78 83	6 45
519.17	9 00	3.26	3 15	89 17	11 56	4 93	89 17	5 82
533.87	8.00	2 26	2 21	103 87	9 95	3 45	103 87	5 14
552 53	7.00	1.26	1.24	122 53	8.48	1 94	122 53	4 51
562.83	6.60	0 86	0 85	132 83	7 85	1 33	132 83	4 24
588.25	6 00	0 26	0 26	158 25	6 66	0 41	158 25	3.72
622.00	5 85	0 11	0.11	192 00	5 58	0 17	192 00	3 24
652.00	5.83	0.09	0 09	222.00	4.90	0 14	222 00	2 94
682.00	5.81	0 07	0 07	252 00	4 40	0.11	252 00	2 71
712.00	5.81	0 07	0 07	282 00	4.00	0.11	282 00	2 52
742.00	5.80	0.06	0 06	312 00	3.69	0.09	312 00	2 38
772.00	5.80	0.06	0 06	342.00	3 43	0 09	342.00	2 26

023206

STEP DRAWDOWN TEST - WELL ERT 10

OBSERVATION WELL - ERT-9

Saturated Thickness 50 feet

static water level 5.55 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti	ADJUSTED TIME min	s/Q	RECOVERY TIME-t' min	t/t'
0.00	5.55	0.00	0.00		0.00	0.00		
4.50	5.82	0.27	0.27		4.50	0.13		
11.50	6.08	0.53	0.53		11.50	0.26		
15.50	6.31	0.76	0.75		15.50	0.37		
20.50	6.49	0.94	0.93		20.50	0.45		
25.50	6.60	1.05	1.04		25.50	0.51		
30.50	6.66	1.11	1.10		30.50	0.54		
35.50	6.72	1.17	1.16		35.50	0.56		
40.50	6.78	1.23	1.21		40.50	0.59		
45.50	6.82	1.27	1.25		45.50	0.61		
50.50	6.85	1.30	1.28		50.50	0.63		
55.50	6.87	1.32	1.30		55.50	0.64		
60.50	6.91	1.36	1.34		60.50	0.65		
70.50	6.96	1.41	1.39		70.50	0.68		
80.50	6.98	1.43	1.41		80.50	0.69		
90.50	6.96	1.41	1.39		90.50	0.68		
100.50	6.90	1.35	1.33	3.50	12662.56	1.59		
105.50	6.82	1.27	1.25	8.50	3970.94	1.49		
110.50	6.76	1.21	1.20	13.50	2283.27	1.42		
115.50	6.71	1.16	1.15	18.50	1615.67	1.36		
120.50	6.67	1.12	1.11	23.50	1269.43	1.32		
125.50	6.63	1.08	1.06	28.50	1061.75	1.27		
130.50	6.60	1.05	1.04	33.50	925.35	1.24		
135.50	6.58	1.03	1.02	38.50	830.10	1.21		
140.50	6.57	1.02	1.01	43.50	760.59	1.20		
145.50	6.55	1.00	0.99	48.50	708.18	1.18		
150.50	6.54	0.99	0.98	53.50	667.69	1.17		
155.50	6.53	0.98	0.97	58.50	635.80	1.16		
160.50	6.52	0.97	0.96	63.50	610.32	1.14		
170.50	6.50	0.95	0.94	73.50	572.96	1.12		
180.50	6.49	0.94	0.93	83.50	547.94	1.11		
190.50	6.48	0.93	0.92	93.50	531.03	1.10		
200.50	6.48	0.92	0.92	103.50	519.73	1.09		
210.50	6.46	0.91	0.90	113.50	512.47	1.07		
220.50	6.47	0.92	0.91	123.50	508.20	1.09		
232.30	6.46	0.91	0.90	135.30	506.06	1.07		
240.00	6.47	0.92	0.91	143.00	505.99	1.09		
249.10	6.45	0.90	0.89	152.10	506.98	1.06		
261.50	6.44	0.89	0.88	164.50	509.86	1.05		
269.60	6.42	0.87	0.86	172.60	512.52	1.03		
281.70	6.44	0.89	0.88	184.70	517.43	1.05		
289.35	6.42	0.87	0.86	192.35	521.03	1.03		

023207

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti	ADJUSTED TIME min	s/Q	RECOVERY TIME-t' min	t/t'
302.15	6.42	0.87	0.86	205.15	527.76	1.03		
309.33	6.40	0.85	0.84	212.33	531.88	1.00		
321.65	6.35	0.80	0.79	4.65	2382.69	1.24		
333.00	6.32	0.77	0.76	16.00	1648.66	1.19		
341.33	6.31	0.76	0.75	24.33	1466.01	1.18		
351.82	6.28	0.73	0.72	34.82	1333.76	1.13		
359.50	6.27	0.72	0.71	42.50	1269.65	1.12		
371.77	6.25	0.70	0.70	54.77	1197.95	1.09		
379.18	6.25	0.70	0.70	62.18	1166.33	1.09		
391.65	6.22	0.67	0.67	74.65	1125.96	1.04		
400.12	6.20	0.65	0.65	83.12	1105.17	1.01		
411.43	6.18	0.63	0.63	94.43	1083.46	0.98		
419.50	6.17	0.62	0.62	102.50	1071.27	0.96		
431.90	6.15	0.60	0.60	1.90	556.15	0.93	1.90	227.32
436.50	6.15	0.60	0.60	6.50	161.90	0.93	6.50	67.15
441.92	6.12	0.57	0.57	11.92	87.91	0.89	11.92	37.07
448.50	6.08	0.53	0.53	18.50	56.39	0.82	18.50	24.24
452.50	6.05	0.50	0.50	22.50	46.26	0.78	22.50	20.11
456.00	6.02	0.47	0.47	26.00	39.96	0.73	26.00	17.54
461.50	5.99	0.44	0.43	31.50	32.90	0.68	31.50	14.65
467.00	5.95	0.40	0.40	37.00	27.95	0.62	37.00	12.62
472.00	5.93	0.38	0.38	42.00	24.59	0.59	42.00	11.24
477.00	5.90	0.35	0.35	47.00	21.95	0.54	47.00	10.15
482.50	5.88	0.33	0.33	52.50	19.63	0.51	52.50	9.19
490.00	5.85	0.30	0.30	60.00	17.16	0.47	60.00	8.17
500.00	5.82	0.27	0.27	70.00	14.70	0.42	70.00	7.14
510.00	5.80	0.25	0.24	80.00	12.87	0.38	80.00	6.38
520.00	5.76	0.21	0.20	90.00	11.45	0.32	90.00	5.78
530.00	5.72	0.17	0.17	100.00	10.33	0.27	100.00	5.30
540.00	5.71	0.16	0.16	110.00	9.41	0.25	110.00	4.91
550.00	5.70	0.15	0.14	120.00	8.65	0.23	120.00	4.58
560.00	5.68	0.13	0.13	130.00	8.01	0.20	130.00	4.31
590.00	5.65	0.10	0.10	160.00	6.59	0.16	160.00	3.69
620.00	5.61	0.06	0.06	190.00	5.63	0.09	190.00	3.26
650.00	5.59	0.04	0.04	220.00	4.94	0.06	220.00	2.95
680.00	5.58	0.03	0.03	250.00	4.43	0.05	250.00	2.72
710.00	5.58	0.03	0.03	280.00	4.03	0.05	280.00	2.54
740.00	5.57	0.02	0.02	310.00	3.71	0.03	310.00	2.39
770.00	5.56	0.01	0.01	340.00	3.45	0.02	340.00	2.26

023208

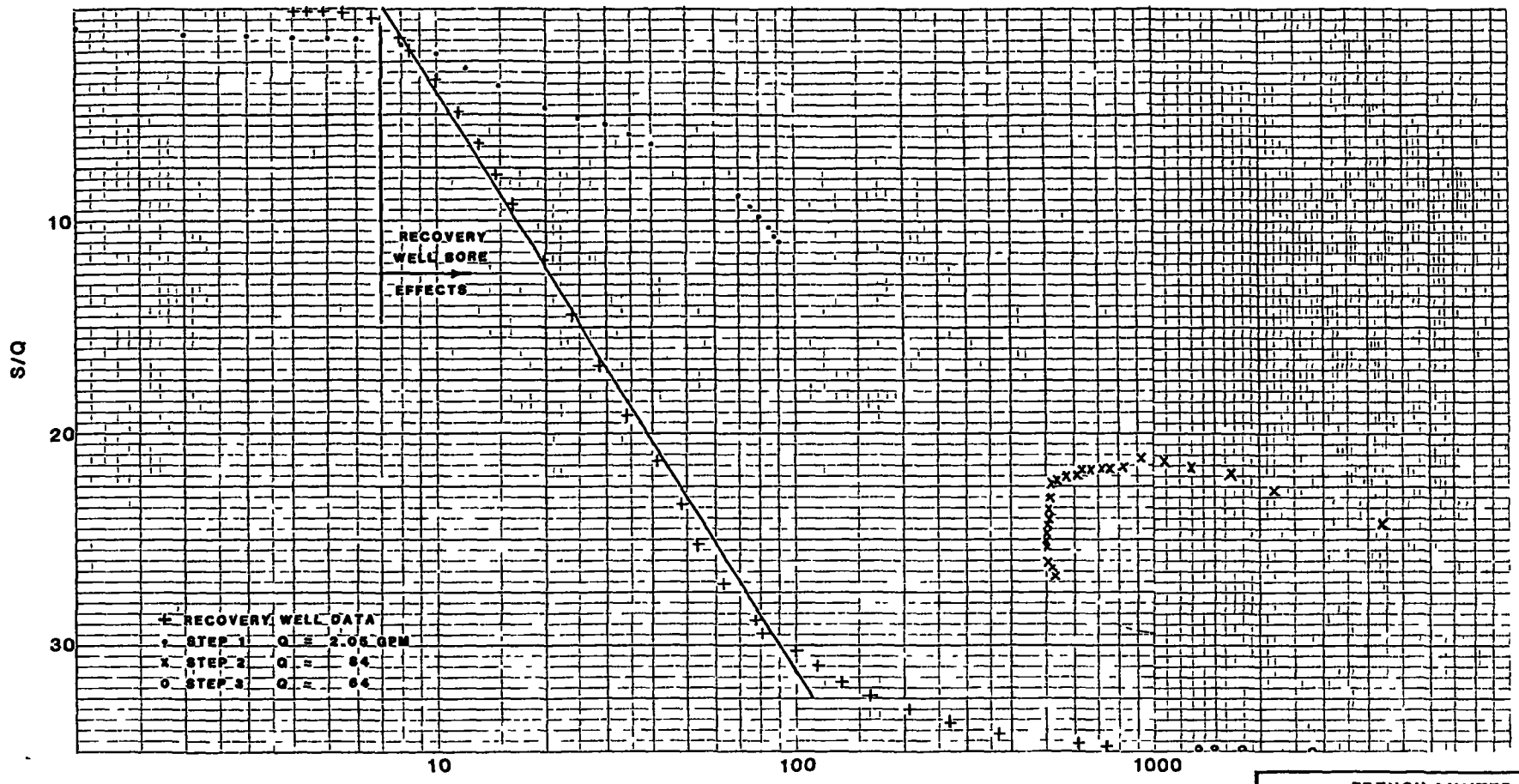
STEP DRAWDOWN TEST - WELL ERT 10

OBSERVATION WELL - REI-10-4

Saturated Thickness 42.54 feet

static water level 5.46 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	RECOVERY TIME-t' min	t/t'
0.00	5.46	0.00	0.00		
20.00	5.60	0.14	0.14		
40.00	5.85	0.39	0.39		
68.00	6.02	0.56	0.56		
91.00	6.11	0.65	0.65		
125.00	6.04	0.58	0.58		
150.00	5.97	0.51	0.51		
181.00	5.95	0.49	0.49		
214.00	5.95	0.49	0.49		
246.00	5.94	0.48	0.48		
273.00	5.93	0.47	0.47		
308.00	5.93	0.47	0.47		
344.00	5.88	0.42	0.42		
365.00	5.88	0.42	0.42		
392.00	5.84	0.38	0.38		
420.00	5.82	0.36	0.36		
430.00	5.82	0.36	0.36		
431.00	5.82	0.36	0.36	1.00	431.00
435.00	5.81	0.35	0.35	5.00	87.00
440.00	5.80	0.34	0.34	10.00	44.00
448.00	5.78	0.32	0.32	18.00	24.89
453.00	5.77	0.31	0.31	23.00	19.70
458.00	5.75	0.29	0.29	28.00	16.36
475.00	5.70	0.24	0.24	45.00	10.56
490.00	5.66	0.20	0.20	60.00	8.17
505.00	5.63	0.17	0.17	75.00	6.73
520.00	5.60	0.14	0.14	90.00	5.78
535.00	5.58	0.12	0.12	105.00	5.10
550.00	5.57	0.11	0.11	120.00	4.58
565.00	5.55	0.09	0.09	135.00	4.19
595.00	5.55	0.09	0.09	165.00	3.61
625.00	5.51	0.05	0.05	195.00	3.21
655.00	5.50	0.04	0.04	225.00	2.91
685.00	5.50	0.04	0.04	255.00	2.69
715.00	5.49	0.03	0.03	285.00	2.51
745.00	5.48	0.02	0.02	315.00	2.37
775.00	5.47	0.01	0.01	345.00	2.25



FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-1
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

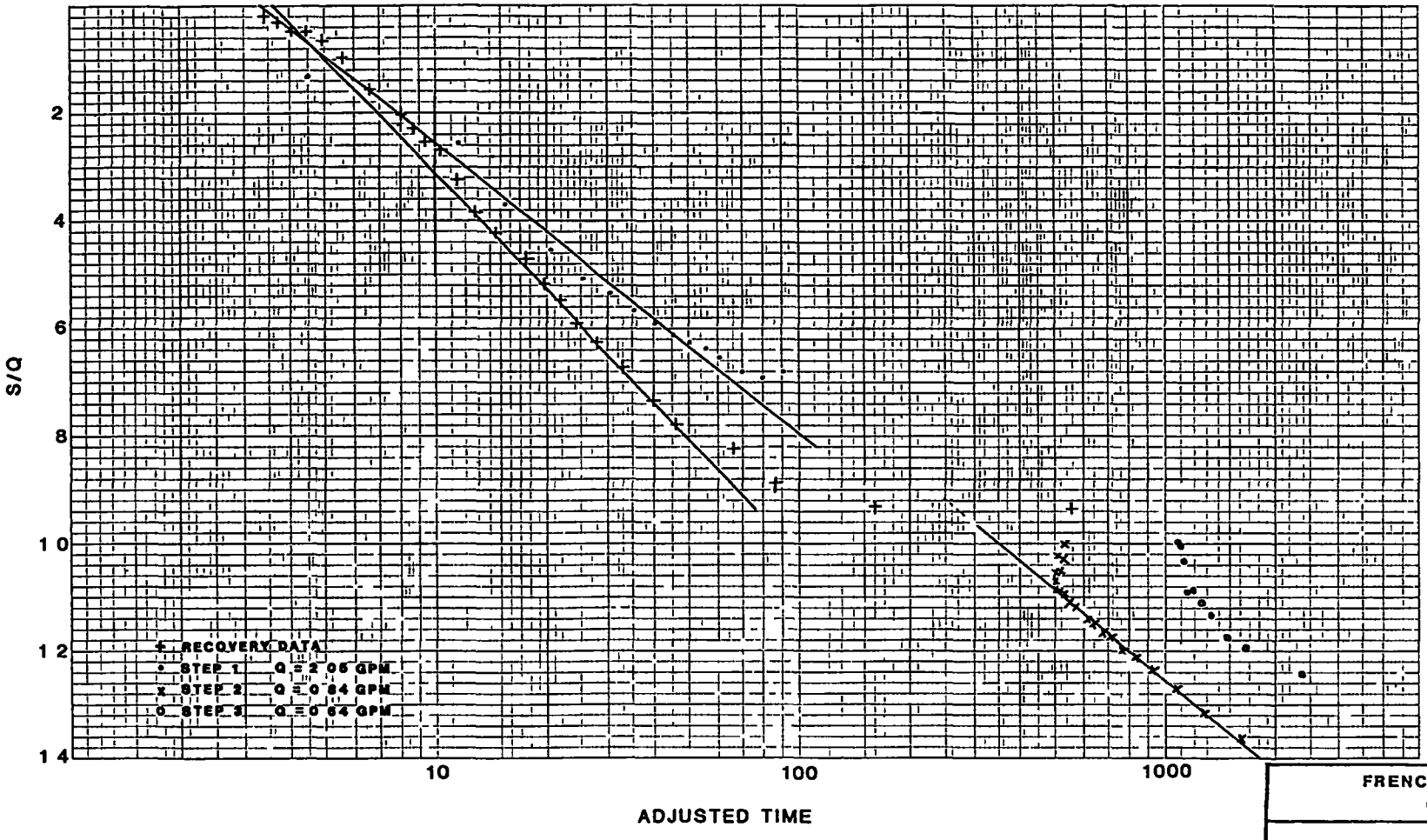
PUMPED WELL ERT-10
OBSERVATION WELL ERT-10
DATE(S) AUG 15, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023209

023210



Recovery Analysis

$T = \frac{264}{\Delta (S/Q)}$ gpd/ft

$T = \frac{264}{0\ 54} = 489$ gpd/ft

$S = \frac{T\ (to)}{4790\ r^2}$

$S = \frac{489\ (3\ 4)}{4790\ (9\ 05)^2}$

S = 0042

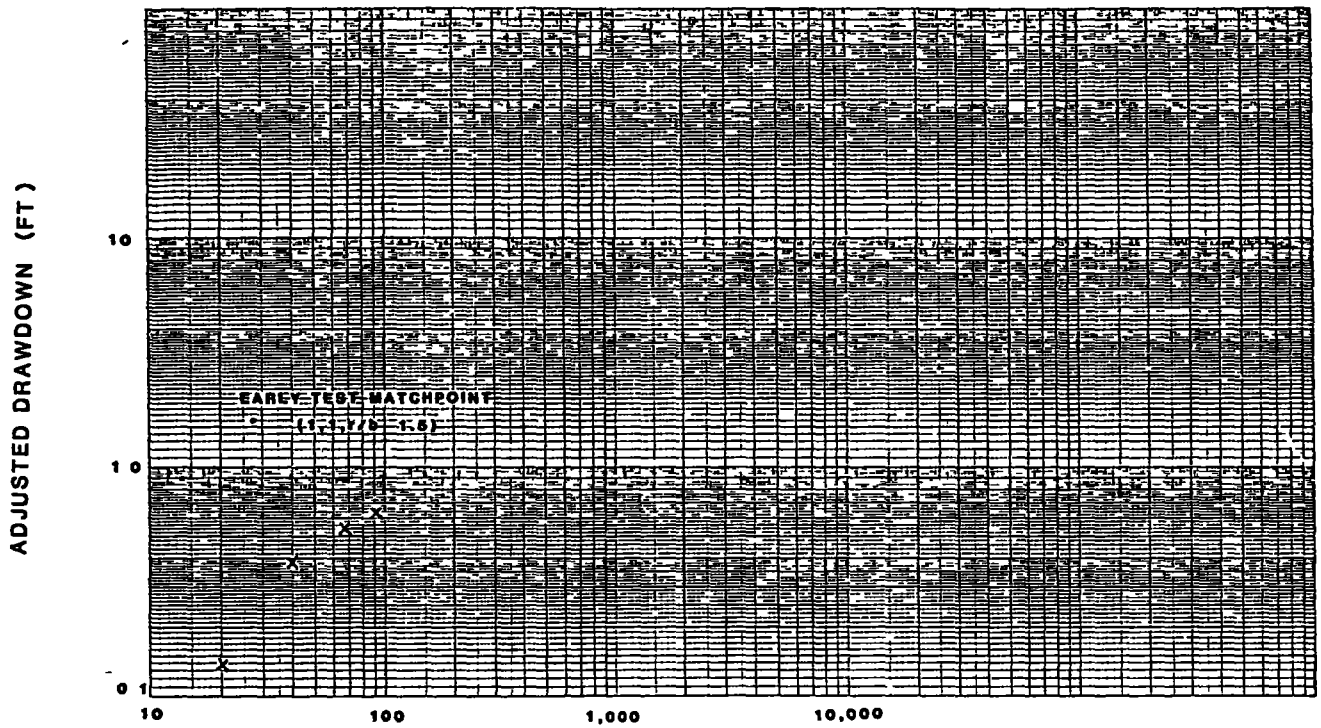
FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A·2
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL ERT-10
OBSERVATION WELL ERT-9
DATE(S) AUG 15, 1988

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO



$$T = \frac{1\ 0\ Q}{4\ \ S} = \frac{2.05 \times 1440 \text{ min /day}}{4\ (1\ 62)}$$

$$T = 145 \text{ gpd/ft} = 01346 \text{ ft}^2\text{/min}$$

$$Se = \frac{4\ T\ t}{r^2} = \frac{4\ (\ 01346 \text{ ft}^2\text{/min})\ (27 \text{ min}\ )}{(44\ 6)^2}$$

$$Se = 000785$$

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-3

BOULTON DELAYED YIELD ANALYSIS

PUMPED WELL ERT-10

OBSERVATION WELL REI-10-4

DATE(S) AUGUST 15, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023212

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-10 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 18-15-86 STATIC WATER LEVEL DEPTH 5.74

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

Pumping well ERT 10

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
:35			5.74		09:03	5 GAL 3 min 15 sec
51			5.74		09:07	5 GAL
09:01			7.68			
09:02			8.16			
09:03			8.40			
09:04			8.57			
09:05			8.70			
09:06			8.80			
09:07			8.86			5 GAL 3 min 39 sec
09:08			9.12			
09:09			9.16			
09:10			10.20			5 GAL 2 min 35 sec
09:11			10.27			
09:12			11.84			
09:13			12.42			5 GAL 2 min 51 sec
09:14			13.02			
09:15			13:58			5 GAL 2 min 10 sec
09:20			16:08	CASING STORAGE		
09:25			17:35		09:20.5	5 GAL 2 min 0 sec
09:30			18.47		09.23	5 GAL 2 min 10 sec
09:35			19:67		09:26	" 2 min 22 sec
09.40			20:95		09:29	" 2 min 13 sec
09:45			21:16		09.32	" 2 min 14 sec
09:50			21:06		09:35	" 2:16
09:55			21.15		09:37	" 2:17
10:00			21.15		09:41	" 2 20
10:10			29.02		09:44	" 2.21
10:15			31.07		09:48	" 2.22
10:20			33.25		09:54	" 2 21
10:25			36.20		09:57	" 2.23
10:28			37.82		10:00	" 2.17
10.30			39.2		10:04	" 2 20
10:37	shut pumping rate back to				10:06	" 2.22
					10:09	" 2.23
10:38:30			39.30		10:12	" 2.23
					10:15	" 2.24
10:40			37.82		10:18	" 2.25
10:45			33.97		10:23	" 2.26
10:50			31.15		10:26	" 2.30
					10:29	" 2 30
					10.32	" 2.35
					10:46	" 6 2.5

023213

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-10 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8-15-86 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS min SEC.	
10:55			29.9		10:53	5 GAL. 6.42	
11:00			29.42		10:59	" 5.30	
11:05			29.05		11:05	" 5.40	
11:10			28.90		11:11 34	" 5.39	
11:15			29.35		11:17	" 5.22	
11:20			29.47		11:23	" 5.24	
11:25			29.50		11:32	" 5.53	
11:30			29.60		11:38	" 4.52	
11:35			29.60		11:45	[illegible]	
11:40			29.92				
11:50			30.20		11:50	5' 56"	
					11:58	5' 55"	11 52 -
12 00			30.62		12:04	5' 59"	
12:10			30.93		12:11	6' 06	12 05-
					12:17	5' 40"	12:12
12:20			31.46		12:23	5' 45.	12:18
12:30			32.85		12:29	5' 45"	12:24
					12:36	5' 55"	12:30
12:40			33.68		12:42	5' 51"	12.37
12:50			34.35		12:49	5' 58"	12.43
					12:55	5' 54"	12:50
13.00	~~(60)~~		35.21		13:02	5' 54"	12:56:30
13:10			36.05		13:08	5' 49"	13'03
					13:15	6' 20"	13:09:02
13:20			36.73		13:21	5' 48"	13:14
					13:27	5' 49	13 22
13:30			38.04		13:31	5' 45"	13:29
13:40			38.84		13:42	6' 5"	13'36
					13:48	5' 30"	13' 43
13:50			38.75		13:55	6' 20"	13:49
					13:-	6' 30"	13.59
14 04:30			38 74		14 13.30	6' 25'	14' 07
					14 28-	7' 20"	14 16 15
14 14 00		MAYBE	~39 66 (?)				14 "
14 20 00		ON TOP	~39 74 (?)				14 26 00
14 23 00		OF	39 96				
14 30 100		PUMP	39 23		14 34	8' 05"	
					1442	7' 10"	1435

023214

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HYDROLOGIC TEST DATA SHEET

WELL # ERT 10

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-16

STATIC WATER LEVEL DEPTH 5.74

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumping Well.

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS (FLOW RATE)	
							14 41
14:40			39 41		14 51	7'35"	
14 50			39.32				
					14 51	7'35"	14 53
15 10			40.00		15.00	7'02"	
15:00					15:09	7'45	15:01:15
15:10			>40.2'		15:18	8'02	15:09:50
15:20			>40.25		15:26	8'16"	15:18:10
15:30			>40.25'		15:35	8'10"	15:27
15:40			>40.25'		15:44	8'17"	15:36
15.50			>40.25'		15'53	8'19"	15.45
16:00			>40.25'		16:02	8'31	15.54
16.10	Stop Pump		>40.25		4.4 gal in	7'0"	16'03
Start Recover							
~~16:10:09~~	16:11:20		39.3'				
	16:11:44		37.0				
	16:12.53		38.0				
	16:14:01		37.0'				
	16:15.05		36.0				
	16:16.30		35.0'				
	16:17:49		34.0'				
16:19:08			33 0				
16:20:30			32.0				
16:22:54			31 0				
16:23.20			30.0				
16:26:26			28.0				
16:29:30			26.0				
16:31:30			24.0				
16:34.58			22.0				
16:40.03			20.0				
16.46.05			18.0				
16:53 10			16.0				
17:01:55			14.0				
17.13:25			12.0				
17.20:30			11.0				
17:28:50			10.0				
17:39:10			9.0				
17:53:52			8.0				
18:12:32			7.0				
18:22:50			6.5				

023215

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HYDROLOGIC TEST DATA SHEET

WELL # ERJ-10

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15

STATIC WATER LEVEL DEPTH 5.74

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumping Well

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
18:29:50			6.6			
18:48:15			6.0			
19.22			5.85			
19:52			5.83			
20:22			5.81			
20:52			5.81			
21:22			5.80			
21:52			5.80			

023216

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-91

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15-86

STATIC WATER LEVEL DEPTH _____

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumped well ERI 10 radial distance 15.05 ft

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
8:34			5.30			
8:54			5.30			
9:00	Start					
9:05:15			5.26			
09:10:00			5.28			
09:15:00			5.28			
09:20:00			5.29			
09:25:00			5.28			
09:30:00			5.29			
09:35:00			5.29			
09:40:00			5.30			
09:45:00			5.30			
09:50:00			5.30			
09:55:00			5.31			
10:00:00			5.31			
10:10:00			5.31			
10:20:00			5.31			
10:30:00			5.31			
10:40:00			5.31			
10:45:00			5.31			
10:50:00			5.31			
10:55:00			5.31			
11:00:00			5.31			
11:05:00			5.31			
11:15:00			5.31			
11:20:00			5.31			
11:25:00			5.31			
11:30:00			5.31			
11:35:00			5.31			
11:40:00			5.31			
11:50:00			5.32			
12:00:00			5.32			
12:10:00			5.32			
12:20:00			5.32			
12:30:00			~~5.32~~ 5.31			
12:40:00			5.31			
12:51:00			5.31			
13:00:00			5.31			
13:10:00			5.32			

023217

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HYDROLOGIC TEST DATA SHEET

WELL # FRT-9 9

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15-85

STATIC WATER LEVEL DEPTH 5.30

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
13:20.51			5.31			
13:30:01			5.30			
13 40.11			5.30			
13:50:14			5.30			
14:01.17			5.30			
14:10.25			5.30			
14:20:28			5.30			
14:32:10			5.28			
14:42.31			5.27			
14:55:01			5.27			
15 00.30			5.27			
15:10:46			5.28			
15.20.14			5.27			
15:30:30			5.27			
15:41:12			5.27			
15:50 30			5.27			
16:00:12			5.27			
		START RECOVERY				
16.10.			5.25			
16.15.10			5.27			
16.21.10			5.27			
16:26			5.25			
16 31			5.25			
16 36			5.25			
16 40			5.25			
16.45			5.25			
16:51			5.25			
16 56			5.25			
17:01			5.25			
17:06			5.25			
17:14			5.25			
17:29			5.25			
17 34			5.24			
17 44			5.23			
18:59			5.23			
18:04			5.23			
18:19			5.22.5			

023218

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HYDROLOGIC TEST DATA SHEET

WELL # IFRJ 9A

TESTED INTERVAL _____

DATE 8-15-88

PERSONNEL _____

GR. ELEVATION _____

M.P. ELEVATION _____

STATIC WATER LEVEL DEPTH 5.30

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
~~18:49~~						
18:19			5.225			
18:49			5.225			
19:19			5.23			
19:49			5.24			
20:19			5.25			
20:49			5.25			
21:19			5.25			
21:49			5.25			

023219

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HYDROLOGIC TEST DATA SHEET

WELL # BR1-7 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8 15-86 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

Pumped well LR1 10 radial distance 9.05ft

CLOCK TIME	TIME AFTER TEST STARTED	-	DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
[illegible]			[illegible]			
[illegible]			[illegible]			
[illegible]						
09 00						
09 07 30			[illegible]			
09 14 30			6 08			
09 15 30			6 31			
09 20 30			6 41			
09 25 30			6 16			
[illegible]						
09 35 30			6 72			
09 40 30			6.78			
09 45 30			6.82			
09 50 30			[illegible]			
09 [illegible]			[illegible]			
10 00 30			6 71			
10 10 30			6 71			
10 20 30			6.48			
10 30 30			6.70			
10 40 30			6 40			
10.45.30			6.87			
10.50.30			6.76			
10 55 30			6.71			
11 00 30			[illegible]			
[illegible]			6.62			
11.10 30			6 61			
11 15 30			6 58			
11.20 30			6 57			
11.25.30			6.55			
11 30 30			6 54			
11 35 30			6 53			
11 40 30			6 52			
11 50 30			6 50			
12 00 30			6 49			
12 10 30			6 48			
12 20 30			6.475			
12.30.30			6.41			
12 40 30			6 47			
12.52.30			6 46			

023220

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HYDROLOGIC TEST DATA SHEET

WELL # LRT-9

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15-91

STATIC WATER LEVEL DEPTH _____

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
13:00:00			6.47			
13:04.02			6.43			
13:21.29			6.41			
13:29:23			6.43			
13:41:42			6.42			
13:44.21			6.43			
14:02:04			6.43			
14:04:13			6.40			
14.21.34			6.34			
14.37.01			6.30			
14:41:21			6.31			
14:51.44			6.23			
14:51.36			6.21			
15:11:46			6.23			
15.19.11			6.25			
15.31.09			6.22			
15.40.07			6.20			
15:51.26			6.18			
15.59.30			6.11			
[illegible]			6.13			
[illegible]			6.15			
16.21:35			6.12			
16:28.30			6.14			
16:30:30			6.05			
16:36			6.02			
16.41:30			5.985			
16:47			5.95			
16:52			5.93			
16:57			5.90			
17:02:30			5.88			
17:10			5.85			
17:20			5.80			
17:30			5.795			
17.40			5.755			
1750			5.72			
18:00			5.71			
18:10			5.695			
18:20			5.68			

023221

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HYDROLOGIC TEST DATA SHEET

WELL # ERT 9

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15-88

STATIC WATER LEVEL DEPTH 5.55

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumped well ERT-10

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
18:10			5.695			
18:20			5.68			
18:50			5.65			
19:20			5.61			
19:50			5.59			
20:20			5.58			
20:50			5.58			
21:20			5.57			
21:50			5.56			

023232

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HYDROLOGIC TEST DATA SHEET

WELL # FRT 10A

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15 85

STATIC WATER LEVEL DEPTH _____

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumped well FRT 10 radial distance 11.4

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
8 45			5.40			
8:55			5.42			
9:00	5 hr 1		~~5.42~~			
9 05			5.40			
9 11			5.40			
9:13 30			5.41			
09 18 30			5.41			
09 23 30			5.42			
09:28 30			5.42			
09:33:30			5.42			
09 39 30			5.42			
09 44 00			5.42			
09:49 00			5.43			
09 54 00			5.43			
09:59:00			5.43			
10 04 00			5.43			
10:19:00			5.42			
10.29 00			5.42			
10 34:00			5.42			
10:39 00			5.43			
10:41:00			5.43			
10 54.00			5.43			
10 59 00			5.43			
11 04 00			5.43			
11 14 00			5.43			
11 19 00			5.43			
11 24 00			5.43			
11 29 00			5.43			
11 34 00			5.43			
11 39 00			5.43			
11 44 00			5.44			
11:54:00			5.44			
12 01 00			5.44			
12 11 00			5.43			
12 21 00			5.43			
12 31:00			5.43			
12 41:00			5.43			
13 00 45			5.42			
13:01 45			5.42			

023223

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HYDROLOGIC TEST DATA SHEET

WELL # FRT 107 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE _____ STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
13:14:43			5.42			
3.31 35			5.42			
13 29:51			5.41			
13.51 28			5.42			
13:04 54			5.42			
14.11:36			5.42			
14:17:33			5.42			
14.30.18			5.40			
14:38.17			5.40			
14.47.50			5.40			
15.01.04			5.40			
15 04 51			5.39			
15:21:13			5.38			
15:29:26			5.38			
15.42 32			5.38			
15.44 34			5.38			
16:01:03			5.38			
16.09 51			5.05			
		START RECOVERY				
16:13 26			5.40			
16:15			5.31			
16:20			5.36			
16.25			5.35			
16.30			5.35			
11.34			5.35			
11:37			5.31			
16 41 30			5.36			
16.45			5.37			
16:53			5.365			
16.55			5.365			
17:03:30			5.365			
16.64						
17.11			5.37			
17.21			5.37			
17:33			5.37			
17:41			5.36			

023224

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HYDROLOGIC TEST DATA SHEET

WELL # LRT 10A

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-15-88

STATIC WATER LEVEL DEPTH 5.42

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
17:51			5.36			
18:01			5.36			
18:11			5.36			
18:21			5.36			
18:51			5.36			
19:21			5.36			
19:51			5.36			
20:21			5.37			
20:51			5.38			
21:21			5.39			
21:51			5.32			

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test - Well ERT-10 DATE 8-15-88

ME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
:40	ERT-1				6.32		
:44	ERT-1A				6.24		
:49	ERT-8				4.53		
:50	ERT-8A				5.16		
:46	RET-10-4	radial distance from	ERT-10 = 44.6'		5.46		
7:18	ERT-1				6.31		
:22	ERT-1A				6.53		
:24	RET-10-4				5.60		
24:30	ERT 8				4.53		
.25	ERT-8A				5.17		
:40	RET-10-4				5.85		
:43	ERT-1				6.32		
:44	ERT-1A				6.52		
48	ERT-8				4.54		

023226

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test in Well ERT-10 DATE 8-15-88

IME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL ((R±CF)±MP)
50	ERT 8A				5.17		
08	RET-10-4				6.02		
11	ERT-1				6.34		
12	ERT-1A				6.64		
18	ERT-8				4.54		
19	ERT-8A				5.18		
31	RET-10-1				6.11		
33	ERT-1				6.35		
34	ERT-1A				6.55		
42	ERT-8A				5.18		
42	ERT-8				4.54		
01	ERT 1				6.35		
02	ERT 1A				6.5		
04	RET-10-1				6.04		

023227

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test ~ ERT-10 DATE 8-15-88

Control Wells

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
08	ERT-8				4.54		
09	ERT 8A				5.19		
10	Lagoon				.92		
1:30	RET-10-4				5.97		
1:34	ERT-1				6.36		
1:35	EAT-1A				6.52		
1:40	ERT 8				4.54		
1:41	EAT 8A				5.19		
1:42	Lagoon				.91		
2:01	RET-10-4				5.95		
2:02	ERT-1				6.35		
2:02	ERT-1A				6.57		
2:07	ERT-8				4.54		
2:07	ERT 8-A				5.19		

023228

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump test ERT-10 Control wells DATE 8-15-85

TIME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL ((R±CF)±MP)
2:28	Legoon				.92		
2:32	ERT 1				6.35		
2:33	ERT 11				6.55		
2:34	RET-10-4				5.95		
2:45	ERT-8				4.53		
2:45	ERT 8A				5.18		
2:46	Legoon				.92		
3:04	ERT-1				6.34		
3:05	ERT-11				6.55		
3:06	RET 10-4				5.94		
3:11	ERT-8				4.52		
3:12	ERT-8A				5.17		
3:13	Legoon				0.92		
3:31	ERT-1				6.33		

023229

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test Well ERT-10 DATE 8-15-88

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
3:32	ERT-1A				~6.5		
3:30	REI 10-4				5.93		
3:37	ERT-8				4.52		
3:37	ERT-8A				5.16		
3:35	Lagoon				0.92		
02	ERT 1A				—		
08	REI 10-4				5.93		
12	ERT 8				4.52		
13	ERT 8A				5.17		
14	Lagoon				0.92		
03	ERT 1				6.34		
4:41	ERT 1				6.32		
4:42	ERT 1A				~6.5		
4:44	REI 10-4				5.88		

023230

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test well ERT-10 DATE 8-15-88

IME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
1:47	ERT 8				4.50		
1:48	ERT 8A				5.15		
1:49	Lagoon				0.92		
5:05	REI 104				5.88		
5:08	ERT-1				6.31		
5:09	ERT 1A				~ 6.5		
5:12	ERT 8				4.50		
5:13	ERT 8A				5.13		
5:14	Lagoon				.925		
5:32	REI 10-4				5.84		
5:34	ERT 1				6.31		
5:36	ERT 1A				~ 6.5		
5:39	ERT 8				4.48		
5:38	Lagoon				0.925		

023231

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump Test ERT 10 DATE

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
540	ERT 8A				5.13		
50	ERT 1				6.29		
54	ERT 1A				~ 6.50		
08	REI 10-4				5 82		
03	ERT 8				4 475		
-04	ERT 8A				5 12		
05	LABCOM				0.925		
10	Stop Pump.				5 82		
11	REI 10-4				5.82		
15	REI 10-4				5.81		
20	REI 10-4				5 80		
21	ERT 1				6.27		
022	ERT 1A				~ 6.5		
	ERT 8				4 41		

023232

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Recovery test ERT 10 DATE 8-15-88

NO	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL ((R±CF)±MP)
25	ERT 8A				5.12		
27	Lagoon				0.925		
28	RET 10-4				5.78		
33	RET 10-4				5.77		
37	ERT 1				6.27		
38	RET 10-4				5.75		
40	ERT 8				4.46		
41	ERT 8A				5.12		
42	LAGOON				0.925		
55	RET-10-4				5.70		
57	ERT 1				6.26		
59	ERT 8				4.46		
100	ERT 8A				5.11		
701	Lagoon				0.93		

023233

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Recovery Test ERT-10 DATE 8-15-88

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
10	REI-10-4				5.66		
125	REI-10-4				5.63		
126	ERT-1				6.26		
728	ERT-8				4.46		
729	ERT-8A				5.11		
730	Lagoon				0.93		
740	REI-10-4				5.60		
755	REI-10-4				5.58		
756	ERT-1				6.26		
757	ERT-1A				6.91 (? oil phase)		
800	ERT-8				4.46		
801	ERT-8A				5.12		
802	Lagoon				0.93		

023234

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Recovery test ERT-10 DATE 8-15-88

ME	WELL NO	LAST PEADING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
10	REI-10-4				5.57		
25	REI-10-4				5.55		
826	ERT-1				6.27		
828	ERT-8				4.47		
29	ERT-8A				5.13		
830	Lagoon				0.93		
855	REI 10-4				5.55		
856	ERT-1				6.27		
858	ERT-8				4.48		
859	ERT-8A				5.14		
900	Lagoon				0.93		
925	REI-10-4				5.51		
926	ERT-1				6.27		

023235

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Recovery test ERT-10 DATE 8-15-88

NE	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
28	ERT-8				4.48		
29	ERT-8A				5.14		
30	Lagoon				0.93		
55	REI-10-4				5.50		
56	ERT-1				6.28		
58	ERT-8				4.49		
59	ERT-8A				5.15		
00	Lagoon				0.93		
25	REI-10-4				5.50		
26	ERT-1				6.28		
28	ERT-8				4.50		
29	ERT-8A				5.15		
30	Lagoon				0.93		

023236

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Recovery test ERT-10 DATE 8-15-88

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
055	REI-10-4				5.49		
056	ERT-1				6.29		
058	ERT-8				4.50		
059	ERT-8A				5.16		
100	Lagoon				0.93		
125	REI-10-4				5.48		
126	ERT-1				6.28		
128	ERT-8				4.50		
129	ERT-8A				5.16		
130	Lagoon				0.93		
155	REI-10-4				5.47		
156	ERT-1				6.29		
158	ERT-8				4.51		
159	ERT-8A				5.16		
200	Lagoon				0.93		

023237

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HYDROLOGIC TEST DATA SHEET

WELL # ERT 10

TESTED INTERVAL _____

DATE 8-12

PERSONNEL _____

GR. ELEVATION _____

M.P. ELEVATION _____

STATIC WATER LEVEL DEPTH _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
			13.30			
17:55					5 gal / 2 min 33"	5:55 -
17:57					/ 2 min 20"	
18:00			14.02		5 gal / 2 min 20"	6:01:10
18:03						
18:05			14.92			
Pump off 18:06	⇒ Pump	off	15.06			
18:06:30			13.72			
18:07:30			11.63			
18:08:30			10.16			
18:09:30			9.12			
18:10:30			8.34			
18:11:30			7.80			
18:12:30			7.39			
18:13:30			7.11			
18:14:30			6.91			
18:15:30			6.78			
18:16:30			6.67			
18:17:30			6.59			
18:18:30			6.52			
18:19:30			6.47			
18:20:30			6.43			
18:21:30			6.39			
18:26:30			6.29			
18:31:30			6.21			
18:36:30			6.16			

023238

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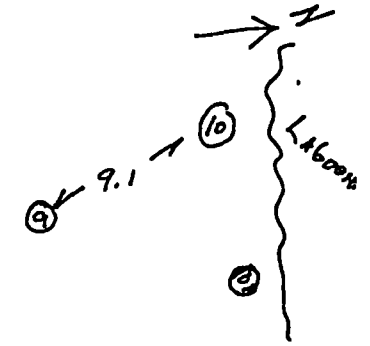

HYDROLOGIC TEST DATA SHEET

WELL # ERT-10 GR. ELEVATION _____

TESTED INTERVAL _____ M P. ELEVATION _____

DATE 8-12 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well ERT10

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL	~~Flow~~	COMMENTS
16:19			5.78'			
16:25			5.78			
16:51			5.77			
16:54			5.78			
16:57			5.78			
Start 17 00:00						
17 00:30						
17 01:00			~~[illegible]~~	7.02		
17:01:30			~~[illegible]~~ 7.18			
17:02:30			~~[illegible]~~ 7.53			
17:03:30			7.70			
17:04:30			7.83			
17:05:00						5gal/5'10"
17.05.30			7.93			
17 06:30			8.01			
17:07 30			8 08			
17 08.30			8 12			
17.09:30			8.06			
17:10:30			8 06			
17.11:00						5gal/5'10"
17:11:30			8.15			
17:12:30			8.14			
17:13.30			8 04			
17:15.00			7.96			5gal/5'15"
17:20:00			7.91			5gal/6'10" 5:14-
17:25			7.79			5gal/5'15"
17:30			8.11			
17:31	stepped up pump rate to				5gal/	2'43"
17:35			10.03			
17:37					5gal/	2'10"
17:40			11.69		5gal/	2'13"
17:42					5gal/	2'16" 5:41-
17:45			12.47		5gal/	2'15" 5:43:30
17:48					5gal/	2'12"
17:50			13.28		5gal/	2'14" -5:49
17.54					5gal/	2'28" -5:52

023239

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-10

GR. ELEVATION _____

TESTED INTERVAL _____

M P. ELEVATION _____

DATE 8-12

STATIC WATER LEVEL DEPTH 5.78

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
18:26:30			6 29			
18:31:30			6.21			
18:36:30			6.16			
18:41:30			6.12			
18:46:30			6.10			
18:51:30			6.07			
18:56:30			6 05			
19:01:30			6:03			
19:16:30			5.98			
19:31:30			5.95			
19:46:30			5.92			
20:01:30			591			
20:31:30			5.88			
21 01:30			5.87			
21:31:30			5.86			
22 01:30			585			

023240

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-9 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8-12 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well ERT to radial distance 9.1 ft

	CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
	16:20			5.60			
	16:37			5.60			
	16:52			5.60			
start	17.00						
	17:02			5.65			
	17:04			5.75			
	17:06			5.84			
	17:08			5.90			
	17:10			5.95			
	17:12			5.99			
	17:14			6.02			
	17:15:30			6.03			
	17:20:30			6.06			
	17:25:30			6.06			
	17:30:30			6.10			
	17:35:30			6.28			
	17:40:30			6.50			
	17:45:30			6.63			
	17:50:30			6.72			
	17:55:30			6.76			
	18:00:30			6.79			
	18:05:30			6.85			
	18:07			6.85			
	18:09			6.76			
	18:11			6.63			
	18:13			6.50			
	18:15			6.39			
	18:17			6.31			
	18:19			6.25			
	18:21			6.19			
	18:26			6.10			
	18:31			6.03			
	18:36			5.98			

023241

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HYDROLOGIC TEST DATA SHEET

WELL # ERT-9

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8-12

STATIC WATER LEVEL DEPTH 5.6

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
18:26			6.1			
18:31			6.03			
18:36			5.98			
18:41			5.94			
18:46			5.90			
18:51			5.89			
18:56			5.86			
19:01			5.84			
19:16			5.79			
19:31			5.76			
19:46			5.74			
20:01			5.72			
20:31			5.69			
21:01			5.67			
21:31			5.66			
22:01			5.66			

023242

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Well ERT 29 test- Control Wells & Recovery DATE 6-12

TIME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
	ERT 23				cap jammed		
	ERT 28				cap jammed	returned to trailer to get a tool to remove cap	
109	ERT 29				11.80		
108	ERT 30				14.40		
143	ERT-23				7 03		
	ERT-28				cannot remove cap		
.014	ERT-23				7.03		
011	ERT-28				—	Note at 2005, found a Mr Whitmire on site looking at wells He left the site after I asked his name.	
008	ERT-29				11.85		
006	ERT-30				14.42		
114	ERT-23				7.05		
109	ERT-29				11.85		
107	ERT-30				14.43		

023243

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT ERT-29 Recovery test DATE 8-12-88

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL ((R±CF)±MP)
2215	ERT-23				7.04		
2211	ERT-29				11.85		
208	ERT-30				14.43		

023244

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TESTS· August 8 and 9, 1988

PUMPED WELL: ERT-20

TOTAL DEPTH· 50 FEET

SCREENED INTERVAL· 20 FT TO 50 FT CASING DIAMETER· 4 INCHES

OBSERVATION WELLS GW-08

CONTROL WELLS ERT-21, REI-6-2, ERT-7 and ERT-7A

BACKGROUND AND DESCRIPTION OF TEST

The test of ERT-20 was included to provide information about aquifer characteristics in the vicinity of possible groundwater recovery wells south of the French Limited lagoon There was no preliminary pumping testing data upon which to base a pumping rate for the test We decided to attempt to pump the well at 10 gpm because at this rate there was a possibility that a response would occur tin observation well GW-08 during an 8 hour test An observation well response would be needed to determine a storage coefficient at this location and we felt that pumping at a lower rate would not likely produce a response in the closest well

The test was started and a flow measurement of 10 gpm was obtained using the bucket and stop watch The water level was drawn down to the pump after about 25 minutes and the test was terminated after 25 5 minutes of pumping. Only one measurements had been taken with a bucket and stop watch The flow was observed to have declined to a trickle after 25 minutes Recovery measurements were taken on the pumped well for about 3 75 hours following termination of pumping

The test was re-run on August 9 During this test the water was pumped through a hose directly into the French Limited Lagoon some distance away Flow measurements were taken using the bucket and stop watch by personnel monitoring the control wells and were recorded on the control well monitoring forms. The valve was set to maintain a constant rate and the flow rate remained constant at about 2 04 gpm for the first 75 minutes of the test However, the flow increased to about 2 5 gpm after 85 minutes of pumping. It was assumed that the pumping rate changed after 78 minutes into the test although the change may have been mor gradual than abrupt The flow measurement after 115 minutes of pumping showed a rate of 2 67 gpm. Even though the generator was changed 99 minutes into the test this was not thought to have contributed to the rise in the pumping rate because most of the rate increase occurred prior to changing generators At approximately 136 5 minutes into the test, the pump cut out and water level recovery measurements were taken on the pumped well during the first two hours following termination of pumping

The pump was pulled following completion of the recovery measurements A short in the cable had caused the pump to cut out The cable was replaced. However, it was decided not to repeat the test because the pumping rate which could be sustained during the 8 hour test was most unlikely to have produced a response in the closest observation well GW-08, located about 157 feet from the pumped well There would be little value to repeating a single well test of longer duration at the site and the effort could be spent more productively at another location Following discussions with Kathleen O'Reiley on site on August 11, it was agreed that a pump test of well ERT-22 would be more useful than conducting a longer term test on well ERT-20

Water produced from the test was pumped into 55-gallon drums during the first test. The contents of the 55-gallon drums were emptied into the French Limited lagoon following completion of the first test During the second test, a hose

Observation and control wells were monitored for water levels about every one half hour during pumping but were not monitored during recovery Field measurements are attached

INTERPRETATION

The control wells ERT-7, ERT-7a, ERT-21 and GW-8 showed no obvious response due to pumping well ERT-20 The water levels in all four wells declined from 0 to 0 04 feet during the test These changes were obviously small and thought to follow a diurnal pattern similar to that observed for the control wells during the ERT-10 well test

Drawdown values determined from water level measurements in the production well ERT-20 were adjusted using Jacob's correction for water table conditions Jacob's correction is

$$s_{adj} = s - (s^2/2*m)$$

where s is drawdown,
s_{adj} is adjusted drawdown, and
m is the aquifer thickness from static measurements

Drawdown and adjusted drawdown values are included in the attached spread sheet Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data.

The ratio of adjusted drawdown to the associated pumping rate for the production well ERT-20 were plotted against the log of adjusted time on the attached semi-log plot in Figure A-4 The ratio of the adjusted residual drawdown (recovery) to the final pumping rate were also plotted against the log of dimensionless time on the same semi-log plots Well bore effects had a significant influence on a large portion of the response data The transmissivity calculated from the valid portion of the recovery data from the semilog plots was 695 gpd/ft. The transmissivity calculated from the valid portion of the initial drawdown data was 343 gpd/ft. The estimate from the recovery data is considered to be the more reliable estimate Delayed yield

023246

effects were not observed but could have been masked by the variable pumping rate.

A storage coefficient could not be determined from the single well response data

023247

STEP DRAWDOWN TEST - WELL ERT-20

Saturated Thickness 44.24 feet

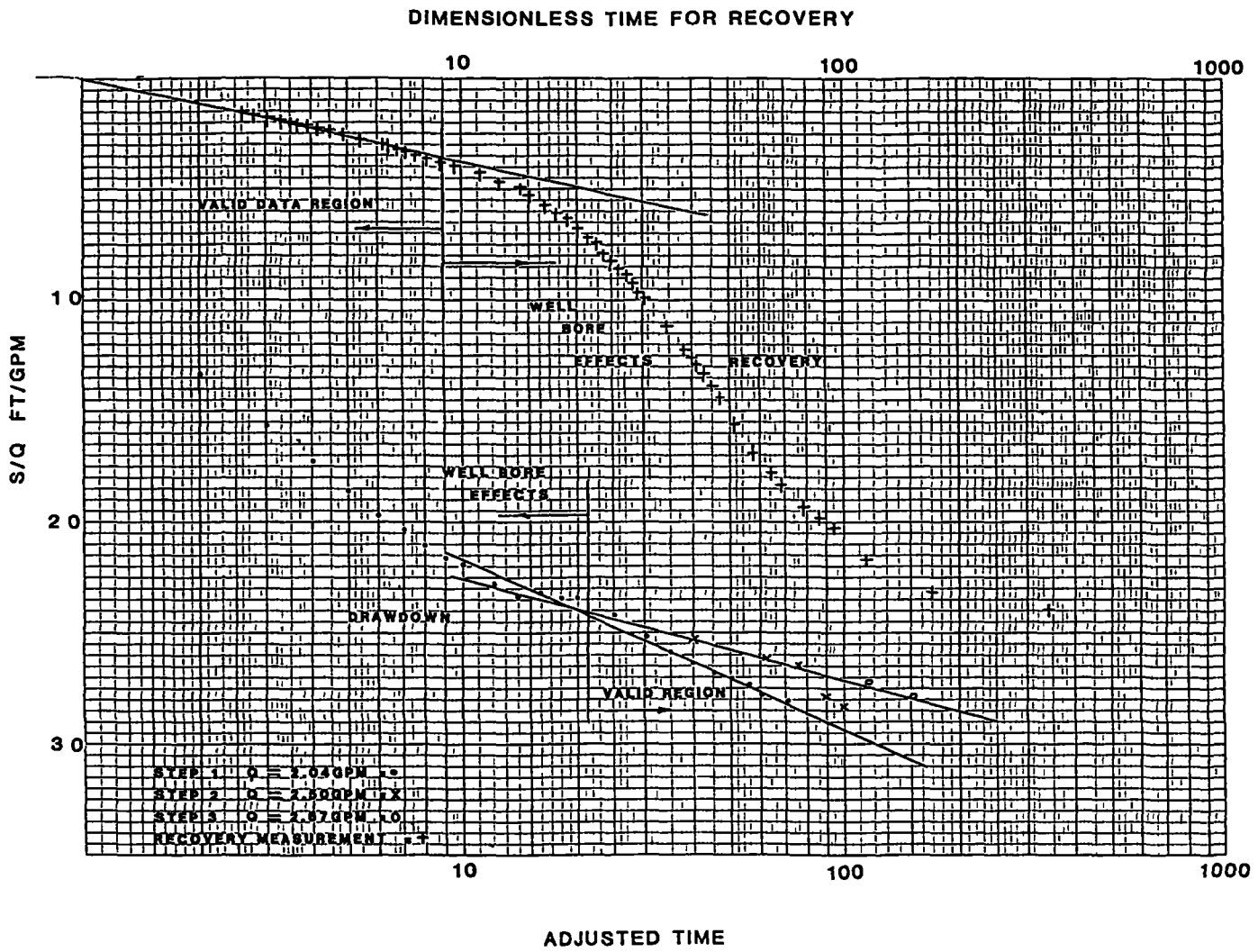
static water level 5.76 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-tn	adjusted time	s/Q	RECOVERY TIME-t' min	t/t'
0.00	5.76	0.00	0.00		0.00	0.00		
0.50	7.16	1.40	1.38		0.50	0.68		
1.00	7.80	2.04	1.99		1.00	0.98		
2.00	8.56	2.80	2.71		2.00	1.33		
3.00	9.07	3.31	3.19		3.00	1.56		
4.00	9.42	3.66	3.51		4.00	1.72		
5.00	9.73	3.97	3.79		5.00	1.86		
6.00	9.96	4.20	4.00		6.00	1.96		
7.00	10.13	4.37	4.15		7.00	2.04		
8.00	10.28	4.52	4.29		8.00	2.10		
9.00	10.39	4.63	4.39		9.00	2.15		
10.00	10.48	4.72	4.47		10.00	2.19		
12.00	10.67	4.91	4.64		12.00	2.27		
14.00	10.80	5.04	4.75		14.00	2.33		
16.00	10.76	5.00	4.72		16.00	2.31		
18.00	10.81	5.05	4.76		18.00	2.33		
20.00	10.81	5.05	4.76		20.00	2.33		
25.00	11.00	5.24	4.93		25.00	2.42		
30.00	11.22	5.46	5.12		30.00	2.51		
35.00	11.40	5.64	5.28		35.00	2.59		
40.00	11.51	5.75	5.38		40.00	2.64		
45.00	11.61	5.85	5.46		45.00	2.68		
50.00	11.67	5.91	5.52		50.00	2.70		
55.00	11.75	5.99	5.58		55.00	2.74		
60.00	11.85	6.09	5.67		60.00	2.78		
70.00	11.91	6.15	5.72		70.00	2.81		
80.00	12.61	6.85	6.32	2.00	40.58	2.53		
90.00	12.85	7.09	6.52	12.00	62.12	2.61		
100.00	12.95	7.19	6.61	22.00	75.68	2.64		
111.00	13.40	7.64	6.98	33.00	88.80	2.79		
120.00	13.53	7.77	7.09	42.00	98.92	2.84		
150.00	13.77	8.01	7.28	25.00	117.93	2.73		
180.00	13.96	8.20	7.44	55.00	151.35	2.79		
197.00	12.70	6.94	6.40	0.50	338.80	2.40	0.25	788.00
197.50	12.45	6.69	6.18	1.00	169.93	2.32	0.75	263.33
198.00	12.00	6.24	5.80	1.50	113.64	2.17	1.25	158.40
198.33	11.55	5.79	5.41	1.83	93.18	2.03	1.58	125.29
198.50	11.40	5.64	5.28	2.00	85.49	1.98	1.75	113.43
198.67	11.25	5.49	5.15	2.17	78.98	1.93	1.92	103.63
199.00	10.95	5.19	4.89	2.50	68.60	1.83	2.25	88.44
199.17	10.79	5.03	4.74	2.67	64.37	1.78	2.42	82.40
199.50	10.50	4.74	4.49	3.00	57.34	1.68	2.75	72.55
199.83	10.12	4.36	4.15	3.33	51.72	1.55	3.08	64.82
200.17	9.80	4.04	3.86	3.67	47.10	1.44	3.42	58.58
200.33	9.65	3.89	3.72	3.83	45.11	1.39	3.58	55.91

023248

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-tn	adjusted time	s/Q	RECOVERY TIME-t' min	t/t'
200.50	9.51	3.75	3.59	4.00	43.27	1.34	3.75	53.47
200.67	9.36	3.60	3.45	4.17	41.58	1.29	3.92	51.23
200.83	9.27	3.51	3.37	4.33	40.02	1.26	4.08	49.19
201.00	9.14	3.38	3.25	4.50	38.58	1.22	4.25	47.29
201.50	8.82	3.06	2.95	5.00	34.83	1.11	4.75	42.42
202.20	8.50	2.74	2.66	5.70	30.68	0.99	5.45	37.10
202.40	8.40	2.64	2.56	5.90	29.67	0.96	5.65	35.82
202.63	8.30	2.54	2.47	6.13	28.59	0.92	5.88	34.44
202.92	8.20	2.44	2.37	6.42	27.37	0.89	6.17	32.90
203.20	8.10	2.34	2.28	6.70	26.25	0.85	6.45	31.50
203.53	8.00	2.24	2.18	7.03	25.06	0.82	6.78	30.01
203.88	7.90	2.14	2.09	7.38	23.92	0.78	7.13	28.58
204.30	7.80	2.04	1.99	7.80	22.70	0.75	7.55	27.06
204.75	7.70	1.94	1.90	8.25	21.52	0.71	8.00	25.59
205.30	7.60	1.84	1.80	8.80	20.24	0.67	8.55	24.01
205.87	7.50	1.74	1.71	9.37	19.08	0.64	9.12	22.58
206.53	7.40	1.64	1.61	10.03	17.88	0.60	9.78	21.11
207.42	7.30	1.54	1.51	10.92	16.52	0.57	10.67	19.44
208.45	7.20	1.44	1.42	11.95	15.18	0.53	11.70	17.82
209.00	7.10	1.34	1.32	12.50	14.56	0.49	12.25	17.06
211.00	7.00	1.24	1.22	14.50	12.69	0.46	14.25	14.81
213.00	6.90	1.14	1.13	16.50	11.28	0.42	16.25	13.11
216.00	6.82	1.06	1.05	19.50	9.70	0.39	19.25	11.22
218.00	6.77	1.01	1.00	21.50	8.90	0.37	21.25	10.26
220.00	6.73	0.97	0.96	23.50	8.23	0.36	23.25	9.46
222.00	6.68	0.92	0.91	25.50	7.67	0.34	25.25	8.79
224.00	6.64	0.88	0.87	27.50	7.18	0.33	27.25	8.22
226.00	6.61	0.85	0.84	29.50	6.77	0.32	29.25	7.73
228.00	6.57	0.81	0.80	31.50	6.40	0.30	31.25	7.30
230.00	6.55	0.79	0.78	33.50	6.08	0.29	33.25	6.92
235.00	6.47	0.71	0.70	38.50	5.43	0.26	38.25	6.14
240.00	6.42	0.66	0.66	43.50	4.92	0.25	43.25	5.55
245.00	6.37	0.61	0.61	48.50	4.52	0.23	48.25	5.08
250.00	6.36	0.60	0.60	53.50	4.19	0.22	53.25	4.69
255.00	6.31	0.55	0.55	58.50	3.92	0.20	58.25	4.38
260.00	6.29	0.53	0.53	63.50	3.69	0.20	63.25	4.11
265.00	6.27	0.51	0.51	68.50	3.50	0.19	68.25	3.88
270.00	6.24	0.48	0.48	73.50	3.33	0.18	73.25	3.69
280.00	6.21	0.45	0.45	83.50	3.05	0.17	83.25	3.36
290.00	6.17	0.41	0.41	93.50	2.83	0.15	93.25	3.11
302.00	6.14	0.38	0.38	105.50	2.63	0.14	105.25	2.87

023249



Recovery Analysis

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{38} = 695$ gpd/ft

Draw down Analysis

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{77} = 343$ gpd/ft

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A4
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL ERT-20
OBSERVATION WELL ERT-20
DATE(S) AUG 9, 1988

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023250

Applied Hydrology Associates

(1)

HYDROLOGIC TEST DATA SHEET

WELL # ERT-20 GR. ELEVATION _____

TESTED INTERVAL _____ M P. ELEVATION _____

DATE 8/9/88 STATIC WATER LEVEL DEPTH 5.76

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well

CLOCK TIME	TIME AFTER TEST STARTED	..	DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS Q gl
7:20			5.76			
7:30						
[illegible]	.5		7.16			
7:31	1.0		7.80			
7:32	2.0		8.56			
7:33	3.0		9.07			
7:34	4.0		9.42			50/2:26
7:35	5.0		9.73			
7:36	6.0		9.96			
7:37	7.0		10.13			
7:38	8.0		10.28			
7:39	9.0		10.39			
7:40	10.0		10.48			
7:42	12.0		10.67			
7:44	14.0		10.80			50/2.27
7:46	16.0		10.78			
7:48	18.0		10.81			
7:50	20.0		10.81			
7:55	25.0		11.00			
8:00	30.0		11.22			
8:05	35.0		11.40			
8:10	40.0		11.51			50/2.27
8:15	45.0		11.61			
8:20	50.0		11.67			
8:25	55.0		11.75			
8:30	60.0		11.85			
8:40	70.0		11.91			50/2:7
8:50	80.0		12.61			50/2:00
9:00	90.0		12.85			
9:10	100.0		12.95			9.04 change
9:20	110.0		13.40			
9:30	120.0		13.53			50/1.52
10:00	150.0		13.77			
10:30			13.96			
11:00						
11:30						
12:00						
12:30						
13:00						

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(2)

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-20 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8/9/88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well

CLOCK TIME	TIME AFTER TEST STARTED	..	DEPTH OF WATER LEVEL BELOW M P	DRAWDOWN OF WATER LEVEL		COMMENTS
1047	197		12.70			pump off
4756	197.50		12.45			problem - cut out
48	198		12.00			at 1046:45
4820	198.333		11.55			
30	198.5		11.40			
4840	198.667		11.25			
4900	199.00		10.95			
4910	199.167		10.79			
4930	199.50		10.50			
4950	199.833		10.12			
5010	200.167		9.80			
5020	200.333		9.65			
5030	200.50		9.51			
5040	200.667		9.36			
5050	200.833		9.27			
51	201.		9.14			
5130	201.5		8.82			
~~54~~	~~202.000~~		~~8.60~~			
5212	202.2		8.50			
5224	202.4		8.40			
5238	" .633		8.30			
5255	" .917		8.20			
5312	203.20		8.10			
5332	203.533		8.00			
5353	" .883		7.90			
5418	204.30		7.8			
5445	" .75		7.7			
5518	205.30		7.6			
5552	" .867		7.5			
5632	206.533		7.4			
5725	207.417		7.3			
5827	208.45		7.2			
5954	209.		7.1			
110121	211.		7.0			
110340	213.		6.9			
110600	216		6.82			
110800	218		6.77			
111000	220		6.72			
111200	222		6.68			
111400	224		6.64			

023252

(3)

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERI-26 GR. ELEVATION _____

TESTED INTERVAL _____ M P ELEVATION _____

DATE 8/9/88 STATIC WATER LEVEL DEPTH 5.76

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
1116	226		6.61			
1118	228		6.57			
1120	230		6.55			
1125	235		6.47			
1130	240		6.42			
1135	245		6.37			
1140	250		6.36			
1145	255		6.31			
1150	260		6.29			
1155	265		6.27			
1200	270		6.24			
1210	280		6.21			
1220	290		6.17			
1230	302		6.14			
1240	310					
1250	320					
1300	330					

023253

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Controls Wells for Pumping Test ERT-20 DATE 9/8/88

ID	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
36	RE1 6-2	7.20					
	Precip	0					
41	ERT-7	483					
40	ERT7-A	542					
54	ERT 21	479					
9	GW 8	4.52					
34	Flow m/g	2:26/59					
35	Flow	2:27/5					
09	Flow	2:27/5					
11	GW8	4.53					
12	6-2	7.20					
15	7A	5.43					
16	7	4.85					
35	21	4.79					

023254

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT French Controls for GRT 20 DATE 9/8/88

ME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
15	Flow	2.27/5					
17	GW 8	4.54					
19	6-2	720					
52	7A	544					
3	7	485					
55	Flow	200/5	* change	?			
33	GW 8	4.54					
20	Flow	1:57/5					
55	6-2	721					
37	7A	545					
38	7	485					
44	Flow	1:54/5					
52	GRT20	13.73					
001	21	479					

023255

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT _____ DATE _____

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
28	1	485					
231	7A	543					
34	6-2	721					
256	KW-8	456					
57	Flow	155/5					

023256

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-20 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8/8/88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

Pumped well ERT-20 TD: 44 ft $s' = s - \frac{s^2}{2D}$

D: 44 - 5.68 = 38.32 T = 411 gpd/ft

S = .008

	CLOCK TIME	TIME AFTER TEST STARTED t	t' time after pump off	DEPTH OF WATER LEVEL BELOW M.P	corrected DRAWDOWN OF WATER LEVEL s'	t/t'	COMMENTS
-30	10:36			5.68	static		Top of casing
-20	10:47						pump down
-10	11:02			5.65			
-5							
-1							
start	12:00			5.65	static		pump on
5	12:00 30	.5		9.28	3.43		
10	01	1		11.77	5.61		10 gpm
15	01:30	1.5		14.57	7.86		
20	1:02	2		15.63	8.66		
25	02:30	2.5		17.15	9.75		
30	1:03	3		18.06	10.38		
35	03:30	3.5		18.76	10.85		
40	1:04	4					
45	1:04 30	4.5		20.67	12.06		
50	1:05	5		21.32	12.45		
60	1:06	6		21.59	12.61		
70	1:07						problem with pump
80							
90	1:09 30	9.5		22.34	13.04		
100	1:10	10		22.43	13.09		
110	1:11	11		22.32	13.03		
120	1:12	12		22.98	13.39		
130	1:13	13		22.95	13.38		
140	1:14 30	14.5		23.03	13.42		
150	1:15	15		23.10	13.46		
200	1:20	20		24.15	14.02		
250	1:25:30			21.1			pump off
300	1:26			18.70			no data
350	1:27			19.13			Danger! from time
400	1:27:30			14.51			
450	1:28			13.54			
500	1:29			12.25			
600	1:30			11.18			
700	1:31			10.43			
800	1:32			9.61			
900	1:33:30			8.50			
1000	1:34			8.43			
1300	1:35			8.13			

30 min now

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HYDROLOGIC TEST DATA SHEET

WELL # FPT-20

TESTED INTERVAL

DATE 8/8/88

PERSONNEL

GR. ELEVATION

M.P. ELEVATION

STATIC WATER LEVEL DEPTH

STATIC WATER LEVEL ELEVATION

37 ft to top pump

CLOCK TIME	TIME AFTER TEST STARTED t	t'	DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
1237			7.98			
1238			7.80			
1240			7.50			
1242			7.31			
1244						
1248			6.90			
1250			6.81			
1255			6.60			
1255:30			6.60			
1300			6.51			
1305						
1309			6.33			
1322			6.20			
1328:30			6.16			
1330			6.10			
1342			6.01			
1350			5.99			
1410			5.91			
1420						

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Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # GW-08

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE _____

STATIC WATER LEVEL DEPTH _____

PERSONNEL AHA & ERT

STATIC WATER LEVEL ELEVATION _____

Pumping Well ERT-20
radial distance 157 ft

	CLOCK TIME	TIME AFTER TEST STARTED	..	DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL	Q - g/t	COMMENTS
	10:31			4.45			
Start	1200						
1.0	1201						
2.0	1202						
3.0	1203			4.40			
4.0	1204			4.40			
5.0	1205			4.39			
7.0	1207			4.39			
9.0	1209			4.36			
11.0	1211			4.38			
13.0	1213			4.39			
15.0	1215			4.39			
20.0	1220			4.39			
25.0	1225			No measurement			
30.0	1230			4.39			
35.0							
40.0							
45.0							
50.0							
60.0							
1hr 70.0							
80.0							
90.0							
100.0							
130.0							
160.0							

023259

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control Wells for Pumping Test · ERT-20 DATE 8/8/88

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
1830	REF 6-2	7.12					
	Precip	dry					
25	ERT-7	4.76					
2330	ERT-7a	5.38					
47	ERT-21	4.70					
17	REF 6-2	7.08					
224	ERT 7	4.71					
23	ERT 7A	5.35					
	ERT 21						

023260

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST: August 10, 1988

PUMPED WELL· ERT-21

TOTAL DEPTH· 50 FEET

SCREENED INTERVAL 20 FT TO 50 FT CASING DIAMETER 4 IN

OBSERVATION WELLS GW-03

CONTROL WELLS ERT-20, REI-6-1, REI-3-3 and REI-3-2

BACKGROUND AND DESCRIPTION OF TEST

The test of ERT-21 was included to provide information about aquifer characteristics in the vicinity of possible groundwater recovery wells south of the French Limited lagoon There was no preliminary pumping testing data upon which to base a pumping rate for the test The original work plan recommended a pumping rate of 4 gpm although we could not sustain a 4 gpm rate at well ERT-20 or at the wells near the REI-10 well cluster The well did appear to be in the more productive portion of the alluvial aquifer similar to wells ERT-7 and ERT-8 Therefore it was decided to attempt to pump the well at a rate of approximately 4 gpm

The test was started and the rotometer set at 4 1 gpm Since the water was pumped through a hose to the French Limited Lagoon some distance away, the flow measurements using the bucket and stop watch were taken by personnel monitoring the control wells and were recorded on the control well monitoring forms. Measurements with a bucket and stop watch indicated a relatively constant pumping rate of 3 83 gpm The pumping test was terminated after 8 hours Recovery measurements were taken periodically for 4 hours after the test A recovery measurement was also taken 12 hours after termination of the test. Control wells were monitored for water levels about every one half hour during pumping but were not monitored during recovery Field measurements are attached.

As indicated previously, the water produced from the test was pumped through a hose and directly into the French Limited lagoon

INTERPRETATION

The control wells ERT-20, REI 3-2, REI 3-3 and REI 6-1 showed different diurnal patterns as shown in Figure 1 The diurnal fluctuation in well REI 6-2 was greatest at 0 08 feet No precipitation was recorded during the test Wells REI 3-2 and REI 3-3 showed a slight drop in water levels during the day This decline is unlikely to have been related to pumping because observation well GW-3 which much closer to the pumped well declined by only 0 03 feet

during the test The water levels in control wells ERT-20 and REI 6-1 showed a diurnal pattern similar to that observed in the control wells during the ERT-10 test The highest water levels appeared between 14 00 and 16 00 and the lowest levels appeared between 11 00 and 12 00.

Based on the pattern of fluctuations seen in the control wells, we see no basis to adjust the measurements in wells ERT-21 and GW-3 for the observed diurnal fluctuations because of the small magnitude of the fluctuations in the control wells and the lack of consistency in the pattern of fluctuations between the control wells

Drawdown values determined from water level measurements in well ERT-21 were adjusted using Jacob's correction for water table conditions Jacob's correction is

$$s_{adj} = s - (s^2/2*m)$$

where s is drawdown,
s_{adj} is adjusted drawdown, and
m is the aquifer thickness from static measurements

Drawdown and adjusted drawdown values are included in the attached spread sheet

Adjusted drawdown values from the pumped well ERT-21 were plotted against the log of time on the attached Jacob semi-log plot in Figure A-5 A rise in the water level observed at 120 minutes into the test could not be explained by a change in pumping rate Measurements of pumping rate taken before and after the rise in water level were consistent It is possible that the rise was simply a flattening of the drawdown response due to delayed yield effects that are often typical of water table pump test response (see Neuman, 1975)

Well bore storage effects were determined to have influenced the drawdown response during the first 25 minutes of the test The transmissivity value determined from the response from 25 minutes to 90 minutes (just before the rise in water levels) was 184 gpd/ft For the drawdown response after the rise at 210 minutes, the calculated transmissivity was 277 gpd/ft

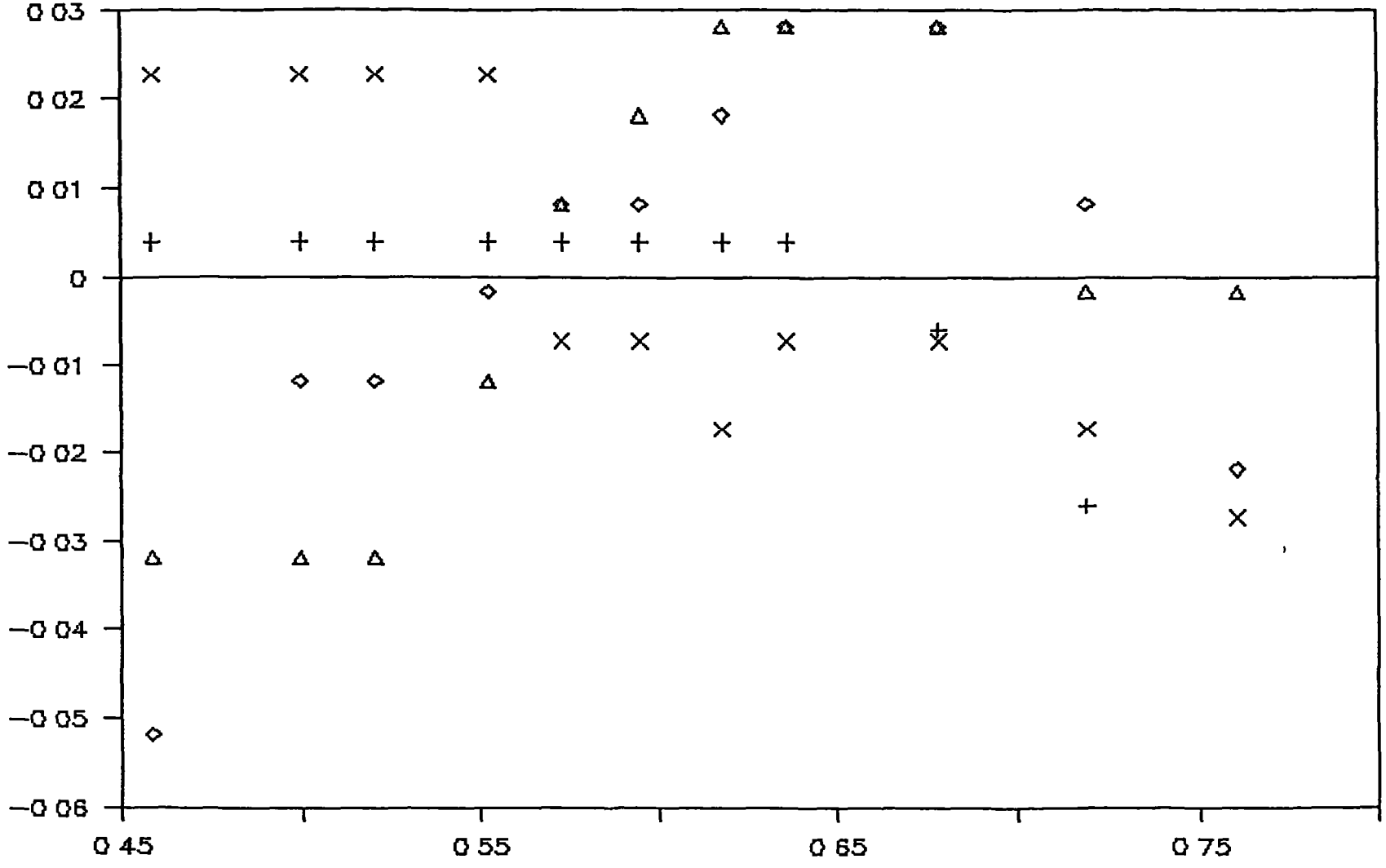
The water level recovery data from well ERT-21 were analyzed on semi-log plots of residual drawdown values adjusted using Jacob's correction versus the log of t/t', where t is time since pumping started and t' is time since pumping stopped. The residual drawdown plot in Figure A-6 did not exhibit the fluctuations apparent in the drawdown analyses Well bore storage effects were determined to have influenced the recovery plot for values of t/t' greater than 20 A straight line fit to the portion of the residual drawdown curve for values of t/t' less than 20 produced a transmissivity estimate of 595 gpd/ft It was concluded that the recovery measurements provided the most reliable data for assessing the transmissivity in the vicinity of the ERT-21 well.

The drawdown response in well GW-03 due to the constant pumping during the 8 hour test at well ERT-21 was matched to a Theis curve as shown in Figure The match was not good because of the variability in the drawdown data and the transmissivity calculated from the match was unreasonably large Furthermore,

the total magnitude of the response was actually less than the natural variability observed in control wells It appears that if there was an actual response in well GW-03 due to pumping well ERT-21 for 8 hours, the magnitude of the response was insufficient to provide an accurate estimate of drawdown response that could be used for a quantitative analysis

AQUIFER PUMP TEST WELL ERT-21

CONTROL WELL WATER LEVEL FLUCTUATIONS



+ REI 3-2 ◇ REI-6-1 △ ERT-20 × REI3-3

023264

PUMPED WELL: ERT-21

CONTROL WELL WATER LEVEL FLUCTUATIONS

HOUR	min	REI3-3	MEAN-DEV REI3-3 5.402	REI3-2	MEAN-DEV REI3-2 4.924	REI6-1	MEAN-DEV REI6-1 6.108	ERT-20	MEAN-D ERT-20 6.118
11	0	5.38	0.022						
11	59	5.38	0.022						
12	29	5.38	0.022						
13	15	5.38	0.022						
13	45	5.41	-0.00						
14	16	5.41	-0.00						
14	49	5.42	-0.01						
15	15	5.41	-0.00						
16	16	5.41	-0.00						
17	15	5.42	-0.01						
18	15	5.43	-0.02						
12	0			4.92	0.004				
12	30			4.92	0.004				
13	15			4.92	0.004				
13	50			4.92	0.004				
14	15			4.92	0.004				
14	48			4.92	0.004				
15	16			4.92	0.004				
16	15			4.92	0.004				
17	16			4.93	-0.00				
18	16			4.95	-0.02				
15	33					6.08	0.028		
16	1					6.08	0.028		
17	0					6.1	0.008		
18	0					6.13	-0.02		
11	23					6.16	-0.05		
12	31					6.12	-0.01		
13	1					6.12	-0.01		
13	31					6.11	-0.00		
14	0					6.1	0.008		
14	32					6.1	0.008		
15	0					6.09	0.018		
15	29							6.09	0.028
16	0							6.09	0.028
18	0							6.12	-0.00
19	0							6.12	-0.00
10	50							6.15	-0.03
12	30							6.15	-0.03
13	0							6.15	-0.03
13	30							6.13	-0.01
14	4							6.11	0.008
14	30							6.1	0.018
15	4							6.09	0.028

023265

STEP DRAWDOWN TEST - WELL ERT-21

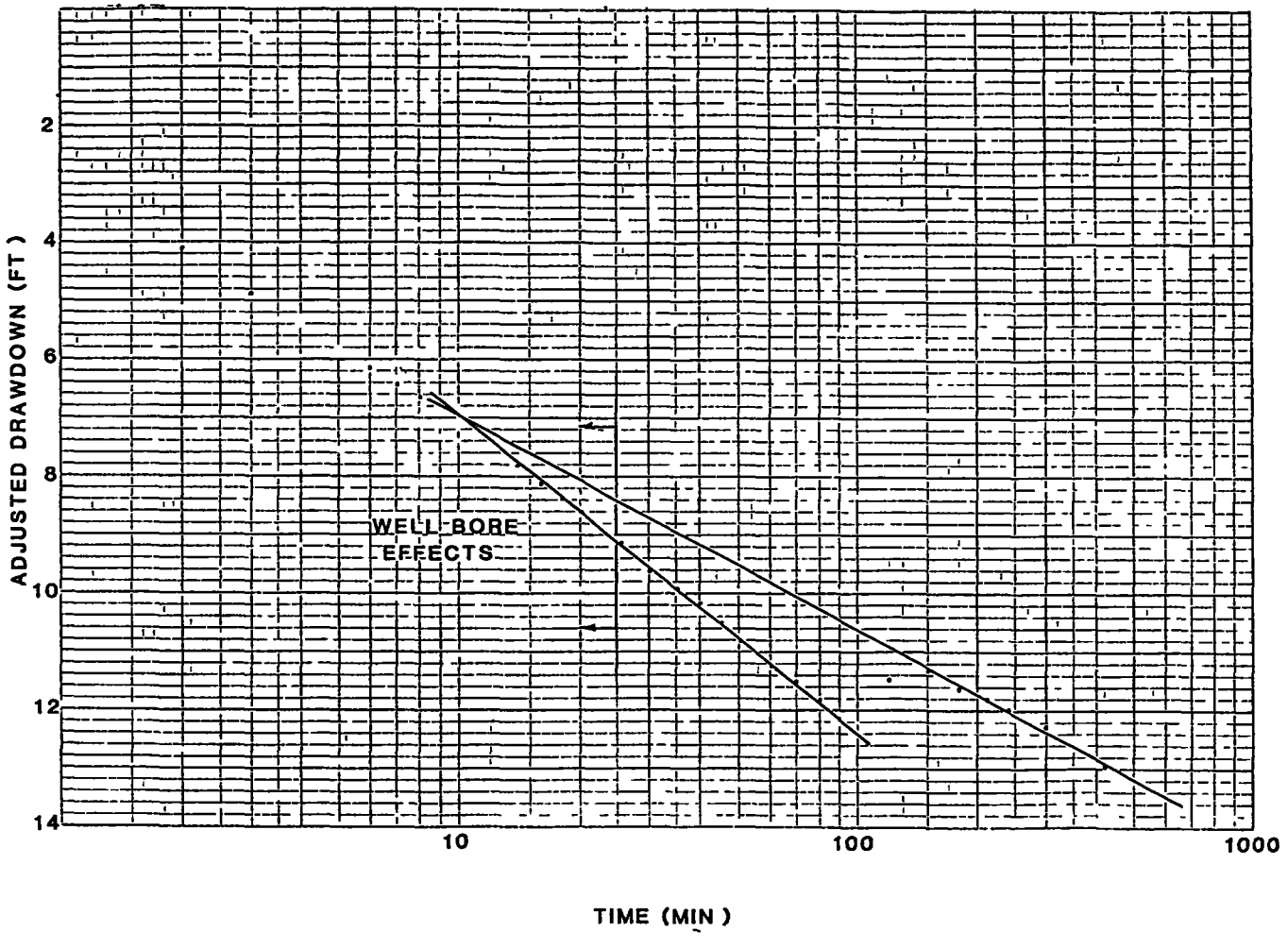
Saturated Thickness 45.12 feet

static water level 4.88 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	RECOVERY TIME-t' min	t/t'
0	4.88	0	0.00		
0.5	6.8	1.92	1.88		
1	7.74	2.86	2.77		
2	9.15	4.27	4.07		
3	10.02	5.14	4.85		
4	10.64	5.76	5.39		
5	11.12	6.24	5.81		
6	11.51	6.63	6.14		
7	11.83	6.95	6.41		
8	12.1	7.22	6.64		
9	12.4	7.52	6.89		
10	12.7	7.82	7.14		
12	13.15	8.27	7.51		
14	13.5	8.62	7.80		
16	13.9	9.02	8.12		
18	14.21	9.33	8.37		
20	14.5	9.62	8.59		
25.5	15.2	10.32	9.14		
30	15.79	10.91	9.59		
35	16.2	11.32	9.90		
40	16.57	11.69	10.18		
45	17	12.12	10.49		
50	17.45	12.57	10.82		
60	18.02	13.14	11.23		
70	18.44	13.56	11.52		
80	18.86	13.98	11.81		
90	19.33	14.45	12.14		
120	18.31	13.43	11.43		
150	18.15	13.27	11.32		
180	18.56	13.68	11.61		
210	18.82	13.94	11.79		
240	19.08	14.2	11.97		
300	19.5	14.62	12.25		
360	19.8	14.92	12.45		
420	20.57	15.69	12.96		
480	20.97	16.09	13.22		
480.5	19.58	14.7	12.31	0.50	961.00
481	18.67	13.79	11.68	1.00	481.00
482	16.52	11.64	10.14	2.00	241.00
483	14.46	9.58	8.56	3.00	161.00
484	13.17	8.29	7.53	4.00	121.00
485	11.87	6.99	6.45	5.00	97.00
486	11.03	6.15	5.73	6.00	81.00
487	10.09	5.21	4.91	7.00	69.57
488	9.26	4.38	4.17	8.00	61.00

023266

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	RECOVERY TIME-t' min	t/t'
489	8.67	3.79	3.63	9.00	54.33
490	8.23	3.35	3.23	10.00	49.00
492	7.64	2.76	2.68	12.00	41.00
494	7.28	2.4	2.34	14.00	35.29
496	7.02	2.14	2.09	16.00	31.00
498	6.86	1.98	1.94	18.00	27.67
500	6.72	1.84	1.80	20.00	25.00
505	6.45	1.57	1.54	25.00	20.20
510	6.25	1.37	1.35	30.00	17.00
515	6.12	1.24	1.22	35.00	14.71
520	5.99	1.11	1.10	40.00	13.00
525	5.91	1.03	1.02	45.00	11.67
530	5.8	0.92	0.91	50.00	10.60
540	5.71	0.83	0.82	60.00	9.00
550	5.57	0.69	0.68	70.00	7.86
560	5.48	0.6	0.60	80.00	7.00
575	5.38	0.5	0.50	95.00	6.05
600	5.28	0.4	0.40	120.00	5.00
630	5.21	0.33	0.33	150.00	4.20
660	5.14	0.26	0.26	180.00	3.67
690	5.11	0.23	0.23	210.00	3.29
720	5.07	0.19	0.19	240.00	3.00
1200	4.94	0.06	0.06	720.00	1.67



Before 90 Minutes

$T = \frac{264\ Q}{S}$ gpd/ft

$= \frac{264\ (3\ 83)}{5\ 5} = 184$ gpd/ft

After 90 minutes

$T = \frac{264\ Q}{S}$ gpd/ft

$T = \frac{264\ (3\ 83)}{3.65} = 277$ gpd/ft

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A5
SEMI-LOG DRAWDOWN ANALYSIS

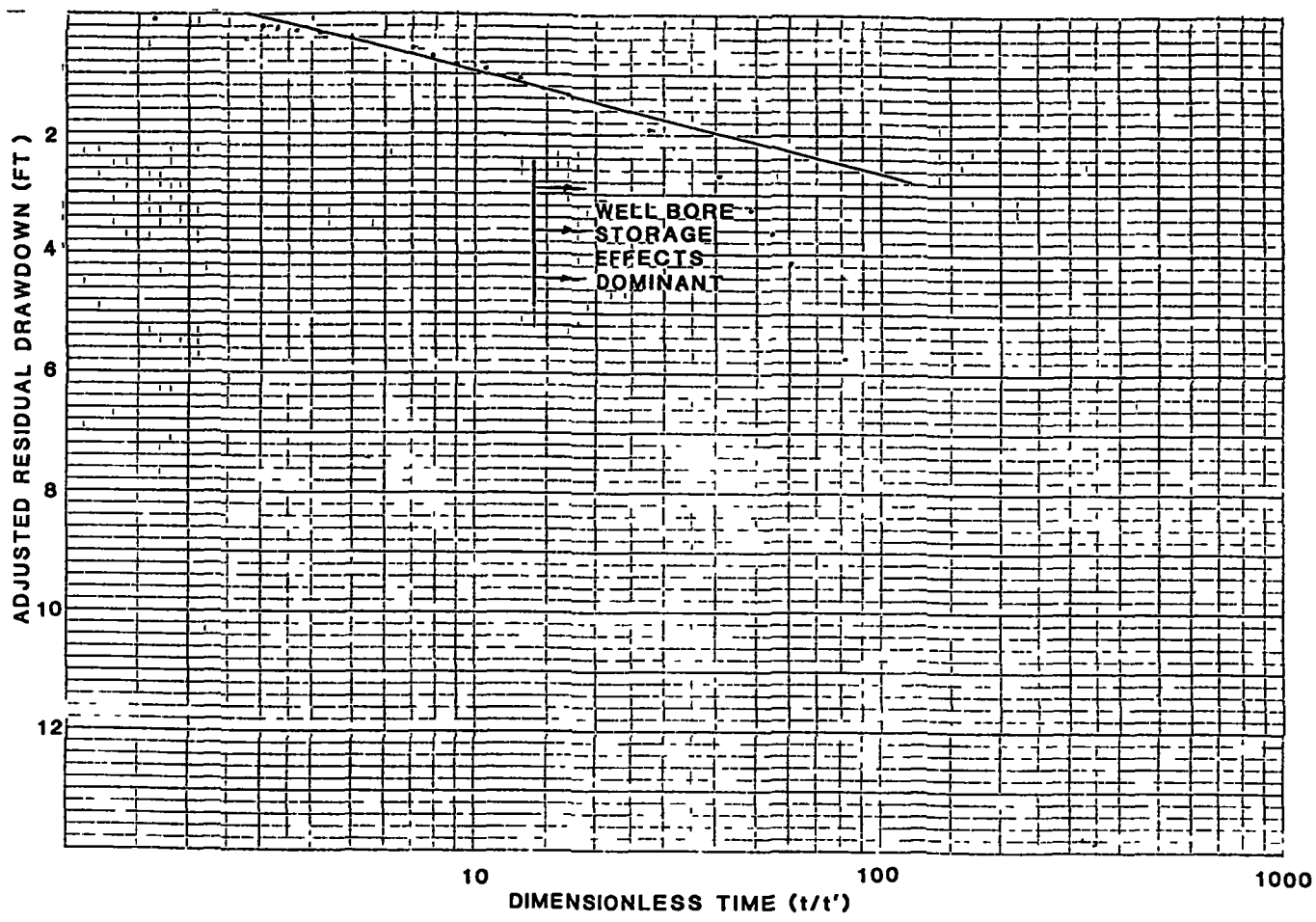
PUMPED WELL ERT-21
OBSERVATION WELL ERT-21
DATE(S) AUG 10, 1988 26

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023 26

023268



$$T = \frac{264\ Q}{\Delta S}\ \text{gpd/ft}$$

$$T = \frac{264\ (3.83)}{1\ 7} = 595\ \text{gpd/ft}$$

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A6
THEIS RECOVERY ANALYSIS

PUMPED WELL: ERT-21
OBSERVATION WELL ERT-21
DATE(S) AUG 10, 1988

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023269

Applied Hydrology Associates

Art - we need to send pump test data Paul or Raj

HYDROLOGIC TEST DATA SHEET

Kathleen O'reilly. 214-655-6710

WELL # ERT-21

GR. ELEVATION _____

TESTED INTERVAL _____

M P. ELEVATION _____

DATE 8/10/88

STATIC WATER LEVEL DEPTH 488

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumped well

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS TD 4825
0850			4841			TOC
1056			4.86			
			7.0			Test started valve to flow meter (low out)
1200	0		488			Test - 1
1200:30	.5		6.80			
1201	1		7.74			
1202	2		9.15			
1203	3		10.02			
1204	4		10.64			
1205	5		11.12			
1206	6		11.51			
1207	7		11.83			
1208	8		12.10			
1209	9		12.40			
1210	10		12.70			
1212	12		13.15			
1214	14		13.50			
1216	16		13.90			
1218	18		14.21			
1220	20		14.50			
1225:30	25.5		15.20			
1230	30		15.79			
1235	35		16.20			
1240	40		16.57			Flow rate 4.1 gpm
1245	45		17.00			
1250	50		17.45			
1300	60		18.02			
1310	70		18.44			
1320	80		18.86			
1330	90		19.33			apparent water level change pump may have quit
1400	120		18.31			
1430	150		18.15			
1500	180		18.56			
1530	210		18.82			
1600	240		19.08			

023270

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-21 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8/10/88 STATIC WATER LEVEL DEPTH 4.88

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well ERT-21

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
1700	300		19.5			Rain in area
1800	360		19.80			
1900	420		20.57			
2000	480		20.97			pump off
2000:30	480.5		19.58			
2001	481		18.67			
2002	482		16.52			
2003	3		14.46			
2004	4		13.17			
2005			11.87			
2006			11.03			
2007			10.09			
2008			9.26			
2009			8.67			
2010	490		8.23			
2012	492		7.64			
2014			7.28			
2016			7.02			
2018			6.86			
2020	500		6.72			
2025	505		6.45			
2030	510		6.25			
2035	515		6.12			
2040	520		5.99			
2045	625		5.91			
2050	530		5.80			
2100	540		5.71			
2110	550		5.57			
2120	560		5.48			
2135	575		5.38			
2200	600		5.28			
2230	630		5.21			
2300	660		5.14			
2330	690		5.11			
2400	720		5.07			
8/11/88 0800	1200		4.94			

Recovery

023271

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # GW-3 GR. ELEVATION ?

TESTED INTERVAL _____ M.P. ELEVATION ?

DATE 8-10-88 STATIC WATER LEVEL DEPTH _____

PERSONNEL J. Barringer STATIC WATER LEVEL ELEVATION _____

pumped well ERT-21

Initial 4.91 @ 12:00

	CLOCK TIME	TIME AFTER TEST STARTED	:	DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS TD 23
MIN	1200			4.91			TOC
1	12:01			4.910			"
2	12:02			4.910			"
3	12:03			4.915			
4	12:04			4.915			
5	12:05			4.915			
6	12:06			4.915			
7	12:07			4.915			
8	12:08			4.915			
9	12:09			4.915			
MIN 10	1210			4.915			
12	1212			4.915			
14	1214			4.915			
16	1216			4.920			
18	1218			4.920			
MIN 20	1220			4.920			
25	1225			4.920			
30	1230			4.920			
35	1235			4.920			
40	1240			4.920			
45	1245			4.920			
50	1250			4.920			
60	1300			4.920			
70	1311			4.920			
80	1320			4.920			
90	1330			4.920			
120	1400			4.920			
150	1430			4.920			
180	1500			4.920			
240 ~~210~~	1600			4.925			
300 ~~240~~	1700			4.930			
360 ~~300~~	1800			4.92			
420 ~~360~~	1900			4.93			
	~~1800~~ 1959			4.94			
STOP PUMP.	2000						

023272

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control wells for pumping test ERT-21 DATE 8/10/88

IME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
.00	REI-3-3	5 38					
1:59	REI-3-2	4 88					
	ERT-20						
	REI-6-1						
	Precip.						
'59	REI 3-3	5 38					
200	REI 3-2	4.92					
229	REI 3-3	5.38					
230	REI 3-2	4 92					
3:15	REI 3-3	5.38					
3 15	REI 3-2	4 92					
3 45	REI 3-3	5 41					
350	REI 3-2	4.92					
715	REI 3-2	4.92					

023273

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT [illegible] well for pumping test ERT-21 DATE 8/10/88

TIME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
46	REI 3-3	5.41		-			
1490	REI 3-2	4.92					
49	REI 3-3	5.42					
15	REI 3-3	5.41					
16	REI 3-2	4.92					
15	REI 3-2	4.92					
16	REI 3-3	5.41					
715	REI 3-3	5.42					
716	REI 3-2	4.93					
815	REI 3-3	5.43					
816	REI 3-2	4.95					

023274

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control For ERT-21 DATE 8-10-88

IME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
529	ERT-20	6.09					
533	REI 6-1	6.08	15:36-1:19				
600	ERT-20	6.09	16:00-1:20	✓			
601	REI 6-1	6.08					
	ERT-20	—					
700	REI 6-1	6.18	1:21 / 5/9 ~~93 / 5~~				
	ERT-20	—					
800	REI 6-1	6.13	93 sec / 5				
800	ERT-20	6.12					
1900	ERT 20	6.12	1:18 / 59				
1900	REI 6-2	6.13					

023275

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT _____ DATE 8-10-88

every 30 m 5 GAL. WATER FLOW

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
1:00	ERT-20	6.15			1200 - 1.18		
23	REI 6-1	6.16			1215 - 1.12		
					12.33 - 1.15		
					12.45 - 1.13		
1:30	ERT-20	6.15			13.00 1.16		
31	REI 6-1	6.12			13:15 - 1.15		
300	ERT-20	6.15			13:32 - 1.17		
301	REI-6-1	6.12					
330	ERT-20	6.13					
331	REI-6-1	6.11					
401	ERT-20	6.11					
400	REI-6-1	6.10			1400 - 1.17		
430	ERT-20	6.10					
432	REI-6-1	6.10			1498 - 1.21		
5.04	ERT-20	6.09					
5.00	REI-6-1	6.09			15.03 1.21		

023276

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST· August 11, 1988

PUMPED WELL ERT-22

OBSERVATION WELLS: none

CONTROL WELLS: ERT-23, ERT-7A and ERT-7

BACKGROUND AND DESCRIPTION OF TEST·

The test of well ERT-22 was not in the original work plan for pump testing the shallow alluvial aquifer zone. This well was included to help address concerns by EPA and Jacobs Engineering about the nature and extent of a higher transmissive zone south of the French Limited Lagoon and the ERT-7 and ERT-8 wells.

There was no preliminary pumping testing data upon which to base a pumping rate for the test. The original work plan recommended a pumping rate of 4 gpm. Since the well did appear to be in the more productive portion of the alluvial aquifer similar to wells ERT-21, ERT-7 and ERT-8, we decided to attempt to pump the well at a rate of approximately 4 gpm.

Heavy rain occurred for about 3 hours prior to the start up of the test and was responsible for delaying the start of testing A canopy cover was purchased and placed over the pumping well and generator and the test was started at about 16 40. Intermittent rain fell during the pumping period and recovery period. Total storm event rainfall was estimated at 1.25 inches.

Since the water was pumped through a hose to the French Limited Lagoon some distance away, the flow measurements using the bucket and stop watch were taken by personnel monitoring the control wells and were recorded on the control well monitoring forms. Measurements with a bucket and stop watch indicated a relatively constant pumping rate of 4.35 gpm. This pumping rate could not be sustained and was cut back to 2.4 gpm and held at this rate for 270 minutes. The variable pumping rate was not considered to pose problems for interpretation since this was a single well test. Also, it was felt that the variable rate test would help discriminate the drawdown due to formations loss from that due to well inefficiency The pumping rate was increased to 2.88 gpm for the last 90 minutes of the pump test Total pumping time for the test was 7 hours.

Recovery measurements were taken periodically for 8 hours after termination of pumping. Control wells were monitored for water levels about every one half hour during pumping and for 1 5 hours into the recovery period. A water level measurement of the control wells was also taken after 8 hours of recovery. Field measurements are attached

023277

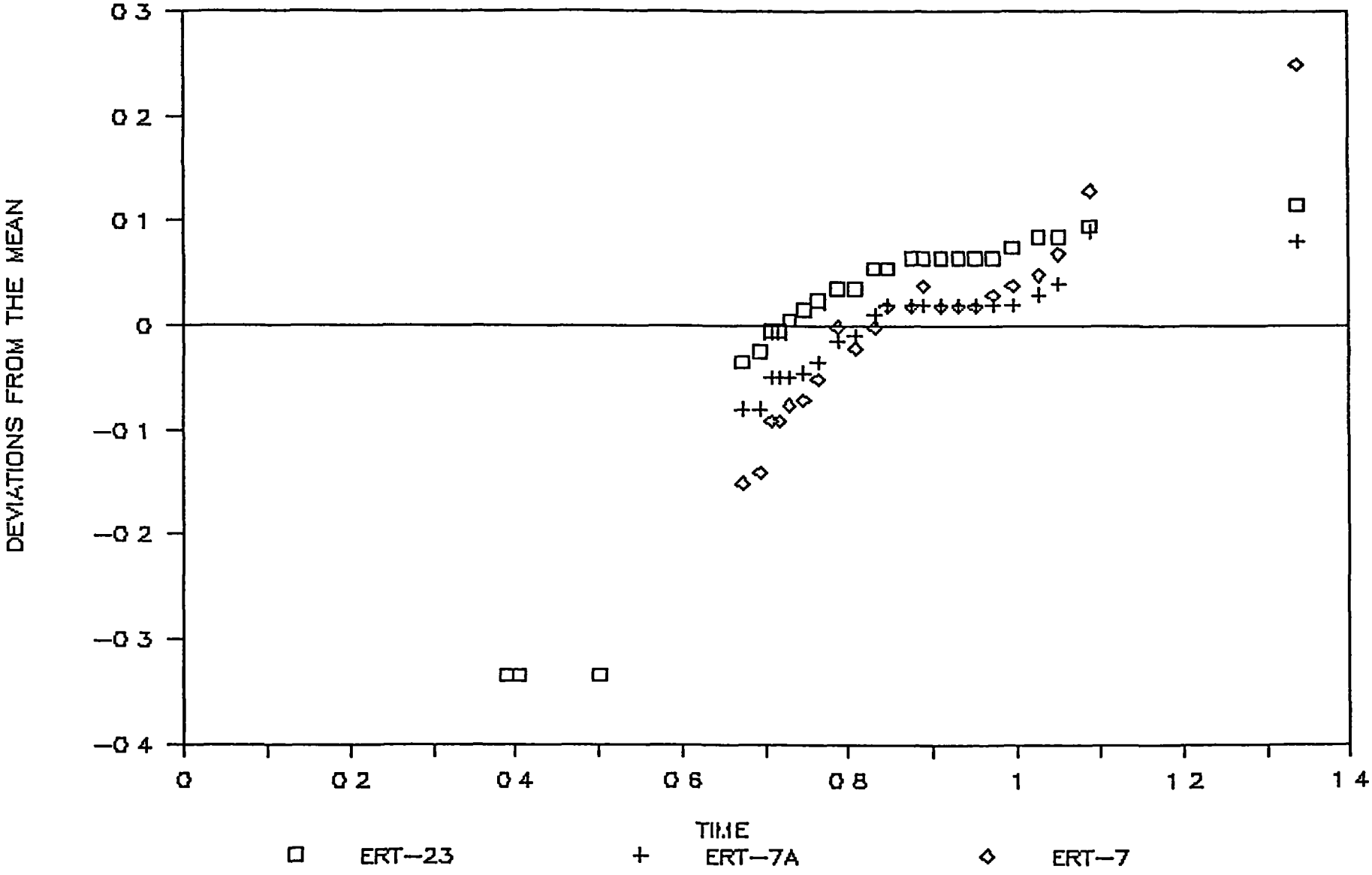
As indicated previously, the water produced from the test was pumped through a hose and directly into the French Limited lagoon

Control wells were monitored for water levels about every one half hour but were not monitored during recovery Field measurements are attached.

As indicated previously, the water produced from the test was pumped through a hose and directly into the French Limited lagoon.

AQUIFER PUMP TEST WELL ERT-22

CONTROL WELL WATER LEVEL FLUCTUATIONS



023279

PUMPED WELL: ERT-22

CONTROL WELL WATER LEVEL FLUCTUATIONS

HOUR	MIN	ERT-23	MEAN-DEV ERT-23 7.1533	ERT-7A	MEAN-DEV ERT-7A 5.2702	ERT-7	MEAN-DE ERT-7 4.7488
9	19	7.45	-0.30				
9	42	7.45	-0.30				
12	1	7.45	-0.30				
16	7	7.15	0.00				
16	38	7.18	-0.03				
16	58	7.16	-0.01				
17	12	7.16	-0.01				
17	29	7.15	0.00				
17	53	7.14	0.01				
18	18	7.13	0.02				
18	53	7.12	0.03				
19	23	7.12	0.03				
19	56	7.10	0.05				
20	16	7.10	0.05				
20	58	7.09	0.06				
21	18	7.09	0.06				
21	48	7.09	0.06				
22	18	7.09	0.06				
22	48	7.09	0.06				
23	18	7.09	0.06				
23	52	7.08	0.07				
20	36	7.07	0.08				
13	11	7.07	0.08				
14	6	7.06	0.09				
16	1			5.35	-0.08		
16	19			5.35	-0.08		
16	57			5.32	-0.05		
17	11			5.32	-0.05		
17	27			5.32	-0.05		
17	47			5.32	-0.04		
18	13			5.31	-0.03		
18	49			5.29	-0.01		
19	14			5.28	-0.01		
19	51			5.26	0.01		
20	19			5.25	0.02		
20	54			5.25	0.02		
21	15			5.25	0.02		
21	45			5.25	0.02		
22	15			5.25	0.02		
22	45			5.25	0.02		
23	15			5.25	0.02		
23	59			5.25	0.02		
0	28			5.24	0.03		
1	7			5.23	0.04		
14	11			5.18	0.09		
19	58			5.19	0.08		
16	2					4.90	-0.15

023280

HOUR	MIN	ERT-23	MEAN-DEV ERT-23 7.1533	ERT-7A	MEAN-DEV ERT-7A 5.2702	ERT-7	MEAN-DE ERT-7 4.7488
16	18					4.89	-0.14
16	58					4.84	-0.09
17	10					4.84	-0.09
17	26					4.83	-0.08
17	43					4.82	-0.07
18	14					4.80	-0.05
18	48					4.75	-0.00
19	15					4.77	-0.02
19	50					4.75	-0.00
20	18					4.73	0.02
20	53					4.73	0.02
21	14					4.71	0.04
21	44					4.73	0.02
22	14					4.73	0.02
22	44					4.73	0.02
23	14					4.72	0.03
23	56					4.71	0.04
0	30					4.70	0.05
1	6					4.68	0.07
14	10					4.62	0.13
19	56					4.50	0.25

023281

STEP DRAWDOWN TEST - WELL ERT-22

Saturated Thickness 47.02 feet

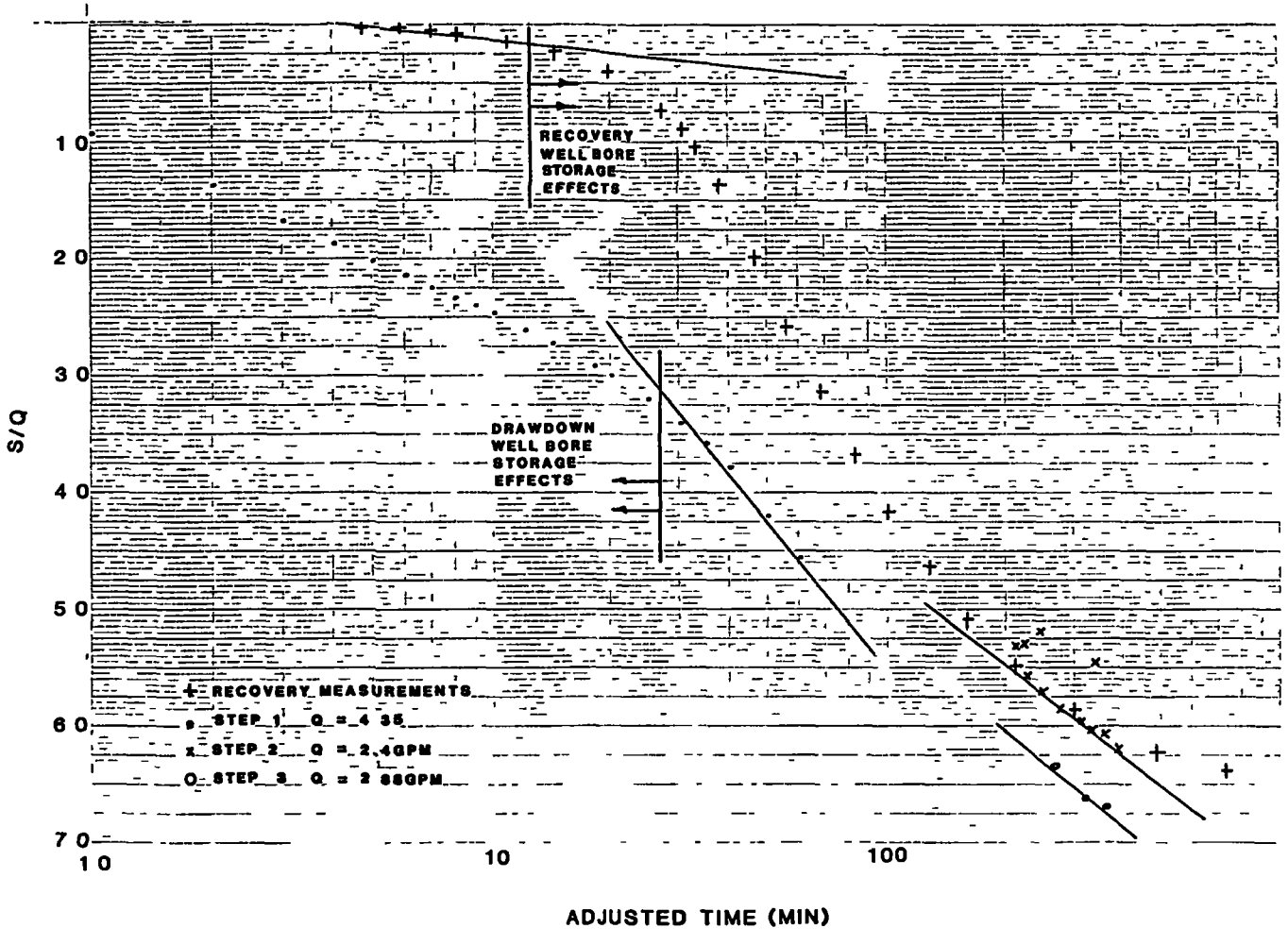
static water level 2.98 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti min	ADJUSTED TIME min	s/Q ft/gpm	RECOVERY TIME-t' min	t/t'
0.00	2.98	0.00	0.00		0.00	0.00		
0.50	5.63	2.65	2.58		0.50	0.59		
1.00	7.17	4.19	4.00		1.00	0.92		
2.00	9.35	6.37	5.94		2.00	1.37		
3.00	10.91	7.93	7.26		3.00	1.67		
4.00	11.99	9.01	8.15		4.00	1.87		
5.00	12.83	9.85	8.82		5.00	2.03		
6.00	13.49	10.51	9.34		6.00	2.15		
7.00	14.04	11.06	9.76		7.00	2.24		
8.00	14.53	11.55	10.13		8.00	2.33		
9.00	15.00	12.02	10.48		9.00	2.41		
10.00	15.37	12.39	10.76		10.00	2.47		
12.00	16.17	13.19	11.34		12.00	2.61		
14.00	16.87	13.89	11.84		14.00	2.72		
16.00	17.49	14.51	12.27		16.00	2.82		
18.00	18.07	15.09	12.67		18.00	2.91		
20.00	18.66	15.68	13.06		20.00	3.00		
25.00	20.06	17.08	13.98		25.00	3.21		
30.00	21.33	18.35	14.77		30.00	3.40		
35.00	22.77	19.79	15.62		35.00	3.59		
40.00	24.22	21.24	16.44		40.00	3.78		
45.00	25.76	22.78	17.26		45.00	3.97		
50.00	27.77	24.79	18.25		50.00	4.20		
60.00	31.40	28.42	19.83		60.00	4.56		
70.00	18.70	15.72	13.09	10.00	340.20	5.46		
80.00	17.78	14.80	12.47	20.00	246.75	5.20		
90.00	18.10	15.12	12.69	30.00	219.74	5.29		
120.00	18.20	15.22	12.76	60.00	210.75	5.32		
150.00	19.20	16.22	13.42	90.00	227.17	5.59		
180.00	19.59	16.61	13.67	120.00	250.23	5.70		
210.00	20.17	17.19	14.05	150.00	276.02	5.85		
248.00	20.50	17.52	14.26	188.00	310.59	5.94		
270.00	20.84	17.86	14.47	210.00	331.16	6.03		
300.00	20.99	18.01	14.56	240.00	359.63	6.07		
330.00	21.47	18.49	14.86	270.00	388.44	6.19		
360.00	27.76	24.78	18.25	30.00	269.19	6.34		
390.00	29.56	26.58	19.07	60.00	319.67	6.62		
419.00	30.09	27.11	19.29	89.00	359.35	6.70		
420.50	28.11	25.13	18.41	0.50	722.57	6.39	0.50	841.00
420.75	27.11	24.13	17.94	0.75	482.14	6.23	0.75	561.00
421.22	25.11	22.13	16.92	1.22	297.62	5.88	1.22	346.11
421.73	23.11	20.13	15.82	1.73	209.39	5.49	1.73	243.35
422.30	21.11	18.13	14.63	2.30	158.08	5.08	2.30	183.61
422.92	19.11	16.13	13.36	2.92	124.92	4.64	2.92	144.98
423.63	17.11	14.13	12.01	3.63	100.55	4.17	3.63	116.61

02328

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-T1 min	ADJUSTED TIME min	s/Q ft/gpm	RECOVERY TIME-t' min	t/t'
424.45	15.11	12.13	10.56	4.45	82.32	3.67	4.45	95.38
425.40	13.11	10.13	9.04	5.40	68.06	3.14	5.40	78.78
426.55	11.11	8.13	7.43	6.55	56.33	2.58	6.55	65.12
428.08	9.11	6.13	5.73	8.08	45.89	1.99	8.08	52.96
429.90	7.11	4.13	3.95	9.90	37.70	1.37	9.90	43.42
431.28	6.11	3.13	3.03	11.28	33.23	1.05	11.28	38.22
432.38	5.61	2.63	2.56	12.38	30.39	0.89	12.38	34.92
433.90	5.11	2.13	2.08	13.90	27.21	0.72	13.90	31.22
439.57	4.11	1.13	1.12	19.57	19.68	0.39	19.57	22.46
447.93	3.61	0.63	0.63	27.93	14.15	0.22	27.93	16.04
457.99	3.38	0.40	0.40	37.99	10.72	0.14	37.99	12.05
472.93	3.19	0.21	0.21	52.93	8.02	0.07	52.93	8.93
482.22	3.13	0.15	0.14	62.22	7.00	0.05	62.22	7.75
498.25	3.03	0.05	0.05	78.25	5.80	0.02	78.25	6.37
522.55	3.04	0.06	0.06	102.55	4.69	0.02	102.55	5.10
556.20	2.86	-0.12	-0.12	136.20	3.80	-0.04	136.20	4.08
770.00	2.65	-0.33	-0.34	350.00	2.12	-0.12	350.00	2.20
908.00	2.61	-0.37	-0.37	488.00	1.81	-0.13	488.00	1.86

023283



Recovery Analysis

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{37} = 714$ gpd/ft

Drawdown Analysis

$T = \frac{264}{(S/Q)}$ gpd/ft

$T = \frac{264}{2\ 65} = 100$ gpd/ft

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-7
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL ERT-22
OBSERVATION WELL ERT-22
DATE(S) AUG 11, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023284

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-22 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8/11/88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

Pumped well ERT 22 pump set at 37.75

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
11:06			9.98			
11:12			9.92			
11:20	install pump					rain from about 12:50 on
16:35			2.87			
1613			2.77			
1624			2.77			
						rain stopped ~4:00
16.40						start test
1640 30			5.63			
1641			7.17			
1642			9.35			
1643			10.91			
1644			11.99			
1645			12.83			
1646			13.49			
1647			14.04			
1648			14.53			
1649			15.00			
1650			15.37		@1650	5gal/68s
1652			16.15			
1654			16.85			
1656			17.47			
1658			18.05			
1700			18.64			
1705			20.04			
1710			21.35			
1715			22.75			
1720			24.20			+ 5g/69s
1725			25.73			
1730			27.74		@1731 hrs	5g/70s
1740			31.37	pump rate	cut back	~2 gal
1750			18.67			@1744 -2.4 gpm
1800			17.75			@1749 -2.4 gpm
1810			18.05			@1757 -2.4 gpm
1840			18.13			@1823 5g/76s
1910			19.13			
1940			19.50			
2010	210		20.07			
2048	248		20.40			

023285

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-22 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 8-11-88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

PUMPED WELL

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
2110	~~200~~		20.73			
2140	~~270~~ 300		20.89			
2210	~~320~~ 330		21.37			@ 2211 pump rate
2240	~~350~~ 360		27.66			≈ 3 gpm
2310	~~380~~ 390		29.45		@ 2319	5 gal/102 sec
2334	419		29.98		@ 2324	5 gal/103 sec
234030	4205		29.0			
234045	~~4250~~ 420.75		27.0			23:45
234113	421.217		25.0			
234144	421.734		23.0			
234218	422.301		21.0			
234255	422.918		19.0			
234324	423.635		17.0			
234427	424.45		15.0			
234524	425.40		13.0			
234633	426.55		11.0			
234805	428.083		9.0			
234974	429.90		7.0			
235117	431.283		6.0			
235223	432.383		5.5			
235344	433.9		5.0			
235424	439.567		4.0			
000756	447.933		3.5			
1756	457.933		3.26			
3256	472.933		3.07			
4213	482.217		3.0			
5815	498.25		2.9			
012233	~~524.55~~	522.33	2.9			
015612	556.20		2.7			
0530	~~723~~ 770		2.45			
0748	~~928~~ 908		2.40			

120/18 #

3.34

: Joel - take readings on the control wells ERT-7, ERT-21 and ERT-23

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Well ERT-~~29~~ 22 - pumping DATE 8/11/88

TIME	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	MEASURING POINT (MP) HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
19	ERT-23				7.45	+.04	
42	ERT23				7.45	+.04	
01	ERT23				7.45	+.04	
07	ERT 23				7.15	+.04	
01	ERT-7A				5.35		
02	ERT-7				4.90		
15	ERT-7				4.89		
19	ERT-7A				5.35		
38	ERT-23	Changed Sounders old Sounder reading 7.14			7.18		
46	pump	5 gal in 68 sec					
50	"	5 gal in 68 sec			~~5.84~~		
58	ERT 7				4.84		
59	ERT 7A				5.32		
58	ERT 23				7.16		

023287

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Pump test of well ERT-22 DATE 8/11/88

IME	WELL NO.	~~LAST READING~~ DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
10 to	ERT 7	4.84					
11 ≠	ERT 7A	5.32					
00	Pump	5gal/68 sec					
09	Pump	5gal/68 sec.					
12	ERT-23	7.16					
20	Pump	5gal/69sec					
26	ERT 7	4.825					
27	ERT 7A	5.32					
29	ERT 23	7.15					
31	Pump	5gal/70sec.					
37	Pump	5gal/70 sec					
44	Pump	5gal/124 sec	pump rate cut back after 1 hr		TO		
43	ERT 7	4.82					
47	ERT 7A	5.315					

023288

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT _____ DATE _____

IME	ELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
7.48	Pump	5gal in 125sec				= 2.4gpm	
7.53	ERT-23				7.14		
7:50	Pump	5gal in 125sec					
3:13	ERT-7A				5.305		
:14:30	ERT-7				4.80		
3:15	Pump	5gal in 126 sec			~~4.80~~		
3:18	ERT-23				7.13		
3:23	Pump	5gal in 126 sec					
8:48	ERT-7				4.75		
8:49	ERT-7A				5.285		
8:50	Pump	5gal in 126 sec					
8:53	ERT 23				7.12		
8:57	Pump	5 gal in 125 sec					
7:14:40	ERT-7A				5.28		

023289

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT _____ DATE _____

E	WELL NO	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
15:30	ERT-7				4.77		
16	Pump	5 gal	in 125 sec				
23	ERT23				7.12		
28	Pump	5 gal	in 125 sec				
50	ERT-7				4.75		
:51	ERT-7A				5.26		
:52	Pump	5 gal	in 127 sec				
:56	ERT 23				7.10		
:00	Pump	5 gal	in 126 sec				
18	ERT-7				4.73		
19	ERT-7A				5.25		
:16	ERT23				7.10		
:20	Pump	5 gal	in 125 sec				

023290

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT ERT-22 pump test DATE 8-11-88

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
53	ERT 7				4.73	5 gals / 125 sec.	2054
54	ERT 7A				5.25		
58	ERT 23				7.09	5 gals / 125 sec	2102
114	ERT 7				4.71	5 gals / 126 sec	2115
15	ERT 7A				5.25		
18	ERT 23				7.09	5 gals / 126 sec	2122 ~~2122~~
144	ERT 7				4.73	5 gals / 125 sec	2146
145	ERT 7A				5.25		
48	ERT 23				7.09	5 gals / 125 sec	2153
214	ERT 7				4.73	5 gals / 102 sec	2216
215	ERT 7A				5.25		
218	ERT 23				7.09	5 gals / 103 sec	2223

023291

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT ERT-22 pump test DATE

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
:44	ERT 7				4.73	5 gals/105 sec	2245
45	ERT 7A				5.25		
48	ERT 23				7.09	5 gals/104sec	2251
314	ERT 7				4.72	5 gals/104 sec	2316
315	ERT 7A				5.25		
318	ERT 23				7.09	5 gals/104 sec	2322
352	ERT 23				7.08		
356	ERT-7				4.71		
359	ERT-7A				5.25		
28	ERT-7A				5.24		
20	ERT-7				4.70		
36	ERT 23				7.07		
0	ERT-7				4.68		
07	ERT-7A				5.23		

023292

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT ERT-22 pump test DATE 8-11 and 8-12

5/12 ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
:11	ERT-23				7.07		
2:10	ERT 7				4.62		
11	ERT 7A				5.18		
. :6	ERT 23				7.06		
' 56	ERT 7				4.50		
59	ERT 7A				5.19		
:1	ERT 23				7.04		

FRENCH LIMITED SITE
AQUIFER TESTING PROGRAM

DATE OF TEST August 12, 1988

PUMPED WELL· ERT-29

TOTAL DEPTH· 50 FEET

SCREENED INTERVAL· 20 FT TO 50 FT CASING DIAMETER 4 IN

OBSERVATION WELLS ERT-28 and ERT-30

CONTROL WELLS ERT-23

BACKGROUND AND DESCRIPTION OF TEST·

The test of ERT-28 was included to provide information about aquifer characteristics between the French Limited lagoon and the Riverdale Subdivision The preliminary pumping test program indicated that the well had been pumped at 11 gpm for almost 20 minutes Based on these results, we attempted to pump the well at 4 gpm on August 11 The water level was drawn down to the pump after just 6 5 minutes and the test was terminated Measurements had not yet been taken with a bucket and stop watch, so it is possible that the actual pumping rate may have been greater than 4 gpm Also in subsequent discussions with Norm Nielsen, it was discovered that during the preliminary pump test which was conducted during well purging prior to sampling, the well was pumped without a valve control and the 11 gpm rate was based on one bucket and stop watch measurement Thus, the flow rate estimates for the preliminary pump test may be in error

The test was re-run on August 12, with the flow rate set to and maintained at about 0 75 gpm Subsequent measurements with a bucket and stop watch indicated a pumping rate of 0 66 gpm At these low pumping rates, it was concluded that observation wells ERT-28 and ERT-30 located over 150 feet from the pumped well would not experience any drawdown due to pumping during an 8 hour test Nevertheless, these two wells and control well ERT-23 were monitored for water levels about every one half hour

After 1 hour of pumping at 0 66 gpm the drawdown was less than 4 feet and had appeared to level out We decided to increase the pumping rate to about 1 1 gpm since the variable rate test would help discriminate the drawdown due to formations loss from that due to well inefficiency At 106 3 minutes into the test, the pump stopped for two minutes and the generator was re-fueled Even though the valves were not adjusted, the pumping rate after re-fueling dropped to about 0 78 gpm The flow was maintained at this rate for about 102 minutes Then at 210 minutes into the test, the rate was stepped up to about 1 89 gpm After pumping at this rate for about 10 minutes, the rate started to drop but was not adjusted immediately because the rotometer measured rates only up to 1 gpm The pumping rate from averaged about 1 53 gpm for the next 30 minutes. The pump rate was increased to about 4.2 gpm for the last 10

minutes and recovery measurements were taken for about 2 hours following the test Water levels in the pumping well had recovered to within 0 11 feet of the original static water level Field measurements are attached

Water produced from the test was pumped into 55-gallon drums during the test The contents of the 55-gallon drums were emptied into the French Limited lagoon following completion of the test

INTERPRETATION

The control wells ERT-30, ERT-28 and ERT-23 showed no obvious response due to pumping well ERT-29 The water levels in all four wells rose near the latter portion of the pumping period but started dropping shortly before the pump was shut off The decline continued into the recovery period The total water level fluctuation in the control wells was less than 0 05 feet, as shown in Figure 1. These changes were small and appeared to follow a diurnal pattern similar to that observed for the control wells during the ERT-10 well test

Drawdown values determined from water level measurements in the production well ERT-29 were adjusted using Jacob's correction for water table conditions Jacob's correction is

$$s_{adj} = s - (s^2/2*m)$$

where s is drawdown,
s_{adj} is adjusted drawdown, and
m is the aquifer thickness from static measurements

Drawdown and adjusted drawdown values are included in the attached spread sheet Following the procedures of Birsoy and Summers (1980), an adjusted time was calculated for the drawdown data and a dimensionless time was calculated for the recovery data

The ratio of adjusted drawdown to the associated pumping rate for the production well ERT-29 were plotted against the log of adjusted time on the attached semi-log plot in Figure A-8 The ratio of the adjusted residual drawdown (recovery) to the final pumping rate were also plotted against the log of dimensionless time on the same semi-log plot in Figure A-8 Well bore effects had a significant influence on a large portion of the response data The drawdown response during the latter portion of the drawdown response was too erratic to allow for an estimation of the transmissivity from the drawdown data The reason for the eratic response is not entirely clear It appears to be the result of fluctuations in the pumping rate, although the bucket and stop watch measurements did not indicate a significant change in the pumping rate.

A transmissivity was calculated from the valid portion of the recovery data from the semilog plots Unfortunately there were only three data points in the recovery plots that were determined to be outside the range of well bore storage effects. The transmissivity determined from the semi-log recovery analysis using the dimensionless time of Summers and Birsoy was 1886 gpd/ft This estimate appears to have considerable error since it does not correspond with the low specific capacity of the well The large error is probably because it was derived from three data points near the final stages of

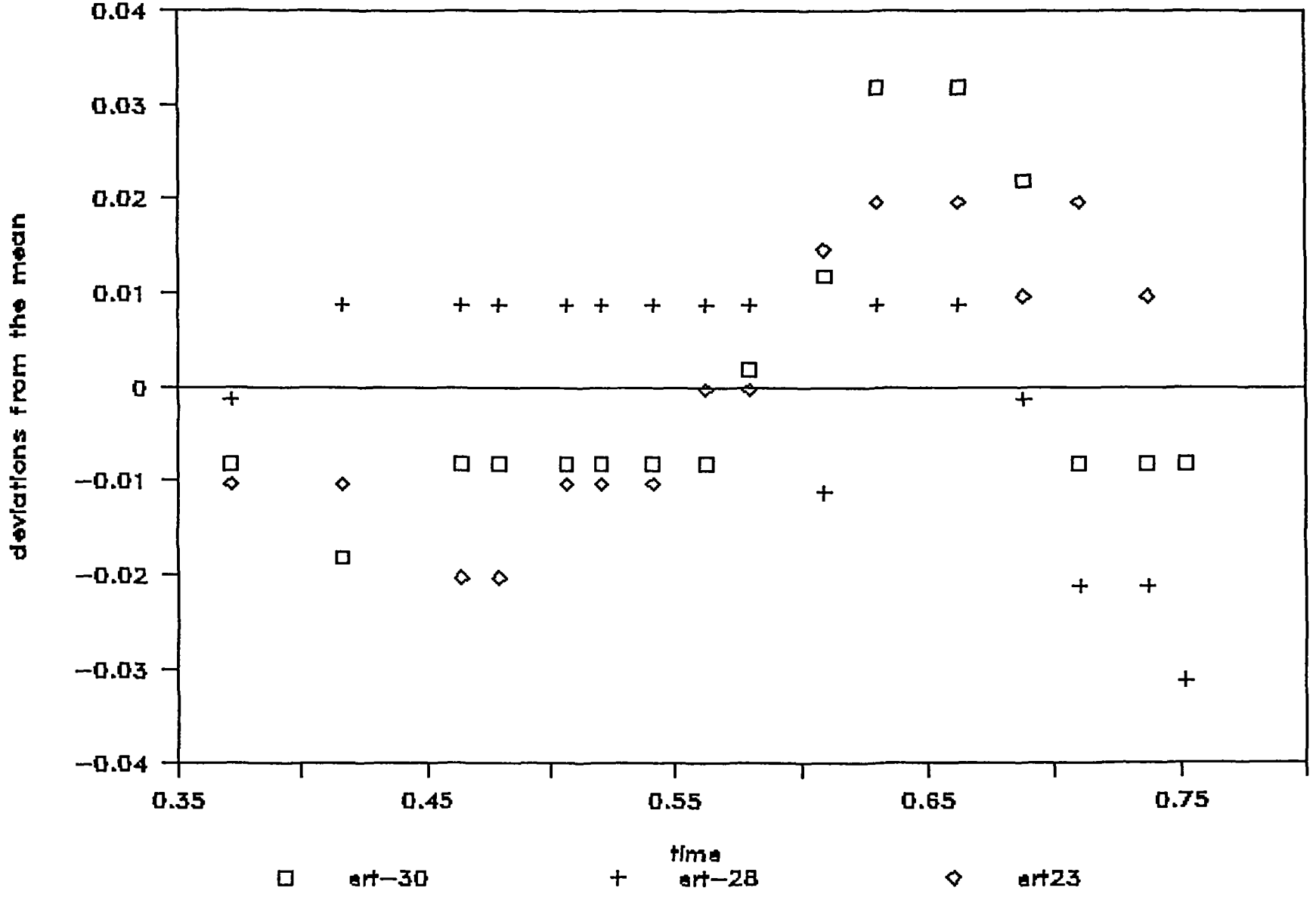
recovery Measurement errors and water level response to influences other than pumping would be relatively significant in the latter stages of recovery where the residual drawdown is less than 0 1 feet A transmissivity of 1221 gpd/ft was also calculated from the valid portion of the recovery data using the Theis recovery method in Figure A-9 This estimate may also have consideravble error for the same reasons described previously

Delayed yield effects were not observed but could have been masked by the variable pumping rate A storage coefficient could not be determined from the single well response data

The transmissivity estimate from the recovery analyses seems to be high in comparison with the results from the more productive wells such as ERT-22, ERT-21 and ERT-7 If an accurate estimate of transmissivity is needed in the region around the well ERT-29, then a new test should be performed. The pump test should be run long enough to produce a response in wells ERT-28 and ERT-30 or an observation well should be installed closer to the pumped well

Aquifer Pump Test – Well ERT–29

control well water level fluctuations



023297

PUMPED WELL: ERT-29

CONTROL WELL WATER LEVEL FLUCTUATIONS

HOUR	min	ERT-30	MEAN-DEV ERT-30 14.42	ERT-28	MEAN-DEV ERT-30 13.82	ERT-23	MEAN-DEV ERT-30 7.039
8	55	14.43	-0.01				
9	59	14.44	-0.02				
11	9	14.43	-0.01				
11	30	14.43	-0.01				
12	9	14.43	-0.01				
12	29	14.43	-0.01				
12	59	14.43	-0.01				
13	30	14.43	-0.01				
13	55	14.42	0.00				
14	37	14.41	0.01				
15	7	14.39	0.03				
15	53	14.39	0.03				
16	30	14.40	0.02				
17	2	14.43	-0.01				
17	41	14.43	-0.01				
18	3	14.43	-0.01				
8	59			13.83	-0.00		
9	55			13.82	0.01		
11	5			13.82	0.01		
11	34			13.82	0.01		
12	5			13.82	0.01		
12	31			13.82	0.01		
13	2			13.82	0.01		
13	27			13.82	0.01		
13	58			13.82	0.01		
14	34			13.84	-0.01		
15	0			13.82	0.01		
15	46			13.82	0.01		
16	27			13.83	-0.00		
17	0			13.85	-0.02		
17	37			13.85	-0.02		
18	6			13.86	-0.03		
9	6					7.05	-0.01
11	2					7.05	-0.01
11	39					7.06	-0.02
12	1					7.06	-0.02
12	35					7.05	-0.01
13	5					7.05	-0.01
13	25					7.05	-0.01
14	1					7.04	-0.00
14	30					7.04	-0.00
15	3					7.03	0.01
15	43					7.02	0.02
16	24					7.02	0.02
16	57					7.03	0.01
17	34					7.02	0.02
18	10					7.03	0.01

023298

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti min	Adjusted time min	s/Q	RECOVERY TIME-t' min	t/t'
212.5	19.8	8.14	7.38	2.5	16.46	3.90		
215	21.7	10.04	8.88	5	24.74	4.70		
220	23.43	11.77	10.17	10	37.35	5.38		
225	23.38	11.72	10.14	5	81.07	6.62		
230	22.82	11.16	9.72	10	85.56	6.36		
238	22.28	10.62	9.32	18	96.41	6.09		
240	22.25	10.59	9.30	20	99.22	6.08		
250	22.24	10.58	9.29	30	113.06	6.07		
262	31.74	20.08	15.46	2	14.25	3.68	2.00	131.00
262.5	30	18.34	14.49	2.567	11.46	3.45	2.57	102.29
263.0	28	16.34	13.29	3.067	9.85	3.16	3.07	85.77
264.4	26	14.34	11.99	4.4	7.34	2.86	4.40	60.09
265.2	24	12.34	10.61	5.25	6.40	2.53	5.25	50.52
266.0	20	8.34	7.56	6.083	5.73	1.80	6.08	43.74
267.8	17	5.34	5.04	7.85	4.77	1.20	7.85	34.12
270.2	15	3.34	3.24	10.283	3.98	0.77	10.28	26.28
272.3	14	2.34	2.30	12.383	3.54	0.55	12.38	22.00
276.0	13	1.34	1.34	16.067	3.04	0.32	16.07	17.18
277.3	12.8	1.14	1.14	17.317	2.92	0.27	17.32	16.01
279.0	12.6	0.94	0.95	19.083	2.77	0.23	19.08	14.62
281.8	12.4	0.74	0.75	21.883	2.59	0.18	21.88	12.88
286.8	12.2	0.54	0.55	26.833	2.34	0.13	26.83	10.69
292.1	12.1	0.44	0.45	32.15	2.16	0.11	32.15	9.09
301.8	12	0.34	0.36	41.883	1.94	0.08	41.88	7.21
325	11.93	0.27	0.27	65	1.66	0.06	65.00	5.00
350	11.9	0.24	0.24	90	1.51	0.06	90.00	3.89
380	11.88	0.22	0.22	120	1.40	0.05	120.00	3.17

023299

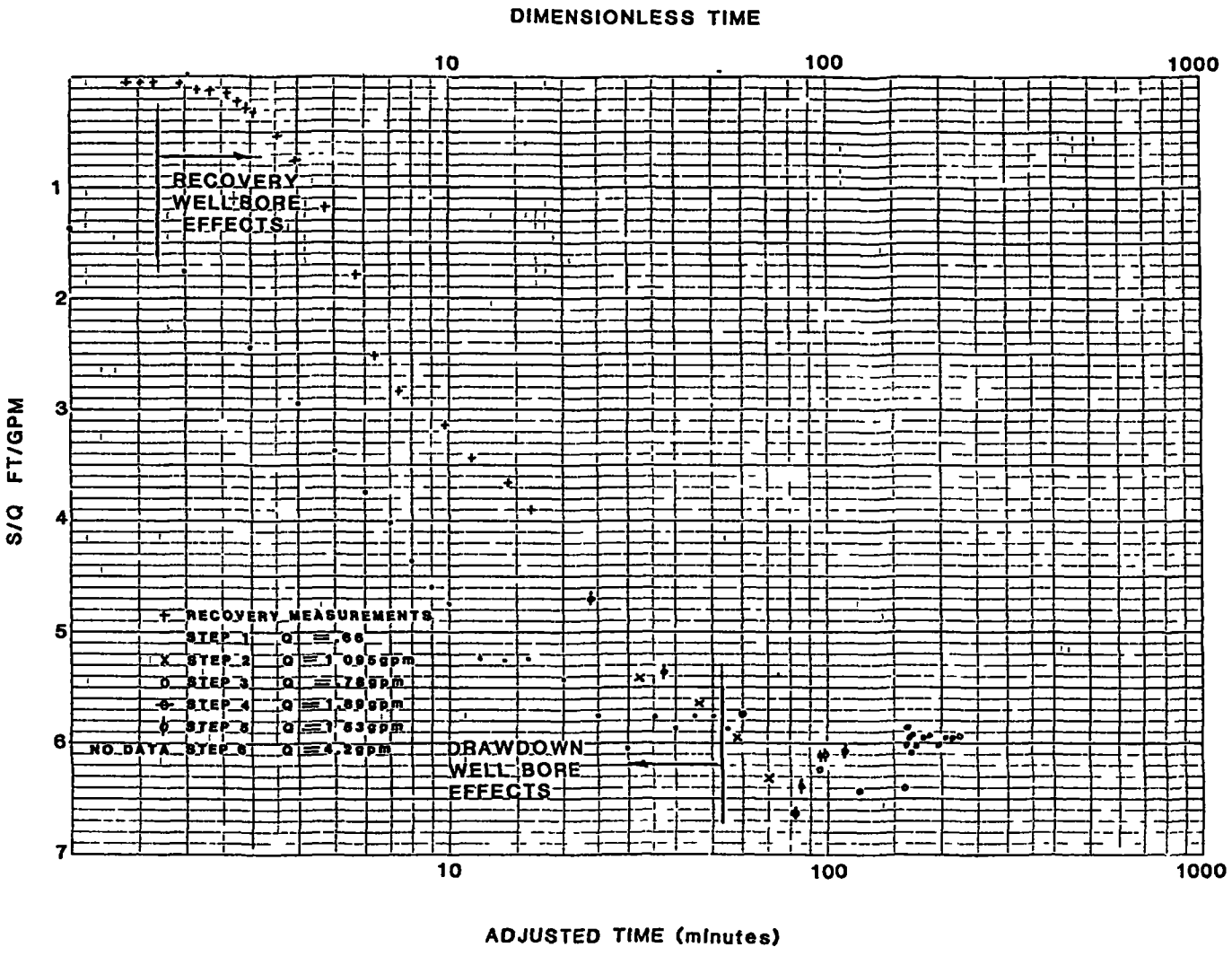
STEP DRAWDOWN TEST - WELL ERT-29

Saturated Thickness 43.34 feet

static water level 11.66 feet

TIME-t min	DEPTH ft	DRAWDOWN ft	ADJUSTED DRAWDOWN ft	t-Ti min	Adjusted time min	s/Q	RECOVERY TIME-t' min	t/t'
0	11.66	0	0.00		0.00	0.00		
0.5	12.37	0.71	0.70		0.50	1.07		
1	12.58	0.92	0.91		1.00	1.38		
2	12.84	1.18	1.16		2.00	1.76		
3	13.3	1.64	1.61		3.00	2.44		
4	13.66	2	1.95		4.00	2.96		
5	13.95	2.29	2.23		5.00	3.38		
6	14.21	2.55	2.47		6.00	3.75		
7	14.4	2.74	2.65		7.00	4.02		
8	14.65	2.99	2.89		8.00	4.37		
9	14.81	3.15	3.04		9.00	4.60		
10	14.91	3.25	3.13		10.00	4.74		
12	15.26	3.6	3.45		12.00	5.23		
14	15.28	3.62	3.47		14.00	5.26		
16	15.27	3.61	3.46		16.00	5.24		
18	15.32	3.66	3.51		18.00	5.31		
20	15.39	3.73	3.57		20.00	5.41		
25	15.63	3.97	3.79		25.00	5.74		
30	15.87	4.21	4.01		30.00	6.07		
35	15.65	3.99	3.81		35.00	5.77		
40	15.72	4.06	3.87		40.00	5.86		
45	15.64	3.98	3.80		45.00	5.75		
50	15.63	3.97	3.79		50.00	5.74		
55	15.73	4.07	3.88		55.00	5.88		
60	15.62	3.96	3.78		60.00	5.73		
70	18.05	6.39	5.92	10	32.31	5.41		
80	18.36	6.7	6.18	20	46.12	5.65		
90	18.75	7.09	6.51	30	58.17	5.95		
100	19.23	7.57	6.91	40	69.49	6.31		
108.3	16.72	5.06	4.76	2.017	38.97	4.35		
109.3	16.9	5.24	4.92	1.017	95.06	6.23		
110	17.08	5.42	5.08	1.7	121.30	6.43		
115	17.05	5.39	5.05	6.7	159.86	6.40		
120	16.72	5.06	4.76	11.7	161.72	6.03		
125	16.58	4.92	4.64	16.7	162.16	5.87		
130	16.65	4.99	4.70	21.7	163.31	5.95		
135	16.63	4.97	4.69	26.7	165.20	5.93		
140	16.77	5.11	4.81	31.7	167.69	6.09		
150	16.7	5.04	4.75	41.7	173.93	6.01		
160	16.65	4.99	4.70	51.7	181.26	5.95		
170	16.63	4.97	4.69	61.7	189.27	5.93		
180	16.7	5.04	4.75	71.7	197.74	6.01		
190	16.65	4.99	4.70	81.7	206.52	5.95		
200	16.64	4.98	4.69	91.7	215.52	5.94		
210	16.63	4.97	4.69	101.7	224.70	5.93		

023300



$$t_c = \frac{9}{Q/S} = 52 \text{ MINUTES}$$

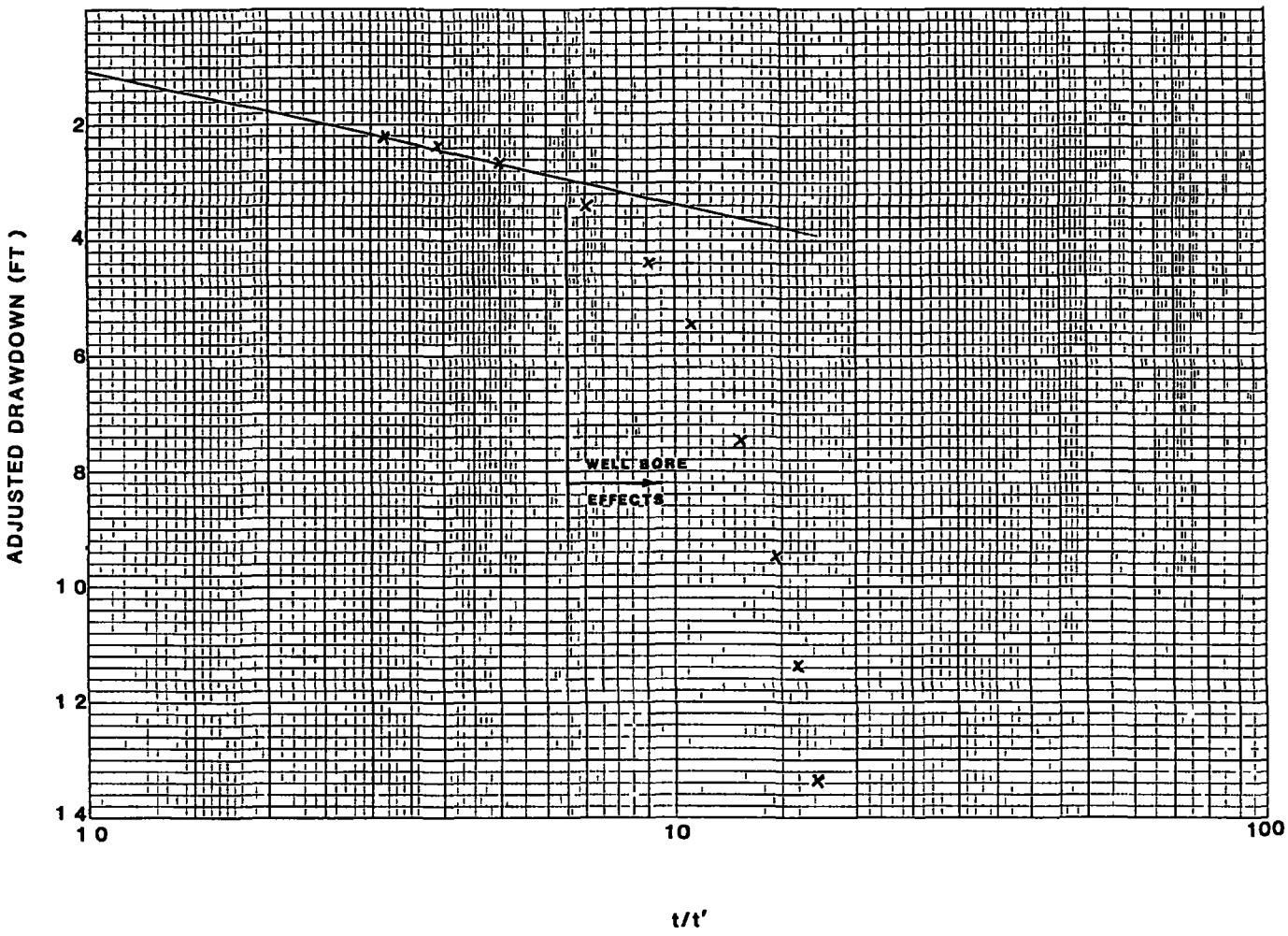
FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-8
SEMI-LOG PLOT OF S/Q VERSUS ADJUSTED TIME

PUMPED WELL ERT-29
OBSERVATION WELL ERT-29
DATE(S) AUG 12 -, 1988

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO



$T = \frac{264\ Q\ (gpm)}{\Delta S}$ gpd/ft

T = 1221 gpd/ft

FRENCH LIMITED PROJECT
CROSBY, TEXAS

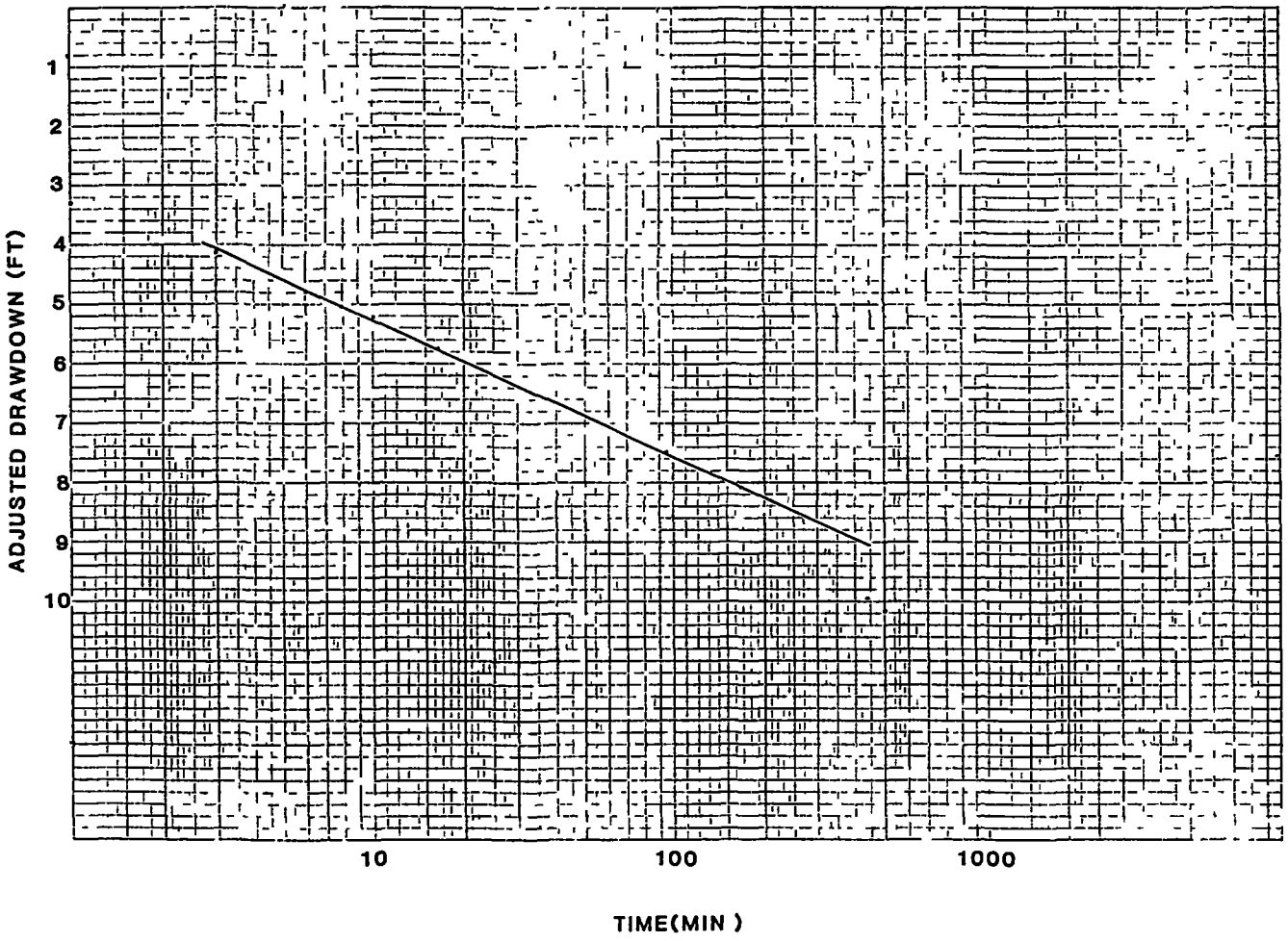
FIGURE A-9
THEIS RECOVERY ANALYSIS

PUMPED WELL ERT-29
OBSERVATION WELL ERT-29
DATE(S) AUG 12, 1988

PROJECT No 26	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023301



$$T = \frac{264\ Q}{S}\ \text{gpd/ft}$$

$$T = \frac{264(6\ 67)}{1\ 2} = 1467\ \text{gpd/ft}$$

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-10
SEMI-LOG DRAWDOWN ANALYSIS

PUMPED WELL ERT-7
OBSERVATION WELL ERT-7
DATE(S) AUG 9, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

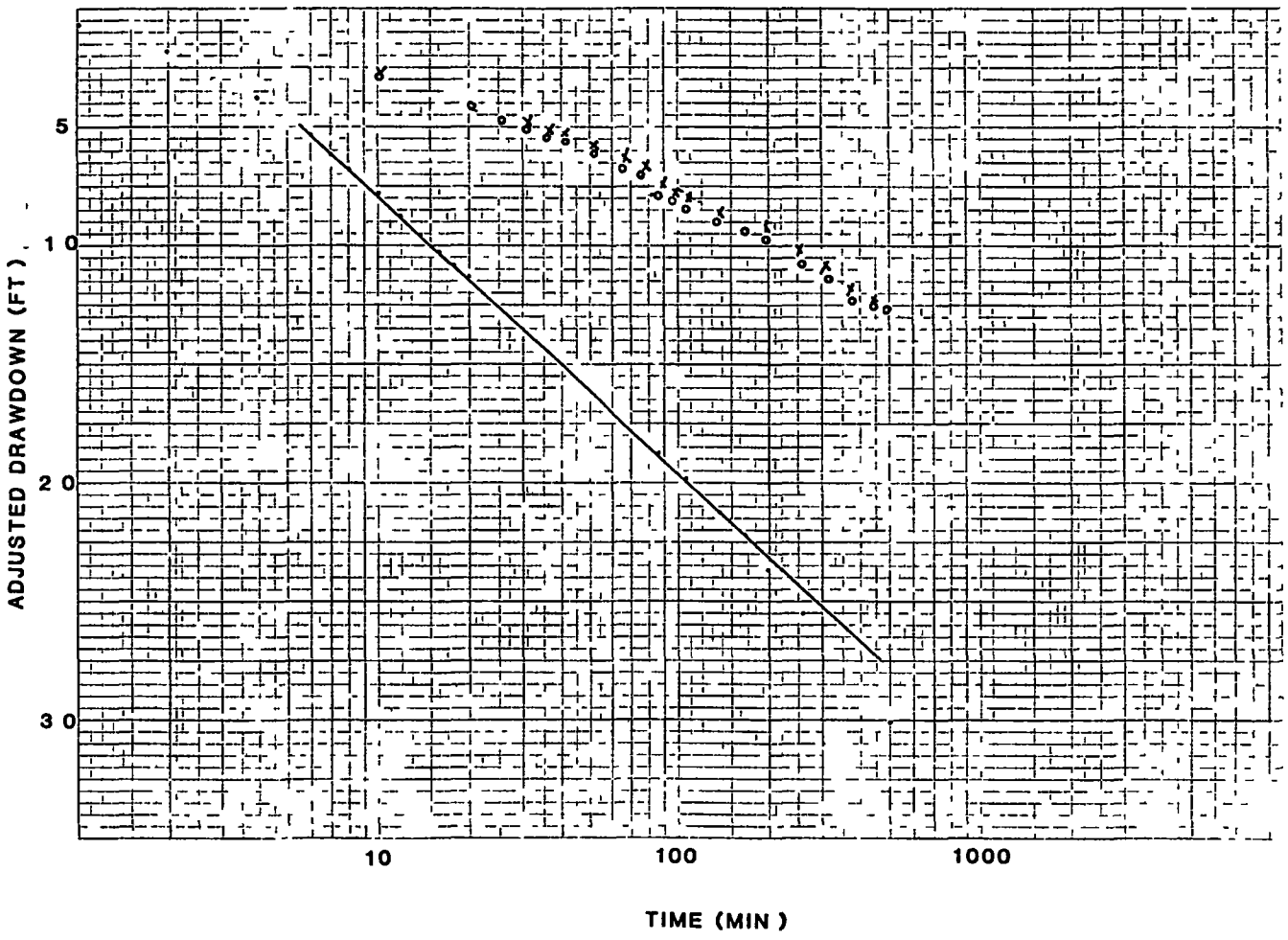
02220

023303

Well, ERT 8 Analysis

$$T = \frac{264\ (Q)}{S}\ \text{gpd/ft}$$

$$T = \frac{264\ (6\ 67)}{2\ 3} = 766\ \text{gpd/ft}$$



- Well ERT 8(r=9 2ft)
- Well ERT 7A (r = 10 7 ft)
- Well ERT 8A (r = 13 8 ft)

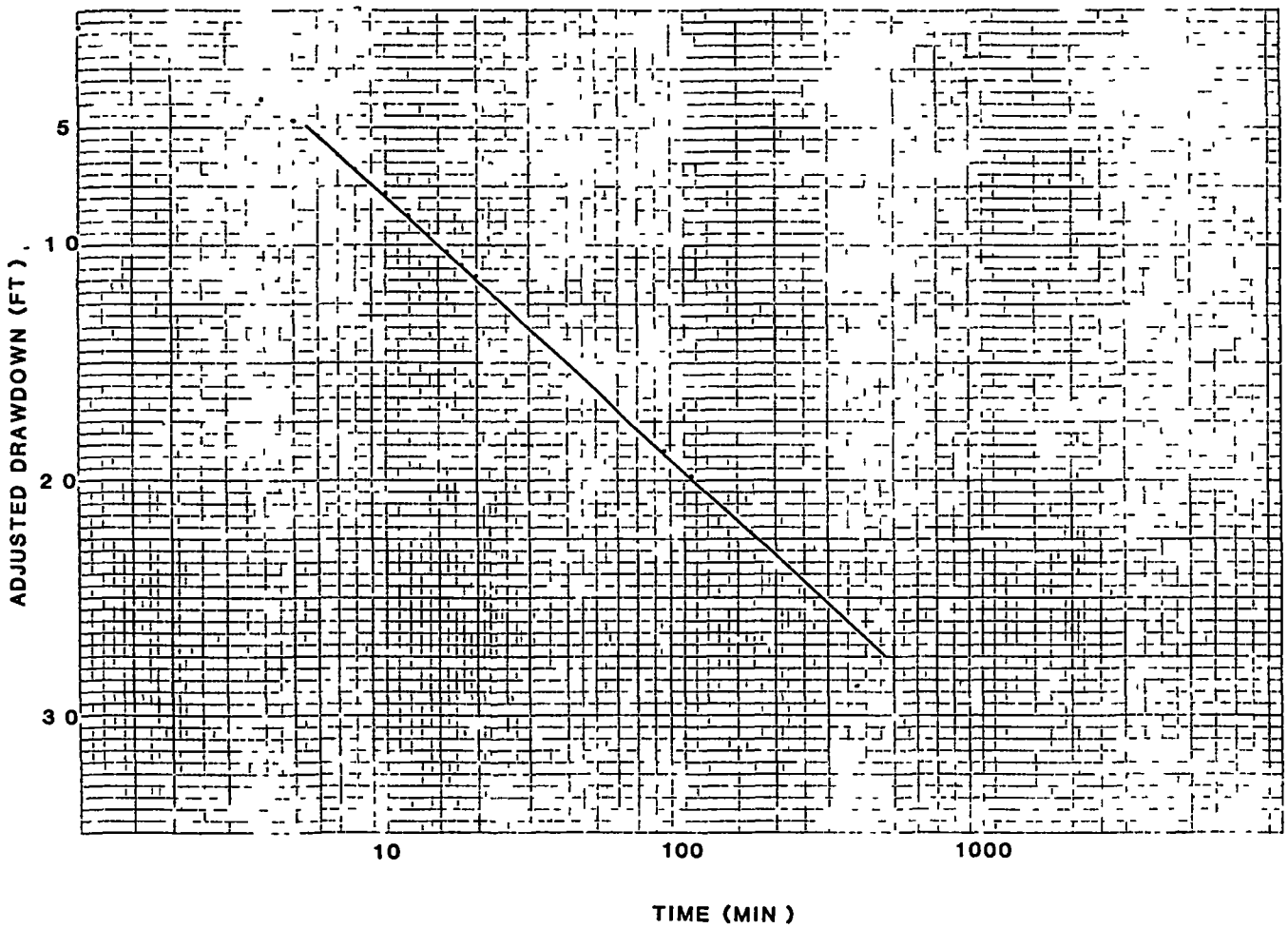
FRENCH LIMITED PROJECT
CROSBY TEXAS

FIGURE A-10
SEMI-LOG DRAWDOWN ANALYSIS

PUMPED WELL ERT-7
OBSERVATION WELL ERT-8
DATE(S) AUG 9, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO



$$T = \frac{264\ (Q)}{S}\ \text{gpd/ft}$$

$$T = \frac{264\ (6\ 67)}{2\ 3} = 766\ \text{gpd/ft}$$

FRENCH LIMITED PROJECT
CROSBY, TEXAS

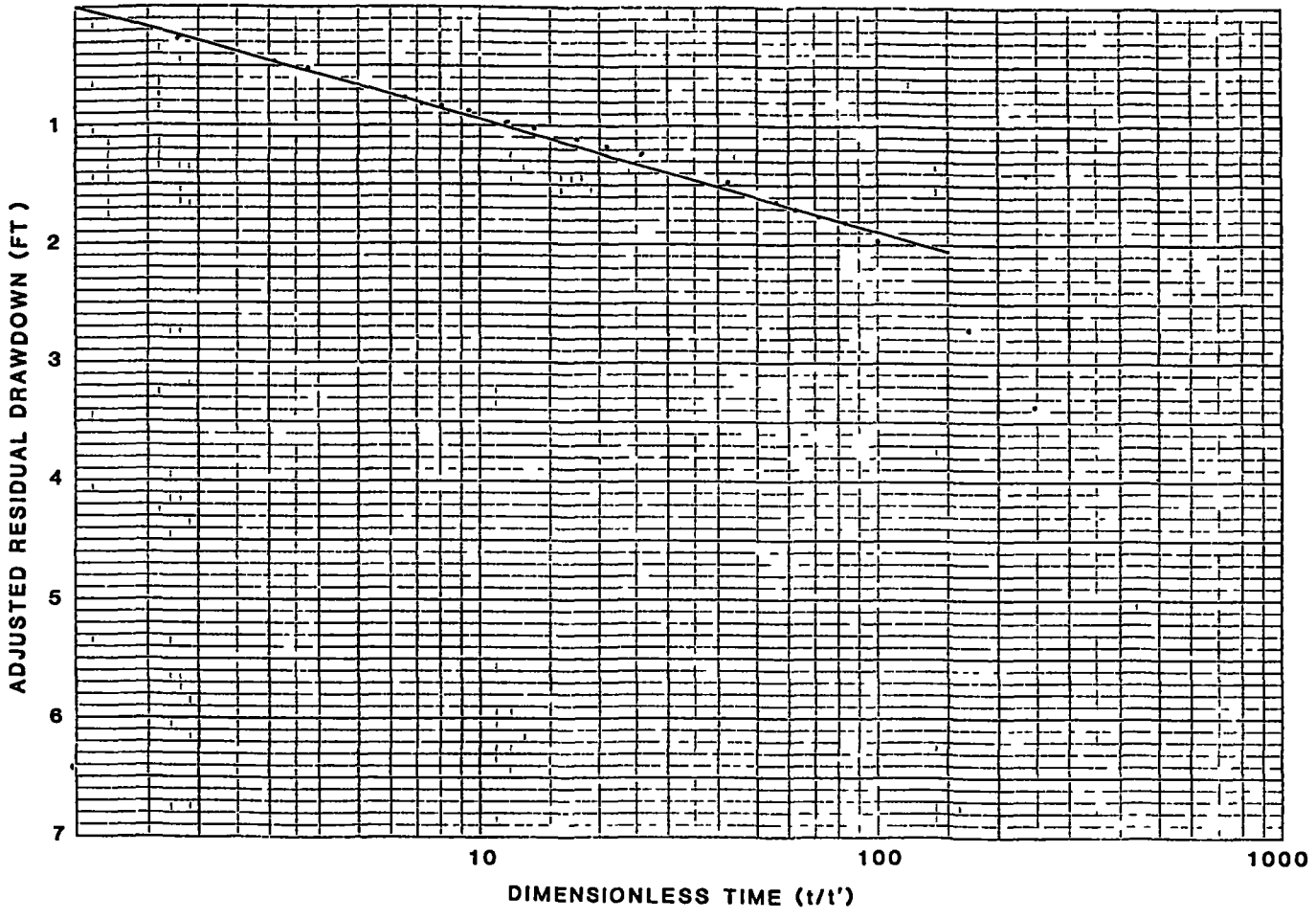
FIGURE A-11
SEMI-LOG DRAWDOWN ANALYSIS

PUMPED WELL ERT-7
OBSERVATION WELL ERT-8
DATE(S) AUG 9, 1988

PROJECT No 26	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023304



$$T = \frac{264\ Q}{\Delta S}\ \text{gpd/ft}$$

$$T = \frac{264\ (6\ 67)}{.95} = 1854\ \text{gpd/ft}$$

FRENCH LIMITED PROJECT
CROSBY TEXAS

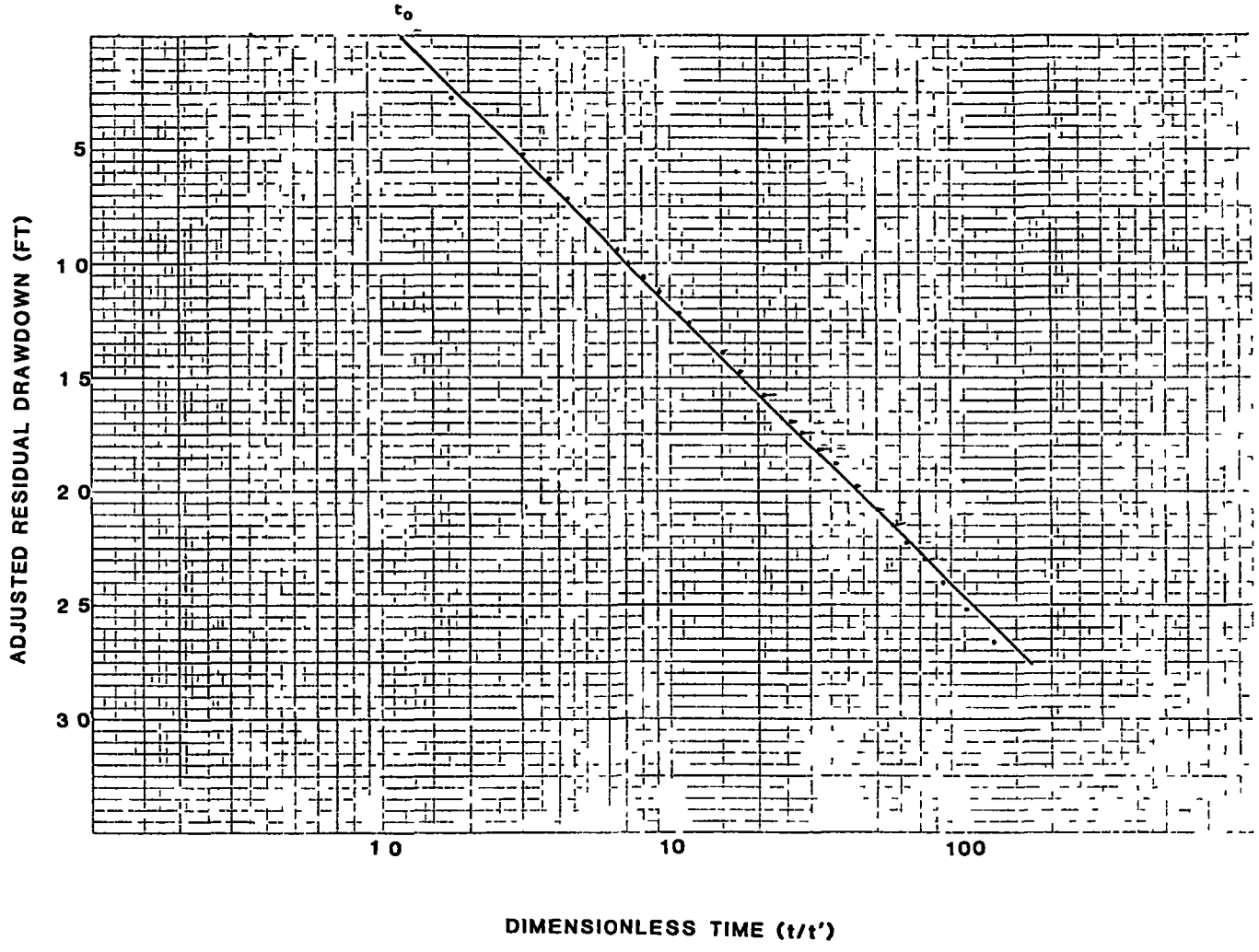
FIGURE A/2
THEIS RECOVERY ANALYSIS ERT

PUMPED WELL ERT-7
OBSERVATION WELL ERT-7
DATE(S) AUG 9, 1988

PROJECT No	DATE	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023305



$$T = \frac{264\ Q}{\Delta Sc} = \frac{264\ (6\ 67)}{1\ 26}$$

T = 1387 gpd/ft

$$S = \frac{T\ (to)}{4790\ r2}$$

$$= \frac{1387\ (1\ 2\ min\ )}{4790\ (9\ 2)2}$$

S = 0041

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE A-13
THEIS RECOVERY ANALYSIS

PUMPED WELL ERT-7
OBSERVATION WELL ERT-8
DATE(S) AUG 9, 1988

PROJECT No	DATE 9/12	REVISION

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER CO

023 ~~006~~

023307

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # ERT-7 GR. ELEVATION _____

TESTED INTERVAL _____ M P ELEVATION _____

DATE 9/8/88 Aug 9, 88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

pumped well ERT-7 TD : 42.50

Frequency

CLOCK TIME	TIME AFTER TEST STARTED	-30 min	DEPTH OF WATER LEVEL BELOW M.P 4.76	DRAWDOWN OF WATER LEVEL		COMMENTS
1545			4.73	static level		pump on
1546	1		8.15			
1547	2		8.82			
1548	3		9.06			6.67 gpm
1549	4		9.15			
1550	5		9.66			5 gpm / 45 sec
1551	6		9.80			
1552	7		10.00			
1553	8		10.07			
1555	10		10.26			
1557	12		10.41			
1559	14		10.66			
1601:30	16.5		10.90			@ 1600 5 g/45 sec
1603	18		10.89			
1605	20		10.97			
1610	25		11.15			
1615	30		11.33			5 gal / 45 sec
1620	35		11.41			
1625	40		11.53			
1630	45		11.63			5 gal / 45 sec
1635	50		11.71			
1640	55		11.87			5 gal / 45 sec
1650	65		12.13			
1700	75		12.31			5 gal / 45 sec
1710	85		12.75			
1720	95		12.90			@ 1721 5 gal / 45 sec
1730:30	105.5		12.90			
1800	135		13.36			5 gal / 45 sec
1830	165		13.54			5 gal / 45 sec
1900	195		14.07			
2000	255		14.65			5 gal / 45 sec
2100	315		15.18			5 gal / 45 sec
2200	375		15.65			5 gal / 45 sec
2300	435		15.93			5 gal / 45 sec
2400	495		16.30			

023308

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # 7 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 9/10/88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

N

Recovery Test ERT-7

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
2470						pump off
0000	495.5		13.42			
0001	1		10.87			
0002	2		8.60			
0003	3		7.55			
0004	4		7.03			
0005	5		6.72			
0006	6		6.61			
0007	7		6.53			
0008	8		6.46			
0009	9		6.39			
0010	10		6.33			
0012	12		6.23			
0014	14		6.17			
0016	16		6.11			
0018	18		6.06			
0020	20 515		6.02			
0025	25 520		5.92			
0030	30 525		5.85			
0035	35 530		5.80			
0040	40 535		5.75			
0045	45 540		5.70			
0050	50 ~~550~~	545	5.68			
0100	60 ~~560~~	555	5.62			
0110	70 ~~570~~	565	5.58			
0120	80 ~~580~~	575	5.55			
0130	90 ~~590~~	585	5.51			
0200	120	615	5.37			
0230	150	645	5.30			
0300	180	675	5.25			
0400	240	735	5.19			
1024	1119	~~1104.40~~	5.01			

023309

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # 74 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 9/8/88 Aug 9, 88 STATIC WATER LEVEL DEPTH 5.38

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

19.6 - TOTAL DEPTH (TOC) Radial Dist 10.7'
pumped well 7. (ERT-7)

CLOCK TIME	TIME AFTER TEST STARTED	.	DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
154500	0		538			Static water level
154530	.5		538			TOC
4600	1.0		538			
4700	2		542			
4800	3		546			
4900	4		550			
5000	5		553			
5100	6		555			
5200	7		558			
53	8		560			
54	10		565			
57	12		568			
59	14		570			
1601	16		574			
1603	18		576			
05	20		578			
10	25		584			
15	30		585			
20	35		588			
25	40		590			
30	45		592			
35	50		594			
40	55		596			
50	65		600			
1700	75		603			
1712	87		610			
1721	96		614			
1731:30	106.5		615			
1800	135		622			
1830	165		626			
1900	195		629			
2000	255		638			
2100	315		646			
2200	375		653			
2300	435		657			
2359	494		661			

023310

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

Oh4 WELL # ERT-7a

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE _____

STATIC WATER LEVEL DEPTH _____

Recovery

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

Pumped well ERT-7

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
235900						
240000						
240030	495.5		6.60			
000100	496.0		6.59			
200	497		6.56			
300	498		6.50			
400	499		6.47			
500	500		6.42			
600	501		6.40			
700	502		6.37			
800	503		6.33			
900	504		6.32			
1000	505		6.30			
12	507		6.26			
14	509		6.24			
16	511		6.22			
18	513		6.20			
20	515		6.18			
25	520		6.13			
30	525		6.11			
35	530		6.07			
40	535		6.06			
45	540		6.03			
50	545		6.02			
001.00	555		5.97			
110	565		5.94			
0120	575		5.90			
0130	585		5.89			
0200	615		5.83			
0230	645		5.83			
0300	675		5.73			
~~0330~~	6		~~5.70~~			
0400	735		5.70			
1027	[illegible]	1122	5.56			

023311

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # 8 GR. ELEVATION _____

TESTED INTERVAL _____ M.P. ELEVATION _____

DATE 9/8/88 STATIC WATER LEVEL DEPTH _____

PERSONNEL _____ STATIC WATER LEVEL ELEVATION _____

TOTAL DEPTH OF ERT-8 = 49.66

Radial Dist. = 9.2 PUMPED WELL : ERT-7

	CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
	1500			4.88			static
0.5	1545:30			4.90			
1.0	1546			4.95			
2	1547			5.06			
3	1548			5.16			
4	1549			5.25			
5	1550			5.35			
6	1551			5.42			
7	1552			5.50			
8	1553			5.56			
9	1554			~~5.68~~ CKT			
10	1555			~~5.76~~ 5.68			
12	1557			5.76			
14	1559			5.84			
16	1561			5.92			
18	1603			5.98			
20	1605			6.03			
25	1610			6.14			
30	1615			6.22			
35	1620			6.29			
40	1625			6.35			
45	1630			6.41			
50	1635			6.45			
55	1640			6.50			
[illegible]	1650	60		6.59			
	1700	70		6.68			
	1711	81		6.79			
	1720	90		6.85			
	1730	100		6.91			
	1800	130		7.06			
	1830	160		7.16			
	1900	190		7.31			
	2000	250		7.51			
	2100	310		7.69			
	2200	370		7.85			
	2300	430		7.93			
	2359	489		8.00			

023312

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

Obs

WELL # ERT-8

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 9/8/88

STATIC WATER LEVEL DEPTH _____

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

pumped well ERT-7

Recovery

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P	DRAWDOWN OF WATER LEVEL		COMMENTS
2400		490				
~~24~~ 00030		490.5				
0001		491				
0002	7.90	492				
0003	7.79	3				
0004	7.62	4				
0005	7.48	5				
0006	7.35	6				
0007	7.25	7				
0008	7.16	8				
0009	7.08	9				
0010	7.02	500				
0012	6.91	502				
0014	6.81	504				
0016	6.73	506				
0018	6.66	508				
0020	6.60	510				
0025	6.48	515				
0030	6.38	520				
0035	6.30	525				
0040	6.22	530				
0046	6.16	536				
0050	6.11	540				
0055	—	545				
0100 ~~006~~	6.02	550				
0110	5.95	560				
0120	5.90	570				
0130	5.82	580				
0200	5.69	610				
0230	5.60	640				
0300	5.51	670				
~~0330~~						
0400	5.40	730				
1025	5.15	1115				

023313

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

Obs WELL # ERT-84

GR. ELEVATION _____

TESTED INTERVAL _____

M.P. ELEVATION _____

DATE 8/9/88

STATIC WATER LEVEL DEPTH _____

PERSONNEL _____

STATIC WATER LEVEL ELEVATION _____

pumped well ERT-7
Radial Distance 13.85'

CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
15 00			4.49			static level
15 45.30	.5		5.5			
15 46	1.0		5.5			
15 47	2		5.52			
15 48	3		5.57			
15 49	4		5.61			
15 50	5		5.64			
15 51	6		5.67			
15 52	7		5.70			
15 53	8		5.72			
15 55	10		5.77			
15 57	12		5.81			
15 59	14		5.85			
16 01	16		5.87			
16 03	18		5.9			
16 05	20		5.92			
16 10	25		5.97			
16 15	30		6.01			
16 20	35		6.05			
16 25	40		6.07			
16 30	45		6.1			
16 35	50		6.12			
16 40	55		6.15			
1650	65		6.19			
1700	75		6.21			
1711	86		6.26			
1720	95		6.28			
1730	105		6.31			
1800	135		6.37			
1830	165		6.41			
1900	195		6.46			
2000	255		6.56			
2100	315		6.63			
2200	375		6.72			
2300	435		6.76			
2359	494		6.80			

023314

Applied Hydrology Associates

HYDROLOGIC TEST DATA SHEET

WELL # 8A

GR. ELEVATION

TESTED INTERVAL

M P. ELEVATION

DATE 8/10/88

STATIC WATER LEVEL DEPTH

PERSONNEL

STATIC WATER LEVEL ELEVATION

Recovery

	CLOCK TIME	TIME AFTER TEST STARTED		DEPTH OF WATER LEVEL BELOW M.P.	DRAWDOWN OF WATER LEVEL		COMMENTS
	2400	495		6.79			
	~~0000~~						
	0001	496					
	0002	7					
	0003	8		6.75			
	0004	9		6.70			
	0005	500		6.66			
	0006	501		6.63			
	0007	502		6.60			
	0008	3		6.55			
	0009	4		6.54			
	0010	5		6.52			
	0012	7		6.48			
	0014	9		6.45			
	0016	511		6.42			
	0018	513		6.40			
	0020	515		6.38			
	0025	520		6.35			
	0030	25		6.30			
	0035	30		6.27			
	0040	35		6.25			
	0045	40		6.21			
	0050	45		6.20			
0400	~~0055~~	550		6.16			
0110	0100	560		6.12			
	0120	570		6.10			
	0130	580		6.07			
	0200	610		5.98			
	0230	640		5.94			
	0300	670		5.92			
	~~0330~~	6					
	0400	730		5.85			
+386	1026	1116		5.70			

023315

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control Wells For ERT-7 DATE 8-9-88

IE	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
35	ERT-1						6 56 1535
	REI 10-4						
545	REI 6-2						7 17 1545
05	ERT-1	6.56					6 56 1605
16	REI 6-2	7.18					7 18 1616
35	ERT-1	6.56					
30	REI 10-4	5 67					
45	REI 6-2	7.18					
05	ERT-1	6 57					
20	REI 10-4	5 68					
	REI 6-2						
35	ERT-1	6.50					
40	REI-10 4	5.64					
45	REI-6-2	7.08					

023316

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control wells for ERT-7 DATE 8-9-88

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL [(R±CF)±MP]
09	ERT-1	6.52					
12	REI-10-4	5.69					
18	REI-6-2	7.16					
55	ERT-1	6.53					
50	REI-10-4	5.66					
945	REI 6-2	7.18					
108	ERT-1	6.57					
105	REI-10-4	5.69					
250	REI-6-2	7.17					
155	ERT-1	6.61					
158	REI-10-4	5.75					
205	REI 6-2	7.16					

023317

TABLE 3: Water Level Measurement Form

APPLIED HYDROLOGY ASSOCIATES
MULTIPLE WATER LEVEL FIELD MEASUREMENT FORM

PROJECT Control Wells for ERT-7 DATE 8-9-88

ME	WELL NO.	LAST READING DEPTH (FT)	MEASURING POINT (MP) DESCRIPTION	HEIGHT (FT)	INSTRUMENT READING (R) AT MP (FT)	INSTRUMENT CORRECTION FACTOR (CF) (FT)	STATIC WATER LEVEL ((R±CF)±MP)
2255	ERT-1	6.67					
2258	RET-10-4	5.76					
2305	RET-6-2	7.20					

BOOKMARK

023318

APPENDIX B

PUMP TEST OF WELL REI-3-3

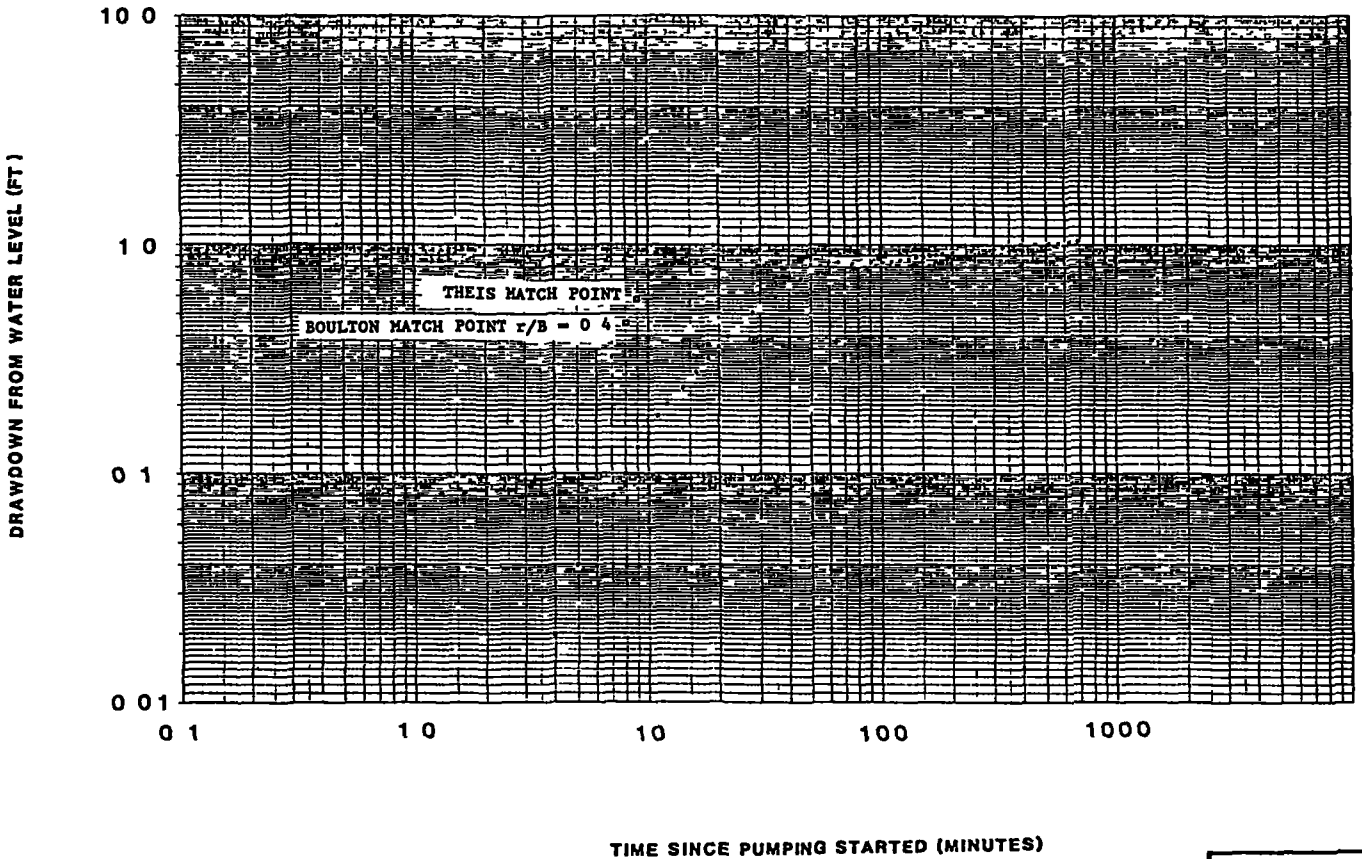
PUMP TESTING OF WELL REI-3-3 (August 11)

The first test was performed on the upper part of the upper alluvial zone aquifer at well REI 3-3. This well was tested previously in November, 1985 with results provided in the Draft RI Report. Questions were raised about the method of interpretation and the number of monitoring wells required for interpretation An additional observation well REI-3-5 was completed during the 1986 field program and a new pump test was performed The initial plan was to use the new well, REI-3-5 as the pumped well The well did not produce enough to run a sustained pump test. Consequently, REI-3-3 was selected as the pumped well

The REI-3-3 well was pumped at a fairly steady rate of 3 0 gpm for 750 minutes. A slightly higher pumping rate of 3 2 to 3 4 gpm was recorded about 50 minutes into the test Water levels in the pumped well and two observation wells, REI-3-5 and an un-numbered piezometer, were monitored manually using conventional well sounders Measurement accuracy is about +/- 0 02 feet. The water level response of the three wells during the drawdown portion of the test is shown in Figures 6-1, 6-2 and 6-3

The water level drop noted in all wells after about 50 minutes probably reflects the adjustment of pumping rate noted above. The flattening of the water level response observed in all wells following this drop is believed to be attributable both to the onset of delayed yield effects (Boulton, 1963) and recharge effects from an adjacent pond about 70 feet from the pumping well. It is difficult to isolate the effects of these two influences.

The most reliable part of the test for analysis of hydrogeologic characteristics is the early time data prior to the noted increase in pumping rate and also before the onset of recharge or delayed yield effects. Analysis of the responses in the two observation wells were performed using the type-curve match method described by Boulton (1963) developed for non-steady state response to pumping in unconfined aquifers Actually, for early time matches before the onset of delayed yield effects the Boulton type curves are identical to the Theis (1935) type curve. The analysis indicates a transmissivity for the uppermost part of the upper alluvial zone of about 500 gpd/ft (0.72 cm^2/sec). For a saturated thickness of about 19 feet, an average hydraulic conductivity of about 1.2×10^{-3} cm/sec is indicated for this unit The storage coefficient calculated for the unit is about 0.003 which is reasonable for unconfined aquifer units (Freeze and Cherry, 1979).



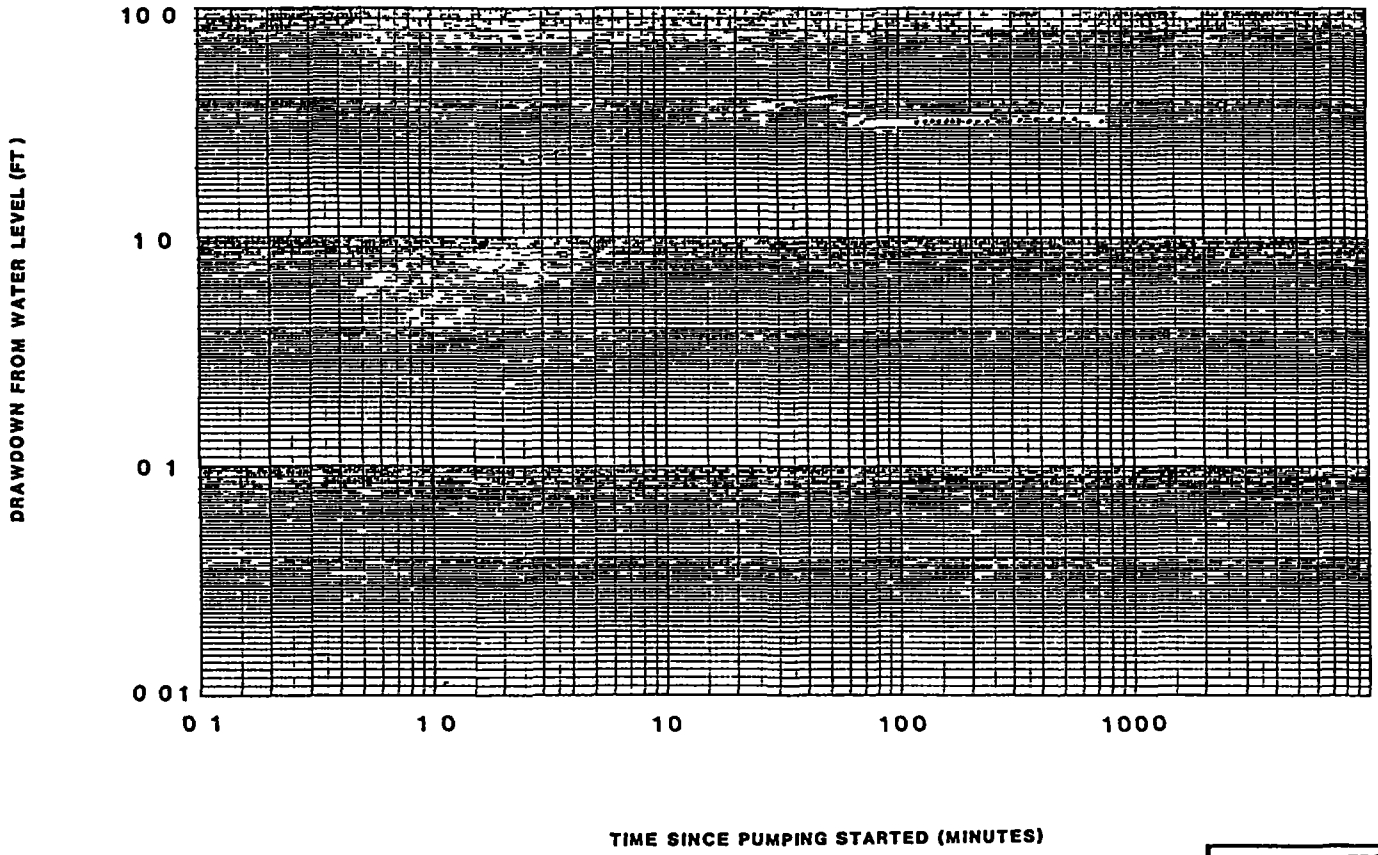
FRENCH LIMITED PROJECT
CROSBY TEXAS

FIGURE 6-1
WATER LEVEL RESPONSE PLOT

OBSERVATION WELL REI 3-5 PUMPED WELL REI 3-3
DATE(S) 8/11/88 to 8/12/88 COMMENTS

PROJECT No PR86-006	DATE 11-26-86	REVISION 1

PREPARED BY APPLIED HYDROLOGY ASSOCIATES DENVER CO



FRENCH LIMITED PROJECT
CROSBY TEXAS

FIGURE6-3
WATER LEVEL RESPONSE PLOT
OBSERVATION WELL REI 3-3 PUMPED WELL REI 3-3
DATE(S) 8/11/86 to 8/12/86 COMMENTS

PROJECT No PR86-006	DATE 11-26-86	REVISION 1

PREPARED BY APPLIED HYDROLOGY ASSOCIATES, DENVER, CO

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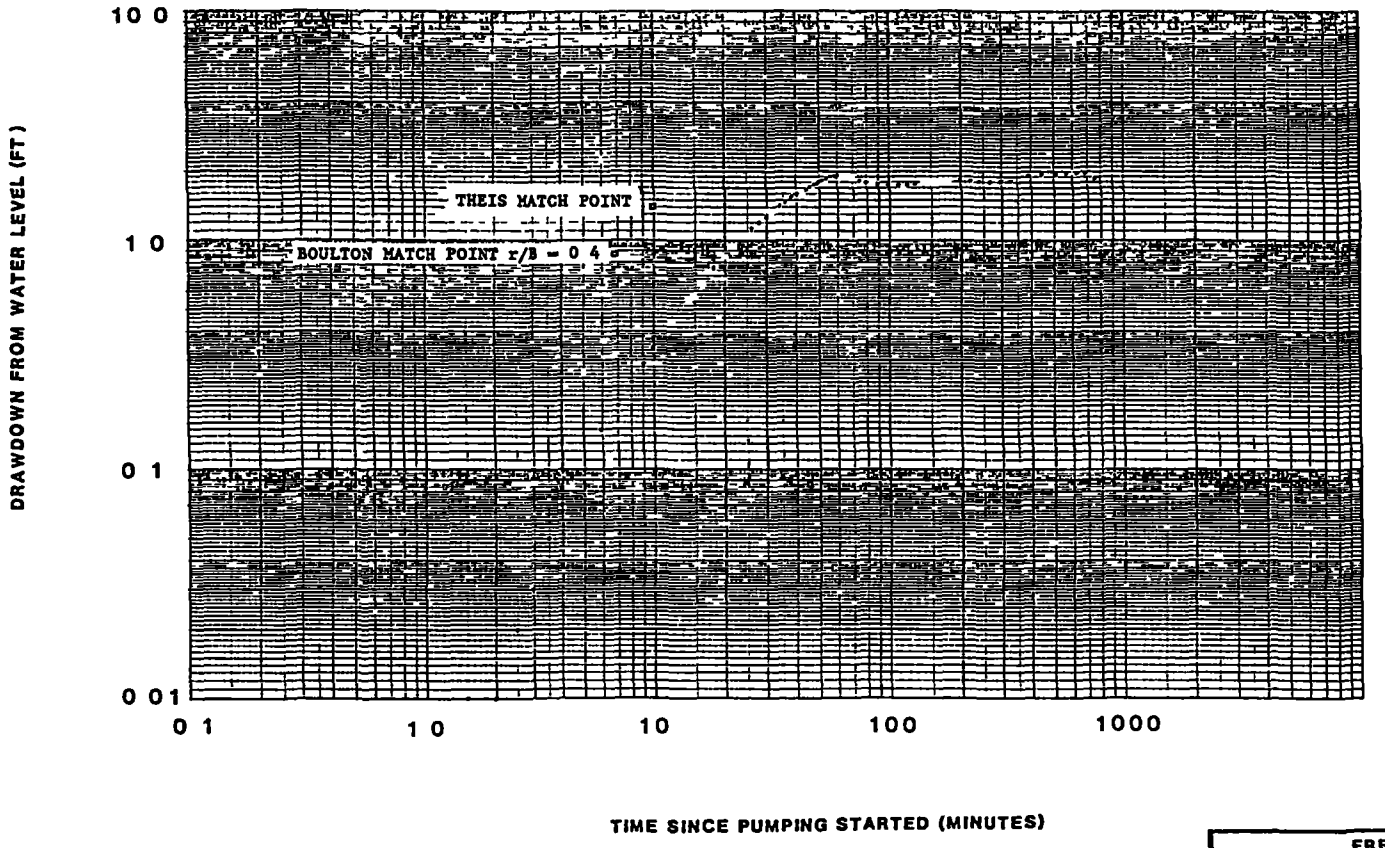

FRENCH LIMITED PROJECT
CROSBY, TEXAS

FIGURE 6-2
WATER LEVEL RESPONSE PLOT

OBSERVATION WELL REI P-3-3 PUMPED WELL REI 3-3
DATE(S) 8/11/86 to 8/12/86 COMMENTS

PROJECT No PRTL-006	DATE 11-26-86	REVISION 1

PREPARED BY APPLIED HYDROLOGY ASSOCIATES DENVER CO

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