Libyan Arab Republic

Kufra and Sarir Authority

Jalu - Tazerbo Project: Phase 2

APPENDIX 2

T(FF1-65)

SITE REPORT

Hydrogeological Department
Institute of Geological Sciences
Exhibition Road, London SW7 2DE

1974

The Institute of Geological Sciences was formed by the incorporation of the Geological Survey of Great Britain and the Museum of Practical Geology with Overseas Geological Surveys and is a constituent body of the Natural Environment Research Council.

Printed in England for the Institute of Geological Sciences by North London Offset Services Limited

IGS 1056 50 6/74

CONTENTS

TABLES

FIGURES

FILE DATA NOT REPRODUCED IN THIS APPENDIX

A. General

1. Rest water levels in all wells taken simultaneously
2. Specific electrical conductance logs
3. Geophysical logs as listed in section 5 of contents
4. Verticality survey of T(FF1-65)P for cased section
5. Grain size analysis data
6. Grain size analysis plots
7. Slug tests on existing water wells west, central and east and T(FF1-65)01 and 02
8. Airlift test data on water well east with observations on water wells central and west
9. Company (B. P.) water well records of existing wells

B. Pumping Test

1. All recorder charts
2. Data from level pumping including meter readings, tabulated drawdown, discharge readings, etc.
3. Preliminary 5 hr. test on full depth of production well: tabulated data
4. Main test on production well: tabulated data
5. Drawdown and recovery plots from all observation wells

Jalu–Tazerbo Project: Phase 2

Appendix 2: T(FF1-65) Site Report

1. Location: 27° 51' 33" North 22° 17' 23" East

2. Ground elevation: 308.4 feet above mean sea level at FF1-65

3. Site plan: Figure 1 and Table 1

4. Existing water wells: There are three existing water wells at this site. Company records exist for all three wells and selected data are shown in Table II. Current status is shown in Table III.

TABLE I
Site elevations above m.s.l.

Site	Ground level ft	Top of casing ft
FF1-65	308.4	-
W.W.West	308.8	309.1
W.W.Central	308.8	309.8
W.W.East	308.8	311.5
01	308.5	311.3
02	307.8	311.1
P	308.8	309.6

TABLE II
Data from BP Exploration Company (Libya) Limited water well records

1	2	3
489	424	378-424
490	430	386-430
493	431	388-431

1. Company well file number
2. Total depth on completion in feet
3. Perforated interval below ground level in feet

TABLE III
Current data on existing water wells

1	2
W.W.East	428
W.W.Central	428
W.W.West	424

1. Well location
2. Total depth after cleaning

5. Geophysical logs: The following logs are available on file but are not enclosed with this report:

   i FF1-65: Final lithological/gamma ray/neutron logs by Schlumberger from 150 feet to 3190 feet

   ii FF1-65: SP/resistivity/conductivity logs by Schlumberger from 2770 feet to 8740 feet

   iii FF1-65: Sonic log by Schlumberger from 150 feet to 280 feet

   iv FF1-65: Mud log by BP Exploration Company (Libya) Ltd. from 0 to 4000 feet

   v T(FF1-65)01: gamma ray log (IGS) in cased hole from 3-169 metres

   vi T(FF1-65)02: gamma ray log (IGS) in cased hole from 3-133 metres

   vii T(FF1-65)P: gamma ray log (IGS) in drilling string from 96-162 metres

   viii Existing water wells: gamma ray logs (IGS) in Water Well East (3.5-121.5 metres), Central (3.5-125.5 metres), West (3.5-126.5 metres)

6. Drilling and completion:

(a) T(FF1-65)01 (Figure 2) was drilled by rotary rig using Quiktrol mud. Completion was with 3½ inch casing, a lower Hagusta 80 mm screened section from 510 feet to 519.2 feet and an upper screen of 3½ ins slotted and wire-wrapped steel casing from 285.58 feet to 295.98 feet. Cement plugs were set in the 9.7/8 in borehole between 315 and 345 feet and between 410 and 519 feet, the annulus being backfilled from 270 feet to 465 feet.

(b) T(FF1-65)02 (Figure 3) was likewise drilled by rotary rig using Quiktrol mud. Only Hagusta 80 metre screens were used with a 3½ in casing string, the two screened sections being between 370-379.2 feet and 425-434.2 feet. A single cement plug was set in the annulus of the 9.7/8 in borehole between 315 and 345 feet. The well was cleaned and developed by swabbing and air lift pumping.

(c) T(FF1-65)P (Figure 4) was drilled by rotary rig using bentonite mud for the first 356 feet. From 0 to 350 feet the hole was drilled 20 ins diameter and from 350 to 356 feet 15 inches diameter with 16 inch steel casing being landed at 356.3 feet and cemented in position. Drilling was then continued with a $12\frac{1}{4}$ inch bit to a TD of 556.5 feet, using Revert mud. This lower section was screened with 200 mm Hagusta screen between 365.8 and 456 feet, and between 472.4 and 546.2 feet, the remainder being 200 mm Hagusta blank. The well was then developed by swabbing and air-lift pumping.

7. Lithology and stratigraphy: A summary of the stratigraphic and lithologic data is shown in Table IV and graphic logs in cross-section BB' of the main report and in Figure 5 of this Appendix. Selected size analysis data are shown in Table V. The Calanscio formation is mostly sands, clayey sands, 'sandstones' (or low porosity sands), and clays. The 'sandstones' etc are apparent in the neutron log as of lower porosity than the adjacent sand. They occur between 190 and 330 feet below ground level. Within this interval, the section between 190 and 250 feet has a low to moderate grain size permeability (average value of 214 U.S. galls/day/ft^2). The section below from 250-330' bgl has an apparent average permeability of 510 U.S. galls/day/ft^2. Apparent log porosities for the two sections are of the same order. It is possible that the difference could be one of cementation, possibly restricted to the deeper subsection. The presence of sandstones is indicated in the BP mud log and the sonic log shows rather variable consolidation over this interval but does not differentiate particularly the two sections referred to. The base of the Calanscio occurs at 454 feet bgl. The section below and forming the lower part of the Upper Aquifer Unit is entirely of sandy carbonate. The Middle Aquifer Unit is here composed almost entirely of limestone, probably also sandy although the mudlog does not refer. The top of the Oligocene is based upon a change in the sonic log indicating a high degree of consolidation. A bigger change in this log occurs at a higher level in consequence of the lithological change from a predominantly clayey sequence to arenaceous rocks but the change at the lower level is selected in preference since it can be recognised over a wide area extending beyond that in which a marked central clay horizon exists. The Oligocene is composed generally of clayey sands, sands, clays (or shales) and minor 'sandstones'. The latter are apparent from porosity determinations in both neutron and sonic log and the latter log confirms the likelihood of interstitial cement.

8. Pump testing:

(a) Air lift tests. Air lift pumping tests were carried out on the three existing water wells at this site in 1967 and again in 1973. The earlier test made use of the west well as a pumping well with observations carried out on the other two. The test duration was 72 hours. In the later test, the east well was pumped and it is significant that a much lower discharge was obtained consistent with the differing values of slug test transmissivity (Table VI). Test duration was 5 hours.

The data from the 1967 test have been reanalysed and the results along with those of the 1973 test are given in Table VII. Analyses were based on log-log and semi-log plots. In view of the uncertainty of the aquifer response relations, the results cannot be related quantitatively to the aquifer but they are informative in assessing the value of the existing wells for observation purposes. The screen sections of the existing wells are set in a rather clayey sequence judging by the IGS gamma-ray logs but that of Water Well West appears to set rather lower than the main clay level which may account for its higher slug test transmissivity. Water Well East was poorly productive on pumping, has a low slug test transmissivity but gave anomalously high values of T and S when used for observation. It is probably that its screened interval is largely unrelated to the abstraction interval with consequent low drawdowns and therefore giving an apparent high transmissivity. Wells West and Central gave moderately comparable results in the 1967 and 1973 tests and the latter also gave generally comparable results in both series of the current tests. It would appear that these two wells occur in the same responding section of the aquifer.

(b) Development Pumping T(FF1-65)P. Development pumping was carried out during the 27th and 28th September over a period of 21 hours. Three different pumping rates were used and the results are shown in Table VIII. The discharge was virtually sand free and the results indicate no significant improvement in the wells performance throughout the period of development. The final specific capacity was 4.30 U.S. galls/min/ft.

(c) Aquifer testing. It is apparent from Figure 5 that the production well screen extends over a wide section of sandy carbonate in its lower levels. For maximum productivity from the Upper Aquifer Unit, this screen length is justified, but for aquifer testing the situation is complicated by the screen's extension across two responding intervals with an intervening clay layer. Aquifer testing was therefore carried out in two stages, firstly a short test using the full screen but determining the response from the upper subsection by flow meter log. Piezometric levels in the lower subsection were measured by pressure transducer installed below a packer device. Voltage measurements were made by an avometer and because the instrument was being used at the extreme limit of its range, the results were mainly of qualitative value. Piezometric heads in the upper (main) subsection were monitored by all three existing wells and by T(FF1-65)02. Piezometric heads in the first (non-responding) section above was monitored by the upper screen of T(FF1-65)01 and measurement made by electrical probe. For the second test of longer duration, the well screen of T(FF1-65)P was backfilled with fine sand to 460 feet bgl so that production was presumed to be limited to the upper responding section.

Test 1 was carried out on September 30 at an average pumping rate of 622 U.S. galls/minute (39.3 litres/sec). The specific capacity after one hour was measured as 4.78 U.S. galls/min/foot and after 268 minutes at 4.75. This improvement over the final specific capacity measured during development pumping is anomalous but may relate to a further breakdown of the revert mud. A flow meter log was run during test 1 and the results are shown graphically in Figure 6 and numerically in Table IX. There is an anomaly in the calculated flow velocity discharge as compared with the surface measurements and it may well be that the instrument requires re-calibration. The estimated discharge is based on a relative counts per minute reduction for the upper section. The flow velocity log shows that 76% comes from the sands/clay sands as compared with 24% from the sandy carbonate. A rather surprising feature is that 4% only was obtained from a sand section 430-454' with an apparent high permeability and porosity. Elsewhere the effect of cementation is clearly apparent since the grain size permeability of the clay sands and sandy carbonates is approximately the same.

The second pumping test commenced at 0915 hours on the 7 October and continued until 10.15 hours on the 12 October. The pumping rate averaged 358 U.S. galls/min (22.6 litres/sec) with a measured specific capacity after 84 hours of 4.07. During the first 20 hours, the pumping rate showed considerable fluctuations between 345 and 405 U.S. galls/min but subsequently became more constant and was maintained within +5% and -7% of the average value. The problem lay in maintaining sensitivity of the pump whilst running at high rpm. It is hoped eventually to use a valve regulation at the end of the discharge line. The valve sited close to the pump has proved very insensitive to regulation.

(d) Aquifer analysis. During the first main test, drawdowns were expected in both upper and lower responding intervals and for the latter, measurement responses were expected in the pressure transducer system. Apparent drawdowns did occur progressively for the first 70 minutes, but readings subsequently became erratic and included fluctuating positive and negative changes. A complimentary correlation of some of these changes with levels in the upper section suggest that leakage around the packer was occurring. Drawdowns in the upper section were progressive showing that actual piezometric changes were occurring in the upper screen as well as possible leakage round the packer. During the second test, the lower section of the screen was backfilled and if the intermediate clay layer between the two responding sections had formed an effective seal, no drawdowns would have been expected. In the event, rather erratic voltage fluctuations occurred in the pressure transducer output which could have been partly electrical or else related to drawdowns consequent upon vertical flow across the clay layer. Unfortunately, no certainty of the true cause is known. Regular drawdowns of an artesian head did occur in the upper section. These were of a considerably lower order than in T(FF1-01)2 but showed that a vertical downward component of flow existed. The rates of fall did not entirely accord with the abstraction rates from the upper responding section although the deviation was not great as the results below show.

i Test 1 Q_1 (upper responding section) 29.78 litres/sec
Test 2 Q_2 (upper responding section) 21.76 litres/sec

Q_1/Q_2 = 1.37

ii Test 1 Δ S from semi-log plot in upper section of 01 = 0.43

Test 2 Δ S = 0.22

S_1/S_2 = 1.95

Had the drawdowns been directly related to the discharge rates, the ratios would have been identical. The excessive drawdown in Test 1 could have been due to continuous leakage around the packer.

The results obtained by analysis of the drawdown/recovery data in the two main tests are shown in Table VII. Drawdown data were commonly analysed by log-log and semi-log plots, recovery data by log-log only. The data generally plotted on clear artesian trends with some progressively reducing deviation of the early time values consistent with local storage and skin affects. The significance of these deviations will correlate with screen section permeability which can be calculated approximately from slug tests. This data from Water Well West showed virtually no deviation from the Theis curve unlike that of W.W. East and 02. It is significant that the data plotted on Theis artesian curves despite the evidence of vertical inflow from higher levels as is apparent in the drawdowns in 01 (upper). It must be assumed that the intermediate clay layer was a relatively minor barrier and the combined layers responded in artesian fashion, with the vertical flow component becoming effective instantaneously and precluding any 'leaky' effect on the drawdown pattern. The value of transmissivity determined by the analysis can be expected to be somewhat higher than the true value for the upper responding layer.

The other important characteristic of the drawdown data is that in the case of two of the existing wells, two values of transmissivity are apparent, the later being lower than the earlier. The effects became apparent after 150 minutes which is the reason why they do not occur in drawdown plots of W.W. Central in the first main test. The average values of aquifer constants for the two tests are shown below.

	W.W. East		W.W. West	
Test 1	T	S x 10^{-4}	T	S x 10^{-4}
	460	4.0	353	5.6 (i)
			186	5.5 (ii)
	W.W. Central		T(FF1-65)02	
	T	S x 10^{-4}	T	S x 10^{-4}
	284	5.3	289	7.9

	W.W. East		W.W. West	
Test 2	T	S x 10^{-4}	T	S x 10^{-4}
	680	3.3	401	6.0 (i)
			208	6.1 (ii)
	W.W. Central		T(FF1-65)02	
	420	6.1 (i)	311	7.8
	332	4.5 (ii)		

The transmissivity values for the second test are in general higher than their counterparts in the first test and a close comparison only exists for W.W. West and T(FF1-65)02. No ready explanation for the anomalously high values for the second test is available. One possibility is perhaps that the drawdowns in the second test were affected by vertical inflow for the lower responding layer; during this first test this would not occur since flow movement was essentially horizontal towards the screen.

For the purpose of assessing the general aquifer constants at the site the average values of Water Wells West and Central and combined with the average value for 02 and the total average taken. On this basis the transmissivity of the upper responding section is arrived at 317 m^2/day (25,825 U.S. gpd/ft) and storage coefficient of 6.8 x 10^{-4}. The permeability of the claysands and sands is estimated as 9.8 m/day (32.3 m responding section) equivalent to 240 gpd/ft^2. This compares quite closely with the average grain size permeability of 304 gpd/ft^2. Using the flow velocity data the average permeability of the carbonate section will be one third of the claysands, ie 3.3 m/day.

(e) Well efficiency T(FF1-65)P

i Based on Main Test 1

1. Transmissivity of upper responding layer = 317 m^2/day = 25,525 gpd/ft
2. Storage coefficient = 6 x 10^{-4}
3. Nominal screen radius = 0.5'
4. Estimated transmissivity for lower responding layer = 6,400 gpd/ft (Permeability estimated at 80 gpd/ft^2)
5. Total transmissivity (1+4) = 31,925 gpd/ft
6. Theoretical specific capacity after 60 minutes = 22.8 gpm/ft
7. Observed specific capacity = 4.78
8. Efficiency = 21%

ii <u>Based on Main Test 2</u>

1. Calculated theoretical specific capacity after 60 min based on transmissivity of upper responding layer = 15.30 gpm/ft
2. Observed specific capacity = 4.07
3. Efficiency = 27%

Both these values of efficiency are decidedly low and on this basis, additional well development would be advisable. The results are surprising since efficiencies in the Phase 1 production wells using the same completion techniques are considerably higher.

TABLE IV

Summary of stratigraphical and lithological data at T(FF1-65)

	feet ± msl	feet bgl
Exploration well FF1-65	308	0
Static water level	218	90
Base Calanscio	-146	454
Base Upper Aquifer	-342	650
Top Middle Aquifer	-604	912
Base Middle Aquifer	-688	996
Top ?Oligocene	-1446	1754
Base Oligocene	-2476	2784

Table V is on page 7

TABLE VI

Response data on observation wells at T(FF1-65)

Well	B.E.[1] %	Tst[2] m^2/day	Available screen[3] length (m)	K[4] m/day
W.W.West	36	94	11.0	8.5
W.W.Central	26	32	12.8	2.5
W.W.East	32	20	14.0	1.5
T(FF1-65)02	22	10	5.0	2.0

1. Barometric efficiency
2. Transmissivity based on slug test
3. Length of screen exposed after cleaning
4. Permeability - ratio of 2 and 3

TABLE V

T(FF1-65): Selected size analysis data

Interval feet bgl		D50 microns	D90 microns	Cu[1] (D40/D90)	σ[2]	K[3]	Lithology[4]
90	100						
100	110						cs
110	120	620	170	4.58	1.565	150	
120	130	780	325	2.83	0.891	780	
130	140	410	170	2.82	1.015	295	s
140	150	620	230	3.48	1.332	260	
150	160	1150	340	4.12	1.177	580	
160	170	940	260	4.5	1.273	380	
170	180	360	170	2.41	1.013	255	s
180	190	445	195	2.87	1.185	260	
190	200	420	180	3.00	1.192	245	
200	210	410	140	3.71	1.533	140	ss
210	220	-	-	-	-	-	
220	230	428	135	3.85	1.303	220	
230	240	470	160	3.63	1.146	285	ss
240	250	450	125	4.56	1.426	180	
250	260	-	-	-	-	-	c
260	270	-	-	-	-	-	
270	280	640	235	3.26	1.093	430	
280	290	900	270	4.26	1.232	400	ss
290	300	900	305	3.61	1.034	680	
300	310	1010	340	3.59	1.049	720	
310	320	-	-	-	-	-	ss
320	330	490	165	3.57	1.145	320	
330	340	660	180	4.55	1.334	250	
340	350	-	-	-	-	-	c
350	360	360	135	3.26	1.203	215	
360	370	380	130	3.50	1.210	130	cs
370	380	415	180	2.72	0.988	295	
380	390	400	155	3.03	1.034	380	
390	400	-	-	-	-	-	sm
400	410	500	160	3.94	1.247	260	
410	420	470	150	3.87	1.229	260	cs
420	430	425	170	3.06	1.124	265	
430	440	710	290	2.93	1.037	505	
440	450	560	250	2.72	1.006	430	s
450	460	550	250	2.58	0.861	500	
460	470	350	115	-	1.280	200	c
470	480	265	100	-	1.177	175	
480	490	340	120	3.38	1.100	225	
490	500	390	140	3.32	1.085	260	sc
500	510	265	86	3.72	1.167	175	
510	520	300	112	3.13	1.052	207	
520	530	370	125	3.36	1.202	235	sc
530	540	355	130	3.31	1.198	215	
540	550	305	110	3.27	1.137	195	
550	560	340	135	3.00	1.132	218	sc
560	570	405	165	2.91	1.024	290	
570	580	360	145	2.96	1.09	240	c
580	590	340	110	3.77	1.204	205	
							sc

1. Cu: uniformity coefficient
2. σ : standard deviation (see Masch and Denny, 1966)
3. K : permeability in U.S. galls/day/ft^2 calculated from σ and D50 size
4. Lithology: symbols standard (see main report)

TABLE VII

T(FF1-65): Summary of aquifer test data

Well	Transmissivity (m^2/day)	Storage Coefficient x 10^{-4}		Analysis[1]
i Air lift test, 1967 (discharge of 11 litres/sec from W.W.West)				
W.W.Central r = 23 m	138	7.2		DD/LL
W.W.East r = 46 m	805	116.0		DD/LL
ii Air lift test, 1973 (discharge of 0.89 litres/sec from W.W.East)				
W.W.West r = 46 m	311	8.3		DD/LL
	338	9.2		RDD/SL
W.W.Central r = 23 m	155	2.5		DD/LL
	230	2.5		RDD/SL
iii Main test I: T(FF1-65)P				
W.W.East r = 110 m	435	4.3		DD/LL; tsl = 215 min
	485	3.6		DD/SL; slp from 70-300 mins
W.W.West r = 156 m	353	5.6	T_1	DD/LL; T_1 from 0-70 mins
	186	5.5	T_2	T_2 from 70 mins +
W.W.Central r = 133 m	284	5.3		DD/LL; tsl = 594 min
T(FF1-65)02 r = 55 m	270	6.8		DD/LL; tsl = 134 min
	248	8.9		DD/SL; slp from 70-300 min
iv Main test II: T(FF1-65)P				
W.W.East r = 110 m	713	2.4		DD/LL; tsl = 73 min
	614	4.0		DD/SL; slp from 60-1400 min
	713	3.4		R/LL
W.W.West r = 156 m	429	5.8	T_1	DD/LL; T_1 from 0-100 min
	241	6.3	T_2	" T_2 from 100-2000 min
	277	5.9		DD/SL; slp from 100-1000 min
	374	7.2	T_1	R/LL; T_1 from 0-150 min
	287	6.2	T_2	" T_2 from 150 min +
W.W.Central	453	5.0	T_1	DD/LL; T_1 from 0-150 min
	365	2.9	T_2	" T_2 from 150 min +
	388	7.3	T_1	R/LL; T_1 from 0-150 min
	299	6.0	T_2	" T_2 from 150 min +
T(FF1-65)02 r = 55 m	332	3.7		DD/LL
	298	10.0		DD/SL
	304	9.7		R/LL

1. Analysis
RDD = residual drawdown; DD = drawdown; R = recovery; LL = log-log;
SL = semi-log; slp = straight line plot

TABLE VIII

Development pumping: T(FF1-65)P

1	2	3	4	5
1690	457	358	1900	4.24
1800	532	235	1940	4.26
1900	636	716	1950	4.32

Columns:

1. Pump rpm
2. Discharge rate in U.S. galls/min
3. Period of pumping in minutes
4. Specific electrical conductance in micromhos/cm
5. Specific capacity in U.S. galls/min/foot of drawdown measured after 60 minutes of pumping at referred rate

TABLE IX

Down-hole flow velocity data: T(FF1-65)P on 30.9.73

1.	Count rates per minute with meter at 359 feet below ground level	= 318
2.	Calculated discharge in U.S. galls/min	= 781
3.	Measured surface discharge in U.S. galls/min	= 621
4.	Percentage flow from Upper Responding Section (364-460 feet bgl)	= 76
5.	Equivalent discharge based on 4 and 3 in:	
	U.S. galls/min	= 472
	litres/sec	= 29.78

TABLE X

Field and Laboratory Chemical Analysis T(FF1-65)

IGS reference			74/45	
Date of sampling	8.10.73	10.10.73	11.10.73	12.10.73
Specific electrical conductance	1960	1970	1970	1890
pH	-	7.43	-	7.43
eH	+269	+264	+249	n.d.
Ca^{2+}				95
Mg^{2+}				57
Na^{+}				208
K^{+}				35
HCO_3^- (field)				289
SO_4^{2-}				206
Cl^-				401
NO_3				45
Total determined major constituents	-	-	-	1336
Sr^{2+}				4.0
F^-				0.71
B				0.24
Total Fe				0.003
Total Mn				< 0.007
Cd				< 0.0005
Co				0.001
Cu				< 0.001
Ni				0.002
Pb				0.004
Zn				0.001
Σ cations				19.36
Σ anions				20.13
Ionic balance				-1.96
SO_4/Cl				0.30
Mg/Ca				0.99
K/Na				0.10

TABLE XI

Corrater Readings and Corrosion Rates (12.10.73)

Metal/alloy	A	B	R
Copper	2.15	1.90	2.02
Stainless steel 316	0.98	1.00	0.99
Aluminium 6063	1.13	1.00	1.06
Aluminium 5052	1.15	1.00	1.07
Zinc	-5.50	+7.92	1.21
Mild steel 1010	1.40	3.75	2.57
Mild steel 1020	-0.5	6.20	2.85
Bronze 660	1.16	1.91	1.53
Red brass 123	1.65	1.75	1.70
AP1 H40	13.4	2.4	7.90
308L Stainless	1.0	1.0	1.00

Note: Columns A and B refer to readings at different polarity, R is the average

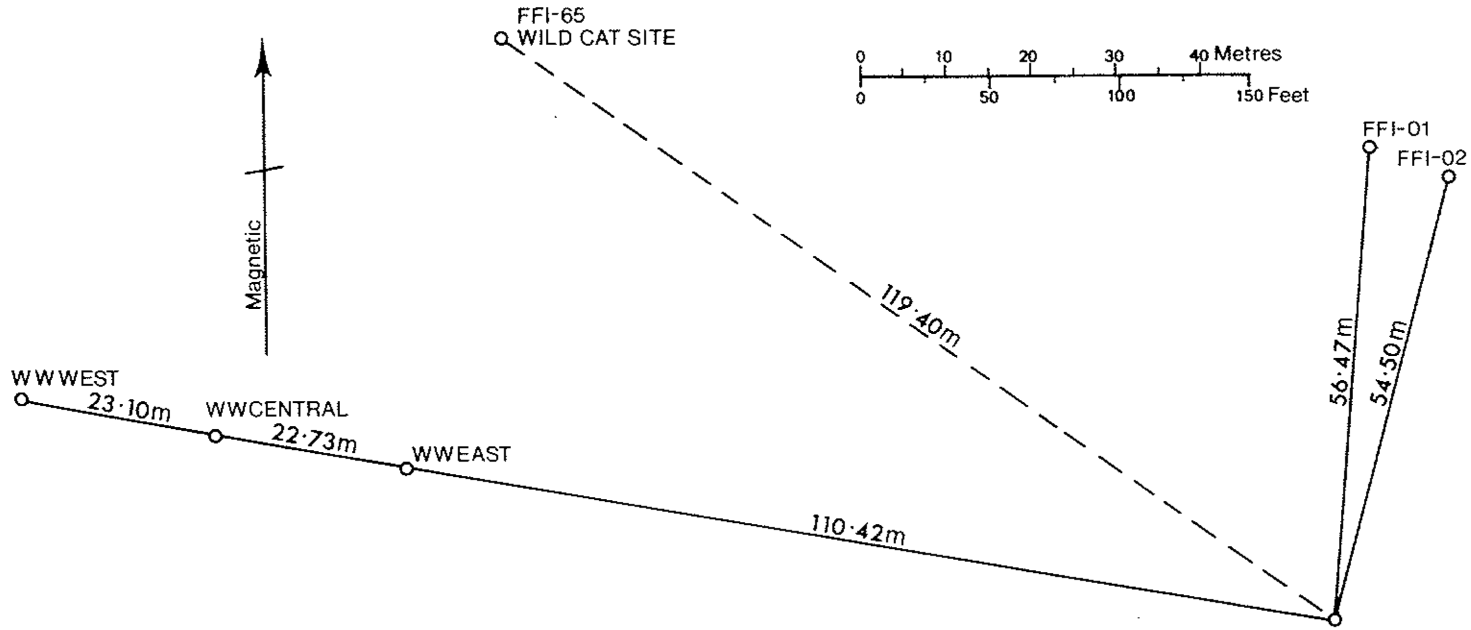


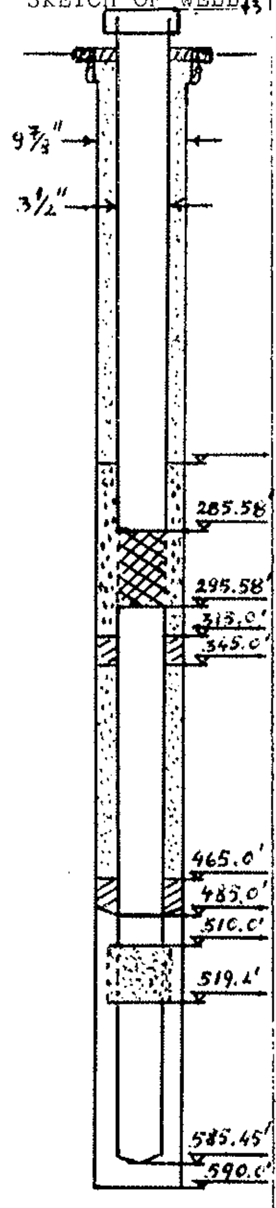
Figure 1. Site Plan

WATER WELL T(FF1-65)-01

CUSTOMER : K.A.C LOCATION : T(FF1-65)-01	RIGGING UP ON: 13.8.1973 RELEASE LOCATION: AT 22.8.1973	TOOL PUSHER: AGEJEV DRILLERS: MILOSHEVIC BIZJAK	RIG NO 4.

FORMATION

SKETCH OF WELL



DRILLING

Bit Ø 9⅞" from 0.0' to 590.0'

LOST CIRCULATION from .... to ....

MUD MATERIALS USED

Bentonite....... kg Spersen ....kg

Caustic Soda.... kg CMC.................kg

QUIKTROL 56 kgs. CEMENT 20 SKS

~~CASING~~ TUBING Ø OD 3½" from +3' to 285.58'

from 295.58' to 510.0'

from 519.2' 585.45'

HAGUSTA 30 % SCREENS Ø ID from 510.0' to 519.2'

AND SLOTTED TBG AND WIRE WRAPPED Ø 3½" → 285.58' 295.58'

I PLUG UPPER FROM 315.0' TO 345.0', II PLUG FROM 465.0 TO 485.

CEMENT BASKET AT 485.0'

BACK FILLING FROM 465.0 TO 345.0' AND FROM 315.0 TO 210.0'. TOTAL BACK FILLED 165'

JETTING PIPE Ø to..........

Range :

WELL DELIVERY

14 l/min ...... Dynamic W.L. ....

.... Dynamic W.L. ....

STATIC WATER LEVEL after jetting 28 m

WELL HEAD

FUEL.................

GAZOLINE.........

Toolpusher signature

REMARK.

THREE EXISTING WELLS HAS BEEN CLEANED AND TESTED BY AIR LIFTING.

USED 3½" TBG BLANK TOTAL 569.25'.

USED 3½" TBG TORCH SLOTTED & WIRE WRAPPED 10'.

PROJECT SUPPLIED HAGUSTA SCREEN LENGHT 9.2'.

DRILLING RIG MOVED TO NEXT WELL DISTANCE 10 m.

Figure 2. Site T(FF1-65)01: Contractor's completion report

WATER WELL

CUSTOMER : K.A.C. LOCATION : T(FF1-65)-02	RIGGING UP ON: 23.8.73 AT RELEASE LOCATION: AT 27.8.73.	TOOL PUSHER: AGEJEV DRILLERS: BIZJAK MILOSHEVIC	RIG NO 4

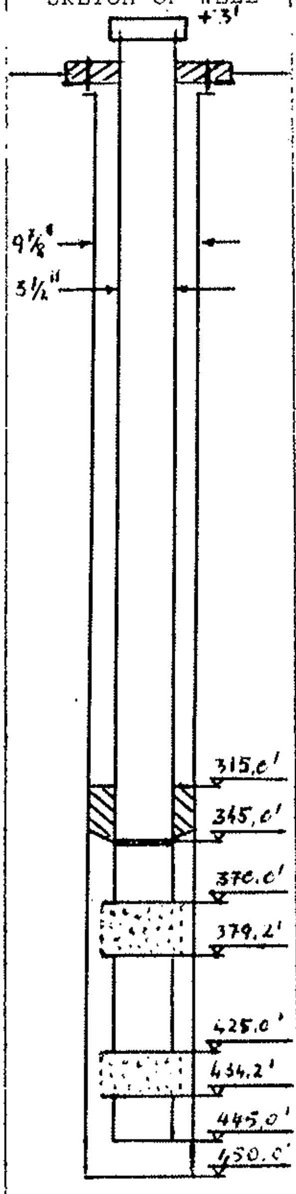
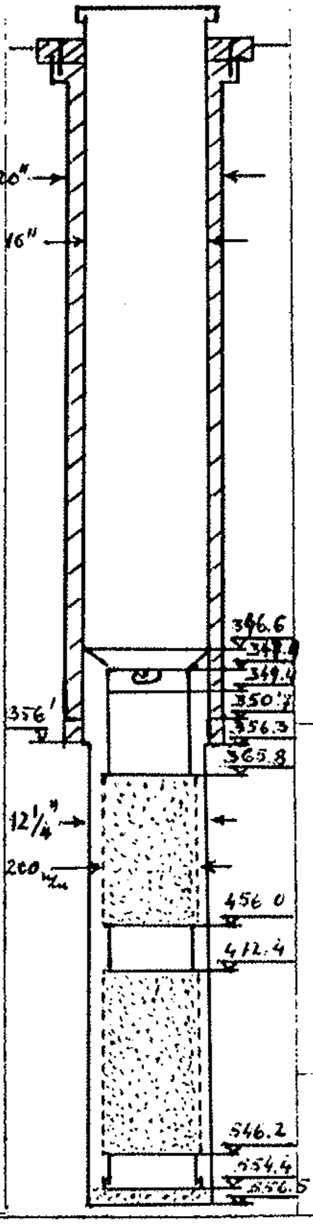
FORMATION	SKETCH OF WELL	
		DRILLING Dit Ø 9 7/8" ...... from 0.0' ..... to 450' ...... LOST CIRCULATION from .... to .... MUD MATERIALS USED Bentonite .... kg Spersen .... kg Caustic Soda .... kg CMC .... kg QUIKTROL 30 SX ~~CASING~~ TUBING Ø ID 3 1/2" from +3 ...... to 370.0' ..... from 379.2' .... to 425.0' ..... from 434.2' .... to 445.0' ..... HAGUSTA SCREENS Ø ID 80 mm from 370.0' ... to 379.2' ..... ~~or SLOTTED CO~~ AND 425.0' ... 434.2' ..... PLUG. FROM 345.0' TO 315.0' .... CEMENT BASKET. SET AT 345.0' .... JETTING PIPE Ø to .... Range : WELL DELIVERY 14.4 l/min .... Dynamic W.L .... Dynamic W.L. .... STATIC WATER LEVEL after jetting .... WELL HEAD FUEL .... Toolpusher signature GAZOLINE ....

Figure 3. Site T(FF1-65)02: Contractor's completion report

WATER WELL

CUSTOMER : KAC. LOCATION : T(FF1-65)-P	RIGGING UP ON: 28.8.73 AT RELEASE LOCATION: AT 17.9.73	TOOL PUSHER: AGEJEV DRILLERS: BILJAK KIRICH	RIG NO 4

FORMATION	SKETCH OF WELL	



DRILLING

Bit Ø 20" from 0.00' to 350.7'
15" 350.7' 356
12¼" 356 556.5'

LOST CIRCULATION from............to..........

MUD MATERIALS USED

Bentonite 110 Mes kg Spersen ....kg
Caustic Soda 6 kg CMC...............kg
REVERT 27 SKS

CASING Ø OD 16" from +1.70' to 356.30'
from.......... to..........

SCREENS Ø ID ** from.......... to..........
or SLOTTED CG

PLUG CONCRETE BASE 4×4×2 FT.
CEMENT ~~BASKET~~ ANNULUS 20"/16" FROM 0.0' TO 350.7'

JETTING PIPE Ø to..........
Range :
WELL DELIVERY
.... Dynamic W.L. ....
.... Dynamic W.L. ....
STATIC WATER LEVEL after jetting..............
WELL HEAD

FUEL...............
GAZOLINE..........

Toolpusher signature

** SCREEN INSTALLATION
LEAD SEAL FROM 346.6' TO 349.4'
BLANK HAGUSTA 349.4' TO 365.8'
-"- -"- FROM 456.0' TO 472.4'
-"- -"- -"- 546.2' TO 554.4'
TOTAL HAGUSTA BLANK = 41.0'

HAGUSTA SCREEN Ø 200 mm ID.
FROM 365.8' TO 431.4' GRAIN 1-2 mm
FROM 431.4 TO 456.0' -"- 0.7-1 mm
FROM 472.4 TO 488.8' -"- 1-2 mm
FROM 488.8' TO 513.4' -"- 0.7-1 mm
FROM 513.4 TO 538.0' -"- 1-2 mm
FROM 538.0 TO 546.2 -"- 0.7-1 mm
TOTAL HAGUSTA SCREEN = 164.0'

Figure 4. Site T(FF1-65)P: Contractor's completion report

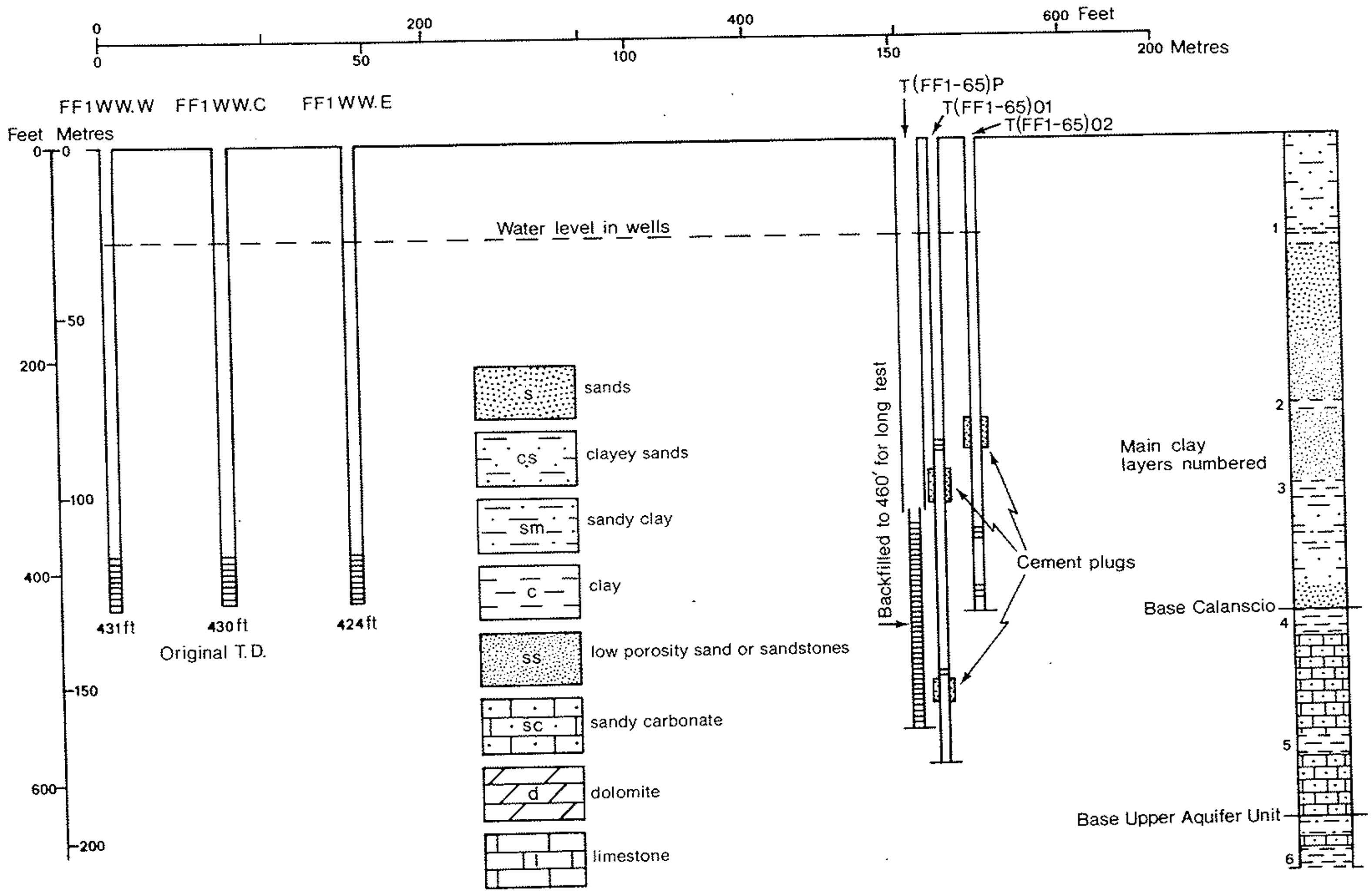


Figure 5. Site FF1-65: Lithological log and cross-section

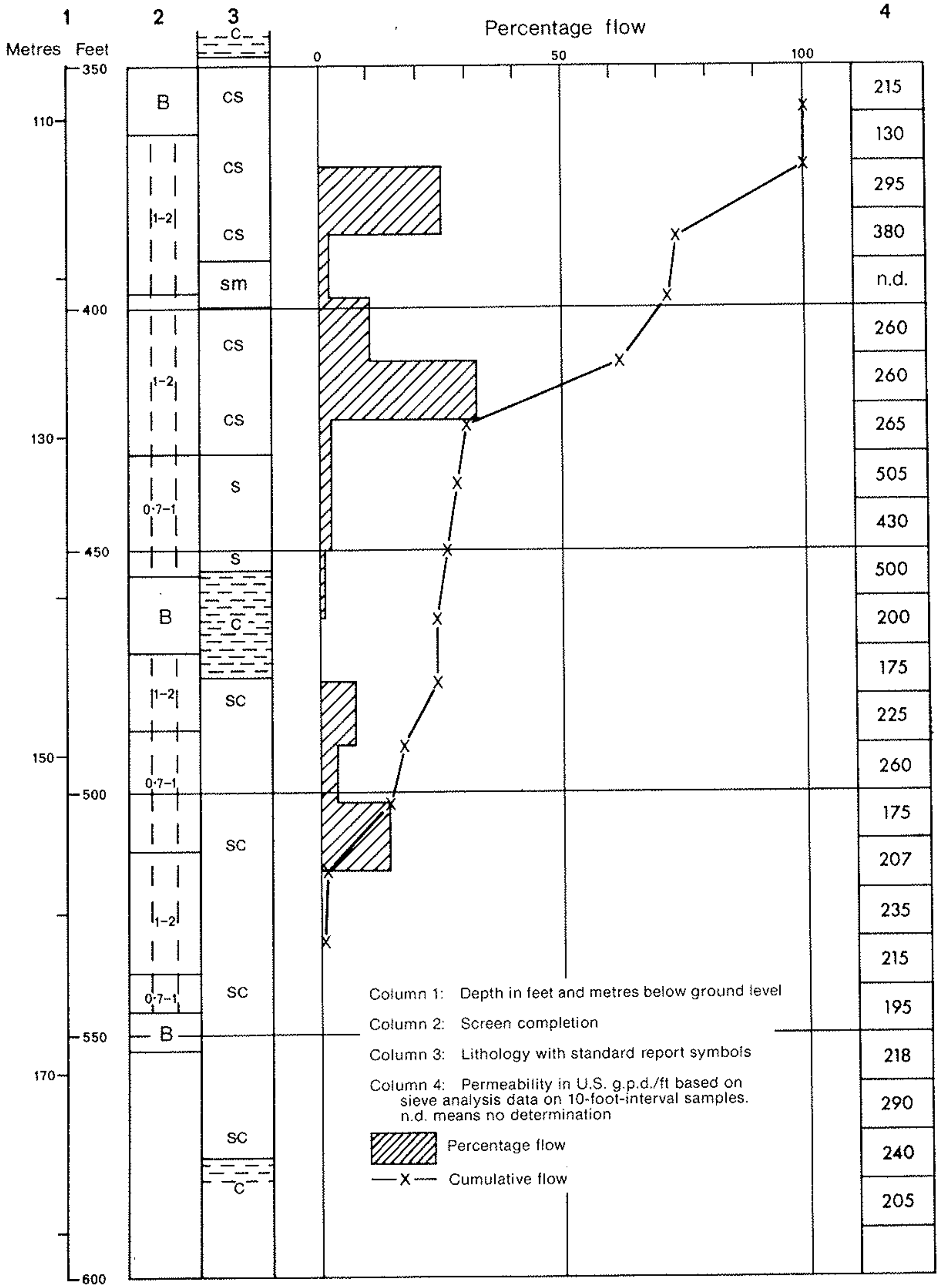


Figure 6. Flow velocity data T(FF1-65)P