Permeability Test Data

Slug Test Analysis Using Hvorslev Shape Factors

Variable head permeability test

Depth below top of casing/standpipe to :

(a) bottom of borehole :	87.000 m
(b) bottom of casing :	37.500 m
(c) top of filter material :	28.500 m
(d) length of filter :	28-38 m
(e) initial ground water level :	19.390 m
Height of casing/standpipe above surface :	0.000 m
Elevation of casing/standpipe above surface :	m (OD)

Site :	PARRYS QUARRY
Project No :	
Date :	15/12/2000
Ground Level (OD):	m
Weather :	
Type of test :	Falling Head Permeability
Diameter of pipe :	0.05 m
Length of filter:	10.0 m Dia. of borehole : 0.1270 m
Type of piezometer :	slotted screen

Location :	BUCKLEY
Borehole No :	PQW2
Sheet:	1 of 2
Contractor:	

Test Record

Time	Elapsed Time min	Depth to water level m	Drawdown (Ho) m	Drawdown Ratio (H/Ho)
13:10:00	0:00:00	19.39		
13:10:10	0:00:10	19.39		
13:10:20	0:00:20	19.39		
13:10:30	0:00:30	19.39		
13:10:40	0:00:40	19.39		
13:10:50	0:00:50	19.39		
13:11:00	0:01:00	19.39	A	
13:11:10	0:01:10	19.39	D	
13:11:20	0:01:20	19.39	D	
13:11:30	0:01:30	19.39	I	
13:11:40	0:01:40	19.39	N	
13:11:50	0:01:50	19.26876	G	
13:12:00	0:02:00	19.25011		
13:12:10	0:02:10	19.10089	W	
13:12:20	0:02:20	18.97965	A	
13:12:30	0:02:30	18.88639	T	
13:12:40	0:02:40	18.72785	E	
13:12:50	0:02:50	18.68122	R	
13:13:00	0:03:00	18.57863		
13:13:10	0:03:10	18.47604		
13:13:20	0:03:20	18.33615	1.05	
13:13:30	0:03:30	18.66256	0.73	
13:13:40	0:03:40	18.84909	0.54	
13:13:50	0:03:50	18.94235	0.45	
13:14:00	0:04:00	19.00763	0.38	
13:14:10	0:04:10	19.05426	0.34	
13:14:20	0:04:20	19.09157	0.30	
13:14:30	0:04:30	19.11954	0.27	
13:14:40	0:04:40	19.14752	0.24	
13:14:50	0:04:50	19.16618	0.22	
13:15:00	0:05:00	19.18483	0.21	
13:15:10	0:05:10	19.20348	0.19	
13:15:20	0:05:20	19.21281	0.18	
13:15:30	0:05:30	19.22213	0.17	
13:15:40	0:05:40	19.23146	0.16	
13:15:50	0:05:50	19.240783	0.15	
13:16:00	0:06:00	19.25011	0.14	
13:16:10	0:06:10	19.268764	0.12	
13:16:20	0:06:20	19.268764	0.12	
13:16:30	0:06:30	19.278091	0.11	
13:16:40	0:06:40	19.287414	0.10	
13:16:50	0:06:50	19.287414	0.10	
13:17:00	0:07:00	19.287414	0.10	
13:17:10	0:07:10	19.296741	0.09	
13:17:20	0:07:20	19.296741	0.09	
13:17:30	0:07:30	19.306068	0.08	
13:17:40	0:07:40	19.306068	0.08	
13:17:50	0:07:50	19.315395	0.07	
13:18:00	0:08:00	19.315395	0.07	
13:18:10	0:08:10	19.315395	0.07	
13:18:20	0:08:20	19.324718	0.07	
13:18:30	0:08:30	19.324718	0.07	
13:18:40	0:08:40	19.324718	0.07	
13:18:50	0:08:50	19.324718	0.07	
13:19:00	0:09:00	19.334045	0.06	
13:19:10	0:09:10	19.334045	0.06	
13:19:20	0:09:20	19.334045	0.06	
13:19:30	0:09:30	19.334045	0.06	
13:19:40	0:09:40	19.343372	0.05	
13:19:50	0:09:50	19.343372	0.05	
13:20:00	0:10:00	19.343372	0.05	
13:20:10	0:10:10	19.343372	0.05	
13:20:20	0:10:20	19.343372	0.05	
13:20:30	0:10:30	19.352699	0.04	
13:20:40	0:10:40	19.343372	0.05	
13:20:50	0:10:50	19.352699	0.04	
13:21:00	0:11:00	19.352699	0.04	
13:21:10	0:11:10	19.352699	0.04	
13:21:20	0:11:20	19.352699	0.04	
13:21:30	0:11:30	19.352699	0.04	
13:21:40	0:11:40	19.3527	0.04	
13:21:50	0:11:50	19.3527	0.04	
13:22:00	0:12:00	19.3527	0.04	
13:22:10	0:12:10	19.36203	0.03	
13:22:20	0:12:20	19.36203	0.03	
13:22:30	0:12:30	19.36203	0.03	
13:22:40	0:12:40	19.3527	0.04	
13:22:50	0:12:50	19.36203	0.03	
13:23:00	0:13:00	19.36203	0.03	
13:23:10	0:13:10	19.36203	0.03	
13:23:20	0:13:20	19.36203	0.03	
13:23:30	0:13:30	19.36203	0.03	
13:23:40	0:13:40	19.36203	0.03	
13:23:50	0:13:50	19.36203	0.03	
13:24:00	0:14:00	19.36203	0.03	
13:24:10	0:14:10	19.36203	0.03	
13:24:20	0:14:20	19.36203	0.03	
13:24:30	0:14:30	19.36203	0.03	
13:24:40	0:14:40	19.36203	0.03	
13:24:50	0:14:50	19.37135	0.02	
13:25:00	0:15:00	19.37135	0.02	
13:25:10	0:15:10	19.37135	0.02	

Calculation

General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

Cross Sectional Area A = 1.56E-03 m^2

Intake Factor F = 10.18

Time at t_1 0:03:20 min — Drawdown at H_1 0.054 m

Time at t2 0:09:10 min — Drawdown at H2 0.036 m

K= 0.078 m/d — if use borehole dia in area

K= 8.97E-07 m/s

K= 0.140 m/d — if use pipe diameter

K= 1.60E-06 m/s

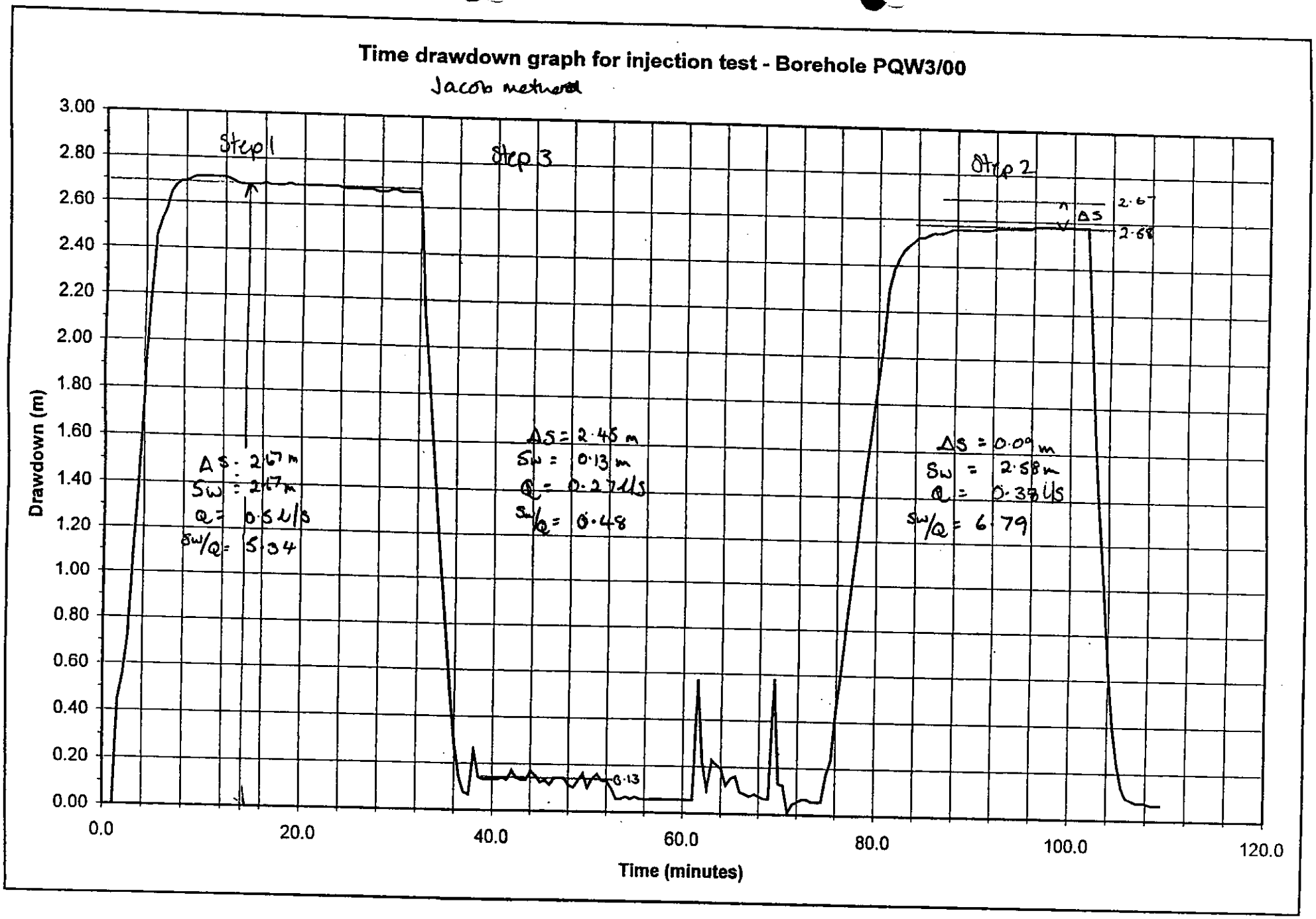
Injection test

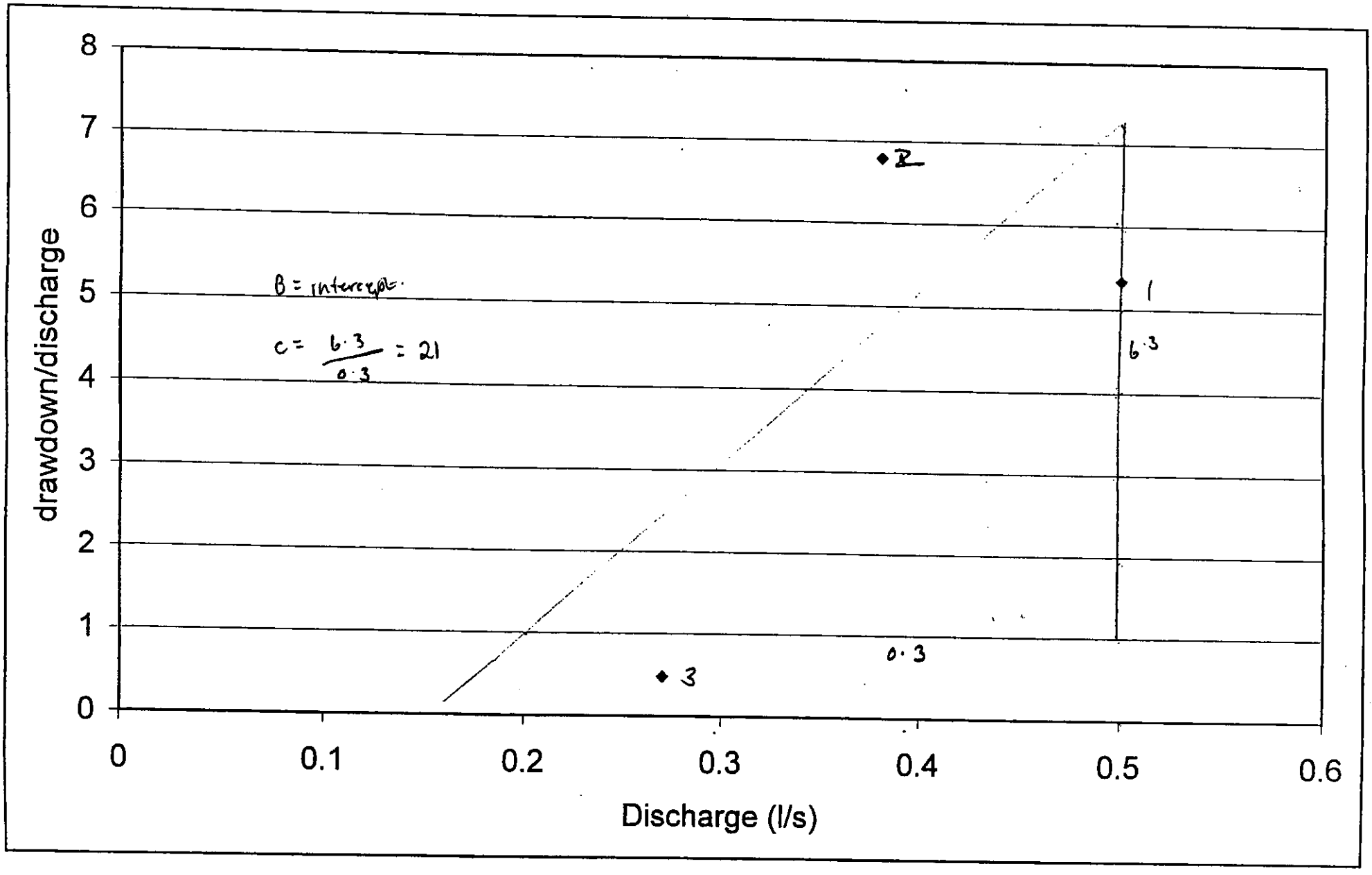
pqw3
15-Dec-2000 10:38:00

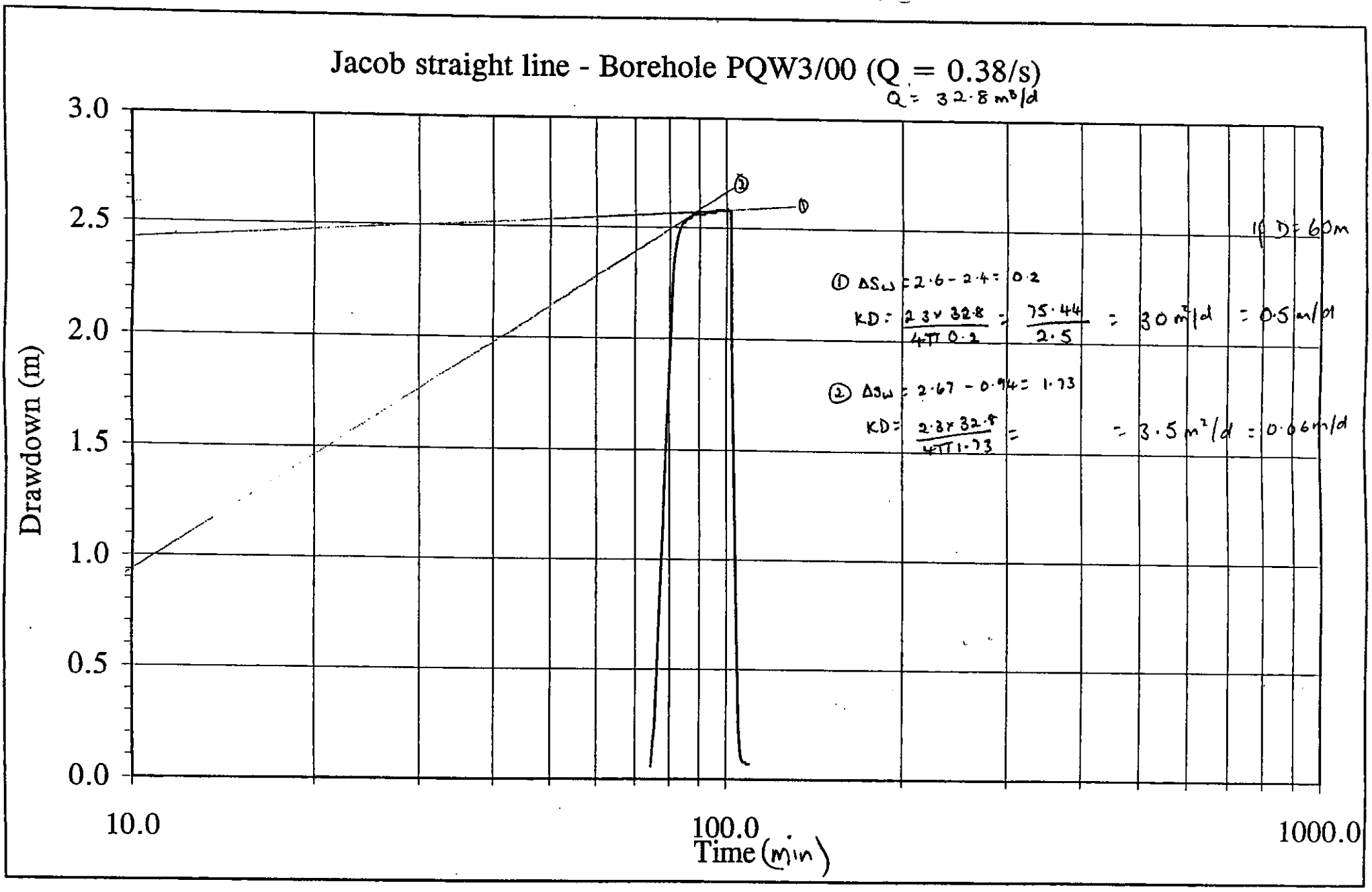
Date and time	m BGL	Comments
15/12/2000 10:38:00	3.388675	
15/12/2000 10:38:30	3.388675	
15/12/2000 10:39:00	3.388675	
15/12/2000 10:39:30	2.939426	Start pumping @ 0.5l/s
15/12/2000 10:40:00	2.834283	
15/12/2000 10:40:30	2.66223	
15/12/2000 10:41:00	2.260773	
15/12/2000 10:41:30	1.916667	
15/12/2000 10:42:00	1.629912	
15/12/2000 10:42:30	1.19978	
15/12/2000 10:43:00	0.932142	
15/12/2000 10:43:30	0.865233	
15/12/2000 10:44:00	0.817441	
15/12/2000 10:44:30	0.740973	
15/12/2000 10:45:00	0.712297	
15/12/2000 10:45:30	0.69318	
15/12/2000 10:46:00	0.69318	
15/12/2000 10:46:30	0.683622	
15/12/2000 10:47:00	0.674063	
15/12/2000 10:47:30	0.674063	
15/12/2000 10:48:00	0.674063	
15/12/2000 10:48:30	0.674063	
15/12/2000 10:49:00	0.674063	
15/12/2000 10:49:30	0.674063	
15/12/2000 10:50:00	0.674063	
15/12/2000 10:50:30	0.683622	
15/12/2000 10:51:00	0.69318	
15/12/2000 10:51:30	0.702739	
15/12/2000 10:52:00	0.702739	
15/12/2000 10:52:30	0.702739	
15/12/2000 10:53:00	0.702739	
15/12/2000 10:53:30	0.702739	
15/12/2000 10:54:00	0.69318	
15/12/2000 10:54:30	0.702739	
15/12/2000 10:55:00	0.702739	
15/12/2000 10:55:30	0.702739	
15/12/2000 10:56:00	0.702739	
15/12/2000 10:56:30	0.69318	
15/12/2000 10:57:00	0.702739	
15/12/2000 10:57:30	0.702739	
15/12/2000 10:58:00	0.702739	
15/12/2000 10:58:30	0.702739	
15/12/2000 10:59:00	0.702739	
15/12/2000 10:59:30	0.702739	
15/12/2000 11:00:00	0.702739	
15/12/2000 11:00:30	0.702739	
15/12/2000 11:01:00	0.702739	
15/12/2000 11:01:30	0.702739	
15/12/2000 11:02:00	0.712297	
15/12/2000 11:02:30	0.712297	
15/12/2000 11:03:00	0.712297	
15/12/2000 11:03:30	0.712297	
15/12/2000 11:04:00	0.712297	
15/12/2000 11:04:30	0.712297	
15/12/2000 11:05:00	0.712297	
15/12/2000 11:05:30	0.721856	
15/12/2000 11:06:00	0.721856	
15/12/2000 11:06:30	0.721856	
15/12/2000 11:07:00	0.712297	
15/12/2000 11:07:30	0.712297	
15/12/2000 11:08:00	0.721856	
15/12/2000 11:08:30	0.721856	
15/12/2000 11:09:00	0.721856	
15/12/2000 11:09:30	0.721856	
15/12/2000 11:10:00	0.721856	Stopped pumping
15/12/2000 11:10:30	1.238014	Recovery started
15/12/2000 11:11:00	1.476977	
15/12/2000 11:11:30	1.77329	
15/12/2000 11:12:00	2.08872	
15/12/2000 11:12:30	2.385033	
15/12/2000 11:13:00	2.643113	
15/12/2000 11:13:30	2.891634	

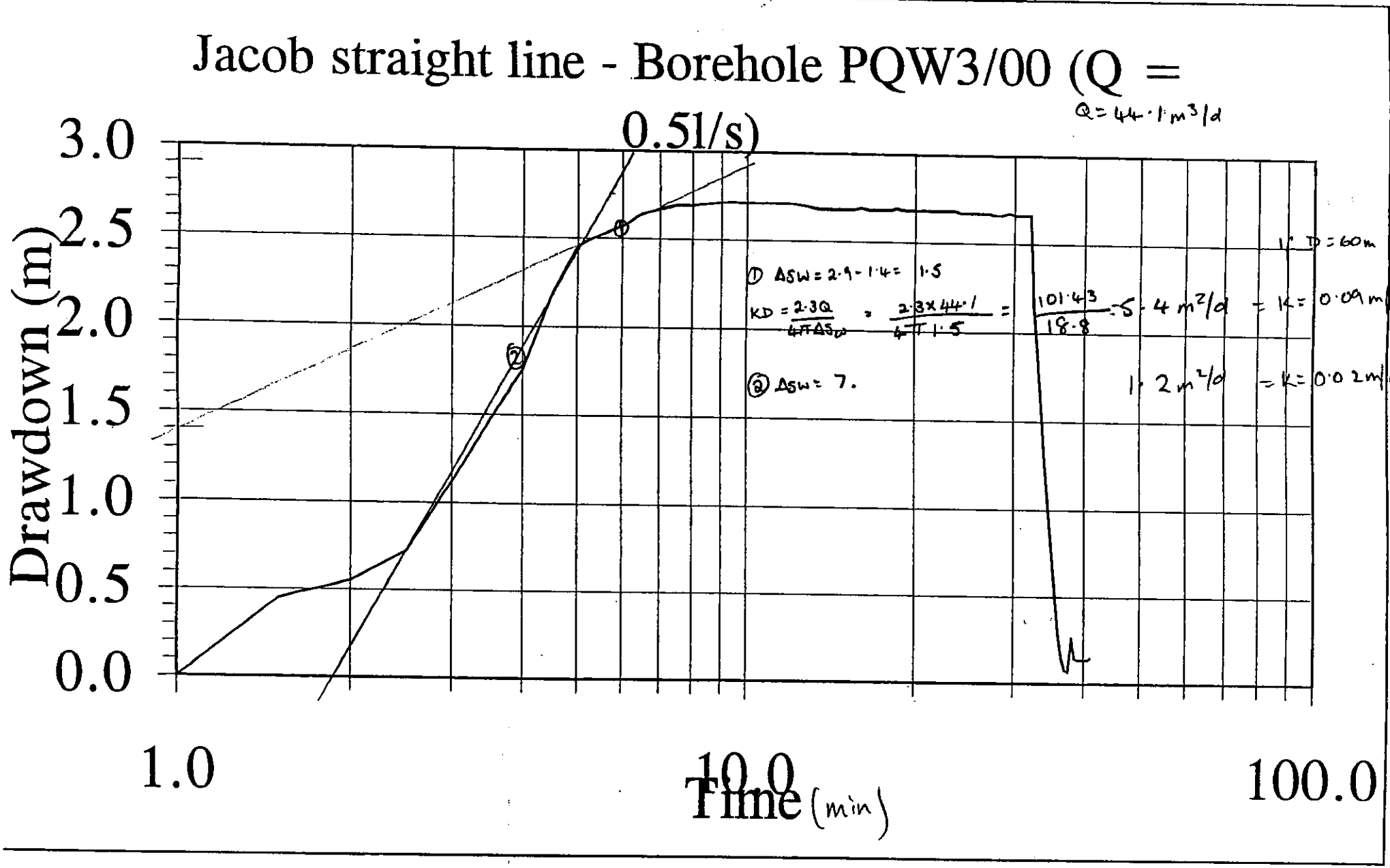
15/12/2000 11:14:00	3.111479	
15/12/2000 11:14:30	3.245298	
15/12/2000 11:15:00	3.312207	
15/12/2000 11:15:30	3.321766	
15/12/2000 11:16:00	3.130596	
15/12/2000 11:16:30	3.245298	
15/12/2000 11:17:00	3.254856	
15/12/2000 11:17:30	3.254856	
15/12/2000 11:18:00	3.254856	
15/12/2000 11:18:30	3.254856	
15/12/2000 11:19:00	3.245298	
15/12/2000 11:19:30	3.254856	Started pumping @ 0.2l/s
15/12/2000 11:20:00	3.216622	
15/12/2000 11:20:30	3.245298	
15/12/2000 11:21:00	3.254856	
15/12/2000 11:21:30	3.254856	
15/12/2000 11:22:00	3.216622	
15/12/2000 11:22:30	3.235739	
15/12/2000 11:23:00	3.264415	
15/12/2000 11:23:30	3.254856	
15/12/2000 11:24:00	3.273973	
15/12/2000 11:24:30	3.245298	
15/12/2000 11:25:00	3.245298	
15/12/2000 11:25:30	3.245298	
15/12/2000 11:26:00	3.273973	
15/12/2000 11:26:30	3.283532	
15/12/2000 11:27:00	3.254856	
15/12/2000 11:27:30	3.226181	
15/12/2000 11:28:00	3.283532	
15/12/2000 11:28:30	3.245298	
15/12/2000 11:29:00	3.226181	
15/12/2000 11:29:30	3.254856	
15/12/2000 11:30:00	3.254856	Stopped pumping
15/12/2000 11:30:30	3.283532	Recovery started
15/12/2000 11:31:00	3.331324	
15/12/2000 11:31:30	3.331324	
15/12/2000 11:32:00	3.321766	
15/12/2000 11:32:30	3.331324	
15/12/2000 11:33:00	3.321766	
15/12/2000 11:33:30	3.331324	
15/12/2000 11:34:00	3.331324	
15/12/2000 11:34:30	3.331324	
15/12/2000 11:35:00	3.331324	
15/12/2000 11:35:30	3.331324	
15/12/2000 11:36:00	3.331324	
15/12/2000 11:36:30	3.331324	
15/12/2000 11:37:00	3.331324	
15/12/2000 11:37:30	3.331324	
15/12/2000 11:38:00	3.331324	
15/12/2000 11:38:30	3.331324	
15/12/2000 11:39:00	3.331324	
15/12/2000 11:39:30	2.815166	Started pumping @ 0.4l/s
15/12/2000 11:40:00	3.16883	Abandoned pumping
15/12/2000 11:40:30	3.283532	
15/12/2000 11:41:00	3.159271	
15/12/2000 11:41:30	3.178388	
15/12/2000 11:42:00	3.197505	
15/12/2000 11:42:30	3.264415	
15/12/2000 11:43:00	3.235739	
15/12/2000 11:43:30	3.226181	
15/12/2000 11:44:00	3.29309	
15/12/2000 11:44:30	3.302649	
15/12/2000 11:45:00	3.312207	
15/12/2000 11:45:30	3.302649	
15/12/2000 11:46:00	3.312207	
15/12/2000 11:46:30	3.321766	
15/12/2000 11:47:00	3.321766	
15/12/2000 11:47:30	2.805607	
15/12/2000 11:48:00	3.254856	
15/12/2000 11:48:30	3.560728	
15/12/2000 11:49:00	3.379117	
15/12/2000 11:49:30	3.340883	
15/12/2000 11:50:00	3.331324	
15/12/2000 11:50:30	3.321766	
15/12/2000 11:51:00	3.321766	

15/12/2000 11:51:30	3.331324	
15/12/2000 11:52:00	3.331324	
15/12/2000 11:52:30	3.331324	
15/12/2000 11:53:00	3.216622	
15/12/2000 11:53:30	3.149713	
15/12/2000 11:54:00	2.929868	
15/12/2000 11:54:30	2.748256	
15/12/2000 11:55:00	2.547528	
15/12/2000 11:55:30	2.365916	
15/12/2000 11:56:00	2.203422	
15/12/2000 11:56:30	2.002694	
15/12/2000 11:57:00	1.830641	
15/12/2000 11:57:30	1.687263	
15/12/2000 11:58:00	1.515211	
15/12/2000 11:58:30	1.343158	
15/12/2000 11:59:00	1.094637	Started pumping @ 0.4l/s
15/12/2000 11:59:30	1.00861	
15/12/2000 12:00:00	0.960818	
15/12/2000 12:00:30	0.922584	
15/12/2000 12:01:00	0.903467	
15/12/2000 12:01:30	0.88435	
15/12/2000 12:02:00	0.865233	
15/12/2000 12:02:30	0.865233	
15/12/2000 12:03:00	0.855675	
15/12/2000 12:03:30	0.846116	
15/12/2000 12:04:00	0.846116	
15/12/2000 12:04:30	0.846116	
15/12/2000 12:05:00	0.836558	
15/12/2000 12:05:30	0.826999	
15/12/2000 12:06:00	0.826999	
15/12/2000 12:06:30	0.826999	
15/12/2000 12:07:00	0.826999	
15/12/2000 12:07:30	0.826999	
15/12/2000 12:08:00	0.826999	
15/12/2000 12:08:30	0.826999	
15/12/2000 12:09:00	0.826999	
15/12/2000 12:09:30	0.826999	
15/12/2000 12:10:00	0.817441	
15/12/2000 12:10:30	0.817441	
15/12/2000 12:11:00	0.817441	
15/12/2000 12:11:30	0.817441	
15/12/2000 12:12:00	0.817441	
15/12/2000 12:12:30	0.817441	
15/12/2000 12:13:00	0.817441	
15/12/2000 12:13:30	0.817441	
15/12/2000 12:14:00	0.807882	
15/12/2000 12:14:30	0.807882	
15/12/2000 12:15:00	0.807882	
15/12/2000 12:15:30	0.807882	
15/12/2000 12:16:00	0.807882	
15/12/2000 12:16:30	0.807882	
15/12/2000 12:17:00	0.807882	
15/12/2000 12:17:30	0.807882	
15/12/2000 12:18:00	0.807882	
15/12/2000 12:18:30	0.807882	
15/12/2000 12:19:00	0.807882	
15/12/2000 12:19:30	0.807882	Stopped pumping
15/12/2000 12:20:00	1.247573	Recovery started
15/12/2000 12:20:30	1.658586	
15/12/2000 12:21:00	2.060045	
15/12/2000 12:21:30	2.423267	
15/12/2000 12:22:00	2.738698	
15/12/2000 12:22:30	2.97766	
15/12/2000 12:23:00	3.140154	
15/12/2000 12:23:30	3.245298	
15/12/2000 12:24:00	3.29309	
15/12/2000 12:24:30	3.302649	
15/12/2000 12:25:00	3.312207	
15/12/2000 12:25:30	3.312207	
15/12/2000 12:26:00	3.312207	
15/12/2000 12:26:30	3.321766	
15/12/2000 12:27:00	3.321766	
15/12/2000 12:27:30	3.321766	

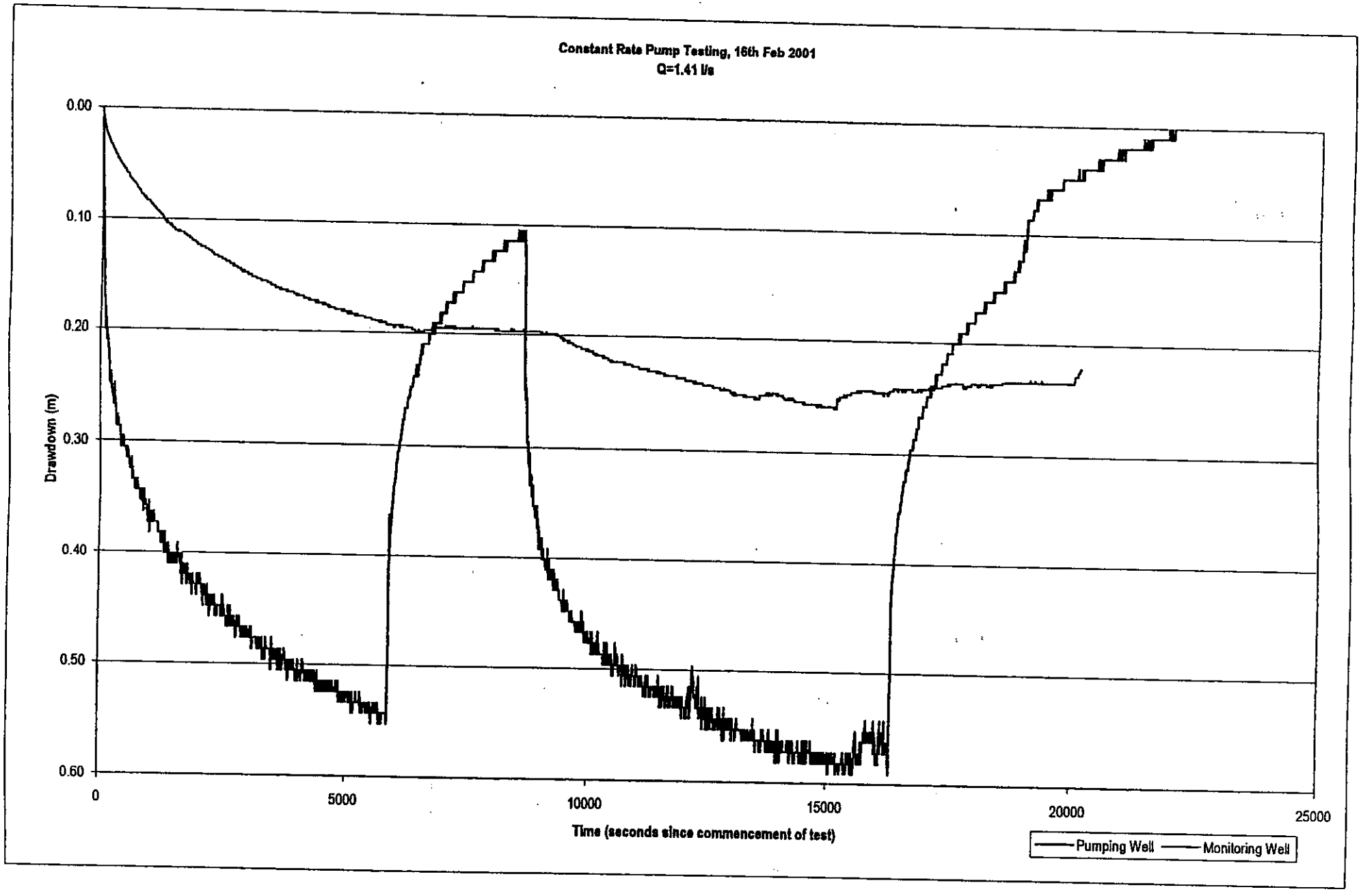

Time drawdown graph for injection test - Borehole PQW3/00
Jacob method
Step 1
Step 3
Step 2
ΔS = 2.67 m
Sw = 2.67 m
Q = 0.5 l/s
Sw/Q = 5.34
ΔS = 2.45 m
Sw = 0.13 m
Q = 0.2 l/s
Sw/Q = 0.48
ΔS = 0.09 m
Sw = 2.58 m
Q = 0.38 l/s
Sw/Q = 6.79
ΔS
2.67
2.58
0.13
Drawdown (m)
Time (minutes)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
2.20
2.40
2.60
2.80
3.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0


drawdown/discharge
Discharge (l/s)
0
1
2
3
4
5
6
7
8
0
0.1
0.2
0.3
0.4
0.5
0.6
B = intercept
c = 6.3 / 0.3 = 21
2
1
3
6.3
0.3

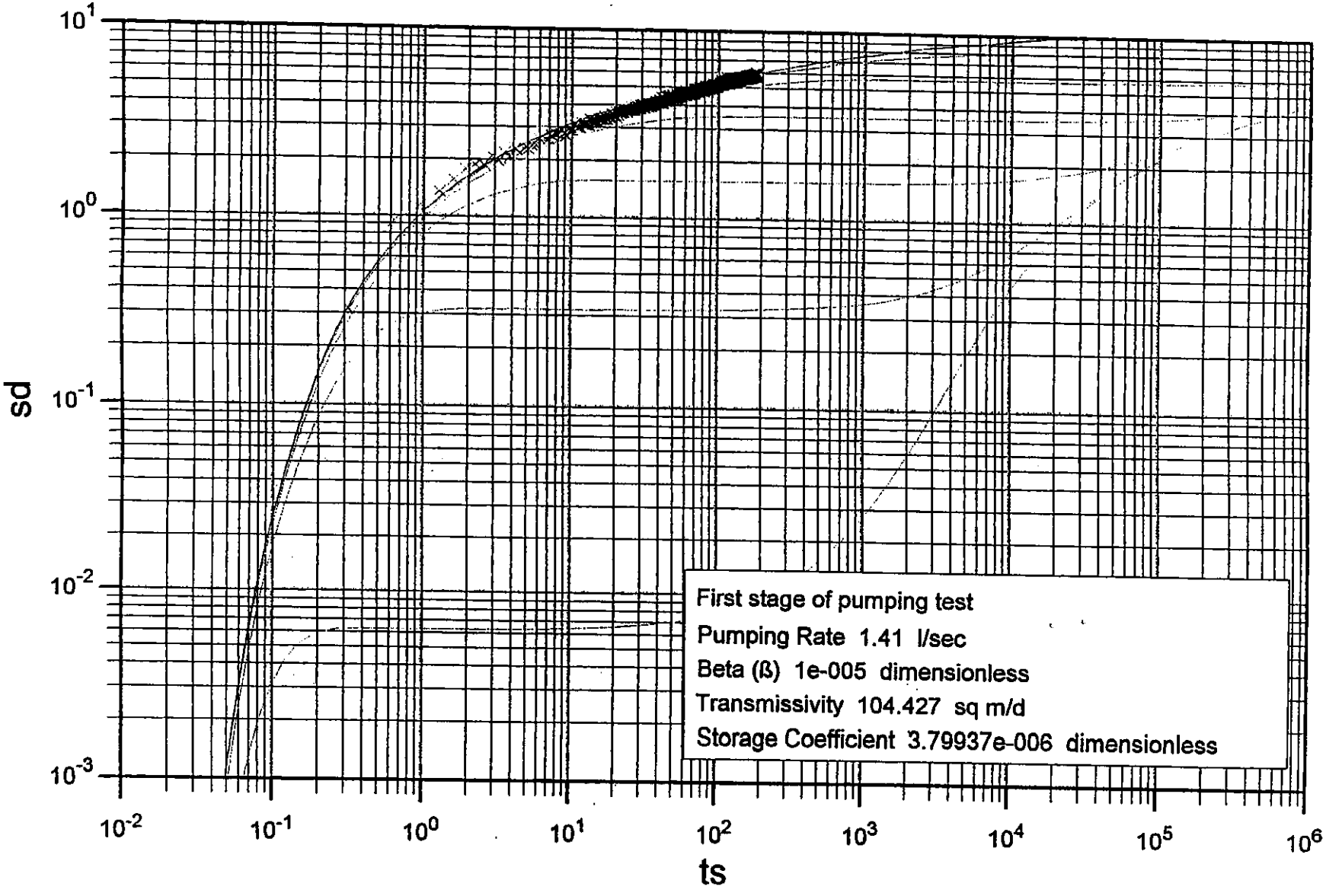

Jacob straight line - Borehole PQW3/00 (Q = 0.38/s)
Q = 32.8 m³/d
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Drawdown (m)
10.0
100.0
1000.0
Time (min)
① D = 60m
① ΔSw = 2.6 - 2.4 = 0.2
KD = 2.3 × 32.8 / 4π 0.2 = 75.44 / 2.5 = 30 m²/d = 0.5 m/d
② ΔSw = 2.67 - 0.94 = 1.73
KD = 2.3 × 32.8 / 4π 1.73 = = 3.5 m²/d = 0.06 m/d


Jacob straight line - Borehole PQW3/00 (Q = 0.5l/s)
Q = 44.1 m³/d
Drawdown (m)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1.0
10.0
100.0
Time (min)
1" D = 60m
① ΔSw = 2.9 - 1.4 = 1.5
KD = 2.3Q / 4πΔS_D = 2.3 x 44.1 / 4πT 1.5 = 101.43 / 18.8 = 5.4 m²/d = K = 0.09 m/d
② ΔSw = 7.
1.2 m²/d = K = 0.02 m/d

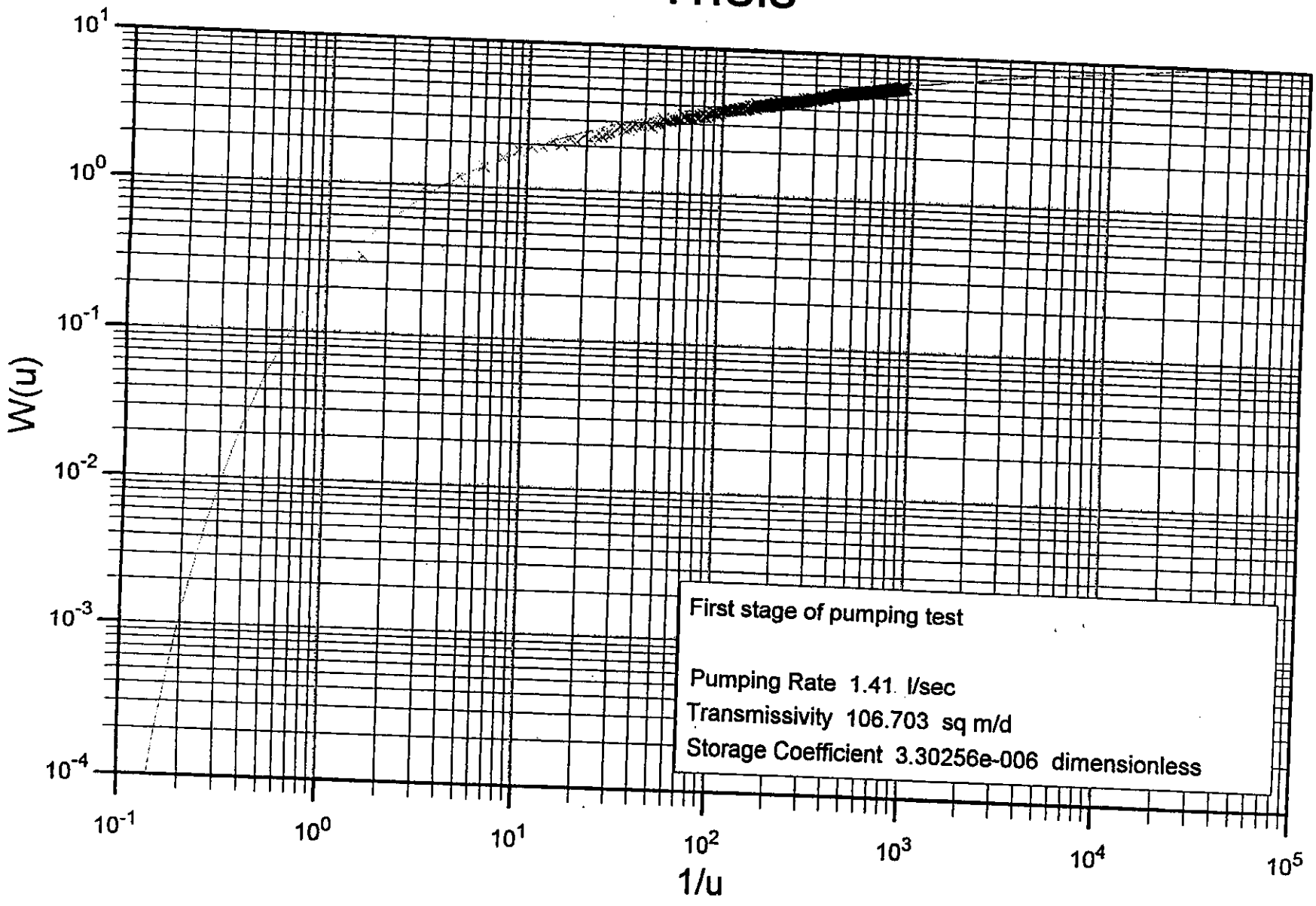
Pump Test Data


Constant Rate Pump Testing, 16th Feb 2001
Q=1.41 l/s
Drawdown (m)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0
5000
10000
15000
20000
25000
Time (seconds since commencement of test)
Pumping Well
Monitoring Well

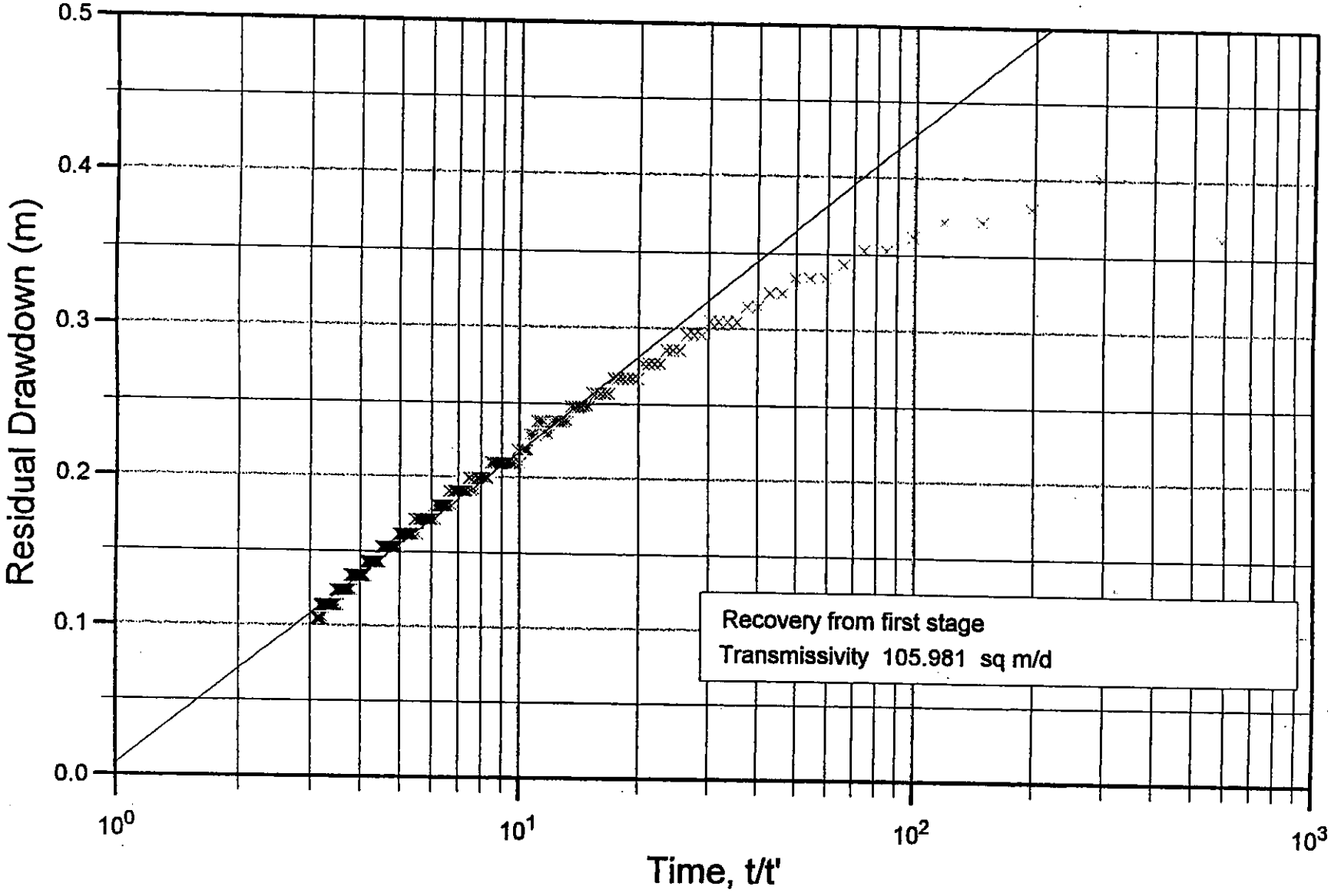
Neuman


sd
ts
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
10^{5}
10^{6}
First stage of pumping test
Pumping Rate 1.41 l/sec
Beta (ß) 1e-005 dimensionless
Transmissivity 104.427 sq m/d
Storage Coefficient 3.79937e-006 dimensionless

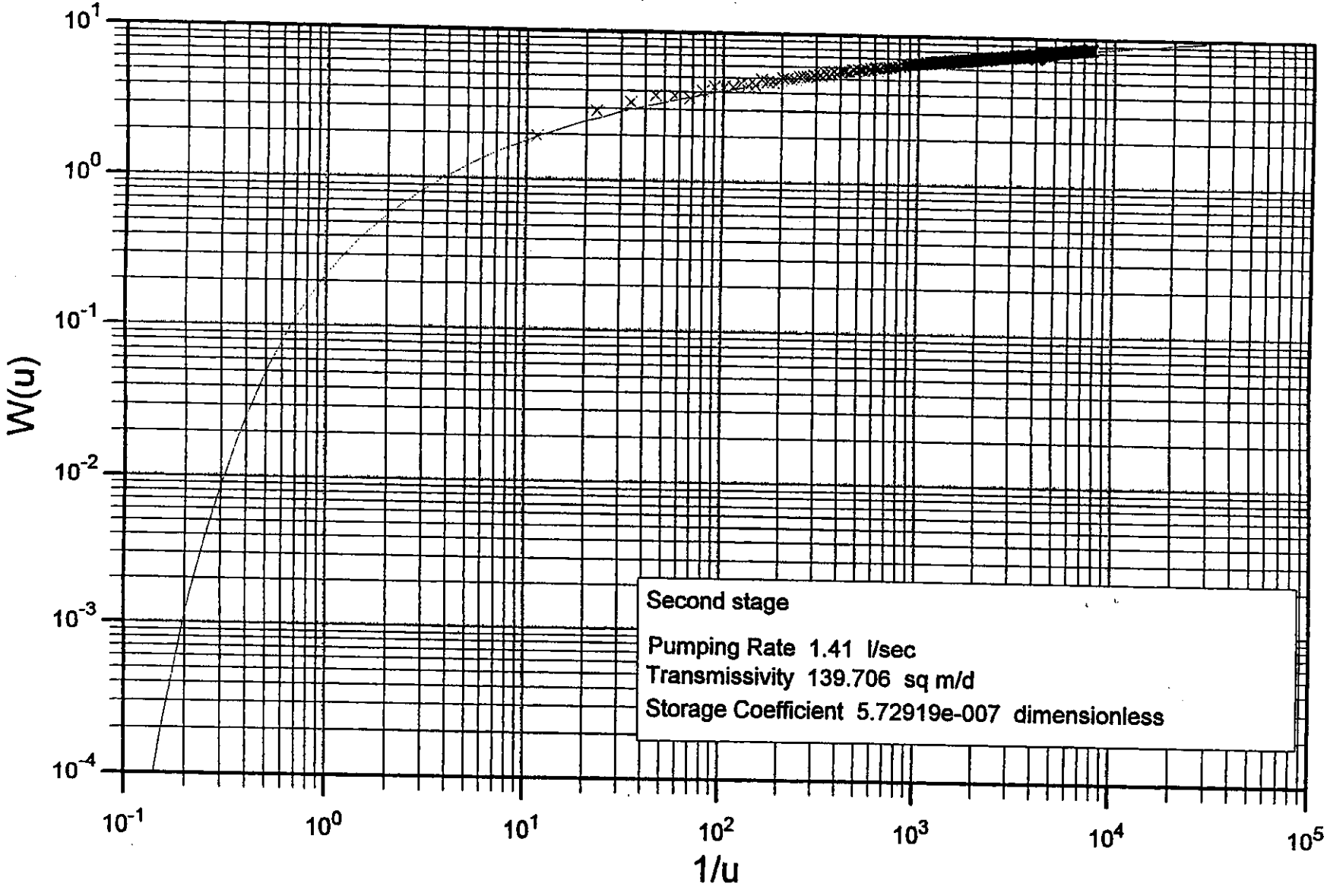
Theis


W(u)
1/u
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
10^{5}
First stage of pumping test
Pumping Rate 1.41 l/sec
Transmissivity 106.703 sq m/d
Storage Coefficient 3.30256e-006 dimensionless

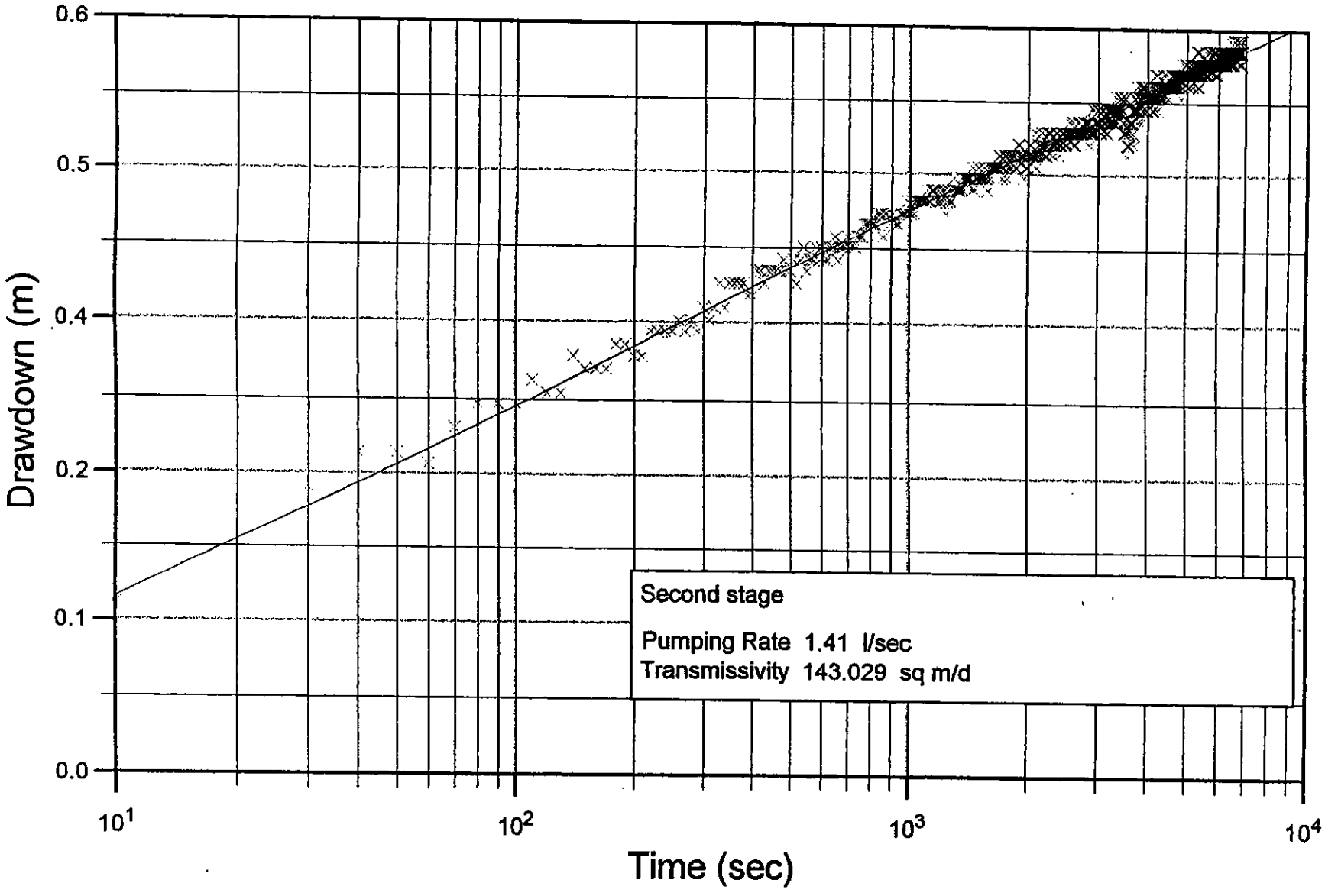
Theis Recovery



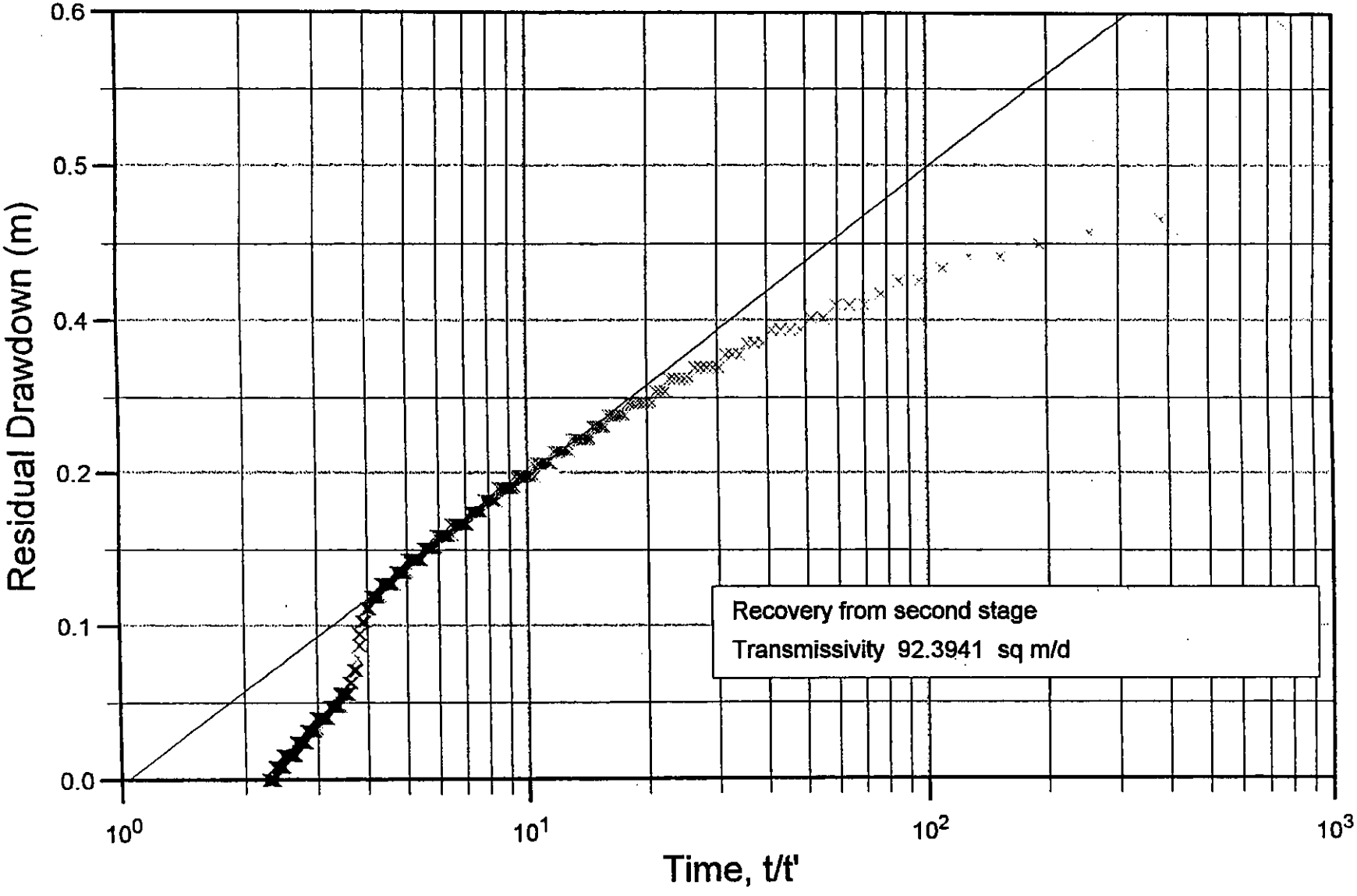
Theis


W(u)
1/u
Second stage
Pumping Rate 1.41 l/sec
Transmissivity 139.706 sq m/d
Storage Coefficient 5.72919e-007 dimensionless

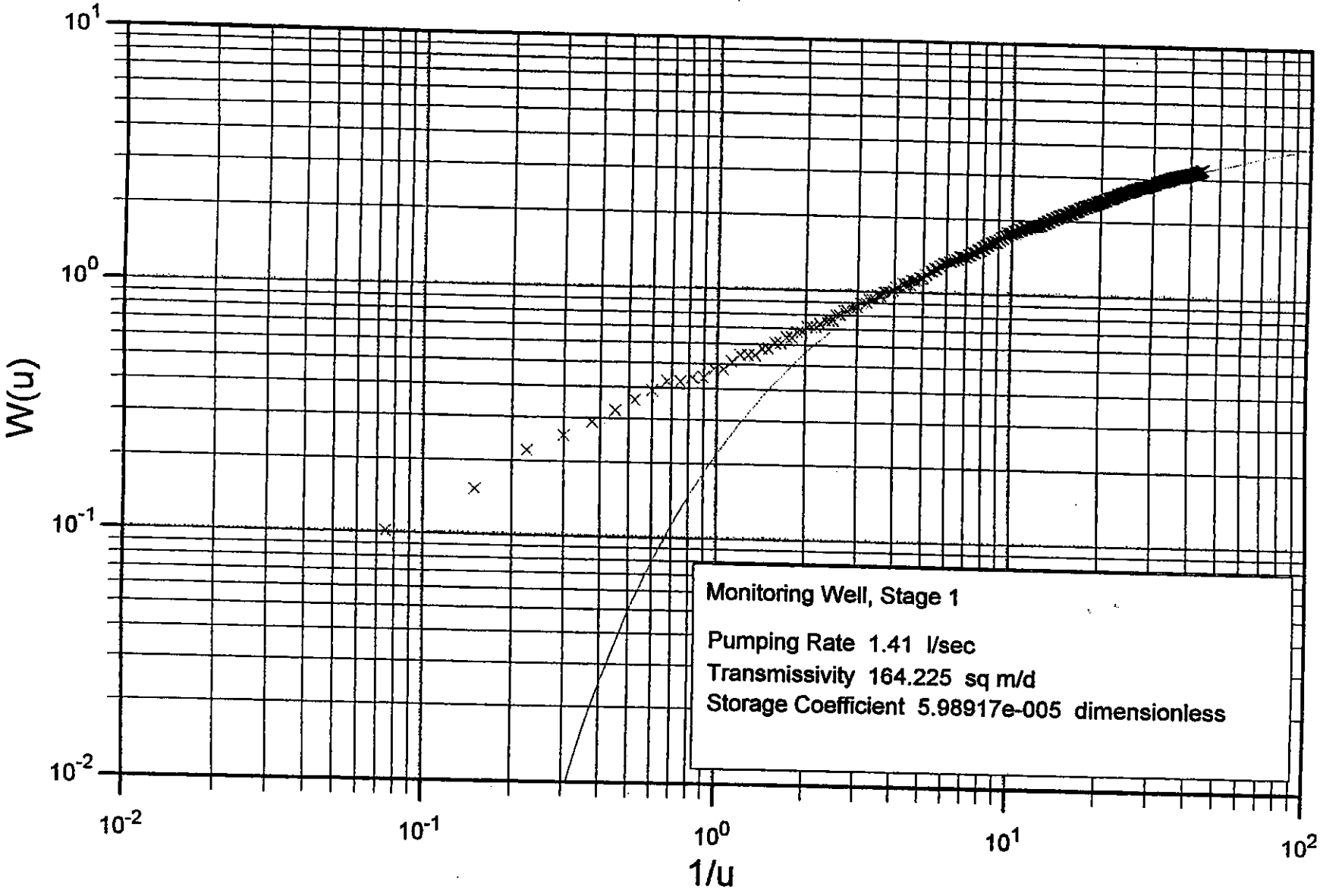
Cooper and Jacob



Theis Recovery



Theis


W(u)
1/u
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Monitoring Well, Stage 1
Pumping Rate 1.41 l/sec
Transmissivity 164.225 sq m/d
Storage Coefficient 5.98917e-005 dimensionless