N42237.AR.000186
NSB KINGS BAY
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LETTER REGARDING TECHNICAL BULLETIN INITIAL AQUIFER PUMPING TEST AT SITE 11 KINGS BAY GA
12/6/1993
ABB ENVIRONMENTAL

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ASEA BROWN BOVERI

31547.000
16.01.00.0011

December 6, 1993

United States Geological Survey
Water Resources Division
Peachtree Business Center
3030 Amwiller Road, Suite 130
Atlanta, Georgia 30360

Attention: Mr. H.H. Bud Zehner

SUBJECT: Technical Bulletin - Initial Aquifer Pumping Test at Site 11, Old Camden County Landfill Naval Submarine Base (NSB) Kings Bay

Dear Mr. Zehner:

As requested by Ed Lohr of the Southern Division Naval Facilities Engineering Command we have enclosed a copy of the Initial Aquifer Pumping Test Technical Bulletin for your review.

Please feel free to contact me if you have any questions regarding the initial aquifer pumping test at Site 11 or this technical bulletin.

Sincerely,

ABB ENVIRONMENTAL SERVICES, INC.

Kurt Sichelstiel
Principal Hydrologist

pc: Mr. G.E. Lohr
Mr. D. Driggers
Mr. F.B. Cater/ABB-ES

ABB Environmental Services Inc.

1400 Centerpoint Blvd.
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TECHNICAL BULLETIN

INTERIM MEASURE ACTIVITIES
SITE 11, OLD CAMDEN COUNTY LANDFILL
NSB KINGS BAY, GEORGIA

SUBJECT Initial Aquifer Pumping Test

SUMMARY An aquifer pumping test was conducted as part of the IM installation activities at Site 11, Old Camden County Landfill. This initial pumping test was conducted at the first recovery well (RW-1) on October 25 and 26, 1993. This test was conducted during the early portion of the IM installation activities to guide the IM project team's well installation program and reinforce design specifications. This initial test was designed to:

- provide preliminary radius of influence data,
- assess vertical head potential relationships within the stressed (due to pumping) aquifer, and
- provide a reality check on preliminary estimates of aquifer parameters and proposed well pumping rates.

Aquifer response due to pumping stress at RW-1 has been analyzed to provide preliminary estimates of transmissivity and isotropic nature. Early projections of the radius-of-influence has been estimated from distance versus drawdown data. Preliminary capture zone analysis has been performed using the U.S. Environmental Protection Agency's (EPA) Wellhead Protection Area (WHPA) Model to determine the optimum location of the forth recovery well, RW-4. An anomalous aquifer response was observed at a paired-set of observation wells. Due to this anisotropic response, a fifth recovery well (RW-5) screened in the shallow portion of the aquifer was installed.

This technical bulletin is preliminary in nature and provides only a brief discussion of the results of the initial aquifer pumping test. In-depth analysis of the initial pumping test will be provided as part of Technical Memorandum No. 1; scheduled for March, 1994. Additionally, more extensive aquifer pumping tests and comprehensive evaluation of the results are planned for the pilot-scale operation and evaluation periods.

ATTACHMENTS

Attachment 1:	Figure 1-1, Recovery Well and Observation Well Location Map; Figure 1-2, Initial Pumping Test Monitoring Points
Attachment 2:	Raw Data Output
Attachment 3:	Analytical Results of Chemical Analyses of RW-1 Effluent
Attachment 4:	Table 1, Measured Drawdown During GWE 25-Hour Test; Table 2, Aquifer Properties
Attachment 5:	Graphical Analyses of Hydraulic Data
Attachment 6:	Figure 1-3, Projected Radius-of-Influence Estimates
Attachment 7:	Capture Zone Plots - Semi-Analytical Model Output (U.S. EPA's Wellhead Protection Area (WHPA) Model, RESSQC Module)

of these analyses are provided as Attachment 3. Based on the relatively low concentrations of dissolved iron and other ETPs indicated by the analytical results, pretreatment upstream of the pilot-scale air sparging unit will not be necessary.

Aquifer test data were interpreted using several methods of analysis. Drawdown values at each of four observation wells (PS-1, PS-2, PS-3, PS-4) and the recovery well were plotted with respect to time. These computer-generated plots and hand-plotted graphs were analyzed using the Cooper-Jacob method of analysis. The Neuman method of analysis (unconfined aquifer with delayed gravity response) was used for interpretation of PS-2 and PS-3 data to check the validity of the Cooper-Jacob method results. Drawdown values for all observation wells indicated on Table 1 (Attachment 4) were plotted with respect to radial distance from RW-1 and analyzed using the Copper-Jacob method. Residual drawdown values at RW-1 after the pump was shut-off were plotted with respect to t/t' (time since pumping started over time since pumping stopped) and analyzed using the Theis Recovery method of analysis. Attachment 5 includes the hand-plotted graphs and computer-generated plots for RW-1, PS-1, PS-2, PS-3, and PS-4. Results of the analyses are indicated in Table 2 (Attachment 4).

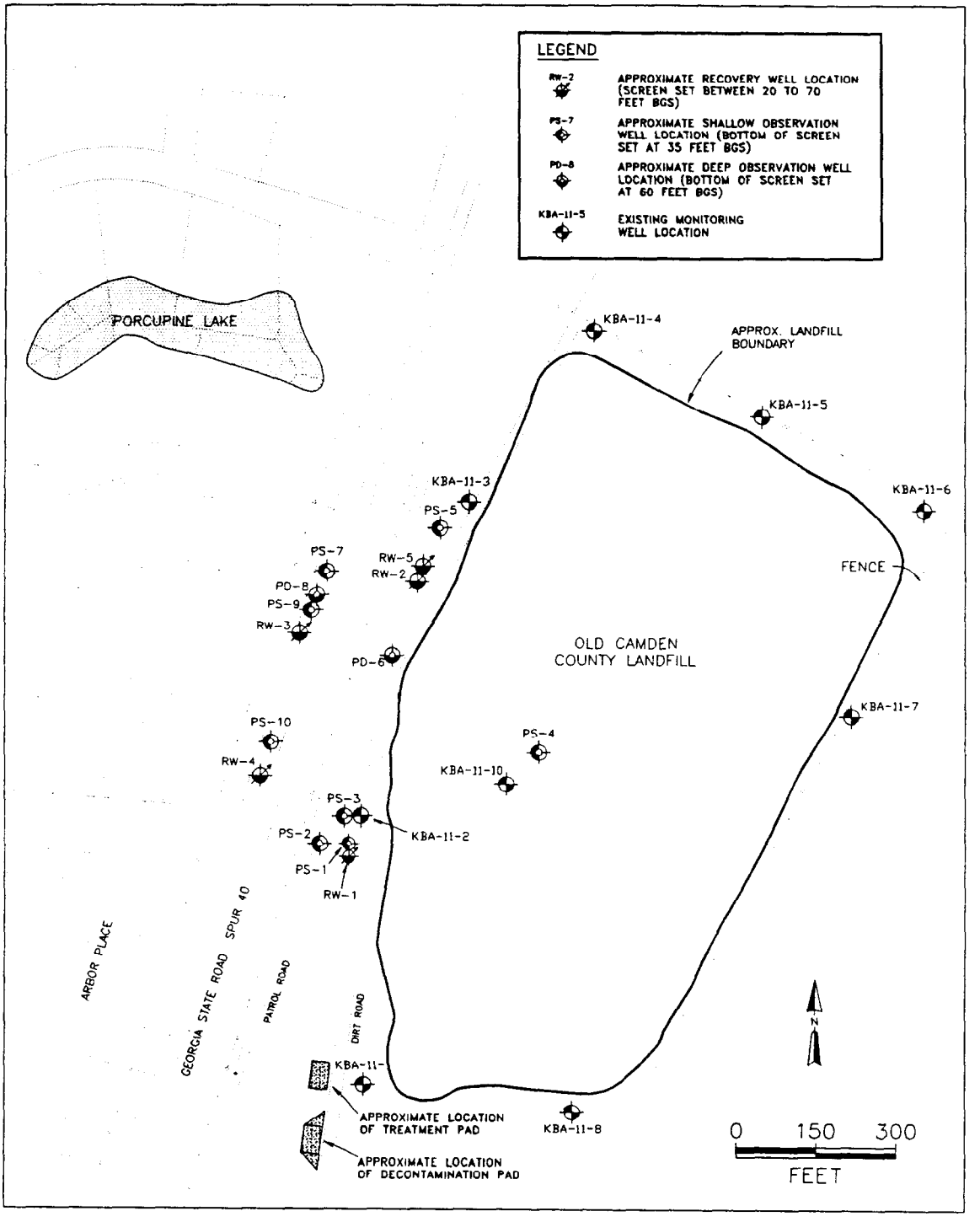
Transmissivity values estimated from this aquifer pumping test ranged from 97 ft^2/day to 5,181 ft^2/day. The transmissivity value estimated from the distance versus drawdown plot was 970 ft^2/day. Further discussion and interpretation of the aquifer parameters will be presented in the forthcoming Technical Memorandum No. 1.

The distance versus drawdown plot (see Attachment 4) indicates a radius-of-influence of 680 feet projected from RW-1. Assuming similar aquifer characteristics, Figure 1-3 (Attachment 6) shows projected radius-of-influence surrounding each of the four recovery well locations. Actual radius-of-influence for these wells, which will include synergistic effects on drawdown caused by well interference, will be monitored during IM pilot-scale operations.

Preliminary capture zone analysis of the planned groundwater extraction system (GWE) was performed with the U.S. EPAs WHPA model. The semi-analytical model RESSQC, a module of WHPA, was used to model several different scenarios. Variations on well placement (location) of RW-4, direction of ambient hydraulic gradient, effective porosity and pumping rates were input to the model. Transmissivity, saturated thickness, and hydraulic gradient were kept constant at 1,000 ft^2/day, 75 feet, and 0.003 feet/foot, respectively. RESSQC output represents time related capture zones with streamlines indicating flow toward a well [location] center.

ATTACHMENT 1

Figure 1-1, Recovery Well and Observation Well Location Map
Figure 1-2, Initial Pumping Test Monitoring Points



DWN: NLW	PROJECT NO.: 08503	TITLE: APPROXIMATE RECOVERY WELL AND OBSERVATION WELL LOCATIONS	IM TECHNICAL BULLETIN
CHKD: KDS	FIGURE NO.: 1-1		NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
DATE: 12/02/93			

ATTACHMENT 2

Raw Data Output

SE2000
Environmental Logger
10/27 08:51

Unit# 546 Test 0

Setups:	INPUT 1	INPUT 2	INPUT 3	INPUT 4	INPUT 5	INPUT 6
Type	Level (F)	Level (F)	Level (F)	Level (F)	Level (F)	Level (F)
Mode	TOC	TOC	TOC	TOC	TOC	TOC
I.D.	RW−1	PS−1	PS−2	PS−3	KBA−11−2	PS−4
Reference	11.420	6.950	7.640	8.440	8.800	10.210
SG	1.000	1.000	1.000	1.000	1.000	1.000
Linearity	0.000	0.117	0.042	0.042	0.046	0.043
Scale factor	29.925	19.999	10.025	10.031	9.988	10.008
Offset	−0.115	−0.004	−0.005	0.010	0.023	0.004
Delay mSEC	50.000	50.000	50.000	50.000	50.000	50.000

Step 1 10/25 11:00:01 DRAWDOWN

Elapsed Time	INPUT 1	INPUT 2	INPUT 3	INPUT 4	INPUT 5	INPUT
0.0000	11.504	6.943	7.640	8.452	8.803	10.194
0.0083	11.561	6.943	7.640	8.452	8.800	10.194
0.0166	11.231	6.950	7.640	8.452	8.800	10.197
0.0250	11.835	6.950	7.640	8.452	8.800	10.194
0.0333	11.363	6.943	7.640	8.455	8.800	10.194
0.0416	11.514	6.943	7.640	8.452	8.800	10.194
0.0500	11.608	6.950	7.640	8.455	8.800	10.194
0.0583	11.599	6.950	7.640	8.452	8.800	10.194
0.0666	11.646	6.950	7.640	8.455	8.800	10.194
0.0750	11.674	6.950	7.640	8.455	8.800	10.194
0.0833	11.712	6.950	7.640	8.455	8.800	10.197
0.0916	11.750	6.950	7.640	8.455	8.800	10.197
0.1000	11.778	6.950	7.640	8.455	8.800	10.194
0.1083	11.816	6.950	7.640	8.455	8.800	10.194
0.1166	11.854	6.950	7.643	8.452	8.800	10.194
0.1250	11.891	6.950	7.640	8.455	8.800	10.194
0.1333	11.920	6.950	7.640	8.452	8.800	10.194
0.1416	11.957	6.950	7.640	8.455	8.800	10.194
0.1500	11.986	6.950	7.640	8.452	8.800	10.194
0.1583	12.023	6.950	7.643	8.455	8.800	10.194
0.1666	12.061	6.950	7.640	8.455	8.800	10.194
0.1750	12.089	6.950	7.640	8.455	8.800	10.194
0.1833	12.137	6.950	7.643	8.455	8.800	10.194
0.1916	12.203	6.950	7.640	8.455	8.800	10.194
0.2000	12.240	6.950	7.643	8.452	8.800	10.194

0.9000	14.873	6.988	7.643	8.455	8.796	10.194
0.9166	14.920	6.988	7.643	8.455	8.796	10.190
0.9333	14.967	6.988	7.643	8.455	8.796	10.190
0.9500	15.033	6.988	7.643	8.455	8.796	10.190
0.9666	15.090	6.988	7.643	8.455	8.796	10.187
0.9833	15.147	6.994	7.643	8.455	8.800	10.190
1.0000	15.213	6.994	7.643	8.455	8.796	10.190
1.2000	15.939	7.007	7.646	8.459	8.796	10.190
1.4000	16.486	7.013	7.643	8.459	8.800	10.194
1.6000	16.996	7.026	7.649	8.459	8.800	10.194
1.8000	17.487	7.045	7.649	8.462	8.800	10.194
2.0000	17.930	7.057	7.652	8.462	8.800	10.194
2.2000	18.336	7.070	7.652	8.465	8.796	10.194
2.4000	18.685	7.083	7.659	8.468	8.800	10.194
2.6000	18.987	7.096	7.662	8.471	8.800	10.190
2.8000	19.223	7.108	7.662	8.474	8.796	10.190
3.0000	19.487	7.121	7.668	8.474	8.796	10.190
3.2000	19.713	7.134	7.671	8.484	8.800	10.194
3.4000	19.912	7.140	7.678	8.484	8.800	10.194
3.6000	20.081	7.153	7.681	8.487	8.796	10.194
3.8000	20.242	7.159	7.681	8.490	8.800	10.190
4.0000	20.374	7.172	7.687	8.494	8.800	10.194
4.2000	20.516	7.178	7.690	8.497	8.800	10.194
4.4000	20.629	7.184	7.690	8.500	8.796	10.190
4.6000	20.751	7.191	7.693	8.503	8.796	10.190
4.8000	20.865	7.204	7.700	8.506	8.800	10.184
5.0000	20.968	7.210	7.703	8.509	8.796	10.187
5.2000	21.063	7.216	7.706	8.513	8.796	10.184
5.4000	21.148	7.223	7.709	8.519	8.800	10.184
5.6000	21.233	7.229	7.709	8.519	8.800	10.184
5.8000	21.336	7.235	7.716	8.522	8.800	10.184
6.0000	21.412	7.242	7.716	8.525	8.800	10.184
6.2000	21.497	7.248	7.719	8.528	8.796	10.187
6.4000	21.553	7.254	7.722	8.532	8.796	10.190
6.6000	21.619	7.261	7.725	8.535	8.796	10.187
6.8000	21.676	7.261	7.728	8.535	8.800	10.187
7.0000	21.733	7.273	7.728	8.538	8.796	10.187
7.2000	21.780	7.273	7.735	8.544	8.796	10.190
7.4000	21.827	7.280	7.738	8.544	8.796	10.190
7.6000	21.884	7.286	7.738	8.548	8.796	10.190
7.8000	21.931	7.292	7.741	8.551	8.800	10.187
8.0000	21.969	7.292	7.741	8.551	8.796	10.184
8.2000	22.006	7.299	7.744	8.554	8.800	10.187
8.4000	22.044	7.305	7.747	8.560	8.800	10.184
8.6000	22.072	7.305	7.751	8.563	8.796	10.184
8.8000	22.101	7.311	7.754	8.563	8.800	10.187
9.0000	22.129	7.318	7.757	8.570	8.800	10.187
9.2000	22.157	7.318	7.757	8.570	8.800	10.187
9.4000	22.176	7.324	7.760	8.570	8.800	10.187

140.000	22.978	7.673	8.056	8.878	8.796	10.254
160.000	23.299	7.673	8.059	8.878	8.803	10.257
180.000	23.299	7.686	8.068	8.888	8.800	10.260
200.000	23.337	7.686	8.071	8.891	8.796	10.244
220.000	23.365	7.692	8.075	8.891	8.796	10.244
240.000	23.403	7.692	8.075	8.894	8.796	10.241
260.000	23.356	7.692	8.075	8.891	8.796	10.241
280.000	23.422	7.692	8.075	8.894	8.800	10.248
300.000	23.384	7.692	8.078	8.897	8.796	10.251
320.000	23.384	7.699	8.081	8.903	8.800	10.254
340.000	23.393	7.705	8.087	8.903	8.800	10.254
360.000	23.422	7.712	8.090	8.910	8.796	10.254
380.000	23.403	7.712	8.097	8.916	8.803	10.260
400.000	23.478	7.718	8.103	8.922	8.803	10.263
420.000	23.507	7.724	8.106	8.922	8.803	10.267
440.000	23.629	7.724	8.106	8.926	8.803	10.267
460.000	23.554	7.724	8.106	8.926	8.803	10.267
480.000	23.554	7.724	8.110	8.929	8.803	10.267
500.000	23.592	7.737	8.113	8.935	8.800	10.273
520.000	23.629	7.737	8.116	8.938	8.806	10.273
540.000	23.601	7.731	8.113	8.935	8.806	10.273
560.000	23.582	7.737	8.116	8.935	8.806	10.273
580.000	23.610	7.737	8.116	8.938	8.806	10.273
600.000	23.610	7.737	8.122	8.942	8.806	10.273
620.000	23.563	7.737	8.119	8.942	8.806	10.276
640.000	23.582	7.737	8.119	8.938	8.806	10.273
660.000	23.592	7.743	8.119	8.942	8.806	10.273
680.000	23.526	7.737	8.119	8.938	8.806	10.273
700.000	23.582	7.737	8.116	8.938	8.806	10.270
720.000	23.573	7.737	8.116	8.935	8.806	10.270
740.000	23.563	7.737	8.119	8.935	8.806	10.273
760.000	23.610	7.737	8.116	8.935	8.806	10.270
780.000	23.610	7.737	8.116	8.935	8.809	10.270
800.000	23.601	7.731	8.113	8.929	8.806	10.267
820.000	23.601	7.737	8.113	8.932	8.806	10.267
840.000	23.544	7.731	8.113	8.932	8.806	10.270
860.000	23.535	7.737	8.113	8.932	8.806	10.267
880.000	23.488	7.731	8.116	8.935	8.809	10.267
900.000	23.554	7.724	8.110	8.929	8.809	10.267
920.000	23.592	7.731	8.113	8.932	8.809	10.267
940.000	23.582	7.724	8.106	8.926	8.809	10.263
960.000	23.620	7.724	8.106	8.926	8.809	10.260
980.000	23.676	7.724	8.100	8.919	8.806	10.257
1000.00	23.667	7.724	8.103	8.922	8.809	10.257
1050.00	23.658	7.724	8.106	8.926	8.812	10.260
1100.00	23.714	7.724	8.110	8.932	8.812	10.263
1150.00	23.771	7.737	8.113	8.935	8.812	10.263
1200.00	23.799	7.743	8.122	8.942	8.815	10.270
1250.00	23.827	7.750	8.129	8.948	8.818	10.276

SE2000
Environmental Logger
10/27 09:02

Unit# 546 Test 0

Setups: INPUT 7 INPUT 8

Type	Level (F) Function	
Mode	TOC	
I.D.	KBA-1110 BARO	
Reference	7.840	
SG	1.000	
Linearity	0.041	0.044
Scale factor	10.022	7.961
Offset	0.007	8.013
Delay mSEC	50.000	50.000

Step 1 10/25 11:00:01 Drawdown (cont'd)

Elapsed Time	INPUT 7	INPUT 8
0.0000	7.840	14.731
0.0083	7.843	14.731
0.0166	7.843	14.731
0.0250	7.843	14.730
0.0333	7.843	14.730
0.0416	7.840	14.730
0.0500	7.840	14.730
0.0583	7.843	14.730
0.0666	7.843	14.730
0.0750	7.843	14.730
0.0833	7.843	14.730
0.0916	7.843	14.730
0.1000	7.840	14.730
0.1083	7.840	14.730
0.1166	7.843	14.730
0.1250	7.843	14.730
0.1333	7.843	14.730
0.1416	7.843	14.730
0.1500	7.840	14.730
0.1583	7.840	14.730
0.1666	7.843	14.730
0.1750	7.843	14.730
0.1833	7.840	14.730
0.1916	7.843	14.730
0.2000	7.840	14.730

0.9000	7.840	14.730
0.9166	7.843	14.730
0.9333	7.840	14.730
0.9500	7.840	14.730
0.9666	7.840	14.730
0.9833	7.840	14.730
1.0000	7.840	14.730
1.2000	7.843	14.730
1.4000	7.843	14.731
1.6000	7.843	14.731
1.8000	7.843	14.732
2.0000	7.843	14.731
2.2000	7.843	14.731
2.4000	7.843	14.731
2.6000	7.843	14.731
2.8000	7.843	14.730
3.0000	7.843	14.730
3.2000	7.843	14.731
3.4000	7.843	14.731
3.6000	7.846	14.730
3.8000	7.843	14.730
4.0000	7.846	14.730
4.2000	7.843	14.731
4.4000	7.843	14.730
4.6000	7.840	14.730
4.8000	7.836	14.730
5.0000	7.836	14.730
5.2000	7.836	14.730
5.4000	7.836	14.730
5.6000	7.836	14.731
5.8000	7.836	14.730
6.0000	7.836	14.730
6.2000	7.836	14.729
6.4000	7.836	14.729
6.6000	7.836	14.729
6.8000	7.840	14.730
7.0000	7.840	14.730
7.2000	7.840	14.730
7.4000	7.840	14.730
7.6000	7.840	14.730
7.8000	7.840	14.730
8.0000	7.840	14.730
8.2000	7.836	14.730
8.4000	7.836	14.730
8.6000	7.836	14.730
8.8000	7.836	14.730
9.0000	7.836	14.730
9.2000	7.836	14.730
9.4000	7.836	14.730

140.000	7.830	14.711
160.000	7.833	14.702
180.000	7.833	14.698
200.000	7.817	14.694
220.000	7.824	14.691
240.000	7.820	14.686
260.000	7.824	14.686
280.000	7.824	14.685
300.000	7.827	14.683
320.000	7.827	14.681
340.000	7.824	14.685
360.000	7.820	14.684
380.000	7.827	14.689
400.000	7.824	14.690
420.000	7.827	14.691
440.000	7.824	14.690
460.000	7.824	14.690
480.000	7.824	14.688
500.000	7.824	14.691
520.000	7.824	14.696
540.000	7.824	14.694
560.000	7.824	14.695
580.000	7.824	14.695
600.000	7.824	14.696
620.000	7.824	14.696
640.000	7.824	14.694
660.000	7.824	14.695
680.000	7.820	14.692
700.000	7.817	14.688
720.000	7.817	14.688
740.000	7.817	14.687
760.000	7.817	14.684
780.000	7.814	14.680
800.000	7.814	14.676
820.000	7.814	14.676
840.000	7.814	14.678
860.000	7.814	14.674
880.000	7.814	14.676
900.000	7.811	14.673
920.000	7.814	14.673
940.000	7.811	14.666
960.000	7.808	14.663
980.000	7.808	14.657
1000.00	7.811	14.656
1050.00	7.811	14.659
1100.00	7.811	14.661
1150.00	7.811	14.666
1200.00	7.814	14.676
1250.00	7.820	14.687

SE2000
Environmental Logger
10/27 09:08

Unit# 546 Test 0

Setups:	INPUT 1	INPUT 2	INPUT 3	INPUT 4	INPUT 5	INPUT 6
Type	Level (F)	Level (F)	Level (F)	Level (F)	Level (F)	Level (F)
Mode	TOC	TOC	TOC	TOC	TOC	TOC
I.D.	RW−1	PS−1	PS−2	PS−3	KBA−11−2	PS−4
Reference	11.420	6.950	7.640	8.440	8.800	10.210
SG	1.000	1.000	1.000	1.000	1.000	1.000
Linearity	0.000	0.117	0.042	0.042	0.046	0.043
Scale factor	29.925	19.999	10.025	10.031	9.988	10.008
Offset	−0.115	−0.004	−0.005	0.010	0.023	0.004
Delay mSEC	50.000	50.000	50.000	50.000	50.000	50.000

Step 2 10/26 12:01:00 Recovery Phase

Elapsed Time	INPUT 1	INPUT 2	INPUT 3	INPUT 4	INPUT 5	INPUT
0.0000	23.865	7.743	8.125	8.951	8.831	10.286
0.0083	23.856	7.750	8.125	8.951	8.834	10.289
0.0166	23.875	7.743	8.125	8.948	8.834	10.286
0.0250	23.724	7.743	8.125	8.948	8.831	10.289
0.0333	23.667	7.743	8.125	8.948	8.831	10.286
0.0416	23.705	7.743	8.125	8.951	8.834	10.289
0.0500	23.724	7.743	8.125	8.951	8.831	10.289
0.0583	23.724	7.743	8.125	8.951	8.834	10.286
0.0666	23.705	7.743	8.125	8.951	8.834	10.286
0.0750	23.667	7.743	8.125	8.951	8.831	10.289
0.0833	23.639	7.743	8.125	8.951	8.834	10.289
0.0916	23.601	7.743	8.125	8.948	8.834	10.289
0.1000	23.573	7.743	8.125	8.948	8.831	10.289
0.1083	23.544	7.743	8.125	8.951	8.834	10.289
0.1166	23.516	7.743	8.125	8.951	8.834	10.289
0.1250	23.488	7.743	8.125	8.948	8.834	10.289
0.1333	23.459	7.743	8.125	8.951	8.831	10.289
0.1416	23.431	7.743	8.125	8.951	8.834	10.289
0.1500	23.403	7.743	8.125	8.948	8.831	10.289
0.1583	23.375	7.743	8.125	8.951	8.834	10.289
0.1666	23.346	7.743	8.125	8.951	8.834	10.289
0.1750	23.318	7.743	8.125	8.951	8.831	10.289
0.1833	23.290	7.743	8.125	8.951	8.834	10.289
0.1916	23.261	7.743	8.125	8.948	8.831	10.289
0.2000	23.233	7.743	8.122	8.948	8.831	10.289

0.9000	21.119	7.718	8.122	8.948	8.831	10.289
0.9166	21.072	7.718	8.122	8.948	8.834	10.289
0.9333	21.034	7.724	8.122	8.948	8.834	10.289
0.9500	20.987	7.718	8.122	8.948	8.834	10.289
0.9666	20.940	7.718	8.122	8.948	8.834	10.292
0.9833	20.893	7.718	8.122	8.945	8.834	10.292
1.0000	20.855	7.718	8.122	8.948	8.831	10.292
1.2000	20.346	7.705	8.119	8.948	8.831	10.295
1.4000	19.874	7.699	8.119	8.945	8.831	10.298
1.6000	19.421	7.686	8.119	8.948	8.834	10.301
1.8000	18.996	7.680	8.119	8.945	8.834	10.301
2.0000	18.591	7.673	8.116	8.945	8.834	10.301
2.2000	18.223	7.654	8.113	8.942	8.834	10.301
2.4000	17.864	7.642	8.110	8.942	8.834	10.305
2.6000	17.534	7.635	8.106	8.938	8.834	10.305
2.8000	17.213	7.623	8.103	8.935	8.834	10.308
3.0000	16.921	7.610	8.103	8.935	8.834	10.314
3.2000	16.637	7.604	8.100	8.932	8.834	10.317
3.4000	16.383	7.597	8.094	8.932	8.837	10.327
3.6000	16.137	7.585	8.094	8.932	8.837	10.333
3.8000	15.892	7.578	8.090	8.929	8.834	10.333
4.0000	15.675	7.565	8.087	8.926	8.834	10.330
4.2000	15.467	7.559	8.084	8.919	8.834	10.317
4.4000	15.269	7.546	8.081	8.916	8.831	10.308
4.6000	15.071	7.540	8.075	8.913	8.831	10.298
4.8000	14.882	7.534	8.071	8.907	8.831	10.289
5.0000	14.722	7.521	8.068	8.903	8.831	10.282
5.2000	14.571	7.515	8.068	8.897	8.831	10.276
5.4000	14.420	7.508	8.062	8.894	8.831	10.273
5.6000	14.288	7.502	8.059	8.891	8.831	10.270
5.8000	14.156	7.496	8.056	8.888	8.831	10.267
6.0000	14.033	7.483	8.052	8.884	8.831	10.267
6.2000	13.920	7.477	8.049	8.878	8.834	10.267
6.4000	13.807	7.470	8.049	8.875	8.834	10.267
6.6000	13.703	7.470	8.049	8.875	8.834	10.267
6.8000	13.609	7.464	8.043	8.872	8.837	10.270
7.0000	13.514	7.458	8.040	8.868	8.834	10.273
7.2000	13.429	7.451	8.040	8.868	8.834	10.276
7.4000	13.354	7.445	8.036	8.865	8.834	10.279
7.6000	13.269	7.438	8.033	8.862	8.834	10.276
7.8000	13.193	7.432	8.030	8.859	8.837	10.276
8.0000	13.127	7.426	8.030	8.859	8.837	10.276
8.2000	13.061	7.426	8.027	8.856	8.837	10.282
8.4000	13.005	7.419	8.024	8.849	8.834	10.282
8.6000	12.948	7.413	8.021	8.846	8.837	10.282
8.8000	12.891	7.413	8.017	8.849	8.834	10.286
9.0000	12.844	7.407	8.017	8.843	8.837	10.286
9.2000	12.788	7.400	8.011	8.840	8.834	10.282
9.4000	12.741	7.400	8.011	8.834	8.834	10.282

140.000	11.476	7.007	7.693	8.494	8.828	10.175
160.000	11.467	6.994	7.681	8.484	8.831	10.175
180.000	11.448	6.988	7.671	8.471	8.828	10.175
200.000	11.448	6.981	7.668	8.468	8.831	10.165
220.000	11.438	6.969	7.662	8.459	8.828	10.162
240.000	11.438	6.969	7.659	8.459	13.954	10.165
260.000	11.429	6.962	7.652	8.452	13.957	10.162
280.000	11.429	6.962	7.652	8.452	13.960	10.175
300.000	7.827	14.683				
320.000	7.827	14.681				
340.000	7.824	14.685				
360.000	7.820	14.684				
380.000	7.827	14.689				
400.000	7.824	14.690				
420.000	7.827	14.691				
440.000	7.824	14.690				
460.000	7.824	14.690				
480.000	7.824	14.688				
500.000	7.824	14.691				
520.000	7.824	14.696				
540.000	7.824	14.694				
560.000	7.824	14.695				
580.000	7.824	14.695				
600.000	7.824	14.696				
620.000	7.824	14.696				
640.000	7.824	14.694				
660.000	7.824	14.695				
680.000	7.820	14.692				
700.000	7.817	14.688				
720.000	7.817	14.688				
740.000	7.817	14.687				
760.000	7.817	14.684				
780.000	7.814	14.680				
800.000	7.814	14.676				
820.000	7.814	14.676				
840.000	7.814	14.678				
860.000	7.814	14.674				
880.000	7.814	14.676				
900.000	7.811	14.673				
920.000	7.814	14.673				
940.000	7.811	14.666				
960.000	7.808	14.663				
980.000	7.808	14.657				
1000.00	7.811	14.656				
1050.00	7.811	14.659				
1100.00	7.811	14.661				
1150.00	7.811	14.666				
1200.00	7.814	14.676				
1250.00	7.820	14.687				

SE2000
Environmental Logger
10/27 09:15

Unit# 546 Test 0

Setups: INPUT 7 INPUT 8

Type	Level (F) Function	
Mode	TOC	
I.D.	KBA-1110 BARO	
Reference	7.840	
SG	1.000	
Linearity	0.041	0.044
Scale factor	10.022	7.961
Offset	0.007	8.013
Delay mSEC	50.000	50.000

Step 2 10/26 12:01:00 Recovery Phase (cont'd)

Elapsed Time	INPUT 7	INPUT 8
0.0000	7.827	14.712
0.0083	7.827	14.713
0.0166	7.827	14.712
0.0250	7.827	14.712
0.0333	7.830	14.712
0.0416	7.827	14.712
0.0500	7.827	14.712
0.0583	7.827	14.712
0.0666	7.830	14.712
0.0750	7.827	14.712
0.0833	7.827	14.712
0.0916	7.827	14.712
0.1000	7.830	14.712
0.1083	7.827	14.712
0.1166	7.830	14.712
0.1250	7.827	14.712
0.1333	7.827	14.712
0.1416	7.827	14.712
0.1500	7.827	14.712
0.1583	7.830	14.712
0.1666	7.827	14.712
0.1750	7.830	14.712
0.1833	7.827	14.712
0.1916	7.827	14.712
0.2000	7.827	14.712

0.9000	7.830	14.712
0.9166	7.830	14.712
0.9333	7.830	14.712
0.9500	7.830	14.712
0.9666	7.830	14.712
0.9833	7.830	14.712
1.0000	7.830	14.711
1.2000	7.833	14.712
1.4000	7.836	14.712
1.6000	7.836	14.711
1.8000	7.840	14.711
2.0000	7.840	14.711
2.2000	7.840	14.711
2.4000	7.840	14.711
2.6000	7.840	14.710
2.8000	7.840	14.710
3.0000	7.843	14.711
3.2000	7.849	14.710
3.4000	7.855	14.711
3.6000	7.862	14.711
3.8000	7.862	14.710
4.0000	7.859	14.710
4.2000	7.852	14.710
4.4000	7.846	14.710
4.6000	7.836	14.710
4.8000	7.830	14.710
5.0000	7.824	14.710
5.2000	7.820	14.710
5.4000	7.814	14.710
5.6000	7.814	14.710
5.8000	7.811	14.710
6.0000	7.811	14.710
6.2000	7.811	14.710
6.4000	7.811	14.710
6.6000	7.811	14.710
6.8000	7.814	14.710
7.0000	7.817	14.710
7.2000	7.820	14.710
7.4000	7.820	14.710
7.6000	7.820	14.710
7.8000	7.820	14.710
8.0000	7.820	14.710
8.2000	7.824	14.710
8.4000	7.827	14.710
8.6000	7.827	14.710
8.8000	7.824	14.710
9.0000	7.824	14.710
9.2000	7.824	14.711
9.4000	7.824	14.711

140.000	7.811	14.689
160.000	7.814	14.689
180.000	7.817	14.684
200.000	7.817	14.687
220.000	7.817	14.686
240.000	7.817	14.686
260.000	7.824	14.689
280.000	7.830	14.691
300.000	7.827	14.683
320.000	7.827	14.681
340.000	7.824	14.685
360.000	7.820	14.684
380.000	7.827	14.689
400.000	7.824	14.690
420.000	7.827	14.691
440.000	7.824	14.690
460.000	7.824	14.690
480.000	7.824	14.688
500.000	7.824	14.691
520.000	7.824	14.696
540.000	7.824	14.694
560.000	7.824	14.695
580.000	7.824	14.695
600.000	7.824	14.696
620.000	7.824	14.696
640.000	7.824	14.694
660.000	7.824	14.695
680.000	7.820	14.692
700.000	7.817	14.688
720.000	7.817	14.688
740.000	7.817	14.687
760.000	7.817	14.684
780.000	7.814	14.680
800.000	7.814	14.676
820.000	7.814	14.676
840.000	7.814	14.678
860.000	7.814	14.674
880.000	7.814	14.676
900.000	7.811	14.673
920.000	7.814	14.673
940.000	7.811	14.666
960.000	7.808	14.663
980.000	7.808	14.657
1000.00	7.811	14.656
1050.00	7.811	14.659
1100.00	7.811	14.661
1150.00	7.811	14.666
1200.00	7.814	14.676
1250.00	7.820	14.687

ATTACHMENT 3

Analytical Results of Chemical Analyses of RW-1 Effluent

CLIENT SAMPLE ID

GWRW1

REPORT OF ANALYTICAL RESULTS
PURGEABLE HALOCARBONS/AROMATICS

Date collected:	10/26/93	Sample Group:	GN-90187
Date extracted:	N/A	Lab Sample ID:	GN-90187001D1
Date analyzed:	10/28/93	Lab file 1 ID:	K28M010
Matrix:	WATER	Lab file 2 ID:	K28N010
Method:	8010/8020M	Dilution Factor:	10.0000
% Moisture:	100	Reporting units:	ug/L

CAS NUMBER	COMPOUND NAME	REPORTING LIMIT	RESULT
71-43-2	Benzene	10	U
75-27-4	Bromodichloromethane	10	U
75-25-2	Bromoform	10	U
74-83-9	Bromomethane	10	U
56-23-5	Carbon tetrachloride	10	U
108-90-7	Chlorobenzene	10	U
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	10	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	10	U
95-50-1	1,2-Dichlorobenzene	10	U
541-73-1	1,3-Dichlorobenzene	10	U
106-46-7	1,4-Dichlorobenzene	10	U
74-71-8	Dichlorodifluoromethane	10	U
75-34-3	1,1-Dichloroethane	10	14
107-06-2	1,2-Dichloroethane	10	U
75-35-4	1,1-Dichloroethene	10	U
156-59-4	cis-1,2-Dichloroethene	10	220
156-60-5	trans-1,2-Dichloroethene	10	U
78-87-5	1,2-Dichloropropane	10	U
10061-01-5	cis-1,3-Dichloropropene	10	U
10061-02-6	trans-1,3-Dichloropropene	10	U
100-41-4	Ethyl Benzene	10	U
1634-04-4	Methyl tert butyl ether	10	U
75-09-2	Methylene chloride (Dichloromethane)	50	U
79-34-5	1,1,2,2-Tetrachloroethane	10	U
127-18-4	Tetrachloroethene	10	U
108-88-3	Toluene	10	170
71-55-6	1,1,1-Trichloroethane	10	U
79-00-5	1,1,2-Trichloroethane	10	U
79-01-6	Trichloroethene	10	U
75-69-4	Trichlorofluoromethane	10	U
75-01-4	Vinyl chloride	10	41
108-38-3/106-42-3	m- and p-Xylene	20	U
95-47-6/100-42-5	o-Xylene/Styrene	10	U
	SURROGATE-Fluorobenzene (QC Limits - 61 to 133%)		107 % Rec.

FORM I GC

Table 4 Wastewater Characterization
Site 11, NSB Kings Bay, Georgia

Analyte	Sample 10-26-93 (μg/ℓ)	Duplicate Sample 10-26-93 (μg/ℓ)
Aluminum		
Antimony		
Arsenic		
Barium		
Beryllium		
Cadmium	<5	<5
Calcium		
Chromium	<10	<10
Cobalt		
Copper		
Iron	1,610	1,620
Lead	<3	<3
Magnesium		
Manganese	31	31
Mercury		
Nickel		
Potassium		
Selenium		
Silver		
Sodium		
Thallium		
Vanadium		
Zinc		

ATTACHMENT 4

Table 1, Measured Drawdown During GWE 25-Hour Test
Table 2, Aquifer Properties

Table 1 Initial Aquifer Pumping Tests
Measured Drawdown During GWE 25-Hour Pumping Test
NSB Kings Bay

Well Number	*Distance from RW-01	*Orientation From RW-01	Total Depth (BGS)	Screened Interval (BGS)	Drawdown
KBA-PS-1	13'	N-NW	38.0'	30.0' - 35.0'	0.80'
KBA-PS-2	62'	W	38.0'	30.0' - 35.0'	0.51'
KBA-PS-3	65'	N	39.4'	31.4' - 36.4'	0.49'
KBA-PS-4	400'	NE	38.2'	30.1' - 35.1'	0.10'
KBA-11-1	436'	S-SE	14.5'	2.5' - 12.5'	0.00'
KBA-11-2	66'	N	15.0'	3.0' - 13.0'	0.03'
KBA-11-6	1,230'	NE	15.0'	3.0' - 13.0'	0.00'

* Are approximations, exact location not yet surveyed.

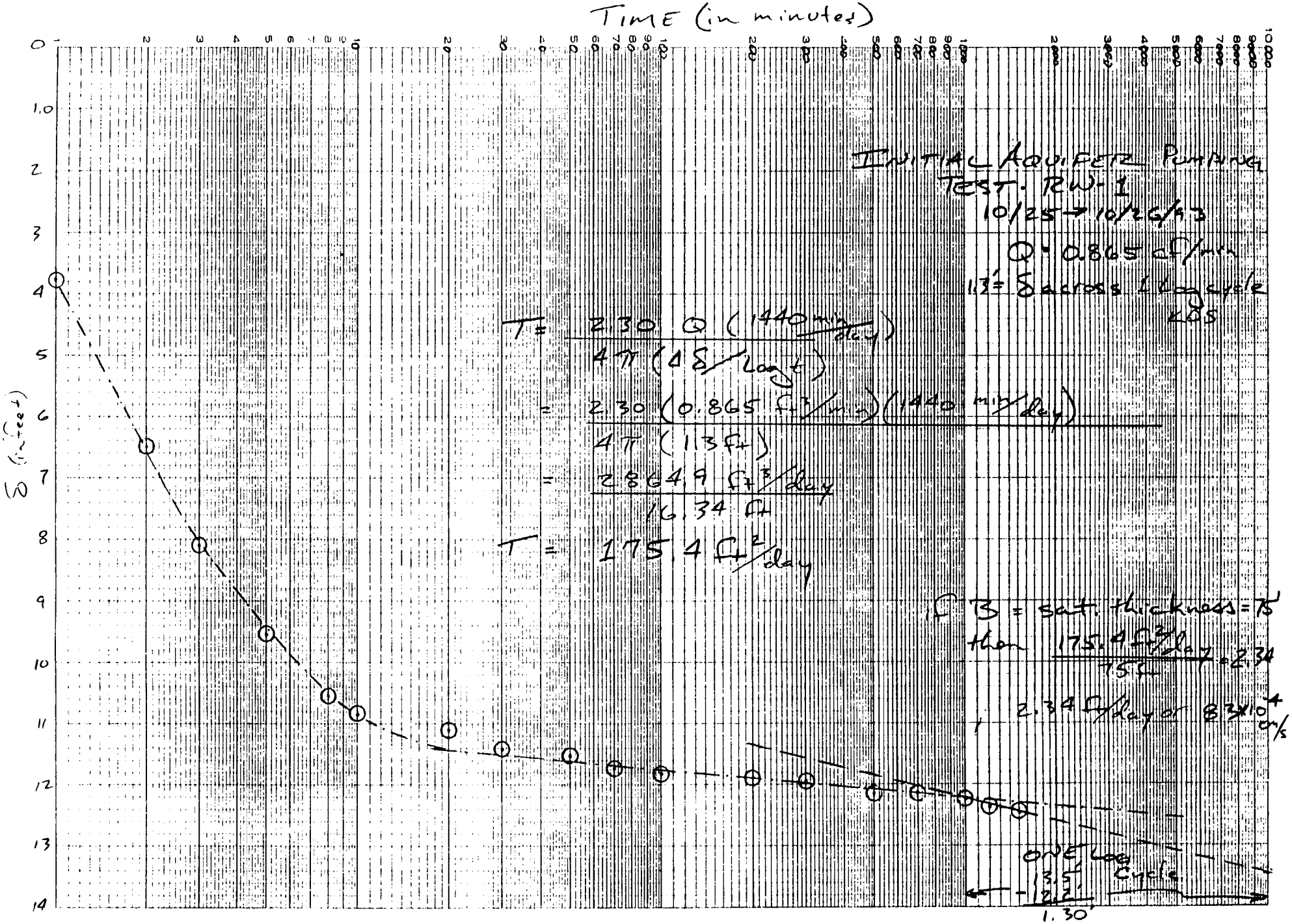
BGS = below ground surface

ATTACHMENT 5

Graphical Analyses of Hydraulic Data

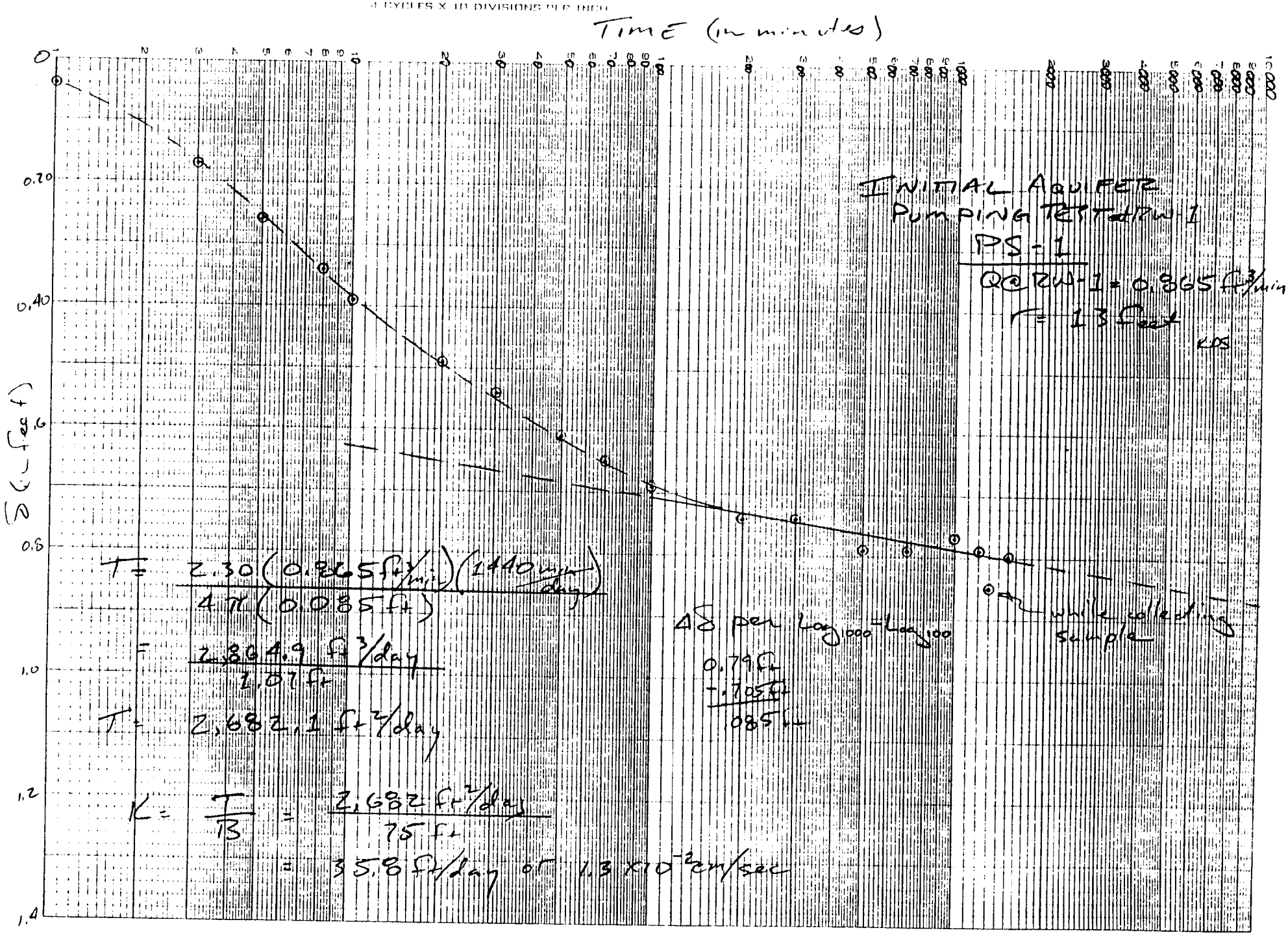
NO. 340R-L410 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



NO. 340R-L410 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



$$T = \frac{2.30\,(0.865\ ft^3/min)(1440\ min/day)}{4\pi\,(0.085\ ft)}$$

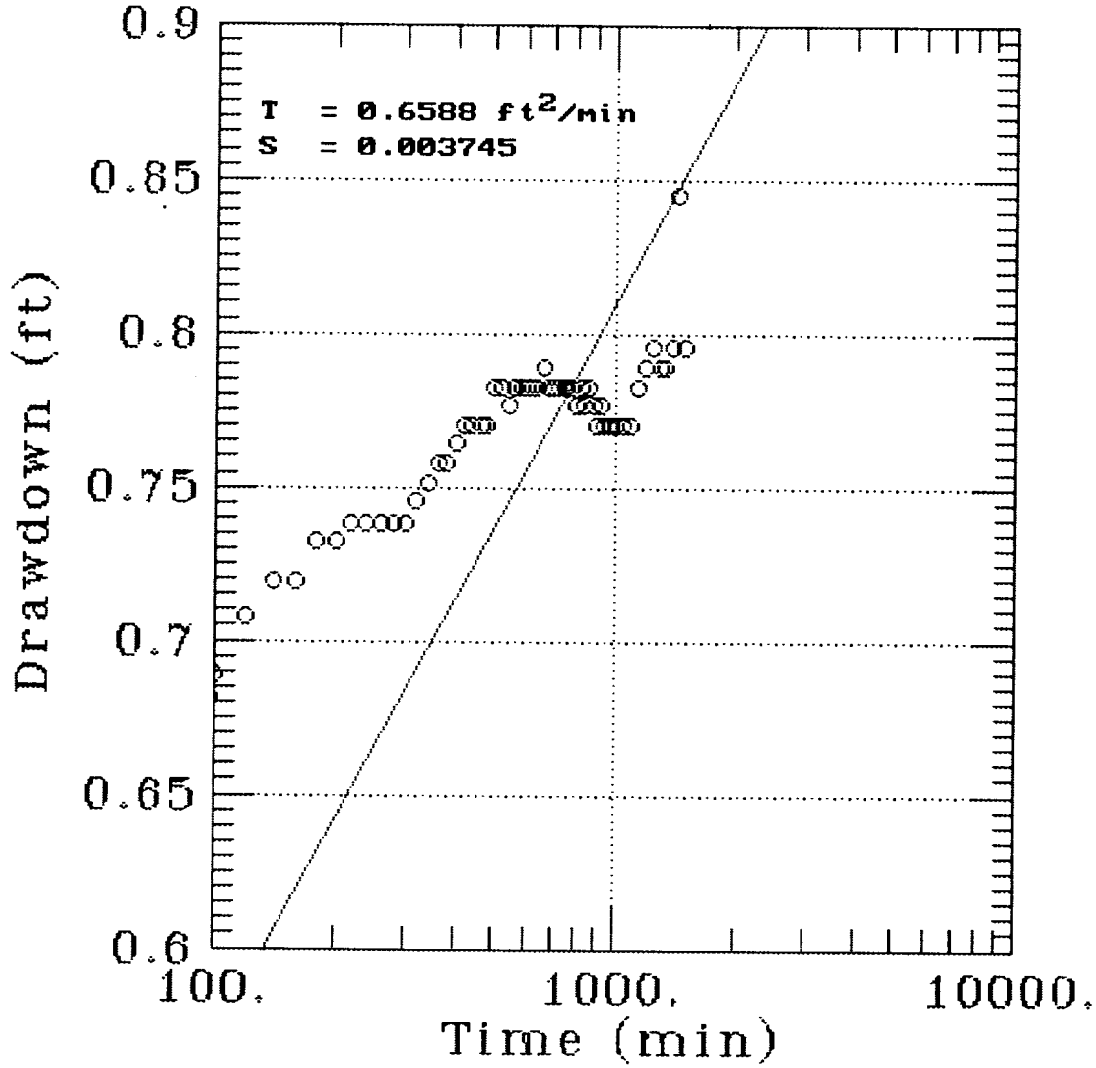
$$= \frac{2,804.9\ ft^3/day}{1.07\ ft}$$

$$T = 2,682.1\ ft^2/day$$

$$K = \frac{T}{B} = \frac{2,682\ ft^2/day}{75\ ft}$$

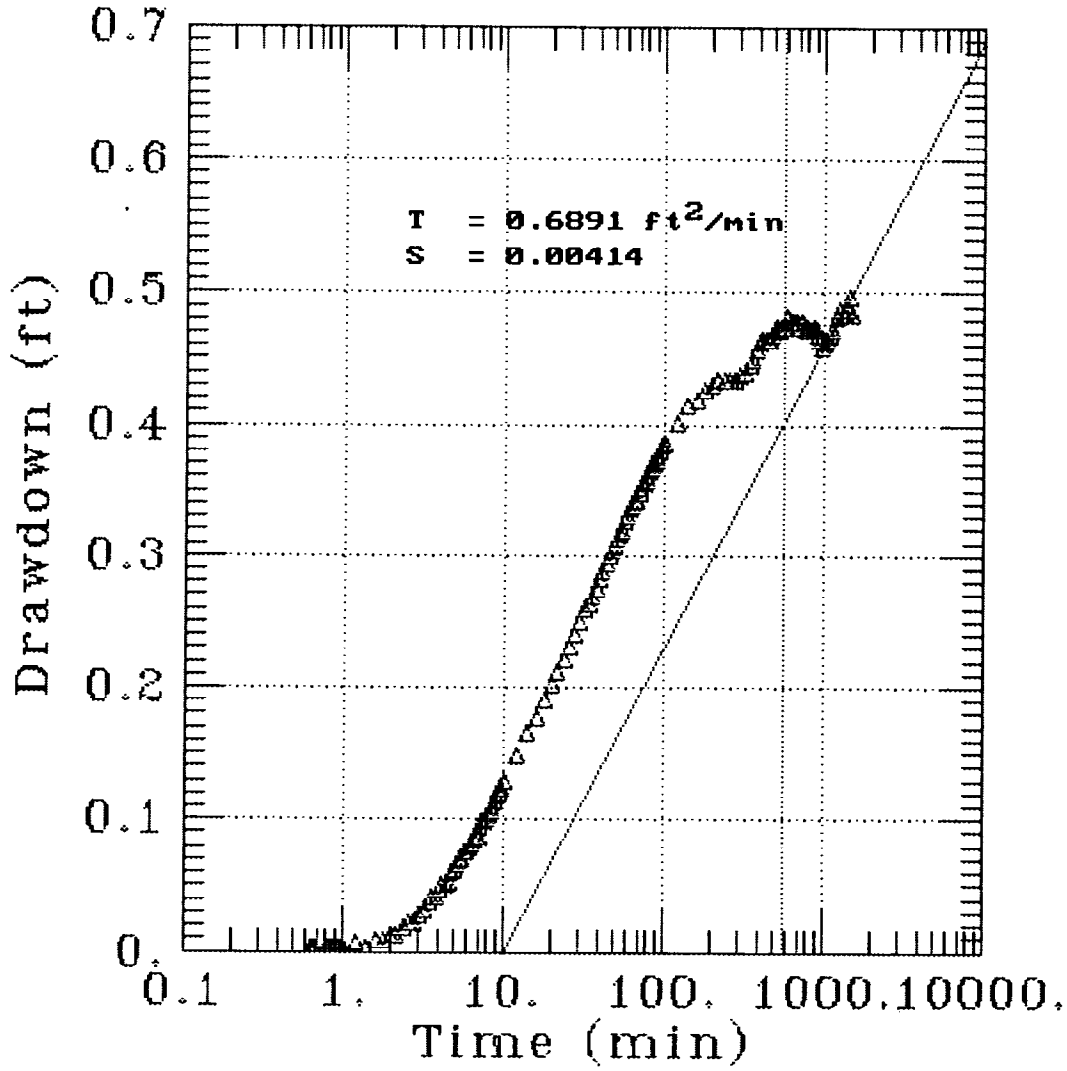
$$= 35.8\ ft/day \text{ or } 1.3 \times 10^{-2}\ cm/sec$$

NSB KingsBay IM:Initial Pumping Test/PS1

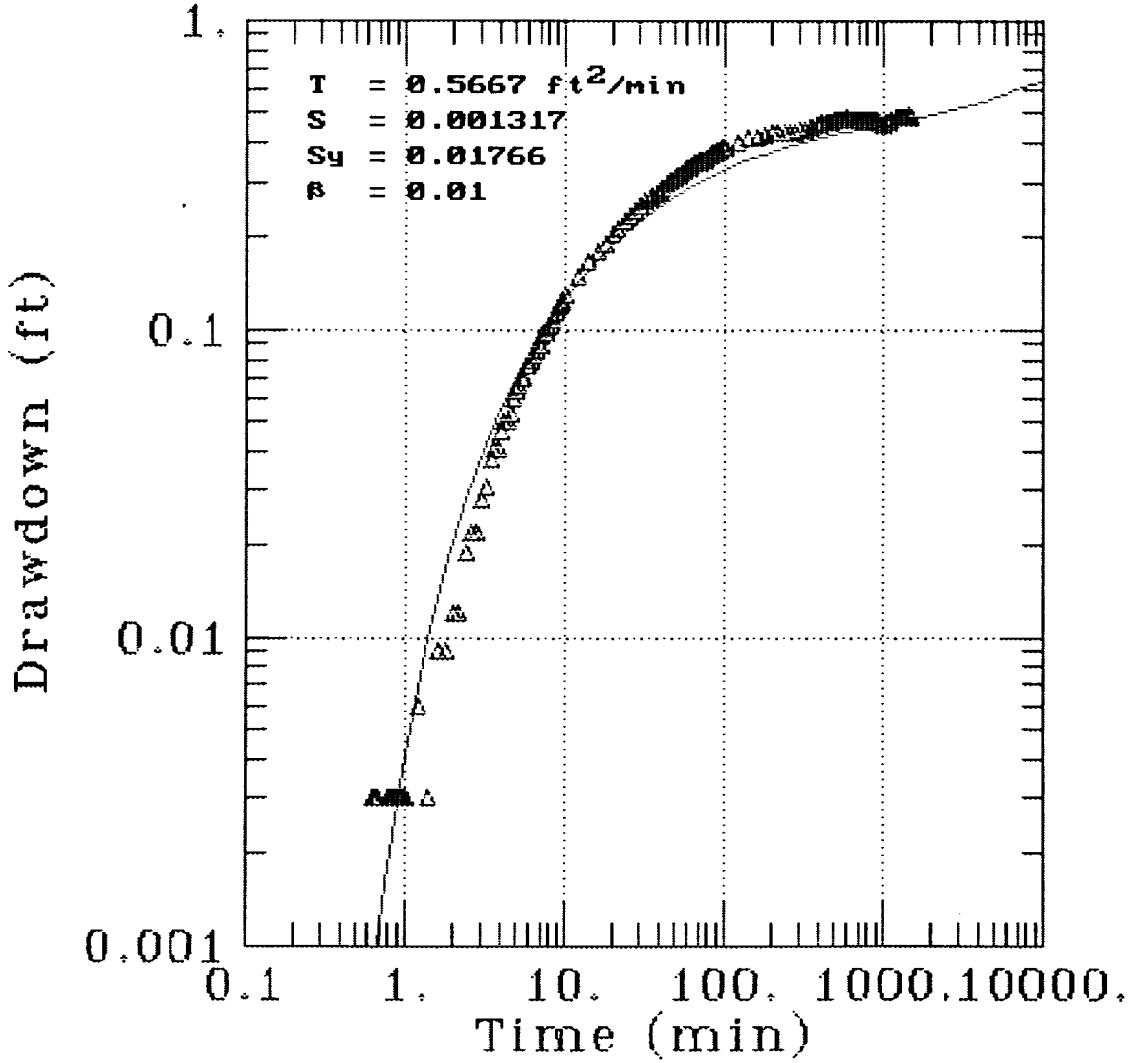


*rB

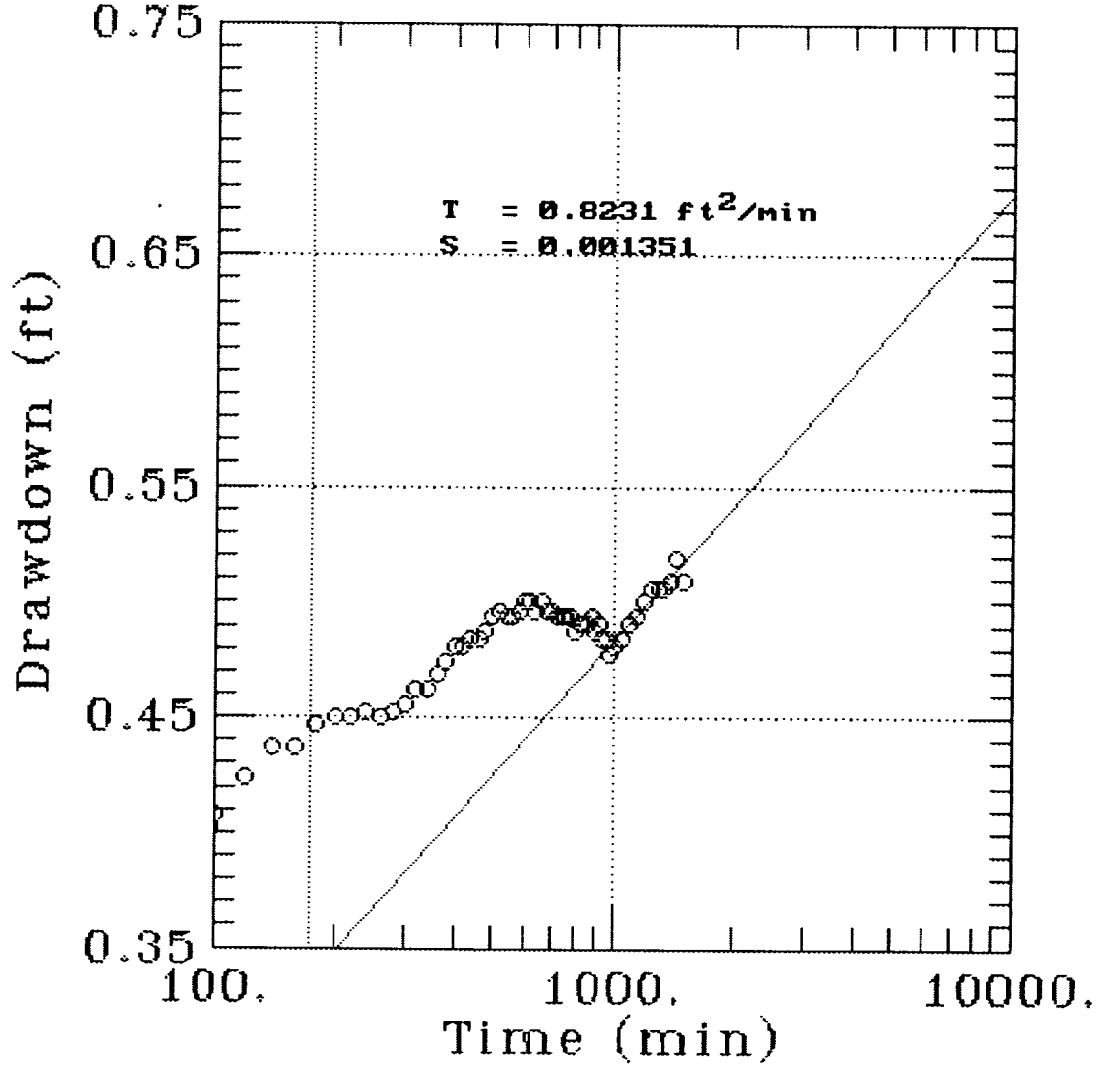
NSB KingsBay IM:Initial Pumping Test/PS2



NSB KingsBay IM:Initial Pumping Test/PS2

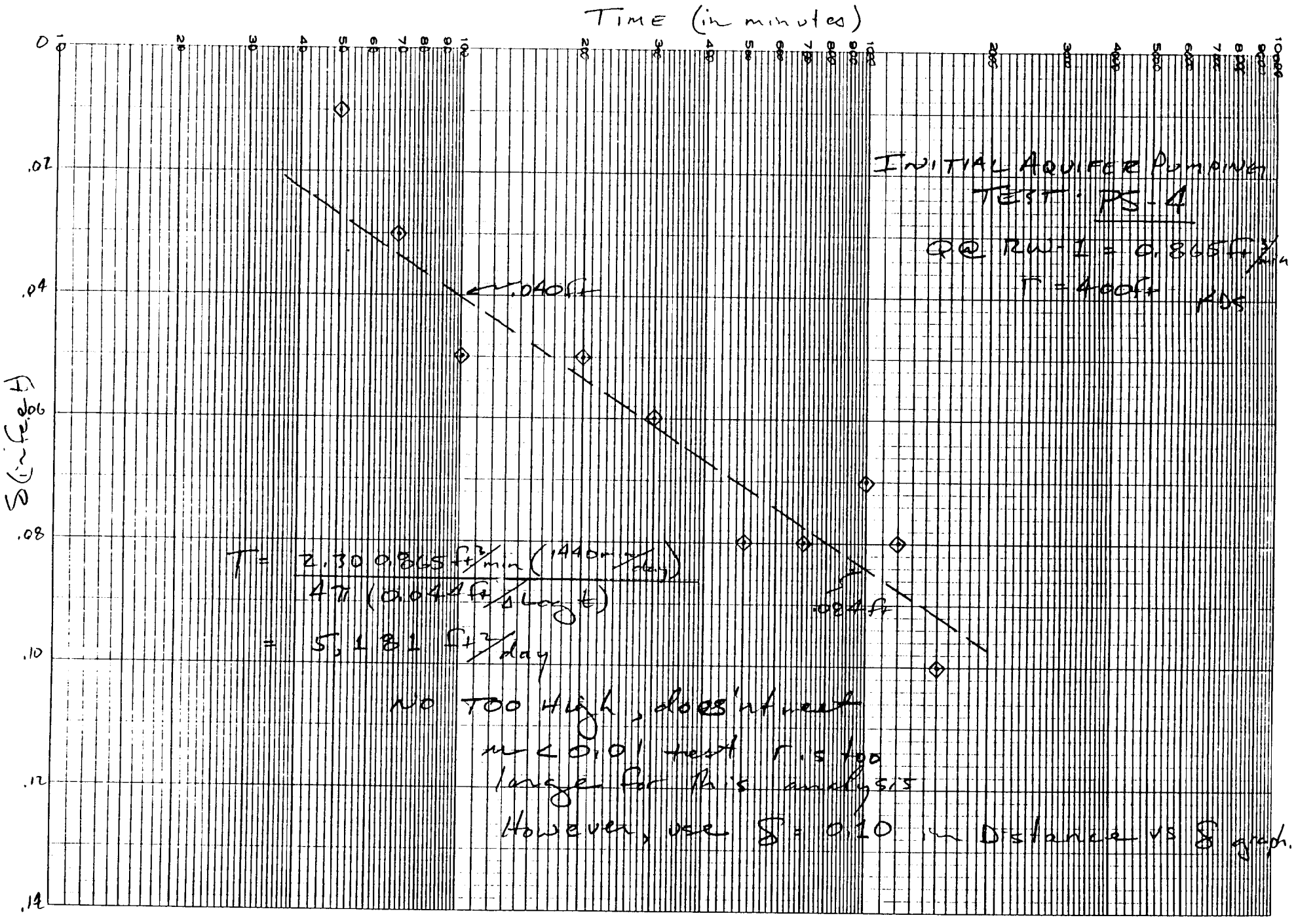


NSB KingsBay IM:Initial Pumping Test/PS3



NO. 341-L310 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
3 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



INITIAL AQUIFER PUMPING TEST: PS-4

Q @ RW-1 = 0.865 ft³/min

r = 400 ft ADS

$$T = \frac{2.30\ 0.865\ ft^3/min\ (1440\ min/day)}{4\pi\ (0.044\ ft/\Delta \log t)}$$

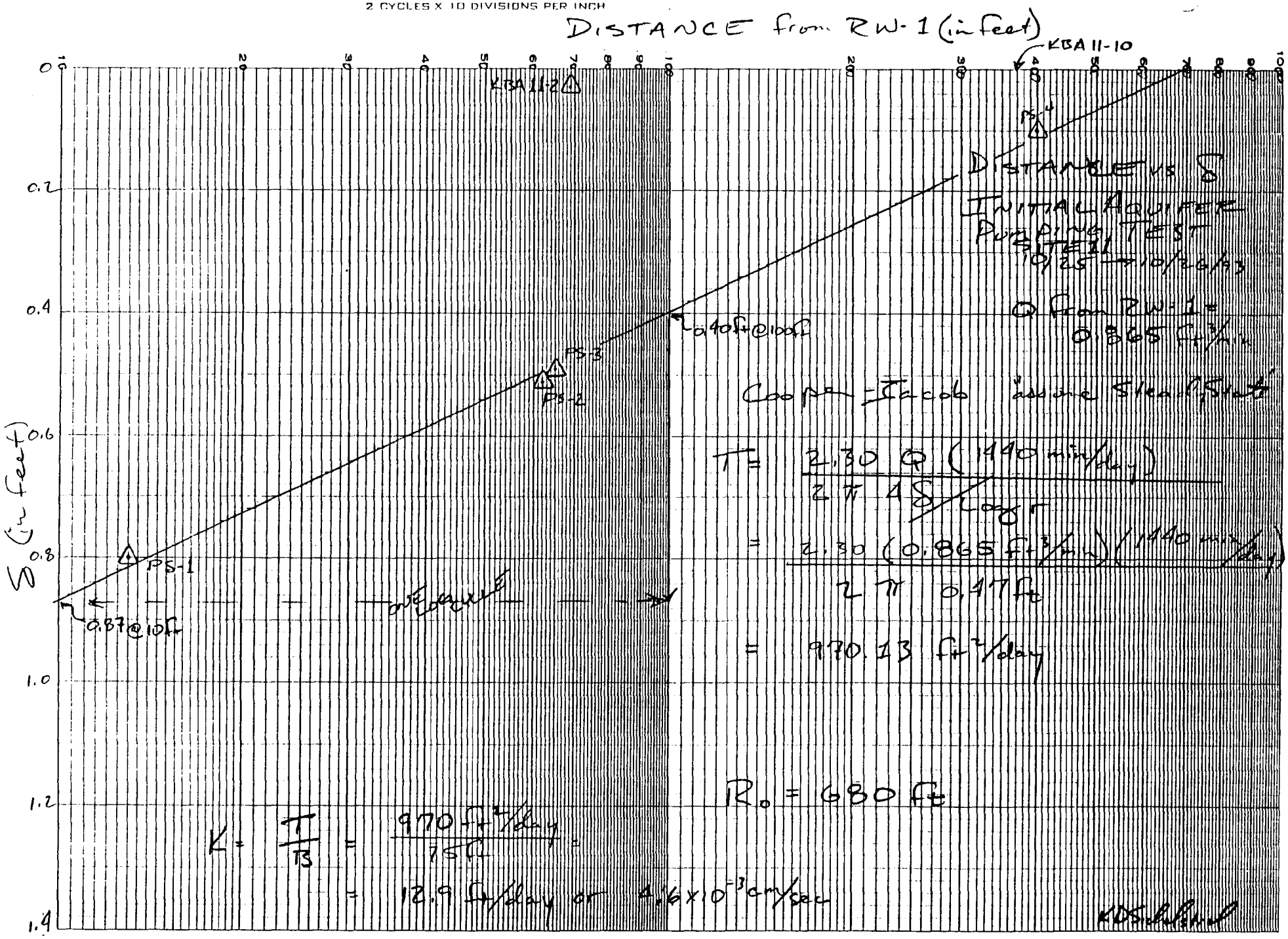
$$= 5{,}181\ ft^2/day$$

NO TOO High, doesn't meet $u < 0.01$ test r is too large for this analysis

However, use $\delta = 0.10$ in Distance vs δ graph.

NO. 341-L210 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



DISTANCE vs S
INITIAL AQUIFER
PUMPING TEST
SITE 11
10/25 → 10/26/83

Q from RW-1 =
0.865 ft³/min

Cooper-Jacob "assume steady state"

$$T = \frac{2.30\,Q\,(1440\ \text{min/day})}{2\pi\,\Delta S/\log_{10}} = \frac{2.30\,(0.865\ \text{ft}^3/\text{min})(1440\ \text{min/day})}{2\pi\ 0.17\ \text{ft}} = 970.13\ \text{ft}^2/\text{day}$$

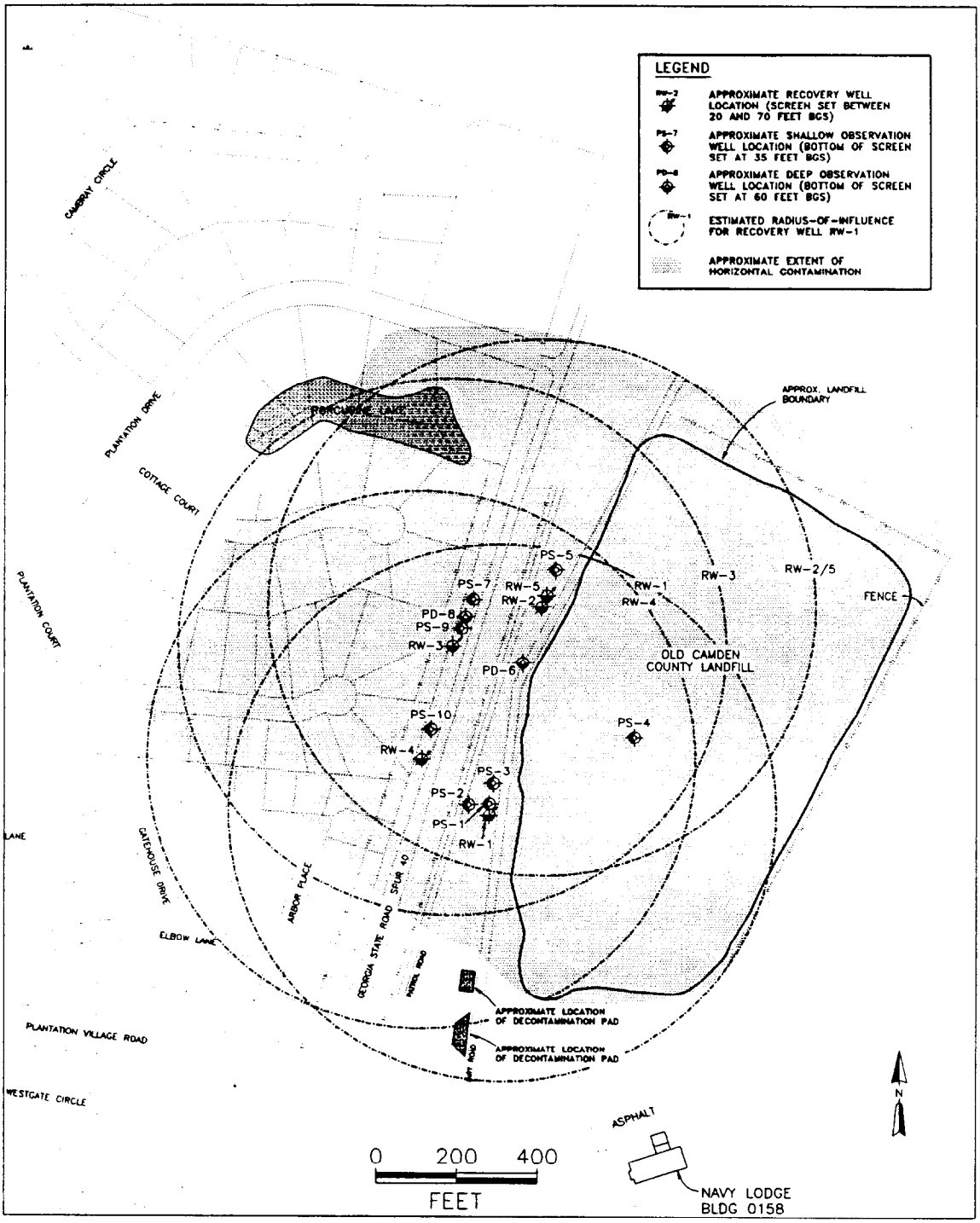
$R_o = 680$ ft

$$K = \frac{T}{TS} = \frac{970\ \text{ft}^2/\text{day}}{75\ \text{ft}} = 12.9\ \text{ft/day or } 4.6\times10^{-3}\ \text{cm/sec}$$

KDS

ATTACHMENT 6

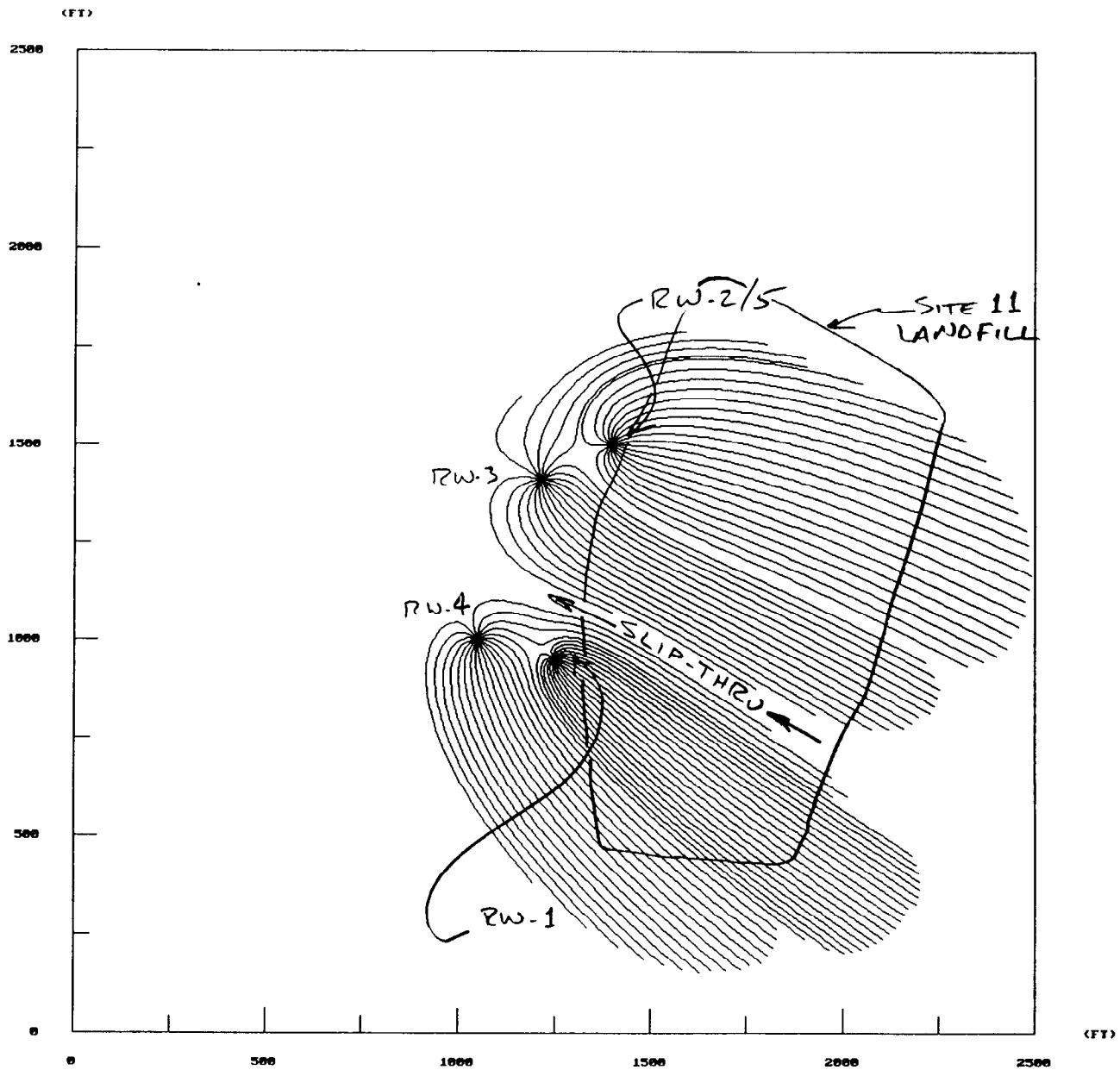
Figure 1-3, Projected Radius-of-Influence Estimates



DWN: NLW	PROJECT NO.: 08503	TITLE: PROJECTED ESTIMATE OF RADIUS-OF-INFLUENCE SURROUNDING RECOVERY WELLS	IM TECHNICAL BULLETIN
CHKD: KDS	FIGURE NO.: 1-3		NAVAL SUBMARINE BASE KINGS BAY, GEORGIA
DATE: 12/02/93			

ATTACHMENT 7

Capture Zone Plots - Semi-Analytical Model Output (U.S. EPA's Wellhead Protection Area (WHPA) Model, RESSQC Module)



5 wells 4 locations as originally planned in IMWP

$T = 1000\ ft^2/day$

$S_y = 0.20$

$i = 0.003\ ft/ft$ @ 150°

RW-1 7 gpm (1348 ft^3/day)

RW-2/5 12.5 gpm (2407 ft^3/day)

RW-3 9.0 gpm (1733 ft^3/day)

RW-4 9.0 gpm (1733 ft^3/day)

Pumping for 10 yrs