ANALYSIS OF A SAND-AND-GRAVEL AQUIFER PUMP TEST WRIGHT LANDFILL, OKALOOSA COUNTY, FLORIDA

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INTRODUCTION

To assist remediation activities addressing ground water contamination, Okaloosa County conducted a pump test at Wright Landfill on July 9-12, 1990. The 72-hour test was carried out in the northwest corner of the property (Section 22, Township 1S, Range 24W) and consisted of a pumping well and three observation wells. Analysis of the test data determined the hydraulic properties in that portion of the Sand-and-Gravel Aquifer.

This report provides a format to bring together information relevant to the aquifer test. Analysis of the test data by NWFWMD allows for an independent assessment of the hydraulic properties of the Sand-and-Gravel Aquifer underlying the site. Combined with results from similar tests implemented at other sites, these properties provide a basis for decisions related to the availability and management of the ground water resource of the Sand-and-Gravel Aquifer in the area.

HYDROGEOLOGY

The Sand-and-Gravel Aquifer is composed of fine to coarse grained sands with varying percentages of clay. The aquifer thickens across the panhandle from east to west with thicknesses of 100 to 150 ft in the vicinity of the landfill. The sands overlie a sequence of predominately fine-grained sediments representing the Intermediate System. Underlying the Intermediate System is the Floridan Aquifer. The confining nature of the Intermediate System serves to restrict the exchange of water between the Sand-and-Gravel Aquifer and the Floridan Aquifer.

Rainfall is the sole source of recharge to the Sand-and-Gravel Aquifer. Due to the complex arrangement of the sands and the varying percentages of clay, the quantity of recharge to and rate of horizontal and vertical movement through the aquifer can be highly variable. Water that does recharge the system eventually discharges to surface water bodies such as streams, wetlands, or bays.

Okaloosa County prepared a detailed lithologic log of the site based on split spoon samples taken from a test bore every 5 ft from 0 to 92 ft below land surface (bls). From 92 to 115 ft, no change in lithology was noted. Below is a simplified version of the lithologic log prepared by Okaloosa County. There was no dramatic change in the composition of the samples from 0 to 86 ft. Below 86 ft, the change in lithology was interpreted by the county to be the top of the Pensacola Clay, signifying the transition from the Sand-and-Gravel Aquifer to the Intermediate System.

LITHOLOGIC DESCRIPTION

0-67 ft	Quartz sand, fine-very coarse grained, predominately medium grained, very slightly-slightly silty, moderately-well sorted, subrounded-well rounded grains, yellowish tan-yellowish brown top 12 ft changing to brown below, small blebs orange clay 25-27 ft, 2 inch seam of iron cementation in sample of 45-47 ft.
67-77 ft	Quartz sand, very fine-coarse grained, predominately very fine-fine grained, slightly silty and clayey, poorly-moderately sorted, subangular-well rounded grains.
77-86 ft	Quartz sand, fine-very coarse grained, predominately medium grained, slightly silty and clayey, moderately-well sorted, subrounded-rounded grains.
86-115 ft	Quartz sand, fine-granule size grains, predominately medium grained, poorly-moderately sorted, subrounded-well rounded grains, shell fragments, green, silty, slightly clayey, becomes more consolidated with depth, interpreted to be the top of the Pensacola Clay.

AQUIFER TEST

The aquifer test included a fully-penetrating production well, two fully-penetrating observation wells and a partially-penetrating observation well. The 6-inch production well (P-1) was constructed in the initial test boring. The NWFWMD ran gamma log and electric logs on the test boring prior to completion. These logs do not indicate the presence of any significant semi-confining layer within the Sand and-Gravel Aquifer at the site. The production well was completed at a depth of 89 ft bls with 80 ft of screen extending from 9 ft to 89 ft. The static water level prior to the aquifer test was 10.02 ft bls (60.08 ft NGVD).

The three observation wells were all 2-inch diameter. Observation Well 1 (OW-1) was located 30 ft northeast of P-1. It was a fully-penetrating well completed at a depth of 76 ft bls with 70 ft of screen extending from 6 ft to 76 ft. Observation Well 2 (OW-2) was located 100 ft northeast of P-1. It was a fully-penetrating well completed at a depth of 86 ft with 80 ft of screen extending from 6 ft to 86 ft. Observation Well 3 (OW-3) was located 30 ft southwest of P-1. It was a partially-penetrating well completed at a depth of 24 ft with 10 ft of screen extending from 14 ft to 24 ft.

A 78-minute pre-test was completed on June 14, 1990 during the development of P-1. A pumping rate of approximately 164 gallons per minute (gal/min) produced a drawdown in OW-1 and OW-2 of 2.92 ft and 1.69 ft respectively. The actual test was initiated July 9, 1990. Prior to the aquifer test, the static water levels in OW-1, OW-2, and OW-3 were 9.56 ft bls (60.24 ft NGVD), 7.93 ft bls (60.47 ft NGVD), and 10.21 ft bls (60.29 ft NGVD) respectively. During the test, the pumping rate was calculated to vary between 116.2 and 217.5 gal/min with an average rate of 155 gal/min. Between minutes 3,801 and 3,854, the

pump was stopped in order to repair a fan belt. Due to potential complications the malfunction could cause in interpreting the trend of observed water levels, data gathered after 3,801 minutes was not used in the analysis presented here. Because the number of water level measurements made between minute 3,801 and the conclusion of the test were so few, the exclusion of this data is not believed to impact the analysis. At the conclusion of the test on July 12, 1990, the water level had drawn down 4.12 ft in OW-1, 2.81 ft in OW-2, and 2.29 ft in OW-3.

TEST ANALYSIS

Analysis of the test data was performed using AquiferWin32 software. AquiferWin32 is proprietary software produced by Environmental Simulations, Inc. The Neuman (1972) analytical solution was used to analyze the test data for wells OW-1 and OW-2. The method is intended to simulate the response of an unconfined aquifer with fully-penetrating wells to pumping. It has the added advantage of being able to accommodate the variable pumping rate that existed during the aquifer test. Assumptions inherent to the solution are as follows:

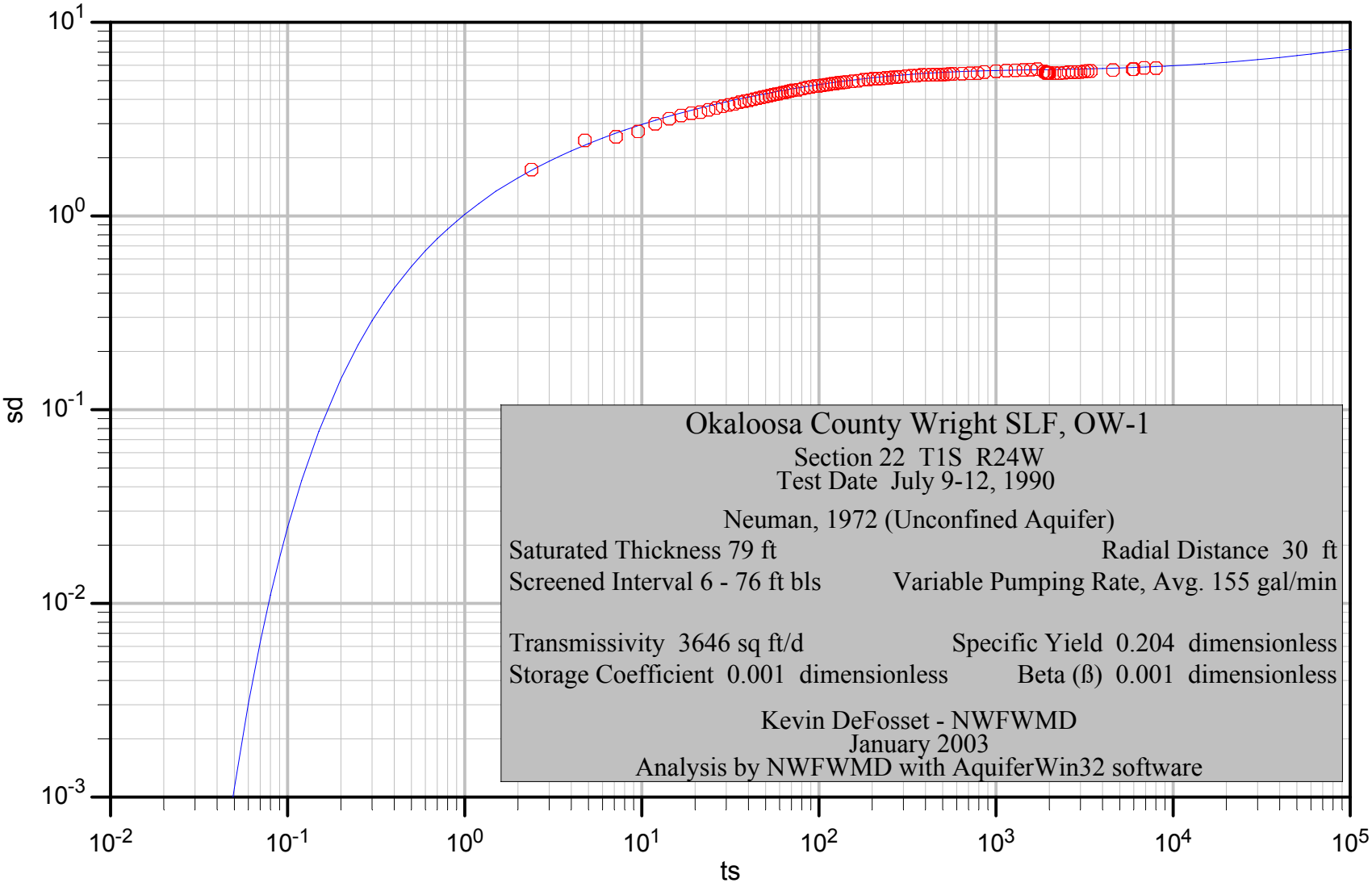
- The aquifer has an infinite areal extent.
- The aquifer is homogeneous and of uniform thickness over the area influenced by the test.
- Prior to pumping, the water table is horizontal over the area influenced by the test.
- The aquifer is isotropic or anisotropic.
- The flow to the well is in an unsteady state.
- The influence of the unsaturated zone upon the drawdown in the aquifer is negligible.
- Due to the small diameter of the wells, storage in them can be neglected.

Considering a saturated thickness of 79 ft and distances from the pumping well of 30 ft for OW-1 and OW-3 and 100 ft for OW-2, the following hydraulic properties were obtained from analysis of the test results:

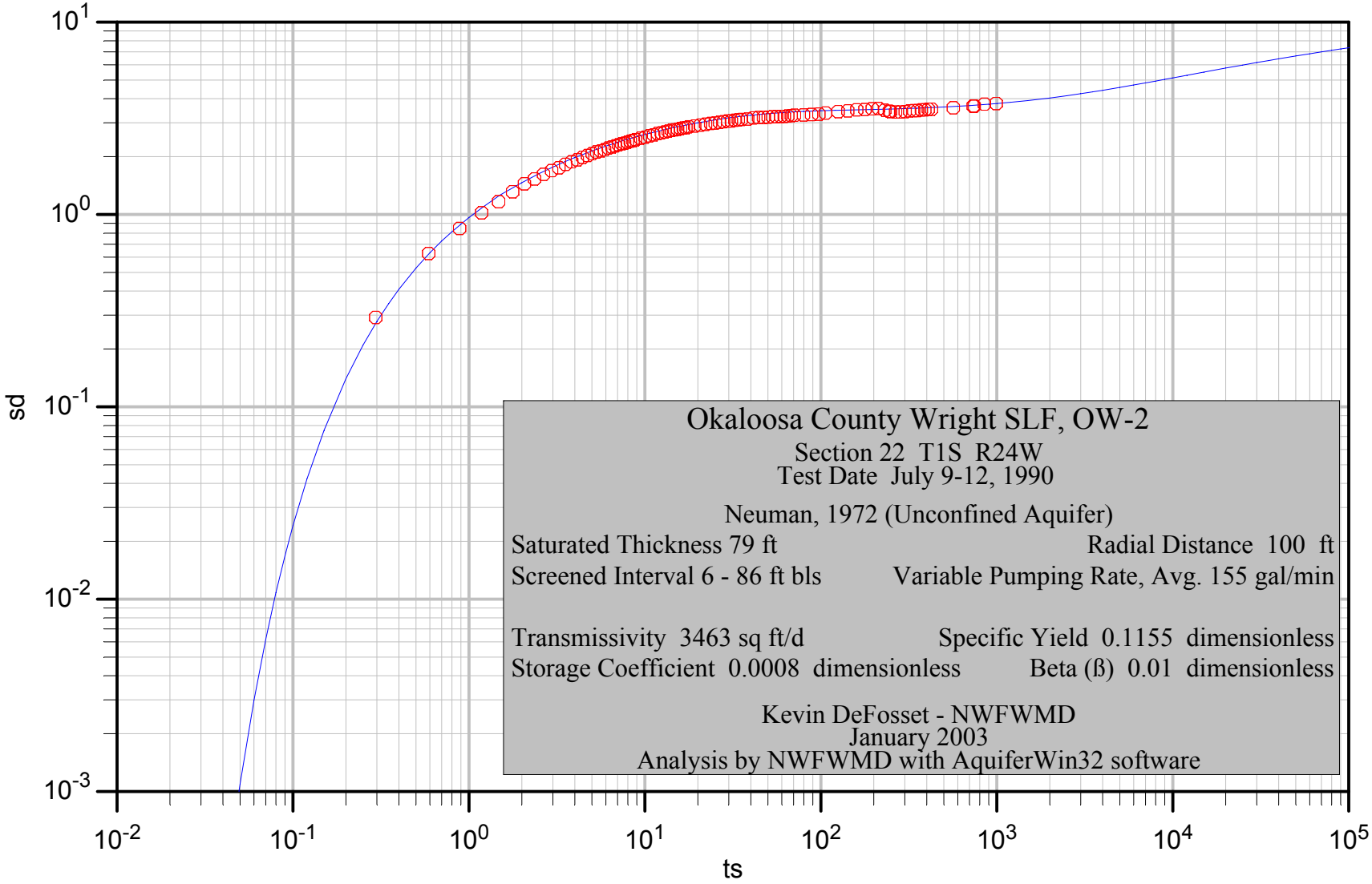
Hydraulic Parameter	**OW-1**	**OW-2**	**OW-3**
Saturated Thickness (ft)	79	79	79
Radial distance from P-1 (ft)	30	100	30
Transmissivity (sq ft/d)	3,600 (rounded)	3,500 (rounded)	4,700 (rounded)
Storage Coefficient (dimensionless)	0.001	0.0008	0.006
Specific Yield (dimensionless)	0.20 (rounded)	0.12 (rounded)	0.23 (rounded)
Beta (dimensionless)	0.001	0.01	0.05
Kz/Kr (dimensionless)			0.05

Neuman (1974) was used to analyze the test data for well OW-3. The solution addresses the response of an unconfined aquifer with partially-penetrating wells to pumping. Assumptions inherent to this method are similar to those of Neuman (1972). A reasonable type curve match was achieved. Also, the hydraulic parameters calculated appear to reasonably agree with those from OW-1 which is located the same distance from P-1. However, it is acknowledged that the drawdown data are less than ideal and therefore, the results from OW-3 should be viewed with caution.

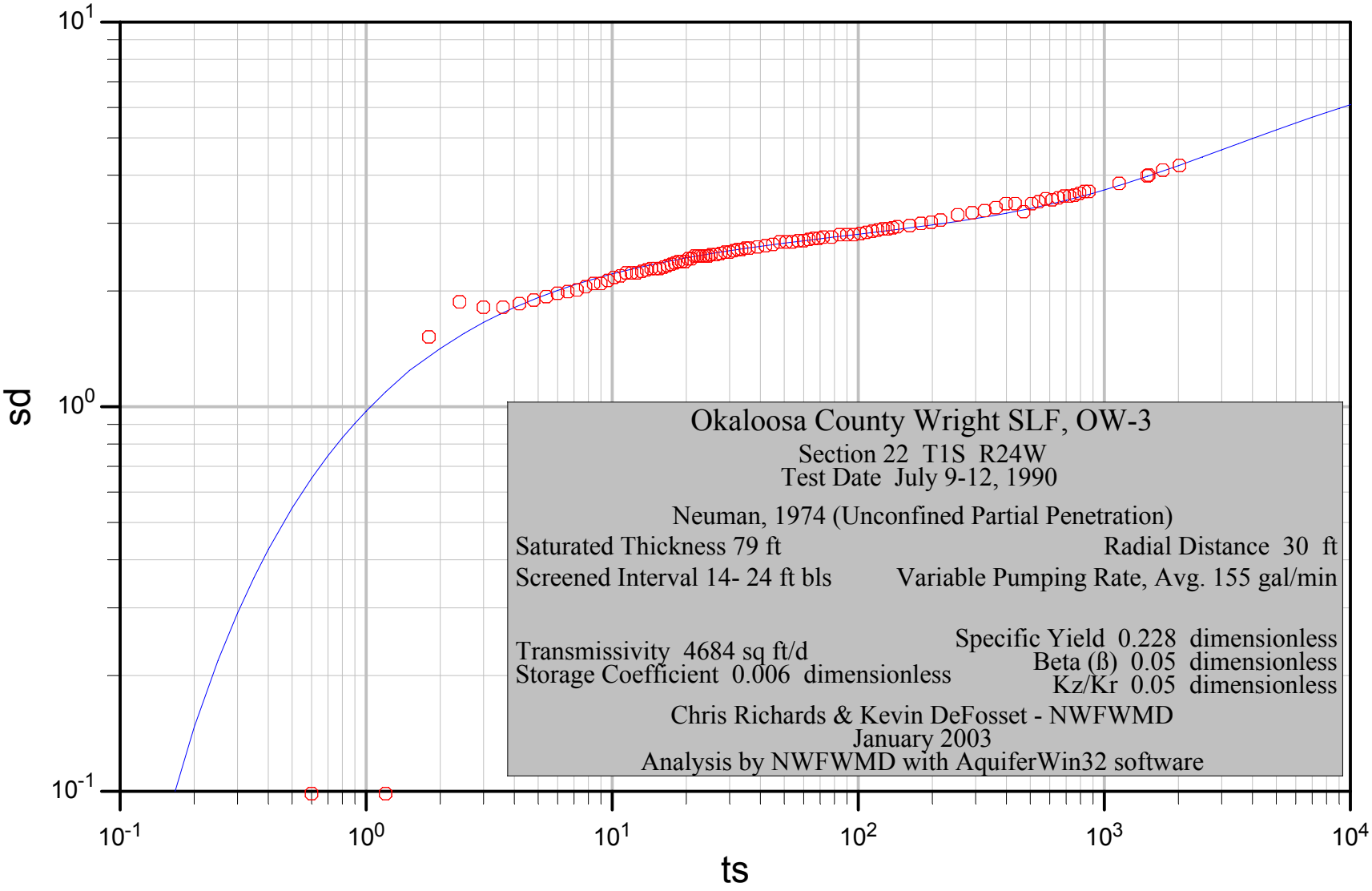
OKALOOSA CO. WRIGHT SLF SAND-AND-GRAVEL AQUIFER TEST, OW-1



OKALOOSA CO. WRIGHT SLF SAND-AND-GRAVEL AQUIFER TEST, OW-2



OKALOOSA CO. WRIGHT SLF SAND-AND-GRAVEL AQUIFER TEST, OW-3



SAND-AND-GRAVEL AQUIFER PUMP TEST
Wright Landfill, Okaloosa County, Florida

Test date: July 9-12, 1990	Test conducted by: Okaloosa County/ B.C.M. Engineers, Inc.
Production well: P-1	Observation wells: OW-1, OW-2, OW-3
Tested aquifer: Sand and Gravel	Production rate: Variable; 155 gal/min average
Test duration: 72 hrs.	Data type: Drawdown

ELAPSED TIME (min)	OW-1 DRAWDOWN (ft)	ELAPSED TIME (min)	OW-1 DRAWDOWN (ft)
1	1.13	36	3
2	1.6	38	3.02
3	1.67	40	3.05
4	1.78	42	3.06
5	1.95	44	3.08
6	2.07	46	3.1
7	2.15	48	3.12
8	2.21	50	3.14
9	2.24	52	3.15
10	2.3	54	3.17
11	2.35	56	3.18
12	2.4	58	3.19
13	2.44	60	3.2
14	2.47	65	3.23
15	2.52	70	3.25
16	2.55	75	3.29
17	2.58	80	3.3
18	2.61	85	3.33
19	2.64	90	3.33
20	2.67	95	3.34
21	2.69	100	3.36
22	2.72	105	3.37
23	2.75	110	3.39
24	2.77	115	3.39
25	2.79	120	3.41
26	2.82	130	3.43
27	2.83	140	3.45
28	2.86	150	3.45
29	2.88	160	3.49
30	2.9	170	3.48
32	2.92	180	3.49
34	2.96	190	3.49

ELAPSED TIME (min)	OW-1 DRAWDOWN (ft)
200	3.49
210	3.5
220	3.51
230	3.52
240	3.525
270	3.535
300	3.555
330	3.56
360	3.605
420	3.64
480	3.67
540	3.68
600	3.7
660	3.71
720	3.73
780	3.63
800	3.58
802	3.58
804	3.58
806	3.58
808	3.58
813	3.58
823	3.57
827	3.565
835	3.56
840	3.565
900	3.56
960	3.555
1020	3.575
1080	3.605
1140	3.6
1200	3.61
1260	3.61
1320	3.635
1380	3.65
1440	3.65
1920	3.69
2483	3.725
2520	3.73
2880	3.79
3360	3.78

ELAPSED TIME (min)	OW-2 DRAWDOWN (ft)	ELAPSED TIME (min)	OW-2 DRAWDOWN (ft)
1	0.2	54	1.92
2	0.43	56	1.93
3	0.58	58	1.94
4	0.7	60	1.96
5	0.8	65	1.98
6	0.9	70	2
7	0.99	75	2.02
8	1.05	80	2.04
9	1.11	85	2.05
10	1.16	90	2.07
11	1.2	95	2.08
12	1.25	100	2.1
13	1.29	105	2.1
14	1.32	110	2.12
15	1.36	115	2.13
16	1.39	120	2.14
17	1.42	130	2.15
18	1.45	140	2.18
19	1.47	150	2.19
20	1.49	160	2.19
21	1.52	170	2.2
22	1.54	180	2.21
23	1.56	190	2.21
24	1.58	200	2.22
25	1.6	210	2.22
26	1.61	220	2.23
27	1.63	230	2.24
28	1.65	240	2.25
29	1.66	270	2.26
30	1.68	300	2.27
32	1.71	330	2.28
34	1.73	360	2.31
36	1.76	425	2.35
38	1.78	482	2.37
40	1.81	542	2.4
42	1.82	603	2.41
44	1.84	663	2.43
46	1.86	722	2.44
48	1.88	782	2.39
50	1.89	830	2.36
52	1.9	842	2.35

ELAPSED TIME (min)	OW-2 DRAWDOWN (ft)
901	2.34
961	2.34
1021	2.35
1082	2.37
1142	2.38
1201	2.38
1262	2.4
1322	2.4
1381	2.42
1441	2.42
1918	2.46
2486	2.51
2523	2.51
2881	2.57
3361	2.59

ELAPSED TIME (min)	OW-3 DRAWDOWN (ft)	ELAPSED TIME (min)	OW-3 DRAWDOWN (ft)
1	0.05	24	1.16
2	0.05	25	1.16
3	0.77	26	1.16
4	0.95	27	1.17
5	0.92	28	1.18
6	0.92	29	1.19
7	0.94	30	1.2
8	0.96	31	1.21
9	0.98	32	1.21
10	1	33	1.21
11	1.01	34	1.23
12	1.02	35	1.23
13	1.04	36	1.25
14	1.06	37	1.25
15	1.06	38	1.25
16	1.08	39	1.25
17	1.1	40	1.25
18	1.11	41	1.25
19	1.13	42	1.26
20	1.13	44	1.26
21	1.13	46	1.27
22	1.14	48	1.28
23	1.15	50	1.28

ELAPSED TIME (min)	OW-3 DRAWDOWN (ft)	ELAPSED TIME (min)	OW-3 DRAWDOWN (ft)
52	1.29	963	1.76
54	1.3	1024	1.75
56	1.3	1084	1.77
58	1.31	1144	1.79
60	1.31	1203	1.79
65	1.32	1263	1.8
70	1.33	1323	1.82
75	1.34	1383	1.84
80	1.36	1442	1.84
85	1.36	1916	1.93
90	1.36	2489	2.02
95	1.37	2525	2.03
100	1.37	2883	2.09
105	1.38	3371	2.15
110	1.39		
115	1.39		
120	1.4		
130	1.4		
140	1.42		
150	1.42		
160	1.42		
170	1.43		
180	1.44		
190	1.45		
200	1.46		
210	1.47		
220	1.47		
230	1.48		
240	1.49		
270	1.5		
300	1.52		
330	1.53		
360	1.55		
423	1.6		
484	1.62		
544	1.64		
605	1.67		
665	1.71		
724	1.71		
784	1.63		
845	1.71		
903	1.73		

ELAPSED TIME (min)	PUMPING RATE (gpm)	ELAPSED TIME (min)	PUMPING RATE (gpm)
5	160	1860	151.7
7	160	1920	143.3
8	157	1980	170
10	156	2040	160
14	150	2100	126.7
20	156	2160	153.3
30	160	2220	170
35	170	2280	156.7
43	150	2340	148.3
55	156	2400	160
60	156	2460	138.3
90	157.4	2501	150
180	217.5	2527	153.8
240	156.7	2580	150.9
270	136.7	2640	156.7
300	180	2700	151.7
360	156.7	2760	153.3
420	161.7	2820	158.3
480	156.7	2880	150
540	156.7	2940	150
600	163.3	3000	155
660	156.7	3060	151.7
720	158.3	3120	151.7
780	156.7	3180	153.3
817	116.2	3240	153.3
840	208.7	3300	156.7
900	155	3360	138.3
960	148.3	3420	180
1020	155	3480	143.3
1080	153.3	3540	153.3
1140	155	3600	136.7
1200	151.7	3660	148.3
1260	151.7	3720	170
1320	155	3780	135
1380	153.3		
1440	153.3		
1500	155		
1560	155		
1620	153.3		
1680	155		
1740	155		
1800	153.3		