

**APPENDIX C.3**

**PACKER TEST DATA**

**NORTH ANNA COL**

**DATA REPORT REV. 0  
JANUARY 23, 2007**

**MACTEC PROJECT NO. 6468-06-1472**



**MACTEC ENGINEERING AND CONSULTING, INC.**

**RALEIGH, NORTH CAROLINA**

**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
(WATERWAYS EXPERIMENT STATION, RTH 381-80)**

**PROJECT NAME: NORTH ANNA COL  
PROJECT NUMBER: 6468-06-1472  
REPORT DATE: 12/7/2006 Revised 1-13-07  
BORING NO: B-901**

**Given Parameters**

Test Section Length,  $l$ , ft: 10  
 Radius of Borehole  $r_0$ , in: 2.00  
 GW Depth, ft: 23.30 (from top of casing) 21.30 (from ground surface)

Prepared by: ZO  
 Checked by: [Signature]

Date: 12-7-06  
 Date: 1-17-07

Test Number	Q (GPM)	$P_{Test}$ (psi)	$P_T$ (psi)	$P_M$ (psi)	$P_B$ (psi)	Q (cfs)	$H_M$ (ft)	$K_e$ (fpy)
<b>Interval 1, ft: 77 - 87 (from ground surface)</b>								
1	0	46.51	0.46	27.08	32.05	0.00	107.33	0.00
2	0	65.94	0.46	27.08	32.05	0.00	152.17	0.00
3	0	85.97	0.46	27.08	32.05	0.00	198.39	0.00
4	TNP	56.52	-	-	-	-	130.43	-
5	TNP	85.97	-	-	-	-	198.39	-
<b><math>K_e</math>, ft/year:</b>								<b>0.00</b>

<b>Interval 2, ft: 92 - 102 (from ground surface)</b>								
1	0	53.54	0.17	31.29	36.31	0	123.55	0.00
2	0.4	75.8	0.17	31.29	36.31	0.0008913	174.92	14.81
3	6.2873	98.73	0.17	31.29	36.31	0.0140091	227.84	153.66
4	0.2	65.01	0.17	31.29	36.31	0.0004456	150.02	9.77
5	6.0182	98.73	0.17	31.29	36.31	0.0134095	227.84	147.09
<b><math>K_e</math>, ft/year:</b>								<b>NA</b>

Report two  $K_e$  values: Avg  $K_e$  intervals 2+4 = 12.4; Avg  $K_e$  intervals 3+5 = 150.4

<b>Interval 3, ft: 107 - 117 (from ground surface)</b>								
1	0	63.09	2.27	38.02	43.08	0	145.59	0.00
2	0	88.17	2.27	38.02	43.08	0	203.47	0.00
3	5.2345	114.01	2.27	38.02	43.08	0.0116633	263.10	113.54
4	0	76.01	2.27	38.02	43.08	0	175.41	0.00
5	5.3473	114.01	2.27	38.02	43.08	0.0119147	263.10	116.00
<b>Report <math>K_e</math> based on intervals 3+5 <math>K_e</math> for intervals 3+5 = 114.8</b>								<b>0.0</b>

**Notations:**

Q = flow rate  
 $H_M = P_g$  converted to feet of head ( $P_g * 144 \text{ in}^2 / \text{ft}^2 / \gamma_w$ )  
 $P_{Test}$  = test pressure  
 $K_e = ((Q/H_M) * (1/l)) * 1/2 * \ln(R/r_0) * (525,600 \text{ min/year}) * (0.1337 \text{ ft}^3/\text{gal})$   
 $P_T$  = pressure above top packer, near water surface  
 R = total length between packers,  $l$   
 $P_M$  = pressure in the test section  
 TNP = Test not performed  
 $P_B$  = pressure below bottom packer  
 NM = not measured

Note: Pressures  $P_t$ ,  $P_m$  and  $P_b$  taken from final data point for transducers after all testing.  
 Outside diameter of boring is 4 in.

Test Number	Q (GPM)	P <sub>Test</sub> (psi)	P <sub>T</sub> (psi)	P <sub>M</sub> (psi)	P <sub>B</sub> (psi)	Q (cfs)	H <sub>M</sub> (ft)	K <sub>e</sub> (fpy)
<b>Interval 4, ft: 118 - 128 (from ground surface)</b>								
1	0.1033	82.26	2.74	42.3	NM	0.1033	189.83	6.27
2	0.6455	97.82	3.23	43.02	49.09	0.6455	225.74	19.60
3	3.89	125.79	2.62	42.87	51.71	3.8945	290.28	78.04
4	0.5018	84.66	2.21	42.77	50.45	0.5018	195.37	20.11
5	3.47	125.79	2.01	43.02	53.23	3.4709	290.28	69.55
<b>K<sub>e</sub>, ft/year:</b>								<b>NA</b>

Report two Ke values: Avg Ke intervals 2+4 = 19.8; Avg Ke intervals 3+5 = 73.8

<b>Interval 5, ft: 145 - 155 (from ground surface)</b>								
1	0	90.04	0.19	86.94	NM	0	207.78	0.00
2	0	122.27	0.18	59.43	NM	0	282.16	0.00
3	0.00	155.47	0.2	83.87	60.7	0	358.78	0.00
4	TNP	106.64	-	-	-	-	246.09	-
5	TNP	155.82	-	-	-	-	359.58	-
<b>K<sub>e</sub>, ft/year:</b>								<b>0.00</b>

<b>Interval 5-2, ft: 145 - 155 (from ground surface) Second test with higher capacity pump</b>								
1	0.00	87.28	2.84	75.87	60.39	0.00	201.42	0.00
2	1.92	119.5	2.38	87.8	62.22	1.92	275.77	49.02
3*	0.00	152.71	2.25	59.33	62.8	-	352.41	-
4	0.07	103.88	2.54	81.45	61.29	0.07	239.72	2.45
5*	TNP	152.77	-	-	-	-	352.55	-
<b>K<sub>e</sub>, ft/year:</b>								<b>NA</b>

Report Avg Ke from intervals 2 and 4: Ke = 25.7

Notations:

- Q = flow rate
- P<sub>Test</sub> = total test pressure
- P<sub>T</sub> = pressure above top packer, near water surface
- P<sub>M</sub> = pressure in the test section
- P<sub>B</sub> = pressure below bottom packer
- H<sub>M</sub> = P<sub>Test</sub> converted to feet of head (P<sub>Test</sub>\*144in<sup>2</sup>/ft<sup>2</sup>/γ<sub>w</sub>)
- K<sub>e</sub> = ((Q)/(H<sub>M</sub>-P<sub>m</sub>))\*(1/l)\*1/2π\*ln(R/r<sub>0</sub>)\*(525,600 min/year)\*(0.1337ft<sup>3</sup>/gal)
- R = total length between packers, l
- TNP = Test not performed
- NM = not measured

Note:

- Pressures Pt, Pm and Pb taken from initial data for transducers.
- Outside diameter of boring is 4 in.
- \* Pressure pushes packers out. 30GPM/120 psi pump is used

*JW 1-17-07*

**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL

Project Number: 6468-06-1472

Date: 8/30/2006

Boring No: B-901

Test Interval: 79 ft to 89 ft (from top casing)

Stick up length: 2 ft

Test Interval: 77.0 ft to 87 ft (from surface)

Test Type: Double Packer Technique

Depth of Water

Table= 23.30 ft (from top of casing)

h1= 24.30 (from top of casing)

h2 = 60.7 ft (from top of casing)

$\rho_w = 62.4 \text{ lb/ft}^3$

Prepared by: ZO

Date: 12-7-06

Checked by: JAZ

Date: 1-17-07

**Abbreviations:**

N.O. Not Observed

N.A. Not Applicable

Calc  $P_0$  Max= 58.90 psi Value on field data sheet= 58.89

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. Actual excess pressures given below.

TEST #1

TEST #2

TEST #3

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure= 19.43 psi				Actual Excess Pressure= 38.86 psi				Actual Excess Pressure= 58.89 psi			
Initial Middle Transducer Reading= 27.08 psi				Initial Middle Transducer Reading= 27.08 psi				Initial Middle Transducer Reading= 27.08 psi			
Test Pressure= 46.51 psi				Test Pressure= 65.94 psi				Test Pressure= 85.97 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2868.5		2.3	0	2869.4		3.2	0	2869.5		-1.5
0.5	2869.2	1.4	16.4	0.5	2869.5	0.2	28.8	0.5	2869.8	0.6	44.8
1	2869.2	0.0	3.4	1	2869.5	0.0	32	1	2869.8	0.0	45.3
1.5	2869.4	0.4	23.2	1.5	2869.5	0.0	30.4	1.5	2869.8	0.0	51.6
2	2869.4	0.0	5.0	2	2869.5	0.0	30.4	2	2869.8	0.0	51.7
2.5	2869.4	0.0	11.1	2.5	2869.5	0.0	30.5	2.5	2869.8	0.0	51.4
3	2869.4	0.0	11.9	3	2869.5	0.0	31.2	3	2869.8	0.0	51.1
3.5	2869.4	0.0	11.8	3.5	2869.5	0.0	29.2	3.5	2869.8	0.0	51.5
4	2869.4	0.0	11.7	4	2869.5	0.0	31.4	4	2869.8	0.0	52.1
4.5	2869.4	0.0	11.7	4.5	2869.5	0.0	30.3	4.5	2869.8	0.0	51.2
5	2869.4	0.0	11.6	5	2869.5	0.0	30.9	5	2869.8	0.0	52.0
pressure release at 1 min and 2 min											

Average Q: 0.2 gpm  
Excess Pore pressure: 19.43 psi

Average Q: 0.0 gpm  
Excess Pore pressure: 38.86 psi

Average Q: 0.0 gpm  
Excess Pore pressure: 58.89 psi

JES  
1-17-07

**TEST #4**

**TEST #5**

Actual Excess Pressure= 29.44 psi				Actual Excess Pressure= 58.89 psi			
Initial Middle Transducer 27.08 psi				Initial Middle Transducer 27.08 psi			
Test Pressure= 56.52 psi				Test Pressure= 85.97 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Hole not taking any water. Test not performed				Hole not taking any water. Test not performed			

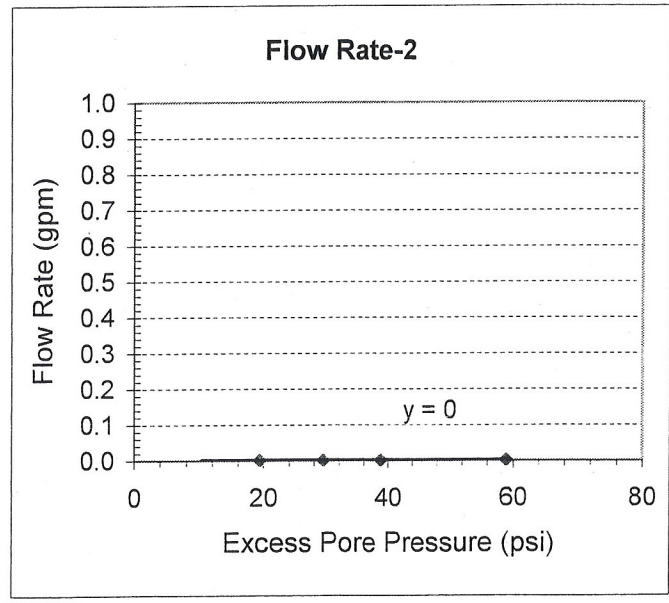
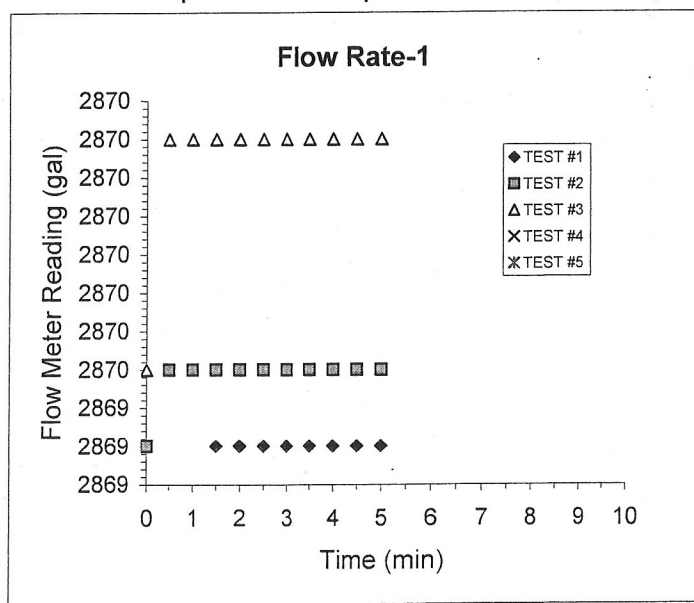
**Boring No:** B-901  
 Test Interval: 77 ft to 87 ft  
 (from surface)

Density of water,  $\rho_w = 62.4 \text{ lb/ft}^3$   
 $= 0.0361 \text{ lb/in}^3$   
 Length = 10 ft  
 Borehole radius = 2.00 in  
 R ranges from 5-10 ft:  
 choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	19.43	0.000	44.84	0.00
2	38.86	0.000	89.68	0.00
3	58.89	0.000	135.90	0.00
4	29.44	-	67.94	
5	58.89	-	135.9	

Average Q: gpm  
 Excess Pore pressure: 29.44 psi

Average Q: gpm  
 Excess Pore pressure: 58.89 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q * \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec}$$

$$= 0.00 \text{ ft/year}$$

# Pressure Decay Test

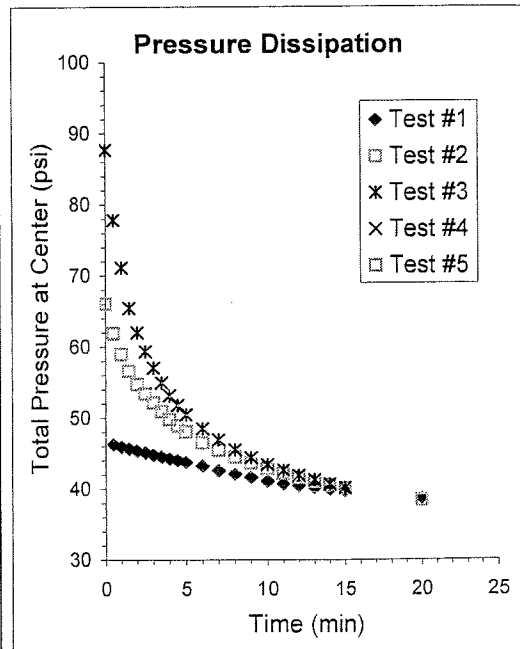
Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 8/30/2006

Prepared by: ZO Date: 12-7-06  
 Checked by: *[Signature]* Date: 1-17-07  
 N.O. Not Observed  
 N.A. Not Applicable

Boring No: B-901  
 Test Interval: 77 ft to 87 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	11.6	46.49	0.0	30.9	66.05	0.0	52	87.64
0.5	11.2	46.22	0.5	26.7	61.88	0.5	47.8	77.79
1.0	11	45.89	1.0	23.9	58.96	1.0	36	71.10
1.5	10.7	45.6	1.5	21.6	56.61	1.5	30.3	65.40
2.0	10.4	45.31	2.0	19.6	54.67	2.0	26.2	61.97
2.5	10.2	45.04	2.5	18	53.37	2.5	23.7	59.32
3.0	9.9	44.76	3.0	16.8	52.09	3.0	21.3	56.98
3.5	9.6	44.48	3.5	15.7	50.88	3.5	19.2	54.91
4.0	9.3	44.21	4.0	14.6	49.78	4.0	18.0	53.10
4.5	9.1	43.96	4.5	13.7	48.87	4.5	16.5	51.75
5.0	8.9	43.7	5.0	13.1	48.05	5.0	15.2	50.39
6.0	8.4	43.2	6.0	11.7	46.47	6.0	13.4	48.43
7.0	7.8	42.53	7.0	10.5	45.43	7.0	11.9	46.85
8	7.3	42.04	8.0	9.6	44.47	8.0	10.5	45.46
9	6.9	41.58	9.0	8.8	43.60	9.0	9.5	44.35
10	6.4	41.02	10.0	8.1	42.81	10.0	8.6	43.36
11	6.0	40.64	11.0	7.4	42.18	11.0	7.8	42.58
12	5.8	40.38	12.0	6.8	41.57	12.0	7.1	41.83
13	5.5	40.13	13.0	6.4	41.00	13.0	6.5	41.21
14	5.3	39.88	14.0	5.9	40.52	14.0	6.1	40.61
15	5	39.61	15.0	5.5	40.09	15.0	5.5	40.07
20	4.1	38.55	20.0	3.9	38.31			

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
Test not conducted			Test not conducted		



**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL  
Project Number: 6468-06-1472  
Date: 8/30/2006

Prepared by: ZO Date: 12-7-06  
Checked by: [Signature] Date: 1-11-07

Boring No: B-901  
Test Interval: 94 ft to 104 ft  
Stick up length: 2 ft  
Test Interval: 92.0 ft to 102 ft (from surface)  
Test Type: Double Packer Technique

Depth of Water  
Table = 23.30 ft (from top of casing)  
h1 = 24.30 ft (from top of casing)  
h2 = 75.7 ft (from top of casing)  
 $\rho_w = 62.4 \text{ lb/ft}^3$

<b>Abbreviations:</b>	
N.O.	Not Observed
N.A.	Not Aplicable

$P_0 \text{ Max} = 67.45 \text{ psi}$  Value on field data sheet = 67.44

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. Actual excess pressures given below.

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure =		22.25 psi		Actual Excess Pressure =		44.51 psi		Actual Excess Pressure =		67.44 psi	
Initial Middle Transducer Reading =		31.29 psi		Initial Middle Transducer Reading =		31.29 psi		Initial Middle Transducer Reading =		31.29 psi	
Test Pressure =		53.54 psi		Test Pressure =		75.80 psi		Test Pressure =		98.73 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2799.9		0.0	0	2801.9		4.1	0	2804.9		3.6
0.5	2801.6	3.4	17.3	0.5	2803.1	2.4	15.1	0.5	2806.8	3.8	45.6
1	2801.6	0.0	18.2	1	2803.3	0.4	25.9	1	2807.4	1.2	48.1
1.5	2801.8	0.4	20.1	1.5	2803.9	1.2	38.1	1.5	2811.1	7.4	58.6
2	2801.8	0.0	18.4	2	2804.2	0.6	39	2	2815.4	8.6	60.8
2.5	2801.8	0.0	20.0	2.5	2804.4	0.4	38.1	2.5	2818.8	6.8	58.6
3	2801.8	0.0	20.0	3	2804.4	0.0	39.2	3	2822.1	6.6	59.3
3.5	2801.8	0.0	18.1	3.5	2804.6	0.4	38.6	3.5	2825.2	6.2	59.1
4	2801.8	0.0	21.0	4	2804.7	0.2	39	4	2828.4	6.4	59.9
4.5	2801.8	0.0	19.2	4.5	2804.8	0.2	39.4	4.5	2831.4	6.0	60
5	2801.8	0.0	19.7	5	2805.0	0.4	39.1	5	2834.8	6.8	57.4

Average Q: 0.4 gpm  
Excess Pore pressure: 22.25 psi

Average Q: 0.4 gpm  
Excess Pore pressure: 44.51 psi

Average Q: 6.9 gpm  
Excess Pore pressure: 67.44 psi

Job  
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TEST #4

TEST #5

TEST #4				TEST #5			
Actual Excess Pressure=		33.72 psi		Actual Excess Pressure=		67.44 psi	
Initial Middle Transducer		31.29 psi		Initial Middle Transducer		31.29 psi	
Test Pressure=		65.01 psi		Test Pressure=		98.73 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2834.8		-8.6	0	2836.7		-8.4
0.5	2835.3	1.0	14.9	0.5	2837.9	2.4	41.6
1	2835.8	1.0	24.2	1	2839.6	3.4	55.6
1.5	2836	0.4	24.1	1.5	2844.9	10.6	60
2	2836.1	0.2	23.6	2	2847.1	4.4	60.4
2.5	2836.2	0.2	23.4	2.5	2850.3	6.4	60.5
3	2836.3	0.2	23.4	3	2853.1	5.6	58.4
3.5	2836.4	0.2	23.7	3.5	2856.4	6.6	59.6
4	2836.5	0.2	23.8	4	2859.6	6.4	60
4.5	2836.6	0.2	23.8	4.5	2862.2	5.2	60.4
5	2836.7	0.2	23.5	5	2865.5	6.6	59.1
				5.5	2868.5	6.0	60

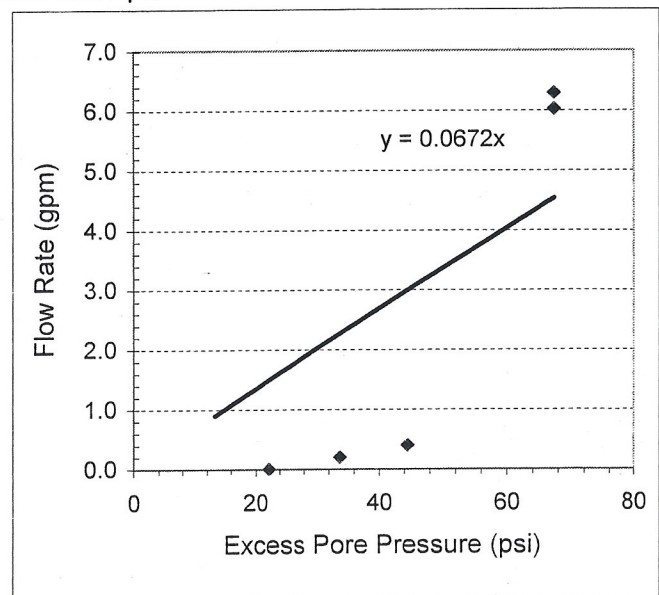
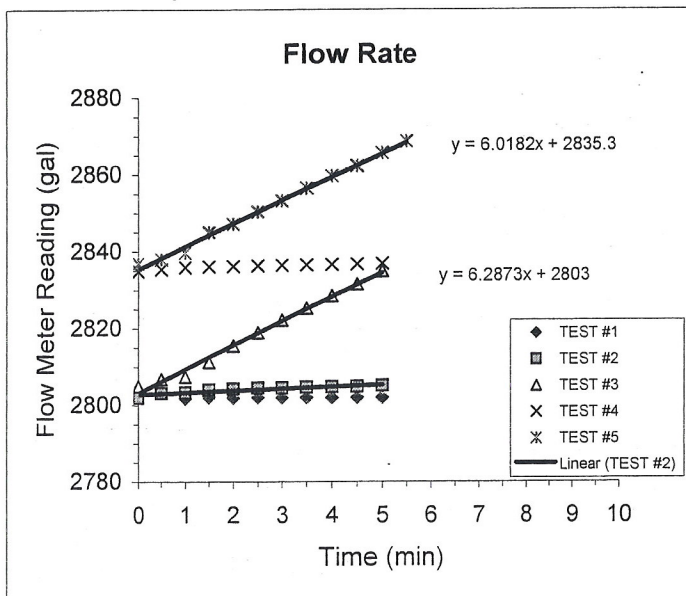
Boring No: B-901  
Test Interval: 92 ft to 102 ft  
(from surface)

Density of water,  $\rho_w = 62.4$  lb/ft<sup>3</sup>  
= 0.0361 lb/in<sup>3</sup>  
Length = 10 ft  
Borehole radius = 2.00 in  
R ranges from 5-10 ft:  
choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	22.25	0.000	51.35	0.00
2	44.51	0.400	102.72	14.81
3	67.44	6.287	155.63	153.66
4	33.72	0.200	77.83	9.77
5	67.44	6.018	155.6	147.09

Average Q: 0.2 gpm  
Excess Pore pressure: 33.72 psi

Average Q: 6.4 gpm  
Excess Pore pressure: 67.44 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q * \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec} = 0.00 \text{ ft/year}$$



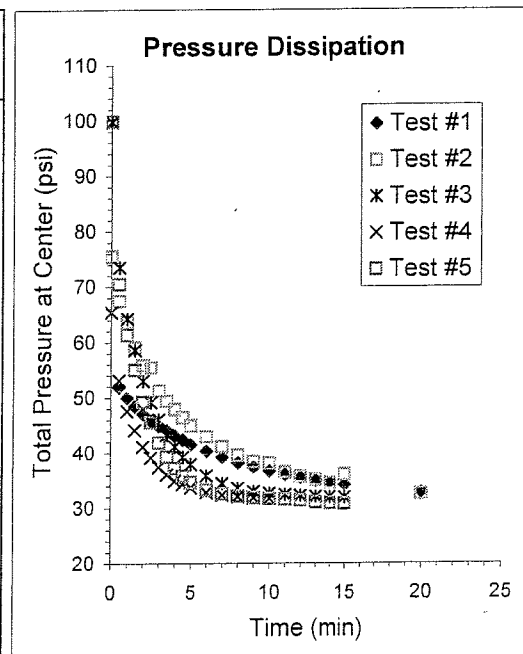
**Pressure Decay Test**

Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 8/18/2006  
 Boring No: B-901  
 Test Interval: 92 ft to 102 ft (from surface)

Prepared by: ZO Date: 12-7-06  
 Checked by: [Signature] Date: 1-7-07  
 N.O. Not Observed  
 N.A. Not Applicable

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	19.7	53.73	0.0	39.1	75.49	0.0	57.4	99.70
0.5	18.1	51.77	0.5	31.4	67.4	0.5	32.7	73.43
1.0	16.5	49.85	1.0	27.5	63.58	1.0	23.6	64.15
1.5	15.3	48.33	1.5	24.1	58.96	1.5	16.1	58.55
2.0	14.4	46.97	2.0	21.4	55.78	2.0	11.5	52.93
2.5	13.4	45.72	2.5	19.4	55.36	2.5	7.6	49.03
3.0	12.5	44.73	3.0	17.7	51.2	3.0	4.1	45.96
3.5	11.9	43.94	3.5	16.2	49.32	3.5	1.4	43.16
4.0	11.3	43.03	4.0	15	47.82	4.0	-0.5	41.06
4.5	10.7	42.25	4.5	14	46.3	4.5	-2.2	39.11
5.0	10.2	41.37	5.0	13	44.88	5.0	-3.3	37.86
6.0	9.4	40.2	6.0	11.5	42.85	6.0	-5.5	35.74
7.0	8.6	39.06	7.0	10.2	41.02	7.0	-7	34.38
8	8	38.07	8.0	9.2	39.47	8.0	-7.8	33.49
9	7.4	37.29	9.0	8.4	38.31	9.0	-8.2	32.92
10	7	36.55	10.0	7.1	37.99	10.0	-8.5	32.56
11	6.6	35.94	11.0	7.2	36.45	11.0	-8.7	32.33
12	6.3	35.39	12.0	6.7	35.68	12.0	-8.7	32.13
13	6	34.89	13.0	6.4	35.02	13.0	-8.7	31.98
14	5.7	34.44	14.0	6	34.5	14.0	-8.8	31.86
15	5.5	34.08	15.0	5.7	35.98	15.0	-8.8	31.77
20	4.7	32.72	20.0	4.8	32.47			

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	23.5	65.32	0.0	60.0	99.81
0.5	10.1	53.04	0.5	27.3	70.43
1.0	6.2	47.51	1.0	20.6	61.27
1.5	2.3	44.08	1.5	12.5	54.95
2.0	-0.2	41.01	2.0	7.8	49.17
2.5	-2.2	39.04	2.5	3.5	45.44
3.0	-3.8	37.34	3.0	0.4	41.81
3.5	-5	35.98	3.5	-2.2	39.25
4.0	-5.9	34.81	4.0	-4.4	37.16
4.5	-6.5	34.21	4.5	-5.7	35.70
5.0	-7.1	33.57	5.0	-6.9	34.59
6.0	-7.7	32.72	6.0	-8.1	33.17
7.0	-8	32.27	7.0	-8.7	32.51
8	-8.2	31.95	8	-9.1	32.09
9	-8.4	31.75	9	-9.3	31.80
10	-8.4	31.62	10	-9.4	31.63
			11	-9.4	31.48
			12	-9.5	31.31
			13	-9.7	31.00
			14	-9.7	30.78
			15	-9.8	30.67



**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL  
Project Number: 6468-06-1472  
Date: 8/30/2006

Prepared by: ZC Date: 12-7-06  
Checked by: *[Signature]* Date: 1-17-07

Boring No: B-901  
Test Interval: 109 ft to 119 ft  
Stick up length: 2 ft  
Test Interval: 107.0 ft to 117 ft (from surface)  
Test Type: Double Packer Technique

Depth of Water  
Table= 23.30 ft (from top of casing)  
h1= 24.30 (from top of casing)  
h2= 90.70 ft (from top of casing)  
 $\rho_w = 62.4 \text{ lb/ft}^3$

**Abbreviations:**  
N.O. Not Observed  
N.A. Not Applicable

$P_0 \text{ Max} = 76.00 \text{ psi}$  Value on field data sheet= 75.99  
Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure=		25.07 psi		Actual Excess Pressure=		50.15 psi		Actual Excess Pressure=		75.99 psi	
Initial Middle Transducer Reading=		38.02 psi		Initial Middle Transducer Reading=		38.02 psi		Initial Middle Transducer Reading=		38.02 psi	
Test Pressure=		63.09 psi		Test Pressure=		88.17 psi		Test Pressure=		114.01 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2931.0		0.6	0	2933.0		9	0	2934.7		7.5
0.5	2931.4	0.8	2.7	0.5	2934	2.0	18.6	0.5	2935.9	2.4	26.3
1	2933.0	3.2	28.8	1	2934.4	0.8	46.8	1	2936.2	0.6	47.9
1.5	2933.0	0.0	25.7	1.5	2934.5	0.2	46.5	1.5	2937.7	3.0	69.2
2	2933.0	0.0	24.2	2	2934.5	0.0	47.4	2	2941.2	7.0	74.8
2.5	2933.0	0.0	24.2	2.5	2934.5	0.0	47.3	2.5	2944.2	6.0	69.7
3	2933.0	0.0	24.0	3	2934.6	0.2	47.5	3	2947.2	6.0	68.5
3.5	2933.0	0.0	26.1	3.5	2934.6	0.0	47.4	3.5	2950.5	6.6	68.1
4	2933.0	0.0	24.7	4	2934.6	0.0	48	4	2953.3	5.6	68.1
4.5	2933.0	0.0	23.6	4.5	2934.7	0.2	44.5	4.5	2956.4	6.2	67.9
5	2933.0	0.0	24.5	5	2934.7	0.0	44.9	5	2959.3	5.8	68.7

Average Q: 0.4 gpm  
Excess Pore pressure: 25.07 psi

Average Q: 0.1 gpm  
Excess Pore pressure: 50.15 psi

Average Q: 5.8 gpm  
Excess Pore pressure: 75.99 psi

Job 117-07

TEST #4

TEST #5

TEST #4				TEST #5			
Actual Excess Pressure=		37.99 psi		Actual Excess Pressure=		75.98 psi	
Initial Middle Transducer		38.02 psi		Initial Middle Transducer		38.02 psi	
Test Pressure=		76.01 psi		Test Pressure=		114.0 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2959.4		-9.4	0	2961.2		9.6
0.5	2959.6	0.4	43	0.5	2961.5	0.6	45.2
1	2959.8	0.4	26.9	1	2962.3	1.6	60.5
1.5	2960.0	0.4	29	1.5	2965.7	6.8	70.2
2	2960.1	0.2	29	2	2969.9	8.4	69.1
2.5	2960.3	0.4	29	2.5	2972	4.2	67.1
3	2960.5	0.4	29.4	3	2974.7	5.4	67.2
3.5	2960.7	0.4	29.2	3.5	2977	4.6	68.2
4	2960.8	0.2	29.4	4	2980.3	6.6	67.8
4.5	2961	0.4	29.4	4.5	2983.3	6.0	68.0
5	2961.2	0.4	29.7	5	2986.3	6.0	68.3

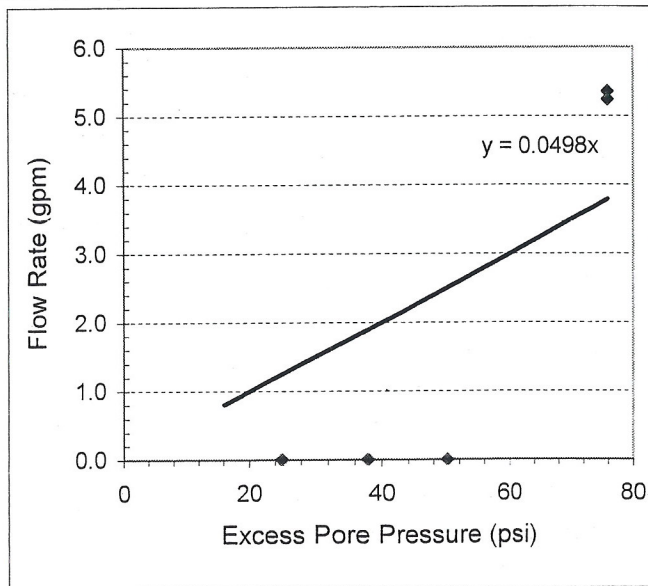
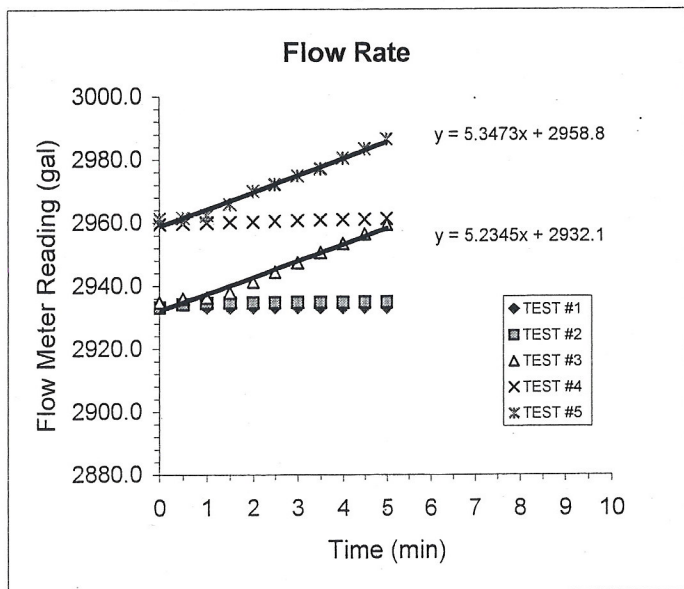
Boring No: B-901  
 Test Interval 107 ft to 117 ft  
 (from surface)

Density of water,  $\rho_w = 62.4$  lb/ft<sup>3</sup>  
 = 0.0361 lb/in<sup>3</sup>  
 Length = 10 ft  
 Borehole radius = 2.00 in  
 R ranges from 5-10 ft:  
 choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	25.07	0.000	57.85	0.00
2	50.15	0.000	115.73	0.00
3	75.99	5.235	175.36	113.54
4	37.99	0.000	87.67	0.00
5	75.98	5.347	175.3	116.00

Average Q: 0.3 gpm  
 Excess Pore pressure: 37.99 psi

Average Q: 6.0 gpm  
 Excess Pore pressure: 75.98 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q \cdot \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec} = 0.00 \text{ ft/year}$$

# Pressure Decay Test

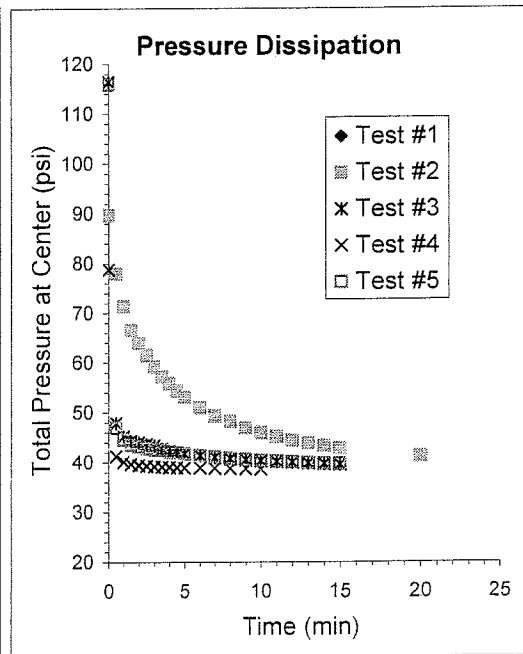
Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 8/30/2006  
 Boring No: B-901  
 Test Interval: 107 ft to 117 ft

Prepared by: ZO Date: 12-7-06  
 Checked by:                      Date: 1-11-07  
 N.O. Not Observed  
 N.A. Not Applicable

(from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
Test not conducted			0.0	44.9	89.68	0.0	68.7	116.32
			0.5	36.6	78	0.5	-1	47.83
			1.0	30.5	71.36	1.0	-3.3	45.17
			1.5	26.4	66.63	1.5	-4.3	44.23
			2.0	24.1	63.97	2.0	-4.6	43.95
			2.5	21.9	61.51	2.5	-5.0	43.57
			3.0	20.1	59.21	3.0	-5.2	43.31
			3.5	18.6	57.14	3.5	-5.9	42.63
			4.0	17.7	55.81	4.0	-6.3	42.21
			4.5	16.5	54.36	4.5	-6.6	41.95
			5.0	15.8	53.14	5.0	-6.8	41.71
			6.0	14.5	51.02	6.0	-7.1	41.32
			7.0	13.3	49.33	7.0	-7.4	41.00
			8.0	12.4	48.18	8.0	-7.7	40.72
			9.0	11.6	46.93	9.0	-7.9	40.48
			10.0	11	45.98	10.0	-8.1	40.28
11.0	10.5	45.15	11.0	-8.3	40.10			
12.0	10.1	44.43	12.0	-8.4	39.92			
13.0	9.7	43.84	13.0	-8.5	39.78			
14.0	9.4	43.28	14.0	-8.6	39.64			
15.0	9	42.8	15.0	-8.7	39.51			
20.0	8.1	41.15						

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	29.7	78.71	0.0	68.3	115.89
0.5	-7.2	41.15	0.5	-2.4	46.89
1.0	-8.1	40.1	1.0	-4.0	44.53
1.5	-8.6	39.65	1.5	5.0	43.57
2.0	-8.8	39.39	2.0	-5.5	43.16
2.5	-9	39.22	2.5	-5.9	42.76
3.0	-9.1	39.12	3.0	-6.1	42.55
3.5	-9.1	39.06	3.5	-6.3	42.44
4.0	-9.1	38.98	4.0	-6.7	41.99
4.5	-9.2	38.93	4.5	-6.8	41.88
5.0	-9.2	38.88	5.0	-7.0	41.74
6.0	-9.3	38.82	6.0	-7.3	41.39
7.0	-9.3	38.77	7.0	-7.6	41.08
8	-9.3	38.71	8	-7.9	40.82
9	-9.4	38.67	9	-8.1	40.57
10	-9.4	38.62	10	-8.3	40.40
			11	-8.5	40.20
			12	-8.6	40.05
			13	-8.8	39.90
			14	-8.9	39.77
			15	-9.0	39.67



**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL  
Project Number: 6468-06-1472  
Date: 8/30/2006

Prepared by: ZO Date: 12-7-06  
Checked by: [Signature] Date: 1-17-07

Boring No: B-901  
Test Interval: 120 ft to 130 ft  
Stick up length: 2 ft  
Test Interval: 118.0 ft to 128 ft (from surface)  
Test Type: Double Packer Technique

Depth of Water  
Table= 23.30 ft (from top of casing)  
h1= 24.30 (from top of casing)  
h2 = 101.7 ft (from top of casing)  
 $\rho_w = 62.4 \text{ lb/ft}^3$

<b>Abbreviations:</b>	
N.O.	Not Observed
N.A.	Not Applicable

$P_0 \text{ Max} = 82.27 \text{ psi}$  Value on field data sheet= 82.26  
Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure=		27.14 psi		Actual Excess Pressure=		54.29 psi		Actual Excess Pressure=		82.26 psi	
Initial Middle Transducer Reading=		43.53 psi		Initial Middle Transducer Reading=		43.53 psi		Initial Middle Transducer Reading=		43.53 psi	
Test Pressure=		70.67 psi		Test Pressure=		97.82 psi		Test Pressure=		125.8 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2887.8		-1.5	0	2889.5		0	0	2893		-1.1
0.5	2889.0	2.4	-29.1	0.5	2890.2	1.4	5.7	0.5	2894.1	2.2	45.6
1	2889.0	0.0	23.3	1	2890.8	1.2	42.6	1	2894.4	0.6	48.1
1.5	2889.2	0.4	22.8	1.5	2891.1	0.6	45.8	1.5	2895.1	1.4	70
2	2889.2	0.0	24.1	2	2891.4	0.6	46.2	2	2897.1	4.0	74.1
2.5	2889.3	0.2	23.7	2.5	2891.6	0.4	46.7	2.5	2899	3.8	74.7
3	2889.4	0.2	22.2	3	2891.9	0.6	46.3	3	2901.2	4.4	75
3.5	2889.4	0.0	22.3	3.5	2892.2	0.6	47.2	3.5	2903.2	4.0	74.5
4	2889.4	0.0	22.2	4	2892.4	0.4	47.5	4	2905.4	4.4	74.2
4.5	2889.4	0.0	22.5	4.5	2892.7	0.6	47.2	4.5	2907.5	4.2	74.2
5	2889.5	0.2	23.0	5	2893.1	0.8	47.2	5	2909.8	4.6	74.4

Average Q: 0.3 gpm  
Excess Pore pressure: 27.14 psi

Average Q: 0.6 gpm  
Excess Pore pressure: 54.29 psi

Average Q: 3.9 gpm  
Excess Pore pressure: 82.26 psi

TEST #4

TEST #5

02-17-07

Boring No: B-901  
 Test Interval 118 ft to 128 ft  
 (from surface)

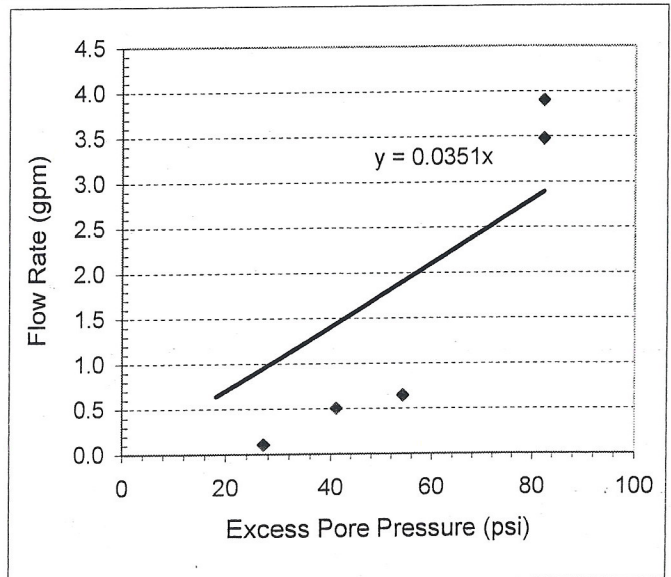
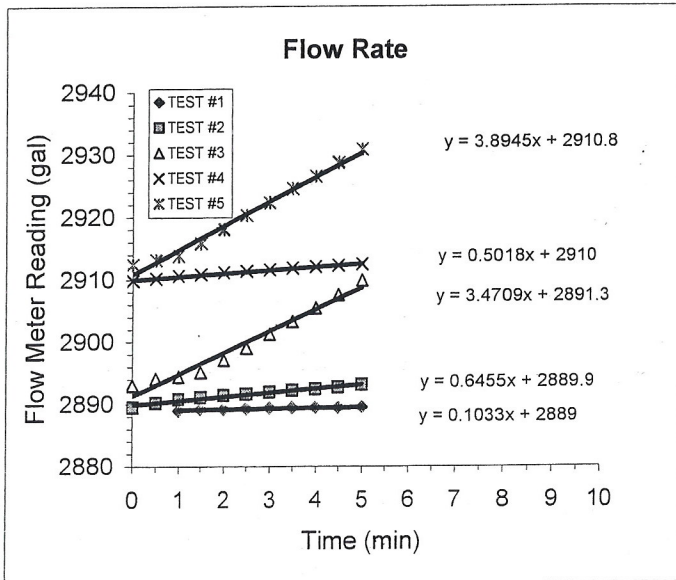
Actual Excess Pressure= 41.13 psi Initial Middle Transducer 43.53 psi Test Pressure= 84.66 psi				Actual Excess Pressure= 82.26 psi Initial Middle Transducer 43.53 psi Test Pressure= 125.79 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2909.8		-7.8	0	2912.4		-7.7
0.5	2910.2	0.8	20.8	0.5	2913.1	1.4	45
1	2910.6	0.8	31.5	1	2913.8	1.4	66.1
1.5	2910.8	0.4	31.8	1.5	2915.8	4.0	72.9
2	2911.1	0.6	32	2	2918	4.4	74.4
2.5	2911.3	0.4	32.2	2.5	2920.3	4.6	73.6
3	2911.5	0.4	32.6	3	2922.3	4.0	74.7
3.5	2911.8	0.6	30.0	3.5	2924.5	4.4	74.5
4	2912	0.4	29.9	4	2926.5	4.0	75.1
4.5	2912.2	0.4	29.9	4.5	2928.7	4.4	74.6
5	2912.4	0.4	30.1	5	2930.8	4.2	75

Density of water,  $\rho_w = 62.4$  lb/ft<sup>3</sup>  
 = 0.0361 lb/in<sup>3</sup>  
 Length = 10 ft  
 Borehole radius = 2.00 in  
 R ranges from 5-10 ft  
 choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	27.14	0.103	62.63	6.27
2	54.29	0.646	125.28	19.60
3	82.26	3.895	189.83	78.04
4	41.13	0.502	94.93	20.11
5	82.26	3.471	189.83	69.55

Average Q: 0.5 gpm  
 Excess Pore pressure: 41.13 psi

Average Q: 4.3 gpm  
 Excess Pore pressure: 82.26 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q * \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec} = 0.00 \text{ ft/year}$$

# Pressure Decay Test

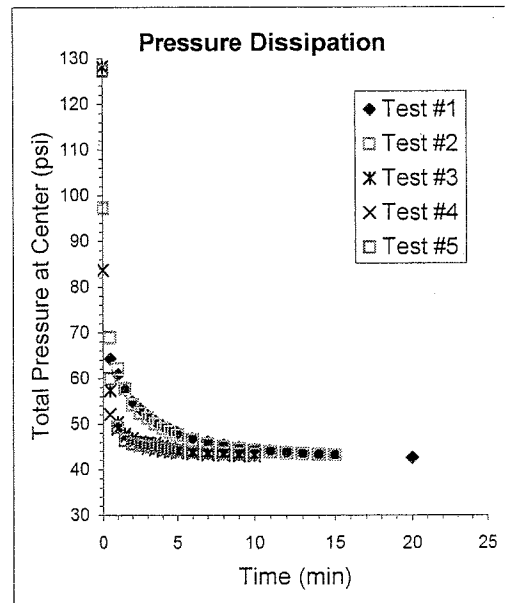
Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 8/18/2006

Prepared by: ZO Date: 12-7-06  
 Checked by: Gar Date: 1-17-07  
 N.O. Not Observed  
 N.A. Not Applicable

Boring No: B-901  
 Test Interval: 118 ft to 128 ft (from surface)

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	23	21.5	0.0	47.2	97.26	0.0	74.4	128.07
0.5	16.6	64.17	0.5	19.4	68.95	0.5	4.6	57.30
1.0	13.1	60.72	1.0	13.1	62.05	1.0	-3.3	50.30
1.5	11	57.48	1.5	8.7	57.72	1.5	-5.3	47.72
2.0	9	54.86	2.0	6.9	54.2	2.0	-5.8	46.78
2.5	7.8	53.19	2.5	5.2	52.30	2.5	-6.2	46.07
3.0	6.6	51.83	3.0	4.3	51.23	3.0	-6.4	45.81
3.5	5.8	50.58	3.5	3.3	49.96	3.5	-6.3	45.69
4.0	5.2	49.61	4.0	2.7	49.03	4.0	-6.8	45.03
4.5	4.7	48.77	4.5	2.1	48.2	4.5	-7.1	44.58
5.0	4.2	48.04	5.0	1.7	47.51	5.0	-7.4	44.26
6.0	3.5	46.77	6.0	1.1	46.54	6.0	-7.6	43.86
7.0	2.9	45.98	7.0	0.5	45.56	7.0	-7.7	43.60
8	2.6	45.31	8.0	0.2	44.98	8.0	-7.8	43.41
9	2.2	44.78	9.0	0	44.53	9.0	-7.8	43.28
10	1.9	44.34	10.0	-0.2	44.18	10.0	-7.9	43.16
11	1.8	43.97	11.0	-0.4	43.87			
12	1.6	43.69	12.0	-0.5	43.61			
13	1.4	43.46	13.0	-0.7	43.44			
14	1.3	43.23	14.0	-0.7	43.27			
15	1.2	43.08	15.0	-0.8	43.13			
20	0.9	42.55						

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	3.01	83.63	0.0	75.0	127.35
0.5	-0.2	52.00	0.5	1.3	59.90
1.0	-3.3	48.91	1.0	-4.0	49.30
1.5	-5	47.08	1.5	-6.8	46.37
2.0	-5.8	45.96	2.0	-7.5	45.62
2.5	-6.3	45.26	2.5	-8.0	45.27
3.0	-6.6	44.73	3.0	-8.2	44.97
3.5	-6.9	44.37	3.5	-8.0	44.99
4.0	-7.1	44.06	4.0	-8.3	44.59
4.5	-7.3	43.86	4.5	-8.5	44.27
5.0	-7.3	43.68	5.0	-8.7	44.07
6.0	-7.5	43.42	6.0	-8.8	43.80
7.0	-7.6	43.23	7.0	-8.9	43.63
8	-7.6	43.09	8	-8.9	43.50
9	-7.7	42.98	9	-8.9	43.38
10	-7.7	42.92	10	-8.9	43.27



**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL  
Project Number: 6468-06-1472  
Date: 8/30/2006

Prepared by: ZO Date: 12-7-06  
Checked by: [Signature] Date: 1-17-07

Boring No: B-901  
Test Interval: 147 ft to 157 ft  
Stick up length: 2 ft  
Test Interval: 145.0 ft to 155 ft (from surface)  
Test Type: Double Packer Technique

Depth of Water  
Table= 23.30 ft (from top of casing)  
h1= 24.30 (from top of casing)  
h2 = 128.7 ft (from top of casing)  
 $\rho_w = 62.4 \text{ lb/ft}^3$

**Abbreviations:**  
N.O. Not Observed  
N.A. Not Applicable

$P_0 \text{ Max} = 97.66 \text{ psi}$  Value on field data sheet = 97.65

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure=		32.22 psi		Actual Excess Pressure=		64.45 psi		Actual Excess Pressure=		97.65 psi	
Initial Middle Transducer Reading=		57.82 psi		Initial Middle Transducer Reading=		57.82 psi		Initial Middle Transducer Reading=		57.82 psi	
Test Pressure=		90.04 psi		Test Pressure=		122.27 psi		Test Pressure=		155.47 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2795.7		0.1	0	2797.8		0.1	0	2798.9		0.4
0.5	2796.7	2.0	4.8	0.5	2798.8	2.0	24.7	0.5	2799.7	1.6	24.8
1	2797.6	1.8	24.5	1	2798.9	0.2	34.3	1	2799.9	0.4	35.3
1.5	2797.7	0.2	29.2	1.5	2798.9	0.0	36	1.5	2799.9	0.0	37.0
2	2797.8	0.2	31.7	2	2798.9	0.0	36.8	2	2799.9	0.0	37.4
2.5	2797.8	0.0	31.8	2.5	2798.9	0.0	37.1	2.5	2799.9	0.0	38
3	2797.8	0.0	31.7	3	2798.9	0.0	37.4	3	2799.9	0.0	38.6
3.5	2797.8	0.0	31.7	3.5	2798.9	0.0	38.6	3.5	2799.9	0.0	39.4
4	2797.8	0.0	32.0	4	2798.9	0.0	38.4	4	2799.9	0.0	38
4.5	2797.8	0.0	32.1	4.5	2798.9	0.0	38.3	4.5	2799.9	0.0	37.8
5	2797.8	0.0	32.1	5	2798.9	0.0	39.3	5	2799.9	0.0	38.4

Average Q: 0.4 gpm  
Excess Pore pressure: 32.22 psi

Average Q: 0.0 gpm  
Excess Pore pressure: 64.45 psi

Average Q: 0.0 gpm  
Excess Pore pressure: 97.65 psi



11-17-07

TEST #4

TEST #5

Actual Excess Pressure= 48.82 psi			Actual Excess Pressure= 97.65 psi				
Initial Middle Transducer 57.82 psi			Initial Middle Transducer 57.82 psi				
Test Pressure= 106.64 psi			Test Pressure= 155.5 psi				
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
Test not Conducted				Test not Conducted			

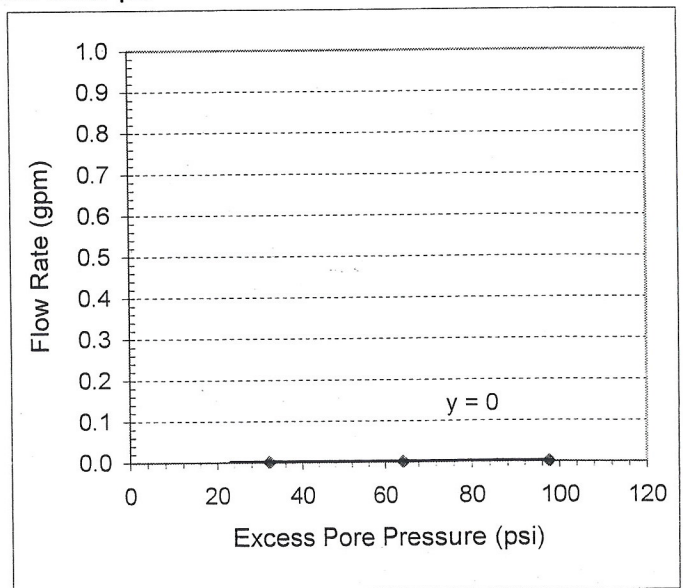
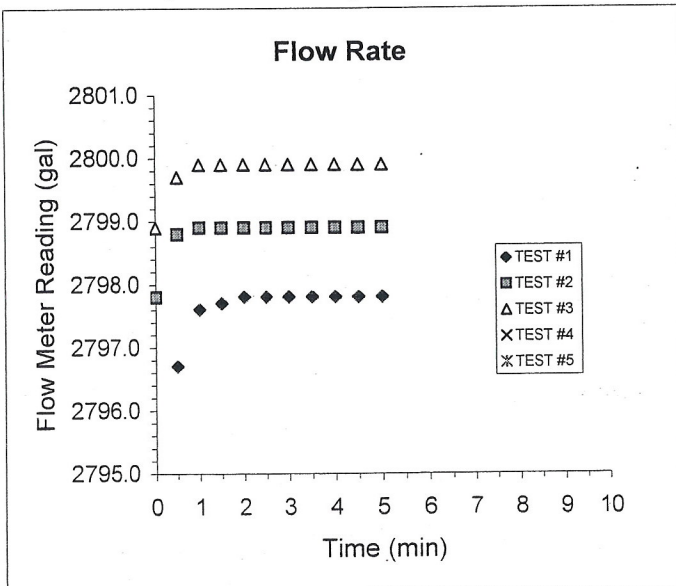
Boring No: B-901  
 Test Interval 145 ft to 155 ft  
 (from surface)

Density of water,  $\rho_w = 62.4$  lb/ft<sup>3</sup>  
 = 0.0361 lb/in<sup>3</sup>  
 Length = 10 ft  
 Borehole radius = 2.00 in  
 R ranges from 5-10 ft:  
 choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	32.22	0.000	74.35	0.00
2	64.45	0.000	148.73	0.00
3	97.65	0.000	225.35	0.00
4	48.82		112.66	
5	97.65		225.3	

Average Q: gpm  
 Excess Pore pressure: 48.82 psi

Average Q: gpm  
 Excess Pore pressure: 97.65 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q \cdot \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec} = 0.00 \text{ ft/year}$$

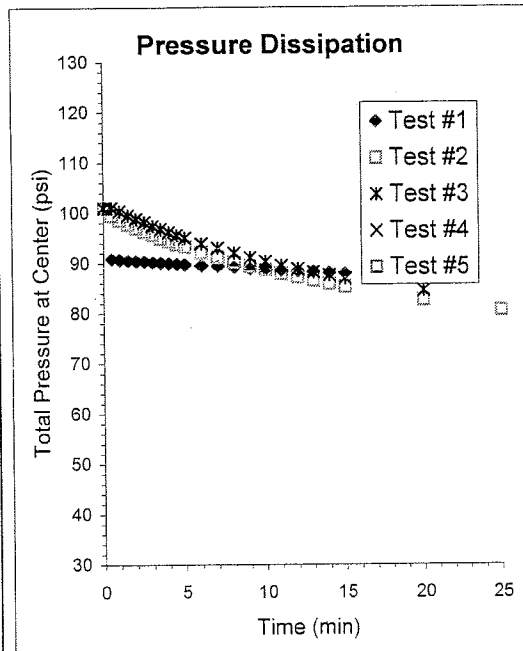
**Pressure Decay Test**

Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 8/30/2006  
 Boring No: B-901  
 Test Interval: 145 ft to 155 ft

Prepared by: ZO Date: 12-7-06  
 Checked by:                      Date: 1-17-07  
 N.O. Not Observed  
 N.A. Not Applicable

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	32.1	90.66	0.0	39.3	100.88	0.0	38.4	101.00
0.5	32.1	90.78	0.5	37.8	99.41	0.5	38.8	101.00
1.0	31.9	90.64	1.0	37.2	98.57	1.0	38.8	100.32
1.5	31.8	90.5	1.5	36.4	97.71	1.5	37.5	99.47
2.0	31.7	90.38	2.0	35.7	96.96	2.0	36.8	98.82
2.5	31.6	90.27	2.5	35.1	96.24	2.5	36.2	98.14
3.0	31.7	90.15	3.0	34.4	95.6	3.0	35.5	97.42
3.5	31.3	90.02	3.5	33.8	94.92	3.5	34.9	96.74
4.0	31.3	89.93	4.0	33.3	94.28	4.0	34.3	96.09
4.5	31.2	89.81	4.5	32.6	93.7	4.5	33.7	95.53
5.0	31.1	89.64	5.0	32.3	93.18	5.0	33.2	94.94
6.0	30.9	89.47	6.0	31.3	92.07	6.0	32.1	93.82
7.0	30.7	89.25	7.0	30.4	91.12	7.0	31.2	92.91
8	30.6	89.06	8.0	29.6	90.17	8.0	30.4	91.89
9	30.4	88.85	9.0	28.8	89.34	9.0	29.5	91.00
10	30.2	88.68	10.0	28.2	88.55	10.0	28.9	90.20
11	30.1	88.52	11.0	27.5	87.83	11.0	28.1	89.43
12	30.0	88.35	12.0	26.9	87.07	12.0	27.5	88.76
13	29.8	88.18	13.0	26.3	86.46	13.0	226.9	88.13
14	29.7	88.02	14.0	25.7	85.81	14.0	26.4	87.46
15	29.5	87.88	15.0	25.2	85.23	15.0	25.8	86.88
			20.0	22.8	82.57	20.0	23.5	84.38
			25.0	21.1	80.49			

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
Test not Conducted			Test not Conducted		



**IN SITU DETERMINATION OF ROCK MASS PERMEABILITY USING WATER PRESSURE TEST  
IN ACCORDANCE WITH CORPS OF ENGINEERS,  
WATERWAYS EXPERIMENT STATION, RTH 381-80**

Project Name: NORTH ANNA COL  
Project Number: 6468-06-1472  
Date: 9/6/2006

Prepared by: ZO Date: 12-7-06  
Checked by: *[Signature]* Date: 1-17-07

**Boring No:** B-901  
**Test Interval:** 147.0 ft to 157 ft (from Datum)  
**Stick up length:** 2 ft  
**Test Interval:** 145.0 ft to 155.0 ft (from surface)  
**Test Type:** Double Packer Technique

**Note: This is a retest using higher capacity pump**

Depth of Water  
Table= 23.30 ft (from top of casing)  
h1= 24.30 (from top of casing)  
h2 = 128.7 ft (from top of casing)  
 $\rho_w = 62.4 \text{ lb/ft}^3$

**Abbreviations:**  
N.O. Not Observed  
N.A. Not Applicable

**P<sub>0</sub> Max= 97.66 psi** Value on field data sheet= 97.65

Target excess pressures were 1/3Pmax, 2/3Pmax, Pmax, 1/2 Pmax and Pmax. **Actual** excess pressures given below.

TEST #1				TEST #2				TEST #3			
Actual Excess Pressure= 32.22 psi Initial Middle Transducer Reading= 55 psi Test Pressure= 87.28 psi				Actual Excess Pressure= 64.44 psi Initial Middle Transducer Reading= 55 psi Test Pressure= 119.5 psi				Actual Excess Pressure= 97.65 psi Initial Middle Transducer Reading= 55 psi Test Pressure= 152.7 psi			
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2871		0.1	0	2875		1.8				
0.5	2871.5	1.0	2	0.5	2876.7	3.4	44.3				
1	2873.1	3.2	28.3	1	2876.8	0.2	52.11				
1.5	2873.3	0.4	31.6	1.5	2877.1	0.6	58.8				
2	2873.3	0.0	30.8	2	2878.2	2.2	60.2				
2.5	2873.3	0.0	30.3	2.5	2879.4	2.4	59.4				
3	2873.3	0.0	29.8	3	2880.4	2.0	59.6				
3.5	2873.3	0.0	29.1	3.5	2881.6	2.4	59.9				
4	2873.3	0.0	30.6	4	2882.7	2.2	58.7				
4.5	2873.3	0.0	30.1	4.5	2883.7	2.0	58.2				
5	2873.3	0.0	29.6	5	2884.7	2.0	58.9				
Pressure pushes packers out of place-Test is not performed											

**Average Q: 0.0 gpm**  
**Excess Pore pressure: 32.22 psi**

**Average Q: 2.2 gpm**  
**Excess Pore pressure: 64.44 psi**

**Average Q: gpm**  
**Excess Pore pressure: 97.65 psi**

02/11-07

TEST #4

TEST #5

Boring No: B-901  
 Test Interval 145 ft to 155 ft  
 (from surface)

TEST #4				TEST #5			
Actual Excess Pressure=		48.82 psi		Actual Excess Pressure=		97.65 psi	
Initial Middle Transducer		55 psi		Initial Middle Transducer		55 psi	
Test Pressure=		103.90 psi		Test Pressure=		152.7 psi	
Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)	Time (min)	Flow Meter Reading (Gal)	Q (GPM)	Surface Gauge (psi)
0	2887		2.8				
0.5	2887.8	1.6	48.7				
1	2887.8	0.0	46.1				
1.5	2887.8	0.0	44.1				
2	2887.8	0.0	42.6				
2.5	2887.8	0.0	41.3				
3	2887.8	0.0	44.6				
3.5	2887.8	0.0	43.1				
4	2887.8	0.0	41.8				
4.5	2887.8	0.0	40.4				
5	2887.8	0.0	39.5				

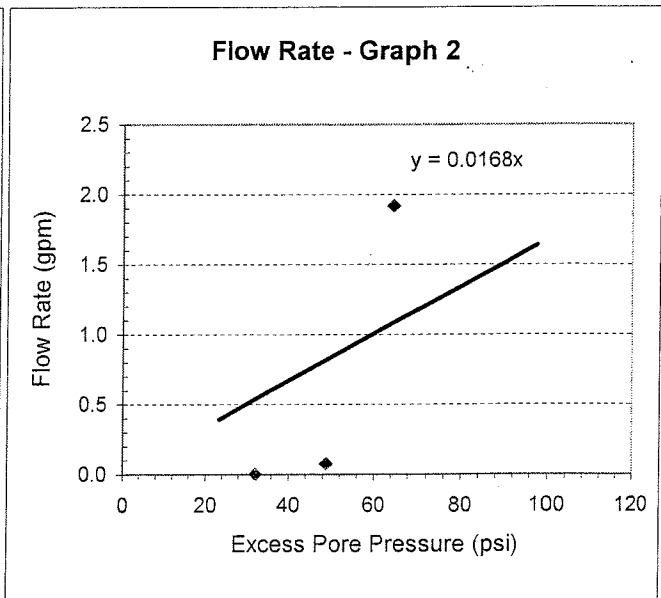
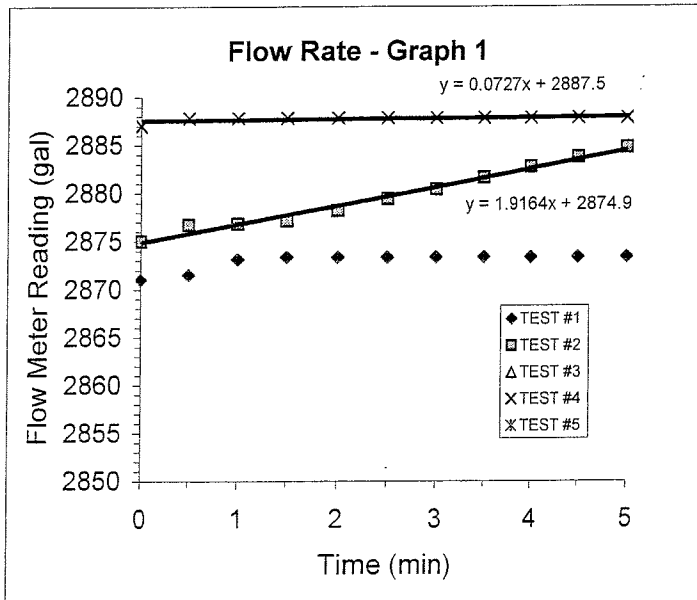
Pressure pushes packers out of place-Test is not performed

Density of water,  $\rho_w = 62.4$  lb/ft<sup>3</sup>  
 = 0.0361 lb/in<sup>3</sup>  
 Length = 10 ft  
 Borehole radius = 2.00 in  
 R ranges from 5-10 ft:  
 choose R = 5 ft

	Excess Pressure (psi)	Q (gpm)	Test Pres. (ft)	$k_e$ (fpy)
1	32.22	0.00	74.35	0.00
2	64.44	1.92	148.71	49.02
3	97.65		225.35	
4	48.82	0.07	112.66	2.45
5	97.65		225.3	

Average Q: 0.2 gpm  
 Excess Pore pressure: 48.82 psi

Average Q: gpm  
 Excess Pore pressure: 97.65 psi



obtain Q from graph 2 in gpm/psi --> 0.0000 gal/psi

$$k_e = Q * \ln(R/r_0) / (2\pi L H_0)$$

$$k_e = 0.00E+00 \text{ cm/sec} = 0.00 \text{ ft/year}$$

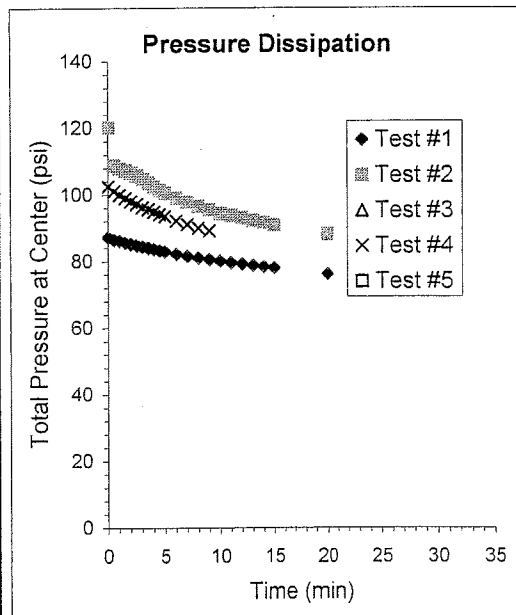
# Pressure Decay Test

Project Name: NORTH ANNA COL  
 Project Number: 6468-06-1472  
 Date: 9/6/2006  
 Boring No: B-901  
 Test Interval: 145 ft to 155 ft (from surface)

Prepared by: ZQ Date: 12-7-06  
 Checked by: [Signature] Date: 1-17-07  
 N.O. Not Observed  
 N.A. Not Applicable

Test #1			Test #2			Test #3		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	29.6	87.13	0.0	58.9	120.19	No data Test not conducted		
0.5	28.9	86.35	0.5	47	108.75			
1.0	28.7	86.04	1.0	46.4	107.8			
1.5	28.3	85.59	1.5	46	107.16			
2.0	27.9	85.13	2.0	45.5	106.54			
2.5	22.6	84.76	2.5	44.8	105.69			
3.0	27.2	84.31	3.0	43.8	104.64			
3.5	26.8	83.91	3.5	42.6	103.55			
4.0	26.6	83.54	4.0	41.6	102.17			
4.5	26.3	83.17	4.5	40.6	101.28			
5.0	26	82.83	5.0	39.7	100.4			
6.0	25.4	82.11	6.0	38.5	98.94			
7.0	24.9	81.5	7.0	37.3	97.63			
8.0	24.4	80.97	8.0	36.4	96.52			
9.0	24.1	80.48	9.0	35.4	95.44			
10.0	23.7	79.98	10.0	34.3	94.3			
11.0	23.3	79.5	11.0	33.8	93.71			
12.0	23	79.07	12.0	33.1	92.88			
13.0	22.6	78.64	13.0	32.4	92.15			
14.0	22.3	78.23	14.0	31.9	91.49			
15.0	22	77.84	15.0	31.3	90.77			
20.0	20.7	76.15	20.0	28.9	88.07			

Test #4			Test #5		
Time (min)	Surface Gauge (psi)	Center Tranducer (psi)	Time (min)	Surface Gauge (psi)	Center Tranducer (psi)
0.0	39.5	102.33	No data Test not conducted		
0.5	38.3	100.9			
1.0	37.4	99.9			
1.5	36.4	98.89			
2.0	35.5	97.93			
2.5	34.7	97.17			
3.0	34	96.12			
3.5	33.1	95.49			
4.0	32.4	94.79			
4.5	31.8	93.95			
5.0	31.1	93.38			
6.0	30.1	92.01			
7.0	29.1	90.97			
8.0	28.1	89.93			
9.0	27.2	89.02			
10.0	26.4	88.15			
11.0	25.8	87.35			
12.0	25.1	86.54			
13.0	24.3	85.81			
14.0	23.8	85.15			
15.0	23.2	84.53			
20.0	20.7	81.21			



PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8.30-06

Boring No. 6468-06-1472

Test Interval: 79.0 to 89.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

h<sub>1</sub> = Distance from the datum to the water level

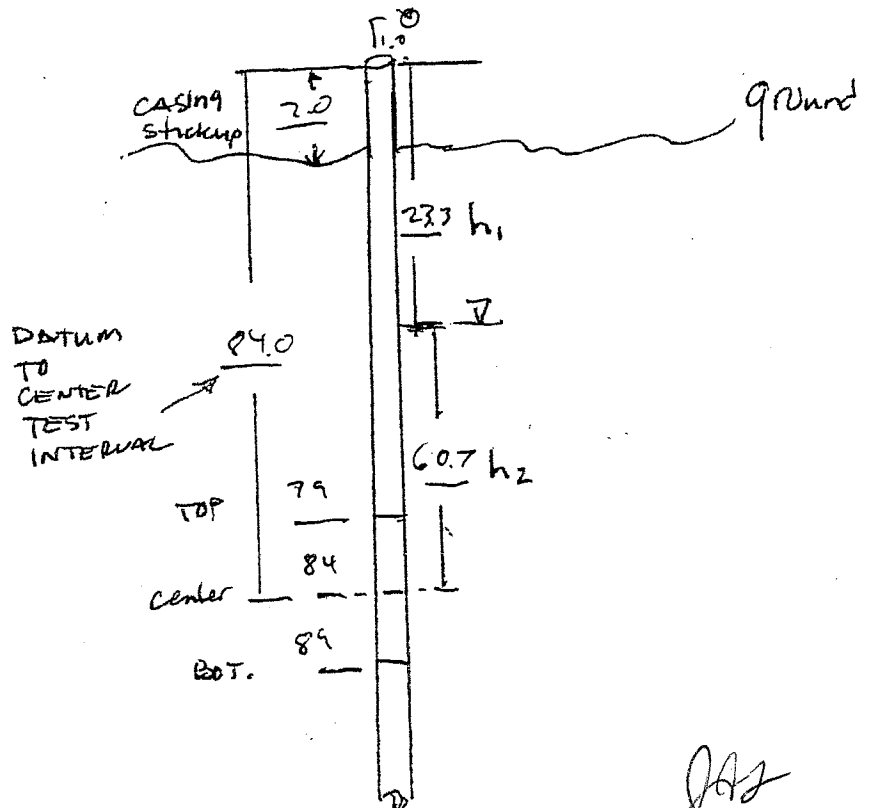
h<sub>2</sub> = Distance from the water level to the center of the test interval

h<sub>1</sub> = 24.3

h<sub>2</sub> = 84.0 - 23.3 = 60.7

P MAX = 24.3 + 34.59 = 58.89

SKETCH



JAZ  
12-6-06

JJ  
12-6-06

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 60.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  58.50 ( $P_0 = [(A+B) * 1] + C * .57$  psi) 125

TEST NUMBER: 1 TEST PRESSURE 46.5 psi PACKER PRESSURE: 100.5 psi 831

Initial Transducer Readings: Top .46, Middle 27.08, Bottom 32.05

Transducer Readings after initial pressurization:

Top 1.05, Middle 30.84, Bottom 31.89

Transducer Readings after final flow measurement:

Top .40, Middle 38.17, Bottom 31.12

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2868.5	/	2.3	
0.5	2869.2	1.4	46.4	
1.0	2869.2	0	3.4	Release Pressure
1.5	2869.4	0.4	23.2	
2.0	2849.4	0	5.0	Release Pressure
2.5	2869.4	0	11.1	
3.0	2869.4	0	11.9	
3.5	2869.4	0	11.8	
4.0	2869.4	0	11.7	
4.5	2869.4	0	11.7	
5.0	2899.4	0	11.6	

Using 30 gpm / 120 psi pump

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 3

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 79 FT. TO 89 FT.

DATA COLLECTED BY: Stoward

*JKJ*  
*12-6-06*

*Page 2 not used*

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	11.6	46.49
0.5	11.3	46.22
1.0	11.0	45.89
1.5	10.7	45.60
2.0	10.4	45.31
2.5	10.2	45.04
3.0	9.9	44.76
3.5	9.6	44.48
4.0	9.3	44.21
4.5	9.1	43.96
5.0	8.9	43.70
6.0	8.4	43.20
7.0	7.8	42.53
8.0	7.3	42.04
9.0	6.9	41.58
10.0	6.4	41.02
11.0	6.0	40.64
12.0	5.8	40.38
13.0	5.5	40.13
14.0	5.3	39.88
15.0	5.0	39.61
20.0	4.1	38.55

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

017423

542-30

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M1 79-89

" - B1 79 - "

" - T1 79 - "



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JGJ*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 60.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  58.89 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 2 TEST PRESSURE 65.94 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .46, Middle 27.08, Bottom 32.05

Transducer Readings after initial pressurization:  
Top .40, Middle 36.17, Bottom 31.8 <sup>548.71</sup> <sub>12</sub>

Transducer Readings after final flow measurement:  
Top \*, Middle 37.12, Bottom 30.75

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2869.4	/	3.2	
0.5	2869.5	0.2	28.8	
1.0	2869.5	<del>0.2</del>	32.0	
1.5	2869.5	<del>0</del>	30.4	
2.0	2869.5	<del>0</del>	30.4	
2.5	2869.5	<del>0</del>	30.5	
3.0	2869.5	<del>0</del>	31.2	
3.5	2869.5	<del>0</del>	29.2	
4.0	2869.5	<del>0</del>	31.4	
4.5	2869.5	<del>0</del>	30.3	
5.0	2869.5	<del>0</del>	30.9	

\* Batteries died in top transducer

using 30 spm / 120 psi pump

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 79 FT. TO 89 FT.

DATA COLLECTED BY: Stoward

*Job 12-6-06  
Page 2 not used*

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	30.9	66.05
0.5	26.7	61.88
1.0	23.9	58.96
1.5	21.6	56.61
2.0	19.6	54.67
2.5	18.0	53.37
3.0	16.8	52.09
3.5	15.7	50.88
4.0	14.6	49.79
4.5	13.7	48.87
5.0	13.1	48.05
6.0	11.7	46.47
7.0	10.5	45.43
8.0	9.6	44.47
9.0	8.8	43.60
10.0	8.1	42.81
11.0	7.4	42.12
12.0	6.8	41.57
13.0	6.4	41.00
14.0	5.9	40.57
15.0	5.5	40.09
	3.9	38.71

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

017423

5# 8-31

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M 79-89

" - B279 - "

" - T279 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JH*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Howard DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 307.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 27.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 60.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  58.89 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 3 TEST PRESSURE 87.97 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .44, Middle 27.08, Bottom 32.05

Transducer Readings after initial pressurization:  
Top .14, Middle 32.21, Bottom 30.51

Transducer Readings after final flow measurement:  
Top .13, Middle 39.83, Bottom 30.44

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2869.5	/	-1.5	
0.5	2869.8	0.6	44.8	
1.0	2869.8	Ø	45.3	
1.5	2869.8	Ø	51.6	
2.0	2869.8	Ø	51.7	
2.5	2869.8	Ø	51.4	
3.0	2869.8	Ø	51.1	
3.5	2869.8	Ø	51.5	
4.0	2869.8	Ø	52.1	
4.5	2869.8	Ø	51.2	
5.0	2869.8	Ø	52.0	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 3/2

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 79 FT. TO 89 FT.

DATA COLLECTED BY: Shawand

*JJ*  
12-6-06  
Page 2 not used

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	52.0	87.64
0.5	47.0	77.79
1.0	36.0	71.10
1.5	30.3	65.40
2.0	26.2	61.97
2.5	23.7	59.32
3.0	21.3	56.28
3.5	19.2	54.91
4.0	18.0	53.10
4.5	16.5	51.75
5.0	15.2	50.39
6.0	13.4	48.43
7.0	11.9	46.85
8.0	10.5	45.46
9.0	9.5	44.35
10.0	8.6	43.36
11.0	7.8	42.58
12.0	7.1	41.83
13.0	6.5	41.21
14.0	6.1	40.61
15.0	5.5	40.07

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10036 (Top), 10191 (Middle), 10036 (Bottom) 017423  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 548-31  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M 379 - 89  
 " - B379 - " "  
 " - T379 - " "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JAJ*  
17.6.06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Howard DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 60.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  58.89 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

$\frac{1}{2}$

TEST NUMBER: 4 TEST PRESSURE 76.52 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .46, Middle 27.08, Bottom 32.05

29.44

Transducer Readings after initial pressurization:

Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

Transducer Readings after final flow measurement:

Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Hole not taking water, testing abandoned per A/Fice's instructions

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 79 FT. TO 89 FT.

DATA COLLECTED BY: Stoward

JAZ 12-6-06  
Page 2 not a sub

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0		
0.5		
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~(Bottom) 017423

Surface Pressure Gauge: Omega DPG serial number 2634708001 518-31

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M 4 79 - 89  
 " " B 4 79 - " "  
 " " T 4 79 - " "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*AG*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 79.0 FT. TO 89.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.7 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 60.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  58.89 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 5 TEST PRESSURE 85.97 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top .46, Middle 27.08, Bottom 32.05

Transducer Readings after initial pressurization:  
Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

Transducer Readings after final flow measurement:  
Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

*Hole not taking water, testing abandoned per ALT's instructions*

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-30-06

Boring No. B901

Test Interval: 94.0 to 104.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

h<sub>1</sub> = Distance from the <sup>Cause 5148-30</sup> datum to the water level

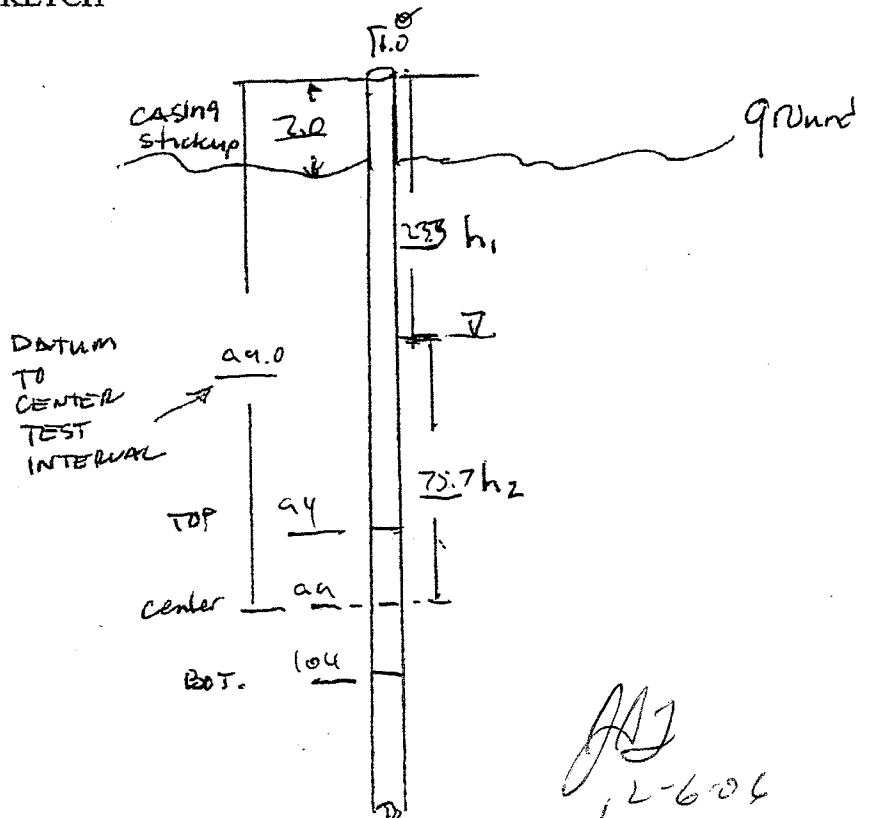
h<sub>2</sub> = Distance from the water level to the center of the test interval

h<sub>1</sub> = 24.3

h<sub>2</sub> = 99.0 - 23.3 = 75.7

P MAX = 24.3 + 43.14 = 67.44

SKETCH





DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JAG*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 94.0 FT. TO 104.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 27.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  69.44 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 1 TEST PRESSURE 5354 psi PACKER PRESSURE: 120 psi

Initial Transducer Readings: Top .17, Middle 31.29, Bottom 36.31

Transducer Readings after initial pressurization:  
Top .16, Middle 32.25, Bottom 36.75

Transducer Readings after final flow measurement:  
Top .15, Middle 32.63, Bottom 37.05

22.25  
1/3

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	279.99	/	0.0	
0.5	2801.6	3.24 <sup>279.99-2801.6</sup>	17.3	
1.0	2801.6	0	18.2	
1.5	2801.8	.4	20.1	
2.0	2801.8	0	18.4	
2.5	2801.8	0	20.0	
3.0	2801.8	0	20.0	
3.5	2801.8	0	18.1	
4.0	2801.9	.2	21.0	
4.5	2801.9	0	19.2	
5.0	2801.9	0	19.7	

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 94 FT. TO 104 FT.

DATA COLLECTED BY: Stoward

*Handwritten notes:*  
 2  
 12/6-06  
 Page 2 not used

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	19.7	53.73
0.5	18.1	51.77
1.0	16.5	49.85
1.5	15.3	48.93
2.0	14.4	46.97
2.5	13.4	45.72
3.0	12.5	44.75
3.5	11.9	43.54
4.0	11.3	43.03
4.5	10.7	42.25
5.0	10.2	41.37
6.0	9.4	40.20
7.0	8.6	39.06
8.0	8.0	38.07
9.0	7.4	37.29
10.0	7.0	36.55
11.0	6.6	35.94
12.0	6.3	35.39
13.0	6.0	34.89
14.0	5.7	34.44
15.0	5.5	34.08
20.0	4.7	32.72

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ <sup>SH 8-2 017423</sup> (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

*Handwritten notes:*  
 Tests: B901-M194-104  
 " - B194 - "  
 " - T194 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*J* 12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. Ba01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 94.0 FT. TO 104.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  6744 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 2 TEST PRESSURE 75.8 psi PACKER PRESSURE: 120 psi

Initial Transducer Readings: Top .17, Middle 31.29, Bottom 36.31

Transducer Readings after initial pressurization:

Top .15, Middle 32.63, Bottom 37.05

Transducer Readings after final flow measurement:

Top .17, Middle 32.23, Bottom 37.20

2/3  
44.51

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2801.9	/	4.1	
0.5	2803.1	4.4	15.1	
1.0	2803.3	0.4	25.9	
1.5	2803.9	1.2	38.1	
2.0	2804.2	0.6	39.0	
2.5	2804.4	.4	38.1	
3.0	2804.4	0	39.2	
3.5	2804.6	<del>0.2</del> 0.4	38.6	
4.0	2804.7	.2	39.0	
4.5	2804.8	.2	39.4	
5.0	2805.0	.4	39.1	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472  
 BORING NO.: B901  
 DATE: 8-30-06  
 TEST NUMBER: 2  
 TEST INTERVAL (FROM DATUM): FROM 94 FT. TO 104 FT.  
 DATA COLLECTED BY: Stoward

PAGE 3  
 2  
 Jay  
 12-6-06  
 Page 2 not a seal

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	39.1	15.49
0.5	38.4 21.4	17.40
1.0	37.5 22.5	63.5-8.5
1.5	24.1	58.96
2.0	21.4	55.78
2.5	19.4	53.36
3.0	17.7	51.20
3.5	16.2	49.32
4.0	15.0	47.82
4.5	14.0	46.30
5.0	13.0	44.88
6.0	11.5	42.85
7.0	10.2	41.02
8.0	9.2	39.47
9.0	8.4	38.71
10.0	7.7	37.99
11.0	7.2	36.45
12.0	6.7	35.68
13.0	6.4	35.02
14.0	6.0	34.50
15.0	5.7	33.98
20.0	4.8	32.47

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ (Bottom) 017429  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 5 ft 8-7  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M294-104  
 " - B294 - 11  
 " - T294 - 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*John 12606*

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Howard DATE COLLECTED: 8-30-06

BORING NO. Ba01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 94.0 FT. TO 104.0 FT.

TOTAL BORING DEPTH FROM DATUM: 702.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  67.44 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 3 TEST PRESSURE 98.77 psi PACKER PRESSURE: 120 psi

Initial Transducer Readings: Top .17, Middle 31.29, Bottom 36.71

Transducer Readings after initial pressurization:

Top .17, Middle 32.23, Bottom 37.20

Transducer Readings after final flow measurement:

Top .19, Middle 31.72, Bottom 40.56

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2804.9	—	3.6	
0.5	2806.8	3.8	45.6	
1.0	2807.4	1.2	48.1	
1.5	2811.1	7.4	58.6	
2.0	2815.4	8.6	60.8	
2.5	2818.8	6.8	58.6	
3.0	2822.1	6.6	59.3	
3.5	2825.2	6.2	59.1	
4.0	2828.4	6.4	59.9	
4.5	2831.4	6.0	60.0	
5.0	2834.8	6.8	57.4	

*Change to 30 GPM / 120 psi pump*

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 2

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 94 FT. TO 104 FT.

DATA COLLECTED BY: Stoward

*J.S.*  
12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	57.4	99.70
0.5	32.7	73.43
1.0	29.6	64.15
1.5	16.1	58.55
2.0	11.5	52.93
2.5	7.6	49.03
3.0	4.1	45.96
3.5	1.4	43.16
4.0	-0.5	41.06
4.5	-2.2	39.41
5.0	-3.7	37.86
6.0	-5.5	35.74
7.0	-7.0	34.38
8.0	-7.8	33.49
9.0	-8.2	32.92
10.0	-8.5	32.56
11.0	-8.7	32.33
12.0	-8.7	32.13
13.0	-8.7	31.98
14.0	-8.8	31.86
15.0	8.8	31.77

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom) 017423  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 54 8-31  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M3 94 - 104  
 " - B3 94 - 11  
 " - T3 94 - 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JLJ*  
2606

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 94.0 FT. TO 104.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 27.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  67.44 ( $P_o = [(A+B) * 1] + C * .57$  psi)

$\frac{1}{2}$  TEST NUMBER: 5424 TEST PRESSURE 62.01 psi PACKER PRESSURE: 120 psi

33.72 Initial Transducer Readings: Top .17, Middle 31.24, Bottom 36.31

Transducer Readings after initial pressurization:  
Top .19, Middle 32.23, Bottom 40.56

Transducer Readings after final flow measurement:  
Top .19, Middle 31.40, Bottom 38.44

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	28 34.8	/	-8.6	
0.5	28 35.3	1.0	14.9	
1.0	28 35.8	1.0	24.2	
1.5	28 36.0	0.4	24.1	
2.0	28 36.1	0.2	23.6	
2.5	28 36.2	0.2	23.4	
3.0	28 36.3	0.2	23.4	
3.5	28 36.4	0.2	23.7	
4.0	28 36.5	0.2	23.8	
4.5	28 36.6	0.2	23.8	
5.0	28 36.7	0.2	23.5	

using 30 GPM/120 psi pump

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 3

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 94 FT. TO 104 FT.

DATA COLLECTED BY: Stoward

*JG 12-4-06*

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	23.5	65.72
0.5	10.1	53.04
1.0	6.2	47.27
1.5	2.3	42.08
2.0	0.2	41.01
2.5	-2.2	39.04
3.0	-3.8	37.34
3.5	-5.0	35.98
4.0	-5.9	34.89
4.5	-6.5	34.21
5.0	-7.1	33.57
6.0	-7.7	32.72
7.0	-8.0	32.27
8.0	-8.2	31.95
9.0	-8.4	31.75
10.0	-8.4	31.62

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom) 017423  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 3H 2-3  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M4 94-104  
 " - B424 - "  
 " - T424 - "



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JJ*  
12604

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 94.0 FT. TO 104.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  67.44 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 5 TEST PRESSURE 98.73 psi PACKER PRESSURE: 120 psi

Initial Transducer Readings: Top .17, Middle 31.29, Bottom 36.71

Transducer Readings after initial pressurization:  
Top .19, Middle 31.40, Bottom 38.44

Transducer Readings after final flow measurement:  
Top .19, Middle 30.60, Bottom 46.37

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2836.7	/	-8.4	
0.5	2837.9	2.4	41.6	
1.0	2839.6	3.4	55.6	
1.5	2844.9	10.6	60.0	
2.0	2847.1	4.4	60.4	
2.5	2850.3	6.4	60.5	
3.0	2853.1	5.6	58.4	
3.5	2856.4	6.6	59.6	
4.0	2859.6	6.4	60.0	
4.5	2862.2	5.2	60.4	
5.0	2865.5	6.6	59.1	
5.5	2868.5	6.0	60.0	

using 30 gpm / 120 psi

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 5

TEST INTERVAL (FROM DATUM): FROM 94 FT. TO 104 FT.

DATA COLLECTED BY: Stoward

2  
12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	60.0	99.81
0.5	27.3	70.43
1.0	20.6	61.27
1.5	12.5	54.25
2.0	7.8	49.17
2.5	3.5	45.44
3.0	0.4	41.81
3.5	-2.2	39.25
4.0	-4.4	37.16
4.5	-5.7	35.70
5.0	-6.9	34.59
6.0	-8.1	33.17
7.0	-8.7	32.57
8.0	-9.1	32.09
9.0	-9.3	31.80
10.0	-9.4	31.63
11.0	-9.4	31.48
12.0	<del>-9.5</del> -9.5	31.31
13.0	-9.7	31.0
14.0	-9.7	30.78
15.0	-9.8	30.67

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

014423

5th 2-31

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M594-104

" - B594 - "

" - T594 - "

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-30-06

Boring No. B901

*JH*  
126-06

Test Interval: 109.0 to 119.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

h<sub>1</sub> = Distance from the datum to the water level

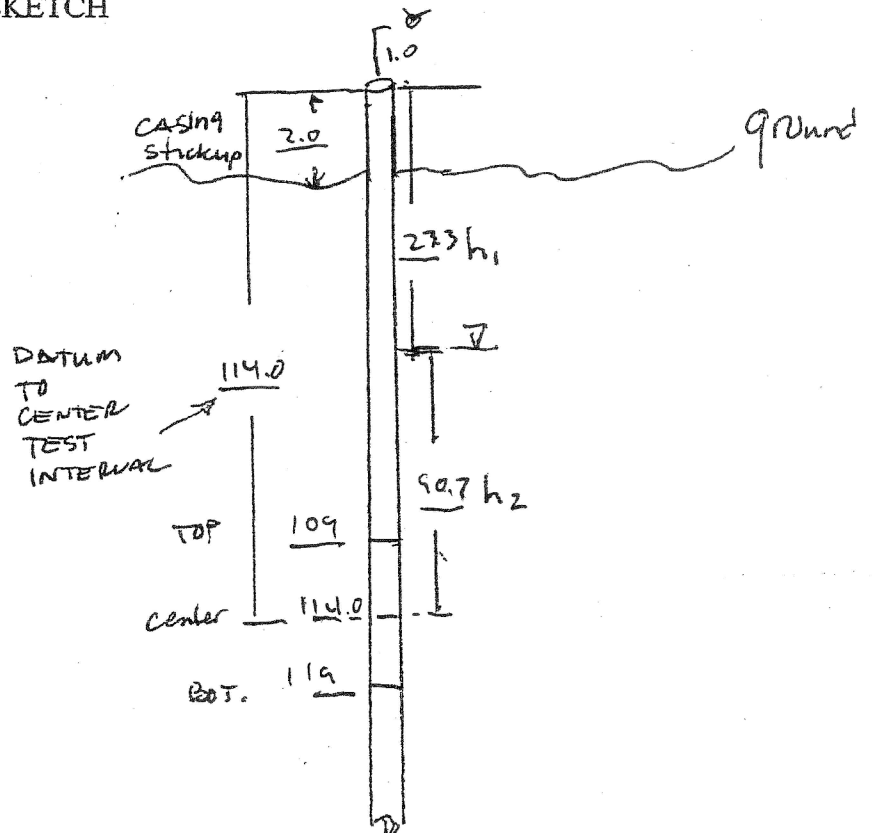
h<sub>2</sub> = Distance from the water level to the center of the test interval

h<sub>1</sub> = 24.3

h<sub>2</sub> = 114.0 - 23.3 = 90.7

P MAX = 24.3 + 51.69 = 75.99

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

126-01

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-30-06 <sup>SM</sup>

BORING NO. Ba 01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 100.0 FT. TO 110.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 90.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  75.99 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 1 TEST PRESSURE 6309 psi PACKER PRESSURE: 100 psi <sup>SM</sup> <sub>9-7</sub>

1/3

25.07

Initial Transducer Readings: Top 2.27, Middle 38.02, Bottom 43.08

Transducer Readings after initial pressurization:

Top 2.81, Middle 39.91, Bottom 43.58

Transducer Readings after final flow measurement:

Top 1.82, Middle 42.53, Bottom 43.94

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2931.0	/	.6	
0.5	2931.4	.8	2.7	
1.0	2933.0	3.2	28.8	
1.5	2933.0	∅	25.7	
2.0	2933.0	∅	24.2	
2.5	2933.0	∅	24.2	
3.0	2933.0	∅	24.0	
3.5	2933.0	∅	24.1	
4.0	2933.0	∅	24.7	
4.5	2933.0	∅	23.6	
5.0	2933.0	∅	24.5	

used 30 GPM / 120 psi pump

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JH*  
12-6-26

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 9-7-50 . 06 JH

BORING NO. Ba 01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 102.0 FT. TO 119.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 160 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 75.99 FT.

MAXIMUM TEST PRESSURE,  $P_o$  75.99 ( $P_o = [(A+B) * 1] + C * .57$  psi)

<sup>2/3</sup> TEST NUMBER: 2 TEST PRESSURE 88.17 psi PACKER PRESSURE: 140 psi <sup>569-7</sup>

<sup>50.5</sup> Initial Transducer Readings: Top 2.27, Middle 38.02, Bottom 43.08

Transducer Readings after initial pressurization:  
Top 1.82, Middle 42.53, Bottom 43.94

Transducer Readings after final flow measurement:  
Top 1.37, Middle 41.15, Bottom 44.22

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2933.0	/	9.0	
0.5	2934.0	2.0	18.6	
1.0	2934.4	.8	46.8	
1.5	2934.5	.2	46.5	
2.0	2934.5	∅	47.4	
2.5	2934.5	∅	47.3	
3.0	2934.6	.2	47.5	
3.5	2934.6	∅	47.4	
4.0	2934.6	∅	48.0	
4.5	2934.7	.2	44.5	
5.0	2934.7	∅	44.9	

BORING NO.: B901

DATE: ~~9-7-30-06~~ 5/4

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 109 FT. TO 119 FT.

DATA COLLECTED BY: Stoward

2  
JJS  
12-4-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	44.9	89.68
0.5	36.6	78.00
1.0	30.5	71.36
1.5	26.4	66.63
2.0	24.1	63.97
2.5	21.9	61.51
3.0	20.1	59.21
3.5	18.6	57.14
4.0	17.7	55.81
4.5	16.5	54.36
5.0	15.8	53.14
6.0	14.5	51.02
7.0	13.3	49.33
8.0	12.4	48.18
9.0	11.6	46.93
10.0	11.0	45.98
11.0	10.5	45.15
12.0	10.1	44.43
13.0	9.7	43.84
14.0	9.4	43.28
15.0	9.0	42.80
20.0	8.1	41.15

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: <sup>10036 546-7</sup> 10417 (Top), 10191 (Middle), <sup>017423 546-7</sup> 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M2 109 - 119  
 " - B2 109 - "  
 " - T2 109 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL

PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 9-28-30-06-14

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 109.0 FT. TO 119.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 90.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  75.00 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 3 TEST PRESSURE 114.01 psi PACKER PRESSURE: 140 psi 3149.7

Initial Transducer Readings: Top 2.27, Middle 38.02, Bottom 43.08

Transducer Readings after initial pressurization:

Top 1.37, Middle 41.15, Bottom 44.22

Transducer Readings after final flow measurement:

Top 1.53, Middle 38.86, Bottom 45.46

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2934.7	/	7.5	
0.5	2935.9	2.4	26.7	
1.0	2936.2	.6	47.9	
1.5	2937.7	3.0	69.2	
2.0	2941.2	7.0	74.8	
2.5	2944.2	6.0	69.7	
3.0	2947.2	6.0	68.5	
3.5	2950.5	6.6	68.1	
4.0	2953.3	5.8	68.1	
4.5	2956.4	6.2	67.9	
5.0	2959.3	5.8	68.7	

Rock fractured at this pressure & drained clot of water.

used 30 GPM/120psi pump

BORING NO.: B901

DATE: ~~2-18-30-06~~ 5K

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 109 FT. TO 119 FT.

DATA COLLECTED BY: Stoward

*Handwritten initials and date:*  
PJ  
12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	54.9-7 116.32 68.7	68.7 116.32
0.5	-1.0	47.83
1.0	-2.3	45.17
1.5	-4.3	44.23
2.0	-4.6	43.95
2.5	-5.0	43.57
3.0	-5.2	43.31
3.5	-5.4	42.63
4.0	-6.3	42.21
4.5	-6.6	41.95
5.0	-6.8	41.71
6.0	-7.1	41.32
7.0	-7.4	41.00
8.0	-7.7	40.72
9.0	-7.9	40.45
10.0	-8.1	40.20
11.0	-8.3	40.10
12.0	-8.4	39.92
13.0	-8.5	39.78
14.0	-8.6	39.64
15.0	-8.7	39.57

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10036549-7 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M3 109-119  
 11 - B3 109-11  
 11 - T3 109-11



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JAS  
12.6.06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stewart DATE COLLECTED: 6-28-30-0654

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 109.0 FT. TO 119.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 90.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  75.99 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 4 TEST PRESSURE 76.01 psi PACKER PRESSURE: 140 psi 549-7

Initial Transducer Readings: Top 2.27, Middle 38.02, Bottom 43.08

Transducer Readings after initial pressurization:  
Top 1.53, Middle 38.86, Bottom 45.46

Transducer Readings after final flow measurement:  
Top 1.43, Middle 38.48, Bottom 44.74

1/2  
37.99

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2959.4	/	-9.4	
0.5	2959.6	.4	43.0	
1.0	2959.8	.4	26.9	
1.5	2960.0	.4	29.0	
2.0	2960.1	.2	29.0	
2.5	2960.3	.4	29.0	
3.0	2960.5	.4	29.4	
3.5	2960.7	.4	29.2	
4.0	2960.8	.2	29.4	
4.5	2961.0	.4	29.4	
5.0	2961.2	.4	29.7	



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JES*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-30-06 54

BORING NO. Ba 01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 109.0 FT. TO 119.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 90.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  75.99 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 5 TEST PRESSURE 114.0 psi PACKER PRESSURE: 140 psi <sup>54 9-7</sup>

Initial Transducer Readings: Top 2.27, Middle 38.02, Bottom 43.08

Transducer Readings after initial pressurization:  
Top 1.43, Middle 38.48, Bottom 44.74

Transducer Readings after final flow measurement:  
Top 1.62, Middle 39.00, Bottom 45.91

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2961.2	-	9.6	
0.5	2961.5	0.6	45.2	
1.0	2962.3	1.6	60.5	
1.5	2965.7	6.8	70.2	
2.0	2969.4	8.4	69.1	
2.5	2972.0	4.3 <del>4.2</del>	67.1	
3.0	2974.7	5.4	67.2	
3.5	2977.0	4.6	68.2	
4.0	2980.3	6.6	67.8	
4.5	2983.3	6.0	68.0	
5.0	2986.3	6.0	68.3	

used 30 GPM/1120 psi pump

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 3

BORING NO.: B901

DATE: ~~ant 8-30-06~~ 5/4

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 109 FT. TO 119 FT.

DATA COLLECTED BY: Stoward

*JJ*  
12-4-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	68.3	115.89
0.5	-7.4	46.89
1.0	-4.0	44.53
1.5	-5.0	43.57
2.0	-5.5	43.16
2.5	-5.9	42.76
3.0	-6.1	42.55
3.5	-6.3	42.24
4.0	-6.7	41.99
4.5	-6.8	41.88
5.0	-7.0	41.74
6.0	-7.3	41.59
7.0	-7.6	41.08
8.0	-7.9	40.82
9.0	-8.1	40.57
10.0	-8.3	40.40
11.0	-8.5	40.20
12.0	-8.6	40.05
13.0	-8.8	39.90
14.0	-8.9	39.77
15.0	-9.0	39.67

EQUIPMENT USED

10036549-7

017423 5#9-7

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-MS 109 - 119  
 " - BS 109 - " "  
 " - TS 109 - " "

PACKER TESTING CALCULATIONS FOR P(MAX)

*JJ*  
12-6-06

Date: 8-30-06

Boring No. B901

Test Interval: 120.0 to 125.0 <sup>130.0</sup> <sup>042-20</sup> feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

h<sub>1</sub> = Distance from the <sup>case</sup> datum <sup>stickup</sup> to the water level

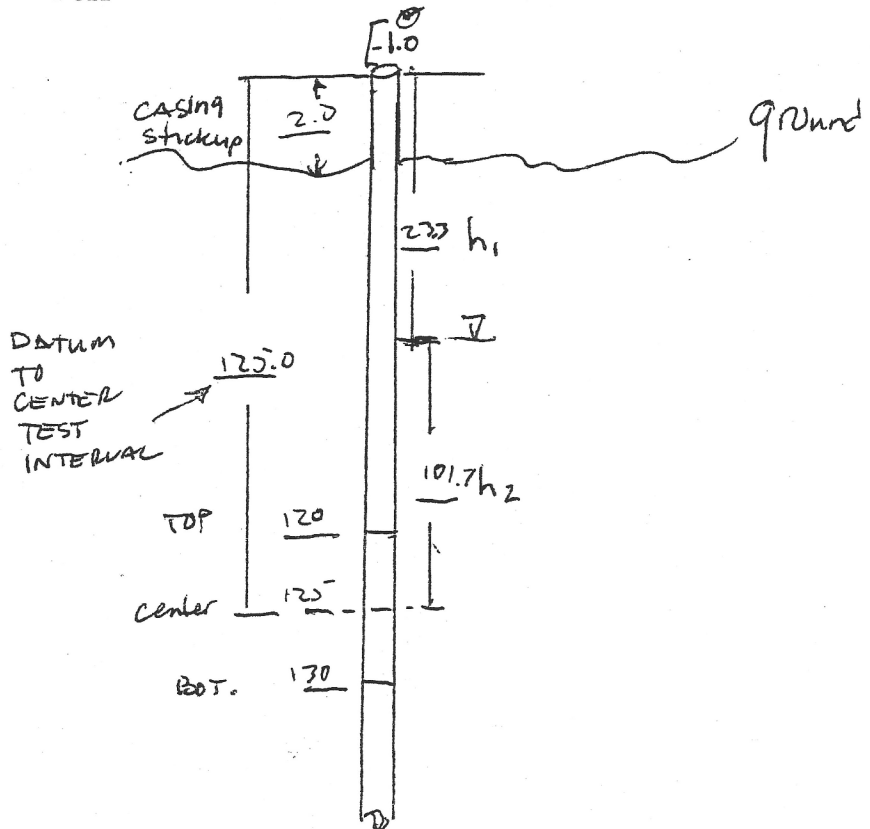
h<sub>2</sub> = Distance from the water level to the center of the test interval

h<sub>1</sub> = 24.3

h<sub>2</sub> = 125.0 - 23.3 = 101.7

P MAX = 24.3 + 57.96 = 82.26

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JHJ*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472 <sup>54 a-c</sup>

DATA COLLECTED BY: Howard DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 101.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  82.26 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 1 TEST PRESSURE 70.67 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.0, Middle 43.53, Bottom 48.51

Transducer Readings after initial pressurization:  
Top 3.73, Middle 44.04, Bottom 48.93

Transducer Readings after final flow measurement:  
Top 2.74, Middle 42.30, Bottom \*

1/3  
27.14

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2887.8	/	-1.5	
0.5	2889.0	4.4	29.1	
1.0	2889.0	Ø	23.3	
1.5	2889.2	.4	23.8	
2.0	2889.2	Ø	24.1	
2.5	2889.3	.2	23.7	
3.0	2889.4	.2	22.2	
3.5	2889.4	Ø	22.3	
4.0	2889.4	Ø	22.2	
4.5	2889.4	Ø	22.5	
5.0	2889.5	.2	23.0	

\* Bottom Transducer stopped working during test

using 30 GPM / 120 psi pump

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472  
 BORING NO.: B901  
 DATE: 9-6-8-3006 JH  
 TEST NUMBER: 1  
 TEST INTERVAL (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.  
 DATA COLLECTED BY: Stoward

PAGE 3  
 2  
 Jo 2-12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	23.0	71.5
0.5	16.6	64.17
1.0	13.1	60.72
1.5	11.0	57.48
2.0	9.0	54.86
2.5	7.8	53.19
3.0	6.6	51.83
3.5	5.8	50.58
4.0	5.2	49.61
4.5	4.7	48.77
5.0	4.2	48.04
6.0	3.5	46.77
7.0	2.9	45.98
8.0	2.6	45.31
9.0	2.2	44.78
10.0	1.9	44.34
11.0	1.8	43.97
12.0	1.6	43.69
13.0	1.4	43.46
14.0	1.3	43.23
15.0	1.2	43.08
20.0	.9	42.55

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: <sup>10036 JH69</sup> ~~10417~~ (Top), 10191 (Middle), <sup>017423</sup> ~~10036~~ (Bottom)  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 <sup>5179-6</sup>  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M 120-130  
 " - B 120 - "  
 " - T 120 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*Job* 12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 9-6-06

BORING NO. Ba01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 120 FT. TO 130 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 27.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 104.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  87.26 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 2 TEST PRESSURE 57.82 psi PACKER PRESSURE: 140 psi

Initial Transducer Readings: Top 3.0, Middle 43.53, Bottom 48.51

Transducer Readings after initial pressurization:  
Top 4.15, Middle 44.61, Bottom 49.07

Transducer Readings after final flow measurement:  
Top 3.23, Middle 43.02, Bottom 49.04

2/3  
54.24

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	28 89.5	/	0.0	
0.5	28 90.2	1.4	5.7	
1.0	28 90.8	1.2	42.6	
1.5	28 91.1	.6	45.8	
2.0	28 91.4	.6	46.2	
2.5	28 91.6	.4	46.7	
3.0	28 91.9	.6	46.3	
3.5	28 92.2	.6	47.2	
4.0	28 92.4	.4	47.5	
4.5	28 92.7	.6	47.2	
5.0	28 93.1	.8	47.2	

30 GPM / 120 psi pump



BORING NO.: B901

DATE: ~~2-4-8-2006~~ 5/4

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

DATA COLLECTED BY: Stoward

2  
J 2/26-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	47.2	47.26
0.5	19.11	68.45
1.0	13.1	62.05
1.5	8.7	57.72
2.0	6.9	54.20
2.5	5.7	52.30
3.0	4.3	51.23
3.5	3.3	49.96
4.0	2.7	49.03
4.5	2.1	48.20
5.0	1.7	47.51
6.0	1.1	46.54
7.0	.5	45.56
8.0	.2	44.98
9.0	0.0	44.53
10.0	-.2	44.18
11.0	-.4	43.87
12.0	-.5	43.61
13.0	-.7	43.44
14.0	-.7	43.27
15.0	-.8	43.13

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10036 I496 (Top), 10191 (Middle), ~~10036~~ (Bottom) 017423  
 Surface Pressure Gauge: Omega DPG serial number 2634708001 5/4 9-6  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M2120 - 130  
 " - B2120 - "  
 " - T2120 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

JG  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: SH 8-30-06 <sup>9-6</sup>

BORING NO. Ba01 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 27.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 101.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  82.24 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

8226 TEST NUMBER: 3 TEST PRESSURE 125.79 psi PACKER PRESSURE: 150 psi <sup>549-c</sup>

Initial Transducer Readings: Top 3.0, Middle 43.53, Bottom 48.51

Transducer Readings after initial pressurization: Top 3.23, Middle 43.02, Bottom 49.09

Transducer Readings after final flow measurement: Top 2.62, Middle 42.87, Bottom 51.71

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2893.0	/	-1.1	
0.5	2894.1	2.2	45.6	
1.0	2894.4	.6	48.1	
1.5	2895.1	1.4	70.0	
2.0	2897.1	4.0	74.1	
2.5	2899.0	3.8	74.7	
3.0	2901.2	4.4	75.0	
3.5	2903.2	4.0	74.5	
4.0	2905.4	4.4	74.2	
4.5	2907.5	4.2	74.2	
5.0	2909.8	4.6	74.4	

DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472

PAGE 3

BORING NO.: B901

DATE: 9-6-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

DATA COLLECTED BY: J Howard

2  
JAS  
12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	74.4	128.07
0.5	4.6	57.30
1.0	-3.3	50.30
1.5	-5.3	47.72
2.0	-2.8	46.78
2.5	-6.2	46.07
3.0	-6.4	45.89
3.5	-6.3	45.66
4.0	-6.8	45.03
4.5	-7.1	44.58
5.0	-7.4	44.26
6.0	-7.6	43.86
7.0	-7.7	43.60
8.0	-7.8	43.41
9.0	-7.8	43.28
10.0	-7.9	43.16

EQUIPMENT USED  
 Transducers: Mini Troll Serial Numbers: 100305#9-6 (Top), 017423 (Middle), 10191 (Bottom), 10036 (Bottom)  
 Surface Pressure Gauge: Omega DPG serial number 2634708001  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06  
 Tests: B901-M3120 - 130  
 " - B3120 - 11  
 " - T3120 - 11

12-6-06

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Stoward DATE COLLECTED: 5/29/06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

TOTAL BORING DEPTH FROM DATUM: 3020 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 19.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  82.26 ( $P_o = [(A+B) * 1] + C * .57$  psi)

1/2  
41.13

TEST NUMBER: 4 TEST PRESSURE 84.66 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.0, Middle 43.53, Bottom 48.51

Transducer Readings after initial pressurization:  
Top 2.62, Middle 42.87, Bottom 51.71

Transducer Readings after final flow measurement:  
Top 2.21, Middle 42.77, Bottom 50.45

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2909.8	/	-7.8	
0.5	2910.2	.8	20.8	
1.0	2910.6	.8	31.5	
1.5	2910.8	.4	31.8	
2.0	2911.1	.6	32.0	
2.5	2911.3	.4	32.2	
3.0	2911.5	.4	32.6	
3.5	2911.8	.6	30.0	
4.0	2912.0	.4	29.9	
4.5	2912.2	.4	29.9	
5.0	2912.4	.4	30.1	

using 30 GPM / 120 psi pump



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JHJ*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472 *a-6-*

DATA COLLECTED BY: Stoward DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN. *5H*

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 120.0 FT. TO 130.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 233 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 101.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  82.26 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 5 TEST PRESSURE 125.79 psi PACKER PRESSURE: 100 psi

Initial Transducer Readings: Top 3.0, Middle 43.53, Bottom 45<sup>219.6</sup> 8.61

Transducer Readings after initial pressurization:  
Top 2.62, Middle 42.87, Bottom 51.8<sup>50 9-6</sup> 07.71

Transducer Readings after final flow measurement:  
Top 2.01, Middle 43.02, Bottom 53.23

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	29 12.4	/	-7.7	
0.5	29 13.1	1.4	45.0	
1.0	29 13.8	1.4	66.1	
1.5	29 15.8	4.0	72.9	
2.0	29 18.0	4.6 <sup>4.6</sup>	74.4	
2.5	29 20.3	4.6	73.6	
3.0	29 22.3	4.0	74.7	
3.5	29 24.5	4.4	74.5	
4.0	29 26.5	4.0	75.1	
4.5	29 28.7	4.4	74.6	
5.0	29 30.8	4.2	75.0	

*using 30 GPM / 120 psi pump*



145-155  
I-2  
Jan

JAJ  
12-6-06

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 8-30-06

Boring No. B 901

Test Interval: 147.0 to 157.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

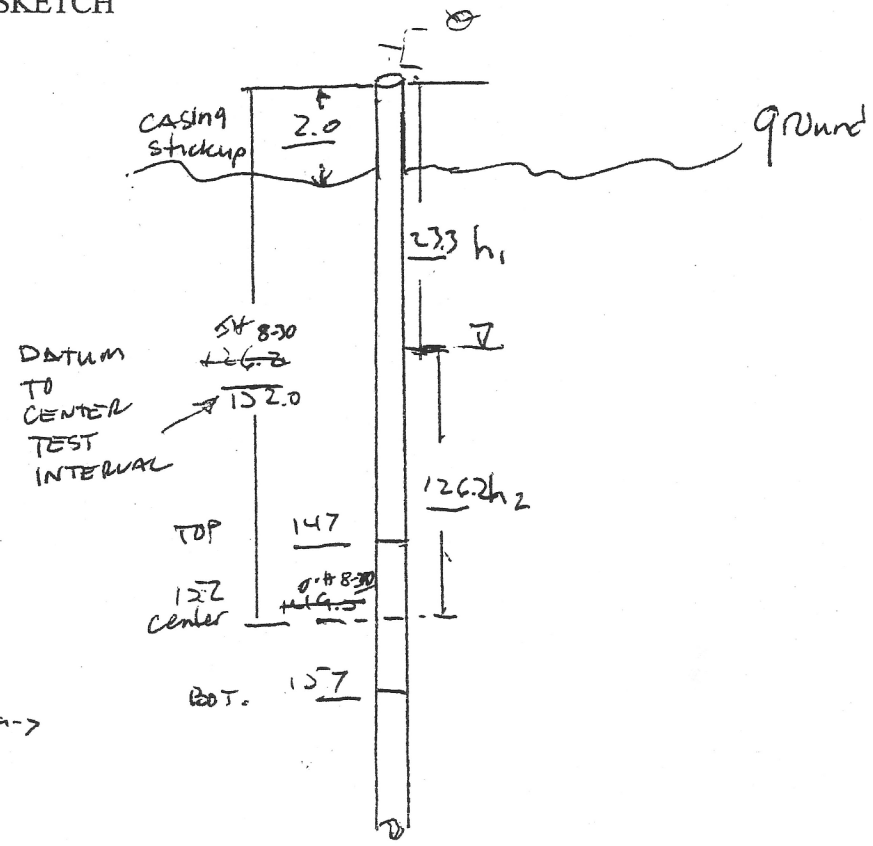
h<sub>1</sub> = Distance from the Gage ~~datum~~ to the water level  
 h<sub>2</sub> = Distance from the water level to the center of the test interval

$$h_1 = \frac{24.3}{152.0 - 548.30} = 23.3$$

$$h_2 = \frac{548.30 - 126.2}{126.2} = 128.7$$

$$P_{MAX} = \frac{24.3}{548.30} + \frac{77.35 - 71.97}{548.30} = \frac{27.65}{548.30} = 66.23$$

SKETCH



Original test done  
 @ 147-157 w/ 150 548-7  
 50GPM/100psi pump



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JS*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Shawad DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 233 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 126.2 FT.

MAXIMUM TEST PRESSURE,  $P_o$  97.63 (Po = [(A+B) \* 1] + C\*.57 psi)

TEST NUMBER: 1 TEST PRESSURE 90.04 psi PACKER PRESSURE: 140 psi

Initial Transducer Readings: Top 1.53, Middle 57.82, Bottom 62.6

Transducer Readings after initial pressurization: Top .55, Middle 58.70, Bottom 61.39

Transducer Readings after final flow measurement: Top .19, Middle 86.94, Bottom \*

*54*  
*31.73*  
*32.22*

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2795.7	/	.1	
0.5	2796.7	2.0	4.8	
1.0	2797.6	1.8	24.5	
1.5	2797.7	.2	29.2	
2.0	2797.8	.2	31.7	
2.5	2797.8	Ø	31.8	
3.0	2797.8	Ø	31.7	
3.5	2797.8	Ø	31.7	
4.0	2797.8	Ø	32.0	
4.5	2797.8	Ø	32.1	
5.0	2797.8	Ø	32.1	

\* Technical error, computer can't find/read bottom transducer.

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 1

TEST INTERVAL (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

DATA COLLECTED BY: Shouad

*Handwritten:* 12/6/06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	32.1	90.66
0.5	32.1	90.78
1.0	31.9	90.64
1.5	31.8	90.50
2.0	31.7	90.38
2.5	31.6	90.27
3.0	31.7	90.15
3.5	31.3	90.02
4.0	31.3	89.93
4.5	31.2	89.81
5.0	31.1	89.69
6.0	30.9	89.47
7.0	30.7	89.25
8.0	30.6	89.06
9.0	30.4	88.85
10.0	30.2	88.68
11.0	30.1	88.52
12.0	30.0	88.35
13.0	29.8	88.18
14.0	29.7	88.02
15.0	29.5	87.88

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

*Handwritten:* Tests: B901-M1147-157  
 " - B1147 - "  
 " - T1147 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JH*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: <sup>302.0</sup>300.2 FT. <sup>548.30</sup>

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 126.2 FT.

MAXIMUM TEST PRESSURE,  $P_0$  <sup>96.5</sup>96.5 (  $P_0 = [(A+B) * 1] + C * .57$  psi) <sup>548.30</sup>

TEST NUMBER: 2 TEST PRESSURE 122.27 psi PACKER PRESSURE: <sup>58.30</sup>42.14 psi

Initial Transducer Readings: Top 1.53, Middle 57.82, Bottom 62.6

Transducer Readings after initial pressurization:  
Top .57, Middle 59.52, Bottom 60.96

Transducer Readings after final flow measurement:  
Top .18, Middle 79.43, Bottom \*

*Handwritten notes:*  
2/3  
64.45

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	27 97.8	/	0.1	
0.5	27 98.8	2.0	24.7	
1.0	27 98.9	.2	34.3	
1.5	27 98.9	Ø	36.0	
2.0	27 98.9	Ø	36.8	
2.5	27 98.9	Ø	37.1	
3.0	27 98.9	Ø	37.4	
3.5	27 98.9	Ø	38.6	
4.0	27 98.9	Ø	38.4	
4.5	27 98.9	Ø	38.3	
5.0	27 98.9	Ø	39.3	

\* Bottom transducer not working again, stopped during test

DATA REPORT Rev. 0 MACTEC ENGINEERING & CONSULTING, INC. 1/25/07

BORING NO.: Ba01

DATE: 8-30-06

TEST NUMBER: 2

TEST INTERVAL (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

DATA COLLECTED BY: J Howard

*J Howard*  
8-30-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	39.3	100.88
0.5	37.8	99.41
1.0	37.7	98.57
1.5	36.4	97.71
2.0	35.7	96.96
2.5	35.1	96.24
3.0	34.4	95.60
3.5	33.8	94.92
4.0	33.3	94.28
4.5	32.6	93.70
5.0	32.3	<del>93.18</del> 93.18
6.0	31.5	92.07
7.0	30.4	91.12
8.0	29.6	90.17
9.0	28.8	89.34
10.0	28.2	88.55
11.0	27.5	87.83
12.0	26.9	87.87
13.0	26.3	86.46
14.0	25.7	85.81
15.0	25.2	85.23
20.0	22.8	82.57
25.0	21.1	80.49

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests B901 - M2147 - 157  
 " - B2147 - "  
 " - T2147 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*AG*  
126-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 1.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE     

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 23.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 126.2 FT.

MAXIMUM TEST PRESSURE,  $P_o = \frac{A+B}{2} + C \cdot 0.57$  (psi) 56.25 (psi)

TEST NUMBER: 3 TEST PRESSURE 155.47 psi PACKER PRESSURE: 40 psi

Initial Transducer Readings: Top 153, Middle 57.82, Bottom 62.0

Transducer Readings after initial pressurization:  
Top 0.19, Middle 59.31, Bottom 60.75

Transducer Readings after final flow measurement:  
Top -2.0, Middle 83.87, Bottom 60.70

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2799.9	/	0.4	
0.5	2799.7	1.6	24.8	
1.0	2799.9	.4	35.3	
1.5	2799.9	0	38.0	
2.0	2799.9	0	37.4	
2.5	2799.9	0	38.0	
3.0	2799.9	0	38.6	
3.5	2799.9	0	39.4	
4.0	2799.9	0	38.0	
4.5	2799.9	0	37.8	
5.0	2799.9	0	38.4	

BORING NO.: B901

DATE: 8-30-06

TEST NUMBER: 3

TEST INTERVAL (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

DATA COLLECTED BY: J Howard

2  
983  
2-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	38.4	101.0
0.5	38.6	101.0
1.0	38.8	100.32
1.5	37.5	99.47
2.0	36.8	98.82
2.5	36.2	98.14
3.0	35.5	97.42
3.5	34.9	96.74
4.0	34.3	96.04
4.5	33.7	95.53
5.0	33.2	94.94
6.0	32.1	93.82
7.0	31.2	92.91
8.0	30.4	91.89
9.0	29.5	91.00
10.0	28.2	90.20
11.0	28.1	89.43
12.0	27.5	88.76
13.0	26.9	88.13
14.0	26.4	87.46
15.0	25.8	86.88
20.0	23.5	84.38

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: 10417 (Top), 10191 (Middle), ~~10036~~ (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

017423 ↗  
change out Transducers

Above calibrated 5-5-06 or 5-18-06

Tests: B901 - M3147-157  
" - B3147 - "  
" - T3147 - "

PACKER TESTING CALCULATIONS FOR P(MAX)

Date: 9-6-06

Boring No. B901

Test Interval: 147.0 to 157.0 feet from Datum

Casing Stickup 2.0 feet

PoMAX = (h<sub>1</sub> x 1) + (h<sub>2</sub> x 0.57). h<sub>1</sub> and h<sub>2</sub> are in feet, see sketch. PoMAX is in psi

*JW*  
12-6-06

h<sub>1</sub> = Distance from the <sup>g-usc</sup> datum to the water level

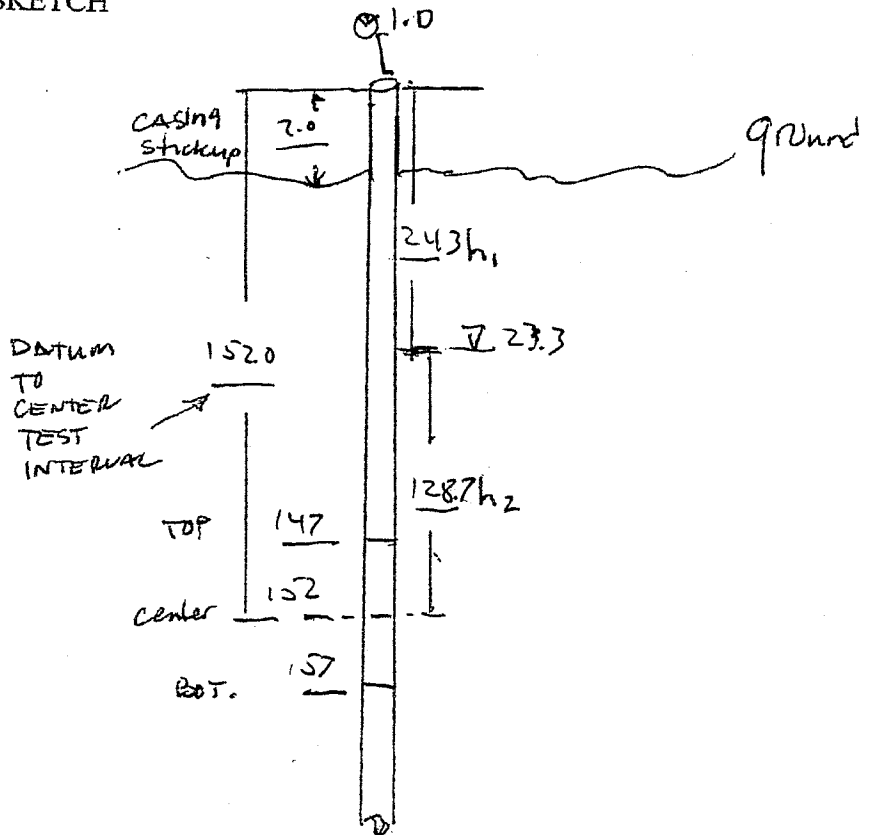
h<sub>2</sub> = Distance from the water level to the center of the test interval

h<sub>1</sub> = 24.3

h<sub>2</sub> = 152 - 23.3 = 128.7

P MAX = 24.3 + 73.35 = 97.65

SKETCH



DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*Jan 26 2006*

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 9-0 8-30-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 24.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 128.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  97.65 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 1 TEST PRESSURE 87.28 psi PACKER PRESSURE: 120 psi <sup>J49-6</sup>

$\frac{1}{3}$   
32.22

Initial Transducer Readings: Top <sup>5 ft</sup> 4.6 14 3.0, Middle 55.06, Bottom 60.11

Transducer Readings after initial pressurization:  
Top 7.70, Middle 57.00, Bottom 60.30

Transducer Readings after final flow measurement:  
Top 2.84, Middle 75.87, Bottom 60.39

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	28 71.0	/	0.1	
0.5	28 71.5	1.0	7.0	
1.0	28 73.1	3.2	28.3	
1.5	28 73.3	0.4	31.6	
2.0	28 73.3	Ø	30.8	
2.5	28 73.3	Ø	30.3	
3.0	28 73.3	Ø	29.8	
3.5	28 73.3	Ø	29.1	
4.0	28 73.3	Ø	30.6	
4.5	28 73.3	Ø	30.1	
5.0	28 73.3	Ø	29.6	

30 GPM/120 psi pump used.



DOUBLE PACKER TEST DATA SHEET, MACTEC PROJECT NO. 6468-06-1472  
 BORING NO.: B901  
 DATE: 9-6-83 06 SH  
 TEST NUMBER: 1  
 TEST INTERVAL (FROM DATUM): FROM 147 FT. TO 157 FT.  
 DATA COLLECTED BY: Stoward

PAGE 3

2  
 JJ  
 12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	29.4	87.13
0.5	28.9	86.75
1.0	28.7	86.04
1.5	28.7	85.59
2.0	27.9	85.13
2.5	27.6	84.76
3.0	27.2	84.31
3.5	26.8	83.91
4.0	26.6	83.54
4.5	26.3	83.17
5.0	26.0	82.87
6.0	25.4	82.11
7.0	24.9	81.57
8.0	24.4	80.97
9.0	24.1	80.48
10.0	23.7	79.98
11.0	23.3	79.50
12.0	23.0	79.07
13.0	22.6	78.64
14.0	22.3	78.23
15.0	22.0	77.84
	20.7	76.15

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: <sup>1086</sup>10417 (Top), 10191 (Middle), <sup>17423</sup>10036 (Bottom)  
 Surface Pressure Gauge: Omega DPG serial number 2634708001  
 Flow Meter Omega FTB-4110 serial number 32019518  
 Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901-M1147-157  
 11 - B1147 - 11  
 11 - T1147 - 11

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JS*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Steward DATE COLLECTED: 9-6-06

BORING NO. Ba 01 BOREHOLE DIAMETER: 41 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING X GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 24.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 128.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  97.65 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 2 TEST PRESSURE 119.5 psi PACKER PRESSURE: 150 psi

Initial Transducer Readings: Top 7.0, Middle 55.06, Bottom 60.11

Transducer Readings after initial pressurization:  
Top 2.84, Middle 75.87, Bottom 60.39

Transducer Readings after final flow measurement:  
Top 2.38, Middle 87.80, Bottom 62.22

2/3  
64.44

Packers  
Failed, test  
restarted

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	<del>2873</del> 2875.0		57.7 1.8	
0.5	<del>2874.0</del> 2876.7	1.8	57.4 44.3	
1.0	<del>2876.4</del> 2876.8	.2	57.5 52.11	
1.5	2877.1	.6	58.8	
2.0	2878.2	2.2	60.2	
2.5	2879.4	2.4	59.4	
3.0	2880.4	2.0	59.6	
3.5	2881.6	2.4	59.4	
4.0	2882.7	2.2	58.7	
4.5	2883.7	2.0	58.2	
5.0	2884.7	2.0	58.9	

30 GPM / 120 psi Pump used

BORING NO.: B 901

DATE: 9-2-06

TEST NUMBER: 01447 2

TEST INTERVAL (FROM DATUM): FROM 147 FT. TO 157 FT.

DATA COLLECTED BY: Howard

*Handwritten signature and date:*  
 [Signature]  
 12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	58.9	120.19
0.5	47.0	108.75
1.0	46.4	107.80
1.5	46.0	107.16
2.0	45.5	106.54
2.5	44.8	105.69
3.0	43.8	104.64
3.5	42.6	103.55
4.0	41.6	102.17
4.5	40.6	101.28
5.0	39.7	100.40
6.0	38.5	98.64
7.0	37.3	97.63
8.0	36.4	96.52
9.0	35.4	95.44
10.0	34.3	94.30
11.0	33.8	93.71
12.0	33.1	92.88
13.0	32.4	92.15
14.0	31.9	91.40
15.0	31.3	90.77
20.0	28.0	88.07

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: <sup>10036 545.6</sup> ~~10417~~ (Top), 10191 (Middle), <sup>017425</sup> ~~10036~~ (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

*Handwritten notes:*  
 Test B901 - M2147 - 157  
 " - B2147 - "  
 " - 52147 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JJD*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: Sheward DATE COLLECTED: 9-6-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 24.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 128.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  97.65 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

*max*

TEST NUMBER: 3 TEST PRESSURE 152.71 psi PACKER PRESSURE: 120 psi

Initial Transducer Readings: Top 3.00, Middle 55.06, Bottom 60.11

Transducer Readings after initial pressurization:  
Top 2.38, Middle 87.80, Bottom 62.22

Transducer Readings after final flow measurement:  
Top 2.25, Middle 59.33, Bottom 62.80

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2884.7	/	27.6	
0.5	2885.0	.6	49.1	
1.0	2886.8	.	67.5	
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Pressure up to 127 psi, can't test at this range, the pressure pushes our packers out.

*30 GPM / 120 psi pumped*

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JDS*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL

PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: S Howard DATE COLLECTED: 9-6-06

BORING NO. B901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147.0 FT. TO 157.0 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 24.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 128.7 FT.

MAXIMUM TEST PRESSURE,  $P_o$  97.65 ( $P_o = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 4 TEST PRESSURE 103.88 psi PACKER PRESSURE: 150.0 psi

Initial Transducer Readings: Top 3.0, Middle 55.06, Bottom 60.11

Transducer Readings after initial pressurization:  
Top 3.21, Middle 59.55, Bottom 61.75

Transducer Readings after final flow measurement:  
Top 2.54, Middle 81.45, Bottom 61.29

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0	2887.0	/	2.8	
0.5	2887.8	1.6	48.7	
1.0	2887.8	<del>0</del>	46.1	
1.5	2887.8	<del>0</del>	44.1	
2.0	2887.8	<del>0</del>	42.6	
2.5	2887.8	<del>0</del>	41.3	
3.0	2887.8	<del>0</del>	44.6	
3.5	2887.8	<del>0</del>	43.1	
4.0	2887.8	<del>0</del>	41.8	
4.5	2887.8	<del>0</del>	40.4	
5.0	2887.8	<del>0</del>	39.5	

30 GPM / 120 psi Pump used

BORING NO.: B 201

DATE: 9-6-06

TEST NUMBER: 4

TEST INTERVAL (FROM DATUM): FROM 147 FT. TO 157 FT.

DATA COLLECTED BY: S Howard

*JES*  
12-6-06

SHUT-IN TEST

PRESSURE: \_\_\_\_\_ psi

TIME, MIN	SURFACE GAUGE PRESSURE, PSI	MIDDLE TRANSDUCER PRESSURE, PSI
0.0	39.5	102.33
0.5	38.7	100.90
1.0	37.4	99.90
1.5	36.4	98.89
2.0	35.5	97.93
2.5	34.7	97.17
3.0	34.0	96.12
3.5	33.1	95.49
4.0	32.4	94.79
4.5	31.8	93.95
5.0	31.1	93.38
6.0	30.1	92.01
7.0	29.1	90.97
8.0	28.1	89.93
9.0	27.2	89.02
10.0	26.4	88.15
11.0	25.8	87.35
12.0	25.1	86.54
13.0	24.3	85.81
14.0	23.8	85.15
15.0	23.2	84.53
20.0	20.7	81.71

EQUIPMENT USED

Transducers: Mini Troll Serial Numbers: <sup>10036 549.6</sup> 10417 (Top), 10191 (Middle), <sup>017423</sup> 10036 (Bottom)

Surface Pressure Gauge: Omega DPG serial number 2634708001

Flow Meter Omega FTB-4110 serial number 32019518

Stop Watch: serial number SW1

Above calibrated 5-5-06 or 5-18-06

Tests: B901 - M4147 - 157  
 " - B4147 - "  
 " - T4147 - "

DOUBLE PACKER BOREHOLE PERMEABILITY TEST DATA SHEET

*JGZ*  
12-6-06

MACTEC ENGINEERING AND CONSULTING, INC.

PROJECT: NORTH ANNA COL PROJECT NO.: 6468-06-1472

DATA COLLECTED BY: J Howard DATE COLLECTED: 9-6-00

BORING NO. B 901 BOREHOLE DIAMETER: 4 IN.

SURFACE CASING HEIGHT ABOVE GROUND: 2.0 FT.

CHECK DATUM USED: TOP OF CASING  GROUND SURFACE

DATUM ELEVATION NA

DISTANCE BOTTOM OF TOP PACKER TO TOP OF BOTTOM PACKER 10.0 FT.

TEST INTERVAL DEPTH (FROM DATUM): FROM 147 FT. TO 157 FT.

TOTAL BORING DEPTH FROM DATUM: 302.0 FT.

(A) DEPTH TO WATER TABLE FROM DATUM: 24.3 FT.

(B) SURFACE GAUGE HEIGHT ABOVE DATUM: 1.0 FT.

(C) DISTANCE WATER TABLE TO CENTER OF TEST INTERVAL: 128.7 FT.

MAXIMUM TEST PRESSURE,  $P_0$  97.65 ( $P_0 = [(A+B) * 1] + C * .57$  psi)

TEST NUMBER: 5 TEST PRESSURE 152.77 psi PACKER PRESSURE: \_\_\_\_\_ psi

Initial Transducer Readings: Top 3.0, Middle 55.06, Bottom 60.11

Transducer Readings after initial pressurization:  
Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

Transducer Readings after final flow measurement:  
Top \_\_\_\_\_, Middle \_\_\_\_\_, Bottom \_\_\_\_\_

TIME (MIN)	FLOW METER READING, (GAL)	Q (GPM)	SURFACE GAUGE, PSI	REMARKS
0.0				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				
3.5				
4.0				
4.5				
5.0				

Test cannot be performed, see test 3

30 GPM / 120 psi pump used

②

511

8-15-06

James Howard

DATA REPORT Rev. 0

MACTEC ENGINEERING & CONSULTING, INC.

1/23/07

700 Arrive  
730 safety meet  
8am - 1245 Ready Pucker tests

~~Work Inst~~  
~~1245 - 1 Safety meet~~

1- 1130 Pucker stand by & setup 3949

1.5 hrs stand by



(13)

8-30-00

James Howard

Miller: Mark Huster

BAD

Jeremy Johnson

JH

7 am Arrive

7:30 safety meeting

8-8:30 Driller setup, I do paperwork

8:30-11:15 setup packers

11:15-11:45 lunch

11:45-1 Run tests at 147-157'

1-2 Technical problems, new battery  
for Bottom transducer

2-3 Fix Top transducer

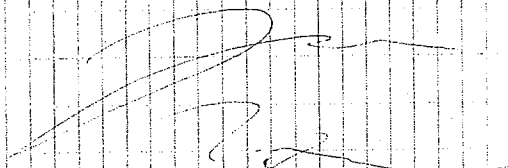
3-4:30 Run tests

4:30- Clean up & paperwork

24 water B914 275'

3 stage gets you 50 Gal/min  
@ 100 psi

7 stage 30 gal/min @ 120 psi



(14)

8-31-06

James Howard

Miller: Mark Hughes, Jeremy Johnson

B a o l, pack tests

7am arrive

8:30 safety meeting

8-8:30 meet about p imp. issues

8:30-11 Pack tests @ 94' to 104'

11-11:30 lunch

11:30-2 finish tests at 94'-104'

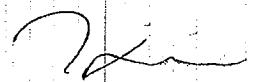
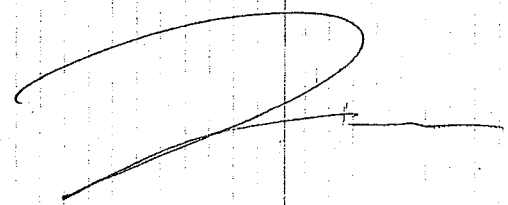
2-<sup>5:45-7:30</sup> 4:30 Test at 79' to 89'

4:25 pack up

5-5:30 paperwork

JK

Water @ 24.3



15

01-1-06

James Howard

M. L. Miller, Mark Hughes, Jeremy <sup>Singh</sup> ~~Allen~~ Soliman

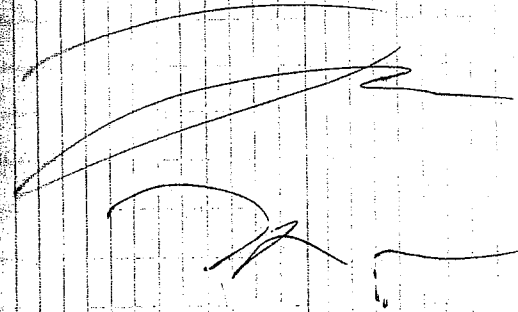
13901

7 a.m.

730 Safety meeting

8-815 cleanup site

SH



(17)

9-6-06

James Howard

~~Morefee~~<sup>5<sup>th</sup></sup> Miller: M. Hughes, Johnson

B901

Arrive @ Town

Safety meeting 7:30

8-11:30 Packer test 147-157

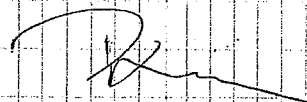
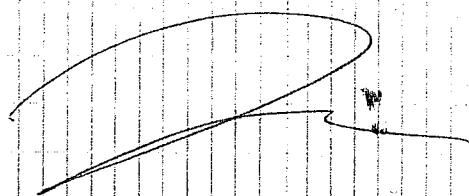
11:30-12 Lunch

12-4 Packer test 120-130

4-4:30 Paperwork

Str

water @ 23.5



(18)

9-7.06

James Howard

Miller : Mark Hughes, Jeremy Robinson

B901

Arrive @ 7 am

Safety meeting 7:30

Packer Test B901, 109-119' 8-1130

1130-12 Lunch

12-2 Pack up

2-3 Paperwork for packers

3-430 Setup on B933 w/G. Adams

430-5 Paperwork

5/4

Water @ 22.8 B901