Appendix D

Field Hydraulic Conductivity Testing

Hydraulic Conductivity Testing

Hydraulic conductivity (slug) tests were performed on each of the four new monitoring wells installed at the site for the feasibility study, including water table wells MW-29, MW-30, and MW-31 and piezometer MW-30P. The slug tests were performed by rapidly lowering a solid cylinder (slug) into the well to cause an instantaneous rise in water level (falling head test), then measuring the return of the water level to its static condition. A second test was performed by removing the slug (rising head test), and again measuring the response of the water level in the well. Water level data were recorded with an In-Situ, Inc. automated pressure transducer (Level TROLL 700) and data logger system. Slug test data were evaluated using Waterloo Hydrologic Aquifer Test Pro v. 2013.1 graphical analysis and reporting software. The slug tests were analyzed using the methods of Bouwer and Rice (1976)[1] for unconfined aquifers.

Hydraulic conductivity values (recovery test only) calculated for water table observation wells ranged from 1.1×10^{-2} cm/sec in well MW-29, screened primarily in silty sand, silt and clay deposits, to 1.4×10^{-3} cm/sec in well MW-31, screened in silty sand and clay deposits. The hydraulic conductivity value calculated for the piezometer, which is screened in silty sand, was 2.1×10^{-2} cm/sec.

[1] Bouwer, H. and R.C. Rice, A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, *Water Resources Research*, Vol.12, No.3, 1976, pp.423-428

Table _
Summary of Slug Test Parameters
Adams County Landfill

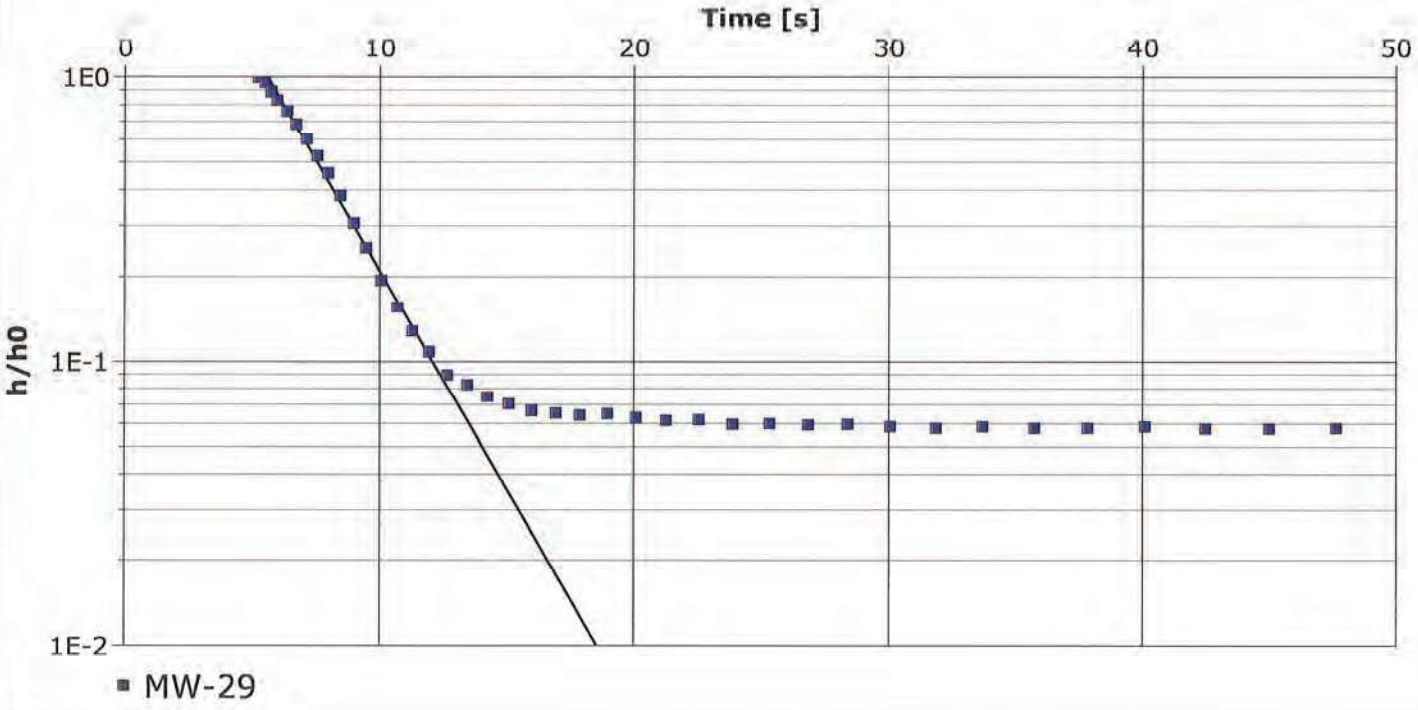
Well Number	Test Number	Depth of Well (ft)	Depth to Water (ft)	Initial Drawdown Elevation (t_0) (ft)	Internal Well Radius (r) (ft)	Effective Well Radius (R) (ft)	Sat. Aquifer Thickness (ft)	Screen Length (L) (ft)	Height of Water Column (b) (ft)
MW-29	Slug In	34.1	24.76	24.95	0.083	0.33	9.34	10	9.34
	Slug Out			22.76					
MW-30	Slug In	46.9	38.48	39.03	0.083	0.33	8.42	9	8.42
	Slug Out			37.77					
MW-30P	Slug In	75.8	44.22	46.4	0.083	0.33	32	5	31.58
	Slug Out			42.36					
MW-31	Slug In	41.4	32.70	33.15	0.083	0.33	8.70	9	8.70
	Slug Out			30.59					

Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-29 Slug Out	Test Well: MW-29
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-29 Slug Out Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 10.00 ft		

Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-29 Slug Out	Test Well: MW-29
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-29 Slug Out Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 10.00 ft		

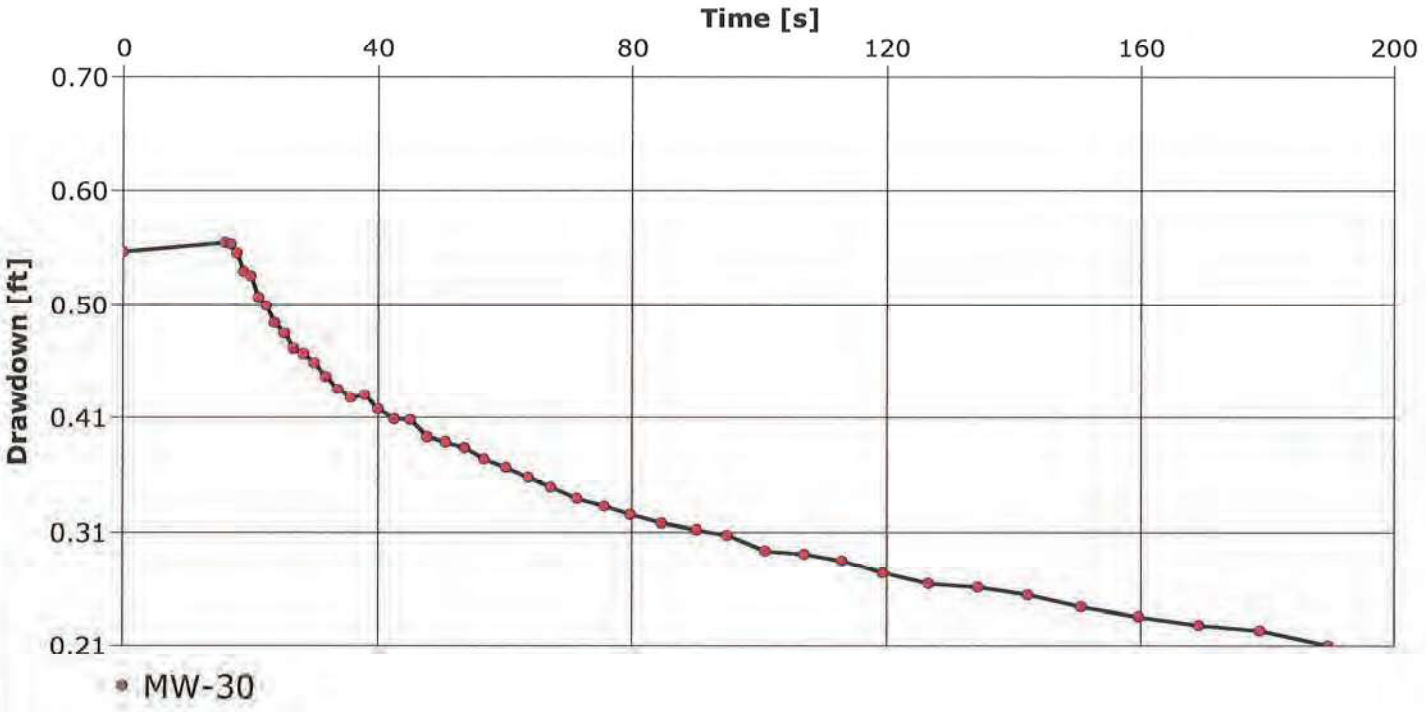


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-29	3.80×10^{-4}	

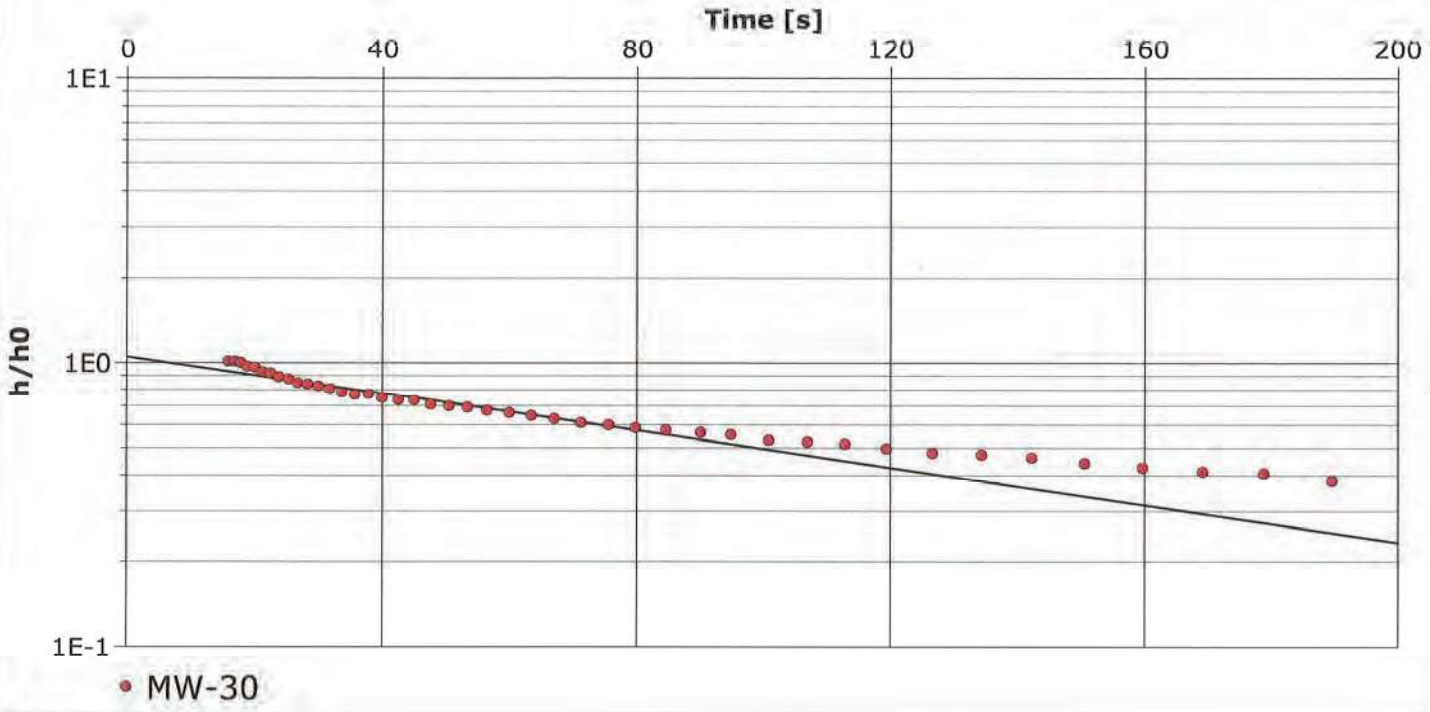
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30 Slug In	Test Well: MW-30
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30 Slug In Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 8.42 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30 Slug In	Test Well: MW-30
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30 Slug In Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 8.42 ft		

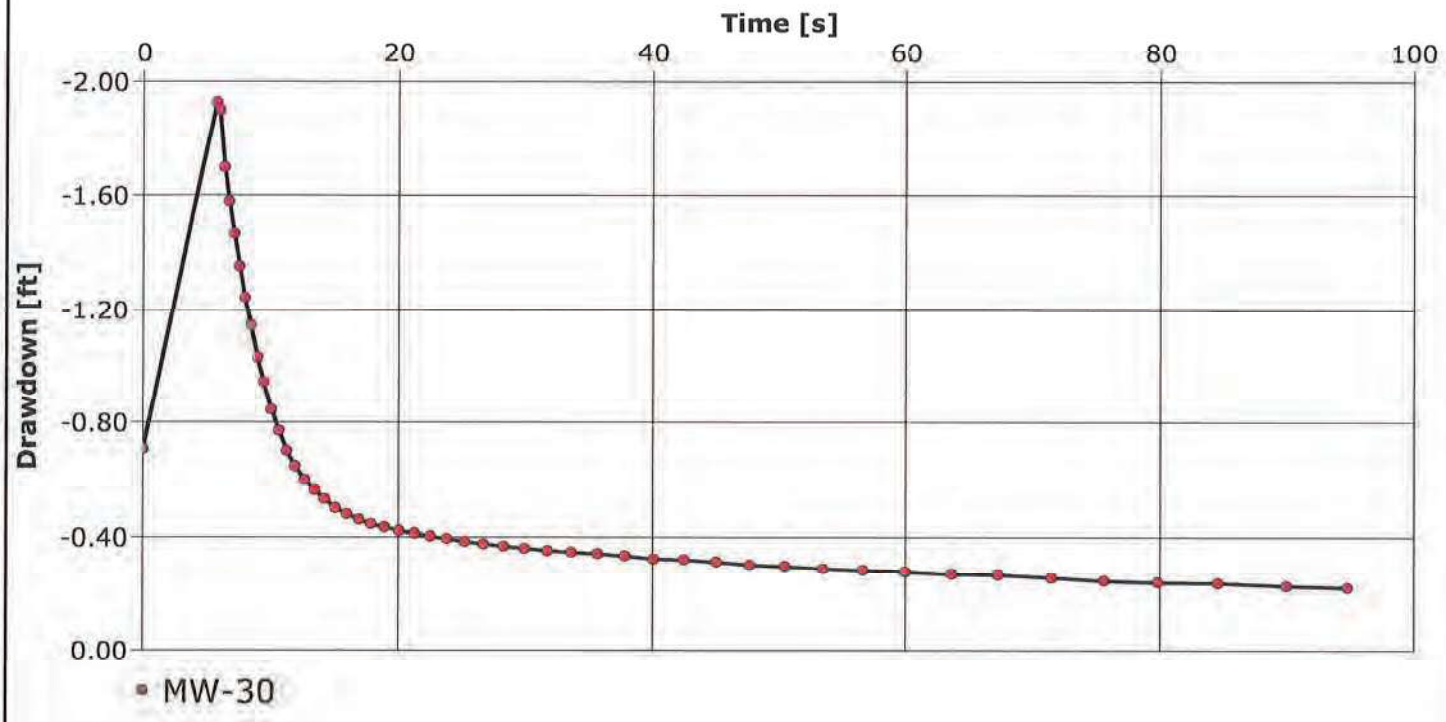


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-30	8.68×10^{-6}	

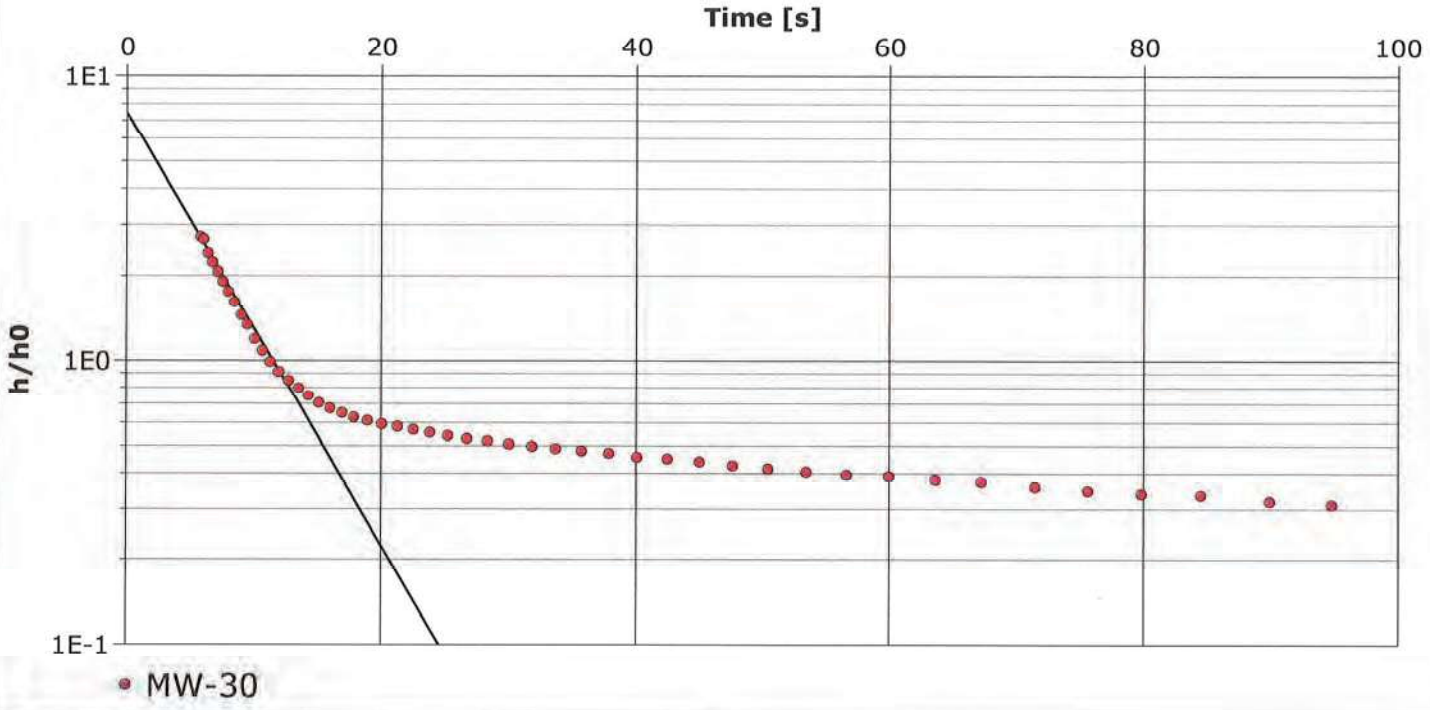
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30 Slug Out	Test Well: MW-30
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30 Slug Out Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 8.42 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30 Slug Out	Test Well: MW-30
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30 Slug Out Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 8.42 ft		

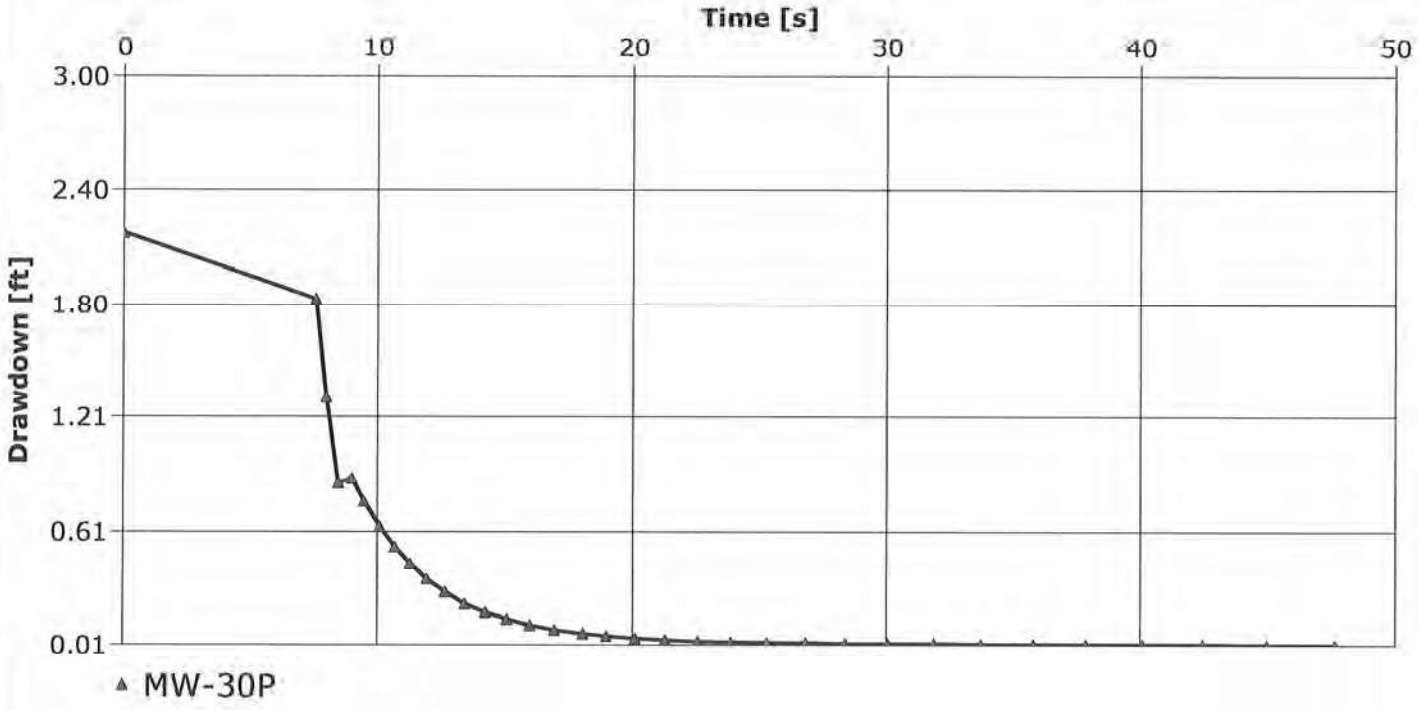


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-30	2.02×10^{-4}	

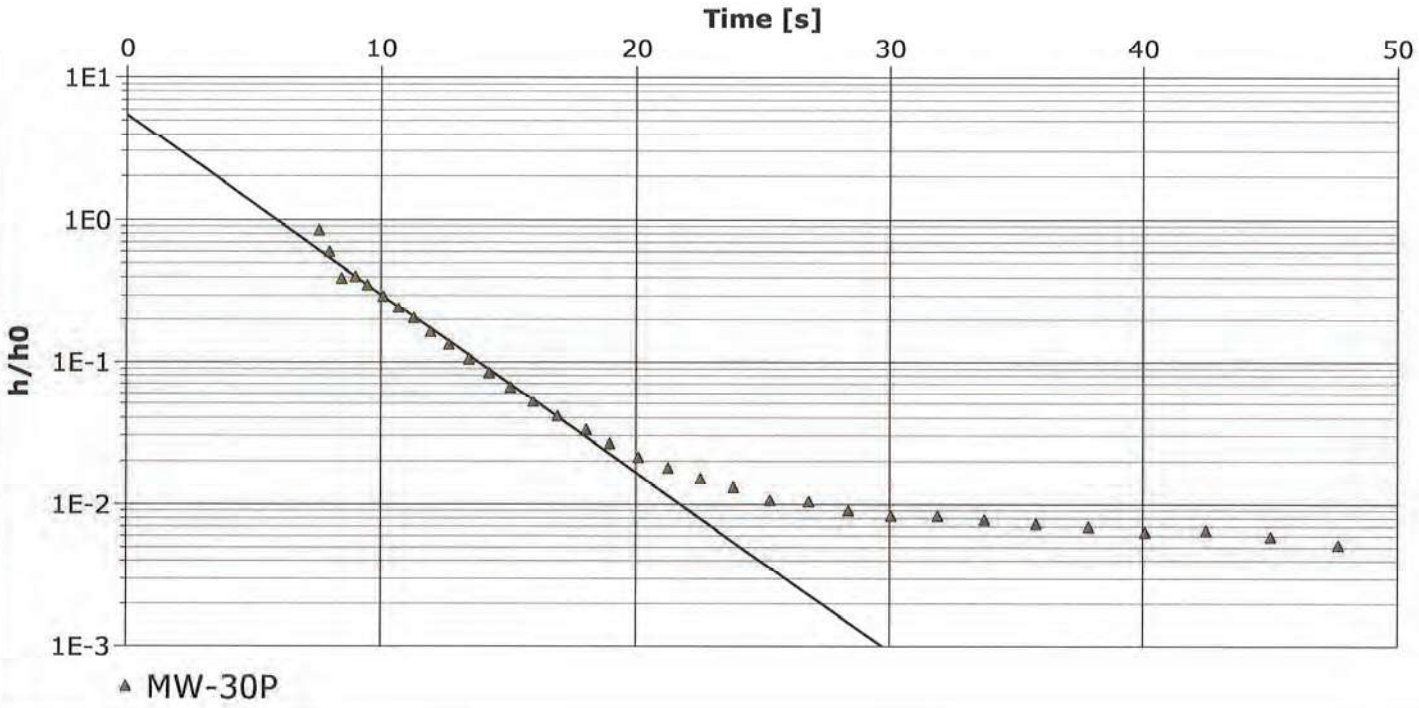
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30P Slug In	Test Well: MW-30P
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30P Slug In Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 32.00 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30P Slug In	Test Well: MW-30P
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30 Slug In Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 32.00 ft		

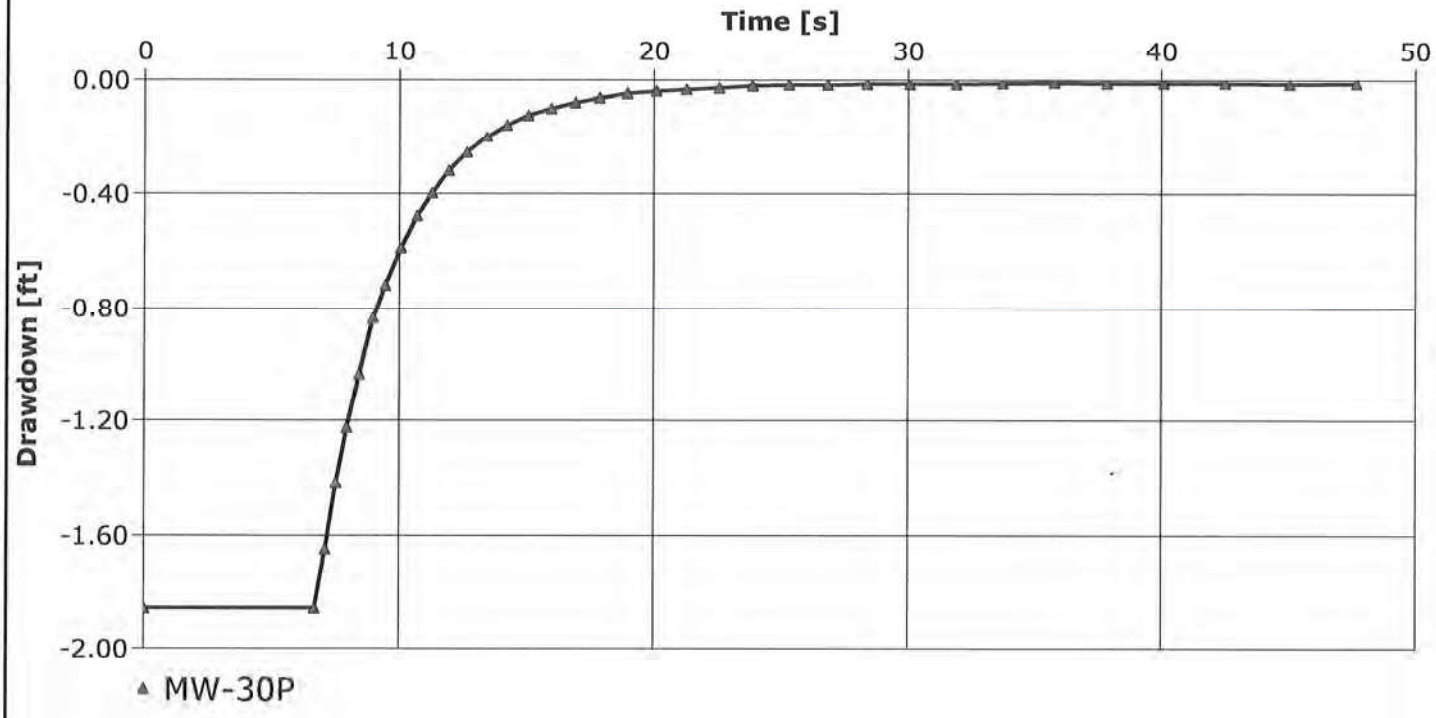


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-30P	6.31×10^{-4}	

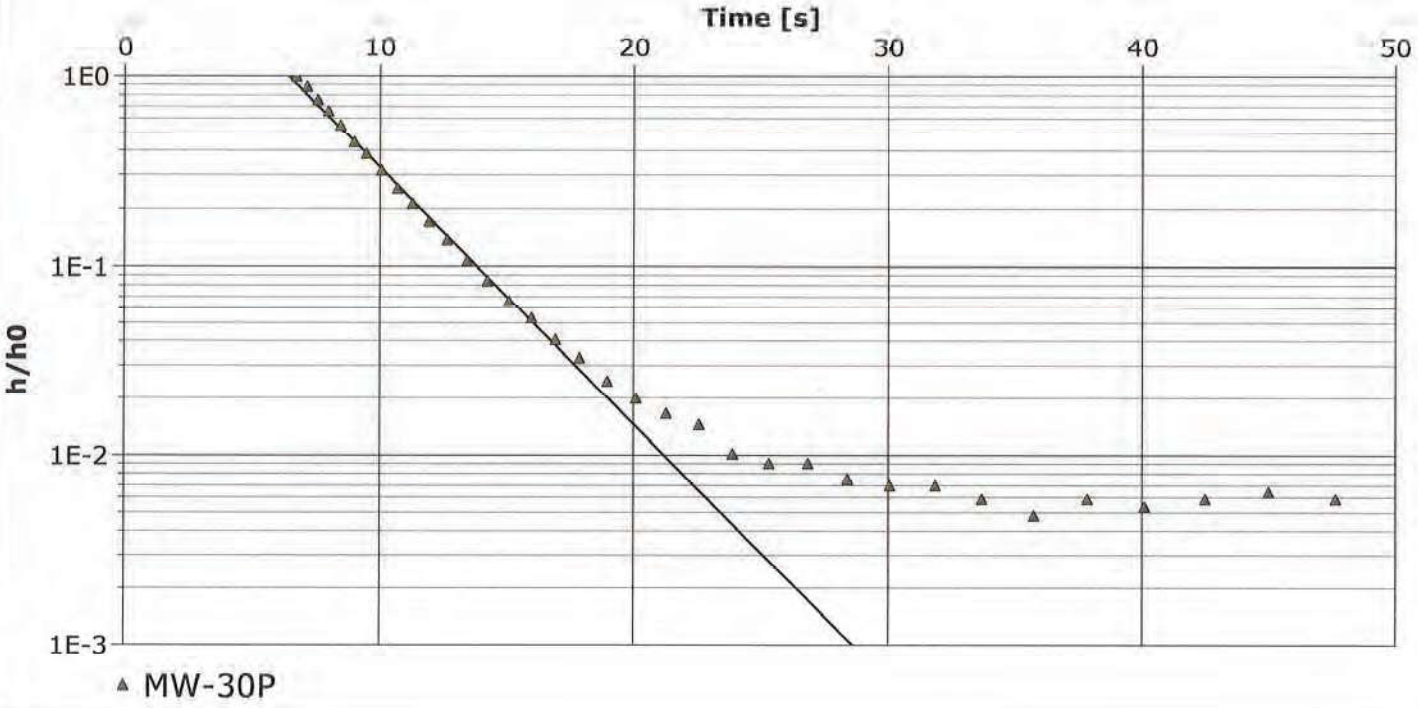
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30P Slug Out	Test Well: MW-30P
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30P Slug Out	Analysis Date: 1/29/2016
Aquifer Thickness: 32.00 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	**Slug Test Analysis Report**
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-30P Slug Out	Test Well: MW-30P
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-30P Slug Out Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 32.00 ft		

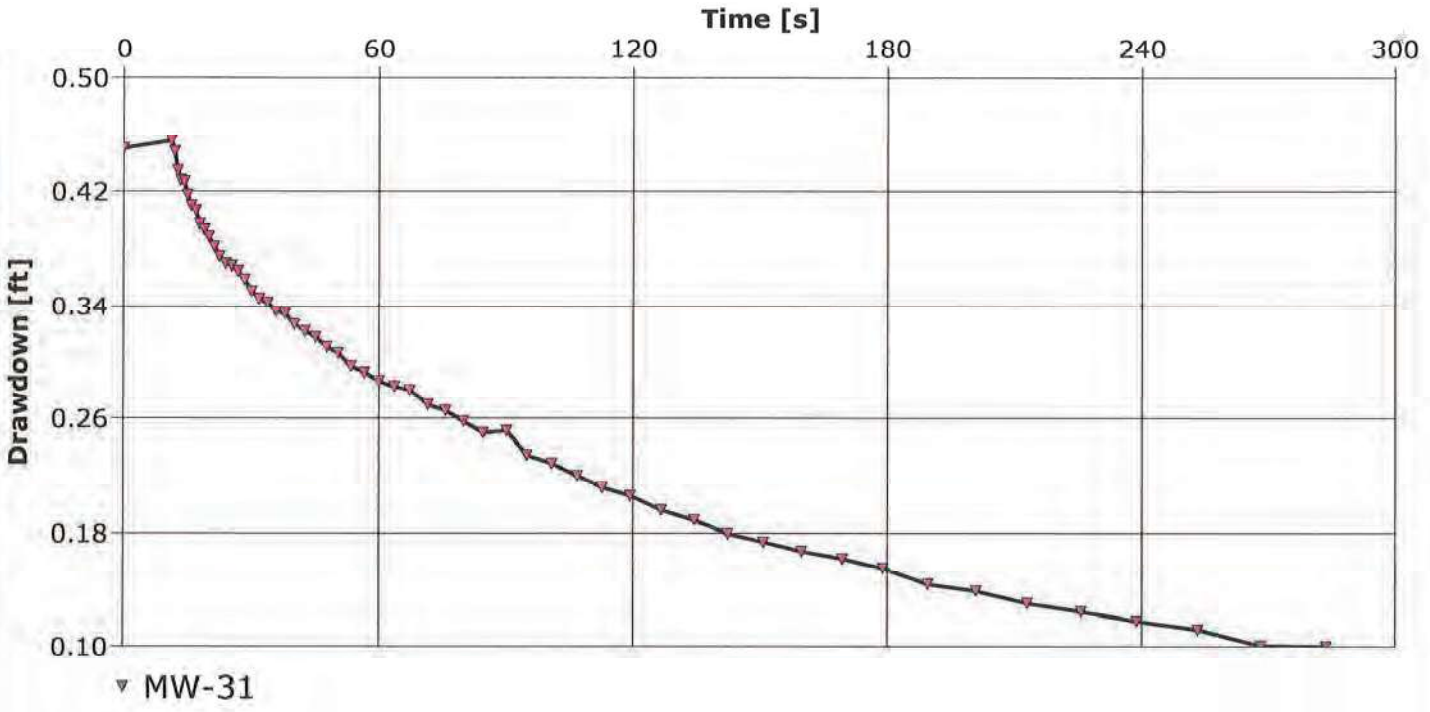


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-30P	6.79×10^{-4}	

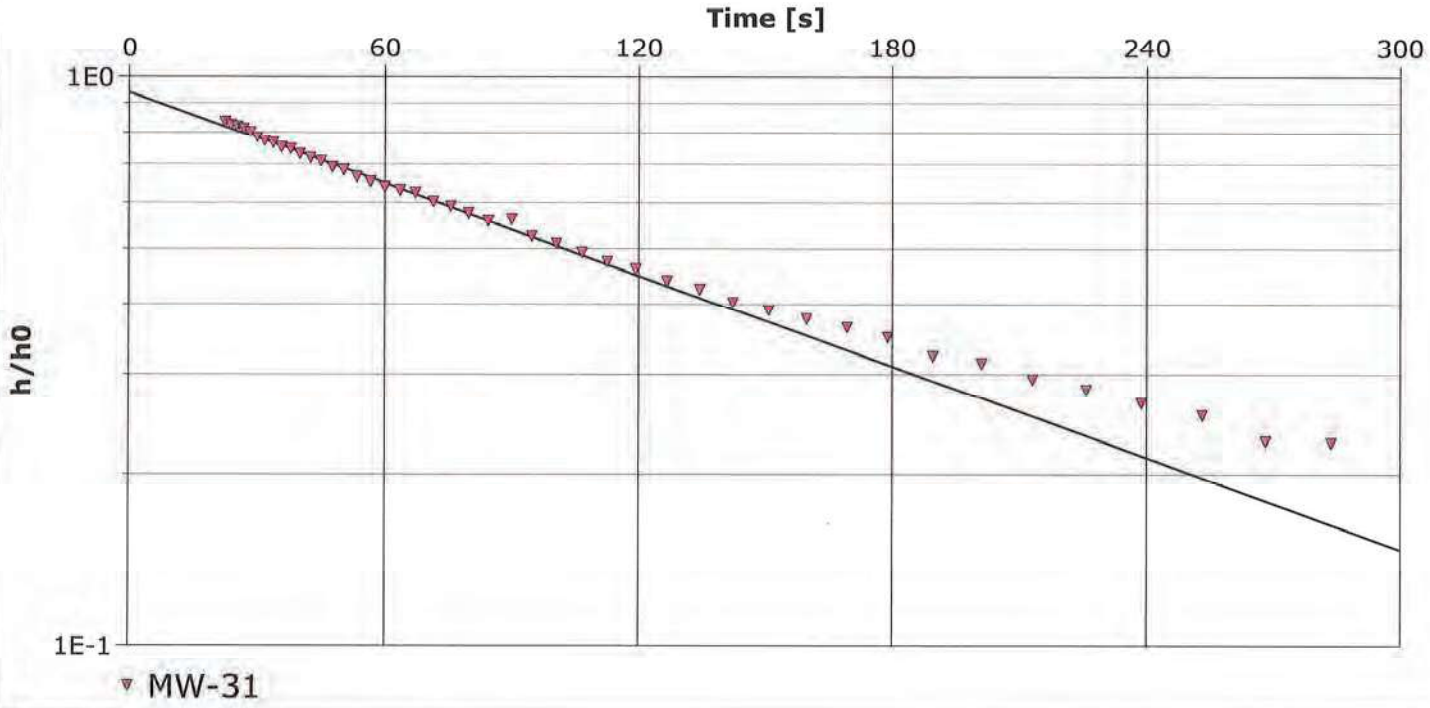
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-31 Slug In	Test Well: MW-31
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by:	MW-31 Slug In Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 8.70 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-31 Slug In	Test Well: MW-31
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-31 Slug In Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 8.70 ft		

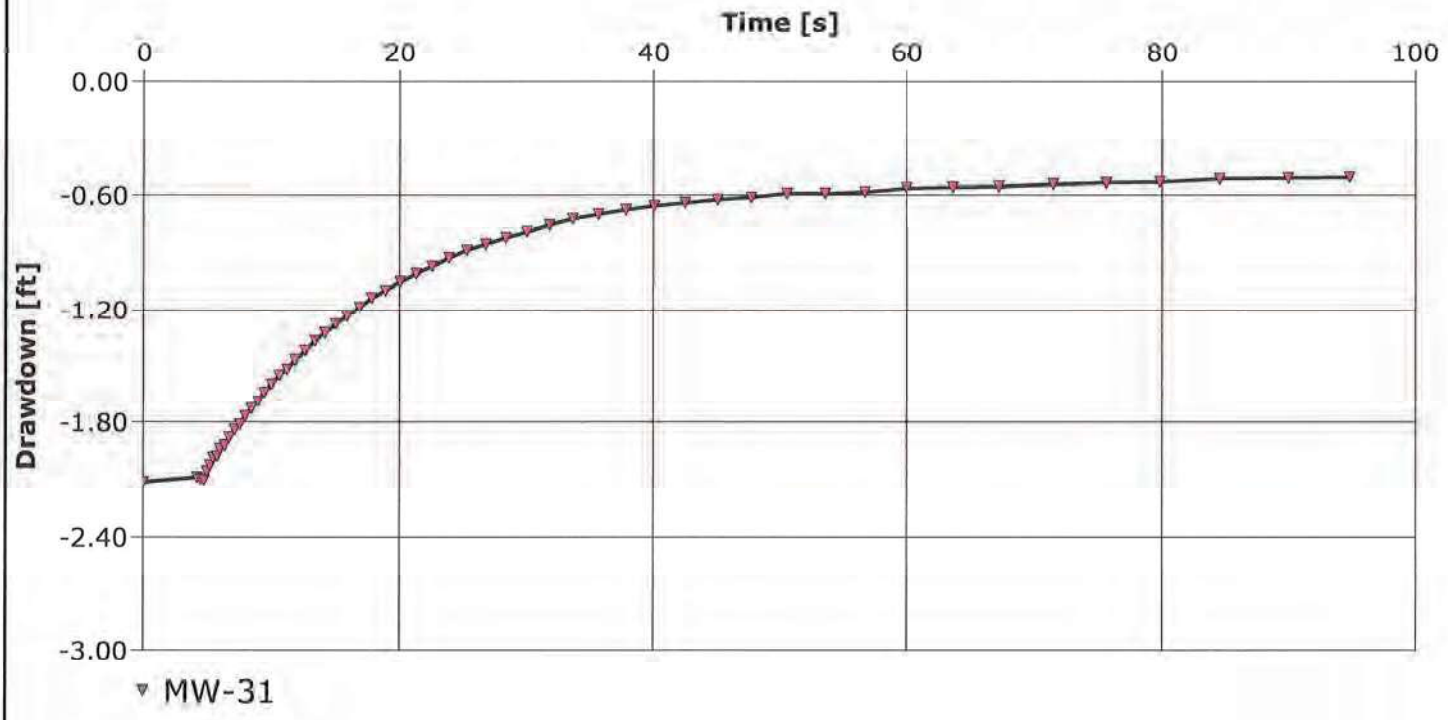


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-31	7.11×10^{-6}	

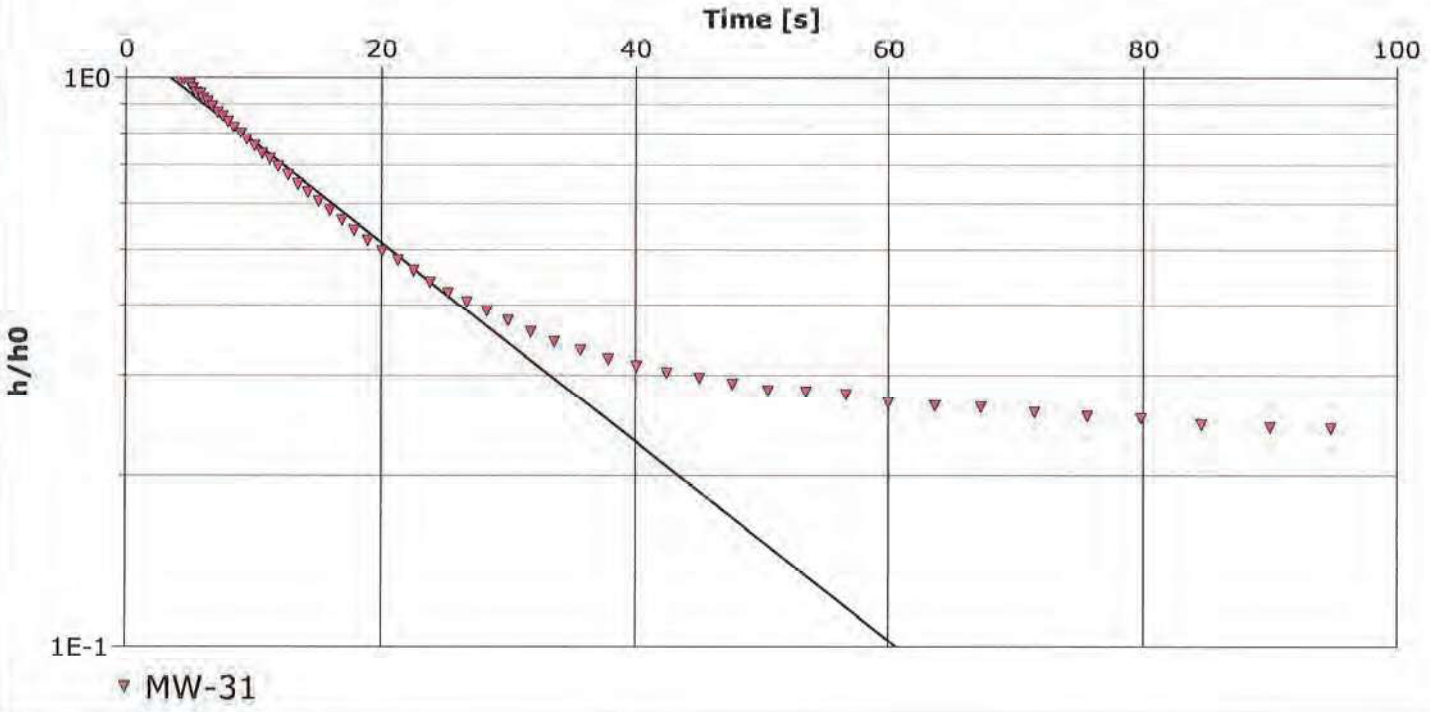
Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-31 Slug Out	Test Well: MW-31
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-31 Slug Out Time-Drawdown	Analysis Date: 1/29/2016
Aquifer Thickness: 8.70 ft		



Ayres Associates 5201 E. Terrace Drive, Suite 200 Madison, WI 53718	Slug Test Analysis Report
	Project: Adams County Landfill
	Number: 10-1070.12
	Client: Adams County Solid Waste Department

Location: Adams, WI	Slug Test: MW-31 Slug Out	Test Well: MW-31
Test Conducted by: Jeff Steiner		Test Date: 1/28/2016
Analysis Performed by: Jeff Steiner	MW-31 Slug Out Bouwer & Rice	Analysis Date: 1/29/2016
Aquifer Thickness: 8.70 ft		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/s]	
MW-31	4.65×10^{-5}	

INFIELD PERMEABILITY REPORT

Bail Down Test Methodology

Each bail down test was conducted by initially putting a pressure transducer, with LCD readout in feet, into a well below the static water level. After recording the initial water level, a four foot by 3/4-inch galvanized iron pipe was lowered below the water level, the water was allowed to stabilize and the stabilized reading was recorded. The pipe was then removed from the well. At the instant the minimum water level reading was recorded (a few seconds into the test) a stopwatch was started and rising water level measurements (h) with time (t) were recorded.

The analytical methodology used to evaluate these data is based upon theory presented by Spangler and Handy*.

The formula for hydraulic conductivity is:

$$K = 0.617 * \frac{r}{S*d} * \frac{dh}{dt} * 30.48 \text{ cm/ft}$$

Where:

K = hydraulic conductivity (cm/second)

r = borehole radius (ft)

S = a coefficient which is dependent on the ratios h/d and r/d (Fig. 11-11 of Soil Engineering),

d = depth of borehole below water table (ft).

h = depth (ft) of water in hole at the time dh/dt is determined

dh/dt = rate of rise of water level (ft/second) in hole at depth h, and

t = time (seconds),

* Spangler, M.G. and R.L. Handy, Soil Engineering, 3rd Edition, Intext Educational Publishers, New York, 1973, p. 253-256.

Slug Test Methodology

Each slug test was conducted by initially putting a pressure transducer, with LCD readout in feet, into a well below the static water level. After recording the initial starting level (H), a four foot by 3/4-inch galvanized iron pipe (slug) was lowered below the water level and the maximum water level reading (Ho) recorded. At the instant this maximum water level was reached (a few seconds into the test), a stopwatch was started and declining water level measurements (h) with time (t) were recorded.

Also noted for the purposes of data evaluation were the well casing diameter (r), the boring diameter (R), and the well screen length (L).

The analytical methodology used to evaluate these data is based upon theory presented by Freeze and Cherry*. The formula for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln(L/R)}{2 L T_o}$$

The key variable in this equation is T_o, the basic time lag. T_o is derived by plotting the natural logarithon of the residual head ratio (RHR - the ratio of [h-H], the difference between the maximum rise in water level and the starting water level), against the time (t) at which the head measurement (h) was taken. On semi-log paper these points plot as a straight line.

FIGURE NO. H-1

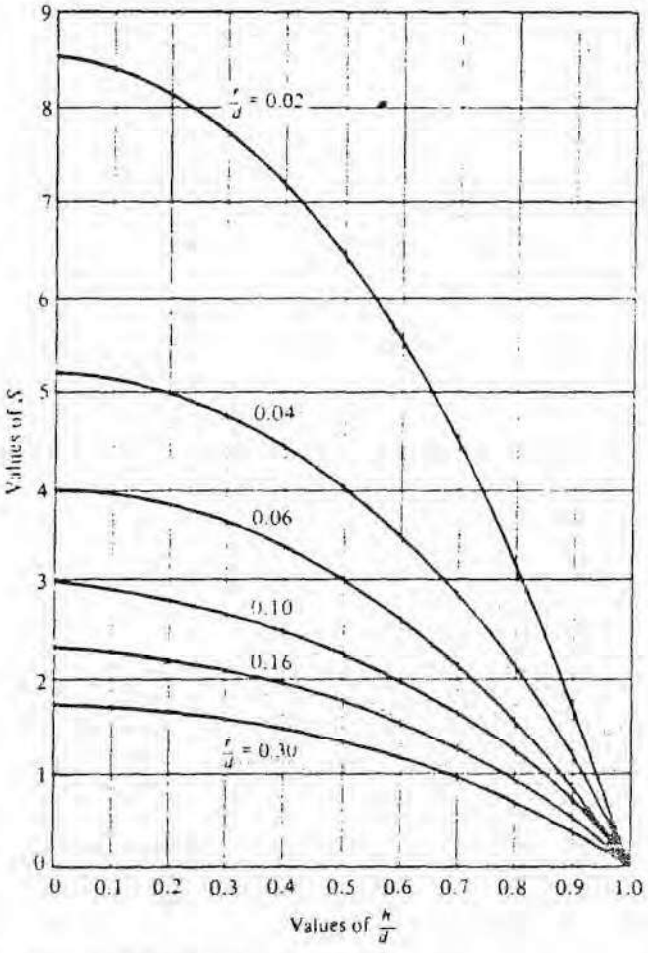


Fig. 11-11. Values of S in Eq. (11-17).

Source: Spangler, M.G. and R.L. Handy, Soil Engineering, 3rd. Edition, Intext Educational Publishers, New York, 1973, p. 255

WATER TABLE MONITORING WELL
HYDRAULIC CONDUCTIVITY SUMMARY

Well	t (sec)	r (ft)	d (ft)	r/d	h (ft)	h/d	S	dh/dt (ft/s)	K (cm/s)
MW-1*	10	0.292	11.95	0.02	11.89	0.99	0.1	0.015	6.9×10^{-2}
MW-2*	40	0.292	12.56	0.02	11.90	0.95	0.8	0.002	1.1×10^{-3}
MW-3*	15	0.292	13.32	0.02	12.62	0.95	0.8	0.015	7.7×10^{-3}
MW-6	15	0.333	11.60	0.03	10.90	0.94	0.8	0.007	4.7×10^{-3}
MW-7	5	0.333	5.62	0.06	5.24	0.93	0.6	0.022	4.1×10^{-2}
MW-8	15	0.333	7.21	0.05	6.71	0.93	0.7	0.007	8.7×10^{-3}
MW-9	10	0.333	3.53	0.09	3.02	0.86	1.0	0.0075	1.3×10^{-2}
MW-16	15	0.333	6.70	0.05	6.18	0.92	0.8	0.014	1.6×10^{-2}
MW-17	15	0.333	10.58	0.03	9.84	0.93	1.1	0.010	5.4×10^{-3}
MW-18	15	0.333	6.40	0.05	5.91	0.92	0.8	0.013	1.6×10^{-2}

*Screen wrapped in filter fabric

The slope of this line is used to determine the time (t) at which ln(RHR) is -1. This time value is T_o, which is then used in the above equation to calculate the value of hydraulic conductivity for the test.

* Freeze, R.A. and J.A. Cherry, Groundwater, Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 1979, pp. 340-341.

IN FIELD HYDRAULIC CONDUCTIVITY SUMMARY
PIEZOMETER RESULTS - SLUG TEST METHOD

Well	K (cm/s)
MW-3P	2.4×10^{-4}
MW-6P	4.5×10^{-4}
MW-7P	2.2×10^{-3}
MW-18P	4.6×10^{-4}

ADAMS COUNTY LANDFILL
FEASIBILITY STUDY PERMEABILITY TESTS
SLUG TEST RESULTS: WELL 3P

Equation: $K = \frac{r^2 \ln(L/R)}{2 L T_o}$

r = well radius = 2.54 cm

L = screen sand pack length = 228.60 cm

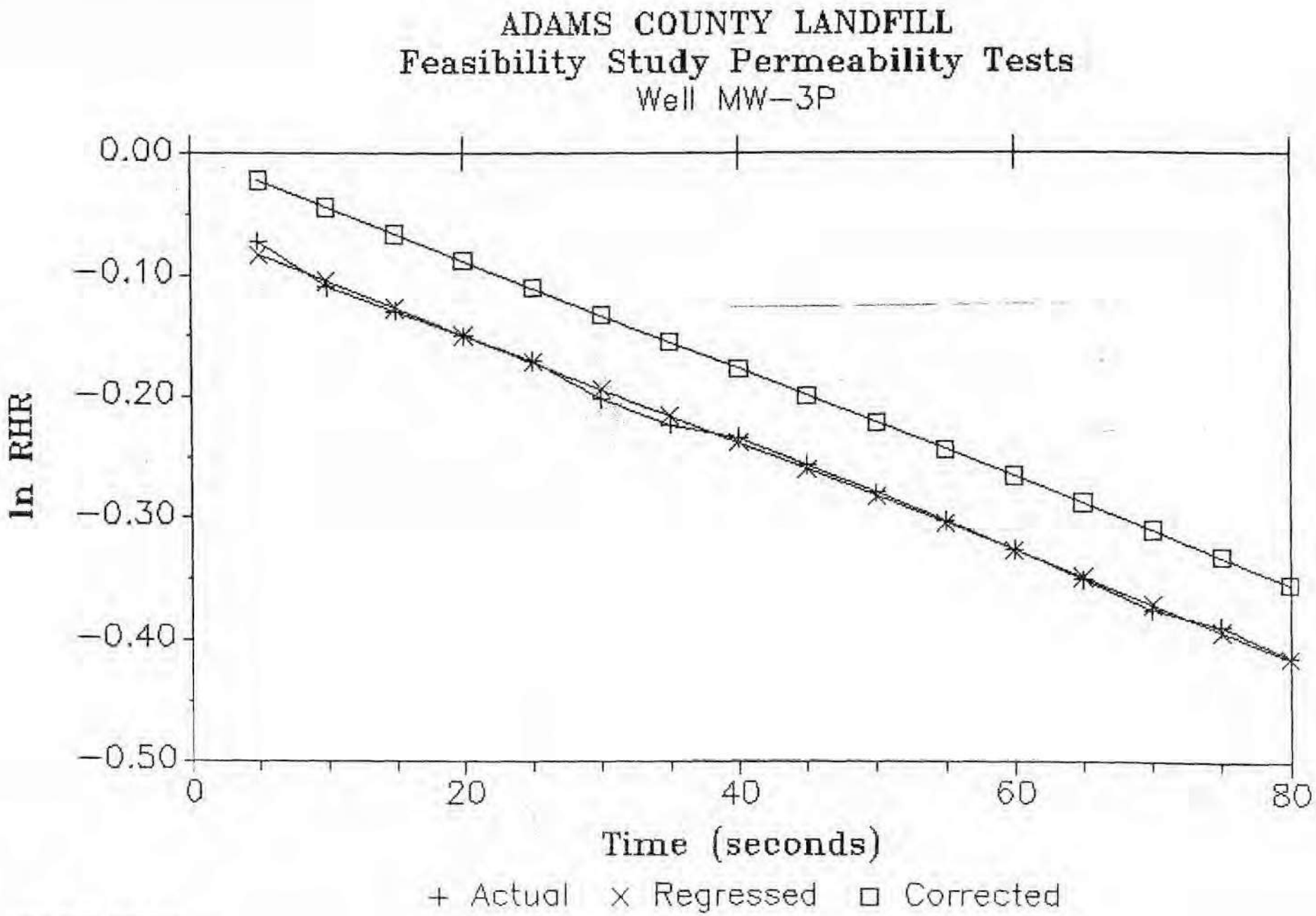
R = borehole radius = 5.08 cm

H_o = initial head difference = 1.15 feet

T_o = time lag = 224.8 seconds

---> K = hydraulic conductivity = 2.4×10^{-4} cm/second

Note: -T_o corresponds to the time when the natural log (ln) of the residual head ratio is -1.00
-RHR is the Residual Head Ratio which is the ratio of the unrecovered head difference (H) and the initial head difference (H_o) created by the added/removed water


ADAMS COUNTY LANDFILL
Feasibility Study Permeability Tests
Well MW-3P
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
ln RHR
0
20
40
60
80
Time (seconds)
+ Actual × Regressed □ Corrected
Data From Slug Test

ADAMS COUNTY LANDFILL
FEASIBILITY STUDY PERMEABILITY TESTS
SLUG TEST RESULTS: WELL 6P

Equation: $K = \frac{r^2 \ln(L/R)}{2 L T_o}$

r = well radius = 2.54 cm

L = screen sand pack length = 243.84 cm

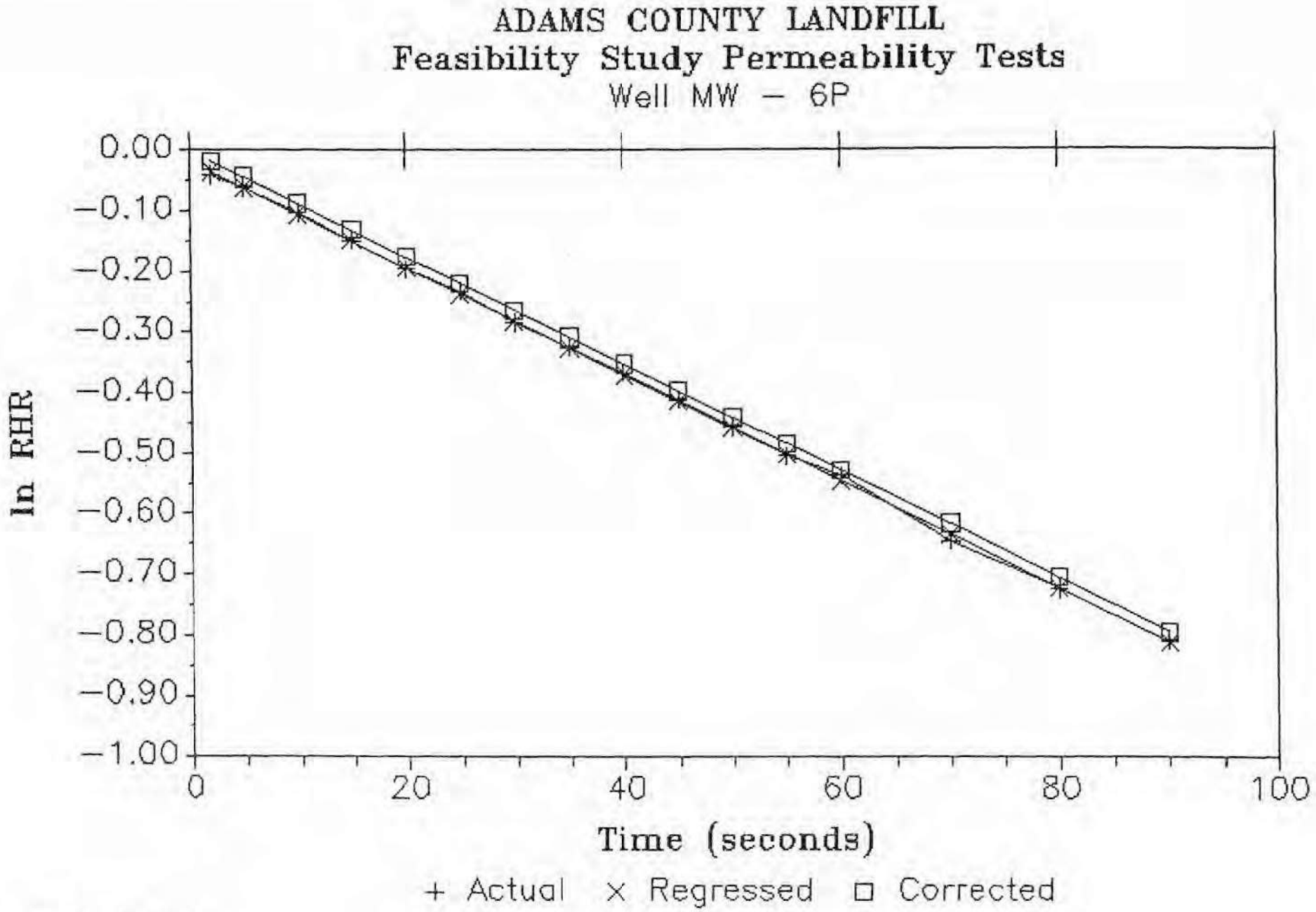
R = borehole radius = 5.08 cm

H_o = initial head difference = 1.01 feet

T_o = time lag = 112.9 seconds

---> K = hydraulic conductivity = 4.5×10^{-4} cm/second

Note: -T_o corresponds to the time when the natural log (ln) of the residual head ratio is -1.00
-RHR is the Residual Head Ratio which is the ratio of the unrecovered head difference (H) and the initial head difference (H_o) created by the added/removed water


ADAMS COUNTY LANDFILL
Feasibility Study Permeability Tests
Well MW – 6P
0.00
−0.10
−0.20
−0.30
−0.40
−0.50
−0.60
−0.70
−0.80
−0.90
−1.00
ln RHR
0
20
40
60
80
100
Time (seconds)
+ Actual × Regressed □ Corrected
Data From Slug Test

ADAMS COUNTY LANDFILL
FEASIBILITY STUDY PERMEABILITY TESTS
SLUG TEST RESULTS: WELL 7P

Equation: $K = \frac{r^2 \ln(L/R)}{2 L T_o}$

r = well radius = 2.54 cm

L = screen sand pack length = 243.84 cm

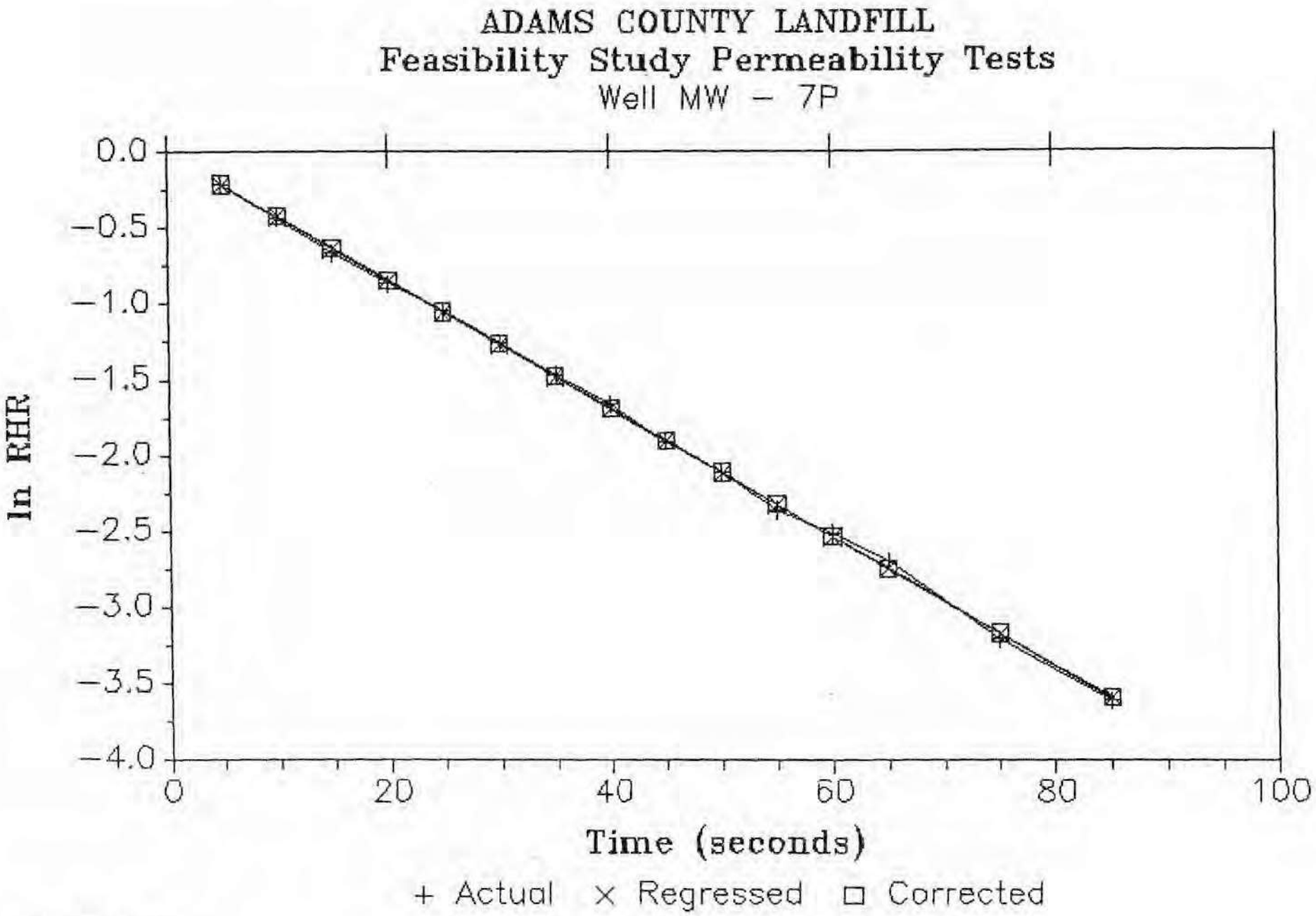
R = borehole radius = 5.08 cm

H_o = initial head difference = 0.74 feet

T_o = time lag = 23.6 seconds

---> K = hydraulic conductivity = 2.2×10^{-3} cm/second

Note: -T_o corresponds to the time when the natural log (ln) of the residual head ratio is -1.00
-RHR is the Residual Head Ratio which is the ratio of the unrecovered head difference (H) and the initial head difference (H_o) created by the added/removed water


ADAMS COUNTY LANDFILL
Feasibility Study Permeability Tests
Well MW - 7P
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
ln RHR
0
20
40
60
80
100
Time (seconds)
+ Actual × Regressed □ Corrected
Data From Slug Test

ADAMS COUNTY LANDFILL
FEASIBILITY STUDY PERMEABILITY TESTS
SLUG TEST RESULTS: WELL 18P

Equation: $K = \frac{r^2 \ln(L/R)}{2 L T_o}$

r = well radius = 2.54 cm

L = screen sand pack length = 228.60 cm

R = borehole radius = 5.08 cm

H_o = initial head difference = 1.39 feet

T_o = time lag = 116.6 seconds

---> K = hydraulic conductivity = 4.6×10^{-4} cm/second

Note: -T_o corresponds to the time when the natural log (ln) of the residual head ratio is -1.00
-RHR is the Residual Head Ratio which is the ratio of the unrecovered head difference (H) and the initial head difference (H_o) created by the added/removed water

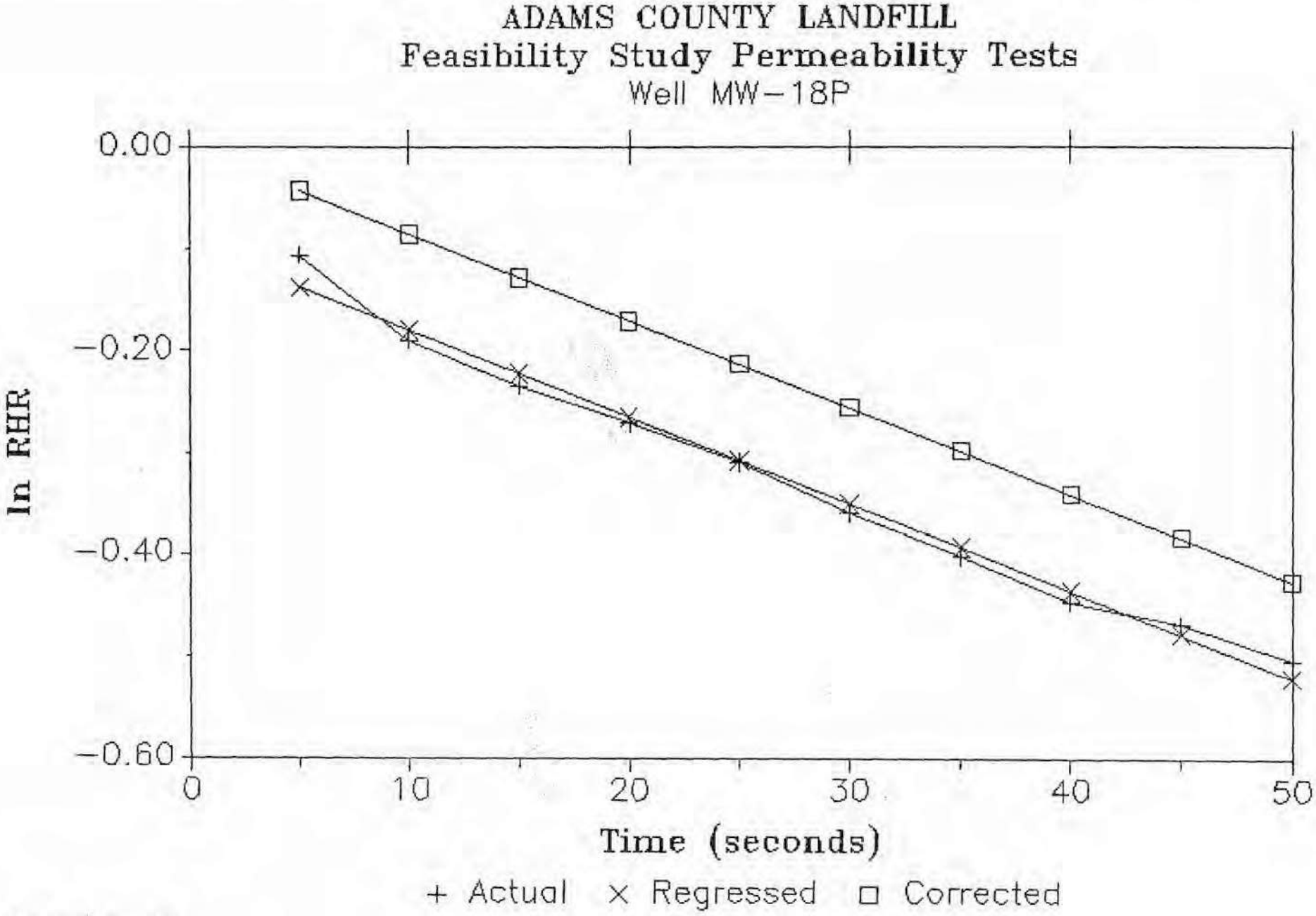

ADAMS COUNTY LANDFILL
Feasibility Study Permeability Tests
Well MW-18P
0.00
-0.20
-0.40
-0.60
ln RHR
0
10
20
30
40
50
Time (seconds)
+ Actual × Regressed □ Corrected
Data From Slug Test

TABLE NO. 6-7

IN-FIELD PERMEABILITY TESTS

Well	Hydraulic Conductivity (cm/sec)	Soil Type	Well Screen Elevation (USGS)
MW-1	6.9×10^{-2}	SP;CL	935 - 920
MW-2	1.1×10^{-3}	SP;CL	943 - 928
MW-3	7.7×10^{-3}	SP;CL	938 - 923
MW-3P	2.4×10^{-4}	SP	897 - 892
MW-6	4.7×10^{-3}	SP;CL,ML	945 - 930
MW-6P	4.5×10^{-4}	SP	907 - 902
MW-7	4.1×10^{-2}	SM	943 - 933
MW-7P	2.2×10^{-3}	SP	909 - 904
MW-8	8.7×10^{-3}	SM;SP,CL	943 - 933
MW-9	1.3×10^{-2}	SM;SP	942 - 932
MW-16	1.6×10^{-2}	ML,CL,SM	945 - 935
MW-17	5.4×10^{-3}	ML,CL,SM	943 - 933
MW-18	1.6×10^{-2}	SP;ML,CL,SM	944 - 934
MW-18P	4.6×10^{-4}	SP	908 - 903

Foth & Van Dyke
Engineers/Architects
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

FALLING/CONSTANT HEAD TEST

No. of Layers	
No. of Blows/Hammer Size	
Vol. of Water Added (c.c.)	
Wt. of Cyl. + Soil, Wm (lbs.)	
Wt. of Cyl., Wc (lbs.)	
Wt. of Soil, W (lbs.)	
Average Water Content, w(%)	
Moist Density, FM (lbs./ft.^{3})	
Dry Density, FM (dry) (lbs./ft.^{3})	
% Compaction	

JOB NO.:	86A22
BORING NO.:	10
SAMPLE NO.:	FR-17
DEPTH:	30-33'
TUBE DIAMETER	A = 2.80"
LENGTH OF SAMPLE	6.8125"
DIST. FROM TOP OF TUBE TO LOWER WATER LEVEL	26.3 cm
DATE:	July 18, 1986
TECH. NAME:	R. Rouse

	TIME AM/PM DATE	TIME INTERVAL (MIN.)	H @ START OF TEST	H @ FINISH	TARE	TOTAL WT. TARE + WATER, GR.	WEIGHT OF WATER, GR.	K CM/SEC.
(1)	08:05 (AM) PM 7/18/86 16:08 AM (PM) 7/18/86	(483) 28,980	SATURATION 101.0	96.1	201.7	299.8	98.1	2.50×10^{-6}
(2)	16:08 AM (PM) 7/18/96 10:37 (AM) PM 7/21/86	(3985) 239,100	-- 96.1	83.3	201.7	436.7+	235.0+	9.00×10^{-7}
(3)	10:37 (AM) PM 7/21/86 07:32 (AM) PM 7/22/86	(1255) 75,300	@ 2 psi 83.3	74.6	201.7	379.8	178.1	8.00×10^{-7}
(4)	07:32 (AM) PM 7/22/86 07:11 (AM) PM 7/23/86	(1419) 85,140	-- 74.6	72.2	201.7	246.4	44.7	5.00×10^{-7}
(5)	07:11 (AM) PM 7/23/86 22:58 AM (PM) 7/26/86	(5267) 316,020	-- 72.2	66.3	201.7	312.6	110.9	4.00×10^{-7}
(6)	22:58 AM (PM) 7/26/86 09:43 (AM) PM 7/29/86	(3525) 211,500	66.3	62.9	201.7	260.7	59.0	4.00×10^{-7}
(7)	09:43 (AM) PM 7/29/86 14:33 AM (PM) 8/04/86	(8930) 535,800	@ 2 psi 62.9	55.7	201.7	330.1	128.4	9.61×10^{-8}
(8)	14:33 AM (PM) 8/04/86 11:43 (AM) PM 8/10/86	(8470) 508,200	@ 1 psi 55.7	49.4	201.7	310.0	108.3	1.00×10^{-7}
(9)	11:43 (AM) PM 8/10/86 07:38 (AM) PM 8/12/86	(2635) 158,100	@ 1 psi 49.4	47.7	201.7	231.0	29.3	1.00×10^{-7}
(10)	07:38 (AM) PM 8/12/86 13:10 AM (PM) 8/18/86	(8972) 538,320	@ 1 psi 47.7	41.2	201.7	318.7	117.0	2.00×10^{-7}
(11)	13:10 AM (PM) 8/18/86 09:20 (AM) PM 8/21/86	(4090) 245,400	@ 1 psi 41.2	38.2	201.7	251.9	50.2	2.00×10^{-7}
(12)	09:20 (AM) PM 8/21/86 09:20 (AM) PM 8/25/86	(5760) 345,600	@ 1 psi 38.2	34.3	201.7	--	--	2.00×10^{-7}
	AM/PM AM/PM							
	AM/PM AM/PM					Perm Rate		2×10^{-7}

Foth & Van Dyke
Engineers/Architects

2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

PROJECT: Adams County Feasibilit

JOB NO.: 86A22

DATE: September 11, 1986

PERMEABILITY TEST
CONSTANT HEAD

SAMPLE NO.: FR-25 - Boring #11 at 10' to 15' depth

SOIL DESCRIPTION: SAND, fine to medium grained, light brown (SP)

% COMPACTION --

COMPACTED DRY DENSITY = 103.3 pcf

MOISTURE = 7.4%

SAMPLE DIAMETER = 4.00"

SAMPLE HEIGHT = 4.5625" (4-9/16")

RUN NO.	HEAD, (CM)	DURATION, (Seconds)	PERMEABILITY, CM/SEC.	REMARKS
1	83.0	15	1.06×10^{-2}	
2	83.0	15	1.03×10^{-2}	
3	83.0	15	1.03×10^{-2}	
4	83.0	15	1.05×10^{-2}	
5	83.0	15	1.04×10^{-2}	
		Average for Test	1.04×10^{-2}	
		Perm Rate	1×10^{-2}	

Foth & Van Dyke
Engineers/Architects
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

PROJECT: Adams County Feasibil y

JOB NO.: 86A22

DATE: September 11, 1986

PERMEABILITY TEST
CONSTANT HEAD

SAMPLE NO.: FR-21 – Boring #12 at 5' to 10' depth

SOIL DESCRIPTION: SILTY SAND, fine grained, light brown (SM)

% COMPACTION 92

COMPACTED DRY DENSITY = 106.7 pcf

MOISTURE = 10.4%

SAMPLE DIAMETER = 4.0"

SAMPLE HEIGHT = 4.5625"

RUN NO.	HEAD, ~~INCHES~~ (CM)	DURATION, ~~MINUTES~~ (Seconds)	PERMEABILITY, CM/SEC.	REMARKS
1	84.5	30	6.60×10^{-4}	
2	84.5	30	6.43×10^{-4}	
3	84.5	30	6.77×10^{-4}	
4	84.5	30	6.77×10^{-4}	
5	84.5	30	6.43×10^{-4}	
		Average of Tests	6.60×10^{-4}	
		Perm Rate	7×10^{-4}	

Foth & Van Dyke
Engineers/Architects
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

FALLING/CONSTANT HEAD TEST

No. of Layers	
No. of Blows/Hammer Size	
Vol. of Water Added (c.c.)	
Wt. of Cyl. + Soil, Wm (lbs.)	
Wt. of Cyl., Wc (lbs.)	
Wt. of Soil, W (lbs.)	
Average Water Content, w(%)	
Moist Density, FM (lbs./ft.^{3})	
Dry Density, FM (dry) (lbs./ft.^{3})	
% Compaction	

JOB NO.:	86A22
BORING NO.:	12
SAMPLE NO.:	FR-16
DEPTH:	32'
TUBE DIAMETER	A = 2.80"
LENGTH OF SAMPLE	7.0"
DIST. FROM TOP OF TUBE TO LOWER WATER LEVEL	26.0 cm
DATE:	July 16, 1986
TECH. NAME:	R. Rouse

	TIME AM/PM DATE	TIME INTERVAL (MIN.)	H @ START OF TEST	H @ FINISH	TARE	TOTAL WT. TARE + WATER, GR.	WEIGHT OF WATER, GR.	K CM/SEC.
	16:25 AM/PM 7/16/86		SATURATION					
	AM/PM	--	102.8	--	207.3	--	--	
(1)	12:35 AM/PM 7/17/86	(1657)						
	16:12 AM/PM 7/18/86	99,420	102.4	102.0	207.3	220.4	13.1	5.79×10^{-8}
(2)	16:12 AM/PM 7/18/86	(3986)						
	10:38 AM/PM 7/21/86	239,160	102.0	101.2	207.3	217.1	9.8	4.84×10^{-8}
(3)	10:38 AM/PM 7/21/86	(2675)						
	07:13 AM/PM 7/23/86	160,500	101.2	99.0	207.3	242.9	35.6	2.00×10^{-7}
(4)	07:13 AM/PM 7/23/86	(4546)						
	10:59 AM/PM 7/26/86	272,760	99.0	94.4	207.3	288.9	81.6	3.00×10^{-7}
(5)	10:59 AM/PM 7/26/86	(4245)						
	09:44 AM/PM 7/29/86	254,700	94.4	91.6	207.3	260.6	53.3	2.00×10^{-7}
(6)	09:44 AM/PM 7/29/86	(8931)						
	14:35 AM/PM 8/04/86	535,860	91.6	84.6	207.3	329.6	122.3	2.00×10^{-7}
(7)	14:35 AM/PM 8/04/86	(8470)						
	11:45 AM/PM 8/10/86	508,200	84.6	78.4	207.3	317.4	110.1	2.00×10^{-7}
(8)	11:45 AM/PM 8/10/86	(2635)						
	07:40 AM/PM 8/12/86	158,100	78.4	76.5	207.3	239.3	32.0	2.00×10^{-7}
(9)	07:40 AM/PM 8/12/86	(8956)						
	12:56 AM/PM 8/18/86	537,370	76.5	70.3	207.3	317.2	109.9	2.00×10^{-7}
(10)	12:56 AM/PM 8/18/86	(4120)						
	09:36 AM/PM 8/21/86	247,200	70.3	67.4	207.3	255.3	48.0	3.00×10^{-7}
(11)	09:36 AM/PM 8/21/86	(5794)						
	10:10 AM/PM 8/25/86	347,640	67.4	63.7	207.3	--	--	2.00×10^{-7}
	AM/PM							
	AM/PM							
	AM/PM							
	AM/PM					Perm Rate		2×10^{-7}

Foth & Van Dyke
Engineers/Architects

2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

PROJECT: Adams County Study

JOB NO.: 86A22

DATE: September 10, 1986

PERMEABILITY TEST
CONSTANT HEAD

SAMPLE NO.: FR-20 Boring #13 at 10' - 13' depth

SOIL DESCRIPTION: Sand, fine grained, brown (SP)

% COMPACTION = 91 1/2

COMPACTED DRY DENSITY = 101.7 pct

MOISTURE = 5.6%

SAMPLE DIAMETER = 4.00"

SAMPLE HEIGHT = 4.5625" (4 9/16")

RUN NO.	HEAD, CM	DURATION, Seconds	PERMEABILITY, CM/SEC.	REMARKS
1	82.1	15	7.66×10^{-3}	
2	82.1	15	7.37×10^{-3}	
3	82.1	15	7.40×10^{-3}	
4	82.1	15	7.31×10^{-3}	
5	82.1	15	7.09×10^{-3}	

Average of Tests = 7.37×10^{-3}

Foth & Van Dyke
Engineers/Architects
2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

FALLING/CONSTANT HEAD TEST

Recompacted Perm

No. of Layers	4
No. of Blows/Hammer Size	25/10#
Vol. of Water Added (c.c.)	
Wt. of Cyl. + Soil, Wm (lbs.)	5409
Wt. of Cyl., Wc (lbs.)	3357
Wt. of Soil, W (lbs.)	2052
Average Water Content, w(%)	11.1
Moist Density, FM (lbs./ft.^{3})	135.7
Dry Density, FM (dry) (lbs./ft.^{3})	122.2
% Compaction	95

JOB NO.:	86A22 FR
BORING NO.:	MW-8
SAMPLE NO.:	
DEPTH:	50-55'
TUBE DIAMETER	A = 4.0"
LENGTH OF SAMPLE	4.50
DIST. FROM TOP OF TUBE TO LOWER WATER LEVEL	33.2 cm
DATE:	September 13-19, 1986
TECH. NAME:	RRR

TIME AM/PM DATE	TIME INTERVAL (MIN.)	H @ START OF TEST	H @ FINISH	TARE	TOTAL WT. TARE + WATER, GR.	WEIGHT OF WATER, GR.	K CM/SEC.
12:25 AM (PM) 9/13/86 06:50 (AM) PM 9/16/86	(3985) 239100	@ 3 psi 100.0	96.6	207.3	239.4	32.1	2.13×10^{-8}
06:50 (AM) PM 9/16/86 07:30 (AM) PM 9/17/86	(1480) 88800	@ 3 psi 96.6	94.6	207.3	240.1	32.8	3.40×10^{-8}
07:30 (AM) PM 9/17/86 07:22 (AM) PM 9/18/86	(1432) 85920	@ 3 psi 94.6	93.1	207.3	234.5	27.2	2.65×10^{-8}
07:22 (AM) PM 9/18/86 17:05 AM (PM) 9/18/86	(583) 34980	@ 3 psi 93.1	92.5	207.3	2 ↕		3.49×10^{-8}
17:05 AM (PM) 9/18/86 06:37 (AM) PM 9/19/86	(812) 48720	@ 3 psi 92.5	91.7	207.3	233.0	25.7	2.82×10^{-8}
AM/PM AM/PM							
AM/PM AM/PM				Average of last 4 readings			3.09×10^{-8}
AM/PM AM/PM				Perm Rate			3×10^{-8}
AM/PM AM/PM							
AM/PM AM/PM							
AM/PM AM/PM							
AM/PM AM/PM							
AM/PM AM/PM							
AM/PM AM/PM							

Foth & Van Dyke
Engineers/Architects

2737 S. Ridge Road
P. O. Box 19012
Green Bay, Wisconsin 54307-9012
414/497-2500

PROJECT: Adams County Study

JOB NO.: 86A22 FR

DATE: September 10, 1986

PERMEABILITY TEST
CONSTANT HEAD

SAMPLE NO.: FR-19 Boring MW-9 at 10' depth

SOIL DESCRIPTION: Sand, fine grained, brown (SP)

% COMPACTION - 90

COMPACTED DRY DENSITY = 100.1 pct

MOISTURE = 1.7%

SAMPLE DIAMETER = 4.00"

SAMPLE HEIGHT = 4.5625 (4 9/16")

RUN NO.	HEAD, ~~INCHES~~ CM.	DURATION, ~~MINUTES~~ Seconds	PERMEABILITY, *CM/SEC.*	REMARKS
1	82.7 cm	15	8.54×10^{-3}	
2	82.7 cm	15	8.49×10^{-3}	
3	82.7 cm	15	8.47×10^{-3}	
4	82.7 cm	15	7.95×10^{-3}	
5	82.7 cm	15	7.88×10^{-3}	
		Average of Tests =	8.27×10^{-3}	