Larry Rose

11-07
P

CDM Camp Dresser & McKee

consulting
engineering
construction
operations

5400 Glenwood Avenue, Suite 300
Raleigh, North Carolina 27612
Tel: 919 787-5620 Fax: 919 781-5730

Fac/Perm/Co ID #	Date	Doc ID#
BC	1/26/11	DIN

JUL 1998
Received
Solid Waste
Section

July 2, 1998

Ms. Cheryl Marks
Solid Waste Section
401 Oberlin Road
Suite 150
Raleigh, North Carolina 27605-1350

Re: Buncombe County Construction and Demolition Landfill

Dear Ms. Marks:

While reviewing my files for the Buncombe County Construction and Demolition (C&D) Landfill, it is unclear whether the borings logs for monitoring wells MW-9 and MW-9D, slug test data, and analytical results for the initial sampling event were submitted to the Solid Waste Section (SWS). Therefore, in order to ensure that the files are complete, I am sending you the above listed material. A copy of this letter is also being send to Larry Rose so that he has a copy of the analytical data.

Samples were collected from the monitoring wells and the surface water sampling location, SW-4, on December 8, 1997 and were submitted for laboratory analysis of the Appendix I constituents. These samples were collected prior to this facility receiving any C&D debris. None of the Appendix I constituents were detected in concentrations above the detection limit. A copy of the laboratory analytical data and a table summarizing the field parameter measurements is attached following this letter.

Also attached are the boring and well completion logs for the two wells. Both wells are completed within the bedrock. MW-9 was screened in the upper portion of the bedrock with a 15 foot screen length (screen interval 10.8' to 25.8' bls). MW-9D was completed with a 5 foot screen length deeper into the bedrock, targeting the fracture zone encountered at 36 feet (screen interval - 34.5' to 39.5' bls). Prior to installing the wells, a boring was advanced to identify lithology. The boring, identified as B-09 in the boring log, was advanced using hollow stem augers until refusal was encountered 9.5 feet. The boring was then further advanced using core drilling to a depth of 29.5 feet. After completion, this boring was abandoned by grouting.

After development of the wells, both rising and falling head slug tests were conducted at each well. The slug test data is attached and the results are summarized below.

	Hydraulic Conductivity (feet/day)	
Monitor Well	Falling Head	Rising Head
MW-9	0.14	0.14
MW-9D	0.55	0.5

This submittal should complete your files for this project. If you have any questions or need additional information, please do not hesitate to call me.

Sincerely,

CAMP DRESSER & McKEE

Tim Grant

Timothy D. Grant, P.G.

cc: Larry Rose, Solid Waste Section
Bob Hunter, Buncombe County
Joe Wiseman, CDM

CAMP DRESSER & McKEE

CDM

401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

BOREHOLE LOG
B-09

Client: BUNCOMBE COUNTY
Project Location: BUNCOMBE COUNTY, NORTH CAROLIINA

Project Name: BUNCOMBE COUNTY C & D LANDFILL
Project Number: 6447-13772

Drilling Contractor: METRO DRILL INC.
Drilling Method/Rig: HSA 2 1/4" ID and Coring / Mobil Drill
Drillers: Tim Brown
Drilling Date: Start 10/7/97 **End** 10/7/97
Borehole Coordinates:
N Not Surveyed **E** Not Surveyed

Surface Elevation (ft. MSL):
Total Depth (ft. BGS): 29.5
Depth to Initial Water Level (ft. BGS): 8
Abandonment Method:: Bentonite and Portland Cement
Field Screening Instrument: None
Logged By: ANDREW R. KEAR

Sample Type	Sample Number	Organic Vapor (ppm)	Recov./ Adv.	Blows per 6 Inches	Elev. Depth (ft.)	Graphic Log	Material Description
					0 / 0		0'-3.5': Brown SILT (from cuttings);
			5.5"/18"	50 per 5.5"	-5.0 / 5		3.5'-5.0': Brown SILT w/ a little quartz fragments; dry;
							5.0'-8.5': Brown to gray SILT (from cuttings); dry;
			2"/18"	50 per 2"			8.5'-9.5': Brown SILT w/ weathered bedrock (saprolite); quartz and biotite fragments;
	39% RQD		68.5"/ 120"		-10.0 / 10		9.5'-12.0': Granite to Granitic GNEISS (biotite, quartz, orthoclase); granoblastic texture; Note: Switched to coring @ 9.5';
					-15.0 / 15		12.0'-15.5': Quartz-plagioclase-biotite-hornblende GNEISS; three distinct fractures (46-degrees, 48-degrees, 54-degrees) at 13', 13.3' and 15' below ground surface (bgs); dry;
							15.5'-19.5': Granitic GNEISS;
	7% RQD		21"/60"		-20.0 / 20		19.5'-25.5': Biotite-Hornblende GNEISS; highly fractured zone; initially dry; fractures produced water later;
	74% RQD		54"/60"				

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.6" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
WOH - Weight of Hammer

REMARKS

RQD = Rock Quality Designation

At 9.5', switched from hollow step auger to coring.

Reviewed by: **Date:**

CAMP DRESSER & McKEE
CDM
401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

BOREHOLE LOG
B-09

Client: BUNCOMBE COUNTY
Project Name: BUNCOMBE COUNTY C & D LANDFILL
Project Location: BUNCOMBE COUNTY, NORTH CAROLIINA
Project Number: 6447-13772

Sample Type	Sample Number	Organic Vapor (ppm)	Recov./ Adv.	Blows per 6 Inches	Elev. Depth (ft.)	Graphic Log	Material Description
	74% RQD		54"/60'				25.5'-29.5': Biotite-Hornblende Gneiss w/ some orthoclase; two distinct fractures (43-degrees and 36-degrees) at 25' and 26.5' bgs; folded; fractures produced water later;
					-30.0 / 30		29.5': End of Core
					-35.0 / 35		
					-40.0 / 40		
					-45.0 / 45		
					-50.0 / 50		
					-55.0 / 55		
					-60.0 / 60		

CAMP DRESSER & McKEE

CDM

401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

MONITORING WELL DETAIL

MW-9D

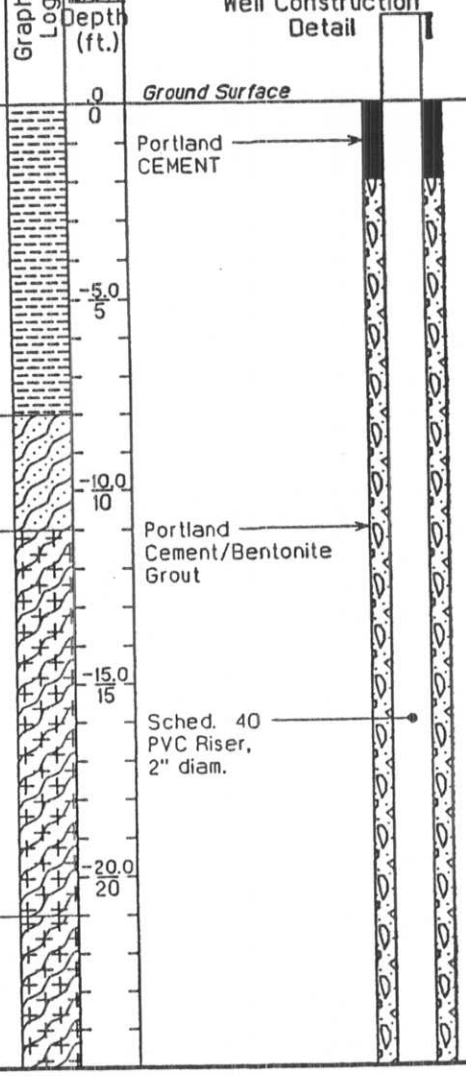
2" diam

Client: BUNCOMBE COUNTY
Project Name: BUNCOMBE COUNTY C & D LANDFILL
Project Location: BUNCOMBE COUNTY, NORTH CAROLINA
Project Number: 6447-13772

Drilling Contractor: Reuben Caldwell Drilling Inc.
Drilling Method/Rig: Air Rotary (6" dia. drill bit)/Driltech D25K
Drillers: Bill Nye
Drilling Date: Start 10/9/97 **End** 10/9/97
Well Coordinates:
N Not Surveyed **E** Not Surveyed
Development Date: Start 10/14/97 **End** 10/14/97

Surface Elevation (ft. MSL):
Total Depth (ft. BGS): 39.5
Depth to Initial Water Level (ft. BGS): 16
Development Method: Air Lift
Field Screening Instrument: None
Logged By: ANDREW R. KEAR
Top of Riser Elevation (ft.): Not Surveyed

Sample Type	Sample Number	Organic Vapor (ppm)	Blows per 6 Inches	Recov./ Adv.	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
					0'-8.0': Brown SILT (from cuttings); dry;		0	Ground Surface; Portland CEMENT
					8.0'-11.0': Gray silt (from cuttings); occasional Granite to Granitic GNEISS fragments w/ biotite and quartz; dry;		5.0 / 5; 10.0 / 10	Portland Cement/Bentonite Grout
					11.0'-21.0': Gray sand (from cuttings); common Biotite/Hornblende (mafic) GNEISS fragments w/ some quartz and plagioclase; dry;		15.0 / 15	Sched. 40 PVC Riser, 2" diam.
					Fracture @ 21';		20.0 / 20	
					21.0'-27.0': Gray silt and sand (from cuttings); common Biotite/ Hornblende GNEISS and Granitic GNEISS fragments;			



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
HA - Hand Auger
AR - Air Rotary
DTR - Dual Tube Rotary
FR - Foam Rotary
MR - Mud Rotary
RC - Reverse Circulation
CT - Cable Tool
JET - Jetting
D - Driving
DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.6" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
WOH - Weight of Hammer

REMARKS

MW-9D is a stick-up well (approximately 3-feet above ground surface).

Reviewed by: **Date:**

CAMP DRESSER & McKEE

CDM

401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

MONITORING WELL DETAIL

MW-9D

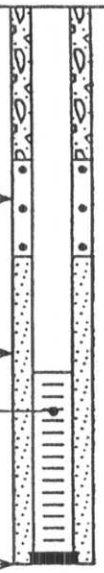
Client: BUNCOMBE COUNTY

Project Name: BUNCOMBE COUNTY C & D LANDFILL

Project Location: BUNCOMBE COUNTY, NORTH CAROLINA

Project Number: 6447-13772

Sample Type	Sample Number	Organic Vapor (ppm)	Blows per 6 Inches	Recov./ Adv.	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
					some orthoclase fragments; initially dry; Fracture zone from 26'-33'; 27.0'-33.0': Gray, silty sand (from cuttings); occasional Biotite/ Hornblende GNEISS fragments w/ rare Granitic GNEISS; initially dry;		30.0 / 30	Bentonite PELLETS
					33.0'-39.5': Gray, silty sand (from cuttings); occasional Hornblende GNEISS fragments; Fracture zone from 36'-39'; 38.0'-39.5': w/ occational quartz fragments; wet;		35.0 / 35	SAND Pack; Screen - Sched. 40 PVC Screen, 2" diam., 0.010" slot, 15' length
					39.5': End of Boring		40.0 / 40	Bottom of Boring @39.5'
							45.0 / 45	
							50.0 / 50	
							55.0 / 55	
							60.0 / 60	



CAMP DRESSER & McKEE

CDM

401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

MONITORING WELL DETAIL

2" diam

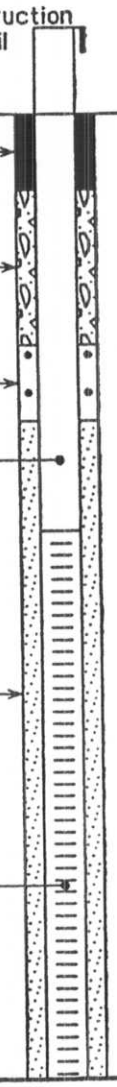
MW-9

Client: BUNCOMBE COUNTY
Project Location: BUNCOMBE COUNTY, NORTH CAROLINA
Project Name: BUNCOMBE COUNTY C & D LANDFILL
Project Number: 6447-13772

Drilling Contractor: Reuben Caldwell Drilling Inc.
Drilling Method/Rig: Air Rotary (6" dia. drill bit)/Driltech D25K
Drillers: Bill Nye
Drilling Date: Start 10/9/97 End 10/9/97
Well Coordinates:
N Not Surveyed E Not Surveyed
Development Date: Start 10/14/97 End 10/14/97

Surface Elevation (ft. MSL):
Total Depth (ft. BGS): 25.8
Depth to Initial Water Level (ft. BGS): 16.3
Development Method: Air Lift
Field Screening Instrument: None
Logged By: ANDREW R. KEAR
Top of Riser Elevation (ft.): Not Surveyed

Sample Type	Sample Number	Organic Vapor (ppm)	Blows per 6 Inches	Recov./ Adv.	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
					0'-10.0': Brown SILT (from cuttings); dry;		0	Ground Surface; Portland CEMENT; Portland Cement/Bentonite Grout; Bentonite PELLETS; Sched. 40 PVC Riser, 2" diam.
					10.0'-15.0': Gray Sand and Gravel (from cuttings); Granite to Granitic GNEISS fragments common; occasional quartz and orthoclase; some hornblende/biotite fragments; dry;		10	SAND Pack
					Small fracture @ 15'; 15.0'-23.0': Gray Sand (from cuttings); Biotite/Hornblende GNEISS common; occasional quartz; trace micaceous; dry;		15	Screen - Sched. 40 PVC Screen, 2" diam., 0.010" slot, 15' length
					Fracture @ 23'-24';		20	
					23.0'-25.0': Brown silt w/ a little sand (from cuttings); Granitic GNEISS			



EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
HSA - Hollow Stem Auger
SSA - Solid Stem Auger
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DTC - Drill Through Casing

SAMPLING TYPES:
AS - Auger/Grab Sample
CS - California Sampler
BX - 1.6" Rock Core
NX - 2.1" Rock Core
GP - Geoprobe
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
OTHER:
WOH - Weight of Hammer

REMARKS

MW-9 is a stick-up well (approximately 3-feet above ground surface).

Reviewed by: Date:

CAMP DRESSER & McKEE

CDM

401 Pennsylvania Parkway, Suite 104
Indianapolis, Indiana 46280

MONITORING WELL DETAIL

MW-9

Client: BUNCOMBE COUNTY

Project Name: BUNCOMBE COUNTY C & D LANDFILL

Project Location: BUNCOMBE COUNTY, NORTH CAROLINA

Project Number: 6447-13772

Sample Type	Sample Number	Organic Vapor (ppm)	Blows per 6 Inches	Recov./ Adv.	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
					(cont.) fragments; trace quartz and orthoclase; wet after 20 minutes;			Bottom of Boring @25.8'
					25.8': End of Boring			
							-30.0 / 30	
							-35.0 / 35	
							-40.0 / 40	
							-45.0 / 45	
							-50.0 / 50	
							-55.0 / 55	
							-60.0 / 60	

Field Parameters
December 8, 1997
Buncombe County C & D Landfill

Monitoring Well Designation	pH (-)	Conductivity (µS)	Temp. (deg. C)	Depth to Groundwater (feet below TOC)
MW-9	5.67	271	13.2	17.77
MW-9d	5.53	237	12.8	15.90
SW-4	6.20	121	0.6	

Notes:
1. SW denotes Surface Water Sampling Location

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles
by GCMS 8260B

Client Sample ID: MW-9D
Client Project ID: C&D Landfill -Buncombe Co.,N.C.
Lab Sample ID: 33739
Lab Project ID: G175-15
Matrix: Water

Date Analyzed: 12/16/97
Analyzed By: LAW
Date Collected: 12/8/97
Date Received: 12/9/97
Dilution: 1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)
Acetone	100	BQL
Acrylonitrile	200	BQL
Benzene	5.0	BQL
Bromochloromethane	5.0	BQL
Bromodichloromethane	5.0	BQL
Bromoform	5.0	BQL
Carbon disulfide	100	BQL
Carbon tetrachloride	10	BQL
Chlorobenzene	5.0	BQL
Chloroethane	10	BQL
Chloroform	5.0	BQL
Chlorodibromomethane	5.0	BQL
DBCP (1,2-Dibromo-3-chloropropane)	25	BQL
Ethylene dibromide (EDB)	5.0	BQL
o-Dichlorobenzene	5.0	BQL
p-Dichlorobenzene	5.0	BQL
t-1,4-Dichloro-2-butene	100	BQL
1,1-Dichloroethane	5.0	BQL
Ethylene dichloride	5.0	BQL
Vinylidene chloride	5.0	BQL
cis-1,2-Dichloroethene	5.0	BQL
t-1,2-Dichloroethene	5.0	BQL
Propylene dichloride	5.0	BQL
cis-1,3-Dichloropropene	10	BQL
t-1,3-Dichloropropene	10	BQL
Ethylbenzene	5.0	BQL
Methyl butyl ketone	50	BQL
Methyl bromide	10	BQL
Methyl chloride	10	BQL
Methylene bromide	10	BQL
Methylene chloride	10	BQL
MEK (2-Butanone)	100	BQL
Methyl iodide	10	BQL
Methyl isobutyl ketone	100	BQL
Styrene	10	BQL
1,1,1,2-Tetrachloroethane	5.0	BQL
1,1,2,2-Tetrachloroethane	5.0	BQL
Tetrachloroethylene	5.0	BQL
Toluene	5.0	BQL
1,1,1-Trichloroethane	5.0	BQL
1,1,2-Trichloroethane	5.0	BQL
Trichloroethene	5.0	BQL
CFC-11 (Trichlorofluoromethane)	5.0	BQL
1,2,3-Trichloropropane	15	BQL
Vinyl acetate	50	BQL
Vinyl chloride	10	BQL
Xylenes (total)	5.0	BQL

Reviewed by: MA

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles
by GCMS 8260B

Client Sample ID:	MW-9D	Date Analyzed:	12/16/97
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Analyzed By:	LAW
Lab Sample ID:	33739	Date Collected:	12/8/97
Lab Project ID:	G175-15	Date Received:	12/9/97
Matrix:	Water	Dilution:	1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)

Surrogate Spike Recoveries Compound	Spike Added (ug/L)	Surrogate Result (ug/L)	%Rec
Bromofluorobenzene	10.0	9.0	90
1,2-Dichloroethane-d4	10.0	10.7	107
Toluene-d8	10.0	10.0	100

Comments:

All results are corrected for dilution.

Reviewed by: Mr

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles

by GCMS 8260B

Client Sample ID: MW-9
Client Project ID: C&D Landfill -Buncombe Co.,N.C.
Lab Sample ID: 33740
Lab Project ID: G175-15
Matrix: Water

Date Analyzed: 12/16/97
Analyzed By: LAW
Date Collected: 12/8/97
Date Received: 12/9/97
Dilution: 1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)
Acetone	100	BQL
Acrylonitrile	200	BQL
Benzene	5.0	BQL
Bromochloromethane	5.0	BQL
Bromodichloromethane	5.0	BQL
Bromoform	5.0	BQL
Carbon disulfide	100	BQL
Carbon tetrachloride	10	BQL
Chlorobenzene	5.0	BQL
Chloroethane	10	BQL
Chloroform	5.0	BQL
Chlorodibromomethane	5.0	BQL
DBCP (1,2-Dibromo-3-chloropropane)	25	BQL
Ethylene dibromide (EDB)	5.0	BQL
o-Dichlorobenzene	5.0	BQL
p-Dichlorobenzene	5.0	BQL
t-1,4-Dichloro-2-butene	100	BQL
1,1-Dichloroethane	5.0	BQL
Ethylene dichloride	5.0	BQL
Vinylidene chloride	5.0	BQL
cis-1,2-Dichloroethene	5.0	BQL
t-1,2-Dichloroethene	5.0	BQL
Propylene dichloride	5.0	BQL
cis-1,3-Dichloropropene	10	BQL
t-1,3-Dichloropropene	10	BQL
Ethylbenzene	5.0	BQL
Methyl butyl ketone	50	BQL
Methyl bromide	10	BQL
Methyl chloride	10	BQL
Methylene bromide	10	BQL
Methylene chloride	10	BQL
MEK (2-Butanone)	100	BQL
Methyl iodide	10	BQL
Methyl isobutyl ketone	100	BQL
Styrene	10	BQL
1,1,1,2-Tetrachloroethane	5.0	BQL
1,1,2,2-Tetrachloroethane	5.0	BQL
Tetrachloroethylene	5.0	BQL
Toluene	5.0	BQL
1,1,1-Trichloroethane	5.0	BQL
1,1,2-Trichloroethane	5.0	BQL
Trichloroethene	5.0	BQL
CFC-11 (Trichlorofluoromethane)	5.0	BQL
1,2,3-Trichloropropane	15	BQL
Vinyl acetate	50	BQL
Vinyl chloride	10	BQL
Xylenes (total)	5.0	BQL

Reviewed by: mr

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles
by GCMS 8260B

Client Sample ID:	MW-9	Date Analyzed:	12/16/97
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Analyzed By:	LAW
Lab Sample ID:	33740	Date Collected:	12/8/97
Lab Project ID:	G175-15	Date Received:	12/9/97
Matrix:	Water	Dilution:	1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)

Surrogate Spike Recoveries

Compound	Spike Added (ug/L)	Surrogate Result (ug/L)	%Rec
Bromofluorobenzene	10.0	9.3	93
1,2-Dichloroethane-d4	10.0	10.6	106
Toluene-d8	10.0	9.7	97

Comments:

All results are corrected for dilution.

Reviewed by: ha

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles
by GCMS 8260B

Client Sample ID:	SW-4	Date Analyzed:	12/16/97
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Analyzed By:	LAW
Lab Sample ID:	33741	Date Collected:	12/8/97
Lab Project ID:	G175-15	Date Received:	12/9/97
Matrix:	Water	Dilution:	1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)
Acetone	100	BQL
Acrylonitrile	200	BQL
Benzene	5.0	BQL
Bromochloromethane	5.0	BQL
Bromodichloromethane	5.0	BQL
Bromoform	5.0	BQL
Carbon disulfide	100	BQL
Carbon tetrachloride	10	BQL
Chlorobenzene	5.0	BQL
Chloroethane	10	BQL
Chloroform	5.0	BQL
Chlorodibromomethane	5.0	BQL
DBCP (1,2-Dibromo-3-chloropropane)	25	BQL
Ethylene dibromide (EDB)	5.0	BQL
o-Dichlorobenzene	5.0	BQL
p-Dichlorobenzene	5.0	BQL
t-1,4-Dichloro-2-butene	100	BQL
1,1-Dichloroethane	5.0	BQL
Ethylene dichloride	5.0	BQL
Vinylidene chloride	5.0	BQL
cis-1,2-Dichloroethene	5.0	BQL
t-1,2-Dichloroethene	5.0	BQL
Propylene dichloride	5.0	BQL
cis-1,3-Dichloropropene	10	BQL
t-1,3-Dichloropropene	10	BQL
Ethylbenzene	5.0	BQL
Methyl butyl ketone	50	BQL
Methyl bromide	10	BQL
Methyl chloride	10	BQL
Methylene bromide	10	BQL
Methylene chloride	10	BQL
MEK (2-Butanone)	100	BQL
Methyl iodide	10	BQL
Methyl isobutyl ketone	100	BQL
Styrene	10	BQL
1,1,1,2-Tetrachloroethane	5.0	BQL
1,1,2,2-Tetrachloroethane	5.0	BQL
Tetrachloroethylene	5.0	BQL
Toluene	5.0	BQL
1,1,1-Trichloroethane	5.0	BQL
1,1,2-Trichloroethane	5.0	BQL
Trichloroethene	5.0	BQL
CFC-11 (Trichlorofluoromethane)	5.0	BQL
1,2,3-Trichloropropane	15	BQL
Vinyl acetate	50	BQL
Vinyl chloride	10	BQL
Xylenes (total)	5.0	BQL

Reviewed by: MS

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix I Volatiles
by GCMS 8260B

Client Sample ID:	SW-4	Date Analyzed:	12/16/97
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Analyzed By:	LAW
Lab Sample ID:	33741	Date Collected:	12/8/97
Lab Project ID:	G175-15	Date Received:	12/9/97
Matrix:	Water	Dilution:	1.0

Compound	Quantitation Limit (ug/L)	Result (ug/L)

Surrogate Spike Recoveries Compound	Spike Added (ug/L)	Surrogate Result (ug/L)	%Rec
Bromofluorobenzene	10.0	9.3	93
1,2-Dichloroethane-d4	10.0	10.8	108
Toluene-d8	10.0	9.9	99

Comments:

All results are corrected for dilution.

Reviewed by: _____

Flags: BQL = Below Quantitation Limit

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix 1 Metals

Client Sample ID:	MW-9D	Analyzed By:	JMF
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Date Collected:	12/8/97
Lab Sample ID:	33739	Date Received:	12/9/97
Lab Project ID:	G175-15	Matrix:	Water

Metals	Result	Quantitation Limit	Units	Procedure	Date Analyzed
Antimony	BQL	0.0300	MG/L	6010A	12/22/97
Arsenic	BQL	0.0100	MG/L	6010A	12/22/97
Barium	BQL	0.500	MG/L	6010A	12/22/97
Beryllium	BQL	0.0020	MG/L	6010A	12/22/97
Cadmium	BQL	0.0010	MG/L	6010A	12/22/97
Chromium	BQL	0.0100	MG/L	6010A	12/22/97
Cobalt	BQL	0.0100	MG/L	6010A	12/22/97
Copper	BQL	0.200	MG/L	6010A	12/22/97
Lead	BQL	0.0100	MG/L	6010A	12/22/97
Nickel	BQL	0.0500	MG/L	6010A	12/22/97
Selenium	BQL	0.0200	MG/L	6010A	12/22/97
Silver	BQL	0.0100	MG/L	6010A	12/22/97
Thallium	BQL	0.0100	MG/L	6010A	12/22/97
Vanadium	BQL	0.0400	MG/L	6010A	12/22/97
Zinc	BQL	0.0500	MG/L	6010A	12/22/97

Comments
BQL = Below Quantitation Limits

Reviewed By: MZ

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix 1 Metals

Client Sample ID:	MW-9	Analyzed By:	JMF
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Date Collected:	12/8/97
Lab Sample ID:	33740	Date Received:	12/9/97
Lab Project ID:	G175-15	Matrix:	Water

Metals	Result	Quantitation Limit	Units	Procedure	Date Analyzed
Antimony	BQL	0.0300	MG/L	6010A	12/22/97
Arsenic	BQL	0.0100	MG/L	6010A	12/22/97
Barium	BQL	0.500	MG/L	6010A	12/22/97
Beryllium	BQL	0.0020	MG/L	6010A	12/22/97
Cadmium	BQL	0.0010	MG/L	6010A	12/22/97
Chromium	BQL	0.0100	MG/L	6010A	12/22/97
Cobalt	BQL	0.0100	MG/L	6010A	12/22/97
Copper	BQL	0.200	MG/L	6010A	12/22/97
Lead	BQL	0.0100	MG/L	6010A	12/22/97
Nickel	BQL	0.0500	MG/L	6010A	12/22/97
Selenium	BQL	0.0200	MG/L	6010A	12/22/97
Silver	BQL	0.0100	MG/L	6010A	12/22/97
Thallium	BQL	0.0100	MG/L	6010A	12/22/97
Vanadium	BQL	0.0400	MG/L	6010A	12/22/97
Zinc	BQL	0.0500	MG/L	6010A	12/22/97

Comments

BQL = Below Quantitation Limits

Reviewed By: [illegible]

PARADIGM ANALYTICAL LABORATORIES, INC.

Results for Appendix 1 Metals

Client Sample ID:	SW-4	Analyzed By:	JMF
Client Project ID:	C&D Landfill -Buncombe Co.,N.C.	Date Collected:	12/8/97
Lab Sample ID:	33741	Date Received:	12/9/97
Lab Project ID:	G175-15	Matrix:	Water

Metals	Result	Quantitation Limit	Units	Procedure	Date Analyzed
Antimony	BQL	0.0300	MG/L	6010A	12/22/97
Arsenic	BQL	0.0100	MG/L	6010A	12/22/97
Barium	BQL	0.500	MG/L	6010A	12/22/97
Beryllium	BQL	0.0020	MG/L	6010A	12/22/97
Cadmium	BQL	0.0010	MG/L	6010A	12/22/97
Chromium	BQL	0.0100	MG/L	6010A	12/22/97
Cobalt	BQL	0.0100	MG/L	6010A	12/22/97
Copper	BQL	0.200	MG/L	6010A	12/22/97
Lead	BQL	0.0100	MG/L	6010A	12/22/97
Nickel	BQL	0.0500	MG/L	6010A	12/22/97
Selenium	BQL	0.0200	MG/L	6010A	12/22/97
Silver	BQL	0.0100	MG/L	6010A	12/22/97
Thallium	BQL	0.0100	MG/L	6010A	12/22/97
Vanadium	BQL	0.0400	MG/L	6010A	12/22/97
Zinc	BQL	0.0500	MG/L	6010A	12/22/97

Comments

BQL = Below Quantitation Limits

Reviewed By: [illegible]

PARADIGM ANALYTICAL LABORATORIES, INC.
2627 Northchase Parkway SE, Wilmington, NC 28405
Phone: (910)-350-1903 FAX: (910)-350-1557

Chain-of Custody Record & Analytical Request

COC# 12056

Page 1 of 1

Client: CDM / Buncombe County (Camp Dresser & McKee)
Address: Carolina Corporate Cntr 300
Address: Raleigh, NC (5400 Glenwood Ave, Suite 300)
Quote #:

Project ID: BUNCOMBE COUNTY, NC (C&D Landfill)
P.O. Number:
Contact: Tim Grant
Phone: (919) 787-5620

Date: 12-8-97
Turnaround: Standard
Job Number:

Report To: Tim Grant
CDM - Raleigh, NC

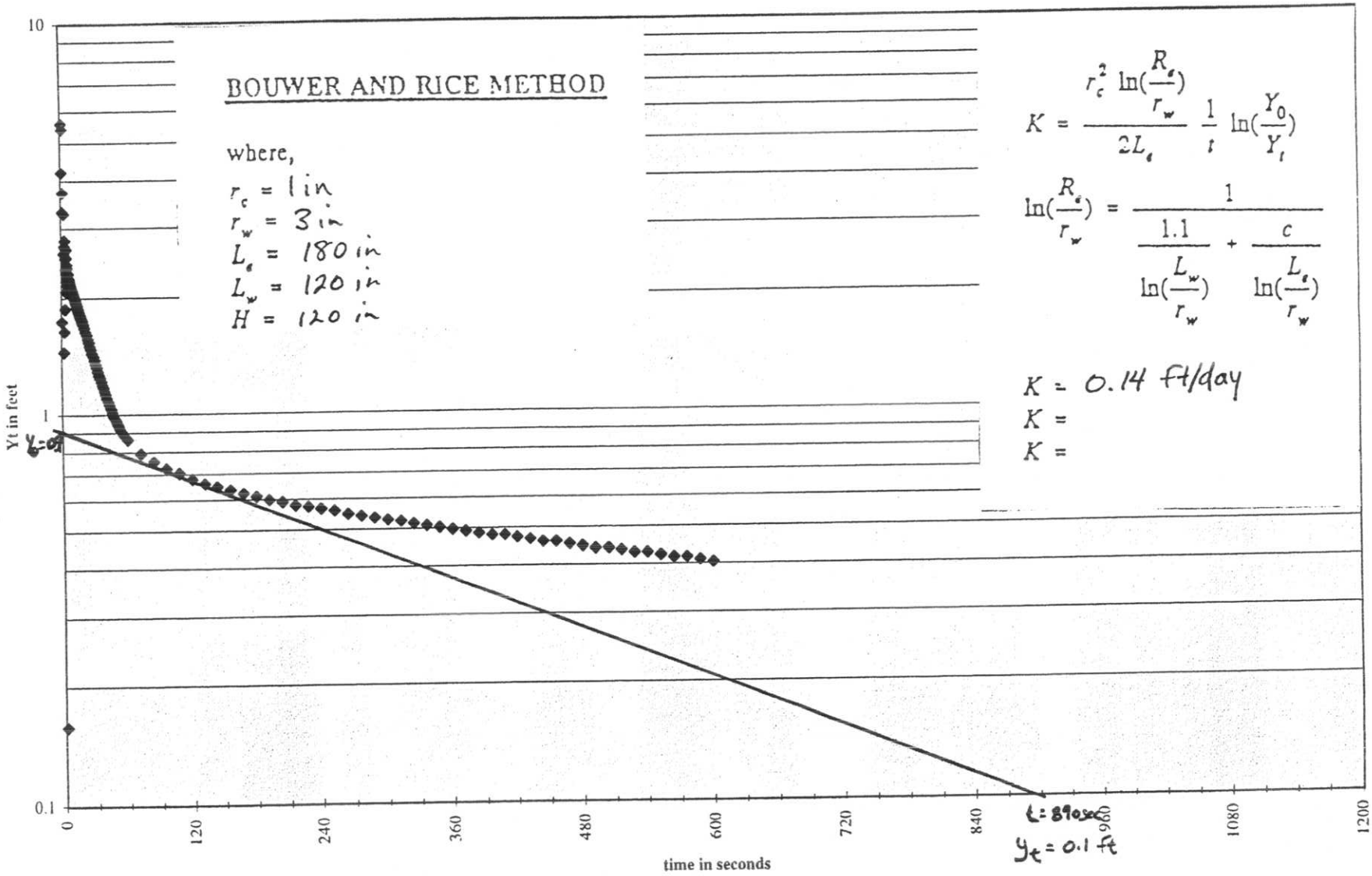
Invoice To: ~~Ti~~

Sample ID	Date	Time	Matrix	Preservatives: HCl	Preservatives: HNO_3			Analyses: VOC Appendix 1 NC	Analyses: Metals Appendix 1 NC								Comments: Please specify any special reporting requirements
																	call Tim Grant at CDM Raleigh to confirm Anal. Methods + Reporting
MW-9D	12-8-97	12:45	W	3	1			✓	✓								
MW-9	12-8-97	13:40	W	3	1			✓	✓								GT175-15
SW-4	12-8-97	14:00	W	3	1			✓	✓								

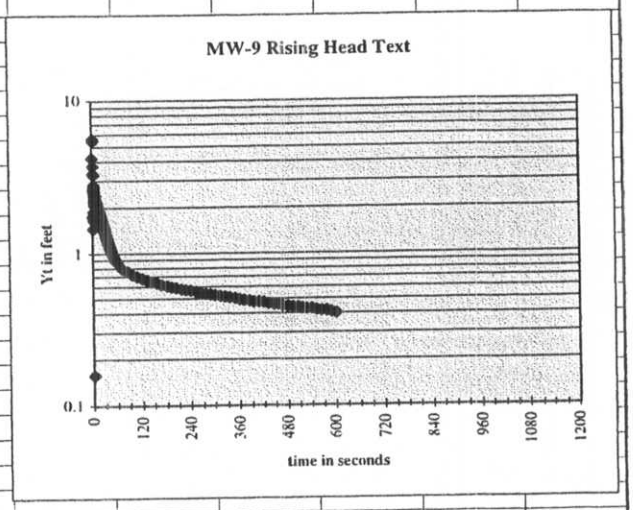
Relinquished By	Date	Time	Received By	Date	Time	Temperature	Sampled By	Airbill #
Andrea L Putscher	12/8/97	17:00	Erica Price	12/9/97	1035	received on ice		

ORIGINAL

MW-9 Rising Head Text



	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 RISING HEAD TEST											
2	HERMIT OUTPUT FOR TEST 3											
3	Time	Water mark		time	Yt							
4	in minute	in feet		in seconds	in feet							
5												
6	0	15.893		0	0.007							
7	0.0033	15.9		0.198	0							
8	0.0066	16.038		0.396	-0.138							
9	0.01	14.163		0.6	1.737							
10	0.0133	11.699		0.798	4.201							
11	0.0166	10.291		0.996	5.609							
12	0.02	10.467		1.2	5.433							
13	0.0233	12.579		1.398	3.321							
14	0.0266	15.742		1.596	0.158							
15	0.03	15.849		1.8	0.051							
16	0.0333	12.17		1.998	3.73							
17	0.0366	13.308		2.196	2.592							
18	0.04	14.453		2.4	1.447							
19	0.0433	12.623		2.598	3.277							
20	0.0466	13.188		2.796	2.712							
21	0.05	14.257		3	1.643							
22	0.0533	13.1		3.198	2.8							
23	0.0566	13.214		3.396	2.686							
24	0.06	14.025		3.6	1.875							
25	0.0633	13.371		3.798	2.529							
26	0.0666	13.245		3.996	2.655							
27	0.07	13.823		4.2	2.077							
28	0.0733	13.534		4.398	2.366							
29	0.0766	13.364		4.596	2.536							
30	0.08	13.729		4.8	2.171							
31	0.0833	13.629		4.998	2.271							
32	0.0866	13.465		5.196	2.435							
33	0.09	13.698		5.4	2.202							
34	0.0933	13.673		5.598	2.227							
35	0.0966	13.515		5.796	2.385							
36	0.1	13.729		6	2.171							
37	0.1033	13.71		6.198	2.19							
38	0.1066	13.591		6.396	2.309							
39	0.11	13.679		6.6	2.221							
40	0.1133	13.729		6.798	2.171							
41	0.1166	13.654		6.996	2.246							
42	0.12	13.685		7.2	2.215							
43	0.1233	13.748		7.398	2.152							
44	0.1266	13.704		7.596	2.196							
45	0.13	13.717		7.8	2.183							
46	0.1333	13.761		7.998	2.139							
47	0.1366	13.742		8.196	2.158							
48	0.14	13.748		8.4	2.152							
49	0.1433	13.78		8.598	2.12							
50	0.1466	13.773		8.796	2.127							
51	0.15	13.773		9	2.127							
52	0.1533	13.798		9.198	2.102							
53	0.1566	13.798		9.396	2.102							
54	0.16	13.805		9.6	2.095							
55	0.1633	13.823		9.798	2.077							
56	0.1666	13.83		9.996	2.07							
57	0.17	13.83		10.2	2.07							
58	0.1733	13.842		10.398	2.058							
59	0.1766	13.855		10.596	2.045							
60	0.18	13.855		10.8	2.045							
61	0.1833	13.868		10.998	2.032							
62	0.1866	13.874		11.196	2.026							
63	0.19	13.88		11.4	2.02							
64	0.1933	13.886		11.598	2.014							
65	0.1966	13.899		11.796	2.001							
66	0.2	13.905		12	1.995							
67	0.2033	13.912		12.198	1.988							
68	0.2066	13.918		12.396	1.982							



	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 RISING HEAD TEST											
2	HERMIT OUTPUT FOR TEST 3											
3	Time	Water mark		time	Yt							
69	0.21	13.93		12.6	1.97							
70	0.2133	13.937		12.798	1.963							
71	0.2166	13.943		12.996	1.957							
72	0.22	13.949		13.2	1.951							
73	0.2233	13.956		13.398	1.944							
74	0.2266	13.968		13.596	1.932							
75	0.23	13.974		13.8	1.926							
76	0.2333	13.981		13.998	1.919							
77	0.2366	13.987		14.196	1.913							
78	0.24	13.993		14.4	1.907							
79	0.2433	14.006		14.598	1.894							
80	0.2466	14.012		14.796	1.888							
81	0.25	14.018		15	1.882							
82	0.2533	14.025		15.198	1.875							
83	0.2566	14.031		15.396	1.869							
84	0.26	14.044		15.6	1.856							
85	0.2633	14.05		15.798	1.85							
86	0.2666	14.056		15.996	1.844							
87	0.27	14.063		16.2	1.837							
88	0.2733	14.069		16.398	1.831							
89	0.2766	14.075		16.596	1.825							
90	0.28	14.081		16.8	1.819							
91	0.2833	14.094		16.998	1.806							
92	0.2866	14.1		17.196	1.8							
93	0.29	14.107		17.4	1.793							
94	0.2933	14.113		17.598	1.787							
95	0.2966	14.119		17.796	1.781							
96	0.3	14.125		18	1.775							
97	0.3033	14.132		18.198	1.768							
98	0.3066	14.138		18.396	1.762							
99	0.31	14.144		18.6	1.756							
100	0.3133	14.151		18.798	1.749							
101	0.3166	14.157		18.996	1.743							
102	0.32	14.169		19.2	1.731							
103	0.3233	14.176		19.398	1.724							
104	0.3266	14.182		19.596	1.718							
105	0.33	14.188		19.8	1.712							
106	0.3333	14.195		19.998	1.705							
107	0.35	14.226		21	1.674							
108	0.3666	14.264		21.996	1.636							
109	0.3833	14.295		22.998	1.605							
110	0.4	14.333		24	1.567							
111	0.4166	14.364		24.996	1.536							
112	0.4333	14.402		25.998	1.498							
113	0.45	14.427		27	1.473							
114	0.4666	14.465		27.996	1.435							
115	0.4833	14.49		28.998	1.41							
116	0.5	14.522		30	1.378							
117	0.5166	14.553		30.996	1.347							
118	0.5333	14.578		31.998	1.322							
119	0.55	14.61		33	1.29							
120	0.5666	14.635		33.996	1.265							
121	0.5833	14.66		34.998	1.24							
122	0.6	14.685		36	1.215							
123	0.6166	14.71		36.996	1.19							
124	0.6333	14.729		37.998	1.171							
125	0.65	14.754		39	1.146							
126	0.6666	14.773		39.996	1.127							
127	0.6833	14.799		40.998	1.101							
128	0.7	14.817		42	1.083							
129	0.7166	14.836		42.996	1.064							
130	0.7333	14.855		43.998	1.045							
131	0.75	14.868		45	1.032							
132	0.7666	14.887		45.996	1.013							
133	0.7833	14.905		46.998	0.995							

	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 RISING HEAD TEST											
2	HERMIT OUTPUT FOR TEST 3											
3	Time	Water mark		time	Yt							
134	0.8	14.918		48	0.982							
135	0.8166	14.931		48.996	0.969							
136	0.8333	14.943		49.998	0.957							
137	0.85	14.956		51	0.944							
138	0.8666	14.968		51.996	0.932							
139	0.8833	14.981		52.998	0.919							
140	0.9	14.993		54	0.907							
141	0.9166	15		54.996	0.9							
142	0.9333	15.012		55.998	0.888							
143	0.95	15.019		57	0.881							
144	0.9666	15.025		57.996	0.875							
145	0.9833	15.031		58.998	0.869							
146	1	15.038		60	0.862							
147	1.2	15.107		72	0.793							
148	1.4	15.144		84	0.756							
149	1.6	15.176		96	0.724							
150	1.8	15.195		108	0.705							
151	2	15.22		120	0.68							
152	2.2	15.239		132	0.661							
153	2.4	15.251		144	0.649							
154	2.6	15.264		156	0.636							
155	2.8	15.277		168	0.623							
156	3	15.289		180	0.611							
157	3.2	15.302		192	0.598							
158	3.4	15.308		204	0.592							
159	3.6	15.321		216	0.579							
160	3.8	15.327		228	0.573							
161	4	15.333		240	0.567							
162	4.2	15.34		252	0.56							
163	4.4	15.352		264	0.548							
164	4.6	15.358		276	0.542							
165	4.8	15.365		288	0.535							
166	5	15.371		300	0.529							
167	5.2	15.377		312	0.523							
168	5.4	15.384		324	0.516							
169	5.6	15.39		336	0.51							
170	5.8	15.396		348	0.504							
171	6	15.402		360	0.498							
172	6.2	15.409		372	0.491							
173	6.4	15.415		384	0.485							
174	6.6	15.421		396	0.479							
175	6.8	15.421		408	0.479							
176	7	15.428		420	0.472							
177	7.2	15.434		432	0.466							
178	7.4	15.44		444	0.46							
179	7.6	15.44		456	0.46							
180	7.8	15.447		468	0.453							
181	8	15.453		480	0.447							
182	8.2	15.459		492	0.441							
183	8.4	15.459		504	0.441							
184	8.6	15.465		516	0.435							
185	8.8	15.472		528	0.428							
186	9	15.472		540	0.428							
187	9.2	15.478		552	0.422							
188	9.4	15.484		564	0.416							
189	9.6	15.484		576	0.416							
190	9.8	15.491		588	0.409							
191	10	15.497		600	0.403							

MW-9 (RISING HEAD)

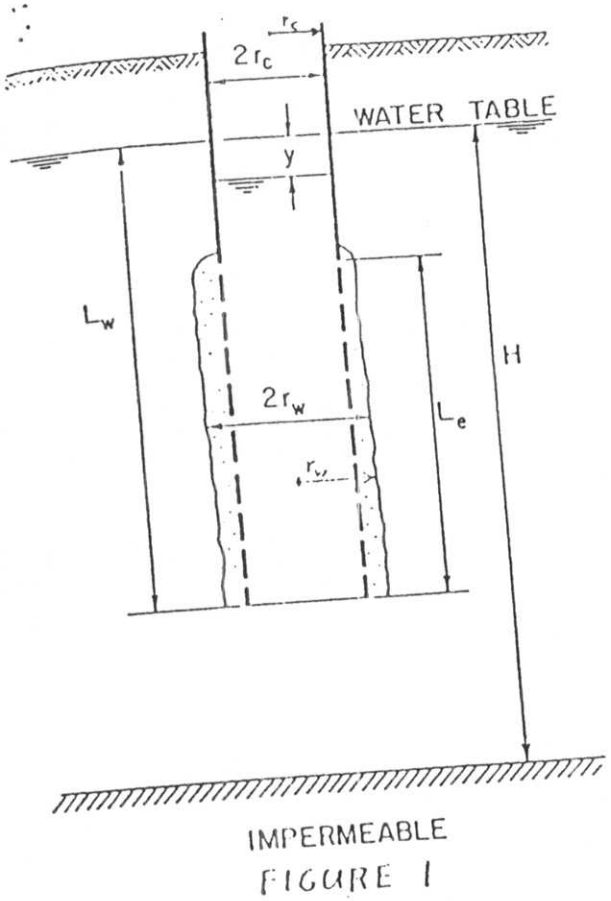


FIGURE 1

r_c = 1 (in)

r_w = 3 (in)

L_e = 180 (in)

L_w = 120 (in)

H = 120 (in)

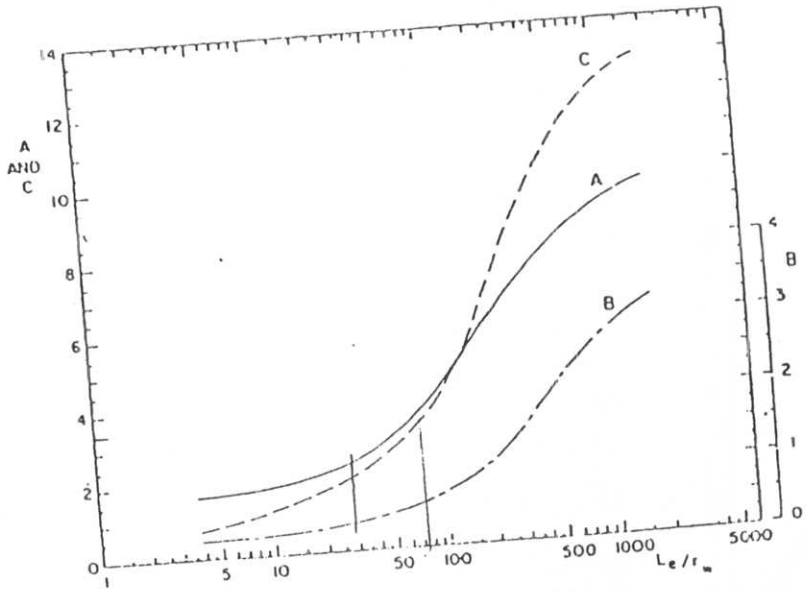


Fig. 2. Dimensionless parameters A, B, and C as a function of L_e/r_w for calculation of $\ln(R_e/r_w)$.

AMP DRESSER & McKEE

CLIENT BUNCOMBE COUNTY
PROJECT C&D LANDFILL HYDRO-GEO
DETAIL MW9 RISING HEAD SLUG TEST

JOB NO.
DATE CHECKED
CHECKED BY

COMPUTED BY MT
DATE 1-20-98
PAGE NO.

STEP 1

$r_c = 1 in$
$r_w = 3 in$
$L_e = 180 in$
$L_w = 120 in$
$H = 120 in$

STEP 2 & 3 SEE ATTACHED GRAPH

STEP 4

$y_0 = 0.9 ft$
$y_t = y_{890} = 0.1 ft$
$1/t = 0.0011 \ 1/sec$
$\ln(y_0/y_t) = \ln(0.9/0.1) = \ln 9.0 = 2.197$

STEP 5 $L_e/r_w = 180/3 = 60$
$L_w = H$ & $C_{60} = 2.9$ (DIMENSIONLESS PARAMETERS)

$$\ln(R_e/r_w) = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{C}{(L_e/r_w)}}$$

$$= \frac{1}{\frac{1.1}{\ln(120/3)} + \frac{2.9}{(180/3)}}$$

$$= \frac{1}{\frac{1.1}{3.689} + \frac{2.9}{60}} = \frac{1}{0.298 + 0.048}$$

$$= \frac{1}{0.346}$$

$\ln(R_e/r_w) = 2.89$

STEP 6

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln(y_0/y_t)$$

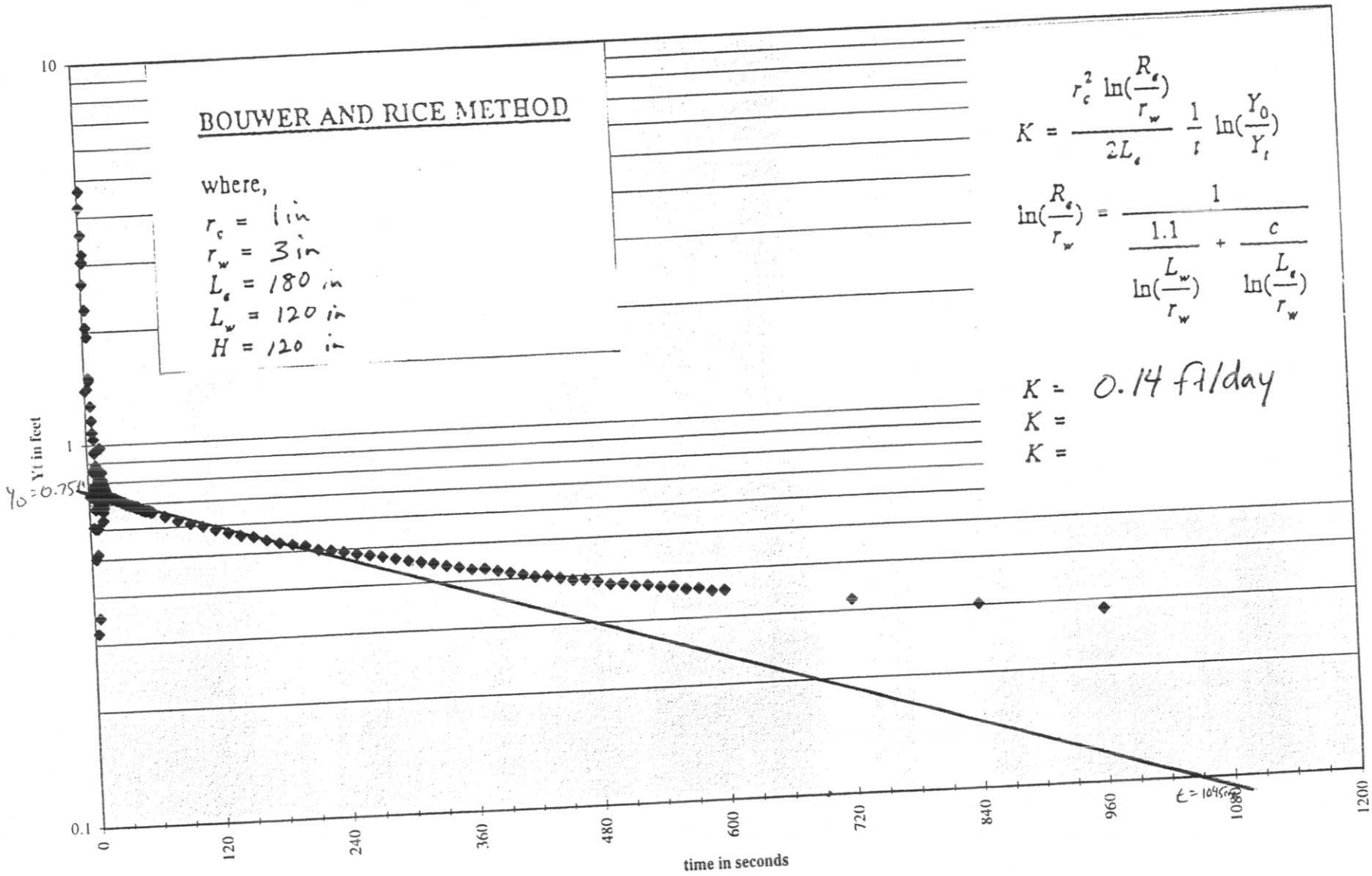
$$= \frac{1 in^2 (2.89)}{360 in} \times 0.0011 \ 1/sec \times 2.197$$

$= 0.008 in \times 0.002 \ 1/sec$

$= 0.00002 in/sec \times 7200$

$K_{MW9} = 0.14 ft/day$

MW-9 falling head test



BOUWER AND RICE METHOD

where,

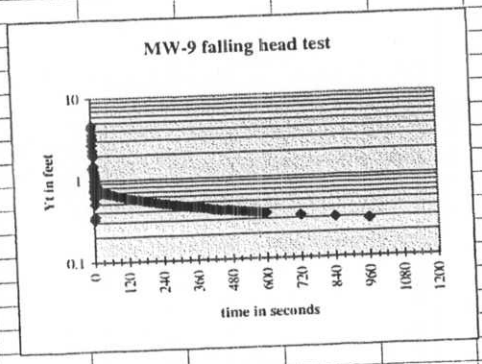
r_c = 1 in
r_w = 3 in
L_e = 180 in
L_w = 120 in
H = 120 in

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln\left(\frac{Y_0}{Y_t}\right)$$

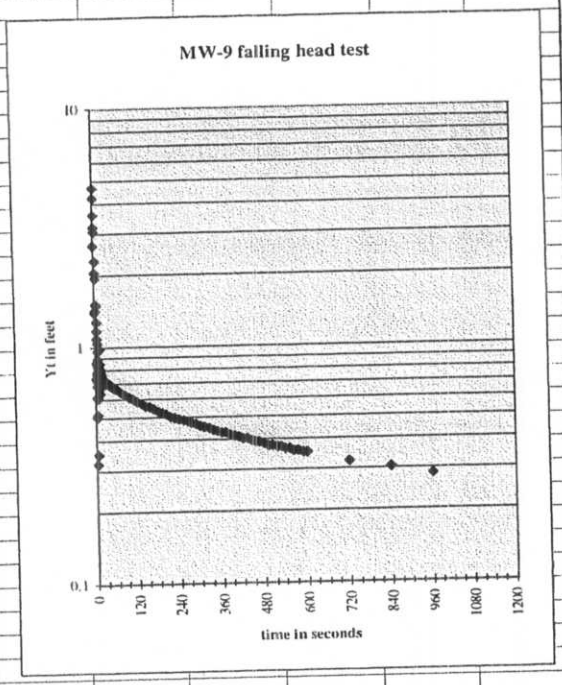
$$\ln\left(\frac{R_e}{r_w}\right) = \frac{1}{\frac{1.1}{\ln\left(\frac{L_w}{r_w}\right)} + \frac{c}{\ln\left(\frac{L_e}{r_w}\right)}}$$

K = 0.14 ft/day
K =
K =

	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 Falling Head Test											
2	HERMIT OUTPUT TEST2											
3				16.176	initial water mark							
4	time (min)	water mark (ft	Yt in feet		time in sec	Yt in feet						
5	0	16.176	0		0.198	0.006						
6	0.0033	16.182	0.006		0.396	0.012						
7	0.0066	16.188	0.012		0.6	1.391						
8	0.01	17.567	1.391		0.798	2.663						
9	0.0133	18.839	2.663		0.996	4.237						
10	0.0166	20.413	4.237		1.2	3.047						
11	0.02	19.223	3.047		1.398	-0.321						
12	0.0233	15.855	-0.321		1.596	0.736						
13	0.0266	16.912	0.736		1.8	3.589						
14	0.03	19.765	3.589		1.998	4.679						
15	0.0333	20.855	4.679		2.196	3.047						
16	0.0366	19.223	3.047		2.4	1.41						
17	0.04	17.586	1.41		2.598	2.046						
18	0.0433	18.222	2.046		2.796	3.185						
19	0.0466	19.361	3.185		3	2.285						
20	0.05	18.461	2.285		3.198	0.321						
21	0.0533	16.497	0.321		3.396	-1.063						
22	0.0566	15.113	-1.063		3.6	0.61						
23	0.06	16.786	0.61		3.798	1.939						
24	0.0633	18.115	1.939		3.996	1.504						
25	0.0666	17.68	1.504		4.2	0.503						
26	0.07	16.679	0.503		4.398	-0.113						
27	0.0733	16.063	-0.113		4.596	0.856						
28	0.0766	17.032	0.856		4.8	1.485						
29	0.08	17.661	1.485		4.998	1.271						
30	0.0833	17.447	1.271		5.196	0.604						
31	0.0866	16.78	0.604		5.4	0.352						
32	0.09	16.528	0.352		5.598	0.78						
33	0.0933	16.956	0.78		5.796	1.164						
34	0.0966	17.34	1.164		6	1.082						
35	0.1	17.258	1.082		6.198	0.68						
36	0.1033	16.856	0.68		6.396	0.516						
37	0.1066	16.692	0.516		6.6	0.768						
38	0.11	16.944	0.768		6.798	1.038						
39	0.1133	17.214	1.038		6.996	0.956						
40	0.1166	17.132	0.956		7.2	0.774						
41	0.12	16.95	0.774		7.398	0.604						
42	0.1233	16.78	0.604		7.596	0.742						
43	0.1266	16.918	0.742		7.8	0.868						
44	0.13	17.044	0.868		7.998	0.887						
45	0.1333	17.063	0.887		8.196	0.774						
46	0.1366	16.95	0.774		8.4	0.711						
47	0.14	16.887	0.711		8.598	0.749						
48	0.1433	16.925	0.749		8.796	0.831						
49	0.1466	17.007	0.831		9	0.831						
50	0.15	17.007	0.831		9.198	0.812						
51	0.1533	16.988	0.812		9.396	0.717						
52	0.1566	16.893	0.717		9.6	0.742						
53	0.16	16.918	0.742		9.798	0.787						
54	0.1633	16.963	0.787		9.996	0.818						
55	0.1666	16.994	0.818		10.2	0.774						
56	0.17	16.95	0.774		10.398	0.787						
57	0.1733	16.963	0.787		10.596	0.705						
58	0.1766	16.881	0.705		10.8	0.78						
59	0.18	16.956	0.78		10.998	0.742						
60	0.1833	16.918	0.742		11.196	0.793						
61	0.1866	16.969	0.793		11.4	0.768						
62	0.19	16.944	0.768		11.598	0.761						
63	0.1933	16.937	0.761		11.796	0.749						
64	0.1966	16.925	0.749		12	0.761						
65	0.2	16.937	0.761		12.198	0.768						
66	0.2033	16.944	0.768		12.396	0.982						
67	0.2066	17.158	0.982		12.6	0.635						
68	0.21	16.811	0.635		12.798	0.667						
69	0.2133	16.843	0.667		12.996	0.705						
70	0.2166	16.881	0.705		13.2	0.85						
71	0.22	17.026	0.85									



	A	B	C	D	E	F
1	MW-9 Falling Head Test					
2	HERMIT OUTPUT TEST2					
3				16.176	initial water mark	
4	time (min)	water mark (ft	Yt in feet		time in sec	Yt in feet
5	0	16.176	0			0
6	0.0033	16.182	0.006		0.198	0.006
7	0.0066	16.188	0.012		0.396	0.012
8	0.01	17.567	1.391		0.6	1.391
9	0.0133	18.839	2.663		0.798	2.663
10	0.0166	20.413	4.237		0.996	4.237
11	0.02	19.223	3.047		1.2	3.047
12	0.0233	15.855	-0.321		1.398	-0.321
13	0.0266	16.912	0.736		1.596	0.736
14	0.03	19.765	3.589		1.8	3.589
15	0.0333	20.855	4.679		1.998	4.679
16	0.0366	19.223	3.047		2.196	3.047
17	0.04	17.586	1.41		2.4	1.41
18	0.0433	18.222	2.046		2.598	2.046
19	0.0466	19.361	3.185		2.796	3.185
20	0.05	18.461	2.285		3	2.285
21	0.0533	16.497	0.321		3.198	0.321
22	0.0566	15.113	-1.063		3.396	-1.063
23	0.06	16.786	0.61		3.6	0.61
24	0.0633	18.115	1.939		3.798	1.939
25	0.0666	17.68	1.504		3.996	1.504
26	0.07	16.679	0.503		4.2	0.503
27	0.0733	16.063	-0.113		4.398	-0.113
28	0.0766	17.032	0.856		4.596	0.856
29	0.08	17.661	1.485		4.8	1.485
30	0.0833	17.447	1.271		4.998	1.271
31	0.0866	16.78	0.604		5.196	0.604
32	0.09	16.528	0.352		5.4	0.352
33	0.0933	16.956	0.78		5.598	0.78
34	0.0966	17.34	1.164		5.796	1.164
35	0.1	17.258	1.082		6	1.082
36	0.1033	16.856	0.68		6.198	0.68
37	0.1066	16.692	0.516		6.396	0.516
38	0.11	16.944	0.768		6.6	0.768
39	0.1133	17.214	1.038		6.798	1.038
40	0.1166	17.132	0.956		6.996	0.956
41	0.12	16.95	0.774		7.2	0.774
42	0.1233	16.78	0.604		7.398	0.604
43	0.1266	16.918	0.742		7.596	0.742
44	0.13	17.044	0.868		7.8	0.868
45	0.1333	17.063	0.887		7.998	0.887
46	0.1366	16.95	0.774		8.196	0.774
47	0.14	16.887	0.711		8.4	0.711
48	0.1433	16.925	0.749		8.598	0.749
49	0.1466	17.007	0.831		8.796	0.831
50	0.15	17.007	0.831		9	0.831
51	0.1533	16.988	0.812		9.198	0.812
52	0.1566	16.893	0.717		9.396	0.717
53	0.16	16.918	0.742		9.6	0.742
54	0.1633	16.963	0.787		9.798	0.787
55	0.1666	16.994	0.818		9.996	0.818
56	0.17	16.95	0.774		10.2	0.774
57	0.1733	16.963	0.787		10.398	0.787
58	0.1766	16.881	0.705		10.596	0.705
59	0.18	16.956	0.78		10.8	0.78
60	0.1833	16.918	0.742		10.998	0.742
61	0.1866	16.969	0.793		11.196	0.793
62	0.19	16.944	0.768		11.4	0.768
63	0.1933	16.937	0.761		11.598	0.761
64	0.1966	16.925	0.749		11.796	0.749
65	0.2	16.937	0.761		12	0.761
66	0.2033	16.944	0.768		12.198	0.768
67	0.2066	17.158	0.982		12.396	0.982
68	0.21	16.811	0.635		12.6	0.635
69	0.2133	16.843	0.667		12.798	0.667
70	0.2166	16.881	0.705		12.996	0.705
71	0.22	17.026	0.85		13.2	0.85



	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 Falling Head Test											
2	HERMIT OUTPUT TEST2											
3				16.176	initial water mark							
4	time (min)	water mark (ft	Yt in feet		time in sec	Yt in feet						
72	0.2233	16.988	0.812		13.398	0.812						
73	0.2266	16.906	0.73		13.596	0.73						
74	0.23	16.862	0.686		13.8	0.686						
75	0.2333	16.912	0.736		13.998	0.736						
76	0.2366	16.969	0.793		14.196	0.793						
77	0.24	16.963	0.787		14.4	0.787						
78	0.2433	16.912	0.736		14.598	0.736						
79	0.2466	16.887	0.711		14.796	0.711						
80	0.25	16.918	0.742		15	0.742						
81	0.2533	16.95	0.774		15.198	0.774						
82	0.2566	16.944	0.768		15.396	0.768						
83	0.26	16.912	0.736		15.6	0.736						
84	0.2633	16.9	0.724		15.798	0.724						
85	0.2666	16.918	0.742		15.996	0.742						
86	0.27	16.937	0.761		16.2	0.761						
87	0.2733	16.931	0.755		16.398	0.755						
88	0.2766	16.912	0.736		16.596	0.736						
89	0.28	16.912	0.736		16.8	0.736						
90	0.2833	16.918	0.742		16.998	0.742						
91	0.2866	16.925	0.749		17.196	0.749						
92	0.29	16.918	0.742		17.4	0.742						
93	0.2933	16.912	0.736		17.598	0.736						
94	0.2966	16.912	0.736		17.796	0.736						
95	0.3	16.918	0.742		18	0.742						
96	0.3033	16.918	0.742		18.198	0.742						
97	0.3066	16.918	0.742		18.396	0.742						
98	0.31	16.912	0.736		18.6	0.736						
99	0.3133	16.912	0.736		18.798	0.736						
100	0.3166	16.912	0.736		18.996	0.736						
101	0.32	16.912	0.736		19.2	0.736						
102	0.3233	16.912	0.736		19.398	0.736						
103	0.3266	16.912	0.736		19.596	0.736						
104	0.33	16.906	0.73		19.8	0.73						
105	0.3333	16.912	0.736		19.998	0.736						
106	0.35	16.906	0.73		21	0.73						
107	0.3666	16.906	0.73		21.996	0.73						
108	0.3833	16.9	0.724		22.998	0.724						
109	0.4	16.9	0.724		24	0.724						
110	0.4166	16.9	0.724		24.996	0.724						
111	0.4333	16.893	0.717		25.998	0.717						
112	0.45	16.893	0.717		27	0.717						
113	0.4666	16.893	0.717		27.996	0.717						
114	0.4833	16.887	0.711		28.998	0.711						
115	0.5	16.887	0.711		30	0.711						
116	0.5166	16.881	0.705		30.996	0.705						
117	0.5333	16.881	0.705		31.998	0.705						
118	0.55	16.881	0.705		33	0.705						
119	0.5666	16.881	0.705		33.996	0.705						
120	0.5833	16.874	0.698		34.998	0.698						
121	0.6	16.874	0.698		36	0.698						
122	0.6166	16.874	0.698		36.996	0.698						
123	0.6333	16.868	0.692		37.998	0.692						
124	0.65	16.868	0.692		39	0.692						
125	0.6666	16.868	0.692		39.996	0.692						
126	0.6833	16.868	0.692		40.998	0.692						
127	0.7	16.862	0.686		42	0.686						
128	0.7166	16.862	0.686		42.996	0.686						
129	0.7333	16.862	0.686		43.998	0.686						
130	0.75	16.856	0.68		45	0.68						
131	0.7666	16.862	0.686		45.996	0.686						
132	0.7833	16.856	0.68		46.998	0.68						
133	0.8	16.856	0.68		48	0.68						
134	0.8166	16.849	0.673		48.996	0.673						
135	0.8333	16.849	0.673		49.998	0.673						
136	0.85	16.849	0.673		51	0.673						
137	0.8666	16.843	0.667		51.996	0.667						
138	0.8833	16.843	0.667		52.998	0.667						

	A	B	C	D	E	F	G	H	I	J	K	L
1	MW-9 Falling Head Test											
2	HERMIT OUTPUT TEST2											
3				16.176	initial water mark							
4	time (min)	water mark (ft	Yt in feet		time in sec	Yt in feet						
139	0.9	16.843	0.667		54	0.667						
140	0.9166	16.843	0.667		54.996	0.667						
141	0.9333	16.843	0.667		55.998	0.667						
142	0.95	16.843	0.667		57	0.667						
143	0.9666	16.837	0.661		57.996	0.661						
144	0.9833	16.837	0.661		58.998	0.661						
145	1	16.837	0.661		60	0.661						
146	1.2	16.818	0.642		72	0.642						
147	1.4	16.799	0.623		84	0.623						
148	1.6	16.786	0.61		96	0.61						
149	1.8	16.774	0.598		108	0.598						
150	2	16.761	0.585		120	0.585						
151	2.2	16.749	0.573		132	0.573						
152	2.4	16.736	0.56		144	0.56						
153	2.6	16.73	0.554		156	0.554						
154	2.8	16.717	0.541		168	0.541						
155	3	16.705	0.529		180	0.529						
156	3.2	16.698	0.522		192	0.522						
157	3.4	16.692	0.516		204	0.516						
158	3.6	16.679	0.503		216	0.503						
159	3.8	16.673	0.497		228	0.497						
160	4	16.667	0.491		240	0.491						
161	4.2	16.66	0.484		252	0.484						
162	4.4	16.654	0.478		264	0.478						
163	4.6	16.648	0.472		276	0.472						
164	4.8	16.642	0.466		288	0.466						
165	5	16.635	0.459		300	0.459						
166	5.2	16.629	0.453		312	0.453						
167	5.4	16.623	0.447		324	0.447						
168	5.6	16.616	0.44		336	0.44						
169	5.8	16.61	0.434		348	0.434						
170	6	16.604	0.428		360	0.428						
171	6.2	16.604	0.428		372	0.428						
172	6.4	16.597	0.421		384	0.421						
173	6.6	16.591	0.415		396	0.415						
174	6.8	16.585	0.409		408	0.409						
175	7	16.579	0.403		420	0.403						
176	7.2	16.579	0.403		432	0.403						
177	7.4	16.572	0.396		444	0.396						
178	7.6	16.566	0.39		456	0.39						
179	7.8	16.566	0.39		468	0.39						
180	8	16.56	0.384		480	0.384						
181	8.2	16.553	0.377		492	0.377						
182	8.4	16.553	0.377		504	0.377						
183	8.6	16.547	0.371		516	0.371						
184	8.8	16.547	0.371		528	0.371						
185	9	16.541	0.365		540	0.365						
186	9.2	16.541	0.365		552	0.365						
187	9.4	16.535	0.359		564	0.359						
188	9.6	16.535	0.359		576	0.359						
189	9.8	16.528	0.352		588	0.352						
190	10	16.528	0.352		600	0.352						
191	12	16.497	0.321		720	0.321						
192	14	16.478	0.302		840	0.302						
193	16	16.459	0.283		960	0.283						
194												
195												

MW-9 (FALLING HEAD)

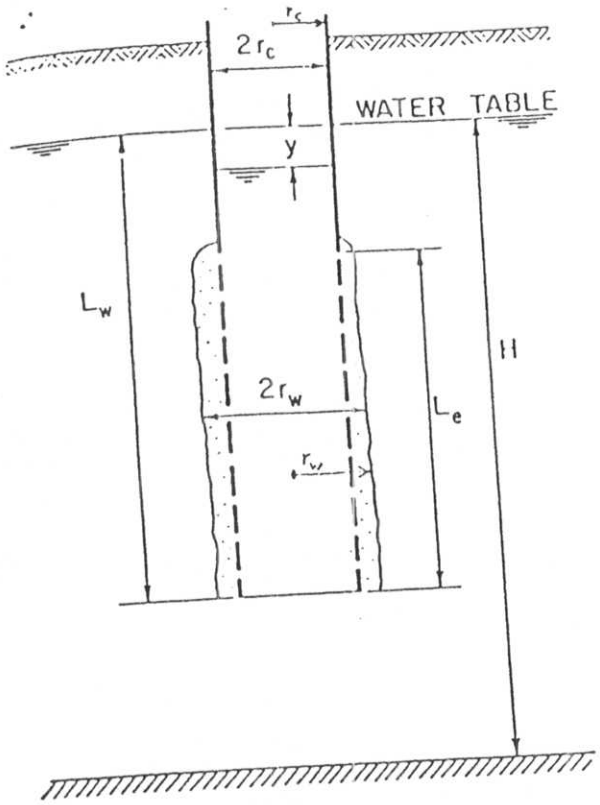


FIGURE 1

r_c = 1 (in)

r_w = 3 (in)

L_e = 180 (in)

L_w = 120 (in)

H = 120 (in)

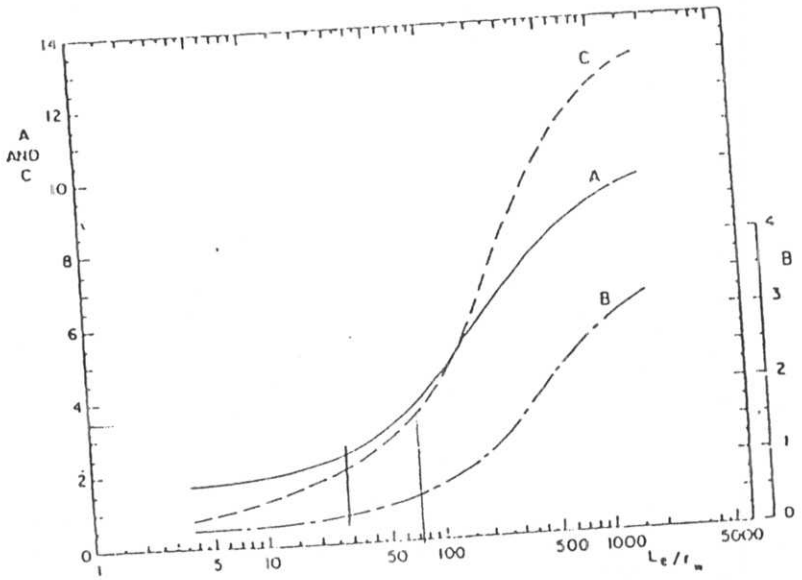


Fig. 2. Dimensionless parameters A, B, and C as a function of L_e/r_w for calculation of $\ln(R_e/r_w)$.

CAMP DRESSER & McKEE

CLIENT BUNCOMBE COUNTY
PROJECT C&D LANDFILL - HYDRO-GEO
DETAIL MW-9 FALLING HEAD SLUG TEST

JOB NO.
DATE CHECKED
CHECKED BY

COMPUTED BY MFS
DATE 1-20-98
PAGE NO.

Step 1

$r_c = 1 in$
$r_w = 3 in$
$L_e = 180 in$
$L_w = 120 in$
$H = 120 in$

Step 2 & 3

SEE ATTACHED CHART

Step 4

$y_0 = 0.75 ft$
$y_t = y_{1045} = 0.1 ft$
$1/t = 0.0010 \ 1/sec$

$$\ln(y_0/y_t) = \ln(0.75/0.1) = \ln 7.5 = 2.015$$

Step 5

$L_e/r_w = 180/3 = 60$
$L_w = H$ ∴ determine $C_{60} = 2.9$

$$\ln(R_e/r_w) = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{C}{(L_e/r_w)}}$$

$$= \frac{1}{\frac{1.1}{\ln(120/3)} + \frac{2.9}{(180/3)}}$$

$$= \frac{1}{\frac{1.1}{\ln 40} + \frac{2.9}{60}} = \frac{1}{\frac{1.1}{3.689} + 0.048}$$

$$= \frac{1}{0.298 + 0.048} = \frac{1}{0.346}$$

$$\ln(R_e/r_w) = 2.89$$

Step 6

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \cdot \frac{1}{t} \cdot \ln(y_0/y_t)$$

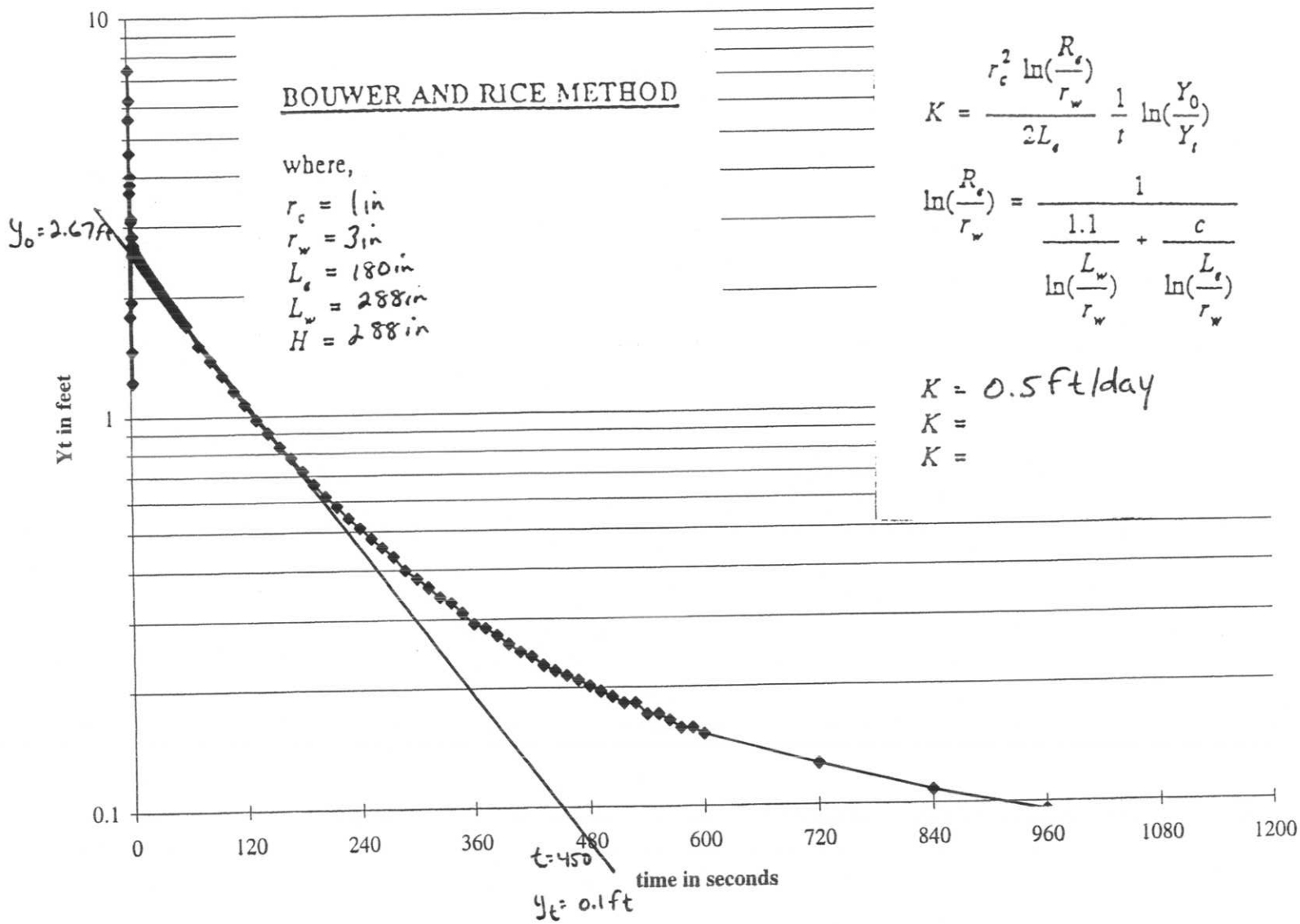
$$= \frac{1 in^2 (2.89)}{360 in} \times 0.0010 \ 1/sec \times 2.015$$

$$= 0.008 in \times 0.002 \ 1/sec$$

$$= 0.00002 \ in/sec \times 7200$$

$$K_{MW-9} = 0.14 \ ft/day$$

MW-9D Rising Head Test



$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L_e} \frac{1}{t} \ln\left(\frac{Y_0}{Y_t}\right)$$

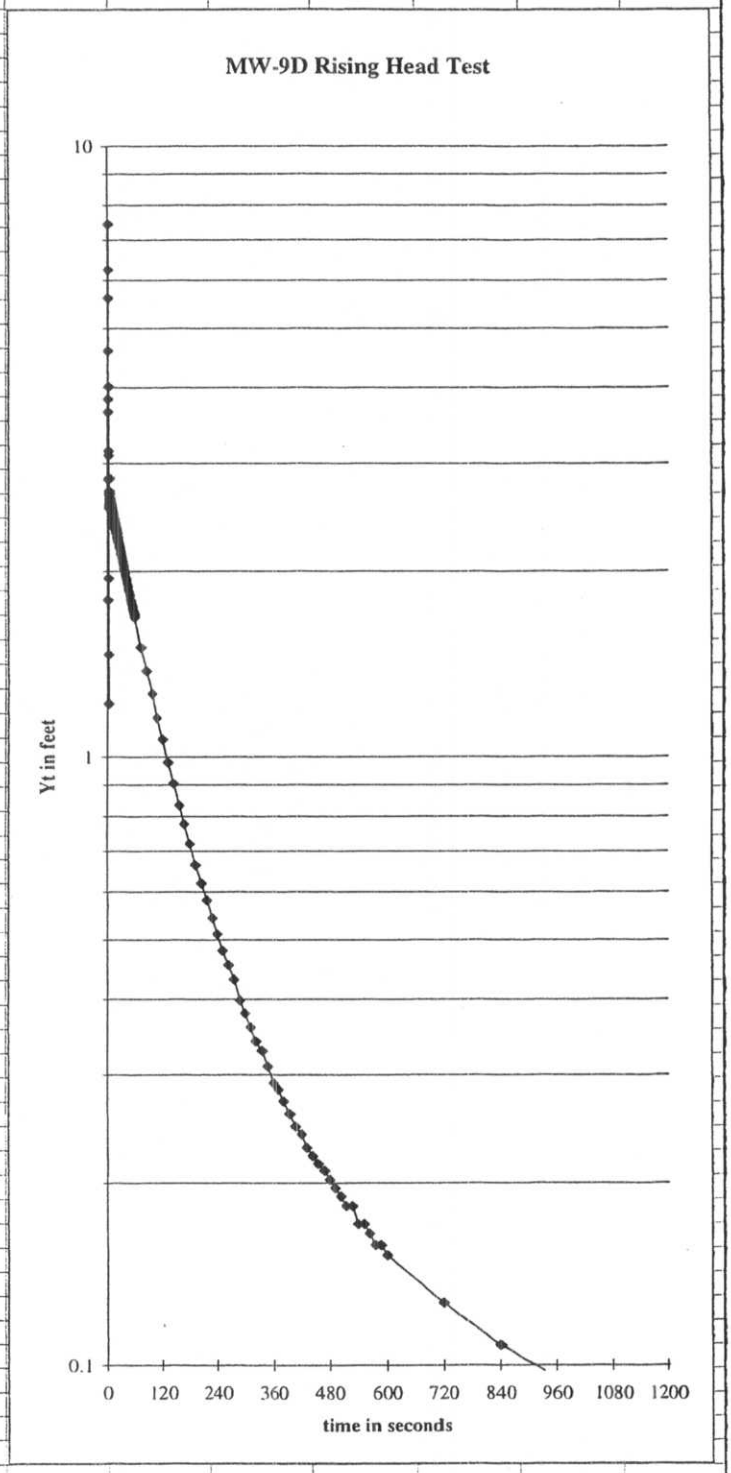
$$\ln\left(\frac{R_e}{r_w}\right) = \frac{1}{\frac{1.1}{\ln\left(\frac{L_w}{r_w}\right)} + \frac{c}{\ln\left(\frac{L_e}{r_w}\right)}}$$

K = 0.5 ft/day

K =

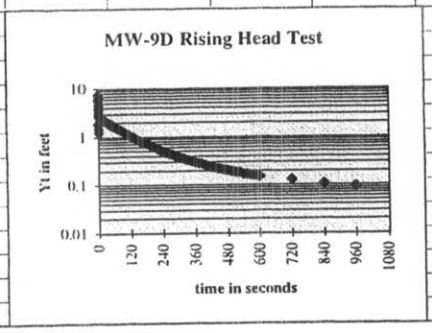
K =

	A	B	C	D	E
1	MW-9D Rising Head Test				
2					
3	HERMIT OUTPUT		16	=:Reference initial depth to water	
4	Time	depth to	Yt	time	Yt
5	in minutes	water	in feet	in seconds	in feet
6		in feet			
7	0	16	0	0	0
8	0.0133	14.208	1.792	0.798	1.792
9	0.0166	10.4	5.6	0.996	5.6
10	0.02	8.574	7.426	1.2	7.426
11	0.0233	9.745	6.255	1.398	6.255
12	0.0266	12.348	3.652	1.596	3.652
13	0.03	11.402	4.598	1.8	4.598
14	0.0333	12.165	3.835	1.998	3.835
15	0.0366	14.782	1.218	2.196	1.218
16	0.04	14.536	1.464	2.4	1.464
17	0.0433	11.982	4.018	2.598	4.018
18	0.0466	12.903	3.097	2.796	3.097
19	0.05	14.056	1.944	3	1.944
20	0.0533	13.174	2.826	3.198	2.826
21	0.0566	12.852	3.148	3.396	3.148
22	0.06	13.457	2.543	3.6	2.543
23	0.0633	13.464	2.536	3.798	2.536
24	0.0666	13.161	2.839	3.996	2.839
25	0.07	13.293	2.707	4.2	2.707
26	0.0733	13.432	2.568	4.398	2.568
27	0.0766	13.331	2.669	4.596	2.669
28	0.08	13.312	2.688	4.8	2.688
29	0.0833	13.394	2.606	4.998	2.606
30	0.0866	13.382	2.618	5.196	2.618
31	0.09	13.363	2.637	5.4	2.637
32	0.0933	13.401	2.599	5.598	2.599
33	0.0966	13.407	2.593	5.796	2.593
34	0.1	13.407	2.593	6	2.593
35	0.1033	13.413	2.587	6.198	2.587
36	0.1066	13.419	2.581	6.396	2.581
37	0.11	13.413	2.587	6.6	2.587
38	0.1133	13.426	2.574	6.798	2.574
39	0.1166	13.432	2.568	6.996	2.568
40	0.12	13.432	2.568	7.2	2.568
41	0.1233	13.445	2.555	7.398	2.555
42	0.1266	13.438	2.562	7.596	2.562
43	0.13	13.445	2.555	7.8	2.555
44	0.1333	13.457	2.543	7.998	2.543
45	0.1366	13.464	2.536	8.196	2.536
46	0.14	13.464	2.536	8.4	2.536
47	0.1433	13.47	2.53	8.598	2.53
48	0.1466	13.476	2.524	8.796	2.524
49	0.15	13.483	2.517	9	2.517
50	0.1533	13.476	2.524	9.198	2.524
51	0.1566	13.489	2.511	9.396	2.511
52	0.16	13.495	2.505	9.6	2.505
53	0.1633	13.495	2.505	9.798	2.505
54	0.1666	13.502	2.498	9.996	2.498
55	0.17	13.508	2.492	10.2	2.492
56	0.1733	13.508	2.492	10.398	2.492
57	0.1766	13.514	2.486	10.596	2.486
58	0.18	13.52	2.48	10.8	2.48
59	0.1833	13.527	2.473	10.998	2.473
60	0.1866	13.527	2.473	11.196	2.473
61	0.19	13.533	2.467	11.4	2.467
62	0.1933	13.539	2.461	11.598	2.461
63	0.1966	13.539	2.461	11.796	2.461
64	0.2	13.546	2.454	12	2.454
65	0.2033	13.552	2.448	12.198	2.448
66	0.2066	13.558	2.442	12.396	2.442
67	0.21	13.558	2.442	12.6	2.442
68	0.2133	13.565	2.435	12.798	2.435
69	0.2166	13.571	2.429	12.996	2.429



	A	B	C	D	E	F	G	H	I	J	K	L	M
70	0.22	13.571	2.429	13.2	2.429								
71	0.2233	13.577	2.423	13.398	2.423								
72	0.2266	13.583	2.417	13.596	2.417								
73	0.23	13.583	2.417	13.8	2.417								
74	0.2333	13.59	2.41	13.998	2.41								
75	0.2366	13.59	2.41	14.196	2.41								
76	0.24	13.596	2.404	14.4	2.404								
77	0.2433	13.596	2.404	14.598	2.404								
78	0.2466	13.602	2.398	14.796	2.398								
79	0.25	13.609	2.391	15	2.391								
80	0.2533	13.609	2.391	15.198	2.391								
81	0.2566	13.615	2.385	15.396	2.385								
82	0.26	13.621	2.379	15.6	2.379								
83	0.2633	13.621	2.379	15.798	2.379								
84	0.2666	13.628	2.372	15.996	2.372								
85	0.27	13.628	2.372	16.2	2.372								
86	0.2733	13.634	2.366	16.398	2.366								
87	0.2766	13.64	2.36	16.596	2.36								
88	0.28	13.64	2.36	16.8	2.36								
89	0.2833	13.647	2.353	16.998	2.353								
90	0.2866	13.653	2.347	17.196	2.347								
91	0.29	13.653	2.347	17.4	2.347								
92	0.2933	13.653	2.347	17.598	2.347								
93	0.2966	13.659	2.341	17.796	2.341								
94	0.3	13.665	2.335	18	2.335								
95	0.3033	13.665	2.335	18.198	2.335								
96	0.3066	13.672	2.328	18.396	2.328								
97	0.31	13.678	2.322	18.6	2.322								
98	0.3133	13.684	2.316	18.798	2.316								
99	0.3166	13.684	2.316	18.996	2.316								
100	0.32	13.684	2.316	19.2	2.316								
101	0.3233	13.691	2.309	19.398	2.309								
102	0.3266	13.697	2.303	19.596	2.303								
103	0.33	13.697	2.303	19.8	2.303								
104	0.3333	13.703	2.297	19.998	2.297								
105	0.35	13.722	2.278	21	2.278								
106	0.3666	13.741	2.259	21.996	2.259								
107	0.3833	13.76	2.24	22.998	2.24								
108	0.4	13.779	2.221	24	2.221								
109	0.4166	13.798	2.202	24.996	2.202								
110	0.4333	13.81	2.19	25.998	2.19								
111	0.45	13.829	2.171	27	2.171								
112	0.4666	13.848	2.152	27.996	2.152								
113	0.4833	13.867	2.133	28.998	2.133								
114	0.5	13.88	2.12	30	2.12								
115	0.5166	13.899	2.101	30.996	2.101								
116	0.5333	13.918	2.082	31.998	2.082								
117	0.55	13.93	2.07	33	2.07								
118	0.5666	13.949	2.051	33.996	2.051								
119	0.5833	13.962	2.038	34.998	2.038								
120	0.6	13.981	2.019	36	2.019								
121	0.6166	13.993	2.007	36.996	2.007								
122	0.6333	14.012	1.988	37.998	1.988								
123	0.65	14.025	1.975	39	1.975								
124	0.6666	14.044	1.956	39.996	1.956								
125	0.6833	14.056	1.944	40.998	1.944								
126	0.7	14.069	1.931	42	1.931								
127	0.7166	14.088	1.912	42.996	1.912								
128	0.7333	14.101	1.899	43.998	1.899								
129	0.75	14.113	1.887	45	1.887								
130	0.7666	14.132	1.868	45.996	1.868								
131	0.7833	14.145	1.855	46.998	1.855								
132	0.8	14.157	1.843	48	1.843								
133	0.8166	14.17	1.83	48.996	1.83								
134	0.8333	14.183	1.817	49.998	1.817								
135	0.85	14.202	1.798	51	1.798								
136	0.8666	14.214	1.786	51.996	1.786								
137	0.8833	14.227	1.773	52.998	1.773								
138	0.9	14.239	1.761	54	1.761								

	A	B	C	D	E	F
139	0.9166	14.252	1.748	54.996	1.748	
140	0.9333	14.265	1.735	55.998	1.735	
141	0.95	14.277	1.723	57	1.723	
142	0.9666	14.29	1.71	57.996	1.71	
143	0.9833	14.302	1.698	58.998	1.698	
144	1	14.315	1.685	60	1.685	
145	1.2	14.498	1.502	72	1.502	
146	1.4	14.624	1.376	84	1.376	
147	1.6	14.738	1.262	96	1.262	
148	1.8	14.845	1.155	108	1.155	
149	2	14.933	1.067	120	1.067	
150	2.2	15.022	0.978	132	0.978	
151	2.4	15.097	0.903	144	0.903	
152	2.6	15.167	0.833	156	0.833	
153	2.8	15.223	0.777	168	0.777	
154	3	15.28	0.72	180	0.72	
155	3.2	15.337	0.663	192	0.663	
156	3.4	15.381	0.619	204	0.619	
157	3.6	15.419	0.581	216	0.581	
158	3.8	15.457	0.543	228	0.543	
159	4	15.488	0.512	240	0.512	
160	4.2	15.52	0.48	252	0.48	
161	4.4	15.545	0.455	264	0.455	
162	4.6	15.57	0.43	276	0.43	
163	4.8	15.602	0.398	288	0.398	
164	5	15.621	0.379	300	0.379	
165	5.2	15.64	0.36	312	0.36	
166	5.4	15.659	0.341	324	0.341	
167	5.6	15.671	0.329	336	0.329	
168	5.8	15.69	0.31	348	0.31	
169	6	15.709	0.291	360	0.291	
170	6.2	15.716	0.284	372	0.284	
171	6.4	15.728	0.272	384	0.272	
172	6.6	15.741	0.259	396	0.259	
173	6.8	15.753	0.247	408	0.247	
174	7	15.76	0.24	420	0.24	
175	7.2	15.772	0.228	432	0.228	
176	7.4	15.779	0.221	444	0.221	
177	7.6	15.785	0.215	456	0.215	
178	7.8	15.791	0.209	468	0.209	
179	8	15.798	0.202	480	0.202	
180	8.2	15.804	0.196	492	0.196	
181	8.4	15.81	0.19	504	0.19	
182	8.6	15.817	0.183	516	0.183	
183	8.8	15.817	0.183	528	0.183	
184	9	15.829	0.171	540	0.171	
185	9.2	15.829	0.171	552	0.171	
186	9.4	15.835	0.165	564	0.165	
187	9.6	15.842	0.158	576	0.158	
188	9.8	15.842	0.158	588	0.158	
189	10	15.848	0.152	600	0.152	
190	12	15.873	0.127	720	0.127	
191	14	15.892	0.108	840	0.108	
192	16	15.905	0.095	960	0.095	



CAMP DRESSER & McKEE

CLIENT BUNCOMBE COUNTY
PROJECT C&D LANDFILL-HYDROGEO
DETAIL MW9D SLUGTEST RISING HEAD

JOB NO.
DATE CHECKED
CHECKED BY

COMPUTED BY ALP
DATE 12/1/97
PAGE NO. 1 OF 4

STEP 1 : DETERMINE WELL DIMENSIONS

21.99
16.15 16.15
5.84 - 5.84

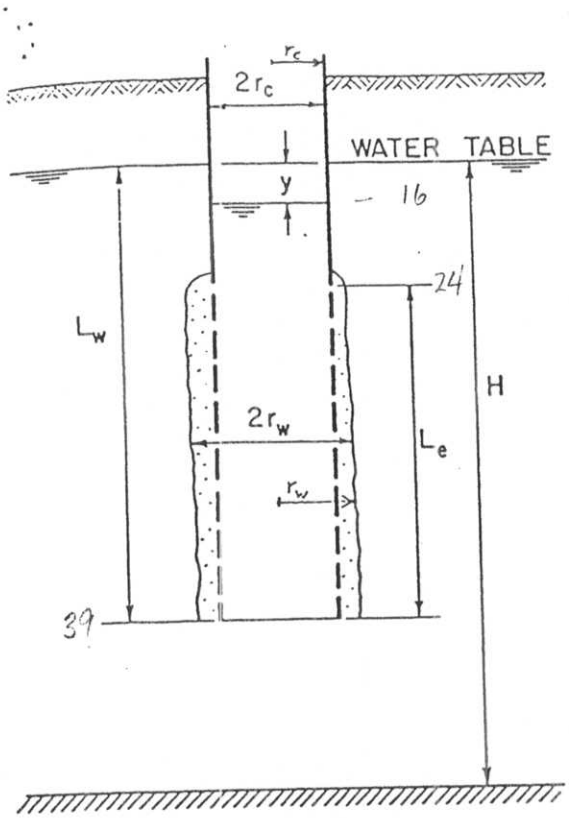


FIGURE 1

r_c = 1 (in).

r_w = 3 (in)

L_e = 180 (in) 15'×12

L_w = 288 (in) 40-16=24×12

H = 288 (in) 40-16=24×12 = L_W

r.e. STEP 5

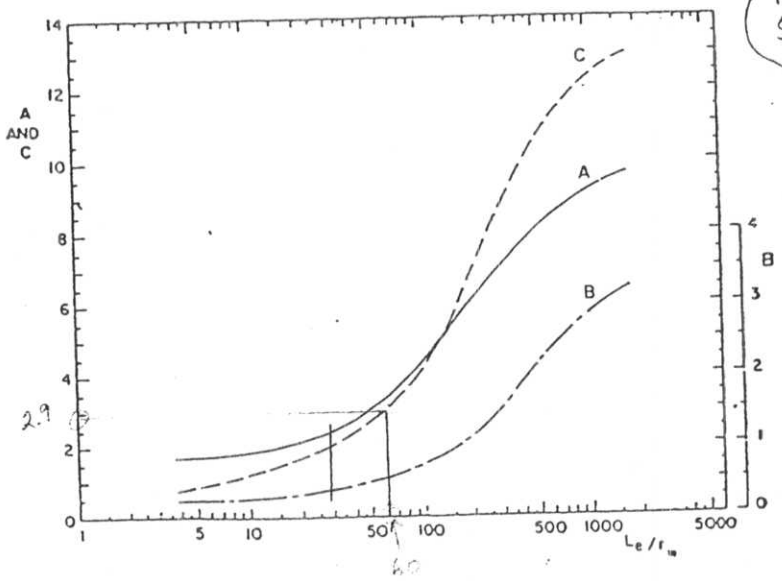


Fig. 2. Dimensionless parameters A, B, and C as a function of L_e/r_w for calculation of $\ln(R_e/r_w)$.

BUNCOMBE COUNTY
MW-9D

STEP 1 - SEE PG 1 of 4

STEP 2: on ATTACHED GRAPH (EXCEL chart wizard (Page 4 of 4)

Y_t is difference in elevation (in feet) → vertical axis (logarithmic), between the static water level and the water level at time, t → horizontal axis (linear)

STEP 3: No double straight line, sand pack remains saturated throughout

Best fit straight line shown. Extrapolated to axes

STEP 4: • $Y_0 = 2.67$ ft

• at $t = 450$: $Y_t = Y_{450} = 0.1$ ft

• $1/t = .0022 = \frac{1}{450 \text{ sec}}$ $\boxed{t = 450 \text{ sec}}$

$$\ln \frac{Y_0}{Y_t} = \ln \frac{2.67}{0.1} = \ln 26.7 = \underline{3.285}$$

STEP 5: FROM STEP 1 (Page 1)

• $L_e / r_w = 180/3 = 60$

• $L_w = H$ from Figure 2 Dimensionless parameters

$$\ln R_e/r_w = \frac{1}{\frac{1.1}{\ln L_w/r_w} + \frac{C}{(L_e/r_w)}}$$ $\boxed{C_{60} = 2.9}$

$$\ln R_e/r_w = \frac{1}{\frac{1.1}{\ln\left(\frac{288}{3}\right)} + \frac{2.9}{60}} = \frac{1}{\frac{1.1}{\ln 96} + 0.0483}$$

$$\ln R_e/r_w = \frac{1}{\frac{1.1}{4.56} + 0.0483} = \frac{1}{0.24 + 0.0483} = \frac{1}{0.289} = \underline{\underline{3.46}}$$

STEP 6: SEE FOLLOWING PAGE

STEP 6:

from Step 4: $1/t = 0.0022$ $\ln Y_0/Y_t = 3.285$

$$1/t \ \ln Y_0/Y_t = 0.0022\,(3.285) = 0.0073$$

from Step 5: $\ln\left(R_e/r_w\right) = 3.46$

$r_c^2 =$ from STEP 1: $r_c = 1$ in $r_c^2 = 1$ in

$2L_e =$ from STEP 1: $L_e = 180 \rightarrow 2L_e = 360$

$$K = \frac{r_c^2 \ \ln(R_e/r_w)}{2L_e} \ \frac{1}{t} \ \ln\left(Y_0/Y_t\right)$$

$$K = \frac{\overset{(in^2)}{1} \times 3.46}{\underset{(in)}{2 \times 180}} \times \overset{\frac{1}{sec}}{(.0022)} \times (3.285)$$

$$K = \frac{3.46}{360} \times 0.0073$$

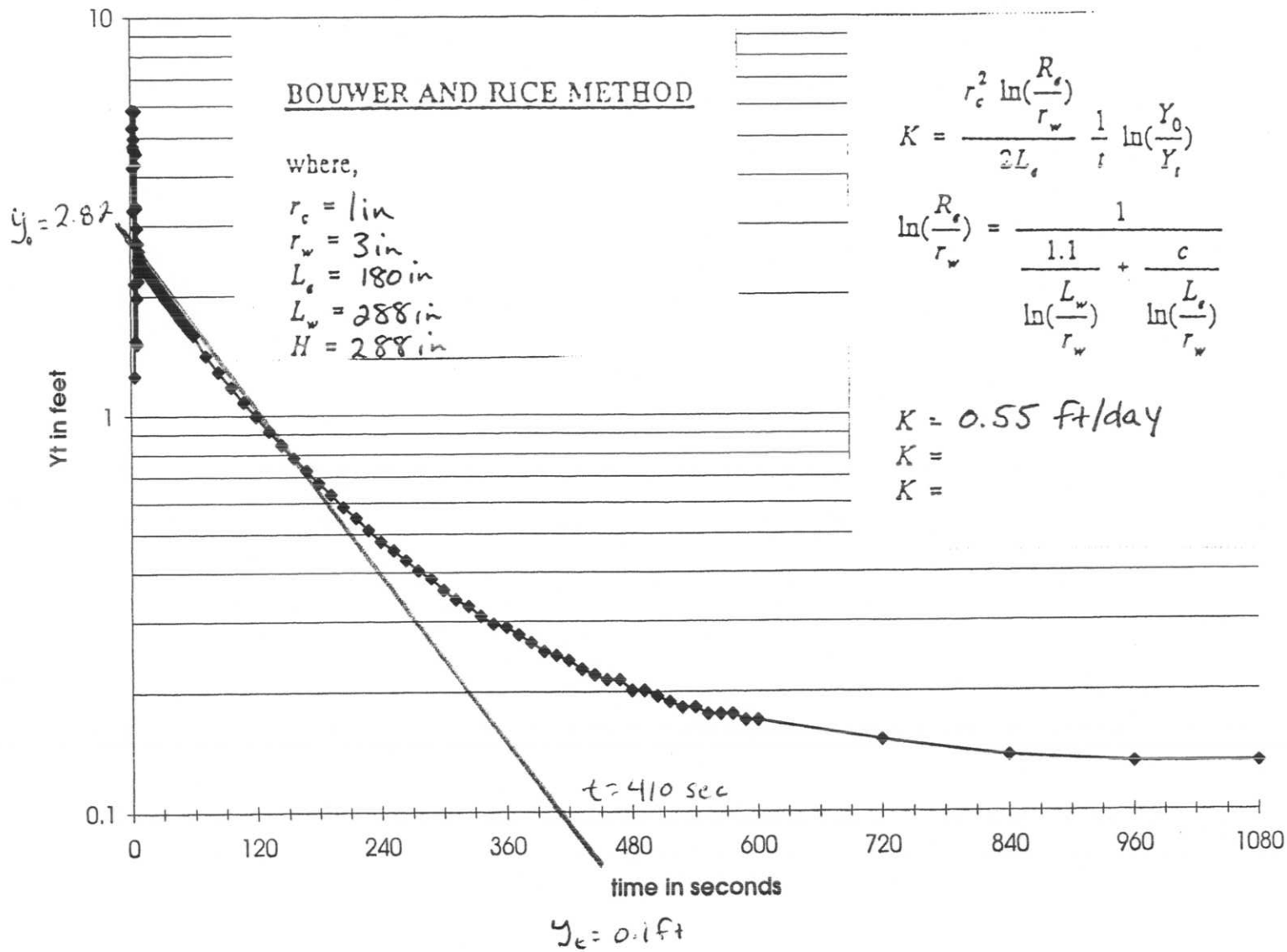
$$K = 0.0096 \times 0.0073$$

$$K = 0.00007 \ in/sec \times 1ft/12in \times 60 sec/min \times 60 min/hr \times 24 hr/day$$

$$K = 0.00007 \times 7200$$

$$K = 0.5 \ ft/day$$

MW-9D Falling Head Test



BOUWER AND RICE METHOD

where,

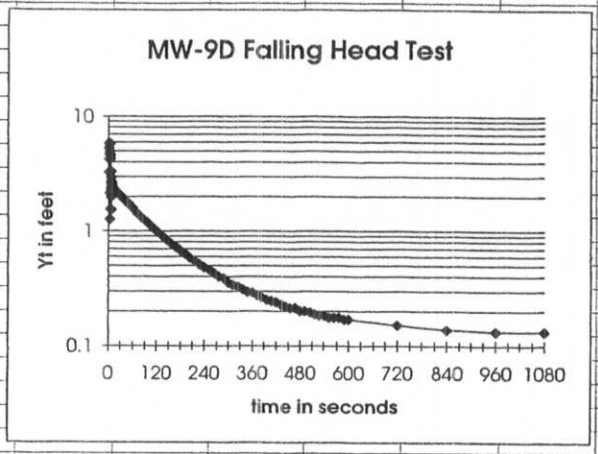
$r_c = 1$ in
$r_w = 3$ in
$L_e = 180$ in
$L_w = 288$ in
$H = 288$ in

$$K = \frac{r_c^2 \ln(\frac{R_e}{r_w})}{2L_e} \frac{1}{t} \ln(\frac{Y_0}{Y_t})$$

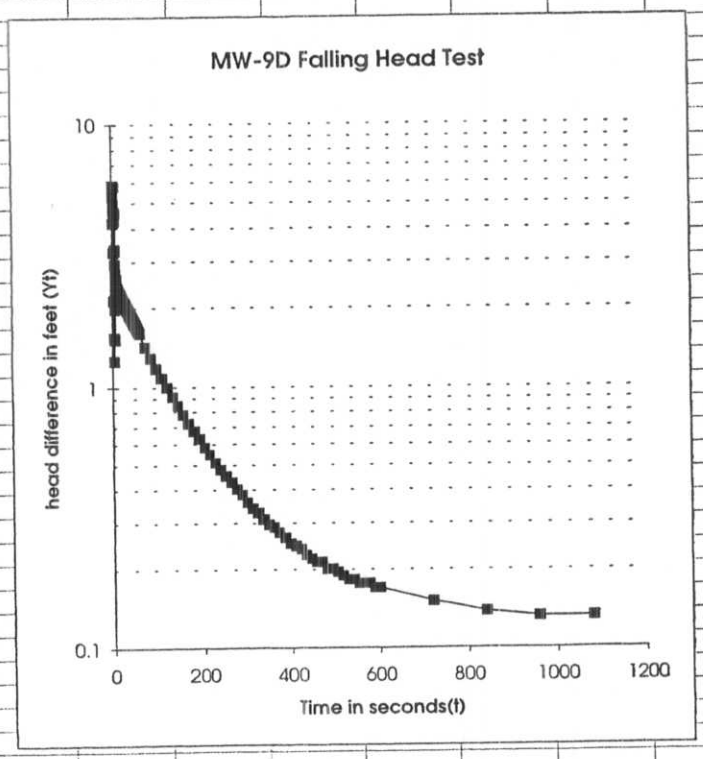
$$\ln(\frac{R_e}{r_w}) = \frac{1}{\frac{1.1}{\ln(\frac{L_w}{r_w})} + \frac{c}{\ln(\frac{L_e}{r_w})}}$$

K = 0.55 ft/day
K =
K =

	B	C	D	E
1	MW-9D Falling Head Test			
2	HERMIT DATA			
3	time	depth		
4	in minutes	to water	16.15	=:Reference initial depth to water
5		in feet	Time in second:	Yt in feet
6	0	16.282	0	0.132
7	0.0033	16.288	0.198	0.138
8	0.0066	16.301	0.396	0.151
9	0.01	16.882	0.6	0.732
10	0.0133	18.479	0.798	2.329
11	0.0166	17.437	0.996	1.287
12	0.02	16.711	1.2	0.561
13	0.0233	19.944	1.398	3.794
14	0.0266	21.442	1.596	5.292
15	0.03	21.998	1.8	5.848
16	0.0333	21.473	1.998	5.323
17	0.0366	20.355	2.196	4.205
18	0.04	19.414	2.4	3.264
19	0.0433	19.426	2.598	3.276
20	0.0466	20.911	2.796	4.761
21	0.05	21.113	3	4.963
22	0.0533	20.822	3.198	4.672
23	0.0566	18.296	3.396	2.146
24	0.0633	17.412	3.798	1.262
25	0.0666	20.778	3.996	4.628
26	0.07	21.992	4.2	5.842
27	0.0733	21.992	4.398	5.842
28	0.0766	20.424	4.596	4.274
29	0.08	17.696	4.8	1.546
30	0.09	19.508	5.4	3.358
31	0.0933	20.715	5.598	4.565
32	0.0966	19.47	5.796	3.32
33	0.1	18.132	6	1.982
34	0.1033	17.671	6.198	1.521
35	0.1066	18.315	6.396	2.165
36	0.11	19.104	6.6	2.954
37	0.1133	18.851	6.798	2.701
38	0.1166	18.492	6.996	2.342
39	0.12	18.46	7.2	2.31
40	0.1233	18.858	7.398	2.708
41	0.1266	18.618	7.596	2.468
42	0.13	18.327	7.8	2.177
43	0.1333	18.675	7.998	2.525
44	0.1366	18.58	8.196	2.43
45	0.14	18.744	8.4	2.594
46	0.1433	18.428	8.598	2.278
47	0.1466	18.574	8.796	2.424
48	0.15	18.593	9	2.443
49	0.1533	18.593	9.198	2.443
50	0.1566	18.555	9.396	2.405
51	0.16	18.548	9.6	2.398
52	0.1633	18.567	9.798	2.417
53	0.1666	18.555	9.996	2.405
54	0.17	18.542	10.2	2.392
55	0.1733	18.542	10.398	2.392
56	0.1766	18.542	10.596	2.392
57	0.18	18.536	10.8	2.386
58	0.1833	18.529	10.998	2.379
59	0.1866	18.529	11.196	2.379
60	0.19	18.523	11.4	2.373
61	0.1933	18.523	11.598	2.373
62	0.1966	18.517	11.796	2.367
63	0.2	18.51	12	2.36
64	0.2033	18.51	12.198	2.36
65	0.2066	18.504	12.396	2.354
66	0.21	18.504	12.6	2.354
67	0.2133	18.498	12.798	2.348
68	0.2166	18.492	12.996	2.342
69	0.22	18.485	13.2	2.335
70	0.2233	18.485	13.398	2.335
71	0.2266	18.485	13.596	2.335



	B	C	D	E
1	MW-9D Falling Head Test			
2	HERMIT DATA			
3	time	depth		
4	in minutes	to water	16.15	=:Reference initial depth to water
5		in feet	Time in seconds	Yt in feet
72	0.23	18.479	13.8	2.329
73	0.2333	18.473	13.998	2.323
74	0.2366	18.466	14.196	2.316
75	0.24	18.466	14.4	2.316
76	0.2433	18.46	14.598	2.31
77	0.2466	18.46	14.796	2.31
78	0.25	18.454	15	2.304
79	0.2533	18.454	15.198	2.304
80	0.2566	18.447	15.396	2.297
81	0.26	18.441	15.6	2.291
82	0.2633	18.441	15.798	2.291
83	0.2666	18.435	15.996	2.285
84	0.27	18.435	16.2	2.285
85	0.2733	18.428	16.398	2.278
86	0.2766	18.428	16.596	2.278
87	0.28	18.422	16.8	2.272
88	0.2833	18.416	16.998	2.266
89	0.2866	18.416	17.196	2.266
90	0.29	18.409	17.4	2.259
91	0.2933	18.409	17.598	2.259
92	0.2966	18.403	17.796	2.253
93	0.3	18.403	18	2.253
94	0.3033	18.397	18.198	2.247
95	0.3066	18.39	18.396	2.24
96	0.31	18.39	18.6	2.24
97	0.3133	18.39	18.798	2.24
98	0.3166	18.384	18.996	2.234
99	0.32	18.378	19.2	2.228
100	0.3233	18.378	19.398	2.228
101	0.3266	18.372	19.596	2.222
102	0.33	18.372	19.8	2.222
103	0.3333	18.365	19.998	2.215
104	0.35	18.346	21	2.196
105	0.3666	18.321	21.996	2.171
106	0.3833	18.302	22.998	2.152
107	0.4	18.289	24	2.139
108	0.4166	18.27	24.996	2.12
109	0.4333	18.252	25.998	2.102
110	0.45	18.233	27	2.083
111	0.4666	18.22	27.996	2.07
112	0.4833	18.201	28.998	2.051
113	0.5	18.188	30	2.038
114	0.5166	18.169	30.996	2.019
115	0.5333	18.151	31.998	2.001
116	0.55	18.132	33	1.982
117	0.5666	18.119	33.996	1.969
118	0.5833	18.1	34.998	1.95
119	0.6	18.087	36	1.937
120	0.6166	18.068	36.996	1.918
121	0.6333	18.056	37.998	1.906
122	0.65	18.037	39	1.887
123	0.6666	18.024	39.996	1.874
124	0.6833	18.005	40.998	1.855
125	0.7	17.993	42	1.843
126	0.7166	17.98	42.996	1.83
127	0.7333	17.961	43.998	1.811
128	0.75	17.948	45	1.798
129	0.7666	17.936	45.996	1.786
130	0.7833	17.917	46.998	1.767
131	0.8	17.904	48	1.754
132	0.8166	17.892	48.996	1.742
133	0.8333	17.879	49.998	1.729
134	0.85	17.866	51	1.716
135	0.8666	17.854	51.996	1.704
136	0.8833	17.841	52.998	1.691
137	0.9	17.829	54	1.679



	B	C	D	E	F	G	H	I	J	K	L	M
1		MW-9D Falling Head Test										
2	HERMIT DATA											
3	time	depth										
4	in minutes	to water	16.15	=:Reference initial depth to water								
5		in feet	Time in seconds	Yt in feet								
138	0.9166	17.81	54.996	1.66								
139	0.9333	17.797	55.998	1.647								
140	0.95	17.784	57	1.634								
141	0.9666	17.772	57.996	1.622								
142	0.9833	17.759	58.998	1.609								
143	1	17.746	60	1.596								
144	1.2	17.57	72	1.42								
145	1.4	17.443	84	1.293								
146	1.6	17.33	96	1.18								
147	1.8	17.235	108	1.085								
148	2	17.147	120	0.997								
149	2.2	17.065	132	0.915								
150	2.4	16.995	144	0.845								
151	2.6	16.932	156	0.782								
152	2.8	16.875	168	0.725								
153	3	16.825	180	0.675								
154	3.2	16.781	192	0.631								
155	3.4	16.736	204	0.586								
156	3.6	16.699	216	0.549								
157	3.8	16.661	228	0.511								
158	4	16.629	240	0.479								
159	4.2	16.604	252	0.454								
160	4.4	16.579	264	0.429								
161	4.6	16.553	276	0.403								
162	4.8	16.534	288	0.384								
163	5	16.509	300	0.359								
164	5.2	16.49	312	0.34								
165	5.4	16.478	324	0.328								
166	5.6	16.459	336	0.309								
167	5.8	16.446	348	0.296								
168	6	16.44	360	0.29								
169	6.2	16.427	372	0.277								
170	6.4	16.415	384	0.265								
171	6.6	16.402	396	0.252								
172	6.8	16.396	408	0.246								
173	7	16.389	420	0.239								
174	7.2	16.377	432	0.227								
175	7.4	16.37	444	0.22								
176	7.6	16.364	456	0.214								
177	7.8	16.364	468	0.214								
178	8	16.351	480	0.201								
179	8.2	16.351	492	0.201								
180	8.4	16.345	504	0.195								
181	8.6	16.339	516	0.189								
182	8.8	16.333	528	0.183								
183	9	16.333	540	0.183								
184	9.2	16.326	552	0.176								
185	9.4	16.326	564	0.176								
186	9.6	16.326	576	0.176								
187	9.8	16.32	588	0.17								
188	10	16.32	600	0.17								
189	12	16.301	720	0.151								
190	14	16.288	840	0.138								
191	16	16.282	960	0.132								
192	18	16.282	1080	0.132								
193			2000	0.011								
194												
195												

MW-9D (FALLING HEAD)

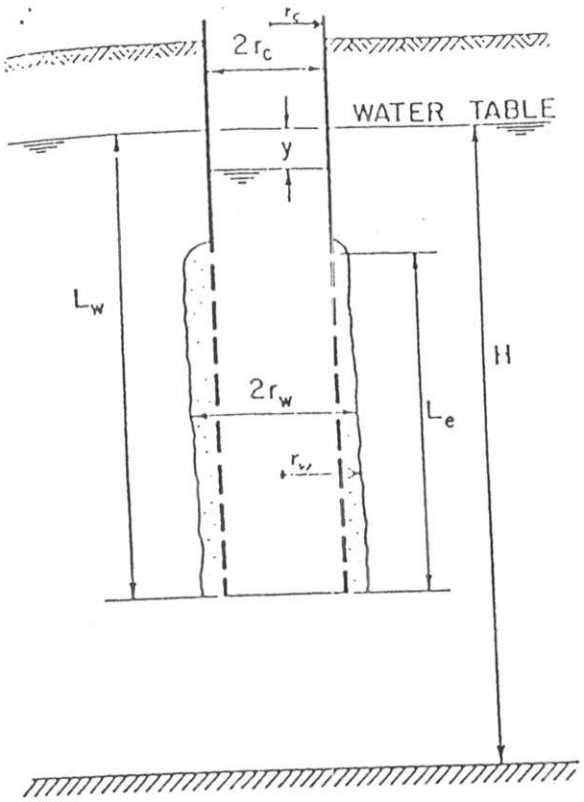


FIGURE 1

r_c = 1 (in)

r_w = 3 (in)

L_e = 180 (in)

L_w = 288 (in)

H = 288 (in)

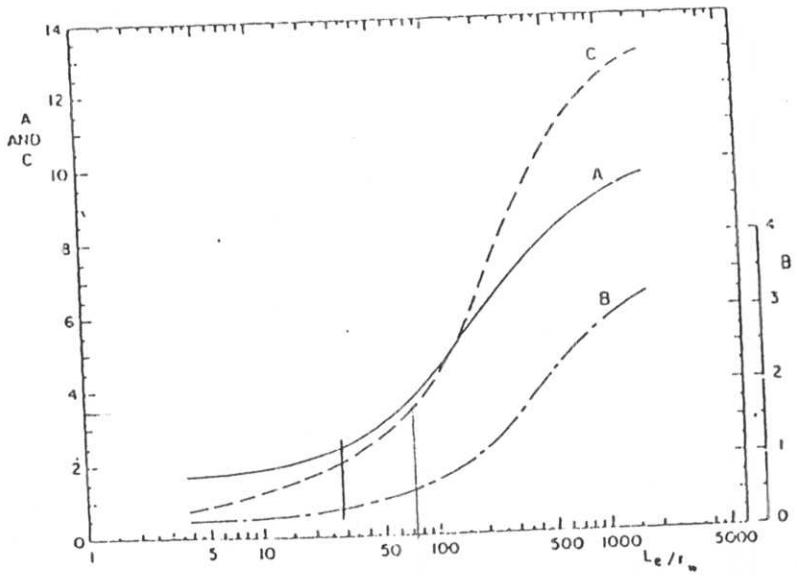


Fig. 2. Dimensionless parameters A, B, and C as a function of L_e/r_w for calculation of $\ln(R_e/r_w)$.

CAMP DRESSER & McKEE

CLIENT Buncombe County
PROJECT CED LANDFILL - HYDRO-GEO
DETAIL MW-9D FALLING HEAD SLUG TEST

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MW 9D - FALLING HEAD

Step 1

$r_c = 1in$
$r_w = 3in$
$L_e = 180in$
$L_w = 288in$
$H = 288in$

Step 4

$y_0 = 2.82$
$t = 410 sec$
$y_t = 0.1 ft$

$1/t = 1/410 = 0.0024\ 1/sec$

$\ln(y_0/y_t) = 2.82/0.1 = \ln 28.2 = 3.339$

Step 5

$L_e/r_w = 180/3 = 60$
$L_w = H$ ∴ determine $C_{60} = 2.9$

$$\ln(R_e/r_w) = \frac{1}{\frac{1.1}{\ln(L_w/r_w)} + \frac{2.9}{(L_e/r_w)}}$$

$$= \frac{1}{\frac{1.1}{\ln(288/3)} + \frac{2.9}{(180/3)}}$$

$$= \frac{1}{\frac{1.1}{4.56} + 0.048}$$

$$= \frac{1}{0.241 + 0.0483} = \frac{1}{0.289} = 3.46$$

$$K = \frac{r_c^2 (\ln R_e/r_w)}{2L_e} \cdot \frac{1}{t} \cdot \ln(y_0/y_t)$$

$$= \frac{1in^2 (3.46)}{360} \cdot 0.0024\ 1/sec \cdot 3.339$$

$$= 0.0096 \cdot 0.008$$

$$= 0.00008\ in/sec \times 7200$$

$$= 0.55\ ft/day$$