Laboratory Report for

U.S. Geologic Survey

(The Big River DEQ00)

May 1, 2009

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109

May 1, 2009

David S. Armstrong
MA-RI Water Science Center
U.S. Geological Survey
10 Bearfoot Road
Northborough, MA 01532-1528
(508) 490-5060

Re: DBS&A Laboratory Report for U.S. Geological Survey The Big River DEQ00

Dear Mr. Armstrong:

Enclosed is the final report for the U.S. Geological Survey The Big River DEQ00 samples. Please review this report and provide any comments as samples will be held for a maximum of 30 days. After 30 days samples will be returned or disposed of in an appropriate manner.

All testing results were evaluated subjectively for consistency and reasonableness, and the results appear to be reasonably representative of the material tested. However, DBS&A does not assume any responsibility for interpretations or analyses based on the data enclosed, nor can we guarantee that these data are fully representative of the undisturbed materials at the field site. We recommend that careful evaluation of these laboratory results be made for your particular application.

The testing utilized to generate the enclosed final report employs methods that are standard for the industry. The results do not constitute a professional opinion by DBS&A, nor can the results affect any professional or expert opinions rendered with respect thereto by DBS&A. You have acknowledged that all the testing undertaken by us, and the final report provided, constitutes mere test results using standardized methods, and cannot be used to disqualify DBS&A from rendering any professional or expert opinion, having waived any claim of conflict of interest by DBS&A.

We are pleased to provide this service to U.S. Geological Survey and look forward to future laboratory testing on other projects. If you have any questions about the enclosed data, please do not hesitate to call.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.
LABORATORY / TESTING FACILITY

Ryan Marshall
Assistant Laboratory Manager

Enclosure

Daniel B. Stephens & Associates, Inc.
Soil Testing & Research Laboratory
5840 Osuna Rd. NE
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505-889-7752
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Summaries

Summary of Tests Performed

Laboratory Sample Number	Initial Soil Properties[1]		Saturated Hydraulic Conductivity[2]			Moisture Characteristics[3]								Particle Size[4]			Specific Gravity[5]		% Organic Matter	Atterberg Limits	Proctor Compaction
	VM	VD	CH	FH	FW	HC	PP	FP	DPP	RH	EP	WHC	K_{unsat}	DS	WS	H	F	C			
BEAR	X		X			X	X		X	X			X						X		
REYN	X		X																X		
CEDA	X		X			X	X		X	X			X						X		
SCAR	X		X			X	X		X	X			X						X		
CONG	X		X																X		

[1] VM = Volume Measurement Method, VD = Volume Displacement Method

[2] CH = Constant Head Rigid Wall, FH = Falling Head Rigid Wall, FW = Falling Head Rising Tail Flexible Wall

[3] HC = Hanging Column, PP = Pressure Plate, FP = Filter Paper, DPP = Dew Point Potentiometer, RH = Relative Humidity Box, EP = Effective Porosity, WHC = Water Holding Capacity, Kunsat = Calculated Unsaturated Hydraulic Conductivity

[4] DS = Dry Sieve, WS = Wet Sieve, H = Hydrometer

[5] F = Fine (<4.75mm), C = Coarse (>4.75mm)

Summary of Volume Changes

Sample Number	Initial Sample Data[1]		Volume Change Post Saturation[2]			Volume Change Post Drying Curve[3]		
	Moisture Content (%, g/g)	Dry Bulk Density (g/cm^3)	Dry Bulk Density (g/cm^3)	% Volume Change (%)	% of Initial Density (%)	Dry Bulk Density (g/cm^3)	% Volume Change (%)	% of Initial Density (%)
BEAR	66.5	0.93	0.93	---	100.0%	1.07	(-) 13.2%	115.2%
CEDA	46.5	1.15	1.15	---	100.0%	1.28	(-) 10.3%	111.5%
SCAR	67.5	0.93	0.93	---	100.0%	1.05	(-) 12.2%	113.9%

[1]Initial Sample Data: The 'as received' dry bulk density and moisture content.

[2]Volume Change Post Saturation: Volume change measurements were obtained after saturated hydraulic conductivity testing.

[3]Volume Change Post Drying Curve: Volume change measurements were obtained throughout hanging column and pressure plate testing. The 'Volume Change Post Drying Curve' values represent the final sample dimensions after the last pressure plate point.

Notes:

(+) indicates sample swelling, (-) indicates sample settling, and "---" indicates no volume change occurred.

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

	Moisture Content						
	As Received		Remolded				
Sample Number	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
BEAR	66.5	61.5	---	---	0.93	1.54	65.1
REYN	51.5	57.0	---	---	1.11	1.68	58.3
CEDA	46.5	53.5	---	---	1.15	1.68	56.6
SCAR	67.5	62.5	---	---	0.93	1.55	65.1
CONG	93.3	68.8	---	---	0.74	1.42	72.2

NA = Not analyzed

--- = This sample was not remolded

Technician Notes:

All samples contained organic material (roots, twigs, etc.). All samples were peaty, wet, and spongy. Organic odor was noted. As directed, testing sub samples were taken from what appeared to be the most dense portion of the core, which was the bottom of the core in all cases. Sub-samples were 3" in length.

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Oversize Corrected K_{sat} (cm/sec)	Method of Analysis	
			Constant Head	Falling Head
BEAR	4.5E-05	NA	X	
REYN	2.2E-05	NA	X	
CEDA	1.1E-05	NA	X	
SCAR	7.5E-05	NA	X	
CONG	6.2E-05	NA	X	

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BEAR	0	63.9
	14	62.5
	42	59.4
	116	53.4
	337	51.2 ‡‡
	8566	4.7 ‡‡
	34163	2.8 ‡‡
	165208	1.8 ‡‡
	851293	1.0 ‡‡
CEDA	0	55.2
	15	54.2
	46	51.5
	126	48.0
	337	50.3 ‡‡ **
	10402	19.1 ‡‡
	23761	16.6 ‡‡
	278405	11.2 ‡‡
	851293	8.1 ‡‡
SCAR	0	63.6
	17	59.8
	49	57.7
	127	57.2 ‡‡
	398	53.5 ‡‡
	18050	11.4 ‡‡
	25291	8.9 ‡‡
	203960	5.9 ‡‡
	851293	3.5 ‡‡

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).
**Based on ~10% volume loss (shrinkage) at the 337 cm point. Notice effect on predicted water retention curve and corresponding van Genuchten parameters.

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r (% vol)	θ_s (% vol)	Oversize Corrected θ_r (% vol)	Oversize Corrected θ_s (% vol)
BEAR	0.0022	1.8365	0.79	60.80	NA	NA
CEDA**	0.0016	1.4579	7.27	53.04	NA	NA
SCAR	0.0017	1.4707	0.00	60.40	NA	NA

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NA = Not analyzed
** Based on ~10% volume loss (shrinkage) at the 337 cm point. Notice effect on predicted water retention curve and corresponding van Genuchten parameters.

Summary of Percent Organic Matter

Sample Number	Organic Matter (%)
BEAR	8.23
REYN	6.79
CEDA	7.14
SCAR	11.77
CONG	13.06

Laboratory Data and Graphical Plots

Initial Properties

Summary of Initial Moisture Content, Dry Bulk Density Wet Bulk Density and Calculated Porosity

	Moisture Content						
	As Received		Remolded				
Sample Number	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Gravimetric (%, g/g)	Volumetric (%, cm^3/cm^3)	Dry Bulk Density (g/cm^3)	Wet Bulk Density (g/cm^3)	Calculated Porosity (%)
BEAR	66.5	61.5	---	---	0.93	1.54	65.1
REYN	51.5	57.0	---	---	1.11	1.68	58.3
CEDA	46.5	53.5	---	---	1.15	1.68	56.6
SCAR	67.5	62.5	---	---	0.93	1.55	65.1
CONG	93.3	68.8	---	---	0.74	1.42	72.2

NA = Not analyzed

--- = This sample was not remolded

Technician Notes:

All samples contained organic material (roots, twigs, etc.). All samples were peaty, wet, and spongy. Organic odor was noted. As directed, testing sub samples were taken from what appeared to be the most dense portion of the core, which was the bottom of the core in all cases. Sub-samples were 3" in length.

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: BEAR
Project Name: The Big River
Project Number: DEQ00

	As Received	Remolded
Test Date:	12-Mar-09	---
Field weight of sample* (g):	457.05	
Tare weight, ring (g):	31.33	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	255.74	
Sample volume (cm^3):	276.32	
Assumed particle density (g/cm^3):	2.65	
Gravimetric Moisture Content (% g/g):	66.5	
Volumetric Moisture Content (% vol):	61.5	
Dry bulk density (g/cm^3):	0.93	
Wet bulk density (g/cm^3):	1.54	
Calculated Porosity (% vol):	65.1	
Percent Saturation:	94.5	

Laboratory analysis by: K. Wright/ R. Marshall
Data entered by: R. Marshall
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: REYN
Project Name: The Big River
Project Number: DEQ00

	As Received	Remolded
Test Date:	12-Mar-09	---
Field weight of sample* (g):	469.56	
Tare weight, ring (g):	30.06	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	290.07	
Sample volume (cm^3):	262.36	
Assumed particle density (g/cm^3):	2.65	
Gravimetric Moisture Content (% g/g):	51.5	
Volumetric Moisture Content (% vol):	57.0	
Dry bulk density (g/cm^3):	1.11	
Wet bulk density (g/cm^3):	1.68	
Calculated Porosity (% vol):	58.3	
Percent Saturation:	97.7	

Laboratory analysis by: K. Wright/ R. Marshall
Data entered by: R. Marshall
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: CEDA
Project Name: The Big River
Project Number: DEQ00

	As Received	Remolded
Test Date:	12-Mar-09	---
Field weight of sample* (g):	482.64	
Tare weight, ring (g):	30.61	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	308.61	
Sample volume (cm^3):	268.29	
Assumed particle density (g/cm^3):	2.65	
Gravimetric Moisture Content (% g/g):	46.5	
Volumetric Moisture Content (% vol):	53.5	
Dry bulk density (g/cm^3):	1.15	
Wet bulk density (g/cm^3):	1.68	
Calculated Porosity (% vol):	56.6	
Percent Saturation:	94.5	

Laboratory analysis by: K. Wright/ R. Marshall
Data entered by: R. Marshall
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: SCAR
Project Name: The Big River
Project Number: DEQ00

	As Received	Remolded
Test Date:	12-Mar-09	---
Field weight of sample* (g):	444.67	
Tare weight, ring (g):	30.35	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	247.31	
Sample volume (cm^3):	267.18	
Assumed particle density (g/cm^3):	2.65	
Gravimetric Moisture Content (% g/g):	67.5	
Volumetric Moisture Content (% vol):	62.5	
Dry bulk density (g/cm^3):	0.93	
Wet bulk density (g/cm^3):	1.55	
Calculated Porosity (% vol):	65.1	
Percent Saturation:	96.1	

Laboratory analysis by: K. Wright/ R. Marshall
Data entered by: R. Marshall
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Data for Initial Moisture Content, Bulk Density, Porosity, and Percent Saturation

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: CONG
Project Name: The Big River
Project Number: DEQ00

	As Received	Remolded
Test Date:	12-Mar-09	---
Field weight of sample* (g):	406.84	
Tare weight, ring (g):	29.60	
Tare weight, pan/plate (g):	0.00	
Tare weight, other (g):	0.00	
Dry weight of sample (g):	195.17	
Sample volume (cm^3):	264.77	
Assumed particle density (g/cm^3):	2.65	
Gravimetric Moisture Content (% g/g):	93.3	
Volumetric Moisture Content (% vol):	68.8	
Dry bulk density (g/cm^3):	0.74	
Wet bulk density (g/cm^3):	1.42	
Calculated Porosity (% vol):	72.2	
Percent Saturation:	95.3	

Laboratory analysis by: K. Wright/ R. Marshall
Data entered by: R. Marshall
Checked by: J. Hines

Comments:

* Weight including tares
NA = Not analyzed
--- = This sample was not remolded

Saturated Hydraulic Conductivity

Summary of Saturated Hydraulic Conductivity Tests

Sample Number	K_{sat} (cm/sec)	Oversize Corrected K_{sat} (cm/sec)	Method of Analysis	
			Constant Head	Falling Head
BEAR	4.5E-05	NA	X	
REYN	2.2E-05	NA	X	
CEDA	1.1E-05	NA	X	
SCAR	7.5E-05	NA	X	
CONG	6.2E-05	NA	X	

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	U.S. Geological Survey	*Type of water used:*	TAP
Job number:	LB09.0061.00	*Collection vessel tare* (g)*:*	9.15
Sample number:	BEAR	*Sample length* (cm)*:*	7.65
Project Name:	The Big River	*Sample diameter* (cm)*:*	6.78
Project Number:	DEQ00	*Sample x-sectional area* (cm^2)*:*	36.12

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
17-Mar-09	10:21:16	20.5	10.5	12.8	3.6	1585	4.6E-05	4.5E-05
17-Mar-09	10:47:41							
Test # 2:								
17-Mar-09	12:41:27	21.0	9.8	16.1	6.9	3211	4.7E-05	4.6E-05
17-Mar-09	13:34:58							
Test # 3:								
17-Mar-09	14:12:02	21.0	9.3	14.9	5.7	2811	4.6E-05	4.5E-05
17-Mar-09	14:58:53							

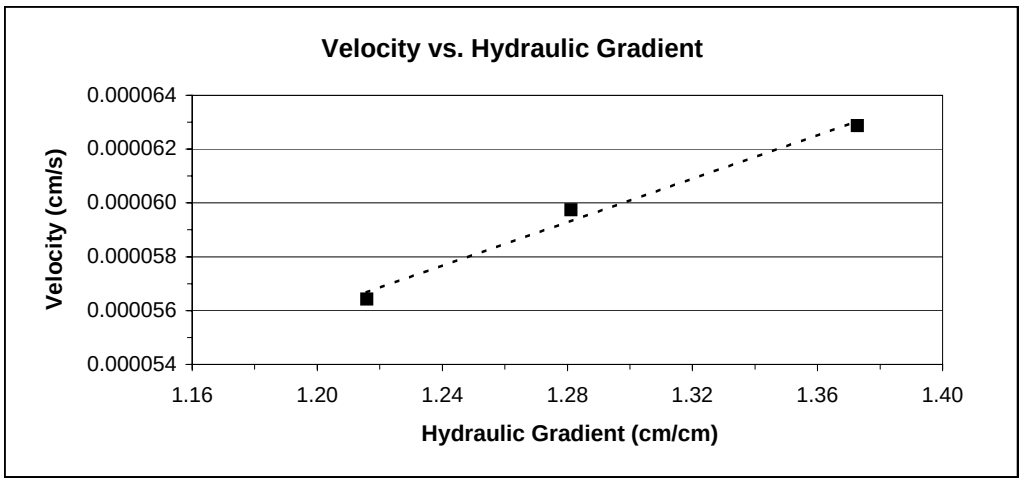
Average Ksat* (cm/sec)*: **4.5E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not analyzed



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	U.S. Geological Survey	*Type of water used:*	TAP
Job number:	LB09.0061.00	*Collection vessel tare* (g)*:*	9.19
Sample number:	REYN	*Sample length* (cm)*:*	7.30
Project Name:	The Big River	*Sample diameter* (cm)*:*	6.77
Project Number:	DEQ00	*Sample x-sectional area* (cm^2)*:*	35.95

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
17-Mar-09	10:19:16	20.5	11.0	11.2	2.0	1597	2.3E-05	2.2E-05
17-Mar-09	10:45:53							
Test # 2:								
17-Mar-09	12:41:08	21.0	10.3	12.7	3.6	3031	2.3E-05	2.3E-05
17-Mar-09	13:31:39							
Test # 3:								
17-Mar-09	14:12:35	21.0	9.8	12.3	3.1	2780	2.3E-05	2.2E-05
17-Mar-09	14:58:55							

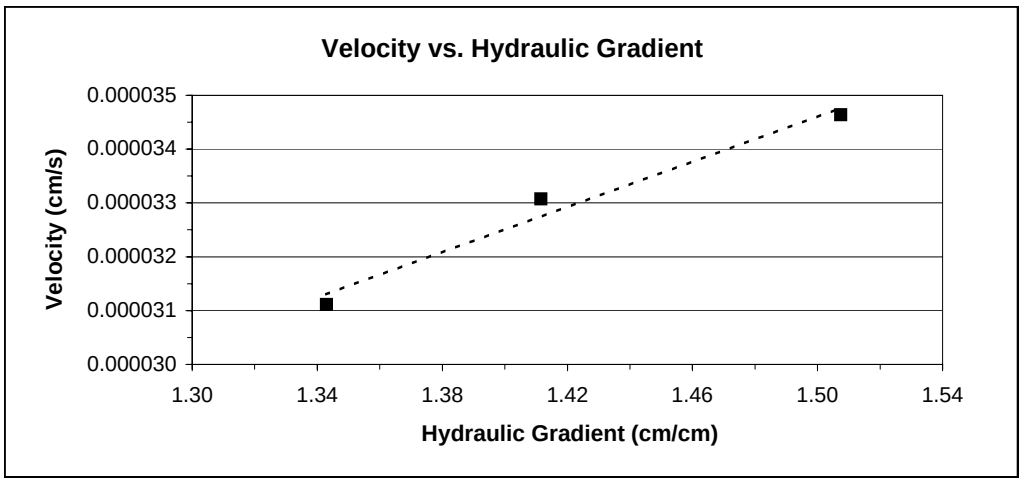
Average Ksat* (cm/sec)*: **2.2E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not analyzed



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	U.S. Geological Survey	*Type of water used:*	TAP
Job number:	LB09.0061.00	*Collection vessel tare* (g)*:*	9.20
Sample number:	CEDA	*Sample length* (cm)*:*	7.44
Project Name:	The Big River	*Sample diameter* (cm)*:*	6.78
Project Number:	DEQ00	*Sample x-sectional area* (cm^2)*:*	36.05

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
17-Mar-09	09:08:51	20.5	12.1	11.2	2.0	3027	1.1E-05	1.1E-05
17-Mar-09	09:59:18							
Test # 2:								
17-Mar-09	12:42:16	21.0	11.8	11.2	2.0	3265	1.1E-05	1.1E-05
17-Mar-09	13:36:41							
Test # 3:								
17-Mar-09	14:12:40	21.0	11.5	10.8	1.6	2675	1.1E-05	1.0E-05
17-Mar-09	14:57:15							

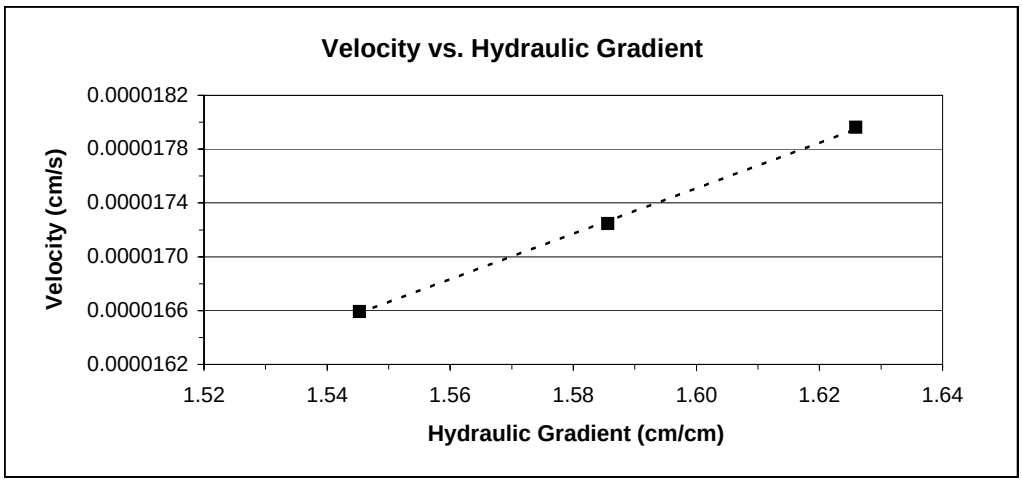
Average Ksat* (cm/sec)*: **1.1E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not analyzed



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	U.S. Geological Survey	*Type of water used:*	TAP
Job number:	LB09.0061.00	*Collection vessel tare* (g)*:*	9.19
Sample number:	SCAR	*Sample length* (cm)*:*	7.45
Project Name:	The Big River	*Sample diameter* (cm)*:*	6.76
Project Number:	DEQ00	*Sample x-sectional area* (cm^2)*:*	35.85

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
17-Mar-09	09:09:55	20.5	12.2	21.9	12.7	2727	7.9E-05	7.8E-05
17-Mar-09	09:55:22							
Test # 2:								
17-Mar-09	12:42:41	21.0	11.5	21.9	12.7	3021	7.6E-05	7.4E-05
17-Mar-09	13:33:02							
Test # 3:								
17-Mar-09	14:12:56	21.0	11.0	19.6	10.4	2700	7.3E-05	7.1E-05
17-Mar-09	14:57:56							

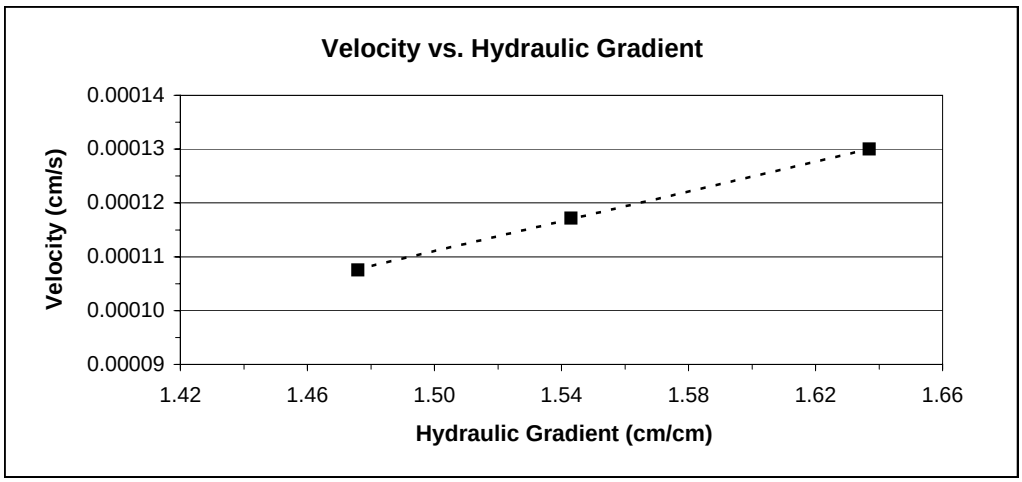
Average Ksat* (cm/sec)*: **7.5E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not analyzed



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Saturated Hydraulic Conductivity
Constant Head Method

Job name:	U.S. Geological Survey	*Type of water used:*	TAP
Job number:	LB09.0061.00	*Collection vessel tare* (g)*:*	9.15
Sample number:	CONG	*Sample length* (cm)*:*	7.33
Project Name:	The Big River	*Sample diameter* (cm)*:*	6.78
Project Number:	DEQ00	*Sample x-sectional area* (cm^2)*:*	36.15

Date	Time	Temp (°C)	Head (cm)	Q + Tare (g)	Q (cm^3)	Elapsed time (sec)	Ksat (cm/sec)	Ksat @ 20°C (cm/sec)
Test # 1:								
17-Mar-09	11:15:02	20.5	12.0	15.7	6.6	1722	6.5E-05	6.4E-05
17-Mar-09	11:43:44							
Test # 2:								
17-Mar-09	12:41:55	21.0	11.3	19.9	10.8	3027	6.4E-05	6.2E-05
17-Mar-09	13:32:22							
Test # 3:								
17-Mar-09	14:13:12	21.0	10.8	17.7	8.5	2582	6.2E-05	6.1E-05
17-Mar-09	14:56:14							

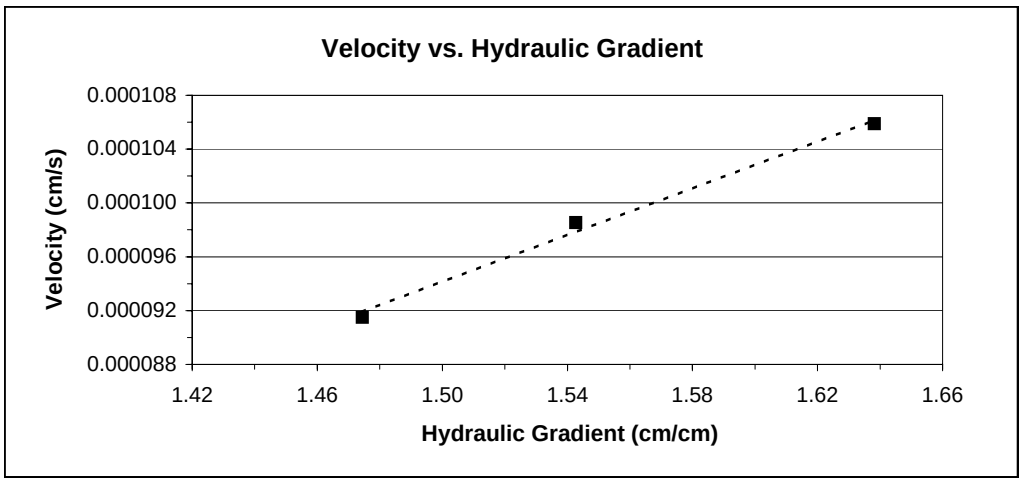
Average Ksat* (cm/sec)*: **6.2E-05**

Oversize Corrected Ksat* (cm/sec)*: **NA**

Comments:

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass

NA = Not analyzed



Laboratory analysis by: K. Wright

Data entered by: K. Wright

Checked by: J. Hines

Moisture Retention Characteristics

Summary of Moisture Characteristics of the Initial Drainage Curve

Sample Number	Pressure Head (-cm water)	Moisture Content (%, cm^3/cm^3)
BEAR	0	63.9
	14	62.5
	42	59.4
	116	53.4
	337	51.2 ‡‡
	8566	4.7 ‡‡
	34163	2.8 ‡‡
	165208	1.8 ‡‡
	851293	1.0 ‡‡
CEDA	0	55.2
	15	54.2
	46	51.5
	126	48.0
	337	50.3 ‡‡ **
	10402	19.1 ‡‡
	23761	16.6 ‡‡
	278405	11.2 ‡‡
	851293	8.1 ‡‡
SCAR	0	63.6
	17	59.8
	49	57.7
	127	57.2 ‡‡
	398	53.5 ‡‡
	18050	11.4 ‡‡
	25291	8.9 ‡‡
	203960	5.9 ‡‡
	851293	3.5 ‡‡

‡‡ Volume adjustments are applicable at this matric potential (see data sheet for this sample).
**Based on ~10% volume loss (shrinkage) at the 337 cm point. Notice effect on predicted water retention curve and corresponding van Genuchten parameters.

Summary of Calculated Unsaturated Hydraulic Properties

Sample Number	α (cm^{-1})	N (dimensionless)	θ_r (% vol)	θ_s (% vol)	Oversize Corrected θ_r (% vol)	Oversize Corrected θ_s (% vol)
BEAR	0.0022	1.8365	0.79	60.80	NA	NA
CEDA**	0.0016	1.4579	7.27	53.04	NA	NA
SCAR	0.0017	1.4707	0.00	60.40	NA	NA

--- = Oversize correction is unnecessary since coarse fraction < 5% of composite mass
NA = Not analyzed
** Based on ~10% volume loss (shrinkage) at the 337 cm point. Notice effect on predicted water retention curve and corresponding van Genuchten parameters.

Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: BEAR
Project Name: The Big River
Project Number: DEQ00

Dry wt. of sample (g): 255.74
Tare wt., ring (g): 31.33
Tare wt., screen & clamp (g): 28.08
Initial sample volume (cm^3): 276.32
Initial dry bulk density (g/cm^3): 0.93
Assumed particle density (g/cm^3): 2.65
Initial calculated total porosity (%): 65.07

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)	
Hanging column:	18-Mar-09	13:45	491.77	0.00	63.92	
	24-Mar-09	11:35	487.93	13.50	62.53	
	30-Mar-09	9:19	479.29	42.00	59.40	
	6-Apr-09	10:10	462.84	116.00	53.45	
Pressure plate:	15-Apr-09	7:55	437.91	336.53	51.19	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.00	---	---	---	---
	13.50	---	---	---	---
	42.00	---	---	---	---
	116.00	---	---	---	---
Pressure plate:	336.53	239.81	-13.21%	1.07	59.76

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: R. Marshall
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: BEAR

Dry weight of dew point potentiometer sample* (g)*:* 145.90
Tare weight, jar (g)*:* 112.78
Initial sample bulk density (g/cm^3)*:* 0.93

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Dew point potentiometer:	17-Mar-09	12:45	147.36	8566.3	4.70	‡‡
	17-Mar-09	10:55	146.77	34163.3	2.81	‡‡
	18-Mar-09	10:10	146.45	165207.6	1.78	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	8566.3	239.81	-13.21%	1.07	59.76
	34163.3	239.81	-13.21%	1.07	59.76
	165207.6	239.81	-13.21%	1.07	59.76

Dry weight of relative humidity box sample* (g)*:* 80.39
Tare weight (g)*:* 42.91
Initial sample bulk density (g/cm^3)*:* 0.93

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Moisture Content † (% vol)	
Relative humidity box:	23-Mar-09	9:55	80.73	851293	0.98	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	851293	239.81	-13.21%	1.07	59.76

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

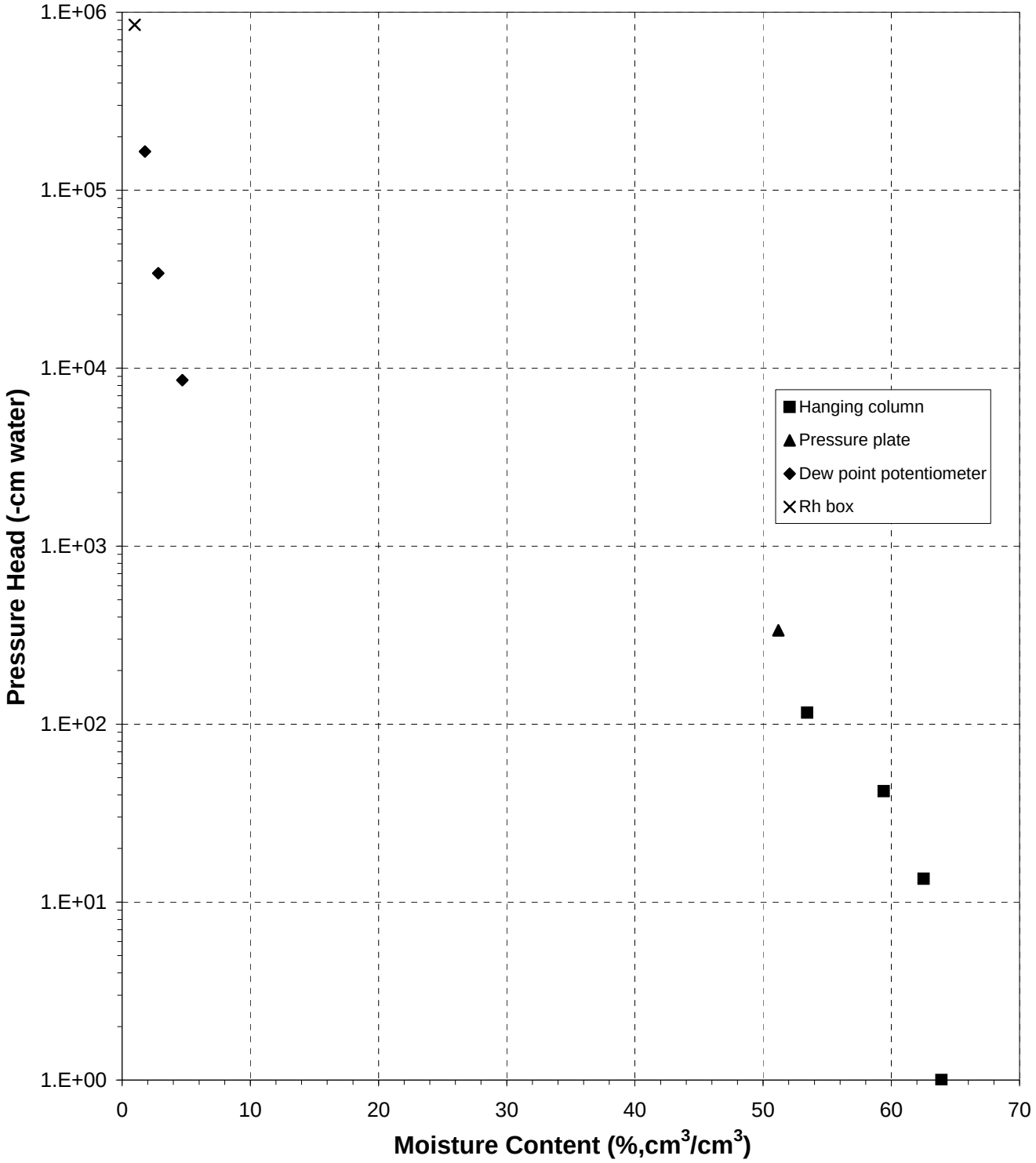
† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: D. O'Dowd
Data entered by: R. Marshall
Checked by: J. Hines

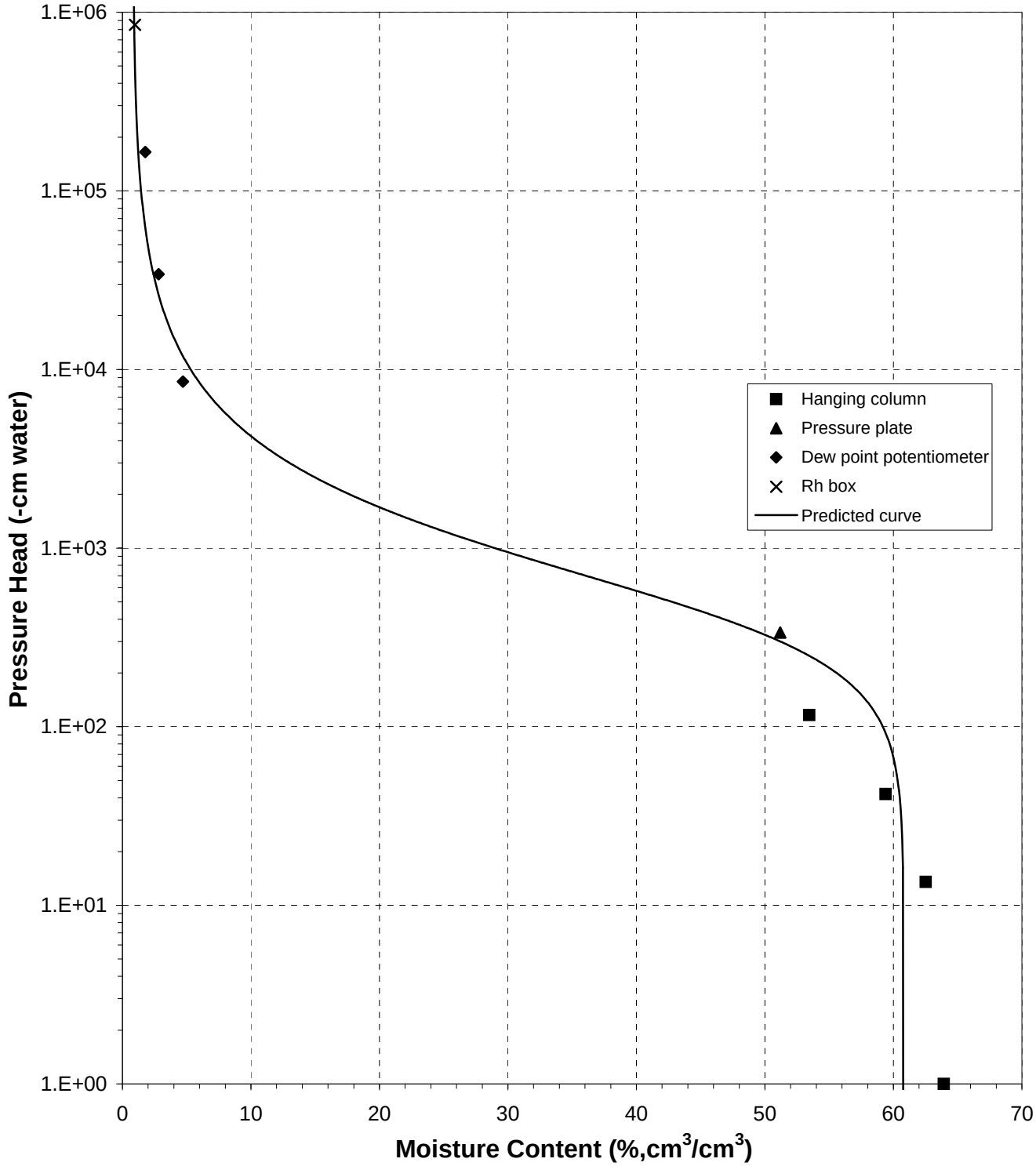
Water Retention Data Points

Sample Number: BEAR



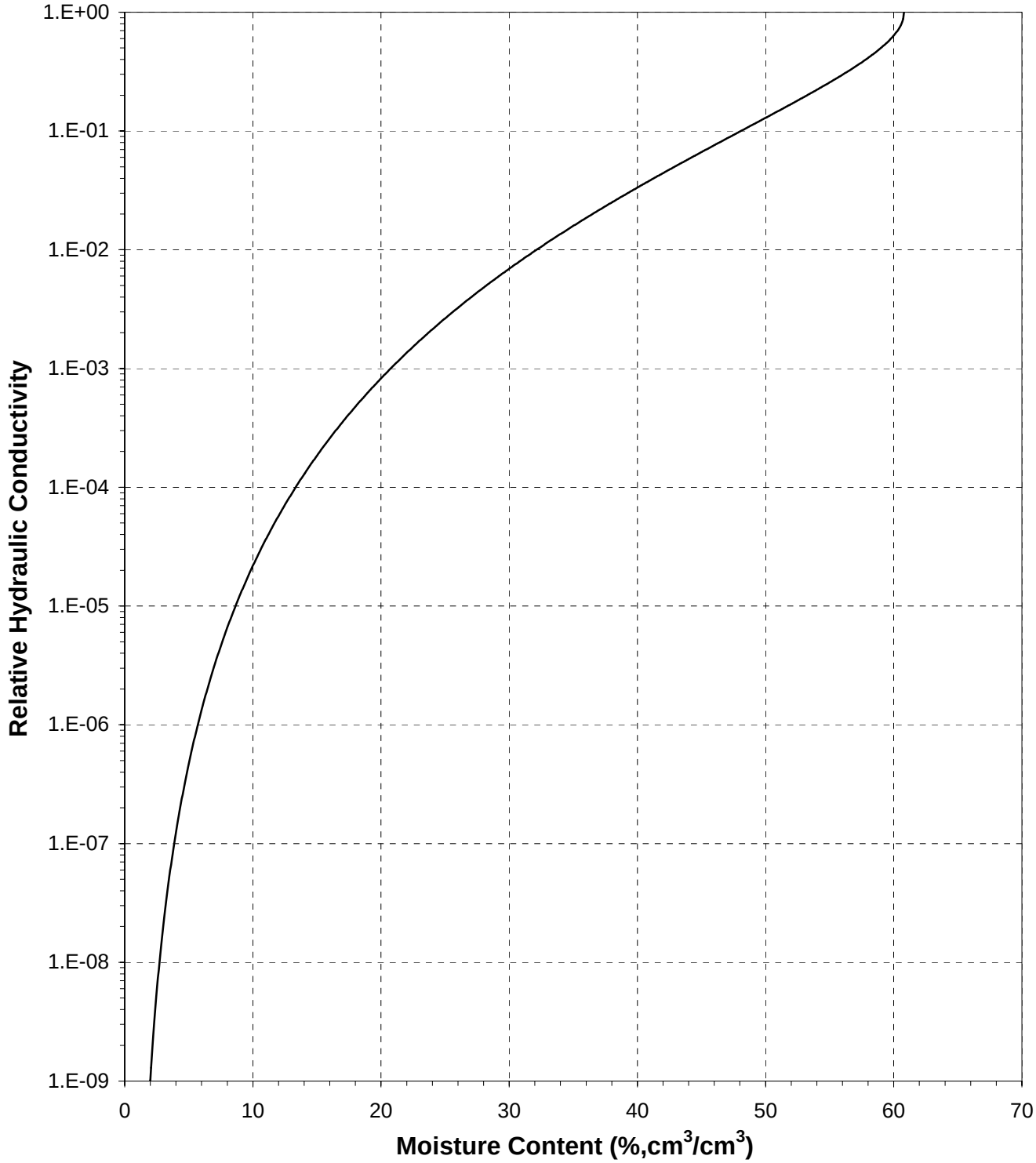
Predicted Water Retention Curve and Data Points

Sample Number: BEAR



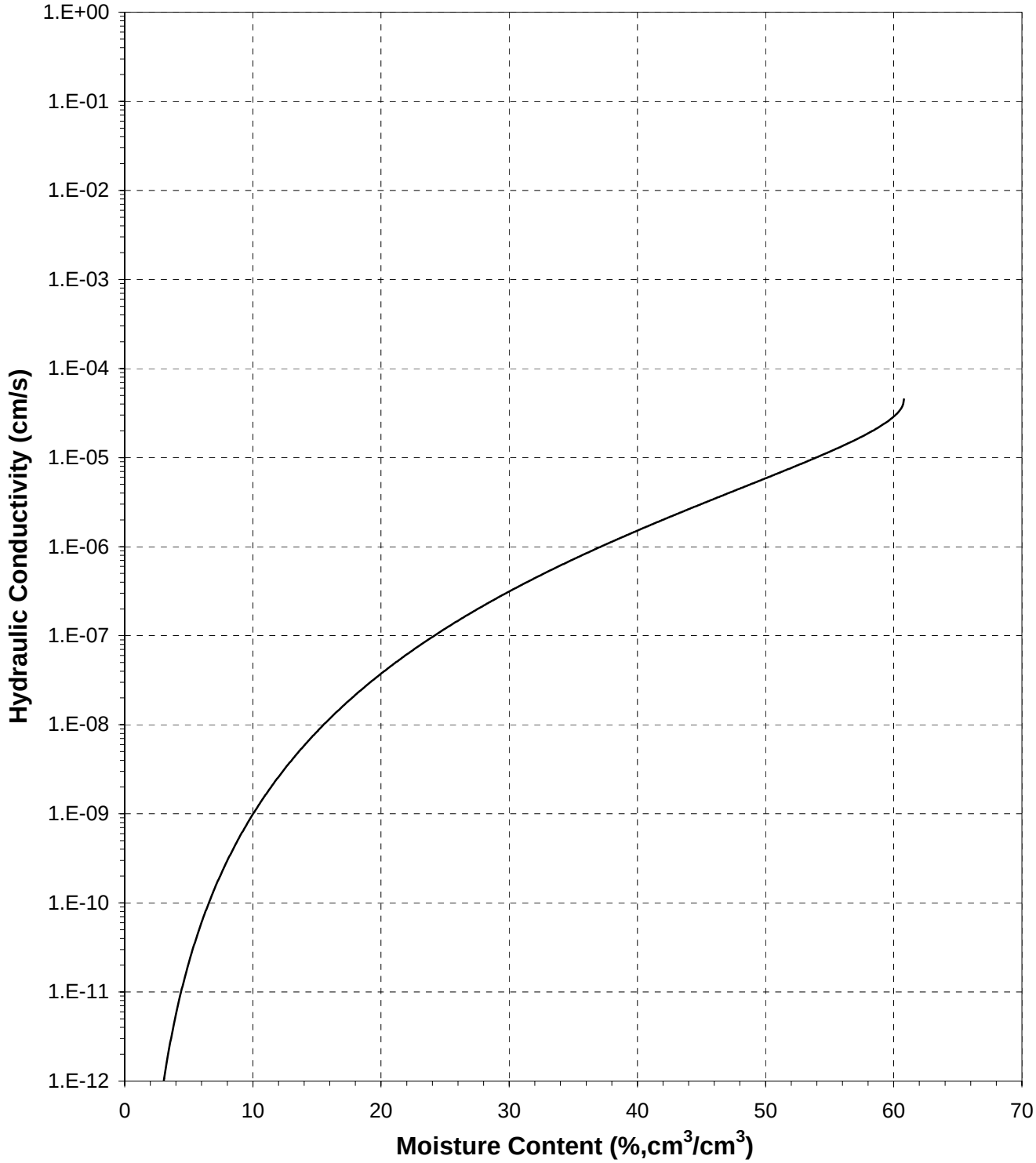
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: BEAR



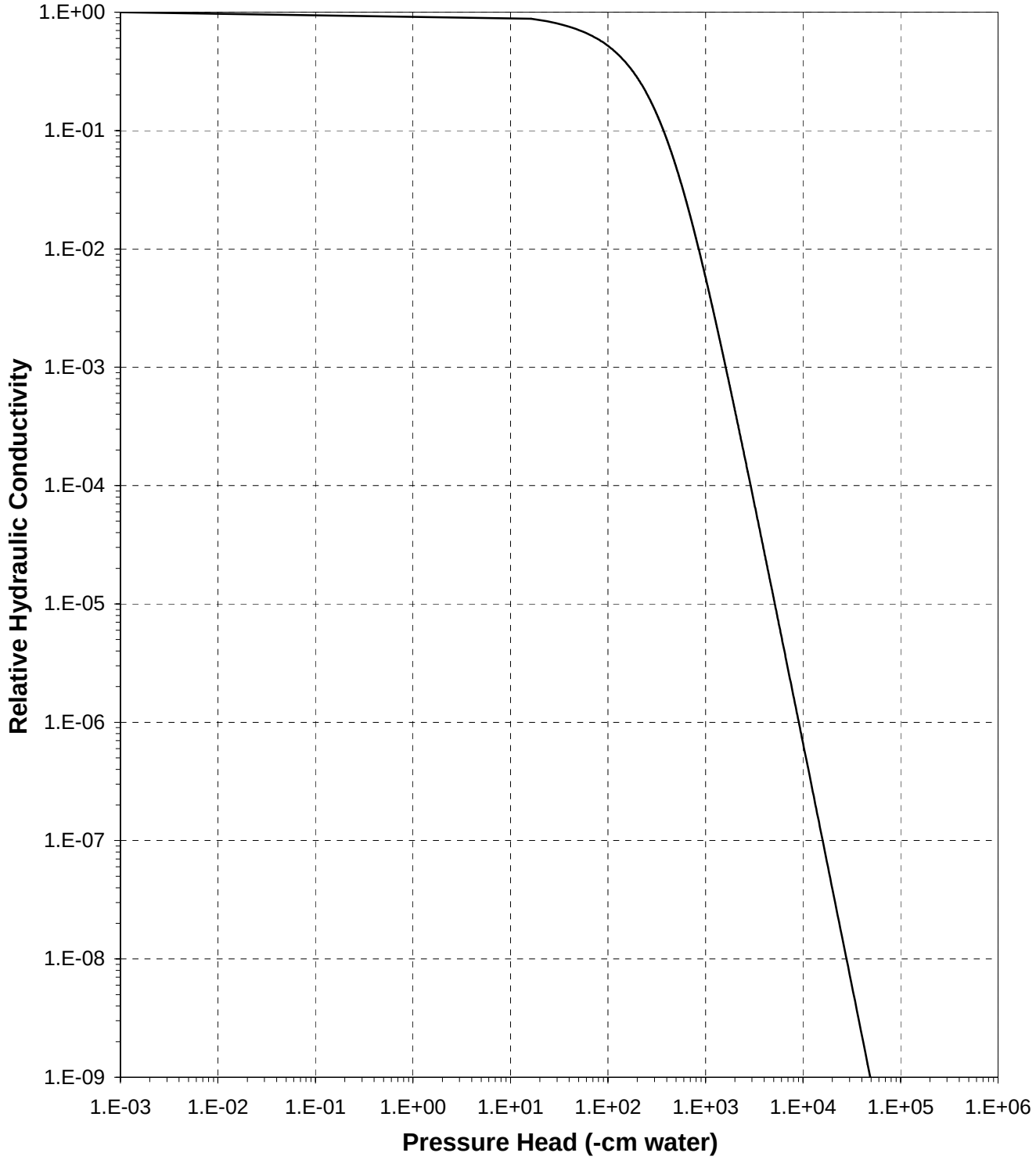
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: BEAR



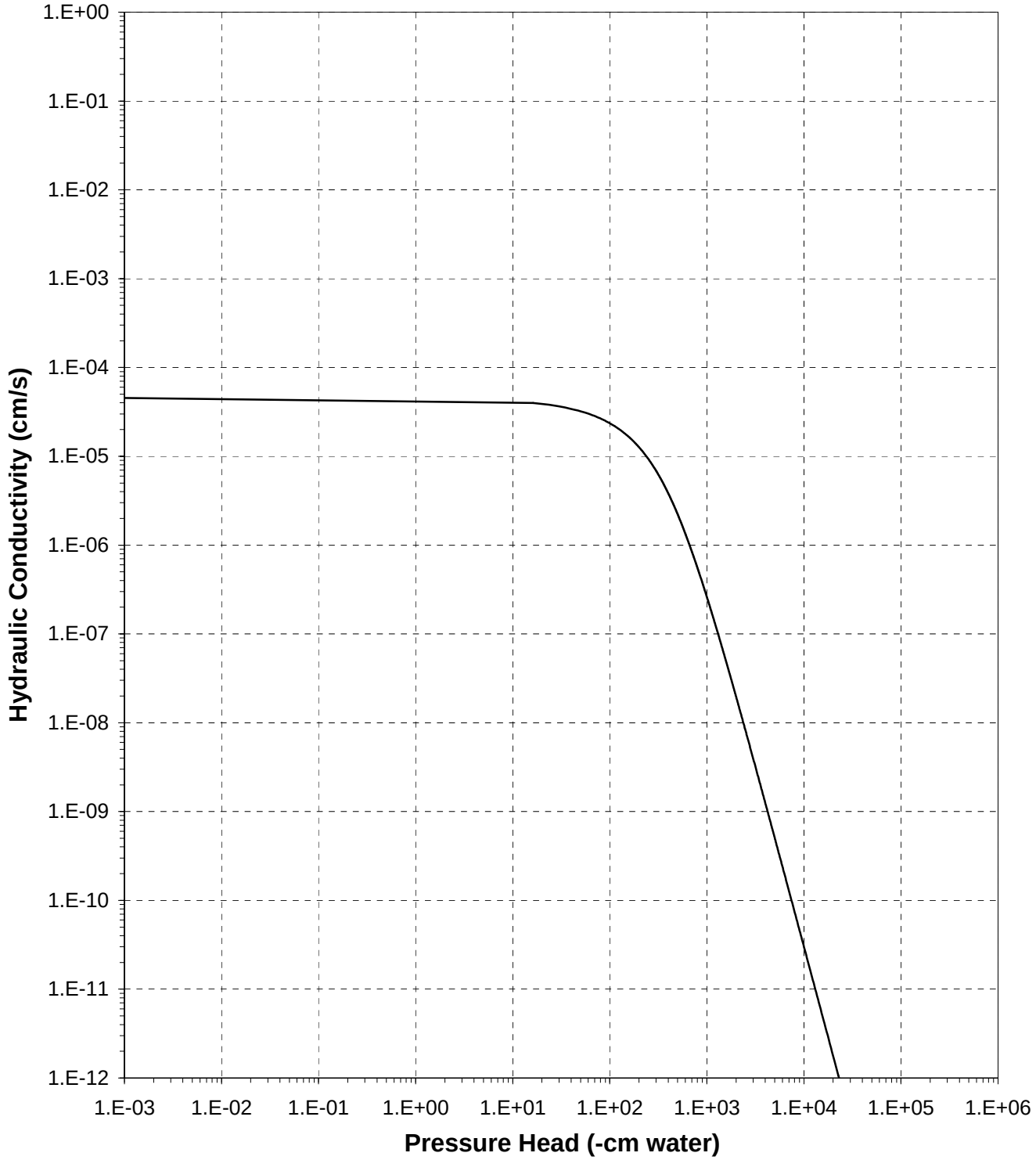
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: BEAR



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: BEAR



Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: CEDA
Project Name: The Big River
Project Number: DEQ00

Dry wt. of sample (g): 308.61
Tare wt., ring (g): 30.61
Tare wt., screen & clamp (g): 27.47
Initial sample volume (cm^3): 268.29
Initial dry bulk density (g/cm^3): 1.15
Assumed particle density (g/cm^3): 2.65
Initial calculated total porosity (%): 56.59

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content† (% vol)	
Hanging column:	18-Mar-09	13:50	514.80	0.00	55.21	
	24-Mar-09	11:40	512.09	14.50	54.20	
	30-Mar-09	9:20	504.96	46.00	51.54	
	6-Apr-09	10:12	495.50	126.00	48.01	
Pressure plate:	15-Apr-09	7:55	487.78	336.53	50.33	‡‡ **

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.00	---	---	---	---
	14.50	---	---	---	---
	46.00	---	---	---	---
	126.00	---	---	---	---
Pressure plate:	336.53	240.61	-10.32%	1.28	51.60

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

** Based on ~10% volume loss (shrinkage) at the 337 cm point. Notice effect on predicted water retention curve and corresponding van Genuchten parameters.

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: C. Krous
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: CEDA

Dry weight of dew point potentiometer sample* (g)*:* 132.47
Tare weight, jar (g)*:* 117.96
Initial sample bulk density (g/cm^3)*:* 1.15

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Dew point potentiometer:	17-Mar-09	13:25	134.63	10402.0	19.11	‡‡
	17-Mar-09	11:55	134.35	23761.3	16.58	‡‡
	17-Mar-09	11:10	133.74	278405.4	11.18	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	10402.0	240.61	-10.32%	1.28	51.60
	23761.3	240.61	-10.32%	1.28	51.60
	278405.4	240.61	-10.32%	1.28	51.60

Dry weight of relative humidity box sample* (g)*:* 67.31
Tare weight (g)*:* 39.94
Initial sample bulk density (g/cm^3)*:* 1.15

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Moisture Content † (% vol)	
Relative humidity box:	23-Mar-09	9:55	69.04	851293	8.11	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	851293	240.61	-10.32%	1.28	51.60

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

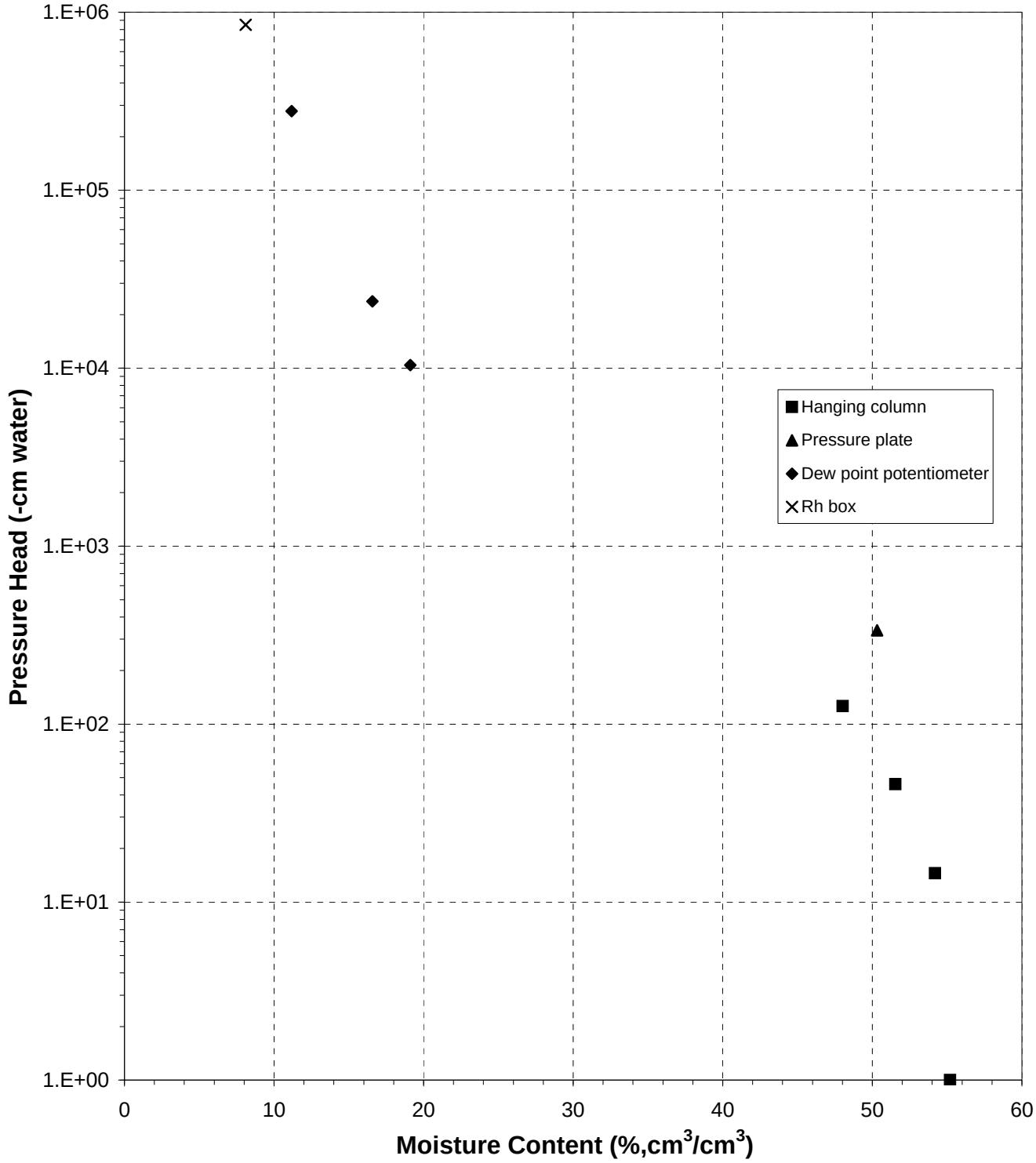
† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: D. O'Dowd
Data entered by: C. Krous
Checked by: J. Hines

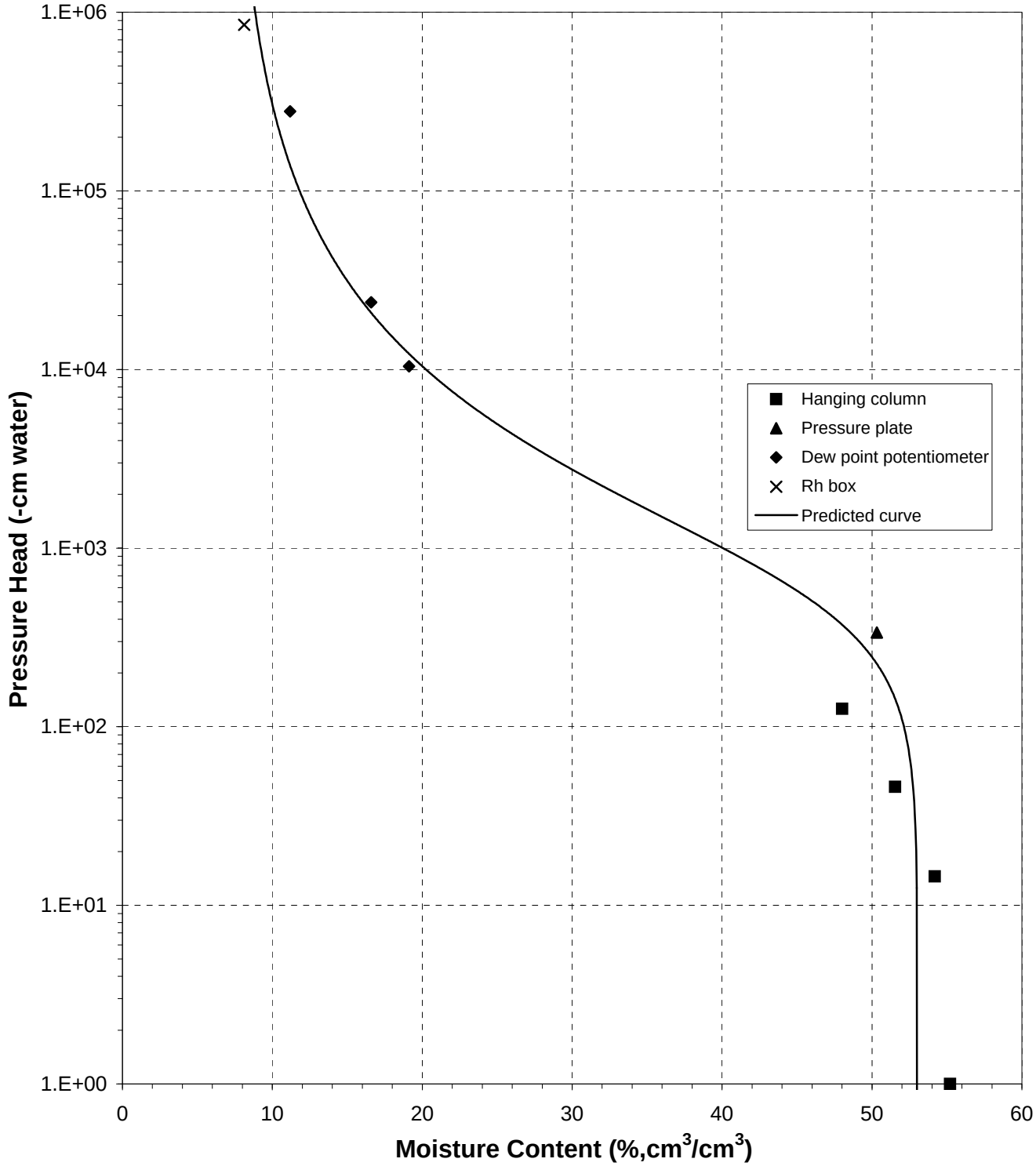
Water Retention Data Points

Sample Number: CEDA



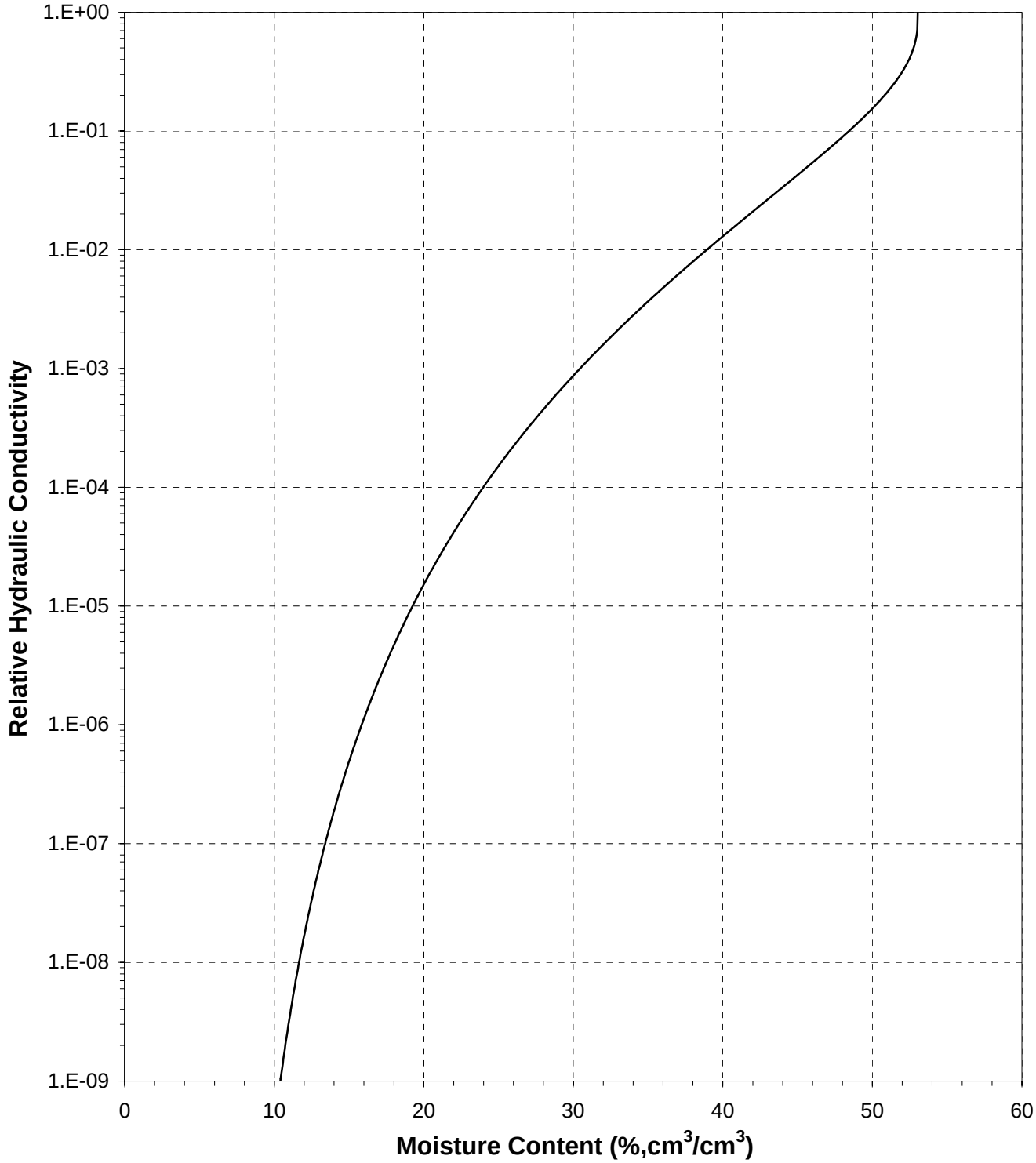
Predicted Water Retention Curve and Data Points

Sample Number: CEDA



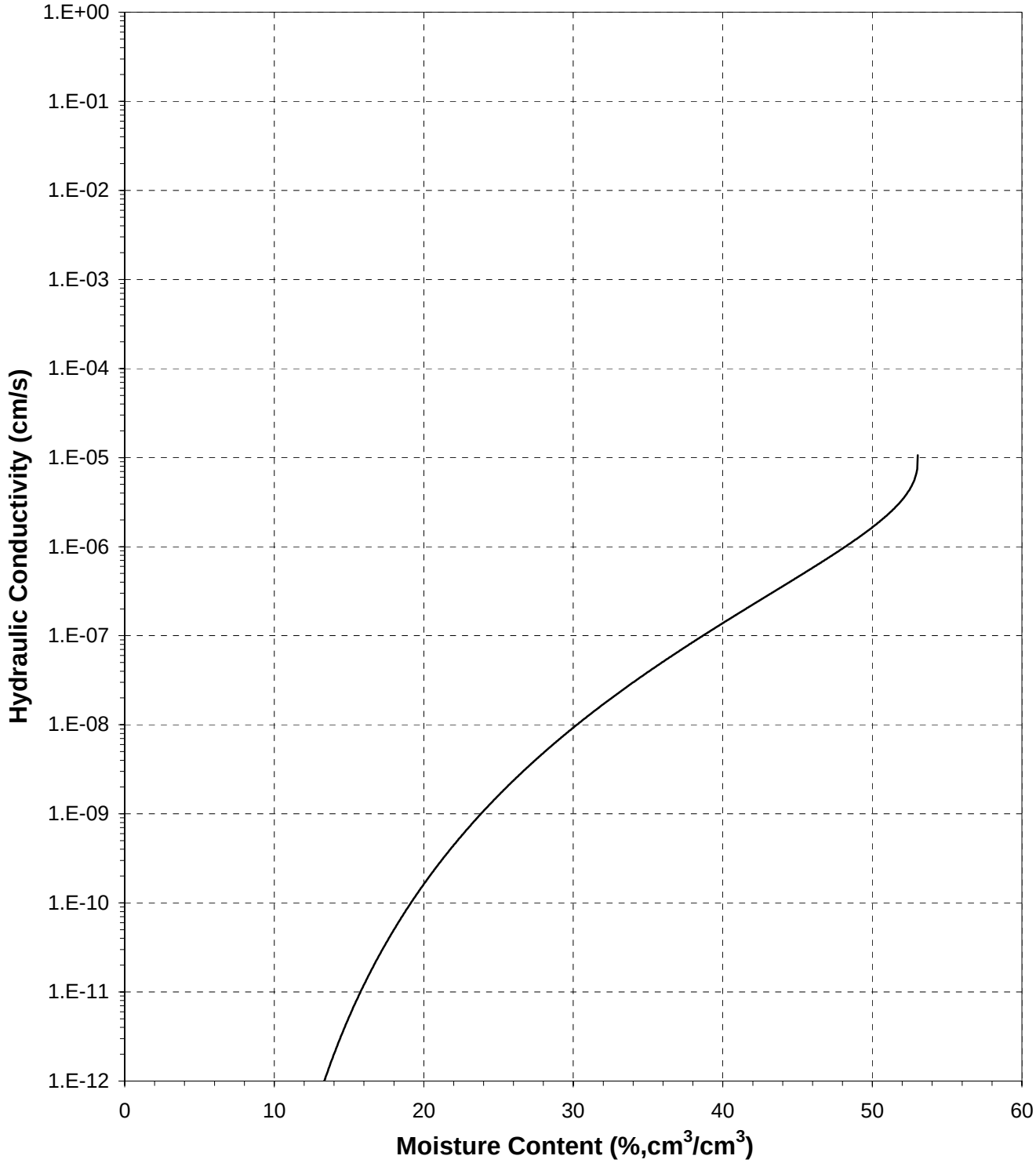
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: CEDA



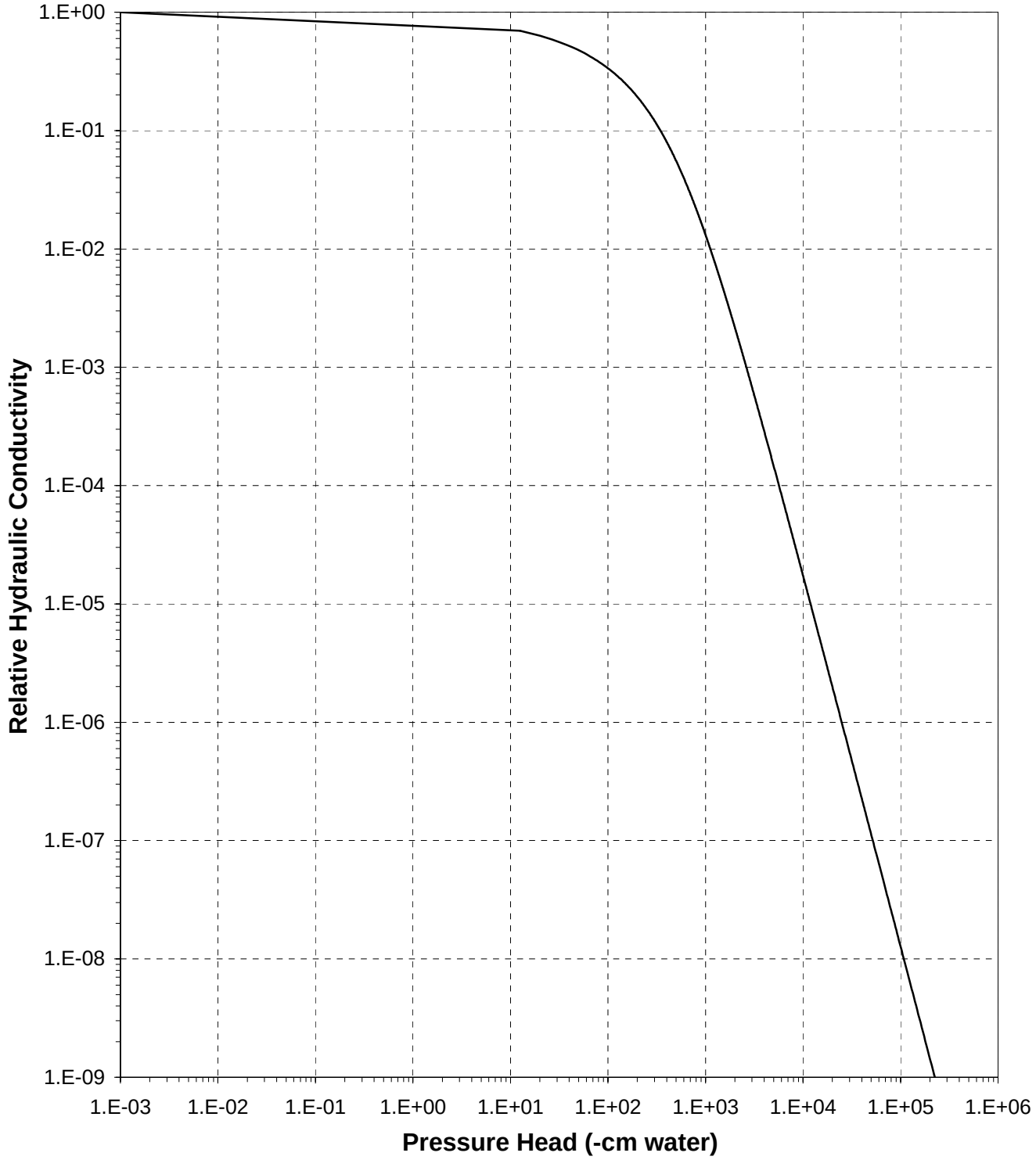
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: CEDA



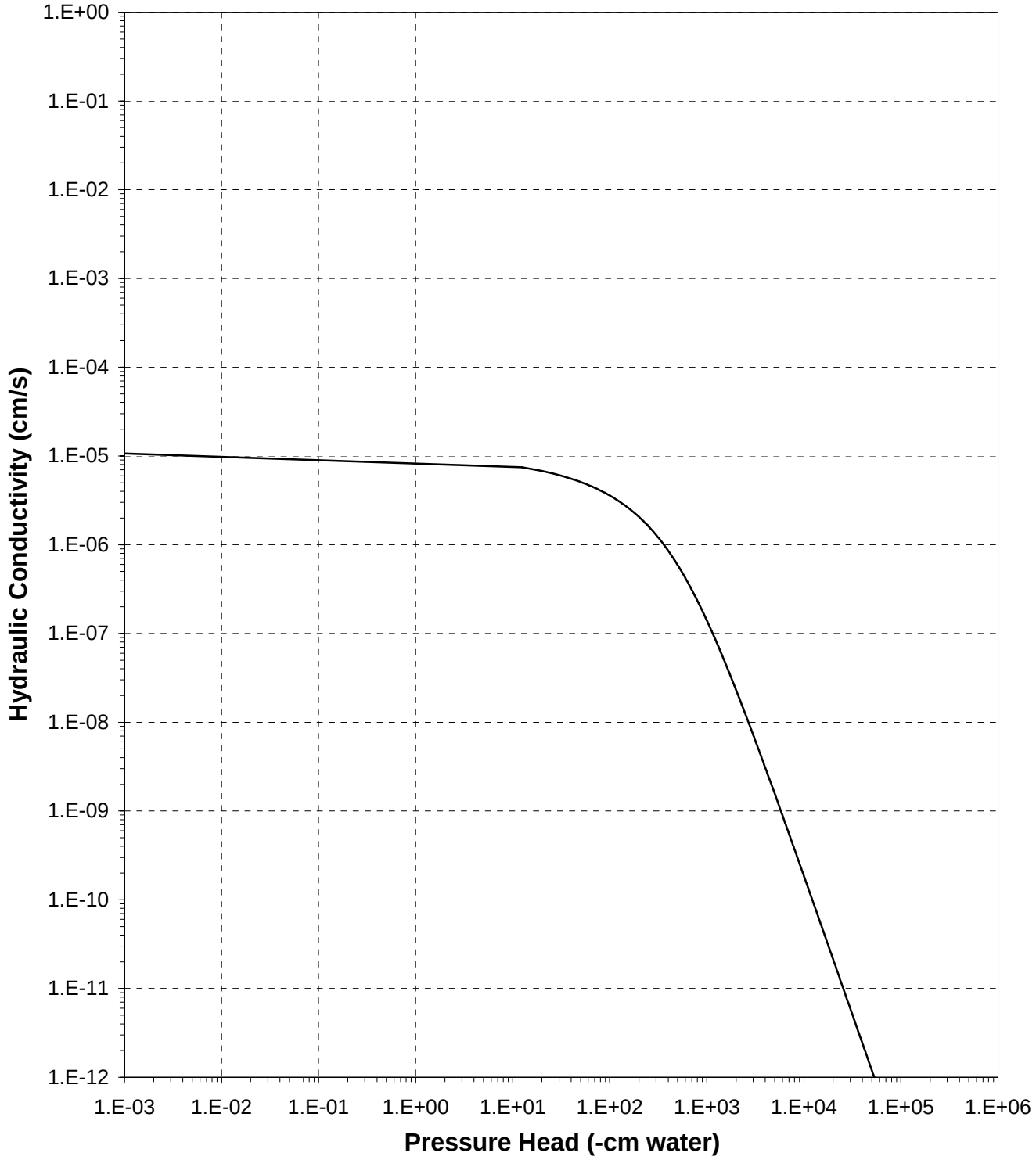
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: CEDA



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: CEDA



Moisture Retention Data

Hanging Column / Pressure Plate

(Soil-Water Characteristic Curve)

Job Name: U.S. Geological Survey
Job Number: LB09.0061.00
Sample Number: SCAR
Project Name: The Big River
Project Number: DEQ00

Dry wt. of sample (g): 247.31
Tare wt., ring (g): 30.35
Tare wt., screen & clamp (g): 29.23
Initial sample volume (cm^3): 267.18
Initial dry bulk density (g/cm^3): 0.93
Assumed particle density (g/cm^3): 2.65
Initial calculated total porosity (%): 65.07

	Date	Time	Weight* (g)	Matric Potential (-cm water)	Moisture Content † (% vol)	
Hanging column:	18-Mar-09	13:05	476.73	0.00	63.57	
	30-Mar-09	9:22	466.59	17.00	59.77	
	6-Apr-09	10:15	461.06	49.00	57.70	
	13-Apr-09	15:03	448.95	127.00	57.22	‡‡
Pressure plate:	22-Apr-09	9:00	432.43	397.72	53.50	‡‡

Volume Adjusted Data [1]

	Matric Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calculated Porosity (%)
Hanging column:	0.00	---	---	---	---
	17.00	---	---	---	---
	49.00	---	---	---	---
	127.00	248.29	-7.07%	1.00	62.41
Pressure plate:	397.72	234.67	-12.17%	1.05	60.23

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Technician Notes:

Laboratory analysis by: D. O'Dowd
Data entered by: C. Krous
Checked by: J. Hines

Moisture Retention Data

Dew Point Potentiometer / Relative Humidity Box

(Soil-Water Characteristic Curve)

Sample Number: SCAR

Dry weight of dew point potentiometer sample* (g)*:* 132.83
Tare weight, jar (g)*:* 112.93
Initial sample bulk density (g/cm^3)*:* 0.93

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Content † (% vol)	
Dew point potentiometer:	17-Mar-09	14:00	134.98	18050.5	11.39	‡‡
	17-Mar-09	13:00	134.51	25291.0	8.89	‡‡
	17-Mar-09	11:03	133.95	203960.0	5.94	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Dew point potentiometer:	18050.5	234.67	-12.17%	1.05	60.23
	25291.0	234.67	-12.17%	1.05	60.23
	203960.0	234.67	-12.17%	1.05	60.23

Dry weight of relative humidity box sample* (g)*:* 57.77
Tare weight (g)*:* 38.04
Initial sample bulk density (g/cm^3)*:* 0.93

	Date	Time	Weight* (g)	Water Potential (-cm water)	Moisture Moisture Content † (% vol)	
Relative humidity box:	23-Mar-09	9:55	58.43	851293	3.52	‡‡

Volume Adjusted Data [1]

	Water Potential (-cm water)	Adjusted Volume (cm^3)	% Volume Change [2] (%)	Adjusted Density (g/cm^3)	Adjusted Calc. Porosity (%)
Relative humidity box:	851293	234.67	-12.17%	1.05	60.23

Comments:

[1] Applicable if the sample experienced volume changes during testing. 'Volume Adjusted' values represent each of the volume change measurements obtained after saturated hydraulic conductivity testing and throughout hanging column/pressure plate testing. "---" indicates no volume changes occurred.

[2] Represents percent volume change from original sample volume. A '+' denotes measured sample swelling, a '-' denotes measured sample settling, and '---' denotes no volume change occurred.

* Weight including tares

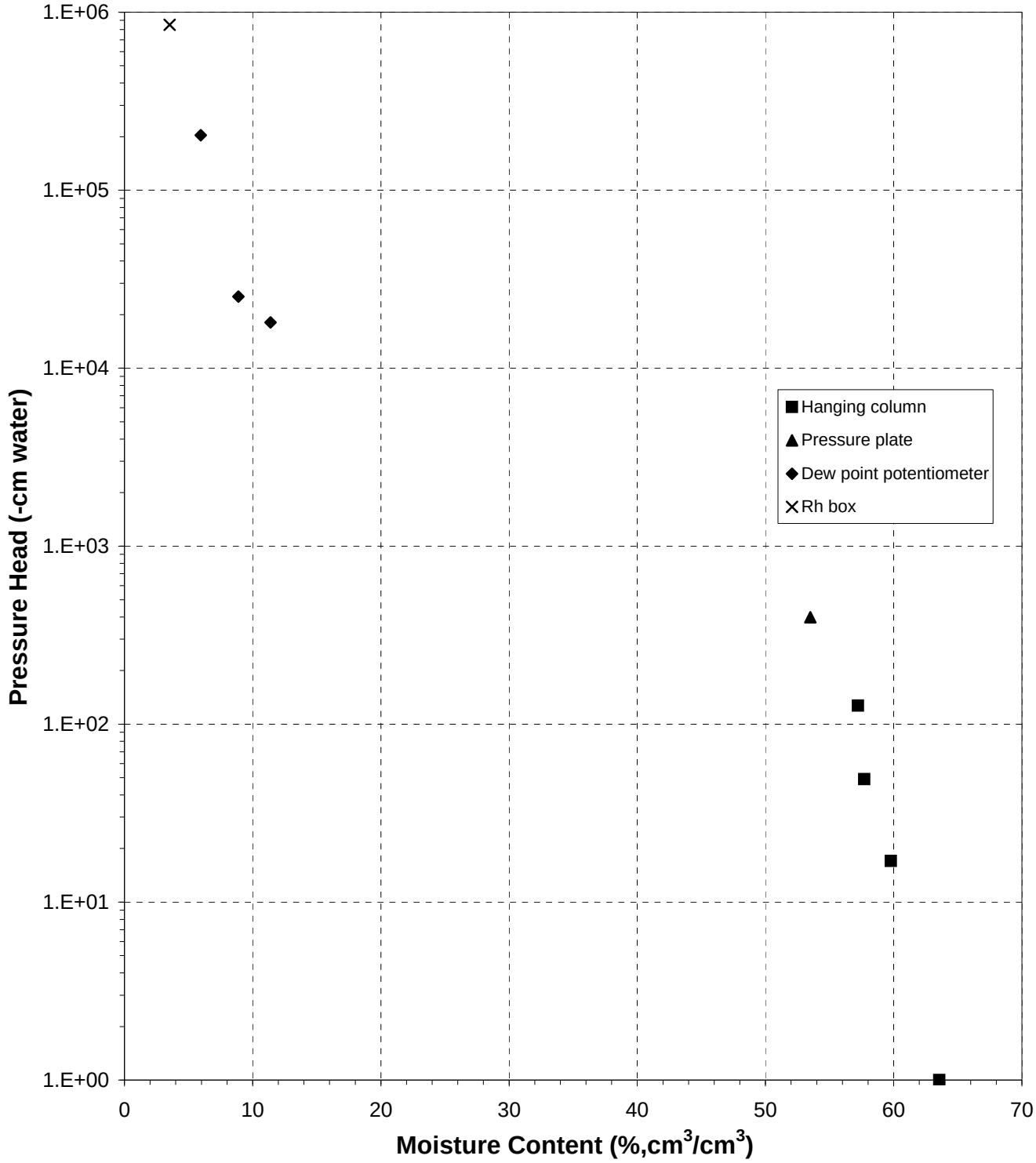
† Assumed density of water is 1.0 g/cm^3

‡‡ Volume adjustments are applicable at this matric potential (see comment #1).

Laboratory analysis by: D. O'Dowd
Data entered by: C. Krous
Checked by: J. Hines

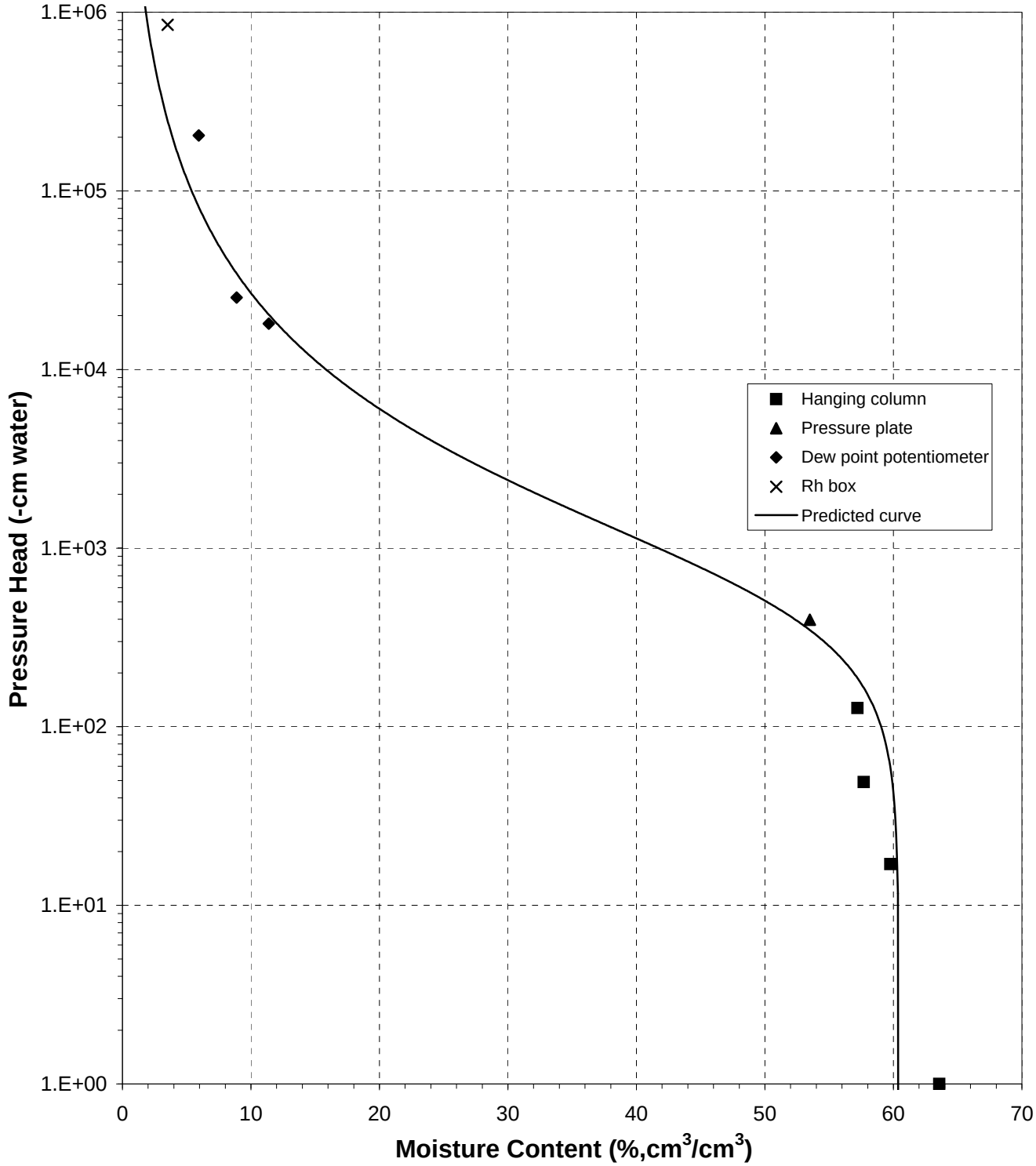
Water Retention Data Points

Sample Number: SCAR



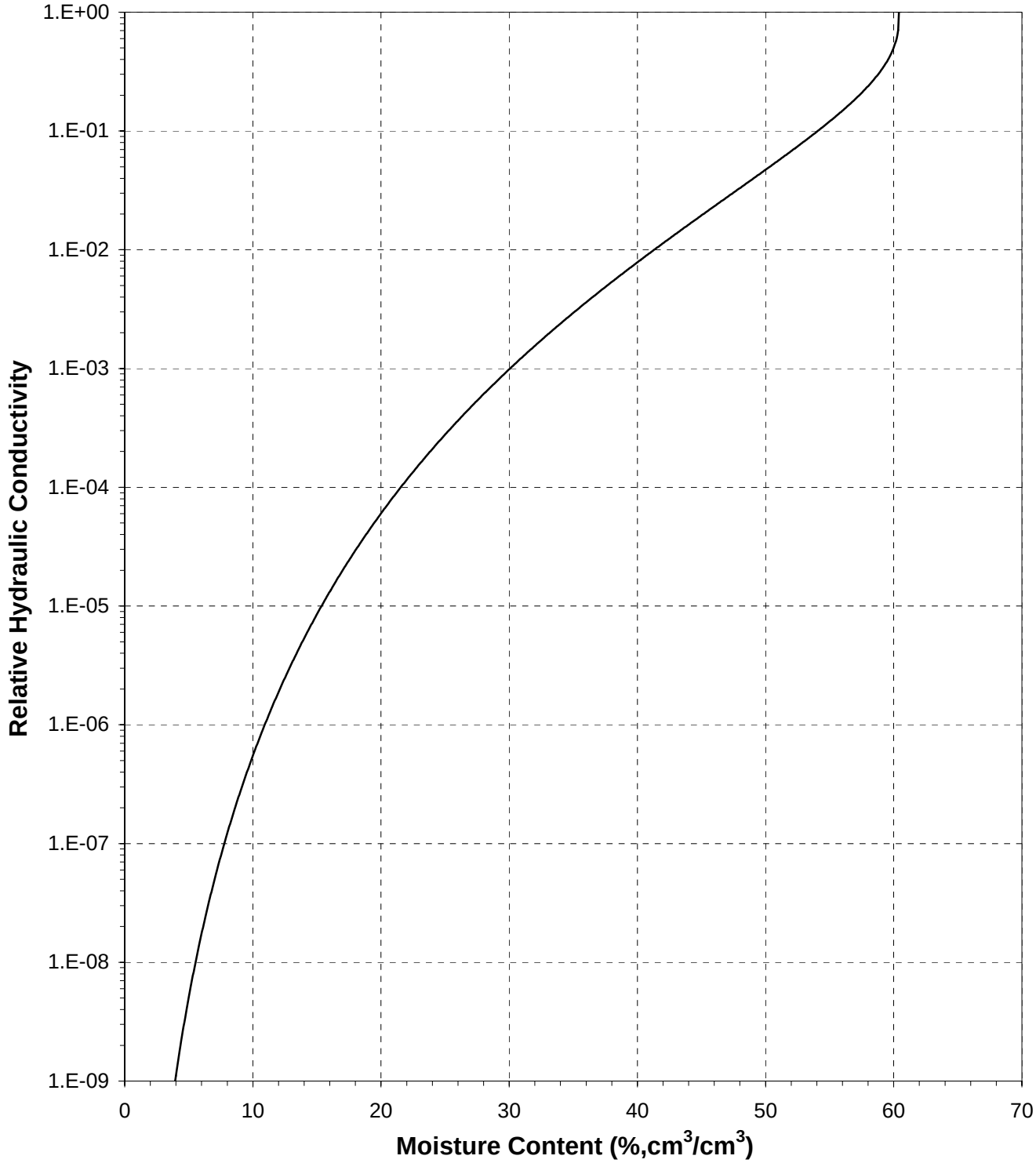
Predicted Water Retention Curve and Data Points

Sample Number: SCAR



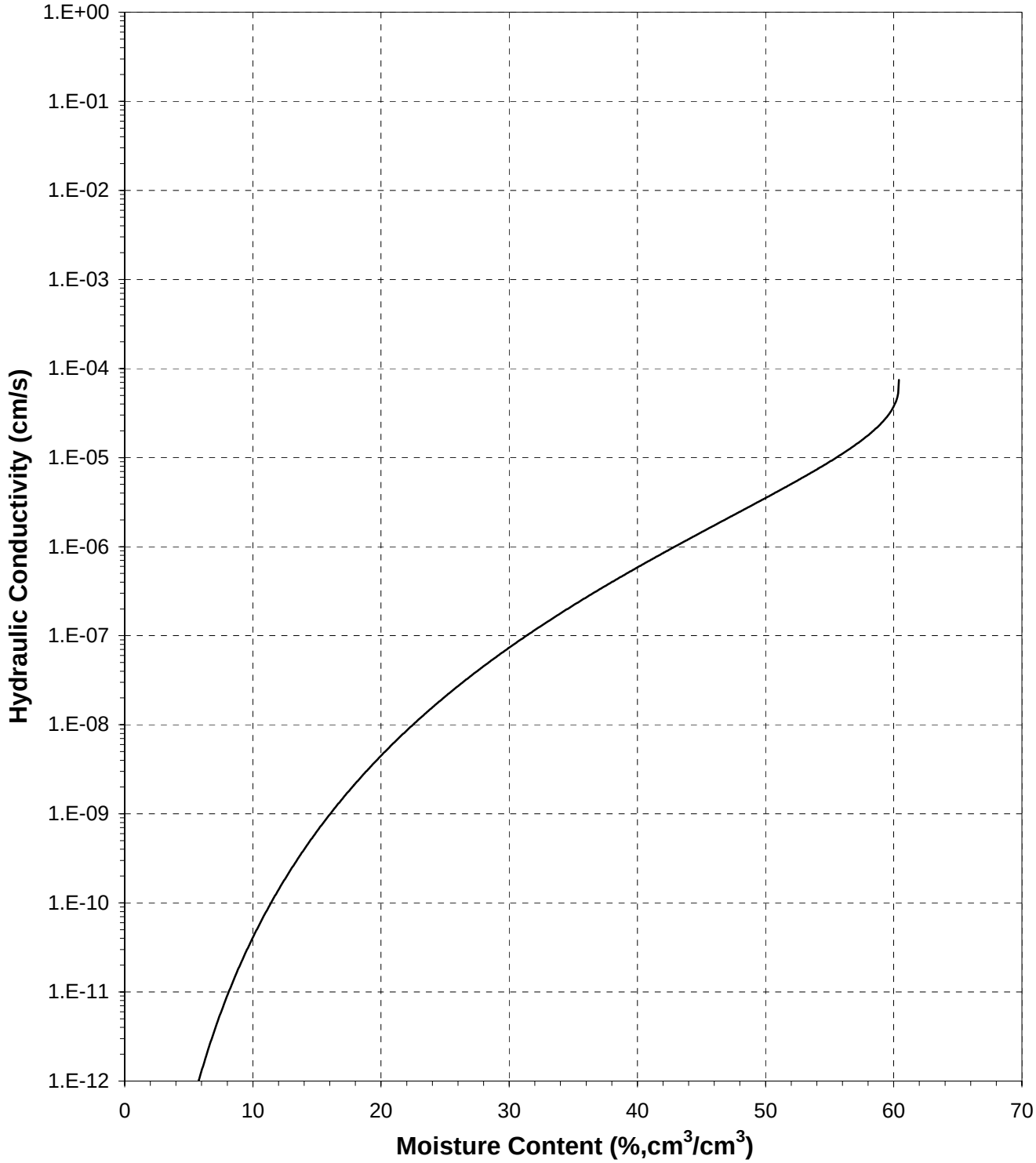
Plot of Relative Hydraulic Conductivity vs Moisture Content

Sample Number: SCAR



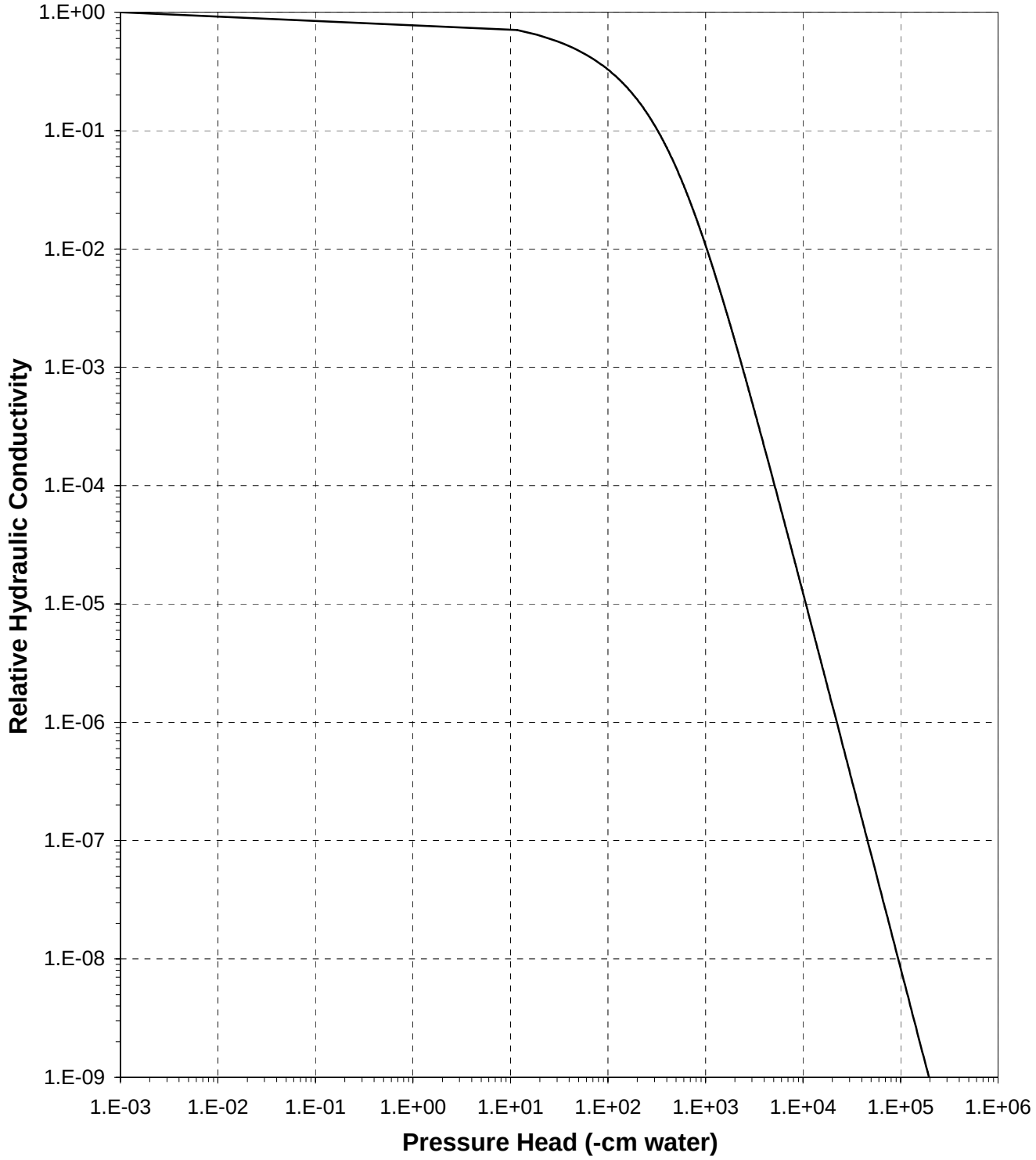
Plot of Hydraulic Conductivity vs Moisture Content

Sample Number: SCAR



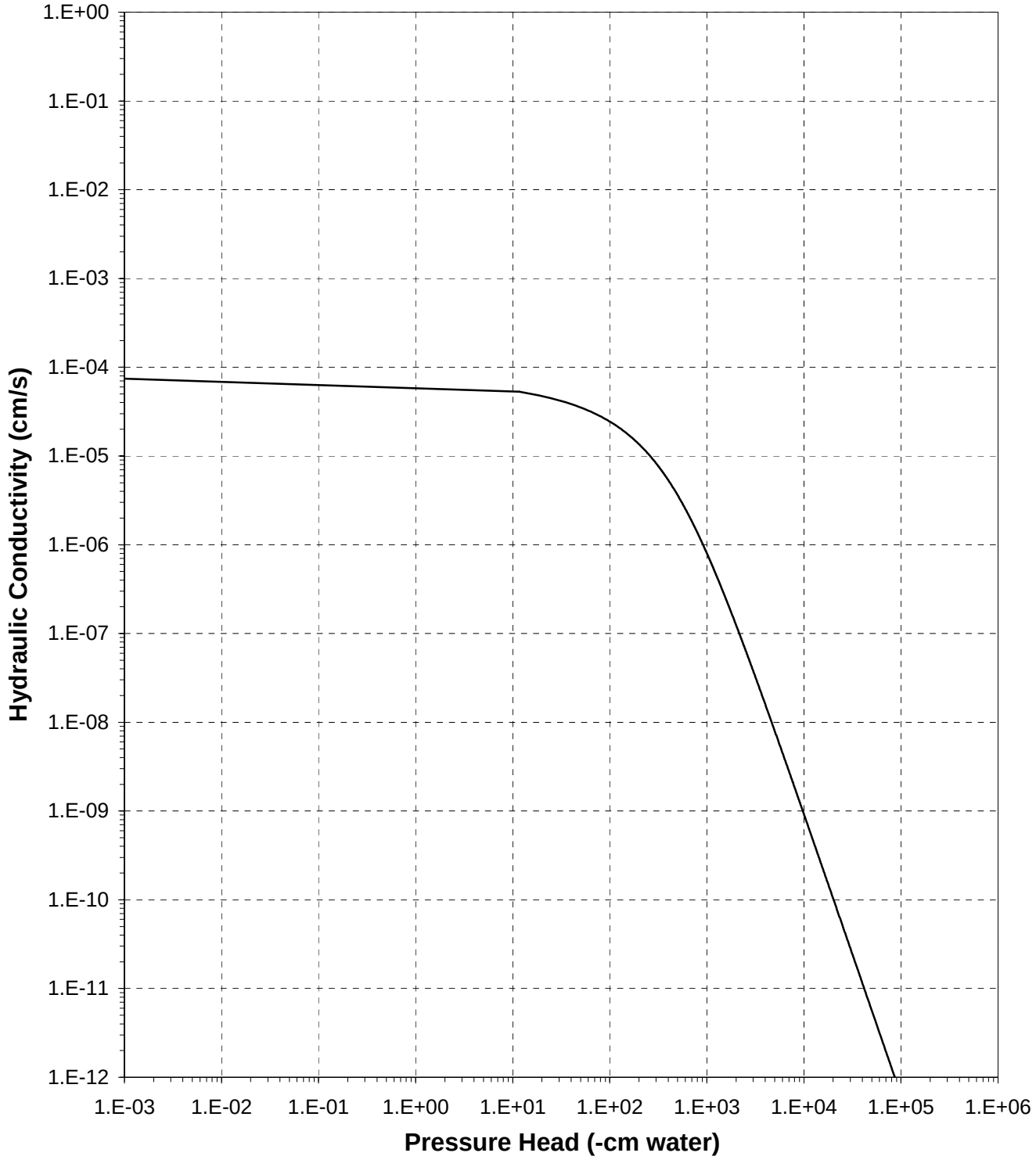
Plot of Relative Hydraulic Conductivity vs Pressure Head

Sample Number: SCAR



Plot of Hydraulic Conductivity vs Pressure Head

Sample Number: SCAR



Percent Organic Matter

Summary of Percent Organic Matter

Sample Number	Organic Matter (%)
BEAR	8.23
REYN	6.79
CEDA	7.14
SCAR	11.77
CONG	13.06

Percent Organic Matter

Job Name:	U.S. Geological Survey
Job Number:	LB09.0061.00
Sample Number:	BEAR
Project Name:	The Big River
Project Number:	DEQ00
Test Date:	22-Apr-09
Oven Dry weight of sample* (g):	632.77
Tare weight, pan (g):	377.03
Tare weight, cap/plate/epoxy (g):	0.00
Muffle Furnace Dry weight of sample (g):	236.30
Muffle Furnace Temperature (ºC):	440
Assumed particle density:	2.65
Organic Matter (%, g/g):	8.23

Comments:

* Weight including tares

Laboratory analysis by:	R. Marshall
Data entered by:	R. Marshall
Checked by:	J. Hines

Percent Organic Matter

Job Name:	U.S. Geological Survey
Job Number:	LB09.0061.00
Sample Number:	REYN
Project Name:	The Big River
Project Number:	DEQ00
Test Date:	22-Apr-09
Oven Dry weight of sample* (g):	667.37
Tare weight, pan (g):	378.38
Tare weight, cap/plate/epoxy (g):	0.00
Muffle Furnace Dry weight of sample (g):	270.61
Muffle Furnace Temperature (ºC):	440
Assumed particle density:	2.65
Organic Matter (%, g/g):	6.79

Comments:

* Weight including tares

Laboratory analysis by:	R. Marshall
Data entered by:	R. Marshall
Checked by:	J. Hines

Percent Organic Matter

Job Name:	U.S. Geological Survey
Job Number:	LB09.0061.00
Sample Number:	CEDA
Project Name:	The Big River
Project Number:	DEQ00
Test Date:	22-Apr-09
Oven Dry weight of sample* (g):	685.54
Tare weight, pan (g):	377.03
Tare weight, cap/plate/epoxy (g):	0.00
Muffle Furnace Dry weight of sample (g):	287.94
Muffle Furnace Temperature (ºC):	440
Assumed particle density:	2.65
Organic Matter (%, g/g):	7.14

Comments:

* Weight including tares

Laboratory analysis by:	R. Marshall
Data entered by:	R. Marshall
Checked by:	J. Hines

Percent Organic Matter

Job Name:	U.S. Geological Survey
Job Number:	LB09.0061.00
Sample Number:	SCAR
Project Name:	The Big River
Project Number:	DEQ00
Test Date:	22-Apr-09
Oven Dry weight of sample* (g):	635.59
Tare weight, pan (g):	388.16
Tare weight, cap/plate/epoxy (g):	0.00
Muffle Furnace Dry weight of sample (g):	221.37
Muffle Furnace Temperature (ºC):	440
Assumed particle density:	2.65
Organic Matter (%, g/g):	11.77

Comments:

* Weight including tares

Laboratory analysis by:	R. Marshall
Data entered by:	R. Marshall
Checked by:	J. Hines

Percent Organic Matter

Job Name:	U.S. Geological Survey
Job Number:	LB09.0061.00
Sample Number:	CONG
Project Name:	The Big River
Project Number:	DEQ00
Test Date:	25-Apr-09
Oven Dry weight of sample* (g):	583.11
Tare weight, pan (g):	388.18
Tare weight, cap/plate/epoxy (g):	0.00
Muffle Furnace Dry weight of sample (g):	172.42
Muffle Furnace Temperature (ºC):	440
Assumed particle density:	2.65
Organic Matter (%, g/g):	13.06

Comments:

* Weight including tares

Laboratory analysis by:	R. Marshall
Data entered by:	R. Marshall
Checked by:	J. Hines

Laboratory Tests and Methods

Tests and Methods

Dry Bulk Density:	ASTM D6836
Moisture Content:	ASTM D2216; ASTM D6836
Calculated Porosity:	ASTM D6836
Saturated Hydraulic Conductivity:	
Constant Head: (Rigid Wall)	ASTM D 2434 (modified apparatus)
Hanging Column Method:	ASTM D6836; Klute, A. 1986. Porosity. Chp.26, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Pressure Plate Method:	ASTM D6836; ASTM D2325
Water Potential (Dewpoint Potentiometer) Method:	ASTM D6836; Rawlins, S.L. and G.S. Campbell, 1986. Water Potential: Thermocouple Psychrometry. Chp. 24, pp. 597-619, in A. Klute (ed.), Methods of Soil Analysis, Part 1. American Society of Agronomy, Madison, WI.
Relative Humidity (Box) Method:	Karathanasis & Hajek. 1982. Quantitative Evaluation of Water Adsorption on Soil Clays.SSA Journal 46:1321-1325; Campbell, G. and G. Gee. 1986. Water Potential: Miscellaneous Methods.Chp. 25, pp. 631-632, in A. Klute (ed.), Methods of Soil Analysis, American Society of Agronomy, Madison, WI
Moisture Retention Characteristics & Calculated Unsaturated Hydraulic Conductivity:	ASTM D6836; van Genuchten, M.T. 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. SSSAJ 44:892-898; van Genuchten, M.T., F.J. Leij, and S.R. Yates. 1991. The RETC code for quantifying the hydraulic functions of unsaturated soils. Robert S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Ada, Oklahoma. EPA/600/2091/065. December 1991
Percent Organic Matter:	ASTM D2974