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SOIL LINER

JUNE 1993

SUMMARY OF PRECONSTRUCTION LABORATORY TESTING – CLAY SOILS
ALLEN PARK CLAY MINE – CELL 2
FORD MOTOR CO.

917–1203

CURVE NUMBER	SOURCE	SAMPLE NUMBER	NATURAL MOISTURE CONTENT (%)	ATTERBERG LIMITS			MODIFIED PROCTOR		USCS	TESTED BY	REMARKS
				LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTIC INDEX (%)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)			
1	I-696	BLOCK 115	–	26	14	12	133.6	10.2	CL	NTH	
2	I-696	BAG 110	–	26	14	12	133.9	9.0	CL	NTH	
3	I-696	NO. 6	–	24	13	11	135.5	8.5	CL	GAI	
3A	I-696	NO. 7	9.3	25	13	12	135.5	9.0	CL	GAI	
4	I-696	NO. 2	9.2	18	10	8	134.0	8.8	CL	GAI	NO GRAIN SIZE PLOT
5	NATIVE	BLOCK 104	–	32	17	15	132.4	9.4	CL	NTH	
6	I-696	BLOCK 113	–	27	14	13	132.6	9.3	CL	NTH	
7	I-696	S-4	–	24	13	11	133.2	8.5	CL	GAI	
8	LONDON	3	–	–	–	–	132.4	9.4	CL	GAI	NO GRAIN SIZE PLOT
9	ANN ARBOR	S-5	13.7	24	13	11	133.5	8.5	CL	GAI	NO GRAIN SIZE PLOT
10	LONDON	P-1	9.2	18	10	8	122.3	12.7	CL	GAI	
11	LONDON	P-2	13.9	25	13	12	128.2	9.8	CL	GAI	
12	I-696	BAG 100	–	–	–	–	132.8	9.1	CL	NTH	NO GRAIN SIZE PLOT
13	LONDON	L-1	8.2	25	14	11	132.1	9.1	CL	GAI	
14	NATIVE	N-1	9.4	25	13	12	134.9	8.8	CL	GAI	
15	NATIVE	N-2	10.3	26	14	12	132.8	9.0	CL	GAI	
16	LONDON	PC-1	12.5	25	16	9	132.5	8.5	CL	GAI	
17	LONDON	PC-2	13.9	26	15	11	132.5	9.0	CL	GAI	
18	LONDON	PC-3	10.4	25	15	10	134.0	8.5	CL	GAI	
19	LONDON	PC-4	12.1	26	16	10	133.5	9.0	CL	GAI	
20	LONDON	PC-5	12.4	26	16	10	130.5	9.5	CL	GAI	
21	LONDON	PC-7	31.3	27	16	10	132.0	9.5	CL	GAI	
22	LONDON	SL-1	10.1	28	15	10	134.5	8.5	CL	GAI	
22A	LONDON	SL-2	9.2	25	14	11	130.5	9.5	CL	GAI	
23	LONDON	PC-9	12.0	25	14	10	133.0	9.0	CL	GAI	
24	LONDON	PC-10	11.8	26	15	11	129.0	11.0	CL	GAI	
25	LONDON	PC-11	11.3	26	15	11	133.0	9.5	CL	GAI	
26	I-696	PC-12	8.9	25	13	12	135.0	8.5	CL	GAI	
27	I-696	PC-13	9.0	26	15	11	135.0	9.0	CL	GAI	
28	LONDON	PC-14	16.8	27	16	11	131.5	9.0	CL	GAI	
29	LONDON	PC-15	13.1	26	16	10	132.0	10.0	CL	GAI	
30	LONDON	PC-16	14.1	26	16	10	130.5	10.5	CL	GAI	
31	LONDON	PC-21	–	27	15	12	132.0	9.5	CL	GAI	
32	LONDON	PC-18	12.8	26	16	10	133.5	9.5	CL	GAI	
33	LONDON	PC-19	–	27	15	12	132.5	9.0	CL	GAI	
34	LONDON	PC-20	–	26	16	10	131.5	9.0	CL	GAI	
35	LONDON	PC-17	12.8	26	16	10	132.0	9.5	CL	GAI	
36	LONDON	PC-22	–	27	15	12	131.5	10.0	CL	GAI	

CURVE 1

NTH CONSULTANTS, LTD.

MOISTURE - DENSITY RELATIONS

PROJECT: Allen Park Clay Mine - Cell II

PROJECT NO.: 89365 OW

LOCATION: Allen Park, Michigan

DATE: 11/18/89

SUPPLIER/SOURCE: I-696 Excavation

TESTED BY: JN

SAMPLE LOCATION: Cell II; 3560 6970E, elevation 579.2

CHECKED BY: SG

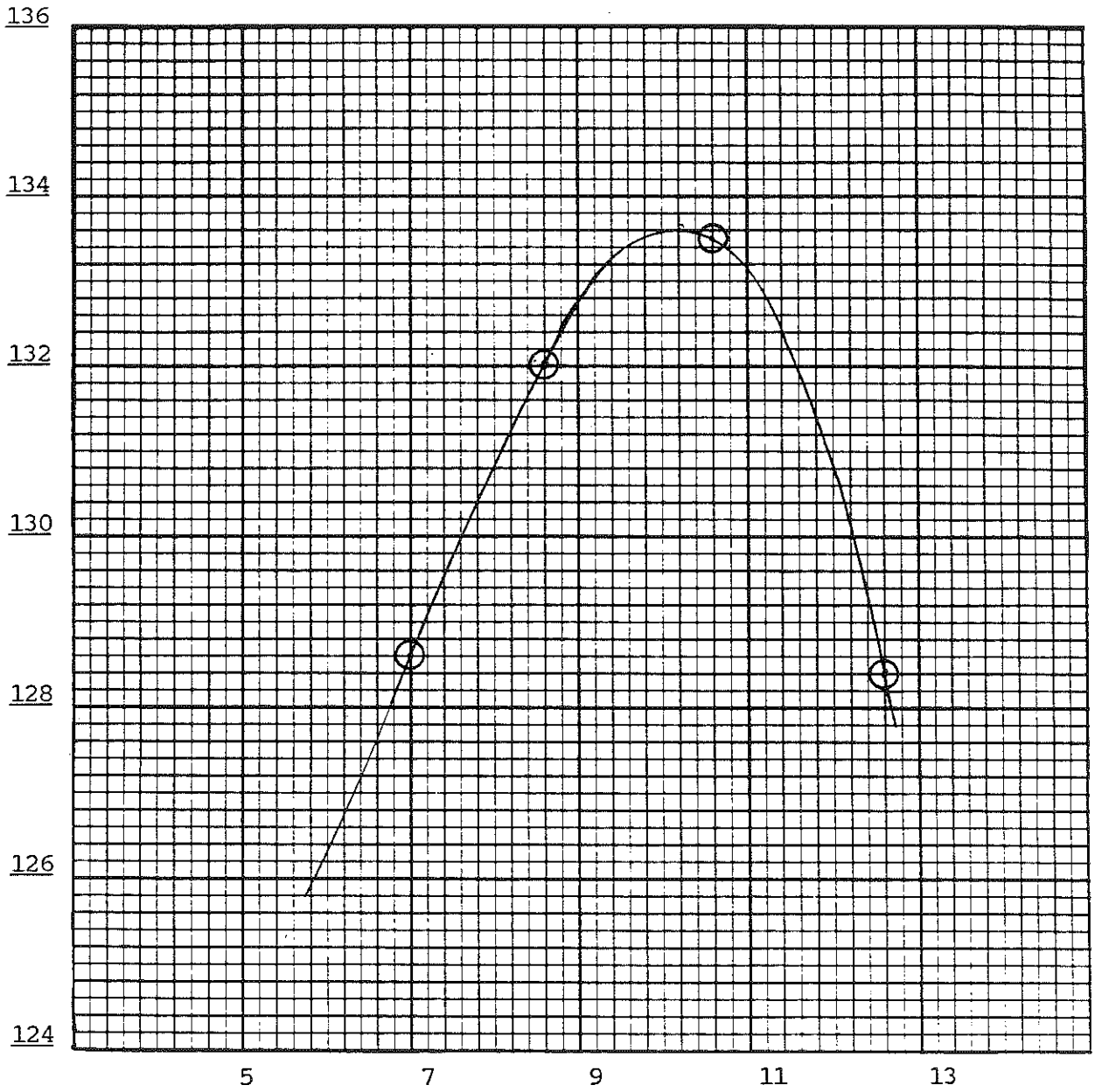
METHOD OF COMPACTION: ASTM D-1557 Method A

LAB SAMPLE NO.: 7282

MOLD NO.: A VOLUME: 0.0330 CUBIC FEET MATERIAL DESIGNATION NO.: Block 115

SAMPLE DESCRIPTION: Gray SILTY CLAY with Some Sand and Trace of Gravel

MAXIMUM DRY DENSITY: 133.6 PCF OPTIMUM MOISTURE CONTENT: 10.2 %



NTH/2.88-006

NTH Consultants, Ltd.

GRAIN SIZE DISTRIBUTION CURVE

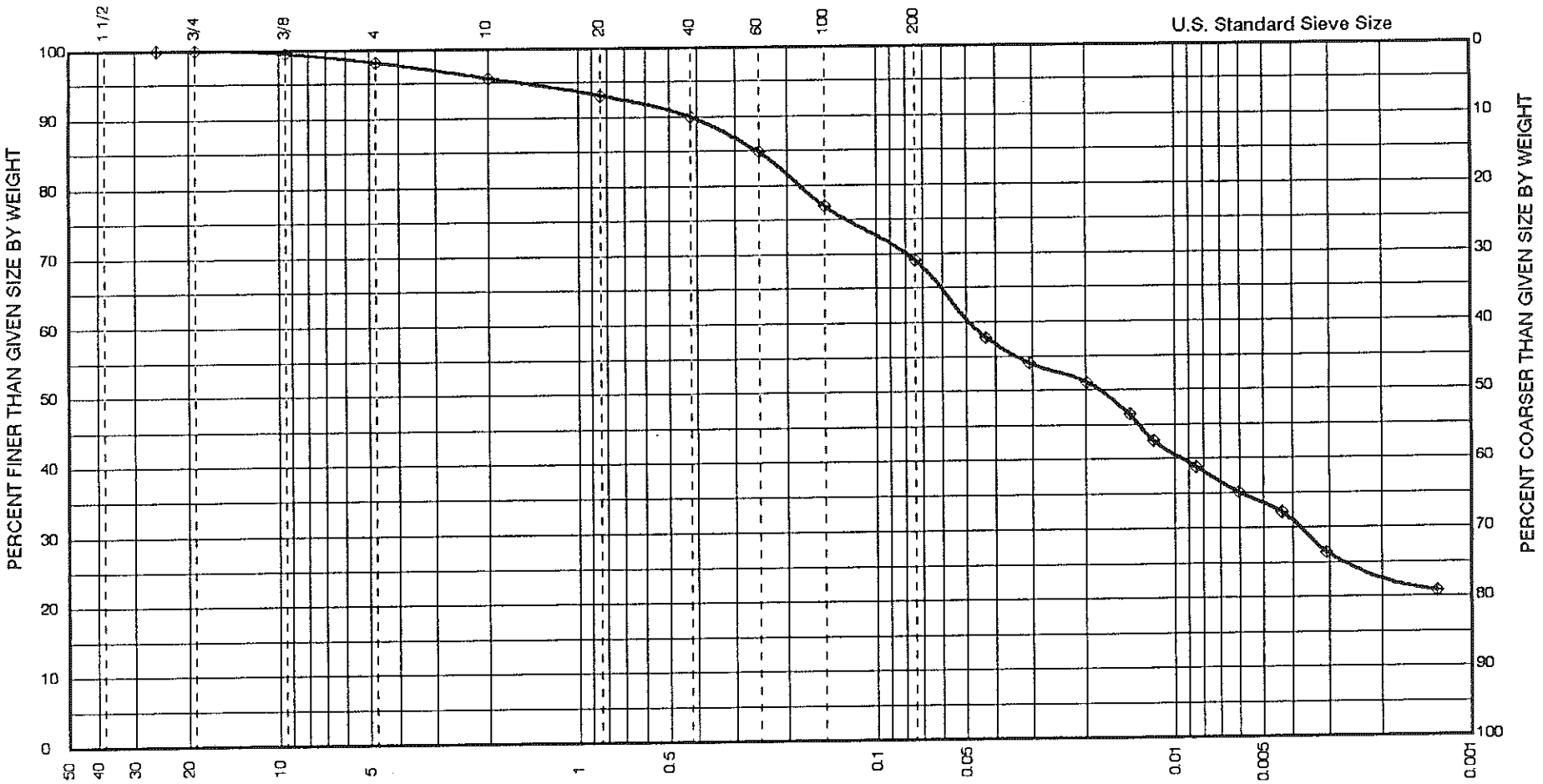
Project No. 89365-OW Lab Sample No. 7282 Source I-696 Excavation

Project Location Dearborn, Michigan For Allen Park Clay Mine - As Built Characteristics

Boring No. Field Sample No. Block 115 Sample Depth Sample Elev. (Tip)

Sample Description Gray **SILTY CLAY** with Some Sand and Trace of Gravel

Sampled By DHH Date 10/24/89 Tested By R.O. Date 10-27-89



Grain Size in MM.

Gravel		Sand			Fines		
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids

TABULATION OF LABORATORY TEST DATA

NTH Consultants, Ltd.

ALLEN PARK CLAY MINE
ALLEN PARK, MICHIGAN

Date: 11/18/89

NTH Proj. No.: 89365 OW

Sample Designation: Block 115

Sample Location: Cell II; 3560N 6970E; elevation 579.2

Lab Sample No.: 7282

Date Sampled: 10/24/89

Soil Properties and Description

GRAIN SIZE DISTRIBUTION:

Gravel:	1.9	%
Coarse Sand:	2.4	%
Medium Sand:	5.8	%
Fine Sand:	20.9	%
Silt:	35.7	%
Clay:	33.3	%

ATTERBERG LIMITS

Liquid Limit: 26
Plasticity Index: 12

UNIFIED SOIL CLASSIFICATION: CL

SAMPLE DESCRIPTION:
Gray SILTY CLAY with Some Sand and Trace of Gravel

Modified Proctor Test Result
(Per ASTM D 1557-78)

Maximum Dry Density: 133.6 pcf
Optimum Moisture Content: 10.2 %

Moisture/Density and Permeability Relationship

Moisture Content:	Percent of Maximum Dry Density	Coefficient of Permeability (1)
11.9 %	94.1 %	K = 4.7E - 9 cm/sec

REMARKS:
1.

2.

Checked By: _____

CURVE 2

NTH CONSULTANTS, LTD.

MOISTURE - DENSITY RELATIONS

PROJECT: Allen Park Clay Mine - Cell II

PROJECT NO.: 89365 OW

LOCATION: Allen Park, Michigan

DATE: 09/04/89

SUPPLIER/SOURCE: I-696 Excavation

TESTED BY: GM

SAMPLE LOCATION: I-696 Stockpile

CHECKED BY: SG

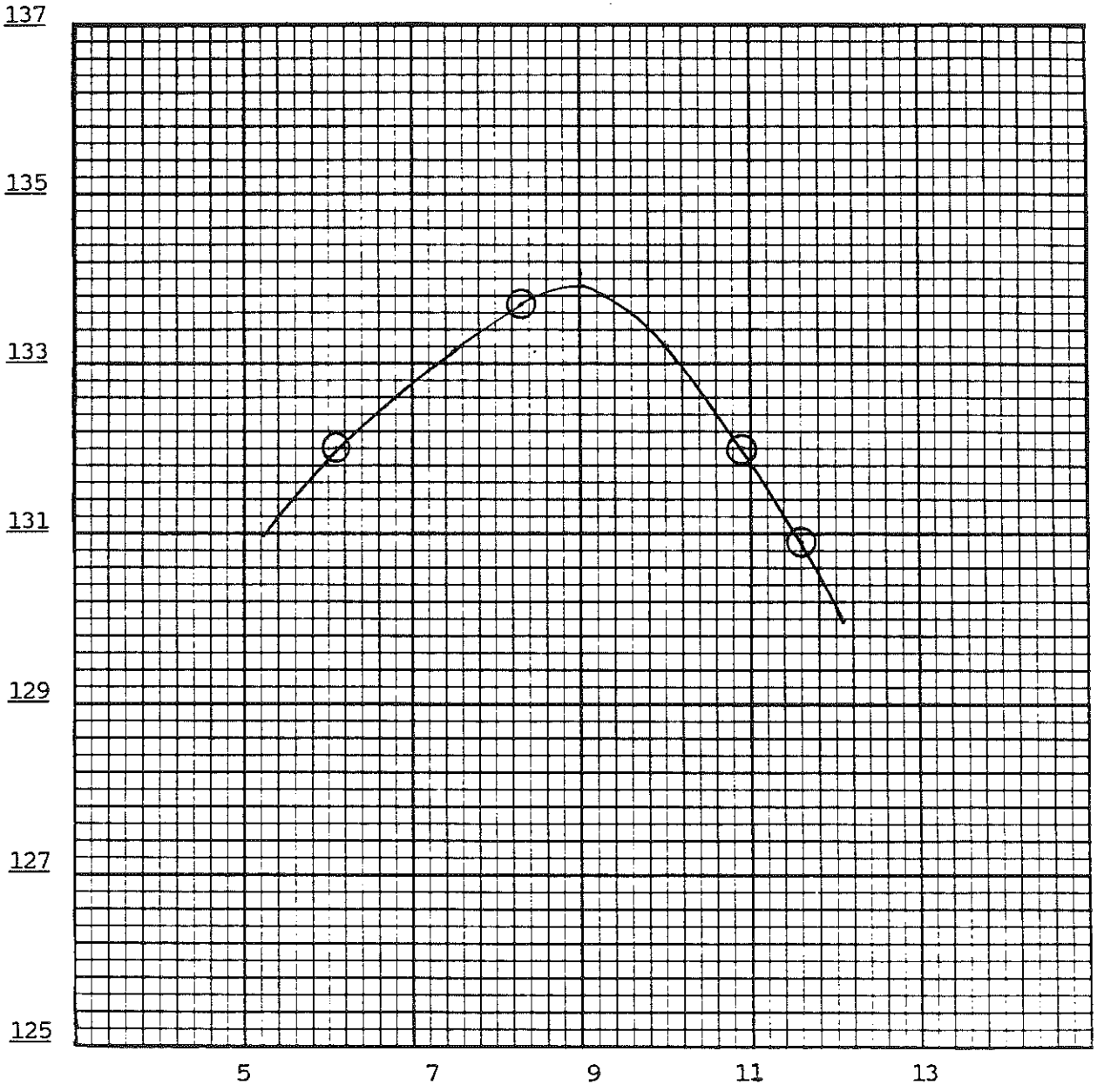
METHOD OF COMPACTION: ASTM D-1557 Method A

LAB SAMPLE NO.: 7013

MOLD NO.: B VOLUME: 0.0330 CUBIC FEET MATERIAL DESIGNATION NO.: Bag 110

SAMPLE DESCRIPTION: Gray SILTY CLAY with Some Sand and Trace of Gravel

MAXIMUM DRY DENSITY: 133.9 PCF OPTIMUM MOISTURE CONTENT: 9.0 %



NTH/2.88-006

NTH Consultants, Ltd.

GRAIN SIZE DISTRIBUTION CURVE

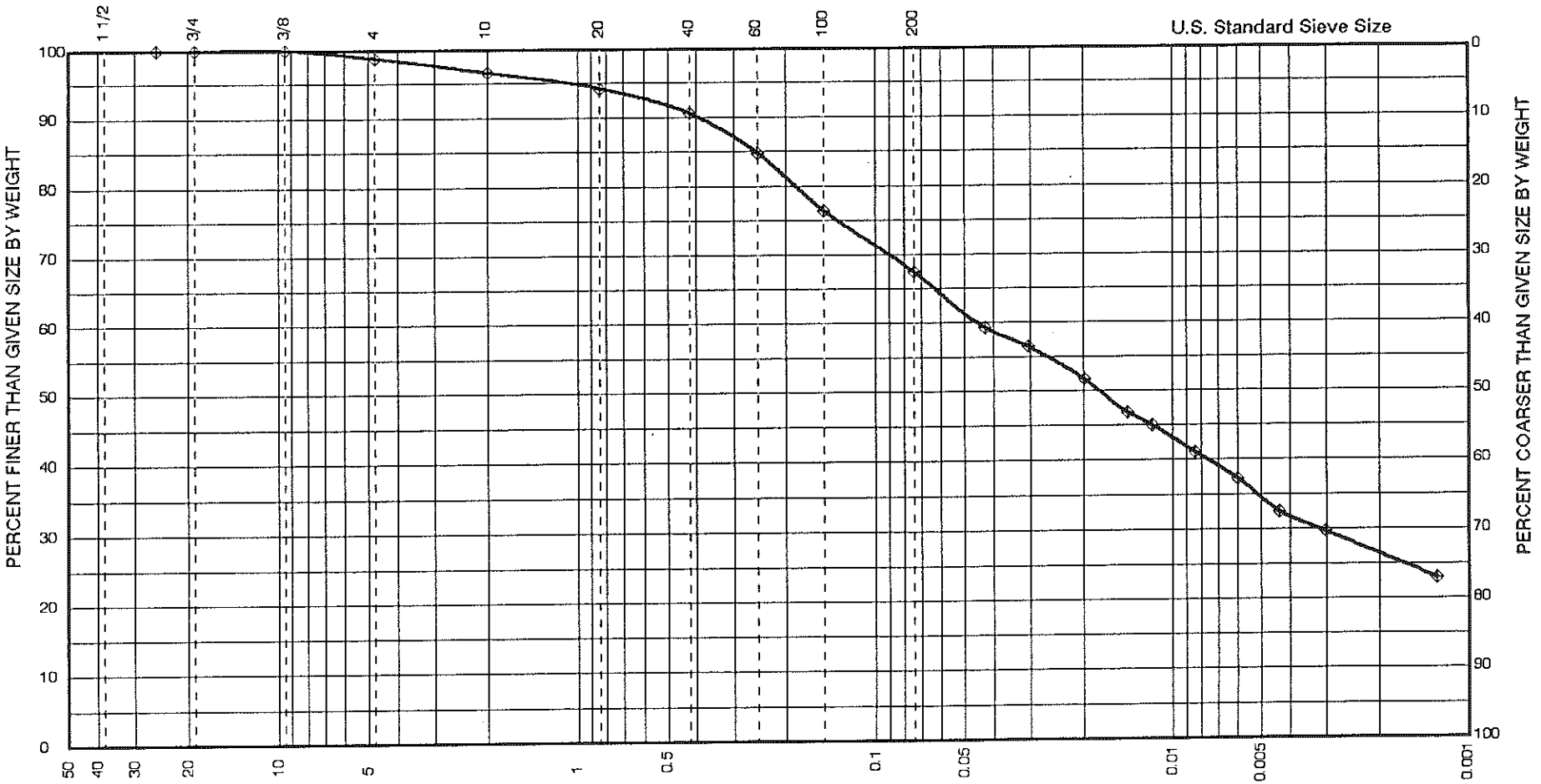
Project No. 89365-OW Lab Sample No. 7013 Source I-696 Excavation

Project Location Allen Park, Michigan For Allen Park Clay Mine - Material Characteristics

Boring No. Field Sample No. Bag 110 Sample Depth Sample Elev. (Tip)

Sample Description Gray **SILTY CLAY** with Some Sand and Trace of Gravel

Sampled By MJ Date 9/4/89 Tested By E.W. Date 9-8-89



Gravel		Sand			Fines		
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids

TABULATION OF LABORATORY TEST DATA

NTH Consultants, Ltd.

ALLEN PARK CLAY MINE
ALLEN PARK, MICHIGAN

Date: 10/24/89

NTH Proj. No.: 89365 OW

Sample Designation: Bag 110

Sample Location: I-696 Stockpile

Lab Sample No.: 7013

Date Sampled: 09/04/89

Soil Properties and Description

GRAIN SIZE DISTRIBUTION:

Gravel:	1.0	%
Coarse Sand:	2.0	%
Medium Sand:	6.0	%
Fine Sand:	23.0	%
Silt:	34.0	%
Clay:	34.0	%

ATTERBERG LIMITS

Liquid Limit: 26
Plasticity Index: 12

UNIFIED SOIL CLASSIFICATION: CL

SAMPLE DESCRIPTION:
Gray SILTY CLAY with Some Sand and Trace of Gravel

Modified Proctor Test Result
(Per ASTM D 1557-78)

Maximum Dry Density:	133.9	pcf
Optimum Moisture Content:	9.0	%

REMARKS:
1.

2.

Checked By: _____

CURVE 3

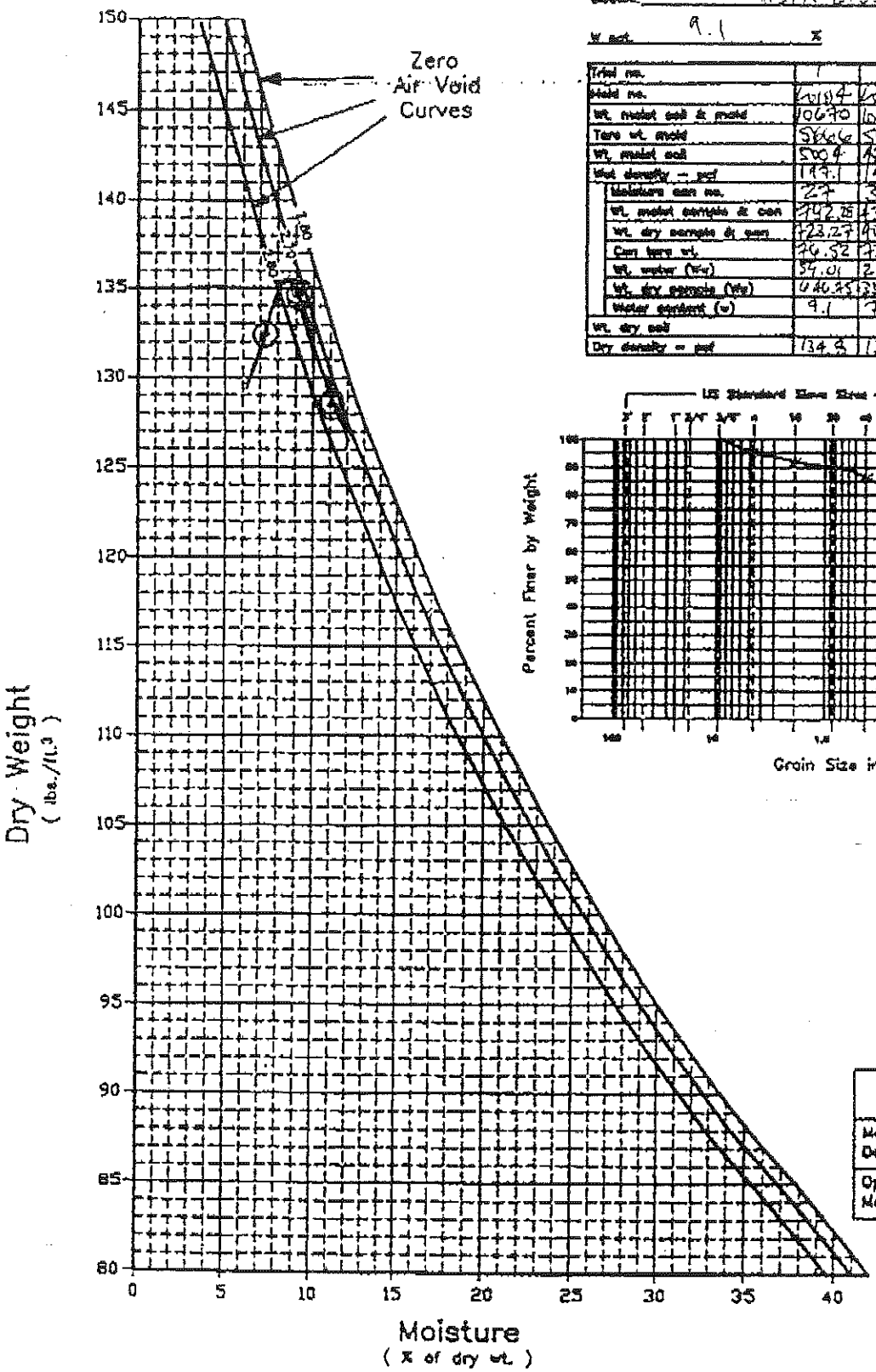
Sample Number: (6) I-696

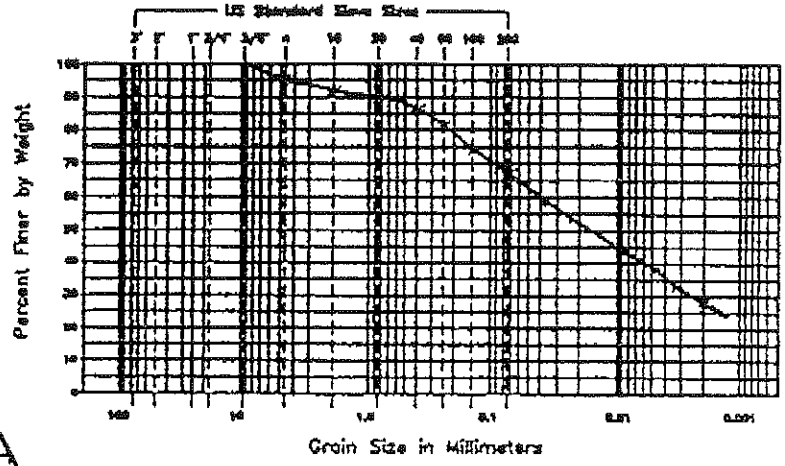
Description: Dark Yellowish Brown (10 YR 4/2) CLAYEY SILT, some c.f. sand

Method: ASTM D1557-C

W act. 9.1 % MOLD volume 0.075 cf

Trial no.	1	2	3			
Mold no.	40184	40194	40184			
Wt. moist soil & mold	10670	10495	10523			
Tare wt. mold	5666	5666	5666			
Wt. moist soil	5004	4829	4857			
Wet density — pcf	133.1	131.9	142.8			
Moisture can no.	27	39	23			
Wt. moist sample & can	742.25	432.85	626.19			
Wt. dry sample & can	723.27	408.61	591.60			
Can tare wt.	76.52	73.99	77.00			
Wt. water (Ww)	34.01	24.24	34.58			
Wt. dry sample (Ws)	646.75	334.62	514.60			
Water content (w)	9.1	7.2	11.0			
Wt. dry soil						
Dry density — pcf	134.9	132.4	129.6			





D_{10}	NA
D_{30}	NA
D_{50}	NA
C_u	NA
C_z	NA

SUMMARY	
Maximum Density (pcf)	135.5
Optimum Moisture (%)	8.5

Figure

MOISTURE-DENSITY RELATIONSHIP OF SOIL

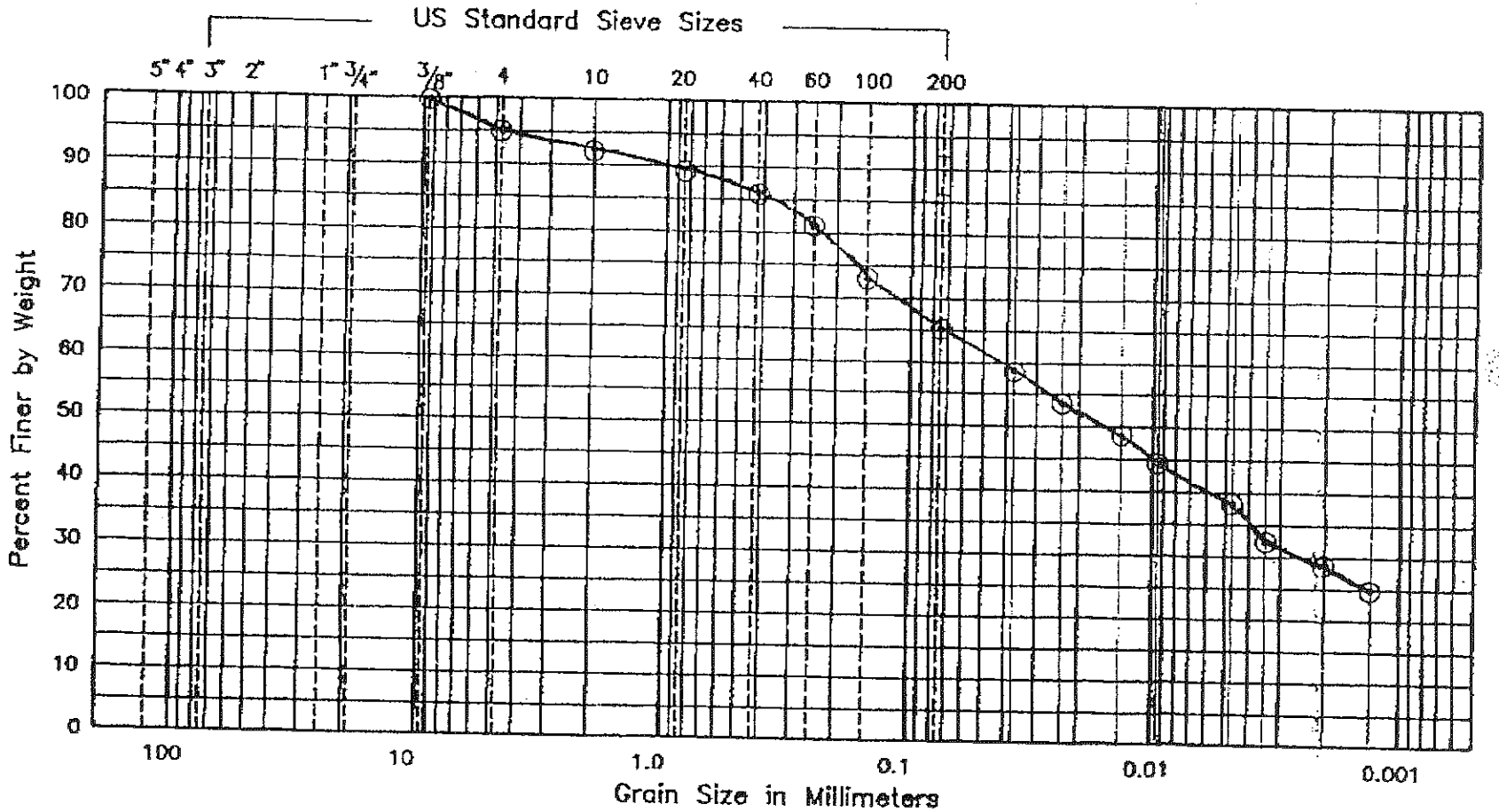
Project: Ford Motor Co. MI Project No. 903-3078 Date 7-12-90 Tested By RICM Approved By DPO

Golder Associates

983-1350\5404

GRAIN SIZE DISTRIBUTION

Project: ECS / Ford Motor Co. / AT
Project No. 903-3373 Date 2-12-90 Tested By RLA Approved By DRO



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

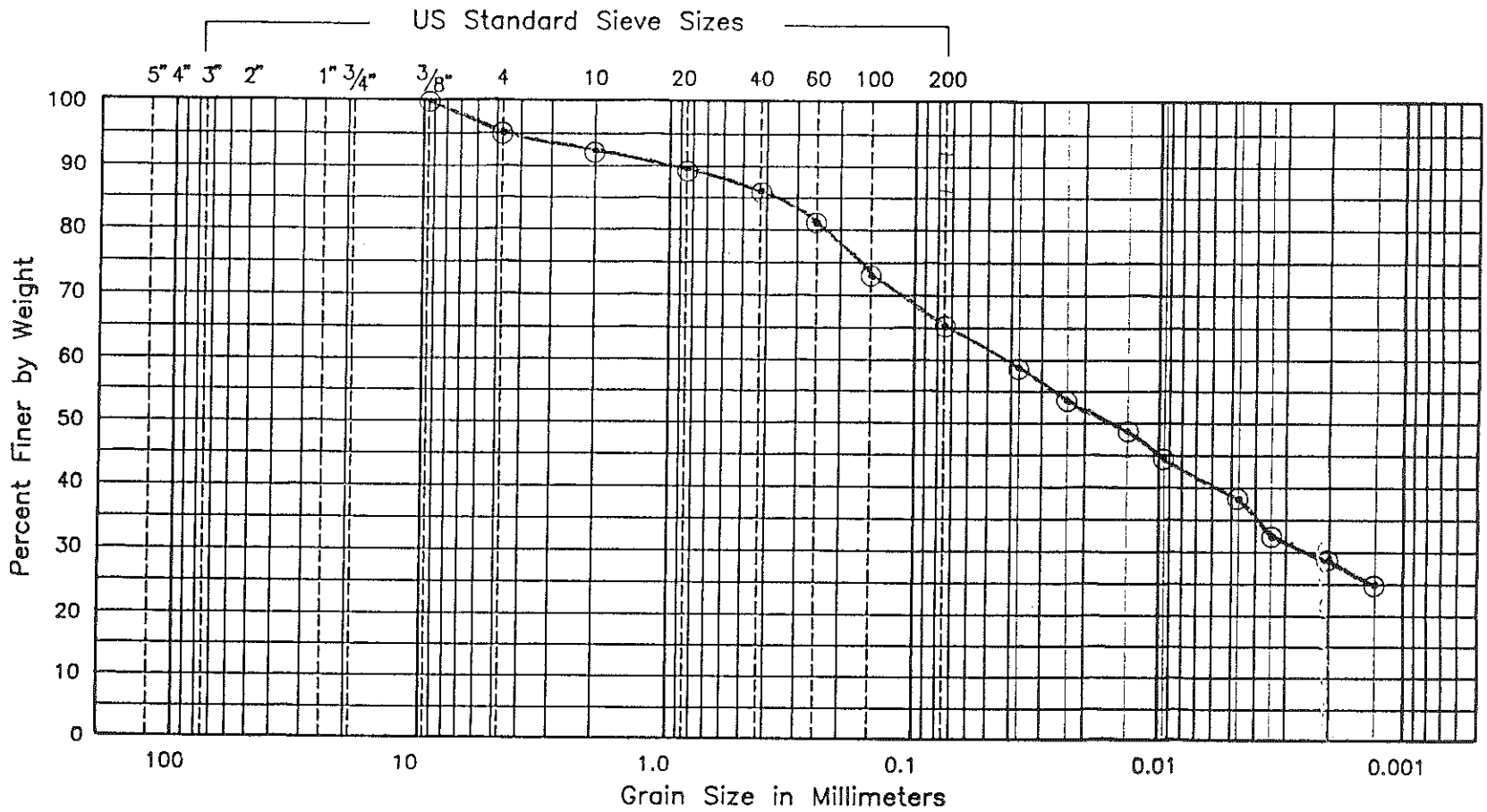
Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
E-696 (6)		9.1	25	11	14	Dark yellowish brown (10 YR 4/2), CLAYEY SILT, some c-f SAND, tr f gravel, (CL).

Golder Associates

GRAIN SIZE DISTRIBUTION

Project: ECS / Ford Motor Co. / AI
Project No. 903-3078 Date 2-12-90 Tested By RICK Approved By DXC

Golder Associates



Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
I-696 (6)		9.1	25	11	14	Dark yellowish brown (10 YR 4/2), CLAYEY SILT, some c-f SAND, tr f gravel, (CL).

CURVE 3A

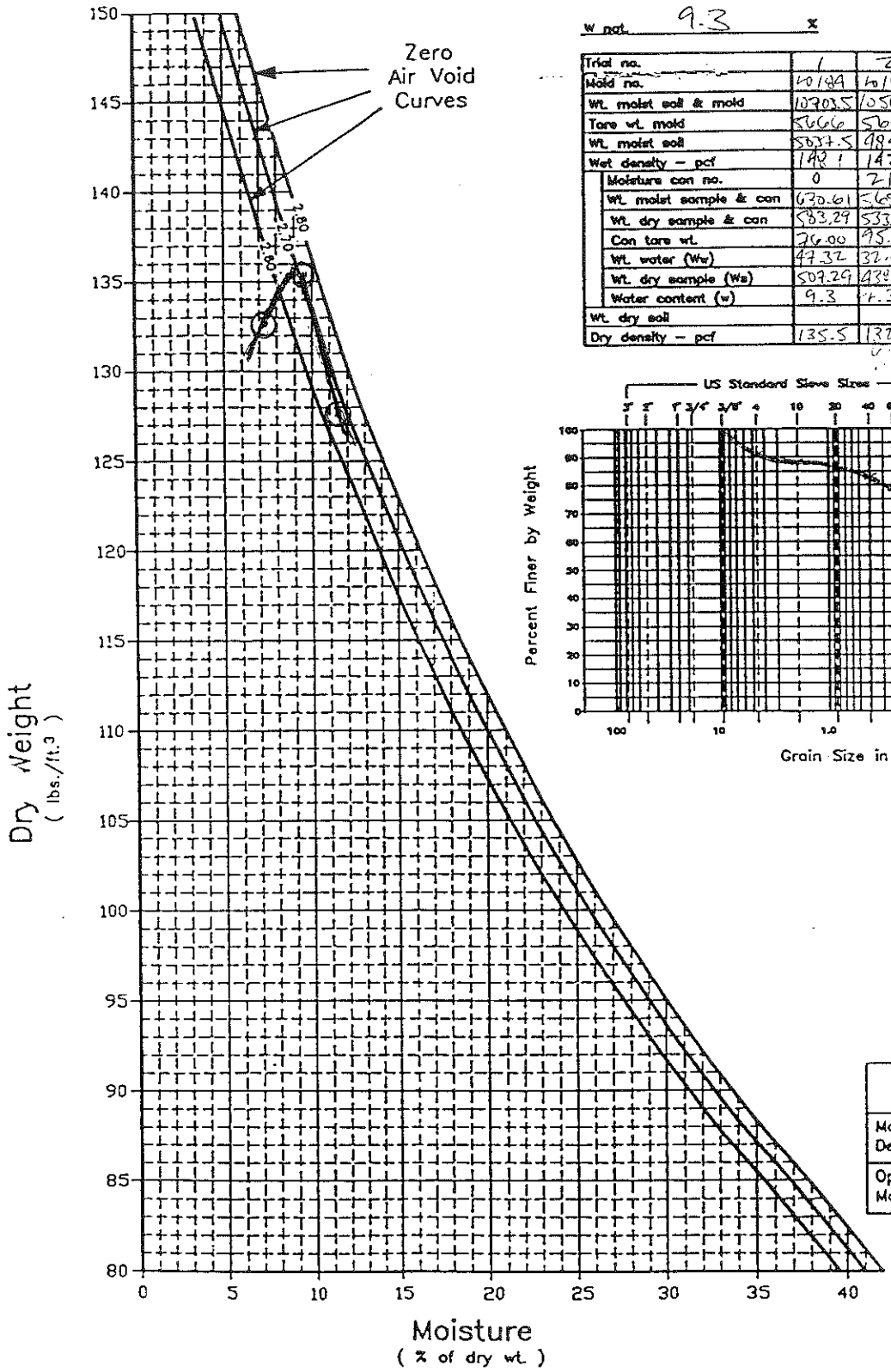
Sample Number: (7) I-696

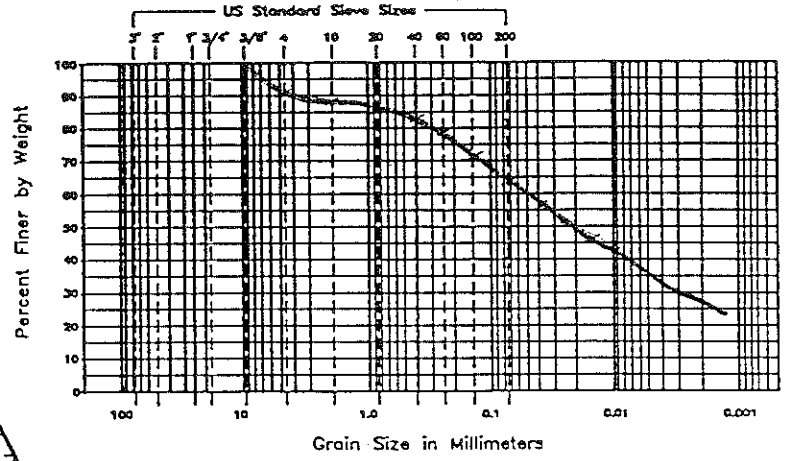
Description: Grayish brown (5 YR 3/2), CLAYEY SILT, some c-f sand, little f gravel (CL).

Method: ASTM D1557-C

W nat. 9.3 % MOLD volume 0.075 cf

Trial no.	1	2	3			
Mold no.	6184	6184	6184			
Wt. moist soil & mold	10703.5	10514	10519.5			
Tare wt. mold	5666	5666	5666			
Wt. moist soil	5037.5	4848	4853.5			
Wet density – pcf	142.1	142.5	142.4			
Moisture can no.	0	21	20			
Wt. moist sample & can	630.61	565.44	465.39			
Wt. dry sample & can	583.29	533.67	427.14			
Can tare wt.	76.00	95.18	94.98			
Wt. water (Ww)	47.32	32.07	38.25			
Wt. dry sample (Ws)	507.29	438.49	332.16			
Water content (w)	9.3	7.3	11.5			
Wt. dry soil						
Dry density – pcf	135.5	132.8	127.7			





D_{10}	NA
D_{30}	NA
D_{60}	NA
C_U	NA
C_Z	NA

SUMMARY	
Maximum Density (pcf)	135.5
Optimum Moisture (%)	9.0

Figure

MOISTURE-DENSITY RELATIONSHIP OF SOIL

Project ECS / Ford Motor Co. / MI

Project No. 903-3078 Date 7-12-90 Tested By RCM Approved By [illegible]

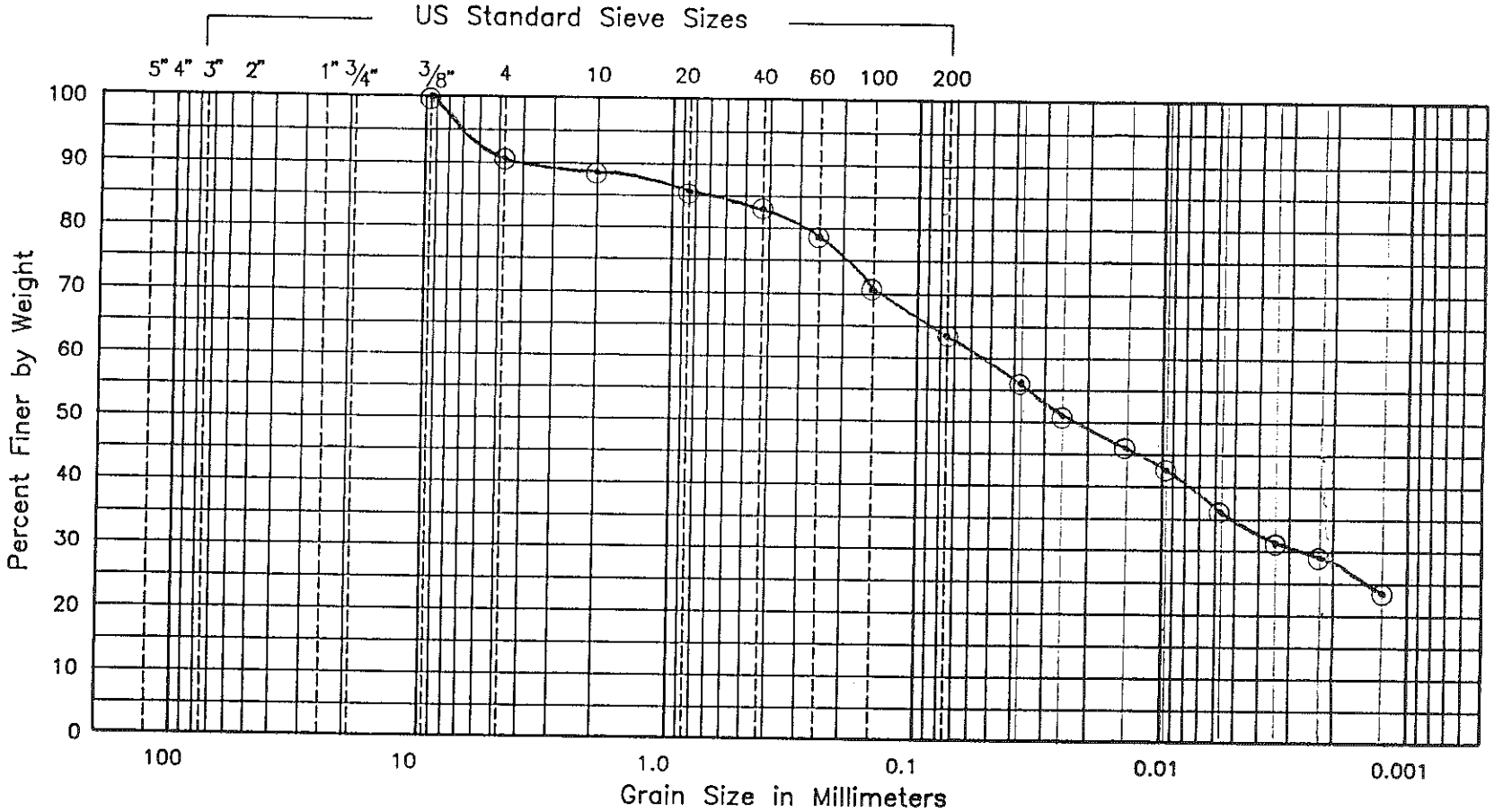
Golder Associates

993-1350\5404

GRAIN SIZE DISTRIBUTION

Project: ECS / Ford Motor Co / MI
Project No. 903-3513 Date 7-12-96 Tested By RLM Approved By DRV

Golder Associates

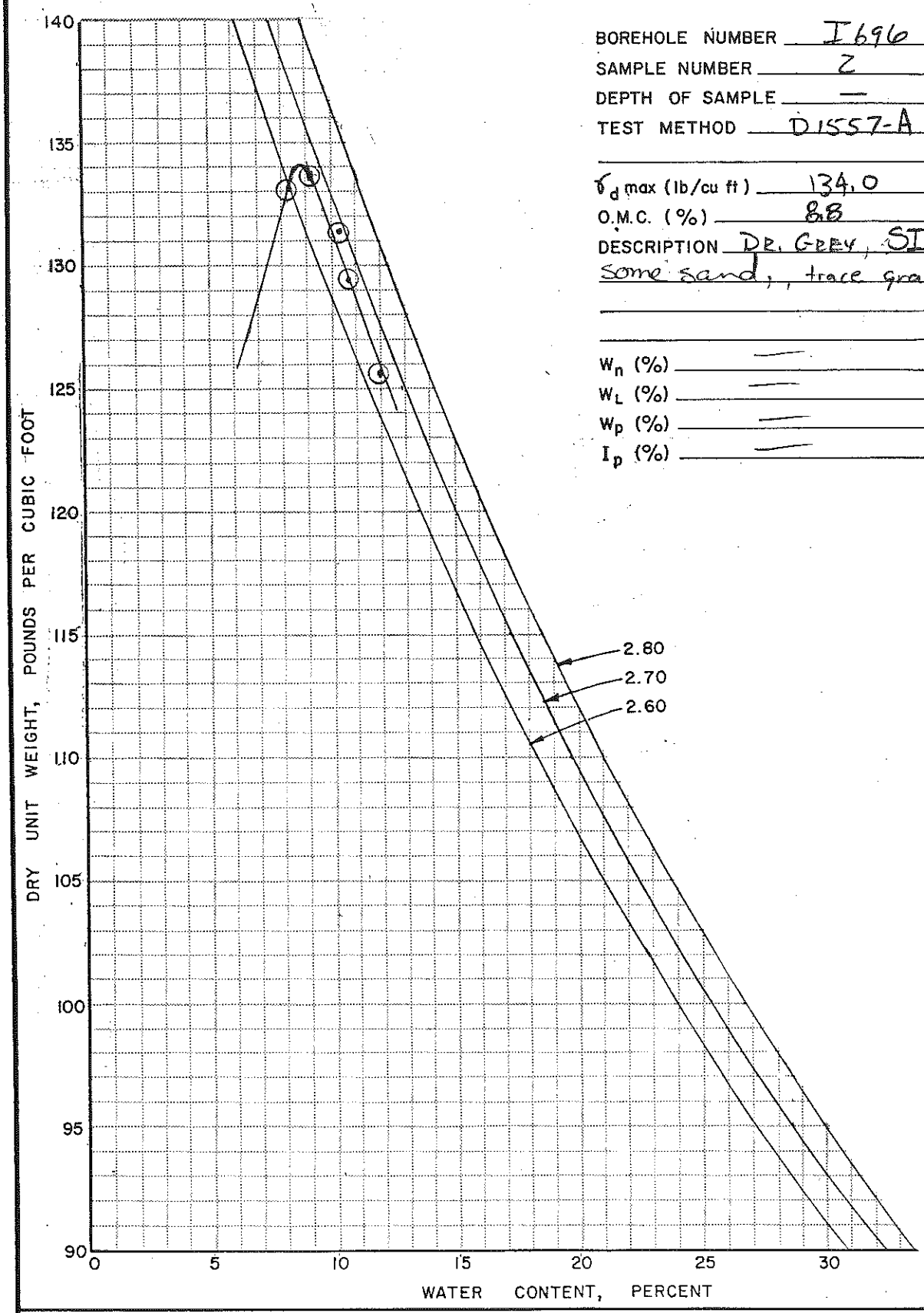


Cobbles	Gravel		Sand			Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

Boring No.	Elev. or Depth	W_n	W_L	W_P	I_P	Description
I-696 (7)		9.3	25	13	12	Grayish brown (5 YR 3/2), CLAYEY SILT, some c-f sand, little fine gravel, (CL).

COMPACTION TEST RESULTS

CURVE 4



BOREHOLE NUMBER I696

SAMPLE NUMBER 2

DEPTH OF SAMPLE —

TEST METHOD D1557-A

γ_d max (lb/cu ft) 134.0

O.M.C. (%) 8.8

DESCRIPTION DK. GREY, SILTY CLAY, some sand, trace gravel

W_n (%) —

W_L (%) —

W_P (%) —

I_P (%) —

Date 6/4/90

Job No. 903-3078

Golder Associates

Drawn WMS

Checked RAW

Approved BM

NTH CONSULTANTS, LTD.

CURVE 5

MOISTURE - DENSITY RELATIONS

PROJECT: Allen Park Clay Mine - Cell II

PROJECT NO.: 89365 OW

LOCATION: Allen Park, Michigan

DATE: 8/18/89

SUPPLIER/SOURCE: Cell II Native Soil

TESTED BY: DM

SAMPLE LOCATION: 3650N, 7300E

CHECKED BY: SG

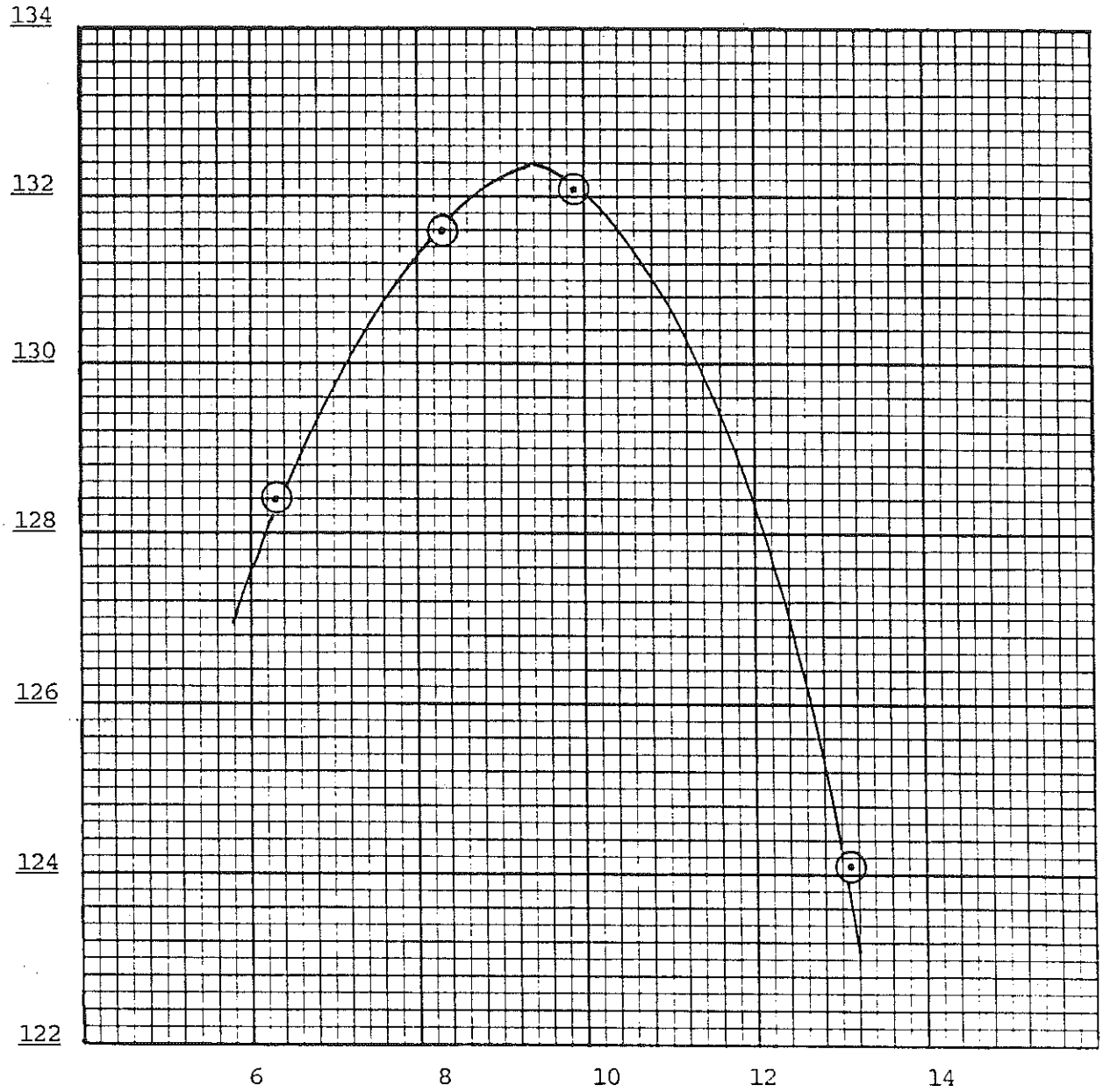
METHOD OF COMPACTION: ASTM D-1557 Method A

LAB SAMPLE NO.: 6480

MOLD NO.: B VOLUME: 0.0332 CUBIC FEET MATERIAL DESIGNATION NO.: Block 104

SAMPLE DESCRIPTION: Gray SILTY CLAY with Little Sand and Gravel

MAXIMUM DRY DENSITY: 132.4 PCF OPTIMUM MOISTURE CONTENT: 9.4 %



NTH Consultants, Ltd.

GRAIN SIZE DISTRIBUTION CURVE

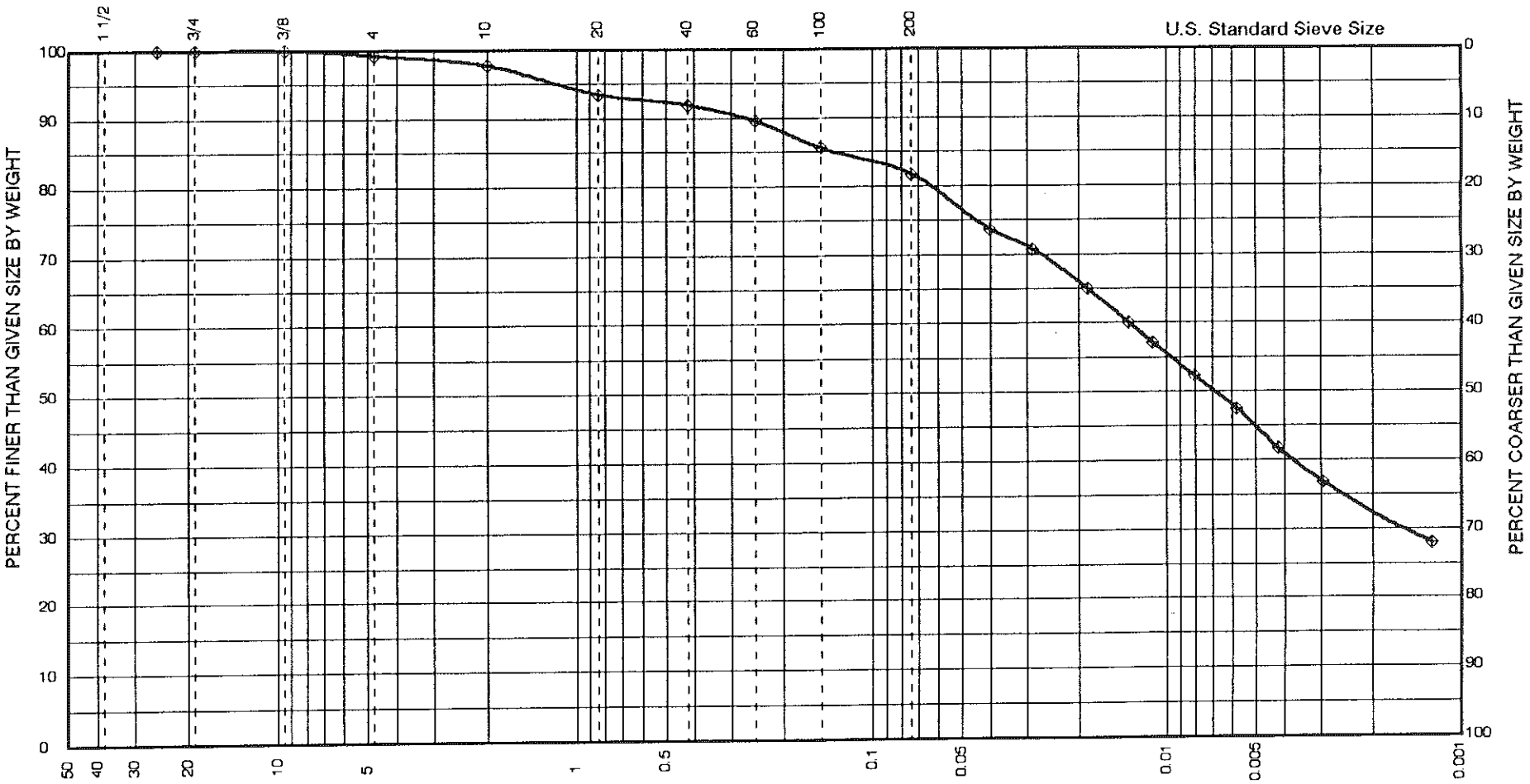
Project No. 89365 OW Lab Sample No. 6480 Source Cell II Native Soil

Project Location Allen Park, Michigan For Allen Park Clay Mine - Material Characteristics

Boring No. _____ Field Sample No. Block 104 Sample Depth _____ Sample Elev. (Tip) _____

Sample Description Gray **SILTY CLAY** with Little Sand and Trace of Gravel

Sampled By MJ Date 8/10/89 Tested By MS Date 8/17/89



Gravel		Sand			Fines		
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids

TABULATION OF LABORATORY TEST DATA

NTH Consultants, Ltd.

ALLEN PARK CLAY MINE
ALLEN PARK, MICHIGAN

Date: 08/29/89

NTH Proj. No.: 89365 OW

Sample Designation: Block 104

Sample Location: Cell II South Stabilization Berm, 3650N, 7300E

Lab Sample No.: 6480

Date Sampled: 08/10/89

Soil Properties and Description

GRAIN SIZE DISTRIBUTION:

Gravel:	1.0	%
Coarse Sand:	1.0	%
Medium Sand:	6.0	%
Fine Sand:	10.0	%
Silt:	37.0	%
Clay:	45.0	%

ATTERBERG LIMITS

Liquid Limit: 32
Plasticity Index: 15

UNIFIED SOIL CLASSIFICATION: CL

SAMPLE DESCRIPTION:
Gray SILTY CLAY with Little Sand and Trace of Gravel

Modified Proctor Test Result

(Per ASTM D 1557-78)

Maximum Dry Density: 132.4 pcf
Optimum Moisture Content: 9.4 %

Moisture/Density and Permeability Relationship

Moisture Content:	Percent of Maximum Dry Density	Coefficient of Permeability (1)
12.8 %	91.4 %	K = 6.9E - 8 cm/sec

REMARKS:
1.

2.

Checked By: _____

CURVE 6

NTH CONSULTANTS, LTD.

MOISTURE - DENSITY RELATIONS

PROJECT: Allen Park Clay Mine - Cell II

PROJECT NO.: 89365 OW

LOCATION: Allen Park, Michigan

DATE: 11/18/89

SUPPLIER/SOURCE: I-696 Excavation

TESTED BY: JN

SAMPLE LOCATION: Cell II South Slope

CHECKED BY: SG

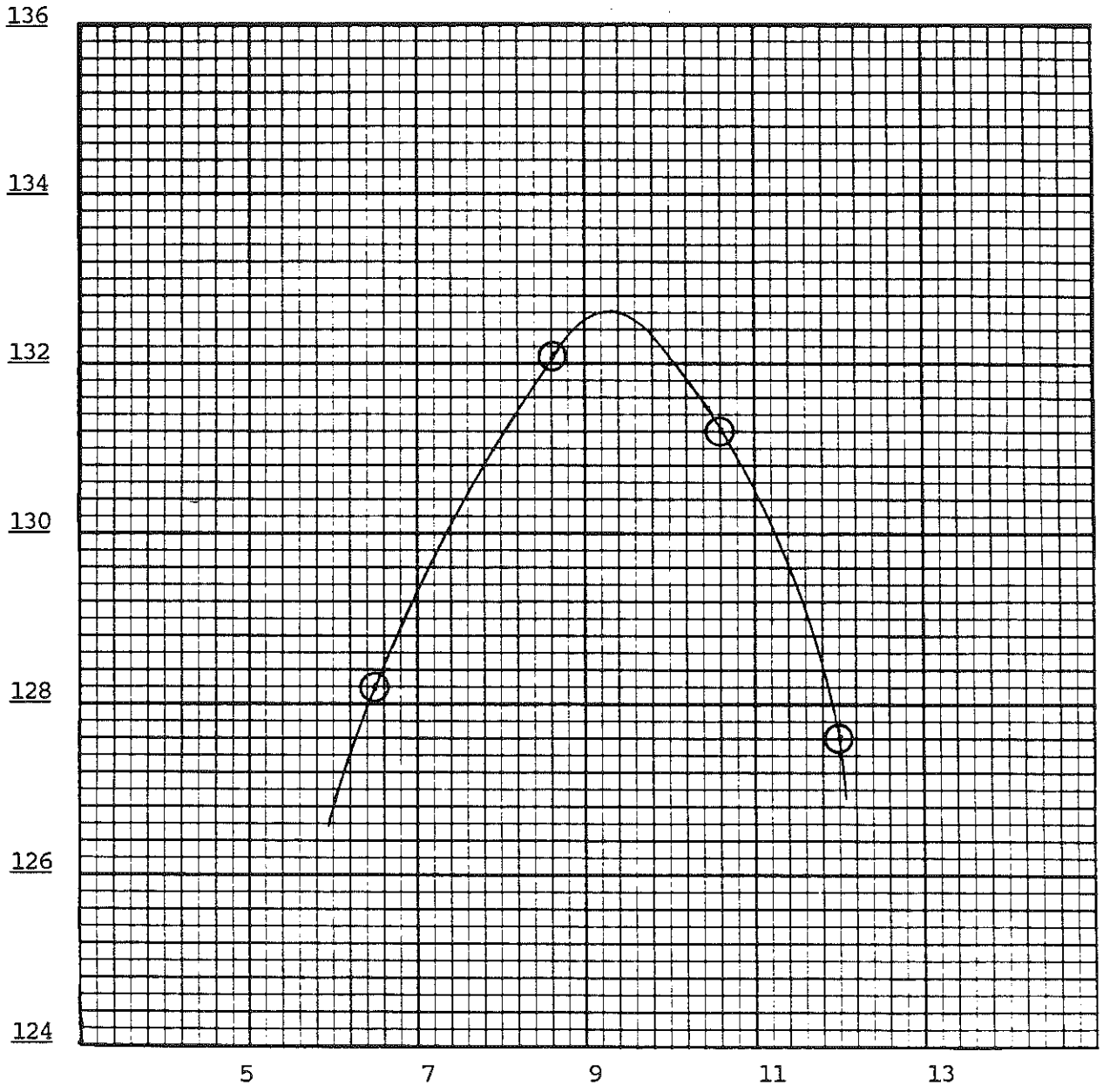
METHOD OF COMPACTION: ASTM D-1557 Method A

LAB SAMPLE NO.: 7263

MOLD NO.: A VOLUME: 0.0330 CUBIC FEET MATERIAL DESIGNATION NO.: Bag 113

SAMPLE DESCRIPTION: Gray SILTY CLAY with Some Sand and Trace of Gravel

MAXIMUM DRY DENSITY: 132.6 PCF OPTIMUM MOISTURE CONTENT: 9.3 %



NTH/2.88-006

NTH Consultants, Ltd.

GRAIN SIZE DISTRIBUTION CURVE

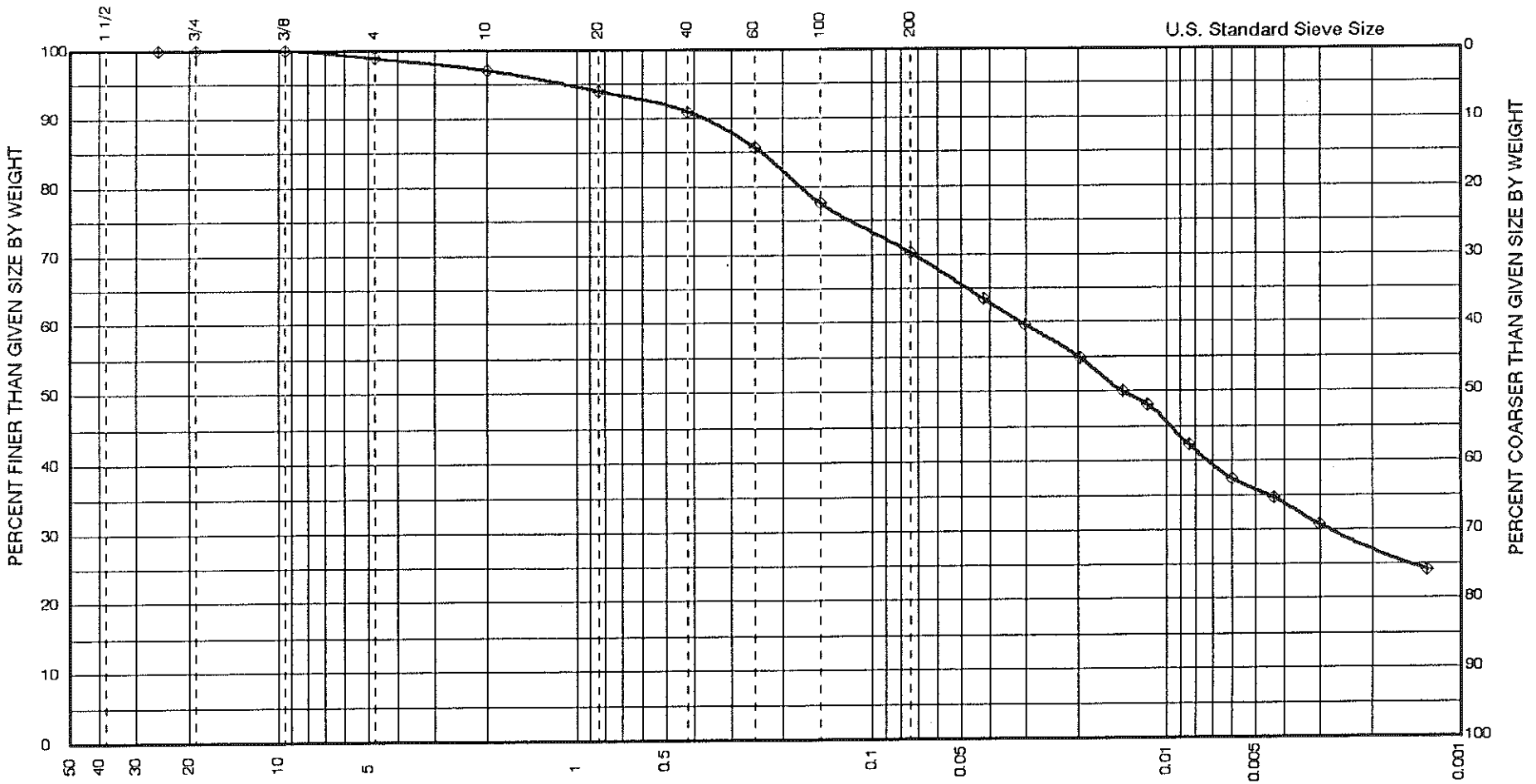
Project No. 89365-OW Lab Sample No. 7263 Source I-696 Excavation

Project Location Dearborn, Michigan For Allen Park Clay Mine - Material Characteristics

Boring No. _____ Field Sample No. Bag 113 Sample Depth _____ Sample Elev. (Tip) _____

Sample Description Gray **SILTY CLAY** with Some Sand and Trace of Gravel

Sampled By DHH Date 10/18/89 Tested By R.O. Date 10-23-89



Gravel		Sand			Fines		
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids

TABULATION OF LABORATORY TEST DATA

NTH Consultants, Ltd.

ALLEN PARK CLAY MINE
ALLEN PARK, MICHIGAN

Date: 11/18/89

NTH Proj. No.: 89365 OW

Sample Designation: Bag 113

Sample Location: Cell II South Slope

Lab Sample No.: 7263

Date Sampled: 10/18/89

Soil Properties and Description

GRAIN SIZE DISTRIBUTION:

Gravel:	1.2	%
Coarse Sand:	1.8	%
Medium Sand:	6.1	%
Fine Sand:	20.7	%
Silt:	34.4	%
Clay:	35.8	%

ATTERBERG LIMITS

Liquid Limit: 27
Plasticity Index: 13

UNIFIED SOIL CLASSIFICATION: CL

SAMPLE DESCRIPTION:
Gray SILTY CLAY with Some Sand and Trace of GRavel

Modified Proctor Test Result
(Per ASTM D 1557-78)

Maximum Dry Density:	132.6	pcf
Optimum Moisture Content:	9.3	%

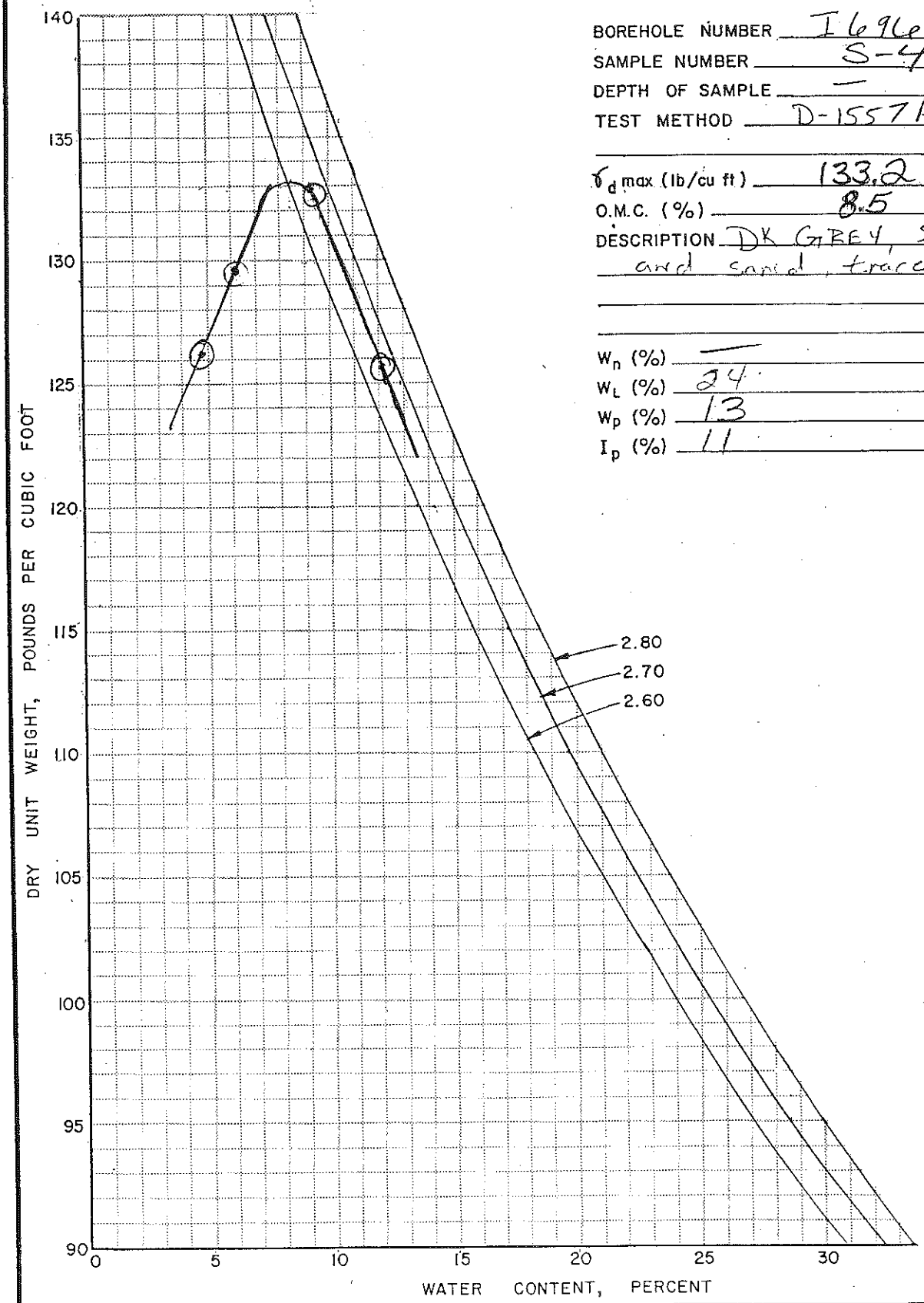
REMARKS:
1.

2.

Checked By: _____

COMPACTION TEST RESULTS

CURVE 7



BOREHOLE NUMBER I696
SAMPLE NUMBER S-4
DEPTH OF SAMPLE —
TEST METHOD D-1557A

γ_d max (lb/cu ft) 133.2
O.M.C. (%) 8.5
DESCRIPTION DK GREY, SILTY CLAY, and sand, trace gravel

W_n (%) —
W_L (%) 24
W_P (%) 13
I_P (%) 11

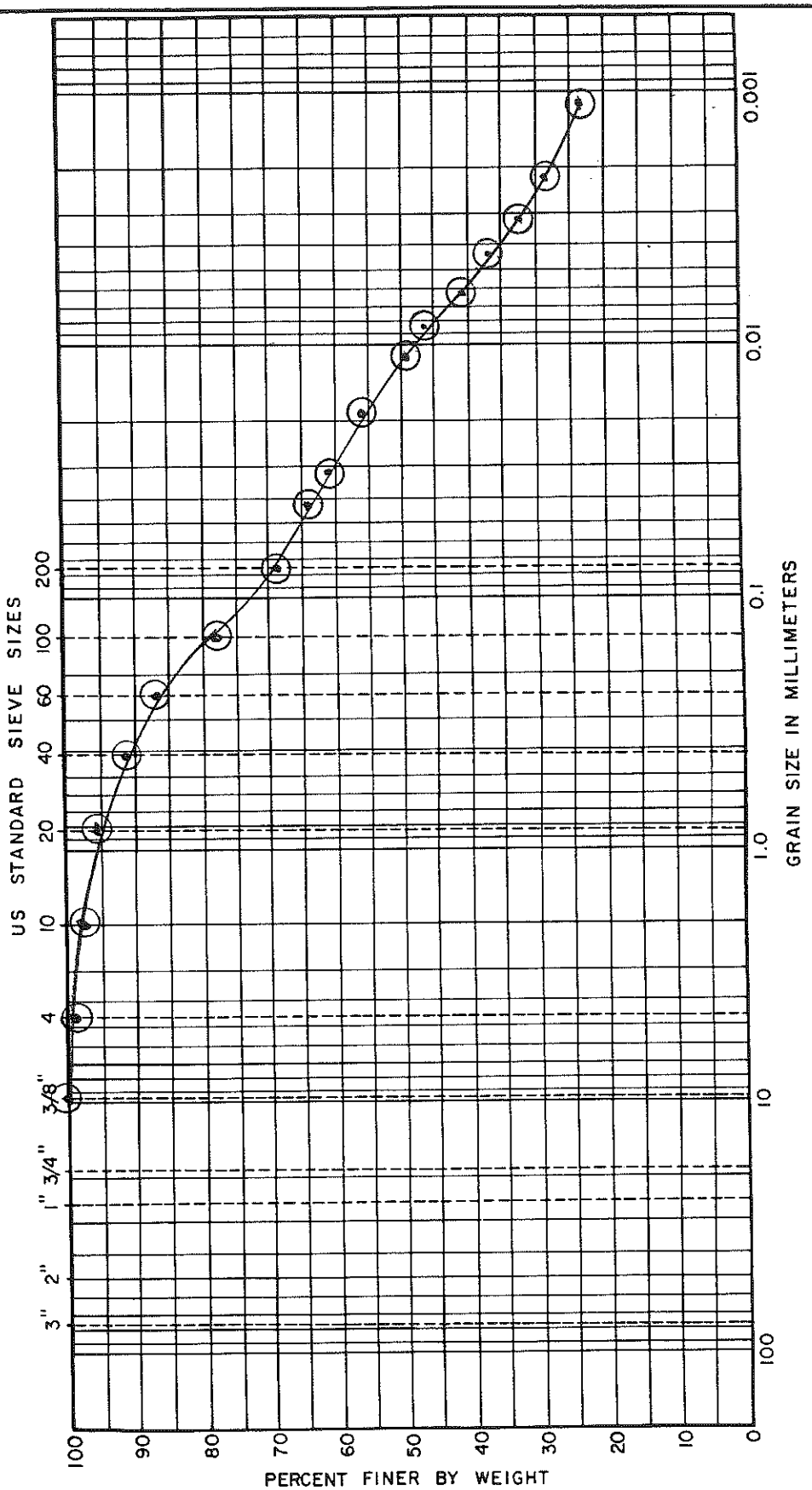
Date 6/14/90
Job No. 903-2078

Golder Associates

Drawn Wms
Checked BCP
Approved

GRAIN SIZE DISTRIBUTION

FIGURE



BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
I696	—	—	24	13	11	DK. GREY, SILTY CLAY, and sand trace (gravel) (CL)

Date 6/22/90

Job No. 903-3078

Golder Associates

Drawn WMS

Checked BOP

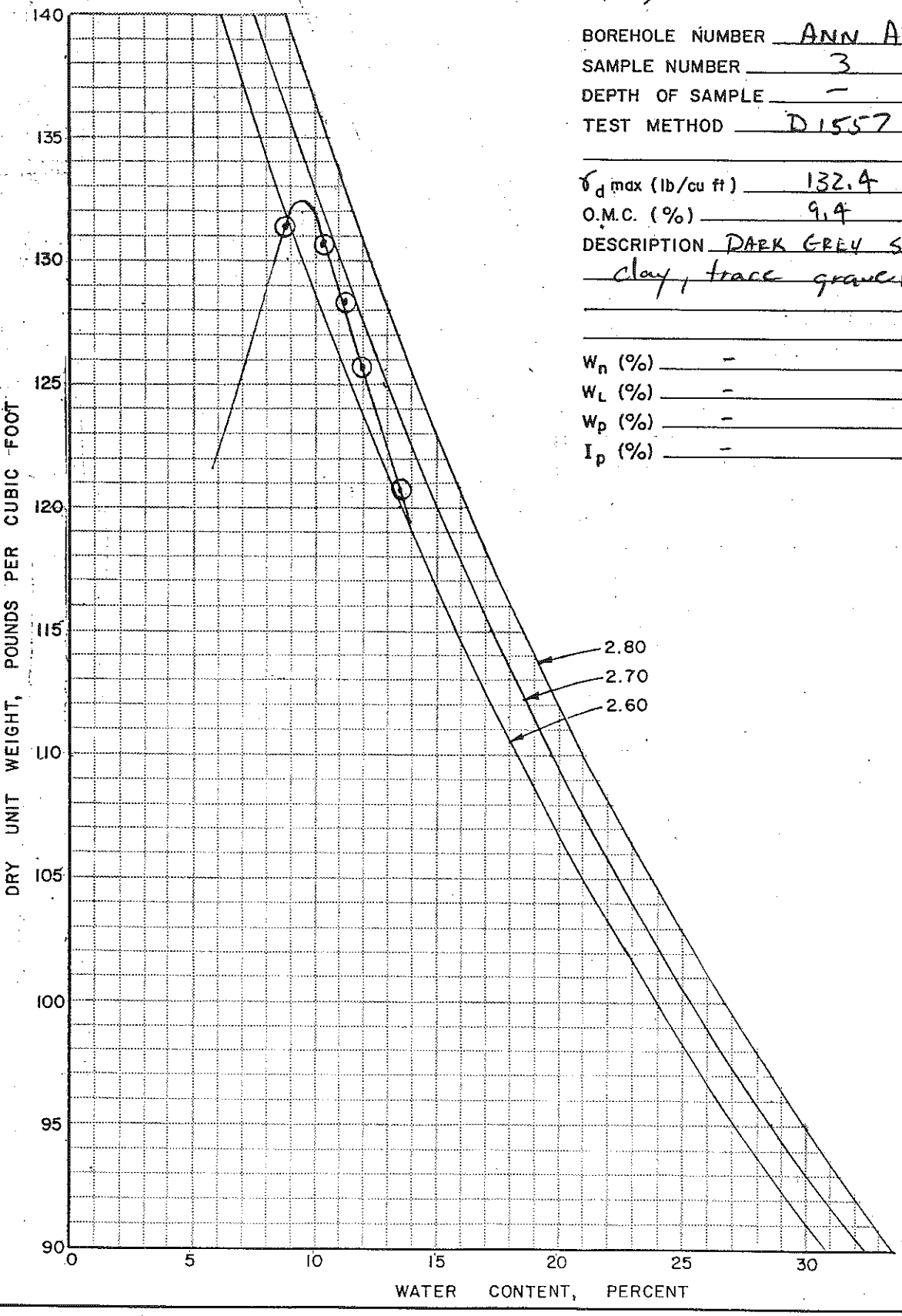
Reviewed

CURVE 8

COMPACTION TEST RESULTS

FIGURE

Sampled 5/31/ by [illegible]



BOREHOLE NUMBER ANN ARBOR

SAMPLE NUMBER 3

DEPTH OF SAMPLE –

TEST METHOD D1557 A

γ_d max (lb/cu ft) 132.4

O.M.C. (%) 9.4

DESCRIPTION DARK GREY SAND, and silty clay, trace gravel

W_n (%) –

W_L (%) –

W_P (%) –

I_P (%) –

Date 6/4/90

Job No. 903-3078

Golder Associates

Drawn Wms

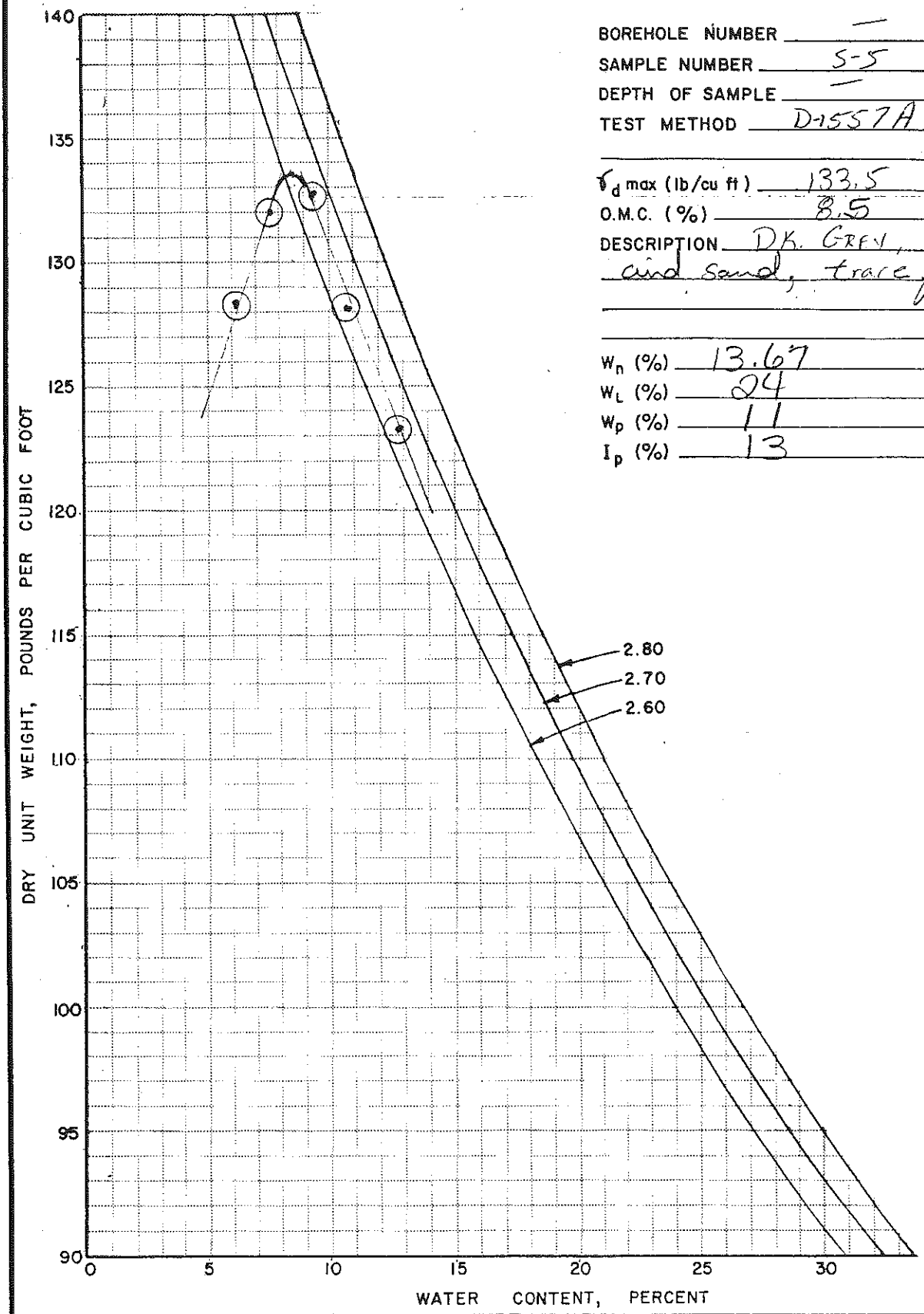
Checked [illegible]

Approved

CURVE 9

COMPACTION TEST RESULTS

FIGURE



BOREHOLE NUMBER —

SAMPLE NUMBER S-5

DEPTH OF SAMPLE —

TEST METHOD D-1557A

γ_d max (lb/cu ft) 133.5

O.M.C. (%) 8.5

DESCRIPTION Dk. Grey, SILTY CLAY and sand, trace f gravel (CL)

W_n (%) 13.67

W_L (%) 24

W_p (%) 11

I_p (%) 13

Date 6/20/90

Job No. 903-3078

Golder Associates

Drawn

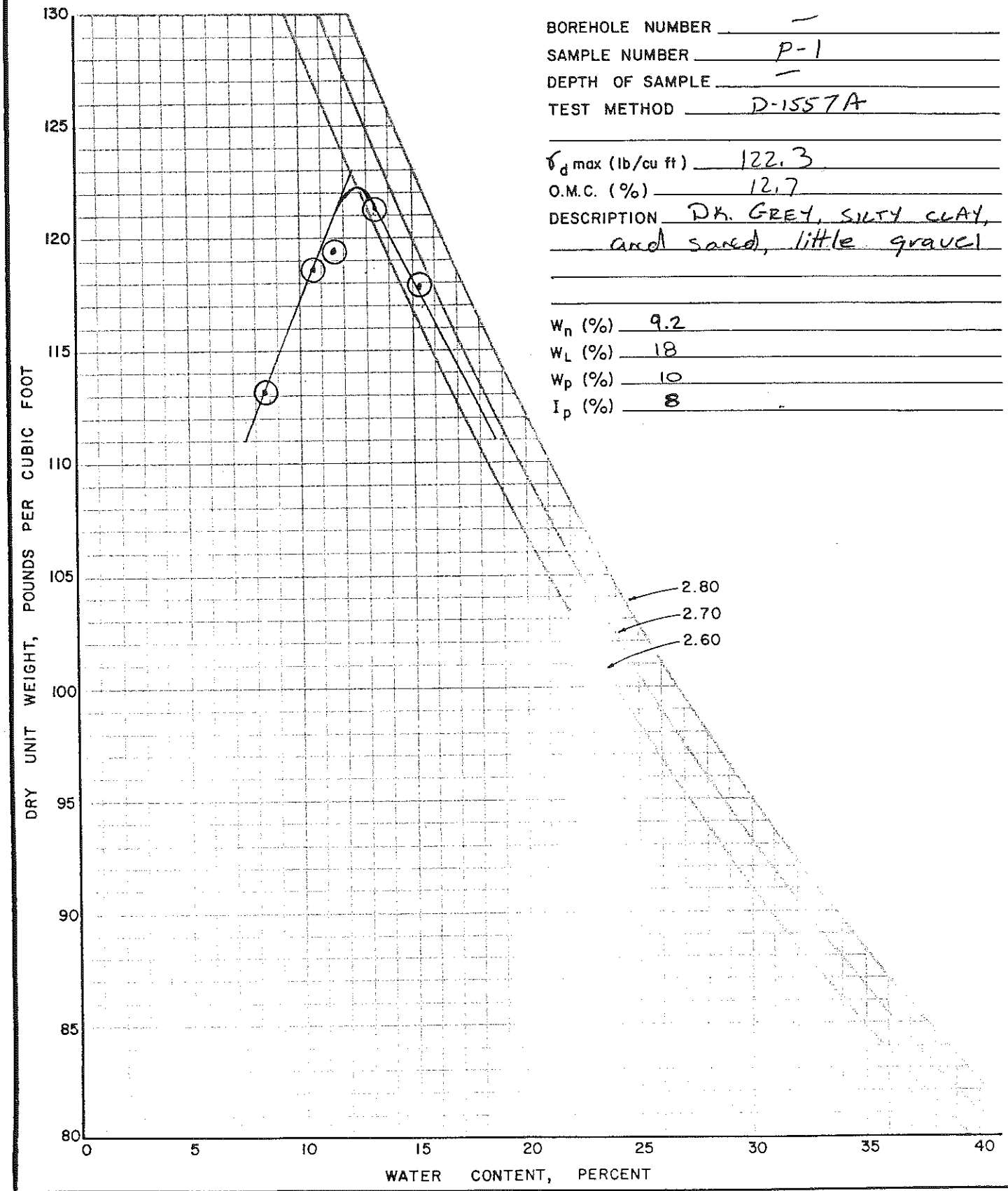
Checked

Approved

CURVE 10

COMPACTION TEST RESULTS

FIGURE



BOREHOLE NUMBER —

SAMPLE NUMBER P-1

DEPTH OF SAMPLE —

TEST METHOD D-1557A

γ_d max (lb/cu ft) 122.3

O.M.C. (%) 12.7

DESCRIPTION DK. GREY, SILTY CLAY, and sand, little gravel

W_n (%) 9.2

W_L (%) 18

W_P (%) 10

I_P (%) 8

Date 6/25/90

Job No. 903-3078
907-1045

Golder Associates

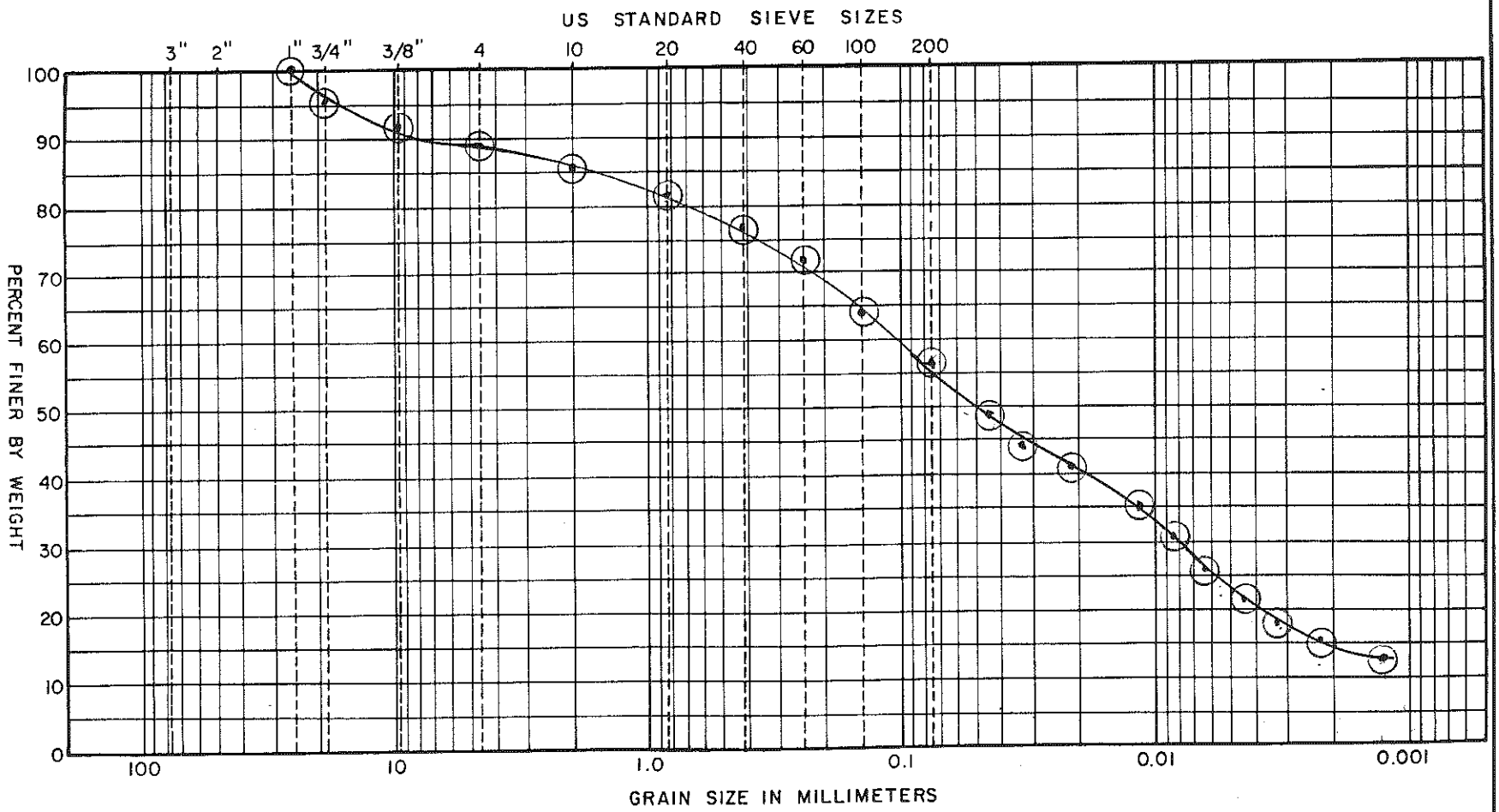
Drawn WMS

Checked MRA

Approved

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
P-1	—	9.19	18	10	8	DK. GREY, SILTY CLAY, and sand little gravel. (CL)

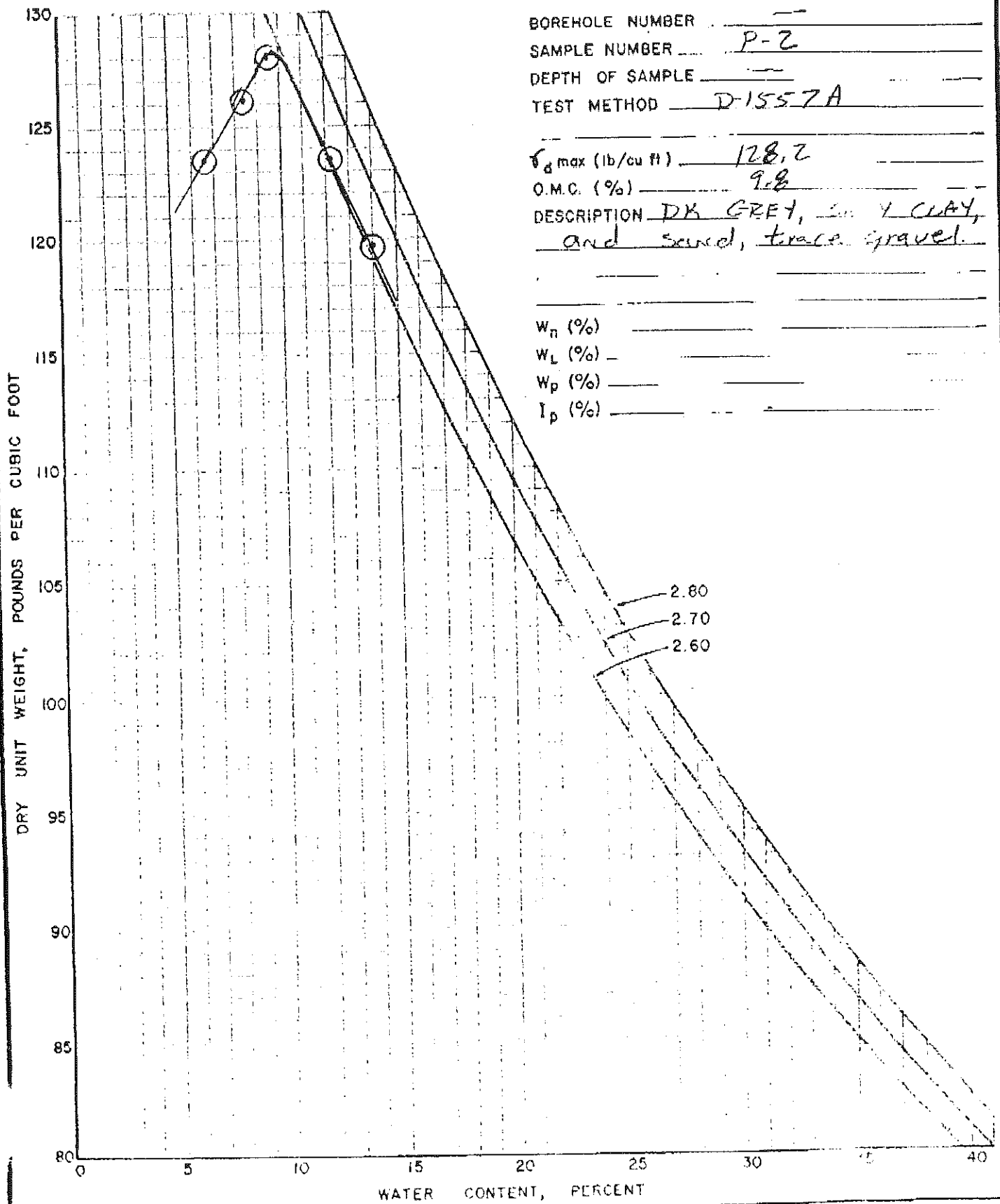
Date 7/3/90
Job No. 903-3078

Golder Associates

Drawn WMS
Checked
Reviewed

COMPACTION TEST RESULTS

CURVE 11



BOREHOLE NUMBER —

SAMPLE NUMBER P-2

DEPTH OF SAMPLE —

TEST METHOD D-1557A

γ_d max (lb/cu ft) 128.2

O.M.C. (%) 9.8

DESCRIPTION DK GREY, SILTY CLAY, and sand, trace gravel.

W_n (%)

W_L (%)

W_p (%)

I_p (%)

Date 6/25/90

Job No 903-3098
907-1045

Golder Associates

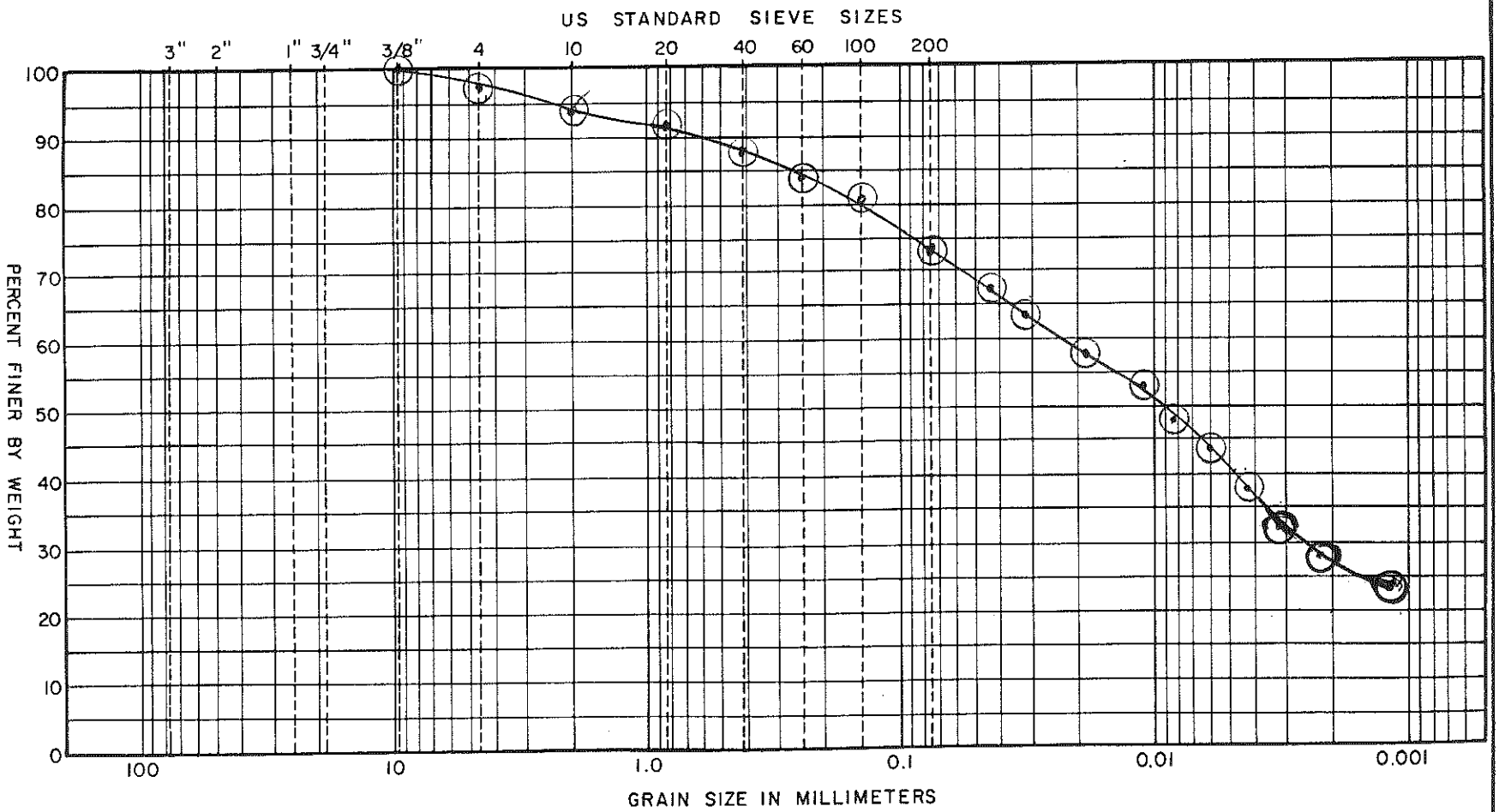
Drawn WMS

Checked MKS

Approved

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT OR CLAY

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
P-2	—	13.90	25	13	12	DK. GREY, SILTY CLAY, some sand trace fgravel (CL)

Date 7/3/90
Job No. 903-3078

Golder Associates

Drawn WMS
Checked
Reviewed

NTH CONSULTANTS, LTD.

CURVE 12

MOISTURE - DENSITY RELATIONS

PROJECT: Allen Park Clay Mine - Cell II

PROJECT NO.: 89365 OW

LOCATION: Allen Park, Michigan

DATE: 8/16/89

SUPPLIER/SOURCE: I-696 Brown Clay and Native Gray Clay

TESTED BY: JKR

SAMPLE LOCATION: Cell II Floor

CHECKED BY: MS

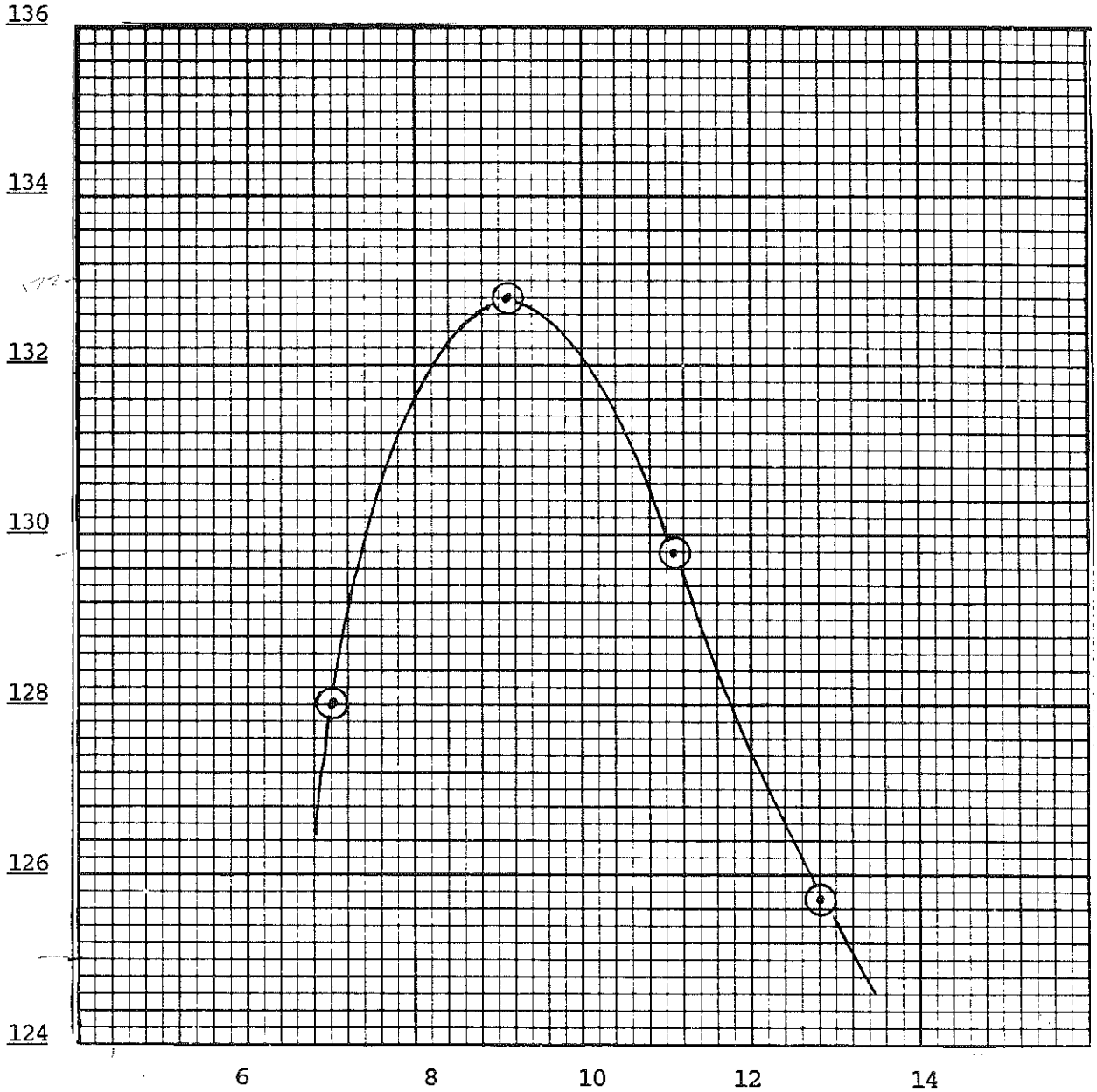
METHOD OF COMPACTION: ASTM D-1557 Method A

LAB SAMPLE NO.: 6461/6462

MOLD NO.: A VOLUME: 0.0330 CUBIC FEET MATERIAL DESIGNATION NO.: Bag 100

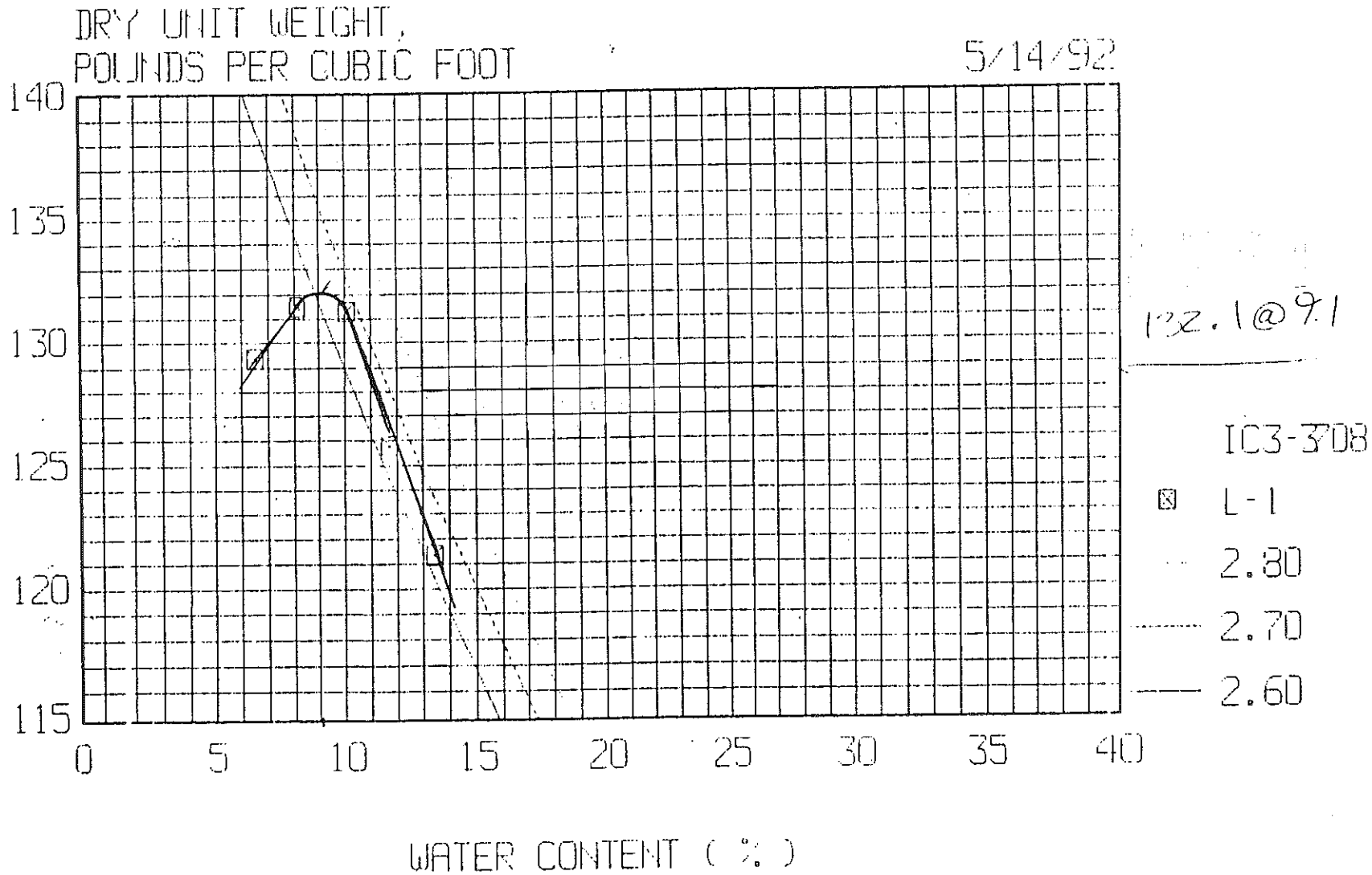
SAMPLE DESCRIPTION: Brown and Gray SILTY CLAY with Trace of Sand and Gravel

MAXIMUM DRY DENSITY: 132.8 PCF OPTIMUM MOISTURE CONTENT: 9.1 %



NTH/2.88-006

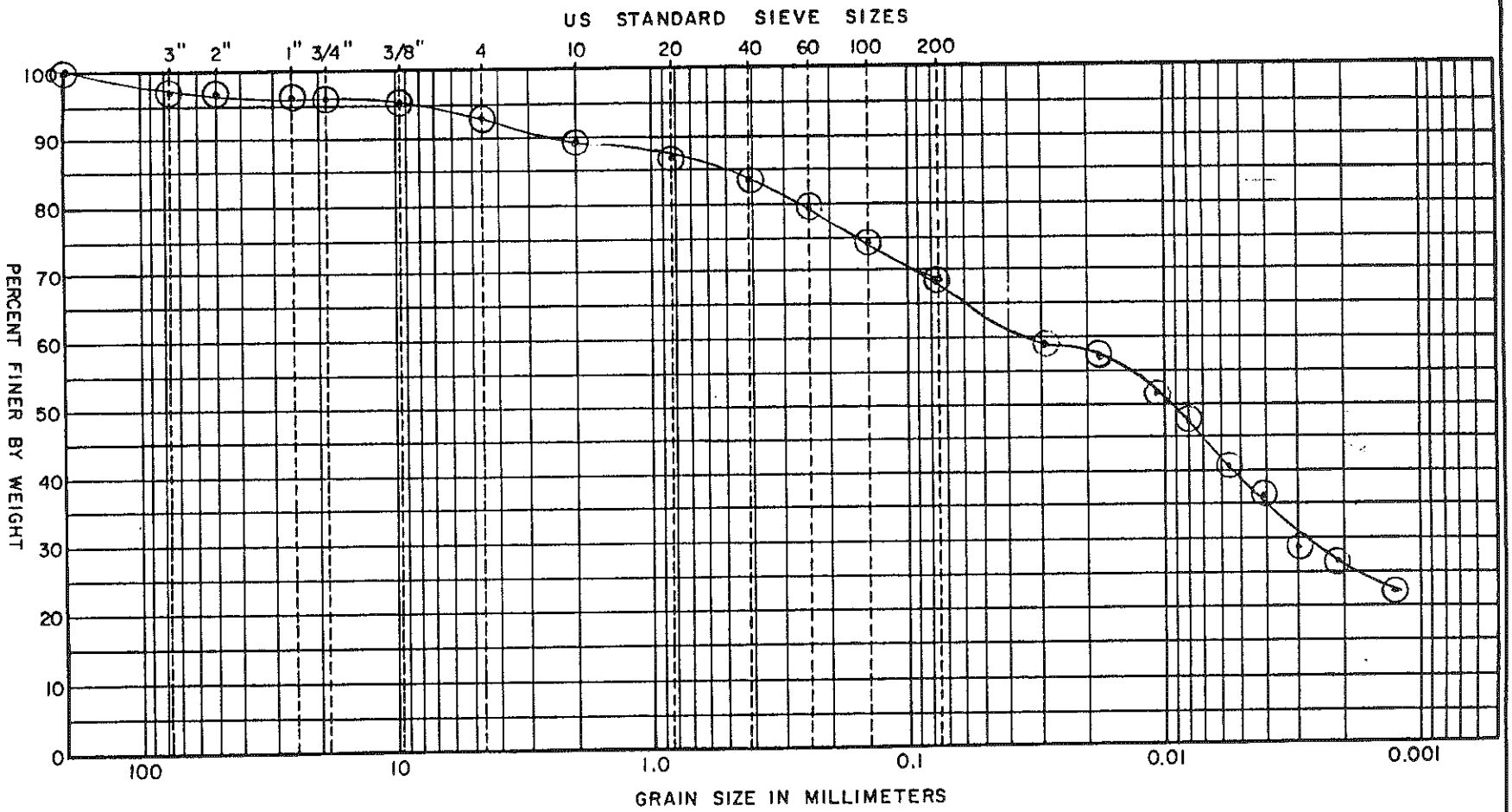
COMPACTION TEST



CURVE 13

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

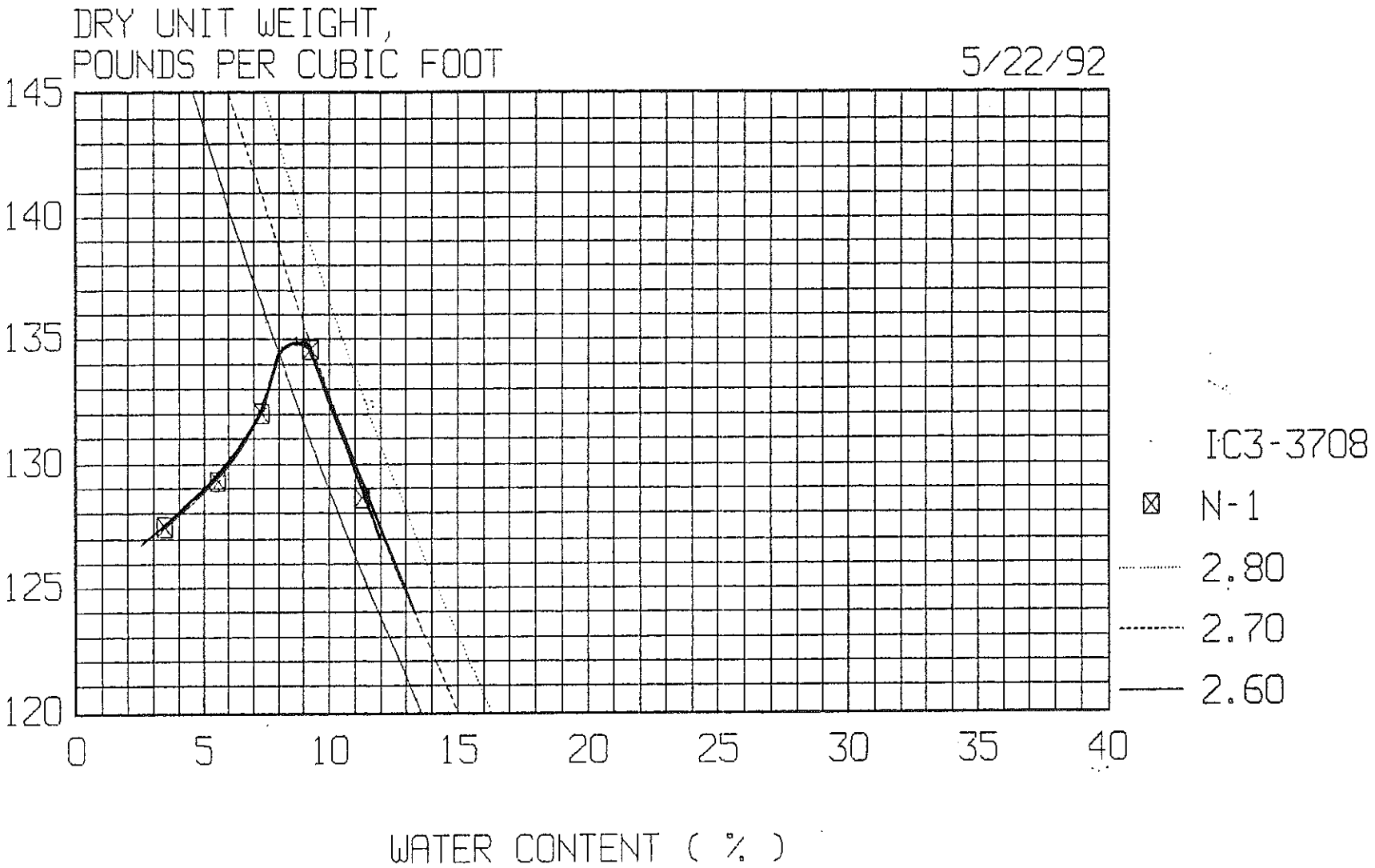
BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
L-1	—	8.21	25	14	11	Gray, SILTY CLAY, some of sand, trace of gravel trace cobbles (CL)

Date 3/20/92
Job No. IC3-3708

Golder Associates

Drawn TT
Checked
Reviewed

COMPACTION TEST



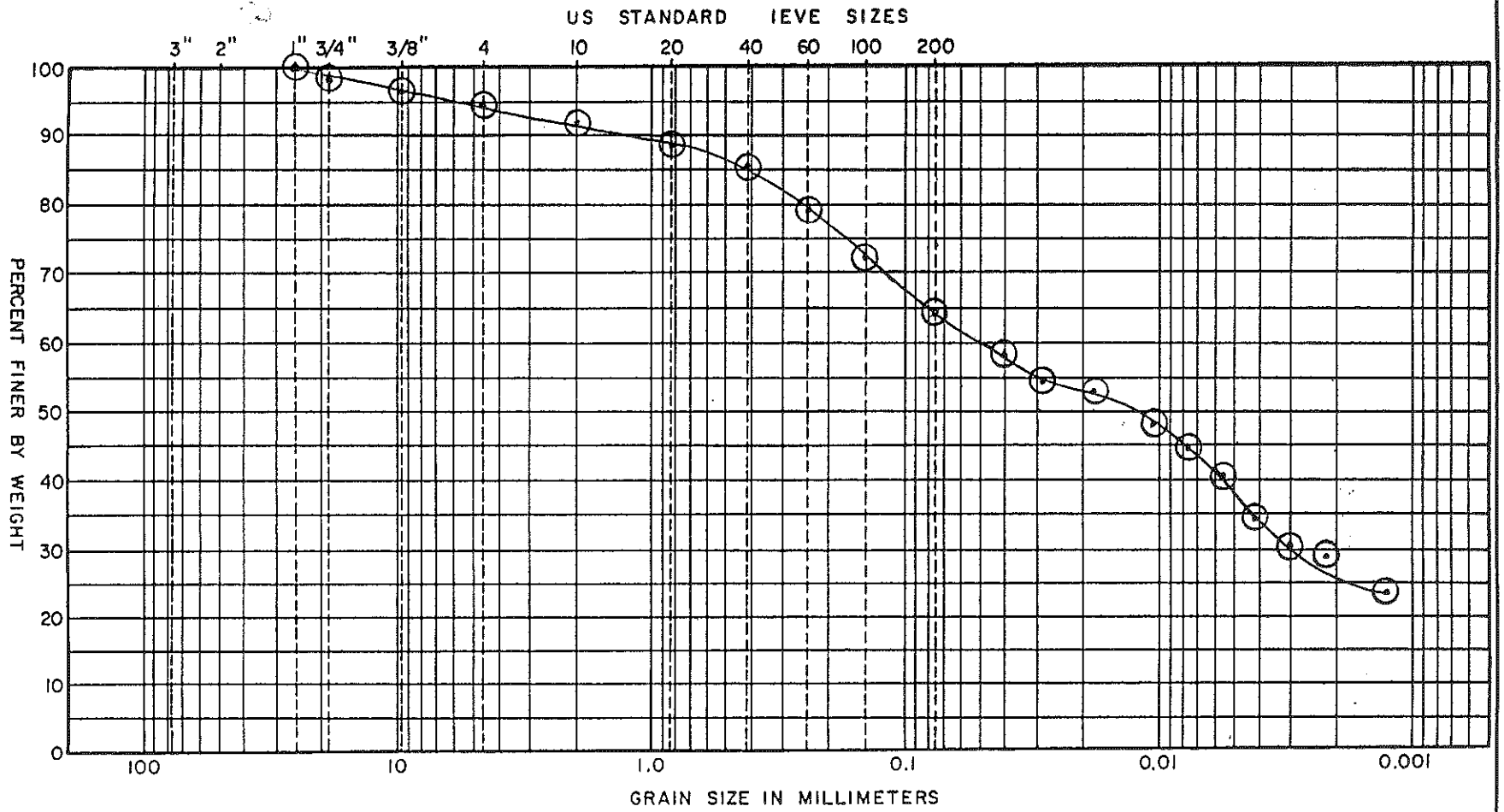
CURVE 14

Date 5/27/92
Job No. TC3-3709

Golder Associates

GRAIN SIZE DISTRIBUTION

FIGURE

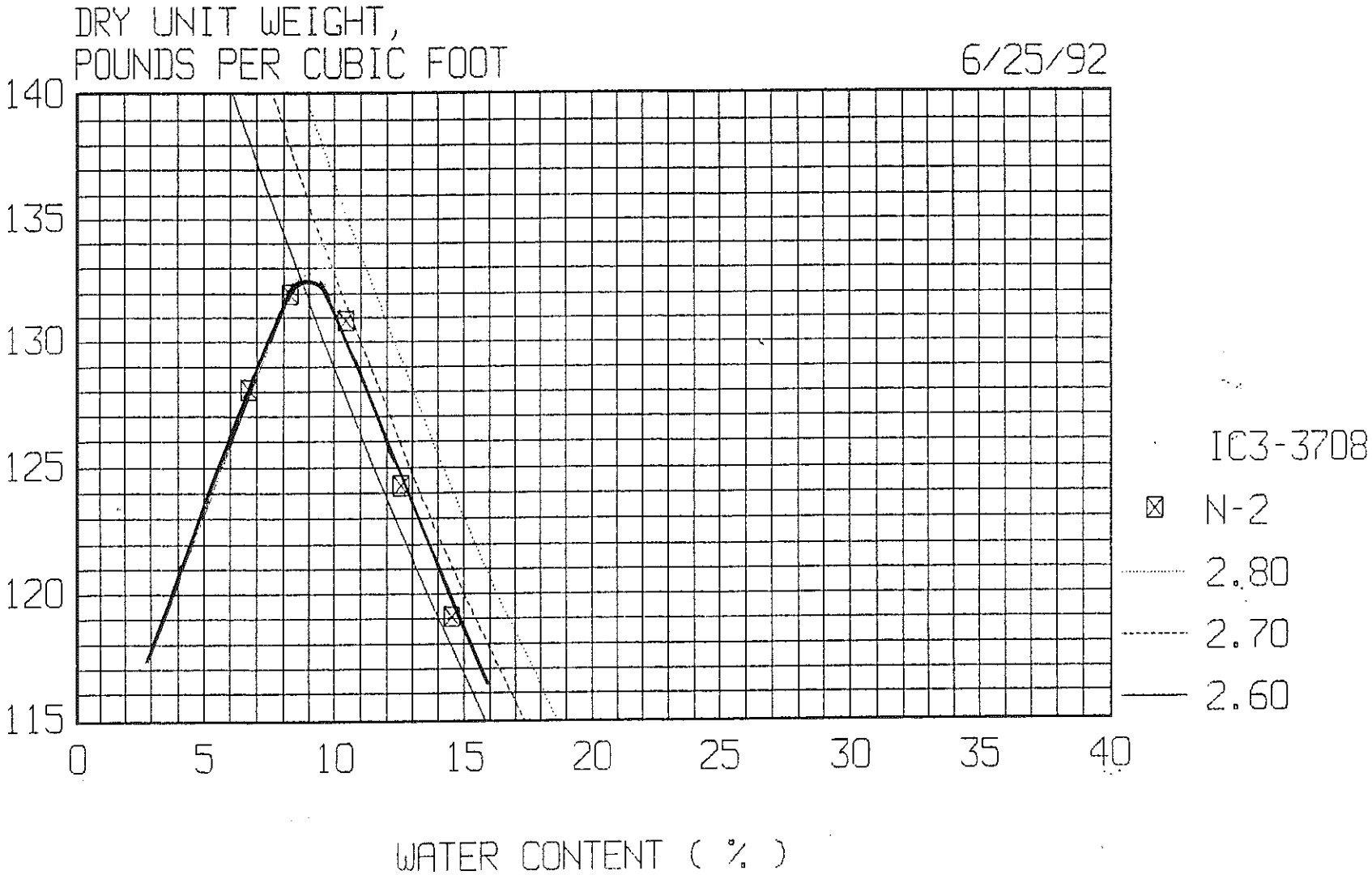


COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
Bag N-1	—	9.36.	25	13	12.	Grey, SILTY CLAY, some c-f sand, little f gravel (CL)

Drawn TT
Checked MM
Reviewed BM

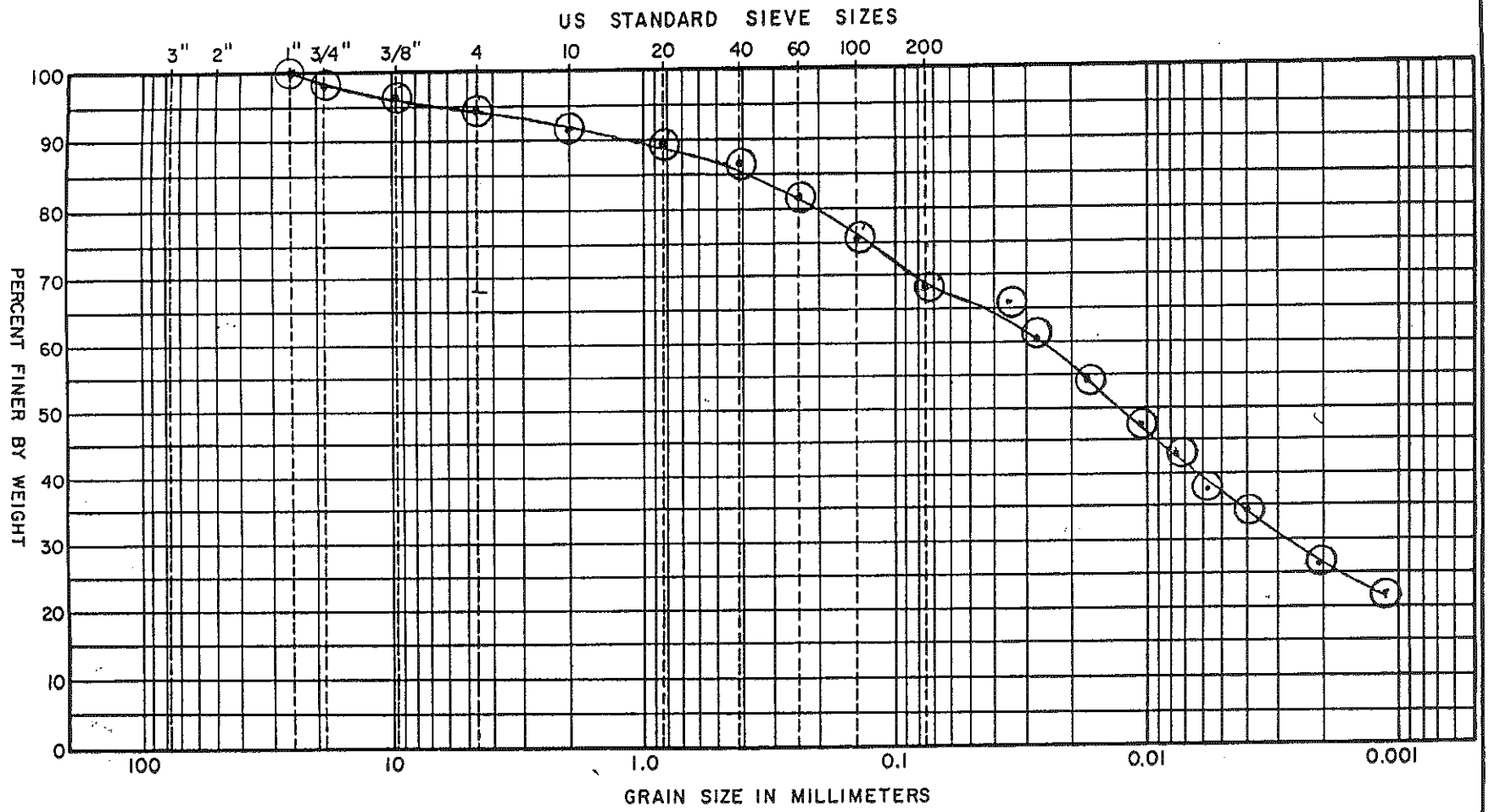
COMPACTION TEST



CURVE 15

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
N-2	—	10.29	26	14	12	Greyish Brown, SILTY CLAY, Some c-f sand, little c-f gravel (CL)

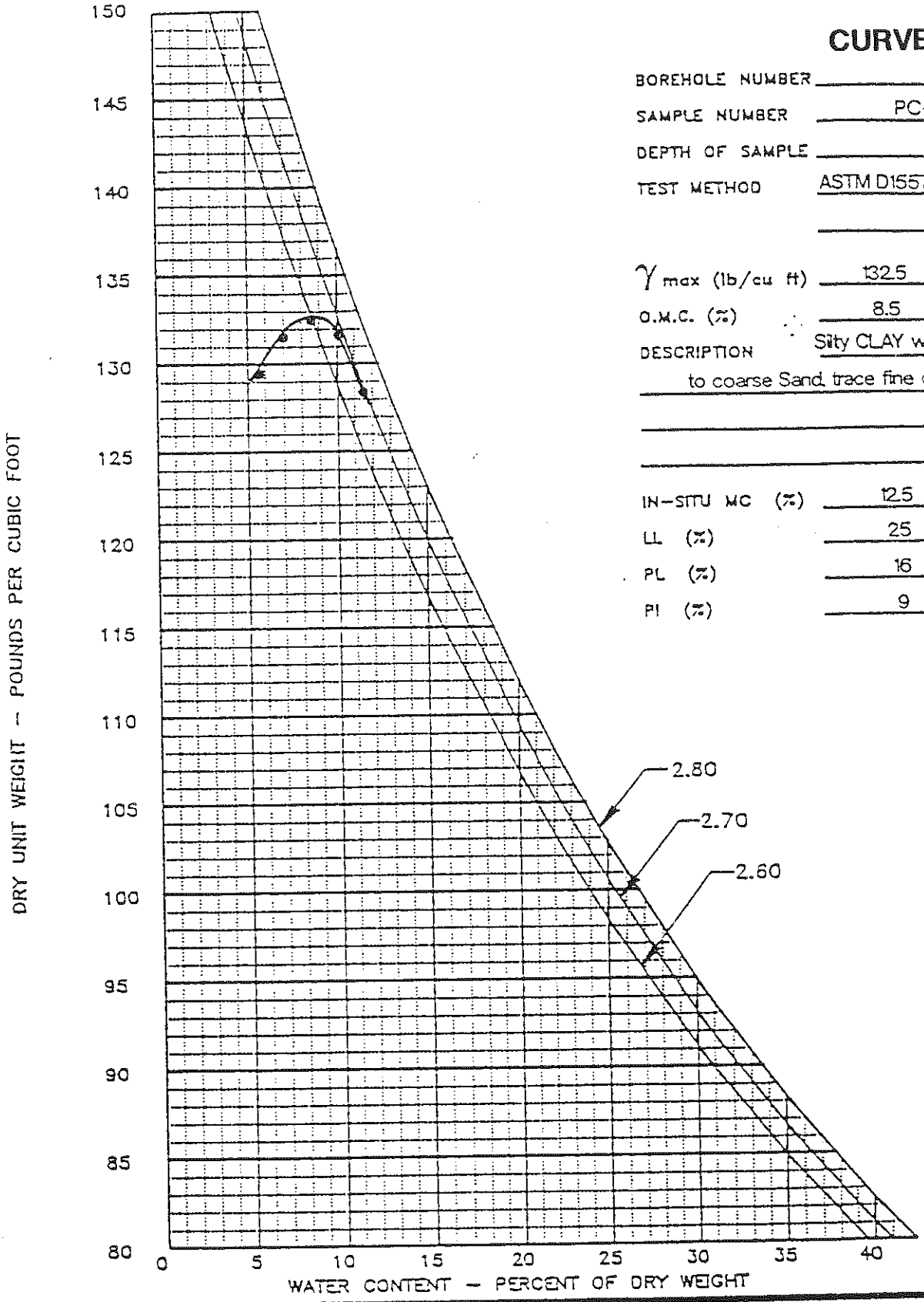
Date 6/30/92
Job No. 163-3708

Golder Associates

Drawn
Checked
Reviewed

AF 26816C

DRAFTRACE 280



CURVE 16

BOREHOLE NUMBER

SAMPLE NUMBER PC-1

DEPTH OF SAMPLE

TEST METHOD ASTM D1557 METHOD A

γ max (lb/cu ft) 132.5

O.M.C. (%) 8.5

DESCRIPTION Silty CLAY with some fine to coarse Sand, trace fine gravel (CL)

IN-STU MC (%) 12.5

LL (%) 25

PL (%) 16

PI (%) 9

Golder Associates Denver, Colorado

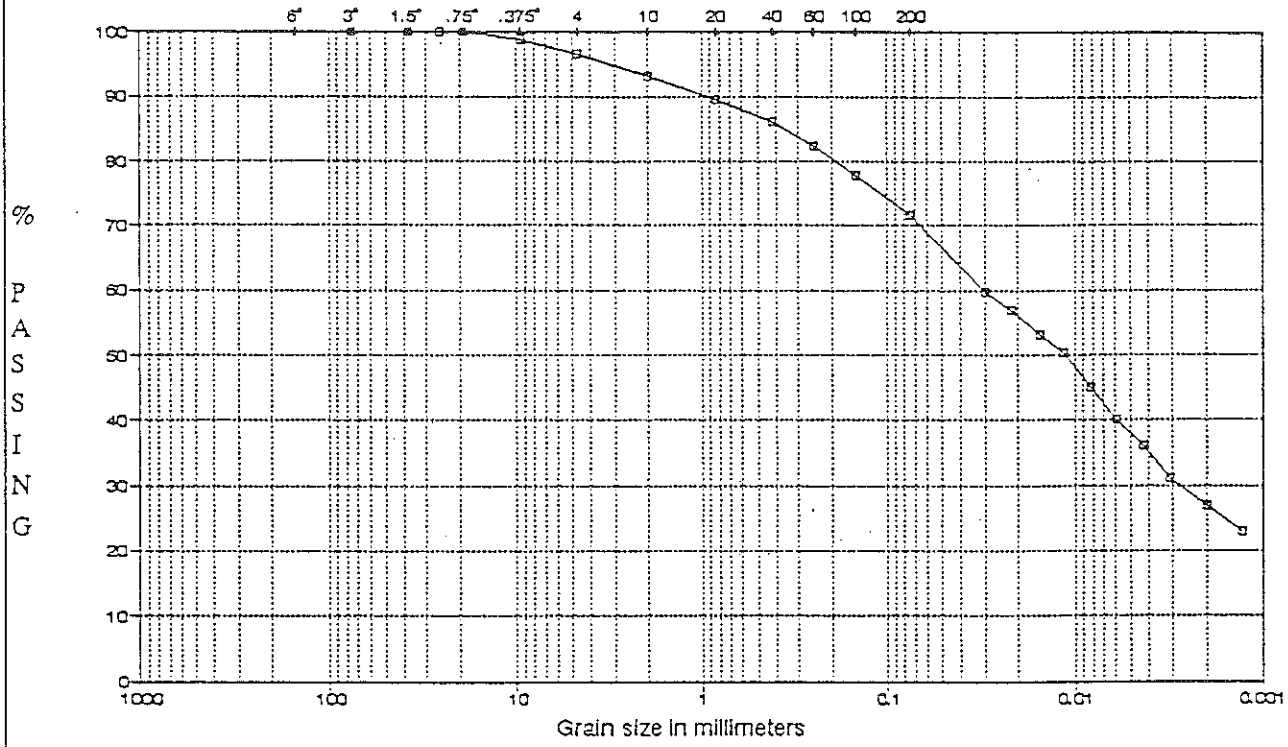
TITLE PROCTOR CURVE PC-1

CLIENT/PROJECT GCS/917-1203/MI

DRAWN CG	DATE AUG 1992	JOB NO.	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED	FILE NO. WATER.DWG	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-1 DEPTH	12.5	25	16	9	2.71	Silty CLAY with some fine to coarse sand, trace fine gravel

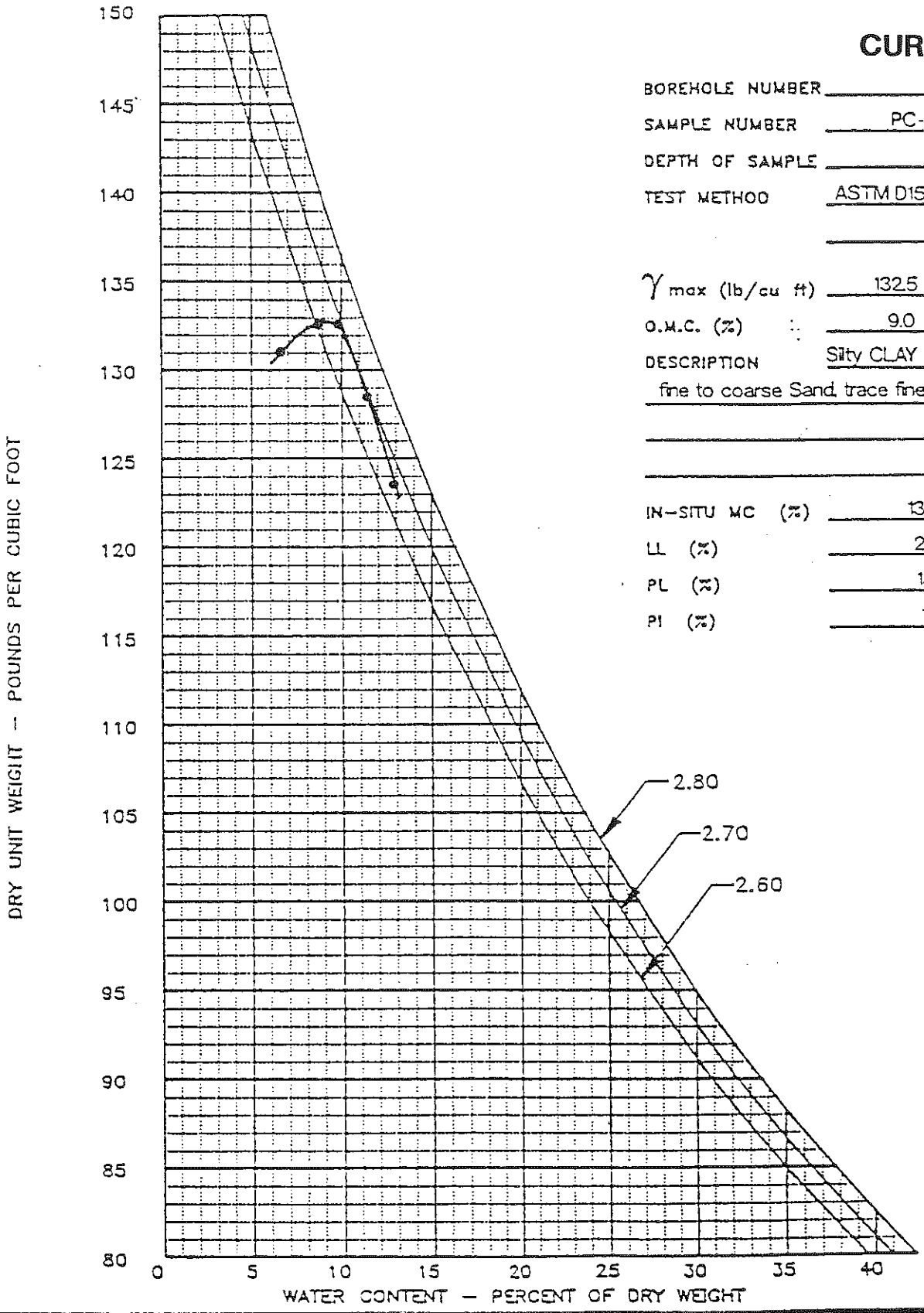
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: CG
DATE: 09/29/92
CHECKED: TT
REVIEWED:

FORD/CELL 2/MI
IC3-2048

FILENAME: 3048PC1

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 17

BOREHOLE NUMBER _____

SAMPLE NUMBER PC-2

DEPTH OF SAMPLE _____

TEST METHOD ASTM D1557 METHOD A

γ max (lb/cu ft) 132.5

O.M.C. (%) 9.0

DESCRIPTION Silty CLAY with some fine to coarse Sand, trace fine gravel (CL)

IN-SITU MC (%) 13.9

LL (%) 26

PL (%) 15

PI (%) 11

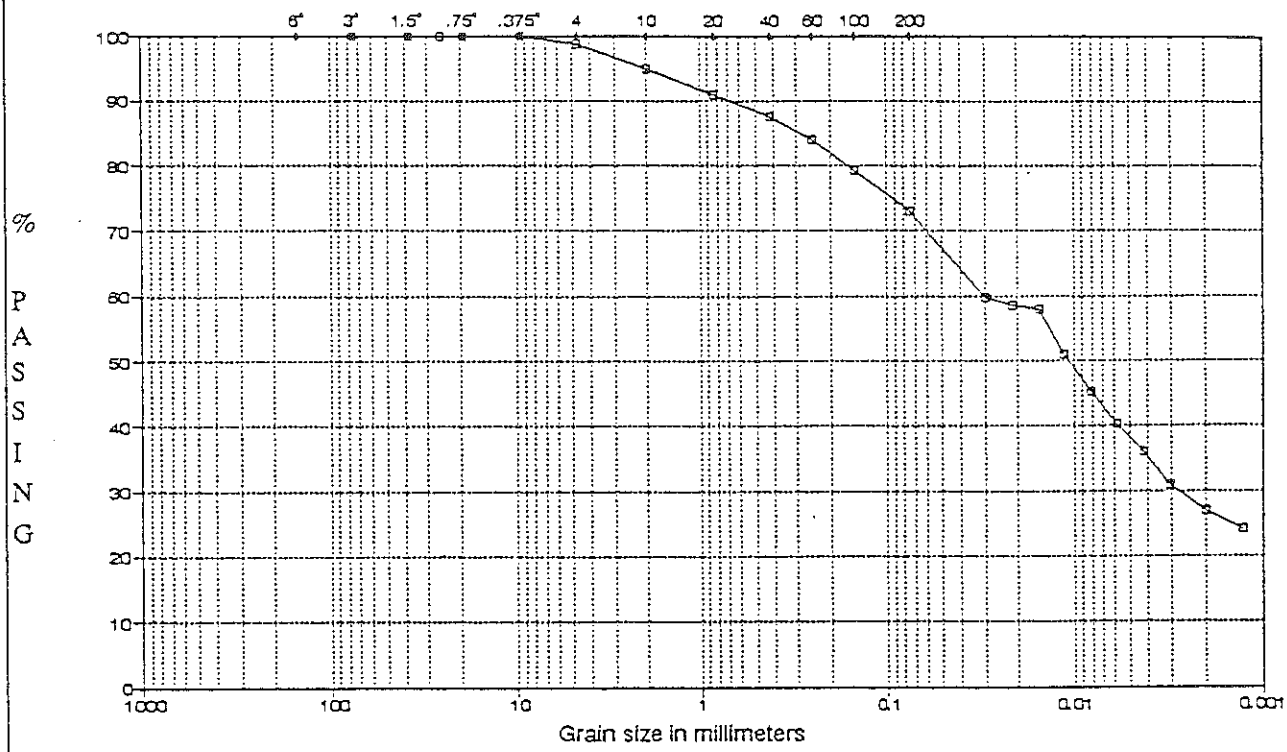
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-2

CLIENT/PROJECT	DRAWN CG	DATE AUG 1992	JOB NO.
GCS/917-1203/MI	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED	FILE NO. WATER.DWG	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	Coarse	Fine	Cor	Med	Fine	FINES (Silt and Clay)
		GRAVEL		SAND			

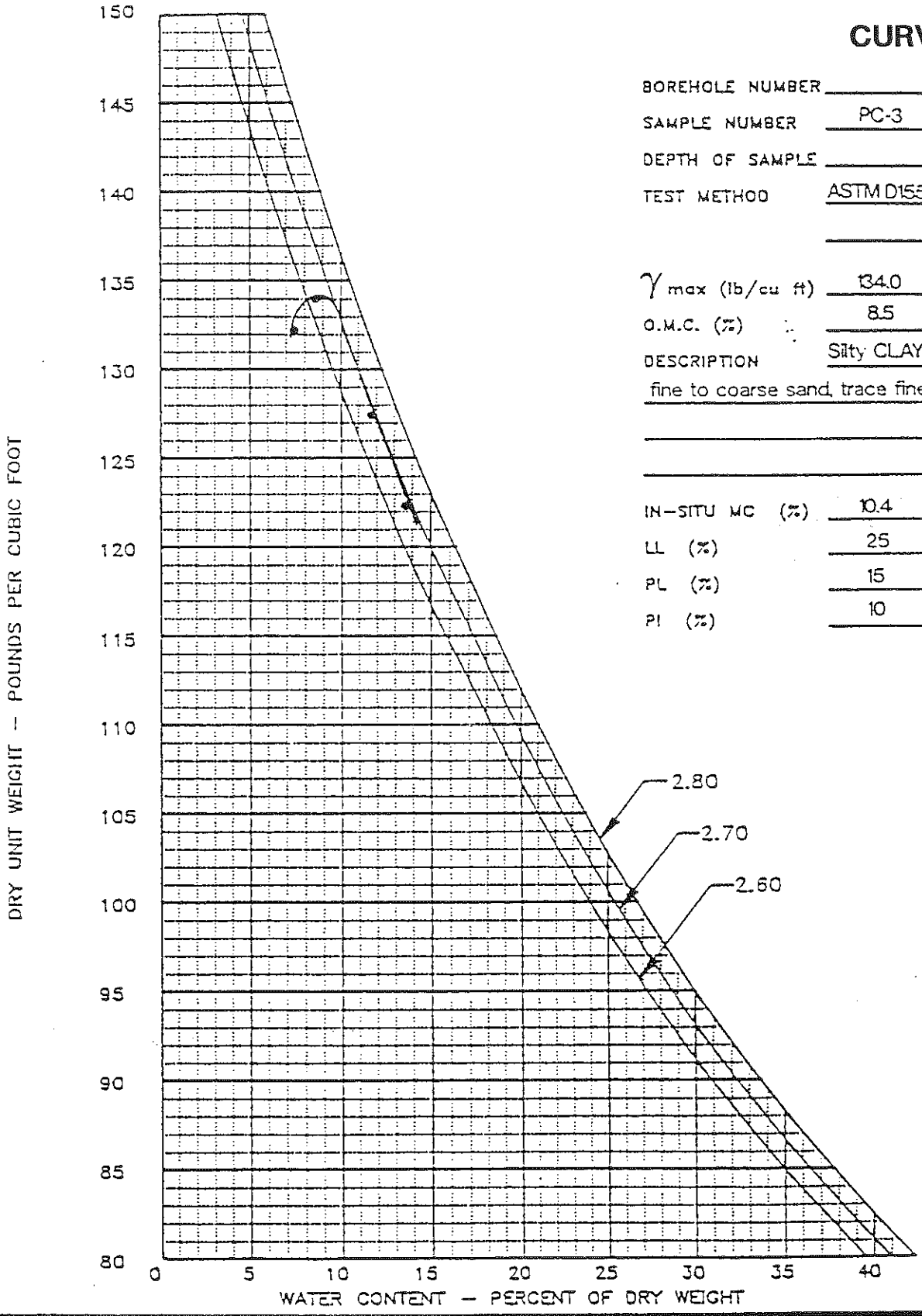
SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-2 DEPTH	13.9	26	15	11	2.75	Silty CLAY with some fine to coarse sand, trace fine gravel
Sample Type:	Date Tested: AUGUST 1992					USCS: CL

TECH: MS
DATE: 09/29/92
CHECKED: TT
REVIEWED:

FORD/CELL 2/MI
IC3-2048

FILENAME: 3048PC2

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 18

BOREHOLE NUMBER _____

SAMPLE NUMBER PC-3

DEPTH OF SAMPLE _____

TEST METHOD ASTM D1557 METHOD A

γ max (lb/cu ft) 134.0

O.M.C. (%) 8.5

DESCRIPTION Silty CLAY with some fine to coarse sand, trace fine gravel (CL)

IN-SITU MC (%) 10.4

LL (%) 25

PL (%) 15

PI (%) 10

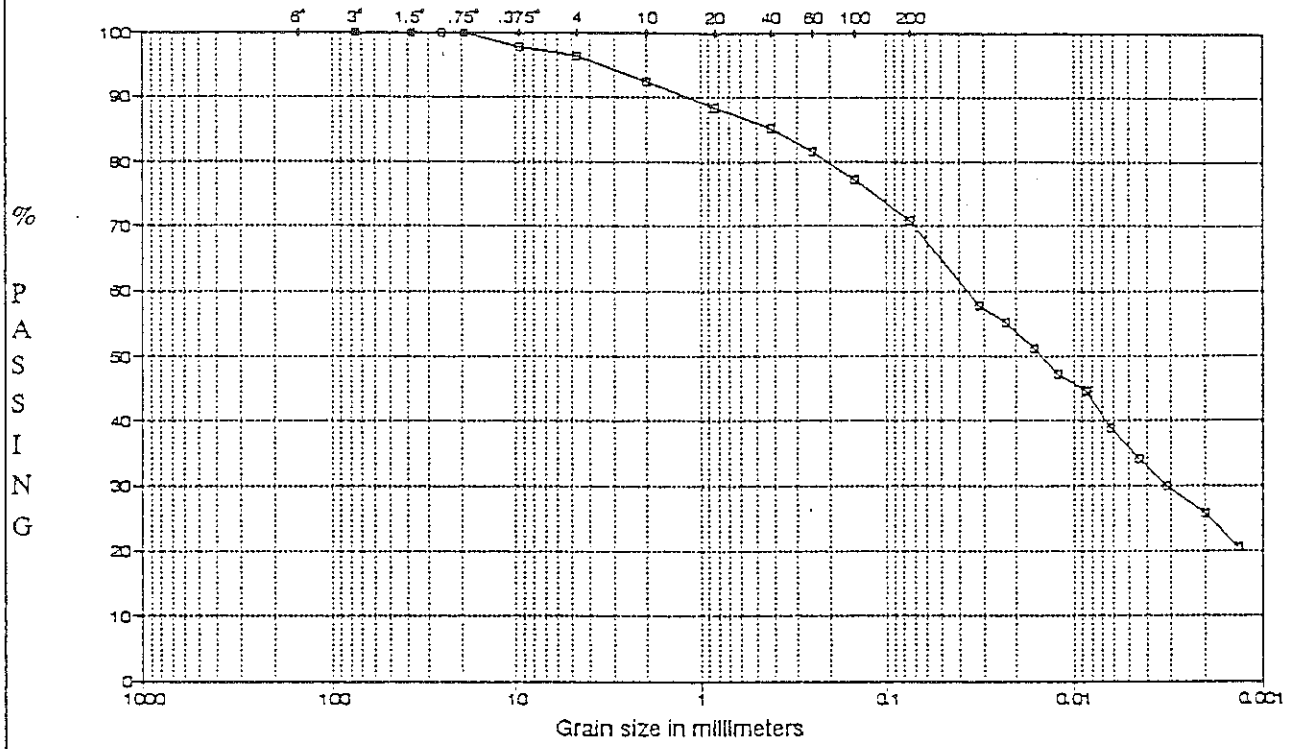
Golder Associates Denver, Colorado

TITLE PROCTOR CURVE PC-3

CLIENT/PROJECT	DRAWN MS	DATE AUG 1992	JOB NO. IC3-2048
GCS/917-1203/MI	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-3 DEPTH	10.4	25	15	10	2.72	Silty CLAY with some fine to coarse sand, trace fine gravel

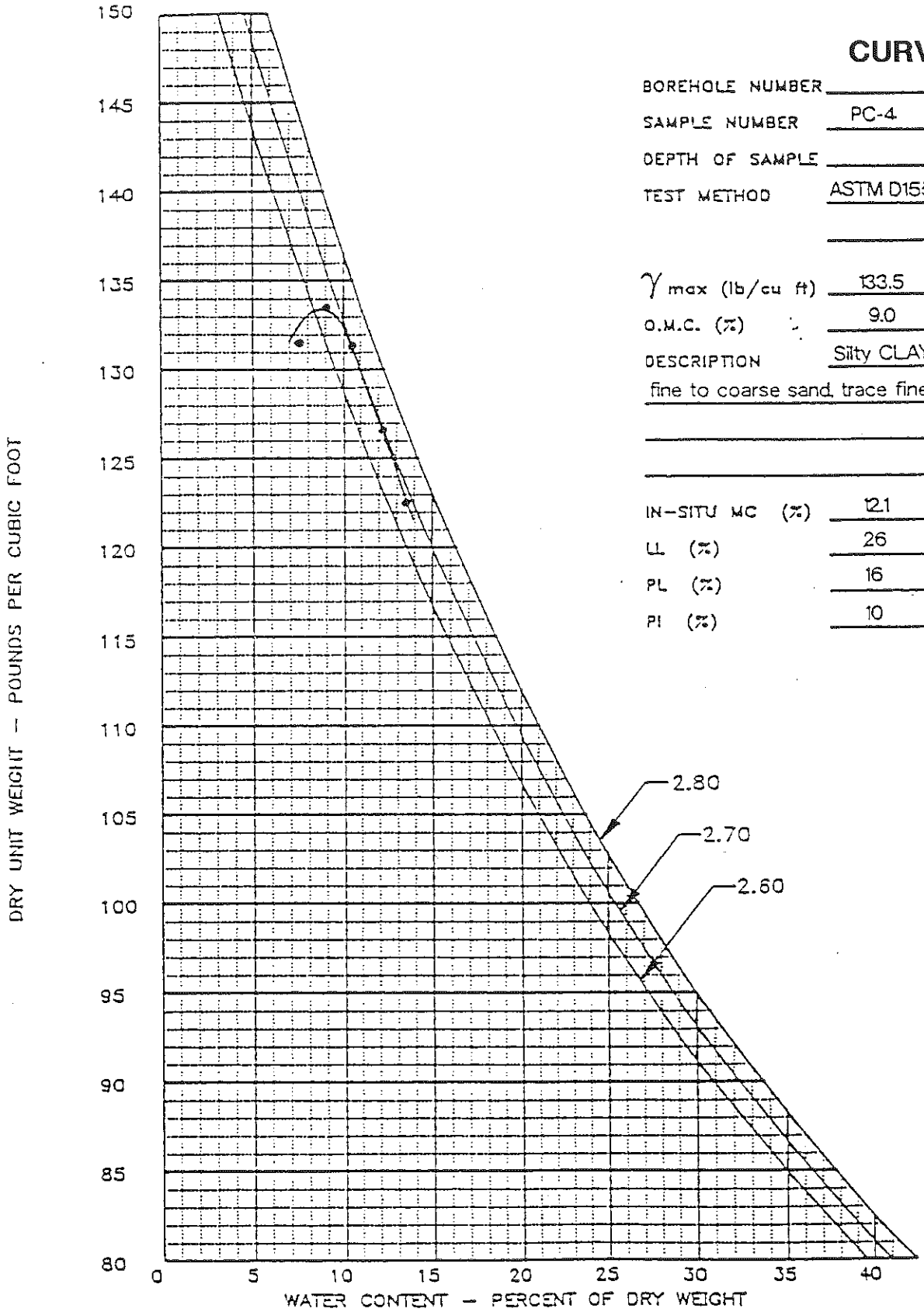
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: CG
DATE: 09/29/92
CHECKED: TT
REVIEWED:

GCS/917-1203/MI
IC3-2048

FILENAME 2048PC3

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 19

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-4
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	133.5
O.M.C. (%)	9.0
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	12.1
LL (%)	26
PL (%)	16
PI (%)	10

Golder Associates Denver, Colorado

TITLE

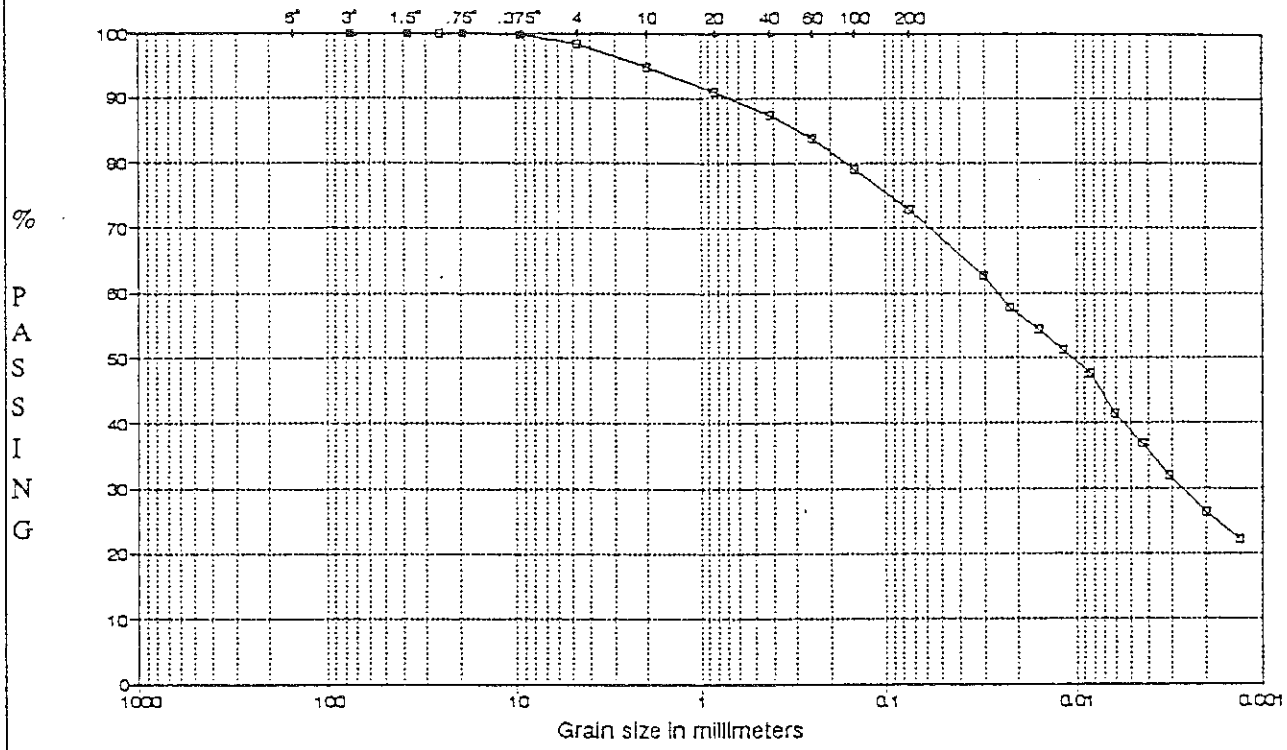
PROCTOR CURVE
PC-4

CLIENT/PROJECT

GCS/917-1203/MI

DRAWN	MS	DATE	AUG 1992	JOB NO.	IC3-2048
CHECKED	TT	SCALE		DWG NO./REV. NO.	
REVIEWED		FILE NO.		FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-4 DEPTH	12.1	26	16	10	2.72	Silty CLAY with some fine to coarse sand, trace fine gravel

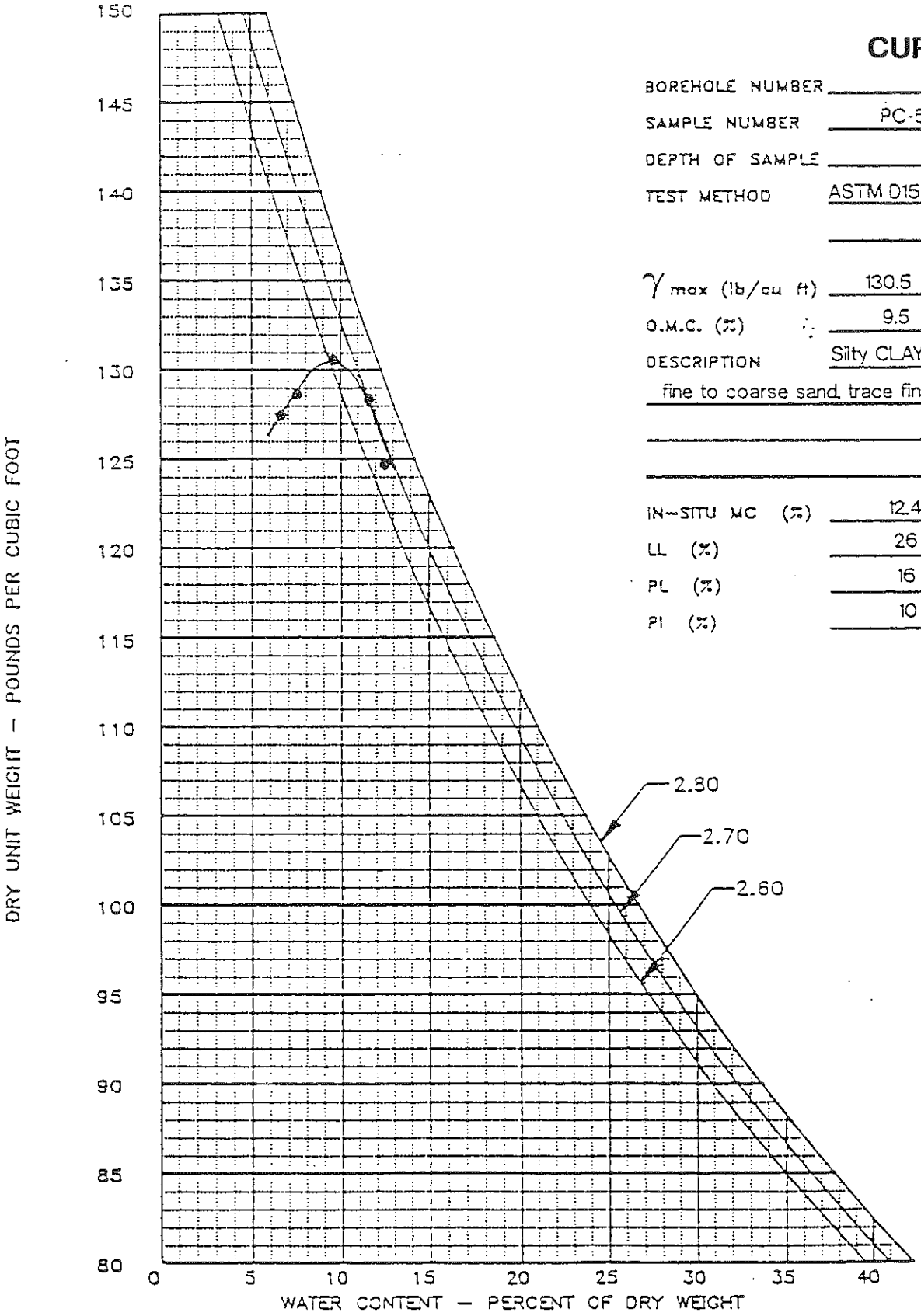
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: CG
DATE: 09/29/92
CHECKED: TT
REVIEWED:

GCS/917-1203/MI
IC3-2048

FILENAME: 2048ed

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 20

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-5
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	130.5
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	12.4
LL (%)	26
PL (%)	16
PI (%)	10

Golder Associates Denver, Colorado

TITLE

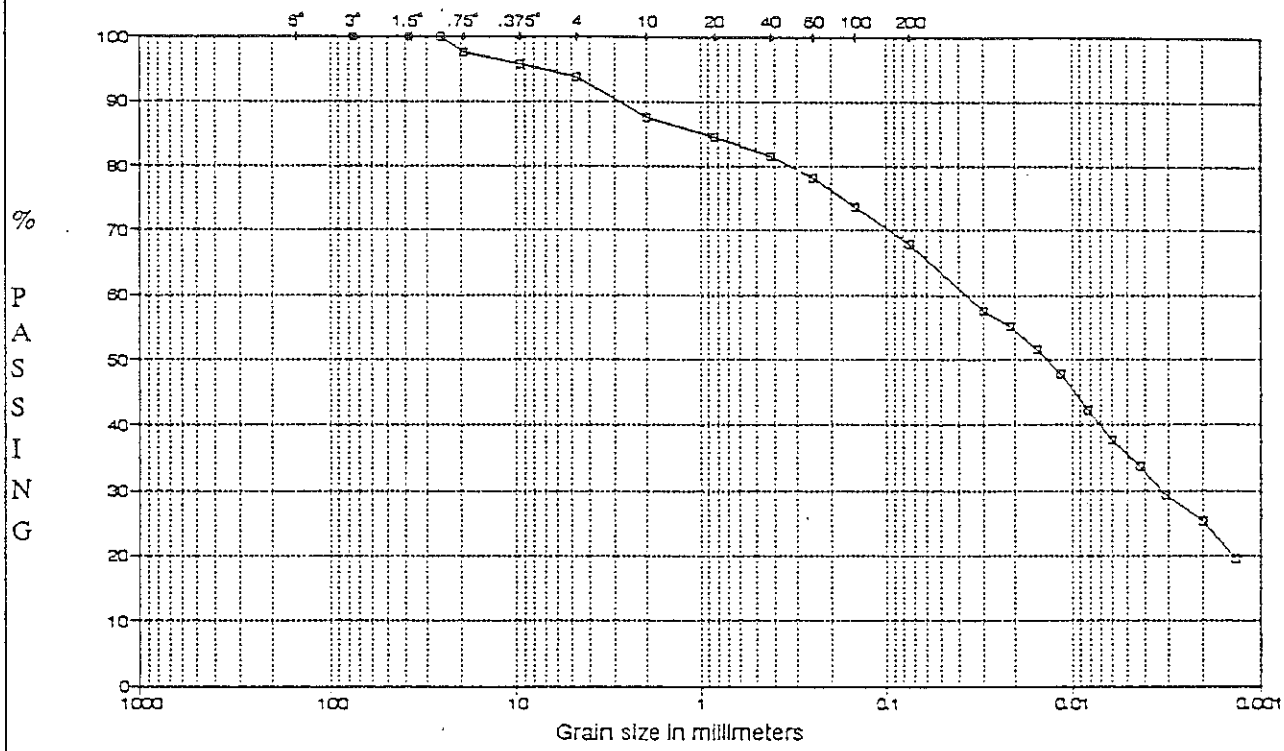
PROCTOR CURVE
PC-5

CLIENT/PROJECT

GCS/927-1203/MI

DRAWN MS	DATE AUG 1992	JOB NO. IC3-2048	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED DR	FILE NO.	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Car	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-5 DEPTH	12.4	26	16	10	2.77	Silty CLAY with some fine to coarse sand, trace fine gravel

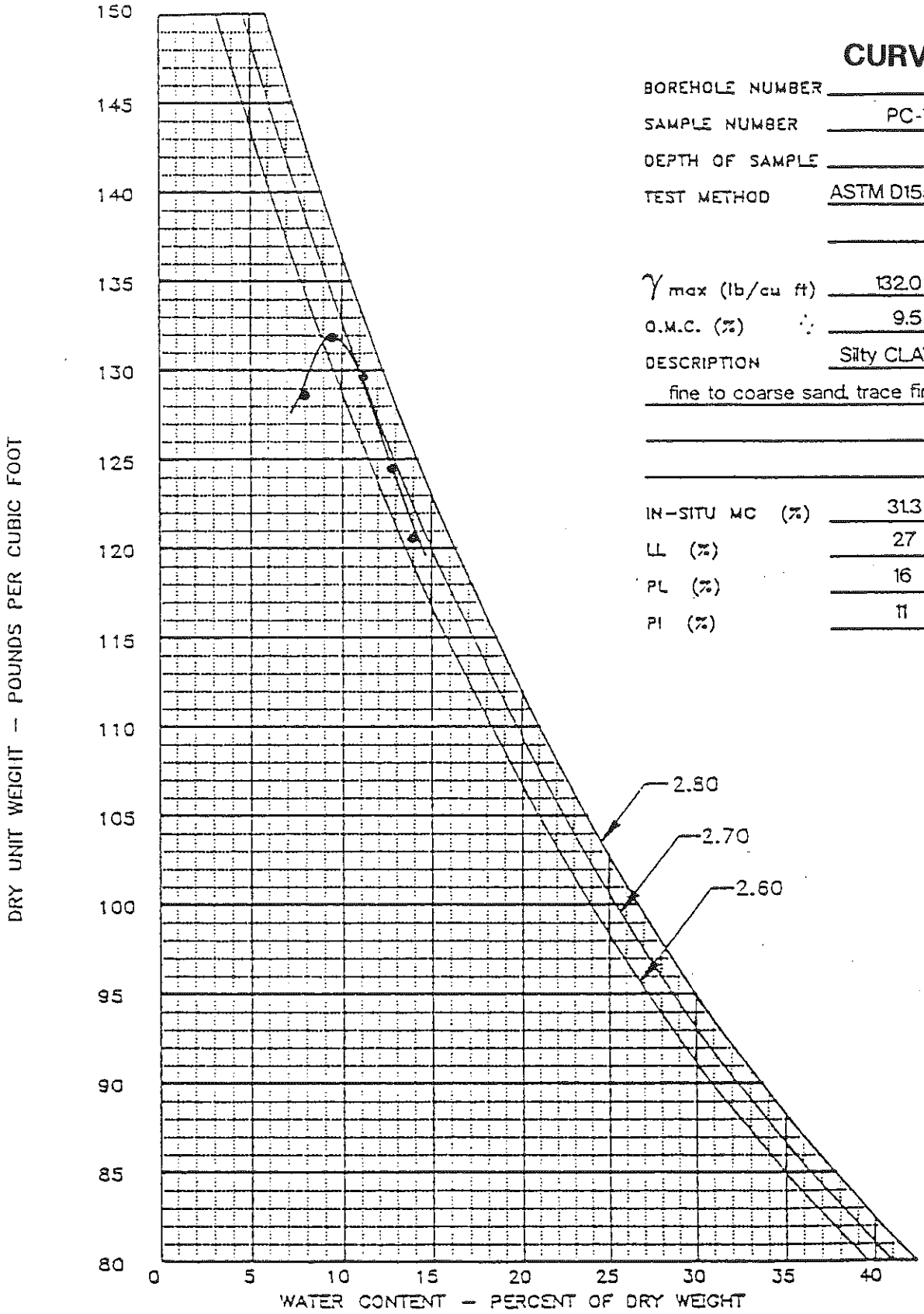
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: MS
DATE: 09/29/92
CHECKED: TT
REVIEWED:

FORD/CELL 2/MI
IC3-2048

FILENAME: 2048PC5

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 21

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-7
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	132.0
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	31.3
LL (%)	27
PL (%)	16
PI (%)	11

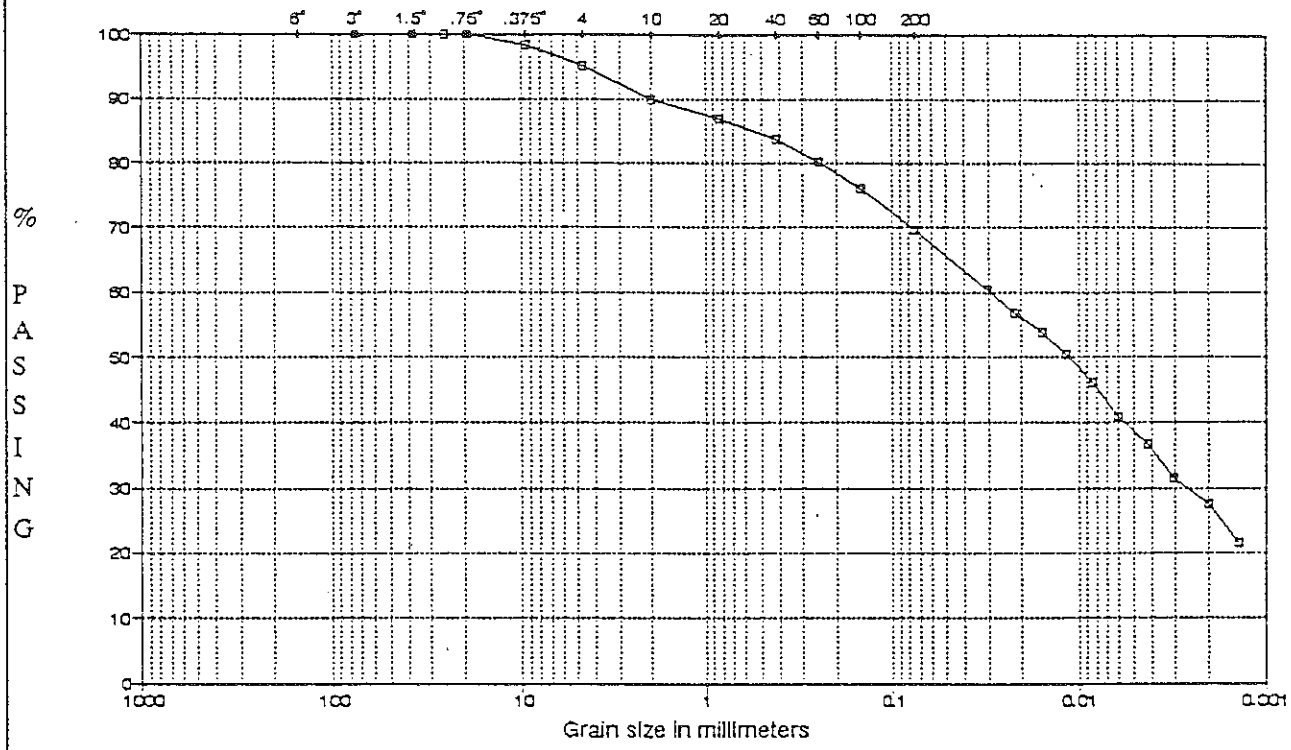
Golder Associates Denver, Colorado

TITLE: PROCTOR CURVE PC-7

CLIENT/PROJECT: GCS/927-1203/MI

DRAWN CG	DATE AUG 1992	JOB NO. IC3-2048
CHECKED TT	SCALE	DWG NO./REV. NO.
REVIEWED DR	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-7 DEPTH	11.8	27	16	11	2.73	Silty CLAY with some fine to coarse sand, trace fine gravel

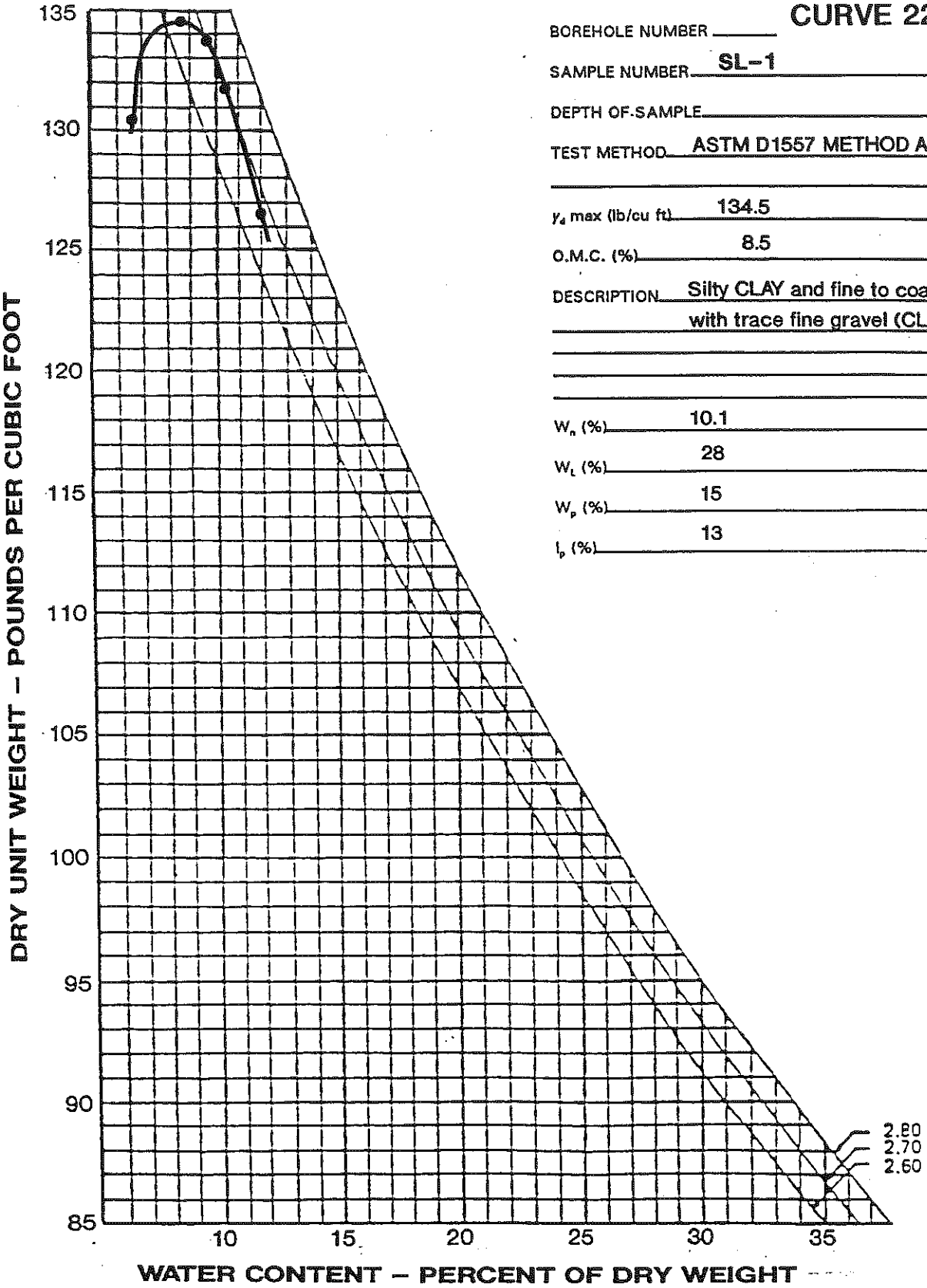
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: MS
DATE: 09/29/92
CHECKED: TT
REVIEWED: DR

FORD/CELL 2/MI
IC3-2048

FILENAME: 2048PC7

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



BOREHOLE NUMBER CURVE 22

SAMPLE NUMBER SL-1

DEPTH OF SAMPLE

TEST METHOD ASTM D1557 METHOD A

γ_d max (lb/cu ft) 134.5

O.M.C. (%) 8.5

DESCRIPTION Silty CLAY and fine to coarse SAND with trace fine gravel (CL).

W_n (%) 10.1

W_L (%) 28

W_p (%) 15

I_p (%) 13

Golder Associates Inc.
Denver, Colorado

CLIENT/PROJECT ECS/917-1203/MI

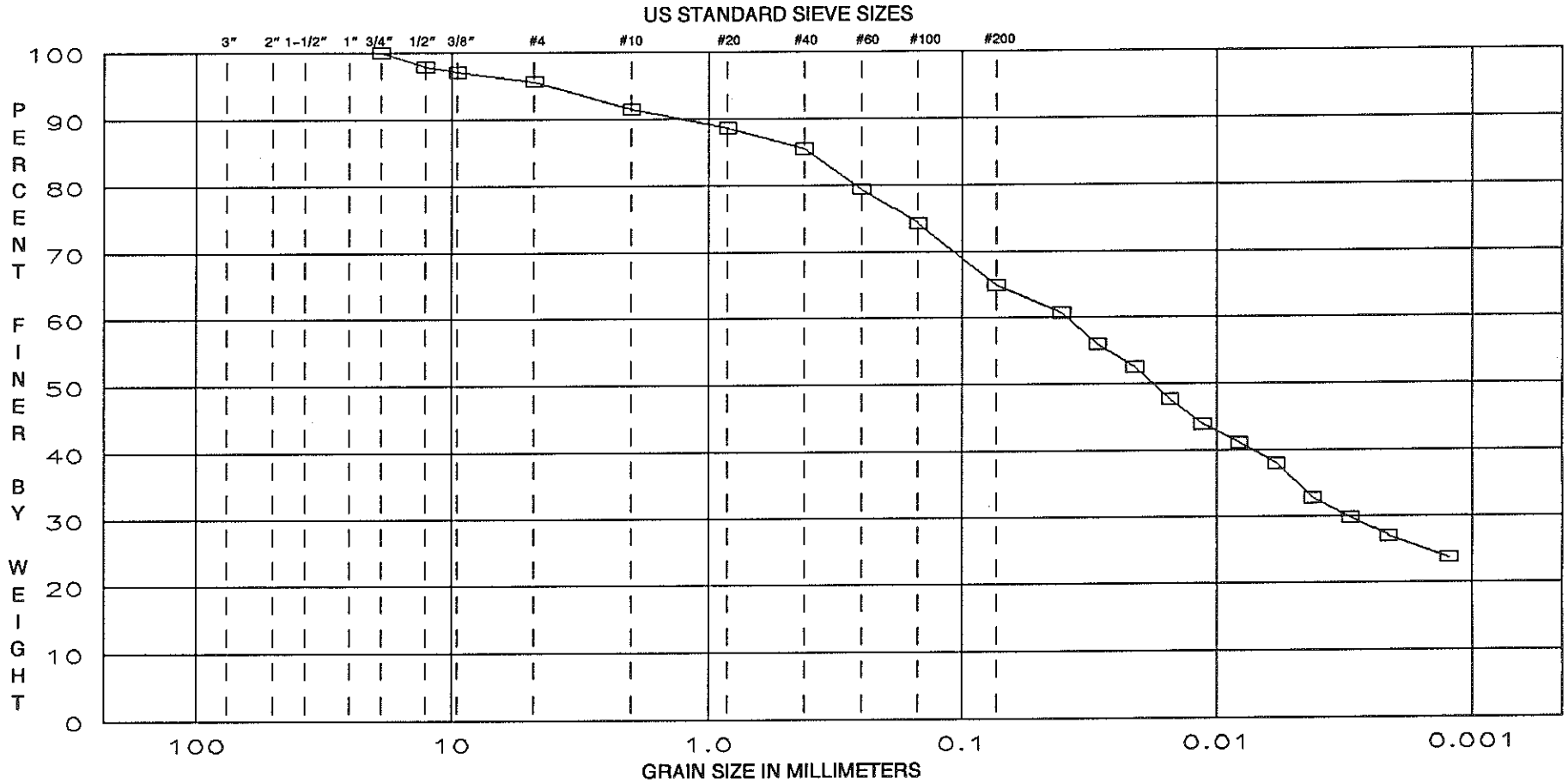
TITLE PROCTOR CURVE SL-1

DATE	SCALE	JOB NO.
JULY 1991	AS SHOWN	913-2346

DRAWN	CHECKED	REVIEWED	FILE	DWG. NO.	FIGURE
MWB	KMR	MES			

Requirement ≥ 25% passing .005 mm.

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Sample No	Depth	MC	LL	PL	PI	DESCRIPTION
	SL-1		10.1	28	15	13	Silty CLAY and fine to coarse SAND with trace fine gravel (CL)

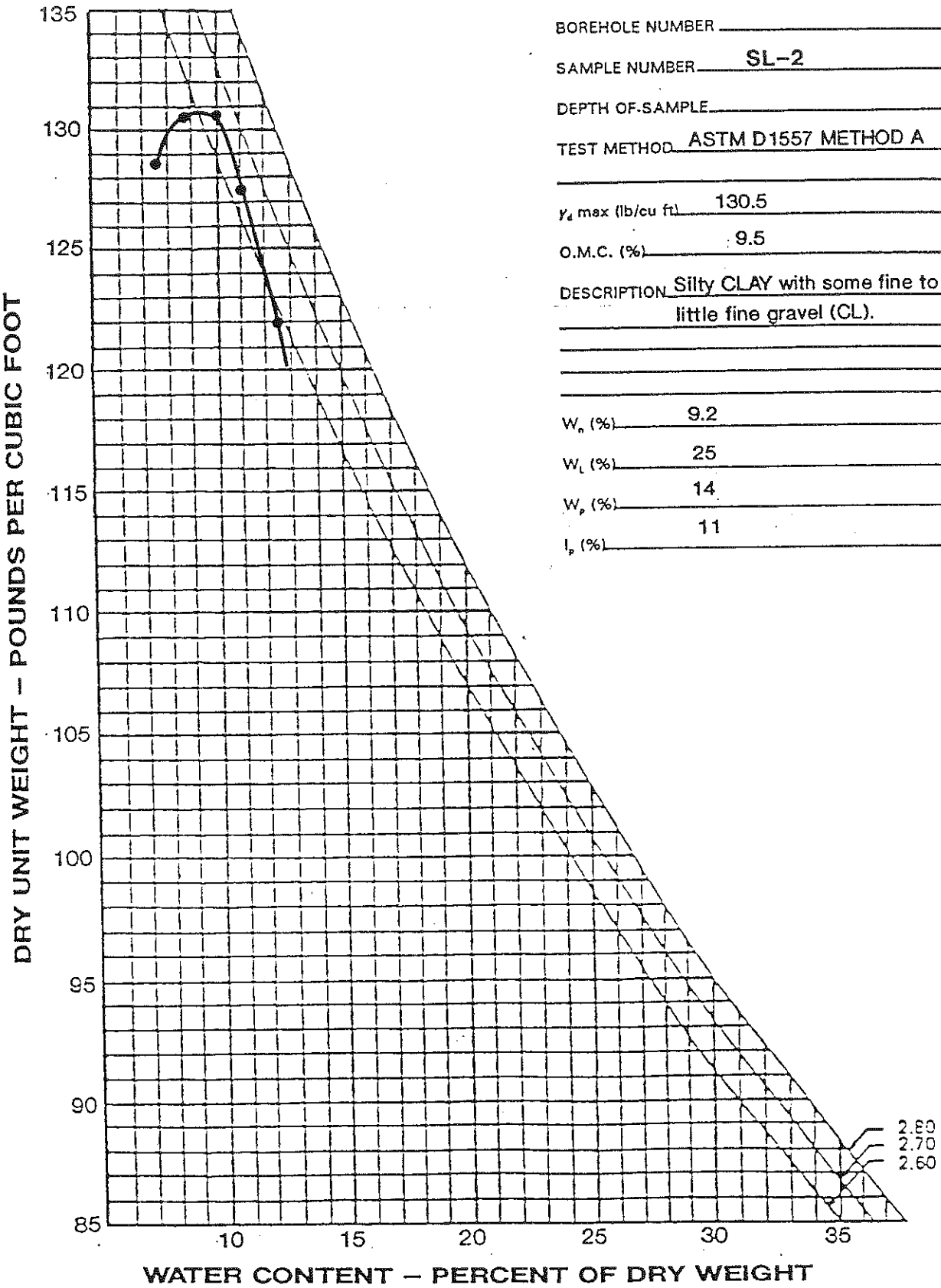
JOB NUMBER: 913-2346
DATE: JULY 1991
PROJECT: ECS/917-1203
LOCATION: MICHIGAN
CHECKED: KMR
REVIEWED: MES

FIGURE

GOLDER ASSOCIATES INC.

FILE NAME: 2346SL-1.WK1

CURVE 22A



BOREHOLE NUMBER

SAMPLE NUMBER SL-2

DEPTH OF SAMPLE

TEST METHOD ASTM D1557 METHOD A

γ_d max (lb/cu ft) 130.5

O.M.C. (%) 9.5

DESCRIPTION Silty CLAY with some fine to coarse sand, little fine gravel (CL).

W_n (%) 9.2

W_L (%) 25

W_p (%) 14

I_p (%) 11

Golder Associates Inc.
Denver, Colorado

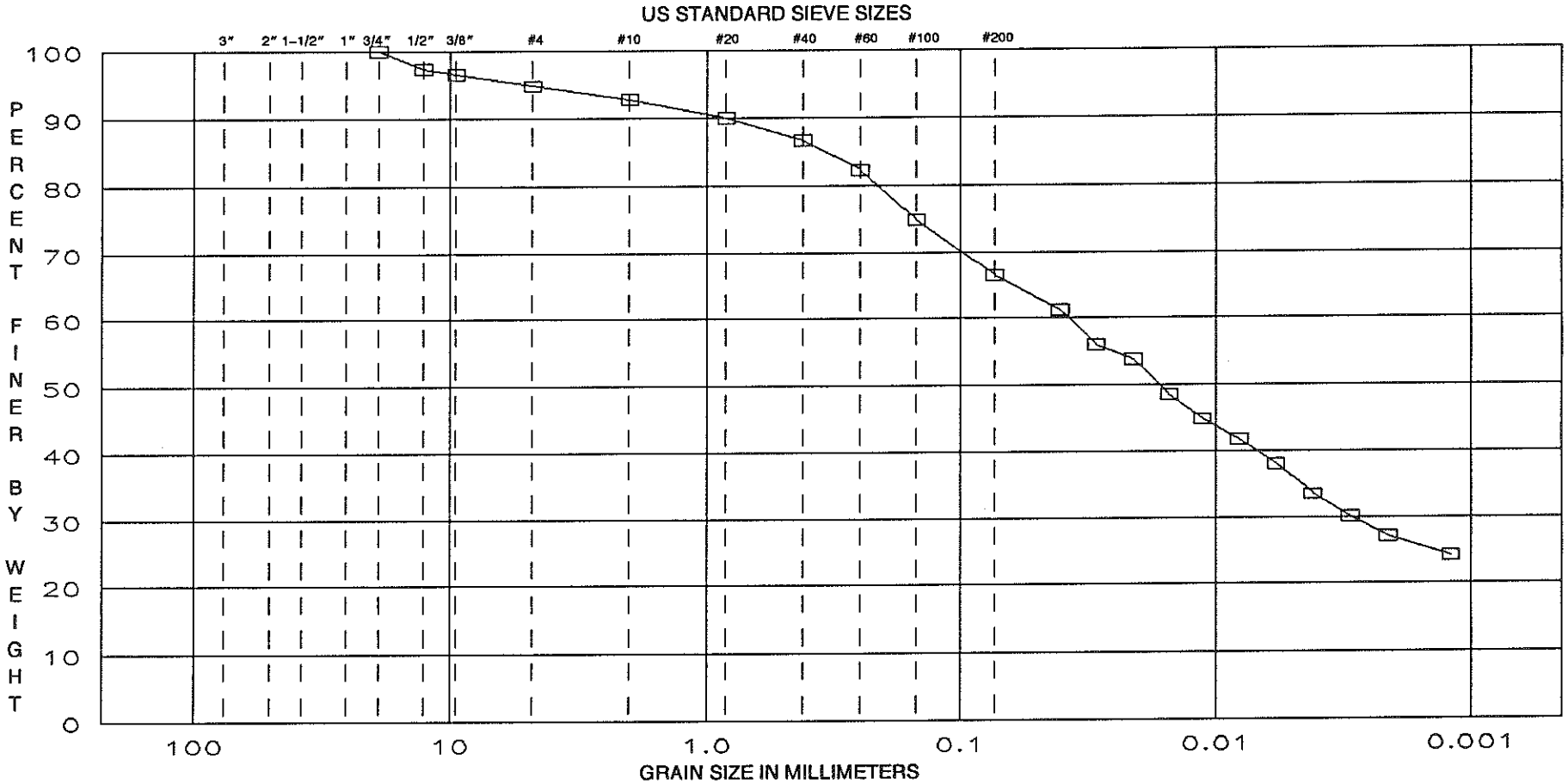
TITLE: PROCTOR CURVE SL-2

CLIENT/PROJECT: ECS/917-1203/MI

DATE	SCALE	JOB NO.
JULY 1991	AS SHOWN	913-2346

DRAWN	CHECKED	REVIEWED	FILE	DWG. NO.	FIGURE
TJS	KMR	MES			

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

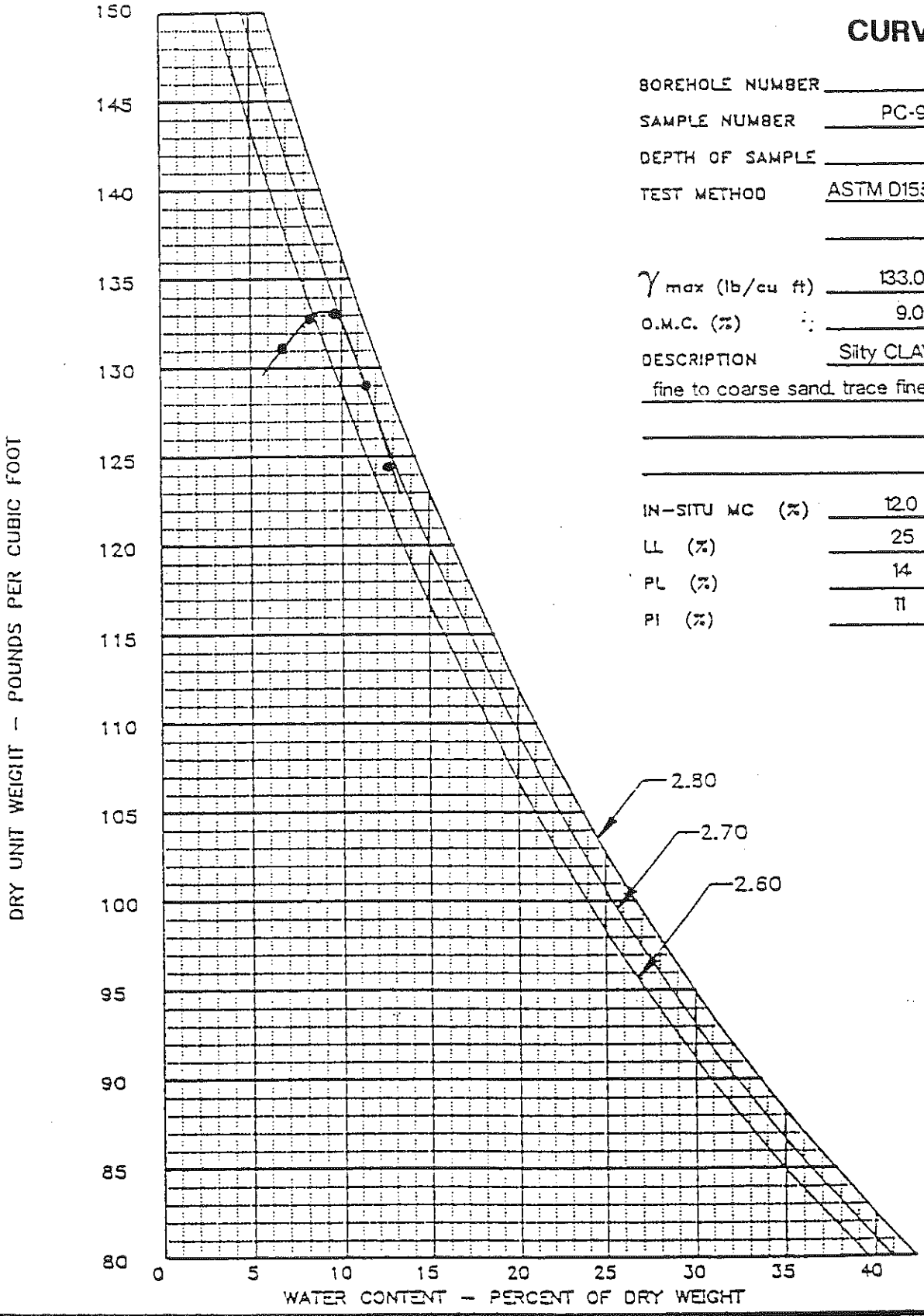
Boring No.	Sample No	Depth	MC	LL	PL	PI	DESCRIPTION
	SL-2		9.2	25	14	11	Silty CLAY with some fine to coarse sand, fine gravel (CL)

JOB NUMBER: 913-2346
DATE: JULY 1991
PROJECT: ECS/917-1203
LOCATION: MICHIGAN
CHECKED: KMR
REVIEWED: MES

FIGURE

GOLDER ASSOCIATES INC.

FILE NAME: 2346SL-2.WK1



CURVE 23

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-9
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	133.0
O.M.C. (%)	9.0
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	12.0
LL (%)	25
PL (%)	14
PI (%)	11

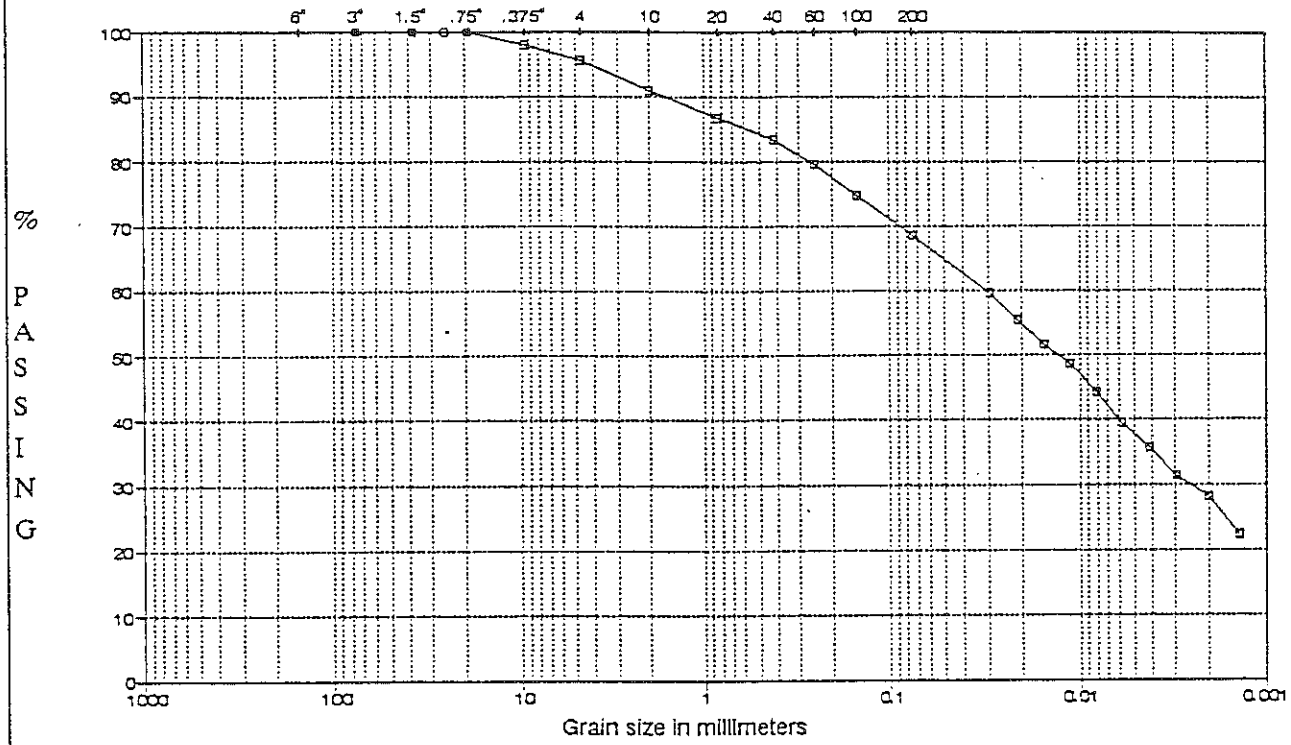
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-9

CLIENT/PROJECT			
GCS/927-1203/MI	DRAWN CG	DATE AUG 1992	JOB NO. IC3-2048
	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED DR	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION-ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-9 DEPTH	12.0	25	14	11	2.70	Silty CLAY with some fine to coarse sand, trace fine gravel

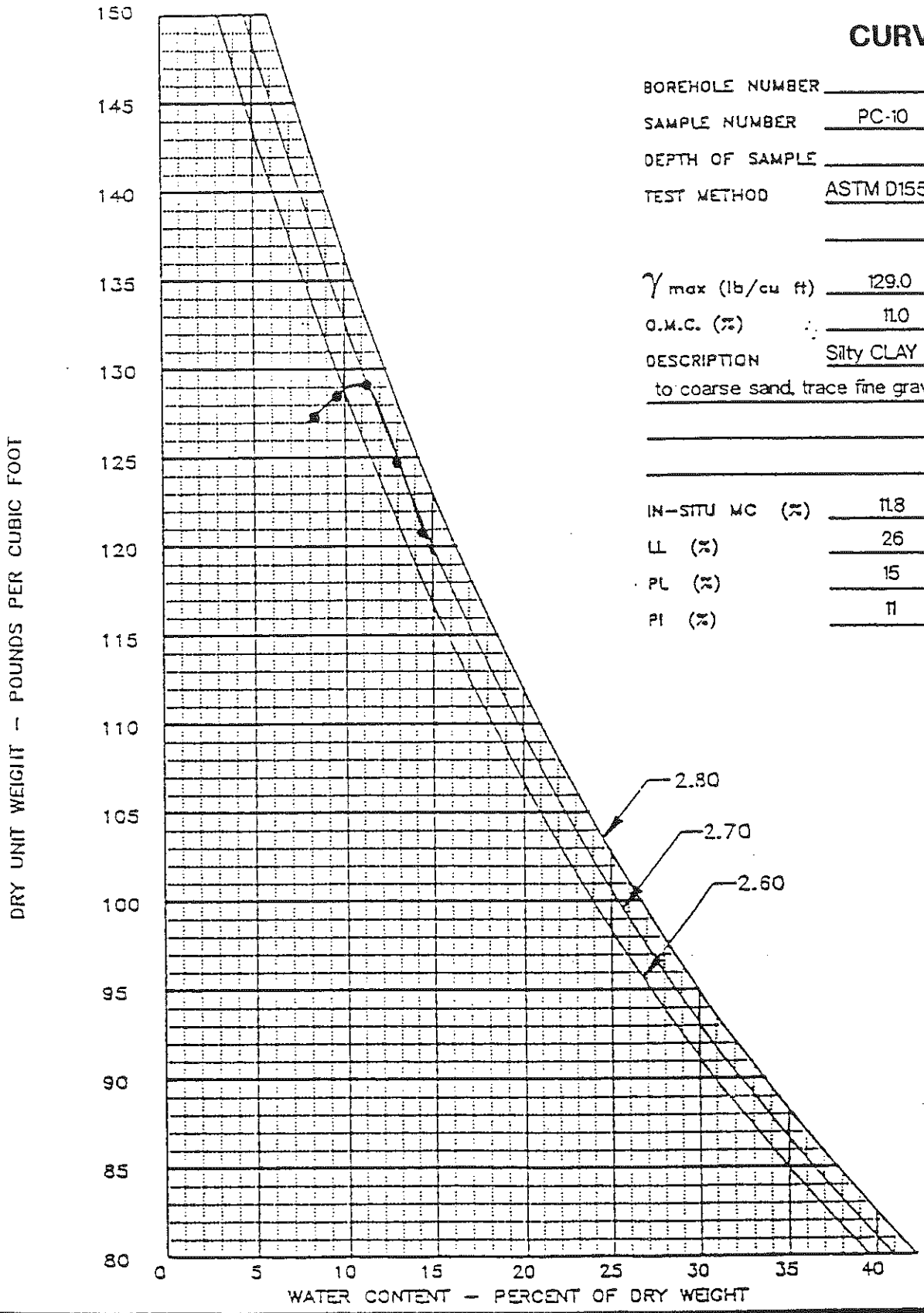
Sample Type: Date Tested: SEPT 1992 USCS: CL

TECH: MS
DATE: 09/29/92
CHECKED: TT
REVIEWED: DR

FORD/CELL 2/MI
IC3-2048

FILENAME: 3048PC9

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 24

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-10
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	129.0
O.M.C. (%)	11.0
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	11.8
LL (%)	26
PL (%)	15
PI (%)	11

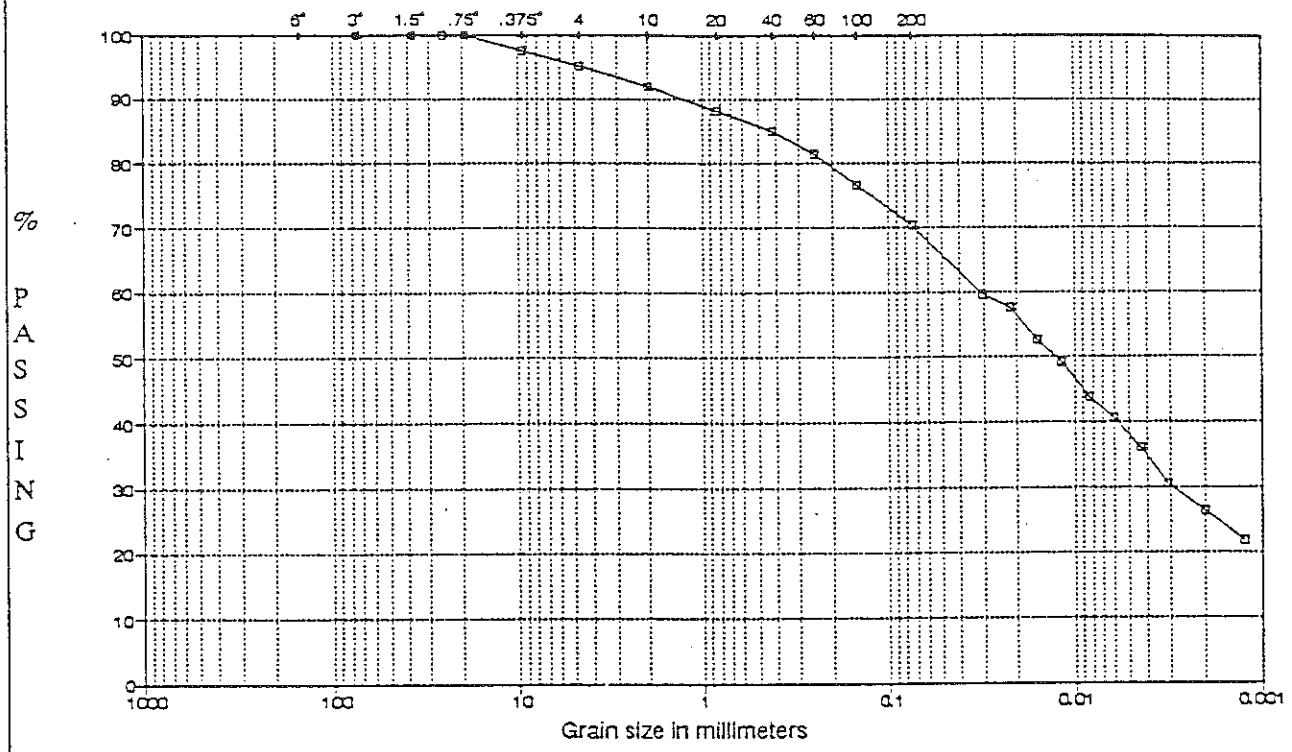
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-10

CLIENT/PROJECT: GCS/927-1203/MI	DRAWN CG	DATE AUG 1992	JOB NO. IC3-2048
	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED DR	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
	Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-10 DEPTH	11.8	26	15	11	2.73	Silty CLAY with some fine to coarse sand, trace fine gravel

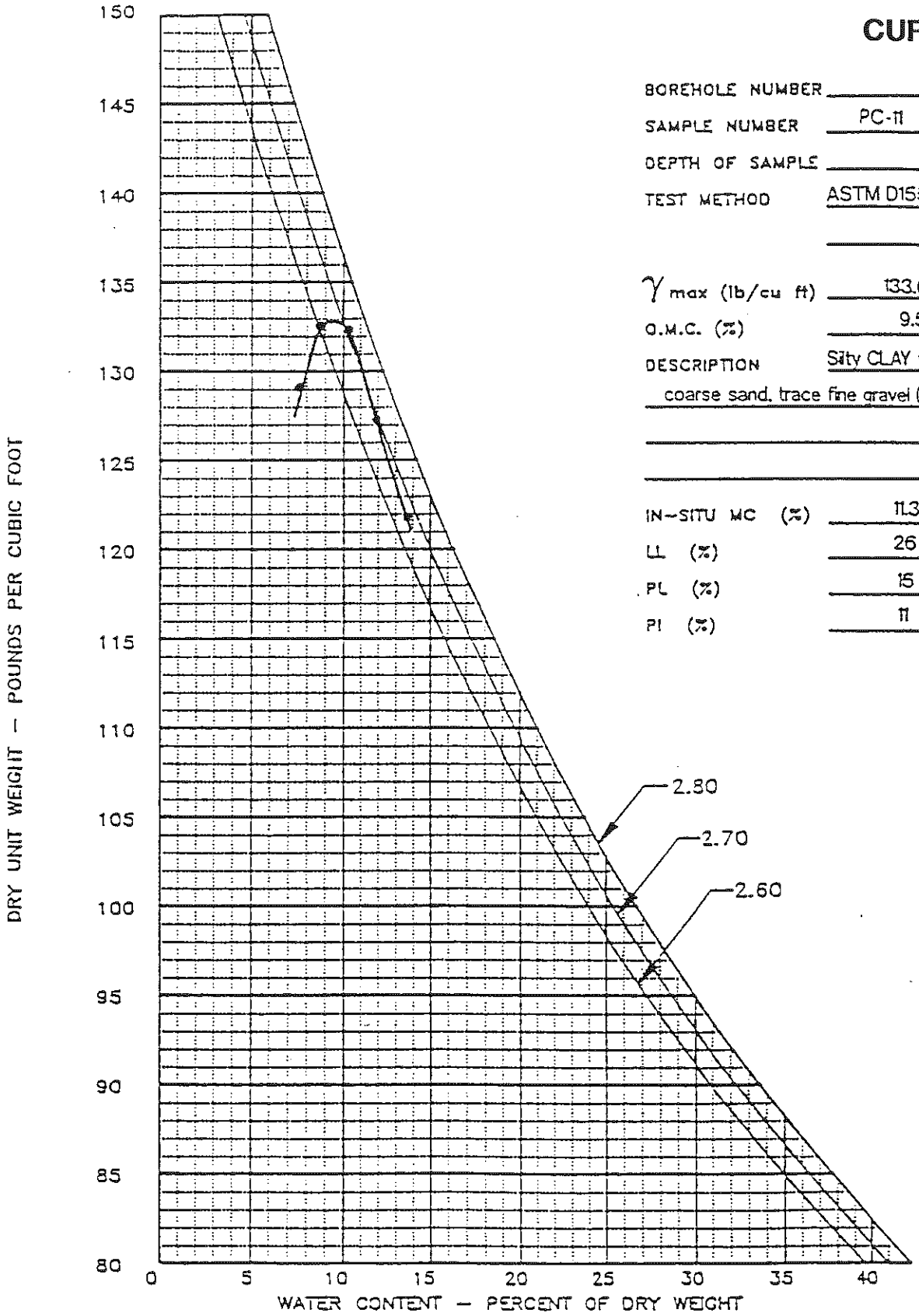
Sample Type: Date Tested: AUGUST 1992 USCS: CL

TECH: MS
DATE: 09/29/92
CHECKED: TT
REVIEWED: DR

FORD/CELL 2/MI
IC3-2048

FILENAME: 2048PC10

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 25

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-11
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	133.0
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine gravel (CL)
IN-SITU MC (%)	11.3
LL (%)	26
PL (%)	15
PI (%)	11

Golder Associates Denver, Colorado

TITLE

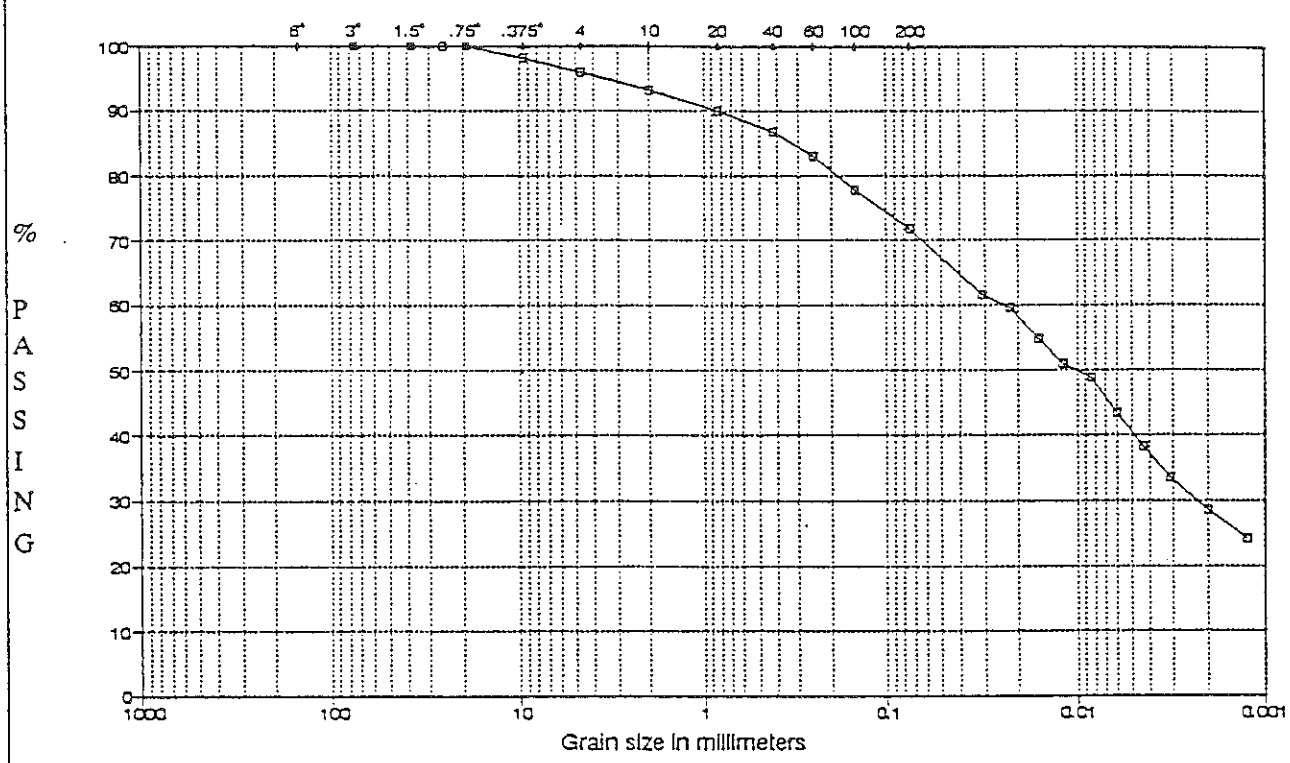
PROCTOR CURVE
PC-11

CLIENT/PROJECT

GCS/927-1203/MI

DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED DR	FILE NO.	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	Coarse	Fine	Cor	Med	Fine	FINES (Silt and Clay)
		GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-11 DEPTH	11.3	26	15	11	2.77	Silty CLAYwith some fine to coarse sand, trace fine gravel

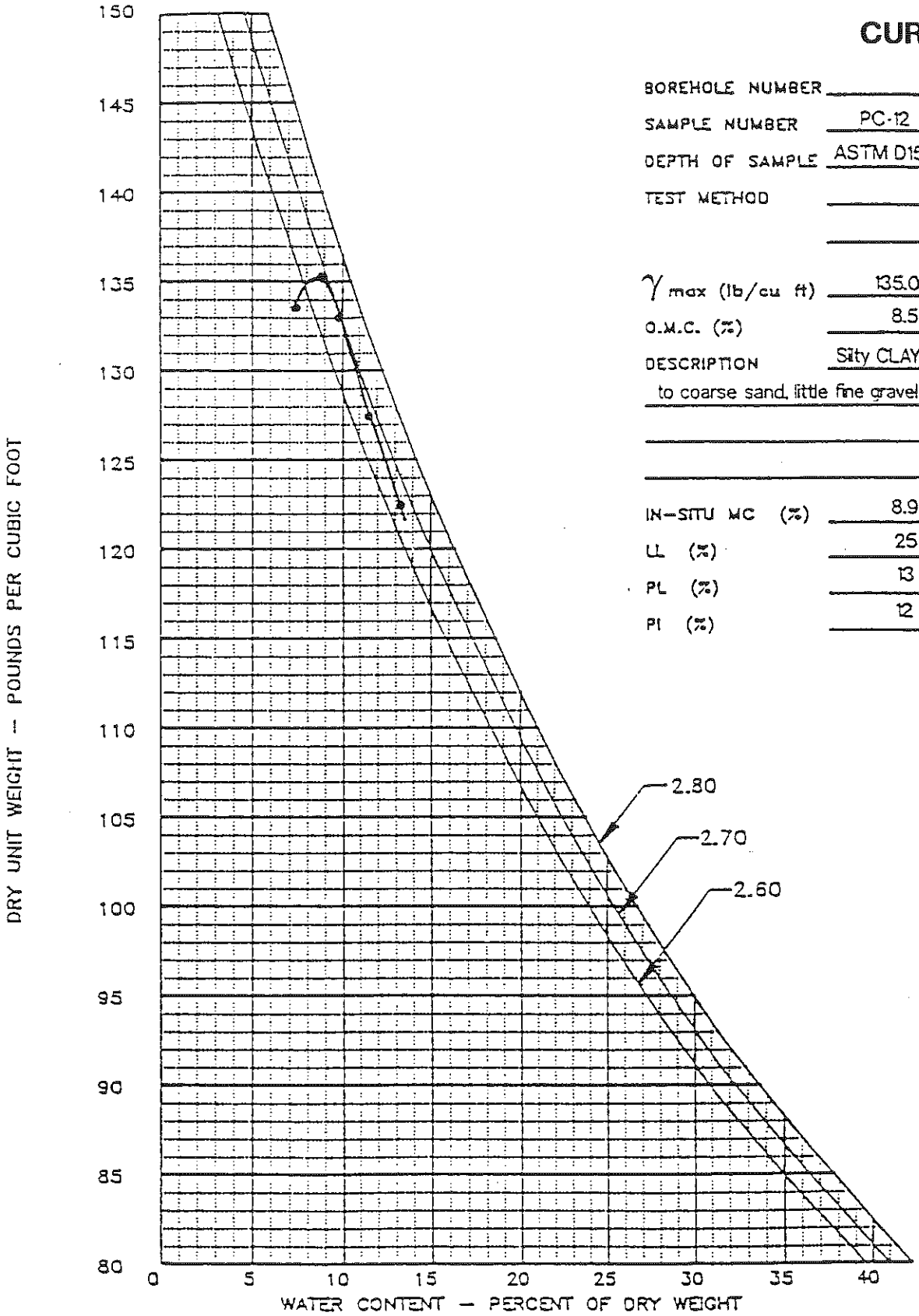
Sample Type: Date Tested: SEPT 1992 USCS: CL

TECH: CG
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PCT1

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 26

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-12
DEPTH OF SAMPLE	ASTM D1557 METHOD A
TEST METHOD	
γ max (lb/cu ft)	135.0
O.M.C. (%)	8.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, little fine gravel (CL)
IN-SITU MC (%)	8.9
LL (%)	25
PL (%)	13
PI (%)	12

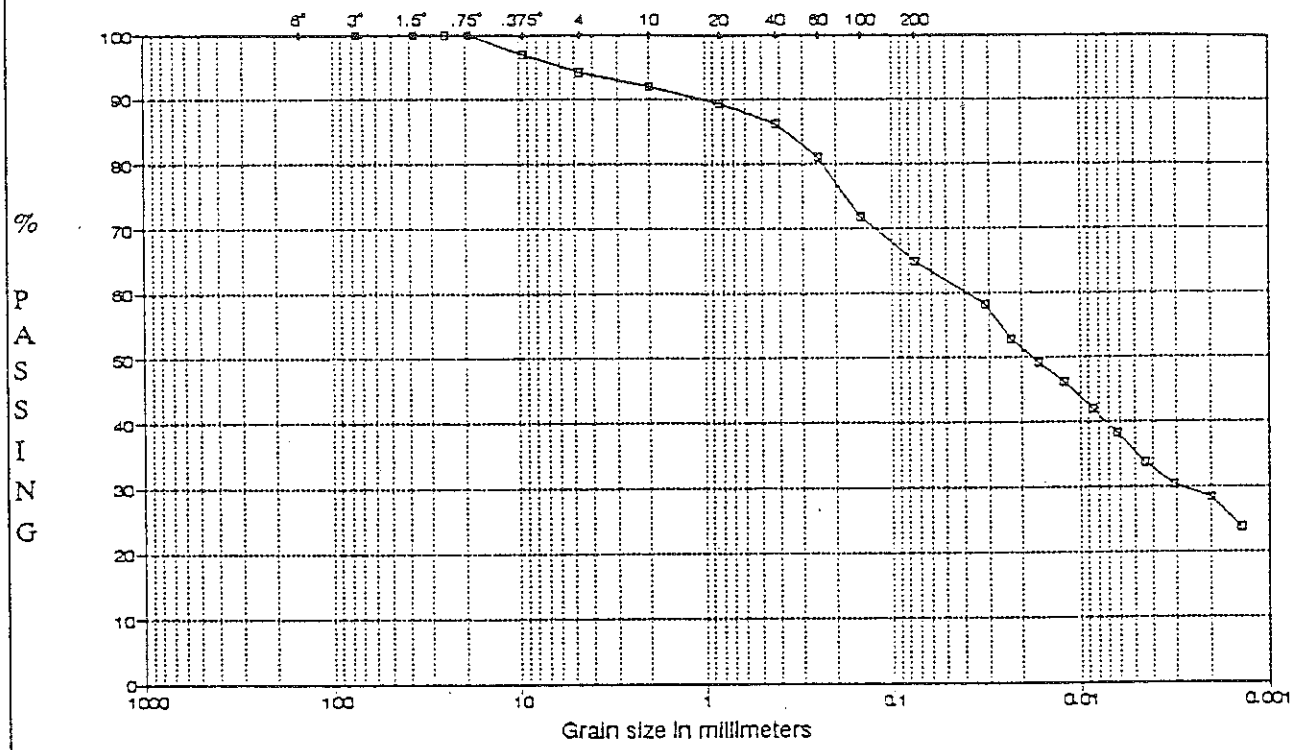
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-12

CLIENT/PROJECT GCS/927-1203/MI	DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048
	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED DR	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-12 DEPTH	8.9	25	13	12	2.70	Silty CLAY and fine to coarse SAND, trace fine gravel

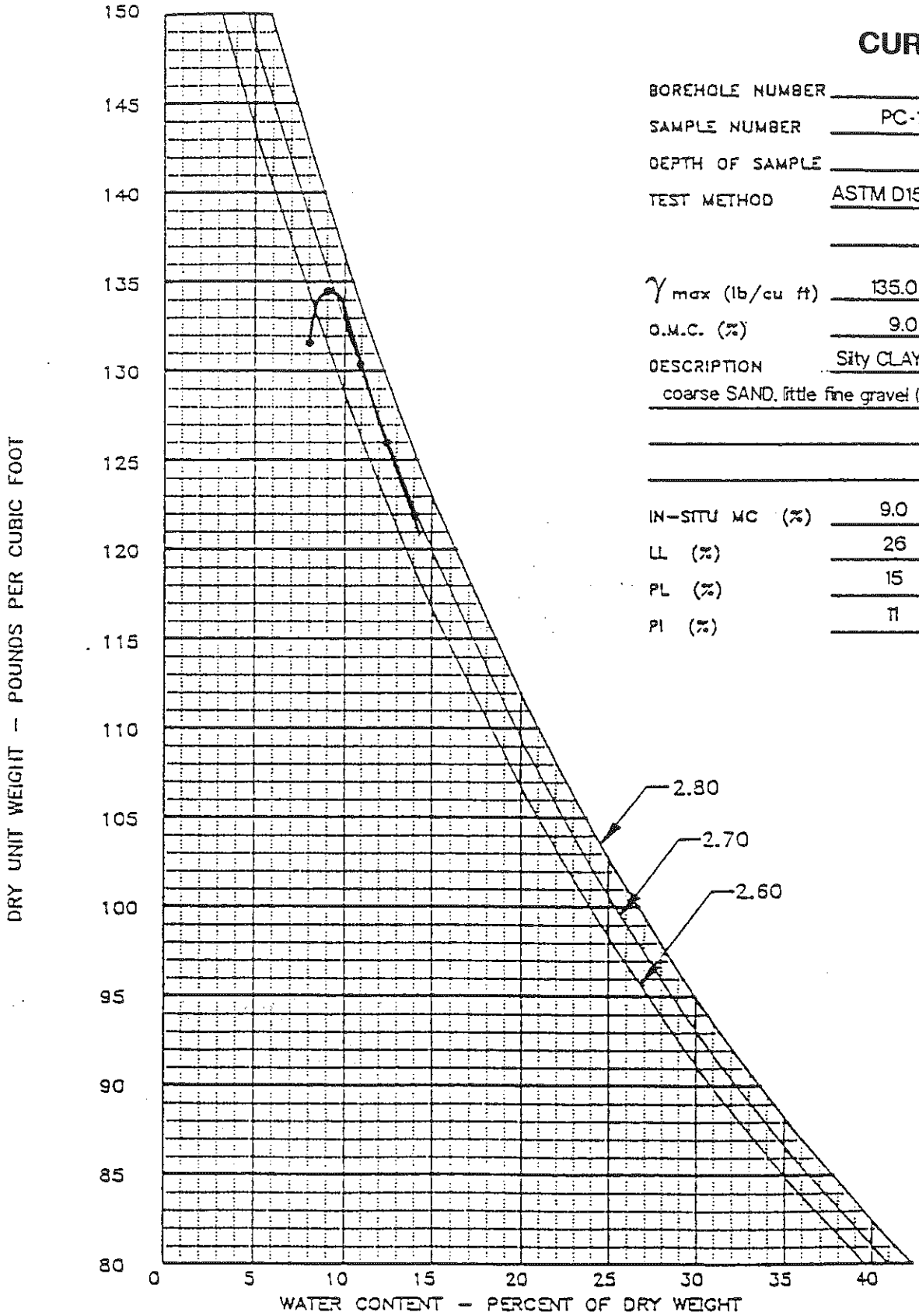
Sample Type: Date Tested: SEPT 1992 USCS: CL

TECH: CG
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC12

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 27

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-13
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	135.0
O.M.C. (%)	9.0
DESCRIPTION	Silty CLAY and fine to coarse SAND, little fine gravel (CL)
IN-SITU MC (%)	9.0
LL (%)	26
PL (%)	15
PI (%)	11

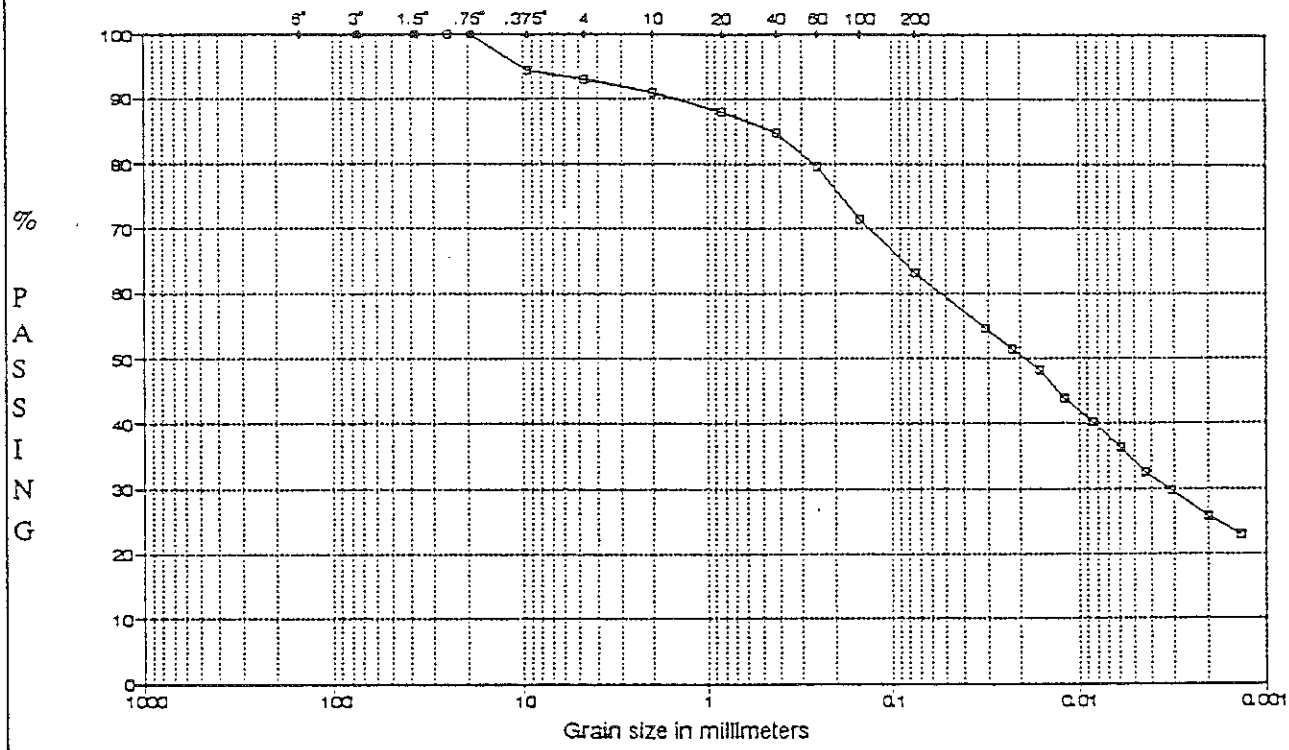
Golder Associates Denver, Colorado

TITLE: PROCTOR CURVE PC-13

CLIENT/PROJECT: GCS/927-1203/MI

DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED DR	FILE NO.	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Car	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-13 DEPTH	9.0	26	15	11	2.81	Silty CLAY and fine to coarse SAND, little fine gravel

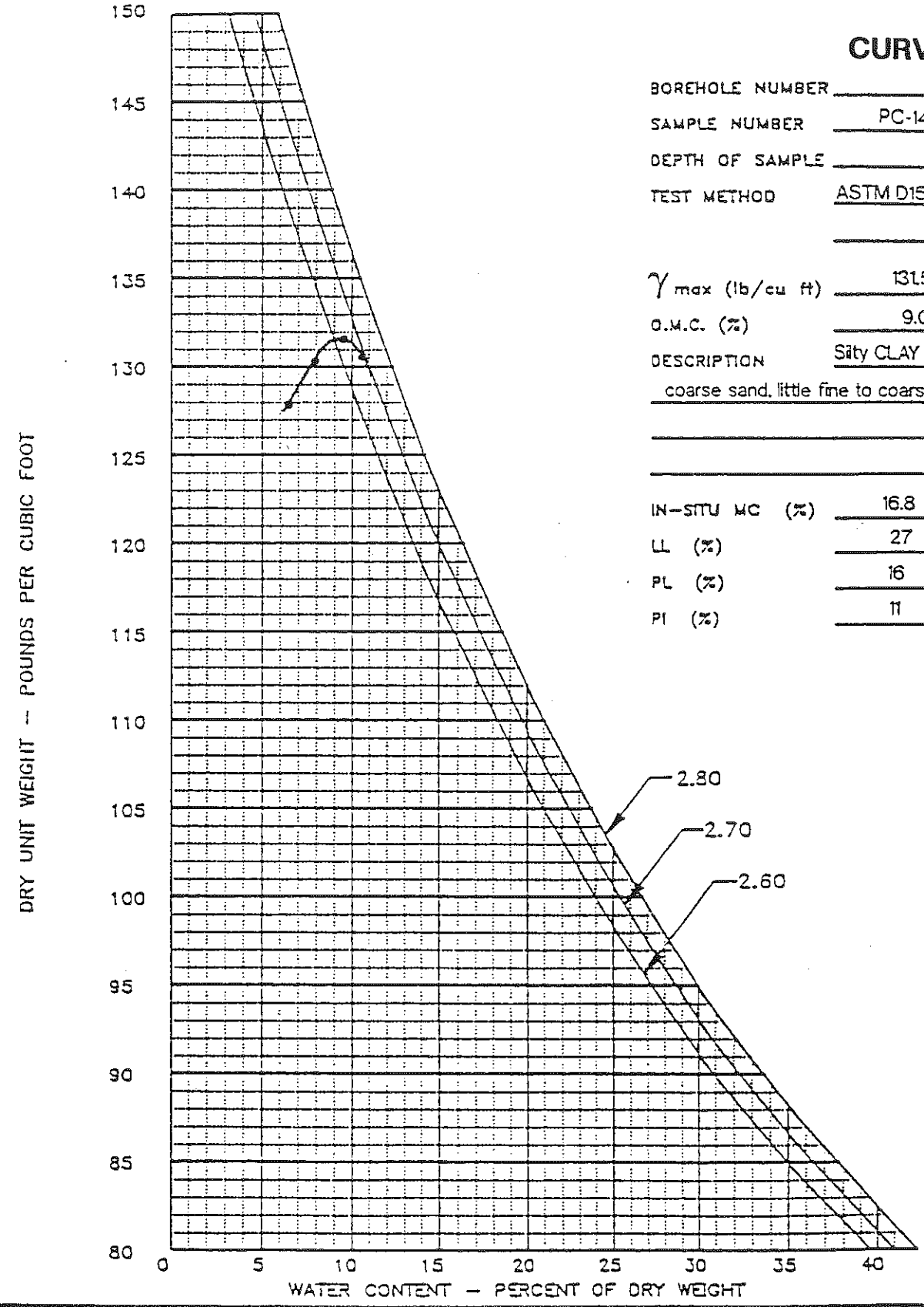
Sample Type: Date Tested: SEPT 1992 USCS: CL

TECH: CG
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 3048PC13

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 28

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-14
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	131.5
O.M.C. (%)	9.0
DESCRIPTION	Silty CLAY with some fine to coarse sand, little fine to coarse gravel (CL)
IN-STU MC (%)	16.8
LL (%)	27
PL (%)	16
PI (%)	11

Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-14

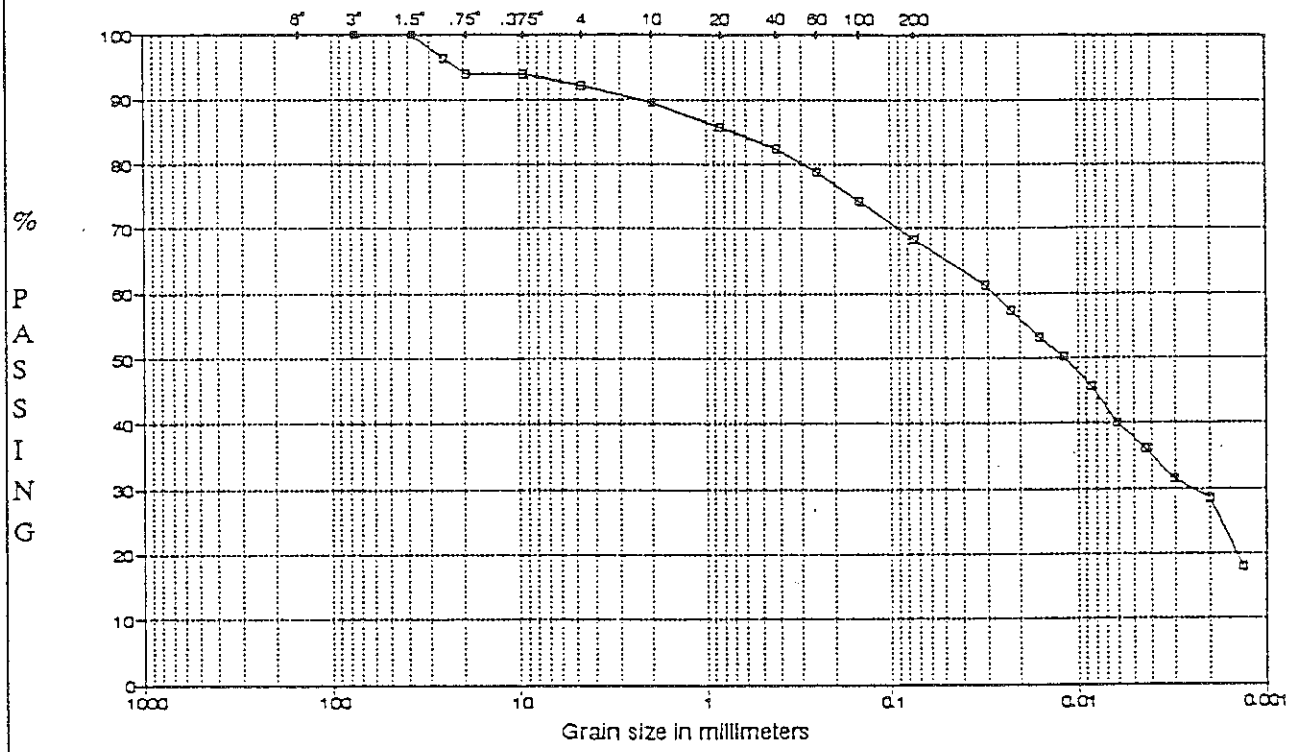
CLIENT/PROJECT

GCS/927-1203/MI

DRAWN	DATE	JOB NO.
CHECKED	SCALE	DWG NO./REV. NO.
REVIEWED	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	Coarse	Fine	Cor	Med	Fine	FINES (Silt and Clay)
		GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-14 DEPTH	16.8	27	16	11	2.77	Silty CLAY with some fine to coarse sand, little fine to coarse gravel

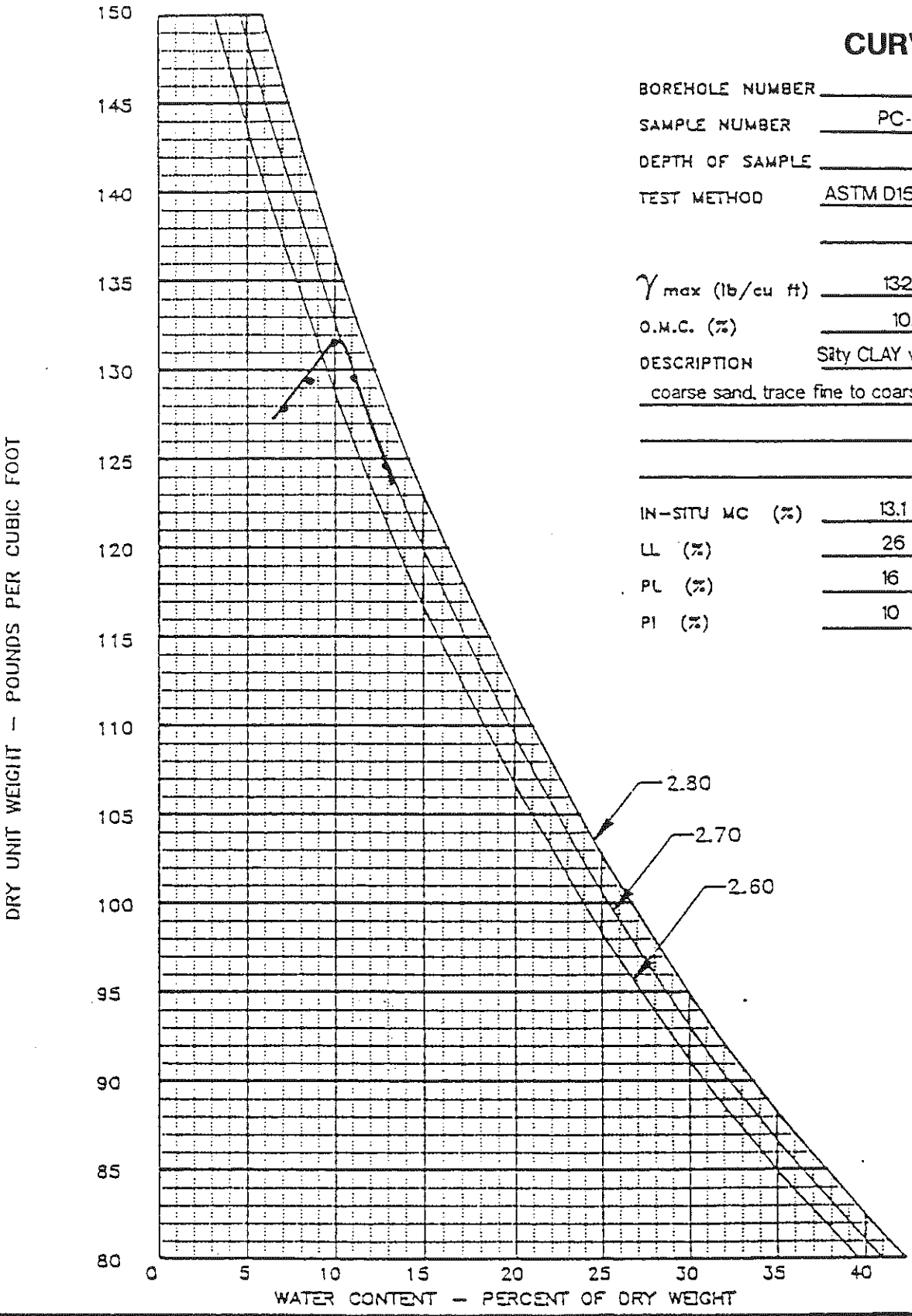
Sample Type: Date Tested: SEPT 1992 USCS: CL

TECH: CG
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 3948PC14

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 29

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-15
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	132.0
O.M.C. (%)	10.0
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel (CL)
IN-SITU MC (%)	13.1
LL (%)	26
PL (%)	16
PI (%)	10

Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-15

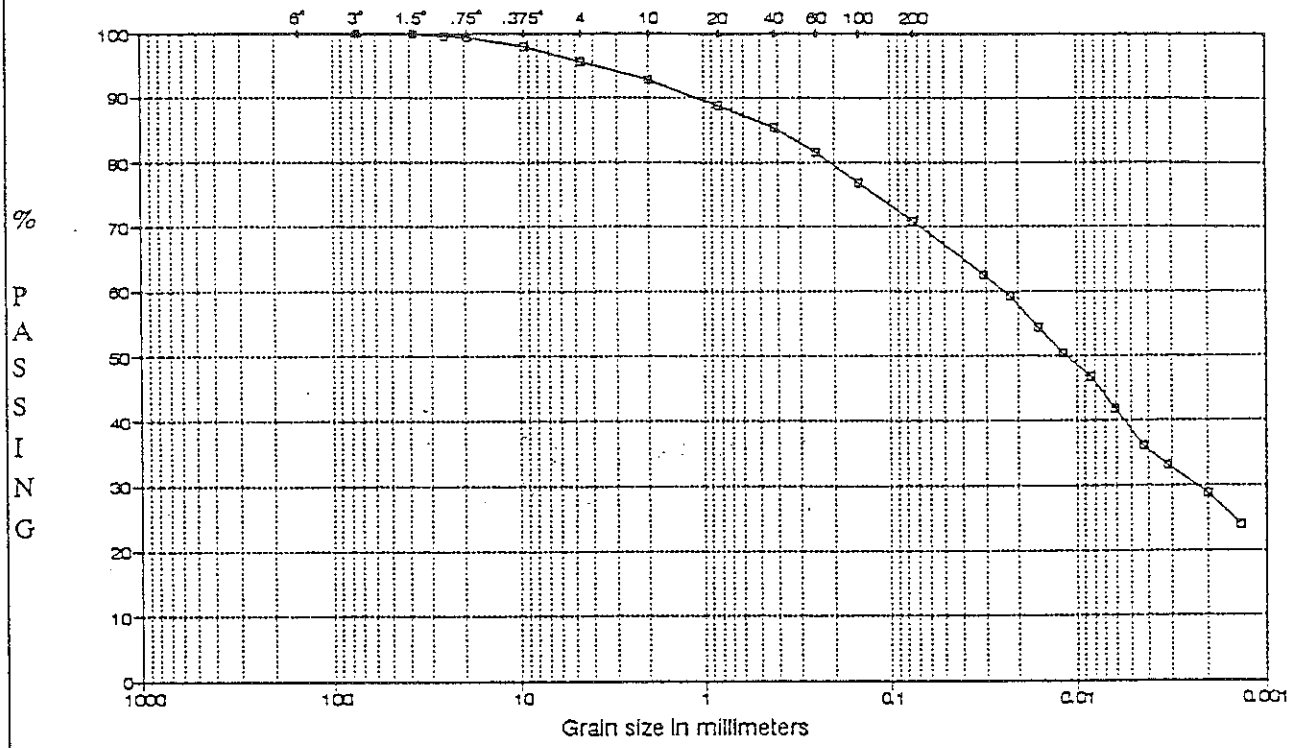
CLIENT/PROJECT

GCS/927-1203/MI

DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED DR	FILE NO.	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	Coarse	Fine	Cor	Med	Fine	FINES (Silt and Clay)
		GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-15 DEPTH	13.1	26	16	10	2.74	Silty CLAY with some fine to coarse sand, trace fine gravel

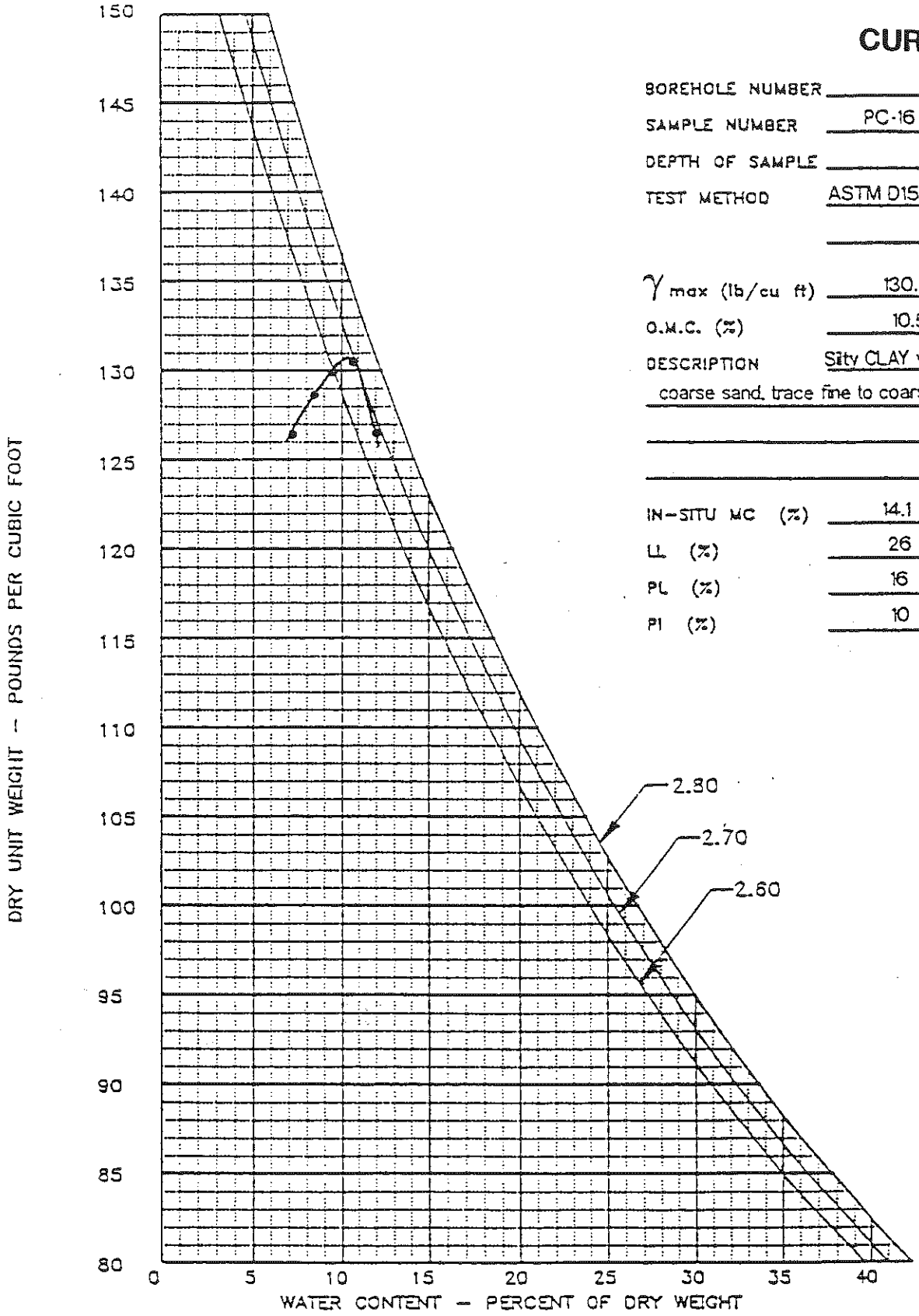
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: CG
DATE: 10/07/92
CHECKED: TT
REVIEWED:

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC15

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 30

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-16
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	130.5
O.M.C. (%)	10.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel (CL)
IN-SITU MC (%)	14.1
LL (%)	26
PL (%)	16
PI (%)	10

Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-16

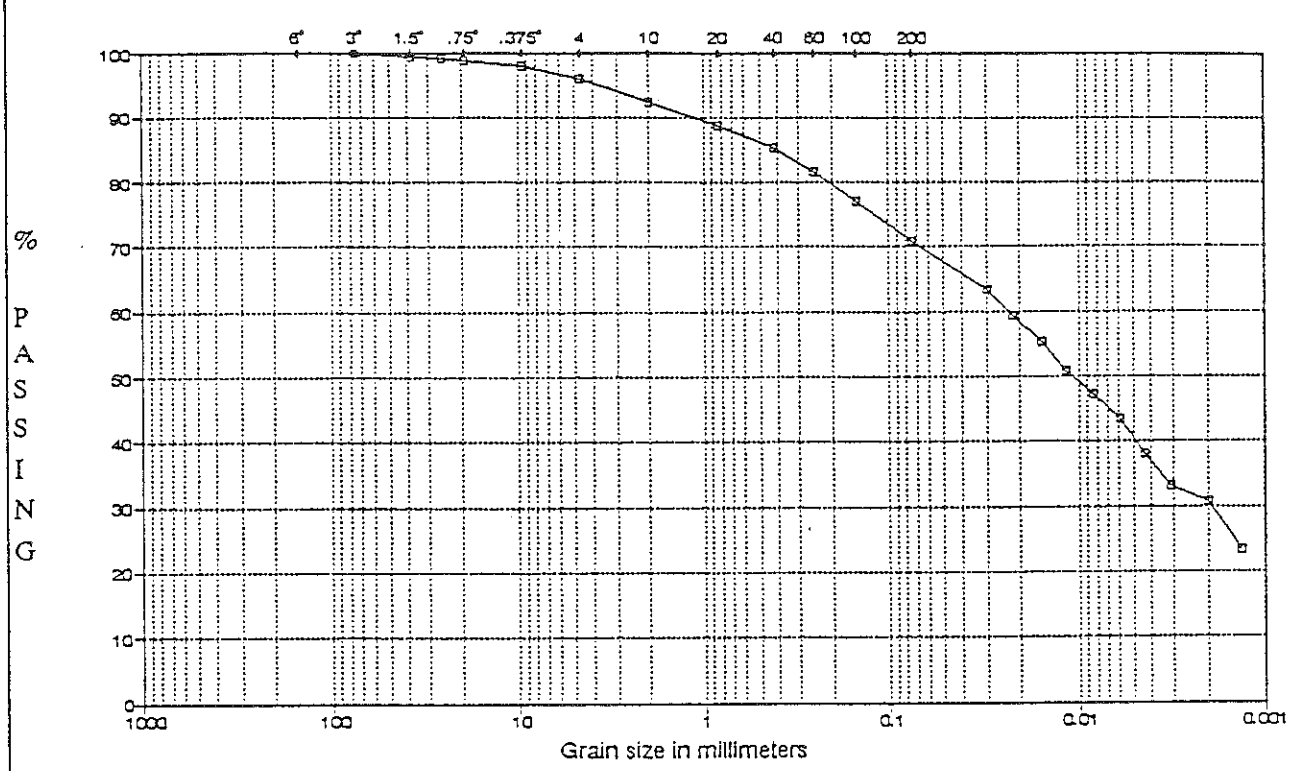
CLIENT/PROJECT

GCS/927-1203/MI

DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048	
CHECKED TT	SCALE	DWG NO./REV. NO.	
REVIEWED DR	FILE NO.	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
	Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-16 DEPTH	14.1	26	16	10	2.72	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel

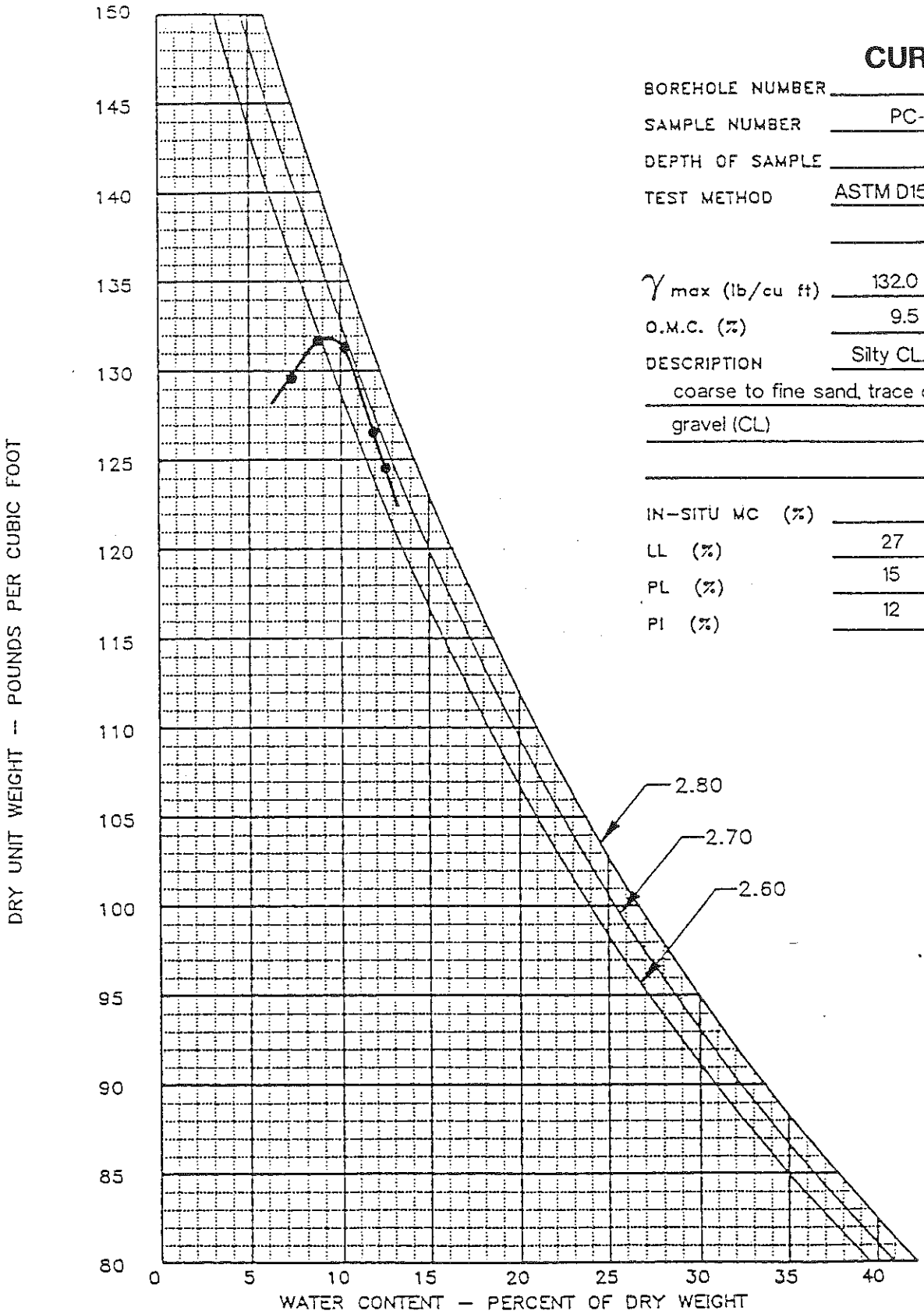
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: KRB
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 3048PC16

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 31

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-21
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	132.0
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some coarse to fine sand, trace coarse to fine gravel (CL)
IN-SITU MC (%)	
LL (%)	27
PL (%)	15
PI (%)	12

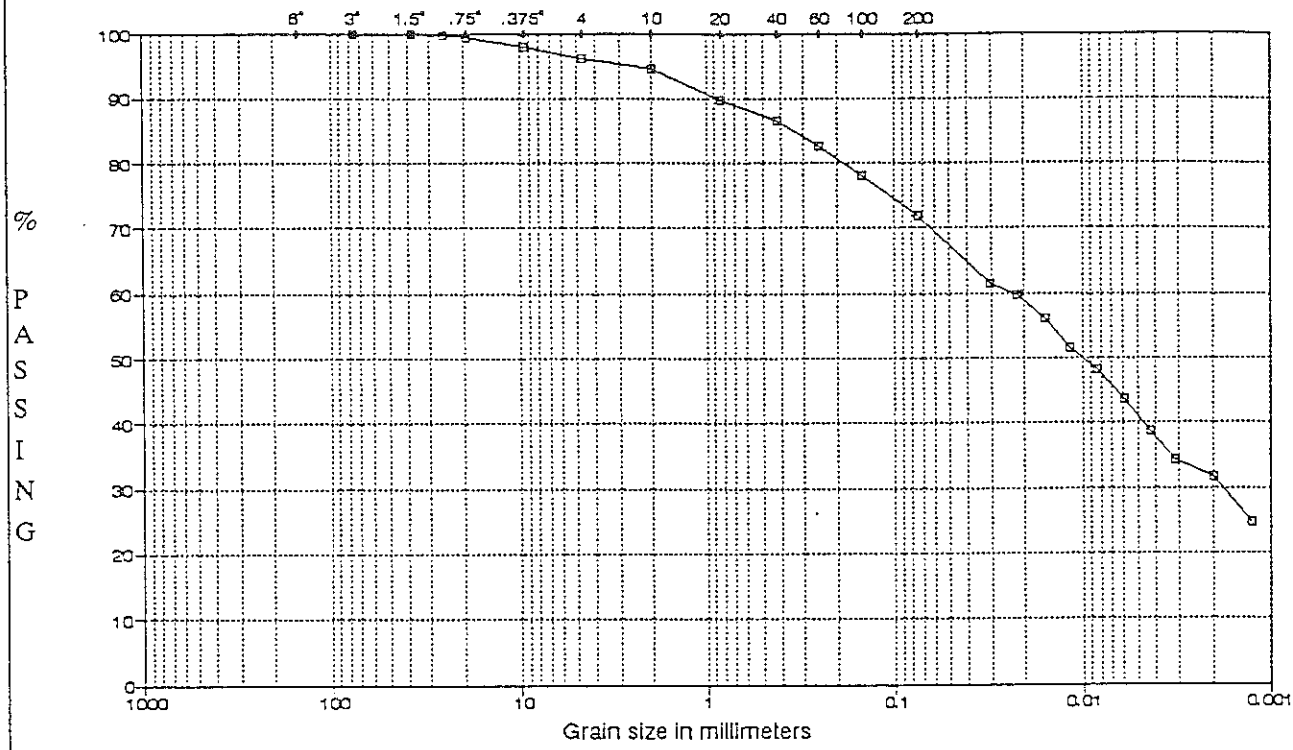
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-21

CLIENT/PROJECT			
GCS/927-1203/MI	DRAWN CG	DATE NOV 1992	JOB NO. IC3-2048
	CHECKED KR	SCALE AS SHOWN	DWG NO./REV. NO.
	REVIEWED DR	FILE NO. WATER.DWG	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	Coarse	Fine	Cor	Med	Fine	FINES (Silt and Clay)
	GRAVEL		SAND			

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-21 DEPTH		27	15	12	2.72	Silty CLAY with some coarse to fine sand, trace coarse to fine gravel

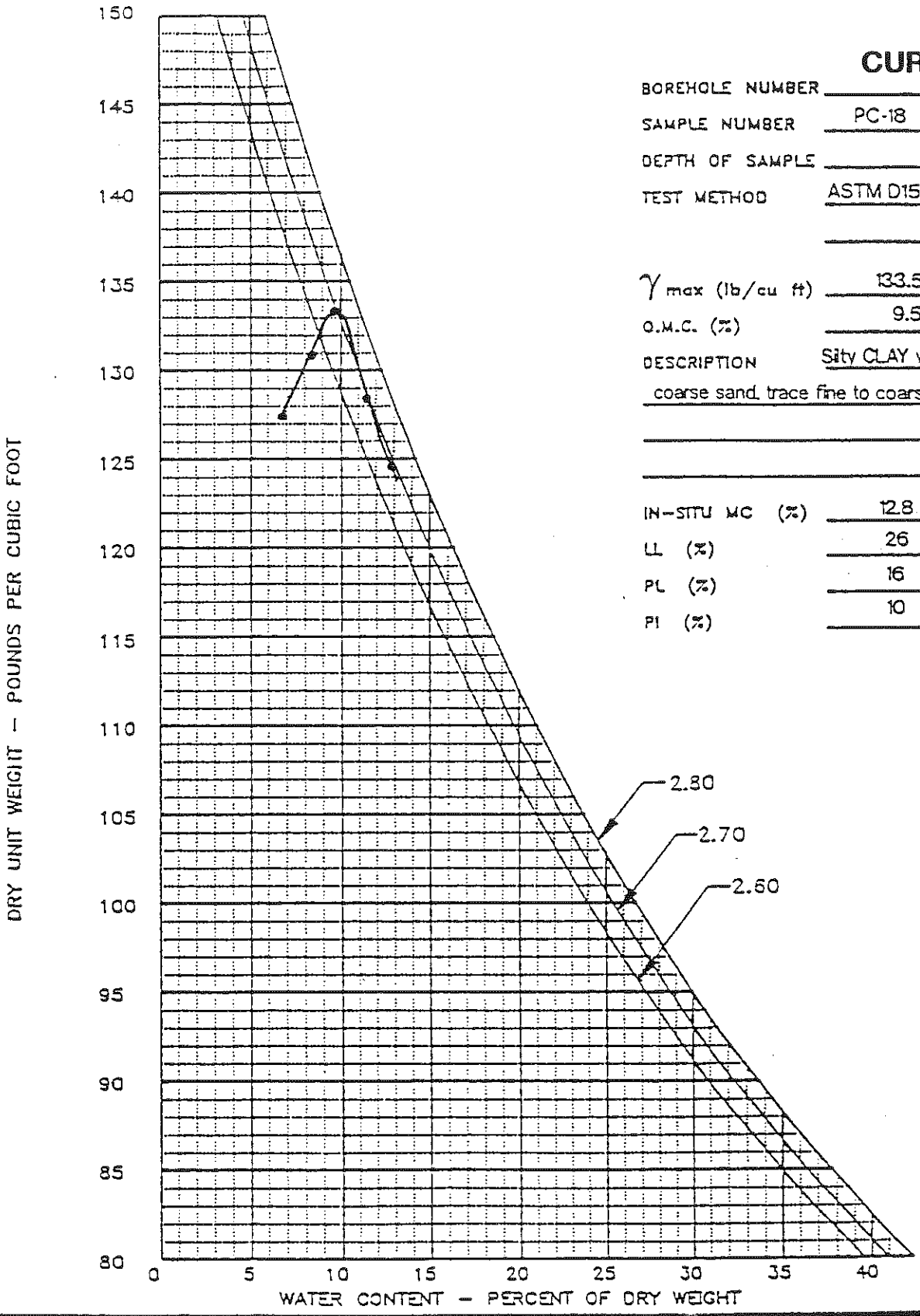
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: MK
DATE: 11/09/92
CHECKED: KR
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC21

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 32

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-18
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	133.5
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel (CL)
IN-STU MC (%)	12.8
LL (%)	26
PL (%)	16
PI (%)	10

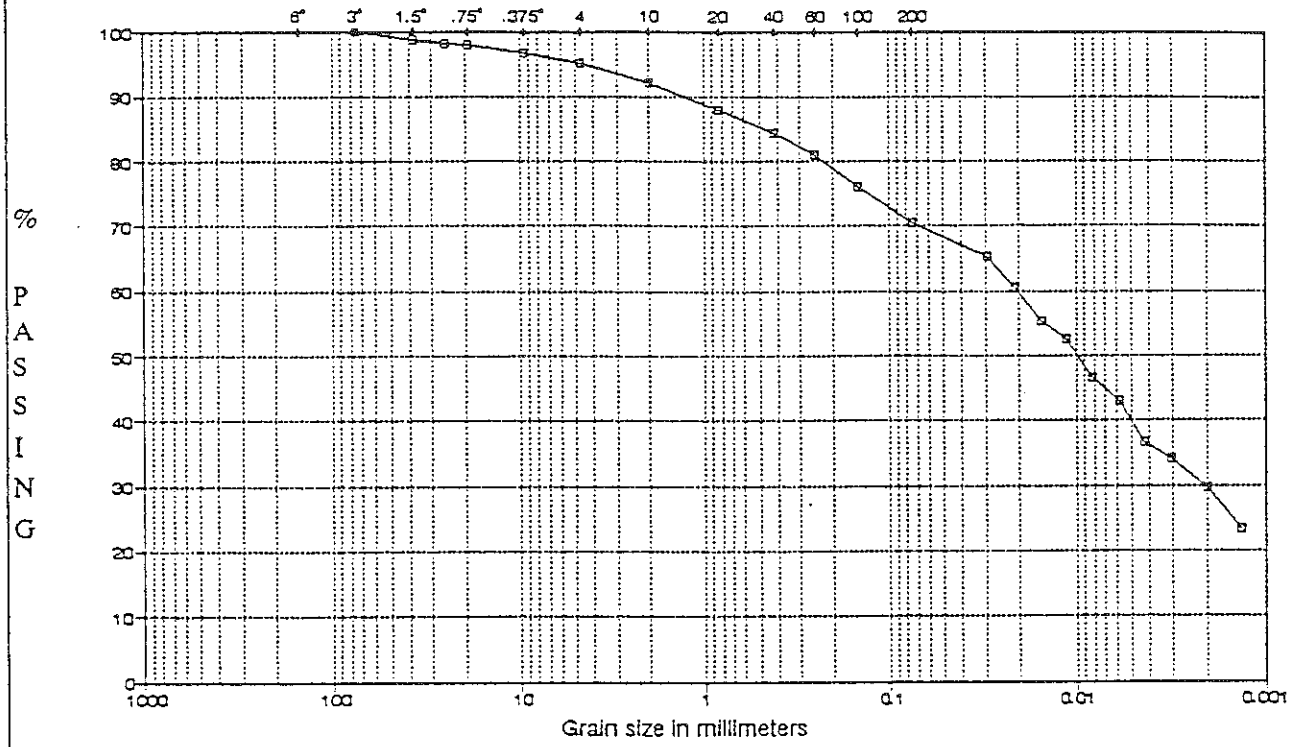
Golder Associates
Denver, Colorado

TITLE
PROCTOR CURVE
PC-18

CLIENT/PROJECT
GCS/927-1203/MI

DRAWN	CG	DATE	OCT 1992	JOB NO.	1C3-2048
CHECKED	TT	SCALE		DWG NO./REV. NO.	
REVIEWED	DR	FILE NO.		FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-18 DEPTH	12.8	26	16	10	2.74	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel

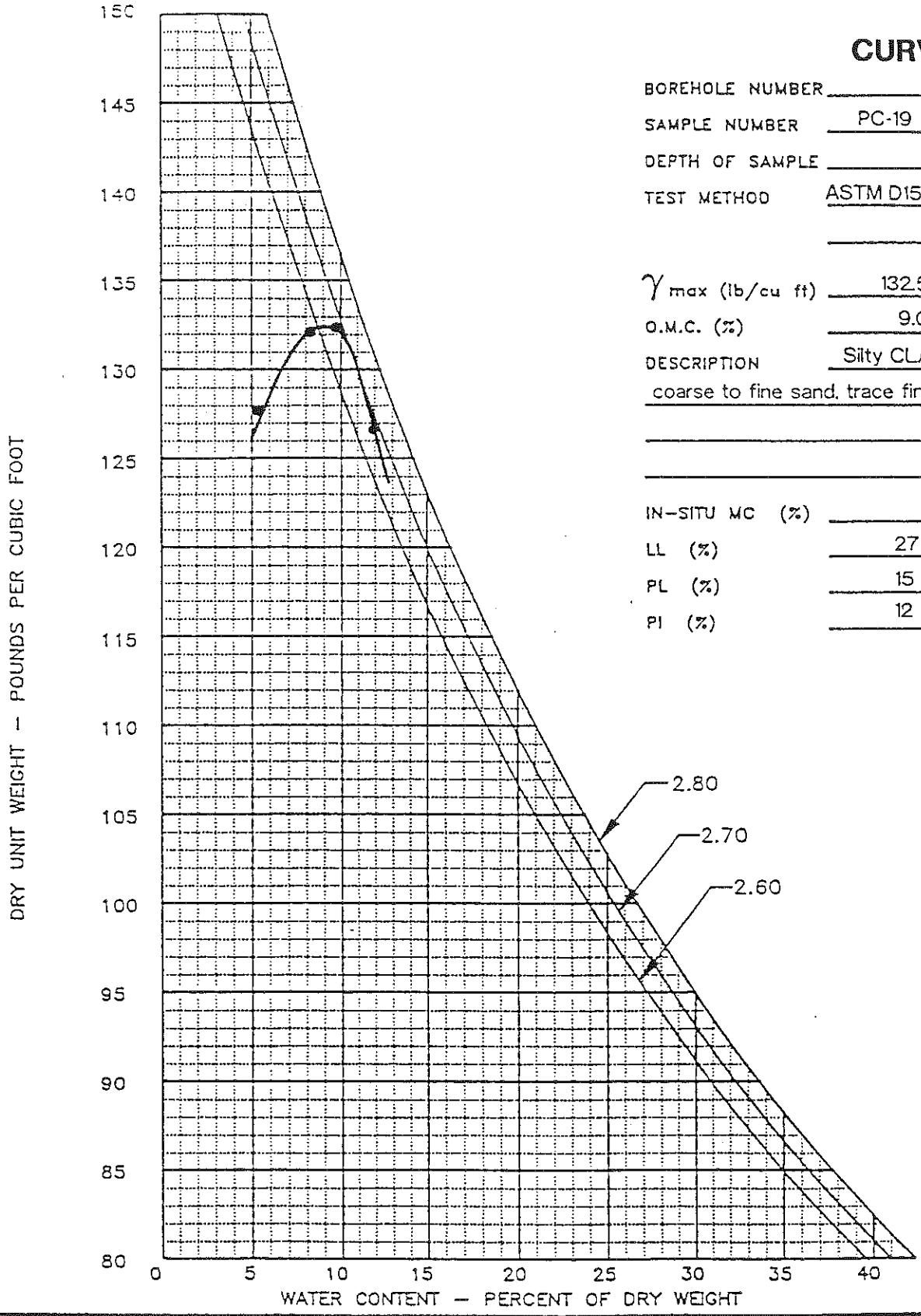
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: KRB
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 3D4PC18

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 33

BOREHOLE NUMBER

SAMPLE NUMBER PC-19

DEPTH OF SAMPLE

TEST METHOD ASTM D1557 METHOD A

γ max (lb/cu ft) 132.5

O.M.C. (%) 9.0

DESCRIPTION Silty CLAY with some coarse to fine sand, trace fine gravel (CL)

IN-SITU MC (%)

LL (%) 27

PL (%) 15

PI (%) 12

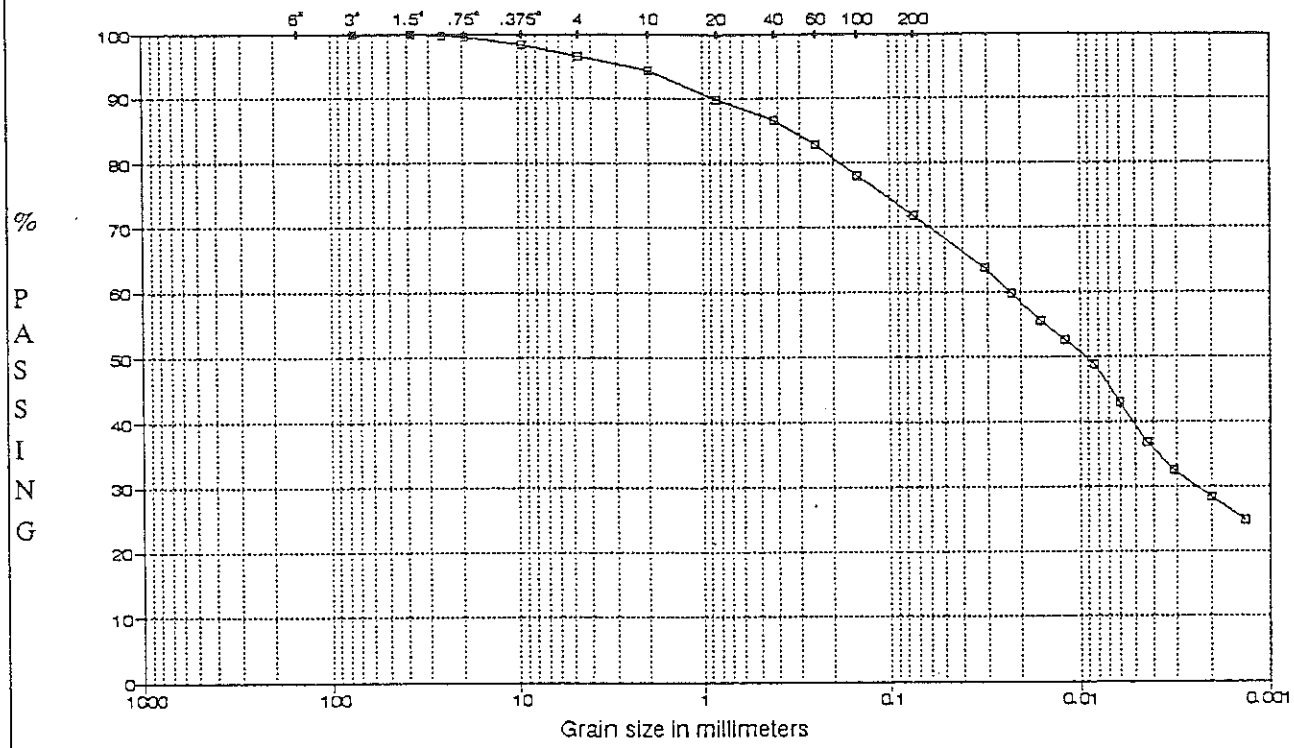
Golder Associates Denver, Colorado

TITLE

PROCTOR CURVE
PC-19

CLIENT/PROJECT			
GCS/927-1203/MI	DRAWN MS	DATE NOV 1992	JOB NO. IC3-2048
	CHECKED KR	SCALE AS SHOWN	DWG NO./REV. NO.
	REVIEWED DR	FILE NO. WATER.DWG	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422
US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-19 DEPTH		27	15	12	2.72	Silty CLAY with some coarse to fine sand, trace fine gravel

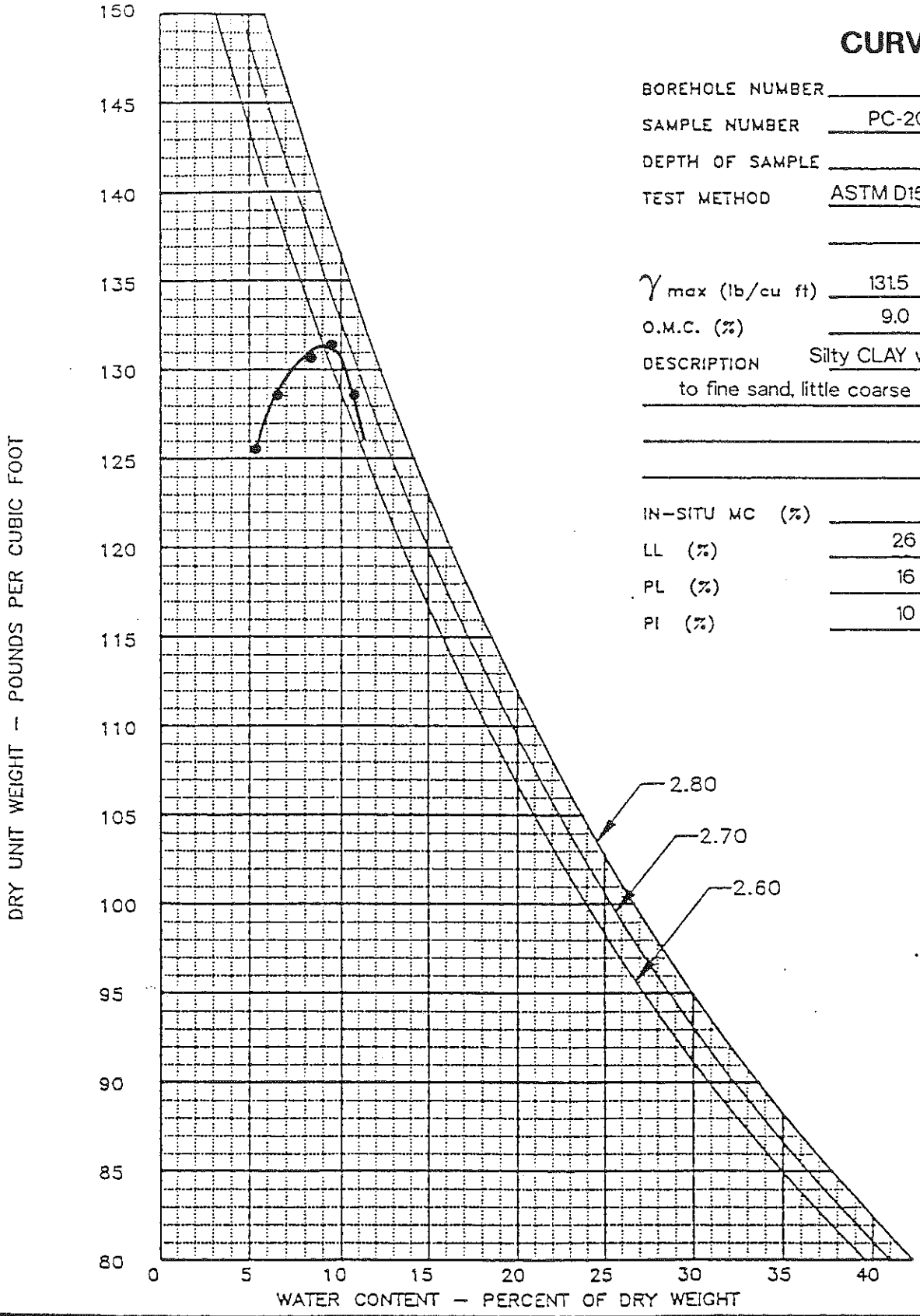
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: MK
DATE: 11/10/92
CHECKED: KR
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC19

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 34

BOREHOLE NUMBER

SAMPLE NUMBER PC-20

DEPTH OF SAMPLE

TEST METHOD ASTM D1557 METHOD A

γ max (lb/cu ft) 131.5

O.M.C. (%) 9.0

DESCRIPTION Silty CLAY with some coarse to fine sand, little coarse to fine gravel (CL)

IN-SITU MC (%)

LL (%) 26

PL (%) 16

PI (%) 10

Golder Associates Denver, Colorado

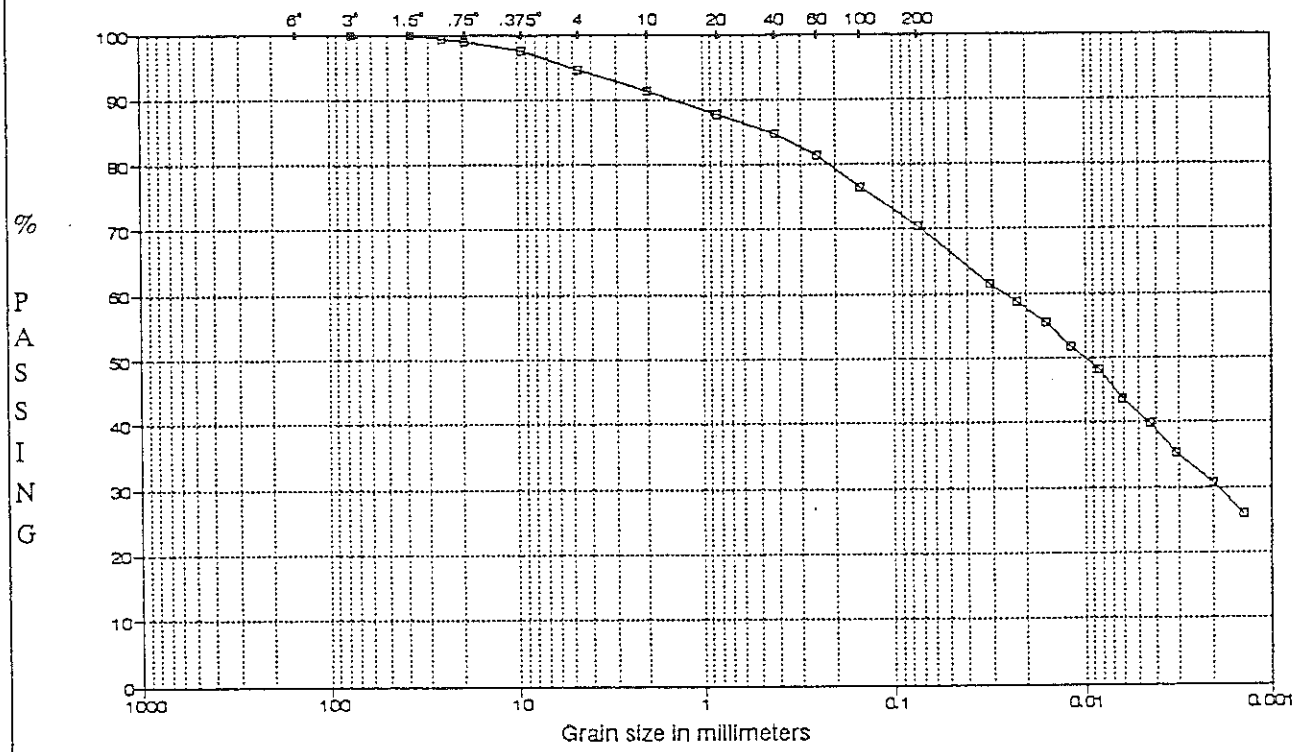
TITLE

PROCTOR CURVE
PC-20

CLIENT/PROJECT			
GCS/927-1203/MI	DRAWN MS	DATE NOV 1992	JOB NO. IC3-2048
	CHECKED KR	SCALE AS SHOWN	DWG NO./REV. NO.
	REVIEWED DR	FILE NO. WATER.DWG	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-20 DEPTH		26	16	10	2.71	Silty CLAY with some coarse to fine sand, little coarse to fine gravel

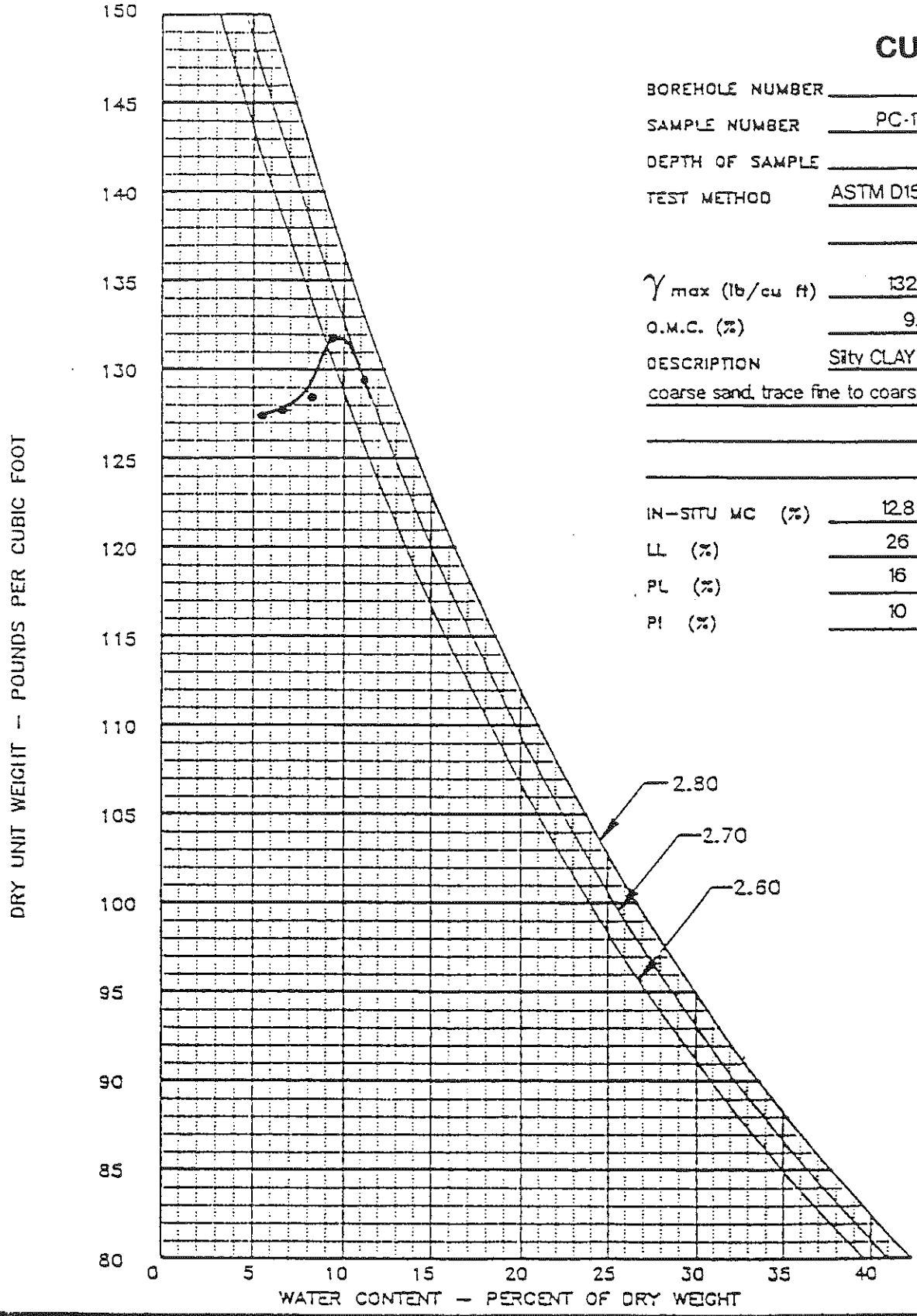
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: MK
DATE: 11/09/92
CHECKED: KR
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC20

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 35

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-17
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	132.0
O.M.C. (%)	9.5
DESCRIPTION	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel (CL)
IN-STTU MC (%)	12.8
LL (%)	26
PL (%)	16
PI (%)	10

Golder Associates Denver, Colorado

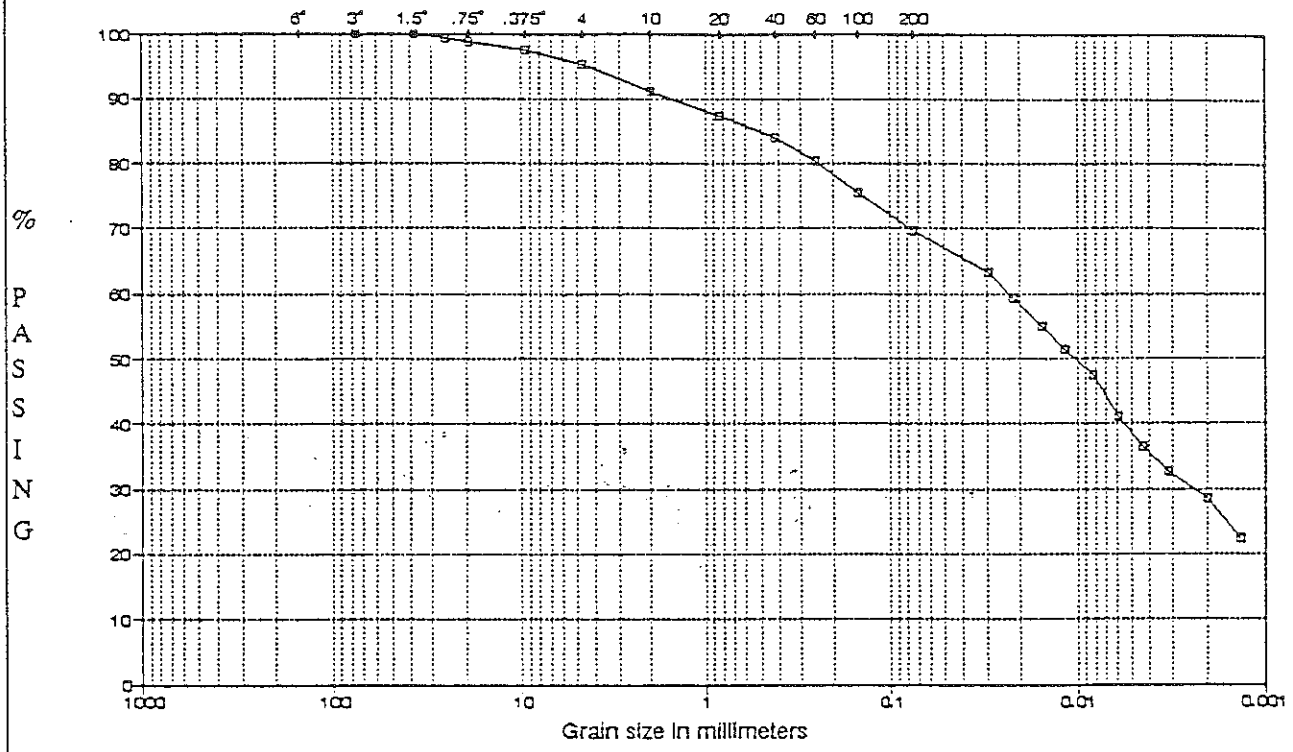
TITLE

PROCTOR CURVE
PC-17

CLIENT/PROJECT			
GCS/927-1203/M1	DRAWN CG	DATE OCT 1992	JOB NO. IC3-2048
	CHECKED TT	SCALE	DWG NO./REV. NO.
	REVIEWED DR	FILE NO.	FIGURE NO.

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS	COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
		Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-17 DEPTH	12.8	26	16	10	2.69	Silty CLAY with some fine to coarse sand, trace fine to coarse gravel

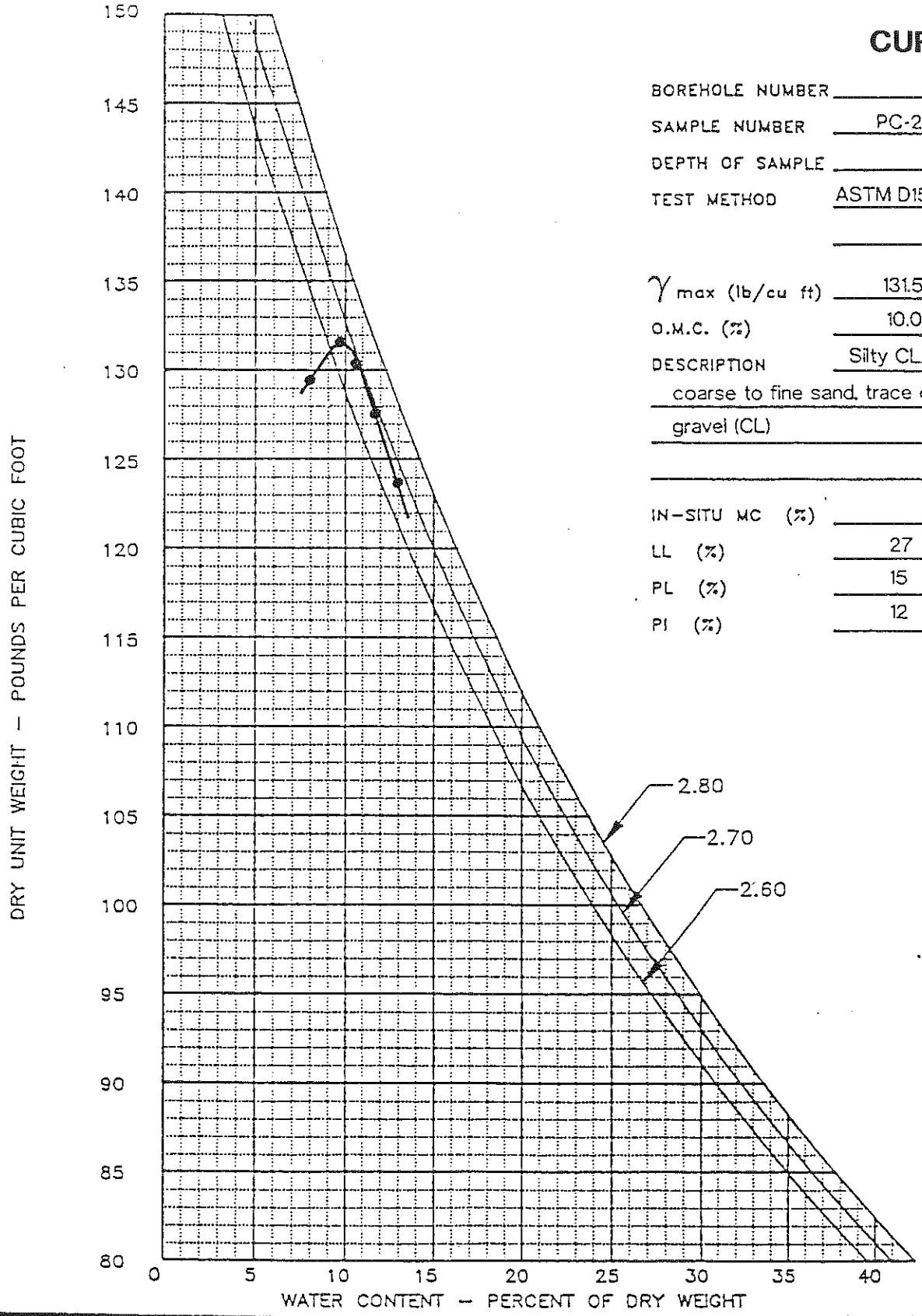
Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: KRB
DATE: 10/07/92
CHECKED: TT
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC17

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO



CURVE 36

BOREHOLE NUMBER	
SAMPLE NUMBER	PC-22
DEPTH OF SAMPLE	
TEST METHOD	ASTM D1557 METHOD A
γ max (lb/cu ft)	131.5
O.M.C. (%)	10.0
DESCRIPTION	Silty CLAY with some coarse to fine sand, trace coarse to fine gravel (CL)
IN-SITU MC (%)	
LL (%)	27
PL (%)	15
PI (%)	12

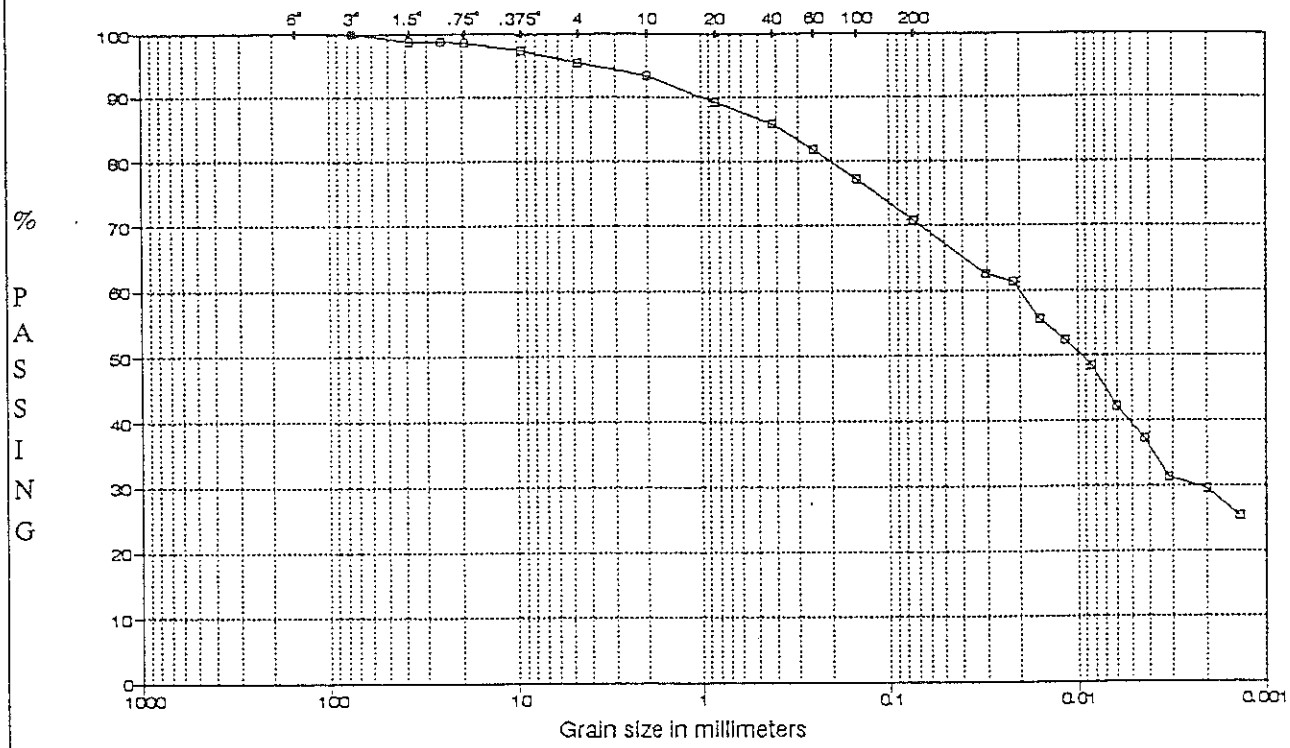
Golder Associates
Denver, Colorado

TITLE
PROCTOR CURVE
PC-22

CLIENT/PROJECT				
GCS/927-1203/MI	DRAWN CG	DATE NOV 1992	JOB NO. IC3-2048	
	CHECKED KR	SCALE AS SHOWN	DWG NO./REV. NO.	
	REVIEWED DR	FILE NO. WATER.DWG	FIGURE NO.	

PARTICLE SIZE DISTRIBUTION ASTM D421 AND D422

US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	GRAVEL		SAND			FINES (Silt and Clay)
	Coarse	Fine	Cor	Med	Fine	

SAMPLE ID	W%	LL	PL	PI	Gs	DESCRIPTION
BOREHOLE SAMPLE NO. PC-22 DEPTH		27	15	12	2.68	Silty CLAY with some coarse to fine sand, trace coarse to fine gravel

Sample Type: Date Tested: OCT 1992 USCS: CL

TECH: MK
DATE: 11/09/92
CHECKED: KR
REVIEWED: DR

GCS/927-1203/MI
IC3-2048

FILENAME: 2048PC22

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

D.2

DRAINAGE AGGREGATES

D.2.1

GRAVEL

JUNE 1993

917-1203

SUMMARY OF GRANULAR MATERIAL LABORATORY TEST RESULTS
ALLEN PARK CLAY MINE – CELL 2
FORD MOTOR CO.

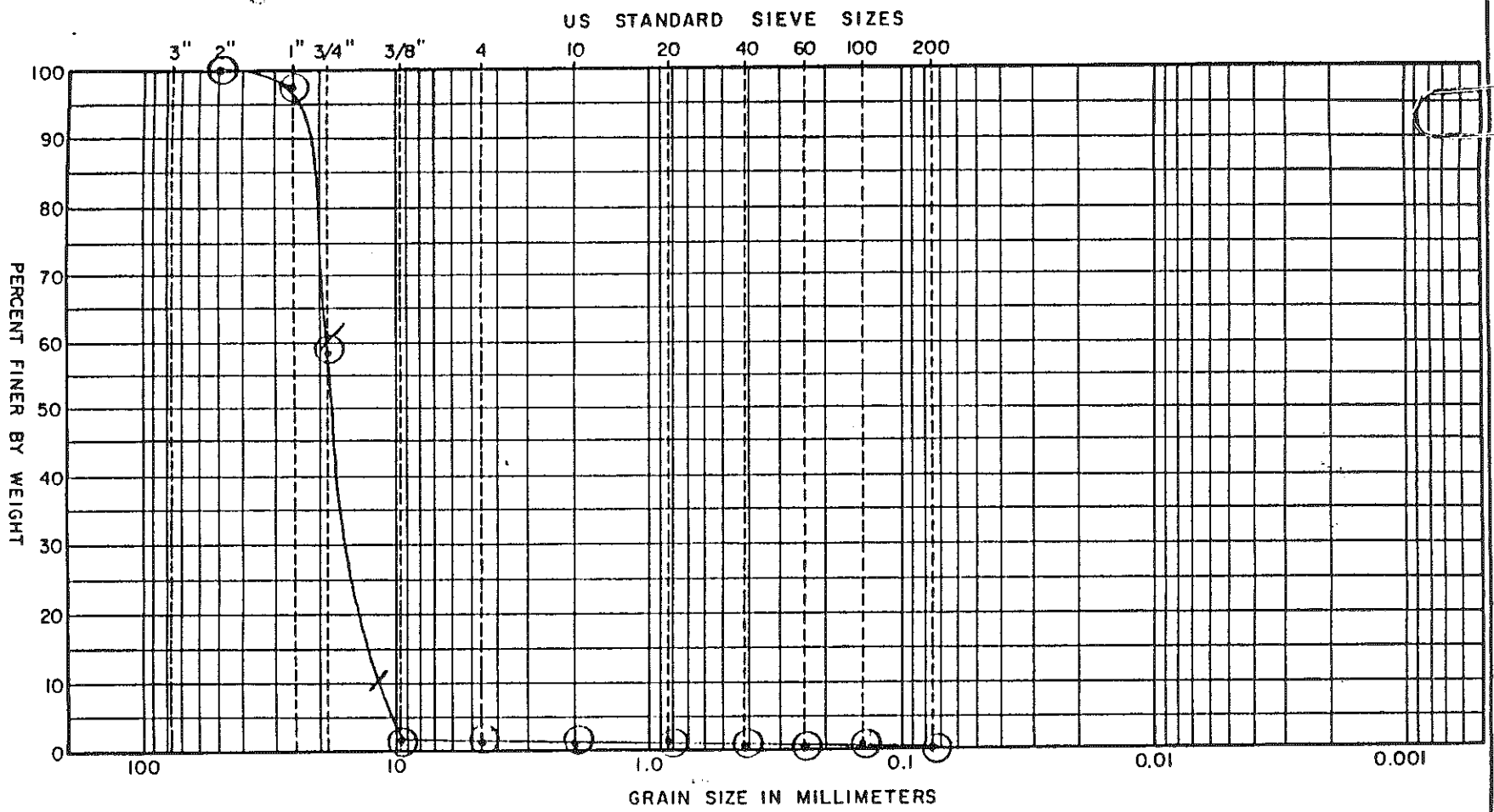
SAMPLE NO.	NATURAL MOISTURE CONTENT (%)	DRY DENSITY (pcf)	WET DENSITY (pcf)	GRAIN SIZE ANALYSIS		HYDRAULIC CONDUCTIVITY (cm/s)	TEST BY
				% PASSING #4 SIEVE	% PASSING #200 SIEVE		
GRAVEL LAYER MATERIALS							
GA-1 (GP)	1.61	100.8	102.5	0.38	0.00	4.72	GAI
GA-2 (GP)	–	–	–	1.61	0.82	–	GAI

FILENAME = TBL-GRAV.WK1 disk 5

Date 6/23/92
Job No. 162-2728

Golder Associates

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

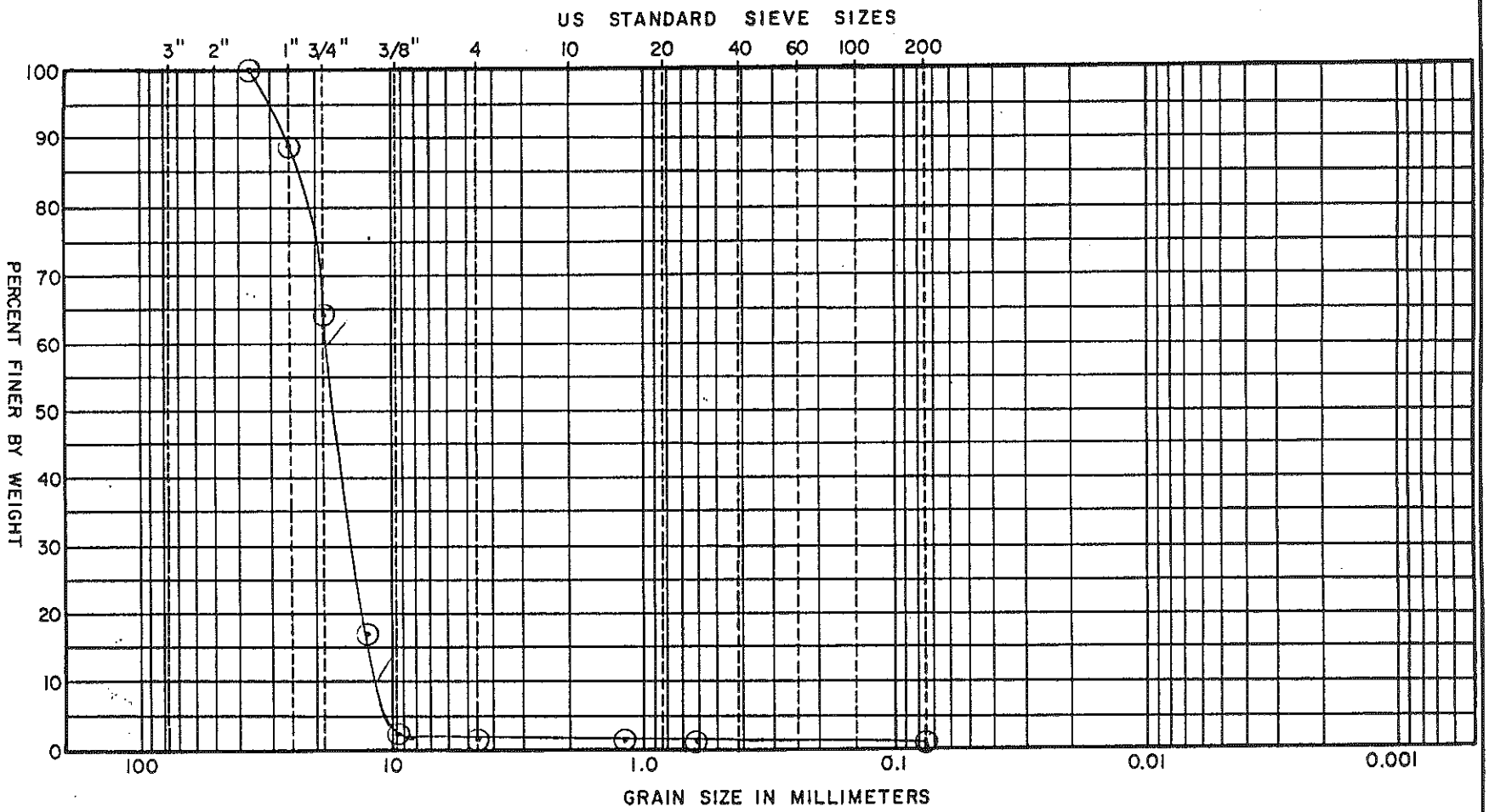
BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
GA-1	—	1.61	—	—	—	Tan, Brown, White, C-F GRAVEL, (rounded to subrounded), trace sand $D_{60}/D_{10} = 1.46 \Rightarrow$ (GP)

Drawn wms
Checked
Reviewed

FIGURE

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_P	I_P	DESCRIPTION OR CLASSIFICATION
Stockpile, GA-2	—	—	—	—	—	Grey, C-F GRAVEL, trace sand. (GP) $C_u = \frac{19}{12} = 1.6$

Golder Associates

Date 12/10/82
Job No. 123-3708

Drawn
Checked
Reviewed

AF 26816C

DRAFTRACE 280

D.2.2

SAND

JUNE 1993

917-1203

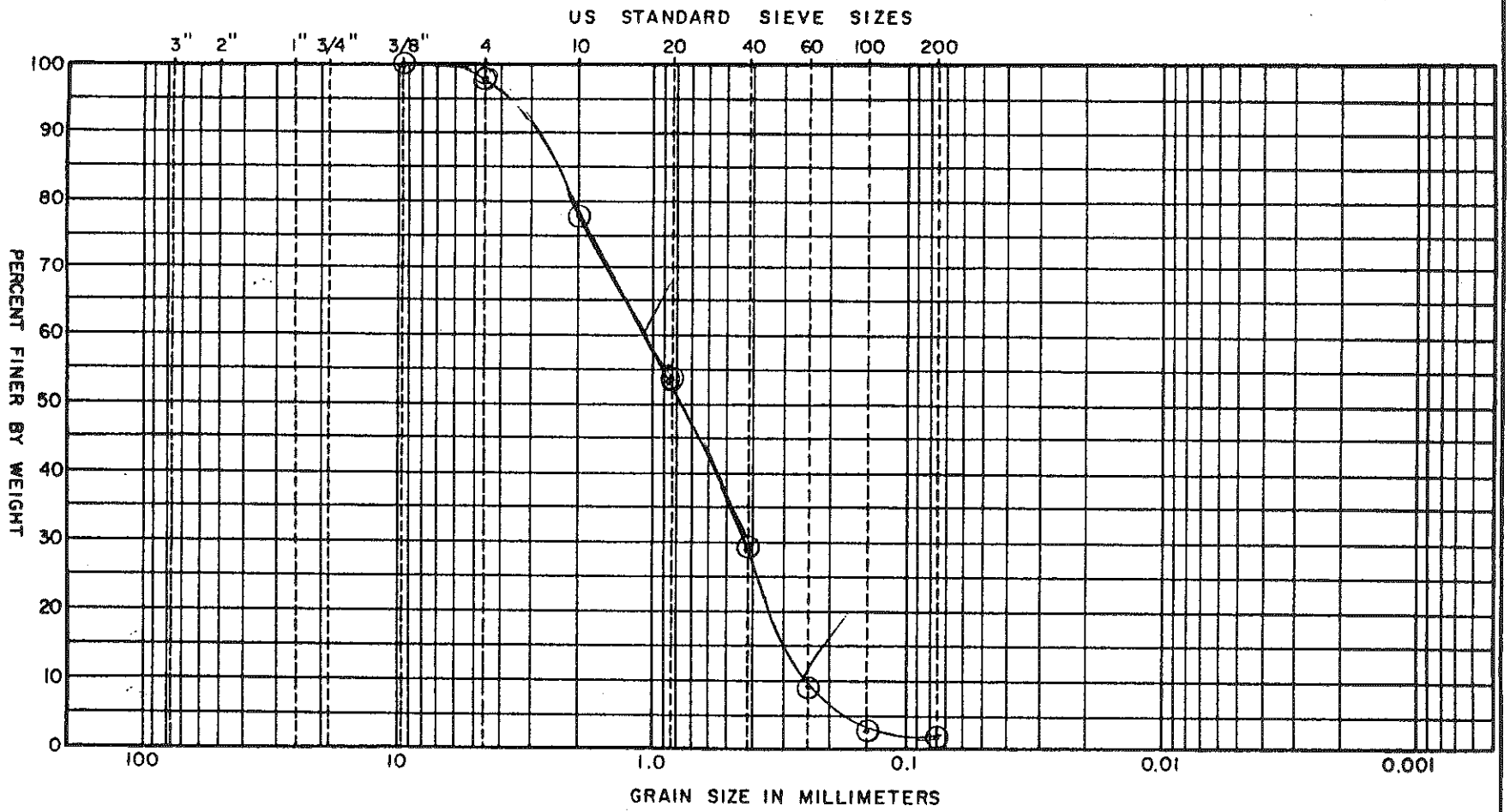
SUMMARY OF GRANULAR MATERIAL LABORATORY TEST RESULTS
ALLEN PARK CLAY MINE – CELL 2
FORD MOTOR CO.

SAMPLE NO.	NATURAL MOISTURE CONTENT (%)	DRY DENSITY (pcf)	WET DENSITY (pcf)	GRAIN SIZE ANALYSIS		HYDRAULIC CONDUCTIVITY (cm/s)	TEST BY
				% PASSING #4 SIEVE	% PASSING #200 SIEVE		
GRANULAR SYSTEM OF LEACHATE COLLECTION/REMOVAL SYSTEM							
LB-2 (SP)	3.7	97.2	100.8	98.90	1.60	4.8E-02	GAI
LB-3 (SP)	4.1	100.0	104.0	99.25	2.03	4.4E-02	GAI
KENT LAKE 2NS	9.9	113.2	–	–	–	1.2E-02	SME

FILENAME = TBL-SAND.WK1 disk 5

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
Kent Lake, LB-2	—					Tannish Brown, C-F SAND, trace silt, trace f-gravel (SP) $C_u = \frac{1.15}{.26} = 4.4$

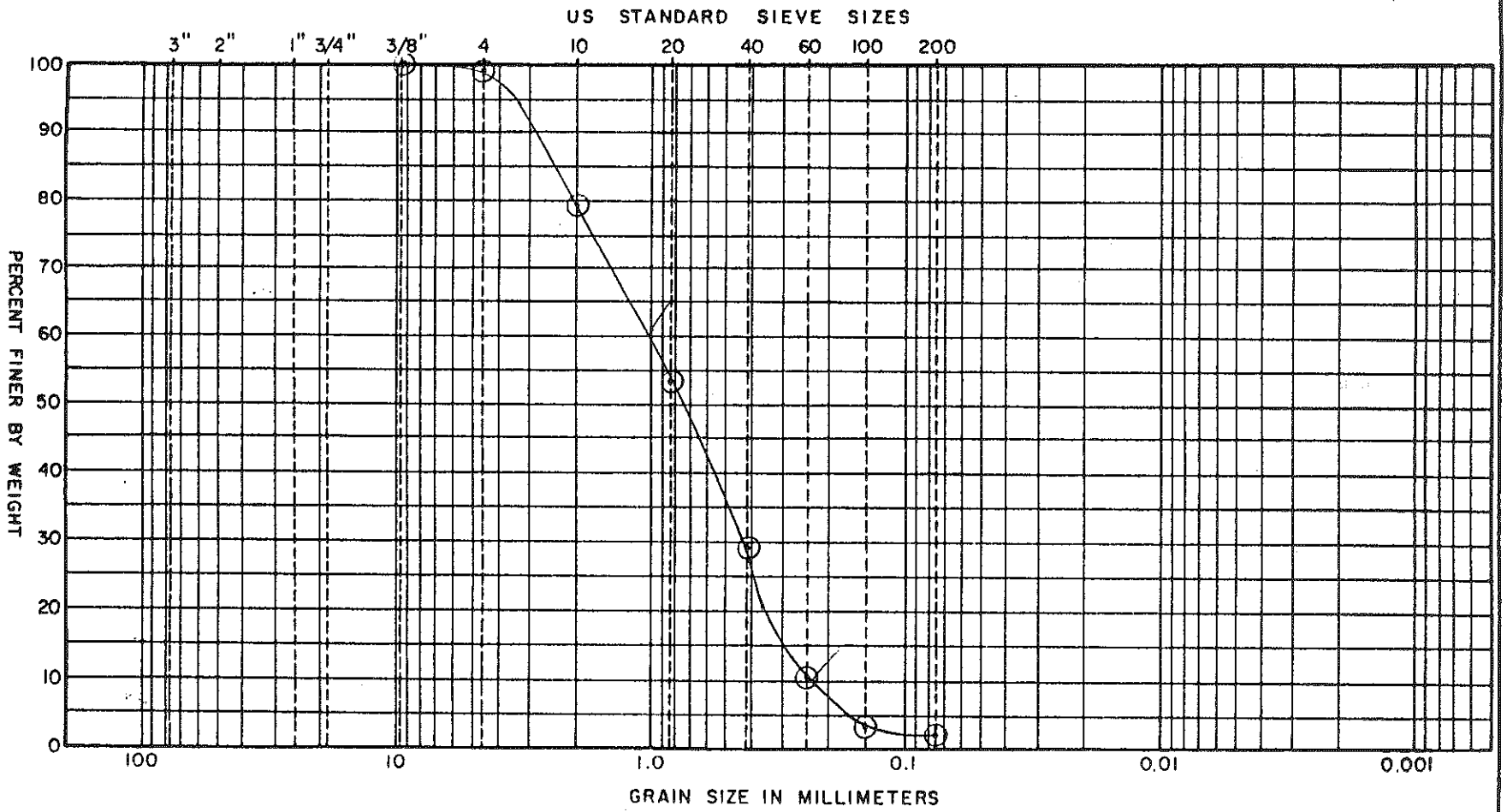
Golder Associates

Date 10/7/92
Job No. 103-3708

Drawn
Checked
Reviewed

GRAIN SIZE DISTRIBUTION

FIGURE



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
Stockpile, LB-3						Tan & Brown mix, C-F SAND, trace silt (SP)
						$C_u = \frac{1.0}{.24} = 4.2 < 6$

Date 10/30/92
Job No. 1C3-3703

Golder Associates

Drawn JWE
Checked
Reviewed