

TRF RESERVOIR STUDY							
SEDIMENT REDUCTION - THIEF RIVER							
X-SECT.	STATION	SEDIMENT ELEV.		SEDIMENT			
		BEFORE DRAWDOWN	AFTER DRAWDOWN	REDUCTION			
				(FEET)			
14	2+99	1112.60	1111.00	-1.60			
	2+57	1111.00	1108.40	-2.60			
	2+33	1109.50	1107.90	-0.60			
	2+00	1107.20	1107.50	0.30			
	1+55	1107.60	1108.00	0.40	AVERAGE		
	1+04	1106.50	1104.50	-2.00	SEDIMENT		
	0+72	1102.00	1101.70	-0.30	REDUCTION		
	0+43	1104.30	1105.80	1.50	-0.29		
	0+31	1107.20	1108.20	1.00			
16	2+23	1109.60	1109.60	0.00			
	1+71	1110.90	1111.00	0.10			
	1+52	1111.60	1111.50	-0.10			
	1+10	1112.90	1112.80	-0.10			
	0+56	1112.20	1111.60	-0.60			
	0+32	1111.60	1111.30	-0.30			
	0+21	1112.80	1112.60	-0.20			
	1+70	1110.70	1111.40	0.70			
20	1+57	1109.70	1101.90	-1.80			
	1+43	1101.60	1101.80	0.20			
	1+23	1102.10	1100.90	-1.20			
	0+85	1107.50	1107.00	-0.50			
	0+52	1112.10	1111.80	-0.30			
	0+37	1112.30	1112.00	-0.30			
	0+22	1112.20	1112.70	0.50			
	1+89	1113.40	1113.40	0.00			
21	1+84	1113.20	1112.90	-0.30			
	1+73	1109.80	1109.70	-0.10			
	0+70	1110.60	1108.60	-2.00			
	0+48	1113.60	1112.90	-0.70			
	0+27	1114.00	1113.60	-0.40			
	4+64	1112.80	1112.60	-0.20			
23	4+59	1110.80	1111.50	0.70			
	3+26	1113.80	1113.40	-0.40			
	3+12	1113.90	1113.70	-0.20			
	2+88	1113.80	1113.50	-0.30			
	2+56	1113.50	1113.30	-0.20			
	2+21	1113.00	1112.90	-0.10			
	1+89	1113.00	1112.80	-0.20			
	1+52	1113.10	1112.90	-0.20			
	1+01	1112.60	1112.30	-0.30			
	0+76	1112.00	1112.20	0.20			
	0+56	1112.60	1112.60	0.00			
	0+42	1113.20	1113.00	-0.20			
	0+32	1113.30	1113.20	-0.10			
Sample Size	Mean	Median	Maximum	Minimum	St. Dev	-1 St. Dev	+ 1 St. Dev
44	-0.29	-0.20	1.50	-2.60	0.77	-1.06	0.48

ANNEX E

TRF RESERVOIR STUDY					
SEDIMENT REDUCTION - RED LAKE RIVER					
SEDIMENT VOLUME BEFORE DRAWDOWN:					
X-SECT.	RIVER STATION	SEDIMENT AREA	AVERAGE SEDIMENT AREA	L	VOLUME (CU.YD.)
3	17+80	598.90	533.55	1182.00	23,358
4	29+62	468.20	565.00	473.00	9,898
5	34+35	661.80	950.55	1418.00	44,670
6	48+53	1039.30	731.55	709.00	19,210
7	55+62	423.80	437.95	867.00	14,063
8	64+29	452.10	359.35	946.00	12,591
9	73+75	266.60	377.90	1576.00	22,058
10	89+51	489.20	410.15	1773.00	26,933
11	107+24	331.10	295.35	1221.00	13,356
12	119+45	259.60			
					186,137
SEDIMENT VOLUME AFTER DRAWDOWN:					
X-SECT.	RIVER STATION	SEDIMENT AREA	AVERAGE SEDIMENT AREA	L	VOLUME (CU.YD.)
3	17+80	568.90	518.55	1182.00	22,701
4	29+62	468.20	565.00	473.00	9,898
5	34+35	661.80	793.00	1418.00	41,647
6	48+53	924.20	598.05	709.00	15,704
7	55+62	271.90	301.30	867.00	9,675
8	64+29	330.70	292.85	946.00	10,261
9	73+75	255.00	370.70	1576.00	21,638
10	89+51	488.40	408.75	1773.00	26,841
11	107+24	331.10			

TRF RESERVOIR STUDY					
SEDIMENT REDUCTION - THIEF RIVER					
SEDIMENT VOLUME BEFORE DRAWDOWN:					
X-SECT.	RIVER STATION	SEDIMENT AREA	AVERAGE SEDIMENT AREA	L	VOLUME (CU.YD.)
14	1+98	480.80	849.25	593.00	18,652
16	7+91	1237.70	743.55	1039.00	28,613
20	18+30	249.40	352.50	742.00	9,687
21	25+72	455.60	746.75	544.00	15,046
23	31+16	1037.90			71,998
SEDIMENT VOLUME AFTER DRAWDOWN:					
X-SECT.	RIVER STATION	SEDIMENT AREA	AVERAGE SEDIMENT AREA	L	VOLUME (CU.YD.)
14	1+98	246.70	721.70	593.00	15,851
16	7+91	1196.70	691.40	1039.00	26,606
20	18+30	186.10	291.35	742.00	8,007
21	25+72	396.60	669.65	544.00	13,492
23	31+16	942.70			63,956
REDUCTION IN SEDIMENT VOLUME=				11.17%	

ANNEX F

Thief River Falls Reservoir Study Plant Identification / Biomass

Cross Section #	Location	Species Present	Relative Abundance
	All are Red Lake River Cross Sections		A = Abundant C = Common S = Sparse
3	West Bank	Coontail, Sago Pondweed, Cattails Wildrice, Curled Pondweed	A, S, A S, S
	East Bank	N/A	
4	West Bank	Water Celery	S
	East Bank	Water Celery, Wildrice, Sago Pondweed Milfoil	S, S, S S
5	West Bank	Water Celery, Milfoil, Cattails	S, S, S
	East Bank	N/A	
6	North Bank	White Water Lily, Water Celery, Milfoil Coontail	C, S, C C
	South Bank	Wildrice	S
7	North Bank	Clasping Pondweed, Water Celery, Wildrice Coontail, Milfoil	S, S, C S, A
	South Bank	Sago Pondweed, White Water Lily	C, S
8	North Bank	White Water Lily, Wildrice, Water Celery Sago Pondweed, Coontail	S, S, A S, S
	South Bank	Wildrice, Water Celery Floating Leaf Pondweed	S, S A
9	North Bank	Water Celery, Milfoil, Coontail Sago Pondweed	C, A, S S
	South Bank	Water Celery	S
10	North Bank	Waterweed, Wildrice, Milfoil, Sago Pondweed Clasping FW, Coontail, Arrowhead, Floating Leaf P	C, A, S, C C, A, S, C
	South Bank	Wildrice, Sago Pondweed, Water Celery	C, S, S
11	North Bank	Wildrice, White Water Lily, Sago Pondweed	C, S, S
	Middle Bar	Wildrice	C
	South Bank	Wildrice, Clasping Pondweed Sago Pondweed, White Water Lily	A, A S, C
12	North Bank	Wildrice, Clasping Pondweed	A, C
	South Bank	Wildrice, White Water Lily	A, C

Thief River Falls Reservoir Study Plant Identification / Biomass

Cross Section #	Location	Species Present	Relative Abundance
	All are Thief River Cross Sections		A = Abundant C = Common S = Sparse
14	West Bank	White Water Lily, Water Celery	C, S
	East Bank	Water Celery, Milfoil, Coontail	A, C, S
16	West Bank	Elodea, Coontail, Water Celery, Floating Leaf P.W. Wild Rice, White Water Lily, Sago Pondweed, Milfo	A, S, C, S S, S, C, C
	East Bank	Water Celery, Typha, Floating Leaf Pondweed Duckweed, Milfoil, Sago Pondweed	S, C, A A, S, C
20	West Bank	Milfoil, Sago Pondweed, Claspig Pondweed Water Celery, Coontail, Elodea, Green Fruited Bure	S, S, S S, C, S, S
	East Bank	Water Celery	A
21	West Bank	Floating Leaf Pondweed, Coontail, Elodea Milfoil, Sago Pondweed	S, S, S C, A
	East Bank	Sago Pondweed, Water Celery Green Fruited Buread	C, A S
22	West Bank	Milfoil, Green Fruited Buread	A, C S, A
	East Bank	Floating Leaf Pondweed, Water Celery	A, C

Annex G

Annex G contains the results from the laboratory tests that were performed on the sediment samples collected from the reservoir. This includes the density and particle size analysis results.

By conducting a drawdown we expected to achieve consolidation of the sediments. This would include an overall settling of the material as the water drained out. By accomplishing this, the expected outcome would be an increase in sediment density.

The following tables show the results of the particle size and density analyses. June 1995 was before the drawdown, October 1995 was before refilling, and December 1995 was two months after refilling the reservoir. The observed results were contrary to what we expected. The October and December samples actually showed a decrease in sediment density.

The consistently lower density of samples collected after the drawdown, contradicts the sediment consolidation theory. We consulted several soil scientists at the University of Minnesota regarding this. After studying our methods and results, their consensus was that these results could be attributed to field sampling variability. The December density analysis, which included duplicate sampling as well as the particle size analysis, was done to illustrate this sampling variability. Our density results again showed a decrease in sediment densities. The particle size analysis results differed greatly from our 1991 results. This illustrates field sampling variability, since the same sites were sampled both times.

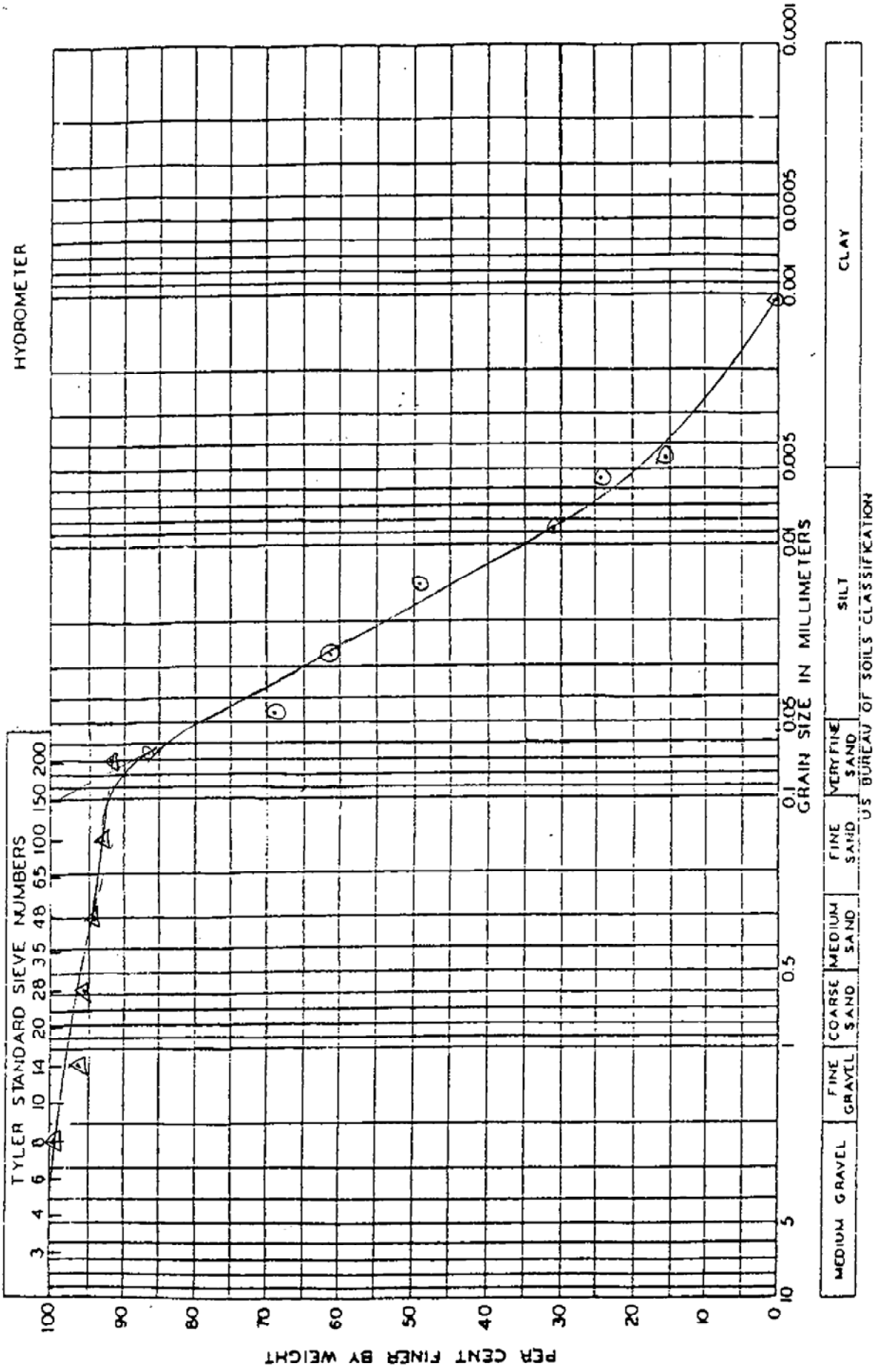
**Thief River Falls Reservoir Study
Sediment Density Analysis**

Sample #	Date Sampled	Weight of Container (grams)	Volume of Container (mL)	Weight of Water and Sediment (grams)	Dry Weight of Sediment (grams)	Moisture Content	Density Inplace g/cm ³	Dry Density g/cm ³
6	Jul-91					1.48		0.51
	Jun-95	14.2	75	110.6	47.6	1.32	1.48	0.64
	Oct-95	14.1	75	91.4	24.6	2.72	1.22	0.33
	Dec-95	14.4	75	107.3	43.8	1.45	1.43	0.58
	Dec-95	14.4	75	103.7	40.3	1.57	1.38	0.54
8	Jul-91					1.06		0.66
	Jun-95	14.2	75	119.1	61.2	0.95	1.59	0.82
	Oct-95	14.1	75	97.2	29.2	2.32	1.3	0.39
	Dec-95	14.1	75	102.5	87	1.77	1.37	0.49
11	Jun-95	14.2	75	109.8	47.9	1.29	1.46	0.64
	Oct-95	13.8	75	107.3	44.6	1.41	1.43	0.59
	Dec-95	14.4	75	94.7	25	2.78	1.26	0.33
	Dec-95	14.4	75	93.6	24.4	2.84	1.25	0.33
16	Jul-91					0.82		0.8
	Jun-95	14.2	75	139.5	92.1	0.52	1.86	1.23
	Oct-95	13.9	75	109.1	52	1.1	1.45	0.69
	Dec-95	14.3	75	109.8	49	1.24	1.46	0.65
	Dec-95	14	75	106.7	49.1	1.17	1.42	0.66
22	Jun-95	13.2	75	131.9	81.4	0.62	1.76	1.09
	Oct-95	13.9	75	118.5	60.4	0.96	1.58	0.81
	Dec-95	14.9	75	114.8	64.5	0.78	1.53	0.86

PARTICLE SIZE COMPARISONS

Sample #	6	6 Duplicate	8	11	11 Duplicate	16	16 Duplicate	22
Date Sampled	Jul-91	Dec-95	Jul-91	Dec-95	Dec-95	Jul-91	Dec-95	Dec-95
Sample f.D.	Red Lake River	Red Lake River	Red Lake River	Red Lake River	Red Lake River	Thief River	Thief River	Thief River
Soil Classification	Loam	Silt Loam	Sandy Loam	Silt Loam	Silty Clay Loam	Sandy Clay Loam	Loam	Clay Loam
Sand .05 to 2.0 mm	43	21	56	28	17	62	35	27
Silt .005 to .05 mm	39	59	30	57	50	14	42	42
Clay 0.00 to .005 mm	18	20	14	15	33	24	23	31
Moisture Content (when received %)	148	145	106	177	278	82	124	78
Grain Size Analysis Particle Size (mm)								
5	99	100	97.5	100	100	100	100	100
3	99	99.5	97	100	100	100	100	100
2	99	99	95.5	97	97	99	97	98
1	99	97.5	91	90	92.5	96.5	91.5	96
0.75	98.5	97	88.5	88	91.5	94.5	90	95
0.5	98.5	96	84	86	91	93	88	93.5
0.2	98	94	69	83	90	75	82.5	85
0.1	83.5	92.5	56	81	87.5	49.5	77.5	80
0.075	75	88	51	78	85.5	44	76	77
0.05	57	87.5	44.5	72	83	40	65	72
0.02	35	63	29.5	37	70	32	45	58
0.01	25.5	45	21	24	51	28	32.5	44
0.005	16.5	27.5	14	15	32	24	22.5	26
0.001	8	0	7	5	0	17	5	4

HYDROMETER



MEDIUM GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	VERY FINE SAND	SILT	CLAY
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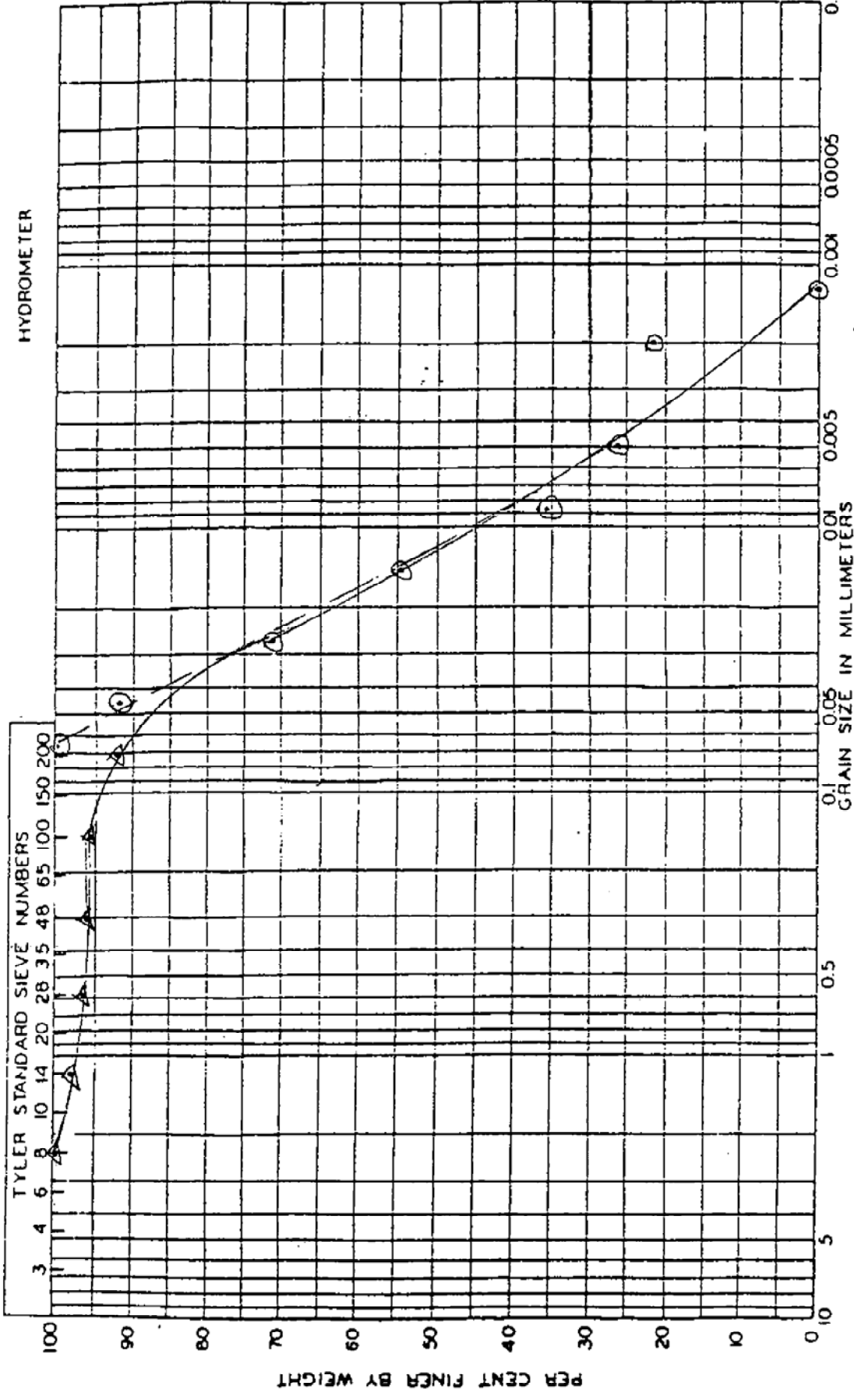
U.S. BUREAU OF SOILS CLASSIFICATION

PROJECT _____ BORING NO. _____ SAMPLE NO. A-6

DEPTH _____ ELEVATION _____ REMARKS _____

A = Sieve
B = Hydrometer

GRAIN SIZE DISTRIBUTION DIAGRAM



MEDIUM GRAVEL FINE GRAVEL COARSE SAND MEDIUM SAND FINE SAND VERY FINE SAND SILT CLAY
 US BUREAU OF SOILS CLASSIFICATION
 PROJECT TRF Drains BORING NO. X-Station 6.Dip
 DEPTH _____ ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION DIAGRAM

Total Solids = 15.56

HYDROMETER

TYLER STANDARD SIEVE NUMBERS

3 4 6 8 10 14 20 28 35 48 65 100 150 200

PER CENT FINER BY WEIGHT

0 10 20 30 40 50 60 70 80 90 100

0.1 0.075 0.05 0.01 0.005 0.001 0.0001

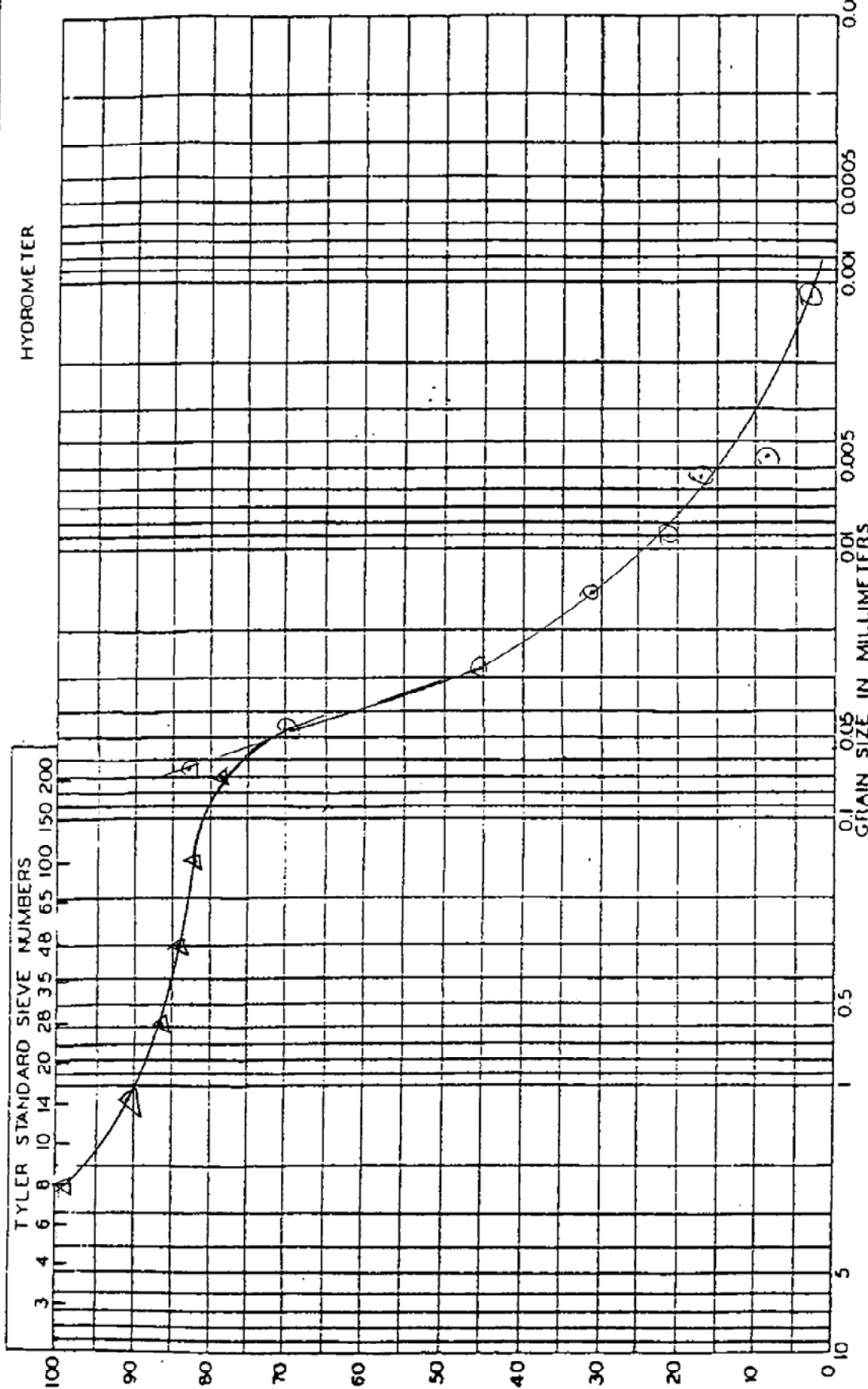
MEDIUM GRAVEL FINE GRAVEL COARSE SAND MEDIUM SAND FINE SAND VERY FINE SAND SILT CLAY

U.S. BUREAU OF SOILS CLASSIFICATION

PROJECT TRF - Down town BORING NO. SAMPLE NO. 7-section #8

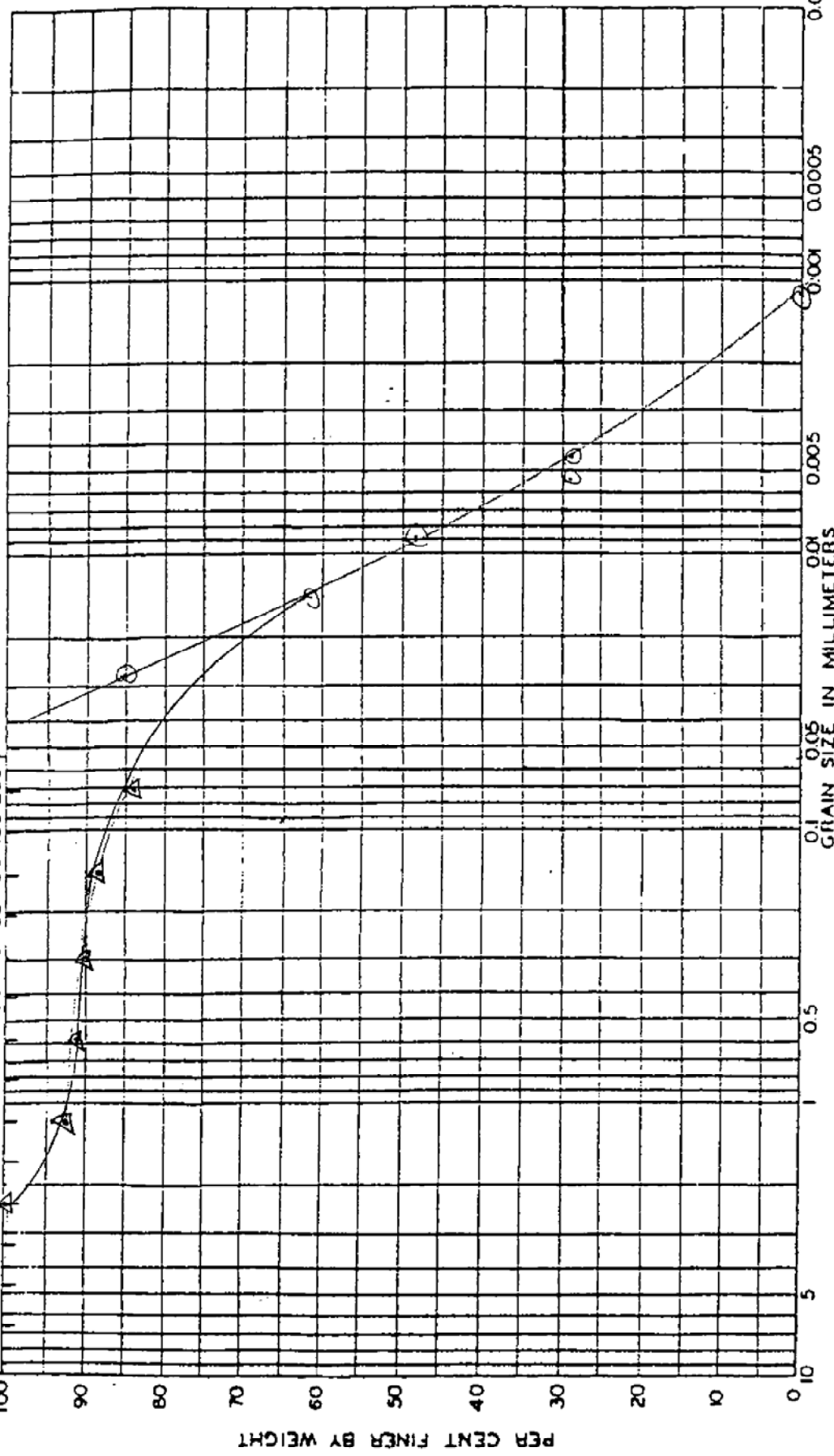
DEPTH ELEVATION REMARKS

GRAIN SIZE DISTRIBUTION DIAGRAM



HYDROMETER

TYLER STANDARD SIEVE NUMBERS
3 4 6 8 10 14 20 28 35 48 65 100 150 200



MEDIUM GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	VERY FINE SAND	SILT	CLAY
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US BUREAU OF SOILS CLASSIFICATION

PROJECT TRF Driveway BORING NO. SAMPLE NO. X-Sections #11

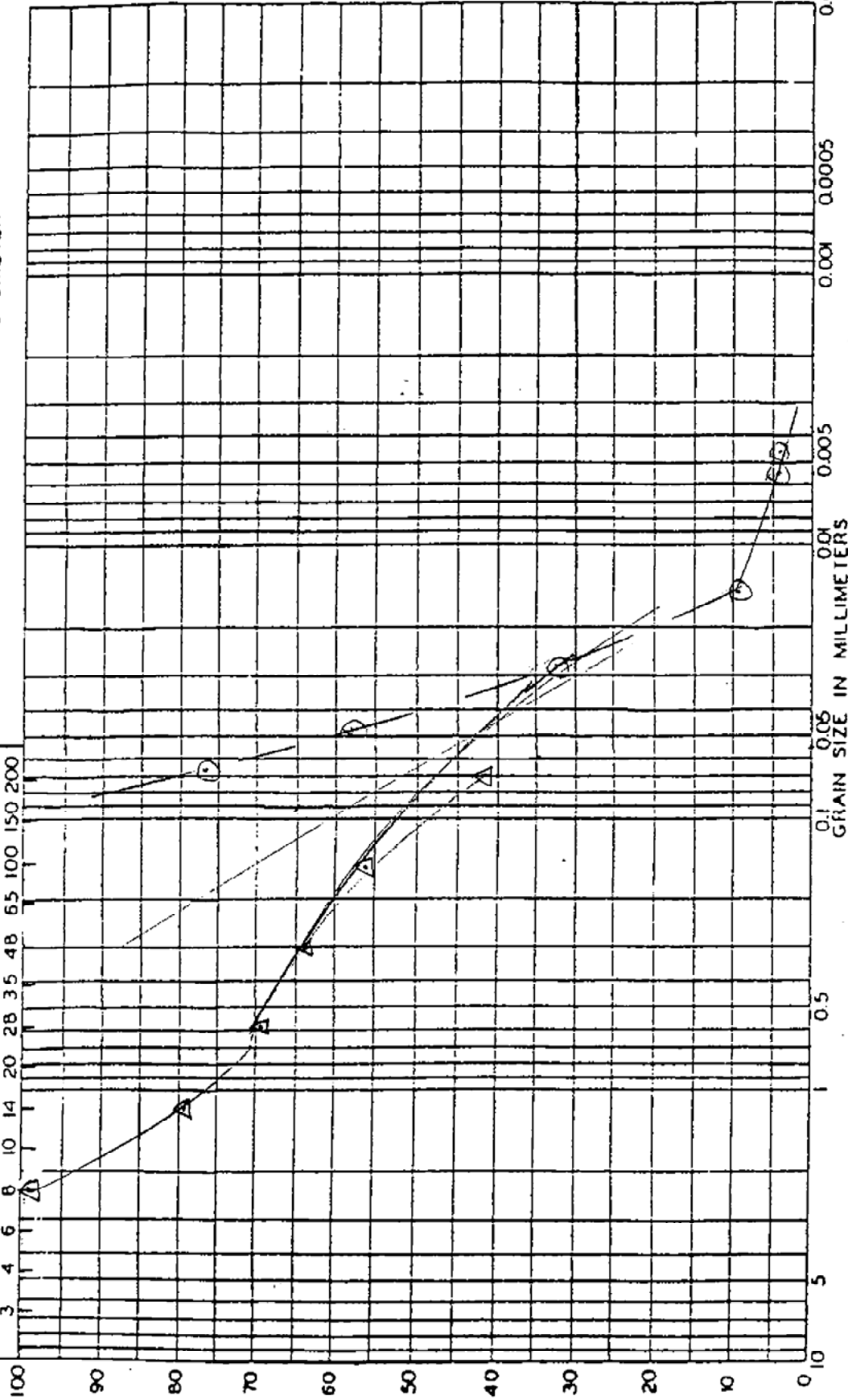
DEPTH ELEVATION REMARKS

GRAIN SIZE DISTRIBUTION DIAGRAM

HYDROMETER

TYLER STANDARD SIEVE NUMBERS
3 4 6 8 10 14 20 28 35 48 65 100 150 200

PER CENT FINER BY WEIGHT



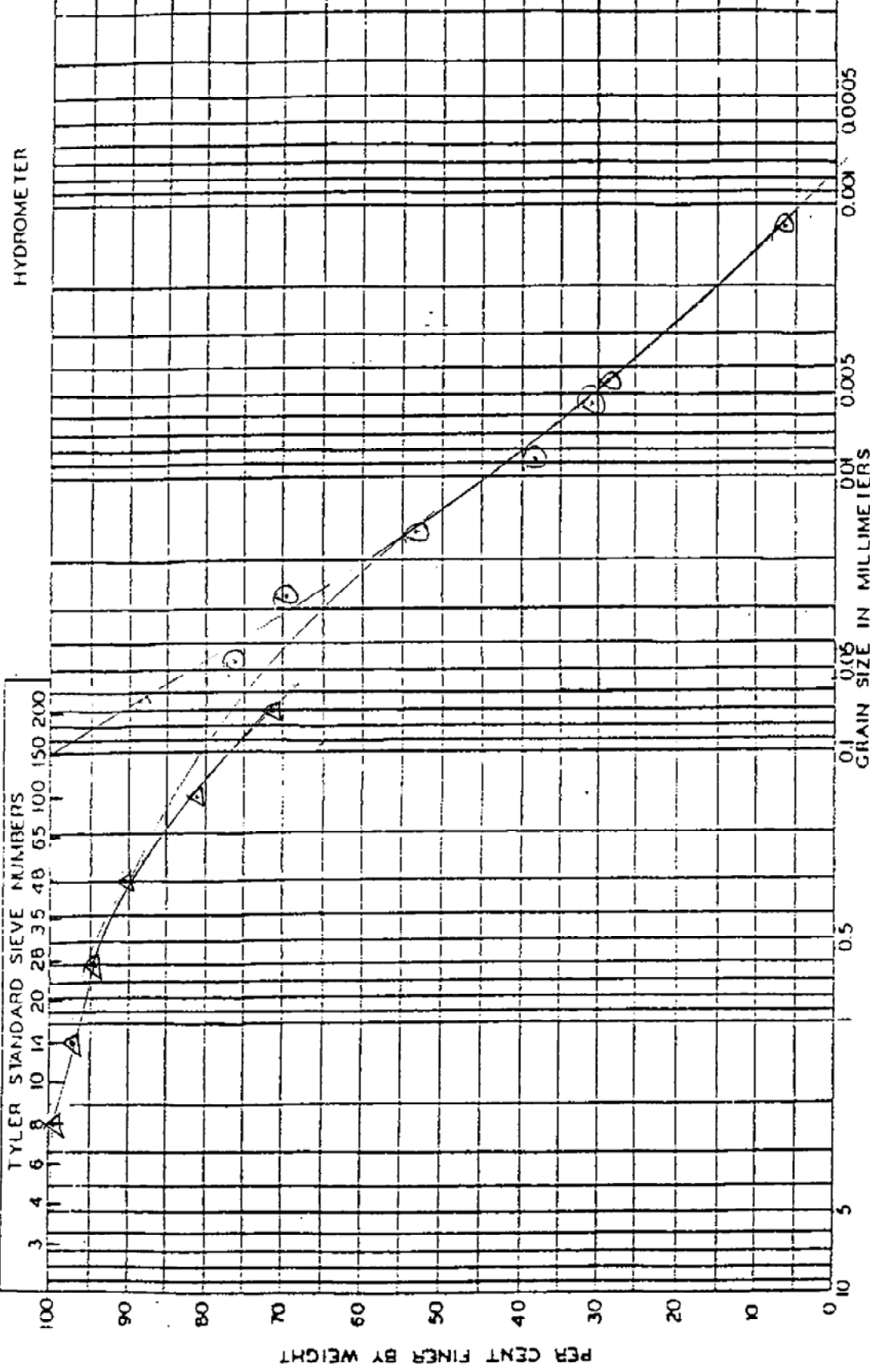
US BUREAU OF SOILS CLASSIFICATION			
MEDIUM GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND
		FINE SAND	VERY FINE SAND
			SILT
			CLAY

PROJECT _____ BORING NO _____ SAMPLE NO A-Section 11-Dup
 DEPTH _____ ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION DIAGRAM

HYDROMETER

TYLER STANDARD SIEVE NUMBERS



MEDIUM GRAVEL FINE GRAVEL COARSE SAND MEDIUM SAND FINE SAND VERY FINE SAND
 CLAY
 US BUREAU OF SOILS CLASSIFICATION

PROJECT TRF Drawdown BORING NO. _____ SAMPLE NO. X-Section 22
 DEPTH _____ ELEVATION _____ REMARKS _____

GRAIN SIZE DISTRIBUTION DIAGRAM