HDD PA-WM1-0157.0000-RD

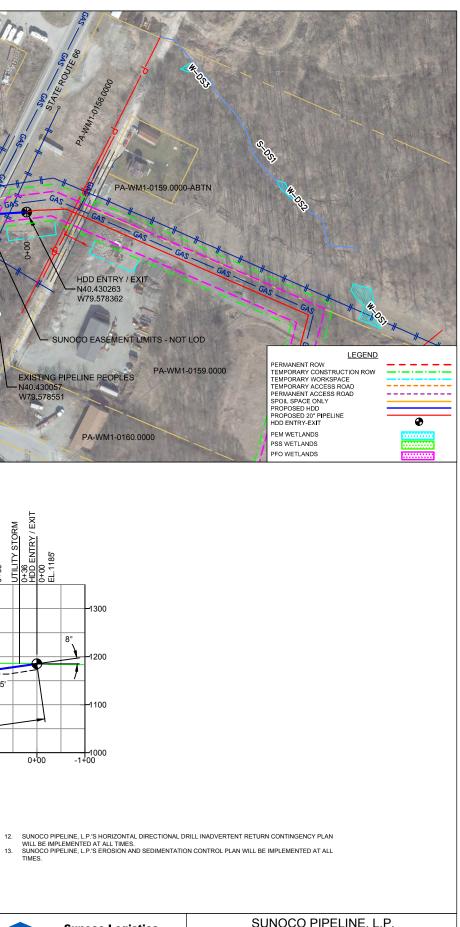
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts, if they were to occur, are also minimized to the maximum extent.

The drill will enter/exit 1,450 feet from the western edge of State Road 66 (S201) and enter/exit 70 feet from the eastern edge. The drill will cross 15 feet below the road. Geotechnical results from Delmont Station, at the end of the drill, were used to determine the entry/exit angles, and depths to pass through the best substrates while maintaining the pipe integrity (e.g., no large bends). According to the geotechnical report the primary substrates the drill will pass through are clays and sandy-clay mixtures as well as shale, coal, and other bedrock materials at lower depths. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PROFILE VIEW SUNOCO WESTMORELAND COUNTY, PENNSYLVANIA - MURRYSVILLE/SALEM TOWNSHIP 8 S1B-0280 SUNO EXISTING PIPELINE S 5+34 EXISTING PIPELINE S 5+19 EXIT ő UTILITY STORM 0+36 HDD ENTRY / EXI ШX WATER PEL TE ROUTE Z CUR <u>HDD ENTRY</u> / F 5+51 EL.1240' <u>OVERHEAD</u> P 2+71 PC HORZ CUI)+91 +23 +91 +91 +90 GRADE 1300 20' EXISTING SUNOCO 1200 12" PIPELINE - R=2000' 154' L=694' S=698' LOW PT EL. 1105' HORIZONTAL CURVE 438 1100 R=2000' __STA. 11+23 EL. 1149' STA. 4+29__ L=211' EL. 1125 433 1000 17+00 16+00 15+00 14+00 13+00 12+00 10+00 9+00 8+00 7+00 6+00 5+00 3+00 2+00 0+00 11+00 4+00 1+00 DESIGN AND CONSTRUCTION: CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING UTILITIES SHOWN OR NOT SHOWN ON
THIS DRAWING. 5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50). INTERNAL DESIGNER HAD YOU GENERAL DIRECTIONAL DESIGN FACTOR U.S.). INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD). PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM (FORSINGS. THIS DRAWING. 2. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE. 3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4 4. CROSSING PIPE SPECIFICATION: HDD HORZ. LENGTH (L=):1551' HDD PIPE LENGTH (L=):1551' HDD PIPE LENGTH (S=):1569' 20'x 0.456'' WT.X.65, APISL, PSL2, ERW, BFW COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95) 13. TIMES. STREAM CROSSINGS. 8. CARRIER PIPE NOT ENCASED. 9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER. 10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG. 11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOTES		REF. DR	AWING		REVISIONS						• • • •	SU	NOCO PIPELINE, L.P.
1. ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83	ES-1.70	TO ES-1.71	EROSION & SEDIMENT PLAN								Sunoco Logistics	00	
 STATIONING IS BASED ON HORIZONTAL DISTANCES. ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION 	SHEET 52	TO SHEET 52	AERIAL SITE PLAN								Partners L.P.	00 10 10 11	
OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING. INC. AND SUNOCO PIPELINE.													HORIZONTAL DIRECTIONAL DRILL
LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.				EP2 REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MF	RS 09/30/16	RMB 09/30	/16 AAW	09/30/16				
 CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING. 				EP1 REVISED PER PADEP COMMENTS	MF	RS 05/06/16	RMB 05/06	/16 AAW	05/06/16	TET	RA TECH ROONEY	PENNS	SYLVANIA PIPELINE PROJECT
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.				EP	JT	W 03/15/16	RMB 03/15	/16 AAW	03/15/16	1 IGI			
	DWG NO	DWG NO	DESCRIPTION	NO. DESCRIPTION	в	BY DATE	CHK DA	TE APP	DATE	(303) 792–5911	SCALE: 1"=200'	DWG. NO: PA-WM1-0157.0000-RD
	-												





TETRA TECH

240 Continental Drive, Suite 200 Newark, Delaware 19713 302.738.7551 fax: 302.454.5988

TEST BORING LOG

Project	t Name:		SUNOC	O MARIN	NER E/	AST			Project No	o.: 10)3IP34	406	
Project	t Locatio	n:	DELMO	NT STAT	TION, S	SUNOC	O LOGISTICS, DELMONT, PA		Page 1 of	1			
Test Bo	oring No	.:	SB-01				Dates(s) Drilled: 10-08-15	Inspector:	E. WATT				
Drilling	Contrac	tor:	HAD DR	RILLING			Drilling Method: SPT - ASTM D1586	Driller:	S. HOFFE	R			
Surface	rilling Contractor: HAD DRILLING urface Elevation: ~1225						Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft):	40.1				
Sample No.	Sample I From	Depth (ft) To	Strata D From	Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materi	als		6" lr B			Ν
	1 1.0 2.5 0.0 18						TOPSOIL (NONE)						
1							BROWN AND GRAY SILTY CLAY AND FINE SA	ND, SLIGHTLY		3	3	6	9
						-	MICACEOUS, TRACE FINE GRAVEL.						
2	3.5	5.0			16	CL	BROWN AND GRAY SILTY CLAY AND FINE SA			2	2	3	5
-	0.0	0.0		. . .	10					~	-	Ŭ	Ŭ
	5.5 MICACEOUS, TRACE FINE GRAVEL. (USCS: CL).							_					
3	6.0	7.5	5.5		18	_	BROWN AND GRAY FINE SAND AND SILTY CL	AY, TRACE		5	6	4	10
						_	OXIDIZED SHALE.						
4	9.0	10.5			8		DARK GRAY FINE TO MEDIUM SAND WITH A I	LITTLE SILTY		1	1	1	2
						~~~	CLAY, TRACE FINE GRAVEL.						
5	15.0	16.5			18	SC	BROWN MICACEOUS FINE TO MEDIUM SAND	WITH SOME		2	4	5	9
						-	SILTY CLAY, TRACE FINE SANDSTONE GRA	VEL. (USCS: SC).					
6	20.0	21.5			16	_	BROWN AND GRAY FINE SAND WITH SOME S			7	37	12	49
	20.0	21.0		26.0	10	_	SOME FINE TO COARSE SANDSTONE AND				01	12	
-	05.0	00 5	00.0	20.0							4	-	•
7	25.0	26.5	26.0		8		BLACK COAL			4	4	5	9
						COAL							
8	30.0	31.5			18	ŏ	BLACK COAL			5	4	8	12
				31.1									
9	35.0	35.1	31.1		<1	LY RED	GRAY PARTIALLY WEATHERED SANDSTONE		50	)/1"			>50
						OCK							
10	40.0	40.1		40.1	<1	PARTIALLY WEATHERED ROCK	GRAY PARTIALLY WEATHERED SANDSTONE		50	)/1"			>50
							CAVED AND DRY AT 34'.						
							AUGERS STARTED GRINDING AT 35'.						
							AUGENS STARTED GRINDING AT 35.						
													1

Notes/Comments:

Pocket Pentrometer Testing

S2: 2.0 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments. N: Number of blows to drive spoon from 6" to 18" interval.



#### TETRA TECH

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# **TEST BORING LOG**

1			tax: 302.45	4.0000								
Projec	t Name:		SUNOC	O MARIN	NER E/	AST			Project No.: 1	03IP34	06	
Projec	t Locatio	n:	DELMO	NT STAT	TION, S	SUNOC	O LOGISTICS, DELMONT, PA		Page 1 of 1			
Test B	oring No	.:	SB-02				Dates(s) Drilled: 10-07-15	Inspector:	E. WATT			
				RILLING			Drilling Method: SPT - ASTM D1586	Driller:	S. HOFFER			
Surfac	illing Contractor: HAD DRILLING irface Elevation: ~1233 mole Sample Depth (ft) Strata Depth (ft) 3 Strata						Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft):	22.3			т —
Sample No.					Recov. (in)	Strata (USCS)	Description of Materia	als		Increm Blows '	Ν	
			0.0	0.4			TOPSOIL (5")					
1	1.0	2.5	0.4		12	~	LIGHT BROWN TO BROWN SILTY CLAY, WITH	A LITTLE FINE	2	2	3	5
				4.0		CL	SAND.					
2	3.5	5.0	4.0		18		MOTTLED BROWN AND GRAY FINE TO MEDIL	IM SAND AND	2	4	5	9
							SILTY CLAY, TRACE FINE GRAVEL. (USCS: S	SC).				-
3	6.0	7.5			18		MOTTLED BROWN AND GRAY FINE T MEDIUM	I SAND WITH SOM	E 8	5	5	10
					-	SC	SILTY CLAY, TRACE FINE GRAVEL.				-	-
4	9.0	10.5			18	-	LIGHT BROWN AND LIGHT GRAY FINE SAND,	SOME F-C GRAVE	46	8	10	18
•	0.0	10.0		9.5			INIITIALLY IN SAMPE, SOME SILTY CLAY.			Ū	10	
5	15.0	15.8	9.5	0.0	8		GRAY AND BROWN PARTIALLY WEATHERED	SHALE	25	50/3"		>5
5	15.0	15.0	9.5		0	, ock		SHALL.	23	50/5		>50
•	00.0				_	ALLY ED R				50/48		<u> </u>
6	20.0	20.8			8	ARTI	GRAY AND BROWN PARTIALLY WEATHERED	SHALE (FISSILE).	38	50/4"		>50
7	22.0	22.3		22.3	2	PARTIALLY WEATHERED ROCK	GRAY AND BROWN PARTIALLY WEATHERED	SHALE (FISSILE).	50/3"			>50
												-
							AUGER REFUSAL AT 22'.					
												-
							CAVED AND DRY AT 18'.					+
												–
												—
												–
					1							1
												1

Pocket Pentrometer Testing

S1: 1.5 TSF

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments. N: Number of blows to drive spoon from 6" to 18" interval.

# Ŧ

#### TETRA TECH

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# **TEST BORING LOG**

				4.5988									
Project	t Name:		SUNOC	O MARIN	NER EA	AST			Project No	o.: 1	03IP34	106	
Project	t Locatio	n:	DELMO	NT STAT	TON, S	SUNOC	O LOGISTICS, DELMONT, PA		Page 1 of	1			
Test B	oring No	.:	SB-03				Dates(s) Drilled: 10-08-15	Inspector:	E. WATT				
Drilling	Contrac	tor:	HAD DR	RILLING			Drilling Method: SPT - ASTM D1586	Driller:	S. HOFFE	R			
Surfac	e Elevati	on:	~1228				Groundwater Depth (ft): 33.0	Total Depth (ft):	۷	1.3			
Sample No.	Sample I From	Depth (ft) To	Strata D	Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materia	als		6" I E			Ν
			0.0	0.3			TOPSOIL (3")						
1	1.0	2.5	0.3				BROWN AND ORANGE BROWN FINE TO MEDI	UM SAND AND		1	1	1	2
							SILTY CLAY, TRACE FINE GRAVEL.						
2	3.5	5.0					VARIEGATED (GRAY, ORANGE BROWN, BROW	VN) FINE SAND		3	5	7	12
							AND SILTY CLAY, TRACE FINE GRAVEL. (US	SCS: SC).					
3	6.0	7.5				SC	BROWN FINE TO MEDIUM SAND WITH SOME	SILTY CLAY,		4	5	6	11
							TRACE FINE GRAVEL.						
4	9.0	10.5					GRAY AND BROWN HIGHLY WEATHERED SAM	DSTONE (F-M		6	14	25	39
			-	14.0		-	SAND AND F-C GRAVEL, SOME SILTY CLAY)	. (USCS: SC).					
5	15.0	15.8	14.0				PARTIALLY WEATHERED SHALE.		:	20	50/4"		>50
						ALL ^Y IEREI SK							
6	20.0	21.2	-			ARTI EATH RO(	PARTIALLY WEATHERED SHALE.		:	20	35	2	37
				21.0		₫Ѯ							
7	25.0	26.5	21.0				BLACK COAL			1	1	1	2
						AL							
8	30.0	31.5				COAL	BLACK COAL			2	1	5	6
				33.5									
9	35.0	35.1	33.5			LLY RED	GRAY TO YELLOWISH BROWN PARTIALLY W	EATHERED	50	)/1"			>50
						RTIAL THEF	SANDSTONE.						
10	40.0	41.3		41.3		PARTIALLY WEATHERED ROCK	LIGHT GRAY PARTIALLY WEATHERED SANDS	TONE.		8	17	50/3"	>50
							WATER LEVEL THROUGH AUGERS AT 33'.						
						1	CAVED AT 39', WATER LEVEL ON CAVE AT 33'						
						1							

Notes/Comments:

Pocket Pentrometer Testing

Strata (USCS) Designations are approximated based on visual review, except where indicated in Description of Materials.

* Number of blows of 140 lb. Hammer dropped 30 in. required to drive 2 in. split-spoon sampler in 6 in. increments. N: Number of blows to drive spoon from 6" to 18" interval.

# LABORATORY TESTING SUMMARY SUNOCO MARINER EAST DELMONT STATION

Test					Water	Percent	Atterburg	g Limits (ASTN	M D4318)	USCS
Boring	Sample		Depth of S	ample (ft.)	Content, %	Silts/Clays, %	Liquid	Plastic	Plasticity	Classif.
No.	No.	Strata	From	То	(ASTM D2216)	(ASTM D1140)	Limit, %	Limit, %	Index, %	(ASTM D2487)
	2	Α	3.5	5.0	22.3	66.2	39	26	13	CL
	3	В	6.0	7.5	15.1	38.0	-	-	-	-
	4	В	9.0	10.5	8.6	18.9	-	-	-	-
SB-01	5	В	15.0	16.5	9.5	30.9	37	22	15	SC
	6	В	20.0	21.5	2.9	21.8	-	-	-	-
	7	C1	25.0	26.5	6.0	7.7	-	-	-	-
	10	C1	40.0	40.1	1.8	27.0	-	-	-	-
	2	В	3.5	5.0	22.7	39.2	40	24	16	SC
SB-02	3	В	6.0	7.5	13.4	23.9	-	-	-	-
5D-02	5	С	15.0	15.8	5.2	29.1	-	-	-	-
	6	С	20.0	20.8	2.3	20.9	-	-	-	-
	2	В	3.5	5.0	18.1	46.1	41	24	17	SC
	3	В	6.0	7.5	10.9	34.3	-	-	-	-
SB-03	4	В	9.0	10.5	7.2	36.9	38	22	16	SC
30-03	5	С	15.0	15.8	3.1	19.9	-	-	-	-
	6	С	20.0	21.2	5.7	17.3	-	-	-	-
	9	С	35.0	35.1	22.3	44.9	-	-	-	-

# Notes:

1) Sample depths based on feet below grade at time of exploration.

# REGIONAL GEOLOGY SUMMARY SUNOCO PENNSYLVANIA PIPELINE PROJECT DELMONT STATION

SITE NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
	SB-01				cyclic			
Delmont	SB-02	Monongahela Group: consists of cyclic sequences of limestone, shale, sandstone, and coal in the Uniontown and Pittsburgh Formations.	Variable topography	Monongahela Group	sequences of limestone, shale,	250		Historic mining operations are recorded in the area.
	SB-03				sandstone,			

<u>Note</u> : Source of well log data - http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm. All other sources as referenced in comments section.

# FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

## **GRANULAR SOILS**

(Sand, Gravel & Combinations)

<u>Density</u>	<u>N (blows)*</u>	Particle Si	ize Identifica	tion
Very Loose	5 or less		8 in. diamet	
Loose	6 to 10	Boulders	0 0.0	
Medium Dense	11 to 30	Cobbles	3 to 8 in. di	ameter
Dense	31to 50	Gravel	Coarse (C)	3 in. to ¾ in. sieve
Very Dense	51 or more		Fine (F)	¾ in. to No. 4 sieve
Very Dense	51 01 11016	Sand	Coarse (C)	No. 4 to No. 10 sieve
				(4.75mm-2.00mm)
Relative Proportion	ons		Medium	No. 10 to No. 40 sieve
Description Term	<u>Percent</u>		(M)	(2.00mm – 0.425mm)
Trace	1 - 10			No. 40 to No. 200 sieve
Little	11 - 20			(0.425 – 0.074mm)
Some	21 - 35	Silt/Clav	Less Than a	. , , .
And	36 - 50	-, ,		
Little Some	11 - 20 21 - 35	Silt/Clay	Fine (F) Less Than a	No. 40 to No. 200 sieve (0.425 – 0.074mm) No. 200 sieve (<0.074mm)

#### **COHESIVE SOILS**

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>	Plasticity	
Very Soft	3 or less	Degree of Plasticity	Plasticity Index
Soft	4 to 5	None to Slight	0 - 4
Medium Stiff	6 to 10	Slight	5 - 7
Stiff	11 to 15	Medium	8- 22
Very Stiff	16 to 30	High to Very High	> 22
Hard	31 or more	6 , 6	

#### ROCK

## (Rock Cores)

Rock	Rock
Quality Designation	Quality <u>Descripti</u>
<u>(RQD), %</u>	<u>on</u>
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

*N - Standard Penetration Resistance. Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

*Groundwater* observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

## UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]

	Major Divisions ອັງ ທີ		Group Symbols	Typical Descriptions		Laboratory Classification	ons		
	n is larger	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel- sand mixtures, little or no fines	nbols ⁽¹⁾	$C_{u=\frac{D_{60}}{D_{10}}}$ greater than 4: $C_{c=\frac{1}{10}}$	$(D_{30})^2_{D_{10} \times D_{60}}$ between 1 and 3		
(6	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean (Little or	GP	Poorly graded gravels, gravel- sand mixtures, little or no fines	d gravet from grain size curve. d gravet from grain size curve. classified as follows: GW, GP, SW, SP GM. GC, SM, SC Borderline cases requiring dual symbols ⁽¹⁾	Not meeting $C_u$ or $C_c$ requiren	nents for GW		
o. 200 sieve	Gra n half of co than No. 4	Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	grain size grain size ithan No. 2 illows: /, SP , SC ases requiri	Atterberg limits below A Line or I $_{\rm P}$ less than 4	Limits plotting in hatched zone with I p between 4 and 7 are		
d Soils ger than Ne	More tha	Gravel v (Appre amount	GC	Clayey gravels, gravel-sand-clay mixtures	gravel from gravel from tion smaller assified as fr W, GP, SW M. GC, SM orderline c	Atterberg limits above A line with I _p greater than 7	borderline cases requiring use of dual symbols		
Coarse Grained Soils if material is larger tha	maller than		Well graded sands, gravely sands, little or no fines	of sand and g of fines (fract ad soils are cla percent G percent B	$C_{u=\frac{D_{60}}{D_{10}}}$ greater than 6: $C_{c=\frac{1}{10}}$	$\frac{(D_{30})2}{D_{10} \times D_{60}}$ between 1 and 3			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SP	Poorly graded sands, gravelly sands, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM GC, SM, SC 5 to 12 percent Borderline cases requiring dual s)	Not meeting $C_u$ or $C_c$ require	ments for SW		
(We	Sa nalf of coars No. 4	th fines ciable of fines)	SM	Silty sands, sand- silt mixtures	Determ bepending	Atterberg limits below A Line or I _p less than 4	Limits Plotting in hatched		
	(More than I	Sands with fines (Appreciable amount of fines)	SC	Clayey sands, sand-clay mixtures		Atterberg limits above A line with I _p greater than 7	zone with I _p between 4 and 7 are borderline cases requiring use of dual symbols		
Major	Divisions	Group Symbols	Туріса	Descriptions	For soils plotting nea When w _L is near 50	rly on A line use dual symbols i.e ., l _p use CL-CH or ML-MH. Take near as	= 29.5, w _L =60 gives CH-MH. ± 2 percent.		
	s an 50)	ML	sands, rock f	s and very fine lour, silty or clayey r clayey silts with ly	60 <u></u> A Lir	e:			
200 sieve)	silts and clays d limit less than 50)	CL	Inorganic clays of low to r	velly clays , sandy	50 U Lii	1	ON I		
ls r than No.	Silt (Liquid li	OL	Organic silts clays of low	and organic silty plasticity	% (Id) X		N ^o O ^N		
Fine-grained soils (More than half of material is smaller than No. 200	iquid limit 50)	мн		s, micaceous or s fine sandy or silty silts	Plasticity Index (PI), %	NUR A	MH or OH		
Fir half of mat	Silts and Clays (Liquid limit greater than 50)	СН	Inorganic cla fat clays	ys of high plasticity,					
More than	Silts ar 9	ОН	Organic clays plasticity, org	s of medium to high anic silts		CL-ML ML or OL			
)	Highly organic soils	Pt	Peat and oth soils	er highly organic		0 20 30 40 50 6 Liquid Limit (LL	0 70 80 90 100 ),%		

(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.