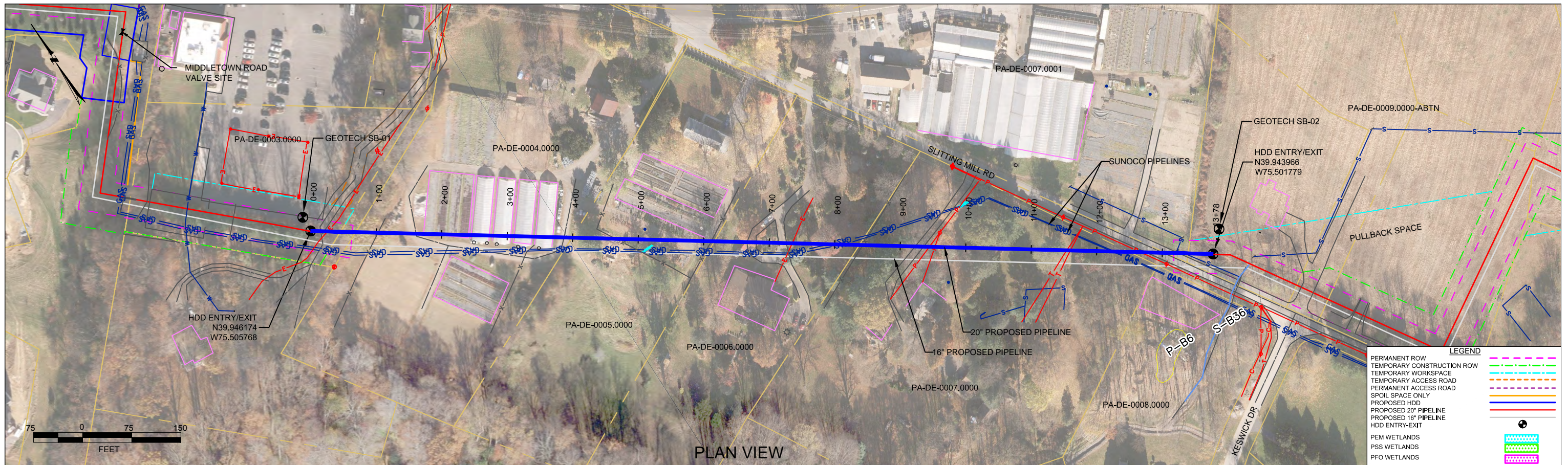


***HDD PA-DE-0008.0000-RD (Slitting Mill Road)***

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.

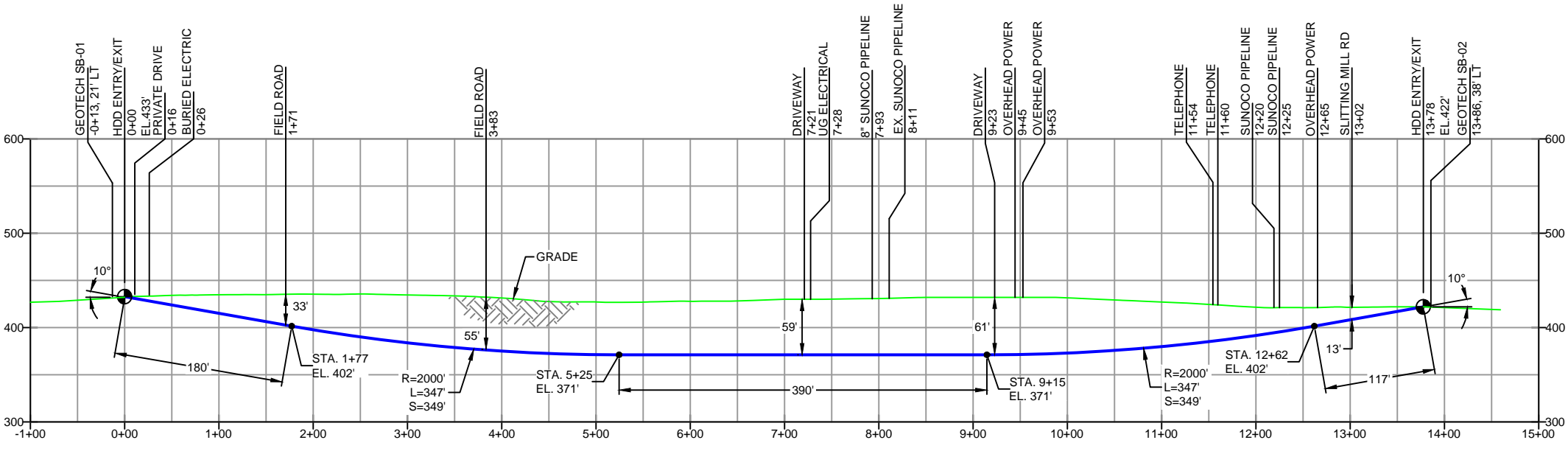
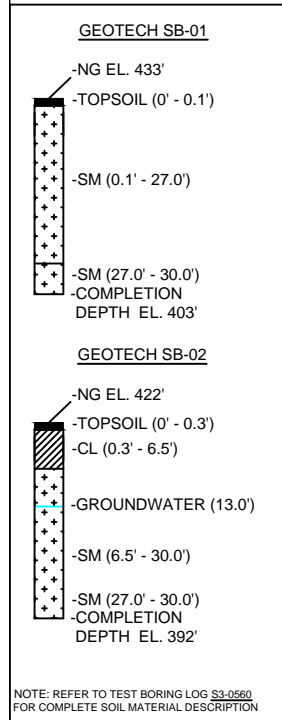
The drill will enter/exit 1302 feet northwest of Slitting Mill Road. The southwest entry/exit point is 76 feet southeast Slitting Mill Road. The drill will pass 13 feet under this road. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be silty sand, and clay.



PLAN VIEW

DELEWARE COUNTY, PA - EDMONT TOWNSHIP  
S3-560

PROFILE VIEW



- DESIGN AND CONSTRUCTION:
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - 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.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
HDD HORZ. LENGTH (L): 1378'  
HDD PIPE LENGTH (S): 1385'  
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW  
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

NOTES

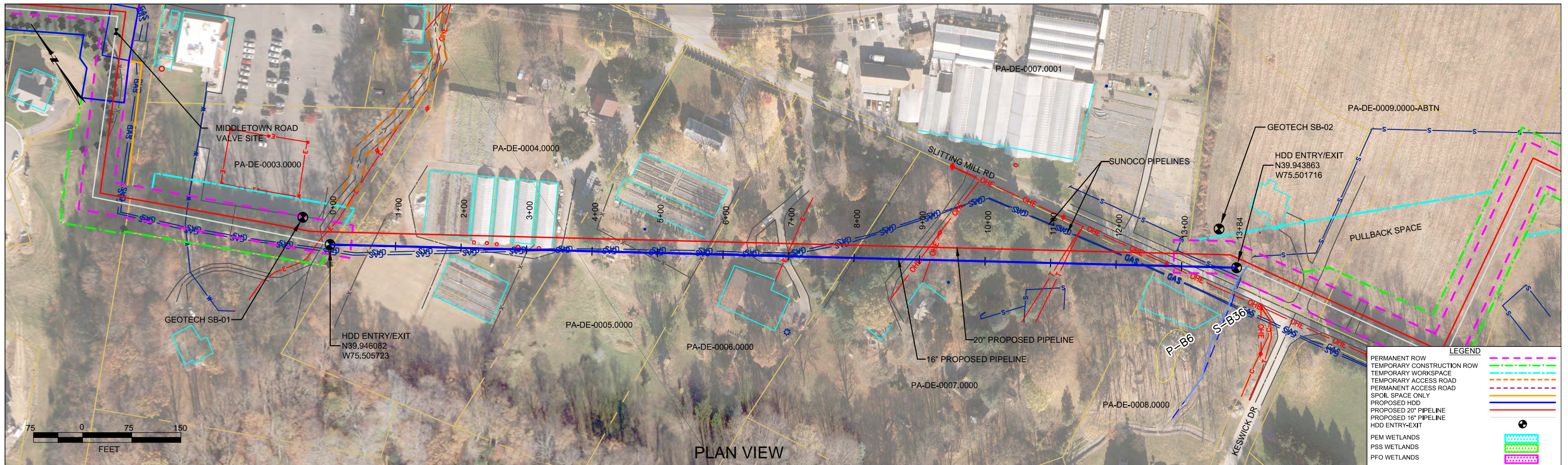
- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION OF FOREIGN UTILITIES SHOWN IN PLOT PLAN OR PROFILE. THE INFORMATION SHOWN HEREON IS FURNISHED WITHOUT LIABILITY ON THE PART OF ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
- CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING	NO.	DESCRIPTION	REF. DRAWING	NO.	DESCRIPTION
ES-6.02	TO	ES-6.03	EROSION & SEDIMENT PLAN	EP1	REVISED PER PADEP COMMENTS
SHEET 1	TO	SHEET 2	AERIAL SITE PLAN	EP	
				D	ADDED GEOTECH INFO
				C	ISSUED FOR BID/DESIGN CHANGE
				B	ISSUED FOR BID
				A	ISSUED FOR REVIEW

REVISIONS					
BY	DATE	CHK	DATE	APP	DATE
MRS	05/20/16	RMB	05/20/16	AAW	05/20/16
MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
MRS	10/01/15	RMB	10/01/15	AAW	10/01/15
DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
KB	03/30/15	RMB	03/30/15	AAW	03/30/15



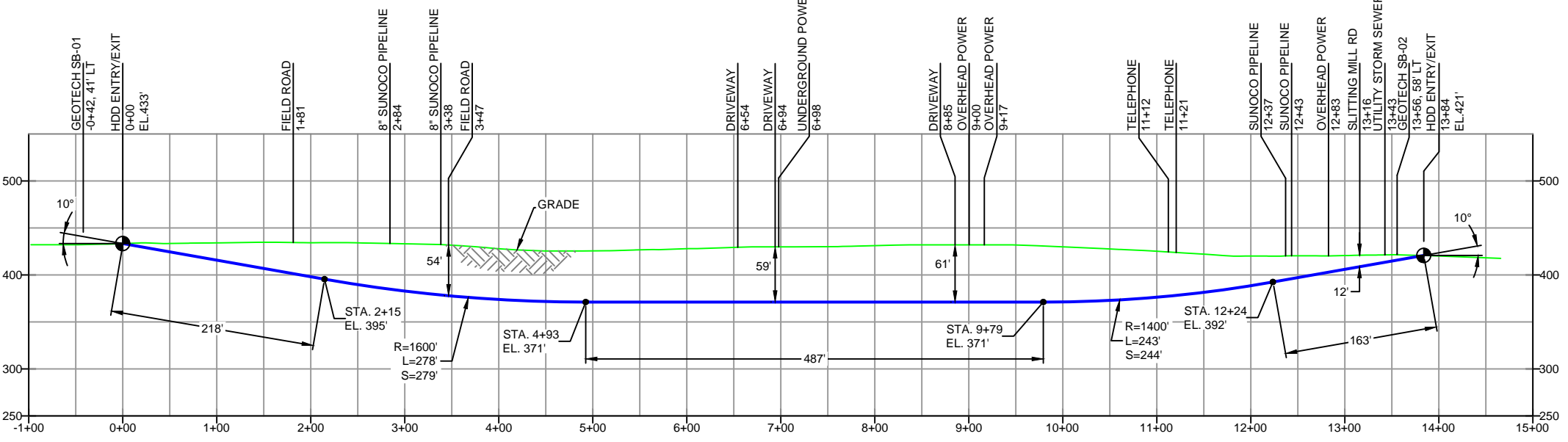
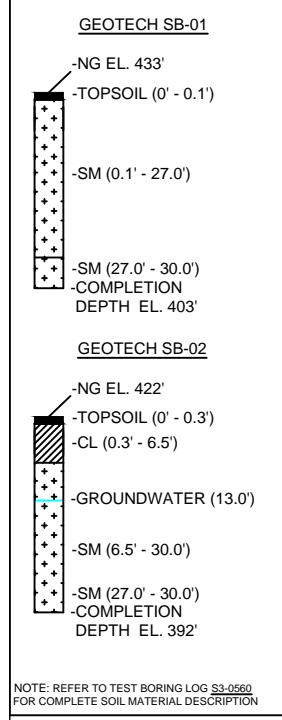
<b>SUNOCO PIPELINE, L.P.</b>	
20-INCH HORIZONTAL DIRECTIONAL DRILL SLITTING MILL RD PENNSYLVANIA PIPELINE PROJECT	
SCALE: 1"=150'	DWG. NO: PA-DE-0008.0000-RD



PLAN VIEW

DELEWARE COUNTY, PA - EDMONT TOWNSHIP  
S3-0560-16

PROFILE VIEW



- DESIGN AND CONSTRUCTION:**
- CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
  - 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.
  - DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
  - CROSSING PIPE SPECIFICATION:  
 HDD HORZ. LENGTH (L=): 1400'  
 HDD PIPE LENGTH (S=): 1408'  
 16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW  
 COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE R95)
  - INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50).
  - INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
  - PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
  - CARRIER PIPE NOT ENCASED.
  - PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
  - CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
  - SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
  - SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
  - SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

**NOTES**

- ALL COORDINATES SHOWN ARE IN LATITUDE AND LONGITUDE. ALL MSL ELEVATIONS ARE NAD83
- STATIONING IS BASED ON HORIZONTAL DISTANCES
- ROONEY ENGINEERING, INC. AND SUNOCO PIPELINE, LP ARE NOT RESPONSIBLE FOR LOCATION 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, LP, FOR ANY DAMAGES RESULTING FROM ERRORS OR OMISSIONS THEREIN.
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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING		EROSION & SEDIMENT PLAN	
DWG NO	DESCRIPTION	DWG NO	DESCRIPTION
ES-6.02	TO SHEET 1	ES-6.03	TO SHEET 2
		EP1	REVISED PER PADEP COMMENTS
		EP	
		B	ADDED GEOTECH INFO
		A	ISSUED FOR BID

**REVISIONS**

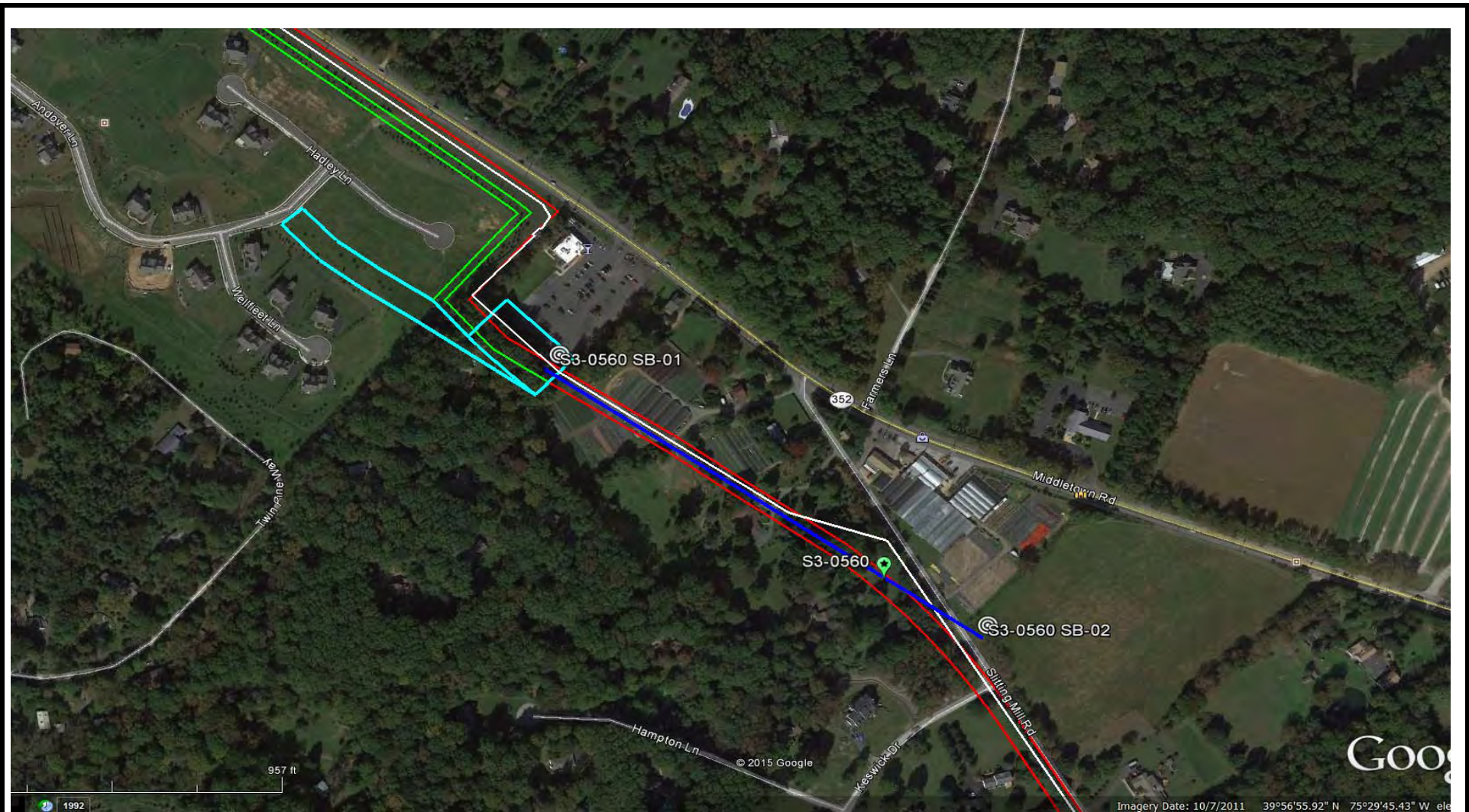
BY	DATE	CHK	DATE	APP	DATE
MRS	05/17/16	RMB	05/17/16	AAW	05/17/16
MRS	03/15/16	RMB	03/15/16	AAW	03/15/16
MRS	10/01/15	RMB	10/01/15	AAW	10/01/15
MRS	08/31/15	RMB	08/31/15	AAW	08/31/15



**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
SLITTING MILL RD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'    DWG. NO: PA-DE-0008.0000-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS

HDD S3-0461

DELAWARE COUNTY, THORNBURY/EDGMONT TWPS, PA  
 SUNOCO PENNSYLVANIA PIPELINE PROJECT



**TETRA TECH**

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

**TEST BORING LOG**

Project Name: SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406	
Project Location: 192 MIDDLETOWN ROAD, DUFFERS TAVERN, GLEN MILLS, PA		Page 1 of 1	
HDD No.: S3-0560	Dates(s) Drilled: 07-07-15	Inspector: E. WATT	
Boring No.: SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 30.0	
Boring Location Coordinates:	39° 56' 46.464" N	75° 30' 20.742" W	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (ft)	Strata (USCS)	Description of Materials	6" Increment Blows *				N	
	From	To	From	To									
			0.0	0.1			TOPSOIL (NONE, GRAVEL SURFACE)						
1	3.0	5.0	0.1		21	SM	DR, VARIEGATED BROWN, ORANGE BROWN AND LIGHT BROWN MICACEOUS F-M SAND, SOME SILT, TRACE FINE ROCK FRAGS.	2	7	4	6	11	
2	8.0	10.0			24		DR, VARIEGATED BROWN, ORANGE BROWN, WHITE FINE TO MEDIUM SAND, SOME SILT, TRACE FINE ROCK FRAGS.	3	13	8	11	21	
3	13.0	15.0			24		DR, VARIEGATED LIGHT GRAY, WHITE, LIGHT BROWN FINE TO MEDIUM SAND, SOME SILT, TRACE FINE ROCK FRAGS.	3	8	12	15	20	
4	18.0	19.9			20		DR, VARIEGATED LIGHT BROWN AND GRAY FINE MICACEOUS SAND AND SILT (USCS: SM).	2	5	5	8	10	
5	23.0	25.0			19		DR, VARIEGATED LIGHT BROWN AND GRAY FINE MICACEOUS SAND WITH SOME SILT.	3	7	6	10	13	
				27.0									
6	28.0	28.5	27.0		5		SM	DR, LIGHT BROWN AND ORANGE BROWN FINE SAND AND SILT, A LITTLE MICACEOUS.	50/6"				>50
				30.0									
							AUGERED TO 30'.						
							CAVED AND DRY AT 27.5'.						

Notes/Comments: Pocket Penetrometer Testing DR: DECOMPOSED ROCK

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.



**GEOTECHNICAL LABORATORY TESTING SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S3-0560**

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S3-0560	SB-01	2	8.0	10.0	11.1	24.5	-	-	-	-
		3	13.0	15.0	11.1	29.9	-	-	-	-
		4	18.0	19.9	16.1	42.8	30	24	6	SM
		5	23.0	25.0	15.1	33.5	-	-	-	-
		6	28.0	28.5	20.5	47.6	-	-	-	-
	SB-02	1	3.0	5.0	23.0	97.9	41	23	18	CL
		2	8.0	10.0	44.8	48.1	-	-	-	-
		3	13.0	15.0	28.5	44.1	-	-	-	-
		4	18.0	19.9	20.9	40.1	29	23	6	SM
		6	28.0	30.0	27.7	42.0	-	-	-	-

Notes:

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

**REGIONAL GEOLOGY SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S3-0560**

HDD No.	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
S3-0560		SB-01	Felsic gneiss - Light, medium grained; includes rocks of probable sedimentary origin.	Generally level, slightly dipping to the north	Felsic gneiss (Precambrian age)	Felsic gneiss; Secondary - paragneiss	Unknown	Widely ranging from 4 to 95 ft bgs, Avg. 47 ft bgs (.25 mile radius)	
		SB-02		Generally level					

Note : 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>
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 or more

### Relative Proportions

<u>Description Term</u>	<u>Percent</u>
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

### Particle Size Identification

Boulders	8 in. diameter or more
Cobbles	3 to 8 in. diameter
Gravel	Coarse (C) 3 in. to ¾ in. sieve Fine (F) ¾ in. to No. 4 sieve
Sand	Coarse (C) No. 4 to No. 10 sieve (4.75mm-2.00mm) Medium (M) No. 10 to No. 40 sieve (2.00mm – 0.425mm) Fine (F) No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)

## COHESIVE SOILS

(Silt, Clay & Combinations)

<u>Consistency</u>	<u>N (blows)*</u>
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

### Plasticity

<u>Degree of Plasticity</u>	<u>Plasticity Index</u>
None to Slight	0 - 4
Slight	5 - 7
Medium	8- 22
High to Very High	> 22

## ROCK

(Rock Cores)

<u>Rock Quality Designation (RQD), %</u>	<u>Rock Quality Description</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		Group Symbols	Typical Descriptions	Laboratory Classifications			
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve size	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for GW		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines			
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4  Atterberg limits above A line with $I_p$ greater than 7  Limits plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			GC	Clayey gravels, gravel-sand-clay mixtures			
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6: $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3  Not meeting $C_u$ or $C_c$ requirements for SW		
			SP	Poorly graded sands, gravelly sands, little or no fines			
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Atterberg limits below A Line or $I_p$ less than 4  Atterberg limits above A line with $I_p$ greater than 7  Limits Plotting in hatched zone with $I_p$ between 4 and 7 are borderline cases requiring use of dual symbols		
			SC	Clayey sands, sand-clay mixtures			
		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 symbols <sup>(1)</sup>					
		Major Divisions		Group Symbols	Typical Descriptions	For soils plotting nearly on A line use dual symbols i.e., $I_p = 29.5$ , $w_L = 60$ gives CH-MH. When $w_L$ is near 50 use CL-CH or ML-MH. Take near as $\pm 2$ percent.	
Fine-grained soils (More than half of material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity				
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		OL	Organic silts and organic silty clays of low plasticity				
	Silt and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		CH	Inorganic clays of high plasticity, fat clays				
		OH	Organic clays of medium to high plasticity, organic silts				
	Highly organic soils	Pt	Peat and other highly organic soils				

(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.