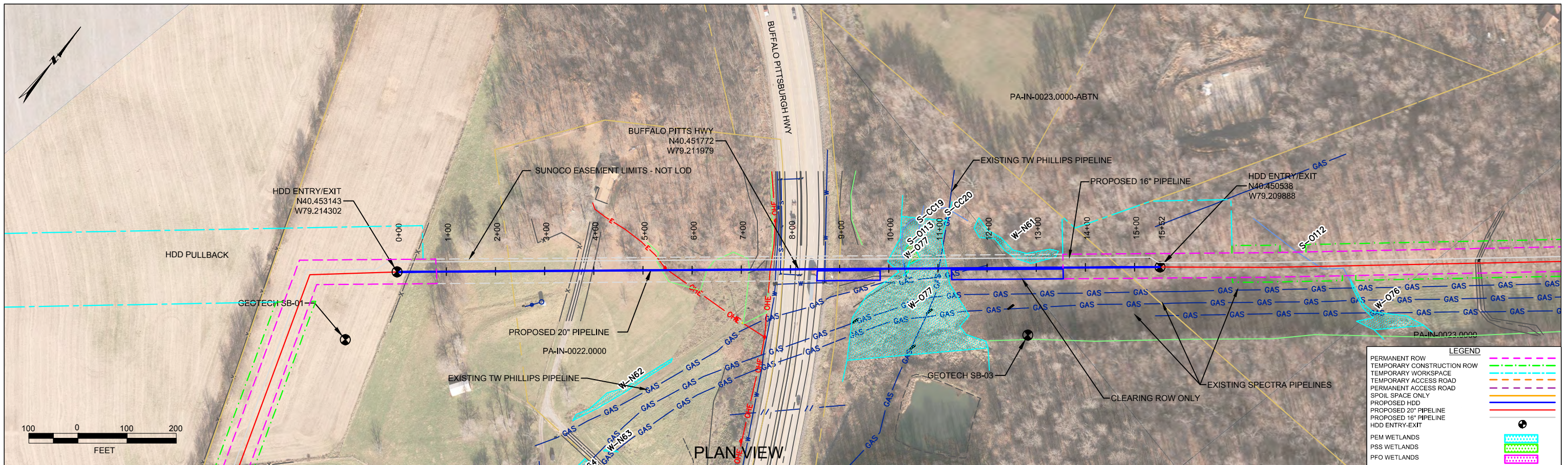


HDD PA-IN-0022.0000-RD (W-O77 and S-0113)

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.

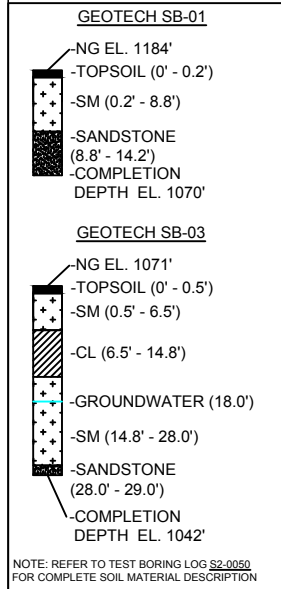
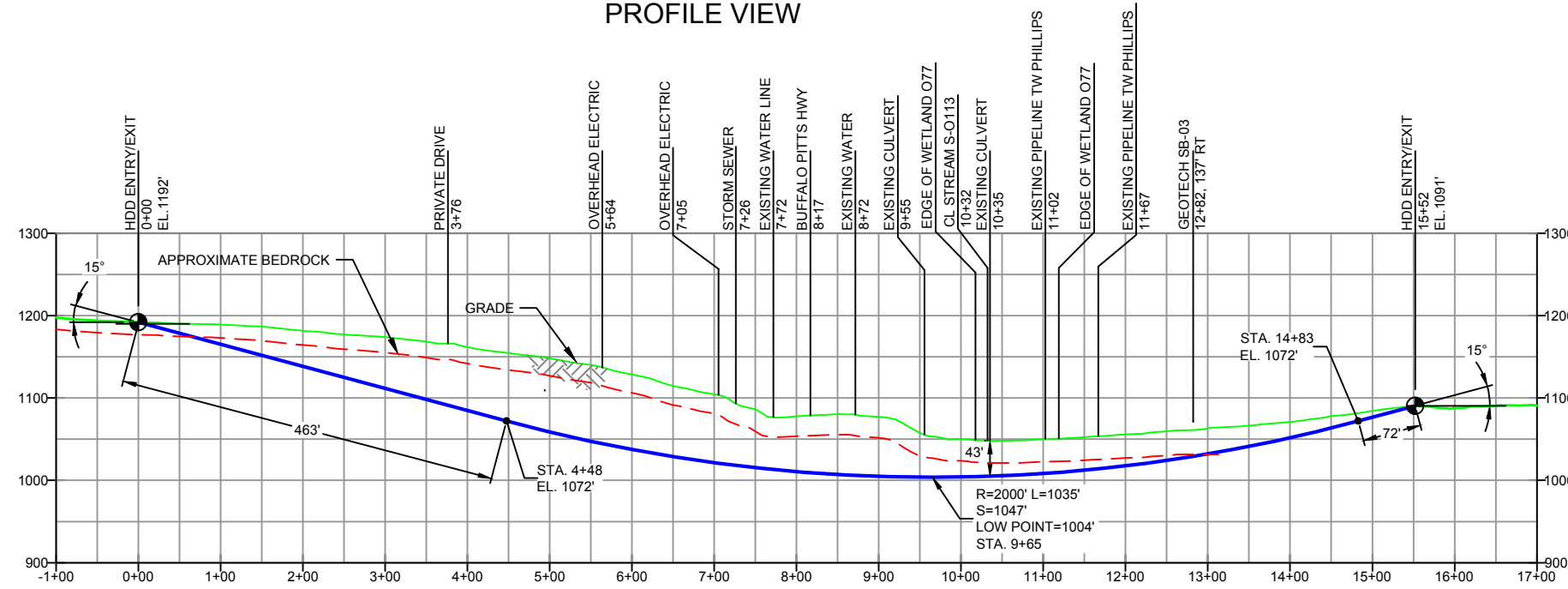
The drill will enter/exit 1010 feet northwest of wetland W-O77. The drill will pass 40 feet under the northwestern most boundary of the wetland and 40 feet under the southeastern most boundary of the wetland. The drill will enter/exit 442 feet southeast of the southeastern most boundary of wetland M59. 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 clayey sand, silt sand and silty clay.

The drill will enter/exit 1032 feet northwest of stream 0113. The drill will pass 43 feet under this stream. The east entry/exit point is 520 feet southeast of this stream. 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 clayey sand, silt sand and silty clay.



INDIANA COUNTY, PENNSYLVANIA - BURRELL TOWNSHIP
S2-0050

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=): 1552'
HDD PIPE LENGTH (S=): 1582'
20" x 0.456" W.T., X-65, API5L, PSL2, ERW, 8FW
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

ES-2.15	TO	ES-2.16	EROSION & SEDIMENT PLAN
SHEET 11	TO	SHEET 11	AERIAL SITE PLAN

REVISIONS

EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16
EP1	REVISED PER PADEP COMMENTS
EP	
C	ADDED GEOTECH INFO
B	ISSUED FOR BID
A	ISSUED FOR REVIEW

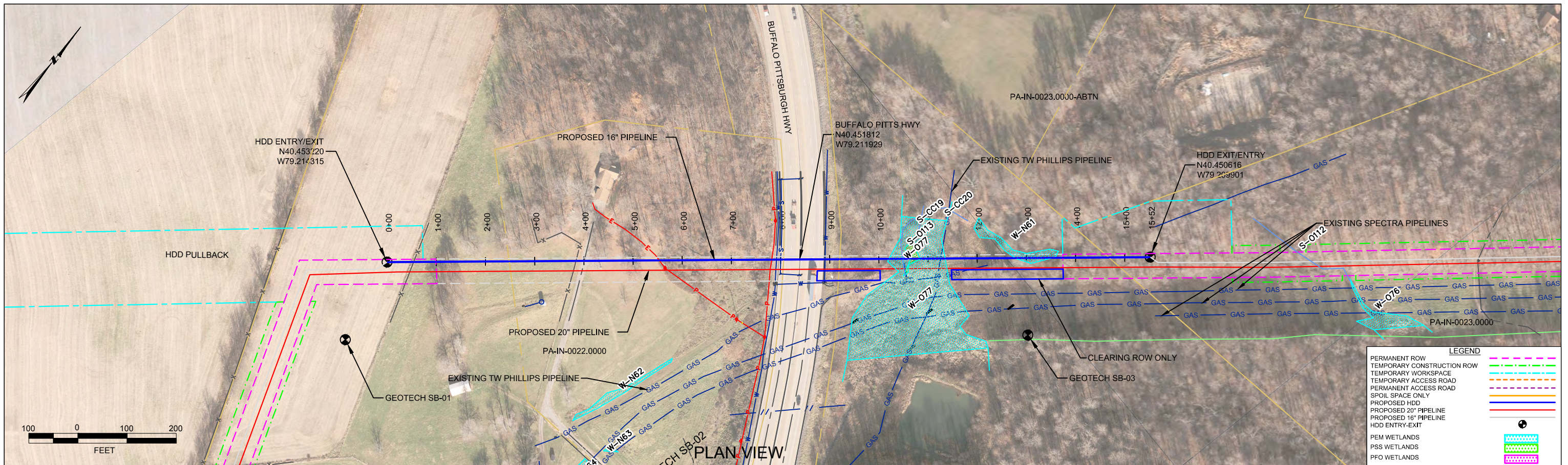
MRS	09/30/16	RMB	09/30/16	AAW	09/30/16
JTW	05/06/16	RMB	05/06/15	AAW	05/06/16
DLM	03/15/16	RMB	03/15/16	AAW	03/15/16
MRS	09/07/15	RMB	09/07/15	AAW	09/07/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
JAM	03/25/15	RMB	03/25/15	AAW	03/25/15



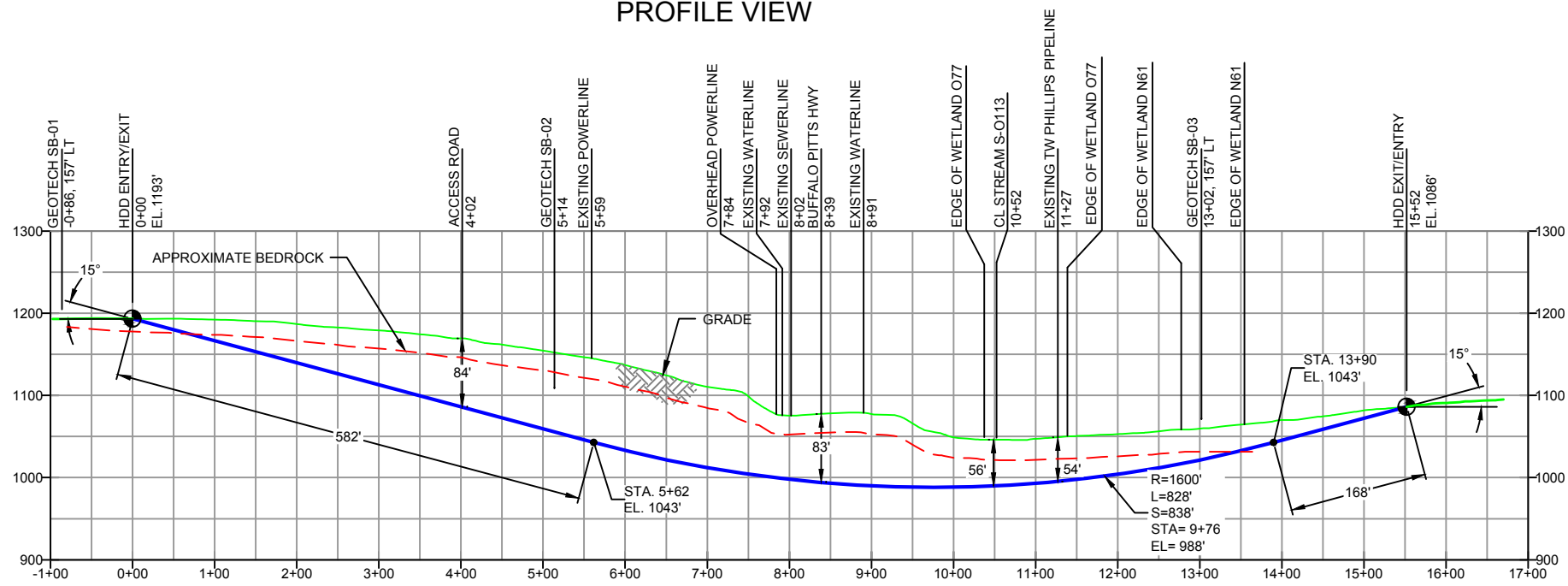
SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL
BUFFALO PITTSBURGH HIGHWAY
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-IN-0022.0000-RD



PROFILE VIEW



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- DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
- CROSSING PIPE SPECIFICATION:
HDD HORZ. LENGTH (L=): 1552'
HDD PIPE LENGTH (S=): 1588'
16" x 0.438" W.T., X-70, API 5L, PSL2, ERW, BFW
COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
- 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.
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NOTES

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- SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REF. DRAWING

ES-2.15	TO	ES-2.16	EROSION & SEDIMENT PLAN
SHEET 11	TO	SHEET 11	AERIAL SITE PLAN

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	JTW	05/06/16	RMB	05/06/16	AAW	05/06/16
EP		DLM	03/15/16	RMB	03/15/16	AAW	03/15/16
B	ADDED GEOTECH INFO	MRS	09/08/15	RMB	09/08/15	AAW	09/08/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

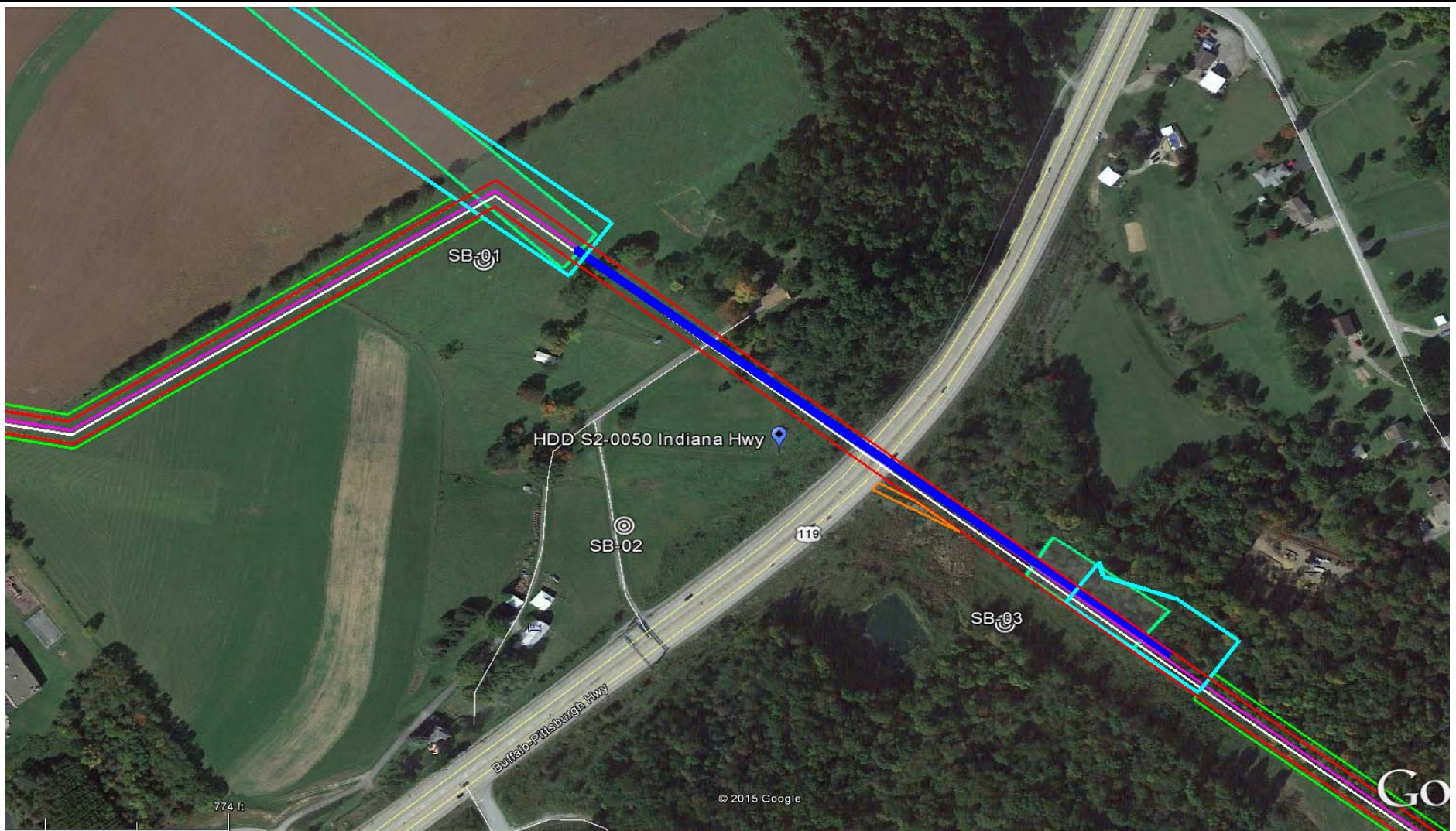
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL
BUFFALO PITTSBURGH HIGHWAY
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-IN-0022.0000-RD-16



LEGEND:

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS
HDD S2-0050
INDIANA COUNTY, BURRELL TOWNSHIP, 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: US 119, BLAIRSVILLE, PA			Page 1 of 1		
HDD No.: S2-0050		Dates(s) Drilled: 04-13-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 18.0		Total Depth (ft): 38.0	
Boring Location Coordinates:		40° 27' 4.830" N		79° 12' 49.938" W	

Sample No.	Sample Depth (ft)		Strata Depth (ft)		Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
	From	To	From	To								
			0.0	0.5			TOPSOIL (6")					
1	3.0	5.0	0.5		14	SM	BROWN AND GRAY MICACEOUS FINE TO MEDIUM SAND WITH A LITTLE SILT, WITH A LITTLE F-C SANDSTONE GRAVEL.	11	18	10	4	28
2	8.0	10.0	6.5		17	CL	MOTTLED (BROWN AND GRAY) SILTY CLAY AND FINE SAND, TRACE F-C GRAVEL. (USCS: CL).	1	1	3	4	4
3	13.0	15.0	14.8		24	SM	LIGHT BROWN FINE TO COARSE MICACEOUS SAND WITH SOME SILT, TRACE FINE GRAVEL.	6	26	5	10	31
4	18.0	20.0			20		LIGHT BROWN FINE TO COARSE MICACEOUS SAND WITH SOME SILT, TRACE FINE GRAVEL. (USCS: SM)	2	6	10	50	16
5	23.0	23.8			9		LIGHT BROWN FINE TO COARSE MICACEOUS SAND WITH A LITTLE SILT AND A LITTLE GRAVEL.	6	50/3"			>50
6	28.0	28.5	28.0	29.0	5		PARTIALLY WEATHERED LIGHT GRAY SANDSTONE.	50/6"				>50
							AUGER REFUSAL AT 29'.					
							ROCK CORING					
RUN 1	29.0	33.0	29.0		44	FRACTURED SANDSTONE	GRAY MODERATELY TO INTENSELY FRACTURED MICACEOUS SANDSTONE. MICACEOUS SILT SEAM FROM 30.1' TO 30.3'.	TCR: 92%, SCR: 62%, RQD: 51%				
RUN 2	33.0	38.0	33.0		60		GRAY MODERATELY TO INTENSELY FRACTURED MICACEOUS SANDSTONE.	TCR: 100%, SCR: 95%, RQD: 75%				
							CORE TESTING RESULTS (DEPTH 35'):					
							COMPRESSIVE STRENGTH: 8,410 PSI					
							UNIT WEIGHT: 166.5 PCF					
							WET ON SPOON AT 18'.					
							WATER LEVEL THROUGH AUGERS AT 18'					
							CAVED AT 26'.					

Notes/Comments:
Pocket Pentrometer Testing
 S2(8'): 0.5 TSF
 S2(10'): 1.25 TSF
 S3: 0.75 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.

**GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0050**

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, %	
S2-0050	SB-01	1	3.0	5.0	9.8	23.4	-	-	-	-
		2	8.0	9.3	8.5	27.8	33	25	8	SM
		3	13.0	13.1	9.5	37.4	-	-	-	-
	SB-02	1	3.0	5.0	11.4	12.8	-	-	-	-
		2	8.0	10.0	17.4	60.9	25	15	10	CL
		3	13.0	15.0	11.6	33.9	-	-	-	-
		4	18.0	20.0	8.7	33.9	30	23	7	SM
		5	23.0	23.8	6.8	18.8	-	-	-	-
	SB-03	1	3.0	5.0	16.1	97.5	38	22	16	CL
		2	8.0	9.9	9.3	77.9	-	-	-	-
		3	13.0	13.8	15.6	60.5	36	23	13	CL
		4	18.0	18.8	14.3	28.8	33	21	12	SC
		5	23.0	25.0	8.5	18.1	-	-	-	-
		6	28.0	28.8	5.7	28.1	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-02	2	35.0	8,410	166.5

Notes:

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

**REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0050**

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
S2-0050	Indiana Highway	SB-01	Casselman Formation - Cyclic sequences of shale, siltstone, sandstone, red beds, thin, impure limestone, and thin, nonpersistent coal; red beds are associated with landslides; base is at top of Ames limestone.	Rolling hills, moderate relief	Casselman	Shale-sandstone with limestone-clastic-coal	236-525	10-20	Yields range from 2-7 gpm (0.4-mile radius)
		SB-02							
		SB-03	Glenshaw Formation - Cyclic sequences of shale, sandstone, red beds, and thin limestone and coal; includes four marine limestone or shale horizons; red beds are involved in landslides; base is at top of Upper Freeport coal.		Glenshaw	Shale-sandstone with limestone-clastic-coal	280-375		

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.

**ROCK CORE DESCRIPTION SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S2-0050**

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S2-0050	SB-2	1	29	33	92	62	51	29	29.25	Moderate to heavily	Sandstone	3"	Greenish Gray	Fragments only at top of rock/start of run
								29.25	30.5	Heavily	Sandstone	12"	Light to Dark Gray	Alternating competent rock and highly weathered mud; Fractures ranging from 2° to 30°, Avg. 11°
								30.5	33	Moderate	Sandstone	18"	Light Gray with Dark Gray Laminations	Ripple marks throughout section, approximately horizontal; Fractures ranging from 3° to 25°, Avg. 14°
		2	33	38	100	95	75	33	33.25	Heavily	Sandstone	3"	Greenish Gray	Fragments only at apparent group contact
								33.25	38	Moderate	Slightly Carbanaceous Sandstone	Massive	Light Gray	Fractures ranging from 1° to 30°, Avg. 7°

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

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)

Relative Proportions

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

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 ⁽¹⁾				
		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 ± 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.