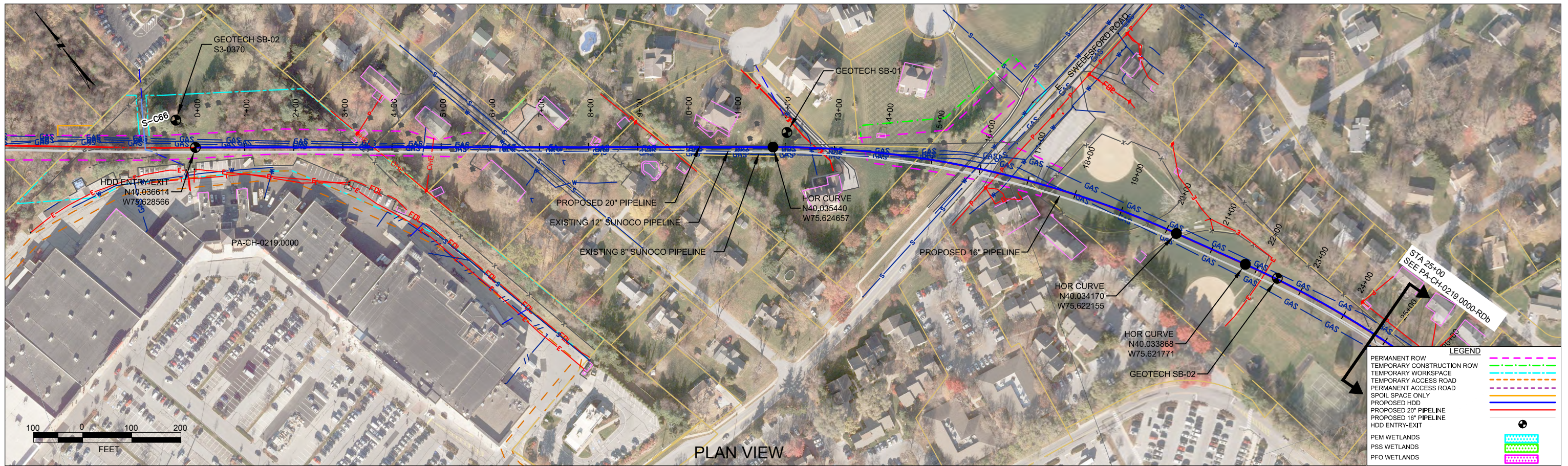


***HDD PA-CH-0219.0000-RD (S-B81, W-B71, and S-B79)***

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 3189 feet northwest of stream B81. This is also the northwestern most boundary of wetland B71. The drill will pass 36 feet under this stream. The southeastern most boundary of the wetland is 3460 feet from the northwest entry/exit point and 1577 feet from the southeast entry/exit point. The drill will pass 36 feet under this southeastern boundary. 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 dolomite.

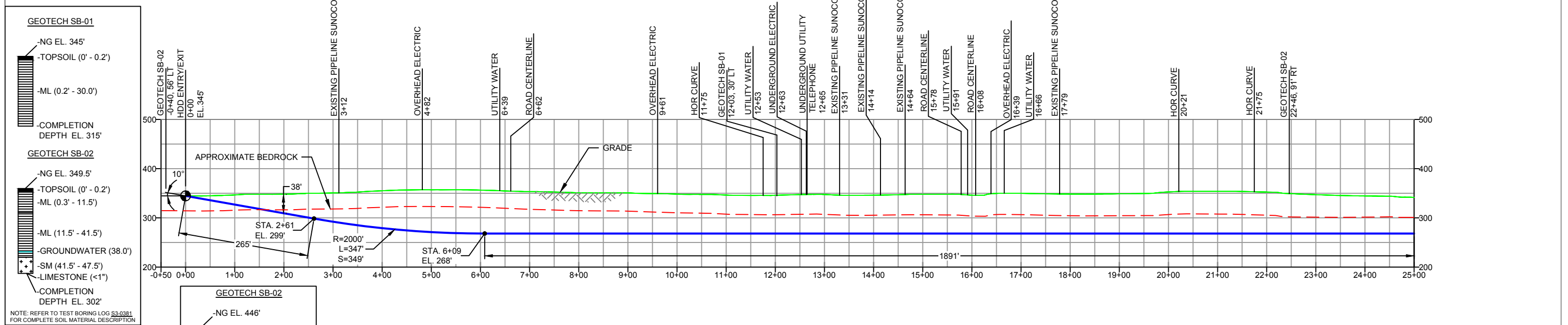
The drill will enter/exit 1000 feet southeast of stream B79. The drill will pass 47 feet under this stream. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be silty sand and dolomite.



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0381

PROFILE VIEW



- NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION
- NOTE: REFER TO TEST BORING LOG S3-0370 FOR COMPLETE SOIL MATERIAL DESCRIPTION
- 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)=5.037'  
HDD PIPE LENGTH (S)=5.048'  
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	NO.	DESCRIPTION	
ES-6.45	TO	ES-6.48	EROSION & SEDIMENT PLAN	EP1	REVISED PER PADEP COMMENTS
SHEET 26	TO	SHEET 32	AERIAL SITE PLAN	EP	
				D	ADDED GEOTECH INFO
				C	ISSUED FOR BID
				B	ISSUED FOR BID
				A	ISSUED FOR REVIEW

REVISIONS

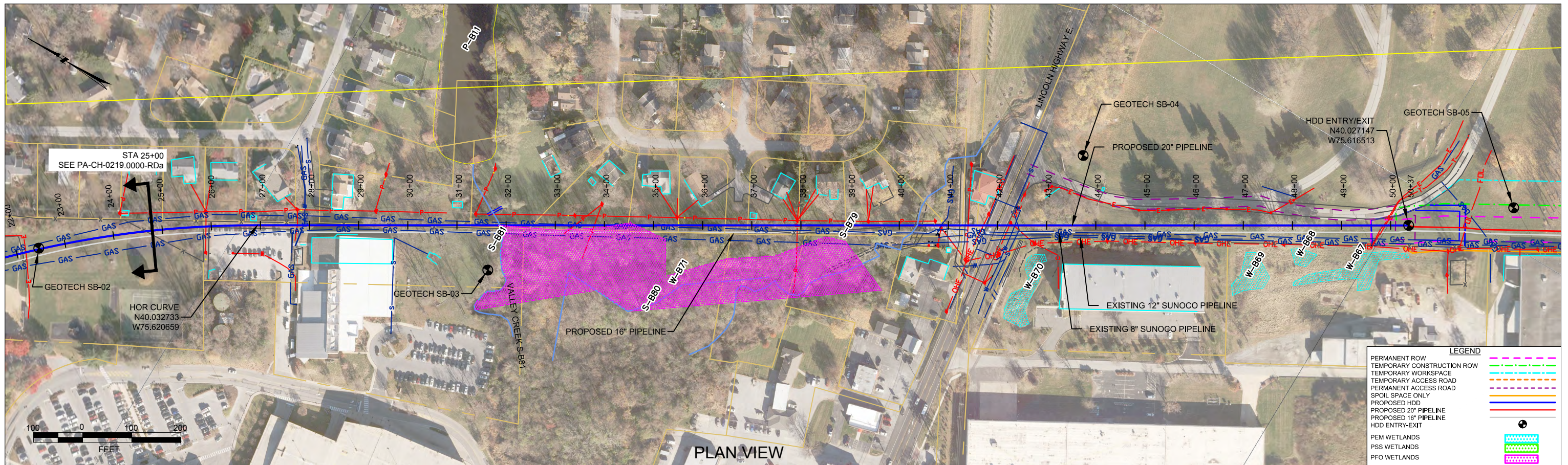
BY	DATE	CHK	DATE	APP	DATE
MRS	05/11/16	RMB	05/11/16	AAW	05/11/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
MRS	09/29/15	RMB	09/29/15	AAW	09/29/15
DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
JVA	03/26/15	RMB	03/26/15	AAW	03/26/15

(303) 792-5911

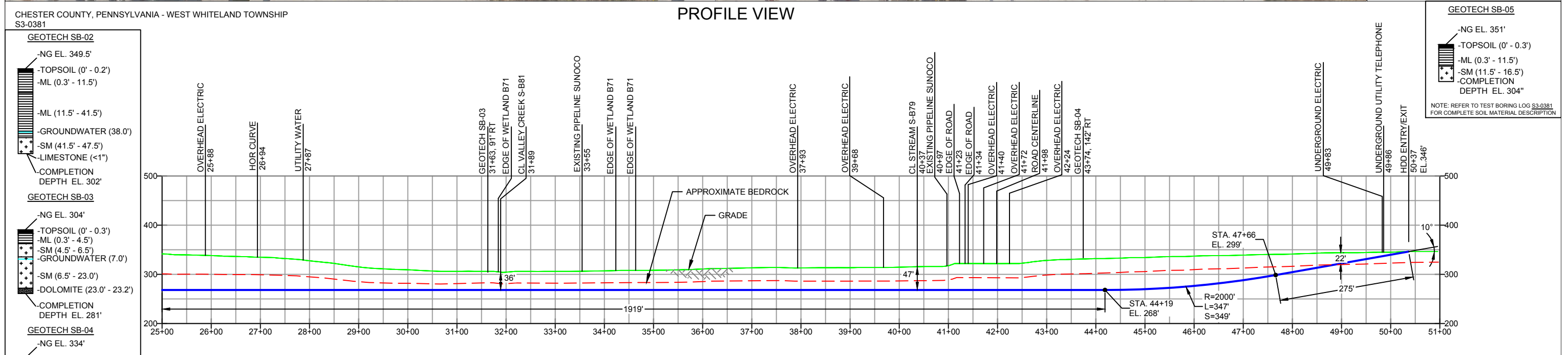
SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL  
E.SWEDESFORD ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'    DWG. NO: PA-CH-0219.0000-RDa



PLAN VIEW



PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0381

- GEOTECH SB-02**
- NG EL. 349.5'
  - TOPSOIL (0' - 0.2')
  - ML (0.3' - 11.5')
  - ML (11.5' - 41.5')
  - GROUNDWATER (38.0')
  - SM (41.5' - 47.5')
  - LIMESTONE (<1")
  - COMPLETION DEPTH EL. 302'
- GEOTECH SB-03**
- NG EL. 304'
  - TOPSOIL (0' - 0.3')
  - ML (0.3' - 4.5')
  - SM (4.5' - 6.5')
  - GROUNDWATER (7.0')
  - SM (6.5' - 23.0')
  - DOLOMITE (23.0' - 23.2')
  - COMPLETION DEPTH EL. 281'
- GEOTECH SB-04**
- NG EL. 334'
  - TOPSOIL (0' - 0.5')
  - ML (0.5' - 14.0')
  - SM (14.0' - 18.0')
  - DOLOMITE (18.0' - 30.0')
  - COMPLETION DEPTH EL. 304'
- NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- 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)=5037'  
HDD PIPE LENGTH (S)=5048'  
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	NO.	DESCRIPTION	
ES-6.45	TO	ES-6.48	EROSION & SEDIMENT PLAN	EP1	REVISED PER PADEP COMMENTS
SHEET 26	TO	SHEET 32	AERIAL SITE PLAN	EP	
				D	ADDED GEOTECH INFO
				C	ISSUED FOR BID
				B	ISSUED FOR BID
				A	ISSUED FOR REVIEW

REVISIONS

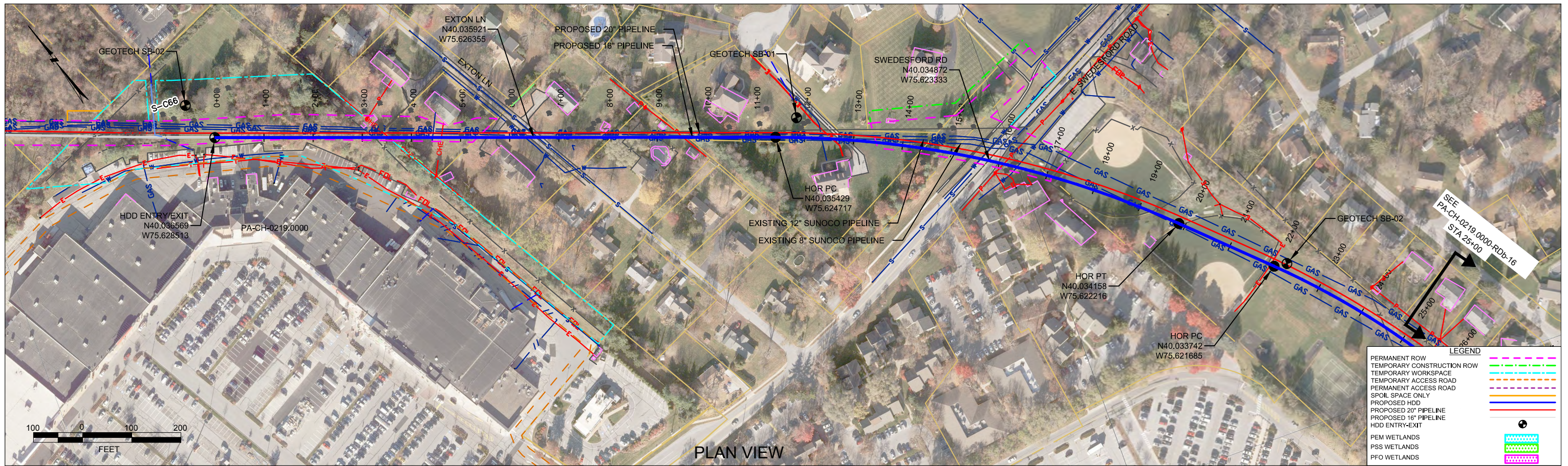
BY	DATE	CHK	DATE	APP	DATE
MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
MRS	09/30/15	RMB	09/30/15	AAW	09/30/15
DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
JVA	03/26/15	RMB	03/26/15	AAW	03/26/15

(303) 792-5911

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL  
E. SWEDESFORD ROAD  
PENNSYLVANIA PIPELINE PROJECT

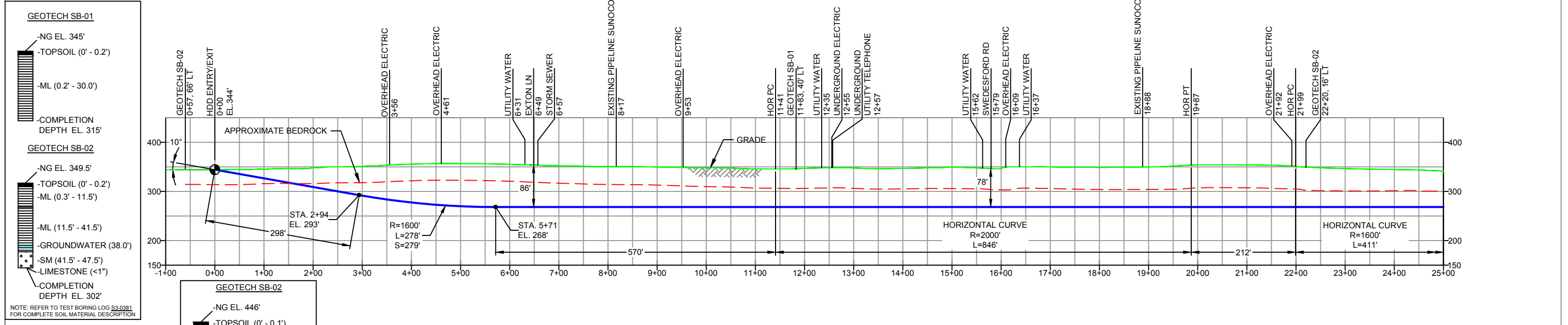
SCALE: 1"=200' DWG. NO: PA-CH-0219.0000-RDb



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0381A-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)=4988'  
HDD PIPE LENGTH (S)=4999'  
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.
- 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		REVISIONS		
ES-6.45	TO ES-6.48	EROSION & SEDIMENT PLAN		
SHEET 26	TO SHEET 32	AERIAL SITE PLAN		
		EP1	REVISED PER PADEP COMMENTS	
		EP		
		B	ADDED GEOTECH INFO	
		A	ISSUED FOR BID	
DWG NO	DWG NO	DESCRIPTION	NO.	DESCRIPTION

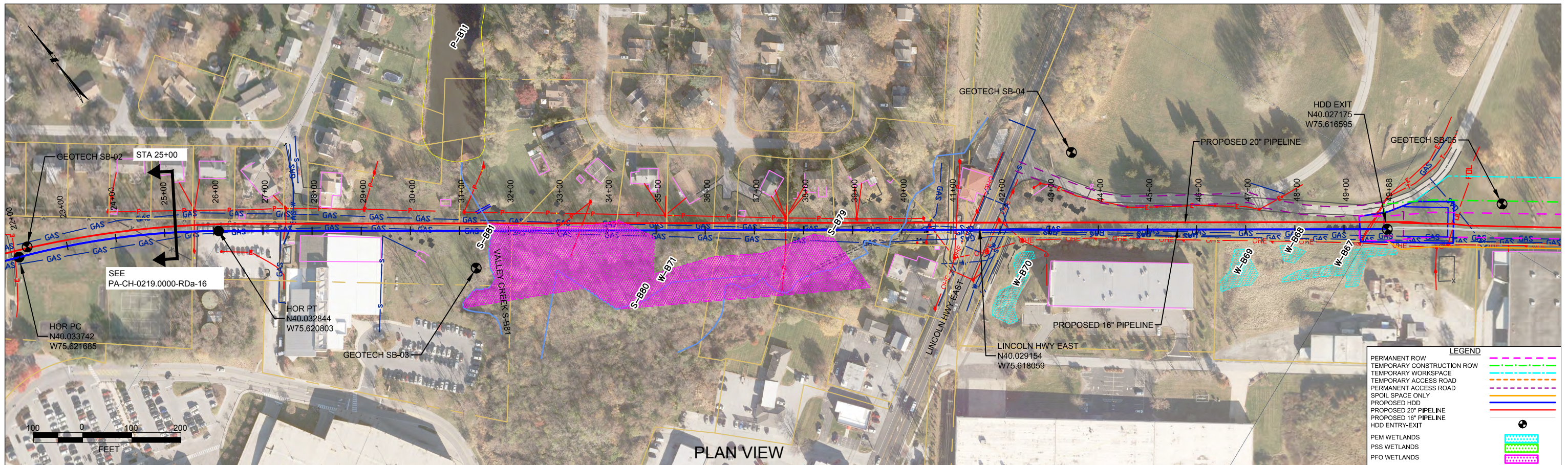
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

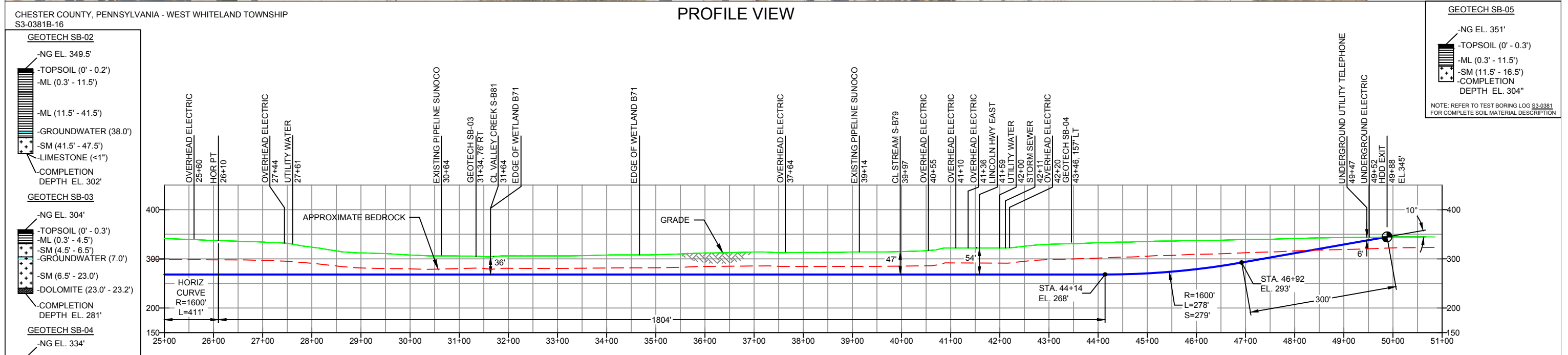
**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
E.SWEDESFORD ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NO: PA-CH-0219.0000-RDa-16



PLAN VIEW



PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - WEST WHITELAND TOWNSHIP  
S3-0381B-16

- GEOTECH SB-02**
- NG EL. 349.5'
  - TOPSOIL (0' - 0.2')
  - ML (0.3' - 11.5')
  - ML (11.5' - 41.5')
  - GROUNDWATER (38.0')
  - SM (41.5' - 47.5')
  - LIMESTONE (<1")
  - COMPLETION DEPTH EL. 302'
- GEOTECH SB-03**
- NG EL. 304'
  - TOPSOIL (0' - 0.3')
  - ML (0.3' - 4.5')
  - SM (4.5' - 6.5')
  - GROUNDWATER (7.0')
  - SM (6.5' - 23.0')
  - DOLOMITE (23.0' - 23.2')
  - COMPLETION DEPTH EL. 281'
- GEOTECH SB-04**
- NG EL. 334'
  - TOPSOIL (0' - 0.5')
  - ML (0.5' - 14.0')
  - SM (14.0' - 18.0')
  - DOLOMITE (18.0' - 30.0')
  - COMPLETION DEPTH EL. 304"

NOTE: REFER TO TEST BORING LOG S3-0381 FOR COMPLETE SOIL MATERIAL DESCRIPTION

- 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): 4988'  
HDD PIPE LENGTH (S): 4999'  
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.
- 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	NO.	DESCRIPTION
ES-6.45	TO	ES-6.48	EROSION & SEDIMENT PLAN	
SHEET 26	TO	SHEET 32	AERIAL SITE PLAN	
		EP1	REVISED PER PADEP COMMENTS	
		EP		
		B	ADDED GEOTECH INFO	
		A	ISSUED FOR BID	

**REVISIONS**

BY	DATE	CHK	DATE	APP	DATE
MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
MRS	02/26/16	RMB	02/26/16	AAW	02/26/16
MRS	10/01/15	RMB	10/01/15	AAW	10/01/15
MRS	08/31/15	RMB	08/31/15	AAW	03/26/15

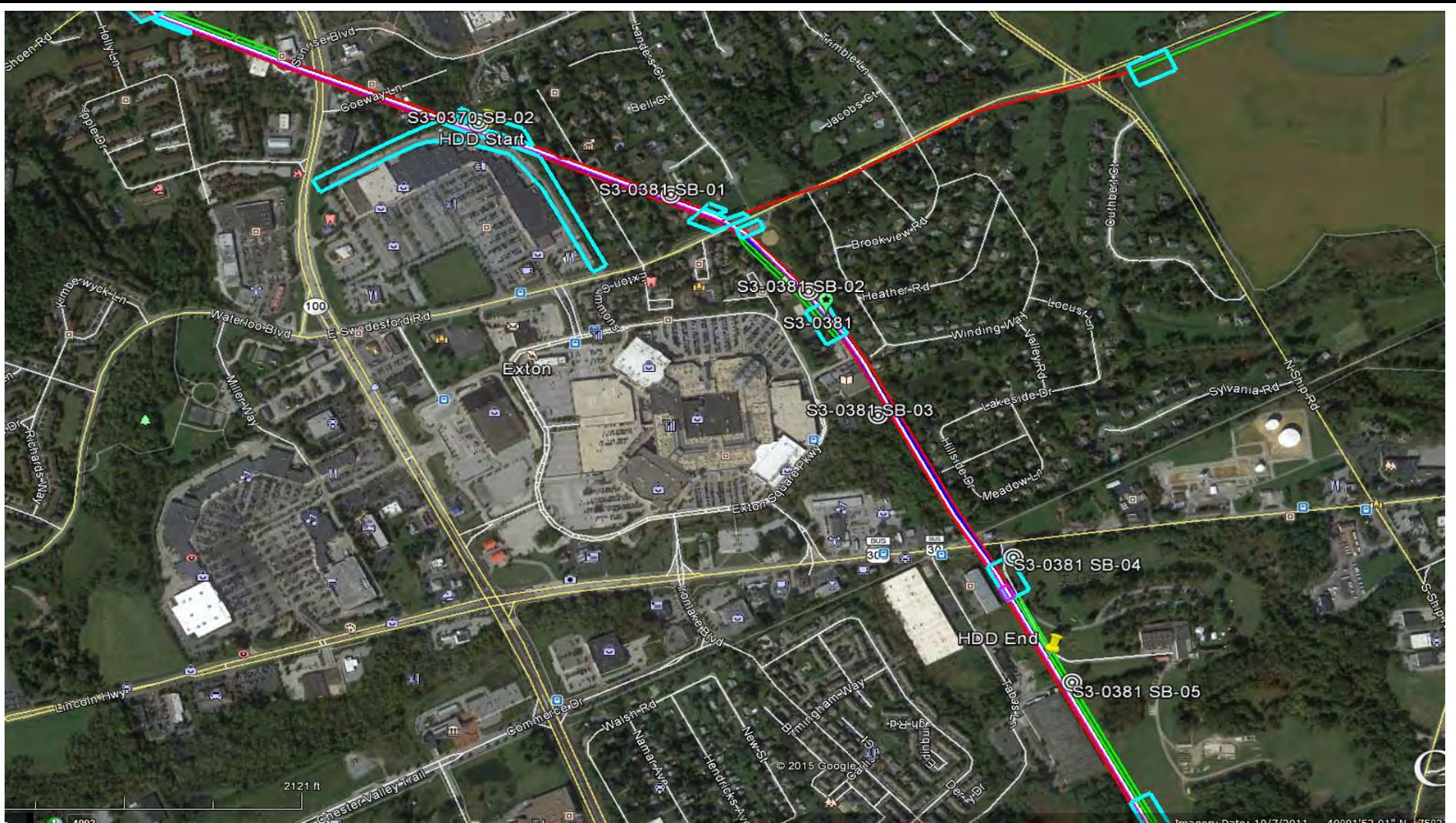
**Sunoco Logistics Partners L.P.**

**TETRA TECH ROONEY**  
(303) 792-5911

**SUNOCO PIPELINE, L.P.**

16-INCH HORIZONTAL DIRECTIONAL DRILL  
E.SWEDESFORD ROAD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'  
DWG. NO: PA-CH-0219.0000-RDb-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S3-0381  
 CHESTER COUNTY, WEST WHITELAND 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: 300 QUINN CT., EXTON, PA			Page 1 of 1		
HDD No.: S3-0381		Dates(s) Drilled: 06-15-15		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:			40° 2' 7.761" N		75° 37' 28.220" 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	0.2			TOPSOIL (2")						
1	3.0	5.0	0.2		24	ML	VARIEGATED BROWN, LIGHT BROWN, DARK BROWN, ORANGE BRWN	5	5	5	9	10	
							SILT WITH SOME FINE SAND, TRACE FINE GRAVEL. (DR)						
2	8.0	10.0			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	2	3	6	9	9	
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL. (USCS: ML)						
3	13.0	15.0			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	1	4	5	7	9	
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL						
4	18.0	19.5			24		DR, VARIEGATED DARK BRWN, WHITE, LIGHT BROWN SILT WITH SOME	1	2	4	7	6	
							FINE SAND, TRACE UNWEATHERED FINE GRAVEL. (USCS: ML)						
5	23.0	25.0			24		DR, VARIEGATED BROWN, LIGHT BROWN AND WHITE SILT WITH SOME	2	5	8	11	13	
							FINE SAND, TRACE QUARTZ FINE GRAVEL.						
6	28.0	30.0			18	DR, VARIEGATED BROWN, DARK BRWON AND WHITE SILT WITH A	1	2	4	4	6		
				30.0			LITTLE FINE SAND.						
							WET ON SPOON AT 25'						
							NO WATER LEVEL THROUGH AUGERS.						
							CAVED AND DRY AT 29'.						

**Notes/Comments:**

Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 4': 2.25 TSF 13': 2.5 TSF 25': 1.75 TSF  
 8': 3.0 TSF 20': 2.25 TSF 28': 1.25 TSF  
 10': 2.5 TSF 23': 3.75 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.



**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: MEADOW BROOK MANOR PARK, EXTON, PA			Page 1 of 1		
HDD No.: S3-0381		Dates(s) Drilled: 06-12-15		Inspector: E. WATT	
Boring No.: SB-02		Drilling Method: SPT - ASTM D1586		Driller: S. HOFFER	
Drilling Contractor: HAD DRILLING		Groundwater Depth (ft): 38.0		Total Depth (ft): 52.2	
Boring Location Coordinates:			40° 2' 1.433" N		75° 37' 17.663" 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	0.3			TOPSOIL (3")						
1	3.0	5.0	0.3		15	ML	BROWN SILT AND FINE SAND.	2	4	4	6	8	
2	8.0	10.0			15		BROWN SILT AND FINE SAND.	2	3	4	3	7	
				11.5									
3	13.0	15.0	11.5		24	ML	DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	2	4	6	8	10	
							UNWEATHERED GRAY PHYLLITE GRAVEL.						
4	18.0	19.5			14		DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	3	7	8	11	15	
							UNWEATHERED GRAY PHYLLITE GRAVEL. (USCS: ML).						
5	23.0	25.0			24		DR, LIGHT GRAY AND BROWN SILT AND FINE SAND, TRACE FINE	2	7	7	9	14	
							UNWEATHERED GRAY PHYLLITE GRAVEL.						
6	28.0	30.0			19		DR, LIGHT BROWN, BROWN, AND YELLOW BROWN SILT WITH SOME	2	7	6	7	13	
							F-SAND, TRACE UNWEATHERED FINE PHYLLITE GRAVEL. (USCS: ML)						
7	33.0	35.0			24		DR, BROWN SILT AND FINE SAND, WITH A TRACE FINE UNWEATHERED	1	7	11	17	18	
							PHYLLITE GRAVEL.						
8	38.0	40.0			18	DR, BROWN SILT AND FINE SAND, WITH A TRACE FINE UNWEATHERED	6	6	3	3	9		
				41.5		PHYLLITE GRAVEL.							
9	43.0	45.0	41.5		24	SM	DR, BROWN AND GRAY FINE TO MEDIUM SAND WITH SOME SILT,	5	11	10	12	21	
				47.5			WITH A LITTLE UNWEATHERED FINE GRAVEL.						
10	48.0	48.0			<1		GRAY DOLOMITE OR LIMESTONE.	50/0"				>50	
11	52.0	52.2					GRAY DOLOMITE OR LIMESTONE.	50/2"				>50	
							AUGER GRINDING AT 47.5'.						
							AUGER REFUSAL AT 52'.						
							WET ON SPOON AT 38'.						
							WATER LEVEL THROUGH AUGERS AT 41'.						
							CAVED AT 47', WATER LEVEL ON CAVE AT 31'.						

Notes/Comments:  
 Pocket Pentrometer Testing  
 S6: 1.5 TSF  
 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.



**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:	CHESTER COUNTY LIBRARY, 450 EXTON SQUARE PKWY, EXTON, PA	Page 1 of 1	
HDD No.:	S3-0381	Dates(s) Drilled:	06-12-15
Boring No.:	SB-03	Inspector:	E. WATT
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	S. HOFFER
		Groundwater Depth (ft):	7.0
		Total Depth (ft):	23.2
Boring Location Coordinates:	40° 1' 53.372" N	75° 37' 12.338" 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	0.3			TOPSOIL (4")						
			0.3	4.5		ML	SOFT GRAY AND DARK BROWN SILT WITH SOME FINE SAND.						
1	3.0	5.0	4.5		13	SM	GRAY FINE TO COARSE SAND WITH A LITTLE SILT, WITH A LITTLE FINE QUARTZ GRAVEL.	1	1	3	4	4	
2	8.0	10.0	6.5		24	SM	DR, WHITE TO LIGHT BROWN FINE SAND WITH SOME SILT, WITH A LITTLE F-C UNWEATHERED DOLOMITE GRAVEL.	17	35	28	10	63	
3	13.0	15.0			24	SM	DR, VARI-COLORED (WHITE, BROWN, LIGHT BROWN) FINE SAND AND SILT. (USCS: SM).	4	7	8	6	15	
4	18.0	18.3			2		DR, WHITE AND LIGHT BROWN FINE SAND AND SILT, WITH A LITTLE FINE UNWEATHERED DOLOMITE GRAVEL.	50/3"					>50
5	23.0	23.2	23.0	23.2	<1		LIGHT BROWN PARTIALLY WEATHERED DOLOMITE.	50/2"					>50
							AUGER REFUSAL AT 23'. AUGERS STARTED GRINDING AT 16'.						
							WET ON SPOON AT 7'.						
							WATER LEVEL THROUGH AUGERS AT 8'.						
							CAVED AT 12', WATER LEVEL ON CAVE AT 5'.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 3': 0.75 TSF  
 4': 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.



**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:	CHESTER COUNTY LIBRARY, 450 EXTON SQUARE PKWY, EXTON, PA	Page 1 of 1	
HDD No.:	S3-0381	Dates(s) Drilled:	06-11/12-15
Boring No.:	SB-04	Inspector:	J. CCOSTELLO
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	GREG
		Groundwater Depth (ft):	SEE BELOW
		Total Depth (ft):	30.0
Boring Location Coordinates:	40° 1' 44.117" N	75° 37' 2.012" 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	0.5			TOPSOIL (6")						
1	3.0	5.0	0.5		20	ML	DR, REDDISH BROWN SILT WITH SOME FINE SAND, TRACE FINE GRAVEL.	1	2	2	3	4	
2	8.0	10.0			24		DR, BROWN SILT AND FINE SAND, TRACE MICA.	1	2	2	2	4	
3	13.0	15.0			24		DR, VARIEGATED YELLOWISH BROWN, BROWN, AND WHITE SILT WITH A LITTLE FINE SAND, TRACE GRAY ROCK FRAGS. (USCS: ML)	1	3	12	8	15	
				14.0									
			14.0	18.0		SM	BROWN FINE SAND AND SILT.						
4	18.0	18.3	18.0	19.0			PARTIALLY WEATHERED LIGHT GRAY DOLOMITE.	50/3"				>50	
							AUGER REFUSAL AT 19'.						
							<u>ROCK CORING</u>						
RUN 1	19.0	19.8	19.0		6.5	ROCK	MODERATELY FRACTURED WHITE TO LIGHT GRAY DOLOMITE.	TCR: 68%, SCR: 68%, RQD: 68%					
RUN 2	19.8	22.2			22		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY DOLOMITE.	TCR: 76%, SCR: 38%, RQD: 21%					
RUN 3	22.2	27.0			60		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY DOLOMITE.	TCR: 100%, SCR: 27%, RQD: 17%					
RUN 4	27.0	30.0			36		MODERATELY TO INTENSELY FRACTURED WHITE TO LIGHT GRAY DOLOMITE.	TCR: 100%, SCR: 69%, RQD: 49%					
				30.0									
							<u>CORE TESTING RESULTS (RUN 2, DEPTH 20 TO 20.5'):</u>						
							COMPRESSIVE STRENGTH: 13,700 PSI						
							UNIT WEIGHT: 170.9 PCF						
							PERCHED WATER CONDITIONS OVER ROCK AT 15.0'.						
							CAVED AND DRY AT 18'.						

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S1: > 4 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**

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:	500 LINCOLN HYW, EXTON, PA	Page 1 of 1	
HDD No.:	S3-0381	Dates(s) Drilled:	06-12-15
Boring No.:	SB-05	Inspector:	J. CCOSTELLO
Drilling Contractor:	HAD DRILLING	Drilling Method:	SPT - ASTM D1586
		Driller:	GREG
		Groundwater Depth (ft):	NOT ENCOUNTERED
		Total Depth (ft):	16.5
Boring Location Coordinates:	40° 1' 36.077" N	75° 36' 57.617" 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	0.3			TOPSOIL (3")						
1	3.0	5.0	0.3		21	ML	BROWN TO YELLOWISH BROWN SILT AND FINE SAND, TRACE FINE GRAVEL.	1	3	3	11	6	
2	8.0	10.0			21		BROWN SILT WITH SOME FINE SAND, TRACE FINE GRAVEL. (USCS: ML).	1	3	7	11	10	
3	13.0	14.8	11.5			SM	DR, DARK BROWN AND GRAY MICACEOUS FINE TO MEDIUM SAND AND SILT, TRACE FINE ROCK FRAGMENTS.	1	1	2	50/3"	>50	
			16.5										
							AUGER REFUSAL AT 16.5'. REFUSAL MATERIAL APPEARS TO BE DARK GRAY LIMESTONE (BASED ON AUGER CUTTINGS).						
							LIMESTONE ROCK OUTCROPS ARE LOCATED IN VICINITY OF SB-05.						
							CAVED AND DRY AT 15'.						

Notes/Comments: Pocket Pentrometer 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 S3-0381**

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, %	
S3-0370	SB-02	1	3.0	5.0	18.7	64.9	-	-	-	-
		2	8.0	10.0	28.3	85.4	45	37	8	ML
		4	18.0	19.5	26.0	88.2	-	-	-	-
		5	23.0	25.0	34.6	63.9	41	33	8	ML
		6	28.0	30.0	27.6	68.9	-	-	-	-
S3-0381	SB-01	2	8.0	10.0	28.4	72.4	44	32	12	ML
		4	18.0	19.5	27.0	72.0	46	34	12	ML
		5	23.0	25.0	27.1	70.7	-	-	-	-
		6	28.0	30.0	25.7	82.7	-	-	-	-
	SB-02	2	8.0	10.0	14.1	53.8	-	-	-	-
		4	18.0	19.5	10.6	60.4	36	27	9	ML
		5	23.0	25.0	9.1	56.7	-	-	-	-
		6	28.0	30.0	15.9	78.9	38	28	10	ML
		7	33.0	35.0	19.4	66.3	-	-	-	-
	SB-03	1	3.0	5.0	14.4	18.3	-	-	-	-
		2	8.0	10.0	13.3	32.6	-	-	-	-
		3	13.0	15.0	20.4	47.8	32	25	7	SM
		4	18.0	18.3	13.3	41.0	-	-	-	-
	SB-04	1	3.0	5.0	17.0	77.7	-	-	-	-
		2	8.0	10.0	9.2	56.0	-	-	-	-
		3	13.0	15.0	27.8	86.2	37	27	10	ML
	SB-05	1	3.0	5.0	15.0	63.6	-	-	-	-
		2	8.0	10.0	18.3	72.1	33	26	7	ML
		3	13.0	14.8	39.9	44.2	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-04	2	20 to 20.5	13,700	170.9

**Notes:**

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

**ROCK CORE DESCRIPTION SUMMARY  
SUNOCO PENNSYLVANIA PIPELINE PROJECT  
HDD S3-0381**

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					
S3-0381	SB-4	1	19	19.8	68	68	68	19	30	Slight	Dolomite	Massive	White to light gray	Fractures ranging from 5° to 85°, Avg 45°
		2	19.8	22.2	76	38	21							
		3	22.2	27	100	27	17							
		4	27	30	100	69	47							

**REGIONAL GEOLOGY SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S3-0381**

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
S3-0370		SB-02	Chickies Formation - Light-gray, hard, massive, Scolithus-bearing quartzite and quartz schist; thin, interbedded dark slate at top; conglomerate (Hellam Member) at base.	Generally level, slight slope to the west	Chickies Formation (Cambrian)	Quartzite, schist, slate, conglomerate	600	Ranges from 20 to 78 ft bgs, Avg. 56 ft bgs (.5 mile radius)	
S3-0381		SB-01	Chickies Formation - Light-gray, hard, massive, Scolithus-bearing quartzite and quartz schist; thin, interbedded dark slate at top; conglomerate (Hellam Member) at base.	Generally level	Chickies Formation (Cambrian)	Quartzite, schist, slate, conglomerate	600	Ranges from 7 to 65 ft bgs, Avg. 26 ft bgs (.5 mile radius)	Few sinkholes mapped in this area, mostly depressions (potential soft soils)
		SB-02	Ledger Formation - Light-gray, locally mottled, massive, pure, coarsely crystalline dolomite; siliceous in middle part.	Generally level	Ledger Formation (Cambrian)	Dolostone (Dolomite)	2,000	Ranges from 7 to 65 ft bgs, Avg. 26 ft bgs (.5 mile radius)	
		SB-03	Ledger Formation - Light-gray, locally mottled, massive, pure, coarsely crystalline dolomite; siliceous in middle part.	Generally level, slight slope to the south	Ledger Formation (Cambrian)	Dolostone (Dolomite)	2,000		
		SB-04	Ledger Formation - Light-gray, locally mottled, massive, pure, coarsely crystalline dolomite; siliceous in middle part.	Gentle slope to the N	Ledger Formation (Cambrian)	Dolostone (Dolomite)	2,000		
		SB-05	Conestoga Formation - Light-gray, thin-bedded, impure, contorted limestone having shale partings; conglomeratic at base; in Chester Valley, includes micaceous limestone in upper part, phyllite in middle, and alternating dolomite and limestone in lower part.	Gentle slope to the W	Conestoga Formation (Ordovician and Cambrian)	Limestone; secondary: phyllite; other types: conglomerate, dolostone, shale	At least 300		

*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

### 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	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	Atterberg limits above A line with $I_p$ greater than 7		
	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	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	Atterberg limits above A line with $I_p$ greater than 7		
		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.