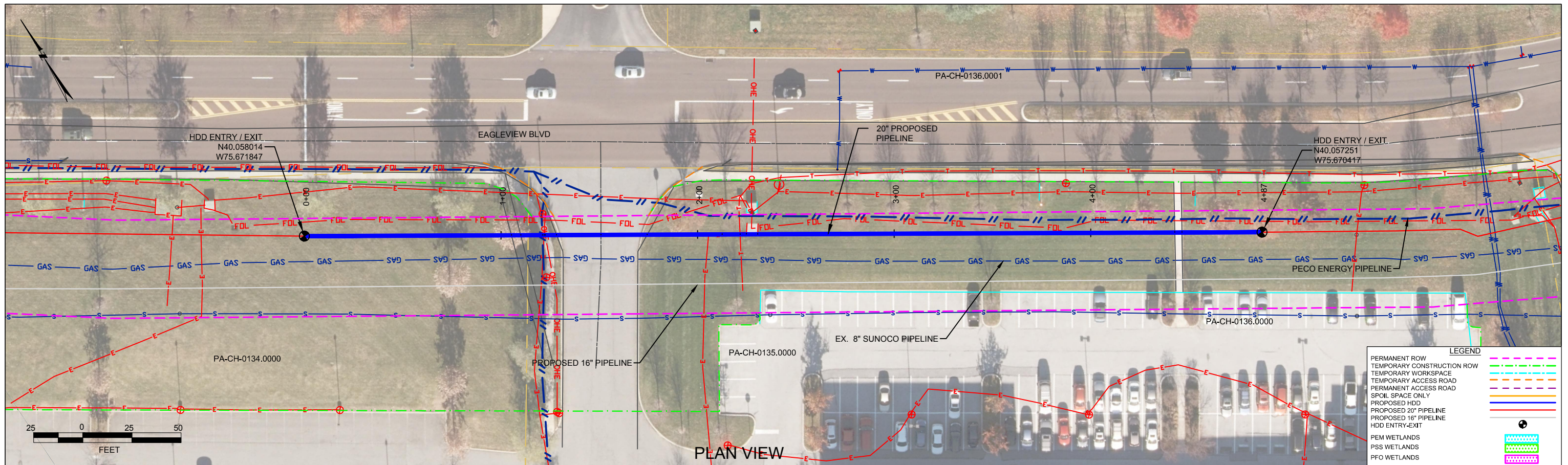


***HDD PA-CH-0135.0000-RD***

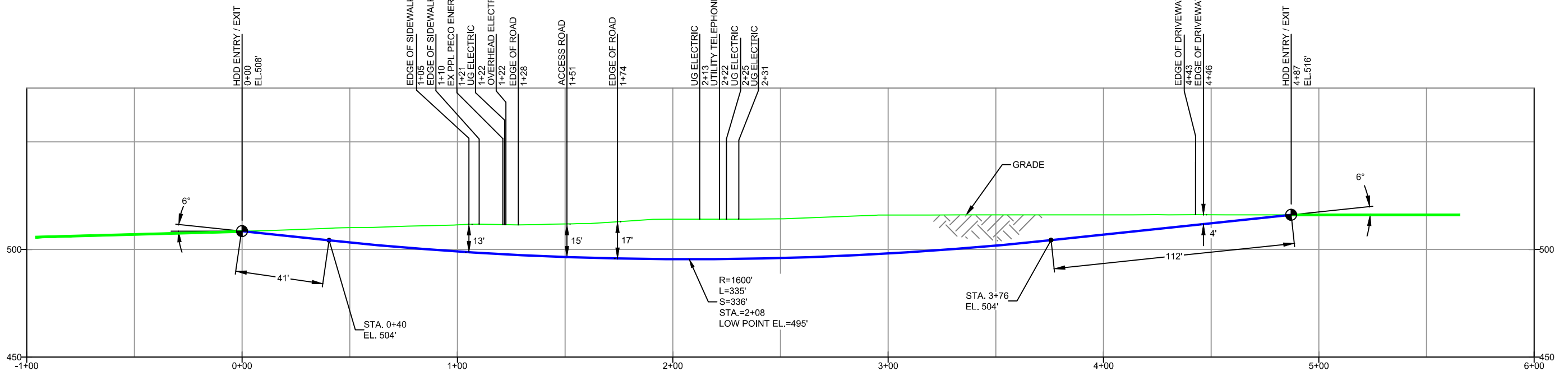
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

The drill will parallel Eagleview Blvd. for a distance of 490 feet to allow access to business buildings in the area. The drill will pass 15 feet below the business driveway and will reach a maximum depth of 20 feet below grade. A geotechnical boring (HDD S3-0320 SB-03) was taken from 300 feet west of the drill indicates the substrate is fine to medium sand with silt. With no water bodies in the immediate area the environmental impact of any inadvertent returns is minimal. Based on the geotechnical report and the drill profile minimal inadvertent returns are expected.



PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - UWCHLAN TOWNSHIP  
S3-0321



- 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-):487'  
HDD PIPE LENGTH (S-):488'  
20" x 0.456" W.T., X-65, APISL, 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	
DWG NO	DESCRIPTION	NO.	DESCRIPTION
ES-6.36	EROSION & SEDIMENT PLAN		
SHEET 21	AERIAL SITE PLAN		
		1	REVISED PER ENGINEERING COMMENTS
		0	ISSUED FOR CONSTRUCTION

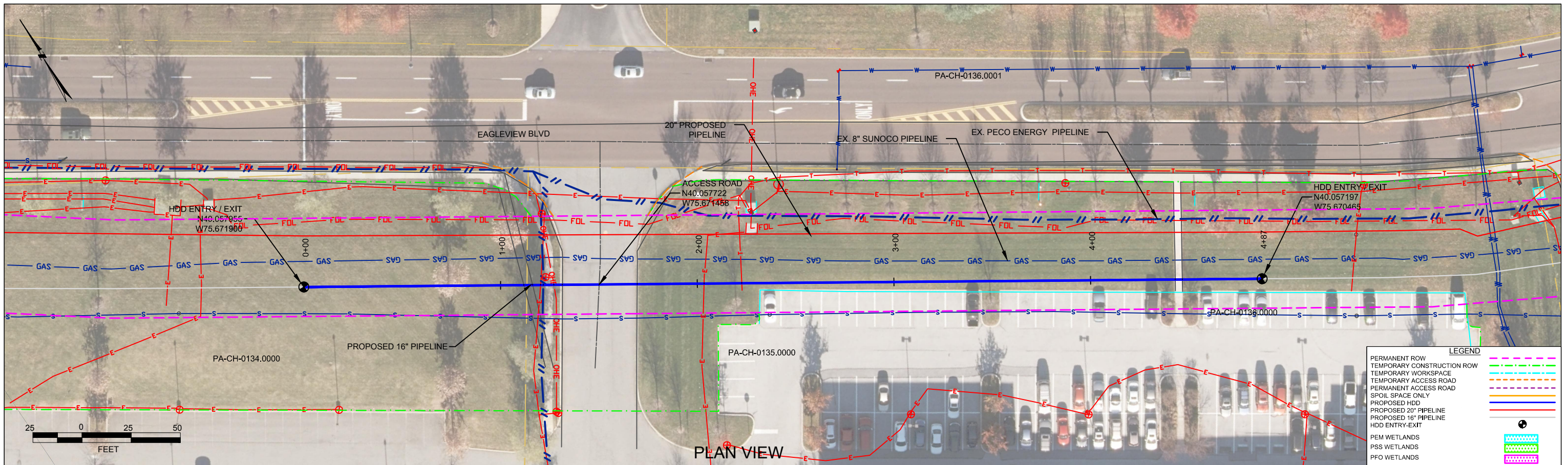
**Sunoco Logistics Partners L.P.**

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

**SUNOCO PIPELINE, L.P.**

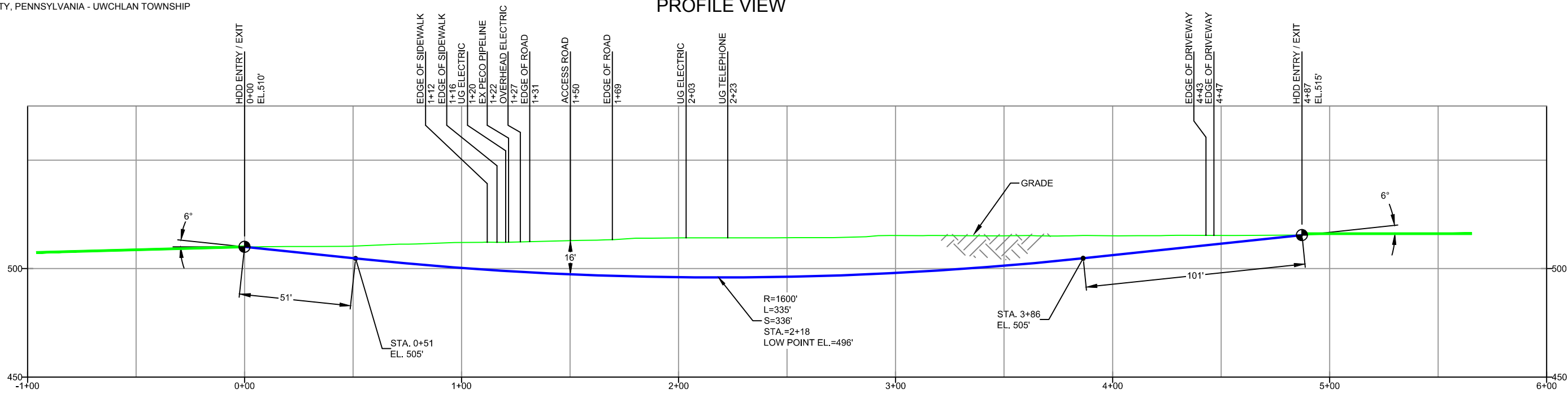
20-INCH HORIZONTAL DIRECTIONAL DRILL  
EAGLEVIEW BLVD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=50'    DWG. NO: PA-CH-0135.0000-RD



PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - UWCHLAN TOWNSHIP  
S3-0321-16



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)=487'  
HDD PIPE LENGTH (S)=488'  
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

ES-6.36	TO	ES-6.37	EROSION & SEDIMENT PLAN
SHEET 21	TO	SHEET 22	AERIAL SITE PLAN
			EP
			1 REVISED PER ENGINEERING COMMENTS
			0 ISSUED FOR CONSTRUCTION
DWG NO	DWG NO	DESCRIPTION	NO.

REVISIONS

BY	DATE	CHK	DATE	APP	DATE
MRS	10/07/16	RMB	10/07/16	AAW	10/07/16
MRS	08/12/16	RMB	08/12/16	AAW	08/12/16
MRS	04/23/16	RMB	04/23/16	AAW	04/23/16

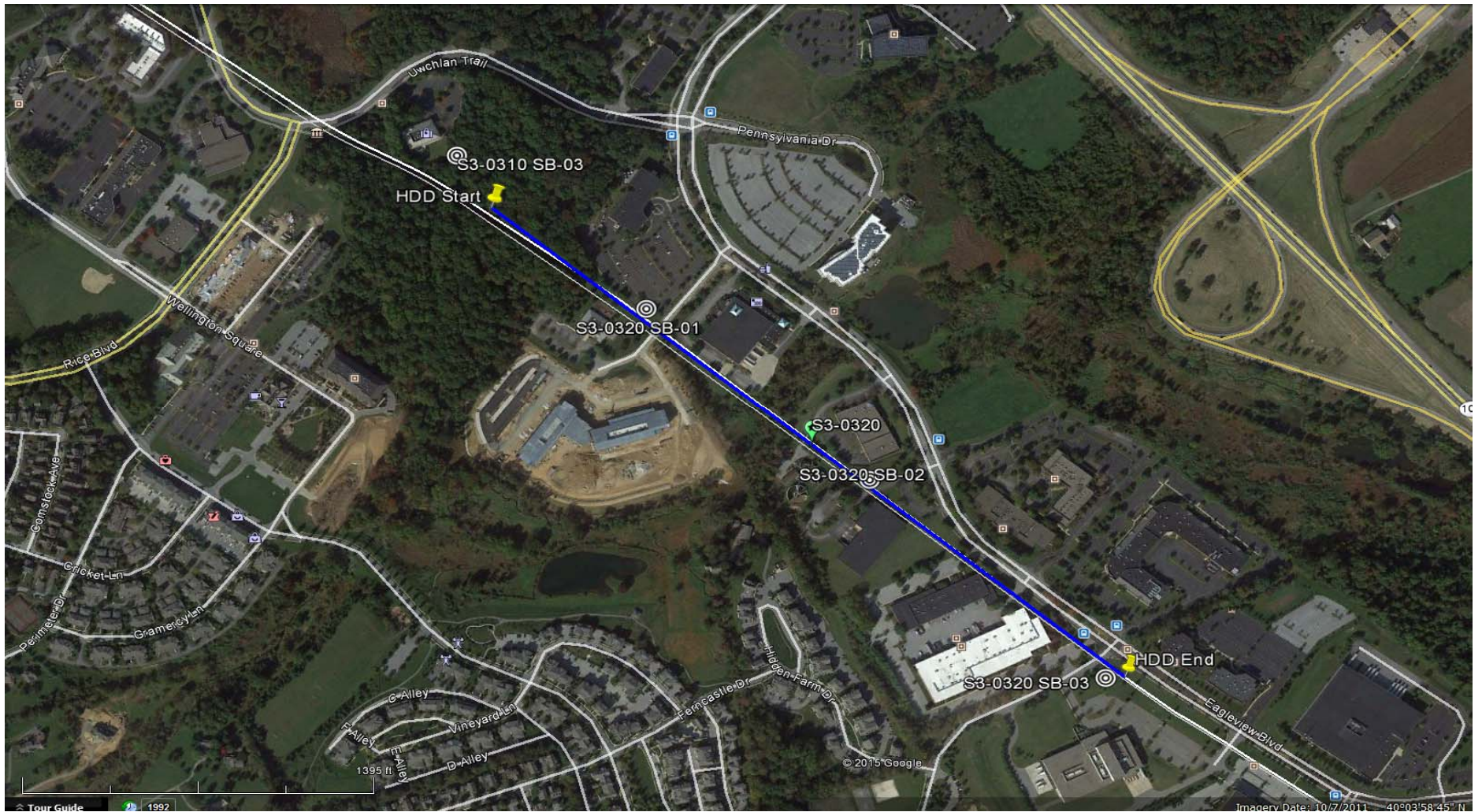
**Sunoco Logistics Partners L.P.**

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

SUNOCO PIPELINE, L.P.

16-INCH HORIZONTAL DIRECTIONAL DRILL  
EAGLEVIEW BLVD  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=50' DWG. NO: PA-CH-0135.0000-RD-16



**LEGEND:**

⊙ Geotechnical Soil Boring (SB) Locations



GEOTECHNICAL BORING LOCATIONS  
 HDD S3-0320  
 CHESTER COUNTY, UWCHLAN TWP, 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: 360 EAGLE ROAD, DOWNINGTOWN, PA		Page 1 of 1	
HDD No.: S3-0320	Dates(s) Drilled: 07-31-15	Inspector: J. COSTELLO	
Boring No.: SB-03	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN	
Drilling Contractor: HAD DRILLING	Groundwater Depth (ft): NOT ENCOUNTERED	Total Depth (ft): 19.0	
Boring Location Coordinates: 40° 3' 30.634" N		75° 40' 23.263" 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			ML	REDDISH BROWN SILT AND FINE SAND, TRACE MICA.	1	1	2	4	3
				6.5								
2	8.0	10.0	6.5			SM	DR, REDDISH BROWN FINE SAND AND SILT, TRACE FINE GNEISS	4	4	5	9	9
							ROCK FRAGMENTS. (USCS: SM)					
3	13.0	15.0				SM	DR, VARIEGATED (BROWN, YELLOW, BLACK) FINE TO MEDIUM SAND	7	13	22	29	35
				18.5			WITH SOME SILT, WITH A LITTLE F-C GNEISS ROCK FRAGS.					
4	18.0	18.8	18.5	19.0			PARTIALLY WEATHERED GNEISS.	9	50/3"			>50
							AUGER REFUSAL AT 19'.					
							CAVED AND DRY AT 16.4'.					

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 S3-0320**

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, %	
S3-0310	SB-03	1	3.0	4.0	10.6	44.7	-	-	-	-
		2	8.0	9.9	10.8	28.3	NV	NP	NP	SM
		4	18.0	18.5	4.9	20.1	-	-	-	-
		5	23.0	23.2	4.6	22.8	-	-	-	-
S3-0320	SB-01	2	8.0	10.0	15.0	44.5	NV	NP	NP	SM
		3	13.0	15.0	12.7	48.9	-	-	-	-
		4	18.0	20.0	16.9	41.9	-	-	-	-
		5	23.0	25.0	22.3	48.0	NV	NP	NP	SM
		6	28.0	28.8	6.2	24.0	-	-	-	-
		7	33.0	35.0	13.7	18.1	-	-	-	-
		8	38.0	38.8	12.4	43.6	-	-	-	-
	SB-02	9	43.0	44.3	8.6	17.3	-	-	-	-
		1	3.0	5.0	23.3	43.2	-	-	-	-
		2	8.0	10.0	16.1	30.3	-	-	-	-
		3	13.0	15.0	12.2	23.3	NV	NP	NP	SM
		4	18.0	20.0	13.9	34.7	-	-	-	-
	SB-03	5	23.0	24.9	22.0	46.1	32	25	7	SM
		1	3.0	5.0	25.7	60.3	-	-	-	-
		2	8.0	10.0	27.7	47.8	40	27	13	SM
		3	13.0	15.0	10.3	33.6	-	-	-	-

Rock Core Testing Results				
Boring No.	Core Run	Approximate Depth (ft)	Compressive Strength (psi)	Unit Weight (pcf)
SB-01	1/2	Cores did not have sections of suitable length to perform compressive strength testing		

**Notes:**

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

**REGIONAL GEOLOGY SUMMARY**  
**SUNOCO PENNSYLVANIA PIPELINE PROJECT**  
**HDD S3-0320**

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
S3-0310		SB-03	<b>Felsic and intermediate gneiss</b> - Medium grained, light pink to greenish gray; largely quartz, feldspar, and mica; commonly gneissic, containing alteration minerals; interfingers with gabbroic gneiss.	Gently sloping to the South	Felsic and intermediate gneiss (PreCambrian)	Felsic gneiss	No information found during literature review	Ranges from 30 to 95 ft bgs, Avg. 52 ft bgs (.5 mile radius)	
S3-320		SB-01	<b>Felsic and intermediate gneiss</b> - Medium grained, light pink to greenish gray; largely quartz, feldspar, and mica; commonly gneissic, containing alteration minerals; interfingers with gabbroic gneiss.	Generally level, slight slope to the west	Felsic and intermediate gneiss (PreCambrian)	Felsic gneiss	No information found during literature review	Ranges from 30 to 57 ft bgs, Avg. 44 ft bgs (.5 mile radius)	
		SB-02		Gently sloping to the NW	Felsic and intermediate gneiss (PreCambrian)			Ranges from 25 to 50 ft bgs, Avg. 38 ft bgs (.5 mile radius)	
		SB-03	<b>Banded mafic gneiss</b> - Dark, fine to medium grained; includes rocks of probable sedimentary origin; may be equivalent to "PZmgh."	Generally level, slightly sloping to the north	Banded mafic gneiss (PreCambrian)	Mafic gneiss	Ranges from 25 to 50 ft bgs, Avg. 42 ft bgs (.5 mile radius)		

*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.