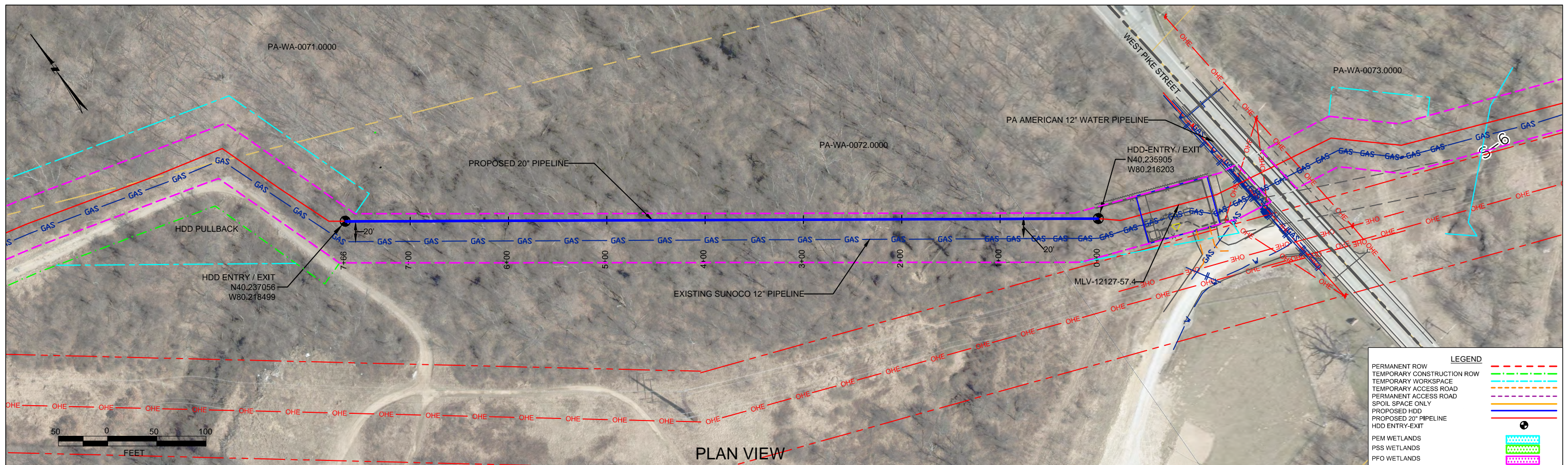


***HDD PA-WA-0072.0000-SR***

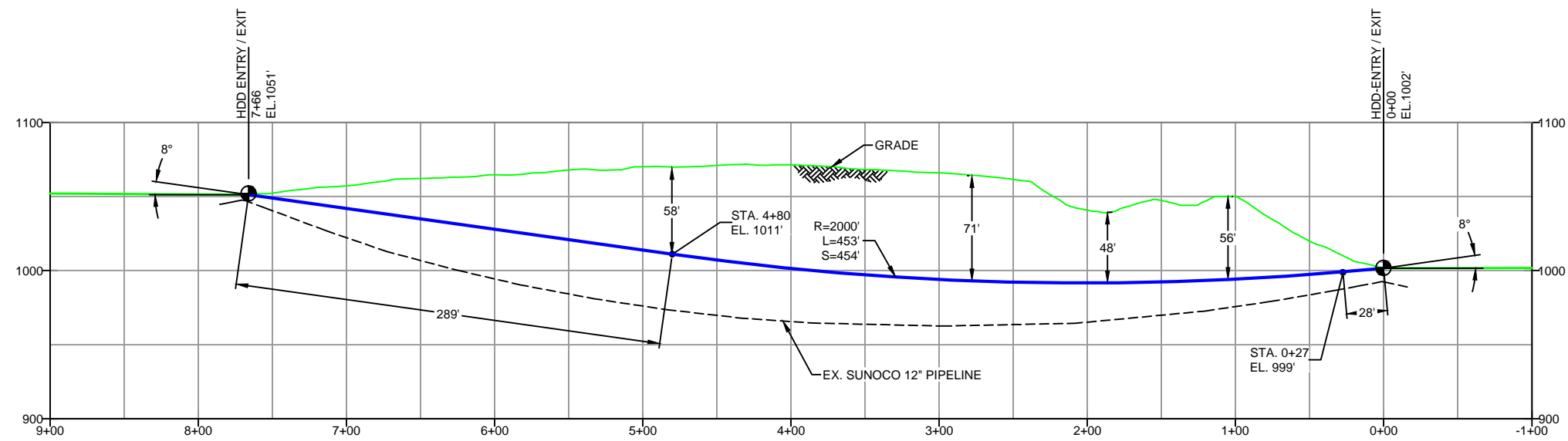
Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable and in this case that threat is considered to be low. Implementing this design, along with adherence to the Pennsylvania Pipeline Project Inadvertent Return Contingency Plan will ensure inadvertent impacts,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

This drill will not cross any high risk environmental areas, such as streams or wetlands, or any transportation lines, such as roads or railroads. The 20" drill does parallel the existing ME1 12" pipeline drill. The geotechnical results from November 2014, as well as the previous drill information and other data points 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 substrate the drill will travel through is a silty clay down to 20 feet and potentially rock beyond that. Based on the geotechnical report, the drill profile, and the previous drill data minimal inadvertent returns are expected.



PLAN VIEW  
PROFILE VIEW

WASHINGTON COUNTY, PENNSYLVANIA, CHARTIERS TOWNSHIP  
SIB-0010



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=): 766'  
HDD PIPE LENGTH (S=): 771'  
20" x 0.456" W.T., X-65, API5L, 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.
- 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-1.13 | TO     | ES-1.13     | EROSION & SEDIMENT PLAN |
|---------|--------|-------------|-------------------------|
| SHEET 9 | TO     | SHEET 9     | AERIAL SITE PLAN        |
| DWG NO  | DWG NO | DESCRIPTION | NO.                     |

REVISIONS

| NO. | DESCRIPTION                                  | BY  | DATE     | CHK | DATE     | APP | DATE     |
|-----|--|-----|----------|-----|----------|-----|----------|
| EP2 | REVISED PER PADEP COMMENTS RECEIVED 09-06-16 | MRS | 09/30/16 | RMB | 09/30/16 | AAW | 09/30/16 |
| EP1 | REVISED PER PADEP COMMENTS                   | MRS | 05/05/16 | RMB | 05/05/16 | AAW | 05/05/16 |
| EP  |  | JTW | 03/15/16 | RMB | 03/15/16 | AAW | 03/15/16 |

**Sunoco Logistics Partners L.P.**

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

SUNOCO PIPELINE, L.P.

20-INCH HORIZONTAL DIRECTIONAL DRILL  
PIKE STREET  
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=100'

DWG. NO: PA-WA-0072.0000-SR



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

# TEST BORING LOG

|  |  |   |                        |                        |  |
|--|--|---|------------------------|------------------------|--|
| Project Name: SUNOCO MARINER EAST      |  |   | Project No.: 103IP2762 |                        |  |
| Project Location: WEST PIKE VALVE SITE |  |   | Page 1 of 1            |                        |  |
| Test Boring No.: SB-01                 |  | Dates(s) Drilled: 11/14/14              |                        | Inspector: J. COSTELLO |  |
| Drilling Contractor: HYNES             |  | Drilling Method: SPT - ASTM D1586       |                        | Driller: JUSTIN        |  |
| Surface Elevation (ft):                |  | Groundwater Depth (ft): NOT ENCOUNTERED |                        | Total Depth (ft): 21.0 |  |

| Sample No. | Sample Depth (ft) |      | Strata Depth (ft) |      | Recov. (in) | Strata (USCS) | Description of Materials  | 6" Increment Blows * |    |    | N  |
|------------|-------------------|------|-------------------|------|-------------|---------------|---|----------------------|----|----|----|
|            | From              | To   | From              | To   |             |               |   |                      |    |    |    |
| 1          | 0                 | 2.0  | 0.0               |      | 18          | CL            | VARI-COLORED (BROWN, BLACK, GRAY) SILTY CLAY WITH SOME FINE SAND, TRACE F-GRAVEL. STIFF. (USCS: CL).                            | 5                    | 5  | 8  | 13 |
| 2          | 3.0               | 4.5  |                   |      | 16          |               | DARK BROWN SILTY CLAY AND FINE SAND WITH THIN APPARENT COAL SEAMS, TRACE F-GRAVEL. VERY STIFF.                                  | 5                    | 10 | 13 | 23 |
| 3          | 6.0               | 7.5  |                   |      | 18          |               | DARK BROWN TO REDDISH BROWN (WITH MOTTLES OF GRAY) SILTY CLAY AND FINE SAND, TRACE F-GRAVEL. VERY STIFF.                        | 5                    | 7  | 12 | 19 |
| 4          | 9.0               | 10.5 |                   |      | 14          |               | DARK BROWN TO REDDISH BORWN (WITH MOTTLES OF GRAY) SILTY CLAY, A LITTLE F- SAND, TRACE F-GRAVEL. USCS: CL. STIFF TO VERY STIFF. | 5                    | 6  | 9  | 15 |
| 5          | 14.0              | 15.5 |                   |      | 16          |               | YELLOWISH TO GREENISH BROWN SILTY CLAY AND FINE SAND, TRACE FINE SILTSTONE GRAVEL. VERY STIFF.                                  | 5                    | 6  | 10 | 16 |
|            |                   |      |                   | 19.5 |             |               |   |                      |    |    |    |
| 6          | 19.0              | 20.5 | 19.5              | 21.0 | 14          |               | PARTIALLY WEATHERED LIGHT GRAY SHALE OR SILTSTONE.  | 10                   | 25 | 29 | 54 |
|            |                   |      |                   |      |             |               | AUGER REFUSAL AT 21'.   |                      |    |    |    |
|            |                   |      |                   |      |             |               | CAVED AND DRY AT 13'.   |                      |    |    |    |
|            |                   |      |                   |      |             |               | BORING LOCATION IS LOCATED APPROXIMATELY 10' BELOW PREVIOUS NATURAL GRADE (ROUGH, VISUAL ONLY).                                 |                      |    |    |    |

**Notes/Comments:**

Pocket Pentrometer Testing

S1: 2.0 TSF

S3: 3.0 TSF

S4: 3.0 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**

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 Newark, Delaware 19713  
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 fax: 302.454.5988

**TEST BORING LOG**

|  |  |   |                        |                        |  |
|--|--|---|------------------------|------------------------|--|
| Project Name: SUNOCO MARINER EAST      |  |   | Project No.: 103IP2762 |                        |  |
| Project Location: WEST PIKE VALVE SITE |  |   | Page 1 of 1            |                        |  |
| Test Boring No.: SB-02                 |  | Dates(s) Drilled: 11/14/14              |                        | Inspector: J. COSTELLO |  |
| Drilling Contractor: HYNES             |  | Drilling Method: SPT - ASTM D1586       |                        | Driller: JUSTIN        |  |
| Surface Elevation (ft):                |  | Groundwater Depth (ft): NOT ENCOUNTERED |                        | Total Depth (ft): 20.0 |  |

| Sample No. | Sample Depth (ft) |      | Strata Depth (ft) |      | Recov. (in) | Strata (USCS) | Description of Materials  | 6" Increment Blows * |    |    | N  |
|------------|-------------------|------|-------------------|------|-------------|---------------|---|----------------------|----|----|----|
|            | From              | To   | From              | To   |             |               |   |                      |    |    |    |
| 1          | 0                 | 2.0  | 0.0               |      | 18          | CL            | VARI-COLORED (BROWN, BLACK, GRAY) SILTY CLAY WITH SOME FINE SAND, TRACE F-GRAVEL (USCS: CL). STIFF. | 3                    | 5  | 7  | 12 |
| 2          | 3.0               | 4.5  |                   | 5.5  | 16          |               | LIGHT GRAY TO BROWN SILTY CLAY, WITH A TRACE OF FINE SAND, TRACE F-GRAVEL (USCS: CL). VERY STIFF.   | 3                    | 7  | 10 | 17 |
| 3          | 6.0               | 7.5  | 5.5               |      | 14          | SC/CL         | YELLOWISH BROWN FINE SAND AND SILTY CLAY WITH A LITTLE SILTSTONE F-GRAVEL. MEDIUM DENSE.            | 4                    | 9  | 15 | 24 |
| 4          | 9.0               | 10.5 | 10.0              |      | 16          |               | GRAY TO YELLOWISH BROWN SILTY CLAY AND FINE SAND WITH SOME FINE TO COARSE SHALE GRAVEL. HARD.       | 6                    | 19 | 22 | 41 |
| 5          | 14.0              | 15.5 |                   | 17.0 | 16          | CL            | REDDISH BROWN SILTY CLAY WITH A LITTLE FINE SAND AND GRAVEL (USCS: CL). HARD.                       | 15                   | 24 | 26 | 50 |
| 6          | 19.0              | 19.4 | 17.0              | 20.0 | 4           |               | PARTIALLY WEATHERED REDDISH BROWN SHALE.  | 50/5"                |    |    |    |
|            |                   |      |                   |      |             |               | AUGER REFUSAL AT 20'.   |                      |    |    |    |
|            |                   |      |                   |      |             |               | CAVED AND DRY AT 9'.  |                      |    |    |    |

Notes/Comments:  
Pocket Pentrometer Testing DR: DECOMPOSED ROCK  
 S1: 2.75 TSF  
 S2: 3 TSF  
 S5: >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.

**LABORATORY TESTING SUMMARY  
SUNOCO MARINER EAST  
VARIOUS VALVE SITES**

| Valve Site/<br>Soil Boring<br>No. | Sample<br>No. | Depth of Sample (ft.) |      | Water<br>Content, %<br>(ASTM D2216) | Percent<br>Silts/Clays, %<br>(ASTM D1140) | Atterburg Limits (ASTM D4318) |                     |                        | USCS<br>Classif.<br>(ASTM D2487) |
|-----------------------------------|---------------|-----------------------|------|-------------------------------------|---|-------------------------------|---------------------|------------------------|----------------------------------|
|                                   |               | From                  | To   |                                     |   | Liquid<br>Limit, %            | Plastic<br>Limit, % | Plasticity<br>Index, % |                                  |
| WEST PIKE/SB-01                   | 1             | 0.0                   | 2.0  | 18.2                                | 72.7                                      | 40                            | 23                  | 17                     | CL                               |
|                                   | 2             | 3.0                   | 4.5  | 14.5                                | 59.4                                      | -                             | -                   | -                      | -                                |
|                                   | 3             | 6.0                   | 7.5  | 17.0                                | 60.8                                      | -                             | -                   | -                      | -                                |
|                                   | 4             | 9.0                   | 10.5 | 23.3                                | 83.5                                      | 37                            | 23                  | 14                     | CL                               |
|                                   | 5             | 14.0                  | 15.5 | 18.3                                | 62.3                                      | -                             | -                   | -                      | -                                |
|                                   | 6             | 19.0                  | 20.5 | 12.4                                | 51.3                                      | -                             | -                   | -                      | -                                |
| WEST PIKE/SB-02                   | 1             | 0.0                   | 2.0  | 19.8                                | 70.0                                      | -                             | -                   | -                      | -                                |
|                                   | 2             | 3.0                   | 4.5  | 16.8                                | 97.9                                      | 38                            | 23                  | 15                     | CL                               |
|                                   | 3             | 6.0                   | 7.5  | 10.1                                | 49.0                                      | -                             | -                   | -                      | -                                |
|                                   | 4             | 9.0                   | 10.5 | 8.5                                 | 61.5                                      | -                             | -                   | -                      | -                                |
|                                   | 5             | 14.0                  | 15.5 | 8.3                                 | 89.9                                      | 39                            | 22                  | 17                     | CL                               |
|                                   | 6             | 19.0                  | 19.4 | 9.6                                 | 85.4                                      | -                             | -                   | -                      | -                                |

**Notes:**

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

# 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<br>Fine (F) ¾ in. to No. 4 sieve  |
| Sand      | Coarse (C) No. 4 to No. 10 sieve<br>(4.75mm-2.00mm)<br>Medium (M) No. 10 to No. 40 sieve<br>(2.00mm – 0.425mm)<br>Fine (F) No. 40 to No. 200 sieve<br>(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<br>(More than half of material is larger than No. 200 sieve) | Gravels<br>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<br><br>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<br><br>Atterberg limits above A line with $I_p$ greater than 7<br><br>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<br>(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<br><br>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<br><br>Atterberg limits above A line with $I_p$ greater than 7<br><br>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:<br><br>Less than 5 percent GW, GP, SW, SP<br>More than 12 percent GM, GC, SM, SC<br>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<br>(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.