REPORT NO. 1
CONTRACT NO. 3Z800A
(REPORT NO. 254, MRCE SERIES)
SECTION G-4aL, ADDISON ROUTE SUPPLEMENTARY SUBSURFACE INVESTIGATION

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September 22, 2000

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Washington, DC 20001

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16. Abstracts

Results are summarized herein of five supplementary borings to investigate subsurface conditions along the subway alignment at the planned location of the Addison Route crossing of the Capital Beltway. The report contains geological sections which summarize information from the borings, logs of borings, results of laboratory tests on samples recovered and text describing design and construction problems.

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September 22, 2000

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Re: Beltway Crossing
Section G4aL Addison Route
Final Subsurface Investigation
MRCE File No. 9406

Dear Mr. Palmer:

In accordance with our schedule, we submit herewith one copy of this final report for the final subsurface investigation of the Beltway Crossing of Section G4aL of Addison Route. A draft of this report was submitted on July 27, 2000. Comments received from WMATA have been incorporated into this final report. Copies of this report are being sent to WMATA OGPM and the CTC project team under separate cover. We believe that this report completes all of our studies required for the Beltway Crossing.

Very truly yours,

MUESER RUTLEDGE CONSULTING ENGINEERS

By: Hugh S. Lacy
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DWC:HSL/cov-ltr

Exhibits

REPORT NO. 1
CONTRACT NO. 3Z800A
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SECTION G4aL, ADDISON ROUTE
SUPPLEMENTARY SUBSURFACE INVESTIGATION

1.0 INTRODUCTION

1.1 Authorization

Contract No. 3Z800A between DMJM/DeLeuw JV and Mueser Rutledge Consulting Engineers (MRCE) provides for subsurface investigations, laboratory testing, and summary reports relating to certain portions of the Rapid Transit System (RTS). One portion of that contract covers the making of five supplementary borings at the planned location of the Addison Route crossing of the Capital Beltway. The purpose of the investigation was to provide geotechnical information on the subsurface materials that will be encountered at the bridge foundations.

The following MRCE reports contain exploratory data for the Addison Route or relevant to this section:

1. Final Report, Subsurface Investigation, Addison Route Station 290 (G002) to 499 (G003), dated November 1973. (MRWJ Series Report No. 95).

2. Supplementary Subsurface Investigation, Addison Route Section G003, dated November 22, 1974 (MRWJ Series Report No. 118).

3. Report on Pumping Test, Addison Route Section G003, dated July 7, 1975, (MRWJ Series Report No. 135).

4. Preliminary Subsurface Investigation, G-Route Addison Road to Largo Town Center, dated November 14, 1996 (MRCE Series Report No. 249).

5. Preliminary Subsurface Investigation, Sections G4 and G5 Addison Route, dated May 16, 2000 (MRCE Series Report No. 252).

6. Supplementary Subsurface Investigation, Section G4aL Addison Route, dated May 19, 2000 (MRCE Series Report No. 253).

Data from Report No. 253 has been utilized directly in this study of the Beltway Crossing and that report should be consulted for a more detailed description of the general geological setting and test data relating to the encountered soils.

1.2 Scope of Work

The scope of work comprises the subsurface investigation for the planned crossing of the Addison Route over the Capital Beltway. The completed fieldwork consists of a group of five borings, designated MR-66, MR-67, MR-68U, MR-69 and MR-70. Borings Nos. MR-66 and MR-67 were drilled at the west pier, Borings Nos. MR-69 and MR-70 were drilled at the east pier, and Boring MR-68U was drilled at the center pier to supplement Boring MR-56 drilled in May 2000 at the center pier.

Boring operations commenced in May 2000 following WMATA authorization to proceed and were completed in June 2000. All borings were made by GeoServices Corporation under subcontract to Geotech Engineers, Inc. and were inspected and logged by GeoServices. An MRCE representative was present at the site on a part-time basis during the boring operations to verify that the work was performed in accordance with Metro standards. The boreholes were made by conventional soil boring methods utilizing a tricone roller bit with the aid of casing and water to advance the hole. All borings were grouted at completion. Corrosion tests on samples recovered from selected borings were performed by Artech Testing LLC of Chantilly, VA under subcontract to Geotech Engineers, Inc. The results of these tests are included in an appendix to this report.

All soil samples recovered from the borings were transported to our laboratory in New York City for examination, check of field classification, and performance of identification testing and engineering properties tests. Soil samples remaining after completion of laboratory testing were returned to Washington, DC, and placed in the designated storage facility.

2.0 TEST BORING AND LABORATORY PROGRAM

2.1 Presentation of Boring Data

Information from the five supplementary borings and nearby borings of earlier investigations are presented on two geological section drawings, Nos. G4aL-SO-13 and G4aL-SO-13a. The numbering sequence follows numbers established earlier in the several reports covering Sections G4 and G5. Locations of the new and nearby borings are shown in the upper panels of both sheets. The geological section along the outbound track is shown on the lower panel of Drawing No. G4aL-SO-13, and the geological section along the inbound track is shown in the lower panel of Drawing No. G4aL-SO-13a. Stationing is referenced to the outbound track. All geological sections are drawn at an exaggerated scale of one to four. Soil data plotted on the geological sections includes sample number designation and position, Standard Penetration Test resistance of the soil sampler, Unified Soil Classification, water contents of the fine grained soils, Atterberg Limits, and shear strength in ksf. Generalized strata descriptions for the project are presented on Drawing No. G4aL-SO-17. Final logs of the completed five borings are presented on two Drawings Nos. GaL-SO-22 and G4aL-SO-23. These logs are based on laboratory examination of soil samples and identification testing, and they may differ in detailed interpretations from the driller's logs.

Coordinate locations and ground surface elevations at the five new borings are presented on Table No. 1. General Information Drawing No. F-1 presents notes and legends applicable to the geological sections and boring log drawings.

2.2 Laboratory Testing Program

Two three-inch undisturbed samples of the Cretaceous Potomac group soils were recovered using a Pitcher Sampler. These samples were transported to our New York City laboratory for testing of engineering properties. Six unconsolidated undrained triaxial shear tests were performed on Potomac group soils of Strata P1 and P1(CL). In addition, Atterberg Limits were performed on one sample. The results of these tests are listed in Table No. 2, Summary of Laboratory Data. All split-spoon samples were examined in the laboratory, classifications were checked and water contents determined for clayey and fine grained soils.

2.3 Potential Corrosion Characteristics

Tests relating to potential corrosion characteristics included pH, resistivity, chlorides, sulfates, and total sulfur. Results of that testing are presented in the Appendix to this report. All samples tested exhibited pH values between 4 and 6, indicating acidic soils.

2.4 Groundwater Conditions

Water levels measured in borings made for this investigation and earlier investigations and in observation wells installed in earlier borings are indicated on the geologic sections by a solid triangle. An average water table position estimated from this group of readings is indicated by a dashed line on the geological sections. In general, the groundwater level is a subdued reflection of the ground surface.

3.0 SUMMARY AND CONCLUSIONS

Subsoil conditions in the vicinity of the Beltway Crossing are described in MRCE Report No. 253. The overall stratification and groundwater conditions between Borings MR-37 and MR-55 of that report are generally confirmed by the recent exploration. The only significant change to the stratification is that the top of the Potomac group within portions of the Beltway corridor was raised about five to eight feet based on the recent borings. This elevation is in good agreement with MR-56 drilled previously in the Beltway median, and is somewhat higher than in the previous borings to the east and west.

Soil conditions in the area consist of fill overlying sands and clays of Strata Es and Ec, overlying interlayered sand and clay of Strata Ms and Mc, overlying interlayered sand and clay of Strata P1, P1(CL), P2, P2(SP-SM), and P2(G). The soils of Strata Es and Ms are generally loose to medium compact and those of Strata Ec and Mc are generally soft to medium in consistency, as determined by N-values. The soils of Strata P1, and P1(CL) are generally stiff to hard in consistency and those of Strata P2, P2(SP-SM), and P2(G) are generally medium compact to very compact in consistency. Groundwater levels are five to ten feet below the ground surface. Based on the low relative density of the shallow soils and the presence of groundwater at shallow depth, shallow spread bearing for support of the bridges is not recommended. Further, the bridges are on a curve and therefore subject to lateral and centrifugal forces. The lateral forces could impose unequal base pressures on spread foundations, causing tilting of the aerial structures. Rigorous limitations on differential settlements imposed by WMATA criteria would probably be exceeded if the piers are founded on spread footings. Pile support of the piers appears necessary.

The presence of cemented sand layers in the Cretaceous strata may present difficulties in driving piles. In Section F10 of the Outer F-Route, cementation of the upper Cretaceous sands of Stratum Ms required predrilling and other measures to achieve the recommended pile tip elevations. Similar difficulties should be anticipated here, particularly in the cemented sands of Stratum P2 where SPT values reached 100 blows for less than 12 inches of sampler penetration.

Piles of up to 70 ton compressive capacity could consist of precast concrete piles, closed-end pipe piles or steel H-piles. We estimate 70 ton pile penetration into the Cretaceous Potomac group of Strata P1, P1(CL), P2, P2(SP-SM), and P2(G) of about 15 to 20 feet for precast and pipe piles and about 20 to 30 feet for steel H-piles. Pile sizes are expected to be 12 to 14 inches in diameter or width. The Potomac group was encountered at about Elev. 105 in this area. The choice of pile type will be influenced by market prices, but it is expected that the shorter precast pile will be more economical.

Pile dimensions will be based on their structural capacity and an evaluation of pile driveability including dynamic pile stress during driving. Pile driving resistance should be estimated using the Wave Equation Analysis Program (WEAP). Pile capacity and required driving resistance should be confirmed using dynamic monitoring and a Pile Dynamic Analyzer (PDA) plus static load tests prior to installation of production piles.

The recommended piles will also develop tension capacity in the strata of the Potomac group, the magnitude of which will be dependent on several factors including depth of penetration and predrilling. If substantial tension capacity is required, tension load testing should be performed prior to installation of production piles.

The positioning of the piers adjacent to the Capital Beltway are critical to minimize the cost sf the work restrictions related to maintenance of highway traffic. The impact of pile driving and pile cap construction on the 84-inch steel water line to the west should be considered in the design. Piles driven within about 30 feet of an underground utility should be predrilled to the level of the utility invert to minimize the risk of damage. The pile caps should be constructed as shallow as possible to minimize dewatering requirements and costs. The piers on the east of the Beltway is very close to an existing stream which will affect excavations made for construction of those piers.

TABLE NO. 1, SURVEY DATA FOR BORINGS (SECTION G4aL - ADDISON ROUTE)

BORING NUMBER	HORIZONTAL CONTROL COORDINATES:		VERTICAL CONTROL: GROUND SURFACE	STATUS OF OBSERVATION WELLS		
	NORTH	EAST	ELEVATION (FT)	INSTALLED	TYPE	PRESENT CONDITION
MR-66	448,108	1,355,154	129.6			
MR-67	448,054	1,355,175	128.9			
MR-68U	448,137	1,355,303	124.8			
MR-69	448,284	1,355,408	118.7			
MR-70	448,265	1,355,411	118.2			

TABLE NO. 2

SUMMARY OF LABORATORY TEST DATA

SAMPLE IDENTIFICATION				CLASSIFICATION PROPERTIES									PHYSICAL PROPERTIES													
													STRENGTH								CONSOLIDATION					
										UNIFIED SOIL CLASSIFICATION SYSTEM			UNCONFINED COMPRESSION			TRIAXIAL COMPRESSION										
BORING NUMBER	SAMPLE NUMBER	DEPTH FT.	STRATUM DESIGNATION	NATURAL WATER CONTENT % (W) AVERAGE OF ENTIRE SAMPLE	LIQUID LIMIT (W_L)	PLASTICITY INDEX (I_p)	NATURAL WATER CONTENT OF LIMIT SAMPLE, Wn,%	SPECIFIC GRAVITY OF SOLIDS (G_s)	DRY DENSITY, PCF	SOIL TYPE	% SAND (<# 4 >#200 SIEVE)	% FINES (<#200 SIEVE)	COMPRESSIVE STRENGTH TSF	WATER CONTENT AT END OF TEST, %	STRAIN AT FAILURE, %	TYPE OF TEST	DEVIATOR STRESS (σ_1-σ_3), TSF	CONFINING PRESSURE (σ_3), TSF	NATURAL WATER CONTENT, Wn, %	WATER CONTENT AT END OF TEST, W_f, %	NATURAL WATER CONTENT, Wn, %	EXISTING OVERBURDEN STRESS P_o, TSF	ESTIMATED PRECONSOLIDATION STRESS, P_c, TSF	COMPRESSION INDEX, C_c	SWELLING INDEX, C_s	VOID RATIO AT START OF SWELL, e_r
MR-68U	14C	46	P1	18						CL						Q	2.16	0.50	18	20						
			P1							CL						Q	4.42	1.00	16	16						
			P1		34	13	20			CL						Q	3.26	2.00	20	20						
	16C	51	P1(CL)	19						CL						Q	0.87	0.50	22	22						
										CL						Q	1.12	1.00	19	20						
										CL						Q	2.74	2.00	18	19						

1. ALL TESTS SUMMARIZED ABOVE WERE PERFORMED IN THE SOILS LABORATORY OF MUESER RUTLEDGE CONSULTING ENGINEERS.
2. THE SAMPLE DEPTH LISTED ABOVE IS THE AVERAGE DEPTH OF THE SAMPLE RECOVERED.
3. FOR GROUND SURFACE ELEVATIONS AT THE BORINGS SEE TABLE NO. 1. FOR GENERALIZED STRATA DESCRIPTIONS SEE DRAWING NO. F-1.
4. "NATURAL WATER CONTENT OF THE ENTIRE SAMPLE" IS A WEIGHTED AVERAGE OF ALL MATERIAL TYPES RECOVERED.
5. THE TRIAXIAL COMPRESSION TESTS PERFORMED WERE:
    - Q - QUICK TESTS (UU - UNCONSOLIDATED UNDRAINED TESTS)
    - Qc - CONSOLIDATED QUICK TESTS (CU - CONSOLIDATED UNDRAINED TESTS)
6. STRENGTH TESTS WERE PERFORMED ON PISTON TYPE SAMPLES (U) APPROXIMATELY 2.9 INCHES IN DIAMETER AND ON SHELBY TYPE SAMPLES (S) APPROXIMATELY 1.8 INCHES IN DIAMETER. THE RATIO OF HEIGHT TO DIAMETER OF ALL STRENGTH TEST SPECIMENS WAS APPROXIMATELY 2.0.
7. THE TRIAXIAL COMPRESSION TESTS WERE PERFORMED AT A RATE OF STRAIN OF APPROXIMATELY 1 PER CENT PER MINUTE.
8. THE DIRECT SHEAR TESTS WERE PERFORMED AT A CONSTANT RATE OF STRAIN EQUAL TO A HORIZONTAL DISPLACEMENT OF 0.02 INCHES PER HOUR. THE SPECIMENS WERE OF APPROXIMATELY 1/2 INCH THICKNESS.
9. COMPRESSION INDEX Cc - STRAIGHT LINE PORTION OF THE VIRGIN CURVE OF CONSOLIDATLION TEST: $e = eo - Cc \log P/Po$
10. SWELLING INDEX Cs - STRAIGHT LINE PORTION OF THE REBOUND CURVE OF CONSOLIDATION TEST: $e = eo - Cs \log P/Po$

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
CAPITAL TRANSIT CONSULTANTS
DMJM/DELEUW JOINT VENTURE

DATE JUL-00 FILE NO. 9406 SHEET 1 OF 1 TABLE NO. 2

GENERAL NOTES

1. THIS DRAWING CONTAINS REFERENCE INFORMATION FOR ANY SUBSURFACE INVESTIGATION PERFORMED FOR THE WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY (WMATA). SPECIFIC DETAILS WHICH PERTAIN TO INDIVIDUAL INVESTIGATIONS ARE CONTAINED ON BORING LOG DRAWINGS OR GEOLOGICAL SECTIONS IN A SERIES OF TECHNICAL REPORTS.

2. THE BORINGS WHOSE DETAILED LOGS ARE CONTAINED IN THESE REPORTS WERE MADE BY A BORING CONTRACTOR UNDER THE CONTINUOUS INSPECTION OF RESIDENT ENGINEERS OF MUESER, RUTLEDGE, WENTWORTH & JOHNSTON (MRWJ). THESE DETAILED LOGS WERE DERIVED FROM MRWJ FIELD BORING LOGS AFTER EXAMINATION AND CHECK OF SOIL CLASSIFICATION IN THE LABORATORY. SOIL DESCRIPTIONS MAY NOT AGREE WITH THE ORIGINAL MRWJ FIELD LOGS OR WITH THE BORING CONTRACTOR'S LOGS, COPIES OF WHICH ARE ON FILE AT WMATA. THESE SOURCES SHOULD BE CONSULTED FOR ADDITIONAL DETAILS REGARDING BORING OPERATIONS AND THE NATURE OF MATERIALS ENCOUNTERED.

3. SOIL SAMPLES AND ROCK CORES RECOVERED IN BORINGS MADE FOR WMATA WHICH REMAINED AFTER LABORATORY TESTING HAVE BEEN STORED IN WASHINGTON D.C. AT THE WMATA WAREHOUSE AND ARE AVAILABLE FOR INSPECTION.

4. ELEVATIONS SHOWN ON THE DRAWINGS OR NOTED ON THE BORING LOGS REFER TO USC&GS MEAN SEA LEVEL DATUM OF 1929, WHICH IS DESIGNATED AS PROJECT DATUM. COORDINATES LISTED FOR BORING LOCATIONS REFER TO THE COORDINATE SYSTEMS EMPLOYED ON THIS PROJECT WHICH GENERALLY COMPRISE THE MARYLAND STATE PLANE COORDINATE SYSTEM OR THE VIRGINIA STATE PLANE COORDINATE SYSTEM, ADJUSTED FOR SCALE AND ELEVATION TO THE PROJECT GRID.

5. THE PLAN AND PROFILE ON GEOLOGICAL SECTION DRAWINGS GENERALLY SHOW THE CENTERLINE OF THE SUBWAY OUTBOUND TRACK, STATIONING ON THAT CENTERLINE, THE POSITION OF TOP OF RAIL IN PROFILE, AND, IN SOME INSTANCES, THE TOP AND BOTTOM OF THE EXTERIOR OF THE SUBWAY STRUCTURE IN PROFILE. THESE DATA WERE OBTAINED FROM THE DE LEUW, CATHER AND COMPANY GENERAL PLANS WHICH WERE AVAILABLE AT THE DATE OF THE REPORT. THE SUBWAY PLAN AND PROFILE WHICH ARE SHOWN IN REPORTS MADE PRIOR TO CONSTRUCTION ARE SUBJECT TO CHANGE IN FINAL PLANS.

6. GEOLOGICAL SECTION DRAWINGS DEPICT THE OVERALL SUBSURFACE STRATIFICATION, DIVIDING MATERIALS INTO THE BROAD CATEGORIES LISTED UNDER "GENERALIZED STRATA DESCRIPTIONS". THE LINES SEPARATING STRATA ARE NECESSARILY INTERPOLATED BETWEEN BORINGS AND MAY OR MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

7. IN CERTAIN INSTANCES THE SUBSURFACE INVESTIGATIONS FOR WMATA HAVE UTILIZED BORING DATA AND REPORTS PREPARED BY OTHER ORGANIZATIONS FOR OTHER PROJECTS. COPIES OF THESE ORIGINAL DATA AND REPORTS ARE ON FILE AT WMATA AND SHOULD BE CONSULTED FOR FURTHER DETAILS.

8. THE GROUND WATER LEVELS NOTED ON THE DETAILED BORING LOGS AND PLOTTED ON THE GEOLOGICAL SECTIONS REPRESENT AVERAGE OR TYPICAL VALUES OBSERVED DURING THE PERIOD OF THE BORING OPERATION OR SHORTLY AFTER COMPLETION OF A BORE HOLE. THESE OBSERVATIONS MAY NOT REFLECT SEASONAL CHANGES IN THE WATER TABLE OR THE EFFECTS OF INTENSE RAINFALL OR RUNOFF. IN ANY EXCAVATION TRICKLING FLOW OR SEEPAGE MAY BE ENCOUNTERED FROM PERCHED WATER WHICH IS AT LEVELS ABOVE THE WATER TABLE OBSERVED IN THE BORINGS.

9. OBSERVATION WELLS OR PIEZOMETERS CONSISTING OF A STEEL OR PVC STANDPIPE WITH A PERFORATED INTAKE POINT HAVE BEEN INSTALLED IN CERTAIN OF THE TEST BORINGS, AS NOTED ON THE BORING LOGS. MEASUREMENTS OF WATER LEVELS HAVE BEEN MADE IN CERTAIN OF THESE STANDPIPES AT VARIOUS TIMES. THESE DATA ARE ON FILE AT WMATA AND SHOULD BE CONSULTED FOR AN INDICATION OF SEASONAL FLUCTUATIONS OF GROUND WATER LEVELS.

UNIFIED CLASSIFICATION SYSTEM

COARSE GRAINED SOILS (MORE THAN HALF LARGER THAN NO. 200 SIEVE)	GRAVELS AND GRAVELLY SOILS (MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4)	CLEAN (LESS THAN 5% SMALLER THAN NO.200)	GW	WELL GRADED GRAVEL, LITTLE OR NO FINES.
			GP	SINGLE-SIZE, NARROWLY GRADED GRAVEL, FEW FINES
			GP-GM	GRAVEL WITH MODERATE FINES, 5% TO 12% PASSING NO.200.
		DIRTY (MORE THAN 12% SMALLER THAN NO.200)	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES.
			GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURES.
			GM-GC	GRAVEL-SAND MIX WITH SILTY CLAY OR CLAYEY SILT FINES.
	SANDS AND SANDY SOILS (MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4)	CLEAN (LESS THAN 5% SMALLER THAN NO.200)	SW	WELL GRADED SAND, LITTLE OR NO FINES.
			SP	SINGLE-SIZE NARROWLY GRADED LEVEL, FEW FINES.
			SP-SM	SAND WITH MODERATE FINES, 5% TO 12% PASSING NO.200.
		DIRTY (MORE THAN 12% SMALLER THAN NO.200)	SM	SILTY SAND, SAND-SILT MIXTURES.
			SC	CLAYEY SAND, SAND-CLAY MIXTURES
			SM-SC	SAND WITH SILTY CLAY OR CLAYEY SILT FINES.
FINE GRAINED SOILS (MORE THAN HALF SMALLER THAN NO.200 SIEVE)	SILTS AND CLAYS LL<50		ML	INORGANIC SILT, ROCK FLOUR, CLAYEY SILT (LIMITS PLOT BELOW A-LINE)
			CL	INORGANIC CLAY OF LOW TO MEDIUM PLASTICITY (LIMITS PLOT ABOVE A-LINE)
			OL	ORGANIC SILT AND SILTY CLAY OF LOW PLASTICITY LIMITS PLOT BELOW A-LINE)
	SILTS AND CLAYS LL>50		MH	INORGANIC SILT, SPONGY, TALCY, MICACEOUS SILT (LIMITS PLOT BELOW A-LINE)
			CH	INORGANIC PLASTIC CLAY, TOUGH AND FAT CLAY (LIMITS PLOT ABOVE A-LINE)
			OH	ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY (LIMITS PLOT BELOW A-LINE
	PEAT AND HIGHLY ORGANIC		PT	PEAT, HIGHLY ORGANIC SOIL, SPONGY, COMPRESSIBLE, DARK COLOR, FIBROUS, DISTINCT ORGANIC ODOR (LIMITS PLOT BELOW A-LINE)

NOTES AND LEGEND FOR PLANS AND GEOLOGICAL SECTIONS

SYMBOLS UTILIZED ON LOCATION PLANS AND STRIP MAPS

1. BORINGS MADE IN THIS INVESTIGATION FOR WMATA UNDER THE CONTINUOUS INSPECTION OF MRWJ RESIDENT ENGINEERS ARE SHOWN THUS:

ON LOCATION PLANS AND STRIP MAPS:
BORINGS WITHOUT UNDISTURBED SAMPLES: ⊕
BORINGS WITH UNDISTURBED SAMPLES: ⊕

ON GEOLOGICAL SECTIONS:
BORINGS WITHOUT UNDISTURBED SAMPLES: ○
BORINGS WITH UNDISTURBED SAMPLES: ◎

2. BORINGS WHICH HAVE BEEN MADE BY OTHER ORGANIZATIONS FOR OTHER PROJECTS AND ARE UTILIZED IN THIS INVESTIGATION ARE SHOWN THUS:

ON LOCATION PLANS AND STRIP MAPS:* ■
ON GEOLOGICAL SECTIONS: □

THE GENERAL LOCATION OF THESE PROJECTS IN PLAN ARE SHOWN WITH A NUMBER DESIGNATION WITHIN A DIAMOND SYMBOL: ◇5

3. LOCATION AND ORIENTATION OF GEOLOGICAL SECTIONS GENERALLY ARE SHOWN ON THE PLAN ON WHICH BORING LOCATIONS ARE PLOTTED.

Ⓐ SYMBOLS UTILIZED ON GEOLOGICAL SECTIONS

I = LOCATION AND LENGTH OF SOIL SAMPLE
I = LOCATION AND LENGTH OF ROCK CORE RUN
A = NUMBER AND LOCATION OF BORING.
B = NUMBER AND TYPE OF SOIL SAMPLE:

SUFFIX "D"	=	DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
SUFFIX "S"	=	SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
SUFFIX "U"	=	UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
SUFFIX "R"	=	SAMPLE TAKEN WITH OPEN-END DRILL ROD;
SUFFIX "UD" OR "SD"	=	THIN TUBE SAMPLE DISTURBED IN SAMPLING;
"NR"	=	SAMPLE ATTEMPTED BUT NOT RECOVERED;
SUFFIX "C"	=	ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL, PRODUCING CORE APPROXIMATELY 2-1/8" ϕ;
"CORE"	=	CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT OR ROTARY DRILLING BIT.

C = SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT EXCEPT WHERE SPECIFIC DISTANCE IS NOTED.
SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30".
P = THIN TUBE SAMPLE ADVANCED BY PUSHING
T = THIN TUBE SAMPLE ADVANCED BY TAPPING.
WR = SAMPLER ADVANCED UNDER WEIGHT OF RODS
WH = SAMPLER ADVANCED UNDER WEIGHT OF RODS AND HAMMER
(R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")

D = SAMPLE CLASSIFICATION ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM
E = SAMPLE NATURAL WATER CONTENT IN PERCENT OF DRY WEIGHT
[F] = ATTERBERG LIQUID LIMIT VALUE.
[G] = ATTERBERG PLASTIC LIMIT VALUE.
[H] = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONFINED COMPRESSION TEST FOR SOIL SAMPLES OR COMPRESSIVE STRENGTH IN KSI FOR ROCK CORES.
(J) = SHEAR STRENGTH IN KSF DETERMINED FROM UNCONSOLIDATED-UNDRAINED TRIAXIAL SHEAR TEST.
K = NUMBER DESIGNATION OF NX SIZE ROCK CORE RUN.
L = LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN
M = ROCK QUALITY DESIGNATION (RQD) IN PERCENT.
▽ = GROUND WATER LEVELS OBSERVED DURING THE PERIOD OF THIS FIELD INVESTIGATION PROGRAM.
▽ = GROUND WATER LEVELS OBSERVED AT AN EARLIER TIME IN BORINGS NOT MADE FOR THIS INVESTIGATION.
▨ = POSITION OF POROUS BACKFILL SURROUNDING OBSERVATION WELL IN BORINGS MADE FOR WMATA.
M.L. = POSITION OF MATCH LINE BETWEEN GEOLOGICAL SECTIONS.
◁J = CORROSION TEST OF SOIL SAMPLE.
◁W = CORROSION TEST OF WATER SAMPLE.

NOTES AND LEGEND FOR BORING LOG DRAWINGS

Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

A = DEPTH BELOW GROUND SURFACE IN FEET

B = NUMBER OF BLOWS OF 300 LB. HAMMER FALLING 18" REQUIRED TO DRIVE CASING OF THE SIZE NOTED ONE FOOT.

C = NUMBER AND TYPE OF SAMPLE

SUFFIX "D"	=	DRY SAMPLE TAKEN WITH 2" OD SPLIT SPOON;
SUFFIX "S"	=	SHELBY SAMPLE TAKEN WITH 2" OD THIN TUBE;
SUFFIX "U"	=	UNDISTURBED SAMPLE TAKEN WITH 3" OD THIN TUBE USING PISTON SAMPLER;
SUFFIX "R"	=	SAMPLE TAKEN WITH OPEN-END DRILL ROD;
SUFFIX "UD" OR "SD"	=	THIN TUBE SAMPLE DISTURBED IN SAMPLING;
"NR"	=	SAMPLE ATTEMPTED BUT NOT RECOVERED;
SUFFIX "C"	=	ROCK CORE RUN USING NX SIZE DOUBLE TUBE DIAMOND CORE BARREL, PRODUCING CORE APPROXIMATELY 2-1/8" ϕ;
"CORE"	=	CORING IN OVERBURDEN OR CORING IN BEDROCK WITH SAWTOOTH BIT OR ROTARY DRILLING BIT.

D = SAMPLER PENETRATION RESISTANCE IN BLOWS PER 6" OF DRIVING EXCEPT WHERE SPECIFIC DISTANCE IS NOTED.
SAMPLER DRIVEN WITH 140 LB. HAMMER FALLING 30"
P = THIN TUBE SAMPLE ADVANCED BY PUSHING
T = THIN TUBE SAMPLE ADVANCED BY TAPPING
WR = SAMPLER ADVANCED UNDER WEIGHT OF RODS
WH = SAMPLER ADVANCED UNDER WEIGHT OF RODS AND HAMMER
(R SAMPLES DRIVEN WITH 300 LB. HAMMER FALLING 18")
78/25 — LENGTH OF ROCK CORE RECOVERY EXPRESSED AS A PERCENT OF LENGTH OF CORE RUN
— ROCK QUALITY DESIGNATION (RQD) IN PERCENT

E = DESCRIPTION OF INDIVIDUAL SOIL SAMPLE, INCLUDING UNIFIED SOIL CLASSIFICATION SYMBOL, OR DESCRIPTION OF INDIVIDUAL ROCK CORE RUN.

F = DESCRIPTION OF PRINCIPAL SOIL STRATA OR PRINCIPAL DIVISIONS OF BEDROCK. STRATA DIVISION LINES ARE NOTED WITH DEPTH BELOW GROUND SURFACE.

CONSISTENCY OR COMPACTNESS FROM SAMPLER PENETRATION RESISTANCE

THE DEGREE OF CONSISTENCY OR COMPACTNESS OF SAMPLES IS NOT GIVEN IN THE BORING LOG DESCRIPTIONS BUT IS INDICATED BY THE FOLLOWING VALUES OF STANDARD SAMPLER PENETRATION RESISTANCE IN BLOWS PER FOOT:

FINE GRAINED SOILS, SILTS AND CLAYS:
LESS THAN 2 BPF = VERY SOFT
2 TO 4 BPF = SOFT
4 TO 8 BPF = MEDIUM STIFF
8 TO 15 BPF = STIFF
15 TO 30 BPF = VERY STIFF
GREATER THAN 30 = HARD

COARSE GRAINED SOILS, SANDS AND GRAVELS:
LESS THAN 4 BPF = VERY LOOSE
4 TO 10 BPF = LOOSE
10 TO 30 BPF = MEDIUM COMPACT
30 TO 50 BPF = COMPACT
GREATER THAN 50 = VERY COMPACT

ABBREVIATIONS

MISCELLANEOUS
BOTTOM = BOT.
CARBONACEOUS = CARB.
CAVITIES = CVTS.
CEMENTED = CEM.
CONCRETIONS = CONC.
DITTO = Do.
FRAGMENTS = FGMTS.
INTERBEDDED = INTRBD.
INTERLAYERED = INLRD.
LAYERS = LYRS.
LENSES = LNS.
MATERIAL = MTL.
MATTER = MTR.
MEADOW MAT = MDW.MT.
MICACEOUS = MIC.
MISCELLANEOUS = MISC.
NUMEROUS = NUM.
OCCASIONAL = OCC.
ORGANIC = ORG.
PARTICLES = PCLS.
PEAT = PT.
PIECES = PCS.
POCKET = PKT.
PROBABLY = PROB.
ROOTS = RTS.
SEAMS = SMS.
SLICKENSIDED = SLKS.
SLIGHTLY = SL.
SOME = SM.
TRACE = TR.
VEGETATION = VEG.
VERY = V
WITH = W/

GRAIN SIZE AND SHAPE
ANGULAR = ANG.
COARSE = C
COARSE TO FINE = C-F
COARSE TO MEDIUM = C-M
FINE = F
FINE TO COARSE = F-C
FINE TO MEDIUM = F-M
MEDIUM = M
MEDIUM TO COARSE = M-C
MEDIUM TO FINE = M-F
SMALL = SML.

CONSISTENCY
COMPACT = CPT.
MEDIUM COMPACT = MED.CPT.
DECAYED = DCYD.
DECOMPOSED = DEC.
DISINTEGRATED = DSNTG.
FRACTURED = FRCT.
HARD = HD.
MEDIUM = MED.
RELATIVELY SOUND = REL.SND.
SOFT = SFT.
SOUND = SND.
STIFF = STF.
WEATHERED = WTHRD.

COLOR
BLACK = BLK.
BLUE = BL.
BROWN = BRN.
DARK = DK.
GRAY = GRY.
GREEN = GRN.
LIGHT = LT.
MOTTLED = MTLD.
PURPLE = PRP.
ORANGE = OR.
WHITE = WHT.
YELLOW = YEL.

SOIL OR ROCK TYPE
BOULDER = BLDR.
BRICK = BRK.
CINDERS = CNDR.
CLAY = CL.
CLAYEY SAND = CL.SA.
CLAYEY SILT = CL.SI.
COBBLE = CBL.
GNEISS = GNS.
GRANITE = GRT.
GRAVEL = GVL.
LIGNITE = LIGN.
SAND = SA.
SANDY CLAY = SA.CL.
SANDY SILT = SA.SI.
SCHIST = SCH.
SHALE = SH.
SHELLS = SLS.
SILT = SI.
SILTY CLAY = SI.CL.
SILTY SAND = SI.SA.

GENERALIZED STRATA DESCRIPTIONS

SYMBOL	DESCRIPTION	UNIFIED SOIL CLASSIFICATION PRIMARY	UNIFIED SOIL CLASSIFICATION SECONDARY	SOURCE AND AGE
Ⓕ	FILL, GENERALLY COMPOSED OF INORGANIC SOIL OBTAINED FROM NEARBY NATURAL MATERIALS. MAY BE DERIVED FROM TERRACE, CRETACEOUS SOILS OR DECOMPOSED ROCK.	ML SM	SC CL	MAN-MADE IN HISTORIC TIMES
(A1)	VERY SOFT TO MEDIUM STIFF DARK GRAY AND BROWN ORGANIC CLAY WITH LENSES OF HIGHLY ORGANIC MATERIAL (WHERE LOCATED UNDER WATER). SOFT TO STIFF MOTTLED GRAY-BROWN SLIGHTLY ORGANIC SILTY OR SANDY CLAY (WHERE LOCATED ON LAND).	CL CH OH	OL PT	RIVER ALLUVIUM OF POST-GLACIAL TIMES
(A2)	LOOSE TO MEDIUM COMPACT GRAY OR DARK BROWN SILTY FINE TO MEDIUM SAND WITH OCCASIONAL POCKETS OR LENSES OF SMALL GRAVEL. MAY BE SLIGHTLY TO MODERATELY ORGANIC.	SM	SP	
(T1)	STIFF TO MEDIUM STIFF LIGHT BROWN OR GRAY OR MOTTLED BROWN-GRAY SILTY CLAY OR CLAYEY SILT WITH LENSES OF BROWN SILTY FINE SAND. IN SOME AREAS, SEVERAL SEPARATE LAYERS OF PLEISTOCENE CLAYS HAVE BEEN ENCOUNTERED, WHICH ARE DISTINGUISHED BY A LETTER SUFFIX: T1A, T1C, ETC.	CL ML CH	LENSES OF SM OR SC	PORTIONS OF THE "25-FOOT" "50-FOOT" AND "90-FOOT" TERRACES, DEPOSITED BY RIVERS IN PLEISTOCENE TIMES
(T0)	MEDIUM STIFF TO STIFF DARK GRAY ORGANIC CLAY WITH NUMEROUS WOOD FRAGMENTS. USUALLY FOUND INTERLENSED WITH STRATUM T4.	CL OL	CH OH	
(T2)	MEDIUM COMPACT TO COMPACT BROWN AND RED-BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE OF GRAVEL AND OCCASIONAL BOULDERS.	SM SC	SP SW	
(T3)	COMPACT TO VERY COMPACT BROWN AND RED-BROWN FINE TO COARSE SAND WITH SOME SILT AND GRAVEL AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS.	SW SM	SP GM	
(T4)	MEDIUM COMPACT TO COMPACT GRAY AND GRAY-BROWN FINE TO MEDIUM SAND WITH SOME SILT AND SMALL GRAVEL, CONTAINING LENSES OF DARK GRAY CLAY, OCCASIONALLY SLIGHTLY ORGANIC.	SM SP	SW	
(T5)	COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL, SOME TO TRACE OF SILT AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS, OFTEN CONCENTRATED AT BASE OF LAYER.	SW SM	SP GM	
(Q1)	LOOSE TO MEDIUM COMPACT LIGHT BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE OF SMALL GRAVEL.	SM SC		BRANDYWINE FORMATION OF EARLY PLEISTOCENE OR PLIOCENE TIMES
(Q2)	LOOSE TO MEDIUM COMPACT LIGHT BROWN OR TAN SILTY OR CLAYEY MEDIUM TO FINE SAND WITH SOME SMALL GRAVEL.	SM SC	SP	
Ⓒ	MEDIUM COMPACT GRAY AND TAN SILTY FINE SAND OR MEDIUM STIFF TO STIFF DARK GRAY TO OLIVE-GREEN CLAY. CALVERT FORMATION OF MIOCENE AGE.	SM CH	SP CL	MARINE DEPOSITS OF TERTIARY OR UPPER CRETACEOUS PERIODS
Ⓔ	MEDIUM STIFF DARK GREEN OR BROWN CLAY AND SILTY CLAY. AQUIA FORMATION OF EOCENE AGE.	MH CH	ML CL	
Ⓜ	MEDIUM STIFF TO STIFF GREEN OR BROWN SILT AND CLAY. MONMOUTH FORMATION OF UPPER CRETACEOUS AGE.	MH CL	ML CH	
(P1)	HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY AND TAN PLASTIC CLAY WITH OCCASIONAL POCKETS OF FINE SAND. GENERALLY CONSISTS OF PATAPSCO FORMATION BUT MAY INCLUDE RARITAN FORMATION AT UPPER LEVELS.	CH	CL	POTOMAC GROUP OF CRETACEOUS PERIOD
(P2)	COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS. ALSO INCLUDES MAGOTHY FORMATION OF UPPER CRETACEOUS AGE.	SM SC SP	SP	
(P3)	HARD GRAY-GREEN OR GRAY-BLUE-GREEN SILTY OR SANDY CLAY AND VERY COMPACT SILTY OR CLAYEY FINE TO MEDIUM SAND WITH OCCASIONAL SMALL GRAVEL AND SCATTERED BOULDERS.	CL SC	ML SM	
(P4)	VERY COMPACT MOTTLED LIGHT GRAY, TAN, BUFF OR WHITE SILTY OR CLAYEY FINE TO MEDIUM SAND WITH SOME GRAVEL AND SCATTERED LIGNITE FRAGMENTS, FREQUENTLY WITH DENSE NESTS AND POCKETS OF ANGULAR ROCK FRAGMENTS, COBBLES AND BOULDERS.	SM SW SC	SP GM	

NOTE

THE GENERALIZED STRATA DESCRIPTIONS NOTED IN THIS COLUMN AND GIVEN IN THE TEXT OF THE MRJD REPORTS ON SUBSURFACE INVESTIGATIONS ARE INTENDED TO COVER THE TYPICAL RANGE OF MATERIALS GROUPED WITHIN A PARTICULAR STRATUM.

FOR A DETAILED BREAKDOWN OF THE ACTUAL CONSTITUENT MATERIALS WITHIN THAT STRATUM, REFERENCE SHOULD BE MADE TO BORING AND LABORATORY TEST INFORMATION RELEVANT TO ANY SPECIFIC LOCATION.

DEFINITION OF MODIFYING ADJECTIVES USED TO DESCRIBE SOIL CONSTITUENTS IN SAMPLE AND STRATA DESCRIPTIONS

CONSTITUENT	PROPORTIONS OF SOIL CONSTITUENTS	PERCENTAGE BY DRY WEIGHT
MAJOR	NOUN FORM: GRAVEL, SAND, SILT, ETC.	50 OR MORE
MINOR	ADJECTIVE FORM: GRAVELLY, SANDY, ETC.	31 TO 49
	SOME: SOME SAND SOME SILT, ETC.	13 TO 30
	TRACE: TRACE GRAVEL, TRACE CLAY	1 TO 12
	AND: SAND AND GRAVEL	USE FOR EQUAL AMOUNTS
	WITH: WITH ROCK FRAGMENTS WITH ORGANIC MATTER	INDICATES PRESENCE ONLY

DESIGNED ______ DATE
DRAWN ______ DATE
CHECKED ______ DATE
APPROVED ______ DATE

REVISIONS

DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION
3-86	JPG.	Revised Abbreviations.	3-76	JPG	Revised Generalized Strata Descriptions
5-93	JPG	Revised Percentage limits of Soil adjectives "trace" and "Some".	5-80	JPG.	Revised General Notes and Sampler Penetration Resistance.
			3-81	JPG.	Added Note on Generalized Strata Descriptions and Definition of Soil Adjectives.

DISTRICT OF COLUMBIA
WILLIAM H. MUESER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MUESER · RUTLEDGE · WENTWORTH & JOHNSTON
CONSULTING ENGINEERS
415 MADISON AVE., NEW YORK 17, N.Y.

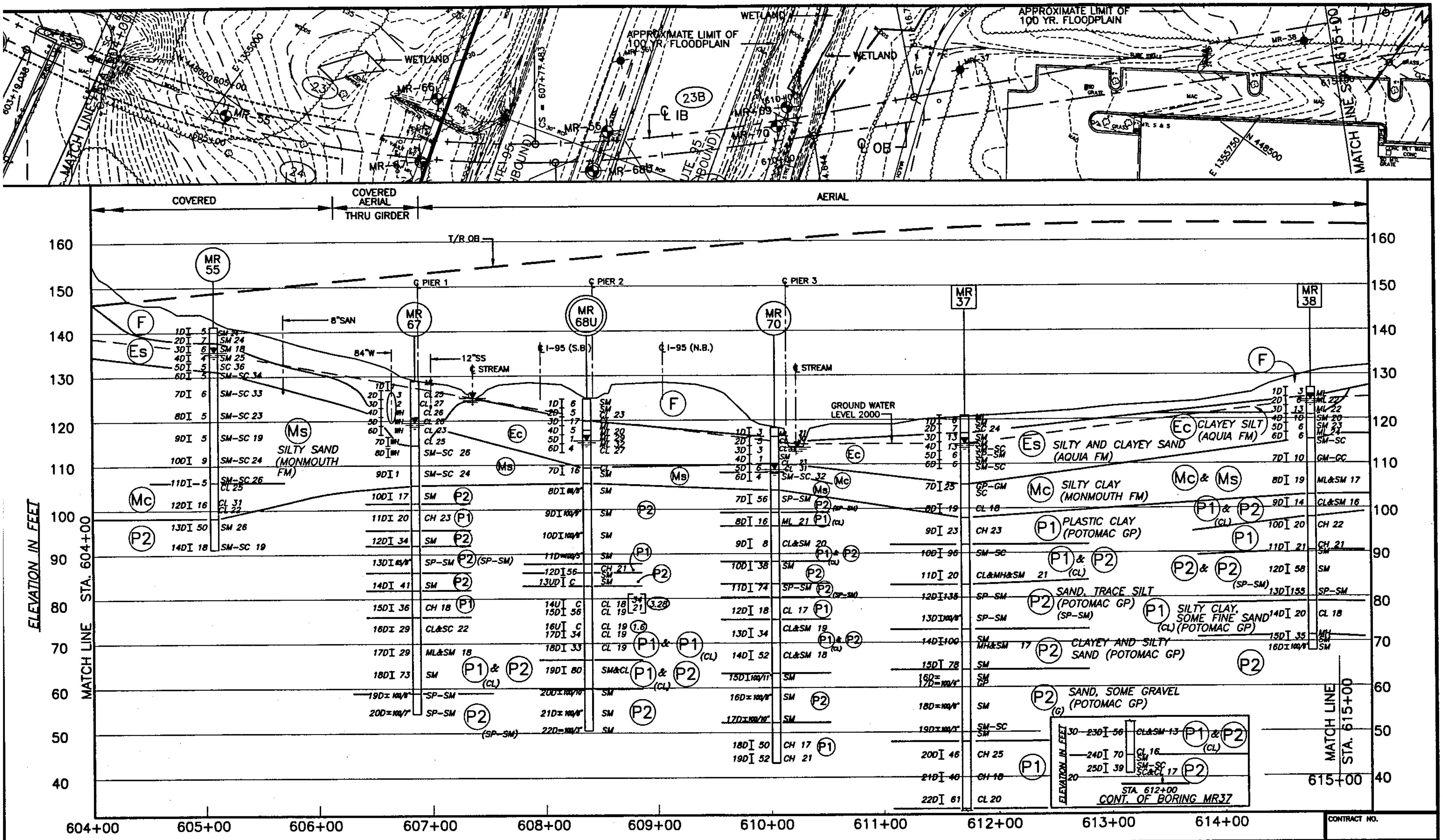
SUBMITTED William H. Mueser

DE LEUW, CATHER & COMPANY ☐
GENERAL ENGINEERING CONSULTANT
HARRY WEESE & ASSOCIATES ☐
GENERAL ARCHITECTURAL CONSULTANT

APPROVED ______

SUBSURFACE INVESTIGATION
GENERAL INFORMATION DRAWING

SCALE
DRAWING NO. F-1



CONTRACT NO.

DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4aL-SO-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION
9/00	D.W.C.	ADDED BORING NOS. MR-67, MR-68U AND MR-70. ADJUSTED SECTION AND REVISED TITLE BLOCK

STATE OF MARYLAND
HUGH B. LACY
REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

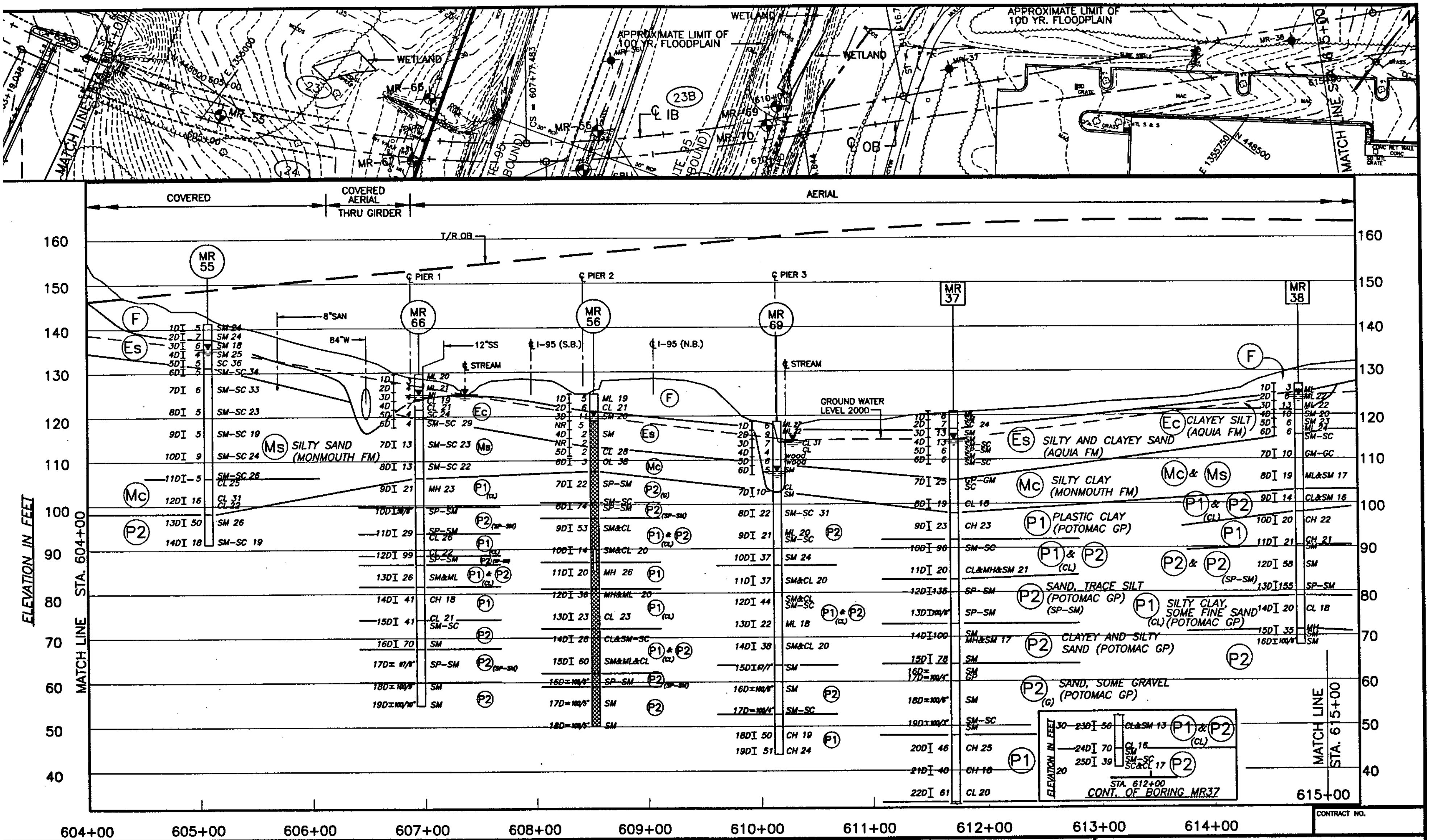
CAPITAL TRANSIT CONSULTANTS
SECTION DESIGNER

SUBMITTED
PROJECT MANAGER

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 604+00 to STA. 615+00 OB

SCALE GRAPHIC 20 0 20 40 / 5 0 5 10

DRAWING NO. G4aL-SO-13



DESIGNED		DATE
DRAWN	AH	5-00
CHECKED	AAA, DWC, HSL	5-00
APPROVED		DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1 & G4dL-SO-17	GENERAL NOTES, LEGEND AND GENERAL STRATA DESCRIPTIONS

REVISIONS

DATE	BY	DESCRIPTION
9/00	D.W.C.	ADDED BORING NOS. MR-66 AND MR-69, ADJUSTED SECTION AND REVISED TITLE BLOCK

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

CAPITAL TRANSIT CONSULTANTS
SECTION DESIGNER

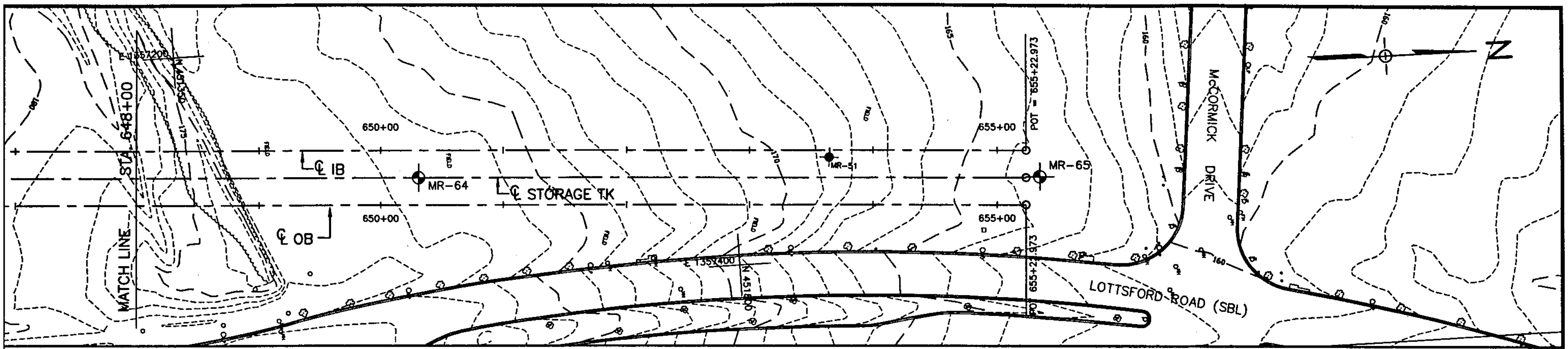
SUBMITTED PROJECT MANAGER

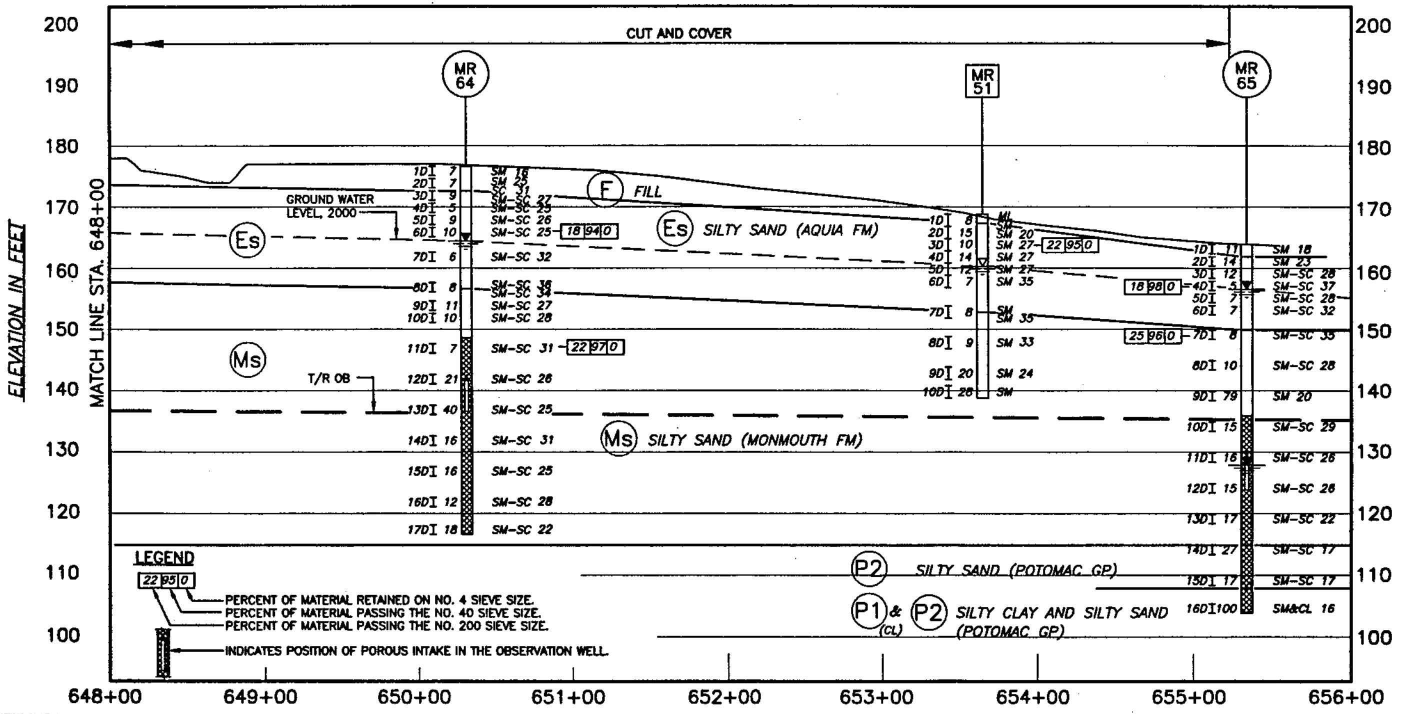
ADDISON ROUTE
SITE PREPARATION AND MITGATION
PLAN AND GEOLOGICAL SECTION
STA. 604+00 to STA. 615+00 IB

SCALE GRAPHIC 20 0 20 40 / 5 0 5 10

DRAWING NO. G4aL-SO-13a

CONTRACT NO.





GENERAL STRATA DESCRIPTIONS:

STRATUM Cc (CALVERT), PLASTIC CLAY, SILTY AND SANDY CLAY OR CLAYEY SILT: MEDIUM TO STIFF DARK GRAY, GREEN, BROWN AND YELLOW ORANGE PLASTIC CLAY, SILTY AND SANDY CLAY OR CLAYEY SILT, TRACE FINE SAND, GRAVEL.

STRATUM Cs (CALVERT), FINE SAND, TRACE TO SOME SILT, CLAY AND SILTY OR CLAYEY FINE SAND: LOOSE TO MEDIUM COMPACT DARK GRAY, OLIVE GRAY, GREEN BROWN AND YELLOW ORANGE FINE SAND, TRACE TO SOME SILT, CLAY AND SILTY OR CLAYEY FINE SAND, TRACE GRAVEL.

STRATUM Ec (AQUIA), PLASTIC TO SILTY AND SANDY CLAY OR CLAYEY SILT: MEDIUM TO STIFF GRAY, GREEN OLIVE GRAY PLASTIC CLAY TO SILTY AND SANDY CLAY OR CLAYEY SILT, TRACE LIGNITE WITH OCCASIONAL SLIGHTLY ORGANIC FINE SANDY AND SILTY CLAY LAYERS, TRACE SHELLS.

STRATUM Es (AQUIA), SILTY AND CLAYEY FINE SAND: LOOSE TO MEDIUM COMPACT GRAY GREEN, OLIVE GRAY SILTY SAND, CLAYEY FINE SAND, TRACE SHELLS WITH OCCASIONAL SLIGHTLY ORGANIC SILTY AND CLAYEY FINE SAND LAYERS.

STRATUM Mc (MONMOUTH), SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT AND CLAYEY SILT: LOOSE TO VERY COMPACT DARK GREEN SLIGHTLY ORGANIC MICACEOUS FINE SANDY SILT, AND VERY STIFF TO HARD CLAYEY SILT TO SILTY CLAY TRACE SHELLS, OCCASIONALLY CEMENTED.

STRATUM Ms (MONMOUTH), SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND AND CLAYEY FINE SAND: LOOSE TO VERY COMPACT DARK GREEN SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY AND CLAYEY FINE SAND AND FINE SAND, SOME SILT, TRACE TO SOME SHELLS, OCCASIONALLY CEMENTED, CEMENTED SAND LAYERS.

STRATUM P1 (POTOMAC), PLASTIC CLAY: STIFF TO HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY PLASTIC CLAY TO SILTY CLAY, TRACE FINE SAND, SILT POCKETS, SAND POCKETS, CEMENTED SAND, LIGNITE, GENERALLY SLICKENSIDED.

STRATUM P1(CL) (POTOMAC), SANDY CLAY: STIFF TO HARD GRAY SILTY CLAY, SOME FINE SAND LAYERS TO SANDY CLAY, TRACE CEMENTED SAND, LIGNITE.

STRATUM P2 (POTOMAC), SAND, SOME SILT, CLAY: COMPACT TO VERY COMPACT, LIGHT GRAY, BROWN OR TAN FINE TO MEDIUM SAND, SOME SILT, CLAY TO SILTY OR CLAYEY FINE TO MEDIUM SAND, TRACE CEMENTED SAND LAYERS, GRAVEL, LIGNITE.

STRATUM P2(SP-SM) (POTOMAC), SAND, TRACE SILT, CLAY: VERY COMPACT GRAY FINE TO MEDIUM SAND, TRACE SILT, CLAY, TRACE CEMENTED SAND LAYERS, GRAVEL, OCCASIONAL CLAY POCKETS.

STRATUM P2(G) (POTOMAC), SAND, SOME GRAVEL: VERY COMPACT LIGHT GRAY AND BROWN FINE TO COARSE SAND, SOME GRAVEL, TRACE TO SOME SILT, CLAY, CEMENTED SAND FRAGMENTS.

CONTRACT NO.

DESIGNED ________ DATE
DRAWN AH 5-00 DATE
CHECKED AAA, DWC, HSL 5-00 DATE
APPROVED ________ DATE

REFERENCE DRAWINGS	
NUMBER	DESCRIPTION
F-1	GENERAL NOTES AND LEGEND

REVISIONS		
DATE	BY	DESCRIPTION
9/00	D.W.C.	REVISED TITLE BLOCK

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

CAPITAL TRANSIT CONSULTANTS
SECTION DESIGNER

SUBMITTED ________
PROJECT MANAGER

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
PLAN AND GEOLOGICAL SECTION
STA. 648+00 to 655+00

SCALE
H: 1" = 40'
V: 1" = 10'

DRAWING NO.
G4aL-S0-17

DEPTH BELOW GROUND SURFACE, FEET

BORING NUMBER MR-66
Ground surface elevation +129.6

3 4 3 3	1D	1,1,2,2	Brown fine sandy silt, trace clay, roots (Fill) (ML)	FILL
	2D	2,2,2,2	Brown gray fine sandy silt, trace clay, roots (Fill) (ML)	
	3D	1,2,2,4	Top: Do 2D (Fill) (ML) Bot: Stiff gray brown silty clay (CL)	5.5'
	4D	2,3,4,4	Stiff gray brown silty clay, some fine sand, trace gravel (CL)	STIFF SI CL, SM F SA, TR GVL 8.0'
	5D	WH,1,3,5	Brown gray clayey fine sand, trace mica (SC)	LOOSE CL F SAND 10.0'
	6D	1,1,3,4	Black slightly organic micaceous silty fine sand, trace clay (SM-SC)	LOOSE TO MEDIUM COMPACT BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, GRAVEL
	7D	4,6,7	Do 6D (SM-SC)	
	8D	3,6,7	Do 6D, trace gravel (SM-SC)	23.5'
	9D	5,9,12	Very stiff gray clayey silt, trace fine sand lenses, lignite (MH)	VERY STIFF GRAY CLAYEY SILT, TRACE FINE SAND LENSES, LIGNITE 30.0'
	10D	41,39,20/2"	Light gray fine sand, trace silt (SP-SM)	VERY COMPACT GRAY FINE SAND, TRACE SILT 36.0'
	11D	13,13,16	Top: Do 10D (SP-SM) Bot: Very stiff gray silty clay, some fine sand, trace fine sand seams (CL)	VERY STIFF GRAY SILTY CLAY, SOME FINE SAND 41.0'
	12D	10,34,86	Top: Do 11D, Bot (CL) Bot: Light gray fine sand, trace silt (SP-SM)	V CPT F SAND, TR SILT 43.0'
	13D	12,13,13	Gray silty fine sand, some fine sandy silt layers, lignite, trace clay, wood (SM&ML)	MEDIUM COMPACT SILTY FINE SAND, SM F SANDY SILT LYRS, LIGNITE, TR CLAY 48.0'
	14D	13,19,22	Very stiff mottled gray & red clay (CH)	VERY STIFF MOTTLED GRAY & RED CLAY TO SILTY CLAY, TRACE FINE SAND 55.5'
	15D	11,16,25	Top: Very stiff gray red silty clay, trace fine sand (CL) Bot: Red silty fine sand, trace clay, silt seams (SM-SC)	VERY COMPACT RED & GRAY FINE SAND, SM SILT, TR CLAY, SILT SEAMS 62.0'
	16D	16,35,35	Red & gray fine sand, some silt, trace clay (SM)	
	17D	56,42/2"	Light gray fine to medium sand, trace silt (SP-SM)	VERY COMPACT LIGHT GRAY FINE TO MEDIUM SAND, TRACE SILT 69.5'
	18D	58,42/3"	Brown fine to medium sand, some silt, cemented sand, trace clay seams (SM)	VERY COMPACT BRN F-M SAND, SOME SILT, CEMENTED SAND 74.8'
	19D	45,55/4"	Brown fine to medium sand, some silt, trace cemented sand (SM)	

Boring started 5-31-00 completed 6-6-00
Final depths:
Boring = 74.8' Casing = 4.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 4.7' =El. +124.9

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used potable water below 4' depth to maintain hole open.

Encountered trace to some cemented sand between 69.5' and 74.8' depth.

Borehole was grouted upon completion.

BORING NUMBER MR-67
Ground surface elevation +128.9

2 3 3 3	1D	WH/12",1,2	Soft brown clayey silt, some fine sand (Fill) (ML)	FILL
	2D	1,1,2,1	Soft brown silty clay, some fine sand, trace roots, gravel (Fill) (CL)	
	3D	1,1,1,1	Soft gray silty clay, trace fine sand, gravel, lignite (Fill) (CL)	
	4D	WH/24"	Soft gray silty clay, trace gravel, roots, organics (Fill) (CL)	
	5D	WH/24"	Soft gray silty clay, trace gravel, plastic, organics (Fill) (CL)	
	6D	WH/24"	Soft gray silty clay, trace gravel, wood, organics (Fill) (CL)	
	7D	WH/24"	Soft gray silty clay, trace gravel, roots (Fill) (CL)	14.5'
	8D	WH/24"	Black slightly organic micaceous silty fine sand, trace clay, gravel (SM-SC)	LOOSE BLACK SLIGHTLY ORGANIC MICACEOUS SILTY FINE SAND, TRACE CLAY, GRAVEL
	9D	WH/12",1	Do 8D (SM-SC)	23.5'
	10D	8,9,8	Light gray silty fine sand, some clayey silt layers (SM)	MED CPT SI F SAND, SM CL SI LAYERS 27.5'
	11D	6,8,12	Very stiff gray clay (CH)	VERY STIFF GRAY CLAY 33.5'
	12D	8,12,22	Light gray fine sand, some silt, trace clay (SM)	CPT GRAY FINE SAND, SM SILT 37.0'
	13D	53,44,21/2"	Light gray fine sand, trace silt (SP-SM)	VERY COMPACT LIGHT GRAY FINE SAND, TRACE SILT 43.0'
	14D	15,17,24	Gray silty fine sand, trace clay lenses, lignite (SM)	CPT GRAY SILTY FINE SAND, TR LIGNITE 47.0'
	15D	11,14,22	Very stiff light gray clay (Slickensided) (CH)	VERY STIFF LIGHT GRAY CLAY (SLICKENSIDED) 53.0'
	16D	6,11,18	Stiff gray silty clay, some clayey fine sand layers (CL&SC)	INTERLAYERED MEDIUM COMPACT TO VERY COMPACT GRAY & BROWN SILTY TO CLAYEY FINE SAND & STIFF SILTY CLAY TO CLAYEY SILT
	17D	10,11,16	Interlayered stiff brown & light grey clayey silt & silty fine sand (ML&SM)	
	18D	16,24,40	Light gray silty fine sand, some clayey silt layers (SM)	70.0'
	19D	72,28/2"	Brown fine sand, trace silt (SP-SM)	VERY COMPACT BROWN FINE SAND, TRACE SILT 74.6'
	20D	89,11/1"	Do 19D (SP-SM)	

Boring started 6-9-00 completed 6-12-00
Final depths:
Boring = 74.6' Casing = 4.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 9.4' =El. +119.5

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Used potable water below 4' depth to maintain hole open.

Depth of groundwater recorded does not appear to be stabilized because the depth of groundwater was recorded immediately after completion of the boring.

Borehole was grouted upon completion.

BORING NUMBER MR-68U
Ground surface elevation +124.8

6 9	1D	2,3,3,5	Top 3": Top soil Bot:Brn f-m sand, sm gvl, si, tr c sa(Fill)(SM)	FILL
8 15	2D	1,2,3,4	Top 6": Do 1D, Bot (SM) Bot:Gry brn red si cl, tr f-c sand, gvl(Fill)(CL)	5.0'
10 12	3D	6,9,8,5	Top: Gray silty clay, some gravel (Fill) (CL) Bot:Brn gry cl si,sm f sa,tr gvl,rts,cl pkts(ML)	SOFT TO MEDIUM GRAY BROWN SILTY CLAY TO CLAYEY SILT, TRACE TO SOME FINE SAND, TRACE CEMENTED SILT, ROOTS
11 14	4D	2,3,2,2	Top: Do 3D, Bot (ML) Bot: Soft gray cl silt, sm f sand, tr rts (ML)	
13 21	5D	1/12",1,2	Soft gray brown clayey silt, some fine sand (ML)	
22 21 19 19 18	6D	1,2,2,3	Soft gray brown silty clay, trace fine sand, cemented silt, roots (CL)	15.5'
14 16 15 17 19	7D	6,7,9,9	Top: Soft gray silty clay (CL) Bot: Black slightly organic fine sand, some silt, trace gravel, (SM)	MED CPT SL ORG F SAND, SM SILT 19.0'
29 32 32 34 34	8D	31,53,16/2"	Brown fine to medium sand, some silt, trace gravel (SM)	VERY COMPACT RED BROWN FINE TO MEDIUM SAND, SOME SILT, TRACE TO SOME CEMENTED SAND, TRACE CLAY LAYERS, GRAVEL
36 43 43 42	9D	25,50,50/3"	Red brown fine to medium sand, some silt (SM)	
	10D	29,79,21/2"	Red brown fine to medium sand, some silt, trace red clay layers, cemented sand (SM)	
	11D	100/5"	Red fine sand, some silt, cemented sand (SM)	37.0'
	12D	8,16,40	Top:V stiff red & gry clay(Slickensided)(CH) Bot: Red brown fine sand, some silt (SM)	V STIFF CL (SLICKENSIDED) 39.0'
	13UD	C	Red brown fine to medium sand, some silt (SM)	CPT F-M SAND, SOME SILT 42.0'
	14U	C	Very stiff light gray red silty clay, tr to sm fine sand lyrs, tr fine sand,	VERY STIFF GRAY RED SILTY CLAY, TRACE TO SOME FINE SAND LAYERS, TRACE FINE SAND WITH OCCASIONAL LAYERS OF STIFF GRAY BRN FINE SANDY CLAY (OCCASIONALLY SLICKENSIDED)
	15D	15,25,31	Very stiff gray silty clay, trace fine sand (CL)	
	16U	C	Stiff gray brn fine sandy clay, some silty clay lyrs & pkts, f sand lyrs &	
	17D	12,14,20	Very stiff gray silty clay, trace fine sand, silt pockets (Slickensided) (CL)	
	18D	13,16,17	Do 17D, trace fine sand seams (CL)	58.5'
	19D	17,31,49	Light gray fine sand, some silt, red gray silty clay layers (SM&CL)	VERY COMPACT LT GRAY F SAND, SM SILT, RED GRAY SILTY CLAY LAYERS 65.0'
	20D	47,53/4"	Light gray fine sand, some silt, trace clay seams (SM)	VERY COMPACT LIGHT GRAY & BROWN FINE TO MEDIUM SAND, SOME SILT, CEMENTED SAND, TRACE GRAVEL, CLAY LAYERS
	21D	80,40/2"	Brown fine to medium sand, some silt, trace clay layers (SM)	74.3'
	22D	100/3"	Dark brown fine to medium sand, some silt, cemented sand, trace gravel (SM)	

Boring started 6-19-00 completed 6-21-00
Final depths:
Boring = 74.3' Casing = 29.0'
Casing diameter = 5"
Average depth of ground water
observed in the boring = 9.4' =El. +115.4

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Washed ahead of casing between 5' and 29' depth and then drove casing. Casing blows are not representative of the consistency of the soil.

Used potable water below 29' depth to maintain hole open.

Encountered cemented sand from 30' to 36.7' and from 74' to 74.3' depths.

Obtained 3" undisturbed soil samples with Pitcher Sampler.

Depth of groundwater recorded does not appear to be stabilized because the depth of groundwater was recorded immediately after completion of the boring.

Borehole was grouted upon completion.

NOTES

1. BORINGS NOS. MR-66 THROUGH MR-70 WERE MADE AND INSPECTED BY GEO SERVICES CORPORATION UNDER SUBCONTRACT TO GEOTECH ENGINEERS, INC., BETWEEN MAY AND JUNE, 2000.
2. "C" - IN THE SOIL OVERBURDEN INDICATES SOIL CORED WITH PITCHER SAMPLER.
3. COORDINATE LOCATIONS OF THE BORINGS ARE LISTED IN TABLE NO. 1 OF MRCE REPORT NO. 254.

DESIGNED ______ DATE
DRAWN MC 8-00 DATE
CHECKED AAA, DWC, HSL 8-00 DATE
APPROVED ______ DATE

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1	GENERAL NOTES AND LEGEND
G4aL-SO-13	BORING LOCATION PLAN AND
G4aL-SO-13a	GEOLOGIC SECTION

REVISIONS

DATE	BY	DESCRIPTION

STATE OF MARYLAND
HUGH B. LACY
REGISTERED PROFESSIONAL ENGINEER

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

CAPITAL TRANSIT CONSULTANTS
SECTION DESIGNERS
SUBMITTED ______ PROJECT MANAGER

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
LOGS OF MR-SERIES BORINGS MR-66 TO MR-68U

SCALE
VERT. 0 6' 12'

DRAWING NO. G4aL-SO-22

CADFILE

DEPTH BELOW GROUND SURFACE, FEET

BORING NUMBER MR-69
Ground surface elevation +118.7

	3	1D	2,3,3,3	Dark brown fine sandy silt, trace roots, clay (Fill) (ML)	FILL
	4 5	2D	2,3,6,6	Gray brown fine sandy silt, trace clay seams, roots (Fill) (ML)	
5	8 16	3D	3,3,4,5	Medium stiff dark gray silty clay, trace cemented sand (Fill) (CL)	
	12 14	4D	1,1,3,5	Top:Gry si clay, sm gvl, tr cem sa(Fill)(CL) Bot: Wood (Fill)	
	43 13	5D	8,3,3,4	Wood, trace coarse to fine sand, gravel (Fill)	
10	10 11	6D	3,2,3,3	Brown gray gravelly fine to medium sand, some silt, trace clay, coarse sand (Fill) (SM)	
	25 26 18				
15		7D	8,3,7,12	Top: Brown silty clay, some fine to coarse sand, gravel, trace cinder, wood (Fill) (CL) Bot: Light gray fine to medium sand, some silt, trace clay pockets (SM)	16.0'
20		8D	6,9,13	Dark gray silty fine sand, trace clay, lignite, gravel (SM-SC)	MEDIUM COMPACT TO COMPACT RED & GRAY SILTY FINE SAND, TRACE CLAY, CLAY POCKETS & LAYERS, LIGNITE, GRAVEL
25		9D	4,8,12	Top: Stiff gray clayey silt, trace fine sand (ML) Bot: Red silty fine sand, trace clay, clay layers (SM-SC)	
30		10D	12,18,19	Red & gray silty fine sand, trace clay, silt seams (SM)	32.5'
35		11D	10,17,20	Interlayered gray fine sand, some silt & stiff red brown silty clay (SM&CL)	INTERLAYERED COMPACT GRAY & BROWN FINE TO MEDIUM SAND, SOME SILT, TRACE CLAY & STIFF SILTY CLAY TO CLAYEY SILT
40		12D	10,19,26	Top: Interlayered red fine to medium sand, some silt & silty clay (SM&CL) Bot: White gray fine sand, some silt, trace clay (SM-SC)	
45		13D	8,9,13	Stiff light gray clayey silt, some fine sand, trace fine sand seams (ML)	
50		14D	14,18,22	Brown fine sand, some silt, clay layers (SM&CL)	55.0'
55		15D	36,54,13/1"	Red fine sand, some silt (SM)	VERY COMPACT BROWN, RED & GRAY FINE SAND, SOME SILT, TRACE CLAY, CEMENTED SAND, CLAY LENSES
60		16D	58,42/2"	Brown red & gray fine sand, some silt, trace cemented sand (SM)	
65		17D	100/4"	Brown fine sand, some silt, trace clay, clay lenses, cemented sand (SM-SC)	66.0'
70		18D	12,22,28	Hard gray red clay, trace silt pockets (Slickensided) (CH)	HARD GRAY RED CLAY, TRACE SILT POCKETS (OCCASIONALLY SLICKENSIDED)
75		19D	11,22,29	Do 18D (CH)	75.0'

Boring started 5-24-00 completed 5-26-00
Final depths:
Boring = 75.0' Casing = 15.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 11.4' =El. +107.3

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Washed ahead of casing between 4' and 15' depth and then drove casing. Casing blows are not representative of the consistency of the soil.

Used potable water below 15' depth to maintain hole open.

Encountered cemented sand between 59' and 66' depth.

Depth of groundwater recorded does not appear to be stabilized because the depth of groundwater was recorded immediately after completion of the boring.

Borehole was grouted upon completion.

BORING NUMBER MR-70
Ground surface elevation +118.2

	2 3	1D	1,1,2,2	Brown fine sandy silt, trace clay, roots (Fill) (ML)	FILL 2.0'
	4 7	2D	1,1,4,4	Medium stiff brown silty clay, trace fine sand, roots (CL)	MEDIUM STIFF BROWN SILTY CLAY, TR FINE SAND, FINE SAND LYRS, ROOTS ORGANICS 8.0'
5	16 12	3D	1,1,2,2	Medium stiff brown silty clay, trace organics (CL)	
	15 15	4D	WH/12",1,2	Top: Gray si fine sand, sm clay lyrs (SM) Bot: Med gray silty clay, tr f sand, gvl (CL)	
	13 7	5D	3,3,3,2	Medium gray silty clay, trace gravel, gravel layer, organics (CL)	MED SI CLAY, TR GRAVEL 10.0'
10	6 8	6D	2,2,2,2	Gray slightly organic silty fine sand, trace clay, clay layers, gravel, lignite (SM-SC)	LOOSE SLIGHTLY ORGANIC SI F SAND, TR GVL, LIGNITE 14.0'
	15 24 34				
15	80 200 220 235 335	7D	13,25,31,37	Light brown fine sand, trace silt (SP-SM)	VERY COMPACT BROWN FINE SAND, TRACE SILT 19.0'
20		8D	8,8,8,13	Stiff gray clayey silt, some fine sand, trace lignite, decomposed wood (ML)	STIFF GRAY CL SILT, TR LIGN, WOOD 22.0'
25		9D	3,5,3,13	Interlayered stiff red fine sandy clay & silty fine sand (CL&SM)	INTERLAYERED STIFF RED FINE SANDY CLAY & MEDIUM COMPACT SILTY FINE SAND 30.0'
30		10D	10,16,22,24	Red fine sand, some silt, trace clay (SM)	COMPACT RED FINE SAND, SOME SILT, TRACE CLAY 35.0'
35		11D	21,34,40, 26/3"	Brown fine sand, trace silt (SP-SM)	V CPT FINE SAND, TR SILT 38.0'
40		12D	6,7,11,14	Very stiff brown silty clay, trace fine sand (CL)	VERY STIFF BROWN SILTY CLAY, TRACE FINE SAND 43.0'
45		13D	8,16,18,31	Interlayered stiff brown silty clay, trace fine sand & fine sand, some silt (CL&SM)	INTERLAYERED STIFF BROWN SILTY CLAY, TRACE FINE SAND & COMPACT TO VERY COMPACT FINE SAND, SOME SILT
50		14D	11,25,27,39	Do 13D (CL&SM)	55.0'
55		15D	27,54,46/5"	Brown & gray fine sand, some silt (SM)	VERY COMPACT RED BROWN GRAY FINE TO MEDIUM SAND, SOME SILT, TRACE CEMENTED SAND LAYERS
60		16D	89,31/2"	Brown gray fine to medium sand, some silt, trace silt pockets, cemented sand layers (SM)	
65		17D	40,52/4"	Red brown fine to medium sand, some silt (SM)	66.0'
70		18D	13,20,30,36	Hard mottled red gray clay, trace silt pockets (CH)	HARD MOTTLED RED GRAY CLAY, TRACE SILT POCKETS
75		19D	12,23,29,37	Do 18D (CH)	75.0'

Boring started 5-19-00 completed 5-24-00
Final depths:
Boring = 75.0' Casing = 20.0'
Casing diameter = 4"
Average depth of ground water
observed in the boring = 9.4' =El. +108.8

REMARKS:

Used 140 lb. automatic hammer to drive 2-inch O.D. split spoon sampler.

Washed ahead of casing between 4' and 16' depth and then drove casing. Casing blows are not representative of the consistency of the soil.

Used potable water below 20' depth to maintain hole open.

Encountered cemented sand layers between 60' and 61' depth.

Depth of groundwater recorded does not appear to be stabilized because the depth of groundwater was recorded immediately after completion of the boring.

Borehole was grouted upon completion.

DESIGNED		DATE	
DRAWN	MC	DATE	8-00
CHECKED	AAA, DWC, HSL	DATE	8-00
APPROVED		DATE	

REFERENCE DRAWINGS

NUMBER	DESCRIPTION
F-1	GENERAL NOTES AND LEGEND
G4aL-SO-13	BORING LOCATION PLAN AND
G4aL-SO-13a	GEOLOGIC SECTION

REVISIONS

DATE	BY	DESCRIPTION

HUGH S. LACY
No. 15983

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

CAPITAL TRANSIT
CONSULTANTS
SECTION DESIGNERS
SUBMITTED
PROJECT MANAGER

ADDISON ROUTE
SITE PREPARATION AND MITIGATION
LOGS OF MR-SERIES BORINGS
MR-69 TO MR-70

SCALE
VERT. 0 6' 12'

DRAWING NO.
G4aL-SO-23

CADFILE

APPENDIX A

ARTECH TESTING, L.L.C.

14554 LEE ROAD · CHANTILLY, VA 20151-1632
703 378-7263 · 800 283-7848 · FAX 703 378-7274

PRODUCT TESTING
FAILURE ANALYSIS
LITIGATION SUPPORT
CHEMICAL ANALYSIS
ENGINEERING CONSULTING
MATERIALS RESEARCH
BIOMATERIALS
FOOTWEAR TESTING

July 28, 2000

Mr. Rajesh Geol
Geotech Engineers, Inc.
11890-U Old Baltimore Pike
Beltsville, MD 20705

Subject: Analysis of WMATA Soil Borings

Reference: Geotech Contract #212, Job # 96909C
ARTECH C00130

Dear Mr. Geol:

On 7/6/2000 six samples of soil were submitted to ARTECH Testing for the determination of pH, chloride, sulfate, total sulfur, and resistivity. Chloride ion was determined by California Department of Transportation Test 432. Sulfate ion was determined gravimetrically by combusting a portion of the sample and analyzing by APHA Method 4500-SO_4 C. Total sulfur was determined by combustion followed by idometric titration. All chemical properties are reported in dry weight percent. The pH and resistivity were determined by California Department of Transportation Test 643. The results are presented in the following table:

Geotech ID	ARTECH Lab ID	% Solids	pH	% Chloride	% Total Sulfur	% Sulfate	Resistivity ohm/cm	
MR 66/10.0'	C00130-1	76.83	4.58	0.0052	0.545	1.36	76,000	Ec
MR 66/20.0'	C00130-2	81.02	4.37	0.0028	0.527	1.10	38,600	Ms
MR 68/10.0'	C00130-3	83.37	5.55	0.0029	0.005	0.036	48,400	Ec
MR 68/20.0'	C00130-4	77.16	5.32	0.0081	0.371	0.684	51,600	P2
MR 69/10.0'	C00130-5	83.02	5.73	0.0019	0.016	0.072	37,800	F
MR 69/20.0'	C00130-6	76.31	5.14	0.0064	0.197	0.649	31,800	P2

If ARTECH Testing can be of any further assistance, on this or any other matter, please contact us at any time.

Sincerely,
ARTECH Testing, LLC

Sandra Conley

Sandra Conley
Manager, Chemistry Lab