ITEM 530 SPECIAL – STRUCTURES, GROUND IMPROVEMENT

1. PART 1 - SCOPE

THE CONTRACTOR SHALL FURNISH ALL LABOR, EQUIPMENT, AND MATERIALS NECESSARY TO PLAN, DESIGN, AND CONSTRUCT THE GROUND IMPROVEMENTS TO SUPPORT THE PROPOSED ROADWAY EMBANKMENT, MSE WALLS, AND PAVEMENT. THESE METHODS SHALL BE DESIGNED AND INTENDED FOR USE IN PEAT SOIL AND OTHER NATIVE SOILS (ORGANIC SILT, AND SOFT CLAY) AS INDICATED IN THE GEOTECHNICAL BORINGS. THE WORK SHALL INCLUDE THE GROUND IMPROVEMENT METHOD AND ASSOCIATED TESTING, MONITORING, SAMPLING, AND RECORDING TO MEET THE PERFORMANCE REQUIREMENTS OUTLINED IN THESE SPECIFICATIONS AND THE PLANS. IF REQUIREMENTS CONFLICT, THE STRICTER REQUIREMENT SHALL GOVERN.

2. PART 2 - PERFORMANCE CRITERIA

A. PROJECT DESCRIPTION: THE WORK SHALL CONSIST OF DESIGNING AND CONSTRUCTING GROUND IMPROVEMENTS IN THE INSTALLATION AREAS NOTED ON THE PLANS. THE GROUND IMPROVEMENT DESIGNER MUST DEMONSTRATE BY CALCULATIONS THAT THE GROUND IMPROVEMENT SYSTEMS SATISFY THE FOLLOWING PERFORMANCE REQUIREMENTS:

i. GROUND IMPROVEMENTS SHALL SATISFY THE FACTORED BEARING RESISTANCE REQUIREMENTS OF THE PLANNED EMBANKMENTS AND MSE WALLS AT THE DESIGNATED BEARING LEVELS, AS SHOWN IN PLANS AND LISTED BELOW.

ii. GLOBAL AND LOCAL STABILITY OF GROUND IMPROVEMENT SYSTEMS SUPPORTING EMBANKMENTS AND WALLS MUST EXCEED 1.3 FOR BOTH SHORT-TERM AND LONG-TERM CONDITIONS.

iii. LATERAL SQUEEZE CALCULATIONS MUST DEMONSTRATE A MINIMUM FACTOR OF SAFETY OF 2.0.

iv. OVERTURNING, SLIDING, INTERNAL FORCES, AND OTHER CHECKS IN ACCORDANCE WITH LRFD BRIDGE DESIGN REQUIREMENTS.

v. A LOAD TRANSFER PLATFORM SHALL BE PROVIDED IF REQUIRED BY THE GROUND IMPROVEMENT DESIGN TO LIMIT PENETRATION (PUNCHING) OF GROUND IMPROVEMENT ELEMENTS AND DIFFERENTIAL SETTLEMENT OF MSE WALLS AND EMBANKMENTS BETWEEN GROUND IMPROVEMENT ELEMENTS. IF A LOAD TRANSFER PLATFORM IS NOT REQUIRED, PROVIDE A 1-FOOT LAYER OF ODOT CMS ITEM 703.16.C.3 COMPACTED PER ITEM 203 TO SUPPORT MSE LEVELING PADS AND SELECT GRANULAR EMBANKMENT MATERIALS.

vi. SETTLEMENT CRITERIA:

a. TOTAL SETTLEMENT OF GROUND IMPROVEMENT SYSTEM IS TO BE LIMITED TO 3 INCHES OR LESS OCCURRING WITHIN 30 DAYS AFTER THE SUPPORTED EMBANKMENT/MSE WALL REACHES HEIGHT TO THE BOTTOM OF BRIDGE FOOTING. PILE DRIVING SHALL NOT RESUME UNTIL SETTLEMENT CRITERIA HAS BEEN MET AND ARCHITECT/ENGINEER (A/E) HAS PROVIDED APPROVAL.

a) TOTAL SETTLEMENT AFTER THE 30 DAY WAITING PERIOD IS LIMITED TO 0.4 INCHES. PAYMENT FOR CORRECTIVE REPAIRS NEEDED RESULTING FROM SETTLEMENT EXCEEDING 0.4 INCHES AFTER THE 30 DAY WAITING PERIOD WILL ALSO NOT BE MADE.

b) AFTER PLACEMENT OF MSE WALL TO FULL DESIGN HEIGHT (LESS 1 FOOT SUBGRADE MATERIAL, PAVEMENT AND/OR COPING), THE SETTLEMENT SHALL CONTINUE TO BE MONITORED UNTIL IT HAS ATTENUATED TO A RATE OF 0.02 FT PER 14 DAYS OR LESS, AT WHICH POINT THE FINAL SUBGRADE LIFTS, PAVEMENT, AND COPING CAN BE INSTALLED.

vii. MAXIMUM DIFFERENTIAL SETTLEMENT FOR GROUND IMPROVEMENTS IN THE LONGITUDINAL DIRECTION (ALONG THE MSE WALL FACING) IS 0.5% FOR CONVENTIONAL MSE FACING PANELS AND 1.0% FOR SLIP-JOINTED PANELS. MAXIMUM DIFFERENTIAL SETTLEMENT FOR GROUND IMPROVEMENTS IN THE TRAVERSE DIRECTION (PERPENDICULAR TO THE MSE WALL FACING) IS 1%.

viii. THE GROUND IMPROVEMENT SYSTEM AND CONSTRUCTION PROCESSES SHALL NOT CAUSE ANY ADDITIONAL LOADING, DETRIMENTAL SETTLEMENT, OR DAMAGE TO ADJACENT EXISTING OR NEW BRIDGE, UTILITIES, OR EMBANKMENTS.

B. DESIGN THE GROUND IMPROVEMENT SYSTEM TO EFFICIENTLY DISTRIBUTE EMBANKMENT AND MSE WALL LOADS PLUS SURCHARGE LIVE AND DEAD LOADS. GROUND IMPROVEMENT ELEMENTS SHALL NOT BE LOCATED AT PROPOSED STRUCTURE PILE LOCATIONS. IF A GROUND IMPROVEMENT ELEMENT IS DETERMINED TO BE IN CONFLICT WITH A STRUCTURE PILE LOCATION, PROVIDE A PLAN TO ADDRESS THE CONDITION. THIS MAY INCLUDE AUGURING THROUGH THE GROUND IMPROVEMENT THEN PLACING THE PILE.

i. THE GROUND IMPROVEMENT SYSTEM SHALL BE DESIGNED IN ACCORDANCE WITH FHWA RECOMMENDATIONS. THE FOLLOWING VARIABLES ARE USED IN THE CRITERIA BELOW (AS APPLICABLE TO THE METHOD USED):

S = COLUMN CENTER-TO-CENTER SPACING, IF COLUMN TYPE IMPROVEMENTS ARE USED

A = COLUMN WIDTH, IF COLUMN TYPE IMPROVEMENTS ARE USED

H = EMBANKMENT HEIGHT,

A(S) = AREA REPLACEMENT RATIO (COLUMN AREA DIVIDE BY COLUMN TRIBUTARY AREA),

T = COMPONENT LAYER THICKNESS.

NOTE THAT A COMPONENT LAYER IS DEFINED AS N =10 BLOWS/FT FOR SANDS AND AN UNDRAINED SHEAR STRENGTH, S_U = 50 PSF FOR CLAYS. A CONSERVATIVE LOW AVERAGE, OF THE COMPETENT SOIL THICKNESS, T, SHOULD BE USED IN THE CRITERIA BELOW:

a) AT A MINIMUM, THE FOLLOWING CRITERIA MAY BE CONSIDERED AS A GUIDELINE IF COLUMN TYPE IMPROVEMENTS ARE USED: THE MAXIMUM CENTER-TO-CENTER COLUMN SPACING, S, IS GIVEN BY THE RELATIONSHIP BELOW:

S =< MINIMUM of (0.67H + a + 0.5) or (1.23H – 1.20a)

b) THE MINIMUM THICKNESS OF SELECT FILL INCLUDING THE DESIGN OF LOAD TRANSFER PLATFORMS, INCLUDING SELECT FILL AND GENERAL EMBANKMENT FILL MATERIALS, NUMBER OF REINFORCEMENT LAYERS, TYPE OF REINFORCEMENT, AND PROPERTIES OF THE GEOSYNTHETIC REINFORCEMENT.

C. THE GROUND IMPROVEMENT DESIGN CONCEPT SHALL INCLUDE THE DESIGN OF LOAD TRANSFER PLATFORMS (IF REQUIRED BY THE UNDERLYING IMPROVEMENT DESIGN), INCLUDING SELECT FILL AND GENERAL EMBANKMENT FILL MATERIALS, NUMBER OF REINFORCEMENT LAYERS, TYPE OF REINFORCEMENT AND PROPERTIES OF THE GEOSYNTHETIC REINFORCEMENT.

D. PRIOR TO SUBMITTING THE BID, THE CONTRACTOR AND GROUND IMPROVEMENT DESIGNER SHALL REVIEW THE AVAILABLE SUBSURFACE INFORMATION TO ASSESS SITE GEOMETRY, GROUND IMPROVEMENT INSTALLATION METHOD VIABILITY, EQUIPMENT ACCESS CONDITIONS, AND LOCATION OF ABOVE GROUND UTILITIES AND EXISTING BRIDGE AND EMBANKMENT.

E. GEOTECHNICAL DESIGN CRITERIA FOR GROUND IMPROVEMENT

THE PURPOSE OF THE SUBGRADE IMPROVEMENT IS TO PROVIDE SUPPORT FOR MSE WALL AND ADJACENT EMBANKMENTS IN THE AREAS INDICATED IN THE PLANS. IT IS ANTICIPATED THAT GROUND IMPROVEMENT WILL EXTEND THROUGH THE VARIABLE FILL AND ORGANIC SOILS AND BEAR IN THE UNDERLYING LAYERS.

i. GROUND IMPROVEMENT FOR REAR MSE WALL
   a) MINIMUM FACTORED BEARING RESISTANCE REQUIRED: 5.2 KSF
   b) STRATA TO BE REINFORCED: ORGANIC SOILS AND SOFT CLAY, AS INDICATED IN PLANS AND BORING LOGS.
   c) ZONE TO BE STABILIZED: AS INDICATED IN PLANS.
   d) CRITERIA FROM SECTION 2.A OF THIS SPECIFICATION.

ii. GROUND IMPROVEMENT FOR FORWARD MSE WALL
   a) MINIMUM FACTORED BEARING RESISTANCE REQUIRED: 5.2 KSF
   b) STRATA TO BE REINFORCED: ORGANIC SOILS AND SOFT CLAY, AS INDICATED IN PLANS AND BORING LOGS.
   c) ZONE TO BE STABILIZED: AS INDICATED IN PLANS.
   d) CRITERIA FROM SECTION 2.A OF THIS SPECIFICATION.

iii. GROUND IMPROVEMENT TYPES MAY INCLUDE, BUT ARE NOT LIMITED TO:
   a) DEEP MIXED METHOD (DMM)
   b) CONSTRAINED AGGREGATE COLUMNS (I.E. GEOTEXTILE WRAPPED STONE COLUMNS)
   c) CONTROLLED MODULUS COLUMNS (CMC)
   d) STEEL H PILES
   e) STEEL PIPE PILES
   f) PRE-CAST CONCRETE PILES

   NOTE: “OPEN HOLE” TECHNIQUES ARE NOT PERMITTED IN PEAT AREAS DUE TO THE POTENTIAL FOR THE PEAT MATERIALS TO BECOME SEMI-LIQUID WHEN DISTURBED.

iv. THE GROUND IMPROVEMENT CONTRACTOR MAY UTILIZE LIGHTWEIGHT EMBANKMENT AND MSE WALL FILL MATERIALS, IF AVAILABLE, IN CONJUNCTION WITH GROUND IMPROVEMENT DESIGN CONCEPTS.

3. <u>PART 3 - REFERENCES</u>

THE MOST PERTINENT, RELEVANT SPECIFICATION AS PRODUCED BY FHWA, ASTM, AASHTO OR OTHER GOVERNING ORGANIZATION SHALL GOVERN THE DESIGN. THE LATEST PUBLICATION AS OF THE ISSUE DATE OF THE SPECIFICATIONS SHALL GOVERN. THE BELOW LIST IS FOR CONTRACTOR CONVENIENCE ONLY AND MAY NOT BE ALL INCLUSIVE.

A. FEDERAL HIGHWAY ADMINISTRATION (FHWA). (2012). *DEEP MIXING MANUAL FOR EMBANKMENT AND FOUNDATION SUPPORT*, U.S. DEPARTMENT OF TRANSPORTATION, WASHINGTON, DC.
B. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 9TH EDITION, 2020, AND CONSTRUCTION SPECIFICATIONS, 4TH EDITION, 2010.
C. FHWA NHI-16-027 AND 028 FHWA GEC 013 GROUND IMPROVEMENT METHODS: REFERENCE MANUAL VOLUMES I & II, APRIL 2017.
D. FHWA-NHI-16-009 FHWA GEC 012: DESIGN AND CONSTRUCTION OF DRIVEN PILE FOUNDATIONS VOLUMES I & II, 2016.
E. FHWA-RD-83-026 DESIGN AND CONSTRUCTION OF STONE COLUMNS, VOL. I.

F. FHWA NHI-06-089 SOILS AND FOUNDATIONS REFERENCE MANUAL VOLUMES I & II, 2006.
G. FHWA GEC NO. 8 DESIGN AND CONSTRUCTION OF CONTINUOUS FLIGHT AUGER PILES, 2007.
H. ASTM D 6637 STANDARD TEST METHOD FOR DETERMINING TENSILE PROPERTIES OF GEOGRIDS BY THE SINGLE OR MULTI-RIB TENSILE METHOD.

4. PART 4 - QUALIFICATIONS OF CONTRACTOR

A. THE CONTRACTOR CONSTRUCTING THE GROUND IMPROVEMENT SYSTEM SHALL HAVE A MINIMUM 5+ YEARS EXPERIENCE INSTALLING GEOSYNTHETIC REINFORCEMENT AND THE GROUND IMPROVEMENT TYPE SUBMITTED IN THE CONTRACTOR'S BID PROPOSAL.

B. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR THREE RECENT, SUCCESSFUL PROJECTS COMPLETED WITH SIMILAR SITE CONDITIONS AND IMPROVEMENT CRITERIA. THE CONTRACTOR SHALL PROVIDE NAMES AND CONTACT INFORMATION OF INDIVIDUALS WHO CAN ATTEST TO THE ADEQUACY OF THE WORK PERFORMED.

C. THE CONTRACTOR MUST ASSIGN A PROJECT MANAGER WHO HAS BEEN RESPONSIBLE FOR THE GROUND IMPROVEMENT WORK ON AT LEAST THREE (3) PROJECTS. THE PROJECT MANAGER SHALL HAVE BEEN IN FULL-TIME EMPLOYMENT OF THE CONTRACTOR FOR AT LEAST TWO OF THOSE PROJECTS. A DESIGNER THAT IS A CONSULTANT ON THIS PROJECT CANNOT BE THE PROJECT MANAGER.

D. THE GROUND IMPROVEMENT SYSTEM SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF OHIO WITH EXPERIENCE IN THE DESIGN OF AT LEAST THREE SUCCESSFULLY COMPLETED GROUND IMPROVEMENT PROJECTS OVER THE PAST FIVE YEARS. THE DESIGNER MAY BE EITHER AN EMPLOYEE OF THE CONTRACTOR OR A SEPARATE CONSULTANT DESIGN ENGINEER MEETING THE STATED EXPERIENCE REQUIREMENTS.

E. THE CONTRACTOR MUST ASSIGN A FULL-TIME PROJECT SUPERINTENDENT WITH AT LEAST THREE (3) YEARS EXPERIENCE IN GROUND IMPROVEMENT CONSTRUCTION AND WHO HAS BEEN RESPONSIBLE FOR A MINIMUM OF THREE (3) GROUND IMPROVEMENT PROJECTS OF THE TYPE PROPOSED BY THE CONTRACTOR.

F. WRITTEN REQUESTS FOR SUBSTITUTION OF THESE KEY PERSONNEL MUST BE SUBMITTED PRIOR TO PERSONNEL CHANGES. DOCUMENTATION MUST BE SUBMITTED TO THE A/E THAT DEMONSTRATES THAT THE SUBSTITUTE MEETS THE REQUIREMENTS LISTED ABOVE.

5. PART 5 - AVAILABLE INFORMATION

A. THE SUBSURFACE CONDITIONS EXPECTED CAN SIGNIFICANTLY IMPACT THE CONTRACTOR'S CHOICE OF EQUIPMENT, METHODS, MATERIALS, BIDDING PROCESS, AND CONTRACT ADMINISTRATION. POTENTIALLY DIFFICULT AND VARIABLE GROUND CONDITIONS ARE PRESENT AT THE SITE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ANTICIPATE AND ALLOW FOR VARIABILITY IN SUBSURFACE CONDITIONS AS DISCUSSED IN THE GEOTECHNICAL REPORT. THE CONTRACTOR SHALL REVIEW THE AVAILABLE SUBSURFACE INFORMATION TO ASSESS THE SITE GEOMETRY, EQUIPMENT ACCESS CONDITIONS, LOCATION OF EXISTING STRUCTURES, AND ABOVE-GROUND UTILITIES.

B. AVAILABLE INFORMATION DEVELOPED BY THE OWNER OR BY THE OWNER'S DULY AUTHORIZED REPRESENTATIVE (A/E) INCLUDES THE FOLLOWING ITEMS:

CTL GEOTECHNICAL REPORT NO. 20050048CLE TITLED STRUCTURE FOUNDATION EXPLORATION REPORT, DATED December 1, 2022.

6. PART 6 - SUBMITTALS

A. SUBMIT WORKING DRAWINGS AND DESIGN TO THE A/E FOR REVIEW PRIOR TO STARTING THE WORK INDICATING THE GROUND IMPROVEMENT DETAILS (MATERIAL TYPES, ELEVATIONS, GEOSYNTHETIC REINFORCEMENT, ETC.), DIMENSIONS, ELEMENT TYPE, ELEMENT LAYOUT, ELEMENT SIZE, SPACING OF ELEMENTS, TOP ELEVATIONS, AND THE DEPTH OF ELEMENTS OR OTHER CRITERIA AS RELEVANT OR INCLUDED IN THE CONTRACTORS PROPOSED METHODS TO ACHIEVE THE CRITERIA OUTLINED IN THE SPECIFICATION AND CONTRACT PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ALL LINES AND GRADES FOR DIMENSIONS AND LOCATION OF ELEMENTS, INCLUDING LOCATIONS OF ALL UTILITIES AND SURVEY MARKERS.

B. A GROUND IMPROVEMENT DEMONSTRATION/LOAD TESTING PROGRAM TO DEMONSTRATE INSTALLATION TECHNIQUES AND COMPLIANCE WITH THE PERFORMANCE CRITERIA. THE LOAD TEST PROGRAM SHALL INCLUDE THE INSTALLATION OF ONE OR MORE TYPICAL GROUND IMPROVEMENT ELEMENTS OF THE SIZE, TYPE AND SPACING SPECIFIED BY THE GROUND IMPROVEMENT DESIGNER IN EACH STABILIZED ZONE IDENTIFIED IN THE APPROVED DESIGN. THE GROUND IMPROVEMENT DESIGNER SHALL PRESCRIBE A LOAD TEST PROCEDURE FOR MEASURING THE PERFORMANCE OF THE GROUND IMPROVEMENT ELEMENTS (I.E. ASTM D1143 PROCEDURE FOR PILE ELEMENTS), SUBJECT TO ACCEPTANCE BY THE A/E. THE TEST PROGRAM SHALL INCLUDE AT A MINIMUM:

i. MEASUREMENT OF VERTICAL SURFACE DEFLECTIONS BOTH OVER THE IMPROVMENTS AND IN BETWEEN IMPROVED AND UNIMPROVED ZONES BY A SUITABLE METHOD.

ii. GROUND IMPROVEMENT SHALL HAVE SUFFICIENT STRENGTH AND STIFFNESS TO SATISFY BEARING CAPACITY AT 150 PERCENT OF THE DESIGN STRESS AND TO SATISFY SETTLEMENT CRITERIA (PERFORMANCE CRITERIA) AT 100 PERCENT OF THE DESIGN STRESS. IN THE EVENT THAT TEST GROUND IMPROVEMENTS FAIL TO COMPLY WITH DESIGN REQUIREMENTS. CONTRACTOR SHALL INSTALL ADDITIONAL TEST GROUND IMPROVEMENTS AND CONDUCT ADDITIONAL TESTS AT NO COST TO THE TURNPIKE.

iii. ANY PLANNED DEVIATIONS FROM THE ABOVE-DESCRIBED LOAD TEST PROCEDURE MUST BE DESCRIBED IN THE CONTRACTOR'S DESIGN SUBMITTAL, APPROVED BY THE DESIGNER, AND ACCEPTED BY THE A/E.

iv. CONTRACTOR SHALL SUBMIT DESIGN CALCULATIONS FOR THE LOAD TEST REACTION ELEMENTS INCLUDING DIMENSIONS, TYPE, REINFORCEMENT, DEPTH AS WELL AS REACTION FRAME AND BEAMS FOR REVIEW BY THE A/E. THE CONTRACTOR SHALL DESIGN THE REACTION PILES AND FRAME FOR MINIMUM ONE AND HALF TIMES THE MAXIMUM TEST LOAD. ALL SHOP DRAWINGS AND SUPPORTING SHOP DRAWINGS CALCULATIONS SHALL BE SIGNED AND SEALED BY PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF OHIO.

v. SUBMIT CALIBRATION RECORDS FOR LOAD CELLS, HYDRAULIC JACKS, PUMPS AND PRESSURE GAUGES AT LEAST 7 DAYS PRIOR TO PERFORMING THE LOAD TESTS.

vi. SUBMIT THE FOLLOWING TO THE A/E AFTER THE LOAD TESTS ARE COMPLETED:

a) A REPORT DOCUMENTING THE OBSERVATIONS AND RESULTS OF ALL TESTS. THE REPORTS WILL CERTIFY THAT THE REQUIRED BEARING RESISTANCE HAS BEEN ACHIEVED WITHIN THE SETTLEMENT TOLERANCES AS DETAILED IN THE PERFORMANCE CRITERIA.

b) AS-BUILT DRAWINGS INDICATING THE GROUND IMPROVEMENTS DIMENSIONS AND IDENTIFICATION NUMBER FOR EACH GROUND IMPROVEMENT TESTED.

vii. GROUND IMPROVEMENT PRODUCTION SHALL ONLY START UPON COMPLETION OF TWO LOAD TESTS AND AFTER THE A/E ACCEPTS THE GROUND IMPROVEMENT DESIGNER'S FINAL TIP ELEVATION, INSTALLATION CRITERIA, AND DIMENSIONS.

C. FOLLOWING AWARD OF THE CONTRACT AND PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR SHALL SUBMIT DESIGNER-APPROVED DETAILS, SPECIFICATIONS, DRAWINGS, CONSTRUCTION SEQUENCES, DESIGN CALCULATIONS, QUALITY CONTROL PLAN, MONITORING PLAN, AND ANY OTHER REQUIRED INFORMATION FOR THE FOR THE GROUND IMPROVEMENT SYSTEM. THE A/E SHALL REVIEW THE SUBMITTAL ITEMS FOR CONFORMANCE WITH THE PERFORMANCE SPECIFICATION. THE CONTRACTOR SHALL ALLOW A MINIMUM OF 14 DAYS FOR THE REVIEW OF THE INITIAL SUBMISSION AND SHALL ALSO ACCOUNT FOR THE SUBSEQUENT REVIEW AND ACCEPTANCE PROCESS WHICH WILL DEPEND ON THE ACCURACY AND QUALITY OF THE SUBMISSION DOCUMENTS.

D. THE FOLLOWING SHALL BE SUBMITTED TO THE A/E AT LEAST 30 DAYS PRIOR TO BEGINNING WORK:

i. PROPOSED GROUND IMPROVEMENT CONSTRUCTION SEQUENCE AND SCHEDULE.

ii. LOAD TRANSFER PLATFORM SUBMITTALS (IF LOAD TRANSFER PLATFORMS ARE INCORPORATED IN DESIGN)

a) GRADATION, ATTERBERG LIMITS, AND THE RESULTING USCS CLASSIFICATION FOR ALL FILL MATERIALS USED.

b) THE CONTRACTOR SHALL SUBMIT A CERTIFICATE STATING THAT THE GEOSYNTHETIC REINFORCEMENT MEETS THE DESIGN REQUIREMENTS FOR ULTIMATE STRENGTH, CREEP, DURABILITY, INSTALLATION DAMAGE, AND COEFFICIENT OF INTERACTION FOR SLIDING IN ACCORDANCE WITH THE DESIGN SUBMITTAL.

iii. A DETAILED WRITTEN PROCEDURE OF PLANS TO PROTECT ADJACENT BRIDGE AND EMBANKMENTS FROM DAMAGE, INCLUDING DESIGN CALCULATIONS. ADJACENT EXISTING STRUCTURES AND PAVEMENT MUST REMAIN IN SERVICES AT ALL TIMES, EXCEPT WHEN CLOSED PER MOT PLANS.

E. ACCEPTANCE OF THE PROPOSED DESIGN AND CONSTRUCTION METHODOLOGIES SHALL NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY FOR THE SAFETY OF THE METHOD OR EQUIPMENT USED OR THE RESPONSIBILITY OF CARRYING OUT THE WORK IN FULL ACCORDANCE WITH THE REQUIREMENTS OF THE CONTRACT DOCUMENT.

F. THE CONTRACTOR SHALL SUBMIT AS-BUILT DRAWINGS TO THE A/E NO-LATER-THAN 30 DAYS FOLLOWING COMPLETION OF CONSTRUCTION.

7. <u>PART 7 - MATERIALS AND EQUIPMENT</u>

A. THE EQUIPMENT REQUIRED FOR SUBSURFACE IMPROVEMENT WILL VARY DEPENDING ON THE IMPROVEMENT TYPE. EQUIPMENT FOR INSTALLATION SHOULD MEET FHWA OR OTHER APPLICABLE CRITERIA FOR THE TYPE OF GROUND IMPROVEMENT SELECTED.

B. EQUIPMENT FOR FILL AND GEOSYNTHETIC PLACEMENT SHALL NOT CAUSE EXCESSIVE LOADS OR SETTLEMENT TO THE SOFT GROUND BETWEEN IMPROVED ZONES.

C. IF LOAD TRANSFER PLATFORMS (LTP) ARE REQUIRED FOR THE GROUND IMPROVEMENT METHOD SELECTED, SELECT FILL SHALL MEET GRANULAR MATERIAL, TYPE C. 703.16.C.3.

D. IN ADDITION TO THE LONG-TERM ALLOWABLE STRENGTH REQUIREMENT, THERE IS A SERVICEABILITY REQUIREMENT. FOR SERVICEABILITY, THE GEOSYNTHETIC MUST HAVE A CREEP LIMITED STRENGTH AS A STRAIN OF 5% ACCORDING TO ASTM D 5262 THAT IS EQUAL TO OR GREATER THAN THE REQUIRED STRENGTH T(G).

8. PART 8 – EXECUTION

A. GENERAL: GROUND IMPROVEMENTS SHALL BE CONSTRUCTED TO THE LINES, GRADES, AND CROSS SECTIONS INDICATED IN THE PLANS AND SHALL MEET THE STRENGTH AND UNIFORMITY REQUIREMENTS AS DESCRIBED IN THIS SPECIFICATION. THE CONTRACTOR SHALL ESTABLISH CONSISTENT PROCEDURES DURING CONSTRUCTION TO ENSURE THAT THE ACCEPTANCE CRITERIA ARE SATISFIED. THE PROCEDURES SHALL BE ESTABLISHED BASED ON THE RESULTS OF THE POST-INSTALLATION PERFORMANCE PLAN.

9. PART 9 - QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

A. PRE-CONSTRUCTION MEETING: A PRE-CONSTRUCTION MEETING SHALL BE HELD AMONG THE A/E, CONTRACTOR, AND DESIGNER PRIOR TO MOBILIZING EQUIPMENT TO THE PROJECT SITE. AT THE MEETING, THE GROUND IMPROVEMENT INSTALLATION MEANS/METHODS, OBSERVATION, ACCEPTANCE/REJECTION PROCEDURES, TESTING, AND GROUND IMPROVEMENT CONSTRUCTION PROCEDURES SHALL BE DISCUSSED AND FORMALIZED.

B. WORKING DRAWINGS

i. THE CONTRACTOR SHALL ENSURE A FIRM WORKING PLATFORM ON WHICH HEAVY EQUIPMENT CAN BE OPERATED SAFELY UNDER ITS OWN POWER. THE WORK PLATFORM MUST COMPLY WITH ITEM 203.

ii. THE CONTRACTOR SHALL ACCURATELY LOCATE THE LIMITS OF GROUND IMPROVEMENT INSTALLATION AND EMBANKMENT EXTENTS IN ACCORDANCE WITH THE CONTRACT PLANS.

iii. STABILITY OF ALL THE TEMPORARY SHEETING AND/OR TEMPORARY SLOPES, IF USED TO FACILITATE INSTALLATION OF THE GROUND IMPROVEMENTS AND/OR EMBANKMENT, IS THE RESPONSIBILITY OF THE CONTRACTOR. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE CAUSED BY HIS ACTIVITIES AT NO ADDITIONAL COST TO THE TURNPIKE.

iv. THE CONTRACTOR SHALL EXERCISE CAUTION AND ACCOUNT FOR THE TEMPORARY INSTABILITY THAT MAY BE CAUSED BY GROUND IMPROVEMENT UNTIL THE GROUND IMPROVEMENT FEATURES GAIN STRENGTH WITH TIME.

C. GROUND IMPROVEMENT COLUMN TOLERANCES (WHEN COLUMN-TYPE ELEMENTS ARE USED)

i. THE GROUND IMPROVEMENT DESIGNER SHALL SPECIFY IN THE CONTRACTOR'S SUBMITTAL THE ALLOWABLE TOLERANCES FOR:

a) COLUMN VERTICALITY.
b) HORIZONTAL TOLERANCE FROM PLAN LOCATION.
c) VERTICAL TOLERANCE FOR COLUMN TOP.
d) ACCEPTABLE CONDITION OF COLUMN TOPS PRIOR TO INSTALLATION OF LOAD TRANSFER PLATFORM.

e) MINIMUM COLUMN CONDITIONS.
f) COLUMN OVERLAP REQUIREMENTS, IF APPLIABLE.
g) MINIMUM STRENGTH REQUIREMENTS OF COLUMN MATERIALS.
h) MATERIAL PROPERTIES, AS INCORPORATED INTO THE COLUMNS.
i) OTHER ITEMS, AS REQUIRED BY PROJECT SPECIFICATIONS.

ii. BEFORE BEGINNING INSTALLATION, THE CONTRACTOR SHOULD ACCURATELY STAKE THE LOCATION OF THE GROUND IMPROVEMENTS USING A LICENSED SURVEYOR. THE CONTRACTOR SHOULD PROVIDE AN ADEQUATE METHOD FOR LOCATING ELEMENTS TO ALLOW THE A/E TO VERIFY THE AS-BUILT LOCATION OF THE ELEMENTS DURING CONSTRUCTION. THE CONTRACTOR WILL NOT BE COMPENSATED FOR ELEMENTS THAT ARE LOCATED OUTSIDE OF THE SPECIFIED TOLERANCES. IF THE A/E DETERMINES THAT MISALIGNED ELEMENTS WILL INTERFERE WITH CONSTRUCTION, A METHOD OF CORRECTION SHOULD BE PREPARED BY THE GROUND IMPROVEMENTS DESIGNER AND SUBMITTED BY THE CONTRACTOR TO THE A/E FOR REVIEW AND ACCEPTANCE.

iii. GROUND IMPROVEMENT ELEMENTS INSTALLED BEYOND THE MAXIMUM ALLOWABLE TOLERANCES SHALL BE ABANDONED AND REPLACED WITH NEW IMPROVEMENTS, UNLESS THE DESIGNER APPROVES THE CONDITION OR PRESCRIBES OTHER REMEDIAL MEASURES TO BE COMPLETED BY THE CONTRACTOR AND GROUND IMPROVEMENT DESIGNER. ALL MATERIAL AND LABOR REQUIRED TO REPLACE OR REMEDY REJECTED IMPROVEMENTS SHALL BE PROVIDED AT NO ADDITIONAL COST TO THE TURNPIKE. REMEDIAL MEASURES MUST BE SUBMITTED TO THE A/E FOR REVIEW AND ACCEPTANCE.

D. THE CONTRACTOR MAY ENCOUNTER OBSTRUCTIONS WITHIN ZONE TO BE IMPROVED. A CONTINGENCY PLAN TO REMOVE OR PREDRILL SUCH OBSTRUCTIONS SHOULD BE CONSIDERED. IN THE EVENT THAT PREDRILLING OR REMOVAL OF THE OBSTRUCTION IS NOT POSSIBLE, SUBMIT A PLAN FOR MODIFICATION OF GROUND IMPROVEMENT PLACEMENT TO ADDRESS THE OBSTRUCTION. THIS PLAN IS SUBJECT TO APPROVAL. EXISTING PILES FROM THE BRIDGE TO BE REMOVED ALSO EXIST IN THE GROUND IMPROVEMENT ZONE, AND SHOULD BE LOCATED AND ACCOUNTED FOR IN DESIGN AND PLACEMENT OF THE GROUND IMPROVEMENTS.

E. AS-BUILT GROUND IMPROVEMENT INSTALLATION RECORDS: THE CONTRACTOR MUST SUBMIT AS-BUILT FIELD MEASUREMENT DATA INDICATING SURVEYED AS-BUILT PLAN LOCATIONS OF EACH GROUND IMPROVEMENT ELEMENT, INCLUDING THE ELEMENT CENTER (PER SITE SPECIFIC COORDINATES), THE ELEMENT DIMENSIONS, VERTICALITY, AND THE TOP AND BOTTOM ELEVATIONS OF EACH ELEMENT TO THE ACCURACY REQUIRED BY THE PROJECT SPECIFICATIONS. THE AS-BUILT DOCUMENTATION MUST BE APPROVED BY THE DESIGNER AND SUBMITTED TO THE A/E NO LATER THAN 90 DAYS AFTER THE COMPLETION OF EACH GROUND IMPROVEMENT-STABILIZED ZONE. A DISINCENTIVE OF $300.00 PER DAY WILL BE ASSESSED FOR EACH DAY BEYOND 90 DAYS THAT THE COMPLETED AS-BUILT DRAWINGS ARE NOT SUBMITTED TO THE A/E.

F. SELECT FILL PLACEMENT AND QC/QA REQUIREMENTS (LOAD TRANSFER PLATFORMS, IF REQUIRED)

i. PRIOR TO CONSTRUCTION OF THE LOAD TRANSFER PLATFORM, THE CONTRACTOR SHALL PREPARE SUBGRADE, AND REMOVE ANY DELETERIOUS MATERIALS SUCH AS TREE ROOTS. THE GROUND IMPROVEMENTS SHALL BE OBSERVED AND APPROVED BY THE A/E PRIOR TO PLACEMENT OF SELECT REINFORCED FILL.

ii. IF CEMENTITIOUS GROUND IMPROVEMENT METHODS ARE USED, PLACEMENT OF FILL MATERIAL SHALL NOT START UNTIL THE GROUND IMPROVEMENTS HAVE GAINED REQUIRED BEARING

STRENGTH TO SUPPORT THE FILL MATERIALS AND FILL INSTALLATION AND CONSTRUCTION EQUIPMENT.

iii. SELECT REINFORCED FILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 12 IN. IN UNCOMPACTED THICKNESS FOR HEAVY COMPACTION EQUIPMENT. FOR ZONES WHERE COMPACTION IS ACCOMPLISHED WITH HAND-OPERATED COMPACTION EQUIPMENT, FILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 6 IN. IN UNCOMPACTED THICKNESS.

iv. SELECT REINFORCED FILL SHALL BE PLACED AND COMPACTED IN ACCORDANCE WITH ITEM 203. THIS MAY NOT BE ACHIEVABLE FOR THE FIRST LIFT FILL BECAUSE OF THE WEAK SUBGRADE BETWEEN GROUND IMPROVEMENT ELEMENTS, HOWEVER, SUBSEQUENT LIFTS SHOULD MEET MINIMUM REQUIREMENTS.

v. TEST METHODS AND FREQUENCY, AND VERIFICATION OF MATERIAL SPECIFICATIONS AND COMPACTION, SHALL BE PER CONTRACT REQUIREMENTS.

G. GEOSYNTHETIC REINFORCEMENT PLACEMENT AND QC/QA REQUIREMENTS (IF GEOSYNTHETIC REINFORCEMENT IS INCORPORATED IN GROUND IMPROVEMENT DESIGN)

i. PLACE REINFORCEMENT AT THE LOCATIONS AND ELEVATIONS SHOWN ON THE CONTRACTORS WORKING DRAWINGS. NO CHANGES TO THE GEOSYNTHETIC REINFORCEMENT LAYOUT, INCLUDING, BUT NOT LIMITED TO THE LENGTH, REINFORCEMENT TYPE (I.E. STRENGTH), DIRECTION OF REINFORCEMENT, OR ELEVATION SHALL BE MADE WITHOUT THE EXPLICIT WRITTEN APPROVAL OF THE DESIGNER, SHOW SHALL SUBMIT THE CHANGES TO THE A/E FOR ACCEPTANCE.

ii. CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY ON THE GEOSYNTHETIC REINFORCEMENT. A MINIMUM FILL THICKNESS OF 6IN. IS REQUIRED FOR OPERATIONS OF VEHICLES OVER THE REINFORCEMENT. TURNING OF VEHICLES SHOULD BE KEPT TO A MINIMUM TO PREVENT TRACKS OR TIRES FROM DISPLACING THE FILL AND/OR GEOSYNTHETIC REINFORCEMENT.

iii. HANDLE AND PLACE GEOSYNTHETIC MATERIALS IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND THE GROUND IMPROVEMENT DESIGN. THIS INCLUDES OVERLAPS, INSPECTION, CONTACT WITH DELETERIOUS MATERIALS, STORAGE TEMPERATURES, EXPOSURE TO SUNLIGHT, AND SEAM REPAIRS.

iv. ANY ROLL OR PORTION OF A ROLL OF GEOSYNTHETIC DAMAGED BEFORE, DURING, AND/OR AFTER INSTALLATION SHALL BE REPLACED BY THE CONTRACTOR.

10. <u>PART 10 – POST-INSTALLATION PERFORMANCE MONITORING INSTRUMENTATION</u>

A. POST-INSTALLATION PERFORMANCE MONITORING INCLUDES A MINIMUM OF EIGHT (8) SETS OF GROUND IMPROVEMENT MONITORING INSTRUMENTATION. THIS INSTRUMENTATION WILL BE PLACED TO MONITOR THE PERFORMANCE OF THE GROUND IMPROVEMENT SYSTEM AFTER IT HAS BEEN SUCCESSFULLY CONSTRUCTED AND IS SUBJECTED TO THE CONSTRUCTION LOADING AND SUBSEQUENT SERVICE LOADING. THE INSTALLATION MAY BE PERFORMED BY THE PRIME CONTRACTOR, THE CONTRACTOR, OR AN INSTRUMENTATION SUBCONTRACTOR OR CONSULTANT (OR IN WHOLE OR IN PART BY COMBINATIONS THEREOF). IMPORTANT NOTE: IN THE EVENT THAT QA MONITORING WORK IS NOT TO BE COORDINATED OR PERFORMED BY THE GROUND IMPROVEMENT CONTRACTOR, THE GROUND IMPROVEMENT CONTRACTOR SHALL BE REQUIRED TO SPECIFICALLY COORDINATE THIS WORK AND SUBMIT A WORK PLAN TO THE A/E PRIOR TO INITIATING THE GROUND IMPROVEMENT WORK.

i. THE INSTRUMENTATION SHALL BE INSTALLED AS DESCRIBED IN THE FOLLOWING SUBSECTIONS, IN AREA TO BE DETERMINED THE CONTRACTOR AND APPROVED BY THE A/E SUCH THAT CONSTRUCTION INTERFERENCE AND THE POTENTIAL FOR DAMAGE IS MINIMIZED. THE INSTALLATIONS SHALL ALSO BE PLACED SUCH THAT DATA MAY CONTINUE TO BE ACQUIRED ONCE

THE IMPROVEMENTS HAVE BEEN PLACED IN SERVICE. DETAILS OF THE EXACT INSTALLATION LOCATIONS WILL BE DETERMINED BY THE DESIGNER PRIOR TO THE PRE-CONSTRUCTION MEETING.

ii. MINIMUM INSTRUMENTATION PROVIDED BY THE CONTRACTOR IS TO CONSIST OF:
   a. SLOPE INCLINOMETERS INSTALLED OUTSIDE OF AND IMMEDIATELY ADJACENT TO THE GROUND IMPROVEMENT STABILIZATION ZONE. THE INCLINOMETERS ARE INTENDED TO MONITOR POTENTIAL GROUND MOVEMENTS WITH THE MATERIAL ADJACENT TO THE STABILIZED ZONE. THE CONTRACTOR WILL ALSO SELF-PERFORM OR RETAIN A CONSULTANT TO OBTAIN INCLINOMETER READINGS DURING THE REQUIRED MONITORING PERIOD.
   b. SETTLEMENT PLATES, TO BE INSTALLED ON TOP OF THE LOAD/TRANSFER PLATFORM, AT THE LOCATIONS INDICATED IN PLANS AND PAID FOR UNDER ITEM 203 SPECIAL – SETTLEMENT PLATFORMS. ADDITIONAL LOCATIONS MAY BE PROVIDED BASED ON DESIGNER AND CONTRACTOR RECOMMENDATION AND SHALL BE INCIDENTAL TO ITEM 530: GROUND IMPROVEMENT TEST PROGRAM.
   c. PIEZOMETERS TO MONITOR PORE PRESSURES BENEATH THE MSE WALLS AND EMBANKMENTS IN THE STABILIZED ZONE.

iii. CONTRACTOR SHALL COLLECT INSTRUMENTATION DATA FROM THE TIME OF INSTALLATION (END OF GROUND IMPROVEMENT CONSTRUCTION) UNTIL 30 DAYS AFTER THE WALLS AND EMBANKMENTS REACH THEIR FINAL PLAN ELEVATION (LESS COPING AND PAVEMENTS). READINGS SHALL BE TAKEN TWICE WEEKLY DURING EMBANKMENT FILL PLACEMENT AND AT INTERVALS NOT TO EXCEED 15 CALENDAR DAYS AT OTHER TIMES. DATA FROM ALL SENSORS SHALL BE READ IN A UNIFORM MANNER, SUCH THAT ALL DATA IS TAKEN WITHIN A 2-DAY PERIOD AT THE 15 (OR 30) DAY INTERVALS TO AID IN THE EVALUATION OF THE DATA AND SUBSEQUENT PRESENTATION OF RESULTS.

iv. IF THE EMBANKMENTS SUPPORTED OVER THE GROUND IMPROVEMENT ELEMENTS HAVE COMPLETED SETTLEMENT IN ACCORDANCE WITH THE PERFORMANCE CRITERIA WITHIN 30 DAYS OF SUBSTANTIAL EMBANKMENT COMPLETION AS DEFINED ABOVE, THE CONTRACTOR MAY TURN OVER FURTHER MONITORING OF THE DATA TO THE TURNPIKE. IF THE EMBANKMENTS HAVE NOT COMPLETED SETTLEMENT IN ACCORDANCE WITH THE DESIGN CRITERIA, THE CONTRACTOR SHALL CONTINUE MONITORING EFFORTS (AT NO ADDITIONAL COST) AS DIRECTED BY THE A/E.

v. INSTRUMENTATION SHALL BE INSTALLED AFTER THE CONSTRUCTION OF THE GROUND IMPROVEMENT ELEMENTS WITHIN THE IN-SITU SOILS AND PRIOR TO MSE WALL CONSTRUCTION OR EMBANKMENT FILL PLACEMENT. A MINIMUM OF 2 SETS OF BASELINE READINGS SHALL BE TAKEN AND CONFIRMED PRIOR TO THE CONSTRUCTION OF ELEMENTS ABOVE THE INSTALLED GROUND IMPROVEMENT CONSTRUCTION.

vi. INSTRUMENTATION SHALL BE ELECTRONIC AND SELF-RECORDING, WHERE PRACTICAL AND SHALL BE PROVIDED WITH CALIBRATION CERTIFICATES FROM THE MANUFACTURER, AS APPROPRIATE. INSTRUMENTS SHALL MEET ACCEPTED INDUSTRY STANDARDS FOR ACCURACY AND PRECISION.

vii. INSTRUMENTATION SHALL HAVE AN OPERATING TEMPERATURE RANGE AS APPROPRIATE FOR CONDITIONS ANTICIPATED WHERE INSTALLED.

viii. THE INSTRUMENTATION INSTALLATIONS SHALL BE ADEQUATELY PROTECTED FROM THE CONSTRUCTION IMPACTS, DURING CONSTRUCTION, AS WELL AS WEATHER EFFECTS. APPROPRIATE CASINGS AND/OR REMOVABLE CABLING OR RELATED PROTECTIVE DEVICES SHALL BE PROVIDED TO ENSURE THE INTEGRITY OF THE INSTRUMENTATION OVER THE PROPOSED MONITORING DURATION.

ix. THE PLAN FOR INSTALLATION OF INSTRUMENTATION SHALL BE APPROVED BY THE DESIGNER AND SUBMITTED TO THE A/E FOR ACCEPTANCE PRIOR TO PLACEMENT.

11. <u>PART 11 – ACCEPTANCE CRITERIA</u>
   A. ACCEPTANCE CRITERIA: THE GROUND IMPROVEMENT IS CONSIDERED ACCEPTABLE WHEN THE EMBANKMENT CONSTRUCTION AND QC/QA REQUIREMENTS ARE COMPLETED IN ACCORDANCE WITH THE POST INSTALLATION MONITORING REQUIREMENTS, COMPLIANCE WITH THE PERFORMANCE

CRITERIA IS DEMONSTRATED, AND NO DAMAGE TO ADJACENT BRIDGE AND EMBANKMENT IS FOUND OR COMPENSATION IS MADE FOR DAMAGED CAUSED OR DAMAGE IS REPAIRED AT CONTRACTOR'S EXPENSE.

12. PART 12 – GROUND IMPROVEMENT MEASUREMENT AND PAYMENT

A. ITEM SPECIAL GROUND IMPROVEMENT MOBILIZATION/DEMOBILIZATION: ALL COST IN CONNECTION WITH MOBILIZATION AND DEMOBILIZATION OF MATERIALS, EQUIPMENT AND LABOR FOR THE CONSTRUCTION OF GROUND IMPROVEMENT AS REQUIRED IN THIS SPECIFICATION, SHALL BE PAID FOR PER LUMP SUM.

B. ITEM SPECIAL GROUND IMPROVEMENT PRODUCTION WORKS: ALL COST IN CONNECTION WITH DESIGN, EQUIPMENT, MATERIAL, AND LABOR FOR THE INSTALLATION OF GROUND IMPROVEMENTS, INCLUDING MATERIALS AND CONSTRUCTION, WORKING AND LOAD TRANSFER PLATFORM MATERIALS, WICK DRAINS IF NECESSARY TO MEET SETTLEMENT REQUIREMENTS, AND THE GEOSYNTHETIC REINFORCEMENT IF USED, SHALL BE PAID PER LUMP SUM CONTRACT PRICE. SEPARATE PAYMENT WILL NOT BE MADE FOR SITE PREPARATION, DEWATERING, TEMPORARY WORKS TO FACILITATED CONSTRUCTION, ETC. INCLUDE ALL THE ANTICIPATED COSTS IN PRICE BID FOR GROUND IMPROVEMENT PRODUCTION WORKS. GROUND IMPROVEMENT AREAS HAVE BEEN DEFINED IN THE PLANS FOR BIDDING PURPOSES. ADDITIONAL GROUND IMPROVEMENTS SHALL BE PROVIDED AS NECESSARY BEYOND THE DEFINED AREAS TO SATISFY GLOBAL STABILITY OF THE PROPOSED SYSTEM AND SHALL BE INCIDENTAL TO THUS ITEM.

SHEET PILE IS NOT REQUIRED IF THE GROUND IMPROVEMENT METHOD DOES NOT PRODUCE EFFLUENT WHICH COULD CONTAMINATE GROUNDWATER AND IF IT IS NOT REQUIRED FOR PLACEMENT OR FINAL DESIGN OF THE GROUND IMPROVEMENT SYSTEM. IF SHEET PILE IS REQUIRED FOR DESIGN OR EFFLUENT CONTROL, IT MAY BE REMOVED OR LEFT IN PLACE BASED ON THE GROUND IMPROVEMENT DESIGN. SHEET PILING MAY BE PERMANENT IF THE DESIGN REQUIRES THE SHEETING FOR GLOBAL STABILITY OR OTHER DESIGN CHECKS OR CANNOT BE REMOVED DUE TO POTENTIAL DAMAGE TO THE GROUND IMPROVEMENTS. THIS SHEETING SHALL BE CONSIDERED INCIDENTAL TO THE GROUND IMPROVEMENT WORK.

C. ITEM SPECIAL GROUND IMPROVEMENT TEST PROGRAM AND QC/QA TESTING: ALL COSTS ASSOCIATED WITH THE INSTALLATION OF TEST GROUND IMPROVEMENTS, REACTION FRAMES, INSTRUMENTATION, QC MONITORING, INSTRUMENTATION PERFORMANCE, ANALYSIS, AND REPORTING OF TEST RESULTS TO A/E SHALL BE PAID ON A LUMP SUM BASIS FOR GROUND IMPROVEMENT TEST PROGRAM AND QC/QA TESTING.

D. MEASUREMENT AND PAYMENT ITEMS ARE DETAILED IN TABLE 2.

TABLE 2. MEASUREMENT AND PAYMENT ITEMS FOR GROUND IMPROVEMENTS.

ITEM	UNIT OF MEASUREMENT
MOBILIZATION/DEMOBILIZATION	LUMP SUM
GROUND IMPROVEMENT TEST PROGRAM AND QC/QA TESTING (INCLUDING TESTS REQUIRED FOR THE PREPRODUCTION TEST PROGRAM, INSTRUMENTATION AND MONITORING)	LUMP SUM
GROUND IMPROVEMENT PRODUCTION WORKS	LUMP SUM