TRANSPORTATION CABINET
Frankfort, Kentucky 40622
www.transportation.ky.gov/

Steven L. Beshear
Governor

Michael W. Hancock, P.E.
Secretary

November 13, 2012

CALL NO. 206
CONTRACT ID NO. 121354
Addendum # 3

Subject: MARSHALL-TRIGG CountIES, 121GR12D054-BRO
Letting November 16, 2012

(1) Revised – Special Note For deep soil Mixing – Pages 20-36(b) of 177
(2) Revised – Special Note for Pile testing – Page 96(b) of 177

Proposal revisions are available at
http://transportation.ky.gov/Construction-Procurement

Plan Revisions are available at: http://www.lynnimaging.com/kytransportation/

If you have any questions, please contact us at (502) 564-3500.

Sincerely,

Ryan Griffith

Ryan Griffith
Director
Division of Construction Procurement

RG:jj

Enclosures

SPECIAL NOTE FOR WET DEEP SOIL MIXING
US 68 / KY 80 OVER KENTUCKY LAKE

Marshall and Trigg Counties; Item No. 01-180.75

1.0 Description. This work shall consist of using deep soil mixing (DSM) construction techniques to improve subsurface soils by mixing a binder material with in-situ soil to produce a DSM column composed of a soil-binder mixture that has increased compressive strength and stiffness properties compared to the original in-situ soil properties. A column is defined as the extent that the existing ground is improved by insertion and removal of the mixing tool to the full improvement depth required in the plans. The wet mixing method on a proposed grid pattern is described in further detail in subsection 1.1. The purpose for constructing DSM columns is to improve subsurface soils for liquefaction mitigation and to improve slope stability under seismic loads at one (1) end bent location which is Lagoon Bridge End Bent 2.

The work shall consist of Wet Soil Mixing for soil improvement, within the following project limits; the Plan Column Tip being approximately 5' below the lowest liquefiable layer:

Station 974+60 to Station 976+04 (Proposed Toe of Embankment on Left to 60' Right);
Plan Column Tip = Elevation 303'

An exclusionary zone where pile foundations are to be constructed at Lagoon Bridge End Bent 2 will also be utilized. See the plans for more information on the location of this exclusionary zone. The Contractor will not be permitted to install DSM columns through permanent Granular Embankment. To construct the DSM columns in water, the Contractor can use a barge and/or construct a temporary earthen/aggregate platform within the proposed causeway footprint. This temporary platform will be designed and constructed at the Contractor's own risk and at no additional cost to the Department. This temporary working platform, if chosen, will need to remain within the proposed permanent embankment for permitting requirements. However, if the Contractor obtains any necessary permits for this temporary platform to extend outside of the permanent footprint and meets all applicable requirements, then it will be acceptable to the Department for the Contractor to construct the temporary working platform outside the limits of the proposed permanent embankment. These temporary platforms will have to be removed prior to placing the Granular Embankment up to Elevation 363' as detailed in the project plans. Also, all DSM columns shall begin with the top at the existing ground surface and not at the top of the temporary working platform. All costs associated with installing and removing the temporary work platform are incidental to the bid price for "Wet Soil Mixing" (CY). The Contractor shall submit plans for the temporary earthen/aggregate platform for review by the Department. Refer to Section 2.0 of this special note for the time allotted for the plans review by the Department.

The work covered by this special note includes furnishing all necessary plant, labor, equipment, geotechnical investigation, pre-production laboratory testing, test section(s), in-situ testing, sampling/coring, QA/QC testing, reporting, and other work described below. The Contractor shall be familiar with the project geotechnical conditions especially the possibility of

encountering chert. Based on the boring data at Lagoon Bridge End Bent 2, chert could be encountered above the plan column tip elevations. A plan view drawing of existing contours and the borings and cone penetration tests (CPT's) that have been completed at Lagoon Bridge End Bent 2 are attached to this special note. Subsurface data for these borings and CPT's are shown in the bridge and roadway plans.

1.1 DSM Mixing Methods: This special note contains specifications for construction of DSM columns by the mechanical wet mixing method. The Contractor shall use the DSM mechanical wet mixing method specified in the plans unless other methods are accepted in writing by the Engineer. The wet method consists of mixing a binder in slurry form (i.e. cement grout) with existing soils using auger-type equipment (paddles, augers, and other rigid mixing tools), to form a DSM column consisting of a homogeneous mixture of cement grout and in-situ soils. High pressure jets attached to the soil mixing tool will be acceptable. Only jets external to the soil mixing tool will be excluded. A soil-cement column formed by the wet mixing method is abbreviated herein as DSM-SCC.

2.0 Submittals. A minimum of 60 calendar days prior to beginning the DSM work, the Contractor shall submit the DSM Construction Plan and Shop Plans/Working Drawings for review and acceptance by the Engineer. The DSM Construction Plan and Shop Plans/Working Drawings shall be prepared, signed, and sealed by an agent/representative of the DSM Contractor that is a professional engineer licensed in the State of Kentucky. The Contractor shall not commence DSM installation without the acceptance of all submittals by the Engineer. Acceptance or approval by the Engineer will not relieve the Contractor of its responsibilities to provide materials and equipment necessary to install DSM columns in accordance with the plans and specifications. If, at any time, the Engineer considers that the Contractor's installation operation does not produce a satisfactory DSM column, the Contractor shall alter its method and/or equipment as necessary to comply with the plans and specifications at no additional cost to the Department. Submittal Reviews by the Engineer shall not cause delays in the schedule. Time allotted for the review and response by the Department of the shop plans, working drawings, schedule and construction plan submittals will be 10 business days. All other submittals will be allotted 5 business days for review by the Department. For purposes of this Special Note for Wet Deep Soil Mixing, "business days" relative to Department response times include all days except Saturdays, Sundays, Holidays, as defined in Section 101.03 of the Standard Specifications, December 22, 2012 through January 1, 2013, and December 23, 2013 through January 1, 2014.

2.1 Qualifications: Evidence of six years of accumulated experience over a period of 10 years and competence to construct the required DSM columns by the wet mixing method required for the project shall be submitted. As a minimum, the Contractor shall submit a detailed description of three DSM projects completed using the wet mixing method within the previous six years that demonstrate the Contractor's experience and competence. Each DSM project submitted as proof of experience and competence shall have a minimum total treatment volume of not less than 20 percent of the DSM treatment volume for this project or 2,500 cubic yards of DSM treatment volume. Each DSM project submitted shall have the following information:

a. Project name, location, and completion date.
b. Current contact information (address, phone number, and email) of project client/owner, designer and geotechnical consultant (if different than designer).
c. Surface and subsurface conditions, and strength (average, ranges, and means used to determine strength) of DSM columns installed.
d. Minimum, maximum, and average rates of DSM installation.
e. Project cost and duration of DSM installation.
f. Average depths and ranges of depths of DSM columns installed. Provide total linear footage and volume (cubic yards) of DSM columns installed.

g. Percent of project total based on QA/QC testing that met the project Acceptance Criteria and percent of project total based on QA/QC testing that required remediation techniques after initial DSM installation.

The Contractor shall also submit resumes of management, supervisory and other key personnel. The Contractor's proposed DSM superintendent shall have a minimum of three years of accumulated experience with DSM construction equipment and construction management within the past six years. The DSM superintendent shall have been employed by the Contractor for the most recent three years. The proposed DSM superintendent shall have been superintendent for the Contractor on at least one of the three DSM projects submitted by the Contractor as evidence of their experience. Experience and training records shall be submitted for proposed DSM superintendent and operators of construction equipment. The DSM Contractor cannot claim a consultant's involvement or time on previous DSM projects as experience for the DSM Contractor. Any changes in DSM construction personnel shall require submittal of qualifications for approval.

2.2 DSM Construction Plan: The DSM Construction Plan shall document and provide, as a minimum, the following information:

1. *Protection of Utilities:* Location of all subsurface utilities in the area.

2. *Preparation of Staging Area:* A plan to remove all existing riprap material near the location of Lagoon Bridge End Bent 2 is required so as to not interfere with the construction of the DSM columns.

3. *Equipment and Procedures:* A detailed description of the equipment (include catalog cut sheets of equipment dimensions) and procedures to be used during all facets of the project including, but not limited to the conduct of the following:
    a. Test section(s)
    b. Site preparation including removal of existing riprap
    c. Stage construction of DSM test section(s) and production DSM (if required)
    d. Locating the DSM columns in the field
    e. DSM spoil containment, handling, and disposal
    f. Method to overcome concentrated zones of chert (if encountered)
    g. Confirming method to check that the DSM are installed plumb
    h. Quality control program
    i. Monitoring quality control parameters
    j. Sample collecting for laboratory confirmation testing

4. *DSM Test Section Subsurface Information and Location:* Pre-approval of the test section location(s) shall be required before commencing Pre-production field and laboratory testing (Section 4.0). Indicate on a plan drawing the location of the test section(s), dimensions, and layout of the test section(s), and number of DSM columns (include designation of each DSM column).

5. *Cement and Cement Grout Mix Design:* Proposed cement and cement grout mix design when DSM columns are constructed using the wet mixing method (DSM-SCC). The design shall include the following:
    a. Cement type and Cement manufacturer's certificate of compliance.
    b. Cement grout water-cement ratio, by weight. Include details to fully describe and illustrate the methods for grout proportioning to achieve the design mix.

c. Cement Factor (also known as Residual Cement Factor) which is the amount of cement, dry weight in pounds, that remains in the ground after mixing, per cubic yard of in-situ soil-cement.

These mix design parameters will be reviewed based on the pre-production field and laboratory testing results developed in accordance with Section 4.0. The acceptance of the proposed grout mix/soil/cement mix design shall be contingent on the test section(s) results meeting the acceptance criteria of Section 11.0. The Contractor may propose to expand the size of the test section to demonstrate that somewhat different grout water/cement ratio and/or cement factor is workable in achieving the required soil-cement strength under actual in-situ conditions. Provide documentation of calibration of the mixing plant.

6. *Independent Laboratory Testing:* Identification of all independent AASHTO certified materials laboratory testing facilities that will be used on the project and the type laboratory testing that will be conducted at each laboratory. All laboratory testing shall be performed at a materials laboratory that is pre-qualified by KYTC for Geotechnical Laboratory Testing as well as AASHTO Materials Reference (AMRL) Accredited for the type of test being conducted.

7. *Calibrations:* Calibration tests for all metering equipment, including mixing systems, delivery systems, alignment systems, mixing tool rotational and vertical speed, injection pressure, rotation penetration/extraction rates, etc. that are applicable to the mixing method being used on the project.

8. *Runoff and Spoil Containment:* Details of all run-off and spoil containment devices will be required when DSM columns are constructed including construction that will be required from a barge in the waters of Kentucky Lake or the Kentucky Lake Lagoon. These devices will be used to prevent the migration of either cement grout or soil-cement return spoils, disturbed in-situ soils, or other soil material beyond the immediate limits of the soil-cement mixing operation. Also, provide descriptions of processes and procedures to be used to collect and retain the soil-cement return, and other spoil materials, in such manner, as to allow the spoils to solidify for the necessary time to become a hard, dry cohesive material.

   “DOT Type II Floating Turbidity Curtains” will be required for the removal of the existing rip-rap and for containing the spoils in the waters for Kentucky Lake and Kentucky Lake Lagoon. 54” Diameter Casing could also be utilized for containing the spoils as determined necessary by the Contractor. Any other methods besides the use of a turbidity curtain or casing for containing the spoils may be proposed by the Contractor but must be submitted to the Engineer and may be accepted by the Department subject to the concurrence of applicable permitting agencies. Install the turbidity curtains in order to contain the full extent of activities associated with removing rip-rap in the lake and wet soil mixing in the lake.

   Once the spoils are contained they must be legally transported to an approved off-site location or they could possibly be utilized for a portion of the embankment materials above Elevation 363 feet. Certain requirements have to be met as specified in the geotechnical notes for the project if the spoils are utilized for the embankment materials above Elevation 363 feet. These requirements include having a specified classification

as well as meeting minimum strength parameters as determined from required triaxial testing. The hardened spoils shall be legally disposed of off-site, at no additional cost to the Department if not utilized in the embankment materials above Elevation 363 feet.

All costs associated with installing and removing the turbidity curtains, and containing and removing spoils are incidental to the bid price for "Wet Soil Mixing" (CY).

9. *Concentrated Zones of Chert:* To reach the required plan tip elevation, concentrated zones of chert in the sandy soil layers, are expected to be encountered. None of the DSM columns will be required to extend into the deeper bedded chert layers. Refer to Section 8.3 of this Special Note for additional information.

10. *Daily Production Control Report and Installation Log*: Provide a sample report and installation log, in paper and electronic format that will be used to record the construction of all production DSM columns. The Daily Production Control Report/Log shall contain at least the following information:

    a. Project Name.
    b. DSM column number and reference drawing number.
    c. Date.
    d. Name of DSM Superintendent and equipment operator.
    e. Start/Finish time of DSM column installation.
    f. Machine/Rig Number.
    g. Type of mixing tool and indicate if single or multiple columns formed per stroke.
    h. DSM column(s) diameter/size.
    i. DSM column(s) total length (include top and bottom elevations).
    j. DSM column center-to-center spacing from adjacent DSM column.
    k. Verticality of mixing tool in two orthogonal planes for each DSM column.
    l. A description of obstructions, interruptions, DSM column construction out of tolerance or other difficulties encountered during installation of DSM column and how they were resolved.
    m. *Material Certifications:* Supplier's certifications of binder materials quality and other additives, if used.
    n. Final current draw for the drilling equipment at the bottom 2 feet of penetration or final hydraulic pressure, if hydraulic motors are used to turn the mixing tools.
    o. Grout injection pressure and volume
    p. Estimate of spoil volume
    q. Target and actual cement factors and grout specific gravity measurements per DSM-SCC column.
    r. Date, time, plan location, and elevation and other details of all soil-cement wet grab samples and any other samples taken during work shift.
    s. The following information shall be logged using automated computer technology for each DSM-SCC installed at intervals no greater than 4 feet and presented in table and graphical forms:
        - Elevation in feet.
        - Mixing tool rotation penetration and withdrawal speed in revolutions per minute vs. depth in feet.
        - Mixing tool rotation penetration and withdrawal rates in feet per minute vs. depth in feet.
        - Grout injection rate in gallons per minute vs. depth in feet.
        - Average quantity of grout injected in gallons per foot injected per vertical foot of DSM-SCC vs. depth in feet.

2.3 Shop Plan/Working Drawing: The Shop Plan/Working Drawing shall contain the location and extent of all production DSM columns that will be constructed as indicated in the plans. Designate DSM column spacing, including overall dimensions of ground improvement area. Provide the production DSM column numbering system/identification for each location where DSM columns will be constructed. The Shop Plan/Working Drawing shall be prepared, signed, and sealed by a professional engineer licensed in the State of Kentucky.

2.4 Construction Schedule: A construction schedule for the DSM work shall contain start dates and durations for all portions of the work, including equipment mobilization, equipment setup, test section(s) construction, production DSM construction at each location, and QC testing.

3.0 Pre-Construction Project Meeting. A separate Pre-Construction meeting for Wet Deep Soil Mixing is required prior to starting construction of the soil-cement columns. This would be necessary to discuss the soil mix process, the special note requirements and the anticipated work schedule.

4.0 Pre-Production Field and Laboratory Testing. A pre-production field and laboratory testing program will be required to develop the proposed DSM mix design prior to the construction of the test section(s). The field testing program consists of conducting a geotechnical subsurface investigation in accordance with subsection 4.1 of this special note. Soil samples obtained from the geotechnical subsurface investigation shall be used to develop and conduct the pre-production laboratory testing. The pre-production laboratory testing will be required to establish a "base line" of the degree of ground improvement that is possible under optimal construction circumstances for various DSM binder mixes for each distinct soil type that will be encountered during the DSM ground improvement. It is recognized that the pre-production laboratory testing will be used as a general indicator of ground improvement that may be obtained in-situ because of substantial differences inherent between laboratory and in-situ mixing conditions. The Contractor shall take appropriate account of these differences, based on published documents and the Contractor's experience, to develop a DSM binder mix design that can be used for constructing the test section(s) based on the results of the pre-production laboratory testing. A pre-production laboratory testing program shall be required for each test section. A DSM binder mix design shall be developed for each major soil type encountered throughout the depth of ground improvement. As a minimum, two binder mix designs for two types of soil shall be required per test section. The minimum pre-production laboratory testing requirements are provided in subsection 4.2 of this special note.

The Contractor shall submit the geotechnical subsurface investigation plan of the proposed field sampling and laboratory testing to the Engineer for review and approval prior to commencing the geotechnical subsurface investigation. The Contractor shall submit the results of the geotechnical subsurface investigation including the boring logs and the pre-production laboratory testing plan to the Engineer for review and approval prior to commencing the pre-production laboratory testing. The results of the pre-production field and laboratory testing, along with the proposed DSM binder mix designs, shall be included in the Pre-Production Binder Mix Design Report as described in Section 4.3.

4.1 Geotechnical Subsurface Investigation: In-situ soils used for the pre-production laboratory testing shall be obtained from additional subsurface investigation conducted at or near the location of the approved test section(s) location. The Contractor shall retain the services of a geotechnical consultant in the state of Kentucky that is pre-qualified by KYTC for Geotechnical Drilling Services and shall also submit resume(s) of the drill crew supervisor(s). Geotechnical Drilling Services are to include the drilling of a minimum of three (3) 3-inch soil borings for Lagoon Bridge End Bent 2, sampling at a minimum of every 5 vertical feet or at a

more frequent interval to obtain sufficient material to perform the pre-production laboratory testing as detailed in subsection 4.2. The sampling shall be performed in such a manner that provides representative samples of the soil cement column. This can be effectively accomplished via Geo-probe sampling techniques, undisturbed sampling in fine-grained soils, split-spoon sampling, or any other sampling technique proposed by the Contractor and accepted by the Engineer. Refer to subsection 4.2 of this special note for more information regarding the soil test samples.

The contractor shall check for utility conflicts at boring locations with appropriate utility agencies, survey boring locations and survey locations tied to the project baseline alignment. The borings shall extend from the ground surface to the bottom elevation of the DSM columns shown in the plans to establish general soil and groundwater conditions in the vicinity of the work prior to construction of the test section(s). The geotechnical investigation shall be done in conformance with the latest version of the KYTC Geotechnical Manual.

All soil samples to be used for the pre-production laboratory testing shall be stored in a manner that prevents any loss of moisture and in accordance with ASTM. Do not allow field samples of the clay to lose moisture between the time of removal from ground and pre-production laboratory mixing/testing.

4.2 Pre-Production Laboratory Testing. Pre-Production laboratory testing will require the development of a DSM binder mix testing program for each type of soil where ground improvement will be performed to demonstrate that the required compressive strength is at least a minimum of 75 PSI. Testing at 28 days will be required, but earlier testing before 28 days will be accepted if the compressive strength of 75 PSI is met. This is required to be able to proceed with the test section. The soils obtained from the geotechnical subsurface investigation performed (Subsection 4.1) will be used to perform the laboratory testing.

The testing laboratory shall prepare the soil, mix the binder reagent (i.e. cement, etc.) and water to make grout, and then mix grout and soil together. A minimum of twenty (20) specimens shall be mixed per soil stratum at the Lagoon Bridge End Bent 2 location using a minimum of four (4) different DSM binder mixes to provide insight into the relationship of cement factor and grout water/cement ratio on the 28-day compressive strength of the soil-binder specimens. Binder materials and individual proportions of cement or admixtures (if used) used shall be documented for each specimen. The procedures outlined by Filz and Stewart (2005) may be used to provide guidance in developing a laboratory testing program.

All test specimens shall be prepared using the lab mixing energy level similar to energy levels used by the Contractor's field equipment. Test specimen cylinders shall be prepared according to procedures submitted to the Department and approved. Strength test three cylinders of soil-binder mixture at 7, 14 and 28 days following mixing. 56 day testing will not be required but samples should be retained in case the minimum strength required at 28 days is not met. Strength testing shall be performed in accordance with subsection 9.3.

4.3 Pre-Production DSM Binder Mix Design Report: Final report of pre-production laboratory and field testing will be used to develop proposed wet mix design for the construction of the test section(s). The pre-production laboratory and field testing shall conform to Section 4.0 of this special note.

5.0 Materials.

Cement: Portland cement shall be low alkali Type I conforming to ASTM C150. Slag cement shall conform to ASTM C 989. All cement shall be homogeneous in composition and properties, and shall be manufactured using the same methods at one plant by one supplier. Tri-calcium aluminate content shall not exceed 7 percent.

Water: Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of grout shall be used to manufacture the grout.

Admixtures: Cement admixtures will not be allowed without written acceptance by the Engineer. Cement admixtures are ingredients that are used to permit efficient use of materials and proper workability of the binder material being mixed into the in-situ soils. The Contractor is required to submit any proposed admixtures and their intended effect when the binder mix design is submitted for acceptance by the Engineer.

Cement Grout: The cement grout shall be a stable homogeneous mixture of cement, admixtures (if accepted), and water in proportions determined by the results of the test section and accepted by the Engineer. The cement grout is mixed with the in-situ soils to form DSM-SCC columns.

Soil-Cement Mixture: The DSM column shall be composed of a stable and uniform soil-cement mixture of cement grout and in-situ soil that meets the project compressive strength and other requirements in the plans and this special note. The proposed ratios of concrete grout to in-situ soils and quantities of various components shall be determined by the results of the test section and accepted by the Engineer.

5.1 Delivery, Storage, and Handling of Materials: Portland cement shall be measured, handled, transported, and stored in bulk in accordance with the manufacturer's recommendations. Portland cement packaged in cloth or paper bags shall be sealed with plastic or rubber vapor barriers. The Portland cement shall be stored to prevent damage by moisture. Materials that become caked due to moisture absorption shall not be used. Bags of cement shall be stacked no more than ten bags high to avoid compaction. Cement containing lumps or foreign matter of a nature that may be deleterious to the grout mixing or delivery or injection operations shall not be used.

6.0 DSM Column Spacing. The DSM columns shall be spaced and arranged as indicated on the plans or as otherwise directed by the Engineer. DSM columns are to be put on a grid pattern with a minimum diameter of 4 feet and a center-to-center spacing of 8 feet.

6.1 DSM Column Construction Tolerances:

1. *Horizontal Alignment:* The location of the DSM column shown in the Plans shall be accurately staked by a licensed surveyor before beginning installation. The horizontal alignment of DSM columns shall be within 4 inches of the planned DSM top location.

2. *Vertical Alignment:* The equipment operator shall control vertical alignment of the equipment and constructed DSM column. Two measures of verticality shall be monitored, longitudinal and transverse to the DSM column alignment. The DSM column shall be installed plum as measured with the on board telemetry equipment on the drill. The tolerance for vertical plumbness shall not exceed two (2) percent.

3. *DSM Column Lengths:* The tops of the DSM columns shall begin at the existing ground surface. The top of DSM column elevations shown in the plans are approximate. Natural soils

above the water table, at the completion of DSM installation, shall have been treated to produce the full column design strengths up to within 3 feet of the existing ground surface.

The bottom of DSM columns shall extend to the line and grades shown in the plans. The DSM column bottom elevations indicated in the Plans provide the minimum required penetration of the DSM columns. The Engineer may require the Contractor to shorten or deepen the bottom of DSM columns indicated in the plans.

7.0 Installation Equipment. The DSM column construction equipment and support equipment shall be equipped with mixing tools that are capable of thoroughly blending the in situ soils and binder material into a homogeneous column of soil-binder to the depths and size required in the plans. The DSM columns shall be constructed using computerized self-contained construction equipment.

7.1 Construction Equipment: The DSM-SCC construction equipment shall meet the following requirements:

1. DSM-SCC shall be constructed using real-time computerized self-contained DSM-SCC construction equipment capable of monitoring, controlling, and recording installation data. The DSM-SCC construction equipment shall be equipped with electronic sensors, built into the soil mixing equipment, to perform the following:
    a. Determine vertical alignment of the leads in two directions: fore-aft and left-right. The verticality shall be measured using instrumentation that is capable of measure deviations from verticality to a tolerance of 2 percent.
    b. Monitor cement and water proportioning, grout mixing, and water-cement ratios.
    c. Monitor the mixing tool depth, penetration/withdrawal speed, and rotation speed.
    d. Monitor injection quantities and pressure with flow meter and other measuring equipment having precision accuracy not less than 99.5 percent.
    e. All output from the sensors shall be routed to a console that is visible to the operator and the Engineer during penetration and withdrawal.
    f. The sensors shall be calibrated at the beginning of the project and calibration data provided to the Engineer. The calibration shall be repeated at intervals not to exceed one month.
    g. All of these monitored functions shall be fully adjustable during operation of the equipment.

2. The DSM-SCC construction equipment power source for driving the mixing tool shall be sufficient to maintain the required revolutions per minute (RPM) or injection pressure and penetration rate from a stopped position at the maximum depth required as determined from the test section(s) for DSM column spacing. The Contractor shall also consider the wide range of expected subsurface conditions, indicated by the geotechnical information at the project site.

3. The DSM-SCC construction equipment shall utilize sufficient mixing and injecting equipment to adequately produce a distribution of cement grout throughout the mixed in-situ soils that meet the acceptable criteria. The mixing tools shall uniformly inject cement grout through hollow stem, or other piping, at locations that distribute the grout across the full diameter of the mixing tools and such that the full auger/mixing paddle assembly passes through the column of soil after the grout is introduced, on both the insertion and withdrawal strokes. Grout shall only be injected in direction within the diameter of the augers or mixing paddles. If grout injection jets are used, they shall not spray beyond the auger diameter.

4. Continuous auger flights longer than 3 feet or with more than one full, uninterrupted revolution of auger are not allowed as part of the mixing tools. Auger flights and mixing paddles on a shaft shall all reach to the full column diameter, and shall have discontinuous lengths and be oriented as to thoroughly break up the in-situ soils, and disperse and blend soils with injected cement grout to form a homogeneous soil-cement mixture.

5. The auger mixing equipment shall form the required diameter and size of the DSM-SCC as submitted by the Contractor's accepted submittals.

6. Injection volume estimates shall be only made by precision inline flow meters. Counting or measuring grout pump strokes shall not be acceptable. Injection quantities must be measured in real time by direct measurements of volume and/or mass for each DSM column having injection capabilities, with flow meters and other measuring equipment having precision accuracy not less than 99.5%. Gauges and flow meters and other measuring equipment shall be calibrated and certified as precise and accurate before the start of the equipment's work on the project.

7. The DSM-SCC construction equipment shall be adequately marked to allow the Engineer to confirm the penetration depth to within 6 inches during construction.

8. The cement grout batching plant shall include all storage silos and sheds, pumps, scales, mixers, valves, gauges, and regulating devices required to continuously measure and mix cement grout in real time. Grout shall be mixed in a mixing plant, using a batch process, which combines dry materials and water in predetermined proportions. The plant mixer shall consist of grout mixer, grout agitator, grout pump, automatic batching scales, and a computer control unit. The mixing plant shall meet the following requirements:

    a. To accurately control grout mix proportions, the addition of water and cement shall be determined by weight using automatic batch scales in the mixing plant.
    b. Admixtures, if used, may be delivered to the mixing plant by calibrated auger provided the Contractor can demonstrate that the auger can deliver the material at the same accuracy as by weight.
    c. The mixing components shall be calibrated prior to beginning the work and monthly thereafter. The calibration data shall be provided to the Engineer.
    d. The mixing plant shall have tanks or silos with adequate storage for continuous production. The tanks shall be equipped with air filters.

9. All equipment shall have real time monitoring of all of the DSM parameters and the contractor shall provide a print out of these monitored for each column produced. The printouts shall be submitted to the Engineer within 3 business days after completing each column.

10. Progressive cavity pumps shall be used to transfer the grout from the mixing plant to the mixing tool. If the DSM-SCC construction equipment has multiple shafts and multiple mixing tools, the grout shall be delivered to each shaft by an individual positive displacement pump.

11. All gauges, flow meters, metering equipment, and other measuring equipment shall be calibrated and certified as precise and accurate before starting DSM column construction (i.e. test section(s) or production DSM columns), and then again every 4 months or at least every 325,000 feet of DSM column installed, whichever is sooner. The calibrations and certifications shall be supplied to the Engineer. A representative from

the manufacturer of the soil mixing tools that are being used will be required to perform the calibrations. The representative from the manufacturer shall have knowledge of and a minimum of one year of experience performing these types of calibrations.

8.0 Construction Requirements. The Contractor shall furnish all materials, labor and equipment necessary to construct the DSM columns in accordance with the plans and this special note. The DSM columns shall be constructed to the lines, grades, and cross sections indicated in the Plans.

Production DSM shall be constructed using the same equipment and construction criteria (i.e. mix design, mixing parameters, etc.) established in the accepted test section construction (subsection 10.0). DSM construction that is out of tolerance (subsection 6.1) or is subject to unforeseen conditions (subsection 8.3) shall be evaluated and corrected as accepted by the Engineer with no additional cost or schedule impact to the Department.

8.1 Site Preparation: The presence and location of buried pipes, sewers, and other utilities shall be identified and precautions taken to protect the utilities from damage during the construction of the DSM columns. The Contractor shall be responsible for any damage resulting from the construction of the DSM columns. The site shall be cleared and grubbed in accordance with the Contract documents. Also, as mentioned previously, the existing riprap near Lagoon Bridge End Bent 2 must be removed prior to DSM installation.

Establish DSM column limits and locations by a licensed surveyor. Individual column locations shall be marked. Sufficient horizontal and vertical control shall be provided to establish DSM columns are located accurately and reach the required plan depths.

8.2 DSM-SCC Soil-Grout Mixing: Soil shall be broken up and blended with grout in place by the pugmill type action of the soil mixing equipment. The completed DSM-SCC shall be a uniform mixture of cement and the in situ soils. The soil-grout mixture shall achieve a minimum unconfined compressive strength in 28 days of 75 PSI. Soil mixing shall be performed with the following minimum requirements:

1. *Grout Preparation:* The dry materials shall be fed to the mixers for agitation and shearing. The mixing ratio of the grout shall be controlled by measuring the weight of grout components using automatic batch scales in the mixing plant. Grout mixture shall be mixed for a minimum of three minutes, with a maximum holding time of two hours, calculated from the beginning of initial mixing. The specific gravity of the grout (determined in the test section) shall be tested at least once per shift per rig, using the methods outlined in ASTM D 4380, and shall not deviate more than three percent from the calculated specific gravity for the design cement ratio. Additional tests may be required by the Engineer. If the specific gravity or density is lower than the design mix, the Contractor shall add additional cement, remix, and/or recalibrate batch scales and retest the grout until the design density is achieved, at no additional cost to the Department.

2. *Grout Injection:* The grout shall be pumped through and injected from the mixing tool. The grout injection rate per vertical foot of DSM-SCC shall be in accordance with the requirements of the design mix established during the test section. Injection rates falling below this requirement shall require the DSM-SCC to be remixed and additional grout injected (at the design grout-soil ratio) to a depth at least three feet below the deficient zone, at no additional cost to the Department.

3. *Rotation Speeds:* The mixing tool rotational speeds (measured in RPM) and penetration/withdrawal rates shall be in accordance with the parameters established during the test section(s). If these parameters are varied more than 15 percent from those determined during the test section(s), the DSM-SCC section shall be remixed while injecting grout at the design grout ratio to a depth at least three feet below the deficient zone, at no additional cost to the Department.

4. *On-Board Computer:* The preset data in the on-board computer shall be verified for each column as correct and adjusted if necessary. The operator shall monitor and adjust, as necessary during column installation, the feeding of material, grout injection rate, mixing tool rates of rotation, and penetration/withdrawal rates of the mixing tool.

5. *Changes in Grout Mix Design:* The Contractor may request that the established grout mix to be modified during the production DSM-SCC installation. To verify acceptable results for the modified mix design, the Engineer may require additional testing or a new test section, at no additional cost to the Department.

6. *Spoils:* During the course of soil-cement stabilization, return/spoil material shall not be dumped into or otherwise be allowed to enter the soil-cement column. The Contractor shall develop a spoil containment system including the use of turbidity curtains that allows the channeling of the spoils to the temporary holding pit in such a direction and manner as to keep the spoils away from the site perimeter, and out of the traveled paths. Soil-cement return and spoil material shall be piped or channeled to holding ponds or other retention structures within the work area. The Contractor shall remove all excess grout and grout mixed soil generated from ground improvement activities from the construction site in accordance with the accepted DSM Installation Plan.

   The Contractor shall take all necessary precautions and implement measures to prevent any soil-cement return, other spoil material or stockpiled materials from entering the Kentucky Lake or the Kentucky Lake Lagoon waters outside of the turbidity curtains. In the event soil-cement return, spoil material or stockpiled materials enter the lake waters, the Contractor shall collect and remove all of these materials, and perform all other required/necessary remediation that may be directed by the Engineer or responsible environmental agency, at no additional cost or schedule impact to the Department. The Contractor shall conduct all soil-cement operations to conform to sedimentation and turbidity control requirements of federal, state, and local agencies having jurisdiction over the work.

7. *Delays:* The installation of each DSM-SCC column shall be continuous without interruption. If an interruption of more than two hour occurs, the DSM-SCC shall be remixed for the entire column height using fresh cement grout as though there had not been any cement grout installed, or the column may be abandoned, at no cost or schedule impact to the Department. The Contractor shall install additional columns if the interrupted columns cannot be acceptably remixed.

8. *Instability:* Soil-cement column(s) which exhibit partial or total instability at any time, or collapse as a result of mechanical failure of any equipment; inadequacy of cement, water supplies, cement grout; improper drilling, injection or mixing procedures; or other cause, the Contractor shall halt DSM-SCC construction and backfill to ground surface with cement grout. After the backfill has attained sufficient strength to stabilize the ground, complete the required installation by re-drilling from ground surface, at no additional expense to the Department. The Engineer will evaluate the potential impacts of the instability and may require one or more additional re-drilled columns at

overlapping or adjacent locations as determined by the Engineer, and at no additional expense to the Department.

9. *Daily Quality Control Report:* The Contractor shall submit a Daily Quality Control Report for each day that DSM-SCC work is performed. The log shall contain, at a minimum, the information listed in item 10 of Section 2.2. The report shall be delivered to the Engineer by the end of the next working day following the report date.

10. *Protective Covers:* While working on land, immediately after completing a soil-cement column, the Contractor shall install protective covers or another method accepted by the Engineer to prevent persons from falling or stepping into the unhardened soil-cement column.

8.3 Unforeseen Conditions and Corrective Remediation: An unforeseen condition or obstruction will be defined based on comparison with the results of the test section columns as well as the production columns previously installed in the immediate area around the potential obstruction using the submitted DSM Daily Production Control Reports and Installation Logs. When interruption of the installation process occurs because of an unforeseen condition or obstruction, the Contractor shall notify the Engineer or inspector immediately, document the interruption on the DSM Daily Production Control Report and Installation Log and notify the Engineer in writing by the end of that day of such encounter and shall provide all pertinent information relating to DSM column identification, plan location coordinates, depth, and expected extent of the obstruction. The Contractor shall attempt to penetrate very dense layers by first removing mixing tools from the excavation and then using auger drilling equipment or other accepted methods to allow the installation of the DSM column. The cost of using auger drilling equipment will be included in the unit bid price for Wet Soil Mixing (CY). When the Engineer and Contractor agree that the obstruction cannot be penetrated or removed, the DSM column shall be completed to the maximum depth penetrated, as directed by the Engineer.

Unforeseen conditions that result in deficient column construction that are no fault of the contractor, as described in the preceding paragraph, are expected to be remediated by relatively minor design modifications. These modifications could include the use of adjacent columns at a closer spacing. If a column is terminated higher than the plan tip elevation, skip a minimum of four adjacent columns in each direction until directed otherwise by the Engineer. If the Engineer directs to the Contractor to terminate a DSM column at an Elevation higher than the plan column tip due to an unforeseen condition or obstruction that is no fault of the Contractor, as described in the preceding paragraph, and subsequently directs the Contractor to install additional DSM quantities to remediate the high termination then the Department will pay the Contractor for the completed and additional quantity installed at the contract price per cubic yard. However, deficient DSM columns that are not a result of obstructions or unforeseen conditions will be remediated by the Contractor at no additional cost to the Department.

DSM column construction deficiencies, and how they were addressed, shall be noted in the DSM Daily Production Control Report and Installation Log. DSM column deficiencies that result from changes in rotation speeds of mixing tools, rate of penetration/withdrawal of mixing tools, changes in the rate of grout/binder injection, delays, or changes in binder mix shall be corrected as indicated in subsection 8.2. If there are DSM column interruptions that do not meet the DSM construction requirements (subsection 8.2), the DSM column installation shall be re-drilled a minimum of 1 foot below the elevation of the interruption and the DSM column construction restarted.

Deficient DSM columns due to out of tolerances (subsection 6.1) or not in compliance with DSM construction acceptance (subsection 8.4) will require that the DSM Contractor to submit

proposed remedial measures to the Engineer for review and acceptance. Remedial plans shall show the location, depth, construction exceptions requested, and proposed method of remediating the deficient DSM ground improved areas. Remedial plans, if accepted, shall be at no cost or schedule impact to the Department.

8.4 DSM Construction Acceptance: The QC reporting (logs), testing, and acceptance procedures for the DSM test section(s) and production DSM columns shall be the same. QC testing methods are described in Section 9.0 and Acceptance Criteria are provided in Section 11.0.

9.0 DSM Testing Methods. QC testing of DSM columns consists of using field and laboratory testing techniques to evaluate the integrity, consistency, and strength of the DSM column for the entire full depth of soil improvement. QC testing methods that will be used include coring and sampling (subsection 9.1) and wet grab sampling (subsection 9.2).

The results of the compressive testing shall be used to develop correlations for the design parameters which were based on the following correlation:

Soil-Cement Column Cohesion = 0.35 to 0.50 x Soil Mix Unconfined Compression

As mentioned previously, the minimum unconfined compression strength required is 75 PSI.

9.1 Coring and Sampling: Please refer to Section 4.1 for the drilling prequalification requirements.

1. 2% of the elements should be cored.
2. Coring/sampling shall be performed in the presence of the Engineer, unless otherwise directed. The Contractor shall notify the Engineer at least seven calendar days in advance and confirmed 2-days (48 hours) prior to beginning coring/sampling operations.
3. High quality continuous core sampling shall be obtained after the soil-binder mixture has hardened sufficiently to approximately a compressive strength of 42 PSI (6,050 PSF).
4. Each core run shall be at least four feet in length and contain at least four acceptable test specimens. Three samples per core run are required to perform compressive strength testing with one reserve sample.
5. A minimum core run recovery of 80 percent for each 4-foot-long core run shall be achieved. During coring, the elevation of the bottom of the holes shall be measured after each core run in order that the core recovery for each run can be calculated. The core recovery and RQD for every core run shall be reported in the logs. Additional cores may be required, at no additional cost to the Department, if core run recovery is less than 80 percent.
6. Upon retrieval, the samples shall be field logged and documented by taking pictures. Samples shall be selected for testing and submitted to the Engineer for approval.
7. Following logging and test specimen selection, the entire full-depth sample, including the designated test specimens, shall be immediately sealed in plastic wrap to prevent drying, placed in suitable core boxes, and transported to the materials testing laboratory by the Contractor within 24 hours. Please refer to subsection 2.2 for the geotechnical lab pre-qualifications.

8. Cores shall be transported by the Contractor to the AASHTO certified materials testing laboratory where the samples will be stored and tested. Samples shall be stored and cured in accordance with ASTM D 1632 until the test date. Please refer to subsection 2.2 the geotechnical lab pre-qualifications.

9.2 Wet Grab Sampling:

1. Wet Grab Samples should be obtained from discrete locations and cast and cured under consistent conditions.
2. Wet Grab Sampling shall be done for 0.5% of the elements (i.e. one sample per 200 DSM columns). Additional grab sampling and testing beyond what is required may be performed at the discretion of the Contractor and will be at the expense of the Contractor and at no cost to the Department.
3. Bailer type sampling tools, including tubes or boxes should be utilized to collect the samples.
4. Samples shall be placed into the appropriate cylinders at a minimum of 3 layers. After the placement of each layer, the sample must be tapped or vibrated to remove trapped air bubbles.
5. The samples should be sealed to prevent moisture from entering or leaving the samples.
6. Eight (8) test specimens should be prepared from each wet sample.
7. Test specimens should not be transported to an off-site testing facility or subjected to vibration before a curing age of 3 days to minimize sample disturbance.

9.3 Compressive Strength Testing of Samples:

1. All samples shall be kept out of sunlight, held at 70 to 75 degrees F, and under fully humid conditions throughout storage and curing, which prevents loss of sample moisture via evaporation.
2. Samples suitable for strength testing shall have a height to diameter ratio of 2.0.
3. Strength testing shall be performed by unconfined compression testing method per AASHTO specification T-208-96, but with strain rate not faster than 0.5% per minute, but not slower than 0.25%/minute, and with the test equipment set up to record in both tabular and graphical form the axial stress and strain constant increments of axial strain no larger than every 0.05% axial strain.
4. Unconfined compression testing may be performed at 7, 14, 28, and 56 days for both the cored samples and the wet grab samples. Unconfined compression testing at 56 days is only required if unconfined compression tests at 28 days prove to be less than the minimum required of 75 PSI.
5. Compressive strength testing results shall be transmitted to the Engineer for review within 24 hours of the compression test completion. The remaining portions of the full-depth samples that are not tested shall be retained by the Contractor, until completion and acceptance of the work, for possible inspection and confirmation testing by the Engineer.

10.0 DSM Test Section and QC Testing Program. The test area shall include one (1) test section at Lagoon Bridge End Bent 2. The minimum size of the test location should be approximately 25' x 25'. The pre-production borings and test section should be performed within a perimeter area that extends approximately 35' outward from where the DSM production columns will be installed. The layout of the production columns are shown in the soil cement columns sheet (R83 in the Roadway Plans). This perimeter area shall be the only allowable location to perform the pre-production borings and test section. The pre-production borings and test section can be performed on land by cutting a bench into the existing causeway or by performing the work on the water from a barge or from a temporary work-platform within the proposed footprint consisting of earth fill at the Contractor's own risk. Any temporary slopes created for the pre-production DSM borings and test section shall be in accordance with OSHA guidelines.

The QC testing program for the test section will be submitted to the Engineer within 5 days after test section DSM column installation and shall be based on the results of DSM pre-production laboratory testing and review of samples obtained for strength testing. The approved compressive strength program (i.e. Plan location, sample depth, and elapsed time after construction to perform compressive testing) shall then be submitted to the Contractor's laboratory testing firm.

Unless otherwise directed by the Engineer, a minimum of four locations shall have QC testing, per test section. QC testing at each Plan location shall consist of continuous corings and wet grab sampling per subsections 9.1 and 9.2, respectively. A minimum of six samples at each QC testing Plan location shall be selected by the Contractor and approved by the Engineer for compressive strength testing. Compressive strength testing of cores, resulting from a continuous vertical column, (subsection 9.3) at QC testing Plan locations shall be conducted at 7, 14 and 28 days after test DSM column installation. A test DSM column compressive strength testing report shall be compiled by the independent testing company and submitted to the Contractor and the Engineer. The compressive strength testing report shall document the core sampling, wet grab sampling and compressive strength testing conducted on the cores.

The Contractor shall use the results of the test sections to establish the DSM production construction criteria. Prior to 28 days, if sufficient evidence is shown that the columns in the test section have strength equal to or greater than the minimum 75 PSI, production columns can begin. The DSM production construction criteria shall be developed to produce DSM columns that meet the Acceptance Criteria in Section 11.0. DSM production construction criteria for DSM columns shall include, at a minimum, the following criteria.

DSM-SCC Production Construction Criteria:

1. Grout mix design including ratios of all materials mixed to form the grout.
2. Grout specific gravity.
3. Grout injection rates.
4. Type of equipment.
5. Mixing tool penetration and withdrawal rates.
6. Mixing tool rotation speed.
7. Construction procedures and techniques.

The Contractor shall use the results of the test sections to establish the Production Quality Control (QC) testing program per Section 9.0.

Construction of production DSM columns may begin only after written acceptance by the Engineer of the "DSM Production Construction Criteria" and the "Production Quality Control (QC) Testing Program." If construction criteria, construction procedures, equipment, new

mobilizations, or changes in personnel are made, following acceptance of the test sections, the Department reserves the right to require the Contractor to construct a new test section at no additional cost to the Department.

11.0 Acceptance Criteria. Determination that the DSM columns meet the Acceptance Criteria (for DSM construction, DSM column continuity, and DSM compressive strength requirements) shall be evaluated solely by the Engineer based on a review of daily Quality Control Report/Log of the production DSM columns and QC testing results conducted by an independent testing company.

11.1 DSM Construction Acceptance Criteria: DSM columns shall be considered acceptable when daily Quality Control Report/Log of the production DSM columns and any remediation reports indicate that the:

1. Location of the top of the columns has been verified to be within design tolerances
2. Penetration of the column has been verified as correct by the Engineer.
3. Continuously recorded injection quantity of cement grout for DSM-SCC has been verified to be within 10% of the design (preset) value established for the production DSM construction criteria based on the results of accepted production DSM construction design criteria.

11.2 Design Compressive Strength Acceptance: Unless directed otherwise by the Engineer, strength testing shall confirm that a minimum of 85 percent of all strength samples shall meet or exceed the design compressive strength of 75 PSI at 28 days. Along with the acceptance testing at 28 days, DSM QC compressive strength testing at 7 days will help gauge early conformance or non-conformance of the columns. An early indication of conformance of the strength tests at 7 days is based on a minimum of 70% of the design compressive strength of 75 PSI (or 52.5 PSI). However, the acceptance of the DSM production columns will be based solely on the 28 day QC compressive strength testing requirements described earlier (i.e. a minimum of 85 percent of all strength samples shall meet or exceed the design compressive strength of 75 PSI).

Failure to meet the 28 day QC compressive strength testing criterion shall deem the DSM column to be in non-conformance. The Contractor may elect to conduct additional QC strength testing before and/or after 28 days, with approval of the Engineer, at no additional cost to the Department. Unless otherwise determined by the Engineer, the extent of the non-conformance QC test area shall be considered to include all DSM constructed during all rig shifts that occurred after construction when passing tests were achieved. Non-conforming DSM QC test areas shall be remedied by the Contractor at no additional cost to the Department. This remedy shall include but not limited to re-drilling all or a portion of the nonconforming DSM QC test area and mixing additional cement grout for DSM-SCC columns while raising the mixing tool. The Contractor shall submit a proposed plan for remixing or repair of failed sections for review and acceptance by the Engineer.

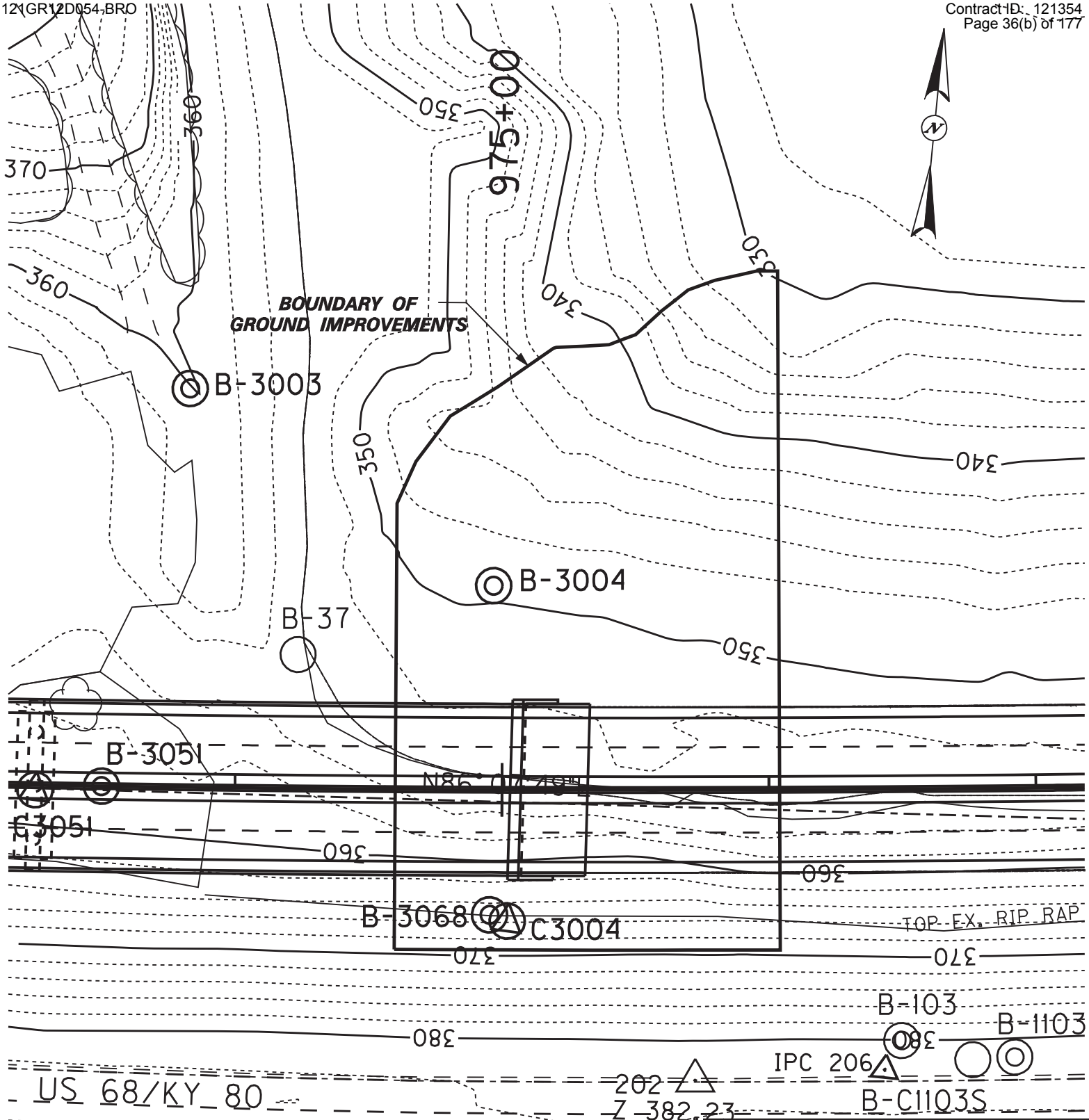
12.0 As-Built Plans. Following completion of the production DSM column construction, the Contractor shall furnish to the Engineer a set of as-built plans detailing the locations of the DSM columns in terms of project coordinates, top and bottom elevations, QC compressive strength testing results, and any other dimensions of the DSM columns that are pertinent to the project.

13.0 Measurement and Payment. DSM constructed using grid spacing will be measured by the total improved volume (in cubic yards) as accepted by the Engineer. Material used to remix an area found to be unacceptable by the Engineer will not be measured.

Payment will be based on the theoretical neat volume per foot for the minimum 4' diameter columns (cubic yards per foot). This factor is 0.47 cubic yards per foot of columns installed. The "bottom of column" will be the actual bottom elevation determined in the field, but for payment will be no lower than the plan tip elevation unless a lower elevation is specified by the Engineer. The encountered ground surface elevation will be the "top of column". The pay quantity for each column will be determined by subtracting the "bottom of column" elevation from the "top of column" elevation (both in feet) and then multiplying the difference by 0.47 (CY/foot) to obtain the pay quantity for a particular column in CY.

Payment for the DSM columns will be full compensation to perform all work as specified in this special note. This includes, but is not necessarily limited to, construction and testing of test sections, construction of DSM columns, obtaining samples for QC testing, QC testing, handling and hauling of excavated spoils and site cleanup. Separate measurements will not be made for additional quantities of soil-cement to overcome obstructions or for areas found unacceptable by the Engineer. Transportation and disposal of spoils, turbidity curtain and installation and removal of the temporary earthen/aggregate platform will also not be a separate pay item but will be included in the unit bid price for Wet Soil Mixing (CY). Payment will be made under:

CODE	PAY ITEM	PAY UNIT
24554ED	Wet Soil Mixing	CY



DATE: NOVEMBER 2012	CHECKED BY
DESIGNED BY:	
DETAILED BY:	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY
TRIGG AND MARSHALL

ROUTE	CROSSING
US 68/80	KENTUCKY LAKE

LAGOON BRIDGE EB2 – DSM BOUNDARY

LAKE BRIDGES
Over Kentucky Lake & Lake Barkley

ITEM NUMBER	PREPARED BY	SHEET NO.
01–180.75	Florence & Hutcheson, An ICA Company	DRAWING NO.

ADDENDUM NO. 2 TO
SPECIAL NOTE FOR STATIC AND PSEUDO-STATIC PILE TESTING

Marshall/Trigg Counties Item No. 1-180.75
Lagoon and Kentucky Lake Bridge

STATIC AXIAL PILE TESTING – APPARATUS AND REACTION SYSTEM

Replace the third paragraph of Section 1.2.1 of this Special Note with the following:

Provide apparatus for applying compressive loads to the test pile similar to that shown in Figure 1 and the example provided in the attached drawings. Design of apparatus shall be performed by a professional engineer meeting the requirements outlined in Section 1.1.3 of this Special Note. The piles will be loaded to maximum test loads of 6000 kips for Pile K-1, 600 kips for L-1, and 1600 kips for L-2. The reaction system design engineer will be responsible for proposing an AASHTO design code (or another code allowed by the Department) and associated load factor(s) to apply to the maximum test loads based on the code. The design and construction of the reaction system will be included in the applicable unit bid item for Static Pile Testing.