PROJECT SPECIAL PROVISIONS

ROADWAY

CLEARING AND GRUBBING – METHOD III:

(4-6-06) (Rev 3-18-08) M2 R02

Perform clearing on this project to the limits established by Method "III" shown on Standard No. 200.03 of the *2006 Metric Roadway Standard Drawings*.

Revise the *2006 Metric Standard Specifications* as follows:

Page 2-2, Article 200-3, Clearing, add the following as the 6th paragraph:

At bridge sites, clear the entire width of the right of way beginning at a station 1 m back of the beginning extremity of the structure and ending at a station 1 m beyond the ending extremity of the structure.

HAND CLEARING:

11-18-08	SPI 2-09 Rev.

Perform the work of hand clearing in those locations indicated in contract documents and as directed by the Engineer. No separate measurement will be made for hand clearing. The cost of this work will be included in the lump sum payment for *Clearing & Grubbing*.

CONTAMINATED SOIL AND GROUNDWATER

The Contractor's attention is directed to the fact that soil and groundwater containing petroleum hydrocarbon compounds and volatile organic compounds exist within the project area. Soil samples collected from Parcel #17, Lamb's of Camden, Inc., indicated petroleum contaminated soil is present in the right of way. Groundwater samples also collected from Parcel #17 indicated volatile organic compounds are adjacent to the right of way and may have migrated into the right of way.

The following are known areas of contamination and their approximate station location:

Parcel #17 -L- Stations 52+65 to 53+16, 6 to 15 Meters Left
-L- Stations 52+89 to 53+03, 5 to 15 Meters Left (Groundwater)

Information relating to these contaminated areas, sample locations, and laboratory results are available at the following web address:

www.ncdot.org/doh/preconstruct/ps/contracts/letting.html

Impact to contamination is possible during any earthwork activities on the project. The Contractor shall only excavate those soils which the Engineer designates necessary to complete a particular task.

Parcel #17
The Engineer shall determine if soil is contaminated based on petroleum odors and unusual soil staining. Contaminated soil not required to be excavated is to remain in place and undisturbed. The Contractor shall stockpile all contaminated soil excavated from the project in a location approved by the Engineer. The stockpile shall be constructed in accordance with the "Diagram for Temporary Containment of Petroleum Contaminated Soil" detail located in the plans. The Engineer is to notify the Geotechnical Engineering Unit if petroleum contaminated soil is encountered and the Geotechnical Engineering Unit shall arrange for the sampling and disposal of the contaminated soil.

In the event that dewatering must occur in proximity to the above referenced station numbers the Contractor shall containerize the water on site. The container vessel shall be a large tanker vessel capable of being transported on and off site. Capacity shall be no less than 1/4 of the total anticipated liquid volume of the contaminated water. The Department will be responsible for testing and disposal of the groundwater.

Measurement and Payment:

The quantity of contaminated soil excavated and stockpiled shall be the actual number of metric tons of material, which has been acceptably excavated, transported, and weighed with certified scales. Include in the unit bid price for *Excavating and Stockpiling Contaminated Soil* all costs associated with this activity including excavation, stockpile construction material, and personal protective equipment.

The *Contaminated Water Storage Vessel* will be paid based upon the actual number of days rental for the storage vessel.

Payment shall be made under:

Pay Item	**Pay Unit**
Excavation and Stockpiling Contaminated Soil	Metric Ton
Contaminated Water Storage Vessel Daily Rental	Each

BUILDING AND UNDERGROUND STORAGE TANK REMOVAL:
(1-1-02) (Rev. 5-17-11) M2 R15 A

Building Removal

Remove the buildings and appurtenances listed below in accordance with Section 215 of the *2006 Metric Standard Specifications* and the following:

Prior to removal of any building, comply with the notification requirements of *Title 40 Code of Federal Regulations*, Part 61, Subpart M, which are applicable to asbestos. Give notification to

the North Carolina Department of Health and Human Services, Division of Public Health Epidemiology Branch and/or the appropriate county agency when the county performs enforcement of the Federal Regulation. Submit a copy of the notification to the Engineer prior to the building removal.

The Department has performed asbestos assessments and abatement for building items identified below. Copies of this report may be obtained through the Division Right-of-Way Agent. When asbestos is discovered after the opening of bids for the project, the Engineer may have the abatement performed by others or the cost of asbestos removal and disposal will be paid in accordance with Article 104-7 of the *2006 Metric Standard Specifications*. When directed to perform removal and disposal of asbestos, do so in accordance with the requirements of *Title 40 Code of Federal Regulations*; comply with all Federal, State and local regulations when performing building removal and/or asbestos removal and disposal. Any fines resulting from violations of any regulation are the sole responsibility of the Contractor and the Contractor agrees to indemnify and hold harmless the Department against any assessment of such fines. When a building has had or will have asbestos removed and the Contractor elects to remove the building such that it becomes a public area, the Contractor is responsible for any additional costs incurred including final air monitoring.

Underground Storage Tank Removal

Known Underground Storage Tanks (UST's) will be removed by the Department prior to the opening of bids. When UST's are discovered after the opening of bids for the project, the Engineer may have the work performed by others or the cost of assessment, closure, and/or removal will be paid for in accordance with Article 104-7 of the *2006 Metric Standard Specifications.*

When directed to remove UST'S, prior to their removal, comply with the notification requirements of the *Title 40 Code of Federal Regulations*, Part 280.71(a). Give notification to the appropriate regional office of the North Carolina Department of Environment and Natural Resources, Division of Waste Management, UST Section. Submit a copy of the notification to the Engineer prior to the removal of the underground storage tank.

Permanently close UST systems by removal and disposal in compliance with the regulations set forth in *Title 40, Code of Federal Regulations*, Part 280.71 and *North Carolina Administrative Code (NCAC)* Title 15A, Chapter 2, Subchapter 2N and any applicable local regulations. Assess Underground Storage Tank sites at closure for the presence of contamination as required in *NCAC* Title 15A, Chapter 2, Subchapter 2N, Section .0803 and as directed by the appropriate Regional Office of the Division of Waste Management. Remove and dispose of UST systems and contents in a safe manner in conformance with requirements of *American Petroleum Institute Bulletin 1604*, Removal and Disposal of Used Underground Petroleum Storage Tanks, Chapters 3 through 6. (Note: As an exception to these requirements, the filling of the tank with water as a means of expelling vapors from the tank as described in Section 4.2.6.1 of *American Petroleum Institute Bulletin 1604*, will not be allowed. Comply with all Federal, State and local regulations when performing UST removal and contaminated material disposal. Any fines resulting from violations of any regulation are the sole responsibility of the Contractor and the

Contractor agrees to indemnify and hold harmless the Department against any assessment of such fines.

Disposal of any contaminated material associated with underground storage tanks will be made as provided in Article 107-26 of the *2006 Metric Standard Specifications*.

Building Removal
Parcel #0017 – Left of Sruvey Station 52+60, Survey Line -L-
Canopy

Building Removal
Parcel #073 – Right of Survey Station 87+65, Survey Line -L-
1SBlk Vegetable Stand

Building Removal
Parcel #074 – Right of Survey Station 88+40, Survey Line -L-
1SFSD

EMBANKMENTS:
(5-16-06) (Rev 10-19-10) M2 R18

Revise the *2006 Metric Standard Specifications* as follows:

Page 2-17, Article 235-3 MATERIALS, amend as follows:

Add the following as the second sentence of the first paragraph:

> Do not use material meeting the requirements of AASHTO M145 for soil classification A-2-5 and A-5 with a plasticity index (PI) of less than 8 within 300 mm of the subgrade.

Add the following as the second sentence of the second paragraph:

> Aerate and dry material containing moisture content in excess of what is required to achieve embankment stability and specified density.

Page 2-18, Subarticle 235-4(B) Embankment Formation, add the following:

(16) Do not place rock or broken pavement in embankment areas where piles or drilled shaft foundations are to be constructed. This shall include but not be limited to piles and foundations for structures, metal signal poles, overhead sign structures, and high mount lighting.

TEMPORARY DETOURS:
(7-1-95) (Rev 4-15-08) M2 R30 A

Construct temporary detours required on this project in accordance with the typical sections in the plans or as directed.

After the detours have served their purpose, remove the portions deemed unsuitable for use as a permanent part of the project as directed by the Engineer. Salvage and stockpile the aggregate base course removed from the detours at locations within the right of way, as directed by the Engineer, for removal by State Forces. Place pavement and earth material removed from the detour in embankments or dispose of in waste areas furnished by the Contractor.

Aggregate base course and earth material that is removed will be measured and will be paid for at the contract unit price per cubic yard for *Unclassified Excavation*. Pavement that is removed will be measured and will be paid for at the contract unit price per square yard for *Removal of Existing Pavement*. Pipe culverts removed from the detours remain the property of the Contractor. Pipe culverts that are removed will be measured and will be paid for at the contract unit price per linear foot for *Pipe Removal*. Payment for the construction of the detours will be made at the contract unit prices for the various items involved.

Such prices and payments will be full compensation for constructing the detours and for the work of removing, salvaging, and stockpiling aggregate base course; removing pipe culverts; and for placing earth material and pavement in embankments or disposing of earth material and pavement in waste areas.

AGGREGATE SUBGRADE:

(9-18-07) (Rev 3-16-10) M2 R35

Description

Construct aggregate subgrades in accordance with the contract or as directed by the Engineer. Undercut as needed in cut areas. Install fabric for soil stabilization and place Class IV Subgrade Stabilization at locations shown on the plans.

Materials

Refer to Division 10 of the *Metric Standard Specifications.*

Item	Section
Select Material, Class IV	1016
Fabric for Soil Stabilization, Type 4	1056

Use Class IV Select Material for Class IV Subgrade Stabilization. If Class IV Subgrade Stabilization does not meet the requirements of Article 1010-2 of the *Metric Standard Specifications*, the Engineer may consider the material reasonably acceptable in accordance with Article 105-3 of the *Metric Standard Specifications*.

Construction Methods

When shallow undercut is required to construct aggregate subgrades, undercut 150 mm to 600 mm as shown on the plans or as directed by the Engineer. Perform undercut excavation in accordance with Section 225 of the *Metric Standard Specifications*. Install fabric for soil stabilization in accordance with Article 270-3 of the *Metric Standard Specifications*. Place Class IV Subgrade Stabilization (standard size no. ABC) by end dumping ABC on the fabric. Do not operate heavy equipment on the fabric until it is covered with Class IV Subgrade Stabilization. Compact ABC to 92% of AASHTO T180 as modified by the Department or to the highest density that can be reasonably obtained.

Maintain Class IV Subgrade Stabilization in an acceptable condition and minimize the use of heavy equipment on ABC in order to avoid damaging aggregate subgrades. Provide and maintain drainage ditches and drains as required to prevent entrapping water in aggregate subgrades.

Measurement and Payment

Shallow Undercut will be measured and paid for in cubic meters. Shallow undercut will be measured in accordance with Article 225-7 of the *Metric Standard Specifications*. The contract unit price for *Shallow Undercut* will be full compensation for excavating, hauling and disposing of materials to construct aggregate subgrades.

Class IV Subgrade Stabilization will be measured and paid for in metric tons. Class IV Subgrade Stabilization will be measured by weighing material in trucks in accordance with Article 106-7 of the *Metric Standard Specifications*. The contract unit price for *Class IV Subgrade Stabilization* will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining ABC.

Fabric for Soil Stabilization will be measured and paid for in accordance with Article 270-4 of the *Metric Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Shallow Undercut	Cubic Meter
Class IV Subgrade Stabilization	Metric Ton

SHOULDER AND FILL SLOPE MATERIAL:

(5-21-02) M2 R45 C

Description

Perform the required shoulder and slope construction for this project in accordance with the applicable requirements of Section 560 and Section 235 of the *2006 Metric Standard Specifications* except as follows:

Construct the top 150 mm of shoulder and fill slopes with soils capable of supporting vegetation.

Provide soil with a P.I. greater than 6 and less than 25 and with a pH ranging from 5.5 to 6.8. Remove stones and other foreign material 50 mm or larger in diameter. All soil is subject to test and acceptance or rejection by the Engineer.

Obtain material from within the project limits or approved borrow source.

Compensation

When the Contractor elects to obtain material from an area located beneath a proposed fill sections which does not require excavation for any reason other than to generate acceptable shoulder and fill slope material, the work of performing the excavation will be considered incidental to the item of *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow* or *Shoulder Excavation* in the contract, this work will be considered incidental to *Unclassified Excavation*. Stockpile the excavated material in a manner to facilitate measurement by the Engineer. Fill the void created by the excavation of the shoulder and fill slope material with suitable material. Payment for material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*. If there is no pay item for *Borrow Excavation* or *Shoulder Borrow*, then the material will be paid for at the contract unit price for *Unclassified Excavation*. The material used to fill the void created by the excavation of the shoulder and fill slope material will be made at the contract unit price for *Unclassified Excavation*, *Borrow Excavation*, or *Shoulder Borrow*, depending on the source of the material.

Material generated from undercut excavation, unclassified excavation or clearing and grubbing operations that is placed directly on shoulders or slope areas, will not be measured separately for payment, as payment for the work requiring the excavation will be considered adequate compensation for depositing and grading the material on the shoulders or slopes.

When undercut excavation is performed at the direction of the Engineer and the material excavated is found to be suitable for use as shoulder and fill slope material, and there is no area on the project currently prepared to receive the material generated by the undercut operation, the Contractor may construct a stockpile for use as borrow at a later date. Payment for the material used from the stockpile will be made at the contract unit price for *Borrow Excavation* or *Shoulder Borrow*.

When shoulder material is obtained from borrow sources or from stockpiled material, payment for the work of shoulder construction will be made at the contract unit price per cubic yard for *Borrow Excavation* or *Shoulder Borrow* in accordance with the applicable provisions of Section 230 or Section 560 of the *2006 Metric Standard Specifications*.

LATERAL DITCHES:

Excavate lateral ditches to full depth and designated outlets. Allow drainage to function for 30 days or an adequate time designated by the Engineer before undercutting or any embankment construction. Payment will be made under Section 240 of the *Standard Specifications*.

EMBANKMENT MONITORING:`

The instrumentation will consist of 28 settlement gauges and 12 two-level vibrating wire piezometers. Place the settlement gauges at the locations as shown in the embankment monitoring detail plan or as directed by the Engineer. The Department's personnel will install the piezometers at the following 12 locations.

Station (-L)	Offset
55 + 75 ±	11 m ± LT
55 + 75 ±	13 m ± RT
55 + 90 ±	11 m ± LT
55 + 90 ±	13 m ± RT
73 + 20 ±	10 m ± LT
73 + 20 ±	12 m ± RT
73 + 35 ±	10 m ± LT
73 + 35 ±	12 m ± RT
73 + 65 ±	10 m ± LT
73 + 65 ±	12 m ± RT
88 + 90 ±	12 m ± LT
88 + 90 ±	11 m ± RT

Settlement Gauge:

Furnish and install Settlement Gauges as shown in the plans. Place the base on a level surface near the natural ground as shown in the plans. Provide threaded 50 mm (minimum) diameter metal pipe meeting ASTM A53 Type F and having a black finish. Add pipe sections at threaded couplings as the embankment progresses. Maintain the top of the pipe be no less than 0.3 meter above the embankment surface and no higher than 1.8 meter. Make the exposed length of pipe conspicuous to avoid damage.

Compact fill around the gauge pipes and plates to the same density as the surrounding material. Restore or replace any settlement gauge pipe damaged or destroyed due to fault or negligence on the part of the Contractor at no additional cost to the Department. No additional payment will be made for compaction of fill around and over the settlement gauges or for interference with the Contractor's operations resulting from settlement gauge installations. Care shall be taken that the pipe remains plumb.

Piezometer:

The Department will purchase, supply, and install the piezometers. The Contractor shall provide access and make necessary arrangements for the Department's personnel to install the piezometers and make pore water pressure measurements at the locations described above. It is estimated to take about eight hours to complete the piezometer installation at each location. Pore water pressure measurement will be made on a weekly basis until the waiting period ends and will continue on a monthly basis until the project completion. Also, the Contractor shall make reasonable efforts not to damage the piezometers, cables, and readout devices installed and maintained by the Department's personnel.

Method of Measurement:

The quantity of settlement gauges to be paid for will be the actual number of each of these items which have been incorporated into the completed and accepted work.

No separate measurement for payment will be made of piezometer installation as this work will be performed by the Department's personnel. Any work performed by the Contractor for installation and maintenance of the piezometers will not be measured for payment.

Basis of Payment:

The quantity of settlement gauges, measured as provided above, will be paid for at the contract unit price each for "Embankment Settlement Gauge". Such price and payment will be full compensation for all materials, labor, equipment and other necessary to complete the work satisfactorily.

Any work performed by the Contractor for installation and maintenance of the piezometers will be considered as incidental to other pay items in the contract and no separate payment will be made.

Pay Item: Embankment Settlement Gauge.....Each

SELECT GRANULAR MATERIAL: **(10-19-10)**

Revise the *Standard Specifications* as follows:

Page 2-23, Delete Section 265 SELECT GRANULAR MATERIAL and replace it with the following:

SECTION 265
SELECT GRANULAR MATERIAL

265-1 Description

Furnish and place select granular material in accordance with the contract or as directed by the Engineer.

265-2 Materials

Refer to Division 10 of the *Standard Specifications.*

Item	Section
Select Material, Class III	1016

265-3 Construction Methods

Use select granular material over fabric for soil stabilization and for backfill in water.

Place select granular material to 1 meter above fabric and water level.

265-4 Measurement and Payment

Select Granular Material, Class III will be measured and paid for in cubic meters. When *Undercut Excavation* is in accordance with Section 226 (Comprehensive Grading) of the *Standard Specifications* and the Engineer requires undercut to be backfilled with select granular material, the second sentence of the sixth paragraph of Article 226-3 will not apply, as payment for the backfill will be made as specified in this provision.

Select granular material will be measured by in place measurement in accordance with Article 230-5 of the *Standard Specifications* or by weighing material in trucks in accordance with Article 106-7 of the *Standard Specifications* as determined by the Engineer. When select granular material is weighed in trucks, a unit weight of 2,162 kilograms per cubic meter will be used to convert the weight of select granular material to cubic meters. At the Engineer's discretion, truck measurement in accordance with Article 230-5 of the *Standard Specifications* may be used in lieu of weighing material in trucks.

The contract unit prices for *Select Granular Material, Class III* as described above will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining select granular material.

Payment will be made under:

Pay Item	Pay Unit
Select Granular Material, Class III	Cubic Meter

1500 MM TEMPORARY PIPE FOR CONSTRUCTION (SPECIAL)

Description

This work consists of furnishing, installing, maintaining and removing any and all temporary pipe used on this project at the culvert sites during the settlement phase.

Construction Methods

The Contractor shall install temporary pipe in locations shown on the plans in such a manner approved by the Engineer. The temporary pipe shall provide a passageway for the stream through the work-site. The pipe shall be 1500 mm CSP with 76.2 mm x 25.4 mm corrugations and rod and lug type connections. The pipe shall perform as required during the settlement phase.

Measurement and Payment

1500 mm Temporary Pipe will be measured and paid for at the contract unit price per linear meter of temporary pipe approved by the Engineer and measured in place from end to end. Such price and payment will be full compensation for all work covered by this section including but not limited to furnishing all materials required for installation, construction, maintenance, and removal of temporary pipe.

Payment will be made under:

Pay Item	Pay Unit
1500 mm Temporary Pipe (at Mass Soil Mixing Area)	Linear Meter

PIPE ALTERNATES:

(7-18-06) (Rev 4-17-07) M3 R36

Description

The Contractor may substitute Aluminized Corrugated Steel Pipe, Type IR or HDPE Pipe, Type S or Type D up to 1219 mm in diameter in lieu of concrete pipe in accordance with the following requirements.

Material

Item	Section
HDPE Pipe, Type S or D	1032-10
Aluminized Corrugated Steel Pipe, Type IR	1032-3(A)(7)

Aluminized Corrugated Steel Pipe will not be permitted in counties listed in Article 310-2 of the *2006 Metric Standard Specifications*.

Construction Methods

Aluminized Corrugated Steel Pipe Culverts and HDPE Pipe Culverts shall be installed in accordance with the requirements of Section 300 of the *2006 Metric Standard Specifications* for Method A, except that the minimum cover shall be at least 300 mm. Aluminized Corrugated Steel Pipe Culvert and HDPE Pipe Culvert will not be permitted for use under travelways, including curb and gutter.

Measurement and Payment

____ *mm Aluminized Corrugated Steel Pipe Culvert* to be paid for will be the actual number of linear meters installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Metric Standard Specifications*.

_____ *mm HDPE Pipe Culvert* to be paid for will be the actual number of linear meters installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Metric Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
___mm Aluminized Corrugated Steel Pipe Culverts, ___mm Thick	Linear Meter
___mm HDPE Pipe Culverts	Linear Meter

PIPE INSTALLATION:
(10-20-09)(Rev 01-18-11) M3 R40A

Revise the *Metric Standard Specifications for Roads and Structures* as follows:

Replace Section 300 with the following:

SECTION 300
PIPE INSTALLATION

300-1 DESCRIPTION

Excavate, undercut, provide material, condition foundation, lay pipe, joint and couple pipe sections, and furnish and place all backfill material as necessary to install the various types of pipe culverts and fittings required to complete the project.

Install pipe in accordance with the detail in the plans.

Do not waste excavation unless permitted. Use suitable excavated material as backfill; or in the formation of embankments, subgrades, and shoulders; or as otherwise directed. Furnish disposal areas for the unsuitable material. The Engineer will identify excavated materials that are unsuitable.

Where traffic is to be maintained, install pipe in sections so that half the width of the roadway is available to traffic.

300-2 MATERIALS

Refer to Division 10:

Item	Section
Flowable Fill	1000
Select Materials	1016
Joint Materials	1032-9(G)
Engineering Fabrics	1056

Provide foundation conditioning material meeting the requirements of Article 1016-3 for Class V or VI Select Material as shown in the contract documents.

Provide bedding material meeting the requirements of Article 1016-3 for Class II (Type 1 only) or Class III Select Material as shown in contract documents.

Provide backfill material meeting the requirements of Article 1016-3 for Class II (Type 1 for Flexible Pipe) or Class III Select Material as shown in the contract documents.

Provide filter fabric meeting the requirements of Article 1056-2 for any type of engineering fabric.

Provide foundation conditioning fabric meeting the requirements of Article 1056-2 for Type 2 Engineering Fabric.

Do not use corrugated steel pipe in the following counties:

Beaufort, Bertie, Bladen, Brunswick, Camden, Carteret, Chowan, Columbus, Craven, Currituck, Dare, Gates, Hertford, Hyde, Jones, Martin, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, and Washington.

300-3 UNLOADING AND HANDLING

Unload and handle pipe with reasonable care. Do not roll or drag metal pipe or plates over gravel or rock during handling. Take necessary precautions to ensure the method used in lifting or placing the pipe does not induce stress fatigue in the pipe. Use a lifting device that uniformly distributes the weight of the pipe along its axis or circumference. Repair minor damage to pipe when permitted. Remove pipe from the project that is severely damaged or is rejected as being unfit for use. Undamaged portions of a joint or section may be used where partial lengths are required.

300-4 PREPARATION OF PIPE FOUNDATION

Prepare the pipe foundation in accordance with the applicable method as shown in the contract documents, true to line and grade, and uniformly firm.

Camber invert grade an amount sufficient to prevent the development of sag or back slope in the flow line. The Contractor shall determine the amount of camber required and submit to the Engineer for approval.

Where material is found to be of poor supporting value or of rock and when the Engineer cannot make adjustment in the location of the pipe, undercut existing foundation material within the limits established on the plans. Backfill the undercut with foundation conditioning material. Encapsulate the foundation conditioning material with foundation conditioning fabric prior to placing bedding material. Overlap all transverse and longitudinal joints in the fabric at least 450 mm.

Maintain the pipe foundation in a dry condition.

300-5 INVERT ELEVATIONS

The proposed pipe culvert invert elevations shown on the Drainage Summary Sheets are based upon information available when the plans were prepared. If proposed invert elevations are adjusted during construction based upon actual conditions encountered, no claim for an extension of time for any reason resulting from this information will be allowed.

When a pipe culvert is to be installed in a trench and the average actual elevation of the pipe between drainage structures deviates from the average proposed elevation shown on the Drainage Summary Sheets by more than 0.3 m a pay adjustment will be made as follows:

$$\text{Pay Adjustment (per linear meter)} = [(\text{APE}-\text{AAE}) \pm 0.3 \text{ meter}] (0.15 \times \text{CUP})$$

Where: CUP = Contract Unit Price of Pipe Culvert

AAE = Average Actual Elevation $\dfrac{(\text{Actual Inlet elev.} + \text{Actual Outlet elev.})}{2}$

APE = Average Plan Elevation $\dfrac{(\text{Plan Inlet elev.} + \text{Plan Outlet elev.})}{2}$

When the actual location of a pipe culvert is changed from the location shown on the plans, the Engineer will make a pay adjustment deemed warranted based upon the relation of the pipe culvert as shown on the plans to the finished roadway and the relation of the pipe culvert as constructed to the finished roadway.

The top elevation column on the drainage summary sheet indicates the flow elevation at the top of structures intended to collect surface water.

The top elevation column on drainage structures not intended to collect surface water indicates the elevation at the top of the cover.

300 -6 LAYING PIPE

The Department reserves the right to perform forensic testing on any installed pipe.

(A) Rigid Pipe

Concrete and welded steel pipe will be considered rigid pipe. Lay pipe on prepared foundation, bell or groove end upgrade with the spigot or tongue fully inserted. Check each joint for alignment and grade as the work proceeds.

Use flexible plastic joint material except when material of another type is specified in the contract documents. Joint material of another type may be used when permitted.

Repair lift holes in concrete pipe, if present. Thoroughly clean and soak the lift hole and completely fill the void with an approved non-shrink grout. Submit alternate details for repairing lift holes to the engineer for review and approval.

For all pipes 1050 mm in diameter and larger, wrap filter fabric around all pipe joints. Extend fabric at least 300 mm beyond each side of the joint. Secure fabric against the outside of the pipe by methods approved by the Engineer.

(B) Flexible Pipe (Except Structural Plate Pipe)

Corrugated steel, corrugated aluminum, corrugated polyethylene (HDPE), and polyvinylchloride (PVC) pipe will be considered flexible pipe. Place flexible pipe carefully on the prepared foundation starting at the downstream end with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

Handle coated corrugated steel pipe with special care to avoid damage to coatings.

Join pipe sections with coupling band, fully bolted and properly sealed. Provide coupling bands for annular and helical corrugated metal pipe with circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections, and prevent backfill infiltration. Match-mark all pipe 1500 mm or larger in diameter at the plant for proper installation on the project.

At locations indicated in the plans, corrugated steel pipe sections shall be jointed together with rod and lug coupling bands, fully bolted. Sleeve gaskets shall be used in conjunction with rod and lug couplings and the joints properly sealed. Coupling bands shall provide circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections and prevent infiltration of backfill material.

300-7 BEDDING AND BACKFILLING

Loosely place bedding material, in a uniform layer, a depth equal to the inside diameter of the pipe divided by 6 or 150 mm, whichever is greater. Leave bedding material directly beneath the pipe uncompacted and allow pipe seating and backfill to accomplish compaction. Excavate recesses to receive the bells where bells and spigot type pipe is used.

Place fill around the pipe in accordance with the applicable method shown on the plans in layers not to exceed 150 mm loose unless otherwise permitted. Compact to the density required by Subarticle 235-4(C). Approval of the backfill material is required prior to its use. Use select material as shown in the contract documents.

Take care during backfill and compaction operations to maintain alignment and prevent damage to the joints. Keep backfill free from stones, frozen lumps, chunks of highly plastic clay, or other objectionable material.

Grade and maintain all pipe backfill areas in such a condition that erosion or saturation will not damage the pipe foundation or backfill.

Excavatable flowable fill may be used for backfill when approved by the Engineer. When using excavatable flowable fill, ensure that the pipe is not displaced and does not float during backfill. Submit methods for supporting the pipe and material placement to the Engineer for review and approval.

Do not operate heavy equipment over any pipe until it has been properly backfilled with a minimum 1 m of cover. Place, maintain, and finally remove the required cover that is above the proposed finished grade at no cost to the Department. Remove and replace, at no cost to the Department, pipe that becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations.

300-8 INSPECTION AND MAINTENANCE

Prior to final acceptance, the Engineer will perform random video camera and or mandrel inspections to ensure proper jointing and that deformations do not exceed allowable limits. Replace pipes having cracks greater than 2.5 mm or deflections greater than 7.5 percent. Repair or replace pipes with cracks greater than 0.25 mm, exhibiting displacement across a crack, exhibiting bulges, creases, tears, spalls, or delamination. Maintain all pipe installations in a condition such that they will function continuously from the time the pipe is installed until the project is accepted.

300-9 MEASUREMENT AND PAYMENT

General

No measurement will be made of any work covered by this section except as listed below. Removal and disposal of existing pavement is a part of the excavation for the new pipe culvert installation. Repair of the pavement will be made in accordance with Section 654.

Foundation Conditioning

Using Local Material

Undercut excavation is all excavation removed by undercutting below the bottom of the trench as staked. *Undercut Excavation* will be measured as the actual number of cubic meters of undercut excavation, measured in its original position and computed by the average end area method, that has been removed as called for in the contract and will be paid for at double the contract unit price for *Unclassified Excavation* as provided in Article 225-7.

Local material used for conditioning the foundation will be measured and paid for in accordance with Article 225-7 for *Unclassified Excavation* or in accordance with Article 230-5 for *Borrow Excavation* depending on the source of the material.

Local material used to replace pipe undercut excavation will be measured and paid for in accordance with Article 225-7 or Article 230-5.

Using Other Than Local Material

No measurement and payment will be made for *Undercut Excavation*. The material used to replace pipe undercut excavation will be classified as foundation conditioning material.

Foundation Conditioning Material, Minor Structures will be measured and paid as the actual number of metric tons of this material weighed in trucks on certified platform scales or other certified weighing devices.

No direct payment will be paid for undercut excavation. Payment at the contract unit price for *Foundation Conditioning Material, Minor Structures* will be full compensation for all work of pipe undercut excavation.

Foundation Conditioning Fabric

Foundation Conditioning Fabric will be measured and paid in square meters. The measurement will be based on the theoretical calculation using length of pipe installed and two times the standard trench width. No separate measurement will be made for overlapping fabric or the vertical fabric dimensions required to encapsulate the foundation conditioning material.

Bedding and Backfill - Select Material

No measurement will be made for select bedding and backfill material required in the contract documents. The select bedding and backfill material will be included in the cost of the installed pipe.

Where unclassified excavation or borrow material meets the requirements for select bedding and backfill and is approved for use by the Engineer, no deductions will be made to these pay items to account for use in the pipe installation.

Payment will be made under:

Pay Item	Pay Unit
Foundation Conditioning Material, Minor Structures	Metric Ton
Foundation Conditioning Fabric	Square Meter

SEALED DRAINAGE SYSTEM:
(3-10-04) SPI

Description

The Contractor's attention is directed to the fact that there is an area containing petroleum contaminated soil on this project.

The work covered by these provisions consists of constructing a special sealed system of underground storm drainage pipes and structures through this area, in accordance with these special provisions and with the lines, grades, dimensions, locations and details as shown on the plans or established by the Engineer.

No underdrains will be allowed for any reason in the area of the sealed drainage system.

Materials

The Engineer shall approve all backfill material.

Portland Cement Concrete shall meet the requirements of Section 1000 of the *Standard Specifications.*

Ductile Iron drainage pipe shall be Pressure Class 350 and shall conform to ANSI A21.51 (AWWA C151). Such pipe shall be push-on joint and installed with gaskets in accordance with the applicable sections of ANSI A21.11 (AWWA C111). Gaskets for ductile iron pipe shall be made of Nitrile, Teflon, or other gasoline resistant material and shall be approved for use with Pressure Class 350 Ductile Iron Pipe. Ductile Iron Pipe shall be cement mortar lined with a seal coat in accordance with ANSI A21.4 (AWWA C104).

Masonry Drainage Structures shall be in accordance with the applicable requirements of Section 840 of the *Standard Specifications* and this provision. Masonry Drainage Structures shall be precast concrete conforming to ASTM C478. Joints between sections shall conform to ASTM C443. Joints shall be sealed with O-Ring gaskets in accordance with the applicable sections of ASTM C443. O-Ring gaskets shall be made of Nitrile Teflon, or other gasoline resistant material and shall be approved for use with precast drainage structure sections.

Connection of pipe to drainage structure shall be by a flexible, resilient connector conforming to the applicable requirements of ASTM C923. The drainage structure to pipe connector shall be made of Nitrile, Teflon, or other gasoline resistant material.

Grout used in precast drainage structure shall meet the requirements of Article 1040-9 of the *Standard Specifications* except that the mixture shall consist of 1 part portland cement to 2 part mortar sand.

The Contractor shall submit to the Engineer catalog cuts and/or shop drawings for materials he proposes to use on the project. Forty days shall be allowed for the review of each submittal.

Materials which have not been approved shall not be delivered to the project. Eight (8) copies of each catalog cut and/or drawing shall be submitted and each shall show the material description, brand name, stock number, size, rating, manufacturing specification and the use for which it is intended.

Construction Methods

All portions of the excavations shall be made so that the safe slope of the earth is not exceeded. Backfill with contaminated material is prohibited. All excavated material and contaminated water shall be handled and disposed of as set forth elsewhere in these contract documents. The Contractor shall comply with all OSHA requirements and provide a competent person on site to supervise excavation at all times. It shall be the responsibility of the Contractor to properly and adequately protect any part of the excavation from caving or slipping by the use of sheeting, bracing, or shoring as required. All timbering or underpinning shall be put in place or driven by men skilled in such work and shall be so arranged that it may be withdrawn as backfilling progresses without disturbing the pipe or adjacent area.

No more trench (30 meters ±) shall be opened in advance of the pipe laying than is necessary to expedite the work unless prior approval is given by the Engineer. Ground conditions and/or location requirements shall govern the amount of trench open at any one time as determined by the Engineer.

Trench width for pipe 825 mm and smaller in inside diameter shall be equal to the outside diameter (as measured at the bells) of the pipe plus 400 mm. Trench width for pipe larger than 825 mm inside diameter shall be equal to the outside diameter (as measured at the bells) of the pipe plus 600 mm. Trench width shall be measured between faces of cut at the top of the pipe bell.

All timbering in trench excavations shall be withdrawn in stages on both sides of the trenches to prevent lateral movement of the pipe as the backfilling progresses, except where the Engineer permits the timbering to be left in place at the Contractor's request. The Contractor shall cut off any sheeting left in place at least 600 mm below finished grade wherever directed and shall remove and dispose of the material cut off.

The Contractor shall take all measures necessary to keep surface water out of the trenches by

diking, ditching, or otherwise avoiding it. Provisions for surface drainage shall meet the approval of the Engineer.

All excavations shall be kept free of water while the work is in progress. Water may be removed by pumps, but must be handled as required by the contract documents.

Where the foundation material is found to be of poor supporting value or of rock, the Engineer may make minor adjustment in the location of the structure to provide a more suitable foundation. Where this not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the Engineer and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material as classified in Article 1016-3, consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by the Engineer as being suitable material for the purpose intended. The class of select material to be used for foundation conditioning will be stated on the plans or determined by the Engineer.

All backfill areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

Heavy equipment shall not be operated over any pipe until it has been properly backfilled with a minimum 1 meter of cover. Where any part of the required cover is above the proposed finish grade, the Contractor shall place, maintain, and finally remove such material at no cost to the Department. Pipe which becomes misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations shall be removed and replaced by the Contractor at no cost to the Department.

Sealed Drainage System Installation:
Install pipe in accordance with the project special provision entitled **Pipe Installation** elsewhere in these contract documents and this provision. During the progress of the work and until the completion and final acceptance, the pipelines and drainage structures shall be kept clean throughout. Any obstructions or deposits shall be removed and disposed of properly.

If, at any time before completion of the contract, any broken pipe or any defects are found in any materials, they shall be replaced. All materials shall be carefully examined for defects before placing, and any found defective shall not be used.

Pipe shall not be laid upon a foundation into which frost has penetrated, or at any time, that in the opinion of the Engineer, there is danger of the formation of ice or frost at the bottom of the excavation. The Engineer may at his discretion allow construction of the pipeline to continue under freezing conditions provided the Contractor promptly backfills the trench as directed.

Pipe and accessories shall be carefully lowered into the trench with suitable equipment. Under no circumstances shall any of the materials be dropped or dumped into the trench.

Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing

skids across trenches shall be of wood and shall have broad flat faces to prevent damage to the pipe or pipe coating.

The full length of each section of pipe shall rest solidly upon the pipe bed with recesses excavated to accommodate bells, couplings, and joints. Pipe that has been disturbed after laying shall be taken up and relaid.

When work is not in progress, open ends of pipe shall be securely closed so that water, earth, or other foreign substances can not enter.

Pipe laying shall proceed upgrade with the spigot ends pointing in the direction of flow. Each pipe shall be laid in such a manner as necessary to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. As the work progresses, the interior of the pipe shall be cleared of all foreign materials. Where cleaning after laying is difficult because of small pipe size, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after the jointing has been completed. Trenches shall be kept free from water until backfilled and pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work.

Any pipeline or drainage structure which contains any silt, sedimentation or other foreign material will not be accepted. The Contractor shall at his own expense flush, or otherwise cause the line (and drainage structures) to be cleaned out.

Material removed by cleaning or flushing shall be disposed of properly. Material removed by cleaning or flushing, if determined by the Engineer to be contaminated, must be handled and disposed of as approved by the Engineer. Approval must be obtained prior to any cleaning or flushing activities.

Gasket joints for pipe and drainage structures shall be handled, lubricated where necessary, and installed in accordance with the recommendations of the manufacturer.

No precast drainage structure shall be placed until the foundation has been approved by the Engineer. The precast units shall be assembled in accordance with the manufacturer's instructions. Drainage structures over 1 meter in depth shall have steps spaced 400 mm on center, of the type shown in the Standard Drawings. Steps shall be installed as directed by the Engineer and shall be tested as required in ASTM C478.

Where pipes enter drainage structures they shall be placed as the work is built up, properly connected, and accurately spaced and aligned. Pipe connections shall be made so that the pipe does not project farther than is necessary beyond the inside wall of the drainage structure. Pipe connections shall be grouted to make a smooth and uniform surface on the inside of the drainage structure.

After the drainage structure has been completed, including all pipe connections, the excavation shall be backfilled. The backfilling shall not be done until masonry has cured for at least 7 curing days, unless otherwise permitted by the Engineer. A curing day shall be as defined in

Article 825-9 of the *Standard Specifications* for concrete or Article 830-5 for brick or block masonry. Backfill for drainage structure shall be of a type, placed, and compacted as required for ductile iron drainage pipe.

Sealed Drainage System Testing:

The special sealed drainage system shall be tested in accordance with Article 1520-4 (B) (1) of the *Standard Specifications*. Both infiltration and exfiltration tests will be required. Allowable leakage for both tests will be 0.02 liters per mm diameter per kilometer of pipe per hour. For the exfiltration test the system shall be plugged and filled to the rim of the drainage structure as directed by the Engineer.

Measurement and Payment

Trenching, excavation and backfilling for special sealed drainage system will be considered as included in the contract price for the applicable pay item and no separate measurement will be made therefore. Such work as shoring, sheeting and dewatering of the excavation will also be considered as included in the contract price for the applicable pay item and no separate measurement will be made.

Ductile Iron Pipe will be measured and paid for as the actual number of linear meters that has been incorporated into the completed and accepted work.

Masonry Drainage Structures shall be measured and paid for in accordance with Section 840 of the Standard Specifications.

Such prices and payments will be full compensation for all work covered by these special provisions, including, but not limited to: materials, labor, equipment, backfilling, compaction, testing, pumping and incidentals necessary to complete the work as required.

Payment will be made under:

Pay Items	**Pay Units**
___ mm Ductile Iron Pipe	Linear Meter

PROTECTION OF ROADWAY:

Heavy equipment shall not be allowed on areas where fabric for soil stabilization or shallow undercut may be required in order to minimize disturbance of natural ground or backfill material.

FINE GRADING SUBGRADE, SHOULDERS AND DITCHES:
(7-21-09) M5 R01

Revise the *Standard Specifications* as follows:

Page 5-1, Article 500-1 DESCRIPTION, replace the first sentence with the following:

Perform the work covered by this section including but not limited to preparing, grading, shaping, manipulating moisture content, and compacting either an unstabilized or stabilized roadbed to a condition suitable for placement of base course, pavement, and shoulders.

AGGREGATE BASE COURSE:
12-19-06 M5 R03

Revise the *2006 Metric Standard Specifications* as follows:

Page 5-9, Article 520-5 Hauling and Placing Aggregate Base Material, 6th paragraph, replace the first sentence with the following:

Base course that is in place on November 15 shall have been covered with a subsequent layer of pavement structure or with a sand seal. Base course that has been placed between November 16 and March 15 inclusive shall be covered within 7 calendar days with a subsequent layer of pavement structure or with a sand seal.

MASS SOIL MIXING

1.0 GENERAL

The work covered by this provision consists of furnishing all equipment, labor, and materials, and performing all operations required for installing and testing mass soil mixing as specified herein and shown on the contract plans. The term "Mass Soil Mixing" used in this provision is intended as a generic term to cover both wet soil mixing and dry soil mixing and refers to a mechanical method of blending in-situ soil with a reagent binder or grout using a mixing tool. The binder or grout is injected and in-situ soils are mixed to achieve a design strength. Mass soil mixing shall treat 100% of all soil volume within the limits shown in the Mass Soil Mixing plan sheets or revised limits as directed by the Engineer. The Contractor shall hire a specialty subcontractor who meets the requirements of the subcontractor qualifications in Section 2.0 below. The Contractor shall perform all work described in this provision in accordance with this provision and the NCDOT Standard Specifications for Road and Structures unless otherwise directed by the Engineer.

2.0 SUBCONTRACTOR QUALIFICATIONS

The mass soil mixing subcontractor shall have a minimum of five continuous years of documented experience in soil mixing and shall provide at least one project manager, site superintendent, and operator with a minimum of three years of documented experience in soil mixing within the last five years. Both the site superintendent and the operator shall be on-site for this project on a full-time basis. A list of potential subcontractors is provided below in an alphabetical order for the Contractor's information; however, the Department does not verify that these firms meet the qualification requirements described herein, nor endorse any of them. The

Contractor may choose any other subcontractor who meets the qualification requirements described herein.

Geo-Con
4075 Monroeville Boulevard
Monroeville, PA 15146
Phone: 412/ 856-7700
Fax: 412/ 373-3357

Geo-Solutions
1250 Fifth Ave.
New Kensington, PA 15068
Phone: 724-335-7273
Fax: 724-335-7271

Hayward Baker
208 Little Santee Road
Colfax, NC 27235
Phone: 336-668-0884
Fax: 336-668-3259

Remedial Construction Services
214 Brookstone Circle
Dewitt, Michigan 48820
Phone:(517) 669-6707
Fax:(517) 669-7184

3.0 SUBMITTALS

3.1 Before beginning of mass soil mixing construction, the Contractor shall submit the following for approval by the Engineer. Send the submittals directly to both the Resident Engineer and the Geotechnical Engineering Unit (GEU). GEU's mailing address is as follows: Mr. K. J. Kim, Eastern Regional Geotechnical Office, 3301 Jones Sausage Road, Suite 100, Garner, NC 27529. Within ten (10) business days of the receipt of the submittal, the Engineer will notify the Contractor of approval or rejection of the subcontractor's qualification.

A. Detailed documentation to prove that the subcontractor meets the qualification requirements stated in Section 2.0.
B. List of soil mixing projects the subcontractor has performed with contact information of the project owners.
C. List of soil mixing projects the project manager has performed with contact information of the project owners.
D. List of soil mixing projects the site superintendent has performed with contact information of the project owners.
E. List of soil mixing projects the operator has performed with contact information of the project owners.
F. Resumes of the project manager, site superintendent, and operator
G. Certifications and training records of the soil mixing operator

3.2 After the Engineer's approval of the mass soil mixing subcontractor, but no less than 30 days before beginning of mass soil mixing construction, the Contractor shall submit the following for approval by the Engineer. Send the submittals directly to both the Resident Engineer and the Geotechnical Engineering Unit. Within 20 business days of the receipt of the submittal, the Engineer will notify the Contractor of approval or rejection of the submittals. The Contractor shall not perform any soil mixing work until all of the items listed below have been approved by the Engineer.

A. List and sizes of proposed equipment, tools, binder or grout delivery system including mixing tool used to mix the in-situ soil and binder or grout.
B. Soil mix design including sources and type of binder material with proportions. Also, proposed binder or grout mixture, mixing rates, flow rates, air injection pressure and volume flow rates, auger/mixing tools rotational speed, auger down pressure, and auger penetration and withdrawal rates.
C. Mass soil mixing construction sequence and step-by step description of work procedures outlining means and methods to achieve the specified criteria detailed in this Special Provision.
D. Mass soil mixing construction schedule.
E. Design plans and supporting engineering analysis and calculations of temporary embankment and slope stabilization to assure stability of both the existing and widened roadway embankments during the mass soil mixing work. A professional engineer registered in the state of North Carolina shall prepare the design plans, and the mass soil mixing specialty contractor shall review and accept the design for comparability with his methods and procedures of mass soil mixing work prior to submission to the Department.
F. Material suppliers' certifications of quality.
G. Contractor's Quality Assurance-Quality Control (QA/QC) Plan, including, but not limited to:
    a. Details and procedures of all testing and sampling
    b. Measures to be implemented each day during Soil Mixing to monitor, modify, record, and control binder or grout ratios and quantities, mixing time, and other related aspects of the Soil Mixing process

F. Sample log to be used to report daily production records of mass soil mixing. The log shall contain at least the following information:
    a. project name
    b. date, start and finish time, and duration of mixing operation
    c. machine number
    d. type of mixing tool
    e. location of the treated area in terms of station number and offset from –L-
    f. surface area, depth, and volume of the treatment
    g. quantity of binder material and injection ratio
    h. installation air pressure
    i. rate of insertion and withdrawal of mixing tool
    j. description of obstructions or interruptions of mass soil mixing operation
    k. weather

4.0 PRECONSTRUCTION MEETING

After approval of the submittals in Section 3.0, but before starting any mass soil mixing work including the test section, the Contractor shall have a preconstruction meeting to discuss the details of materials, equipment, construction, inspection, and testing for the mass soil mixing. Schedule this meeting with the representatives of the Department's Resident Engineer, Construction Unit, and Geotechnical Engineering Unit, and the Contractor and the mass soil mixing subcontractor including the project manager, site superintendent, and operator. Notify them of the meeting schedule a minimum of seven days in advance of the meeting.

5.0. SOIL MIXING EQUIPMENT AND STORAGE TANKS FOR BINDER OR GROUT MATERIALS

A. Soil Mixing Equipment

Use self-contained soil mixing rigs for soil mixing. The minimum equipment requirements are:

a. One or more pressure tanks rated to safely contain an air pressure 8 bar, if dry mixing is used.
b. Base equipment capable of firmly supporting the mixing tool throughout the installation process.
c. Torque and rotational speed suitable for thorough mixing.
d. Specially designed mixing tools with the capacity to construct the required geometries and dimensions as shown in the plan

The soil mixing equipment shall have a real-time computer control system to permit accurate and continuous monitoring, recording, and control of the following: binder and water proportioning, grout mix, water-cement ratio, mixing tool depths, binder or grout injection pressures and quantities, auger rotational speeds, auger torque, and auger advancement and withdrawal rates.

The soil mixing equipment shall be of sufficient size, capacity, and torque to perform the required mass soil mixing operations. The equipment shall be capable of advancing through the soft untreated ground or previously installed and cured mass soil mixing area as necessary to complete the work.

Soil mixing equipment must allow the use of compressed air or grout during mixing. Mixing tools must be capable of injecting binder or grout through the mixing tool. Rotate and orient mixing tools sufficiently to break up the in situ soils and disperse and blend with injected binder or grout to form the soil/binder mixture. Continuous auger flights are not allowed. Mixing tools shall be rotated sufficiently fast and be oriented to thoroughly break up the in situ soils and disperse and blend with injected cement/grout to form a homogenous mixture.

B. Storage Tanks for Binder Materials or Grout Mixing Plant

Store and deliver binder materials to the mixing points in closed pressure tanks suitable to be used as pressure vessels, for all pressures required including those to be used to load and unload the materials. Provide storage tanks or silos for adequate storage space for continuous production. The bulk storage equipment includes all pumps, scales, mixers, valves, gauges, and regulating devices required to measure and mix binder.

If wet soil mixing method is used, the grout mixing plant shall include the necessary equipment including a high shear mixer capable of producing a colloidal suspension of cement and additives in water and pumps, valves, hoses, supply lines, and all other equipment as required to adequately supply grout to the mixing tool. Positive displacement grout pumps shall be used to transfer the grout to the mixing auger. The grout pump shall be capable of pumping to the required distance and elevations to provide an adequate supply of grout to the mixing tool. The plant shall be equipped to accept dry or liquid additives in measured amounts. Storage tanks shall be provided (as needed) to store and allow for an adequate supply of batches or continuously mixed grout to the soil mixing machine. Grout shall be agitated until fully mixed and recirculated in the storage tanks to maintain a homogeneous mix and prevent flash set. Grout meters or calibrated tanks shall be provided to measure injection volumes.

6.0 MATERIALS

A. Reagent Binder

Use a binder material consisting of cement or a mixture of cement and slag. The percentage of slag shall not exceed 75% of the binder material by weight. The binder shall be delivered in a powder form. Protect the binder material from damage by moisture while in transit to and in storage at the job site.

1. Cement:

   Use Type I or II Portland Cement in accordance with Section 1024 of the Standard Specifications for Roads and Structures. No other types of cement will be allowed. All cement shall be homogeneous in composition and properties, and shall be manufactured using the same method at one plant by the same manufacturer. Material which has 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 material that may be deleterious to the mass soil mixing operation shall not be used. Tricalcium aluminate content shall not exceed 7%.

2. Slag

   Use ground granulated blast furnace slag. Other types of slag or fly ash may be allowed upon approval of the Engineer.

3. Additives

   All additives shall be included in the mix design submittal for the Engineer's review and approval. No admixtures shall be used without the Engineer's approval.

B. Grout

Grout shall be a stable homogeneous mixture of cement, slag, and water. The percentage of slag shall not exceed 75% of the binder material by weight. The Contractor shall not change grout composition unless conditions encountered so require, in which case the Contractor shall submit the change in writing with substantiating reasons for the Engineer's review and approval. Send the submittals directly to both the Resident Engineer and the Geotechnical Engineering Unit. The Engineer will notify the Contractor of approval or rejection of the submittals within three (3) business days of the receipt of the submittals. The requirements of cement, slag, additives, and water for grout are the same as the reagent binder material above.

C. Water

Water used in mass soil mixing shall be clean and potable, of neutral pH, and free from sewage, oil, acid, alkali, salts, organic materials, and other deleterious contamination. If the Contractor obtains water from sources other than public drinking water supply, then the Contractor shall provide water quality test data to prove that the water meets this requirement.

7.0 FIELD TEST SECTION

The Contractor shall construct a mass soil mixing test section before beginning full-scale production work. The test section construction is to verify that the Contractor is capable of performing the mass soil mixing work in accordance with this provision and other contract requirements. In addition, the test section construction is to verify that the Contractor's proposed construction method, procedures, and equipment will produce the mass soil mixing meeting the acceptance criteria specified in this provision. The test section shall be constructed at a location designated in the contract plan unless otherwise directed by the Engineer. The size of the test section shall be 9 to 10 meters in width and 9 to 10 meters in length unless otherwise approved by the Engineer. The Contractor shall use the same materials, equipment, and construction method and procedures for the test section construction as he proposes for production mass soil mixing in this project. The quality control and quality assurance (QC/QA) measures specified in this provision shall also be implemented in the test section construction. The sampling and testing requirements for the test section are as follows:

1) Unconfined Compressive Testing (UCT) of Wet Samples: one sample at every two meter depth of the treated soil mass at two different locations selected by the Engineer
2) Cone Penetration Test (CPT): two CPT tests at locations selected by the Engineer down to a depth of two meters below the bottom of the mass soil mixing

The Engineer will determine acceptance or rejection of the test section based on the acceptance criteria specified in this provision. The Engineer will notify the Contractor of acceptance or

rejection of the test section within five (5) business days from the date all construction records and the results of the UCT and CPT are received from the Contractor. If the test section is accepted by the Engineer, it will become part of the production mass soil mixing and will be paid for accordingly. The Contractor may continue the mass soil mixing operation upon the Engineer's acceptance of the test section. If the test section fails to meet the acceptance criteria, the Contractor shall cease all soil mixing operations and submit a revised soil mix design, a list of revised equipment and tools, and/or revised construction methods and procedures including the applicable items in Section 3.2 for the Engineer's review and approval. Send the submittals directly to both the Resident Engineer and the Geotechnical Engineering Unit. The Engineer will notify the Contractor of approval or rejection of the submittals within five (5) business days of the receipt of the submittals. After the Engineer's approval of the revised submittals, the Contractor shall construct a new test section at a location designated by the Engineer following the same requirements applied in the previous test section construction. If the second test section fails to meet the acceptance criteria, the Contractor shall either replace all key personnel of the mass soil mixing subcontractor including the project manager, site superintendent, and operator, or change the mass soil mixing subcontractor. In either case, the Contractor shall resubmit all of the items listed in Section 3.0 for the Engineer's review and approval. The Engineer will notify the Contractor of approval or rejection of the submittals within ten (10) business days of the receipt of the submittals. This process shall repeat until the test section is accepted by the Engineer.

8.0 CONSTRUCTION METHODS

8.1 The Contractor shall furnish all labor, equipment, and materials necessary to conduct all mass soil mixing operations. The Contractor shall use same procedures, materials, and construction methods and equipment used in the test section construction throughout the production mass soil mixing work. Variations may be proposed with the condition that the Contractor demonstrates by constructing a new test section as required in Section 7.0 that the revised procedures, materials, or construction methods or equipment will provide mass soil mixing that meets all of the acceptance criteria. The Contractor shall continuously monitor the soil mixing operation, and if necessary, shall propose modification to any aspects of the work, such as water/cement ratio, to achieve compliance with contract requirements and acceptance criteria, all subject to the Engineer's review and approval. If at any time, the Contractor's equipment, methods, or materials do not produce a satisfactory mass soil mixing, the Contractor shall stop the soil mixing operation and submit for the Engineer's review and approval a plan of action to produce mass soil mixing that meets the acceptance criteria described in this provision.

8.2 Relative to the overall site requirements and preparatory work prior to mass soil mixing work, the Contractor shall perform all survey layouts and utility clearances associated with the mass soil mixing operation and coordination will all local, state, and federal agencies having jurisdiction, and all utility companies having facilities that could be impacted by the mass soil mixing construction. Also, The Contractor shall perform clearing and grubbing prior to the soil mixing operation in accordance with Section 200 of the NCDOT Standard Specifications for Roads and Structures. Remove underground obstructions either before

or during mass soil mixing in accordance with the *Obstruction Removal for Mass Soil Mixing* special provision.

8.3 The Contractor shall design, construct, and maintain stable working surfaces for all mass soil mixing operations. The Contractor shall provide timber crane mats of sufficient width and length to form a stable working platform for the mixing equipment and other support equipment.

8.4 The Contractor shall design, construct, and maintain temporary embankment and slope stabilization measures during the entire mass soil mixing operation to assure stability of both the existing and widened roadway embankments. A professional engineer registered in the state of North Carolina with a minimum five (5) years of experience in geotechnical engineering shall design the temporary embankment and slope stabilization measures and seal all plans and supporting engineering analysis and calculations. Submit the design plans and supporting engineering analysis and calculations as specified in Section 3.2 of this provision.

8.5 The Contractor shall mobilize and maintain a sufficient number of personnel and equipment to meet the schedule completion dates and other milestones. The Contractor shall coordinate all mass soil mixing operations with all other aspects of the work in the contract, including maintenance of traffic, traffic phasing, embankment construction, culvert construction, impervious dikes, and temporary drainage pipe installation and maintenance.

8.6 The Contractor shall design a mass soil mixing sequence layout to achieve the plan area coverage as designated on the contract plans, to the required elevations and limits. The total depth of penetration shall be measured and recorded. Pre-measured marks on the mixing tool may be used to determine the depth of mixing. The Contractor shall perform the mass soil mixing operation in such a manner to produce a homogeneous mass of mixed soils meeting all of the acceptance criteria specified in this provision.

8.7 At all times during and at completion of mass soil mixing operations, the site shall be maintained clear of all debris. Any spoil material shall be piped or channeled to holding ponds or other retention structures within the work area. If approved by the Resident Engineer, the Contractor may remove and satisfactorily dispose of spoil material in an approved off-site location provided by the Contractor. The Contractor shall take all necessary precautions and implement measures to prevent any materials from the mass soil mixing operation from entering storm drain structures, drainage courses, other utility lines, or from leaving the site via surface runoff. The Contractor shall prevent any materials from migrating to any water body. In the event any materials enter storm drain structures, drainage courses, or other utilities, including, but not limited to, surface water bodies beyond the limits of the mass soil mixing operations, 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 mass soil mixing operations to conform to the in-water construction moratorium, sedimentation and turbidity

control requirements, and all other regulatory requirements of federal, state, and local agencies having jurisdiction over the work.

8.8 The Soil mixing tool shall penetrate the ground as the binder powder or grout is injected into the soil from a nozzle located on the mixing tool. The tool is rotated at a high speed while it is moved back and forth through a known volume of soil until the designed weight of binder or injection rate of grout has been added. The binder take (or injection rate) per cubic meter of soil shall be adjusted upwards if minimum strength parameters cannot be obtained. Pumps will be used to transfer the binder from the pressure vessel to the Soil Mixing rig. The pressure vessel will be equipped with a load cell which indicates the weight of the binder in the vessel. Inject a known weight of binder into a known volume of soil to achieve the required binder concentration. Inject binder or grout by air pressure as the mixing tool advances through the soil. The number of passes necessary for either mixing or reagent injection must be submitted for review and acceptance before proceeding with production mixing.

8.9 Alert the Engineer immediately if the installation process is interrupted due to obstructions or a dense layer above the planned mixing elevation. Obstructions shall be penetrated with approved methods of either removing the obstructions or loosening them, including any dense soil layers, sufficiently to allow Soil Mixing unless otherwise directed by the Engineer. Remove underground obstructions either before or during mass soil mixing in accordance with the *Obstruction Removal for Mass Soil Mixing* special provision.

8.10 The operator shall monitor and adjust as necessary during soil mixing the feeding of material, the injection air pressure, and the rates of rotation. All metering equipment shall be calibrated at the beginning of the project and as frequently as recommended by the metering equipment manufacturer. Submit the calibration results to the Engineer. Keep the injection of binder within ten (10) percent of the target unit weight per volume.

8.11 Within 24 hours of completion of the mass soil mixing operation, place a separation fabric on the entire surface of freshly mixed soil area and cover it with 0.6 m thickness of the common borrow material in one lift for embankment construction meeting the NCDOT Standard Specifications for Road and Structures. Use a light weight equipment equal to D-6 dozer or smaller to place the borrow material. No other equipment or construction traffic will be allowed until the mixed soil mass has attained the required strength. Wait until the mixed soil mass achieves the required design strength specified in the acceptance criteria herein. The Contractor shall not place any other fill materials over the mass soil mixing area until the mixed soil mass has attained the required strength. After the mixed soil mass has attained the required strength, the cover material shall be compacted to the required density specified in the NCDOT Standard Specifications. Do not place vibratory rollers on the mixed soil mass until strength requirements have been achieved.

8.12 Use a mix design to produce the completed and cured mixed soil mass that meets the acceptance criteria specified in Section 11.0 of this provision. However, ensure the stiffness of the completed mixed soil mass will permit installation of sheet piles and impervious dike for culvert construction.

9.0 QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM

9.1 The Contractor shall implement a Quality Assurance and Quality Control (QA/QC) program to confirm the mass soil mixing work satisfies the specified performance requirements and acceptance criteria. The QA-QC program shall be implemented as part of the mass soil mixing work, at no additional cost to the Department.

9.2 The Contractor shall undertake general Quality Control for construction of homogeneous mixed soil mass, which shall include, at a minimum, real time (computer) monitoring and graphical recording of the following soil mixing parameters continuously throughout the depth of each operation:

a. Drilling and mixing depth

b. Mixing tool penetration and withdrawal rates

c. Mixing tool rotation speeds

d. Binder or grout injection rate of each auger

e. Amperage resistance to penetration, if applicable.

9.3 The Contractor shall obtain, form, preserve, cure, and transport the core samples, including all sample labeling and documentation in the format accepted by the Engineer.

9.4 QC Daily Reports shall be submitted for each work shift, within 24 hours of the end of each work shift. Each QC Daily Report shall document progress of the mass soil mixing construction, present the results of QC parameter monitoring, and present the results of the strength testing of wet-grab samples and continuity of core samples.

9.5 The QC Daily Report shall, at a minimum, include the following results of the QC parameters monitored for each mass soil mixing operation:

a. Identification of Area of Work, by way of geographic orientation and stations/offsets

b. Rig number and names of the Superintendent and the Operator

c. Date and time (start and finish) of each operation

d. Mass soil mixing treated surface area, top and bottom elevations, and volume.

e. Binder or grout injection pressure, rate and volume

f. Date, time, plan location, and elevation and other details of all mass soil mix wet grab samples and any other samples taken during the work shift, and the names of persons responsible for obtaining the wet samples

g. Description of obstructions, interruptions, or other difficulties experienced during installation and how they were resolved, and notes of observations of any unusual behavior of any equipment during the mass soil mixing operation

h. Graphical results derived from real time (computer) monitoring for each rig operation at each 0.3 meter of penetration and withdrawal, and for every minute of mixing tool rotation without vertical motion:

1. Shaft rotation speed and revolution number at each 0.3 meter of penetration.

2. Penetration and withdrawal rates in meter per minute vs. depth.

3. Quantity of binder or grout injection of each rig operation at every 0.3 meter vertical interval for insertion, mixing, and withdrawal.

10.0 TESTING REQUIREMENTS

The Contractor shall hire a geotechnical firm to conduct the following testing to verify that the mass soil mixing product meets the acceptance criteria specified in Section 11.0 of this provision. Use a geotechnical firm prequalified by the Contractual Services Unit of the Department for each type of testing. The Engineer reserves the right to request additional testing at no additional cost to the Department if the test was performed improperly or the test results are inconclusive or unreliable. In addition, the Contractor shall provide access for the Department's personnel to perform its own testing such as coring and dynamic cone penetration testing to assure the mass soil mixing product meets the design requirements.

10.1 Unconfined Compressive Testing of Wet Samples

The Contractor shall hire a geotechnical firm meeting the prequalification requirements for both drilling for geotechnical investigations (work code 3050) and laboratory and technician certification to collect wet samples for unconfined compressive testing. After completion of the mass soil mixing of every 200 square meters of surface area, collect a minimum of one sample at every two meter depth of the treated soil mass as directed by the Engineer. Prepare the test specimens and perform the compressive strength tests in accordance with the ASTM D 1633, except that soaking is not required.

10.2 Cone Penetration Test (CPT)

The Contractor shall hire a geotechnical firm meeting the prequalification requirements for both geotechnical engineering services of roadway foundation investigation and design and drilling for geotechnical investigations (work code 3050) to conduct cone penetration tests as specified

herein. The firm shall also have a minimum three (3) years of CPT experience and shall use a CPT rig capable of performing the test as specified herein. Conduct a minimum of one CPT per 100 square meter of mass soil mixing area a minimum of seven days after completion of the mass soil mixing work at a location designated by the Engineer. The CPT shall be performed down to a depth of two meters below the bottom of the mass soil mixing, unless penetration refusal occurs as determined by the Engineer.

11.0 ACCEPTANCE CRITERIA

The completed mass soil mixing shall meet all of the following requirements for an element to be considered acceptable and compliant. If any item listed below is not met, the affected area as determined by the Engineer shall be considered as defective and shall be subject to a remedial work. No work shall be performed in the defective area until the Engineer approves the remedial measures proposed by the Contractor. The Engineer will notify the Contractor of acceptance or rejection of each mass soil mixing element within three (3) business days from the date all construction records and the results of the tests (UCT and CPT) are received from the Contractor.

11.1 The limits of the mass soil mixing in both horizontal and vertical dimensions shall be as shown in the contract plans or as directed by the Engineer.

11.2 All construction records including the QA/QC records have been submitted to the Engineer and demonstrate that the mass soil mixing operation was done in conformance with all of the requirements specified in this provision and produces a homogeneously mixed soil mass.

11.3 The results of the unconfined compressive testing of wet samples as specified in Section 10.1 show an average and a minimum unconfined compressive strength not less than 165 KPa and 83 KPa at seven (7) days, respectively.

11.4 The Cone Penetration Test (CPT) as specified in Section 10.2 demonstrates a homogeneous and thorough treatment of the mass soil mixing throughout the entire depth of penetration. In addition, the CPT results show a minimum average corrected cone resistance (q_t) of 1,100 KPa within any one (1) meter interval of the mass soil mixing depth. The cone resistance (q_c) shall be corrected to q_t to account for pore water effects in accordance with ASTM D5778. If CPT refusal occurs after three (3) attempts within two (2) meters by two (2) meters area, this section is considered to meet the CPT requirements.

11.5 Any additional test conducted by the Engineer confirms that the mass soil mixing product meets the acceptance criteria stated above.

12.0 REMEDIAL WORK

The Contractor shall submit a plan of remedial work for the mass soil mixing area determined by the Engineer as defective based on the acceptance criteria in Section 11.0. The Engineer will review the submittal and approve or reject it within five (5) business days from the date the submittal is received. All remedial work shall be performed in accordance with this provision

including the acceptance criteria unless otherwise approved by the Engineer. The Contractor shall perform all remedial work at his own expense. No additional compensation or time extension will be made for any remedial work.

13.0 MEASUREMENT AND PAYMENT

The quantity of mass soil mixing to be paid for shall be the quantity of the completely treated and accepted soil mass in cubic meters. Measurement shall be made from the limits of mass soil mixing shown on the plans or from the revised limits as directed by the Engineer. No separate measurement for payment will be made of any remedial work. No separate measurement for payment will be made of the temporary embankment and slope stabilization since this work is considered as incidental to the mass soil mixing.

The quantity of mass soil mixing measured as specified above will be paid for at the contract unit price per cubic meter of "Mass Soil Mixing". The unit bid price for this pay item shall include the cost of furnishing all equipment, labor, and materials, temporary embankment and slope stabilization, mobilization, testing, QA/QC, remedial work, and incidentals necessary to complete the required work. Temporary shoring for maintenance of traffic, impervious dike for mass soil mixing, nonwoven fabric for soil separation, settlement monitoring, embankment fill, and surcharge placement and removal will be measured and paid for separately.

Pay Item:

Mass Soil Mixing ..... Cubic Meter

SURCHARGE PLACEMENT, MAINTENANCE AND REMOVAL:

Construct the embankment between Stations indicated on the plans, to a point 0.6 meter above finished graded roadway section in order to surcharge the embankment. Place the surcharge earth material 0.6 meter above finished graded roadway section or as directed by the Engineer to the limits as shown on the plans. Compact the surcharge material as normal roadway embankment.

Notify the Engineer when the waiting period is ready to begin.

Maintain the embankments at an elevation of 0.6 meter above finished graded roadway section during the waiting period.

Completed sections of roadway shall be restored to full surcharge after it has settled a maximum of 150 mm. Surcharge earth material required to maintain this elevation will be paid for at the contract unit price per cubic meter for "Borrow Excavation", unless Unclassified Excavation was utilized for surcharge placement.

The surcharge earth material shall remain in place for three (3) months or as directed by the Engineer. Remove the surcharge earth material after the material has remained in place for the

required waiting period. Also, remove the embankment fill material from the culvert areas at this time.

The placement of the surcharge material above finished graded roadway section will be measured and paid for at the contract unit price per cubic meter for "Borrow Excavation", unless Unclassified Excavation was utilized for surcharge placement.

Removal of the surcharge earth material above graded roadway section and removal of the embankment fill material from the culvert areas will be measured and paid for at the contract unit price per cubic meter for "Unclassified Excavation".

IMPERVIOUS DIKE FOR MASS SOIL MIXING:

DESCRIPTION

The work covered by this provision consists of furnishing all equipment, labor, and materials for installing, maintaining, and removing impervious dike for mass soil mixing as specified herein, as shown on the contract plans, and as directed by the Engineer. The impervious dike shall provide a complete barrier along the limits of mass soil mixing and contain all materials including, but not limited to, reagent binder, grout, water, and mixed soil, within the limits of mass soil mixing during mixing operation and curing of the mixed soil. Also, it shall not permit seepage of water into the mass soil mixing site during mixing operation and curing of the mixed soil.

The top of the impervious dike for mass soil mixing shall be at a minimum one (1) meter above the ground surface or water elevation, whichever is higher. The impervious dike for mass soil mixing shall extend at a minimum to the bottom of the mass soil mixing. The impervious dike for mass soil mixing shall be a steel sheet pile with an ample strength to withstand the pressures imposed by the surrounding soils and water, unless other types of impervious dike for mass soil mixing that meet the requirements specified herein are proposed by the Contractor and approved by the Engineer.

Before beginning of impervious dike construction, the Contractor shall submit a proposed design including detailed design calculations of impervious dike for mass soil mixing, either a sheet pile or other types, for the Engineer's review and approval. A professional engineer registered in the state of North Carolina with a minimum five (5) years of experience in geotechnical engineering shall design the impervious dike for mass soil mixing and seal all plans and supporting engineering analysis and calculations. Also, the mass soil mixing specialty contractor shall review and accept the design for comparability with his methods and procedures of mass soil mixing work prior to submission to the Department. Send the proposed design submittal directly to both the Resident Engineer and the Geotechnical Engineering Unit (GEU). GEU's mailing address is as follows: Mr. K. J. Kim, Eastern Regional Geotechnical Office, 3301 Jones Sausage Road, Suite 100, Garner, NC 27529. Within ten (10) business days of the receipt of the submittal, the Engineer will notify the Contractor of approval or rejection of the proposed design.

MATERIALS

Steel sheet piles shall meet the requirements of ASTM A328. Provide Type 7 Contractor's Certifications in accordance with Article 106-3 of the *Standard Specifications* for all materials used for construction of impervious dike for mass soil mixing. Load, transport, unload and store all materials such that they are kept clean and free of damage.

CONSTRUCTION

Install sheet piles in accordance with the applicable parts of Section 452 of the *Standard Specifications*. Install and interlock sheet piling as shown on the plans with a tolerance of 40mm per meter from vertical. Perform welding in accordance with Article 1072-20 of the *Standard Specifications*. The Contractor shall maintain the impervious dike until it is no longer needed as determined by the Engineer. Remove the impervious dike in a manner that does not damage or disturb the mass soil mixing treated soils, roadway embankment, culvert, or surrounding areas.

MEASUREMENT AND PAYMENT

The quantity of Impervious Dike for Mass Soil Mixing to be paid for shall be the actual number of linear meters of impervious dike constructed and measured in place from end to end of installation that has been completed and accepted. Quantity to be measured for payment is the linear length in a straight line along the horizontal alignment of the impervious dike for mass soil mixing.

The quantity of Impervious Dike for Mass Soil Mixing measured as specified above will be paid for at the contract unit price per linear meter of Impervious Dike for Mass Soil Mixing. Such price and payment shall be considered as full compensation for furnishing all labor, tools, equipment, materials and all incidentals necessary to install, maintain, and remove the impervious dike and complete the work as described in this provision.

Payment will be made under:

Pay Item	**Pay Unit**
Impervious Dike for Mass Soil Mixing	Linear Meter

OBSTRUCTION REMOVAL FOR MASS SOIL MIXING:

Description

Remove subsurface obstructions including tree stumps and roots in excess of 6" in diameter as necessary to perform Mass Soil Mixing. Backfill Obstruction Removal for Mass Soil Mixing with Borrow Material. Removal of stumps as part of clearing and grubbing in Section 200 of the Standard Specifications is not considered as obstruction removal described in this provision.

Materials

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Borrow Material	1018

Construction Methods

Remove subsurface obstructions including tree stumps and roots in excess of 6" in diameter as necessary to perform Mass Soil Mixing. Utilize equipment in obstruction removal and backfilling operations of such weight, size, and capability to efficiently remove and replace the material within the limits established by the Engineer. Use equipment of a size and weight that will not displace the underlying or adjacent material. Due to soft ground conditions, working off mats may be necessary.

Backfill Obstruction Removal for Mass Soil Mixing with Borrow Material. Borrow Material shall be furnished in accordance with Section 230 of the *Standard Specifications*.

Measurement and Payment

Obstruction Removal for Mass Soil Mixing will be measured and paid for at the contract unit price per cubic meter of material removed. The contract unit prices for *Obstruction Removal for Mass Soil Mixing* as described above will be full compensation for excavating, hauling, handling, disposal of excavated material, and any Mass Soil Mixing equipment and labor down time associated with obstruction removal prior to and/or during Mass Soil Mixing.

Borrow Material will be measured and paid for as *Borrow Excavation* in accordance with Section 230 of the *Standard Specifications*.

Payment will be made under:

Pay Items:	Pay Unit
Obstruction Removal for Mass Soil Mixing	Cubic Meter
Borrow Excavation	Cubic Meter

NONWOVEN FABRIC FOR SOIL SEPARATION

Description:

This work consists of furnishing and installing nonwoven fabric for soil separation in accordance with this provision or as directed by the Engineer. The work shall include maintaining the fabric in the required configuration until completion and acceptance of overlying work items. Place fabric at the locations shown in the plans or as directed by the Engineer.

Material:

The nonwoven fabric for soil separation shall be made of polyester or polypropylene. The fabric shall meet the following physical requirements:

Fabric Properties	Test Method	Requirements
Grab Tensile Strength	ASTM D-4632	530 N
Elongation	ASTM D-4632	50% Max.
Puncture Strength	ASTM D-4833	310 N
Trapezoidal Tear	ASTM D-4533	220 N
Max. Apparent Opening Size	ASTM D-4751	# 70 US Sieve
Permittivity	ASTM D-4491	1.80 sec^{-1}
UV Resistance, % Retained	ASTM D-4355	70 %

Any sampled roll must meet or exceed the minimum values in this table. Furnish a Type 2 Typical Certified Mill Test Report for the nonwoven fabric for soil separation in accordance with Section 106-3 of the NCDOT Standard Specifications; however, the material shall be subject to inspection, test, or approval by the Engineer. Four weeks prior to construction of nonwoven fabric for soil separation, provide a sample of one (1) meter by one (1) meter nonwoven fabric for soil separation to the Engineer for review and approval.

Construction Methods:

Install nonwoven fabric for soil separation in accordance with Article 270-3 of the Standard Specifications.

Method of Measurement:

The quantity of fabric to be paid for will be the number of square meter of surface area of the ground on which the fabric has been acceptably placed. No separate measurement will be made of overlapping fabric for payment.

Basis of Payment:

The quantity of fabric, measured as provided above, will be paid for at the contract unit price per square meter for "Nonwoven Fabric for Soil Separation". Such price and payment will be full compensation for furnishing, placing, and all incidentals necessary to complete the work.

Pay Item: Nonwoven Fabric for Soil Separation ..... Square Meter

ASPHALT PAVEMENTS - SUPERPAVE:
(7-18-06)(Rev 3-15-11) M6 R01

Revise the *2006 Metric Standard Specifications* as follows:

Page 6-2, Article 600-9 Measurement and Payment, delete the second paragraph.

Page 6-10, Subarticle 609-5(C)(2), Required Sampling and Testing Frequencies, first partial paragraph at the top of the page, delete last sentence and replace with the following:

If the Engineer allows the mix to remain in place, payment will be made in accordance with Article 105-3.

Page 6-10, Subarticle 609-5(C)(2), Quality Control Minimum Sampling and Testing Schedule, delete first paragraph and replace with the following:

Sample and test the completed mixture from each mix design per plant per year at the following minimum frequency during mix production:

Second paragraph, delete the fourth sentence and replace with the following:

When daily production of each mix design exceeds 100 metric tons and a regularly scheduled full test series random sample location for that mix design does not occur during that day's production, perform at least one partial test series consisting of Items A and B in the schedule below.

Page 6-10, Subarticle 609-5(C)(2)(c) Maximum Specific Gravity, add after (AASHTO T 209):

or ASTM D 2041

Page 6-11, Subarticle 609-5(C)(2)(e) Tensile Strength Ratio (TSR), add a heading before the first paragraph as follows:

(i) Option 1

Insert the following immediately after the first paragraph:

(ii) Option 2

Mix sampled from truck at plant with one set of specimens prepared by the Contractor and then tested jointly by QA and QC at a mutually agreed upon lab site within the first 7 calendar days after beginning production of each new mix design.

Second paragraph, delete and replace with the following:

Test all TSR specimens required by either option noted above on either a recording test press or a test press that maintains the peak load reading after the specimen has broken.

Page 6-11, Subarticle 609-5(C)(3) Control Charts, delete the second sentence of the first paragraph and replace with the following:

For mix incorporated into the project, record full test series data from all regularly scheduled random samples or directed samples that replace regularly scheduled random samples, on control charts the same day the test results are obtained.

Page 6-12, Subarticle 609-5(C)(3) Control Charts, fourth paragraph on this page, delete the last sentence and replace with the following:

Denote the moving average control limits with a dash green line and the individual test limits with a dash red line.

Subarticle 609-5(C)(3)(a), (b) and (c), replace (a) (b) and (c) with the following:

(a) A change in the binder percentage, aggregate blend, or G_{mm} is made on the JMF, or,

(b) When the Contractor elects to stop or is required to stop production after one or two moving average values, respectively, fall outside the moving average limits as outlined in Subarticle 609-5(C)(6) or,

(c) If failure to stop production after two consecutive moving averages exceed the moving average limits occurs, but production does stop at a subsequent time, re-establish a new moving average beginning at the actual production stop point.

Subarticle 609-5(C)(4) Control Limits, replace the first paragraph and the CONTROL LIMITS Table on page 6-13 with the following:

The following are established as control limits for mix production. Apply the individual limits to the individual test results. Control limits for the moving average limits are based on a moving average of the last 4 data points. Apply all control limits to the applicable target source.

CONTROL LIMITS

Mix Control Criteria	Target Source	Moving Average Limit	Individual Limit
2.36 mm Sieve	JMF	±4.0 %	±8.0 %
0.075 mm Sieve	JMF	±1.5 %	±2.5 %
Binder Content	JMF	±0.3 %	±0.7 %
VTM @ N_{des}	JMF	±1.0 %	±2.0 %
VMA @ N_{des}	Min. Spec. Limit	Min Spec. Limit	-1.0%
$P_{0.075}$/ P_{be} Ratio	1.0	±0.4	±0.8
%G_{mm} @ N_{ini}	Max. Spec. Limit	N/A	+2.0%
TSR	Min. Spec. Limit	N/A	- 15%

Page 6-13, Subarticle 609-5(C)(5) Warning Bands, delete this subarticle in its entirety.

Pages 6-13 through 6-15, Subarticle 609-5(C)(6) Corrective Actions, delete the word "warning" and replace with the words "moving average".

Page 6-13, Subarticle 609-5(C)(6) Corrective Actions, first paragraph, first sentence, delete and replace with the following:

Immediately notify the Engineer when moving averages exceed the moving average limits.

Page 6-14, Subarticle 609-5(C)(6) Corrective Actions, second paragraph, delete and replace with the following:

Failure to stop production when required due to an individual mix test not meeting the specified requirements will subject all mix from the stop point tonnage to the point when the next individual test is back on or within the moving average limits, or to the tonnage point when production is actually stopped, whichever occurs first, to being considered unacceptable.

Fifth full paragraph, delete the first, second, and third sentence and replace with the following:

Immediately notify the Engineer when any moving average value exceeds the moving average limit. If two consecutive moving average values for any one of the mix control criteria fall outside the moving average limits, cease production of that mix, immediately notify the Engineer of the stoppage, and make adjustments. The Contractor may elect to stop production after only one moving average value falls outside the moving average limits.

Page 6-14, Subarticle 609-5(C)(6) Corrective Actions, eighth paragraph, delete and replace with the following:

If the process adjustment improves the property in question such that the moving average after four additional tests is on or within the moving average limits, the Contractor may continue production with no reduction in payment.

Page 6-14, delete the last paragraph and the first paragraphs on Page 6-15, including the Table for Payment for Mix Produced in the Warning Bands and substitute the following:

If the adjustment does not improve the property in question such that the moving average after four additional individual tests is outside the moving average limits, the mix will be evaluated for acceptance in accordance with Article 105-3. Reduced payment for or removal of the mix in question will be applied starting from the plant sample tonnage at the stop point to the sample tonnage when the moving average is on or within the moving average limits. In addition, any mix that is obviously unacceptable will be rejected for use in the work.

Page 6-15, Second full paragraph, delete and replace with the following:

Failure to stop production and make adjustments when required due to two consecutive moving average values falling outside the moving average limits will subject all mix produced from the stop point tonnage to the tonnage point when the moving average is back on or within the moving average limits or to the tonnage point when production is actually stopped, whichever occurs first, to being considered unacceptable. Remove this material and replaced with materials that comply with the Specifications at no additional costs to the Department, unless otherwise approved. Payment will be made for the actual quantities of materials required to replace the removed quantities, not to exceed the original amounts.

Page 6-16, Subarticle 609-5(D)(1) General, delete the last paragraph, and replace with the following:

Perform the sampling and testing at the minimum test frequencies as specified above. Should the density testing frequency fail to meet the minimum frequency as specified above, all mix without the required density test representation will be considered unsatisfactory. If the Engineer allows the mix to remain in place, payment will be made in accordance with Article 105-3.

Page 6-18, Subarticle 609-5(D)(4) Nuclear Gauge Density Procedures, third paragraph, insert the following as the second sentence:

Determine the Daily Standard Count in the presence of the QA Roadway Technician or QA Nuclear Gauge Technician on days when a control strip is being placed.

Page 6-18, Subarticle 609-5(D)(5) Limited Production Procedure, delete the last paragraph including (a), (b), (c) and substitute the following:

Proceed on limited production when, for the same mix type and on the same contract, one of the following conditions occur (except as noted in the first paragraph below).

(a) Two consecutive failing lots, except on resurfacing*
(b) Three consecutive failing lots on resurfacing*
(c) Two consecutive failing nuclear control strips.

* Resurfacing is defined as the first new uniform layer placed on an existing pavement.

Page 6-20, Article 609-6 QUALITY ASSURANCE, DENSITY QUALITY ASSURANCE, insert the following items after item (E):

(F) By retesting Quality Control core samples from control strips (either core or nuclear) at a frequency of 100% of the frequency required of the Contractor;

(G) By observing the Contractor perform all standard counts of the Quality Control nuclear gauge prior to usage each nuclear density testing day; or

(H) By any combination of the above

Page 6-23 through Page 6-24, Subarticle 610-3(A) Mix Design-General, delete the fourth and fifth paragraphs and replace with the following:

Reclaimed Asphalt Pavement (RAP) or Reclaimed Asphalt Shingles (RAS) may be incorporated into asphalt plant mixes in accordance with Article 1012-1 and the following applicable requirements.

Reclaimed asphalt pavement (RAP) may constitute up to 50% of the total material used in recycled mixtures, except for mix Type S 12.5D, Type S 9.5D, and mixtures containing reclaimed asphalt shingle material (RAS). Reclaimed asphalt shingle (RAS) material may constitute up to 6% by weight of total mixture for any mix. When both RAP and RAS are used, do not use a combined percentage of RAS and RAP greater than 20% by weight of total mixture, unless otherwise approved. When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 20% but not more than 30% of the total binder in the completed mix, the virgin binder PG grade shall be one grade below (both high and low temperature grade) the binder grade specified in Table 610-2 for the mix type, unless otherwise approved. When the percent of binder contributed from RAS or a combination of RAS and RAP exceeds 30% of the total binder in the completed mix, the Engineer will establish and approve the virgin binder PG grade. Use approved methods to determine if any binder grade adjustments are necessary to achieve the performance grade for the specified mix type.

For Type S 12.5D and Type S 9.5D mixes, the maximum percentage of reclaimed asphalt material is limited to 20% and shall be produced using virgin asphalt binder grade PG 76-22. For all other recycled mix types, the virgin binder PG grade shall be as specified in Table 610-2A for the specified mix type.

When the percentage of RAP is greater than 20% but not more than 30% of the total mixture, use RAP meeting the requirements for processed or fractionated RAP in accordance with the requirements of Article 1012-1.

When the percentage of RAP is greater than 30% of the total mixture, use an approved stockpile of RAP in accordance with Subarticle 1012-1(C). Use approved test methods to determine if any binder grade adjustments are necessary to achieve the performance grade for the specified mix type. The Engineer will establish and approve the virgin asphalt binder grade to be used.

Page 6-28, Subarticle 610-3(C) Job Mix Formula, delete Table 610-2 and associated notes and replace with the following:

TABLE 610-2
SUPERPAVE MIX DESIGN CRITERIA

Mix Type	Design ESALs Millions (a)	Binder PG Grade (b)	Compaction Levels No. Gyrations @		Max. Rut Depth (mm)	Volumetric Properties (c)			
			N_{ini}	N_{des}		VMA % Min.	VTM %	VFA Min. - Max.	$\%G_{mm}$ @ N_{ini}
S-4.75A(e)	< 0.3	64 -22	6	50	-----	20.0	7.0 - 15.0	-----	-----
SF-9.5A	< 0.3	64 -22	6	50	11.5	16.0	3.0 - 5.0	70 - 80	≤ 91.5
S-9.5B	0.3 - 3	64 -22	7	65	9.5	15.5	3.0 - 5.0	65 - 80	≤ 90.5
S-9.5C	3 - 30	70 -22	7	75	6.5	15.5	3.0 - 5.0	65 - 78	≤ 90.5
S-9.5D	> 30	76 -22	8	100	4.5	15.5	3.0 - 5.0	65 - 78	≤ 90.0
S-12.5C	3 - 30	70 -22	7	75	6.5	14.5	3.0 - 5.0	65 - 78	≤ 90.5
S-12.5D	> 30	76 -22	8	100	4.5	14.5	3.0 - 5.0	65 - 78	≤ 90.0
I-19.0B	< 3	64 -22	7	65	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.5
I-19.0C	3 - 30	64 -22	7	75	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.0
I-19.0D	> 30	70 -22	8	100	-----	13.5	3.0 - 5.0	65 - 78	≤ 90.0
B-25.0B	< 3	64 -22	7	65	-----	12.5	3.0 - 5.0	65 - 78	≤ 90.5
B-25.0C	> 3	64 -22	7	75	-----	12.5	3.0 - 5.0	65 - 78	≤ 90.0

	Design Parameter	Design Criteria
All Mix Types	1. Dust to Binder Ratio ($P_{0.075}$ / P_{be})	0.6 – 1.4
	2. Retained Tensile Strength (TSR) (AASHTO T283 Modified)	85% Min. **(d)**

Notes:
(a) Based on 20 year design traffic.
(b) When Recycled Mixes are used, select the binder grade to be added in accordance with Subarticle 610-3(A). Payment for Binder Grade for recycled mixes shall be based solely on the grade for the specified mix type as shown in the above table.
(c) Volumetric Properties based on specimens compacted to N_{des} as modified by the Department.
(d) AASHTO T 283 Modified (No Freeze-Thaw cycle required). TSR for Type S 4.75A, Type B 25.0B, and Type B 25.0C mixes is 80% minimum.
(e) Mix Design Criteria for Type S 4.75A may be modified subject to the approval of the Engineer.

Page 6-28, Insert the following immediately after Table 610-2:

TABLE 610-2A
SUPERPAVE MIX DESIGN CRITERIA

	Percentage of RAP in Mix		
	Category 1	**Category 2**	**Category 3**
Mix Type	% RAP ≤20%	20.1% ≤ %RAP ≤ 30.0%	%RAP > 30.0%
All A and B Level Mixes, I19.0C, B25.0C	PG 64 -22	PG 64 -22	TBD
S9.5C, S12.5C, I19.0D	PG 70 -22	PG 64-22	TBD
S 9.5D and S12.5D	PG 76-22	N/A	N/A

Note: (1) Category 1 RAP has been processed to a maximum size of 50mm.
(2) Category 2 RAP has been processed to a maximum size of 25 mm by either crushing and or screening to reduce variability in the gradations.
(3) Category 3 RAP has been processed to a maximum size of 25 mm, fractionating the RAP into 2 or more sized stockpiles.
(4) Payment for binder grade shall be based solely on Table 610-2.

Page 6-29, Table 610-3 delete and replace with the following:

TABLE 610-3
ASPHALT PLACEMENT- MINIMUM TEMPERATURE REQUIREMENTS

Asphalt Concrete Mix Type	**Minimum Air Temperature**	**Minimum Surface Temperature**
ACBC, Type B 25.0B, C, B 37.5C	2°C	2°C
ACIC, Type I 19.0B, C, D	2°C	2°C
ACSC, Type S 4.75A, SF 9.5A, S 9.5B	4°C	10°C*
ACSC, Type S 9.5C, S 12.5C	7°C	10°C
ACSC, Type S 9.5D, S 12.5D	10°C	10°C

* 2°C if surface is soil or aggregate base for secondary road construction.

Page 6-36, Article 610-8 SPREADING AND FINISHING, third full paragraph, replace the first sentence with the following:

Use the 9 m minimum length mobile grade reference system or the non-contacting laser or sonar type ski *with at least four referencing stations mounted on the paver at a minimum length of 7.3 m* to control the longitudinal profile when placing the initial lanes and all adjacent lanes of all layers, including resurfacing and asphalt in-lays, unless otherwise specified or approved.

Page 6-37, Article 610-8 SPREADING AND FINISHING, delete the fourth paragraph on page 6-37 and replace with the following:

Use a Material Transfer Vehicle (MTV) when placing all asphalt concrete plant mix pavements which require the use of asphalt binder grade PG 76-22 and for all types of OGAFC, unless otherwise approved. Use a MTV for all surface mix regardless of binder grade placed on

Interstate facilities. Where required above, utilize the MTV when placing all full width travel lanes, collector lanes, ramps, and loops.

Page 6-41, Article 610-13 DENSITY ACCEPTANCE, delete the second full paragraph and replace with the following:

As an exception, when the first layer of mix is a surface course and is being placed directly on an unprimed aggregate or soil base, the layer will be included in the "Other" construction category.

Delete the formula and description in the middle of the page and replace with the following:

$$PF = 100 - 10(D)^{1.465}$$

Where: PF = Pay Factor (computed to 0.1%)
D = the deficiency of the lot average density, not to exceed 2.0%

Page 6-42, Article 610-15 MEASUREMENT AND PAYMENT, fourth paragraph, delete and replace with the following:

Furnishing asphalt binder will be paid for as provided in Article 620-4.

Page 6-43, Article 620-4 MEASUREMENT AND PAYMENT, modify as follows:

Second paragraph, delete the first sentence and replace with the following:
Where recycled plant mix is being produced, the grade of asphalt binder shall be paid for based on the grade for the specified mix type as shown in Table 610-2.

Sixth paragraph, delete the last sentence.

Seventh paragraph, delete the paragraph and replace with the following:

The adjusted contract unit price will then be applied to the theoretical quantity of asphalt binder authorized for use in the plant mix placed during the partial payment period involved, except that where recycled plant mix is used, the adjusted unit price will be applied only to the theoretical number of tons of additional asphalt binder materials required by the job mix formula.

Add the following pay item:

Pay Item	**Pay Unit**
Asphalt Binder for Plant Mix, Grade PG 70-28	Metric Ton

Page 6-49, Article 650-5 CONSTRUCTION REQUIREMENTS delete the seventh paragraph on page 6-49 beginning "Use a Material Transfer Vehicle (MTV)..." and replace with the following:

Use a Material Transfer Vehicle (MTV) when placing all asphalt concrete plant mix pavements which require the use of asphalt binder grade PG 76-22 and for all types of OGAFC, unless otherwise approved. Use a MTV for all surface mix regardless of binder grade placed on Interstate facilities. Where required above, utilize the MTV when placing all full width travel lanes, collector lanes, ramps, and loops.

Page 6-57, TABLE 660-1 MATERIAL APPLICATION RATES AND TEMPERATURES, add the following:

Type of Coat	Grade of Asphalt	Asphalt Rate L/M^2	Application Temperature °C	Aggregate Size	Aggregate Rate $KG./M^2$ Total
Sand Seal	CRS-2 or CRS-2P	1.00-1.36	66-79	Blotting Sand	6-8

Page 6-62, Subarticle 660-9(B) Asphalt Seal Coat, add the following as sub-item (5):

(5) Sand Seal

Place the fully required amount of asphalt material in one application and immediately cover with the seal coat aggregate. Uniformly spread the fully required amount of aggregate in one application and correct all non-uniform areas prior to rolling.

Immediately after the aggregate has been uniformly spread, perform rolling.

When directed, broom excess aggregate material from the surface of the seal coat.

When the sand seal is to be constructed for temporary sealing purposes only and will not be used by traffic, other grades of asphalt material meeting the requirements of Articles 1020-6 and 1020-7 may be used in lieu of the grade of asphalt required by Table 660-1 when approved.

Page 6-63, Article 661-1 DESCRIPTION, add the following as the 2nd paragraph:

Provide and conduct the quality control and required testing for acceptance of the UBWC in accordance with *Quality Management System for Asphalt Pavements (OGAFC, PADL, and Ultra-Thin HMA Version)*, included in the contract.

Page 6-63, Article 661-2 MATERIALS, add the following after Asphalt Binder, Grade 70-28:

Item	Section
Asphalt Binder, Grade 76-22	1020
Reclaimed Asphalt Shingles	1012

Page 6-65, Subarticle 661-2(E), Asphalt Binder For Plant Mix, Grade PG 70-28, rename as ASPHALT BINDER FOR PLANT MIX and add the following as the first paragraph:

Use either PG 70-28 or PG 76-22 binder in the mix design. Where PG 76-22 is being used in the production of Ultra-thin, the grade of asphalt binder to be paid for will be PG 70-28, unless otherwise approved.

Page 6-65, Subarticle 661-2(G) Composition of Mix, add the following as the third sentence of the first paragraph:

The percent of asphalt binder contributed from the RAS shall not exceed 20% of the total binder in the completed mix.

Page 6-66, Article 661-2(G) Composition of Mix, replace Table 661-4 and associated notes with the following:

TABLE 661-4 – MIXTURE DESIGN CRITERIA

Gradation Design Criteria (% Passing by Weight)				
Standard Sieves		**12.7 mm Type A**	**9.5 mm Type B**	**6.4 mm Type C**
ASTM	**mm**	**(% Passing by Weight)**		
¾ inch	19.0	100		
½ inch	12.5	85 - 100	100	
3/8 inch	9.5	60 - 80	85 - 100	100
#4	4.75	28 - 38	28 – 44	40 - 55
#8	2.36	19 - 32	17 – 34	22 - 32
#16	1.18	15 - 23	13 - 23	15 - 25
#30	0.600	10 - 18	8 - 18	10 - 18
#50	0.300	8 - 13	6 - 13	8 - 13
#100	0.150	6 - 10	4 - 10	6 - 10
#200	0.075	4.0 - 7.0	3.0 - 7.0	4.0 - 7.0

Mix Design Criteria			
	12.7 mm Type A	**9.5 mm Type B**	**6.4 mm Type C**
Asphalt Content, %	4.6 - 5.6	4.6 - 5.8	5.0 – 5.8
Draindown Test, AASHTO T 305	0.1% max.		
Moisture Sensitivity, AASHTO T 283*	80% min.		
Application Rate, Kg/M^2	49	38	27
Approximate Application Depth, mm	19.0	15.9	12.5
Asphalt PG Grade, AASHTO M 320	PG 70-28 or PG 76-22	PG 70-28 or PG 76-22	PG 70-28 or PG 76-22

NOTE: *Specimens for T-283 testing are to be compacted using the SUPERPAVE gyratory compactor. The mixtures shall be compacted using 100 gyrations to achieve specimens approximately 95 mm in height. Use mixture and compaction temperatures recommended by the binder supplier.

Page 6-66, Subarticle 661-3(A) Equipment, add the following as the first paragraph:

Use asphalt mixing plants in accordance with Article 610-5 of the *Standard Specifications*.

Page 6-68, Subarticle 661-3(C), Application of Ultra-thin Bonded Wearing Course, delete the first paragraph and add the following as the first and second paragraphs:

Use only one asphalt binder PG grade for the entire project, unless the Engineer gives written approval.

Do not place Ultra-thin Bonded Wearing Course between October 31 and April 1, when the pavement surface temperature is less than 10°F or on a wet pavement. In addition, when PG 76-22 binder is used in the JMF, place the wearing course only when the road pavement surface temperature is 16°F or higher and the air temperature in the shade away from artificial heat is 16°F or higher.

Page 10-33, Subarticle 1012-1(A) General, add the following at the end of the last paragraph, last sentence:

or ultra-thin bonded wearing course.

Page 10-34, Table 1012-1, delete the entries for OGAFC and add new entries for OGAFC and a row for UBWC with entries:

Mix Type	Coarse Aggregate Angularity [(b)] ASTM D5821	Fine Aggregate Angularity % Minimum AASHTO T304 Method A	Sand Equivalent % Minimum AASHTO T176	Flat & Elongated 5:1 Ratio % Maximum ASTM D4791 Section 8.4
S 9.5 D	100/100	45	50	10
OGAFC	100/100	N/A	N/A	10
UBWC	100/85	40	45	10

Delete Note (c) under the Table 1012-1 and replace with the following:

(c) Does not apply to Mix Types SF 9.5A and S 9.5B.

Page 10-34, Subarticle 1012-1(B)(6) Toughness (Resistance to Abrasion), add as the last sentence:

The percentage loss for aggregate used in UBWC shall be no more than 35%.

Page 10-35, Subarticle 1012-1(F) Reclaimed Asphalt Shingle Material (RAS), insert the following immediately following the first paragraph:

(1) Mix Design RAS

Incorporate RAS from stockpiles that have been tested for uniformity of gradation and binder content prior to use in an asphalt mix design.

(2) Mix Production RAS

New Source RAS is defined as acceptable material which was not included in the stockpile when samples were taken for mix design purposes. Process new source RAS so that all materials will pass a 12.5 mm sieve prior to introduction into the plant mixer unit.

After a stockpile of processed RAS has been sampled and mix designs made from these samples, do not add new source RAS to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAS before blending with the existing stockpile.

Store new source RAS in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAS may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity prior to its use in the recycled mix.

RAS contamination including but not limited to excessive dirt, debris, clean stone, concrete will not be allowed.

Field approval of new source RAS will be based on the table below and volumetric mix properties on the mix with the new source RAS included. Provided these tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAS may continue to be used.

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of the table below, do not use the new source RAS unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

NEW SOURCE RAS GRADATION and BINDER TOLERANCES
(Apply Tolerances to Mix Design Data)

0-6% RAS	
P_b %	**±1.6%**
Sieve Size (mm)	**Tolerance**
9.5	±1
4.75	±5
2.36	±4
1.18	±4
0.300	±4
0.150	±4
0.075	±2.0

Page 10-35 through 10-37, Subarticle 1012-1(G), delete this in its entirety and replace with the following:

(G) Reclaimed Asphalt Pavement (RAP)

(1) Mix Design RAP

Incorporate RAP from stockpiles or other sources that have been tested for uniformity of gradation and binder content prior to use in an asphalt mix design. Use reclaimed asphalt pavement that meets all requirements specified for *one of* the following *two* classifications.

(a) Millings

Existing reclaimed asphalt pavement (RAP) that is removed from its original location by a milling process as specified in Section 607. Millings should be such that it has a uniform gradation and binder content and all materials will pass a 50 mm sieve prior to introduction into the plant mixer unit.

(b) Processed RAP

RAP that is processed in some manner (possibly by crushing and/or use of a blending method) to produce a uniform gradation and binder content in the RAP prior to use in a recycled mix. Process RAP so that all materials have a uniform gradation and binder content and will pass a 25 mm sieve prior to introduction into the plant mixer unit.

(c) Fractionated RAP

Fractionated RAP is defined as having two or more RAP stockpiles, where the RAP is divided into coarse and fine fractions. Grade RAP so that all materials will pass a 25 mm sieve. The coarse RAP stockpile shall only contain material retained on a 9.5 mm screen, unless otherwise approved. The fine RAP stockpile shall only contain material passing the 9.5 mm screen, unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 9.5 mm screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse, fine, or the combination of both. Utilize a separate cold feed bin for each stockpile of fractionated RAP used.

(d) Approved Stockpiled RAP

Approved Stockpiled RAP is defined as fractionated RAP which has been isolated and tested for asphalt content, gradation, and asphalt binder characteristics with the intent to be used in mix designs with greater than 30% RAP materials. Fractionate the RAP in accordance with

Subarticle 1012-1(G)(1)(c). Utilize a separate cold feed bin for each approved stockpile of RAP used.

Perform extraction tests at a rate of 1 per 1000 metric tons of RAP, with a minimum of 5 tests per stockpile to determine the asphalt content and gradation. Separate stockpiles of RAP material by fine and coarse fractions. Erect and maintain a sign satisfactory to the Engineer on each stockpile to identify the material. Assure that no deleterious material is allowed in any stockpile. The Engineer may reject by visual inspection any stockpiles that are not kept clean, separated, and free of foreign materials.

Submit requests for RAP stockpile approval to the Engineer with the following information at the time of the request:

(1) Approximate tons of materials in stockpile
(2) Name or Identification number for the stockpile
(3) Asphalt binder content and gradation test results
(4) Asphalt characteristics of the Stockpile.

For the Stockpiled RAP to be considered for approval, the gradation and asphalt content shall be uniform. Individual test results, when compared to the target, will be accepted if within the tolerances listed below:

APPROVED STOCKPILED RAP GRADATION and BINDER TOLERANCES
(Apply Tolerances to Mix Design Data)

P_b %	±0.3%
Sieve Size (mm)	**Percent Passing**
25.0	±5%
19.0	±5%
12.5	±5%
9.5	±5%
4.75	±5%
2.36	±4%
1.18	±4%
0.300	±4%
0.150	±4%
0.075	±1.5%

Note: If more than 20% of the individual sieves are out of the gradation tolerances, or if more than 20% of the asphalt binder content test results fall outside the appropriate tolerances, the RAP shall not be used in HMA unless the RAP representing the failing tests is removed from the stockpile.

Do not add additional material to any approved RAP stockpile, unless otherwise approved by the Engineer.

Maintain at the plant site a record system for all approved RAP stockpiles. Include at a minimum the following: Stockpile identification and a sketch of all stockpile areas at the plant site; all RAP test results (including asphalt content, gradation, and asphalt binder characteristics).

(2) Mix Production RAP

During mix production, use RAP that meets the criteria for one of the following categories:

(a) Mix Design RAP

RAP contained in the mix design stockpiles as described above may be used in all applicable JMFs. These stockpiles have been pretested: however, they are subject to required QC/QA testing in accordance with Subarticle 609-5(C)(2).

(b) New Source RAP

New Source RAP is defined as any acceptable material that was not included in the stockpile or other source when samples were taken for mix design purposes. Process new source RAP so that all materials have a uniform gradation and binder content and will pass a 50 mm sieve prior to introduction into the plant mixer unit.

After a stockpile of millings, processed RAP, or fractionated RAP has been sampled and mix designs made from these samples, do not add new source RAP to the original stockpile without prior field testing to insure gradation and binder uniformity. Sample and test new source RAP before blending with the existing stockpile.

Store new source RAP in a separate stockpile until the material can be sampled and tested for comparison with the original recycled mix design data. New source RAP may also be placed against the existing stockpile in a linear manner provided it is sampled for mix design conformity prior to its use in the recycled mix.

Unprocessed RAP is asphalt material that was not milled and/or has not been processed to obtain a uniform gradation and binder content and is not representative of the RAP used during the applicable mix design. Unprocessed RAP shall not be incorporated into any JMFs prior to processing. Different sources of unprocessed RAP may be stockpiled together provided it is generally free of contamination and will be processed prior to use in a recycled mix. RAP contamination in the form of excessive dirt, debris, clean stone, concrete, etc. will not be allowed. Incidental amounts of dirt, concrete,

and clean stone may be acceptable. Unprocessed RAP may be processed and then classified as a new source RAP as described above.

Field approval of new source RAP will be based on Table 1012-2 below and volumetric mix properties on the mix with the new source RAP included. Provided the Table 1012-2 tolerances are met, volumetric properties of the new mix will then be performed. If all volumetric mix properties meet the mix design criteria for that mix type, the new source RAP may continue to be used.

If the gradation, binder content, or any of the volumetric mix properties are not within the allowable tolerances of Table 1012-2, do not use the new source RAP unless approved by the Engineer. The Contractor may elect to either not use the stockpile, to request an adjustment to the JMF, or to redesign the mix.

TABLE 1012-2
NEW SOURCE RAP GRADATION and BINDER TOLERANCES
(Apply Tolerances to Mix Design Data)

Mix Type	0-20% RAP			20^{+}-30 % RAP			30^{+} % RAP		
Sieve (mm)	**Base**	**Inter.**	**Surf.**	**Base**	**Inter.**	**Surf.**	**Base**	**Inter.**	**Surf.**
P_b %		± 0.7%			± 0.4%			± 0.3%	
25.0	±10	-	-	±7	-	-	±5	-	-
19.0	±10	±10	-	±7	±7	-	±5	±5	-
12.5	-	±10	±10	-	±7	±7	-	±5	±5
9.5	-	-	±10	-	-	±7	-	-	±5
4.75	±10	-	±10	±7	-	±7	±5	-	±5
2.36	±8	±8	±8	±5	±5	±5	±4	±4	±4
1.18	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.300	±8	±8	±8	±5	±5	±5	±4	±4	±4
0.150	-	-	±8	-	-	±5	-	-	±4
0.075	±4	±4	±4	±2	±2	±2	±1.5	±1.5	±1.5

ASPHALT PAVEMENTS - WARM MIX ASPHALT SUPERPAVE:

(1-18-11) (Rev 2-15-11) M6 R02A

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed.

Notify the Engineer at least 2 weeks before producing the WMA so the Engineer can arrange a pre-pave meeting. Discuss special testing requirements necessary for WMA at the pre-pave meeting. Include at the pre-pave meeting the Contractor's QC manager, Paving Superintendent, and manufacturer's representative for the WMA technology, the Department's Roadway

Construction Engineer, Resident Engineer, State Pavement Construction Engineer, and Quality Assurance Supervisor.

Require a manufacturer's representative for the WMA technology used to be present on site at the plant during the initial production and on the roadway during the laydown of the warm mix asphalt.

The requirement for the manufacturer's representative to be present at the pre-pave meeting and on-site at the plant may be waived by the Engineer based on previous work experience with the specific WMA technology used.

If the use of WMA is suspended during production, and the Contractor begins using Hot Mix Asphalt (HMA), then the Contractor shall be required to use HMA for the remainder of the specific route or map unless otherwise approved by the Engineer.

Revise the *2006 Metric Standard Specifications* as follows:

Page 6-7, Article 609-1 Description, insert the following as the second paragraph:

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed. Use WMA at the Contractor's option when shown in the contract.

Page 6-7, Article 609-4 Field Verification of Mixture and Job Mix Formula Adjustments, second paragraph, insert the following immediately after the first sentence:

When producing a WMA, perform field verification testing including Tensile Strength Ratio (TSR) testing in accordance with AASHTO T 283 as modified by the Department.

Third paragraph, delete the third sentence and replace with the following:

Verification is satisfactory for HMA when all volumetric properties except $\%G_{mm}@N_{ini}$ are within the applicable mix design criteria and the gradation, binder content, and $\%G_{mm}@N_{ini}$ are within the individual limits for the mix type being produced. Verification is satisfactory for WMA when all volumetric properties except $\%G_{mm}@N_{ini}$ are within the applicable mix design criteria, the TSR meets the design criteria, and the gradation, binder content, and $\%G_{mm}@N_{ini}$ are within the individual limits for the mix type being produced.

Page 6-10, Subarticle 609-5(C)(2)(d) Bulk Specific Gravity of Compacted Specimens, add after (AASHTO T 312):

When producing WMA, gyrate specimens to specified N_{des} compaction effort without reheating mix other than to desired compaction temperature. Record time needed to reheat samples (if any).

Page 6-11, Subarticle 609-5(C)(2)(e) Tensile Strength Ratio, insert the following immediately after the third paragraph:

When producing WMA, perform TSR testing:
(i.) Prior to initial production for each JMF and
(ii.) Every 13,600 metric tons.

After three (3) consecutive passing TSR tests for a specific JMF, a request may be submitted to the State Asphalt Design Engineer to revert the *Hot-Mix Asphalt QMS Manual* procedures for TSR testing on that JMF. This request shall be submitted in writing and include all Material and Tests Unit Form 612s performed on the specific JMF.

Page 6-22, Article 610-1 Description, insert the following as the third paragraph:

Warm Mix Asphalt (WMA) is defined as additives or processes that allow a reduction in the temperature at which asphalt mixtures are produced and placed. Use WMA at the Contractor's option when shown in the contract.

Page 6-23, Article 610-2 Materials, insert the following at the end of this Article:

Use only WMA technologies on the allowable routes listed on the Department's approved list maintained by the Materials and Tests Unit. The Department's approved list can be found at the following website: **http://www.ncdot.org/doh/operations/materials/pdf/wma.pdf.**

Page 6-26, Subarticle 610-3(B) Mix Design-Criteria, add the following as the fifth paragraph:

When WMA is used, submit the mix design without including the WMA additive.

Page 6-26, Subarticle 610-3(C) Job Mix Formula, add the following as the second paragraph:

When WMA is used, document the technology used, the recommended dosage rate, and the requested plant mix temperature on the JMF submittal. Verify the JMF based on plant produced mixture from the field verification test.

Immediately following PG 76-22 335°F, add the following paragraph:

When WMA is used, produce an asphalt mixture within the temperature range of 107°C to 135°C.

ASPHALT BINDER CONTENT OF ASPHALT PLANT MIXES:
(11-21-00) M6 R15

The approximate asphalt binder content of the asphalt concrete plant mixtures used on this project will be as follows:

Asphalt Concrete Base Course	Type B 25.0__	4.3%
Asphalt Concrete Intermediate Course	Type I 19.0__	4.7%
Asphalt Concrete Surface Course	Type S 4.75A	7.0%
Asphalt Concrete Surface Course	Type SF 9.5A	6.5%
Asphalt Concrete Surface Course	Type S 9.5__	6.0%
Asphalt Concrete Surface Course	Type S 12.5__	5.5%

The actual asphalt binder content will be established during construction by the Engineer within the limits established in the *2006 Metric Standard Specifications.*

ASPHALT PLANT MIXTURES:
(7-1-95) M6 R20

Place asphalt concrete base course material in trench sections with asphalt pavement spreaders made for the purpose or with other equipment approved by the Engineer.

PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:
(11-21-00) M6 R25

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the *2006 Metric Standard Specifications.*

The base price index for asphalt binder for plant mix is **$681.96** per metric ton.

This base price index represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals on **May 1, 2010**.

FINAL SURFACE TESTING - ASPHALT PAVEMENTS (Rideability):
(5-18-04) (Rev. 7-15-08) M6 R45

On portions of this project where the typical section requires two or more layers of new pavement, perform acceptance testing of the longitudinal profile of the finished pavement surface in accordance with these provisions using a North Carolina Hearne Straightedge (Model No. 1). Furnish and operate the straightedge to determine and record the longitudinal profile of the pavement on a continuous graph. Final surface testing is an integral part of the paving operation and is subject to observation and inspection by the Engineer as deemed necessary.

Push the straightedge manually over the pavement at a speed not exceeding 2 miles per hour. For all lanes, take profiles in the right wheel path approximately 3 feet from the right edge of pavement in the same direction as the paving operation, unless otherwise approved due to traffic control or safety considerations. As an exception, lanes adjacent to curb and gutter, expressway gutter, or shoulder berm gutter may be tested in the left wheel path. Make one pass of the straightedge in each full width travel lane. The full lane width should be comparable in ride

quality to the area evaluated with the Hearne Straightedge. If deviations exist at other locations across the lane width, utilize a 10 foot non-mobile straightedge or the Hearne Straightedge to evaluate which areas may require corrective action. Take profiles as soon as practical after the pavement has been rolled and compacted, but no later than 24 hours following placement of the pavement, unless otherwise authorized by the Engineer. Take profiles over the entire length of final surface travel lane pavement exclusive of -Y- line travel lanes less than or equal to 1000 feet in length, ramps less than or equal to 1000 feet in length, turn lanes less than or equal to 1000 feet in length, structures, approach slabs, paved shoulders, loops, and tapers or other irregular shaped areas of pavement, unless otherwise approved by the Engineer. Test in accordance with this provision all mainline travel lanes, full width acceleration or deceleration lanes, -Y- line travel lanes greater than 1000 feet in length, ramps, full width turn lanes greater than 1000 feet in length, and collector lanes.

At the beginning and end of each day's testing operations, and at such other times as determined by the Engineer, operate the straightedge over a calibration strip so that the Engineer can verify correct operation of the straightedge. The calibration strip shall be a 100 foot section of pavement that is reasonably level and smooth. Submit each day's calibration graphs with that day's test section graphs to the Engineer. Calibrate the straightedge in accordance with the current NCDOT procedure titled *North Carolina Hearne Straightedge - Calibration and Determination of Cumulative Straightedge Index*. Copies of this procedure may be obtained from the Department's Pavement Construction Section.

Plot the straightedge graph at a horizontal scale of approximately 25 feet per inch with the vertical scale plotted at a true scale. Record station numbers and references (bridges, approach slabs, culverts, etc.) on the graphs. Distances between references/stations must not exceed 100 feet. Have the operator record the Date, Project No., Lane Location, Wheel Path Location, Type Mix, and Operator's Name on the graph.

Upon completion of each day's testing, evaluate the graph, calculate the Cumulative Straightedge Index (CSI), and determine which lots, if any, require corrective action. Document the evaluation of each lot on a QA/QC-7 form. Submit the graphs along with the completed QA/QC-7 forms to the Engineer, within 24 hours after profiles are completed, for verification of the results. The Engineer will furnish results of their acceptance evaluation to the Contractor within 48 hours of receiving the graphs. In the event of discrepancies, the Engineer's evaluation of the graphs will prevail for acceptance purposes. The Engineer will retain all graphs and forms.

Use blanking bands of 0.2 inches, 0.3 inches, and 0.4 inches to evaluate the graph for acceptance. The 0.2 inch and 0.3 inch blanking bands are used to determine the Straightedge Index (SEI), which is a number that indicates the deviations that exceed each of the 0.2 inch and 0.3 inch bands within a 100 foot test section. The Cumulative Straightedge Index (CSI) is a number representing the total of the SEIs for one lot, which consist of not more than 25 consecutive test sections. In addition, the 0.4 inch blanking band is used to further evaluate deviations on an individual basis. The CSI will be determined by the Engineer in accordance with the current procedure titled "North Carolina Hearne Straightedge - Calibration and Determination of Cumulative Straightedge Index".

The pavement will be accepted for surface smoothness on a lot by lot basis. A test section represents pavement one travel lane wide not more than 100 feet in length. A lot will consist of 25 consecutive test sections, except that separate lots will be established for each travel lane, unless otherwise approved by the Engineer. In addition, full width acceleration or deceleration lanes, ramps, turn lanes, and collector lanes, will be evaluated as separate lots. For any lot that is less than 2500 feet in length, the applicable pay adjustment incentive will be prorated on the basis of the actual lot length. For any lot which is less than 2500 feet in length, the applicable pay adjustment disincentive will be the full amount for a lot, regardless of the lot length.

If during the evaluation of the graphs, 5 lots require corrective action, then proceed on limited production for unsatisfactory laydown in accordance with Article 610-12 of the *Standard Specifications*. Proceeding on limited production is based upon the Contractor's initial evaluation of the straightedge test results and shall begin immediately upon obtaining those results. Additionally, the Engineer may direct the Contractor to proceed on limited production in accordance with Article 610-12 due to unsatisfactory laydown or workmanship.

Limited production for unsatisfactory laydown is defined as being restricted to the production, placement, compaction, and final surface testing of a sufficient quantity of mix necessary to construct only 2500 feet of pavement at the laydown width. Once this lot is complete, the final surface testing graphs will be evaluated jointly by the Contractor and the Engineer. Remain on limited production until such time as acceptable laydown results are obtained or until three consecutive 2500 foot sections have been attempted without achieving acceptable laydown results. The Engineer will determine if normal production may resume based upon the CSI for the limited production lot and any adjustments to the equipment, placement methods, and/or personnel performing the work. Once on limited production, the Engineer may require the Contractor to evaluate the smoothness of the previous asphalt layer and take appropriate action to reduce and/or eliminate corrective measures on the final surface course. Additionally, the Contractor may be required to demonstrate acceptable laydown techniques off the project limits prior to proceeding on the project.

If the Contractor fails to achieve satisfactory laydown results after three consecutive 2500 foot sections have been attempted, cease production of that mix type until such time as the cause of the unsatisfactory laydown results can be determined.

As an exception, the Engineer may grant approval to produce a different mix design of the same mix type if the cause is related to mix problem(s) rather than laydown procedures. If production of a new mix design is allowed, proceed under the limited production procedures detailed above.

After initially proceeding under limited production, the Contractor shall immediately notify the Engineer if any additional lot on the project requires corrective action. The Engineer will determine if limited production procedures are warranted for continued production.

If the Contractor does not operate by the limited production procedures as specified above, the 5 lots, which require corrective action, will be considered unacceptable and may be subject to removal and replacement. Mix placed under the limited production procedures for unsatisfactory laydown will be evaluated for acceptance in accordance with Article 105-3.

The pay adjustment schedule for the Cumulative Straightedge Index test results per lot is as follows:

Pay Adjustment Schedule for Cumulative Straightedge Index (CSI) (Obtained by adding SE Index of up to 25 consecutive 100 foot test sections)				
*CSI	ACCEPTANCE CATEGORY	CORRECTIVE ACTION	PAY ADJUSTMENT	
			Before Corrective	After Corrective Action
0-0	Acceptable	None	$300 incentive	None
1-0 or 2-0	Acceptable	None	$100 incentive	None
3-0 or 4-0	Acceptable	None	No Adjustment	No Adjustment
1-1, 2-1, 5-0 or 6-0	Acceptable	Allowed	$300 disincentive	$300 disincentive
3-1, 4-1, 5-1 or 6-1	Acceptable	Allowed	$600 disincentive	$600 disincentive
Any other Number	Unacceptable	Required	Per CSI after Correction(s) (not to exceed 100% Pay)	

***Either Before or After Corrective Actions**

Correct any deviation that exceeds a 0.4 inch blanking band such that the deviation is reduced to 0.3 inches or less.

Corrective actions shall be performed at the Contractor's expense and shall be presented for evaluation and approval by the Engineer prior to proceeding. Any corrective action performed shall not reduce the integrity or durability of the pavement that is to remain in place. Corrective action for deviation repair may consist of overlaying, removing and replacing, indirect heating and rerolling. Scraping of the pavement with any blade type device will not be allowed as a corrective action. Provide overlays of the same type mix, full roadway width, and to the length and depth established by the Engineer. Tapering of the longitudinal edges of the overlay will not be allowed.

Corrective actions will not be allowed for lots having a CSI of 4-0 or better. If the CSI indicates *Allowed* corrective action, the Contractor may elect to take necessary measures to reduce the CSI in lieu of accepting the disincentive. Take corrective actions as specified if the CSI indicates *Required* corrective action. The CSI after corrective action shall meet or exceed *Acceptable* requirements.

Where corrective action is allowed or required, the test section(s) requiring corrective action will be retested, unless the Engineer directs the retesting of the of the entire lot. No disincentive will apply after corrective action if the CSI is 4-0 or better. If the retested lot after corrective action has a CSI indicating a disincentive, the appropriate disincentive will be applied.

Test sections and/or lots that are initially tested by the Contractor that indicate excessive deviations such that either a disincentive or corrective action is necessary, may be re-rolled with asphalt rollers while the mix is still warm and in a workable condition, to possibly correct the

problem. In this instance, reevaluation of the test section(s) shall be completed within 24 hours of pavement placement and these test results will serve as the initial test results.

Incentive pay adjustments will be based only on the initially measured CSI, as determined by the Engineer, prior to any corrective work. Where corrective actions have been taken, payment will be based on the CSI determined after correction, not to exceed 100 percent payment.

Areas excluded from testing by the N.C. Hearne Straightedge will be tested by using a non-mobile 10-foot straightedge. Assure that the variation of the surface from the testing edge of the straightedge between any two contact points with the surface is not more than 1/8 inch. Correct deviations exceeding the allowable tolerance in accordance with the corrective actions specified above, unless the Engineer permits other corrective actions.

Furnish the North Carolina Hearne Straightedge(s) necessary to perform this work. Maintain responsibility for all costs relating to the procurement, handling, and maintenance of these devices. The Department has entered into a license agreement with a manufacturer to fabricate, sell, and distribute the N.C. Hearne Straightedge. The Department's Pavement Construction Section may be contacted for the name of the current manufacturer and the approximate price of the straightedge.

No direct payment will be made for the work covered by this section. Payment at the contract unit prices for the various items covered by those sections of the specifications directly applicable to the work constructed will be full compensation for all work covered by this section including, but not limited to, performing testing in accordance with this specification, any corrective work required as a result of this testing and any additional traffic control as may be necessary.

MASONRY DRAINAGE STRUCTURES:
(10-16-07) M8 R01

Revise the *2006 Standard Specifications* as follows:

Page 8-25, Article 840-4 Measurement and Payment, add the following at the end of the second paragraph:

For that portion of *Masonry Drainage Structure* measured above a height of 3 meters, payment will be made at 1.3 times the contract unit price per linear meter for *Masonry Drainage Structure.*

BORROW EXCAVATION AND SHPO DOCUMENTATION FOR BORROW/WASTE SITES:
(12-18-07) (4-15-08) M8 R02

Revise the *2006 Metric Standard Specifications* as follows:

Division 2 Earthwork

Page 2-12, Subarticle 230-1(D), add the words: *The Contractor specifically waives* as the first words of the sentence.

Page 2-13, Article 230-4(B) Contractor Furnished Sources, first paragraph, first sentence replace with the following:

Prior to the approval of any borrow sources developed for use on any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the removal of the borrow material from the borrow sources(s) will have no effect on any known district, site building, structure, or object, architectural and/or archaeological that is included or eligible for inclusion in the National Register of Historic Places.

Division 8 Incidentals

Page 8-8, Article 802-2 General Requirements, add the following as the 1st paragraph:

Prior to the removal of any waste from any project, obtain certification from the State Historic Preservation Officer of the State Department of Cultural Resources certifying that the deposition of the waste material to the proposed waste area will have no effect on any known district, site building, structure, or object, architectural and/or archaeological that is included or eligible for inclusion in the National Register of Historic Places. Furnish a copy of this certification to the Engineer prior to performing any work in the proposed waste site.

Page 8-8, Article 802-2, General Requirements, 7th paragraph, add the following as the 2nd sentence:

The Department's borrow and waste site reclamation procedures for contracted projects is available on the NCDOT website and shall be used for all borrow and waste sites on this project.

CONCRETE TRANSITIONAL SECTIONS FOR CATCH BASINS AND DROP INLETS:
(1-20-09) M8R03

Revise the *Metric Standard Specifications* as follows:

Page 8-26, Article 840-4 Measurement and Payment, delete the eighth full paragraph and replace with the following:

No separate payment will be made for Concrete Aprons as shown in Standard Drawings 840.17, 840.18, 840.19, 840.26, 840.27 and 840.28 and will be incidental to the other work in this section.

Page 8-31, Article 852-4 Measurement and Payment, add the following as the fourth paragraph.

Concrete Transitional Section for Catch Basin will be measured and paid for in units of each.

Concrete Transitional Section for Drop Inlet will be measured and paid for in units of each.

Payment will be made under:

Pay Item	Pay Unit
Concrete Transitional Section for Catch Basin	Each
Concrete Transitional Section for Drop Inlet	Each

Revise the *Metric Roadway Standard Drawings* as follows:

On page 852.04, change Pay Limits for Concrete Apron for Drop Inlets in two places on the drawing to *Pay Limits for Concrete Transitional Section for Drop Inlet.*

On page 852.05, change Concrete Apron for Catch Basin on the drawing to *Concrete Transitional Section for Catch Basin.*

On page 852.06, change Pay Limits for Concrete Apron for Drop Inlets in two places on the drawing to *Pay Limits for Concrete Transitional Section for Drop Inlet.*

SUBSURFACE DRAINAGE:
(7-20-10) M8 R05

Revise the *2006 Metric Standard Specifications* as follows:

Page 8-11, Delete Section 815 SUBSURFACE DRAINAGE and replace it with the following:

SECTION 815
SUBSURFACE DRAINAGE

815-1 Description

Construct subsurface drains, underdrains, blind drains and other types of drains in accordance with the contract or as directed by the Engineer. Install markers to locate concrete pads for drains as shown on the plans. This provision does not apply to shoulder drains.

815-2 Materials

Refer to Division 10 of the *Standard Specifications.*

Item	Section
Portland Cement Concrete, Class B	1000
Select Material, Class V	1016
Subsurface Drainage Materials	1044
Filter Fabric for Subsurface Drains, Type 1	1056
Steel Markers	1072-4
Steel Marker Paint	1080-14
Pavement Marker Paint	1087

Use Class B Concrete for concrete pads and Class V Select Material for subdrain coarse aggregate. Provide subdrain coarse aggregate for subsurface drains and subdrain fine aggregate for underdrains and blind drains.

815-3 Construction Methods

Do not leave filter fabrics uncovered for more than 7 days. Excavate trenches as necessary in accordance with the contract or as directed by the Engineer. For subsurface drains, line trench with filter fabric and overlap fabric ends a minimum of 150 mm on top of subdrain coarse aggregate.

Install blind drains at a depth of 1.2 to 1.8 meters below subgrade elevation. Install subdrain pipes for subsurface drains and underdrains at a depth of 1.2 to 1.8 meters below subgrade elevation unless the subgrade will be proof rolled. For subsurface drains and underdrains in subgrades that will be proof rolled, install subdrain pipes at a depth of 1.8 meters below subgrade elevation. Firmly connect subdrain pipes together as needed. Place perforated subdrain pipes with perforations down except for pipes in dry materials, in which case turn perforations up or use non-perforated pipes. For concrete pipes in dry materials, construct mortar joints in accordance with Subarticle 300-6(A) of the *Standard Specifications*.

Place subdrain aggregate beneath, around and over subdrain pipes such that pipes are covered by at least 150 mm of aggregate unless shown otherwise on the plans. Do not displace or damage subdrain pipes while placing and compacting subdrain aggregate. Lightly compact backfill material such that settlement is minimized.

Use solvent cement for connecting polyvinyl chloride (PVC) outlet pipes and fittings such as wyes, tees and elbows. Provide connectors for outlet pipes and fittings that are watertight and suitable for gravity flow conditions. Cover open ends of outlet pipes with rodent screens as shown on the plans.

Connect drains to concrete pads or existing drainage structures at ends of outlet pipes. Construct concrete pads and provide an Ordinary Surface Finish in accordance with Subarticle 825-6(B) of the *Standard Specifications*. Furnish and install steel and pavement markers at concrete pads as shown on the plans.

Allow drains to function for up to 30 days or a sufficient time as determined by the Engineer before undercutting, proof rolling or constructing embankments over drains.

815-4 Measurement and Payment

Subdrain Excavation will be measured and paid for in cubic meters. Excavation will be measured based on the trench width shown on the plans or as directed by the Engineer and the actual trench depth as determined by the Engineer. The contract unit price for *Subdrain Excavation* will be full compensation for excavating trenches and backfilling above subdrain aggregate.

Filter Fabric for Subsurface Drains will be measured and paid for in square meters. Filter fabric in a trench will be measured in place based on the subdrain aggregate width shown on the plans or as directed by the Engineer and the actual aggregate depth as determined by the Engineer. No additional payment will be made for overlapping fabric. The contract unit price for *Filter Fabric for Subsurface Drains* will be full compensation for supplying, transporting and installing filter fabric.

Subdrain Fine Aggregate and *Subdrain Coarse Aggregate* will be measured and paid for in cubic meters. Subdrain aggregate in a trench will be measured in place based on the aggregate width shown on the plans or as directed by the Engineer and the actual aggregate depth as determined by the Engineer. When subdrain aggregate is not placed in a trench, aggregate will be measured in place based on the aggregate dimensions shown on the plans or as determined by the Engineer. The contract unit prices for *Subdrain Fine Aggregate* and *Subdrain Coarse Aggregate* will be full compensation for furnishing, hauling, handling, placing, compacting and maintaining subdrain aggregate.

__mm Perforated Subdrain Pipe and *__mm Outlet Pipe* will be measured and paid for in linear feet. Pipes will be measured in place as the pipe length, including fittings, to the nearest 0.1 meters with no deduction for fittings. The contract unit prices for *__mm Perforated Subdrain Pipe* and *__mm Outlet Pipe* will be full compensation for supplying, transporting and installing pipes, fittings and rodent screens and making joint connections.

Subdrain Pipe Outlets will be measured and paid for in units of each. Outlets will be measured as the number of concrete pads or connections to existing drainage structures. The contract unit price for *Subdrain Pipe Outlets* will be full compensation for concrete pads including furnishing concrete, constructing pads and providing and placing markers and connecting pipes to existing drainage structures including cutting into structures, removing existing paved ditches and grouting around connections.

Payment will be made under:

Pay Item	**Pay Unit**
Subdrain Excavation	Cubic Meter
Filter Fabric for Subsurface Drains	Square Meter
Subdrain Fine Aggregate	Cubic Meter
Subdrain Coarse Aggregate	Cubic Meter
__mm Perforated Subdrain Pipe	Linear Meter
__mm Outlet Pipe	Linear Meter
Subdrain Pipe Outlets	Each

ENDWALLS:
(5-20-08) M8 R25

Revise the *Standard Specifications* as follows:

Page 8-23, Article 838-4 Replace the 1st and 2nd paragraph with the following:

Endwalls will be measured and paid for in cubic meters of concrete or brick that have been completed and accepted. This quantity will be computed from the dimensions shown on the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used in lieu of cast-in-place units the quantity to be paid for will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast in lieu of cast in place endwalls.

Reinforced Endwalls will be measured and paid for in cubic meters of concrete or brick that have been completed and accepted. This quantity will be computed from the dimensions shown on the plans or from revised authorized dimensions. Where precast concrete units have been approved and are used in lieu of cast-in-place units the quantity to be paid for will be computed the same as if cast-in-place units were used, as no reduction in pay quantity will be made due to the use of precast in lieu of reinforced cast in place endwalls.

GUARDRAIL ANCHOR UNITS, TYPE 350:
(4-20-04) M8 R65

Description

Furnish and install guardrail anchor units in accordance with the details in the plans, the applicable requirements of Section 862 of the *2006 Metric Standard Specifications*, and at locations shown in the plans.

Materials

The Contractor may at his option, furnish any one of the guardrail anchor units.

Guardrail anchor unit (ET-2000) as manufactured by:

Trinity Industries, Inc.
2525 N. Stemmons Freeway
Dallas, Texas 75207
Telephone: 800-644-7976

The guardrail anchor unit (SKT 350) as manufactured by:

Road Systems, Inc.
3616 Old Howard County Airport
Big Spring, Texas 79720
Telephone: 915-263-2435

Prior to installation the Contractor shall submit to the Engineer:

(A) FHWA acceptance letter for each guardrail anchor unit certifying it meets the requirements of NCHRP Report 350, Test Level 3, in accordance with Section 106-2 of the *2006 Standard Specifications*.

(B) Certified working drawings and assembling instructions from the manufacturer for each guardrail anchor unit in accordance with Section 105-2 of the *2006 Metric Standard Specifications*.

No modifications shall be made to the guardrail anchor unit without the express written permission from the manufacturer. Perform installation in accordance with the details in the plans, and details and assembling instructions furnished by the manufacturer.

Construction Methods

Guardrail end delineation is required on all approach and trailing end sections for both temporary and permanent installations. Guardrail end delineation consists of yellow reflective sheeting applied to the entire end section of the guardrail in accordance with Section 1088-3 of the *2006 Metric Standard Specifications* and is incidental to the cost of the guardrail anchor unit.

Measurement and Payment

Measurement and payment will be made in accordance with Articles 862-6 of the *2006 Metric Standard Specifications*.

Payment will be made under:

Pay Item	**Pay Unit**
Guardrail Anchor Units, Type 350	Each

FENCE:
(3-6-06) M8 R86

Revise the *2006 Metric Standard Specifications* as follows:

Page 8-44, Subarticle 866-3(A), second sentence,

Add *existing fencing* after stumps

PREFORMED SCOUR HOLE WITH LEVEL SPREADER APRON:

(10-15-02) (Rev 6-17-08) M8 R105

Description

Construct and maintain preformed scour holes with spreader aprons at the locations shown on the plans and in accordance with the details in the plans. Work includes excavation, shaping and maintaining the hole and apron, furnishing and placing filter fabric, rip rap (class as specified in the plans) and permanent soil reinforcement matting.

Materials

Item	Section
Plain Rip Rap	1042
Filter Fabric	1056

The permanent soil reinforcement matting shall be permanent erosion control reinforcement mat and shall be constructed of 100% coconut fiber stitch bonded between a heavy duty UV stabilized cuspated (crimped) netting overlaid with a heavy duty UV stabilized top net. The three nettings shall be stitched together on 38 mm centers UV stabilized polyester thread to form a permanent three dimensional structure. The mat shall have the following physical properties:

Property	*Test Method*	*Value Unit*
Light Penetration	ASTM D6567	15 %
Thickness	ASTM D6525	13 mm
Mass Per Unit Area	ASTM D6566	0.339 kg/m^2
Tensile Strength	ASTM D6818	572 kg/m
Elongation (Maximum)	ASTM D6818	49 %
Resiliency	ASTM D6524	> 70 %
UV Stability*	ASTM D4355	≥80 %
Porosity (Permanent Net)	Calculated	≥85 %
Minimum Filament	Measured	0.76 mm
Maximum Permissible Shear Stress (Vegetated)	Performance Test	≥ 39.1 kg/m^2
Maximum Allowable Velocity	Performance Test	≥ 4.9 m/s

*ASTM D1682 Tensile Strength and % strength retention of material after 1000 hours of exposure.

Submit a certification from the manufacturer showing:

(A) the chemical and physical properties of the mat used, and
(B) conformance of the mat with this specification

Soil Preparation

All areas to be protected with the mat shall be brought to final grade and seeded in accordance with Section 1660. The surface of the soil shall be smooth, firm, stable and free of rocks, clods,

roots or other obstructions that would prevent the mat from lying in direct contact with the soil surface. Areas where the mat is to be placed will not need to be mulched.

Measurement and Payment

Preformed Scour Holes with Level Spreader Aprons will be measured and paid as the actual number that has been incorporated into the completed and accepted work. Such price and payment will be full compensation for all work covered by this provision.

Payment will be made under:

Pay Item	Pay Unit
Preformed Scour Hole with Level Spreader Aprons	Each

DETECTABLE WARNINGS FOR PROPOSED WHEELCHAIR RAMPS;
(6-15-10) M8 R126

Description

Construct detectable warnings consisting of integrated raised truncated domes on proposed concrete wheelchair ramps in accordance with the *2006 Standard Specifications,* plan details, the requirements of the *28 CFR Part 36 ADA Standards for Accessible Design* and this provision.

Materials

Detectable warning for proposed wheelchair ramps shall consist of integrated raised truncated domes. The description, size and spacing shall conform to Section 848 of the *Standard Specifications.*

Use material for detectable warning systems as shown herein. Material and coating specifications must be stated in the Manufacturers Type 3 Certification and all Detectable Warning systems must be on the NCDOT Approved Product List for Wheelchair Ramps.

Install detectable warnings created from one of the following materials: precast concrete blocks or bricks, clay paving brick, gray or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile. Only one material type for detectable warning will be permitted per project, unless otherwise approved by the Engineer.

(A) **Detectable Warnings shall** consist of a base with integrated raised truncated domes, and **when constructed of precast concrete** they shall conform to the material requirements of Article 848-2 of the *Standard Specifications.*

(B) **Detectable Warnings shall** consist of a base with integrated raised truncated domes, and **may be comprised of other materials including but not limited to clay paving brick, gray iron or ductile iron castings, mild steel, stainless steel, and engineered plastics, rubber or composite tile,** which are cast into the concrete of the wheelchair ramps. The material shall have an integral color throughout the thickness of the material. The

detectable warning shall include fasteners or anchors for attachment in the concrete and shall be furnished as a system from the manufacturer.

Prior to installation, the Contractor shall submit to the Engineer assembling instructions from the manufacturer for each type of system used in accordance with Article 105-2 of the *Standard Specifications*. The system shall be furnished as a kit containing all consumable materials and consumable tools, required for the application. They shall be capable of being affixed to or anchored in the concrete ramp, including green concrete (concrete that has set but not appreciably hardened). The system shall be solvent free and contain no volatile organic compounds (VOC). The static coefficient of friction shall be 0.8 or greater when measured on top of the truncated domes and when measured between the domes in accordance with ASTM C 1028 (dry and wet). The system shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to degradation by motor fuels, lubricants and antifreeze.

(C) When steel or gray iron or ductile iron casting products are provided, only products that meet the requirements of Article 106-1(B) of the *Standard Specifications* may be used. Submit to the Engineer a Type 6 Certification, catalog cuts and installation procedures at least 30 days prior to installation for all.

Construction Methods

(A) Prior to placing detectable warnings in proposed concrete ramps, adjust the existing subgrade to the proper grade and in accordance with Article 848-3 of the *Standard Specifications*.

(B) Install all detectable warning in proposed concrete ramps in accordance with the manufacturer's recommendations.

Measurement and Payment

Detectable Warnings installed for construction of proposed wheelchair ramps will not be paid for separately. Such payment will be included in the price bid for *Concrete Wheelchair Ramps*.

CONCRETE STEPS:
(11-18-08) SPI 8-3

Description

Construct reinforced concrete steps in accordance with the contract documents.

Materials

Refer to Division 10:

Item	Section
Portland Cement Concrete, Class B	1000
Curing Agents	1026
Steel Bar Reinforcement	1070-2

Construction Methods

Construct concrete in accordance with Section 825 of the *Standard Specifications*, except as otherwise provided herein. Furnish and place reinforcement, as shown on the plans, in accordance with Section 425 of the *Standard Specifications*. Give formed surfaces of the concrete a rubbed finish. Give unformed surfaces a float finish. Compact backfill to a degree comparable to the adjacent undisturbed material.

Measurement and Payment

Concrete Steps will be measured and paid for in cubic meters computed from the dimensions shown on the plans or established by the Engineer that has been incorporated into the completed and accepted steps. Work includes but is not limited to excavation and backfilling, furnishing and placing concrete, reinforcing steel, and all labor, tools, materials, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	**Pay Unit**
Concrete Steps	Cubic Meter

STREET SIGNS AND MARKERS AND ROUTE MARKERS:
(7-1-95) M9 R01

Move any existing street signs, markers, and route markers out of the construction limits of the project and install the street signs and markers and route markers so that they will be visible to the traveling public if there is sufficient right of way for these signs and markers outside of the construction limits.

Near the completion of the project and when so directed by the Engineer, move the signs and markers and install them in their proper location in regard to the finished pavement of the project.

Stockpile any signs or markers that cannot be relocated due to lack of right of way, or any signs and markers that will no longer be applicable after the construction of the project, at locations directed by the Engineer for removal by others.

The Contractor shall be responsible to the owners for any damage to any street signs and markers or route markers during the above described operations.

No direct payment will be made for relocating, reinstalling, and/or stockpiling the street signs and markers and route markers as such work shall be considered incidental to other work being paid for by the various items in the contract.

STEEL U-CHANNEL POSTS AND STEEL SQUARE TUBE SUPPORTS:
(7-18-06) (Rev 1-18-11) M9 R02

Revise the *2006 Standard Specifications* as follows:

Page 9-15 Subarticle 903-3(D) delete the last sentence in the first paragraph and add the following:

Use posts of sufficient length to permit the appropriate sign mounting height. Spliced posts are not permitted on new construction.

Page 9-16 Subarticle 903-3(G) delete the last sentence in the first paragraph and add the following:

Use posts of sufficient length to permit the appropriate sign mounting height. Spliced posts are not permitted on new construction.

Page 9-16 Subarticle 903-3(G), delete the fourth paragraph and add the following:

Do not weld or cut supports in the field except for the saw cutting of steel square tube material for the frames and cross-braces that may be required for Types D, E, and F signs with two or more supports.

GALVANIZED HIGH STRENGTH BOLTS, NUTS AND WASHERS:
(2-17-09) (Rev 5-17-11) M10 R02

Revise the *Metric Standard Specifications* as follows:

Page 10-101, Subarticle 1072-7(F)(3) Change the AASHTO reference to ASTM B695 Class 55.

Page 10-201, Table 1092-2, Steel Sign Materials, Change High Strength Bolts, Nuts & Washers ASTM Specifications for Galvanizing to B695 Class 55.

Page 10-211, Subarticle 1094-1(A) Breakaway or Simple Steel Beam Sign Supports, replace the first full paragraph with the following:

Fabricate high strength bolts, nuts, and washers required for breakaway supports from steel in accordance with ASTM A325 and galvanize in accordance with ASTM B695 Class 55.

Page 10-212, Article 1096-2 Steel Overhead Sign Structures, replace the last sentence with the following:

The galvanizing shall meet ASTM B695 Class 55 for fasteners and ASTM A123 for other structural steel.

GALVANIZING:
(8-17-10) M10 R03

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-121, Subarticle 1076-1, Galvanizing, add a second paragraph as the follows:

Allow the Engineer to obtain samples of molten zinc directly from the galvanizing vat upon request.

AGGREGATE PRODUCTION:

(11-20-01) M10 R05

Provide aggregate from a producer who uses the current Aggregate Quality Control/Quality Assurance Program that is in effect at the time of shipment.

No price adjustment is allowed to contractors or producers who use the program. Participation in the program does not relieve the producer of the responsibility of complying with all requirements of the *2006 Metric Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

CONCRETE BRICK AND BLOCK PRODUCTION:

(11-20-01) M10 R10

Provide concrete brick and block from a producer who uses the current Solid Concrete Masonry Brick/Unit Quality Control/Quality Assurance Program that is in effect on the date that material is received on the project.

No price adjustment is allowed to contractors or producers who use the program. Participation in the program does not relieve the producer of the responsibility of complying with all requirements of the *2006 Metric Standard Specifications*. Copies of this procedure are available upon request from the Materials and Test Unit.

VOLUMETRIC CONCRETE BATCHING:

(5-18-10) M10 R13

Revise the *2006 Standard Specifications* as follows:

Page 10-19, after **Article 1000-12**, add the following as a new article:

1000-13 VOLUMETRIC MIXED CONCRETE

Upon written request by the contractor, the Department may approve the use of concrete proportioned by volume. The volumetric producer must submit and have approved a process control plan and product quality control plan by the Materials and Tests Unit. If concrete is proportioned by volume, the other requirements of these specifications with the following modifications will apply. Unless otherwise approved by the Department, use of concrete proportioned by volume shall be limited to Class B concrete and a maximum of 22.94 cubic meters per unit per day.

(A) Materials

Use materials that meet the requirements for the respective items in the *Standard Specifications* except that they will be measured by a calibrated volume-weight relationship.

Storage facilities for all material shall be designed to permit the Department to make necessary inspections prior to the batching operations. The facilities shall also permit identification of approved material at all times, and shall be designed to avoid mixing with or contaminating by unapproved material. Coarse and fine aggregate shall be furnished and handled so variations in the moisture content affecting the uniform consistency of the concrete will be avoided.

Moisture content of the coarse and fine aggregate will be made available onsite for the Engineer's review for each load. The frequency of moisture testing will be dependent on certain variables such as weather, season and source; however, moisture tests should be performed at least once at the beginning of the work day for each source material. Additional daily moisture tests for the coarse and fine aggregate shall be performed if requested by the Engineer.

Unused materials should be emptied from hopper daily. Concrete should not be mixed with materials that have been left in the hopper overnight.

(B) Equipment

Provide volumetric mixers with rating plates indicating that the performance of the mixer is in accordance with the Volumetric Mixer Manufacturer Bureau or equivalent. Mixers must comply with ASTM C685. Unless otherwise specified, all mixing operations must be in strict accordance with the manufacturer's recommended procedures. Such procedures shall be provided to the Department for review upon request.

The volumetric mixer shall be capable of carrying sufficient unmixed dry bulk cement, pozzolan (if required), fine aggregate, coarse aggregate, admixtures and water, in separate compartments and accurately proportioning the specified mix. Each batching or mixing unit (or both) shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator.

The concrete mixing device shall be an auger-type continuous mixer used in conjunction with volumetric proportioning. The mixer shall produce concrete, uniform in color and appearance, with homogeneous distribution of the material throughout the mixture. Mixing time necessary to produce uniform concrete shall be established by the contractor and shall comply with other requirements of these specifications. Only equipment found acceptable in every respect and capable of producing uniform results will be permitted.

Each volumetric mixer shall be equipped with an onboard ticketing system that will electronically produce a record of all material used and their respective weights and the total volume of concrete placed. Alternate methods of recordation may be used if

approved by the Engineer. Tickets should also identify the following information, at minimum:

- Contractor Name
- Contractor Phone Number
- NCDOT Project No. and TIP No.
- Date
- Truck No.
- Ticket No.
- Time Start/End of Pour
- Mix ID & Description (Strength)
- Aggregate Moisture Before Mixing

(C) Proportioning Devices

Volume proportioning devices, such as counters, calibrated gate openings or flow meters, shall be easily accessible for controlling and determining the quantities of the ingredients discharged. All indicating devices that affect the accuracy of proportioning and mixing of concrete shall be in full view of and near enough to be read by the operator and Engineer while concrete is being produced. In operation, the entire measuring and dispensing mechanism shall produce the specified proportions of each ingredient.

The volumetric mixer shall provide positive control of the flow of water and admixtures into the mixing chamber. Water flow shall be indicated by a flow meter and be readily adjustable to provide for slump control and/or minor variations in aggregate moisture. The mixer shall be capable of continuously circulating or mechanically agitating the admixtures.

Liquid admixtures shall be dispensed through a controlled, calibrated flow meter. A positive means to observe the continuous flow of material shall be provided. If an admixture requires diluting, the admixture shall be diluted and thoroughly mixed prior to introducing the admixture into the dispenser. When admixtures are diluted, the ratio of dilution and the mixing shall be approved by and performed in the presence of the Department.

The volumetric mixer shall be capable of measurement of cement, pozzolan (if required), liquids and aggregate being introduced into the mix.

(D) Calibration

Volume-weight relationships will be based on calibration. The proportioning devices shall be calibrated by the contractor prior to the start of each NCDOT job, and subsequently at intervals recommended by the equipment manufacturer. Calibrations will be performed in the presence of the Department and subject to approval from the Department. Calibration of the cement and aggregate proportioning devices shall be accomplished by weighing (determining the mass of) each component. Calibration of the

admixture and water proportioning devices shall be accomplished by weight (mass) or volume. Tolerances in proportioning the individual components will be as follows:

TABLE 1000-4
VOLUMETRIC MIXED CONCRETE CALIBRATION
PROPORTION TOLERANCES

Item	Tolerance
Cement, Weight (Mass) percent	0 to +4
Fine Aggregate, Weight (Mass) percent	± 2
Coarse Aggregate, Weight (Mass) percent	± 2
Admixtures, Weight (Mass) or Volume percent	± 3
Water, Weight (Mass) or Volume percent	± 1

Each volumetric mixer must be accompanied at all times by completed calibration worksheets and they shall be made available to the Department upon request.

(E) Verification of Yield

Verification of the proportioning devices may be required at any time by the Department. Verification shall be accomplished by proportioning the rock and sand based on the cement meter count for each concrete mobile mixer. Once the count (revolutions) for 42.64 kilograms of cement has been determined then delivery of the correct amount of rock and sand can be verified.

(F) Uniformity

When concrete is produced, have present during all batching operations a Certified Concrete Batch Technician. During batching and placement, the sole duty of this employee is to supervise the production and control of the concrete, perform moisture tests, adjust mix proportions of aggregates for free moisture, complete and sign approved delivery tickets, and assure quality control of the batching.

Two samples of sufficient size to make the required tests will be taken after discharge of approximately 15 and 85 percent of the load. Each of the 2 samples of concrete will be separately tested for the properties listed in Table 1000-3. Tests will be conducted in accordance with the test procedures specified in Table 1000-3 or procedures established by the Materials and Tests Unit. The Engineer may recheck mixer performance at any time when in his opinion satisfactory mixing is not being accomplished.

PORTLAND CEMENT CONCRETE (Alkali-Silica Reaction):
(2-20-07) M10 R16

Revise the *2006 Metric Standard Specifications* as follows:

Article 1024-1(A), replace the 2nd paragraph with the following:

Certain combinations of cement and aggregate exhibit an adverse alkali-silica reaction. The alkalinity of any cement, expressed as sodium-oxide equivalent, shall not exceed 1.0 percent. For mix designs that contain non-reactive aggregates and cement with an alkali content less than 0.6%, straight cement or a combination of cement and fly ash, cement and ground granulated blast furnace slag or cement and microsilica may be used. The pozzolan quantity shall not exceed the amount shown in Table 1024-1. For mixes that contain cement with an alkali content between 0.6% and 1.0%, and for mixes that contain a reactive aggregate documented by the Department, regardless of the alkali content of the cement, use a pozzolan in the amount shown in Table 1024-1.

Obtain the list of reactive aggregates documented by the Department at:
http://www.ncdot.org/doh/operations/materials/pdf/quarryasrprob.pdf

Table 1024-1
Pozzolans for Use in Portland Cement Concrete

Pozzolan	*Rate*
Class F Fly Ash	20% by weight of required cement content, with 1.2 kg Class F fly ash per kg of cement replaced
Ground Granulated Blast Furnace Slag	35%-50% by weight of required cement content with 1 kg slag per kg of cement replaced
Microsilica	4%-8% by weight of required cement content, with 1 kg microsilica per kg of cement replaced

WATER FOR CONCRETE:
(10-19-10) M10 R17

Revise the 2006 *Metric Standard Specifications for Roads and Structures* as follows:

Page 10-51, Article 1024-4, replace article with the following:

1024-4 WATER

Ensure that water used to condition, wash, or as an integral part of materials is clear and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substance. It shall not be salty or brackish. Water used in the production of concrete or grout shall be from wells or public water systems which are suitable for drinking and must meet the criteria listed in Table 1024-1.

Test all water from wells and public water supplies from all out of state locations and in the following counties: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrell,

and Washington unless the Engineer waives the testing requirements. Water from a municipal water supply in all other NC counties may be accepted by the Engineer without testing.

TABLE 1024-1
ACCEPTANCE CRITERIA FOR WATER
USED IN THE PRODUCTION OF CONCRETE

Requirement	Limit	Test Method
Compressive Strength, minimum percent of control at 3 and 7 days	90 percent	NCDOT Modified / AASHTO T106
Time of set, deviation from control	From 1:00 hr. earlier to 1:30 hr. later	NCDOT Modified / AASHTO T131
pH	4.5 to 8.5	NCDOT Modified / AASHTO T26
Chloride Ion Content, Max.	250 ppm	ASTM D512
Total Solids Content (Residue), Max.	1000 ppm	NCDOT Modified / Standard Methods for Examination of Water and Wastewater
Resistivity, Min.	0.500 kohm-cm	NCDOT Modified / ASTM D1125
Sulfate as SO_4, Max.	1500 ppm	NCDOT Modified / ASTM D516
Presence of Sugar	None	NCDOT Procedure
Dissolved Organic Matter	None	NCDOT Modified / AASHTO T26

Page 10-53, Article 1026-4, replace article with the following:

1026-4 WATER

All water used for curing concrete shall meet the requirements of Article 1024-4 and Table 1024-1. Water from wells, streams, ponds, or public water systems may be used.

CULVERT PIPE:
(1-19-10) M10R32

Revise the *Metric Standard Specifications for Roads and Structures* as follows:

Page 10-67, Article 1032-1, replace (A), (B), (C), (D), (E) and (F) with the following:

(A) Coated corrugated metal culvert pipe and pipe arches.
(B) Coated corrugated metal end sections, coupling band, and other accessories
(C) Corrugated aluminum alloy structural plate pipe and pipe arches
(D) Corrugated aluminum alloy end sections, coupling band, and other accessories
(E) Welded steel pipe

Page 10-69, Subarticle 1032-3(A)(5) Coating Repair, replace with the following:

Repair shall be in accordance with Section 1076-6 of the *Standard Specifications*.

Subarticle 1032-3(A)(7) Aluminized Pipe, replace with the following:

Aluminized pipe shall meet all requirements herein, except that the pipe and coupling bands shall be fabricated from aluminum coated steel sheet meeting the requirements of AASHTO M274.

Page 10-71, Article 1032-4 Coated Culvert Pipe, replace (A), (1), (2), (3), (4), (B), (C), (D), (E), (F) and (G) with the following:

(A) Coatings for Steel Culvert Pipe or Pipe Arch

The below coating requirements apply for steel culvert pipe, pipe arch, end sections, tees, elbows, and eccentric reducers.

(1) Steel Culvert pipe shall have an aluminized coating, meeting the requirement of AASHTO M274

(2) When shown on the plans or as approved by the Engineer, a polymeric coating meeting the requirements of AASHTO M246 for Type B coating may be substituted for aluminized coating.

(B) Acceptance

Acceptance of coated steel culvert pipe, and its accessories will be based on, but not limited to, visual inspections, classification requirements, check samples taken from material delivered to the project, and conformance to the annual Brand Registration.

Page 10-73, Article 1032-5, sixth paragraph, third sentence, remove the word "spelter"

Page 10-74, 1032-7 Vitrified Clay Culvert Pipe, delete section in its entirety.

Page 10-75, Article 1032-8 Welded Steel Pipe, change title to WELDED STEEL PIPE FOR DRAINAGE

Subarticle 1032-9(B) Plain Concrete Culvert Pipe, delete section in its entirety.

Page 10-77, Article 1032-10 Corrugated Polyethylene Culvert Pipe, change title to CORRUGATED POLYETHYLENE (HDPE) CULVERT PIPE

Add the following: Article 1032-11 Polyvinyl Chloride (PVC) Pipe

Polyvinyl Chloride pipe shall conform to AASHTO M 304 or ASTM 949. When rubber gaskets are to be installed in the pipe joint, the gasket shall be the sole element relied on to maintain a tight joint. Test pipe joints at the plant hydrostatically using test methods in ASTM D 3212. Soil tight joints shall be watertight to 13.8 kPa. Watertight joints shall be watertight to 34.5 kPa unless a higher pressure rating is specified in the plans.

GLASS BEADS:
(7-18-06)(Rev 10-19-10) M10 R35

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-181, 1087-4(A) Composition, add the following as the fourth paragraph:

Glass beads shall have no more than 75 parts per million of arsenic as determined by the United States Environmental Protection Agency Method 6010B in conjunction with the United States Environmental Protection Agency Method 3052 modified.

Page 10-182, 1087-4(C) Gradation & Roundness, delete the last paragraph and replace the second sentence of the first paragraph with the following:

All Drop-On and Intermixed Glass Beads shall be tested in accordance with ASTM D1155.

Page 10-184, 1087-8 Material Certification, add the following below the first sentence:

Glass Beads (for paint, thermoplastic and polyurea) – Type 3 Material Certification for no more than 75 parts per million of arsenic

ENGINEERING FABRICS:
(7-18-06) (Rev 10-19-10) M10 R40

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-78, Delete Section 1056 ENGINEERING FABRICS and replace it with the following:

SECTION 1056
ENGINEERING FABRICS

1056-1 General

Use engineering fabrics that meet the requirements of Article 4.1 of AASHTO M288 and have been evaluated by National Transportation Product Evaluation Program (NTPEP). When required, sew fabrics together in accordance with Article X1.1.4 of AASHTO M288. Provide sewn seams with seam strengths meeting the required strengths for the engineering fabric type and class specified.

Load, transport, unload and store fabrics such that they are kept clean and free of damage. Label, ship and store fabrics in accordance with Section 7 of AASHTO M288. Fabrics with defects, flaws, deterioration or damage will be rejected. Do not unwrap fabrics until just before installation. With the exception of fabrics for temporary silt fences and mechanically stabilized earth (MSE) wall faces, do not leave fabrics exposed for more than 7 days before covering fabrics with material.

When required, use pins a minimum of 5 mm in diameter and 450 mm long with a point at one end and a head at the other end that will retain a steel washer with a minimum outside diameter of 38 mm. When wire staples are required, provide staples in accordance with Subarticle 1060-8(D) of the *2006 Metric Standard Specifications*.

1056-2 Fabric Properties

Provide Type 1 Certified Mill Test Report, Type 2 Typical Certified Mill Test Report or Type 4 Certified Test Report in accordance with Article 106-3 of the *2006 Metric Standard Specifications*. Furnish certifications with minimum average roll values (MARV) as defined by ASTM D4439 for all fabric properties with the exception of elongation and apparent opening size (AOS). For testing fabrics, a lot is defined as a single day's production.

Provide engineering fabric types and classes in accordance with the contract. Machine direction (MD) and cross-machine direction (CD) are as defined by ASTM D4439. Use woven or nonwoven fabrics with properties meeting the requirements of Table 1056-1.

TABLE 1056-1
FABRIC PROPERTY REQUIREMENTS

Property	ASTM Test Method	Requirements (MARV[1])				
		Type 1	**Type 2**	**Type 3[2]**	**Type 4**	**Type 5[3]**
Typical Application		*Shoulder Drains*	*Under Riprap*	*Temporary Silt Fence*	*Soil Stabilization*	*Temporary MSE Walls*
Elongation (MD & CD)	D4632	≥ 50 %	≥ 50 %	≤ 25 %	< 50 %	< 50 %
Grab Strength (MD & CD)	D4632	400 N	900 N	445 N	800 N	---
Tear Strength (MD & CD)	D4533	180 N	350 N	---	300 N	---
Puncture Strength	D6241	900 N	1925 N	---	1650 N	---
Wide Width Tensile Strength @ Ultimate (MD & CD)	D4595	---	---	---	---	35 kN/m (unless required otherwise in the contract)
Permittivity	D4491	0.20 sec^{-1}	0.20 sec^{-1}	0.05 sec^{-1}	0.05 sec^{-1}	0.20 sec^{-1}
Apparent Opening Size (AOS)[4]	D4751	0.25 mm	0.25 mm	0.60 mm	0.43 mm	0.60 mm
Ultraviolet Stability (retained strength)[5]	D4355	50 %	50 %	70 %	50 %	50%

[1]MARV does not apply to elongation and AOS
[2]Minimum roll width of 900 mm required
[3]Minimum roll width of 4 m required unless otherwise approved
[4]Maximum average roll value
[5]After 500 hours of exposure

PRECAST DRAINAGE STRUCTURES - MACRO-SYNTHETIC FIBERS

(7-15-08)(Rev 11-18-08) SP 10 R42

Description

Substitute as an option, macro-synthetic fibers in lieu of 100 mm x 100 mm W1.4 x W1.4 welded wire fabric reinforcement for selected precast concrete products in accordance with the following requirements.

Materials

Item	Section
Portland Cement Concrete	1077-5

(A) Substitute macro-synthetic fibers only for steel reinforcement with an area of steel of 254 mm^2/m or less in the following items:

(1) **Precast Drainage Structure** units in accordance with the requirements of *Standard Drawing 840.45*.

(2) **Precast Manhole 1.2 Meter' Riser Sections** in accordance with the requirements of *Standard Drawing 840.52*.

All other requirements, including reinforcement for these precast concrete items will remain the same.

(B) **Submittal** Submit to the Department for approval by the precast producer and fiber manufacturer, independently performed test results certifying the macro-synthetic fibers and the precast concrete products meet the requirements listed herein:

(C) **Macro-Synthetic Fibers**

(1) Manufacture from virgin polyolefins (polypropylene and polyethylene) and comply with ASTM C 1116.4.1.3.

Fibers manufactured from materials other than polyolefins Submit test results certifying resistance to long-term deterioration when in contact with the moisture and alkalies present in cement paste and/or the substances present in air-entraining and chemical admixtures.

(2) Fiber length - no less than 38 mm.

(3) Macro-synthetic fibers - aspect ratio (length divided by the equivalent diameter of the fiber) between 45 and 150.

(4) Macro-synthetic fibers - Minimum tensile strength of 2812 kg/cm^2 when tested in accordance with ASTM D 3822.

(5) Macro-synthetic fibers - minimum modulus of elasticity of 28,123 kg/cm^2 when tested in accordance with ASTM D 3822.

(D) Fiber Reinforced Concrete

(1) Approved structural fibers may be used as a replacement of steel reinforcement in allowable structures of NCDOT Standards 840.45 and 840.52. The dosage rate, in pounds of fibers per cubic yard, shall be as per recommended by the fiber manufacturer to provide a minimum average residual strength (in accordance with ASTM C 1399) of concrete of no less than that of the concrete with the steel reinforcement that is being replaced, but no less than 2.97 kg/m^3. Submit the recommendations of the manufacturer that correlate the toughness of steel-reinforced concrete with that of the recommended dosage rate for the fiber-reinforced concrete.

(2) Fiber reinforced concrete - 4.5% air content, ± 1.5% tolerance.

(3) Fiber reinforced concrete - develop a minimum compressive strength 2.97 kg/m^3 in 28 days.

(4) Workability of the concrete mix - determine in accordance with ASTM C995. The flow time - not be less than 7 seconds or greater than 25 seconds.

(5) Assure the fibers are well dispersed and prevent fiber balling during production. After introduction of all other ingredients, add the plastic concrete and mix the plastic concrete for at least 4 minutes or for 50 revolutions at standard mixing speed.

Measurement and Payment

No separate payment will be made for substitution of macro-fiber synthetic reinforcement for the steel reinforcing. The price bid for the precast units will be full compensation for furnishing and incorporating the macro-fiber synthetic reinforcement.

QUALIFICATION OF WELDS AND PROCEDURES:
(7-21-09) M10 R43

Page 10-114, Subarticle 1072-20(D) Qualification of Welds and Procedures, replace the third sentence of the first paragraph with the following:

For all prequalified field welds, submit Welding Procedure Specifications (WPS) for each joint configuration for approval at least 30 days prior to performing any welding. In lieu of this, use the WPS provided and preapproved by the Department. These preapproved WPS are available from the Materials and Tests Unit or at:
http://www.ncdot.org/doh/operations/materials/structural/appr_proc.html. Use non-prequalified welds only if approved by the Engineer. Submit WPS for all non-prequalified welds to the Engineer for approval. At no cost to the Department, demonstrate their adequacy in accordance with the requirements of the Bridge Welding Code.

PORTABLE CONCRETE BARRIER
(2-20-07) M10 R50

The *2006 Metric Standard Specifications* is revised as follows:

Page 10-200, Article 1090-1(A) General, add the following after the first sentence:

The requirement for approved galvanized connectors will be waived if the barrier remains the property of the Contractor.

CHANNELIZING DEVICES (Drums):
7-20-10 M10 R60

Revise the *2006 Metric Standard Specifications* as follows:

Page 10-192, Subarticle 1089-5(A) Drums (1) General, replace the paragraph with the following:

(1) General

Provide drums composed of a body, alternating orange and white 4 band pattern of Type III-High Intensity Microprismatic Sheeting and ballasts that have been evaluated by NTPEP.

The following guidelines will be used during the transition from drums with the standard 5 band engineer's grade sheeting to the new 4 band configuration.

(a) All **new** drums purchased **after July 20, 2010** shall have the new sheeting and 4 band configuration.

(b) Existing 5 band drums with engineer's grade sheeting (both new and used devices in existing inventories) will be allowed for use on all on-going construction projects until project completion and will also be allowed for use on other projects until a sunset date has been established.

(c) Intermixing of "old drums" and "new drums" on the same project is acceptable during the transition.

(d) 4 band drums with engineer's grade sheeting will not be allowed at anytime.

Page 10-192, Subarticle 1089-5(A) Drums (3) Retroreflective Stripes, replace the paragraph with the following:

(3) Retroreflective Bands

Provide a minimum of 4 retroreflective bands- 2 orange and 2 white alternating horizontal circumferential bands. The top band shall always be orange. Use a 150mm to 200 mm wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or

better that meets the requirement of Section 1093 for each band. Do not exceed 50 mm for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 150 mm band. Apply the retroreflective sheeting directly to the drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugations areas. No damage to the reflective sheeting should result from stacking and unstacking the drums, or vehicle impact.

Page 10-193, Subarticle 1089-5(B) Skinny-Drums (1) General, replace the paragraph with the following:

(1) General

All existing skinny-drums that do not have Type III-High Intensity Microprismatic Sheeting as a minimum will have the same transition requirements as drums as stated above. All **new** skinny-drums purchased **after July 20, 2010** shall have Type III–High Intensity Microprismatic Sheeting as the minimum. Type IV and higher grade sheeting is acceptable for use on both new and used devices.

Provide skinny-drums composed of a body, reflective bands, and ballasts that have been evaluated by NTPEP.

Page 10-193, Subarticle 1089-5(B) Skinny Drums (3) Retroreflective Stripes, replace the paragraph with the following:

(3) Retroreflective Bands

Provide a minimum of 4 retroreflective bands- 2 orange and 2 white alternating horizontal circumferential bands for each skinny-drum. The top band shall always be orange. Use a 150mm to 200 mm wide band Type III–High Intensity Microprismatic Retroreflective Sheeting or better that meets the requirement of Section 1093 for each band. Do not exceed 50 mm for any non-reflective spaces between orange and white stripes. Do not splice the retroreflective sheeting to create the 150 mm band. Apply the retroreflective sheeting directly to the skinny-drum surface. Do not apply the retroreflective sheeting over a pre-existing layer of retroreflective sheeting. Do not place bands over any protruding corrugations areas. No damage to the reflective sheeting should result from stacking and unstacking the skinny-drums, or vehicle impact.

TEMPORARY SHORING:

(2-20-07) (Rev 9-25-07) M11 R02

Description

Design and construct temporary shoring in accordance with the contract. Temporary shoring includes standard shoring, temporary mechanically stabilized earth (MSE) walls and non-anchored temporary shoring. Trench boxes are not considered temporary shoring. "Standard shoring" refers to *standard temporary shoring* and *standard temporary MSE walls*. Notes on

plans may restrict the use of one or both types of standard shoring. Notes on plans may also require or prohibit temporary MSE walls.

Unless noted otherwise on the plans, temporary shoring is required as shown on the plans and to maintain traffic. Temporary shoring to maintain traffic is defined as shoring necessary to provide lateral support to the side of an excavation or embankment parallel to an open travelway when a theoretical 2:1 (H:V) slope from the bottom of the excavation or embankment intersects the existing ground line closer than 1.5 m from the edge of pavement of the open travelway.

This provision is not applicable to anchored temporary shoring or the installation of pipes, drop inlets and utilities unless noted otherwise on the plans. Provide all shoring submittals before beginning work.

Materials

(A) Certifications, Storage and Handling

Provide Type 7 Contractor's Certifications in accordance with Article 106-3 of the *2006 Metric Standard Specifications* for all shoring materials used with the exception of reinforcing fabrics and geogrids. Furnish Type 2 Typical Certified Mill Test Reports in accordance with Article 106-3 of the *2006 Metric Standard Specifications* for all seam strengths and reinforcing fabric and geogrid properties. Provide minimum average roll values (MARV) in accordance with ASTM D4759 for test reports. For testing reinforcing fabric and geogrids, a lot is defined as a single day's production.

Load, transport, unload and store shoring materials such that they are kept clean and free of damage. Identify, store and handle all geogrids and geotextile fabrics in accordance with ASTM D4873. Geogrids and fabrics with defects, flaws, deterioration or damage will be rejected. Do not leave fabrics or geogrids uncovered for more than 7 days.

(B) Shoring Backfill

Use shoring backfill for the construction of all temporary shoring including backfilling behind non-anchored temporary shoring and in the reinforced zone for temporary MSE walls. Unless backfilling around culverts, use shoring backfill that meets the requirements of Class II Type I, Class III, Class V or Class VI select material in accordance with Section 1016 of the *2006 Metric Standard Specifications* or AASHTO M145 for soil classification A-2-4 with a maximum plasticity index (PI) of 6. For backfilling around culverts, use shoring backfill as defined herein except for A-2-4 soil.

(C) Non-anchored Temporary Shoring

Use steel shapes, plates and piles that meet the requirements of ASTM A36 and steel sheet piles that meet the requirements of Article 1084-2 of the *2006 Metric Standard Specifications*. Use timber lagging with a minimum allowable bending stress of 6.9 MPa that meets the requirements of Article 1082-1 of the *2006 Metric Standard Specifications*. For standard temporary shoring, use pile sections and lengths and lagging sizes as shown on the plans.

(D) Temporary MSE Walls

Use welded wire reinforcement forms, facings, mesh and mats that meet the requirements of AASHTO M55 or M221. Use connector bars and wires for welded wire wall components and support struts that meet the requirements of AASHTO M32. For standard temporary MSE walls, use wire gauges, strut sizes and welded wire components as shown on the plans.

(1) Geotextile Fabrics

Use geotextile fabrics that meet the requirements of Article 1056-1 of the *2006 Metric Standard Specifications*.

(a) Reinforcing Fabric

The reinforcement direction (RD) is defined as the direction perpendicular to the wall face and the cross-reinforcement direction (CRD) is defined as the direction parallel to the wall face.

Use woven polyester or polypropylene fabric that meets the following properties:

Property	Test Method	Requirement (MARV)
Wide Width Tensile Strength @ Ultimate (RD)	ASTM D4595	Varies – 35 kN/m min
Wide Width Tensile Strength @ Ultimate (CRD)	ASTM D4595	18 kN/m min
Trapezoidal Tear Strength	ASTM D4533	0.44 kN min
CBR Puncture Strength	ASTM D6241	2.67 kN min
UV Resistance after 500 hrs	ASTM D4355	70 %
Apparent Opening Size (AOS), US Sieve	ASTM D4751	0.212 mm min – 0.850 mm max
Permittivity	ASTM D4491	0.20 sec^{-1}

For standard temporary MSE walls (temporary fabric wall) use reinforcing fabric wide width tensile strengths and lengths in the RD as shown on the plans.

(b) Retention Fabric

Retain shoring backfill at the face of temporary MSE walls with retention fabric. Use fabric that meets the requirements of Class 3 and the UV resistance, AOS and permittivity for separation geotextile in accordance with AASHTO M288.

(2) SierraScape Temporary Wall

Use uniaxial (UX) geogrids composed of high-density polyethylene (HDPE) manufactured by Tensar Earth Technologies. Test geogrids in accordance with ASTM D6637. Use connection rods manufactured by Tensar Earth Technologies to transfer the load between the facings and geogrids.

For standard temporary MSE walls (SierraScape temporary wall) use geogrid types and lengths as shown on the plans.

(3) Terratrel Temporary Wall

Use ribbed reinforcing steel strips manufactured by The Reinforced Earth Company that meet the requirements of ASTM A572, Grade 450. Use connector rods that meet the requirements of AASHTO M31, Grade 415 and hair pin connectors that meet the requirements of ASTM A1011, Grade 345. Use bolts, nuts and washers that meet the requirements of AASHTO M164.

For standard temporary MSE walls (Terratrel temporary wall) use ribbed steel strip size and lengths, rod lengths and diameters, hairpin connectors, bolts, nuts and washers as shown on the plans.

Embedment

"Embedment" is defined as the depth of shoring below the bottom of the excavation or the grade in front of the shoring. For cantilever shoring, embedment is the depth of the piling below the grade in front of the shoring. For temporary MSE walls, embedment is the difference between the grade elevation in front of the wall and the elevation of the bottom of the reinforced zone.

Portable Concrete Barriers

Provide portable concrete barriers in accordance with the plans and if shoring is located within the clear zone as defined in the *AASHTO Roadside Design Guide*. Use NCDOT portable concrete barriers (PCBs) in accordance with Roadway Metric Standard Drawing No. 1170.01 and Section 1170 of the *2006 Metric Standard Specifications*. Use Oregon Tall F-Shape Concrete Barriers in accordance with detail drawing and special provision obtained from:

http://www.ncdot.org/doh/preconstruct/wztc/DesRes/English/DesResEng.html

The clear distance is defined as the horizontal distance from the back face of the barrier to the edge of pavement and the minimum required clear distance is shown on the traffic control plans. At the Contractor's option or if the minimum required clear distance is not available, set an unanchored PCB against the traffic side of the shoring and design shoring for traffic impact or use the "surcharge case with traffic impact" for the standard temporary shoring. An anchored PCB or Oregon barrier is required for barriers above and behind temporary MSE walls.

Contractor Designed Shoring

"Contractor designed shoring" is defined as non-anchored temporary shoring or temporary MSE walls designed by the Contractor. Unless prohibited or required, Contractor designed shoring is optional. Contractor designed shoring is required when notes on plans prohibit the use of standard shoring. Non-anchored Contractor designed shoring is prohibited when notes on plans require the use of temporary MSE walls and Contractor designed temporary MSE walls are prohibited when notes on plans prohibit the use of temporary MSE walls.

Before beginning design, survey the shoring location to determine existing elevations and actual design heights. Submit design calculations and drawings including typical sections for review and acceptance showing details of the proposed design and construction sequence in accordance with Article 105-2 of the *2006 Metric Standard Specifications*. Have shoring designed, detailed and sealed by a Professional Engineer registered in the State of North Carolina. Submit 3 hard copies of design calculations and 10 hard copies of drawings and an electronic copy (pdf or jpeg format on CD or DVD) of both the calculations and drawings.

Design non-anchored temporary shoring in accordance with the *AASHTO Guide Design Specifications for Bridge Temporary Works* and temporary MSE walls in accordance with the *AASHTO Allowable Stress Design Standard Specifications for Highway Bridges*. Use the following soil parameters for shoring backfill in the reinforced zone.

Total Unit Weight = 18.8 kN/m^3
Friction Angle = 30 degrees
Cohesion = 0 kPa

Design temporary shoring in accordance with the in-situ assumed soil parameters shown on the plans. Design shoring for a 3-year design service life and a traffic surcharge equal to 11.5 kPa. This surcharge is not applicable for construction traffic. If a construction surcharge will be present within a horizontal distance equal to the height of the shoring, design the shoring for the required construction surcharge. If the edge of pavement or a structure to be protected is within a horizontal distance equal to the height of the shoring, design shoring for a maximum deflection of 75 mm. Otherwise, design shoring for a maximum deflection of 150 mm.

For non-anchored temporary shoring, the top of shoring elevation is defined as the elevation where the grade intersects the back face of the shoring. For traffic impact, apply 29.2 kN/m to the shoring 450 mm above the top of shoring elevation. When designing for traffic impact, extend shoring at least 800 mm above the top of shoring elevation. Otherwise, extend shoring at least 150 mm above the top of shoring elevation.

Standard Shoring

Unless notes on plans prohibit the use of one or both types of standard shoring, standard shoring is optional. Submit a "Standard Temporary MSE Wall Selection Form" for each standard temporary MSE wall location and a "Standard Temporary Shoring Selection Form" for up to

three standard temporary shoring locations. Submit selection forms at least 14 days before beginning shoring construction. Obtain standard shoring selection forms from:

http://www.ncdot.org/doh/preconstruct/highway/geotech/formdet/

(A) Standard Temporary Shoring

Determine the shoring height, traffic impact, groundwater condition and slope or surcharge case for each standard temporary shoring location. Determine the minimum required extension, embedment and sheet pile section modulus or H pile section from the plans for each location.

(B) Standard Temporary MSE Walls

Choose a standard temporary MSE wall from the multiple temporary MSE wall options shown in the plans. Do not use more than one option per wall location.

Step bottom of reinforced zone in increments equal to vertical reinforcement spacing for the wall option chosen. Determine the wall height and slope or surcharge case for each section of standard temporary MSE wall. With the exception of either the first or last section of wall, use horizontal section lengths in increments equal to the following for the wall option chosen.

Standard Temporary MSE Wall Option	Increment
Temporary Fabric Wall	2.7 m min (varies)
Hilfiker Temporary Wall	3.0 m min (varies)
SierraScape Temporary Wall	5.7 m
Retained Earth Temporary Wall	7.3 m
Terratrel Temporary Wall	6.0 m

Determine the appropriate facings and/or forms and reinforcement length, spacing, strength, type, density and/or size from the plans for each wall section.

Construction Methods

When using an anchored PCB, anchor the barrier in accordance with Roadway Metric Standard Drawing 1170.01 and Section 1170 of the *2006 Metric Standard Specifications*. Control drainage during construction in the vicinity of temporary shoring. Collect and direct run off away from temporary MSE walls, shoring and shoring backfill.

(A) Non-anchored Temporary Shoring

Install and interlock sheet piling or install piles as shown on the plans or accepted submittals with a tolerance of 42 mm per meter from vertical. Contact the Engineer if the design embedment is not achieved. If piles are placed in drilled holes, perform pile

excavation to the required elevations and backfill excavations with concrete and lean sand grout.

Remove grout as necessary to install timber lagging. Install timber lagging with a minimum bearing distance of 75 mm on each pile flange. Backfill voids behind lagging with shoring backfill.

Perform welding in accordance with the accepted submittals and Article 1072-20 of the *2006 Metric Standard Specifications*.

(1) Pile Excavation

Excavate a hole with a diameter that will result in at least 75 mm of clearance around the entire pile. Use equipment of adequate capacity and capable of drilling through soil and non-soil including rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance excavations. Blasting for core removal is permitted only when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the *2006 Metric Standard Specifications*. Drilling spoils consist of all excavated material including water removed from excavations by either pumping or drilling tools.

If unstable, caving or sloughing soils are encountered, stabilize excavations with clean watertight steel casing. Steel casings may be either sectional type or one continuous corrugated or non-corrugated piece. Provide casings of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth or backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of 6 mm.

Before placing concrete, check the water inflow rate in the excavation after any pumps have been removed. If the inflow rate is less than 150 mm per half hour, remove any water and free fall the concrete into the excavation. Ensure that concrete flows completely around the pile. If the water inflow rate is greater than 150 mm per half hour, propose and obtain approval of the concrete placement procedure before placing concrete.

Center the pile in the excavation and fill the excavation with Class A concrete in accordance with Section 1000 of the *2006 Metric Standard Specifications* except as modified herein. Provide concrete with a slump of 150 to 200 mm. Use an approved high-range water reducer to achieve this slump. Place concrete in a continuous manner to the bottom of shoring or the elevations shown on the accepted submittals. Fill the remainder of the excavation with a lean sand grout and remove all casings.

(B) Temporary MSE Walls

The Engineer may require a wall preconstruction meeting to discuss the construction and inspection of the temporary MSE walls. If required, conduct the meeting with the Site Superintendent, the Resident or Bridge Maintenance Engineer, the Bridge Construction Engineer and the Geotechnical Operations Engineer before beginning wall construction.

Perform all necessary clearing and grubbing in accordance with Section 200 of the *2006 Metric Standard Specifications*. Excavate as necessary as shown on the plans or accepted submittals. Notify the Engineer when foundation excavation is complete. Do not place shoring backfill or first reinforcement layer until obtaining approval of the excavation depth and foundation material.

If applicable, install foundations located within the reinforced zone in accordance with the plans or accepted submittals.

Erect and maintain facings and forms as shown on the plans or accepted submittals. Stagger vertical joints of facings and forms to create a running bond when possible unless shown otherwise on the plans or accepted submittals.

Place facings and forms as near to vertical as possible with no negative batter. Construct temporary MSE walls with a vertical and horizontal tolerance of 75 mm when measured with a 3 m straight edge and an overall vertical plumbness (batter) and horizontal alignment of less than 150 mm.

Place reinforcement at locations and elevations shown on the plans or accepted submittals and in slight tension free of kinks, folds, wrinkles or creases. Repair or replace any damaged reinforcement. Contact the Engineer when existing or future structures such as foundations, pavements, pipes, inlets or utilities will interfere with reinforcement. To avoid structures, deflect, skew and modify reinforcement.

Do not splice reinforcement in the reinforcement direction (RD), i.e., parallel to the wall face. Seams are allowed in the cross-reinforcement direction (CRD). Bond or sew adjacent reinforcing fabric together or overlap fabric a minimum of 450 mm with seams oriented perpendicular to the wall face.

Place shoring backfill in 200 to 250 mm thick lifts and compact in accordance with Subarticle 235-4(C) of the *2006 Metric Standard Specifications*. Use only hand operated compaction equipment within 1 m of the wall face. Do not damage reinforcement when placing and compacting shoring backfill. End dumping directly on the reinforcement is not permitted. Do not operate heavy equipment on reinforcement until it is covered with at least 250 mm of shoring backfill. Do not use sheepsfoot, grid rollers or other types of compaction equipment with feet.

Cover reinforcing and retention fabric with at least 75 mm of shoring backfill. Place top reinforcement layer between 100 to 600 mm below top of wall as shown on the plans or accepted submittals.

Bench temporary MSE walls into the sides of excavations where applicable. If the top of wall is within 1.5 m of finished grade, remove top form or facing and incorporate the top

reinforcement layer into the fill when placing fill in front of the wall. Temporary MSE walls remain in place permanently unless required otherwise.

Measurement and Payment

Temporary Shoring will be measured and paid for at the contract unit price per square meter of exposed face area at locations shown on the plans or required by the Engineer. For temporary MSE walls, the wall height will be measured as the difference between the top and bottom of wall and does not include the embedded portions of the wall or any pavement thickness above the wall. For all other temporary shoring, the shoring height will be measured as the difference between the top and bottom of shoring elevation. The bottom of shoring elevation is defined as where the grade intersects the front face of the shoring. The top of shoring elevation is defined as where the grade intersects the back face of the shoring. No payment will be made for any extension of shoring above the top of shoring or any embedment below the bottom of shoring. Such price and payment will be full compensation for furnishing all labor, tools, equipment, materials and all incidentals necessary to design and install the temporary shoring and complete the work as described in this provision.

No payment will be made for temporary shoring not shown on the plans or required by the Engineer including shoring for OSHA reasons or the Contractor's convenience. No value engineering proposals will be accepted based solely on revising or eliminating the shoring locations shown on the plans or the estimated quantities shown in the bid item sheets as a result of actual field measurements or site conditions.

No additional payment will be made for anchoring PCBs or providing Oregon barriers in lieu of unanchored PCBs. Additional costs for anchoring PCBs or providing Oregon barriers will be considered incidental to *Temporary Shoring*.

Payment will be made under:

Pay Item	**Pay Unit**
Temporary Shoring	Square Meter

CHANGEABLE MESSAGE SIGNS
(11-21-06) M11 R11

Revise the *2006 Metric Standard Specifications* as follows:

Page 11-7, Article 1120-3, Replace the 3rd sentence with the following:

Sign operator will adjust flash rate so that no more than two messages will be displayed and be legible to a driver when approaching the sign at the posted speed.

FLAGGERS:
(2-15-11) M11 R20

Revise the *2006 Metric Standard Specifications* as follows:

Page 11-10, Article 1150-3 Construction Methods, replace the article with the following:

Provide the service of properly equipped and qualified flaggers (see *Roadway Standard Drawing* 1150.01) at locations and times for such period as necessary for the control and protection of vehicular and pedestrian traffic. Anyone who controls traffic is required to be qualified. Qualification consists of each flagger receiving proper training in the set-up and techniques of safely and competently performing a flagging operation. Qualification of flaggers is to be done at an NCDOT approved training agency. For a complete listing of these, see the Work Zone Traffic Control's webpage, http://www.ncdot.gov/doh/preconstruct/wztc/.

Prior to beginning work on the project, a Qualification Statement that all flaggers used on the project have been properly trained through an NCDOT approved training resource shall be provided to the Engineer.

Flagging operations are not allowed for the convenience of the Contractor's operations. However, if safety issues exist (i.e. sight/stopping site distance), the Engineer may approve the use of flagging operations. Use flagging methods that comply with the guidelines in the MUTCD.

PAVEMENT MARKING LINES:
(11-21-06) (Rev. 08-17-10) M12 R01

Revise the *2006 Metric Standard Specifications* as follows:

Page 12-2, 1205-3(D) Time Limitations for Replacement, add the following at the beginning of the chart:

Facility Type	Marking Type	Replacement Deadline
Full-control-of-access multi-lane roadway (4 or more total lanes) and ramps, including Interstates	All markings including symbols	By the end of each workday's operation if the lane is opened to traffic

Page 12-4, 1205-3 (H) Observation Period, delete 1205-3 (H) and replace with the following:

Maintain responsibility for debonding and color of the pavement markings during a 12 month observation period beginning upon final acceptance of the project as defined under Article 105-17. Guarantee the markings under the payment and performance bond in accordance with Article 105-17.

During the 12 month observation period, provide pavement marking material that shows no signs of failure due to blistering, chipping, bleeding, discoloration, smearing or spreading under heat or poor adhesion to the pavement materials. Pavement markings that debond due to snowplowing will not be considered a failed marking. Replace, at no additional expense to the

Department, any pavement markings that do not perform satisfactorily under traffic during the 12 month observation period.

Page 12-6, 1205-4 (C) Application, delete the last two sentences of the second paragraph and replace with the following:

Produce in place markings with minimum retroreflective values shown below, as obtained with a LTL 2000 Retroreflectometer or Department approved mobile retroreflectometer. Retroreflective measurements will be taken within 30 days after final placement of the pavement marking.

Page 12-7, 1205-4 (D) Observation Period, delete the entire section and replace with the following:

In addition to the requirements of Subarticle 1205-3(H), maintain responsibility for minimum retroreflective values for a 30-day period beginning upon the Engineer's acceptance of all markings on the project. Guarantee retroreflective values of the markings during the 30-day period under the payment and performance bond in accordance with Article 105-17.

Page 12-8, 1205-5 (B) Application, delete the second sentence of the fourth paragraph and replace with the following:

Produce in place markings with minimum retroreflective values shown below, as obtained with a LTL 2000 Retroreflectometer or Department approved mobile retroreflectometer. Retroreflective measurements will be taken within 30 days after final placement of the pavement marking.

Page 12-8, 1205-5 (C) Observation Period, delete this entire section and replace with the following:

Maintain responsibility for minimum retroreflective values for a 30-day period beginning upon satisfactory final placement of all markings on the project. Guarantee retroreflective values of the markings during the 30-day period under the payment and performance bond in accordance with Article 105-17.

Page 12-11, Article 1205-9, Maintenance, delete Article 1205-9 and replace with the following:

Replace pavement markings that prematurely deteriorate, fail to adhere to the pavement, lack reflectorization, or are otherwise unsatisfactory during the life of the project or during the 12 month observation period as determined by the Engineer at no cost to the Department.

Upon notification from the Engineer, winterize the project by placing an initial or additional application of paint pavement marking lines in accordance with Article 1205-8. Payment for *Paint Pavement Marking Lines* required to winterize the project will be made in accordance with Article 1205-10 except that no payment will be made on resurfacing projects where paving is completed more than 30 days prior to the written notification by the Department that winterization is required.

Page 12-11, Article 1205-10, Measurement and Payment, add the following after the first sentence of the first paragraph:

In addition, *Paint Pavement Marking Lines* will be paid per linear foot for each 15 mil application placed in accordance with Subarticle 1205-8(C).

EXCAVATION, TRENCHING, PIPE LAYING AND BACKFILLING FOR UTILITIES:
(2-17-09) M15 R01

Revise the *2006 Metric Standard Specifications* as follows:

Page 15-4, Article 1505-4 Repair of Pavements, Sidewalks and Driveways, first paragraph, add at the end of the first sentence

in accordance with Section 848

Page 15-5, Article 1505-6

Second paragraph,

Delete *(E) Repair of Sidewalks and Driveways* in its entirety

Add as the eighth paragraph:

__mm Concrete Sidewalk and *__mm Concrete Driveways* will be measured and paid for in accordance with Article 848-4.

PERMANENT SEEDING AND MULCHING:
(7-1-95) M16 R01

The Department desires that permanent seeding and mulching be established on this project as soon as practical after slopes or portions of slopes have been graded. As an incentive to obtain an early stand of vegetation on this project, the Contractor's attention is called to the following:

For all permanent seeding and mulching that is satisfactorily completed in accordance with the requirements of Section 1660, Seeding and Mulching, and within the following percentages of elapsed contract times, an additional payment will be made to the Contractor as an incentive additive. The incentive additive will be determined by multiplying the number of acres of seeding and mulching satisfactorily completed times the contract unit bid price per acre for Seeding and Mulching times the appropriate percentage additive.

Percentage of Elapsed Contract Time	Percentage Additive
0% - 30%	30%
30.01% - 50%	15%

Percentage of elapsed contract time is defined as the number of calendar days from the date of availability of the contract to the date the permanent seeding and mulching is acceptably completed divided by the total original contract time.