Rosemary Street Drainage Improvement

APPENDIX C

City of Fayetteville Public Services

Technical Specifications

(By Reference Only)

FAYETTEVILLE NC

AMERICA'S CAN DO CITY

10/01/2024

FAYETTEVILLE NC
PUBLIC SERVICES

TECHNICAL SPECIFICATIONS

MAY 2022

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SECTION 00127

UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Delineation of measurement and payment criteria applicable to Work performed under Contract by the unit price payment method.

1.02 FIELD MEASUREMENT

A. Take measurements and compute quantities for submittal of the monthly pay request unless specified otherwise in the measurement paragraphs as indicated in this Section.

1.03 CHANGE IN QUANTITIES

A. Increase in the quantity of a bid item up to 100% may be authorized by the Engineer above what is indicated in the Bid Form, after 100% increase the contract unit price will be negotiated only by a Change Order as required by the Contract Documents. Revised contract unit prices pertaining to quantity increases will be applicable only to that portion of the overrun in excess to the percentages stated above.

B. A final adjusting Change Order shall be made for adjustment of the actual quantities installed prior to submittal of the final pay request.

1.04 GENERAL

A. Items with a "(X)" in the title of the following bid items represents the size or depth as indicated on the Bid Form.

B. Method of measurement for the individual Bid Items shall be as specified below.

C. Payment for each item shall be in accordance with the Contract Unit Price times the number of units installed in accordance with the Contract Documents.

D. Work for each bid item shall include, but not be limited to, the work listed below and the labor, materials, equipment, and services required and reasonably implied by the Contract Documents for a complete installation.

E. Administrative cost including, but not limited to, video and photographic records, coordination of construction activities (including but not limited to updating master construction schedule, providing weekly tasks schedule, coordination with owner, engineer, utility providers, permitting agencies, etc.), as-built documentation, and office administration for the Project construction shall be included in the individual unit price items. If a Contractor elects to use a trailer, it is at no cost to the Owner.

1.05 MOBILIZATION – LUMP SUM

A. Measurement shall not be made for this item.

B. Work shall include administrative cost including, but not limited to, mobilization, bonds, insurance, project signage, shop drawing submittal and pre-construction video, if required. General office administration for the Project construction shall be included in the individual unit price items.

C. Mobilization will be paid as contract lump sum price. Partial payments for Mobilization will be made with the first and second partial pay estimates paid on the contract and will be made at the rate of 50% lump sum price on each of these partial pay estimates, provided the

amount bid for Mobilization does not exceed 5% of the total amount bid for the contract. Where the amount bid for Mobilization exceeds 5% of the total amount bid for the contract, 2.5% of the total amount bid will be paid on each of the first 2 partial pay estimates. That portion exceeding 5% will be paid on the last partial pay estimate. As an exception to the above, where the work covered by the contract is limited exclusively to the resurfacing of an existing pavement, payment of the entire lump sum price Mobilization will be made with the first partial payment estimate paid on the contract, provided the amount bid does not exceed 5% of the total amount bid for the contract. Where the amount bid for Mobilization exceeds 5% of the total amount bid for the contract, 5% of the total amount bid will be paid on the first partial pay estimate. That portion exceeding 5% will be paid on the last partial pay estimate.

1.06 CLEARING AND GRUBBING

A. Determination of Measurement: The area to be paid for shall be the area in acres, measured horizontally of the areas designated on the plans or directed by the Engineer to be cleared and/or grubbed as called for in the Proposal. Measurement shall be made to the nearest square foot. No measurement or allowance will be made for removing isolated trees within an area designated by the Engineer to be cleared and/or grubbed, nor for cutting and removal of grain, grass, weeds, or other plants. Clearing and grubbing shall include all selective tree removal unless otherwise specified by the Contract.

B. Basis for Payment: The area measured as provided above shall be paid for at the contract unit price bid per acre for clearing and/or grubbing as the case may be.

C. Work: Price and payment shall be full compensation for furnishing all labor, equipment, material, tools, legal disposal of material and all other incidentals necessary to complete the work.

1.07 SELECTED TREE REMOVAL

A. Determination of Measurement: By the number of various sizes of selected trees removed. Diameters will be measured at a height of 4'-6" above the ground.

B. Basis for Payment: Payment shall be for each selected tree removed as indicated in the sizing chart below. Selected trees shall NOT be paid for within an area designated as clearing and grubbing. Trees measuring less than 4” in diameter shall be considered saplings. Payment for saplings is paid for under clearing and grubbing and shall not be paid as selective tree removal.

PAY ITEM SIZE	ACTUAL TREE DIAMETER
6"	4" up to 8"
10"	8" up to 12"
15"	12" up to 18"
18"	Above 18"

C. Work: Price and payment shall be full compensation for furnishing all labor, equipment, material, tools, and all other incidentals necessary for complete removal and legal disposal of selected trees.

1.08 SOIL TYPE BASE COURSE

A. Determination of Measurement: Measurement shall be based on truck quantity minus 25% from certified scale ticket for each load of material. Certified scale tickets must be provided within 24 hours.

B. Basis for Payment: Soil base course will be paid on a contract price per cubic yard.

C. Work: Excavating, loading, hauling, spreading and compacting, etc. as required for placement of soil base course.

1.09 AGGREGATE BASE COURSE

A. Determination of Measurement: Measurement shall be by certified scale ticket with each load of material. Ticket must be provided within 24 hours. Penalty may be assessed if tickets not received timely.

B. Basis for Payment: Contractor will be paid on a contract unit price per ton of stone that is placed.

C. Work: The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.

1.10 UNCLASSIFIED AND UNDERCUT EXCAVATION

A. Determination of Measurement: The number of cubic yards of Unclassified Excavation measured in original position by cross sectioning and computed by the average end area method. When it is not feasible to cross section the volume of excavation which is to be replaced with borrow back-fill, the loads of material hauled in shall be counted.

B. Determination of Measurement: Undercut Excavation will be measured by the volume (cubic yards) of unsuitable material excavated, authorized by the Engineer, to the depths and widths so established. Excavation to greater depths and/or widths, unauthorized, shall be refilled with select backfill material used for backfilling and compacted at no additional cost to the City.

C. Basis for Payment: Contractor will be paid on a contract unit price per cubic yard for unclassified/undercut excavation, which price and payment shall be full compensation for the excavation and hauling; formation and compaction of embankments; removal and disposal of surplus drain pipes, existing walls, steps and surplus materials within the right-of-way, removal and disposal of all roots, stumps, logs, and other debris excavated from drainage ditches; for all sloping and trimming of the ditches, preparation and completion of the sub-grade and shoulders, ditches, slopes, and furnishing of all labor, equipment, tools, and incidentals necessary to complete the work

D. Work: Complete removal and disposal of unstable soil including, but not limited to, excavating, loading, hauling, properly disposing of excavated material, and providing select granular material for backfill. Providing select granular material for backfilling shall include, but not be limited to, material, loading, hauling, placing and compacting.

1.11 REMOVE EXISTING PAVEMENT

A. Determination of Measurement: By the square yard of existing pavement removed. The existing pavement shall be measured by the Engineer prior to its removal.

B. Basis for Payment: Payment will be on a contract unit price per square yard for removal and proper disposal of existing pavement.

C. Work: Shall include labor, equipment, tools, saw cutting, legal disposal, and all other incidentals necessary to complete the work.

1.12 REMOVE EXISTING SIDEWALK

A. Determination of Measurement: By the square yard of the existing sidewalk removed. The existing walks shall be measured by the Engineer prior to its removal.

B. Basis for Payment: Payment will be on a contract unit price per square yard for removal and proper disposal of existing sidewalks.

C. Work: Shall include labor, equipment, tools, saw cutting, legal disposal, and all other incidentals necessary to complete the work.

1.13 SILT FENCE

A. Determination of Measurement: Measure along the base of the silt fence installed.

B. Basis for Payment: Payment will be on a contract unit price per linear foot of silt fence installed.

C. Work: Posts, wire mesh, fabric, base trench, stone, and maintenance during construction, removal and clean up.

1.14 HIGH HAZARD SILT FENCE

A. Determination of Measurement: Measure along the base of the silt fence installed.

B. Basis for Payment: Payment will be on a contract unit price per linear foot of high hazard silt fence installed.

C. Work: Posts, wire fencing, wire mesh, woven filter fabric, base trench, stone, and maintenance during construction, removal and clean up.

1.15 MILLING BITUMINOUS PAVEMENT AND INCIDENTAL MILLING

A. Determination of Measurement: The quantity of milled bituminous pavement and incidental milling to be paid for will be the actual number of square yards of pavement surface which has been milled to depth indicated on drawings in accordance with the requirements of the contract. In measuring this quantity, the length will be the actual length milled, measured along the pavement surface. The width will be the width required by the plans or directed by the Engineer, measured along the pavement surface.

B. Basis of Payment: The quantity of milled bituminous pavement will be paid for at the contract unit price per square yard for "Milling Bituminous Pavement" or "Incidental Milling" as the case may be.

C. Work: Shall include milling and re-milling the pavement, cleaning the milled surface, loading, hauling, stockpiling the milled material for use in recycled bituminous mixtures and disposal of any excess milled materials. Any equipment necessary to remove asphalt in the areas of manholes, water valves, curb and gutter and any other obstructions shall be part of milling contract price.

1.16 PAVEMENT JOINT SEALER

A. Determination of Measurement: Measure total number of pounds of joint sealer placed on the roadway.

B. Basis for Payment: Payment will be on a contract unit price per pound of joint sealer placed.

C. Work: Material, equipment, labor, clean up and all associated appurtenances for installation of pavement joint sealer.

1.17 PLANT MIX BITUMINOUS CONCRETE SURFACE COURSE AND BITUMINOUS CONCRETE BASE COURSE (TYPE B 25.0 C; TYPE I 19.0 C; TYPE S 9.5 B; TYPE S 9.5 C)

A. Determination of Measurement: Measurement shall be per ton of each ton of type placed.

B. Basis for Payment: Payment on a contract price per ton.

C. Work: Production, delivery, placement and compaction to successfully install bituminous pavement.

1.18 INCIDENTAL STONE

A. Determination of Measurement: Measurement shall be per ton of each type placed as approved by the Engineer prior to placement. Contractor shall remove a minimum of two (2) inches of soil or aggregate base course, place and compact stone in order for this item to be applicable.

B. Basis for Payment: Payment shall be on a contract unit price per ton. Contractor shall furnish a "certified scale ticket" with each load of stone to the Engineer within 24 hours in order to be considered for payment. Incidental stone that is stockpiled or not placed will not be considered for payment. No separate payment shall be made for incidental stone placed in mainline or service lateral trenches unless approved by the Engineer.

C. Work: Labor, tools, materials, equipment, furnishing, placing, supplementing stone required for maintenance, grading/leveling stone, hauling, wetting, blading, compacting, removing and disposal of incidental stone immediately prior to asphalt pavement patch.

1.19 REMOVE AND REPLACE CONCRETE CURB AND GUTTER

A. Determination of Measurement: Measurement shall be per linear foot. Measurement of the curb and gutter shall be along the top of the curb excluding catch basin openings.

B. Basis for Payment: Payment shall be on a contract unit price per linear foot.

C. Work: Removal and disposal of existing concrete curb, furnishing, hauling, fine grading sub grade, compacting sub grade, seeding, backfilling behind curb with topsoil, adding soil amendments, placing all materials, and all equipment, materials, tools, labor, and incidentals necessary to complete the work.

1.20 REMOVE AND REPLACE CONCRETE DRIVEWAYS (NO OVERAGES ALLOWED)

A. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Engineer.

B. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of four (4) inches for residential, six (6) inches for commercial, or matching existing concrete thickness, whichever is greater.

C. Work: Saw cutting and removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction, expansion joint materials, curing and placing all materials, forms and all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.

1.21 REMOVE AND REPLACE ASPHALT DRIVEWAYS (NO OVERAGES ALLOWED)

A. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Engineer.

B. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of two (2) inches or matching existing asphalt thickness, whichever is greater.

C. Work: Saw cutting and removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction,

placing all materials, forms and all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.

1.22 REMOVE AND REPLACE GRAVEL DRIVEWAYS WITH AGGREGATE BASE COURSE (NO OVERAGES ALLOWED)

A. Determination of Measurement: Measurement shall be in square yards.

B. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted. Existing gravel and/or soil driveway shall be replaced with six (6) inch thick stone, compacted Aggregate Base Course (ABC) or whichever matches existing type stone.

C. Work: Removal of the existing driveway, removing and disposing of excess or unsuitable materials off-site, furnishing, hauling, fine grading the sub-grade, compaction, all equipment, tools, labor, and incidentals necessary to complete the work. Replacement of the drive shall be to existing or better condition.

1.23 REMOVE AND REPLACE CONCRETE SIDEWALK

A. Determination of Measurement: Measurement shall be in square yards.

B. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted.

C. Work: Saw cutting and removal to the nearest joint, proper disposal of the existing concrete sidewalk and unsuitable materials, compaction, furnishing, hauling, and placing all materials, fine grading the sub-grade, installation of necessary expansion joints, installation and removal of forms, concrete placement, curing and all equipment, tools, labor, and incidentals necessary to complete the work.

1.24 PERMANENT ASPHALT PAVEMENT PATCH

A. Determination of Measurement: Measurement shall be to the nearest one-tenth square yards. The designated number of square yards to be removed shall be on the plan or as directed by the Project Coordinator.

B. Basis for Payment: Payment shall be on a contract unit price bid per square yard completed and accepted with a minimum thickness of two (2) inches or matching existing asphalt thickness, whichever is greater and eight (8) inches of Aggregate Base Course or matching existing, whichever is greater.

C. Work: Labor, materials, tools, and equipment necessary to complete the work which shall include saw cutting (NO WHEEL CUTTING ALLOWED) pavement to straight uniform widths parallel and perpendicular to the road with no jagged edges, removal and disposal of asphalt offsite, re-compaction, removing and disposing of excess soil base course, re-compaction of pavement sub-grade, placement and compaction of ten (10) inches of ABC, maintaining ABC as necessary to maintain stone at pavement grade until removal of upper two (2) inches of stone for paving, adjusting castings as required, tack coat, placing and compacting asphalt material, cleanup and all other incidental work as shown on the details.

1.25 CONCRETE CURB AND GUTTER

A. Determination of Measurement: The quantity to be paid for in this section shall be the actual number of linear feet of combination curb and gutter measured in place, completed and accepted. This measurement of curb and gutter shall be along the top of the curb.

B. Basis for Payment: Payment shall be on a contract unit price per linear foot.

C. Work: Furnishing, hauling, and placing all materials, fine grading of sub-grade, installation and removal of forms, compacting subgrade, soil amendments, backfilling behind curb with

topsoil, all equipment, tools, curing and labor and incidentals necessary to complete the work.

1.26 CONCRETE SIDEWALK

A. Determination of Measurement: The quantity shall be measured in square yards of concrete sidewalk in place, completed and accepted.

B. Basis for Payment: Payment shall be on a contract unit price per square yard. The amount of grade work required to obtain the proper sub-grade from the finished grade of the sidewalk will be included as part of the per square yard price for concrete sidewalk

C. Work: Furnishing, hauling, and placing all materials, fine grading of sub-grade, installation and removal of forms, compacting subgrade, soil amendments, backfilling behind curb with topsoil, all equipment, tools, curing and labor and incidentals necessary to complete the work.

1.27 UTILITY PIPING

A. Determination of Measurement: Measure horizontally or from station to station as shown or indicated on the Drawings for the various types and sizes of pipes installed.
   1. (X) inch Storm Sewer: Measure pipe inside wall to inside wall of structures and from pipe end to longest point of opposing pipe end. Depth of pipe will not effect measurement.

B. Basis for Payment: Payment shall be on a contract unit price per linear foot of storm sewer that is installed.

C. Work: Shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
   1. Excavating, shoring and bracing where required, dewatering as required, installing, backfilling (including Class I material as specified for the pipe bedding, haunching, and initial backfill).
   2. Installation of warning / identification tape over utilities.
   3. Temporary support and protection of existing underground facilities.
   4. Pipe, concrete blocking and encasement, connection to existing piping, and fittings.
   5. Flushing and treatment, as required.
   6. Adjust existing and new manhole and valve boxes to finished surface elevations, if applicable.
   7. Grade disturbed areas to original surface profile prior to seeding.
   8. Pipe bedding.
   9. Joint materials.
   10. Traceable wire.
   11. Clean up.

1.28 SEEDING

A. Measurement: Per acre seeded.

B. Basis for Payment: Payment shall be on a contract unit price per acre that is seeded.

C. Work: Shall include the full width of the disturbed area for the cleanup and seeding. Work shall include, but not be limited to, the following:
   1. Removal and proper disposal of debris and excess material.
   2. Grade disturbed areas to original or proposed surface profile.
   3. Cleaning of paved surfaces.
   4. Proper seeding, fertilizing, mulching and other incidentals necessary to properly seed project area.

1.29 FLOWABLE FILL (EXCAVATABLE AND NON-EXCAVATABLE)

A. Determination of Measurement: Measure by the cubic yard of flowable fill delivered and placed.

B. Basis for Payment: Payment shall be on a contract unit price per cubic yard that is installed.

C. Work: Material, placement, steel plating, backfilling, tools, equipment, etc.

1.30 BID ITEMS LISTED BY THE UNIT "EACH" (EA)

A. Measurement: By the number installed.

B. General work items:
   1. Adjust Existing Manhole Cover with Portland Cement Concrete: Excavating at existing manhole cover as necessary. Raise or lower existing manhole cover as necessary to set cover at desired elevation. Concrete backfill (collar) and clean up. Ramping included if necessary.
   2. Adjust Existing Valve Box with Portland Cement Concrete: Excavating at existing valve box as necessary. Raise or lower existing valve box as necessary to set box at desired elevation, installing new valve box extension if necessary. Concrete backfill (collar) and clean up. Ramping included if necessary.
   3. New Manhole Cover with Portland Cement Concrete: Excavating at existing manhole cover and removal as necessary. Set new manhole cover to desired elevation. Concrete backfill (collar) and clean up.
   4. New Valve Box with Portland Cement Concrete: Excavating at existing valve box and removal as necessary. Set new valve box to desired elevation, installing valve box extension if necessary. Concrete backfill (collar) and clean up.

C. Storm sewer work items:
   1. (X) inch Concrete Flared-End Section: Excavation, backfilling, and compacting for flared-end section.
   2. Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert, steps, and weep holes.
   3. Double Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert, steps and weep holes.
   4. Open Throat Catch Basin: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, invert, steps, weep holes, and precast top.
   5. Drop Inlet: Excavation, backfilling and compacting, stone bedding, concrete base, brick work as required for the depth, grate, frame, invert steps and weep holes.
   6. Junction Box: Excavation, backfilling and compacting, concrete base, brick work as required for the depth, grate and frame.
   7. Concrete Pipe Collar: Excavation, forms, backfilling, compacting, concrete, and hauling.
   8. Precast Concrete Box: Excavation, materials, pipe boots, grout, backfilling, compaction, grading.
   9. New catch basin frame and grate: Remove and properly dispose of existing grate, frame, and hood. Provide new grate, frame, and hood adjusting to grade of new curb and gutter elevations.

1.31 EROSION CONTROL (LUMP SUM)

A. Measurement shall not be made for this item.

B. Basis for Payment: Payment for Erosion Control shall be made over the life of the project. Initially, 90% of the lump sum bid shall be divided by the number of months scheduled for

the project, and payment shall be made each month in that amount. The final 10% will be held until the final payment.

C. Work: Shall include all labor, equipment, materials and incidentals for all work including monitoring, reporting and maintaining proper erosion control on the project.

1.32 (X)' DIA. MANHOLES, DEPTH (X) –(X) FT

A. Measurement: By the number of various sizes and at the depth installed. Measure depths from manhole cover to lowest pipe invert.

B. Basis of Payment: Payment shall be per unit contract price for each manhole installed.

C. Work: Excavating, backfilling, stone sub base, concrete sections as required for the depth, top adjusting rings, steps, ring and cover, invert and joint sealer.

1.33 THERMOPLASTIC PAVEMENT MARKING LINES

A. Determination of Measurement: The quantity of thermoplastic pavement marking lines to be paid for will be the actual number of linear feet of thermoplastic pavement marking lines which have been satisfactorily placed. The quantity of solid lines will be the summation of the linear feet of solid line measured end to end of the line. The quantity of skip or intermittent lines will be the summation of the linear feet derived by multiplying the nominal length of the marking lines by the number of marking lines in place.

B. Basis for Payment: The quantity of thermoplastic pavement marking lines measured will be paid for at the contract unit price per linear foot for thermoplastic pavement marking lines.

C. Work: Layout, materials, testing, tools, traffic control necessary to install markings, pre-marking, or interim lines/markings, equipment, labor and all other requirements necessary to complete the work.

1.34 THERMOPLASTIC PAVEMENT MARKING SYMBOLS

A. Determination of Measurement: The quantity of thermoplastic pavement marking symbols to be paid for will be the actual number of thermoplastic pavement marking symbols satisfactorily placed.

B. Basis for Payment: The quantity of thermoplastic pavement marking symbols measured will be paid for at the contract unit price per each for thermoplastic pavement marking symbols.

C. Work: Layout, materials, testing, tools, traffic control necessary to install markings, pre-marking or interim markings, equipment, labor and all other requirements necessary to complete the work.

1.35 RAISED REFLECTIVE PAVEMENT MARKERS

A. Determination of Measurement:

1. The quantity of raised reflective pavement markers to be paid for will be the actual number of markers which have been satisfactorily installed and accepted. Any reference to quantities is provided as an estimate only, and shall not serve to obligate the City to purchase any minimum amount, nor shall such reference serve to furnish any maximum amount which the Contractor is required to furnish.

2. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The City of Fayetteville may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient.

3. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided for the contract.

B. Basis for Payment: The quantity of raised reflective pavement markers measured will be paid for at the contract unit price per each raised reflective pavement marker installed.

C. Material: Shall be an NCDOT approved material.

D. Work: Adhesive, required traffic control devices, equipment and incidentals, cleaning of pavement surface and furnishing and installing raised reflective pavement markers.

1.36 TRAFFIC CONTROL

A. Determination of Measurement: Measurement shall not be made for this item.

B. Basis of Payment: Traffic control shall be billed and compensated as a lump sum item based on the following percentage schedule:

50%	First Payment
25%	Completion of 50% of project
15%	Completion of 75% of project
10%	Final Payment

C. Work: Materials and labor to provide traffic control.

1.37 REMOVAL OF PAVEMENT MARKING LINES

A. Determination of Measurement: Will be measured and paid as the actual number of linear feet of pavement marking lines satisfactorily removed and accepted by the Engineer. The quantity of solid lines will be the summation of the linear feet of solid line measured end-to-end of the line. The quantity of skip or broken lines will be the summation of the linear feet derived by multiplying the nominal length of lines by the number of marking lines satisfactorily removed.

B. Basis for Payment: The quantity of pavement marking lines removed will be paid for at the contract unit price for each linear foot. No payment will be made for the removal of removable pavement marking tape.

C. Work: Layout, materials, tools, traffic control, equipment, labor and all other requirements necessary to complete the work.

1.38 REMOVAL OF PAVEMENT MARKING SYMBOLS AND CHARACTERS

A. Determination of Measurement: Will be measured and paid as the actual number of pavement marking symbols and characters satisfactorily removed and accepted by the Engineer.

B. Basis for Payment: The quantity of pavement marking symbols and characters removed will be paid for at the contract unit price.

C. Work: Layout, materials, tools, traffic control, equipment, labor and all other requirements necessary to complete the work.

1.39 TEMPORARY PAVEMENT MARKING TAPE LINES

A. Determination of Measurement: The quantity of temporary pavement marking tape to be paid for lines will be the actual number of linear feet which has been satisfactorily installed and accepted. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Engineer may

increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work.

B. Basis for Payment: The quantity of temporary marking tape measured will be paid for at the contract unit price per linear foot installed.

C. Work: Labor, placement, removal, disposal, materials, equipment and any other necessary incidentals.

1.40 TEMPORARY PAVEMENT MARKING TAPE SYMBOLS

A. Determination of Measurement: The quantity of temporary pavement marking tape to be paid for symbols will be the actual number of symbols which have been satisfactorily installed and accepted by the City Traffic Engineer. The quantities shown in the itemized proposal for the project are considered to be approximate only and are given as the basis for comparison of bids. The Engineer may increase or decrease the quantity of any item or portion of the work as may be deemed necessary or expedient. An increase or decrease in the quantity of any item will not be regarded as sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work.

B. Basis for Payment: The quantity of temporary marking tape measured will be paid for at the contract unit price for each symbol installed.

C. Work: Labor, placement, removal, disposal, materials, equipment and any other necessary incidentals.

1.41 EMULSIFIED ASPHALT SLURRY SEAL

A. Determination of Measurement: Measurement shall be in square yards installed.

B. Basis of Payment: The quantity of emulsified slurry seal will be paid for at the contract unit price per square yard.

C. Work: Shall include cleaning, loading, hauling, equipment, labor, compaction, material and any other incidentals required for installation.

1.42 SELECT BORROW

A. Determination of Measurement: Measurement shall be in cubic yards installed. The cubic yards of excavation and the cubic yards of select granular material backfill to be paid for shall be 75 percent of the volume obtained by multiplying the gross volume of the trucks hauling the material by the number of loads hauled.

B. Basis of Payment: The quantity of subsoil will be paid for at the contract unit price per cubic yard of subsoil installed.

C. Work: Shall include material loading, hauling, placing, and compacting, equipment, labor, supplying suitable subsoil material and any other incidentals required for installation.

1.43 TOPSOIL

A. Determination of Measurement: Measurement shall be in cubic yards installed.

B. Basis of Payment: The quantity of topsoil will be paid for at the contract unit price per cubic yard of topsoil installed.

C. Work: Shall include removal of unusable topsoil including rocks and debris, excavation, grading, loading, hauling, equipment, labor, compaction, supplying suitable topsoil material and any other incidentals required for installation.

1.44 MANHOLE ADJUSTMENT

A. Determination of Measurement: Measurement shall be for each manhole adjusted.

B. Basis of Payment: The quantity of adjusted manholes will be paid for at the contract unit price per each adjustment made.

C. Work: Shall include cleaning, equipment, labor, material, leveling, adjustments and any other incidentals required for installation.

1.45 RIP-RAP SWALE

A. Determination of Measurement: Measurement shall be per ton of rip-rap placed on swale.

B. Basis for Payment: Payment will be on a contract unit price per ton of rip-rap swales installed. Contractor shall furnish a "certified scale ticket" with each load of stone to the Engineer within 24 hours.

C. Work: Furnishing, hauling, placing materials, fabric, staples, grading, equipment, tools, labor and other incidentals required to install swale.

1.46 IRRIGATION SYSTEM

A. Determination of Measurement: No measurement shall be made for this item.

B. Basis of Payment: Payment will be lump sum for complete installation of the irrigation system as shown.

C. Work: Shall include labor, material, equipment, services and any other incidentals required for installation.

1.47 FENCE REMOVAL

A. Determination of Measurement: Measurement shall be by the linear foot measured from center post to center post. No deduction will be made for gates.

B. Basis of Payment: Payment will be per linear foot per type of fence removed. Gates will be included in the linear foot price.

C. Work: Shall include labor, material, equipment, grading and any other incidentals required for removal.

1.48 FENCE INSTALLATION

A. Determination of Measurement: Measurement shall be by the linear foot measured from center post to center post. No deduction will be made for gates.

B. Basis of Payment: Payment will be per linear foot per type of fence installed. Gates will be included in the linear foot price.

C. Work: Shall include labor, material, equipment, grading and any other incidentals required for installation. Fence to match existing fence material or as specified by the Engineer.

1.49 SOD

A. Determination of Measurement: Measurement shall be to the nearest square yard.

B. Basis of Payment: Payment will be at the contract unit price per square yard of sod installed.

C. Work: Sod, pest control, disease control, anchoring, placing, soil amendments, fertilizer, topsoil, grading, raking, sod bed preparation, water, maintenance, sod replacement, protection, damage repair and other incidentals required.

1.50 TREES, PLANTS AND GROUND COVER

A. Determination of Measurement: Measurement shall be for each unit.

B. Basis of Payment: Payment will be at the contract unit price per each unit installed.

C. Work: Preparation of subgrade and topsoil, placing soils, planting, watering and maintenance.

1.51 WHEELCHAIR RAMP

A. Determination of Measurement: By the number installed (per type).

B. Basis of Payment: Payment will be for the contract unit price for handicap curb ramps installed.

C. Work shall include the excavation, forming, concrete placement and finishing, truncated dome, construction and expansion joints, and backfill.

1.52 HANDRAIL

A. Determination of Measurement: By the linear foot installed.

B. Basis of Payment: Payment will be for the contract unit price for handrail installed.

C. Work shall include the fabrication, primer, paint, installation, core holes, grout and any other incidental required for installation.

1.53 ENDWALL FOR CAST-IN-PLACE OR PRE-CAST CULVERT

A. Determination of Measurement: By the number installed per type.

B. Basis of Payment: Payment will be for the contract unit price per endwall per type installed.

C. Work shall include the block, brick, concrete, reinforcing steel, materials, excavation, bedding, grading and all other incidentals in order to build endwall.

1.54 PRECAST CONCRETE HEADWALL / FLARED END SECTION

A. Determination of Measurement: By the number installed per type.

B. Basis of Payment: Payment will be for the contract unit price per headwall/flared end section installed.

C. Work shall include the materials, excavation, bedding, grading and all other incidentals needed to construct headwall/flared end section.

1.55 DRIVEWAY APRON (CONCRETE)

A. Determination of Measurement: By square yard per thickness specified by the Engineer. Measurement from back of curb to edge of apron.

B. Basis of Payment: Payment shall be per unit contract price per square yard installed.

C. Work: Complete installation including, but not limited to, excavation, backfilling and compacting of subgrade, form work, concrete, finishing, and backfilling around concrete.

1.56 WHEELCHAIR RAMP AT EXISTING CURB

A. Determination of Measurement: By the number installed.

B. Basis of Payment: Payment shall be per unit contract price for each handicap ramp installed.

C. Work shall include the cutting and removal of the existing concrete sidewalk and curb and gutter, excavation, forming, concrete placement and finishing (including new depressed curb

& gutter), truncated dome, construction and expansion joints, and backfill behind new ramp with topsoil, curing, labor and incidentals necessary to complete the work.

1.57 RIP RAP

A. Determination of Measurement: Measurement shall be in tons per type specified.

B. Basis for Payment: Payment will be on a contract unit price per ton of rip-rap installed. Contractor shall furnish a “certified scale ticket” with each load of stone to the Engineer within 24 hours.

C. Work shall include furnishing filter fabric under stone, stone, hauling, placing material, staples, equipment, tools, labor and incidentals.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00127

SECTION 00132

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section specifies administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
   1. Project Management.
   2. Coordination.
   3. Administrative and supervisory personnel.
   4. General installation provisions.
   5. Cleaning and protection.

1.02 GENERAL COORDINATION REQUIREMENTS

A. Responsibilities of Contractor:
   1. Coordinate construction activities for the Project to assure efficient and proper installation of each part of the Work.
   2. Where availability of space is limited, coordinate installation of components to assure maximum accessibility for maintenance. Make adequate provisions to accommodate components scheduled for later installation.
   3. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. A copy of all memoranda shall be submitted to the Engineer.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Installation meetings.
   6. Project Close-out activities.
   7. Payment Applications.

C. Project Meetings: A Pre-construction conference shall be held prior to the beginning of the Work. Construction progress meetings shall be held monthly. Project close-out conference shall be held during the final phases of the Work. The Engineer may schedule additional meetings. The location of meetings is to be determined by the Engineer. The Contractor's project superintendent shall attend meetings. Suppliers and subcontractors will be notified to attend meetings as appropriate or as required by the Engineer. The Contractor shall schedule pre-installation conferences as required in the individual specification sections and shall notify the Engineer of project meetings scheduled by the Contractor. The Engineer will schedule and administer meetings throughout the progress of the Work, except for meetings held by the Contractor for normal coordination of the Work. Meeting agenda shall include, but not be limited to, the following: Project Administration, Submittals, Construction Schedules and Methods, Safety and Health Regulations, Project Coordination, Payment Application, Change Orders, and Site Inspections. Engineer will prepare agenda with copies

to participants, preside at meetings, prepare minutes and distribute to participants for meetings scheduled by the Engineer.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

E. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as Owner's property.

1.03 CLOSE-OUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit set of Record Documents indicating changes during construction as required in Section, Submittal Procedures.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and final amount due.

E. Submit the following with final Application for Payment:
1. Affidavit of Release of Liens
2. Consent of Surety for Final Payment
3. Affidavit of Payment of Debts and Claims
4. Final Certified Payroll Information

F. Submit warranties as required by individual equipment specifications.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 SPECIAL REQUIREMENTS

END OF SECTION 00132

SECTION 00150

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, telephone service, water, and sanitary facilities.

B. Work on public right-of-way.

C. Traffic control.

D. Temporary Controls: Barriers, enclosures and fencing, water control, dust control, erosion and sediment control, and protection of the work.

E. Construction Facilities: Access roads, parking, progress cleaning, project signage, and field offices.

1.02 TEMPORARY UTILITIES

A. Electricity
   1. Provide and pay for required power service for construction from Utility source.

B. Lighting
   1. Provide and maintain lighting for construction operations as required by Contractor.
   2. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required by Contractor.

C. Telephone Service
   1. Provide, maintain and pay for telephone service to field office as required by Contractor.

D. Water
   1. Provide, maintain, and pay for suitable quality water, including any necessary service(s) required for construction operations. Exercise measures to conserve water during construction.

E. Sanitary Facilities
   1. Provide and maintain required facilities and enclosures as necessary to comply with the laws and ordinances of the authority having jurisdiction and the State of North Carolina.
   2. General Contractor shall provide the above sanitary facilities for all contractors, sub-contractors, Owner and Engineer at the Project Site.

1.03 WORK ON PUBLIC RIGHTS-OF-WAY

A. Work on this Project is along rights-of-way under jurisdiction of the following N.C. Department of Transportation (NCDOT) and/or City of Fayetteville offices and Owner:
   1. NCDOT Division 6, District 2, District Engineer
   2. City of Fayetteville, City Engineer

B. Work shall comply with requirements of the Encroachment Agreement(s) and Driveway Permit as attached to Project Supplementary Conditions.

C. Post Bonds as required.

D. Prior to start of Work notify the Office of the NCDOT as indicated in the encroachment agreement and driveway permit. Also notify the Owner.

E. Work shall conform to the requirements and be subject to the approval of the above agency (ies).

F. Contractor shall be responsible to the Owner for the cost of all DOT inspection that is billed to the Owner by the NCDOT as indicated in the Special Provisions of the Encroachment Agreement.

G. Submit letter to the above District Engineer(s) when work is complete as required by the Encroachment Agreement.

H. Submit letter of approval for completed Work from the above agency (ies) with Final Payment Request.

I. Clean rights-of-way as work progresses and daily.

J. Power broom existing pavement as work progresses.

K. Work shall be in accordance with the latest edition of the N.C. Division of Highways, "Policies and Procedures for Accommodating Utilities on Highway Right-of -Way" and City of Fayetteville standards.

L. Consult with the above agency (ies) in establishing public thoroughfares to be used for haul routes and site access. Truck route permit and bond may be required.

M. Confine construction traffic to designated haul routes.

N. Provide traffic control along haul routes to regulate traffic and to minimize interference with public.

O. Provide and maintain access to fire hydrants, free of obstructions.

1.04 TRAFFIC CONTROL

A. On public and private road rights-of-way provide traffic control devices when construction encroaches within the right-of-way. Devices shall include, but not be limited to, cones, drums, flares, warning signs, temporary pavement marking, warning lights, and flagman.

B. Traffic control devices shall provide the following:
   1. Protection of motorists, pedestrians and workers from accident hazards.
   2. Advance public information of proposed work sites.
   3. Establishment of an orderly and safe flow of traffic and to minimize traffic congestion.
   4. Provision of access for emergency vehicles.

C. Traffic control devices shall be used in accordance with the latest edition of the NC DOT "Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)."

D. Provide personnel trained and certified in traffic control, as required by NCDOT and City of Fayetteville.

1.05 TEMPORARY CONTROLS

A. General
   1. Temporary controls shall be the responsibility of each Contractor for their respective work unless noted otherwise.

B. Barriers
   1. Provide barriers to prevent unauthorized entry to construction areas for the safety of the public, the protection of the work, and to protect existing facilities and adjacent properties from damage from construction operations.
   2. Provide barricades required by agency in (ICS) 1.03A of this section for public rights-of-way and for public access to existing buildings.

3. Provide protection for plant life designated to remain. Replace damaged plant life.
4. Protect vehicular traffic, stored materials, site, and structures from damage.

C. Water Control
1. Grade site to drain. Provide, operate, and maintain pumping equipment to maintain excavations free of water.
2. Protect site from running water.

D. Dust Control
1. Execute Work by methods designed to minimize raising dust from construction operations.
2. Provide positive means to prevent airborne dust from dispersing into atmosphere.

E. Erosion and Sediment Control
1. Provide Erosion and Sediment Control as indicated on the Drawings and Specifications.

F. Protection of Installed Work
1. Protect installed Work and provide special protection where specified in individual specification Sections.
2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
3. Prohibit traffic from landscaped areas.

1.06 CONSTRUCTION FACILITIES

A. General
1. Construction facilities shall be the responsibility of each Contractor for their respective work unless noted otherwise.

B. Access Roads
1. Contractor shall construct and maintain temporary drives as necessary to access public thoroughfares and existing drives to serve the construction area.
2. Provide means of removing mud from vehicle wheels before entering streets.

C. Parking
1. When site space is not adequate, arrange for temporary off site surface parking areas to accommodate construction personnel.
2. Do not allow vehicle parking in existing right-of-way or to block existing drives.
3. Do not allow vehicle parking on private property without prior approval.

D. Progress Cleaning
1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
2. Remove waste materials, debris, and rubbish from site periodically and dispose off site.

1.07 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, and materials, prior to Final Inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00150

SECTION 00170

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination.

B. Cutting and patching.

C. General installation provisions.

D. Cleaning and protection.

E. Final inspection and tests.

1.02 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specifications sections.

D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.03 CUTTING AND PATCHING

A. General
   1. Do not cut, or alter the work of other contractors without written approval of the Engineer.
   2. Work removed shall be replaced or repaired by the Contractor who removed or damaged the work, and a craftsman, skilled in the trade that the particular replacement requires, shall do the work. (i.e.: A mason, not an electrician, shall replace masonry removed by the Electrical Contractor.)
   3. Conduct removal operations in a manner that will eliminate hazards to persons and property and prevent the release of dust and rubbish into the air. Existing work, which is to remain and is damaged by contract operations shall be replaced with new materials at no additional cost to the Owner.
   4. For replacement of work removed, comply with specifications for type of work to be done.

B. Inspection
   1. Inspect existing conditions of work including elements subject to movement or damage during cutting and patching, and excavating and backfilling.
   2. After uncovering work, inspect conditions affecting installation of new products.

C. Preparation prior to cutting
   1. Provide shoring, bracing, and support as required to maintain structural integrity of project.
   2. Provide protection for other portions of project.
   3. Provide protection from elements.

D. Performance
   1. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, finishes.
   2. Execute cutting and demolition by clear sawcut methods, perpendicular to prevent damage to other work and provide proper surfaces to receive installation of repairs and new work.
   3. Execute excavating and backfilling as specified in Section, Trenching for Utilities.
   4. Restore work, which has been cut or removed; install new products to provide completed work in accordance with requirements of contract documents.
   5. Refinish surfaces as necessary to provide an even finish.

1.04 GENERAL INSTALLATION PROVISIONS

A. Require Installer of each major component to inspect conditions under which Work is to be performed. Clean substrate surfaces prior to applying next material or substance. Do not proceed until unsatisfactory conditions have been corrected.

B. Comply with manufacturer's recommendations to the extent that they are more explicit or stringent than requirements contained in Contract Documents.

C. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

D. Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.

E. Check dimensions before starting each installation.

F. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

G. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

H. Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Engineer for final decision.

1.05 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration.

B. Clean and maintain completed construction as frequently as necessary through the construction period. Adjust and lubricate components as required to ensure proper operation.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, or dangerous exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
   1. Excessive static or dynamic loading.
   2. Excessive internal or external pressures.
   3. Excessively high or low temperatures.
   4. Thermal shock.
   5. Air contamination or pollution.

6. Water or ice.
7. Abrasion.
8. Heavy traffic.
9. Misalignment.
10. Improper shipping or handling.
11. Theft.
12. Vandalism.

D. Clean Project prior to final inspection. Project clean up shall include, but not be limited to, the following:
1. Clean glass.
2. Clean surfaces exposed to view as recommended by manufacturer.
3. Remove temporary labels.
4. Vacuum carpeted areas.
5. Clean fixtures to a sanitary condition.
6. Repaint damaged paint surfaces.
7. Clean debris from roofs, gutters, down spouts, and drainage systems.
8. Sweep paved areas.
9. Rake clean landscaped surfaces.
10. Remove waste and surplus materials.
11. Remove temporary construction facilities.

1.06 FINAL INSPECTION

A. Complete punch list items within contract time to avoid liquidated damages.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00170

SECTION 00405

CLEARING, GRUBBING, AND SELECTED TREE REMOVAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This item should consist of the furnishing of all labor, equipment, and materials in performing all operations in connection with clearing and grubbing and selected tree removal, in accordance with this section of the specifications and the applicable drawings or as designated by the Engineer, and subject to the terms and conditions of the contract.

PART 2 PRODUCTS

2.01 MATERIALS

A. For cut or scarred surfaces, damaged area should be trimmed with a sharp blade to remove shredded or loose outer layer(s) and left to heal on its own. No paint or dressing is required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Protection: Locate and protect property corners and survey control stakes prior to start of clearing operations. Contractor shall protect underground utilities in the area.

B. Clearing: Clearing shall consist of the felling and cutting up of trees, the trimming of trees, and the satisfactory disposal of trees and other vegetation together with down timber, snags, brush and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation as may be indicated on the drawings or designated by the Engineer to be left standing, and all stumps, roots, and brush in areas to be cleared shall be cut off flush with or slightly below the original ground surface. Trees and stumps that are to be grubbed under the same contract may be cut to any height up to three feet (3'). When it is necessary to remove limbs and branches from trees which are to be left standing, the cut shall be neatly made close to the bole of the tree or to main branches. Individual trees, groups of trees, and other vegetation to be left standing shall be thoroughly protected from damage incident to construction operations by the erection of barriers or by other approved means. Clearing operations shall be conducted so as to prevent damage by falling trees to trees to be left standing, existing structures and installations, and to those under construction, and so as to provide safety of employees and others.

C. No trees, brush, stumps or other refuse from clearing shall be thrown upon adjacent property, but trees unavoidably falling outside the specified limits shall be removed to within the clearing and disposed of there.

D. Grubbing: Grubbing shall consist of the removal and disposal of all stumps, roots larger than three inches in diameter and matted roots from the areas designated to be grubbed. All stumps, roots, logs, or other timber more than three inches in diameter, matted roots, and other suitable debris shall be excavated and removed to a depth not less than three feet below any subgrade, shoulder, or slope. All depressions excavated for or by the removal of stumps and roots, shall be refilled with suitable material thoroughly compacted.

E. Selective Tree Removal: Selected trees to be removed shall consist of trees six inches or more in diameter either shown on the plans or as designated by the Engineer. All roots, or

other timber more than three inches in diameter, and matted roots shall be excavated and removed to a depth not less than three feet below any subgrade, shoulder, or slope. Selected trees shall NOT be paid for within an area designated as clearing and grubbing.

F. Clearing And Grubbing: The combined item of clearing and grubbing shall also include the removal and satisfactory disposal of fences, steps, walls, chimneys, slabs, building foundations, basements, signs and other rubble and debris unless otherwise specified by the Engineer.

G. Disposal of Cleared And Grubbed Material And Trees: All timber, logs, stumps, roots, brush, rotten wood, and other debris from the clearing and grubbing operations shall be disposed of legally by the Contractor

H. Erosion Control: Clear areas required to install erosion control devices, which shall be in place and operational prior to other land disturbing activity. Install erosion control devices in accordance with Project Manual and Drawings and Erosion Control Permit.

I. Access Roads: Clear for access roads. Limit clearing and grubbing for access roads to maximum width necessary or as shown on plans.

END OF SECTION 00405

SECTION 00410

PROOFROLLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This item shall consist of furnishing and operating, at the direction of the Engineer, heavy pneumatic tired compaction equipment or fully loaded tandem dump truck for compacting the roadbed and testing the roadbed for stability and uniformity of compaction.

B. The Contractor may operate the proofrolling equipment at times other than when directed by the Engineer. Such use is at the Contractor's option and is not to be considered as work performed under this section and will not be considered for payment.

C. The requirement for proofrolling may not be eliminated or modified without the approval of the Engineer.

PART 2 PRODUCT

2.01 EQUIPMENT

A. The Engineer shall check to see that the equipment conforms to the requirements of this article. A tandem dump truck legally fully loaded (not less than 28 tons) with soil or stone may be used to proofroll.

B. If requested weight tickets signed by a licensed public weighmaster may be used to determine the weight of the dump truck and the weight of load to be used.

C. Requests by the Contractor to substitute other types of equipment shall be forwarded to the Engineer for approval or disapproval.

D. The Contractor shall not be permitted to drive the loaded dump truck over existing structures or curbing. The Contractor shall use rubber tired or other types of tractive equipment for operation on the roadbed. The Contractor shall protect all structural facilities within the project area, such as, but not limited to, bridges, box culverts, pipe culverts and utilities. Damage resulting from proofrolling equipment shall be repaired by contractor at no cost to the City. The entire assembly, including motivating equipment, shall be capable of executing a 180° turn.

PART 3 EXECUTION

3.01 INSTALLATION

A. Proofrolling is to be done when the roadbed is within plus or minus 0.5 foot of finished grade and the roadbed shall be rolled for a width located between points 2 feet outside the proposed edges of pavement including shoulder pavement.

B. A coverage is considered to be that stage in the rolling procedure when the entire area to be proofrolled has been in contact with the pneumatic tires of the roller or loaded dump truck. One complete coverage shall be made with additional coverage as required when failure is suspected. Areas which have failed and been repaired shall be given a complete coverage after repair has been completed.

C. Equipment shall be operated at a speed between 225 ft/min and 300 ft/min.

D. The Engineer shall follow (walking is preferable) a short distance behind the proofroller observing the action of the roadbed produced immediately behind the tires of the roller.

When the roadbed material compresses and remains compressed, the roadbed is satisfactory. When the roadbed material compresses and then rebounds to any appreciable extent, further testing and investigation shall be made. Horizontal slippage or crust breakage is not considered as failure. Any slippage or breakage shall be repaired.

E. The Engineer shall take immediate steps to determine the cause of any failure observed. Failures are usually due to the necessity for underdrains, unsuitable materials or excessively wet materials. These conditions may be found to be as much as 6 feet below the roadbed surface. Assistance in determining corrective action required when needed, may be obtained from the Engineer.

F. Should it be determined that the failure is due to negligence or weather, the City Engineer shall so inform the Contractor, verbally and in writing and shall document all work (including equipment, personnel and time) necessary for correction of the area.

END OF SECTION 00410

SECTION 00415

SOIL TYPE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of the construction of a base composed of one or more natural materials proportioned and blended on the road, compacted, and shaped to conform to the lines, grades, depths, and typical sections shown on the plans and established by the Engineer.

B. Conditioning Existing Base: The work covered in this section consists of scarifying, shaping, and compacting the existing base to conform to the required lines, grades, depths, and typical sections established by the plans or modified by the Engineer.

1.02 DESIGN REQUIREMENTS

A. The soil type base course is to conform to the Table below:

Requirements	Limits Type A	Limits Type B	Limits Type C
Passing 2" Sieve		100%	
Passing 1" Sieve	100%	70% - 100%	
Passing ½" Sieve		55% - 100%	
Passing No. 4 Sieve		35% - 100%	
Passing No. 10 Sieve	65% - 100%	25% - 65%	100%
Passing No. 40 Sieve		15% - 45%	
Passing No. 200 Sieve		5% - 25%	

B. The base course material shall be free from vegetative matter and lumps or balls of clay.

PART 2 PRODUCTS

2.01 MATERIALS

A. Soil type base course shall be either Type A, B, or C.

2.02 SOURCE QUALITY CONTROL AND TESTS

A. Samples will be tested for gradation in accordance with AASHTO T-88. The liquid limit test will be in accordance with AASHTO T-89 and the plasticity index will be tested in accordance with AASHTO T-90.

B. Gradation testing shall be performed a minimum of one test per road or every 2,000 feet for roads less than 27 feet in width and every 1,000 feet for roads greater than 27 feet in width.

C. Sand cone test shall be utilized for density testing. Density testing shall be performed a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.

PART 3 EXECUTION

3.01 INSTALLATION

A. Soil type base course shall be placed on a sub-grade that has been cut to the required depth as shown on the plans. Sub-grade should be checked by the inspector or Engineer before

any base course can be placed. Upon the placing of the base material the Contractor shall start mixing operations. Mixing shall be done in a manner which will produce a thoroughly and uniformly mixed soil base course.

B. The base shall be finally shaped to conform to the lines, grades, and typical sections shown on the plans. Care shall be taken to prevent the formation of slippage planes in the surface. All soft or unstable areas shall be thoroughly dried, re-mixed, or reworked and replaced.

END OF SECTION 00415

SECTION 00420

AGGREGATE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.

1.02 REFERENCES

A. Standard Specifications for Roads and Structures: Section 520, most recent edition by the North Carolina Department of Transportation will govern the work under these specifications except as they are modified hereinafter.

1.03 SCHEDULING

A. No aggregate base course will be laid until the sub-grade is approved for grade and density by the Engineer.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL AND TESTS

A. Gradation testing may be required by Engineer if visible segregation in material is noted.

B. Sand cone test shall be utilized for density testing. Density testing shall be performed a minimum of one test per road or every 1,000 feet for roads less than 27 feet in width and every 500 feet for roads greater than 27 feet in width.

PART 3 EXECUTION

NOT USED

END OF SECTION 00420

SECTION 00425

EXCAVATION/BACKFILLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roadway: This item shall consist of the removal and satisfactory disposal of all materials excavated within the area of the street to be paved, the removal and replacement of unsuitable sub-grade material with satisfactory material, the formation, compacting, and shaping of all embankments to the lines and grades established by the Engineer, excavation from borrow areas of suitable materials to be hauled in and used as fill or back-fill, when sufficient quantities of suitable material are not available from the roadway, all in accordance with this section of the specification, and subject to the terms and conditions of the contract. The classification of all material excavated shall be either "Unclassified Excavation" or "Undercut Excavation."

B. Storm Sewer: The Contractor shall provide labor, equipment and material to perform required excavating, backfilling and compacting for storm sewer utilities and related structures to the depths shown on the plans or as directed by the Engineer. The width of the trench shall not exceed the width required to properly tamp backfill material around pipe or to adequately shore trench, but shall be limited to pipe diameter plus two feet or pipe diameter plus ½ pipe diameter, whichever is greater.

C. All pipes shall be laid true to lines and grades shown on the plans or as designated by the Engineer. Recesses shall be excavated to receive the bells of the pipe.

D. When the foundation materials are of poor supporting value, the pipe foundation shall be reinforced by one of the following methods:
   1. By replacing the unsuitable material in a minimum depth of six inches, or as directed by the Engineer with sand, sand-clay, gravel or crushed stone and thoroughly tamped.
   2. By constructing supporting cradles of concrete under each joint.

E. Excavation below grade shall be back-filled at the Contractor's expense, as directed by the Engineer, and thoroughly tamped. When select borrow material is required by the Engineer, it shall be paid for as Select Borrow.

F. The ground adjacent to all excavation shall be graded to prevent surface water running in. The Contractor shall, at his expense, remove by pumping or other means approved by the Engineer any water accumulated in the trench.

G. All banks or trenches shall conform to City and OSHA safety standards (whichever more stringent). The Contractor shall, at his expense, do all bracing, sheeting, and shoring necessary to perform and protect all excavations, as required for safety, and as directed by the Engineer or when the Contractor deems it necessary.

H. The excavation for manholes and catch basins shall be of sufficient width and depth to permit ready construction.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Methods: The Contractor shall proceed with excavation and disposal of material at such locations and in such sequence as the Engineer may approve.

1. All excess excavated material from a project shall be disposed of by the Contractor at his expense unless ordered to another project by the Engineer. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any right of property in any material taken from any excavation.

B. Sub-Grade: The sub-grade shall be graded and regulated either by hand labor, the use of one-man motor graders or other approved methods. The sub-grade of the area to be paved shall be in a true plane parallel with and to the grade line established by the Engineer. Should soft or yielding places develop in the sub-grade, the unsuitable material shall be removed and replaced with suitable material and thoroughly compacted. Care shall be taken to ensure that all utility excavations have been thoroughly backfilled and compacted. Any settlement evident after base has been placed shall be corrected at the Contractor's expense. No soil, sand-clay or other base material shall be placed on the sub-grade until the sub-grade has been checked and approved by the Engineer. A variation of more that one-half inch (½") shall be cause for rejection of the sub-grade. Compaction testing for subgrade and for base is 100% compaction.

C. Unclassified Excavation: All excavation of every description and of whatever substance including rock and rock-like material encountered shall be to the lines and grades indicated or otherwise as specified. The classification of all material excavated shall be "Unclassified Excavation." The work shall consist of the excavation, placement, compaction or satisfactory disposal of all materials encountered within the limits of the work, necessary for the construction of the roads, parking lots, building pads, and utilities. Suitable material excavated shall be transported to and placed in fill areas within the work limits. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. All excess unsuitable excavated material from the project shall be legally disposed of by the Contractor at his expense.

D. Undercut Excavation: All undercut excavation consists of the excavation, placement, and compaction and/or satisfactory disposal of materials removed from a location below finished grade roadway cross section.

E. Drainage Ditches: Drainage ditches shall be excavated in accordance with the plans, sections, and grades, and at the time directed by the Engineer. No deviation from alignment, grade, or section will be allowed except by the Engineer.

1. The Contractor shall, in general, be required to excavate all drainage ditches in proper sequence or at the time directed by the Engineer. All roots, stumps, and objectionable matter in the sides and bottom of the ditch shall be cut to conform to the slope, grade, and shape of the section. The Contractor shall dispose of the excavated material as directed by the Engineer and no excavated material or spill from a drainage ditch shall be deposited or left within three feet of the edge of the ditch, but shall be scattered back and not left piled up in a ridge along the ditch, unless otherwise shown on the plans or directed by the Engineer in writing.

F. Removal of Old Pipe, Walls, Steps, Curb, Gutter, Sidewalk and Pavement: All old pipe, walls, steps, curb, gutter, sidewalks, and pavement shall be removed (including saw cutting) as directed by the Engineer, and legally disposed of by the Contractor. None of the above pay items shall be removed until measured in place by the Engineer.

G. Private Driveways: The Contractor shall keep private driveways open and unobstructed as far as practicable and shall regrade same from curb to property line when directed by the Engineer.

END OF SECTION 00425

SECTION 00430

EROSION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work consists of providing all labor, material, equipment, and services required to conduct erosion control as described herein and indicated on drawings in accordance with the requirements of the North Carolina Sedimentation Pollution Control Act of 1973 and the rules and regulations promulgated pursuant to the provisions of said act. Erosion control devices shall be selected based on field conditions.

PART 2 PRODUCTS

A. Products specified are for establishing the type, design and quality required. Products of equal type, design and quality produced by other manufacturers will be considered.

B. Filter Cloth (Silt Fence) shall be a synthetic, permeable barrier sheet that is resistant to soil chemicals and mildew, stable under freeze-thaw cycles, will not shrink or expand under wet conditions, and will not unravel or become clogged during use. The filter cloth shall have a minimum tensile strength of 120 pounds. Allowable open area shall not exceed 36 percent and shall not be less than 4 percent. Percent open area is defined as the summation of the open areas divided by the total area of the filter cloth. Equivalent opening size (EOS) shall not be finer than the U.S. Standard Sieve No. 70. EOS is defined as the number of the U.S. Standard sieve having openings closest in size to the filter cloth openings.

C. Erosion Control Stone

1. Use field stone or rough unhewn quarry stone for plain rip rap. Use stone that is sound, tough, dense, resistant to the action of air and water and suitable in all other respects for the purpose intended. Where broken concrete from demolished structures or pavement is available, it may be used in place of stone provided that such use meets with the approval of the Engineer. However, the use of broken concrete that contains reinforcing steel will not be permitted.

2. All stone shall meet the approval of the Engineer. While no specific gradation is required, there shall be equal distribution of the various sizes of the stone within the required size range. The size of an individual stone particle will be determined by measuring its long dimension.

3. Stone or broken concrete for rip rap shall meet the following for the class and size distribution.

ACCEPTANCE CRITERIA FOR RIP RAP AND STONE FOR EROSION CONTROL

	Required Stone Sizes, Inches		
Class	**Minimum**	**Midrange**	**Maximum**
A	2	4	6
B	5	8	12
1	5	10	17
2	9	14	23

No more than 5.0% of the material furnished can be less than the minimum size specified nor no more than 10.0% of the material can exceed the maximum size specified.

D. Erosion Control Matting:

Matting for erosion control shall be excelsior matting or straw matting. Furnish a material certification certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the Engineer in writing before being used. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.

1. Excelsior Matting

   Excelsior matting shall consist of a machine produced mat of curled wood excelsior at least 47" in width and weigh 0.975 lb/sy with a tolerance of ± 10%. At least 80% of the individual excelsior fibers shall be 6" or more in length. Evenly distribute the excelsior fibers over the entire area of the blanket. Cover one side of the excelsior matting with an extruded plastic mesh. The mesh size for the plastic mesh shall be no more than 1" x 1".

2. Straw Matting

   Straw matting shall consist of a machine produced mat of 100% grain straw. The straw matting shall have a width of at least 48" and no more than 90" and weighing at least 0.50 lb/sy and no more than 0.75 lb/sy. Evenly distribute the straw over the entire area of the blanket. Cover one side of the blanket with photodegradable netting with a maximum mesh (netting) size of 0.75" x 0.75" sewn together with a degradable thread. The grain straw shall contain no weed seeds. Package each roll separately.

3. Wire Staples

   Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape. The size when formed shall be not less than 6" in length with a throat of not less than 1" in width.

PART 3 EXECUTION

A. Install Erosion Control Devices:
   1. Install erosion control devices, which shall be in place and operational prior to other land disturbing activity.
   2. After installing erosion control devices as indicated on the Drawings, verify that reasonable measures have been taken to prevent the sedimentation of nearby watercourses, existing and new facilities, and adjacent property.
   3. Should Contractor believe that additional measures are necessary to adequately prevent erosion, immediately notify Engineer. If rain is predicted before the Engineer can be notified, take measures as necessary to prevent siltation of nearby water courses.
   4. After installing erosion control devices, request an inspection by the local agency having jurisdiction and the Engineer.
   5. Incorporate permanent erosion control work into the project at the earliest practicable time. Coordinate temporary erosion control measures with permanent erosion control measures and other work on the project to assure effective and continuous erosion control throughout the construction and post construction period.
   6. Maintain erosion control devices during construction until the disturbed areas are stabilized and the agency having jurisdiction and the Engineer have approved the removal of the erosion control devices.

B. Borrow and Disposal Areas:
   1. Obtain and pay for erosion control permit for borrow and disposal areas as required by Engineer and the local agency having jurisdiction. (NCDENR)
   2. Install and maintain erosion control devices in accordance with Contractor's approved plan.

C. Silt Fences: Provide posts and metal fence fabric as detailed on the drawings and cover with filter cloth as indicated to furnish an effective filtering medium to separate soil sediment from the storm water runoff. The filter cloth shall be permanently attached to the fence to prevent displacement and the bottom of the filter cloth shall be buried to prevent under-washing in heavy rainstorms.

D. Filters: Gravel filters as detailed on the drawings, consisting of piles of #57 stone shall be placed around permanent and temporary drainage structures to allow storm water to flow into natural drainage channels while separating soil sediment from the storm water runoff.

E. Rock Inlet Sediment Traps: Provide posts, staples, hardware cloth and stone of type and class as detailed on the drawings. Structural stone, per class specified, shall be placed around the outside perimeter of the inlet structure with approximately 2:1 side slopes and plate the upstream side with #57 stone.

F. Rock Pipe Inlet Sediment Traps: Provide stone of type and class detailed on the drawings. Surround structure with a sediment storage area built to 3600 cubic feet per disturbed acre. Dam must be a minimum of 18 inches high.

G. Temporary Swales and Ditches: Temporary swales and ditches shall be graded to the profiles and sections indicated and in the locations directed. Slope all swales and ditches to drain to the basins and/or filters as indicated.

H. Erosion Control Matting:

   Matting for erosion control shall be excelsior matting or straw matting. Furnish a material certification certifying that the matting meets this article. Other acceptable material manufactured especially for erosion control may be used when approved by the

Engineer in writing before being used. Matting for erosion control shall not be dyed, bleached or otherwise treated in a manner that will result in toxicity to vegetation.

1. Excelsior Matting

   Excelsior matting shall consist of a machine produced mat of curled wood excelsior at least 47" in width and weigh 0.975 lb/sy with a tolerance of ± 10%. At least 80% of the individual excelsior fibers shall be 6" or more in length. Evenly distribute the excelsior fibers over the entire area of the blanket. Cover one side of the excelsior matting with an extruded plastic mesh. The mesh size for the plastic mesh shall be no more than 1" x 1".

2. Straw Matting

   Straw matting shall consist of a machine produced mat of 100% grain straw. The straw matting shall have a width of at least 48" and no more than 90" and weighing at least 0.50 lb/sy and no more than 0.75 lb/sy. Evenly distribute the straw over the entire area of the blanket. Cover one side of the blanket with photodegradable netting with a maximum mesh (netting) size of 0.75" x 0.75" sewn together with a degradable thread. The grain straw shall contain no weed seeds. Package each roll separately.

3. Wire Staples

   Staples shall be machine made of No. 11 gauge new steel wire formed into a U-shape. The size when formed shall be not less than 6" in length with a throat of not less than 1" in width.

I. Seeding: Refer to Section 00480.

J. Maintenance
   1. The Contractor shall be responsible for periodic reviews of the conditions of the erosion control measures and shall remove all soil sediment and debris as it accumulates in and around the sediment collection structures.
   2. The Contractor shall make all necessary repairs to the erosion control measures to insure their proper operation and function throughout the duration of the project.

K. Self-Inspection and Monitoring:
   1. Provide self-inspection and reporting as required by the Sedimentation Pollution Control Act for the duration of the project. These inspections will be performed to ensure that the approved sedimentation and erosion control measures on the Drawings are installed, maintained, and working adequately.
      a. The inspections need to be conducted after each phase of the project, and continue until permanent ground cover is established.
      b. The self-inspection forms and information regarding this program are provided at the following website: http://www.dlr.enr.state.nc.us/pages/sedimentation new.html.
      c. Documentation of inspections shall be recorded on a single copy of the approved erosion and sedimentation control drawings. These Drawings and inspection reports shall be made available at the project site.
   2. Provide weekly self-monitoring in accordance with the NPDES Stormwater permit for all construction activities

L. Removal of Temporary Erosion Control Measures: Remove erosion control devices upon the approval of the permanent stabilization of the site by the agency having jurisdiction of the area (NCDEQ) and the Engineer. Dress sediment deposits remaining in place after the erosion control devices are removed to conform to the existing grade, prepared and seeded.

Include cost of removal and cleanup in the cost of the installation of the device. All grassed areas disturbed as a result of this removal shall be re-grassed as called for in Section 00480.

END OF SECTION 00430

SECTION 00435

TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall design, furnish, and install any trench stabilization necessary to maintain excavations for pipe and drainage structure installation. The Contractor shall be responsible for installation and removal of any trench stabilization. The Contractor shall also be responsible for any damage to adjacent structures resulting from the installation, removal or absence of trench stabilization. Payment for all labor, equipment, and materials involved in this specification will be considered incidental to the cost of construction.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 00435

SECTION 00440

MILLING BITUMINOUS PAVEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Summary Of Work: The work covered by this section consists of milling bituminous pavement at locations, depths, widths, and typical sections indicated in the plans and special provisions or as directed by the Engineer.

B. The work also includes removing, transporting, and disposing of the milled material and cleaning the milled pavement surface.

C. The milled material shall become the property of the Contractor. All milled material shall be legally disposed of by the Contractor in areas provided by him which are outside the right-of-way, except where the milled material is used in the work. Milled material must be removed and disposed of on same day.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Equipment shall include a self-propelled unit capable of removing the existing bituminous pavement to the depths, widths, and typical sections shown in the plan, special provisions or as directed by the Engineer. The equipment shall have been designed and built exclusively for pavement milling operations and shall have sufficient power, traction, and stability to accurately maintain depth of cut and slope. The milling machine shall be equipped with a grade control system which will automatically control the longitudinal profile and cross slope of the milled surface by the use of one or more skid sensors moving along the pavement surface. The machine shall be capable of leaving a uniform surface suitable for handling traffic without excessive damage to the underlying pavement structure. The milling machine and other loading equipment shall be capable of loading milled material to be used in other parts of the work without excessive segregation. The milling machine must be on tracks, not wheels.

B. Additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb and gutter, and other obstructions shall be provided.

C. The milling equipment shall be equipped with a means of effectively limiting the amount of dust escaping from the removal operation in accordance with local, State and Federal air pollution control laws and regulations.

2.02 TOLERANCES

A. Tolerance: Removal of the existing pavement shall be to the depth required by the plans or project special provisions. The Engineer may vary the depth of milling by not more than one inch.

PART 3 EXECUTION

3.01 INSTALLATION

A. The existing pavement shall be milled in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section at the locations and in accordance with typical sections shown in the plans. Where indicated in the plans or project special provisions, removal shall be to a specified depth and shall produce a specified cross slope. The Contractor shall mill intersections and other irregular areas as indicated in the plans, project special provisions, or as directed by the Engineer.

B. The Contractor may elect to make multiple cuts to achieve the required depth of cut or cross slope required by the plans.

C. The longitudinal profile of the milled surface shall be established by a mobile string line on the side of the cut nearest the centerline of the road or as directed by the Engineer. The cross slope of the milled surface shall be established by an automatic cross slope control mechanism or by a second skid sensing device located on the opposite edge of the cut. The Engineer may waive the requirement for automatic grade and cross slope controls where conditions warrant.

D. The milling equipment shall be operated in such a manner as to prevent damage to the underlying pavement structure, utilities, drainage facilities, curb and gutter, paved surfaced outside the milled area, and reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage as determined by the Engineer. Any leveling or patching required as a result of negligence by the Contractor shall be repaired with hot bituminous plant mix at no cost to the City of Fayetteville and in a manner acceptable to the Engineer. The Contractor shall coordinate the adjustment of manholes, meter boxes and valve boxes with the milling operation.

E. Milling limits will be determined by Engineer before operation begins.

F. Inspector must be present during milling.

G. The Engineer may require re-milling of any area exhibiting defects such as lamination or other defects. If the defects are determined to be the result of the Contractor's negligence, then measurement of the re-milling, as specified in Unit Prices, will not be made. If, however, the Engineer directs the re-milling of an area which is not due to the Contractor's negligence, measurement of the re-milled area will be made under provisions of Unit Prices.

H. The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust and other objectionable material by the use of power brooms, power blowers, power vacuums or other means. Disposal or wasting of oversized pavement or loose aggregate material will not be permitted within the right-of-way.

I. The pavement removal operations shall be conducted to effectively minimize the amount of dust being emitted. The operations shall be planned and conducted so that it is safe for persons and property adjacent to the work including the traveling public.

END OF SECTION 00440

SECTION 00445

PAVEMENT JOINT SEALER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of the furnishing and placement of joint sealer material in accordance with these specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Joint sealer shall be hot poured rubber asphalt conforming to AASHTO M 173, except as otherwise provided below.

B. The joint sealer shall be free of all foreign material. When melted it shall be free of lumps. The composition of the material shall be a mixture of virgin synthetic rubber, or a combination of both, with asphalt, plasticizers, and tackifiers. Under no circumstances shall ground cured rubber scrap be used in place of virgin or reclaimed rubber.

C. The requirements of AASHTO M 173 for flow and bond shall be modified as follows:
   1. Flow test at 140 degrees F. 1.0 CM Max.
   2. Bond test shall be performed at minus 20 degrees F. instead of 9 degrees F.
   3. Ductility shall be not less than 40 CM when tested in accordance with ASTM D113.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Methods: All existing pavement cracks in excess of 1/8 inch but less than 1 ½ inches will be cleaned using a hot compressed air lance. The cracks shall be sealed with hot poured rubber asphalt meeting the requirements with these specifications.

B. The joint sealer shall be allowed to dry tack free prior to placing traffic on a sealed area of roadway. Apply DeTack (brand name) or equivalent to remove tackiness. Material shall be placed using the wand followed by a "V- shaped" asphalt squeegee. This method will allow uniform filing of the cracks and reduce excess material due to over-banding.

C. The Contractor shall provide all traffic control in accordance with the Manual on Uniform Traffic Control Devices.

END OF SECTION 00445

SECTION 00450

PLANT MIX BITUMINOUS CONCRETE SURFACE COURSE
AND
BITUMINOUS CONCRETE BASE COURSE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of the production, delivery, placement and compaction of all types of bituminous plant mixed bases and surface courses.

1.02 REFERENCES

A. The "Standard Specification for Roads and Structures" current edition and any revisions by the North Carolina Department of Transportation (NCDOT) will govern in its entirety the work under these specifications except as they are modified hereinafter.

B. Bituminous Plants Production: All bituminous plants shall meet specification 610 of the Standard Specifications of Roads and Structures current edition and any revisions by the NCDOT. All bituminous plants that produce bituminous mixes that are to be used within the rights-of-way of the City of Fayetteville, or on any new street that is to be accepted by the City of Fayetteville, shall have a current and up to date certification of the asphalt plant on file with the City of Fayetteville.

1. Any bituminous mix that is produced by a plant that does not have NCDOT certification is unacceptable for use within the City of Fayetteville.

C. Quality Management System for Asphalt Pavements: The Contractor shall produce and construct asphalt mixtures and pavements in accordance with a quality management system as described in Section 609 of the NCDOT Standard Specifications. The Contractor shall submit only NCDOT approved mix design and must be approved by the Engineer prior to delivery. Apply these specifications to all materials and work performed in accordance with Division 6 of the NCDOT Standard Specifications. Perform all quality control activities in accordance with NCDOT “Hot Mix Asphalt Quality Management System (HMA/QMS)” Manual.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Weather and Temperature Limitations: This section addresses air temperature, road surface temperatures, seasonal limitations, weather requirements, the layer thickness that apply when producing and/or placing the various mixture types. Bituminous mixtures shall not be produced or placed during rainy weather, when the sub-grade or base course is frozen, nor when the moisture on the surface to be paved would prevent proper bond. Bituminous material shall not be placed when the air temperature, measured in the shade away from artificial heat at the location of the paving operations, is less than the following temperatures:

	TEMPATURE OF LAYER BEING PLACED	
Material Type	Minimum Air Temperature	Minimum Road Surface Temperature
ACBC, Types B 25.0C, B 37.5 C, PADC	35 degree F (2 degree C)	35 degree F (2 degree C)
ACIC, Types I 19.0C	35 degree F (2 degree C)	35 degree F (2 degree C)
ACSC, Types S 4.75A, SF 9.5B	40 degree F (5 degree C)	40 degree F (5 degree C)
ACSC, Types S 9.5C	40 degree F (5 degree C)	40 degree F (5 degree C)

* For final layer of surface mixes containing recycled asphalt shingles (RAS) the minimum surface and air temperature shall be 50°F.

1. In addition, surface course material, which is to be the final layer of pavement, shall not be placed between December 15 and March 16, except that open-graded asphalt friction courses (OGAFC) will not be placed between October 31 and April 1 of the next year, unless otherwise approved by the Engineer.
2. As an exception to the above, when in any day's operations the placement of a layer of bituminous base course material or binder material 2" or greater in thickness has started, it may continue until the temperature drops to 32 degrees Fahrenheit (F).

PART 2 PRODUCTS

2.01 MATERIALS

A. Composition of Mixtures (Job Mix Formula): All bituminous plant mixes that shall be used within the rights-of-way of the City of Fayetteville shall be produced in a NCDOT certified bituminous plant.

B. All bituminous base courses and surface course mixes that are to be use within the rights-of-way of the City of Fayetteville shall be NCDOT approved and have all job mix formulas on file with the City of Fayetteville. No other bituminous mixes will be acceptable. Must submit mix design for the project.

C. All binder shall meet the appropriate requirements of Section 610 of the NCDOT Standard Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Requirement: The production, spreading, finishing, weather limitation, joints, compaction, density and surface requirements shall be in accordance with the Standard Specifications for Roads and Structures current edition and any revisions by the NCDOT.

B. Transportation of Bituminous Mixture: The mixture shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been sprayed with a lime solution, a soap and oil solution, or other approved material, to prevent the mixture from adhering to the beds. Fuel oil is not permitted for this purpose. Truck beds shall be drained prior to loading. Each load of mixture shall be fully covered with a canvas or other suitable material. All covers shall be so constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature. A 3/8 inch diameter hole shall be provided on each side of the vehicle body near the center of the body and 6 inches above the bed of the vehicle for the purpose of inserting a thermometer.

C. The temperature of the mixture immediately prior to discharge from the hauling vehicle shall be within a tolerance of plus 15 degrees F to minus 25 degrees F of the specified job mix temperature.

TABLE 610-1 MIXING TEMPERATURE AT THE ASPHALT PLANT

Binder Grade	JMF Temperature
PG 64-22	300°F
PG 70-22	315°F
PG 76-22	335°F

D. The contractor is required to have a certified Roadway Technician with each paving operation at all times. This person is responsible for monitoring all roadway paving operations and directly supervising all quality control processes and activities. Provide a certified nuclear gauge operator when nuclear density control is being used. Provide the City of Fayetteville with an organizational chart, including names, telephone numbers, and current certification numbers of all personnel responsible for the quality control program while asphalt paving work is in progress.

E. Utilize the 30 foot minimum length mobile grade system to control longitudinal profile when placing the initial lanes and all adjacent lanes of all courses, including resurfacing, leveling courses, and asphalt in-lays, unless otherwise approved by the Engineer. Where public traffic is being maintained, apply only as much tack coat as can be covered during the same day's operation. In addition, the Engineer may limit the application of tack coat in advance of the paving operation depending on traffic conditions, project location, proximity to business or residential areas, or other reasons. In the event that tack coat material is not covered in the same day's operation, the Engineer may require the application of suitable granular material or other means to provide a safe traffic condition at no additional cost to the City of Fayetteville. The contractor will be responsible for any clean-up of the materials that was placed at no cost to the City of Fayetteville.

F. Contractor will furnish with each load of asphalt a scale ticket by a certified weigh master showing the amount of asphalt on the truck. Contractor will be paid on a unit price per ton of asphalt that is actually placed and rolled to a finish asphalt surface or base course.

G. The Engineer may prohibit or restrict the use of vibratory rollers where damage to the pavement being placed, the underlying pavement structure, drainage structures, utilities, or other facilities is likely to occur or is evident.

H. The final surface course material shall be compacted using two steel-wheel rollers and a pneumatic tired roller. For any paving operations, two rollers required on site.
   1. Initial rolling shall be achieved using an 8 to 10 ton steel wheel roller.
   2. Intermediate rolling shall be achieved using a pneumatic tired roller.
   3. Final rolling shall be achieved using an additional steel wheel roller.

I. Surface Smoothness:
   1. Base Course – 1/4" in 10 feet.
   2. Surface Course – 1/8" between any two contact points, 10 foot straight edge.

3.02 SPECIAL CONSIDERATION

A. Traffic Loops: When paving intersections requiring loop installations, the Owner shall be given ten (10) calendar days between completion of the first course and beginning of the second course in which to execute said loop installation. Contractor shall install loops before final layer, no later than five (5) days from when milled or as approved by the Engineer.

END OF SECTION 00450

SECTION 00451

PERMANENT PAVEMENT PATCH

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removing pavement in parking lots, roads, sidewalks, curb and gutters, drives etc. Installation of the permanent patch shall be completed in accordance with City of Fayetteville Specifications and Drawings. Maximum widths for trenches have been established for all sanitary sewer mains, force mains, sewer laterals, water mains, water laterals and storm drainage, regardless of the depth of excavation or type of existing pavement. Maximum widths shown include a minimum cutback of twelve (12) inches each side of the trench prior to placing pavement trench patch. Any pavement removed or damaged beyond the limits specified herein, shall be replaced by the Contractor at his own cost unless directed otherwise by the Engineer. No payment for overage beyond the quantity shown in the Bid Form will be made.

Maximum Widths for Pavement Trench Patch

Storm Drainage	6’	(for pipe 24” in diameter and less)
Storm Drainage	8’	(for pipe 30” up to 42” in diameter)
Storm Drainage	10’	(for pipe 48” up to 54” in diameter)
Storm Drainage	12’	(for pipe greater than 54”)
Sanitary Sewer	10’	(0’ to 10’ depth, measured to invert of pipe)
Sanitary Sewer	12’	(greater than 10’ depth, measured to invert of pipe)
Sewer Laterals	6’	
Water Main	4’	
Water Services	4’	

B. Contractor shall be required to remove installed patch, re-compact base and sub-base, dispose of unsuitable material off-site and re-patch any areas of settlement at no expense to the Owner. When excavating prior to paving, transitions shall be made to accommodate road travel at no additional cost to the Owner.

C. After completion of the excavation, etc., any trench or opening in any street or sidewalk shall be properly backfilled following City standards for compaction. The material used in replacing the surface course shall be of the same type and thickness and equal in quality to that which was removed. Excavatable flowable fill in accordance with the City’s specifications may be used instead of backfill from the invert to the base layer elevation at the discretion of the Engineer.

D. Any street that is degraded 25% or greater between intersection shall be overlayed with a minimum of 1-½ (1.5) inches of asphalt for the entire length between the intersecting streets. Percentage of degradation will be determined prior to excavation including existing and new degradation. A temporary patch flush with the existing asphalt elevation is to be used for one (1) year to allow settlement prior to final asphalt layer. The contractor may elect to pay in-lieu-of overlay in accordance with the City’s fee schedule. For additional requirements on excavation in the right of way, refer to Chapter 24, Article 11.

E. Contractor shall repair any pavement markings, signal loops and any other traffic device damaged during work.

F. All work shall be performed with the appropriate traffic control standards and in accordance with the latest edition of MUTCD and City Standards.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PERMANENT ASPHALT PAVEMENT PATCH

A. Remove and replace asphalt pavement as described in the unit prices section and as indicated on the bid form. Asphalt and stone shall be installed as indicated in applicable specifications and details or as directed.

3.02 REPLACE GRAVELS/SOIL DRIVEWAYS WITH AGGREGATE BASE COURSE (NO OVERAGE ALLOWED)

A. Existing gravel and/or soil driveway shall be replaced with six (6) inch thick stone; compacted Aggregate Base Course (ABC) or whichever matches existing type stone. Replacement of the drive shall be to existing or better condition.

END OF SECTION 00451

SECTION 00455

CONCRETE (CURB AND GUTTER, SIDEWALK, DRIVEWAY)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This work shall consist of Portland cement concrete combination curb and gutter, sidewalk and driveway constructed on a prepared sub-grade, in one course, in conformity with the lines, grade and typical cross section shown on the plans and in accordance with these specifications.

1.02 DESIGN REQUIREMENTS

A. Proportioning of Concrete: The concrete shall be mixed in proportions approved by the Engineer. The concrete shall develop at 28 days a minimum compressive strength of 3,000 pounds per square inch. The consistency range in slump of the concrete shall be two to four inches.

B. Air Entrainment of Concrete: All exposed concrete shall have 6 percent (+ or - 1.5 percent) entrained air as discussed in ASTM C 494-80. Measurement shall be with a roll-meter in accordance with ASTM C173-81 or a pressure meter in accordance with ASTM C281-81. Use of other testing procedures will be considered if requested in writing.
   a) The concrete from a central plant shall be delivered by a mobile agitator type mixer and deposited at the consistency specified without segregation. The time lapsing from mixing to placing the concrete shall be in accordance with NCDOT requirements.
   b) Concrete shall be mixed only in such quantities as are required for immediate use and all such material shall be used while fresh and before initial set has taken place. Any concrete in which set has begun shall not be used in the work. Re-tempering of concrete will not be allowed.

C. Finished grade of the sidewalk shall be based on the top of curb elevation.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather and Night Concreting: Concreting shall be done when weather conditions are favorable unless otherwise directed by the Engineer. Concrete operations shall be discontinued when the temperature of 40° Fahrenheit is reached on a falling thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw and plastic or other thermal insulation satisfactory to the Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Engineer at the Contractor's expense.
   a) No more concrete shall be laid than can be properly finished and covered during daylight, unless adequate artificial light satisfactory to the Engineer is provided.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: The cement used in this item shall be a standard brand of Portland cement or high-early-strength Portland cement conforming to the requirements of AASHTO Specifications. Different brands of cement, or the same brand from different mills, shall not

be mixed nor shall they be used alternately in any one continuous pouring between transverse joints.

2.02 SOURCE QUALITY CONTROL

A. Testing: The Engineer shall engage and pay an approved independent testing agency to conduct the routine testing of material for compliance in accordance with ACI 301-72, Chapter 16.

B. Test reports shall be furnished to the Engineer in quadruplicate at the earliest possible date following the testing.

C. If cylinder test results indicate that the concrete has not or will not reach the required 28-day compressive strength, the Engineer shall have the right to require any additional testing as necessary to determine the actual in-place strength of the concrete. Such additional testing will be at the Contractor's expense.

D. The Engineer shall have the right to require the removal and subsequent replacement of any concrete not meeting the minimum 28-day compressive strength. Such removal and replacement shall be at the Contractor's expense.

2.03 CONCRETE

A. The concrete shall be an approved NCDOT certified mix.

PART 3 EXECUTION

3.01 PREPARATION

A. Cleaning Site: Prior to the acceptance of the work, unsightly objects such as stones, stumps, limbs, roots, concrete, etc., shall be removed from the site and disposed of to the satisfaction of the Engineer. Work shall not be considered complete until all cleaning up has been done and the site is of a neat appearance.

3.02 INSTALLATION

A. Sub-grade: The sub-grade shall be excavated to the required depth below the finished surface in accordance with the plans and lines and grades established by the Engineer. All soft and yielding material or other unsuitable material shall be removed and replaced with approved material, and compacted thoroughly at the expense of the Contractor. If the sub-grade is in a filled section, the entire area shall be compacted to an unyielding surface.

B. Forms: Forms shall be set true to the lines and grades established by the Engineer. Sections less than 5 feet will not be accepted. Forms shall be held rigidly in position and shall be of sufficient strength to resist springing out of line when the concrete is placed. Forms shall be metal of the necessary dimensions to construct the combined curb and gutter, sidewalk or driveway shown on the drawings or specified. Wood forms may be used only where conditions make the use of metal forms impractical, and then only when approved by the Engineer. Forms for straight curb and gutter or radius curb and gutter having a radius of 350 feet or over shall be of steel of an approved type. Bent steel forms or steel forms with top or bottom flanges out of square sides or forms without pin lugs shall not be used and shall be removed from the construction site. Flexible steel forms shall be used on all radius curb having less than a 350 foot radius.

C. Placing of Concrete (Curb and Gutter): The curb and gutter shall be constructed in place in uniform sections 10 feet in length. The joints between sections shall be formed by steel templates 3/16 inches in thickness. Templates shall conform strictly to the curb and gutter

section. All joints shall be at right angles to straight curb and in radius line in radius curb. Any broken edges or joints may be cause for rejection. Templates must be pulled halfway out before concrete is set in order that concrete may run under the template. After concrete is set and while the forms are still in place, the templates are to be completely removed. When a curbing machine is used, the Contractor should use all precautions to prevent curb from settling when first starting, especially when grade is critical (below 1 percent). Contractor shall check grade on new poured curb before concrete has set so that correction can be made to the flow line of the curb.

a) Expansion joints of approved material for curb and gutter shall be provided every 90 feet or as directed by the Engineer. Joint material shall be not less than ½ inch in thickness, cut true to section, and shall be placed against the steel template forming the joint. Care shall be taken not to disturb the position of the expansion joint filler material during the removal of the templates.

b) Prior to placing of concrete, the sub-grade shall be moistened and the contact side of the forms shall be coated with a heavy oil. After the placing of the concrete within the forms, the sides of the forms shall be spaded with a flat spade of approved type. All voids that may appear after forms have been removed, shall be wetted thoroughly and plastered. An excess of voids will be cause for rejection. A slip form concrete machine may be used only on a trial basis and must meet the approval of the Engineer.

D. Placing of Concrete (Driveways and Sidewalks): Thickness shall be minimum of 4" for residential driveway aprons and 6" for commercial driveway aprons. Expansion joints of approved material shall be provided every 10 feet or as directed by the Engineer. Joint material shall be not less than ½ inch in thickness, cut true to section, and shall be placed against the template forming the joint. Care shall be taken not to disturb the position of the expansion joint filler materials during the removal of the templates. Seal expansion joints where sidewalk and curb ramps are placed adjacent to concrete curb and/or gutter. Do not seal grooved joints.

a) Prior to placing of concrete, the sub-grade shall be moistened and the contact side of the forms shall be coated with heavy oil. After the placing of the concrete within the forms, the sides of the forms shall be spaded with a flat spade of approved type. All voids that may appear, after forms have been removed, shall be wetted thoroughly and plastered. An excess of voids will be cause for rejection. A Slip Form Concrete Machine may be used only on a trial basis and must meet the approval of the Engineer.

E. Finishing: All concrete within forms shall be brought to true section by the use of an approved straight edge and shall be tamped with straight edge to bring mortar to the surface, after which it shall be floated smooth by means of wood floats. No steel floats will be permitted. After true surface of section has been obtained, and after initial set has taken place, the entire surface shall be broom finished with a dampened broom. Broom finished in direction of flow, all joints and all exposed edges shall be rounded off with approved jointing and edging tools.

F. Curing: Immediately after finishing operations have been completed, the entire surface of the concrete shall be sprayed with white curing compound (type 11 white pigment). The use of liquid retarding agents shall conform to standards specified by current AASHTO or ASTM specifications.

G. Removal of Forms: Forms shall not be removed from freshly placed concrete until it has set for at least 24 hours. They shall be carefully removed and in such a manner as to prevent damage to the edges of the concrete. Honeycombed areas shall be promptly filled with mortar composed of one part cement and two parts sand.

3.03 FIELD QUALITY CONTROL

A. The Engineer shall have the authority to require the Contractor to remove and replace any curb and gutter, sidewalk, or driveway which has been placed at grade elevations other than those shown on the plans and/or cut sheet. The finished grade of sidewalk is based on the top of curb. Such curbing, sidewalk, or driveway shall be removed and replaced at the Contractor's expense.

B. Curbing, sidewalk, or driveway found to be holding "ponding" water will be removed and replaced at the Contractor's expense.

3.04 PROTECTION OF FINISHED WORK

A. Protection of Concrete: After 72 hours the forms may be removed. Immediately after the forms have been removed and all honeycombed areas repaired, the back of the curb shall be back-filled to prevent under-wash. Traffic shall be excluded from crossing the concrete for a period of approximately 7 days by erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 7 day period and he shall remove and replace any concrete damaged as directed by the Engineer.

END OF SECTION 00455

SECTION 00465

ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES PORTLAND CEMENT CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of adjustment to existing manhole covers and valve boxes.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 INSTALLATION

A. Excavate all material from around casting to a width of 12 inches and to a depth of at least 2 inches below existing brickwork, existing structure or valve box. Remove and dispose of all loose material.

B. The height of any casting adjustment shall be determined by the use of a string line. The string line is to be pulled across casting and for at least 10 feet on each side of casting parallel to curb. Hold string at height of adjustment. Example: 1 inch above existing pavement for resurfacing and/or 2 inches above sand/clay or stone base. Then string is pulled perpendicular across casting from edge of pavement at curb to center line of street. The string shall be set at same adjustment height. Every effort shall be taken to ensure that the surface course and casting shall provide as smooth a ride as possible.

C. When setting casting higher than existing, all brick are to be placed in a "spoke" pattern and laid in a bed of clean fresh mortar. The Contractor is to ensure all brick are set firm to eliminate movement of casting.

D. When setting casting lower than existing, all brick and concrete are to be cut away, leaving a smooth surface. A cap of clean fresh mortar shall be applied to surface as a setting bed for casting.

E. The casting is then placed back on brick and care shall be taken to ensure that it is set on a bed of clean fresh mortar to eliminate movement. Mortar shall meet requirements of N.C. Department of Transportation Standard Specifications current edition and any revisions Section 1040-9 for mortar and Section 1014-1 for mortar sand.

F. The excavated area shall then be back-filled with 3,000 psi Portland cement concrete level to existing surface. The top of concrete shall then be struck smooth with existing surface. Casting is to be cleaned of any concrete spillage. Asphalt shall not be used to back-fill around casting.

G. All adjustments shall then be protected for at least 72 hours before the placement of any surfacing material. A finish surface tolerance shall not vary more than 1/4 inch in any direction.

H. After casting has been adjusted to grade, all excess debris and mortar shall be removed from manhole or valve box.

END OF SECTION 00465

SECTION 00471

NEW MANHOLE COVERS AND VALVE BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of new manhole cover and valve box installations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manhole covers and valve boxes shall be constructed in accordance with the *North Carolina Department of Transportation Standard Specifications for Roads and Structures,* latest edition and revisions.

PART 3 EXECUTION

3.01 INSTALLATION

A. Excavate all material from around casting to width of 18 inches and to a depth of at least 2". Remove and dispose of all loose material.

B. The height of casting adjustment shall be determined by the use of a string line. The string line is to be pulled across casting and for at least 10 feet on each side of casting parallel to curb. Hold string at height of adjustment. Example: 1 inch above existing pavement for resurfacing and/or 2 inches above sand/clay or stone base. Then string is pulled perpendicular across casting from edge of pavement at curb to centerline of street. The string shall be set at same adjustment height. Every effort shall be taken to ensure that the surface course and casting shall provide as smooth a ride as possible.

C. When setting new casting higher than existing, all brick are to be placed in a "spoke" pattern and laid in a bed of clean fresh mortar. The Contractor is to ensure all brick are set firm to eliminate movement of casting.

D. When setting new casting lower than existing, all brick and concrete are to be cut away, leaving a smooth surface. A cap of clean fresh mortar shall be applied to surface as a setting bed for casting.

E. The casting is then placed back on brick and care shall be taken to ensure that it is set on a bed of clean fresh mortar to eliminate movement. Mortar shall meet requirements of NC DOT Standard Specifications current edition and any revisions, Section 1040-9 for mortar and Section 1014-1 for mortar sand.

F. The exposed brick work and face of the existing asphalt shall be cleaned. The excavated area shall be back-filled with 3000 lb. strength concrete to within 2" of finished grade. Concrete shall comply with NCDOT mix design. Casting is to be cleaned of any concrete spillage.

G. All adjustments shall then be protected for at least 24 hours before the placement of any surfacing material. A finish surface tolerance shall not vary more than 1/4 inch in any direction.

H. After casting has been adjusted to grade, all excess debris and concrete shall be removed from manhole cover or valve box.

END OF SECTION 00471

SECTION 00475

STORM SEWER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This item shall consist of storm sewer pipes and structures of the classes, sizes, and dimensions designated, furnished and installed at such places as are designated in accordance with the lines and grades given and in conformity to these specifications. This item shall also include furnishing and construction of such joints and connections to other pipes, catch basins, manholes, endwalls, etc., as may be required to complete the work as shown on the plans.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipes: All pipes shall be of the type and class indicated on the plans.

1. Reinforced concrete pipe shall conform to A.S.T.M. Specifications C-76, Class III, and 15" through 36" diameter shall be of modified or improved tongue and groove type. No plain or straight wall grooves shall be used.

2. Corrugated galvanized metal pipe shall conform to latest AASHTO Specifications. All metal pipe culverts used shall be fully coated inside and outside with an asphalt cement to a minimum thickness of 0.05 of an inch when measured on the crest of the percent soluble in carbon disulfide. The pipe shall be coated with the bituminous material in a manner so that a smooth pavement will be formed in the invert (inside bottom of pipe when installed), filling the corrugation for at least 25 percent of the periphery of the pipe. The pavement shall have a minimum thickness of 0.125 of an inch then measured on the crests of the corrugations.

3. Castings: All casting shall be of the type and duty shown on the plans and shall be approved by the Engineer prior to installation. Castings shall be made of gray iron, ASTM A-48 – class 30, or ductile iron, ASTM A536, grade 65-45-12. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16 inch per foot of dimension. Top shall set neatly in frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame. All covers and gratings shall seat firmly without rocking. The Contractor shall replace all faulty castings installed by him at his expense.

4. Mortar*:* Mortar used in brick masonry and joints shall be composed of one-part Portland cement and hydrated lime, (not more that 10 percent of lime, based on the volume of cement, shall be used) and two-parts sand. Portland cement and hydrated lime shall meet the requirements of the latest A.S.T.M. specifications. The sand shall be composed of clean, well graded aggregate. The mortar shall be mixed in a tight mortar box or in an approved mechanical mixer. Mortar shall be used within *45* minutes after mixing.

5. Bedding material shall be #57 washed stone. Stone depth shall be 6” below the pipe (or as specified by the Engineer) and full width of trench as specified in Section 00435 and in standard details.

6. Tracer wire shall be installed on non-metallic pipe. Tracer wire shall be #12 AWG solid-copper wire with green insulation.

PART 3 EXECUTION

3.01 INSTALLATION

A. The trench shall be shaped true to line and grade, and bedding surface for the pipe shall provide a firm foundation. Grooves shall be cut in the trench for bells so that each joint of pipe shall be bedded for its full length.

B. Concrete pipe culverts shall be carefully seated with bells or grooves upgrade and ends fully closed. Joints of concrete pipe shall be thoroughly wet before making the mortar joint. RAM-NEK can be used instead of mortar to seal joints.

C. Modified Tongue and Groove Concrete Pipes: Before succeeding sections of pipe are laid, the lower portions of the bell or groove of the pipe shall be filled on the inside with cement mortar of sufficient thickness to bring the inner surface of the abutting pipes flush and even. After the pipe is laid, the remainder of the joint shall be solidly filled with mortar and sufficient additional mortar to form a bead or ring around the outside of the joint. The inside of the joint shall be wiped and finished smooth. All pipe runs 100 LF or greater shall be videoed to ensure proper alignment and joint sealing. Pipe which is not true to alignment or which shows any settlement after laying shall be taken up and reinstalled without extra compensation.

D. Manholes, Inlets, Junction Boxes, Catch Basins, Etc.: Excavation shall be made to the required depth. The foundation on which the brick masonry is to be laid shall be approved by the Engineer prior to the laying of bricks. The bricks shall be laid so that they will be thoroughly bonded into the mortar by means of the *"shove joint"* method; buttered or plastered joints will not be permitted. The headers and stretchers shall be so arranged as to bond the mass. Brick work shall be of alternate headers and stretchers with consecutive courses breaking joints. All mortar joints shall be completely filled with mortar. No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a corner. Competent bricklayers shall be employed on the work and all details of construction shall be in accordance with approved practice and to the satisfaction of the Engineer.

1. Steps shall be in accordance with ASTM C478 and made of ½-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs. Steps as shown on the plans shall be placed in all manholes, catch basins and inlets when they are greater than 42" in depth. The steps shall be set in the masonry as the work is built up, thoroughly bonded and accurately spaced and aligned. Place steps on narrow side of structure.

2. Existing manholes, catch basins and inlets shall be adjusted by the Contractor when designated by the Engineer. The work will be considered an adjustment where the manhole, catch basin or inlet in question is extended or lowered three feet or less in elevation, or where a catch basin can be adjusted to line without tearing out and rebuilding an entire wall. More work than this will not be considered an adjustment, but shall be classified as reconstruction.

3. Inverts in appurtenances shall be shaped to form smooth and regular surfaces free from sharp or jagged edges. They shall be sloped adequately to prevent sedimentation.

4. The casting shall be set in full mortar beds. All castings when set shall conform to the finished grade as established by the Engineer. Any castings not conforming shall be adjusted to the correct grade without extra compensation.

5. Concrete pipe collars may be used for repairing storm drain pipes. Concrete collars may not be installed within 16’ of any structure. Damage within 16’ of structures shall be replaced with new pipe. See detail for more information on installation.

END OF SECTION 00475

SECTION 00480

SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work consists of providing all labor, material, equipment, and services required for all work as described herein and indicated on drawings.
   1. Work specified in this section:
      a. Preparation and placement of top soil. Seeding required within 24 hours after preparation.
      b. Initial maintenance of all planting.

1.02 SUBMITTALS

A. Construction sequence and time schedule.

B. Soil additives and mulch materials.

C. Fertilizers, sterilants, herbicides.

D. Monthly maintenance record: List all herbicides, insecticides, and disease control chemicals used; list a corrective action or replacement of work performed.

E. Suggested maintenance plan for maintenance by City to include chemical recommendations, amount of watering and all other proper care necessary to assure quality plant growth.

F. All other materials: Manufacturer and the product designation.

1.03 MAINTENANCE

A. The Maintenance Period shall extend for a period of one (1) year dating from final inspection.

B. Maintenance requirements:
   1. Maintenance shall include mowing, watering, weeding, leaf raking, fertilizing, and all other care dictated by the standard of the best horticultural practices. (In the event the irrigation system is inoperable or in the absence of such system, it shall be the responsibility of the landscape Contractor to supply sufficient watering from the beginning of planting through the one (1) year warranty period at no additional cost to the City).
   2. Maintain all seeded areas from the time of installation until final acceptance of the entire work.
   3. Keep all seeded areas clean and free of weeds, rubbish, and debris at all times.
   4. Seeded areas shall be protected at all times against trespassing and damage of all kinds for the duration of the maintenance period. If any areas become damaged or injured, they shall be treated or replaced as directed by the City at no additional cost to the City.

C. Final inspection and acceptance:
   1. Prior to request for final inspection, Contractor shall again thoroughly clean all seeded areas.
   2. Final inspection will be made upon request and upon notification that Maintenance Period has ended.
   3. Acceptance will be given upon satisfactory findings in the final inspection or upon satisfactory correction of any deficiencies disclosed by the final inspection.

1.04 REGULATORY REQUIREMENTS

A. City Contract Policies

1.05 COORDINATION

A. Coordinate with installation of irrigation system.

B. Coordinate with all earth work and site work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Substitutions for any materials will not be permitted unless authorized in writing by the City.

B. Topsoil:
   1. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality. The topsoil shall be stripped so that there is no admixture of subsoil and shall be free from clay clumps, stones, roots, or similar substances two inches or more in diameter, debris, or other objects which might be a hindrance to planting operations. The City reserves the right to reject topsoil in which more than 60 percent of the materials passing V.S.S. #100 sieve consist of clay as determined by the Bonyoucous Hydrometer by the dried weights of the materials.

C. Soil Additives:
   1. Manure: Well-rotted, unleached, sterilized stable manure which is free of wood shavings, sawdust, or other undesirable litter and contains no chemical or other ingredients harmful to plants and shall not be less than 9 months old and not more than 2 years.
   2. Peat: Domestic product consisting of partially decomposed vegetable matter of natural occurrence. It shall be brown, clean, and low in content of mineral and wood material, mildly acid, and granulated or shredded.
   3. Lime: Shall be ground limestone (Dolomite) containing not less than 85 percent of total carbonates and shall be ground to such a fineness that 50 percent will pass through a 100 mesh sieve and 90 percent will pass through a 20 mesh sieve. Coarser material will be acceptable, provided the specified rates or application are increased proportionately on the basis of quantities passing through the 100 mesh sieve.
   4. Fertilizer:
      a. Turf Areas, Ground Covers, and Flowers shall be a controlled release formula and shall conform to the applicable State Board of Agriculture fertilizer laws. It shall be uniform in composition, dry and free-flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which has become caked or otherwise damaged making it unsuitable for use will not be acceptable.
      b. All fertilizer and soil conditioners shall be first quality, standard brand agricultural products.

D. Mulch: Use grain straw as mulch at any time of the year. If permission to use material other than grain straw is requested and the use of such material is approved by the Engineer, the season limitations, the methods and rates of application, the type of binding material or other conditions governing the use of such material will be established by the Engineer at the time of approval. Apply mulch within 24 hours of seeding unless otherwise permitted. Spread mulch uniformly by hand or by approved mechanical spreader or blower.

E. Plant Materials: Certificates of inspection shall accompany the invoice for each shipment of seeds as may be required by laws for transportation. File certificates with the City prior to acceptance of the material.

2.02 SOURCE QUALITY CONTROL AND TESTS

A. Testing and Inspection: Within ten days following acceptance of the bid, the City shall be notified of the sources of the materials required, desired to be inspected or tested.

B. Testing:
   1. Top Soil: All new loam or stripped topsoil used in the work of this section of the specifications shall be tested and approved for use by the Engineer prior to being spread. Stripped material may be used if approved and shall be stockpiled so as not to interfere with the other work or with other subgrade of fill materials.
   2. Testing other than soil testing shall be paid for by the City if the City deems the testing necessary.

C. Inspections:
   1. All areas to be planted shall be inspected by the Planting Contractor before starting work. Any defects, such as incorrect grading, etc., shall be reported to the City prior to beginning this work. The commencement of work by the Contractor shall indicate his acceptance of the areas to be planted, and he shall assume full responsibility for the work of this Section.
   2. During construction and installation, onsite inspections by the City will be made periodically to ensure proper implementation of design. The City retains the right to accept or reject any material or other incidentals needed to complete the project in whole or part and also may stop all work until all discrepancies are resolved.
   3. Any work scheduled beyond normal working hours or on weekends, shall be brought to the attention of the City Inspector for approval. Any work accomplished during these hours and in question will be subject to being done over at the request of the City, at no additional cost to the City.
   4. The City will inspect topsoil to be used to determine whether or not it meets the requirements specified.
   5. City representative shall be present during the application of post emergent sterilization.
   6. After completion of project, Contractor will provide a one (1) year warranty letter.

PART 3 EXECUTION

3.01 INSTALLATION

A. Soil Preparation:
   1. Add any amendments necessary to bring topsoil up to City Standards.
   2. All topsoil must be approved by Engineer.
   3. Coordinate with irrigation work, if any, to assure all lines have been installed prior to placement of topsoil or any other preparation for planting areas.
   4. Rough grades for planting areas have been left 8-12 inches below adjacent paving and/or curbing under work of General Contractor. (Landscape Contractor should plan to provide soil and labor to backfill curbing and sidewalk and should coordinate the work with the general Contractor as his work progresses. It shall be the responsibility of the Landscape Contractor to provide the specified grade for planting areas -- City will not be responsible for any excavation needed to acquire desired depth.)
   5. Debris removal: In all seeding areas, remove and dispose of all wire, rubbish, debris, concrete waste, base rock, or other plant materials which might hinder soil preparation, grading, seeding, or subsequent maintenance. Rake to smooth soil.
   6. Scarify existing earthwork: Soil in all on-grade paling areas shall be ripped or cultivated to depth of 10 inches. Water shall be added and ripping or cultivating shall be continued until the entire specified depth is loose and friable. All debris, pavement,

concrete, and rocks over 2 inches in diameter shall be removed to the specified depth and shall be removed from the site.

7. Place approved topsoil at grade in seeding areas.
8. Rake soil smooth to finished grade, pitched evenly for drainage. Round all changes in gradient and eliminate all depressions where water will pool.
9. Water areas to settle soil. After drying, correct low spots, irregularities, and reestablish finished grade.

B. Finished Grading: When weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled, all planting areas shall be smooth graded, ready for placement of plant materials and for seeding and/or sodding.

C. Seeded Lawn Areas:
   1. General:
      a. Once site is prepped with lime and fertilizer, it shall be seeded within a 24 hour period.
      b. Seed all lawn areas not covered by sod or other planting areas within scope of construction.
      c. After the areas have been loosened, conditioned, and finish graded as previously specified, they shall be hand raked to remove all clods, weeds, roots, debris and rocks 1 inch in diameter and larger.
      d. Final grades shall be approved by the City prior to seeding.
      e. After final grading has been accepted, no heavy equipment (except lawn rollers) will be allowed onto planting surfaces. Any damaged areas will be prepared using previous method.
      f. De-thatching shall be done in areas not requiring topsoil and grading work and in areas where existing lawn will be top seeded. Use a motor driven de-thatcher to remove all thatch buildup and loosen all areas to be seeded. Area should be hand raked and all debris promptly removed. All seeding shall take place within 24 hours following dethatching. City shall approve all areas for seeding prior to doing so.
   2. Seed Selection:
      a. Seed quantities and mixtures as specified on drawings.
      b. Provide seed complying with the official seed analysis of North America with respect to purity and germination percentages.
      c. Seed should be newly packaged seed (not greater than one year) and should arrive at the job site in the original container. City retains the right to inspect seed specification tag remaining intact on container.
      d. Do not use any seed that has been dampened, moldy, or suffered any other damage in transit or storage.

3. Seed Schedule

COMMON NAME	MIN SEED PURITY	MIN GERMINATION	MAX WEED SEED
Bermuda	90%		1.00%
Fescue tall, (Ky, 31)	98%		1.00%
Wheat	98%	MIN 90%	0.10%
German Millet	98%	MIN 90%	0.10%

POUNDS PER ACRE				
	K-31 Fescue	**German Millet**	**Bermuda Hulled**	**Bermuda Unhulled**
March 15 – Sept 15	100	25	25	--
	K-31 Fescue	**Wheat**	**Bermuda Hulled**	**Bermuda Unhulled**
Sept 15 – March 15	100	30		30

4. Once the seed is applied, the area shall be very lightly raked, either by hand or by mechanical means. All road right-of-ways and/or private grounds shall also be reseeded or sodded with the same type of grass previously found. The seed mixture specifications shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.
5. All seeded areas will be mulched with 4000 pounds per acre of small grain straw spread uniformly. Approximately 1/4 of the ground should be visible to avoid smothering seedlings. Asphalt emulsion may be used to anchor the straw applied at 150 gal/ton of straw. If asphalt emulsion is used, the Contractor shall not deface buildings, curbs or plantings with asphalt materials. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage which may occur.

3.02 CLEANING

A. Any soil or similar material which has been brought into paved areas by hauling operations or otherwise shall be removed promptly, keeping these areas clean at all times.

B. Upon completion of work under this section, all excess stones, debris, and soil resulting from work under this section which have not previously been cleaned up shall be cleaned up and removed from the project site.

C. All pavements shall be broomed and hosed clean.

3.03 CONTRACT CLOSEOUT

A. Final Inspection:
1. Prior to requesting final inspection, Contractor shall have completed all of the work of seeding. All seeding areas shall be cleaned of all rubbish and debris, all adjacent pavement or surfaces shall be clean, and entire work shall be neat and presentable.
2. The final inspection will be made upon request and upon notification that all work installation is completed.
3. Approval will be given upon satisfactory findings in the final inspection or upon satisfactory correction of any deficiencies disclosed by the final inspection.

END OF SECTION 00480

SECTION 00485

FLOWABLE FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this specification consists of furnishing and placing flowable fill. Flowable fill is a controlled low strength material consisting of Portland cement, fly ash, fine aggregate, and water. It is suitable for filling underground storage tanks and pipe culverts and for back-filling culverts, bridges (where culverts or pipes are installed under a bridge), retaining walls, and roadway trenches.

B. The Contractor shall state on Form 312 the intended use of the flowable fill. The Form shall be accompanied by a listing of compressive strength of at least three 4" x 8" cylinders at the age of 7 and 28 days. The Engineer will advise the Contractor in writing of the acceptability of the mix design.

C. The Contractor may use flowable fill as an option to conventional fill and backfill methods with the approval of the Engineer.

1.02 DELIVERY, HANDLING, AND STORAGE

A. Mixing and Delivery: The Contractor shall comply with the applicable portions of Section 00455.

B. Temperature Requirements: The temperature requirements of Section 00455, Paragraph 1.03A., shall apply.

1.03 DESIGN REQUIREMENTS

A. Composition and Design: The Contractor shall submit to the Engineer the proposed mix design(s) on M&T Form 312 at least 35 day prior to use. Mix proportions shall be determined by a testing laboratory which has been approved by the NC Division of Highways and shall be based on laboratory trial batches meeting the following requirements:

BATCH ITEM	FILL TO BE EXCAVATED	FILL TO REMAIN IN PLACE
Compressive Strength @ 28 Days	80-150 PSI Max	500 PSI Min.
Approximate Quantities Per C.Y.		
Cement	40-100 Lbs. Min.	150 Lbs. Min.
Fly Ash	250-600 Lbs. Min.	300 Lbs. Min.
Fine Aggregate	2000-2500 Lbs. SSD	2650 Lbs. SSD
Water	60 Gals	60 Gals

1.04 To achieve desired placement consistency, flowability may be adjusted by varying the water content approximately + or - 5 gallons per cubic yard without quantitative changes in other materials. Less flowable mixes are desirable when it is necessary to put traffic back on a roadway quickly (i.e., within 8 to 10 hours) or when less buoyant fill is needed to backfill pipes that could float out of position. Pipes that could float shall be anchored or placement shall be in stages to prevent the pipe from floating.

PART 2 PRODUCTS

2.01 MATERIALS

A. All materials shall meet the requirements of N.C. Department of Transportation Standard Specifications dated January 2012, or current edition, Division 10 shown below:

Fine Aggregate	Article 1014-1
Portland Cement	Article 1024-1
Type IP Blended Cement	Article 1024-1
Fly Ash	Article 1024-5
Type IS Blended Cement	Article 1024-1
Water	Article 1024-4
Chemical Admixtures	Article 1024-3

B. Steel plates shall be Grade A36 steel and of a size to cover openings completely and shall be of suitable thickness to support all traffic that may pass over the plate. Steel plates shall be solid with only small holes on the sides to aid in lifting and moving the plates.

PART 3 EXECUTION

3.01 INSTALLATION

A. Placing: Flowable fill shall be discharged directly from the truck into the space to be filled, or by other methods approved by the Engineer. The mix may be placed full depth or in lifts as site conditions dictate. In roadway trenches, the flowable fill shall be brought level with the bottom of the pavement and then paved over. Between filling and paving operations, steel plates may be placed over the trench to accommodate traffic.

END OF SECTION 00485

SECTION 00490

PRECAST DRAINAGE STRUCTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section includes round and rectangular pre-cast concrete drainage structures including inlet structure components, sub-grade structure components, grates, covers and accessories.

B. The Contractor shall build inverts in all drainage structures in accordance with NCDOT standards. The additional work and materials required to install inverts will not be measured for payment as this work will be considered incidental to the construction of Drainage Structures.

1.02 REFERENCES

A. Pre-stressed Concrete Institute: Manual for Quality Control for Plants and Production of Pre-cast and Pre-stressed Concrete Products.

B. National Pre-cast Concrete Association: Quality Control Manual for Pre-cast Concrete Plants.

C. American Society for Testing and Materials:
   1. ASTM C478: Standard Specification for Precast Reinforced Concrete Manhole Sections.
   2. ASTM C890: Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Pre-cast Concrete Water and Wastewater Structures.
   3. ASTM C891: Standard Practice for Installation of Underground Pre-cast Concrete Utility Structures.
   4. ASTM C913: Standard Specification for Pre-cast Concrete Water and Wastewater Structures.

D. American Association of State Highway and Transportation Officials Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets (AASHTO M198).

E. American Concrete Institute: Building Code Requirements for Reinforced Concrete (ACI 318).

F. Occupational Safety and Health Administration: Standard 1926.704, Requirements for Pre-cast Concrete.

1.03 SUBMITTALS

A. The following information must be submitted to the project Engineer:
   1. Schedule of the drainage structure components to be provided on the project including the following:
      a. Sheet number where the structure plan and profile are shown.
      b. Line number when applicable.
      c. Drainage structure number or station number.
      d. Invert elevation of the influent and effluent lines as shown on the plans.
      e. Inlet structure flow-line elevation as shown on the plans.
      f. Total height required from top of base slab to top of structure.
      g. Total height of the individual and assembled drainage structure components.
      h. Top and bottom elevation of the drainage structure as calculated.

i. Manufacturer's part or catalog number and number required of each component.
j. Each pipe size, type and hole size and its distance from top of base slab.
k. Pipe location in degrees clockwise from step centerline on round structures.
l. Pipe location on rectangular structures by wall and intersecting angle relative to wall.
m. Minimum round inside diameter or rectangular inside dimensions required.

B. Detail of each pre-cast concrete component to be provided, sealed by the registered Professional Engineer including the following:
1. Manufacturer's part number or catalog number.
2. Inside diameter or dimensions and lay length.
3. Wall thickness and base or top thickness where applicable.
4. Handling weight and lift hole or insert or loop description and location.
5. Wire size, spacing and area provided per vertical foot (when applicable).
6. Reinforcing bar size and spacing or location.
7. Design loads for all rectangular components and round top slab components.
8. Step locations on round structures.
9. Concrete design strength and manufacturer's mix number.
10. Height, width, slope and annular space of the tongue and groove for products requiring tongue and groove joints.

C. Step detail and material specifications.

D. Joint material detail, material specifications and calculations showing that the joint material cross section is greater than the joint's annular space times its height.

E. Lifting device and hole detail including design loads.

F. At the request of the Engineer or owner, submit the following:
1. Structural analysis and design calculations for precast rectangular components and round top slab components, performed in accordance with applicable codes and standards, showing that allowable stresses will not be exceeded. All calculations must be sealed by a Registered Professional Engineer.
2. Calculations or test results verifying that the lifting device components and holes are designed in accordance with OSHA Standard 1926.704.
3. Concrete 28 day compression strength results for every day production of Pre-cast Components for the project was performed, showing the required strength according to the guidelines established in ACI 318.
4. Reinforcing and cement mill reports for materials used in the manufacture of Pre-cast Components for this project.
5. The above test reports for similar Pre-cast Components recently produced, submitted prior to production of Pre-cast Components for this project.

1.04 QUALIFICATIONS

A. The pre-cast manufacturer shall comply with the following requirement:
1. The Precast Manufacturer shall be a NCDOT approved manufacturer of precast concrete structures and have a minimum of 5 years of experience in manufacturing the required components.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to a minimum 40 degrees F prior to, during, and 48 hours after completion of masonry, grouting or concreting work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete shall conform to ASTM C478, C858 and as follows:
   1. Compressive strength: 4000 psi minimum at 28 days.
   2. Air Content: 6% ± 1.5%.
   3. Cementitious Materials: Minimum of 564 pounds per cylinder yard.
   4. Course Aggregates: ASTM C33, bound, crushed, angular granitic stone only.
   5. Fine Aggregates: ASTM C33 free from organic impurities.
   6. Chemical Admixtures: ASTM C494 calcium chloride or admixtures containing calcium chloride shall not be used.
   7. Air Entraining Admixtures: ASTM C260.

B. Reinforcing steel shall be ASTM A615 Grade 60 deformed bar, ASTM A82 wire or ASTM A185 welded wire fabric.

C. Lift Loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars shall not be allowed.

D. Flexible joint sealants shall be butyl rubber based conforming to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1 percent volatile matter and suitable for application temperatures between 10 and 100 degrees F.

E. Epoxy gels shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

2.02 COMPONENTS

A. Pre-cast Components shall be designed and manufactured as described in this paragraph and in the following paragraphs for the specific components.
   1. Lifting Inserts, Holes and Devices shall comply with OSHA Standard 1926.704. Lift holes and inserts shall be sized for a precision fit with the lift devices. Lifting devices shall be provided by the Pre-cast Manufacturer.
   2. Joints shall be sealed internally between the tongue and groove and additionally around the external perimeter of the joint as follows:
      a. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than 1/16 inch thick and 6 inches wide applied to the outside perimeter of the joint.
      b. Internal Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 14 feet long and having a cross-sectional area no less than the annular space times the height of the joint
      c. At the option of the Contractor, Internal Seals on round joints may consist of an O-Ring Gasket conforming to ASTM C443, installed according to the Pre-cast manufacturer's recommendation.
   3. Rings, Covers, Grates, and Frames shall be Class 30 gray cast iron and shall be designed for 16,000 pound wheel loads when located in roadways.
   4. Pre-cast Base Sections shall be cast monolithically without construction joints or with approved galvanized or PVC water-stop cast in the cold joint between the base slab and the walls. The minimum size of the base section shall be as specified in the schedules.
   5. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable. Form ties through the wall are not allowed. Exterior slab surfaces below grade shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be as set forth in the appropriate References. Exposed Drainage Structure Top Components shall have a form finish or a light broom finish on their exposed surfaces. Fins, voids, chips, or fractures over 3/8 inch in diameter shall be filled with thin cement paste and finished to a color and texture

reasonably consistent with that of formed finish. Rings and covers cast in exposed tops shall be free from cement paste build up.

6. Provisions for pipe entrances in the structures shall be cast or cored openings.
    a. Pipe openings in round structures shall remain 6 inches clear of other pipe openings.
    b. Pipe openings in rectangular structures shall not extend into the corners and may extend across a joint only when structural analysis shows stresses to be within the allowable.
7. Components shall be designed in accordance with ACI, ASTM C890 and following loads:
    a. Horizontal Load on Walls: An earth load of 80 psf per foot of burial depth plus a live lateral surcharge due to HS20 traffic loads of 80 psf.
    b. Vertical Load on Below Grade Adapter Slabs and Tops: An earth load of 120 psf per foot of overburden plus a live HS20 traffic load.
    c. Vertical Load on Exposed Inlet tops: A live 300 psf load.
    d. Vertical Load on Cast Iron Covers and Grates Supported Around Perimeter: A live HS20 load.

B. Round Sub-grade Components shall be designed and manufactured in conformance with ASTM C478 and as follows:
1. Riser Sections shall have a minimum lay length of 16 inches.
2. Pre-cast Concentric and Eccentric Cone Sections shall have an inside diameter at the top of 24 inches. The width of the top ledge shall be no less than the wall thickness required for the cone section.
3. Pre-cast Transition Cone or Top Sections may be used to provide an eccentric transition from 60 inch and larger structures to 48 inch diameter risers, cones, and adaptor slabs. Transition tops shall only be used in areas not subject to vehicle traffic with no more than 20 feet of cover.
4. Provide Steps in Bases, Risers, Cones, Transition Cones, and Transition Top sections aligned vertically on 16 inch centers when 42” deep or greater. Secure steps to the wall with a compression fit in cast or drilled holes or cast in place. Steps shall not be vibrated or driven into freshly cast concrete or grouted in place. The steps shall be Copolymer Polypropylene Plastic reinforced with a ½ inch diameter grade 60 bar and have serrated tread and tall end lugs. Pullout strength shall be a minimum of 2,000 pounds when tested according to ASTM C497.
5. Joints of Bases, Risers and Cones shall be manufactured to the joint surface design and tolerance requirements of ASTM C361.

C. Rectangular Sub-grade Components shall be no less than 22 inches wide, 34 inches long, designed and manufactured in conformance with ASTM C913 and as follows:
1. Riser sections shall not be allowed on boxes smaller than 4 feet long by 4 feet wide.
2. Pre-cast Transition Top Sections may be used to provide an eccentric transition from 4 foot by 4 foot and larger storm drain structures to 48-inch diameter risers, cones and adapter slabs. The maximum amount of fill over the transition top section shall be 20 feet.
3. Joints between precast components shall be keyways or tongue and groove. Joints to accept cast iron frames shall be flat and no less than 5" wide.

D. (Access Manhole) Inlet Components shall have cast iron rings and covers shall be as shown in the details with an opening diameter of 22 inches. Adapter slabs and cones shall have a minimum opening diameter of 24 inches. Precast grade rings conforming to ASTM C478, with a minimum lay length of 4 inches and totaling no more than 12 inches in height shall be used to adjust rings and covers to finished grade.

2.03 CONFIGURATION

A. Construct (Access Manhole) Structures to the elevations shown on the plans and as follows:
   1. A 24-inch diameter Cast Iron Ring and Cover
   2. A Concentric or Eccentric Cone or an Adapter Slab and a Round or Rectangular Subgrade Structure sized according to the schedule.

B. Drainage Structures greater than 8 feet deep shall be no less than 48 inches in diameter or 48 inches wide by 48 inches long.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect Precast components prior to unloading from the delivery truck.

3.02 PREPARATION

A. Product Delivery, Storage and Handling: Coordinate delivery with the manufacturer, handle and store the Precast Components in accordance with ASTM C891 and the manufacturer's recommendations using methods that will prevent damage to the components and the joint surfaces.

3.03 PLACING PRECAST CONCRETE SECTIONS

A. Excavate to the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6" beyond the precast base and follow ASTM C891 excavation standards.

B. Set base plumb and level, aligning pipe opening with pipe invert.

C. Thoroughly clean joint tongue and grooves to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against bottom groove. Leave protective wrapper attached until sealant is entirely unrolled against groove. Do not stretch. Overlap from side to side not top to bottom.

D. Set risers and tops, aligning internal wall surfaces, so that proper alignment is achieved, taking particular care to clean, prepare and seal joints.

E. When recommended by the manufacturer, fill the void between horizontal joint surfaces with a sand cement grout around the outside perimeter as risers are set.

F. After joining precast sections, apply the butyl sealant sheet around the outside perimeter of the joints below grade.

G. Secure Pipe Connectors to Pipe according to the Connector Manufacturer Instructions. When pipe stub outs are installed, provide restraint from longitudinal movement before backfill.

H. Lift Holes leaving less than 2" of wall thickness shall be plugged from the outside using a sand cement mortar and then covered with butyl sealant sheet. Lift Holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8" thick extending 2" beyond the penetration.

I. Perform the final finishing to the Structure interior by filling all chips or fractures greater than 1/2" in length, width or depth and depressions more than 1/2" deep in inverts with a sand cement mortar. Clean the interior of the Structure, removing all dirt, spills or other foreign matter.

3.04 SCHEDULES

A. Round Storm Drain Structures.

1. Provide round sub-grade structures with minimum inside diameters in inches based on the pipe's outside diameter and the angle formed with the adjacent entering pipe as shown in the table below:

Largest	Minimum Degrees Between Pipe Entering Structure										
Pipe OD	180	165	150	135	120	105	90	75	60	45	30
15	48	48	48	48	48	48	48	48	48	72	96
21	48	48	48	48	48	48	48	60	60	84	120
27	48	48	48	48	48	48	60	60	72	96	N/A
33	48	48	48	48	48	60	60	72	84	120	N/A
39	48	48	48	60	60	60	72	84	96	N/A	N/A
45	60	60	60	60	72	72	84	96	108	N/A	N/A
51	72	72	72	72	72	84	84	108	120	N/A	N/A
57	72	72	72	72	84	84	96	108	N/A	N/A	N/A
63	84	84	84	84	84	96	108	120	N/A	N/A	N/A
69	84	84	84	84	96	108	120	N/A	N/A	N/A	N/A
75	96	96	96	96	96	108	120	N/A	N/A	N/A	N/A
81	96	96	96	96	108	120	N/A	N/A	N/A	N/A	N/A

2. Structures with smaller inside diameters may be supplied when pipes are of different diameters and calculations or shop drawings show that a minimum of 6 inches clearance will be maintained between pipe openings.
3. The minimum lay length of the base section shall be no less than the diameter of the pipe opening for pipe OD up to 87 inches.

B. Rectangular Storm Drain Structures

1. Provide rectangular sub-grade structures with minimum inside wall widths based on the entering pipe's outside diameter and the angle formed with the penetrated wall as shown in the chart below:

Largest	Minimum Degrees Between Pipe and Wall						
Pipe OD	90	80	70	60	50	40	30
15	22	22	22	22	22	34	34
21	22	22	22	34	34	34	46
27	34	34	34	34	46	46	58
33	34	34	46	46	46	58	70
39	46	46	46	46	58	70	82
45	46	46	58	58	70	70	94
51	58	58	58	70	70	82	106
57	58	58	70	70	82	94	118
63	70	70	70	82	82	106	130
69	70	70	82	82	94	118	142
75	82	82	82	94	106	118	154
81	82	82	94	94	106	130	166
87	94	94	94	106	118	142	178

2. Structures with narrower walls may be supplied when pipes are different diameters than shown and calculations of shop drawings show that the pipe will not penetrate the corners of the structure.

END OF SECTION 00490

SECTION 00495

THERMOPLASTIC PAVEMENT MARKINGS
(Alkyd/Maleic)

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section consists of the furnishing and placement of Alkyd/Maleic Thermoplastic Reflective Markings in the form of lines and symbols as shown on the pavement marking plans. These markings shall be installed at the locations shown on the pavement marking plans or where directed by the City Traffic Engineer. Installation shall be performed in accordance with the lines, symbols, and dimensions shown on the pavement marking plans or as directed by the City Traffic Engineer. The Contractor shall furnish all materials, services, labor, and equipment necessary for the required pavement preparation and pavement marking installation. The Contractor shall provide sufficient personnel experienced in handling and applying the thermoplastic pavement marking materials to assure that the work is done properly.

1. The work shall meet the requirements of this section and the *North Carolina Department of Transportation Standard Specifications for Roads and Structures*, current revision, and any attached standard pavement marking typical drawings and/or project plans.

B. This special provision covers machine applied hot Alkyd/Maleic Thermoplastic Pavement Marking Material with both incorporated glass beads and drop-on glass beads. The material shall be plainly visible to the motorist both day and night. Nighttime visibility shall be enhanced by retroreflection induced by standard automobile headlights.

1.02 QUALIFICATIONS

A. All Alkyd/Maleic thermoplastic reflective pavement marking products shall be pre-qualified by the City of Fayetteville Traffic Services Division. The process of pre-qualification shall be handled through the Traffic Services Division.

1.03 DELIVERY, STORAGE, AND HANDLING

A. All thermoplastic and glass bead material shall be delivered to the project in containers filled by the manufacturer. Each material container shall be clearly and adequately marked to indicate the material, the date of manufacture, the process, batch or lot number, and the manufacturer's name and location.

B. Dry mixed thermoplastic material shall be shipped in leak proof moisture proof containers.

C. The thermoplastic pavement marking material shall be in block or granular form packaged in either suitable corrugated containers or thermal degradable plastic bags to which it will not adhere during shipment or storage. The packages shall weigh approximately 23 kg (50 pounds). The corrugated containers shall consist of blocks approximately 14 inches x 28 inches x 2 1/4 inch size. Each container shall designate the color, manufacturer's name, batch number and date of manufacture. The label shall warn the user that the material shall be heated in the range of 204° to 227°C (400° to 440° Fahrenheit [F]) during application.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Thermoplastic pavement markings shall not be applied on existing pavement surfaces or new concrete pavements unless the ambient air temperature and the temperature of the pavement is 50° Fahrenheit and rising.

B. Thermoplastic pavement markings shall not be applied on new asphalt surfaces unless the ambient air temperature is 50° F and rising and the temperature of the pavement is 50° F.

C. Thermoplastic pavement markings shall not be placed when the pavement surface shows visible evidence of containing moisture.

1.05 WARRANTY

A. Thermoplastic Pavement Marking Observation Period

1. The Contractor shall warrant the thermoplastic pavement markings in accordance with the Contract.
2. During the warranty period the thermoplastic pavement marking material furnished and installed under this contract shall be warranted against failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing, or spreading under heat, deterioration due to contact with oil, grease deposits, diesel fuel or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, loss of reflectivity, damage from traffic, and wear.
3. The Contractor, at no expense to the City of Fayetteville shall replace any pavement markings that will not perform satisfactorily under traffic during the warranty period due to defective materials and/or workmanship in manufacture and/or application. (Failure to comply with any portion of this specification shall be considered as unsatisfactory performance of the thermoplastic pavement marking material.)
4. Marking replacement shall be performed in accordance with the requirements specified herein for the initial application, including but not limited to surface cleaning, pavement marking removal, seasonal and weather limitations, etc.
5. Traffic shall be operating on the facility during the warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The material manufacturer has the option of formulating the Thermoplastic Material according to his own specifications, however, the Contractor shall provide to the City Traffic Engineer a certificate of certification that the thermoplastic meets North Carolina Department of Transportation Standard Specification for Roads and Structures, current edition and any revision, Division 10, Section 1087.

PART 3 EXECUTION

3.01 PREPARATION

A. To ensure maximum possible adhesion, the pavement surface upon which the thermoplastic markings are to be placed shall be properly cleaned and free of oil, mud, dust, dirt, grass, loose gravel, and other deleterious material, prior to the application of the thermoplastic pavement markings. Cleaning shall be performed on all surfaces which are to receive new thermoplastic pavement markings. The area to be cleaned shall be a minimum of 2 inches wider that the thermoplastic pavement markings to be placed, such that, an additional 1 inch of cleaned area is on each side of the thermoplastic pavement markings after they are applied.

B. Where cleaning of objectionable material is obscuring existing pavement markings of a lane occupied by public traffic, the residue including but not limited to dust, shall be removed immediately from the surface being treated. Such removal shall be by methods approved by the City Traffic Engineer.

C. On Portland Cement Concrete surfaces, a liquid epoxy resin primer-sealer or equivalent shall be applied to the area where new thermoplastic pavement markings are to be placed unless otherwise recommended by the manufacturer or Engineer. The primer-sealer shall be that recommended by the manufacturer of the thermoplastic material, and shall be approved by the City Traffic Engineer. The material shall form a continuous film which shall dry rapidly and which shall adhere to the pavement surface, thermoplastic material. The primer-sealer shall not discolor nor cause any noticeable change in the appearance of the thermoplastic pavement markings and/or the pavement outside the edge of the finished pavement markings. A sample of the primer-sealer shall be submitted to the City Traffic Engineer, and shall be approved by the City Traffic Engineer prior to application.

D. No direct payment shall be made for this surface preparation (pavement cleaning and application of primer-sealer) as such work shall be considered incidental to the work being paid for by the various thermoplastic pavement marking items in this contract.

3.02 PREMARKING

A. Where no existing markings are in place, the existing markings are not visible, and/or the existing markings are to be removed, the Contractor shall be required to pre-mark each installation of thermoplastic pavement marking materials prior to application. The pre-marking shall be of a manner that will be helpful to the Contractor and the Engineer in placing the thermoplastic pavement markings as directed in the plans. The actual placement of the thermoplastic pavement marking materials shall not be performed until the pre-marking has been inspected and approved by the Engineer.

B. No direct payment shall be made for this pre-marking as such work shall be considered incidental to the work being paid for by the various thermoplastic pavement marking items in the contract.

3.03 METHODS OF APPLICATION

A. The Contractor shall furnish and install by the specified method of application, thermoplastic pavement markings as directed by and in accordance with the pavement markings plans:
   1. Machine applied, hot extruded thermoplastic with glass spheres in the proper ratio to immediately produce a highly reflective marking as described elsewhere in this proposal conventional extrusion equipment or “ribbon gun” extrusion devices.
   2. Machine applied, hot sprayed thermoplastic with glass spheres in the proper ratio to immediately produce a highly reflective marking as described elsewhere in this proposal form. This method shall be approved by the Engineer prior to application.

B. The thermoplastic pavement markings shall be applied to the road surface in a molten state with a homogenous surface application of glass spheres. When applied properly and at the designated uniform thickness and width, the marking shall, upon cooling, be uniformly reflectorized and have the ability to resist deformation caused by traffic throughout its entire length.

C. Application of Thermoplastic Marking Material
   1. The parts of the application and pre-melting equipment shall be thoroughly cleaned of foreign material prior to the introduction of the thermoplastic pavement marking proposed in this specification.
   2. Openings of three to six inches in length shall be provided at intervals of 250 feet in edge-lines placed on the inside of curves and in edge-lines on the low side of tangents as directed by the City Traffic Engineer.
   3. The material shall be heated uniformly throughout and shall have a homogenous dispersant of binder, pigment, and glass beads when applied to the surface of the pavement.

4. To avoid blistering and poor adhesion, the thermoplastic pavement marking material shall be applied to dry pavements in a molten state at a minimum temperature of 205° C (400° F) for Bituminous Pavements and at a minimum temperature of 218° C (425° F) for Portland Cement Concrete Pavements. The temperature shall be checked every 10 minutes for compliance with the specified application temperature range.
5. "Drop-on Beads" shall be uniformly applied to the surface of the molten thermoplastic pavement marking material so that the beads are partially embedded. The beads shall be applied at a rate of 7 pounds per 100 square feet of marking. The cross-sectional thickness of the thermoplastic pavement marking material above the surface of the pavement for center lines, skip lines, transverse lines, mini skip lines, legends, and median islands shall be a minimum of 0.120 inches; edgelines, gorelines, 12-inch crosswalk lines, arrows and diagonals shall be a minimum of 0.90 inches.
6. The thermoplastic pavement marking materials, when formed into traffic symbols and lines, shall have a uniformly thick and smooth surfaced cross-section throughout its entire length.
7. All pavement marking widths, as a minimum, shall not vary by more than ½ inch.
8. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as specified in the plans and/or directed by the City Traffic Engineer. Longitudinal lines shall be offset a minimum of 2 inches from longitudinal construction joints of pavements. Longitudinal lane lines of multilane roads shall be offset 2 inches toward the median.
9. The finished lines shall have well defined edges and be free of horizontal fluctuations. The lateral deviation of the finished lines shall not exceed ½ inch from the proposed location alignment, as specified in the plans and/or directed by the City Traffic Engineer, at any point. Any greater deviations shall be sufficient cause for requiring the Contractor to remove and correct such pavement markings at no additional expense to the City of Fayetteville.
10. All pavement marking lines shall be applied with one pass of the pavement marking equipment, except the "X" of the railroad crossing symbol, 24 inch stop bars and 24 inch transverse bands, where two passes of the equipment will be permitted.
11. The stem portion of the straight arrows is to be applied in a single pass and the stem portion of turn arrows is to be applied in a maximum of two passes of the application equipment. Arrow heads may be applied by multiple passes of the application equipment, not to exceed three passes.
12. All pavement marking lines and symbols installed by multiple passes of the application equipment shall exhibit no gaps separating the application passes.
13. The various letters and symbols shall conform to the size and shape outline in the most recent edition of the Manual on Uniform Traffic Control Devices for Street and Highways, and NCDOT Standard, and as shown on the pavement marking plans.
14. The thermoplastic pavement marking material, when formed into traffic symbols and stripes, shall be readily renewable by placing a thin overlay of compatible new material directly over the old material.
15. The Contractor shall protect the pavement markings until they are track free by placing warning devices as directed by the Engineer.
16. Any molten pavement marking which is crossed by a vehicle shall be reapplied, and any subsequent marking made by the vehicle shall be removed by methods acceptable to the Engineer and at no additional expense to the Owner.
17. The Contractor shall be responsible for removing all pavement marking materials spilled upon the road surface by a method acceptable to the Engineer.

END OF SECTION 00495

SECTION 00496

RAISED REFLECTIVE PAVEMENT MARKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of furnishing and installing raised reflective pavement markers.

B. All work performed is to be in accordance with:
1. The North Carolina Department of Transportation Standard and Specifications for Roads and Structures, current edition.
2. The North Carolina Department of Transportation's Highway Design Branch Roadway Standard Drawings, current edition.
3. The Manual on Uniform Traffic Control Devices (MUTCD).
4. The North Carolina Supplement to the MUTCD.
5. Any project plans or sketches.
6. Any project special provisions as attached.
7. The Engineer.

C. All work will be subject to inspection by the City of Fayetteville Traffic Services Division before final payment is made.

D. Under this contract, the Contractor is to install materials identified by the City of Fayetteville. Any tools and/or installation equipment not specifically shown as being furnished by the City of Fayetteville in these special provisions is the responsibility of the Contractor.

1.02 REFERENCES

A. Refer to Roadway Standard Drawing in pavement marking section of the North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings, current edition for placement of pavement markers.

1.03 QUALIFICATIONS

A. Pre-qualifications: Raised reflective pavement markers are required to be pre-qualified by the City of Fayetteville Traffic Services Division. The process of pre-qualification will be accomplished through the City of Fayetteville Traffic Services Division at (910) 433-1660.

1.04 REGULATORY REQUIREMENTS

A. The Contractor shall comply with all applicable local ordinances and regulations prior to beginning work. He shall obtain all permits and licenses required by state and local agencies having jurisdiction in his area of work.

PART 2 PRODUCTS

2.01 MATERIALS

2.02 All materials for raised reflective pavement markers, shall meet the requirements of the most recent edition of the North Carolina Standard Specifications for Roads and Structures.

A. Your quote shall be at the contract unit price each for the following items for all work http://arcg.is/1rjP9Tinvolved in this project and needs to be submitted on the enclosed bid sheet.
1. Type 1 - Raised non-snow-plowable crystal/white.
2. Type 2 - Raised non-snow-plowable yellow/yellow.

3. Type 3 - Raised non-snow-plowable crystal/red.

B. The work to be performed by the Contractor includes the material, labor, equipment, and traffic control necessary to install these devices.

C. Hot bitumen adhesive shall be used for mounting the pavement markers to the pavement. Other adhesives such as epoxy or cold bituminous adhesive pads will not be acceptable.

D. The pavement marker reflector lens shall be of the glass face type and as illustrated in the most recent edition of North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Methods
1. Construction methods shall meet the requirements of the North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition and any revisions.
2. The markers shall be seated on the bituminous adhesive with all edges of the marker lapped by adhesive. Markers shall not be installed on the asphalt seam or joint.
3. Traffic control will be installed in accordance with the most recent edition of North Carolina Department of Transportation Standard Specifications for Roads and Structures.

B. Completion and final acceptance of the project shall be contingent upon successful completion of the observation period. The observation period shall be considered a part of the work required to be completed after the final completion date specified herein (15 days after the date of availability of the work).

C. After the completion of the work, the Contractor shall have the work inspected as required by local inspectors having jurisdiction in the area and receive written approval of his work. The Contractor shall be responsible for maintaining traffic in a safe and efficient manner at all work sites. Local ordinances involving the time of day the Contractor may work are to be observed.

END OF SECTION 00496

SECTION 00497

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of furnishing, erecting, maintaining, relocating and removing traffic control devices for maintenance of traffic during construction operations.

1.02 REFERENCES

A. All work performed is to be in accordance with:
   1. The North Carolina Department of Transportation Standards and Specifications for Road and Structures, current edition and any revisions.
   2. The North Carolina Department of Transportation Highway Design Branch Roadway Standard Drawings, January 2018 edition and revisions or current edition and any revisions.
   3. The Manual on Uniform Traffic Control Devices (MUTCD).
   4. The North Carolina Supplement to the MUTCD.
   5. Any project plans or sketches.
   6. Any project special provisions.

1.03 SUBMITTAL

A. If the traffic control plan is not included as a part of the project plans, the individual project traffic control plan must be submitted to the City Traffic Engineer within two weeks of being declared the lowest responsible bidder. The City Traffic Engineer will approve or revise and approve the traffic control plan within 5 working days of submittal.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor shall use interim pavement marking paint as described in the most recent edition of The North Carolina Department of Transportation Standard Specifications for Roads and Structures.

B. Traffic cones may be used when approved by the City Traffic Engineer. When cones are used, they shall be either double stacked or have special heavy bottoms such that they will not be blown over by traffic.

C. All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise required by the Special Provisions.

PART 3 EXECUTION

3.01 PREPARATION

A. Street Closure
   1. Intended street closures must be requested, in writing to the City of Fayetteville Traffic Engineer, a minimum of five (5) working days prior to the desired closure date. The

request shall state the street name, the from and to locations, and the length of closure time of the individual street to be closed.

2. The request must also be accompanied by a traffic control plan, showing the detour information of through traffic. This plan must be in accordance with the current edition of the MUTCD.
3. After approval, in writing, the Contractor bears full responsibility for the closure to include installation, maintenance and removal of all traffic control devices, as well as all implied liability.

B. No work shall start until all the traffic control devices required for the particular work activity have been installed, inspected, and approved by the Traffic Engineer or his representative.

3.02 TEMPORARY ROAD CLOSURE

A. Conditions represented are for work that requires closings during daytime hours only.

B. This application is intended for a planned temporary closing not to exceed 15-20 minutes.

C. The flaggers shall stop the first vehicle from the position shown, then move to the centerline to stop approaching traffic.

D. A portable message sign may be used in addition to the initial warning sign.

E. NOTE: The spacing between signs has a recommended standard of 200' but can be modified by the City Inspector according to the location of the work space.

3.03 LANE CLOSURE ON MINOR STREET

A. The traffic control procedure shown is appropriate only for low volume, low speed facilities, such as local residential streets.

B. Traffic can regulate itself when volumes are low and the length of the work space is short, thus enabling drivers to readily see the roadway beyond.

C. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.

D. NOTE: The spacing between signs has a recommended standard of 200' but can be modified by the City Inspector according to the location of the work space.

3.04 SIDEWALK CLOSURES

A. Additional advance warning may be necessary.

B. Only the traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets. Use lane closure signing as required.

3.05 INSTALLATION

A. The furnishing, erecting, maintaining, relocating and removing of traffic control devices will be in accordance with the current edition of *The Manual on Uniform Traffic Control Devices* for streets and highways.

B. All traffic control devices must be in place before beginning work each day, removed during intervals when work is not ongoing and removed at the end of the workday.

C. The Contractor shall not obstruct or impede any of the traffic on adjacent streets while installing traffic control or doing construction work.

D. The Contractor shall not close a lane to through traffic at night and during periods of construction inactivity, unless otherwise approved by the Engineer.

E. The Engineer may restrict the Contractor from placing lane closures during certain hours, holidays, or special events because traffic may be unusually heavy. All lane closure types, hours of installation and lengths, will be controlled by and required to be approved by the Engineer.

F. When working within the travelway, the Contractor shall use a standard lane closure or a moving operation caravan utilizing a shadow vehicle and truck mounted impact attenuator, as approved by the City Traffic Engineer. A moving operation caravan shall only be used if the marker operation maintains a minimum speed of 3 MPH at all times with no stops that would narrow or close a lane of travel.

G. The use of police and/or trained flaggers to control traffic through the work site will be provided by the Contractor as required. The Contractor will be responsible for obtaining trained personnel to direct traffic and contacting local authorities for use of police for traffic control where applicable.

H. Time limitation for placement and replacement on pavement markings and markers completed by contractors on newly resurfaced areas:
   1. Marking By Contractor
      a. Divided and Multi-Lane Facilities
         1) For all Interstate highways and access ramps, place all markings including symbols and legends, by the end of each workday's operation.
         2) For all divided and multi-lane facilities, place all center line and lane line markings and railroad and school symbols and stop bars by the end of each workday's operation. Place all edge lines, gore lines, and other symbols within 3 calendar days after they have been obliterated by the resurfacing operation.
         3) A Multi-lane facility is defined as any roadway having more than two lanes to include a two-lane, two-way with two-way center left turn lane.
      b. Two-Lane, Two-Way Facilities
         1) For all two-lane, two-way facilities, place all centerline markings, railroad and school symbols within 5 calendar days after they have been obliterated by the resurfacing operation. Place all edge lines and other symbols within 15 calendar days after they have been obliterated by resurfacing operations.
      c. All Facilities
         1) Place two applications of paint on newly resurfaced asphalt which will remain in place over three (3) months. Place the second application of paint upon ample drying time of the first, as determined by the Engineer.
         2) Install permanent markers within sixty (60) calendar days after completing the resurfacing on each map.

END OF SECTION 00497

SECTION 00499

TEMPORARY PAVEMENT MARKING TAPES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work covered in this section consists of furnishing and applying temporary pavement marking tapes.

B. All work performed is to be in accordance with:

1. The North Carolina Department of Transportation Standard and Specifications for Roads and Structures, current edition.
2. The North Carolina Department of Transportation's Highway Design Branch Roadway Standard Drawings, current edition.
3. The Manual on Uniform Traffic Control Devices (MUTCD).
4. The North Carolina Supplement to the MUTCD.
5. Any project plans or sketches.
6. Any project special provisions as attached.
7. The Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to be used are 3-M Scotch Lane removable tape #5710 (white or yellow) and Black Line mask #145 or approved equal.

B. Materials other than those listed above must be determined to be an approved equal by the City Traffic Engineer prior to use.

PART 3 EXECUTION

3.01 TEMPERATURE

A. Air and pavement temperature must be at least 50 degrees F and rising.

3.02 PREPARATION

A. Road surface shall be cleaned with high pressure air or by sweeping.

B. Mark pavement where tape is to be applied.

3.03 INSTALLATION

A. Temporary pavement marking tapes shall be applied per manufacturer's instructions.

B. Do not overlap material--use butt splices.

3.04 TAMPING

A. Tape must be tamped, a minimum of three (3) passes back and forth, using one of the following methods:
   1. Roller tamper cart with a minimum load of 200 pounds.
   2. Driving a vehicle tire slowly (2-3 MPH) over the tape.

B. Do not twist or turn the tamping device on the tape.

C. Insure all edges have firmly adhered before opening to traffic.

3.05 REMOVAL

A. For your own safety, wear gloves and eye protection when removing temporary pavement marking tape.

B. Use a chisel-like tool to pry up the edge of the tape.

C. Pull the tape up at a 90 degree angle to the pavement.

D. Burning or grinding is <u>not</u> recommended.

END OF SECTION 00499

SECTION 00900

EMULSIFIED ASPHALT SLURRY SEAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of furnishing and applying and emulsified asphalt slurry seal in accordance with the North Carolina Department of Transportation Standard Specifications for Roads and Structures, current edition, hereinafter referred to as the Specifications, and these Special Provisions.

1.02 REFERENCES

A. The Specifications will govern in its entirety the work under these specifications except as they are modified hereinafter.

PART 2 PRODUCTS

2.01 MATERIALS

A. Asphalt Emulsion: The emulsified asphalt shall conform to the requirements of Section 1020 of the NCDOT Specifications.

B. Quick Setting Emulsion: Quick setting emulsion shall be used and the following requirements shall apply:

1. The emulsion shall meet the requirements of Cationic Type CRS-1H of ASTM D 2397. Each change in formulation requires a test as referenced in NCDOT Specifications indicated above.

C. Fine Aggregate: Fine aggregate shall be polish resistant natural or manufactured sand, slag, or a combination thereof. The quality of fine aggregate shall conform to the requirements of Section 1014 of the NCDOT Specifications.

D. Mineral Filler: Mineral filler shall conform to the requirements of Section 1012.1 of the NCDOT Specifications.

E. Water: Water used in the mix shall conform to the requirements of Section 1024.4 of the NCDOT Specifications.

F. Mix Requirements: The Contractor shall submit to City of Fayetteville a mix design and results of the wear loss by the Wet Track Abrasion Test (WTAT) as prepared by an approved testing laboratory. The WTAT will be performed in accordance with ADSTM D 3910. The wear loss by the WTAT shall not be greater than 100 grams per square foot. The wear loss shall apply to the asphalt content limits designated on the job mix formula.

1. The Contractor shall place a test strip for approval by the Engineer prior to beginning the work. Once the consistency of the mix has been approved by the Engineer, the total water content shall be maintained within 3 percent of the approved blend during the course of operation.

2. The gradation of the mix produced shall conform to the job mix range. The asphalt content (residual asphalt)* shall not vary more than 1.5 percent from the approved mix design.

JOB MIX RANGE

TYPE SIEVE SIZE	C PERCENT PASSING
3/8”	100
# 4	90-100
# 8	70-90
# 16	32-54
# 30	23-38
# 50	16-29
#100	9-20
#200	5-15
Design Asphalt Content, Percent #	8.5-11.5

* Residual Asphalt content by Weight of Dry Aggregate.

G. Sampling Requirements: Samples for gradation will be taken from aggregate stockpiles designated by the Contractor for use. Samples for asphalt content and total water content shall be taken from the completed mixture. Samples of aggregate, filler, and emulsion for WTAT will be taken from the job site. The frequency of sampling and testing will be established by the Engineer.

2.02 EQUIPMENT

A. General: All equipment and tools used in the performance of this work shall be furnished and maintained in satisfactory working condition. The mixing and spreading equipment shall be combined in a single mobile operating unit. A burlap drag approximately 19 inches wide shall be attached to the back of the unit for the purpose of smoothing the slurry seal.
   1. The mobile unit shall be equipped with an approved feeder which will accurately meter or otherwise introduce a predetermined amount of material into the mixer simultaneously with the aggregate. The feeder shall be used whenever mineral fill is added to the mix.
   2. The mobile unit shall be equipped with a water pressure system and fog spray bar capable of completely fogging the surface to which slurry seal is to be applied.
   3. The mobile unit shall be capable of an operative speed of at least 60 ft/min and have sufficient storage capacity to mix and apply a minimum of 5 tons of slurry.

B. Mixer: The mixer shall be a continuous flow type mixer and shall be capable of delivering water and a predetermined proportion of aggregate and asphalt emulsion to a revolving multi-blade mixer tank. The mixer shall discharge the thoroughly mixed product on a continuous basis. The blades of the mixing unit shall be capable of thoroughly blending all ingredients.

C. Spreader: The spreader shall be equipped with a flexible type squeegee positioned in contact with the pavement surface. The spreader shall be designed to apply a uniform spread with a minimum loss of slurry.

D. Auxiliary Equipment: Hand squeegees, shovels, and other hand equipment shall be provided as necessary to perform work in areas which are inaccessible to the unit.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall notify the Engineer at least five (5) working days prior to beginning work. The Contractor shall give the Engineer sufficient notice of all operations for any sampling, inspections or acceptance testing required.

B. Preparation of Surface: the surface upon which slurry seal is to be applied shall be thoroughly cleaned of all loose material, vegetation, silt spots, and other objectionable materials immediately preceding application by either brooming or the use of compressed air.

C. Application: Aggregate shall be wetted immediately prior to mixing with the emulsion. The Engineer may direct that the surface of the pavements be fogged with water (approximately 0.05 gallon per square yard) immediately preceding the pass of the spreader. The slurry mixture shall be of a consistency such that it "rolls" in the spreader box in a continuous mass. Slurry that segregates in the spreader box, so that flowing of liquids (water and emulsion) is evident, is not acceptable and shall not be applied. The liquid portion of slurry mixture shall not flow from either the spreader box or the applied slurry. Evidence of such flow shall be sufficient cause for rejection of the applied material. The slurry shall be placed on the road in full lane widths up to and including 12 feet. A mechanical device such as an auger shall be used to distribute the slurry mix in the spreader box.
   1. Excess buildup of slurry on longitudinal and transverse joints shall be corrected.
   2. Treated areas shall not be opened to traffic until such time as the slurry seal has cured to the extent that it will no longer be damaged by traffic. The applied slurry mixture shall be uniform in texture and shall not flush under traffic. Any areas not considered satisfactory by the Engineer shall be corrected by the Contractor at no additional cost to the City of Fayetteville. Nothing contained herein is intended to relieve the Contractor from sharing in the responsibility and performance of the treatments, should a failure occur prior to acceptance of the contract.
   3. Slurry Seal surface shall not be applied on surfaces containing ponding water and the minimum surface temperature shall be 50 degrees F.
   4. The Engineer may require the surface area to which the slurry has been applied by hand to be rolled using a pneumatic-tire roller. The roller shall be operated at an approximate tire pressure of 50 pounds per square inch and the paved area shall be subjected to a minimum of two coverages.
   5. Should oversize aggregate be encountered in the stockpile, the Contractor shall immediately cease operations and remove the oversize aggregate by screening.

D. Thickness of Application: The average minimum thickness of application shall not be less than 5/16" for Type C unless otherwise specified.

E. In the event of a test failure on compatibility and/or WTAT (loss greater than 100 grams per square foot) for a sample of material being applied to the road, corrective action shall be taken by the Contractor prior to start-up of another's day run. Should the sample taken following adjustment also fail the compatibility and/or WTAT, the Contractor shall cease application on the road. The Contractor shall be responsible for furnishing additional compatibility and/or WTAT results and field application site(s) and will not be permitted to return to the road until he clearly demonstrates the acceptability of seal.

END OF SECTION 00900

SECTION 01020

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.

B. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is evaluated. If necessary, additional requirements will be issued by Change Order.

C. Types of allowance include the following:

1.02 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise the Owner of the date when the final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the work.

B. At the Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the work.

C. Purchase products and systems selected by the Owner from the designated supplier.

1.03 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.04 CONTINGENCY ALLOWANCES

A. Use the allowance(s) only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Change Orders authorizing use of funds from the allowance(s) will include Contractor's related cost and maximum fifteen (15) percent combined overhead and profit. (7.5% overhead plus 7.5% profit).

1.05 UNUSED MATERIALS

A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.

B. When requested by the Owner, prepare unused material for storage where it is not economically practical to return the material for credit. When directed by the Owner, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine products covered by an allowance promptly upon delivery for damage or defects.

3.02 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION 01020

SECTION 02205

SOIL MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Subsoil materials.

B. Topsoil materials.

1.02 REFERENCES

A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.

B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

C. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

D. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

E. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

F. ASTM D2487 - Classification of Soils for Engineering Purposes.

G. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D3017 - Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS FOR INFORMATION

A. Materials Source: Submit name of imported materials source.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with State of North Carolina standards. Maintain one copy on site.

PART 2 PRODUCTS

2.01 SUBSOIL MATERIALS

A. Subsoil Type S1: Conforming to State of North Carolina standard.

B. Subsoil Type S2:
   1. Excavated and re-used material.
   2. Graded.
   3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

2.02 TOPSOIL MATERIALS

A. Topsoil Type S3: Conforming to State of North Carolina standard.

B. Topsoil Type S4:
   1. Excavated and reused material.

2. Graded.
3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.

C. Topsoil Type S5:
1. Imported borrow.
2. Friable loam.
3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
4. Acidity range pH of 5.5 to 7.5.
5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.

PART 3 EXECUTION

3.01 SOIL REMOVAL

A. Excavate subsoil and topsoil from areas designated.

B. Remove lumped soil, boulders, and rock.

C. Stockpile excavated material on approved site and remove excess material, not being used, from site.

D. Remove excavated material from site. When no on site, stockpile area is approved.

3.02 STOCKPILING

A. Stockpile materials on approved site.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Prevent intermixing of soil types or contamination.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.03 STOCKPILE CLEANUP

A. Remove stockpile, leave area in a clean and neat condition, with permanent ground cover. Grade site surface to prevent free standing surface water.

B. If a borrow area is indicated, leave area in a clean and neat condition, with permanent ground cover. Grade site surface to prevent free standing surface water.

END OF SECTION 02205

SECTION 02532

MANHOLE ADJUSTMENT RINGS

PART 1 GENERAL

1.01 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division I Specification Sections, apply to this Section.

B. The work covered in this section includes furnishing and installing adjustment rings for manholes requiring a rise of one inch or greater. Adjusting rings less than one inch are not acceptable.

C. The adjustment of manholes and valve boxes shall not be attempted until after the placement of the base course and any leveling course, and prior to placement of the overlay. Any debris that has fallen into the manholes or water valves during the adjustment process shall be removed before cleanup is complete.

D. Badly damaged or worn castings shall be replaced with new castings provided by OWNER at no cost to the contractor. Contractor is responsible for exchanging castings at the OWNER'S facility.

E. Final surface overlay will be placed within 10 days after adjustments have been completed on each individual street.

PART 2 PRODUCTS

2.01 MATERIALS

A. Riser rings shall consist of domestic A-36 steel 3/4 inch thickness steel inner ring, and domestic A-36 1/2 inch thickness steel outer ring. The riser system shall be anchored to the manhole frame to prevent any movement from traffic loads and shall be pre-approved by the Engineer. The adjustment device shall be fabricated from stainless steel, have a positive lock and be in line with the lower bearing bar. It shall be capable of adjustment plus or minus 3/8 inches from nominal.

B. The manhole adjustment ring shall fit within the existing casting without interference and the manhole lid shall have bearing on all of the surface of the inner ring to prevent locking. The lid shall be able to be removed without binding.

C. The inner and outer ring shall be securely welded to prevent any differential movement between the inner and outer rings under traffic loads, and shall be fabricated to plus or minus 1/16 inch concentricity. The outer riser ring shall have an inside diameter no greater than 3/16 inch larger than the outside diameter of the manhole lid.

D. All material shall be bituminous asphalt coated.

E. All welding shall be in accordance with AWS D1.5 by certified welders.

PART 3 EXECUTION

3.01 MEASUREMENT

A. Each manhole to receive adjusting rings shall be inspected and properly measured, with the measurements following all manufacturers' guidelines. Measurement for the height of

adjustment shall be made only after any asphalt-leveling course has been placed. The contractor will be required to provide personnel to individually measure each structure in the presence of the OWNER. The measurements will include top and bottom lid diameters, lid thickness, as well as the required rise.

B. Adjustment rings for rise less than one inch shall be unacceptable.

C. Special attention shall be given to structures needing replacement rings due to wear or other factors which may not be suitable for adjustment rings. Adjustment rings shall not be placed on any existing casting which has been deemed unacceptable by the OWNER.

3.02 INSTALLATION

A. The adjusting ring shall be adjusted to the outside diameter of the manhole lid before placement can proceed. The outer ring shall have an inside diameter of no greater than 3/16 inch larger than the outside diameter of the lid. The area on the existing casting where the ring will seat shall be thoroughly cleaned using a steel wire brush. The ring can then be placed making sure there is full bearing of the lower section to the existing casting. The set screws can be tightened to assure no movement due to traffic.

B. Frames and covers shall be set to proposed grade and sloped to match slope and crown of road within 0.25 inches of the final surface.

C. The contractor shall provide personnel to assist the OWNER in inspecting the adjustment. The height of adjustment shall be checked by the following procedure:
   1. Pull string line parallel to the curbing across the casting for at least 10 feet on either side of the casting.
   2. Hold string at a height of 1 inch above the required adjustment and subtract 1 inch from the measurements.
   3. Measurements shall be made from the top of lid (and ring) to the string line.
   4. The height shall then be checked with the same string line pulled perpendicular to the curbing.
   5. The final adjustment height shall not vary more than 1/4 inch from the thickness of the over lay, in either direction

D. The contractor shall open the manhole for inspection of how the lid fits and a field check to assure the ring is secure.

E. Any unacceptable adjustments shall be repaired by the Contractor or replaced with a concrete adjustment, with no additional expense to the OWNER.

END OF SECTION 02532

SECTION 02542

FILTER FABRIC

REFERENCE – North Carolina Department of Transportation (Raleigh, N.C.) – Standard Specifications for Roads and Structures, current edition and any revisions.

PART 1 GENERAL

1.01 The fabric shall consist of strong rot-proof synthetic fibers formed into a woven fabric or a nonwoven needle punched fabric meeting all applicable requirements of this section.

1.02 The fabric shall be free from any treatment or coating which might significantly alter in physical properties before or after installation. The fabric fibers shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from ultraviolet or heat exposures. The fabric shall be a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other. The edge of the fabric shall be finished to prevent the outer fibers from pulling away from the fabric. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties. Sheets of fabric may be sewn or bonded together with a fungus resistant material. No deviation from any physical requirements will be permitted due to the presence of the seam.

1.03 During all periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, mud, dust, dirt, and debris. The fabric shall not be exposed to temperatures greater than 140°.

1.04 When anchor pins are required, they shall be fabricated of steel, and installed per manufacturer's recommendation unless otherwise specified by the Engineer.

PART 2 INSTALLATION

2.01 This item shall include all labor, equipment and materials necessary for the placement of filter fabric under Rip Rap and Reno Mattress as required by the plans. Filter fabric shall be placed as shown on the plans and in strict accordance with manufacturer's written instructions. To be acceptable for use, all filter fabric must be certified by the manufacturer to meet the specified requirements (minimum roll average) and shall be packaged and labeled according to ASTM procedures. Filter fabric for this job shall meet the following specifications:

PROPERTY	TEST PROCEDURE	VALUE
Grab Tensile	ASTM D-4632	300 lbs.
Grab Elongation	ASTM D-4632	15%
Mullen Burst	ASTM 3786	600 lbs.
Puncture	ASTM D-4633	120 lbs.
Trapezoidal Tear	ASTM D-4633	120 lbs.
AOS	ASTM D-4751	30/70 US Sieve

PART 3 ACCEPTANCE

3.01 The Contractor shall furnish a Type I Certified Mill Test Report, Type 2 Typical Certified Mill Test Report, or Type 4 Certified Test Report for the fabric in accordance with Article 106-3 of the NCDOT Standard Specifications for Roads and Structures, current edition and any revisions.

Additionally, the material shall be subject to inspection, test or rejection by the Engineer at any time.

3.02 Fabric will be rejected if more than 72 hours has elapsed between the time the protective wrapping has been removed and the fabric is covered up during installation except where the fabric is used for temporary silt fence.

END OF SECTION 02542

SECTION 02723

RIP RAP SWALE

PART 1 GENERAL

1.01 SCOPE

A. The work includes all stone placement used to reduce the velocity of flow within the swale and control the amount of erosion that takes place.

B. All swales shall be constructed of materials specified or indicated in the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation. Any defect in manner or workmanship shall be cause for the replacement and correction of such defect as directed by the Engineer at no expense to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. All rip-rap lining shall be in accordance with the North Carolina Department of Transportation (NCDOT) – Standard Specifications for Roads and Structures, current edition and any revisions. 1042-2 for Class A Rip-Rap. The stones should vary in size from 2" to 6".

B. Filter fabric shall conform to NCDOT – Standard Specifications for Roads and Structures, current edition and any revisions Section 1056. The fabric shall consist of strong rot-proof synthetic fibers formed into a woven fabric or a non-woven needle punched fabric. The fabric shall be free from any coatings or treatments which might significantly alter its physical properties. The fabric fibers shall contain a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with each other. The edge of fabric shall be finished to prevent the outer fibers from pulling away from the fabric. Sheets of fabric may be sewn or bonded together with a fungus resistant material. The fabric shall meet the requirements for Type 2 fabric as stated in the NCDOT – Standard Specifications for Roads and Structures, current edition and any revisions, Table 1056-1.

2.02 INSTALLATION

A. The rip-rap shall be placed and graded as specified in the NCDOT – Standard Specifications for Roads and Structures, current edition and any revisions, Section 876 and other applicable sections. The stone shall be placed on the slopes as indicated on the plans, or as the Engineer directs. The stone shall be graded so that the smaller stones are uniformly distributed throughout the mass. The Contractor may place the stone by mechanical methods, augmented by hand placing, provided that when completed, the rip-rap shall be at a depth of at least that which is shown on the plans.

B. Surfaces to receive filter fabric shall be graded to the lines and grades shown on the plans, unless otherwise directed by the Engineer. The surface shall be free of obstructions, debris, and pockets of soft or low density material. The fabric shall be laid smooth and free from tension, stress, folds, wrinkles, or creases. Horizontal overlaps shall be a minimum of 18" with the upper fabric overlapping the lower. Vertical overlaps shall be a minimum of 18" with the upstream fabric overlapping the downstream. The Engineer reserves the authority to reject any material that is felt to not meet the necessary requirements.

C. The stone lining shall be placed upon the filter fabric and smooth graded to a depth as shown on plans in such a way as to not damage the underlining fabric liner. Any damage to the fabric liner shall necessitate the removal and replacement of the damaged area.

D. The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the proper distribution. The finished grade of the rip-rap should blend with the surrounding area. No over fall or protrusion of rip-rap should be apparent.

PART 3 EXECUTION

NOT USED

END OF SECTION 02723

SECTION 02810

IRRIGATION SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work to be done includes furnishing all labor, materials, equipment and services required to complete all irrigation work indicated on the Drawings, as specified herein, or both.

B. The mechanical point of connection for the irrigation system shall be a new tap of the domestic water supply provided by others, as specified.

C. The electrical point of connection for the irrigation system shall be to a 120-volt, 20-amp building electrical circuit provided by others.

D. The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Engineer for decision, and his interpretation shall be final, conclusive and binding.

E. All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Engineer.

F. Trench excavation, backfilling and bedding materials, together with the testing of the completed installation shall be included in this work.

G. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

H. Record Drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall also be included in this work.

I. The irrigation system shown on the Drawings and described within these Specifications represents a single controller, turf and landscape irrigation system supplied from municipal water. The system is designed for 27 gallons per minute. Minimum 65-psi static and 55-psi dynamic pressure at full system flow is required from the point of connection.

1.02 RELATED WORK

A. Carefully examine all of the Contract Documents for requirements that affect the Work of this Section.

1.03 ORDINANCES, PERMITS AND FEES

A. The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.

B. The Contractor shall obtain and pay for any and all permits, tests and certifications required for the execution of Work under this Section, including water supply tap fee.

C. Furnish copies of Permits, Certifications and Approval Notices to the Owner's Representative prior to requesting payment.

D. The Contractor shall include in his bid any charges by the Water Department, Utility Company, or other authorities for work done by them and charged to the Contractor.

1.04 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform himself of existing conditions on the site before submitting his bid, and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the GENERAL CONDITIONS.

1.05 QUALITY ASSURANCE

A. Installer: A qualified firm which has experience in work of the type and size required by this Section, and which is acceptable to the Engineer.

B. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
   1. American Society for Testing & Materials (ASTM)
   2. National Plumbing Code (NPC)
   3. National Electric Code (NEC)
   4. National Sanitary Foundation (NSF)
   5. American Society of Agricultural Engineers (ASAE)
   6. Underwriters Laboratories, Inc. (UL)
   7. Occupational Safety and Health Regulations (OSHA)

1.06 TESTS

A. Observation: The Engineer will be on site at various times to ensure the system is being installed according to the Specifications and Drawings.

B. Operational Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Engineer. Demonstrate to the Engineer that all irrigated areas are being adequately covered (See Part 3 - Execution).

1.07 SHOP DRAWINGS

A. The Contractor shall provide copies of product specification sheets on all proposed equipment to be installed to the Engineer for approval prior to the start of work, in accordance with the parameters of Division-1. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:
   1. Sprinkler Heads
   2. Valves: Manual and Automatic
   3. Controller
   4. Valve Boxes
   5. Pipe and Fittings
   6. Wire and Connectors
   7. Quick Coupling Valves
   8. Rain Sensor
   9. Backflow Preventer/ Enclosure
   10. Miscellaneous Materials

B. The Contractor shall maintain complete Record Drawings of the system as the project proceeds. Record Drawings shall specify sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller, rain sensor, quick coupling valves, water meters, back flow prevention device and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types).

1.08 DELIVERY, STORAGE AND HANDLING

A. Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage.

1.09 GUARANTEE

A. The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.

B. In addition to the manufacturer’s guarantees, the Contractor shall warrant the entire irrigation system, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.

C. As part of the one-year warranty the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system.

1.10 COORDINATION

A. The Contractor shall at all times coordinate his work closely with the Engineer to avoid misunderstandings and to efficiently bring the project to completion. The Engineer shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the changes are made. The Contractor shall also coordinate his work with that of his sub-contractors.

B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Engineer.

1.11 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Contractor shall include in his Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Engineer shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE “Project Name”, shall be submitted to the Engineer’s office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:
   1. Table of Contents
   2. Written description of Irrigation System.
   3. System drawings:
      a. One (1) copy of the original irrigation plan;
      b. One (1) copy of the Record Drawing;
      c. One (1) reproducible of the Record Drawing;
      d. One (1) copy of the controller valve system wiring diagram

4. Listing of Manufacturers.
5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
    a. "APPROVED" submittals of all irrigation equipment;
    b. Operation:
    c. Maintenance: including complete troubleshooting charts.
    d. Parts list.
    e. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.
6. Winterization and spring start-up procedures.
7. Guarantee data.

1.12 PROCEDURE

A. Notify all city departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.

B. Provide temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Engineer.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Engineer.

2.02 PVC IRRIGATION PIPE

A. All pipe in sizes 1-1/2 inches and smaller shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 and D3036 as manufactured by Certainteed, Cresline, JM or equal.

2.03 PVC PIPE SLEEVES

A. All pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Certainteed, Cresline, JM or equal. Minimum sleeve size to be 2-inch.

2.04 WIRE CONDUIT

A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-80 conduit, as manufactured by Certainteed, Cresline, JM or equal.

B. Conduit for above ground wiring to rain sensor or controller shall be galvanized, rigid metallic conduit.

2.05 PVC IRRIGATION FITTINGS

A. Fittings for solvent weld PVC pipe, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.

B. All PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 male threads will not be approved for installation.

C. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 fittings. Cement is to meet ASTM D2564 and FF493 for potable water pipes. PVC solvent cement shall be Rectorseal Gold, or equal, and shall be used in conjunction with the appropriate primer.

D. All nipples to be schedule 80 PVC.

2.06 SPRAY SPRINKLERS

A. Full and part circle pop up spray sprinklers shall be pressure regulating, plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the Drawings and in the legend. Pop-up height shall be 6 inches for turf and ground cover, 12 inches for shrubs and annual beds.

B. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Toro model 570Z-PRX, Rain Bird model 1800-SAM-PRS or approved equal.

2.07 ROTARY SPRINKLERS

A. Rotary sprinklers shall be gear-driven, rotary type heads, designed for in-ground installation with integral check valves. Sprinkler shall be capable of covering a 34-40 foot radius and flow range of 1.6-6.8 gpm at 40 pounds per square inch of pressure. Sprinklers shall have a one hundred percent warranty for two years minimum against defects in workmanship.

B. The nozzle assembly shall elevate a minimum of four inches when in operation and retraction shall be achieved by a stainless steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.

C. All sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. The sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.

D. Sprinkler shall be manufactured by Toro, model S700C-XX-15/30/60-LA, Hunter Industries, model I20-ADV-15/35/80 or approved equal.

2.08 ELECTRIC CONTROL VALVES

A. Electric control valves shall be one, one and one half and two-inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 150 psi pressure rating. Valves shall be globe/angle combination configuration.

B. Valves shall be manufactured by Toro, model 252, Rain Bird, model PGA or approved equal.

2.09 VALVE BOXES

A. Valve boxes for single electric valves, isolation valves and quick coupling valves shall be 10-inch round valve boxes with metal detection and bolt down covers

B. Valve boxes for dual electric valves shall be 12-inch standard valve boxes with metal detection and bolt down covers.

C. Valve box extensions shall be provided as required for proper box depth.

D. Valve boxes shall be manufactured by Ametek or approved equal.

2.10 AUTOMATIC CONTROLLER

A. Controller shall be electronic in construction with capability of up to 10 hour run times per zone in increments of 1 or 10 minutes. Controllers to have minimum two independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, sensor input terminal, locking, weather resistant plastic cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120 volt, 60 Hertz, A.C. type.

B. Controller shall be as manufactured by Toro, Custom Command Series, model CC-P-24, Rain Bird, Model ESP-24LX+ or approved equal.

C. Station quantity shall be minimum of 24.

2.11 QUICK COUPLING VALVES

A. The valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under all conditions when the key is not inserted.

B. The top of the valve body receiving the key shall be equipped with a single slot and smooth face to allow the key to open and close the valve slowly with a one-half turn. The quick coupling valve shall be equipped with a locking vinyl cover.

C. The valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

D. Keys shall be single lug with 1-inch male thread and 3/4 inch female thread at the top.

E. Contractor shall provide two (2) keys for quick couplers, two (2) 1 inch x 1 inch swivel hose ells and two (2) cover keys for quick coupling valves.

F. Quick coupling valves, keys and swivels shall be manufactured by Toro models 474-03, 464-01 and 477-02, Rain Bird models 44NP, 44K and SH-2 or approved equal.

2.12 WIRE

A. All valve control wire shall be minimum #14-awg, common #12-awg, single strand, solid copper, 600v, direct burial (UF) and shall meet all state and local codes for this service. Individual wires must be used for each zone valve. Common wire shall be white in color, control wire for spray and rotor zones shall be red in color, and spare wires, installed where indicated on the drawings shall be blue.

B. In ground wire connections shall be UL listed, manufactured by 3M, model DBY-6 splice kits or approved equal. All wire splices shall be made in valve boxes, at controller, or at valves.

C. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

2.13 ISOLATION VALVES

A. Isolation valves 2-1/2 inches and smaller in size shall be gate type, of bronze construction, US Manufacture, 600 WOG with steel cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco, model T-113-irr, or approved equal.

2.14 SWING JOINTS

A. Sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Quick coupling valves to be installed on one-inch brass swing joint, minimum 12-inches in length with Leemco model LS-120 stabilizer, or approved equal.

2.15 AUTOMATIC RAIN SENSOR

A. Rain sensor shall be plastic in construction with adjustable interruption point and 1/2-inch IPS threads. Rain sensor shall be manufactured by Hunter Industries, model Mini-Clik-C or approved equal.

2.16 BACKFLOW PREVENTION DEVICE

A. Back flow prevention device shall be 1-1/2-inch Reduced Pressure Assembly. Back flow prevention device shall have maximum 8-psi pressure loss at system flow.

B. Back flow prevention device shall be as manufactured by Watts model 909-M1or approved equal.

2.17 CRUSHED STONE

A. Crushed stone shall be used under valve boxes and below all sprinklers.

2.18 SAND

A. Sand shall be used for backfilling of trenches; under, around and over PVC lines.

2.19 CONCRETE

A. Cement concrete for concrete base under enclosure shall be 2,500 psi, 1-1/2 inch aggregate.

2.20 BACK FLOW ENCLOSURE

A. The back flow prevention device enclosure shall be of a vandal and weather resistant nature manufactured entirely of marine grade aluminum alloy 5052-H32, with a wall thickness of 1/8 inch.

B. The mounting base shall be manufactured entirely of stainless steel. The main housing shall be of solid sheet construction punched on the sides with a rectangular pattern for viewing back flow prevention device operation. The length of the enclosure shall be expandable to allow for site adjustment. The enclosure shall have a mounting lip on one end and a locking mechanism on the other end. The mounting base shall be submerged into the concrete a minimum of two inches, and position the enclosure two and one half inches above the concrete for drainage purposes.

C. The locking mechanism shall be of the full release type, which allows for complete removal of the enclosure from its mounting base without the use of tools. The handle controlling the locking mechanism shall be concealed within the surface of the enclosure and provide for a padlock.

D. The enclosure shall be 30 inches high, 16 inches wide and 45 inches long. Unit shall be as manufactured by VIT Products, Inc., model SBBC-45AL or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Engineer for timely resolution.

B. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Engineer prior to proceeding.

C. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.

3.02 PIPE AND FITTINGS INSTALLATION

A. Using proper width trencher chain, excavate a straight and true trench.

B. Loam encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

C. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1 inch or sharp edges; if not, excavate to 2 inch below pipe invert and provide sand base or #57 washed stone upon which to lay pipe.

D. Back filling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock larger than 1 inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment matching adjacent undisturbed area. Frozen material shall not be used for backfill.

E. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow connections to set minimum 24 hours before pulling or pressure is applied to the system. Provide for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).

F. Mainline pipe shall have minimum 24 inches of cover (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of cover (excavate to invert as required by pipe size).

G. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.

H. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from

the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 35ºF or below. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

I. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1 inch and larger.

J. Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.

K. Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

3.03 ELECTRICAL WIRE CONDUIT INSTALLATION

A. Electrical conduit shall be installed in all non-soil areas, as well as for all above ground wiring to controllers and rain sensor.

3.04 PIPE SLEEVING INSTALLATION

A. Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 24 inches as shown on the detail.

3.05 ISOLATION VALVE INSTALLATION

A. Install isolation valves per detail where indicated on the Drawings. Install all isolation valves on a level #57 washed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

3.06 VALVE BOX INSTALLATION

A. Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, and wire splice.

B. All valve access boxes shall be installed on a minimum 4-inch #57 washed stone base. Finish elevation of all boxes shall be at grade. All stone to be supplied by the Contractor and installed before valve box. Stone shall not be poured into previously installed valve boxes.

3.07 24 VOLT CONTROL VALVE INSTALLATION

A. Control valves shall be installed on a level #57 washed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening.

B. Adjust zone valve operation after installation using flow control device on valve.

3.08 WIRING INSTALLATION

A. Wiring shall be installed along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

B. All wire shall be laid in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and back-filled. The wires shall have a minimum of 12 inches of cover. Wire not to be installed that day shall not be laid out.

C. An expansion curl shall be provided within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.

D. Provide a common ground wire of white color. No white color shall be used for power wire. Control wire shall be red, and spare wiring shall be blue in color.

E. Service wiring in connection with Drawings and local codes for 24-volt service. All in-ground wire connections shall be waterproofed with 3M DBY, or approved equal, splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided in splice box--valve box shall be used). Splice locations shall be shown on the Record Drawings.

F. Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

3.09 CONTROLLER INSTALLATION

A. Contractor to install controller on wall in mechanical room, generally where shown on the drawings. Contractor to wire valves and rain sensor into controller and set proper program.

B. Wire controller to 120-volt electrical supply provided to the controller locations by OTHERS.

C. Keys shall be turned over to Engineer.

3.10 RAIN SENSOR INSTALLATION

A. Install rain sensor on exterior building wall, generally where indicated on the drawings. Coordinate final location of rain sensor with Engineer. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.

B. Install rain sensor wiring within ½ inch conduit where exposed. All above ground wires shall be installed in conduits.

3.11 SPRINKLER INSTALLATION

A. Spray and rotary sprinklers shall be installed flush to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Adjust sprinkler zone pressure with flow control on valve.

C. Sprinkler installation prohibited inside City of Fayetteville right-of-way.

3.12 QUICK COUPLING VALVE INSTALLATION

A. Provide quick coupling valves where indicated on the Drawings.

B. Quick coupling valves to be mounted on 1-inch brass swing joint with stabilizer as per details.

3.13 BACKFLOW PREVENTION INSTALLATION

A. Install 1-1/2-inch reduced pressure back flow prevention assembly in above grade enclosure as specified.

3.14 BACK FLOW ENCLOSURE INSTALLATION

A. Install enclosure on concrete pad as indicated on the detail, generally where indicated on the drawings. Final location of enclosure shall be coordinated with the Engineer as to best screen the enclosure and deter vandalism. Final location shall also be coordinated with utility department to ensure proper placement of water supply line.

B. Concrete pad for back flow enclosure shall be 53 inches long by 24 inches wide by 8 inches deep.

3.15 CHECK/TEST/START-UP/ADJUST

A. Flushing:
   1. After all piping, valves and sprinkler bodies are in place and connected, but prior to installation of sprinkler internals, flush piping under a full head of water

B. Testing:
   1. Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.
   2. Coverage test: perform a coverage test in the presence of the Engineer (notify Engineer at least seven (7) days in advance of scheduled coverage test). Engineer will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.
   3. All testing shall be at the expense of the Contractor.

3.16 CLEANING AND ADJUSTING

A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.

B. Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.

C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.

D. Each control zone shall be operated for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

3.17 ACCEPTANCE AND OPERATION BY OWNER

A. Upon completion of the work and acceptance by the Owner, the Contractor shall be responsible for the training of the Owner's Representative(s) in the operation of the system (provide minimum 48 hours written notice in advance of test). The Contractor shall furnish, in addition to the Record Drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. The Contractor shall guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.

3.18 CLEAN UP

A. Upon completion of all installation work, Contractor shall remove all leftover materials and equipment from the site in a safe and legal manner.

3.19 WINTERIZATION

A. Winterization: The irrigation system is designed to be completely drained to protect pipe from bursting prior to freezing temperatures. To adequately drain the system the following procedure must be followed:
   1. Air blow-out
      a. Set automatic controller stations to 2-1/2 minutes timing.
      b. Attach hose from portable air compressor to 1-inch air inlet installed on main line at back flow preventer.
      c. Operate compressor at 100 cubic feet per second at 60-80 psi.
   2. Manual drain valves: Open manual drain valves located at low points on the main line to drain main completely after air blow-out has been completed.
   3. Backflow Preventer: Rotate backflow unit at unions and open petcocks and drain. Reverse operation and tighten unions to resume irrigation.

END OF SECTION 02810

SECTION 02831

FENCING
(CHAIN LINK)

PART 1 GENERAL

1.01 SCOPE

A. Provide chain link fencing where indicated on the Drawings and specified herein.

B. Work shall include, but not be limited to, the following major items and necessary accessories for a complete and operational system:
   1. Clearing as necessary for installation of fence.
   2. Fence post, frame, and concrete foundation.
   3. Chain link fabric and barbed wire.
   4. Gates.

1.02 SYSTEM DESCRIPTION

A. Fencing Location
   1. Fence Height: As shown on drawings
   2. Provide posts, bottom intermediate and top rails as indicated. Provide corner and brace assemblies.
   3. Provide fabric gauges as indicated and install fabric on outside of fence and anchor to framework such that fabric remains in tension after pulling force is released.

1.03 SUBMITTALS

A. Submit the following in accordance with Section, Submittal Procedures:
   1. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Equipment to be furnished for the Project shall be clearly indicated including all options to be provided.
      a. Individual components of the fencing system.
   2. Shop Drawings: Submit Project specific shop drawings for the following:
      a. Layout drawing showing spacing of posts and location of gate, corner, end, and pull posts.
   3. Manufacturer's Installation Procedures.

PART 2 PRODUCTS

2.01 FABRIC

A. Selvage: Fabric shall be twisted and barbed at both selvages. Both selvages of meshes less than 2 inches shall be knuckled. Bottom tension wire shall be 7 gauge and shall terminate at posts.

B. Galvanized Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufactures Institute (CLFMI) “Product Manual” and with requirements indicated below:
   1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gage).
   2. Coating: ASTM A 392-74, Class 2, galvanized.

2.02 FRAMING

A. Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts are often referred to in ASTM standard specifications by Nominal pipe sizes (NPS) or the equivalent trade sized inches. The following indicates these equivalents all measured in inches:

Actual OD Size (in)	NPS Size	Trade
1.660	1 1/4	1 5/8
1.900	1 1/2	2
2.375	2	2 1/2
2.875	2 1/2	3
4.000	3 1/2	4

B. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669. Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per square foot. Type coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual OD Size (in)	Weight (lb/ft)	NPS Size
1.660	2.27	1-1/4
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2 1/2
4.000	9.11	3 1/2

C. Top Rail: Manufacturer's longest lengths (21 feet) with expansion-type coupling, approximately 6 inches long for joining. Provide rail ends of other means for attaching top rail securely to each gate, corner, pull, and end post.
   1. Round Steel: 1.660-inch OD Type.

D. Steel posts for all fabric heights:
   1. Round Line or Intermediate Posts: 2.375-inch OD Type I steel pipe.
   2. Round End, Corner, and Pull Posts: 2.875-inch OD Type I steel pipe.

E. Swing Gate Posts: Furnish post to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows.
   1. Steel posts for fabric height of 8 feet or less and gate leaf width:
      a. Up to and including 4 feet: 2.875-inch OD pipe weighing at least 5.79 lb per foot.
      b. Over 4 to 10 feet: 4.000-inch OD pipe weighing at least 9.11 lb per ft.

2.03 FITTINGS AND ACCESSORIES

A. Material: Comply with ASTM F 626. Galvanized iron or steel to suit manufacturer's standards.
   1. Steel and Iron: Unless specified otherwise, hot-dip galvanize steel or cast-iron fence fittings and accessories with at least 1.2 oz. Zinc per sq. ft. as determined by ASTM A 90.

B. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive top rail.

C. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast iron or cast-aluminum cap for each end.
   1. Round Steel: 1.6600-inch OD Type I steel pipe.

D. Bottom and Center Rail: (Where indicated on drawings). Same material as top rail unless indicated otherwise. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.

E. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4, and a minimum of 1.2 oz of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.

F. Tension and Brace Bands: 3/4 –inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of Zinc coating per sq. ft.
   1. Tension Bands: 0.074-inch thick (14 gauge) minimum.
   2. Brace Bands: 0.105 inch thick (12 gauge) minimum

G. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.
   1. Coating Type II zinc in the following class as determined by ASTM A 90.
      a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.

H. Tie Wire: (9-gauge) aluminum wire alloy 1350-H19 or equal.

2.04 BARBED WIRE

A. Provide three lines of 4 point pattern barbed wire. Barbed wire shall be double strand 12-1/2 gauge twisted wire with 14 gauge, 4 point round aluminum barbs spaced on approximately 5 inch centers conforming to the requirements of ASTM A121. Extension arms to accommodate barbed wire shall withstand a 250-pound pulldown load from end of arm and have a 3-inch apron around post. The top most barbed wire shall be approximately 18 inches above the fabric and approximately 18 inches out from fence line. Barbed wire shall be securely fastened in slots by heavy wire pins. Arms having projections to bend down over barbed wire will not be acceptable.

2.05 CONCRETE

A. Concrete: Provide concrete consisting of Portland cement per ASTM C150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

B. Package Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2-inch to 3-inch slump.

2.06 GATES

A. General: Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members a maximum of 8 feet apart unless otherwise indicated.
   1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.

2. Bracing: Install an adjustable truss rod diagonally on gates six foot wide and greater to prevent sagging.

B. Swing Gates: Comply with ASTM F 900.
   1. Framework: Fabricate using 1.660-inch minimum OD Type I steel pipe or 1-inch-square galvanized steel tubing weighing 1.84 lb per sq. ft.
   2. Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:
      a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
      b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.
      c. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
      d. Gate stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameter and spacings indicated, in firm, undisturbed or compacted soil.
   1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
   2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

C. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
   1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and hold in position during placement and finishing operations.
      a. Pour concrete footings to a level 2” below finished grade and cover with fresh earth from excavation.

D. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

E. Center Rails: Install center rails in one piece between posts and flush with post on fabric side, using rail ends and special offset fittings where indicated.

F. Brace Assemblies: Install braces at end and gateposts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric. Install so posts are plumb when diagonal rod is under proper tension.

G. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.

H. Fabric: Pull fabric taut and tie to post, rails, and tension wires.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and Gateposts with tension bands spaced not over 15 inches o.c.

J. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
   1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

L. Netting Ties: Fasten safety netting to tension cable and fence top rail with cable ties at 12" o.c.

M. Barbed Wire: Install three parallel wires on each extension arm on security side of fence, unless otherwise indicated. Pull wires taut.

N. Gates: Install gates plumb, level and secure for full opening without interference. Install ground set items in concrete for anchorage as recommended by the manufacturer.

END OF SECTION 02831

SECTION 02931

SOD

PART 1 GENERAL

Restoration of existing lawn areas disturbed by construction activities shall be by installation of new sod where indicated on plans or otherwise directed to install sod by the Engineer. Restoration and sod shall be performed as soon as practical, but the time period between initial disturbance, the utility installation and sod placement shall not exceed 60 days. Sod is defined as blocks, squares, strips of turf grass and adhering soil used for vegetative planting. Sodding and preparation of the sod bed shall be performed by an experienced landscape subcontractor specializing in this type of operation unless otherwise approved by the Engineer in writing. The Contractor shall adhere to the standards set forth by the American Association of Nurseryman and the Associated Landscape Contractors of America. All personnel shall be appropriately trained with regard to the degree of involvement so to assure the owner of the highest level of workmanship. Sod species suitable in this area are Hybrid Bermuda, Centipede and Zoysia; however the sod placed for each individual's lawn shall be the same species of sod as existing. Sodding may be performed at any time of the year except frozen sod shall not be placed nor shall sod be placed on frozen ground. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of a vigorous, disease free and weed free sod lawn.

1.01 MATERIAL

A. Materials, equipment and products incorporated in the work shall be approved by the Engineer. The Contractor shall submit a list of the proposed materials with samples, if required. Package materials should be delivered in unopened original containers showing weight, analysis and name of manufacturer. Protect material from deterioration.

B. Sod shall contain 95 percent permanent grass; not more than 5 percent weeds and undesirable grasses, good texture and free from obnoxious grasses, roots, stones and foreign materials. Sod shall be uniformly 1 1/2 to 2 inches thick with a well-developed fibrous root mat system in topsoil with clean cut edges. The sod shall be sufficiently dense and cut to the minimum required thickness such that if one corner suspends the sod, the sod will not tear apart. The sod shall be recently mowed to a height of not more than 3 inches prior to harvest. The sod shall be supplied and maintained in a healthy condition as evidenced by the grass being a normal green color in appearance, dense, and free from insects, pests, disease or injury. Sod shall be delivered to the job site within 24 hours after being cut and shall be installed within 24 hours after delivery. Any sod which is torn, broken or too dry will be rejected.

1.02 SOIL BED PREPARATION

A. Before landscape construction is to begin, the site shall be cleaned and disposed of brush, rubbish, stones, gravel and other foreign material within the area to be landscaped. Exposed ground surfaces disturbed during construction activities shall be graded to the original contours (allowing for the thickness of the sod) or as in the case of an altered contour such as a fill slope, graded as directed by the Engineer to finish grade, or typical cross section. The sod bed shall be excavated to such a depth that after sod placement the top of the sod shall be flush with surrounding grade or contours. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions. Do not start work until conditions are satisfactory and do not work during inclement or impending inclement weather.

B. The surface area to receive sod shall contain a minimum of 4 inches of good, fertile, friable, organic natural topsoil loam as a base for laying the sod. Topsoil shall be free of clumps, brush, sticks, weeds, stones, roots, trash or other objectionable material. Contractor shall

ensure all topsoil to be free of plants or plant parts of Quackgrass, Johnson grass, nut sedge, poison ivy or other noxious weeds. Soil preparation shall not be performed in frozen or extremely wet conditions. The finished topsoil bed shall be uniform in grade, with a yard like appearance. All changes in grade shall have smooth, rounded peaks and valleys.

C. The soil shall be scarified or otherwise loosened to a depth of not less than 5 inches and all clods shall be broken. The top 4 inches shall be worked into an acceptable smooth, friable and uniformly fine texture sod bed by use of soil pulverizes, drags, harrows or by other methods approved by the Engineer. Commercial grade fertilizer (8% Nitrogen, 8% Phosphate, 8% Potash) shall be applied at a rate of 20 pounds per 100 square feet, Super-Phosphate at 12 pounds per 1000 square feet and lime (Dolomite limestone containing not less than 85% total carbonates) shall be applied at a rate of 25 pounds per 1000 square feet or at a rate recommended for the type of sod being placed. Apply soil amendments within 24 hours after raking topsoil base surface and not more than 48 hours prior to laying sod. Mix thoroughly a minimum depth into the upper 4 inches of topsoil and lightly water to aid in dissipation. Sod placement shall not begin until the soil preparation is inspected and approved by the Engineer. During application of soil amendment fertilizer etc., adequate precautions shall be taken to prevent damage to existing features such as traffic, structures, landscape, trees, vegetation, utilities or any other appurtenances. The Contractor shall be required to repair or clean any damages.

1.03 PLACING SOD

A. The Contractor and his landscape subcontractor shall coordinate the placing of the sod to begin within 24 hours after the topsoil base preparation is completed and accepted by the Engineer. Sod shall be brought to the site as near to the time of placing as possible. Store sod in the shade, and keep watered particularly in extreme hot and dry condition to insure vitality and to prevent the dropping off of soil during handling. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing. Handling shall be done in a manner which will prevent tearing, breaking, drying or other damage. Carefully place sod in rows with the longer side perpendicular to slopes and the ends staggered in each successive row in a brick-like pattern. Butt the ends and sides together tightly and do not overlap or stretch the sod. Do not leave any voids or gaps.

B. Insure sod that abuts valve box covers, manhole covers and/or utility poles, walks, etc. is 1/4" below the edge of the structure to allow for positive drainage. Soil shall not dam up water adjacent to walks, etc. or exhibit ponding. Unavoidable gaps shall be closed with small pieces of torn or broken sod if kept moist and approved by the Engineer. After the sod is laid, irrigate thoroughly to allow water to penetrate a minimum 6 inches into the soil below the sod. Sod shall not be placed when the atmospheric temperature is below 32° F.

C. Tamp and roll completed sod installation with a manual roller or approved equipment to eliminate minor irregularities and to form close contact with the soil bed immediately after placing and watering. The type of rolling and tamping equipment to be used shall be submitted to the Engineer for approval prior to construction. On steep slopes 3:1 (horizontal and vertical) or greater, in drainage ditches or any areas where sod slipping may occur, anchor sod with approved wooden stakes (1/2"x 3/4" x 12") or staples spaced not over 2 feet apart in any direction and/or in sufficient number to prevent slippage or displacement. The anchors shall be driven flush with the surface of the sod. The wide flat side of the stake shall be driven parallel to the slope. Staking shall be done concurrently with sod placement and prior to tamping. Sod shall be laid with the long horizontal edge of the strips parallel to the contour starting at the bottom of the slope. The edge of the sod shall be turned slightly in the ground at the top of a slope and a layer of earth placed over it and compacted so as to

conduct the surface water over and onto the top of the sod. Upon completion of the above-described work, the surface of the sodded areas shall coincide with the finished grade and not exceed 1/4" plus or minus variation to adjoining grade or proposed contour. Extreme care shall be taken to prevent the installed sod from being torn or displaced. Where sod is placed adjacent to travel way Contractor shall protect sod from vehicular or other shoulder traffic by roping off temporarily or providing other suitable means of protection until sod has set.

1.04 MAINTENANCE

A. The Contractor shall, at no additional cost to the Owner, make whatever arrangements necessary to insure an adequate supply of water to meet the needs of this Contract. The Contractor shall supply water of suitable quality and purity to sustain and encourage vigorous plant growth, and supply all equipment for proper de1ivery and application to planted areas. Water obtained from PWC fire hydrant shall be metered and properly protected with an approved backflow prevention device. All costs for bulk water use where applicable shall be borne by the Contractor. PWC must inspect and approve any connections to their water system to include the proposed water application and storage equipment. The Contractor shall not use private resident's water. The Contractor is solely responsible to provide watering of the sod. The Engineer shall approve the method of application of water. Limit watering to early morning or late afternoon to enable the soil to absorb the maximum amount of water with limited runoff.

B. Maintenance shall begin immediately after sodding operation. Contractor shall provide a written schedule to the Engineer of proposed maintenance methods and scheduled maintenance. The Contractor shall maintain all sodded areas until sod is firmly established and as outlined below. Maintenance will include watering, fertilizer, pest control, soil amendments, disease control, erosion repair, mowing, protecting turf area from traffic (i.e. temporary fences, barriers, signs, etc.) and replacement of any dead or damaged sod.
   1. Watering
      a. Water lawn areas once a day with a minimum 1/2-inch water for the first 3 weeks after area sodded.
      b. After the 3-week period, water twice a week with a 3/4-inch of water each time unless a comparable amount of rainfall has occurred.
      c. Make weekly inspections to determine moisture content of soil and supplement the above watering schedule as needed.
      d. Excessive runoff, puddling, and wilting shall be prevented.
   2. Fertilizer and Pest Control
      a. Evenly spread fertilizer composite at a rate of 40 pounds per 5000 square feet or as recommended by the manufacturer. Fertilizer shall not be applied until 2 weeks after initial placement of the sod or prior to the advent of winter
      b. Treat areas of weed and insect infestation as recommended by the treatment manufacturer.
   3. Mowing
      a. The Contractor shall do mowing operations, (in yards not being mowed by residents) until provisional acceptance.
      b. Mowing shall be done only when the grass is dry with a rotary type mower having a blade height set not lower than l 1/2 inches nor higher than 3 inches.
      c. Mowing operations shall be conducted at intervals, which insure grass height does not exceed 4 inches between mowing.
      d. The Contractor shall complete at least one mowing operation before the work will be considered for provisional acceptance.
      e. The Contractor shall protect and not allow access of vehicular traffic into any newly sodded areas and shall repair any damaged turf to original grade.

Maintenance shall continue for a period of one (1) year after placement or until provisional acceptance by the Engineer. A written record shall be furnished to the Engineer of the maintenance work performed. At least two weeks shall elapse after chemical control is applied before a request of inspection.

1.05 ACCEPTANCE

A. Fifteen (15) days prior to the end of the one (1) year maintenance period, the Contractor shall make written request to the Engineer for an inspection and provisional acceptance of the sod. Failure to notify the Engineer will not relieve the Contractor of the maintenance provisions required and the Contractor will continue to be responsible for the maintenance of the sod.

B. Replacement of dead sod shall be performed within 7 days after notification by the Engineer and the maintenance period for these areas or individual lawns shall be extended for the 90-day maintenance period. Failure to replace dead sod within the specified 7 day period will result in the Owner having the work performed and deducting the cost from the Contract, however, the Contractor shall be responsible for the maintenance and if necessary replacement of sod.

C. Final acceptance will be given upon satisfactory contract performance exhibited at final inspection and acceptance. Sodded areas are to be fully rooted prior to acceptance. The Engineer shall be the sole judge as to whether or not the lawns are acceptable. Should any deficiencies be disclosed at final inspection, the Contractor shall make the necessary corrections in a timely manner and request re-inspection.

D. After the completion of the project, the Contractor will provide a warranty letter for one (1) year.

1.06 GUARANTEE

A. The Contractor shall guarantee a dense, vigorous stand of turf free of weeds, disease, pests or any dead areas more than one half of a square foot in size for a period of one (1) year from initial placement or replacement whichever is greater. Total dead area shall not exceed 1% of total square footage for each individual resident's lawn.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION 02931

SECTION 02950

TREES, PLANTS, AND GROUND COVER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation of soil.

B. Topsoil bedding.

C. Relocation of trees, plants and ground cover.

D. Mulch and fertilizer.

E. Maintenance.

F. Tree Pruning.

1.02 REFERENCES

A. ANSI Z60.1 - Nursery Stock.

B. NAA (National Arborist Association) - Pruning Standards for Shade Trees.

1.03 DEFINITIONS

A. Weeds: Any plant life not specified or scheduled.

B. Plants: Living trees, plants, and ground cover specified in this Section [, and described in ANSI Z60.1].

1.04 SUBMITTALS - PROJECT CLOSEOUT

A. Maintenance Data: Include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.

B. Submit list of plant life sources.

1.05 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with three years' experience.

B. Installer Qualifications: Company registered and specializing in installing and planting the plants with 3 years' experience.

C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

D. Tree Pruning: NAA - Pruning Standards for Shade Trees.

E. Maintenance Services: Performed by installer.

1.06 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Plant Materials: Certified by state department of agriculture. Described by ANSI Z60.1, free of disease or hazardous insects.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.08 COORDINATION

A. Install plant life after and coordinate with installation of underground irrigation system piping and watering heads specified in Section 02810.

1.09 WARRANTY

A. Provide one year warranty.

B. Warranty: Includes coverage for one continuous growing season; replace dead or unhealthy plants.

C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

1.10 MAINTENANCE SERVICE

A. Maintain plant life for 24 months after Date of Substantial Completion.

B. Maintain plant life immediately after placement until plants are well established and exhibit a vigorous growing condition. Continue maintenance until termination of warranty period.

C. Maintenance to include:
1. Cultivation and weeding plant beds and tree pits.
2. Applying herbicides for weed control in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
3. Remedy damage from use of insecticides.
4. Irrigating sufficient to saturate root system.
5. Pruning, including removal of dead or broken branches, and treatment of pruned areas or other wounds.
6. Disease control.
7. Maintaining wrapping, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.
8. Replacement of mulch.

PART 2 PRODUCTS

2.01 TREES, PLANTS, AND GROUND COVER

A. Trees, plants and ground cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.02 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, capable of sustaining vigorous plant growth; free of subsoil, clay or impurities, plants, weeds and roots

2.03 SOIL AMENDMENT MATERIALS

A. Fertilizer: Nitrogen 5 percent, phosphoric acid 10 percent, soluble potash 5 percent.

B. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

C. Water: Clean, fresh, and free of substances or matter which could inhibit vigorous growth of plants.

2.04 MULCH MATERIALS

A. Mulching Material: Hardwood mulch.

2.05 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: Softwood lumber, pointed end. Mild steel angle, galvanized, pointed end.

C. Cable, Wire, Eye Bolts [and Turnbuckles]: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared subsoil is ready to receive work

B. Saturate soil with water to test drainage.

C. Verify that required underground utilities are available, in proper location, and ready for use.

3.02 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Dig pits and beds 6 inches larger than plant root system.

3.03 PLACING TOPSOIL

A. Spread topsoil to a minimum depth of 4 inches over area to be planted. Rake smooth.

B. Place topsoil during dry weather and on dry unfrozen sub-grade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install topsoil into pits and beds intended for plant root balls, to a minimum thickness of 6 inches.

3.04 FERTILIZING

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 2 inches of topsoil.

D. Lightly water to aid the dissipation of fertilizer.

3.05 PLANTING

A. Place plants for best appearance for review and final orientation by Architect/Engineer.

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Set plants in pits or beds, partly filled with prepared plant mix, at a minimum depth as indicated on drawings under each plant. Loosen burlap, ropes, and wires, from the root ball.

E. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch lifts. Maintain plant life in vertical position.

F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.06 PLANT RELOCATION AND RE-PLANTING

A. Relocate plants as directed by Engineer.

B. Re-plant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth as indicated on drawings under each plant. Loosen burlap, ropes, and wires, from the root ball.

C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position.

D. Saturate soil with water when the pit or bed is half full of topsoil and again when full.

3.07 FIELD QUALITY CONTROL

A. Field inspection and testing.

B. Plants will be rejected if a ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.08 MAINTENANCE

A. Neatly trim plants where necessary.

B. Immediately remove clippings after trimming.

C. Water to prevent soil from drying out.

D. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

E. Apply pesticides in accordance with manufacturer’s instructions.

END OF SECTION 02950

SECTION 04000

MASONRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

A. Mortar

B. Brick masonry

C. Cast Stone

D. Unit pavers

1.03 QUALITY ASSURANCE

A. All produces and execution shall conform to applicable standards and specifications published by the following:

1. The American Society for Testing and Materials (ASTM)
2. American National Standards Institute (ANSI)
3. National Concrete Masonry Institute (NCMA)
4. Structural Clay Products Institute (SPCI)
5. Underwriters Laboratories, Inc. (UL)

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and other data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Include instructions for handling, storage installations and protections.

1.05 JOB CONDITIONS

A. Protection of Work: During erection, cover top of walls with heavy waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1.06 COLD WEATHER PROTECTION

A. Remove any ice or snow formed on masonry bed by carefully applying heat until tip surface is dry to the touch.

B. Remove all masonry determined to be frozen or damaged by freezing conditions.

C. Perform the following construction procedures while the work is progressing:

1. When air temperature is from 40 degrees F (4 degrees C) to 32 Degrees F (0 degrees C), heat sand or mixing water to produce mortar temperatures between 40 degrees F (4 degrees C) and 120 degrees F (49 degrees C)
2. Do not lay masonry when the temperature of the surrounding air is 32 degrees F (0 degrees C) and falling.

D. Perform the following protections for completed masonry and masonry not being worked on:

1. When the mean daily air temperature is from 40 degrees F (4 degrees C) to 32 degrees F (0 degrees C), protect masonry from rain or snow for at least 24 hours by covering with weather resistive membrane.

2. When mean daily air temperature is from 32 degrees F (0 degrees C) to 25 degrees F (-4 degrees C), completely cover masonry with weather-resistive membrane for at least 24 hours.

3. When mean daily air temperature is from 25 degrees F (-4 degrees C) to 20 degrees C) completely cover masonry with insulating blankets or similar protection for at least 24 hours.

4. When mean daily temperature is 20 degrees F (-7 degrees C) and below, maintain masonry temperature above 32 degrees F (0 degrees C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other acceptable methods.

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

A. Portland Cement: ASTM C150, Type I. Provide natural color or white cement as required to produce the required mortar color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregates: ASTM C 144, except for joints less that ¼" use aggregate graded with 100% passing the No. 16 sieve.

D. Mortar Color: Supply mortar color with fast-color, mineral pigments to produce color of mortar selected by architect.

E. Water: Clean, free of deleterious materials which would impair strength or bond.

2.02 CAST STONE

A. Ornamental Ball: Ornamental Ball shall be design PC-3/12, 12" diameter without pier cap, S-15 color, SK finish, as manufactured by Dura Art Stone, Conley Georgia or approved equal.

B. Balustrade: Balustrade shall consist of the following components, all of which manufactured by Dura Art Stone of Georgia:

1. Base Rails shall be BR4, *' sections with appropriate end sections. Provide with dowels for anchoring to bridge deck. Fabricated for equal baluster spacing of approximately 8.4".

2. Baluster shall be RB2, round, spaced approximately 8.4" on center. Provide with dowels for anchoring to base rails and gap rails. Provide half balusters each side of intermediate piers and inside of end piers. Balusters shall be 31" high.

3. Piers: Intermediate piers shall be 12" straight, provincial. End piers shall be 7" end, provincial.

4. Cap Rail shall be CR4, 8' sections with appropriate end sections. Fabricate for equal baluster spacing of approximately 8.4".

5. Keystone for arch shall be fabricated according to dimensions on details. Composition, color and finish shall match other cast stonework. Cast dowels into keystone for anchoring into brick arch.

6. System Design: Balustrade system shall be designed by the manufacturer. Submit drawings showing complete elevation, spacing of balusters, piers, and details for installation. Color for all components shall be S-15 (silica white), finish shall be SK (sharked smooth).

2.03 UNIT PAVERS

A. Solid concrete interlocking paving stones; ASTM C936-82 paving stones shall be Holland Stone as manufactured by Metromont Materials, Spartanburg, South Carolina or approved equal. Paving stones shall be 2 3/8" x 4" x8" with hidden spacer and meet the following physical requirements:

1. Compression Strength- At the time of delivery to the work site, the average compressive strength shall not be less than 8,000 psi with no individual unit strength less than 7,200 psi with testing procedures in accordance with ASTM Standard C-140.

2. Absorption- The average absorption shall not be greater than five percent (5%) with no individual unit absorption greater than seven percent (7%).

3. Proven Field Performance – Satisfying field performance is indicated with units similar in composition, and made with the same manufacturing equipment as those to be supplied to the purchaser, do not exhibit objectionable deterioration after at least one (1) year.

4. All units shall be manufactured with a separate surfaced hardened mix to ensure consistent texture and concentration of color on the wearing surface.

B. Visual Inspection

1. All units shall be sound and free of defects that would interfere with the proper placing of the unit of impair the strength of performance of the construction. Minor cracks incidental to the usual methods of manufacture, or minor chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

C. Sampling and Testing

1. The purchaser or his authorized representative shall be accorded facilities to inspect and sample the units at the place of manufacture from lots ready for delivery.

2. Sample and test units in accordance with ASTM Methods C-140.

D. Rejection

1. In case the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new test units shall be selected at random by the purchaser from the retained lot and tested at the expense of the manufacturer. In case the second set of test unit fails to confirm to the specified requirements, the entire lot shall be rejected.

E. Expense of Tests

1. The expense of inspection and testing shall be borne by the purchaser unless otherwise agreed.

F. Sand Laying Course

1. The sand laying course shall be a well graded, clean washed sharp sand with 100% passing 3/8" sieve size and a maximum of 3% passing a No. 200 sieve size. This is commonly known as manufactured concrete sand, river sand, granite screenings, or similar. DO NOT USE MASON SAND.

2. Bedding sand to conform to ASTM C-33 – The sand-laying course should be the responsibility of the paving stone installer.

PART 3 EXECUTION

3.01 MORTARED BRICK MASONRY

A. Do not lower the freezing point of mortar by use of admixtures or antifreeze agents.

B. Do not use calcium chloride in mortar by use of admixtures or antifreeze agents.

1. Type M: ¼ part lime per part of Portland cement.

2. Type S: Over ¼ up to ½ part lime per part Portland cement.

C. Thickness: Build masonry construction to the full thickness shown, except, build single-width walls (if any) to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

D. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full units without cutting wherever possible.

E. Do not wet concrete masonry units.

F. Frozen Materials and Work: Do not use frozen materials or materials mixed or coated with ice or frost. For masonry, which is specified to be wetted, comply with BIA recommendations. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.

G. Lay-up walls plumb and true and courses level accurately spaced and coordinated with other work.

H. Stopping and Resuming Work: Rack back ½-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and removed loose masonry units and mortar prior to laying fresh masonry.

I. Mortar Bedding and Jointing:

1. Use Type M mortar for masonry below grade and in contact with earth, interior and exterior load bearing walls.

2. Use Type S mortar for exterior above grade and in contact with earth, interior and exterior load bearing walls.

3. Measure and batch materials either by volume or weight, such that the required proportions for mortar can be accurately controlled and maintained. Measurement of sand exclusively by shovel will not be permitted.

4. Mix mortars with the maximum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.

5. Mix mortar ingredients for a minimum amount of water consistent with workability to provide maximum tensile bond strength within the capacity of the mortar.

6. Mix mortar ingredients of a minimum of 5-minutes in a mechanical batch mixer. Use water clean and free of deleterious materials, which would impair the work. Do not use mortar, which has begun to set, or if more than 2 ½ hours has elapsed since initial mixing. Re-temper mortar during 2 ½ hour period as required to restore workability.

7. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also, bed webs in mortar in starting course on footings and foundation walls and in all courses of piers, columns and pilasters, and where adjacent to cells, or cavities to be reinforced or to be filled with concrete or grout.

8. Joints: Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not otherwise indicated, lay walls with 3/8" joints. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials.

9. Remove masonry units disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

10. Formwork for Supporting Reinforced Masonry: Construct formwork to fully support reinforced arch for its entire length. Tolerance for formwork shall be 1/8" true to radius, 1/16" true to level. Leave formwork in place for 14 days after erection.

3.02 CAST STONE

A. Cast stone shall be constructed per manufacturer's recommendations. Drawings and recommendations shall be submitted for review prior to beginning of construction. Joints shall be ½", slightly concave, color to match cast stone. Base rails and bridge shall be drilled and dowelled and grouted securely.

3.03 UNIT PAVERS

A. The paving stone installer/contractor must have related experience in the installation of interlocking concrete paving stones.

B. Base Course Preparation

1. A suitable base must be prepared as detailed in other sections of the project specifications.

2. The base course shall be shaped to grade and cross section with an allowable tolerance of 1.4" (5mm).

3. The compacted base thickness is as follows: Patios, sidewalk, pool decks, and other designated areas for pedestrian walkways shall be at least 4" (100mm) on well drained soils. For other areas such as driveways, receiving wheeled traffic loads, a minimum of 6" (150mm) base thickness is required. A minimum of 8" (200mm) base thickness is required on low volume residential street application. Heavier traffic loads shall require a layer of Geotextile fabric or Geogrids as needed. Reference Tables 1 and 2 of National Concrete Masonry Association's TEK 87-A for minimum physical requirements for Soil Separation Geotextile or Base Reinforcement Geogrids.

C. Construction of the Sand Laying Course

1. The finished base course shall be approved before the placement of the sand-laying course.

2. The uncompacted sand-laying course shall be spread evenly over the area to be paved and then screeded to a level that will produce 1" (25mm) thickness when the paving stones have been placed. Normally, it is good practice to have final elevation of paving stones slightly higher than adjacent curb, gutter, other paving, to allow for any minor settling that may occur within the base. Maximum bedding sand thickness shall not exceed 1 ½".

3. Once screeded and leveled to the desired elevation, this sand laying course shall not be disturbed in any way.

D. Laying of Concrete Paving Stones

1. The paving stones shall be laid in the approved pattern as noted or shown on the drawings. Layering pattern shall be Runner bond.

2. The paving stones shall be laid in such a manner that the desired pattern is maintained and the joints between the stones are as tight as possible. Joints between stones shall not exceed 1/8" (3mm).

3. String lines should be used to hold all pattern lines true.

4. The gaps at the ends of the paver surface be filled with standard edge stone or with stones cut to fit. Cutting shall be accomplished to leave clean edge to the traffic surface using a masonry saw. Whenever possible, no cuts should result with a paver less than 1/3 of original dimension.

5. Paving stones shall be vibrated into the sand-laying course using a vibrator capable of 3,000 to 5,000 pounds of compaction force with the surface clean and joints open. At least two passes with the vibrator should be made across the surface.

6. After vibration, clean masonry type sand containing at least 30% of the 1/8" (3mm) particles shall be spread over the paving stones surface, allowed to dry, and vibrated into joints with additional vibrator passes and brushing so as to completely fill joints. Sweep sand to meet ASTM C-144.

7. Surplus materials shall then be swept from the surface or left on surface during construction time in ensure complete filling of joints during initial use. This sand also may provide surface protection from construction debris.

8. Do not vibrate within three feet of unrestrained edge. All work within three feet of the laying face must be fully compacted edge of the laying face and sand with a waterproof coverage. Sweep off excess sand when the job is complete.

9. Upon completion of work covered in the Section, the Contractor shall cleanup all work areas by removing all debris, surplus material and equipment from the site.

10. Cleaning- all dirt, grime, and fresh oil and grease shall be removed from the concrete paver surface prior to job being complete. Spray or brush cleaner onto paver surface and then rinse away with clean, potable water. Flammable ingredients or acids are not to be used. Use Addiment Dirt and Grim Remover, or Addiment Efflorescence Remover and General Cleaner, or approved equal.

11. Sealers- No sealer shall be applied until after a thorough cleaning of paver surface. Sealer shall be sprayed or rolled onto clean, dry surface, using Addiment Paver Seal - WB, or approved equal.

END OF SECTION 04000

DIVISION 2
SITE WORK

02660 WATER DISTRIBUTION

GENERAL

Water lines and all appurtenant items shall be constructed of materials specified and/or as indicated on the approved drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defects in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Fayetteville Public Works Commission (PWC) at no expense to the Fayetteville Public Works Commission.

RELATED SECTIONS

A. 02211 – Grading, Utilities
B. 02222 – Excavation and Backfilling for Utility Systems
C. 02301 – Boring And Jacking (Roadways And Railroads)

MATERIALS

MANUALLY OPERATED GATE VALVES

All manually operated gate valves four (4) inches and larger shall be ductile iron or cast iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to American Water Works Association (AWWA) C-509/C-515 and NSF 61. All valves must open counter-clockwise equipped with a two (2) inch square operating nut. The operating nut shall have an arrow cut in the metal, indicating the direction of opening. All valves shall have a non-rising stem. All valves up to and including thirty-six (36) inch diameter shall have triple "O" ring stem seals. The design and machining of valves shall be such as to permit the replacement of the upper two (2) "O" rings without undue leakage while the valve is wide open and in service. The wedge shall be ductile iron encapsulated in nitrile rubber (for four (4) inch through 12 inch) and SBR rubber for 14-inch through 24-inch sizes.. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating complying with ANSI/AWWA C550 applied electrostatically prior to assembly, conforming to AWWA C-550-90. All valves up to and including 36-inch diameter shall have a safe working pressure of 250 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500.

Gate valves installed in meter vaults shall have a wheel in lieu of a square operating nut and shall also have a non-rising stem. The wheel shall have an arrow cut in the metal indicating the direction of opening. Flanges shall not be buried. An approved pit shall be provided for all flange connections.

Resilient seated tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS-SP60. Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the

proper alignment required to prevent damage by a misaligned shell cutter. The interior of the waterway in the body shall be a full opening and capable of passing a full sized shell cutter equal to the nominal diameter of the valve.

All valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Valves shall be manufactured by: Mueller Company, Clow Corporation, or American Darling Company. Certification shall be furnished to the Fayetteville Public Works Commission by the manufacturer that all valves are in accordance with PWC standards. Where specified on the plans and approved by the Fayetteville Public Works Commission, resilient wedge gate valves may be furnished with spur gearing for valves installed in a vertical position and bevel gearing for valves installed in a horizontal position. All gate valves shall be installed in accordance with PWC standard details.

BALL VALVES

For all valves smaller than four (4) inches, ball valves shall be used. Ball valves shall be installed in accordance with PWC standard details.

Ball valves shall be all bronze construction, with tee head operator and having a removable disc. Ball valves shall have threaded connections, in accordance with PWC standard details. Ball valves shall be manufactured and tested in accordance with AWWA/ANSI C800. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM Specifications and shall also meet the approval of the Public Works Commission. The turn required to travel from fully closed to fully open on the ball valve shall be 90 degrees.

VALVE BOXES

Valve boxes shall be "slip-type" made of close-grained, gray cast iron metal painted with a protective asphaltic coating. Construction shall be in three pieces as follows: The lower of base pieces, which shall be flanged at the bottom, the upper part which shall be flanged on the lower end, and of such size as to telescope over the lower part, the upper end being constructed in the form of a socket to receive the cap or cover; and the cover or cap shall have cast on the upper surface, in raised letters, the word "WATER". All valve boxes shall be equal in quality and workmanship to those manufactured by Sigma Corporation (VB-462), Tyler Union (6855 Series), Star Pipe Products (VB-0004), or an approved equal. The valve box shall be installed in accordance with PWC standard details. The valve box shall have a 3/8-inch hole drilled in the upper part four (4) to six (6) inches from the top of the box to accommodate a ¼-inch x 1-1/2-inch galvanized bolt for securing tracer wire.

Valve box protector rings shall be installed to protect valve boxes located outside pavement. The ring shall be constructed and installed in accordance with PWC standard details.

FIRE HYDRANTS

All fire hydrants shall be dry barrel, traffic type and conform to the latest revision of AWWA Specification C-502 except as listed below or as otherwise directed by the Public Works Commission. All working parts shall be bronzed. The size of the fire hydrants (designated by the nominal diameter of the valve opening) shall not be less than four and one-half (4 ½) inches. All hydrants shall be able to deliver a minimum of 1,000 gallons per minute with a friction loss of not more than five (5) pounds per square inch (psi) total head loss through the hydrant. Hydrants shall be of compression type (opening shall be of such design that when the barrel is broken off the hydrant valve will remain closed and reasonably tight against leakage). All hydrants shall be mechanical joint to accommodate the spigot end of six (6) inch Pressure Class 150, AWWA Standard, ductile iron pipe. The installation of the fire hydrant shall be in accordance with PWC standard details. Bosses (6") may be substituted for tees in pipe sizes exceeding 24 inches in diameter, with prior approval from PWC. The boss shall be welded to the bottom of the main to provide effective flushing of the system.

All hydrants shall be furnished with two (2) two and one-half (2 ½) inch nozzles and one (1) four and one-half (4 ½) inch pumper nozzle. Outlets shall have American National Standard fire hose coupling thread, in accordance with the City of Fayetteville standard, and shall be provided with nozzle caps securely chained to the body of the hydrant. The base of the hydrant shall have two (2) cast lugs suitable for use in strapping the hydrant to the connecting pipe. The operating nut shall be pentagonal in shape, finished with a slight taper to one and one-half (1 ½) inches from point to flat to conform to the standard wrench used by the Fayetteville Public Works Commission. All hydrants shall open left or counter-clockwise. Hydrants shall be suitable for working pressure of 150 psi and a test pressure of twice the working pressure. Fire hydrants shall be specific models manufactured by Mueller Company (Model Centurian 200), Clow Corporation (Medallion), American Darling (Model Mark 73-1) or approved equal. The interior of the hydrant shoe shall be coated with a four (4) mil thickness FDA approved epoxy coating.

COMBINATION AIR VALVES ASSEMBLY

Combination air valves shall be of the single housing style that combines the operation features of both an air/vacuum and air release valve. The combination air valve shall have a two (2) inch inlet and one (1) inch outlet connections and an orifice diameter to be determined by the Design Engineer for each project for a maximum working pressure of 300 psi. The assembly shall be equipped with a two (2) inch cut-off valve as shown on the PWC standard detail. The combination air valve body shall be constructed of 316 stainless steel or reinforced nylon with the only exception being the Buna-N Rubber seat and gasket. Valves shall be as manufactured by Crispin (Model UX20), ARI (D-020), or approved equal. Combination air valves shall be installed in accordance with PWC standards.

WATER DISTRIBUTION PIPE

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe shall be designated as "Pressure Class", unless otherwise specified. The pipe furnished shall have a minimum thickness calculated in accordance with ANSI A 21.50 (AWWA C-150), with a factor of safety of two (2); a working pressure of 150 psi to 350 psi, plus 100 psi water hammer allowance; and AASHTO H-20 live truck load with 2.5 feet of cover. In no case shall "Pressure Class" pipe's nominal thickness be less than the following:

SIZE	PRESSURE CLASS	NOMINAL THICKNESS (In.)
4"	350	0.25
6"	350	0.25
8"	350	0.25
10"	350	0.26
12"	350	0.28
16"	250	0.30
24"	250	0.37

PUSH-ON JOINTS

Push-on joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Push on joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified. All ductile iron pipe shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). The pipe shall have an outside asphaltic coating as specified in AWWA Standard C-151.

RESTRAINED JOINTS

Factory Restrained Joints

Factory restrained joint pipe shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint pipe shall be furnished for the locations shown on the approved drawings. The pipe, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes.

All factory restrained joint pipe shall have the restraints internal to the pipe (i.e., "boltless"). All restrained joint ductile iron pipe and fittings larger than 12-inches shall be as manufactured by U.S. Pipe's TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company's Flex-Ring Joint, or approved equal. The method of restraining the valves to the factory restrained ductile iron pipe shall be reviewed and approved by PWC on a case by case basis. The valves shall have the same working pressure as the pipe.

Flanged Joints

Flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable.

Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8 inch thickness. Linings and coatings shall be as previously outlined for all ductile iron pipe and fittings.

Mechanical Joints

Mechanical joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four (4) inch pipe through 12-inch pipe. Mechanical joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified.

Special accessories such as mechanical joint retainer glands or mega-lugs are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

Field Lok Gaskets

Special accessories such as US Pipe's Field-LOK gasket, Ford’s Uni-Ring, or Romac’s Grip-Ring are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

FITTINGS

Mechanical Joint

All fittings shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be mechanically restrained, ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for four (4) inch through 12 inch sizes only. Where thrust blocking is utilized, fittings shall be full body ductile iron in accordance with ANSI A 21.53 (AWWA C110).

All ductile iron fittings shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). All fittings shall have an outside asphaltic coating as specified in AWWA Standard C-151 and C-110, respectively.

Factory Restrained

Factory restrained joint fittings shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint fittings shall be furnished for the locations shown on the approved drawings. The fittings, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as previously specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes. All factory restrained joint fittings shall have the restraints internal to the fitting (i.e., "boltless"). All fittings shall be compatible with the factory restraint system. All restrained joint ductile iron fittings larger than 12-inches shall be as manufactured by U.S. Pipe's TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company's Flex-Ring Joint, or approved equal.

Bosses

Tangential welded on outlets (i.e., bosses) shall only be utilized on pipe 24-inches and larger, as approved by PWC. All bosses shall be factory welded; field fabrication is not allowed. The pipe shall be in accordance with these specifications. Bosses shall be of the size and location indicated on the approved drawings.

AERIAL CROSSINGS

For aerial crossings, the ductile iron pipe shall be thickness class, as specified on the plans and standard details. All thickness class pipe shall be in accordance with ANSI A21.51 and AWWA C-151, with a minimum working pressure of 200 psi.

For aerial crossings which are four (4) inches to 12 inches in diameter, Class 53 manufactured factory restrained joint or Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details. No other means of restraint are allowed for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details.

All aerial crossings shall be designed and installed in accordance with PWC standard details.

PIPE IN CASINGS

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

All restrained joint ductile pipe in casings shall be in accordance with the PWC standard details.

TRENCHLESS APPLICATIONS

All ductile iron pipe (regardless of diameter) utilized for trenchless installations (i.e., horizontal directional drilling, pipe-bursting, etc.) shall be factory restrained, in accordance with these specifications and the applicable specification section for the trenchless technology. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized.

PVC PIPE

Two (2) inch water main pipe shall be manufactured using Grade 1 PVC compound material as defined in ASTM D-1784 and shall be SDR21, pressure class 200 in accordance with ASTM D 2241. Fittings for two (2) PVC pipe shall be solvent weld Schedule 80 PVC. Brass FIP x pack joint for PVC fittings shall be used to transition from PVC to brass. The pipe shall be plainly marked with the manufacturer's name, size, material (PVC) type and grade or compound, NSF seal, date of manufacture, pressure rating and reference to appropriate product standards.

All PVC pipe (4-inches through 12-inches diameter) shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4,000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Class 150 and conform to the thickness requirements of DR18. The pipe shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1,000 hours tested in accordance with ASTM D-1598. The pipe joints shall be of the integral bell type with rubber gaskets and shall conform to the requirements of ASTM D-3139 or ASTM F-477.

PVC fittings are not acceptable for water mains four (4) inches or greater. Fittings and specials shall be ductile iron, bell end in accordance with AWWA C-110, 150 psi pressure rating unless otherwise shown or specified. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Ductile iron fittings and specials shall be cement mortar lined (standard thickness) in accordance with ANSI A21.4.

Mechanical restraining systems (i.e. mega-lug, grip-ring) shall not be used on PVC pipe.

TRACING WIRE

For the purpose of locating non-metallic pipes, a continuous "detectable" tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. Splices shall be accomplished utilizing a corrosion proof wire connector. The connectors shall "lock" the wires in place and contain a dielectric sealant to prevent corrosion. The connector shall be the "Snake Bite" connector manufactured by Copperhead Industries, LLC, or approved equal. The wire shall be buried continuously along the pipe. The wire shall be secured into valve boxes such that a direct/conductive metal detector may be used to trace the pipe location. Bolts shall be used to secure the wire and the attachment location shall be readily available from finished grade without special equipment.

POLYETHYLENE PLASTIC WATER TUBING

Polyethylene (PE) plastic water tubing shall be installed in accordance with PWC standard details. All services installed in new construction shall be one continuous run of pipe with no splices from the corporation stop to the meter. The PE water tubing shall meet the requirements of ASTM D2737, AWWA C901, and NSF Standards 14 and 61. Pipe dimensions shall meet Iron Pipe Size (IPS) standards.

The PE tubing material shall be high density polyethylene conforming to the minimum requirements of cell classification 445574E, as defined and described in ASTM D3350. The resin shall have a material designation code of PE4710 by the Plastic Pipe Institute.

The PE water tubing shall be SIDR 7, with a minimum pressure rating of 250 psi. Fittings for the PE water pipe shall be cast brass compression fittings, made to the PE water pipe dimension. All brass fittings shall have a 300 psi minimum pressure rating.

For the purpose of locating plastic water services during trenching, a continuous tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. The wire shall be buried along the water service lateral from the main to the meter box. The wire shall extend a minimum of 12 inches into the meter boxes.

COPPER WATER TUBING

Copper water tubing shall be installed in accordance with PWC standards. All services installed shall be one continuous run of pipe with no splices from the corporation stop to the meter.

Copper water tubing shall be Type K, soft copper manufactured in accordance with ASTM B88. The minimum pressure rating for the copper water pipe shall be 655 psi. Fittings for the copper water pipe shall be brass compression fittings, made to the copper water pipe dimensions. All brass fittings shall have a 300 psi minimum pressure rating.

TAPPING SLEEVES

Tapping sleeves shall be ductile iron mechanical joint or stainless steel and have a minimum working pressure of 150 psi for all tapping of mains up to and including 24-inch diameter with a branch less than or equal to 12-inches diameter. Branch diameter greater than 12-inches on a 16-inch diameter pipe and larger shall require full body ductile iron mechanical joint tapping sleeve.

Ductile iron mechanical joint tapping sleeves shall be as manufactured by Clow, M&H, Mueller, American, or an approved equal and shall be furnished with complete joint accessories. The mechanical joint sleeve shall be compatible with type and class of pipe being tapped. The outlet flange shall be class 125 per ANSI B16.1 compatible with approved tapping valves.

Stainless steel tapping sleeves shall be as manufactured by Romac, Smith-Blair, or approved equal, and shall be furnished with all accessories. The sleeve, lugs, bolts and nuts shall be 18-8 type 304 stainless steel, as provided by the manufacturer. The outlet flange shall be ductile iron or stainless steel. The gasket shall be a grid pattern design and shall provide full circumferential sealing around pipe to be

tapped. The sleeve shall include a 3/4 NPT test plug. All welds shall be passivated. The outlet flange shall be class D per AWWA C-207-ANSI 150 lb. drilling compatible with approved tapping sleeves.

The tapping sleeve and valve shall be in accordance with PWC standard details.

All tapping sleeves shall be hydrostatically pressure tested prior to the tap being accomplished. **Use of air to complete the pressure test is not acceptable.** The tapping sleeve shall be tested to 150 psi. The PWC Project Coordinator shall witness and approve the testing.

WATER SERVICE SADDLES

All water service saddles for use on two (2) inch PVC shall be one (1) inch brass saddles as manufactured by Ford, McDonald, or Mueller.

Water service saddles for one (1) and two (2) inch taps on four (4), six (6), eight (8), 12-inch and larger size PVC and asbestos-cement (AC) and also four (4) inch and larger size iron pipe shall be ductile iron with stainless steel strap(s), bolts, nuts and washers. Ford Models FS 101, FS 202; Romac Models 101S, 202S; or Smith-Blair Model 315.317 shall be used. Stainless steel straps must be pre-formed at the factory to the specified outside diameters of the pipe.

Water service saddles with a two (2) inch outlet shall be double strap.

Water service saddles for pipe sizes 12-inch through 24-inch shall be double strap.

Water service saddles for pipe sizes exceeding 24-inches shall be as specified by the PWC Water Resources Engineering Department.

INSTALLATION

GENERAL

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE INSTALLATION

Pipe installation shall be in accordance with the manufacturer's instructions. All pipes and fittings shall be handled to prevent damage to the protective coatings and linings.

All dust, dirt, oil, tar, or other foreign matter shall be cleaned from the jointing surfaces, and shall be lubricated with lubricant recommended by the manufacturer.

All pipe shall be installed in accordance with the approved drawings and cut sheets, unless otherwise directed by PWC.

All dead ends on new mains shall have a two (2) inch blow-off assembly as indicated on the approved drawings. The blow-off assembly shall be in accordance with PWC standard details.

For pipe sizes up to 12-inches, mechanical equipment should not be utilized to assemble the pipe. For pipe sizes over 12-inches, mechanical equipment may be utilized, in accordance with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

When pipe installation is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is present, the plug shall remain in place until the water is lowered to a level that allows for proper installation. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

The Contractor shall be responsible for installing the pipe and appurtenances to proper line and grade.

All ductile iron pipe and fittings shall be installed in accordance with ANSI/AWWA C-110/A21.10. All C-900 pipe shall be installed in accordance with ASTM D-2774. The amount of deflection in the PVC or ductile iron pipe shall not exceed the applicable AWWA standards and the manufacturer's recommendations. If the required deflection exceeds the specified limitations or as determined by the Public Works Commission, mechanical joint bends shall be utilized.

Pipe passing through walls of NCDOT bridges, retaining walls, and other concrete structures shall be factory restrained joint ductile iron and be installed in casings/sleeves in accordance with NCDOT specifications. Annular space between walls and sleeves shall be filled with an approved cement mortar that meets NCDOT specifications. The annular space between the sleeve and the pipe shall be filled with an approved mastic.

Pipe passing through the walls of meter vaults, valve pits, and storm drainage structures shall be restrained joint ductile iron, as specified by PWC. Pipe shall be installed in a casing/sleeve if determined to be necessary. Annular space between walls and sleeves shall be filled with an approved cement mortar. Annular space between pipe and sleeves shall be filled with an approved mastic. Proposed conflict boxes with storm and water shall be reviewed by the PWC Water Resources Engineer and approved on a case by case basis.

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of mechanical restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

When pipe is field cut, the cut end shall be smooth and at right angles to the axis of the pipe. All sharp edges shall be removed. All field cut pipe shall be beveled. The beveled end of PVC pipe shall be removed, when installing into mechanical joint ductile iron fittings.

When connecting unlike (class, material, etc.) pipe, an approved PWC fitting shall be used. All pipe shall be installed in accordance with AWWA C-600 or C-605 as applicable, for buried lines and the manufacturer's recommendations. For mechanical joint pipe and fittings, all nuts shall be torqued to the manufacturer's recommendations.

Concrete thrust blocking shall be utilized on all PVC water mains. The concrete thrust blocking shall be in accordance with PWC standard details. When thrust blocking is to be utilized, backfilling shall not occur until the concrete has time to set. No hydrostatic pressure testing shall occur until the concrete thrust blocking has cured for a minimum of five (5) calendar days.

FIRE HYDRANTS

Fire hydrants shall be installed as shown on the approved drawings. Each fire hydrant shall be connected to the main with a six (6) inch branch line and shall have a minimum of 42-inches of cover. Fittings between the valve and fire hydrant may be utilized, with prior approval from PWC. The valve shall be located at the main unless otherwise approved by PWC. Hydrants shall be set plumb with pumper nozzle facing the roadway. The hydrant branch shall not be backfilled until inspected and approved by the PWC Project Coordinator. Fire hydrants shall be installed in accordance with PWC standard details.

HYDROSTATIC TESTS

All mains and laterals shall be subjected to a hydrostatic pressure test. Each valved section maybe tested individually.

The Contractor shall furnish all labor and material, including test pumps, taps, and corporations, necessary to complete the work. Any taps which are not to be utilized shall be killed out at the main. If any taps are to be used for irrigation laterals they shall be installed in accordance with PWC standard details. A PWC Project Coordinator shall be present and observe all valve operation by the Contractor. Under no circumstances shall a Contractor operate any PWC-owned valves unless it is an emergency.

The duration of the pressure test shall be at least one hour or longer, as directed by the PWC Project Coordinator. The hydrostatic pressure shall be 200 psi. The pipe to be tested shall be slowly filled with water and the specified test pressure shall be applied. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow offs are not located to properly expel the air, taps shall be made as approved by PWC.

Damaged or defective materials discovered as a result of the pressure test shall be removed and replaced with new material, and the test shall be repeated until the test results are satisfactory to the Public Works Commission.

All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Public Works Commission. All repairs shall be reviewed and approved by PWC prior to backfill. The use of couplings, fittings, sleeves, etc. shall be reviewed and approved by PWC prior to use. The main must successfully pass the hydrostatic test prior to sterilization.

STERILIZATION

Sterilization shall be in accordance with the requirements of NCDEQ, the North Carolina Rules Governing Public Water Supply, AWWA C651, and AWWA C655 (most recent editions). The Contractor shall furnish all chlorinating equipment, sterilization solution, materials, excavation, barricades, backfilling, and any taps and corporations necessary to complete the work. The Contractor shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

Prior to performing the hydrostatic test, water mains, laterals, and appurtenances shall be flushed to remove air, sediment, contaminants, and/or foreign matter. After completion of a successful hydrostatic test, the water system shall be disinfected by the thorough dispersion of a chlorine solution. The chlorine level shall be between 50 parts per million (ppm) and 100 ppm throughout the water system. In no case shall the chlorine level exceed 300 ppm. If the chlorine level is over 300 ppm, the system shall be completely flushed and re-chlorinated. **In no case shall chlorine be introduced into the water system in a dry solid state.**

The chlorine solution shall remain in contact with the interior surfaces of the water system for a minimum period of 24 hours and shall result in not less than 10 ppm of chlorine throughout the system. Then the water system shall be flushed with water from the existing PWC water system until the chlorine solution is dispelled. The Contractor shall take all necessary measures to prevent downstream erosion caused by flushing the lines. All erosion/damages shall be repaired at no additional expense to the Public Works Commission. All environmental regulations governing the release and/or disposal of chlorinated testing water shall be met by the Contractor. AWWA C655 defines “highly chlorinated” water as water having more than four (4) ppm. Any water with a chlorine level greater than four (4) ppm shall be de-chlorinated by the Contractor prior to being released to the environment.

If any disruption to the disinfection process occurs, or if any repair procedure is necessary then the disinfection process shall start over.

After disinfection, the water supply shall not be accepted or placed into service until bacteriological tests results or representative water samples analyzed in the Public Works Commission’s laboratory are found to be satisfactory. The disinfection shall be repeated until tests indicate the absence of pollution for at least two (2) full days. The PWC Project Coordinator shall be responsible for taking the sample(s) and transporting them to the PWC laboratory.

If the initial sample taken after disinfection and flushing does not indicate that the water main is sterilized, the Contractor shall, in conjunction with the PWC Project Coordinator, flush the lines. Once flushing is complete, another sample will be taken to the Public Works Commission’s laboratory for analysis. Should this second sample also fail to indicate that the main is sterilized; the Contractor shall repeat the disinfection process. This process shall be repeated until the samples are satisfactory. The Contractor shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

DIVISION 2
SITE WORK

02730 SANITARY SEWER SYSTEMS

GENERAL

Sanitary sewer lines and all appurtenant items shall be constructed of materials specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Public Works Commission.

RELATED SECTIONS

A. 02211 – Grading, Utilities
B. 02222 – Excavation and Backfilling for Utility Systems
C. 02732 – Sewage Force Mains

MATERIALS

SEWER MAINS

Prior to shipment each joint of pipe shall be stamped by an independent testing laboratory, certifying compliance with the specifications stated therein. Pipe sizes indicated shall be understood to be nominal inside diameter of the pipe. All sewer pipe materials shall be either PVC (as specified herein) or ductile iron (as specified herein), unless otherwise approved in writing by the Public Works Commission. Written approval shall be obtained prior to installation.

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe and fittings shall be in strict accordance with ANSI A21.51 and AWWA C151, Class 50 or Class 51, as applicable, in every respect. The working pressure shall be a minimum of 200 psi. Pipe shall be furnished in 18 or 20-foot lengths. All pipe joints used in open trench construction shall be furnished with "push-on" joints, unless otherwise indicated on the drawings or specified. All joints and fittings shall be in accordance with ANSI A21.11 and AWWA C111. All ductile iron interior surfaces shall be lined with two (2) coats of ceramic epoxy to produce a total minimum dry film thickness of 40 mils (Protecto401 or approved equal). The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110. Specifications for the ceramic epoxy can be found in Specification Section 09802.

For aerial crossings which are 4 inches through 12 inches in diameter, manufactured restrained joint ductile iron pipe Class 53, or Class 53 flanged ductile iron pipe shall be utilized in accordance with the standard Public Works Commission detail for aerial crossings. Mega-lugs, field-lok, and gripper rings are not an allowable means of restraint for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, flange joint ductile iron pipe, Class 53, shall be utilized in accordance with the standard Public Works Commission details. The location of flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable. Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8" thickness. Linings and coatings shall be as outlined for ductile iron pipe.

If the Public Works Commission determines that an expansion coupling is required, it shall be installed as indicated on the drawings. The expansion coupling shall not be buried.

For subsurface water crossings (i.e., streams, wetlands), restrained joint ductile iron pipe shall be utilized. No mechanical restraint systems (e.g., mega-lugs, field-lok gaskets, etc.) shall be utilized. The pipe shall be installed in a casing, in accordance with the approved Public Works Commission detail, unless otherwise specifically approved by the Public Works Commission.

PVC PIPE

PVC sewer pipe and fittings 4 inches thru 15 inches shall be in accordance with ASTM D-3034 with a standard dimension ratio (SDR) of 26 for sewer mains and laterals. Larger diameter pipe (18 inches through 27 inches) shall be in accordance with ASTM F-679, with a SDR of 26. Both pipe and fittings shall be made of PVC plastic having a cell classification of 12454 as specified in ASTM D-1784.

Pipe joining shall be push on elastomeric gasket joints only and the joints shall be manufactured and assembled in accordance with ASTM D-3212. Elastomeric seals shall meet the requirements of ASTM F-477. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory and in accordance with ASTM D-3212 and contain a steel reinforcing ring. PVC sewer pipe shall be made by continuous extrusion of prime green unplasticized PVC and contain identification markings as required by the applicable ASTM standard.

SEWER FITTINGS

Ductile Iron Push-on Fittings:

Ductile iron sewer fittings on PVC mains shall be deep bell, gasketed joint, and air test rated. Gasket groves shall be machined in the factory. Material shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12 and ASTM F1336. Wall thickness shall meet the requirements of AWWA C153. Gaskets shall have a minimum cross sectional area of 0.20 square inches, and conform to ASTM F477.

All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. All ductile iron fittings on PVC pipe shall provide a flow line that provides a smooth transition between the materials. Ductile iron fittings shall be as manufactured by the Harrington Corporation (Harco), or approved equal.

Mechanical Joint Fittings:

Joints shall be installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four inch (4") pipe and larger. Fittings and specials shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for 4" thru 24" sizes only. Note: mechanical joint wyes are not included in the AWWA C-153 specification. Pressure rating shall be not less than 200 psi unless otherwise specified. All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. Mechanical joint fittings shall be utilized on ductile iron mains and ductile iron laterals. Mechanical joint fittings shall not be utilized on PVC mains, unless otherwise approved by the Public Works Commission.

PVC Fittings:

PVC fittings shall be manufactured in accordance with ASTM D-3034, F-1336, and F-679. Molded fittings shall be utilized in sizes from 4” to 8” (or larger, if available). Fabricated fittings shall only be utilized with prior approval from the Public Works Commission. Fabricated fittings are defined as those fittings that are made from pipe or a combination of pipe and molded components. All PVC fittings shall contain identification markings as required by the applicable ASTM standard. All PVC fittings shall be gasketed joint, except as indicated for interior drop structures. Plastic fittings shall be as manufactured by GPK Products, Inc., Plasti-Trends, the Harrington Corporation (Harco), or approved equal.

Ductile Iron Pipe Size x SDR26 Transition Adapter:

All ductile iron x PVC transition adapters shall be one (1) piece, bell x bell (gasket x gasket). Transition adapters shall range in size from four (4) inches through 12 inches. Transition adapters for pipe larger than 12-inches shall be as specified by the Public Works Commission. All transition adapters shall have a flow way tapered to allow a smooth transition between the ductile iron and PVC. Transition adapters shall be either PVC or ductile iron, in accordance with the following:

PVC – All PVC transition fittings shall be made from DR 18 C900 pipe stock. The C900 pipe stock shall meet the requirements of AWWA C900/C905, and have a minimum cell classification of 12454 as defined in ASTM D1784. The wall thickness shall meet or exceed DR 18. PVC transition fittings shall have SBR gaskets in accordance with ASTM F477. All six (6) inch and eight (8) inch adapters shall be molded. Molded fitting joints shall be 235 psi rated, in accordance with ASTM D3139, and shall have SBR rubber gaskets. Four (4) inch, ten (10) inch and 12 inch transition adapters shall have SBR Rieber style gaskets meeting ASTM F477. Joints shall be 235 psi rated, in accordance with ASTM D3139 for the C900 (ductile iron) bell, and in accordance with ASTM D3212 for the sewer (SRD26) bell. Molded C900 bell depths shall comply with AWWA C907. Fabricated (4-inch, 10-inch and 12-inch) bell depths and molded sewer (SDR26) bell depths shall be in accordance with ASTM F1336. PVC transition adapters shall be manufactured by the Harrington Corporation (Harco), GPK Products, or approved equal.

Ductile iron – Ductile iron transition fittings shall be deep bell, push-on joint, and air test rated. The ductile iron material shall comply with ASTM A536, Grade 65-45-12 or 80-55-06. The bell depth shall be in accordance with ASTM F1336. Gaskets shall be of SBR rubber, in accordance with ASTM F477. Transition gaskets are not allowed. All ductile iron transition fittings shall have an interior coating of Protecto401 or approved equal. Ductile iron transition fittings shall be manufactured by the Harrington Corporation (Harco) or approved equal.

Saddles:

Sewer service saddles may be utilized for sewer lateral installations. All sewer service saddles shall be ductile iron with stainless steel straps, bolts, nuts, and washers. The nuts shall be coated to prevent galling. The saddle body shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12. The gasket material shall be SBR, in accordance with ASTM D2000. Saddles for PVC or DI laterals shall have an alignment flange. Sewer service saddles shall be as manufactured by Geneco, or approved equal. All stainless steel straps shall be pre-formed at the factory, to the specified outside diameters of the pipe.

SEWER LATERALS

Ductile iron laterals – For ductile iron mains, utilize mechanical joint fittings or an approved saddle with an alignment flange (Geneco or approved equal). For PVC mains, utilize an approved saddle with an alignment flange (Geneco or approved equal) or ductile iron fittings as specified above.

PVC laterals – utilize a saddle with an alignment flange (Geneco or approved equal) on PVC or ductile iron mains; utilize a mechanical joint tee with SDR 35 transition gaskets on ductile iron mains; or utilize PVC fittings as specified above on PVC mains.

The following table summarizes the materials to be utilized for sewer main to lateral connections:

	PVC Main	DI Main
DI Lateral	DI fitting or approved saddle	MJ fitting or approved saddle
PVC Lateral	PVC fitting or approved saddle	MJ fitting with transition gasket or approved saddle

Sewer laterals shall be in accordance with these Specifications and PWC standard details S.10, S.11, and S.12.

PRECAST CONCRETE MANHOLES

Pre-cast circular reinforced concrete manhole units shall be in accordance with ASTM C-478. The tongue and groove ends of the manhole sections shall be manufactured for jointing with rubber gaskets (i.e., con-seal). An eccentric cone shall be utilized on all manholes, unless otherwise approved by the Public Works Commission.

Manhole steps shall be placed in all manholes and shall be steel reinforced (½" grade 60) copolymer polypropylene plastic steps in accordance with ASTM C-478 for material and design. The steps shall be spaced 16" on center with serrated treads and wide enough to stand on with both feet.

Manhole frames and covers shall be made of gray cast-iron, and the iron shall possess a tensile strength of not less than 18,000 psi. Cast iron shall conform to ASTM Specification A 48-83 Class 35. The frame and cover shall be manufactured by the same manufacturer. All castings shall be in accordance with Public Works Commission standard details. Any defective castings shall be removed and replaced.

Any special linings and coatings that are specified for a manhole and installed at the production facility, in the field, or during repairs, shall be applied in accordance with the applicable special coatings specification and the manufacturer's specifications for that material.

Camlock ring and covers shall be in accordance with Public Works Commission standard details. Camlock bolt head shall be compatible with PWC standard tool for turning camlock mechanism. Camlock ring and covers shall be installed as indicated on the drawings, in accordance with PWC standard details.

SELECT BEDDING MATERIAL

Select bedding material shall be crushed stone (No. 57 or No. 5), in accordance with Public Works Commission standard details. Bedding material shall be provided for all pipe materials.

INSTALLATION

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE LAYING

Pipe installation shall be in accordance with the manufacturer's instructions. Proper equipment shall be utilized to perform the work in a manner satisfactory to PWC. All pipes and fittings shall be carefully lowered into the trench in such a manner to prevent damage to the protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench. Pipe shall be carried into position and not dragged.

All dust, dirt, oil, tar (other than standard coating), or other foreign matter shall be cleaned from the jointing surfaces, and the gasket, bell, and spigot shall be lubricated with lubricant recommended by the manufacturer.

The pipe shall be laid upgrade, beginning at the lower end with the tongue or spigot ends pointing in the direction of the flow to the correct line and grade, unless otherwise approved by PWC. The pipe section to be installed shall be aligned by batter board or laser beam with the last installed pipe section. Mechanical equipment should not be used to assemble the pipe. Pipe shall be assembled in accordance

with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

At any time when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

All pipe shall be installed to the required lines and grades. Structures shall be installed at the required locations. The lines and grades of the pipe will generally be indicated by stakes parallel to the line of the pipe. The Contractor shall be responsible for installing the pipe to proper line and grade.

Pipe shall be visually inspected by shining a light between structures and /or by closed circuit television inspection. Any defects discovered, including poor alignment, shall be corrected as directed by the Public Works Commission.

The bottom of the trench shall be excavated to a minimum of four inches (4") below the outside bottom of the pipe being installed to allow adequate placement and compaction of bedding material prior to installation.

Select bedding material shall be placed a minimum of four inches (4") and a maximum of six inches (6") under the pipe for full width of the trench and halfway up the pipe on the sides. Bedding material shall be placed in layers not exceeding six inches (6") loose thickness for compacting by vibratory mechanical tamps under the haunches and concurrently on each side of the pipe for the full width of the trench. The final result shall be "Class B" bedding for rigid pipe. If the existing material under the pipe bedding material is unsuitable, the unsuitable material shall be removed and replaced with select bedding material (No. 57 or No. 5 stone), as authorized and approved by the Public Works Commission Project Coordinator.

The same material pipe shall be utilized from manhole to manhole, unless otherwise approved by PWC. If the section of pipe between manholes is 250 feet or less, no transitions will be allowed (either all PVC or all ductile iron). Should the length between manholes exceed 250 feet, only one transition will be allowed. Use of a C900 x SDR 26 adaptor shall be used to accomplish the transition. A transition is defined as the use of one C900 x SDR26 adaptor. No more than one (1) adaptor shall be utilized in any given manhole to manhole segment.

All manholes shall be constructed to Public Works Commission's standards. Installation shall be in accordance with ASTM C-891 and PWC standards.

Manholes shall be constructed of precast reinforced concrete circular sections installed on a base riser section with integral floor and shall be cored to accommodate the various pipe connections, as indicated on the drawings. Pipe connections to a manhole shall be by gasketed flexible watertight connections (boot for small diameter and A Loc for larger diameter pipe) or as approved by the Public Works Commission. The manhole size shall be in accordance with the following table, unless otherwise specified:

Pipe Size	Manhole Diameter **
24" and less	48" *
27" - 36"	60"
42"	72"

* Where interior drop structures are required, use 60" diameter as required in the Public Works Commission standard details.
** Where multiple connections or acute angles are required, larger diameter manhole may be required as indicated on the plans.

The invert channel shall be constructed of brick and mortar, in accordance with Public Works Commission standard details. **Precast inverts are not allowed**. The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel walls shall be constructed to three quarters (3/4) of the height of the crown of the outlet sewer and in such a manner not to obstruct maintenance, inspection or flow in the sewers. The inverts shall have a minimum slope of one (1) percent across the bottom of the manhole. A shelf shall be provided on each side of any manhole invert channel. Inverts in manholes with standing water will not be acceptable. The shelf shall be sloped not less than 1:12 (min) and no more than 2:12 (max). The bottom of the boot for the new sewer main or lateral shall be set one inch above existing shelf unless otherwise indicated.

When used in a paved street, the ring and cover shall be set in suitable mortar surrounded by a concrete collar in accordance with Public Works Commission standard details. When used in places other than in a paved street, the ring and cover shall be set to the grade shown on the plans or directed by the Public Works Commission. In unpaved areas cam-lock ring and cover shall be used. Camlock ring and cover shall be installed in accordance with Public Works Commission standard details.

The interior manhole riser joints, lift holes and grade adjustment rings shall be sealed with non-shrinking mortar to provide a watertight manhole. Lift holes sealed by the manufacturer with plastic caps do not require mortar seal. The hardened mortar shall be smooth to rub with no sharp edges. Use of grade rings with cam-lock ring and cover are not allowed, unless approved by the PWC Project Coordinator. **Use of grade rings is not allowed for above grade adjustments**.

All exterior manhole riser joints, including the joint at the cone, shall be sealed with an external rubber sleeve. The sleeve shall be made of stretchable, self-shrinking rubber, with a minimum thickness of 30 mils. The back side of each wrap shall be coated with a cross-linked reinforced butyl adhesive. The butyl

adhesive shall be a non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the manhole joint and then overlap to create a fused bond between the rubber and butyl adhesive. The application shall form a continuous rubber seal for the life of the application. The sealing system shall be as manufactured by Concrete Sealants, Inc. (Con-Seal), Sealing Systems, Inc., or approved equal. The wrap shall be a minimum of six (6) inches in width, and shall be centered on the joint. All manhole joints (including the cone section to the last riser) shall be wrapped and sealed. Care shall be taken to prevent damage to the wrap during backfill operations. The manhole surface shall be prepared in accordance with manufacturer's specifications, prior to installing the joint wrap.

Materials shall not enter the sewer line during construction of the manhole. The manhole shall be kept clean of any and all debris or materials. Any debris or material that entered the manhole shall be immediately removed. This condition shall be maintained until final acceptance of the work.

CONNECTION TO EXISTING MANHOLES OR LIFT STATIONS

All connections to existing manholes and/or lift stations shall be approved by the Public Works Commission. Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manhole invert as is necessary shall be removed and a new invert shall be constructed to accommodate both new and existing flows. All work shall conform to the requirements specified for new manholes. The existing structure connection shall be cored and a flexible watertight connection (i.e., boot) installed. The boot shall be installed in accordance with Public Works Commission standard details and requirements. The Contractor shall coordinate and cooperate with the Public Works Commission's Project Coordinator.

PIPE TO MANHOLE CONNECTOR (BOOT)

A watertight, flexible pipe-to-manhole connector shall be utilized on all pipe to manhole connections, for both new and existing manholes and pipes, unless otherwise specifically authorized in writing by the Public Works Commission.

The connector assembly shall be the sole element to provide a watertight seal of the pipe to the manhole or other structure. The connector shall consist of a rubber gasket, an internal compression sleeve, and one or more external take-up clamps. The connector shall consist of natural or synthetic rubber and Series 300 non-magnetic stainless steel. No plastic components shall be allowed.

The rubber gasket shall be constructed of synthetic or natural rubber, and shall meet or exceed the requirements of ASTM C-923. The connector shall have a minimum tensile strength of 1,600 psi. The minimum cross-sectional thickness shall be 0.275 inches.

The internal expansion sleeve shall be comprised of Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction.

Installation of the connector shall be performed utilizing a calibrated installation tool furnished by the connector manufacturer. Installation shall require no re-tightening after the initial installation. Installation shall be done in accordance with the manufacturer's instructions.

The external compression take-up clamps shall be Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction. The clamps shall be installed utilizing a torque-setting wrench furnished by the connector manufacturer. Installation shall be done in accordance with the manufacturer's instructions.

The Contractor shall utilize the proper size connector in accordance with the connector manufacturer's recommendations. All dead-end pipe stubs shall be restrained in accordance with ASTM C-923.

The finished connection shall provide a sealing to a minimum of 13 psi, and shall accommodate a minimum pipe deflection of seven (7) degrees without the loss of seal.

The pipe to manhole connector shall be PSX: Direct Drive as manufactured by Press-Seal, or approved equal.

INSIDE DROP MANHOLE STRUCTURE

Inside manhole drop structures shall be constructed and installed in accordance with Public Works Commission standard details.

CLEANING

Prior to final inspection, all sanitary sewer laterals, mains, and manholes newly installed on the collection system shall be flushed and cleaned. During the flushing operation, the downstream manhole shall be closed with a watertight plug to protect the existing sewer main. All water and debris shall be removed and properly disposed of by the Contractor. This condition shall be maintained until the Public Works Commission issues final acceptance for the project.

TESTING

Completed sewers shall be tested in accordance with the provisions outlined below. The Contractor shall furnish all equipment, labor, materials, and pay all costs associated with the tests performed. The Contractor shall schedule all testing with the Public Works Commission's Project Coordinator, a minimum of 48 hours in advance. The Contractor shall cooperate with the Public Works Commission's Project Coordinator and furnish any needed assistance necessary to complete the required testing.

For annexation and/or retrofit projects: No testing shall be conducted prior to successful completion of the compaction testing.

For all other projects: No testing shall be completed until all utilities are installed, prior to preparation of the road subgrade. The Contractor may elect to perform testing to satisfy them that the sewer utility is installed properly prior to commencing installation of other utilities. However, such testing shall not be construed as acceptance by PWC.

The deflection/mandrel test shall not be performed until a minimum of thirty (30) calendar days after backfill operations are completed and the area graded to final contours. In lieu of waiting thirty (30) calendar days, the Contractor has the option to have an independent testing laboratory verify that compaction has been completed to achieve the maximum density as shown in the detail. The location and elevation of the compaction testing shall be determined reviewed and approved by the Public Works Commission's Project Coordinator. The Contractor shall provide the Public Works Commission with a copy of the density testing results.

Compaction testing shall be done in accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems.

Vacuum Testing Manholes:

All precast sanitary sewer manholes installed by the Contractor shall be vacuum tested for leakage. This test shall be done in accordance with ASTM C-1244 and in the presence of a Public Works Commission Project Coordinator. The Contractor shall be responsible for providing all the necessary labor, materials, equipment, testing apparatus, and all other incidentals necessary to complete the vacuum test. All testing equipment utilized shall be approved for use in vacuum testing manholes.

Each manhole shall be tested after assembly. All lift holes shall be plugged with an approved non-shrink grout. All lines, including laterals, entering the manhole shall be temporarily plugged. The Contractor should take care to ensure that the pipes and plugs are secure in place to prevent them being drawn into the manhole. The test head shall be placed directly on top of the concrete surface of the manhole following the manufacturer's recommendations, rather than to the cast iron seating ring.

Manholes may be tested either prior to backfill or post backfill at the contractor's option. For pre-backfill testing, a vacuum of 10 inches of Mercury (inches Hg) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of Mercury (inches Hg). The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of Mercury to 9 inches of Mercury meets or exceeds the values indicated below:

	Diameter of Manhole		
Manhole Depth	**4' Diameter**	**5' Diameter**	**6' Diameter**
10' or less	**25 sec**	**33 sec**	**41 sec**
11' to 15'	**38 sec**	**49 sec**	**62 sec**
16' to 20'	**50 sec**	**65 sec**	**81 sec**
21' to 25'	**62 sec**	**82 sec**	**101 sec**
25' to 30'	**74 sec**	**98 sec**	**121 sec**

Vacuum testing backfilled manholes is not recommended in the presence of groundwater. Vacuum testing a backfilled manhole that is subjected to hydrostatic pressure may exceed the design limits of the flexible connecters and could lead to failure of the structure, joints, and/or connectors. Where groundwater is present a reduction in the vacuum pressure applied to the manhole will be required. The vacuum shall be reduced by 1 inch of Mercury for every 1 foot of hydrostatic head between 12 feet and 21 feet. A vacuum test should not be performed when the hydrostatic head exceeds 22 feet. See the chart below:

Hydrostatic Head (ft)*	12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	**

*Hydrostatic head above the critical connector (critical connector is bottom most flexible connector)
**Do not perform vacuum test

If the manhole fails the initial test, the manhole shall be repaired by an approved method until a satisfactory test is obtained. All repair methods shall be approved by the Public Works Commission prior to being utilized. Retesting shall be performed until a satisfactory test is accomplished.

Mandrel Testing:

Deflection tests shall be performed on all PVC pipe installations. PVC pipe's maximum deflection after backfilling shall not exceed five (5) percent. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on the type of pipe manufactured and the applicable ASTM Standard. The PVC pipe shall be measured in compliance with ASTM D2122 “Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings”. The Contractor shall supply all labor, equipment and materials necessary to perform the test in the presence of the Public Works Commission’s Project Coordinator. The test shall be performed without mechanical pulling devices. The mandrel shall be constructed so as to preclude any yield in diameter, and with a pull line on each end to facilitate withdrawal. If the deflection exceeds the allowable, the Contractor shall remove and replace the pipe.

Air Testing:

Air testing shall be performed on all mains and laterals to determine acceptability. The length of sewer subject to an air test shall be the distance between two adjacent manholes. The tests shall be conducted in accordance with the appropriate ASTM standard. The air test shall be coordinated with the Public Works Commission. The Contractor is required to supply all equipment, labor, materials and pay all costs associated with the test performed.

Air Test for PVC Pipe

The low pressure air test on PVC pipe shall be performed with satisfactory results in accordance with ASTM F1417 “Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air”. The pipe, including lateral assemblies, shall be plugged and air added slowly until the internal pressure of the line is raised to 4.0 psi. After the pressure of 4.0 psi is obtained, regulate the air-supply so that the pressure is maintained between 3.5 and 4.0 psi for at least two (2) minutes,

depending on air/ground temperature conditions. The pressure will drop slightly until equilibrium is obtained; however, a minimum of 3.5 psi is required. Once the 3.5 psi is maintained, the test will begin. If the pressure drops 1.0 psi within the time indicated below, the test fails.

Pipe Dia (in)	Minimum time (minutes)	Length for Min Time (ft)	Time for Longer Length (sec)
4	3:46	597	0.380L
6	5:40	398	0.854L
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	199	3.418L
15	14:10	159	5.342L
18	17:00	133	7.692L
21	19:50	114	10.470L
24	22:40	99	13.674L
27	25:30	88	17.306L
30	28:20	80	21.366L
33	31:10	72	25.852L
36	34:00	66	30.768L

The Contractor shall observe all safety precautions to include allowing no one in the manholes during testing, securing all plugs and providing additional plug bracing. The Contractor shall be required to furnish, install and remove after testing at no additional cost, a temporary glue cap/plug to be airtight for all cleanout stacks to accomplish air testing. The air pressure shall never exceed 8 psi. All gauges shall be accessible outside of the manholes.

HYDROSTATIC TESTS

After the ductile iron sewer pipe has been laid within the "protected" area and backfilled to finished grade, the pipe shall be subjected to a hydrostatic pressure test. All laterals within the “protected” area shall be ductile iron. All sewers subject to hydrostatic testing shall include (1) sewers entering or crossing streams, (2) sewers located less than 100 feet from any public or private water supply source including any WS-I waters or Class I or Class II impounded reservoirs, (3) where the minimum 18 inch vertical and 10 feet horizontal separation cannot be maintained between sewers and water mains (see NC DENR Regulations), or (4) as specified and/or indicated on the drawings. The Contractor will furnish all labor and material, including test pumps, plugs, and all other incidentals for making hydrostatic tests. Hydrostatic pressure testing shall be conducted on the completed main, including the laterals.

The duration of the pressure test shall be at least one hour or longer, as directed by the Public Works Commission. The hydrostatic pressure shall be 150 psi. Each section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Public Works Commission. Before applying the specified test pressure, all air shall be expelled from the pipe.

All joints showing visible leaks shall be made tight. Cracked or defective pipe, joints, laterals, and fittings discovered in consequence of the pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic test may be waived by the Public Works Commission in certain situations. The test shall be repeated until satisfactory to the Public Works Commission.

The results of the pressure tests shall be satisfactory as specified. All replacement, repair, or retesting shall be accomplished by the Contractor. All repairs shall be reviewed and approved by the Public Works Commission prior to backfill. The use of couplings, sleeves, etc. shall be reviewed and approved by the Public Works Commission prior to use.

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