SECTION 31.10.00
SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. This work consists of clearing, grubbing, removing, and disposing of all debris and of all vegetation.
2. Removal of buildings and foundations not removed by others that are within designated construction areas, except for such objects that the Owner or Owner’s Representative designates to remain.
3. The work shall also include preserving and protecting from injury or defacement all vegetation and objects designated to remain.
4. Topsoil excavation is not included.

B. Related Sections:

1. Section 310000 – Earthwork
2. Section 312500 – Erosion and Sedimentation Controls
3. Section 329219 – Seeding

1.3 DEFINITIONS: NOT USED

1.4 SUBMITTALS

A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

1.5 QUALITY ASSURANCE

A. Perform work in compliance with applicable requirements of authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. Contractor shall obtain all necessary permits from regulatory agencies including signing and resubmitting Notices of Intent (NOI) and Stormwater Pollution Prevention Plans (SWPPP).

B. Obtain any other necessary permits required to perform this work.
PART 2 - PRODUCTS

A. Not Used.

PART 3 - EXECUTION

3.1 PROTECTION

A. The Owner or Owner’s Representative will designate all trees, shrubs, plants, and other items within the project area that are to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be an asphaltum base paint prepared especially for tree surgery and approved by the Engineer.

B. Preserve from injury all trees and other vegetation that are not within designated areas of clearing and grubbing, unless marked for removal by the Owner or Owner’s Representative.

3.2 CLEARING

A. The project area shall be cleared of all dead trees, stumps, brush, hedges, weeds, logs and other objectionable material and vegetation. Remove tree stumps, boulders, and obstructions to a depth of 2 feet below subgrade. Scarify rock to a depth of 1 foot below subgrade.

B. In areas where excavation is to be made and 5 feet beyond the excavation limits, all trees, stumps, roots, brush, hedge, heavy growth of vegetation, etc., shall be cleared and grubbed.

C. In areas where embankments are to be constructed, all trees, stumps, roots, brush, hedge, heavy growth of vegetation, etc., shall be cleared and grubbed to a point 5 feet beyond slope intercepts. All depressions made below the ground surface shall be refilled with suitable material and compacted before the embankment is started. Unsatisfactory material such as brush, hedge, roots, stump, branches and logs of trees, heavy vegetation, etc. shall not be embedded or buried within the embankment.

D. All slopes of cuts, embankments, ditches, channels, waterways and all structures, both old and new, shall be cleared and cleaned of all brush, hedges, weeds, heavy vegetation, obstruction, rubbish and other objectionable material or growth; and shall be maintained in a neat, serviceable and satisfactory condition until the project is accepted.

E. Borrow pits and other material pits shall be cleared and grubbed of all trees, stumps, roots, brush, hedge, and other heavy growths of vegetation, and in addition shall be stripped of overburden laying above the material to be obtained. This work is to be completed before any excavation is made in the pit area.

F. All clearing and grubbing shall be completed a satisfactory distance ahead of the construction operations before construction stakes are set.
3.3 CLEANUP AND PROTECTION

A. Unless otherwise approved by the Owner or Owner’s Representative, all materials and debris from the clearing and grubbing operation shall be burned, completely destroyed, or otherwise disposed of from the project limits by the Contractor in a satisfactory manner.

B. The Contractor must obtain written permission from any property owner if private property is used for disposal, and furnish a copy to the Engineer. All Federal, State, local laws, regulations and ordinances related to burning or disposal shall be observed. If on-site disposal is approved by the Owner, coordinate the exact location of disposal with the Owner.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
   3. Excavating and backfilling for buildings and structures.
   4. Excavation, placing, and spreading of topsoil.
   5. Excavation and grading of roadways, borrow pits, waterways, ditches, and other specified items, within the project limits.
   6. Excavation of unsuitable material beneath embankment areas.
   7. Excavating select material for specific use in the construction; trimming, shaping and dressing of all slopes; preparation of the subgrade for building slabs, walks, and pavements.
   8. Disposing of all excavated materials. Constructing of embankments and the placing and compacting of approved material in the project area, finish grading.

B. Related Sections:
   1. Section 311000 – Site Clearing
   2. Section 312333 – Trenching and Backfilling
   3. Section 312500 – Erosion and Sedimentation Control
   4. Section 329219 - Seeding

1.3 DEFINITIONS

A. Backfill: Soil, aggregate, or controlled low-strength material used to fill an excavation.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Excavation: Removal of material encountered above subgrade elevations and to the lines, grades, elevations, and dimensions indicated on the Plans. Excavation shall also consist of the legal and appropriate disposal of unsatisfactory materials. THE CLASSIFICATION OF EXCAVATION WORK MUST BE DEFINED AND APPROVED BY THE OWNER OR OWNER’S REPRESENTATIVE PRIOR TO BIDDING, PRICING, AND BEGINNING WORK.

D. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions.
1. Borrow Excavation: Consists of material required for the construction of embankments or other portions of the work, and shall be obtained from the approved sources outside project limits, unless otherwise designated in the Plans. This item shall consist of the satisfactory removal and placement of the approved material, outside that required to complete the work contained in the Contract Documents.

2. Common Excavation: Excavation as described above including slabs or fragments of rock of less than 1/2 cubic yard in volume and all other material not otherwise classified in these specifications. Common Excavation does not include the stripping, stockpiling and placing of topsoil.

3. Mass Rock Excavation: Consists of the removal and satisfactory disposal of non-degradable rock which, in place, rings under the hammer or which cannot be economically excavated by the proper use of a power shovel or without the use of explosives; and any boulder, slab or fragment of rock having a volume of 1/2 cubic yard or more.

4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at no additional cost to the Owner.

5. Unclassified Excavation: Without regard to the materials encountered, all general excavation shall be unclassified. It shall be distinctly understood that any reference to rock, earth, or any other material on the Plans is not to be taken as an indication of classified excavation or the quantity of rock, earth, or any other material involved. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling and/or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements and/or similar materials, shall be considered as unclassified excavation, and no separate payment will be made. No allowance or extra payments will be made by reason of variation in types of soil encountered or variations in moisture contents. Additional fill material required shall be furnished and included as a part of the work. The bidders must draw their own conclusions as to the conditions to be encountered.

E. Fill: Satisfactory materials used to raise existing grades.

F. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1/2 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

G. Satisfactory Materials or Structural Soil Fill: ASTM D 2487 soil classification groups GW, GP, SW, SP, SM, ML, CL, CH, and SC or a combination of these group symbols and also include:

1. Soil materials that are clean, free or organics, debris, waste, frozen materials, vegetation and other deleterious material, containing no rock fragments or gravel larger than 4 inches in any dimension.

2. Soil material with a standard Proctor maximum dry density of 90 pounds per cubic foot (pcf) or greater, a plasticity index (PI) of 35 percent or less, and a liquid limit (LL) of 55 percent or less.

3. All material to be used as structural fill should be tested by the geotechnical engineer to confirm that it meets the project requirements before being placed.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
J. Undercutting: Removal and disposal of unsatisfactory material excavated below the subgrade in cut sections from areas which embankments are to be placed. The quantity of undercut material shall be quantified by the Geotechnical Engineer. Undercut areas shall be backfilled with satisfactory material.

K. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory and include:

1. Man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory materials which contains root and other organic matter or frozen material. The ITL shall be notified of any contaminated materials.

2. Soils that are too soft, expansive soils having a plasticity index and a liquid limit not consistent with the requirements of satisfactory soils as defined herein.

3. Soils classified as PT, OH, and OL.

L. Topsoil: Natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity; obtained from naturally well-drained areas; shall not be excessively acid or alkaline nor contain toxic substances that may be harmful to plant growth. Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, or similar substances 2 inches or more in diameter, debris, or other objects that are a hindrance to planting operations. Topsoil may include soils that have been stripped from the site and that have been stockpiled as specified elsewhere. If the quantity of topsoil on the job is inadequate, furnish enough additional topsoil to meet the requirements of the project specifications.

M. Wet Soils: Soils that are too wet to use as backfill in their current state, but that meet the requirements of satisfactory soils. These soils are considered to be satisfactory soils. The Contractor shall be responsible to employ either mechanical or chemical methods to dry on-site soils so that the specified compaction can be achieved.

1.4 SUBMITTALS

A. Submittals shall be in pdf format electronic form (e.g., via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

B. Report the results of all density tests to the Owner or Owner’s Representative. Include location of test, date of test, note of re-test, test location, depth below finished grade, wet density, moisture content, dry density, percent compaction of test sample, maximum dry density used for comparison, and any other information specified.

C. Provide as-built elevations of building subgrades and top of stone prior to pouring foundations or pads.

1.5 QUALITY ASSURANCE

A. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Testing shall be the responsibility of either the Contractor or the Owner. DO NOT BID, PRICE, OR BEGIN WORK on this project until the ownership of this responsibility has been adequately identified and agreed upon by both parties. Do not assume that the Contractor will provide these services. Notify the Engineer once an arrangement has been made.
C. Testing shall be performed by a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection services for quality control testing during earthwork operations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling of materials shall be in accordance with the Contract Documents and the local, State, and Federal requirements.

B. Transport off site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

1.7 FIELD CONDITIONS

A. If available, data in subsurface investigation reports used for the basis of the design and are available to Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Additional test borings and other exploratory operations may be performed by Contractor, at Contractor's option. However, no change in the contract price will be authorized for such additional exploration.

C. Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active. Repair damaged utilities to satisfaction of utility owner.

D. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

E. Contractor shall obtain all necessary permits from regulatory agencies including signing and resubmitting Notices of Intent (NOI) and Stormwater Pollution Prevention Plans (SWPPP).

F. Do not bring explosives onto site or use in work without prior written permission from the Owner, Engineer, and authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted. Provide a pre-blast survey before beginning work.

G. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by authorities having jurisdiction.

H. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

I. Perform excavation by hand within drip-line of large trees to remain. Protect root systems from damage or dry-out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.
J. Protect improvements on adjoining properties and on the Owner's property. Do not disturb any improvements outside the work area defined on the Plans. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL AND ROCK MATERIALS

A. Fill and Backfill: Excavated and re-used material for subsoil fill as defined herein and as considered satisfactory soils.

B. Imported or Borrow Fill Material: Satisfactory material that is provided from off-site borrow areas when sufficient satisfactory materials are not available from required excavations. Locations for imported or borrow material shall be approved by Owner.

C. Dense Graded Aggregate Fill and Backfill: Dense graded aggregate used as fill below the building or pavement subgrade areas, particularly in areas where soft soil conditions are encountered and undercut near subgrade level. Crushed stone fill should be Type A, Class A, and Grading E in accordance with Section 903.05 of the Tennessee Department of Transportation specifications.

D. Topsoil as specified herein.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, datum, elevations, and grades necessary for construction as shown on the Plans.

B. Complete all necessary clearing and grubbing, removal of structures and obstructions, and installation of erosion and sediment controls prior to beginning excavations.

C. Notify utility companies to remove or relocate public utilities that are in conflict with proposed improvements. Pothole utilities to confirm that there will be no interferences or reduction in cover beyond the required minimum.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs, unless otherwise noted on the drawings from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

F. Excavation within the limits of the project shall be performed to the lines and grades as indicated on the Plans. Excavations carried below the depths indicated, without specific directions, shall, except as otherwise specified, be refilled to the proper grade with satisfactory material as directed by the Engineer.
3.2 DEWATERING

A. Provide dewatering systems as required for excavations, in general this includes:

1. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a “quick” or “boiling” condition. System shall not be dependent solely upon sumps or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation’s stability.

2. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow Work to be installed in a dry condition.

3. Control, by acceptable means, all water regardless of source. Contractor shall be responsible for disposal of the water.

4. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary, lower water level in advance of excavation utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.

5. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.

6. Open pumping with sumps and ditches will be allowed provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.

7. Install wells or wellpoints, if required, with suitable screens and filters so that continuous pumping of fines does not occur. Arrange discharge to facilitate collection of samples by the Owner. During normal pumping and upon development of wells, levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.

8. Control grading around excavations to prevent surface water from flowing into excavation areas.

9. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.

B. Designate and obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work. Contractor shall be responsible for the accuracy of the Plans, design data, and operational records required. Contractor shall be responsible for the design, installation, operation, maintenance, and failure of any component of the system.

C. Contractor shall be responsible for and shall repair any damage to work in place, other contractor’s equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation. Contractor responsibility shall also include, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor’s negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

D. Remove subgrade materials rendered unsatisfactory by excessive wetting and replace with approved backfill material at no additional cost to the Owner.

E. Maintaining Excavation in Dewatering Condition:

1. Dewatering shall be a continuous operation. Interruptions due to power outages or any other reason will not be permitted.
2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.

3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.

4. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components and any other work required to maintain excavation in dewatered condition.

F. Upon completion of the work, remove dewatering equipment from the site, including related temporary electrical service.

G. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

3.3 TOPSOIL EXCAVATION

A. Strip topsoil within the limits of excavation to full depth or to a minimum depth of 6-inches. Stripping operations should extend a minimum of 5 feet beyond the limits of proposed pavement areas and 10 feet beyond building limits.

B. Temporarily stockpile topsoil in storage piles. Confirm the location of the storage areas with the Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Remove excess topsoil from site unless specifically noted otherwise on the Plans.

3.4 GENERAL EXCAVATION

A. When performing grading operations during periods of wet weather, provide adequate dewatering, drainage and ground water management to control moisture of soils.

B. Excavate to the line and grade as shown on the Plans being careful not to over excavate beyond elevations needed for building subgrades.

C. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

D. Remove from site, material encountered in grading operations that, in opinion of the Engineer is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to the Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.

E. Unsatisfactory excavated material shall be disposed of in manner and location that is acceptable to Owner and local governing agencies.
F. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction including OSHA (29 CFR Part 1926) excavation trench safety standards. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

G. Shore and brace excavations where sloping is not possible either because of space restrictions or stability of material excavated. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Shoring and bracing design, installation, maintenance, and removal are the sole responsibility of the Contractor. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

H. A professional engineer that is licensed in the area where the work is being performed shall design the sheeting, shoring, and bracing system. However, the contractor is solely responsible for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of the system.

I. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

3.5 SUBGRADE PREPARATION

A. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8 inches and compacted as specified hereinafter. Extend proofrolling operations a minimum of 10 feet beyond proposed building lines.

B. Subgrades shall be proofrolled to detect areas of insufficient compaction and soft pocket, or areas of excess yielding. Proof-rolling shall be accomplished by making minimum of 2 complete passes with fully loaded tandem axle dump truck with a minimum weight of 20 tons, or approved equal, in each of 2 perpendicular directions while under the supervision and direction of the Geotechnical Engineer. Limit vehicle speed to 3 mph. Areas of failure such as soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Engineer, shall be excavated and re-compacted as specified herein. Continual failure areas shall be stabilized in accordance with the requirements of the Geotechnical Engineer and at no additional cost to Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions.

C. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities at no additional cost to the owner.

3.6 BACKFILLING

A. Fill areas to contours and elevations shown on the Plans with satisfactory materials.

B. Unless otherwise specified for rock fill, rock or stone less than 6-inches in largest dimension may be used in fill below structures, paving, and graded areas, up to 24 inches below surface of proposed subgrade or finish grade of graded areas when mixed with satisfactory material. Rock or stone less than 2 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with satisfactory material.
C. Place backfill in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Do not place backfill on surfaces that are muddy, frozen, or contain frost or ice.

E. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift.

3.7 COMPACTION

A. In excavated areas, scarify the upper 6 to 10 inches of the subgrade and compact.

B. Compact each lift of structural soil fill or dense graded aggregate to at least 98 percent of the soil’s maximum dry density per the standard Proctor method (ASTM D 698) and within the range of minus (-) 2 percent to plus (+) 2 percent of the optimum moisture content.

C. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

E. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

F. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by diskig, harrowing, or pulverizing, until moisture content is maintained to within the specified range of optimum.

3.8 MAINTENANCE OF SUBGRADE

A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than that specified on the Plans. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross section.

D. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from subgrade at all times.

E. Construction traffic patterns should be varied to prevent the degradation of previously stable subgrade.
3.9 FINISH GRADING

A. Do not begin work until the earth is dry enough to be tillable. Inspect subgrades to see that they generally conform to the elevations, slopes, and standards as specified on the Plans and within these specifications, particularly with regard to the approximate depths required for the work. After work is completed, inspect it to ensure that the finish grading complies with the design requirements and Plans.

B. Subgrades shall be graded to within not more than 0.10’ above or below the required elevations.

C. Grassed or finish areas to receive topsoil shall be graded to within not more than 0.10’ above or below the required elevations.

D. Shape surface of areas under pavement and sidewalks to line, grade, and cross-section, with finish surface not more than 0.04’ above or below the required subgrade elevation.

E. Grade surface of fill under building slab smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.04’ above or below the required final elevation.

3.10 PLACING AND SPREADING TOPSOIL

A. Place topsoil uniformly over disturbed areas that do not receive other work. Obtain approval of the finish grading from the Engineer before starting to place topsoil.

B. Scarify subgrade to a depth of 3 inches and place the topsoil to a depth of 6 inches when lightly rolled or, on rock, to a depth of 12 inches.

C. Level the topsoil so that it slopes uniformly and has no water pockets. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over 1 inch in diameter, and other foreign materials from the surface. Dispose of excess excavated materials and debris away from the site.

3.11 FIELD QUALITY CONTROL

A. The Geotechnical Engineer shall test each lift of backfill to confirm that the contractors’ compaction method is capable of achieving the project requirements before placing any subsequent lifts. Field density tests will be made with a minimum of one test for every 10,000 sq. ft. per lift and for every 5,000 sq. ft. per lift in building areas.

B. The Contractor shall furnish a portion of the job office building at the site for the field technician in charge of making field density determinations. Both electrical current and water shall be provided by the Contractor at or near this designated area for the technician’s use.

C. Insufficiently compacted areas shall be scarified and loosened to the full depth of fill or otherwise reworked as necessary to re-compact to the specified density.

3.12 DISPOSAL, PROTECTION, AND CLEANUP

A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
B. The Contractor is responsible for the stability of all embankments and cut slopes until final acceptance.

C. Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

D. Remove waste materials, including unacceptable excavated material, trash and debris, from the Owner's property and legally dispose of it.

END OF SECTION
SECTION 31.23.33
TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Excavation of trenches for installation of utilities.
   2. Backfilling trenches with bedding material as specified and filling trenches with suitable material to proposed subgrade.
   3. Compacting backfill materials in acceptable manner.
   4. Borings and casings under roads.

B. Related Sections:
   1. Section 311000 – Site Clearing
   2. Section 312000 – Earthwork
   3. Section 312500 – Erosion and Sedimentation Control
   4. Section 329219 – Seeding
   5. Section 331100 – Water Lines
   6. Section 333100 – Sanitary Sewer (Gravity)
   7. Section 334000 – Storm Sewer

1.3 DEFINITIONS

A. Backfill or Fill: Refer to Section 312000 – Earthwork for definitions of satisfactory soils, structural soil fill, and unsatisfactory soils.

B. Base Rock: Granular material upon which manhole bases and other structures are placed.

C. Bedding Material: Class B granular material upon which pipes, conduits, cables, or duct banks are placed.

D. Borrow or Imported Material: Suitable structural backfill material obtained by Contractor from source(s) offsite. Refer to Section 312000 – Earthwork.

E. Excavation Classifications: The classification of TRENCH excavation work IS CONSIDERED UNCLASSIFIED unless defined otherwise by the Owner prior to bidding, pricing, and beginning work. Refer to Section 312000 – Earthwork for excavation classifications.

F. Lift: Loose (uncompacted) layer of material.
G. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

H. Trench: The word “trench” shall mean excavations having vertical sides whose depths exceed its width, made for storm water drainage, sanitary sewer, water, gas pipes, electric power or lighting, communications, steam conduits, and related uses.

I. Trench Excavation (unclassified) shall consist of the removal of all materials necessary for the construction of storm sewers, culvert pipes, other pipe lines and all drainage structures such as manholes, catch basins, junction boxes, head walls, wing walls and concrete collars.

1.4 SUBMITTALS

A. Submittals shall be in pdf format electronic form (e.g., via email) and shall be stamped by the Contractor. Do not submit un-stamped shop drawings. Submit to the Owner or Owner’s representative.

B. Report the results of all density tests to the Owner or Owner’s Representative. Include location of test, date of test, note of re-test, test location, depth below finished grade, wet density, moisture content, dry density, percent compaction of test sample, maximum dry density used for comparison, and any other information specified.

1.5 QUALITY ASSURANCE

A. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by a Registered Land Surveyor and replaced, as necessary, by same.

B. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

C. Trench design and safety for pipe and conduit construction is solely the responsibility of the contractor and shall conform to all applicable local, state, and OSHA regulations.

D. Accurately record actual locations of subsurface utilities, structures, and obstructions installed or encountered.

E. Testing shall be the responsibility of either the Contractor or the Owner. Do not bid, price, or begin work on this project until the ownership of this responsibility has been adequately identified and agreed upon by both parties.

F. Testing shall be performed by a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection services for quality control testing during earthwork operations.

G. Do not bring explosives onto site or use in work without prior written permission from the Owner, Engineer, and authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted. Provide a pre-blast survey before beginning work.
H. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required by authorities having jurisdiction.

I. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

J. Perform excavation by hand within drip-line of large trees to remain. Protect root systems from damage or dry-out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

K. Protect improvements on adjoining properties and on the Owner's property. Do not disturb any improvements outside the work area defined on the Plans. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling of materials shall be in accordance with the Contract Documents and the local, State, and Federal requirements.

1.7 PROJECT CONDITIONS

A. If available, data in subsurface investigation reports used for the basis of the design are available to Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Additional test borings and other exploratory operations may be performed by Contractor, at Contractor's option. However, no change in the contract price will be authorized for such additional exploration.

C. Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active. Repair damaged utilities to satisfaction of utility owner.

D. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

E. Contractor shall obtain all necessary permits from regulatory agencies including signing and resubmitting Notices of Intent (NOI) and Stormwater Pollution Prevention Plans (SWPPP).

PART 2 - PRODUCTS

2.1 MATERIALS

A. Bedding Material (Class B): Bedding material shall be compacted granular material consisting of well-graded crushed stone or crushed gravel meeting the requirements of TDOT (latest edition), Section 903, Grading Size No. 57 or No. 67.
B. Backfill Material (Open Areas): Material excavated from trenches or from other on-site sources or borrow (i.e., imported) material from off-site and as defined in Section 312000 – Earthwork as satisfactory soils. Backfill material shall not contain rock or stone with a maximum size greater than 2 inches.

C. Backfill Material (Paved Areas): Backfill material for pipe under pavement or less than 5 feet from the outside edge of the pavement shall be as specified on the Plans. Based on the reviewing jurisdiction, backfill material shall be either:

1. Mineral aggregate base crushed stone meeting the requirements of TDOT (latest edition), Subsection 903.05, Class A aggregate Grading D.
2. Well-graded crushed stone or crushed gravel meeting the requirements of TDOT (latest edition), Section 903, Grading Size No. 57 or No. 67.

D. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on Construction Plans.

E. Topsoil: Topsoil as defined in Section 312000 – Earthwork.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to the beginning of grading, all necessary clearing and grubbing, removal of structures and obstructions, and placement of erosion and sediment controls in that area shall have been completed.
B. Contact local utility companies before excavation begins.

C. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in trenching excavation.

D. Verify location, size, elevation, depth (by potholing or other approved methods), and other pertinent data required to make connections or to avoid interfering with existing utilities and drainage systems.

E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

F. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

G. Perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the Engineer deems necessary to maintain vehicular or pedestrian traffic.

H. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

I. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 EXCAVATION FOR TRENCHES

A. Excavation within the limits of the project shall be performed to the lines and grades as indicated on the Plans. Excavations carried below the depths indicated, without specific directions, shall, except as otherwise specified, be refilled to the proper grade with satisfactory material as directed by the Engineer.

B. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel type trenching machines are used, do not use clods for backfill.

C. Trench design and safety is solely the responsibility of the contractor. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Unless regulated otherwise, lateral travel distance to exit ladder or steps shall not be greater than 25-feet in trenches 4-feet or deeper. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

D. Unless the construction of lines by tunneling, jacking, or boring is called for by the Plans or specifically authorized by the Engineer, make excavation for pipelines in open cut and true to the lines and grades shown on the Plans or established by the Engineer on the ground. Any cut made in excess of the minimum trench width, formula outside diameter 4/3 O.D. + 15” or the typical trench dimensions as shown on the Plans shall be at the expense of the Contractor and may be cause for the Engineer to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.
E. Locate and retain soil materials away from edge of excavations. In all cases where materials are deposited along open trenches, place them so that in the event of rain or surcharge loading from such deposits, no damage will result to the work and/or to adjacent property. Do not store within drip line of trees indicated to remain.

F. Pipe trenches shall not be excavated more than 400 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.

G. For work within public right-of-ways and during working hours, the maximum amount of exposed pipe trench shall be 50 feet of pipe or two pipe joints, whichever is shorter. During nonworking hours, use one of the following methods of trench protection:
   1. Steel plate, minimum 5/8 inch thick, over entire trench or excavation overlapping each pavement edge by 1 foot minimum.
   2. Concrete barriers placed around entire trench or excavation.
   3. Backfill and compact entire trench or excavation.

H. Trench Bottoms: Accurately excavate and shape trench bottoms to designated elevations, to provide uniform bearing and support for each section of pipe once bedding material is installed at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections.
   1. For pipes 15 inches and smaller, excavate the bottom of the trench 4 inches below the bottom of pipe that is to be installed;
   2. For pipes 18 inches to 36 inches, excavate the bottom of the trench 6 inches below the bottom of pipe that is to be installed;
   3. For pipes 42 inches and larger, excavate the bottom of the trench 8 inches below the bottom of pipe that is to be installed;
   4. Where rock or other unyielding bearing material is encountered, excavate trenches 6 inches below required elevation and backfill with a 6-in. layer of TDOT no. 57 or No. 67 crushed stone prior to installation of pipe bedding;
   5. For bell and spigot pipe, excavate bell holes at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper jointing of the pipe. Do not excavate bell holes more than 2 joints ahead of pipe laying;
   6. If wet or unstable soil is encountered, over excavate from trench bottom as necessary to provide suitable base for continuous and uniform bedding;
   7. Remove projecting stones and sharp objects along trench subgrade.

I. Excavation for manholes, inlets, and other incidental structures may be performed with non-vertical banks except beneath pavements or adjoining existing improvements and shall not be greater in horizontal area than that required to allow a 2 foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the Plans. No earth backfilling will be permitted under manholes, inlets, headwalls, or similar structures. Should the Contractor excavate below the elevations shown or specified, he shall, at his own expense, fill the void with either concrete or granular material approved by the Engineer.

J. Remove excavated materials not required or not suitable for backfill or embankments and legally waste off-site or on-site at Owner approved locations. Provide other suitable material at no additional cost to Owner.
3.3 SHEETING, SHORING, AND BRACING

A. Where sloping is not possible either because of space restrictions or stability of material excavated, sufficiently sheet, shore, and brace the sides of excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage.

B. A Professional Engineer shall design the sheeting, shoring, and bracing system. However, the contractor is solely responsible for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of the system. Sheetin, shoring, and bracing shall conform to all applicable local, state, and OSHA regulations. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

C. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. Underpin adjacent structures in substantial compliance with Plans sealed by a Professional Engineer wherever necessary. Notify adjacent property owner of the excavation.

D. Sheetin, shoring, or bracing materials shall not be left in place unless this is called for by the Plans, ordered by the Engineer, or deemed necessary or advisable for the safety or protection of the new or existing work or features. Remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.

E. All holes and voids that remain due to the removal of sheeting, shoring, or bracing shall be filled and compacted as specified herein.

F. A trench box may be used, which is a prefabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system.

3.4 DEWATERING OF EXCAVATION

A. Prevent surface water and subsurface or groundwater from flowing into excavations and re-route surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

B. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other de-watering system components necessary to convey water away from excavations.

C. Provide and keep in operation enough suitable pumping equipment whenever necessary. Give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift. Dewatering shall occur only in accordance with applicable Laws and Regulations, approved permits, and industry best management practices.
3.5 PIPE BEDDING

A. Bedding shall be installed by placing bedding material from the trench bottom, for the entire trench width, up to the bottom of the pipe. The middle of the bedding, under the pipe invert, equal to 1/3 of the pipe O.D. should be loosely placed and accurately shaped to conform to the lower portion of the pipe barrel, with the remainder compacted to minimum standard proctor density. Backfill the haunches of the pipe in loose lifts not exceeding 6-inches and compact. Continue backfilling and compacting each lift vertically up to the spring line of the pipe.

B. Do not place bedding material over porous, wet, frozen, or spongy subgrade surfaces.

3.6 BACKFILL AND FILL

A. Do not backfill trenches until the pipe has been laid to line and grade and properly bedded, tests and inspections have been made, utility systems comply with and are accepted by applicable governing authorities, and backfilling is authorized by the Owner. Use care in backfilling to avoid damage or displacement of pipe or conduit systems.

B. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces. Backfill evenly and simultaneously on both sides of the pipe up to the subgrade elevation.

C. Under unpaved areas (i.e., open areas), backfill the trench as follows:
   1. For flexible pipe in unpaved areas, the initial backfill above the spring line shall be granular material as specified in Section 2.1 Materials. Place in loose lifts not exceeding 6-inches, compact, and extend to 12-inches above the top of the pipe. The final backfill shall be suitable excavated or borrow (i.e., imported) material as specified in Section 2.1 Materials. Place material in loose lifts not exceeding 6-inches, compact, and extend to the required subgrade elevation.
   2. For rigid (i.e., concrete) pipe in unpaved areas, backfill above the spring line with suitable excavated or borrow (i.e., imported) material as specified in Section 2.1 Materials. Place material in loose lifts not exceeding 6-inches, compact, and extend to the required subgrade elevation.
   3. Under paved areas, within 5 feet of pavement edge, and within 10 feet of a building pad backfill above the spring line with granular material as specified in Section 2.1 Materials. Place material in loose lifts not exceeding 6-inches, compact, and extend to the required subgrade elevation.

D. Flowable Fill or Controlled Low Strength Material (CLSM): Where indicated on the Plans or as required to expedite trench backfill or to protect pipe, backfill with CLSM or flowable fill above pipe bedding. Do not allow dirt or foreign material to become mixed with concrete during placement. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in the trench. Place in lifts as necessary to prevent uplift (flotation) of new and existing pipes.

E. Concrete: Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footing.

F. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
G. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Adjust moisture content as necessary to obtain specified compaction.

H. Backfill to the subgrade elevations as determined from the Plans.

3.7 COMPACTION

A. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

B. Mechanically compact each lift (e.g., vibratory sleds, jumping jacks) prior to placing succeeding lifts. Compaction of the haunch layer may require a small tamping mechanism to obtain the specified compaction in a confined area.

C. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.

D. Maintain moisture content within the specified range of optimum of fill materials as specified in Section 312000 – Earthwork to attain required compaction density.

E. Compact each lift of aggregate backfill to at least 98% of the standard Proctor maximum density (ASTM D 698). In open areas, compact each lift of soil backfill to at least 95% of the standard Proctor maximum density (ASTM D 698).

F. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by diskling, harrowing, or pulverizing, until moisture content is maintained within the specified range of optimum.

3.8 PLACING AND SPREADING TOPSOIL

A. Place topsoil uniformly over disturbed areas that do not receive other work. Obtain approval of the finish grading from the Owner before starting to place topsoil.

B. Level the topsoil so that it slopes uniformly and has no water pockets. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over 1 inch in diameter, and other foreign materials from the surface. Dispose of excess excavated materials and debris away from the site.

3.9 FIELD QUALITY CONTROL

A. Beginning at a depth of 2 feet above the top of the pipe, provide a density test for each lift of compacted fill, at a maximum horizontal spacing of 200 feet, and at all proposed or existing street or pavement crossings. If necessary, excavate to the depth and size as required by the Engineer to allow compaction tests.

B. The Contractor shall furnish a portion of the job office building at the site for the field technician in charge of making field density determinations. Both electricity and water shall be provided by the Contractor at or near this designated area for the technician's use.
C. Insufficiently backfilled or compacted areas shall be scarified and loosened to the full depth of fill or otherwise re-worked as necessary to re-compact to the specified density.

3.10 PROTECTION AND CLEANUP

A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, re-shape, and compact to required density prior to further construction.

C. Remove waste materials, including unacceptable excavated material, trash and debris, from the Owner's property and legally dispose of it.

END OF SECTION
SECTION 31.25.00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Tennessee Erosion and Sediment Control Handbook (Tennessee Department of Environment and Conservation, latest edition) and the regulations, policies, etc. of the local jurisdiction regarding materials, installation, and maintenance of best management practices for erosion and sedimentation controls.

C. The project Stormwater Pollution Prevention Plan (SWPPP).

1.2 SUMMARY
A. Section includes:
   1. Erosion and sediment control for excavation, backfill, and/or other construction activities within the limits of the construction site, within any temporary or permanent easements, and within any borrow site.
   2. Work necessary to ensure that construction activities do not temporarily or permanently harm the waters of the State of Tennessee, nor properties of the Owner, nor adjoining owners.

B. Related Sections:
   1. Section 311000 – Site Clearing
   2. Section 310000 – Earthwork
   3. Section 329219 – Seeding

1.3 DEFINITIONS
A. Fines from Regulators: Any fines levied by the Federal, State, and/or local governments for non-conformance with their respective regulations related to erosion and pollution control shall be paid for by the Contractor.

B. Duration of Maintenance: Protect the site throughout the construction period regardless of weather conditions until the time that permanent vegetation is established.

C. Responsibility: These activities are related to the means and methods the Contractor uses to pursue the work and as such cannot be predicted in advance. For this reason, the Contractor is solely responsible for conforming to related local, State, and Federal requirements.

1.4 SUBMITTALS
A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.
B. Submit shop drawings for material substitutions. Do not submit shop drawings for materials that are consistent with the plans. These submittals will be marked “Not Requested for Review” and returned.

1.5 QUALITY ASSURANCE

A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.

1.6 DELIVERY, STORAGE, & HANDLING

A. Delivery, storage, and handling of materials shall be in accordance with these specifications and the manufacturer’s requirements.

1.7 PROJECT CONDITIONS

A. Verify the locations of the existing underground utilities by contacting the utility owners and by potholing in the field.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials for erosion and pollution control shall be in accordance with the Plans and the “Tennessee Erosion and Sediment Control Handbook” (Tennessee Department of Environment and Conservation, latest edition) and the requirements. These include, but are not limited to:
   1. Silt Fencing
   2. Erosion Control Matting
   3. Storm Drain Inlet Protection
   4. Rip Rap
   5. Straw
   6. Temporary and Permanent Seeding

2.2 PHYSICAL CONTROLS

A. Physical controls for erosion and pollution control shall be in accordance with the Plans and the “Tennessee Erosion and Sediment Control Handbook” (Tennessee Department of Environment and Conservation, latest edition) and the requirements. These include, but are not limited to:
   1. Sediment Traps / Ponds
   2. Diversion Ditches
PART 3 - EXECUTION

3.1 GENERAL

A. The temporary erosion and pollution control provisions shown on the Plans are considered the minimum necessary, with the final design, implementation, and maintenance being the responsibility of the Contractor.

B. The Contractor shall prepare a Stormwater Pollution Prevention Plan (SWPPP) and submit or amend the project Notice of Intent (NOI) to include their project specific activities.

C. Install temporary sediment traps where appropriate. Muddy water collected in sediment traps shall be held until it is at least as clear as the upstream water before it is discharged to surface waters. Discharge through a pipe or lined channel so that the discharge does not cause erosion and sedimentation.

D. Install temporary diversion berms or diversion channels as necessary to divert storm water from running onto the disturbed areas and to divert runoff from disturbed areas to the temporary sediment traps.

E. Apply temporary seeding whenever grading operations are temporarily halted for over 14 days and final grading of exposed surfaces is to be completed within one year. Apply temporary seeding to soil stockpiles.

3.2 FIELD QUALITY CONTROL

A. Maintain erosion and sedimentation controls throughout the life of the project. Replace controls and/or add additional ones as needed to meet the requirements of the local, State, and Federal requirements.

3.3 CLEANUP AND PROTECTION

A. Remove erosion and sedimentation control structures once the site has been permanently stabilized. Properly dispose of these materials off-site.

B. Backfill, topsoil, seed, and straw areas disturbed as a result of the cleanup efforts.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, construction methods, and materials specifications contained in the TDOT Specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

1.2 SUMMARY

A. Section includes installation of asphalt paving as follows:
   1. Installation of aggregate base.
   2. Installation of asphalt pavement.
   3. Striping asphalt pavement.

B. Related Sections:
   1. Section 310000 – Earthwork
   2. Section 321600 – Curbs and Gutters

1.3 SUBMITTALS

A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

B. Within 14 working days prior to the scheduled start of asphalt construction, submit the actual design mix to the Owner or Owner’s representative for review and approval. Design mix submittal shall follow a format in accordance with the Marshall Method of Mix Design (AASHTO T 245) and as modified by TDOT. This information shall include the information as specified by TDOT and as a minimum the following:
   1. Type/name of mix.
   2. Gradation analysis.
   3. Grade of asphalt cement used and optimum asphalt content in percent.
   4. RAP size and gradation.
   5. Location of the plant.
   6. Mixing and compaction temperatures
   7. Direct references to TDOT specifications sections for each material.

C. Submit certification that mix design conforms to specification requirements. Materials certificate shall be signed by materials producer and Contractor, certifying that materials and mix design conform to requirements specified herein.

CONSTRUCTION DOCUMENTS PACKAGE
31-AUG-15
D. Laboratory reports of compaction tests and proof rolling of soil sub-grade.

E. The Contractor shall certify in writing that asphalt pavement (i.e., base and asphalt courses) was placed in accordance with specification requirements. This certification shall include:

1. Verification of the subgrade, mineral aggregate base, and pavement slopes, elevations, and surface smoothness.
2. Results of the mineral aggregate base density tests, laboratory air void, Marshall stability, and flow results, coring locations, compacted thicknesses, asphalt density, and asphalt extraction and aggregate gradation results.

1.4 QUALITY ASSURANCE

A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.

B. An independent testing laboratory may be selected and paid by the Owner to perform construction testing of in-place asphalt courses for compliance with requirements of materials, thickness, compaction, and surface smoothness. This does not relieve the Contractor of any quality assurance responsibilities.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Asphalt delivery, storage, and handling shall be in accordance with the latest edition of the TDOT specifications.

1.6 PROJECT CONDITIONS

A. Weather limitations for pavement to be properly placed, compacted, and finished shall be in accordance with the latest edition of the TDOT specifications, generally these are:

1. For a compacted thickness of 1.5 in. or less the minimum placement air temperature or surface temperature (whichever is less) shall be: 45°F for unmodified mixes and 55°F for modified mixes. For compacted thicknesses greater than 1.5 in., 40°F for unmodified mixes and 50°F for modified mixes.

2. Do not apply when base is wet, contains excess moisture, during rain, or when frozen.

B. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

1.7 GUARANTEE

A. Contractor shall guarantee in writing, the materials and workmanship for a period of two (2) years, beginning on the date of substantial completion or upon Owner’s possession, which ever comes later.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Mineral Aggregate Base: Type A Base, Grading D crushed stone (TDOT Specification Section 303);

B. Bituminous Prime Coats: Emulsified asphalt or Grade AE-P (TDOT Specification Section 402);

C. Tack Coat: Emulsified asphalt, SS-1, SS-1h, CSS-1, CSS-1h, TST-1p, CQS 1h (TDOT Specification Section 403);

D. Bituminous Plant Mix Base (Hot Mix): Grading B or BM as directed by the Engineer (TDOT Specification Section 307);
   1. Asphalt Cement: Grading B and BM shall range between 4.2 to 6.2;
   2. Asphalt temperature: the mixing temperature for PG 64-22 is 290° F minimum and 350° F maximum. The compaction temperature for PG 64-22 is 280° F minimum and 310° F maximum.
   3. For Grading B (307B), the RAP maximum particle size is 1-½ in. For Grading BM (307BM) the RAP maximum particle size is ¾ in. The percent RAP (non-processed) is 0% and 25% (processed) for both mixes.
   4. The aggregate fractions shall be sized, graded, and combined in such proportions that the resulting composite blend will be met:

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<tr>
<th>Sieve Size</th>
<th>Total % Passing by Weight</th>
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<tr>
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<td>Grading B</td>
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<tr>
<td>2 in.</td>
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<tr>
<td>1-1/4 in.</td>
<td>95 – 100</td>
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<tr>
<td>3/4 in.</td>
<td>70 – 85</td>
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<td>5/8 in.</td>
<td>-</td>
</tr>
<tr>
<td>1/2 in.</td>
<td>-</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>49 – 72</td>
</tr>
<tr>
<td>No. 4</td>
<td>34 – 51</td>
</tr>
<tr>
<td>No. 8</td>
<td>23 – 42</td>
</tr>
<tr>
<td>No. 30</td>
<td>11 – 22</td>
</tr>
<tr>
<td>No. 50</td>
<td>9 – 14</td>
</tr>
<tr>
<td>No. 100</td>
<td>4 – 10</td>
</tr>
<tr>
<td>No. 200</td>
<td>2.5 – 6.5</td>
</tr>
</tbody>
</table>

E. Asphaltic Concrete Surface (Hot Mix): Grading D or E as specified (TDOT Specification Section 411).
   1. Asphalt cement content for both mixes shall range between 5.3 to 7.0;
   2. Asphalt temperature: the mixing temperature for PG 64-22 is 290° F minimum and 350° F maximum. The compaction temperature for PG 64-22 is 280° F minimum and 310° F maximum.
   3. RAP maximum particle size is ½ in. Percent of RAP (non-processed) is 0% for both mixes and percent RAP (processed) for Grade D is 15% (PG64-22, PG67-22) or 10% (PG 70-22, PG 76-22, PG 82-22) and for Grade E is 25%.
4. The aggregate fractions shall be sized, graded, and combined in such proportions that the resulting composite blend will be met:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Grading D</th>
<th>Grading E</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 in.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>5/8 in.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1/2 in.</td>
<td>95 - 100</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3/8 in.</td>
<td>80 - 93</td>
<td>80 - 93</td>
</tr>
<tr>
<td>No. 4</td>
<td>54 - 76</td>
<td>54 - 76</td>
</tr>
<tr>
<td>No. 8</td>
<td>35 - 57</td>
<td>35 - 57</td>
</tr>
<tr>
<td>No. 30</td>
<td>17 - 29</td>
<td>17 – 29</td>
</tr>
<tr>
<td>No. 50</td>
<td>10 - 18</td>
<td>10 – 18</td>
</tr>
<tr>
<td>No. 100</td>
<td>3 - 10</td>
<td>3 – 11</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 – 6.5</td>
<td>0 - 8</td>
</tr>
</tbody>
</table>

F. Pavement Marking Paint: White and Yellow (TDOT Specification Section 716);

PART 3 - EXECUTION

3.1 SUBGRADE

A. Before any base material is installed, prepare subgrade in accordance with the requirements of the Earthwork Section. The subgrade shall be constructed to the grades shown on the Plans, with an allowable working tolerance of plus or minus 0.1 ft.

B. Protect and maintain subgrade until placement of the final surface is achieved.

C. Establish grades and set grade stakes to the desired section. In establishing the grades, make due allowances for existing improvements, proper drainage, adjoining property rights, and good appearance.

D. The joint between new and existing pavement shall be true and approximately at right angles to the centerline of the existing pavement. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 1 foot beyond the limit of the joint between the old and new base course. Take special care to ensure good compaction of the new base course at the joint. Apply and compact the surface to conform to the existing pavement so that it will have no surface irregularity.

3.2 AGGREGATE BASE

A. Install a mineral aggregate base of the type specified above in accordance with Section 303 of the TDOT Specifications. The maximum compacted thickness of any one layer shall not exceed 6 inches and the total thickness of the base shall be that indicated on the Plans.
3.3 **PRIME COAT SURFACE PREPARATION**

A. Uniformly apply a bituminous prime coat of emulsified asphalt or Grade AE-P at a rate of 0.2 to 0.5 gal./s.y. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete course to the thickness and width shown on the Plans.

3.4 **ASPHALTIC CONCRETE PLACEMENT**

A. For all areas of more than 1,000 square yards, spread and strike off the asphalt binder course with a paver. Correct any irregularities in the surface of the pavement course directly behind the paver. Remove excess material forming high spots with a shovel or lute. Fill indented areas with hot mix, and smooth with a lute or the edge of a shovel being pulled over the surface. Casting of mix over such areas will not be permitted.

B. If it is impractical to use a paver or spread box in areas of 1,000 square yards or less, the asphalt binder course may be spread and finished by hand. Carefully place by hand to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

C. Remove over-pavement of asphalt and stone from underneath landscape areas up to the limits that have been specified (refer to the curb detail) in order to provide a solid base for the concrete curb.

D. If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under Materials at a rate of 0.05 to 0.10 gal./s.y. when directed by the Engineer. Take care to prevent the bituminous material's splashing on exposed faces of curbs, gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime or tack coat has been properly cured, apply the asphaltic concrete to the thickness and width shown on the Plans. Apply the surface course as described above for the binder course.

3.5 **ROLLING AND COMPACTION**

A. After being spread, mixture shall be compacted by rolling as soon as it will bear the weight of rollers without undue displacement. Number, weight, types of rollers, and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in workable condition.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Breakdown Rolling: Perform breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling with hot material.

D. Second Rolling: Follow breakdown rolling as soon as possible while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked. Any masked or marred finish surfaces shall be repaired or smoothed.

3.6 JOINTS

A. Place each asphaltic paving layer as continuous as possible to keep the number of joints to a minimum. Create joints between old and new pavement, between successive days work, and where the mixture has become cold (less than 140 degrees F). Make these joints in such a manner as to create a continuous bond between the old and new pavement construction courses.

B. Offset joint of successive courses by at least 6 inches.

C. Transverse Joints: If placing of material is discontinued or if material in place becomes cold, make a joint running perpendicular to the direction traveled by the paver. Before placement continues, trim the edge of the previously placed pavement to a straight line perpendicular to the paver and cut back to expose an even vertical surface for the full thickness of the course. When placement continues, position the paver on the transverse joint so that sufficient hot mixture will be spread in order to create a joint after rolling that conforms to the required smoothness. If the temperature of the previously placed pavement material drops below 140 degrees F before paving is resumed, give the exposed vertical face a thin coat of liquid asphalt just before paving is continued.

D. Longitudinal Joints: Coat longitudinal joints that are not completed before the previously laid mixture has cooled to a temperature below 140 degrees F, with liquid asphalt just before paving is continued.

3.7 TOLERANCES

A. The finished surface of each asphalt course shall conform to the lines and grades shown on the Plans. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12 foot straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

B. The top surface of the base and binder courses shall be installed to the line, grade, and cross-section as shown on the Plans with a variance in elevation of no greater than plus or minus 0.10 ft.

C. The top of the surface course shall be installed to the line, grade, and cross-section as shown on the Plans with a variance in elevation of no greater than plus or minus 0.04 ft.
3.8 FIELD QUALITY CONTROL

A. The Contractor is responsible for the quality of construction and materials.

B. Verify that the slope, elevations, and smoothness of the subgrade and mineral aggregate base conform to the requirements of the Plans and the specifications.

C. Perform density tests on Type A mineral aggregate base at a minimum rate of 5 density tests per 90,000 sq. ft. The average density shall be not less than 100% of maximum density determined in accordance with AASHTO T 99, Method D with no individual test less than 97% of maximum density.

D. Laboratory Air Void, Marshall Stability, and Flow: During production, mixture samples shall be taken at least four times for every 2000 tons or 8 hour day and compacted into specimens, using compactive blows (35, 50, or 75) equal to mix design per side with the Marshall hammer as described in AASHTO T 245. Temperature shall be equal to temperature at paving machine with reheating. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

E. Asphaltic pavement courses shall be randomly cored at minimum rate of 1 core per 20,000 sq. ft of paving, but not less than 3 cores. Asphaltic concrete pavement samples shall be tested for conformance with mix design. Cores shall be cut from areas representative of project. Coring holes shall be immediately filled by the Contractor with full-depth asphaltic concrete.

F. Thickness Test: Measure thickness of each core sample taken. The thickness of the course or the combined courses shall meet or exceed the indicated thickness.

G. Density tests shall be conducted on each core sample taken in accordance with ASTM D1188 or D2726 as applicable. The average density shall not be less than 92% of the mixtures maximum theoretical specific gravity with no individual test less than 87%.

H. Asphalt Extraction and Aggregate Gradation: Asphalt extraction and gradation of extracted aggregate testing shall be performed on a minimum of 2 cores in accordance with AASHTO TP 53 and ASTM D5444 respectively.

I. Areas of deficient paving, including thickness, compaction, smoothness, ponding of water for longer more than 24 hours, and asphalt mixture shall be delineated, removed, and replaced in compliance with the specifications requirements unless corrected otherwise as directed and approved by the Owner or Owner’s Representative.

3.9 CLEANING AND PROTECTION

A. Remove any excess debris and trash.

B. Prohibit access of vehicles onto any of the asphaltic courses for vehicles that exceed the design load for the current condition of the pavement.

END OF SECTION
SECTION 32.13.13
CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Standard specifications of the Tennessee Department of Transportation (TDOT) sections 501, 604, 702, and 905. Even though the weather limitations, construction methods, and materials specifications contained in the TDOT Specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.
C. ACI 301, Specifications for Structural Concrete for Buildings.

1.2 SUMMARY
A. Section includes installation of curbs and gutters as follows:
   1. Furnishing all plant, labor, equipment, appliances, and materials and of performing all operations in connection with the construction of concrete pavements, sidewalks, concrete steps, and driveway ramps.
B. Related Sections:
   1. Section 310000 – Earthwork
   2. Section 321600 – Curbs and Gutters
   3. Section 321616 – Asphalt Paving

1.3 SUBMITTALS
A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

1.4 QUALITY ASSURANCE
A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.
B. An independent testing laboratory may be selected and paid by the Owner to perform construction testing of in-place asphalt courses for compliance with requirements of materials, thickness, compaction, and surface smoothness. This does not relieve the Contractor of any quality assurance responsibilities.
C. Materials, sampling, and testing shall meet the applicable requirements of the Concrete Sections, ACI, and the latest revision of TDOT Section 501, 604, 702, and 905.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Concrete delivery, storage, and handling shall be in accordance with the latest edition of TDOT specifications.

1.6 PROJECT CONDITIONS

A. Weather limitations for pavement to be properly placed, compacted, and finished shall be in accordance with the latest edition of the TDOT specifications, generally these are:

B. Do not place concrete when the ambient temperature is below 35 degrees F, nor when the concrete is, without special protections, likely to be subject to freezing temperatures before final setting has occurred. The temperature of the concrete when placed shall be not less than 50 degrees F, nor more than 90 degrees F. Heating of the mixing water and/or aggregates will not be permitted until the temperature of the concrete has decreased to 55 degrees F. Heated materials shall be free from ice, snow, and frozen lumps before entering the mixer. Methods and equipment for heating shall be subject to the Owner or Owner’s Representative’s approval. Provide suitable means for maintaining the concrete at a temperature of at least 40 degrees F for not less than 72 hours after placement. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor.

C. Do not apply when base is wet, contains excess moisture, during rain, or when frozen.

D. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete: Concrete shall be $f'_c = 4,000$ psi (unless otherwise shown on the Plans), as defined by ACI standards, air entrained. The applicable provisions of ACI 301, Specifications for Structural Concrete for Buildings, form a part of this specification. Concrete slump shall range from 0 to 3-in.

B. Joint Filler: Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628; FS HH-F-341, Type II, Class A or approved equal.


PART 3 - EXECUTION

3.1 SUBGRADE AND FORMS

A. Provide and operate a template for checking the contour of the subgrade. The template shall rest on the side forms and shall be provided with adjustable rods that project downward to the subgrade at 1 foot intervals. Adjust these rods to the required cross sections of the bottom of the slab when the template is supported at its sides.
B. Forms shall be of metal or wood and subject to approval by the Engineer.

C. Test the subgrade with respect to elevation and density prior to setting forms. Complete the subgrade to the plane of the typical sections shown on the drawings and to the lines and grades established by the drawings. Compact subgrades in accordance with the requirements in the Earthwork section.

D. After preparing the subgrade as described above, set the forms. The subgrade under the forms shall be firm and cut true to grade so that each form section will, when placed, be firmly in contact for its entire length and base width. Stake the form into position so that the top, when tested by a 10 feet straightedge, conforms to the requirements specified for the surface of the concrete and so that the longitudinal axis of the upstanding leg does not vary more than 1/4 inch. Tightly lock form sections together.

E. Finish the subgrade to the exact section of the bottom of the pavement shown on the drawings. Wet the subgrade down far enough in advance of the placing of the concrete to ensure that it is firm and moist. In cold weather, the subgrade shall be entirely free from frost when the concrete is deposited.

F. Leave forms in place at least 24 hours after the concrete has been placed against them. Do not use crowbars or heavy tools against green concrete when removing the forms. Clean the forms well before re-oiling and reuse.

3.2 PLACING

A. Concrete shall be in place within 45 minutes from the time all ingredients are charged in the mixing drum and before the concrete has obtained its initial set. Deposit concrete so that minimum handling will be necessary, and distribute it so that, when consolidated and finished, the slab thickness and surface grade required by the drawings will be obtained at all points. Place concrete rapidly and continuously between expansion joints. Use shovels for any necessary hand spreading. Consolidate the concrete adjacent to forms and joints with forks and spades.

B. Do not place concrete when the ambient temperature is below 35 degrees F, nor when the concrete is, without special protections, likely to be subject to freezing temperatures before final setting has occurred. The temperature of the concrete when placed shall be not less than 50 degrees F, nor more than 90 degrees F. Heating of the mixing water and/or aggregates will not be permitted until the temperature of the concrete has decreased to 55 degrees F. Heated materials shall be free from ice, snow, and frozen lumps before entering the mixer. Methods and equipment for heating shall be subject to the A/E's approval. Provide suitable means for maintaining the concrete at a temperature of at least 40 degrees F for not less than 72 hours after placement. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor.

3.3 FINISHING

A. Immediately after placement, properly finish the concrete. The sequence of operations shall be as follows: hand finishing, longitudinal floating, straightedge finishing, and edging the joints.

B. Provide an approved hand strike template, approved tamping template, and a longitudinal float for the hand finishing of pavement. The templates shall be at least 1.0 foot longer than the pavement width and at least 4 inches wide. The longitudinal float shall be 6 feet to 8 feet long. The float shall be rigid and substantially braced and provided with suitable handles to ensure smooth and effective manipulation. The bottom edges of the base of the float shall be rounded. Floats made of metal or a combination of wood and metal may be used.
C. As soon as concrete is placed, strike off and screed to the appropriate cross section and to an elevation above grade which, when the concrete is consolidated and finished, will ensure that the surface of the pavement is at the exact elevation indicated on the drawings. Tamp the entire surface, and continue tamping until the required compaction and reduction of internal and surface voids are secured. Immediately after the final tamping of the surfaces, float the pavement longitudinally by hand. If contact with the pavement is not made at all points by the float, additional concrete shall be required and screeded, and the float operated until a satisfactory surface is obtained.

D. After the longitudinal floating is complete, eliminate minor irregularities and score marks remaining in the pavement surface by removing surplus material or, if necessary, by adding and working in freshly mixed concrete with long handled floats and filling in open textured areas in the pavement surfaces. Make the final finish with straightedges 8 feet in length. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than 1/2 of the pavement width. Place the straightedge at the centerline and pull uniformly to the edge. Do not advance the straightedge along the pavement in successive stages more than 1/2 its length. Immediately fill depressions with freshly mixed concrete, strike off, consolidate, and refinish. Remove projections above the required elevation while the concrete is still plastic and workable, doing so in a time sequence that will ensure the removal of all water and laitance from the surface. Continue the straightedge testing and refloating until the entire surface is free from observable departures from the straightedge, conforms to the required grade and contour, and will, when the concrete has hardened, conform with the surface requirements specified herein.

E. After hand finishing has been completed but before the concrete has attained initial set, carefully finish the edges of slabs along forms and at joints with an edging tool of 1/2-inch radius to form a smooth, rounded surface. Clean corners or edges of slabs that have crumbled and any areas that lack enough mortar for proper finishing by removing loose fragments and soupy mortar, and then fill solidly and finish with a mixture of the correct proportions and appropriate consistency. Eliminate unnecessary tool marks, and leave edges smooth and true to line. After removing the forms, fill any damaged or honeycombed areas with mortar composed of one part cement and two parts sand.

F. Form transverse and contraction joints in the finished pavement prior to initial set, spacing them as shown on the drawings. Contraction joints shall be 1/4-inch wide and 3/4-inch deep and shall be finished with an edging tool of 1/4-inch radius.

G. Place transverse and premolded expansion joints 1/2-inch thick in such a way that the joint will be filled to within 1/2 inch of the surface of the walk. Place them to full depth and normal to the grade. Wherever concrete walks abut against transverse steps, other walks, or adjacent structures, provide expansion joints. Clean all concrete from the top of the premolded joints and edge the concrete as specified above.

3.4 PROTECTION AND CURING

A. Protect and cure concrete with an approved curing compound applied according to the manufacturer's directions.

3.5 SURFACE TEST

A. Remove any portion of the pavement that shows a variation or departure greater than 1/4-inch from the testing edge of a 10 feet straightedge, and replace or correct as directed by the Engineer.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard specifications of the Tennessee Department of Transportation (TDOT) sections 702. Even though the weather limitations, construction methods, and materials specifications contained in the TDOT Specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

C. ACI 301, Specifications for Structural Concrete for Buildings.

1.2 SUMMARY

A. Section includes installation of curbs and gutters as follows:
   1. Installation of post curbs, extruded curbs, gutters, or combined curb and gutters.

B. Related Sections:
   1. Section 310000 – Earthwork
   2. Section 321313 – Concrete Paving.
   3. Section 321616 – Asphalt Paving.

1.3 SUBMITTALS

A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

B. Submit templates of the curb cross sections if alternates are proposed; these must be approved by the Owner or Owner’s Representative prior to construction. Replace curbing that is installed without the Owner or Owner’s Representative’s approval.

1.4 QUALITY ASSURANCE

A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.

B. An independent testing laboratory may be selected and paid by the Owner to perform construction testing. This does not relieve the Contractor of any quality assurance responsibilities.

C. Materials, sampling, and testing shall meet the applicable requirements of the Concrete Sections, ACI, and the latest revision of TDOT Section 501, 604, 702, and 905.
1.5  DELIVERY, STORAGE, AND HANDLING

A. Concrete delivery, storage, and handling shall be in accordance with the latest edition TDOT specifications.

1.6  PROJECT CONDITIONS

A. Weather limitations for pavement to be properly placed, compacted, and finished shall be in accordance with the latest edition of the TDOT specifications, generally these are:

B. Do not place concrete when the ambient temperature is below 35 degrees F, nor when the concrete is, without special protections, likely to be subject to freezing temperatures before final setting has occurred. The temperature of the concrete when placed shall be not less than 50 degrees F, nor more than 90 degrees F. Heating of the mixing water and/or aggregates will not be permitted until the temperature of the concrete has decreased to 55 degrees F. Heated materials shall be free from ice, snow, and frozen lumps before entering the mixer. Methods and equipment for heating shall be subject to the Owner or Owner’s Representative’s approval. Provide suitable means for maintaining the concrete at a temperature of at least 40 degrees F for not less than 72 hours after placement. Any concrete damaged by freezing shall be removed and replaced at the expense of the Contractor.

C. Do not apply when base is wet, contains excess moisture, during rain, or when frozen.

D. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1  MATERIALS

A. Concrete: Concrete shall be $f'c = 5,000$ psi (unless otherwise shown on the Plans), as defined by ACI standards, air entrained. The applicable provisions of ACI 301, Specifications for Structural Concrete for Buildings, form a part of this specification. Concrete slump shall range from 0 to 3”.

B. Joint Filler: Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628, F5 HH-F-341, Type II, Class A or approved equal.


PART 3 - EXECUTION

3.1  SUBGRADE AND FORMS

A. Provide and operate a template for checking the contour of the subgrade. The template shall rest on the side forms and shall be provided with adjustable rods that project downward to the subgrade at 1 foot intervals. Adjust these rods to the required cross sections of the bottom of the slab when the template is supported at its sides.

B. Forms shall be of metal or wood and subject to approval by the Engineer.
C. The Contractor may elect to use extruded machine curb or curb and gutter. The Owner reserves the right to approve the machine used, the contour and finish of the curb and gutter, and the design mix and the right to designate the spacings for expansion and contraction joints.

D. Test the subgrade with respect to elevation and density prior to setting forms. Complete the subgrade to the plane of the typical sections shown on the drawings and to the lines and grades established by the drawings. Compact subgrades in accordance with the requirements in the Earthwork Section.

E. After preparing the subgrade as described above, set the forms. The subgrade under the forms shall be firm and cut true to grade so that each form section will, when placed, be firmly in contact for its entire length and base width. Stake the form into position so that the top, when tested by a 10 feet straightedge, conforms to the requirements specified for the surface of the concrete and so that the longitudinal axis of the upstanding leg does not vary more than 1/4 inch. Tightly lock form sections together.

F. Finish the subgrade to the exact section of the bottom of the pavement shown on the drawings. Wet the subgrade down far enough in advance of the placing of the concrete to ensure that it is firm and moist. In cold weather, the subgrade shall be entirely free from frost when the concrete is deposited.

G. Leave forms in place at least 24 hours after the concrete has been placed against them. Do not use crowbars or heavy tools against green concrete when removing the forms. Clean the forms well before reoiling and reuse.

3.2 PLACING

A. Concrete shall be in place within 45 minutes from the time all ingredients are charged in the mixing drum and before the concrete has obtained its initial set. Deposit concrete so that minimum handling will be necessary, and distribute it so that, when consolidated and finished, the slab thickness and surface grade required by the drawings will be obtained at all points. Place concrete rapidly and continuously between expansion joints. Use shovels for any necessary hand spreading. Consolidate the concrete adjacent to forms and joints with forks and spades.

B. Construct concrete curb or combination concrete curb and gutter, where specified on the Plans, in uniform sections of length specified on the Plans.

C. Form joints between sections either by steel templates, 1/8-inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2-inches below surface of curb and gutter; or with 3/4-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least 2-inches while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold it's shape, but shall be removed while forms are still in place.

D. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, where specified on the Plans, to concrete pavement with 1/2-inch round deformed reinforcement bars of length and spacing shown on the Plans.

E. Transverse Expansion Joints: Concrete curb, combination concrete curb and gutter, or concrete sidewalk shall have filler cut to exact cross section of curb, gutter, or sidewalk. Joints shall be similar to type of expansion joint used in adjacent pavement.
F. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

G. Joint Sealants: Seal joints with approved exterior pavement joint sealants. Install in accordance with manufacturer's recommendations.

3.3 FINISHING

A. Immediately after placement, properly finish the concrete. The sequence of operations shall be as follows: hand finishing, longitudinal floating, straightedge finishing, and edging the joints.

B. Provide an approved hand strike template, approved tamping template, and a longitudinal float for the hand finishing of pavement. The templates shall be at least 1.0 foot longer than the pavement width and at least 4 inches wide. The longitudinal float shall be 6 feet to 8 feet long. The float shall be rigid and substantially braced and provided with suitable handles to ensure smooth and effective manipulation. The bottom edges of the base of the float shall be rounded. Floats made of metal or a combination of wood and metal may be used.

C. As soon as concrete is placed, strike off and screed to the appropriate cross section and to an elevation above grade which, when the concrete is consolidated and finished, will ensure that the surface of the pavement is at the exact elevation indicated on the drawings. Tamp the entire surface, and continue tamping until the required compaction and reduction of internal and surface voids are secured.

D. Form contraction joints in the finished concrete prior to initial set, spacing them as shown on the Plans. Unless otherwise noted, contraction joints shall be 1/4-inch wide at 10-ft. intervals.

E. Form expansion joints in the finished concrete prior to initial set, spacing them as shown on the Plans. Unless noted otherwise, premolded expansion joints shall be 3/4-inch thick at 100-ft. maximum spacing between joints. Provide expansion joints at tangent points of circular curbs, between curbs and rigid objects, at locations where stresses may develop, and wherever concrete abuts against transverse steps, walks, or adjacent structures.

F. Finish the edges of joints on ¼-in. radii. Clean all concrete from the top of the premolded joints.

3.4 PROTECTION AND CURING

A. Cure concrete with an approved curing compound applied according to the manufacturer's directions and as specified in “water-curing” section of ACI 308.

B. Protect the curbing until final acceptance. Repair sections that are damaged during this period by removing and reconstructing each 10-ft. section that has been damaged.

C. Backfill the curb immediately after the concrete has set sufficiently and after the forms have been removed. Place material in layers not exceeding 4-in. in loose thickness, and compact until firm and stable. Completely fill to the top of the back of curb and eliminate ponding behind the curbs.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

1.2 SECTION INCLUDES

A. Painting and marking of pavements, curbs, guard posts, and light pole bases.

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation (AASHTO)
   AASHTO M248 - Ready-Mixed White and Yellow Traffic Paints

B. American Society for Testing and Materials (ASTM)
   ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness by Notched Gauges.

C. Federal Specifications (FS)
   FS A-A-2886 - Paint, Traffic, Solvent Based (supersedes FS TT-P-85 and FS TT-P-115, Type I)
   FS TT-P-1952 - Paint, Traffic And Airfield Marking, Waterborne

1.4 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs, and warning lights as required.

B. Use trained and experienced personnel in applying the products and operating the equipment required for properly performed work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Paint shall be waterborne or solvent borne, colors as shown or specified herein. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

B. Waterborne Paint: Paints shall conform to FS TT-P-1952,..

C. Solvent Borne Paint: Paint shall conform to FS A-A-2883 or AASHTO M248. Paint shall be non-bleeding, quick-drying, and alkyd petroleum base paint suitable for traffic-bearing surface and be mixed in accordance with manufacturer's instructions before application for colors White, Yellow, Blue, and Red.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine the work area and correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION
A. Sweep and clean surface to eliminate loose material and dust.
B. Where existing pavement markings are indicated on Construction Drawings to be removed or would interfere with adhesion of new paint, a motorized abrasive device shall be used to remove the markings. Equipment employed shall not damage existing paving or create surfaces hazardous to vehicle or pedestrian traffic. Within public rights-of-way, appropriate governing authority shall approve method of marking removal.
C. New pavement surfaces shall be allowed to cure for not less than 30 days before application of marking materials.

3.3 CLEANING EXISTING PAVEMENT MARKINGS
A. In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or do not interfere with the adhesion of the new marking material do not require removal. Whenever grinding, scraping, sandblasting or other operations are performed, the work shall be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.4 APPLICATION
A. Apply two coats of paint at manufacturer's recommended rate, without addition of thinner, with maximum of 100 square feet per gallon or as required to provide a minimum wet film thickness of 15 mils and dry film thickness of 7 ½ mils per coat. Paint shall be applied for a total dry film thickness of 15 mils. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use straightedge to ensure uniform, clean, and straight stripe.
B. Install pavement markings according to manufacturer's recommended procedures for the specified material.
C. Following items shall be painted with colors noted below:
   Pedestrian Crosswalks: White
   Exterior Sidewalk Curbs, Light Pole Bases, and Guard posts: Yellow
   Fire Lanes: Red or per local code
   Lane Striping where separating traffic moving in opposite directions: Yellow
   Lane Striping where separating traffic moving in the same direction: White
   ADA Symbols: Blue or per local code
   ADA parking space markings as shown on the drawings.
   Parking Stall Striping: Yellow, unless otherwise noted on Construction Drawings
   Associate Parking Area: White, unless otherwise noted on Construction Drawings
3.5 FIELD QUALITY CONTROL

A. Inspection: After the paint has thoroughly dried, visually inspect the entire application and touch up as required to provide clean, straight lines and surfaces throughout.

B. Testing: Testing of wet film thickness shall be performed a minimum of two times on each parking row (including striped islands) and pedestrian cross walks, and a minimum of one test on each lane/alignment striping. At least one test shall be performed after refilling paint striping machine, changing operators of striping machine, and changing paint types, brands, etc. This shall be performed in addition to the testing stated above. These tests shall be performed on each coat applied. Testing shall be performed in accordance with ASTM D4414.

3.6 CLEANING

A. Waste materials shall be removed at the end of each workday. Upon completion of the work, all containers and debris shall be removed from the site. Paint spots upon adjacent surfaces shall be carefully removed by approved procedures that will not damage the surfaces and the entire job left clean and acceptable.

END OF SECTION
SECTION 32.92.19
SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes:
   1. Supplying and placing soil additives, seed, and mulch as specified on prepared ground in accordance with the Plans and these Specifications.
   2. Sodding or seeding all non-construction areas that show signs of excessive erosion and all newly graded earthen areas that are not to be paved, stabilized unless otherwise indicated on the Plans or as directed by the Engineer.
B. Related Sections:
   1. Section 312000 - Earthwork

1.3 SUBMITTALS
A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

1.4 QUALITY ASSURANCE
A. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
B. Do not disturb any areas outside the work area as defined on the Plans. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Delivery, storage, and handling of materials shall be in accordance with the Contract Documents and the local, State, and Federal requirements.

1.6 PROJECT CONDITIONS
A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Grass Seed: Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year’s crop and in no case shall the weed seed content exceed 0.25% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed, and properly marked containers. Seed shall comply with State and Federal seed laws. Seed that has become wet, moldy, or otherwise damaged will not be accepted. All Fescues shall contain Acromonium endophytes. Seed containing endophyte must be kept cool and dry at all times; do not stockpile in the sun. Seed mixture for general lawn conditions shall be as follows:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Proportion By Weight</th>
<th>Germination Minimum</th>
<th>Purity Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Fescue</td>
<td>50%</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Chewings Fescue</td>
<td>25%</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td>Creeping Red Fescue</td>
<td>25%</td>
<td>85%</td>
<td>95%</td>
</tr>
</tbody>
</table>

1. Tall fescue shall be improved turf-type blends. Kentucky 31 tall fescue shall not be used.
2. Provide 3 varieties minimum for each Fescue species.
3. Seed may be mixed by an approved method on the site or may be mixed by a dealer. If the seed is mixed on the site, each variety shall be delivered in the original containers that shall bear the dealer’s guaranteed analysis. If the seed is mixed by a dealer, provide the dealer’s guaranteed statement of the composition of the mix.

B. Fertilizer: Use a slow-release starter fertilizer in standard containers that are clearly marked with name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.

C. Lime: Use lime containing a minimum of 85% calcium carbonate and magnesium carbonate and shall be ground to such fineness that 40% will pass the No. 100 mesh sieve and 95% of which will pass through the No. 20 mesh sieve. Contractor shall be aware of loam borrow pH and the amount of lime needed to adjust pH to specifications in accordance with testing lab recommendations.

D. Mulch: Stalks of rye, oats, wheat, or other approved grain crops properly cured prior to baling, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

E. Water: The Contractor shall be responsible to furnish their supply of water to the site at no additional cost. If possible, the Owner may furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Owner’s water supply is not available or not functioning, the Contractor shall be responsible to furnish adequate supplies at their cost. All work injured or damaged due to the lack of water or the use of too much water, shall be the Contractor’s responsibility to correct. Water shall be free from impurities injurious to vegetation.

F. Matting: provide matting as shown on the Plans for slopes steeper than 3:1 or as otherwise specified on the Plans.
PART 3 - EXECUTION

3.1 GENERAL

A. Before starting seeding operations on any area, final dressing and placing of topsoil shall have been completed in accordance with the applicable Specifications. Seed, fertilize, lime, and mulch within 30 days of attainment of finish grade.

B. Apply temporary seeding whenever grading operations are temporarily halted for over 14 days and final grading of exposed surfaces is to be completed within one year. Also apply temporary seeding to soil stockpiles.

3.2 PREPARATION

A. Each area to be seeded shall be scarified, disked, harrowed, raked or otherwise worked until it has been loosened and pulverized to a depth of not less than 2 inches and brought to the lines and grades indicated on the Plans or directed by the Engineer. This operation shall be performed only when the soil is in a tillable and workable condition.

B. Apply fertilizer at the rate of 1 pound of nitrogen per 1,000 square feet, and lime at the rate of 50 pounds per 1,000 square feet, shall be uniformly incorporated in the soil for a depth of approximately 1 inch. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. Do not apply lime without a soil test.

3.3 SEEDING

A. Seed shall be sown as soon as preparation of the seed bed has been completed. It shall be sown uniformly by means of a rotary seeder or other satisfactory means. Seed shall be sown at the rate of 8 pounds per 1,000 square feet. Hydro-seeding is not allowed.

B. No seeding shall be done during windy weather or when the ground surface is frozen, wet or otherwise non-tillable.

C. When seeding during February 1 through April 1 and October 1 through November 30, add an additional 3 pounds per 1000 square feet of annual rye grass. No seeding shall be performed during December and January unless otherwise permitted.

3.4 MULCHING

A. When the mulching material is hay or straw, it shall be spread evenly over the seeded area at an approximate rate of 2 bales (100 pounds minimum) per 1,000 square feet for straw and 150 pounds per 1,000 square feet for hay immediately following the seeding operations. The Engineer depending on the texture and condition of the mulch material and the characteristics of the area seeded may vary this rate.
3.5 MAINTENANCE

A. All seeded areas shall be cared for properly to the Owner or Owner’s Representative’s satisfaction until acceptance of the work. Areas, which have been previously seeded and mulched in accordance with this Section, but which, have been damaged or failed to successfully establish an acceptable stand of grasses shall be repaired as directed by the Owner or Owner’s Representative. All material and labor required to repair seeded areas made necessary by negligence on a part of the Contractor will be furnished by the Contractor at no cost.

B. If within 60 days of the planting less than 50% is successful, rework the ground, refertilize, reseed, and remulch.

3.6 CLEANUP AND PROTECTION

A. After the completion of seeding, the area shall be cleaned of all rubbish, excess material, and any other items that will mar the appearance of the projects as in accordance with the General Specifications.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes installation of asphalt paving as follows:
   1. Installation of sanitary sewage gravity lines, lateral connections, and structures.

B. Related Sections:
   1. Section 015000 – Temporary Facilities and Controls
   2. Section 312000 – Earthwork
   3. Section 311100 – Site Clearing
   4. Section 312500 – Erosion and Sedimentation Controls

1.3 SUBMITTALS

A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s Representative.

B. Unless noted otherwise, only submit items that vary from the construction plans. Describe in the submittal why the substitution is being requested.

1.4 QUALITY ASSURANCE

A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with the manufacturer’s specifications and recommendations and also that of the utility Owner or Owner’s Representative.

1.6 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.
2.1 MATERIALS

A. All materials will be visually inspected by the Owner or Owner’s Representative at the site for conformance to the specifications. At the Owner or Owner’s Representative's discretion the Contractor may be required to supply certified mill tests, samples, or other suitable form of verification that the material meets the required specifications.

2.2 PIPE MATERIALS

A. Polyvinyl Chloride (PVC) pipe: Pipe and fittings shall meet or exceed the requirements of ASTM D3034, SDR 35 for pipe from 4" to 15" in diameter. For sizes from 18" to 27" in diameter, the pipe shall meet or exceed the requirements of ASTM F-679, wall thickness T-1. All PVC pipe shall meet the requirements of the Materials Specifications herein.

B. Ductile Iron Pipe (DIP): Pipe shall be made of good quality ductile iron in conformance with the latest revision of ANSI/AWWA C-151/A21.51 Standard. The pipe shall be push-on joint with a minimum pressure class of 150 psi, cement-lined according to ANSI 21.4/AWWA C-104, and coated inside and outside with an asphaltic coating. Ductile iron pipe and fittings shall conform to the requirements of the Materials Specifications herein.

C. Sewer laterals shall include 6-inch tees of the same material as the sewer main, which are able to withstand all test pressures without leakage.

2.3 FLEXIBLE COUPLINGS

A. Flexible couplings are designed to join sewer pipes of the same or different material or sizes. Flexible couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in non-pressure applications. Flexible couplings shall flex with normal earth movement to maintain integrity of seal. Use of flexible couplings shall be at the Owner or Owner’s Representative's discretion.

B. Flexible couplings shall be manufactured from elastomeric Polyvinyl chloride (PVC) which is unaffected by soil conditions and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 minimum to 65 maximum Shore A durometer hardness. Couplings shall conform to the applicable parts of ASTM C-443, C-425, C-564, and D-1869.

C. Each flexible coupling shall be supplied with two corrosion resistant series 300 stainless steel clamps, which when tightened to 60 inch-pounds torque, seal the joint.

D. Flexible couplings shall be approved and listed by all of the following code agencies: SBCCI (southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).
2.4 SADDLE TEES

A. Saddle tees shall consist of a gasketed skirt sized to fit the existing pipe and an integral 6-inch branch connection. The saddle shall include two stainless steel straps or a single 3-1/2” wide stainless steel strap to attach it to the existing pipe. Saddle tees shall meet the requirements of ASTM 3034 and F-477.

PART 3 - EXECUTION

3.1 GENERAL

A. Sewers shall be designed with a 10-foot horizontal separation from any existing or proposed water main. If this is not practical, the sewer may be placed closer than 10 feet to a water main, provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main, or as directed by the Owner or Owner’s Representative or Owner or Owner’s Representative’s Representative.

B. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation, or the water main shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the sewer with a full pipe section of the water main centered over the sewer, or as directed by the Owner or Owner’s Representative.

1. Minimum slope for sanitary sewers shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Min. % Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>6”</td>
<td>0.62%</td>
</tr>
<tr>
<td>8”</td>
<td>0.40%</td>
</tr>
<tr>
<td>10”</td>
<td>0.28%</td>
</tr>
<tr>
<td>12”</td>
<td>0.22%</td>
</tr>
<tr>
<td>15”</td>
<td>0.15%</td>
</tr>
<tr>
<td>18”</td>
<td>0.12%</td>
</tr>
<tr>
<td>21”</td>
<td>0.10%</td>
</tr>
<tr>
<td>24”</td>
<td>0.08%</td>
</tr>
</tbody>
</table>

Minimum slope for other diameters shall be such that a minimum velocity of 2 ft/sec is maintained while the pipe is flowing full.

C. Where the slope of a sewer line is in excess of 20%, the line shall be constructed of mechanical joint ductile iron pipe with concrete anchors at each joint or as specified by the Owner or Owner’s Representative or Owner or Owner’s Representative’s Representative.

D. Minimum cover in roadways and other traffic-bearing areas is 48 inches for PVC pipe and 30 inches for ductile iron pipe. In non-traffic-bearing areas, the minimum cover is 30 inches for either type of pipe.

E. Maximum depth for standard PVC pipe is 17 feet. Depths greater than 17 feet will generally require ductile iron pipe and shall be approved by the Owner or Owner’s Representative or Owner or Owner’s Representative’s Representative.
F. Ductile iron pipe shall be used beneath waterways which have a continuous flow of water. Concrete encasement shall be provided when joints on the ductile iron pipe are located beneath waterways, or as directed by the Owner or Owner’s Representative or Owner or Owner’s Representative’s Representative.

G. The maximum spacing for manholes shall be 400 feet for pipe diameters of 21 inches and smaller and 500 feet for larger pipes.

H. Where the difference in the invert elevations of two sewers intersecting in a manhole is 2 feet or more, a drop manhole shall be provided.

I. When ductile iron pipe must be used on a portion of a new sewer line segment due to minimum or maximum cover, water line proximity, or waterway crossing, the entire length of sewer must be installed with ductile iron pipe. No flexible couplings will be permitted on new construction to convert to PVC between manholes.

3.2 PIPE INSTALLATION

A. All pipe shall be installed in the presence of the Owner or Owner’s Representative. Do not begin the backfilling of trenches until the pipe in place has been visually inspected by the Owner or Owner’s Representative. Pipe installation shall begin at the lowest elevation, unless otherwise approved by the Owner or Owner’s Representative.

B. Trench bottoms that are found to be unsuitable for foundations after pipe laying operations have started shall be corrected by bringing them to exact line and grade with material approved by the Owner or Owner’s Representative.

C. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipelaying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

D. Excavation for bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Excavate out bell holes no more than 2 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid foundation as specified in the Earthwork section. Install each pipe with a close concentric joint to avoid sudden offsets or inequalities in the flow line.

E. As the work progresses thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, carefully inspect it, and remove and, in accordance with all laws and regulations, dispose of all earth, trash, rags, and other foreign matter from its interior.

F. Install tee branches in sewer lines to serve properly each lot adjoining the sewer and at such other locations as may be designated by the Owner or Owner’s Representative. If tee branches are not to be used immediately, close them with approved plugs that are held in place to prevent infiltration and withstand all test requirements.

G. For all tees that are plugged and laid in rock, blast a minimum of 6 linear feet of ditch line in the direction and to the approximate grade of the future lateral as directed by the Owner or Owner’s Representative, but do not excavate the material. Furnish the Owner or Owner’s Representative with a record of the exact location of each tee installed.
H. If the work consists of constructing a new sewer to replace an existing one, connect existing laterals to the new line. Laterals which have been disconnected, cut or abandoned shall be plugged and sealed with a backing block securing the plug.

I. Cleanouts will be required only for those laterals crossing a roadway. Cleanouts should be located on the property line in most cases. However, where a long lateral crosses another private property, the cleanout should be located at the road right-of-way. In that case, a 4-inch line may be installed upstream of the cleanout to the property line.

J. For new laterals to be installed on existing sewer lines larger than 6 inches in diameter, a sewer saddle as specified in Part 2 above may be used in lieu of a tee section. The saddle shall be installed on a clean-cut, properly sized hole on the existing sewer, such that a watertight connection results. The cut in the existing pipe shall be made with a hole saw which retains the coupon. Sewer saddles shall not be used on vitrified clay pipe, or any other pipe deemed unsuitable for this method by the Owner or Owner’s Representative, unless approved by the Owner or Owner’s Representative.

K. For new laterals to be installed on existing sewer lines 6 inches in diameter, or as required by the Owner or Owner’s Representative, the existing line shall be cut and a watertight tee section shall be installed, while pumping the existing wastewater flow around the work zone. The tee section shall consist of a new tee of the same diameter as the existing pipe, with short sections of pipe on either end. The tee section shall be installed with waterproof flexible couplings on each end as specified in Part 2 above to connect the pipe to the new tee section.

L. Install new connections to existing manholes as specified in Section 02530, Manholes-Sewer. Reshape the bottom at the manhole as necessary to fit the invert of the sewer pipe.

M. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other sections of these Specifications. Any such work shall be considered incidental to the construction of sewer mains.

N. Water service connections will be repaired or replaced in accordance with the Water Service Assemblies section, by the Contractor at his expense as an incidental part of the work.

O. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor at his own expense as an incidental part of the work.

P. Wastewater flow must be maintained in the existing sewers. Whenever pipe-laying progresses to the point where this flow must be interrupted, the Contractor shall plug the sewer upstream of the construction and provide by-pass pumping to the downstream manhole. All downstream pipes, manholes and appurtenances must be tested and acceptable to the Owner or Owner’s Representative to receive wastewater flow. Discharging raw wastewater to natural waterways will not be permitted. The Contractor shall notify the Owner or Owner’s Representative prior to proceeding with by-pass pumping. When working in areas where interruption of wastewater flow may occur, the Contractor shall have lines and all other equipment in readiness at the site to provide by-pass pumping. A back-up pump and hose is required. Contractor will be liable for clean-ups, fines, and any other problems that may occur. All equipment will be checked by Owner or Owner’s Representative for proper working conditions.
3.3 TESTING OF GRAVITY SEWERS

A. Visual Tests

1. Prior to backfilling, the Owner or Owner’s Representative shall make a visual inspection of the sewer. The visual tests shall include a check for proper grade and alignment, sufficient pipe bedding, pipe condition, and general cleanliness. The Contractor shall immediately repair all defects found by such inspection.

2. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than ½ inch on pipe 36 inches internal diameter or smaller and ¾ inch on pipe larger than 36 inches internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the Contractor's expense.

3. The Contractor will be held strictly responsible that all parts of the work bear the load of the backfill. If cracks 1/100 inch develop in the pipe within one year from the date of final acceptance of the work, the Contractor will be required to replace, at his expense, all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer, ensuring proper service of sewer pipe under conditions established by the drawings, specifications, and local conditions at the site of the work.

B. Air Testing for Sewers 24 inches in Diameter and Smaller

1. The Contractor is responsible for providing all labor and equipment for air testing.

2. This recommended practice defines the proper procedures for acceptance testing of installed gravity sewer pipe using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test method, and minimum holding times. Air test results shall be recorded on the work sheet, which is included below in paragraph E., Air Test Data Sheet.

3. Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. During sewer construction, all service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged to prevent air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps, and tie-rods or wire harnesses over the pipe bells.

4. Unless otherwise specified, the Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed sewer without the prior approval of the Owner or Owner’s Representative. Using sealant in a sewer is not the equivalent of a sound sewer pipe. Proper structural repair work is much preferred and may be required by the Owner or Owner’s Representative.

5. The Owner or Owner’s Representative shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. The Owner or Owner’s Representative
should inform the Contractor regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test.

6. It is extremely important and essential that all plugs be installed and braced in such a way that blowouts are prevented. As an example of the hazard, a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24-inch plug by an internal pressure of 5 psig. It must be realized that sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line.

It is further recommended that no internal pressure of more than 9 psig be permitted except for leak location equipment where the plugs are firmly tied together.

Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or brace the plugs to the manhole wall as an added safety precaution throughout the test.

7. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)

8. To facilitate test verification by the Owner or Owner’s Representative, all air used shall pass through a single, above ground control panel. The above ground air control equipment shall include a shut-off valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of +/- 0.04 psi. Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

9. After a manhole-to-manhole reach of pipe has been backfilled to final grade and compacted, prepared for testing, and a 24-hour waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important to high groundwater situations.
When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.

10. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. If the groundwater table is above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer, up to a maximum of 9.0 psig. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater backpressure), the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average backpressure of any groundwater over the pipe). At a reading of 3.5 psig, timing shall commence with a stopwatch.

If the time shown for the designated pipe size and length (see paragraph D., Air Test Time Tables, below) elapses before the air pressure drops 0.5 psig, the section undergoing test shall have passed. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop has not occurred. If the pressure drops 0.5 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

If the section fails to meet these requirements, the Contractor shall determine at his own expense the source, or sources, of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Owner or Owner’s Representative. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of the Owner or Owner’s Representative. The completed pipe installation shall then be retested and required to meet the requirements of this test.

C. Testing for Sewers Larger than 24 Inches in Diameter

1. The Contractor is responsible for providing all labor and equipment for testing.

2. Where the natural groundwater is 24 inches or more above the top of a section of pipe, the Contractor shall measure the flow of water in the pipe and the rates of seepage and infiltration. Measure the flow rate by using a calibrated weir. Leave the weir in the line until the flow rate has stabilized. The Contractor is responsible for verifying the groundwater level by providing sight gauges in manholes or digging test holes at suitable locations.

The total seepage and infiltration of groundwater as determined by the test shall in no case exceed 50 gallons per 24 hours per inch-mile of pipe. Make infiltration tests on all sewer construction before placing the lines in service and before making any connections to other sewers. If the amount of infiltration into the sewer(s) is in excess of the maximum quantity specified above, then repair the joints, relay the sewer (if necessary), or perform other remedial construction, at the Contractor's expense, in order to reduce groundwater infiltration to within the specified limits.
In making infiltration tests, furnish the required equipment and labor and do the necessary pumping under the direction on the Owner or Owner’s Representative. Tests may be repeated until each sewer individually meets the specifications for infiltration amounts as set above.

3. Where the groundwater is not 24 inches or more above the top of the pipe section being tested, the Contractor shall perform an exfiltration test. Bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device. Insert a vent pipe 48 inches long in the stopper of the upper end of that section. Then fill the lower manhole with water, or add water until there is a minimum of 4 feet over the upper end; make certain that all air is forced out through the vent tube. Measure the drop in the level of the water in the manhole due to exfiltration over a specific time, and calculate the water loss due to exfiltration. The total exfiltration shall not exceed that specified above for infiltration.

D. **Air Test Time Tables**

The following tables indicate the time that must elapse before the air pressure inside the pipe drops 0.5 psig. If the pressure inside the pipe drops 0.5 psig before the time has completely elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

### MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015 ft.$^3$/min.

<table>
<thead>
<tr>
<th>1 Pipe Dia. (in.)</th>
<th>2 Min. Time (min.:sec.)</th>
<th>3 Length For Min. Time (ft.)</th>
<th>4 Time for Longer Length (sec.)</th>
<th>Specification Time for Length (L) Shown (min.:sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100 ft.</td>
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<tr>
<td>4</td>
<td>1:53</td>
<td>597</td>
<td>.190 L</td>
<td>1:53</td>
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<tr>
<td>6</td>
<td>2:50</td>
<td>398</td>
<td>.427 L</td>
<td>2:50</td>
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<tr>
<td>12</td>
<td>5:40</td>
<td>199</td>
<td>1.709 L</td>
<td>5:40</td>
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<tr>
<td>15</td>
<td>7:05</td>
<td>159</td>
<td>2.671 L</td>
<td>7:05</td>
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<tr>
<td>18</td>
<td>8:30</td>
<td>133</td>
<td>3.846 L</td>
<td>8:30</td>
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<tr>
<td>30</td>
<td>14:10</td>
<td>80</td>
<td>10.683 L</td>
<td>17:48</td>
</tr>
<tr>
<td>36</td>
<td>17:00</td>
<td>66</td>
<td>15.384 L</td>
<td>25:39</td>
</tr>
</tbody>
</table>


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<thead>
<tr>
<th>Pipe Dia. (in.)</th>
<th>Min. Time (min.:sec.)</th>
<th>Length For Min. Time (ft.)</th>
<th>Time for Longer Length (sec.)</th>
<th>Specification Time for Length (L) Shown (min.:sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1:53</td>
<td>597</td>
<td>.190 L</td>
<td>1:53</td>
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<td>21</td>
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<td>36</td>
<td>17:00</td>
<td>66</td>
<td>15.384 L</td>
<td>76:55</td>
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</tbody>
</table>

E. Air Test Data Sheet

Air test results shall be recorded on the following worksheet:

AIR TEST DATA SHEET

CONSTRUCTION DOCUMENTS PACKAGE
31-AUG-15
### Field Test Data: (To be filled in by the inspector)

- **Date:**
- **Specified Maximum Pressure Drop:** psig

#### Identification of Pipe Material Installed:

<table>
<thead>
<tr>
<th>Pipe Under Test</th>
<th>Specification Time</th>
<th>Field Test Operations Data</th>
</tr>
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<tbody>
<tr>
<td>Upstream MH sta #</td>
<td>Downstream MH sta #</td>
<td>Dia. D (in.)</td>
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</tbody>
</table>

**Inspector's Name and Title:**

**Signature of Inspector:**

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If a section fails, the following items should be completed:

- Identify section(s) that failed:
- Leak (was) (was not) located. Method used:
- Description of leakage found:
- Description of corrective action taken:

For test results after repair refer to Test No.: Inspectors:

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### 3.4 DEFLECTION TESTING FOR PVC PIPE

A. The Contractor is responsible for providing all labor and equipment for deflection testing.
B. Test deflection of the pipe by manually pulling with twine a one-piece 9-arm go/no-go mandrel (sized in accordance with ASTM D3034) through the pipe. Within 24 hours after compaction of the backfill is complete, the line shall be tested using a 5% deflection mandrel. If the line is satisfactory, it shall be retested using a 7.5% deflection mandrel no less than 30 days following the completion of compaction.

3.5 CLEANUP

A. After completing each section of the sewer line, all debris and construction materials shall be removed from the work site and disposed of in compliance with all applicable laws and regulations and with Section 02321, paragraph 3.4. Then the surface shall be graded and smoothed on both sides of the line. The entire area shall be left clean and in a condition satisfactory to the Owner or Owner’s Representative. The Contractor shall keep cleanup operations as close to active pipe laying activities as practical, generally following by less than 300 feet, or as approved by the Owner or Owner’s Representative.

END OF SECTION
SECTION 33.40.00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Plans and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Storm drainage pipe work including furnishing and installation of pipes, joint materials, and couplings.
2. Storm drainage structures including furnishing and installation of manholes, catch basins, area drains, and other structures incidental to the construction of storm sewers.

B. Related Sections:

1. Section 312000 – Earthwork for excavation (defined as unclassified) for pipe trenches and structures and backfill.

1.3 DEFINITIONS

A. The diameter of pipe culverts and storm drains shown on the project drawings and bid schedule are based on Manning's n-value of 0.013, pipes flowing full, and the slopes shown on the Plans and profiles. If alternative materials and types of pipe culverts and storm drains are used, alter the diameter of the pipe shown to accommodate the required flow.

B. The length of pipe as shown on the Plans is based on its in place length as measured along the centerline with no deductions for storm structures. Actual quantity of pipe may vary; supply and install the necessary quantity of pipe to construct the complete system.

1.4 SUBMITTALS

A. Submittals shall be in electronic form (via email) and shall be stamped by the Contractor. Submit to the Owner or Owner’s representative.

B. Submit shop drawings for material substitutions. Do not submit shop drawings for materials that are consistent with the plans. These submittals will be marked "Not Requested for Review" and returned.

C. Results of the mandrel and deflection tests for each line of pipe.
1.5 QUALITY ASSURANCE

A. Provide and maintain a quality control system that will provide reasonable assurance that materials and construction conform to the specified requirements.

1.6 DELIVERY, STORAGE, & HANDLING

A. Delivery, storage, and handling shall be in accordance with these specifications and the manufacturer’s requirements.

B. All pipe, structures, and appurtenances shall be inspected and accepted by an approved commercial testing laboratory prior to delivery to the work site. Each joint and each structure shall be stenciled or otherwise marked with the laboratory's mark of acceptance. Furnish the Engineer with a certified copy (via email) of the laboratory's report of inspection, test, and acceptance on all pipe and appurtenances prior to its incorporation in the work.

1.7 PROJECT CONDITIONS

A. Verify the locations of the existing underground utilities by contacting the utility owners and by potholing in the field.

B. Notify the utility owners prior to beginning work.

PART 2 - PRODUCTS

2.1 SEWER PIPE MATERIALS

A. Reinforced Concrete Pipe (RCP): All concrete sewer pipe with an internal diameter of 15 inches or less shall be extra strength sewer pipe conforming to ASTM C14. All concrete pipe with an internal diameter of 18 inches or more shall be Class III reinforced concrete pipe conforming to ASTM C76. Horizontal elliptical shall conform to C-507 Class HE-II, HE-III, or HE-IV as specified on the drawings.

B. Corrugated Metal Pipe (CMP): Shall conform to the requirements of AASHTO M36 specifications for corrugated metal culvert pipe or AASHTO M 196 for aluminum coated steel pipe. Pipe diameters of 18-inches or smaller shall be 14-gauge minimum. Pipe diameters from 24-inch to 48-inch shall be 12-gauge minimum. Pipe diameters of 54-inch or greater shall be 10-gauge minimum.

C. High Density Polyethylene (HDPE) Pipe: Pipe and appurtenances shall be high density polyethylene (HDPE) conforming to the requirements of ASTM F2306/F2306M-05. The pipe shall have a smooth interior and annular-corrugated exterior.
2.2 STORM PIPE ACCESSORIES

A. Joint Materials:

1. Cement Mortar Joints: Joints shall consist of a mixture of 1 part standard portland cement, 2 parts sand, and enough water to produce a uniform mixture of proper consistency and workability that will adhere to the pipe. The cement, sand, and water shall be in conformity with the applicable provisions of Section 03301, Concrete Work. Do not use mortar that has been mixed longer than 30 minutes for making pipe joints.

2. Asphaltic Joints: Jointing compounds shall be equivalent in quality and type to GK asphaltic jointing compound. The selection by the Contractor of an asphaltic jointing compound shall be approved by the Engineer prior to the purchase or use of same. Furnish the Engineer with complete technical and construction data on the jointing compound to be approved.

3. Rubber Gasket Joints: The bell and spigot and the tongue and groove of the pipe shall be specially manufactured and prepared for the use of the type of joint selected. The rubber gaskets shall be watertight (WT) and meet the requirements of ASTM F2306, AASHTO M252, or AASHTO 294.

4. O-Ring Rubber Gasket Joints: Joints shall consist of a bell and spigot type joint with an O-ring rubber gasket that is watertight (WT) meeting the requirements of ASTM F477.

B. Couplings: Couplings shall be of the same material and as the pipe and corrugated to match the corrugations. Couplings shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Use bell and spigot, split collar, or screw-on collar couplings.

2.3 STRUCTURES AND APPURTEANCES

A. Catch basins, manholes, and area drains shall be precast concrete as shown on the Plans or as otherwise directed by the Engineer. Precast concrete shall meet the applicable requirements of ASTM C478 with a minimum $f'c = 4,000$ psi.

B. Brick: Grade SM, ASTM C32, or concrete brick conforming to the requirements of ASTM C55, Grade N-I.

C. Grates, Frames, And Curb Castings: Conforming to the requirements of ASTM A-48, Class 30. Machining of contact surfaces will be required so that covers and grates rest securely on the frames.


E. Mortar: Shall be composed of one part Portland cement and 2 parts sand (volumetric measure). Mortar that has been mixed for more than 30 minutes which has been retempered or which has "set" shall not be used in the work.

F. Headwalls and End Sections: Shall be precast concrete as shown on the Plans or as otherwise directed by the Engineer.
PART 3 - EXECUTION

3.1 PIPELINE CONSTRUCTION

A. Carefully protect all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work from damage at all times. Wherever it is necessary for the proper accomplishment of the work to repair, remove, and/or replace any utility or structure, do so in accordance with the provisions set forth in the General and Supplementary Conditions.

B. Before constructing or placing joints, demonstrate to the Engineer, by completing at least one sample joint, that the methods employed conform to the specifications and will provide a watertight joint, and further that the workmen intended for use on this phase of the work are thoroughly familiar and experienced with the type of joint proposed.

C. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in the Earthwork section.

D. Wherever necessary to provide a satisfactory bearing surface, place concrete cradles as shown on the drawings or as directed by the Engineer. Cradles shall be of concrete with $f'_c = 4,000$ psi, as defined by ACI standards, and shall conform to the dimensions shown on the detailed Plans.

E. Tightly stretch a mason's line or wire above the ground level, parallel to and directly above the axis of the pipe to be installed; this line is to be supported at intervals of no more than 50 feet on sewers being laid on a grade of 2% or more and not exceeding 25 feet for grades of less than 2%. Determine the exact line and grade for each section of pipe by measuring down from this line to the invert of the pipe in place. Accurately place each pipe to the exact line and grade called for on the drawings. Furnish all labor and materials necessary for erecting batter boards. The use of laser beams will be allowed.

F. Do not allow water to run or stand in the trench while pipe laying is in progress, before the joint has completely set, or before the trench has been backfilled. Do not at any time open up more trench than the available pumping facilities are able to dewater.

G. Correct trench bottoms found to be unsuitable for foundations after pipe laying operations have been started, and bring them to exact line and grade with compacted earth as necessary.

H. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade.

I. Bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Cut bell holes out not more than 10 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel will rest on a solid foundation for its entire length. Lay each pipe joint so as to form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.

J. Jointing operations shall follow pipe laying very closely; failure to comply with this provision will result in the Engineer stopping all pipe laying operations until jointing operations catch up.
K. After the joints have been completed, they shall be inspected, tested, and accepted by the Engineer before they can be covered. The pipe shall meet test requirements for watertightness; immediately repair any leaks or defects discovered at any time after completion of the work. Take up any pipe that has been disturbed after joints were formed; clean and remake the joints; and relay the pipe at the Contractor's expense. Carefully protect all pipe in place from damage until backfill operations are completed.

L. Do not begin the backfilling of trenches until the pipe in place has been inspected and approved by the Engineer. Backfilling shall be performed in accordance with the requirements provided in the Earthwork section.

M. As the work progresses, thoroughly clean the interior of all pipe in place. On small pipe, keep a swab or drag in the pipeline, and pull forward past each joint immediately after it has been made. After laying each line of pipe, carefully inspect it, and remove all earth, trash, rags, and other foreign matter from its interior.

3.2 JOINT CONSTRUCTION

A. Cement Mortar Joints: Roll a gasket of jute or oakum thick enough to fill completely the annular space between the bell of one pipe and the spigot of another. This gasket shall be thoroughly saturated in a cement grout composed of neat portland cement and clean water mixed to the heaviest fluid consistency that will thoroughly impregnate gasket material to the Engineer's satisfaction. Then lay the gasket in the bell in the lower 1/3 of the circumference of the joint, and cover with mortar. Insert the spigot of the pipe, and carefully drive home; then insert a small amount of mortar into the annular space around the entire circumference of the pipe.

B. Wrap the ends of the gasket around one pipe, and solidly ram into the joint with a caulking tool. The depth of caulking shall be such as will leave a space of approximately 1-1/2 inches in pipe 18 inches and less in diameter or of 2-1/4 inches in pipe 21 inches and larger in diameter, measured from the end of the bell. Drive the mortar previously placed ahead of the gasket. Then fill the joints with Portland cement mortar. This mortar must be placed by hand; take care to fill the joint completely entirely around the pipe by pushing the mortar in by hand, using a rubber glove with fingers and a wooden caulking tool. Bevel the joints off at an angle of 45 degrees with the outside of the pipe, and protect with a wetted strip of muslin placed completely around the joint.

C. Make joints in tongue and groove pipe with cement mortar in the manner specified above for bell and spigot pipe, except that the gasket material shall be omitted and both the outside and inside surfaces of the joints shall be wiped smooth. When modified tongue and groove pipe is used, bevel the joints off at an angle of 45 degrees with the outside of the pipe, and protect with muslin as specified above for bell and spigot pipe.

D. Asphaltic Joints: Install asphaltic joints in accordance with the manufacturer's recommendations and specifications in respect to heating, pouring, and joint construction. When asphaltic jointing compound is used, alternate joints may be poured before the 2 sections are lowered into the trench. In such cases, the joint must be allowed to set before placing and the bottom of the trench carefully graded to provide uniform bearing after the pipes are placed in final position.
E. Rubber Joints: Rubber gaskets and the method of joint construction shall form a flexible watertight seal and shall be in strict compliance with the manufacturer's directions and requirements. Adequately lubricate the gaskets with special cement provided for this purpose. Pipe joints shall be adequately and thoroughly driven home or seated.

F. O-Ring Rubber Gasket Joints: O-ring rubber gasket joints shall be placed on the spigot end at least two corrugations of the spigot must insert into the bell end.

G. Couplings: Install couplings in accordance with the manufacturer’s specifications. Split collar couplings shall engage at least two full corrugations on each pipe section and screw-on collars shall be in width at least one-half the nominal diameter of the pipe.

3.3 WYES AND TEES

A. Install wyes and tee branches in the sewer line as shown on the drawings and/or at such other locations as may be designated by the Engineer. If such branches are not to be used immediately, close them with manufacturer approved stoppers.

3.4 CONNECTIONS

A. Make connections to all existing sewer lines as shown on the Plans or as directed by the Engineer. Make connections either by removing a section of the sewer from the existing line and inserting in the space a wye branch of the proper size or by constructing a manhole, junction box, regulator chamber, or other structure as shown on the Plans.

B. Make connections to existing manholes or inlets by cutting a hole in the wall of the existing structure, inserting a length of pipe into the hole, filling around the pipe with concrete or mortar, and troweling the inside and outside surfaces of the joint to a neat finish. Shape or reshape the bottoms of manholes as necessary to fit the invert of the sewer pipe.

3.5 PIPE PROTECTION

A. Construction loads may exceed design loads. These heavy loads can cause damage if construction equipment crosses over the installed pipe before adequate fill has been placed or moves too close to the trench walls, creating unbalanced loadings. Provide additional protective fill or other appropriate protection at equipment crossings.

B. If pipe sewer has less than 1-1/2 feet of cover when completed, provide concrete protection as shown on the drawings or required by the Engineer. Place the protection in accordance with the Plans.

3.6 INSTALLATION OF STRUCTURES AND APPURTENANCES

A. Construct inlets to the sizes, shapes, and dimensions shown on the drawings or as directed by the Engineer to meet special conditions. Excavate for structures in accordance with the applicable provisions of the Earthwork section.
B. Where inlets are to be constructed in existing pavements and/or curbs and gutters, cut such pavements and/or curbs and gutters to a neat line with an air hammer or other suitable equipment, removing no more pavement and/or curb and gutter than is essential.

C. Protect inlet foundations from damage by water and/or other causes. Place no concrete until the trench has been freed from water and/or mud, and maintain the trench in a reasonably dry condition during the progress of construction on structures.

D. When the foundation has been prepared and is approved by the Engineer, construct the bottom to the required line and grade. After the bottom has been allowed to set for a period of no less than 24 hours, construct the inlet thereon, taking care to form the pipe or pipes into the walls at the required elevations.

E. Lay brick in common bond with joints staggered from course to course. All joints at the face of wall shall be no more than 1/2 inch thick and shall be trowel struck joints to provide a clean, smooth wall surface. Wet each brick thoroughly by immersing it in water immediately before placement; lay each brick separately in a full and close joint of mortar on its bed, sides, and/or ends in one operation by shoving the brick into the mortar. Make no joints by working mortar into the joints, by grouting, or by "slushing" after the brick is in place. Brick work shall be plumb and in conformance with the drawing dimensions.

F. Whenever work is discontinued for any purpose, rack the unfinished brick masonry back into courses, and remove all mortar from exposed surfaces. When work is resumed, clean and thoroughly wet the exposed surfaces before adding any new work.

G. Carefully protect fresh brickwork against damage from freezing and against movement from any cause. Remove and properly rebuild any work that, in the opinion of the Engineer has been damaged by any cause either before or after backfilling.

H. Set all castings accurately to line and grade in full cement mortar beds on the brick masonry. Unless otherwise shown on the Plans and/or directed by the Engineer, set all grate frames no less than 1 inch below the normal grade of surrounding pavement and no less than 3 inches below the normal surface of unpaved areas; then slope the surrounding area to the grates on an approximate slope of 12:1. Mount frame in grout, secured to the top cone section to the elevation as indicated on the Plans.

I. After the masonry and frames have time to set, but in no case less than 24 hours, the space around the drainage structure shall be backfilled and compacted to the required grade and as specified in the Earthwork section.

J. Install headwalls and/or end sections as shown on the Plans and in accordance with the manufacturer’s specifications.

3.7 FIELD QUALITY CONTROL

A. After backfilling and the embankment are complete and prior to placing the base, the contractor shall perform deflection and alignment tests on each line of pipe. For pipe diameters of less than 30-inches, deflection testing shall be performed using a 9-vane mandrel with a diameter that is 5% less than the nominal diameter of the pipe being tested. The mandrel vanes shall be equally spaced around the central core. At the Contractor’s expense, replace any line of pipe through which the mandrel does not freely pass.
B. For pipe diameters 30-inches or greater, deflection shall be tested as described above or may be checked by other means as approved by the Engineer. Pipe with a deflection of 5% or greater of the nominal pipe diameter or with undue misalignment shall be replaced at the contractor’s expense.

C. After backfill has been placed and compacted to a depth not less than one foot above top of pipe, a visual inspection shall be made by flashing a light between manholes. Any displacement or misalignment of invert shall be corrected.

D. Install drainage structures and pipes to the line, grade, and cross-section as shown on the Plans and with finish elevation not more than 0.04’ above or below the required elevation.

3.8 CLEANUP AND PROTECTION

A. After completing each section of storm drainage line, remove all debris and construction materials and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean, neat, and serviceable condition.

B. The interior of catch basins, area drains, and manholes shall be cleaned of debris and excess material, the grating or cover placed, and all unused material, equipment, tools, and debris removed from the area.

END OF SECTION