SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, and turf and grasses.
2. Excavating and backfilling for buildings and structures.
3. Subbase course for concrete walks and pavements.
4. Subbase course and base course for asphalt paving.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.
6. Testing requirements for testing agency.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
2. Division 01 Section “Execution” for underground utility location to be provided prior to all excavating work commencing.
3. Division 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
4. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

C. Unless noted otherwise, the Contractor shall excavate, backfill, grade, and replace site surface materials as required for the complete and proper execution and installation of all work. Work shall include, but is not necessarily limited to: excavation, backfilling, rough grading, and finish grading as required to allow for new construction including retaining walls, curbs, sidewalks, paving, landscaping, site utilities, mechanical services, electrical utilities, and all other miscellaneous items required.

D. For the basis of bidding, all excavation shall be assumed to be earth. In the event rock is encountered in the excavation, the contractor will be additionally compensated for the rock excavation as set forth in Division 01 Section "Contract Modification Procedures."

E. Use of explosives will not be permitted without the consent of the Owner.

1.3 UNIT PRICES

A. Specific work of this section is itemized as Unit Prices on the Bid Form to add or deduct specific units of work to the project. Unit Price descriptions, requirements and units of work are enumerated in Division 01 Section "Unit Prices." Unit Prices are inclusive of all labor, materials, overhead, and profit per unit of work indicated.

1. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.

1.4 ALLOWANCES

A. Work Included in the Base Bid: The Contractor shall include in the space provided on the Bid Form, the allowances for work of this section itemized on the Bid Form. The cost of these quantities shall be computed using the Unit Prices stated on the Bid Form. The work listed is in addition to that required to complete the work of the Contract and, consequently, the sum therefore may be deducted from the Contract amount if the corresponding work is not required by actual conditions encountered.

1.5 DEFINITIONS

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

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

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

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be provided by Contractor without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. PADOT or PennDOT: Pennsylvania Department of Transportation.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Rock Excavation by Hand: Removal of rock type materials by a worker using pneumatic vibrating chipper or air spade.
2. Rock Excavation by Ram Hammer: Removal of rock type materials using equipment equivalent to Caterpillar Model No. 320 GC track-mounted hydraulic excavator, equipped with a 42-inch-wide short-tip radius rock bucket, rated at not less than 145-hp flywheel power (150 9249) with bucket

force of not less than 28,000 lbs and stick force of not less than 22,000 lbs. This type of excavation shall be employed when other rock removal methods are ruled out as too dangerous to existing building and its stability.

3. Rock Excavation by Ripping: Removal of rock type materials using equipment equivalent to Caterpillar Model No. D8T, heavy-duty, track-type tractor rated at not less than 345-hp flywheel power and developing minimum of 50,000-lb pry-out force. Rock ripping method shall be attempted for all bulk rock excavation as it is encountered at the site; however, this method shall be limited to bulk rock excavation work only. Existing site rock which cannot be ripped with ripper tractors, as determined by trial ripping, and verified by the Architect, shall be excavated by rock excavation methods employing drilling and blasting and only when agreed to by the Owner.

J. 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.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. 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.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Controlled low-strength material, including design mixture.
2. Warning tapes.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

C. Topsoil Analysis Report: Contractor is responsible to have on-site topsoil tested and new (import) topsoil tested by qualified agronomist. Prior to seeding, verify necessary soil amendments. Copies of test results to be submitted for review and approval.

D. Preexcavation Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins. Failure by the Contractor to do so shall prevent Contractor from submitting claims for additional cost required to correct any damage identified after earth moving activities commence.

1.8 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 REGULATORY REQUIREMENTS

A. Comply with all applicable federal, state, and local codes, ordinances, and regulations, in addition to the following:

1. International Building Code, Chapter 18 "Soils and Foundations."
2. The Commonwealth of Pennsylvania Department of Transportation Specifications, Publication 408, latest edition.
3. Department of Environmental Protection publications relative to work required.

B. These regulatory requirements shall form a part of these specifications as if physically attached hereto. In case of conflict, the provisions ensuring the greater public safety shall govern.

1.10 PREINSTALLATION MEETINGS

A. Preexcavation Conference: Conduct conference at Project site.

1. Review specification requirements.
2. Review regulatory requirements
3. Review installation procedures.
4. Review all site and foundation drawings
5. Inspect project conditions.
6. Coordination of work with utility location service.
7. Field quality control.

1.11 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

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

B. Notify utility locator service "PA One Call" for area where Project is located a minimum of one week before beginning earth moving operations. Where utilities are indicated to remain, provide adequate means of support and protection during earthwork operations.

1. In addition to the PA One Call, Contractor shall utilize ground-penetrating radar as indicated in Division 01 Section “Execution” to confirm and locate all underground utilities.
2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for direction. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Any damaged utilities shall be repaired at the Contractor’s expense and to the satisfaction of the utility Owner and Architect.

3. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.

    a. Provide minimum of 48-hour notice to Architect and Owner's Representative and receive written notice to proceed before interrupting any utility.

4. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," are in place.

D. Do not commence earth moving operations until plant-protection measures are in place.

E. Do not commence earth moving operations until utility location work required by Division 01 Section “Execution” is complete.

F. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
3. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

G. Provide traffic control for excavation within and adjacent to state roads and their right-of-way.

1. Comply with authorities having jurisdiction for traffic control.
2. Refer to PADOT Publication 213, Temporary Traffic Control Guidelines for short or long term operations as applicable.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Backfill and fill: Satisfactory soil materials, unless otherwise indicated.

F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Structural (Engineered) Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve (common name of “2A Modified” Stone).

H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

K. Sand: ASTM C 33; fine aggregate.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

M. Non-Structural Backfill and Fill Materials (for Lawn Areas): Excavated soil materials free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

2.2 TOPSOIL

A. Acceptable topsoil shall be stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide (at no additional cost) additional topsoil as required to complete landscape work.

B. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.

1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.
2. Topsoil shall be a loam or sandy loam. The particle gradation of the topsoil shall be within the following range as a percentage of the total mix:

    a. Sand (0.500 MM to 0.050 MM) up to 80%.
    b. Silt (0.050 MM to 0.005 MM) up to 25%.
    c. Clay (0.003 MM and smaller) up to 10%.

3. Ideal Topsoil Nutrients: All topsoil for lawns (both on-site and new) to receive proper amendments so nutrients fall within the following guidelines:

Element	Ideal Range
pH	6.8
P O	300.00 lbs.
K O	3.5%
Ca	65.0%
Mg	10.0%

Element	Ideal Range
B	1.2 ppm
Fe	200.0 ppm
Mn	20-85 ppm
Cu	0.5-3.0 ppm
Zn	3-10.0 ppm

C. New Topsoil: Before delivery of topsoil, furnish Architect with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years. Submit a sample for review and approval. Contractor will be responsible to test new topsoil to determine the soil amendments necessary for lawns or planting areas. Copies of test results to be submitted for review and approval.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils 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 deep; colored as follows:

1. Red: Electric.
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. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
3. Maintain dewatering until dewatering is no longer required.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth. Do not excavate rock until it has been classified and cross sectioned by Architect or Owner's Representative. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs-on-grade.
f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
g. Depth required for minimum scheduled aggregate base and paving under bituminous paving.
h. 6" below bottom of topsoil under lawn and planting areas.

3. Contractor shall keep a running account of all rock excavation completed and shall have the Owner's Representative sign off on quantities daily. A specifically designated set of plans shall be kept noting location, quantity, type of excavation and date of removal for all rock excavation, and each quantity shall be initialed by Architect directly on this plan signifying agreement to its removal. When all excavation work is completed, this rock excavation report shall be submitted to

the Architect to serve as a permanent record of rock excavation work completed. Cost for rock removal shall be based on the following payment System for Classified Rock Excavation:

a. Condition A: Owner shall be given a credit for the unperformed earth excavation replaced by rock excavation. Contractor will be paid an extra to cover the additional rock excavation. The credit for unperformed earth excavation and the extra for rock excavation shall be computed by multiplying the quantity by the applicable Unit Price stated in the Bid Form.
b. Condition B: Extra excavation is ordered over and above contract requirements. Contractor will be compensated for this excavation by multiplying the additional quantity by the applicable Unit Price stated in the Bid Form.
c. Condition C: Unit Prices submitted for rock excavation are determined to be unbalanced or unreasonable and hence rejected. Rock excavation shall proceed on a time and material cost basis acceptable to all parties, following Architect's written instructions. Owner shall be given credit for the unperformed earth excavation replaced by rock excavation.

3.4 STABILITY OF EXCAVATIONS

A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope or bench sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses. Remove shoring and bracing when no longer required.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 6-9 inches each side of pipe or conduit or as indicated, whichever is greater.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.8 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

B. Cold Weather Protection of Interior Column Footings: During cold weather, the General Contractor shall take whatever measures are necessary to protect the interior column footings from heaving due to frost. The Contractor, at its option, may pour the interior footings lower than the elevations noted on the foundation plans, at no additional cost to the Owner. Any change to the Contract Drawings shall first be reviewed and accepted by the Architect and/or Engineer.

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Legally dispose of excess excavated soil material and materials not acceptable for use as backfill or fill at an acceptable off-site location.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Surveying locations of underground utilities for Record Documents.
2. Testing and inspecting underground utilities.
3. Removing trash and debris.
4. Removing temporary shoring and bracing, and sheeting.
5. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03 Section "Cast-in-Place Concrete"

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 PLACEMENT PREPARATION

A. Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructing and deleterious materials from ground surface prior to placement of fill.

3.15 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use clean, approved satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material or imported structural fill.
3. Under steps and ramps, use structural fill.
4. Under building slabs, use structural fill up to the 4 inch of crushed stone base.
5. Under footings and foundations, use structural fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. Import fill included in the Base Bid and at no additional cost to Owner.

1. Under Sidewalks, Steps, Foundations, and Ramps (Structural Fill): Number 2A crushed aggregate in accordance with PADOT-408, Section 703, for use to bring subgrade up to required elevation.

3.16 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials 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.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry density according to ASTM D 1557:

1. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
2. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

D. Footings, structural fill and stone bases shall not be placed until subgrade is approved by the Testing Laboratory's Soils Engineer.

3.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.
4. Swales: Finish swales to ensure proper flow and drainage. Conduct final rolling operations to produce hard, uniform and smooth cross-section.

C. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.19 TOPSOILING

A. After the areas required to be topsoiled have been brought to the subgrades shown on the Drawings, and immediately prior to dumping and spreading the topsoil, loosen the subgrade, wherever excessively compacted by traffic or other causes, by discing or by scarifying to a depth of at least 3 inches, to permit bonding of the topsoil to the subgrade.

B. Spread topsoil uniformly on all areas not covered by paving or other construction and evenly spread to a thickness of 6 inches. The spreading shall be performed in such a manner that seeding can proceed with little additional soil preparation or tillage. Correct irregularities in the surface resulting from topsoiling or other operations in order to prevent the formation of depressions where water will stand. Do not place when subgrade is excessively wet, extremely dry or in a condition otherwise detrimental to proper grading.

C. After the topsoil has been spread and graded as required, clear surface of all stones, stumps, or other objects larger than 1 inch in thickness or diameter and of all roots, brush, wire, grade stakes, or other objects. Keep paved areas, over which hauling operations are conducted, clean.

D. Where any portion of the surface becomes gullied or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoiling and then re-topsoil.

3.20 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
3. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Contractor shall engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Contractor shall engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, (sandcone method) and ASTM D 2167 (rubber balloon method), ASTM D 2922 (nuclear method), as applicable. Tests will be performed at the following locations and frequencies:

1. Test bottom of excavation using drop penetration bar consisting of 1 inch diameter rod, 8 foot long, with collar securely welded at center. Raise 25 pound sliding weight to top of rod and allow to drop, striking collar and driving rod into soil. Record number of blows for each foot of penetration and determine the soil bearing pressure.

2. Paved Areas Subgrade: Soil, fill, structural fill, and backfilling in all areas throughout the project shall be tested, including plumbing, electrical and HVAC trenches. The Contractor's selected Testing Laboratory shall perform, as a minimum, the following tests:

a. Field test of compacted fill for moisture content and dry weight of compacted soils. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 2000 sq.ft. of each 16" loose layer of fill under bituminous paved areas.
b. Field density compaction test for density of soil in place. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 2000 sq.ft. of each 16" loose layer of fill under bituminous paved areas.

c. Approve the subgrade and fill material as suitable for percentage compaction specified, identify soil type by ASTM D 2487 classification, and give moisture content by ASTM D 1557 – Modified Proctor Test. Soils Engineer from testing laboratory shall recommend compaction equipment and work methods required to achieve compaction specified. Submit copy of all test data and recommendations to Architect, all field compaction work shall follow these recommendations.

d. If in opinion of Architect, based on testing laboratory reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

3. Lawn Areas: Soil, fill, and backfilling in all areas throughout the project shall be tested, including plumbing, electrical and HVAC trenches. The Contractor's selected Testing Laboratory shall perform as a minimum, the following tests:

a. Field test of compacted fill for moisture content and dry weight of compacted soils. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 5,000 sq.ft. of each loose layer of fill under lawns.

b. Field density compaction test for density of soil in place. One test per 50 lineal feet per 16" of backfill depth for trenches, and parallel to backfilled foundation walls. One test for each 5,000 sq.ft. of each 16" loose layer of fill under lawns.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00