SECTION 02200
EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Soil Testing and Field Quality Control.

B. Related Sections:

1. Section 01400 - Quality Control.
2. Section 02010 - Subsurface Exploration: For Contractor's information and reference.
3. Section 02110 - Site Clearing
4. Section 02111 – Tree and Plant Protection
5. Section 02221 - Trenching, Backfilling, Compacting: Pipe bedding and coverage materials including placement procedures.

1.2 INTENT:

1.3 CODES AND STANDARDS:

A. The most recent City of Boulder Design & Construction Standards are incorporated by reference into the University Standards. When there is a conflict between standards, the more stringent requirement shall apply. The University’s Civil must approve in writing any deviation from these standards prior to construction.

1.4 QUALITY ASSURANCE:

A. Perform all earthwork operations in conformance to the requirements herein specified. The Contractor may refer to the City of Boulder, Colorado Design and Construction Standards, most recent edition, for work not covered in this standard. The University of Colorado at Boulder Utilities Engineer shall approve the use of particular City of Boulder standards.

B. Pre-Installation Conference: Prior to the start of the work of this section, conduct a pre-installation conference with Contractor, Owner, Architect, and Soils Engineer to discuss the following:

1. Site preparation.
2. Grading specifications.
3. Equipment to be used.
4. Unusual soil conditions.
5. Special requirements.

C. Test Reports-Excavating, Filling and Grading:

1. The following tests are generally performed by the Owner's testing laboratory. Copies of test reports may be available to the Contractor. Coordinate with the Owner to determine
which test information will be provided.

a. Field density reports for fills and backfills.
b. Testing reports on borrow material, including mechanical analysis, moisture-density curve and plasticity index.
c. Verification of each footing subgrade.
d. One optimum moisture-maximum density curve for each type of soil encountered.
e. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.

1.3 SUBMITTALS:

A. Submit six copies of a report from a testing laboratory verifying that the material conforms to the gradation specified. This includes on-site materials that will be reused.

B. Dewatering plan including disposition of groundwater is required for University review. Also include a copy of any applicable and completed discharge permit, if required.

1.4 PROJECT/SITE CONDITIONS:

A. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
2. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn by Contractor.
3. Data are made available for the convenience of the Contractor.
4. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Owner.

B. Use of Explosives: The use of explosives is not permitted.

C. Existing Utilities:

1. At least 48 hours prior to starting any work disturbing, moving or penetrating the ground, contact the Utility Notification Center of Colorado, 534-6700 or 1-800-922-1987, to locate, stake and identify depth of all buried utilities within the construction limits.
2. Locate existing underground utilities in the areas of work. Protect utilities to remain.
3. The existence and location of underground utilities and construction indicated as existing are not guaranteed. Excavate carefully so as not to damage uncharted utilities.
4. Should uncharted, or incorrectly charted, utilities be encountered, notify the Owner immediately for directions.
5. Do not interrupt existing utilities without Utility Owner's consent and, pending approval by the affected building users. Approval of affected users must be obtained at least 72 hours in advance of interruption.
6. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with appropriate utility provider or University Engineer for shut-off of services if lines are active.
D. Protect structures, utilities, and all other improvements from damage during earthwork operations. If structures, utilities or other improvements are damaged, replace them in the same or better condition.

E. Water-Jet using a truck mounted system and videotape storm sewers where debris may have accumulated. Comply with Section 02722 requirements. This must be completed prior to acceptance by the University. University fire hydrants are not to be used for flushing purposes.

F. Contractor is required to maintain adjacent sidewalks and streets free of dirt accumulation arising out of earthwork.

PART 2 - MATERIALS

2.1 SOIL:

A. Earth backfill and earth fill shall be excavated material that is free from organic matter, roots, debris, and rocks larger than 3 inches in the greatest dimension.

B. If sufficient earthwork material to complete the work is not available at the site, the contractor shall secure his own source of material and necessary permits to complete the project requirements.

C. All soil materials to be used, whether from on or off-site, must be approved by the Soils Engineer as suitable for intended use and specifically for required location or purpose.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Follow the City of Boulder’s Design and Construction Standards, section 9.02(c).

3.2 SITE GRADING:

A. Perform earthwork to the lines and grades shown in the drawings. Shape, trim and finish slopes of channels to conform with the lines, grades and cross sections as shown. Remove exposed roots and loose rocks exceeding 3 inches in diameter. Round tops of banks to circular curves to not less than a 6-foot radius. Neatly and smoothly trim rounded surfaces. Do not over-excavate and backfill to achieve the proper grade.

3.3 SITE PREPARATION:

All sites to be occupied by permanent construction or embankments shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleared and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of the Contractor.

In natural areas where excavation will occur, strip all topsoil, or in the absence of topsoil, strip the top six (6) inches of surface material and store separately from other excavated materials.
For concrete walks, roadways, parking areas and road crossings, saw-cut existing pavement full depth to a true line before excavation.

### 3.4 STABILITY OF SITE EXCAVATIONS:

A. Slope sides of excavations to comply with local codes, EPA and OSHA requirements, and soil engineers recommendations. Shore and brace where sloping is not possible, or permitted.

B. Shoring:
   i. Any damage to new or existing pipes or structures resulting from settlements, heaving, water or earth pressures, slides, caving, or other causes, due to lack of shoring, sheeting, or bracing, or due to failure of shoring, or due to improper shoring, or due to any other negligence on the part of the contractor, shall be repaired at the contractor’s expense.

### 3.5 DEWATERING:

A. Remove surface and subsurface water from excavations. Do not allow water to accumulate in excavations. Do not use footing or foundation trenches for temporary drainage ditches. Coordinate with Owner where water is to be discharged.

B. If applicable, obtain and comply with discharge permit or recommendations from federal and state regulatory authorities, prior to commencing dewatering operations.

### 3.6 PLACEMENT AND BACKFILL:

A. Earthfills and Embankments
   To the maximum extent available, excess suitable material obtained from structure and trench excavations shall be used for construction of fills and embankments.

   All material deposited in fills and embankments shall be free from rocks or stones, brush, stumps, logs, roots, debris, and organic or other objectionable materials, and shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content.

B. Excavation is unclassified. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate earthmoving equipment within 5 feet of walls of existing structures or newly completed construction. Place and compact fill or backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

C. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, perimeter drainage, perimeter insulation, and basement and first floor slabs unless foundations are braced to prevent damage and movement.
   2. Inspection, testing, approval, and recording locations of underground utilities.

D. Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.
E. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content.

F. The University may employ a geotechnical engineer to perform independent tests for compaction, moisture content, etc. The contractor must improve of any work that does not meet the requirements of these specifications.

3.7 MOISTURE CONTROL OF BACKFILLS AND EMBANKMENTS:

During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the backfill material. Maintain moisture content uniform throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the backfill material. At the time of compaction, the water content of the material shall be at optimum water content or within 2 percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

3.8 COMPACTION:

A. Compact soil to not less than the following percentage of maximum dry density determined in accordance with either ASTM D698 or D1557.

1. Structural Fills Below Footings: Compact top 12" of subgrade and each layer of backfill or fill material to 100% maximum dry density.  
2. Structural Fills Below Interior Slabs: Compact top 9" of subgrade and each layer of backfill or fill material to 95% maximum dry density. 
3. Foundation and Retaining Wall Backfill: Compact each layer of backfill material to 95% maximum dry density.

4. Exterior Slabs, Steps, Walkways, Pavements: Compact top 6" of subgrade and each layer of backfill and fill material at 95% maximum dry density.

5. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum dry density.

6. All Deep Fill Areas (Fills Over 12 ft Depth): Comply with above requirements, except compact each layer of backfill or fill material between 98% and 100% maximum dry density.

3.9 FIELD QUALITY CONTROL:

A. Quality Control Testing During Construction:

1. Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

2. Testing agency will test as follows: Field density tests in accordance with ASTM D2922 or D1556. Check calibration curves furnished with moisture gages in accordance with ASTM D3017.

Contractor will schedule the subsequent compaction tests during the course of the work by contacting the soils testing firm and setting the date and time for the testing. Testing
frequency shall be determined by the soils engineer, however the frequency shall not exceed more than 150 linear feet in trenching holes. Various depths shall be observed and tested by the soils testing agency during the backfill operations.

3. Coordinate with the Owner to schedule initial testing of first lifts of structural fill. Owner reserves the option to provide continual observation.

4. Project Manager to provide test results to Parking and Transportation Services (PTS) when impacting parking facilities.

B. Test Evaluation:

1. If in opinion of the Architect, based on testing service reports and inspections, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to Owner.

3.10 SETTLING:

A. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), excavate as directed, add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

B. All backfill shall be maintained in a satisfactory condition and all places showing signs of settlement shall be filled and maintained for a period of one (1) year following the date of final acceptance of all work. When the contractor discovers or is notified by the Owner that any backfill is not in compliance with the project standards, the contractor shall correct such conditions. The contractor shall repair any utilities and road surfacing damaged by such settlement to the satisfaction of the Owner. In addition, the contractor shall be responsible for the cost to the Owner of all claims for damages due to settlement of backfilled areas.

3.11 DISPOSAL OF EXCESS AND WASTE MATERIALS:

A. No area is available adjacent to the site for storage of excess fill material.

B. Trash, debris, waste and excess materials shall be removed from the Owner’s property and legally dispose of by the contractor at his expense.

END OF SECTION 02200