

SECTION 02200 – EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers earthwork associated with general excavation, backfill and compaction required for the Work.
- B. This section also covers the handling, storage, transportation and disposal of all excavated material; sheeting and shoring, subgrade preparation, dewatering as necessary or required, protection of adjacent property, construction of fills and embankments, surfacing and grading; and other appurtenant work.
- C. Additional requirements for excavation, backfill and compaction for trenching can be found in Section 02250 – Trenching, Pipe Embedment and Backfill.

1.02 SPECIFICATION MODIFICATIONS

- A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements or as otherwise indicated on the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 00700 – General Conditions.
- B. Section 01000 – General Project Requirements.
- C. Section 01015 – Specific Project Requirements.
- D. Section 02180 – Clearing and Grubbing.
- E. Section 02190 – Demolition.
- F. Section 02250 – Trenching, Pipe Embedment and Backfill.
- G. Section 02230 – Geotextiles.
- H. Section 02930 – Seeding.
- I. Section 02931 – Sodding.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft³).
 - ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
 - ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - ASTM D4546 Standard Test Method for One-Dimensional Swell or Collapse of Soils.
 - ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

- C. City of Kansas City, Missouri Department of Public Works, Construction and Material Specifications (<http://kcmo.gov/publicworks/design-construction-standards/>) KCMO PW 2202, Subsection 2202, Untreated Compacted Aggregate.
- D. Kansas Department of Transportation, Standard Specification and Construction Manual, Division 1100, Aggregates.
- E. Missouri Department of Transportation, Missouri Standard Specifications for Highway Construction, Division 1000, Materials Details.

1.05 DEFINITIONS

- A. Paved Areas – Areas for which the final surfacing will be street pavement, shoulders, driveways, parking lots, curbs, gutters, sidewalks, gravel roads or other surface features.
- B. Unpaved Areas – Areas for which the final surfacing will be in a green space.

1.06 INFORMATION PROVIDED BY THE CITY

- A. As provided in the Contract Documents.

1.07 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Shop Drawings:
 - 1. Sheeting and Shoring Plan – Prior to excavation, the Contractor shall submit a shoring design that is signed and sealed by a registered professional engineer in the State of Missouri for all excavations greater than twenty (20) feet in depth (in accordance with 29 CFR Part 1926 - OSHA Subpart P - Excavations and Trenches). Submittal will be for informational purposes only.
- C. Testing Reports:
 - 1. Laboratory testing results for proposed Borrow Materials.
 - 2. Laboratory testing results and quarry control reports for Granular Material.
 - 3. Laboratory testing results for and quarry control reports Granular Bedding.
 - 4. Moisture-density (Proctor) test results.
 - 5. In-Place Density test results.
- D. Other Submittals:
 - 1. Commercial Laboratory – submit name, contact information and certification of the commercial testing laboratory required by paragraph 1.08.
 - 2. Blasting (as applicable):
 - (a) Pre-blast survey.
 - (b) Monitoring Plan.
 - (c) Permit for blasting.
 - (d) Post-blast survey.

1.08 QUALITY ASSURANCE

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. Sampling and Testing:
 - 1. Tests to determine conformance with all requirements of this Specification for quality and properties of all Contractor-secured materials, including borrow materials proposed for use, shall be performed by an independent, state-certified, commercial laboratory retained and compensated by the Contractor and approved by the City/Design Professional.

2. All work associated with QUALITY ASSURANCE shall be included in the Bid Price and will be incidental to the Work. No separate measurement or payment will be made.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. The City will furnish the Site in accordance with Section 00700 – General Conditions.
- B. See Section 01000 – General Project Requirements, paragraph EASEMENTS AND RIGHT-OF-WAY for use of private property for delivery, storage and handling.
- C. Perform in a manner to prevent contamination or segregation of materials.

1.10 EXISTING UTILITIES

- A. The Contractor shall notify utilities prior to excavation in accordance with Section 00700 – General Conditions, Article 6 – Contractor’s Responsibilities, paragraph NOTIFICATION OF UTILITIES.
- B. Movement of construction machinery and equipment over pipes and utilities during construction is at the Contractor's sole risk.
- C. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand, start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.
- D. Support uncovered lines or other existing work affected by the excavation until approval for backfill is granted by the City.
- E. Report damage to utility lines or subsurface construction immediately to the City.

PART 2 - PRODUCTS

2.01 MATERIALS ENCOUNTERED

- A. Suitable Materials – Materials suitable for use in backfill, fill and embankment include job excavated or borrow material that is free of debris, roots, organic matter, frozen matter and shale particles/rock/stone or gravel with all dimensions less than 2 inches:
 1. Cohesion-less materials include gravels, gravel-sand mixtures, sands and gravelly sands; generally exclusive of clayey and silty material with the following properties:
 - (a) Free-draining.
 - (b) Impact compaction will not produce a well-defined moisture-density relationship curve.
 - (c) Maximum density by impact methods will generally be less than by vibratory methods.
 - (d) Generally less than 15% by dry weight of soil particles pass a No. 200 sieve.
 2. Cohesive materials include materials made up predominately of silts and clays generally exclusive of sands and gravel with the following properties:
 - (a) Impact compaction will produce a well-defined moisture-density relationship curve.
 - (b) Are not free draining.
- B. Unsuitable Materials – Materials unsuitable for use in backfill, fill and embankment include all material that contains debris, roots, organic matter, frozen matter, shale particles/rock/stone or gravel with any dimension greater than 2 inches.

Additionally, as determined by the City/Design Professional, any other materials that are too wet or otherwise unsuitable for providing a stable subgrade or stable foundation for structures or trenches.

C. Material used for embankment or fill:

1. For soils used below structural elements (such as: footings, slabs, pavements and mats), the portion of material passing the No. 40 sieve shall have a liquid limit not exceeding 40 and a plasticity index not exceeding 25 when tested in accordance with ASTM D4318.

2.02 TOPSOIL

- A. On-Site Topsoil – Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified herein. When available, topsoil must be existing surface soil stripped and stockpiled on the Site.
- B. Off-Site Topsoil – Conform to requirements specified herein. Additional topsoil must be furnished by the Contractor.
- C. Composition – Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 1- inch diameter, brush, weeds, toxic substances and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.
- D. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, debris and well suited to support plant growth.

2.03 SOIL CONDITIONS

- A. All Materials encountered, regardless of type, character composition and condition shall be considered "unclassified" for the purpose of payment. Determine quantity of various materials to be excavated prior to submitting Bid. Rock encountered shall be handled at no extra cost to City.

2.04 WASTE MATERIALS

- A. Waste materials, as described for purposes of this Section, consist of unsuitable materials such as: rock, surplus excavated material, demolition debris and other materials considered unacceptable for use as fill.
- B. Waste materials shall not include environmental pollutants, hazardous substances, contaminated products, by-products, samples or waste materials of any kind that are regulated under environmental laws.
- C. Dispose of Demolition Debris in accordance with Section 02190 – Demolition. Dispose of other waste materials in accordance with Paragraph DISPOSAL OF EXCAVATED MATERIALS.

2.05 BORROW MATERIALS

- A. Suitable fill materials, granular materials and topsoil obtained from locations arranged for by Contractor (off the Site) are required to the extent sufficient suitable materials cannot be obtained from excavation and trenching.
- B. Borrow materials shall not exhibit characteristics of high shrink or swell potential as determined from Atterberg limit tests (ASTM D4318) and/or swell tests (ASTM D4546) unless otherwise specified herein.

2.06 GRANULAR FILL MATERIAL

- A. Granular fill material shall consist of crushed stone, sand and gravel or reclaimed asphalt or concrete. The aggregate shall not contain more than 15 percent deleterious

rock and shale. The fraction passing the No. 40 sieve shall have a plasticity index not to exceed six. Any sand, silt, clay and any deleterious rock and shale shall be uniformly distributed throughout the material.

- B. Reclaimed asphalt or concrete materials meeting the requirements of aggregate must be approved for use by the City.
- C. Granular fill material shall be in accordance with the following gradation requirements defined in Table 1 below:

Table 1. Gradation for Granular Fill Material

Sieve Size	Mass Percent Passing		
	MoDOT Type 5	KDOT Type AB-3	KCMO PW 2202**
2 inch		100	
1 ½ inch		95 to 100	
1 ¼ inch			100
1 inch	100		72 to 100
¾ inch		70 to 95	60 to 90
½ inch	60 to 90		
3/8 inch			43 to 74
No. 4	35 to 60	40 to 65	28 to 60
No. 8		30 to 55	
No. 10			16 to 40
No. 30	10-35		
No. 40		16 to 40	3 to 22
No. 200	0-15	8 to 20*	0 to 15**

* For Type AB-3, the fraction passing the No. 200 sieve shall not exceed ¾ of the fraction passing the No. 40 sieve.

** For KCMO PW 2200, the difference between Mass Percent Passing of successive sieve sizes shall not exceed 25%. That fraction of material passing the No. 40 sieve shall have a plasticity index not to exceed 8.

1. MoDOT Type 5 material shall conform to Missouri Department of Transportation, Standard Specifications for Highway Construction, Section 1007, Type 5 Aggregate.
2. KDOT Type AB-3 material shall conform to Kansas Department of Transportation, Standard Specification and Construction Manual, Division 1100, Aggregates.

2.07 GEOTEXTILE

- A. Geotextile shall conform to the requirements of Section 02230 – Geotextiles.

2.08 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

- A. See Section 02250 – Trenching, Pipe Embedment and Backfill.

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Demolition shall be conducted in accordance with Section 02190 – Demolition.

3.02 CLEARING AND GRUBBING

- A. Perform clearing and grubbing, in accordance with Section 02180 – Clearing and Grubbing, as indicated and as required to perform the Work.

3.03 STRIPPING

- A. Stripping shall consist of scraping areas clean of all brush, grass, weeds, roots and other materials.
- B. Remove topsoil from areas within limits of excavation, trenching, borrow and areas designated to receive fill.
- C. Strip to a minimum depth of 6 inches, but to a sufficient depth to remove excessive roots in heavy vegetation, unsuitable material or brush areas and as required to remove all soil containing organic material or segregate topsoil.
- D. Stockpile topsoil in areas designated or approved by the City/Design Professional where it will not interfere with construction operations or existing facilities. Stabilize and protect stockpiles from runoff per the SWPPP plan.

3.04 GENERAL REQUIREMENTS FOR OPEN EXCAVATIONS

- A. Excavations shall be restored to the level of the adjacent surfaces as soon as practicable.
- B. Unsupervised or unprotected excavations are prohibited. The Contractor shall adhere to the City's no open excavation policy.
- C. Protective Measures in Paved Areas:
 - 1. Excavations within paved areas shall be protected and secured in accordance with existing federal, state and local codes and standards. This includes, but not limited to, the most current edition of the Manual of Uniform Traffic Control Devices.
- D. Protective Measures Unpaved Areas:
 - 1. Supervision – As a temporary measure, the Contractor may provide personnel to supervise an open excavation that is not otherwise protected. Supervision shall ensure that the public is protected and shall serve the same function as a protective cover or fencing. A protective cover or fencing shall be installed for all excavations that are not supervised.
 - 2. Protective Cover – A protective cover shall be installed over the excavation so that it can sustain the weight of any persons and/or objects placed upon it. The cover shall be of sufficient weight or fixed to the ground so it cannot be moved. Protective covers shall have no opening(s) or protuberance(s) of sufficient size to cause a fall or injury. Advance warning devices shall be installed as required by the City/Design Professional.
 - 3. Fencing – Any excavation that is not covered shall be fenced in so that it surrounds the entire excavation area and prevents entry. The fencing shall be a minimum of 42 inches in height. The fence shall be secured and upright at all times.
- E. Inspection and Maintenance – Protective measures (coverings and fences) shall be inspected by the Contractor at least daily to assure integrity. Protective measures in heavy traffic areas shall be inspected more often as necessary.

F. Excavation permits shall be secured prior to starting the work.

3.05 EXCAVATION

- A. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms.
- B. In no case shall excavation faces be undercut for extended footings.
- C. Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.
- D. Classification of Excavated Materials – No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition or condition thereof.

3.06 BLASTING

- A. Unless otherwise noted in Section 01015 – Specific Project Requirements, blasting or other use of explosives for excavation will not be permitted
- B. If allowed, blasting shall conform to all applicable ordinances, rules, regulations, permit requirements including Kansas City, Missouri Ordinance 180591 and the Missouri Blasting and Safety Act.
- C. Contractor shall provide a plan for pre-blast surveys, monitoring during blasting and post blast surveys to City prior to use of explosives.
- D. All existing safety regulations, permits, laws and ordinances regarding the storage, transportation and use of explosives shall be observed.
- E. Blasting will be permitted only when proper precautions are taken for the protection of all persons, the work, private property and public utilities from damage or injury. Any damage done by blasting will be repaired by the Contractor at no additional cost to the City.

3.07 DEWATERING

- A. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches or other parts of the Work.
- B. To prevent damage from hydrostatic pressure, flotation or other cause, all excavations shall be protected and kept dry during subgrade preparation and continually thereafter until the structure is built or the pipe is installed and the area is backfilled.
- C. All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12 inches or more below the bottom of the excavation.
- D. Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.
- E. If the material within the excavation becomes unsuitable or unstable as a result of the Contractor's inability to implement adequate surface diversion or dewatering measures, then the Contractor shall remove unsuitable materials and replace with approved compacted fill material as directed by City and at no additional cost to the City.
- F. Surface water and groundwater that contains silt and soil shall not be disposed of without pre-treatment.
- G. The Contractor is responsible for the condition of any pipe, conduit or drainage way which is utilized for drainage purposes. Any such pipe, conduit or drainage way utilized shall be left clean and free of sediment.

3.08 SHEETING AND SHORING

- A. The Contractor shall provide all shoring, bracing, cribbing, trench boxes, underpinning and sheeting as necessary to support excavations.
- B. The Contractor shall provide a Sheeting and Shoring Plan that includes provisions that will accomplish the following:
 - 1. Prevent undermining of pavements, foundations and slabs.
 - 2. Prevent slippage or movement in banks or slopes adjacent to the excavation.
 - 3. Allow for the abandonment of shoring and sheeting materials in place in critical areas as the Work is completed. In these areas, backfill the excavation to within 3 feet of the finished grade and remove the remaining exposed portion of the shoring before completing the backfill.
 - 4. Except where banks are cut back on a stable slope, excavations for structures shall be supported as necessary to prevent caving or sliding.
 - 5. Excavations shall provide adequate working space and clearances for the Work to be performed.
 - 6. Undercutting of excavation faces is prohibited.

3.09 BACKFILL AND COMPACTION

- A. See Section 02250 – Trenching, Pipe Embedment and Backfill for additional requirements.
- B. Fills and embankments shall be constructed to the lines and grades indicated on the Drawings, using suitable material or as specified in Section 01015 – Specific Project Requirements.
- C. Weather Limitations – Construction of fills and embankments during freezing weather shall not be done except by permission of the City/Design Professional. No fill or embankment materials shall be installed on frozen surfaces, nor shall froze material, snow or ice be placed in the fill or embankment.
- D. To the extent possible, excess suitable material obtained from trench excavation can be used for the construction of fills and embankments. Additional material shall be provided as required.
- E. After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that surface materials of the subgrade will be compacted and well bonded with the first layer of the fill or embankment and for subsequent layers.
- F. All fill and embankment materials shall be placed in layers not to exceed 8 inches in un-compacted thickness.
- G. Material deposited in piles or rows by excavating and hauling equipment shall be spread and leveled before compacting.
- H. No shale particles, rock, gravel or stone with any dimension greater than 2 inches shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so that they do not interfere with proper compaction.
- I. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted as follows:
 - 1. Unpaved Areas:
 - (a) 90% of maximum dry density at moisture content range from 3% below optimum to 2% above optimum as determined by ASTM D698.
 - (b) If the material fails to meet the density specified, compaction methods shall be altered.

2. Paved Areas:
 - (a) All subgrades below paved area and within 1 foot of a paved areas shall be compacted to 95% of maximum dry density at moisture content range from 3% below optimum to 2% above optimum as determined by ASTM D698 for the subgrade 1 foot outside of paved areas.
 - (b) If the material fails to meet the density specified, compaction methods shall be altered.
3. Project specific requirements for backfill and compaction may be modified in Section 01015 – Specific Project Requirements.
- J. Trenches in Embankments – Wherever a trench is to pass through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation not less than 36 inches above the top of pipe elevation before the trench is re-excavated.
- K. Unless otherwise specified in Section 01015 – Specific Project Requirements, trenches and pipes that pass through a water-containing embankment shall eliminate the granular embedment material and the trench bottom shall be graded to provide uniform and continuous support for the pipe. The pipe shall be embedded in embankment material containing no rocks, stones or other pervious material. The embedment material shall be compacted as specified for the embankment.

3.10 GRANULAR FILLS

- A. See Section 02250 – Trenching, Pipe Embedment and Backfill for additional requirements.
- B. Granular fill material shall be provided where indicated on the drawings.
- C. Granular fill material shall be placed on suitably prepared subgrades and compacted by vibration.
- D. Backfill and Compaction – The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted with a vibratory compactor to 95% of maximum dry density at moisture content range from 3% below optimum to 2% above optimum as determined by ASTM D698.
- E. If the material fails to meet the density specified, compaction methods shall be altered.
- F. Where granular fills are to be covered with concrete, the top surface shall be graded to the required subgrade.

3.11 FIELD QUALITY CONTROL

- A. See Section 02250 – Trenching, Pipe Embedment and Backfill for additional requirements.
- B. Compaction Tests:
 1. Two initial gradation tests shall be made for each type of embedment, fill and backfill material used and one additional gradation test shall be made for each additional 500 tons of each material. At the sole expense of the Contractor, moisture-density (Proctor) tests, relative density tests on the materials and all in-place field density tests shall be performed by the Contractor. All tests performed shall be done in accordance with ASTM D698.
 2. The method of in-place compaction testing including density and moisture content shall be as follows:

- (a) Density - Cohesive materials: ASTM D2167, ASTM D1556 or ASTM D6938.
- (b) Density - Cohesion-less materials: ASTM D6938.
- (c) Moisture Content: ASTM D6938.
- 3. The minimum frequency of in-place compaction testing including density and moisture content will be as follows:
 - (a) At least one test for every 2,000 cubic yards of material placed in a mass fill.
 - (b) At least one test when the City suspects the quality of moisture control or effectiveness of compaction.
- 4. Any material/fill failing to meet required densities shall be removed, replaced and compacted as necessary to achieve specified results.
- 5. Removal of in-place material and replacement with approved new material will be required if scarifying and re-compaction do not produce the required densities.

3.12 EQUIPMENT

- A. The Contractor shall utilize appropriate equipment to obtain the compaction requirements specified. Acceptable equipment includes, but is not limited to, the following:
 - 1. Tamping Rollers.
 - 2. Pneumatic Rollers.
 - 3. Vibratory Rollers.
 - 4. Other methods that have been tested and have been shown to meet the specified compaction rates.
- B. Power tampers or rammers shall be used for the compaction of material in areas where it is impractical or unsafe to use heavy equipment or as recommended by the City.
- C. Vibratory plate compactors, manual or attached to excavation equipment, may be used for consolidation of embedment and compaction of granular fill in areas where it is impractical or unsafe to use heavy equipment or as recommended by the City.
- D. All compaction equipment is subject to the approval of the City/Design Professional.

3.13 FINAL GRADING AND PLACEMENT OF TOPSOIL

- A. After all trenching, backfilling, compaction and embankments to be constructed have been rough graded, all areas shall be final graded to the indicated elevations, slopes and contours.
- B. All cuts, fills, embankments and other areas which have been disturbed or damaged by construction operations shall be surfaced with at least 6 inches of topsoil to meet final grade.
- C. Use of graders or other power equipment will be permitted for final grading and dressing slopes, provided the result is uniform and equivalent to manual methods.
- D. All surfaces shall be graded to provide effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.
- E. Final grade shall be smooth, even and free from clods, rocks, stones, weeds, brush and other debris.

3.14 DISPOSAL OF EXCESS EXCAVATED MATERIALS

- A. Except as otherwise permitted, all excess excavated materials shall be disposed of off-site.
- B. Demolition Debris, see Section 02190 – Demolition.

- C. Rock – Excavated rock in excess of the amount permitted to be installed in trench backfill (see Section 02250 – Trenching, Pipe Embedment and Backfill) shall be disposed of off-site.
- D. Other Debris – Waste material and other debris encountered in during excavation shall be disposed of off-site.
- E. The disposal of waste and surplus excavated materials, including hauling, handling and grading is incidental to Earthwork. No separate measurement or payment shall be made.

3.15 SEEDING AND SODDING

- A. All areas disturbed by the Contractor's operations shall be seeded or sodded according to the requirements of Section 02930 – Seeding or Section 02931- Sodding.

3.16 SETTLEMENT

- A. The Contractor is solely responsible for all settlement which may occur within the correction period (as stipulated in the General Conditions and Supplementary Conditions). Within 30 days after notice from the City, the Contractor shall make all settlement repairs and the associated restoration caused by correcting the settlement.

END OF SECTION