

SECTION 1100 – GRADING

1101 SCOPE. This section covers the performance of all the work and appurtenances required for grading the project in coordination with all previous work performed at the locations shown on the contract drawings.

1102 MATERIALS AND DEFINITIONS.

A. Grading. Grading shall be defined as meaning the performance of all excavation, embankment and backfill in connection with the construction of all improvements.

B. Excavation. Excavation is defined as the removal of materials from the construction area to the lines and grades as shown on the contract drawings.

Unless otherwise provided for in the Special Provisions and included in the proposal, all excavation shall be unclassified excavation and the Contractor shall satisfactorily remove and dispose of all materials encountered regardless of their nature.

C. Embankment. Embankment - Fill or Backfill, is defined as the placing and compacting of material in the construction area to the lines and grades as shown on the contract drawings.

Materials suitable for earth embankment shall be free of organic materials, waste material, trash and debris, contain less than ten (10) percent by volume of rock and gravel, and contain no particles having a dimension greater than three (3") inches.

Materials suitable for rock embankment shall be free of organic materials, waste material, trash and debris, and contain ten (10) percent or greater by volume of rock or gravel containing particles ranging in size from a minimum dimension of three (3") inches to a maximum of twenty-four (24") inches.

Material not suitable for use as embankment material shall include, but shall not be limited to, frozen material, organic material, topsoil, rubbish, brick, asphaltic concrete, and other debris and soil not containing the characteristics and moisture content to obtain the required compaction. Rock and broken concrete shall not be included in embankment material unless rock embankment is specified in the Special Provisions and the materials meet the size requirements indicated in this section.

D. Topsoil. Topsoil shall be soil which 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 1 1/2" in any dimension, and other extraneous or toxic matter harmful to plant growth.

E. Structures. Structures, as used herein, refers to bridges, basins, drainage structures, headwalls, retaining walls, and similar construction.

F. Alternative Definitions. When provided for in the Project Special Provisions and included in the proposal, the excavation may be classified according to the following categories.

1. Common Excavation. Suitable materials shall include all earth free of rock greater than three (3") inches in diameter, sod, weeds, roots and other debris, and containing the soil characteristics and moisture content to obtain the required compaction.
2. Common Excavation/Borrow (Contractor Furnished) Common Excavation, or Borrow, is to be furnished by the Contractor in accordance with the notes as shown on the plans. The Contractor shall furnish material from sites provided by the Contractor. All Contractor furnished sites are subject to approval by the Engineer.
3. Unclassified Excavation. Unclassified Excavation shall include any and all materials encountered during construction of work.
3. Rock Excavation. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the Engineer, requires drilling, jack hammered or blasting to remove the material.

1103 CONSTRUCTION - GENERAL. During grading the work shall be performed in a manner and sequence that will provide drainage at all times. Soft spots or areas that develop during grading operations shall be removed, the area then backfilled with suitable material and compacted to obtain the required density. No additional payment will be made to the Contractor for this work. Erosion control measures shall be in place prior to the start of grading operations.

1104 EXCAVATION - GENERAL Excavation shall be performed to the lines and grades indicated on the contract drawings. All suitable material removed by excavation shall be used as far as practicable in the formation of embankments or elsewhere as indicated or specified, or as directed by the

Engineer. It shall be the responsibility of the Contractor to handle excavation in any manner s/he sees fit, provided that suitable materials will be available when required. No additional compensation will be allowed for any special sequence of excavating or placing of such materials or any re-handling of materials.

The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground.

The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

Excavated materials in excess of the amount needed to complete the grading shall be considered as waste material, which shall be removed from the site by and at the expense of the Contractor.

Any additional fill material required which is not available from excavation within the construction limits shall be supplied by the Contractor at no expense to the Owner unless provided for in the proposal and Special Provisions. All such material brought to the site and incorporated in the work shall be subject to the approval of the Engineer. During grading operations if materials are encountered below grade or otherwise which are determined as being unsuitable or unstable by the Engineer or his/her representative they shall be removed to the depth required reaching stable material. The area involved shall then be backfilled with suitable material as determined by the Engineer and compacted to obtain the required density.

All roadway excavation in rock (shale, sandstone, limestone, etc.) shall be undercut no less than eighteen (18") inches for the full width of the roadway and backfilled with suitable soil or granular material. Undercut shall be unclassified excavation.

Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient, in the opinion of the Engineer, to carry trench loads based on trench width to the back of sheeting. When ordered by the Engineer, sheeting shall be left permanently in the trench. When trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner, which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Payment for sheeting required to be left in place will be paid as additional work.

- 1105 EXCAVATION – TRENCHING. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or four hundred (400) feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction. The Contractor shall backfill all open trench by the end of the day's work, except that which is necessary for inspection or immediate continuation of the following day's work. All open areas shall be fenced.

Except where tunneling is shown on the drawings, is specified, or is permitted by the Engineer, all trench excavations shall be open cut from the surface.

The alignment, depth, and grade of all trenches shall be maintained as shown on the drawings by overhead grade lines parallel to the pipe invert. All open trenches shall be provided with adequate protective devices.

Trenches shall be excavated to a width, which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six (6) inches below and on each side of all pipes. These distances are minimum clear distances, which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will

not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one (1) foot above the top of the pipe.

Limiting trench widths below an elevation of one (1) foot above the exterior top of the installed pipe shall be not less than fifteen (15) inches nor more than twenty-four (24) inches greater than the nominal outside diameter of the pipe.

Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted, either special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the Contractor, with one or more layers of crushed rock or other suitable material, where and as necessary to provide a firm and stable base for granular fill pipe foundation material to be placed thereon. Not more than one-half (1/2) inch depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one (1) foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Over excavating the trench sidewall to obtain clearance will not be permitted.

If the Contractor prefers to undercut the bottom of the trench and bring to grade with one half (1/2) inch crushed rock, he may do so, provided the depth of undercut and backfill with crushed rock shall not exceed four (4) inches. Where crushed rock is used, it shall be placed in the trench, spread uniformly, and graded prior to placing the pipe in the trench.

- 1106 EMBANKMENT - FILL. Embankments shall be formed with suitable materials, as herein defined, procured from excavations made on the project site, or from Contractor furnished borrow pits as required to complete the grading work. Embankment construction shall not be performed when material contains frost, is frozen, or a blanket of snow prevents proper compaction.

Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than one (1) vertical to six (6) horizontal, the existing slope shall be benched or stepped in approximately eighteen (18") inch rises as the new fill is brought up in eight (8") inch lifts. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Materials thus cut out shall be re-compacted to the required density along with the new embankment material. Material cut out, bladed into place, and compacted shall not be measured and paid for directly but will be considered as incidental work.

The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material, such as topsoil, peat, mulch, coal seams, disintegrated shale, rubbish, logs or stumps, bricks, asphaltic concrete, and unconfined saturated soils, removed to the depths shown before starting the embankment work.

Where embankments two (2') feet or less in depth are to be placed on areas covered by existing concrete pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted as specified in paragraph 1108. Where embankments greater than two (2') feet in depth are to be placed on areas covered by existing concrete pavement, the existing pavement may be broken into pieces not larger than twenty four (24") inches maximum dimension, left in place and the embankment started thereon.

Earth embankment shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of material shall not exceed eight (8") inches in thickness (loose measurement) and shall be compacted as specified in paragraph 1108 before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading will be required to level the surface and to ensure uniform compaction.

Successive horizontal layers of rock embankment not exceeding two (2') feet in depth shall be made by placing larger stones uniformly over the embankment area. Small stone fragments, sand, earth, or gravel shall be placed between the larger stones to fill all voids. Each layer shall be thoroughly compacted before the next layer is placed.

Large rocks shall be withheld from the top two (2) feet or more of the embankment and only crushed stone or earth used in this layer. The crushed stone shall be well graded to form a dense mass when compacted and maintained adequate cohesive and interlocking characteristics.

1107 EMBANKMENT- BACKFILL.

- A. GENERAL. Each successive lift of backfill material shall be rolled with a tamping or sheepsfoot roller, except as provided below for sand and gravel, making a sufficient number of trips over the entire surface to compact all material thoroughly and uniformly.

Sand and gravel, which cannot be compacted satisfactorily with a sheepsfoot roller, shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

Backfilling behind curb or curb and gutter shall be done within seven (7) days after cure is complete unless otherwise approved by the Engineer. The material used to fill the void behind curb or curb and gutter shall be suitable material free of rock and debris, and shall be of a type that will leave no voids to pocket water and that will self-compact.

Unless otherwise shown on the contract drawings, the finish grading from the back of the curb to the right-of-way line and/or utility easement line or construction easement line shall be performed to provide a smooth transition between existing yard grades at the right-of-way line and/or easement line to the curb so that positive drainage will exist.

The top portion of the backfill within right-of-way areas shall be finished with at least six (6") inches of topsoil. Topsoil shall generally be friable loam, sandy loam, sit loam, sandy clay loam, or clay loam free of debris, trash, stumps, rocks, roots and noxious weeds. Prior to placement the Engineer shall approve topsoil, which, unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during grading operations.

Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by scarifying to a depth of two (2") inches to permit bonding of the topsoil to the underlying surface. Placement of all topsoil should be done in a manner so that roadway surfaces and sidewalks are not covered by material being placed.

- B. TRENCHES. Compacted backfill shall be required for the full depth of the trench above the embedment of street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

The top portion of the backfill beneath established areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than,

that underlying adjoining areas. The Engineer prior to placement shall approve topsoil, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

At the option of the Contractor, compacted backfill may be job-excavated material or graded gravel. Embedment shall be graded gravel Type CA-5, three fourth (3/4) inch or one (1) inch washed aggregate. All street crossings (existing or proposed) shall have total flowable fill (mix design to be approved by Engineer) backfill from two (2) feet back of curb or two (2) feet from sidewalk. Above the initial backfill, job-excavated material may be used for compacted final backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three (3) inches in the greatest dimension.

Gravel for compacted backfill, other than for street crossings, shall conform to the following gradation.

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than twenty five (25) and a plasticity index not greater than five (5). The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than ninety (90%) percent relative density as determined by ASTM D2049.

C. FLOWABLE MORTAR

Materials. Flowable mortar shall consist of the following materials.

- 1) Cement, 50 lbs/CY, Type I
- 2) Fly Ash, 200 lbs/CY
- 3) Water, 370 lbs/CY

- 4) Fine Aggregate, 3000 lbs/CY, shall be natural sand with one hundred (100%) percent passing the one half (½) inch sieve and 0%-10% passing the No. 200 sieve. The sand shall stay in suspension in the mortar to the extent required for proper flow.

Placement. Flowable mortar shall be discharged from the mixer by a reasonable means into the trench area to be filled. Filling operations shall proceed simultaneously on both sides of pipe or conduit so that the two fills are kept at approximately the same elevation at all times. An external load shall be applied to the pipe or conduit, sufficient to hold it in place, before filling.

The flowable mortar shall be placed to the bottom of existing or future pavement, with no embedment placed around the pipe or conduit, unless otherwise specified in the contract documents.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to ninety (90%) percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the city Engineer.

Uncompacted earth backfill material to be placed above embedment shall be free of brush, roots more than two (2) inches in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth.

Uncompacted backfill material above embedment may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5') feet into the trench unless cushioned by at least two (2) feet of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus material, shall be placed in the upper eighteen (18) inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed within three (3) feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result. All stones must be a minimum of two (2) feet below the surface.

- D. STRUCTURES. Backfill around and outside of structures shall be deposited in layers not to exceed eight (8") inches in uncompacted thickness. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

Material for structure backfill shall be composed of earth only and shall contain no organic materials, broken concrete, stones, trash, or debris of any kind.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

1108 COMPACTION

- A. Moisture Control Requirements. The moisture content of the soil at the time of compaction shall be plus or minus three (3%) percent of optimum moisture or as necessary to obtain the density as designated on the standard proctor curve unless it is determined by the Engineer that the soil is unstable with that moisture content.

When the moisture content of the soil is not satisfactory to the Engineer, water shall be added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. Moisture content shall be distributed uniformly and water for correction of moisture content shall be added sufficiently in advance that proper moisture distribution and compaction will be obtained. In no case, shall water be added without the consent of the Engineer.

All work involved in either adding moisture to, or removing moisture from embankment materials shall be considered incidental to the completion of the grading operation.

B. Compaction Control Requirements. Earth embankment/fill and backfill materials shall be placed in horizontal layers not exceeding eight (8") inches unless otherwise approved by the Engineer and compacted as specified below before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction.

1. Subgrade for Embankments: Compact to a minimum of 90% of standard proctor maximum density as determined by ASTM D698.
2. Embankments/Fills: Compact backfill to a minimum of 95% of the standard proctor maximum density for the material used as determined by ASTM D698.
3. Backfill: Unless otherwise specified, compact backfill to a minimum of 95% of the standard proctor maximum density for the material used as determined by ASTM D698. All fill material placed behind the curb and gutter beneath and either side of sidewalks within the right-of-way shall be compacted to a minimum of 90% of standard proctor maximum density as determined by ASTM D698.
4. Structure Backfill: Compact to a minimum of 90% of standard proctor maximum density as determined by ASTM D698. Backfill around and outside of structures that will ultimately lie under proposed pavements shall be compacted to the requirements of SECTION 1200 "Subgrade Preparation."

1109 FINAL GRADING. After embankments and backfills are completed, all areas on the site of the work, which are to be graded, shall be brought to grade at the indicated elevations, slopes, and contours, including shoulder, berm, and sidewalk spaces. The graded surface shall be made free of rock, concrete, and brick, or fragments thereof, or rubbish. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and conforming to the lines and grades shown on the plans. The Contractor shall repair any damaged surface and shall not use any equipment that will leave a marred surface.

Topsoil shall be placed to a minimum depth of six (6) inches in all areas indicated or specified to be seeded or sodded. Topsoil may be obtained from the project site by segregating appropriate material from other material during excavation and trenching operations, or from off-site locations. Topsoil from off-site locations shall be provided at no additional cost to the Owner.

- 1110 CLEANUP. Cleanup shall follow the work progressively and final cleanup shall follow immediately behind the finishing. The Contractor shall remove from the site of the work all equipment, tools, and discarded materials, and other construction items. The entire right-of-way or easement shall be left in a finished and neat condition. Cleanup shall be considered a subsidiary obligation of the grading work.

In the event the Contractor does not promptly comply with the terms of such instructions, the city may have the defective work corrected or the rejected work removed and replaced and all direct and indirect cost of such removal and replacement, including compensation for additional professional services, shall be paid by the Contractor. The Contractor will also bear the expenses of repairing work of others destroyed or damaged by his/her correction, removal or replacement of defective work.

- 1111 SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills, and embankments, which may occur within one year after final acceptance of the contract under which the work was performed. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer.

- 1112 TEMPORARY SURFACING. If during construction activities it is deemed necessary to provide ingress and egress to the public by placement of temporary surfacing, the Contractor shall do so at the direction of the Engineer. Temporary surfacing shall meet the requirements of the KDOT classification CA-5 for aggregates, or approved equal. Larger aggregates (3/4" or 1") may be used if; in the opinion of the Engineer additional stabilization is necessary. The Contractor shall maintain temporary surfacing at no additional expense to the Owner.