SECTION 02321
EXCAVATION, BEDDING, AND BACKFILL FOR UTILITIES

PART 1. GENERAL

1.01 SCOPE

A. The Work called for by this section shall consist of clearing and grubbing in accordance with Section 02230, Clearing and Grubbing, loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction purposes; furnishing, placing, and maintaining the protective system necessary for the proper protection and safety of the Work, the workmen, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe zone; the placement of tracer wire or nondetectable marking tape; the backfilling and tamping of trenches, foundations, and other structures; the preparation of fills and embankments; the removal of unsuitable material from outside the normal limits of excavation and, where ordered by OWNER, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the Work. This Work shall be performed as specified below. Work required under this section will not be measured and paid for as a separate pay item, unless stated otherwise in the contract.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's descriptive literature for nondetectable marking tapes.

B. Informational Submittals:
   1. Flowable Fill: Certified mix design and test results; include material types and weight per cubic yard for each component of mix.
   2. Excavations twenty feet or greater in depth: Should the CONTRACTOR excavate twenty feet deep or greater, a protective system designed by a registered professional engineer shall be submitted prior to start of work. CONTRACTOR shall provide a drawing which identifies the type and location of protective system to be used with supporting data provided as necessary.

1.03 QUALITY ASSURANCE

A. CONTRACTOR shall provide adequate survey control as required, or as requested by RPR or Project Manager.

B. When custom designed protective systems are used, the design must be performed by a Registered Professional Engineer as required by OSHA 29 CFR 1926.650(b) and 29 CFR 1926.652(c)(4).

1.04 SAFETY

A. Contractor shall comply with all aspects of 29 CFR 1926.650; 1926.651; and 1926.652 with applicable appendices.
   1. Before starting construction, ensure utilities are marked as per the most recent Tennessee Underground Utility Damage Prevention Act.
   2. CONTRACTOR will designate a competent person who will remain onsite while excavation activities are conducted. The excavation competent person shall have sufficient training that meets or exceeds Local, State and Federal requirements.
   3. When excavations are greater than five feet in depth CONTRACTOR shall install a protective system meeting or exceeding OSHA 29 CFR 1926.652, Requirement for Protective System.
   4. Ensure means of egress from trench excavations via stairway, ladder, ramp or other safe means of egress that are four feet or more in depth so as to require no more than twenty five feet of lateral travel for employees per OSHA.
   5. A competent person must conduct daily inspections of excavations and the adjacent areas. Protective systems shall be ~~made~~ inspected by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions according to OSHA CFR 1926.651(k)(1-2).
   6. CONTRACTOR shall maintain and make all documents relative to soil classification, protective system selection, inspections, and required training available for the OWNER to review upon request.

B. Refer to KUB Standards and Specifications Section 0700, General Conditions for minimum required personnel protective equipment.

PART 2. PRODUCTS

2.01 PIPE MARKING

A. Tracer Wire: Solid copper wire of #12-gauge (or larger).

B. Warning Tape:
   1. Inert polyethylene, non metallic, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
   2. Thickness: 5 mils minimum.
   3. Width: 4 inches minimum.
   4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
   5. Manufacturers and Products:
      a. Reef Industries; Terra Tape.
      b. Mutual Industries; Non-detectable Tape.
      c. Presco; Non-detectable Tape.
   6. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color*	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 TRENCH STABILIZATION MATERIAL

A. Base Rock: TDOT Mineral Aggregate Base Class A, Aggregate Grading D as specified in Section 903.05 of the TDOT Standard Specifications for Road and Bridge Construction.

B. Granular Backfill: TDOT #57 stone as specified in Section 903.22 of the TDOT Standard Specifications for Road and Bridge Construction.

2.03 PIPE ZONE MATERIAL

A. Crushed stone, TDOT #7 as specified in Section 903.22 –Sizes of Coarse Aggregate AASHTO M 43, of the TDOT Standard Specifications for Road and Bridge Construction; Class B aggregate.

B. Excavated materials suitable for use shall consist of sand, clay, or soil free from large rocks, silt, roots, organic matter, or trash. Excavated materials shall be approved by the OWNER (see Part 3, Execution, Section 3.10, Pipe Zone).

2.04 EARTH BACKFILL

A. Soil, clay, or other excavated material suitable for use as backfill.

B. Free from roots or organic matter, refuse, boulders and material larger than 6 inches in diameter, or other deleterious materials.

2.05 FLOWABLE FILL

A. Select and proportion ingredients to obtain compressive strength between 50 psi and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:
   1. Cement: ASTM C150, Type I or Type II.
   2. Aggregate: ASTM C33, Size 7.
   3. Fly Ash (if used): ASTM C618, Class C.
   4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.06 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:
   1. Imported earth backfill, including specified class.
   2. Trench stabilization material.
   3. Pipe zone material.

B. Certify Laboratory Performance of Mix Designs: Flowable fill.

PART 3. EXECUTION

3.01 PREPARATION OF THE SITE

A. Before starting construction, ensure utilities are marked as per the most recent Tennessee Underground Utility Damage Prevention Act.

B. Remove from the Site all vegetation growth (except as hereinafter excluded), debris, or other objectionable matter as well as any buildings or other structures that the Drawings or OWNER specifically indicate are to be removed. Dispose of this refuse material in a manner that complies with all applicable Laws and Regulations.

C. In certain areas it may be desirable for existing trees, shrubs, or other vegetation on the Site to be preserved for the permanent landscape. Such vegetation may be shown on the Drawings, specifically listed in the Specifications, marked on the Site, or identified by OWNER. CONTRACTOR shall not damage or remove such growth without written permission from OWNER.

D. If the area to be excavated is occupied by trees, brush, or other vegetation growth, clear such growth and grub the excavated area in accordance with Section 02230, Clearing and Grubbing and remove all large roots to a depth of not less than 2 feet below the bottom of the proposed construction. Dispose of the growth removed in compliance with all applicable laws and regulations. Fill all holes or cavities created during this Work that extend below the subgrade elevation with suitable material, and compact to the same density as the surrounding material.

E. Trees, cultivated shrubs, etc., that are situated within public rights-of-way or construction easements through private property, but not directly within the excavation area, shall remain undisturbed unless it is necessary to remove them so that the Work can be performed safely and unless their removal is specifically ordered by OWNER. Take special precautions to protect and preserve such growth throughout all stages of the construction.

F. If excavation is to be completed under any pavement or concrete, the pavement or concrete must be cut or sawed to straight, clean lines before excavation begins.

3.02 UNSUITABLE MATERIALS

A. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered beneath the level of the lines, grades, or cross sections on the Drawings, remove it and continue excavation until suitable material is encountered, or as directed by OWNER. The material removed shall be disposed of in the manner described in this section. Then refill the areas excavated for this reason with material approved by OWNER up to the level of the lines, grades, or cross-sections shown on the Drawings. The first 6 inches of this refill shall be No. 7 (TDOT) crushed stone for bedding, as specified below.

3.03 ROCKS AND BOULDERS

A. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, or similar materials shall be considered as unclassified excavation, and no separate payment will be made therefore unless specifically outlined in the contract.

B. Should rock be encountered in the excavation, remove it by blasting or other mechanical methods. Refer to Section 02311, Control Blasting.

C. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the outside bottom of pipe and 6 inches between the side of the pipe and trench wall for pipe up to 30 inches in diameter, and not less than 12 inches below and beside for larger pipes if rock extends to such depth. Then backfill the space below grade with No. 7 (TDOT) crushed stone or other approved material, mechanically compact to the proper grade, and make ready for construction.

3.04 EXCAVATION FOR TRENCHES FACILITIES AND STRUCTURES

A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of all piping and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the Drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.

B. CONTRACTOR may, if it chooses, use a motor powered trenching machine. If they do, however, they shall be fully responsible for the preservation or repair of existing utility service connections and the adequate compaction of backfill material.

C. Unless the construction of lines by tunneling, jacking, or boring is called for by the Drawings or specifically authorized by OWNER, make excavation for pipelines in open cut trenches true to the lines and grades shown on the Drawings or established by OWNER on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline.

D. When approved in writing by OWNER, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to nonvertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline.

E. Trench Width:
   1. Minimum Trench Width:
      a. Single Pipes:
         1) Outside Diameter Less than 4 inches: trench 4 inches greater on each side of the pipe.
         2) Outside Diameter 4 inches to 12 inches: trench 6 inches greater on each side of the pipe.
         3) Outside Diameter Greater than 12 inches to 24 inches: trench 8 inches greater on each side of the pipe.
         4) Outside Diameter Greater than 24 inches: trench 24 inches on each side of pipe.
      b. Multiple Pipes in Single Trench: 18 inches greater than aggregate width of pipes plus space between.
      c. Increase trench widths by thicknesses of sheeting.
   2. Maximum Trench Width: Shall not be greater than the minimum trench width plus 12 inches nor less than the width required to insert trench boxes. No additional compensation will be allowed to CONTRACTOR for trenches wider than minimum widths stated above including restoration, asphalt, and concrete structures.
   3. If a motor powered trenching machine is approved by OWNER, the dimensions listed above shall be modified to conform to the trench width of the trenching machine pipe diameter and pipe material being used. CONTRACTOR shall be required to meet backfill compaction requirements regardless of trenching method that is approved by OWNER.

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

G. Where materials are deposited along open trenches, place them so that no damage will result to the Work or to adjacent property in the event of rain or surcharge loading from such deposits.

H. Open Trench Safety:
   1. During Working Hours: Maximum length of open trench shall be 100 feet. The CONTRACTOR shall use protection measures at all times to protect workers and the public from falling into trenches. Open trench lengths greater than 100 feet must be approved by the OWNER.
   2. During Nonworking Hours: The CONTRACTOR shall make every effort to backfill trenches by the end of the work day. If the trench is left open, the CONTRACTOR shall use proper protection measures to protect the public from falling into trenches.

3. Proper protection measures for nonworking hours include steel plates or barriers:
   a. Steel plates must be a minimum thickness of 1" and able to withstand H-20 traffic loading without any movement and be fabricated to meet ASTM A36 or A572. Steel plates shall extend at least 12 inches beyond the edges of the excavation. Asphalt cold patch shall be installed 12 inches around the entire edge of the steel plate to allow for traffic to smoothly transition on and off the plate and to keep the plate from moving out of position. If plates are used, proper road signage must be in installed to alert drivers.
   b. Concrete barriers or water filled interlocking barriers, that are not leaking or damaged, and caution tape placed around the entire trench or excavation.
   c. Additional safety measures may be required at the OWNERS request to include concrete barriers, cones, barrels, fencing, illumination, and manned by flagmen.

3.05 PROTECTIVE SYSTEMS

A. Special care shall be taken to avoid damage wherever excavation is being done. Sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage. Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.

B. Wherever employees may be exposed to moving ground or cave-ins, CONTRACTOR shall comply with 29 CFR 1926 Subpart P-Excavations to select the proper excavation protective system.

C. Excavation below the level of the base or footing of any foundation, roadway or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when: A support system such as underpinning, is provided to ensure the safety of employees and the stability of the structure or A Licensed Tennessee Professional Engineer has approved the determination that such excavation work will not pose a hazard to employees. Sidewalks, pavements and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

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

E. All holes and voids left in the Work by the removal of sheeting, shoring, or bracing shall be filled and compacted as specified herein.

3.06 DEWATERING OF EXCAVATION

A. CONTRACTOR shall provide and keep in operation enough suitable pumping equipment whenever necessary or whenever directed to do so by OWNER. CONTRACTOR shall give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift. Dewatering shall occur only in accordance with applicable Laws and Regulations, approved permits, and industry best management practices. Refer to Section 01570 Erosion Control. Water shall not be discharged to sanitary sewers, unless approved by OWNER in advance.

3.07 BORROW EXCAVATION

A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then CONTRACTOR shall obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, CONTRACTOR shall make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material.

B. Before a borrow pit is opened, the quality and suitability of its material shall be approved by OWNER. Testing of the material for suitability shall be at CONTRACTOR's expense.

C. All state and local regulations concerning borrow pits, drainage and erosion control shall be strictly followed.

D. Furnish OWNER with copies of a written agreement with the owner of the property on which the borrow sites are located, approval of the owner(s) of any utilities within the proposed borrow area, and approvals from regulatory agencies.

E. In all instances, excavate, and maintain borrow pits in a manner satisfactory to the owner of the property.

F. Material used from the borrow pit shall be clean backfill with no organic material or rocks greater than 6 inches in diameter.

G. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work; no separate payment shall be made for this.

3.08 GENERAL BACKFILLING METHODS

A. Backfilling operations shall be performed so as not to disturb or injure any pipe or structure against which the backfill is being placed. If any pipe or structure is damaged or displaced during backfilling, CONTRACTOR shall open up the backfill and make whatever repairs are necessary. This work shall be done at no cost to OWNER.

B. Backfilling and clean-up operations shall closely follow pipe laying. See Section 02050, Wastewater General Information and Section 01740, Surface Restoration Special Provisions for cleanup requirements. Failure to comply with these provisions will result in OWNER requiring that CONTRACTOR's other activities be suspended until backfilling and clean-up operations follow pipe laying more closely. In this event, extension of contract completion date will not be warranted.

C. Backfilling operations around facilities and structures shall be conducted in the same manner as specified for pipelines except that even greater care is necessary to prevent damage to the utility structure.

D. Consolidating by flooding will not be permitted under or adjacent to paved or unpaved traffic areas. If tests for in-place density consistently fail to meet the requirements, OWNER may require CONTRACTOR to change his method of compaction.

E. Polyethylene pipe backfill materials and practices should be in compliance with ASTM D2774, "Standard Practice for Installation of Thermoplastic Pressure Piping".

3.09 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with imported trench stabilization material when trench excavation exceeds elevation of trench zone as directed by OWNER.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.10 PIPE ZONE

A. Pipe zone for pipe used on wastewater installations shall consist of an envelope of No. 7 (TDOT) crushed stone from 6 inches below pipe bell to 12 inches above pipe crown for full trench width.

B. In general, crushed stone bedding is not required for gas and water pipe, or electrical conduit installations. However, when rock, unsuitable materials, pipe under paved surfaces, or a trench edge within three feet of the pavement, bedding shall consist of an envelope of No. 7 (TDOT) crushed stone, or sand as approved by the Owner for steel pipe, from 6 inches below the pipe bell to 6 inches above crown for full trench width.

C. Hand grade and mechanically compact each lift to provide a firm, unyielding surface.

D. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe.

E. Polyethylene pipe shall be laid and continuously supported on undisturbed or well compacted soil. Do not use blocks or allow pipe to rest on rocks or large clods of dirt because this will set up shearing stresses in the pipe during backfilling. Prior to beginning backfilling, the entire trench shall be examined to make sure the pipe is continuously supported at all points on undisturbed or well-compacted soil.

F. The bedding material shall be shaped for bell and spigot pipe at proper intervals to provide uniform bearing under the entire length of the pipe.

G. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

H. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

I. Restrain pipe as necessary to prevent their movement during backfill operations.

J. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes installed in same trench.
   1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
   2. Pipe Over 10-Inch Diameter: Maximum 8-inch lifts.

K. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a rod to ensure that voids are completely filled before placing each succeeding lift.

L. After the full depth of the pipe bedding material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.

M. Do not use power-driven impact compactors to compact pipe bedding material.

3.11 BACKFILL ABOVE PIPE BEDDING

A. General:
   1. Process excavated material to meet specified gradation requirements.
   2. Adjust moisture content as necessary to obtain specified compaction.
   3. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
   4. Do not use power driven impact type compactors for compaction until at least 12 inches of backfill is placed over top of pipe.
   5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
   6. Backfill around structures with same class backfill as specified for adjacent trench, unless otherwise shown or specified.

B. Unimproved and Unsurfaced areas:
   1. Backfill with excavated material. For trenches 5 feet or less, tamp material in 18 inch lifts or as directed by the Owner. For trenches greater than 5 feet, tamp material in lifts as directed by the Owner.
   2. Leave trench with backfill material neatly mounded across the entire trench width 1 inch of mound above the adjacent ground surface for each foot of trench depth.
   3. In lawn, garden, or similar type areas, maintain trench level with the existing adjacent grade. See Paragraph, Maintenance.

C. Under paved surfaces or trench within 3 feet of pavement edge: Use the latest version of KUB's "Paving Detail Sheet, D-1" for the backfill materials, compaction equipment, and lift requirements.

D. Flowable Fill Backfill:
   1. Place above pipe bedding where required to expedite trench backfill or to protect pipe.
   2. Do not allow dirt or foreign material to become mixed with concrete during placement.
   3. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in trench.
   4. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
   5. Fill trench section as shown on Drawings.

3.12 PIPE MARKING

A. Tracer Wire for Pipe:
   1. Place within 6 inches of pipe where practical and directly above if possible.
   2. Do not wrap around pipe or connectors except at the riser. Never wrap tracer wire around pipe or fittings.
   3. Install so electrical continuity is maintained throughout the pipe system.
   4. Connections:
      a. Make as few connections as possible in tracer wire.
      b. Make by stripping the insulation back 1 inch and joining the two ends using an approved mechanical connector. Twisting of copper wire will not be acceptable.
      c. Wrap exposed wire thoroughly with electrical tape.
   5. Coil, bury, and terminate 5 feet of additional tracer wire at the ends of the pipeline. On the 5-foot tracer wire section, strip back 1 foot of insulation at the ends prior to burial. Bring ends to within 1 foot of the surface.

B. Nondetectable Marking Tape:
   1. Install 1 foot above the pipe. The marking tape shall identify the utility type.

3.13 DISPOSAL OF MATERIALS

A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the Drawings or directed by the OWNER shall be used for these purposes. Any surplus materials not so used shall be managed by CONTRACTOR as either consisting solely of earth, rock, concrete or asphalt paving materials ("Clean Spoil") or, if determined by OWNER to be something other than Clean Spoil, as Waste Materials.

B. Clean Spoil may be deposited in spoil areas at site locations found by CONTRACTOR. For all such areas, the CONTRACTOR shall complete Contractor Certification Form attached at end of the section and furnish to OWNER in advance of depositing any such Clean Spoil on any such site location. Receipt by OWNER of the Contractor Certification shall not relieve the CONTRACTOR of its responsibilities to comply fully with its obligations under the Contract Documents and all Laws and Regulations relating to such Clean Spoil.

C. Unless otherwise provided in the Contract Documents, Waste Materials shall be properly classified by CONTRACTOR and lawfully transported to and disposed of in an appropriate permitted facility approved by OWNER. Proof of each such transport and disposal shall be provided to OWNER within 24 hours after such disposal.

D. Once any part of the Work is completed, the CONTRACTOR shall properly manage all surplus Clean Spoil and lawfully dispose of all Waste Materials left within the constructions limits of that Work. The CONTRACTOR is responsible for the removal, hauling and final management of Clean Spoil and Waste Materials. The CONTRACTOR is responsible for locating spoil sites for depositing of Clean Spoil and appropriate landfills for disposal of Waste Materials and for obtaining all related permissions from spoil site owners and landfill operators, as appropriate, and all required permits from all governmental agencies having jurisdiction over the depositing of such Clean Spoil or disposal of such Waste Materials.

E. The depositing of Clean Spoil and the disposal of Waste Materials in the manner described above shall be considered an integral part of the excavation work, and one for which no separate payment shall be allowed.

3.14 MAINTENANCE

A. CONTRACTOR shall seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by OWNER.

B. CONTRACTOR shall maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by OWNER. Continue such maintenance until final acceptance of the Project or until OWNER issues a written release.

3.15 SLOPES

A. All open slopes shall be neatly trimmed and finished to conform either to the slope lines shown on the Drawings or the directions of OWNER. Leave the finished

surfaces of bottom and sides in reasonably smooth and uniform planes like those normally obtainable with hand tools, though CONTRACTOR will not be required to use hand methods if he is able to obtain the required degree of evenness with mechanical equipment. Conduct grading operations so that material is not removed or loosened beyond the required slope.

3.16 EMBANKMENT

A. This work shall consist of forming embankments, other than for building pads, with materials from excavation or other approved sources and in conformance with the lines, grades, and cross-section shown on the Drawings.

B. Complete the clearing and grubbing of embankment areas in accordance with the requirements of Section 02230, Clearing and Grubbing before placing embankment thereon.

C. Conduct all embankment operations in accordance with the requirements of the erosion control plan approved by OWNER. Refer to Section 01570, Erosion Control.

D. Use only acceptable materials in embankment formation. Place no frozen material, stumps, logs, roots or other perishable materials in any embankment. Place no stone or masonry fragment greater than 4 inches in any dimension within 12 inches of the finished subgrade elevation.

E. Remove topsoil from all embankment areas to a depth of approximately 6 inches, or to a greater depth wherever the soils investigation report so indicates.

F. Form soil, soft shale, soft sandstone, weathered rock, bank gravel or creek gravel embankment by distributing the material in successive uniform horizontal layers no more than 12 inches thick (loose depth) to the full width of the cross-section. However, layers less than 12 inches in loose thickness will be required whenever necessary to obtain the specified density. Compact each layer as specified below. Shape the upper surface of the embankment so as to provide complete drainage of surface water at all times. The forming of ruts will not be permitted.

G. In embankments constructed principally of unweathered limestone, hard shale or hard sandstone, the layer thickness shall not exceed 2 feet; the maximum dimensions of boulders or large rocks placed in the embankment shall be 2 feet vertically and horizontally. Larger pieces may be placed in the embankment face when permitted by the OWNER. Keep rocks with any dimension greater than 2 feet at least 2 feet below the subgrade elevation. Do not dump the rock into final position, but instead distribute it by blading or dozing in a manner that will ensure proper placement in the embankment so that voids, pockets and bridging will be reduced to a minimum. The slope shall conform substantially to the requirements of the Drawings.

H. In areas where layers of rock and shale or soil are encountered and embankments are constructed of a mixture of rock and shale or rock and soil, place, manipulate and compact the material in layers no more than 8 inches thick; however, when the thickness of the rock exceeds 8 inches, the thickness of the embankment layers may be increased (except beneath building areas) as necessary due to the nature of the

material and as approved by OWNER. In no case allow the layer thickness to exceed 2 feet. Do not dump the mixture into final position, but distribute it by blading or dozing in a manner that will ensure proper placement in the embankment so that voids, pockets and bridging will be reduced to a minimum. Then compact the mixture with suitable compaction equipment.

I. Compact the embankment to a density of at least 98 percent of the maximum density as determined by ASTM D698 (Standard Procter).

J. During compaction, embankment material that does not have enough moisture for proper compaction, shall have water added and thoroughly mixed as necessary to obtain proper compaction. Embankment material containing an excess of moisture shall be allowed to dry before compacting; manipulating as necessary to speed drying.

K. Perform construction operations so that simultaneous rolling and placing of material in the same lane or section is prevented. To avoid uneven compaction, see that hauling equipment traverses the full width of the cross-section as much as possible. Compact each layer as necessary before depositing material for the next layer.

L. The density requirements shall be the controlling factor in compaction. Use only such equipment as will satisfy the density requirements at all times.

M. For embankment adjacent to structures, including utility structures, first construct backfill in accordance with the guidelines included within this section.

N. When embankment is placed around adjoining or opposite faces of a structure, compact it to the same level on all sides before proceeding to the next layer next to the structure. As precaution against wedging action, begin compaction for each layer next to the structure.

O. Construct embankments adjacent to structures as outlined to the height of the structure and slope far enough away from the structure to permit easy access of compacting equipment used in normal embankment construction.

CONTRACTOR CERTIFICATION FORM

I, _____, understand that the Contract Documents under which I am working (e.g., Section 02321, Excavation, Bedding, and Backfill for Utilities) establish that it is the CONTRACTOR's responsibility to manage lawfully any and all surplus material excavated during the performance of the Work. Accordingly I hereby certify that I will deposit surplus excavation or fill materials consisting solely of earth, rock, concrete, or asphalt paving materials ("Clean Spoil") that result from OWNER's Project, _____, only at and upon the following fill site location(s): _____.

I further certify that (1) this repository site is appropriate for the above-described Clean Spoil, (2) I have cooperation from the fill site's property owner, _____, from whom I have received a written agreement that allows the placement of such Clean Spoil at and upon such Site (a copy of said agreement has been provided to OWNER, and (3) no Waste Material from OWNER's project has been disposed of at and upon such Site.

In addition, I certify that any and all applicable local, state, and federal permits have been applied for and obtained, either by the property owner or myself. Copies of all such permits have been provided to OWNER, and all work will proceed in compliance with all applicable laws, rules and regulations.

To my knowledge, no other material from any other source has been placed at and upon this location, and none will be permitted by the property owner until completion of Clean Spoil placement and grading.

I hereby certify the above and release, indemnify, and save harmless the OWNER, from any and all claims which might arise as a result of placement of Clean Spoil from OWNER's project at this or at any site. I further acknowledge that nothing in this certification, including but not limited to the receipt by OWNER of the various documents referenced herein and to be furnished by CONTRACTOR, relieves the CONTRACTOR of its responsibilities under the Contract Documents to fully comply with all legal requirements pertaining to the performance of the Work and the proper and lawful disposition of any and all surplus materials that result from any required excavation.

	Acknowledged:
By: _____	By:_____
Date: _____	Date:_____
(CONTRACTOR)	(OWNER)

Address: _____

Telephone #: _____

END OF SECTION