SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. Clearing, grubbing and site preparation
2. Handling, storage, transportation and disposal of excavated material
3. Sheeting, shoring, bracing and protection work
4. Pumping and dewatering as required or necessary
5. Permitting for dewatering discharges
6. Excavation
7. Backfilling
8. Compaction
9. Excavation, subgrade preparation, structural fill and backfill, structure bedding
   a. Furnish and install all imported soil and aggregate materials specified
10. Pipe embedment
11. Construction of fills and embankments
12. Finish grading
13. Appurtenant work

B. Additional Requirements Specified Elsewhere

1. Section 01010: Summary of Work
2. Section 01060: Regulatory Requirements
3. Section 01340: Shop Drawings, Product Data, and Samples
4. Section 01400: Quality Control
5. Section 01500: Construction Facilities and Temporary Controls

C. Related Requirements Specified Elsewhere

1. Section 02010: Subsurface Investigation
2. Section 02270: Sedimentation and Erosion Control
3. Section 02271: Soil Stabilization and Filter Fabrics
4. Section 02273: Riprap
5. Section 02500: Paving and Surfacing
6. Section 02525: Concrete Curbs, Gutters and Walks
7. Section 02612: Reinforced Concrete Pipe
8. Section 02615: Ductile Iron Pipe
9. Section 02622: Plastic Pipe
10. Section 02641: Valves and Accessories
11. Section 02708: Pressure Pipelines and Appurtenances
12. Section 02709: Gravity Pipelines and Appurtenances
13. Section 02900: Landscaping
14. Section 03300: Cast-In-Place Concrete

15. Construction Standards

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. OSHA Excavation Regulations
2. State of Colorado, Department of Public Health and Environment Construction Dewatering Discharge Permit
3. El Paso County Department of Transportation Utility Cut and Driveway Permits
4. State of Colorado general permit for Stormwater Discharges Associated with Construction Activities (aka Stormwater Construction Permit)
5. Refer to Section 01060 - Regulatory Requirements for additional requirements

1.3 JOB CONDITIONS

A. Protection

1. Protect adjacent structures, surface improvements and surrounding areas from damage during excavation, filling, backfilling and compacting
2. Do not remove trees from outside excavation or fill areas unless authorized by the Engineer; protect from permanent damage by construction activities
3. Protect Work from erosion or other similar types of damage until the project has been completed
4. Provide temporary bridges for roadways, walkways, driveways, etc.
5. Protect area outside designated limits of site perimeter stock fence

B. Weather

1. Do not backfill or construct fills during freezing weather
2. Do not use frozen materials, snow or ice in any backfill or fill area
3. Do not backfill or construct fill on frozen surfaces
4. Protect any excavation from entry of surface runoff from any source

C. Underground Obstructions

1. Protect from damage any underground pipes, utilities or structures encountered during construction
   a. Restore any damaged underground obstructions to their original condition at no cost to the Owner unless evidence of other arrangements satisfactory to all parties is presented to Owner
2. Before commencing work, obtain information concerning location, type and extent of concealed existing utilities on the site and adjacent projects
   a. Consult records and personnel of local utility companies, municipal utility departments and telephone company
   b. File "Notice of Excavation" with these agencies
3. Underground obstructions known to Engineer, except service lines, are shown on the Drawings or otherwise referred to in the Specifications
   a. Locations shown may prove to be inaccurate or other obstructions not shown may be encountered

b. Contractor's responsibility to verify actual locations and to protect or restore all underground obstructions encountered

1.4 SUBMITTALS

A. Gradations for each fill material proposed for use

B. Costs for testing of materials proposed for use to be borne by Contractor

C. Refer to Section 01340 - Shop Drawings, Product Data, and Samples for additional requirements

PART 2 - PRODUCTS

2.1 MATERIALS

A. Classification of Excavated Materials

1. None
2. Remove and handle excavated materials regardless of type, character, composition, condition or depth

B. Fills and Embankments

1. Earth
   a. To the maximum extent practical use excess earth from excavation for fills and embankments
   b. Obtain additional material from borrow areas as necessary
   c. Free from rocks or stones larger than 6" in greatest dimension and free from brush, stumps, logs, roots, debris and organic or other deleterious materials
   d. Acceptable to Engineer
   e. No rocks or stones in upper 18" of fill or embankment
   f. Where allowed, distribute rocks and stones through the fill so as not to interfere with compaction

C. Topsoil

1. Native material removed and stockpiled before excavation
2. Free from trash, debris and/or surface vegetation more than 6" high
3. Refer to Section 02900 - Landscaping for additional requirements

D. Pipe Embedment

1. Class B bedding required for all piping, utility sleeves, casing, ducts and raceways
2. Class B embedment material
   a. Granular material
      1) Well-graded, crushed stone or gravel meeting the requirements of ASTM C33, Gradation 67 (¾" to No. 4)

2) Recycled concrete products meeting the requirements of ASTM C33, Gradation 67, may be utilized in lieu of crushed natural gravel or stone
3) Utilize for all gravity pipelines with plastic piping materials
4) Provide for all sleeves or casings for use with pressure or gravity pipelines

b. Fine granular material
1) Natural (pit run) or manufactured sand meeting the following requirements

Well Graded Sand

Sieve Size	% Passing by Weight
⅜"	100
No. 4	95-100
No. 8	85-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

2) Utilize for all pressure pipelines utilizing ductile iron or steel material
3) Utilize for gravity flow storm water piping utilizing concrete, ductile iron, steel or plastic piping materials
4) Utilize for all electrical duct runs and raceways which are not encased in concrete including duct bank assemblies

c. Other locations specified on the Drawings

E. Trench Backfill

1. Placed in pipeline trench above pipe embedment and select backfill material
2. Compacted material
a. Job excavated material
1) Finely divided, free of debris, organic material and stones larger than 3" in greatest dimension
2) Without masses of moist, stiff clay
3) Free of brush, debris, roots more than 2" in diameter
4) May contain rubble and detritus from rock excavation, stones and boulders if well separated and arranged not to interfere with backfill compaction
5) In upper 18" no rock or rock excavated detritus except with specific approval of Engineer
6) No stones larger than 8" in greatest dimension within 3' of top of pipe

b. Fine granular material: As specified for pipe embedment

F. Structural Backfill

1. Location
a. Fill placed beneath all structures including manholes, vaults, basins, tanks and slabs
b. Interior and exterior foundation backfill of wall structures including manholes, vaults, basins, tanks and slabs

c. Clean, well-graded, non-expansive, crushed, non-porous rock or crushed or uncrushed gravels, sands or combinations thereof
   1) Required gradation

Sieve Size	Percent Passing
1"	100
No. 4	95-100
No. 40	10-55
No. 200	5-20
Liquid Limit	30 max
Plasticity Index	6 max

   2) Recycled concrete products are acceptable subject to conformance with gradation requirements

G. Trench Stabilization

1. Location: As directed by the Engineer to stabilize the trench bottom
2. Gradation: Clean, well-graded rock, 2" to 4" in diameter

H. Geotextile Support Fabric

1. Mirafi® 500X woven geotextile

I. Unsuitable Materials

1. All material removed in stripping and all material containing perishable matter such as roots, sod, grass, decayed vegetable matter, debris or materials having unsatisfactory compaction characteristics
2. Materials which are temporarily unusable due to excessive moisture or improper gradation will not be classified as unsuitable unless such material cannot be satisfactorily reclaimed by screening, manipulation, aerating or blending with other materials as determined by the Engineer
3. Frozen material

PART 3 - EXECUTION

3.1 INSPECTION

A. Field verify the location of all underground utilities, pipelines and structures

B. Clear sites to be occupied by permanent construction of logs, trees, roots, brush, tree trimmings and other objectionable material and debris

1. Grub stumps
2. Clean and strip subgrade for fills and embankments of surface vegetation, sod and organic topsoil
3. Properly dispose of waste material off-site
4. Do not use open burning

C. Right-of-Way Clearing

1. Clear as necessary for access, stringing of pipeline materials and construction of pipelines and appurtenant structures
2. Remove debris from site and properly dispose of off-site; on-site burning is not permitted

3.2 PERFORMANCE

A. General

1. Provide adequate working space and clearances for work performed within excavations and for installation and removal of concrete forms
2. Do not undercut excavation faces for extended footings
3. Clean subgrades of loose material before concrete is placed thereon
4. Except where exterior surfaces are to be dampproofed, concrete structures that do not have footings that extend beyond the outside face of exterior walls may be placed directly against excavation faces without outer forms
5. Preservation of trees
   a. Do not remove trees outside fill or excavated areas except as authorized by Engineer
   b. Protect trees left standing from permanent damage by construction operations
   c. Trim standing trees as directed by Engineer
6. Except as otherwise authorized, indicated or specified, replace all material excavated below the bottom of concrete walls, footings, slabs on grade, and foundations with concrete placed at the same time and monolithic with the concrete above

B. Blasting

1. Blasting or other use of explosives is not permitted

C. Topsoil

1. Remove and stockpile sufficient topsoil to surface, to a minimum depth of 6", fill, embankment and other areas where the original topsoil will be covered or disturbed by construction activities
2. At the completion of other work in each area, place and grade topsoil to Engineer's satisfaction
3. Refer to Section 02900 - Landscaping for additional requirements

D. Dewatering

1. Prior to commencement of dewatering operations, obtain temporary dewatering discharge permit from the Colorado Department of Public Health and Environment
   a. Comply with requirements of dewatering permit throughout the course of construction
   b. Maintain discharge within permit levels

c. All costs associated with the dewatering permit to be borne by the Contractor

2. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering excavations, trenches and other parts of the work
3. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result
4. Dewater excavations which extend to or below ground water by lowering and keeping the ground water level at least 12" below the bottom of the excavation
   a. Where the bottom of the excavation is sound, reasonably impervious material such as rock, sandstone, claystone, hard shale or similar material, free-draining granular material may be placed, consolidated and used as a means to convey ground water to points of withdrawal (sumps)
   b. Ground water shall be maintained below the top of any clean, free-draining granular material placed as described
5. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
6. Submit detailed dewatering plan to Engineer for review prior to the commencement of construction activities
7. Contractor is responsible for the condition of any pipe or conduit used for drainage; all drainage pipes shall be left clean and free of sediment
8. All costs for dewatering shall be borne by the Contractor, except as otherwise provided in the Contract Documents
9. Refer to Section 02372 - Drilled Caissons for dewatering and concrete placement requirements for caisson excavations

E. Sheeting, Shoring and Bracing

1. Provide proper and substantial sheeting, shoring and bracing as required to prevent caving or sliding, to protect the Work and to protect existing structures and facilities
2. Design and build sheeting, shoring and bracing to withstand all loads that might be caused by earth movement or pressure, and to be rigid, maintaining shape and position under all circumstances
3. Do not pull trench sheeting before backfilling unless pipe strength is sufficient, in Engineer's opinion, to carry trench loads based on trench width to the back of sheeting

F. Excavation

1. Complete all site preparation in accordance with these specifications
2. Complete excavation of every description to lines and grades indicated on the plans or specifications
3. When excavation to required grade discloses unsuitable soil, notify Engineer immediately
   a. Engineer may require Contractor to remove unsuitable material and backfill with approved material

4. If any areas are inadvertently over-excavated, fill such over excavation with suitable compacted fill material or concrete as directed by Engineer
5. Complete excavation work to the grade elevations called for on the Drawings

G. Stabilization

1. Thoroughly compact and consolidate subgrades for concrete structures and trench bottoms so they remain firm, dense and intact during required construction activities
2. Remove all mud and muck during excavation
3. Reinforce subgrades with 2" crushed rock where allowable if they become mucky during construction activities
   a. Confirmation of the requirement for trench subgrade stabilization before installation by the Owner's representative is required before payment for this work item will be considered
4. Finished elevation of stabilized subgrades to be at or below subgrade elevations indicated on Drawings
5. Allow no more than ½" depth of mud or muck to remain on trench bottoms when pipe embedment material is placed thereon
6. Payment for stabilization material
   a. In accordance with contract conditions and as approved by Owner prior to installation
7. Contractor shall exercise extreme caution during site preparation, excavation and subgrade stabilization to ensure that subgrade pumping will not occur
8. Any areas of existing or new subgrades which exhibit signs of pumping shall be removed and replaced
9. Payment will not be made for stabilization of subgrades which have been inadequately dewatered or improperly prepared

H. Roadway Excavation

1. Excavate for roadways, drives and parking areas per the lines, grades, cross sections and dimensions indicated on Drawings
2. Excavate unsuitable material from the subgrade
3. Scarify subgrade to a minimum depth of 8"
4. After shaping, compact subgrade to 95% of maximum density at optimum moisture content, ASTM D698, to a minimum depth of 8"
5. Reshape and wet as required
6. Proofroll the subgrade with a heavily loaded pneumatic-tired vehicle
   a. Remove and replace with suitable material, soft or otherwise unsuitable material
7. Refer to Section 02500 - Paving and Surfacing for additional requirements

I. Fills and Embankments

1. Complete all site preparation in accordance with these Specifications
2. Subgrade preparation
   a. Plow, step or bench sloped surfaces steeper than 4:1 on which fill or backfill is to be placed in such manner that fill material will adequately bond with existing surfaces

b. Scarify all surfaces to receive backfill to a minimum depth of 8" prior to backfilling
c. After shaping, compact subgrade to 95% of maximum density at optimum moisture content, ASTM D698, to a minimum depth of 12"
d. In areas designated on the Drawings for placement of fills and embankments where there will be no pipelines, structures or driving surfaces, compaction may be accomplished utilizing wheel rolling from earthmoving equipment. Expected density is to be no less than 80% of maximum density at optimum moisture content determined in accordance with ASTM D698
    1) In general, these areas are for placement and onsite storage of excess excavated material and are to only receive landscape treatment
    2) Areas so designated for this compaction effort must be confirmed with the Engineer prior to placement

3. Placement and compaction
    a. Place in approximate horizontal layers of thin loose lifts, 8" maximum uncompacted thickness
    b. Spread and level material deposited in piles and windrows before compacting
    c. Compact each layer only when material has the best practicable uniform moisture content for satisfactory compaction
    d. Add water and harrow, disc, blade or otherwise work each layer to obtain the uniform moisture content for adequate compaction
    e. Thoroughly compact each layer by rolling or other means acceptable to Engineer to 95% of maximum density at optimum moisture content, ASTM D698
    f. Alter compaction methods if material fails to meet specified density
    g. Where a trench passes through a fill or embankment
        1) Place and compact fill and embankment to 12" above top of the pipe before excavating the trench
    h. Fills and embankments over structures
        1) Use methods which will not damage or overload structure
        2) Use rubber-tired vehicles to extent practicable
        3) Operate equipment to prevent impact loads on structure
        4) Distribute equipment loads with planks or a layer of earth or gravel 12" minimum, 18" maximum thick
        5) Do not pile earth or gravel more than 3' deep
        6) Take special care to prevent damaging or disturbing roofing membrane, drains or granular fill material
    i. For areas where wheel rolling by excavation material is deemed satisfactory compaction effort, layers of loose material shall be no greater than 12 inches in thickness. Moisture conditioning will be required to attain moisture content at optimum +/- 3%

4. Borrow pits
    a. Obtain material required to complete fills and embankments from borrow pits in the area or on-site job excavated material
    b. The location, size, shape, depth, drainage and surfacing of borrow pits shall be acceptable to Engineer
    c. Make borrow pits regular in shape with graded and surfaced side and bottom slopes when completed

d. Cut side slopes not steeper than 2:1 and uniform for the entire length of any one side

J. Spoil Areas

1. Complete site preparation, subgrade preparation, placement, etc. in accordance with these Specifications

K. Trench Excavation

1. Do not open more trench in advance of pipe laying than is necessary to expedite the work; 50' maximum
   a. Finish grading and cleanup activities shall follow pipe laying by not greater than 50'
2. Except where tunneling is indicated on the Drawings, specified, or permitted by Engineer, excavate trenches by open cut from the surface
3. Alignment, grade and minimum cover
   a. Excavate trenches so pipes can be laid straight at uniform grade, without dips or bumps, between the terminal elevations indicated on the Drawings
   b. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection
   c. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of the pipe
      1) Increase depth as required at vertical curves and for clearance beneath other pipes, conduits, drains, drainage structures or other conflicting structures encountered at normal pipe elevation
      2) Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation or to future lower surface elevations where indicated on Drawings; enter all data into As-Constructed record documents
      3) Refer to the Drawings for additional requirements
4. Limiting trench widths
   a. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment
   b. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1' above the top of the pipe
   c. Stipulated minimum clearances are minimum clear distances, not minimum average distances
   d. Maximum trench width from bottom of trench up to 6" above the installed pipe: Pipe O.D. plus 24"
   e. Minimum trench width from bottom of trench up to 6" above the installed pipe: Pipe O.D. plus 12"
5. If the width of the lower portion of the trench exceeds the maximum permitted, provide pipe of adequate strength, special pipe embedment, or arch concrete encasement as required by loading conditions and as determined by Engineer
6. Mechanical excavation
   a. Do not use where its operation would damage buildings, culverts or other existing property, structures or utilities above or below ground; hand-excavate only in such areas

b. Use mechanical equipment of a type, design and construction and operated so that
   1) Rough trench bottom elevation can be controlled
   2) Uniform trench widths and vertical side walls are obtained from 1' above the top of the installed pipe to the bottom of the trench
   3) Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench side walls
c. Do not undercut trench sidewalls

7. Cuts in surface construction
   a. All underground construction is to occur prior to placement of any surface finishes or surface improvements
8. Excavation below pipe subgrade
   a. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Construction Standards to provide for installation of pipe embedment material
9. Artificial foundation in trenches
   a. Whenever so directed by Engineer, excavate to such depth below a grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct
   b. Provide timber, concrete or other foundations made necessary by unstable soil as directed by Engineer
10. Bell holes
   a. Excavate to provide adequate clearance for tools and methods of pipe installation
   b. Do not allow any part of bells or couplings to contact the trench bottom, walls or pipe embedment when pipe is joined

L. Pipe Embedment

1. Embed pipes above and below the bottom of pipe as indicated in the Construction Standards and as specified
2. Spread and surface grade compacted pipe embedment where allowed to provide for a continuous and uniform support beneath pipe at all points between bell holes or pipe joints
3. Slightly disturbing finished subgrade surface during withdrawal of slings and lifting tackle is permissible
4. After grading, aligning, placing pipe in final position and shoving home, deposit and compact sufficient pipe embedment under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent operations
5. Carefully place and compact pipe embedment material uniformly and simultaneously on both sides of pipe to prevent lateral displacement
6. Carefully place and compact Class "B" pipe embedment material to 1' over top of pipe
7. Fine granular material and select backfill material
   a. Compact to 95% maximum density at optimum moisture content as determined by ASTM D698
   b. Compact to 12" above top of pipe
8. Granular material and squeegee sand

a. Maximum uncompacted thickness of layers: 6"
b. Compact by slicing with shovel or vibrating

M. Trench Backfill

1. Compacted material
   a. Provide for the full depth of trench above pipe embedment
   b. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to 1' above the top of the upper pipe prior to excavating the upper trench
   c. Finish the top portion beneath established sodded areas with 6" minimum topsoil corresponding to, or better than, underlying adjacent areas
   d. Suitable job excavated material or graded gravel; Contractor's option
   e. Job excavated materials
      1) Place in horizontal layers of uniform thickness as required to achieve specified compaction
      2) Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe
      3) Compact to 95% of maximum density at optimum moisture content per ASTM D698 or to 70% relative density per ASTM D2049 when appropriate
   f. Graded gravel
      1) Deposit in horizontal layers of uniform thickness
      2) Compact with suitable vibrating roller or platform vibrator to not less than 70% relative density per ASTM D2049
2. Finish the top portion of backfill with at least 6" of topsoil corresponding to, or better than, that underlying adjoining areas in accordance with Specification Section 02900 - Landscaping
3. Uncompacted trench
   a. None permitted

N. Structural Fill, Structural Subgrade and Backfill

1. Place in 6" horizontal layers (compacted thickness) to achieve specified compaction
2. Compact with mechanical, platform-type tampers
3. Structural subgrade
   a. Thoroughly compact each layer to 100% of maximum density at +2% optimum moisture content as determined by ASTM D698 for fill placed beneath structures
4. Thoroughly compact each layer to 95% of maximum density at +2% optimum moisture content as determined by ASTM D698 for fill placed on exterior sides of walls including foundation walls
5. Use roller for compaction if necessary to prevent damage to structure and desired density can be obtained
6. Compaction by inundation with water will not be permitted
7. If trench passes through a structure backfill, compact backfill to an elevation of 12" above top of pipe before trenching
8. Do not deposit or compact tamped or otherwise mechanically compacted backfill in water

9. Take particular care to compact backfill which will be beneath pipes, drives, roads, parking areas, curbs, gutters or other surface construction
10. Compact backfill adequately to support items constructed or placed thereon
11. Structural backfill shall not be placed against cast-in-place concrete walls until said concrete and concrete for suspended floor slabs has reached design strength
12. Compacted structural backfill against tank walls and other below grade walls not backfilled on both sides shall be sloped up from the base of the wall at an angle of at least 35 degrees from vertical (1.0 Horiz. to 1.43 Vertical). In exterior locations, the upper 2 feet of wall backfill shall be relatively impervious to minimize surface water infiltration in the backfill zone

O. Compaction

1. Moisture content of material in layers being compacted shall be near optimum and shall be as nearly uniform as practicable throughout the layer
   a. As determined in accordance with ASTM D1557 or ASTM D698 based on nature of underlying soils
2. Perform all compaction with acceptable equipment well suited to location and material being compacted
   a. Use heavy vibrating rollers where heavy equipment is authorized
   b. Do not operate heavy equipment closer to foundations than a horizontal distance equal to height of backfill above bottom of foundation
      1) Compact remaining area with hand tampers suitable for material being compacted
3. Place and compact backfill around pipes with care to avoid damage to pipe
4. Compact fill materials to specified densities

P. Drainage Maintenance

1. Do not backfill trenches across roadways, driveways, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid
2. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic
3. Backfill so that water does not accumulate in unfilled or partially filled trenches
4. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade and contour
5. Do not obstruct surface drainage any longer than necessary
   a. Provide provisions to prevent damage to upstream and downstream property
6. Install and maintain erosion control and sediment containment structures and sediment fence as specified and necessary

Q. Protection of Trench Backfill

1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion

a. Install sedimentation and erosion control where indicated on the Drawings and in accordance with Section 02270

R. Disposal of Unsuitable Materials

1. Except as otherwise permitted, dispose of unsuitable materials off site
2. Dispose of excavated rock in excess of the amount permitted to be and actually installed in the trench backfill in areas on the site specified by the Engineer and Owner
   a. In general, this is located in areas of embankment of excess soil material and areas where there are no pipes, structures, surfacing or surface improvements
3. Dispose of junk and debris encountered in excavation work and other similar waste materials off site
4. Dispose of vegetation materials removed in clearing and grubbing off-site which are not suitable for incorporation in topsoil
   a. Refer to conditions of the Grading and Erosion Control Plans appurtenant to the local governing agency Erosion and Stormwater Quality Control Permit (ESQCP)

S. Final Grading

1. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours all areas of the site to be graded
2. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work
3. Grade all surfaces for effective drainage
4. Provide a 2% minimum slope except as otherwise required
5. Round all horizontal and vertical corners to provide a neat, uniform appearance
6. Grade and surface to Engineer's satisfaction

T. Settlement

1. Guarantee for settlement of all fills, embankments and backfills is two years from final completion of Contract under which Work is performed
2. Repair or replace within 30 days after notice by Engineer or Owner

3.2 FIELD QUALITY CONTROL

A. Refer to Section 01400 - Quality Control

B. Soil Compaction Tests

1. Conduct in accordance with requirements of ASTM D698 or ASTM D2049
2. Two standard Proctor compaction tests, ASTM D698 or two relative density tests, ASTM D2049, as appropriate for each type of embedment or backfill material proposed
3. Use method A, B, C or D as appropriate, based on soil condition and judgment of testing laboratory

4. Samples tested to be representative of materials to be placed
5. Use test results as a basis for compaction control

C. Density Control

1. Conduct tests for density control during compaction operations in accordance with requirements of the following
   a. ASTM D2922 - Tests for Density of Soil-in-Place by Nuclear Methods, or
   b. ASTM D1556 - Test for Density of Soil-in-Place by Sand-Cone Method, or
   c. ASTM D2167 - Test for Density of Soil-in-Place by the Rubber-Balloon Method
2. Conduct a minimum of one test for each layer of specified depth of fill or backfill as follows
   a. Foundations: For each 100 lineal feet or less of foundation
   b. Slabs on grade: For each 500 square feet or less of building or slab area
   c. Pavement and walks: For each 1,000 square feet or less
   d. All other areas: For each 1,000 square feet or less
   e. Pipe trench: For each 50 lineal feet or less of trench

3.3 SCHEDULES

A. Pipeline Embedment

1. Class "A" arch encasement: Not required unless improper trenching or unexpected trench conditions require its use as determined by Engineer or where indicated on the Drawings
2. Class "B" embedment
   a. Use for all piping unless otherwise indicated on the Drawings
3. Class "C" embedment
   a. Impermissible embedment
4. Class "D" embedment
   a. Impermissible embedment

END OF SECTION