SECTION 311020

TRENCHING, BACKFILLING AND COMPACTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all trenching for pipelines and appurtenances, including drainage, filling, backfilling, disposal of surplus material and restoration of trench surfaces and easements.

B. Excavation shall extend to the width and depth shown on the Construction Plans or as specified herein and shall provide suitable room for installing pipe, structures and appurtenances.

C. Furnish and place all sheeting, bracing and supports and remove from the excavation all materials which the City or Engineer may deem unsuitable for backfilling. The bottom of the excavation shall be firm and dry and in all respects. If conditions warrant, deposit gravel for pipe bedding, or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.

D. All excavation, trenching and related sheeting, bracing, etc., shall conform to the requirements of the Florida "State Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 29 CFR 1926 Subpart P.

E. Wherever the requirement for 95 or 98 percent compaction is referred to herein it shall mean "at least 95 or 98 percent of maximum density as determined by ASTM D1557, Method D".

F. Prior to the start of work submit the proposed method of backfilling and compaction to the Engineer and City for review.

G. All erosion and sediment control shall be in accordance with FDOT Standard Specifications for Road and Bridge Construction, latest edition.

1.2 RELATED WORK

A. Granular fill material is included in Section 311030.

1.3 DEWATERING

A. See Section 311010 Dewatering.

1.4 JOB CONDITIONS

A. The Contractor shall examine the site and review the available test borings or undertake his/her own soil borings prior to submitting his/her bid, taking into consideration all conditions that may affect his/her work. The City will not assume responsibility for variations of sub-soil quality or conditions at locations other than places shown and at the time the investigation was made. Boring log data and soil samples shall be examined if applicable.

B. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, notify the City of such piping or utility immediately for direction.

2. Cooperate with the City and utility companies in keeping respective services and facilities in operation. Repair/replace damaged utilities to satisfaction of utility owner.

3. Demolish and completely remove from site existing underground utilities indicated on the Construction Plans to be removed.

C. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights and/or signs. Operate warning lights shall be used as recommended by authorities having jurisdiction.

1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

1.5 SUBMITTALS

A. Submit, in accordance with Section 013000, complete product data for materials specified in this Section.

B. For each material obtained from other than onsite sources, the Contractor shall notify the Engineer and the City of the source of the

material.

C. Furnish product data for all imported fill material to include:

1. Material Source: Submit name of imported material suppliers.

2. Supplier's Certificate: Certify that products meet or exceed specified requirements.

1.6 REFERENCED STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M 288 - Geotextiles.

B. ASTM International:

1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

2. ASTM D 4355 / D 4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

3. ASTM D 4533/ D 4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

4. ASTM D 4632/ D 4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

5. ASTM D 6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

6. ASTM D 4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.

C. Florida "State Safety Act" (CS/SB 2626).

D. FDOT Standard Specifications for Road and Bridge Construction.

E. Occupational Safety and Health Administration (OSHA):

1. 29 CFR Part 1926 Subpart P.

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Base, Fill, and Backfill:

1. Satisfactory soil materials are defined as those complying with American Association of State Highway and Transportation Officials (AASHTO) M 145, soil classification Groups A-2 and A-3.

2. Unsatisfactory soil materials are those defined in AASHTO M 145 soil classification Groups A-1, A-24, A-25, A-26, A-27, A-4, A-5, A-6, and A-7 along with peat and other highly organic soils.

B. Structural Fill:

1. Well graded soil material consisting of coarse aggregate to medium to fine grain sized sand, free of organic, deleterious and/or compressible material.

   a. Shall not contain rock or stones exceeding three and one-half (3-1/2”) inches in diameter, hardpan, cobbles, or other similar materials.

C. Select Common Fill:

1. Soil material containing no more than 15 percent by weight finer than No. 200 mesh sieve.

   a. Shall be free from organic matter, muck, marl, rock exceeding three and one-half (3-1/2”) inches in diameter, broken concrete, masonry, rubble, or other similar materials.

2. Material falling within the above specification, encountered during the excavation, may be stored in segregated stockpiles for reuse. All material which, in the opinion of the Engineer or the City, is not suitable for reuse shall be spoiled as specified herein for disposal of unsuitable materials.

D. Bedding Rock:

1. Bedding rock shall be FDOT No. 57, gradation washed and graded lime rock or shell.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 3; AASHTO M 288.

2. Survivability: As follows:

   a. Grab Tensile Strength: 120 lbf (534 N); ASTM D 4632/ D 4632M.

   b. Tear Strength: 50 lbf (223 N); ASTM D 4533/D 4533 M.

   c. Puncture Strength: 310 lbf 1 N); ASTM D 6241.

3. Apparent Opening Size: No. 70 (0.212-mm) sieve, maximum; ASTM D 4751.

4. Permittivity: 0.1 per second, minimum; ASTM D 4751.

5. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355/D 4355M.

6. Product: Provide “Mirafi 140N,” by TenCate Geosynthetics – Nicolon Corporation, or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

A. All excavation, backfill, and grading necessary to complete the work shall be made by the Contractor and the cost thereof shall be included in the contract price.

B. Material shall be furnished as required from off-site sources and hauled to the site.

C. The Contractor shall take all the necessary precautions to maintain the work area in a safe and workable condition.

D. The Contractor shall always protect his/her work by flagging, marking, lighting, and barricading. It shall also be the Contractor's responsibility to preserve and protect all above and underground structures, pipe lines, conduits, cables, drains or utilities which are existing at the time he/she encounters them. Failure of the Construction Plans to show the existence of these obstructions shall not relieve the Contractor from this

responsibility. The cost of repair of any damage which occurs to these obstructions during or as a result of construction shall be borne by the Contractor without any additional cost to the City.

3.2 TRENCH EXCAVATION

A. Trench excavation shall include material of every description and of whatever substance encountered, except rock and boulders. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.

B. Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

C. While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.

D. Excavation for all trenches required for the installation of pipes and electrical ducts shall be made to the depths indicated in the Construction Plans. Excavate in such manner and to such widths as will give suitable room for laying the pipe or installing the ducts within the trenches, for bracing and supporting and for pumping and drainage facilities. The trench width at the top of the pipe shall not exceed the allowable as determined by the depth of cut and indicated in the Construction Plans.

1. For water mains, excavate trench to provide a minimum of 36 inches of clear cover over the pipe bell unless otherwise noted in the Construction Plans or herein.

E. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed. Subgrade soils which become soft, loose, "quick", or otherwise unsatisfactory as a result of inadequate excavation, dewatering or other construction methods shall be removed and replaced by screened gravel fill as required by the Engineer at the Contractor's expense.

F. Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last one (1) foot of depth.

G. Rock shall be removed to a minimum four (4”) inches to six (6”) inches of clearance around the bottom and sides of all the pipe or ducts being

laid as shown in the Construction Plans.

H. The bottom of the excavations shall be firm and dry and, in all respects, acceptable to the City. Excavate unsatisfactory soil material from the bottom of the trench to a depth determined by the City and replace with rock or shell bedding.

I. Where pipe or ducts are to be laid in bedding or encased in concrete the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

J. Where the pipes or ducts are to be laid directly on the trench bottom the lower part of the trenches shall not be excavated to the trench bottom by machinery. The last of the material being excavated shall be done manually in such a manner that will give a flat bottom true to grade so that pipe or duct can be evenly and uniformly supported along its entire length on undisturbed material or bedding rock. Bell holes shall be made as required manually so that there is no bearing surface on the bells and pipes are supported along the barrel only.

3.3 PIPE INTERFERENCES AND ENCASEMENT

A. The Contractor shall abide by the following schedule of criteria concerning interferences with other utilities. In no case shall there be less than 0.3 feet between any two pipe lines or between pipe lines and structures. Concrete encasement shall be provided in accordance with the typical detail as shown in the Construction Plans.

3.4 BEDDING

A. Where select common bedding material is used for pipe support as shown in the Construction Plans, the trench bottom or bedding should be prepared in accordance with Paragraph 3.2.E of this Section and the top six (6”) inches shall be compacted using mechanical equipment to a minimum of 95 percent (or 98 percent if adjacent to a roadway) of the maximum dry density as determined by ASTM D1557, Method D.

B. Where rock or shell is used for pipe support, gravity sewer pipe shall have rock or shell bedding to six (6”) inches over top of pipe, and four (4”) inches to six (6”) inches below the invert. Pressure pipe shall have rock or shell bedding to springline of pipe, and four (4”) inches to six (6”) inches below the invert depending on the diameter as shown in the Construction Plans. Rock or shell bedding shall be placed in maximum lift thicknesses of four (4”) inches to six (6”) inches with each lift compacted using mechanical equipment.

C. Rock or shell bedding may be used under certain circumstances as a

drain for ground water control, subject to the approval of the City. The Contractor shall take all precautions necessary to maintain the shell or rock bedding in a compacted state and to prevent washing, erosion, or loosening of this bed.

3.5 SHEETING AND BRACING

A. Furnish, put in place and maintain sheeting and bracing required by Federal, State or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.

B. Where sheeting and bracing is required to support the sides of trenches, engage a professional engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design and certification of this shall be provided by the professional engineer.

C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the screened gravel backfill.

1. When installing rigid pipe (R.C., V.C., A.C., etc.), any portion of the box extending below mid diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.

2. When installing flexible pipe (PVC, etc.), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be re-compacted to provide uniform side support for the pipe.

D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing and later removal of sheeting.

E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.

F. No payment will be given for sheeting, bracing, etc., during the progress of the work. No payment will be given for sheeting which has been left in the trench for the convenience of the Contractor.

G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least one (1') ft above the top of the pipe.

3.6 TEST PITS

A. Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.

B. Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.7 BACKFILLING

A. Backfilling over pipes shall begin as soon as practicable after the pipe has been laid, jointed, and inspected and the trench filled with suitable bedding material.

B. Backfilling over ducts shall begin not less than three (3) days after placing concrete encasement.

C. All backfilling shall be performed expeditiously and as detailed in the Construction Plans.

D. Any space remaining between the pipe and sides of the trench shall be packed full by hand shovel with selected earth, free from stones having a diameter greater than two (2") inches and thoroughly compacted with a tamper as fast as placed, up to a level of one (1') foot above the top of the pipe. The material shall be compacted to a minimum of 95 percent (or 98 percent if adjacent to a roadway) of the maximum dry density as determined by ASTM D1557, Method D in layers not to exceed four inches (4") up to the centerline of the pipe from the trench bottom and in layers not to exceed six (6") inches from the pipe centerline to twelve (12") inches above the pipe.

E. The filling shall be carried up evenly on both sides with at least one person tamping for each person shoveling material into the trench.

F. The remainder of the trench above the compacted backfill, as just described above, shall be filled and thoroughly compacted with select common fill with mechanical equipment. Compact select common fill in six (6”) inch layers to a minimum of 95 percent (or 98 percent if adjacent to a roadway) of the maximum dry density determined by ASTM D1557, Method D.

G. Where the pipes are laid in streets, the remainder of the trench up to a depth of twelve (12”) inches below the bottom of the specified permanent paving shall be backfilled with common fill material in layers not to exceed one (1’) foot and thoroughly compacted. The subbase layer for paving shall be of bank-run gravel thoroughly compacted in six (6”) inch layers.

H. In locations where pipes pass through building walls, the Contractor shall take the following precautions to consolidate the refill up to an elevation of at least one (1’) foot above the bottom of the pipes:

1. Place structural fill in such areas for not less than three (3’) feet either side of the center line of the pipe in level layers not exceeding six (6”) inches in depth.

2. Wet each layer to the extent requested and thoroughly compact each layer with a power tamper.

I. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or screened gravel has been placed and compacted to a level one (1’) foot over the pipe.

J. Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping, to 92 percent compaction. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.

K. Compaction by puddling or water jetting shall not be permitted.

L. Compaction in confined areas shall be by use of hand or pneumatic ramming with tools weighing at least 20 lbs. The material shall be spread and compacted in layers not exceeding six (6”) inches thick, uncompacted loose measure thickness.

M. Backfill around structures shall be granular fill material as specified and as shown on the Drawings. All backfill shall be spread and compacted as specified, especially under and over pipes connected to the structures.

N. Bituminous paving shall not be placed in backfilling unless specifically permitted, in which case it shall be broken up as directed.

O. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall always be employed.

P. The Contractor shall coordinate and pay for density tests to determine compaction of backfill spaced as required by the agencies having jurisdiction, or at a minimum of one in every 300 feet of trench cut per lift and shall include a test at the spring line of the pipe. The tests shall be sign and sealed by a Florida Licensed Engineer.

3.8 GRADING

A. Grading shall be performed at such places as are indicated in the Construction Plans, to the lines, grades, and elevations shown or as approved by the City and shall be made in such a manner that the requirements for formation of embankments can be followed. All unacceptable material encountered, of whatever nature within the limits indicated, shall be removed and disposed of as requested. During the process of excavation, the grade shall be maintained in such condition that it will always be well drained. Temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the prosecution or condition of the Work.

B. If at the time of excavation, it is not possible to place any material in its proper section of the permanent structure, it shall be stockpiled in approved areas for later use. No extras will be considered for the stockpiling or double handling of excavated material.

C. The right is reserved to make minute adjustments or revisions in lines or grades if found necessary as the work progresses, due to discrepancies in the Construction Plans or in order to obtain satisfactory construction.

D. Stones or rock fragments larger than one and one-half (1-1/2”) inches in their greatest dimensions will not be permitted in the top one (1’) foot of the subgrade line of all dikes, fills, or embankments.

E. All fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown in the Construction Plans, or as approved in writing by the City.

F. In cuts, all loose or protruding rocks on the back slopes shall be jarred loose or otherwise removed to line or finished grade of slope. All cut and fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown in the Construction Plans or as approved in writing by the City.

G. No grading is to be done in areas where there are existing pipe lines that may be uncovered or damaged until such lines which must be maintained are relocated, or where lines are to be abandoned, all required valves are closed and drains plugged at manholes.

H. The Contractor shall replace all pavement cut or otherwise damaged during the progress of the Work as specified elsewhere herein.

3.9 RESTORING TRENCH SURFACE

A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate the backfill and maintain the surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

B. In streets and adjacent to streets, the twelve (12”) inches of trench backfill below the specified initial pavement shall consist of compacted bank-run gravel. Should the Contractor wish to use material excavated from the trench as gravel subbase for pavement replacement, the Contractor shall, at his/her own expense, have samples of the material tested by an independent testing laboratory at intervals not to exceed 500-ft, in order to establish its compliance with the specifications. Only material which has been tested and approved by the Engineer shall be allowed to be incorporated into the work.

C. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored to a condition at least equal to that existing before work began.

D. In sections where the pipeline passes through grassed areas, the Contractor, shall at his/her own expense, remove and replace the sod, or loam and seed the surface to the satisfaction of the Engineer.

3.10 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL

A. Excavated material shall be stacked without excessive surcharge on the trench bank or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be segregated for use in backfilling as

specified below.

B. All surplus and/or unsuitable excavated material shall be disposed of in the following manner:

1. Transport from City's property and legally dispose the material. Any permit required for the hauling and disposing of this material beyond City's property shall be obtained prior to commencing hauling operations.

C. Suitable excavated material may be used for fill if it meets the Technical Specifications for select common fill and is approved by the Engineer and the City. Excavated material that has been approved may be neatly stockpiled at the site in a location designated by the City, provided there is an area available where it will not interfere with the operation of the facility nor inconvenience traffic or adjoining property owners.

END OF SECTION