Section 02200 - EARTHWORK

1. SCOPE. This section covers earthwork and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

2. GENERAL REQUIREMENTS. With reference to the terms and conditions of the construction standards for excavations set forth in the OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, the Contractor shall employ a competent person and, when necessary, a registered professional engineer, to act upon all pertinent matters of the Work of this section.

Excavations shall provide adequate working space and clearances for the Work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Monolithic concrete manholes and other concrete structures, or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

3. LATERAL SEPARATION MAINS.

3.01. Water and Sanitary Sewer Mains. Refer to Standard Details for additional information. Water mains shall be laid at least ten feet laterally from existing or proposed sanitary sewers, unless local conditions or barriers prevent a 10 foot lateral separation in which case:

a. The water main is laid in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sanitary sewer, or

b. The water main is laid in the same trench as the sanitary sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sanitary sewer.

Crossing a water main over a sewer: Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18 inch vertical separation - in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

Crossing a water main under a sewer: Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the path point of crossing.

3.02. Storm Sewer and Sanitary Sewer. When a sanitary sewer crosses over or under a storm sewer, the sanitary sewer shall have 12 inches of vertical separation from the storm sewer or the sanitary sewer shall be constructed of ductile iron pipe with joints that are equivalent to water main standards for a minimum distance of 10 feet on each side of point of crossing.

3.03. Storm Sewer and Water Mains. When a water main crosses over or under a storm sewer, the water main shall have 12 inches of vertical separation from the storm sewer or the water main shall be constructed of ductile iron pipe with joints that are equivalent to water main standards for a minimum distance of 10 feet on each side of point of crossing.

3.04. Streams and Other Water Bodies and Sanitary Sewer. Sewers entering or crossing streams shall be constructed of ferrous material pipe with mechanical joints; otherwise they shall be constructed so they will remain watertight and free from changes in alignment or grade and tested to 150 psi. PVC pipe may be used where a minimum of 3 feet of cover can be maintained. Material used to backfill the trench shall be of material which will not easily erode, cause siltation, damage pipe during placement, or corrode the pipe.

3.05. Minimum Separation. Where the required minimum separations cannot be maintained, ferrous sewer pipe with joints equivalent to water main standards must be used. However, minimum separations shall not be less than 25 feet from a private well or 50 feet from a public water supply well in accordance with NCAC 2H .0219(i)(2)(G)(xii).

4. CLASSIFICATION OF EXCAVATED MATERIALS. Classification of excavated materials will be made as follows:

a. Rock. Rock is defined as being sandstone, limestone, flint, granite, quartzite, slate, hard shale, or similar material in masses more than 1 cubic yard in volume or in ledges 4 inches or more in thickness, and the Observer agrees that the excavated material is rock.

Should rock be encountered in two or more ledges, each ledge being not less than 3 inches thick and with interlying strata of earth, clay, or gravel not more than 12 inches thick in each stratum, the entire volume between the top of the top ledge and the bottom of the bottom ledge will be classified as rock.

b. Earth. All material not classified as rock.

5. CLEARING. All clearing on the temporary and permanent easements shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

The permanent easement or other limits as shown on the Drawings shall be cleared of all logs, trees, roots, brush, tree trimmings, and other objectionable materials and debris. All stumps shall be grubbed. Subgrades for fills and embankments shall be cleaned and stripped of all surface vegetation, sod, and organic topsoil. All waste materials shall be removed from the site and disposed of by and at the expense of the Contractor.

Trees 6 inches in diameter and larger shall only be removed from temporary construction easement when it is necessary for the trenching operation; and only then with permission of the Owner.

6. BLASTING. The Contractor shall be responsible for all damage caused by blasting operations. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.

The local Fire Authority shall be contacted to obtain blasting permits as may be required.

All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.

Rock shall be removed to provide a minimum clearance of 6 inches below and 8 inches to the sides of the pipe barrel, valves and fittings. Compacted suitable job excavated material shall be used to backfill to the bottom of the appropriate pipe embedment.

7. UNAUTHORIZED EXCAVATION. Except where otherwise authorized, indicated, or specified, all materials excavated below the bottom of concrete walls, footings, slabs

on grade, and foundations shall be replaced, by and at the expense of the Contractor, with concrete placed at the same time and monolithic with the concrete above.

8. DEWATERING. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level beneath such excavations 12 inches or more below the bottom of the excavation.

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

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

9. SHEETING AND SHORING. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be sheeted, braced, and shored, as necessary to prevent caving or sliding and to comply with OSHA trenching and excavation regulations as revised in Subpart P of Part 1926 in the Federal Register.

Trench sheeting shall be removed slowly and in a manner not to disturb the pipelines. The pipe shall be backfilled with at least the first lift prior to removing the sheeting. When directed by the Owner, sheeting shall be left permanently in the trench. Payment for the timber portion of the sheeting will be made in accordance with the provisions of the Contract Documents for changes in the Work and the Contract Price at the local market price for such timber and no allowance being made for any labor used in connection with handling or placing thereof.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

10. STABILIZATION. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed

rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches; if the required depth exceeds 4 inches, the material shall be furnished and installed as specified for granular fills. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the Drawings.

11. TRENCH EXCAVATION. No more trench shall be opened in advance of pipe laying than is necessary to expedite the Work. One block or 200 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction. Failure to comply with this requirement shall be cause for the shutdown of that portion of the project until such backfilling is accomplished.

Except where tunneling is indicated on the Drawings, is specified, or is permitted by the Engineer, all trench excavation shall be open cut from the surface.

11.01. Alignment, Grade, and Minimum Cover. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

Where pipe grades or elevations are not definitely fixed by the Contract Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 36 inches. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation, except where future surface elevations are indicated on the Drawings.

11.02. Limiting Trench Widths. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths from the bottom of the trench to an elevation one foot above the top of installed pipe, and the minimum permissible sidewall clearances between the installed pipe and each trench wall, shall be as follows:

Nominal Pipe Size inches	Minimum Trench Width inches
36 to 6	Pipe OD plus 16

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot above the top of the pipe.

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

11.03. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

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

11.04. Cutting Concrete Surface Construction. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-1/2 inches deep along each side of the trench and along the perimeter of cuts for structures.

Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 12 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

Pavement removed for connections to existing lines or structures shall not be of greater extent than necessary for the installation.

Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts as specified for pavement.

11.05. Excavation Below Pipe Subgrade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as indicated on Figure 11 of Standard Details, to provide for the installation of granular embedment.

11.06. Stabilization Stone. Whenever unsuitable or unstable soil conditions are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with stabilization stone. Stabilization stone shall be No. 467 washed crushed stone having a maximum size of 2 inches. Approval to use stabilization stone shall be specifically obtained from the Owner prior to excavating below the bottom of the required depth for the pipe embedment. In such cases, stabilization stone shall be paid for at the unit price included in the Bid Form. Stabilization stone installed without approval of Owner will not be paid for, and the cost shall be the sole responsibility of the Contractor.

11.07. Bell Holes. Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

12. PIPE EMBEDMENT. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements indicated on the Standard Details and to the following supplementary requirements.

Embedment material shall contain no cinders, clay lumps, or other material which may cause pipe corrosion.

12.01. Embedment Classes. The following embedment classes shall be used on all pipe. The embedment class selected for a particular installation shall depend on the trench conditions and the type and size of the pipe. The Contractor shall use the embedment class indicated herein or as specified in the Special Conditions.

a. Class A Arch Encasement. Class A arch encasement shall be used where specified in Special Conditions or on the Drawings.

b. Class B Bedding. Class B bedding may be used for all steel, ductile iron, concrete, reinforced concrete cylinder, PVC, FRP, and all other pipelines not otherwise specified.

c. Class C Bedding. Class C bedding may be used for all reinforced concrete, prestressed concrete, steel, PVC, and ductile iron pipelines.

d. Class D Bedding. Class D bedding may be used for all reinforced concrete, steel, and ductile iron.

12.01.01. Water lines shall be installed using Class D embedment.

12.01.02. PVC sewer lines shall be installed using Class B embedment. DIP sewer lines shall be installed using Class C embedment.

12.02. Placement and Compaction. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted 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 pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

Class C and D embedment shall be compacted to the top of the pipe.

Granular embedment for 20 inch and larger pipe shall be vibrated with a mechanical probe type vibrator during placement to ensure that all spaces beneath the pipe are filled.

12.03. Groundwater Barrier. Continuity of embedment material shall be interrupted by low permeability groundwater barriers to impede passage of water through the embedment. Groundwater barriers for sewer lines shall be compacted soil, meeting soil classification GC, SC, CL, or ML-CL, compacted to 95 percent of maximum density and spaced not more than 400 feet apart. Material may be finely divided, suitable job excavated material, free from stones, organic matter, and debris.

13. TRENCH BACKFILL. All trench backfill above pipe embedment shall conform to the following requirements.

A layer of backfill material not more than 8 inches deep may be placed over concrete arch encasement or concrete reaction blocking after the concrete has reached its initial set, to aid curing.

13.01. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in all locations.

The top portion of backfill beneath established lawn areas shall be finished with at least 6 inches of topsoil corresponding to, or better than, that underlying adjoining lawn areas.

At the option of the Contractor, compacted backfill may be (a) suitable job excavated material, or (b) suitable borrow pit material, as described below:

a. Job Excavated Material. Job excavated material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders or other corrosive material, and stones

larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used. Job excavated materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Each layer of material shall have the best possible moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Increased layer thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the Engineer that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. Job excavated material shall be compacted to 95 percent of maximum density at optimum moisture content, as determined by ASTM D698 when that test is appropriate, or to 70 percent relative density, as determined by ASTM D4253 and D4254 when those tests are appropriate.

b. Suitable Borrow Pit Material. When job excavated material is unsuitable for use as compacted backfill, suitable material shall be delivered to the site from an acceptable borrow pit. Suitable material shall be placed in the same manner as suitable job excavated material.

All permits associated with the borrow pit shall be obtained by the Contractor or borrow pit operator. The Owner accepts no responsibility for the work at the borrow pit.

The material shall be free from large roots, broken pavement, rocks, and stones larger than 6 inches in any dimension, frozen earth, debris, organic material, or other objectionable matter.

No stone larger than 6 inches in any dimension shall be placed in the upper 12 inches of the trench nor shall any stone larger than 6 inches in any dimension be placed within 18 inches of the top of the pipe.

14. TESTS. As stipulated in the quality control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of the Contractor. Two initial gradation tests shall be made for each type of embedment, fill, or backfill material, and one additional gradation test shall be made for each additional 500 tons of each material. Moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made at the expense of the Owner.

15. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed

and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other watercourses crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

16. PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other watercourses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds one percent, ditch checks shall be installed. Ditch checks shall extend at least 2 feet below the original ditch or watercourse bottom for the full bottom width and at least 18 inches into the side slopes, and shall be at least 12 inches thick.

17. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least one percent shall be provided.

Final grading and surfacing shall be smooth, even, and free from clods and stones larger than one inch in greatest dimension, weeds, brush, and other debris.

18. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the Work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the Work.

Excess earth from excavations located in unimproved property may be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of 6 inches above the original ground surface elevation at and across the trench and sloping uniformly each way. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing, shall be a subsidiary obligation of the Contractor and no separate payment will be made therefore.

19. SETTLEMENT. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or the Owner.

End of Section