

SECTION 11

UTILITY EXCAVATION AND BACKFILL

11.1 DESCRIPTION

A. General: This work consists of excavation, backfill and compaction of trenches for installation of underground utilities, which includes Private Utility Installations, Water Piping Systems, Sanitary Sewers, and Storm Sewers and Pipe Culverts. This includes, but is not limited to, dewatering, rock excavation and disposal, bedding, and shoring and bracing.

B. Related Work:

Section 7	General Conditions
Section 8A	Water
Section 8B	Corrosion Protection – Plastic Pipe Systems
Section 9	Sanitary Sewer
Section 10	Clearing and Grubbing
Section 12	Roadway and Drainage Excavation and Embankment
Section 13	Removal Items
Section 17	Salvaging, Stockpiling, and Placing Topsoil
Section 18	Erosion, Sediment, and Water Pollution Control
Section 19	Incidental Work
Section 41	Utility Trench Resurfacing
Section 54	Drainage Pipe Installation
Section 90	Roadway Signs and Delineators
Section 112	Select Granular Backfill
Section 117	Aggregates for Granular Bases and Surfacing
Section 120	Drainage Pipe Materials
Section 200	Controlled Low Strength Material
Section 202	Geosynthetics for Roadways

C. Soil Tests: The Contractor shall provide the Engineer with the results of a modified proctor soil compaction test, as determined by AASHTO T180, for those locations determined by the Engineer. The Engineer's representative shall be present during sample collection. Soil samples shall be submitted to a certified soil testing lab within 24 hours of the Engineer's request. Failure to do so will cause the City to submit the samples and charge the Contractor at one and a half (1½) times the cost incurred. Results shall be delivered to the City directly from the testing Laboratory.

D. Sewer Main / Storm Sewer and Water Main Crossings:

1. Vertical Separation: Sewer and storm sewer mains may cross water mains with a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or storm sewer main. This shall be the case where

the water is either above or below the sewer or storm sewer with preference to the water main located above the sewer or storm sewer. At the crossings one full length of water pipe shall be located so both joints are as far from the sewer or storm sewer as possible.

In the event that 18 inches of vertical separation cannot be maintained, adhere to one of the following:

- a) The use of bends to lower the water main under the sewer or storm sewer main to meet minimum 18 inches vertical separation.
 - b) Install an encasement pipe around either the water main or sewer main. The encasement pipe shall be 20 feet minimum in length, centered where the pipes intersect. The pipe shall have chocks/spacers, and sealed at both ends with end seals.
- 2. Horizontal Separation:** Sewer and storm sewer mains shall be constructed with a minimum of 10 feet of horizontal separation from any existing or proposed water main. The 10 feet horizontal separation shall be the clear distance (measured edge to edge) and not the centerline distance between the utilities.

The following installation requires Engineer's approval and is appropriate for installations where the 10 feet minimum separation physically is not possible or practical, adhere to one of the following:

- a) A sewer main may be constructed closer than 10 feet to a water main if it is laid in a separate trench, or it is laid in the same trench on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer main.
- b) The sewer main shall be constructed of water main pipe (pressure class pipe) meeting the requirements of Section 8A.2 or equal and pressure tested for water tightness in accordance with AWWA standards for leakage testing.
- c) The storm sewer pipe is constructed with sealed joints and passes a low pressure (5 psi) pressure test. The pressure test shall be maintained for a minimum of 30 minutes. The pressure test shall otherwise comply with the requirements of the "Low Pressure Air Test" in Section 9 Sanitary Sewer. The "Low Pressure Air Test" may be waived by the Engineer for round RCP storm sewer utilizing gasketed joints in compliance with ASTM C443.
- d) Minimum horizontal distance of 3 feet shall be maintained between storm sewer curb inlets and water mains. All other storm sewer structures and culverts shall be considered as storm sewer mains for the purposes of this section.

- e) For the purposes of horizontal separation, sanitary sewer manholes shall be treated the same as sanitary sewer mains.
- E. Sewer Main and Storm Sewer Crossings:** Storm sewer crossing over sewer mains shall have no less than 6 inches of clearance. Special structural support and insulation will be required if there is less than 18 inches clearance. The minimum horizontal clearance shall be 2 feet. Clearance refers to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe.
- F. Service Line Separation:** A 10-foot horizontal separation shall be maintained between water services and sewer services. Where a water service crosses a sewer service a vertical separation of at least 12 inches shall be provided between the water service and the sewer service and the sewer service should be below the water service. The pipe joints shall be placed as far away from the crossing as the material will permit. Water services, where possible, should cross over sanitary sewer mains and storm sewers. Sewer services, where possible, should cross under water mains and storm sewers.

11.2 MATERIALS

- A. Select Granular Backfill and Bedding:** Shall be in accordance with Section 112 - Select Granular Backfill. Contractor shall provide a submittal to the Engineer for select granular backfill and bedding materials used.
- B. Controlled Low Strength Material:** Used for bedding or backfill shall be in accordance with Section 200 - Controlled Low Strength Material. Contractor shall provide a submittal to the Engineer for controlled low strength material when used.
- C. Water and Sewer Main Insulation:** Insulation shall be Extruded-Polystyrene Board Insulation formed from polystyrene base resin by an extrusion process using hydrochloro-fluorocarbons as blowing agent to comply with ASTM C578, Type IV, with 1.60 lb./cu. Ft. minimum density and a compressive strength of 25 lb./ sq. in as specified in ASTM D1622 and ASTM D1621 respectively. The maximum thermal conductivity of the insulation shall conform to ASTM C518, C177, and C578. The maximum water absorption percentage by volume shall be 1% in accordance with ASTM D2842. The range of water vapor permeance shall be 0.4 to 1.0 perm in accordance with ASTM E96.

Type IV Styrofoam Brand—"Square Edge" or "Score Edge" as manufactured by Dow Chemical Company or approved equal shall be used for insulating water and sewer pipes where required. The width and thickness of insulation shall be per standard detail unless otherwise noted in plans. The minimum insulation thickness shall not be less than 2 inches.

- D. Trench Check Dam Material:** Check dam material shall be compacted cohesive clay that contains a minimum of 25% minus no. 200 sieve material, with 70% passing a 3/4 inch sieve. If the normal excavated material is not suitable for construction of the check dam, then the Contractor shall obtain material from outside sources.

Check dam installation and material shall be considered as incidental to the pipe installation.

11.3 CONSTRUCTION REQUIREMENTS

A. Utility Locates: The Contractor shall contact South Dakota One Call (811) for the locations of public and private utilities prior to any excavation. Underground utilities shown on the plans are not necessarily exact and, therefore, must be located by the individual utility company prior to excavation activities. The Contractor shall contact the local residents/owners whenever any excavation may affect their property.

B. Trenching

1. Methods: Under ordinary conditions and where the depth of excavation and soil conditions will allow, excavation shall be by open cut from the surface. Tunneling or boring under sidewalks, curb and gutter, or other surface structures may be allowed by the Engineer on a case by case basis. Tunneling or boring under streets, turfed areas, or areas not addressed above may be required by Engineer for some installations.

The first pavement saw cuts shall be, at a minimum, the same width as the minimum trench width centered over the utility. The second saw cut shall be 1 foot outside the disturbed area on each side of the trench (see Section 41 Standard Detail).

Streets that utilize an engineering geotextile or geogrid underlayment shall be excavated down to the underlayment by hand, or other method that will prevent damage. The underlayment shall be cut longitudinally centered over the utility, laid back, then trench excavation and backfill in normal fashion. When the backfill is completed to the elevation of the original underlayment, the cut ends shall be placed back on the backfilled material. A new piece of underlayment shall be placed over the splice with a minimum overlap of 12 inches each side of the splice, or the manufacturer's minimum overlap, whichever is greater. See Section 41 Standard Details.

The geotextile or geogrid repair shall be inspected by the Engineer prior to placing base course or cushion. After inspection of the geotextile or geogrid, it may be covered with base course to the existing paving base grade. The base course can then be compacted and readied for pavement.

Where surface conditions allow, the Contractor will be permitted to slope or bench the trench sidewalls from a point three inches above the top of the pipe barrel. Below this point, the trench walls shall be vertical. Contractor shall shore as necessary. This requirement does not relieve the Contractor of the responsibility of meeting all applicable OSHA requirements.

Excavated material suitable for backfill shall be deposited a sufficient distance from the trench to limit the potential for cave-in and minimize inconvenience to the public.

All excavated material not used for the project shall be removed from the project by the Contractor at the Contractor's expense, as directed by the Engineer.

Rock, including excavated bedrock, large loose rock, boulders, fieldstones, or other unsuitable material, which cannot be used as backfill, shall be segregated from the rest of the excavated material and removed from the project by the Contractor at the Contractor's expense. Unsuitable material, which cannot be used for backfill, shall be determined by the Engineer.

Established drainage in streets, alleys, or drainage ditches, must be maintained by the Contractor during construction operations.

When either geotextile, geogrid, or under-drains are inadvertently encountered and damaged, the Contractor is responsible to notify the Engineer as soon as practical. No further excavation or repairs of the area shall be effected without the knowledge of the Engineer.

Where the proposed trench intersects an under-drain, the under-drain shall be repaired with similar material 12 inches on either side of the trench width. The pipe joints shall utilize a factory repair coupling. New fabric shall overlap existing fabric a minimum of 12 inches. New clean rock shall be placed across the trench intersection and backfilled with appropriate material. The drain repair shall be inspected by the Engineer prior to placing the clean rock.

Damage to the property of others, such as; geotextile, geogrid, under-drains, private or public utilities, fences, trees, shrubs, lawns, sidewalks, etc. shall be repaired or replaced at the Contractor's expense unless removal of such is shown on the plans or written permission was first obtained from the Engineer.

- 2. Protection of the Excavation:** The Contractor shall be solely responsible for providing a safe trenching operation and shall, as a minimum, comply with all OSHA regulations, regardless of limits of trench width imposed by project plans work limits, site constraints or the direction of the Engineer.

The Contractor shall employ qualified and properly trained personnel to install, design, place, and maintain shoring during progress of work until the trench is backfilled.

Failure to properly shore and/or brace excavations shall be at the risk of the Contractor and any damage to pipes, curb and gutter, street pavement, grassed areas, storm sewer and appurtenances, gas mains, and/or other public or private property occurring through settlements, heaving, water or earth pressures, slides, caving, or other causes due to failure of shoring, improper shoring, or lack of

shoring, or due to negligence on the part of the Contractor, shall be repaired by the Contractor at their own expense and to the satisfaction of the Engineer.

When utilized, the shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has progressed far enough to provide adequate strength. Unless left in place by written order of the Engineer, shoring shall be removed as work progresses. Shoring devices and methods of construction utilizing shoring devices are the sole responsibility of the Contractor.

- 3. Dewatering:** The Contractor shall be responsible for evaluating soil and groundwater conditions and for furnishing and maintaining necessary and suitable dewatering devices and equipment.

The Contractor shall provide for positive drainage away from the excavation or otherwise take steps to protect the excavation and backfill from becoming excessively wet prior to placing the finished surface.

At all times, the Contractor shall provide and maintain ample means and devices, with which to remove promptly and properly dispose of all water that enters the excavation.

The Contractor shall dispose of water in accordance with all permits (City and/or State) and without damage to adjacent property or without creating a health hazard or nuisance condition. Water may not be discharged to private property or to irrigation ditches without prior approval from the affected property owner or ditch company. No water shall be drained into work built or under construction without prior consent of the Engineer.

Dewatering shall be accomplished by placing well points, sumps or any other acceptable method, which will insure a dewatered trench. Any proposed dewatering method shall be subject to the approval of the Engineer. The Contractor will not be permitted to allow groundwater to drain through completed sewer or water mains. The Contractor will be required to thoroughly clean all debris and sediment from newly installed sewer or water mains as directed by the Engineer.

The Contractor shall provide for positive drainage of water away from the excavation and take the necessary action to protect the excavation and backfill from becoming excessively wet prior to placing the finished surface. If the Engineer determines that any portion of the backfill or trench has become excessively wet due to actions or inactions of the Contractor after the initial excavation, the Contractor shall remove the soil and/or pipe or appurtenance(s) to the satisfaction of the Engineer and furnish an approved backfill material that meets specifications and reinstall the pipe and/or appurtenance(s) as specified herein, all at no expense to the City.

- 4. Trench Dimensions:** The following table shall be used to determine the acceptable minimum trench widths for the City. The table in general is a compilation of AWWA criteria and Uni-Bell criteria. The criteria used in compiling this table are presented in Paragraphs a. and b. For purposes of establishing acceptable minimum trench widths, the dimensions in the table shall govern unless specifically indicated otherwise in plans and detailed specifications.

**TABLE 11-1
MINIMUM TRENCH WIDTH TABLE**

<u>Pipe Diameter</u>	<u>Minimum Width</u>
<8 in	24 in
8 in -12 in	30 in
14 in –18 in	36 in
20 in -21 in	42 in
24 in –36 in	1.25(Pipe OD) plus 12 in
>36 in	Per plans

The Contractor shall adhere as closely as possible to the minimum trench widths for water, sanitary sewer, and storm sewer installations, unless otherwise specified in the detailed plans and specifications.

The Contractor will not be allowed to excavate excessive trench width in lieu of adequate dewatering or shoring.

- a) Pressure Pipe Installation (Water and Force Mains):** For reference, only Table 11-1 will be enforced.

Minimum Trench Width: The minimum clear trench width measured at a point three inches above the top of the pipe barrel shall not be less than 18 inches or the outside pipe diameter, plus 12 inches, whichever is greater or such width as approved by the Engineer.

- b) Non-Pressure Pipe Installation (Gravity Sewer Main):** For reference, only Table 11-1 will be enforced.

Minimum Trench Width: The minimum clear trench width measured at a point three (3) inches above the top of the pipe barrel shall not be less than the greater of:

- 1) Minimum of eighteen (18) inches, or
- 2) The outside pipe diameter, plus sixteen (16) inches, or
- 3) The outside pipe diameter multiplied by 1.25, plus (12) inches, or
- 4) Such width as approved by the Engineer.

- c) Maximum Trench Length:** Not more than 300 linear feet of trench shall be open at any one time in the public Right-of-Way, in easements that contain

City owned utilities, or near roadways, unless prior written approval of the Engineer has been obtained.

- 5. Foundations:** Foundations shall be considered as that material which is neither bedding nor backfill, but is used under the pipe or conduit for support in the bottom of the trench.
- a) Normal Trench Bottom:** The bottom of the normal trench where the undisturbed soil is of a supportive nature for the pipe or conduit laid, as determined by the Engineer, shall be accurate for line and grade to provide uniform bearing and support for each section of pipe or conduit. Bell holes and depressions for joints shall be dug after the trench bottom is graded, and shall be no greater in length, depth, and width than required for making the joint. The undisturbed trench bottom shall be at least 3 inches below the bottom of pipe, to allow for the placement of Type 1 Bedding material.
 - b) Rock Trench Bottom:** When solid rock, large loose rock, such as field stone, very coarse gravel, or any other material of a similar nature that is stable but will not allow a proper foundation for the pipe or conduit, is encountered at the trench bottom, it shall be excavated to a sufficient depth to allow refilling under the body and joints of pipe or conduit. The undisturbed trench bottom shall be at least 3 inches below the bottom of pipe, to allow for the placement of Type 1 Bedding material.
 - c) Unstable Trench Bottom:** When the trench bottom is earth that will not support the pipe or conduit, the earth shall be considered an unstable foundation and shall be excavated below grade as directed by the Engineer. A solid foundation shall be built with select granular backfill material or with controlled low strength material.

The amount and type of foundation material required will vary depending upon the soil encountered. Generally, foundation material shall be Type 1 Bedding Material or Type 3 Foundation Material, per Section 112 or Controlled Low Strength Material per Section 200.

In some circumstances, larger foundation material may be necessary and in these cases Type 4 Foundation Material or Stabilization Rock maybe used per Section 112. If Type 4 Foundation Material or Stabilization Rock is used, then a minimum 6 inches of Type 3 Foundation Material shall be placed directly above the material and prior to the placement of the Type 1 Bedding Material. This helps to minimize the potential for the Type 1 Bedding material to migrate into the larger foundation material and result in loss of pipe support. The Engineer shall authorize the use of Controlled Low Strength Material or Foundation materials, in cases of unstable trench bottom.

Foundation material shall be compacted and placed in separate lifts from the trench bottom up to 3 inches below the bottom of the pipe. Foundation material lifts shall not exceed eight inches and each lift shall be compacted

separately. Lifts for Type 4 foundation material will be allowed to be 1.5 times the largest particle diameter.

- 6. Rock Excavation:** Rock excavation shall include solid rock in ledges, bedded deposits, un-stratified masses and conglomerate deposits so firmly cemented as to present the characteristics of solid rock. In order to be considered as Rock Excavation the material must be removed by drilling, blasting, jack hammering, or hydraulic ripper. Shale, regardless of the nature of deposit, or loose boulders or large fieldstone will not be considered rock excavation unless so designated on the plans, or as determined by the Engineer. The responsibility and cost of satisfactorily demonstrating to the Engineer that the material being considered for rock excavation cannot be removed by means other than drilling, blasting, jack hammering, or hydraulic ripper shall be the obligation of the Contractor.

In order for material to be considered as Rock Excavation, at a minimum, it shall be demonstrated that a normal excavating machine being skillfully operated cannot be effectively removed. "Effectively removed" shall be defined as, the normal production rate being reduced to 25% of normal. A normal excavating machine will be considered to be a +230 HP hydraulic excavator, crawler weighing +78,000 pounds with a - 1 CY bucket equipped with ripper teeth.

The Engineer has the sole discretion to determine if the material removed is suitable or unsuitable for backfill. The Contractor shall dispose of all unsuitable excavated material. The Contractor shall provide a disposal site for unsuitable backfill materials. The disposal site shall be approved by the Engineer.

The Contractor shall furnish an approved backfill material to fill the voids left by rock excavation. He shall also provide the results of a modified proctor (AASHTO T-180) test for the furnished backfill. Suitable backfill material to replace excavated rock within the trench shall be incidental to the Rock Excavation bid item.

The Contractor shall keep accurate daily records of the quantity of rock removed so a comparison can be made with the Inspector's records. The Contractor shall deliver their records of Rock Excavation to the Engineer or their representative within 48 hours of request. Records of Rock Excavation delivered after this period shall be declared invalid and no payment for Rock Excavation will be made.

- 7. Blasting and the Use of Explosives:** Where blasting is necessary, the Contractor shall comply with the laws, ordinances, and applicable safety code requirements relative to the handling, storage and use of explosives and the protection of life and property. Suitable covering or shielding shall be provided to confine all materials lifted by blasting to the limits of the trench or excavation, and prevent injury to property or life. The Contractor shall be responsible for all damages caused by the blasting operations. The Contractor shall demonstrate that they are in compliance with all applicable laws, rules, and regulations, and they have the required expertise in advance of any blasting work. The Contractor

shall notify all governmental agencies, property owners and utility owners that may be affected by the blast no less than five (5) calendar days in advance.

All materials removed by blasting which are deemed unsuitable shall be handled and disposed of separately from suitable backfill materials as directed by the Engineer.

The Contractor shall obtain a City permit for any proposed blasting. The Contractor shall be responsible for any safeguards or monitoring required by the Engineer for the blasting operations and shall be responsible for any and all damages resulting from the blasting operations.

- 8. Unsuitable Backfill Material Excavation:** Unsuitable Backfill Material Excavation shall consist of the removal and disposal of material which, in the opinion of the Engineer, is not suitable as backfill. Materials containing organics or contaminated soils are considered unsuitable. Typical soil contaminants are petroleum hydrocarbons, polynuclear aromatic hydrocarbons "PAH's" (such as naphthalene and benzo(a)pyrene), solvents, pesticides, lead, and other heavy metals. If the Contractor encounters material that they suspect to be contaminated because of odor, color, or other indicators, they shall immediately contact the Engineer. The Contractor shall provide an approved disposal site for unsuitable material.

The shortage of backfill material created by the removal of the unsuitable material shall be replaced by the Contractor with an imported backfill material approved by the Engineer. Payment for imported backfill will be considered if the Contractor has not exported suitable material from the project. The Contractor shall provide the results of a modified proctor analysis (AASHTO T-180) for all furnished imported backfill material.

9. Pipe Bedding:

- a) Bedding by Pipe Material:** All water and sanitary sewer pipe, appurtenances, and service lines shall be bedded from 3 inches below the pipe invert to 3 inches above the pipe crown over the full width of the trench. Frozen material shall not be used.

Water and Sewer pipe, appurtenances, and service lines shall be installed as per Sections 8A and 9 with bedding as described below:

- 1) Water Service Lines:** Copper and HDPE water service lines shall be bedded with washed sand, crusher fines, 3/8 inch river rock, or pea gravel. PVC water service lines may be bedded with washed sand, crusher fines, 3/8 inch river rock, pea gravel or Type 1 bedding per Section 112.

- 2) **Sewer Service Lines:** PVC sewer service lines shall be bedded with Type 1 bedding meeting the requirements of Section 112, washed sand, crusher fines, 3/8 inch river rock, or pea gravel.
- 3) **Water and Sewer Mains:** Water and sewer mains shall be bedded with Type 1 Bedding and shall meet the requirements of Section 112.
- 4) **Storm Sewer:** For storm sewer bedding requirements see Sections 54 and 112.

b) Bedding Installation:

1) Granular Material:

- I. Bedding shall be compacted and placed as a separate lift from the trench bottom, or top of foundation material, to the pipe invert and shall be placed and compacted prior to installing the pipe or appurtenance.
- II. Bedding shall be hand tamped and placed as a separate lift from the pipe invert to the pipe spring line. Maximum lift shall not exceed 6 inches.
- III. Bedding shall be hand tamped and placed as a separate lift from the pipe spring line to 3 inches above the pipe crown. Maximum lift shall not exceed 6 inches.
- IV. Bedding material shall be incidental to water and sewer pipe per Sections 8A and 9. Prior to commencing installation of water and sewer pipes, the Contractor and Engineer shall confirm the rates of material to be used for each diameter of pipe being installed, in conjunction with the Contractor's proposed maximum trench width. Weekly, or at the direction of the Engineer, the Contractor shall provide weight tickets to verify the quantity of bedding material used, along with the corresponding quantity of water and sewer pipe installed. The weigh tickets shall clearly state, the type of bedding and that it is incidental. All stockpiled bedding material used for water and sewer pipe installation shall be clearly identified on the project.

- 2) **Select Bedding:** Bedding material from 3 inches above the pipe crown to 12 inches above the pipe crown shall be "Select Bedding Material". Select Bedding Material may include loam, clay, sand, and gravel, but shall be free of cinder, ashes, refuse, organic matter, rock or material determined unsuitable by the Engineer. No material larger than one (1) inch in size shall be permitted. Frozen material shall not be used. See Section 54 for select bedding of drainage pipe.

Select Bedding Material may be native excavated material or material brought from offsite. Select Bedding Material shall be hand-tamped in the trench for its full width on each side of the pipe, simultaneously. Mechanical tampers may be used if pipe damage will not occur.

- 10. Backfill:** Normal Backfill shall start one (1) foot above the pipe or conduit crown and continue to the surface of the trench. The Contractor shall take precautions to backfill trenches in a manner that installed pipe or conduit will not be disturbed.

All backfill material shall be free from cinders, ashes, refuse, vegetation or organic material, boulders, rocks, or stones, or other material, which the Engineer determines to be unsuitable. From one foot above the pipe or conduit crown to two feet above the pipe or conduit crown, the maximum stone size shall be limited to 3 inches in diameter. From 2 feet above the top of the pipe, stones up to 12 inches along their longest dimension may be included in the backfill, unless otherwise specified.

Frozen material shall not be permitted as trench backfill.

Where excavated material is deemed unsuitable, by the Engineer, or where there is a shortage of backfill material, the Contractor shall furnish an approved Imported Backfill. Controlled Low Strength Material will be considered acceptable as backfill material when installed in accordance with Section 200 or as directed by the Engineer.

Should the Contractor cause the trench to be excavated to a greater depth or width than that designated in the plans or detailed specifications, the Contractor shall refill to grade, at their own expense, with an approved material. It may be necessary for the Contractor to bring such material from other localities or to purchase suitable material.

Prior to backfilling, the Contractor shall not sell, remove, or permit to be removed, suitable backfill material required to complete the project. If suitable backfill material is removed, the Contractor shall document the quantity of material removed and provide this information to the Engineer within 24 hours of its removal.

- 11. Insulation:** Insulation shall be placed where noted on the plans. Minimum Cover depth shall be measured from the top of pipe to finished grade. See Sections 8A and 9 for minimum cover. If minimum cover cannot be achieved and plans do not provide provisions for insulation, insulation may be used with approval from the Engineer. Insulation may also be required in instances where adequate separation between culverts or storm sewers cannot be achieved.

Insulation board shall be placed above the pipe bedding and shall be covered with select backfill material. The build-up of insulation sheeting shall be done by staggering the joints. An acceptable adhesive may be used to retain the individual sheets in the final specified dimensions.

12. Controlled Low Strength Material: Maybe used in lieu of Type 1 Bedding or Select Bedding Material as approved by the Engineer or as required in the plans and detailed specifications. Controlled Low Strength Material shall be installed in accordance with Section 200.

13. Check Dam Installation: Check dams shall be installed at intervals of 450 feet for water and sewer mains, at all laterals (tees and crosses), in service line trenches (outside of main trench), and also at locations as indicated on the plans and detailed specifications.

The check dams shall extend at a 1:1 slope vertically from the bottom of the excavation through the bedding material to the "Normal Backfill" zone and shall extend horizontally the full width of the trench. Trench check dams shall extend longitudinally a minimum distance equal to the trench width. At the location where the pipe intersects the trench check dam the length shall not be more than twice the trench width. The check dam shall seal the bedding material to prevent ground water movement in the bedding material along the trench. Check dam material shall be per Section 11.2 and compacted to the density of surrounding soil of the trench. Check dam installation and material shall be considered to be incidental to the installation of the main or service.

14. Embankment: Where embankment is necessary to support pipe or to cover or protect it in any way, it shall be placed to the dimensions shown in the plans and detailed specifications or as directed by the Engineer. The surface of the ground receiving the embankment shall be cleared of all unsuitable material and scarified, or loosened with a disc or multi-toothed hydraulic ripper; moisture adjusted and re-compacted as directed by the Engineer. Embankment shall be an approved material and compacted to the densities specified herein unless otherwise specified. Embankment shall be placed a minimum of 3-feet above invert of pipe prior to laying pipe. Unless otherwise approved, pipe laid in embankment shall be trenched in.

15. Compaction and Testing: The Contractor shall compact all materials to the following densities, unless modified by the detailed specifications or by the direction of the Engineer:

<u>SOIL TYPE</u>	<u>BACKFILL MOISTURE CONTENT</u>	<u>% OF MAXIMUM DRY DENSITY</u>
Cohesive	3% Below to 6% Above Optimum	92% Minimum
Non-cohesive	Workable	95% Minimum

Maximum dry density and optimum moisture content shall be determined by the AASHTO T-180, Modified Proctor Test.

Backfill moisture and density shall be determined at least every 200 feet horizontally and every three (3) feet vertically in each trench. The Engineer shall determine the location for moisture and density tests within each trench. The Engineer has the authority to require/take additional moisture and density tests at any location and depth desired. The Contractor shall, at their own expense, excavate the backfill at the locations and depths required by the Engineer to conduct moisture/density tests. For the purposes of calculating the number of tests required, each service line and each lateral pipe shall constitute a separate trench. If the final vertical test is not within 6-inches of the subgrade surface, a final test shall be taken within 6-inches of the subgrade surface.

- a) **Water and Sewer Vertical Testing:** The location of the first test shall be measured from the top of the pipe bedding for water and sewer.
- b) **Storm Sewer Vertical Testing:** Storm sewer vertical testing: Testing within the below described locations shall alternate from side to side of the pipe or box culvert. If a different source of backfill material or compaction procedure is used on either side, each zone shall be tested on both sides.
 - 1) On round pipe 24 inch or less in diameter or arch pipe 30 inches, or less, one test approximately half way up the pipe then every three (3) feet vertically.
 - 2) On round pipe that is 30 inch up to 72 inch in diameter, arch pipe that is 36 inch up to 84 inch, or box culverts up to 6 feet in height, one test in the lower one-half, one test in the upper one-half and then every three (3) feet vertically.
 - 3) On round pipe greater than 72 inch in diameter, arch pipe 96 inch or greater, or box culverts greater than 6 feet in height, one test in the bottom one-third, one test in the middle one-third, one test in the top one-third and then every three (3) feet vertically.

When specified moisture contents are not met, the Contractor has the options of drying wet soil, furnishing approved materials meeting specifications, or adding water as necessary, to soils that are too dry to meet specifications. If water is added to dry soil, it must be thoroughly mixed with the soil to provide uniform moisture content prior to use.

Backfill material not meeting specified densities shall receive additional compaction or shall be removed and replaced at the Contractor's expense as necessary to meet specified densities.

Wet soils that otherwise meet the requirements for backfill do not necessarily constitute unsuitable material. It is the Contractor's responsibility to either dry the material or furnish other approved material at their expense. When the Contractor furnishes backfill material, he shall also furnish the results of the AASHTO T-180 test for the furnished material.

Controlled Low Strength Material installed in accordance with Section 200 or as directed by the Engineer will not require compaction testing.

The Contractor shall not place gravel cushion, base course, topsoil, grass, etc. until the specified densities are met at each test location and the Engineer has given their approval for placement.

Trench flooding as a method of compaction is prohibited.

- 16. Frost:** When frost in the ground becomes deep enough to inhibit excavation, the Contractor may request a stop-work order. However, it shall be the Contractor's responsibility to prove to the Engineer that the cost of excavation due to the frost is excessive and a stop-work order is justified. The request for the stop-work order shall be made in writing. Regardless of when the request is made, contract time will not stop until the stop-work order is issued, i.e. the order will not be retroactive.

As a prerequisite to issuance of the stop-work order, the Contractor shall backfill and compact all open excavations and clean up the project to the satisfaction of the Engineer.

The Engineer may issue a notice to proceed when conditions improve to the point where frost does not inhibit excavation and a resumption of work is possible.

- 17. Cleanup:** Trenches located in public right-of-way shall be backfilled, compacted, and restored to original condition as soon as practicable. In cases where the permanent surfacing will not be placed within 24 hours of backfill, the Engineer may require temporary surfacing. Temporary surfacing shall be considered as incidental to the bid item for the pipe or conduit for which it pertains unless a bid item is specifically provided for Temporary Surfacing.

Temporary Surfacing shall consist of materials as specified in Section 112, Section 117, or asphalt millings.

- 18. Bedding Boxes and Other Similar Devices:** If bedding material is a unit price pay item the Contractor shall use a bedding box or other similar device for the storage of Type 1 Bedding Material and Select Granular Backfill Materials. The bedding box shall follow the progression of work and shall be used to store the materials prior to their placement in the trench. The use of such devices will minimize contamination and waste of the material. The Engineer may make a deduction in the quantity, for payment purposes, of Type 1 Bedding Material and/or Select Granular Backfill Material if the material is being contaminated or wasted.

- 19. Underground Obstructions:** The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies

and the City, but this does not relieve the Contractor of the responsibility of determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables or structures that will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the owners of the structures involved and the Engineer. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.

Portions of existing utilities may be relocated, altered or reconstructed by the utility companies if they are found to interfere with the line and / or grade of the proposed utility, or the Engineer may order changes in the work to avoid interference.

The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed pipe can be adjusted as necessary. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the pipe being installed, the Contractor shall notify the Engineer so that the Engineer may modify the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstruction(s). The Contractor shall not deviate from plan line or grade without the Engineer's approval.

When the plans or specifications provide for the Contractor to alter, relocate, or reconstruct an existing utility, all costs for such work shall be included in the bid price for the associated bid item unless a separate bid item is provided.

Temporary or permanent relocation or alteration of existing utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where existing utility relocation or reconstruction is impractical, the Engineer may order a deviation from line and grade.

The Contractor shall be responsible for notifying the various utility companies if the Contractor's work will expose, affect, or endanger any existing utility. All cost of investigation and any necessary protection, support, removal or relocation of said structures shall be included in the contract bid price for installing pipe, manholes, etc. The Contractor shall not begin construction until all utility companies have been contacted and their respective underground utilities have been located and marked.

All costs for exploratory investigation/excavation necessary for determining the location and depth of utilities shall be included in the contract bid price for installing the proposed utility, unless otherwise stated in the plans.

The Contractor shall be responsible for notifying utility companies if the Contractor's progression of work damages the utility.

11.4 METHOD OF MEASUREMENT

- A. Insulation:** Water and sewer main insulation shall be measured by the square foot.
- B. Protection of the Excavation:** No measurement will be made, as these items are considered to be incidental to utility being installed, unless specifically indicated otherwise.
- C. Dewatering:** No measurement will be made, as this item is considered to be incidental to utility being installed, unless specifically indicated otherwise.
- D. Rock Excavation:** Measurement will be based on the measured and/or calculated volume of the open trench to the nearest whole cubic yard and will be limited to a maximum trench width of six (6) feet. For pipe diameters larger than 30 inches measurement will be limited to a maximum trench width of four (4) feet plus the outside diameter of the pipe being installed unless otherwise indicated in the plans or detailed specifications. At manholes the allowable trench width for computation will be 10 feet wide for a distance of seven (7) feet each side of the manhole center. For manhole diameters larger than 60 inches measurement will be limited to a maximum trench width of four (4) feet plus the outside diameter of the manhole being installed for a distance of seven (7) feet each side of the manhole center unless otherwise indicated in the plans or detailed specifications.
- E. Select Granular Backfill Materials:** Measurement for Select Granular Backfill materials will be in accordance with Section 112. Type 1 Bedding material for water and sewer pipe within 3-inches of the top and bottom of pipe shall be incidental to the pipe. Granular material for foundation or other purpose shall be measured to the nearest 0.1 tons.
- F. Imported Backfill:** Measurement of the Imported Backfill, unless otherwise stated will be to the nearest cubic yard as delivered to the project site. If suitable material was wasted from the project prior to encountering unsuitable material, measurement and payment for Imported Backfill will not be considered.
- G. AASHTO T-180 Soil Test:** This item will be measured per each as submitted to a certified lab and approved by the Engineer.

When the Contractor furnishes backfill material, he shall also furnish the results of the AASHTO T-180 test for the furnished material and these AASHTO T-180 tests will be considered as incidental to the Contractor furnished backfill material.

- H. Controlled Low Strength Material:** Measurement for Controlled Low Strength Material will be in accordance with Section 200.

- I. **Encasement (Casing Pipe):** Measurement for encasements will be measured to the nearest whole linear foot, with lengths as noted in the plans or detailed specifications.

11.5 BASIS OF PAYMENT

- A. **Insulation:** Payment will be at the unit price bid for insulation furnished and installed, including cushion material.
- B. **Protection of the Excavation:** No payment will be made, as these items are considered to be incidental to utility being installed, unless specifically indicated otherwise.
- C. **Dewatering:** No payment will be made, as this item is considered to be incidental to utility being installed, unless specifically indicated otherwise.
- D. **Rock Excavation:** Payment for rock excavation will be made under the bid item Rock Excavation. When no bid item exists and the Engineer agrees to pay for rock excavation, a unit price shall be negotiated. Suitable backfill material to replace excavated rock within the trench shall be incidental to the Rock Excavation bid item.
- E. **Select Granular Backfill Materials:** Payment for Select Granular Backfill materials will be in accordance with Section 112. Type 1 Bedding material for water and sewer pipe within 3-inches of the top and bottom of pipe shall be incidental to the pipe. Payment for select granular backfill materials shall include all associated costs of excavation and disposal of excavated materials, unless otherwise called for in the plans or detailed specifications.
- F. **Imported Backfill:** Payment for Imported Backfill will be made under the appropriate bid item for the material furnished and installed. Payment for Imported Backfill shall include all associated costs of excavation and disposal of excavated material unless otherwise called for. If suitable material was wasted from the project prior to encountering unsuitable material, measurement and payment for imported backfill material will not be considered.
- G. **AASHTO T-180 Soil Test:** Payment for providing the results of the AASHTO T-180 test shall be made on a per-each basis under the bid item "AASHTO T-180 Soil Test" and shall be full compensation for obtaining the soil sample, delivering it to the certified lab, conducting the test, and providing the Engineer with the results. Payment will be made for only those Proctor tests required by the Engineer.

When the Contractor furnishes backfill material, he shall also furnish the results of the AASHTO T-180 test for the furnished material and these AASHTO T-180 tests will be considered as incidental to the Contractor furnished backfill material.

- H. **Controlled Low Strength Material:** Payment for Controlled Low Strength Material will be in accordance with Section 200.

- I. **Encasement (Casing Pipe):** Payment for encasements will be at the contract unit price per linear foot. Payment shall be for the casing pipe, end seals, chocks/spacers, and all other necessary labor and materials. The pipe being encased shall be paid for separately.

END OF SECTION