SECTION 31 2333 – TRENCHING AND UTILITY BACKFILLING (BMU)

PART 1.0 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. Excavating and backfilling for utility trenches, including water, sanitary sewer, electric conduit and storm sewer pipe. This specification does not include the requirements for the construction of roads and their associated subgrades.

1.2 SECTION INCLUDES

A. Trench Stabilization Material

B. Pipe Bedding

C. Imported Engineered Fill Material

D. Imported Clay Material

1.3 RELATED REQUIREMENTS

A. SECTION 01 3000 – ADMINISTRATIVE REQUIREMENTS

B. SECTION 31 1000 – SITE CLEARING

C. SECTION 31 2319 – DEWATERING (BMU)

D. SECTION 31 2400 – ROADWAY EXCAVATION AND EMBANKMENT (COB)

E. SECTION 33 1000 – WATER UTILITIES (BMU)

F. SECTION 33 1419 – VALVE AND FIRE HYDRANTS (BMU)

G. SECTION 33 3100 – SANITARY SEWER UTILITIES (BMU)

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Initial Backfill: Pipe bedding material placed beside and over pipe in a trench, including haunches to support sides of pipe.

C. Final Backfill: Backfill placed over initial backfill to fill a trench.

D. Pipe Bedding Material: Aggregate course placed over the excavated subgrade in a trench before laying pipe.

E. Trench Stabilization Material: Aggregate used where soft, spongy, unstable or other similar material is encountered and removed upon which the Pipe bedding material or pipe is to be places.

F. Imported Trench Backfill Material: Granular or clay material used as backfill of utility trenches.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 3/4 cu. yd. for footing, trench, and pit excavation that

cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping, or blasting, when permitted.

H. Structures: Buildings, footings, foundations, manholes, water structures, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Utilities: On-site underground pipes, conduits, ducts, and cables. Excluded underground services within 5 feet of and under buildings.

1.5 GEOTECHNICAL REPORT

A. In the event that a geotechnical report, prepared by a licensed South Dakota Professional Engineer, exists for the proposed project, the requirements of that report shall be strictly adhered to.

B. Any requirements for, but not limited to compaction requirements, dewatering, testing frequency, the need for imported materials or trench stabilization included in the geotechnical report shall be followed regardless of the specific requirements in the following subsections.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Engineer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

3. Contact utility-locator service for area where Project is located before excavating.

A. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2.0 - PRODUCTS

2.1 TRENCH STABILIZATION MATERIAL

A. In poor trench conditions, or if directed by the BMU Engineer's Representative, the Contractor shall be required to use trench stabilization consisting of 3/4-inch to 4-inch crushed angular, well-graded material.

B. Larger crushed angular material may be required if deemed necessary by the BMU Engineer's Representative to stabilize the bottom of the trench.

C. The use of trench stabilization material will not eliminate the need for pipe bedding material.

2.2 PIPE BEDDING MATERIAL

A. Contractor shall use 1/4" x 3/4" clean angular crushed rock for pipe bedding, with the following minimum percentage gradation requirements:

Table 1- Pipe Bedding Gradation

Sieve Size	Percentage Passing
1-inch	100%
3/4-inch	85% to 100%
1/2-inch	15% to 85%
#4	0% to 15%

2.3 IMPORTED ENGINEERED FILL MATERIAL

A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported engineered fill material for backfilling the water trench.

B. Imported engineered fill material shall be a granular material conforming to requirements for "PIT RUN" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING", processed sand or gravel having a maximum particle size of 1-inch.

2.4 IMPORTED CLAY MATERIAL

A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported clay backfill material for backfilling the water trench.

B. Clay material is available from the Brookings Regional Landfill (605-693-3667). Contractor shall be responsible for contacting the landfill to determine the availability and cost of the material. Contractor shall be responsible for loading, hauling and placing the clay material.

C. The moisture content of the imported clay material shall be 1 to 4% below the optimum moisture content at time of placing and compacting the material. The Contractor shall be responsible for drying material to obtain the optimum moisture conditions.

PART 3.0 - EXECUTION

3.1 PREPARATION

A. 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. The Engineer will establish construction lines and designate all tress, shrubs, plants and other things to remain. All surface objects and all trees, stumps, roots and other obstructions not designated to remain, shall be cleared as required and properly disposed of.
   2. The Contractor shall be responsible for the proper removal, care and resetting of all portable culvers, drainage pipe and other minor structure authorized by the Engineer for temporary relocation from alignment of the work.

3. Removal of surface improvements where not indicated to be removed on the plans such as street paving, curbs, gutters and sidewalks shall be held to a minimum. When it is necessary to excavate through existing asphalt or concrete paving, sidewalks, or curb and gutter; before excavating, the cut shall be first made with a concrete saw for the full depth of the existing surface. All material removed and the method employed to replace the surface improvement to its original grade, depth and alignment shall be first authorized and approved by the Engineer. Rubble material shall be considered property of the contractor and be disposed of by the Contractor at a sited provided by the Contractor.

B. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 PROTECTION OF EXISTING UTILITIES

A. Existing utilities shall be protected from damage during the excavation and backfilling operations. If damaged, the Contractor shall immediately contact the appropriate utility company. Any damage shall be repaired by the Contractor, at his expense or by the utility company, at possible expense to the Contractor. It shall be the Contractor's responsibility to arrange with each utility company known to maintain utilities in the area of work to have all underground facilities located and staked by the utility company prior to excavation.

A. It is understood and agreed that the Contractor has considered in the bid the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans. Additional compensation will not be allowed for delays, inconvenience or damage sustained due to interference from the utility appurtenances or the operation of moving them.

3.3 PROTECTION OF EXCAVATION

A. The Contractor shall provide suitable sheeting, shoring, and bracing to protect all excavations to provide safe working conditions, and in strict conformance with safety regulations. Damage or injury resulting from settlement, slides, cave-ins, water pressure, or other causes shall be the responsibility of the Contractor and damage shall be repaired at his own expense.

B. The Contractor shall provide adequate signs, barricades, flashing lights, and watchmen and take all necessary precautions for the protection of the work and the safety of the public. All barricades and obstructions shall be protected at night by flashing signal lights in proper working order, which shall be kept burning from sunset to sunrise. Barricades shall be of substantial construction with reflective markings to increase their visibility at night. Suitable signs shall be so placed as to show in advance where construction, barricades, or detours exist.

C. The Contractor shall at all times so conduct his work as to insure the least possible obstruction to traffic and inconvenience to the general public and shall at all times maintain access to existing public and private property.

D. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.4 STORAGE OF SOIL MATERIALS

A. It shall be the responsibility of the Contractor to provide all materials, including borrow, earth cover, and topsoil.

B. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

C. Stockpile soil materials away from edge of excavations.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. The utility trench backfill will be categorized into four (4) different zones. These zones are:

1. Trench Stabilization Zone (*Only when required*)
2. Pipe Bedding Zone, area immediately adjacent to the pipe. A minimum of 6-inches above and below and 12-inches beside the utility pipe.
3. Initial Backfill Zone, area above the pipe bedding zone. This zone is a minimum of 12-inches and will vary with trench depth (*Only when required*)
4. Final Backfill Zone, area immediately below the road subgrade. This zone will be no greater than six (6) feet in depth.

C. The trench base shall be undercut a minimum of 6-inches below the bottom of the pipe and uniformly backfilled with bedding material to 6-inches above the pipe. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
2. All water service lines shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

D. Under no circumstances will it be permissible to leave a pipeline excavation unprotected or unguarded when work is not actually in progress on the pipeline. If it becomes necessary for the Contractor to leave the pipeline excavation for any reason, it shall be the Contractor's responsibility to leave one of his employees at the site to watch the site so unauthorized personnel do not enter the excavation.

3.6 FIELD QUALITY CONTROL

A. Allow testing agency to inspect and test each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

B. Perform field in-place density tests according to ASTM D1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, refer to the calibration curves furnished with the moisture gauges according to ASTM D 3017. A schedule of density tests may be submitted to the Engineer for approval.

C. When testing agency reports that backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained. In the event of a compaction test that does not meet the required density, the Contractor will be required to correct all areas that have been compacted since the last passing test at no cost to the Owner. The Contractor has the option of performing additional compaction tests between the last passing and the failing compaction test at no cost to the Owner.

D. All costs for removal, replacement, recompaction and retesting of the material shall be paid for by the Contractor.

3.7 UTILITY TRENCH BACKFILL

A. Trench Stabilization Zone (*Only when required*)

1. Wherever, in the opinion of the Engineer, the bottom of the trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth as is required and replaced with trench stabilization material.

   a. Trench stabilization material is to be installed in the over excavated area to achieve stability so that bedding material can be placed 6-inches below the bottom of the pipe.

   b. In no scenario does the trench stabilization material replace the pipe bedding material to support the pipe.

B. Pipe Bedding Zone

1. Place compacted pipe bedding material on trench bottoms and where indicated. Shape pipe bedding material to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. The bedding material shall be "shovel-sliced" or hand tamped around and under the haunches of the pipe to insure adequate support along the bottom of the pipe. Care shall be taken to prevent dislodging and misalignment of the pipe and to provide an adequate bell hole for the pipe.

2. All water service lines shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

C. Initial Backfilling Zone (*Only when required*)

1. Immediately above the bedding area, minimum of 12-inches, the pipe shall be backfilled with acceptable native material (Class I, II, and III as described in C605), approved by the Engineer of Record.
   a. If unacceptable initial backfill material is not found onsite, Contractor shall furnish and install import engineered fill or clay material in the initial backfilling area. Imported material shall be placed in a minimum of two (2) lifts.
2. The initial backfill shall be placed evenly so as not to disturb the grade or line of the pipe.
3. At least 12-inches of cover shall be placed over the top of the pipe before the trench is wheel-loaded, and 48-inches of cover shall be placed over the top of the pipe before the trench is hydro-hammered for compaction.
4. Stones larger than 3 inches in diameter shall not be placed within initial backfill of the pipe trench. Care shall be taken in placing backfill over the pipe to avoid damage to the pipe.

5. Native material for all initial backfilling of the pipe trench shall be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3-inch in diameter shall not be placed within the initial backfill area.

D. Final Backfilling Zone (*no greater than six feet*)
   1. All final backfill material shall consist of acceptable native excavation material, approved by the Engineer of Record, and shall be placed in maximum 12-inch lifts and compacted by suitable and approved compaction.
      a. If unacceptable final backfill material is encountered in the trench excavations, it shall be replaced with other suitable material available at the project site, imported engineered fill, imported clay material or with other suitable imported material, as approved by the Engineer of Record.
   2. Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material.
   3. Place and compact final backfill of satisfactory soil to final subgrade elevation.
   4. In final backfill areas below pavement, the Engineer may direct the Contractor to use native material a specified distance below the pavement elevation to ensure a consistent material is utilized under the pavement section.
   5. Excess material not required for final backfilling shall be removed by the Contractor or otherwise disposed of as directed by the Engineer.

3.8 CLAY DAMS

A. As indicated on the project plans and at intervals of no more than 500 feet, the Contractor shall be required to place, within the pipe bedding zone, a 12-inch thick clay fill dam.

B. This dam shall extend through the previous bedding material and into the normal backfill and sides of the trench to prevent the conveyance of water through the bedding material.

C. If the normal backfill material is not suitable for construction of these clay dams, the Contractor will be required to obtain material from other outside sources for this purpose. Clay dams should not be constructed at or near the bell of the pipe but should be constructed near the center of full length of pipe.
   1. Clay dams will not be paid for directly but will be considered to be included in the cost of pipe bedding.

3.9 UTILITY STRUCTURES BACKFILL

A. Backfill, or fill, as the case may be, for precast or cast-in-place structures, such as, but not limited to, manholes, transition structures, junction structures, vaults, and valve boxes shall start at the subgrade for the structure.

B. Except where the pipe must remain exposed for leakage and exfiltration tests and subject to the provisions herein, the Contractor shall proceed as soon as possible with backfilling operations. Care shall be exercised so that the structure or pipe will not be damaged or displaced. If the pipe is supported by concrete cradle placed between the trench wall and the pipe, backfill above the concrete bedding shall not be placed nor sheeting pulled for at least 24 hours after placement of the concrete.

C. Unless otherwise specified or authorized by the Engineer, backfill against or over the top of any cast-in-place structure shall not be placed prior to seven (7) days after completion of concrete placement.

D. Voids left by the removal of sheeting, piles and similar sheeting supports shall be immediately backfilled with clean sand which shall be jetted into place to assure dense and complete filling of the voids.

E. Where it is necessary for any reason to undercut below the bottom of concrete poured in place structures, the void below the bottom of the structure shall be filled with concrete at the same time and of the same quality as that of the structure itself, unless otherwise shown on the Drawing or approved by the Engineer.

F. Excavation for structures and accessories, including manholes, shall be of sufficient size so as to leave at least twelve (12) inches of clear space between the outer surface of the structure and the embankment or sheathing and bracing which may be used to hold and protect them. Unless otherwise shown on the Drawings or authorized by the Engineer, the bottom of the excavation shall be undercut below the bottom grades established by a minimum of 4". Manhole installations shall be completed and completely backfilled the same day in which the excavation was started.

G. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

3.10 SOIL MOISTURE CONTROL

A. The moisture content of backfill material should be adjusted to a moisture level that is within plus or minus two (2) percent of optimum moisture content as determined by a standard proctor (ASTM: D698).

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3. The moisture content of granular backfill material should be maintained at a level that will be conductive for vibratory compaction.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

1. Compaction by bucket packing is not allowed.

2. Imported material shall be placed in a minimum of two (2) lifts.

C. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

D. Unless otherwise required, the pipeline excavation shall be completely backfilled and compacted at the end of each days' operation and reopened when work resumes on this

portion of the line. The Contractor shall be responsible to mark the end of the pipe in such a manner that it may be easily found when the ditch is reopened.

E. All bedding and backfill areas shall be subject to compaction testing by nuclear or standard methods according to the latest applicable ASTM Specifications.

F. Frequency of compaction tests shall be completed in accordance with South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads and Bridges, current edition. (*Horizontal – Every 300 feet of trench. Vertical - 2 feet above top of pipe and every 3 feet above that*)

G. The areas requiring compaction testing shall include the initial backfill zone and, final backfill zone.

1. Trench Stabilization Zone (*Only when required*)

a. Achieve 100-percent compaction by placing in trench

2. Pipe Bedding Zone

a. Achieve 100-percent compaction by placing in trench

3. Initial Backfilling Zone (*Only when required*)

a. Compaction methods in a manner to achieve at least 97-percent Standard Proctor Density, or as otherwise specified

4. Final Backfilling Zone (*no greater than six feet*)

a. Compaction methods in a manner to achieve at least 95-percent Standard Proctor Density, or as otherwise specified

H. Compaction Testing Requirements

1. The Engineer of Record may require random compaction tests of the material. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall re-compact said material at no additional cost to the Owner, and the Engineer of Record shall then have the right to take additional compaction tests to assure that this material is compacted to the proper density without any additional cost to the Owner.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

B. All material generated by this project must be disposed of at a permitted site. Depending on what material is generated and whether it is contaminated or uncontaminated will

determine which permitted facility can accept it. Permitted facilities include construction and demolition debris sites, restricted use sites, and regional landfills. Contact the SDDANR Waste Management Program at (605) 773-3153 to identify locally permitted disposal sites for various categories of contaminated and uncontaminated materials.

C. Before final acceptance of the work the Contractor shall clear the entire work site of equipment, unused materials, and rubbish so as to present a satisfactory clean and neat appearance. Agricultural areas shall be scarified with a farm type disc and smoothed out with an agriculture type drag. The final surface shall be smooth and free of rocks and debris.

PART 4.0 - MEASUREMENT AND PAYMENT

4.1 EXCAVATION, BEDDING, BACKFILLING AND INCIDENTALS

A. All excavation of every description; site preparation; sheeting and shoring; dewatering; on-site bedding; backfilling; compaction; water for compaction; removal of trees and shrubs; moving and resetting fences, portable culverts and minor structures; grading; shaping; salvaging, stockpiling and placing topsoil; site cleanup and other "incidentals" required to complete the work shall not be measured for payment separately, but shall be considered as a subsidiary obligation of the Contractor in the installation of pipe, structures, specials and other items of measurement; and the entire cost thereof shall be included in the Contract unit prices bid for furnishing and installing pipe, structures, specials or other items for which payment is established.

4.2 TRENCH STABILIZATION MATERIAL

A. Trench stabilization material furnished, transported, placed and compacted into place shall be measured as tons to the nearest 0.1 ton for the trench stabilization material.

B. Payment for trench stabilization material shall be paid at the contract unit price per ton for trench stabilization material. Payment for trench stabilization material will be full compensation for furnishing, transporting, placing, compacting, labor, equipment, and incidentals necessary to complete the work.

4.3 PIPE BEDDING MATERIAL

A. Pipe bedding material furnished, transported, placed and compacted into place shall be measured as tons to the nearest 0.1 ton for the pipe bedding material.

B. Payment for pipe bedding material shall be paid at the contract unit price per ton for pipe bedding material. Payment for pipe bedding material will be full compensation for furnishing, transporting, placing, compacting, labor, equipment, and incidentals necessary to complete the work.

OR

A. No measurement or individual Bid Item payment will be made for pipe bedding material. Pipe bedding material shall be considered incidental to the installation of the water main, water services and appurtenances.

4.4 IMPORTED ENGINEERED FILL MATERIAL

A. Imported engineered fill material furnished, transported, placed and compacted into place shall be measured as tons to the nearest 0.1 ton for the engineered fill material.

B. Payment for engineered fill material shall be paid at the contract unit price per ton for engineered fill material. Payment for engineered fill material will be full compensation for furnishing, transporting, placing, compacting, labor, equipment, and incidentals necessary to complete the work.

OR

A. No measurement or individual Bid Item payment will be made for imported engineered fill material. Imported engineering fill material shall be considered incidental to the installation of the water main, water services or any other appurtenances.

4.5 IMPORTED CLAY MATERIAL

A. Imported clay material furnished, transported, placed and compacted into place shall be measured as tons to the nearest 0.1 ton for the imported clay material.

B. Payment is for loading, hauling and placing acceptable clay materials from an acceptable source or the Brookings Regional Landfill. Payment for imported clay material will be full compensation for furnishing, transporting, placing, compacting, labor, equipment, and incidentals necessary to complete the work. Quantity will be determined by documenting the trench width, length and depth to determine the volume of imported clay material install on the project.

END OF SECTION 31 2333