

# TECHNICAL SPECIFICATIONS FOR THE CONSTRUCTION OF UNDERGROUND UTILITIES

(Updated January 2024)

## **1. SCOPE**

**1.01** This technical specification contains requirements for furnishing labor, materials, equipment, tools, and services as they pertain to the construction of underground utilities, pipelines, and/or other appurtenant structures. This specification shall be superseded by the Drawings and Special Provisions.

## **2. ALIGNMENT**

**2.01 GENERAL** - The construction of all underground pipelines shall conform to the horizontal and vertical alignment shown in the Drawings or indicated in the Special Provisions, except when conditions warrant, the Engineer shall have the exclusive authority to modify the alignment as necessary for the proper completion of the Project.

**2.02 CONSTRUCTION STAKING** - The Engineer will furnish all horizontal and vertical alignment stakes, bench marks and/or other control as may be necessary for the construction of underground pipelines and as specified in the General Requirements. It is the exclusive responsibility of the Contractor to protect all construction stakes from damage or alteration. The Contractor shall be required to pay all costs for the repair or replacement of damaged or altered construction stakes, when in the opinion of the Engineer, the damage or alteration results from the negligence of the Contractor to protect the construction stakes.

**2.03 ALIGNMENT CONTROL** - The Contractor shall control the horizontal and vertical alignment of the pipeline using methods acceptable to the Engineer. The preferred method of alignment control is a laser beam system capable of continuously projecting both horizontal and vertical alignment along the pipeline as it is constructed with the laser beam being referenced as each successive section of pipe is installed. Other methods of alignment control may be allowed with the prior approval of the Engineer. The Contractor shall periodically check the horizontal and vertical alignment using the construction stakes provided. If a visual or other check discloses an apparent error in alignment, the construction of the pipeline shall be suspended and the Engineer notified. The entire cost for the removal and reconstruction of an improperly aligned pipeline shall rest solely with the Contractor, unless an error in the construction stakes provided by the Engineer can be verified. At no time shall the Contractor change the horizontal or vertical alignment without the prior approval of the Engineer. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of alignment control shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

## **3. CONSTRUCTION AREA**

**3.01 GENERAL** - The Construction Area shall be defined as that portion of the Project Site where the actual construction of the Project is occurring, including trench locations, excavation or material stockpile areas, and/or any other areas disturbed by the construction operation.

**3.02 LIMITATIONS ON CONSTRUCTION AREAS** - The Construction Area shall be limited to minimize any interference to adjacent property owners and/or the general public. Whenever the construction of the Project requires the limitation of public access to a public street, alley, or other similar thoroughfare, the extent of the Construction Area shall be subject to the approval of the Engineer. Generally, the active Construction Area shall be limited to the equivalent of two (2) consecutive city blocks and one (1) street intersection.

## **4. EXCAVATION**

**4.01 GENERAL** - All pipeline construction shall occur in open trenches. The top edge of the trench shall be sufficiently protected from any overburden which could cause a collapse or sliding of the trench walls, including the excavation stockpile, construction loads or traffic loads. When conditions warrant, the use of short tunnels may be allowed provided all applicable safety Laws and Regulations are observed. All excavation shall be classified as either "earth" or "rock."

**4.02 EARTH EXCAVATION** - All excavation, excluding rock excavation, required for the construction of the Project, regardless of the character of the material or the presence of obstructions, shall be classified as earth excavation, including over-excavation for foundation stabilization. The Contractor shall excavate the trench to the proper depth and configuration necessary for the safe construction of the Project as described in the Contract Documents. The Engineer shall approve the method of earth excavation before its commencement. *Unless otherwise defined in the Special*

*Provisions, the Bid Form, or the Drawings, the entire cost of earth excavation shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**4.03 ROCK EXCAVATION** - All rock excavation shall be under one classification. It shall include solid ledge rock in its natural location that requires systematic quarrying, drilling, blasting, or other method of fracturing to allow for its removal, and boulders that exceed one half (½) cubic yard in volume. All other material shall be classified as earth excavation. Whenever rock is encountered in the trench, it shall be stripped of earth and the Engineer notified and given time to make a profile for the determination of quantities before any rock excavation begins. The Engineer shall approve the procedure for rock excavation before its commencement. The rock shall be removed from the rock surface to a point 6 inches below the pipe and to the minimum width specified under Trench Configuration, except the trench width shall not be increased above the pipe until the uppermost surface of the rock.

**4.03 (a) BLASTING** – Express written permission from the City Engineer and the City Fire Chief shall be obtained before the use of explosives will be allowed. The Contractor shall further employ expert personnel acceptable to the City of Watertown for the execution of all blasting operations. The magnitude of charge used shall be limited to ensure the prevention of any damage to public or private property through vibrations or other means. The Contractor shall provide adequate protection to insure that no rock fragments or other flying debris are discharged as a result of blasting. Proof of insurance protection in an amount acceptable to the City of Watertown shall be provided by the Contractor before the commencement any blasting activities. The City may further require the Contractor to purchase special insurance protection, in addition to the standard liability insurance, to cover all damages that may result from the use of explosives.

**4.03 (b) ROCK EXCAVATION** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for rock excavation shall include all labor, materials, equipment, tools, and services required to excavate the rock as described in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the cubic yard of rock removed and disposed of in compliance with the Contract Documents and accepted by the Engineer. The volume of rock excavation shall be computed based on the minimum width and depth of rock removal required by the Contract Documents.*

**4.04 EXCAVATION STOCKPILES** - All material removed from the trench during the excavation process shall be stockpiled by the Contractor. Generally, the excavation stockpile may be placed adjacent the trench from which the material was excavated. However, circumstances (both foreseeable and unforeseeable) may arise which require excavation stockpiles to be placed elsewhere on the Project Site. Excavation material unsuitable for use as foundation, bedding, or backfill material, such as construction debris, rock, boulders, muck, peat, expansive clays and/or organic materials shall be classified as surplus excavation material and separated from the excavation stockpile. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost for handling, sorting, and stockpiling the excavated material on the Project Site shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**4.05 SURPLUS EXCAVATION MATERIAL** - Excavation material unsuitable for use as foundation, bedding or backfill material, such as construction debris, rock, boulders, muck, peat, expansive clays and/or organic materials as well as all excess excavation material present in the excavation stockpile at the completion of the backfilling operation shall be classified as Surplus Excavation Material. The Contractor shall dispose of surplus excavation material outside the Project Site at an appropriate disposal site. The Contractor shall be responsible for the procurement of the disposal site. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost for handling, transporting and disposing of Surplus Excavation Material outside the project site shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**4.06 PROTECTIVE TRENCH SHEILDING** - The Contractor shall employ sheeting, bracing, or the use of a trench box or other protective shielding as required by Laws and Regulations to protect personnel, equipment, property and/or the Project from any collapse or sliding of the trench walls. Should the specified trench configuration or bedding zone, make it impossible to place the protective shielding on grade at the bottom of the excavation, the protective shielding shall rest on ledges above the pipe, and a narrower, deeper trench will be cut inside the protective shielding to accommodate the pipe, bedding material, and/or backfill material up to twelve (12) inches above the top of the pipe. However, this requirement in no way relieves the Contractor of any legal responsibility for safety on the Project Site. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost for protective shielding shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**4.07 PROTECTION OF EXCAVATED AREAS** - The Contractor shall provide and maintain adequate signs, barricades, and other work zone safety measures in compliance with MUTCD and OSHA.

## **5. TRENCH CONFIGURATION**

**5.01 GENERAL** - Trench walls shall be as near to vertical as conditions will allow. The width of the trench shall be no wider than is necessary to properly construct the pipe foundation, place the pipe, place and compact the bedding material, and place and compact the backfill material.

**5.02 BEDDING ZONE TRENCH WIDTH** - The trench width from a point six (6) inches above the top of the pipe to the bottom of the excavation, and at all points between, shall meet the following requirements.

**5.02 (a) - MINIMUM TRENCH WIDTH IN THE BEDDING ZONE** – The minimum trench width in the bedding zone shall be at least twelve (12) inches plus the outside diameter of the pipe.

**5.02 (a) - MAXIMUM TRENCH WIDTH IN THE BEDDING ZONE** – The maximum trench width in the bedding zone should be no greater than twenty-four (24) inches plus the outside diameter of the pipe, except, the width shall be increased where necessary to ensure the proper placement and compaction of the bedding material under the pipe.

**5.03 TRENCH WIDTH ABOVE THE BEDDING ZONE** - The width of the trench from six (6) inches above the top of the pipe to the top of the trench shall be no wider than necessary to provide for worker access to the pipe and clearance for protective shielding. Additionally, the Contractor may slope or bench the trench side walls from six (6) inches above the top of the pipe to the top of the trench with the prior approval of the Engineer.

## **6. REMOVAL OF WATER**

**6.01 GENERAL** - The trench and entire Construction Area shall be maintained in a dry condition until all construction operations including backfilling and compaction have been completed. The Contractor shall at all times during construction provide and maintain ample equipment for the removal and proper disposal of all surface and ground water entering the Construction Area. The Contractor shall be responsible for all damages resulting from the disposal of water. The entire construction of all pipelines shall occur under dry conditions. No construction activities shall occur in the trench when in the opinion of the Engineer the trench is not sufficiently dry to allow for the proper construction of the Project.

**6.02 SURFACE WATER** – The Construction Area shall be graded to prevent the accumulation of surface runoff in the trench, or at any other locations within the Construction Area. The Contractor shall promptly remove all accumulations of surface runoff whether resulting from natural occurrences such as rainfall or snowfall, or as otherwise may occur due to other non-natural causes. The method for removal and disposal of surface runoff accumulations shall be approved by the Engineer before implementation of dewatering efforts. The preferred method of removal and disposal of surface runoff accumulations is by the use pumps to transport the surface water to an adjacent storm sewer or other existing drainage structure as approved by the Engineer. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of removing and disposing of surface water as may accumulate in the Construction Area, shall not be paid for directly, but shall be considered subsidiary to other Pay Items. The Contractor may be entitled to additional compensation because of any unusual or severe surface runoff, provided the Contractor employed appropriate and adequate steps to protect the Construction Area. The Contractor may submit a Change Proposal to the Engineer requesting additional compensation and/or extra time.*

**6.03 ANTICIPATED GROUND WATER** - The Special Provisions, the Bid Form, or the Drawings may indicate those areas where it is anticipated existing ground water levels will interfere with the proper construction of the Project. The Contractor shall be required to lower the elevation of the water table to a point at least twelve (12) inches below the maximum depth of excavation in the trench. The method for removal and disposal of ground water shall be approved by the Engineer before implementation of dewatering efforts. The preferred method of lowering the water table is by well points spaced in close enough proximity along the trench to adequately lower the water table at every location along the trench. The preferred method of disposing of the water is to transport the ground water to an adjacent storm sewer or other existing drainage structure as approved by the Engineer.

**6.03 (a) ANTICIPATED GROUND WATER REMOVAL AND DISPOSAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for anticipated ground water removal and disposal shall include all labor, materials, equipment, tools, and services required to furnish, install, operate, maintain, and remove upon completion of dewatering activities, equipment necessary to lower the water table as specified in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the linear foot of trench successfully dewatered in compliance with the Contract Documents and accepted by the Engineer.*

**6.04 UNANTICIPATED GROUND WATER** - The Special Provisions, the Bid Form, or the Drawings may indicate those areas where it is anticipated existing ground water levels will interfere with the proper construction of the Project. Should unanticipated ground water be encountered during the excavation process, the construction of the pipeline shall be suspended and the Engineer notified. The Contractor shall be required to lower the elevation of the water table to a point at least twelve (12) inches below the maximum depth of excavation in the trench. The method for removal and disposal of ground water shall be approved by the Engineer before implementation of dewatering efforts. The preferred method of lowering the water table is through the use of well points spaced in close enough proximity along the trench to adequately lower the water table at every location along the trench. The preferred method of disposing of the water is to transport the ground water to an adjacent storm sewer or other existing drainage structure as approved by the Engineer. *The Contractor may be entitled to additional compensation because of any unanticipated ground water. The Contractor shall submit in writing a detailed request for additional compensation to the Engineer. Upon the Engineer's acceptance of the request, it will be forwarded to the City Council for approval.*

**6.05 PERMITS OR NOTIFICATIONS** - Before undertaking any surface or ground dewatering operations, the Contractor shall be solely and exclusively responsible for obtaining all permits and for notifying any governing agencies as may be required by law. The South Dakota Department of Agriculture and Natural Resources (SD DANR) may require a "General Permit to Discharge under the Surface Water Discharge System for Temporary Dewatering Activities in South Dakota." An application may be obtained from SD DANR at the Joe Foss Building, 523 East Capitol Avenue, Pierre, SD 57501-3181. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of all notifications, and permits for dewatering including any fines resulting from the Contractors failure to obtain a permit, shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

## **7. FOUNDATION PREPARATION**

**7.01 GENERAL** - All pipelines and appurtenant structures shall be constructed on a stable and uniform foundation. The foundation shall be shaped such that the pipe rests at the established horizontal and vertical alignment, and to provide uniform bearing and support for the lower quadrant of each pipe along its entire length. Where necessitated by the configuration of the pipe joints, bell holes shall be constructed in the foundation to ensure uniform bearing and support of the pipe between the joints, and to allow for the proper construction of the pipe joints. Inadvertent over-excavation shall be backfilled with bedding or foundation material as directed by the Engineer. When native bedding material is specified, the foundation should be constructed using the undisturbed native material in the trench floor. When imported bedding material is specified, the foundation shall be constructed using the imported bedding material. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of foundation preparation shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

## **8. FOUNDATION STABILIZATION**

**8.01 GENERAL** - When, in the opinion of the Engineer, the undisturbed native material in the trench precludes the construction of an acceptable foundation, the Contractor shall modify, reconstruct, or otherwise stabilize the trench using methods acceptable to the Engineer. The preferred method of foundation stabilization is over-excavation of the trench to remove the unsuitable material and replace it with foundation material. Foundation material shall be classified as either "native" or "imported."

**8.02 OVER-EXCAVATION** - The Engineer shall determine the extent of over-excavation required for stabilization of the foundation. Over-excavation for foundation stabilization shall be classified as earth excavation and the resultant material as surplus excavation material. Over-excavated areas shall be backfilled with foundation material extending across the entire trench width from the over-excavated trench floor up to the bottom of the bedding zone. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost for excavating, handling, transporting and disposing of over-excavated material for foundation stabilization shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**8.03 FOUNDATION MATERIAL SELECTION** - Unless otherwise specified in the Special Provisions, or the Drawings, no foundation stabilization is anticipated and therefore no foundation material will be required. When the

undisturbed native material in the trench is determined to be unacceptable by the Engineer and over-excavation is chosen as the method of foundation stabilization, the Engineer will determine the type of foundation material to be used based on the severity of the instability and the availability of suitable foundation material in the excavation stockpile.

**8.04 NATIVE FOUNDATION MATERIAL** - Native foundation material will be chosen from the most suitable material available within the excavation stockpile, and shall be approved by the Engineer before its incorporation into the Project. It shall be placed and compacted using methods approved by the Engineer.

**8.04 (a) NATIVE FOUNDATION MATERIAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for native foundation material shall include all labor, materials, equipment, tools, and services required to select, place, and compact the native foundation material as described in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the linear foot of trench floor stabilized in compliance with the Contract Documents and accepted by the Engineer. No payment will be made for native foundation material when, in the opinion of the Engineer, the circumstances necessitating its incorporation into the Project result from the neglect of the Contractor to dewater or otherwise protect the Construction Area.*

**8.05 IMPORTED FOUNDATION MATERIAL** - Imported foundation material shall be supplied by the Contractor from an approved source outside the Project Site. Imported foundation material shall be approved by the Engineer before its incorporation into the Project, and be placed and compacted using methods approved by the Engineer. Imported foundation material shall consist of clean, uniformly graded gravel free from organic matter and/or other foreign substances and meeting the following gradation requirements.

| FOUNDATION MATERIAL GRADATION |                               |
|-------------------------------|-------------------------------|
| Sieve Size                    | Percent Passing by Dry Weight |
| 4 inch                        | 100 %                         |
| 2 inch                        | 95 - 100 %                    |
| 1½ inch                       | 90 - 100 %                    |
| 1 inch                        | 20 - 55 %                     |
| ¾ inch                        | 0 - 15 %                      |

**8.05 (a) IMPORTED FOUNDATION MATERIAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for imported foundation material shall include all labor, materials, equipment, tools, and services required to furnish, place and compact the imported foundation material as described in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the ton of imported foundation material installed in compliance with the Contract Documents and accepted by the Engineer. No payment will be made for imported foundation material when, in the opinion of the Engineer, the circumstances necessitating its incorporation into the Project result from the neglect of the Contractor to dewater or otherwise protect the Construction Area.*

**8.06 FOUNDATION MATERIAL PLACEMENT** - Foundation material shall be placed beginning on a stable, uniformly shaped trench floor. The preferred method of placement shall be to carefully deposit the foundation material in horizontal lifts of approximately six (6) inches in uncompacted thickness, with each lift being compacted before the placement of the next lift. This procedure shall be repeated up to the bottom of the bedding zone, or other level deemed appropriate by the Engineer for the construction of the Project. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. Foundation stabilization shall not occur over frozen ground or when the foundation material is frozen.

**9. PIPE BEDDING**

**9.01 GENERAL** – All pipelines shall be bedded using appropriate materials, placement procedures, and compaction methods such that the pipe is fully supported and protected. Bedding material shall be continuously placed throughout the bedding zone, along the entire length of the pipeline, except where clay dams are specified. Bedding material shall be classified as either “native” or “imported.”

**9.02 BEDDING MATERIAL SELECTION** - Unless otherwise specified in the Special Provisions, the Bid Form, the Drawings, native bedding material shall be utilized for pipe bedding. When imported bedding material is specified, the Engineer shall have the right to order a change to native bedding material if, in the opinion of the Engineer, the native material in the excavation stockpile is suitable for use as bedding material.

**9.03 NATIVE BEDDING MATERIAL** - Native bedding material will be chosen from the most suitable material available within the excavation stockpile, and shall be approved by the Engineer before its incorporation into the Project. It shall be free from rocks greater than two (2) inches, and shall be placed and compacted using methods approved by the Engineer. All material must meet or exceed SDDOT specifications. *Unless otherwise defined in the, the Special Provisions, the Bid Form, or the Drawings, the entire cost of selecting, placing, and compacting the native bedding material shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**9.04 IMPORTED BEDDING MATERIAL** - Imported bedding material shall be supplied by the Contractor from an approved source outside the Project Site. Imported bedding material shall be approved by the Engineer before its incorporation into the Project, and be placed and compacted using methods approved by the Engineer. Imported bedding material shall consist of a clean, course-grained gravel or gravel/sand. It shall be free from organic matter and/or other foreign substances and meet the following gradation requirements.

| IMPORTED BEDDING MATERIAL GRADATION |                               |
|-------------------------------------|-------------------------------|
| Sieve Size                          | Percent Passing by Dry Weight |
| 1 inch                              | 100 %                         |
| 3/4 inch                            | 70 - 100 %                    |
| 3/8 inch                            | 20 - 55 %                     |
| # 4                                 | 0 - 20 %                      |
| # 8                                 | 0 - 5 %                       |

**9.04 (a) IMPORTED BEDDING MATERIAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for imported bedding material shall include all labor, materials, equipment, tools, and services required to furnish, place and compact the imported bedding material as described in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the ton of imported bedding material installed in compliance with the Contract Documents and accepted by the Engineer. No payment will be made for imported bedding material when, in the opinion of the Engineer, the circumstances necessitating its incorporation into the Project result from the neglect of the Contractor to dewater or otherwise protect the Construction Area.*

**9.05 BEDDING ZONE** - The bedding zone shall consist of that region of the trench immediately over, under, and around the pipe. Unless otherwise specified in the Special Provisions, or the Drawings, the bedding zone shall extend along the entire length of the pipeline and across the entire trench width up to a minimum of six (6) inches above the pipe. When native bedding material is specified, the foundation will be constructed using the undisturbed native material in the trench floor and the base of the bedding zone will be the bottom of the pipe. When imported bedding material is specified, the foundation shall be constructed using the imported bedding material, and the base of the bedding zone shall be a minimum of four (4) inches below the pipe.

**9.06 BEDDING MATERIAL PLACEMENT** - Bedding material shall be placed and compacted as pipe laying progresses. Bedding material shall be placed beginning on a stable, uniformly shaped trench floor or when foundation stabilization has occurred, immediately above the foundation material. The preferred method of placement shall be to carefully deposit the bedding material in horizontal lifts of approximately six (6) inches in uncompacted thickness, with each lift being compacted before the placement of the next lift. This procedure shall be repeated up to the top of the bedding zone, or other level deemed appropriate by the Engineer for the construction of the Project. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. Bedding shall not occur over frozen ground or when the bedding material is frozen. The Contractor shall exercise great care in the placement of the bedding material so as not to leave any voids under the pipe haunches and to ensure the pipe rests at the established horizontal and vertical alignment.

## **10. CLAY DAMS**

**10.01 GENERAL** - Clay dams shall be twelve (12) inch thick, and constructed at intervals of not more than 100 feet, or as otherwise indicated in the Special Provisions or the Drawings. Clay dams shall extend through the bedding material into the undisturbed native material along the trench walls, and from the undisturbed native material along the trench floor to the top of the bedding material. The Contractor shall furnish the clay material for the construction of the clay dams from the excavation stockpile or other outside source. The clay material provided shall be sufficiently impermeable to prevent the conveyance of water along the trench through the bedding material and/or foundation material. Clay material selection shall be approved by the Engineer prior its incorporation into the Project. Clay dams shall be constructed near the center of a full length of pipe and away from any pipe joints. *Unless otherwise defined in the Bid Form, Special Provisions, or the Drawings, the entire cost of providing the clay material and constructing the clay dams shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**10.02 WATER PIPELINES** - Unless otherwise specified in the Special Provisions, or the Drawings, clay dams SHALL be required for all water pipelines when the native material is determined to be impermeable by the Engineer. If the native material is of a granular nature, clay dams may not be required.

**10.03 SANITARY SEWER PIPELINES** - Unless otherwise specified in the Special Provisions, or the Drawings, clay dams SHALL be required for all sanitary sewer pipelines when the native material is determined to be impermeable by the Engineer. If the native material is of a granular nature, clay dams may not be required.

**10.04 STORM SEWER PIPELINES** - Unless otherwise specified in the Special Provisions, or the Drawings, clay dams SHALL NOT be required for storm sewer pipelines.

## **11. BACKFILLING**

**11.01 GENERAL** - All trenches shall be backfilled using the appropriate backfill material, placement procedures, and compaction methods. Backfill material shall be classified as “native,” “imported,” or “imported select.” The appropriate backfill material shall be installed beginning at the top of the bedding zone.

**11.02 BACKFILL MATERIAL SELECTION** - Unless otherwise specified in the Special Provisions, the Bid Form, or the Drawings, native backfill material shall be used for backfilling the trench.

**11.03 NATIVE BACKFILL MATERIAL** - Native backfill material will be chosen from the excavation stockpile. It shall be free from rocks greater than six (6) inches, and shall be placed and compacted using methods approved by the Engineer. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of selecting and placing the native backfill material shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**11.04 IMPORTED BACKFILL MATERIAL** - Imported backfill material shall be supplied by the Contractor from an approved source outside the Project Site. Imported backfill material shall be approved by the Engineer before its incorporation into the Project, and be placed and compacted using methods approved by the Engineer. Imported backfill material shall be free from rocks greater than six (6) inches, organic matter, and/or other foreign substances and shall be placed and compacted using methods approved by the Engineer.

**11.04 (a) IMPORTED BACKFILL MATERIAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for imported backfill material shall include all labor, materials, equipment, tools, and services required to furnish, place and compact the imported backfill material as described in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the ton of imported backfill material installed in compliance with the Contract Documents and accepted by the Engineer. No payment will be made for imported backfill material when, in the opinion of the Engineer, the circumstances necessitating its incorporation into the Project result from the neglect of the Contractor to dewater or otherwise protect the Construction Area.*

**11.05 IMPORTED SELECT BACKFILL MATERIAL** - Imported select backfill material shall be supplied by the Contractor from an approved source outside the Project Site. Imported select backfill material shall be approved by the Engineer before its incorporation into the Project, and be placed and compacted using methods approved by the Engineer. Imported select backfill material shall consist of a clean, uniformly graded granular material free from organic matter and/or other foreign substances and meeting the following gradation requirements.

| IMPORTED SELECT BACKFILL MATERIAL GRADATION |                               |
|---|-------------------------------|
| Sieve Size                                  | Percent Passing by Dry Weight |
| 2 inch                                      | 100 %                         |
| # 4   | 40 - 70 %                     |
| # 8   | 0 - 15 %                      |

**11.05 (a) IMPORTED SELECT BACKFILL MATERIAL** - *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the Pay Item for imported select backfill material shall include all labor, materials, equipment, tools, and services required to furnish, place and compact the imported select backfill material as specified in the Contract Documents and directed by the Engineer. This Pay Item shall be measured for payment by the ton of imported select backfill material installed in compliance with the Contract Documents and accepted by the Engineer. No payment will be made for imported select backfill material when, in the opinion of the Engineer, the circumstances necessitating its incorporation into the Project result from the neglect of the Contractor to dewater or otherwise protect the Construction Area.*

**11.06 BACKFILL MATERIAL PLACEMENT** – Placement and compaction of backfill material shall not lag behind excavation and laying of pipe by more than three hundred (300) feet. Backfill material shall be placed beginning immediately above the bedding zone. The preferred method of placement shall be to carefully deposit the backfill material in horizontal lifts of approximately six (6) inches in uncompacted thickness, with each lift being compacted before the placement of the next lift. This procedure shall be repeated until the trench is filled to the level of the surrounding terrain or other level deemed appropriate by the Engineer for the construction of the Project. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. Backfilling shall not occur over frozen ground or when the backfill material is frozen.

## **12. COMPACTION**

**12.01 GENERAL** - Foundation, bedding and backfill materials shall be compacted utilizing procedures and equipment which, with adequate moisture content, will result in a stable, uniformly compacted embankment. The Engineer shall approve the method of compaction for the various materials before their placement. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of compacting foundation, bedding, and/or backfill material shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

**12.02 COMPACTION METHOD** - The preferred method of compaction for foundation and backfill material shall be the uniform densification of the material in ascending horizontal lifts by mechanical means wherever practicable. Sufficient cover shall be in place above the pipe before compaction with heavy equipment such as wheel or sheep's foot rollers is allowed. The preferred method of compaction for bedding material shall be the uniform densification of the material in ascending horizontal lifts by shovel slicing and pneumatic tamping. The Engineer may require the use of hand compaction equipment when compacting material in close proximity to a pipe or other structure to protect them from damage by mechanical equipment. The Engineer shall determine the maximum allowable uncompacted thickness of a lift based on the material properties and the anticipated compaction method. However, changing conditions or failure to meet relative density requirements shall result in the Contractor being required to re-work and/or re-compact previously compacted materials.

**12.03 DENSITY REQUIREMENTS** - The relative density of foundation, and bedding materials shall meet or exceed ninety-five (95) percent of maximum dry density at all locations. Backfill material shall meet or exceed ninety-five (95) percent of maximum dry density at all locations within public right-of-way and outside of public right-of-way when subject to traffic loads. At locations outside of public right-of-way, and NOT subject to traffic loads, backfill material shall meet or exceed eighty-five (85) percent of maximum dry density. Additionally, variations in relative density between successive vertical or horizontal measurements shall not exceed five (5) percent. When excessive variations occur, the Engineer may direct the Contractor to re-work and/or re-compact previously compacted areas to provide a uniformly compacted embankment even when minimum density requirements are met.

**12.04 MOISTURE CONTENT** - The minimum moisture content shall be not less than four (4) percent below optimum moisture content. However, when the material to be compacted consists primarily of course gravel, sufficiently free from fines, the Engineer may allow a reduction in the minimum moisture content, provided relative density requirements are achieved. The maximum moisture content shall be limited such that relative density requirements are achieved, resulting in a stable, uniformly compacted embankment. When moisture content is outside the specified range, the Engineer may direct the Contractor to scarify, adjust the moisture content, and re-compact previously compacted areas even when minimum density requirements are met.



**12.05 MOISTURE CONTROL AND ADJUSTMENT** - The moisture content of all foundation, bedding, and/or backfill materials shall be uniform before compaction. When conditions warrant, the Contractor shall be required to modify the existing moisture content of the material using methods acceptable to the Engineer. The preferred method of reducing water content in excessively wet materials shall be to repeatedly scarify and aerate the material until reaching an acceptable, uniform moisture content. The preferred method of increasing water content in excessively dry materials shall be to repeatedly wet and mix the material until reaching an acceptable, uniform moisture content. Blending of wet and dry materials to achieve an acceptable, uniform moisture content may be used to adjust moisture content with the prior approval of the Engineer. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of moisture control and adjustment for foundation, bedding, and/or backfill materials, including providing and applying water, shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*

### **13. DENSITY AND MOISTURE CONTENT TESTING**

**13.01 GENERAL** - All foundation, bedding and backfill material shall be subject to density and moisture content testing. The Engineer will perform laboratory and field tests to determine the relative density and moisture content of all soil materials placed during the construction of the Project to ensure strict compliance with the Contract Documents. Density and moisture tests will be performed on a periodic basis dependent on the progress of construction of the Project. The frequency of testing shall be approximately one density test and one moisture test performed for every five vertical feet of depth and three hundred linear feet of trench. Density test requirements will be per Chapter 15 of the Engineering Design Standards.

**13.02 TESTING METHODS** - All testing shall be performed in accordance with the latest published ASTM Standard. The maximum dry density and optimum moisture content of the various materials shall be determined in accordance with ASTM D-698 (Standard Proctor Method). The relative density of the compacted material shall be determined in accordance with ASTM D-1556 (Sand Cone Method), ASTM D-2167 (Balloon Method), or ASTM D-2922 (Nuclear Method). The moisture content of the compacted material shall be determined in accordance with ASTM D-2216 (Laboratory Method), or ASTM D-2922 (Nuclear Method).

**13.03 RE-TESTING** - The Engineer shall be responsible for all costs associated with the first density and moisture test performed at any given location. Areas of embankment failing to meet the density and/or moisture requirements in the Contract Documents shall be rejected by the Engineer and alternately re-worked and re-tested until compliance with the Contract Documents is verified. If the second density or moisture test fails at any location, all costs for the second density and moisture test and all subsequent tests shall be the responsibility of the Contractor. If the second set of tests pass, the Engineer shall be responsible for all costs associated with the second test.

### **14. TELEVISION INSPECTION**

**14.01 GENERAL** - The City Wastewater Department will inspect the pipeline by remote camera prior to paving. Any defects in workmanship or material identified during the inspection shall be corrected by the Contractor before final acceptance of the Project.

**14.02 NOTICE** – The Contractor shall give the City Wastewater Department notice when any section of pipeline is cleaned and ready for remote camera inspection. The City Wastewater Department will not clean the pipeline or other appurtenant structures before remote camera inspection. If the pipeline is not clean or otherwise acceptable for inspection, the Contractor shall be required to clean or otherwise prepare the pipeline or other appurtenant structures. The Contractor shall be responsible for pumping, blocking, or any other means necessary for the City to televise the pipe before acceptance.

**14.03 REPAIRS AND RESTORATION** - The Contractor should allow adequate time before commencement of any surface restorations or paving operations for the City Wastewater Department to perform the remote camera inspection. The Contractor shall be required to correct any defects that are identified, regardless of the presence of seeding, sod, PCC pavement, Asphalt concrete pavement, or any other surface improvements. *Unless otherwise defined in the Special Provisions, the Bid Form, or the Drawings, the entire cost of correcting any defects, including replacement of previously completed and accepted work, shall not be paid for directly, but shall be considered subsidiary to other Pay Items.*