SECTION 02223 – TRENCHING, BACKFILLING, AND COMPACTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes materials, installation, and testing of trench excavation, backfilling, removal and disposal of surplus and objectionable materials, and compacting, unless otherwise noted on the Project Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Record Drawings and Submittals

B. Section 01500 – Construction Facilities and Temporary Controls

C. Section 02140 – Dewatering

D. Section 02160 – Excavation Support Systems

E. Section 02000 - Earthwork

F. Section 02222 – Protecting Existing Underground Utilities

G. City of Oceanside Water, Sewer, and Recycled Water and Design and Construction Manual (Water Utilities Manual)

1.3 REFERENCE STANDARDS

A. The publications below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D75	Standard Practice for Sampling Aggregates
ASTM C90	Standard Specification for Load Bearing Concrete Masonry Units
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

1.4 EARTHWORK AND REPAIRS IN CITY, COUNTY, AND STATE RIGHTS OF WAY

A. Conform to the requirements and provisions of the permits issued by those agencies in addition to the requirements of these Special Provisions Technical Specifications. If a permit is not required, earthwork and repairs shall conform to the standards of the agency in whose right of way the work is done in addition to the requirements of these Specifications.

1.5 SAFETY PRECAUTIONS

A. Observe safety precautions in all phases of the work. Included shall be trench shoring, bracing, lighting, and barricades as dictated by reason and by the Safety Orders of the Division of Industrial Safety, State of California (CAL/OSHA). Acquire a trenching permit from the California Division of Industrial Safety (CAL/OSHA) and comply with Labor Code Section 6705, Excavation Plans For Worker Protection. Submit a copy of the trenching permit with excavation drawings to the AGENCY prior to excavation work.

B. Provide vertical or sloped cuts, benches, shields, support systems, or other systems providing the necessary protection in accordance with OSHA regulations, 29 C.F.R. 1926, Subpart P-Excavations. Protect the stability of adjoining buildings, walls, sidewalks, pavements, other structures, or when excavating close to the right of way line.

1.6 OBSTRUCTIONS

A. The CONTRACTOR'S attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the Drawings. Preserve and protect any such improvements whether shown on the Drawings or not. Expose such improvements in advance of the pipeline construction to allow for changes in the alignment as necessary. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained, and permanently replaced by the CONTRACTOR at its expense. Protect existing underground utilities in accordance with the standard specifications.

1.7 SUBMITTALS

A. Submit shop drawings in accordance with the standard specifications.

B. Pipe Base and Pipe Zone Material: Submit current certification and test results for all utility pipe zone and base material. Pipe base and pipe zone material will conform in all respects to the latest edition of the Oceanside Water Utilities Manual.

C. Import Trench Zone Material: Submit current certifications and test results for all imported trench zone material to be used as backfill in lieu of native material.

Submit a report from a testing laboratory verifying that imported material is asbestos-free and conforms to the specified gradations or characteristics.

1.8 TESTING FOR COMPACTION

A. The AGENCY will require the CONTRACTOR to test for compaction as described below.

1. Determine the density of soil in place by the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017.

2. Determine laboratory moisture-density relations of soils by ASTM D 1557.

3. Determine the relative density of cohesionless soils by ASTM D 4253 and D 4254.

4. Sample backfill materials by ASTM D 75.

5. "Relative compaction" is the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

6. Make excavation for compaction tests at the locations and to the depths designated by the AGENCY. Backfill and re-compact the excavations at completion of testing. When tests indicate that the compaction is less than the specified relative compaction, rework and retest those areas until the specified relative compaction has been obtained. All cost for compacting work and compaction testing including those due to failing test results shall be borne by the CONTRACTOR.

7. See the Water Utilities Manual, Appendix C, for additional requirements.

1.9 PIPE ZONE

A. The pipe zone area shall include the area extending the full width of trench from six (6) inches below the bottom of the pipe bell to a horizontal level twelve (12) inches above the pipe bell. Where multiple pipes are placed in the same trench, the pipe zone shall extend from six (6) inches below the bottom of the lowest pipe bell to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be a minimum of twelve (12) inches.

1.10 TRENCH ZONE

A. The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the structural pavement zone or to the existing surface in unpaved areas.

1.11 PAVEMENT ZONE

A. The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

1.12 WATER FOR CONSTRUCTION

A. Water shall be obtained in accordance with the standard specifications.

1.13 BEDDING AND BACKFILL TESTING

A. The AGENCY shall require testing of bedding and backfill material. See Water Utilities Manual for additional requirements

PART 2 – MATERIALS

2.1 NATIVE EARTH BACKFILL-TRENCH ZONE

A. Native earth backfill used above the pipe zone shall be excavated fine grained materials or loose soil free of asbestos, organic matter, roots, debris, rocks larger than 3 inches in diameter, clods, clay balls, broken pavement, and other deleterious materials. Backfill material shall be graded in conformance with the Oceanside Water Utilities Manual. The coarser materials shall be well distributed throughout the finer material. Backfill materials that are obtained from trench excavated materials to the extent such material is available, shall be either screened directly into the trench or screened during the trenching operation. If screened during trenching, the material shall be maintained free of unscreened material during the handling and backfilling process. Hand selecting of rocks from earth as it is placed into the trench will not be permitted in lieu of the specified screening. Under no circumstances will native earth backfill be allowed or used in the pipe base or pipe zone areas.

2.2 IMPORTED MATERIAL FOR BACKFILL - TRENCH ZONE

A. Imported material shall conform to that specified for native earth backfill or imported sand.

2.3 IMPORTED SAND - PIPE BASE AND PIPE ZONE (PRESSURE PIPE)

A. Imported sand used in the pipe base and pipe zone shall consist of natural or manufactured granular material, or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances. Under no circumstances will decomposed granite or native earth backfill be allowed or used in the pipe base or pipe zone areas. Imported sand shall have the following gradation or similar:

Sieve Size	Percent Passing By Weight
3/8-inch	100
No.4	90 - 100
No.30	12 - 50
No.100	5 - 20
No.200	0 - 5

B. Imported sand shall have a sand equivalent (S.E.) of 30 or greater; pH of 6.5 to 8.5; resistivity of 2,000 - 50,000 ohm-cm; and a sulfate concentration of 1,500 ppm or less.

2.4 GRANULAR MATERIAL FOR BACKFILL

A. Where crushed aggregate base is called for in these Specifications or Drawings, the granular material for backfill shall be free of asbestos, organic materials, clay balls, and shall have the following gradation:

Sieve Size	Percent Passing By Weight
1-inch	100
3/4-inch	90 - 100
1/2-inch	40 - 70
3/8-inch	20 - 50
No.4	0 - 10
No.8	0 - 5

B. Whenever the phrase “crushed aggregate base backfill material" is used in these Specifications, it shall mean granular material for backfill as described above.

2.5 CONCRETE FOR BELOW GROUND INSTALLATIONS

A. Concrete for anchors, collars, encasements, supports, and thrust blocks shall be as specified in the Oceanside Water Utilities Manual.

B. Provide concrete support blocks at all valves.

2.6 WATER FOR COMPACTION

A. Water used in compaction shall have a maximum chloride concentration of 500 mg/L, a maximum sulfate concentration of 500 mg/L, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe or coatings. Salt water will not be allowed.

PART 3 – EXECUTION

3.1 COMPACTION REQUIREMENTS

A. Unless otherwise shown on the Drawings, otherwise described in the Specifications or required by the AGNECY, relative compaction in pipe trenches shall be a minimum as follows:

1. Pipe base - 95% relative compaction.

2. Pipe zone - 95% relative compaction.

3. Trench zone - 95% relative compaction.

4. Pavement zone - 95% relative compaction.

B. No “jetting” or “ponding” compaction will be allowed. All compaction shall be by mechanical means, either through hand tamping, vibratory equipment, machinery, or as limited by other parts in this Specification.

3.2 SHEETING, SHORING, AND BRACING OF TRENCHES

A. Trenches shall have sheeting, shoring, and bracing conforming to 29CFR 1926, Subpart P - Excavations, CAL/OSHA requirements, and the standard specifications.

3.3 SIDEWALK, PAVEMENT, AND CURB REMOVAL

A. Sawcut asphalt concrete, concrete pavement, curbs, gutters, and sidewalks regardless of the thickness prior to excavation of the trenches with a pavement saw and a vacuum, which shall be used to remove the debris and water as the saw cutting is taking place. No water or debris shall be permitted to flow into any storm drain system. The widths between the saw cuts shall be at least equal to the required width of the trench at ground surface. Remove and haul pavement and concrete materials from the site to a legal disposal site. Do not use any broken asphalt or concrete for trench backfill.

3.4 DEWATERING

A. Provide dewatering in accordance with the standard specifications. Maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, during the hydration process, and until the backfill at the pipe zone and trench zone has been completed. These provisions shall apply during the noon hour as well as overnight. If dewatering is required, the CONTRACTOR shall obtain a National Pollutant Discharge Elimination System (NPDES) Permit from the San Diego Regional Water Quality Control Board (SDRWQCB). The CONTRACTOR is responsible for all groundwater treatment

necessary to comply with the NPDES Permit. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory AGENCY requirements. Do not drain trench water through the pipeline under construction.

3.5 MATERIAL REPLACEMENT

A. Remove and replace any trenching and backfilling material which does not meet the Specifications, at no additional cost to the AGENCY.

3.6 TRENCH WIDTHS

A. Pipe trench widths in the pipe zone will be limited as follows:

Nominal Inside Pipe Diameter	Minimum Trench Width	Maximum Trench Width
4” through 12”	OD plus 12”	OD plus 16”
14” through 48”	OD plus 16”	OD plus 24”

B. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing. Where shoring or encasement is required, trench widths shall be increased accordingly.

3.7 TRENCH EXCAVATION

A. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

B. Excavate the trench to the lines and grades shown on the Drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base. If the trench is excavated below the required subgrade, refill any part of the trench excavated below the subgrade at no additional cost to the AGENCY with imported sand or ¾-inch crushed rock. Place the refilling material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base.

C. Trench depth shall accommodate the pipe and the pipe base at the elevations shown in the profile on the Drawings. In the absence of such profile, the top of pipe shall be located a minimum of 4 feet below the surface elevation of the centerline of the street or 3 feet below existing ground at the pipe location, whichever is lower.

D. Construct trenches in rock by removing rock to a minimum of 6 inches below bottom of pipe and backfilling with imported sand or ¾-inch crushed rock.

E. The use of Water Jetting for excavation is not allowed under any circumstance.

3.8 LOCATION OF EXCAVATED MATERIAL

A. During trench excavation, place the excavated material only within the working area or within the areas shown on the Drawings. Do not obstruct any roadways or streets. Trench spoils shall be removed from the right-of-way at the end of each working shift. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

3.9 OPEN TRENCH

A. Where pipelines are located beneath or adjacent to existing paved roads, backfill all trenches at the end of each workday and place temporary paving. Clean all new and adjacent existing paved surfaces of residual excavated and backfill materials. Perform dust control operations in these areas with a vacuum type mobile street sweeper that is equipped with a water spray nozzle. No open trenches will be allowed in these areas.

B. Provide ingress and egress to buildings and property at all times. Provide traffic rated recessed, non-skid steel plates for covering for vehicular access and protect excavation which must remain open beyond the initial day of excavation in accordance with the standard specifications. Recessed steel plates shall be installed so that the top surface of the plate is flush with the surface of the surrounding pavement.

3.10 FOUNDATION STABILIZATION

A. After the required excavation has been completed, the CONTRACTOR's Quality Control Team and the AGENCY will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation will be conducted in all areas within the influence of the pipeline where unacceptable materials such as soft, spongy or deleterious materials exist at the exposed grade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a minimum width equal to the maximum trench width and to a depth to competent material or to a depth of 24 inches below the bottom of the pipeline, whichever is less. Backfill the trench to the established subgrade of the pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6 inches deep to the required grade. Place imported sand on the compacted foundation stabilization. Continue this procedure until the voids of the rock refill have been filled with imported sand. Do not apply water in such quantities that it will damage the integrity of the foundation stabilization. Rock refill material and imported sand may be placed and compacted at the same time.

3.11 TRENCH BACKFILLING

A. Place the specified thickness of pipe base material (imported sand or ¾-inch crushed rock) over the full width of trench and compact to the specified relative compaction. Grade the top of the pipe base material ahead of the pipe laying to provide firm, continuous, uniform support along the full length of the trench for the pipe, fittings, and valves.

B. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill and compact the area excavated for the joints with the pipe zone material.

C. After the pipeline has been laid, and after tracer wire has been placed per the standard specifications for water mains and sewer force main lines, place pipe zone material (imported sand or ¾-inch crushed rock) simultaneously on both sides of the pipe, fittings, and valves, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel haunches are completely supported and that no voids or un-compacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe (haunch) to prevent lateral movement during subsequent backfilling. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

D. Compact imported bedding material (sand or ¾-inch crushed rock) in the pipe zone by hand tamping only. Care shall be exercised in backfilling to avoid damage to pipe.

E. After installing the detectable warning tape on top of the pipe zone material, push the native earth backfill or imported material for trench zone backfill carefully onto the imported material previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Compact backfill material in the trench zone to the specified relative compaction by mechanical compaction or hand tamping.

F. Place and compact imported sand or ¾-inch crushed rock in the pipe zone in layers not exceeding 8 inches. Place and compact native earth or imported material for backfill in the trench zone in layers not exceeding 8 inches.

3.12 MECHANICAL COMPACTION OR HAND TAMPING

A. Place imported sand and backfill materials in uniform layers of the indicated thickness. Compact each layer to the required minimum relative compaction at the optimum moisture content. Do not use heavy duty compaction equipment with an overall weight in excess of 125 pounds until backfill has been completed to a depth of 2 feet over the top of pipe. Use of high impact hammer-type equipment (i.e. hydrohammer) is strictly prohibited.

3.13 DISPOSAL OF EXCESS EXCAVATED MATERIAL

A. CONTRACTOR shall make its own arrangements for removal and disposal of the excess material and bear all incidental costs. It is the intent of these Specifications that all surplus material not required for backfill or fill shall be disposed of legally by the CONTRACTOR outside the limits of the public rights-of-way and/or easements at no cost or liability to the AGENCY.

B. No excavated material shall be deposited on private property unless written permission from the private property owner thereof is secured by the CONTRACTOR. The private property written permission agreement shall be submitted to the AGENCY for review and approval prior to hauling any material to the private property site. Before the AGENCY will accept the work as being completed, the CONTRACTOR shall file a written release signed by all property owners with whom he has entered into agreements for disposal of surplus excavated material absolving the AGENCY and its officers, agents, and employees from any liability connected therewith.

3.14 FINAL CLEAN-UP

A. After backfilling, grade the right-of-way to the contours of the original ground and match the adjacent undisturbed ground. Make surfaces free of all cleared vegetation, rubbish and other construction wastes. Dispose of all excavated or surface rocks and lumps which cannot be readily covered by spreading.

B. Replace in kind street improvements, such as asphalt concrete, concrete paving, striping and markings, curbs and gutters, barricades, traffic islands, signalization, fences, signs, mail boxes, landscaping, irrigation systems and other existing improvements that are cut, removed, damaged, or otherwise disturbed by the construction.

****END OF SECTION****