SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.1 DESCRIPTION

A. The Work specified in this Section includes pavement cutting, trench excavation, shoring of excavations during construction, limits of the trench support work, backfilling and compaction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Other Contract Documents, including Drawings, relevant Sections of the Standard Specifications and Special Provisions apply to the Work specified herein.

B. Section 01 55 26 – Traffic Control

C. Section 33 33 00 – Sanitary Sewerage Utilities

1.3 REFERENCES

A. DPW Standard Specifications (SSDPWSF), revised November, 2000.

B. ANSI/ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D1557 – Test Methods for Moisture–Density Relations of Soils and Soil–Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.

D. ANSI/ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Method (Shallow Depth)

E. Sections 6705 and 6707 of the California Labor Code.

F. DPW Order No. 187,005, “Regulations for Excavating and Restoring Streets in San Francisco”.

G. Article 2.4 of the Public Works Code, “Excavation in the Public Right–Of–Way”.

H. Caltrans Standard Specifications (CTSS), 2018 Edition.

1.4 SUBMITTALS

A. Plans and calculations for the shoring system shall be submitted for review and approval by the City prior to trench excavation. If such plans vary from the shoring standard established by the Construction Safety Orders, the plans shall be prepared by a licensed Civil Engineer registered in the State of California. Approval will not relieve the Contractor of the responsibility to provide a satisfactory and safe shoring system.

B. Prior to commencing excavation or construction, the Contractor shall submit dewatering plans compatible with the shoring system to the City Representative for review and approval.

C. Details and calculations for full horizontal and vertical structural support for all exposed and/or undermined sections of water facilities, which are to be signed and stamped by a California licensed Civil or Structural Engineer.

1.5 POST EXCAVATION REPAIR AND MAINTENANCE OBLIGATION OF CONTRACTOR (WARRANTY PERIOD)

A. The Contractor is responsible to maintain, repair or reconstruct the site of the excavation so as to maintain a condition acceptable to the City for a period of three (3) years following the date of the acceptance of the Work.

1.6 EXCAVATION / SHORING SUPPORT

A. The Contractor shall provide all engineering, including design, details and calculations, installation and construction of shoring, sheeting and bracing necessary to support the sides of the excavation to prevent movement, which may damage adjacent pavements, utilities or structures, damage or delay the Work, or endanger life and health as required by Cal–OSHA and other applicable governmental regulations and agencies. All trench work will also be performed with the applicable provisions of California Labor Code Sections 6705 and 6707.

B. The provisions specified herein will complement and not substitute for, nor diminish, the obligations of the Contractor for providing a safe work area and for protecting the Work, structures and other improvement.

C. Regardless of the shoring system used, the Contractor shall prevent ground loss along the project alignment. Cantilever type of shoring walls is not acceptable. No sloping/benching type shoring system is allowed. Steel shims or filler plates will be installed to obtain a tight fit and bearing.

D. The Contractor is solely responsible for any damage to adjacent properties caused by its construction operations.

1.7 WATER FACILITY SUPPORT AND WORK AROUND

A. If the project work exposes water facilities, the Contractor is required to:

1. Backfill and compact in compliance with SFDPW Street Excavation Code as required by CDD Engineering; and

2. Coordinate through the City Representative to perform soil compaction testing for backfill material placed within five (5) feet, horizontal or vertically, from the outside edge of a water facility, with all test results furnished to CDD Engineering.

B. For excavations that expose more than four (4) feet of water facilities, either in the horizontal or vertical direction, the Contractor is required to backfill with Control Density Fill (CDF) material.

1.8 HANDLING OF GROUND WATER

A. The Contractor is responsible for the continuous control of ground water at all times during the course of construction, including Saturdays, Sundays and holidays.

B. If required, dewatering plans shall be designed, stamped and signed by a licensed Civil Engineer registered in the State of California. By approving the plans, the City accepts no responsibility for the adequacy thereof nor for any damages to public or private

property that may result. All such responsibility shall rest with the Contractor. The plans shall include detailed working drawings and pertinent descriptions of the proposed ground water control system, including a schedule of installation and details of the system operation plan, contingency plans for interruption or failure of the proposed ground water control system and disposal plans. Provisions shall also include removal of storm water or any other water that may enter into the excavations.

PART 2 – PRODUCTS

2.1 FILL MATERIALS

A. All fill materials shall be free of organic and deleterious materials, and stock piling shall be in accordance with the requirements of Section 700.06 of the DPW Standard Specifications.

B. Imported sand type or equivalent backfill shall be free from rock, concrete, organic material and other objectionable material. Backfill material will have 100% passing the 3/8" sieve size, 93% to 100% passing the No. 4 sieve size and 0% to 10% passing the No. 200 sieve size. Samples approximately 50 pounds weight shall be submitted to and approved by the DPW Material Testing Laboratory, 2099 Kearny Street, San Francisco, prior to placement. Unacceptable material shall be immediately removed from the site.

C. CDF material shall be free of organic materials and other deleterious substances. The CDF material shall have produced 28 days unconfined compressive strength from 50 pounds per square inch (psi) to a maximum of 125 psi and shall contain aggregate no larger than 3/8" top size with the 3/8" aggregate comprised of less than 30% of the total aggregate content.

D. Caltrans CLSM material shall be free of organic materials and other deleterious substances, and conform to Section 19-3.02G, "Controlled Low-Strength Material" of the Caltrans Standards Specifications (2018 edition). The CLSM material shall have 28-day compressive strength from 50 to 100 pounds per square inch (psi). Aggregate may consist of either commercial-quality concrete sand, or aggregate material following the gradation requirements tabled below:

Sieve Size	**Percentage Passing**
1-1/2"	100
1"	80-100
¾"	60-100
3/8"	50-100
No.4	40-80
No. 100	10-40

2.2 MATERIALS FOR TRENCH SUPPORT SYSTEM

A. Steel sheet piling, if employed, shall be of rolled steel shapes of the continuous interlocking type forming a continuous wall when individual sheets are installed side by side. Steel sheet piling shall be installed in a manner that interlocking is kept continuous without separation at the joints. Sheet pilings, if used, shall not be installed by hard driving. The Contractor shall propose and submit for approval, a suitable installation method, which will minimize noise and vibrations. Other equivalent methods that will effectively prevent water leakage through the joint such as insitu–soil cement mixing will be acceptable. The interlocking sheet piling and all accessories shall conform to the requirements of ASTM A328.

B. Lagging members, if employed, shall be installed in accordance with approved design and in a manner, which shall prevent loss of ground. Where, in the judgment of the City, the loss of ground cannot be prevented by wedging the lagging tight against the original ground, e.g., at the sandy non–cohesive soils, the Contractor shall prevent the loss of ground by an approved method. This shall not be a cause for changed condition or for claims for extra cost by the Contractor.

C. All timber, lumber and structural steel employed for the trench supporting system, whether new or used, shall be sound and free from defects that might impair their strength. Where sheet piles or soldier piles are to be removed, they may be removed after backfilling is completed. Voids left by such removal shall be immediately backfilled with an acceptable bode type structural mix ready on site, at no extra cost to this Contract. The Contractor shall meet the requirements to control settlements and plan its operations accordingly.

D. All timber lagging left in place shall be pressure treated with wood preservative in accordance with the requirements of Section 415.05 of the DPW Standard Specifications.

E. Except for bracing struts, allowable basic stresses for rolled steel sections, including sheet piling, may be increased by twenty percent (20%) for all temporary shoring structures. Allowable basic stresses for all temporary shoring structures shall be in accordance with the latest AISC Code. Allowable stresses for struts shall not exceed those allowed by the AISC Code for permanent structures. All welds shall be designed according to AISC Code without any increase in the allowable stresses for temporary structures. Lagging and all timber structures shall be designed using allowable stresses determined by the National Design Specifications In Wood Construction, latest Edition. The duration of the load shall not be taken as less than three (3) months.

F. Trench shields shall not be used for shoring.

PART 3 – EXECUTION

3.1 EXAMINATION

A. The Contractor shall verify fill material to be reused is acceptable.

3.2 PREPARATION

A. The Contractor shall identify required lines, levels, contours and datum shown on the Drawings.

B. The Contractor shall maintain and protect existing utilities remaining, which pass through the site.

C. The Contractor shall protect bench marks, existing structures, sidewalks and curbs from excavation equipment and vehicular traffic.

3.3 PAVEMENT CUTTING AND STREET EXCAVATION

A. Pursuant to Section 373 of the San Francisco Public Works Code, the Contractor may use concrete saw cutting or vibratory pavement breaker or equal.

B. No machine or device that breaks pavement by blows struck by a falling or driven hammer or weight will be allowed. Hoe–ram and trenching machines shall not be used

for concrete street at the edge of pavement restoration. Such prohibition, however, shall not be construed as barring the use of hand tools or manually operated air tools such as jack hammers.

C. The use of the rock wheel cutter for street excavation is prohibited unless permitted by special order of the Director of Public Works for specific locations. If permitted, rock wheel cutter shall only be used to remove the pavement (concrete base and asphalt concrete wearing surface), and only after potholing has been done to determine the pavement thickness. Rock wheel cutters shall not be used on concrete streets, shall not be used as a trenching device, and shall not be used within 10 feet of a signalized intersection.

D. All areas of pavement to be cut shall be in neat and straight lines, and overcutting of lateral trenches will not be allowed. Dust control shall be provided by using non–potable water with the rock cutting wheel. Protection from flying rocks, debris, etc., shall be provided.

E. Excavation and backfill shall be in accordance with the requirements of Part 7 of the DPW Standard Specifications.

F. The pavement shall be restored in accordance with the requirements of Part 2 of the DPW Standard Specifications.

G. All City noise requirements shall be observed at all times.

3.4 TRENCH EXCAVATION

A. The Contractor shall excavate every type of material encountered within the limits of the Work to the lines, grades and elevations indicated on the Drawings and specified herein, except materials indicated on the Drawings or directed by the City to remain.

B. Unauthorized Excavation:

1. Unauthorized excavation will be excavation below indicated subgrade elevations or beyond indicated dimensions without specific instruction from the City.

2. Under footings, foundations or retaining walls:

   a. The Contractor shall fill unauthorized excavation by lowering the indicated bottom elevation of the footing or base to the excavation bottom, without altering the required top elevation.

   b. Lean concrete fill may be used to bring bottom elevations to proper position, subject to the City's approval.

3. Elsewhere, the Contractor shall backfill and compact unauthorized excavation as specified for authorized excavations, unless otherwise directed by the City.

C. Excavation of unsound subgrade material shall be in accordance with the requirements of Section 700.10 of the DPW Standard Specifications.

3.5 TRENCH SUPPORT WORK

A. The shoring of excavation during construction shall be in accordance with the requirements of Section 700.04 of the DPW Standard Specifications, and shall include adequate sheeting shoring and bracing etc. or equivalent method, for the protection of life and limb, and conforming to applicable safety orders of Cal–OSHA and the State of California Division of Industrial Safety.

B. Sections 6705 and 6707 of the California Labor Code shall apply to any excavation 5 feet or more in depth, constructed under this Contract.

C. Sheet piling, lagging and bracing may be removed during backfilling, and shall be in accordance with the requirements of Section 700 of the DPW Standard Specifications.

D. The width of the trench shall be in accordance with the requirements of Section 700 of the DPW Standard Specifications.

3.6 BEDDING

A. The Contractor shall support the new pipes during placement and compaction of crushed rock bedding fill. Crushed rock shall comply with the requirement of Section 703.05 and 712 of the DPW Standard Specifications and as shown on SW-drawings.

B. The placement of crushed rock bedding fill shall not alter the pipe alignment. Crushed rock bedding fill shall be placed to ensure continuous contact with the pipes. Care shall be taken to completely fill all spaces under the haunches.

3.7 BACKFILLING AND COMPACTION

A. The Contractor shall backfill excavations as promptly as progress of Work permits, and shall be in accordance with the requirements of Sections 703, 712 and all other applicable Sections of the DPW Standard Specifications.

B. The Contractor shall place crushed rock beneath and backfill material around structures. The Contractor shall not begin backfill operations until concrete has achieved a minimum compressive strength of 3,000 psi.

C. Placement of CDF Bedding Material:

1. The length of the CDF bedding material will be the width of the sewer trench less the minimum space necessary for formwork. The width of CDF bedding material shall be the outer diameter of the water main pipe plus one (1) foot on each side. The depth of CDF bedding material shall be three (3) feet below the bottom of the water main pipe and no higher than the water main pipe's spring-line. There shall be a minimum one (1) foot vertical separation between the top of the sewer main and the bottom of the CDF material.

2. CDF bedding material placement will be at the discretion of the CDD Inspector. The CDF bedding material will be formed on all vertical sides. Placing CDF against sewer trench shoring to be removed or exposed soil will not be allowed. Any volume of CDF spillage due to improper form work will not be considered for payment and shall be removed prior to backfilling the trench.

3. The Contractor shall place the CDF prior to backfilling the sewer trench. Placing temporary backfill, and re-excavating the area at a later time to place CDF before final trench excavation is not allowed. If the water facility becomes damaged due to improper placement of CDF bedding prior to backfilling the sewer trench, then the Contractor will be held liable.

D. Compaction of fill and backfill materials shall be in accordance with the requirements of Section 707 and all other applicable Sections of the DPW Standard Specifications.

E.. The Contractor shall compact all materials by mechanical means in lifts not to exceed 8 inches unless permitted otherwise in writing by the City. Flooding or jetting will not be

permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the Contractor prior to continued placement.

F. The Contractor shall compact all fill materials to the following relative dry densities per ASTM D1557, D6938 or other reference standards acceptable to the City:

1.	Asphaltic Concrete Pavement Subgrade Areas	95%
2.	Landscape Planting Areas	85%
3.	Structural Fill	95%
4.	Trench Backfill	90-95%*

*90% compaction from bottom of trench to within 4 ft of finish grade and 95% compaction for the remainder of the trench.

G. During compaction, the Contractor shall protect new and any existing pipes, and structural walls from damage due to the operations of the compaction equipment. The Contractor shall not operate earth–moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material. The Contractor shall compact backfill adjacent to concrete walls with hand–operated tampers or similar equipment that will not damage the structure.

H. The Contractor shall place detectable warning tape at a distance of 12 inches above the top of the sewer pipe.

3.8 REMOVAL OF WATER

A. The Contractor shall provide and operate equipment adequate to keep all excavations and trenches free of water. The Contractor shall avoid settlement or damage to adjacent properties. When dewatering the excavations, the Contractor shall dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Dewatering, contingency and disposal plans will be submitted for approval by the City.

3.9 FIELD QUALITY CONTROL

A. The Contractor shall secure the Testing Agency’s inspection and testing, and the City Representative’s approval of testing results and visual inspection and approval for subgrades and fill layers before proceeding with construction thereon.

B. Fill and backfill materials shall be compacted to densities in accordance with the requirements of Sections 703, 706, 707 and 709 of the DPW Standard Specifications.

C. If, based on reports from a testing laboratory, subgrade or fills, which have been placed are below specified requirements, the Contractor shall provide additional compacting and retest at no cost to the City.

3.10 MAINTENANCE

A. The Contractor shall protect newly graded areas from traffic and erosion, and keep the areas free from trash and weeds. The Contractor shall repair and re–establish grades in settled, eroded and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the Contractor shall scarify the surface, reshape and compact to the

required density prior to further construction.

END OF SECTION