

SECTION 02220

EXCAVATING, BACKFILLING, AND COMPACTING

1.0 **GENERAL**

1.1 **Section Includes**

- A. General Excavation.
- B. Trench Excavation.
- C. General Backfill and Compaction.
- D. Trench Backfill and Compaction.

1.2 **Related Sections**

- A. Section 02205, **SOIL AND AGGREGATE MATERIALS**
- B. Section 03300, **CAST-IN-PLACE CONCRETE**

1.3 **References**

- A. Standard Details:
 - 1. Contra Costa County – August 1966, or latest edition.
 - 2. Contact individual agencies for additional information.
- B. ASTM D1556 – “Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.”
- C. ASTM D1557 – “Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.”
- D. ASTM D2922 – “Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.”
- E. STANDARD SPECIFICATIONS and STANDARD PLANS – California Department of Transportation (Caltrans), July 1999.
- F. Construction Safety Orders, California Code of Regulations, Title 8, Chapter 4 – State of California Occupational Safety and Health Standards Board (CAL/OSHA), 1999.

1.4 **Submittals**

- A. Submit the following to the Construction Administrator for review:
 - 1. Excavation Permit: The Contractor shall submit a CAL/OSHA excavation permit prior to commencing with work.
 - 2. Groundwater and Surface Water Handling Plan: The Contractor shall submit a groundwater and surface water-handling plan; detailing the methods of keeping the excavation free of water.

1.5 **Quality Assurance**

- A. Perform work in accordance with all referenced codes, specifications, and standards, except as modified herein.
- B. Verify that survey, benchmark, control point, and intended elevations for the work are as shown on the Drawings.

1.6 **Dewatering**

- A. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- B. The Contractor shall furnish all materials and equipment and perform all work required to install and maintain the drainage systems it proposes for handling groundwater and surface water encountered during construction of structures and pipelines.

2.0 **PRODUCTS**

2.1 **Backfill Materials**

- A. General: No material shall be used for backfill which, because of excessive moisture or any other reason, cannot be compacted to the degree specified. Any such material shall be considered unsuitable, and if it is placed, it shall be removed and replaced with suitable material.
- B. Type I Backfill: Type I Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- C. Type II Backfill: Type II Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- D. Type III Backfill: Type III Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- E. Type IV Backfill: Type IV Backfill shall be as specified in Section 02205, **SOIL AND AGGREGATE MATERIALS**.
- F. Controlled Low Strength Material (CLSM): Shall be specified in Section 02312, **CONTROLLED LOW STRENGTH MATERIAL**.

3.0 **EXECUTION**

3.1 **Preparation**

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, and other features remaining as a portion of the final landscaping.
- C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs

from excavating equipment and vehicular traffic. Any modification or relocation of such items shall be made at the Contractor's expense.

- D. Prior to excavation, the Contractor shall notify the appropriate regional center of all excavations, as required under Government Code Section(s) 4216-4216.9. The Contractor shall contact Underground Service Alert at 1-800-227-2600 for the location of subsurface installations. It shall be the responsibility of the Contractor to determine the exact location and depth of all utilities, including service connections, which have been marked by the respective owners, and which the Construction Administrator believes may affect or be affected by the Contractor's operations.
- E. Locations of known underground utilities and structures are shown on the drawings as they are supposed to exist. Appurtenances and service laterals are not usually shown. Locations shown may be based on information furnished by the utility owners at the time of design, derived from visible surface facilities, or based on subsurface exploration.
- F. The Contractor shall notify the District, County, City, and other agencies having jurisdiction, and any other parties directly or indirectly affected by the project, forty-eight (48) hours in advance of the intention to commence excavation.
- G. The Contractor shall identify a suitable location to store excavated materials that will minimize the obstruction of traffic.

3.2 **General Excavation**

- A. General:
 - 1. All lines and grades shall be established by the Contractor, in accordance with the Project Drawings and Specifications. The Contractor shall submit verification record of all such survey work to the Construction Administrator, as may be required. The Contractor shall carefully preserve all survey stakes and reference points. Should any stakes or points be removed or destroyed during the installation, they shall be reset by the Contractor at the Contractor's expense.
 - 2. Remove all materials encountered that may interfere with the completion of the work.
 - 3. Blasting will not be permitted.
 - 4. Excavation shall be kept dry throughout construction operations.
 - 5. Excavated surfaces shall be properly graded to provide good drainage.
 - 6. **Classification of Excavated Materials.** No classification of excavated materials will be made for payment purposes. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the Work, regardless of the type, character, composition, or condition thereof.
 - 7. **Preservation of Trees.** No trees shall be removed outside excavated or filled areas, unless their removal is authorized by the District. Trees left standing shall be adequately protected from permanent damage by construction operations.

B. Stripping:

1. Topsoil and other materials unsuitable for use in the work shall be removed from excavation and fill areas, as required to expose satisfactory material or foundation.
2. Topsoil and other unsuitable materials shall be offhauled and disposed of legally off the project site.

C. Excavation:

1. Excavate to the required lines and grades, as shown on the Drawings.
2. Material below the foundation grade shall not be disturbed, except where so indicated on the Drawings or by the Construction Administrator. The foundation grade for concrete placement shall not be more than ½-inch above the specified grade at any point, and the average elevation over any selected area, ten (10) square feet in dimension, shall be at or below the established grade.
3. Where the material at the bottom of the excavation is of soft or unstable material, has been saturated and degraded, or is otherwise considered unsuitable for the support of structures, the Contractor shall overexcavate to an additional depth, as required by the Construction Administrator, backfill with Type I Backfill Material, and compact in accordance with the requirements of these specifications.
4. Excavation shall include the removal of all soil, rock, pavement, tree stumps and other vegetation or vegetable matter, waste or debris, abandoned pipelines and other structures shown on the Drawings, ground water and materials of any nature which interfere with the construction work.
5. Excavations shall provide adequate working space and clearances for the Work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
6. Except where exterior surfaces are specified to be damp proofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.
7. **Stabilization.** Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.
8. Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space

shall be removed. The finished elevation of stabilized subgrades shall not be above subgrade elevations indicated on the Drawings.

D. Dewatering

1. Contractor shall design, install, operate, maintain, and remove all necessary dewatering systems. Contractor shall have sole responsibility for all aspects of furnishing, operating, maintaining, and removing the dewatering systems. Methods for care of surface water and for controlling the surface and groundwater levels shall be subject to approval of the Construction Administrator
2. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the Work. Each excavation shall be kept free of standing water during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
3. Maintain all excavations to be backfilled free of water at all times during the work. Take care during excavation to prevent disturbing foundations. If groundwater is encountered during excavation, commence dewatering and provide dewatering in advance of and concurrently with further excavation. Dewatering shall be accomplished in a manner that will prevent loss of fine material from foundation or excavated surfaces, will maintain stability and prevent heaving of excavated slopes and bottoms of excavations, and will result in construction operations being performed in conditions free of standing water and excess moisture that prevents foundation preparation and fill placement as specified. Foundations shall be free of water at the time backfill, bedding, or concrete is placed. Water control shall continue as necessary to prevent damage to operations and finished work.
4. If suitable foundation material has been disturbed by the Contractor's operations, has been damaged by water, or has been removed for the Contractor's convenience in dewatering the foundation, the foundation shall be restored by the Contractor, at the Contractor's expense, to a condition at least equal to the undisturbed foundation as determined by the Construction Administrator.
5. All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth as required, beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.
6. Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.
7. Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.
8. Contractor shall obtain from the appropriate agencies and authorities, the

dewatering and storm water discharge permits required to remove and dispose of groundwater, surface water, and any other water used in Contractor's operations. The permits shall be obtained prior to start of construction.

E. Bracing Excavations:

1. Excavations shall be braced and supported such that ground adjacent to the excavation will not settle or slide, and so that all surfaces or subsurface improvements, both public and private, will be fully protected from damage.
2. If any damage does result to such improvements, the Contractor shall perform the necessary repairs or reconstruction at their own expense, and to the satisfaction of the owner of the damaged improvement as directed by the Construction Administrator.

F. Sheeting and Shoring

1. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.
2. Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.
3. Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state of California and retained by Contractor.
4. Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by Construction Administrator. Trench sheeting will not be removed, if in the opinion of Construction Administrator, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off twelve (12) inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

G. Safety: The Contractor shall make sufficient excavation to construct all the work contained in the contract documents and shall abide by the requirements of the State of California Occupational Safety and Health Standards Board (CAL/OSHA) "Construction Safety Orders" and "General Industrial Safety Orders."

H. Disposal of Unsuitable Material:

1. All excavated material not utilized in the construction shall become the property of the Contractor and be removed and disposed of legally off the project site.
2. No excavated materials shall be removed from the site of the work or disposed of by the Contractor, except as approved by the Construction Administrator. Materials shall be neatly piled until used or otherwise disposed of as directed. Material shall be stored in an area of sufficient distance from excavations so as not to create a surcharged soil loading adjacent to the excavation.

3.3 **Trench Excavation**

A. General

1. All trench excavation shall be open cut from the surface.
2. Contractor shall excavate all tie-in points to verify conditions prior to manufacturing the pipes.
3. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.
4. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits.

B. Mechanical Excavation.

1. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
2. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

C. Cutting Concrete Surface Construction.

1. In paved area, pavement shall be cut and removed on neat lines to minimum trench width specified. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1½-inches deep along each side of the trench and along the perimeter of cuts for structures.
- 2.
3. Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than six (6) inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. The trench width at the bottom

shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

4. Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.
5. Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

D. Excavation Below Pipe Subgrade.

1. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, to provide for the installation of granular embedment or CLSM.
2. Bell holes shall provide adequate clearance for tools and methods used for installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

E. Artificial Foundations in Trenches.

1. Whenever unsuitable or unstable soil conditions are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases, adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3.4 **General Backfill and Compaction**

A. General:

1. Remove all loose material, wood, and debris from the trench prior to backfilling.
2. Backfill to level of original ground surface, to underside of pavement base course, or as shown on the Drawings. Backfill for concrete structures shall not be placed until the concrete has attained at least ninety percent (90%) of design strength.
3. Remove sheeting, shoring, and bracing using methods that minimize caving. Metal sheeting, shoring, and bracing may be left in place on approval by the Construction Administrator.

B. Structural Backfill :

1. When material beneath the foundation grade for structures is required to be excavated, the excavation shall be backfilled with material shown on the drawings, or as directed by the Construction Administrator. Material shall be placed and spread in successive, approximately horizontal lifts not exceeding eight (8) inches in loose thickness.

2. The sides of structures shall be backfilled as shown on the Drawings. Material shall be placed and spread in successive, approximately horizontal lifts not exceeding eight (8) inches in loose thickness.

C. Fill:

1. Fills shall be constructed from Type I or II Backfill Material as shown on the Drawings or directed by the Construction Administrator. In areas where over-excavation is required fills shall be constructed with Type III backfill.
2. All topsoil shall be stripped, and the foundation prepared for constructing the fill.
3. Exposed surfaces shall be scarified to a depth of at least six (6) inches (unless the surface is rock), and compacted at a moisture content that will permit proper compaction as outlined in these specifications.
4. Prior to placing fill material, obtain the Construction Administrator's approval of the site preparation in the area to be filled.
5. Place and spread the material in successive, approximately horizontal layers, not exceeding eight (8) inches in loose thickness.
6. Earth slopes shall be keyed into as the work is brought up.
7. Portions of the fill surface shall be moistened, scarified, or plowed, as directed by the Construction Administrator, to a depth of at least six (6) inches, and recompact when necessary to produce a uniform, stable fill.

D. Compaction:

1. Structure Fill or Backfill:
 - a. Sides of Structures: Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557.
 - b. Structure Foundation: Compact each lift to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
2. Fill: Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557. Where Type I backfill is used, compact to at least 95 percent (95%) relative compaction in accordance with ASTM D 1557. Compact upper six (6) inches of road subgrade or ditch to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
3. At the time of compaction, the moisture content of the fill and backfill material shall be such that the required relative compaction will be obtained. Condition material which contains insufficient moisture or excess moisture until the moisture content is such that the relative compaction will be obtained.
4. Compaction Equipment shall be standard type capable of producing the

specified relative compaction with the specified fill and backfill materials.

5. Hand-operated tampers shall be used only in areas which are inaccessible to self-propelled or towed mechanical compacting equipment, or where damage to existing facilities by the use of self-propelled or towed compacting equipment is probable.
6. If the compacted fill material fails to pass the compaction test requirements of these specifications, no additional material shall be placed until the unsatisfactory fill has been reworked or replaced and satisfactory compaction test results are obtained.
7. Tolerances: The elevation of the top layer of any one compacted fill material shall not vary more than ½-inch from the elevation indicated on the Drawings.
8. Controlled Low Strength Material (CLSM) does not require compaction.

3.5 **Pipe Bedding, Embedment and Backfill**

A. Pipe Bedding

1. Pipe bedding will consist of either Controlled Low Strength Material as per Section 02312 or Type IV Backfill as per Section 02205.

B. Pipe Embedment

1. For permanently installed pipes pipe embedment will consist of either CLSM as per Section 02312 or Type IV Backfill as per Section 02205.
2. For the temporary bypass system, pipe embedment shall consist of either Type II Backfill per Section 02205 or CLSM per Section 02312 at the direction of the Construction Administrator, If Type II Backfill is used for installation of the temporary bypass diversion, the plasticity index requirement in Section 02205 can be waived at the discretion of the Construction Administrator.

C. Trench Backfill

1. Material used for permanent pipe installations will consist of Type II Backfill as per specification Section 02205.
2. Material used during installation of the temporary bypass system will consist of Type II Backfill as per Section 02205, except that the plasticity index requirement in Section 02205 Part C. can be waived at the discretion of the Construction Administrator. Native soils are acceptable provided they are free of organics, debris and particles greater than 3 inches in diameter.
3. Material used for backfilling the trench of the temporary bypass diversion after removal of the pipe shall consist of Type II Backfill as per Section 02205, except that the plasticity index requirement in Section 02205 Part C can be waived at the discretion of the Construction Administrator. Native soils are acceptable provided they are free of organics, debris and particles greater than 3 inches in diameter.

D. Placement and Compaction of Granular Embedment Material

1. Granular bedding and embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.
2. After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof by shovel slicing or other suitable methods to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.
3. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
4. Embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified and also around the restrained pipe sections.
5. Each lift of granular embedment material shall be vibrated with a mechanical probe type vibrator or shovel sliced during placement to ensure that all spaces beneath the pipe are filled. Granular embedment shall be placed in maximum lift thickness of six (6) inches and compacted. Each lift of embedment material shall be compacted with three (3) passes (round trip) of a platform type vibrating compactor.
6. Where indicated on the Drawings, migration of soil into the embedment material shall be prevented with filter fabric Type A or by use of inundated sand embedment. Filter fabric shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped twelve (12) inches.

E. Placement of CLSM Bedding and Embedment- Shall be as specified in Section 02312- Controlled Low Strength Material

F. Placement and Compaction of Trench Backfill

1. Place and spread the material in successive, approximately horizontal layers, not exceeding eight (8) inches in loose thickness.
2. Compact each lift to not less than ninety percent (90%) relative compaction, in accordance with ASTM D1557. Compact upper six (6) inches of road subgrade to not less than ninety-five percent (95%) relative compaction, in accordance with ASTM D1557.
3. At the time of compaction, the moisture content of the trench backfill material shall be such that the required relative compaction will be obtained. Condition material which contains insufficient moisture or excess moisture until the moisture content is such that the relative compaction will be obtained.
4. Compaction Equipment shall be standard type capable of producing the specified relative compaction with the specified trench backfill materials.

5. If the compacted fill material fails to pass the compaction test requirements of these specifications, no additional material shall be placed until the unsatisfactory fill has been reworked or replaced and satisfactory compaction test results are obtained.
6. The compaction requirements for temporary backfills used for the MP 8.65 canal bypass diversion can be waived upon approval by the Construction Administrator.

3.6 **Testing**

- A. General: As part of the inspection program, the Construction Administrator or designee will take samples and perform moisture content, gradation, Atterberg limits, compaction, and density tests during placement of backfill materials to check compliance with these Specifications. The Contractor shall remove surface material at locations designated by the Construction Administrator and provide such assistance as necessary for sampling and testing by the Construction Administrator.
- B. Standards: Unless otherwise specified, the most recent standard of the following test methods shall be used:

| TEST DESCRIPTION | ASTM TEST METHOD NUMBER |
|--|-------------------------|
| Maximum Density and Optimum Moisture Content | D-1557 |
| Relative Compaction | D-1556 or D-2922 |

3.7 **Unusual Conditions**

- A. In the event that any unusual conditions not covered by the special provisions are encountered during grading operations, the Construction Administrator shall be immediately notified in accordance with the General Requirements.

***** END OF SECTION *****