SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.1 RELATED WORK

A. Section 31 10 00: Site Preparation

B. Section 31 00 00: Earthwork

C. Section 32 12 00: Flexible Paving

D. Section 32 16 00: Concrete Paving, Curbs, Headers and Ramps

E. Section 32 00 01: Site Restoration and Rehabilitation

F. Special Conditions for Water Discharge Management and Environmental Pollution Prevention

1.2 SYSTEM DESCRIPTION

A. A trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation.

B. Excavations for appurtenant structures, such as but not limited to manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and boring pits shall be deemed to be in the category of trench excavation.

C. Unless otherwise indicated on the Plans, all excavation for pipelines shall be open cut. No boring or tunneling operations shall be used unless in conformance with an approved boring/tunneling plan.

1.3 REFERENCES

A. California Department of Transportation (Caltrans):
   1. Standard Specifications Section 61 – 67

C. California Code of Regulations, Title 8, Industrial Relations, and CAL/OSHA Construction Safety Orders.


1.4 SUBMITTALS

A. Certificates: The Contractor shall provide the Project Manager with two copies of material certificates signed by the material producer and the Contractor, certifying that each material item complies with, or exceeds, specified requirements.

B. Trench Excavation and Shoring: The Contractor shall provide Stanford Utilities with a letter identifying the Company’s “Competent Person” overseeing excavation activities, and a copy of the company’s OSHA permit.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL

A. All proposed fill material to be used for the project shall be submitted to and approved by the Geotechnical Engineer. Excavated materials from the site may be used if approved by the Geotechnical Engineer. Imported fill, where required, shall be a clean non-expansive and predominantly granular soil or soil-rock mixture which is free from organic matter, deleterious substances, and contamination and which does not contain materials over 6 inches in greatest dimension. Materials having dimension greater than 4 inches shall not be used in the upper 6 inches of fill. Fill material shall have a minimum "R" value of 25, a Plasticity Index less than 15, and at least 20% and no more than 60% passing the No. 200 sieve.

2.2 SELECT BACKFILL MATERIAL (SAND)

A. Sand shall be free of constituents that could cause adverse environmental impact. Used blasting abrasives containing toxic constituents at or above State or Federal hazardous waste levels shall not be used as backfill material. Backfill material shall consist of natural sand, manufactured sand, existing native material, or combinations thereof, and shall conform to the physical properties listed below:

1. Organic Impurities – ASTM C-40: Supernatant shall not be darker than Plate 3 when compared to standard Gardiner Color Series
3. pH Value-ASTM G-51-77: Equal to or greater than 4.5 and less than 9.
4. Resistivity R – ASTM G-57: Equal to or greater than 5,000 Ohms-cm.
If Resistivity R is smaller than 5,000 Ohms-cm, the following chemical contents limits shall apply:

- Total chloride content shall be equal to or less than 500 parts per million as determined by EPA Method 300.0 prepared by Parr O2 bomb combustion.
- Total sulfate content shall be equal to or less than 150 parts per million as determined by EPA Method 300.0 prepared by Parr O2 bomb combustion.

5. Compaction – ASTM D-1557: When material is compacted to a relative compaction of 95% or greater, as determined by ASTM D-1557, the material shall not slough when cross trenched.


<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing (By Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>½”</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>75-100&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>No. 50</td>
<td>0-70</td>
</tr>
<tr>
<td>No. 100</td>
<td>0-30</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-15</td>
</tr>
</tbody>
</table>

<sup>1</sup>For grains retained on No. 4 sieve, the grain shape shall be rounded or sub-rounded as defined by ASTM D-2488.

7. Coefficient of Uniformity, Cu≥2.5: \( C_u = \frac{D_{60}}{D_{10}} \); \( D_n \) = Diameter of grain size which n% of the total sample is passing

8. Standard Specifications

- ASTM C-40: Test for Organic Impurities in Fine Aggregates for concrete
- ASTM D-2419: Test for Sand Equivalent Value of Soil and Fine Aggregate
- ASTM G-51-77: pH of Soil for Use in Corrosion Testing
- ASTM G-57: Soil Resistivity Field Measurement Using Wenner Four Electrode Technique
- EPA Method 300.0: Determination of Inorganic Anions in Water by Iron Chromatography
- ASTM C-136: Sieve Analysis of Fine and Coarse Aggregate
- ASTM C-117: Test for material Finer than No. 200 Sieve by washing
- ASTM D-75: Practice for Sampling Aggregate

2.3 PIPE DETECTION MATERIAL

A. Tracer wire shall be #8 AWG insulated copper wire, solid or stranded.

2.4 CRUSHED ROCK FOR PIPE BEDDING
A. Bedding for large pipes 18-inch diameter or greater shall be Caltrans Class 3 aggregate sub-base, compacted to a minimum of 90% relative compaction.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 200</td>
<td>5 max.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>% Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
</tr>
<tr>
<td>No. 200</td>
</tr>
</tbody>
</table>

2.5 SAND FOR JETTING

A. Sand for jetting shall only be used if specified on the plans and approved in advance by Stanford Utilities. Select backfill material shall be sand, free from clay or organic matter, of the same quality from suppliers as referenced below. Select backfill material shall have a size and gradation falling within the following limits when determined by California Test No. 202:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percentage Passing Sieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 200</td>
<td>5 max.</td>
</tr>
</tbody>
</table>

Higher percent fines, between 14 to 20 percent, are acceptable but the sand bedding should be compacted and tested as the material is being placed.

B. Approved suppliers:

- West Coast Aggregates (Pilarcitos Quarry), Half Moon Bay
- Stevens Creek Quarry, Cupertino
- Mission Valley Ready-Mix, Sunol

**PART 3 EXECUTION**

3.1 PREPARATION

A. The Contractor shall perform the following prior to excavating:

1. Contact Underground Service Alert (U.S.A.) at 811 or 1-800-227-2600 a minimum of 48 hours (two working days) prior to excavating to have existing utilities marked.

2. Excavate at locations specifically indicated on the plans, if any, where proposed new lines cross other utilities of uncertain depth to determine the elevation of the existing utility to ensure there is no conflict with the new line.

3. For work in landscaped areas and under any existing tree canopies, contact the
Stanford Grounds Department at 650-723-3050 for assistance in locating existing irrigation lines, to have automatic irrigation systems turned off, and to evaluate location of trenching for impact to trees and significant plantings. Significant vegetation may need relocating if conflicts with utilities cannot be resolved.

4. When excavation is adjacent to communications duct banks or conduits, the Contractor shall notify the University’s Communications Repair Service at 650-723-1611. The Contractor shall report the location and duration of the excavation and the name of the Stanford Utilities Representative.

5. When excavation is adjacent to water/sewer utilities, call Water Shop at 650-723-1300.

6. When excavation is adjacent to steam lines, call Steam Shop at 650-723-4899

7. When excavation is adjacent to high volt facilities, call High Volt Shop at 650-723-3490.

B. If after excavation, an existing utility presents an obstruction, then the line and/or grade of the new line will be adjusted as directed by the Utilities Department Representative to clear the utility.

3.2 TRENCH EXCAVATION

A. General:

1. Excavation shall include removal of all water and materials that interfere with construction. The Contractor shall remove any water which may be encountered in the trench by pumping or other methods during the pipe laying, bedding and backfill operations. Material shall be sufficiently dry to permit acceptable pipe joints.

2. Excavation shall include the construction and maintenance of bridges required for vehicular and pedestrian traffic, support for adjoining structures, and where necessary, the rearrangement and repair of adjoining utilities. Water valves and access to manholes shall remain uncovered and visible at all times.

3. Safe vehicular and pedestrian passage shall be maintained through or around the work area at all times. See Article 10.3.4 of the Stanford GPI General Conditions and the Special Conditions.

4. Relocate, reconstruct, replace or repair, at Contractor’s own expense, all improvements which are in the line of construction or which may be damaged, removed, disrupted or otherwise disturbed by the Contractor. Except as specified in other Sections or shown on the Plans, this provision applies to all surface improvements of whatever nature such as walls, fences, above-grade utilities, landscaping, paving, structures, or other physical features whether shown on the
Plans or not and to all subsurface improvements such as utilities which are indicated on the Plans or marked in the field. The Contractor shall connect such utilities to existing systems and leave all in a workable and operating condition. The cost of this work shall be considered as included in other items of work and no additional compensation will be allowed therefore.


B. Existing Paving and Concrete:

1. Existing pavement shall be neatly sawcut along the limits of excavation, removed, and properly disposed of. If a longitudinal pavement joint or the edge of pavement is located within three feet of the limit of excavation, all intervening pavement shall be removed and replaced after completion of backfilling.

2. Existing concrete shall be sawcut to its full depth, in straight lines either parallel to the curb or at right angles to the alignment of the sidewalk. No section to be replaced shall be smaller than 30 inches in either length or width. If the sawcut falls within 30 inches of a construction or expansion joint, or edge, or within 12 inches of a score mark, the concrete shall be removed to the joint, edge, or mark. All adjacent surfaces shall match and be smoothly integrated into new surfaces without obvious transitions between new and old materials.

3. Boards or other suitable material shall be placed under equipment outrigging to prevent damage to paved surfaces.

C. Trench Width:

1. Unless otherwise specified on the drawings, the maximum allowable trench widths at the top of pipes shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Maximum Trench Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic, Copper, Galvanized Iron</td>
<td>Pipe Barrel OD + 18”</td>
</tr>
<tr>
<td>CIP, DIP, CMP, RCP Welded Steel, Concrete Cylinder</td>
<td>Pipe Barrel OD + 24”</td>
</tr>
</tbody>
</table>

a. The maximum trench width shall be inclusive of all shoring.
b. If the maximum trench width is exceeded, the Utilities Department Representative may direct the Contractor to encase or cradle the pipe in concrete at no additional charge to the project.

2. For pipe diameters greater than 3”, the free working space on each side of the pipe barrel shall not be less than 6 inches.

D. Open Trench:

1. Contractor shall keep open excavations to a minimum. The maximum length of open trench excavations shall be limited to the length in which pipe can be placed and backfilled in one day. Contractor is required to barricade and cover all open excavations with ASSHTO H-20 rated non-slip traffic plates or secure the construction area with a 6-foot high screened temporary construction fence/barrier to prevent unauthorized access outside of normal working hours.

2. Provisions for trench crossings and free access shall be made at all street crossings, driveways, utility manholes and valves, and fire hydrants.

E. Excavation Bracing:

1. The excavation shall be supported and excavation operations conducted in accordance with Title 8 of the California Code of Regulations, the California Industrial Accident Commission and CAL/OSHA. The Contractor shall have a “Competent Person” on the jobsite in accordance with CAL/OSHA regulations.

2. The Contractor shall, at his own expense, furnish, place, and maintain such sheeting and bracing as may be required to support the sides of all excavations (whether above or below the pipe grade), and to prevent any movement which could in any way diminish the required trench section or otherwise injure or delay the work. The sheeting and bracing shall be withdrawn in a manner such as to prevent any earth movement that might overload the pipe.

F. Excavated Material:

1. All excavated material not required for backfill shall be immediately removed and legally and properly disposed of off-campus by the Contractor. The Contractor shall submit to the Utilities Department Representative the location of the off-campus site for approval. The Contractor shall be responsible for all costs associated with removal of the excavated material from the site, including all required testing which may be required by the off-campus disposal site.

2. Material excavated in streets and roadways to be re-used shall be laid alongside the trench no closer than allowed by CAL/OSHA and shall be kept trimmed to minimize inconvenience to public traffic.
3. Provisions shall be made whereby all storm water can flow uninterrupted in gutters or drainage channels.

4. Excavated material shall not be stored on landscaping.

### 3.3 PIPE BEDDING

A. Bedding Excavation: The trench shall be excavated below the grade of the pipe bottom to the following minimum depths:

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic &lt; 2½&quot;</td>
<td>3”</td>
</tr>
<tr>
<td>Galvanized Iron, Copper, CMP, RCP</td>
<td></td>
</tr>
<tr>
<td>Concrete Cylinder, Welded Steel</td>
<td>4”</td>
</tr>
<tr>
<td>Plastic &gt; 2½”</td>
<td>6”</td>
</tr>
<tr>
<td>CIP, DIP, VCP, ACP</td>
<td></td>
</tr>
</tbody>
</table>

B. Stabilization of Trench Bottom: When the trench bottom is unstable due to wet or spongy foundation, it shall be stabilized with gravel or crushed rock. The Utilities Department Representative shall determine the suitability of the trench bottom and the amount of gravel or crushed rock needed to stabilize the soft foundation. Soft material shall be removed and replaced with gravel or crushed rock when ordered by the Utilities Department Representative.

C. Placement of Bedding Material: The trench bottom shall be cleaned to remove all loose native material prior to placing bedding material. Sufficient select backfill material (as bedding) shall be placed and compacted to bring the trench bottom up to grade of the bottom of pipe. The relative compaction of tamped material shall be not less than 90 percent as determined using California Test Method 216 or ASTM D2922 and ASTM D1557 or other approved method. It is the intention of these requirements to provide uniform bearing under the full length of the pipe to a minimum width of 60 percent of the external diameter.

### 3.4 TRENCH BACKFILL

A. Initial Backfill:

1. Prior to trench backfill, the condition of the trench and laying of pipe must be inspected and approved by the Utilities Department Representative.

2. Following placement and inspection of the pipe, select backfill material shall be placed and compacted to the appropriate depth:

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Depth</th>
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<td></td>
<td></td>
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</tbody>
</table>
3. **Initial backfill compaction** shall be by mechanical means except as noted in Paragraph 3.4 D (below). The initial backfill material shall be compacted in layers not exceeding 8 inches in uncompacted depth and shall be brought up uniformly on both sides of the pipe to avoid bending or distortional stress. After compaction, the relative compaction of the initial backfill material shall be not less than 90 percent.

B. In trenches containing pressurized pipes, including ductile iron pipe, tracer wire shall be placed directly above the pipe and shall be run to all valve boxes, and connected to existing exposed tracer wires and other appurtenances as appropriate (see Stanford Drawing CS-102).

C. **Subsequent Backfill:**

1. Above the level of initial backfill, the trench shall be backfilled with native material from trench excavation or with imported select backfill material (Contractor's option). Subsequent backfill shall be free of vegetable matter, stones or lumps exceeding 3 inches in greatest dimension, and other unsatisfactory material. The Utilities Department Representative shall approve the backfill material prior to placement.

2. Except as noted in Paragraph 3.4 D (below), subsequent backfill compaction shall be by mechanical means with backfill material placed in layers not exceeding eight inches in loose depth. Each layer shall be thoroughly compacted before succeeding layers are placed. Compacting equipment and methods shall be acceptable to the Stanford Utilities Department Representative or designated Geotechnical Consultant. The use of excessive force, vibration, or excessively noisy equipment shall not be permitted. Compacting equipment designed for trench compaction such as hoe-mounted sheepsfoot rollers and vibrating plates, remote controlled rollers, handheld or guided plates are acceptable. The use of tampers, stompers, drop hammers, and similar equipment which produce intermittent loading to the soil and pipe are not acceptable.

3. Subsequent backfill shall be compacted to a relative compaction of not less than 90 percent except the relative compaction shall not be less than 95 percent within 2½ feet of finished permanent surface grade or 1½ feet below the finished subgrade, whichever is greater.

<table>
<thead>
<tr>
<th>Plastic: 2½” and smaller Copper, Galvanized Iron</th>
<th>6” above top of pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic: 3” and larger CIP, DIP, VCP, ACP Concrete Cylinder, Welded Steel</td>
<td>12” above top of pipe</td>
</tr>
<tr>
<td>CMP, RCP</td>
<td>½ pipe OD</td>
</tr>
</tbody>
</table>

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D. Jetting: Jetting is not allowed unless approved by Stanford Utilities.

3.5 COMPACTION TESTING

Compaction testing will be in accordance with Section 31 00 00 - Earthwork.

3.6 TRENCH SURFACING

A. General: In unimproved areas, the trench surface shall be restored to its original condition. No mounds of earth shall be left along the trench.

B. Temporary Surfacing:

1. Temporary surfacing shall be a minimum of 1 inch of cutback asphalt on 6 inches of Class 2 Aggregate Base and shall be placed at all trench locations subject to vehicular or pedestrian traffic.

2. Temporary surfacing shall be laid within one day after backfilling (except where the Contractor elects to place permanent surfacing within this time period).

3. Prior to the trenching area being opened to traffic, all excess dirt, rock, and debris shall be removed and the pavement swept clean.

4. Temporary surfacing shall be maintained to prevent the occurrence of mudholes or tripping hazards.

C. Permanent Surfacing: Refer to Sections 32 12 00 – Flexible Paving, 32 16 00 – Concrete Paving, Curbs and Ramps, and 32 00 01 – Site Restoration and Rehabilitation.

END OF SECTION