

## SECTION 02324

### TRENCHING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Excavating trenches for site utility lines including domestic water lines.
  - 2. Compacted fill from top of utility bedding to top of trench.
  - 3. Backfilling and compaction of trenches.
  
- B. Related Sections:
  - 1. Section 02060 - Aggregate.
  - 2. Section 02512 - Site Water Distribution: Site water lines including domestic water lines.

##### 1.2 REFERENCES

- A. Colorado Department of Transportation:
  - 1. 2005 CDOT Standard Specifications for Road and Bridge Construction.
  
- B. American Society for Testing and Materials:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 4. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.

##### 1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

#### 1.4 SUBMITTALS

- A. Obtain City of Cañon City Excavation Permit prior to any excavation.
- B. Excavation Protection Plan: as required by applicable codes, laws, and standards.
- C. Materials Source: Submit name of imported fill materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Cañon City and industry standards.
- B. Maintain one copy of each required document on site.

#### 1.6 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Colorado.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to work.

#### 1.8 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. Verify locations, types, and sizes of existing facilities that will be integrated with project Work.

## PART 2 PRODUCTS

### 2.1 FILL MATERIALS

- A. Road Base: Type Class 6 as specified in Section 02060.
- B. Stabilizing Material: Minimum of 1 ½ inch, uniformly graded, clean rock, or as directed by Engineer.
- C. Blended Aggregate: Type A3 as specified in Section 02060. This backfill shall be allowed under new streets in approved subdivisions. A geotechnical engineer shall design all backfill. The developer's engineer shall provide oversight of installation and compaction including compaction testing. Native soil shall be allowed for the top 2 foot of trench backfill when trench is under an open drainage/irrigation channel for the purpose of sealing the channel and minimizing leakage.
- D. Flow-Fill: Structural Backfill that meets the requirements of 2005 CDOT Standard Specifications for Road and Bridge Construction, Section 206.02; within the following limits:
  - 1. Components per cubic yard

Fine Aggregates (Type A2 as specified in Section 02060)	1,845 lbs.
Coarse Aggregates (Type A1 as specified in Section 02060)	1,700 lbs.
Cement	50 lbs.
Water	325 lbs.
  - 2. Slump – 6 inch minimum, 8 inch maximum
  - 3. Strength – 10 psi minimum in 1 day, 60 psi maximum in 18 days.

## PART 3 EXECUTION

### 3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
  - 1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use staking for alignment and elevation of water mains to establish lines and grades.

### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities indicated to remain.
- E. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.
- F. Prior to excavation in paved areas, the pavement shall be cut in such a manner as to effect a smooth, straight edge and a vertical face 6 inches minimum beyond the trench wall.

### 3.3 TRENCHING

- A. Excavate subsoil by open cut to the depth required, unless written permission is given by Engineer to do otherwise, for utilities at the required locations.
- B. Remove lumped subsoil, boulders, and rock.
- C. When rock or hard clay is encountered, the trench shall be over-excavated 6 inches.
- D. Excavation performed within 24 inches of existing utility service shall be done in accordance with utility's requirements.
- E. Do not advance open trench more than 200 feet ahead of installed pipe, unless Engineer determines a shorter length is necessary for the safety of the public.
- F. Cut trenches to the width necessary to permit the pipe to be laid, jointed properly, inspected, and backfilled properly. No trench shall have a width of less than the diameter of the pipe plus 12 inches. The maximum clear trench width, measured 1 foot above the top of the pipe barrel shall not be greater than that shown in the following table unless otherwise specified:

<u>Pipe Diameter (inches)</u>	<u>Maximum Trench Width (inches)</u>
6	26
8	28
10	30
12	32
16	36
20	44
24	48
30	56
36	64

- G. When maximum trench widths are exceeded and Engineer determines that the design load limits of the pipe are exceeded, the Contractor will be required to either cradle the pipe in concrete or to use a pipe of a stronger class.
- H. Remove water or materials that interfere with Work. Contractor shall provide and maintain at all times ample means and devices to promptly and properly dispose of all water entering trench excavation. Water shall be disposed of in a suitable manner without damage to adjacent property or without a menace to public health and convenience. Unless authorized, in writing, trench water shall not be allowed to enter any water or sewer lines. Protect pipeline against damage from water in the event of a storm or pump failure.

- I. Excavate trenches to depth indicated on Drawings. The trench shall be excavated to a depth below the established grade equal to 1/8 the outside diameter of the pipe, but not less than 4 inches. Provide uniform and continuous bearing and support for bedding material and pipe. A continuous trough shall be excavated to receive the bottom quadrant of the pipe barrel and bell ends. Excavate adequate space for required restraints, valves, and fittings prior to placing pipe in trench.
- J. Do not interfere with the bearing soil of foundations of existing structures.
- K. When Project conditions permit, slope side walls of excavation starting 1 foot above top of pipe. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- L. When subsurface materials at bottom of trench are loose, soft, or otherwise unsuitable, excavate to greater depth as directed by Engineer until suitable material is encountered. It shall be replaced, as directed by Engineer, with approved backfill material and methods to provide a suitable foundation for the pipe, which may include 1 ½ inch clean rock.
- M. Trim excavation. Remove loose matter.
- N. Correct areas over-excavated with compacted backfill as specified for authorized excavation as directed by Engineer.
- O. Remove excess subsoil, not intended for reuse, from site. Top soil shall be removed and piled separately for use in finish grading the site. Excavated material that is suitable for backfilling shall be piled in an orderly manner, a sufficient distance from the trench to avoid over-loading and to prevent slides or cave-ins.
- P. Boring, Tunneling, and Jacking:
  - 1. May be required under existing sidewalk, curb and gutter, or other structures, where depth of trench and soil conditions permit.
  - 2. Written permission by Engineer is required.
  - 3. Tunneling will not be permitted for distances greater than 10 feet.
  - 4. When jacking is required, only persons experienced in such work, using suitable equipment, shall perform the operation.
  - 5. Flow-fill shall be used as backfill under any structure that has had material excavated from beneath them, been jacked, or for any tunnel.

### 3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Design sheeting and shoring to be removed at completion of excavation work.
- C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

### 3.5 BEDDING

- A. Bedding installation and material shall be in accordance to the utility's specifications. All water lines shall be bedded in Class 6 material per Section 2512.

### 3.6 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen, non-organic, or otherwise suitable fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact in accordance with City of Cañon City Standard Detail. Flow-fill may be used from 4 inches above the pipe barrel to the top of the trench.
- D. Compact backfill material to 95 percent, maximum dry density, ASTM D698, Standard Proctor, except for the top 4 feet of the trench, which shall be compacted to 97 percent, maximum dry density, ASTM D698, Standard Proctor.
- E. Lifts will not exceed 8 inches in depth unless a sheep's foot compactor or a hydraulic plate compactor (headshaker) mounted on excavation equipment of adequate size is used. Lift size may be increased by using this compaction equipment when it is demonstrated that compaction requirements can be met. Engineer will make final determination on the thickness of each lift in the field. Only equipment designed for the purposes of compaction shall be used.
- F. Employ placement method that does not disturb or damage utilities in trench, and other existing structures or facilities.
- G. Maintain optimum moisture content, plus or minus ( $\pm$ ) 2 percent, of fill materials to attain required compaction density.
- H. Do not leave more than 25 feet of trench open at end of working day.

- I. Protect open trench to prevent danger to the public.

### 3.7 SURFACE RESTORATION

- A. Pavement (either asphalt or concrete), curb and gutter, sidewalks, drainage culverts, headwalls, etc., or other improved surfaces that have been removed during the course of work shall be restored to a condition as equal to or better than that prior to removal and to the same elevation and alignment.
- B. The subgrade for all restored surfaces shall be thoroughly compacted by mechanical or hand tampers weighing not less 20 pounds, by vibratory rollers, or by other means of compaction approved by Engineer.
- C. Surface restoration shall be per current applicable City of Cañon City Specifications and Standard and subject to review by Engineer.
- D. Where excavation occurs in paved areas, the pavement shall be repaired as required in Sections 00710, 02740, 02750, and 03300.

### 3.8 FIELD QUALITY CONTROL

- A. Compaction Testing: In accordance with ASTM D698.
- B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest
- C. Compaction Testing for Bedding and Backfill:
  - 1. Contractor is required to hire an independent, licensed engineer experienced in soil analysis and evaluation to perform required compaction tests in accordance with ASTM D698. Copies of all Proctor curves and test results showing exact location of sample collection and test sites must be furnished to Engineer. Engineer shall be informed prior to testing and he may designate areas of testing.
  - 2. Performed by City personnel or Contractor at option of Engineer in accordance with ASTM D698.
  - 3. Testing is to be done at various elevations in trench, which may require excavation by Contractor after backfill is installed.
  - 4. Frequency of Compaction Tests will be specified by Engineer in field but shall be no less than every 200 feet at every 1 foot of depth of the trench or anytime the means and methods of compaction change.
  - 5. For trenches greater than 4 feet in depth, compaction effort shall be visually observed based on an initial test to determine a best means and methods of compaction that can subsequently be used for trench side observation. A new initial test shall be performed whenever backfill materials or means and methods of compaction change.
  - 6. Testing shall use the Standard Proctor method. Alternatives such as Modified Proctor or Relative Density based on necessity due to material type may be used with the permission of the Engineer so long as the necessary conversion data, testing, and information has been completed and submitted prior commencement of the work.

### 3.9 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.
- B. All areas showing signs of settlement shall be filled and maintained by Contractor during all construction phases and for a period of 2 years following the date of final acceptance.
- C. When Contractor is notified by the City or Engineer that any backfill is hazardous, the condition shall be corrected at once.

END OF SECTION