

# Town of Mead Design Standards and Construction Specifications

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## SECTION 31 00 00 EARTHWORK

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Clearing, grubbing and site preparation
- B. Removal and disposal of debris
- C. Handling, storage, transportation, and disposal of excavated material
- D. Sheeting, shoring, bracing and protection work
- E. Pumping and dewatering as required or necessary
- F. Backfilling
- G. Pipe embedment
- H. Construction of fills and embankments
- I. Excavation for buildings & structures
- J. Pavement Subgrade preparation
- K. Trench Stabilization
- L. Final grading
- M. Slope Stabilization
- N. Appurtenant work

#### 1.2 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials
- B. ASTM – American Society for Testing and Materials
  - 1. ASTM C33 – Concrete Aggregates
  - 2. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates
  - 3. ASTM D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
  - 4. ASTM D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
  - 5. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
  - 6. ASTM D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
  - 7. ASTM D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
  - 8. ASTM D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - 9. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)
- C. ACI – American Concrete Institute
  - 1. ACI 229 – Controlled Low-Strength Materials
- D. CABO/ANSI – Council of American Building Officials/American National Standards Institute
  - A117.1 – Accessible and Useable Buildings and Facilities Standards

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- E. CDOT – Colorado Department of Transportation
- F. OSHA – Occupational Safety and Health Administration
  - 1. Part 1926 – Safety and Health Regulations for Construction

## 1.3 SUBMITTALS

- A. Product Data: Submit on all products or materials supplied herein
- B. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment.

## 1.4 REGULATORY REQUIREMENTS

- A. Obtain and comply with all requirements of the Town of Mead Grading Permit for all land disturbing activities and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Excavation work will be performed in compliance current OSHA requirements.

## 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling.
- B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.
- C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising.
- D. Do not use frozen materials, snow, or ice in any backfill or fill area.
- E. Do not backfill or construct fill on frozen surfaces.
- F. Protect excavated material from becoming frozen.
- G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved.
- H. Do not remove trees from outside excavation or fill areas unless authorized by the Town; protect from permanent damage by construction activities.
- I. Provide temporary bridges for roadways, walkways, driveways, etc.

## 1.6 QUALITY ASSURANCE

- A. All imported material to be free of hazardous and organic wastes, “clean” as defined by EPA, and approved for its intended use by the Town or a project Geotechnical Engineer.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.
- B. Fills and Embankments
  - 1. To the maximum extent practical, use excess earth from onsite excavation for fills and embankments.

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2. Fills and embankments shall be free from rocks or stones larger than 12 inches in greatest dimension and free from brush, stumps, logs, roots, debris, and organic and other deleterious materials.
  3. Fill and embankment material must be acceptable to the project's Engineer.
  4. No rocks or stones larger than six (6) inches are allowed in the upper 18 inches of fill or embankment. Where allowed, distribute rocks and stones through the fill to prevent interference with compaction.
- C. Imported Fill for Fills and Embankments
1. The Contractor is responsible for obtaining additional material for fills and embankments as necessary to meet the requirements shown on the approved drawings.
  2. Imported fill conforming to the following:
    - a. Gradation (percent finer by weight ASTM C136): 3-inch – 100% passing, No. 4 Sieve – 50-100% passing, and No. 200 Sieve – 35% passing (maximum).
    - b. Liquid Limit: 35 (maximum), Plasticity Index: 15 (maximum), Group Index: 10 (maximum).
- D. Structural Fill
1. Imported structural fill, such as a ½-inch minus, CDOT Class 7 Aggregate Road Base, shall conform to the following:
    - a. Gradation: 1" – 100% passing (percent finer by weight ASTM C136), No. 8 Sieve – 20-85% passing, and No. 200 Sieve – 15% (maximum).
    - b. Liquid Limit: 30 (maximum), Plasticity Index: 6 (maximum).
- E. Topsoil
1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than two (2) inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted.
  2. Clean topsoil free of plants and seeds will be spread to 4-inch minimum depth or as specified by approved drawings, whichever is greater, for areas of the site as detailed by the landscape plans.
- F. Grubbings
1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
  2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.
- G. Pipe Embedment: Graded gravel
1. Comply with requirements for pipe embedment for public utilities.

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2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100
1-1/2"	95-100
1"	80-95
3/4"	30-45
1/2"	10-25
3/8"	<1

3. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
No. 4	0-10
No. 8	0-5
No. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Squeegee

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	85-100
No. 8	30-70
No. 16	5-40
No. 30	0-15
No. 50	0-10
No. 100	0-5
No. 200	<1

6. Drain Gravel

- a. Crushed rock, granular material with a maximum size of 1-1/2 inch.
- b. Minimum 50% passing No. 4 sieve, maximum 5% retained on No. 200 sieve.

H. Compacted Trench Backfill

1. Job excavated material finely divided, free of debris, organic material, and stones larger than six (6) inches in greatest dimension without masses of moist, stiff clay, or topsoil.
2. In upper 18 inches, no rock or rock excavated detritus, larger than six (6) inches except with specific approval from Geotechnical Engineer.

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3. No rock greater than three (3) inches in greatest dimension within three (3) feet of top of pipe.
  4. Graded gravel: as specified or shown on the approved drawings for pipe embedment.
- I. Coarse Base Rock
1. Granular material, maximum three (3) inches, less than 10% passing 1-inch sieve.
  2. Free of trash, clay and dust.
  3. Compaction as specified by Geotechnical Engineer.
- J. Road Base
1. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
1"	100
3/4"	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

- K. Clay for irrigation channels, cut-off walls or clay for use as a barrier material in utility trenches
1. USCS Classification: CL, CH or OH
    - a. Percent passing No. 200 Sieve: 30% or greater by weight
    - b. Plasticity Index: 15 or greater
    - c. Maximum Permeability:  $1 \times 10^{-5}$  cm/sec
    - d. Maximum Particle Size: 3/4-inch
    - e. Minimum Clay Liner Thickness: two (2) feet at side slopes and end of wing walls or as specified in plans and details.
    - f. Maximum horizontal loose lift thickness: 12-inches or less

## 2.2 ACCESSORIES

- A. Controlled Low Strength Material (Flow Fill)
1. Comply with Utility Service Provider's specifications and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
  2. Product will be a lean, sand-cement slurry, "flowable fill" or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.
- B. Non-woven geotextile fabric
1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Field verify the location of all underground utilities, pipelines and structures prior to excavation.

### 3.2 PERFORMANCE — GENERAL

- A. Perform work in a safe and proper manner with appropriate precautions against hazard.

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- B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities.
- C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor.
- D. Maintain service to pipelines and utilities indicated on approved drawings during construction.

## 3.3 PREPARATION

### A. Clearing and Grubbing

- 1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
- 2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on approved drawings.
- 3. Remove all waste materials from site and dispose. Stockpile all acceptable grubblings for reuse in revegetation areas.
- 4. Remove and dispose of tree stumps and roots over three (3) inches in diameter to a minimum depth of 18 inches below the natural surface or five (5) feet below finished surface level, whichever is lower.
- 5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site. On-site burning is not permitted.
- 6. Backfill all excavated depression include grub holes with approved material.

### B. Preservation of Trees

- 1. Do not remove trees outside fill or excavated areas, except as authorized by the Town.
- 2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operations.
- 3. Trim standing trees in conflict with construction operations as directed by the Town.

### C. Topsoil Stripping

- 1. Strip onsite material meeting the topsoil definition to minimum depth of six (6) inches from areas to receive grading as shown on approved drawings.
- 2. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.

### D. Waste and Debris

- 1. Stockpile all acceptable grubbing for reuse in native revegetation areas.
- 2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site.

### E. Stockpiles

- 1. Segregate materials suitable for the following:
  - a. Topsoil
  - b. Embankments and fills
  - c. Backfill
  - d. Spoils and waste only
- 2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the work, either by direct pressure or indirectly by overloading banks contiguous to the operation.

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3. Stockpile soil materials away from edge of excavations.
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices.

## **3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES**

- A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.
- B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work.
- C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition.
- D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Town, will be borne by the Contractor.

## **3.5 DEWATERING**

- A. General
  1. Perform all dewatering activities in accordance with all federal, state, and Town standards regarding site drainage, dewatering, and erosion and sediment control including permitting requirements.
  2. Dewatering requires a Colorado Department of Public Health and Environment dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, including water treatment prior to discharge, if necessary.
- B. Design
  1. Contractor will be responsible for the accuracy of the approved drawings, design data, and operational records required.
  2. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system.
- C. Damages
  1. Contractor will be responsible for and will repair any damage to work in place, or other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
  2. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Town.
- D. Maintaining Excavation in Dewatered Condition
  1. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted.
  2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade

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support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.

3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Town.
  4. System maintenance will include supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition.
- E. System Removal
1. Remove dewatering equipment from the site, including related temporary electrical service.
  2. Wells will be removed or cut off a minimum of three (3) feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

## **3.6 SHEETING, SHORING AND BRACING**

- A. All sheeting, shoring and bracing shall be in accordance with OSHA and IBC requirements.
- B. Prevent undermining and damage to all structures, buildings, underground facilities, pavements and slabs.
- C. Contractor will be responsible for obtaining all required permits or easements for encroachments into the public right-of-way and for coordinating any encroachments onto adjacent properties.
- D. If sheet pile cut off walls are required, submit design calculations stamped by a Colorado licensed Professional Engineer.
- E. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component.
- F. Provide proper and substantial sheeting, shoring, and bracing, in accordance with OSHA Standards as required, to prevent caving or sliding, to protect workmen and the work, and to protect existing structures and facilities.
- G. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for cut and cover, open cut, temporary bypass road, or trench excavations, including bracing, dewatering, and all associated items to support the sides and ends of excavations where excavation slopes may endanger in-place or proposed improvements, extend beyond construction right-of-ways or as otherwise specified or indicated in the approved drawings.
  1. Design and build sheeting, shoring, and bracing to withstand all loads that might be caused by earth movement or pressure.
  2. Design and build sheeting, shoring and bracing to be rigid, and to maintain shape and position under all circumstances.
- H. Design excavation support system and components for the following to allow safe and expeditious construction of permanent structures without movement/settlement of the ground and to prevent damage to or movement of adjacent buildings, structures, other improvements and underground facilities:
  1. To support lateral earth pressures.
  2. Loads from utilities, traffic, construction, buildings and surcharge loads.
- I. Provide sheeting, shoring and bracing equipment and materials onsite prior to start of excavation in each section, making adjustments as required, to meet unexpected conditions.

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- J. Contractor will make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and will select and design support systems, methods, and details as will assure safety to the public, adjacent property, and the completed work.
- K. Space and arrange sheeting and bracing as required to exclude adjacent material and according to the stability of excavation slopes.
- L. Do not pull trench sheeting before backfilling.
- M. Do not brace sheeting left in place against the pipe, but support it in a manner that precludes concentrated loads or horizontal thrusts on pipe.
- N. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed.

## **3.7 TRENCH STABILIZATION**

- A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities.
- B. Remove all mud and unstable soil during excavation.
- C. Reinforce subgrades with crushed rock or gravel if they become unstable during construction activities.
- D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on approved drawings.
- E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon.

## **3.8 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION**

- A. Excavate subgrade for asphalt pavement areas per the lines, grades, and dimensions indicated on approved drawings within a tolerance of plus or minus 0.10 foot. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on approved drawings within a tolerance of plus or minus 0.05 foot.
- B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to depth shown on approved drawings or as specified by a project Geotechnical Engineer.
- C. Extend subgrade preparation a minimum of one foot beyond proposed pavement, slabs, curbs and walks.
- D. Proof roll at a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. The vehicle must have a loaded GVW of 50,000 pounds with a loaded single axle weight of at least 18,000 pounds and a tire pressure of 90 psi. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture. After recompaction, these areas will be proof rolled again and all failures again corrected.
- E. If the Contractor fails to place the sub base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again.

## **3.9 FILLS AND EMBANKMENTS**

- A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on approved drawings.

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- B. Place fill in horizontal layers at maximum uncompacted depth per compaction specifications herein.
- C. Do not place fill on frozen surface. Do not place snow, ice or frozen materials in fill.
- D. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment.
- E. Plow and scarify subgrade to a minimum depth of six (6) inches until uniform and free of large clods.
- F. Spread and level material deposited in piles and windrows before compacting.
- G. Thoroughly compact each layer by rolling or other means acceptable to a project Geotechnical Engineer to meet the moisture and compaction specifications herein.
- H. Alter compaction methods if material fails to meet specified densities.
- I. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inches above the top of the pipe before excavating the trench.
- J. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction.

## 3.10 COMPACTION

- A. Place backfill and fill materials in layers not more than eight (8) inches in loose depth for material compacted by heavy compaction equipment, and not more than four (4) inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure as described herein.
- C. Comply with a project Geotechnical Engineer's additional requirements for site development material, subexcavation, compaction and related earthwork operations.
- D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Public Surface Improvement	Compaction %	Moisture Content
Paved Areas	98%	-2 to +2
Trenches Under Paved Areas	98%	-2 to +2
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2

- E. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
- F. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.

## 3.11 BORROW OR SPOIL AREA

- A. The location, size, shape, depth, drainage, and surfacing of borrow or spoil pits will be approved by the Town.
- B. Make all areas regular in shape with graded and surfaced side and bottom slopes when completed.
- C. Cut side slopes not steeper than 1:1 and uniform for the entire length of any one side.

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- D. Final grade disturbed areas of borrow to uniform slope (maximum slope = 4:1, minimum slope = 50:1).
- E. Use material free of debris and deleterious material.
- F. Contractor is responsible for compliance with Colorado Discharge Permit System and local erosion control permitting requirements for any and all onsite and offsite, disturbed spoil and borrow areas. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of the offsite property owner and the Town.

## 3.12 BLASTING

- A. Blasting or other use of explosives is not permitted without the Town's approval.

## 3.13 TRENCH EXCAVATION

- A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.
- B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the approved drawings.
- C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection.
- D. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation.
- E. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 100 feet.
- F. Total length of open trench will be limited to 200 feet unless otherwise approved by the Town Engineer.
- G. Except where tunneling or boring is indicated on the approved drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface.
- H. Limiting trench widths
  - 1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing and embedment.
  - 2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than one (1) foot above the top of the pipe.
  - 3. Stipulated minimum clearances are minimum clear distances, not minimum average distances.
  - 4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches.
  - 5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping.

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1' 6"	2' 6"
4	1' 6"	2' 6"
6	1' 6"	2' 6"
8	1' 8"	2' 8"
10	2' 0"	3' 0"
12	2' 0"	3' 0"
16	2' 8"	3' 8"
18	3' 0"	4' 0"

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Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
24	3' 6"	4' 6"
36	4' 6"	5' 0"

- I. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions.
- J. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing.
- K. Trench Side Walls
  - 1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations.
  - 2. Sheet and brace where necessary and as specified herein.
  - 3. Excavate without undercutting.
- L. Trench Bottom
  - 1. Will be thoroughly protected and maintained when suitable natural materials are encountered.
  - 2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required.
  - 3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
  - 4. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined.
  - 5. PVC pipe will not be laid directly on trench bottom
- M. Mechanical excavation
  - 1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas.
  - 2. Use mechanical excavation equipment of a type and design which can be operated to provide the following:
    - a. Rough trench bottom to a controlled elevation.
    - b. Uniform trench widths and vertical sidewalls from one (1) foot above the top of the installed pipe to the bottom of the trench.
    - c. Trench alignment that pipe can be accurately laid to specified alignment and that pipe is centered in the trench with adequate clearance between pipe and trench sidewalls.
  - 3. Do not undercut trench sidewalls.
  - 4. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material.
- N. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the approved drawings to provide for installation of granular embedment pipe foundation material.
- O. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined.
- P. Cuts in existing surface construction

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1. No larger than necessary to provide adequate working space.
2. Breakout grooves shall be cut perpendicular to the surface of the pavement and shall be sawed full-depth to form a neat breakout line in the pavement. Alternately to full depth saw cuts, breakout grooves sawed to a minimum of 1½ inches will only be allowed with approval from the Town Engineer.
3. Remove pavement and base pavement to provide shoulder not less than six (6) feet wide between cut edge and top edge of trench.
4. Do not undercut trenches, resulting in bottom trench width greater than top widths.
5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation. Make pavement cuts in patterns that will minimize the extents of pavement grooves beyond the edges of pavement to be removed.
6. Remove pavement for connections to existing lines or structures only to the extent required for the installation.
7. Removal and replacement of sidewalks or other concrete pavements shall be to the nearest existing joint not damaged by the construction.
8. Street and alley pavement removals:
  - a. Shall have no horizontal dimension less than three (3) feet.
  - b. Shall not leave any existing portion of pavement in place less than five (5) feet as measured to the nearest joint or edge of pavement.
  - c. Concrete curb and gutter that is parallel to the utility trench and of at least 12 inches in width may remain, provided that the curb and gutter is not damaged by the construction activity.
9. Replace the pavements between saw cuts to match original surface construction, or current pavement thickness standards, whichever is greater

## 3.14 PIPE EMBEDMENT

- A. Embed pipes above and below the bottom of pipe as indicated on the approved drawings and as specified herein.
- B. Granular embedment
  1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
    - a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length.
    - b. Barrel of pipe will have a bearing for its full length.
  2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position. After grading, aligning, and placing pipe in final position, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations.
  3. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement.
  4. Complete embedment promptly after jointing operations and approval to proceed by Town Engineer.
  5. Compact granular embedment by slicing with shovel or vibrating.
    - a. Maximum uncompacted thickness of layers: six (6) inches

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6. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557.
  - a. Maximum uncompacted depth thickness of horizontal layers: 8 inches
- C. Ground Water Barriers and Cut-off Walls
  1. To impede passage of water through bedding material, construct ground water barriers.
    - a. Horizontally extending one (1) foot minimum past either side of the full trench width and approximately two (2) feet of minimum thickness along the length of the utility pipe.
    - b. Vertically, extending one (1) foot minimum from the bottom of granular bedding material and one (1) foot minimum above the top of granular bedding material.
  2. Spacing:
    - a. Approximately 10 feet downstream of each manhole for sanitary sewers and storm drains.
    - b. Every 400 feet on water lines and force main.
    - c. Place a groundwater barrier 20 feet downstream of the edge of all drainage ways, streams and water courses.
  3. Minimum Compaction: 95% proctor
  4. Moisture Content: -1% to 2% Optimum Moisture Content
- D. Arch and concrete encasement
  1. Include in locations indicated on approved drawings or where over-width trench conditions need correction as approved by Town Engineer.
  2. Install and form as indicated on approved drawings.
  3. Concrete will have a 28-day minimum 4,000 psi compressive strength.
- E. Do not backfill until tests and inspections have been made and backfilling is authorized by Town Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

## 3.15 TRENCH BACKFILL

- A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible.
- B. Compacted backfill
  1. Compact the backfill to full depth of trench above embedment at all locations.
  2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures.
  3. In street or highway shoulders.
  4. In established sodded areas.
  5. Beneath fills and embankments.
- C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench.
- D. Site excavated materials
  1. Place job excavated materials in eight (8) inches maximum uncompacted thickness, uniform layers.
  2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Town Engineer's satisfaction that specified compacted density will be achieved.

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3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe.
  4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.
- E. Graded gravel
1. Deposit graded gravel in uniform layers of eight (8) inches maximum uncompacted thickness.
  2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254.
- F. Uncompacted backfill
1. Compaction of backfill above pipe embedment, in locations other than those specified, is required to prevent future settlement.
  2. May be placed by any method acceptable to Town Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe.
  3. Until compacted depth over conduit exceeds three (3) feet, do not drop fill material over five (5) feet. Distance may be increased two (2) feet for each additional 1 foot of cover.
- G. Finish the top portion of backfill with at least four (4) inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, the underlying adjoining turf areas.
- H. Trench backfill within the public right-of-way shall conform to Town of Mead street and utility standards.
- I. Trench backfills through unimproved areas should be restored to previous conditions and left 3" above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.
- J. Protection of trench backfill
1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion.
  2. Install ditch checks where the ditch grade exceeds one (1) percent.
    - a. Minimum depth: two (2) feet below the original ditch or water course bottom for the full bottom width
    - b. Minimum width: 18 inches minimum into the side slopes
    - c. Minimum thickness: 12 inches

## **3.16 DRAINAGE MAINTENANCE**

- A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid.
- B. Backfill so that water does not accumulate in unfilled or partially filled trenches.
- C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours.
- D. Do not obstruct surface drainage any longer than necessary.
- E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic.

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- F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

## **3.17 FINAL GRADING**

- A. After completion of all other outside work, and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours and all areas being graded on site.
- B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work.
- C. Grade all surfaces for effective drainage and provide a two (2) percent minimum slope except as otherwise shown on the approved drawings.
- D. Provide a smooth transition between adjacent existing grades and new grades.
- E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended.
- G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch.
- H. Finish grades will be no more than 0.1 foot above or below those indicated on approved drawings.
- I. Finish all ditches, swales and gutters to drain readily.
- J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths.

## **3.18 SLOPE AND CHANNEL STABILIZATION**

- A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 4H to 1V and where indicated on the approved drawings.
- B. Lay fabric smoothly on surface and bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench, rake smooth, and level with adjacent soil.
- C. Secure outside edges and overlaps at 48-inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition.
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges a minimum of six (6) inches.
- F. Maintain integrity of erosion control fabric.
- G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections or as specified on approved drawings.

## **3.19 SETTLEMENT**

- A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which work is performed.
- B. Repair or replace settlements of earthwork within 30 days after notice by the Town.

## **3.20 FIELD QUALITY CONTROL**

- A. Fills and Embankment Testing
  - 1. Provide two moisture-density relationship tests, ASTM D698, on each type of fill material.

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2. Provide one in-place compaction test for each 5,000 square feet and at every 1.5 feet of vertical lift of material placed.
  3. Provide additional in-place compaction tests at the discretion of the Town.
- B. Pipe Embedment and Backfill Testing
1. Provide two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material.
  2. Provide one in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938.
  3. Provide one in-place compaction test near top of trench for trench depth of two (2) feet or less, per ASTM D6938.
  4. Provide additional in-place compaction tests at the discretion of the Town.
- C. Pavement and Structural Subgrade Testing
1. At a minimum, provide two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type of backfill material proposed.
  2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 2,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than three (3) tests). Test at subgrade and at every vertical lift of backfill materials placed.
  3. Additional in-place compaction tests at the discretion of the Town.

END OF SECTION 31 00 00