



Appendix A

Construction Specifications

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Town of Mead Design Standards and Construction Specifications

APPENDIX A – 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: 1×10^{-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

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SECTION 31 25 00 EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Minimum requirements for soil erosion and sedimentation control on all project sites where soil will be disturbed.
- B. Temporary measures needed to control erosion and water pollution. These temporary measures will include, but are not limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by Town Engineer/Inspector, and as shown on the approved drawings.
- C. The erosion control plan, if presented in the approved drawings, serves as a minimum for the requirements of erosion control during construction.
- D. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.

1.2 REFERENCES

- A. CDOT – Colorado Department of Transportation
- B. MHFD – Mile High Flood District
- C. UDFCD – Urban Drainage and Flood Control District
- D. CDPHE – Colorado Department of Public Health and Environment

1.3 SUBMITTALS

- A. Submit the following information
 - 1. Erosion Control Plan
 - 2. Construction schedule for Erosion Control per Scheduling paragraph below
 - 3. Sequencing Plan per Scheduling paragraph below
 - 4. All applicable permits for Grading and Erosion Control
- B. Product data: Submit on all products or materials supplied herein.

1.4 REGULATORY REQUIREMENTS

- A. 40 Codified Federal Regulations Part 122: EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES)
- B. USEPA Summary Guidance Document 833-R-92-001: Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices
- C. Obtain and comply with all requirements of the Town issued Grading/Construction permits and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.
- D. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
 - 1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
 - 2. All costs for this permit shall be the responsibility of Contractor.

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3. This permit requires that specific actions be performed at designated times.
 4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
 5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
 6. Non-compliance with the permit can result in stoppage of all work.
- E. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or Weld County, the more restrictive laws, rules, or regulations shall apply.

1.5 SCHEDULING

A. Sequencing Plan

1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by the Town.
2. Changes to the Erosion Control Sequencing Plan may be considered by the Town only if presented in writing by the Contractor.

B. Temporary Erosion Control

1. Provide temporary erosion control when so indicated in the Contract Documents, or when directed by the Town. Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.

C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits, and a plan for disposal of waste material.

D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 PRODUCTS

2.1 MATERIALS

A. All materials shall be submitted for approval prior to installation.

B. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.

C. Grass Seed:

1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
2. In accordance with Section 33 47 00 of the **Town of Mead Design Standards and Construction Specifications** prior to installation
3. All grass seed shall be approved by the Town prior to installation

D. Fertilizer and soil conditioners shall be approved by the Town and in accordance with Section 33 47 00 of the **Town of Mead Design Standards and Construction Specifications** prior to installation.

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- E. Silt Fence Fabric: woven polypropylene
 - 1. Mirafi 100X, "Envirofence," or accepted substitution
- F. Temporary Slope Stabilization Mat (short term):
 - 1. Biodegradable
 - 2. Longevity of 12 months.
- G. Temporary Slope Stabilization Mat (extended term):
 - 1. Biodegradable
 - 2. Longevity of 24 months.
 - 3. North American Green, or accepted substitution

PART 3 EXECUTION

3.1 GENERAL

- A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.
- B. The Town Engineer/Inspector will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, the Town will require Contractor to provide additional measures as required to obtain the desired results.
- C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

3.2 WORKING IN OR CROSSING WATERCOURSES AND WETLANDS:

- 1. Construction vehicles shall be kept out of watercourses to the maximum extent possible.
- 2. Where in-channel work is necessary, precautions shall be taken to stabilize the work area during construction to minimize erosion.
 - a. The channel, including bed and banks, shall always be restabilized immediately after in-channel work is completed.
- 3. Where a live (wet) watercourse must be crossed by construction vehicles during construction, a Temporary Stream Crossing shall be provided for this purpose.

3.3 PROTECTION OF ADJACENT PROPERTIES

- A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.
- B. In addition to the erosion control measures that may be required on the approved drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:
 - 1. Vegetated buffer strip around the lower perimeter of the land disturbance.
 - a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
 - 2. Sediment barriers such as straw bales, erosion logs, and silt fences.
 - 3. Sediment basins and porous landscape detention ponds.
 - 4. Combination of above measures.

3.4 CONSTRUCTION

- A. Stabilization of Disturbed Areas:

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1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
 2. Permanent erosion protection measures shall be established within five (5) days after final grading of areas.
- B. Stabilization of Sediment and Erosion Control Measures:
1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
 2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.
 3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.
- C. Stabilization of Waterways and Outlets:
1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
 2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.
- D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.
- E. Construction Access Routes:
1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
 2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
 3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
 4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.5 DISPOSITION OF TEMPORARY MEASURES

- A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by the Town.
- B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.
- C. Contractor will be responsible for maintaining temporary erosion control measures until such time as work has been accepted by the Town and as specified in the Grading Permit.

END OF SECTION 31 25 00

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SECTION 32 12 00 FLEXIBLE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Full depth and/or composite hot bituminous pavement (asphalt) over prepared subgrade.
- B. Overlay, patch and/or pavement rehabilitation applications for streets, parking lots and other miscellaneous asphalt pavement.

1.2 REFERENCES

- A. AASHTO T 230: Standard Method of Test of Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C29 – Unit Weight and Voids in Aggregate
 - 2. ASTM C88 – Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
 - 3. ASTM C117 - Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
 - 4. ASTM C128 – Specific Gravity Test and Absorption of Fine Aggregate
 - 5. ASTM C131 – Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - 6. ASTM C136 – Sieve or Screen Analysis of Fine and Coarse Aggregates
 - 7. ASTM D70 – Specific Gravity of Semi-Solid Bituminous Materials
 - 8. ASTM D2726 – Bulk Specific Gravity of Compacted Bituminous Mixtures
 - 9. ASTM D2041 – Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
 - 10. ASTM D4462 – Viscosity of Asphalts (Bitumens)
 - 11. ASTM D2172 – Quantities Extraction of Bitumens from Bituminous Paving Mixtures
 - 12. ASTM D2419 – Sand Equivalent Value of Soils and Fine Aggregate
 - 13. ASTM D290 – Bituminous Mixing Plant Inspection
 - 14. ASTM D6373 – Performance Graded Asphalt Binder
 - 15. ASTM D692 – Course Aggregate for Bituminous Paving
 - 16. ASTM D1073 – Fine Aggregate for Bituminous Paving Mixtures
 - 17. ASTM D1241 – Materials for Soil-Aggregate Subbase, Base and Surface Courses
 - 18. ASTM D2026 – Cutback Asphalt (Slow-Curing Type)
 - 19. ASTM D2027 – Cutback Asphalt (Medium-Curing Type)
 - 20. ASTM D2028 – Cutback Asphalt (Rapid-Curing Type)
 - 21. ASTM D2950 – Density of Bituminous Concrete in Place by Nuclear Methods
- C. Surface Preparation Standards (SSPC)
 - 1. SP-2: Superior Performing Asphalt Pavement System (Superpave) Level 1 Mix Design
- D. Colorado Department of Transportation
- E. Colorado Asphalt Pavement Association

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1.3 SUBMITTALS

- A. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions. Retain until completion and furnish a final copy to Town of Mead.
- B. Proposed Design Job Mix Formula for each mixture required by the work: the mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design.
- C. Test Reports: Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of, and shall be stamped and signed by, a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:
 - 1. Source of materials
 - 2. Gradation, specific gravity, source and description of individual aggregates and the final blend
 - 3. Aggregate physical properties
 - 4. Source and Grade of the Performance Graded Binder (PG Binder)
 - 5. Proposed Design Job Mix - aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content
 - 6. Required mixing and compaction temperatures
 - 7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
 - 8. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
 - a. Uncompacted asphalt concrete mix
 - i. Asphalt cement content: ASTM D2172 (AASHTO T164)
 - ii. Maximum Specific Gravity: ASTM D2041 (AASHTO T209)
 - b. Compacted asphalt concrete mix
 - i. Bulk density: ASTM D1188 (AASHTO T166)
 - c. Perform at least one test for each day's paving, but not less than one test per each 4,000 sf of each lift.

1.4 QUALITY ASSURANCE

- A. Materials and installation shall conform to applicable portions of Colorado Department of Transportation (CDOT) and Town of Mead construction specifications, standards and details.

1.5 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way, conform to the requirements of **Town of Mead Design Standards and Construction Specifications** and details.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Transport mixture from mix plant in trucks with tight, clean, smooth, non-sticking compartments. Thinly coat hauling compartments with lime-water mixture, paraffin oil or other approved release agent to prevent sticking. Petroleum distillates such as kerosene or fuel oil are not approved release agents. Elevate and drain compartment of excess solution before loading mix.
- B. Cover loads to protect from weather and prevent loss of heat.

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- C. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when underlying surface is muddy, frozen or wet.
- B. Place material only when weather conditions permit pavement to be properly placed and compacted.

The hot mix asphalt will be placed only when both the air and surface temperatures are equal to or exceed the temperatures specified in the table below:

CDOT Table 401-3: Placement Temperature Limitations in F

Compacted Layer Thickness (Inches)	Minimum Air and Surface Temp. (Degrees F and rising)	
	Top Layer	Other Layers
1½ or less	60	50
>1½ to 3	50	40
3 to 4	45	35

- C. Air temperature shall be taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Pavement shall be asphalt of the plant hot mix type. Materials and construction shall comply with Section 403 and 702 of the CDOT Standards and Specifications for Road and Bridge Construction.
- B. Tack Coat:
 1. SS-1 or CSS-1h
 2. AASHTO M208 or M140
- C. Asphaltic Cement
 1. Superpave Performance Graded (PG) binder of PG64-22 or PG58-28 Table 702-1 of CDOT standard section 702
 2. Will not be acidic modified or alkaline modified
 3. Will not contain any used oils that have not been refined
 4. Modifiers will not be carcinogenic
- D. Aggregate for Asphaltic Concrete
 1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
 2. Sand, stone, or slag screening: ASTM D1073
 3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve
- E. Base Course Aggregates for Asphaltic Concrete
 1. Uncrushed gravel may be used in mixture if it meets design criteria specified.
 2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40.

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3. Provide aggregate in gradations for courses to comply with Class S and SX, Colorado Department of Transportation, ASTM C136
 4. A maximum of 20% Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
- F. Surface Course Aggregates for Asphaltic Concrete
1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions.
 2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50.
 3. Provide aggregate in gradations for courses to comply with Class S or SX, Colorado Department of Transportation, ASTM C136. Wearing surface course shall be Grading S or SX for residential roadway classification and Grading S for collectors, arterials, and all industrial/commercial roadways.
- G. Hydrated Lime for Aggregate:
1. May be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment will conform to ASTM C207, Type N. Residue retained on a No. 200 sieve will not exceed 10% when determined in accordance with ASTM C110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.
- H. Weed Control:
1. First application: "Roundup," or accepted substitute.
 2. Second application: Casoron "W-50" or "G-10" with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Traffic Control Devices

1. Signs.
 - a. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by the Town. Private property or nonstandard signs will be maintained by the property owner. Contact the Town for additional details and submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements.
2. Sign Posts.
 - a. For large signs greater than 12" W x 18" H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
 - b. For regular single signs 12" W x 18" H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
 - c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, on all sides over full length. Tube shall be minimum of ten (10) feet in length.
3. Sign Post Anchor Bases (Stubs): All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4" by 2-1/4" anchor for large posts and 1-3/4" by 1-3/4" anchor for regular posts. Bases shall be embedded a minimum of 36" below finished grade and shall extend 3" above finished grade.

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4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6" diameter by 36" deep concrete footing around signs post anchor base for all signs in landscaped areas.
 5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.
 6. All posts shall be mounted and secured with break-away capability, per M.U.T.C.D.
- B. Pavement Marking: Specified pavement marking materials shall be used at locations as identified below.
1. Striping shall be white, blue, yellow and red color epoxy meeting requirements of CDOT Standard Specification 713. Verify colors and extent of epoxy prior to application. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on parking zone pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on public road or street pavements.
 2. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way.

2.3 MIXES/SOURCE QUALITY CONTROL

- A. Determine full depth design mix based upon aggregates furnished.
1. Test mix shall be provided by independent laboratory at Contractor's expense.
 2. Submit mix designs for review and acceptance by Town Engineer
- B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property	S (75)	SX (75)
Air Voids in Mix %, (N Design)	3.5-4.5	3.5-4.5
Initial Gyration	7	7
Design Gyration	75	75
Hveem Stability	28 minutes	28 minutes
Voids Filled w/ Asphalt (%)	65 - 80	65 - 80

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- C. Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following ranges of design mix:

Property	Allowable Range with Respect to Design Mix
Aggregate Sieve Size: ¾-inch and larger	± 6%
Aggregate Sieve Size: #4 - #8	± 5%
Aggregate Sieve Size: #30	± 4%
Aggregate Sieve Size: #200	± 2%
Asphalt Content Tolerance	± 0.3%
Discharge Mix Temperature Tolerance	± 20° F

PART 3 EXECUTION

3.1 EXAMINATION

- A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.
- B. Operate heavy, rubber-tired front loader or fully loaded water truck over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 5 or 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.2 PREPARATION

- A. Prepare subgrade under provisions of Section 31 00 00 Earthwork
- B. Loose and Foreign Material
1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust.
- C. Weed Control
1. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
 2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
 3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
 4. Do not apply within 20 feet of trees or shrubs.

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D. Tack Coat

1. Apply in similar manner as prime coat, except as modified.
2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or Portland cement concrete and surfaces.
3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface using a mechanical distributor (for main line paving).
4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement.
5. Allow surfaces to dry until material is at condition of tackiness to receive pavement.

3.3 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to minimum depth of 1 ½-inches, or as indicated on the plans.
 2. Mill to a uniform finished surface free of gouges, grooves, and ridges of more than ¼ inch depth.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Transport milled hot-mix asphalt to asphalt recycling facility. Town may request that material be stockpiled at Town facility.
 7. Keep milled pavement surface free of loose material and dust.

3.4 RING/FRAME ADJUSTMENTS

- A. Set ring/frames of subsurface structures to final grade as a part of this work.
- B. Placing Ring/Frames
 1. Surround ring/frames set to elevation with a ring of compacted asphalt or concrete base prior to paving.
 2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping.
- C. Adjust frames to proper position to meet paving.
- D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations.
- E. Set ring/frames to grade, flush with surface of adjacent pavement.

3.5 PREPARING THE MIXTURE

- A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation.
- B. Stockpile
 1. Keep each component of the various sized combined aggregates in separate stockpiles.
 2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation.

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C. Heating

1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture.
2. Use lowest possible temperature to suit the temperature viscosity characteristics of asphalt.
3. Do not exceed 350 degrees F.

D. Aggregate

1. Heat-dry aggregates to acceptable moisture content.
2. Deliver to mixer at recommended temperature to suit the penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture.
3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements.

- E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489.

3.6 EQUIPMENT

A. Bituminous Pavers:

1. Pavers shall be self-propelled, spread material without tearing surfaces, be equipped with an activated screed assembly, be heated if necessary, control pavement edges to true lines without use of stationary forms and capable of spreading and finishing the asphalt plant mix material in widths applicable to the typical sections and thicknesses for the work.
2. Pavers used for roadway shoulders, recreational paths and similar construction will be capable of spreading and finishing the courses of asphalt plant mix material in widths shown in the contract documents.
3. Pavers will be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor will be constructed to operate from either or both sides of the paver and will be capable of working with the following devices:
 - a. Ski-type device at least 30 feet in length
 - b. Short ski or short shoe
 - c. At least 5,000 feet of control line and stakes
4. The controls will be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.
5. Manual operation will be permitted:
 - a. For constructing irregularly shaped or minor areas
 - b. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. However, if specified surface tolerances cannot be achieved, paving operations will be suspended until satisfactory correction, repairs of equipment or replacements are made.
6. Placement of hot mix asphalt on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or other protective covering.

B. Rolling Equipment

1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking.

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- 2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines.
- C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools as required.

3.7 PLACING THE MIX

- A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine.
- B. Complete placement over full width of section on each day's run.
- C. Spread mixture at minimum temperature specified by CDOT Table 401-5 for the specific binder used in the asphalt mix:
 - 1. PG 64-22: 320 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
 - 2. PG 58-28: 275 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
 - 3. The maximum mix discharge temperature shall not exceed the minimum discharge temperature by more than 30 F.
 - 4. Delivered mix temperature shall be measured behind the paver screed.
 - 5. Hot asphalt mixture shall be produced at the lowest temperature with the specified temperature range:
 - a. A workable mix that provides for uniform coating of aggregates, in accordance with AASHTO T195.
 - b. Allowing the required compaction to be achieved.
- D. Inaccessible and small areas may be placed by hand.
- E. Conform to the grade, cross section, finish thickness, and density indicated.
- F. Lift Thickness
 - 1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0" thick and no greater than 3.0" thick. Top lift to be 2" thick.
 - 2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift from bottom to top lift (inches)
2"	1	2
3"	1	3
4"	2	2-2
5"	2	3-2
6"	3	2-2-2
7"	3	3-2-2
8"	3	3-3-2
9"	4	3-2-2-2
10"	4	3-3-2-2
>10	Review with Town Engineer	

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G. Paver Placing

1. Unless otherwise directed, place pavers along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow.
2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
3. Complete base courses before placing surface courses.
4. Place mixture in as continuous an operation as practicable.

H. Hand Placing

1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Town Engineer.
2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature.

I. Joints

1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill.
2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course.
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.
4. Offset transverse joints in succeeding courses not less than 24 inches.
5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness.
6. Offset longitudinal joints in succeeding courses not less than 6 inches.
7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness.
8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road.
9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road.
10. Joints shall not be placed in traffic wheel paths.

- J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing.

3.8 COMPACTING THE MIX

- A. All paving will be compacted to 94 +/- 2% of Maximum Theoretical (RICE) density, CP-51 or AASHTO T209: Maximum Specific Gravity of Bituminous Paving Mixtures, as determined by ASTM D 2950. RICE values will be used in calculating Relative Compaction according to CP-44 or AASHTO T166.
- B. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability.
- C. Begin rolling operations when the mixture will bear weight of roller without excessive displacement and complete as quickly as possible after placement occurs.

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- D. Compaction operations will be continuous until the required density is achieved or the density requirements are not met and the mix temperature falls below 185° F or there is obvious surface distress or breakage. Minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on the asphalt binder supplier documentation kept on file at the jobsite.
- E. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.
- F. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- G. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs.
- H. Do not roll centers of sections first under any circumstances.
- I. Breakdown Rolling
 - 1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.
 - 2. Operate rollers as close as possible to paver without causing pavement displacement.
 - 3. Check crown, grade, and smoothness after breakdown rolling.
 - 4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling.
- J. Second Rolling
 - 1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction.
 - 2. Continue second rolling until mixture has been thoroughly compacted.
- K. Finish Rolling
 - 1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers.
 - 2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances.
 - 3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness.
- L. Patching
 - 1. Remove and replace defective areas.
 - 2. Cut-out and fill with fresh, hot asphaltic concrete.
 - 3. Remove deficient areas for full depth of course.
 - 4. Saw cut sides perpendicular and parallel to direction of traffic with edges vertical.
 - 5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture.
 - 6. Compact by rolling to specified surface density and smoothness.

3.9 JOINING TO EXISTING WORK

- A. Saw cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.

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- B. All joints shall be compacted to 94.0% +/- 3.0% of RICE, taken fully on each side of joint, every 200 lineal feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T166.

3.10 FIELD QUALITY CONTROL

- A. The Contractor will engage a certified testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction.
- B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections.
- C. Testing Agency will test in-place pavement for density and thickness.
- D. Asphalt density testing:
 - 1. Every one-hundred fifty (150) lineal feet per driving lane
 - 2. Every 2,000 square feet of parking lot
 - 3. Densities shall be between ninety-four percent (94%) and ninety-six percent (96%) of the RICE unit weight
- E. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections.
- F. The Contractor will core the pavement as required by the testing agency for field density tests in accordance with AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with ASTM D 2950.
 - 1. Minimum testing frequency shall be 1/500 lane feet per lift (min. of 1 per street) or as directed by the Town or testing agency.
 - 2. Testing agency will take not less than 4-inch diameter pavement specimens.
 - 3. At the testing agency's discretion, cores may be required at the beginning of placement of each pavement layer or change of mixture materials or gradation.
 - 4. Untested areas during placement will require cores to be taken to verify compaction.
 - 5. Contractor to repair holes from test specimens.
- G. For each completed course or from locations directed by the testing agency, and at a minimum, a representative asphalt pavement sample shall be taken from the first one thousand (1,000) tons, and all mix properties shall be verified. The percent voids filled with asphalt cement, Hveem stability, and Lottman shall be verified at a minimum of every ten thousand (10,000) tons. Asphalt testing shall comply with ASTM D1559. Two copies of all test reports shall be submitted directly to the Town Engineer.
- H. Acceptable density of in-place course materials is between 92 and 96 percent of the recorded laboratory RICE unit weight. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements.
- I. Thickness: Variations from approved drawings
 - 1. Base course: 1/4-inch +
 - 2. Remove and replace paving less than minimum thickness
- J. Grade Tolerance: ±0.1 feet
- K. Surface Smoothness
 - 1. Test using a 10-foot straight edge applied parallel to direction of drainage.
 - 2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact.
 - 3. Do not permit pockets or depressions where water may pool.

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4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to the Town.
- L. Inspection: The work of this section is subject to the inspection and approval of the Town. The following inspections are required:
 1. Protection of adjacent property
 2. Staking and establishment of elevations
 3. Establishment and compaction of subgrade
 4. Placement and compaction of bituminous base course and wearing surface
 5. Final inspection
 6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

3.11 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of the Town.

3.12 PROTECTION OF FINISHED WORK

- A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.
- B. Provide barricades and warning devices as required to protect pavement and the general public.

3.13 WARRANTY

- A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the Town in accordance with the requirements of the original work.

3.14 SCHEDULE OF MIX PLACEMENT:

- A. Refer to approved drawings for asphalt thickness and subgrade requirements.

END OF SECTION 32 12 00

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SECTION 32 13 00 RIGID PAVING AND FLATWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 REFERENCES

- A. AASHTO M171 – Sheet Materials for Curing Concrete
- B. ACI – American Concrete Institute
 - 1. ACI 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
 - 2. ACI 301 – Specifications for Structural Concrete for buildings
 - 3. ACI 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
 - 4. ACI 305/305R – Hot Weather Concreting
 - 5. ACI 306/306R – Cold Weather Concreting
 - 6. ACI 308 – Standard Practice for Curing Concrete
- C. ASTM
 - 1. ASTM A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
 - 2. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 3. ASTM C31 – Making and Curing Concrete Test Specimens in the Field
 - 4. ASTM C33 – Concrete Aggregates
 - 5. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 6. ASTM C94 – Ready Mix Concrete
 - 7. ASTM C143 – Test Method of Slump of Hydraulic Cement Concrete
 - 8. ASTM C150 – Portland Cement
 - 9. ASTM C260 – Air-Entraining Admixtures for Concrete
 - 10. ASTM C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
 - 11. ASTM C494 – Chemical Admixtures for Concrete
 - 12. ASTM C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - 13. ASTM C1116 – Fiber Reinforced Concrete
 - 14. ASTM D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
 - 15. ASTM D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
 - 16. ASTM C979 – Pigments for Integrally Colored Concrete
 - 17. ASTM D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction

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- 18. ASTM D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- D. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- E. Colorado Department of Transportation (CDOT)
- F. Town of Mead Design Standards and Construction Specifications

1.3 SUBMITTALS

- A. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds.
 - 1. Existing data on proposed design mixes, certified and complete
 - 2. Submit reports of field quality control testing

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301: Conform materials and installation to applicable portions of Colorado Department of Transportation, and the Town of Mead.

1.5 REGULATORY REQUIREMENTS

- A. For work on public streets or rights-of-way conform to the requirements of **Town of Mead Design Standards and Construction Specifications** and details for the construction of curbs, gutters, sidewalks, driveways, Street Paving, and other public right-of-way Improvements.
- B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.
- C. Obtain cementitious materials and aggregate from same source for all work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover.
- B. Rubber and plastic materials: Store in a cool place. Do not expose to direct sunlight.
- C. Prepare a delivery ticket for each load of ready-mixed concrete.
- D. Contractor shall submit tickets for all concrete delivered to site which document the following:
 - 1. Quantity delivered
 - 2. Actual quantity of each material in batch
 - 3. Outdoor temp in the shade
 - 4. Time at which cement was added
 - 5. Numerical sequence of the delivery
 - 6. Quantity of water that can be added in the field based on mix design
 - 7. Free moisture in fine and coarse aggregate in percent by weight
 - 8. Temperature of batch

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Protect concrete from rapid loss of moisture during hot weather placement.

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PART 2

2.1 MATERIALS

A. Form Materials

1. Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.
4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. Reinforcement

1. Where reinforcement is specified herein or indicated on the approved drawings:
 - a. Bars: ASTM A615, Grade 60
 - b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
 - c. Furnish in flat sheets
 - d. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
 - e. Fibrous reinforcement: Collated, fibrillated, polypropylene fibers, tensile strength 70,000 psi
 - i. ASTM C1116
 - ii. Use 1.5 lbs. Per cubic yard minimum
 - iii. Fibermesh or accepted substitution

C. Weed Control: First application, "Roundup." Second application, Casoron "W-50" or "G-10" with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

D. Detectable Warning Plates

1. Detectable warning plates shall consist of cast iron domes and be prefabricated by the manufacturer as a pattern on embeddable cast iron surface plates and meet AASHTO M 333-16 requirements. The final surface shall meet the requirements given in R305 of the PROWAG.
2. DWS provide a cue to pedestrians with visual impairments and are required to contrast visually with the surrounding surface (light on dark or dark on light). The domes and their underlying surface shall contrast visually with adjacent gutter, street or highway, or pedestrian access route surface, either light-on-dark or dark-on light, per R305.1.3 of the PROWAG.
3. The truncated dome pattern of the DWS should be aligned so that the rows of domes are parallel to the direction of pedestrian travel.
4. Prior to installation of the plates, concrete shall be installed and consolidated as a base for the plates. The concrete shall be placed to a thickness that will allow the base surface of the plates to be at the same elevation as the adjacent concrete.

2.2 ACCESSORIES

- #### A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane

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- B. Joint Sealers: Polyurethane base, elastomeric, self-leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions
- C. Sheet Materials: AASHTO M171, 4 millimeters
- D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethylene foam; Texmastic "vinylex 3600," Sonneborn "Sonoflex F," or accepted substitutions

2.3 CONCRETE MIX

- A. Comply with ASTM C94
- B. Maximum Coarse Aggregate Size: 1-inch
- C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete
- D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.45
- E. Slump: 4-inch maximum
 - 1. May be increased to 4.5 inches for hand work, acceptable to Town.
 - 2. As low as possible consistent with proper handling and thorough compaction.
- F. Volumetric Air Content: 5 – 8% by volume (per CDOT Table 601-1)
 - 1. Vary air content with maximum size aggregate, ASTM C94, Table 3.
- G. Strength: Compressive strength as determined by ASTM C39, 4,500 psi minimum at 28 days
- H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded.
- I. Adjust mix as required to meet specifications.
- J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
 - 1. The loss on ignition shall not exceed 3.0 percent
 - 2. The CaO in Class F fly ash shall not exceed 18 percent
- K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification.
- L. Include a water reducing admixture.
- M. Calcium chloride content shall not exceed 0.05% of the cement content by weight.
- N. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk, and pavement. Add fiber reinforcement to mix at plant prior to delivery to jobsite.

2.4 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design to Town of Mead for review and approval prior to commencement of work.
- B. Tests on cement and aggregates will be performed to ensure conformance with specified requirements.
- C. Test samples in accordance with ACI 301.

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PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that the compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify that the gradients and elevations of base are correct.
- C. Check completed formwork for grade and alignment to the following tolerances:
 - 1. Top of forms not more than 1/8-inch in 10 feet
 - 2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

- A. Subgrade
 - 1. Prepare subgrade in accordance with Section 31 00 00 – Earthwork.
 - 2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete.
 - 3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 31 00 00 – Earthwork.
 - 4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high.
 - 5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete.
- B. Weed Control
 - 1. If weeds or vegetation exist at or on the subgrade, apply “Round-up” at rates following manufacturer’s instructions. Apply “Round-up” three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow “Round-up” to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
 - 2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to “Round-up” and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
 - 3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor’s expense.
 - 4. Do not apply within 20 feet of trees or shrubs.

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C. Frame Adjustment

1. Coat surfaces of manhole and catch basin frames with oil or approved board breaker to prevent bond with concrete pavement for concrete collars.
2. Set frames of structures in full grout bed to provide bearing. Set to final grade.
3. Form construction joints and blockouts as indicated on approved drawings.

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete

1. Transporting of mixed concrete shall conform to ACI 305R.
2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling.
3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Town. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Town.
5. Provide delivery ticket and comply with delivery requirements of this Section.

B. Forming

1. Place and secure forms to correct location, dimension, profile, and gradient.
2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement.
3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
4. Oil forms prior to concrete placement.
5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.
6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the approved drawings.
7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face.
8. Backfill behind forms as required to prevent water from entering subgrade.

C. Reinforcement

1. Add fiber reinforcement to mix at plant prior to delivery to jobsite.
2. Place reinforcement at mid-height of slabs-on-grade or as shown on the approved drawings
 - a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire.
 - b. Support with metal chairs. Brick or stone is unacceptable.
3. Hold all tie and marginal dowels in proper position by sufficient supports or pins.
4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip.
5. Interrupt reinforcement at expansion joints.

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6. Place dowels to achieve pavement and curb alignment as detailed.
7. Provide doweled joints at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.
8. Grease dowels on one side of joints with caps on greased end.

D. Placing concrete

1. Place concrete in accordance with ACI 301.
2. Lightly moisten subgrade or base course immediately before placing concrete.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
4. Deposit concrete near final position. Minimize segregation and damage to subgrade.
5. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials.
6. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs.
7. Do not place concrete in forms that has begun to set.
8. Do not place more concrete in one day than can be finished before dark the same day.
9. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.
10. Walks: Construct sidewalks with a minimum thickness of 6-inches per Town of Mead standard details. Tool edges to rounded profile and finish as specified or as shown on the approved drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated.

E. Cold Weather Concreting

1. Conform to ACI 306/306R, except as modified herein.
2. Minimum concrete temperature at the time of mixing will conform to the following table:

Outdoor Temperature at Placement, as measured in the shade	Minimum Concrete Temperature at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

3. Do not place heated concrete which is warmer than 80 degrees F
4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 degrees F for 5 days or 70 degrees F for 3 days with forms in place.
5. Do not allow concrete to cool suddenly.

F. Hot Weather Concreting

1. Conform to ACI 305/305R, except as modified herein.

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2. At air temperature of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection.
 3. Do not allow concrete temperature to exceed 70 degrees F at placement.
 4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
 5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4.
- G. Joints
1. Provide concrete joints per CDOT Standard Details.
 2. Sidewalk and pavement
 - a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut.
 - b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 200 feet.
 - c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length.
 3. Curb and Gutter
 - a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.
 - b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
 - c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.
 4. Place expansion joint filler between paving components and buildings or other appurtenances when temperatures are above 50 degrees F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
 5. Provide keyed joints as indicated in approved drawings
- H. Finishing
1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
 2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
 3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish.
 4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted.
 5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Town before application.

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6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.
 7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
 8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
 9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
 10. Direction of Texturing:
 - a. Curb and Gutter: At right angles to the curb line
 - b. Sidewalk: At right angles to centerline of sidewalk
 11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Town.
 12. Finishing aid shall be submitted to Town Engineer for approval. Water is not allowed as a finishing aid
- I. Joint sealing
1. Seal joints and clean concrete prior to opening to traffic.
 2. Seal all expansion joints.
 3. Separate concrete from other structures with 3/4-inch thick joint filler.
 4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
 5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.
- J. Curing and protection
1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
 2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions.
 3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved.

3.4 FIELD QUALITY CONTROL

- A. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide testing agency sufficient advance notification to schedule tests.
- B. Tolerances
1. Maximum Variation of Surface Grade: 1/4-inch in 10 ft
 2. Maximum Variation from True Alignment: 3/8-inch in 10 ft
- C. Take cylinders and perform slump and air entrainment tests as required in accordance with ACI 301. Unit weight and mix temperature will also be taken.
- D. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three

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consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cubic yards or less cubic yards of concrete placed each day.

- E. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.
- F. One slump and air entrainment test will be taken for each set of test cylinders taken.
- G. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and one at a later date should the test at 28 days fail or as directed by the Town Engineer.
- H. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.
- I. Thickness of fresh concrete may be checked by Town Engineer at random. Coring will be conducted in accordance with Town of Mead requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for Portland cement concrete paving as specified in the contract documents and/or the documented material costs of the concrete in question.
- J. Failure of Test Cylinders or Coring Results: Town may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness.

3.5 SCHEDULE OF CONCRETE

- A. Concrete thicknesses and subgrade preparation shall be per approved drawings and applicable Town of Mead standard detail drawings.

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

- A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement.
- B. Rebar reinforcement required for all cross pans as noted in Town of Mead standard drawings.

END OF SECTION 32 13 00

SECTION 33 01 30.7 CURED IN PLACE PIPE LINING FOR REHABILITATION OF SANITARY SEWERAGE MAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Minimum requirements for the rehabilitation of sanitary sewer pipelines by the installation of Cured-In-Place Pipe (CIPP) within the existing, deteriorated pipe as shown on approved drawings. The work for rehabilitation of sanitary sewer pipelines shall include the cleaning and flushing of existing sanitary sewers prior to installation of CIPP.
- B. The rehabilitation of sanitary sewer pipelines shall be done by the installation of a resin-impregnated flexible tube which, when cured, shall be continuous and tight-fitting throughout the entire length of the original pipe. The CIPP shall extend the full length of the original pipe and provide a structurally sound, jointless and water-tight new pipe within a pipe. The Contractor is responsible for proper, accurate and complete installation of the CIPP using the system selected by the Contractor. Ground water will be present in the existing sanitary sewer. Service connections shall be reestablished after the CIPP is cured.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - 2. D638 – Standard Test Method for Tensile Properties of Plastics
 - 3. D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 4. D1248 – Standard Specification of Polyethylene Plastics Molding and Extrusion Materials
 - 5. D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
 - 6. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 7. D2122 – Determining Dimensions of Thermoplastic Pipe and Fittings
 - 8. D2657 – Standard Practice for Heat-Joining Polyolefin Pipe and Fittings
 - 9. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - 10. D2990 – Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics
 - 11. D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - 12. D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - 13. D5813 - Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
 - 14. F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 - 15. F1533 - Standard Specification for Deformed Polyethylene (PE) Liner

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16. F1606 - Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) Liner
17. F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
18. F1867 - Standard Practice for Installation of Folded/Formed Poly(Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation
19. F1871 - Standard Specification for Folded/Formed Poly(Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation
20. F2019 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

1.3 SUBMITTALS

- A. Shop Drawings and Product Data
 1. Manufacturer
 2. Sufficient data to verify compliance with the specifications and to illustrate construction and assembly of the products.
 3. Detailed specifications and data describing materials used.
 4. Indicate liner dimensions for each pipe size to be relined.
 5. Complete description of proposed wet-out procedures.
- B. Manufacturer's Installation Instructions
 1. Submit detailed description of liner placement and curing procedures for piping.
 2. Include description of procedures for sealing liner material at manholes and reestablishing service connections.
 3. Submit manufacturer's requirements for receiving, handling, and storage of materials.
- C. Manufacturer's Field Start-up Report
 1. Indicate personnel present and actual test procedures that were performed by manufacturer's representative.
 2. Manufacturer to submit field verification of proper assembly.
- D. Contractor's procedures and materials for service renewal
- E. Digital Video Discs (DVDs):
 1. Submit video recordings of piping sections
 2. Show cured liner and reestablished service connections after relining Work is complete.

1.4 COORDINATION

- A. Coordinate Work of this Section with users connected to the system.
- B. Notify home owners and businesses at least 48 hours in advance of expected disruption of sanitary service.
- C. Limit disruption of service to individual properties to one-time occurrence for maximum of eight hours.
- D. Do not disrupt customer service between hours of 5:00 P.M. and 8:00 A.M.
- E. Provide and maintain temporary facilities, including piping and pumps, to meet Town requirements.

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1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains and services that include CIPP liner. Indicate pipe inverts and top of pipe elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience in installation of liner materials and licensed or certified by manufacturer.

1.7 DELIVERY STORAGE AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products. No products shall be shipped to the job site without the approval of the Town Engineer.
- B. Keep products safe from damage. Promptly remove damaged products from the job site. Replace damaged products with undamaged products. Protect material from moisture.
- C. Store hydrophilic end seal gaskets inside, in a dry, humidity controlled environment. The end seal will swell when exposed to moisture, either direct or indirect.

1.8 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrications.
- B. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Material Warranty
 - 1. All CIPP liners shall be certified by the manufacturer for specified material properties for the repair. The manufacturer shall warranty the liner to be free from defects in raw materials for ten years from the date of installation. During the warranty period, any defects which affect the integrity, strength or water tightness of the installed pipe shall be repaired at the contractor's expense.
- B. Installation Warranty
 - 1. The Installer shall guarantee the CIPP liner against defects in installation and workmanship for the period of two (2) years commencing with the date of substantial completion of the CIPP system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. CIPP Liner
- B. Layne, Inc
- C. Insituform Technologies, Inc.
- D. LMK Technologies, LLC
- E. Or accepted substitution approved by Town Engineer

2.2 DESIGN CONSIDERATIONS

- A. CIPP shall be designed in accordance with ASTM F1216 and D5813.
- B. CIPP design for the main sheet shall assume no bonding to the original pipe.

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- C. The resin saturated main sheet must place the resin in full contact with the host pipe. The cured liner must provide coating on the interior of the lateral piping for an improved flow rate.
- D. The liner must be smooth and have an average roughness coefficient “n” factor of 0.013 or lower.

2.3 GENERAL

- A. The CIPP liner shall be constructed of materials and methods that provide a jointless and continuous structurally sound liner able to withstand all imposed static, and dynamic loads on a long-term basis.
- B. Design lining material to have sufficient structural strength to support dead loads, live loads, and groundwater load imposed, assuming existing pipe cannot share loading or contribute to structural integrity of liner.
- C. Field measurements of the existing pipe diameters, ovality and length shall be taken.
- D. Pipe liner shall be capable of installation with water in the carrier pipe and surrounding groundwater.
- E. The flexible tube shall be fabricated to a size that when installed will neatly fit (minimum 99.75%) the internal circumference of the existing sanitary sewer lines (including services). Allowance shall be made for circumferential stretching during insertion so that the final cured product is snug against the wall of the host pipe.
- F. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise shown or specified. The Contractor shall verify the lengths in the field before impregnation.

2.4 CURED-IN-PLACE-LINER (CIPP)

- A. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester or thermosetting vinyl ester resin and catalyst system compatible with the reconstruction inversion process that provides cured physical strengths specified herein, and complies with ASTM D5813, F1216, F1743, and F2019.
- B. Liner material shall be manufactured with resins pre-impregnated within the liner to eliminate the possibility of air bubbles and voids. Resin shall be a corrosion-resistant polyester or vinyl ester resin and catalyst system that, when properly cured within tube composite, meets requirements of ASTM F1216, F1743, and F2019.
- C. The liner thickness shall be sized for a minimum hydrostatic load of 8.0 feet and maximum depth of earth cover as measured in the field. The hydrostatic load shall be increased to the manhole depth plus 1.0 foot for bury depths in excess of 8.0 feet.
- D. The finished pipe liner in place shall be fabricated from materials which when complete is chemically resistant to and will withstand internal exposure to domestic sewage having a pH range of 5 to 11 and temperature of 150°F.
- E. Minimum Design Criteria:
 - 1. Minimum flexural strength: 4,500 PSI
 - 2. Initial Modulus of Elasticity: 250,000 PSI
 - 3. Nominal CIPP Thickness: Per ASTM F1216, Minimum of 6mm

2.5 MAINLINE CONNECTION

- A. The main tube and lateral tube shall form a one-piece assembly by stitching the lateral tube to the mainsheet aperture.
- B. The connecting end of the lateral tube shall be shaped to match the aperture and curvature of the main tube.

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- C. The lateral tube and main tube shall be sealed by use of a flexible UV cured adhesive/sealant applied in a factory controlled setting.
- D. The main/lateral tube assembly shall take the shape of a tee or wye with corresponding dimensions such as a curved circle or a curved elliptical opening in the pipefitting.

2.6 HYDROPHILIC GASKET SEAL

- A. The rubber joint seal shall be an extended hydrophilic rubber compounded from chloroprene (Neoprene) rubber and a hydrophilic resin, which expands on contact with water.
- B. The rubber joint seal shall be bonded with adhesive on one face to hold it in place during assembly.
- C. On contact with water, the rubber shall swell by up to 10 times its original volume if necessary and mold itself to completely fill any gaps and exert pressure evenly to ensure the seal. High compression or bolt up forces shall not be necessary to effect a complete and watertight seal.
- D. Hydrophilic rubber joint seals shall be installed at all manhole walls for all lining products.
- E. The mainline tube shall include a seamless molded flange shaped gasket attached to the main liner tube at the connection or four molded hydrophilic O-rings at the mainline termination ends.
- F. The gaskets must be a minimum of 2.5mm thick and must retain this consistent thickness under installation pressures.
- G. The hydrophilic gasket seals must be manufactured in a controlled factory environment with strict quality control and quality assurance protocols.
- H. A liquid sealant, adhesives or other fluid like materials having paste like consistency will not be accepted.

2.7 SOURCE QUALITY CONTROL

- A. Inspect extruded material for defects and physical properties according to ASTM D1785. Verify liner material is homogeneous and free of defects, cracks, holes, blisters, protrusions, foreign materials, or other deleterious faults.
- B. Marking:
 - 1. For testing purposes, mark each production lot with identical marking number.
 - 2. Mark each reel of folded PVC pipe at intervals not to exceed 5 feet with coded number identifying manufacturer, size, cell class, machine, shift, and date when liner was extruded.
- C. Chemical and Physical Testing: Test cured samples according to ASTM D5260.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cleaning: Clean existing sewer pipes of debris, sedimentation, and mineral deposits with high-velocity cleaner, bucket and scraper, root saws, rolling or balling units, or other appropriate means.
- B. Bypassing Sewage:
 - 1. Set up bypassing pump system to isolate each section of piping for relining.
 - 2. Maintain bypass pumping until lining is totally formed and service connections are reestablished.
- C. The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, severe offsets, and collapsed or crushed pipe sections. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.

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3.2 ACCESS SAFETY

- A. Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.

3.3 SANITARY SEWER REHABILITATION PROCEDURES

- A. Pipe Rehabilitation (CIPP) for limits between manholes, or as shown.
- B. Sewer lines with no indication for either pipe rehabilitation (CIPP) or full replacement are to have no work performed on them.
- C. Where practicable, liners should be installed in continuous runs where there are two or more continuous manhole segments. This is especially desirable to connect several short manhole segments with a continuous lining.
- D. Pipe rehabilitation with cured in place thermosetting resin pipe (CIPP) methods must adhere to ASTM F1216 and F2019 for pulled in place installation.
 1. Work includes installation of continuous lengths of homogeneous resin impregnated flexible tube cured tight to existing pipe wall with UV curing, pressurized steam, or in accordance with the manufacturer's recommendations.
 2. Work includes:
 - a. Field air testing
 - b. Point repair prior to lining where necessary
- E. Contractor Responsibilities Include:
 1. Contractor to install the specified system must be responsible for complete performances of such, including, but not limited to:
 - a. Materials
 - b. Application
 - c. Quality Control
 2. Contractor will supply Town Engineer with documentation showing past installation experience and licensing prior to construction.
 3. Contractor prequalification may be required by individual product manufacturers.
 4. Contractor shall inspect all surfaces and sewers prior to construction and notify Town Engineer of any discrepancies or disparities that may interfere with proper preparation or installation.
 5. Contractor must comply with all requirements of the manufacturer.
 6. Contractor is responsible for all quality assurance testing of systems after construction.
 7. Contractor is responsible for all sewage bypass equipment and traffic control.
 8. Contractor is to verify all existing utilities prior to digging for replacement.
 9. After the liner has been installed, as directed by Town Engineer, existing services shall be temporarily reinstated to 95% of the original opening.
 - a. This shall be done without excavation in pavement areas, and in the case of non-man-entry pipes, from the interior of the pipeline by means of a 360-degree television camera and a cutting device that reestablishes the service connection.
 - b. When a remote cutting device is used and a cleanout is available, then a mini-camera down the service shall also be used to assist the operator in cutting or trimming.

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- c. Restored openings should be neatly and smoothly cut and without rough edges. Care must be exercised not to damage the CIPP or the existing main or lateral pipes.
- d. Connections should not be over-cut as this could damage the pipe, break the CIPP watertight seal and/or interfere with future lining of the lateral. Any damage to the liner or lateral while reinstating services will be repaired by a hat or injection sealing method. No grouting will be allowed and no separate payment shall be made for such repair.

3.4 FINISHED CIPP

- A. It shall be a homogenous CIPP liner assembly from manhole to manhole.
- B. The CIPP shall be smooth with minimal wrinkling and shall increase flow rate.
- C. The profile of the hydrophilic molded gaskets should be visible and verifiable during post-video inspection on liners 6mm or thinner thickness.
- D. The CIPP shall be free of dry spots, lifts, and delamination.
- E. The CIPP shall include a textile taper at each end providing a smooth transition to the host mainline liner for accommodating video equipment and maintaining proper flow in the mainline.

3.5 TESTING

- A. The wall thickness shall be measured in accordance with the applicable sections of ASTM Test Method D5813 and D3567. One test shall be taken for every 500 LF of lining completed.
- B. Flexural strength and flexural modulus of elasticity shall be determined in accordance with ASTM D-790. One test shall be taken for every 500 LF of lining completed.
- C. After installation or during the curing/installation process, Contractor shall conduct a mainline integrity pressure test. The test must demonstrate CIPP mainline is watertight.
 - 1. The Contractor shall furnish all necessary equipment to conduct the test. An acceptable method is a low pressure air test, conducted as follows:
 - 2. Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than 2 minutes. Add air if necessary to keep the pressure above 3.5 psi. At the end of this 2 minute stabilization period, note the pressure (must be 3.5 psi minimum) and begin the timed period. If the pressure drops 0.5 psi in less than the time given in the table below, the section of pipe shall have failed the test.
 - 3. When the prevailing groundwater is above the sewer being tested, test pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer.

Sewer Diameter (Inches)	Minimum Test Time per 100 ft. (seconds)
8	72
10	90
12	108
18	144

- 4. If the time for the pressure to drop 0.5 psi is 125 percent or less of the time given in the table, the line shall immediately be re-pressurized to 3.5 psi and the test repeated.
- 5. The pressure gage used shall be supplied by the Contractor and have minimum divisions of 0.10 psi and be oil filled.

3.6 PROSECUTION OF WORK

- A. All sewer services connected to the main shall be reinstated after the sewer main has been lined or replaced due to defects. The Contractor shall note that not all sewer lines segments have been televised in their entirety due to obstructions blocking further entry, etc. These obstructions shall be cleared to allow TV viewing of the entire segment length before lining is commenced. Existing sanitary sewer segments may be broken and contribute considerable

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ground water to the sewer main or contain considerable amounts of grease, roots or other debris.

3.7 FINAL ACCEPTANCE

- A. All CIPP sample testing and repairs to the installed CIPP as applicable shall be completed, before final acceptance, meeting the requirements of these specifications and documented in written form.
- B. The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, after installation of the CIPP liner and reconnection of the side sewers. The finished liner shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks and other defects. Unedited digital recordings of the inspection shall be provided to the Town within ten (10) working days of the liner installation.
- C. The data shall note the inspection date, manhole depths from rim to inverts, location of all reconnected side sewers, debris, defects in the liner, including but not limited to gouges, cracks, bulges, or bumps. Immediately prior to conducting the video inspection, the Contractor shall thoroughly clean the newly installed liner removing all debris and build-up that may have accumulated, at no additional cost to the Town.
- D. Bypass pumping or plugging from the upstream manhole shall be utilized to minimize sewage from entering the line during the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the inspection.

END OF SECTION 33 01 30.7

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SECTION 33 33 00 SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride (PVC) non-pressure pipe for gravity sanitary sewer with all jointing materials, fittings, and other appurtenances required for a complete installation
- B. Polyvinyl chloride (PVC) pressure pipe for sanitary sewer force main with all jointing materials, fittings, and other appurtenances required for a complete installation
- C. All precast manholes complete with steps, ring and cover as required

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A48 – Standard Specification for Gray Iron Castings
 - 2. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 3. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - 4. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
 - 5. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 6. C33 – Standard Specification for Concrete Aggregates
 - 7. C150 – Standard Specification for Portland Cement
 - 8. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - 9. C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
 - 10. C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 - 11. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
 - 12. C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
 - 13. C1227 – Standard Specification for Precast Concrete Septic Tanks
 - 14. C1619 – Standard Specification for Elastomeric Seals for Joining Concrete
 - 15. C1821 – Standard Practice for Installation of Underground Circular Precast Manhole Structures
 - 16. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 - 17. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
 - 18. D1330 – Standard Specification for Rubber Sheet Gaskets
 - 19. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
 - 20. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC)

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21. D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 22. D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 23. D2240 – Standard Test Method for Rubber Property – Durometer Hardness
 24. D2321 – Standard Specification for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 25. D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 26. D2774 – Standard Specification for Underground Installation of Thermoplastic Pressure Piping
 27. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 28. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 29. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
 30. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 31. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 32. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
 33. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 34. F412 – Standard Terminology Relating to Plastic Piping Systems
 35. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 36. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
 37. F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
 38. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
 39. F2164 – Standard Specification for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
- B. American Water Works Association (AWWA):
1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 4. C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
 5. C150 – Standard for Thickness Design of Ductile-Iron Pipe
 6. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast

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7. C504 – Standard for Rubber-Seated Butterfly Valves
 8. C512 – Standard for Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
 9. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
 10. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
 11. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution
 12. M23 – PVC Pipe: Design and Installation
- C. Colorado Department of Transportation (CDOT)
- D. Occupational Safety and Health Administration (OSHA)
- E. National Association of Corrosion Engineers (NACE):
1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines
- F. Plastics Pipe Institute (PPI):
1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
 2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
 3. Handbook of Polyethylene Pipe
 4. Polyethylene Piping Systems Field Manual for Municipal Water Applications
 5. Material Handling Guide

1.3 SUBMITTALS

- A. Product Data: Submit on all products or materials supplied herein.
- B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications.
- C. Shop Drawings and Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight.
1. Pipe materials
 2. Special, fitting, and coupling details
 3. Gasket materials
 4. Valves
 5. Laying and installation schedule
 6. For sewer rehabilitation work
 - a. Manufacturer
 - b. Sufficient data to verify compliance with the specifications and to illustrate construction and assembly of the products
 - c. Detailed specifications and data describing materials used
 - d. Indicate liner dimensions for each pipe size to be relined
 - e. Complete description of proposed wet-out procedures
 7. Specifications and data sheets

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- 8. Affidavits of compliance for protective shop coatings and linings
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.
- E. Test Reports: Submit reports of field exfiltration/infiltration, mandrel and lamp tests.
- F. TV Inspection Files:
 - 1. Submit videos and reports
 - 2. For rehabilitation work, show cured liner, connections to mains, and reestablished service connections after relining work is complete

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains, valves, connections, invert elevations, and any mapped or unmapped utilities.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. Sewer Rehabilitation Work: Accurately record actual locations of piping mains, laterals, and services that include CIPP liner. Indicate pipe inverts and top of pipe elevations.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the Town of Mead and CDPHE Stormwater and/or Groundwater Discharge Permit, notes on the drawings and as specified herein.
- B. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years.
- C. All PVC pipe, regardless of diameter, shall be supplied by a single manufacturer. Fittings may be provided by another manufacturer.
- D. Perform Work in accordance with the Colorado Department of Public Health and Environment (CDPHE) and Weld County.
- E. Contractor shall conduct visual inspection before installation.
- F. Manufacturer's name and pressure rating shall be marked on piping and valves.
- G. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational sewer lines.

1.6 REGULATORY REQUIREMENTS

- A. Conform to all municipal codes and ordinances, laws and regulations of Weld County, Town of Mead, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit.
- B. In case of apparent conflict, CDPHE requirements govern over these specifications.
- C. Contractor shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities.

1.7 DELIVERY, STORAGE AND HANDLING

- A. During loading, transporting and unloading, exercise care to prevent damage to material
 - 1. Use nylon slings only
 - 2. Do not drop pipe or fittings
 - 3. Do not roll or skid against pipe already on ground
 - 4. Repair any damage done to coating or lining
 - 5. Handle per manufacturer's recommendations

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6. Store rubber gaskets in cool dark location
7. Store all material on wood pallets or timbers
- B. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of the Town.
- C. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline shall be repaired in accordance with these Specifications.
- D. Pipe
 1. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 2. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling PVC pipe during cold weather.
 3. Do not store PVC pipe uncovered in direct UV light.
 4. Pipe stored along the trench side shall be suitably supported off the ground to avoid damage to the coating.
- E. Valves
 1. Prepare valves for shipping as follows:
 - a. Ensure that valves are dry and internally protected against rust and corrosion
 - b. Protect valves against damage to threaded ends, flange faces, and weld ends
 - c. Seal valve ends to prevent entry of foreign materials into valve body
 - d. Set valves in best position for handling
 - e. Set valves closed to prevent damage
 2. Deliver and store valves and accessories in shipping containers with labeling in place.
 3. Storage: Use the following precautions for valves during storage:
 - a. Do not remove end protectors unless necessary for inspection; then reinstall for storage
 - b. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary
- F. Precast Concrete Structures
 1. Transport and handle precast concrete units with equipment to protect from dirt and damage.
 2. Do not place precast concrete units in position which will cause damage.
 3. Handle precast concrete structures by means of lifting inserts. Do not move from manufacturer's yard until curing is complete.

1.8 JOB CONDITIONS

- A. All work which requires the interruption of active sanitary sewer service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the Town.
- B. Underground Obstructions
 1. Underground Obstructions known to Engineer are shown on approved drawings
 - a. Contractor shall field locate and verify all obstructions where or not shown on the Drawings.

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2. Notify each Utility Provider and request utility be field located by surface reference at least 48 hours prior to trenching or excavation.
3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict.
 - a. Notify project's Engineer and the Town in case of a conflict.
 - b. In case of a conflict, the proposed work may be changed by Engineer and will require Town approval to modify approved drawings.
4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances.

PART 2 PRODUCTS

2.1 PIPE, MANHOLES AND ACCESSORIES

- A. Comply with the **Town of Mead Design Standards and Construction Specifications** and standard details.
- B. Provide products in sizes and materials specified in approved drawings.

2.2 PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

- A. The PVC piping shall be non-pressure PVC pipe for gravity sanitary sewer application of sizes indicated in the approved drawings.
- B. Pipe and fittings:
 1. ASTM D3034, T-1 wall, SDR 35, non-pressure pipe
 2. Cell classification: ASTM D1784
 3. Pipe length: 12-20 feet standard manufactured length for construction
- C. Joints: ASTM D3212 and F477 - Rubber gasket with one compression gasket ring, integral bell and spigot type
 1. Designed to hold pipe in alignment, provide flexibility, separate the ends of pipe lengths, resist applied earth pressures, and provide fluid tightness
 2. Rubber rings: ASTM F477

2.3 SOURCE QUALITY CONTROL

- A. Identification Marks: Clearly and permanently marked at not greater than 5-foot intervals with pipe diameter, PVC cell classification (if applicable), manufacturer, plant, shift, ASTM, date designations and service designation.
- B. Testing per ASTM D3034
 1. Test products not manufactured in the U.S. at an acceptable laboratory in the U.S.

2.4 PIPE ACCESSORIES

- A. Underground Type Plastic Line Marker
 1. Manufacturer's standard permanent, continuous-printed plastic tape with metallic core, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SANITARY SEWAGE LINE BURIED BELOW." Provide identification markers of one of the following:
 - a. Allen Systems, Inc.
 - b. Emed Co., Inc.
 - c. Seton Name Plate Corp.

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- d. Or accepted substitution
- B. Tracer Wire for Buried Pipe
 - 1. Provide tracer wire for all HDPE pipe and PVC pipe.
 - 2. All tracer wire shall be 12 AWG solid copper wire coated with 45 mil Type HMW - PE blue insulation compliant with ASTM D1351 specifically designed for direct burial in corrosive soil or water.
 - 3. UL listed
- C. Tracer Wire for Horizontal Directional Drilling
 - 1. Non-UL listed tracer wire specifically developed for Horizontal Directional Drilling application.
 - 2. 1/4-inch 304 Stainless Steel tracer wire
 - a. Performance Wire & Cable Inc.: "Tracer wire, Stranded SS /45 mil HMW-HDPE, 30 Volt, HDD direct bury use only"
 - 3. #12 AWG Solid Carbon Clad Steel Extra High Strength tracer wire
 - a. Copperhead Industries, LLC: "Direct Burial #12 AWG Solid (.0808" diameter), 21% conductivity copper-clad hard drawn high carbon steel extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil. high molecular weight-high density polyethylene jacket complying with ASTM D1248, 30 volt rating"
 - b. Pro-Line Safety Products Co.: "Pro-Trace HDD-CCS PE45"
- D. Tracer Wire Test Stations
 - 1. 4-inch with locking lid
 - 2. Manufacturers:
 - a. CP Test Services
 - b. Glenn Series "Glenn-4"
 - c. Or accepted substitution
- E. Corrosion Control
 - 1. Rust inhibitive primer:
 - a. Tnemec "Series 77H Chem-Prime"
 - b. Or accepted substitution
 - 2. Rust preventative compound:
 - a. Houghton "Rust Veto 344"
 - b. Rust-Oleum "R-9"
 - c. Or accepted substitution

2.5 AIR RELEASE AND VACUUM BREAKER COMBINATION VALVES

- A. Manufacturers:
 - 1. Val-Matic "Model 801A"
 - 2. Dezurik/APCO "Series 440 SCAV"
 - 3. Or accepted substitution
- B. Provide combination air release and vacuum breaker valves as indicated on Drawings.
 - 1. Provide single body type that functions as both an air release and a vacuum breaker valve.
 - 2. Valves shall be manufactured and tested in accordance with AWWA C512.

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3. Provide a shutoff valve and transition piece from HDPE to NPT threaded connection on valve.
 - a. Ball valve: compatible with butt fusion, HDPE fitting
- C. General
 1. Usage: Recommended for service up to a pressure rating indicated by approved drawings
 2. Bodies and covers:
 - a. Gray iron meeting requirements of ASTM A126 Class B
 - b. Globe style of 1-inch valves to increase float clearance and reduce clogging
 3. Exterior coating: universal alkyd primer
 4. Valve cleanout: 2" NPT
 5. Valve drain connection: 1" NPT
 6. Inlet and Outlet:
 - a. Inlet: NPT, 2-inch on 1-inch valves
 - b. Outlet: NPT equal to valve size, 1-inch
 7. Internals:
 - a. Metal internal parts only
 - b. Float sensitive skirt provided
 - c. Float, plug, guide shafts, and bushings: Type 316 stainless steel
 - d. Resilient seats: Buna-N

2.6 ECCENTRIC PLUG VALVES

- A. Manufacturers:
 1. DeZurik
 2. Henry Pratt Company
 3. Milliken
 4. Val-Matic Valve and Manufacturing Corporation
 5. Or accepted substitution
- B. Provide plug valves as indicated on approved drawings.
- C. General
 1. Quarter-turn non-lubricated eccentric plug valves
 2. Resilient faced plug
 3. Valves with vane type seat rings are not acceptable
 4. Valve ends to match connecting piping
 - a. Buried: Mechanical joint, ANSI A21.11/AWWA C111
 - b. Flanged: 125 lb, ANSI B16.1
 - c. Screwed valve ends shall be to the NPT standard
 5. Minimum Working Pressure Rating:
 - a. 175 psi
 6. Opening motion eccentric, lifting plug away from body seat
 7. Valve alignment

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- a. Valve shall be installed so that the plug is horizontal and rotates upward as the valve opens.
 - b. Valve shall be installed with seat on low pressure side of valve.
 8. Provided with fully adjustable plug position stops.
 9. Plugs shall be eccentric type with no backing ring or frame.
 10. Valve body cavity shall be smooth without protrusions or baffles.
 11. Valve body plainly marked to indicate seat end
 12. Valve packing adjustment accessible without removing actuator from valve
- D. Valve Materials
1. Plug and body: Cast iron, ASTM A126, Class B
 2. Resilient plug facing or replaceable style body seats shall be synthetic rubber, neoprene, or Buna N compound suitable for use with water and wastewater applications
 3. Seat rings shall be threaded, or welded of corrosion-resistant stainless steel (18-8), nickel, or Monel conforming to AWWA C504
 4. Sprayed or plated mating seat surfaces are not acceptable.
 5. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel or bronze.
 6. Shaft seals shall be multiple O-ring, self-adjusting U-cup or chevron type packing conforming to AWWA C504
 7. Pull-down packing is not acceptable.
 8. Shaft seals shall be field adjustable or replaceable without valve disassembly.
 9. Plug seat: Chloroprene (Neoprene)
 10. Packing: Acrylonitrile Butadiene V-Type Cup
 - a. Dual U-cup
 11. Upper thrust bearing: TFE
 12. Body seat: Welded-in overlay seat of no less than 90% nickel
 13. Upper and lower trunnion bearings: Sleeve type, 18-8 stainless steel
 14. Valves complete with epoxy coating on the interior and exterior, manufacturer's standard corrosion resistant coating shall be acceptable
- E. Testing
1. Valves shall be capable of drip-tight shut-off up to the full leak test rating.
 - a. Test and certify pressure capacity in the reverse direction.

2.7 MANHOLES

- A. Precast Concrete Units:
1. Manufacturers:
 - a. Rinker Materials
 - b. Old Castle Precast
 - c. Or accepted substitution
 2. Specification: ASTM C478
 3. Minimum wall thickness: greater of 6 inches or 1/12 of internal diameter

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4. Reinforced
5. Grade rings as required
- B. Precast Units or Cast-in-place: Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan. Sawcut in field only if no other option.
- C. Manhole Steps:
 1. Steel bar, ½-inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF," or,
 2. Aluminum, drop-front type with polypropylene coating applied by manufacturer, Type MA Industries Inc. "PS2-PF" or approved substitution or approved substitution

2.8 FABRICATION

- A. Vault/Manhole Sections
 1. Precast concrete dimensions as shown on plans
 2. Minimum manhole inside diameter: 48 inches
 3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H2O loading
 4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
 5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
 6. Access opening: Minimum 24 clear or as indicated
 7. Pipe connection: As indicated on Drawings
 8. Pipe knockout: As indicated on Drawings
 9. Cast-in-place base
 10. Manhole steps: 12 inches on center, vertical alignment above largest bench or open area
- B. Grating and Metal Frame: As specified on drawings

2.9 ACCESSORIES

- A. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Town Engineer/Inspector for pipe stub-outs.
- B. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word "SANITARY".
- C. Reinforcement:
 1. Reinforcing Steel: ASTM A615 Grade 60
 2. Welded Wire Fabric: ASTM A185
- D. Concrete:
 1. Minimum compressive strength: 4,500 psi at 28 days
 2. Cement: ASTM C150, Portland Cement, Type II
 3. Aggregates: ASTM C33, free of deleterious substances
- E. Gaskets and Plastic Sealing Compound:

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1. Mastic:
 - a. Approved sealant manufacturers:
 - i. "Rub'r-Nek", K.T. Snyder Co.
 - ii. "Kent Seal", Hamilton-Kent Manufacturing Co.
 - iii. GS #79, 44, or 4, General Sealants
 - iv. ConSeal, CS202
 - v. Or accepted substitution
 - vi. "Ram-Nek" is not acceptable
2. Rubber: Neoprene, 40±5 hardness when measured by ASTM D2240, Type A durometer
3. Compression Gaskets: ASTM C443
4. Boot Connectors: ASTM C923
 - a. Flexible rubber boots shall provide a watertight seal between the pipe and concrete structure.
 - b. Z-LOK connector by A-LOK Products, Inc. or approved substitution
- F. Frames and Castings: ASTM A48 with asphalt varnish coating hot dip applied at foundry, 6 mils thick Class 30b
- G. Manhole Rings and Covers
 1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces
 2. Covers to seat at all points on ring
 3. Lids
 - a. All sanitary sewer lids shall be forged with the following: "Town of Mead Sanitary Sewer". Sewer manhole lids must be Denver Pick slot style model #1156 manufactured by Deeter Foundry or A-1480 by D&L Foundry.
 - b. Rings and covers shall be cast-iron. Manhole rings and covers shall be twenty-six (26) inch diameter manholes.
 - c. Surface patterns in the lids shall be drivable and per detail. Checker patterns or other textured patterns are not allowed.
 4. Provide type as indicated on the drawings
- H. Manhole Height Adjustment: Use precast concrete grade rings
- I. Rock Subbase: 1-1/2 -inch minus, well-graded gravel over compacted subgrade
- J. Water: Clean and free of deleterious substances

2.10 GROUT MANUFACTURERS

- A. Non-Shrink, Non-Metallic Grout
 1. Master Builders: Masterflow 928
 2. Burke: Non-Ferrous Non-Shrink
 3. M.R. Meadows: Sealtight 588
 4. Sonneborn: Sonogrout G.P.
 5. Tamms: Tammsgrout 621
 6. Sika: SikaGrout 212
 7. Or accepted substitution

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- B. Epoxy Grout
 - 1. Burke: BurkEpoxy Anchoring Grout
 - 2. L&M Inc.: EpogROUT
 - 3. Sika: Sikadur 42, Grout Pack
 - 4. Or accepted substitution

2.11 SOIL MATERIALS

- A. Furnish pipe bedding and cover as specified in Section 31 00 00 – Earthwork

2.12 TAP SADDLE MANUFACTURERS

- A. Fernco, Inc., Flexible Tab Saddle
- B. T-FLEX, Sewer Saddle
- C. Indiana Seal, Flexible Service Saddle
- D. Or accepted substitution

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine pipe and fittings and do not use individual sections containing cracks, dents, abrasions, and other defects

3.2 INSTALLATION OF PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

- A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 31 00 00 - Earthwork
- B. Install pipe in accordance with ASTM D2321 as modified herein or on the drawings.
- C. Cutting
 - 1. Cut and bevel ends in accordance with manufacturer's standard recommendations.
 - 2. Machine cut ends smooth and square to proper dimensions.
 - 3. Do not cut with a cold chisel, iron pipe cutter, flame or any other method that may fracture the pipe or leave ragged, uneven edges.
 - 4. Remove burrs and wipe off all dust and dirt from jointing surfaces.
- D. Pipe Laying
 - 1. Inspect pipe and accessories for cracks and other defects before lowering into trench.
 - 2. Replace any defective, damaged or unsound pipe.
 - 3. Remove all dirt and foreign material from the inside of pipe before laying.
 - 4. Check bedding for firmness and uniformity of surface immediately before laying each section of pipe.
 - 5. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage.
 - 6. Do not dump or drop pipe or accessories into trench.
 - 7. Lay to lines and grades indicated on drawings or as specified.
 - a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
 - b. Closely joint to form a smooth flow line.
 - c. Place bell end or groove ends of piping facing upstream.

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- d. Maximum length of pipe that can be used without exceeding the allowable deflection at a coupling shall be determined.
 8. Utilize implements, tools, and facilities as recommended by the manufacturer.
 9. Keep pipe clean during and after laying.
 10. Close all open ends with watertight expandable type sewer plugs or test plugs.
 11. Remove and relay any pipe which has floated.
 12. Do not lay pipe when:
 - a. There is water in the trench
 - b. Trench conditions are unsuitable
 - c. Weather conditions are unsuitable
 13. Use acceptable adaptors at manhole and structure connections to provide a watertight seal.
 14. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 31 00 00 – Earthwork.
- E. Jointing
1. Assemble in accordance with the manufacturer's instructions.
 2. Wipe clean pipe ends, gasket and gasket groove before inserting gasket.
 3. Apply lubricant furnished by the pipe manufacturer to the gasket and the outside of the spigot end.
 4. Insert the spigot end to the reference mark.
- F. Fittings
1. Install utilizing standard methods.
 2. Lower into trench with rope or other means to prevent damage.
 3. Attach rope around the exterior.
 4. Do not attach rope through the interior.
 5. Carefully connect to pipe or other facility.
 6. Check joint to insure a sound and proper joint.
- G. Water Line and Sanitary Sewer Crossings
1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
 2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
 3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer.

3.3 MANHOLE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located.
- B. Verify that built-in items are in proper location, ready for roughing into Work.
- C. Verify excavation for manholes is correct

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- D. Excavation, Backfill, Subgrade Compaction: Refer to Section 31 00 00 – Earthwork for requirements
- E. Rock Subbase
 - 1. Remove water and place to a 6-inch minimum depth.
 - 2. Vibrate for compaction.
 - 3. Level top to accept precast sections with uniform bearing all around.
 - 4. If material below vault is unsuitable, excavate as directed by the project's Engineer or Geotechnical Engineer and backfill to grade with 1-1/2 inch minus rock and compact.

3.4 PLACING MANHOLE

- A. Place manhole sections plumb and level. If not level, remove and re-level the grade.
- B. Clean ends of sections and place double mastic gasket.
- C. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface.
- D. Completed manholes shall be rigid and watertight.
- E. Coordinate with other sections of work to provide correct size, shape, and location.
- F. For cast-in-place:
 - 1. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around
 - 2. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base of place first manhole section directly in wet concrete

3.5 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints.
- B. Thoroughly clean section joints.
- C. Install gasket type in conformance with precast structure manufacturer's recommendation.
- D. Install gasket in conformance with manufacturer's recommendations.
- E. Only use primer furnished by gasket manufacturer.

3.6 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench ½-inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects.
- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert.
- D. Construct in conformance with standard drawings.

3.7 MANHOLE RINGS AND COVERS

- A. Place rings in bed of non-shrink grout on top of manholes.
- B. Ensure no infiltration will enter manhole at this location.
- C. Carry non-shrink grout over flange of ring.
- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic or as required by approved drawings.
- E. Set manhole ring and cover 1/4-inch to 1/2-inch below roadway surface.

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- F. Use precast grade rings for height adjustment of manhole ring and cover.

3.8 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times.
- B. Prior approval of proposed method for maintaining flow must be obtained from the Town.
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure.
- D. Make connection during low flow periods.
- E. The contractor shall core drill the existing manhole as necessary to insert a "Kor-N-Seal or approved gasket and new sewer pipe.
- F. The existing concrete foundation bench shall be ground to the cross-section of the new pipe in order to form a smooth, continuous invert similar to what would be formed in a new concrete base. Portland cement grout shall be used as necessary to smoothly finish the new invert.

3.9 NEW MANHOLE CONNECTIONS TO ACTIVE SEWER LINES

- A. When connecting to an active line, the connecting manhole shall be poured in place, Class "B" 4,500 psi concrete with a minimum thickness of eight inches (8) below the flow line of the pipe and four inches (4) above the crown is required.
- B. Manhole inverts shall be formed to the full diameter of the pipe to insure full and unobstructed flow. Each pipe must extend no more than four (4) inches into the manhole wall to a formed concrete invert.
- C. Pre-cast bases may be used when specifically authorized by the Town. Pipes extended through manholes and cut to form an invert are not acceptable without prior written permission from the Town.

3.10 FIELD QUALITY CONTROL – GENERAL TESTING REQUIREMENTS

- A. Testing shall be accomplished through a combination of visual inspections, deflection tests, low-pressure air tests, and leakage test methods.
- B. Sanitary sewer pipe and appurtenances shall be cleaned and tested after backfill operations have been completed and acceptable compaction test results have been submitted to the Town Engineer. All testing shall be completed and approved by the Town prior to placement of permanent resurfacing.
- C. All testing shall be witnessed by the Town Engineer. The Contractor shall provide a minimum of 48 hours' notice to Town Engineer prior to testing. Tests performed in the absence of the Town's representative shall be considered invalid and shall be repeated at the Contractor's expense.
- D. The Contractor shall provide the Town a final report of all testing completed.
- E. New sanitary sewer installations shall be televised and as-built shots taken to verify design slope requirements by the Contractor after backfill operations have been completed. The results of the inspection and video shall be submitted to the Town Engineer for approval. Digital video files to be provided with reach noted, footage, inverts, and manhole number at each end, and pipe size and type. Water line installation may not begin until acceptable televised testing video and as-built shots have been submitted and reviewed by the Town.
- F. The Contractor shall have sewers jet washed on new installation prior to the initial television inspection. Debris resulting from the cleaning shall be removed before entering the Town's existing sewer, by either some type of plug or elbow to catch debris. Material shall be removed from the site and disposed of by the Contractor. If on the initial television inspection, the cleaning is unsatisfactory and prevents the television inspection from being completed, the Contractor shall reclean the sewer and shall be responsible for costs incurred by a second television inspection.

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- G. Any damages to the pipe caused by cleaning or testing operations shall be repaired or replaced by the Contractor at their own expense. Should the pipe fail to meet the requirements of the low-pressure air test or infiltration of ground water is noted, the Contractor shall determine the source or sources of the leakage and shall replace defective materials or workmanship. Replacement of defective materials or workmanship as above noted shall be the financial responsibility of the Contractor. Pipe which fails to meet these requirements shall be repaired or replaced and retested in accordance with these requirements.
- H. New sanitary sewer installations may also be televised by the Town for initial acceptance after the installation, cleaning, testing, and final lift of asphalt are complete. Inspection reports and videos shall be available for review by the Responsible Party. The Responsible Party shall be responsible for any repairs or replacement of any portions of the pipeline that are determined defective by the television inspections.
- I. Prior to the final acceptance there may be another television inspection performed by the Town. If there are any discrepancies, a punch list shall be formulated and sent to the Responsible Party. Any discrepancies must be repaired prior to final acceptance being granted.

3.11 PIPE TESTING

A. Low Pressure Air Test

1. The Contractor shall perform a low-pressure air test on each reach of sanitary sewer pipe between manholes. The low-pressure air test shall be required on the entire length of pipe installations. The test shall conform to the recommended practice and calculations established by the ASTM C-828.
2. Pipe outlets shall be plugged with suitable test plugs. Pipe may be tested without pre-wetting. If the pipeline to be tested is submerged in groundwater, the Responsible Party shall determine the groundwater elevation at the test location and provide it to the Town Engineer. The backpressure on the pipe due to groundwater shall be determined and the internal pipeline test pressure shall be established at 4.0 psi (gauge) in excess thereof. Add air slowly to the portions of the pipe being tested. After the pipe has been filled to the required pressure, allow at least two (2) minutes for the air-temperature to stabilize, adding only the amount of air necessary to maintain the test pressure. After the two (2) minute period, disconnect the air supply and allow the initial pressure to drop to 3.5 psi (gauge) in excess of the groundwater back pressure.
3. The time interval required for the sewer internal pressure to drop from 3.5 psi (gauge) to 2.5 psi (gauge) above the excess of ground water backpressure shall be measured and recorded.
4. The basis for acceptance of the air test shall be the minimum time required for the internal pressure to drop 1.0 psi (gauge). The calculations generated by ASTM C-828 shall then be used to check the adequacy of the pipe installation. The minimum allowable time in seconds shall be in accordance with the following tables. The minimum allowable pressure drop time is computed based upon an allowable leakage rate not to exceed 0.003 cfm per square foot of internal pipe surface. Sewers 15 inches in diameter and smaller shall be tested from manhole to manhole. Sewers 18 inches in diameter and larger shall be tested in lengths such that the total loss is no less than two (2) cfm when computed using an allowable rate of 0.003 cfm per square foot of internal surface.
5. Minimum allowable pressure drop times for pipe 15 inches in diameter and smaller (in seconds) per table below:

Pipe Diameter (Inches)	Length of Pipe Being Tested (Feet)			
	100'	200'	300'	400'
8"	38	76	114	152
10"	47	94	141	188

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12"	56	113	170	226
15"	71	141	212	283

6. Minimum allowable pressure drop times for pipe 18 inches in diameter and larger (in seconds) per table below:

Pipe Diameter (inches)	Length of Pipe Being Tested (feet)					Maximum Testing Length (feet)
	25'	50'	75'	100'	126'	
18"	21	42	64	85	106	140
21"	25	50	74	99		120
24"	28	56	85	113		106
27"	32	64	95			94
30"	35	71	106			84
36"	42	85				70

The minimum allowable pressure drop time when using the maximum testing length is 120 seconds.

7. Sewers 36 inches in diameter shall be tested one (1) joint at a time.
8. The Responsible Party shall follow precautions necessary to perform a safe and successful test. Plugs used to isolate the line for the air test must be securely braced to avoid the unintentional release of the plug. Gauges, air piping manifolds, and control valves shall be located above ground. No one shall be permitted to enter a manhole when a plugged pipe is under pressure. Air testing apparatus shall be equipped with a pressure relief device designed to relieve the pressure when in excess of six (6) psi (gauge).

B. Exfiltration Test

1. Contractor shall perform an exfiltration test on each reach of sanitary service and sanitary sewer pipe between manholes or discharge.
 - a. Test the first reach prior to backfilling and before installing any of the remaining pipe.
2. Procedure
 - a. Block off all manhole openings except those connecting with the reach under test.
 - b. Fill the line:
 - i. Average depth: 10 feet above invert except as required by manhole depth
 - ii. Maximum depth at lower end: 25 feet above crown
 - iii. Minimum depth at upper end: 5 feet above crown
 - c. Add and measure water as required to maintain a constant level
 - i. Air pocket entrapment shall be avoided when filling the line with water. Once filled with water, the system shall be allowed to stabilize for a period of one or two hours before starting the test.
 - ii. Maximum exfiltration/infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
 - iii. For the purposes of exfiltration leakage, manholes shall be considered to be concrete pipe of the same diameter as the manhole i.e. 48, 60 or 72-inch diameter.
 - iv. Maintain test for a minimum of 2 hours or as long as necessary, to locate all leaks.
3. Repair and retest any reach which exceeds the allowable exfiltration/infiltration

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- a. If excessive ground water is encountered during construction of a sanitary sewer section or as requested by the Town Engineer, the infiltration test for leakage shall be used.
 - b. Maximum infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
4. Repair and retest any reach which exceeds the allowable infiltration.

C. Infiltration

- 1. If excessive ground water is encountered during construction of a sanitary sewer section or as requested by the Town Engineer, the infiltration test for leakage shall be used.
- 2. Maximum infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
- 3. Repair and retest any reach which exceeds the allowable infiltration

D. Pipe Deflection Test

- 1. Pipe deflection test shall be completed if video inspection shows defects or as required by the Town Engineer.
- 2. No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.).
- 3. Use a rigid mandrel with diameter of at least 95 percent of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter.
- 4. Maximum allowable deflection is 5 percent of the base internal diameter. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	Mandrel O.D.
6	5.792	5.50
8	7.764	7.38
10	9.711	9.23
12	11.558	10.98

- 5. Pull the mandrel through the pipe by hand.
 - 6. Relay or replace all pipe exceeding the 5 percent deflection.
 - 7. Retest repaired sections.
 - 8. Maximum allowable deflection at end of one year correction period, 7-1/2 percent of the base internal diameter tested in the same manner. Uncover and repair sections exceeding the allowable deflection.
- E. TV Inspection shall be provided as requested by the Town. Digital video files to be provided with reach noted, footage, inverts, and manhole number at each end, and pipe size and type.
- F. All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.
- G. Lamp Test
- 1. Each section between manholes will be lamped by Contractor in the presence of the Town Engineer if requested.

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2. A true circle will be required in the lamp tests to indicate a properly constructed sewer line.
3. Repair any sections not passing the lamp test at Contractor's expense.

3.12 MANHOLE TESTING

A. Test all manholes:

1. Vacuum test:
 - a. Plug all inlets and outlets in such a manner as to prevent displacement of plugs.
 - b. Install and operate vacuum tester head assembly in accordance with equipment specifications and manufacturer instructions.
 - c. Attach the vacuum pump assembly to the proper connection on the test head assembly. Ensure that vacuum inlet/outlet valve is closed.
 - d. Inflate sealing element to twice the pressure test to be used. Do not over inflate.
 - e. Start vacuum pump assembly engine and allow preset RPM to stabilize.
 - f. Open vacuum inlet/outlet valve and evacuate manhole to 5-inches Hg (mercury).
 - g. Close vacuum inlet/outlet valve, disconnect vacuum pump and monitor vacuum.
 - h. Record time for vacuum to drop from initial 5 inches Hg to 4 inches Hg.
 - i. Acceptance for manholes when the time to drop from 5 inches Hg to 4 inches Hg meets or exceeds requirements as defined below:

Maximum Allowable Vacuum Drop			
Manhole Depth - Rim to Invert	Manhole Diameter (in)		
	48"	60"	72"
	Vacuum Testing Durations (s)		
8"	20	26	33
10"	25	33	41
12"	30	39	49
14"	35	46	57
16"	40	52	67
18"	45	59	73
20"	50	65	81
22"	55	72	89
24"	59	78	97
26"	64	85	105
28"	69	91	113
30"	74	98	121

- j. Repair all manholes that fail leakage test and retest until manhole passes test.
 - k. If joint mastic or gasket is displaced during vacuum test, disassemble manhole and replace seal.
 - l. If the manhole fails the initial test, necessary repairs should be made with a non-shrink grout. Repairs and retesting shall proceed until a satisfactory test is obtained.
2. All testing shall be witnessed by the Town Engineer or Town Inspector. Contractor shall provide a minimum of 48-hour notice prior to testing.

3.13 TRACER WIRE TESTING

The Contractor shall provide test report for tracer wire continuity.

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3.14 CLEANUP AND RESTORATION

- A. Restore pavements, curbs and gutters, utilities, and other improvements to condition equal to or better than before work began and to satisfaction of the Town.
- B. Deposit waste material in designated waste areas and disposal site graded and shaped.

3.15 FINAL ACCEPTANCE

- A. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
 - 1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete.
- B. Provide record drawings with manhole number, inverts, and location (x, y, z) for each service connection.
- C. Provide test report for tracer wire continuity.
- D. Provide pipe and manhole tests and results.
- E. Provide video files of TV inspection on a DVD.

END OF SECTION 33 33 00

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SECTION 33 40 00 STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping and concrete structures for storm sewer system, roof drainage, and culverts
- B. Riprap for channel lining, outlet protection and rock check dams

1.2 REFERENCES

- A. ACPA - American Concrete Pipe Association
- B. ASTM – American Society for Testing and Materials
 - 1. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 2. ASTM C150 - Portland Cement
 - 3. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
 - 4. ASTM C478 – Precast Concrete Structures
 - 5. ASTM C497 - Testing Concrete Pipe, Manhole Sections, or Tile
 - 6. ASTM A48 - Gray Iron Castings
 - 7. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 8. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 9. ASTM C33 - Concrete Aggregates
 - 10. ASTM C478 - Precast Reinforced Concrete Manhole Sections
- C. Urban Storm Drainage Criteria Manual, Mile High Flood District (MHFD)
- D. Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction

1.3 SUBMITTALS

- A. Shop Drawings: Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, etc. Provide additional detailed information (including elevations, fittings, specialty materials or fabrications, etc.) for special or custom features, structures, junctions and/or pipes. Provide pipe-laying schedule.
- B. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications.
- C. Manufacturers Certificate: Certify that pipe, meets or exceeds specified requirements. Confirm all materials comply with applicable standards.
- D. Test Reports: Submit all shop and field test reports in accordance with the Town of Mead Design Standards and Specifications.
- E. Provide sufficient data to verify compliance with these specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery
 - 1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.
- B. Storage

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1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: (direct sunlight, mud. etc).
 2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months.
 3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging.
 - a. Do not stack pipe higher than five (5) feet.
- C. Handling
1. Handle to ensure installation in sound undamaged condition.
 2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection.
 3. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Weather limitations: Do not install piping over frozen surfaces or in standing water.

PART 2 GENERAL PRODUCTS

2.1 PIPE MATERIALS

- A. General: Provide pipes of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated
- B. Fittings: Furnish bends, ells, tees, wyes, couplings and other fittings of the same type and class of material having equal or superior physical and chemical properties as acceptable to the Engineer
- C. Reinforced Concrete Pipe: ASTM C76,
1. 12-inch RCP Class V, with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 2. 15-inch RCP Class IV (Class V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 3. 18-inch thru 24-inch RCP Class III (Class IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 4. 24-inch thru 36-inch RCP Class II (Class III, IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
- D. PVC Sewer Pipe: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.
- E. HDPE Sewer Pipe: smooth interior, corrugated exterior piping conforming to ASTM D 2412, ASTM D 3212, AASHTO specifications M252 and M 294, joints to conform to ASTM F 477.
- F. Corrugated Metal Pipe (CMP): AASHTO M218 or ASTM A444, helically or circumferentially corrugated, mill galvanized steel.
1. Furnish galvanized sheet metal, 16 gauge, 0.064-inch galvanized thickness, 0.0598-inch base metal thickness and size of conduit as indicated. Sizes indicated are minimal inside diameters.
 2. Furnish width and lap depths and corrugations conforming to AASHTO M36.
- G. Corrugated Aluminum Pipe (CAP): ASTM M197 helically or circumferentially corrugated.
1. Aluminum alloy, 16 gauge, size shown on approved drawings.

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2. Furnish width and lap depths and corrugations conforming to AASHTO M196.
- H. Perforated PVC Sewer Pipe for Underdrains: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.

2.2 MATERIALS

- A. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts.
- B. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word "STORM".
- C. Reinforcement
 1. Reinforcing Steel: ASTM A615 Grade 60
 2. Welded Wire Fabric: ASTM A185
- D. Concrete: Refer to Section 31 13 00 - Rigid Paving and Flatwork Specifications
 1. Minimum compressive strength: 5000 psi at 28 days
 2. Cement: ASTM C150, Portland Cement, Type II
 3. Aggregates: ASTM C33, free of deleterious substances
- E. Gaskets: ASTM C923
 1. Mastic: FS SS-S-210A, "RAM-NEK" or accepted substitution
 2. Rubber: Neoprene, 40+ 5 hardness when measured by ASTM D2240, Type A durometer
- F. Inlet Gratings and Manhole Rings and Covers
 1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces.
 2. Provide bike/pedestrian-safe grates where such traffic is anticipated.
 3. Set grate on frame such that openings maximize inlet intake.
 4. Covers to seat at all points on ring.
 5. Covers to be cast with "STORM SEWER" in 1 1/2" tall flush letters minimum in addition to the symbol of a fish with the phrase "DUMP NO WASTE, DRAINS TO WATERWAYS".
 6. Manhole covers to receive asphalt varnish coating hot dip applied at foundry, 6 mils thick.
- G. Manhole Height Adjustment: Use precast concrete grade rings.
- H. Rock Subbase: 1-1/2 -inch minus, well-graded gravel over compacted subgrade
- I. Water: Clean and free of deleterious substances
- J. Grout:
 1. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
 2. Epoxy Grout: Three Component Epoxy Resin System
 - a. Two liquid epoxy components
 - b. One inert aggregate filtered component
 - c. Each component furnished in separate package for mixing at job site

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2.3 CONCRETE CATCH BASINS AND MANHOLES

A. General:

Comply with Town of Mead Standard Details and CDOT standards and specifications for public storm sewer products.

B. Precast Concrete Units for Catch Basins and Manholes:

1. Manufacturers: Carder Concrete Products, Amcor Precast, or accepted equal
2. Specification: ASTM C478 and C789, wall "B"
 - a. Minimum wall thickness: greater of six (6) inches or 1/12 of internal diameter
 - b. Reinforced
 - c. Grade rings as required
 - d. Cast steps into units.

C. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan or sawcut in field.

D. Cast-in-place Concrete Units: As shown on the approved drawings or standard detail drawings and complying with the Colorado Department of Transportation drainage and design standards.

E. Manhole Steps: Steel bar, 1/2-inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF" or equal

2.4 PVC PLASTIC INLINE DRAINS AND DRAIN BASINS

A. Manufacturer: Nyloplast America Inc. or accepted substitution.

B. Inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermo molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212.

C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.

D. Inline drain and drain basin adapters and accessories:

1. Adaptable to SDR-35 PVC piping.
2. Watertight adapters.

E. Cast iron or ductile iron frames and grates:

1. Light –traffic rated
2. Pedestrian rated
3. Hinged and locking
4. Made specifically for use with the specified inline drains and drain basins
5. Painted black
6. ASTM A-48-83 Class 30B or A536 grade 70-50-05 grade iron
7. Size indicated on the approved drawings

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2.5 CONCRETE FABRICATION

A. Vault/Manhole Sections

1. Precast concrete dimensions as shown on plans
2. Minimum manhole inside diameter: 48 inches
3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading
4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
6. Access opening: Minimum 24 inches clear or as indicated
7. Pipe connection: As indicated on Drawings
8. Pipe knockout: As indicated on Drawings
9. Precast concrete, monolithic base or cast-in-place base
10. Manhole steps: 12 inches on center, vertical alignment above largest bench or open area

B. Grating and Metal Frame: As specified on approved drawings

2.6 SOIL MATERIALS

A. Furnish pipe bedding and cover as specified in Section 31 00 00 – Earthwork.

B. Riprap Materials:

1. Hard, dense, durable stone, angular in shape and resistant to weathering
2. Minimum specific gravity of 2.5
3. Material may be approved by Town Engineer, if by visual inspection, the rock is determined to be sound and durable.
4. Town Engineer may require Contractor to furnish laboratory test results if the material appears to be marginal or unacceptable.
5. Tested material shall meet the following requirements for abrasion resistance or compressive strength:

Test	Test Method	Requirement
Abrasion Resistance by Los Angeles Machine	ASTM C 535	50% loss, max
Unconfined Compressive Strength of Drilled Core Specimen	AASHTO T 24	2500, min

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6. Gradation:

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Mean Particle Size, d_{50} (Inches)
Type L	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	
Type M	70-100	21	12
	50-70	18	
	35-50	12	
	2-10	4	
Type H	70-100	30	18
	50-70	24	
	35-50	18	
	2-10	6	

7. Granular Riprap Bedding:

a. 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

C. Pipe Bedding:

- a. Refer to Section 31 00 00 – Earthwork
- b. Minimum 6 inch deep, unless specified otherwise

D. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

PART 3 EXECUTION

3.1 PIPE PREPARATION

- A. Shape trench and place bedding as specified in Section 31 00 00 and as shown on the approved drawings.
 1. Dig bell or coupling holes.
 2. Do not support pipe on blocks or mounds of earth.

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3. Provide uniform and continuous bearing and support for full length of pipe between bell holes.
 4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle.
- B. Alignment and Grade
1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade.
 2. Use batter boards to determine and check pipe subgrades.
 3. Other methods of maintaining alignment and grade may be acceptable if approved by the Town Engineer.

3.2 PIPE INSTALLATION

- A. Inspect pipe and accessories for defects before lowering into trench.
- B. Replace any defective, damaged or unsound pipe.
- C. Carefully lower pipe, fittings, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage. Do not dump or drop pipe or accessories into trench.
- D. Pipe embedment shall be as specified in Section 31 00 00 – Earthwork for pipe.
- E. Protect from lateral displacement by placing the specified pipe embedment material.
- F. Do not lay pipe in water, under unsuitable weather conditions or under unsuitable trench conditions.
- G. Joint to form true and smooth line.
- H. Remove any pipe not making a good fit.
- I. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer.
- J. Utilize implements, tools and facilities as recommended by the manufacturer and/or catch basins if required to remove debris.
- K. Keep pipe clean during and after laying.
- L. During construction, close all open ends with watertight expandable type plugs.
 1. At the end of each day's operations.
 2. Whenever pipe ends are left unattended.
 3. Deposit adequate backfill on pipe to prevent flotation.
 4. Do not use wood, burlap or other similar temporary plugs.
- M. Remove and re-lay any pipe which has floated.

3.3 PRECAST STRUCTURE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located.
- B. Verify that built-in items are in proper location, ready for roughing into Work.
- C. Verify excavation for manholes is correct.
- D. Excavation and Backfill: Refer to Section 31 00 00 - Earthwork for requirements.
- E. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- F. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction.

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3.4 CATCH BASINS

- A. Construct catch basins to the sizes and shapes indicated, and to conform to requirements of authorities having jurisdiction.
 - 1. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction.
 - 2. For precast units, set in place to accurate elevations on firm, solid bed, plumb and level.
 - 3. Pipe openings, elevations and alignment per plans
 - 4. Seal and grout all pipe penetrations
 - 5. Set cast iron frames and gratings to the elevations indicated.

3.5 PLACING MANHOLE SECTION OR CAST-IN PLACE BASE

- A. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock to a 6-inch minimum depth, and vibrate for compaction.
- B. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around.
- C. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base or place first manhole section directly in wet concrete.
- D. Place manhole sections plumb and level, trim to correct elevations.
- E. Clean ends of sections and place double mastic gasket.
- F. Fill inside and outside of joint completely with non-shrink grout and trowel smooth.
- G. Cure non-shrink grout using approved methods.
- H. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Town Engineer.
- I. Completed manholes shall be rigid and watertight.
- J. Coordinate with other sections of work to provide correct size, shape, and location.

3.6 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints.
- B. Thoroughly clean section joints.
- C. Install gasket in conformance with manufacturer's recommendations.
- D. Only use primer furnished by gasket manufacturer.

3.7 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench ½ inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects.
- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert.
- D. Construct in conformance with standard drawings.

3.8 MANHOLE RINGS AND COVERS

- A. Place rings in bed of non-shrink grout on top of manholes.
- B. Ensure no infiltration will enter manhole at this location.
- C. Carry non-shrink grout over flange of ring.

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- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic.
- E. Set top of ring 6 inches above surfaces in open, unraveled, non-pedestrian areas.
- F. Use precast grade rings for height adjustment.

3.9 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times.
- B. Prior approval of proposed method for maintaining flow must be obtained from Engineer.
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure.
- D. Make connection during low flow periods.

3.10 GROUT

A. PREPARATION

- 1. Non-Shrink, Non-Metallic Grout, General Use
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 hours prior to grouting and remove excess water just prior to placing grout.
 - c. Cold weather conditions
 - i. Warm concrete, substrate and base plate to 40 degrees F, or above; store grout in warm area.
 - ii. Follow manufacturer's recommendations for cold weather application.
 - d. Hot weather conditions
 - i. Use cold mixing water and cool base plate if possible; store grout in cool area.
 - ii. Follow manufacturer's recommendations for hot weather application.
 - e. Apply to clean, sound surface.
 - f. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer.
- 2. Epoxy Grout: Apply only to clean, dry, sound surface.
 - a. Patch cavities in concrete including, but not limited to, tie holes, and structural and equipment support.

B. APPLICATION

- 1. Non-Shrink, Non-Metallic Grout
 - a. Mix in a mechanical mixer
 - b. Use no more water than necessary to produce flowable grout.
 - c. Provide air vents where necessary to eliminate air pockets.
 - d. Place in accordance with manufacturer's instructions.
 - e. Where exposed to view finish grout edges smooth.
 - f. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound.
 - g. Wet cure grout for 7 days, minimum.
 - h. Maintain the temperature at a minimum of 40 degrees F until grout reaches 3000 psi.
 - i. After placement of grout, eliminate excessive external vibration.

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2. Epoxy Grout
 - a. Mix and place in accordance with manufacturer's instructions.
 - b. Completely fill all cavities and spaces around dowels and anchors without voids.
 - c. Obtain manufacturer's technical assistance as required to insure proper placement.
- 3.11 RIPRAP**
- A. Do not place riprap over frozen or spongy subgrade surfaces.
 - B. Place riprap at pipe outlets and in channels as indicated on plans. Top of riprap to match invert of outlet pie and channels.
 - C. Excavate and prepare subgrade.
 - D. Place geotextile fabric per plans under all bedding. Place bedding and place riprap on bedding per plans.
 - E. Material may be machine placed and then arranged as necessary by use of a Gradall with multi-prong grapple device or by hand to minimize voids. Dumping alone is not sufficient to achieve properly placed riprap.
- 3.12 FIELD QUALITY CONTROL**
- A. Field inspection and testing including a lamp test will be performed for every section of pipe after backfill has occurred.
 1. Contractor shall furnish suitable assistance to the Town Engineer.
 2. A minimum of 75% of a true circle will be required to indicate a properly constructed line.
 3. Contractor will repair any section not passing the lamp test.
 - B. Request inspection immediately after placing cover over pipe.
 - C. Backfilling and testing as required per Section 31 00 00 - Earthwork.

END OF SECTION 33 40 00

Town of Mead Design Standards and Construction Specifications

SECTION 33 47 00 LANDSCAPE AND IRRIGATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specifications for concrete paths and bridges and all associated signage, railings, lighting and root barrier
- B. Specifications for grading and fine grading, top soil, soil amendments, fertilizer
- C. Specifications for installation of irrigation improvements including taps, backflow prevention, valves, piping, sprinkler heads, control systems, pumps and signage.
- D. Minimum requirements for seeding, mulching, fertilizer and weed control during establishment of seeded areas to be owned by the Town and common open space owned by the Homeowners Association.
- E. Minimum requirements for sodded areas to be owned by the Town and common open space owned by the Homeowners Association.
- F. Materials and practices to install trees, shrubs and groundcover.

1.2 REFERENCES

- A. AASHTO – American Association of State Highway and Transportation Officials.
- B. USACE – US Army Corps of Engineers
- C. USFWS – US Fish and Wildlife Service
- D. CDPHE – Colorado Department of Health and the environment
- E. UPC – Uniform Plumbing Code
- F. NSF – NSF International (National Science Foundation)
- G. ANSI – American National Standards Institute
- H. ASTM – ASTM International (American Society for Testing and Materials)
- I. Water Provider - Little Thompson Water District or Longs Peak Water, District of Central Weld County Water District
- J. Electric Provider – United Power
- K. Electric Code as currently adopted
- L. UL – Underwriters Laboratory
- M. PE – Polyethylene cable
- N. UF - underground feeder cable; rated for in-ground and damp-area installation
- O. HOA – Homeowners Association or other entity responsible for installation and maintenance of these improvements
- P. B&B – Balled and Burlapped nursery stock

1.3 SUBMITTALS

- A. Submit on all products required for construction to verification of compliance with these Specifications.
- B. Seeding and fertilizers: certificates showing State, Federal or other inspection showing source and origin.
- C. Samples: Mulch; canvas strap or approved equal (when requested by Town).

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1.4 REGULATORY REQUIREMENTS

- A. Conform to all Town codes and ordinances, laws and regulations of Weld County, Town of Mead, CDPHE, USACE, USFWS, the notes and details on the drawings, and as specified herein.
- B. In case of apparent conflict, CDPHE, USACE, USFWS requirements govern over these specifications.
- C. Contractor shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities.

1.5 SCHEDULING

PART 2 PRODUCTS

2.1 GENERAL

- A. The **Town of Mead List of Approved Landscape Materials** is attached to this Section as a separate document, herein referred to as Town Approved Materials List.
 - 1. The **Town of Mead List of Approved Landscape Materials** is periodically updated. Please contact the Town Engineer for the most current list.

2.2 CONCRETE PATHS AND BRIDGES

- A. For specific list of materials accepted by the Town please see Town Approved Materials List.
- B. Concrete mix design: see Section 32 13 00 of these Specifications. Control joints: zip strips or saw cut (soft cut) to one quarter (1/4) the total slab thickness. Curing compound: for all exposed concrete surfaces - white pigmented sealant.
- C. Bridge steel to be CorTen self-weathering steel (preferred) or zinc enamel painted structure (color gloss black or as approved by Town). Concrete reinforced bridges are acceptable. Concrete decking is preferred, however, alternate ironwood decking also acceptable (three inch (3") minimum thickness planks). See approved materials list for pre-approved decking. Approach railing to match bridge steel and paint (if applicable). Safety plate at abutment to be 1/4" minimum textured, galvanized steel plate.
- D. Barrier Railings shall be constructed of minimum two-inch (2") round tubing with three-eighths inch (3/8") walls. All welds shall be ground smooth and railings shall be painted (color per Town approval) with zinc enamel paint. All railing design is to meet current AASHTO standards.
- E. Signage: All non-traffic regulation signs in recreational areas shall be silk-screened with 3M ink on .080" thick aluminum backing plate backing plates. No Electronically Cuttable Film (E.C. Film) shall be permitted unless approved by the Town. All signs shall have a border the same color as the sign text. All signs to include Spanish translation if possible (to be provided by Town). Sign faces to be secured using tamper resistant fasteners.
 - 1. Street identification sign (English only) at underpass – Street name (only) to be secured to the face of the underpass: Color: Royal blue with white letters.
 - 2. Bridge caution loading sign (English only) (with manufacturer's maximum bridge loading information) to be secured to the bridge by the manufacturer: Color: White with black letters
 - 3. Stop sign (English only) at concrete path intersections with roads (standard street sign or smaller version allowed) to be mounted on wood post: Sign Color: red with white letters.
 - 4. Path intersection sign to be mounted on wood post: "Warning: Intersection ahead. Aviso: Intersection a continuation." sign: Color: White Yellow with black letters.
 - 5. Bridge caution sign: "Caution: Slippery when wet. Precaución: Área resbaloso cuando esta mojado." Or, International graphic symbol to be secured to bridge end posts without extending into path or on separate free-standing wood post. Color: yellow with black letters.

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6. Designated ID sign: Name of designated greenway (English only) to be mounted on wood post, Sign Color: White with green letters. Sign to run vertically up post.
 7. Dog waste sign: Copy and color to be provided by Town. Sign face to be mounted on wood post.
 8. Dog waste dispenser: 24" long 4" PVC (Class 200) pipe with 2 end caps – painted black. (2 ea.) 4" diameter holes cut into one side of pipe top and bottom. Dispenser to be mounted on wood post.
 9. Trail Courtesy sign – Color – Green. Copy to be provided by Town. Two sign faces are to be provided (English and Spanish). Mount to wood post with one sign face on each side.
 10. Sign Posts – 4x4" or 6x6" (size as appropriate for sign face) pressure treated wood posts stained gray (Stain Color – Sherwin Williams Grey Birch). Top edges beveled and posts free of significant checking.
- F. Lighting:
1. Vandal resistant, Lexan lens fixtures with metal guard. See approved materials list for pre-approved fixtures.
 2. Root Barrier: See approved materials list for pre-approved barriers.

2.3 FINE GRADING

- A. For specific list of materials accepted by the Town, please see Town Approved Materials List.
- B. Topsoil: a friable loam, typical of cultivated local top soils, containing at least 2% humus. It must be taken from a well-drained, arable site and shall be reasonably free of subsoil, stones, clods, sticks, roots and other objectionable extraneous matter or debris. No stones or other materials over two inches (2") in size shall be allowed. It shall contain no toxic materials. Topsoil shall have an acidity in the range of ph 5.5 to ph 8.5.
 1. Submit sample and written confirmation from supplier of material composition including the percent of organic matter, salts, and nutrient composition. Sample is to be representative.
- C. Soil Amendment: A high quality composted material containing a minimum of 30% organic matter by dry weight. The mixture shall be free from clay subsoil, stones, lumps, plants or roots, sticks, weed stolons, seeds, high sodium content and other materials harmful to plant life. The compost shall be coarsely ground with an even composition and have an acidity in the range of PH 5.5 to PH 7.0. All material shall be sufficiently composted such that no material used is recognizable. The following nutrient analysis should be provided on a dry basis: Nitrogen: 1% min; Phosphorus: 0.4%; Potassium: 1.2%; Salts: 6.5% (as received basis).
- D. Submit sample and written confirmation from supplier of material composition including: percent organic matter, sodium, nutrient composition and trademark. Sample is to be representative.
- E. Fertilizer: Triple superphosphate with a chemical analysis of (0-46-0).

2.4 IRRIGATION

- A. For a specific list of materials accepted by the Town, please see Town Approved Materials List.
- B. Taps: Contractor is responsible for supplying saddle to connect the service pipe.
- C. Backflow Prevention Device and Water Meter: Backflow devices and water meters to be purchased to meet Town and Water Provider specifications.
 1. Above ground reduced pressure backflow preventers are required for all potable systems and for all untreated raw water (non-potable) or with in-line injection system designs.
- D. Master valve: sized to match size of mainline.
- E. Copper: Type K rigid conforming to ASTM Standard B88.

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F. Mainline:

1. Class 200 PVC, NSF approved.
2. Town Owned Areas: For pipe sizes larger than three-fourths of an inch (3/4-inch) use gasketed pipe.
3. Town Owned Areas: No mainline to be sized at 1-1/4 inch.
4. Use ductile iron fittings for mainline sizes larger than four (4) inches.
5. No cold weather glue permitted.

G. Laterals:

1. Class 200 PVC, NSF approved.
2. Town Owned Areas: No laterals smaller than one inch (1") or sized at 1-1/4".
3. Polyethylene Drip Pipe: weather and UV resistant material, NSF approved, SDR pressure rated pipe, only as approved for drip applications.

H. Pipe Fittings:

1. Pipe fittings shall be molded fittings manufactured of the same material as the pipe.
2. Funny Pipe (pop-up heads only): to be compatible with the elbows needed for the sprinkler heads and appropriately sized crimp-type clamps to be used.
3. PVC: Schedule 40, Type 1, PVC solvent weld with ASTM Standards D2466 and D1784. No cold weather glue permitted.
4. Copper pipe: Wrought copper or cast bronze fittings, soldered or threaded per installation details.
5. Use ductile iron fittings for mainline sizes larger than 4".

I. Sleeving:

1. Ductile Iron Pipe or Class 200 PVC under all paved surfaces. Each mainline, lateral or wire crossing of any paved area to be installed in a separate sleeve.
2. Sizes to be a minimum of two sizes larger than the pipe being sleeved. Minimum four-inch (4") diameter, or larger where appropriate, for irrigation lines.
3. Wires to be in separate sleeve from pipe, two inch (2") minimum size pipe for control wire sleeves.
4. Shall have marker tape on upper side and both ends for future locates.

J. Valves:

1. Remote Control Zone Valves (including Master Valves): Electrically operated, appropriate for the water supply (scrubber type for raw water applications), with manual bleed device and flow control stem. Shall have a slow-opening and slow-closing action for protection against surge pressure.
2. Pressure regulating function to be used as needed.
3. Drip Remote Control Valves: Same as remote control zone valves sized to match system requirements, including upstream filter, pressure regulator and y-strainer.
4. Isolation Gate Valves: Able to withstand a continuous operating pressure of 150 psi. Clear waterway equal to full diameter of pipe. Shall be opened by turning square nut to the left (wheel opening is unacceptable).
5. Manual Drain Valve: 3/4" ball valve with tee handle.

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6. Quick Coupling Valves: one-inch (1") brass units with rubber cover and one-inch (1") brass key.
- K. Valve Boxes:
1. House valves in valve box with matching locking cover: One valve per box. Install in Jumbo box sizes, as specified. Also, install a waterproof tag with permanent marker with each valve number. One tag shall be attached to each valve.
- L. Control System:
1. Controller (for systems including Town owned and HOA Owned Common Open space areas): Number of stations shall include two extra stations for possible future use. Controller box shall be weather tight and vandal resistant with locking exterior disconnect.
 - a. Control System Enclosure: Weatherproof security enclosure with floor stand kit and lock kit.
 - b. One per water tap. Number of stations shall include three (3) extra stations for possible future use. System shall come pre-assembled with security enclosure.
- M. Electric Control Wiring:
1. #14 solid copper direct burial UF or PE cable, UL approved, for systems up to 2,000 feet in length. For larger systems, wire is to be #12 solid copper direct burial UF or PE cable, UL approved, or larger, per system design and manufacturer's recommendations.
 2. Five wires with consistent color scheme throughout:
 - a. Red = live White = ground Black = extra (to farthest end of mainline including each branch). Blue = extra (to farthest end of mainline including each branch) Green = extra (to farthest end of mainline including each branch)
 - b. Label each wire with waterproof tape and permanent marker at the controller and the furthest end of each wire.
 - c. Wire connectors and waterproofing sealant specific for direct burial to be used to join control wires to remote control valves.
- N. Sprinkler heads:
1. All heads shall be of the same manufacturer as specified on the plans, and marked with the manufacturer's name and model in such a way that materials can be identified without removal from the system.
 - a. Include check valve in head.
 - b. Gear driven rotor heads: with stainless riser.
- O. Drip system:
1. Spiral barb emitters. No spaghetti tubing allowed. Install tracer wire over all drip pipes, buried a minimum of six inches (6") under the soil.
- P. Thrust blocks:
1. 3000 psi concrete with #4 rebar wrapped with asphalt tar based mastic coating.
- Q. Raw Water Systems:
1. For all raw water irrigation systems, typical "dirty water" equipment shall be required, including purple valve boxes, pipes and rotor heads, scrubber valves and bubblers instead of drip emitters. Raw water systems typically include supply turn-out structure (where applicable), storage pond for 3 days storage (typical). Storage pond to be lined – submit lining material product literature for Town review and approval, and rip rap will be installed 12" minimum below the lowest water level at draw down of irrigation. All raw water systems to include provision for potable back up in the event of raw water delivery system failure.

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R. Pump Systems:

1. Irrigation pump systems for raw water use to be coordinated with Town. Submit information on pump equipment for Town review and approval – using Approved Materials list for equipment as appropriate. Basic system requirements include: Pump system capable of water delivery at required volume and pressure for ultimate landscape build out (Variable Speed Pump to be used if drip irrigation is included in the design or if there is a varying depth of water storage); skid-mounted pump system (typical) with manufacturer per Town approval; pump control system with interface to irrigation controller(s); pump enclosure heating system to maintain 49 degrees minimum temperature at 0 degrees F; lighting and power (GFI) on separate breaker from pump; masonry (typical) enclosure with vandal resistant coatings and steel screen over vent openings; pump access hatch centered over pump; man door access using steel door with lock guard over door hardware; pump enclosure sized to provide adequate walking room around pump skid and controller systems.

S. Signs:

1. Raw Water in Use signs for all raw water systems.

2.5 SEEDING

A. For a specific list of materials accepted by the Town, please see Town Approved Materials List.

B. Seed:

1. Seed shall be of fresh, clean, new crop seed composed of the varieties approved by the Town with tested minimum percentages of purity and germination clearly labeled on the package. All seed shall be free of Poa annual grass and all noxious objectionable weeds with a maximum crop of 0.10% weeds.

C. Mulch:

1. For slopes 3:1 and less: Certified weed free hay for dryland seeded areas and hydromulch for irrigated turf seeded areas.
2. For slopes steeper than 3:1, and inaccessible areas: Hydromulch using wood cellulose fiber.
3. Hydraulic mulching shall not contain any substance or factor which might inhibit germination or growth of grass seed. It shall be dyed a green color to allow metering of its application.

D. Tackifier: Per approved materials (Mandatory for hydromulch).

E. Netting:

1. For slopes steeper than 3:1, use Soil Saver jute netting, or approved equal. Netting to be stapled with No. 11 gauge steel wire forged into a six inch (6") long U shape, and painted for viability in mowed areas.

F. Fertilizer:

1. Slow release type Nitrogen

G. Native grass seeded area signs:

1. A sign is to be erected in all permanent dryland seeded areas in designated pathways reading "Native dryland grass seeding is being established in this area. Prior to establishment, the grasses will be mowed approximately 4-5 times per year to help control noxious weeds. After establishment, the dryland grass will be maintained according to approved maintenance procedures and accepted industry standards, including growth heights of over twelve inches (12") and the irrigation system will be turned off. Eventually, these grasses will provide habitat for wildlife in the area and will help conserve water.

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Thank you for your cooperation." The sign shall be brown with white letters with Town logo and shall be mounted on 6"x6" wood post, mounted 5'-6' above grade.

2. Breakaway Traffic Delineators: Durapost or SafeHit. In-ground mounted, white with reflectors. See Approved Materials List.

2.6 SODDING

A. For a specific list of materials accepted by the Town, please see Approved Materials List.

B. Sod:

1. Sod shall have a clay-loam base that will not break, crumble or tear during sod installation. Netted sod is acceptable. It shall have a healthy, vigorous root system that has undergone a program of regular fertilization, mowing and weed control to obtain thick turf free of objectionable weeds. It shall be free of nematodes, pests and pest larvae as inspected by the entomologist of the Colorado State Department of Agriculture.
 - a. Thickness: one inch (1") thick excluding top growth and thatch.
 - b. Thatch: Not to exceed 1/2" uncompressed.
 - c. Width: Eighteen inch (18") wide strips or forty two inch (42") wide rolls.
2. Fertilizer:
 - a. Ammonium sulfate and diammonium phosphate, with chemical analysis of N 20%, P 10%, K 5%, S 8%, Fe 3% (Urea and sulphur coated Urea only), unless soil test recommendation provides alternative rates.

2.7 TREES PLANTS AND GROUND COVER

A. Nursery Stock: All nursery stock shall conform to the American Standard for Nursery Stock (ANSI Z60.1) and the Colorado State Nursery Act.

B. Plants

1. Plants shall be first class representatives of specified species or variety, in healthy condition with normal developed branch and root systems, free of objectionable features. Must conform to: American Joint Committee on Horticulture (plant names); American Standard for Nursery Stock (ANSI Z60.1); Colorado Nursery Act.
2. Only plants grown in hardiness zones 2, 3, 4, and 5 are acceptable.
3. All material shall be free of disease, insects, eggs, larvae, and parasites of objectionable or damaging nature.
4. Inspect plants to make sure they meet minimum size requirements of the ordinance and the plans, and for proper form including strong central leader and good branching pattern on trees and number and length of canes on shrubs:
 - a. Large or small canopy deciduous trees (>30' mature height): two inch (2") caliper measured six inches (6") above ground, balled and burlapped.
 - b. Ornamental deciduous trees (<30' mature height): 1-1/2" caliper measured six inches (6") above the ground, balled and burlapped.
 - c. Evergreen trees: six feet (6') in height, balled and burlapped.
 - d. Shrubs: # 5 plastic container with deciduous shrubs approximately two feet (2') high and spreading shrubs having 18" – 24" spread.
 - e. Groundcovers, vines, perennials: #1 plastic container.

C. Backfill mix:

1. Mix shall consist of the following and be used in backfilling all plant materials:

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2. One part composted soil amendment; two parts topsoil; three parts native soil from planting pits; superphosphate amendment.
 3. All materials to be thoroughly blended.
- D. Stakes and guys:
1. Shall be standard guying system unless previously approved by town.
 2. Standard guying system:
 - a. Stakes – see approved materials list.
 - b. Guys - see approved materials list.
- E. Miscellaneous: See approved materials list.
- F. Mulch: See approved materials list.
- G. Weed barrier fabric: See approved materials list.
- H. Steel edging: See approved materials list.
- I. Beaver protection: See approved materials list.
- J. Prairie dog enclosure: If required, contact Town or the Colorado Division of Wildlife for recommended enclosures.

PART 3 EXECUTION

3.1 GENERAL

- A. Locate all utilities prior to grading and trenching and protect from damage, per Section 31 00 00 of these Specifications.

3.2 CONCRETE PATHS AND BRIDGES

- A. Submit concrete mix design to Town for approval.
- B. Alignment to be per approved plans. Field modifications in alignment must be approved by Town Engineer prior to formwork.
- C. Coordinate with irrigation installation so necessary sleeves are placed beneath concrete path as needed. Sleeves to be set at standard trench depth per Section 3.4.E.3.
- D. Obtain testing of compaction and moisture and re-compact as needed in order to obtain minimum compaction requirements. Compaction testing needed in accordance with 31 00 00.
- E. Timing of concrete placement to allow for proper finish and product. No placement allowed if rain or snow is pending prior to reasonable cure. Excessively hot or cold weather may be reason for placement rescheduling by the Town of Mead. Weather damage due to precipitation may be cause for rejection of paving.
- F. Slab thickness to be six inch (6") minimum.
- G. No tooled joints are allowed on concrete path construction. Place expansion joints at maximum spacing of four hundred (400) lineal feet or three thousand, two hundred (3,200) square feet, whichever is less. Install expansion material at sufficient depth to allow for sealant and remain flush with finish surface elevation. Expansion joints where flatwork intersects vertical concrete. Dowel per Section 32 13 00 between all cold joints and between concrete path and bridge abutment.
- H. Install control joints on eight foot (8'-0") centers using zip-strip during placement operation so lines are straight and perpendicular to the edge of the concrete path or saw-cut after placement operation with straight and perpendicular cuts. Control joints also to be placed at intersections, radius points and elsewhere as needed to prevent cracking. Saw-cut joints to be timed properly with the setting of the concrete. Cutting shall be started as soon as the concrete has hardened

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sufficiently to prevent aggregates from being dislodged by the saw, and shall be completed before shrinkage stresses has developed sufficiently to induce cracking.

- I. Testing to be done by an independent testing lab per 32 13 00 of these Specifications.
- J. Concrete finish to be smooth and consistent with a light broom finish. Heavy broom finish will not be permitted. Irregularities, poor finish and other deficiencies of workmanship or vandalism will require concrete work to be removed and replaced. Weather damage to finish will also be cause for removal and replacement. Contractor has option to provide sample panel of finish prior to work for Town approval.
- K. No concrete wash is to be dumped onto landscape areas. Any concrete water or spillage is to be contained and removed from the site prior to any landscaping.
- L. Protect concrete with curing compound and other means to prevent premature drying, and protect from frost and rain. Provide watchmen as needed to protect from vandalism until reasonable cure is obtained.
- M. Remove forms twenty four (24) hours after pour unless otherwise approved. Avoid damage to edges of pavement.
- N. Backfill edges of concrete path prior to opening to public use.
- O. Install signs at locations field verified by Town inspectors. Install posts with 30" minimum bury – backfill excavation with washed rock. Offset post from path edge so that edge of sign face is a minimum of 24" from the path edge. Install sign faces in correct orientation to path for sign message readability. Install sign face using vandal resistant fasteners.

3.3 FINE GRADING

- A. Locate all utilities prior to grading or trenching and protect from damage, per Section 31 00 00 of these Specifications.
- B. Install construction fencing and/or silt fencing Storm Water Construction Activity BMP's as needed prior to any grading activities in accordance with Section 31 25 00 – Erosion and Sedimentation Controls
- C. Apply general herbicide or broadleaf herbicide (2-4-D amine 4% A.I.) as applicable to areas where noxious weed beds have been established or where seed mix is to be planted. Herbicide must be applied by certified contractors at the rate recommended by the manufacturer after proper notification has been done in accordance with chemical applicator's standards. Precautions must be taken to avoid drifting of spray onto other properties and shall not be done in breezy conditions. Plant material not designated for herbicide application that is damaged shall be replaced by the Contractor. Timing of application shall allow complete weed kill prior to grading operations and again prior to final grade if re-growth has occurred.
- D. For arterial ROW development adjacent to a road slated for future expansion, survey and stake future horizontal and vertical alignment of the ultimate curb. These stakes are to be maintained throughout the ROW construction process, including irrigation layout, seeding and sodding. Disturbed stakes are to be re-surveyed, as necessary, to maintain the required information during construction. Grades outside the ultimate roadway are to be set to anticipate future road improvements. Grades between the existing road edge and the ultimate curb line are to be graded to provide drainage and a safe shoulder for vehicles.
- E. Take precautions to accommodate proper drainage and flow during and after grading and soil preparation.
- F. Clear and grub the site by removing unsuitable vegetation, woody and rock material present in the surface grade.
- G. Strip topsoil to a maximum depth, as determined by field inspection to recover as much quality topsoil material available and where site is scheduled for cutting or filling. If existing grades

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are to be maintained, topsoil can remain undisturbed. Stockpile stripped topsoil in location separated from grading activities and cover to protect from wind and other erosion.

- H. Proceed with earthwork operation per approved plans. When complete with rough grading, obtain approval from Town. Rough grade inspection is to allow for six inch (12") minimum depth of topsoil and specified soil amendments as part of the fine grading work.
- I. Rip to twelve-inch (12") depth with agriculture subsoiler to receive plantings.
- J. Re-spread or import topsoil to achieve twelve inch (12") minimum depth in all landscaped areas and grade to smooth and even lines. Establish swales and drainage as required per plans.
- K. Evenly distribute soil amendment at rate of three (3) cubic yards per 1,000 square feet of area, or as recommended by Soil Test, over the entire area to be prepared. Till amendments and topsoil into top twelve inches (12") of soil. Compact to a firm, but not hard (80% of Standard Proctor Density at 2% optimum moisture) seed bed. Soil amendment shall be applied no more than thirty (30) days before planting operations.
- L. Remove all objects greater than one-half inch (1/2") in diameter in all irrigated turf areas. For native grass seeded areas, two-inch (2") diameter objects or greater are to be removed.
- M. Trim finish grade elevations adjacent to paved areas to one inch (1") below pavement finish grade.
- N. Evenly distribute triple superphosphate fertilizer at the rate of fifteen (15) pounds per thousand square feet; modify type and rate if soils test recommends otherwise.
- O. Remove all debris piles and other stockpiles from site.
- P. Clean walkways and streets on daily basis to minimize mud tracking and siltation into drainage structures.
- Q. Maintain silt fencing until site is re-vegetated.

3.4 IRRIGATION

- A. Inspect tap or other existing irrigation system, as applicable, prior to work.
- B. Water Service Connections (Taps): Contact Town and Water Provider 48 hours prior to schedule work for water taps and inspections. Backflow prevention devices shall meet Town and Water Provider requirements. Minimum two weeks prior notice to be given for installations which will require meters or backflow devices larger than two inches. Larger devices and meters are not always kept in stock and may have ordering stocking delay.
- C. Contractor is responsible for excavation, connection to corporation stop at the water main, providing the saddle for the PVC or A.C. pipe, making the connection to the existing water service, backfill and compaction, and pavement or shoulder surface treatment or replacement as needed. No soldered joints or fittings are allowed on water service lines where buried. Soldered joints or fittings are permissible above grade or inside a vault. No solder, sealants, fluxes, pipe dope, and other materials shall contain any lead. The contractor shall install all irrigation taps per the Water Provider Standards and IIT all taps and installations are subject to approval and inspection by Town and the Water Provider.
- D. Install meter, master valve, and drain valve inside specified areas and vaults. Inspection of service line (where appropriate), vault, water meter and backflow is to be coordinated with Town and Water Provider. Install meter, master valve, flow meter and drain valve and backflow inside specified vault per Town detail. Install flow meter, backflow, winterization assembly and drain valves as specified adjacent to precast vault per Town detail. Inspection of service line (where appropriate), vault, water meter and backflow is to be coordinated with Town and Water Provider.
 - 1. Meter vaults are to be 60" diameter for taps 2" or less in size. For taps larger than 2", the pipe layout inside the meter vault must be designed to determine the vault size.

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2. Town Owned Areas: Non-potable (raw water) irrigation systems or systems with an in-line injection system are required to have a reduced pressure backflow device upstream of injection nipple, and which cannot be placed in vault.
 3. Install flow meter downstream of meter unit within meter vault with the following minimum spacing upstream and downstream of flow meter the first joint, bend or other fittings: 10 pipe diameters straight pipe upstream; 5 pipe diameters straight pipe downstream.
 4. Install master valve in meter vault within a reasonable distance downstream of flow meter (no closer than 10 pipe diameters).
 5. Copper pipe to be soldered so that a continuous bead shows around the joint circumference. Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, stainless steel) are joined.
 6. Install winterization assembly downstream of meter vault on copper PVC (with no size reduction) for mainlines greater than two inch (2"). Install winterization assembly on PVC (no size reduction) for mainlines two inch (2") or less.
- E. Pipe trenching:
1. Install pipe in open cut trenches of sufficient width to facilitate thorough tamping/puddling of suitable backfill material under and over pipe. Puddling is not allowed where next to walks, curbs and concrete paths. Install mainline and lateral lines in separate trenches.
 2. Pipe location to be offset two foot (2') maximum from walks and curbs to maximize tree planting zones. Field adjustments to this standard must be approved by Town inspectors prior to work.
 3. Trench depths:
 - a. Mainline: Minimum of twenty four inches (24") deep from top of pipe to finished grade.
 - b. Lateral: Minimum of eighteen inches (18") deep from top of pipe to finished grade.
 - c. Drip laterals: Minimum of twelve inches (12") deep from top of pipe to finished grade in the paved and sodded/seeded areas, four inch (4") minimum mulch cover in planting beds.
 4. Sleeves: Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
 - a. Sleeving: Boring shall not be permitted unless obstruction in pipe path cannot be moved, or pipe cannot be re-routed.
 - b. Mainline installed in existing sleeves at greater depth than adjacent pipe, shall have a manual drain valve at the low end.
 - c. Install sleeve so both ends extend past edge of curb, gutter, sidewalk, concrete path or other obstruction, a minimum of two feet (2').
 - d. Mark all sleeves with a "V" chiseled in walk (or other surface) directly over sleeve location.
 - e. Shall be laid to drain at minimum grade of 5"/100'.
 - f. Shall be bedded in two inches (2") of fill sand and covered by six inches (6") of fill sand.
 - g. Sleeves installed for future use shall be capped at both ends.
 - h. Separate sleeve (two inch (2") minimum size) shall be used for all wiring.
 - i. Sleeving shall not have joints unless necessary due to length of sleeving run. If joints are necessary, only solvent welded joints are allowed.
 - j. Compaction of backfill for sleeves shall be 95% of Standard Proctor Density, ASTM D698-78. Use of water (puddling) around sleeves for compaction, will not be allowed.
- F. Pipe Installation:

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1. Use Teflon tape on all threaded joints; only schedule 80 pipe may be threaded. All threaded joints shall be tightened to eliminate leaks per industry standards.
 2. Reducing pipe size shall be with reducing insert couplings: at least six inches (6") beyond last tee of the larger pipe.
 3. Snake PVC lateral pipe from side to side within trench.
- G. Provide emitters to each plant per these standards. Do not use spaghetti tubing.
1. Funny Pipe: Attach funny pipe to elbows using appropriately sized crimp-type clamps to secure.
- H. Thrust blocks:
1. Shall be installed where PVC mainline (2 1/2" or larger) changes direction over 20 degrees.
 2. Minimum of one cubic foot of concrete bearing against undisturbed soil.
 3. Keep pipe joint clean of concrete. Do not encase.
 4. Place wiring away from thrust block to avoid contact with concrete.
 5. #4 rebar wrapped with asphalt tar based mastic coating.
- I. Valve Installation: Install at least twelve inches (12") from and align with adjacent walls or paved edges.
1. Automatic Remote Valves: Install in such a way that valves are accessible for repairs. Make electrical connection to allow pigtail so solenoid can be removed from valve with twenty four inch (24") minimum slack to allow ends to be pulled twelve inches (12") above ground. Locate minimum twelve inches (12") from and align with walks, walls, etc.
 - a. Thoroughly flush piping system under full head of water for three minutes through furthest valve, before installing valves.
 - b. Valve assembly to include ball valve and union per detail for ease of maintenance and repair. Install in locking valve box per details.
 - c. Install a waterproof tag with permanent marker with each valve number. One tag shall be attached to each valve.
 2. Manual Drain Valve: Install per plans, but in no case shall be less than at the low points of the system and at the end of the mainline. Install in six inch (6") CL 200 PVC sleeve access with ten inch (10") locking valve box lid. Install valves on swing joint assembly per detail. Sump to be four (4) cubic feet of crushed gravel over filter fabric.
 3. Quick Coupler Valve: Install in ten inch (10") round locking valve box. Flush completely before installing valve. Thoroughly flush piping system under full head of water for three minutes through furthest valve, before installing valves.
 4. Isolation Gate valves: Install in valve box.
 5. Valve Boxes:
 - a. Brand all valve boxes with the following codes as appropriate: "SV" and the controller valve number per as-built plans for all remote control valves; "DV" for all drain valves; "GV" for all isolation valves; "DRGV" for all drip system isolation valves; "QC" for all quick coupling valves; "WA" for all winterization assemblies; "FM" for all flow meter assemblies; and "MV" for all master valve assemblies. Use a branding iron stamp with three inch (3") high letters.
 - b. Brand boxes in the center of the lids.
 - c. Valve box shall NOT rest on mainline; use brick or other approved non-compressible material per detail. Top of valve box to be flush with finish grade.

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- d. All equipment shall be centered in valve boxes with adequate space to access equipment with ease. A hand should be able to pass unobstructed under the valve.
 - e. Valves shall not be so deep as to be inaccessible for repairs. Three inch (3") depth of 3/4" washed gravel to be placed in the bottom of each valve box with enough space to fully turn valve for removal (see detail).
- J. Head Installation:
- 1. Set heads plumb and level with finish grade. In sloped area, heads to be tilted to match slope to provide full radius spray pattern.
 - 2. Flush lateral lines before installing heads. Thoroughly flush piping system under full head of water for three minutes through furthest head before installing heads. Cap risers if delay of head installation occurs.
 - 3. Pop-Up Heads along walks and bikeways: Bed heads in six inch (6") layer of sand under the base of the head.
 - 4. Nozzles: Supply appropriate nozzle for best performance.
 - 5. Adjustment: Adjust nozzles and radius of throw to minimize overspray onto hard surfaces.
- K. Wiring and Electrical Connections:
- 1. All wire connection and exposed ends to be sealed using wire connectors and waterproof sealant specific for direct burial applications.
 - 2. Electrical installations will be inspected by the Town of Mead's Building Inspection Division and the final connection made by Electric provider. All work, including the low voltage installation to the electric source where applicable, to be supplied by the contractor. All materials to be provided by the contractor. When working near any electric facility, prior coordination and approval is required. Reference the building permit for telephone numbers to request an electrical inspection by the Building Inspector.
 - 3. Label each wire with waterproof tape and permanent marker at the controller and the furthest end of each wire.
- L. Controller Installation:
- 1. To be installed in an above-ground location suitable to prevent vandalism and provide protection from adverse weather conditions, and per Town field direction. All exposed wiring to and from the controller shall be encased in galvanized metal conduit. Exterior controllers to be installed on six inch (6") thick concrete pad with compacted subgrade per concrete specification.
 - 2. Install Controller in accordance with manufacturer's specifications. Install surge protection, grounding rods and other accessory components as specified.
 - 3. Attach wire markers to the ends of control wires inside the controller unit. Label wires with the identification number of the remote control valve active by the wire.
 - 4. Sequence wiring for irrigation zones in logical manner and so it matches as-built drawings.
- M. Wiring:
- 1. Comply with Town electrical codes.
 - 2. Power source brought to controller to a ground fault receptacle installed within controller casing. Clock shall be plugged into receptacle.
 - 3. String control wires as close as possible to mainline, consistently along and slightly below one side of the pipe.

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4. Leave minimum loop of twenty four inches (24") at each valve and controller, at each splice, at the ends of each sleeve, at one hundred foot (100') intervals along continuous runs of wiring, and change of direction of 90 degrees or more. Band wires together at ten foot (10') intervals with pipe wrapping tape.
5. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted. Install three extra wires, as specified, to the furthest valve on the system and each branch of the system.

N. Drip Emitter Installation

1. Install specified number of emitters directly onto lateral hose (spaghetti tubing not allowed).
 - a. Groundcover: one single outlet emitter per square foot planting area.
 - b. Shrubs: two single outlet emitters per shrub.
 - c. Trees: four single outlet emitters per 2-3" tree; six single outlet emitters per four inch (4") tree; eight single outlet emitters per six inch (6") + tree. No spaghetti tubing permitted.
2. All drip emitters are to be tested for operation prior to weed barrier and mulch installation.

O. Signs

1. Install Raw Water in use sign in prominent location.

P. Testing

1. All tests to be run in the presence of Town and Irrigation Design Professional. Irrigation Design Professional conducting inspections is to sign the certification statement on the as-built drawings. All irrigation inspections to be scheduled by coordinating with Town inspector. Schedule all tests and inspections a minimum of 48 hours in advance of tests. Repeat any failed tests until full acceptance is obtained. No testing shall be done when seasonal conditions minimize the ability to sufficiently inspect the system. Generally, testing is not available between the months of November and April. No chemical spraying shall be done within ten (10) days of any irrigation inspections.
 - a. Hydrostatic Test (during irrigation installation before sleeving and backfilling pipe joints): Maintain 120 PSI for four hours. No leakage or loss of pressure is accepted during test period. Test must be run in the presence of Town inspector as noted above. Contractors to provide at their own expense hydrostatic pump, water and other materials as necessary for test. The pressure gauge is to be installed on the end of a fitting, rather than directly into a quick coupler. The pump is to be disconnected at the start of the test.
 - b. Town requires that the Contractor perform an independent pressure test prior to scheduling the required inspection. If numerous tests are required for a system, Town reserves the option to bill the Contractor for numerous tests at \$50/hr. (with a one hour minimum).
2. Operational Test (at Construction Acceptance punch list walk-through): Activate each remote control valve from the controller in the presence of Town inspector and irrigation professional for Town Owned and Common Open Space areas. Replace, adjust or move heads and nozzles as needed to obtain acceptable performance of system. Replace defective valves, wiring or other appurtenances to correct operational deficiencies.
3. Drip Operational Test (after drip lateral installation, but prior to weed barrier and mulch installation): Activate remote control valves in presence of Town inspector and Irrigation Design Professional for Town owned and common open space areas. Replace any emitters that are clogged or not operational. Adjust lateral hose as needed to effectively irrigate plantings.

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4. Central Control System Acceptance Test (at Construction Acceptance punch list walk-through): Town inspector and Irrigation Design Professional will activate each remote control valve from the Central Control System base station using the hand-held remote device.
5. Raw Water Pump Control Inspection: Demonstrate to Town inspectors for and Irrigation Design Professional at pump start up that pump system correctly operates automatically, all sensors perform properly and the system is built per approved plans. The pump designer and/or supplier will be required to attend this inspection.

3.5 ESTABLISHING SEEDING

- A. Inspection: Inspect finish grade and trim where needed to obtain finish grades of one inch (1") below adjacent pavements. Verify positive drainage away from all structures. Verify or complete removal of rock and debris larger than one half inch (1/2") from all irrigated turf grass areas to be seeded, and rock larger than two inches (2") from all dryland native grass areas to be seeded.
- B. Fertilizer
 1. Apply 8 lbs. per 1000 sq. ft. of irrigated turf grass seeded area (2 - 3 lbs. per 1000 sq. ft. of native grass seeded areas), unless soil test recommendation provides alternative fertilization rates, and rake lightly into top 1/8" of soil just prior to seeding operation. Native grass areas do not require fertilizer unless recommended on Soil Fertility test report.
- C. Seeding
 1. Do not sow seed in windy weather or when ground is frozen or otherwise untillable.
 2. Use billion type drill for slopes less than 3:1 in grade. Drill seed in manner such that after surface is raked and rolled, seed has 1/4" of cover.
 3. Hydraulic seeding methods can be used only on slopes steeper than 3:1 or in areas that are not accessible for machine methods. Hydraulic pump capable of being operated at 100 gallons per minute and at 100 pounds per square inch pressure to be used. The equipment shall have an acceptable pressure gauge and a nozzle adaptable to hydraulic seeding requirements. Storage tanks shall have a means of agitation and a means of estimating the volume used or remaining in the tank. Do not seed and mulch in the same operation.
 4. Broadcast seeding can be used only on areas not accessible for machine methods and too small to justify hydraulic seeding. Where broadcast seeding is done, seeding rates are to be doubled. Hand rake seed to cover at 1/4" depth.
 5. Seeding rates (drilled and hydraulic):
 - a. Urban, Non-Native Grass Mix - 20 lbs. pure live seed per acre.
 - b. Native Grass Mix - 12 lbs. pure live seed per acre.
 - c. Irrigated Turf Grass Mix - 150 lbs. pure live seed per acre.
- D. Mulching:
 1. Native Grass Mulch: Apply at a rate of two (2) tons per acre. Crimp into seed bed with disk set straight forward and two inches (2") deep. Disk mulch across slopes to prevent erosion. Mulch seed beds within 24 hours after seeding.
 2. Hydromulching: Wood cellulose fibers must become evenly dispersed when agitated in water. When sprayed uniformly on the soil surface, the fibers shall form a blotter like ground cover, which readily absorbs water and allows infiltration to the underlying soil. Cellulose fiber mulch shall be added with the proportionate quantities of water and other approved materials in the slurry tank. All ingredients shall be mixed to form a homogenous slurry. Using the color of the mulch as a metering agent, apply the slurry mixture by spraying uniformly over the seeded area. Apply with the specified tackifier at a rate of 120 lbs. per

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acre. Unless otherwise ordered for specific areas, fiber mulch shall be applied at the rate of 2,000 pounds per acre.

- a. Hydraulic mulching shall not be performed in the presence of free surface water resulting from rains, melting snow or other causes.

E. Netting:

1. Net areas with slopes greater than 3:1. If Contractor fails to net and subsequent soil erosion occurs, contractor shall re-establish finish grade, soil preparation, seed bed and apply netting at no cost to the Town. Staple per manufacturer's specifications.

F. Watering:

1. Immediately after seeding and mulching, water seeded areas lightly to a depth of two inches, but with care so that no erosion takes place and no gullies are formed. Water lightly as needed to maintain moist seedbed two times per day and keep seeded area moist until turf is established. Sloped areas should be hand watered until turf is established to prevent erosion; water these areas more often but for shorter periods of time.

G. Clean up:

1. Remove all hydromulch and other mulch materials from all plant materials, fences, site furnishings, signs, concrete and other areas except for seed bed.

H. Protection:

1. Provide and install barriers as required to protect seeded areas from pedestrian and vehicular damage. Provide signage and barricades if needed.

3.6 SODDING

A. Inspection: Inspect finish grade and trim where needed to obtain finish grades of one inch (1") below all adjacent paved surfaces. Verify or complete removal of rock larger than one half inch (1/2") which may hinder sodding and perform fine grading as necessary to maintain drainage per plans. Verify that irrigation system is fully operational prior to sodding.

B. Preparation: Clean up and irrigation adjustment

1. Clean out drainage inlet structures.
2. Adjust irrigation heads to proper watering height according to depth of sod material, but lower than mower blade height, to enable lawn mowers to cut grass freely without damage to sprinkler system.

C. Sod cutting and delivery:

1. Cut no more than 24 hours prior to delivery, laid in place within 24 hours of delivery.

D. Transportation:

1. Do not pile sod more than two feet (2') deep. During delivery process, protect roots from exposure to drying sun, winds and heat. Store in shady area and keep moist or store covered with moistened burlap.

E. Timing:

1. Install sod only between spring and fall. Do not install on frozen or saturated soil.

F. Watering:

1. Lightly water area to be sodded.

G. Fertilizer:

1. Distribute fertilizer uniformly at a rate of 50 lbs. per acre, unless otherwise recommended by soils test. Apply within 48 hours before laying sod.

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H. Sodding:

1. Lay sod on slightly moist soil.
2. Lay with longest dimension parallel to contours in continuous right-of-ways.
3. Tightly butt ends of sod together. Stagger joints. Compact vertical joints between sod strips by rolling so sod will be in contact with the ground surface. Cut right-of-ways terminating on property lines to straight line.
4. When sod and soil are moist, roll sod lightly as soon as possible after laying. Roll with enough weight to ensure contact with soil for proper rooting.
5. Add topsoil along exposed edges to match existing grade; feather topsoil out approximately one foot (1').
6. Make sure finished sodded areas positively drain so that no irrigation water or storm water will pond in sodded areas. Relay sod if necessary to correct.
7. Water thoroughly with fine spray immediately after planting.

I. Re-sodding:

1. Re-sod spots larger than 1 sq. ft. not having uniform stand of grass prior to Final Acceptance.

3.7 TREES, PLANTS AND GROUNDCOVER

A. Inspection

1. Schedule a tree delivery and layout inspection with Town. Trees will be inspected for form, condition and health. Rejected trees to be removed immediately from site and replaced. Replacements are subject to re-inspection by Town. Inspection requirements include trees to be off-loaded from trucks to allow for full access. Binding material and trunk protection to be removed by Contractor prior to inspection.
2. Tree layout inspection shall be done at the same time the tree materials are delivered. Utility line locates to be visible in all planting areas. Stakes for proposed tree locations to be placed in planting areas requiring Town inspection.

B. Delivery and storage of plant materials:

1. Shade cloth shall be used to cover trees during transportation. B&B trees should have limbs bound to prevent injury during delivery. Keep root systems moist and protect plants from adverse climate and transportation conditions. B&B stock shall be heeled in immediately upon delivery to the site unless it is planted within 4 hours. Store other plants in shade and protect from adverse weather and from drying out. When handling, do not lift plants by trunk or stem; handle only ball or container. Obtain Town inspection.

C. Layout:

1. Stake plant locations or set out plants per plans. Verify prior to planting that plants when mature will not interfere with existing trees, irrigation, lighting, utilities and other equipment, both underground and overhead. Also verify proper spacing between trees and other hard surfaces. Notify Town for approval if plant locations must be changed.
2. Obtain new utility locates if needed – all utilities must be clearly visible at the time of Town plant material layout inspection.
3. Obtain Town inspection.

D. Excavation of planting pits:

1. Excavate planting pits per Town details; dispose of any rocks off site.
2. Trees: Trees shall be planted at a depth where the root flare above the solid rootball is at grade in depth of pit shall be two inches (2") (non-irrigated areas) and four inches (4")

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(above grade in irrigated turf areas) less than the depth of the root ball so that water will drain away from trunk. Contractor to contact Town staff if they are not sure where the root flare is located on the tree. Modify depth of pit if soil type or conditions warrant and/or per Town direction. Minimum diameter of the base of the planting pit shall be 2 times the diameter of the root ball (minimum). The width of the hole at the top of the pit shall be three (3) times the diameter of the root ball

3. Shrubs, perennials and ground cover: top of root ball shall be positioned slightly higher (1"-2") than finish soil grade so that water will drain away from plant. Modify depth of pit if soil type or conditions warrant and/or per Town direction. Diameter of the pit shall be 2 times the diameter of the root ball (minimum).

E. Planting:

1. Balled and Burlapped trees (B&B) (Do not plant if tree trunk is loose in root ball or if ball is cracked or broken before or during planting process.)
 - a. Remove bottom 1/3 of wire basket from root ball. Wire basket must be completely removed. Place wire on tree stakes for Town inspection prior to removal from site.
 - b. Place in pit with burlap intact on undisturbed soil in center of pit to proper grade, and plumb.
 - c. Face for best effect.
 - d. Cut and remove remaining wire and twine. Do NOT pull wrapping or wire from under ball as it may damage the root ball.
 - e. Backfill 2/3 of pit; remove top 1/3 of burlap; complete backfill. DO NOT compact backfill mix by tamping. DO NOT backfill over crown of root ball or exceed soil depth of root ball; crown must be at proper planting depth.
 - f. Install five inch (5") high watering basin around trees.
 - i. Remove and grade out berm around basin after two thorough waterings in irrigated areas. Mulch after berm basin is removed.
 - ii. Mulch and leave basin in dryland areas.
2. Container grown stock (Do not plant if root ball is cracked or broken before or during planting process.)
 - a. Carefully remove plants from containers without injury or damage to root ball; do not cut cans with spade or ax.
 - b. Vertically score root ball using sharp knife, about 1/8" deep and about every 2-3" in circumference. If stock is root bound, butterfly root ball by cutting ball in half, halfway up from the bottom; flair root ball out to sides when planting.
 - c. Set plant plumb, face for best effect, make sure crown of root ball is at correct grade.
 - d. Backfill and install four inch (4") high watering basin around planting pit. DO NOT compact backfill mix by tamping. DO NOT backfill over crown of root ball or exceed soil depth of container; crown must be at or slightly above finished ground level. Mulch after two thorough waterings.
3. Completion of planting:
 - a. Shape surface of finish grade around root ball so water drains away from trunk or stems and to match finish grade at the edge of the planting pit.
 - b. Remove plant tags from trees and shrubs.

F. Edging:

1. Steel Edging: Install so top of edging is two inch (2") maximum above finish grade and flush with the top elevation of curb or pavement which it abuts. Edging shall meet pavement or

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curb at right angle. Stake at manufacturer's recommended intervals on smooth radius using steel stakes. Punch holes as needed for drainage.

2. Cut Edging: Where steel edging is not used, cut 6" deep vertical straight sided trench at mulch shrub bed edge. For individual trees, edger cut is to be a 3' radius from trunk of tree. Transition 6" deep cut edge to specified mulch depth (4") at a 45 degree angle.
- G. Mulching:
1. Mulch depth:
 - a. Tree pits - four inch (4") deep, keep two inch (2") from trunk.
 - b. Shrub pits – three inch (3") deep (minimum).
 - c. Remaining shrub bed - four inch (4") deep (minimum).
 - d. Groundcover beds – three inch (3") deep (minimum).
 2. Place geo-textile landscape fabric under mulch except in individual tree rings or where any other areas specifically approved for omission. Lay straight and even with eight inch (8") overlap at edges. Staple along edges with steel U pins on twenty four (24") spacing. Staple folds in fabric to keep below mulch material.
 3. Tree rings – mulch to extend to edge of planting pit and shall encompass tree stakes in mulch area.
 4. Timing: The Town recommends delaying mulch application at tree rings in irrigated turf areas until after turf is established to minimize moisture build-up at tree bases. All other plants shall be mulched within two days of planting or after specified number of waterings for individual trees and shrubs.
- H. Staking and guying:
1. Standard Guying System: Pound six-foot (6') long metal or wood stakes into undisturbed soil beyond the planting pit so that stake is secure. Where possible, locate stakes within the required mulched tree ring area. Secure STRAP-X or wire through metal grommets on canvas strap to tree and wrap above first branch on deciduous trees or at mid-point of tree on coniferous trees. Secure guy to stake so that it is taut but allows some movement. Where wire is used as a guy, secure it so that no sharp projections are extending from post and flag it with ½" PVC pipe or white plastic flagging for visibility. Adjust tension on guy if needed. If metal t-posts are used, place PVC caps on top of stakes. Wooden pole stakes (2"x6") may be used without PVC caps.
- I. Pruning:
1. Prune minimum necessary to remove injured twigs and branches, deadwood and suckers to insure healthy tree. Do not prune central leader.
- J. Beaver protection:
1. Install fencing in circle around all deciduous trees (existing and new) in areas prone to harvesting by beaver, as determined by Town. Fencing to be cut in lengths long enough to provide a minimum twelve inch (12") separation between trunk and fence (all sides). Additional sections of fencing are to be wired together in sections if needed to fully cover trunk from ground to first branch. Ends and additional sections of wire fence loop to be securely fastened. Fencing to be cut into lengths in such a manner as to allow cut ends to be bent to secure enclosure around trees. Ends to be bent in to tree to prevent safety hazards and projections. Fence must be in contact with ground around entire tree using steel U pins to secure, if needed.
- K. Prairie dog enclosure:
1. Contact Town or Colorado Division of Wildlife for recommended installation.

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3.8 COMPLETION SERVICES

- A. Provide to Town record drawings including horizontal verification of concrete path and all other structures.
- B. Irrigation Systems:
 - 1. When project construction is substantially complete, request from Town inspector and coordinate with Irrigation Design Professional for inspection and demonstrate system to Town inspector.
 - 2. When project construction is ready for Construction Acceptance, request from Town inspector for an inspection (all punch list items must be complete) and coordinate with Irrigation Design Professional for inspection.
 - a. Demonstrate system to Town inspector and Irrigation Design Professional.
 - b. Submit turn-over items (items must be accompanied by a transmittal letter and delivered to the Town inspectors' offices. Delivery at the project site is not acceptable.
 - c. Provide Town personnel with list of equipment ordering information including model numbers, size and style for all components.
 - d. Provide one mylar, one blue line set and one pdf format electronic file (for all projects), and one electronic file to be able to be opened in AutoCAD Release 2006, in .dwg format (for all Town capital projects), of as-built irrigation drawings no larger than 24" x 36". Common Open Space as-built drawings are to be a separate drawing package from Town Owned areas as-built drawings. The Town may require .dwg AutoCAD files for development projects if future development is anticipated in the area. (Construction plans may be used for as-built base map information. Coordinate with developer and consultant team to obtain). Drawings to have the following information as a minimum:
 - i. System shown as installed with each sheet clearly marked "RECORD DRAWINGS".
 - ii. The name of the project, date of installation, date of as-built drafting, company name of installer, name of as-built drafter, installer company phone number and back-up phone number for night and weekend contact.
 - iii. Sleeves and valves noted with dimensions to each from two different permanent objects.
 - iv. Control valves noted with gpm, valve number and valve size clearly indicated for each valve. Valve numbering to match as-built controller sequencing.
 - v. Horizontal verification of all irrigation pipes, irrigation heads, valve boxes, wiring, electrical boxes, controller, meter, and backflow prevention devices. Noted information shall include all pipe sizes, zone numbers, valve locations, head types, valve types and model numbers, controller type and model number, and drip emitter chart.
 - vi. Irrigation record drawings shall include all pertinent physical features (such as concrete paths, sidewalks, fences, ponds, buildings, pump house, parking lots and athletic fields).
 - vii. No contour lines shall be shown on irrigation record drawings unless required by the Town.
 - viii. Certification statement signed and executed by Irrigation Design Professional and Contractor.
 - e. Provide two sets of all irrigation sheets reduced to 11" x 17", with each zone color coded, and each sheet plastic laminated.
 - f. Provide Town and on-going HOA maintenance personnel with 1 each of all operating keys, servicing tools, test equipment, remote hand-held radios (programmed to Town frequency – for Town Owned areas only), warranties/guarantees, and maintenance

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manuals as needed for on-going maintenance of area. Any exceptions to this requirement are to be obtained in writing from Town inspector staff.

- g. Clean Up: Remove all excess materials, tools, trash and debris from site.
- h. Complete additional punch list items if determined necessary Town Inspector and Irrigation Design Professional.
- i. Schedule re-inspection by Town and Irrigation Design Professional to verify completion and acceptance of all punch list items if necessary.
- j. Request Final Acceptance inspection.
 - i. Problems identified during the punch list inspection and project work-through will be coordinated with Town inspector and Irrigation Design Professional with solutions executed by the Contractor. Contractor shall complete punch list of items requiring resolution prior to issuance of Final Acceptance.
 - (a) At the discretion of Town inspector or Irrigation Design Professional, a new pressure test may be required at the time of Final Acceptance inspection.
 - (b) Clean up: Remove all excess materials, tools, trash and debris from site.
 - ii. Schedule a project re-inspection with Town inspectors and Irrigation Design Professional to verify completion of punch list items and project work-through issues if necessary.

C. Seeding

- 1. Turn over items to town inspector:
 - a. Seed tags to verify seeded mixture matches approved plans.
- 2. Maintenance
 - a. Mowing: When grasses reach three inches (3") in height, mow to two inches (2") in height. Repeat as needed in dryland areas to encourage spread of grass stolons and prevent seed development of weeds. Repeat in areas where mowing is to be standard maintenance practice, to maintain grass height at 2-1/2". Do not cut off more than 1/3 of grass leaf in a single mowing operation. Excessive clippings to be removed from turf areas. Adjacent paved areas to be swept after mowing.
 - b. Weed control: During establishment mechanical weed control should be employed to prevent weed flowering and seed set. When grasses are sufficiently established, chemical weed control can be applied to selectively eradicate invasive and noxious weeds.
 - c. Fertilizing: Apply balanced fertilizer to maintain turf vigor during warranty period.

D. Sod Maintenance

- 1. Mowing: When grass reaches three inches (3") in height, mow to two inches (2") in height. Mow weekly and maintain grass between two inches (2") and 2-1/2" in height. Do not cut off more than 1/3 of grass leaf in a single mowing. Remove grass clippings from all paved surfaces.
- 2. Fertilizing: Distribute fertilizer uniformly at a rate of 5 pounds of balanced fertilizer per 1000 square feet of sodded area unless otherwise recommended by soils test, three weeks after sodding is complete. Fertilizing thereafter is to be in accordance with standard maintenance practices for turf areas, and as needed to achieve and maintain a vigorous and healthy stand of grass.
- 3. Weed Control: During establishment use mechanical means to control weeds. When sod is sufficiently established, chemical weed control can be applied to selectively eradicate invasive and noxious weeds.

E. Record Drawings of trees, plants and groundcover

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1. List of all plant material installed, including sizes and quantities as certified by a Landscape Architect.

3.9 GUARANTEE/WARRANTY

- A. Prior to final acceptance, all bridges, concrete paths and other miscellaneous improvements under this section are to be warranted against defects. Cracking, settling, displacement and damage to those improvements are to be repaired or replaced by the Developer at no cost to the Town. Repairs and replacements are to be covered by warranty.
- B. Irrigation Systems:
 1. For the period following Construction Acceptance notice by Town and prior to Final Acceptance, all irrigation materials, equipment, workmanship and other appurtenances are to be guaranteed/ warranted against defects. Settling of trenches or other depressions, damages to structures or landscaping caused by settling and other defects to be corrected by the contractor at no cost to the Town or homeowners association. Make repairs within seven days of notification by the Town staff representative or Irrigation Design Professional unless an emergency or hazardous situation dictates immediate correction. Guarantee/Warranty applies to all originally installed materials and equipment, and to replacements made during the guarantee/ warranty period.
- C. Seeding
 1. Warranty seeded areas for consistency and completion of coverage. Re-seed as needed to ensure a successful stand of grass as accepted by the Town. Once a vigorously growing stand of grass is achieved, the request for Final Acceptance may be made. A stand of grass is considered to be acceptable when each square foot of grass area has at least 90% coverage in irrigated turf grass areas. In native grass areas, it is considered established when the grass area has at least 70% coverage. Maximum single bare spot acceptable in dryland areas is 2 sq. ft. All seeded areas that do not meet the satisfactory standard of establishment qualifications shall be re-seeded and mulched.
 2. It is the developer's responsibility to maintain seeded areas in a weed free manner. Eradication of weeds prior to Final Acceptance shall be done on an as-needed basis to generally eradicate the noxious weeds.
 3. Extended warranty period may be required as determined by Town inspector.
- D. Sodding
 1. Warrant sodded areas for consistency and completion of coverage. Re-sod areas as needed to obtain acceptance by the Town. Once a vigorously growing stand of grass is achieved, the request for Construction Acceptance may be made.
- E. Trees Plants and Groundcover
 1. For the period prior to Final Acceptance, all plant materials, landscape materials, workmanship and other appurtenances are to be guaranteed/warranted against defects. Settling of depressions, replacement of dead or diseased plant materials and other defects are to be corrected by the contractor at no cost to the Town or Homeowners Association . Plant materials that are in an unhealthy or unsightly condition or that have lost their natural shape due to dead branches or excessive pruning of dead branches are to be replaced at no cost to the Town. Guarantee/Warranty applies to all originally installed materials, and to replacements made during the guarantee/warranty period.
 2. For areas to be maintained by Developer or subsequent property owners/HOAs, requirements per 3.9.C.2 apply in perpetuity.

END OF SECTION 33 47 00

Town of Mead Design Standards and Construction Specifications

TOWN OF MEAD LIST OF APPROVED LANDSCAPE MATERIALS

January, 2021

The following approved materials list applies to all Town of Mead related improvements per Sections 33 47 00 in Appendix A of the Town of Mead **Design Standards and Construction Specifications**:

Proposed substitutes to the following specific brands and/or models shall be submitted to the Town of Mead in writing with all necessary technical information needed for analysis. A written approval from the Town of substitute is REQUIRED for all products.

CONCRETE BIKE PATHS, BRIDGES AND UNDERPASSES

1. Control joints: Zip strip or saw cut.
2. Expansion joints: pre-formed compressible bituminous fiber Type M-213, ½" thick with removable 'void cap' to create ½" reveal for sealant. Sealant to be Tremco "Tremflex 834, Pecora "unicrylic +60, or Sonolastic "Sonolac".
3. Bridge decking: concrete or 2"x8" IPE Ironwood. Decks must be designed with ability to easily replace individual deck boards.
4. Underpass Lighting:
 - a. LED type Cooper Lighting Model FCC-S-2-3750-7-40-120-82/87-ED-SF3- VRSD
5. Root Barrier: Deep Root S24" barrier.
6. Underpass Pavement Markings: Yellow paint – 4" wide solid line at blind corners and through underpasses as approved by City staff.

GRADING AND FINE GRADING

1. Soil Amendment: Premium 3 by A-1 Organics composted aspen humus or other amendments certified as Class I or Class II by Rocky Mountain Organics Council.

IRRIGATION

1. Irrigation Heads: Hunter
 - a. All heads to be installed with Hunter SJ or HSJ Swing Joint
 - b. ½" Inlet
 1. PRO-SPRAY PRS40 bodies
 2. MP Rotator Nozzles
 - c. ¾" Inlet
 1. I-20 (plastic riser) factory check valve installed
 - d. 1" Inlet
 1. I-25 (plastic riser), factory check valve installed
 2. I-40, factory check valve installed
 3. I-40-ON, factory check valve installed
 4. I-90, factory check valve installed
2. Controllers: Rain Master
 - a. Eagle Plus – 2 wire system, wall or pedestal mount
 - b. All wire in the system must be certified by Irritrol, part numbers EV-CAB-COM, EV-CAB-SH-COM, EV-CAB-WS12, EV-CAB-SEN
 - c. Permanently mounted PRO MAX receiver
 - d. Irritrol flow sensor FS-B100, 125,150, 200, 250 or FS-150, 200, 300, 400
 - e. Weather station RM-WETHR-ETRS may be required at the Town's sole discretion
3. Valves: Irritrol
 - a. 100 series for domestic water supply

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- b. 102 series for raw water supply
4. Backflow Device: FEBCO
 - a. 2" or smaller use 825YA model
 - b. Larger than 2" use LF880V
5. Backflow Enclosure: Guard Shack
 - a. S.S. Hinged Model
 - b. S.S. Tall Hinged Model
 - c. S.S. N Pattern
6. All Main lines and Lateral line shall be PVC
7. All PVC fittings shall be cleaned/primed and glued
8. All lateral lines shall be buried a minimum of 12" below final grade
9. All main lines buried a minimum of 18" below final grade
10. Thrust blocks shall be installed on any line that is 2" or larger, with a direction change of more than 20 degrees
11. Unless otherwise directed by the manufacturer, no joint that is directly connected to sprinkler heads, valves, or flow sensors shall have pipe compound or Teflon tape installed.
12. Flow Meter: Data Industrial. For 1" – 4" use drop-in style model # IR228PV. For 6" taps, use threaded style model # IR220BR.
13. Mainline:
 - a. For pipe sizes larger than 3" - J.M. Ringtite Class 200 PVC pipe.
 - b. For Pipe sizes 3" and smaller – Schedule 40 PVC
14. Joint Restraints: For all mainline sized 4" and larger - Leemco ductile iron gasketed fittings and Leemco pipe restraints shall be used.
15. Drip line: Irritrol blue stripe drip pipe, 80 PSI rated. Centennial drip tubing or Rainbird XT-700 only.
16. Valve Boxes: Highline (formerly Pentek) or Carson. Jumbo – sized only.
17. Drip system:
 - a. Emitters: Rainbird XB series with spiral barb emitters.
 - b. Flush caps: Agrifim model #CETC-34. 11.
18. Irrigation Pump Station
 - a. SyncroFlo Eagle Model 820-32L-100-850 prefabricated vertical turbine pump station designed to meet 850 GPM at a discharge pressure of 100 psi. Pump station to include: pumps shafts, bowls, filter screen, motors and associated piping and fittings all mounted on a metal skid. The system shall be factory tested and UL listed.
19. Miscellaneous Irrigation Equipment:
 - a. Waterproof connections:
 1. 3M DBR direct bury splice kits only on common wires
 2. Blazing Snaploc wire connector BVS-2 on 14 gauge (hot) wires
 - b. Elbows: Rainbird SBE-050 - to match pipe brand.
 - c. Risers: Funny pipe for pop-up heads; nipples for rotors.
 - d. Fabricate each swing joints – no prefabricated swing joints permitted
 - e. Pipe Glue: WELD-ON 711 grey glue with P70 purple primer
 - f. Upon the discretion of the Town for large scale projects, a two-wire control system may be utilized. If approved, the two-wire control path wire shall be Page Model P7072D-12 AWG and alterations to the approved controller specification will need to be made to function with this alternate system.

SEEDING

1. Pre-approved Dryland Mixes (for temporary or permanent unmowed and/or non- permanent areas):
 - a. Native Areas (typically below the pathway trail or on the side without the trail):
Canada wildrye 2.84 PLS pounds per acre

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Thickspike wheatgrass (Critana variety) 0.71 PLS lbs. per acre
Slender wheatgrass (San Luis or Pryor variety) 2.05 PLS lbs. per acre
Western wheatgrass (Arriba variety) 1.98 PLS lbs. per acre
Little bluestem (Cimarron or Pastura variety) 0.84 PLS lbs. per acre
Switchgrass (Trailblazer, Nebraska 28, or Blackwell variety) 0.28 PLS lbs. per acre
Alkali sacaton (Salado variety) 0.06 PLS lbs. per acre
Sand dropseed 0.02 PLS lbs. per acre
Side oats grama (Vaughn variety) 1.14 PLS lbs. per acre
Blue grama (Alma, Bad River, or Hachita variety) 0.26 PLS lbs. per acre
Buffalograss 3.89 PLS lbs. per acre

- b. Native Areas between trail and residential area:
 - Blue grama (Alma, Bad River, or Hachita variety) 0.40 PLS lbs. per acre
 - Buffalograss 5.83 PLS lbs. per acre
 - Inland saltgrass 0.42 PLS lbs. per acre
 - Slender wheatgrass 1.37 PLS lbs. per acre
 - Sandberg bluegrass 0.82 PLS lbs. per acre
 - Alkaligrass 0.27 PLS lbs. per acre
- c. Rights of way in areas of future road expansion:
 - Inland saltgrass 1.26 PLS lbs. per acre
 - Blue Grama (Alma, Bad River, or Hachita variety) 0.40 PLS lbs. per acre
 - Alkaligrass 0.64 PLS lbs. per acre
 - Sandberg bluegrass 0.47 PLS lbs. per acre

- 2. Pre-approved Irrigated Turf Seed Mixes:
 - a. 60% Eldorado, Silverado and Monarch Turf type Tall Fescue
30% Manchar Smooth Brome
10% Bluegrass mix (drought tolerant blends)
 - b. 40% Barrington Tall Fescue
40% Labarinth RTF Tall Fescue
20% Barrister Kentucky Bluegrass
 - c. 35% Creeping Red Fescue
25% SR3200 Blue Fescue 12.5% SR3100 Hard Fescue
15% Reubens Canadian Blue
12.5% SR5100 Chewings Fescue
 - d. 30% Matador Tall Fescue
30% Tomahawk RT Tall Fescue
30% Pure Gold Tall Fescue
10% North Star Kentucky Bluegrass

SODDING

- 1. Pre-approved Sod Mixes:
 - a. 60% Eldorado, Silverado and Monarch Turf type Tall Fescue
30% Manchar Smooth Brome
10% Bluegrass Mix (drought tolerant blends)
 - b. 40% Barrington Tall Fescue
40% Labarinth RTF Tall Fescue
20% Barrister Kentucky Bluegrass
 - c. 35% Creeping Red Fescue
25% SR3200 Blue Fescue
12.5% SR3100 Hard Fescue
15% Reubens Canadian Blue
12.5% SR5100 Chewings Fescue
 - d. 30% Matador Tall Fescue
30% Tomahawk RT Tall Fescue

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- 30% Pure Gold Tall Fescue
- 10% North Star Kentucky Bluegrass
- e. VorTEX Texas Bluegrass from Korby Sod LLC

TREES, PLANTS AND GROUNDCOVER

1. Backfill mix: Premium-3 composted aspen humus, by A-1 Organics.
2. Tree wrap: 4" wide Kraft tree wrap.
3. Weed barrier fabric: Mirafi geo-textile fabric 140N.
4. Steel edging: 3/16" x 4" x 16' Ryerson steel edging.
5. Mulch: Aspen bark mulch, pole peelings (linear strips only), recycled rubber (with staff-approved cut sheet), 3"-6" cobble or shredded cedar. Cobble is not to be used in Greenway areas unless otherwise approved by staff.
6. Tree Stakes: Two inch (2") x six feet (6') round wooden posts or six foot (6') long, heavy-duty t-bar steel posts with white tops.
7. Tree Guys: ½" STRAP-X (flat synthetic webbing material) or ½" Central Bag polyester strapping with 17 gauge galvanized steel wire.
8. Tree Grates: Cast Iron only. Minimum 40 square feet (4' x 10' (comes in two pieces) or 9' x 5' (comes in 4 pieces))
9. Misc. Tree Equipment: White tee post caps; Canvas strap; White plastic flagging tape or 1/2" white PVC pipe; four inch (4") wide tree wrap.
10. Beaver protection: Galvanized four foot (4') high (2" x 4" openings) fencing.

MISCELLANEOUS LANDSCAPE ITEMS

1. Benches: Webcoat expanded metal six foot bench – surface mount on appropriately sized concrete pad (B6WBRCM), black color.
2. Trash Receptacles: Webcoat – 32 gallon (TR32 – TSRM) – surface or in-ground mount as appropriate – black color with DOME32 gray top. Also include 30 gallon galvanized trash can (no lid) inside receptacle.
3. Recycling Receptacles: Recycle Away Landscape 34 Gallon Dome (RC-34R DM CANS RBL). Blue color with dome lid.
4. Picnic Tables: Webcoat T6RC and T8RCHDCP tables – surface mount – black color, including Play World #1409 PVC-coated clamps to bolt tables to appropriately sized concrete pad.
5. Bike racks: Madrax inverted U-style #U238-SF, surface mount – black color on appropriately sized concrete pad.
6. Play Equipment: all play equipment shall meet all standards in the most current version of the Public Playground Safety Handbook as set fourth by the United States Consumer Product Safety Commission. The hand book can be found at <https://www.cpsc.gov/s3fs-public/325.pdf> .
 - a. Manufacturers
 1. Gametime
 2. Miracle
7. Surfacing Material:
 - a. Engineered Wood Fiber (EWF)
 - b. Poured-In-Place Rubber
8. All parks shall be designed to meet the most current ADA requirements

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Approved Plant Materials List

The following lists are trees specifically PROHIBITED from Town of Mead regulated areas (and discouraged from use elsewhere)

Tree Name	Any Area	Streetscapes	Trail Corridors
Russian Olive	•	•	•
Lombardy Poplar	•	•	•
Siberian Elm	•	•	•
Boxelder Maple	•	•	•
Ash – any species	•	•	•
Fruit-Bearing Trees*		•	
Thorn-Bearing Trees*		•	
Willow (all varieties)		•	
Tree of Heaven		•	
Cottonwood (all varieties)		•	
Silver Maple		•	

* Trees that drop fruit or bear thorns may be allowed in streetscape areas only if the mature size of the tree does not come within 5' of paths, walks or other pedestrian areas.

RECOMMENDED TREES for Town of Mead regulated areas

Growth rate: S = Slow, M = Medium, F = Fast

Adaptability: H = Hardy, A = Average, M = Marginal)

(Adaptability rating includes cold, soils, moisture tolerance & disease resistance)

Use: S-6 = Street tree in areas 6' maximum tree lawn width

S-8 = Street tree in areas 8' minimum tree lawn width

G = Pathway and Common Open Space

Tree Name	Botanical Name	Growth Rate	Adaptability	Use
Ornamental Trees				
Alder, Thinleaf	Alnus tenuifolia	F	H	S-6,G
Birch, Native River	Birch, Native River	M	A	G
Birch, Whitespire	Betula platyphylla japonica	M	A-M	G
Cherry, Bird (Mayday)	Prunus padus	S	H-A	S-6, G
Cherry, Canada Red	Prunus virginians 'Schubert	M	H	G
Cherry, Montmorency	Prunus cerasus	M	A	G
Cherry, Sargent	Prunus sargentii	M	H	G
Crabapple, Adams	Malus 'Adams'	M	H-A	G
Crabapple, Adirondak	Malus 'Adirondak'	M	H-A	G
Crabapple, Brandywine	Malus 'Brandywine'	M	H-A	G
Crabapple, Centurion	Malus 'Centurion'	M	H-A	G

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Tree Name	Botanical Name	Growth Rate	Adaptability	Use
Crabapple, Coralburst	Malus 'Coralburst'	M	H-A	G
Crabapple, David	Malus 'David'	M	H-A	G
Crabapple, Indian Magic	Malus 'Indian Magic'	M		
Crabapple, Prairifire	Malus 'Prairifire'	M		
Crabapple, Profusion	Malus 'Profusion'	M	H-A	G
Crabapple, Radiant	Malus 'Radiant'	M	H-A	G
Crabapple, Red Barron	Malus 'Red Barron'	M	H-A	G
Crabapple, Royalty	Malus 'Royalty'	M	H-A	G
Crabapple, Spring Snow	Malus 'Spring Snow'	M	H-A	G
Crabapple, Thunderchild	Malus 'Thunderchild'	M	H-A	G
Crabapple, White Cascade	Malus 'White Cascade'	M	H-A	G
Goldenrain Tree	Koelreuteria paniculata	S	M	S-8
Hawthorn, Crusader	Crataegus ambigua	S	H	G
Hawthorn, Russian	Crataegus ambigua	S	H	G
Hawthorn, Thornless Cockspur	Crataegus crus-gali inermis	S	H	G
Hawthorn, Washington	Crataegus phaenopyrum	S	H	G
Hornbeam, Pyridimal Eruopean	Carpinus betulus	M	H	S-6
Lilac, Japanese Tree	Syringa reticula	M	A	S-6
Maple, Ginnala	Acer ginnala	S	H	S-6, G
Maple, Tartarian	Acer tartaricum	S	H	S-6, G
Pear, Aristocrat	Pyrus Calleryanna 'Aristocrat'	M	A	S-6
Pear, Autumn blaze	Pyrus Calleryanna 'Autumn blaze'	M	A	S-6
Pear, Chanticleer	Pyrus Calleryanna 'Chanticleer'	M	A	S-6
Pear, Redspire	Pyrus Calleryanna 'Redspire'	M	A	S-6
Pear, Stonehill	Pyrus Calleryanna 'Stonehill'	M	A	S-6
Plum, American	Prunus americana	S	H	G
Plum, Newport	Prunus cerasifera	S	A	S-6
Redbud, Eastern	Cercis canadensis	S	M	S-6
Serviceberry, Autumn Brilliance	Amelanchier grandiflora 'Autumn Brilliance'	S	H	S-6, G
Serviceberry, Robin Hill	Amelanchier grandiflora 'Robin Hill'	S	H	S-6, G
Serviceberry, Saskatoon	Amelanchier alnifolia 'Saskatoon'	S	H	S-6, G
Serviceberry, Shadblow	Amelanchier cmandensis 'Shadblow'	S	H	S-6, G
Shade (Canopy) Trees				
Tree Common Name	Botanical Name	Growth Rate	Adaptability	Use

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Tree Name	Botanical Name	Growth Rate	Adaptability	Use
Catalpa, Western	Catalpa speciosa	S	H	S-8, G
Coffeetree, Kentucky	Gymnocladus dioica	S	H	S-8, G
Cottonwood, Lanceleaf	Populus acuminata	F	H	G
Cottonwood, Narrowleaf	Populus andustifolia	F	H	G
Cottonwood, Plains	Populus sargentii	F	H	G
Filbert, Turkish	Corylus colurna	M	A	S-8,G
Hackberry, Western	Celtis occidentalis	M	H	S-8, G
Hornbeam, American	Carpinus caroliniana	M	H	S-8,G
Honeylocust, Imperial	Gleditsia tricanthos inermis 'Imperial'	M	H	S-8,G
Honeylocust, Shademaster	Gleditsia tricanthos inermis 'Shademaster'	M	H	S-8,G
Honeylocust, Skyline	Gleditsia tricanthos inermis 'Skyline'	M	H	S-8,G
Locust, Black	Robinia pseudoacacia	F	H	G
Locust, Purple Robe	Robinia pseudoacacia 'Purple Robe'	F	H-A	S-8, G
				S-8
Maple, Hedge	Acer campestre	S	H	S-8
Maple, Autumn Blaze	Acer freemanii	M	M	S-8
Maple, Deborah	Acer platanoides 'Deborah'	S	A-M	S-8
Maple, Emerald Lustre	Acer platanoides 'Emerald Lustre'	S	A-M	S-8
Maple, Emerald Queen	Acer platanoides 'Emerald Queen'	S	A-M	S-8
Maple, Green Mountain Sugar	Acer saccharum 'Green Mountain'	S	A-M	S-8
Maple, Legacy	Acer saccharum 'Legacy'	S	A-M	S-8
Maple, Northwood	Acer rubrum 'Northwood'	M	M	S-8
Maple, Red Sunset	Acer rubrum 'Red Sunset'	M	M	S-8
Maple, Pacific Sunset	Acer truncatum 'Pacific Sunset'	S	A-M	S-8
Linden, American	Tilia Americana	M	H	S-8
Linden, Redmond	Tilia Americana 'Redmond'	M	H	S-8
Linden, Glenleven	Tilia cordata 'Glenleven'	M	H	S-8
Linden, Greenspire	Tilia cordata 'Greenspire'	M	H	S-8
Oak, Bur	Quercus macrocarpa	S	H	S-8, G
Oak, Chinkapin	Quercus muehlenbergii	M	H	S-8, G
Oak, English	Quercus robur	M	H	S-8, G
Oak, Northern Red	Quercus rubra	M	A-M	S-8, G
Oak, Shingle	Quercus imbricaria	M	A	S-8, G
Oak, Shumard	Quercus shumardii	M	A	S-8, G
Oak, Swamp White	Quercus bicolor	M	H-A	S-8, G
Elm, American	Ulmus americana	F	H	S-8, G

Town of Mead Design Standards and Construction Specifications

Tree Name	Botanical Name	Growth Rate	Adaptability	Use
Elm, Accolade	Ulmus japonica x wilsonii 'Accolade'	F	H	S-8, G
Elm, Frontier	Ulmus carpinifoli x parvifolia 'Frontier'	F	H	S-8, G
Willow, Niobe Weeping	Salix alba 'Tristis'	F	H	G
Willow, Peach Leaf	Salix amygdaloides	F	H	G
Willow, Prairie Cascade	Salix pentandra	F	H	G
Willow, Russian Golden	Salix alba vitellina	F	H	G
Conifer (Evergreen) Trees				
Fir, Concolor	Abies concolor	M	A	G
Fir, Douglas	Psuedotsuga menziesii	M	A	G
Juniper, Rocky Mountain	Juniperus scopulorum var.	S	H	G
Pine, Austrian	Pinus nigra	M	H	G
Pine, Bosnian	Pinus heldreichii	M	H	G
Pine, Bristlecone	Pinus ariatada	S	A	S-8, G
Pine, Mugo	Pinus mugo	M	H	G
Pine, Pinon	Pinus edulis	M	H	S-8, G
Pine, Ponderosa	Pinus ponderosa	M	H	S-8, G
Pine, Scotch	Pinus sylvestris	M	H	G
Pine, Southwestern White	Pinus strobiformis	S	A	G
Pine, Swiss Stone	Pinus cembra	M	A	G
Pine, Vanderwolf	Pinus flexilis	M	A	G
Spruce, Bacheri	Picea pungems 'bacheri'	M	H	G
Spruce, Black Hills	Picea glauca densata	M	H	G
Spruce, Colorado Blue	Picea pungens	M	H	G
Spruce, Siberian	Picea omorika	M	H	G